Chapter Comm 20

ADMINISTRATION AND ENFORCEMENT

Subchapter I — Purpose and Scope
Comm 20.01 Purpose.
Comm 20.02 Scope.
Comm 20.03 Effective date.
Comm 20.04 Applications.
Comm 20.05 Exemptions.

Subchapter II — Jurisdiction
Comm 20.06 Procedure for municipalities.
Comm 20.065 State jurisdiction.

Subchapter III — Definitions
Comm 20.07 Definitions.

Subchapter IV — Approval and Inspection of One– and 2–Family Dwellings
Comm 20.08 Wisconsin uniform building permit.
Comm 20.085 Notices of intent and termination.
Comm 20.09 Procedure for obtaining uniform building permit.
Comm 20.10 Inspections.
Comm 20.11 Suspension or revocation of Wisconsin uniform building permit.

Subchapter V — Approval and Inspection of Modular Homes and Their Components
Comm 20.12 Scope.
Comm 20.13 Manufacture, sale and installation of homes.
Comm 20.14 Approval procedures.
Comm 20.15 Effect of approval.
Comm 20.16 Suspension and revocation of approval.
Comm 20.17 Effect of suspension and revocation.

Subchapter VI — Approval of Products
Comm 20.18 Building product approvals.

Subchapter VII — Variances, Appeals, Violations and Penalties
Comm 20.19 Petition for variance.
Comm 20.20 Municipal variance from the code.
Comm 20.21 Appeals of orders, determinations, and for extension of time.
Comm 20.22 Penalties and violations.

Subchapter IX — Adoption of Standards
Comm 20.24 Adoption of standards.

Note: Chapter ILHR 20 was renumbered chapter Comm 20 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, January, 1999. No. 517.

Subchapter I — Purpose and Scope

Comm 20.01 Purpose. (1) The purpose of this code is to establish uniform statewide construction standards and inspection procedures for one– and 2–family dwellings and modular homes in accordance with the requirements of ss. 101.60 and 101.70, Stats.

(2) The purpose of this code is to establish uniform installation and inspection procedures for manufactured homes in accordance with the requirements of s. 101.96, Stats.

Note: The design and construction of manufactured homes is regulated by the federal Department of Housing and Urban Development under Title 24 CFR Part 3280.

Note: See ch. Comm 5 for licensing requirements for manufactured home manufacturers and manufactured home installers.

Note: Other agencies may have regulations that affect the design, construction or placement of the dwelling and accessory structures or systems serving the dwelling. The regulations may necessitate additional administrative procedures or inspections for compliance.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, March, 1992, No. 435, eff. 4–1–92: CR 06–071: renum. s. Comm 20.01 to be (1), cr. (2) Register December 2006 No. 612, eff. 4–1–07; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.02 Scope. (1) GENERAL. The provisions of this code apply to all of the following:

(a) All one– and 2–family dwellings built on or after the effective dates under s. Comm 20.03.

Note: This includes site–built dwellings, manufactured buildings used as dwellings, modular homes and dwellings that may be designated as cabins, seasonal homes, temporary residences, etc., (except for manufactured or HUD homes, which are covered separately under this section).

(b) Adult family homes providing care, treatment and services for 3 or 4 unrelated adults built on or after the effective dates under s. Comm 20.03.

(c) Community–based residential facilities providing care, treatment and services for 5 to 8 unrelated adults built on or after the effective dates under s. Comm 20.03.

(d) The onsite installation of a mobile home or manufactured home on piers, regardless of the date of production of the home.

Note: The design and construction of a manufactured home is regulated by the U.S. Department of Housing and Urban Development and is not subject to UDC requirements. Prior to regulation by HUD in 1976, manufactured homes were known as mobile homes and their design and construction were not uniformly regulated. See s. Comm 20.07 (52m) for the statutory definition.

(e) The onsite installation of a manufactured home, regardless of the type of foundation, where the manufactured home has a production date on or after April 1, 2007.

(f) The design and construction of a crawlspace, basement or foundation, other than piers, under a manufactured home where the manufactured home has a production date on or after the effective dates under s. Comm 20.03.

(g) All garages, carports, porches, stoops, decks, balconies, stairways and similar structures that are attached to any building covered under this section that was constructed or had a production date on or after the effective dates under s. Comm 20.03.

(h) Adjacent, unattached structures listed under par. (g) that serve an exit from a dwelling.

(2) MUNICIPAL ORDINANCES. (a) A municipality may not adopt an ordinance on any subject falling within the scope of this code including establishing restrictions on the occupancy of dwellings for any reason other than noncompliance with the provisions of this code as set forth in s. Comm 20.10 (4). This code does not apply to occupancy requirements occurring after the first occupancy for residential purposes following the final inspection required under s. Comm 20.10 (3) (h)

(b) This code shall not be construed to affect local requirements relating to land use, zoning, post–construction storm water management, fire districts, side, front and rear setback requirements, property line requirements or other similar requirements. This code shall not affect the right of municipalities to establish safety regulations for the protection of the public from hazards at the job site.

(c) Any municipality may, by ordinance, require permits and fees for any construction, additions, alterations or repairs not within the scope of this code.

(d) Any municipality may, by ordinance, adopt the provisions of chs. Comm 20 to 25 to apply to any additions or alterations to existing dwellings.

(e) Nothing in this chapter shall prevent a municipality from any of the following:

1. Implementing erosion and sediment control requirements that are more stringent than the standards of this code when directed by an order of the United States Environmental Protection Agency or by an administrative rule of the department of natural resources under s. NR 151.004.

2. Regulating erosion and sediment control for sites that are not under the scope of this chapter.

(f) This code shall not be construed to affect the authority of the Department of Natural Resources to enforce chapters 281 and 283, Stats., and administrative rules promulgated there under.

(3) LEGAL RESPONSIBILITY. The department or the municipality having jurisdiction shall not assume legal responsibility for the design or construction of dwellings.

(4) RETROACTIVITY. The provisions of this code are not retroactive, except as specified in s. Comm 21.09.

(5) INNOVATIVE DWELLINGS. No part of this code is intended to prohibit or discourage the construction of innovative dwellings such as a dwelling built below ground, a geodesic dome, a concrete house, a fiber–glass house or any other nonconventional structure.

(6) LANDSCAPING. Except for construction erosion control, the scope of this code does not extend to driveways, sidewalks, landscaping and other similar features not having an impact on the dwelling structure.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (intro.), cr. (1) (d), r. and recr. (6), Register, February, 1985, No. 350, eff. 3–1–85; r. (6), Register, January, 1989, No. 397, eff. 2–1–89; am. (3), Register, April, 1990, No. 412, eff. 5–1–90; am. (5), Register, September, 1992, No. 441, eff. 12–1–92; am. (1) (a), Register, November, 1995, No. 479, eff. 12–1–95; CR 00–159: renum. (intro.) to be (1) (a) and (1) to (5) to be (2) to (6); cr. (1) (b), Register September 2001 No. 549 eff. 12–1–01; CR 03–097: r. and recr. (1) Register November 2004 No. 587, eff. 1–1–05; CR 05–113: am. (2) (b), cr. (2) (e) and (f) Register December 2006 No. 612, eff. 4–1–07; CR 06–071: renum. (1) to be (1) (a), cr. (1) (b) Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: r. and recr. (1), am. (2) (e) 1. Register March 2009 No. 639, eff. 4–1–09; corrections in (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.03 Effective date. The effective date of ch. Comm 22 is December 1, 1978. The effective date of chs. Comm 20, 21, 23, 24 and 25 is June 1, 1980.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, January, 1989, No. 397, eff. 2–1–89; correction made under s. 13.93 (2m) (b) 4., Stats., Register, January, 1989, No. 397.

Comm 20.04 Applications. (1) NEW DWELLINGS. (a) This code applies to all dwellings, dwelling units and foundations for dwelling units, for which the building permit application was made or construction commenced on or after the effective date of this code.

(b) All dwellings covered under par. (a) shall meet the requirements of ch. Comm 21.

(c) 1. The installation of heating, air conditioning, plumbing or electrical systems is not required.

2. If any of the systems under subd. 1. are installed, the systems and their installation shall comply with this code.

3. If a heating or air conditioning system is installed, the dwelling shall comply with ch. Comm 22.

(2) ADDITIONS AND ALTERATIONS. Additions and alterations to dwellings covered by this code shall comply with all provisions of this code at the time of permit application or the beginning of the project, if no permit is required.

(3) BED AND BREAKFAST ESTABLISHMENTS. The following portions of a bed and breakfast establishment shall comply with the provisions of this code:

(a) The third floor when used for other than storage.

(b) A structural addition, for which no use other than as a bed and breakfast establishment is proposed.

Note: See s. 254.61, Stats., for further conditions and limitations relating to bed and breakfast establishments.

(4) CHANGE OF USE. A building previously used for another purpose, such as a barn or garage, shall comply with this code upon conversion to residential use.

(5) REUSE OF A DWELLING OR FOUNDATION. (a) *Existing dwelling or manufactured home placed on a different foundation.* Where an existing dwelling or manufactured home is placed on a different foundation, the new foundation is considered an addition or alteration to the existing dwelling or manufactured home.

Note: The applicability of this code to an addition or alteration to an existing dwelling or manufactured home is determined by the original date of construction of the dwelling or manufactured home and is not altered by any movement of the structure.

(b) *New dwelling or manufactured home.* A new dwelling or manufactured home placed on a new or existing foundation shall meet the permitting, construction and inspection requirements of a new dwelling or manufactured home.

(6) SEPARATED BUILDINGS. For a building to be considered a separate single–family dwelling or a separate 2–family dwelling within the scope of this code, regardless of ownership or occupancy arrangements, all of the following conditions shall be met:

(a) No structural members other than a common footing may be shared between any 2 dwellings.

Note: Two separated, insulated foundation walls may share the same structural footing.

(b) The adjoining exterior walls of the separate dwellings shall each have exterior coverings meeting the requirements of s. Comm 21.24.

(c) The adjoining exterior walls, including foundations, of the separate dwellings shall each meet the energy requirements under ch. Comm 22, irrespective of any adjacent dwelling.

(d) Both sides of any 2 adjoining walls, floors, ceilings and attics between dwellings shall meet the dwelling separation requirements of s. Comm 21.08 (1) for 2 dwellings on the same property less than 5 feet apart.

Note: 1. Flashing is acceptable to connect the roofs between dwelling units. See appendix for further information.

2. A building of 3 or more dwelling units without the separations specified in this section is a commercial building and shall meet the requirements set forth in chs. Comm 60 to 66.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (3), Register, January, 1989, No. 397, eff. 2–1–89; am. (1), r. and recr. (3), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (1), renum. (2) and (3) to be (3) and (4), cr. (2) and (5), Register, November, 1995, No. 479, eff. 12–1–95; r. (3) and (4), renum. (1) to be (1) (a) and (5) to be (4), and cr. (1) (b), (c), and (3), Register, March, 2001, No. 543, eff. 4–1–01; CR 06–071: renum. (2) to be (2) (a), cr. (2) (b) and (5) Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: r. and recr. (2) and (5), cr. (6) Register March 2009 No. 639, eff. 4–1–09.**

Comm 20.05 Exemptions. (1) EXISTING DWELLINGS. The provisions of this code shall not apply to dwellings and dwelling units, the construction of which was commenced prior to the effective date of this code, or to additions or alterations to such dwellings.

Note: The provisions of chs. Comm 20 to 25 may be adopted by a municipality to apply to any additions or alterations to existing dwellings.

(2) MULTIFAMILY DWELLINGS. The provisions of this code shall not apply to residences occupied by 3 or more families living independently or occupied by 2 such families and used also for business purposes.

(3) REPAIRS. The provisions of this code do not apply to repairs or maintenance to dwellings or dwelling units, or to the repair of electrical, plumbing, heating, ventilating, air conditioning and other systems installed therein.

(4) ACCESSORY BUILDINGS. With the exception of s. Comm 21.08 (1), the provisions of this code do not apply to detached garages or to any accessory buildings detached from the dwelling.

(5) DETACHED DECKS. The provisions of this code do not apply to detached decks provided the deck does not serve an exit from the dwelling.

(6) FARM BUILDINGS. The provisions of this code do not apply to the buildings used exclusively for farm operations and not for human habitation.

(7) INDIAN RESERVATIONS. The provisions of this code do not apply to dwellings located on Indian reservation land held in trust by the United States.

(8) MANUFACTURED AND MODULAR HOMES. The provisions of this code do not apply to manufactured homes and modular homes used exclusively for display purposes.

(9) MOTOR HOMES AND RECREATIONAL VEHICLES. The provisions of this code do not apply to motor homes and recreational vehicles that are, or have been, titled through the department of transportation.

Note: Section 340.01 (33m) and (48r), Stats., read as follows: "Motor home" means a motor vehicle designed to be operated upon a highway for use as a temporary or recreational dwelling and having the same internal characteristics and equipment as a mobile home.

"Recreational vehicle" means a vehicle that is designed to be towed upon a highway by a motor vehicle, that is equipped and used, or intended to be used, primarily for temporary or recreational human habitation, that has walls of rigid construction, and that does not exceed 45 feet in length.

Note: In accordance with Wis. Stat. s. 342.05 (1), the owner of a (recreational) vehicle, whether or not such vehicle is operated on any highway of this state, shall make application for certificate of title for the vehicle with the department of transportation. Examples of recreational vehicles are: travel trailer, 5th wheel and "park model". Recreational vehicles are normally constructed to the standards: ANSI/NFPA 1192, Standard for RVs, and NFPA 70, National Electrical Code. Recreational vehicles require a towbar (hitch), chassis, axles and wheels for transportation. At the installation site, the chassis and axles shall remain on the unit, with the towbar (hitch) and wheels left at the site. Otherwise the unit, including a park model, is subject to the UDC.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (5), r. (9), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (8), Register, March, 1992, No. 435, eff. 4–1–92; am. (3), Register, November, 1995, No. 479, eff. 12–1–95; r. (8), renum. (6) and (7) to be (7) and (8) and cr. (6) and (9), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (5) Register May 2003 No. 569, eff. 8–1–03; CR 06–071: r. and recr. (9) Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: r. (4), renum. (5) to (9) to be (4) to (8) and am. (6), cr. (9) Register March 2009 No. 639, eff. 4–1–09; correction in (8) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Subchapter II — Jurisdiction

Comm 20.06 Procedure for municipalities. **(1)** MUNICIPAL JURISDICTION. (a) *General.* 1. Except as provided in ss. 101.651 (1) and (2m), Stats., cities, villages and towns shall exercise jurisdiction over the construction and inspection of new dwellings.

Note: Sections 101.651 (1) and (2m), Stats., read as follows.

101.651 Special requirements for smaller municipalities. (1) DEFINITION. In this section, "municipality" means a city, village or town with a population of 2,500 or less.

(2m) ENFORCEMENT OPTIONS. A municipality shall exercise jurisdiction over the construction and inspection of new one– and 2–family dwellings by enacting ordinances under s. 101.65 (1) (a) or shall exercise the jurisdiction granted under s. 101.65 (1) (a) jointly under s. 101.65 (1) (b), unless any of the following conditions are met:

(a) The municipality adopts a resolution requesting under sub. (3) (a) that a county enforce this subchapter or an ordinance enacted under s. 101.65 (1) (a) throughout the municipality and that a county provide inspection services in the municipality to administer and enforce this subchapter or an ordinance enacted under s. 101.65 (1) (a).

(c) Under sub. (3) (b), the department enforces this subchapter throughout the municipality and provides inspection services in the municipality to administer and enforce this subchapter.

2. Municipalities intending to exercise jurisdiction shall, by ordinance, adopt this code in its entirety.

3. No additional requirements within the scope of this code may be adopted by a municipality unless approved by the department in accordance with s. Comm 20.20.

(b) *Intent to exercise jurisdiction.* Municipalities intending to exercise jurisdiction shall notify the department, in writing, at least 30 days prior to the date upon which the municipality intends to exercise jurisdiction under this code. The notification of intent shall include a statement by the municipality as to which of the following methods will be used for enforcement:

1. Individual municipal enforcement;

2. Joint municipal enforcement;

3. Contract with certified UDC inspector or inspectors or independent inspection agency;

4. Contract with another municipality;

(c) *Submission of ordinances and resolutions.* 1. 'Ordinances.' a. Municipalities intending to exercise jurisdiction shall submit all ordinances adopting this code to the department at the same time as the notice of intent.

b. The department shall review and make a determination regarding municipal intent to exercise jurisdiction over new dwellings within 15 business days of receipt of municipal ordinances adopting this code.

c. A municipality may appeal a determination by the department in accordance with the procedure under s. Comm 20.21 (2).

2. 'Resolutions.' Municipalities adopting a resolution under s. 101.651 (2m) (a), Stats., for enforcement by the county, shall file a certified copy of the resolution with the department within 30 days of adoption.

3. 'Recision of ordinances or resolutions.' Municipalities that rescind an ordinance or a resolution under subd. 1. or 2. shall file a certified copy of the recision with the department within 30 days of adoption.

(d) *Passage of ordinances.* A certified copy of all adopted ordinances and subsequent amendments thereto shall be filed with the department within 30 days after adoption.

Note: A copy of a model ordinance for adoption is available from the department.

(2) COUNTY JURISDICTION. A county ordinance shall apply in any city, village or town which has not enacted ordinances pursuant to this section. No county ordinance may apply until after 30 business days after the effective date of this code unless a municipality within the county informs the department of its intent to have this code administered and enforced by the county. This section shall not be construed to prevent or prohibit any municipality from enacting and administering this code at any time after the effective date of this code. The department shall review and make a determination regarding county jurisdiction over new buildings within 15 business days of receipt of the county ordinances adopting the uniform dwelling code.

(3) DEPARTMENTAL JURISDICTION. In municipalities not adopting a resolution under s. 101.651 (2m), Stats., and not adopting an ordinance to enforce the code under s. Comm 20.06, the department will oversee enforcement and inspection services for new dwellings, including manufactured buildings used as dwellings.

(4) CONTINUING JURISDICTION FOR PERMIT ISSUERS. Any dwelling, for which a permit is issued by a municipality or registered UDC inspection agency prior to a municipal action under sub. (1) (c) 2. or 3. shall have all required inspections completed by the municipality or agency that issued the permit.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (b) and (2), Register, February, 1985, No. 350, eff. 3–1–85; am. (1) (a) 3., Register, October, 1996, No. 490, eff. 11–1–96; CR 00–159: r. (1) (intro.), renum. (1) (a) to (c) to be (1) (b) to (d), cr. (1) (a), r. and recr. (1) (c) and (3), Register September 2001 No. 549 eff. 12–1–01; correction in (1) (c) 2. made under s. 13.93 (2m) (b) 7., Stats.; CR 03–097: r. (1) (b) 5., am. (1) (c) 2., cr. (4) Register November 2004 No. 587, eff. 1–1–05.

Comm 20.065 State jurisdiction. **(1)** In accordance with s. 101.64 (8), Stats., municipalities administering the code may be monitored by the department for compliance with the administrative requirements under this code.

(2) In accordance with s. 101.653 (5), Stats., municipalities administering the code may be audited by the department for compliance with the erosion control requirements under this code.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter III — Definitions

Comm 20.07 Definitions. In chs. Comm 20 to 25:

(1) "Accessory building" means a detached building, not used as a dwelling unit but is incidental to that of the main building and which is located on the same lot. Accessory building does not mean farm building.

(2) "Addition" means new construction performed on a dwelling which increases the outside dimensions of the dwelling.

(3) "Allowable stress" means the specified maximum permissible stress of a material expressed in load per unit area.

(4) "Alteration" means an enhancement, upgrading or substantial change or modification other than an addition or repair to a dwelling or to electrical, plumbing, heating, ventilating, air conditioning and other systems within a dwelling.

(5) "Approved" means an approval by the department or its authorized representative. (Approval is not to be construed as an assumption of any legal responsibility for the design or construction of the dwelling or building component.)

(5m) "Attached," defining the relationship between another building and a dwelling, means at least one of the following conditions is present:

(a) There is a continuous, weatherproof roof between the two structures.

Note: The sides are not required to be enclosed with walls.

(b) There is a continuous, structural floor system between the two structures.

(c) There is a continuous foundation system between the two structures.

(6) "Attic" means a space under the roof and above the ceiling of the topmost part of a dwelling.

(7) A "balcony" is a landing or porch projecting from the wall of a building.

(7m) "Base flood elevation" means the depth or peak elevation of flooding, including wave height, which has a one percent or greater chance of occurring in any given year.

(8) "Basement" means that portion of a dwelling below the first floor or groundfloor with its entire floor below grade.

(8m) "Best management practices" is defined in s. 101.653, Stats., and means practices, techniques or measures that the department determines to be effective means of preventing or reducing pollutants of surface water generated from construction sites.

(9) "Building component" means any subsystem, subassembly or other system designed for use in or as part of a structure, which may include structural, electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety.

(10) "Building system" means plans, specifications and documentation for a system of manufactured building or for a type or a system of building components, which may include structural, electrical, mechanical, plumbing and variations which are submitted as part of the building system.

(10m) "Business day" means any day other than Saturday, Sunday or a legal holiday.

(10t) "Carport" means a structure used for storing motorized vehicles that is attached to a dwelling and that has at least 2 sides completely unenclosed.

(11) "Ceiling height" means the clear vertical distance from the finished floor to the finished ceiling.

(12) "Certified inspector" means a person certified by the department to engage in the administration and enforcement of this code.

(13) A "chimney" is one or more vertical, or nearly so, passageways or flues for the purpose of conveying flue gases to the atmosphere.

(14) "Chimney connector". Same as smoke pipe.

(15) "Closed construction" means any building, building component, assembly or system manufactured in such a manner that it cannot be inspected before installation at the building site without disassembly, damage or destruction.

(15g) "Coarse aggregate" means granular material, such as gravel or crushed stone, that is predominately retained on a sieve with square openings of 4.75 mm or 0.18 inch.

(15m) "Coastal floodplain" means an area along the coast of Lake Michigan or Lake Superior below base flood elevation that is subject to wave runup or wave heights of 3 feet or more.

(16) "Code" means chs. Comm 20 to 25, the Wisconsin uniform dwelling code.

(17) "Combustion air" means the total amount of air necessary for the complete combustion of a fuel.

(18) "Common use area" means kitchens, hallways, basements, garages and all habitable rooms.

Note: These areas must meet the circulation requirements under s. Comm 21.035.

(19) "Compliance assurance program" means the detailed system documentation and methods of assuring that manufactured dwellings and dwelling components are manufactured, stored, transported, assembled, handled and installed in accordance with this code.

(19m) "Composting toilet system" means a method that collects, stores and converts by bacterial digestion nonliquid–carried human wastes or organic kitchen wastes, or both, into humus.

(19r) "Control practice" means a method or device implemented to prevent or reduce erosion or the resulting deposition of soil or sediment.

(20) "Cooling load" is the rate at which heat must be removed from the space to maintain a selected indoor air temperature during periods of design outdoor weather conditions.

(21) "Dead load" means the vertical load due to all permanent structural and nonstructural components of the building such as joists, rafters, sheathing, finishes and construction assemblies such as walls, partitions, floors, ceilings and roofs, and systems.

(21m) "Deck" means an unenclosed exterior structure, attached or adjacent to the exterior wall of a building, which has a floor, but no roof.

(23) "Department" means the department of commerce.

(24) "Detached building" means any building which is not physically connected to the dwelling.

(24m) "Dilution air" means air that is provided for the purpose of mixing with flue gases in a draft hood or draft regulator.

(24r) "Direct–vent appliance" means a gas–burning appliance that is constructed and installed so that all air for combustion is derived directly from the outside atmosphere and all flue gases are discharged to the outside atmosphere.

(25) "Dwelling" means any building, the initial construction of which is commenced on or after the effective date of this code, which contains one or 2 dwelling units.

(26) "Dwelling contractor" means any person, firm or corporation engaged in the business of performing erosion control or construction work such as framing, roofing, siding, insulating, masonry or window replacement work covered under this code and who takes out a building permit. "Dwelling contractor" does not include the owner of an existing dwelling, an owner who will reside in a new dwelling or a person, firm or corporation engaging exclusively in electrical, plumbing, or heating, ventilating and air conditioning work.

(27) "Dwelling unit" means a structure, or that part of a structure, which is used or intended to be used as a home, residence or sleeping place by one person or by 2 or more persons maintaining a common household, to the exclusion of all others.

(28t) "Erosion" means the detachment and movement of soil, sediment or rock fragments by water, wind, ice or gravity.

(29) "Exit" means a direct, continuous, unobstructed means of egress from inside the dwelling to the exterior of the dwelling.

(30) "Farm operation" is the planting and cultivating of the soil and growing of farm products substantially all of which have been planted or produced on the farm premises.

Note: According to s. 102.04 (3), Stats., the farm operation includes the management, conserving, improving and maintaining of the premises, tools, equipment improvements and the exchange of labor or services with other farmers; the processing, drying, packing, packaging, freezing, grading, storing, delivery to storage, carrying to market or to a carrier for transportation to market and distributing directly to the consumer; the clearing of such premises and the salvaging of timber and the management and use of wood lots thereon but does not include logging, lumbering and wood–cutting operations unless the operations are conducted as an accessory to other farm operations.

(31) "Farm premises" is defined to be the area which is planted and cultivated. The farm premises does not include greenhouses, structures or other areas unless used principally for the production of food or farm products.

(32) "Farm products" are defined as agricultural, horticultural and arboricultural crops. Animals considered within the defini-

tion of agricultural include livestock, bees, poultry, fur–bearing animals, and wildlife or aquatic life.

(33) "Farming" means the operation of a farm premises owned or rented by the operator.

(33m) "Fireblocking" means a material or device used to retard or prevent the spread of flame or hot gases through concealed spaces into adjacent rooms or areas.

(34) "Firebox" means that part of the fireplace used as the combustion chamber.

(34e) "First floor" means the first floor level above any groundfloor or basement or, in the absence of a groundfloor or basement, means the lowest floor level in the dwelling.

(34f) "Flight" means a continuous series of steps with no intermediate landings.

(34g) "Floodfringe area" means that portion of the floodplain outside of the floodway that is at or below base flood elevation. The term "floodfringe" is intended to designate an area of standing, rather than flowing, water.

(34h) "Floodplain" means land which is subject to flooding which is at or below base flood elevation. The floodplain includes the floodway and floodfringe areas.

(34i) "Floodway" means the channel of a river or stream and those portions of the floodplain adjoining the channel required to carry the flood discharge. The term "floodway" is intended to designate an area of flowing, rather than standing, water.

(34m) "Floor area" means the area of a room that has a ceiling height of at least 7 feet. Rooms with ceilings less than 7 feet in height for more than 50% of the room are not considered to be floor areas.

(34s) "Foundation" means the structural system used to transfer the weight of the building to the earth.

Note: The foundation may include one or more components such as footings, piers, columns, slabs and walls.

(35) "Garage" means a structure used for storing motorized vehicles that has any more than 2 sides completely enclosed.

(36) "Gas appliance" means any device that uses gas as a fuel or raw material to produce light, heat, power, refrigeration or air conditioning.

(36m) "Groundfloor" means that level of a dwelling, below the first floor, located on a site with a sloping or multilevel grade and which has a portion of its floor line at grade.

(37) "Habitable room" means any room used for sleeping, living or dining purposes, excluding such enclosed places as kitchens, closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms, and similar spaces.

(38) "Hearth" means the floor area within the fire chamber of a fireplace.

(38m) "Hearth extension" means the surfacing applied to the floor area extending in front of and at the sides of the fireplace opening.

(40) "Heating load" is the estimated heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. The total heat load includes: the transmission losses of heat transmitted through the wall, floor, ceiling, glass or other surfaces; and either the infiltration losses or heat required to warm outdoor air used for ventilation.

Note: Infiltration losses include heat required to warm outside air which leaks through cracks and crevices, around doors and windows or through open doors and windows.

(40m) "Hollow unit" means a masonry unit which has a net cross–sectional area parallel to the bearing face which is less than 75% of the gross cross–sectional area.

(40t) "Incinerating toilet" means a self–contained device for the treatment of nonliquid carried wastes that deposits the wastes directly into a combustion chamber, reduces the solid portion to ash and evaporates the liquid portion.

(41) "Independent inspection agency" means any person, firm, association, partnership or corporation certified by the department to perform certified inspections under this code.

(42) "Initial construction" means the date of issuance of the Wisconsin uniform building permit.

(43) "Insignia." See "Wisconsin insignia."

(44) "Installation" means the assembly of a manufactured building on site and the process of affixing a manufactured building to land, a foundation, footing or an existing building.

(46) "Kitchen" means an area used, or designed to be used, for the preparation of food.

(46m) "Land disturbing construction .activity" means any man–made alteration of the land surface resulting in a change in the topography or existing vegetative or non–vegetative soil cover, that may result in storm water runoff and lead to an increase in soil erosion and movement of sediment. Land disturbing construction activity includes clearing and grubbing, demolition, excavating, pit or trench dewatering, filling and grading activities.

(47) "Landing" means the level portion of a stairs located between flights of stairs or located at the top and foot of a stairs.

(48) "Listed and listing" means equipment or building components which are tested by an independent testing agency and accepted by the department.

(49) "Live load" means the weight superimposed on the floors, roof and structural and nonstructural components of the dwelling through use and by snow, ice or rain.

(50) "Loft" means an upper room or floor which has at least 50% of the common wall open to the floor below. The opening may be infringed upon by an open guardrail constructed in compliance with s. Comm 21.04 (2), but not by a window or half–wall guardrail. All habitable rooms of lofts are open to the floor below.

(51) "Manufacture" means the process of making, fabricating, constructing, forming or assembling a product from raw, unfinished, semifinished or finished materials.

(52m) "Manufactured home" has the meaning as given in s. 101.91 (2), Stats.

Note: Under s. 101.91 (2), Stats., "manufactured home" means any of the following:

(am) A structure that is designed to be used as a dwelling with or without a permanent foundation and that is certified by the federal department of housing and urban development as complying with the standards established under 42 USC 5401 to 5425.

(c) A mobile home, unless a mobile home is specifically excluded under the applicable statute.

(53) "Mechanical draft venting system" means a venting system for a gas burning appliance that is designed to remove flue or vent gases by mechanical means, such as a fan, which may consist of an induced draft portion under non–positive static pressure or a forced draft portion under positive static pressure.

(53f) "Modular home" has the meaning given in s. 101.71 (6), Stats.

Note: Under s. 101.71 (6) (a), Stats., "modular home" means any structure or component thereof which is intended for use as a dwelling and:

1. Is of closed construction and fabricated or assembled on–site or off–site in manufacturing facilities for installation, connection, or assembly and installation, at the building site; or

2. Is a building of open construction which is made or assembled in manufacturing facilities away from the building site for installation, connection, or assembly and installation, on the building site and for which certification is sought by the manufacturer.

(b) "Modular home" does not mean any manufactured home under s. 101.91 or any building of open construction which is not subject to par. (a) 2.

Note: See s. Comm 20.07 (52m) for the definition of manufactured home.

(53m) "Multiple station smoke alarm" means an assembly that incorporates the smoke detector, the control equipment and the alarm–sounding device in one unit that is capable of being interconnected with one or more additional alarms so that the actuation of one alarm causes the operation of all interconnected alarms.

(54) A "multi–wythe wall" is a masonry wall composed of 2 or more wythes of masonry units tied or bonded together.

(55) "Municipality" means any city, village, town or county in this state.

(55m) "Naturally vented appliance" means an appliance with a venting system designed to remove flue or vent gases under non–positive static vent pressure entirely by natural draft.

(56) "Open construction" means any building, building component, assembly or system manufactured in such a manner that it can be readily inspected at the building site without disassembly, damage or destruction.

(57) "Owner" means any person having a legal or equitable interest in the dwelling.

(58) "Perm" means a unit of permeance which is measured in grains per (hour) (square foot) (inch of mercury vapor pressure difference).

Note: The lower the perm rating of a material is, the more difficult it is for water vapor to pass through it.

(59) "Pilaster" is a projection of masonry or a filled cell area of masonry for the purpose of bearing concentrated loads or to stiffen the wall against lateral forces.

(59m) "Porch" means an unenclosed exterior structure at or near grade attached or adjacent to the exterior wall of any building, and having a roof and floor.

(59t) "Privy" means an enclosed nonportable toilet into which nonwater–carried human wastes are deposited to a subsurface storage chamber.

(60m) "Registered UDC inspection agency" means a person, business or entity that is registered with the department for the purpose of facilitating plan review, issuance of Wisconsin uniform building permits, and inspection of one– and 2–family dwellings in municipalities where the department has jurisdiction pursuant to s. 101.651 (3) (b), Stats.

(61) "Repair" means the act or process of restoring to original soundness, including redecorating, refinishing, nonstructural repairs or maintenance, or the replacement of existing fixtures, systems or equipment with the equivalent fixture, system or equipment.

(62) "Shingle" means a unit of roof covering material that has been manufactured to specific dimensions and is applied in overlapping fashion. 'Shingle' includes all of the following:

(a) "Fiberglass asphalt shingle" means a type of shingle with an internal mat composed of nonwoven, resin–bonded glass fibers, that is impregnated and coated with asphalt.

(b) "Laminated shingle" means a shingle with a second layer of asphalt and mat laminated to the first layer, usually in a design pattern to simulate the dimensional appearance of natural slate or wood shakes.

(c) "Organic asphalt shingle" means a shingle with an internal mat composed of organic fibers, such as cellulose, that is saturated and coated with asphalt.

(d) "Strip shingle" means a rectangular shingle that relies either on a sealant or on a combination of weight and stiffness to resist wind uplift, rather than using interlocking tabs.

(63) A "single–wythe wall" is a masonry wall consisting of one unit of thickness.

(64) A "smoke chamber" is that part of a fireplace which acts as a funnel to compress the smoke and gases from the fire so that they will enter the chimney above.

(65) A "smoke pipe" is a connector between the solid or liquid fuel–burning appliance and the chimney.

(65m) "Solid unit" means a masonry unit which has a net cross–sectional area parallel to the bearing face which is 75% or more of the gross cross–sectional area.

(65r) "Stabilized" means the condition where vegetation is established or other practices are in place on exposed soil surfaces so as to reduce erosion.

(66) A "stairway" is one or more flights of steps, and the necessary platforms or landings connecting them, to form a continuous passage from one elevation to another.

(67) "Step(s)" is a unit(s) consisting of one riser and one tread, alone or in series.

(67m) "Storm water management plan" means a comprehensive plan designed to reduce the discharge of pollutants from storm water, after the site has undergone stabilization, following completion of the construction activity.

(68) A "story" is that portion of a building located above the basement, between the floor and the ceiling.

(69) A "stove" is a nonportable solid–fuel–burning, vented, nonducted heat–producing appliance located in the space that it is intended to heat. This definition does not include cooking appliances.

(70) "Stovepipe." Same as smoke pipe.

(71) "Strain" means a change in the physical shape of a material caused by stress.

(72) "Stress" means internal resistance to an external force expressed in load per unit area; stresses acting perpendicular (compression or tension) to the surface, shear stresses acting in the plane of the surface, or bending stresses which cause curving.

(73) "Structural analysis" is a branch of the physical sciences which uses the principles of mechanics in analyzing the impact of loads and forces and their effect on the physical properties of materials in the form of internal stress and strain.

(75) The "throat" of a fireplace is the slot–like opening above the firebox through which flames, smoke and other products of combustion pass into the smoke chamber.

(75m) "UDC" means chs. Comm 20 to 25, the Wisconsin uniform dwelling code.

(76) "Vent" means a vertical flue or passageway to vent fuel–burning appliances.

(77) A "vent connector" is a connector between a fuel–burning appliance and the chimney or vent.

(77f) "Water–resistive barrier" means a material, including flashing, behind an exterior wall covering that is intended to resist liquid water that has penetrated behind the permanent weather–resistant finish from further intruding into the exterior wall assembly.

(77m) "Waters of the state" includes those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, and all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, watercourses, drainage systems and other surface waters or groundwaters, natural or artificial, public or private, within the state or its jurisdiction.

(78) "Window" means a glazed opening in an exterior wall, including glazed portions of doors, within a conditioned space.

(78m) "Wisconsin Administrative Permit" means a permit issued by a municipality that does not conduct inspections or plan reviews under this code.

(79) "Wisconsin insignia" means a device or seal approved by the department to certify compliance with this code.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (34m) and (36m), Register, February, 1985, No. 350, eff. 3–1–85; am. (8), (22), (36m), (50), (58), (62) and (74), r. (18) and (53), renum. (26) to (29m) and am., cr. (34r), (38m), (40m), (59m) and (65m), r. and recr. (38), Register, January, 1989, No. 397, eff. 2–1–89; am. (16), (34m), (40), (52) (a) (intro.) and (b), cr. (21m), Register, March, 1992, No. 435, eff. 4–1–92; am. (16), cr. (intro), (8m), (28t), (28v), (63m), (65r) and (77m), Register, September, 1992, No. 441, eff. 12–1–92; am. (4) and (65r), renum. (62) to be (73r), cr. (26), (62), (78m), Register, November, 1995, No. 479, eff. 12–1–95; emerg. cr. (7m), (34L) and (40f), eff. 5–8–96; correction in (23) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1996, No. 490; emerg. cr. (7m), (34L) and (40f), eff. 5–8–96; cr. (7m), (15m), (34g), (34h) and (34i), renum. (34k) to be (34e), Register, February, 1997, No. 494, eff. 3–1–97; r. (22), (27m), (39), (73r) and (74), Register, January, 1999, No. 517, eff. 2–1–99; cr. (19m), (40t) and (59t), Register, April, 2000, No. 532, eff. 7–1–00; r. (4m), (28), (28r), (41m), (45), (56m), (60) and (73m), cr. (10m), (15g), (24m), (24r), (33m), (34f), (53), (53m), and (55m), r. and recr. (17) and (36) and am. (47) and (61), Register, March, 2001, No. 543, eff. 4–1–01; CR 00–159: cr. (60m) and (75m), Register September 2001 No. 549 eff. 12–1–01; CR 02–077: cr. (10t), r. and recr. (29) and (35) Register May 2003 No. 569, eff.

8–1–03; CR 05–113: cr. (19r), (46m) and (67m), r. (28v) and (63m), r. and recr. (65r) Register December 2006 No. 612, eff. 4–1–07; CR 06–071: am. (52) (b), cr. (52m) Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: cr. (5m), (18), (34s), (53f) and (77f), r. (29m) and (52) Register March 2009 No. 639, eff. 4–1–09.**

Subchapter IV — Approval and Inspection of One– and 2–Family Dwellings

Comm 20.08 Wisconsin uniform building permit.

(1) WHERE REQUIRED. Except as provided under s. Comm 20.09 (9) (b), a Wisconsin uniform building permit shall be obtained from the municipality administering and enforcing this code or from a registered UDC inspection agency administering and enforcing this code in a municipality where the department has jurisdiction pursuant to s. 101.651 (3) (b), Stats., before any on–site construction, including excavation for a structure, may begin.

(2) INSPECTIONS. A person who obtains a Wisconsin uniform building permit from a registered UDC inspection agency shall retain the same agency to conduct the inspections for the project under s. Comm 20.10.

Note: Section Comm 20.09 (9) (b) permits the issuance of a footing and foundation permit prior to the issuance of the Wisconsin uniform building permit.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, September, 1992, No. 441, eff. 12–1–92; CR 00–159: r. and recr., Register September 2001 No. 549 eff. 12–1–01; CR 03–097: am. (1) Register November 2004 No. 587, eff. 1–1–05; correction in (1) made under s. 13.93 (2m) (b) 7., Stats., Register August 2007 No. 620; **correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.085 Notices of intent and termination.

(1) NOTICE OF INTENT. (a) A notice of intent shall be filed by the owner or owner's agent when land disturbing construction activity involves one or more acres.

(b) For the purposes of par. (a), the application for the UDC permit and the submission of plans under s. Comm 20.09 shall constitute the notice of intent process.

(c) The submittal of a notice of intent to the department for a construction site with one or more acres of land disturbing construction activity constitutes an application for coverage under a storm water construction site general permit issued by the Department of Natural Resources pursuant to s. 283.33, Stats., and ch. NR 216, which contains erosion control standards established by the Department of Commerce pursuant to s. 101.653, Stats.

Note: Although construction site notices of intent are submitted to the Department of Commerce, coverage under the Department Natural Resources' storm water construction site general permit is required by the United States Environmental Protection Agency in accordance with its delegation of Clean Water Act permit authority to the Department of Natural Resources.

Note: Department of Natural Resources rules under s. NR 216.42 (9) state: "Storm water discharges from construction sites of one– and two–family dwellings regulated by the department of commerce pursuant to s. 101.653, Stats., in a manner which is equivalent to the requirements of this subchapter as determined by the department in writing, shall be deemed to hold a WPDES permit issued pursuant to this subchapter." Sites deemed to hold a WPDES permit are subject to DNR enforcement for violations of permit conditions.

(2) NOTICE OF TERMINATION. (a) The owner or owner's agent shall submit a notice of termination in a format prescribed by the department for a site where a notice of intent is required under this section.

(b) The notice of termination shall be submitted when all of the following have occurred:

1. All land disturbing construction activities have ceased.

2. All disturbed areas have been stabilized. A disturbed area shall be considered stabilized by vegetation when a perennial cover has been established with a density of at least 70 percent.

3. All temporary erosion and sediment control practices have been removed.

History: CR 05–113: cr. Register December 2006 No. 612, eff. 4–1–07.

Comm 20.09 Procedure for obtaining uniform building permit.

(1) APPLICATION. Application for a Wisconsin uniform building permit shall be on forms obtained from the department, the municipality or the authorized UDC inspection agency administering and enforcing this code. No application shall be accepted that does not contain all the information requested on the form.

Note: See appendix for a copy of the Wisconsin uniform building permit and application.

Note: Any municipality exercising jurisdiction may require reasonable supplementary information not contained on the Wisconsin building permit application.

(2) FILING OF PERMIT APPLICATIONS. (a) *Construction or installation of a dwelling.* 1. A Wisconsin uniform building permit application for the construction or installation of a dwelling shall be filed with the municipality or the authorized UDC inspection agency administering and enforcing this code.

2. The municipality or authorized UDC inspection agency shall forward a copy of all applications for new dwellings to the department within 30 business days after permit issuance.

Note: The department requires copies of permits that are issued for new dwelling construction or installation, only. Permits issued for additions, alterations, garage construction, etc., should not be filed with the department.

(b) *Additions, alterations and repairs.* 1. When required by local ordinance, permit applications for additions, alterations and repairs shall be filed with municipalities and counties in accordance with their adopted ordinances.

Note: The Department of Commerce requires copies of permits that are issued for new dwelling construction only. Any permits issued for additions, alterations, repairs, garage construction, etc. are not required to be filed with the department.

2. Pursuant to s. 101.65 (1m), Stats., a building permit required under subd. 1. may not be issued unless the conditions of sub. (5) (c) are satisfied, except as provided under s. 101.654 (1) ~~(b), Stats.~~

3. Building permits for additions, alterations and repairs are not required in municipalities where the department has jurisdiction under s. 101.651 (3) (b), Stats.

(c) *General requirements.* 1. The permit application shall be reviewed by a certified UDC inspector.

2. A permit may be issued only after approval of the requirements under this section by a certified UDC inspector.

3. Dwellings for which a permit has been issued shall be inspected in accordance with s. Comm 20.10.

(3) FEES. (a) *Municipal fees.* 1. The municipality shall, by ordinance, determine fees to cover expenses of plan examination, inspection and the issuance of the Wisconsin uniform building permit.

2. The municipality shall purchase a Wisconsin uniform building permit seal from the department for each new dwelling in accordance with s. Comm 2.34.

(b) *Inspection agency fees.* 1. UDC inspection agency fees shall be determined by contract between the municipality and the agency or between the department and the agency, where the agency has been authorized to conduct inspections on behalf of the department.

2. A UDC inspection agency shall purchase a Wisconsin uniform building permit seal from the department in accordance with s. Comm 2.34.

(4) PLAN SUBMITTALS. At least 2 sets of plans for all one– and 2–family dwellings shall be submitted to the municipality or authorized UDC inspection agency administering and enforcing this code, for examination and approval at the time the Wisconsin uniform building permit application is filed.

(5) REQUIRED PLANS. The required building plans shall be legible and drawn to scale or dimensioned and shall include all of the following:

(a) *Site plan.* The site plan shall show all of the following:

1. The location of the dwelling and any other buildings, wells, surface waters and dispersal systems on the site with respect to property lines and surface waters adjacent to the site.

2. The areas of land–disturbing construction activity and the location of all erosion and sediment control measures to be employed in order to comply with s. Comm 21.125.

3. The pre–construction ground surface slope and direction of runoff flow within the proposed areas of land disturbance.

(b) *Floor plan.* 1. Floor plans shall be provided for each floor.

2. The following features shall be included on all floor plans:

a. The size and location of all rooms, doors, windows, structural features, exit passageways and stairs.

b. The use of each room.

c. The location of plumbing fixtures, chimneys, heating and cooling appliances, and a heating distribution layout.

d. The location and construction details of the braced wall lines.

(c) *Elevations.* The elevations shall show all of the following:

1. The exterior appearance of the building, including the type of exterior materials.

2. The location, size and configuration of doors, windows, roof, chimneys, exterior grade, footings and foundation walls.

(d) *Storm water management plan.* 1. A storm water management plan shall be prepared for a site where one acre or more of land will be disturbed.

2. The storm water management plan shall delineate and describe the post–construction storm water management practices to be employed to comply with s. Comm 21.126.

(6) REQUIRED DATA. (a) All plans submitted for approval shall be accompanied by sufficient data, calculations and information to determine if the dwelling will meet the requirements of this code.

(b) The data and information for determining compliance with the energy conservation standards shall be submitted in a format approved by the department.

(c) Except as required under s. Comm 21.33, a municipality exercising jurisdiction may not require plans or calculations to be stamped or sealed by an architect or engineer.

(d) The name of the initial downstream receiving water of the state from the dwelling shall be identified, regarding erosion and sediment control and storm water management.

(7) MASTER PLANS. (a) Where a dwelling is intended to be identically and repetitively constructed at different locations, a master plan may be submitted for approval.

(b) The plans shall include plans and data as required under subs. (5) and (6).

(c) If the plans conform to the provisions of the code, an approval and a master plan number shall be issued.

(d) The number issued may be used in lieu of submitting building plans for each location.

(e) A plot plan shall be submitted for each location at the time of application for the Wisconsin uniform building permit.

(8) APPROVAL OF PLANS. (a) If the municipality or authorized UDC inspection agency administering and enforcing the code determines that the plans submitted for a one– or 2–family dwelling substantially conform to the provisions of this code and other legal requirements, an approval shall be issued.

(b) The plans shall be stamped "conditionally approved" by a certified inspector who holds the respective credential for the plans reviewed.

(c) One copy shall be returned to the applicant and one copy shall be retained by the municipality or authorized UDC inspection agency administering and enforcing this code.

(d) The conditions of approval shall be indicated by a letter or on the permit.

(e) All conditions of the approval shall be met during construction.

(9) ISSUANCE AND POSTING OF PERMITS. (a) *Uniform building permit.* 1. The Wisconsin uniform building permit shall be issued if the requirements for filing and fees are satisfied and the plans have been conditionally approved.

2. Pursuant to s. 101.65 (1m), Stats., a Wisconsin uniform building permit may not be issued to a person unless the person complies with subds. 3. and 4., except as provided under s. 101.654 (1) (b) and (c) 2., Stats.

Note: Section 101.654 (1) (b), Stats., exempts an owner of a dwelling who resides or will reside in the dwelling and who applies for a building permit to perform work on the dwelling from obtaining a dwelling contractor financial responsibility registration. Under s. 101.65 (1r), an owner who obtains a building permit needs to sign a statement advising the owner of the potential consequences of hiring a contractor to perform work under the permit who is not bonded or insured under s. 101.654 (2) (a), Stats.

Note: Section 101.654 (1) (c) 2., Stats., reads: "The continuing education requirements under par. (a) and the rules promulgated by the department under sub. (1m) do not apply to any person who holds a current license issued by the department at the time that the person obtains a building permit if the work the person does under the permit is work for which the person is licensed."

3. A person applying for a Wisconsin uniform building permit for work covered under chs. Comm 21 or 22 who is not the owner who resides or will reside in the dwelling shall hold one of the following credentials issued by the department:

a. A dwelling contractor certification.

b. A dwelling contractor — restricted certification.

c. A dwelling contractor financial responsibility certification.

d. A dwelling contractor financial responsibility — restricted certification.

4. A person applying for a Wisconsin uniform building permit for work covered under chs. Comm 21 or 22 who is not the owner who resides or will reside in the dwelling shall hold or engage, as an employee, a person who holds a certification issued by the department as a dwelling contractor qualifier.

5. The permit shall expire 24 months after issuance if the dwelling exterior has not been completed.

6. Pursuant to s. 101.63 (7), Stats., the name and license number of the Wisconsin master plumber responsible for the installation of plumbing shall be entered on the permit by the issuing entity at the time of issuance.

(b) *Permit to start construction of footings and foundation.* 1. Construction may begin on footings and foundations prior to the issuance of the Wisconsin uniform building permit where a permit to start construction is obtained.

2. Upon submittal of the application for a permit to start construction, a plot plan, complete footing and foundation information including exterior grading, and a fee, the municipality or authorized UDC inspection agency enforcing this code may issue a permit to start construction of the footings and foundation.

3. The issuance of a permit to start construction shall not influence the approval or denial of the Wisconsin uniform building permit application.

(c) *Private onsite wastewater treatment systems.* Pursuant to s. 145.195, Stats., if the proposed construction requires connection to a private onsite wastewater treatment system, a Wisconsin uniform building permit may not be issued unless conformance with s. Comm 83.25 (2) has first been determined.

Note: See appendix for a reprint of s. Comm 83.25 (2).

(d) *Posting of permit.* 1. The Wisconsin uniform building permit shall be posted in a conspicuous place at the dwelling site.

2. The Wisconsin uniform building permit seal shall be affixed to the posted permit or to the Wisconsin uniform building permit application. The permit seal number shall appear on both documents.

(10) DISAPPROVAL OF PLANS AND DENIAL OF PERMITS. (a) *General.* Approval shall be denied if the municipality or authorized UDC inspection agency administering and enforcing this code determines that the Wisconsin uniform building permit application or the plans do not substantially conform to the provisions of this code and other legal requirements.

(b) *Denial of application.* A copy of the denied application, accompanied by a written statement specifying the reasons for denial, shall be sent to the applicant and to the owner as specified on the Wisconsin uniform building permit application.

(c) *Stamping of plans.* 1. Plans which do not substantially conform to the provisions of the code shall be stamped "not approved."

2. One copy shall be returned to the person applying for the Wisconsin uniform building permit and one copy shall be retained by the municipality or authorized UDC inspection agency administering and enforcing the code.

(d) *Appeals.* The applicant may appeal a denial of the application in accordance with the procedure outlined in s. Comm 20.21.

(11) TIME-SPAN FOR APPROVAL OR DENIAL. Action to approve or deny a uniform building permit application shall be completed within 10 business days of receipt of all forms, fees, plans and documents required to process the application, and completion of other local prerequisite permitting requirements.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. (7), Register, February, 1985, No. 350, eff. 3–1–85; am. (4) (b) and (5) (b) 1., Register, January, 1989, No. 397, eff. 2–1–89; am. (3) (a) and (4) (a) 2., Register, March, 1992, No. 435, eff. 4–1–92; am. (4) (a) 1., (5) (a), (b) 2. and (6) (intro.), Register, September, 1992, No. 441, eff. 12–1–92; renum. (2) to be (2) (a) and am., am. (3) and (7), cr. (2) (b), (3) (c), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (5) (b) 1., Register, October, 1996, No. 490, eff. 11–1–96; am. (4) (a) 1. a. and (b), r. and recr. (4) (a) 1. b., r. (4) (a) 1. c. and d., Register, February, 1997, No. 494, eff. 3–1–97; am. (5) (a), Register, March, 1998, No. 507, eff. 4–1–98; cr. (5) (b) 1. c. and d., Register, January, 1999, No. 517, eff. 2–1–99; cr. (5) (b) 3., Register, April, 2000, No. 532, eff. 7–1–00; correction in (5) (b) 3. made under s. 13.93 (2m) (b) 7., Stats; correction in (5) (b) 3. made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 00–159: am. (1), (2), (4) (intro.), (5) (a), (5) (b) 2. and (c), (6) (intro.) and (b), r. and recr. (3), (5) (b) 1. d., cr. (8), Register September 2001 No. 549 eff. 12–1–01; correction in (5) (b) 1. b. made under s. 13.93 (2m) (b) 7., Stats., Register May 2003 No. 569; CR 03–097: am. (1), (2) (a), r. (2) (a) 2., (b), (3) (b), and (8), cr. (2) (b), renum. (3) (c) to be (3) (b) and am, Register November 2004 No. 587, eff. 1–1–05; CR 05–113: r. and recr. (4) (a) 1., renum. (4) (b) and (c) to be (4) (c) and (d) and am. (4) (c), cr. (4) (b) Register December 2006 No. 612, eff. 4–1–07; CR 07–007: r. and recr. (2) (b) and (5) Register August 2007 No. 620, eff. 9–1–07, except (5) (c) 2. eff. 1–1–08; **CR 08–043: r. and recr. Register March 2009 No. 639, eff. 4–1–09.**

Comm 20.10 Inspections. (1) INSPECTOR CERTIFICATION. All inspections, for the purpose of administering and enforcing this code, shall be performed by an inspector certified in accordance with ch. Comm 5 who holds the respective credential for the inspection performed.

(2) GENERAL INSPECTION REQUIREMENTS. (a) *General.* Inspections shall be conducted by the municipality or authorized UDC inspection agency administering and enforcing this code to determine if the construction or installations conform to the conditionally approved plans, the Wisconsin uniform building permit application and the provisions of this code.

(b) *Inspection notice.* 1. The applicant or an authorized representative shall request inspections from the municipality or authorized UDC inspection agency administering and enforcing this code.

2. Except as provided under subd. 3., construction may not proceed beyond the point of inspection until the inspection has been completed.

3. Construction may proceed if the inspection has not taken place by the end of the second business day following the day of notification or as otherwise agreed between the applicant and the municipality or authorized UDC inspection agency.

(3) INSPECTION TYPES. (a) *General.* The inspections described in pars. (b) to (i) shall be performed to determine if the work complies with this code.

(b) *Erosion control inspection.* Erosion control inspections shall be performed concurrently with all other required construction inspections. Additional inspections for erosion control may be performed by the delegated authority.

(c) *Foundation excavation inspection.* 1. The excavation for the foundation shall be inspected after the placement of any forms or required reinforcement and prior to the placement of the permanent foundation material.

2. If a drain tile system is required, by the local inspector or by groundwater levels in the excavation, the presence and location of bleeders used to connect the interior and exterior drain tile shall be inspected at the same time as the excavation.

Note: This excavation inspection may be used to determine the need for drain tile under s. Comm 21.17.

(d) *Foundation reinforcement inspection.* The placement of reinforcement shall be inspected where the reinforcement is required for code compliance.

(e) *Foundation inspection.* The foundation shall be inspected after completion. Where dampproofing, exterior insulation or drain tile are required for code compliance, the foundation shall be inspected prior to backfilling.

(f) *Rough inspection.* 1. A rough inspection shall be performed for each inspection category listed under subd. 1. a. to e. after the rough work is constructed but before it is concealed.

a. The basement floor area.

Note: The inspection of the basement floor area should include the following: any underfloor plumbing, electrical, or HVAC; any interior drain tile with base course required under s. Comm 21.17; the structural base course for the floor slab if required under s. Comm 21.20; and the underfloor vapor retarder as required under s. Comm 22.38.

b. General construction, including framing.

c. Rough electrical.

d. Rough plumbing.

e. Rough heating, ventilating and air conditioning.

2. All categories of work for rough inspections may be completed before the notice for inspection is given, provided the work has not been covered.

3. The applicant may request one rough inspection or individual rough inspections.

4. A separate fee may be charged for each individual inspection.

(g) *Insulation inspection.* An inspection shall be made of the insulation and vapor retarders after they are installed but before they are concealed.

(h) *Final inspection.* 1. Except as provided under subd. 2., the dwelling may not be occupied until a final inspection has been made that finds no critical violations of this code that could reasonably be expected to affect the health or safety of a person using the dwelling.

2. Occupancy may proceed in accordance with local ordinances if the inspection has not been completed by the end of the fifth business day following the day of notification or as otherwise agreed between the applicant and the department or municipality.

(i) *Installation inspection.* An inspection shall be performed on the installation of a manufactured home or modular home.

Note: The design and construction of manufactured homes is regulated by the federal Department of Housing and Urban Development under Title 24 CFR Part 3280.

(4) NOTICE OF COMPLIANCE OR NONCOMPLIANCE. (a) *General.* 1. Notice of compliance or noncompliance with this code shall be written on the building permit or another readily visible means and posted at the job site.

2. Upon finding of noncompliance, the municipality or authorized UDC inspection agency enforcing this code shall also notify the applicant of record and the owner, in writing, of the violations to be corrected.

3. Except as specified under par. (b), the municipality or authorized UDC inspection agency shall order all cited violations corrected within 30 days after written notification, unless an extension of time is granted under s. Comm 20.21.

(b) *Erosion and sediment control requirements.* 1. The time period allowed for compliance with the erosion and sediment control provisions under s. Comm 21.125 shall be determined based on the severity of the noncompliance in relation to soil loss or potential damage to the waters of the state.

2. Pursuant to s. 101.653 (7) (b), Stats., the department, a municipality or the designated UDC inspection agency may issue a special order directing an immediate cessation of construction work on other aspects of the dwelling until compliance with the erosion and sediment control provisions under s. Comm 21.125 is attained. Construction work may resume once the erosion and sediment control compliance corrections are completed.

Note: Section 101.653 (7) (b) reads: "The department or a city, village, town or county may issue a special order directing the immediate cessation of work on a one– or 2–family dwelling until the necessary plan approval is obtained or until the site complies with the rules promulgated under sub. (2)."

(5) VOLUNTARY INSPECTION. The department or its authorized representative may, at the request of the owner or the lawful occupant, enter and inspect dwellings, subject to the provisions of this code, to ascertain compliance with this code.

(6) RECORD KEEPING. (a) *Municipal enforcement.* Municipalities that have adopted an ordinance to enforce this code shall maintain records in accordance with all of the following:

1. A record shall be made of each visit to a site, each inspection type performed and the pass or fail results of each inspection.

2. Approved plans shall be retained for 4 years after completion of the dwelling.

3. Applications forms, correction orders, correspondence and inspection records shall be maintained for 7 years after completion of the dwelling.

(b) *State enforcement.* Inspectors working under state contract shall maintain records in accordance with the provisions of the contract that was in effect at the time the inspections were completed.

Note: Records generated by the plan review and inspection functions are public records and are subject to the open–records law.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (a), Register, February, 1985, No. 350, eff. 3–1–85; cr. (1) (b) 2. f., Register, January, 1989, No. 397, eff. 2–1–89; correction (1) (b) 2. intro. made under s. 13.93 (2m) (b) 4., Stats., Register, January, 1989, No. 397; r. (1) (b) 2. e., renum. (1) (b) 2. f. and 3. and (3) to be (1) (b) 2. e. and 4. and (2), cr. (1) (b) 3., Register, March, 1992, No. 435, eff. 4–1–92; am. (1) (c), Register, September, 1992, No. 441, eff. 12–1–92; cr. (1) (b) 5., Register, November, 1995, No. 479, eff. 12–1–95; am. (intro.), Register, October, 1996, No. 490, eff. 11–1–96; r. and recr. (1) (c), Register, February, 1997, No. 494, eff. 3–1–97; am. (intro.), Register, March, 1998, No. 507, eff. 4–1–98; r. and recr. (1) (b) 4., Register, March, 2001, No. 543, eff. 4–1–01; CR 00–159: am. (1) (intro.), (c) 1. and 2. a., r. and recr. (1) (a), Register September 2001 No. 549 eff. 12–1–01; CR 05–113: r. and recr. (1) (c) 2. Register December 2006 No. 612, eff. 4–1–07; CR 06–071: am. (1) (b) (intro.) cr. (1) (b) 6. and (3) Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: r. and recr. Register March 2009 No. 639, eff. 4–1–09; correction in (3) (i) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.11 Suspension or revocation of Wisconsin uniform building permit. (1) (a) The municipality or the registered UDC inspection agency administering and enforcing this code may suspend or revoke any Wisconsin uniform building permit where it appears that the permit or approval was obtained through fraud or deceit, where the applicant has willfully refused to correct a violation order or where the inspector is denied access to the premises.

(b) No construction may take place on the dwelling after suspension or revocation of the permit.

(2) Any person aggrieved by a determination made by the department, a municipality or a registered UDC inspection agency may appeal the decision in accordance with s. Comm 20.21.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; CR 00–159: r. (1), renum. (intro.) to be (1), am. (2), Register, September 2001 No. 549 eff. 12–1–01.

Subchapter V — Approval and Inspection of Modular Homes and Their Components

Comm 20.12 Scope. This part shall govern the design, manufacture, installation and inspection of modular homes, manufactured building systems and the components of the building systems displaying the Wisconsin insignia.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; **correction made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.13 Manufacture, sale and installation of homes. (1) MANUFACTURE AND SALE. No modular home, manufactured building system or component of the building system subject to this part shall be manufactured for use, sold for initial use or installed in this state unless it is approved by the department and it bears the Wisconsin insignia issued or a state seal or an insignia reciprocally recognized by the department.

(2) INSTALLATION. A Wisconsin uniform building permit shall be obtained in accordance with s. Comm 20.09 (1) to (5) (a) before any on–site construction falling within the scope of this code is commenced for a modular home. The permit shall be issued in accordance with s. Comm 20.09 (9).

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; correction in (2) made under s. 13.93 (2m) (b) 7., Stats., Register August 2007 No. 620; **CR 08–043: am. (2) Register March 2009 No. 639, eff. 4–1–09; correction in (1) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.14 Approval procedures. (1) APPLICATION FOR APPROVAL. (a) An application for approval of any modular home, building system or component shall be submitted to the department in the form required by the department, along with the appropriate fees in accordance with s. Comm 2.34.

(b) The department shall review and make a determination on an application for approval of a modular home, building system or component within 3 months.

(2) APPROVAL OF BUILDING SYSTEMS AND COMPONENTS. (a) *Approval of building systems.* 1. 'Plans and specifications.' All plans and specifications shall be submitted to the department according to subd. 1. a. or b.:

a. Three complete sets of building, structural, mechanical and electrical plans, (including elevations, sections and details), specifications and calculations shall be submitted to the department on behalf of the manufacturer for examination and approval.

b. At least one complete set of building, structural, mechanical and electrical plans, (including elevations, sections and details), specifications and calculations shall be submitted to the department on behalf of a manufacturer. All plans and specifications submitted to the department shall be stamped "conditionally approved" by a UDC certified inspector or inspectors.

2. 'Compliance assurance program.' a. Three sets of the compliance assurance program shall be submitted for examination and approval.

b. The compliance assurance program shall meet the standards of the Model Documents for the Evaluation, Approval and Inspection of Manufactured Buildings or an equivalent standard acceptable to the department.

(b) *Approval of building components.* 1. 'Plans and specifications.' All plans and specifications shall be submitted to the department according to subd. 1. a. or b.:

a. At least 3 complete sets of plans and specifications for manufactured dwelling building components shall be submitted to the department on behalf of the manufacturer for examination and approval.

b. At least one complete set of plans and specifications for manufactured dwelling building components shall be submitted to the department on behalf of the manufacturer. All plans and specifications submitted to the department shall be stamped "conditionally approved" by a UDC certified inspector or inspectors.

2. 'Compliance assurance program.' a. Three sets of the compliance assurance program shall be submitted to the department for examination and approval of components.

b. The compliance assurance program shall meet the requirements established by the department or, where applicable, be in the form of the Model Documents for the Evaluation, Approval and Inspection of Manufactured Buildings or an equivalent standard acceptable to the department.

(3) NOTIFICATION OF APPROVAL OR DENIAL OF PLANS, SPECIFICATIONS AND COMPLIANCE ASSURANCE PROGRAM. (a) *Conditional approval.* If the department determines that the plans, specifications, compliance assurance program and application for approval submitted for such building system or component substantially conform to the provisions of this code, a conditional approval shall be issued. A conditional approval issued by the department shall not constitute an assumption of any liability for the design or construction of the manufactured building.

1. Written notice. The conditional approval shall be in writing and sent to the manufacturer and the person submitting the application for approval. Any noncompliance specified in the conditional approval shall be corrected before the manufacture, sale or installation of the dwelling, building system or component.

2. Stamping of plans, specifications and compliance assurance program. Approved plans, specifications and compliance assurance programs shall be stamped "conditionally approved." At least 2 copies shall be returned to the person designated on the application for approval; one copy shall be retained by the department.

(b) *Denial.* If the department determines that the plans, specifications, compliance assurance program or the application for approval do not substantially conform to the provisions of this code, the application for approval shall be denied.

1. 'Written notice.' The denial shall be in writing and sent to the manufacturer and the person submitting the application for approval. The notice shall state the reasons for denial.

2. 'Stamping of plans, specifications and compliance assurance program.' Plans, specifications and compliance assurance programs shall be stamped"not approved." At least 2 copies shall be returned to the person submitting the application for approval; one copy shall be retained by the department.

(4) EVIDENCE OF APPROVAL. The manufacturer shall keep at each manufacturing plant where such building system or component is manufactured, one set of plans, specifications and compliance assurance program bearing the stamp of conditional approval. The conditionally approved plans, specifications and compliance assurance program shall be available for inspection by an authorized representative of the department during normal working hours.

(5) INSPECTIONS. Manufacturers shall contract with the department or an independent inspection agency to conduct in–plant inspections to assure that the building system and components manufactured are in compliance with the plans, specifications and the compliance assurance program approved by the department. All inspections, for the purpose of administering and enforcing this code, shall be performed by a certified UDC inspector or inspectors.

(6) WISCONSIN INSIGNIA. Upon departmental approval of the plans, specifications and compliance assurance program, and satisfactory in–plant inspections of the building system and components, Wisconsin insignias shall be purchased from the department in accordance with the fee established in s. Comm 2.34. A manufacturer shall be entitled to display the Wisconsin insignia on any approved system or component.

(a) *Lost or damaged insignia.* 1. 'Notification.' If Wisconsin insignias become lost or damaged, the department shall be notified immediately, in writing, by the manufacturer or dealer.

2. 'Return of damaged insignias.' If Wisconsin insignias become damaged, the insignia shall be returned to the department with the appropriate fee to obtain a new insignia.

(b) *Affixing Wisconsin insignias.* Each Wisconsin insignia shall be assigned and affixed to a specific manufactured dwelling or component in the manner approved by the department before the dwelling is shipped from the manufacturing plant.

(c) *Insignia records.* 1. 'Manufacturer's insignia records.' The manufacturer shall keep permanent records regarding the handling of all Wisconsin insignias, including construction compliance certificates, indicating the number of Wisconsin insignias which have been affixed to manufactured dwellings or manufactured building components (or groups of components); which Wisconsin insignias have been applied to which manufactured dwelling or manufactured building component; the disposition of any damaged or rejected Wisconsin insignias; and the location and custody of all unused Wisconsin insignias. The records shall be maintained by the manufacturer or by the independent inspection agency for at least 10 years. A copy of the records shall be sent to the department upon request.

2. 'Construction compliance certificate.' Within 30 days after receiving the original Wisconsin insignias from the department, and at the end of each month thereafter, the manufacturer shall submit a construction compliance certificate, in the form determined by the department, for each manufactured dwelling intended for sale, use or installation in the state.

(d) *Unit identification.* Each modular home and major transportable section or component shall be assigned a serial number. The serial number shall be located on the manufacturer's data plate.

(e) *Manufacturer's data plate.* The manufacturer's data plate for building systems shall contain the following information, where applicable:

1. Manufacturer's name and address;
2. Date of manufacture;
3. Serial number of unit;
4. Model designation;
5. Identification of type of gas required for appliances and directions for water and drain connections;
6. Identification of date of the codes or standards complied with;
7. State insignia number;
8. Design loads;
9. Special conditions or limitations of unit;
10. Electrical ratings; instructions and warnings on voltage, phase, size and connections of units and grounding requirements.

(7) RECIPROCITY. Upon request, the department will make available to any person a list of those states whose dwelling codes are considered equal to the codes established by the department and whose products are accepted reciprocally by Wisconsin.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (a), r. and recr. (2) (a) 1. and (b) 1., Register, February, 1985, No. 350, eff. 3–1–85; correction in (6) (intro.) made under s. 13.93 (2m) (b) 7., Stats., Register, September, 1992, No. 441; am. (1), (2) (a) 2., Register, November, 1995, No. 479, eff. 12–1–95; am. (2) (a) 1. b., (b) 1. b., (5), Register, October, 1996, No. 490, eff. 11–1–96; correction in (6) (intro.) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1996, No. 490; correction in (1) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 1998, No. 507; correction in (2) (a) 2. made under s. 13.93 (2m) (b) 7., Stats., Register May 2003 No. 569; CR 06–119: am. (1) Register July 2007 No. 619, eff. 8–1–07; **CR 08–043: am. (1), (2) (a) 2. and (b) 2. Register March 2009 No. 639, eff. 4–1–09; corrections in (2) (a) 2. b., (b) 2. b. and (6) (d) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.15 Effect of approval. (1) RIGHT TO BEAR INSIGNIA. A modular home or building component approved by the department, manufactured and inspected in accordance with this code, shall be entitled to bear the Wisconsin insignia.

(2) EFFECT OF INSIGNIA. Modular homes and manufactured building components bearing the Wisconsin insignia are deemed to comply with this code, except as to installation site requirements, regardless of the provisions of any other ordinance, rule, regulation or requirement.

(3) RIGHT TO INSTALL. Modular homes and components bearing the Wisconsin insignia may be manufactured, offered for sale and shall be entitled to be installed anywhere in Wisconsin where the installation site complies with the other provisions of this code.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; **corrections made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.16 Suspension and revocation of approval. The department shall suspend or revoke its approval of a manufactured building system or manufactured building component if it determines that the standards for construction or the manufacture and installation of a manufactured building system or manufactured building component do not meet this code or that such standards are not being enforced as required by this code. The procedure for suspension and revocation of approval shall be as follows:

(1) FILING OF COMPLAINT. Proceedings to suspend or revoke an approval shall be initiated by the department or an independent inspection agency or UDC certified inspector having a contract with the manufacturer whose approval is sought to be suspended or revoked. Initiation shall be by a signed, written complaint filed with the department. Any alleged violation of the code shall be set forth in the complaint with particular reference to time, place and circumstance.

(2) INVESTIGATION AND NOTIFICATION. The department may investigate alleged violations on its own initiative or upon the filing of a complaint. If it is determined that no further action is warranted, the department shall notify the persons affected. If the department determines that there is probable cause, it shall order a hearing and notify the persons affected.

(3) MAILING. Unless otherwise provided by law, all orders, notices and other papers may be served by the department by certified mail to the persons affected at their last known address. If the service is refused, service may be made by sheriff without amendment of the original order, notice or other paper.

(4) RESPONSE. Upon receipt of notification of hearing from the department, the person charged with noncompliance or nonenforcement may submit to the department a written response within 30 days of the date of service. If the person charged files a timely written response, such person shall thereafter be referred to as the respondent.

(5) CONCILIATION AGREEMENT PRIOR TO HEARING. If the department and the respondent are able to reach agreement on disposition of a complaint prior to hearing, such agreement shall:

(a) Be transmitted in writing to the secretary;

(b) Not be binding upon any party until signed by all parties and accepted by the secretary;

(c) Not be considered a waiver of any defense nor an admission of any fact until accepted by the secretary.

(6) HEARINGS. (a) *Subpoenas; witness fees.* Subpoenas shall be signed and issued by the department or the clerk of any court of record. Witness fees and mileage of witnesses subpoenaed on behalf of the department shall be paid at the rate prescribed for witnesses in circuit court.

(b) *Conduct of hearings.* All hearings shall be conducted by persons selected by the department. Persons so designated may administer oaths or affirmations and may grant continuances and adjournments for cause shown. The respondent shall appear in person and may be represented by an attorney–at–law. Witnesses may be examined by persons designated by all parties.

(7) FINDINGS. The department shall make findings and enter its order within 14 days of the hearing. Any findings as a result of petition or hearing shall be in writing and shall be binding unless appealed to the secretary.

(8) APPEAL ARGUMENTS. Appeal arguments shall be submitted to the department in writing in accordance with ch. 227, Stats., unless otherwise ordered. The department shall review and make a determination on an appeal of notification of suspension or revocation of approval within 45 business days of receipt of the appeal.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (8), Register, February, 1985, No. 350, eff. 3–1–85; am. (1), Register, October, 1996, No. 490, eff. 11–1–96.

Comm 20.17 Effect of suspension and revocation.

(1) BEARING OF INSIGNIA. Upon suspension or revocation by the department of the approval of any modular home or manufactured building component, no further insignia shall be attached to any home or building component manufactured with respect to which the approval was suspended or revoked. Upon termination of such suspension or revocation, insignias may again be attached to the home or building component manufactured after the date approval is reinstated. Should any home or building component have been manufactured during the period of suspension or revocation, it shall not be entitled to bear the Wisconsin insignia unless the department has inspected, or caused to be inspected, such modular home or manufactured building component and is satisfied that all requirements for certification have been met.

(2) RETURN OF INSIGNIAS. The manufacturer shall return to the department all insignias allocated for a modular home or manufactured building component no later than 30 days from the effective date of any suspension or revocation of the approval by the department. The manufacturer shall also return to the department all insignias which it determines for any reason are no longer needed.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; **corrections made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Subchapter VI — Approval of Products

Comm 20.18 Building product approvals.

(1) VOLUNTARY APPROVAL. (a) Materials, equipment and products regulated by this code may receive a written approval from the department indicating code compliance.

(b) 1. Approval of materials, equipment and products shall be based on sufficient data, tests and other evidence that prove the material, equipment or product is in compliance with the standards specified in this code.

2. Tests, compilation of data, and calculations for materials, equipment and products shall be conducted by a qualified independent third party.

(2) ALTERNATE APPROVAL. (a) Materials, equipment and products which meet the intent of this code and which are not approved under sub. (1) shall be permitted if approved in writing by the department.

(b) 1. Approval of materials, equipment and products shall be based on sufficient data, tests and other evidence that prove the material, equipment or product meets the intent of the standards specified in this code.

2. Tests, compilation of data, and calculations for materials, equipment and products shall be conducted by a qualified independent third party.

(3) EXPERIMENTAL APPROVAL. (a) The department may allow use of an experimental material, equipment or product for the purpose of proving compliance with the intent of this code.

(b) The department may require the submission of any information deemed necessary for review.

(c) The department may limit the number of applications it will accept for approval of experimental materials, equipment or products.

(d) Installations of a material, equipment or product under an experimental approval shall comply with all of the following:

1. Plans detailing the installation for each project where the experimental material, equipment or product is to be used shall be submitted to the department.

2. A copy of the experimental approval shall be attached to the submitted plans and approved plans.

3. a. A letter of consent from the owner of the installation shall be attached to the submitted plans and approved plans.

b. The letter under subd. 3. a. shall acknowledge that the owner has received and read a copy of the experimental approval and is in compliance with all conditions of the approval.

4. A person responsible for construction of the project shall be designated in writing by the owner.

5. The person designated as responsible for the construction of the project shall, upon completion of construction, certify in writing to the department that the installation is in compliance with the experimental approval, approved plans, specifications and data.

(e) 1. Any onsite inspections shall be performed by the department, or other person authorized by the department, at time intervals as specified by the department, but not less than once a year. The inspector shall write an inspection report.

2. The department may assess a fee for each inspection conducted under subd. 1.

(f) Five years and 6 months after the date of the completed installation, the department shall order the removal of the experimental material, equipment or product, or issue an approval for the material, equipment or product.

(g) Paragraphs (e) and (f) do not apply to an experimental system if this code is revised to include or enable the experimental system to conform to the intent of this code.

(4) REVIEW, APPROVAL AND REVOCATION PROCESSES. (a) 1. Upon receipt of a fee and a written request, the department may issue an approval for a material, equipment or product.

2. The department shall review and make a determination on an application for approval after receipt of all forms, fees, plans and information required to complete the review.

3. For voluntary and alternate approvals, a determination shall be made within 40 business days of receipt of all required materials.

4. For an experimental approval, a determination shall be made within 6 months of receipt of all required materials.

(b) 1. The department may include specific conditions in issuing an approval, including an expiration date for the approval.

2. Violations of the conditions under which an approval is issued shall constitute a violation of this code.

(c) If the department determines that the material, equipment or product does not comply with this code or the intent of this code, or that an experimental approval will not be issued, the request for approval shall be denied in writing.

(d) If an approved material, equipment or product is modified, the approval shall be considered null and void, unless the material, equipment or product is resubmitted to the department for review and approval is granted.

(e) 1. The department may revoke or deny an approval of a material, equipment or product for any false statements or misrepresentations of relevant facts or data, unacceptability of a third party providing information, or as a result of material, equipment or product failure.

2. The department may re–examine an approved material, equipment or product and issue a revised approval at any time.

(f) The department may revoke an approval if the department determines that the material, equipment or product does not comply with this code or the intent of this code due to a change in the code or department interpretation of the code.

(g) An approval issued by the department may not be construed as an assumption of any responsibility for defects in design, construction or performance of the approved material, equipment or product nor for any damages that may result.

(h) Fees for the review of a material, equipment or product under this section and any onsite inspections shall be submitted in accordance with ch. Comm 2.

(5) UNGRADED OR USED MATERIALS. (a) Ungraded or used building materials may be used or reused as long as the material possesses the essential properties necessary to achieve the level of performance required by the code for the intended use.

(b) The department or the municipality enforcing this code may require tests in accordance with sub. (1) or (2).

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (3), Register, February, 1985, No. 350, eff. 3–1–85; am. (1), Register, November, 1995, No. 479, eff. 12–1–95; correction in (1) (intro.) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1996, No. 490; r. and recr., Register, September, 2000, No. 537, eff. 10–1–00.

Subchapter VII — Variances, Appeals, Violations and Penalties

Comm 20.19 Petition for variance. The department may grant a variance to a rule only if the variance does not result in lowering the level of health, safety and welfare established or intended by the rule. The department may consider other criteria in determining whether a variance should be granted including the effect of the variance on uniformity.

(1) APPLICATION FOR VARIANCE. The applicant shall submit the petition for variance application to the municipality exercising jurisdiction in order to receive the municipal recommendation. Where no municipality exercises jurisdiction, the application shall be submitted to the department. The following items shall be submitted when requesting a variance:

(a) A clear written statement of the specific provisions of this code from which a variance is requested and the method of establishing equivalency to those provisions.

(b) A fee in accordance with s. Comm 2.52. The municipality may require a fee for the processing of the application in addition to the department's fee.

Note: A copy of the Petition for Variance form (SBD–9890) is contained in the Appendix.

(2) MUNICIPAL RECOMMENDATION. The municipality administering and enforcing this code shall submit all applications for variance to the department, together with a municipal recommendation within 10 business days after receipt of the application. The recommendation of the municipality shall include the following items:

(a) Inspections performed on the property.

(b) The issuance of correction orders on the property.

(c) An assessment of the overall impact of the variance on the municipality.

Note: A copy of the Municipal Recommendation form (SBD–9890) is contained in the Appendix.

(3) DEPARTMENTAL ACTION. Where a municipality administers and enforces the code, the department shall decide petitions for variance and shall mail notification to the municipality and the applicant within 5 business days after receipt of the application and municipal recommendation. Where the department enforces the code, the department shall decide petitions for variance within 15 business days after receipt of the application and fees.

(4) APPEALS. A person or municipality may appeal the determination of the department in the manner set out in s. 101.02 (6) (e) to (i) and (8), Stats.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, November, 1995, No. 479, eff. 12–1–95; correction in (1) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, October, 1996, No. 490.

Comm 20.20 Municipal variance from the code. Any municipality exercising or intending to exercise jurisdiction under this code may apply to the department for a variance permitting the municipality to adopt an ordinance not in conformance with this code. The department shall review and make a determination on a municipal request to adopt an ordinance not in conformance with this code within 60 business days of receipt of the request.

(1) APPLICATION FOR VARIANCE. The department may grant an application only under the following circumstances:

(a) The municipality has demonstrated that the variance is necessary to protect the health, safety or welfare of individuals within the municipality because of specific climate or soil conditions generally existing within the municipality.

(b) The municipality has demonstrated that the granting of the variance, when viewed both individually and in conjunction with other variances requested by the municipality, does not impair the statewide uniformity of this code.

(2) DEPARTMENTAL INQUIRY. Prior to making a determination, the department shall solicit within the municipality and consider the statements of any interested persons as to whether or not said application should be granted.

(3) APPEALS. Any municipality aggrieved by the denial of an application may appeal the determination in accordance with the procedure set out in s. 101.02 (6) (e) to (i) and (8), Stats. The department shall review and make a determination on an appeal of denial of a municipal request to adopt an ordinance not in conformance with this code within 60 business days of receipt of the appeal.

(4) UNIFORMITY. This section shall be strictly construed in accordance with the goal of promoting statewide uniformity.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (intro.) and (3), Register, February, 1985, No. 350, eff. 3–1–85.

Comm 20.21 Appeals of orders, determinations, and for extension of time. (1) APPEALS OF ORDERS AND DETERMINATIONS BY A MUNICIPALITY EXERCISING JURISDICTION. Appeals of order or determination of a municipality exercising jurisdiction under this code, including denials of application for permits, shall be made in accordance with the procedure set out in ch. 68, Stats., prior to making an appeal to the department, except as follows:

(a) *Appeals of final determinations by a municipality exercising jurisdiction.* Appeals of final determination by municipalities shall be made to the department after the procedures prescribed in ch. 68, Stats., have been exhausted. All appeals to the department shall be in writing stating the reason for the appeal. All appeals shall be filed with the department within 10 business days of the date the final determination is rendered under ch. 68, Stats. The department shall render a written decision on all appeals within 60 business days of receipt of all calculations and documents necessary to complete the review.

Note: Chapter 68, Stats., provides that municipalities may adopt alternate administrative appeal procedures that provide the same due process rights as ch. 68, Stats. Municipalities having adopted such alternate procedures may follow those alternate procedures.

(2) APPEALS OF ORDERS AND DETERMINATIONS BY THE DEPARTMENT. Appeals of an order of the department made pursuant to the provisions of this code, including denials of application for permits, shall be in accordance with the procedure set out in s. 101.02 (6) (e) to (i) and (8), Stats. The department shall review and make a determination on an appeal of an order or determination within 60 business days of receipt of all calculations and documents necessary to complete the review.

(3) EXTENSIONS OF TIME. (a) The time for correction of cited orders as set out in s. Comm 20.10 shall automatically be extended in the event that an appeal of said orders is filed. The extension of time shall extend to the termination of the appeal procedure and for such additional time as the department or municipality administering and enforcing this code may allow.

(b) The department or municipality administering and enforcing this code may grant additional reasonable time in which to comply with a violation order.

(4) APPEALS OF SOIL EROSION CONTROL ORDERS BY A MUNICIPALITY FOR CESSATION OF WORK. (a) Appeals of orders for cessation of work issued under s. Comm 20.10 (4) may be made to the authority issuing the cessation of work order. The authority shall make a determination on such appeal within 3 business days. Determination of appeals by a municipality may be conducted in consultation with the department.

(b) Appeals of a final determination by a municipality on cessation of work orders may be made to the department. The department shall issue a final determination on the appeal within 3 business days after receipt of such appeal.

(c) If the issuing authority determines the site to be compliant with s. Comm 21.125, orders shall be rescinded and work may commence.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (a) and (2), Register, February, 1985, No. 350, eff. 3–1–85; cr. (4), Register, September, 1992, No. 441, eff. 12–1–92; **CR 08–043: am. (1) (intro.) Register March 2009 No. 639, eff. 4–1–09; correction in (4) (a) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 20.22 Penalties and violations. (1) VIOLATIONS. No person shall construct or alter any dwelling in violation of any of the provisions of this code.

(a) *Injunction.* When violations occur, the department may bring legal action to enjoin any violations.

(b) *Ordinances.* This code shall not affect the enforcement of any ordinance or regulation, the violation of which occurred prior to the effective date of this code.

(2) PENALTIES. (a) Pursuant to ss. 101.66 and 101.77, Stats., whoever violates this code shall forfeit to the state not less than $25 nor more than $500 for each violation. Each day that the violation continues, after notice, shall constitute a separate offense.

(b) Any person violating any rule of this code applying to manufactured homes is subject to the penalties prescribed in s. 101.94 (8), Stats.

(3) MUNICIPAL ENFORCEMENT. Any municipality which administers and enforces this code may provide, by ordinance, remedies and penalties for violation of that jurisdiction exercised under s. 101.65, Stats. These remedies and penalties shall be in addition to those which the state may impose under subs. (1) and (2).

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (3), Register, March, 1992, No. 435, eff. 4–1–92; CR 06–071: renum. (2) to be (2) (a), cr. (2) (b) Register December 2006 No. 612, eff. 4–1–07.

Subchapter IX — Adoption of Standards

Comm 20.24 Adoption of standards. (1) CONSENT. Pursuant to s. 227.21 (2), Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the standards listed in Tables 20.24–1 to 20.24–12.

(2) ADOPTION OF STANDARDS. The standards referenced in Tables 20.24–1 to 20.24–12 are incorporated by reference into this chapter.

Note: Copies of the adopted standards are on file in the offices of the department and the legislative reference bureau. Copies of the standards may be purchased through the respective organizations listed in Tables 20.24–1 to 20.24–12.

(3) ALTERNATE STANDARDS. (a) Alternate standards that are equivalent to or more stringent than the standards incorporated by reference in this chapter may be used in lieu of incorporated standards when approved by the department or if written approval is issued by the department in accordance with par. (b).

(b) 1. a. Upon receipt of a fee and a written request, the department may issue an approval for the use of the alternate standard.

b. The department shall review and make a determination on an application for approval within 40 business days of receipt of all forms, fees, and documents required to complete the review.

2. Determination of approval shall be based on an analysis of the alternate standard and the incorporated standard, prepared by a qualified independent third party or the organization that published the incorporated standard.

3. The department may include specific conditions in issuing an approval, including an expiration date for the approval. Violations of the conditions under which an approval is issued shall constitute a violation of this code.

4. If the department determines that the alternate standard is not equivalent to or more stringent than the standards incorporated by reference, the request for approval shall be denied in writing.

5. The department may revoke an approval for any false statements or misrepresentations of facts on which the approval was based. The department may re–examine an approved alternate standard and issue a revised approval at any time.

6. Fees for review of standards under this paragraph shall be submitted in accordance with ch. Comm 2.

Table 20.24–1

ACI	American Concrete Institute P.O. Box 9094 Farmington Hills, MI 48333
Standard Reference Number	**Title**
1. 318–05	Building Code Requirements for Structural Concrete
2. 530–05	Building Code Requirements for Masonry Structures
3. 530.1–05	Specification for Masonry Structures

Table 20.24–2

AF&PA	American Forest & Paper Association 1111 19th Street, N.W., Suite 800 Washington, D.C. 20036
Standard Reference Number	**Title**
1. NDS–2005	National Design Specification For Wood Construction Including 2005 Supplement
2. ANSI/AF&PA PWF – 2007	Permanent Wood Foundation Design Specification

Table 20.24–3

AISC	American Institute of Steel Construction One E. Wacker Drive, Suite 3100 Chicago, IL 60601
Standard Reference Number	**Title**
1. 360–05	Specification For Structural Steel Buildings

Table 20.24–4

ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
Standard Reference Number	**Title**
1. C 62–01	Standard Specification For Building Brick (Solid Masonry Units Made From Clay Or Shale)
2. C 90–02	Standard Specification For Hollow Load–Bearing Concrete Masonry Units
3. C 216–02	Standard Specification For Facing Brick (Solid Masonry Units Made From Clay Or Shale)
4. C 270–01a	Standard Specification For Mortar For Unit Masonry

Table 20.24–4 (Continued)

ASTM	American Society for Testing and Materials 1916 Race Street Philadelphia, PA 19103
Standard Reference Number	**Title**
5. C 476–01	Standard Specification For Grout For Masonry
6. C 652–01a	Standard Specification For Hollow Brick (Hollow Masonry Units Made From Clay Or Shale)
7. D 225–01	Standard Specification For Asphalt Shingles (Organic Felt) Surfaced With Mineral Granules
8. D 226–97a	Standard Specification For Asphalt–Saturated Organic Felt Used In Roofing And Water Proofing
9. D 3462–02	Standard Specification For Asphalt Shingles Made From Glass Felt And Surfaced With Mineral Granules
10. D 4869–02	Standard Specification For Asphalt–Saturated Organic Felt Shingle Underlayment Used In Roofing

Table 20.24–5

ASCE	American Society of Civil Engineers 1801 Alexander Bell Drive Reston, VA 20191
Standard Reference Number	**Title**
SEI/ASCE 32–01	Design and Construction of Frost–Protected Shallow Foundations

Table 20.24–6

ASHRAE	American Society of Heating, Refrigerating, and Air–conditioning Engineers, Inc. 1791 Tullie Circle, N.E. Atlanta, GA 30329
Standard Reference Number	**Title**
1. 2005 Fundamentals	ASHRAE Handbook, Fundamentals
2. 2003 HVAC Applications	ASHRAE HVAC Applications Handbook
3. 2004 HVAC Systems & Equipment	ASHRAE HVAC Systems & Equipment Handbook

Table 20.24–7

ICC	The International Code Council 500 New Jersey Avenue, NW, 6th Floor Washington, D.C. 20001
Standard Reference Number	**Title**
ICC/ANSI 400–2007	Standard on the Design and Construction of Log Structures

Table 20.24–8

ILBA	The International Log Builders' Association PO Box 775 Lumby, BC Canada V0E 2G0
Standard Reference Number	**Title**
2000, Section A	Log Building Standards for Residential, Handcrafted, Interlocking, Scribe–fit Construction

Table 20.24–9

NAIMA	North American Insulation Manufacturers Association 44 Canal Canter Plaza, Suite 310 Alexandria, VA 22314
Standard Reference Number	**Title**
1. 3rd Edition, 2002	Fibrous Glass Residential Duct Construction Standards

Table 20.24–10

NFPA	National Fire Protection Association 1 Batterymarch Park Quincy, MA 02269
Standard Reference Number	**Title**
1. NFPA 13D 2002	Standard for the Installation of Sprinkler Systems in One– and Two–Family Dwellings and Manufactured Homes
2. NFPA 54–2006	National Fuel Gas Code

Table 20.24–11

NIST	National Institute of Standards and Technology U.S. Department of Commerce Washington, D.C. 20234
Standard Reference Number	**Title**
1. NBS Building Science Series 87, July 1976	Model Documents for the Evaluation, Approval, and Inspection Of Manufactured Buildings

Table 20.24–12

SMACNA	Sheet Metal and Air Conditioning Contractors National Association 4201 Lafayette Center Drive Chantilly, VA 20151–1209
Standard Reference Number	**Title**
1. Seventh Edition, 1998	Residential Comfort System Installation Standards Manual
2. Seventh Edition, 2003	Fibrous Glass Duct Construction Standards

Table 20.24–13

TPI	Truss Plate Institute, Inc. 218 North Lee Street, Suite 312 Alexandria, VA 22314
Standard Reference Number	**Title**
1. TPI 1–2002	National Design Standard for Metal Plate Connected Wood Truss Construction

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (intro.) and (2), cr. (2m) and (2n), r. and recr. (4), Register, February, 1985, No. 350, eff. 3–1–85; renum. (2m) to be (2k) and am., cr. (2m), Register, July, 1986, No. 367, eff. 1–1–87; am. (intro.), (1), (2k) and (4), r. (2n), cr. (2p), (2s) and (3m), Register, January, 1989, No. 397, eff. 2–1–89; am. (intro.), (1), (2), (2k), (2m), (2p), (2s), (3m), (4), (5), cr. (6), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr., Register, November, 1995, No. 479, eff. 12–1–95; r. and recr., Register, January, 1999, No. 517, eff. 2–1–99; renum. (1) to (14) to be (4) to (17), r. and recr. (intro.) and cr. (2) and (3), Register, September, 2000, No. 537, eff. 10–1–00; renum. (1) to be (1) (a), (1) (b) to be (4) (b), (7) (f) to (i) to be (g) to (j), and (j) to (p) to be (L) to (r), cr. (1) (b), (7) (f), and (k), and am. (4) and (12), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (1) and (2), r. (4) to (17), cr. Tables 20.24–1 to 12 Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. Tables 1 to 3 and 6, r. Tables 4 and 10, renum. Tables 5, 7 to 9, 11 and 12 to be Tables 4, 9 to 11, 12 and 13 and am. 9, 10, 12 and 13, cr. Tables 5, 7 and 8 Register March 2009 No. 639, eff. 4–1–09.**

Chapter Comm 21

CONSTRUCTION STANDARDS

Subchapter I — Scope
Comm 21.01 Scope.

Subchapter II — Design Criteria
Comm 21.02 Loads and materials.
Comm 21.03 Exits.
Comm 21.035 Interior circulation.
Comm 21.04 Stairways and elevated areas.
Comm 21.042 Ladders.
Comm 21.045 Ramps.
Comm 21.05 Natural light and natural ventilation.
Comm 21.06 Ceiling height.
Comm 21.07 Attic and crawl space access.
Comm 21.08 Fire separation and dwelling unit separation.
Comm 21.085 Fireblocking.
Comm 21.09 Smoke detectors.
Comm 21.095 Automatic fire sprinklers.
Comm 21.10 Protection against decay and termites.
Comm 21.11 Foam plastic.
Comm 21.115 Installation of elevators or dumbwaiters.

Subchapter III — Excavations
Comm 21.12 Grade.
Comm 21.125 Erosion control and sediment control.
Comm 21.126 Storm water management.
Comm 21.13 Excavations adjacent to adjoining property.
Comm 21.14 Excavations for footings and foundations.

Subchapter IV — Footings
Comm 21.15 Footings.
Comm 21.16 Frost protection.
Comm 21.17 Drain tiles.

Subchapter V — Foundations
Comm 21.18 Foundations.

Subchapter VI — Floors
Comm 21.19 Floor design.
Comm 21.20 Concrete floors.
Comm 21.203 Garage floors.
Comm 21.205 Wood floors in contact with the ground.
Comm 21.21 Precast concrete floors.
Comm 21.22 Wood frame floors.
Comm 21.225 Decks.

Subchapter VII — Walls
Comm 21.23 Wall design.
Comm 21.24 Exterior covering.
Comm 21.25 Wood frame walls.
Comm 21.26 Masonry walls.

Subchapter VIII — Roof and Ceilings
Comm 21.27 Roof design.
Comm 21.28 Weather protection for roofs.

Subchapter IX — Fireplace Requirements
Comm 21.29 Masonry fireplaces.
Comm 21.30 Masonry chimneys.
Comm 21.32 Factory-built fireplaces.

Subchapter X — Construction in Floodplains
Comm 21.33 Construction in floodplains.
Comm 21.34 Construction in coastal floodplains.

Subchapter XI — Installation of Manufactured Homes
Comm 21.40 Installation standards.

Note: Chapter Ind 21 was renumbered to be chapter ILHR 21, Register, February, 1985, No. 350, eff. 3–1–85. Chapter ILHR 21 was renumbered chapter Comm 21 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 6. and 7., Stats., Register, January, 1999, No. 517.

Subchapter I — Scope

Comm 21.01 Scope. The provisions of this chapter shall apply to the design and construction of all one– and 2–family dwellings.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Subchapter II — Design Criteria

Comm 21.02 Loads and materials. Every dwelling shall be designed and constructed in accordance with the requirements of this section.

(1) DESIGN LOAD. Every dwelling shall be designed and constructed to support the actual dead load, live loads and wind loads acting upon it without exceeding the allowable stresses of the material. The construction of buildings and structures shall result in a system that provides a complete load path capable of transferring all loads from point of origin through the load–resisting elements to the foundation.

(a) *Dead loads.* Every dwelling shall be designed and constructed to support the actual weight of all components and materials. Earth–sheltered dwellings shall be designed and constructed to support the actual weight of all soil loads.

(b) *Live loads.* 1. Floors and ceilings. Floors and ceilings shall be designed and constructed to support the minimum live loads listed in Table 21.02. The design load shall be applied uniformly over the component area.

TABLE 21.02

Component	Live Load (pounds per sq. ft.)
Floors	40
Garage floors	50
Exterior balconies, decks, porches	40
Ceilings (with storage)	20
Ceilings (without storage)	5

2. Snow loads. Roofs shall be designed and constructed to support the minimum snow loads listed on the zone map. The loads shall be assumed to act vertically over the roof area projected upon a horizontal plane.

(c) *Wind loads.* Dwellings shall be designed and constructed to withstand a horizontal and uplift pressure of 20 pounds per square foot acting over the surface area.

(d) *Fasteners.* All building components shall be fastened to withstand the dead load, live load and wind load.

Note: See the Appendix for a schedule of fasteners that will be acceptable to the department for compliance with this subsection. Other fastening methods may be allowed if engineered under s. Comm 21.02 (3).

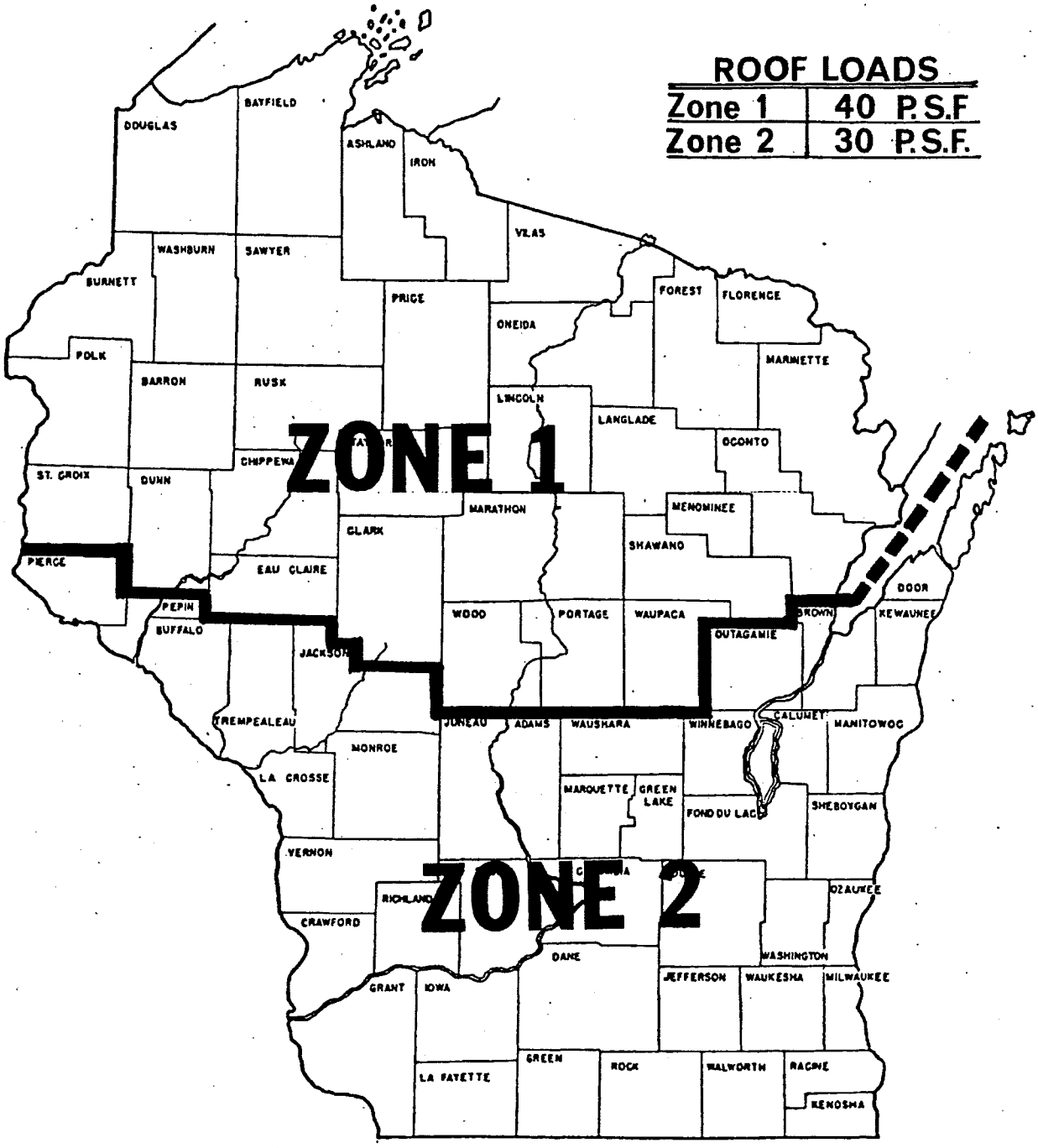
(2) METHODS OF DESIGN. All dwellings shall be designed by the method of structural analysis or the method of accepted practice specified in each part of this code.

Note: See ch. NR 116, rules of the department of natural resources, for special requirements relating to buildings located in flood plain zones. Information regarding the elevation of the regional flood may be obtained from the local zoning official.

(3) STRUCTURAL STANDARDS. (a) *General.* Design, construction, installation, practice and structural analysis shall conform to the following nationally recognized standards.

(b) *Wood.* 1. Except as provided in subd. 1. a. and b., structural lumber, glue–laminated timber, timber pilings and fastenings shall be designed in accordance with the "National Design Specification for Wood Construction" and the "Design Values for Wood Construction," a supplement to the National Design Specification for Wood Construction.

Figure 21.02
ZONE MAP FOR ROOF LOADS



a. Section 2.2.5.3. The cumulative effects of short–time loads, such as snow, shall be considered in determining duration of load. For snow load, no greater duration of load factor than 1.15 shall be used.

b. Section 4.1.7. The provisions of this section shall also apply to reused lumber. Reused lumber shall be considered to have a duration of load factor of 0.90.

2. Span tables for joists and rafters printed in the appendix or approved by the department may be used in lieu of designing by structural analysis.

3. Sawn lumber that is not graded in accordance with the standards under subd. 1., shall use the NDS published allowable design stresses for the lumber species using grade number 3 when used for studs, stringers, rafters or joists and may use grade number 1 when used for beams, posts or timbers.

(c) *Structural steel.* The design, fabrication and erection of structural steel for buildings shall conform to Specification for Structural Steel Buildings, Allowable Stress Design and Plastic Design and the provisions of the accompanying commentary as adopted under Table 20.24–3.

(d) *Concrete.* Plain, reinforced or prestressed concrete construction shall conform to the following standards:

1. ACI Standard 318, "Building Code Requirements for Reinforced Concrete".

2. ACI Standard 318.1, "Building Code Requirements for Structural Plain Concrete".

(e) *Masonry.* The design and construction of masonry shall conform to the following standards:

1. ACI 530, Building Code Requirements for Masonry Structures.

2. ACI 530.1, Specification for Masonry Structures.

(f) *Engineered structural components.* Engineered structural components shall be used in accordance with structural analysis or with load tables supplied by the manufacturer, provided those load tables were developed using structural analysis or load testing.

(g) *Whole logs.* Dwellings constructed of whole logs shall conform to the following standards:

1. ILBA Log Building Standards for Residential, Handcrafted, Interlocking, Scribe–fit Construction.

Note: This standard requires the minimum log diameter to be 8 inches.

2. ICC/ANSI 400, Standard on the Design and Construction of Log Structures.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. (3) (a), am. (3) (c) and Table 21.02, cr. (3) (c) 2., Register, February, 1985, No. 350, eff. 3–1–85; cr. (3) (a) 3., am. (3) (b), renum. (3) (e) to be (3) (d), and am., Register, November, 1995, No. 479, eff. 12–1–95; renum. and am. (1) (c) to be (1) (c) 1., cr. (1) (c) 2. and 3., am. (3) (d), Register, January, 1999, No. 517, eff. 2–1–99; r. (3) (a) 3. and cr. (3) (e), Register, March, 2001, No. 543, eff. 4–1–01; correction in (3) (b) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02–077: am. (1) (intro.) and (d) Register May 2003 No. 569, eff. 8–1–03; corrections in (3) (b) and (d) made under s. 13.93 (2m) (b) 7., Stats., Register May 2003 No. 569; **CR 08–043: r. (1) (c) 2. and 3., renum. (1) (c) 1., (3) (a) to (e) and (intro.) to be (1) (c), (3) (b) to (f) and (3) (a) and am. (3) (a) and (e), am. (3) (title), cr. (3) (b) 3., (e) 1., 2. and (g), am. (3) (e) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.03 Exits. Exits, doors and hallways shall be constructed as specified in this section.

(1) EXITS FROM THE FIRST FLOOR. (a) Except as allowed under par. (h), every dwelling unit shall be provided with at least 2 exit doors accessible from the first floor.

(b) At least one of the exits shall discharge to grade and may not go through a garage. This exit may include interior or exterior stairs.

(c) An additional exit may discharge to an outside balcony that complies with sub. (10).

(d) An additional exit may discharge into an attached garage provided the garage has an exit door that discharges to grade. An overhead garage door may not be used as an exit door.

(e) Except as allowed under pars. (f) and (h), the 2 required exit doors shall be separated by at least the greater of the following distances:

1. One–third the length of the longest diagonal of the floor in plan view, exclusive of an attached garage.

2. 20 feet.

Note: See appendix for examples of exit separation design.

(f) 1. First floor levels that do not meet the separation requirements under par. (e), shall have at least one egress window complying with sub. (6) on that floor level.

2. An egress window to comply with subd. 1. shall be separated from at least one door on the first floor by one of the distances under par. (e).

3. If first floor levels that do not meet the separation requirements under par. (e) contain one or more sleeping rooms, each sleeping room shall have at least one egress window complying with sub. (6).

(g) 1. The exit separation distance required under par. (e) shall be calculated or measured as a straight line from the midpoint of one doorway to the midpoint of the other doorway.

2. For exiting through an attached garage, the separation distance shall be measured using the door connecting the garage and the dwelling. Distance within the garage shall be ignored.

(h) 1. Dwellings consisting of no more than a first floor with a maximum floor area of 400 square feet and a loft area not exceeding half of the first floor area, shall be provided with at least one exit door leading directly to the exterior and at least one egress window that complies with sub. (6).

2. a. Dwellings that meet the size restrictions under subd. 1., are not required to meet the exit separation requirements under par. (e) or (f).

b. If a dwelling that meets the size restrictions under subd. 1., has more than one room on the first floor, the door and the egress window shall be located in different rooms.

(2) EXITS FROM THE SECOND FLOOR. (a) At least 2 exits shall be provided from the second floor. One of the exits shall be a stairway or ramp and lead to the first floor or discharge to grade. The second exit may be via a stairway or ramp which discharges to grade or may discharge to a balcony which complies with sub. (8).

(b) Except as provided in par. (c), windows which comply with sub. (6) may be provided in each second floor bedroom in lieu of the second exit from the floor.

(c) Where the second floor is the lowest floor level in a dwelling unit, as in an up–and–down duplex, windows may not be provided as the second exit from the floor.

(3) EXITS ABOVE THE SECOND FLOOR. (a) Except as provided under pars. (b) and (c), each habitable floor above the second floor shall be provided with at least 2 exits that meet all of the following requirements:

1. The exits shall be stairways or ramps that lead to the second floor or discharge to grade.

2. The exits shall be located such that an exit is accessible to the second floor if another exit is blocked.

(b) A second stairway or ramp exit is not required for habitable areas on a third floor that meet all of the following requirements:

1. The habitable area consists of a single room.

Note: Non–habitable areas, such as closets and bathrooms may be partitioned off.

2. The room is not used for sleeping.

3. The habitable area has a floor area of 400 square feet or less.

4. There is at least one egress window meeting the requirements of sub. (6) in the habitable area.

(c) A second stairway or ramp exit is not required for habitable areas on a third floor that meet all of the following requirements:

1. The dwelling is fully sprinklered in accordance with NFPA 13R or NFPA 13D.

2. If a required exit includes an attached garage, the garage shall be sprinklered.

(4) EXITS FROM LOFTS. (a) At least one stairway exit shall be provided, to the floor below, for a loft exceeding 400 square feet in area.

(b) At least one stairway or ladder exit shall be provided to the floor below for a loft, 400 square feet or less, in area.

(5) EXITS FROM BASEMENTS AND GROUND FLOORS. (a) *General.* Except as provided in par. (b), all basements and ground floors shall be provided with at least one exit of the following types:

1. A door to the exterior of the dwelling.

2. A stairway or ramp that leads to the floor above.

(b) *Basements and ground floors used for sleeping.* 1. Basements and ground floors used for sleeping shall be provided with at least 2 exits.

2. The exits shall be located as far apart as practical.

3. The exits may not be accessed from the same ramp or stairway.

4. In addition to the exit type required under par. (a), the second exit from a basement or ground floor used for sleeping shall be one of the following types:

a. A door to the exterior of the dwelling.

b. A stairway or ramp that leads to the floor above.

c. A stairway that leads to a garage provided the garage has an exit door other than the overhead door.

d. An egress window that complies with sub. (6), located in each bedroom.

(6) WINDOWS USED FOR EXITING. Windows which are installed for exit purposes shall comply with the requirements of this subsection.

(a) The window shall be openable from the inside without the use of tools or the removal of a sash. If equipped with a storm or screen, it shall be openable from the inside.

(b) 1. The nominal size of the net clear window opening shall be at least 20 inches by 24 inches irrespective of height or width. Nominal dimensions shall be determined by rounding up fractions of inches if they are ½–inch or greater or rounding down fractions of inches if they are less than ½–inch.

2. No portion of the window, including stops, stools, meeting rails and operator arms, shall infringe on the required opening.

(c) The area and dimension requirements of par. (b) may be infringed on by a storm window.

(d) 1. For any window used for exiting, the lowest point of clear opening shall be no more than 60 inches above the floor.

2. If the lowest point of clear opening is more than 46 inches above the floor, a permanent platform or fixture shall be installed such that a flat surface at least 20 inches wide and 9 inches deep is located no more than 46 inches directly below the clear opening.

3. The topmost surface of the platform or fixture shall be no more than 24 inches above the floor.

4. The topmost surface of the platform or fixture shall support a live load of at least 200 pounds.

5. A Step used for the sole purpose of reaching the top of the platform or fixture is exempt from the requirements of s. Comm 21.04.

(e) 1. An egress window with any point of clear opening below adjacent grade shall be provided with an areaway in accordance with this section.

2. The width of the areaway shall be at least equal to the width of the window.

3. The areaway shall be a minimum of 36 inches measured perpendicular from the outer surface of the below–grade wall.

4. If the bottom of the areaway is more than 46 inches below adjacent grade or the top of the areaway enclosure, the areaway shall be provided with a ladder or at least one additional step to aid egress. Steps used to comply with this section are exempt from the requirements of s. Comm 21.04.

5. a. Ladders or other steps used to comply with subd. 4. may infringe on the required area of the areaway by a maximum of 6 inches.

b. Ladder rungs shall have a minimum inside width of at least 12 inches and shall project at least 3 inches from the wall behind the ladder.

c. Ladder rungs shall be able to support a concentrated load of 200 pounds.

d. Ladder rungs shall have a maximum rise of 12 inches between rungs and shall extend to within 12 inches of exterior grade.

6. The areaway shall be constructed such that water entering the areaway does not enter the dwelling.

(7) DOORS USED FOR EXITING. (a) Doors used for exiting from a dwelling shall meet the following dimensions:

1. At least one exit door shall be a swing–type door at least 80 inches high by 36 inches wide.

2. Except as allowed under subds. 3. and 4., other required exit doors shall be at least 76 inches high by 32 inches wide.

3. Where double doors are used as a required exit, each door leaf shall provide a clear opening at least 30 inches wide and be at least 76 inches high.

4. Where sliding doors are used as a required exit, the clear opening shall be at least 30 inches wide and be at least 76 inches high.

(b) All exit doors shall be openable from the interior without the use of a key.

(8) BALCONIES. (a) Balconies shall be made of concrete, metal or wood which is treated, protected or naturally decay–resistive in accordance with s. Comm 21.10.

(b) Balconies shall be provided with guardrails in accordance with s. Comm 21.04 (3).

(c) Balconies which are required for exit purposes shall also comply with all of the following requirements:

1. The balcony guardrail shall terminate no more than 46 inches above the floor level of the balcony.

2. The floor level of the balcony shall be no more than 15 feet above the grade below.

3. The floor of the balcony shall have minimum dimensions of 3 feet by 3 feet. The guardrail and its supports may infringe on the dimensions of the required area.

(9) SPLIT LEVEL DWELLINGS. In determining the exit requirement in a split level dwelling, all levels that are to be considered a single story shall be within 5 feet of each other.

(10) TWO–FAMILY DWELLINGS. In a 2–family dwelling, each dwelling unit shall be provided with exits in compliance with this section.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; emerg. am. (1) (b), (2) and (5) (b) 2., eff. 5–7–85; r. (1) (b), renum. (1) (a) to be (1), am. (2), (7) and (8), r. and recr. (5) to (6), cr. (6m) and (10) to (12), Register, January, 1989, No. 397, eff. 2–1–89; am. (3) and (7), r. and recr. (10) and (11), Register, March, 1992, No. 435, eff. 4–1–92; am. (8), r. and recr. (10) (a), Register, November, 1995, No. 479, eff. 12–1–95; am. (6m) (b) 1. and 2., r. (6m) (b) 3., Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (1), (5), (7) and (8), am. (2) (b), r. (6), renum. (6m) to be (6) and r. and recr. (6) (d) and (e) as renum., Register, March, 2001, No. 543, eff. 4–1–01; reprinted to correct printing error in (6) (e) 2., Register September 2001 No. 549; CR 02–077: am. (1) (a), (5) (a) (intro.) and (10) (b), r. and recr. (1) (e), cr. (1) (f) to (h), Register May 2003 No. 569, eff. 8–1–03; CR 03–097: am. (1) (h) 1., Register November 2004 No. 587, eff. 1–1–05; **CR 08–043: am. (title) and (1) (b), r. and recr. (3) and (7), renum. (6) (e) 5. and (10) to (12) to be (6) (e) 5. a. and (8) to (10), cr. (6) (e) 5. b. to d., r. (8) and (9) Register March 2009 No. 639, eff. 4–1–09; correction in (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 21.035 Interior circulation. (1) DOORS AND OPENINGS. All doors and openings to the following areas shall be at least 80 inches high and provide either a net clear opening width of 30 inches or be a 32–inch door:

(a) Except as provided under pars. (b) and (c), all entrances into common use areas.

(b) At least 50% of the bedrooms.

(c) 1. At least one full bathroom, including doors or openings to a sink, toilet and tub or shower. If this bathroom is accessible only through a bedroom, the bedroom door shall meet the minimum width requirements of this section.

2. If one or more full bathrooms are provided on the first floor, the bathroom meeting the requirements under this section shall be on the first floor.

Note: This section does not require a full bathroom on the first floor.

(2) HALLWAYS. (a) Except as allowed under par. (b), the clear width of hallways shall be at least 36 inches.

(b) The following are allowed to infringe on the required clear width of a hallway:

1. Door hardware and finish trim.

2. Handrails may infringe into the minimum width of a hallway up to 4½ inches on each side.

3. Heating registers may infringe into the minimum width of a hallway up to 4½ inches and no part of the register may be more than 38 inches above the floor.

4. Ducts, pipes, light fixtures, structural features, and corner treatments that are within 84 inches of the floor may infringe into the minimum width of a hallway by a maximum of 4½ inches on each side.

5. Unlimited infringements are allowed in a hallway more than 84 inches above the floor.

(3) KITCHENS. (a) There shall be at least 30 inches of clearance between a wall, a permanently–installed kitchen island, permanently–installed kitchen cabinets and the following kitchen appliances, if provided:

1. A range, cook top or oven.

2. A sink, refrigerator or freezer.

(b) Measurements shall be taken from the face of the wall, island, cabinet or appliance, ignoring knobs and handles.

Note: See ICC/ANSI A117.1 chapter 10 for more guidelines relating to doors and accessible routes. Under that standard, doors must be at least 80–inches in height and provide a minimum net clear opening of 31¾–inches in width in order to provide accessibility for people with disabilities.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 21.04 Stairways and elevated areas.

(1) SCOPE. (a) *General.* Except as provided under par. (b), the following stairways shall conform to the requirements of this section.

1. Every interior and exterior stairway attached to, or supported by any part of the structure covered under this code.

2. Tub access steps, unless they are an integral part of an approved plumbing product.

(b) *Exceptions.* The following stairways are not required to comply with the requirements of this section:

1. Stairways leading to non–habitable attics or crawl spaces.

2. Non–required stairways connecting the basement directly to the exterior of the structure without communicating with any other part of the structure.

(2) DETAILS. (a) *Width.* 1. Except for spiral staircases under subd. 2., stairways shall measure at least 36 inches in width. Handrails and associated trim may project a maximum of 4.5 inches into the required width at each side of the stairway.

2. Spiral staircases shall be at least 26 inches wide measured from the outer edge of the supporting column to the inner edge of the handrail.

(b) *Riser height.* 1. a. Except for spiral staircases under subd. 2., risers may not exceed 8 inches in height measured vertically from tread to tread.

b. At the top and bottom of a flight, measurement shall be taken from the top of the nosing to the finished floor surface unless the finished surface is carpeting, in which case measurement shall be made to the hard surface below the carpeting.

2. Risers in spiral staircases may not exceed 9.5 inches in height measured vertically from tread to tread.

(c) *Tread depth.* 1. 'Rectangular treads.' Rectangular treads shall have minimum tread depth of 9 inches measured horizontally from nosing to nosing.

2. 'Spiral staircase treads.' Spiral staircase treads shall have a minimum tread depth of 7 inches from nosing to nosing measured at a point 12 inches from the outer edge of the center column.

3. 'Winder treads in series.' Two or more winder treads may be placed immediately adjacent to each other anywhere in a stairway provided both of the following conditions are met:

a. The winder treads shall have a minimum tread depth of 7 inches measured at a point 12 inches from the narrow end of the tread.

b. The depth of the immediately adjoining winder treads shall be equal at a point 12 inches from the narrow end of the tread or inside face of spindles or balusters.

c. Winder treads may not be used on a straight stairway.

4. 'Individual winder treads.' a. An individual winder tread may be placed between rectangular treads or at the end of a flight of rectangular treads provided the tread depth, measured at a point 12 inches from the narrow end, is equal to the tread depth of the rectangular steps in the flight.

b. There may be more than one individual winder tread in a stairway or in a flight of stairs.

c. Winder treads may not be used on a straight stairway.

(d) *Headroom.* 1. Stairways shall be provided with a minimum headroom clearance of 76 inches measured vertically from a line parallel to the nosing of the treads to the ceiling, soffit or any overhead obstruction directly above that line.

2. The headroom clearance shall be maintained over an intermediate landing.

3. The headroom clearance shall be maintained over a landing that is at the top or bottom of a stairway for a minimum distance of 36 inches in the direction of travel of the stairway.

(e) *Uniformity.* 1. Within a stairway flight, the greatest tread depth may not exceed the smallest tread depth by more than $^3/_8$ inch and the greatest riser height may not exceed the smallest riser height by more than $^3/_8$ inch.

2. The allowed variation in uniformity under subd. 1. may not be used to exceed the maximum riser height under par. (b) or to decrease the minimum tread depth under par. (c).

(f) *Open risers.* Stairways with open risers shall be constructed to prevent the through–passage of a sphere with a diameter of 4 inches or larger between any 2 adjacent treads,

(g) *Walking surface.* The walking surface of stair treads and landings shall be a planar surface that is free of lips or protrusions that could present a tripping hazard.

(3) HANDRAILS AND GUARDRAILS. (a) *General.* 1. Stair flights with more than 3 risers shall be provided with at least one handrail for the full length of the stair flight.

2. Handrails or guardrails shall be provided on all open sides of stair flights consisting of more than 3 risers and on all open sides of areas that are elevated more than 24 inches above the floor or exterior grade.

Note: A handrail provided at 30 to 38 inches above the tread nosing meets the height requirement for a guardrail on a stairway.

3. a. Except as provided in subd. 3. b., handrails and guardrails shall be constructed to prevent the through–passage of a sphere with a diameter of 4 inches or larger.

b. The triangular area formed by the tread, riser and bottom rail shall have an opening size that prevents the through–passage of a sphere with a diameter of 6 inches or larger.

c. Rope, cable or similar materials used in handrail or guardrail infill shall be strung with maximum openings of 3½ inches with vertical supports a maximum of 4 feet apart.

Note: In some cases, the vertical supports could be simple cable stays that offer vertical support to the rope or cable span. Structural posts must be supplied to provide the rail with the minimum 200 pound load resistance, as well as to resist the tensile loads exerted by the tightened rope or cable.

4. a. Handrails and guardrails shall be designed and constructed to withstand a 200 pound load applied in any direction.

b. Handrail or guardrail infill components, balusters and panel fillers shall withstand a horizontally applied perpendicular load of 50 pounds on any one–foot–square area.

c. Glazing used in handrail or guardrail assemblies shall be safety glazing.

5. Exterior handrails and guardrails shall be constructed of metal, decay resistant or pressure–treated wood, or shall be protected from the weather.

(b) *Handrails.* 1. 'Height.' Handrails shall be located at least 30 inches, but no more than 38 inches above the nosing of the treads. Measurement shall be taken from the hard structural surface beneath any finish material to the top of the rail. Variations

in uniformity are allowed only when a rail contacts a wall or newel post or where a turnout or volute is provided at the bottom step.

2. 'Clearance.' The clearance between a handrail and the wall surface shall be at least 1½ inches.

3. 'Winders.' a. Except as provided under subd. 3. b., the required handrail on winder steps shall be placed on the side where the treads are wider.

b. Where all winder steps in a flight have a tread depth of at least 9 inches from nosing to nosing measured at a point 12 inches from the narrow end of the tread, the required handrail may be located on either side of the stairway.

4. 'Projection.' Handrails and associated trim may project into the required width of stairs and landings a maximum of 4½ inches on each side.

5. 'Size and configuration.' Handrails shall be symmetrical about the vertical centerline to allow for equal wraparound of the thumb and fingers.

a. Handrails with a round or truncated round cross sectional gripping surface shall have a maximum whole diameter of 2 inches.

b. Handrails with a rectangular cross sectional gripping surface shall have a maximum perimeter of 6¼ inches with a maximum cross sectional dimension of 2⅞ inches.

c. Handrails with other cross sections shall have a maximum cross sectional dimension of the gripping surface of 2⅞ inches with a maximum linear gripping surface measurement of 6¼ inches and a minimum linear gripping surface of 4 inches.

Note: See appendix for further information on handrail measurement.

6. 'Continuity.' Handrails shall be continuous for the entire length of the stairs except in any one of the following cases:

a. A handrail may be discontinuous at an intermediate landing.

b. A handrail may have newel posts.

c. A handrail may terminate at an intermediate wall provided the lower end of the upper rail is returned to the wall or provided with a flared end, the horizontal offset between the 2 rails is no more than 12 inches measured from the center of the rails, and both the upper and lower rails can be reached from the same tread without taking a step.

(c) *Guardrails.* 1. 'Application.' a. All openings between floors, and open sides of landings, platforms, balconies or porches that are more than 24 inches above grade or a floor shall be protected with guardrails.

b. The requirements under subd. 1. a. apply where insect screens are the only means of enclosure or protection for a surface that is more than 24 inches above grade or a floor.

c. For exterior applications, the 24 inch vertical measurement shall be taken from the lowest point within 3 feet horizontally from the edge of the deck, landing, porch or similar structure.

2. 'Height.' Guardrails shall be located at least 36 inches above the floor. Measurement shall be taken from the hard structural surface be: ith any finish material to the top of the rail.

3. 'Opening size.' Guardrails shall be constructed to prevent the through–passage of a sphere with a diameter of 4 inches or larger.

(4) LANDINGS. (a) *Intermediate landings.* 1. A level intermediate landing shall be provided in any stairway with a height of 12 feet or more.

2. Intermediate landings that connect 2 or more straight flights of stairs, or 2 flights of stairs at a right angle, shall be at least as wide as the stairway and shall measure at least 36 inches in the direction of travel.

3. Curved or irregular landing shall have a radius of at least 36 inches.

4. Curved or irregular landings shall have a minimum straight line measurement of 26 inches between the nosing of the 2 connecting treads measured at a point 18 inches from the narrow end of the landing measured along the nosing of the 2 treads.

(b) *Landings at the top and base of stairs.* A level landing shall be provided at the top and base of every stairs. The landing shall be at least as wide as the stairs and shall measure at least 3 feet in the direction of travel.

(c) *Doors at landings.* 1. Except as provided in subd. 1. a. to c., level landings shall be provided on each side of any door located at the top or base of a stairs, regardless of the direction of swing. In the following exceptions, stairways to attached garages, carports or porches are considered interior stairs:

a. A landing is not required between the door and the top of interior stairs if the door does not swing over the stairs.

b. A landing is not required between the door and the top of an interior stairs of 1 or 2 risers regardless of the direction of swing.

c. A landing is not required between a sliding glass door and the top of an exterior stairway of 3 or fewer risers.

2. The exterior landing, platform or sidewalk at an exterior doorway shall be located a maximum of 8 inches below the interior floor elevation and shall have a length of at least 36 inches in the direction of travel out of the dwelling.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; am. (intro.), r. and recr. (1) (c), renum. (3) (f) to Comm 21.042, Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (intro.) and (3) (c), am. (1) (a), (2) (a) and (c) 2. and (3) (a), cr. (2) (c) 6., March, 1992, No. 435, eff. 4–1–92; r. and recr., Register, November, 1995, No. 479, eff. 12–1–95; am. (1) (c) 1. and (d), renum. (2) (intro.) to (b) to be (2) (a) to (c) and am. (a), r. (2) (b) (intro.), Register, February, 1997, No. 494, eff. 3–1–97; reprinted to restore dropped copy, Register, March, 1997, No. 495; r. (1), renum. (intro.) to be (1) and am., renum. (2) and (3) to be (3) and (4), cr. (2) and r. and recr. (4) (a), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (2) (b) 1., (c) 1. and (3) (a), cr. (2) (f) and (3) (c) 3., r. and recr. (3) (b) 3., renum. (4) (c) to be (4) (c) 1. (intro.), a. to c. and 2. and am. (4) (c) 1. (intro.) and 2. Register May 2003, No. 569, eff. 8–1–03; CR 03–097: am. (2) (f), (3) (a) 3., and (c) 3. Register November 2004 No. 587, eff. 1–1–05; **CR 08–043: r. and recr. (1), am. (2) (c) 2., 3. b. and (e) 1., cr. (2) (c) 3. c., 4. c., (g), (3) (a) 3. c., 4. b., c., (c) 1. b. and c., renum. (3) (a) 4. and (c) 1. to be (3) (a) 4. a. and (c) 1. a. Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.042 Ladders. Ladders which are used as part of a required exit shall conform to this section.

(1) DESIGN LOAD. Ladders shall be designed to withstand loads of at least 200 pounds.

(2) TREAD OR RUNGS. (a) Minimum tread requirements shall be specified in Table 21.042. Treads less than 9 inches in width shall have open risers. All treads shall be uniform in dimension.

TABLE 21.042

Pitch of Ladder Angle to Horizontal (degrees)	Maximum rise (inches)	Minimum Tread (inches)
41.6 to 48.4	8	9
greater than 48.4 to 55.0	9	8
greater than 55.0 to 61.4	10	7
greater than 61.4 to 67.4	11	6
greater than 67.4 to 71.6	12	5
greater than 71.6 to 75.9	12	4
greater than 75.9 to 80.5	12	3
greater than 80.5 to 90	12	2

(b) Rungs may only be used for ladders with a pitch range of 75° to 90°. Rungs shall be at least 1 inch in diameter for metal ladders and 1½ inch for wood ladders. All rungs shall be uniform in dimension.

(3) RISERS. Risers shall be uniform in height and shall conform with Table 21.042.

(4) WIDTH. The width of the ladder shall be a minimum of 20 inches wide and a maximum of 30 inches wide.

(5) HANDRAILS. (a) Handrails shall be required for ladders with pitches less than 65°.

(b) Handrails shall be located so the top of the handrail is at least 30 inches, but not more than 38 inches, above the nosing of the treads.

(c) Open handrails shall be provided with intermediate rails or an ornamental pattern such that a sphere with a diameter of 6 inches or larger cannot pass through.

(d) The clearance between the handrail and the wall surface shall be at least 1½ inches.

(e) Handrails shall be designed and constructed to withstand a 200 pound load applied in any direction.

(6) CLEARANCES. (a) The ladder shall have a minimum clearance of at least 15 inches on either side of the center of the tread.

(b) The edge of the tread nearest to the wall behind the ladder shall be separated from the wall by at least 7 inches.

(c) A passage way clearance of at least 30 inches parallel to the slope of a 90° ladder shall be provided. A passage way clearance of at least 36 inches parallel to the slope of a 75° ladder shall be provided. Clearances for intermediate pitches shall vary between these 2 limits in proportion to the slope.

(d) For ladders with less than a 75° pitch the vertical clearance above any tread or rung to an overhead obstruction shall be at least 6 feet 4 inches measured from the leading edge of the tread or rung.

History: Renum. from Comm 21.04 (3) (f), cr. (intro.), Register, January, 1989, No. 397, eff. 2–1–89; am. (6) (b), Register, November, 1995, No. 479, eff. 12–1–95; am. (5) (b) and (c), Register, January, 1999, No. 517, eff. 2–1–99.

Comm 21.045 Ramps. (1) GENERAL. Every exterior or interior ramp which leads to or from an exit shall comply with the requirements of this section.

Note: See ICC/ANSI A117.1 chapter 5 for more guidelines relating to the design and construction of an accessible ramp. Under that standard, ramps along an accessible route for people with disabilities should have a slope of not more than 1–foot of rise in 12–feet of run and should have handrails on both sides of the ramp.

(2) SLOPE. Ramps shall not have a gradient greater than 1 in 8 or one foot of rise in 8 feet of run. Walkways with gradients less than 1 in 20 or one foot of rise in 20 feet of run are not considered to be ramps.

(3) SURFACE AND WIDTH. Ramps shall have a slip resistant surface and shall have a minimum width of 36 inches measured between handrails.

(4) HANDRAILS. Handrails shall be provided on all open sides of ramps. Every ramp that overcomes a change in elevation of more than 8 inches shall be provided with at least one handrail.

(a) Ramps which have a gradient greater than 8.33% or 1:12 or one foot rise in 12 feet of run and which overcome a change in elevation of more than 24 inches, shall be provided with handrails on both sides.

(b) Handrails shall be located so the top of the handrail is at least 30 inches, but not more than 38 inches above the ramp surface.

(c) Open–sided ramps shall have the area below the handrail protected by intermediate rails or an ornamental pattern to prevent the passage of a sphere with a diameter of 4 inches or larger.

(d) The clear space between the handrail and any adjoining wall shall be at least 1½ inches.

(5) LANDINGS. A level landing shall be provided at the top, at the foot and at any change in direction of the ramp. The landing shall be at least as wide as the ramp and shall measure at least 3 feet in the direction of travel.

History: Cr. Register, January, 1989, No. 397, eff. 2–1–89; am. (3) (intro.), Register, March, 1992, No. 435, eff. 4–1–92; am. (3) (c), Register, November, 1995, No. 479, eff. 12–1–95; am. (3) (b), Register, January, 1999, No. 517, eff. 2–1–99; CR 03–097: am. (3) (c) Register November 2004 No. 587, eff. 1–1–05; **CR 08–043: renum. (intro.) and (1) to (4) to be (1) to (5) and am. (1) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.05 Natural light and natural ventilation. (1) NATURAL LIGHT. All habitable rooms shall be provided with natural light by means of glazed openings. The area of the glazed openings shall be at least 8% of the net floor area, except under the following circumstances:

(a) *Exception.* Habitable rooms, other than bedrooms, located in basements or ground floors do not require natural light.

(b) *Exception.* Natural light may be obtained from adjoining areas through glazed openings, louvers or other approved methods. Door openings into adjoining areas may not be used to satisfy this requirement.

(2) VENTILATION. (a) *Natural ventilation.* Natural ventilation shall be provided to all habitable rooms by means of openable doors, skylights or windows. The net area of the openable doors, skylights or windows shall be at least 3.5% of the net floor area of the room. Balanced mechanical ventilation may be provided in lieu of openable exterior doors, skylights or windows provided the system is capable of providing at least one air change per hour of fresh outside air while the room is occupied. Infiltration may not be considered as make–up air for balancing purposes.

(b) *Exhaust ventilation.* All exhaust ventilation shall terminate outside the building.

(3) SAFETY GLASS. Except as provided in par. (e), glazing shall consist of safety glass meeting the requirements of CPSC 16 CFR, Part 1201 when installed in any of the following locations:

(a) In any sidelight or glazing adjacent to a door that meets all of the following:

1. The nearest point of the glazing is within 2 feet of the door.
2. The nearest point of the glazing is within 5 feet of the floor.
3. The plane of the glazing is within 30 degrees of the plane of the door when the door is in the closed position.

(b) In any wall where the glazing is within 5 feet vertically of the lowest drain inlet and within 3 feet horizontally of the nearest part of the inner rim of a bathtub, hot tub, shower, spa or whirlpool appliance.

(c) Within 4 feet vertically of a tread or landing in a stairway and within one foot horizontally of the near edge of the tread or landing.

(d) Within 4 feet vertically of the floor and 3 feet horizontally of the nosing of the top or bottom tread of a stair.

(e) Safety glass is not required where the size of an individual pane of glass is 8 inches or less in the least dimension.

Note: The U.S. Consumer Product Safety Commission requires safety glass for glazing in internal and external doors, including storm doors and patio doors, as well as for the tub or shower enclosures themselves. These federal rules, contained in 16 CFR, subchapter B, part 1201, apply in addition to any state rules or statutes.

Note: Glass blocks are considered to be masonry products and are regulated under the ACI 530 standard adopted under s. Comm 20.24. They are not required to be safety glazing.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. (1) and (2), Register, February, 1985, No. 350, eff. 3–1–85; r. and recr. (3) and (4), Register, July, 1986, No. 367, eff. 1–1–87; am. (4), Register, January, 1989, No. 397, eff. 2–1–89; am. (2) (a), (4) and (5), Register, March, 1992, No. 435, eff. 4–1–92; am. (2) (a), Register, November, 1995, No. 479, eff. 12–1–95; am. (3), r. and recr. (4) and (5), Register, January, 1999, No. 517, eff. 2–1–99; CR 02–077: am. (1) (a) and (5) (b) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (title), r. (3) and (4), renum. (5) to be (3) and am. (3) (intro.), r. and recr. (3) (a) and (b) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.06 Ceiling height. All habitable rooms, kitchens, hallways, bathrooms and corridors shall have a ceiling height of at least 7 feet. Habitable rooms may have ceiling heights of less than 7 feet provided at least 50% of the room's floor area has a ceiling height of at least 7 feet. Beams and girders or other projections shall not project more than 8 inches below the required ceiling height.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85.

Comm 21.07 Attic and crawl space access. (1) ATTIC. Attics with 150 or more square feet of area and 30 or more inches of clear height between the top of the ceiling framing and the bottom of the rafter or top truss chord framing shall be provided with an access opening of at least 14 by 24 inches, accessible from inside the structure.

(2) CRAWL SPACES. Crawl spaces with 18 inches of clearance or more between the crawl space floor and the underside of the house floor joist framing shall be provided with an access opening of at least 14 by 24 inches.

Note: Access to plumbing or electrical systems may be required under chs. Comm 82–87, Plumbing Code or ch. Comm 16, Electrical Code, Volume 2.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, March, 1992, No. 435, eff. 4–1–92; am. (1), Register, November, 1995, No. 479, eff. 12–1–95.

Comm 21.08 Fire separation and dwelling unit separation. (1) FIRE SEPARATION. Dwelling units shall be separated

from garage spaces, accessory buildings, property lines and other dwelling units in accordance with Table 21.08 and the following requirements:

TABLE 21.08

Between Dwelling And:	Distance Between Objects[1]	Fire Rated Construction[2,5]
Detached garage or accessory building on same property	Less than 5 feet	3/4–hour wall[3] 1/3–hour door or window[3]
Another dwelling on same property	Less than 5 feet	3/4–hour wall[4] 1/3–hour door or window[4]
Detached garage, accessory building, or other dwelling on same property	5 to 10 feet	3/4–hour wall[3] No requirement on openings
Detached garage, accessory building, or other dwelling on same property	More than 10 feet	No requirements
Property Lines	Less than 3 feet	3/4–hour wall 1/3–hour door or window
Property Lines	3 feet or more	No Requirements
Zero Lot Line	None	Follow sub. (2) (d) requirements

[1] Distance shall be measured perpendicular from wall to wall or property line, ignoring overhangs.

[2] Fire rated construction shall protect the dwelling from an exterior fire source.

[3] Fire rated construction may be in either facing wall.

[4] Fire rated construction shall be in both facing walls.

[5] The methods for garage separation in par. (a) 1. are examples of ¾ hour wall construction.

(a) *Attached garages.* 1. The walls and ceiling between an attached garage and any portion of the dwelling, including attic or soffit areas, shall be ¾–hour fire–resistive construction or shall be constructed as specified in any of the following:

a. One layer of $^5/_8$–inch Type X gypsum drywall shall be used on the garage side of the separation wall or ceiling.

b. One layer of ½–inch gypsum drywall shall be used on each side of the separation wall or ceiling.

c. Two layers of ½–inch gypsum drywall shall be used on the garage side of the separation wall or ceiling.

2. For all methods listed under subd. 1., drywall joints shall comply with one of the following:

a. Joints shall be taped or sealed.

b. Joints shall be fitted so that the gap is no more than $^1/_{20}$–inch with joints backed by either solid wood or another layer of drywall such that the joints are staggered.

Note: 1/20–inch is approximately the thickness of a U.S. dime.

3. Vertical separations between an attached garage and a dwelling shall extend from the top of a concrete or masonry foundation to the underside of the roof sheathing or fire–resistive ceiling construction.

(b) *Structural elements exposed in an attached garage.* Beams, columns and bearing walls which are exposed to the garage and which provide support for habitable portions of the dwelling shall be protected by one of the methods specified in par. (a) 1. a. or c. or other ¾ hour fire–resistive protection.

(c) *Doors.* 1. The door and frame assembly between the dwelling unit and an attached garage shall be labeled by an independent testing agency as having a minimum fire–resistive rating of 20 minutes. The test to determine the 20–minute rating is not required to include the hose stream portion of the test.

Note: Acceptable tests for fire rating of door assemblies include ASTM E–152, UL 10B, and NFPA 252.

2. Only glazing allowed by the door's listing may be installed in any door required under this section.

(d) *Other openings.* 1. Access openings in fire separation walls or ceilings shall be protected in one of the following ways:

a. The opening is protected with a material that has a finish rating of at least 20 minutes.

b. The opening is protected in the same way as the wall or ceiling where the opening is located.

2. The cover or door of the access opening shall be permanently installed with hardware that will maintain it in the closed position when not in use.

(2) DWELLING UNIT SEPARATION. (a) *General.* In 2–family dwellings, dwelling units shall be separated from each other and from shared tenant spaces including attics, basements, garages, vestibules and corridors.

(b) *Attic separation.* Dwelling units with attic space that extends over both units shall be separated in accordance with one of the following:

1. 'Complete separation.' The units shall be provided with wall construction under par. (d) that extends all the way to the underside of the roof deck.

2. 'Vertical and horizontal separation.' a. The units shall be provided with wall construction under par. (d) that extends to the dwelling unit ceiling and ceiling construction under par. (e).

b. Dwelling units using this method of separation shall provide attic draft stopping under par. (f) that extends all the way to the underside of the roof deck above and in line with the separation wall.

(c) *Doors.* Any door installed in the dwelling unit separation shall have the door and frame assembly labeled by an independent testing agency as having a minimum fire–resistive rating of 20 minutes. The test to determine the 20–minute rating is not required to include the hose stream portion of the test.

(d) *Walls.* Walls in the dwelling unit separation shall be protected by not less than one layer of $^5/_8$–inch Type X gypsum wallboard or 2 layers of ½–inch gypsum wallboard or equivalent on each side of the wall with joints in compliance with sub. (1) (a) 2.

(e) *Floors and ceilings.* A fire protective membrane of one layer of $^5/_8$–inch Type X gypsum wallboard with joints in compliance with sub. (1) (a) 2., shall be provided on the ceiling beneath the floor construction that provides the separation.

(f) *Draft stopping for concealed roof spaces and attics.* 1. Attic areas, mansards, overhangs and other concealed roof spaces shall be draft stopped above and in line with the separation wall.

2. Acceptable draft stopping materials include:

a. $^3/_8$–inch wood structural panel.

b. ½–inch gypsum board.

(3) PENETRATIONS. (a) *Ducts.* 1. Except as allowed under subd. 2., all heating and ventilating ducts that penetrate a required separation shall be protected with a listed fire damper with a rating of at least 90 minutes.

2. The fire damper required under subd. 1. may be omitted in any of the following cases:

a. There is a minimum of 6 feet of continuous steel ductwork on at least one side of the penetration.

b. The duct has a maximum cross–sectional area of 20 square inches.

(b) *Electrical and plumbing components.* Penetrations of a required separation by electrical and plumbing components shall be firmly packed with noncombustible material or shall be protected with a listed through–penetration firestop system with a rating of at least one hour.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; cr. (1m), am. (2), (5) (c) and Table, Register, January, 1989, No. 397, eff. 2–1–89; am. (2), (4) and (5) (a) (intro.), renum. (5) (b) and (c) to be (5) (c) and (d) and am. (5) (d), cr. (5) (b) and (e), (6), Register, March, 1992, No. 435, eff. 4–1–92; r. (3) (a), (5) (d), renum. (3) (b) and (c), (5) (e) to be (3) (a) and (b), (5) (d), am. (5) (a) (intro.), (6), cr. (6) (c) to (e), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (5) and (6) (b), am. (6) (c) and (d), r. (6) (e) and cr. (7), Register, January, 1999, No. 517, eff. 2–1–99; r. (1) to (4), renum. (5) to (7) to be (1) to (3), and cr. (2) (e), Register, March, 2001, No. 543, eff. 4–1–01; corrections in (2) (c) and (d) were made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02–077: am. (1) (a) 1. and (2) (a) to (c) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (1) (intro.) and Table, r. (1) (a) 4. and (2) (e), renum. (1) (c), (2) (b), (c) and (d) to be (1) (c) 1., (2) (c), (d) and (e) and am. (2) (d), cr. (1) (c) 2., (2) (b) and (f), r. and recr. (1) (d) 1. and (2) (a) Register March 2009 No. 639, eff. 4–1–09; correction in Table 21.08 made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 21.085 Fireblocking. (1) FIREBLOCKING LOCATIONS. Fireblocking shall be provided in all of the following locations:

(a) In concealed spaces of walls and partitions, including furred spaces, at the ceiling and floor levels.

(b) At all interconnections between concealed vertical and horizontal spaces including the attachment between a carport and a dwelling.

(c) In concealed spaces between stair stringers at the top and bottom of the run and at any intervening floor level.

(d) At all openings around wires, cables, vents, pipes, ducts, chimneys and fireplaces at ceiling and floor level.

(2) FIREBLOCKING MATERIALS. Fireblocking shall consist of one of the following:

(a) 2–inch nominal lumber.

(b) Two layers of one–inch nominal lumber.

(c) One thickness of ¾–inch nominal plywood or wood structural panel with any joints backed with the same material.

(d) One thickness of ½–inch gypsum wallboard, face nailed or face screwed to solid wood, with any joints backed with the same material.

(e) Fiberglass or mineral wool batt insulation may be used if both of the following conditions are met:

1. The least dimension of the opening may not exceed 4 inches.

2. The batt shall be installed to fill the entire thickness of the opening or stud cavity.

(f) For wires, cables, pipes and vents only, non–shrinking caulk, putty mortar, or similar material may be used provided no dimension of the opening exceeds ½ inch around the penetrating object.

(g) For chimneys, fireplaces and metal vents, fireblocking shall be metal, cement board or other noncombustible material.

History: Cr. Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (1) (b) Register May 2003 No. 569, eff. 8–1–03.

Comm 21.09 Smoke detectors. (1) A listed and labeled multiple–station smoke alarm with battery backup shall be installed in all of the following locations:

(a) An alarm shall be installed inside each sleeping room.

(b) On floor levels that contain one or more sleeping areas, an alarm shall be installed outside of the sleeping rooms, within 21 feet of the centerline of the door opening to any sleeping room and in an exit path from any sleeping room.

(c) On floor levels that do not contain a sleeping area, an alarm shall be installed in a common area on each floor level.

Note: Section 50.035 (2), Stats., requires the installation of a complete low voltage, interconnected or radio–transmitting smoke detection system in all community–based residential facilities including those having 8 or fewer beds.

Note: Section 101.645 (3), Stats., requires the owner of a dwelling to install a functional smoke detector in the basement of the dwelling and on each floor level except the attic or storage area of each dwelling unit. The occupant of such a dwelling unit shall maintain any smoke detector in that unit, except that if any occupant who is not the owner, or any state, county, city, village or town officer, agent or employee charged under statute or municipal ordinance with powers or duties involving inspection of real or personal property, gives written notice to the owner that the smoke detector is not functional the owner shall provide, within 5 days after receipt of that notice, any maintenance necessary to make that smoke detector functional.

Note: Section 101.745 (4), Stats., requires the manufacturer of a manufactured building to install a functional smoke detector in the basement of the dwelling and on each floor level except the attic or storage area of each dwelling unit.

(2) (a) Except for dwellings with no electrical service, smoke detectors required by this section shall be continuously powered by the house electrical service, and shall be interconnected so that activation of one detector will cause activation of all detectors.

(b) Dwellings with no electrical service shall be provided with battery–powered smoke detectors in the locations under sub. (1). Interconnection and battery–backup are not required in these dwellings.

(3) For family living units with one or more communicating split levels or open adjacent levels with less than 5 feet of separation between levels, one smoke detector on the upper level shall suffice for an adjacent lower level, including basements. Where there is an intervening door between one level and the adjacent lower level, smoke detectors shall be installed on each level.

(4) Smoke alarms and detectors shall be maintained in accordance with the manufacturer's specifications.

(5) For envelope dwellings, at least 3 smoke alarms shall be placed in the air passageways. The alarms shall be placed as far apart as possible.

(6) In basements where two required exits are separated by a continuous wall, a smoke detector shall be placed on each side of the wall within 21 feet of each exit.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; r. and recr. Register, April, 1990, No. 412, eff. 5–1–90; renum. to be (1), cr. (2) and (3), Register, March, 1992, No. 435, eff. 4–1–92; renum. (2) and (3) to be (3) and (4), cr. (2), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (1), r. (2), renum. (3) and (4) to be (2) and (3), and cr. (4) and (5), Register, March, 2001, No. 543, eff. 4–1–01: **CR 08–043: am. (1) (b) and (3), renum. (2) to be (2) (a) and am., cr. (2) (b) and (6) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.095 Automatic fire sprinklers. (1) Except as allowed under sub. (2), where automatic fire sprinklers using a dedicated water supply system are installed, the design, installation, testing and maintenance shall follow the requirements of NFPA 13D.

(2) Limited area dwelling systems are allowed.

Note: See s. Comm 82.40 (3) (e) of the Wisconsin Uniform Plumbing Code for requirements for multi–purpose piping systems. These systems attach fire sprinkler heads to the dwelling's potable water piping system.

Note: Chapter 145, Stats., requires automatic fire sprinkler systems, on dedicated water supply systems, to be installed by a licensed sprinkler fitter.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 21.10 Protection against decay and termites. (1) Wood used in any of the applications under this section shall meet all of the following requirements:

(a) The wood shall be labeled and pressure treated with preservative in accordance with an AWPA standard or shall be naturally durable and decay–resistant or shall be engineered to be decay resistant.

(b) The wood shall be pressure treated with preservative or shall be naturally termite–resistant unless additional steps are taken to make the wood termite–resistant.

(2) Wood used in the following locations shall be as required under sub. (1):

(a) Resting directly upon or embedded in earth.

(b) Floor joists or sleepers that meet all of the following conditions:

1. The joists or sleepers are protected from the weather.

2. The joists or sleepers are within 18 inches above a lower floor surface, deck or soil.

3. There is no vapor retarder that meets the requirements under s. Comm 22.38 (1) (a) between the joists or sleepers and the soil below.

Note: This situation could occur with a floor over a crawl space or when a floor is added over a patio deck or a garage slab.

(c) Floor joists exterior to the dwelling that are within 18 inches above exterior grade, unless protected with a moisture barrier.

Note: Acceptable moisture barriers for this application include ¾–inch exterior preservative–treated plywood, or ice dam protection material listed as meeting the requirements of ASTM D 1970 or vapor retarder material, provided they are protected from physical and UV light damage.

(d) Girders that span directly over and within 12 inches of earth.

(e) Sills and rim joists that rest on concrete or masonry and are also below grade or within 8 inches above final exterior grade.

(f) Siding and sheathing in contact with concrete, masonry or earth and within 6 inches above final exterior grade.

(g) Ends of wood structural members and their shims resting on or supported in masonry or concrete walls and having clearances of less than ½ inch on the top, sides and ends.

(h) Bottom plates or sole plates of walls that rest on concrete or masonry and that are below exterior grade or less than 8 inches above final exterior grade.

(i) Columns in direct contact with concrete or masonry unless supported by a structural pedestal or plinth block at least one inch above the floor.

(j) Any structural part of an outdoor deck, including the decking.

(k) Permanent wood foundations.

(3) Wood girders that rest directly on exterior concrete or masonry shall be protected by one of the following methods:

(a) The wood shall be pressure treated with preservative or shall be a naturally durable and decay–resistant species.

(b) Material, such as pressure–treated plywood, flashing material, steel shims, or water–resistant membrane material shall be placed between the wood and the concrete or masonry.

(4) All pressure–treated wood and plywood shall be identified by a quality mark or certificate of inspection of an approved inspection agency which maintains continued supervision, testing and inspection over the quality of the product.

Note: Heartwood of redwood, cypress, black walnut, catalpa, chestnut, sage orange, red mulberry, white oak, or cedar lumber are considered by the department to be naturally decay–resistant. Heartwood of bald cypress, redwood, and eastern red cedar are considered by the department to be naturally termite resistant.

(5) FASTENERS. (a) Fasteners for pressure–preservative treated wood and fire–retardant–treated wood shall meet one of the following requirements:

1. The fastener is a steel bolt with a diameter of 0.5 inch or greater.

2. The fastener is made of stainless steel.

3. The fastener is made of hot–dipped, zinc–galvanized steel with the coating weight and thickness labeled as complying with ASTM A 153.

4. The fastener is made of steel with a mechanically–deposited zinc coating labeled as complying with ASTM B 695, Class 55 or greater.

5. The fastener has coating types and weights in accordance with the fastener manufacturer's recommendations. In the absence of the manufacturer's recommendations subd. 1., 2., 3., or 4. shall apply.

Note: "Zinc plated," "zinc coated," "chrome plated," etc., fasteners do not necessarily comply with either of these standards.

(b) When a fastener is used with a hanger or other metal fixture, the fastener shall be of the same material as the hanger or metal fixture.

Note: When separate pieces are in close contact, zinc corrodes rapidly in the presence of plain steel. Zinc corrodes much more rapidly in the presence of stainless steel.

(c) For the purposes of this section, a fastener includes nails, screws and bolts, along with nuts and washers.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; am. (1) (b) and (3), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (1) (intro.) and (b), am. (1) (f), renum. (3) (intro.) to be (3) (a), cr. (3) (b), Register, March, 1992, No. 435, eff. 4–1–92; am. (1) (a), (b), (3), cr. (1) (g), Register, November, 1995, No. 479, eff. 12–1–95; r. (1) and (2), renum. (3) to be (4), and cr. (1) to (3), Register, March. 2001, No. 543, eff. 4–1–01; CR 02–077: am. (4) (a) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (1), (2) (a) and (i), r. and recr. (2) (b) and (h), r. (2) (g) and (4) (b), renum. (2) (c) to (f) and (4) (a) to be (2) (d) to (g) and (4) and am. (2) (e), (f) 1. and (g), cr. (2) (c), (k) and (5) Register March 2009 No. 639, eff. 4–1–09; correction in (2) (a) 3. made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 21.11 Foam plastic. (1) (a) *General.* Foam plastic insulation shall have a flame–spread rating of 75 or less and a smoke–developed rating of 450 or less when tested in accordance with ASTM E–84.

(b) *Thermal barrier.* Except as provided in par. (c), foam plastic insulation shall be separated from the interior of the dwelling by one of the following thermal barriers:

1/2 ← 1. ½–inch gypsum wallboard.

1/2 ← 2. ½–inch nominal wood structural panel.

3/4 ← 3. ¾–inch sawn lumber with tongue–and–groove or lap joints.

4. 1–inch of masonry or concrete.

5. A product or material shown by an independent laboratory to limit the temperature rise on the unexposed surface to 250°F for 15 minutes when tested in accordance with ASTM E–119.

6. For doors only, sheet metal with a minimum thickness of 26 standard steel gauge or aluminum with a minimum thickness of 0.032 inch.

Note: Number 26 standard steel gauge is approximately equal to 0.018–inch.

(c) *Exemptions from thermal barrier requirement.* The following applications of foam plastic do not require a thermal barrier:

1. On overhead garage doors.

2. In the box sill of the basement or ground floor, above the bottom of the floor joists.

(2) Insulation that does not meet the requirements of this section may be approved by the department in accordance with s. Comm 20.18. Approval will be based on tests that evaluate materials or products representative of actual end–use applications.

Note: See s. Comm 22.04 (2) for requirements for protecting foam plastic on the exterior of a dwelling.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (b), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (1) (intro.), am. (1) (a), renum. (1) (b) and (c) to be (1) (c) and (d) and am. (1) (c), cr. (1) (b), Register, March, 1992, No. 435, eff. 4–1–92; am. (1) (d), (2), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. Register, March. 2001, No. 543, eff. 4–1–01.

Comm 21.115 Installation of elevators or dumbwaiters. Elevators or dumbwaiters serving dwelling units shall comply with the requirements under ch. Comm 18.

History: CR 08–030: cr. Register December 2008 No. 636, eff. 1–1–09.

Subchapter III — Excavations

Comm 21.12 Grade. The finished grade of the soil shall slope away from the dwelling at a rate of at least ½–inch per foot for a minimum distance of 10 feet, or to the lot line, whichever is less.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; CR 02–077: am. Register May 2003 No. 569, eff. 8–1–03.

Comm 21.125 Erosion control and sediment control. (1) GENERAL. (a) Where land disturbing construction activity is to occur erosion and sediment control practices shall be employed, as necessary, and maintained to prevent or reduce the potential deposition of soil or sediment to all of the following:

1. The waters of the state.

2. Adjacent properties.

(b) Land disturbing construction activities, except those activities necessary to implement erosion or sediment control practices, may not begin until the sediment control practices are in place for each area to be disturbed in accordance with the approved plan.

(c) Erosion and sediment control practices shall be maintained until the disturbed areas are stabilized. A disturbed area shall be considered stabilized by vegetation when a perennial cover has been established with a density of at least 70%.

(d) Erosion and sediment control practices shall either be approved by the department or listed by the department of natural resources in accordance with the process under s. NR 151.32 (2).

Note: Listed practices can be found through the Safety and Buildings Division website at www.commerce.state.wi.us/SB or by contacting the Safety and Buildings Division at (608) 266–3151.

(2) MANDATED PRACTICES. Specific practices at each site where land disturbing construction activity is to occur shall be utilized to prevent or reduce all of the following:

(a) The deposition of soil from being tracked onto streets by vehicles.

(b) The discharge of sediment from disturbed areas into on–site storm water inlets.

(c) The discharge of sediment from disturbed areas into abutting waters of the state.

(d) The discharge of sediment from drainage ways that flow off the site.

(e) The discharge of sediment by dewatering activities.

(f) The discharge of sediment eroding from soil stockpiles existing for more than 7 days.

(3) CONTROL STANDARDS. Including the practices under sub. (2), additional erosion and sediment control practices shall be employed, as necessary, to accomplish one of the following:

(a) A potential annual cumulative soil loss rate of not more than one of the following:

1. Five tons per acre per year where sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay or clay textures are exposed.

2. Seven and a half tons per acre per [year] where silt, silty clay loam or silt loam textures are exposed.

(b) A reduction of at least 80% of the potential sediment load in storm water runoff from the site on an average annual basis as compared with no sediment or erosion controls for the site when the land disturbing construction activity involves one or more acres.

(c) A reduction of at least 40% of the potential sediment load in storm water runoff from the site on an average annual basis as compared with no sediment or erosion controls for the site where less than one acre of land disturbing construction activity is to occur.

Note: See appendix for further explanatory material regarding compliance solutions for 80 and 40% reductions.

(4) SOIL LOSS ANALYSIS. Potential soil loss shall be determined using an engineer analytical modeling acceptable to the department.

Note: The Revised Universal Soil Loss Equation II is an example of an acceptable model to determine soil loss.

(5) MONITORING. (a) The owner or owner's agent shall check the erosion and sediment control practices for maintenance needs at all the following intervals until the site is stabilized:

1. At least weekly.

2. Within 24 hours after a rainfall event of 0.5 inches or greater. A rainfall event shall be considered to be the total amount of rainfall recorded in any continuous 24 hour period.

3. At all intervals cited on the erosion and sediment control plan.

(b) The owner or owner's agent shall maintain a monitoring record when the land disturbing construction activity involves one or more acres.

(c) The monitoring record shall contain at least the following information:

1. The condition of the erosion and sediment control practices at the intervals specified under par. (a).

2. A description of the maintenance conducted to repair or replace erosion and sediment control practices.

(6) MAINTENANCE. (a) 1. Except as provided in subd. 3., off–site sediment deposition resulting from the failure of an erosion or sediment control practice shall be cleaned up by the end of the next day.

Note: Contact the Department of Natural Resources before attempting to clean up any sediment deposited or discharged into the waters of the state.

2. Except as provided in subd. 3., off–site soil deposition, resulting from construction activity, that creates a nuisance shall be cleaned up by the end of the work day.

3. A municipality may enact more stringent requirements regarding cleanup of soil or sediment deposition onto public ways.

(b) 1. Except as required in subd. 2., the owner or owner's agent shall complete repair or replacement of erosion and sediment control practices as necessary within 48 hours of an interval specified under sub. (5).

2. When the failure of erosion or sediment control practices results in an immediate threat of sediment entering public sewers or the waters of the state, procedures shall be implemented immediately to repair or replace the practices.

Note: See Appendix for further explanatory material.

History: Cr. Register, September, 1992, No. 441, eff. 12–1–92; am. (1) (b), Register, November, 1995, No. 479, eff. 12–1–95; am. (1) (a), renum. (1) (b) to (e) to be (1) (c) to (f) and am. (c), cr. (1) (b), Register, February, 1997, No. 494, eff. 3–1–97; CR 02–077: cr. (4) Register May 2003 No. 569, eff. 8–1–03; CR 05–113: r. and recr. Register December 2006 No. 612, eff. 4–1–07.

Comm 21.126 Storm water management. Storm water management practices shall be employed in accordance with s. NR 151.12 and maintained when the land disturbing construction activity involves one or more acres.

Note: See appendix for further explanatory material.

History: CR 05–113: cr. Register December 2006 No. 612, eff. 4–1–07.

Comm 21.13 Excavations adjacent to adjoining property. (1) NOTICE. Any person making or causing an excavation which may affect the lateral soil support of adjoining property or buildings shall provide at least 30 days written notice to all owners of adjoining buildings of the intention to excavate. The notice shall state that adjoining buildings may require permanent protection.

(a) *Exception.* The 30–day time limit for written notification may be waived if such waiver is signed by the owner(s) of the adjoining properties.

(2) RESPONSIBILITY FOR UNDERPINNING AND FOUNDATION EXTENSIONS. (a) *Excavations less than 12 feet in depth.* If the excavation is made to a depth of 12 feet or less below grade, the person making or causing the excavation shall not be responsible for any necessary underpinning or extension of the foundations of any adjoining buildings.

(b) *Excavations greater than 12 feet in depth.* If the excavation is made to a depth in excess of 12 feet below grade, the owner(s) of adjoining buildings shall be responsible for any necessary underpinning or extension of the foundations of their buildings to a depth of 12 feet below grade. The person making or causing the excavation shall be responsible for any underpinning or extension of foundations below the depth of 12 feet below grade.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Comm 21.14 Excavations for footings and foundations. (1) EXCAVATIONS BELOW FOOTINGS AND FOUNDATIONS. No excavation shall be made below the footing and foundation unless provisions are taken to prevent the collapse of the footing or foundation.

(2) EXCAVATIONS FOR FOOTINGS. All footings shall be located on undisturbed or compacted soil, free of organic material, unless the footings are reinforced to bridge poor soil conditions.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Subchapter IV — Footings

Comm 21.15 Footings. (1) GENERAL. (a) The dwelling and attached structures, such as decks and garages, shall be supported on a structural system designed to transmit and safely distribute the loads to the soil.

(b) The loads for determining the footing size shall include the weight of the live load, roof, walls, floors, pier or column, plus the weight of the structural system and the soil over the footing.

(c) Footings shall be sized to not exceed the allowable material stresses.

(d) The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing capacity of the soil.

(e) Structures supported on floating slabs or similar shallow foundations may not be physically attached to structures that are supported by footings that extend below the frost line unless an isolation joint is used between the structures. This isolation shall extend for the full height of the structure.

(2) SIZE AND TYPE. Unless designed by structural analysis, unreinforced concrete footings shall comply with the following requirements:

(a) *Continuous footings.* The minimum width of the footing on each side of the foundation wall shall measure at least 4 inches wider than the wall. The footing depth shall be at least 8 inches nominal. Footing placed in unstable soil shall be formed. Lintels may be used in place of continuous footings when there is a change in footing elevation.

Note: Unstable soil includes soils that are unable to support themselves at a 90 degree angle for the full depth of the footing.

(b) *Column or pier footing.* 1. The minimum width and length of column or pier footings shall measure at least 2 feet by 2 feet.

2. The minimum depth of column or pier footings shall measure at least 12 inches nominal.

(c) *Trench footings.* Footings poured integrally with the wall may be used when soil conditions permit. The minimum width shall be at least 8 inches nominal.

(d) *Chimney and fireplace footings.* Footing for chimneys or fireplaces shall extend at least 4 inches on each side of the chimney or fireplace. The minimum depth shall measure at least 12 inches nominal.

(e) *Floating slabs.* Any dwelling supported on a floating slab on grade shall be designed through structural analysis.

(f) *Deck footings.* Decks attached to dwellings and detached decks which serve an exit shall be supported on a structural system designed to transmit and safely distribute the loads to the soil. Footings shall be sized to not exceed the allowable material stresses. The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing values of the soil.

(3) SOIL–BEARING CAPACITY. No footing or foundation shall be placed on soil with a bearing capacity of less than 2,000 pounds per square foot unless the footing or foundation has been designed through structural analysis. The soil–bearing values of common soils may be determined through soil identification.

Note: The department will accept the soil–bearing values for the types of soil listed in the following table:

Type of soil	PSF
1. Wet, soft clay; very loose silt; silty clay	2,000
2. Loose, fine sand; medium clay; loose sandy clay soils	2,000
3. Stiff clay; firm inorganic silt	3,000
4. Medium (firm) sand; loose sandy gravel; firm sandy clay soils; hard dry clay	4,000
5. Dense sand and gravel; very compact mixture of clay, sand and gravel	6,000
6. Rock	12,000

(a) *Minimum soil–bearing values.* If the soil located directly under a footing or foundation overlies a layer of soil having a smaller allowable bearing value, the smaller soil–bearing value shall be used.

(b) *Unprepared fill material, organic material.* No footing or foundation shall be placed upon unprepared fill material, organic soil, alluvial soil or mud unless the load will be supported. When requested, soil data shall be provided.

Note: The decomposition of organic material in landfill sites established for the disposal of organic wastes may produce odorous, toxic and explosive concentrations of gas which may seep into buildings through storm sewers and similar underground utilities unless provisions are taken to release the gases to the atmosphere.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) (a), Register, January, 1989, No. 397, eff. 2–1–89; cr. (1) (f), Register, March, 1992, No. 435, eff. 4–1–92; am. (1) (e), Register, November, 1995, No. 479, eff. 12–1–95; am. (1) (e), Register, March, 2001, No. 543, eff. 4–1–01; **CR 08–043: renum. (intro.), (1) and (2) to be (1), (2) and (3) and am. (1), (2) (b) and (e), cr. (1) (e) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.16 Frost protection. (1) GENERAL. (a) Except as allowed under sub. (2), footings and foundations, including those for ramps and stoops, shall be placed below the frost penetration level or at least 48 inches below adjacent grade, whichever is deeper.

(b) Footings may not be placed on frozen material.

(2) EXCEPTIONS. (a) Frost protected shallow foundations shall be designed in accordance with ASCE–32 as adopted in Table Comm 20.24–5.

(b) Portions of footings or foundations located directly under window areaways do not require frost protection provided the rest of the foundation is protected in accordance with this section.

(c) Footings and foundations may bear directly on bedrock less than 48 inches below adjacent grade provided all of the following conditions are met.

1. The rock shall be cleaned of all earth prior to placement.

2. All clay in crevices of the rock shall be removed to the level of frost penetration or to 1.5 times the width of the rock crevice, whichever is less.

3. Provisions shall be taken to prevent water from collecting anywhere along the foundation.

Note: See Appendix for further information.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (intro.), Register, February, 1985, No. 350, eff. 3–1–85; renum. (intro.) and (1) to be (1) and (2) and am. (2) (d), cr. (2) (e), Register, January, 1989, No. 397, eff. 2–1–89; am. (1), Register, November, 1995, No. 479, eff. 12–1–95; correction in (2) (e) made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; **CR 08–043: r. and recr. Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.17 Drain tiles. (1) DETERMINATION OF NEED. (a) *New construction.* 1. Except as provided under sub. (2), a complete drain tile or pipe system shall be installed around the foundation of dwellings under construction where groundwater occurs above the bottom of the footing.

2. For the purposes of this section, a complete drain tile or pipe system includes all of the following:

a. The drain tile or pipe installed inside and outside the foundation, except as allowed under s. Comm 21.17 (3) (d) 1. b.

b. Bleeders connecting the inside tile or pipe to the outside tile or pipe.

c. The sump pit or crock.

d. The discharge piping.

e. A pump or other means of discharging water to grade.

(b) *Optional systems.* 1. If a complete drain tile or pipe system is not required by natural conditions under par. (a) or by a municipality or registered UDC inspection agency, a partial drain tile or pipe system may be installed.

2. For the purposes of this section, a partial drain tile or pipe system includes a means of discharging water from the tile or pipe and may include any of the other elements under par. (a) 2.

Note: Means of discharging water include a sump pit, a crock or natural means of drainage to daylight.

(2) OPTIONAL SYSTEMS. (a) *New construction.* 1. For new dwelling construction, a municipality or registered UDC inspection agency may determine the soil types and natural or seasonal groundwater levels for which a complete drain tile or pipe system is required.

2. For new dwelling construction, a municipality may not enact requirements for other than complete drain tile or pipe systems.

(b) *Alterations to an existing dwelling.* For an alteration to an existing dwelling covered by this code, a municipality may not require a complete drain tile or pipe system.

(c) *Partial systems.* Municipalities may allow partial drain tile or pipe systems for new dwellings under construction or existing dwellings.

(3) MATERIAL AND INSTALLATION REQUIREMENTS FOR REQUIRED SYSTEMS. (a) *General.* Complete drain tile or pipe systems required by natural conditions under sub. (1) (a) or by a municipality or registered UDC inspection agency shall comply with the requirements of this subsection.

(b) *Basement floor slabs.* The basement slab shall be placed on at least 4 inches of clean graded sand, gravel or crushed stone.

(c) *Manufactured drainage systems.* Manufactured drainage systems not meeting the requirements of this section shall be submitted to the department for review and approval prior to installation.

(d) *Drain tile or pipe installation.* Drain tile or pipe used for foundation drainage shall comply with the following requirements:

1. a. Except as allowed under subd. 1. b., the top of the tile or pipe shall be at or below the top of the footing.

b. Where the top of the footing is more than 4 inches below the bottom of the floor slab, tile or pipe is required on the interior of the foundation only and it shall be placed directly under the floor.

Note: This situation will commonly occur with a walk–out basement.

2. Drain tile or pipe shall have an inside diameter of at least 3 inches.

3. Drain tile or pipe shall have open seams, joints or perforations to allow water to enter.

4. Where individual tiles are used, they shall be laid with $^1/_8$ inch open joints. Joints between tiles shall be covered with a strip of asphalt or tar impregnated felt.

5. The tile or pipe shall be placed upon at least 2 inches of coarse aggregate and shall be covered on the top and the side facing away from the dwelling with at least 12 inches of coarse aggregate that meets all of the following criteria:

a. 100% of the aggregate shall pass a 1–inch sieve.

b. 90–100% of the aggregate shall pass a ¾–inch sieve.

c. 0–55% of the aggregate shall pass a $^3/_8$–inch sieve.

d. 0–5% of the aggregate shall pass a #8 sieve.

Note: A #8 sieve has square openings of 2.36 mm or 0.09 inch.

Note: These specifications encompass aggregate sizes #6 and #67 per ASTM standard C 33. Of the two sizes, #6 is coarser.

6. a. Bleeder tiles or pipes shall be provided at no more than 8–foot intervals to connect the exterior drain tile or pipe to the interior drain tile or pipe.

b. Bleeder tiles or pipes shall have a minimum interior diameter of 3 inches.

c. Direct connection of the bleeders is not required if the intersection of the bleeder with the tile or pipe is covered with a membrane or fabric that prevents soil and fines from entering the system.

7. The drain tiles or pipe that lead from the footing tiles to the sump pit shall be laid at a grade of at least $^1/_8$ inch per foot leading to the sump pit. The remaining drain tiles or pipe shall be level or graded downward to the line leading to the sump pit.

(e) *Drain tile or pipe discharge.* 1. Drain tiles or pipe shall be connected to the sump pit.

2. The sump pit shall discharge to natural grade or be equipped with a pump.

3. All other aspects of drain tile discharge shall be in accordance with the uniform plumbing code, chs. Comm 82 to 87.

Note: The following is a reprint of a pertinent section of the plumbing code:

Comm 82.36 (8) SUMPS AND PUMPS. (a) *Sumps.* 1. 'General.' All storm building subdrains shall discharge into a sump, the contents of which shall be automatically lifted and discharged, dispersed or used in accordance with sub. (4).

2. 'Construction and installation'. a. Except as provided in subd. 2. c. and d., an interior sump shall have a rim extending at least one inch above the floor immediately adjacent to the sump.

b. A sump shall have a removable cover of sufficient strength for anticipated loads.

c. Where a sump is installed in an exterior meter pit or elevator pit, the rim may be level with the floor.

d. When a sump is provided with an airtight, solid cover.

3. 'Location'. All sumps installed for the purpose of receiving clearwater, groundwater or stormwater shall be separated from water wells by the applicable separation distances contained in chs. NR 811 and 812, or as otherwise permitted by the department of natural resources.

Note: See Appendix A–82.30 (11) (d) for material reprinted from s. NR 812.08.

4. 'Size'. Except as recommended by the pump manufacturer, the size of each sump shall be no smaller than 16 inches in diameter at the top, 14 inches in diameter at the bottom, and 22 inches in depth.

(b) *Pumps.* 1. 'Size.' The pump shall be of a capacity appropriate for the anticipated use.

2. 'Discharge piping.' a. Where a pump discharges into a storm drain system, a check valve shall be installed.

b. The minimum diameter discharge piping shall be based on the design flow rate of the pump and a minimum velocity of one foot/second.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; r. and recr. (3) (a) 3. and (4), Register, May, 1988, No. 389, eff. 6–1–88; am. (2) (f), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr, (4) (c) 3., Register, August, 1991, No. 428, eff. 9–1–91; cr. (5), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. Register, January, 1999, No. 517, eff. 2–1–99; am. (3) (d) 4., Register, March, 2001, No. 543, eff. 4–1–01; CR 03–097: am. (1) (b) 1., (2) (a) 1., and (3) (a) Register November 2004 No. 587, eff. 1–1–05; **CR 08–043: am. (1) (a) 2. and (b) 2., renum. (3) (d) 1. to 4., 5. and 6. to be (3) (d) 2. to 5., 6. a. and 7., cr. (3) (d) 1., 6. b. and c. Register March 2009 No. 639, eff. 4–1–09.**

Subchapter V — Foundations

Comm 21.18 Foundations. (1) GENERAL. (a) *Design.* Foundation walls shall be designed and constructed to support the vertical loads of the dwelling, lateral soil pressure, and other loads without exceeding the allowable stresses of the materials of which the foundations are constructed.

(b) *Lateral support at base.* Lateral support such as floor slabs or framing shall be provided at the base of foundation walls.

(c) *Lateral support at top.* Lateral support shall be provided at the top of the foundation walls by one of the following:

2. Structural analysis. A system designed through structural analysis.

3. Anchor bolts. a. Structural steel anchor bolts, at least ½ inch in diameter, embedded at least 7 inches into the [concrete or] grouted masonry with a maximum spacing of 72 inches and located within 18 inches of wall corners.

b. A properly sized nut and washer shall be tightened on each bolt to the plate or sill.

c. When vertical–reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements under subd. 3. a. shall be modified as necessary so anchor bolts are placed in the same core as the reinforcement without exceeding the limits of subd. 3. a.

4. Other mechanical fasteners. a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. When vertical–reinforcing steel is provided in masonry construction, as required under sub. (3), the location requirements under subd. 4. a. shall be modified as necessary so the fasteners are placed in the same core as the reinforcement without exceeding the limits of subd. 4. a.

(d) *Floor framing.* 1. Floor framing shall be fastened to the sill plate by one of the following methods:

a. Mechanical fasteners used in accordance with the manufacturer's testing and listing.

b. In accordance with structural analysis.

c. In accordance with the fastener table printed in the appendix to this code.

Note: Per s. Comm 21.22 (1), sill plates are not required on foundation walls of poured concrete or on masonry walls with mortar– or grout–filled cores or on masonry walls with a solid block top course.

2. a. Where the floor framing is parallel to the foundation wall, solid blocking or bridging shall be installed in at least the first adjacent joist space at a spacing of no more than 32 inches on center.

b. Blocking and bridging shall be the same depth as the joist.

c. Fastening of the blocking or bridging shall be in accordance with structural analysis or the fastener table printed in the appendix to this code.

(e) *Soil lateral load.* Unless designed through structural analysis, soil lateral loads shall be determined from Table 21.18–A.

TABLE 21.18–A
SOIL LATERAL LOAD

Description of Backfill Material[e]	Unified Soil Classification	Design Lateral Soil Load[a] PSF per Foot of Depth
Well graded, clean gravels; gravel–sand mixes	GW	30[c]
Poorly graded clean gravels; gravel–sand mixes	GP	30[c]
Silty gravels, poorly graded gravel–sand mixes	GM	40[c]
Clayey gravels, poorly graded gravel–and–clay mixes	GC	45[c]
Well–graded, clean sands; gravelly sand mixes	SW	30[c]
Poorly graded clean sands; sand–gravel mixes	SP	30[c]
Silty sands, poorly graded sand–silt mixes	SM	45[c]
Sand–silt clay mix with plastic fines	SM–SC	45[d]
Clayey sands, poorly graded sand–clay mixes	SC	60[d]
Inorganic silts and clayey silts	ML	45[d]
Mixture of inorganic silt and clay	ML–CL	60[d]
Inorganic clays of low to medium plasticity	CL	60[d]
Organic silts and silt clays, low plasticity	OL	b
Inorganic clayey silts, elastic silts	MH	60[d]
Inorganic clays of high plasticity	CH	b
Organic clays and silty clays	OH	b

[a]Design lateral soil loads are given for moist conditions for the specified soils at their optimum densities. Actual field conditions shall govern. Submerged or saturated soil pressures shall include the weight of the buoyant soil plus the hydrostatic loads.

[b]Unsuitable as backfill material.

[c]For relatively rigid walls, as when braced by floors, the design lateral soil load shall be increased for sand and gravel type soils to 60 psf per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered relatively rigid walls.

[d]For relatively rigid walls, as when braced by floors, the design lateral load shall be increased for silt and clay type soils to 100 psf per foot of depth. Basement walls extending not more than 8 feet below grade and supporting flexible floor systems are not considered relatively rigid walls.

[e]Soil classes are in accordance with the Unified Soil Classification System, ASTM D2487, and design lateral loads are for moist soil conditions without hydrostatic pressure.

(2) CONCRETE FOUNDATION WALLS. (a) *General structural requirements.* Except as provided in par. (b), unless designed through structural analysis, the minimum thickness of concrete foundation walls shall be determined from Table 21.18–B, but in no case shall the thickness of the foundation wall be less than the thickness of the wall it supports.

(b) *Equalized loading.* A 6–inch nominal wall thickness may be used provided the fill on one side of the wall is within 12 inches vertically of the fill on the other side of the wall.

Note: See s. Comm 21.15 (1) (c) for trench footing requirements.

TABLE 21.18–B
CONCRETE WALL THICKNESSES

Type of Concrete	Nominal Thickness (inches)	Maximum Height of Unbalanced Fill[1] for Material of Wall Being Supported (Wood frame — feet)
3000 psi	8	8
Unreinforced concrete	10	9
	12[2]	10
	14	11.5

[1]Unbalanced fill is the difference in elevation between the outside grade and the basement floor.

[2]The maximum height of unbalanced fill for a 12–inch thick plain concrete wall may be increased to 12 feet provided the wall is constructed of concrete with a minimum compressive value of 6,000 psi at 28 days.

(3) MASONRY FOUNDATION WALLS. (a) *Dampproofing.* 1. Except as allowed under subd. 3., masonry block foundation walls shall be coated with a layer of minimum $^3/_8$–inch thick type M or S portland cement mortar parging on the exterior of the wall from footing to finished grade.

2. Masonry foundation walls shall be damp–proofed by applying to the exterior surface of the portland cement parging from footing to finished grade, a continuous coating of one of the following:

a. A bituminous coating applied in accordance with the manufacturer's instructions.

b. Acrylic–modified cement applied at a minimum rate of 3 pounds per square yard.

c. A layer of minimum $^1/_8$–inch thick structural surface bonding material labeled as complying with ASTM C887.

Note: The ASTM C887 standard is entitled, "Standard Specification for Packaged, Dry, Combined Materials for Surface Bonding Mortar."

d. A waterproofing treatment applied in accordance with the manufacturer's instructions.

3. a. Parging of masonry block foundation walls is not required where a dampproofing material is sufficiently flexible to be listed or designed for direct application to masonry block.

b. Parging of masonry block foundation walls is not required where a layer of minimum ¼–inch thick structural surface bonding material labeled as complying with ASTM C887 is used for dampproofing.

(b) *Structural requirements.* Unless designed through structural analysis, the masonry foundation walls shall be constructed in accordance with ACI 530.1 and the following requirements:

1. The minimum thickness of unreinforced masonry foundation walls shall be determined by Table 21.18–C, but in no case shall the thickness be less than the thickness of the wall it supports.

TABLE 21.18–C

PLAIN MASONRY FOUNDATION WALLS[d]

Maximum Wall Height (ft–in)	Depth of unbalanced backfill height (ft)	Minimum nominal wall thickness (inches)		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	8	8	8
	5	8	10	10
	6	10	12	10 (solid[b])
	7	12	10 (solid[b])	12 (solid[b])
8–4	4 (or less)	8	8	8
	5	8	10	12
	6	10	12	12 (solid[b])
	7	12	12 (solid[b])	Note c
	8	10 (solid[b])	12 (solid[b])	Note c
9–1	4 (or less)	8	8	8
	5	8	10	12
	6	12	12	12 (solid[b])
	7	12 (solid[b])	12 (solid[b])	Note c
	8	12 (solid[b])	Note c	Note c
	9	Note c	Note c	Note c

[a] For design lateral soils, see s. Comm 21.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
[b] Solid grouted hollow units.
[c] An analysis in compliance with ACI 530 or reinforcement in accordance with Table 21.18–D, 21.18–E or 21.18–F is required.
[d] Mortar shall be Type M or S and masonry shall be laid in running bond.

2. Reinforced masonry walls shall be reinforced in accordance with the requirements of Tables 21.18–D, 21.18–E or 21.18–F. Vertical reinforcement shall be provided on each side of any opening and at intervals indicated in the appropriate table.

TABLE 21.18–D[b,c,d]

8, 10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 5 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#5 at 40″ o.c.
	7	#4 at 40″ o.c.	#5 at 40″ o.c.	#6 at 48″ o.c.
8–4	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#5 at 40″ o.c.
	7	#5 at 48″ o.c.	#6 at 48″ o.c.	#6 at 40″ o.c.
	8	#5 at 40″ o.c.	#6 at 40″ o.c.	#7 at 40″ o.c.
9–1	4 (or less)	#4 at 48″ o.c.	#4 at 48″ o.c.	#4 at 48″ o.c.
	5	#4 at 48″ o.c.	#4 at 48″ o.c.	#5 at 48″ o.c.
	6	#4 at 48″ o.c.	#5 at 48″ o.c.	#6 at 48″ o.c.
	7	#5 at 48″ o.c.	#6 at 48″ o.c.	#7 at 48″ o.c.
	8	#5 at 40″ o.c.	#7 at 48″ o.c.	#8 at 48″ o.c.
	9	#6 at 40″ o.c.	#8 at 48″ o.c.	#8 at 32″ o.c.

[a] For design lateral soil loads, see s. Comm 21.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
[b] Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).
[c] For alternative reinforcement, see s. Comm 21.18 (3) (b).
[d] Mortar shall be Type M or S and masonry shall be laid in running bond.
[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

TABLE 21.18–E[b,c,d]

10 OR 12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 6.75 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	6	#4 at 56″ o.c.	#4 at 48″ o.c.	#4 at 40″ o.c.
	7	#4 at 56″ o.c.	#5 at 56″ o.c.	#5 at 40″ o.c.
8–4	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 48″ o.c.
	6	#4 at 56″ o.c.	#4 at 48″ o.c.	#5 at 56″ o.c.
	7	#4 at 48″ o.c.	#4 at 32″ o.c.	#6 at 56″ o.c.
	8	#5 at 56″ o.c.	#5 at 40″ o.c.	#7 at 56″ o.c.
9–1	4 (or less)	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 56″ o.c.
	5	#4 at 56″ o.c.	#4 at 56″ o.c.	#4 at 48″ o.c.
	6	#4 at 56″ o.c.	#4 at 40″ o.c.	#4 at 32″ o.c.
	7	#4 at 40″ o.c.	#5 at 48″ o.c.	#6 at 48″ o.c.
	8	#4 at 32″ o.c.	#6 at 48″ o.c.	#4 at 16″ o.c.
	9	#5 at 40″ o.c.	#6 at 40″ o.c.	#7 at 40″ o.c.

[a] For design lateral soil loads, see s. Comm 21.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
[b] Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).
[c] For alternative reinforcement, see s. Comm 21.18 (3) (b).
[d] Mortar shall be Type M or S and masonry shall be laid in running bond.
[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

TABLE 21.18–F[b,c,d]

12 IN. REINFORCED MASONRY FOUNDATION WALLS WHERE d ≥ 8.75 in.[e]

Maximum Wall Height (ft–in)	Height of unbalanced backfill (ft)	Vertical reinforcement		
		Soil classes and lateral soil load[a] (psf per foot below exterior grade)		
		GW, GP, SW and SP soils 30	GM, GC, SM, SM–SC and ML soils 45	SC, MH, ML–CL and inorganic CL soils 60
7–8	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	6	#4 at 72″ o.c.	#4 at 64″ o.c.	#4 at 48″ o.c.
	7	#4 at 72″ o.c.	#4 at 48″ o.c.	#5 at 56″ o.c.
8–4	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	6	#4 at 72″ o.c.	#4 at 56″ o.c.	#5 at 72″ o.c.
	7	#4 at 64″ o.c.	#5 at 64″ o.c.	#4 at 32″ o.c.
	8	#4 at 48″ o.c.	#4 at 32″ o.c.	#5 at 40″ o.c.
9–1	4 (or less)	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 72″ o.c.
	5	#4 at 72″ o.c.	#4 at 72″ o.c.	#4 at 64″ o.c.
	6	#4 at 72″ o.c.	#4 at 56″ o.c.	#5 at 64″ o.c.
	7	#4 at 56″ o.c.	#4 at 40″ o.c.	#6 at 64″ o.c.
	8	#4 at 40″ o.c.	#6 at 64″ o.c.	#6 at 48″ o.c.
	9	#5 at 56″ o.c.	#7 at 72″ o.c.	#6 at 40″ o.c.

[a] For design lateral soil loads, see s. Comm 21.18 (1) (e). Soil classes are in accordance with the Unified Soil Classification System and design lateral soil loads are for moist soil conditions without hydrostatic pressure.
[b] Provisions for this table are based on construction requirements specified in s. Comm 21.18 (3) (b).
[c] For alternative reinforcement, see s. Comm 21.18 (3) (b).
[d] Mortar shall be Type M or S and masonry shall be laid in running bond.
[e] The specified location of the reinforcement shall equal or exceed the effective depth distance, d, measured from the face of the soil side of the wall to the center of vertical reinforcement.

3. Vertical reinforcement shall have a minimum yield strength of 60,000 psi.

4. Solid–grouted hollow units or cores containing vertical reinforcement shall be filled with masonry grout that complies with ASTM C 476.

5. In lieu of the reinforcement provisions of Tables 21.18–D, 21.18–E and 21.18–F, alternative reinforcing bar size and spacing having an equivalent cross–sectional area or reinforcement per linear foot of wall is permitted, provided the spacing of the reinforcement does not exceed 72 inches and reinforcing bar size does not exceed No. 11.

6. The depth below grade, wall height and reinforcement spacing may exceed the maximum values indicated in Tables 21.18–D, 21.18–E and 21.18–F only if the design is based on structural analysis.

(4) WOOD FOUNDATIONS. Wood foundations shall be designed and constructed in accordance with the standard adopted in Table 20.24–2.

Note: The department will accept Permanent Wood Foundations Design and Construction Guide published by the Southern Forest Products Association through the Southern Pine Council, as complying with this standard. The Design and Construction Guide requires a 3.5 inch thick floor slab if a poured concrete floor slab is used.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (3) (intro), Register, February, 1985, No. 350, eff. 3–1–85; cr. (2) (c) to (e), r. and recr. Tables C and D, r. (3) (a) 2., renum. (3) (a) 1. to be (a), Register, January, 1989, No. 397, eff. 2–1–89; am. (intro.), (2) (b), (3) (b) and Table 21.18–D, cr. Table 21.18, r. (2) (c), renum. (2) (d) and (e) to be (2) (c) and (d), Register, March, 1992, No. 435, eff. 4–1–92; renum. (1) to (3) to be (2) to (4), and am. (3) (b), (4) (intro.) and (b), Table 21.18–A, r. (intro.) and Table 21.18, cr. (1), (3) (e), Register, November, 1995, No. 479, eff. 12–1–95; am (2), Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (1) (b), (3), Tables 21.18–C and D, am. (2) (a), r. Table 21.18–B, renum. Table 21.18–A to be Table 21.18–B and cr. (1) (c), (d), Tables 21.18–A, E and F, Register March 2001 No. 543, eff. 4–1–01; CR 02–077: r. (1) (c) 1., renum. (1) (d) to be (1) (e), cr. (1) (d), am. (4) (intro.), (b) and Tables 21.18–A, C and F Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (1) (d) 2. b. and Tables 21.18–C to F, cr. (2) (a) (title) and (b) (title), r. and recr. (3) (a) and (4) Register March 2009 No. 639, eff. 4–1–09.**

Subchapter VI — Floors

Comm 21.19 Floor design. Floors shall support all dead loads plus the minimum unit live loads as set forth in s. Comm 21.02. The live loads shall be applied to act vertically and uniformly to each square foot of horizontal floor area. Basements shall be provided with wood or concrete or similar type floors that comply with s. Comm 21.20 or 21.205.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr., Register, March, 1992, No. 435, eff. 4–1–92.

Comm 21.20 Concrete floors. (1) When concrete floors are provided, the thickness of the concrete shall measure at least 3 inches.

(2) When a concrete floor is placed in clay soils, a 4–inch thick base course shall be placed in the subgrade consisting of clean graded sand, gravel or crushed stone.

(3) When a concrete floor is placed on sand or gravel soils, the base course may be omitted unless drain tile is installed. If drain tile is installed, the requirements of s. Comm 21.17 shall be met.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. Register, January, 1999, No. 517, eff. 2–1–99.

Comm 21.203 Garage floors. (1) MATERIALS. Garage floors shall be constructed of concrete or other noncombustible materials which are impermeable to petroleum products. Slab–on–grade concrete garage floors shall be at least 4 inches thick and placed over at least 4 inches of granular fill.

Note: It is not the intent of sub. (1) to require a concrete floor to be sealed to make it completely impermeable.

(2) CONFIGURATION. The floor shall be sloped such that water is removed in accordance with one of the following:

(a) Water drains toward the overhead door or to exterior grade such that no damage will be caused to any structural member or wall covering of the garage or the dwelling.

(b) Water drains into an interior floor drain that complies with the requirements of ch. Comm 82.

Note: See s. Comm 82.34 for floor drain requirements.

History: Cr. Register, November, 1995, No. 479, eff. 12–1–95; CR 02–077: r. and recr. (2) Register May 2003 No. 569, eff. 8–1–03.

Comm 21.205 Wood floors in contact with the ground. Wood floors in contact with the ground shall comply with the requirements under s. Comm 21.18 (4).

History: Cr. Register, January, 1989, No. 397, eff. 2–1–89; am. Register, January, 1999, No. 517, eff. 2–1–99; correction made under s. 13.93 (2m) (b) 7., Stats., Register, March, 2001, No. 543; CR 02–077: r. and recr. Register May 2003 No. 569, eff. 8–1–03.

Comm 21.21 Precast concrete floors. Precast concrete floors shall be designed through structural analysis, or load tables furnished by the precast product fabricator may be used, provided the load tables were developed using structural analysis or load testing.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, March, 1992, No. 435, eff. 4–1–92.

Comm 21.22 Wood frame floors. Unless designed through structural analysis, wood frame floors shall comply with the following requirements:

(1) FLOOR JOISTS. (a) *General.* 1. Floor joists shall comply with the structural requirements and live load determination under s. Comm 21.02.

Note: See Appendix for design information.

2. Where the joists of a floor system are parallel to, and located between bearing walls above and below, the joists shall be doubled.

(b) *Floor joists on concrete walls.* Where a sill plate is provided for floor joists on poured concrete, the sill plates shall be fastened to the foundation.

Note: Section Comm 21.18 (1) (d) requires the floor joists to also be fastened to the sill plate.

(c) *Floor joists on masonry walls with a solid top course.* Where a sill plate is provided for floor joists on solid block top course masonry, the sill plate shall be fastened to the foundation.

(d) *Floor joists on masonry walls with open top course.* 1. Where the masonry wall has an open top course, a sill plate at least as wide as the foundation wall shall be fastened to the foundation.

2. Where anchor bolts are used on masonry walls with an open top course, the minimum width of an individual piece making up the sill plate shall be at least 5.5 inches.

Note: A sill plate can be made of multiple pieces to achieve the full width.

(2) FLOOR TRUSSES. Metal plate connected wood floor trusses shall be designed in accordance with the Design Specifications for Metal Plate Connected Parallel Chord Wood Trusses and the National Design Specification for Wood Construction. Truss members shall not be cut, bored or notched.

(3) GIRDERS AND BEAMS. (a) Girders and beams shall be selected from Table 21.22–A1 or Table 21.22–A2 or shall be designed through structural analysis.

(b) Wood girders and beams shall be fitted at the post or column. Adjoining ends shall be fastened to each other to transfer horizontal loads across the joint. Beams shall also be fastened to the posts with framing anchors, angle clips, or equivalent.

(c) Where intermediate beams are used, they shall rest on top of the girders; or shall be supported by ledgers or blocks fastened to the sides of the girders; or they may be supported by approved metal hangers into which the ends of the beams shall be fitted.

(d) Lateral restraint for all wood beams shall be provided at all columns using a saddle or other approved connection where the beam meets one of the following conditions:

1. The beam is not restrained at both ends.

2. The beam is more than 11.25 inches deep using actual measurement.

Note: A saddle supports the beam on the bottom and allows for the through–connection of fasteners into the side of the beam.

(4) BEARING AND END CONFIGURATION. (a) *Sawn lumber.* 1. 'Joists.' Wood joists made of sawn lumber shall meet the following bearing requirements:

a. Wood joists supported on wood or metal shall have a bearing surface of at least 1½–inches measured from the end of the joist.

b. Wood joists supported on masonry or concrete shall have a bearing surface of at least 3 inches measured from the end of the joist.

c. The tail end of a floor joist may not extend past the edge of a beam by more than the depth of the floor joist.

d. Wood floor joists with ends that intersect over a beam shall have the ends overlap at least 3 inches and be securely fastened together with at least two 12d common nails or the ends shall be butt–jointed or, face–jointed and fastened with ties, straps, plates or solid blocking.

2. 'Beams and girders.' Beams and girders made of sawn lumber shall have a bearing surface on their supports of at least 3 inches parallel to the beam or girder and be at least as wide as the beam or girder.

(b) *Engineered wood products.* Bearing surface for engineered wood products shall be in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing and are applicable to the configuration.

(5) NOTCHING AND BORING. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

(a) *Notching of floor joists.* 1. Notches located in the top or bottom of floor joists shall not have a depth exceeding $1/6$ the depth of the joist, shall not have a length exceeding $1/3$ the joist depth nor be located in the middle $1/3$ of the span of the joist.

2. Where floor joists are notched on the ends, the notch shall not exceed ¼ the depth of the joist. Notches over supports may extend the full bearing width of the support.

(b) *Boring of floor joists.* 1. 'General.' A hole may not be bored in a floor joist within 2 inches of a notch or another hole. In no case shall the distance between adjacent holes be less than the diameter of the larger hole.

2. 'Holes near the edge.' Holes bored in the top or bottom 2 inches of a joist shall follow the limitations for notching under par. (a).

3. 'Other holes.' Holes bored in floor joists that are not within 2 inches of the top or bottom of the joist shall have their diameter limited to $1/3$ the depth of the joist.

(c) *Engineered wood products.* Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing.

(6) OVERHANG OF FLOORS. (a) *General.* Except as provided in pars. (b) and (c), a floor joist overhang shall be cantilevered beyond the outer edge of the supporting wall below it by no more than the actual depth of the joist or shall be designed through structural analysis in accordance with s. Comm 21.02 (3).

(b) *Joist overhangs parallel to the main floor framing system.* Joist overhangs that are extensions of, and parallel to, the main floor framing system may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.

2. a. The overhang supports a uniform load limited to the weight of the bearing wall and the tributary roof area above it.

b. The tributary length of the roof area, excluding the eave overhang, is no more than 2 feet greater than the actual length of the joist directly below.

c. The eave overhang is no more than 2 feet.

Note: The tributary length is usually half the span of the joist or rafter.

3. The joist overhang does not support any concentrated loads. For the purposes of this subsection, a framed opening in the wall with a rough opening of 4 feet or less shall be considered uniform loading.

4. a. The cantilevered joist is doubled at the supporting wall.

b. The doubled joist length extends inward beyond the inner edge of the supporting wall by the same distance as the cantilever.

c. The added joist member is secured to the main joist as stated in the nailing schedule in the appendix, under the heading for "floor framing, built–up girder and beams, top loaded".

(c) *Joist overhangs perpendicular to the main floor framing system.* Joist overhangs that are perpendicular to the main floor framing system, or lookout joists, may extend beyond the depth of the joist without structural analysis provided they meet all of the following conditions:

1. The joist overhang is cantilevered no more than 2 feet beyond the outer edge of the supporting wall below it.

2. a. A double floor joist is used to support the lookout joist.

b. The double floor joist is located a distance of at least 2 times the cantilever length inward from the outer edge of the supporting wall below.

c. The lookout joists are fastened to the double joist with metal hangers.

3. The joist overhang supports no more than either a non–bearing wall or a wall that supports only a roof which spans no more than the floor overhang cantilever length plus the eave overhang.

(d) All overhangs longer than the depth of the supporting joist that do not meet all of the conditions under par. (b) or (c) shall be designed through structural analysis.

(7) FLOOR OPENINGS. Trimmers and headers shall be doubled when the span of the header exceeds 4 feet. Headers which span more than 6 feet shall have the ends supported by joist hangers or framing anchors, unless the ends are supported on a partition or beam. Tail joists (joists which frame into headers) more than 8 feet long shall be supported on metal framing anchors or on ledger strips of at least 2 inches by 2 inches nominal.

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TABLE 21.22–A1

MINIMUM SIZES FOR BEAMS AND GIRDERS OF STEEL OR WOOD

Column Spacing	One Floor Only		Roof/Ceiling and One Floor				Roof/Ceiling+ One Floor/Ceiling + One Floor			
	Wood Beams[1] (in., nominal)	A 36 Steel Beams[2]	Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]		Wood Beams[1,3] (in., nominal)		A 36 Steel Beams[2]	
			Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone2	Zone 1
24 ft. wide house:										
8 ft.	8x8	—	8x10	10x10	—	—	8x12	10x12	—	—
			6x12	6x12	—	—	6x14	8x14	—	—
10 ft.	8x10	—	8x12	10x12	M 10x9	M 10x9	10x14	10x14	M 12x11.8	M 12x11.8
			6x14	8x14	W 6x12	W 8x10	8x16	8x16	W8x15	W 8x15
12 ft.	8x12	—	12x12	10x14	W 12x10	M 12x11.8	14x14	14x14	W 12x16	W 12x16
			10x14	8x16	W 10x11.5	W 8x15	10x16	12x16	W10x17	W 8x21
15 ft.	12x12	—	—	—	W 12x16	W 12x16	—	—	W 12x22	W 14x22
			—	—	W 10x17	W 6x25	—	—	W 8x28	W 8x31
26 ft. wide house:										
8 ft.	6x10	—	10x10	10x10	—	—	10x12	10x12	—	—
			6x12	8x12	—	—	8x14	8x14	—	—
10 ft.	10x10	—	10x12	10x12	M 10x9	M 12x10	10x14	12x14	M 12x11.8	W 12x14
			8x14	8x14	W 8x10	W 8x13	8x16	8x16	W 8x15	W 8x17
12 ft.	8x12	—	10x14	10x14	M 12x11.8	M 12x11.8	14x14	12x16	W 12x16	W 10x19
			8x16	8x16	W 8x15	W 6x20	12x16	10x18	W 8x21	W 8x24
15 ft.	10x14	—	—	—	W 12x16	W 10x19	—	—	W 14x22	W 14x22
			—	—	W 8x21	W 8x24	—	—	W 8x31	W 8x35
28 ft. wide house:										
8 ft.	6x10	—	10x10	8x12	—	—	10x12	10x12	—	—
			8x12	4x16	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	W 10x12	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	8x14	W 8x13	W 8x13	8x16	10x16	W 8x17	W 10x15
12 ft.	10x12	M 10x9	10x14	12x14	M 12x11.8	W 12x14	12x16	12x16	W 10x19	M 14x18
		W 6x12	8x16	10x16	W 8x15	W 8x18	10x18	10x18	W 8x24	W 8x24
15 ft.	10x14	M 12x10	—	—	W 10x19	M 14x18	—	—	W 14x22	W 14x26
		W 8x13	—	—	W 8x24	W 8x24	—	—	W 8x35	W 8x35
30 ft. wide house:										
8 ft.	8x10	—	10x10	8x12	—	—	10x12	12x12	—	—
			8x12	6x14	—	—	8x14	8x14	—	—
10 ft.	10x10	M 10x7.5	10x12	12x12	M 12x10	M 12x10	12x14	12x14	W 12x14	W 12x14
		W 6x9	8x14	10x14	W 8x13	W 8x13	10x16	10x16	W 10x15	W 10x15
12 ft.	10x12	M 10x9	12x14	12x14	W 12x14	W 12x14	12x16	14x16	M 14x18	M 14x18
		W 6x12	8x16	10x16	W 8x18	W 8x18	10x18	12x18	W 8x24	W 8x24
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 10x21	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 8x35	W 10x33
32 ft. wide house:										
8 ft.	8x10	—	8x12	8x12	—	—	12x12	12x12	—	—
			6x14	6x14	—	—	8x14	10x14	—	—
10 ft.	10x10	M 10x7.5	12x12	12x12	W 10x12	W 10x12	12x14	14x14	W 12x14	W 12x16
		W 6x9	8x14	10x14	W 8x13	W 6x16	10x16	10x16	W 10x15	W 10x17
12 ft.	10x12	M 10x9	12x14	14x14	W 12x14	W 12x14	14x16	14x16	M 14x18	W 12x22
		W 6x12	10x16	10x16	W 10x15	W 10x17	12x18	12x18	W 8x24	W 8x28
15 ft.	12x14	M 12x11.8	—	—	M 14x18	W 12x22	—	—	W 14x26	W 14x26
		W 8x15	—	—	W 8x24	W 8x28	—	—	W 10x33	W 10x33

[1]This table is based upon wood with a fiber bending stress of 1,000 psi. Two acceptable wood beam selections are listed for each loading condition.

[2]Two acceptable steel beam selections are listed for each loading condition. The first entry is the most economical selection based upon beam weight.

[3]Wood main beams or girders may be built up from nominal 2–inch members. The 2–inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½–inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece. Where built–up beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

TABLE 21.22–A2

MINIMUM SIZES FOR BUILT–UP WOOD BEAMS IN BASEMENTS AND CRAWL SPACES SUPPORTING ONE FLOOR ONLY

	F_b=800 psi		F_b=1000 psi		F_b=1200 psi		F_b=1400 psi	
HOUSE WIDTH	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size	Col. Spacing ft–in	Beam size
16 ft.	7–8	3–2x8	8–7	3–2x8	9–4	3–2x8	10–2	3–2x8
	8–11	4–2x8	9–11	4–2x8	10–11	4–2x8	11–10	4–2x8
	9–11	3–2x10	11–1	3–2x10	12–1	3–2x10	13–1	3–2x10
	11–4	4–2x10	12–8	4–2x10	13–1	4–2x10	15–0	4–2x10
	12–0	3–2x12	13–5	3–2x12	14–8	3–2x12	15–10	3–2x12
	13–10	4–2x12	15–7	4–2x12	17–0	4–2x12	18–4	4–2x12
20 ft.	6–11	3–2x8	7–8	3–2x8	8–5	3–2x8	9–1	3–2x8
	7–11	4–2x8	8–11	4–2x8	9–9	4–2x8	10–7	4–2x8
	8–10	3–2x10	9–11	3–2x10	10–10	3–2x10	11–8	3–2x10
	10–2	4–2x10	11–4	4–2x10	12–6	4–2x10	13–6	4–2x10
	10–9	3–2x12	12–0	3–2x12	13–2	3–2x12	14–3	3–2x12
	11–5	4–2x12	13–11	4–2x12	15–2	4–2x12	16–5	4–2x12
24 ft.	6–3	3–2x8	7–1	3–2x8	7–8	3–2x8	8–4	3–2x8
	7–3	4–2x8	8–2	4–2x8	8–11	4–2x8	9–8	4–2x8
	8–1	3–2x10	9–0	3–2x10	9–11	3–2x10	10–8	3–2x10
	9–4	4–2x10	10–4	4–2x10	11–5	4–2x10	12–4	4–2x10
	9–9	3–2x12	10–11	3–2x12	12–0	3–2x12	12–11	3–2x12
	11–3	4–2x12	12–7	4–2x12	13–11	4–2x12	15–0	4–2x12
28 ft.	5–10	3–2x8	6–6	3–2x8	7–2	3–2x8	7–8	3–2x8
	6–8	4–2x8	7–6	4–2x8	8–3	4–2x8	8–11	4–2x8
	7–5	3–2x10	8–4	3–2x10	9–1	3–2x10	9–11	3–2x10
	8–7	4–2x10	9–8	4–2x10	10–6	4–2x10	11–4	4–2x10
	9–0	3–2x12	10–1	3–2x12	11–1	3–2x12	10–11	3–2x12
	10–5	4–2x12	11–8	4–2x12	12–10	4–2x12	13–10	4–2x12
32 ft.	5–4	3–2x8	6–1	3–2x8	6–8	3–2x8	7–3	3–2x8
	6–3	4–2x8	7–1	4–2x8	7–8	4–2x8	8–4	4–2x8
	7–0	3–2x10	7–9	3–2x10	8–7	3–2x10	9–2	3–2x10
	8–1	4–2x10	8–11	4–2x10	9–10	4–2x10	10–8	4–2x10
	8–5	3–2x12	9–6	3–2x12	10–4	3–2x12	11–1	3–2x12
	9–9	4–2x12	11–0	4–2x12	12–0	4–2x12	12–11	4–2x12
36 ft.	5–1	3–2x8	5–9	3–2x8	6–3	3–2x8	6–9	3–2x8
	5–11	4–2x8	6–7	4–2x8	6–9	4–2x8	7–10	4–2x8
	6–6	3–2x10	7–4	3–2x10	8–1	3–2x10	8–8	3–2x10
	7–6	4–2x10	8–6	4–2x10	9–4	4–2x10	10–0	4–2x10
	7–11	3–2x12	8–11	3–2x12	9–9	3–2x12	10–7	3–2x12
	9–2	4–2x12	10–4	4–2x12	11–4	4–2x12	12–4	4–2x12

[1]This table provides maximum allowable spans in feet and inches for main beams or girders which are built–up from nominal 2–inch members.

[2]Fiber bending stress for various species and grades of wood is given in Appendix A21.

[3]The 2–inch members shall be laid on edge and fastened together with a double row of common nails not less than 3½–inches in length. Nails shall be spaced not more than 18 inches apart in each row with the end nails placed 4 inches to 6 inches from the end of each piece.

[4]Where built–up wood beams are employed over a single span, the length of each individual piece used to fabricate the beam shall equal the length of the beam.

[5]Where built–up wood beams are continued over more than one span and where lengths of individual pieces are less than the total length of the complete beam, butt joints shall be located over supports or within 6 inches of the quarter points of the clear span. Where located near the quarter points, the joints in built–up beams shall be separated by at least one lamination and shall not exceed the beam width.

(8) FLOOR SHEATHING. BOARDS AND PLANKS. (a) *Plywood sheathing.* Plywood sheathing used for floors shall be limited to the allowable loads and spans shown in Table 21.22–B.

(c) *Combination subfloor–underlayment.* Combination subfloor–underlayment shall be installed in accordance with Table 21.22–D.

(d) *Floor boards.* Where wood boards are used for floor sheathing, the boards shall comply with the minimum thicknesses shown in Table 21.22–E.

(e) *Planks.* Planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed to each beam.

(9) BRIDGING. (a) *Sawn lumber.* Bridging shall be provided for sawn lumber framing at intervals not exceeding 8 feet where the nominal depth to thickness ratio is greater than 4 to 1.

(b) *Engineered products.* Bridging shall be provided for engineered framing products in accordance with the manufacturer's recommendations.

TABLE 21.22–B

ALLOWABLE SPANS FOR PLYWOOD FLOOR SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1]

Span Rating[2]	Plywood Thickness (in inches)	Maximum span[3] (in inches)
$^{32}/_{16}$	$^{15}/_{32}$, $^{1}/_{2}$, $^{5}/_{8}$	16[5]
$^{40}/_{20}$	$^{19}/_{32}$, $^{5}/_{8}$, $^{3}/_{4}$, $^{7}/_{8}$	20[4,5]
$^{48}/_{24}$	$^{23}/_{32}$, $^{3}/_{4}$, $^{7}/_{8}$	24

[1]These values apply to C–D, C–C, and Structural I and II grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

[2]Span Rating appears on all panels in the construction grades listed in footnote 1.

[3]Plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless ¼–inch minimum thickness underlayment or 1½ inches of approved cellular or lightweight concrete is installed or finished floor is $^{25}/_{32}$–inch wood strip. Allowable uniform load based on deflection of $^{1}/_{360}$ of span is 165 pounds per square foot.

[4]For joists spaced 24 inches on center, plywood sheathing with Span Rating $^{40}/_{20}$ or greater can be used for subfloors when supporting 1½ inches lightweight concrete.

[5]May be 24 inches if $^{25}/_{32}$–inch wood strip flooring is installed at right angles to joists.

TABLE 21.22–D

MINIMUM THICKNESS FOR PLYWOOD COMBINATION SUBFLOOR–UNDERLAYMENT. PLYWOOD CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1,2]

		Maximum Support Spacing[3]		
		16″ o.c.	20″ o.c.	24″ o.c.
Plywood Grade	Plywood Species Group	Panel Thickness (inches)	Panel Thickness (inches)	Panel Thickness (inches)
Sanded exterior type	1	$^{1}/_{2}$	$^{5}/_{8}$	$^{3}/_{4}$
	2 & 3	$^{5}/_{8}$	$^{3}/_{4}$	$^{7}/_{8}$
	4	$^{3}/_{4}$	$^{7}/_{8}$	1
Underlayment C–C Plugged Sturd–I–Floor[4]	All Groups	APA Rated Sheathing and APA Rated Sturd–I–Floor shall be installed consistent with their rating.		

[1]Spans shall be limited to values shown, based on possible effect of concentrated loads.

[2]Unsupported edges shall be tongue and groove or blocked except where ¼–inch underlayment or $^{25}/_{32}$–inch finish floor is used.

[3]Underlayment, C–C Plugged, sanded exterior type: allowable uniform load based on deflection of L/360 span for spans 24 inches or less is 125 psf; and for spans 48 inches, 65 psf.

[4]The department will accept subfloor underlayment panels such as Sturd–I–Floor which meet the requirements of APA manufacturing specifications for Sturd–I–Floor panels.

TABLE 21.22–E

MINIMUM THICKNESS OF FLOOR BOARDS

Joist Spacing (inches)	Minimum Net Thickness (inches)	
	Perpendicular to Joist	Diagonal to Joist
24	$^{11}/_{16}$	$^{3}/_{4}$
16	$^{5}/_{8}$	$^{5}/_{8}$

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) and cr. (1m), Register, February, 1985. No. 350, eff. 3–1–85; renum. (8) (c) and (d) to be (8) (d) and (e) and am. (8) (d), renum. Table 21.22–A and D to be Table 21.22 A1 and E, cr. (8) (c), Table 21.22 A2, r. and recr. Tables 21.22 B and C, Register, January, 1989, No. 397, eff. 2–1–89; am. (2). (4), (5). (6) and (9), r. and recr. Table 21.22–A2, Register, March, 1992, No. 435, eff. 4–1–92; am. (5) (b) and cr. (5) (c), Table 21.22–A1, r. Table 21.22–A, Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (9), Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (1m), (4), and (5) (b), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (5) (b) 1., r. and recr. (6) Register May 2003 No. 569. eff. 8–1–03; **CR 08–043: r. and recr. (1), r. (1m), (8) (b) and Table 21.22–C, renum. (3) (intro.), (a) and (b) to be (3) (a), (b) and (c), cr. (3) (d) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.225 Decks. Decks attached to dwellings and detached decks which serve an exit shall comply with the applicable provisions of this chapter, including but not limited to:

(1) Excavation requirements of s. Comm 21.14;

(2) Footing requirements of s. Comm 21.15 (2) (f);

(3) Frost penetration requirements of s. Comm 21.16;

(4) Load requirements of s. Comm 21.02;

(5) Stair, handrail and guardrail requirements of s. Comm 21.04; and

(6) Decay protection requirements of s. Comm 21.10.

History: Cr. Register, March, 1992, No. 435, eff. 4–1–92.

Subchapter VII — Walls

Comm 21.23 Wall design. (1) LIVE AND DEAD LOADS. All walls shall support all superimposed vertical dead loads and live loads from floors and roofs.

(2) HORIZONTAL WIND LOAD. Walls shall be designed to withstand a horizontal wind pressure of at least 20 pounds per square foot applied to the vertical projection of that portion of the dwelling above grade. No wind load reduction shall be permitted for the shielding effect of other buildings.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Comm 21.24 Exterior covering. (1) GENERAL. The exterior walls shall be covered with a permanent weather resistant finish.

(2) DURING CONSTRUCTION. During construction, wall cavity insulation may not be installed until a water–resistant covering is in place over the wall cavity and windows, doors and a roof with at least underlayment are installed.

Note: An example of acceptable water–resistant covering for a wall is foam sheathing with permanently taped joints.

(3) FLASHING. (a) Corrosion–resistant flashing shall be installed in the exterior wall to prevent water from entering the wall cavity or coming in contact with the structural framing components.

(b) The flashing shall extend to the surface of the exterior wall finish and prevent water from reentering the exterior wall.

(c) 1. Any joints between 2 pieces of flashing that form a vertical joint shall be lapped a minimum of 6 inches and sealed.

2. Any joints between 2 pieces of flashing that form a horizontal joint shall be lapped a minimum of 2 inches and sealed unless otherwise specified by the flashing manufacturer.

3. Sealants used for flashing shall be exterior grade and shall be compatible with the materials being sealed.

(d) Flashing shall be provided at all of the following locations:

1. At the top of all exterior door and window openings, unless using self–flashing windows that provide at least one inch of flashing around the opening, including the corners.

2. At the intersection of chimneys or other masonry construction with frame walls.

3. Under and at the ends of masonry, wood or metal copings and sills.

4. Continuously above all projecting wood trim.

5. Where porches, decks or stairs attach to a wall or floor assembly of wood frame construction.

6. At wall and roof intersections.

7. At built–in gutters.

Note: See s. Comm 21.26 (5) for additional flashing requirements with masonry cavity walls and s. Comm 21.28 (7) for additional flashing requirements with roofing.

(4) WATER–RESISTIVE BARRIER REQUIREMENTS. (a) *General.* 1. Exterior walls of wood or metal frame construction shall be provided with a water–resistive barrier from the highest point to the bottom of the permanent weather–resistant covering.

Note: Acceptable water–resistive barrier materials include polymeric–based house wraps and spray–applied water–resistive barriers installed per the manufacturer's instructions, #15 or greater asphalt–saturated felts that comply with ASTM D 226 for type I felt and extruded foam sheathing with permanently taped joints. Duct tape or similar will not result in a permanently taped joint.

2. Structural products with an integral water–resistive barrier may be approved by the department as a complete assembly.

(b) *Material compatibility.* The water–resistive barrier material shall be compatible with the other materials in the wall with which it will come into contact.

Note: Spray–applied water–resistive barriers may not be compatible with foam plastic insulation.

(c) *Performance requirements.* 1. Polymer–based house wraps shall meet all of the following requirements:

a. A water vapor permeability rating of 5 perms or higher when tested in accordance with ASTM E96.

b. An acceptable water–resistance rating determined in accordance with ASTM D779, AATCC 127 or CCMC 07102.

Note: Asphalt–saturated felt or "tar paper" is not a polymeric–based house wrap.

Note: For more information on the water–resistance tests and their results, see the International Code Council Evaluation Services Acceptance Criteria AC 38.

2. Spray–applied water–resistive barriers shall be approved under the International Code Council Evaluation Services.

Note: For approval criteria, see ICC–ES acceptance criteria AC 212 or successor document.

(d) *Application.* 1. Horizontal seams in sheet or strip material shall be overlapped such that the upper layer extends over the lower layer at least 2 inches.

2. Vertical seams in sheet or strip materials shall be overlapped at least 6 inches.

3. Any rips, tears or voids shall be patched in accordance with subds. 1. and 2.

(e) *Penetrations.* 1. Penetrations caused by fasteners of the water–resistive barrier or the weather–resistant exterior covering do not require sealing.

2. Penetrations of 5 square inches or less with an annular space of no more than ½ inch shall be sealed with caulk or similar material.

3. Penetrations of greater than 5 square inches shall be flashed in accordance with sub. (3).

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: cr. (3) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (2), renum. (3) (c) to be (3) (d), cr. (3) (c) and (4) Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.25 Wood frame walls. Unless designed through structural analysis, wood frame walls shall comply with the following requirements.

(1) STUD CONFIGURATION. Wood studs shall comply with the size and spacing requirements indicated in Table 21.25–A. Studs in the exterior walls shall be placed with the wide faces perpendicular to the plane of the wall.

Note: See Appendix for acceptable nailing schedule.

Note: See s. Comm 21.10 for requirements on treating wood for decay and termite resistance.

(2) TOP PLATES. (a) *General.* Except as allowed under subd. 3., top plates shall be provided and configured as follows:

1. Studs at bearing walls shall be capped with double top plates.

2. End joints in double top plates shall be offset at least 2 stud spaces.

3. Double top plates shall be overlapped at the corners and at intersections of partitions.

4. The plate immediately above the stud may have a joint only when directly over the stud.

(b) *Notching and boring.* 1. When piping or ductwork is placed in an exterior wall or an interior load–bearing wall, such that at least half of the top plate is removed, the plate shall be reinforced with a steel angle at least 2 inches by 2 inches by 20 gauge thick.

Note: 20 gauge is approximately 0.036 inch.

2. The steel angle shall span the gap and extend at least to the midpoint of the adjacent stud spaces.

3. Other equivalent materials may be used in accordance with s. Comm 21.02.

(c) *Exceptions.* 1. A single top plate may be used in place of a double top plate provided a rafter is located directly over the studs and the plate is securely tied at the end joints, corners and intersecting walls. Joints may occur in single top plates only when directly over a stud.

2. A continuous header, consisting of two 2–inch members set on edge, may be used in lieu of a double plate if tied to the adjacent wall.

(3) WALL OPENINGS. Where doors or windows occur, headers shall be used to carry the load across the opening.

(a) *Header size.* The size of headers shall be determined in accordance with the spans and loading conditions listed in Tables 21.25–B, 21.25–C and 21.25–D. Headers for longer spans shall be designed by an engineering method under s. Comm 21.02.

(b) *Header support.* Headers in bearing walls shall be supported in accordance with subd. 1. or 2. or 3.

1. Headers 3 feet or less in length shall be directly supported on each end by either:

a. The single common stud and a shoulder stud; or

b. The single common stud with a framing anchor attached.

2. Headers greater than 3 feet but less than or equal to 6 feet in length shall be directly supported on each end by the single common stud and a shoulder stud.

3. Headers greater than 6 feet in length shall be directly supported on each end by the single common stud and 2 shoulder studs.

(4) NOTCHING. Notching and boring of columns or posts is prohibited unless designed through structural analysis. Studs shall not be cut or bored more than $1/3$ the depth of the stud, unless the stud is reinforced.

(5) PARTITIONS. Load–bearing partitions shall be placed over beams, girders, or other load–bearing partitions. Load–bearing partitions running at right angles to the joists shall not be offset from the main girder or walls more than the depth of the joist unless the joists are designed to carry the load.

(6) POSTS AND COLUMNS. (a) *General.* 1. Posts and columns shall be installed to resist imposed loads.

2. Posts and columns shall bear directly over the middle $1/3$ of a footing.

3. Posts and columns shall be restrained at the top and bottom to resist displacement.

4. All columns shall be positively attached to the beams they support using clips, straps or saddles.

5. Posts and columns that use a height adjustment mechanism shall have the mechanism imbedded in concrete or permanently disabled after installation.

(b) *Bearing surface.* Posts and columns shall have a steel bearing plate affixed to one or both ends to distribute any applied loads and to prevent fiber crushing of any structural member being supported.

(c) *Steel posts or columns.* Steel posts or columns shall be sized according to one of the following methods:

1. Manufactured columns shall follow the manufacturer's testing and listing.

2. Columns made solely of steel pipe stock shall follow Table 21.25–E.

3. Columns made of steel stock, not meeting the requirements of subd. 1.or 2., shall follow a nationally accepted design specification or the size shall be determined through structural analysis or load testing.

(d) *Wood posts or columns.* Wood posts or columns shall be sized according to Table 21.25–F or the size shall be determined through structural analysis or load testing.

TABLE 21.25–A

SIZE, HEIGHT AND SPACING OF WOOD STUDS[a]

	Bearing Walls					Nonbearing Walls	
Stud Size (inches)	Laterally unsupported stud height[a] (feet)	Maximum spacing when supporting roof and ceiling only (inches)	Maximum spacing when supporting one floor, roof and ceiling (inches)	Maximum spacing when supporting two floors, roof and ceiling (inches)	Maximum spacing when supporting one floor only (inches)	Laterally unsupported stud height[a] (feet)	Maximum spacing (inches)
2 x 3[b]	–	–	–	–	–	10	16
2 x 4	10	24	16	–	24	14	24
3 x 4	10	24	24	16	24	14	24
2 x 5	10	24	24	–	24	16	24
2 x 6	10	24	24	16	24	20	24

[a] Listed heights are distances between points of lateral support placed perpendicular to the plane of the wall. Increases in unsupported height are permitted where justified by analysis. Studs shall be stud grade or better, except that utility grade may be used when spaced not more than 16 inches on center, supports no more than a roof and ceiling and does not exceed 8 feet in height for exterior walls or 10 feet in height for interior nonload–bearing walls.

[b] May not be used in exterior walls.

Note: A 3–story frame house with walls constructed of 2 x 4 standard grade studs would require a 12–inch stud spacing on the lowest level, a 24–inch stud spacing on the intermediate level, and a 24–inch stud spacing on the upper level.

TABLE 21.25–B

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ROOF/CEILING ASSEMBLIES*

	Header Members									
House Width (feet)	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone2/Zone 1		Zone 2/Zone 1	
24	2.5	2.5	4	4	5	5	7	6	9	8
26	2.5	2	4	3	5	5	7	6	8	7
28	2.5	2	4	3	5	4	6	6	8	7
30	2.5	2	4	3	5	4	6	6	8	7
32	2	2	3	3	5	4	6	5	7	7

TABLE 21.25–C

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR*

	Header Members				
House Width (feet)	Two 2 x 4s	Two 2 x 6s	Two 2 x 8s	Two 2 x 10s	Two 2 x 12s
24	2.5	4	5	6	8
26	2.5	3	5	6	8
28	2	3	5	6	7
30	2	3	4	6	7
32	2	3	4	5	7

TABLE 21.25–D

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR AND ROOF/CEILING ASSEMBLY*

	Header Members									
House Width (feet)	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone2/Zone 1		Zone 2/Zone 1	
24	1.5	1.5	3	2.5	4	3	5	4	6	5
26	1.5	1.5	2.5	2.5	3	3	4	4	5	5
28	1.5	1.5	2.5	2.5	3	3	4	4	5	5
30	1.5	1.5	2.5	2.5	3	3	4	4	5	5
32	1.5	1.5	2.5	2	3	3	4	4	5	5

*These tables are based on wood with a fiber bending stress of 1,000 psi. For other species with different fiber bending stresses, multiply the span by the square root of the ratio of the actual bending stress to 1,000 psi. Example: From Table 21.25–B, the allowable roof/ceiling span for a 28–foot wide house in zone 2, using two 2 x 8 header members with a 1400 psi bending stress, is 5 feet $\times \sqrt{1400/1000} = 5.9$ feet.

TABLE 21.25–E

COLUMNS MADE OF STEEL PIPE STOCK[1,2]

Column Diameter (inches)	Wall Thickness (inches)	Weight/ft (pounds)	Height (feet)	Allowable Load (pounds)
3	0.216	7.58	8	34,000
			10	28,000
			12	22,000
3.5	0.226	9.11	8	44,000
			10	38,000
			12	32,000
4	0.237	10.79	8	54,000
			10	49,000
			12	43,000
5	0.258	14.62	8	78,000
			10	73,000
			12	68,000
6	0.280	18.97	8	106,000
			10	101,000
			12	95,000

[1]This Table is based on a yield strength or Fy of 36,000 psi.

[2]This table is for columns made solely of steel pipe stock. The addition of any adjustment mechanism or other feature will alter the load–carrying capacity of the column.

TABLE 21.25–F

WOOD COLUMNS

Wood Nominal Size (inches)	Cross Section Area (inches)	Height (feet)	Allowable Load (pounds)
4 x 4	12.25	8	4,900
		10	3,100
		12	2,150
4 x 6	19.25	8	7,700
		10	4,900
		12	3,400
6 x 6	30.25	8	30,000
		10	18,900
		12	13,300

Note: This Table is based on a modulus of elasticity or E of 1,000,000 psi and a fiber bending strength or F_b of 1,000 psi.

(7) FOUNDATION CRIPPLE WALLS. (a) Foundation cripple walls shall be framed with studs at least as large as the studs above.

(b) When more than 4 feet in height, cripple walls shall be framed with studs needed for an additional floor level.

(c) Cripple walls with a stud height of less than 14 inches shall be sheathed on at least one side for its entire length with a wood structural panel that is fastened to both the top and bottom plates or the cripple walls shall be constructed of solid blocking.

(d) Cripple walls with a stud height of 14 inches or greater shall be braced in accordance with sub. (8) or (9).

(e) Cripple walls shall be fully supported by a continuous foundation.

(8) WALL BRACING. (a) *General.* Dwellings using wood–framed walls shall be braced in accordance with this section. Where a building, or a portion thereof, does not comply with one or more of the bracing requirements in this section, those portions shall be designed and constructed in accordance with accepted engineering practice.

Note: Acceptable engineering wall bracing practices include the provisions under s. R602.10 of the International Residential Code–2009.

(b) *Bracing Materials and Methods.* Braced wall lines, both interior and exterior shall be braced using one of the following materials and methods:

1. a. Nominal 1–inch–by–4–inch continuous diagonal braces let in to the top and bottom plates.

b. The let–in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.

2. a. Preformed metal continuous diagonal T–bracing not less than 22 gage thick and 1¾ inch wide let in to the top and bottom plates and the intervening studs installed in accordance with the manufacturer's specifications.

b. The let–in bracing shall be placed at an angle not more than 60 degrees or less than 45 degrees from the horizontal.

Note: 22 gage steel is 0.03 inches thick.

3. Wood boards of $^5/_8$–inch net minimum thickness applied diagonally on studs spaced a maximum of 24 inches fastened to studs in accordance with the fastener table in the appendix.

4. Wood structural panel sheathing with all edges fastened to framing or blocking in accordance with the fastener table in the appendix and not less than $^3/_8$ inch thick for 16–inch stud spacing and not less than $^7/_{16}$ inch thick for 24–inch stud spacing.

5. Minimum ½–inch thick structural fiberboard sheathing applied vertically or horizontally on studs spaced a maximum of 16 inches on center. Structural fiberboard sheathing shall be installed in accordance with the fastener table in the appendix.

6. Gypsum board with minimum ½–inch thickness placed on studs spaced a maximum of 24 inches on center and fastened at panel edges including top and bottom plates at 7 inches on center with the size nails specified in the fastener table in the appendix.

7. Alternative methods under sub. (9), including Alternate Braced Wall Panels, sub. (9) (b), and Continuously Sheathed Braced Wall Lines using Wood Structural Panels, sub. (9) (c).

8. Other approved wind bracing materials and methods.

Note: See Appendix for acceptable nailing schedule.

(c) *Minimum length of braced panels.* 1. 'General.' Except as provided under subd. 2., the minimum lengths shall be as follows:

a. For methods under par. (b) 3., 4. and 5., each braced wall panel shall be at least 48 inches in length, covering a minimum of three stud spaces where studs are spaced 16 inches on center and covering a minimum of two stud spaces where studs are spaced 24 inches on center.

b. For the method under par. (b) 6., each braced wall panel and shall be at least 96 inches in length where applied to one face of a braced wall panel and at least 48 inches in length where applied to both faces.

c. For methods under par. (b) 3., 4. and 5., for purposes of computing the percentage of panel bracing required in Table 21.25–H, the effective length of the braced wall panel shall be equal to the actual length of the panel.

d. When the method under par. (b) 6. panels are applied to only one face of a braced wall panel, bracing percentages required in Table 21.25–H under other methods permitted column shall be doubled.

2. 'Exceptions.' a. Lengths of braced wall panels for continuous wood structural panel sheathing shall be in accordance with sub. (9) (c).

b. Lengths of alternate braced wall panels shall be in accordance with sub. (9) (a) or (b).

c. For methods under par. (b) 3., 4. and 5., panels between 36 inches and 48 inches in length shall be permitted to count towards the required percentage of bracing in Table 21.25–H, and the effective contribution shall comply with Table 21.25–G.

TABLE 21.25–G

EFFECTIVE LENGTHS FOR BRACE WALL PANELS LESS THAN 48 INCHES IN ACTUAL LENGTH
(BRACING METHODS PAR. (b) 3., 4. and 5.)

Actual Length of Braced Wall Panel (inches)	Effective Length of Braced Wall Panel (inches)		
	8–foot Wall Height	9–foot Wall Height	10–foot Wall Height
48	48	48	48
42	36	36	N/A
36	27	N/A	N/A

(d) *Braced Wall Panel Location and Amounts.* Braced wall panels shall begin no more than 12.5 feet from each end of a braced wall line per figures 21.25–A and 21.25–B, and shall be located every 25 feet on center. Bracing amounts shall comply with Table 21.25–H for the bracing materials and methods specified under par. (b).

(e) *Braced Wall Lines.* 1. 'General.' Maximum spacing between parallel wall lines shall be no more than 35 feet.

2. 'Exception.' Spacing between braced wall lines may be increased to 50 feet; however, the percentage of wall bracing on the braced wall lines perpendicular to the spacing, must be increased by multiplying the values in Table 21.25–G by a factor equal to the braced wall line spacing divided by 35 feet, and the length to width ratio for the floor/roof diaphragm as measured between braced wall lines does not exceed 3:1.

3. 'Offsets.' Offsets in braced wall lines, out–of–plane of up to 4 feet shall be permitted provided that the total out–to–out offset dimension in any braced wall line is not more than 8 feet per Figure 21.25–C.

4. 'Variation from story to story.' Variation in bracing method from story to story is permitted.

5. 'Variation within a story.' Variation in bracing method from braced wall line to braced wall line within a story is permitted, except that the continuous sheathing method with wood structural panels shall conform to the additional requirements of sub. (9) (c).

Note: See Appendix for further explanatory material.

TABLE 21.25–H

MINIMUM REQUIRED BRACING AMOUNTS FOR WALLS

Wall Supporting:	Amount of Bracing Per Wall Line[4, 5] Braced segments shall be located at least every 25–ft o.c. but not less than the following percentages:	
	Wood Structural Panel Sheathing [Sub. (8) (b) 4. and (9) (b) and (c)]	Other Methods Permitted [Sub. (8) (b) 1., 2., 3., 5. and 6.]
Roof only[1]	16%	16%[2]
Floor and roof	16%	25%[2]
Two floors and roof	25%	35%[3]

[1]The 'Roof only' condition also applies to one braced wall line of wood frame construction on the ground floor where all other exterior walls on the ground floor are constructed of masonry or concrete in accordance with s. Comm. 21.18.

[2]Wood and metal let in bracing exempt from % bracing requirement, but not spacing requirement.

[3]Wood and metal let in bracing not permitted as a bracing method.

[4]Maximum wall heights equal 12 feet. For wall heights over 10 feet, increase percent bracing requirement an additional 20%.

[5]For continuous sheathing method with wood structural panels, percent requirement may be decreased 10% when openings on the wall line do not exceed 85% of wall height and may be decreased 20% when openings do not exceed 67% of wall height. See Table 21.25–J.

FIGURE 21.25–A

BRACED WALL PANELS AND BRACED WALL LINES

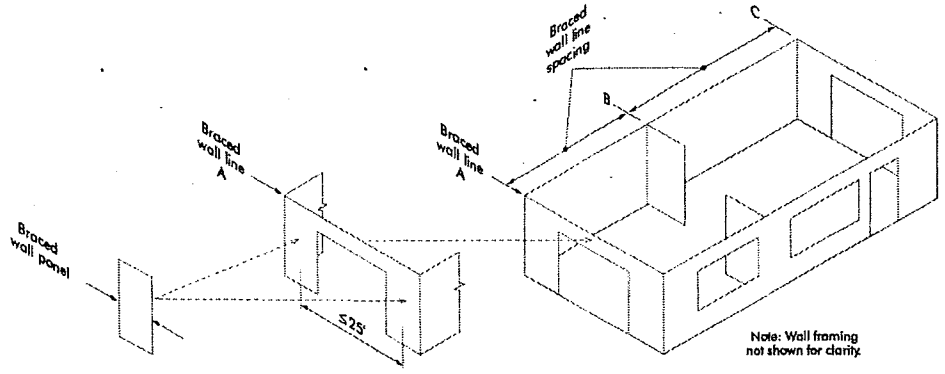


FIGURE 21.25–B
PERMITTED BRACED WALL PANEL DISTANCES
FROM ENDS OF A BRACED WALL LINE

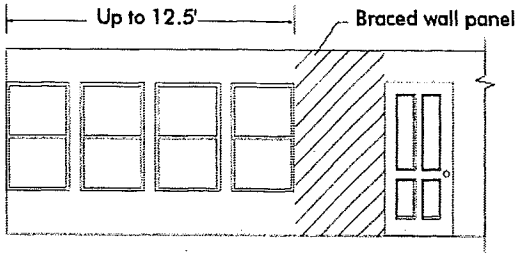
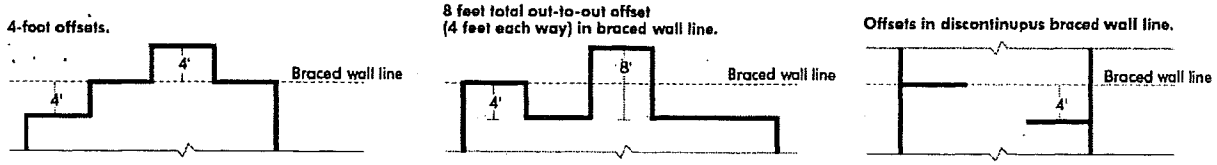


FIGURE 21.25–C
PERMITTED OFFSETS



(f) *Angled Corners.* 1. At corners, braced wall lines may angle out of plane up to 45 degrees with a maximum diagonal length of 8 feet.

2. When determining the percentage of bracing, the length of each braced wall line shall be determined as shown in Figure 21.25–D.

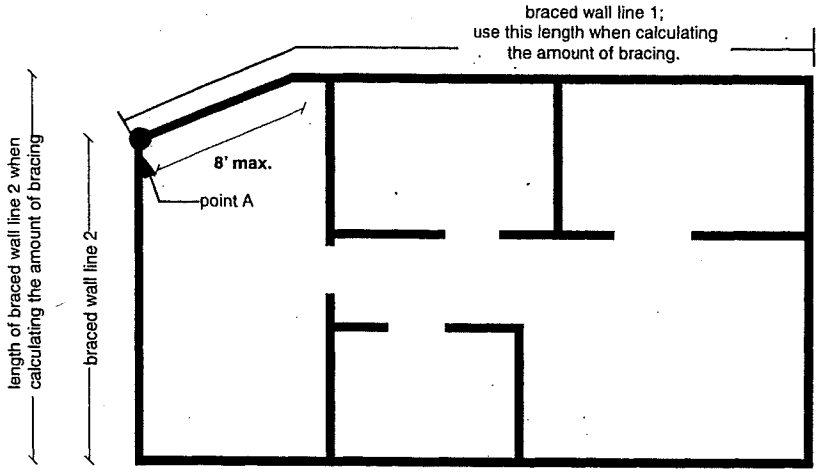
3. The placement of bracing for the braced wall lines shall begin at the point where the braced wall line, which contains the angled wall adjoins the adjacent braced wall line.

Note: This is at Point A as shown in Figure 21.25–D.

4. Where an angled corner is constructed at an angle equal to 45 degrees and the diagonal length is no more than 8 feet in length, the angled wall may be considered as part of either of the adjoining braced wall lines, but not both.

5. Where the diagonal length is greater than 8 feet, it shall be considered its own braced wall line and be braced in accordance with par. (b).

FIGURE 21.25–D
ANGLED CORNERS



(g) *Braced wall panel support.* Braced wall panels shall be supported on floor framing or foundations as follows:

1. Where joists are perpendicular to braced wall lines above or below, blocking shall be provided between the joists at braced wall panel locations to permit fastening of wall plates in accordance with the fastener table in the appendix.

2. Where joists are parallel to braced wall lines above or below, a rim joist or other parallel framing member shall be provided at the wall to permit fastening of wall plates in accordance with the fastener table in the appendix.

3. Braced wall panels shall be permitted to be supported on cantilevered floor joists meeting the cantilever limits of s. Comm 21.22 (6) provided joists are blocked at the nearest bearing wall location, except such blocking is not required for cantilevers not exceeding 24 inches where a full height rim joist is provided.

4. Elevated post or pier foundations supporting braced wall panels shall be designed in accordance with accepted engineering practice.

(h) *Panel joints.* 1. 'General.' Except as provided under subd. 2., all vertical joints of panel sheathing shall occur over, and be fastened to common studs. Horizontal joints in braced wall panels shall occur over, and be fastened to common blocking of a minimum 1½ inch thickness.

2. 'Exceptions.' a. Blocking at horizontal joints is not required in wall segments that are not counted as braced wall panels.

b. Where the bracing percentage provided is at least twice the minimum percentage required by Table 21.25–H, blocking at horizontal joints is not required in braced wall panels using methods par. (b) 4., 5. or 6.

(9) ALTERNATIVE BRACING METHODS AND MODIFICATIONS. (a) *General.* As an alternative to the bracing methods under sub. (8), the wall bracing methods in this subsection may also be used.

(b) *Alternate braced wall panels.* 1. 'General.' Alternate braced wall panels constructed in accordance with subd. 2., 3., 4. or 5. may replace each 4 feet of braced wall panel as required under sub. (8) (b). The maximum height and minimum length of each panel shall be in accordance with Table 21.25–I.

2. 'Supporting roof only.' a. In one–story buildings, each panel shall be sheathed on one face with $^3/_8$–inch–minimum–thickness wood structural panel sheathing nailed with 8d common or galvanized box nails in accordance with the fastening table in the appendix and blocked at all wood structural panel sheathing edges.

b. Two anchor bolts installed in accordance with s. Comm 21.18 (1) (c) 3. shall be provided in each panel.

c. Anchor bolts shall be placed 6 to 12 inches from each end of the plate.

d. Each panel end stud shall have a tie–down device fastened to the foundation, capable of providing an uplift capacity in accordance with Table 21.25–I.

e. The tie–down device shall be installed in accordance with the manufacturer's recommendations.

f. The panels shall be supported directly on a foundation or on floor framing supported directly on a foundation, which is continuous across the entire length of the braced wall line.

g. This foundation shall be reinforced with not less than one number 4 bar at the top and bottom.

h. When the continuous foundation is required to have a depth greater than 12 inches a minimum 12–inch–by–12–inch continuous footing or turned down slab edge is permitted at door openings in the braced wall line.

i. This continuous footing or turned down slab edge shall be reinforced with not less than one number 4 bar at the top and bottom.

j. This reinforcement shall be lapped 15 inches with the reinforcement required in the continuous foundation located directly under the braced wall line.

3. 'Supporting floor and roof only.' In the first story of two–story buildings, each braced wall panel shall be in accordance with subd. 1., except that the wood structural panel sheathing edge nailing spacing shall not exceed four inches on center.

TABLE 21.25–I

MINIMUM LENGTH REQUIREMENTS AND TIE–DOWN FORCES FOR ALTERNATE BRACED WALL PANELS

	Height of Braced Wall Panel				
	8 ft.	9 ft.	10 ft.	11 ft.	12 ft.
Sheathed Length	2′–4″	2′–8″	2′–8″	3′–2″	3′–6″
Sub. (9) (b) 2. Tie–down Force (lbs)	1800	1800	1800	2000	2200
Sub. (9) (b) 3. Tie–down Force (lbs)	3000	3000	3000	3300	3600

4. 'Alternate bracing method with Extended Header over Opening and Tie Downs, supporting a roof only.' a. Each panel shall have a length of not less than 16 inches and a height of not more than 10 feet.

b. Each panel shall be sheathed on one face with a single layer of $^3/_8$–inch–minimum–thickness wood structural panel sheathing nailed with 8d common or galvanized box nails in accordance with Figure 21.25–E.

c. The wood structural panel sheathing shall extend up over the header and shall be nailed in accordance with Figure 21.25–E.

d. Glue laminated beams, LVL's or a built–up header consisting of at least two 2 x 12s fastened in accordance with the fastener table in the appendix may be used.

e. A spacer, if used, shall be placed on the side of the built–up beam opposite the wood structural panel sheathing.

f. The header shall extend between the inside faces of the first full–length outer studs of each panel.

g. The clear span of the header between the inner studs of each panel shall be not less than 6 feet and not more than 18 feet in length.

h. A strap with an uplift capacity of not less than 1,000 pounds shall fasten the header to the side of the inner studs opposite the sheathing.

i. One anchor bolt not less than $^5/_8$–inch–diameter, installed in accordance with s. Comm 21.18 (1) (c) 3. shall be provided in the center of each sill plate.

j. The studs at each end of the panel shall have a tie–down device fastened to the foundation with an uplift capacity of not less than 4,200 pounds.

k. Where a panel is located on one side of the opening, the header shall extend between the inside face of the first full–length stud of the panel and the bearing studs at the other end of the opening.

L. The bearing studs shall also have a tie–down device fastened to the foundation with an uplift capacity of not less than 1,000 pounds.

m. The tie–down devices shall be an embedded–strap type, installed in accordance with the manufacturer's recommendations.

n. The panels shall be supported directly on a foundation, which is continuous across the entire length of the braced wall line.

o. The foundation shall be reinforced with not less than one number 4 bar top and bottom.

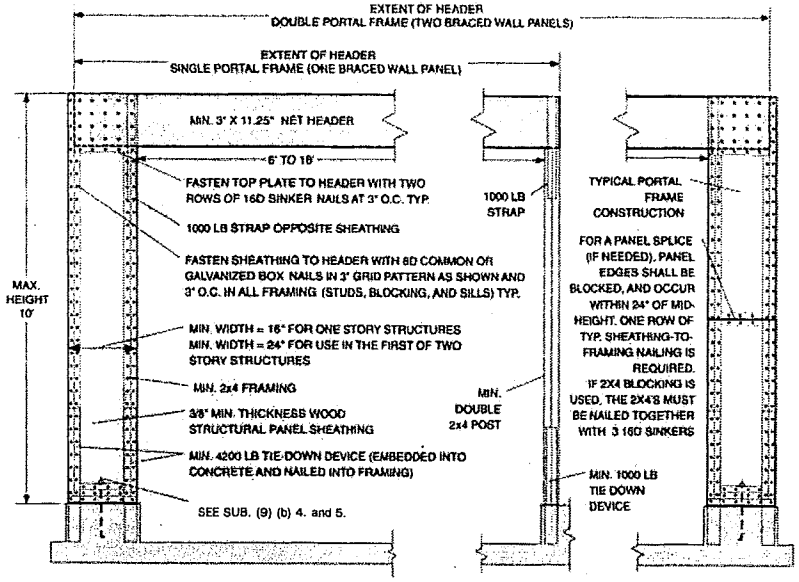
p. Where the continuous foundation is required to have a depth greater than 12 inches, a minimum 12–inch–by–12–inch continuous footing or turned down slab edge is permitted at door openings in the braced wall line.

q. This continuous footing or turned down slab edge shall be reinforced with not less than one number 4 bar top and bottom.

r. This reinforcement shall be lapped not less than 15 inches with the reinforcement required in the continuous foundation located directly under the braced wall line.

5. 'Alternate bracing method with Extended Header Over Opening and Tie Downs, in a wall supporting a floor and roof only.' Each wall panel shall be braced in accordance with subd. 4., except that each panel shall have a length of at least 24 inches.

Figure 21.25–E
ALTERNATE BRACING METHOD WITH EXTENDED HEADER AND TIE DOWNS



(c) *Continuously sheathed braced wall line using wood structural panels.* 1. 'General.' a. Continuously sheathed braced wall lines using wood structural panels shall comply with this section.

b. Different bracing methods are not permitted within a continuously sheathed braced wall line.

c. Other bracing methods prescribed by this code are permitted on other braced wall lines on the same story level or on different story levels of the building.

2. 'Continuously–sheathed braced wall line requirements.' Continuously–sheathed braced wall lines shall be constructed in accordance with Figure 21.25–F and shall comply with all of the following requirements:

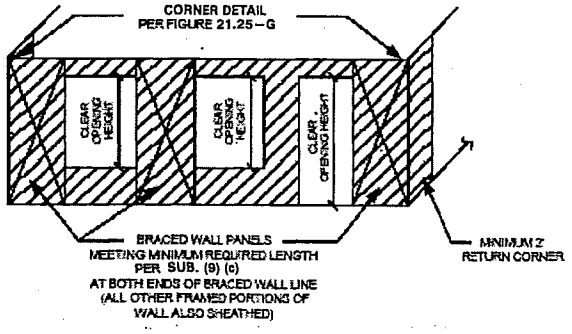
a. Structural sheathing shall be applied to all exterior sheathable surfaces of a braced wall line including areas above and below openings.

b. Only full–height braced wall panels shall be used for calculating the braced wall percentage in accordance with Table 21.25–H.

c. Exterior corner framing shall be constructed and fastened in accordance with details in Figure 21.25–G.

d. Figures 21.25–H, 21.25–I and 21.25–J provide alternative construction options to Figure 21.25–F, when 2 foot wide wood structural panels are not available at the corners of continuous sheathed wall lines and the return wall lines.

FIGURE 21.25–F
CONTINUOUSLY–SHEATHED BRACED WALL LINE



3. 'Braced wall panel length.' In a continuously–sheathed wood structural panel braced wall line, the minimum braced wall panel length shall be permitted to be in accordance with Table 21.25–J.

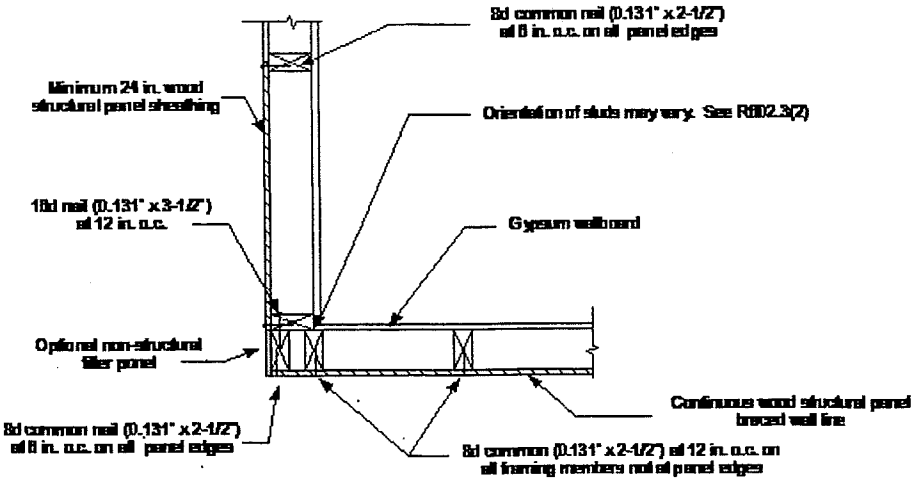
TABLE 21.25–J
LENGTH REQUIREMENTS FOR BRACED WALL PANELS IN A CONTINUOUSLY SHEATHED WALL[1]

Minimum Length of Braced Wall Panel (inches)			Maximum Opening Clear Height Next to the Braced Wall Panel (% of wall height)	Braced Wall Panel Height to Width Ratio
8–foot wall	9–foot wall	10–foot wall		
48	54	60	100%	2:1
32	36	40	85%	3:1
24	27	30	67%	4:1[2]

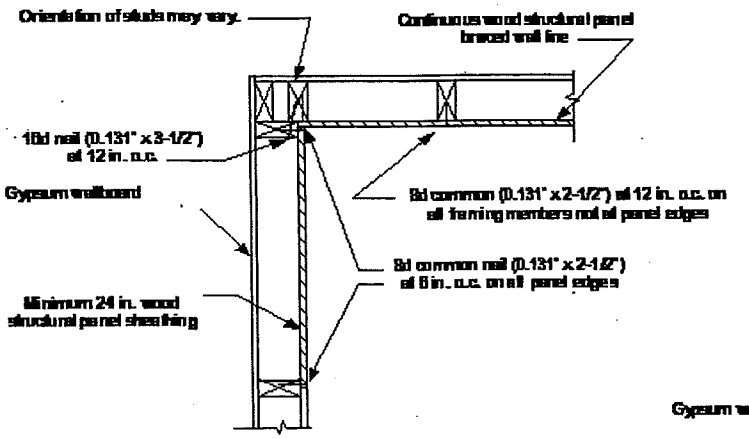
[1]Interpolation is permitted.

[2]A 4:1 aspect ratio is permitted for full–height sheathed wall segments on either side of garage openings.

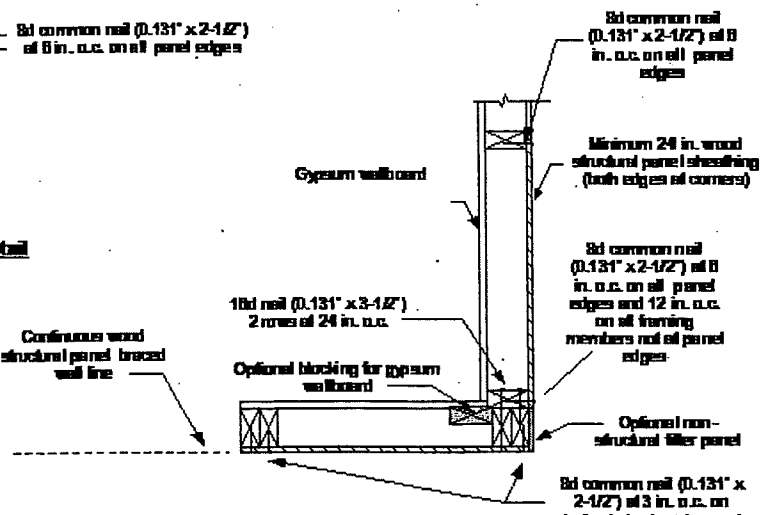
FIGURE 21.25–G
TYPICAL EXTERIOR CORNER FRAMING FOR CONTINUOUS STRUCTURAL PANEL SHEATHING
SHOWING REQUIRED STUD–TO–STUD NAILING



(a) Outside corner detail



(b) Inside corner detail



(c) Garage door corner
See sub. (9) (c) 6.

Figure 21.25–H

CONTINUOUSLY–SHEATHED BRACED WALL LINE WITHOUT CORNER RETURN

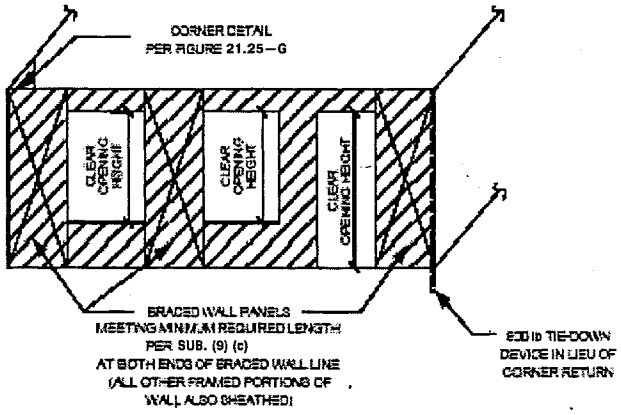


FIGURE 21.25–I

CONTINUOUSLY SHEATHED BRACED WALL LINE — FIRST BRACED WALL PANEL AWAY FROM END OF WALL LINE WITHOUT TIE DOWN

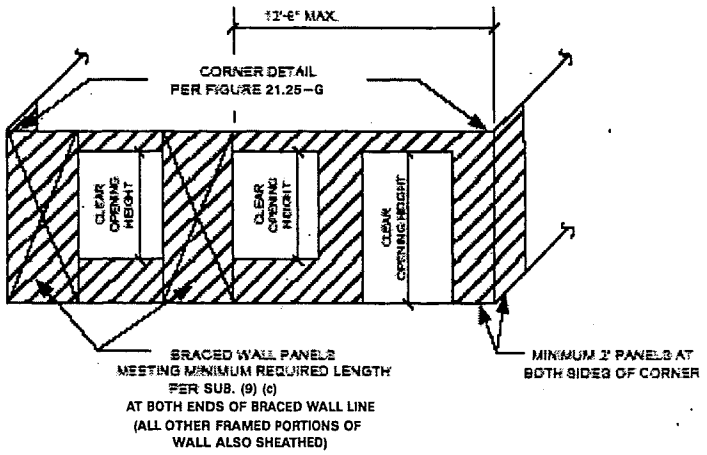
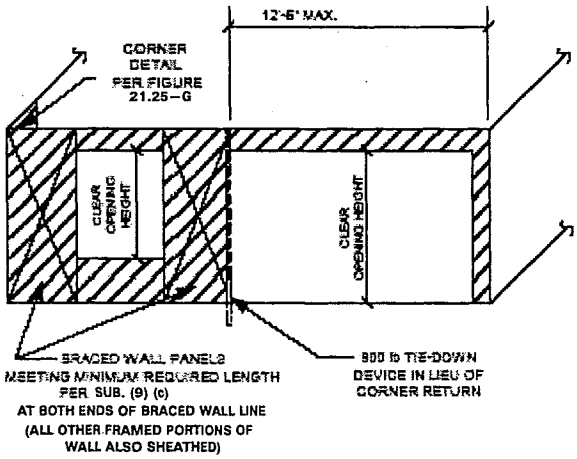


FIGURE 21.25–J

CONTINUOUSLY SHEATHED BRACED WALL LINE — FIRST BRACED WALL PANEL AWAY FROM END OF WALL LINE WITH TIE DOWN



4. 'Braced wall percentage.' In addition to bracing percentage adjustments specified elsewhere in this code, the braced wall percentages for method under sub. (8) (b) 4. from Table 21.25–G shall be permitted to be multiplied by a factor in accordance with Table 21.25–K.

TABLE 21.25–K

ADJUSTMENT FACTORS TO THE PERCENTAGE OF REQUIRED BRACING PER WALL LINE — CONTINUOUSLY SHEATHED

Adjustment Based on Maximum Wall Clear Opening Height:		Multiply Percentage of Bracing Per Wall Line By:
Continuous wood structural panel sheathing when maximum opening height in wall line does not exceed*	85% of wall height	0.9
	67% of wall height	0.8

*Percentage of bracing for continuous wood structural panel sheathing shall be based on sub. (8) (b) 4. requirements.

5. '6:1 aspect ratio continuous structural panel sheathing with extended header.' a. Wall segments having a maximum 6:1 height to width ratio are permitted only when built in accordance with Figure 21.25–K.

b. The maximum 6:1 height–to–width ratio is based on height being measured from the top of the header to the bottom of the wall segment bottom–plate.

c. For purposes of calculating the percentage of panel bracing required by Table 21.25–H, the length of the braced wall panel shall be the measured length of the full height sheathing segment adjacent to the opening.

d. Corners at the ends of walls using this option shall be constructed in accordance with Figure 21.25–G. Where 6:1 ratio segments are used at the ends of braced wall lines, a 2 foot minimum width wood structural panel must be installed on the corner return as shown in Figure 21.25–F. An 800 lb tie down may be installed in lieu of a 2 foot corner return, as shown in Figure 21.25–H.

e. The reduction factors for continuously braced walls from subd. 4. shall be applied when calculating applicable percentages of wall bracing.

f. The number of wall segments having a maximum 6:1 height to width ratio in a wall line may not exceed 4.

g. For purposes of resisting wind pressures acting perpendicular to the wall, the minimum requirements of Figure 21.25–K are sufficient for wind speeds less than 110 mph in exposure category B.

h. For exposure categories C and D, the header to jack stud strap requirements and the number of additional jack studs shall be in accordance with Table 21.25–L.

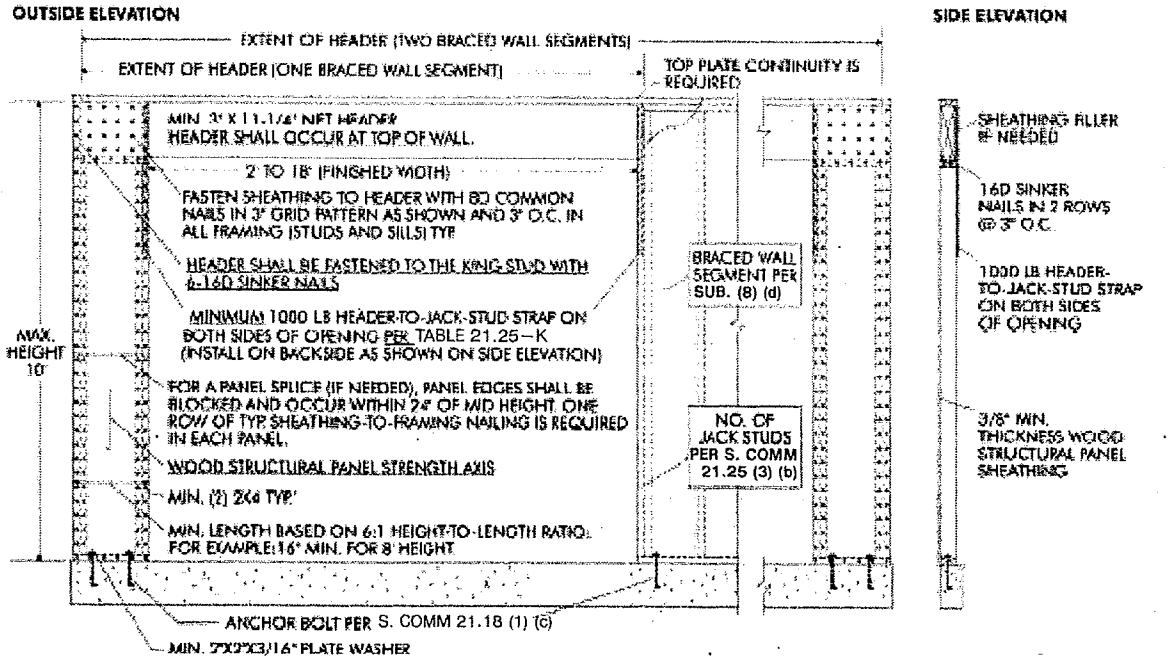
Note: See Table 21.25–L footnotes for definitions of the exposure categories.

i. 6:1 aspect ratio segments with extended header are permitted over raised wood floors or second story applications, when constructed in accordance with rim board/band joist connection in Figure 21.25–K (b) or (c).

FIGURE 21.25–K

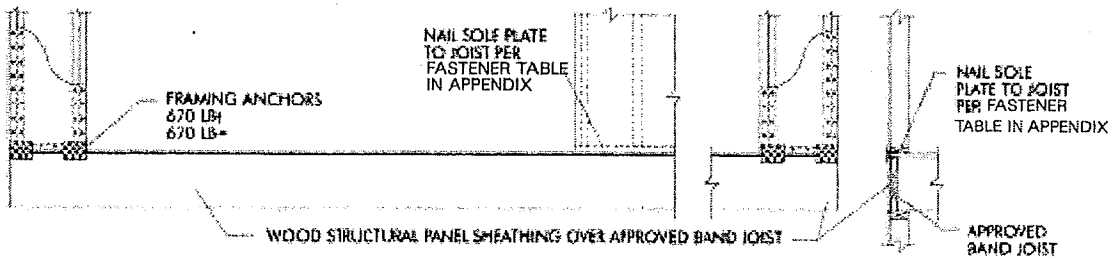
6:1 ASPECT RATIO BRACED WALL PANELS USING CONTINUOUS WOOD STRUCTURAL PANEL SHEATHING AND EXTENDED HEADERS

(a)



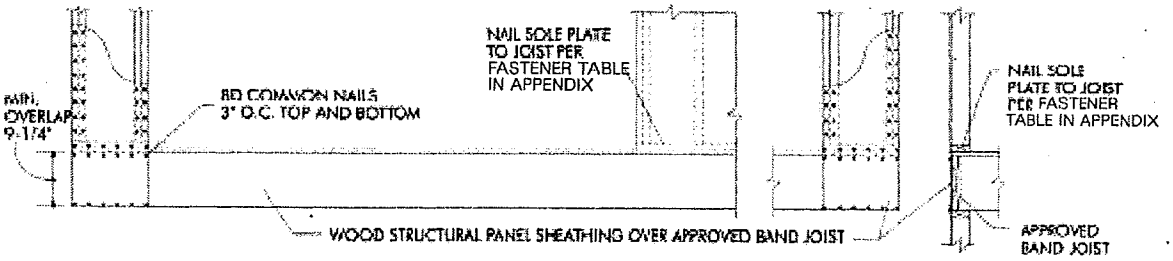
FOR WIND EXPOSURE CATEGORIES C AND D, ADDITIONAL JACK STUDS MAY BE REQUIRED PER TABLE 21.25–L

(b)



OVER RAISED WOOD FLOOR OR SECOND FLOOR – FRAMING ANCHOR OPTION

(c)



OVER RAISED WOOD FLOOR OR SECOND FLOOR – WOOD STRUCTURAL PANEL OVERLAP OPTION

NOT TO SCALE

TABLE 21.25–L

HEADER TO JACK STUD STRAP AND THE NUMBER OF ADDITIONAL JACK STUDS REQUIRED FOR RESISTING WIND PRESSURES PERPENDICULAR TO 6:1 ASPECT RATIO WALLS LOCATED IN WIND EXPOSURE CATEGORIES C AND D[c]

Required Strap Capacity (lb)[a]	Wall Height (ft)	Wind Exposure Category C			Wind Exposure Category D		
		85 mph	90 mph	less than 110 mph	85 mph	90 mph	less than 110 mph
	10 and less	1000	1200	2275	1375	1750	3050
Number of additional 2x4 Jack Studs[b]	8	—	—	—	—	—	1
	9	—	—	1	—	1	2
	10	—	1	2	1	2	3

[a] If 2x6 framing is used, then the required strap capacity may be multiplied by 0.65, but in no case shall the required strap capacity be less than 1,000 lb.

[b] If 2x6 framing is used, then no additional framing shall be required.

[c] Exposure category B is comprised of urban and suburban areas, wooded areas, or other terrain with numerous closely–spaced obstructions having the size of single–family dwellings or larger. Exposure B shall be assumed unless the site meets the definition of another type exposure.

Exposure category C is comprised of flat open country and grasslands with scattered obstructions, including surface undulations or other irregularities, having heights generally less than 30 feet extending more than 1,500 feet from the building site in any quadrant. This exposure also applies to any building located within Exposure B type terrain where the building is directly adjacent to open areas of Exposure C type terrain in any quadrant for a distance of more than 600 feet.

Exposure category D is comprised of flat, unobstructed areas exposed to wind flowing over open water for a distance of at least 1 mile. This exposure applies only to those buildings and other structures exposed to the wind coming from over the water. Exposure D extends inland from the shoreline a distance of 1,500 feet or 10 times the height of the building or structure, whichever is greater.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (1) (d) and am. (3) (b), Register, February, 1985, No. 350, eff. 3–1–85; r. and recr. (3) (b), am. Table 21.25 B and E, Register, January, 1989, No. 397, eff. 2–1–89; am. (3) (a) and (6), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (1) (c), am. Table 21.25–D, cr. Table 21.25–F, Register, November, 1995, No. 479, eff. 12–1–95; am. Table 21.25–A, Register, January, 1999, No. 517, eff. 2–1–99; r. (1) (b) and (c), renum. (1) (d) to be (b), r. and recr. (2), (6) and Tables 21.25–E and F, and am. (3) (b) 3., Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: r. (3) (c) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: am. (1) (title), r. (1) (b), renum. (1) (a) and (6) (a) 4. to be (1) and (6) (a) 5., r. and recr. Table 21.25–A, cr. (6) (a) 4., (7), (8) and (9) Register March 2009 No. 639, eff. 4–1–09; correction in Figure 21.25–E made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 21.26 Masonry walls. Masonry walls shall be constructed in accordance with the requirements of this section.

(1) COLD WEATHER WORK. When ambient air temperature is below 40°F, the cold weather construction procedures under ACI 530.1 shall be followed.

Note: The requirements for cold weather work are in sections 1.8 and 1.8C of the 2005 edition of the ACI standard.

(2) MASONRY UNITS. (a) *Unused concrete units.* Previously unused concrete masonry units shall conform to the ASTM C 90 standard.

(b) *Unused clay or shale units.* Previously unused clay or shale masonry units shall conform to the appropriate ASTM standard: C 62; C 216; or C 652. Units which will be exposed to weathering or frost action shall be Grade SW as specified in these standards.

(c) *Used masonry units.* All previously used masonry units shall be free from physical defects which interfere with the installation or impair the structural properties of the unit.

(3) TYPES OF MORTAR. (a) *Mortar specifications.* The type of mortar shall be determined from Table 21.26–A. The mortar shall conform to the requirements of ASTM C–270.

(b) *Surface bond mortars.* Surface bond mortars for masonry walls shall be mixed in accordance with the proportions specified on the bag.

(4) MORTAR COMPONENTS. Mortar components shall comply with the following requirements:

(a) *Water.* Water shall be clean and free of deleterious amounts of acids, alkalies, or organic materials.

(b) *Admixtures or mortar colors.* Admixtures or mortar colors shall not be added to the mortar unless the resulting mortar conforms to the mortar specifications. Only mineral oxide may be used as mortar color and shall not exceed 10% by weight of the cement.

(c) *Mixing.* Mortar shall be mixed for at least 3 minutes after all ingredients have been added with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to water evaporation shall be retempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2½ hours after mixing.

Note: To ensure proper mortar mixing, machine mixing is recommended.

TABLE 21.26–A

TYPES OF MORTAR FOR VARIOUS KINDS OF MASONRY

Kind of Masonry	Types of Mortar
Foundations:	
Footings	M, S
Walls of solid units	M, S, N
Walls of hollow units	M, S
Hollow walls	M, S
Masonry other than foundation masonry:	
Piers of solid masonry	M, S, N
Piers of hollow units	M, S
Walls of solid masonry	M, S, N, O
Walls of solid masonry not less than 12 in. thick or more than 35 ft. in height, supported laterally at intervals not exceeding 12 times the wall thickness	M, S, N, O
Walls of hollow units; load–bearing or exterior, and hollow walls 12 in. or more in thickness	M, S, N
Hollow walls, less than 12 in. thick	M, S, N
Linings of existing masonry, either above or below grade	M, S
Masonry other than above	M, S, N

(d) *Cementitious material.* Cementitious material shall conform to the standards approved by the department.

Note: The department will accept cementitious material conforming to the following standards: ASTM C91, Masonry Cement; ASTM C150, Portland Cement; ASTM C595, Portland Blast–Furnace Slag Cement; ASTM C207, Hydrated Lime for Masonry Purposes; and ASTM C5, Quick Lime for Structural Purposes.

(e) *Aggregates.* Aggregates for use in masonry mortar shall consist of natural sand or manufactured sand and shall be graded.

Note: The department will accept aggregates in accordance with ASTM C144.

(5) CAVITY WALL. (a) *Corbels.* Corbels shall be constructed in accordance with ACI 530.

(b) *Projections.* The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed 1¼ inches, unless at least ⅔ the mass of the wythe of masonry involved is located directly over the load–carrying member.

(6) OPENINGS AND LINTELS. (a) *Openings.* The masonry above openings shall be supported. The bearing length of structural elements which support the masonry above the opening shall be not less than 4 inches.

(b) *Lintels.* Unless designed through structural analysis, lintels shall be provided using either steel angles or reinforcing bars in accordance with Table 21.26–C.

TABLE 21.26–C
ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER

Size of Steel Angle[1,3]	No Story Above	One Story Above	Two Stories Above	No. of 1/2" or Equivalent Reinforcing Bars[2]
L 3 x 3 x 1/4	6' – 0"	3' – 6"	3' – 0"	1
L 4 x 3 x 1/4	8' – 0"	5' – 0"	3' – 0"	1
L 6 x 3 1/2 x 1/4	14' – 0"	8' – 0"	3' – 6"	2
2 – L 6 x 3 1/4 x 1/4	20' – 0"	11' – 0"	5' – 0"	4

[1]Long leg of the angle shall be placed in a vertical position.

[2]Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.

[3]Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.

(7) MASONRY VENEERS. (a) *Veneer over frame construction.* 1. Masonry veneers may be corbeled over the foundation wall, but the corbeling shall not exceed one inch.

2. A minimum one–inch air space shall be provided between the veneer and the sheathing unless a manufactured offset material is used.

3. Where no brick ledge is formed in the foundation wall, corrosion resistant metal or other water–resistant flashing shall extend over the top of the foundation wall from the outside face of the wall and shall extend at least 6 inches up on the sheathing. The flashing shall be installed to drain any water outward.

4. Weep holes shall be provided at the bottom masonry course at maximum intervals of 2 feet.

5. Ventilation openings shall be provided at the top of the wall.

Note: The ventilation opening could be other than a weep hole.

6. Studs and sheathing behind masonry veneer shall be covered with material used to construct the water–resistive barrier as required under s. Comm 21.24 (4).

Note: Acceptable water–resistive barrier materials include polymeric–based house wraps and #15 or greater asphalt–saturated felts that comply with ASTM D 226 for type I felt.

7. Masonry or brick veneer shall be above final exterior grade unless there is through–wall flashing at grade or within 2 courses above grade.

(b) *Veneer over masonry back–up.* Corrosion–resistant metal or other water–resistant base flashing shall be provided at the bottom of the veneer and shall extend over the top of the foundation and up at least 6 inches and be embedded in the back–up course. The flashing shall be installed to drain any water outward. Weep holes shall be provided at maximum intervals of 3 feet.

(c) *Veneer attachment.* Veneers shall be anchored or adhered in accordance with ACI 530 and ACI 530.1.

(8) FLASHING. (a) *General.* 1. Flashing shall be installed in accordance with this section to drain any water outward away from structural members, sheathing and insulation.

2. Open joints or weep holes shall be provided in the facing immediately above the flashing at a horizontal spacing not exceeding 2 feet.

3. Flashing shall consist of materials that are durable and permanently UV–resistant such as sheet metal or heavy gauge PVC.

Note: Materials including house wrap, asphalt–impregnated building paper, plastic sheeting, peel–and–stick rubberized sheet material, and light gauge PVC are not acceptable as meeting this requirement.

(b) *Location.* 1. 'Lintels and chimneys.' In exterior hollow masonry walls, flashing shall be installed at the backsides of chimneys and at the bottom of the cavity formed by openings such as lintels over doors and windows.

2. 'Veneer.' Flashing shall be installed at the bottom of veneer and shall extend over the top of the foundation and up at least 8 inches and be embedded in the backing course.

(c) *Weep holes.* 1. Weep holes may not be placed below final grade.

2. Rope or similar material used to form a weep hole shall be removed as soon as the mortar sets.

3. Weep holes shall be 3/8–inch minimum diameter.

(9) BEARING. (a) *Concentrated loads.* Beams, girders, trusses, joists and other members producing concentrated loads shall bear a minimum of 3 inches on one of the following:

1. 'Concrete beam.' The equivalent of a nominally reinforced 2,500 psi concrete beam 8 inches in height.

2. 'Solid masonry.' At least 8 inches in height of masonry composed of solid masonry units with all voids and joints completely filled with mortar.

3. 'Metal plate.' A metal plate of sufficient thickness and size to distribute the load to masonry units. For piers and columns, the bearing plate shall not exceed 60% of the cross–sectional area of the pier or column and the resultant reaction of all vertical and horizontal loads shall fall within the middle third of the member.

4. 'Bond beam.' The bond beam shall be the equivalent of not less than an 8–inch lintel (bond beam) block with 2 No. 4 bars embedded in high strength mortar fill or equivalent. The loads shall bear on the fill.

(b) *Continuous loads.* Joists, trusses and beams other than wood, spaced 4 feet or less on center and 40 feet or less in length, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing of 3 inches upon solid masonry at least 2½ inches in height, or as indicated for concentrated loads.

(c) *Stack bond walls.* Concentrated loads shall be distributed into masonry laid in stack bond by a concrete beam or bond beam [as defined in par. (a)]. For masonry of solid units, 2 additional rows of a continuous tie assembly may be used instead of a concrete beam or bond beam.

(d) *Support of wood floor members.* Where a wood structural member is buried in masonry for support, it shall be firecut or a self–releasing device shall be used. Where the end of a wood structural member is built into an exterior wall, a ½–inch air space shall be provided at the sides, top and end of such member.

(10) BONDING. Unless designed through structural analysis, all masonry walls shall be bonded as follows:

(a) *Single–wythe walls.* Masonry units in single–wythe walls shall be lapped at least 2 inches or one–third the height of the masonry unit, whichever is greater, or through the use of continuous tie assemblies spaced at 16–inch vertical intervals.

(b) *Multi–wythe walls.* Adjacent wythes shall be bonded with continuous tie assemblies spaced at vertical intervals not exceeding 16 inches; or individual ties of at least 3/16–inch diameter for each 4½ square feet of wall area, spaced at a maximum vertical distance of 18 inches and a maximum horizontal distance of 36 inches; or bonded with a full course of masonry headers every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid masonry units and 24 inches for hollow masonry units. Hollow walls shall not be bonded with headers.

(11) BOLTS AND ANCHORS. The allowable shear on steel bolts and anchors shall not exceed the values given in Table 21.26.

TABLE 21.26
ALLOWABLE SHEAR ON BOLTS AND ANCHORS

Bolt or Anchor Diameter (inches)	Embedment[1] (inches)	Allowable Shear (pounds)
1/4	4	270
3/8	4	410
1/2	4	550
5/8	4	750
3/4	5	1100
7/8	6	1500
1	7	1850
1 1/8	8	2250

[1]Bolts and anchors shall be solidly embedded in mortar or grout.

(12) JOINTS. Joints in masonry construction shall be constructed in accordance with ACI 530.1.

(13) CLEANING. Chemical cleaning agents shall be prevented from harming the metal reinforcement of structural components and shall not be of a strength which will adversely affect the mortar.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (3) and cr. Table 21.26–B1 Register, February, 1985, No. 350, eff. 3–1–85; am. (9) (b), Register, January, 1989, No. 397, eff. 2–1–89; am. (6) (b), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (2), am. (5) (c), (7) (a) 3., 4., (b), r. (14), Register, November, 1995, No. 479, eff. 12–1–95; CR 02–077: am. (7) (a) 4. Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: r. and recr. (1), (5) (a), (8) and (12), renum. (3) (intro.) and (a) to be (3) (a) and (b) and am. (3) (a), am. (4) (b) and (7) (a) 2., r. (5) (c), Tables 21.26–B and B1, cr. (7) (a) 5. to 7. and (c) Register March 2009 No. 639, eff. 4–1–09.**

Subchapter VIII — Roof and Ceilings

Comm 21.27 Roof design and framing. (1) STRUCTURAL DESIGN. (a) *General.* Roof and roof–ceiling assemblies shall support all dead loads plus the minimum live loads under par. (c) and s. Comm 21.02.

(b) *Applicability of tables.* The joist and rafter tables in the appendix are valid for roofs with a minimum slope of 3 in 12. Lesser slopes require engineering analysis or shall be provided with a ridge beam.

(c) *Sloped roof snow loads.* Snow loads specified in s. Comm 21.02 (1) (b) 2. may be reduced for roof slopes greater than 30° by multiplying the snow load by Cs. The value of Cs shall be determined by the following:

$$Cs = 1 - \frac{(a - 30)}{40}$$

where a is the slope of the roof expressed in degrees.

Note: A roof pitch of 7 in 12 is equal to 30°.

(2) LATERAL RESTRAINT OF WALLS. Provisions shall be taken to absorb the horizontal thrust produced by a sloping roof through the use of wall ties, ceiling joists, beams at the ridge or at the wall or a system designed through structural analysis.

(3) UPLIFT AND SUCTION FORCES. (a) *General.* 1. Roofs shall withstand a pressure of at least 20 pounds per square foot acting upward normal to the roof surface.

2. Roof overhangs, eaves, canopies and cornices shall withstand an upward wind pressure of at least 20 pounds per square foot applied to the entire exposed area.

(b) *Anchorage.* 1. Roof framing members spanning more than 6 feet measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using engineered clips, straps or hangers.

2. Roof framing members spanning 6 feet or less measured from the outermost edge of the roof shall be permanently fastened to the top plate of load bearing walls using toe–nailing or engineered clips, straps or hangers.

Note: For information on toe nailing, see the fastener schedule table in the Appendix.

(4) ROOF RAFTERS. (a) *General.* 1. Rafters shall be notched to fit the exterior wall plate and fastened to the wall.

2. Collar ties shall be installed on the upper third of every third pair of abutting roof rafters or every 48 inches, whichever is less.

Note: Collar ties are intended to provide stability to the roof at the ridge. Lateral restraint for the walls must be provided in accordance with sub. (2).

(b) *Ridge boards.* 1. Where rafters meet to form a ridge, the rafters shall be attached to a ridge board.

2. The ridge board shall have a depth at least equal to the length of the cut end of the rafter abutting it.

3. Where all rafters are placed directly opposite each other or are offset at the ridge board by less than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 1 inch.

4. Where one or more rafters are offset at the ridge board by more than the thickness of the rafter, the ridge board shall have a nominal thickness of at least 2 inches.

(c) *Ridge beams.* Rafters shall be attached to ridge beams using engineered clips, straps or hangers or the connection shall be designed through structural analysis.

(d) *Bearing.* The required bearing for wood rafters shall be in accordance with the NDS adopted in Table 20.24–2, except in no case shall the bearing be less than 1½ inches on wood or metal or less than 3 inches on masonry or concrete.

(e) *Ladders.* 1. Overhangs at gable end walls of more than 12 inches shall be provided with ladders which extend into the structure a distance no less than the length of the overhang.

2. The ladders shall be fastened at the wall.

3. The interior end of each ladder shall be attached to a rafter or truss with a hanger.

Note: For the purposes of this section, a ladder is defined as a perpendicular projection extending beyond the face of the wall below.

(5) CEILING JOISTS. (a) Ceiling joists shall be nailed to exterior walls and to the ends of rafters.

(b) Ends of ceiling joists shall be lapped at least 3 inches and be fastened either with 3–16d nails or in accordance with the floor joist requirements under s. Comm 21.22 (4) (a) 1. d.

Note: See the fastener table in the Appendix for a nailing schedule for ceiling joists.

(c) Where ceiling joists are placed at right angles to the rafters, the lookout joist or ties shall be fastened to the parallel ceiling joists or rafters using engineered clips, straps or hangers or the connection shall be designed through structural analysis.

(6) VALLEY AND HIP RAFTERS. (a) *Valley rafters.* 1. Where no bearing is provided under valley rafters at the intersection of 2 roof areas, the valley rafters shall be doubled in thickness and shall be at least 2 inches deeper than the required common rafter to permit full bearing at the beveled end.

2. Where ridges are provided at different elevations, vertical support shall be provided for the interior end of the lower ridge board or ridge beam.

(b) *Hip rafters.* Where no bearing is provided under hip rafters, the hip rafters shall be of the same thickness as common rafters and shall be at least 2 inches deeper than required to permit full contact with the jack rafter.

(7) ROOF TRUSSES. (a) Metal plate connected wood roof trusses shall be designed in accordance with TPI 1 and the NDS adopted under s. Comm 20.24.

(b) Truss members shall not be cut, bored or notched, except as allowed under sub. (8) (d).

(c) If connection is provided to stabilize a non–load bearing wall, a slotted expansion joint or clip shall be used.

(8) NOTCHING AND BORING. (a) *General.* 1. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

2. Notching and boring of ceiling joists and rafters shall comply with pars. (b) and (c).

(b) *Notching.* 1. Notches located in the top or bottom of ceiling joists and rafters are prohibited from all of the following:

a. Having a depth exceeding $1/6$ the depth of the member.

b. Having a length exceeding $1/3$ the depth of the member.

c. Being located in the middle $1/3$ of the span of the member.

2. Where ceiling joists or rafters are notched at the ends, the notch may not exceed ¼ the depth of the member.

3. Bird mouth cuts may not exceed $1/3$ the depth of the rafter unless the seat cut bears fully on the wall plate.

(c) *Boring.* 1. Holes bored within 2 inches of the top or bottom of ceiling joists or rafters may not be located in the middle $1/3$ of the span of the member.

2. The diameter of a hole may not exceed $1/3$ the depth of the member.

3. A hole may not be bored within 2 inches of a notch or another hole.

4. The distance between adjacent holes may not be less than the diameter of the larger hole.

(d) *Engineered wood products.* Notching or boring of engineered wood products shall be done in accordance with the manufacturer's instructions provided those instructions were developed through structural analysis or product testing.

(9) ROOF SHEATHING, BOARDS AND PLANKING. (a) *Structural sheathing.* The allowable loads and spans for structural sheathing shall be in accordance with the grade stamp on the panel.

(b) *Roof boards.* 1. Where the rafter spacing is 24 inches on center or less, roof boards may be used that have a minimum thickness of $5/8$–inch for solid sheathing and $3/4$–inch for spaced sheathing.

2. Where the rafter spacing is greater than 24 inches on center, roof boards shall be tongue and groove, at least 1.5 inches thick.

(c) *Roof planks.* 1. Roof planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness.

2. Planks shall terminate over beams unless the joints are end matched.

3. The planks shall be laid so that no continuous line of joints will occur except at points of support.

4. Planks shall be nailed or fastened to each beam.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am (3) (a), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (1), am. (3) (a), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (3) (a), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (3) (a) 1. and 2. c., Register, January, 1999, No. 517, eff. 2–1–99; am. (3) (a) 1. a., Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: r. and recr. (3) (b) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: r. and recr. Register March 2009 No. 639, eff. 4–1–09.**

Comm 21.28 Weather protection for roofs. (1) GENERAL. (a) All roofs shall be designed and constructed to assure drainage of water.

(b) All fasteners shall be corrosion resistant.

(2) UNDERLAYMENT FOR SHINGLES. Underlayment consisting of number 15 asphalt–impregnated felt paper or equivalent or other type I material that shows no water transmission when tested in accordance with ASTM D 226 or ASTM D 4869 shall be provided under shingles.

Note: Underlayment materials meeting the requirements of ASTM D 1970 meet the performance requirements of this section.

(3) ASPHALT SHINGLES. (a) *General.* 1. Shingles that have a self–sealing adhesive strip shall include a sealant which has an average bond strength of at least 1.5 pounds per 3.75 inches of shingle width, at 32°F.

Note: The department will accept results of testing conducted in accordance with an approved test method for verifying compliance with the sealant uplift resistance required in this paragraph. Information on the applicable test method may be obtained from the department.

2. Each shingle package shall be labeled by the manufacturer to indicate conformance to the applicable ASTM standard for each type of shingle or the exception in par. (c).

3. Shingles shall be installed in accordance with the manufacturer's recommendations.

4. Shingles shall have at least 4 fasteners per strip shingle or 2 fasteners per interlocking shingle, unless the manufacturer has other specifications.

5. Shingle head lap shall be at least 2 inches, unless the manufacturer has other specifications.

Note: See s. Comm 20.07 (62) for definitions of shingle terms.

Note: The Residential Asphalt Roofing Manual can be purchased from the Asphalt Roofing Manufacturers Association at 6000 Executive Boulevard, Suite 201, Rockville, Maryland 20852–3803. This manual contains extensive information on shingles from manufacture through installation, inspection and maintenance. It includes a recommendation that properly driven and applied nails are the preferred fastening system for asphalt shingles.

Note: Section Comm 20.04 (2) requires compliance with all parts of this code, including these roofing provisions, for an alteration to any dwelling that is regulated under this code.

(b) *Organic shingles.* Organic asphalt shingles shall conform to ASTM D 225 and the Class C requirements of ASTM E 108, and shall pass the wind resistance test of ASTM D 3161.

(c) *Fiberglass shingles.* Fiberglass asphalt shingles shall conform to ASTM D 3462 except that laminated shingles shall have a tear strength of at least 1450 grams in each ply.

(4) ICE DAM PROTECTION. (a) Shingled or shake roofs that extend over a heated area of a dwelling or attached garage and that have a slope of 4:12 or less shall be provided with ice dam protection in the form of sheet metal or a product labeled as meeting the requirements of ASTM D 1970.

(b) The ice dam protection shall extend at least 30 inches up the roof slope from the roof edge and at least 12 inches up the roof slope beyond the inner face of the exterior wall.

(5) OTHER ROOF COVERINGS. All roof coverings not otherwise addressed in this section shall be installed in accordance with the manufacturer's instructions or a national standard recognized by the department.

(6) REROOFING. New roof coverings may not be installed over existing roof coverings where any of the following conditions exist:

(a) The existing roof or roof covering is water–soaked or has deteriorated such that it is inadequate as a base for additional roofing.

(b) The existing roof is wood shake, slate, clay, cement or asbestos–cement tile.

(c) The existing roof has 2 or more applications of any type of permanent roof covering.

(7) FLASHING. (a) *General.* Flashing shall be installed at the junction of chimneys and roofs, in all valleys, and around all roof openings.

(b) *Flashing of open valleys.* 1. Open valleys shall be flashed with at least No. 28 gauge corrosion–resistant sheet metal, 16 inches wide, or a layer of at least 50–pound roll roofing, 16 inches wide, placed over a layer of number 15 roofing underlayment.

2. Flashing sections shall be overlapped by at least 4 inches.

(c) *Flashing of closed valleys.* Where shingles are laced or woven over the valley, the valley shall be flashed with at least one layer of 50–pound roofing, at least 20 inches wide, over a layer of number 15 roofing underlayment.

(d) *Chimney flashing.* 1. Chimneys shall be flashed and counter–flashed to a height of at least 6 inches.

2. Chimney crickets or saddles shall be installed where the upper side of a chimney is more than 30 inches wide on a sloping roof.

3. The intersection of the cricket and the chimney shall be flashed and counter–flashed to a height of at least 6 inches.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (7) (a), r. and recr. Table 21.28–A, Register, January, 1989, No. 397, eff. 2–1–89; am. (1), (5) and

(6), cr. (2m) and (6) (a) 3., r. and recr. (4) (c), Register, March, 1992, No. 435, eff. 4–1–92; cr. (6) (c), Register, November, 1995, No. 479, eff. 12–1–95; CR 02–077: r. and recr. (1) (a), renum. (6) (intro) to (c) to be (6) (a) to (d) and am. (6) (a) to (c) Register May 2003 No. 569, eff. 8–1–03; **CR 08–043: r. and recr. Register March 2009 No. 639, eff. 4–1–09.**

Subchapter IX — Fireplace Requirements

Comm 21.29 Masonry fireplaces. Masonry fireplaces shall be constructed of masonry, stone or concrete. Masonry fireplaces shall be supported on foundations of concrete or masonry. Structural walls shall be at least 8 inches thick. Masonry fireplaces shall conform to the following requirements:

(1) FLUE SIZE. The fireplace flue size shall be based on the type of flue and the fireplace opening indicated in Table 21.29.

TABLE 21.29
MINIMUM FLUE SIZE FOR MASONRY FIREPLACES

Type of Flue	Minimum Cross–Sectional Area
Round	$^1/_{12}$ of fireplace opening but not less than 75 square inches.
Square or rectangular	$^1/_{10}$ of fireplace opening but not less than 75 square inches.

(2) TERMINATION OF CHIMNEY. Masonry fireplace chimneys shall extend at least 3 feet above the highest point where the chimney passes through the roof and at least 2 feet higher than any portion of the dwelling within 10 feet of the chimney.

(3) FIREBOX MATERIALS. The firebox shall be of the preformed metal type, at least ¼–inch thick, or listed by a nationally recognized laboratory; or shall be lined with firebrick, at least 2 inches thick and laid in thin joints of refractory cement. The back and sidewalls of the firebox, including the lining, shall be at least 8 inches nominally thick masonry, at least 4 inches of which shall be solid.

(4) LINTEL. Masonry over the fireplace opening shall be supported by a lintel of steel or masonry.

(5) DUCTS. Warm–air circulating ducts shall be constructed of masonry or metal.

(5m) RETURN AIR GRILLES. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or in a confined space defined under s. Comm 23.06 in which a draft diverter or draft regulator is located.

(6) HEARTH EXTENSION. (a) Masonry fireplaces shall have a hearth extension made of noncombustible material.

(b) The structural support for the hearth and hearth extension shall be a minimum of 4 inches of reinforced concrete.

(c) There shall be no structural framing material within 1 inch of the hearth or hearth extension in any direction. Any wooden forms or supports used during construction shall be removed.

(d) The minimum dimensions of the hearth extension shall be in accordance with Table 21.29–1.

TABLE 21.29–1
HEARTH EXTENSION DIMENSIONS

Fireplace Opening (Sq. Ft.)	Extension from Fireplace Opening (inches)	
	Side	Front
Less than 6	8	16
6 or Greater	12	20

(7) DAMPERS. Dampers shall be made of cast iron or at least No. 12 gauge sheet metal. The area of the damper opening shall be at least 90% of the required flue area when in the open position.

(8) HOODS. Metal hoods, used in lieu of a masonry smoke chamber, shall be constructed of at least No. 19 gauge corrosion–resistant metal with all seams and connections of smokeproof construction. The hood shall be sloped at an angle of 45° or less from the vertical and shall extend horizontally at least 6 inches beyond the firebox limits. Metal hoods shall be kept a minimum of 18 inches from the combustible materials unless approved for reduced clearances.

Note: The department will accept dampers and hoods listed by nationally recognized laboratories.

(9) FLUE LINERS. (a) Flue liners shall be installed in accordance with s. Comm 21.30 (7) and this section.

(b) Flue liners shall start at the top of the fireplace throat and extend to a point at least 4 inches above the top of the chimney cap.

(c) Firebrick may be used in the throat of the fireplace as an inlet to the flue liner.

(10) CLEANOUT OPENINGS. Fireplaces with ash dumps shall be provided with cleanout openings at the base. Doors and frames of the opening shall be made of ferrous materials.

(11) MANTEL SHELVES AND COMBUSTIBLE TRIM. Woodwork or other combustible materials shall not be placed within 6 inches of the fireplace opening. Combustible materials located within 12 inches of the fireplace opening shall not project perpendicularly more than $^1/_8$–inch for each inch distance from the opening.

(12) FRAMING AROUND FIREPLACES. Combustible materials located near fireplaces shall be installed in accordance with s. Comm 21.30 (9).

(13) CORBELING. Unless designed through structural analysis, masonry chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one–inch projection for each brick course.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. Register, February, 1985, No. 350, eff. 3–1–85; am. (6) and Table 21.29–1, Register, January, 1989, No. 397, eff. 2–1–89; am. (intro.) and (12), cr. (5m), r. and recr. (6), Register, March, 1992, No. 435, eff. 4–1–92; r. (12) and renum. (13) and (14) to be (12) and (13), Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (6) and (9), Register, March, 2001, No. 543, eff. 4–1–01.

Comm 21.30 Masonry chimneys. Masonry chimneys shall conform to the following provisions:

(1) MATERIALS. No masonry chimney shall rest upon wood. The foundation shall be designed and built in conformity with the requirements for foundations. Masonry chimney walls shall be at least 4 inches in nominal thickness. Hollow cored masonry units may be used to meet the 4 inch nominal thickness requirement.

(2) FLUE SIZE. Chimney flues for appliances shall be at least equal in area to that of the area of the connector from the appliance.

(3) MULTIPLE FLUE SEPARATION. When more than one flue is contained in the same chimney, a masonry separation of at least 4 inches nominal in thickness shall be provided between the individual flues. The joints of adjacent flue linings shall be staggered by at least 7 inches.

(4) CORBELING. Unless designed through structural analysis, masonry chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry chimney be corbeled from a wall less than 12 inches in nominal thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one–inch projection for each brick course.

(5) INLETS. Inlets to masonry chimneys shall enter the side and be provided with thimbles. Thimbles shall be at least No. 24 manufacturer's standard gauge (0.024 inch) or $^5/_8$–inch thick, refractory material. Each chimney shall have an inlet installed at the time of construction.

(6) CLEAN–OUT OPENING. Every masonry chimney shall be provided with a clean–out opening at the base. Such openings shall be equipped with metal doors and frames arranged to remain closed when not in use. Clean–out openings shall be located below the lowest inlet to the flue.

(7) FLUE LINERS. (a) Masonry chimneys shall be lined with a material that will resist corrosion, softening and cracking at temperatures up to 1800°F, such as vitrified clay sewer pipe or minimum $^5/_8$–inch thick fireclay lining material.

(b) All flue liners shall be laid in a full bed of refractory mortar or refractory cement.

(c) Variations in inside and outside dimensions shall not exceed ¼ inch for clay flue liners.

(d) There shall be a minimum clearance of ½–inch and a maximum clearance of 1–inch between the flue liner and the chimney walls.

(e) Unless serving a masonry fireplace under s. Comm 21.29, flue liners shall commence at the chimney footing.

(8) CHIMNEY CAPS. Chimneys shall be provided with precast or cast–in–place concrete chimney caps. Chimney caps shall have a minimum thickness of 2 inches, shall slope outwards away from the flue, and shall provide a one–inch overhang and drip edge on all sides. A slip joint shall be installed between the flue and the cap. The slip joint shall be filled with ¼–inch felt or similar material and shall be caulked with high–temperature caulk or similar material to prevent water infiltration.

(9) CLEARANCE TO COMBUSTIBLES. (a) The minimum clearance between combustibles and masonry chimneys which have any portion located within the exterior wall of the dwelling shall be 2 inches. The minimum clearance between combustibles and masonry chimneys which have all parts completely outside the dwelling, exclusive of soffit or cornice areas, shall be one inch.

(b) Except as required under pars. (c) and (d), the clearance spaces shall remain completely open.

(c) The clearance spaces between chimneys and wood joists, beams, headers or other structural members shall be fireblocked at each floor level from chimney footing all the way to the roof flashing with galvanized steel, at least 26 gage thick or with noncombustible sheet material.

(d) Noncombustible material shall be used to prevent entry of debris into the clearance spaces.

History: Cr. Register, February, 1985, No. 350, eff. 3–1–85; am. (8), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (8) and (9); Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (7) (a), cr. (7) (d) and (e), and am. (9) (c), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (7) (b) and (d) Register May 2003 No. 569, eff. 8–1–03.

Comm 21.32 Factory–built fireplaces. Factory–built fireplaces consisting of a fire chamber assembly, one or more chimney sections, a roof assembly and other parts shall be tested and listed by a nationally recognized testing laboratory.

(1) FIREPLACE ASSEMBLY AND MAINTENANCE. The fireplace assembly shall be erected and maintained in accordance with the conditions of the listing.

(a) All joints between the wall or decorative facing material and the fireplace unit shall be completely sealed, firestopped or draft–stopped with a noncombustible caulk or equivalent.

(b) Doors installed on factory built fireplaces shall conform with the terms of the listing and the manufacturers installation instructions for the fireplace unit.

(2) DISTANCE FROM COMBUSTIBLES. Portions of the manufactured chimney extending through combustible floors or roof/ceiling assemblies shall be installed in accordance with the distances listed on the chimney in order to prevent contact with combustible materials.

(3) HEARTH EXTENSIONS. Hearth extensions shall be provided in accordance with the manufacturer's listing. Where no hearth extension is specified in the listing, a hearth extension shall be provided in accordance with s. Comm 21.29 (6).

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; renum. from Ind 21.30 and r. and recr. (3), Register, February, 1985, No. 350, eff. 3–1–85; cr. (1) (a) and (b), am. (3) and Table 21.32–1, Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. Register, March, 1992, No. 435, eff. 4–1–92.

Subchapter X — Construction in Floodplains

Comm 21.33 Construction in floodplains. (1) GENERAL. Where dwelling construction is allowed by local zoning ordinances to take place in floodfringe areas of floodplains, the dwelling shall meet the requirements of this subchapter.

Note: The department of natural resources (DNR) and the federal emergency management agency (FEMA) also have regulations that apply to construction in floodfringe areas.

(2) ELEVATION. (a) *General.* Except as provided in pars. (b) and (c), all dwellings constructed within a floodfringe area shall be elevated so the lowest floor and all basement floor surfaces are located at or above the base flood elevation.

(b) *Certified floodproof basements.* Floodproof basements may have the top of the basement floor no more than 5 feet below the base flood elevation provided the basement is designed by a registered architect or engineer to be watertight and impermeable. No limitation is placed on the use or occupancy of a certified floodproof basement by the provisions of this subchapter.

(c) *Other enclosed spaces.* 1. Enclosed spaces not meeting the requirements of par. (b) are allowed at any depth below the base flood elevation provided the spaces are used only for one or more of the following purposes:

a. Means of egress.

b. Entrance foyers.

c. Stairways.

d. Incidental storage of portable or mobile items.

2. Fully enclosed spaces used only for those purposes listed in subd. 1. shall be designed to automatically equalize the hydrostatic pressure on exterior walls by allowing the entry and exit of floodwaters. Designs for meeting this requirement shall be certified by a registered architect or engineer or shall meet all of the following requirements:

a. There shall be at least 2 pressure relieving openings and the openings shall have a total net area of not less than one square inch for every square foot of enclosed area subject to flooding.

b. The bottom of all openings shall be no more than 12 inches above grade.

c. Openings may not be equipped with screens, louvers, valves or other coverings or devices unless such devices permit the automatic entry and discharge of floodwaters.

(3) CERTIFICATION OF ELEVATION. A registered land surveyor, architect or engineer shall certify the actual elevation in relation to mean sea level of the lowest structural member required to be elevated by the provisions of this subchapter.

(4) ANCHORAGE. The structural systems of all dwellings shall be designed, connected and anchored to resist flotation, collapse or permanent lateral movement due to structural loads and stresses at the base flood elevation.

(5) PROTECTION OF ELECTRICAL AND MECHANICAL SYSTEMS. Electrical and mechanical equipment shall be placed above the base flood elevation or shall be designed to prevent water contact with the equipment in case of a flood up to the base flood elevation.

(6) CONSTRUCTION MATERIALS AND METHODS. All dwellings constructed in floodplains shall be constructed using materials and methods designed to minimize flood and water damage.

History: Emerg. cr. eff. 5–8–96; cr. Register, February, 1997, No. 494, eff. 3–1–97.

Comm 21.34 Construction in coastal floodplains. (1) GENERAL. All dwellings constructed in coastal floodplains shall be designed by a registered architect or engineer and shall meet the requirements of this section and s. Comm 21.33.

(2) ELEVATION. All dwellings constructed in a coastal floodplain shall be elevated so the lowest portion of all structural members supporting the lowest floor, with the exception of mat or raft foundations, pilings, piling caps, columns, grade beams and bracing, is located at or above the base flood elevation.

(3) ENCLOSURES BELOW BASE FLOOD ELEVATION. Enclosures below the base flood elevation in a coastal floodplain may not be used for human occupancy and shall be free of all obstructions, except for non–loadbearing walls and partitions. Non–loadbearing walls and partitions below base flood elevation shall be con-

structed to break away without causing any structural damage to the elevated portion of the dwelling or foundation system due to the effect of wind loads and water loads acting simultaneously.

(4) FOUNDATIONS. All dwellings located in a coastal floodplain shall be supported and anchored on pilings or columns. The piling or column shall have adequate soil penetration to resist combined water and wind loads at the base flood elevation. Piling or column design shall consider the effect of scour of soil strata. Mat or raft foundations to support columns may not be used where soil under the mat or raft is subject to scour or other erosion from wave flow conditions.

History: Emerg. cr. eff. 5–8–96; cr. Register, February, 1997, No. 494, eff. 3–1–97.

Subchapter XI — Installation of Manufactured Homes

Comm 21.40 Installation standards. (1) (a) The installation of a manufactured home produced on or after April 1, 2007 shall comply with procedures acceptable to the department.

(b) Acceptable installation procedures shall address all of the following:

1. Soil mechanics.
2. Site preparation.
3. Structural support, stabilization and anchorage.
4. Setting.
5. Ventilation of crawl spaces.
6. Connections, plumbing, electrical, HVAC.
7. Joining of home sections.

Note: Acceptable installation practices can be found through the Safety and Buildings Division's website at www.commerce.state.wi.us/SB or by contacting the Safety and Buildings Division at (608) 264–9596.

Note: The design and construction of basements and perimeter foundations to support manufactured homes is addressed under subchapter V.

(2) (a) Except as provided in par. (b), the installation of a manufactured home produced before April 1, 2007 shall be installed in conformance with the requirements in effect at the time the manufactured home was produced.

(b) The installation of a manufactured home produced before April 1, 2007 to be installed on piers shall conform to at least all of the following requirements:

1. No footing may be placed upon unprepared fill material, topsoil, alluvial soil or mud. All organic matter shall be removed from the area that will be beneath any footing.

2. The soil bearing capacity shall be determined through test by a pocket penetrometer or other means of analysis. If the soil bearing capacity under each intended pier location is less than 2000 pounds per square foot, piers shall be located in accordance with the manufacturer's instructions.

3. The home site shall be graded to permit water to drain from under the home and away from the home for a minimum of 5 feet from the home.

4. Every pier shall be supported by a footing. Each footing shall be no less than a nominal 16 inches by 16 inches.

5. Each footing shall consist of one of the following:

a. One nominal 4–inch by 16–inch by 16–inch solid concrete block or 2 nominal 4–inch by 8–inch by 16–inch solid concrete blocks. If a single block pier and 2 footing blocks are used, the 2 footing blocks shall be positioned with the joint parallel to the main frame. If a double block pier and 2 footing blocks are used, the 2 footing blocks shall be positioned with the joint either parallel or perpendicular to the main frame.

b. A 16–inch by 16–inch pad constructed of acrylonitrile–butadiene–styrene (ABS) having a rated load bearing capacity of not less than 6000 pounds.

c. An 18–inch diameter hole bored to below the frost line or to unfractured bedrock and filled with poured concrete.

d. Any other materials and systems approved in advance by the department.

6. Piers shall be constructed of concrete blocks, manufactured steel stands or manufactured concrete stands. Manufactured stands shall be labeled for use as piers for manufactured homes.

7. Piers constructed of single stacked concrete blocks shall be limited to a height of 36 inches. Piers constructed of concrete blocks and exceeding 36 inches but less than 80 inches shall be constructed using double stacked blocks with each layer opposing the direction of the layer underneath it. Piers constructed of concrete blocks and exceeding 80 inches shall be constructed using double blocks laid in concrete mortar with each layer opposing the direction of the layer underneath it and with each core filled with concrete and a ½–inch steel reinforcing rod.

8. All concrete blocks shall be 2–core design, construction grade blocks having nominal dimensions of at least 8 inches by 8 inches by 16 inches. All concrete blocks shall be placed with the cores open vertically. The concrete block nearest the main frame of the manufactured home shall be perpendicular to the linear direction of the frame. No concrete block may contact the main frame of the home.

9. Alternative materials may be used for pier installations provided they are approved in advance by the department.

10. Piers shall be placed under the main frame of the chassis at intervals of not more than 7 feet on–center and no more than 3 feet from the exterior side of each end wall. The 7–foot spacing requirement may be varied as permitted by footing, spacing and soil capacity tables provided by the home manufacturer.

11. Piers shall be placed under the bearing points of clear–span openings of 4 feet or more in center mating walls.

12. Piers shall be plumb and centered under the contact area at the point of support.

13. a. Each pier shall be capped with a solid concrete block at least 4 inches thick or a solid wood block having a nominal thickness of at least 2 inches.

b. The cap shall be the same width and length as the top of the pier.

c. The cap shall consist of no more than 2 pieces.

d. Two–piece caps shall be positioned with the joint perpendicular to the main frame.

14. Where shims are utilized, wood shims shall be installed between the pier cap and the frame. Shims shall be driven from opposing sides and shall be no less than 4 inches by 8 inches.

15. Wood caps and shims shall be at least equal to No. 2 spruce pine fir having a minimum fiber bending stress rating of 1200 psi. All wood caps shall be the same species of wood, and all shims shall be the same species of wood.

16. The combination of a nominal 2–inch solid concrete block or a nominal 2–inch wood cap plus shims shall not exceed 3 ½ inches.

17. A minimum clearance of 12 inches shall be maintained beneath the lowest point of the main frame in the area of any utility connection. A minimum clearance of 12 inches shall also be maintained under the home for at least 75% of the home. The remainder of the home may be less than 12 inches above the ground but may not touch the ground.

History: CR 05–113: cr. Register December 2006 No. 612, eff. 4–1–07; **CR 08–043: am. (2) (b) 13. Register March 2009 No. 639, eff. 4–1–09.**

Chapter Comm 22

ENERGY CONSERVATION

Subchapter I — Scope and Application
Comm 22.01 Scope.
Comm 22.02 Application.

Subchapter II — Definitions
Comm 22.10 Definitions.

Subchapter III — Insulation Materials and Installation
Comm 22.20 Basic requirements.
Comm 22.21 Protection of insulation.

Subchapter IV — Dwelling Thermal Envelope
Comm 22.30 General design requirements.
Comm 22.31 Prescriptive insulation and fenestration criteria.
Comm 22.32 Specific insulation requirements.
Comm 22.33 Slab floors.
Comm 22.34 Crawl spaces.
Comm 22.35 Thermally isolated sunrooms.
Comm 22.36 Fenestration.
Comm 22.37 Air leakage.
Comm 22.38 Vapor retarders.
Comm 22.39 Ventilation and moisture control.

Subchapter V — Systems
Comm 22.40 Indoor temperatures and equipment sizing.
Comm 22.41 Temperature control.
Comm 22.42 Duct systems.
Comm 22.43 Duct and plenum sealing.
Comm 22.44 Pipe insulation.
Comm 22.45 Air conditioner and heat pump efficiencies.
Comm 22.46 Replacement furnace and boiler efficiencies.

Subchapter VI — Simulated Performance Alternative
Comm 22.50 General.
Comm 22.51 Performance–based compliance.
Comm 22.52 Documentation.
Comm 22.53 Calculation procedure.

Note: Chapter Ind 22 was renumbered to be chapter ILHR 22, Register, February, 1985, No. 350, eff. 3–1–85. Chapter ILHR 22 was repealed and recreated to be chapter Comm 22, Register, January, 1999, No. 517, eff. 2–1–99. **Chapter Comm 22 as it existed on March 31, 2009, was repealed and a new chapter Comm 22 was created effective April 1, 2009.**

Subchapter I — Scope and Application

Comm 22.01 Scope. (1) This chapter applies to all one– and 2–family dwellings covered by this code that use any amount of non–renewable energy for heat generation.

Note: Non–renewable energy sources used for heat distribution only will not require compliance with this chapter.

Note: The Public Service Commission has rules regulating "non–essential uses" of natural gas, such as snow melting and lighting in ch. PSC 136 of the Wisconsin Administrative Code.

(2) The equipment efficiency standards in this chapter apply to all one– and 2–family dwellings covered by this code that use the respective equipment.

(3) The vapor retarder requirements under s. Comm 22.38 and the moisture control and ventilation requirements under s. Comm 22.39 apply to any dwelling with insulation installed, whether or not the insulation is required under this code.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.02 Application. (1) This chapter is not intended to conflict with any safety or health requirements. Where a conflict occurs, the safety and health requirements shall govern.

(2) This chapter allows the designer the option of using various methods to demonstrate compliance with thermal performance requirements. The designer shall identify on the plan submittal form what method or subchapter is being used, and indicate the design criteria and how it is being applied. Unless specifically exempted, all requirements of this chapter apply regardless of the method used.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter II — Definitions

Comm 22.10 Definitions. (1) "Air–impermeable" means having an air permeance less than or equal to 0.02 L/s–m^2 at a pressure differential of 75 pascals when tested according to ASTM E 2178 or ASTM E 283.

(2) "Conditioned floor area" means the sum of areas of all floors in conditioned space in the structure, including basements, cellars, and intermediate floored levels measured from the exterior faces of exterior walls or from the center line of interior walls, excluding covered walkways, open roofed–over areas, porches, exterior terraces or steps, chimneys, roof overhangs and similar features.

(3) "Conditioned space" means space within the dwelling thermal envelope which is provided with heated air or surfaces to provide a heated space capable of maintaining the temperature of the space to at least 50°F at design conditions.

(4) "Crawl space wall" means the opaque portion of a wall which encloses a crawl space and is partially or totally below grade.

(5) "Dwelling thermal envelope" means the elements of a dwelling with enclosed conditioned space through which thermal energy may be transferred to or from unconditioned space or the exterior.

(6) "Exterior wall area" means the normal projection of the dwelling envelope wall area bounding interior space which is conditioned by an energy–using system including opaque wall, window and door area. Any skylight shaft walls that are 12 inches or more in depth, measured from the ceiling plane to the roof deck, are considered in the area of exterior walls and are not considered part of the roof assembly.

(7) "Heated slab" means a floor slab in which an uninsulated heating element, uninsulated hydronic tubing or uninsulated hot air distribution system is in contact with the slab or placed within the slab or the subgrade.

(8) "HVAC" means heating, ventilating and air conditioning.

(9) "HVAC system" means the equipment, distribution network, and terminals that provide either collectively or individually the processes of heating, ventilating, or air conditioning to a building.

(10) "Infiltration" means the uncontrolled inward air leakage through cracks and interstices in any dwelling element and around windows and doors of a dwelling caused by the pressure effects of wind, and the effect of differences in the indoor and outdoor air density.

(11) "IC–rated" means an electrical fixture tested and listed by an independent testing laboratory as being suitable for installation in a cavity where the fixture may be in direct contact with thermal insulation or combustible materials.

(12) "Mass wall" means a wall of concrete block, concrete, insulated concrete forms, masonry cavity, brick other than brick veneer, earth and solid timber or logs.

(13) "Opaque areas" means all exposed areas of a dwelling envelope which enclose conditioned space except openings for windows, skylights, doors and dwelling service systems.

(14) "Proposed design" means a description of the proposed dwelling used to estimate annual energy use for determining compliance based on total building performance.

(15) "Renewable energy sources" means sources of energy, excluding minerals and petroleum products, derived from incoming solar radiation, trees and other plants, wind, waves and tides, lake or pond thermal differences and from the internal heat of the earth.

(16) "Roof assembly" means all components of the roof and ceiling envelope through which heat flows, thus creating a building transmission heat loss or gain, where such assembly is exposed to outdoor air and encloses a heated space. Any skylight shaft walls less than 12 inches in depth, as measured from the ceiling plane to the roof deck, are considered in the roof assembly and are not considered in the area of exterior walls.

(17) "Sun room" means a one–story structure attached to a dwelling with a glazing area in excess of 40% of the gross area of the structure's exterior walls and roof.

Note: A thermally isolated sun room does not count in the calculation of amount of glazing.

(18) "System" means a combination of central or terminal equipment and their components, controls, accessories, interconnecting means, and terminal devices by which energy is transformed so as to perform a specific function, such as HVAC, water heating, or illumination.

(19) "Thermal resistance" or "R–value" means a measure of the ability to retard the flow of heat. The R–value is the reciprocal of thermal transmittance or U–factor expressed as R = 1/U.

Note: The higher the R–value of a material, the more difficult it is for heat to be transmitted through the material.

(20) "Thermal transmittance" or "U–factor" means the time rate of heat flow through a body or assembly which is located between 2 different environments, expressed in Btu/h • ft.^{2} • °F. The U–factor applies to combinations of different materials used in series along the heat flow path and also to single materials that comprise a dwelling section, including cavity air spaces and air films on both sides of a dwelling element.

Note: The lower the U–factor of a material, the more difficult it is for heat to be transmitted through the material.

Note: The thermal transmittance is also referred to as the coefficient of heat transfer or the coefficient of heat transmission.

(21) "Thermally isolated" means physically and thermally separated with separate zone or separate equipment controls for space heating.

(22) "Thermostat" means an automatic control device actuated by temperature and designed to be responsive to temperature.

(23) "Ventilation" means the process of supplying or removing air by natural or mechanical means to or from any space. The air may or may not have been conditioned.

(24) "Zone" means a space or group of spaces within a dwelling with heating requirements sufficiently similar so that comfort conditions can be maintained throughout by a single controlling device.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter III — Insulation Materials and Installation

Comm 22.20 Basic requirements. **(1)** GENERAL. When available, information and values on thermal properties, performance of building envelope sections and components, and heat transfer shall be obtained from the ASHRAE Handbook of Fundamentals.

(2) COMPUTATION OF R–VALUES. (a) Insulation material used in layers, such as framing cavity insulation and insulating sheathing, shall be summed to compute the component R–value.

(b) The manufacturer's settled R–value shall be used for blown insulation.

(c) Computed R–values may not include values for air films or for building materials other than insulation materials.

Note: The REScheck program will automatically account for air films and other building materials.

(3) LABORATORY OR FIELD TEST MEASUREMENTS. (a) *General dwelling thermal envelope materials.* When information specified under sub. (1) is not available, or when a different value is claimed, supporting data shall be obtained using one of the following test methods:

1. ASTM C177, Standard test method for steady state heat flux measurements and thermal transmission properties by means of the guarded–hot–plate apparatus.

2. ASTM C335, Standard test method for steady state heat transfer properties of pipe insulation.

3. ASTM C518, Standard test method for steady state thermal transmission properties by means of the heat flow meter apparatus.

4. ASTM C1363, Standard test method for the thermal performance of building materials and envelope assemblies by means of a hot box apparatus.

(b) *Foam plastic insulation.* 1. When information specified under sub. (1) is not available, or when a different value is claimed, foam plastic insulation that uses a gas other than air as the insulating medium shall use laboratory or field tests conducted on representative samples that have been aged for the equivalent of 5 years or until the R–value has stabilized.

2. The tests shall be conducted by an independent third party using the standards listed under par. (a) and shall be submitted for department review and approval in accordance with s. Comm 20.18.

(c) *Concrete masonry units.* Systems using integrally–insulated concrete masonry units shall be evaluated for thermal performance in accordance with one of the following:

1. Default values as approved by the department with no extrapolations or interpolations.

2. Laboratory or field test measurements specified under par. (a).

3. The material approval process specified in s. Comm 20.18.

(4) GENERAL INSTALLATION. (a) Materials, equipment and systems shall be identified in a manner that will allow a determination of their compliance with the applicable provisions of this code.

(b) All insulation materials, caulking and weatherstripping, fenestration assemblies, mechanical equipment and systems components, and water–heating equipment and system components shall be installed in accordance with the manufacturer's installation instructions.

(c) Manufacturer's installation instructions shall be available on the job site at the time of inspection.

(d) Roof and ceiling, floor and wall cavity batt or board insulation shall be installed in a manner which will permit inspection of the manufacturer's R–value identification mark.

(5) IDENTIFICATION. (a) A thermal resistance identification mark shall be applied by the manufacturer to each piece of dwelling envelope insulation 12–inches or greater in width.

(b) 1. The thickness of blown–in roof and ceiling insulation shall be identified by thickness markings that are labeled in inches and installed at least one for every 300 square feet through the attic space.

2. The markers shall be affixed to trusses or joists marking the minimum initial installed thickness and minimum settled thickness with numbers a minimum of one–inch in height.

3. Each marker shall face the attic access.

4. The thickness of installed insulation shall meet or exceed the minimum initial installed thickness shown by the marker.

(6) CERTIFICATE. (a) A permanent certificate shall be posted on or immediately adjacent to the electrical distribution panel.

(b) The certificate shall be completed by the owner, builder or insulation installer.

(c) The certificate shall list at least the following information:

1. The predominant R–values of insulation installed in or on ceilings or roofs, walls, foundation walls, slabs and any heating ducts that are outside the thermal envelope.

2. The U–factors of all windows, skylights and doors.

(d) If using the REScheck or REM/Rate software programs, the certificate shall be printed from that program.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09; correction in (3) (a) made under s. 13.92 (4) (b) 1., Stats., Register March 2009 No. 639.

Comm 22.21 Protection of insulation. (1) BLANKET INSULATION. Insulating blankets or batts shall be held in place with a covering or other means of mechanical or adhesive fastening.

Note: If the insulation is on a below–grade wall, s. Comm 22.08 (3) may prohibit the use of vapor retarder material used as the covering.

(2) WIND WASH PROTECTION. (a) Except as provided under s. Comm 22.39 (4) for cathedral ceilings, all air–permeable insulation materials installed in any position other than horizontal, shall be covered on the cold–in–winter side with a permanently attached material of low air permeability to maintain the R–value of the insulation.

Note: Suitable materials for this purpose include house wrap permanently attached with batten strips, asphalt–impregnated felt or tar paper, plywood, oriented strand board or OSB, siding material, rigid insulation sheathing, etc.

(b) If non–rigid sheet material is used, it shall be water vapor permeable.

Note: Water vapor permeable materials for this purpose include house wrap permanently attached with batten strips and asphalt–impregnated felt or tar paper.

(3) FOAM PLASTIC INSULATION. (a) Exterior foam plastic insulation shall be protected from physical damage and damage from ultraviolet light with a permanent, opaque, weather–resistant covering or coating.

(b) The protective covering shall cover the exposed exterior insulation and extend a minimum of 6 inches below grade.

Note: For interior applications, a thermal barrier may be required under s. Comm 21.11.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter IV — Dwelling Thermal Envelope

Comm 22.30 General design requirements. (1) GENERAL. Dwelling thermal envelope insulation amounts and details shall be determined using one of the methods described in this subchapter.

(2) INFILTRATION. (a) Infiltration for heating design loads shall be calculated based on a maximum of 0.5 air change per hour in the heated space.

(b) 1. If the proposed design takes credit for a reduced air change per hour level, documentation of the measures providing the reduction or the results of a post–construction blower door test conducted in accordance ASTM E 779 shall be provided to the department.

2. The minimum air change per hour rate may not be less than 0.2, unless mechanical ventilation is provided.

(3) BASEMENTS AND CRAWL SPACES. Where basement and crawl space walls are part of the dwelling thermal envelope, their R–values and U–factors shall be based on the wall components. Adjacent soil may not be considered in the determination.

(4) GARAGES. (a) Except as provided under par. (b), a garage may not be provided with any supplemental heat unless all of the following conditions are met:

Note: Because of the scope of this chapter, the requirements under this subsection apply only to heat generated from non–renewable sources.

1. The dwelling shall be thermally isolated from the garage.

2. The garage floor, ceiling and walls shall be provided with a vapor retarder in accordance with s. Comm 22.38.

3. All building elements shall meet the requirements of s. Comm 22.31.

(b) The thermal envelope requirements under par. (a) are not required if all of the following conditions are met:

1. The thermostat is permanently limited to a maximum of 50°F.

2. Heating equipment is either separate from the dwelling unit equipment or installed as a separate zone.

3. Separate heating equipment shall be sized to provide a maximum indoor temperature of 50°F.

(5) MASONRY VENEER. When insulation is placed on the exterior of a foundation supporting a masonry veneer exterior, the horizontal foundation surface supporting the veneer is not required to be insulated to satisfy the foundation insulation requirement.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.31 Prescriptive insulation and fenestration criteria. (1) REQUIREMENTS. (a) Except as specifically provided under this subchapter, dwellings using the prescriptive method shall meet the requirements of Table 22.31–1 or 22.31–2.

(b) In Tables 22.31–1 and 22.31–2, zone 2 consists of the following 15 northern counties: Ashland, Bayfield, Burnett, Douglas, Florence, Forest, Iron, Langlade, Lincoln, Oneida, Price, Sawyer, Taylor, Vilas and Washburn. Zone 1 consists of all other counties not included in zone 2.

TABLE 22.31–1
INSULATION AND FENESTRATION REQUIREMENTS BY COMPONENT[a]

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value	Floor R–Value	Basement or Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
1	0.35	0.60	49[e]	19[f] or 13+5[g]	15	30[h]	10/13	10/15	10
2	0.35	0.60	49[e]	21[f]	19	30[h]	10/13	10/15	10

[a] R–values are minimums. U–factors are maximums.

[b] The first R–value applies to continuous insulation. The second R–value applies to framing cavity insulation. Either insulation meets the requirement.

[c] The first R–value applies under the entire slab, regardless of depth below grade. The second R–value applies to the slab edge. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches.

[d] The R–value applies to any slab, the bottom of which is less than 12 inches below adjacent grade. Also, see s. Comm 21.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s. Comm 22.32 (1) for application and permitted reduced R–value.

[f] R–19 and R–21 may be compressed into a 2X6 cavity.

[g] "13+5" means R–13 cavity insulation plus R–5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of the exterior, structural sheathing shall be covered with insulated sheathing of at least R–2.

[h] Or insulation sufficient to fill the framing cavity with a minimum of R–19.

TABLE 22.31–2
EQUIVALENT U–FACTORS

Zone	Fenestration U–Factor	Skylight U–Factor	Ceiling U–Factor	Wood Frame Wall U–Factor	Mass Wall U–Factor	Floor U–Factor	Basement Wall U–Factor	Crawl Space U–Factor
1	0.35	0.60	0.026	0.060	0.060	0.033	0.065	0.065
2	0.35	0.60	0.026	0.057	0.057	0.033	0.065	0.065

(2) THERMAL ENVELOPE. (a) *General.* If the total dwelling thermal envelope UA is less than or equal to the total UA resulting from using the U–factors in Table 22.31–2 multiplied by the same assembly area as in the proposed building, the dwelling is in compliance with this chapter. The UA calculation shall be done using a method consistent with the ASHRAE Handbook of Fundamentals and shall include the thermal bridging effects of framing materials.

Note: UA is equal to the product of the U–factor times the assembly area.

Note: REScheck and REM/Rate are acceptable software programs for determining compliance with this section.

(b) *Software edition.* If the REScheck software program is used to show compliance with this section, the version shall be 4.1.0, or later.

Note: Any version of REScheck with a beginning number of 3 or smaller will not support the requirements of this code.

(3) APPLIANCE EFFICIENCY. (a) Except as allowed under par. (b) and s. Comm 22.46, oil–fired and gas–fired furnaces and boilers shall meet the minimum efficiency requirements in Table 22.31–3.

(b) In new construction, an oil–fired or gas–fired furnace or boiler meeting the federal efficiency standard but not the requirements of Table 22.31–3 may be installed if the dwelling thermal envelope requirements of Table 22.31–4 are met.

TABLE 22.31–3
WARM AIR FURNACES AND BOILERS, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Minimum Efficiency	Test Procedure
Natural gas and propane furnace	90% AFUE	DOE 10 CFR Part 430 or ANSI Z21.47
Natural gas and propane hot water boilers	90% AFUE	DOE 10 CFR Part 430
Oil–fired furnaces	83% AFUE	DOE 10 CFR Part 430 or UL 727
Oil–fired hot water boilers	84% AFUE	DOE 10 CFR Part 430

TABLE 22.31–4
COMPONENT DWELLING THERMAL ENVELOPE REQUIREMENTS
FOR DWELLINGS USING LOWER EFFICIENCY APPLIANCES[a]

Fenestration U–Factor	Skylight U–Factor	Ceiling R–Value	Wood Frame Wall R–Value	Mass Wall R–Value	Floor R–Value	Basement or Crawl Space Wall R–Value[b]	Heated Slab R–Value[c]	Unheated Slab R–Value[d]
0.30	0.60	49[e]	21[f] or 19+5[g]	19	30[h]	15/19	10/20	15
Equivalent U–Factors								
0.30	0.60	0.26*	0.057	0.057	0.033	0.045	0.033	0.047

* **Note:** The correct number is .026. An error was discovered in the rule order after completion of the rule–making process.

[a] R–values are minimums. U–factors are maximums.

[b] The first R–value applies to continuous insulation. The second R–value applies to framing cavity insulation.

[c] The first R–value applies under the entire slab, regardless of depth below grade. The second R–value applies to the slab edge. Slab edge insulation shall extend downward from the top of the slab for a minimum of 48 inches or downward to at least the bottom of the slab and then horizontally to the interior or exterior for a minimum total distance of 48 inches.

[d] The R–value applies to any slab, the bottom of which is less than 12 inches below adjacent grade. Also, see s. Comm 21.16 for protection against frost for slabs with supports less than 4 feet below grade.

[e] See s. Comm 22.32 (1) for application and permitted reduced R–value.

[f] R–21 may be compressed into a 2X6 cavity.

[g] "19+5" means R–19 cavity insulation plus R–5 insulated sheathing. If structural sheathing covers 25% or less of the exterior, insulating sheathing is not required where structural sheathing is used. If structural sheathing covers more than 25% of the exterior, structural sheathing shall be covered with insulated sheathing of at least R–2.

[h] Or insulation sufficient to fill the framing cavity with a minimum of R–19.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.32 Specific insulation requirements. **(1)** CEILINGS WITH ATTIC SPACES. R–38 will satisfy the ceiling R–value requirement for a dwelling where the full height of uncompressed R–38 insulation extends over the wall top plate at the eaves.

(2) CEILINGS WITHOUT ATTIC SPACES. Where the design of the roof or ceiling assembly does not allow sufficient space for the required R–49 insulation, the minimum required insulation for the roof or ceiling assembly shall be R–30. This reduction of insulation shall be limited to 500 square feet of ceiling area.

(3) MASS WALLS. (a) The requirements of Table 22.31–1 are applicable in a mass wall where at least 50 percent of the required insulation R–value is on the exterior of, or integral to, the wall.

(b) Mass walls that do not meet the specifications under par. (a) for insulation placement shall meet the wood frame wall insulation requirements of Table 22.31–1.

(4) STEEL–FRAME CEILINGS, WALLS AND FLOORS. (a) Steel–frame ceilings, walls and floors shall meet the insulation requirements of Table 22.32 or shall meet the U–factor requirements in Table 22.31–2.

(b) The calculation of the U–factor for a steel–frame envelope assembly shall use a series–parallel path calculation method.

(5) FLOORS. Floor insulation shall be installed to maintain permanent contact with the underside of the subfloor decking.

(6) BASEMENT WALLS. (a) Walls associated with conditioned basements shall be insulated from the top of the basement wall down to the basement floor.

(b) Walls associated with unconditioned basements shall meet the requirement in par. (a) unless the floor overhead is insulated in accordance with Table 22.31–1.

(c) Where the total basement wall area is less than 50 percent below grade, the entire wall area, including the below–grade portion, is included as part of the area of exterior walls.

(7) BOX SILL AND RIM JOIST SPACES. Box sills and joist spaces at outside walls shall be insulated to the required wall R–value with air–impermeable insulation that is sealed on all sides to all framing members and the foundation, or with air–permeable insulation held in place as required under s. Comm 22.21 (1).

(8) OVERHANG JOIST SPACES. (a) Joist spaces that extend beyond exterior walls shall be insulated with an R–value of 30 or higher with insulation that completely fills the cavity including over the top of the exterior wall supporting the joists.

(b) The joist space insulation shall be air sealed either by using an air–impermeable insulation that is sealed to all framing members or by covering the insulation with a rigid material that is caulked or sealed to all framing members.

(c) If piping that is subject to freezing is located in the joist space, additional insulation shall be provided on the unconditioned side of the space.

(9) WALL INSULATION. Except for closed–cell sprayed foam, wall insulation shall completely fill the wall cavity.

TABLE 22.32

STEEL-FRAME CEILING, WALL AND FLOOR INSULATION R-VALUES

Wood Frame R-Value Requirement	Cold-Formed Steel Equivalent R-Value[a]
Steel Truss Ceilings[b]	
R-30	R-38 or R-30 + 3 or R-26 + 5
R-38	R-49 or R-38 + 3
R-49	R-38 + 5
Steel Joist Ceilings[b]	
R-30	R-38 in 2X4 or 2X6 or 2X8 R-49 in any framing
R-38	R-49 in 2X4 or 2X6 or 2X8 or 2X10
Steel Framed Wall	
R-13	R-13 + 5 or R-15 + 4 or R-21 +.3
R-19	R-13 + 9 or R-19 + 8 or R-25 + 7
R-21	R-13 + 10 or R-19 + 9 or R-25 + 8
Steel Joist Floor	
R-13	R-19 in 2X6 R-19 + 6 in 2X8 or 2X10
R-19	R-19 + 6 in 2X6 R-19 + 12 in 2X8 or 2X10

[a] Cavity insulation R-value is listed first, followed by continuous insulation R-value.

[b] Insulation exceeding the height of the framing shall cover the framing.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.33 Slab floors. (1) HEATED OR UNHEATED SLABS. Any slab floor, the bottom of which is less than 12 inches below adjacent grade, shall be insulated in accordance with Table 22.31-1 or Table 22.31-4.

(2) HEATED SLABS. In addition to meeting the requirement under sub. (1), if applicable, heated slabs of any depth below grade shall meet the R-value requirement in accordance with Table 22.31-1 or Table 22.31-4.

(3) DETAILS. (a) The top edge of insulation installed between the exterior wall and the edge of the interior slab may be cut at a 45 degree angle away from the exterior wall.

(b) Horizontal insulation extending outside of the foundation shall be covered by soil a minimum of 10 inches thick or by pavement.

Note: See Appendix for further explanatory materials.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.34 Crawl spaces. (1) FROST PROTECTION. If the bottom of the crawl space serving as the dwelling foundation is less than 48 inches below adjacent grade, the foundation shall be frost protected in accordance with Table 22.31-1 for frost protected slabs.

(2) VAPOR RETARDER. Any exposed earth in crawl spaces shall be covered with a continuous vapor retarder.

(b) All decayable organic material, including topsoil, shall be removed from crawl space floors prior to placing the vapor retarder.

(c) All joints of the vapor retarder shall overlap by 6 inches and be sealed or taped.

(d) The edges of the vapor retarder shall extend at least 6 inches up the foundation wall and shall be attached to the foundation wall.

(3) UNINSULATED CRAWL SPACES. (a) For crawl spaces that are outside of the thermal envelope, ventilation openings equal to at least 1/1500 of the floor space shall be provided.

(b) At least 50% of the ventilating area shall be provided at opposite sides of the crawl space or as far apart as possible.

(c) The floor above the crawl space shall be insulated in accordance with Table 22.31-1.

(4) INSULATED CRAWL SPACES. (a) As an alternative to insulating floors over unheated crawl spaces, crawl space walls shall be insulated in accordance with Table 22.31-1.

(b) Crawl space wall insulation shall be permanently fastened to the wall and shall extend the entire height of the wall.

(c) The crawl space may not be vented to the outside unless the floor above is insulated in accordance with Table 22.31-1.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.35 Thermally isolated sunrooms. (1) The minimum opaque ceiling insulation R-value shall be R-24. The minimum opaque wall R-value shall be R-13.

(2) The maximum fenestration U-factor shall be 0.50 and the maximum skylight U-factor shall be 0.75.

(3) New walls, windows and doors separating a sunroom from conditioned space shall meet the building thermal envelope requirements.

(4) The temperature in the conditioned space shall be controlled as a separate zone or shall use separate heating equipment.

(5) Glazing in a thermally-isolated sunroom is not considered to be in the dwelling thermal envelope.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.36 Fenestration. (1) AVERAGE U-FACTORS. An area-weighted average of fenestration products may be used to satisfy the U-factor requirements.

(2) MAXIMUM FENESTRATION U-FACTOR. The area weighted average maximum fenestration U-factor permitted using trade offs from s. Comm 22.31 (2) or subchapter VI shall be 0.40 for vertical fenestration, and 0.75 for skylights.

(3) GLAZED FENESTRATION EXEMPTION. Up to 15 square feet of glazed fenestration per dwelling unit may be exempt from U-factor requirements of the chapter.

(4) OPAQUE DOOR EXEMPTION. One opaque door assembly is exempted from the U-factor requirements of this chapter.

(5) REPLACEMENT FENESTRATION. Where an existing fenestration unit is replaced with a new fenestration unit, including sash and glazing, the replacement unit shall meet the U-factor requirements of this chapter.

(6) CERTIFIED PRODUCTS. Except as provided in sub. (7), fenestration rating, certification and labeling of U-factors for windows, doors and skylights shall be in accordance with NFRC 100.

(7) DEFAULT VALUES. When a manufacturer has not determined product U-factor in accordance with NFRC 100, U-factors shall be determined by assigning a default value in accordance with Tables 22.36-1 and 22.36-2. Where a composite of materials of two different product types is used, the product shall be assigned the higher U-factor.

TABLE 22.36–1
U–FACTOR DEFAULT TABLE FOR WINDOWS, GLAZED DOORS AND SKYLIGHTS [a]

Metal without Thermal Break	Single Glazed	Double Glazed
Operable	1.27	0.87
Fixed	1.13	0.69
Door	1.26	0.80
Skylight	1.98	1.31
Site–assembled Skylight	1.36	0.82
Metal with Thermal Break		
Operable	1.08	0.65
Fixed	1.07	0.63
Door	1.10	0.66
Skylight	1.89	1.11
Site–assembled Skylight	1.25	0.70
Vinyl or Metal–clad Wood		
Operable	0.90	0.57
Fixed	0.98	0.56
Door	0.99	0.57
Skylight	1.75	1.05
Wood or Fiberglass		
Operable	0.89	0.55
Fixed	0.98	0.56
Door	0.98	0.56
Skylight	1.47	0.84

[a] Glass block assemblies shall have a default value of 0.60.

TABLE 22.36–2
U–FACTOR DEFAULT TABLE FOR NON–GLAZED DOORS

Steel Doors (1¾ inches thick)	With Foam Core	Without Foam Core
	0.35	0.60
Wood Doors (1¾ inches thick)	**Without Storm Door**	**With Storm Door**
Panel with $^{7}/_{16}$–inch panels	0.54	0.36
Hollowcore flush	0.46	0.32
Panel with $1^{1}/_{8}$–inch panels	0.39	0.28
Solid core flush	0.40	0.26

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.37 Air leakage. (1) GENERAL. The requirements of this section apply to those components that separate interior conditioned space from a garage or an unconditioned space.

(2) WINDOW AND DOOR ASSEMBLIES. (a) *General.* Except as specified in par. (b), windows, skylights and sliding glass doors shall have an air infiltration rate of no more than 0.3 cfm per square foot, and swinging doors no more than 0.5 cfm per square foot, when tested according to NFRC 400 or AAMA/WDMA/CSA 101/I.S.2/A440 by an accredited, independent laboratory and listed and labeled by the manufacturer.

(b) *Exception.* Site–constructed doors and windows shall be sealed with gasketing or weatherstripping or shall be covered with a storm door or storm window.

(3) JOINT AND PENETRATION SEALING. (a) Exterior joints, seams or penetrations in the dwelling envelope, which are sources of air leakage, shall be sealed with durable caulking materials, closed with gasketing systems, taped, or covered with water–vapor–permeable house wrap. Joints to be treated include all of the following:

1. Openings, cracks and joints between wall cavities and window or door frames.

2. Between separate wall assemblies or their sill–plates and foundations.

3. Between walls, roof, ceilings or attic ceiling seals, and between separate wall panel assemblies, including between interior and exterior walls.

4. Penetrations of utility services through walls, floor and roof assemblies, and penetrations through top and bottom wall plates.

(b) Sealing shall be provided at the attic and crawl space panels, at recessed lights and around all plumbing and electrical penetrations, where these openings are located in the dwelling thermal envelope.

(c) The sealing methods between dissimilar materials shall allow for differential expansion and contraction.

(4) RECESSED LIGHTING. When installed in the dwelling envelope, recessed lighting fixtures shall be sealed to limit air leakage between conditioned and unconditioned spaces by one of the following means:

(a) The fixture shall be IC–rated and labeled with enclosures that are sealed or gasketed to prevent air leakage to the ceiling cavity or unconditioned space.

(b) The fixture shall be IC–rated and labeled as meeting ASTM E 283 when tested at 1.57 psi pressure differential with no more than 2.0 cfm of air movement from the conditioned space to the ceiling cavity.

(c) 1. The fixture shall be located inside an airtight sealed box with clearances of at least 0.5 inch from combustible material and 3 inches from insulation.

2. If the fixture is non–IC–rated, the box shall be constructed of noncombustible material that does not readily conduct heat.

Note: Cement board meets the requirements of this section. Drywall and metal do not.

(5) FAN HOUSINGS. Gaps between a fan housing and a ceiling or wall that could result in air leaks shall be gasketed, sealed or caulked.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.38 Vapor retarders. (1) GENERAL. (a). *Definition.* Under this section, a vapor retarder is a material with no intrinsic thermal or structural properties that has a rating of 1.0 perm or less when tested in accordance with ASTM standard E 96, Procedure A.

(b) *Continuity.* The vapor retarder shall be continuous. All joints in a vapor retarder consisting of sheet material shall be overlapped 6 inches and taped or sealed. Rips, punctures and voids in the vapor retarder shall be patched with vapor retarder materials and taped or sealed.

(2) FRAME ASSEMBLIES. (a) *General.* Except as provided under par. (c), all frame walls, frame floors and frame ceilings that comprise the thermal envelope, shall have a vapor retarder installed on the warm–in–winter side of the thermal insulation.

(b) *Coverage.* The vapor retarder shall cover the exposed insulation and the interior face of the framing.

(c) *Exceptions.* 1. Where the vapor retarder is omitted, as allowed under subds. 2. to 4., all sources of air leakage, such as between double top or bottom plates or between double studs, shall be caulked or sealed.

2. No vapor retarder is required in the box sill.

3. No vapor retarder is required where batt insulation is provided with foil or kraft paper backing on the warm–in–winter side and the nailing tabs are tightly fastened to the warm–in–winter face of the framing members.

4. No vapor retarder is required over cavities that are insulated solely with spray–applied foam unless required by the foam manufacturer.

Note: This requirement does not require the cavity to be completely filled. It only requires that the total required R–value come from the foam, including any exterior foam sheathing, and no other insulation material is present in the cavity.

(3) CONCRETE FLOORS. (a) Except as allowed under par. (e), a vapor retarder shall be installed directly under the concrete floor slab or under the base course of concrete floor slabs.

(b) Vapor retarder material shall be at least 6 mils in thickness or shall be a reinforced material.

(c) Joints in the vapor retarder shall be overlapped at least 6 inches and taped or sealed.

(d) The edges of the vapor retarder shall extend up the edges of the slab at least to the top of the slab.

(e) A vapor retarder is not required under the slab of an unconditioned attached garage.

(4) CONCRETE OR MASONRY BASEMENT WALLS. A non–rigid sheet vapor retarder with a perm rating of 0.1 or less is prohibited in all of the following locations:

(a) On a concrete or masonry wall which is below grade to any extent.

(b) On an insulated frame wall constructed in front of a concrete or masonry wall which is below grade to any extent.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.39 Ventilation and moisture control. (1) GENERAL. Design and construction shall prevent deterioration from moisture condensation and ice damming.

(2) VENTED ATTICS. (a) 1. Except as allowed under subd. 6., where air–permeable ceiling or attic insulation is installed in a horizontal position, ventilation shall be provided above the insulation in accordance with this paragraph.

2. At least 50% of the net free ventilating area shall be distributed at the high sides of the roof.

3. The remainder of the net free ventilating area shall be distributed in the lower half of the roof or attic area.

4. If more than 50%, but less than 75% of the net free ventilating area is provided at the high sides of the roof, the total net free ventilating area shall be a minimum of 1/300 of the horizontal area of the ceiling.

5. If 75% or more of the net free ventilating area is provided at the upper sides of the roof, the total net free ventilating area shall be at least 1/150 of the horizontal area of the ceiling.

6. Ventilation is not required for separated roof areas, such as dormers, bump–outs or bays that cover a floor area of 40 ft^2 or less.

(b) Engineered systems that provide equivalent ventilation to that required under this subsection may be used.

(c) Insulation shall not block the free flow of air.

(3) CONDITIONED ATTICS. Attic spaces are not required to be vented where air–impermeable insulation is attached directly to the underside of the roof deck and all of the following conditions are met:

(a) No interior vapor retarders are installed between the living space and the conditioned attic.

(b) The temperature in the attic space is maintained high enough to prevent any moisture condensation on the insulation.

Note: Maintaining the interior surface temperature of the insulation at or above the dew point temperature of the interior air will minimize condensation. Maintaining at least 45°F on the surface of the insulation will minimize condensation on the surface when the interior air temperature is 70°F and the interior relative humidity is 45%.

(4) CATHEDRAL CEILINGS. Air–permeable insulation in a cathedral ceiling assembly shall fill the entire cavity space unless an air barrier separates the top of the insulation from the ventilation space.

(5) MECHANICAL VENTILATION. Outdoor air intakes and exhausts shall have automatic or gravity dampers that close when the ventilation system is not operating.

(6) CLOTHES DRYERS. Clothes dryers shall be vented to the outside of the structure.

Note: See s. Comm 23.14 for vent material requirements.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter V — Systems

Comm 22.40 Indoor temperatures and equipment sizing. (1) GENERAL. The indoor temperatures listed under sub. (2) shall be used to determine the total dwelling heat loss and to select the size of the of the heating equipment.

(2) INDOOR DESIGN TEMPERATURES. Unheated, non–habitable basement areas shall use a heating design temperature of less than 50°F. All other areas of a dwelling shall use a heating design temperature of 70°F.

(3) EQUIPMENT SIZING. Heating design loads including ventilation loads for the purpose of sizing systems shall be determined in accordance with the REScheck or REM/RATE software programs or one of the procedures described in Chapter 29 of ASHRAE Handbook of Fundamentals.

Note: Residential heat balance, residential load factor, Canadian F280 and ACCA Manual J are among the methods recognized as equipment sizing protocols under chapter 29.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.41 Temperature control. (1) GENERAL. Each system shall be provided with an adjustable thermostat for the regulation of temperature.

(2) CIRCULATING HOT WATER SYSTEMS. Circulating hot water systems shall include an automatic or readily accessible manual switch to turn off the circulating pump when the system is not in use.

(3) MERCURY THERMOSTATS. The installation of thermostats containing mercury is prohibited.

Note: This section does not require the replacement of existing mercury–containing thermostats.

(4) HEAT PUMP SUPPLEMENTARY HEAT. Heat pumps having supplementary electric–resistance heat shall have controls that, except during defrost, prevent supplemental heat operation when the heat pump compressor can meet the heating load.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.42 Duct systems. (1) Supply and return heating ducts, or portions thereof, that are not located completely within the thermal envelope, shall be provided with insulation with a thermal resistance of at least R–8.

(2) Building framing cavities may not be used as supply ducts.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.43 Duct and plenum sealing. (1) Duct systems with joints not located entirely within the conditioned space or with joints located on the unconditioned side of stud bays, joist cavities and similar spaces, shall be sealed in accordance with this section.

(2) Sealing shall be accomplished using welds, gaskets, mastics, mastic–plus–embedded–fabric systems or tapes installed in accordance with the manufacturer's instructions.

(3) Insulation that provides a continuous air barrier may be used in lieu of sealing metal ducts.

(4) Tapes and mastics used with rigid fibrous glass ducts shall be listed and labeled as complying with UL 181A.

(5) Tapes and mastics used with flexible air ducts shall be listed and labeled as complying with UL 181B.

(6) Tapes with rubber–based adhesives may not be used.

Note: Standard duct tape or "duck tape" has a rubber–based adhesive and does not comply with the requirements of this section.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.44 Pipe insulation. Heating pipes in unheated spaces shall be insulated with material providing a minimum thermal resistance of R–4 as measured on a flat surface in accordance with ASTM standard C 335 at a mean temperature of 75°F.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.45 Air conditioner and heat pump efficiencies. (1) Heating and cooling equipment shall meet the minimum efficiency requirements in Table 22.45 when tested and rated in accordance with the applicable test procedure.

(2) The efficiency shall be verified through certification under an approved certification program or, if no certification program exists, the equipment efficiency ratings shall be supported by data furnished by the manufacturer.

(3) Where multiple rating conditions or performance requirements are provided, the equipment shall satisfy all efficiency requirements under this chapter.

(4) Where components, such as indoor or outdoor coils, from different manufacturers are used, calculations and supporting data shall be furnished by the designer that demonstrate that the combined efficiency of the specified components meets the requirements under this section.

TABLE 22.45

UNITARY AIR CONDITIONERS AND CONDENSING UNITS AND UNITARY AND APPLIED HEAT PUMPS, ELECTRICALLY OPERATED, MINIMUM EFFICIENCY REQUIREMENTS

Equipment Type	Minimum Efficiency	Minimum Efficiency	Test Procedure
Split system and single package air conditioner, air cooled	13.0 SEER		ARI 210/240
Space constrained product–air conditioner	12 SEER		ARI 210/240
Through–the–wall air conditioner, air cooled, split system	10.9 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)		ARI 210/240
Through–the–wall air conditioner, air cooled, single package	10.6 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)		ARI 210/240
Split system and single package air conditioner, water and evaporatively cooled	12.1 SEER		ARI 210/240
Split system and single package heat pump, air cooled	13.0 SEER	7.7 HSPF	ARI 210/240
Through–the–wall air conditioner and heat pump–split system	10.9 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)	7.1 HSPF (before Jan. 23, 2010) 7.4 HSPF (as of Jan. 23, 2010)	ARI 210/240
Through–the–wall air conditioners and heat pumps–single package	10.6 SEER (before Jan. 23, 2010) 12.0 SEER (as of Jan. 23, 2010)	7.0 HSPF (before Jan. 23, 2010) 7.4 HSPF (as of Jan. 23, 2010)	ARI 210/240
Space constrained products–heat pumps	12 SEER	7.4 HSPF	ARI 210/240
Water source, heating mode, 68°F entering water		4.2 COP	ARI/ASHRAE 13256–1
Groundwater source, heating mode, 50°F entering water		3.6 COP	ARI/ASHRAE 13256–1
Ground source, heating mode, 32°F entering water		3.1 COP	ARI/ASHRAE 13256–1

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.46 Replacement furnace and boiler efficiencies. (1) A replacement furnace in existing construction may meet only the prevailing federal efficiency standard provided the duct distribution system is sealed and tested at 0.02 inches water gage across the entire system, including the manufacturer's air handler enclosure, to have air leakage less than 10 percent of the furnace manufacturer's rated air flow across the blower at high speed.

Note: 0.02 inches water gage is equal to approximately 25 pascals.

(2) A replacement boiler in existing construction may meet only the prevailing federal standard provided there is no installed circulation pump larger than $^1/_{20}$ horsepower and no circulation pump runs continuously.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Subchapter VI — Simulated Performance Alternative

Comm 22.50 General. This subchapter establishes criteria for compliance using simulated energy performance analysis. The analysis shall include heating, cooling, and service water heating energy only.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Comm 22.51 Performance-based compliance. Compliance based on simulated energy performance requires that a proposed dwelling be shown to have an annual energy cost that is less than or equal to the annual energy cost of the standard reference design.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.52 Documentation. (1) COMPLIANCE SOFTWARE TOOLS. Documentation verifying that the methods and accuracy of the compliance software tools conform to the provisions of this subchapter shall be provided to the inspector.

(2) COMPLIANCE REPORT. Compliance software tools shall generate a report that documents that the proposed design has annual energy costs less than or equal to the annual energy costs of the standard reference design. The compliance documentation shall include all of the following information:

(a) Address of the dwelling.

(b) 1. An inspection checklist documenting the building component characteristics of the proposed design as listed in Table 22.53-1.

2. The inspection checklist shall show the estimated annual energy cost for both the standard reference design and the proposed design.

(c) Name of individual completing the compliance report.

(d) Name and version of the compliance software tool.

(3) ADDITIONAL DOCUMENTATION. The inspector may require any of the following documents:

(a) Documentation of the building component characteristics of the standard reference design.

(b) A certification signed by the builder providing the building component characteristics of the proposed design as given in Table 22.53-1.

History: CR 08-043: cr. Register March 2009 No. 639, eff. 4-1-09.

Comm 22.53 Calculation procedure. (1) GENERAL. Except as specifically allowed under this section, the standard reference design and proposed design shall be configured and analyzed using identical methods and techniques.

(2) REFERENCE AND PROPOSED DESIGNS. The standard reference design and proposed design shall be configured and analyzed as specified by Table 22.53-1. Table 22.53-1 shall include by reference all notes contained in Table 22.31-1.

(3) CALCULATION SOFTWARE TOOLS. Calculation procedures used to comply with this section shall be capable of calculating the annual energy consumption of all building elements that differ between the standard reference design and the proposed design and shall include the following capabilities:

(a) Computer generation of the standard reference design using only the input for the proposed design. The calculation procedure may not allow the user to directly modify the building component characteristics of the standard reference design.

(b) Calculation of whole-building sizing as a single zone for the heating and cooling equipment in the standard reference design residence in accordance with s. Comm 22.40 (3).

(c) Calculations that account for the effects of indoor and outdoor temperatures and part-load ratios on the performance of heating, ventilating and air conditioning equipment based on climate and equipment sizing.

(d) Printed code official inspection checklist listing each of the proposed design component characteristics from Table 22.53-1 determined by the analysis to provide compliance, along with their respective performance ratings.

TABLE 22.53-1
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Above-grade walls	Type: mass wall if proposed wall is mass; otherwise wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: from Table 22.31-2	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Basement and crawlspace walls	Type: same as proposed	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: from Table 22.31-2 with insulation layer on interior side of walls	As proposed
Above-grade floors	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: from Table 22.31-2	As proposed
Ceilings	Type: wood frame	As proposed
	Gross area: same as proposed	As proposed
	U-Factor: from Table 22.31-2	As proposed
Roofs	Type: composition shingle on wood sheathing	As proposed
	Gross area: same as proposed	As proposed
	Solar absorptance = 0.75	As proposed
	Emittance = 0.90	As proposed
Attics	Type: vented with aperture = 1 ft^2 per 300 ft^2 ceiling area	As proposed
Foundations	Type: same as proposed	As proposed
Doors	Area: 40 ft^2	As proposed
	Orientation: North	As proposed
	U-Factor: same as fenestration from Table 22.31-2	As proposed

TABLE 22.53–1 (Continued)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Glazing[a]	Total area[b] = (a) The proposed glazing area; where the proposed glazing area is less than 18% of the conditioned floor area (b) 18% of the conditioned floor area; where the proposed glazing area is 18% or more of the conditioned floor area	As proposed
	Orientation: equally distributed to four cardinal compass orientations	As proposed
	U–Factor: from Table 22.31–2	As proposed
	SHGC = 0.40	As proposed
	Interior shade fraction: Summer (all hours when cooling is required) = 0.70 Winter (all hours when heating is required) = 0.85	Same as standard reference design[c]
	External shading: none	As proposed
Skylights	U–Factor: from Table 22.31–2	As proposed
Thermally isolated sunrooms	None	As proposed
Air exchange rate	Specific Leakage Area (SLA)[d] = 0.00036 assuming no energy recovery	For residences that are not tested, the same as the standard reference design; For residences without mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] but not less than 0.35 ACH; For residences with mechanical ventilation that are tested in accordance with ASHRAE 119, Section 5.1, the measured air exchange rate[e] combined with the mechanical ventilation rate[f], which may not be less than 0.01 X CFA + 7.5 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms
Mechanical ventilation	None, except where mechanical ventilation is specified by the proposed design, in which case: Annual vent fan energy use: kWh/yr = 0.03942 X CFA + 29.565 X (N br + 1) where: CFA = conditioned floor area N br = number of bedrooms	As proposed
Internal gains	IGain = 17,900 + 23.8 x CFA + 4,104 X N br (Btu/day per dwelling unit)	Same as standard reference design
Internal mass	An internal mass for furniture and contents of 8 pounds per square foot of floor area	Same as standard reference design, plus any additional mass specifically designed as a thermal storage element[g] but not integral to the building envelope or structure
Structural mass	For masonry floor slabs, 80% of floor area covered by R–2 carpet and pad, and 20% of floor directly exposed to room air;	As proposed
	For masonry basement walls, as proposed, but with insulation required by Table 22.31–2 located on the interior side of the walls;	As proposed
	For other walls, for ceilings, floors, and interior walls, wood frame construction	As proposed

TABLE 22.53–1 (Continued)
SPECIFICATIONS FOR THE STANDARD REFERENCE AND PROPOSED DESIGNS

Building Component	Standard Reference Design	Proposed Design
Heating systems [h,i]	Fuel type: same as proposed design efficiencies: Electric: air–source heat pump with prevailing federal minimum efficiency; Nonelectric furnaces: natural gas furnace in accordance with Table 22.31–3; Nonelectric boilers: natural gas boiler in accordance with Table 22.31–3; Capacity: sized in accordance with section Comm 22.40 (3)	As proposed As proposed As proposed As proposed As proposed
Cooling systems [h,j]	Fuel type: electric Efficiency: in accordance with prevailing federal minimum standards Capacity: sized in accordance with section Comm 22.40 (3)	As proposed As proposed As proposed
Service Water Heating [h,k]	Fuel type: same as proposed design Efficiency: in accordance with prevailing federal minimum standards Use: gal/day = 30 + 10 X N br Tank temperature: 120°F	As proposed As proposed Same as standard reference Same as standard reference
Thermal distribution systems	A thermal distribution system efficiency (DSE) of 0.80 shall be applied to both the heating and cooling system efficiencies	Same as standard reference design, except as specified by Table 22.53–2
Thermostat	Type: manual, cooling temperature set point = 78°F; heating temperature set point = 68°F	Same as standard reference design

a Glazing shall be defined as sunlight–transmitting fenestration, including the area of sash, curbing or other framing elements, that enclose conditioned space. Glazing includes the area of sunlight–transmitting fenestration assemblies in walls bounding conditioned basements. For doors where the sunlight–transmitting opening is less than 50% of the door area, the glazing area is the sunlight transmitting opening area. For all other doors, the glazing area is the rough frame opening area for the door including the door and the frame.

b For residences with conditioned basements, R–2 and R–4 residences and townhouses, the following formula shall be used to determine glazing area: AF = As X FA X F where:

1. AF = Total glazing area.
2. As = Standard reference design total glazing area.
3. FA = (Above–grade thermal boundary gross wall area)/(above–grade boundary wall area + 0.5 x below–grade boundary wall area).
4. F = (Above–grade thermal boundary wall area)/(above–grade thermal boundary wall area + common wall area) or 0.56, whichever is greater.

And where:

5. Thermal boundary wall is any wall that separates conditioned space from unconditioned space or ambient conditions.
6. Above–grade thermal boundary wall is any thermal boundary wall component not in contact with soil.
7. Below–grade boundary wall is any thermal boundary wall in soil contact.
8. Common wall area is the area of walls shared with an adjoining dwelling unit.

c For fenestrations facing within 15 degrees of true south that are directly coupled to thermal storage mass, the winter interior shade fraction may be increased to 0.95 in the proposed design.

d Where Leakage Area (L) is defined in accordance with Section 5.1 of ASHRAE 119 and where: SLA = L/CFA where L and CFA are in the same units.

e Tested envelope leakage shall be determined and documented by an independent party approved by the code official. Hourly calculations as specified in the 2005 ASHRAE Handbook of Fundamentals, Chapter 27, page 27.21, Equation 40, Sherman–Grimsrud model, or the equivalent shall be used to determine the energy loads resulting from infiltration.

f The combined air exchange rate for infiltration and mechanical ventilation shall be determined in accordance with Equation 43 of 2005 ASHRAE Handbook of Fundamentals page 27.23 and the "Whole–house Ventilation" provisions of 2005 ASHRAE Handbook of Fundamentals, page 27.18 for intermittent mechanical ventilation.

g Thermal Storage Element means a component not part of the floors, walls or ceilings that is part of a passive solar system, and that provides thermal storage such as enclosed water columns, rock beds, or phase–change containers. A thermal storage element must be in the same room as fenestration that faces within 15 degrees of true south, or must be connected to a room with pipes or ducts that allow the element to be actively charged.

h For a proposed design with multiple heating, cooling or water heating systems using different fuel types, the applicable standard reference design system capacities and fuel types shall be weighted in accordance with their respective loads as calculated by accepted engineering practice for each equipment and fuel type present.

i For a proposed design without a proposed heating system, a heating system of 90% annual fuel utilization shall be assumed for both the standard reference design and proposed design. For electric heating systems, the prevailing federal minimum efficiency air–source heat pump shall be used for the standard reference design.

j For a proposed design home without a proposed cooling system, an electric air conditioner with the prevailing federal minimum efficiency shall be assumed for both the standard reference design and the proposed design.

k For a proposed design with a non–storage–type water heater, a 40–gallon storage–type water heater with the prevailing federal minimum energy factor for the same fuel as the predominant heating fuel type shall be assumed. For the case of a proposed design without a proposed water heater, a 40–gallon storage–type water heater with the prevailing federal minimum efficiency for the same fuel as the predominant heating fuel type shall be assumed for both the proposed design and standard reference design.

TABLE 22.53–2
DEFAULT DISTRIBUTION SYSTEM EFFICIENCIES FOR PROPOSED DESIGNS[a]

Distribution System Configuration and Condition	Forced Air Systems	Hydronic Systems[b]
Distribution system components located in unconditioned space	0.80	0.95
Distribution systems entirely located in conditioned space[c]	0.88	1.00
Proposed "reduced leakage" with entire air distribution system located in the conditioned space[d]	0.96	—
Proposed "reduced leakage" air distribution system with components located in the unconditioned space	0.88	—
Ductless systems[e]	1.00	—

a Default values given by this table are for untested distribution systems, which must still meet minimum requirements for duct system insulation.

b Hydronic systems means those systems that distribute heating and cooling energy directly to individual spaces using liquids pumped through closed loop piping and that do not depend on ducted, forced air flows to maintain space temperatures.

c Entire system in conditioned space means that no component of the distribution system, including the air handler unit, is located outside of the conditioned space.

d Proposed "reduced leakage" means leakage to outdoors not greater than 3 cfm per 100 ft^2 of conditioned floor area and total leakage not greater than 9 cfm per 100 ft^2 of conditioned floor area at a pressure differential of 0.02 inches w.g. across the entire system, including the manufacturer's air handler enclosure. Total leakage of not greater than 3 cfm per 100 ft^2 of conditioned floor area at a pressure difference of 0.02 inches w.g. across the entire system, including the manufacturer's air handler enclosure, shall be deemed to meet this requirement without measurement of leakage to the outdoors. This performance shall be specified as required in the construction documents and confirmed through field–testing of installed systems as documented by an approved independent party.

e Ductless systems may have forced airflow across a coil but may not have any ducted airflows external to the manufacturer's air handler enclosure.

History: CR 08–043: cr. Register March 2009 No. 639, eff. 4–1–09.

Chapter Comm 23

HEATING, VENTILATING AND AIR CONDITIONING

Subchapter I — Scope
Comm 23.01 Scope.

Subchapter II — Design
Comm 23.02 Design.

Subchapter III — Heating Equipment
Comm 23.03 Selection of equipment.
Comm 23.04 Types and location of equipment.
Comm 23.045 Solid–fuel–burning appliances.
Comm 23.05 Safety controls.
Comm 23.06 Combustion air.
Comm 23.062 Mechanical draft systems.
Comm 23.065 Equipment maintenance information.

Subchapter IV — Delivery Systems
Comm 23.07 Air distribution systems.
Comm 23.08 Ductwork.
Comm 23.09 Dampers, registers and grilles.
Comm 23.10 Piping.

Subchapter V — Chimneys and Vents
Comm 23.11 General requirements.
Comm 23.12 Masonry chimneys.
Comm 23.13 Factory–built chimneys or vents.
Comm 23.14 Gas vents.
Comm 23.15 Chimney connectors, smoke pipes and stovepipes.
Comm 23.155 Multiple appliance venting.
Comm 23.156 Condensate drains.

Subchapter VI — Fuel Supply Systems
Comm 23.16 Fuel storage.

Subchapter VII — Equipment Location and Operation
Comm 23.17 Equipment location.
Comm 23.18 Operation.

Note: Chapter Ind 23 was renumbered to be chapter ILHR 23, Register, February, 1985, No. 350, eff. 3–1–85. Chapter ILHR 23 was renumbered Chapter Comm 23 under s. 13.93 (2m) (b) 1., Stats., and corrections made under s. 13.93 (2m) (b) 7., Stats., Register, January, 1999, No. 517.

Subchapter I — Scope

Comm 23.01 Scope. The provisions of this chapter shall apply to the design, installation and construction of all heating, ventilating and air conditioning systems in dwellings covered by this code.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Subchapter II — Design

Comm 23.02 Design. Every dwelling shall be equipped with a heating system designed in accordance with this section. Heating equipment requirements may be waived for recreational dwellings used only during the non–heating season. Where a cooling system is provided, the cooling requirements of this section shall be met.

(1) HEATING AND COOLING SYSTEM DESIGN. (a) The heating and cooling systems shall be designed to maintain the indoor design temperature at outdoor design conditions.

(b) When requested, room–by–room heat loss and heat gain calculations shall be furnished.

Note: See Appendix for outdoor design temperature map.

(2) DISTRIBUTION SYSTEMS. Distribution systems shall be sized and located to satisfy the heating and cooling loads of each conditioned space. When requested, a layout of the distribution system shall be furnished to show that the system meets the requirements of this code.

(3) VENTILATION. (a) *General.* 1. All exhaust vents shall terminate outside the structure.

2. Automatic or gravity dampers that close when the system is not operating shall be provided for outdoor air intake and exhaust.

(b) *Balancing.* 1. General. Except as provided under subd. 2., mechanical ventilation systems shall be balanced.

2. Exception. Passive intake air ducts providing makeup air for intermittent exhaust fans shall be sized to provide at least 40% of the total air that would be exhausted with all intermittent exhaust ventilation in the dwelling operating simultaneously.

3. Kitchen range hoods. a. Kitchen range hoods that exhaust air from the kitchen area are considered as exhaust ventilation for balancing and makeup purposes.

b. Kitchen range hoods that are listed and installed to recirculate air without exhausting it are not required to be balanced.

4. Infiltration. a. Infiltration may be considered as makeup air for balancing purposes only where there are no naturally vented space– or water–heating appliances in the dwelling.

b. For the purpose of complying with this subdivision, naturally vented space– or water–heating appliances are those that take combustion or dilution air from inside the dwelling, including unsealed fireplaces and draft hood appliances with power venting.

Note: Whole–house fans that are used in the summer to bring cool night air in through open windows and exhaust into the attic are considered to be a supplemental cooling system rather than part of the ventilation system.

Note: See s. Comm 22.14 for additional requirements on mechanical ventilation.

(c) *Habitable rooms.* Habitable rooms without openable windows shall be provided with a balanced mechanical ventilation system producing one air change per hour of fresh outside air while the room is occupied.

(d) *Rooms with toilets, tubs or showers.* 1. Except as provided under subd. 2., any room with a toilet, tub or shower shall be provided with exhaust ventilation capable of exhausting 50 cubic feet per minute on an intermittent basis or 20 cubic feet on a continuous basis.

2. For dwellings with no electrical service, any room with a toilet, tub or shower shall be provided with an openable window.

Note: The department will accept designs which meet the Air Conditioning Contractors of America manual; the Mechanical Contractors Association manual; and the Sheet Metal and Air Conditioning Contractors National Association standards for heating and air conditioning systems for one– and 2–family dwellings.

(4) CONTROLS. The temperature rise through the equipment shall not exceed 100° F unless listed. Controls shall be provided to maintain the inside temperature. Where forced, warm–air systems are used, controls shall be installed to control air movement.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1) Register, January, 1989, No. 397, eff. 2–1–89; am. (3), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (3), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (1) and (3) (a), Register, January, 1999, No. 517, eff. 2–1–99; r. and recr. (3) (a), renum. (3) (b) and (c) to be (3) (c) and (d), and cr. (3) (b), Register, March, 2001, No. 543, eff. 4–1–01; **CR 08–043: r. (1) (a), renum. (1) (b), (c) and (3) (a) to be (1) (a), (b) and (3) (a) 1., cr. (3) (a) 2., am. (3) (d) Register March 2009 No. 639, eff. 4–1–09.**

Subchapter III — Heating Equipment

Comm 23.03 Selection of equipment. All heating and central cooling equipment shall be selected on the basis of air–handling capacity, pumping capacity, and thermal capacity to handle the calculated design heating or cooling load.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Comm 23.04 Types and location of equipment. **(1)** GENERAL. (a) All heat producing appliances and cooling appliances shall be listed by a testing agency acceptable to the department.

(b) Installation and maintenance of gas–fueled appliances shall comply with the appliance listing and the requirements of NFPA 54, National Fuel Gas Code, except as otherwise required under this chapter.

(c) The clearances from combustible materials in Tables 23.04–A and 23.04–B shall apply unless otherwise shown on listed appliances.

TABLE 23.04–A
STANDARD INSTALLATION CLEARANCES (INCHES) FOR HEAT–PRODUCING APPLIANCES

		Appliance[1]				
Residential Type Appliances for Installation in Rooms Which are Large (See Note 2)		**Above Top of Casing or Appliance**	**From Top and Sides of Warm–Air Bonnet or Plenum**	**From Front See Note 3**	**From Back**	**From Sides**
Boilers and Water Heaters	Automatic Oil					
Steam Boilers – 15 psi	or	6	—	24	6	6
Water Boilers – 250° F	Comb. Gas–Oil					
Water Heaters – 200° F	Automatic Gas	6	—	18	6	6
All Water Walls or Jacketed	Electric	6	—	18	6	6
Furnaces – Central	Automatic Oil					
Gravity, Upflow, Downflow,	or	6[4]	6	24	6	6
Horizontal and Duct,	Comb. Gas–Oil					
Warm–Air – 250° F	Automatic Gas	6[4]	6	18	6	6
	Electric	6[4]	6	18	6	6
Furnaces – Floor	Automatic Oil					
For Mounting in Combustible Floors	or	36	—	12	12	12
	Comb. Gas–Oil					
	Automatic Gas	36	—	12	12	12
	Electric	36	—	12	12	12
Heat Exchanger						
Steam – 15 psi Max.						
Hot Water – 250° F Max.	—	1	1	1	1	1
Room Heaters						
Circulating Type	Oil	36	—	24	12	12
Vented or Unvented	Gas	36	—	24	12	12
Radiant or Other Type	Oil	36	—	36	36	36
Vented or Unvented	Gas	36	—	36	18	18
	Gas with dbl metal or ceramic back	36	—	36	12	18
Radiators						
Steam or Hot Water	Gas	36	—	6	6	6
		See Note 5			Firing Side	Opp. Side
Ranges – Cooking Stoves	Oil	30	—	—	—	
Vented or Unvented	Gas	30	—	—	6	6
	Electric	30	—	—	6	6
Clothes Dryers	Gas	6	—	24	6	6
Listed Types	Electric	6	—	24	0	0
Incinerators		See Note 6				
Residential Types	—	36	—	48	36	36

[1] Standard clearances may be reduced by affording protection to combustible material in accordance with Table 23.04–B.

[2] Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room should be figured on the basis of a ceiling height of 8 feet.

[3] The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

[4] For a listed oil, combination gas–oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250° F or this dimension may be one inch if the limit control cannot be set higher than 200° F.

[5] To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at least 1/4–inch thick covered with sheet metal of not less than No. 28 gauge, the distance may be not less than 24 inches.

[6] Clearance above charging door should be not less than 48 inches.

TABLE 23.04–B
CLEARANCES, INCHES, WITH SPECIFIED FORMS OF PROTECTION*

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection. Thicknesses are minimum.	Where required clearance with no projection is:											
	36 inches			18 inches			12 inches			6 inches		
	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector	Above	Sides & Rear	Vent Connector
(a) 1/4–in. insulating millboard** spaced out 1"***	30	18	30	15	9	12	9	6	6	3	2	3
(b) 28 gage sheet metal on 1/4" insulating millboard**	24	18	24	12	9	12	9	6	4	3	2	2
(c) 28 gage sheet metal spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(d) 28 gage sheet metal on 1/4" insulating millboard** spaced out 1"***	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1/4" insulated millboard** on 1" mineral wool batts reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(f) 22 gage sheet metal on 1" mineral wool batts reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(g) 1/4" insulated millboard**	36	36	36	18	18	18	12	12	9	4	4	4

*All clearances shall be measured from the outer surface of the equipment to the combustible material disregarding any intervening protection applied to the combustible material.

**A factory fabricated board formed with noncombustible materials, normally fibers, and having a thermal conductivity in the range of 1 Btu inch per square foot per °F. or less.

***Spacers shall be of noncombustible material.

(2) FURNACES. The input and output capacity of furnaces shall be listed on the nameplate. All nameplates shall show evidence that the equipment has been listed by a recognized testing laboratory.

(a) *Fuel supply.* Furnaces shall be fired with the fuel for which they have been approved, except as provided in par. (d). Fuels shall be supplied to the furnace in the volume and at the pressure required on the label.

(b) *Unvented furnaces and space heaters.* The use of unvented furnaces and space heaters fueled by natural gas, kerosene, alcohol or other fuel shall be prohibited due to concerns about oxygen depletion; contamination from carbon monoxide, carbon dioxide, nitrogen dioxide, formaldehyde and other combustion related contaminants; and water vapor buildups.

(c) *Vented wall furnaces.* Vented wall furnaces shall not be equipped with duct extensions beyond the vertical and horizontal limits of the enclosure unless listed. Vented wall furnaces shall be located to prevent the restriction of air circulation by doors, projections, or other openings. Vented wall furnaces shall be provided with combustion air.

(d) *Conversion burners.* Conversion burners shall be listed by a recognized testing laboratory. The existing equipment shall be reconditioned and defective parts replaced before a conversion burner is installed. Conversion burners shall be installed in accordance with the installation instructions.

(3) HEAT PUMP APPLIANCES. (a) *Size.* Heat pump appliances shall be sized to provide control of the wet and dry bulb temperatures during cooling and maximum performance during heating. The heating balance point shall be considered to determine the outdoor temperature at which the heat pump must operate 100% of the time to offset the dwelling heat loss.

(b) *Auxiliary heaters.* Provisions for auxiliary heat to supplement the heat pump at outdoor temperatures below the balance point shall be provided. Auxiliary heaters shall be sized so that the heat pump auxiliary will offset the dwelling heat loss down to the heating design temperature.

(4) BOILERS. Boilers and solid fuel–fired water–heating appliances that serve a one–or 2–family dwelling, whether located inside or outside the dwelling, shall comply with ch. Comm 41, Boilers and Pressure Vessels.

Note: The department will accept equipment listed by the American Society of Mechanical Engineers, Underwriters' Laboratories, and the American Gas Association.

(5) WATER HEATERS USED FOR SPACE HEATING. (a) *Listing.* 1. Water heaters used for space heating shall be listed for such use.

2. The data plate shall indicate that the unit is suitable for simultaneous water heating and space heating.

Note: ANSI Z21.10.1 or ANSI Z21.10.3 are acceptable listing standards for dual use water heaters.

(b) *Sizing.* A dual use water heater shall be sized to provide sufficient hot water to supply both the daily and hourly peak loads of the dwelling.

(c) *Installation.* Dual use water heaters shall be installed to provide both space heating and potable water.

Note: The Wisconsin Uniform Plumbing Code requires dual use water heaters to be installed by a licensed plumber when installed in a new, not–yet–occupied dwelling. The plumbing code also requires that a floor drain be provided, if the water heater is installed on the lowest floor level and that all piping be suitable for potable water.

(d) *Heat exchanger.* A single–wall heat exchanger may not be used with a toxic heat transfer fluid.

(6) LOCATION. (a) *Enclosed spaces.* Except as provided in par. (c), no space heating or water–heating appliance shall be installed in a bedroom, bathroom, closet, or garage unless listed for such installation.

(b) *Garages.* Appliances installed in garages shall have burners and burner ignition devices located at least 18 inches above the floor and shall be protected or located so the furnace is not subject to damage from a vehicle.

(c) *Exceptions.* 1. Vented decorative gas appliances and decorative gas appliances for installation in vented fireplaces may be installed in bedrooms or bathrooms only when both of the following conditions are met:

a. The volume of the space in which the appliance is located is not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel–burning appliances installed in that space. The space may be made up of more than one room if the rooms are connected through doorway openings without doors.

b. The vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed under s. Comm 22.38.

2. Water heaters may be installed in a closet located in a bathroom or bedroom where the closet is used exclusively for the water heater, where the enclosed space has a weather–stripped solid door with a self–closing device, and where all air for combustion is obtained from the outdoors.

Note: Section Comm 23.06 still requires combustion air to be provided to the appliance.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. (1) (b), and am. (4) (b), Register, February, 1985, No. 350, eff. 3–1–85; correction in (3) made under s. 13.93 (2m) (b) 7., Stats., Register, February, 1985, No. 350; am. (intro.) and Table 23.04–A, r. (4), renum. Figures to ILHR 23.045, Register, January, 1989, No. 397, eff. 2–1–89; correction in (3) made under s. 13.93 (2m) (b) 7., Stats., Register, January, 1989, No. 397; am. (intro.) and (1) (e), r. and recr. Table 23.04–B, Register, March, 1992, No. 435, eff. 4–1–92; r. (1) (e) and cr. (4), Register, March, 2001, No. 543, eff. 4–1–01; CR 08–028: am. (3) Register November 2008 No. 635, eff. 12–1–08; **CR 08–043: renum. (intro.), (1) to (3) and (4) to be (1) to (4) and (6) and am. (1), cr. (5) Register March 2009 No. 639, eff. 4–1–09; correction in (6) (c) 1. b. made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 23.045 Solid–fuel–burning appliances. **(1)** GENERAL. Solid–fuel–burning appliances shall be installed as specified in this section unless the manufacturer or listing specifies the use of protection or clearances other than those specified in this section. All solid–fuel–burning appliances shall be tested and listed by an accepted testing agency.

Note: Factory–built fireplaces shall comply with s. Comm 21.32.

(2) LOCATION OF APPLIANCES. (a) *Servicing.* Every appliance shall be located to permit access to the appliance. Sufficient clearance shall be maintained around the equipment to permit cleaning of surfaces; the replacement of air filters, blowers, motors, controls and chimney connectors; the lubrication and servicing of moving parts; and the adjustment and servicing of stokers and appliance components.

(b) *Garages.* Solid–fuel–burning appliances may not be installed in a garage unless listed for that application.

(3) CHIMNEYS. (a) Solid–fuel–burning appliances shall be connected to one of the following types of chimneys:

1. 'Factory–built chimneys or vents'. A listed residential–type and building heating appliance chimney may be used with solid–fuel–burning appliances if the chimneys have been tested 3 times to a minimum flue gas temperature exposure of 2100° F, under the conditions specified by the listing agency, for at least 10 minutes each time.

Note: Products listed and labeled as complying with UL 103 – "Type HT" meet this requirement. UL 103 uses several temperature ranges for different products but only the "Type HT"–designated products have met the 2100° F testing requirement.

2. 'Masonry chimneys'. Masonry chimneys shall be constructed as specified in s. Comm 21.30.

(b) Wood–burning equipment shall not be connected to a flue serving a fireplace or other equipment.

(c) The chimney shall be designed to create a natural draft to carry away the products of combustion or provision shall be made for mechanically maintaining constant updraft during equipment operation.

(d) A cleanout opening shall be provided.

(e) A listed, multifuel appliance may be vented into a single flue.

(4) CHIMNEY CONNECTORS. (a) All solid–fuel–burning appliances shall be connected to chimneys with factory–built chimney material, Type L vent material or steel pipe with minimum thicknesses as specified in Table 23.045–A.

TABLE 23.045–A
METAL THICKNESS FOR PIPE CONNECTORS

Diameter of Connector (inches)	Sheet Gage No.	Minimum Thickness (inches)
6 to 10	24	.023
over 10 to 16	22	.029
over 16	16	.056

(b) The required clearance to combustibles for chimney connectors shall be 18 inches. This clearance may be reduced in accordance with Table 23.045–B. The specified protection shall be applied to and cover all combustible material as specified in Figure 23.045–A.

(c) Connectors and chimneys for solid fuel–burning appliances shall be designed, located and installed to permit ready access for internal inspection and cleaning.

(d) 1. Chimney connectors shall have no more than two 90° elbows.

2. The horizontal length shall not exceed 75% of the total vertical height of the entire venting system measured from the appliance outlet.

3. The connector shall maintain a rise of at least 1/4 inch per foot from the appliance outlet to the chimney inlet.

4. Connectors shall be securely supported and joints fastened with a minimum of 3 sheet metal screws or rivets.

5. Appliances used mainly for wood burning shall have the joints assembled so that the crimped end points towards the stove. Appliances burning coal shall have the joints assembled so that the crimped end points away from the appliance.

6. A connector to a masonry chimney shall extend through the wall to the innerface of the liner but not beyond.

7. The effective area of the connector shall not be less than the area of the appliance flue collar.

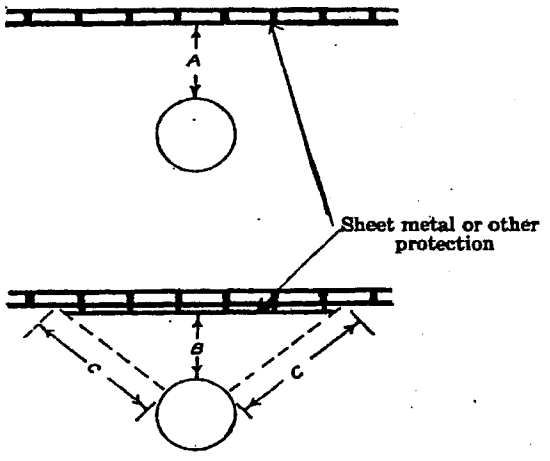
(e) No chimney connectors may pass through any floor, ceiling, window, door or combustible wall nor be concealed in any closet, attic or similar space. A connector may pass through a combustible wall if the connector is guarded at the point of passage by one of the following methods:

1. Metal ventilated thimble not less than 12 inches larger in diameter than the connector.

2. All combustible material in the wall is cut away from the connector a sufficient distance to provide the required 18–inch clearance. Any material used to close up such openings shall be noncombustible.

(f) A manual, cast iron damper to control draft shall be provided in the chimney connector. The damper shall not obstruct more than 80% of the connector area. Listed solid–fuel appliances whose listing prohibits the use of manual dampers in the connector shall not require a manual damper to be installed.

FIGURE 23.045–A
CONSTRUCTION USING COMBUSTIBLE MATERIAL



"A" Equals the required clearance with no protection, specified in s. Comm 23.045 (4) (b).

"B" Equals the reduced clearance permitted in accordance with Table 23.045–B. The wall protection should extend far enough in each direction to make 'C' equal to 'A'.

TABLE 23.045–B
CONNECTOR CLEARANCES WITH SPECIFIED FORMS OF PROTECTION[1,2,3,4]

Type of Protection	Minimum Required Connector Clearances (inches)
0.013 in. (28 gage) sheet metal spaced out a minimum of one inch.	9
31/2 in. thick masonry wall spaced out a minimum of one inch and adequately tied to the wall being protected (see Note 4).	9
0.027 in. (22 gage) sheet metal on one–inch mineral wool batts reinforced with wire or equivalent spaced out a minimum of one inch.	3

[1] Spacers and ties shall be of noncombustible material.

[2] All methods of protection require adequate ventilation between protective material and adjacent combustible walls and ceilings.

3 Mineral wool batts (blanket or board) shall have a minimum density of 8 pounds per cubic foot and a minimum melting point of 1550° F.

4 If a single wall connector passes through the masonry wall there shall be at least 1/2 inch of open ventilated air space between the connector and the masonry.

(5) MOUNTING ON FLOORS. (a) Appliances shall be placed on surfaces as described in Table 23.045–C. Solid–fuel–burning appliances listed specifically for installation on a floor constructed of combustible material may be installed in accordance with the terms of the listing and the manufacturer's instructions.

(6) CLEARANCES. (a) Solid–fuel–burning appliances shall be installed with clearances not less than specified in Table 23.045–D.

1. 'Listed appliances exception'. Listed appliances shall be installed in accordance with the terms of their listing if greater clearances other than those specified by Table 23.045–D are required in accordance with the listing.

2. 'Clearance with protection exception'. Solid–fuel–burning appliances may be installed with reduced clearances provided the combustible material is protected as described in Table 23.045–E. The specified protection shall be applied to and cover all combustible material as specified in Figure 23.045–B.

(7) ACCESSORIES. Accessories for solid fuel–burning appliances such as heat exchangers, stove mats, floor pad and protection shields, shall be listed and shall be installed in accordance with the terms of their listing.

(8) SUPPLEMENTAL UNITS. Supplemental solid–fuel–burning units connected to a furnace shall be connected to the warm air side of the furnace as illustrated in Figures 23.045–C to E.

(a) *Return air duct.* The area of the return air duct shall be at least equal to the area of the warm air supply duct. The return air duct shall be of the same material as specified for supply air ducts. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or in a confined space defined under s. Comm 23.06 in which a draft diverter or draft regulator is located.

(b) *Blower.* The blower on the furnace shall maintain the manufacturer's specifications for cubic feet per minute air flow and static pressure when the supplemental unit is in operation.

(c) *Outside air intake.* The outside air intake shall be connected to the cold air return plenum of the furnace. A volume damper shall be placed in the duct for the fresh air intake.

(d) *Thermostat.* The thermostat control on the supplemental heating unit shall activate the blower motor at a temperature between 100° and 120° F.

(e) *Supplemental units.* Supplemental solid–fuel–burning units shall be installed to maintain a 3–foot clearance between the unit and the furnace or shall be installed in accordance with the listings of both the supplemental unit and the furnace if such an installation is specifically covered by the listings.

TABLE 23.045–C
FLOOR MOUNTINGS FOR SOLID FUEL–BURNING APPLIANCES

Kind of Appliance	Allowed Mounting
(1) All forced air and gravity furnaces, steam and water boilers. or	Floors of fire–resistive construction with noncombustible flooring and surface finish, or fire–resistive arches or slabs. This construction may not have combustible material against the underside. Such construction shall extend at least 18 inches beyond the appliance on all sides.
(2) Residential–type ranges, water heaters, fireplace stoves,room heaters and combination fireplace stove/room heaters, having less than 2 inches of ventilated open space beneath the fire chamber or base of the appliance.	These appliances shall not be placed on combustible floors.
(3) Residential–type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters having legs or pedestals providing 2 to 6 inches of ventilated open space beneath the fire chamber or base of the appliance.	On combustible floors when such floors are protected by 4 inches of hollow masonry, laid to provide air circulation through the masonry layer. Such masonry shall be covered with 24 gage sheet metal. The required floor protection shall extend at least 18inches on all sides of the appliance. Noncombustible floors shall extend at least 18 inches on all sides of the appliance.
(4) Residential–type ranges, water heaters, fireplace stoves, room heaters and combination fireplace stove/room heaters having legs or pedestals providing over 6 inches of ventilated open space beneath the fire chamber or base of the covered appliance.	On combustible floors when such floors are protected by closely spaced masonry units of brick, concrete or stone, which provide at least 2 inches of thickness. Such masonry shall be covered by or placed over a sheet of 24 gage sheet metal. The required floor protection shall extend at least 18 inches on all sides of the appliance. Noncombustible floors shall extend at least 18 inches on all sides of the appliance.

TABLE 23.045–D
STANDARD CLEARANCES FOR SOLID–FUEL–BURNING APPLIANCES

Type of Appliance	Above Top of Casing or Appliance. Above Top and Sides of Furnace Plenum or Bonnet (inches)	Minimum Standard Clearances (inches)		
		From Front	From Back	From Sides
Residential Appliances				
Steam Boilers – 15 psi				
Water Boilers – 250° F max.	6	48	6	6
Water Boilers – 200° F max.				
All Water Walled or Jacketed				
Furnaces				
Gravity and Forced Air	18	48	18	18
Room Heaters, Fireplace Stoves, Combinations	36	36	36	36
			Firing Side	Opp. Side
Ranges				
Lined Firechamber	30	36	24	18
Unlined Firechamber	30	36	36	18

TABLE 23.045–E
MINIMUM ALLOWABLE APPLIANCE CLEARANCE WITH PROTECTION[1,2,3,4,5,6]

Type of Protection	Unprotected Clearances (inches) From Table 23.045–D								
	For Ceilings				For Walls				
	6	18	30	36	6	18	24	36	48
3 1/2 in. thick masonry wall without ventilated air space	–	–	–	–	4	12	16	24	32
1/2 in. thick noncombustible insulation board over 1 in. glass fiber or mineral wool batts without ventilated air space	4	12	20	24	3	9	12	18	24
0.024 in. (24 gage) sheet metal over 1 in. glass fiber or mineral wool batts reinforced with wire, or equivalent, or rear face with ventilated air space	3	9	15	18	2	6	8	12	16
3 1/2 in. thick masonry wall with ventilated air space	–	–	–	–	2	6	8	12	16
0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1/2 in. thick noncombustible insulation board with ventilated air space	3	9	15	18	2	6	8	12	16
0.024 in. (24 gage) sheet metal with ventilated air space over0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16
1 in. glass fiber or mineral wool batts sandwiched between two sheets 0.024 in. (24 gage) sheet metal with ventilated air space	3	9	15	18	2	6	8	12	16

[1] Spacers and ties shall be of noncombustible material. No spacers or ties shall be used directly behind appliance or conductor.

[2] With all clearance reduction systems using a ventilated air space, at least two sides of the protection shall be open to provide adequate air circulation. There shall be at least one inch between the clearance reduction system and combustible walls and ceilings.

[3] Mineral wool bats, blanket or board shall have a minimum density of 8 lb. per cubic foot and have a minimum melting point of 1,500° F.

[4] Insulation material used as part of a clearance reduction system shall have a thermal conductivity (k) of One (Btu) (in)/(Sq. ft.) (Hr.) (°F) or less. Insulation board shall be formed of noncombustible material.

[5] If a single wall connector passes through a masonry wall used as a wall shield, there shall be at least 1/2 inch of open, ventilated space between the connector and the masonry.

[6] Clearances in front of the loading door or ash removal door of the appliance shall not be reduced.

FIGURE 23.045–B
PROTECTION OF COMBUSTIBLE WALLS AND FLOORS

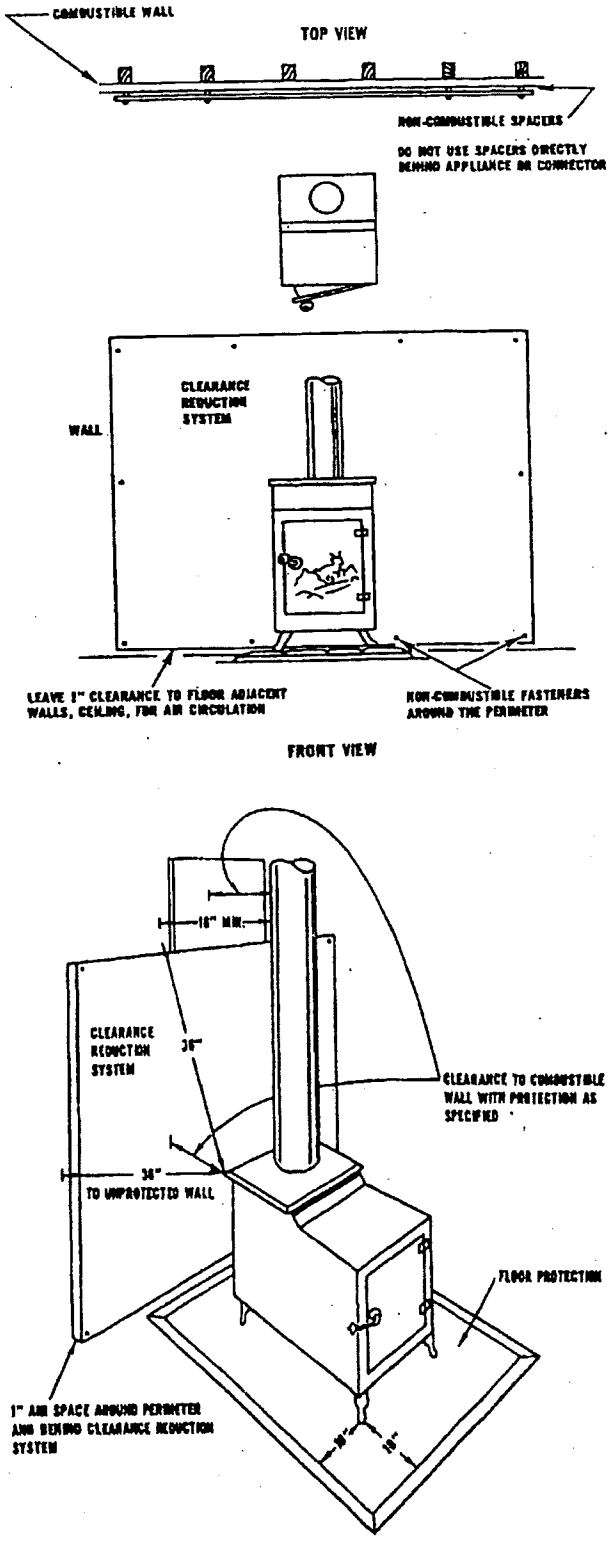


FIGURE 23.045–C

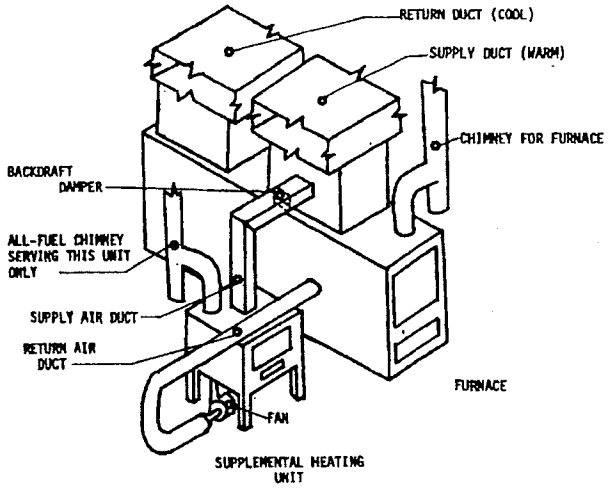
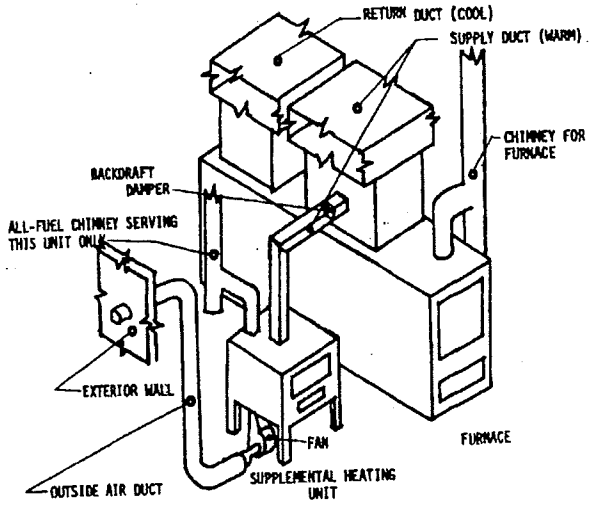


FIGURE 23.045–D



(9) SUPPLY DUCTS. Supply ducts connected to solid–fuel–burning appliances shall have the following minimum clearances to combustibles:

(a) *Horizontal ducts.* The clearance from combustibles for horizontal ducts shall be as specified in Table 23.045–F.

TABLE 23.045–F

Distance of Ducts From Bonnet or Plenum (inches)	Clearance to Combustibles[1] Required (inches)
0 to 36	18
over 36 to 72	6
over 72	1

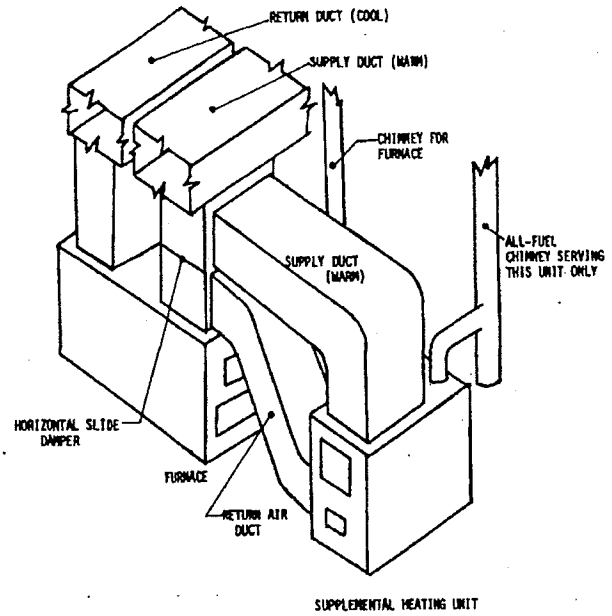
[1] Clearance can be reduced in accordance with Table 23.045–B

(b) *Vertical ducts.* 1. Air shall travel 6 feet and change directions equivalent to one 90° turn before entering an enclosure of combustible material.

2. Ducts shall have 3/16 inch clearance between the duct and any combustible material.

(10) COMBINATION APPLIANCES. Appliances capable of burning multi–types of fuel shall be listed and installed in accordance with their listing.

FIGURE 23.045–E



History: Cr. Register, February, 1985, No. 350, eff. 3–1–85; am. (1), (3) (a) 1., (4) (b), (5). (6) (a), (6) (b) 2., (8) (intro.) and (9) (a), renum. Tables 23.045–B to E to be Tables 23.045–C, D, B and F and am. B and F, Figures 23.045–C to E renum. from Figures 23.01–A to C. cr. (2) (c), (3) (b) to (e) and (8) (e), Table 23.045–E and Figure 23.045–B, r. and recr. (6) (b) 1., Register, January, 1989, No. 397, eff. 2–1–89; am. (1), (2) (b) (intro.), (3) (a) 1., (8) (a) and Table A, cr. (2) (b) 4., r. and recr. Table C, Register, March, 1992, No. 435, eff. 4–1–92; am. Table C, Register, November, 1995, No. 479, eff. 12–1–95; r. (2) (b) and renum. and am. (2) (c) to be (2) (b), Register, March, 2001, No. 543, eff. 4–1–01; **CR 08–043: am. (2) (b) Register March 2009 No. 639, eff. 4–1–09.**

Comm 23.05 Safety controls. High limit, maximum outlet air temperature and similar safety controls shall be provided on heating equipment.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Comm 23.06 Combustion air. (1) SCOPE. (a) Naturally vented appliances and other appliances that require air for combustion and dilution of flue gases to be taken from within the building shall comply with this section.

(b) Appliances that are provided with a direct supply of outside air for combustion in accordance with the manufacturer's installation instructions and listing are not required to comply with this section.

(c) Where the appliance listing and manufacturer's instructions are more stringent than the provisions of this section, the listing and manufacturer's instructions apply.

(2) METHODS FOR PROVIDING AIR. Air for combustion and dilution shall be provided in accordance with one of the following:

(a) If the vapor retarder is not continuous on walls and ceilings exposed to the outside atmosphere as allowed by s. Comm 22.38, air may be provided from inside the building in accordance with sub. (3).

(b) Air may be provided from outside the building in accordance with sub. (4).

(c) The appliance may be installed in accordance with its listing and manufacturer's instructions. Where all walls and ceilings exposed to the outside atmosphere are provided with a continuous vapor retarder, any requirements for unusually tight construction shall be met.

(d) An engineered system providing an adequate supply of air for combustion ventilation and dilution of flue gases may be installed if approved by the department.

(3) AIR FROM INSIDE THE BUILDING. (a) 1. The equipment shall be located in a space with a volume not less than 50 cubic feet per

1000 Btu/h of the combined input rating of all fuel–burning appliances drawing combustion and dilution air from that space.

2. The space may be made up of more than one room if the rooms are connected through doorways without doors or connected through sets of openings described in par. (b).

(b) 1. When needed to connect rooms, two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

2. The net free area of openings shall be calculated in accordance with sub. (5).

3. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and dilution air from the communicating rooms, but shall be not less than 100 square inches.

(4) AIR FROM OUTSIDE THE BUILDING. (a) When air for combustion and dilution is provided from outside the building, as allowed under sub. (2) (b), one of the methods specified in pars. (b) to (d) shall be used.

(b) Openings may be provided to connect rooms containing appliances to the outdoors.

1. a. Two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

b. Openings may connect directly to the outdoors or to the outdoors through a horizontal or vertical duct.

c. The net free area of openings shall be calculated in accordance with sub. (5).

2. The net free area of each direct opening to the outdoors not using a duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel–burning appliances drawing combustion and dilution air from the room.

3. a. The net free area of each opening connected to the outdoors through a horizontal duct shall be a minimum of one square inch per 2000 Btu/h of combined input rating of the fuel–burning appliances drawing combustion and dilution air from the room.

b. The cross–sectional area of the duct shall be equal to or greater than the required size of the opening.

4. a. The net free area of each opening connected to the outdoors through a vertical duct shall be a minimum of one square inch per 4000 Btu/h of combined input rating of the fuel–burning appliances drawing combustion and dilution air from the room.

b. The cross–sectional area of the duct shall be equal to or greater than the required size of the opening.

(c) 1. Where all appliances drawing air for combustion and dilution from the room are gas appliances, air may be provided via a single opening to connect the room to the outdoors in accordance with this paragraph.

2. a. The opening shall be located within one foot of the ceiling of the room.

b. The opening may connect directly to the outdoors, may connect to the outdoors through a horizontal duct, or may connect to the outdoors through a vertical duct.

c. The net free area of the opening shall be calculated in accordance with sub. (5).

3. a. The net free area of the opening shall be a minimum of one square inch per 3000 Btu/h of combined input rating of the fuel–burning appliances drawing combustion and dilution air from the room, and not less than the combined cross–sectional flow areas of the appliance flue collars or draft hood outlets.

b. The cross–sectional area of the duct shall be equal to or greater than the required size of the opening.

4. The appliances shall have a minimum clearance to the surfaces of the room of one inch at the sides and back of the appliance and 6 inches at the front of the appliance.

(d) 1. A combination of openings to the outside and openings to other rooms may be used in accordance with this paragraph.

2. a. One opening shall connect directly to the outdoors, connect to the outdoors through a horizontal duct, or connect to the outdoors through a vertical duct.

b. The net free area of the openings shall be calculated in accordance with sub. (5).

c. The net free area of the opening shall be a minimum of one square inch per 5000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and dilution air from the room.

d. The cross–sectional area of a duct, if used, shall be equal to or greater than the required size of the opening.

3. a. The equipment shall be located in a space with a volume not less than 50 cubic feet per 1000 Btu/h of the combined input rating of all fuel–burning appliances installed in that space.

b. The space may be made up of more than one room if the rooms are connected through openings without doors or connected through sets of openings described in subd. 4.

4. a. When needed to connect rooms, two openings shall be provided, one within one foot of the ceiling of the room and one within one foot of the floor.

b. The net free area of openings shall be calculated in accordance with sub. (5).

c. The net free area of each opening shall be a minimum of one square inch per 1000 Btu/h of combined input rating of the fuel burning appliances drawing combustion and dilution air from the communicating rooms, but shall be not less than 100 square inches.

(5) NET FREE AREA CALCULATION. (a) The required size of openings for combustion and dilution air shall be based on the net free area of each opening.

(b) The net free area of an opening shall be that specified by the manufacturer of the opening covering or by a source approved by the department.

(c) In the absence of such information, openings covered with metal louvers shall be deemed to have a net free area of 75 percent of the area of the opening, and openings covered with wood louvers shall be deemed to have a net free area of 25 percent of the area of the opening.

(6) INTERLOCKING OF DAMPERS. (a) Where the combustion air openings are provided with volume, smoke or fire dampers, the dampers shall be electronically interlocked with the firing cycle of the appliances served, so as to prevent operation of any appliance that draws combustion and dilution air from the room when any of the dampers are closed.

(b) Manually operated dampers shall not be installed in combustion air openings.

(7) SIMULTANEOUS OPERATION. (a) The equipment and appliance within every room containing fuel–burning appliances shall be installed so as to allow the free circulation of air.

(b) Provisions shall be made to allow for the simultaneous operation of mechanical exhaust systems, fireplaces, clothes dryers or other equipment and appliances operating in the same room or space from which combustion air and dilution air is being drawn. The provisions shall prevent the operation of the appliances, equipment and systems from affecting the supply of combustion and dilution air.

Note: Wood typically has a heating value of 8600 BTU per pound.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (intro.), (1) (a) and (2) (a), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. Register, March, 2001, No. 543, eff. 4–1–01; **correction in (2) (a) made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 23.062 Mechanical draft systems. Where a mechanical draft system, such as a fan is used, provision shall be made to prevent the flow of gas to the main burners when the draft system is not performing so as to satisfy the operating requirements of the system for safe performance.

History: Cr. Register, March, 2001, No. 543, eff. 4–1–01.

Comm 23.065 Equipment maintenance information. Required regular maintenance actions for equipment shall be clearly stated and incorporated on a readily accessible label. The label may be limited to identifying, by title or publication number, the operation and maintenance manual for that particular model and type of equipment. Maintenance instructions shall be furnished for equipment which requires preventive maintenance for efficient operation. Manufacturer's manuals for all installed heating and cooling equipment and service water heating equipment shall be provided.

History: Cr., Register, January, 1999, No. 517, eff. 2–1–99.

Subchapter IV — Delivery Systems

Comm 23.07 Air distribution systems. (1) SIZING. All air distribution systems shall be sized using the velocities and static pressure losses listed in Table 23.07.

TABLE 23.07
DUCT VELOCITIES

Designation	Maximum Static Pressure Loss (in WG/100 ft)	Minimum Velocity (feet/minute)	Maximum Velocity (feet/minute)
Main trunk duct	.10	700–900	800–1200
Branch duct	.10	600	700–1000
Branch riser	.10	500	650–800
Outdoor intake	.10	500	800
Grilles or openings	.10	400	600
Return air door undercuts	.10	200	300
Return air door or wall louvers	.10	200	300

WG = Water gauge per 100 feet.

(2) SYSTEM SIZING. The distribution system, including the evaporator coil, air filters (installed external to the heating unit), ducts, fittings, grilles and registers, shall be sized so that the total external static pressure shall not exceed the static pressure capacity of the fan at the system rated air flow.

(3) CHANGES IN DUCT SIZE. Where duct sizes are changed, the slope angle of the transition duct shall not exceed 45°.

History: Cr. Register, November, 1979, No. 287 eff. 6–1–80.

Comm 23.08 Ductwork. (1) DUCT USE. Ducts designed for the transmission of air shall be used for no other purpose.

(2) INTERIOR DUCTS. All interior ducts shall be constructed in accordance with the following:

(a) *Supply and return air ducts.* Supply and return air ducts shall comply with this paragraph except that ducts attached to appliances may be constructed of materials specified in the appliance listing.

1. Kitchen exhaust ducts and ducts for air exceeding 250° F shall be constructed of sheet metal or lined with sheet metal or constructed of other noncombustible noncorrugated materials.

2. Ducts connected to furnaces shall be constructed of sheet metal for at least 6 feet from the furnace.

3. Spaces formed by unlined wood joists, studs or wood I–joists with solid webs may be used as return air ducts. Spaces used as return air ducts shall be cut off from all remaining unused portions of the space by tight–fitting stops of sheet metal or of wood joist material. Bridging shall be removed from the joist space.

(b) *Under–floor plenums.* An under–floor space may be used as a plenum in a single dwelling unit in accordance with this section.

1. The use of the under–floor space shall be limited to buildings not more than 2 stories in height. Except for the floor immediately above the under–floor plenum, supply ducts shall be provided extending from the plenum to registers or other floor levels.

2. The under–floor spaces shall not be used for storage, shall be cleaned of all loose scrap material and shall be tightly and substantially enclosed.

3. The enclosing material of the under–floor space, including the side wall insulation and vapor barriers, shall not be more flammable than one–inch (nominal) wood boards (flame spread classification of 200).

4. Access shall be through an opening in the floor which shall be 18 inches by 24 inches.

5. The furnace supplying warm air to the under–floor space shall be equipped with an automatic control which will start the air circulating fan when the air in the furnace bonnet reaches a temperature not higher than 150° F. Such control shall be one that cannot be set higher than 150° F.

6. The furnace supplying warm air to the under–floor space shall be equipped with an approved temperature limit control that will limit outlet air temperature to 200° F.

7. A noncombustible receptacle shall be placed below each floor opening into the air chamber. The receptacle shall be securely suspended from the floor members and shall be not more than 18 inches below the floor opening. The area of the receptacle shall extend 3 inches beyond the opening on all sides. The perimeter of the receptacle shall have a vertical lip at least one inch high at the open sides if it is at the level of the bottom of the joist, or 3 inches high if the receptacle is suspended.

8. Floor registers shall be designed for easy removal to permit access for cleaning the receptacles.

9. Exterior walls and interior stud partitions shall be firestopped at the floor.

10. Each wall register shall be connected to the air chamber by a register box or boot.

11. A duct conforming to par. (a) shall extend from the furnace supply outlet at least 6 inches below combustible framing.

12. The entire ground surface and enclosing exterior walls of the under–floor space shall be covered with a vapor barrier having a vapor permeability rating of one perm or less and a flame spread rating of 200 or less.

13. Fuel gas lines may not be located within the under–floor space.

14. A smoke detector shall be placed in the under–floor space. The alarm and low–battery signal of the smoke detector shall be audible in the occupied areas of the dwelling, when actuated.

15. The exterior walls of the under–floor spaces shall be insulated in accordance with subch. IV of ch. Comm 22. The insulation may not be omitted under the provisions of s. Comm 22.21 or subch. VII of ch. Comm 22.

Note: Subch. VII of ch. Comm 22 was repealed.

16. Electrical wiring installed in the plenum shall be in conformance with the Wisconsin Administrative Electrical Code Volume 2.

(3) EXTERIOR DUCTS. (a) *General.* Except as provided in par. (b), ducts, which are located in garages, storage attics and similar spaces susceptible to physical damage, shall be constructed of galvanized steel or corrosion–resistive metal.

(b) *Exception.* Plastic may be used for bath fan or air–to–air heat exchanger exhaust runs located in spaces outside the dwelling.

(4) UNDERGROUND DUCTS. Ducts, plenums and fittings constructed of metal encased in concrete or ceramic, or other approved materials, may be installed in the ground. Supply air ducts shall be insulated with a moistureproof material having a resistance value of at least R–5.

(5) DUCT CONSTRUCTION. Ductwork shall be constructed and installed in accordance with any one of the appropriate following standards:

(a) ASHRAE Handbook HVAC Systems and Equipment.

(b) SMACNA, Residential Comfort System Installation Standards Manual

(c) SMACNA, HVAC Duct Construction Standards–Metal and Flexible.

(d) SMACNA Fibrous Glass Duct Construction Standards.

(e) ASHRAE HVAC Applications Handbook.

(f) NAIMA Fibrous Glass Duct Construction Standards.

(6) THICKNESS. Sheet metal ducts shall conform to the minimum thicknesses listed in Table 23.08–A.

(7) DUCT SUPPORT. Rigid metal ductwork shall be supported in accordance with Table 23.08–B.

TABLE 23.08–A
DUCT CONSTRUCTION MINIMUM SHEET METAL GAUGES

	Minimum thickness galvanized sheet gauge	Minimum thickness aluminum B & S gauge
Metal gauges (duct not enclosed in partitions)		
Round ducts		
Diameter, inches		
Less than 12	30	26
12–14	28	26
15–18	26	24
Over 18	24	22
Rectangular Ducts		
Width, inches		
Less than 14	28	24
14–24	26	22
25–30	24	22
Over 30	22	20
Metal gauges (ducts enclosed in partition)		
Width, inches		
14 or less	30	26
Over 14	28	24

TABLE 23.08–B
DUCT SUPPORT FOR RIGID DUCTS — 16 GAGE MAXIMUM THICKNESS

Duct Type	Maximum Size	Duct Position	Hanger Type, Size and Spacing[1]
Circular	10″ diam.	Vertical	Strap — one 18 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — one 22 ga. galv. steel X 1″ @ 12′ o.c. Rod — one ¼″ @ 12′ o.c. Wire — one 12 ga. @ 12′ o.c.
	18″ diam.	Vertical	Strap — one 16 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — one 22 ga. galv. steel X 1″ @ 12′ o.c. Rod — one ¼″ @ 12′ o.c. Wire — one 8 ga. @ 12′ o.c.; or Wire — two 12 ga. @ 12′ o.c.
Rectangular	60″ perim.	Vertical	Strap — one 18 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — pair[2] 22 ga. galv. steel X 1″ @ 10′ o.c. Rods or Wires — pair[2] 10 ga. @ 10′ o.c.; or Rods or Wires — pair[2] 12 ga. @ 5′ o.c.
	144″ perim.	Vertical	Strap— one 16 ga. galv. steel X 2″ @ 12′ o.c.
		Horizontal	Strap — pair[2] 18 ga. galv. steel X 1″ @ 10′ o.c.; or Strap — pair[2] 20 ga. galv. steel X 1″ @ 8′ o.c.; or Strap — pair[2] 22 ga. galv. steel X 1″ @ 5′ o.c. Rods or Wires — pair[2] 3/8″ @ 10′ o.c.; or Rods or Wires — pair[2] ¼″ @ 8′ o.c.

[1] These hangers are the minimum required to support the weight of the duct off of the joist, stud or similar structure. The band, wire or strap cradling the duct shall not cause any deformation of the duct.

[2] "Pair" means that there are 2 vertical legs. One continuous strap can form both vertical legs.

Note: This table does not prohibit nailing for duct support.

(8) JOINTS AND SEAMS. All joints and seams shall be securely fastened or locked. Round pipe slip joints shall be lapped at least one inch.

(9) VIBRATION CONTROL. When used, vibration isolation connectors shall be installed at the joint between the duct and fan or heating equipment. Vibration isolation connectors shall not be used where the air temperature is in excess of 250° F.

(10) AIR PASSAGEWAYS OF ENVELOPE DWELLINGS. The air passageways of envelope type dwellings shall comply with this subsection.

(a) No heating equipment shall be placed in the air passageways.

(b) Wood exposed to the air passageways shall be of at least 2 inches nominal thickness.

(c) Finishes and insulation exposed to the air passageway shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.

(d) A vapor barrier shall be installed on the warm side of insulation which forms a part of the thermal envelope of the dwell-

ing. In the roof–ceiling air passageway, a vapor barrier for the insulation of the ceiling may be omitted if heated air is circulated on both sides of the ceiling insulation. The insulation on the roof side of the air passageway shall be provided with a vapor barrier on the warm side of the insulation. Any vapor barrier exposed to circulating air shall have a flame spread rating of 25 or less and a smoke development rating of 50 or less.

Note: Also see s. Comm 21.08 (1m), Equivalent Firestopping Requirements for Envelope Dwellings.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; cr. (2) (b) and (10), Register, January, 1989, No. 397, eff. 2–1–89; r. and recr. (2) (a), am. (3) and (6), Register, March, 1992, No. 435, eff. 4–1–92; am. (2) (a) 3., (2) (b) 15., (3) (a), and (4), Register, November, 1995, No. 479, eff. 12–1–95; r. and recr. (2) (b) 15. and (5), Register, January, 1999, No. 517, eff. 2–1–99; **CR 08–043: r. and recr. (7) and Table 23.08–B Register March 2009 No. 639, eff. 4–1–09; correction in (2) (b) 15. made under s. 13.92 (4) (b) 7., Stats., Register March 2009 No. 639.**

Comm 23.09 Dampers, registers and grilles. **(1)** VOLUME AND BACKDRAFT DAMPERS. (a) Volume duct dampers shall be provided to permit balancing of the system.

(b) Volume dampers shall be provided with access.

Note: Acceptable means of access include a manufactured access panel, an air grille used as a cover, a plastic ceiling cap or a damper accessible through an air diffuser or grille.

(c) Supply ducts may not terminate in a garage unless a backdraft damper is provided.

(2) AIR REGISTERS AND GRILLES. (a) *Supply air registers.* All supply air outlets shall be provided with registers or devices which will provide a uniform distribution of air.

(b) *Return air grilles.* Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or a confined space in which a draft diverter or draft regulator is located. All other habitable spaces shall have permanent openings to a return air grille equal in area to the supply outlet serving those areas. At least one return air opening shall be provided for each floor.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; **CR 08–043: renum. (1) to (1) (a), cr. (1) (b) Register March 2009 No. 639, eff. 4–1–09.**

Comm 23.10 Piping. **(1)** PIPE SIZES AND ARRANGEMENT. All steam and hot water supply and return piping, air–line piping and auxiliary equipment shall be of appropriate sizes, elevations and arrangements to accomplish the calculated results without stress or other detriment.

Note: The sizes of pipe to be used for mains and risers may be selected from the ASHRAE Guide and Data Book, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers; or the manuals published by the Institute of Boiler and Radiator Manufacturers or the Mechanical Contractors Association of America.

(2) EXPANSION AND CONTRACTION. The piping for the heating system shall be equipped with anchors, expansion swings or joints, supports and similar devices to relieve stress and strain caused by temperature change of the pipe material.

(3) PIPE INSULATION. Unguarded steam, hot water supply and return piping shall be covered with insulating material where the pipes pass through occupied areas and the surface temperature exceeds 180° F.

(4) STEAM AND HOT WATER PIPES. No pipe carrying hot water or steam at a surface temperature exceeding 250° F shall be placed within one inch of any combustible material, pass through a combustible floor, ceiling or partition unless the pipe is protected by a metal sleeve one inch larger in diameter than the pipe or with approved pipe covering.

(5) BALANCING. Balancing cocks shall be provided in each circuit of a hot water distribution system.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Subchapter V — Chimneys and Vents

Comm 23.11 General requirements. **(1)** TYPES OF CHIMNEYS AND VENTS. All heating appliances using solid, liquid or gas fuels shall be vented to the outside by an all–fuel factory–built, masonry chimney or other listed venting system designed to remove the products of combustion.

(2) TERMINATION. (a) *Chimneys.* All listed factory manufactured chimneys depending on a principle of gravity for the removal of the products of combustion shall terminate at the location specified in the product listing. For masonry chimneys or where termination location is not specified as a part of the listing, the chimney shall extend at least 3 feet above the highest point where the chimney passes through the roof of the building, and at least 2 feet higher than any ridge, peak, wall, or roof within 10 feet horizontally of the chimney.

(b) *Vents.* Gas and oil appliance vents shall terminate in locations specified in their listings.

(3) SIZING. Vents for new or replacement equipment shall be sized to adequately exhaust combustion products from the dwelling.

Note: The department recommends vent sizing in accordance with NFPA 54, National Fuel Gas Code or its appendix.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; renum. (intro) to (2) to be (1) to (3) and am. (1), Register, February, 1985, No. 350, eff. 3–1–85; r. (3), Register, January, 1989, No. 397, eff. 2–1–89; am. (2), Register, March, 1992, No. 435, eff. 4–1–92; cr. (3), Register, November, 1995, No. 479, eff. 12–1–95.

Comm 23.12 Masonry chimneys. Masonry chimneys shall conform to the requirements of s. Comm 21.30.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; r. and recr. Register, February, 1985, No. 350, eff. 3–1–85; am. (8), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr., November, 1995, No. 479, eff. 12–1–95.

Comm 23.13 Factory–built chimneys or vents. Factory–built chimneys or vents shall be of an approved type.

Note: The department recognizes as approved, factory–built chimneys or vents designated as "residential type and building heating appliance," "building heating appliance," "B," "BW," and "L" types listed by Underwriters' Laboratories, Inc.

(1) RESIDENTIAL TYPE AND BUILDING HEATING APPLIANCE. An approved "residential type and building heating appliance" chimney may be used with liquid or gas–fired heating appliances where the flue gas temperature does not exceed 1000° F continuously, and does not exceed 1400° F for infrequent brief periods of forced firing.

(2) TYPE "B". An approved type "B" gas vent may be used with a vented, recessed wall heater.

(3) TYPE "BW". An approved type "BW" gas vent may be used with a vented, recessed wall heater.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (1), Register, March, 1992, No. 435, eff. 4–1–92.

Comm 23.14 Gas vents. **(1)** GENERAL. All gas–fired equipment shall be provided with vent pipes conforming with s. Comm 23.15 (2) (e), unless the manufacturer specifies other materials.

(2) DRYER VENTING. (a) Gas–fired clothes dryers shall be provided with metal venting that terminates outside the structure.

Note: s. Comm 22.08 (3) requires all dryer venting to terminate outside the structure.

(b) Where dryer vent piping is concealed, a rigid metal vent pipe conforming with s. Comm 23.15 (2) (e) shall be used.

(3) VENTING SYSTEM LOCATION. (a) A venting system shall terminate at least 3 feet above any forced air inlet located within 10 feet horizontally. This provision does not apply to the combustion air intake of a direct–vent appliance.

(b) The venting system of other than a direct–vent appliance shall terminate at least 4 feet below, 4 feet horizontally from, or one foot above any door, window, or gravity air inlet into any building. The bottom of the vent shall be located at least 12 inches above grade.

(c) The vent terminal of a direct–vent appliance with an input of 10,000 Btu per hour or less shall be located at least 6 inches from any air opening into a building.

(d) The vent terminal of a direct–vent appliance with an input over 10,000 Btu per hour but not over 50,000 Btu per hour shall be located at least 9 inches from any air opening into a building.

(e) The vent terminal of a direct–vent appliance with an input over 50,000 Btu per hour shall be located at least 12 inches from any air opening into a building.

(f) The bottom of the vent terminal and the air intake of a direct–vent appliance shall be located at least 12 inches above grade.

(g) The exit terminal of a mechanical draft system shall be not less than 7 feet above grade where located within 3 feet of a public walkway that is intended for use by the general public.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; correction made under s. 13.93 (2m) (b) 7., Stats., Register, March, 1992, No. 435; r. and recr., November, 1995, No. 479, eff. 12–1–95; cr. (3), Register, March, 2001, No. 543, eff. 4–1–01; CR 02–077: am. (2) (a) Register May 2003 No. 569, eff. 8–1–03.

Comm 23.15 Chimney connectors, smoke pipes and stovepipes. (1) DEFINITION. Chimney connectors, smoke pipes or stovepipes are passages for conducting the products of combustion from a fuel–fired appliance to the chimney.

(2) CONSTRUCTION AND INSTALLATION. The construction and installation of chimney connectors of solid–fuel–burning appliances shall comply with s. Comm 23.045 (4). The chimney connectors of all other fuel–fired appliances shall conform with the following requirements:

(a) *Concealed space.* No chimney connector shall pass through any outside window, door or combustible outside wall, nor be concealed in any closet, attic or similar space.

(b) *Combustible partitions.* Connectors for appliances shall not pass through walls or partitions constructed of combustible material unless they are guarded at the point of passage by:

1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector;

2. Metal or burned fireclay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

(c) *Pitch and length.* Chimney or vent connectors shall have no more than two 45° offsets with the vertical. The horizontal length shall not exceed 75% of the total vertical height of the total venting system measured from the appliance outlet. Chimney or vent connectors shall be pitched at least 1/4–inch per foot from the appliance outlet collar vent to the chimney inlet.

(d) *Dampers.* 1. Manually operated dampers are prohibited in chimney or vent connectors of all appliances except wood–burning appliances.

2. A listed, automatically operated damper may be used with any heating appliance provided it is installed and used in accordance with the appliance and damper listing.

(e) *Materials and thickness.* Chimney or vent connectors serving liquid fuel or gas appliances shall conform to the type of material and thickness indicated in Table 23.15–A or 23.15–B.

(f) *Clearance.* Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table 23.15–C. These clearances may be reduced if the combustible material is protected in accordance with the requirements of Table 23.04–B.

TABLE 23.15–A
MINIMUM CHIMNEY CONNECTOR GAUGES FOR OIL–FIRED APPLIANCES

	Galvanized Steel Gauge Number	
Diameter of Connector	Min. thickness (inch)	Gauge
Less than 6 inches	.019	26
6 inches to less than 10 inches	.024	24
10 inches to 13 inches	.030	22
14 inches to 16 inches	.036	20
Greater than 16 inches	.058	16

TABLE 23.15–B
MINIMUM VENT CONNECTOR GAUGES FOR GAS

	Galvanized Steel Gauge Number	
Diameter of Connector	Min. thickness (inch)	Gauge
1 inch through 4 inches	.016	28
5 inches or over	.026	24

TABLE 23.15–C
CHIMNEY CONNECTOR AND VENT CONNECTOR CLEARANCES FROM COMBUSTIBLE MATERIALS
(See Note 4)

Description of Appliance	Minimum Clearance Inches (See Note 1)
Single–Wall Metal Pipe Connectors	
Gas Appliances Without Draft Hoods	18
Electric, Gas, and Oil Incinerators	18
Oil Appliances	18
Unlisted Gas Appliances With Draft Hoods	9
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	9
Oil Appliances Listed as Suitable for Use With Type L Venting Systems, but only when connected to chimneys	9
Listed Gas Appliances With Draft Hoods. See Note 3.	6
Type L Vent Piping Connectors	
Gas Appliances Without Draft Hoods	9
Electric, Gas, and Oil Incinerators	9
Oil Appliances	9
Unlisted Gas Appliances With Draft Hoods	6
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	6
Oil Appliances Listed as Suitable for Use with Type L Vents	(See Note 2)
Listed Gas Appliances With Draft Hoods	(See Note 3)
Type B Gas Vent Piping Connectors	
Listed Gas Appliances With Draft Hoods	(See Note 3)

[1] These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

[2] If listed type L venting system piping is used, the clearance may be in accordance with the venting system listing.

3 If listed type B or type L venting system piping is used, the clearance may be in accordance with the venting system listing.

[4] The clearances from connectors to combustible materials may be reduced if the combustible material is protected in accordance with Table 23.04–B.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; am. (2) (intro.) and (g), Tables 23.15–A and C, renum. (2) (d) to be ILHR 23.155, Register, January, 1989, No. 397, eff. 2–1–89; r. (2) (c) and (f), renum. (2) (e), (g) and (h) to be (2) (c), (e) and (f), cr. (2) (d), Register, March, 1992, No. 435, eff. 4–1–92; r. and recr. (2) (d), Register, January, 1999, No. 517, eff. 2–1–99.

Comm 23.155 Multiple appliance venting. Two or more listed gas–or liquid–fueled appliances may be connected to a common gravity–type flue provided the appliances are equipped with listed primary safety controls and listed shutoff devices and comply with the following requirements.

(1) The appliances shall be located in the same story, except for engineered venting systems.

(2) The appliances shall be joined at a manifold or Y–type fitting as close to the chimney as possible, unless the connector from each appliance enters a separate chimney inlet and the inlets are offset at least 12 inches vertically or the separate inlets occur at right angles to each other.

(3) The chimney connector and chimney flue shall be sized to accommodate the total volume of flue gases. For gas–burning appliances the venting area shall be at least equal to the size of the

largest vent connectors plus at least 50% of the area of the other vent connectors.

History: Renum. from ILHR 23.15 (2) (d) and am. Register, January, 1989, No. 397, eff 2–1–89; r. (2), renum. (1) (intro.), (a) to (c) to be (intro.), (1) to (3), Register, March, 1992, No. 435, eff. 4–1–92.

Comm 23.156 Condensate drains. Provisions shall be made so that condensate from heating equipment drains into the sanitary drain system.

History: Cr. Register, January, 1989, No. 397, eff. 2–1–89.

Subchapter VI — Fuel Supply Systems

Comm 23.16 Fuel storage. (1) LP GAS STORAGE TANKS. (a) All LP gas storage tanks shall be constructed, installed and maintained to conform with the applicable sections of ch. Comm 40.

(b) LP gas tanks may not be located inside dwellings.

(c) LP gas tanks shall have welded steel supports and be permanently installed on concrete pads or foundations.

(2) OIL STORAGE TANKS. (a) Except as provided in pars. (b) and (c), oil storage tanks shall be installed in accordance with ch. Comm 10, Flammable and Combustible Liquids.

(b) The total storage capacity inside any dwelling unit shall be limited to 550 gallons in one tank, or not more than 275 gallons in each of 2 tanks cross–connected to a single burner.

(c) Oil storage tanks on the inside of any dwelling shall be located at the same level as the burner it serves.

(3) GAS PIPING SYSTEMS. Gas piping systems, extending from the point of delivery to the connection with each gas–fired appliance or device, shall be installed to conform with NFPA 54, National Fuel Gas Code.

(4) SHUTOFF AND CONTROL DEVICES. (a) Any oil–fired appliance or device connected to a fuel piping system shall have an accessible, approved manual shutoff valve installed upstream of any connector.

(b) Automatic gas–burning heating appliances shall be equipped with listed devices which will shut off the gas to the pilot light and main burner(s) in the event of pilot failure.

(c) Liquid fuel–burning appliances shall be equipped with primary safety controls which will shut off the flow of fuel to the burner(s) in the event of ignition failure.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80; correction in (1) (intro.), made under s. 13.93 (2m) (b) 7., Stats. Register, February, 1985, No. 350, 3–1–85; r. and recr. (2), (3) and (4) (a), Register, January, 1989, No. 397, eff. 2–1–89; r. (1) (b), renum. (1) (c) to be (1) (b), am. (2), Register, March, 1992, No. 435, eff. 4–1–92; CR 02–077: r. and recr. (1) Register May 2003 No. 569, eff. 8–1–03.

Subchapter VII — Equipment Location and Operation

Comm 23.17 Equipment location. (1) OUTDOOR EQUIPMENT. Outdoor equipment shall be located so as to not restrict the air flow or recirculation of air. Outdoor equipment so located as to be subject to damage shall be protected.

(2) INDOOR EQUIPMENT. All indoor equipment shall be installed with a minimum of 24 inches of clearance for service.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Comm 23.18 Operation. (1) INSTRUCTIONS. Written instructions shall be provided the owner for the operation and maintenance of the system and equipment.

(2) FINAL TEST REQUIRED. The installer shall test and balance every heating, ventilating and air conditioning system.

History: Cr. Register, November, 1979, No. 287, eff. 6–1–80.

Chapters Comm 20–25 Appendix

UDC Appendix

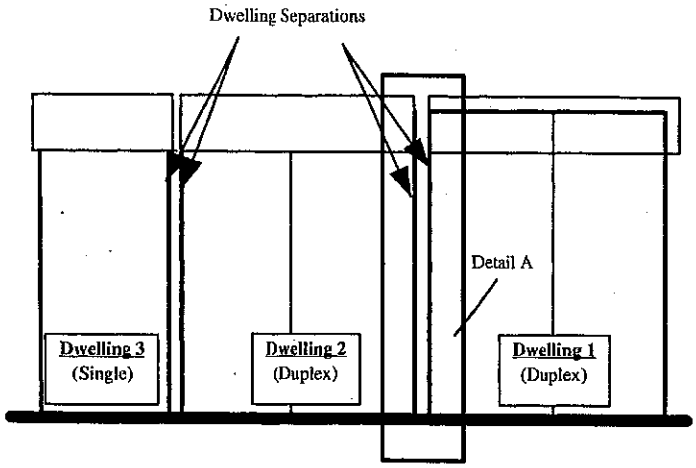
Table of Contents

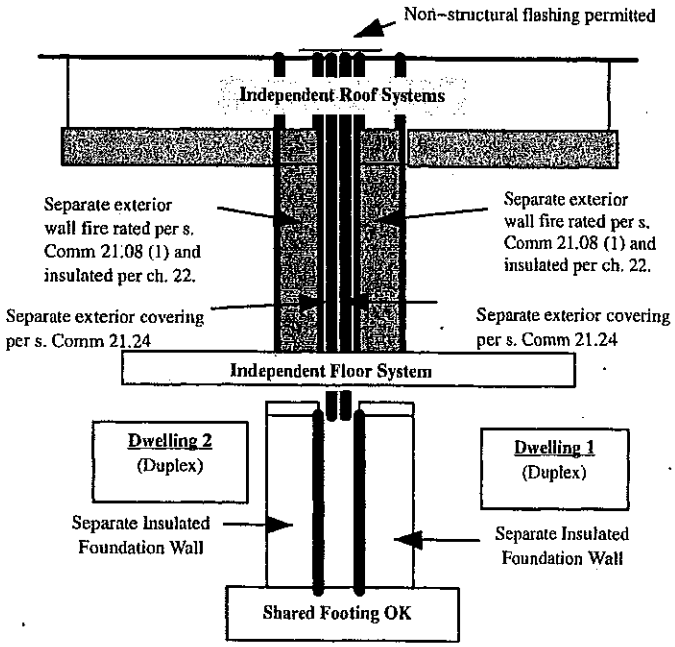
Chapter 20	
Dwelling Separations	76
Model Ordinance	77
Sample Forms	79
Sanitary Permit Requirements	89
Chapter 21	
Fastener Schedule	90
Use of Span & Species Tables	92
Span & Species Tables	98
Handrail Diagrams	123
Carbon Monoxide Detector Emergency Rules	124
Erosion & Stormwater Control Procedures & Standards	128
Frost–Protected Shallow Foundations	217
Lateral Wall Bracing	218
Chapter 22	
Slab--On–Grade Insulation Details	221
Chapter 23	
Outdoor Design Temperatures	222
UDC Index	223

20.04 (6) – Dwelling Separations

Normally, for 3 or more attached dwelling units, the Commercial Building Code (CBC) applies. Attached means some construction (other than footings and their bearing material) is shared by the units.

Where 3 or more adjacent but unattached dwelling units are each built with the outside walls that comply with the Uniform Dwelling Code (UDC), the UDC applies throughout and the CBC does *not* apply, even if those outside walls are adjacent to or adjoin each other. If flashing is added over the top of two such adjoining walls, the UDC would still apply.





Detail A

Model Ordinance for Adoption of Wisconsin Uniform Dwelling Code

It is intended that this model will assist local jurisdictions, working with corporation counsel, through regular procedures, in adopting a local ordinance. The Wisconsin Division of Safety and Buildings also offers an electronic version of this model ordinance and a more comprehensive model building code on our website at www.commerce.state.wi.us/sb on the One– & Two–Family (UDC) program page. Upon adoption of a new building code, send a certified copy to: Safety & Buildings Division, P.O. Box 2658, Madison, WI 53707, Telephone (608) 267–5113, Fax (608) 283–7409 along with the name of your certified inspector(s).

Town, Village, City, County of _____.

ORDINANCE #

CONTENTS

1.1 Authority

1.2 Purpose

1.3 Scope

1.4 Adoption of Wisconsin Uniform Dwelling Code

1.5 Building Inspector

1.6 Building Permit Required

1.7 Building Permit Fees

1.8 Penalties

1.9. Effective Date

1.1 AUTHORITY. These regulations are adopted under the authority granted by s. 101.65, Wisconsin Statutes

[IF COUNTY ORDINANCE] This ordinance shall apply in any municipality of over 2,500 population without a Uniform Dwelling Code enforcement program and the following other municipalities requesting county enforcement: _____ _____ and in the following other municipalities that the Wisconsin Department of Commerce has delegated enforcement to our county _____.

1.2 PURPOSE. The purpose of this ordinance is to promote the general health, safety and welfare and to maintain required local uniformity with the administrative and technical requirements of the Wisconsin Uniform Dwelling Code.

1.3 SCOPE. The scope of this ordinance includes the construction and inspection of one– and two–family dwellings built since June 1, 1980.

[OPTIONAL] Not withstanding s. Comm 20.05, the scope also includes the construction and inspection of alterations and additions to one– and two–family dwellings built before June 1, 1980. Because such projects are not under state jurisdiction, petitions for variance and final appeals under ss. Comm 20.19 and 20.21, respectively, shall be decided by the municipal board of appeals. Petitions for variance shall be decided per s. Comm 20.19 (intro.) so that equivalency is maintained to the intent of the rule being petitioned. As the board of appeals approves petitions for variance, the chief inspector is granted the power to apply the results to similar circumstances by precedent.

[OPTIONAL] Not withstanding s. Comm 20.05, the scope also includes the construction and inspection of detached garages serving one and two family dwellings. The building structure and any heating, electrical or plumbing systems shall comply with the Uniform Dwelling Code. Petitions for variance and appeals shall be handled as in the previous paragraph.

1.4 WISCONSIN UNIFORM DWELLING CODE ADOPTED. The Wisconsin Uniform Dwelling Code, Chs. Comm 20–25 of the Wisconsin Administrative Code, and all amendments thereto, is adopted and incorporated by reference and shall apply to all buildings within the scope of this ordinance.

1.5 BUILDING INSPECTOR. There is hereby created the position of Building Inspector, who shall administer and enforce this ordinance and shall be certified by the Division of Safety & Buildings, as specified by Wisconsin Statutes, Section 101.66 (2), in the category of Uniform Dwelling Code Construction Inspector. Additionally, this or other assistant inspectors shall possess the certification categories of UDC HVAC, UDC Electrical, and UDC Plumbing. (**NOTE**: Contact the Division of Safety & Buildings at (608) 261–8500 for certification information.)

1.6 BUILDING PERMIT REQUIRED. If a person alters a building in excess of **[INSERT AMOUNT]** $_____ value in any 12–month period, adds onto a building in excess of **[INSERT VALUE or AREA AMOUNT]** _____ in any

12–month period, or builds or installs a new building, within the scope of this ordinance, they shall first obtain a building permit for such work from the building inspector. Any structural changes or major changes to mechanical systems that involve extensions shall require permits if over the foregoing thresholds. Restoration or repair of an installation to its previous code–compliant condition as determined by the building inspector is exempted from permit requirements. Residing, re–roofing, finishing of interior surfaces and installation of cabinetry shall be **[CHOOSE OPTION]** included/exempted from permit requirements.

(**NOTE**: Fill in the threshold amount above which permits are required. Also decide whether new interior and exterior surfaces or cabinetry shall be included or exempted.)

1.7 BUILDING PERMIT FEE. The building permit fees shall be determined by resolution and shall include $25.00 to be forwarded to the Wisconsin Department of Commerce for a UDC permit seal that shall be assigned to any new dwelling.

1.8 PENALTIES. The enforcement of this section and all other laws and ordinances relating to building shall be by means of the withholding of building permits, imposition of forfeitures and injunctive action. Forfeitures shall be not less than $25.00 nor more than $1,000.00 for each day of noncompliance.

1.9 EFFECTIVE DATE. This ordinance shall be effective _____, upon passage and publication as provided by law.

1.10 The building inspector(s) shall keep a log of all inspections completed.

Adopted this _____, day of _____,

_____

(Mayor, President, Chairperson)

Attest: _____

Published: _____

Wisconsin Division of Safety and Buildings Wisconsin Stats. 101.63, 101.73	**WISCONSIN UNIFORM BUILDING PERMIT APPLICATION** **Instructions on back of second ply.** The information you provide may be used by other government agency programs [(Privacy Law, s. 15.04 (1)(m)]	Application No. Parcel No.

PERMIT REQUESTED Constr. HVAC Electric Plumbing Erosion Control Other:

Owner's Name	Mailing Address		Tel.
Contractor Name & Type	Lic/Cert#	Mailing Address	Tel. & Fax
Dwelling Contractor (Constr.)			
Dwelling Contr. Qualifier		The Dwelling Contr. Qualifier shall be an owner, CEO, COB or employee of the Dwelling Contr.	
HVAC			
Electrical			
Plumbing			

PROJECT LOCATION	Lot area Sq.ft.	One acre or more of soil will be disturbed	____ 1/4, ____ 1/4, of Section . T N, R E (or) W
Building Address	Subdivision Name	Lot No.	Block No.
Zoning District(s)	Zoning Permit No.	**Setbacks:** Front ft.	Rear ft. Left ft. Right ft.

1. PROJECT	**3. OCCUPANCY**	**6. ELECTRIC**	**9. HVAC EQUIP.**	**12. ENERGY SOURCE**
New Repair Alteration Raze Addition Move Other:	Single Family Two Family Garage Other:	Entrance Panel Amps: ____ Underground Overhead	Furnace Radiant Baseb'd Heat Pump Boiler Central AC Fireplace Other:	Fuel / Nat Gas / LP / Oil / Elec / Solid / Solar Space Htg Water Htg

2. AREA INVOLVED (sq ft)	Unit 1	Unit 2	Total
Unfin. Bsmt			
Living Area			
Garage			
Deck			
Totals			

4. CONST. TYPE	**7. WALLS**
Site-Built Mfd. per WI UDC Mfd. per US HUD	Wood Frame Steel ICF Timber/Pole Other:

5. STORIES	**8. USE**
1-Story 2-Story Other: Plus Basement	Seasonal Permanent Other:

10. SEWER	**11. WATER**
Municipal Sanitary Permit# ____	Municipal On-Site Well

13. HEAT LOSS

____ BTU/HR Total Calculated Envelope and Infiltration Losses ("Maximum Allowable Heating Equipment Output" on Energy Worksheet; "Total Building Heating Load" on Rescheck report)

14. EST. BUILDING COST w/o LAND

$

I understand that I am subject to all applicable codes, statutes and ordinances and with the conditions of this permit; understand that the issuance of the permit creates no legal liability, express or implied, on the state or municipality; and certify that all the above information is accurate. If one acre or more of soil will be disturbed, I understand that this project is subject to ch. NR 151 regarding additional erosion control and stormwater management and the owner shall sign the statement on the back of the permit if not signing below. I expressly grant the building inspector, or the inspector's authorized agent, permission to enter the premises for which this permit is sought at all reasonable hours and for any proper purpose to inspect the work which is being done.

I vouch that I am or will be an owner-occupant of this dwelling for which I am applying for an erosion control or construction permit without a Dwelling Contractor Certification and have read the cautionary statement regarding contractor responsibility on the reverse side of the last ply.

APPLICANT (Print:) _____ **Sign:** _____ **DATE** _____

APPROVAL CONDITIONS This permit is issued pursuant to the following conditions. Failure to comply may result in suspension or revocation of this permit or other penalty. **See attached for conditions of approval.**

ISSUING JURISDICTION	Town of Village of City of County of State→	State-Contracted Inspection Agency#:	Municipality Number of Dwelling Location ___ ___ ___ ___ ___

FEES:		**PERMIT(S) ISSUED**	**WIS PERMIT SEAL #**	**PERMIT ISSUED BY:**
Plan Review	$	Construction		
Inspection	$	HVAC		Name
Wis. Permit Seal	$	Electrical		
Other	$	Plumbing		Date ____ Tel. ____
		Erosion Control		
Total	$			Cert No.

SBD-5823(R.10/08) Distribute: Ply 1 – Issuing Jurisdiction; Ply 2- Issuer forwards to State w/in 30 days; Ply 3- Inspector; Ply 4- Applicant

INSTRUCTIONS

The owner, builder or agents shall complete the application form down through the Signature of Applicant block and submit it and building plans and specifications to the enforcing municipality. Permit application data is used for statewide statistical gathering on new one– and two–family dwellings, as well as for local code administration. **Please type or use ink and press firmly with multi–ply form.**

PERMIT REQUESTED

- Check off type of Permit Requested, such as structural, HVAC, Electrical or Plumbing.
- Fill in owner's current Mailing Address and Telephone Number.
- If the project will disturb one acre or more of soil, the project is subject to the additional erosion control and stormwater provisions of ch. NR 151 of the WI Administrative Code. Checking this box will satisfy the related notification requirements of ch. NR 216.
- Fill in Contractor and Contractor Qualifier Information. Per s. 101.654 (1) WI Stats., an individual taking out an erosion control or construction permit shall enter his or her dwelling contractor certificate number, and name and certificate number of the dwelling contractor qualifier employed by the contactor, unless they reside or will reside in the dwelling. Per s. 101.63 (7) Wis. Stats., the master plumber name and license number must be entered before issuing a plumbing permit.

PROJECT LOCATION

- Fill in Building Address with number and street or sufficient information so that the building inspector can locate the site.
- Local zoning, land use and flood plain requirements must be satisfied before a building permit can be issued. County approval may be necessary.
- Fill in Zoning District, lot area and required building setbacks.

PROJECT DATA – Fill in all numbered project data blocks (1–14) with the required information. All data blocks must be filled in, including the following:

2. Area (involved in project):
   Basements – include unfinished area only
   Living area – include any finished area including finished areas in basements
   Two–family dwellings – include separate and total combined areas
3. Occupancy – Check only "Single–Family" or "Two–Family" if that is what is being worked on. In other words, do not check either of these two blocks if only a new detached garage is being built, even if it serves a one– or two–family dwelling. Instead, check "Garage" and number of stalls. If the project is a community–based residential facility serving 3 to 8 residents, it is considered a single–family dwelling.
9. HVAC Equipment – Check only the major source of heat, plus central air conditioning if present. Only check "Radiant Baseboard" if there is no central source of heat.
10. Plumbing – A building permit cannot be issued until a sanitary permit has been issued for any new or affected existing private onsite wastewater treatment system.
14. Estimated Cost – Include the total cost of construction, including materials and market rate labor, but not the cost of land or landscaping.

SIGNATURE – Sign and date this application form. If you do not possess the Dwelling Contractor certification, then you will need to check the owner–occupancy statement for any erosion control or construction permits.

CONDITIONS OF APPROVAL – The authority having jurisdiction uses this section to state any conditions that must be complied with pursuant to issuing the building permit.

ISSUING JURISDICTION: This must be completed by the authority having jurisdiction.

- Check off Jurisdiction Status, such as town, village, city, county or state and fill in Municipality Name.
- Fill in State Inspection Agency number only if working under state inspection jurisdiction.
- Fill in Municipality Number of Dwelling Location.
- Check off type of Permit Issued, such as construction, HVAC, electrical or plumbing.
- Fill in Wisconsin Uniform Permit Seal Number, if project is a new one– or two–family dwelling.
- Fill in Name and Inspector Certification Number of person reviewing building plans and date building permit issued.

PLEASE RETURN SECOND PLY WITHIN 30 DAYS AFTER ISSUANCE TO: (You may fold along the dashed lines and insert this form into a window envelope.)

Safety & Buildings Division
P.O. Box 2509
Madison, WI 53701–2509

(Part of Ply 4 for Applicants)

Cautionary Statement to Owners Obtaining Building Permits

101.65 (lr) of the Wisconsin Statutes requires municipalities that enforce the Uniform Dwelling Code to provide an owner who applies for a building permit with a statement advising the owner that:

If the owner hires a contractor to perform work under the building permit and the contractor is not bonded or insured as required under s. 101.654 (2) (a), the following consequences might occur:

(a) The owner may be held liable for any bodily inquiry to or death of others or for any damage to the property of others that arises out of the work performed under the building permit or that is caused by any negligence by the contractor that occurs in connection with the work performed under the building permit.

(b) The owner may not be able to collect from the contractor damages for any loss sustained by the owner because of a violation by the contractor of the one– and two– family dwelling code or an ordinance enacted under sub. (1) (a), because of any bodily injury to or death of others or damage to the property of others that arises out of the work performed under the building permit or because of any bodily injury to or death of others or damage to the property of others that is caused by any negligence by the contractor that occurs in connection with the work performed under the building permit.

Additional Responsibilities for Owners of Projects Disturbing One or More Acre of Soil

I understand that this project is subject to ch. NR 151 regarding additional erosion control and stormwater management and will comply with those standards.

Owner's Signature: _____ Date:_____

SITE INFO

SUBDIVISION _____

LOT NO. _____ BLOCK NO. _____

ZONING DISTRICT _____

_____ 1/4, _____ 1/4, SEC _____, T _____, N. R _____ E or W

PARCEL NO. _____

SETBACKS:

FRONT _____ ft REAR _____ ft

LEFT _____ ft RIGHT _____ ft

INSPECTIONS

PHASE	ROUGH	FINAL	EROSION
FOOTING			
FOUNDATION			
BSMT DRAIN TILES			
CONSTRUCTION			
PLUMBING			
HEAT/VENT/AC			
ELECTRICAL			
INSULATION			
OCCUPANCY			

CONTRACTORS

NAME	CREDENTIAL #	PHONE
G.C.		
HVAC		
ELECT.		
PLBG		

SBD-5824 (R. 01/08)

Work shall not proceed until the inspector has approved the various stages of construction or two business days have elapsed since the day of inspection request. This permit will expire 24 months after the date of issuance if the building's exterior has not been completed. **Keep this card posted until final inspection has been made.** (WI Stats. 101.63)

WISCONSIN UNIFORM BUILDING PERMIT

Affix uniform permit seal here (when applicable) Seal No.:

☐ Constr ☐ HVAC ☐ Elect ☐ Plumb ☐ Erosion

Project:

Issued To

OWNER (AGENT)	PHONE
BUILDING SITE ADDRESS	
CITY, VILLAGE, TOWN	

Issued by

PERSON ISSUING	CERT. NO.
DATE ISSUED	TELEPHONE

Comments: _____

NOTICE OF NONCOMPLIANCE: This issuing jurisdiction shall notify the applicant in writing of any violations to be corrected. All cited violations, except erosion control ones, shall be corrected within 30 days of notification, unless extension time is granted.

INSPECTION REPORT AND NOTICE OF NONCOMPLIANCE

Print legibly using black ink.

Report Date:	Inspection Date	Permit No.:	State Seal #	Parcel No:	
Project Address		Subdivision		Lot No.:	Block No.:

Inspection Type(s): ☐Footing ☐Erosion Control ☐Foundation ☐Bsmt Drain Tile ☐Underslab Plbg ☐Rough HVAC ☐Rough Plumbing ☐Rough Electrical ☐Construction ☐Insulation/Energy ☐Final ☐Other:

Area Inspected, if Partial Inspection:	If Final Inspection, Occupancy May: ☐ Take Place Now ☐ Take Place Temporarily for _____ days ☐ Not Take Place Until The Items Below Are Corrected and Inspected ☐ Other:
Owner:	**Contractor:**

AN INSPECTION OF THE ABOVE PREMISES HAS DISCLOSED THE FOLLOWING NONCOMPLIANCES: ☐ **None Noted**

ORDER NO.	CODE SECTION	FINDINGS AND REQUIREMENTS

IMPORTANT: Please report when violations are corrected. AVOID DELAY

NOTICE OF NONCOMPLIANCE: All cited violations shall be corrected within 30 days after written notification unless an extension of time is granted. Each day that the violation continues after notice shall constitute a separate offense and is subject to remedies and penalties by the authority having jurisdiction. Appeals per ch. 68, WI Stats. and s. Comm 20.21.

Enforcing Jurisdiction: ☐Town ☐Village ☐City ☐County **OF:** ☐State Staff ☐State Insp Agency#	Bldg Location Muni # --	Authority By Municipal Ordinance Section::
Inspector's Name:	Violations Explained To:	Compliance Date:
Inspector's Address:	Office Hours:	Telephone No:

Orders Referred for Followup Legal Action To:	Date	Noncompliances Verified to Still Exist? (If needed, notate orders above.) ☐ Yes ☐ No	Additional Fees Collected(+)/Refunded(-) By State-Contracted Agency $ Since Original Permit Issuance:

Distribution: Ply 1 – Contractor Ply 2 – Inspector/State Ply 3 - Owner Ply 4 - File

SBD-6025 (R.06/05

DO NOT REMOVE

OFFICIAL NOTICE

Location/Item: _____

☐ **Lacking** _____ **Permit(s)** ☐ **Need** _____ **Inspection**
☐ **Expired** _____ **Permit** ☐ **Premises Housekeeping**
☐ **Unfit for Use**
☐ **Erosion Control:** ☐ **Perimeter Measures** ☐ Install ☐ Maintain
☐ **Non-Tracking Driveway** ☐ Install ☐ Maintain
☐ **Sediment Cleanup** ☐ Street & Sidewalks ☐ Adjoining Property

Code Section/Other: _____

_____

Action:

☐ **Contact Inspector** ☐ Now ☐ After Corrections
☐ **Correct** ☐ Now ☐ By End Of Today (UDC Tracking Cleanup)
☐ By End Of Next Workday (UDC Sediment Cleanup)
☐ In 48 Hrs (UDC Erosion Controls) ☐ By _____
☐ **Stop All Work** ☐ Except Corrections Code Section: _____

Failure To Comply Subjects You To Applicable Fines & Penalties or Work Stoppages

_____ _____ _____
Inspector/Agency **Phone Number** **Date**

SBD-10266 (R.6/07)

commerce.wi.gov
Wisconsin Department of Commerce

Application for Review, Petition for Variance SBD-9890X
SBD-9890X (R. 02/08) (Check our website at http://www.commerce.state.wi.us/SB/SB-DivForms.html for the most current version of this form)

-Complete all pages-

Safety & Buildings Division

Use this page for fax appointments (fax 877-840-9172)
Indicate date plans will be in S&B office _____

NOTE: Personal information you provide may be used for secondary purposes [Privacy Law s. 15.04(1)(m), Stats.]

1. Facility Information

Facility (Building) Name: _____

Number and Street: _____ Zip: _____

Commerce Site Number (if known): _____

Legal Description: _____

County of: _____

( ) City ( ) Village ( ) Town of: _____

Complete for confirmed appointments*:

Transaction ID: _____

Previous Related Trans. ID: _____

Assigned Reviewer: _____

Assigned Office: _____

Review Start Date*: _____

***Submittal must be received in the office of the appointment no later than 2 working days before the confirmed appointment.**

2. Owner Information Customer #		**3. Designer Information** Customer #	
Name		Designer	
Company Name		Design Firm	
Number and Street		Number and Street	
City, State, Zip Code		City, State, Zip Code	
Contact Person		Contact Person	
Telephone Number	Fax Number	Telephone Number	Fax Number

4. Plan Review Status

__ Plan submitted with petition
__ Plan will be submitted after petition determination
__ Requesting revision __ Other: _____
Commerce Transaction Number _____

Plan previously review by (please enclose a copy of review letter)

__ State __ Municipality __ Approved __ Held __ Denied
Code Being Petitioned __Commercial Building __ HVAC __ Plumbing
__ Private Sewage System__ Swimming Pool __ Electrical __ Flammable Liquids
__ Amusement Rides __ Uniform Dwelling Code __ Boilers __ Elevators
__ Gas Systems__ Refrigeration __ Rental Weatherization __ Other:_____

5. State the code section being petitioned AND the specific condition or issue you are requesting be covered under this petition for variance.

_____

6. Reason why compliance with the code cannot be attained without the variance. (Attach additional sheets, if necessary.)

_____

7. State your proposed means and rationale of providing equivalent degree of health, safety, or welfare as addressed by the code section petitioned.

_____

8. List attachments to be considered as part of the petitioner's statements (i.e., model code sections, test reports, research articles, expert opinion, previously approved variances, pictures, plans, sketches, etc.).

_____

VERIFICATION BY OWNER - PETITION IS VALID ONLY IF NOTARIZED WITH AFFIXED SEAL AND ACCOMPANIED BY REVIEW FEE

Note: Petitioner must be the owner of the building or system or credential applicant for a Comm 5 petition. Tenants, agents, designers, contractors, attorneys, etc., shall not sign petition unless Power of Attorney is submitted with the Petition for Variance Application.

_____, being duly sworn, I state as petitioner that I have read the foregoing petition and I believe
Petitioner's Name (type or print) it is true and that I have significant ownership rights to the subject building or project.

Petitioner's Signature	Subscribed and sworn to before me this date	Notary Public	My commission expires on

MAKE CHECKS PAYABLE TO DEPT. OF COMMERCE
Complete other side for variance from Comm 20-25 and Comm 61-65

TOTAL AMOUNT DUE
$_____
Attach check here.

Owner's Name	Project Location	Plan Number

Page 2 of _____

Fire Department Position Statement

To be completed for fire or life-safety related variances requested from Comm 61-65, Comm 10, Comm 16 and other fire related requirements.

I have read the application for variance and recommend: (check appropriate box)
☐ Approval ☐ Conditional Approval ☐ Denial ☐ No Comment

Explanation for recommendation including any conflicts with local rules and regulations and suggested conditions:

Fire Department Name and Address

Name of Fire Chief or Designee (type or print)	Telephone Number
Signature of Fire Chief or Designee	Date Signed

MUNICIPAL BUILDING INSPECTION RECOMMENDATION

To be completed for variances requested from Comm 20-23. Also to be used for Comm 16 electrical petitions, if Comm 61-65 plan review is by municipality or orders are written on the building under construction; optional in other cases. Please submit a copy of the orders

I have read the application for variance and recommend: (check appropriate box)
☐ Approval ☐ Conditional Approval ☐ Denial ☐ No Comment

Explanation for recommendation including any conflicts with local rules and regulations and suggested conditions:

Municipality Exercising Jurisdiction

Name and Address of Municipal Official (type or print)	Telephone Number of Enforcement Official
Signature of Municipal Enforcement Official	Date Signed

SBD-9890X (R. 12/01/2008)

Safety and Buildings Division
Bureau of Integrated Services

PETITION FOR VARIANCE

INFORMATION AND INSTRUCTIONS Comm 3

In instances where exact compliance with a particular code requirement cannot be met or alternative designs are desired, the Division has a petition for variance program where it reviews and considers acceptance of alternatives which are not in strict conformance with the letter of the code, but which meet the intent of the code. **A variance is not a waiver from a code requirement.** The petitioner must **provide an equivalency which meets the intent** of the code section petitioned to obtain a variance. Documentation of the rationale for the equivalency is requested below. Failure to provide adequate information may delay your petition. Pictures, sketches, and plans may be submitted to support equivalency. If the proposed equivalency does not adequately safeguard the health, safety, and welfare of building occupants, frequenters, firefighters, etc., the variance request will be denied. NOTE: A SEPARATE PETITION IS REQUIRED FOR EACH BUILDING AND EACH CODE ISSUE PETITIONED (i.e., 57.13 window issue cannot be processed on the same petition as 51.16 stair issue). It should be noted that **a petition for variance does not take the place of any required plan review submittal.**

The Division is unable to process petitions for variance that are not properly completed. Before submitting the application, the following items should be checked for completeness in order to avoid delays:

- Petitioner's name (typed or printed)
- Petitioner's signature
- The Petition for Variance Application must be signed by the owner of the building or system unless a Power of Attorney is submitted.
- Notary Public signature with affixed seal
- Analysis to establish equivalency, including any pictures, illustrations or sketches of the existing and proposed conditions to clearly convey your proposal to the reviewer.
- Proper fee
- Any required position statements by fire chief or municipal official

A position statement from the chief of the local fire department is required for fire– or life–safety issues. No fire department position statement is required for nonfire safety topics such as sanitary, plumbing or POWTS systems and energy conservation. Submit a municipal building inspection department position for Comm 16 electrical petitions, if Comm 61–65 plan review is by municipality or orders are written on the building under construction; optional in other cases. (Please submit a copy of the orders.) For rules relating to one– and two–family dwellings, only a position statement from the local enforcing municipality is required. Position statements must be completed and signed by the appropriate fire chief or municipal enforcement official. See the back of SBD–9890–X, Petition for Variance Application form for these position statement forms. Signatures or seals on all documents must be originals. Photocopies are not acceptable.

Contact numbers and fees for the Division's review of the petition for variance are as follows:

Chapter (circle appropriate category)	Revenue Code	Review Office	Contact Number	Fee	Revision Fee
Comm 16, Electrical	7631	Madison, Waukesha	(608) 266–3064	$300	$100
Comm 18, Elevators	8260	Waukesha	(262) 521–5444	$300	$100
Comm 20–25, Uniform Dwelling Code	7655	Madison	(608) 267–5113	$175	$ 50
Comm 34, Amusement Rides	8266	Madison	(608) 267–4434	$300	$100
Comm 40, Gas Systems	8258	Waukesha	(262) 548–8617	$300	$100
Comm 41, Boilers and Pressure Vessels	8258	Waukesha	(262) 548–8617	$300	$100
Comm 43, Anhydrous Ammonia	8258	Waukesha	(262) 548–8617	$300	$100
Comm 45, Mechanical Refrigeration	8258	Waukesha	(262) 548–8617	$300	$100
Comm 60–66, Commercial Building Code	7648	All Offices See Office Numbers Below		$550	$100
(For Fire System Petition for Variances — Contact the Green Bay or Waukesha offices)					
Comm 67, Rental Unit Energy Efficiency Code	7646	Madison	(608) 267–2240	$175	$ 50
Comm 81–85, General Plumbing	7657	All Offices See Office Numbers Below		$300	$ 75
Comm 90, Swimming Pools	7650	Madison	(608) 267–5265	$300	$ 75
Comm 83, POWTS	7657	All Offices See Office Numbers Below		$300	$ 75
All Other Chapters				$300	$100

Revisions are accepted only for 1 year after action on original petition.

Priority Review: The Department will schedule Petitions for Variance at the earliest available date, or the date requested at time of scheduling, whichever is later. Therefore, Priority Reviews are not generally available. In special circumstances, the Section Chief of the reviewing office may permit review prior to the scheduled date upon request by the submitter. If earlier review is permitted by the Section Chief, the Petition review fees will be doubled.

Except for special cases, the Division will review and make a determination on a petition for variance within 30 business days of the scheduled beginning date, provided all calculations, documents, and fees required for the review have been received.

Appointment and Scheduling Information

It is strongly recommended that an appointment be made in advance. **For your convenience we have installed a 24–hour, toll–free number dedicated to receiving faxed plan review appointment requests. The dedicated fax number is (877) 840–9172. Be sure to indicate whether you want the next available review statewide or prefer a choice of an office.** The petition review will be scheduled with the same office where the plan was/will be reviewed. You will receive a Schedule Letter back with an Appointment Date, Transaction ID No. and Assigned Reviewer. You may also email the request to PlanSchedule@commerce.state.wi.us. At the time of making an appointment, you may request review for a specific office of desired (beginning) date for review. Plans must be received in the office of the appointment no later than 2 working days before the confirmed appointment. Non–scheduled submittals or submittals received without a confirmed appointment date and transaction number on the form may be assigned to offices other than the receiving office depending on reviewer availability. **Certain petitions may be limited to certain offices depending on the petition issues. See above table for appropriate office.**

Madison S&BD	**Hayward S&BD**	**LaCrosse S&BD**	**Shawano S&BD**	**Green Bay S&BD**	**Waukesha S&BD**
201 W Washington Ave P.O. Box 7162 Madison WI 53707–7162 (608) 266–3151 Fax: (for sending questions or additional info to reviewers) (608) 267–9566 TTY: Contact Through Relay Email: PlanSchedule@commerce.state.wi.us	10541N Ranch Rd Hayward WI 54843 (715) 634–4870 Fax: (for sending questions to additional info to reviewers) (715) 634–5150 Email: PlanSchedule@commerce.state.wi.us	3824 Creekside La Holmen WI 54636 (608) 785–9334 Fax: (for sending questions or additional info to reviewers) (608) 785–9330 Email: PlanSchedule@commerce.state.wi.us	1340 E Green Bay Shawano WI 54166 (715) 524–3626 Fax: (for sending questions or additional info to reviewers) (608) 283–7444 Email: PlanSchedule@commerce.state.wi.us	2331 San Luis Place Green Bay WI 54304 (920) 492–5601 FAX: (for sending questions or additional info to reviewers) (920) 492–5604 Email: PlanSchedule@commerce.state.wi.us	141 NW Barstow St 4th Floor Waukesha WI 53188–3789 (262) 548–8600 Fax: (for sending questions or additional info to reviewers) (262) 548–8614 Email: PlanSchedule@commerce.state.wi.us

SANITARY PERMIT REQUIREMENTS

Section Comm 20.09 (9) (c) refers to s. Comm 83.25 (2), which reads as follows:

Comm 83.25 (2) ISSUANCE OF BUILDING PERMITS. (a) *General.* Pursuant to s. 145.195, Stats., the issuance of building permits by a municipality for unsewered properties shall be in accordance with this subsection.

Note: See appendix for a reprint of s. 145.195, Stats.

(b) *New construction.* A municipality may not issue a building permit to commence construction or installation of a structure that necessitates the use of a POWTS to serve the structure, unless:

1. The owner of the property possesses a sanitary permit for the installation of a POWTS in accordance with s. Comm 83.21; or

Note: Section Comm 83.21 outlines the procedures for the issuance of sanitary permits. Sections 145.135 and 145.19, Stats., mandate that no private sewage system may be installed unless the owner of the property holds a valid sanitary permit.

2. A POWTS of adequate capability and capacity to accommodate the wastewater flow and contaminant load already exists to serve the structure.

Note: See ss. Comm 83.02 and 83.03 concerning the application of current code requirements to existing POWTS.

(c) *Construction affecting wastewater flow or contaminant load.* 1. A municipality may not issue a building permit to commence construction of any addition or alteration to an existing structure when the proposed construction will modify the design wastewater flow or contaminant load, or both, to an existing POWTS, unless the owner of the property:

a. Possesses a sanitary permit to either modify the existing POWTS or construct a POWTS to accommodate the modification in wastewater flow or contaminant load, or both; or

b. Provides documentation to verify that the existing POWTS is sufficient to accommodate the modification in wastewater flow or contaminant load, or both.

2. For the purpose of this paragraph, a modification in wastewater flow or contaminant load shall be considered to occur:

a. For commercial facilities, public buildings, and places of employment, when there is a proposed change in occupancy of the structure; or the proposed modification affects either the type or number of plumbing appliances, fixtures or devices discharging to the system; and

b. For dwellings, when there is an increase or decrease in the number of bedrooms.

(d) *Documentation of existing capabilities.* Documentation to verify whether an existing POWTS can accommodate a modification in wastewater flow or contaminant load, or both, shall include at least one of the following:

1. A copy of the plan for the existing POWTS that delineates minimum and maximum performance capabilities and which has been previously approved by the department or the governmental unit.

2. Information on the performance capabilities for the existing POWTS that has been recognized through a product approval under ch. Comm 84.

3. A written investigative report prepared by an architect, engineer, designer of plumbing systems, designer of private sewage systems, master plumber, master plumber–restricted service or certified POWTS inspector analyzing the proposed modification and the performance capabilities of the existing POWTS.

(e) Where the performance capability of the existing POWTS serving a dwelling is not based on the number of bedrooms within the dwelling, information documenting that design condition shall be recorded as a covenant running with the deed for the property.

(f) *Setbacks.* 1. A municipality may not issue a building permit for construction of any structure or addition to a structure on a site where there exists a POWTS, unless the proposed construction conforms to the applicable setback limitations under s. Comm 83.43 (8) (i).

2. The applicant for a building permit shall provide documentation to the municipality issuing the building permit showing the location and setback distances for the proposed construction relative to all of the following:

a. Existing POWTS treatment components.

b. Existing POWTS holding components.

c. Existing POWTS dispersal components.

Note: A municipality which issues building permits may delegate to the governmental unit responsible for issuing sanitary permits the determination of whether the proposed construction will affect or interfere with an existing POWTS relating to capability or location of the existing POWTS.

MINIMUM FASTENER SCHEDULE TABLE

Other interior and exterior panel products and finishes installed per manufacturer requirements.

For engineered connectors, use manufacturer's specified fasteners.

Description of Building Materials/Connection	Number and Type of Fastener[1 2 3]
Floor Framing	
Joist to joist, face nailed over support	2–12d
Joist to sill or girder, toe nail	2–16d, 3–8d
Band or rim joist to joist, end nail	3–16d
Band or rim joist to sill or top plate	2–16d at 16″ o.c.
Bridging to joist, toe nail each end	2–8d
Built–up girder and beams, top loaded	10d at 32″ o.c. at top and bottom and staggered and two at ends and at each splice
Built–up girder and beams, side–loaded	16d at 16″ o.c. at top and bottom and staggered and two at ends and at each splice
Ledger strip to beam, face nail	3–16d each joist
Joist on ledger to beam, toe nail	3–8d
Wall Framing	
Sole plate to joist or blocking, face nail	16d at 16″ o.c.
Top or sole plate to stud, end nail	2–16d
Stud to sole plate, toe nail	4–8d or 3–16d
Doubled studs, face nail	16d at 24″ o.c.
Doubled top plates, face nail	16d at 16″ o.c.
Top plates, laps and intersections, face nail	2–16d
Continuous header, two pieces	16d at 16″ o.c. along each edge
Continuous header to stud, toe nail	4–8d
1″ corner brace to each stud and plate, face nail	2–8d or 2 staples, 1¾″
Built–up corner studs	16d at 30″ o.c., 16d at 24″ o.c.
Roof/Ceiling Framing	
Ceiling joists to plate, toe nail	2–16d, 3–8d
Ceiling joist, laps over partitions, face nail	3–16d
Ceiling joist to parallel rafters, face nail	3–16d
Rafter to plate, toe nail (maximum 6 rafter span, engineered connector for longer)	2–16d, 3–8d
Roof rafters to ridge, valley or hip rafters, toe nail	4–16d
Roof rafters to ridge, valley or hip rafters, face nail	3–16d
Collar ties to rafters, face nail	3–8d
Boards and planks	
1″ x 6″ subfloor or less to each joist, face nail	2–8d or 2 staples, 1¾″
Wider than 1″ x 6″ subfloor toe to each joist, face nail	3–8d or 4 staples 1¾″
2″ subfloor to joist or girder, blind and face nail	2–16d
1″ x 6″ roof or wall sheathing to each bearing, face nail	2–8d or 2 staples, 1¾″
1″ x 8″ roof or wall sheathing to each bearing, face nail	2–8d or 3 staples, 1¾″
Wider than 1″ x 8″ roof sheathing to each bearing, face nail	3–8d or 4 staples, 1¾″
2″planks	2–16d at each bearing

Panel Sheathing

Material	Fastener	Spacing of Fastener	
		Edges	Intermediate Supports
Engineered wood panel for subfloor and roof sheathing and wall corner wind bracing to framing			
5/16" to ½"	6d common or deformed nail or staple, 1½"	6"	12" [4]
5/8" to ¾"	8d smooth or common, 6d deformed nail, or staple, 14 ga. 1¾"	6"	12" [4]
7/8" to 1"	8d common or deformed nail	6"	12"
1 1/8" to 1¼"	10d smooth or common, or 8d deformed nail	6"	12"
Combination subfloor/ underlayment to framing			
¾" or less	6d deformed or 8d smooth or common nail	6"	12"
7/8" to 1"	8d smooth, common or deformed nail	6"	12"
1 1/8" to 1 ¼"	10d smooth or common or 8d deformed nail	6"	12"
Wood panel siding to framing			
½" or less	6d corrosion–resistant siding and casing nails	6"	12"
5/8"	8d corrosion–resistant siding and casing nails	6"	12"
½" structural cellulosic fiberboard sheathing	1½" galvanized roofing nail; 8d common nail; staple 16 ga., 1½" long	3"	6"
25/32" structural cellulosic fiberboard sheathing	1¾" galvanized roofing nail; 8d common nail; staple 16 ga., 1¾" long	3"	6"
½" gypsum sheathing[5]	1½" galvanized roofing nail; 6d common nail; staple galvanized 1½" long; 1¼" screws, Type W or S	4"	8"
5/8" gypsum sheathing[5]	1¾" galvanized roofing nail; 8d common nail; staple galvanized 1 5/8" long; 1 5/8" screws, Type W or S	4"	8"

[1] All nails are smooth–common, box or deformed shank except where otherwise stated.

[2] Nail is a general description and may be T–head, modified round head or round head.

[3] Staples are 16–gauge wire, unless otherwise noted, and have a minimum 7/16" o.d. crown width.

[4] Staples shall be spaced at not more than 10" o.c. at intermediate supports for floors.

[5] Apply vertically 4' x 8' or 4' x 9' panels.

UDC Floor & Ceiling Joist and Roof Rafter Span Tables and Design Value Tables

Use the following Span Tables to determine the maximum spans for floor and ceiling joists and roof rafters. These spans are based on:

- Simple, single spans (although the tables may be safely used for continuous two–span floor joists)
- Uniformly distributed loads
- Fully supported members with one edge properly sheathed and nailed
- For floor joists and roof rafters, the top edge shall be properly sheathed and nailed
- Rafters with a minimum 3:12 slope

The criteria for each Span Table is given in the upper left hand corner and is also summarized in the table of Span Tables below. Choose the appropriate Span Table based on the member type and required loading. Select your desired member depth, member spacing and span to determine the minimum Fb value. Note that these tables include recommended deflection criteria. However, for strict code compliance, only the Fb strength requirements must be satisfied. The modulus of elasticity (E) values, would be met for serviceability purposes only.

Note that straight–line interpolation is permitted for intermediate spans and design values. Span is measured from face to face of supports plus one–half of the required bearing of 1.5″ on wood or metal and 3″ on masonry or concrete at each end. For sloping rafters, the span is measured along the horizontal projection.

Section Comm 21.27 allows reduction of the snow live load for roof slopes greater than 30 degrees (7/12 slope) based on the formula Cs = 1 – (a–30)/40, where "a" is the slope of the roof expressed in degrees. Following is a table of tabulated values for certain roof slopes.

Slope	Angle in Degrees	Zone 1 Live Load (psf)	Zone 2 Live Load (psf)
7/12	30	40	30
10/12	40	30	22.5
12/12	45	25	18.8
14/12	50	20	15

Use the Design Value tables following the Span Tables to determine the acceptable species and grades to satisfy minimum Fb values obtained from the Span Tables. The Design Value tables assume at least three members spaced no more than 24″ on center. Use the Normal Duration column Fb values for joists and the Snow Loading column Fb values for rafters.

See the following examples for further guidance.

Tables are reprinted courtesy of American Forest & Paper Association.

Table No.	Member Type	Live Load (psf)	Dead Load (psf)	Condition	(Deflection)*
F–2	Floor Joists	40	10	–	L/360
C–1	Ceiling Joists	10	5	Drywall ceiling, no attic storage	L/240
C–2	Ceiling Joists	20	10	Attic storage	L/240
R–2	Roof Rafters	30 (Zone 2)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/240
R–3	Roof Rafters	40 (Zone 1)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/240
R–10	Roof Rafters	30 (Zone 2)	20	Heavy roof covering (clay tile)	L/240
R–11	Roof Rafters	40 (Zone 1)	20	Heavy roof covering (clay tile)	L/240
R–14	Roof Rafters	30 (Zone 2)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/180
R–15	Roof Rafters	40 (Zone 1)	10	Maximum 2 layers of asphalt shingles or wood shakes/shingles	L/180
R–22	Roof Rafters	30 (Zone 2)	20	Heavy roof covering (clay tile)	L/180
R–23	Roof Rafters	40 (Zone 1)	20	Heavy roof covering (clay tile)	L/180

*Deflection criteria are optional. For roof rafters with drywall on the underside, use the stricter L/240 tables to limit deflection.

Example 1. Floor Joists. Assume a required single span of 12′–9″, dead load of 10 psf and joists spaced 16″ on center. Table F–2 (see following highlighted tables) shows that one solution is a grade of 2x8 having an Fb value of 1255 would allow a span of 12′–10″ which satisfies the condition. (Note that the recommended E value to limit deflection would be 1,600,000.) Going to the Design Value Tables, we find that as an example, 2x8 Hem Fir grade No.1 has an Fb value of 1310 for normal duration. (It also has an E value of 1,500,000 which does not satisfy the recommended deflection criteria.)

Example 2. Rafters. Assume a horizontal projected span of 13′–0″, a live load of 40 psf, dead load of 10 psf, a roof slope of 4/12 and rafters spaced 16″ on center. Since the slope is shallower than 7/12, there is no allowable reduction of the snow live load. Table R–3 shows that a 2x8 having an Fb value of 1300 would allow a span of 13′–1″ which satisfies the condition. (Note that the recommended E value to limit deflection would be 1,120,000.) Going to the Design Value Tables, we find that as an example, 2x8 Douglas Fir–Larch grade No.2 has an Fb value of 1390 for snow loading. (It also has an E value of 1,600,000 which satisfies the recommended deflection criteria.)

Example 1

TABLE F- 2
FLOOR JOISTS WITH L/360 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection - For 40 psf live load.
Limited to span in inches divided by 360.
Strength - Live load of 40 psf plus dead load
of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	8- 6	8-10	9- 2	9- 6	9- 9	10- 0	10- 3	10- 6	10- 9	10-11	11- 2	11- 4	11- 7	11- 9	11-11	12- 1	12- 3
	16.0	7- 9	8- 0	8- 4	8- 7	8-10	9- 1	9- 4	9- 6	9- 9	9-11	10- 2	10- 4	10- 6	10- 8	10-10	11- 0	11- 2
2x 6	19.2	7- 3	7- 7	7-10	8- 1	8- 4	8- 7	8- 9	9- 0	9- 2	9- 4	9- 6	9- 8	9-10	10- 0	10- 2	10- 4	10- 6
	24.0	6- 9	7- 0	7- 3	7- 6	7- 9	7-11	8- 2	8- 4	8- 6	8- 8	8-10	9- 0	9- 2	9- 4	9- 6	9- 7	9- 9
	12.0	11- 3	11- 8	12- 1	12- 6	12-10	13- 2	13- 6	13-10	14- 2	14- 5	14- 8	15- 0	15- 3	15- 6	15- 9	15-11	16- 2
	16.0	10- 2	10- 7	11- 0	11- 4	11- 8	12- 0	12- 3	12- 7	12-10	13- 1	13- 4	13- 7	13-10	14- 1	14- 3	14- 6	14- 8
2x 8	19.2	9- 7	10- 0	10- 4	10- 8	11- 0	11- 3	11- 7	11-10	12- 1	12- 4	12- 7	12-10	13- 0	13- 3	13- 5	13- 8	13-10
	24.0	8-11	9- 3	9- 7	9-11	10- 2	10- 6	10- 9	11- 0	11- 3	11- 5	11- 8	11-11	12- 1	12- 3	12- 6	12- 8	12-10
	12.0	14- 4	14-11	15- 5	15-11	16- 5	16-10	17- 3	17- 8	18- 0	18- 5	18- 9	19- 1	19- 5	19- 9	20- 1	20- 4	20- 8
	16.0	13- 0	13- 6	14- 0	14- 6	14-11	15- 3	15- 8	16- 0	16- 5	16- 9	17- 0	17- 4	17- 8	17-11	18- 3	18- 6	18- 9
2x10	19.2	12- 3	12- 9	13- 2	13- 7	14- 0	14- 5	14- 9	15- 1	15- 5	15- 9	16- 0	16- 4	16- 7	16-11	17- 2	17- 5	17- 8
	24.0	11- 4	11-10	12- 3	12- 8	13- 0	13- 4	13- 8	14- 0	14- 4	14- 7	14-11	15- 2	15- 5	15- 8	15-11	16- 2	16- 5
	12.0	17- 5	18- 1	18- 9	19- 4	19-11	20- 6	21- 0	21- 6	21-11	22- 5	22-10	23- 3	23- 7	24- 0	24- 5	24- 9	25- 1
	16.0	15-10	16- 5	17- 0	17- 7	18- 1	18- 7	19- 1	19- 6	19-11	20- 4	20- 9	21- 1	21- 6	21-10	22- 2	22- 6	22-10
2x12	19.2	14-11	15- 6	16- 0	16- 7	17- 0	17- 6	17-11	18- 4	18- 9	19- 2	19- 6	19-10	20- 2	20- 6	20-10	21- 2	21- 6
	24.0	13-10	14- 4	14-11	15- 4	15-10	16- 3	16- 8	17- 0	17- 5	17- 9	18- 1	18- 5	18- 9	19- 1	19- 4	19- 8	19-11
F_b	12.0	718	777	833	888	941	993	1043	1092	1140	1187	1233	1278	1323	1367	1410	1452	1494
F_b	16.0	790	855	917	977	1036	1093	1148	1202	1255	1306	1357	1407	1456	1504	1551	1598	1644
F_b	19.2	840	909	975	1039	1101	1161	1220	1277	1333	1388	1442	1495	1547	1598	1649	1698	1747
F_b	24.0	905	979	1050	1119	1186	1251	1314	1376	1436	1496	1554	1611	1667	1722	1776	1829	1882

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

Example 1

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern White Pine					
Select Structural	2x4	2155	2480	1,200,000	NELMA NSLB
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	
Select Structural	2x8	1725	1985	1,200,000	
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Hem Fir					
Select Structural	2x4	2415	2775	1,600,000	WCLIB WWPA
No.1 & Btr		1810	2085	1,500,000	
No.1		1640	1885	1,500,000	
No.2		1465	1685	1,300,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	2095	2405	1,600,000	
No.1 & Btr		1570	1805	1,500,000	
No.1		1420	1635	1,500,000	
No.2		1270	1460	1,300,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1930	2220	1,600,000	
No.1 & Btr		1450	1665	1,500,000	
No.1		1310	1510	1,500,000	
No.2		1175	1350	1,300,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1770	2035	1,600,000	
No.1 & Btr		1330	1525	1,500,000	
No.1		1200	1380	1,500,000	
No.2		1075	1235	1,300,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1 & Btr		1210	1390	1,500,000	
No.1		1095	1255	1,500,000	
No.2		980	1125	1,300,000	
No.3		575	660	1,200,000	

Example 2

TABLE R-3

RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength - Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection - For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																				
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
2x 6	12.0	5-6	6-4	7-1	7-9	8-5	9-0	9-6	10-0	10-6	11-0	11-5	11-11	12-4	12-8	13-1	13-6	13-10	14-2				
	16.0	4-9	5-6	6-2	6-9	7-3	7-9	8-3	8-8	9-1	9-6	9-11	10-3	10-8	11-0	11-4	11-8	12-0	12-4	12-7	12-11		
	19.2	4-4	5-0	5-7	6-2	6-8	7-1	7-6	7-11	8-4	8-8	9-1	9-5	9-9	10-0	10-4	10-8	10-11	11-3	11-6	11-9	12-0	12-4
	24.0	3-11	4-6	5-0	5-6	5-11	6-4	6-9	7-1	7-5	7-9	8-1	8-5	8-8	9-0	9-3	9-6	9-9	10-0	10-3	10-6	10-9	11-0
2x 8	12.0	7-3	8-4	9-4	10-3	11-1	11-10	12-7	13-3	13-11	14-6	15-1	15-8	16-3	16-9	17-3	17-9	18-3	18-9				
	16.0	6-3	7-3	8-1	8-11	9-7	10-3	10-10	11-6	12-0	12-7	13-1	13-7	14-0	14-6	14-11	15-5	15-10	16-3	16-7	17-0		
	19.2	5-9	6-7	7-5	8-1	8-9	9-4	9-11	10-6	11-0	11-6	11-11	12-5	12-10	13-3	13-8	14-0	14-5	14-10	15-2	15-6	15-10	16-3
	24.0	5-2	5-11	6-7	7-3	7-10	8-4	8-11	9-4	9-10	10-3	10-8	11-1	11-6	11-10	12-2	12-7	12-11	13-3	13-7	13-11	14-2	14-6
2x10	12.0	9-3	10-8	11-11	13-1	14-2	15-1	16-0	16-11	17-9	18-6	19-3	20-0	20-8	21-4	22-0	22-8	23-3	23-11				
	16.0	8-0	9-3	10-4	11-4	12-3	13-1	13-10	14-8	15-4	16-0	16-8	17-4	17-11	18-6	19-1	19-7	20-2	20-8	21-2	21-8		
	19.2	7-4	8-5	9-5	10-4	11-2	11-11	12-8	13-4	14-0	14-8	15-3	15-10	16-4	16-11	17-5	17-11	18-5	18-11	19-4	19-10	20-3	20-8
	24.0	6-6	7-7	8-5	9-3	10-0	10-8	11-4	11-11	12-6	13-1	13-7	14-2	14-8	15-1	15-7	16-0	16-6	16-11	17-4	17-9	18-1	18-6
2x12	12.0	11-3	13-0	14-6	15-11	17-2	18-4	19-6	20-6	21-7	22-6	23-5	24-4	25-2	26-0								
	16.0	9-9	11-3	12-7	13-9	14-11	15-11	16-10	17-9	18-8	19-6	20-3	21-1	21-9	22-6	23-2	23-10	24-6	25-2	25-9			
	19.2	8-11	10-3	11-6	12-7	13-7	14-6	15-5	16-3	17-0	17-9	18-6	19-3	19-11	20-6	21-2	21-9	22-5	23-0	23-6	24-1	24-8	25-2
	24.0	7-11	9-2	10-3	11-3	12-2	13-0	13-9	14-6	15-3	15-11	16-7	17-2	17-9	18-4	18-11	19-6	20-0	20-6	21-1	21-7	22-0	22-6
E	12.0	0.14	0.22	0.31	0.41	0.51	0.63	0.75	0.88	1.01	1.15	1.30	1.45	1.61	1.77	1.94	2.12	2.30	2.48				
E	16.0	0.12	0.19	0.27	0.35	0.44	0.54	0.65	0.76	0.88	1.00	1.12	1.26	1.39	1.54	1.68	1.83	1.99	2.15	2.31	2.48		
E	19.2	0.11	0.18	0.24	0.32	0.41	0.50	0.59	0.69	0.80	0.91	1.03	1.15	1.27	1.40	1.54	1.67	1.81	1.96	2.11	2.26	2.42	2.58
E	24.0	0.10	0.16	0.22	0.29	0.36	0.44	0.53	0.62	0.71	0.81	0.92	1.03	1.14	1.25	1.37	1.50	1.62	1.75	1.89	2.02	2.16	2.30

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

Example 2

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Cottonwood					
Select Structural	2x4	1510	1735	1,200,000	NSLB
No.1		1080	1240	1,200,000	
No.2		1080	1240	1,100,000	
No.3		605	695	1,000,000	
Stud		600	690	1,000,000	
Construction		805	925	1,000,000	
Standard		460	530	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		935	1075	1,200,000	
No.2		935	1075	1,100,000	
No.3		525	600	1,000,000	
Stud		545	630	1,000,000	
Select Structural	2x8	1210	1390	1,200,000	
No.1		865	990	1,200,000	
No.2		865	990	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1105	1275	1,200,000	
No.1		790	910	1,200,000	
No.2		790	910	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		720	825	1,200,000	
No.2		720	825	1,100,000	
No.3		405	465	1,000,000	
Douglas Fir-Larch					
Select Structural	2x4	2500	2875	1,900,000	WCLIB WWPA
No.1 & Btr		1985	2280	1,800,000	
No.1		1725	1985	1,700,000	
No.2		1510	1735	1,600,000	
No.3		865	990	1,400,000	
Stud		855	980	1,400,000	
Construction		1150	1325	1,500,000	
Standard		635	725	1,400,000	
Utility		315	365	1,300,000	
Select Structural	2x6	2170	2495	1,900,000	
No.1 & Btr		1720	1975	1,800,000	
No.1		1495	1720	1,700,000	
No.2		1310	1505	1,600,000	
No.3		750	860	1,400,000	
Stud		775	895	1,400,000	
Select Structural	2x8	2000	2300	1,900,000	
No.1 & Str		1585	1825	1,800,000	
No.1		1380	1585	1,700,000	
No.2		1210	1390	1,600,000	
No.3		690	795	1,400,000	
Select Structural	2x10	1835	2110	1,900,000	
No.1 & Btr		1455	1675	1,800,000	
No.1		1265	1455	1,700,000	
No.2		1105	1275	1,600,000	
No.3		635	725	1,400,000	
Select Structural	2x12	1670	1920	1,900,000	
No.1 & Btr		1325	1520	1,800,000	
No.1		1150	1325	1,700,000	
No.2		1005	1155	1,600,000	
No.3		575	660	1,400,000	

TABLE F–2
FLOOR JOISTS WITH L/360 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 40 psf live load.
Limited to span in inches divided by 360.
Strength – Live load of 40 psf plus dead load
of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	8–6	8–10	9–2	9–6	9–9	10–0	10–3	10–6	10–9	10–11	11–2	11–4	11–7	11–9	11–11	12–1	12–3
	16.0	7–9	8–0	8–4	8–7	8–10	9–1	9–4	9–6	9–9	9–11	10–2	10–4	10–6	10–8	10–10	11–0	11–2
2x 6	19.2	7–3	7–7	7–10	8–1	8–4	8–7	8–9	9–0	9–2	9–4	9–6	9–8	9–10	10–0	10–2	10–4	10–6
	24.0	6–9	7–0	7–3	7–6	7–9	7–11	8–2	8–4	8–6	8–8	8–10	9–0	9–2	9–4	9–6	9–7	9–9
	12.0	11–3	11–8	12–1	12–6	12–10	13–2	13–6	13–10	14–2	14–5	14–8	15–0	15–3	15–6	15–9	15–11	16–2
	16.0	10–2	10–7	11–0	11–4	11–8	12–0	12–3	12–7	12–10	13–1	13–4	13–7	13–10	14–1	14–3	14–6	14–8
2x 8	19.2	9–7	10–0	10–4	10–8	11–0	11–3	11–7	11–10	12–1	12–4	12–7	12–10	13–0	13–3	13–5	13–8	13–10
	24.0	8–11	9–3	9–7	9–11	10–2	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–3	12–6	12–8	12–10
	12.0	14–4	14–11	15–5	15–11	16–5	16–10	17–3	17–8	18–0	18–5	18–9	19–1	19–5	19–9	20–1	20–4	20–8
	16.0	13–0	13–6	14–0	14–6	14–11	15–3	15–8	16–0	16–5	16–9	17–0	17–4	17–8	17–11	18–3	18–6	18–9
2x10	19.2	12–3	12–9	13–2	13–7	14–0	14–5	14–9	15–1	15–5	15–9	16–0	16–4	16–7	16–11	17–2	17–5	17–8
	24.0	11–4	11–10	12–3	12–8	13–0	13–4	13–8	14–0	14–4	14–7	14–11	15–2	15–5	15–8	15–11	16–2	16–5
	12.0	17–5	18–1	18–9	19–4	19–11	20–6	21–0	21–6	21–11	22–5	22–10	23–3	23–7	24–0	24–5	24–9	25–1
	16.0	15–10	16–5	17–0	17–7	18–1	18–7	19–1	19–6	19–11	20–4	20–9	21–1	21–6	21–10	22–2	22–6	22–10
2x12	19.2	14–11	15–6	16–0	16–7	17–0	17–6	17–11	18–4	18–9	19–2	19–6	19–10	20–2	20–6	20–10	21–2	21–6
	24.0	13–10	14–4	14–11	15–4	15–10	16–3	16–8	17–0	17–5	17–9	18–1	18–5	18–9	19–1	19–4	19–8	19–11
F_b	12.0	718	777	833	888	941	993	1043	1092	1140	1187	1233	1278	1323	1367	1410	1452	1494
F_b	16.0	790	855	917	977	1036	1093	1148	1202	1255	1306	1357	1407	1456	1504	1551	1598	1644
F_b	19.2	840	909	975	1039	1101	1161	1220	1277	1333	1388	1442	1495	1547	1598	1649	1698	1747
F_b	24.0	905	979	1050	1119	1186	1251	1314	1376	1436	1496	1554	1611	1667	1722	1776	1829	1882

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE C–1
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 10 psf live load.
Limited to span in inches divided by 240.
Strength – Live Load of 10 psf plus
dead load of 5 psf determines the required fiber stress value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	9–10	10–3	10–7	10–11	11–3	11–7	11–10	12–2	12–5	12–8	12–11	13–2	13–4	13–7	13–9	14–0	14–2
	16.0	8–11	9–4	9–8	9–11	10–3	10–6	10–9	11–0	11–3	11–6	11–9	11–11	12–2	12–4	12–6	12–9	12–11
2x 4	19.2	8–5	8–9	9–1	9–4	9–8	9–11	10–2	10–4	10–7	10–10	11–0	11–3	11–5	11–7	11–9	12–0	12–2
	24.0	7–10	8–1	8–5	8–8	8–11	9–2	9–5	9–8	9–10	10–0	10–3	10–5	10–7	10–9	10–11	11–1	11–3
	12.0	15–6	16–1	16–8	17–2	17–8	18–2	18–8	19–1	19–6	19–11	20–3	20–8	21–0	21–4	21–8	22–0	22–4
	16.0	14–1	14–7	15–2	15–7	16–1	16–6	16–11	17–4	17–8	18–1	18–5	18–9	19–1	19–5	19–8	20–0	20–3
2x 6	19.2	13–3	13–9	14–3	14–8	15–2	15–7	15–11	16–4	16–8	17–0	17–4	17–8	17–11	18–3	18–6	18–10	19–1
	24.0	12–3	12–9	13–3	13–8	14–1	14–5	14–9	15–2	15–6	15–9	16–1	16–4	16–8	16–11	17–2	17–5	17–8
	12.0	20–5	21–2	21–11	22–8	23–4	24–0	24–7	25–2	25–8								
	16.0	18–6	19–3	19–11	20–7	21–2	21–9	22–4	22–10	23–4	23–10	24–3	24–8	25–2	25–7	25–11		
2x 8	19.2	17–5	18–1	18–9	19–5	19–11	20–6	21–0	21–6	21–11	22–5	22–10	23–3	23–8	24–0	24–5	24–9	25–2
	24.0	16–2	16–10	17–5	18–0	18–6	19–0	19–6	19–11	20–5	20–10	21–2	21–7	21–11	22–4	22–8	23–0	23–4
	12.0	26–0																
	16.0	23–8	24–7	25–5														
2x10	19.2	22–3	23–1	23–11	24–9	25–5												
	24.0	20–8	21–6	22–3	22–11	23–8	24–3	24–10	25–5	26–0								
F_b	12.0	711	769	825	880	932	983	1033	1082	1129	1176	1221	1266	1310	1354	1396	1438	1480
F_b	16.0	783	847	909	968	1026	1082	1137	1191	1243	1294	1344	1394	1442	1490	1537	1583	1629
F_b	19.2	832	900	965	1029	1090	1150	1208	1265	1321	1375	1429	1481	1533	1583	1633	1682	1731
F_b	24.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE C–2
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection – For 20 psf live load.
Limited to span in inches divided by 240.
Strength – Live Load of 20 psf plus
dead load of 10 psf determines the required bending design value.

Size (in)	Spacing (in)	Joist Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
	12.0	7–10	8–1	8–5	8–8	8–11	9–2	9–5	9–8	9–10	10–0	10–3	10–5	10–7	10–9	10–11	11–1	11–3
	16.0	7–1	7–5	7–8	7–11	8–1	8–4	8–7	8–9	8–11	9–1	9–4	9–6	9–8	9–9	9–11	10–1	10–3
2x 4	19.2	6–8	6–11	7–2	7–5	7–8	7–10	8–1	8–3	8–5	8–7	8–9	8–11	9–1	9–3	9–4	9–6	9–8
	24.0	6–2	6–5	6–8	6–11	7–1	7–3	7–6	7–8	7–10	8–0	8–1	8–3	8–5	8–7	8–8	8–10	8–11
	12.0	12–3	12–9	13–3	13–8	14–1	14–5	14–9	15–2	15–6	15–9	16–1	16–4	16–8	16–11	17–2	17–5	17–8
	16.0	11–2	11–7	12–0	12–5	12–9	13–1	13–5	13–9	14–1	14–4	14–7	14–11	15–2	15–5	15–7	15–10	16–1
2x 6	19.2	10–6	10–11	11–4	11–8	12–0	12–4	12–8	12–11	13–3	13–6	13–9	14–0	14–3	14–6	14–8	14–11	15–2
	24.0	9–9	10–2	10–6	10–10	11–2	11–5	11–9	12–0	12–3	12–6	12–9	13–0	13–3	13–5	13–8	13–10	14–1
	12.0	16–2	16–10	17–5	18–0	18–6	19–0	19–6	19–11	20–5	20–10	21–2	21–7	21–11	22–4	22–8	23–0	23–4
	16.0	14–8	15–3	15–10	16–4	16–10	17–3	17–9	18–1	18–6	18–11	19–3	19–7	19–11	20–3	20–7	20–11	21–2
2x 8	19.2	13–10	14–5	14–11	15–5	15–10	16–3	16–8	17–1	17–5	17–9	18–1	18–5	18–9	19–1	19–5	19–8	19–11
	24.0	12–10	13–4	13–10	14–3	14–8	15–1	15–6	15–10	16–2	16–6	16–10	17–2	17–5	17–9	18–0	18–3	18–6
	12.0	20–8	21–6	22–3	22–11	23–8	24–3	24–10	25–5	26–0								
	16.0	18–9	19–6	20–2	20–10	21–6	22–1	22–7	23–1	23–8	24–1	24–7	25–0	25–5	25–10			
2x10	19.2	17–8	18–4	19–0	19–7	20–2	20–9	21–3	21–9	22–3	22–8	23–1	23–7	23–11	24–4	24–9	25–1	25–5
	24.0	16–5	17–0	17–8	18–3	18–9	19–3	19–9	20–2	20–8	21–1	21–6	21–10	22–3	22–7	22–11	23–4	23–8
F_b	12.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864
F_b	16.0	986	1067	1145	1220	1293	1364	1433	1500	1566	1631	1694	1756	1817	1877	1936	1995	2052
F_b	19.2	1048	1134	1216	1296	1374	1449	1522	1594	1664	1733	1800	1866	1931	1995	2058	2120	2181
F_b	24.0	1129	1221	1310	1396	1480	1561	1640	1717	1793	1866	1939	2010	2080	2149	2217	2283	2349

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–2
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																				
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
	12.0	6–2	7–1	7–11	8–8	9–5	10–0	10–8	11–3	11–9	12–4	12–10	13–3	13–9	14–2	14–8	15–1	15–6	15–11				
	16.0	5–4	6–2	6–10	7–6	8–2	8–8	9–3	9–9	10–2	10–8	11–1	11–6	11–11	12–4	12–8	13–1	13–5	13–9	14–1	14–5		
2x 6	19.2	4–10	5–7	6–3	6–10	7–5	7–11	8–5	8–11	9–4	9–9	10–1	10–6	10–10	11–3	11–7	11–11	12–3	12–7	12–10	13–2	13–6	
	24.0	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4
	12.0	8–1	9–4	10–6	11–6	12–5	13–3	14–0	14–10	15–6	16–3	16–10	17–6	18–1	18–9	19–4	19–10	20–5	20–11				
	16.0	7–0	8–1	9–1	9–11	10–9	11–6	12–2	12–10	13–5	14–0	14–7	15–2	15–8	16–3	16–9	17–2	17–8	18–1	18–7	19–0		
2x 8	19.2	6–5	7–5	8–3	9–1	9–9	10–6	11–1	11–8	12–3	12–10	13–4	13–10	14–4	14–10	15–3	15–8	16–2	16–7	16–11	17–4	17–9	
	24.0	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3
	12.0	10–4	11–11	13–4	14–8	15–10	16–11	17–11	18–11	19–10	20–8	21–6	22–4	23–1	23–11	24–7	25–4	26–0					
	16.0	8–11	10–4	11–7	12–8	13–8	14–8	15–6	16–4	17–2	17–11	18–8	19–4	20–0	20–8	21–4	21–11	22–6	23–1	23–8	24–3		
2x10	19.2	8–2	9–5	10–7	11–7	12–6	13–4	14–2	14–11	15–8	16–4	17–0	17–8	18–3	18–11	19–6	20–0	20–7	21–1	21–8	22–2	22–8	
	24.0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8
	12.0	12–7	14–6	16–3	17–9	19–3	20–6	21–9	23–0	24–1	25–2												
	16.0	10–11	12–7	14–1	15–5	16–8	17–9	18–10	19–11	20–10	21–9	22–8	23–6	24–4	25–2	25–11							
2x12	19.2	9–11	11–6	12–10	14–1	15–2	16–3	17–3	18–2	19–0	19–11	20–8	21–6	22–3	23–0	23–8	24–4	25–0	25–8				
	24.0	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2
E	12.0	0.15	0.23	0.32	0.43	0.54	0.66	0.78	0.92	1.06	1.21	1.36	1.52	1.69	1.86	2.04	2.22	2.41	2.60				
E	16.0	0.13	0.20	0.28	0.37	0.47	0.57	0.68	0.80	0.92	1.05	1.18	1.32	1.46	1.61	1.76	1.92	2.08	2.25	2.42	2.60		
E	19.2	0.12	0.18	0.26	0.34	0.43	0.52	0.62	0.73	0.84	0.95	1.08	1.20	1.33	1.47	1.61	1.75	1.90	2.05	2.21	2.37	2.53	
E	24.0	0.11	0.16	0.23	0.30	0.38	0.46	0.55	0.65	0.75	0.85	0.96	1.08	1.19	1.31	1.44	1.57	1.70	1.84	1.98	2.12	2.27	2.41

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–3
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																				
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
	12.0	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2				
	16.0	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11		
2x 6	19.2	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4
	24.0	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0
	12.0	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9				
	16.0	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0		
2x 8	19.2	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3
	24.0	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6
	12.0	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11				
	16.0	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8		
2x10	19.2	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8
	24.0	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6
	12.0	11–3	13–0	14–6	15–11	17–2	18–4	19–6	20–6	21–7	22–6	23–5	24–4	25–2	26–0								
	16.0	9–9	11–3	12–7	13–9	14–11	15–11	16–10	17–9	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9			
2x12	19.2	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2
	24.0	7–11	9–2	10–3	11–3	12–2	13–0	13–9	14–6	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6
E	12.0	0.14	0.22	0.31	0.41	0.51	0.63	0.75	0.88	1.01	1.15	1.30	1.45	1.61	1.77	1.94	2.12	2.30	2.48				
E	16.0	0.12	0.19	0.27	0.35	0.44	0.54	0.65	0.76	0.88	1.00	1.12	1.26	1.39	1.54	1.68	1.83	1.99	2.15	2.31	2.48		
E	19.2	0.11	0.18	0.24	0.32	0.41	0.50	0.59	0.69	0.80	0.91	1.03	1.15	1.27	1.40	1.54	1.67	1.81	1.96	2.11	2.26	2.42	2.58
E	24.0	0.10	0.16	0.22	0.29	0.36	0.44	0.53	0.62	0.71	0.81	0.92	1.03	1.14	1.25	1.37	1.50	1.62	1.75	1.89	2.02	2.16	2.30

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–10
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA
Strength – Live Load of 30 psf plus
Dead Load of 20 psf determines the required bending design value
Deflection – For 30 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																							
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
	12.0	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11		
	16.0	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3
2x 6	19.2	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1
	24.0	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8
	12.0	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11		
	16.0	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10
2x 8	19.2	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2
	24.0	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5
	12.0	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7				
	16.0	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0
2x10	19.2	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11
	24.0	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7
	12.0	11–3	13–0	14–6	15–11	17–2	18–4	19–6	20–6	21–7	22–6	23–5	24–4	25–2	26–0											
	16.0	9–9	11–3	12–7	13–9	14–11	15–11	16–10	17–9	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9						
2x12	19.2	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	24–8	25–2	25–8		
	24.0	7–11	9–2	10–3	11–3	12–2	13–0	13–9	14–6	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6	23–0	23–5	23–10
E	12.0	0.11	0.17	0.23	0.31	0.38	0.47	0.56	0.66	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60		
E	16.0	0.09	0.14	0.20	0.26	0.33	0.41	0.49	0.57	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53
E	19.2	0.09	0.13	0.18	0.24	0.30	0.37	0.44	0.52	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31
E	24.0	0.08	0.12	0.16	0.22	0.27	0.33	0.40	0.46	0.54	0.61	0.69	0.77	0.85	0.94	1.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06

Note: The required modulus of elasticity, E. in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–11
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 240.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																							
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
2x6	12.0	5–0	5–10	6–6	7–1	7–8	8–2	8–8	9–2	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11		
	16.0	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3
	19.2	4–0	4–7	5–1	5–7	6–1	6–6	6–10	7–3	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1
	24.0	3–7	4–1	4–7	5–0	5–5	5–10	6–2	6–6	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8
2x8	12.0	6–7	7–8	8–7	9–4	10–1	10–10	11–6	12–1	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11		
	16.0	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10
	19.2	5–3	6–0	6–9	7–5	8–0	8–7	9–1	9–7	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2
	24.0	4–8	5–5	6–0	6–7	7–2	7–9	8–1	8–7	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5
2x10	12.0	8–5	9–9	10–11	11–11	12–11	13–9	14–8	15–5	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7				
	16.0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0
	19.2	6–8	7–8	8–7	9–5	10–2	10–11	11–7	12–2	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11
	24.0	6–0	6–11	7–8	8–5	9–1	9–9	10–4	10–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7
2x12	12.0	10–3	11–10	13–3	14–6	15–8	16–9	17–9	18–9	21–7	22–6	23–5	24–4	25–2	26–0											
	16.0	8–11	10–3	11–6	12–7	13–7	14–6	15–5	16–3	18–8	19–6	20–3	21–1	21–9	22–6	23–2	23–10	24–6	25–2	25–9						
	19.2	8–1	9–4	10–6	11–6	12–5	13–3	14–1	14–10	17–0	17–9	18–6	19–3	19–11	20–6	21–2	21–9	22–5	23–0	23–6	24–1	25–2	25–8			
	24.0	7–3	8–5	9–4	10–3	11–1	11–10	12–7	13–3	15–3	15–11	16–7	17–2	17–9	18–4	18–11	19–6	20–0	20–6	21–1	21–7	22–0	22–6	23–0	23–5	23–10
E	12.0	0.11	0.17	0.24	0.31	0.39	0.48	0.57	0.67	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60		
E	16.0	0.09	0.15	0.20	0.27	0.34	0.41	0.49	0.58	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53
E	19.2	0.09	0.13	0.19	0.24	0.31	0.38	0.45	0.53	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31
E	24.0	0.08	0.12	0.17	0.22	0.28	0.34	0.40	0.47	0.54	0.61	0.69	0.77	0.85	0.94	2.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–14
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																										
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	3–2	3–11	4–6	5–1	5–6	6–0	6–5	6–9	7–2	7–6	7–10	8–2	8–5	8–9	9–0	9–4	9–7	9–10	10–1	10–4	10–7	10–10	11–1						
	16.0	2–9	3–5	3–11	4–4	4–10	5–2	5–6	5–10	6–2	6–6	6–9	7–1	7–4	7–7	7–10	8–1	8–40	8–6	8–9	9–0	9–2	9–5	9–7	9–9	10–0				
	19.2	2–6	3–1	3–7	4–0	4–4	4–9	5–1	5–4	5–8	5–11	6–2	6–5	6–8	6–11	7–2	7–4	7–7	7–9	8–0	8–2	8–5	8–7	8–9	8–11	9–1	9–3	9–5		
	24.0	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
2x6	12.0	5–0	6–2	7–1	7–11	8–8	9–5	10–0	10–8	11–3	11–9	12–4	12–10	13–3	13–9	14–2	14–8	15–1	15–6	15–11	16–3	16–8	17–0	17–5						
	16.0	4–4	5–4	6–2	6–10	7–6	8–2	8–8	9–3	9–9	10–2	10–8	11–1	11–6	11–11	12–4	12–8	13–1	13–5	13–9	14–1	14–5	14–9	15–1	15–4	15–8				
	19.2	4–0	4–10	5–7	6–3	6–10	7–5	7–11	8–5	8–11	9–4	9–9	10–1	10–6	10–10	11–3	11–7	11–11	12–3	12–7	12–10	13–2	13–6	13–9	14–0	14–4	14–7	14–10		
	24.0	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
2x8	12.0	6–7	8–1	9–4	10–6	11–6	12–5	13–3	14–0	14–10	15–6	16–3	16–10	17–6	18–1	18–9	19–4	19–10	20–5	20–11	21–5	21–11	22–5	22–11						
	16.0	5–9	7–0	8–1	9–1	9–11	10–9	11–6	12–2	12–10	13–5	14–0	14–7	15–2	15–8	16–3	16–9	17–2	17–8	18–1	18–7	19–0	19–5	19–10	20–3	20–8				
	19.2	5–3	6–5	7–5	8–3	9–1	9–9	10–6	11–1	11–8	12–3	12–10	13–4	13–10	14–4	14–10	15–3	15–8	16–2	16–7	16–11	17–4	17–9	18–1	18–6	18–10	19–3	19–7		
	24.0	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
2x10	12.0	8–5	10–4	11–11	13–4	14–8	15–10	16–11	17–11	18–11	19–10	20–8	21–6	22–4	23–1	23–11	24–7	25–4	26–0											
	16.0	7–4	8–11	10–4	11–7	12–8	13–8	14–8	15–6	16–4	17–2	17–11	18–8	19–4	20–0	20–8	21–4	21–11	22–6	23–1	23–8	24–3	24–10	25–4	25–10					
	19.2	6–8	8–2	9–5	10–7	11–7	12–6	13–4	14–2	14–11	15–8	16–4	17–0	17–8	18–3	18–11	19–6	20–0	20–7	21–1	21–8	22–2	22–8	23–1	23–7	24–1	24–6	25–0		
	24.0	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
E	12.0	0.06	0.11	0.17	0.24	0.32	0.40	0.49	0.59	0.69	0.79	0.91	1.02	1.14	1.27	1.39	1.53	1.66	1.80	1.95	2.10	2.25	2.40	2.56						
E	16.0	0.05	0.10	0.15	0.21	0.28	0.35	0.43	0.51	0.60	0.69	0.78	0.88	0.99	1.10	1.21	1.32	1.44	1.56	1.69	1.82	1.95	2.08	2.22	2.36	2.50				
E	19.2	0.05	0.09	0.14	0.19	0.25	0.32	0.39	0.47	0.54	0.63	0.72	0.81	0.90	1.00	1.10	1.21	1.32	1.43	1.54	1.66	1.78	1.90	2.03	2.15	2.28	2.42	2.55		
E	24.0	0.04	0.08	0.12	0.17	0.23	0.29	0.35	0.42	0.49	0.56	0.64	0.72	0.81	0.89	0.99	1.08	1.18	1.28	1.38	1.48	1.59	1.70	1.81	1.93	2.04	2.16	2.28	2.41	2.53

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–15
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																												
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–10	3–6	4–0	4–6	4–11	5–4	5–9	6–1	6–5	6–8	7–0	7–3	7–7	7–10	8–1	8–4	8–7	8–10	9–1	9–3	9–6	9–8	9–11	10–1					
	16.0	2–6	3–0	3–6	3–11	4–3	4–8	4–11	5–3	5–6	5–10	6–1	6–4	6–7	6–9	7–0	7–3	7–5	7–8	7–10	8–0	8–2	8–5	8–7	8–9	8–11	9–1			
	19.2	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	
	24.0	2–0	2–6	2–10	3–2	3–6	3–9	4–0	4–3	4–6	4–9	4–11	5–2	5–4	5–6	5–9	5–11	6–1	6–3	6–5	6–7	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–8	7–10
2x6	12.0	4–6	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11					
	16.0	3–11	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3			
	19.2	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	
	24.0	3–2	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–4
2x8	12.0	5–11	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11					
	16.0	5–2	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10			
	19.2	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	
	24.0	4–2	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5	15–8	15–11	16–3
2x10	12.0	7–7	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7							
	16.0	6–6	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0			
	19.2	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	
	24.0	5–4	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7	20–0	20–4	20–8
E	12.0	0.06	0.11	0.17	0.23	0.31	0.38	0.47	0.56	0.66	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60					
E	16.0	0.05	0.09	0.14	0.20	0.26	0.33	0.41	0.49	0.57	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53			
E	19.2	0.05	0.09	0.13	0.18	0.24	0.30	0.37	0.44	0.52	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31	2.43	2.57	
E	24.0	0.04	0.08	0.12	0.16	0.22	0.27	0.33	0.40	0.46	0.54	0.61	0.69	0.77	0.85	0.94	1.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06	2.18	2.30	2.41

Note: The required modulus of elasticity. E. in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–22
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 30 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 30 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																										
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–10	3–6	4–0	4–6	4–11	5–4	5–9	6–1	6–5	6–8	7–0	7–3	7–7	7–10	8–1	8–4	8–7	8–10	9–0	9–3	9–6	9–8	9–11	10–1	10–4	10–6	10–8	10–11	11–1
	16.0	2–6	3–0	3–6	3–11	4–3	4–8	4–11	5–3	5–6	5–10	6–1	6–4	6–7	6–9	7–0	7–3	7–5	7–8	7–10	8–0	8–2	8–5	8–7	8–9	8–11	9–1	9–3	9–5	9–7
	19.2	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
	24.0	2–0	2–6	2–10	3–2	3–6	3–9	4–0	4–3	4–6	4–9	4–11	5–2	5–4	5–6	5–9	5–11	6–1	6–3	6–5	6–7	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–8	7–10
2x6	12.0	4–6	5–6	6–4	7–1	7–9	8–5	9–0	9–6	10–0	10–6	11–0	11–5	11–11	12–4	12–8	13–1	13–6	13–10	14–2	14–7	14–11	15–3	15–7	15–11	16–2	16–6	16–10	17–1	17–5
	16.0	3–11	4–9	5–6	6–2	6–9	7–3	7–9	8–3	8–8	9–1	9–6	9–11	10–3	10–8	11–0	11–4	11–8	12–0	12–4	12–7	12–11	13–2	13–6	13–9	14–0	14–3	14–7	14–10	15–1
	19.2	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
	24.0	3–2	3–11	4–6	5–0	5–6	5–11	6–4	6–9	7–1	7–5	7–9	8–1	8–5	8–8	9–0	9–3	9–6	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–1	12–4
2x8	12.0	5–11	7–3	8–4	9–4	10–3	11–1	11–10	12–7	13–3	13–11	14–6	15–1	15–8	16–3	16–9	17–3	17–9	18–3	18–9	19–2	19–8	20–1	20–6	20–11	21–4	21–9	22–2	22–6	22–11
	16.0	5–2	6–3	7–3	8–1	8–11	9–7	10–3	10–10	11–6	12–0	12–7	13–1	13–7	14–0	14–6	14–11	15–5	15–10	16–3	16–7	17–0	17–5	17–9	18–1	18–6	18–10	19–2	19–6	19–10
	19.2	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
	24.0	4–2	5–2	5–11	6–7	7–3	7–10	8–4	8–11	9–4	9–10	10–3	10–8	11–1	11–6	11–10	12–2	12–7	12–11	13–3	13–7	13–11	14–2	14–6	14–10	15–1	15–5	15–8	15–11	16–3
2x10	12.0	7–7	9–3	10–8	11–11	13–1	14–2	15–1	16–0	16–11	17–9	18–6	19–3	20–0	20–8	21–4	22–0	22–8	23–3	23–11	24–6	25–1	25–7							
	16.0	6–6	8–0	9–3	10–4	11–4	12–3	13–1	13–10	14–8	15–4	16–0	16–8	17–4	17–11	18–6	19–1	19–7	20–2	20–8	21–2	21–8	22–2	22–8	23–1	23–7	24–0	24–6	24–11	25–4
	19.2	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
	24.0	5–4	6–6	7–7	8–5	9–3	10–0	10–8	11–4	11–11	12–6	13–1	13–7	14–2	14–8	15–1	15–7	16–0	16–6	16–11	17–4	17–9	18–1	18–6	18–11	19–3	19–7	20–0	20–4	20–8
E	12.0	0.04	0.08	0.12	0.17	0.23	0.29	0.35	0.42	0.49	0.57	0.65	0.73	0.82	0.91	1.00	1.09	1.19	1.29	1.39	1.50	1.61	1.72	1.83	1.95	2.07	2.19	2.31	2.43	2.56
E	16.0	0.04	0.07	0.11	0.15	0.20	0.25	0.31	0.36	0.43	0.49	0.56	0.63	0.71	0.78	0.86	0.95	1.03	1.12	1.21	1.30	1.39	1.49	1.59	1.69	1.79	1.89	2.00	2.11	2.22
E	19.2	0.03	0.06	0.10	0.14	0.18	0.23	0.28	0.33	0.39	0.45	0.51	0.58	0.65	0.72	0.79	0.86	0.94	1.02	1.10	1.19	1.27	1.36	1.45	1.54	1.63	1.73	1.83	1.92	2.03
E	24.0	0.03	0.06	0.09	0.12	0.16	0.20	0.25	0.30	0.35	0.40	0.46	0.52	0.58	0.64	0.71	0.77	0.84	0.91	1.99	1.06	1.14	1.22	1.30	1.38	1.46	1.55	1.63	1.72	1.81

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

TABLE R–23
RAFTERS WITH L/180 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength – Live Load of 40 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection – For 40 psf live load.
Limited to span in inches divided by 180.

Size (in)	Spacing (in)	Rafter Bending Design Value, F_b, (psi)																												
		200	300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700	2800	2900	3000
2x4	12.0	2–7	3–2	3–8	4–1	4–6	4–11	5–3	5–6	5–10	6–1	6–5	6–8	6–11	7–2	7–5	7–7	7–10	8–0	8–3	8–5	8–8	8–10	9–0	9–3	9–5	9–7	9–9	9–11	10–1
	16.0	2–3	2–9	3–2	3–7	3–11	4–3	4–6	4–10	5–1	5–4	5–6	5–9	6–0	6–2	6–5	6–7	6–9	7–0	7–2	7–4	7–6	7–8	7–10	8–0	8–2	8–4	8–5	8–7	8–9
	19.2	2–1	2–6	2–11	3–3	3–7	3–10	4–1	4–4	4–7	4–10	5–1	5–3	5–5	5–8	5–10	6–0	6–2	6–4	6–6	6–8	6–10	7–0	7–2	7–3	7–5	7–7	7–9	7–10	8–0
	24.0	1–10	2–3	2–7	2–11	3–2	3–5	3–8	3–11	4–1	4–4	4–6	4–8	4–11	5–1	5–3	5–5	5–6	5–8	5–10	6–0	6–1	6–3	6–5	6–6	6–8	6–9	6–11	7–0	7–2
2x6	12.0	4–1	5–0	5–10	6–6	7–1	7–8	8–2	8–8	9–2	9–7	10–0	10–5	10–10	11–3	11–7	11–11	12–4	12–8	13–0	13–3	13–7	13–11	14–2	14–6	14–9	15–1	15–4	15–7	15–11
	16.0	3–7	4–4	5–0	5–7	6–2	6–8	7–1	7–6	7–11	8–4	8–8	9–1	9–5	9–9	10–0	10–4	10–8	10–11	11–3	11–6	11–9	12–0	12–4	12–7	12–10	13–1	13–3	13–6	13–9
	19.2	3–3	4–0	4–7	5–1	5–7	6–1	6–6	6–10	7–3	7–7	7–11	8–3	8–7	8–11	9–2	9–5	9–9	10–0	10–3	10–6	10–9	11–0	11–3	11–5	11–8	11–11	12–2	12–4	12–7
	24.0	2–11	3–7	4–1	4–7	5–0	5–5	5–10	6–2	6–6	6–10	7–1	7–5	7–8	7–11	8–2	8–5	8–8	8–11	9–2	9–5	9–7	9–10	10–0	10–3	10–5	10–8	10–10	11–0	11–3
2x8	12.0	5–5	6–7	7–8	8–7	9–4	10–1	10–10	11–6	12–1	12–8	13–3	13–9	14–4	14–10	15–3	15–9	16–3	16–8	17–1	17–6	17–11	18–4	18–9	19–1	19–6	19–10	20–3	20–7	20–11
	16.0	4–8	5–9	6–7	7–5	8–1	8–9	9–4	9–11	10–6	11–0	11–6	11–11	12–5	12–10	13–3	13–8	14–0	14–5	14–10	15–2	15–6	15–10	16–3	16–7	16–10	17–2	17–6	17–10	18–1
	19.2	4–3	5–3	6–0	6–9	7–5	8–0	8–7	9–1	9–7	10–0	10–6	10–11	11–4	11–8	12–1	12–5	12–10	13–2	13–6	13–10	14–2	14–6	14–10	15–1	15–5	15–8	16–0	16–3	16–7
	24.0	3–10	4–8	5–5	6–0	6–7	7–2	7–8	8–1	8–7	9–0	9–4	9–9	10–1	10–6	10–10	11–2	11–6	11–9	12–1	12–5	12–8	12–11	13–3	13–6	13–9	14–0	14–4	14–7	14–10
2x10	12.0	6–11	8–5	9–9	10–11	11–11	12–11	13–9	14–8	15–5	16–2	16–11	17–7	18–3	18–11	19–6	20–1	20–8	21–3	21–10	22–4	22–10	23–5	23–11	24–5	24–10	25–4	25–10		
	16.0	6–0	7–4	8–5	9–5	10–4	11–2	11–11	12–8	13–4	14–0	14–8	15–3	15–10	16–4	16–11	17–5	17–11	18–5	18–11	19–4	19–10	20–3	20–8	21–1	21–6	21–11	22–4	22–9	23–1
	19.2	5–5	6–8	7–8	8–7	9–5	10–2	10–11	11–7	12–2	12–9	13–4	13–11	14–5	14–11	15–5	15–11	16–4	16–10	17–3	17–8	18–1	18–6	18–11	19–3	19–8	20–0	20–5	20–9	21–1
	24.0	4–11	6–0	6–11	7–8	8–5	9–1	9–9	10–4	10–11	11–5	11–11	12–5	12–11	13–4	13–9	14–3	14–8	15–0	15–5	15–10	16–2	16–6	16–11	17–3	17–7	17–11	18–3	18–7	18–11
E	12.0	0.04	0.08	0.13	0.18	0.23	0.29	0.36	0.43	0.50	0.58	0.66	0.74	0.83	0.92	1.01	1.11	1.21	1.31	1.41	1.52	1.63	1.74	1.86	1.98	2.10	2.22	2.34	2.47	2.60
E	16.0	0.04	0.07	0.11	0.15	0.20	0.25	0.31	0.37	0.43	0.50	0.57	0.64	0.72	0.80	0.88	0.96	1.05	1.13	1.22	1.32	1.41	1.51	1.61	1.71	1.82	1.92	2.03	2.14	2.25
E	19.2	0.04	0.06	0.10	0.14	0.18	0.23	0.28	0.34	0.40	0.46	0.52	0.59	0.65	0.73	0.80	0.88	0.95	1.04	1.12	1.20	1.29	1.38	1.47	1.56	1.66	1.75	1.85	1.95	2.05
E	24.0	0.03	0.06	0.09	0.13	0.16	0.21	0.25	0.30	0.35	0.41	0.46	0.52	0.59	0.65	0.72	0.78	0.85	0.93	1.00	1.08	1.15	1.23	1.31	1.40	1.48	1.57	1.66	1.75	1.84

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet–inches and are limited to 26′ and less. Check sources of supply for availability of lumber in lengths greater than 20′.

Design Values for Joists and Rafters

These "Fb" values are for use where repetitive members are spaced not more than 24 inches. Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Cottonwood					
Select Structural	2x4	1510	1735	1,200,000	
No.1		1080	1240	1,200,000	
No.2		1080	1240	1,100,000	
No.3		605	695	1,000,000	
Stud		600	690	1,000,000	
Construction		805	925	1,000,000	
Standard		460	530	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		935	1075	1,200,000	
No.2		935	1075	1,100,000	
No.3		525	600	1,000,000	
Stud		545	630	1,000,000	
Select Structural	2x8	1210	1390	1,200,000	NSLB
No.1		865	990	1,200,000	
No.2		865	990	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1105	1275	1,200,000	
No.1		790	910	1,200,000	
No.2		790	910	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		720	825	1,200,000	
No.2		720	825	1,100,000	
No.3		405	465	1,000,000	
Douglas Fir–Larch					
Select Structural	2x4	2500	2875	1,900,000	
No.1 & Btr		1985	2280	1,800,000	
No.1		1725	1985	1,700,000	
No.2		1510	1735	1,600,000	
No.3		865	990	1,400,000	
Stud		855	980	1,400,000	
Construction		1150	1325	1,500,000	
Standard		635	725	1,400,000	
Utility		315	365	1,300,000	
Select Structural	2x6	2170	2495	1,900,000	
No.1 & Btr		1720	1975	1,800,000	
No.1		1495	1720	1,700,000	
No.2		1310	1505	1,600,000	
No.3		750	860	1,400,000	
Stud		775	895	1,400,000	
Select Structural	2x8	2000	2300	1,900,000	WCLIB
No.1 & Str		1585	1825	1,800,000	WWPA
No.1		1380	1585	1,700,000	
No.2		1210	1390	1,600,000	
No.3		690	795	1,400,000	
Select Structural	2x10	1835	2110	1,900,000	
No.1 & Btr		1455	1675	1,800,000	
No.1		1265	1455	1,700,000	
No.2		1105	1275	1,600,000	
No.3		635	725	1,400,000	
Select Structural	2x12	1670	1920	1,900,000	
No.1 & Btr		1325	1520	1,800,000	
No.1		1150	1325	1,700,000	
No.2		1005	1155	1,600,000	
No.3		575	660	1,400,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Douglas Fir–Larch (North)					
Select Structural	2x4	2245	2580	1,900,000	NLGA
No.1 /No.2		1425	1635	1,600,000	
No.3		820	940	1,400,000	
Stud		820	945	1,400,000	
Construction		1095	1255	1,500,000	
Standard		605	695	1,400,000	
Utility		290	330	1,300,000	
Select Structural	2x6	1945	2235	1,900,000	
No.1 /No.2		1235	1420	1,600,000	
No.3		710	815	1,400,000	
Stud		750	860	1,400,000	
Select Structural	2x8	1795	2065	1,900,000	
No.1 /No.2		1140	1310	1,600,000	
No.3		655	755	1,400,000	
Select Structural	2x10	1645	1890	1,900,000	
No.1 /No–2		1045	1200	1,600,000	
No.3		600	690	1,400,000	
Select Structural	2x12	1495	1720	1,900,000	
No.1 /No.2		950	1090	1,600,000	
No.3		545	630	1,400,000	
Douglas Fir–South					
Select Structural	2x4	2245	2580	1,400,000	WWPA
No.1		1555	1785	1,300,000	
No.2		1425	1635	1,200,000	
No.3		820	940	1,100,000	
Stud		820	945	1,100,000	
Construction		1065	1225	1,200,000	
Standard		605	695	1,100,000	
Utility		290	330	1,000,000	
Select Structural	2x6	1945	2235	1,400,000	
No.1		1345	1545	1,300,000	
No.2		1235	1420	1,200,000	
No.3		710	815	1,100,000	
Stud		750	860	1,100,000	
Select Structural	2x8	1795	2065	1,400,000	
No.1		1240	1430	1,300,000	
No.2		1140	1310	1,200,000	
No.3		655	755	1,100,000	
Select Structural	2x10	1645	1890	1,400,000	
No.1		1140	1310	1,300,000	
No.2		1045	1200	1,200,000	
No.3		600	690	1,100,000	
Select Structural	2x12	1495	1720	1,400,000	
No.1		1035	1190	1,300,000	
No.2		950	1090	1,200,000	
No.3		545	630	1,100,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern Hemlock–Tamarack					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Eastern Softwoods					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Eastern White Pine					
Select Structural	2x4	2155	2480	1,200,000	
No.1		1335	1535	1,100,000	
No.2		990	1140	1,100,000	
No.3		605	695	900,000	
Stud		570	655	900,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	800,000	
Select Structural	2x6	1870	2150	1,200,000	
No.1		1160	1330	1,100,000	
No.2		860	990	1,100,000	
No.3		525	600	900,000	
Stud		520	595	900,000	NELMA
Select Structural	2x8	1725	1985	1,200,000	NSLB
No.1		1070	1230	1,100,000	
No.2		795	915	1,100,000	
No.3		485	555	900,000	
Select Structural	2x10	1580	1820	1,200,000	
No.1		980	1125	1,100,000	
No.2		725	835	1,100,000	
No.3		445	510	900,000	
Select Structural	2x12	1440	1655	1,200,000	
No.1		890	1025	1,100,000	
No.2		660	760	1,100,000	
No.3		405	465	900,000	
Hem Fir					
Select Structural	2x4	2415	2775	1,600,000	
No.1 & Btr		1810	2085	1,500,000	
No.1		1640	1885	1,500,000	
No.2		1465	1685	1,300,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	2095	2405	1,600,000	
No.1 & Btr		1570	1805	1,500,000	
No.1		1420	1635	1,500,000	
No.2		1270	1460	1,300,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1930	2220	1,600,000	WCLIB
No.1 & Btr		1450	1665	1,500,000	WWPA
No.1		1310	1510	1,500,000	
No.2		1175	1350	1,300,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1770	2035	1,600,000	
No.1 & Btr		1330	1525	1,500,000	
No.1		1200	1380	1,500,000	
No.2		1075	1235	1,300,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1 & Btr		1210	1390	1,500,000	
No.1		1095	1255	1,500,000	
No.2		980	1125	1,300,000	
No.3		575	660	1,200,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Hem-Fir (North)					
Select Structural	2x4	2245	2580	1,700,000	NLGA
No.1 /No.2		1725	1985	1,600,000	
No.3		990	1140	1,400,000	
Stud		980	1125	1,400,000	
Construction		1325	1520	1,500,000	
Standard		720	825	1,400,000	
Utility		345	395	1,300,000	
Select Structural	2x6	1945	2235	1,700,000	
No.1 /No.2		1495	1720	1,600,000	
No.3		860	990	1,400,000	
Stud		890	1025	1,400,000	
Select Structural	2x8	1795	2065	1,700,000	
No.1 /No.2		1380	1585	1,600,000	
No.3		795	915	1,400,000	
Select Structural	2x10	1645	1890	1,700,000	
No.1 /No.2		1265	1455	1,600,000	
No.3		725	835	1,400,000	
Select Structural	2x12	1495	1720	1,700,000	
No.1 /No.2		1150	1325	1,600,000	
No.3		660	760	1,400,000	
Mixed Maple					
Select Structural	2x4	1725	1985	1,300,000	NELMA
No.1		1250	1440	1,200,000	
No.2		1210	1390	1,100,000	
No.3		690	795	1,000,000	
Stud		695	Boo	1,000,000	
Construction		920	1060	1,100,000	
Standard		520	595	1,000,000	
Utility		260	300	900,000	
Select Structural	2x6	1495	1720	1,300,000	
No.1		1085	1245	1,200,000	
No.2		1045	1205	1,100,000	
No.3		600	690	1,000,000	
Stud		635	725	1,000,000	
Select Structural	2x8	1380	1585	1,300,000	
No.1		1000	1150	1,200,000	
No.2		965	1110	1,100,000	
No.3		550	635	1,000,000	
Select Structural	2x10	1265	1455	1,300,000	
No.1		915	1055	1,200,000	
No.2		885	1020	1,100,000	
No.3		505	580	1,000,000	
Select Structural	2x12	1150	1325	1,300,000	
No.1		835	960	1,200,000	
No.2		805	925	1,100,000	
No.3		460	530	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Mixed Oak					
Select Structural	2x4	1985	2280	1,100,000	NELMA
No.1		1425	1635	1,000,000	
No.2		1380	1585	900,000	
No.3		820	940	800,000	
Stud		790	910	800,000	
Construction		1065	1225	900,000	
Standard		605	695	800,000	
Utility		290	330	800,000	
Select Structural	2x6	1720	1975	1,100,000	
No.1		1235	1420	1,000,000	
No.2		1195	1375	900,000	
No.3		710	815	800,000	
Stud		720	825	800,000	
Select Structural	2x8	1585	1825	1,100,000	
No.1		1140	1310	1,000,000	
No.2		1105	1270	900,000	
No.3		655	755	800,000	
Select Structural	2x10	1455	1675	1,100,000	
No.1		1045	1200	1,000,000	
No.2		1010	1165	900,000	
No.3		600	690	800,000	
Select Structural	2x12	1325	1520	1,100,000	
No.1		950	1090	1,000,000	
No.2		920	1060	900,000	
No.3		545	630	800,000	
Mixed Southern Pine					
Select Structural	2x4	2360	2710	1,600,000	SPIB
No.1		1670	1920	1,500,000	
No.2		1500	1720	1,400,000	
No.3		865	990	1,200,000	
Stud		890	1020	1,200,000	
Construction		1150	1320	1,300,000	
Standard		635	725	1,200,000	
Utility		315	365	1,100,000	
Select Structural	2x6	2130	2450	1,600,000	
No.1		1490	1720	1,500,000	
No.2		1320	1520	1,400,000	
No.3		775	895	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	2010	2310	1,600,000	
No.1		1380	1590	1,500,000	
No.2		1210	1390	1,400,000	
No.3		720	825	1,200,000	
Select Structural	2x10	1730	1980	1,600,000	
No.1		1210	1390	1,500,000	
No.2		1060	1220	1,400,000	
No.3		605	695	1,200,000	
Select Structural	2x12	1610	1850	1,600,000	
No.1		1120	1290	1,500,000	
No.2		1010	1160	1,400,000	
No.3		575	660	1,200,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Northern Red Oak					
Select Structural	2x4	2415	2775	1,400,000	NELMA
No.1		1725	1985	1,400,000	
No.2		1680	1935	1,300,000	
No.3		950	1090	1,200,000	
Stud		950	1090	1,200,000	
Construction		1265	1455	1,200,000	
Standard		720	825	1,100,000	
Utility		345	395	1,000,000	
Select Structural	2x6	2095	2405	1,400,000	
No.1		1495	1720	1,400,000	
No.2		1460	1675	1,300,000	
No.3		820	945	1,200,000	
Stud		865	990	1,200,000	
Select Structural	2x8	1930	2220	1,400,000	
No.1		1380	1585	1,400,000	
No.2		1345	1545	1,300,000	
No.3		760	875	1,200,000	
Select Structural	2x10	1770	2035	1,400,000	
No.1		1265	1455	1,400,000	
No.2		1235	1420	1,300,000	
No.3		695	800	1,200,000	
Select Structural	2x12	1610	1850	1,400,000	
No.1		1150	1325	1,400,000	
No.2		1120	1290	1,300,000	
No.3		635	725	1,200,000	
Northern Species					
Select Structural	2x4	1640	1885	1,100,000	NLGA
No.1 /No.2		990	1140	1,100,000	
No.3		605	695	1,000,000	
Stud		570	655	1,000,000	
Construction		775	895	1,000,000	
Standard		430	495	900,000	
Utility		200	230	900,000	
Select Structural	2x6	1420	1635	1,100,000	
No. 1 / No.2		860	990	1,100,000	
No.3		525	600	1,000,000	
Stud		520	595	1,000,000	
Select Structural	2x8	1310	1510	1,100,000	
No.1/No.2		795	915	1,100,000	
No.3		485	555	1,000,000	
Select Structural	2x10	1200	1380	1,100,000	
No.1 /No.2		725	835	1,100,000	
No.3		445	510	1,000,000	
Select Structural	2x12	1095	1255	1,100,000	
No.1 /No.2		660	760	1,100,000	
No.3		405	465	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Northern White Cedar					
Select Structural	2x4	1335	1535	800,000	NELMA
No.1		990	1140	700,000	
No.2		950	1090	700,000	
No.3		560	645	600,000	
Stud		540	620	600,000	
Construction		720	825	700,000	
Standard		405	465	600,000	
Utility		200	230	600,000	
Select Structural	2x6	1160	1330	800,000	
No.1		860	990	700,000	
No.2		820	945	700,000	
No.3		485	560	600,000	
Stud		490	560	600,000	
Select Structural	2x8	1070	1230	800,000	
No.1		795	915	700,000	
No.2		760	875	700,000	
No.3		450	515	600,000	
Select Structural	2x10	980	1125	800,000	
No.1		725	835	700,000	
No.2		695	800	700,000	
No.3		410	475	600,000	
Select Structural	2x12	890	1025	800,000	
No.1		660	760	700,000	
No.2		635	725	700,000	
No.3		375	430	600,000	
Red Maple					
Select Structural	2x4	2245	2580	1,700,000	NELMA
No.1		1595	1835	1,600,000	
No.2		1555	1785	1,500,000	
No.3		905	1040	1,300,000	
Stud		885	1020	1,300,000	
Construction		1210	1390	1,400,000	
Standard		660	760	1,300,000	
Utility		315	365	1,200,000	
Select Structural	2x6	1945	2235	1,700,000	
No.1		1385	1590	1,600,000	
No.2		1345	1545	1,500,000	
No.3		785	905	1,300,000	
Stud		805	925	1,300,000	
Select Structural	2x8	1795	2065	1,700,000	
No.1		1275	1470	1,600,000	
No.2		1240	1430	1,500,000	
No.3		725	835	1,300,000	
Select Structural	2x10	1645	1890	1,700,000	
No.1		1170	1345	1,600,000	
No.2		1140	1310	1,500,000	
No.3		665	765	1,300,000	
Select Structural	2x12	1495	1720	1,700,000	
No.1		1065	1225	1,600,000	
No.2		1035	1190	1,500,000	
No.3		605	695	1,300,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Red Oak					
Select Structural	2x4	1985	2280	1,400,000	NELMA
No.1		1425	1635	1,300,000	
No.2		1380	1585	1,200,000	
No.3		820	940	1,100,000	
Stud		790	910	1,100,000	
Construction		1065	1225	1,200,000	
Standard		605	695	1,100,000	
Utility		290	330	1,000,000	
Select Structural	2x6	1720	1975	1,400,000	
No.1		1235	1420	1,300,000	
No.2		1195	1375	1,200,000	
No.3		710	815	1,100,000	
Stud		720	825	1,100,000	
Select Structural	2x8	1585	1825	1,400,000	
No.1		1140	1310	1,300,000	
No.2		1105	1270	1,200,000	
No.3		655	755	1,100,000	
Select Structural	2x10	1455	1675	1,400,000	
No.1		1045	1200	1,300,000	
No.2		1010	1165	1,200,000	
No.3		600	690	1,100,000	
Select Structural	2x12	1325	1520	1,400,000	
No.1		950	1090	1,300,000	
No.2		920	1060	1,200,000	
No.3		545	630	1,100,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Redwood					
Clear Structural	2x4	3020	3470	1,400,000	RIS
Select Structural		2330	2680	1,400,000	
Select Structural, open grain		1900	2180	1,100,000	
No.1		1680	1935	1,300,000	
No.1, open grain		1335	1535	1,100,000	
No.2		1595	1835	1,200,000	
No.2, open grain		1250	1440	1,000,000	
No.3		905	1040	1,100,000	
No.3, open grain		735	845	900,000	
Stud		725	835	900,000	
Construction		950	1090	900,000	
Standard		520	595	900,000	
Utility		260	300	800,000	
Clear Structural	2x6	2615	3010	1,400,000	
Select Structural		2020	2320	1,400,000	
Select Structural, open grain		1645	1890	1,100,000	
No.1		1460	1675	1,300,000	
No.1, open grain		1160	1330	1,100,000	
No.2		1385	1590	1,200,000	
No.2, open grain		1085	1245	1,000,000	
No.3		785	905	1,100,000	
No.3, open grain		635	730	900,000	
Stud		660	760	900,000	
Clear Structural	2x8	2415	2775	1,400,000	
Select Structural		1865	2140	1,400,000	
Select Structural, open grain		1520	1745	1,100,000	
No.1		1345	1545	1,300,000	
No.1, open grain		1070	1230	1,100,000	
No.2		1275	1470	1,200,000	
No.2, open grain		1000	1150	1,000,000	
No.3		725	835	1,100,000	
No.3, open grain		585	675	900,000	
Clear Structural	2x10	2215	2545	1,400,000	
Select Structural		1710	1965	1,400,000	
Select Structural, open grain		1390	1600	1,100,000	
No.1		1235	1420	1,300,000	
No.1, open grain		980	1125	1,100,000	
No.2		1170	1345	1,200,000	
No.2, open grain		915	1055	1,000,000	
No.3		665	765	1,100,000	
No.3, open grain		540	620	900,000	
Clear Structural	2x12	2015	2315	1,400,000	
Select Structural		1555	1785	1,400,000	
Select Structural, open grain		1265	1455	1,100,000	
No.1		1120	1290	1,300,000	
No.1, open grain		890	1025	1,100,000	
No.2		1065	1225	1,200,000	
No.2, open grain		835	960	1,000,000	
No.3		605	695	1,100,000	
No.3, open grain		490	560	900,000	

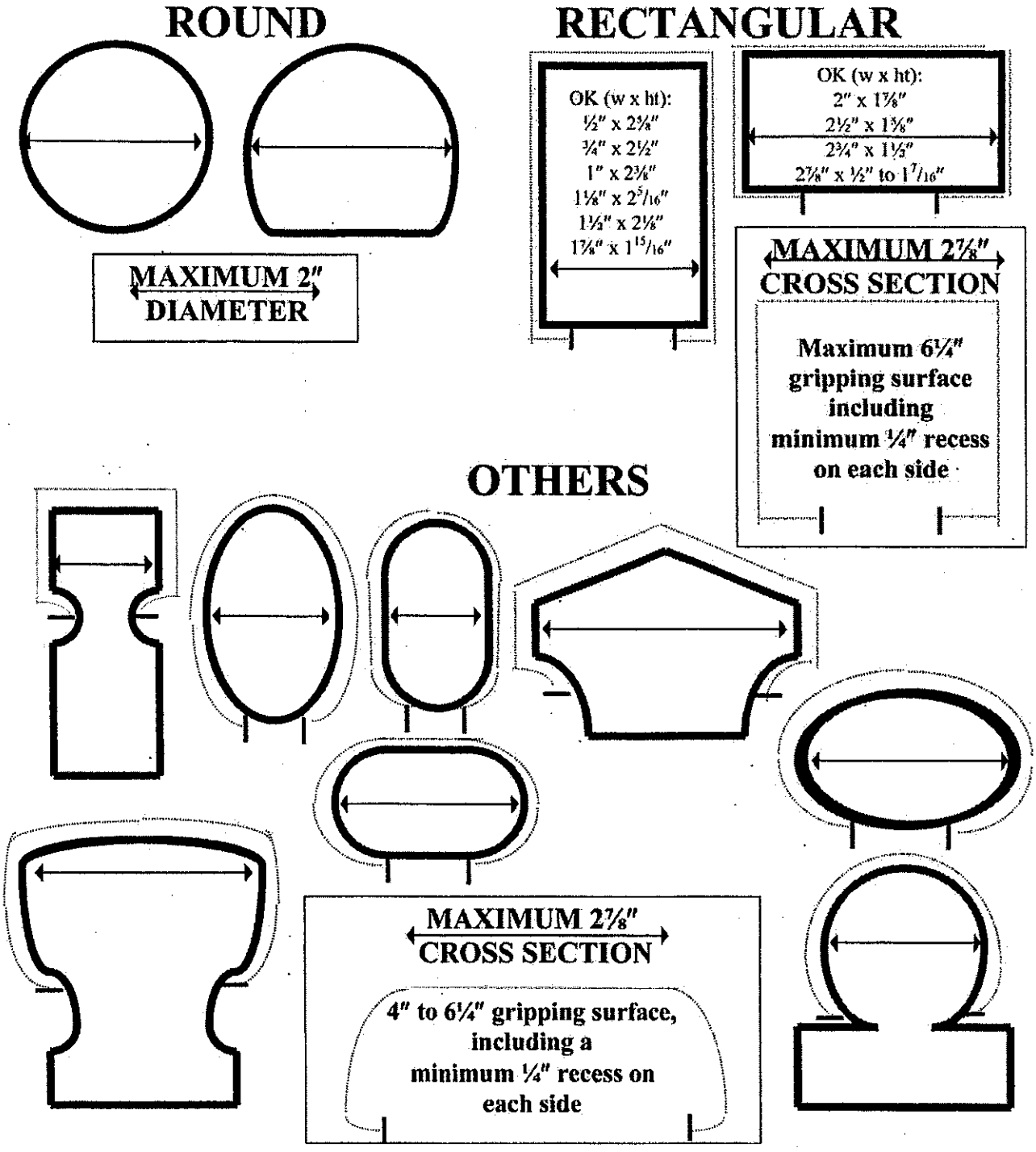
Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Southern Pine					
Dense Select Structural	2x4	3510	4030	1,900,000	
Select Structural		3280	3770	1,800,000	
Non–Dense Select Structural		3050	3500	1,700,000	
No.1 Dense		2300	2650	1,800,000	
No.1		2130	2450	1,700,000	
No.1 Non–Dense		1950	2250	1,600,000	
No.2 Dense		1960	2250	1,700,000	
No.2		1720	1980	1,600,000	
No.2 Non–Dense		1550	1790	1,400,000	
No.3		980	1120	1,400,000	
Stud		1010	1160	1,400,000	
Construction		1270	1450	1,500,000	
Standard		720	825	1,300,000	
Utility		345	395	1,300,000	
Dense Select Structural	2x6	3100	3570	1,900,000	
Select Structural		2930	3370	1,800,000	
Non–Dense Select Structural		2700	3110	1,700,000	
No.1 Dense		2010	2310	1,800,000	
No.1		1900	2180	1,700,000	
No.1 Non–Dense		1720	1980	1,600,000	
No.2 Dense		1670	1920	1,700,000	
No.2		1440	1650	1,600,000	
No.2 Non–Dense		1320	T520	1,400,000	
No.3		865	990	1,400,000	
Stud		890	1020	1,400,000	
Dense Select Structural	2x8	2820	3240	1,900,000	
Select Structural		2650	3040	1,800,000	
Non–Dense Select Structural		2420	2780	1,700,000	SPIB
No.1 Dense		1900	2180	1,800,000	
No.1		1730	1980	1,700,000	
No.1 Non–Dense		1550	1790	1,600,000	
No.2 Dense		1610	1850	1,700,000	
No.2		1380	1590	1,600,000	
No.2 Non–Dense		1260	1450	1,400,000	
No.3		805	925	1,400,000	
Dense Select Structural	2x10	2470	2840	1,900,000	
Select Structural		2360	2710	1,800,000	
Non–Dense Select Structural		2130	2450	1,700,000	
No.1 Dense		1670	1920	1,800,000	
No.1		1500	1720	1,700,000	
No.1 Non–Dense		1380	1590	1,600,000	
No.2 Dense		1380	1590	1,700,000	
No.2		1210	1390	1,600,000	
No.2 Non–Dense		1090	1260	1,400,000	
No.3		690	795	1,400,000	
Dense Select Structural	2x12	2360	2710	1,900,000	
Select Structural		2190	2510	1,800,000	
Non–Dense Select Structural		2010	2310	1,700,000	
No.1 Dense		1550	1790	1,800,000	
No.1		1440	1650	1,700,000	
No.1 Non–Dense		1320	1520	1,600,000	
No.2 Dense		1320	1520	1,700,000	
No.2		1120	1290	1,600,000	
No.2 Non–Dense		1040	1190	1,400,000	
No.3		660	760	1,400,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Spruce–Pine–Fir					
Select Structural	2x4	2155	2480	1,500,000	NLGA
No.1 /No.2		1510	1735	1,400,000	
No.3		865	990	1,200,000	
Stud		855	980	1,200,000	
Construction		1120	1290	1,300,000	
Standard		635	725	1,200,000	
Utility		290	330	1,100,000	
Select Structural	2x6	1870	2150	1,500,000	
No.1 /No.2		1310	1505	1,400,000	
No.3		750	860	1,200,000	
Stud		775	895	1,200,000	
Select Structural	2x8	1725	1985	1,500,000	
No. 1 / No.2		1210	1390	1,400,000	
No.3		690	795	1,200,000	
Select Structural	2x10	1580	1820	1,500,000	
No.1/No.2		1105	1275	1,400,000	
No.3		635	725	1,200,000	
Select Structural	2x12	1440	1655	1,500,000	
No.1 /No.2		1005	1155	1,400,000	
No.3		575	660	1,200,000	
Spruce–Pine–Fir (South)					
Select Structural	2x4	2245	2580	1,300,000	NELMA NSLB WCLIB WWPA
No.1		1465	1685	1,200,000	
No.2		1295	1490	1,100,000	
No.3		735	845	1,000,000	
Stud		725	835	1,000,000	
Construction		980	1125	1,000,000	
Standard		545	630	900,000	
Utility		260	300	900,000	
Select Structural	2x6	1945	2235	1,300,000	
No.1		1270	1460	1,200,000	
No.2		1120	1290	1,100,000	
No.3		635	730	1000,000	
Stud		660	760	1,000,000	
Select Structural	2x8	1795	2065	1,300,000	
No.1		1175	1350	1,200:000	
No.2		1035	1190	1,100,000	
No.3		585	675	1,000,000	
Select Structural	2x10	1645	1890	1,300,000	
No.1		1075	1235	1,200,000	
No.2		950	1090	1,100,000	
No.3		540	620	1,000,000	
Select Structural	2x12	1495	1720	1,300,000	
No.1		980	1125	1,200,000	
No.2		865	990	1,100,000	
No.3		490	560	1,000,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
Western Cedars					
Select Structural	2x4	1725	1985	1,100,000	WCLIB WWPA
No.1		1250	1440	1,000,000	
No.2		1210	1390	1,000,000	
No.3		690	795	900,000	
Stud		695	800	900,000	
Construction		920	1060	900,000	
Standard		520	595	800,000	
Utility		260	300	800,000	
Select Structural	2x6	1495	1720	1,100,000	
No.1		1085	1245	1,000,000	
No.2		1045	1205	1,000,000	
No.3		600	690	900,000	
Stud		635	725	900,000	
Select Structural	2x8	1380	1585	1,100,000	
No.1		1000	1150	1,000,000	
No.2		965	1110	1,000,000	
No.3		550	635	900,000	
Select Structural	2x10	1265	1455	1,100,000	
No.1		915	1055	1,000,000	
No.2		885	1020	1,000,000	
No.3		505	580	900,000	
Select Structural	2x12	1150	1325	1,100,000	
No.1		835	960	1,000,000	
No.2		805	925	1,000,000	
No.3		460	530	900,000	
Western Woods					
Select Structural	2x4	1510	1735	1,200,000	WCLIB WWPA
No.1		1120	1290	1,100,000	
No.2		1120	1290	1,000,000	
No.3		645	745	900,000	
Stud		635	725	900,000	
Construction		835	960	1,000,000	
Standard		460	530	900,000	
Utility		230	265	800,000	
Select Structural	2x6	1310	1505	1,200,000	
No.1		970	1120	1,100,000	
No.2		970	1120	1,000,000	
No.3		560	645	900,000	
Stud		575	660	900,000	
Select Structural	2x8	1210	1390	1,200,000	
No.1		895	1030	1,100,000	
No.2		895	1030	1,000,000	
No.3		520	595	900,000	
Select Structural	2x10	110	1275	1,200,000	
No.1		820	945	1,100,000	
No.2		820	945	1,000,000	
No.3		475	545	900,000	
Select Structural	2x12	1005	1155	1,200,000	
No.1		750	860	1,100,000	
No.2		750	860	1,000,000	
No.3		430	495	900,000	

Species and Grade	Size	Design Value in Bending, "Fb"		Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading		
White Oak					
Select Structural	2x4	2070	2380	1,100,000	NELMA
No.1		1510	1735	1,000,000	
No.2		1465	1685	900,000	
No.3		820	940	800,000	
Stud		820	945	800,000	
Construction		1095	1255	900,000	
Standard		605	695	800,000	
Utility		290	330	800,000	
Select Structural	2x6	1795	2065	1,100,000	
No.1		1310	1505	1,000,000	
No.2		1270	1460	900,000	
No.3		710	815	800,000	
Stud		750	860	800,000	
Select Structural	2x8	1655	1905	1,100,000	
No.1		1210	1390	1,000,000	
No.2		1175	1350	900,000	
No.3		655	755	800,000	
Select Structural	2x10	1520	1745	1,100,000	
No.1		1105	1275	1,000,000	
No.2		1075	1235	900,000	
No.3		600	690	800,000	
Select Structural	2x12	1380	1585	1,100,000	
No.1		1005	1155	1,000,000	
No.2		980	1125	900,000	
No.3		545	630	800,000	
Yellow Poplar					
Select Structural	2x4	1725	1985	1,500,000	NSLB
No.1		1250	1440	1,400,000	
No.2		1210	1390	1,300,000	
No.3		690	795	1,200,000	
Stud		695	800	1,200,000	
Construction		920	1060	1,300,000	
Standard		520	595	1,100,000	
Utility		230	265	1,100,000	
Select Structural	2x6	1495	1720	1,500,000	
No.1		1055	1245	1,400,000	
No.2		1045	1205	1,300,000	
No.3		600	690	1,200,000	
Stud		635	725	1,200,000	
Select Structural	2x8	1380	1585	1,500,000	
No.1		1000	1150	1,400,000	
No.2		965	1110	1,300,000	
No.3		550	635	1,200,000	
Select Structural	2x10	1265	1455	1,500,000	
No.1		915	1055	1,400,000	
No.2		885	1020	1,300,000	
No.3		505	580	1,200,000	
Select Structural	2x12	1150	1325	1,500,000	
No.1		835	960	1,400,000	
No.2		805	925	1,300,000	
No.3		460	530	1,200,000	

21.04 (3) (b) 5.
HANDRAIL SHAPES



Following is an emergency rule that became effective on October 1, 2008 that, among other things, requires carbon monoxide detectors in dwellings covered under the Uniform Dwelling Code and are licensed as tourist rooming cabins by the WI Department of Health Services. We expect to make similar rules permanent sometime in 2009. Additional information is available on our website, www.commerce.wi.gov/sb

DEPARTMENT OF COMMERCE

EMERGENCY RULE RELATING TO CARBON MONOXIDE DETECTORS

Under the nonstatutory provisions of 2007 Wisconsin Act 205, the Department of Commerce is directed to issue emergency rules that implement provisions of the Act. The Act specifically states: "Notwithstanding section 227.24 (1) (a) and (3) of the statutes, neither the department of commerce or the department of health services is required to provide evidence that promulgating rules under this subsection as emergency rules is necessary for the preservation of the public peace, health, safety, or welfare and is not required to provide a finding of emergency for the rules promulgated under this subsection."

The Act mandates the installation and maintenance of carbon monoxide alarms in buildings accommodating certain types of residential occupancies and within which fuel burning appliances are located. Residential occupancies include tourist rooming houses, bed and breakfast establishments, and any public building that is used for sleeping or lodging, such as, hotels, motels, condominiums, apartment buildings, dormitories, fraternities, sororities, convents, seminaries, community based residential facilities, home shelters, but not hospitals and nursing homes. The Act requires the installation of carbon monoxide alarms in new buildings as of October 1, 2008. The owners of existing buildings will have until April 1, 2010 to install the carbon monoxide alarms. The Act also provides for the omission of carbon monoxide alarms in certain instances which are further clarified by the administrative rules.

Pursuant to section 227.24 (1) (c), Stats., this rule is adopted as an emergency rule to take effect on October 1, 2008.

The Wisconsin Department of Commerce adopts an order to renumber Comm 66.0911; to amend Comm 20.24 (1) and (2); and to create s. Comm 21.095, Comm 20.24 Table 20.24–14, Comm 62.1200, Comm 62.3500 (3) (e), Comm 62.3500 (3) Note, Comm 66.0911 (title) and Comm 66.0911 (2), relating to carbon monoxide alarms and affecting small business.

Analysis of Rule

1. Statutes Interpreted

Statutes Interpreted: ss. 101.02 (15) and 101.63 (1), Stats., and s. 101.149, Stats., as created by 2007 Wisconsin Act 205.

2. Statutory Authority

Statutory Authority: ss. 101.02 (1) and (15) (a) and 101.63 (1), Stats., and s. 101.149, Stats., as created by 2007 Wisconsin Act 205.

3. Related Statute or Rule

Statutes: ss. 101.12 (1), Stats.

Administrative Rules: Chapters Comm 60–66, Wisconsin Commercial Building Code
Chapters Comm 20–25, Uniform Dwelling Code

4. Explanation of Agency Authority

Under the statutes cited, the Department of Commerce protects public health, safety, and welfare by promulgating comprehensive requirements for design, construction, use and maintenance of public buildings and places of employment and adopts rules that establish uniform, statewide standards for the construction of 1– and 2–family dwellings. 2007 Wisconsin Act 205 specifically directs the Department to address carbon monoxide alarms involving these types of buildings.

5. Summary of Proposed Rules

The rules establish minimum requirements for the installation and maintenance of carbon monoxide alarms in buildings accommodating residential type occupancies where people sleep or lodge, excluding hospitals and nursing homes, that reflect the statutory mandates of 2007 Wisconsin Act 205. Specifically, the rules would:

For new tourist rooming houses (cabins under the scope of Uniform Dwelling Code) (October 1, 2008), Comm 21.095

- Require the installation of carbon monoxide alarms where any type of fuel burning appliances are installed.
- Require the carbon monoxide alarms to be continuously powered by the building's electrical service with battery backups.

For new commercial buildings: (October 1, 2008),

- Require the installation of carbon monoxide alarms where any type of fuel burning appliances are installed. Comm 62.1200 (2) (a)
- Require the carbon monoxide alarms to be continuously powered by the building's electrical service with battery backups. Comm 62.1200 (2) (c)

For existing commercial buildings (Buildings existing on October 1, 2008 or reviewed and receiving department plan approval under the rules effective prior to October 1, 2008)

- Require the installation of carbon monoxide alarms by April 1, 2010.
- Do not dictate the type of power sources for the carbon monoxide alarms, thereby allowing batteries, electrical outlet plug–ins or wired to the building's electrical service.
- Allow the omission of carbon monoxide alarms provided there are no attached garages and all of the fuel burning appliances are of sealed combustion type either under warranty or annually inspected for carbon monoxide emissions. Comm 62.1200 (2) (a) 4.

The rules require carbon monoxide alarms to be listed and labeled identifying conformance to UL 2034, Underwriters Laboratories Inc, Standard for Safety Single and Multiple Station Carbon Monoxide Alarms.

Under the federal Americans with Disabilities Act, ADA, and the federal Fair Housing Law certain carbon monoxide alarms may be required to have both audible and visual alarm features.

Owners of existing tourist rooming houses will need to install and maintain carbon monoxide alarms in accordance with s. 101.149 (2) and (3), Stats., by April 1, 2010.

6. Summary of, and Comparison with, Existing or Proposed Federal Regulations

An internet–based search of code of federal regulations and the federal register did not indentify any federal requirements for the installation and maintenance of carbon monoxide alarms in residential buildings.

7. Comparison with Rules in Adjacent States

An Internet–based search carbon monoxide alarm regulations for the states of Illinois, Iowa, Michigan and Minnesota found the following:

- Illinois under Public Act 094–0741, the Carbon Monoxide Alarm Detector Act, has required the installation of carbon monoxide alarms in all occupancies and structures which have sleeping rooms since January 1, 2007.
- Iowa requires the installation of carbon monoxide alarms in foster care facilities.
- Michigan has not enacted any carbon monoxide alarm regulations at this time.
- Minnesota statute, 299F.50, requires carbon monoxide alarms in all single family homes and multifamily apartments units; new construction as of January 1, 2007; existing single family homes as of August 1, 2008 and existing multi–family and apartment buildings as of August 1, 2009.

8. Summary of Factual Data and Analytical Methodologies

In developing the rules the Department reviewed the language of 2007 Wisconsin Act 205 in conjunction with the Department's broad authority under ss. 101.02 (15) and 101.63 (1), Stats., to protect public health and safety regarding the construction of public buildings, places of employment and one– and two– family dwellings to be used as tourist rooming houses. The current administrative rules for the installation of fire alarms (smoke detectors) were used as a model for these proposed rules pertaining to carbon monoxide alarms. The Department also analyzed the complexities of compliance under several scenarios where fuel burning appliances are added or replaced during the life of the building, such as residential condominiums.

9. Analysis and Supporting Documents used to Determine Effect on Small Business or in Preparation of Economic Impact Report

The proposed rules implement mandates imposed by 2007 Wisconsin Act 205. The Act affects the owners of commercial buildings where people sleep or lodge and tourist room houses (rental cabins) where fuel burning appliances are installed. The types of commercial buildings affected include apartment buildings, condominiums, hotels, motels, bed and breakfast establishments, fraternities, sororities, dormitories, convents, seminaries, community based residential facilities, and home shelters. The department does not believe that the rules will increase the effect on small businesses over that imposed by the Act. Battery or plug–in type carbon monoxide alarms typically range in cost from $25 to $50. New construction installation costs for a hard–wired type carbon monoxide alarm with battery backup ranges in from $65 to $85 and $90 to $110 if interconnection is involved. Combination carbon monoxide alarms and smoke alarms are also available. Smoke alarms are currently required for residential occupancies. The use of combination carbon monoxide alarms and smoke alarms should result in installation and labor cost savings over that for separate systems.

An economic impact report has not been required to be prepared.

10. Agency Contact.

James Quast, Program Manager, jim.quast@wisconsin.gov, (608) 266–9292

SECTION 1. Comm 20.24 (1) and (2) are amended to read:

Comm 20.24 (1) CONSENT. Pursuant to s. 227.21 (2), Stats., the attorney general ~~and the revisor of statutes have~~ has consented to the incorporation by reference of the standards listed in Tables 20.24–1 to ~~20.24–12~~ 20.14–14.

(2) ADOPTION OF STANDARDS. The standards referenced in Tables 20.24–1 to ~~20.24–12~~ 20.14–14 are incorporated by reference into this chapter.

Note: Copies of the adopted standards are on file in the offices of the department and the legislative reference bureau. Copies of the standards may be purchased through the respective organizations listed in Tables 20.24–1 to ~~20.24–12~~ 20.14–14.

SECTION 2. Comm 20.24 Table 20.24–14 is created to read:

Table 20.24–14

UL	Underwriters Laboratories, Inc 333 Pfingsten Road Northbrook, IL 60062–2096
Standard Reference Number	**Title**
2034–2005	Single and Multiple State Carbon Monoxide Alarms

SECTION 3. Comm 21.095 is created to read:

Comm 21.095 Carbon monoxide alarms. (1) (a) Listed and labeled carbon monoxide alarms with battery secondary power supplies shall be installed and maintained in dwellings to be utilized as licensed tourist rooming houses and which contain fuel–burning appliances in accordance with s. 101.149 (2) and (3), Stats.

Note: Section 101.149 (2) and (3), Stats., reads:

(2) INSTALLATION REQUIREMENTS. (a) Except as provided in par. (b), the owner of a residential building shall install a carbon monoxide detector in all of the following places not later than the date specified under par. (c):

1. In the basement of the building if the basement has a fuel–burning appliance.

2. Within 15 feet of each sleeping area of a unit that has a fuel–burning appliance.

3. Within 15 feet of each sleeping area of a unit that is immediately adjacent to a unit that has a fuel–burning appliance.

4. In each room that has a fuel–burning appliance and that is not used as a sleeping area. A carbon monoxide detector shall be installed under this subdivision not more than 75 feet from the fuel–burning appliance.

5. In each hallway leading from a unit that has a fuel–burning appliance, in a location that is within 75 feet from the unit, except that, if there is no electrical outlet within this distance, the owner shall place the carbon monoxide detector at the closest available electrical outlet in the hallway.

(b) If a unit is not part of a multiunit building, the owner of the residential building need not install more than one carbon monoxide detector in the unit.

(c) 1. Except as provided under subd. 2., the owner of a residential building shall comply with the requirements of this subsection before the building is occupied.

2. The owner of a residential building shall comply with the requirements of this subsection not later than April 1, 2010, if construction of the building was initiated before October 1, 2008, or if the department approved the plans for the construction of the building under s. 101.12, Stats., before October 1, 2008.

(d) Any carbon monoxide detector that bears an Underwriters Laboratories, Inc., listing mark or similar mark from an independent product safety certification organization satisfies the requirements of this subsection.

(e) The owner shall install every carbon monoxide detector required by this subsection according to the directions and specifications of the manufacturer of the carbon monoxide detector.

(3) MAINTENANCE REQUIREMENTS. (a) The owner of a residential building shall reasonably maintain every carbon monoxide detector in the residential building in the manner specified in the instructions for the carbon monoxide detector.

(b) An occupant of a unit in a residential building may give the owner of the residential building written notice that a carbon monoxide detector in the residential building is not functional or has been removed by a person other than the occupant. The owner of the residential building shall repair or replace the nonfunctional or missing carbon monoxide detector within 5 days after receipt of the notice.

(c) The owner of a residential building is not liable for damages resulting from any of the following:

1. A false alarm from a carbon monoxide detector if the carbon monoxide detector was reasonably maintained by the owner of the residential building.

2. The failure of a carbon monoxide detector to operate properly if that failure was the result of tampering with, or removal or destruction of, the carbon monoxide detector by a person other than the owner or the result of a faulty alarm that was reasonably maintained by the owner as required under par. (a).

(b) For the purposes of this section:

1. "Fuel–burning appliance" means a device that is permanently installed in a dwelling and burns fossil–fuel or carbon based fuel where carbon monoxide is a combustion by–product, including stoves, ovens, grills, clothes dryers, furnaces, boilers, water heaters, heaters, fireplaces and stoves.

2. "Tourist rooming house" has the meaning as given under s. HFS 195.03 (20).

Note: Section HFS 195.03 (20) reads: "Tourist rooming house" means all lodging places and tourist cabins and cottages, other than hotels and motels, in which sleeping accommodations are offered for pay to tourists or transients. It does not include private boarding or rooming houses not accommodating tourists or transients, or bed and breakfast establishments regulated under ch. HFS 197.

(2) Carbon monoxide alarms shall be wired to the dwelling's electrical service.

(3) Carbon monoxide alarms within a dwelling unit shall be interconnected so that activation of one alarm will cause activation of all alarms within the dwelling unit.

(4) Carbon monoxide alarms shall conform to UL 2034.

(5) Violation of the provisions of this section shall be subject to the penalties provided under s. 101.149 (8), Stats.

Note: Section 101.149 (8), Stats., reads:

(8) PENALTIES. (a) If the department of commerce or the department of health and family services determines after an inspection of a building under this section or s. 254.74 (1g) that the owner of the building has violated sub. (2) or (3), the respective department shall issue an order requiring the person to correct the violation within 5 days or within such shorter period as the respective department determines is necessary to protect public health and safety. If the person does not correct the violation within the time required, he or she shall forfeit $50 for each day of violation occurring after the date on which the respective department finds that the violation was not corrected.

(b) If a person is charged with more than one violation of sub. (2) or (3) arising out of an inspection of a building owned by that person, those violations shall be counted as a single violation for the purpose of determining the amount of a forfeiture under par. (a).

(c) Whoever violates sub. (4) is subject to the following penalties:

1. For a first offense, the person may be fined not more than $10,000 or imprisoned for not more than 9 months, or both.

2. For a 2nd or subsequent offense, the person is guilty of a Class I felony.

(END)

EFFECTIVE DATE

Pursuant to s. 227.24 (1) (c), Stats., this rule shall take effect as an emergency rule on October 1, 2008.

21.125 (3) CONTROL STANDARDS

The following are designs acceptable by the department to achieve compliance with the control standards of acceptable soil loss or percent reduction of sediment load in runoff from a site.

Less than one acre disturbance (regardless of the lot or property size).

A. Mandated practices:

1. A method to prevent or reduce soil from leaving a site via entries or roads. This may include a tracking pad or tire washing stand designed and installed to meet DNR Standard 1057. Other means of compliance include a gravel mulch, frozen soil, bedrock or some other physical means to prevent soil from leaving the site on vehicle tires which is equivalent to the tracking pad or tire washing stand.

2. Storm water inlet protection. Inlet protection may be accomplished by using DNR Technical Standard, number 1050, "Storm Drain Inlet Protection for Construction Sites". The protection of stormwater inlets in the code is specific to "on–site" inlets; however an off–site inlet may create a direct conduit to a water of the state, which links any inlet that leads to a water of the state to the #3 mandated practice. In that case, special care should be taken to protect both types of inlets from sediment in runoff from a construction site.

3. Protection of adjoining waters of the state. The installation of practices is necessary if runoff from the disturbance could impact a water of the state. Practices may include channel erosion mats, silt fences, vegetative buffers or any other practices applicable to the specific site.

4. Drainage way protection. Any ditches or drainage ways that flow off–site must be protected with appropriate best management practices (BMPs). This may include but is not limited to ditch checks, channel erosion control mats or riprap.

5. Dewatering activity sediment reduction. Any dewatering necessary on the construction site must include measures to reduce the sediment in the water leaving the site. Dewatering BMPs may include filters, fiber rolls or gravel bag berms.

6. Stockpile protection. Any soil stockpiles which are left more than 7 days must be protected by seeding and mulching, erosion mat, silt fencing, covering or other methods. This does not include fill or topsoil piles that are in active use.

B. In addition to mandated practices, the owner/contractor or designer must choose one or more of the following methods in order to achieve compliance with the standards.

1. The Revised Universal Soil Loss Equation may be used to determine the amount of soil lost from a site in order to stay below the 5 tons/acre/year for sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay or clay textures or the 7.5 tons/acre/year soil loss for silt, silty clay loam or silt loam textures. The Commerce–accepted version of an Excel worksheet that is used to calculate the soil loss is available at: http://commerce.wi.gov/SB/SB–SoilErosionControlProgram.html.

2. Silt fence may be placed in accordance with the DNR Technical Standard 1056 and remain on the site until the pervious area is stabilized. This practice, in addition to the mandated practices in part "A" is accepted by the Department of Commerce as compliant with the 40% reduction in sediment load goal.

3. The site may be seeded and mulched, erosion control mat may be installed or polymers may be applied. The erosion control BMPs must be applied within one week of disturbance. Seeding must be accomplished in accordance with DNR Technical Standard 1059 and mulching with DNR Technical Standard 1058. Erosion control mat must be installed in accordance with DNR Technical Standards 1052 and 1053. Polymer application must be done in accordance with DNR Technical Standard 1051. This method is only acceptable when the maximum slope length is 300 feet and the maximum slope is no more than that specified in Table A–21.125–1 and Table A–21.125–2.

4. Practices may be included in the erosion and sediment control plan for the site that achieve compliance with the 40% reduction in sediment load in the runoff from the site. Table A–21.125–3 lists several erosion and sediment control BMPs and the USEPA (United States Environmental Protection Agency) efficiency rating for that BMP.

5. A unique design may be submitted with the UDC permit application for review.

Table A–21.125–1

Slope Limitations for Permissible Soil Loss with max. 300′ slope length[1]

When sites are seeded, mulched or otherwise stabilized within one week of disturbance[2]

Soil Texture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7.5 tons/acre/year allowable soil loss												
Silt loam or Silty clay loam	20%	20%	16%	9%	6%	5%	6%	8%	12%	17%	20%	20%
5 tons/acre/year allowable soil loss												
Sand	20%	20%	20%	14%	10%	8%	9%	12%	19%	20%	20%	20%
Loamy sand	20%	20%	20%	13%	9%	8%	9%	11%	17%	20%	20%	20%
Sandy loam	20%	20%	16%	9%	7%	5%	6%	8%	16%	17%	20%	20%
Loam, Sandy clay loam, Clay loam, Sandy clay	20%	20%	13%	8%	5%	4%	5%	6%	10%	17%	20%	20%
Silty clay	20%	20%	16%	9%	7%	5%	6%	8%	13%	17%	20%	20%
Clay	20%	20%	15%	9%	6%	5%	5%	7%	12%	16%	20%	20%

[1] The information in the table is derived from Grant County rainfall information and the use of the Revised Universal Soil Loss Equation. The slope limitation refers to the maximum slope permitted in order to achieve code compliance for the site specifics in the table. Opening date is the 15th of each month and closing is the 22nd. End date is 60 days past closing date.

[2] Stabilization may be accomplished by temporary seeding and mulching, permanent seeding and mulching, application of polymers or placement of erosion control mats. Additionally, the mandated practices specific to the site must be in place.

Table A–21–125–2

Slope Limitations for Permissible Soil Loss with max. 300′ slope length[1]

When sites are seeded, mulched or otherwise stabilized within 4 weeks of disturbance[2]

Soil Texture	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
7.5 tons/acre/year allowable soil loss												
Silt loam or Silty clay loam	18%	11%	8%	4%	3%	2%	3%	4%	6%	10%	15%	20%
5 tons/acre/year allowable soil loss												
Sand	20%	20%	17%	12%	7%	5%	4%	4%	6%	10%	15%	20%
Loamy sand	20%	20%	16%	11%	6%	4%	4%	4%	5%	9%	14%	20%
Sandy loam	20%	18%	11%	8%	4%	3%	2%	3%	4%	6%	10%	16%
Loam, Sandy clay loam, Clay loam, Sandy clay	20%	9%	6%	4%	2%	2%	4%	3%	5%	8%	13%	20%
Silty clay	18%	11%	8%	4%	3%	2%	4%	6%	6%	10%	15%	20%
Clay	17%	11%	7%	4%	3%	2%	4%	6%	6%	9%	14%	20%

[1] The information in the table is derived from Grant County rainfall information and the use of the Revised Universal Soil Loss Equation. The slope limitation refers to the maximum slope permitted in order to achieve code compliance for the site specifics in the table. Opening date is the 15th of each month and closing is the 15th of the following month. End date is 60 days past closing date.

[2] Stabilization may be accomplished by temporary seeding and mulching, permanent seeding and mulching, application of polymers or placement of erosion control mats. Additionally, the mandated practices specific to the site must be in place.

One acre or more disturbed (regardless of the lot or property size).

A. Mandated practices:

1. A method to prevent or reduce soil from leaving a site via entries or roads. This may include a tracking pad or tire washing stand designed and installed to meet DNR Standard 1057. Other means of compliance include a gravel mulch, frozen soil, bedrock or some other physical means to prevent soil from leaving the site on vehicle tires which is equivalent to the tracking pad or tire washing stand.

2. Storm water inlet protection. Inlet protection may be accomplished by using DNR Technical Standard, number 1060, "Storm Drain Inlet Protection for Construction Sites". The protection of stormwater inlets in the code is specific to "on–site" inlets; however an off–site inlet may create a direct conduit to a water of the state, which links any inlet that leads to a water of the state to the #3 mandated practice. In that case, special care should be taken to protect both types of inlets from sediment in runoff from a construction site.

3. Protection of adjoining waters of the state. The installation of practices is necessary if runoff from the disturbance could impact a water of the state. Practices may include channel erosion mats, silt fences, vegetative buffers or any other practices applicable to the specific site.

4. Drainage way protection. Any ditches or drainage ways that flow off–site must be protected with appropriate best management practices (BMPs). This may include but is not limited to ditch checks, erosion control mats or riprap.

5. Dewatering activity sediment reduction. Any dewatering necessary on the construction site must include measures to reduce the sediment in the water leaving the site. Dewatering BMPs may include filters, fiber rolls or gravel bag berms.

6. Stockpile protection. Any soil stockpiles which are left more than 7 days must be protected by seeding and mulching, erosion mat, silt fencing, covering or other methods. This does not include fill or topsoil piles that are in active use.

B. In addition to mandated practices, the owner/contractor or designer must choose one or more of the following methods in order to achieve compliance with the standards.

1. The Revised Universal Soil Loss Equation may be used to determine the amount of soil lost from a site in order to stay below the 5 tons/acre/year for sand, loamy sand, sandy loam, loam, sandy clay loam, clay loam, sandy clay, silty clay or clay textures or the 7.5 tons/acre/year soil loss for silt, silty clay loam or silt loam textures. The Commerce–accepted version of an Excel worksheet that is used to calculate the soil loss is available at: http://commerce.wi.gov/SB/SB–SoilErosionControlProgram.html.

2. The site may be seeded and mulched, erosion control mat may be installed or polymers may be applied. The erosion control BMPs must be applied within one week of disturbance. Seeding must be accomplished in accordance with DNR Technical Standard 1059 and mulching with DNR Technical Standard 1058. Erosion control mat must be installed in accordance with DNR Technical Standards 1052 and 1053. Polymer application must be done in accordance with DNR Technical Standard 1051. This method is only acceptable when the maximum slope length is 300 feet and the maximum slope is no more than that specified in Table A–21.125–1.

3. Practices may be included in the erosion and sediment control plan for the site that achieve compliance with the 80% reduction in sediment load in the runoff from the site. Table A–21.125–2 lists several erosion and sediment control BMPs and the USEPA (United States Environmental Protection Agency) efficiency rating for that BMP.

4. A unique design may be submitted with the UDC permit application for review.

Table A–21.125–2
Erosion/Sediment Control BMP Efficiency[1]

Practice	Type of Practice	Standard Number[2]	Recognized Efficiency
Straw Bales	Sediment Control	1055	10%[4]
Fiber Rolls	Sediment Control		40%
Sediment Traps	Sediment Control	1063	40%
Silt Fence	Sediment Control	1056	Sand 80% Other soils 40%
Compost Blankets	Erosion Control	See std 1058 for Wisconsin	80%
Polymers	Erosion Control	1050	80%
Sodding	Erosion Control		80%
Seeding	Erosion Control	1059	80%
Mulching	Erosion Control	1058	80%
Non channel control mat	Erosion Control	1052	80%[3]

1 BMP efficiency is derived from information provided on the Environmental Protection Construction Erosion Control website in August, 2006 and only when the BMP is installed per the listed standard.

2 Standard number refers to the Wisconsin Department of Natural Resources Conservation Practice Standard number.

3 This efficiency measure is provided by the Department of Commerce, Safety and Buildings Division.

4 This efficiency measure is provided by the Department of Commerce, Safety and Buildings Division, and only for a short duration as described in the standard.

There are several BMPs that do not have an efficiency assigned by the EPA. These include mandatory controls such as inlet protection, drainage way protection (riprap) and tracking pads. Diversions, both temporary and permanent are also not included in Table 1–21.125–2. Diversions impact the erosion on a site by shortening the length of slope in the Revised Universal Soil Loss Equation (RUSLE).

Following is an example of an erosion and sediment control plan (Figure A–21.125). This plan may be used for reference, however each site is unique and each plan will address the site–specific issues.

Figure 125.125–1

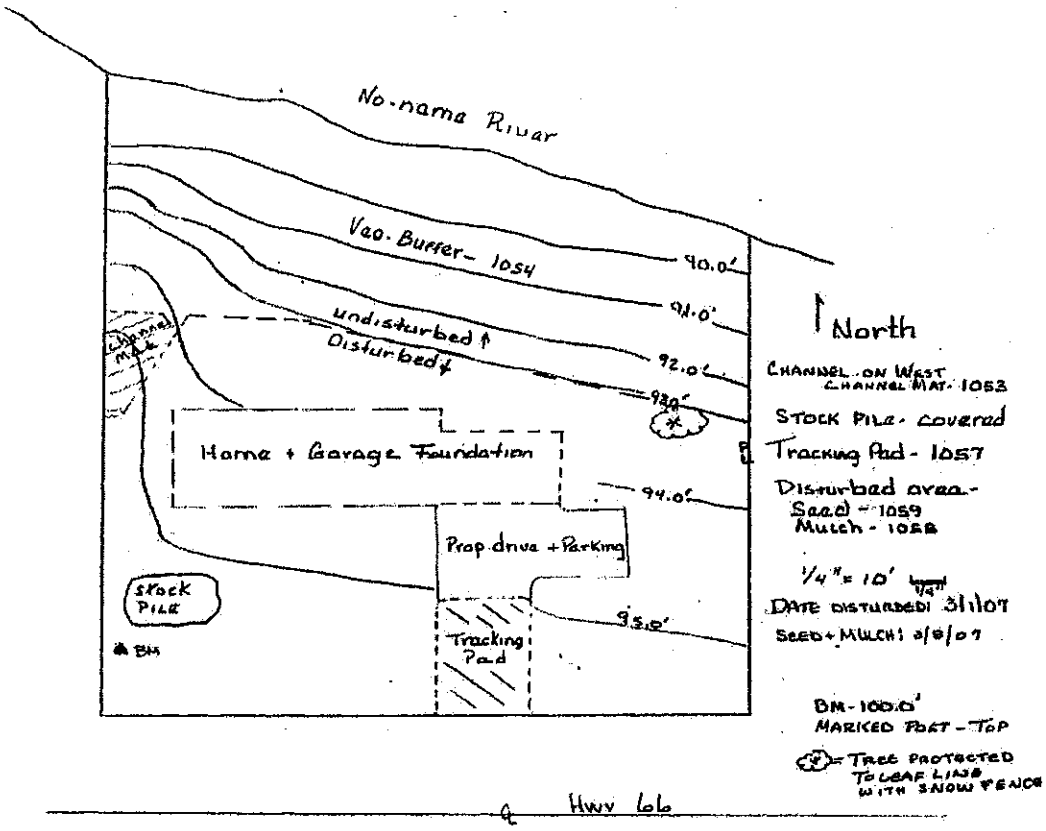


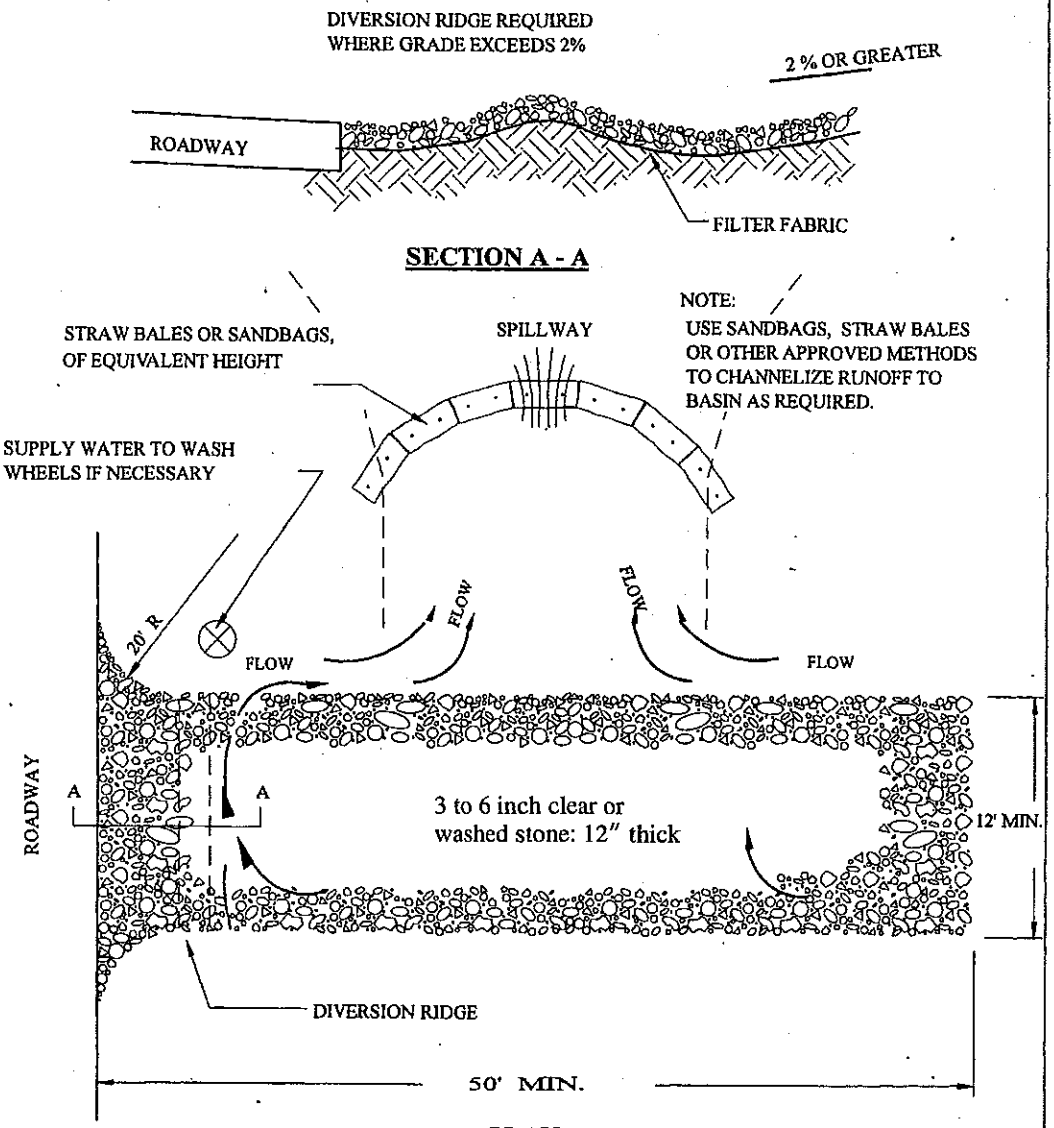
Figure 125.125–2
Sample Page from Erosion Control Checklist

Y	N	N/A	Seeding for Erosion Control – 1059
			Topsoil depth 2 inches for temporary seeding?
			Topsoil depth 4 inches for permanent seeding?
			Rocks, twigs and foreign material removed?
			Clods < 2 inch?
			Seed sown < 1/4 inch deep?
			Temporary species and rates per table?

Species	Lbs/Acre	% Purity	Season
Oats	131	98	Spring & Summer
Cereal Rye	131	97	Fall
Winter Wheat	131	95	Fall
Annual Ryegrass	80	97	Fall

Y	N	N/A	Mulching for Construction Sites 1058
			Area under mulch free of gullies and rills?
			Mulch not in concentrated flow channels?
			Erosion occurring in mulched areas?
			Natural biodegradable materials?
			Free of toxic, noxious or diseased substances?
			Marsh hay only on upland sites?
			Crimped straw or hay fiber length > 6 inches?
			No bark or wood chips on seeded sites?
			Mulch covers 80% of unseeded areas?
			Mulch covers 70% of seeded areas?
			Mulch 1/2 to 1–1/2 inches thick in seeded areas?
			Mulch 1–1/2 to 3 inches thick for unseeded areas?
			Wood chips 1/2 to 1–1/2 inches thick?
			Mulch anchors w/crimping, matting and tackifier?

Note: The entire checklist can be found at: www.commerce.wi.gov/SB



NOTES:

IF SOILS ARE MAINLY COMPOSED OF CLAYS OR SILTS, USE OF A FILTER FABRIC AS A SEPARATION BARRIER BETWEEN THE ROCK AND SOIL IS RECOMMENDED.

1. THE ENTRANCE SHALL BE MAINTAINED IN A CONDITION THAT WILL PREVENT TRACKING OR FLOWING OF SEDIMENT ONTO PUBLIC RIGHT-OF-WAYS. THIS MAY REQUIRE TOP DRESSING, REPAIR AND/OR CLEANOUT OF ANY MEASURES USED TO TRAP SEDIMENT.

2. WHEN NECESSARY, WHEELS SHALL BE CLEANED PRIOR TO ENTRANCE ONTO PUBLIC RIGHT-OF-WAY.

3. WHEN WASHING IS REQUIRED, IT SHALL BE DONE ON AN AREA STABLIZED WITH CRUSHED STONE THAT DRAINS INTO AN APPROVED SEDIMENT TRAP OR SEDIMENT BASIN.

FIG. E - 11
TEMPORARY
GRAVEL CONSTRUCTION ENTRANCE/EXIT

Also see Standard 1060 for additional information.

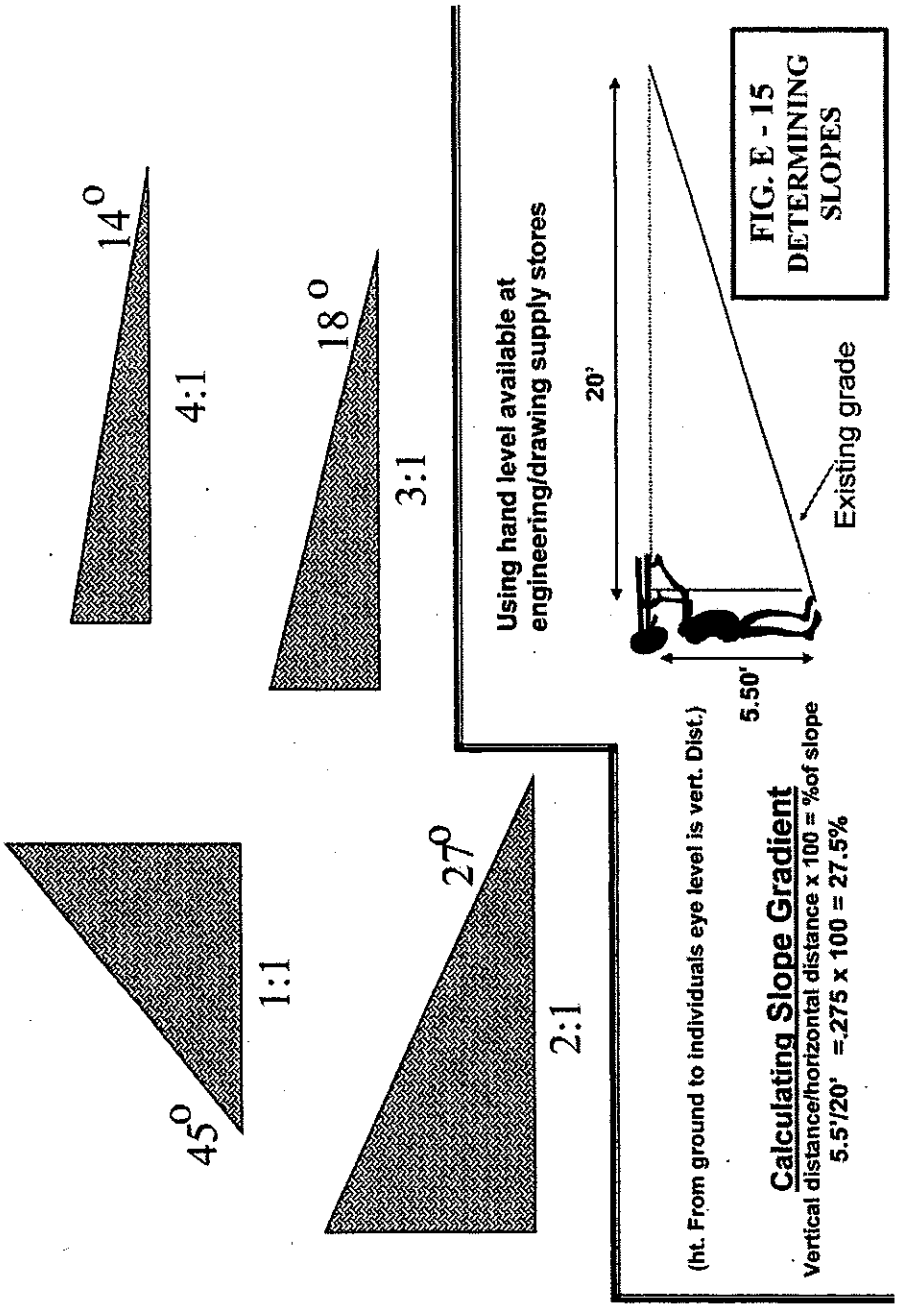


FIG. E - 15
DETERMINING SLOPES

Following are reprints of the DNR Erosion Control Technical Standards, also available at http://www.dnr.state.wi.us/runoff/stormwater/techstds.htm

STANDARD	Number	Effective Date	Page
Channel Erosion Mat	1053	08/05	156
De–watering	1061	04/07	159
Ditch Checks	1062	03/06	166
Construction Site Diversion	1066	03/06	170
Dust Control	1068	03/04	172
Grading Practices for Erosion Control — Temporary	1067	03/04	173
Interim Sediment Control: Water Application of Polymers	1051	11/02	175
Land Application of Anionic Polyacrylamide	1050	07/01	185
Mulching for Construction Sites	1058	06/03	188
Non–channel Erosion Mat	1052	08/03	191
Sediment Bale Barrier	1055	08/03	194
Sediment Basin	1064	03/06	196
Sediment Trap	1063	09/05	205
Seeding	1059	11/03	209
Silt Fence	1056	03/06	213
Silt Curtain	1070	09/05	218
Stone Tracking Pad and Tire Washing	1057	08/03	221
Storm Drain Inlet Protection for Construction Sites	1060	10/03	223
Turbidity Barriers	1069	09/05	227
Vegetative Buffer for Construction Sites	1054	05/03	232

Channel Erosion Mat

1053 (8/05)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in XI. Definitions. The words are italicized the first time they are used.

I. Definition

A protective soil cover of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combination of materials and with varying life spans.

II. Purpose

The purpose of this practice is to protect the channel from erosion or act as turf reinforcement during and after the establishment of grass or other vegetation in a channel. This practice applies to both *Erosion Control Revegative Mats* (*ECRM*[1]) and *Turf–Reinforcement Mats* (*TRM*).

III. Conditions Where Practice Applies

This standard applies where runoff channelizes in intermittent flow and vegetation is to be established. Some products may have limited applicability in projects adjacent to navigable waters.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. To complete the shear calculations, a 2 year, 24 hour storm event shall be used to calculate depth of flows for an ECRM. For sizing a TRM, use the depth of flow corresponding to the maximum design capacity of the channel.

Only mats listed in the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) will be accepted for use in this standard.

To differentiate applications WisDOT organizes erosion mats into three classes of mats, which are further broken down into various Types.

A. Class I: A short–term duration (minimum of 6 months), light duty, organic ECRM with plastic or biodegradable netting.

   1. Type A – Only suitable for slope applications, not channel applications.

   2. Type B – Double netted product for use in channels where the calculated (design) shear stress is 1.5 lbs/ft^2 or less.

B. Class II: A long–term duration (three years or greater), organic ECRM.

   1. Type A – Jute fiber only for use in channels to reinforce sod.

   2. Type B – For use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Made with plastic or biodegradable mat.

   3. Type C – A woven mat of 100% organic material for use in channels where the calculated (design) shear stress is 2.0 lbs/ft^2 or less. Applicable for use in environmentally sensitive areas where plastic netting is inappropriate.

C. Class III: A permanent 100% synthetic ECRM or TRM. Class I, Type B erosion mat or Class II, Type B or C erosion mat must be placed over a soil filled TRM.

1. Type A – An ECRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

2. Type B – A TRM for use in channels where the calculated (design) shear stress of 2.0 lbs/ft^2 or less.

3. Type C – A TRM for use in channels where the calculated (design) shear stress of 3.5 lbs/ft^2 or less.

4. Type D – A TRM for use in channels where the calculated (design) shear stress of 5.0 lbs/ft^2 or less.

VI. Installation

A. ECRM shall be installed after all topsoiling, fertilizing, liming, and seeding is complete.

B. Erosion mats shall extend for whichever is greater: upslope one–foot minimum vertically from the ditch bottom or 6 inches higher than the design flow depth.

C. The mat shall be in firm and continuous contact with the soil. It shall be anchored, overlapped, staked and entrenched per the manufacturer's recommendations.

D. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.

E. At time of installation, document the manufacturer and mat type by saving material labels and manufacturer's installation instructions. Retain this documentation until the site is stabilized.

VII. Considerations

A. Erosion mats shall be selected so that they last long enough for the grass or other vegetation to become densely established.

B. Consider using Class II, Type C mats adjacent to waterways where trapping small animals is to be avoided.

C. Class III TRM may be appropriate as a replacement for riprap as a channel liner. Check the shear stress criteria for the channel to determine mat applicability.

D. Once a gully has formed in a channel, it is difficult to stabilize due to loss of soil structure. Even when the gully is filled with topsoil and reseeded, the soil has a tendency to dislodge in the same pattern. If gully formation continues to be a problem the design should be reevaluated, including other mat classes or riprap.

E. It may be difficult to establish permanent vegetation and adequate erosion protection in a channel with continuous flow. Consider riprap or planting wetland species with an ECRM.

F. Documentation of materials used, monitoring logs, project diary, and weekly inspection forms including erosion and stormwater management plans, should be provided to the authority charged with long term maintenance of the site.

G. Channel cross sections may be parabolic, v–shaped or trapezoidal. The use of "V" channels is generally discouraged due to erosion problems experienced.

H. To help determine the appropriate channel liner, designers can refer to the design matrix in the back of the WisDOT PAL. However, for channels not conforming to the typical section shown in the channel matrix or having a depth of flow greater than 6 inches (150 mm), the designer will need to design for an appropriate channel liner. One way to do this is to use the "tractive force" method presented in FHWA's Hydraulic Engineering Circular (HEC) No. 15. This method requires that the calculated maximum shear stress of a channel is not to exceed the permissible shear stress of the channel liner. To use this method, permissible shear stress values are stated next to each device listed in the channel matrix.

VIII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat

2. Installation sequence

3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

IX. Operation and Maintenance

A. Erosion mats shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

X. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm.

XI. Definitions

Channel Erosion: The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Erosion Control Revegative Mats (ECRM) (II): Erosion control revegetative mats are designed to be placed on top of soil.

Turf–Reinforcement Mats (TRM) (II): Turf–reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved soil stabilizer Type A (as classified in the WisDOT PAL)

Dewatering

Code No.1061 (4/07)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A compartmented container, settling basin, filter, or other appropriate best management practice through which sediment–laden water is conveyed to trap and retain the sediment.

II. Purposes

The purpose of this standard is to determine appropriate methods and means to remove sediment from water generated during dewatering activities prior to discharging off–site or to waters of the state. Practices identified in this standard shall be deemed to meet the de–watering performance standard to prevent the discharge of sediment to the maximum extent practicable (MEP) as defined in s. NR 151.11 (6) (c).

III. Conditions where Practice Applies

This practice applies where sediment laden water needs to be removed for construction or maintenance activities. Dewatering practices shall be in keeping with the effective operating and applicability criteria listed on Figure 2, Dewatering Practice Selection Matrix.

This practice does not apply to:

- Water being discharged directly to groundwater or *karst features*[1]. Refer to NR140
- Well dewatering systems. Refer to NR 812

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This may include activities performed under NR 216 and Chapter 30 permits, for water bodies with *targeted performance standards* per NR 151.004, 303d waterbodies or others. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum allowable limits for design parameters, installation and performance requirements.

Dewatering practices shall be selected based on the predominant soil texture encountered at the dewatering site with consideration given to pumping or flow rates, volumes and device effectiveness. Refer to Figure 1 USDA Soil textural triangle to assist with soil classifications at the site. Figure 2, Dewatering Practice Selection Matrix illustrates acceptable dewatering options and their effective ranges. Practices selected that are not on the matrix must provide an equivalent level of control, with justification provided to the reviewing authority.

A. Site Assessment – A site assessment shall be conducted and documented to determine the physical site characteristics that will affect the placement, design, construction and maintenance of dewatering activities. The site assessment shall identify characteristics such as ground slopes, soil types, soil conditions, bedrock, sinkholes, drainage patterns, runoff constituents, proximity to regulated structures, natural resources, and specific land uses. The site assessment shall include the following:

- Sanitary and storm sewer locations
- Potential contamination – Odor or discoloration other than sediment, or an oily sheen on the surface of the sediment laden water. If contamination is present, notify DNR Spills Reporting
- Soil textural class for areas where dewatering will occur. Soil investigation shall extend below grading and trenching activities
- Depth to the seasonally highest water table
- Discharge outfall locations
- Distance and conveyance method to receiving waters

B. General Criteria Applicable To All Dewatering Activities

1. Contact the WDNR when the discharge from a dewatering practice will enter a WDNR listed *Exceptional Resource Water (ERW), Outstanding Resource Water (ORW)*, or a wetland in an area of special natural resource interest as identified in NR 103.

2. Contact the owner or operator of the municipal separate stormwater system if the discharge is to a municipal storm water conveyance system. The allowable discharge rate shall be limited by the capacity of the system or requirements of the system owner.

3. When practical, dewatering effluent shall be collected in a pump truck for transport to a *treatment facility* or discharged directly to a treatment facility.

4. For surface dewatering, utilize a floating suction hose, or other method, to minimize sediment being sucked off the bottom.

5. For discharges that will be directed to locations on–site verify that the anticipated volume of water can be fully contained.

6. The topography and condition of the ground cover between the pump discharge point and potential receiving waters shall be evaluated for potential erosion. Appropriate stabilization measures shall be incorporated to prevent erosion.

7. When discharge to a karst feature or other direct groundwater connection can not be avoided, the dewatering system must be designed and operated to maintain compliance with the groundwater quality standards contained in applicable regulations, including ch. NR 140 Wis. Adm. Code.

8. If the discharge directly or indirectly enters a stream, the discharge flow rate shall not exceed 50 percent of the peak flow rate of the 2–year 24–hour storm event.

C. Geotextile Bags

1. Geotextile bags shall meet the criteria listed in Table 1.

Table 1: Properties for Geotextile Bags

Property	Test Method	Type I Value	Type II Value
Maximum Apparent Opening Sizes	ASTM D–4751	0.212 mm	0.212 mm
Grab Tensile Strength	ASTM D–4632	200 lbs.	300 lbs.
Mullen Burst	ASTM D–3786	350 psi	580 psi
Permeability	ASTM D–4491	0.28 cm/sec	0.2 cm/sec
Fabric	Nominal Representative Weight	8 oz	12 oz

2. Geotextile bags shall be sized according to the particle size being trapped, expected flow or pumping rate (gallons per minute) per square foot of fabric and a 50% clogging factor. The footprint of the bag shall be no smaller than 100 square feet.

3. Geotextile bags shall be securely attached to the discharge pipe.

4. Polymers can be used to enhance the efficiency of geotextile bags. If polymer is used, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufacturer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

D. Gravity Based Settling Systems

Gravity based systems rely on settling of particles as the primary means of treatment. To effectively accomplish this, quiescent conditions should exist with sufficient detention time. Practices include portable sediment tanks, sediment traps, sediment basins and wet detention basins.

If polymer is used to enhance settling, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufac-

turer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

1. Portable Sediment Tank: These tanks are intended to settle only sands, loamy sands, and sandy loams. If polymer is added, these tanks will also be appropriate for settling loams, silt loams and silts. Portable sediment tanks shall have a minimum of two baffled compartments, and be a minimum of three feet deep. The inlet and outlet pipe shall be a minimum diameter of three inches. Use one of the following methods to size a tank:

   a. Settling: Account for settling of the suspended sediments with the following equation:

      Sa = 1.83 * Q;

   where

      Sa = Tank surface area (sq ft)

      Q = Pumping rate (gallons per minute)

      Note: 1.83 is a factor that includes the conversion from gpm to cfs (1 gpm = 0.0022 cfs) and the particle settling velocity for Soil Class 1 (0.0012 ft/sec) from WDNR Conservation Practice Standard 1064 Sediment Basin.

   b. Filtration: Build the first chamber as large as possible to aid in settling. Flow capacity shall be determined by the end area of the filter media (fabric) and the flow rate (gallons per minute) per square foot of the finest filter media and a 50% clogging factor.

2. Sediment Trap or Sediment Basin: This device is a temporary sediment control device. The design, installation, and operation of the sediment trap or basin shall meet the requirements stipulated in WDNR Conservation Practice Standard 1063 Sediment Trap or Standard 1064 Sediment Basin.

3. Wet Detention Basin: This device is generally a permanent structure designed to address post–construction pollutant reduction requirements. The design, installation, and operation of the wet detention basin shall meet the requirements stipulated in WDNR Conservation Practice Standard 1001 Wet Detention Basin.

E. Passive Filtration Systems

Passive filtration systems rely on filtration as the primary method of removing particles. Sediment removal efficiency will be related to the particle size distribution in the stormwater. Practices include manufactured filters, filter tanks, filter basins, vegetative filters, grass swales, and filtration fabric.

Filter fabric sediment removal efficiency shall be based on the properties specified in Table 1.

1. Manufactured Filters: Filters shall be sequenced from the largest to the smallest pore opening. Sand media filters are available with automatic backwashing features that can filter to 50 μm particle size. Screen or bag filters can filter down to 5 μm. Fiber wound filters can remove particles down to 0.5 μm.

2. Filter Tank (portable): Install, operate and maintain according to manufacturer recommendations.

3. Filter Basin: Install, operate and maintain according to Wisconsin Department of Transportation technical guidance.

4. Vegetative Filter: Refer to WDNR Conservation Practice Standard 1054 Vegetated Buffer for Construction Sites.

F. Pressurize Filtration Systems

Pressurized filtration systems differ from passive systems in that the water flowing through the media is pressurized and the filter media is designed to handle higher flow rates. Practices include portable sand filters, wound cartridge units, membranes and micro–filtration units.

Pressurized filters typically have automatic backwash systems that are triggered by a pre–set pressure drop across the filter. If the backwash water volume is small or substantially more turbid than the stormwater stored in the holding pond or tank, returning backwash water to the pond or tank may be appropriate. However, land application or another means of treatment and disposal may be necessary.

Screen, bag, and fiber filters must be cleaned and/or replaced when they become clogged.

1. Portable Sand Filter: Install, operate and maintain according to manufacturer recommendations.

2. Wound Cartridge Units: Secondary filtration of sediments using high efficiency filter cartridges may be necessary to remove fine particles such as clays. Install, operate and maintain according to manufacturer recommendations.

3. Membranes and Micro–filtration: Install, operate and maintain according to manufacturer recommendations.

4. If polymer is used to enhance settling, the polymer shall be approved by the WDNR and meet the criteria stipulated in WDNR Conservation Practice Standard 1051, Sediment Control Water Application of Polymers. The polymer supplier or applicator shall provide certifications showing that products have met the performance requirements of Standard 1051. If the manufacturer has not completed the required testing, the project may be used to gain that certification provided it meets the site requirements of Standard 1051. Any such testing will be monitored by DNR or WisDOT, with testing done by a qualified third party.

VI. Considerations

A. It may be necessary to clean the municipal storm drainage system prior to and after discharging to the system to prevent scouring solids from the drainage system.

B. Geotextile bags are generally not appropriate when discharging to ORW, ERW, waterbodies supporting cold water communities, trout streams, or to *highly susceptible* and *less susceptible wetlands*.

C. Pressurized filtration systems are the most efficient for removing fine sediments.

D. Portable sediment tanks may be appropriate when other sediment trapping practices cannot be installed due to lack of space or other reasons.

E. Filtration is not an efficient treatment of water with heavy sediment loads. Use a settling tank or sand filter as pretreatment when possible.

F. It may be necessary to use a combination of dewatering practices to achieve the intended results.

VII. Plans and Specifications

All plans, standard detail drawings, or specifications shall include the schedule for installation, inspection, and maintenance and shall be kept on–site with the erosion control plan.

VIII. Operation and Maintenance

A. Sediment shall be removed from devices to maintain effectiveness. All sediment collected in dewatering devices shall be properly disposed of to prevent discharge to waters of the state.

B. The following monitoring shall be conducted. Test results shall be recorded on a daily log kept on site:

1. Discharge duration and specified pumping rate
2. Observed water table at time of dewatering
3. If used, type and amount of chemical used for pH adjustment
4. If used, type and amount of polymer used for treatment
5. Maintenance activities

IX. References

The American Association of State Highway Officials (AASHTO) Soil Classification System

X. Definitions

Exceptional Resource Waters (ERW) (V.B.1): are waters listed in s. NR 102.11.

Highly susceptible wetland (VI.B): include the following types: fens, sedge meadows, bogs, low prairies, conifer swamps, shrub swamps, other forested wetlands, fresh wet meadows, shallow marshes, deep marshes and seasonally flooded basins.

Karst feature (III): are an area or geologic feature subject to bedrock dissolution so that it is likely to provide a conduit to groundwater, and may include caves, enlarged fractures, mine features, exposed bedrock surfaces, sinkholes, springs, seeps or swallets.

Less susceptible wetland (VI.B): include degraded wetlands dominated by invasive species such as reed canary grass.

Outstanding Resource Waters (ORW) (V.B.1): are waters listed in s. NR 102.10.

Targeted performance standard (IV): means a performance standard that will apply in a specific area, where additional practices beyond those contained in NR 151 are necessary to meet water quality standards.

Treatment facility (V.B.3): includes wastewater treatment plants or wet detention basins constructed in accordance with WDNR Conservation Practice Standard 1001 Wet Detention Basin or other approved land application sites.

Figure 1: USDA Soil Textural Triangle

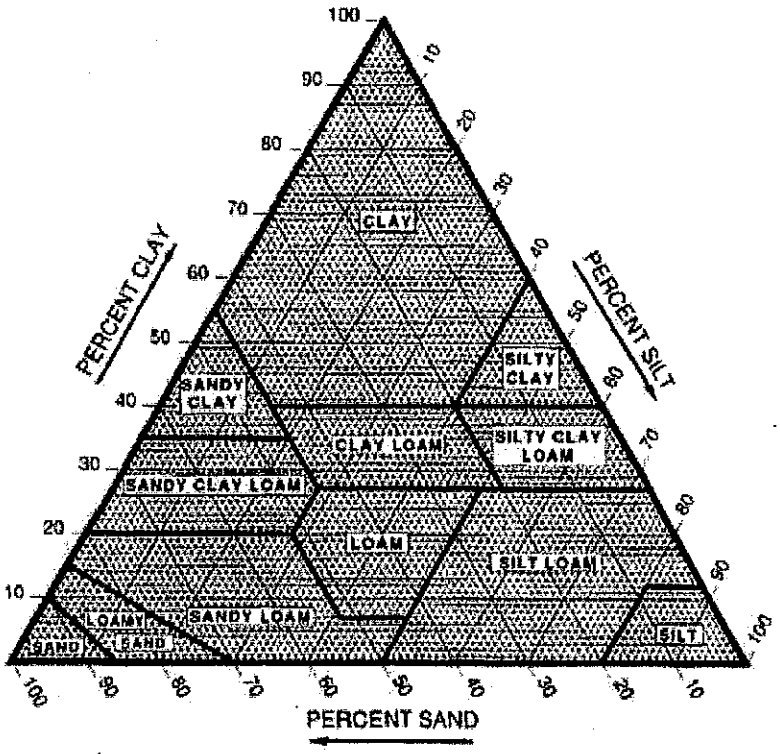


Figure 2: Dewatering Practice Selection Matrix

Type of Dewatering Practice	Soil and Particle Size Classification			Notes
	Coarse to Medium Particles	Medium to Fine Particles	Fine to Very Fine Particles	
	Sand, Loamy Sands, and Sandy Loams	*Loams, Silt Loams, and Silts*	*Clay Loams, Silty Clays and Clay*	
Geotextile Bags				
Type I	▬	●		
Type II	■	▬	●	
Gravity Based Settling				
Sediment Tank (Portable)	▬	●		
Sediment Trap (Temporary)	▬	●		Use Standard 1063 Sediment Trap
Sediment Basin (Temporary)	▬	▬	●	Use Standard 1064 Sediment Basin
Wet Detention Basin (Perm)	▬	▬	▬	Use Standard 1001 Wet Detention Basin
Passive Filtration				
Filter Tank (Portable)	▬	▬	●	Use according to manufacturer's recommendations
Filter Basin	▬	▬	●	See WisDOT Standard Specifications
Vegetative Filter	▬	▬	▬	Effectiveness depends upon the width of the filter and the runoff rate of flow. See Standard 1054 for design guidelines.
Pressurized Filtration				
Portable Sand Filter	▬	●	●	The contractor shall provide a certification sheet from the manufacturer specifying performance of the device based on soil type and pumping rate.
Wound Cartridge Units	■	▬	▬	
Membranes & Micro-filtration	■	■	■	Very effective but high maintenance requirements
Other Practices				
Sanitary Sewer Discharge	▬	▬	▬	
Pump Truck	▬	▬	▬	Transported to treatment facility
Alternative Method				Discuss with regulatory authority

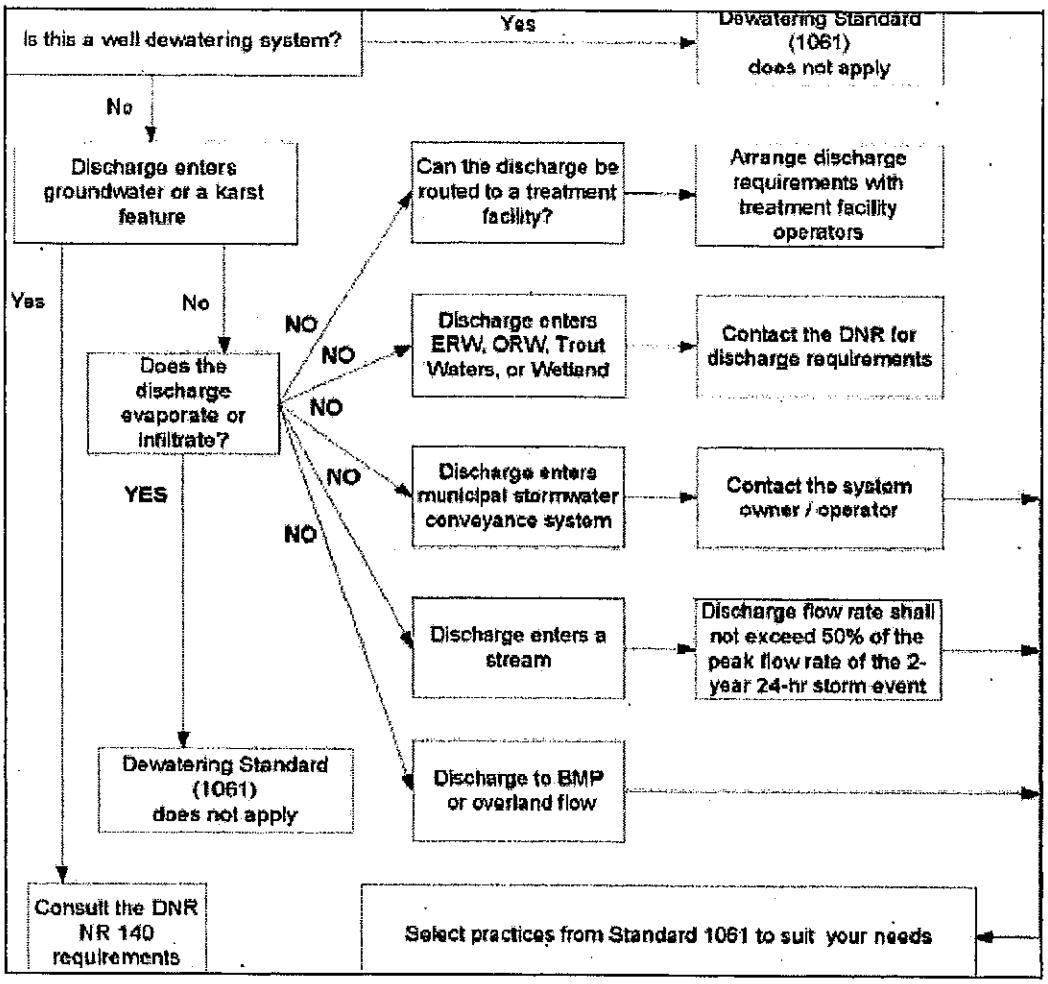
Key:
Effective range of device: ▬
Device applicable but may not be cost effective: ■
Effective range with addition of polymer: ●

Notes:
(1) The effectiveness of many practices can be enhanced through the use of polymer mixture.
(2) Soil classification shall be done in accordance to an accepted method (i.e. USDA, AASHTO)

Conservation Practice Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI. WDNR, WI 4/07

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Figure 3: Factors Influencing The Selection of Dewatering Practices



If the dewatering effluent is discolored, has an order, an oily sheen, or other toxins are present notify the DNR immediately

24 Hours Spills Reporting Hotline 1-800-943-0003

Conservation Practice Standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your local WDNR office or the Standards Oversight Council office in Madison, WI. WDNR, WI 4/07

[1] Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used in the text.

Ditch Check

(Channel)

1062 (3/06)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary dam constructed across a swale or drainage ditch to reduce the velocity of water flowing in the channel. *Ditch checks*[1] can be constructed out of stone, a double row of straw bales or from engineered products found on the Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL).

II. Purpose

The purpose of this practice is to reduce flow velocity and to pond water, thereby reducing active channel erosion and promoting settling of suspended solids behind the ditch check.

III. Conditions Where Practice Applies

This Standard applies where grading activity occurs in areas of channelized flows and a temporary measure is needed to control erosion of the channel until permanent stabilization practices can be applied.

Under no circumstance shall ditch checks be placed in intermittent or perennial stream without permission from WDNR. This Practice may not be substituted for major perimeter trapping measures.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of ditch checks. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Height

1. Installed, the minimum height of ditch checks shall be 10 inches and shall not exceed a maximum height of 16 inches for manufactured or biodegradable materials and 36 inches for stone (or other inorganic materials).
2. Ditch checks must be installed with the center lower than the sides forming a weir. If this is not done stormwater flows are forced to the edge of the ditch check thus promoting scour, or out of the channel causing excessive erosion.
3. Stone ditch checks shall have a minimum top width of 2–feet measured in the direction of flow with maximum slopes of 2:1 (2 horizontal to 1 vertical) on the upslope side and 2:1 on the down slope side.

B. Placement

1. At a minimum install one ditch check for every two feet of drop in the channel.
2. Ditch checks shall be placed such that the resultant ponding will not cause inconvenience or damage to adjacent areas.

C. Material Specifications

1. Stone ditch checks shall be constructed of a well–graded angular stone, a D_{50} of 3 inch or greater, sometimes referred to as breaker run or shot rock.
2. Ditch checks may be constructed of other approved materials but must be capable of withstanding the flow velocities in the channel. Manufactured products listed in WisDOT's PAL are also acceptable for temporary ditch checks.

Note: Silt fence and single rows of straw bales are ineffective as ditch checks and are not permitted.

D. Construction – Refer to Figure 1 & 2

1. Ditch checks shall be utilized during rough grading and shall be removed once the final grading and channel stabilization is applied, unless intended to be part of a permanent stormwater management plan.

2. Channel erosion mat or other non–erodible materials shall be placed at the base of a ditch check, and extended a minimum of 6 feet, to prevent scour and washing out the toe of the ditch check. DNR Conservation Practice Channel Erosion Mat (1053) contains criteria for the placement of erosion mat in this location.

3. Chink or seal stone and rock ditch checks to minimize the flow through the ditch check.

VI. Considerations

A. For added stability, the base of a stone or rock ditch check should be keyed into the soil to a depth of 6–inches.

B. Stone ditch checks may be underlain by a nonwoven geotextile fabric to ease installation and removal. If the geotextile fabric is extended, it can serve purpose specified in section V.D.2

C. Ditch checks installed in grass lined channels may kill the vegetation if water is ponded for extended periods or excessive siltation occurs. Proper maintenance is required to keep areas above and below the ditch check stabilized.

D. The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.

E. When placing ditch checks in swales adjacent to roadways consider designating a 'clear zone' free of obstacles posing a threat to out of control vehicles.

F. Mowing operations may throw stones from ditch checks causing a potential safety hazard.

VII. Plans and Specifications

A. Plans and specifications for installing ditch checks shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location and spacing of ditch check

2. Schedules and sequence of installation and removal

3. Standard drawings and installation details

4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Ditch checks shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

B. Unless incorporated into a permanent stormwater management system, ditch checks shall be removed once the final grading and channel stabilization is applied.

C. Sediment deposits shall be removed when deposits reach 0.5 the height of the barrier. Removal of sediment may require replacement of stone. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Printed copies are no longer distributed.

X. Definitions

D_{50} (V.C.1): The particle size for which 50% of the material by weight is smaller than that size.

Ditch Checks (I) Are commonly referred to as temporary check dams. Stone ditch checks refer to those made out of either stone or rock.

Figure 1

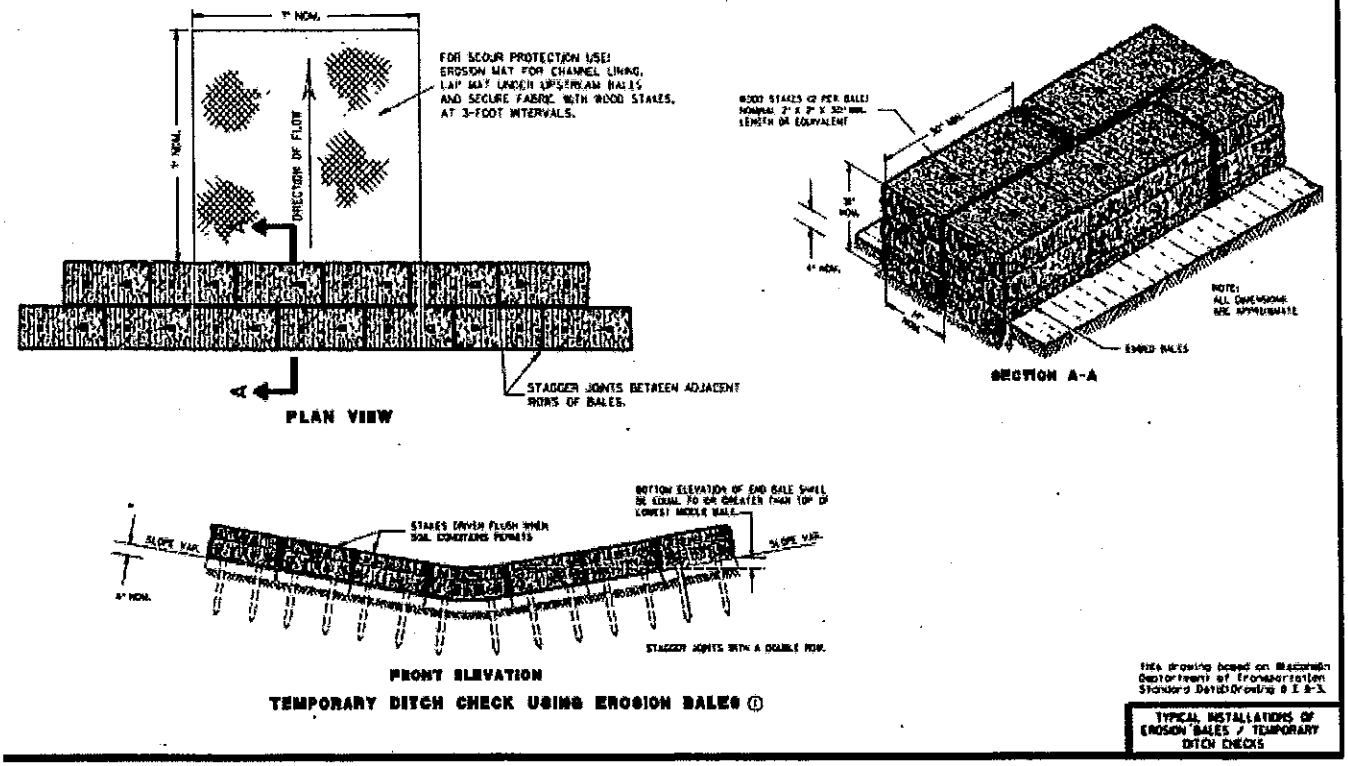
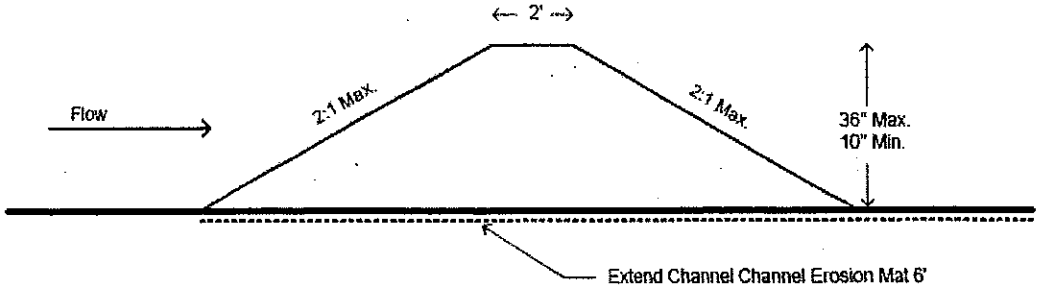


Figure 2. Stone Ditch Check



Side View

Construction Site Diversion

1066 (03/06)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A *temporary*[1] berm or channel constructed across a slope to collect and divert runoff.

II. Purpose

To intercept, divert, and safely convey runoff at construction sites in order to divert clean water away from disturbed areas, or redirect sediment laden waters to an appropriate sediment control facility.

III. Conditions Where Practice Applies

A. This practice is applicable to construction sites where temporary surface water runoff control or management is needed. Locations and conditions include:

1. Above disturbed areas, to limit runoff onto the site.
2. Across slopes to reduce slope length.
3. Below slopes to divert excess runoff to stabilized outlets.
4. To divert sediment–laden water to sediment control facilities.
5. At or near the perimeter of the construction area to keep sediment from leaving the site.

B. This standard does not pertain to permanent diversions. Refer to appropriate design criteria and local regulations when designing permanent diversions.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This standard does not contain the text of federal, state, or local laws.

V. Criteria

A. The diversion shall have stable side slopes and shall not be overtopped during a 2–year frequency, 24–hour duration storm. The minimum berm cross section shall be as follows:

1. Side slopes of 2:1 (horizontal:vertical) or flatter.
2. Top width of two feet.
3. Berm height of 1.5 feet.

B. Sediment–laden runoff from disturbed areas shall be diverted into a sediment control practice. For typical sediment control practices see WDNR Conservation Practice Standards Sediment Trap (1063) or Sediment Basin (1065) for design criteria.

C. When diverting clean water the diversion channel and its outfall shall be immediately *stabilized* for the 2–year frequency, 24–hour duration storm. Build and stabilize clean water diversions before initiating down slope land–disturbing activities.

D. Diversions shall be protected from damage by construction activities. At all points where diversion berms or channels will be crossed by construction equipment, the diversion shall be stabilized or shaped appropriately. Temporary culverts of adequate capacity may be used.

E. For diversions that are to serve longer than 30 days, the side slopes including the ridge, and down slope side the diversion shall be stabilized as soon as they are constructed. The diversion channel should be stabilized (i.e. erosion mat) or a larger sediment control practice shall be needed. For diversions serving less than 30 days, the down slope side of the diversion shall be stabilized as soon as constructed.

VI. Considerations

A. The channel cross section may be parabolic, v–shaped or trapezoidal. The use of "V" channels is generally discouraged due to potential erosion problems.

B. Ditch checks may be used to enhance sediment removal. Ditch checks shall be designed in accordance with WDNR Conservation Practice Standard Ditch Check (1062).

C. For diversion berms consider designing an emergency overflow section or bypass area to limit damage from storms that exceed the 2–year frequency 24–hour duration storm. The overflow section may be designed as a stabilized weir with riprap protection.

VII. Plans and Specifications

A. Plans and specifications for installing diversions shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Diversion location.
2. Channel grade or elevations.
3. Typical cross section.
4. Channel stabilization if required.

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Diversions shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. Maintenance shall be completed as soon as possible with consideration to site conditions.

C. Accumulated sediment shall be removed when it reaches one half the height of the diversion berm. Properly dispose of any sediment removed from the diversion.

D. Diversions shall be removed and the area stabilized according to construction plans.

IX. Definitions

Temporary (I): an erosion control measure that is utilized during construction and grading operations prior to final stabilization.

Stabilized (V.C): means protecting exposed soil from erosion.

Dust Control On Construction Sites

1068 (03/04)

Wisconsin Department of Natural Resources

Conservation Practice Standard

I. Definition

Dust control includes practices used to reduce or prevent the surface and air transport of dust during construction.

Dust control measures for construction activities include minimization of soil disturbance, applying mulch and establishing vegetation, water spraying, surface roughening, applying polymers, spray–on tackifiers, chlorides, and barriers.

II. Purpose

This practice may be used to:

- Reduce wind erosion and dust.
- Minimize deposition of dust and wind transported soils into water bodies through runoff or wind action.
- Reduce respiratory problems.
- Minimize low visibility conditions caused by airborne dust.

III. Conditions Where Practice Applies

Dust control measures may be applied at any construction site, but is particularly important for sites with dry exposed soils which may be exposed to wind or vehicular traffic.

IV. Federal, State, and Local Laws

Users of this standard shall comply with applicable federal, state and local laws, rules, regulations or permit requirements governing this practice. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. The implementation of dust control shall limit the area exposed for dust generation.

B. Asphalt and petroleum based products cannot be used for dust control.

C. Mulch and Vegetation – Mulch or seed and mulch may be applied to protect exposed soil from both wind and water erosion.

Refer to WDNR Conservation Practice Standards Mulching for Construction Sites (1058) and Seeding for Construction Site Erosion Control (1059) for criteria.

D. Water – Water until the surface is wet and repeat as needed. Water shall be applied at rates so that runoff does not occur.

Treated soil surfaces that receive vehicle traffic require a stone tracking pad or tire washing at all point of access. Refer to WDNR Conservation Practice Standard Stone Tracking Pad and Tire Washing (1057) for criteria.

E. Tillage – A control measure performed with chisel type plows on exposed soils. Tillage shall begin on the windward side of the site. Tillage is only applicable to flat areas.

F. Polymers – Polymers can be an effective practice for areas that do not receive vehicle traffic. Dry applied polymers must be initially watered for activation to be effective for dust control. Refer to WDNR Conservation Practice Standard Erosion Control Land Application of Polymers (1050) for application criteria.

G. Tackifiers and Soil Stabilizers Type A – Products must be selected from and installed at rates conforming to the WisDOT Erosion Control PAL. See Section IX for reference. Example products include Latex–based and WDNR, WI

Temporary Grading Practices For Erosion Control

(Surface Roughening and Temporary Ditch Sumps)

1067 (03/04)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Temporary[1] grading practices used to minimize construction site erosion. These practices include, but are not limited to surface roughening (directional tracking and tillage) and temporary ditch sumps.

II. Purpose

The purpose of these practices are to minimize erosion and sediment transport during grading operations on construction sites.

III. Conditions Where Practice Applies

These practices apply where land disturbing activities occur on construction sites. These practices shall be used in conjunction with other erosion control practices.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing these practices. This standard does not contain the text of federal, state, or local laws.

V. Criteria

These interim practices may be employed in addition to the approved grading plan to reduce erosion and sediment transport.

A. Surface Roughening – Surface roughening is abrading the soil surface with horizontal ridges and depressions across the slope to reduce runoff velocities.

1. Directional Tracking – The process of creating ridges with tracked vehicles on unvegetated slopes. This method is used for short durations on sites actively being grad and shall be used in conjunction with other practices. This practice shall be in place at the end of each workday.

   Directional tracking involves driving a tracked vehicle up and down a slope. The tracks create horizontal grooves and ridges. The rough surface slows sheet runoff and helps to prevent rills from forming. (Conversely, if the tracked vehicle is driven along the contour the tracks create vertical grooves and ridges for the water to follow, increasing erosion.)

2. Tillage – Utilizing conventional tillage equipment to create a series of ridges and furrows on the contour no more than 15 inches apart.

B. Temporary Ditch Sump – Temporary ditch sumps are ½ to 5 cubic yard excavations made in a drainageway during earthmoving operations. Their purpose is to slow and pond runoff during the time that drainageways are being graded. Sumps shall be in place prior to anticipated rain events.

Construction involves excavating sumps (holes) in the rough ditch grade, and using the excavated material to form a dike on the downstream side of the sump.

Temporary ditch sumps are not effective perimeter controls. Other sediment control practices shall be utilized prior to channels discharging into public waterways.

VI. Considerations

A. Directional tracking may compact the soil, therefore additional seedbed preparation may be required. Refer to WDNR Conservation Practice Standard Seeding for Construction Site Erosion Control (1059) for seedbed preparation and seeding criteria.

B. When constructing a temporary ditch sump, compacting the dike provides additional stability.

C. Consider at a minimum excavating ½ cubic yard per 1% gradient, for every 500 feet of channel when constructing temporary ditch sumps.

VII. Plans and Specifications

Due to the interim nature of these practices, and the fact that location determinations are made in the field, they need only be referenced in the erosion control plan narration or general notes.

VIII. Operation and Maintenance

These practices shall be inspected and repaired or reinstalled after every runoff event.

IX. References

Virginia Department of Conservation and Recreation. 1992. Virginia Erosion and Sediment Control Handbook, Third Edition. Chapter 3 – 3.29 Surface Roughening.

Dane County. 2002. Dane County Erosion Control and Stormwater Manual, First Edition. Appendix Surface Roughening S–16.1.

X. Definitions

Temporary (I): An erosion control measure that is utilized during construction site grading activities.

Interim Sediment Control

Water Application of Polymers

1051 (11/02)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

The application of products containing *polymers*[1] to *sediment control structures.*

II. Purpose

The purpose of this practice is to settle out or remove suspended *sediment* from water within sediment control structures.

III. Conditions Where Practice Applies

This practice shall be used with self–contained sediment control structures, on a temporary basis for construction sites, in an emergency for post–construction sites and only continually at sites holding an individual permit, if needed to improve the sediment removal efficiency of the structure. Polymers shall not be directly applied to *surface waters of the state.* Sediment control structures may be within, or discharge to, surface waters of the state.

IV. Federal, State and Local Laws

Water applications of polymer shall comply with all federal, state, and local laws, rules or regulations governing polymers. The operator is responsible for securing required permits. This standard does not contain the text of the federal, state, or local laws governing polymers.

V. Criteria

A. Toxicity Criteria

If used in accordance with the use restriction, the polymer mixture shall meet an acceptable level of risk such that the product can be used without significant harm to organisms that inhabit or come in contact with the aquatic environment. Every attempt shall be made to eliminate the use of any chemicals known to be environmentally toxic within a polymer mixture. Polymer mixtures shall be non–combustible.

The manufacturer shall supply toxicity testing data to the Wisconsin Department of Natural Resources (WDNR) based on the polymer mixture, including any binding or buffering agents, catalyst or any other additives.

1. The use of cationic *polyacrylamide* shall be avoided where there is danger of impacting aquatic organisms because its toxicity to aquatic test species occurs at very low concentrations.

2. Anionic polymer mixtures shall have ≤ .05% free acrylamide monomer by weight as established by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA).

3. Each manufacturer shall provide to the WDNR toxicity information (including acute and chronic water column toxicity test data) from a certified lab, as defined in ch. NR 149 Wis.Adm.Code, for the polymer mixture.

   This data shall include all raw and statistical data regarding death, sub–lethal observations such as immobility, and any other test observations. *Standardized toxicity testing* procedures should be used and referenced. A *use restriction* will be calculated by WDNR using the information in Appendix I.

4. Users of polymer mixtures shall obtain and follow all *Material Safety Data Sheet (MSDS)* requirements, manufacturer's recommendations, and WDNR use restrictions.

B. Application Criteria

1. Maximum application rates, per storm event, in pounds per acre–feet shall be the lesser of WDNR's use restriction multiplied by 1.35 or the manufacturer's recommended application rate (1.35 is a conversion factor that is used to change the use restriction from ppm to an application rate in pounds per acre–feet).

2. Neither the manufacturer's written application rate recommendations, nor the application rate shall exceed the WDNR use restriction. The manufacturer or distributor shall provide for the applicator:

   a. Labels affixed to the polymer mixture containers that indicate the recommended application rate and the maximum application rate based on the use restriction.

   b. A product expiration date for the polymer mixture based on product expiration dates of the polymer.

   c. General written application methods.

   d. Written instructions to provide proper safety, storage, and mixing of their product.

3. The application method shall provide for uniform distribution of the product in the sediment control structure and shall consist of either:

   a. Passive Applications: Polymers applied by non–mechanically dosing the sediment–laden inflow prior to it entering the impoundment area of the sediment control structure. The manufacturer shall base passive application rates on the dissolution rate and/or the dead storage volume of the sediment control structure.

   or

   b. Active or Mechanical Applications: Polymer applied by mechanically or hydraulically mixing directly into a sediment control structure.

4. The applicator of the polymer mixture shall at the time of application, document the following:

   - Name of applicator
   - Application rate in pounds per acre–feet of stormwater runoff
   - Date applied
   - Product type
   - Weather conditions during application
   - Method of application

   Copies of this documentation shall be entered into the contractor's monitoring log or a project diary and made available upon request.

C. Product Approval Criteria

The manufacturer shall certify, through independent sampling and test results, that their product performs as per the following requirements. (The product approval process is depicted in flow chart form in Figure 1.)

1. The toxicity information required in section V.A.3. of this standard shall be reviewed by the WDNR and used to generate a written product use restriction for the polymer mixture. Appendix I outlines the information that needs to be submitted as a part of this review, and states where they must be submitted.

2. Polymer mixtures shall achieve = 95% sediment reduction as measured by the standpipe method outlined in Appendix II.

3. Performance criteria – active and passive applications shall be field tested and submitted separately:

   a. The performance of polymer mixtures shall be verified and field–tested in a body of water that is not discharging directly into the waters of the state. The body of water shall be a minimum of 1/3–acre surface area and an average depth of at least 3 feet.

   b. The total suspended solids prior to the polymer treatment must be tested and verified by an independent testing lab, and must have a minimum value of 800 ppm or equivalent N*ephelometric Turbidity Units (NTU)* and be visibly turbid. The relationship between total suspended solids (TSS) and NTU is site–specific and the derivation of a unique TSS–NTU relationship shall be conducted for each sediment control structure. A minimum of two samples per acre–foot of water shall be taken from random locations within the test site.

   c. Within 48 hours from the initial treatment of the water body, the total suspended solids must have a maximum of 80 ppm, or equivalent NTU.

   d. Testing sites may not be used for subsequent testing for a period of 3 months from the time of initial application.

   e. The Wisconsin Department of Transportation (WisDOT) shall be notified at least 7 days prior to testing, and WisDOT and/or WDNR staff shall be allowed to monitor any such testing.

4. The WisDOT Erosion Control Storm Water/Product Acceptability List Committee will review and approve products as per the process set forth in WisDOT's Product Acceptability List (PAL).
5. The polymer mixture must be resubmitted if any portion of the mixture is altered subsequent to its approval. Such alterations may include:
   a. The amendment of base polymers and/or any other additives
   b. The ratios of individual components

VI. Considerations

The following are additional recommendations, which may enhance the use of, or avoid problems with, the practice.

A When using products in impoundments immediately adjacent to, or within waters of the state, consider using products for which the manufacturer's recommended application rate is considerably lower than the use restriction.

B. The applicator should use the least amount of polymer mixture to achieve optimal performance.

C. Polymer mixtures should be applied in conjunction with other erosion control BMPs and under an erosion and sediment control or stormwater management plan.

D. Test the pH of the water in the sediment control structure and follow the manufacturer's recommended pH range for their polymer mixture, as pH will impact the effectiveness of polymer mixtures.

E. Ethylene glycol, propylene glycol or any other known environmental toxicants should not be included in the polymer mixture.

F. Care must be taken to prevent spills of polymer mixtures. Follow the manufacturer's recommended cleanup procedures in the event of a spill.

G. Inhaling granular polymer may cause choking or difficulty breathing. Persons handling and mixing polymer should use personal protective equipment of a type recommended by the manufacturer.

H. Polymer mixtures combined with water are very slippery and can pose a safety hazard.

I. Polymer mixtures should be considered as an aid to removing solids from dredge slurries.

J. Where polymer mixtures are used with sediment control structures in the stream, such as during bridge construction, the structure should not be removed until the water is clarified. If the resulting sediment floc is more than a half a foot deep it should be excavated or filtered out.

VII. Specifications

Erosion and sediment control and stormwater management plans specifying polymer mixtures for sediment control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

VIII. Operation and Maintenance

Sediment levels on the bottom of the sediment control structure shall be monitored to measure the loss of storage capacity over time due to enhanced sedimentation by the polymer mixture.

IX. Definitions

Material Safety Data Sheets (MSDS) (V.A.3) Provide basic information on a material or chemical product intended to help someone work safely with the material. This includes a brief synopsis of the hazards associated with using a material, how to use it safely, and what to do if there is an emergency. The retail distributor and/or manufacturer as per OSHA's Hazard Communication Standard, 29 CFR 1910.1200, must provide MSDS, with the purchase of potentially hazardous products.

Nephelometric Turbidity Units (NTU) (V.C.3.b) A measure of the amount of light scattered by suspended and dissolved materials in the sample.

Polyacrylamide (V.A.1) A generic term for polymers made up of many repeating units of the monomer acrylamide (a simple organic compound).

Polymer (I) Polymers are materials that are either natural or synthetic and that have a chain of carbon molecules that are identical, repeating units. Polymers can be positively charged (cationic), negatively charged (anionic) or have no charge (non–ionic).

Polymer Mixture (V.A) Any reference to polymer mixtures refers to the whole manufactured product, including the polymer and any additives. Additional calcium or lime may be added as a buffering agent without being considered part of the whole manufactured product.

Sediment (II) refers to settleable soil, rock fragments and other solids suspended in runoff.

Sediment control structure (I.) A sediment control structure is an impoundment designed to intercept and detain sediment carried in runoff, prior to the runoff reaching the main channel of a waterway or body of water. Placement of these structures must be outside of the main channel of a waterway and shall not span opposing stream banks in channelized flow. The sediment control structure must provide for dedicated sediment storage to at least a depth of two feet, such that the sediment will not be subject to re–suspension during high velocity flow conditions.

Impoundments may be created by a cofferdam, turbidity barrier, earthen berm, sheet piling, self–contained filtering systems or similar material. Examples include properly maintained construction or post–construction sediment ponds, discharging directly or eventually to a water body. They may also include surface water impoundments that are immediately adjacent to a waterway, whose function is to treat stormwater or dredging material. Another potential application is to isolate localized areas surrounding bridge and culvert construction.

Standardized toxicity testing (V.A.2) Examples of such include, but are not limited to, those outlined in the State of Wisconsin Aquatic Life Toxicity Testing Methods Manual (Fleming, et.al, 1996) or Short–term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Water to Freshwater Organisms (Lewis, et.al, 1994). The WDNR use restriction shall be developed from this data.

Surface Waters of the State (III) "Surface" refers to the sub portion of the waters of the state that discharge at the surface. Waters of the state, as defined by s. 283.01(20), Wis. Stats means those portions of Lake Michigan and Lake Superior within the boundaries of Wisconsin, all lakes, bays, rivers, streams, springs, ponds, wells, impounding reservoirs, marshes, water courses, drainage systems and other surface water or groundwater, natural or artificial, public or private within the state or under its jurisdiction, except those waters which are entirely confined and retained completely upon the property of the person.

Use Restriction (V.A.2) Identifies the concentration below which a product is not expected to cause acute toxicity in the aquatic environment.

X. References

Voluntary Use Of Polymers In DNR Programs (A Field Guide) For copies of this companion document contact Mary Anne Lowndes, Water Resources Engineer Bureau of Watershed Management 101 S. Webster St., Box 7921, Madison, WI 53707–7921 Phone (608) 261–6420 *MaryAnne.Lowndes@dnr.state.wi.us*

Fleming, K., P. Hubbard, N. Krause, R. Masnado, D. Piper, W. Repavich, G. Searle, S. Thon, "State of Wisconsin Aquatic Life Toxicity Testing Methods Manual, Edition 1." Bureau of Watershed Management, Wisconsin Department of Natural Resources, Madison, 1996 (WI. PUBL–WW–033–96).

Lewis, P.A., D.J. Klemm, J.M. Lazorchak, T.J. Norberg–King, W.H. Peltier, and M.A. Heber, "Short–Term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms, 3rd Edition." Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH, 1994 (EPA/600/4–91/002).

Roa–Espinosa, A., Bubenzer, G.D. and Miyashita, E., "Sediment and Runoff Control on Construction Sites Using Four Application Methods of Polyacrylamide Mix." National Conference on Tools for Urban Water Resource Management and Protection, Chicago, pp. 278, February 7–10, 2000.

Roa, A., "Are there Safety Concerns or Environmental Concerns with PAM?" Dane County Land Conservation Department, 1997.

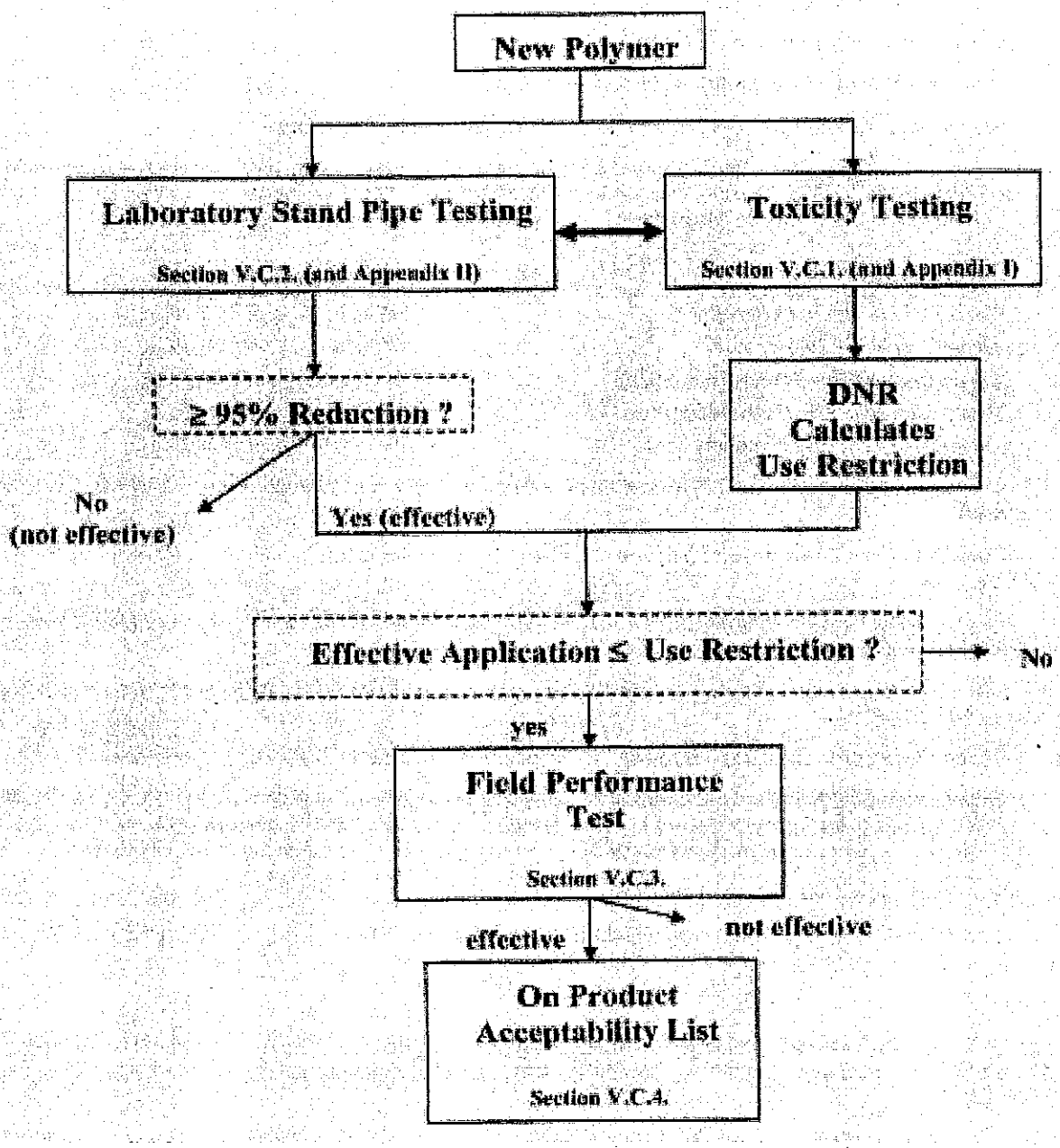
Sojka, R.E. and Lentz, R.D., "A PAM Primer: A brief history of PAM and PAM related issues." Kimberly, ID: USDA–ARS Northwest Irrigation and Soils Research Lab, 1996. http://kimberly.ars.usda.gov/pamprim.ssi

Wirtz, J, R., "The Pros and Cons of the Use of Anionic Polyacrylamides to Control Erosion and Sedimentation in the Lake Mendota Priority Watershed". University of Wisconsin–Madison, MS Thesis, 2000.

WisDOT's Product Acceptability List (PAL). State DOT web site: http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Questions regarding product approvals may be sent to: New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

FIGURE I

POLYMER APPROVAL PROCESS



Interim Sediment Control

Water Application of Polymers

APPENDIX I

REQUIRED TOXICITY INFORMATION FOR WDNR REVIEW

Toxicity information shall be reviewed by the WDNR and will be used to generate a written product use restriction for the polymer. With Chapter 1.7 of the *Whole Effluent Toxicity Program Guidance Document* (Fleming et. al., 2000) as a basis, the following toxicological information/data is required:

a. Manufacturer of the polymer.

b. Chemical name of the polymer.

c. Active Ingredient(s) (if not proprietary information).

d. Chemical Abstracts Service (CAS) #(s) of the polymer and/or active ingredients.

e. Material Safety Data Sheet (MSDS) and/or official toxicity test results listing available aquatic life toxicity data for the WHOLE PRODUCT. Toxicity data for active ingredients is not acceptable for use in calculating a use restriction. The following types of data is acceptable:

Species	Endpoint of Concern
Ceriodaphnia dubia (Cladoceran)	48–hour LC_{50} or EC_{50}/IC_{25}
Daphnia magna (Cladoceran)	48–hour LC_{50} or EC_{50}/IC_{25}
Lepomis macrochirus (Bluegill Sunfish)	96–hour LC_{50} or EC_{50}/IC_{25}
Pimephales promelas (Fathead Minnow)	96–hour LC_{50} or EC_{50}/IC_{25}
Oncorhynchus mykiss (Rainbow Trout)	96–hour LC_{50} or EC_{50}/IC_{25}

LC_{50} = the estimated concentration of polymer that would cause 50% mortality to the test population following the given time period

EC_{50} = the estimated concentration of polymer that would cause a given effect in 50% of the test population following a given time period

IC_{25} = the estimated concentration of polymer that would cause a 25% reduction in some biological measurement of the test population following a given time period

Note: To calculate a use restriction it is necessary to have data from at least one of the cladoceran species and at least one of the fish species (according to s. NR 106.10 (1)).

a. Complete listing of toxicity test conditions. Examples to follow include Tables 11 – 14 in Weber (1993).

b. Standardized test methodology (name of a specific method & its reference may be listed for this, such as "Acute Toxicity Test Procedures for *Daphnia magna*" in Weber (1993). If a modification to a standardized method was used, provide the reference of the specific method along with a specific listing of and reasons for the modifications).

c. Any noted observations from the toxicity tests.

Toxicity test results shall be submitted to: Water Quality Standards Section, WDNR, 101 South Webster Street, P.O. Box 7921, Madison, WI 53707, as one prequalification for field testing.

References:

Weber, C. 1993. *Methods for Measuring the Acute Toxicity of Effluents and Receiving Waters to Freshwater and Marine Organisms, 4th Edition.* Environmental Monitoring Systems Laboratory, U.S. Environmental Protection Agency, Cincinnati, OH. EPA/600/4–90/027F.

Fleming, K., S. Geis, E. Korthals, R. Masnado, G. Searle. 2000. *Whole Effluent Toxicity Program Guidance Document, Revision #3.* Wisconsin Department of Natural Resources, Chapter 1.7.

Interim Sediment Control

Water Application of Polymers

APPENDIX II

LABORATORY STANDPIPE TEST METHODOLOGY

1. Place 40 grams of oven dried "soil" in 2 liters of distilled water within a 2 liter graduated cylinder with stopper. The 40 grams of "soil" represents a "realistic" runoff suspended solids load of 20,000 mg/L (20,000 mg/L x 2 L) according to data collected from commercial and residential construction sites (Owens, et. al. 2000). Repeat a minimum of four times so that there are a minimum of five replicates. The "soil" used in the standpipe test may be characterized by one of the following three options:

   Clays — A clay "soil" is characterized as having greater than 20% of its particles < 2 µm in size. This option is appropriate for those seeking approval* of a polymer for use in any soil condition (clay, silt, or other).

   Silts — A silt "soil" is characterized as having less than 20% of its particles < 2 µm in size AND greater than 20% of its particles 2–25 µm in size. This option is appropriate for those seeking approval* of a polymer for use only in silt soils. The 2–25 µm size is representative of fine to medium silt soils.

   Site–Specific — Use of a site-specific "soil" provides an alternative for those seeking approval* of a polymer that may be customized for optimum performance (in both terms of suspended sediment removal and amount of polymer used) at a particular site. The results of a mechanical soil analysis characterizing the site soil sample particle size composition must be provided. The results of this analysis should be submitted with the results of the standpipe test entered on the "Standpipe Test Data Sheet." This option is provided since each site will have at least slight differences, if not significant differences, in soil chemical and physical characteristics. These differences may influence the effectiveness of any given polymer.

   Indicate which "soil" type is used in the standpipe test on the data sheet under "√ Soil Type Used."

   * Note that final approval of a polymer is granted only after it is demonstrated through both the standpipe and field tests that the polymer is effective and can be effectively applied.

2. Mix the solutions by completely inverting each graduated cylinder 3 times.

3. Add polymer mixture to each graduated cylinder. The volume and concentration of polymer added is the manufacturer's or supplier's choice, but must include a set volume and a gradient of "low" to "high" concentrations. The volume and each polymer concentration must be recorded on the data sheet. The purpose is to determine the lowest polymer mixture concentration needed to achieve effective removal of suspended solids. Ultimately the least amount of polymer mixture needed to achieve optimal performance should be used in the field.

   A minimum gradient of five polymer mixture concentrations is used to achieve the above stated purpose. The purpose of the five concentration gradient is to attempt to pinpoint the concentration that achieves optimal removal of suspended solids (i.e. least amount of polymer mixture required to remove a minimum of 95% of the suspended solids). This gradient should be sufficiently wide to show a range of effectiveness in removing suspended solids (with at least one, but preferably more, meeting the 95% removal level). A second goal of using a minimum of five concentrations is to avoid the occurrence of false negative outcomes in the polymer approval process. By having more concentrations across a gradient it is more likely to find truly effective concentrations that are less than the use restriction value. As is graphically depicted in Figure I, a polymer mixture will not be approved for field testing, and thus for inclusion on the PAL if its effective concentration (as determined in this laboratory stand pipe test) is greater than the use restriction value.

4. Mix the solutions by completely inverting each graduated cylinder 3 times.

5. Let the solution in each graduated cylinder settle for 5 minutes.

6. Determine the percent suspended solids reduction in each graduated cylinder as follows:

   a. Heat/dry one evaporating or drying dish at 103 – 105°C for 1 hour for each graduated cylinder. Store the dishes in a desiccator until needed (steps b).

   b. Weigh a dish out to at least one, and preferably more decimal points. Record this weight on the data sheet.

   c. Collect 20 ml from within one of the graduated cylinders at the 1 liter mark and place in a preweighed evaporating or drying dish (from step a). Repeat steps b and c for each of the other graduated cylinders.

   d. Evaporate and dry each of the 20 ml samples from step b at 98 °C for at least 1 hour.

   e. Cool each dish with sample in a desiccator to balance temperature

f. Weigh each dish with sample. Record this weight on the data sheet.

g. Subtract the weight of the dried dish (from step b) to determine the weight of the solids from the sample. Record this weight on the data sheet.

* These methods follow, with slight modification, those of Standard Methods 2540 B. (1989).

7. The polymer passes this effectiveness test if it achieves ≥ 95 % reduction of suspended solids. Thus, **≥ 95 % reduction is achieved if the weight of the solids from the sample is ≤ 0.2 mg.**

$$\frac{2000 \text{ ml}^{\,1}}{1000 \text{ mg/L}^{\,2}} = \frac{20 \text{ ml}^{\,3}}{X^{\,4}} \; ; \qquad X = 10 \text{ mg/L}$$

[1] = volume of solution in the cylinder

[2] = suspended solids concentration in the cylinder at ≥ 95 % reduction

[3] = volume of sample taken from 1 L mark of the cylinder

[4] = sample solids concentration needed to achieve ≥ 95 % reduction

$$\frac{10 \text{ mg}}{\text{L}} \times \frac{\text{L}}{1000 \text{ ml}} \times \frac{20 \text{ ml}}{} = \mathbf{0.2 \text{ mg}}$$

8. A photocopy of the completed data sheet should be sent to the following address for WisDOT review: New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

References:

Owens, D.W., P. Jopke, D.W. Hall, J. Balousek, and A. Roa. 2000. *Soil erosion from two small construction sites, Dane County, Wisconsin.* U.S. Geological Survey Fact Sheet FS–109–00, 4 p.

Standard Methods Committee. 1989. 2540 Solids. In L.S. Clesceri, A. E. Greenberg, and R.R. Trussell, eds., *Standard Methods for the Examination of Water and Wastewater, 17th Edition.* American Public Health Association, Washington, DC. pp. 2–72 – 2–73.

Interim Sediment Control

Water Application of Polymers

STANDPIPE TEST DATA SHEET

Date(s): _____

Testing Laboratory: _____

Analyst(s) Initials: _____

Polymer Name: _____

Manufacturer Name: _____

Volume of Polymer Mixture Used: _____

√ **Soil Type Used:** ☐ **Clay** ☐ **Silt** ☐ **Site–Specific Soil**

(mechanical analysis results enclosed)

Polymer Mixture Concentration (mg/L or % solution)	Weight of Evaporating/Drying Dish		Final Weight of Solids Sample
	Pre	With Sample	

Which polymer mixture concentration(s) achieved effective (≥ 95%) reduction of suspended solids (i.e. final weight ≤ 0.2 mg solids)?

_____ _____ _____ _____

Notes/Comments:

Please send a photocopy of this completed data sheet to:

New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman B

Erosion Control

Land Application of Anionic Polyacrylamide

Code 1050 (07/01)

Department of Natural Resources

Conservation Practice Standard

I. Definition

The land application of products containing watersoluble anionic polyacrylamide (PAM) as temporary soil binding agents to reduce erosion.

II. Purpose

The purpose of this practice is to reduce erosion from wind and water on construction sites and agricultural lands.

III. Conditions Where Practice Applies

This practice is intended for direct soil surface application to sites where the timely establishment of vegetation may not be feasible or where vegetative cover is absent or inadequate. Such areas may include agricultural lands where plant residues are inadequate to protect the soil surface and construction sites where land disturbing activities or winter shutdown prevent establishment or maintenance of a cover crop. This practice is not intended for application to surface waters of the state as defined by the Wisconsin Department of Natural Resources (WDNR) ch. NR 102.

IV. Federal, State and Local Laws

Anionic PAM application shall comply with all federal, state, and local laws, rules or regulations governing anionic PAM. The operator is responsible for securing required permits. This standard does not contain the text of the federal, state, or local laws governing anionic PAM.

V. Criteria

A. Toxicity Criteria. Anionic PAM mixtures shall be environmentally benign, harmless to fish, aquatic organisms, wildlife, and plants. Anionic PAM mixtures shall be non–combustible.

1. Cationic PAM shall not be used at any level because its toxicity to aquatic test species occurs at very low concentrations.

2. Anionic PAM mixtures shall have _ .05% free acrylamide monomer by weight as established by the Food and Drug Administration (FDA) and the Environmental Protection Agency (EPA).

3. Each manufacturer or supplier shall provide to the WDNR acute toxicity test data from a certified lab, as defined in ch. NR149 Wis. Adm. Code, for their anionic PAM mixture. Procedures specified in the "State of Wisconsin Aquatic Life Toxicity Testing Methods Manual", WDNR, as referenced in s. NR219.04, Wis. Adm. Code shall be used. The WDNR use restriction shall be developed from this data.

4. Users of anionic PAM mixtures shall obtain and follow all Material Safety Data Sheet requirements, manufacturer recommendations, and WDNR use restrictions.

B. Application Criteria

1. The manufacturer or supplier shall provide a product expiration date for anionic PAM mixtures based on product expiration date of PAM in pure form. The manufacturer or supplier shall provide general written application methods, based on site conditions, such as slope and soil type.

2. Application rates shall not exceed manufacturer's written application rate recommendations that shall not exceed the WDNR use restrictions.

3. Maximum application rates, in parts per million (ppm or mg/L or mg/kg), shall be determined by multiplying 1.4 by the number of pounds applied per acre. This number shall be less than or equal to the WDNR use restriction. Higher concentrations of anionic PAM mixtures may actually decrease effectiveness. Repeated applications of anionic PAM mixtures may be applied, if necessary, to ensure adequate effectiveness.

4. The application method shall provide uniform coverage to the target area and avoid drift to non–target areas.

5. The manufacturer or supplier shall provide written instructions to insure proper safety, storage, and mixing of their product.
6. Anionic PAM mixtures shall be used in conjunction with other Best Management Practices (BMPs).
7. When used on bare soil, without seed or mulch, anionic PAM mixtures shall be used on slopes 2.5:1 or flatter.
8. Anionic PAM mixtures shall not be applied to channel bottoms.
9. The applicator of anionic PAM mixture shall document, at the time of application, the following: name of applicator, application rate per acre, date applied, product type, weather conditions during application, and method of application. Copies of this documentation shall be entered into the contractor's monitoring log or project diary and made available upon request.
10. Unused liquid anionic PAM mixtures shall be minimized. Excess material shall not be applied at a rate greater than the maximum application rate. Disposal shall not occur in stormwater conveyance systems (ie. Storm sewer manholes, storm sewer inlets, ditches, and culverts).

C. Product Approval Criteria

1. Toxicity test results shall be reviewed by the WDNR and shall receive a written product use restriction. Toxicity test results shall be submitted to: Water Quality Standards Section, WDNR, 101 South Webster St., P.O. Box 7921, Madison, WI 53707, as a pre–qualification for field testing.
2. Anionic PAM mixtures shall achieve _ 80% reduction in soil loss as measured by a 1 hour storm duration 2"/hour rainfall simulator test performed in accordance with methods used by Bubenzer and Patterson (1982) as a prequalification for field testing.
3. Performance of anionic PAM mixtures shall be verified and field–tested by the WisDOT or other WisDOT–designated facility.
4. The Wisconsin Department of Transportation, Erosion Control Storm Water – Product Acceptability List Committee (ECSW), will review and approve products as per the process set forth in WisDOT's PAL. **Only products approved for use in Wisconsin may be used.** Copies of the PAL are available off the State DOT web site: http://www.dot.state.wi.us/dtid/bhc/pal.html. Questions may be sent to: New Products Engineer, WisDOT, Technology Advancement, 3502 Kinsman Blvd., Madison, WI 53704.

VI. Considerations

The following are additional recommendations, which may enhance the use of, or avoid problems with the practice.

A. Adding seed to the anionic PAM mixture may provide additional erosion protection beyond the life of the anionic PAM.

B. Mulching is typically needed to protect the seed from the effects of wind and sun. Seed germination is not enhanced or impeded by the anionic PAM mixture.

C. Using a minimum 30 ft setback when applying anionic PAM mixture near surface waters of the state is recommended.

D. Applying anionic PAM mixture to soil may provide benefits of improved water quality, infiltration, soil fertility, and visibility by reducing wind and water erosion.

E. For erosion control, the anionic PAM mixture may be applied upgradient of lands planted in food crops.

F. Application of anionic PAM mixture may be particularly effective in the following situations:
- During rough grading operations
- Phased construction projects
- Stockpiles
- After final grading and before paving or final seeding and planting
- Sites having a winter shutdown
- Agricultural lands where plant residues are inadequate
- Sites receiving final landscaping, but where adequate vegetation cannot be established prior to winter.

G. Application of anionic PAM mixture may not be as effective in the following situations:
- When the soil surface is pure sand or gravel with no fines.
- When applied over snow cover.

H. Visible tracer or colorant to visually track application is recommended.

I. Anionic PAM mixtures may be applied in liquid and granular forms.

J. Application rates of anionic PAM mixtures may need to be adjusted based on soil type, slope, and type of erosion targeted (ie. wind or water). Based on manufacturer's recommendations, higher application rates may be necessary when applied in granular form.

K. Anionic PAM mixtures combined with water are very slippery and can be a safety hazard. Care must be taken to prevent spills of anionic PAM mixtures onto paved surfaces. During an application of anionic PAM mixture, prevent over–spray from reaching pavement, as pavement will become slippery.

L. Care should be taken when applying anionic PAM mixtures in liquid form on saturated slopes due to the possibility of slope structural failure. Anionic PAM mixtures may be applied to steeper slopes when used with other erosion control BMPs such as seed and mulch or erosion mat.

VII. Specifications

Erosion control and stormwater plans specifying anionic PAM mixtures for erosion control shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

VIII. Operation and Maintenance

Maintenance will consist of reapplying anionic PAM mixtures to disturbed areas, including high use traffic areas, which interfere in the performance of this practice. Anionic PAM mixture may lose its effectiveness in as little as two months due to weather conditions. Anionic PAM mixtures should be reapplied in areas where wind or rill erosion is apparent and whenever an area has been graded, driven upon, or otherwise disturbed since the anionic PAM mixture was last applied.

IX. References

Bubenzer, G.D., and Patterson, A.E., *Intake Rate: Sprinkler Infiltrometer,* Method of Soil Analysis, Part 1 Physical and Mineralogical Method, Second Edition, Chapter 33, pp. 845–870. (Agronomy Monograph Series #9, 1982). *Managing Irrigation–Induced Erosion And Infiltration With Polyacrylamide, Proceedings From First Conference,* University of Idaho Miscellaneous Publication No. 101–96, (Kimberly, Idaho, USDA–ARS Northwest Irrigation and Soils Research Lab, 1996).

Roa–Espinosa, A., Bubenzer, G.D. and Miyashita, E., Sediment and Runoff Control on Construction Sites Using Four Application Methods.of Polyacrylamide Mix, National Conference on Tools for Urban Water Resource Management and Protection, Chicago, February 7–10, 2000, pp. 278– (EPA, 2000).

Roa–Espinosa, A., Bubenzer, G.D. and Miyashita, E., *Determination of PAM Use in Erosion Control on Construction Sites,* 1st Inter–Regional Conference on Environment–Water: Innovative Issues in Irrigation and Drainage, Lisbon, Portugal, September 1998 (Portuguese National Committee of ICID, 1998).

Roa– Espinosa, A., *Are there Safety Concerns or Environmental Concerns with PAM?* (Dane County Land Conservation Department, 1997).

Sojka, R.E. and Lentz, R.D., "A PAM Primer: A brief history of PAM and PAM related issues," http://kimberly.ars.usda.gov/pamprim.ssi, (Kimberly, ID: USDA–ARS Northwest Irrigation and Soils Research Lab, 1996).

Wisconsin Administration Code (Wis.Adm.Code), Department of Administration, Legislative Reference Bureau, Section 35.84 of the statutes (available at depository public libraries, most law school libraries, and online: http://www.legis.state.wi.us/rsb/code/index.html).

Special recognition goes to Steve Decker of Construction Fabrics & Materials Corp. (CFM). Steve was invaluable during the development of this technical standard because of his extensive field experience, his personal commitment to funding the research for toxicity testing, his vision and his steadfast determination to find an environmentally safe and effective erosion control product.

Mulching For

Construction Sites

1058 (06/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Mulching is the application of organic material to the soil surface to protect it from raindrop impact and overland flow. Mulch covers the soil and absorbs the erosive impact of rainfall and reduces the flow velocity of runoff.

II. Purpose

This practice may be used to:

- Reduce soil erosion
- Aid in seed germination and establishment of plant cover
- Conserve soil moisture

III. Conditions Where Practice Applies

This practice may be applied on exposed soils as a temporary control where soil grading or landscaping has taken place or in conjunction with temporary or permanent seeding. Mulching is generally not appropriate in areas of concentrated flow.

IV. Federal, State, and Local Laws

Users of this standard shall comply with applicable federal, state and local laws, rules, regulations or permit requirements governing mulching. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site Preparation:

Soil surface shall be prepared prior to the application of mulch in order to achieve the desired purpose and to ensure optimum contact between soil and mulch. All areas to be mulched shall be reasonably free of rills and gullies.

B. Materials:

Mulch shall consist of natural biodegradable material such as plant residue (including but not limited to straw, hay, wood chips, bark and wood cellulose fiber), or other equivalent materials of sufficient dimension (depth or thickness) and durability to achieve the intended effect for the required time period.

Mulch shall be environmentally harmless to wildlife and plants. Materials such as gravel, plastic, fabric, sawdust, municipal solid waste, *solid waste byproducts*[1], shredded paper, and non–biodegradable products shall not be used.

Mulch shall be free of diseased plant residue (i.e. oak wilt), *noxious weed* seeds, harmful chemical residues, heavy metals, hydrocarbons and other known environmental toxicants.

Marsh hay shall not be used as mulch in lowland areas but may be used on upland sites to prevent the spread of invasive, non–native species (i.e. reed canary grass) commonly found in marsh hay.

Straw and hay mulch that will be crimped shall have a minimum fiber length of 6 inches.

Wood chips or wood bark shall only be used for sites that are not seeded.

C. Application Rate:

1. Mulch shall cover a minimum of 80% of the soil surface for unseeded areas. For seeded areas, mulch shall be placed loose and open enough to allow some sunlight to penetrate and air to circulate but still cover a minimum of 70% of the soil surface.

2. Mulch shall be applied at a uniform rate of 1½ to 2 tons per acre for sites that are seeded, and 2 to 3 tons per acre for sites that are not seeded. This application results in a layer of ½ to 1½ inches thick for seeded sites, and 1½ to 3 inches thick for sites not seeded.

3. Wood chips or wood bark shall be applied at a rate of 6 to 9 tons per acre to achieve a minimum of 80% ground cover. This application should result in a layer of wood chips or wood bark ½ to 1½ inches thick.

D. Mulch Anchoring Methods

Anchoring of mulch shall be based on the type of mulch applied, site conditions, and accomplished by one of the following techniques:

1. Crimping

Immediately after spreading, the mulch shall be anchored by a mulch crimper or equivalent device consisting of a series of dull flat discs with notched edges spaced approximately 8 inches apart. The mulch shall be impressed in the soil to a depth of 1 to 3 inches.

2. Polypropylene Plastic, or Biodegradable Netting

Apply plastic netting over mulch application and staple according to manufacturer's recommendations.

3. Tackifier

Tackifier shall be sprayed in conjunction with mulch or immediately after the mulch has been placed. Tackifiers must be selected from those that meet the WisDOT Erosion Control Product Acceptability List (PAL). Asphalt based products shall not be applied.

The tackifiers shall be applied at the following minimum application rates per acre:

a. Latex–Base: mix 15 gallons of adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 375 gallons of water.

b. Guar Gum: mix 50 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as tracer with 1,300 gallons of water.

c. Other Tackifiers: (Hydrophilic Polymers) mix 100 pounds of dry adhesive (or the manufacturer's recommended rate which ever is greater) and a minimum of 250 pounds of recycled newsprint (pulp) as a tracer with 1,300 gallons of water.

VI. Considerations

A. Wood products typically absorb available soil nitrogen as they degrade, thus making it unavailable for seed.

B. The use of mulch behind curb and gutter may not be desirable unless anchored by netting, because air turbulence from nearby traffic can displace the mulch. Consider the use of erosion mat or sod as an alternative.

C. In areas where lawn type turf will be established, the use of tackifiers is the preferred anchoring method. Crimping will tend to leave an uneven surface and plastic netting can become displaced and entangled in mowing equipment.

D. A heavier application of mulch may be desired to prevent seedlings from being damaged by frost.

E. It may be beneficial to apply polyacrylimide in addition to mulch. Refer to WDNR Conservation Practice Standard (1050) Erosion Control Land Application of Anionic Polyacrylamide for information about the advantages and proper use of polymers.

F. Concentrated flows above the site where mulch is applied should be diverted.

G. Mulch should be placed within 24 hours of seeding.

H. Mulching operations should not be performed during periods of excessively high winds that would preclude the proper placement of mulch.

I. Materials such as gravel may be effective for erosion control but are not considered mulches.

VII. Plans and Specifications

A. Plans and specifications for mulching shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Type of mulch used
2. Application rate
3. Timing of application
4. Method of anchoring

B. All plans, standard detail drawings, or specifications shall include schedules for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

Mulch shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

Mulch that is displaced shall be reapplied and properly anchored. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT's Erosion Control Product Acceptability List (PAL) can be found on the WisDOT web site: http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Printed copies are no longer being distributed.

X. Definitions

Noxious weed (V.B): Any weed a governing body declares to be noxious within its respective boundaries. The State of Wisconsin list of noxious weeds can be found in s. 66.0407, Stats.

Solid Waste Byproducts (V.B): Includes industrial, commercial, residential, and agricultural wastes that have been processed, incinerated, or composted and still contain inorganic wastes such as glass and metals and organic wastes including plastics, textiles, rubber, leather, and other miscellaneous organic wastes which may be toxic or hazardous in nature.

Non–Channel Erosion Mat

1052 (08/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A protective soil cover made of straw, wood, coconut fiber or other suitable plant residue, or plastic fibers formed into a mat, usually with a plastic or biodegradable mesh on one or both sides. Erosion mats are rolled products available in many varieties and combinations of material and with varying life spans.

II. Purpose

The purpose of this practice is to protect the soil surface from the erosive effect of rainfall and prevent *sheet erosion* [1] during the establishment of grass or other vegetation, and to reduce soil moisture loss due to evaporation. This practice applies to both *Erosion Control Revegetative Mats (ECRM)* and *Turf–Reinforcement Mats (TRM)*.

III. Conditions Where Practice Applies

This standard applies to erosion mat selection for use on erodible slopes.

This standard is not for channel erosion; for channel applications reference WDNR Conservation Practice Standard (1053) Channel Erosion Mat.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of erosion mat. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum allowable standards for design, installation and performance requirements. Only Wisconsin Department of Transportation (WisDOT) Erosion Control Product Acceptability List (PAL) approved mats will be accepted for use in this standard.

Slope and slope length shall be taken into consideration. This information can be found in the Slope Erosion Control Matrix located in the PAL.

To differentiate applications Erosion mats are organized into three Classes of mats, which are further broken down into various Types.

A. Class I: A short–term duration (minimum of 6 months), light duty, organic mat with photodegradable plastic or biodegradable netting.

   1. Type A – Use on erodible slopes 2.5:1 or flatter.

   2. Type B – Double netted product for use on erodible slopes 2:1 or flatter.

B. Class I, Urban: A short–term duration (minimum of 6 months), light duty, organic erosion control mat for areas where mowing may be accomplished within two weeks after installation.

   1. Urban, Type A – Use on erodible soils with slopes 4:1 or flatter.

   2. Urban, Type B – A double netted product for use on slopes 2.5:1 or flatter.

C. Class II: A long–term duration (three years or greater), organic erosion control revegetative mat.

   1. Type A – Jute fiber only for use on slopes 2:1 or flatter for sod reinforcement.

   2. Type B – For use on slopes 2:1 or greater made with plastic or biodegradable net.

   3. Type C – A woven mat of 100% organic fibers for use on slopes 2:1 or flatter and in environmentally and biologically sensitive areas where plastic netting is inappropriate.

D. Class III: A permanent 100% synthetic ECRM or TRM. Either a soil stabilizer Type A or Class I, Type A or B erosion mat must be placed over the soil filled TRM.

1. Type A – An ECRM for use on slopes 2:1 or flatter.
2. Type B or C – A TRM for use on slopes 2:1 or flatter.
3. Type D – A TRM for use on slopes 1:1 or flatter.

E. Material Selection

1. For mats that utilize netting, the netting shall be bonded to the parent material to prevent separation of the net for the life of the product.
2. For urban class mats the following material requirements shall be adhered to:
   a. Only 100% organic biodegradable netted products are allowed, including parent material, stitching, and netting.
   b. The netting shall be stitched with biodegradable thread/yarn to prevent separation of the net from parent material.
   c. All materials and additive components used to manufacture the anchoring devices shall be completely biodegradable as determined by ASTM D 5338.
   d. Mats with photodegradable netting shall not be installed after September 1st.

F. Installation

1. ECRMs shall be installed after all topsoiling, fertilizing, liming and seeding is complete.
2. The mat shall be in firm and intimate contact with the soil. It shall be installed and anchored per the manufacturer's recommendation.
3. TRM shall be installed in conjunction with the topsoiling operation and shall be followed by ECRM installation.
4. At time of installation, document the manufacturer and mat type by retention of material labels and manufacturer's installation instructions. Retain this documentation until the site has been stabilized.

VI. Considerations

A. Urban mats may be used in lieu of sod.

B. Documentation of materials used, monitoring logs, project diary and weekly inspection forms, including erosion and stormwater management plans, should be turned over to the authority charged with long term maintenance of the site.

VII. Plans and Specifications

A. Plans and specifications for installing erosion mat shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of erosion mat
2. Installation Sequence
3. Material specification conforming to standard

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Erosion mat shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. If there are signs of rilling under the mat, install more staples or more frequent anchoring trenches. If rilling becomes severe enough to prevent establishment of vegetation, remove the section of mat where the damage has occurred. Fill the eroded area with topsoil, compact, reseed and replace the section of mat, trenching and overlapping ends per manufacturer's recommendations. Additional staking is recommended near where rilling was filled.

C. If the reinforcing plastic netting has separated from the mat, remove the plastic and if necessary replace the mat.

D. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Printed copies are no longer distributed.

X. Definitions

Sheet and Rill Erosion (II): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Erosion Control Revegetative Mats (ECRM) (II): Erosion control revegetative mats are designed to be placed on the soil surface.

Turf–Reinforcement Mats (TRM) (II): Turf–reinforcement mats are permanent devices constructed from various types of synthetic materials and buried below the surface to help stabilize the soil. TRMs must be used in conjunction with an ECRM or an approved Type A soil stabilizer.

Sediment Bale Barrier

(Non–Channel)

1055 (08/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary sediment barrier consisting of a row of entrenched and anchored straw bales, hay bales or equivalent material used to intercept sediment–laden sheet flow from small drainage areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications where:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).
2. Where adjacent areas need protection from sediment–laden runoff.
3. Effectiveness is required for less than 3 months.
4. Conditions allow for the bales to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall sediment bale barriers be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
2. Where the maximum gradient upslope of the sediment bale barriers is greater than 50% (2:1).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of the sediment bale barrier. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. At a minimum, sediment bale barriers shall be placed in a single row, lengthwise on the contour, with the ends of adjacent sediment bale barriers tightly abutting one another. The holes between bales shall be chinked (filled by wedging) with straw, hay or equivalent material to prevent water from escaping between the bales.
2. The maximum allowable slope lengths contributing runoff to a sediment bale barrier are specified in Table 1.

Table 1.

Slope	Barrier Row Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
33 to 50%	20 feet
> 50%	Not Permitted

3. Sediment bale barriers shall not be placed perpendicular to the contour.

4. The end of the sediment bale barrier shall be extended upslope to prevent water from flowing around the barrier ends.

B. Height – Installed sediment bale barrier shall be a minimum of 10 inches high and shall not exceed a maximum height of 20 inches from ground level.

C. Anchoring and Support

1. The barrier shall be entrenched and backfilled. A trench shall be excavated the width of a sediment bale barrier and the length of the proposed barrier to a minimum depth of 4 inches. After bales are staked and chinked, the excavated soil shall be backfilled and compacted against the barrier. Backfill to ground level on the down slope side. On the upslope side of the sediment bale barrier backfill to 4 inches above ground level.

2. At least two wood stakes, "T" or "U" steel posts, or ½ inch rebar driven through at equidistance along the centerline of the barrier shall securely anchor each bale. The minimum cross sectional area for wood stakes shall be 2.0 by 2.0 inches nominal. The first stake in each bale shall be driven toward the previously laid bale to force the bales together. Stakes shall be driven a minimum 12–inches into the ground to securely anchor the sediment bale barriers.

3. Bales shall be installed so that bindings are oriented around the sides rather than along the tops and bottoms of the bales in order to prevent deterioration of the bindings.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of sediment bale barriers will significantly decrease the effectiveness of this practice.

B. Sediment bale barriers should not be used upslope of the disturbed area.

C. A double row of sediment bale barriers may be installed in areas where additional protection is needed.

D. For safety, place all anchoring flush with the sediment bale barrier or cap any exposed anchoring device.

VII. Plans and Specifications

A. Plans and specifications for installing sediment bale barriers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of sediment bale barrier

2. Contributory drainage area

3. Schedules

4. Standard drawings and installation details

5. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Sediment bale barriers shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. Damaged or decomposed sediment bale barriers, any undercutting, or flow channels around the end of the sediment bale barriers shall be repaired.

C. Sediment shall be properly disposed of once the deposits reach 1/2 the height of the sediment bale barrier.

D. Sediment bale barriers and anchoring devices shall be removed and properly disposed of when they have served their usefulness, but not before the upslope areas have been permanently stabilized.

E. Any sediment deposits remaining in place after the sediment bale barrier is no longer required shall be dressed to conform to the existing grade, prepared and seeded.

IX. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate soil detachment occurs primarily as a result of shear. The transport capacity of the flow in a channel is based on the availability of sediment and is a monatomic function of velocity.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.

Sediment Basin

1064 (03/06)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A sediment control device constructed with an engineered outlet, formed by excavation or embankment to intercept sediment–laden runoff and retain the sediment.

II. Purposes

Detain sediment–laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment basins are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment basins shall be constructed at locations accessible for clean out. Site conditions must allow for runoff to be directed into the basin.

Sediment basins are designed to be in place until the contributory drainage area has been *stabilized*[1]. Sediment basins are temporary and serve drainage areas up to 100 acres however other conservation practices are often more economical for smaller drainage areas. For drainage areas smaller than 5 acres sediment traps or ditch checks may be applicable; for design criteria refer to WDNR conservation Practice Standard Sediment Trap (1063) or Ditch Check (1062).

Design to WDNR Conservation Practice Standard Wet Detention Basin (1001) when a permanent stormwater basin is required.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of sediment basins. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements. Sediment basins meeting these design criteria are deemed 80% effective by design in trapping sediment.

A. Timing – Sediment basins shall be constructed prior to disturbance of up–slope areas and placed so they function during all phases of construction. Sediment basins shall be placed in locations where runoff from disturbed areas can be diverted into the basin.

B. Sizing Criteria – Properly sized sediment basins are more effective at trapping fine–grained particles than sediment traps. Specific trapping efficiency varies based on the surface area and the particle size distribution of the sediment entering the device. See Figure 1 for clarification of terms. Attachment 1 includes a sample design problem.

Treatment Surface Area – The surface area of the sediment basin measured at the invert of the lowest outlet. The treatment surface area shall be sized based on the texture of the soil entering the device and the peak outflow during the 1–year, 24–hour design storm using Equation 1:

$$S_a = 1.2 * (q_{out} / v_s)$$

Where:

S_a = Treatment surface area measured at the invert of the lowest outlet of sediment basin (square feet)

q_{out} = Peak outflow (cubic feet / second) during the 1–year, 24–hour design storm for the principal outlet

v_s = Particle settling velocity (feet/second)

1.2 = EPA recommended safety factor

Particle settling velocities (*Vs*) shall be based on representative soil class as follows:

a. Soil Class 1: $v_s = 1.2*10^{-3}$ ft/sec

b. Soil Class 2: $v_s = 7.3*10^{-5}$ ft/sec

c. Soil Class 3: $v_s = 1.2*10^{-5}$ ft/sec

Note: Particle settling velocities calculated assuming a specific gravity of 2.65 and a water temperature of 68 degrees Fahrenheit.

Soil Class 1 includes particles greater than 20 microns generally corresponding to sand, loamy sand, and sandy loam.

Soil Class 2 includes particles between 5 and 20 microns generally corresponding to loam, silt, and silt loam aggregates as transported in runoff.

Soil Class 3 includes particles between 2 and 5 microns generally corresponding to clay loam, silty clay, and clay aggregates as transported in runoff.

The representative soil class shall be selected based on the dominant textural class of the soil entering the device.

The treatment surface area of sediment basins can be reduced when used in conjunction with water applied polymers. When employing polymers, size the treatment surface area for controlling fine soils (Class 3) using the settling velocity for medium soils (Class 2). When designing for medium sized soils (Class 2) use the settling velocity for coarse soils (Class 1). See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.

Depth below Treatment Surface Area – The depth below the treatment surface area as measured from the invert of the lowest outlet of the sediment basin shall be a minimum of 5 feet deep (2 feet for sediment storage plus 3 feet to protect against scour/ resuspension) and a maximum of 10 feet deep to limit the potential for thermal stratification.

Due to side slope requirements and safety shelf considerations it maybe difficult to maintain 5 feet of depth for the entire treatment surface area. Therefore, 50% of the total treatment surface area shall be a minimum of 5 feet deep. For basins less than 5,000 square feet, maximize the area of 5 feet depth.

Interior side slopes below the lowest invert shall be 2:1 (horizontal: vertical) or flatter to maintain soil stability.

While a permanent pool of water below the lowest invert may form, it is not required to be maintained through irrigation or installation of a liner system.

Active Storage Volume – The volume above the treatment surface area shall be calculated using one of the following methods:

a. The method outlined in TR–55 for determining the storage volume for detention basins. This can be accomplished by using Figure 2 where:

q_o = Peak outflow (cubic feet / second) during the 1–year, 24–hour design storm for the principal outlet calculated using Equation 1 (see section V.B.1).

q_i = Calculated peak inflow or runoff rate (cubic feet / second) during the 1–year, 24–hour design storm.

Vr = Calculated volume of runoff from the 1–year 24–hour design storm for the entire contributory area with the maximum area of disturbance characterized as bare soil.

Vs = Is the required active storage volume determined using Figure 2.

b. The active storage volume may be calculated based on routing the 1–year, 24–hour storm provided the principal outlet requirements stipulated in section V.D.2 are maintained. This method will require the use of a model.

Note: Both these methods require iterative calculations.

Shape – The length to width ratio of the flow path shall be maximized with a goal of 3:1 or greater. The flow path is considered the general direction of water flow within the basin including the treatment surface area and any forebay.

C. Embankments – Earthen embankments shall be designed to address potential risk and structural integrity issues such as seepage and saturation. All constructed earthen embankments shall meet the following criteria.

1. The base of the embankment shall be stripped of all vegetation, stumps, topsoil and other organic matter.

2. Side slopes shall be 3:1 or flatter. The minimum embankment top width shall be adequate to provide structural stability. Where applicable the top width shall be wide enough to provide maintenance access.

3. There shall be a core trench or key–way along the embankment.

Any pipes extending through the embankment shall be bedded and backfilled with equivalent soils used to construct the embankment. The bedding and backfill shall be compacted in lifts and to the same standard as the original embankment. Excavation through a completed embankment shall have a minimum side slope of 1:1 or flatter.

Measures shall be taken to minimize seepage along any conduit buried in the embankment.

D. Outlet – Sediment basins shall have both a principal outlet and an overflow spillway.

1. Timing – Outlets must be constructed in conjunction with the remainder of the basin and must be constructed prior to the basin receiving runoff. Sediment basins are ineffective until the outlet is constructed.

2. Principal Water Quality Outlet – The principal water quality outlet shall be designed to pass the 1–year 24–hour storm without use of the overflow spillway or other outlet structures. The maximum outflow (q_o) from the principal water quality outlet shall be less than or equal to the q_o used in Equation 1 (V.B.1). If the sediment basin is to serve as a permanent stormwater basin, the principal outlet structure can be modified (i.e. removable plates) to meet flow requirements encountered during and after construction; separate outlet structures do not need to be constructed.

Note: Local ordinances may require control of larger storm events such as the 2–year 24 hour storms. In these cases, additional or compound outlets maybe required.

3. Overflow (Emergency) Spillway – An overflow spillway shall be provided consisting of an open channel constructed adjacent to the embankment and built over a stabilized area. The spillway shall be designed to carry the peak rate of runoff expected from a 10–year, 24–hour design storm or one commensurate with the degree of hazard, less any reduction due to flow in the principal outlet. The top of the embankment shall be at least one foot above the design high water level and a minimum of 1 foot above the invert of the overflow spillway. The overflow spillway shall be protected from erosion. Flow from the overflow spillway shall be directed away from the embankment.

4. Outlet Protection – All outlet designs shall incorporate preventive measures for ice damage, trash accumulation, and erosion at the outfall. For orifices less than 8–inches in diameter, or equivalent, additional measures to prevent clogging are required.

E. Inlet Protection – Inlets shall be designed to prevent scour and reduce velocities during peak flows. Possible design options include flow diffusion, plunge pools, directional berms, baffles, or other energy dissipation structures.

F. Location – Temporary sediment basins should be located to provide access for cleanout and disposal of trapped sediment.

G. Removal – Temporary sediment basins shall be removed after the contributing drainage area has been stabilized. Complete final grading and restoration according to the site plans. If standing water needs to be removed it shall be done in accordance with WDNR Conservation Practice Standard Dewatering (1061).

VI. Considerations

A. When constructing a sediment basin that will also serve as the long–term stormwater detention pond, build the sediment basin to the larger of the two sizes required either for stormwater control or erosion control. In addition, when sizing the outlet structure first design the outlet for the long–term stormwater management requirements then check to satisfy the flow requirements for sediment control during construction. If additional flow restriction is needed consider use of a temporary restriction plates or other measures to avoid having to construct separate outlet structures for the sediment basin and stormwater basin.

B. Over–excavation beyond the required depth in the sediment storage area of the sediment basin may allow for less frequent maintenance. Addition of other measures in the contributing drainage area may reduce sediment accumulation and associated maintenance requirements.

C. The use of a sediment forebay can extend the useful life of the main sediment storage area by trapping the majority of sediment in the forebay area. Separation of the forebay from the rest of the basin requires construction of a submerged shelf (if wet) or a stone or stabilized earthen embankment. The forebay should have a surface area equal to at least 12% of the total basin area.

D. In addition to soil stability issues, interior slopes of sediment basins should be selected based on safety issues commensurate with the degree of hazard.

VII. Plans and Specifications

A. Plans and specifications for installing sediment basins shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

1. Location of sediment basin
2. Schedules and sequence of installation and removal
3. Standard drawings and installation details
4. Control structure detail and layout
5. Sizing of sediment storage area
6. Maintenance requirements

B. All plans, standard detail drawings, or specifications shall include sequence for installation, inspection, and maintenance requirements. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Sediment basins shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. Sediment shall be removed to maintain the three foot depth of the treatment surface area as measured from the invert of the principal outlet. Sediment may need to be removed more frequently.

C. If the outlet becomes clogged it shall be cleaned to restore flow capacity.

D. Provisions for proper disposal of the sediment removed shall be made.

E. Maintenance shall be completed as soon as possible with consideration to site conditions.

IX. References

Chapter NR 333, Dam and Design Construction.

Hann, Barfield, and Hayes. Design Hydrology and Sedimentology for Small Catchments. Academic Press Inc., 1994.

Robert E. Pitt, Small Storm Hydrology.

US Bureau of Reclamation, Design of Small Dams. http://www.usbr.gov/pmts/hydraulics_lab/pubs/index.cfm.

USDA, Natural Resources Conservation Service, Ponds – Planning, Design, Construction. Agriculture Handbook No. 590, Revised September 1997.

WDNR Conservation Practice Standard 1001 Wet Detention Basin.

X. Definitions

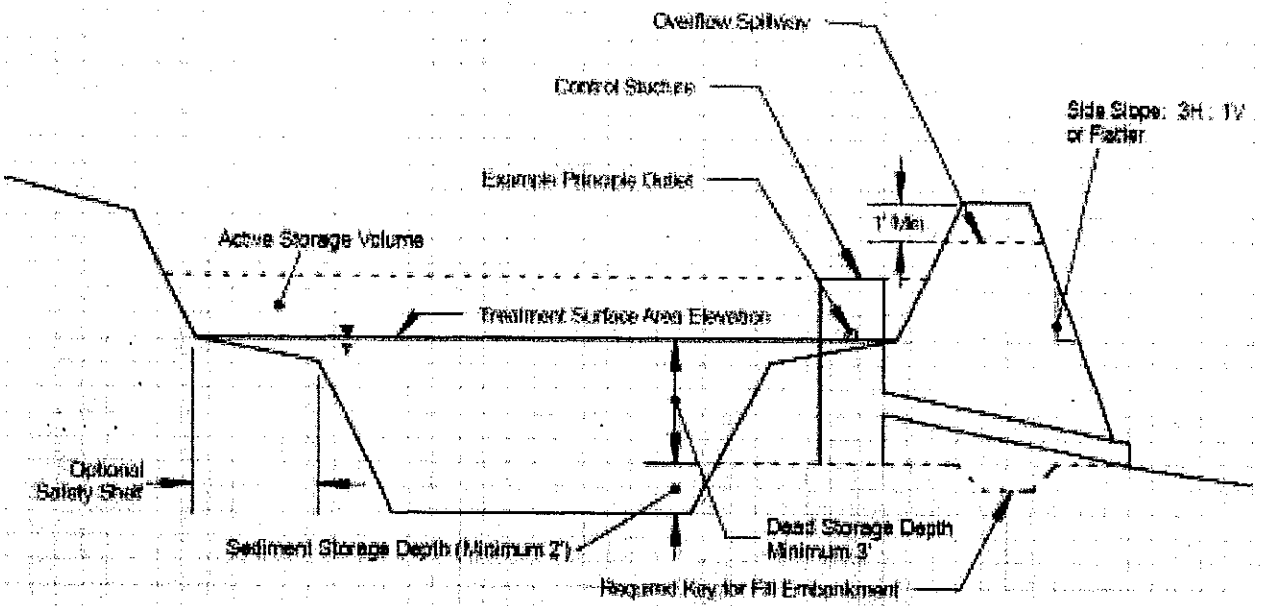
Active Storage Volume (V.B.3) – Is measured from the invert of the lowest outlet to the invert of the emergency spillway.

Stabilized (III) – Means protecting exposed soil from erosion.

Treatment Surface Area (V.B.1) – Is the surface area of the sediment basin measured at the invert of the lowest outlet.

Figure 1

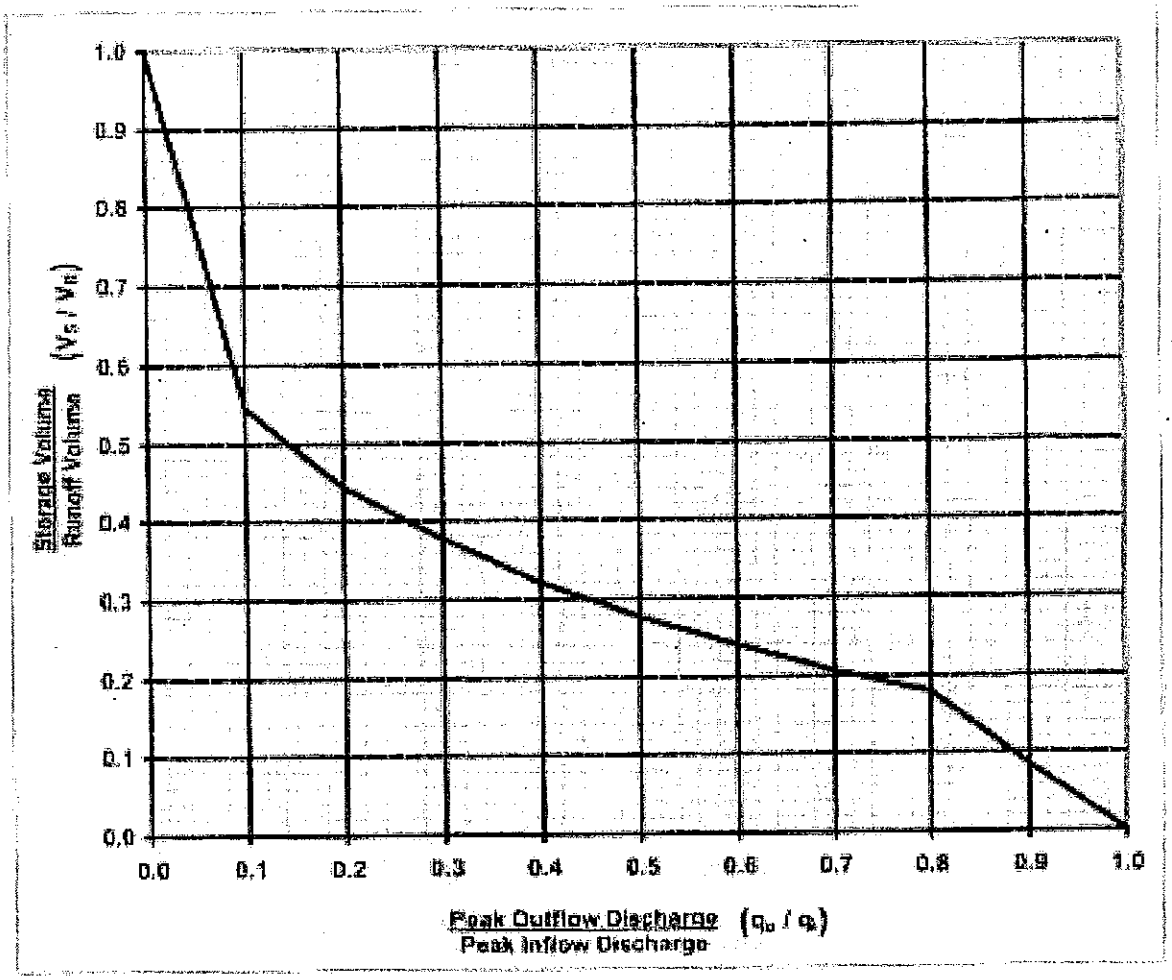
Clarification of Sediment Basin Terminology



Note: Features illustrated are for the purpose of defining terms used in the standard. The Drawing is not to scale.

Figure 2

Approximate Detention Basin Routing for Type II Storms



Source: Technical Release 55, United States Department of Agriculture, Natural Resources Conservation Service, Washington D.C. 1988

Rainfall Quantities:

Table 1 provides a summary of the 1–year, 24–hour rainfall totals using NRCS mandated TP–40 which has not been updated since 1961. Table 2 provides a summary of more current data from the Rainfall Frequency Atlas of the Midwest published in 1992. Local requirements may dictate the use of one dataset over the other.

Table 1
Rainfall for Wisconsin Counties for a 1–Year, 24–Hour Rainfall[1]

Inches of Rainfall	County
2.1 in.	Door, Florence, Forest, Kewaunee, Marinette, Oconto, Vilas
2.2 in.	Ashland, Bayfield, Brown, Calumet, Douglas, Iron, Langlade, Lincoln, Manitowoc, Menominee, Oneida, Outagamie, Price, Shawano, Sheboygan
2.3 in.	Barron, Burnett, Dodge, Fond du Lac, Green Lake, Marathon, Milwaukee, Ozaukee, Portage, Racine, Rusk, Sawyer, Taylor, Washburn, Washington, Waukesha, Waupaca, Waushara, Winnebago, Wood
2.4 in.	Adams, Chippewa, Clark, Columbia, Dane, Dunn, Eau Claire, Jackson, Jefferson, Juneau, Kenosha, Marquette, Pepin, Pierce, Polk, Rock, St. Croix, Walworth
2.5 in.	Buffalo, Green, Iowa, La Crosse, Monroe, Richland, Sauk, Trempealeau, Vernon
2.6 in.	Crawford, Grant, Lafayette

[1]TP – 40 – Rainfall Frequency Atlas of the United States, U.S. Department of Commerce Weather Bureau.

Table 2
Rainfall for Wisconsin Counties for a 1–Year, 24–Hour Rainfall[2]

Zone	Inches of Rainfall	County
1	2.22	Douglas, Bayfield, Burnett, Washburn, Sawyer, Polk, Barron, Rusk, Chippewa, Eau Claire
2	2.21	Ashland, Iron, Vilas, Price, Oneida, Taylor, Lincoln, Clark, Marathon
3	1.90	Florence, Forest, Marinette, Langlade, Menominee, Oconto, Door, Shawano
4	2.23	St. Croix, Dunn, Pierce, Pepin, Buffalo, Trempealeau, Jackson, La Crosse, Monroe
5	2.15	Wood, Portage, Waupaca, Juneau, Adams, Waushara, Marquette, Green Lake
6	1.96	Outagamie, Brown, Kewaunee, Winnebago, Calumet, Manitowoc, Fond Du Lac, Sheboygan
7	2.25	Vernon, Crawford, Richland, Sauk, Grant, Iowa, Lafayette
8	2.25	Columbia, Dodge, Dane, Jefferson, Green, Rock
9	2.18	Ozaukee, Washington, Waukesha, Milwaukee, Walworth, Racine, Kenosha

[2] Bulletin 71: Rainfall Frequency Atlas of the Midwest, Midwest Climate Center and Illinois State Water Survey, 1992.

Attachment 1

Sample Sediment Basin Design Problem

The proper sizing and design of a sediment basin will often require iterative calculations. The technical standard for sizing sediment basins was written to give the designer as much flexibility as possible in designing the basin while meeting water quality requirements. The governing equation relates the surface area of the sediment basin to the outflow and critical particle settling velocity. The larger the sediment basin outflow, the larger the surface area required to settle the particle. As the outflow is reduced, a smaller surface area is required however the required storage volume dictates how small a surface area can become through the storage depth or hydraulic head acting on the outlet.

The particle settling velocities are listed in the standard requiring the designer to either start with a desired outflow based on an outlet size or an estimated starting surface area. The sample equation below starts with an estimated surface area.

Sample Problem:

A 10 acre site is being developed into condos. Eight acres of the site are being disturbed while 2 acres of forest are remaining undisturbed. The dominate soils on the site are silt loam. The 1–year, 24–hour design storm is 2.25 inches.

Step 1: Calculate runoff volume and peak using TR–55 or approved method.

From TR–55 the curve number (CN) for the disturbed area is 86 and the CN for the forested area is 55 resulting in a composite CN of 80. Using TR–55, the runoff volume calculated for the 1–year 24–hour design storm is 0.7 inches (0.6 acre–feet for the entire 10–acre site). The time of concentration was calculated as 0.4 hours resulting in a peak flow of 6 cfs.

Step 2: Begin sizing sediment basin using Equation 1. The technical standard lists silt loam under particle class 2 with a settling velocity of $7.3*10^{-5}$ ft/sec. We are also going to assume a starting surface area of 0.25 acres (10,890 ft^2). An alternative approach is to assume an outflow velocity.

$SA = 1.2 * (q_{out} / v_s)$

Solve for q_{out}: $10{,}980\ ft^2 = 1.2 * (q_{out} / 7.3*10^{-5}\ ft/sec)$

$q_{out} = 0.67$ cfs

Step 3: Using Figure 2: Approximate Detention Basin Routing for Type II Storms determines the volume of storage (V_S) needed.

$q_{out} = 0.67$ cfs (calculated in Step 2)

$q_{in} = 6.0$ cfs (peak flow calculated using TR–55 in Step 1)

$V_R = 0.6$ acre–feet (volume of runoff calculated using TR–55 in Step 1)

$q_{out} / q_{in} = 0.67$ cfs / 6.0 cfs = 0.11. Using Figure 2 with a $q_{out} / q_{in} = 0.11$, the V_S/V_R is determined to be 0.54. Therefore the $V_S = 0.54 * 0.6$ acre–feet = 0.324 acre–feet (14,113 ft^3)

Step 4: Check configuration: Calculate maximum head on outlet using surface area and volume.

SA = 10,890 ft^2 and a $V_S = 14{,}113\ ft^3$ we get a depth (H) of 1.29 feet = 14,113 ft^3 / 10,890 ft^2

Step 5: Size Outlet: Assuming an orifice type outlet calculate the size needed to meet the q_{out} calculated in Step 1 and the H calculated in Step 4.

Using the orifice equation: $q_{out} = C*A*(2gH)^{1/2}$ with C=0.6 (coefficient) , A = Area = ft^2, g = 32.2, and H = hydraulic head expressed in feet.

$q_{out} = 0.6*A*(2*32.2* H)^{1/2}$ so $0.66 = 0.6*A*(2*32.2*1.29)^{1/2}$ therefore A = .12 ft^2

An area of 0.12 ft^2 corresponds to an orifice outlet of 4.7 inches in diameter.

Step 6: Iteration: While the above solution works, the sediment basin has not been optimally sized and we have an orifice diameter that is not a standard pipe size. An iterative approach can be used to reduce the surface area of the sediment basin and obtain a more common orifice diameter. We can assume a 4–inch orifice since it is close to diameter calculated in Step 5 and we can start with the depth we calculated in Step 4. The iterations below each represent Steps 2 through 5.

Iteration 1:

$q_{out} = 0.43\ (H)^{1/2} = 0.43\ (1.29)^{1/2} = 0.48$ cfs which is less than the 0.66 cfs calculated in Step 1. Therefore, we can go back to Step 1 and repeat the sizing procedure and downsize the sediment basin.

$SA = 1.2 * (q_{out} / v_s) = 1.2 * (0.48 \text{ cfs} / 7.3*10^{-5} \text{ ft/sec}) = 7{,}890 \text{ ft}^2$

Using Figure 2:

$q_{out} = 0.48$ cfs

$q_{in} = 6.0$ cfs (peak flow calculated using TR–55 in Step 1)

$V_R = 0.6$ acre–feet (volume of runoff calculated using TR–55 in Step 1)

$q_{out} / q_{in} = 0.48 \text{ cfs} / 6.0 \text{ cfs} = 0.08$. Using Figure 2 with a $q_{out} / q_{in} = 0.08$, the V_S/V_R is determined to be 0.62. Therefore the $V_S = 0.62 * 0.6$ acre–feet = 0.372 acre–feet (16,204 ft^3)

$SA = 7{,}890 \text{ ft}^2$ and a $V_S = 16{,}204 \text{ ft}^3$ we get a depth (H) of 2.05 feet = $16{,}204 \text{ ft}^3 / 7{,}890 \text{ ft}^2$

$q_{out} = 0.43 (H)^{1/2} = 0.43 (2.05)^{1/2} = 0.61$ cfs which is more than the 0.48 cfs we used so iterate.

Iteration 2:

$SA = 1.2 * (q_{out} / v_s) = 1.2 * (0.61 \text{ cfs} / 7.3*10^{-5} \text{ ft/sec}) = 10{,}027 \text{ ft}^2$

Using Figure 2:

$q_{out} = 0.61$ cfs

$q_{in} = 6.0$ cfs (peak flow calculated using TR–55 in Step 1)

$V_R = 0.6$ acre–feet (volume of runoff calculated using TR–55 in Step 1)

$q_{out} / q_{in} = 0.61 \text{ cfs} / 6.0 \text{ cfs} = 0.10$ Using Figure 2 with a $q_{out} / q_{in} = 0.10$, the V_S/V_R is determined to be 0.54. Therefore the $V_S = 0.54 * 0.6$ acre–feet = 0.324 acre–feet (14,113 ft^3)

$SA = 10{,}027 \text{ ft}^2$ and a $V_S = 14{,}113 \text{ ft}^3$ we get a depth (H) of 1.41 feet = $14{,}113 \text{ ft}^3 / 10{,}027 \text{ ft}^2$

$q_{out} = 0.43 (H)^{1/2} = 0.43 (1.41)^{1/2} = 0.51$ cfs which is less than the 0.61 cfs we used so we are OK or we can iterate again until we have q_{out} that are almost identical.

After Iteration 2, we have a sediment basin with a $SA = 10{,}027 \text{ ft}^2$ and a $V_S = 14{,}113 \text{ ft}^3$. We have a principal water quality outlet consisting of a 4–inch orifice. This design meets the water quality requirements of the technical standard.

Sediment Trap

1063 (09/05)

Wisconsin Department of Natural Resources

Conservation Practice Standard

I. Definition

A *temporary*[1] sediment control device formed by excavation and/or embankment to intercept sediment–laden runoff and to retain the sediment.

II. Purposes

To detain sediment–laden runoff from disturbed areas for sufficient time to allow the majority of the sediment to settle out.

III. Conditions Where Practice Applies

Sediment traps are utilized in areas of concentrated flow or points of discharge during construction activities. Sediment traps shall be constructed at locations accessible for clean out. Sediment traps are designed to be in place until the contributory drainage area has been *stabilized.* The contributory drainage area shall be a maximum of 5 acres. For concentrated flow areas smaller than one acre, ditch checks may be installed; refer to WDNR conservation practice standard Ditch Check (1062). For larger drainage areas and/or for sediment basins requiring an engineered outlet structure refer to WDNR conservation practice standard Sediment Basin (1064) or Wet Detention Basin (1001).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of sediment traps. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. **Timing** – Sediment traps shall be constructed prior to disturbance of up–slope areas and placed so they function during all phases of construction. Sediment traps shall be placed in locations where runoff from disturbed areas can be diverted into the traps.

B. **Sizing Criteria** – Properly sized sediment traps are relatively effective at trapping medium and coarse–grained particles. To effectively trap fine–grained particles, the sediment trap must employ a large surface area or polymers. The specific trapping efficiency of a sediment trap varies based on the surface area, depth of dead storage, and the particle size distribution and concentration of sediment entering the device.

1. Surface Area – The minimum surface area of a sediment trap shall be based on the dominant textural class of the soil entering the device. The surface area calculated below represents the surface for the permanent pool area (if wet) or the surface area for the dead storage. This surface area is measured at the invert of the stone outlet (see Figure 1).

a. For coarse textured soils (loamy sand, sandy loam, and sand):

$A_{s\,(coarse)} = 625 * A_{dr}$

b. For medium textured soils (loams, silt loams, and silt):

$A_{s\,(medium)} = 1560 * A_{dr}$

c. For fine textured soils (sandy clay, silty clay, silty clay loam, clay loam, and clay):

$A_{s\,(fine)} = 5300 * A_{dr}$

For the equations above:

A_s = surface area of storage volume in square feet

A_{dr} = contributory drainage area in acres

Note: The equations above were derived using a representative particle distribution for detached sediment for each textural class.

Sediment traps designed based on this standard will achieve 80% reduction of suspended solids for the drainage area.

d. The surface area of sediment traps used in areas with fine to medium sized soils can be reduced when used in conjunction with water applied polymers. When employing polymers, size the surface area for controlling fine particles using the criteria for medium soils (V.B.1.b.) and when controlling medium sized particles use the sizing equation contained in (V.B.1.a.) for coarse soils. See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the proper use and selection of polymers.

2. Depth – The depth of the sediment trap measured from the sediment trap bottom to the invert of the stone outlet, shall be at least three feet to minimize re–suspension and provide storage for sediment.

3. Shape – The sediment trap shall have a length to width ratio of at least 2:1. The position of the outlet to the inlet shall be as such to minimize short–circuiting of the water flow path.

4. Side Slopes – Side slopes shall be no steeper than 2:1.

Note: A sediment trap sized with the surface area equations above, a three–foot depth, and 2:1 side slopes will generally result in an 80% sediment reduction. Slopes flatter than 2:1 will require larger surface areas to provide adequate storage.

C. **Embankment** – Embankments of temporary sediment traps shall not exceed five feet in height measured from the downstream toe of the embankment to the top of the embankment. Construct embankments with a minimum top width of four feet, and side slopes of 2:1 or flatter. Earthen embankments shall be compacted. Where sediment traps are employed as a perimeter control, the embankments shall have stabilization practices place prior to receiving runoff.

D. **Outlet** – Sediment traps shall be constructed with both a principal and emergency spillway. The stone outlet of a sediment trap shall consist of a stone section of embankment (stone outlet) located at the discharge point. The stone outlet section provides a means of dewatering the basin back to the top of the permanent storage between storm events, and also serves as a non–erosive emergency spillway for larger flow events.

1. Outlet Size – The size of the outlet shall depend on the contributory drainage area and desired outflow. The length of the stone outlet / weir outlet can be calculated based on the size of the drainage area found in Table 1. Refer to section IX References for the equation used to calculate flow through a stone outlet or gabion.

Table 1 Weir Length

Drainage Area (acres)	Weir Length (feet)
1	4.0
2	6.0
3	8.0
4	10.0
5	12.0

The emergency spillway (top of the weir) shall be sized to adequately pass the 10–year 24–hour storm without over topping the sediment trap. The crest of the spillway shall be at least one foot below the top of the embankment. The, minimum weir lengths provided in Table 1 are adequate to pass the 10 year event.

Note: The weir length has little effect on overall treatment efficiency provided the sizing criteria in Section V.B. is adhered to. The stone outlet shall have a minimum top width of 2 feet and a maximum side–slope of 2:1. Discharge from the sediment basin shall be safely conveyed to a stormwater facility, drainage way, or waterbody. The discharge velocity shall be below the velocity to initiate scour unless appropriate stabilization methods are employed.

2. Stone Size – Stone shall consist of angular well graded 3 to 6 inch clear washed stone.

3. Keyway Trench – The stone outlet shall be protected from undercutting by excavating a keyway trench across the stone foundation and up the sides to the height of the outlet. See Figure 1. Underlying with geotextile fabric is optional.

E. Provide access for cleanout and disposal of trapped sediment.

VI Considerations

A. Sediment traps generally require excessive surface areas to settle clay particles and fine silts. If these conditions exist on the site consider using a sediment basin (DNR Conservation Practice Standard Sediment Basin 1064) or adding polymer to the sediment trap. See WDNR Conservation Practice Standard Sediment Control Water Application of Polymers (1051) for criteria governing the use of polymers

B. To improve trapping efficiency, filter fabric can be placed on the up–slope side of the stone outlet / gabion and anchored with stone. When fabric is utilized to enhance filtering, more frequent maintenance is required to prevent clogging. When using fabric, a monofilament type fabric shall be used (such as WisDOT Type FF). The apparent opening size of the fabric, not the stone size, will dictate the flow rate through the outlet therefore outlet lengths need to be calculated since values in Table 1 are based on stone. When calculating the size of the outlet a clogging factor of 50% should be used for the fabric.

C. Consider possible interference with construction activities when locating sediment traps.

D. Provisions should be made for protecting the embankment from failure caused by storms exceeding the 10–year design requirement. Consider a stabilized and non–erosive emergency spillway bypass.

E. In general, groundwater impacts from temporary sediment traps that have storage areas in contact with groundwater are not a major concern. However, sediment trap contact with groundwater should be avoided in areas with karst features, fractured bedrock, or areas of significant groundwater recharge.

F. Sediment trapping is achieved primarily by settling within the pool formed by the trap. Sediment trapping efficiency is a function of surface area, depth of pool, and detention time. If site conditions permit, a length to width ratio greater than 2:1 will increase efficiency.

G. If site conditions prevent the sediment trap from having a three–foot depth, then an equivalent storage volume must be created through increasing the surface area.

H. For sediment traps in place longer than 6 months, consider outlets constructed of two types of stone. A combination of coarse aggregate and riprap (WisDOT light riprap classification) should be used to provide stability. A one–foot layer of one inch washed stone then should be placed on the up–slope face to reduce drainage flow rate.

VII Plans and Specifications

A. Plans and specifications for installing sediment traps shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location and spacing of sediment traps
2. Schedules and sequence of installation and removal
3. Standard drawings and installation details
4. Rock gradation

B. All plans, standard detail drawings, or specifications shall include a schedule for installation, inspection, maintenance, and identify the responsible party.

VIII Operation and Maintenance

Sediment Traps shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period. Sediment may need to be removed more frequently.

A. Deposits of sediment shall be removed when they reach a depth of one foot.

B. If the outlet becomes clogged it shall be cleaned to restore flow capacity.

C. Recommend provisions for proper disposal of the sediment removed from the trap.

D. Maintenance shall be completed as soon as possible with consideration given to site conditions.

E. Sediment traps shall be removed and the location stabilized after the disturbed area draining to the sediment trap is stabilized and no longer susceptible to erosion.

IX References

Flow through the stone outlet and gabion can be calculated using the following equation:

$Q = (h_{2/3} * L) / [(W/D) + 25 + W_2]_{1/2}$

Where:

Q = total flow through stone (cfs)

h = depth of flow measured from invert of the stone outlet to the crest of emergency spillway (ft)

W = average width of weir or flow

length through stone outlet (ft)

L = length of weir (ft)

D = Average Rock Diameter (ft)

Note: For a stone outlet, the length of stone outlet (L) will vary with the depth and slope of stone outlet. For a gabion, the length of flow is fixed to gabion width. A complete discussion of this equation and its proper application can be found in:

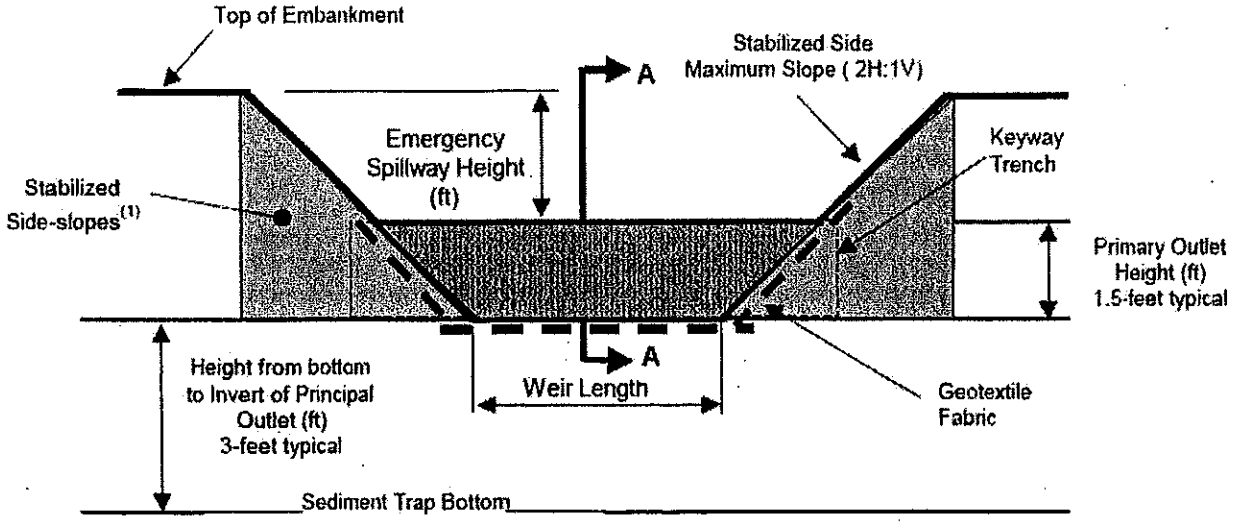
C. McIntyre, G. Aron, J. Willenbrock, and M. Deimler. Report No. 10: Analysis of flow through porous media as applied to gabion dams regarding the storage and release of storm water runoff. NAHB/NRC Designated Housing Research Center at Penn State, Department of Civil Engineering; August 1992.

X Definitions

Stabilized (III): Means that all land disturbing construction activities at the construction site have been completed and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures or that employ equivalent stabilization measures.

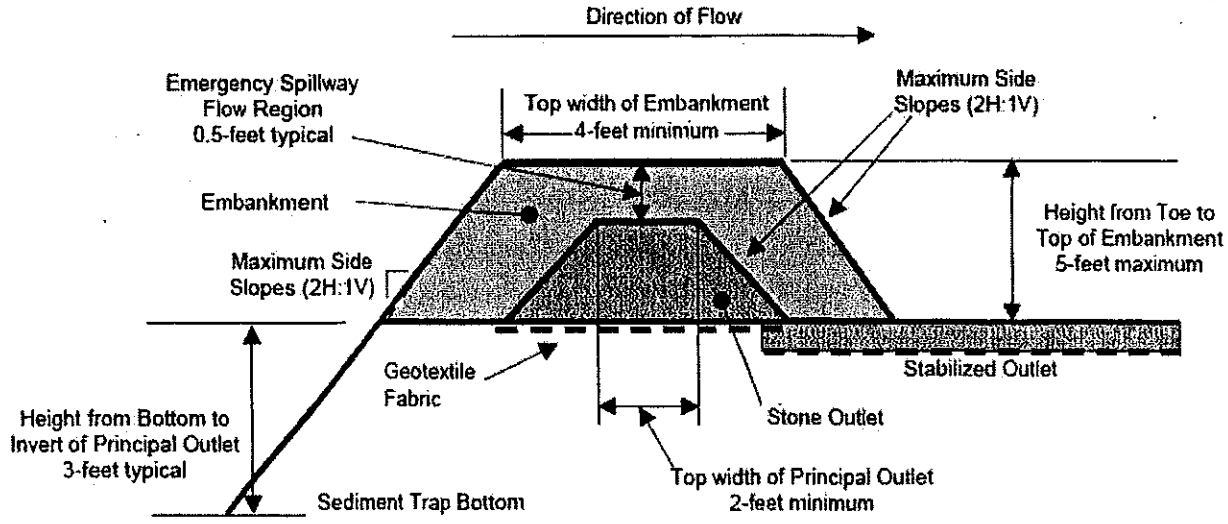
Temporary (I): An erosion control measure that is in place for the duration of construction or until the site is stabilized.

Figure 1: Sediment Trap Outlet Detail



Cross-section View of Principal Outlet

Notes: (1) Side-slopes and faces of earthen embankment around outlet shall be armored with riprap or stabilized with erosion mat sufficient to handle flows from the 10-year storm.



View A - A of Principal Outlet

Seeding For Construction Site Erosion Control

1059 (11/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Planting seed to establish temporary or permanent vegetation for erosion control.

II. Purpose

The purpose of *temporary seeding*[1] is to reduce runoff and erosion until permanent vegetation or other erosion control practices can be established. The purpose of *permanent seeding* is to permanently stabilize areas of exposed soil.

III. Conditions Where Practice Applies

This practice applies to areas of exposed soil where the establishment of vegetation is desired. Temporary seeding applies to disturbed areas that will not be brought to final grade or on which land–disturbing activities will not be performed for a period greater than 30 days, and requires vegetative cover for less than one year. Permanent seeding applies to areas where perennial vegetative cover is needed.

IV. Federal, State and Local Laws

Users of this standard shall be aware of all applicable federal, state and local laws, rules, regulations or permit requirements governing seeding. This standard does not contain the text of federal, state or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Site and Seedbed Preparation

Site preparation activities shall include:

1. Temporary Seeding
   a. Temporary seeding requires a seedbed of loose soil to a minimum depth of 2 inches.
   b. Fertilizer application is not generally required for temporary seeding. However, any application of fertilizer or lime shall be based on soil testing results.
   c. The soil shall have a pH range of 5.5 to 8.0.
2. Permanent Seeding
   a. Topsoil installation shall be completed prior to permanent seeding.
   b. Permanent seeding requires a seedbed of loose topsoil to a minimum depth of 4 inches with the ability to support a *dense* vegetative cover.
   c. Application rates of fertilizer or lime shall be based on soil testing results.
   d. Prepare a tilled, fine, but firm seedbed. Remove rocks, twigs foreign material and clods over two inches that cannot be broken down.
   e. The soil shall have a pH range of 5.5 to 8.0.

B. Seeding

1. Seed Selection
   a. Seed mixtures that will produce dense vegetation shall be selected based on soil and site conditions and intended final use. Section IX References, lists sources containing suggested seed mixtures.
   b. All seed shall conform to the requirements of the Wisconsin Statutes and of the Administrative Code Chapter ATCP 20.01 regarding noxious weed seed content and labeling.

c. Seed mixtures that contain potentially invasive species or species that may be harmful to native plant communities shall be avoided.

d. Seed shall not be used later than one year after the test date that appears on the label.

e. Seed shall be tested for purity, germination and noxious weed seed content and shall meet the minimum purity and germination requirements as prescribed in the current edition of Rules for Testing Seed, published by the Association of Official Seed Analysts.

2. Seed Rates

a. Temporary Seeding (Cover Crop)

Areas needing protection during periods when permanent seeding is not applied shall be seeded with annual species for temporary protection. See Table 1 for seeding rates of commonly used species. The residue from this crop may either be incorporated into the soil during seedbed preparation at the next permanent seeding period or left on the soil surface and the planting made as a no–till seeding.

Table 1

Temporary Seeding Species and Rates

Species	Lbs/Acre	Percent Purity
Oats	131[1]	98
Cereal Rye	131[2]	97
Winter wheat	131[2]	95
Annual Ryegrass	80[2]	97

1 Spring and summer seeding

2 Fall seeding

b. Permanent Seeding

Rates shall be based on pounds or ounces of Pure Live Seed (PLS) per acre. Section IX contains some possible reference documents that provide seeding rates. Permanent seeding rates may be increased above the minimum rates shown in the reference documents to address land use and environmental conditions.

If a *nurse crop* is used in conjunction with permanent seeding, the nurse crop shall not hinder establishment of the permanent vegetation.

A nurse crop shall be applied at 50% its temporary seeding rate when applied with permanent seed.

3. Inoculation

Legume seed shall be inoculated in accordance with the manufacturer's recommendations. Inoculants shall not be mixed with liquid fertilizer.

4. Sowing

Seed grasses and legumes no more than ¼ inch deep. Distribute seed uniformly. Mixtures with low seeding rates require special care in sowing to achieve proper seed distribution.

Seed may be broadcast, drilled, or hydroseeded as appropriate for the site.

Seed when soil temperatures remain consistently above 53° F. *Dormant seed* when the soil temperature is consistently below 53° F (typically Nov. 1st until snow cover). Seed shall not be applied on top of snow.

VI. Considerations

A. Consider seeding at a lower rate and making two passes to ensure adequate coverage.

B. Compacted soil areas may need special site preparation prior to seeding to mitigate compaction. This may be accomplished by chisel plowing to a depth of 12 inches along the contour after heavy equipment has left the site.

C. Sod may be considered where adequate watering is available.

D. When working in riparian areas refer to the NRCS Engineering Field Handbook, Chapter 16, Streambank and Shoreline Protection and Chapter 18, *Soil Bioengineering* for Upland Slope Protection and Erosion Reduction.

E. A site assessment should be conducted to evaluate soil characteristics, topography, exposure to sunlight, proximity to natural plant communities, proximity to nuisance, noxious and/or invasive species, site history, moisture regime, climatic patterns, soil fertility, and previous herbicide applications.

F. Use *introduced species* only in places where they will not spread into existing natural areas.

G. Lightly roll or compact the area using suitable equipment when the seedbed is judged to be too loose, or if the seedbed contains clods that might reduce seed germination.

H. See Section IX. References for suggested seed mixes (NRCS, WisDOT, UWEX) or use their equivalent.

I. Turf seedlings should not be mowed until the stand is at least 6 inches tall. Do not mow closer than 3 inches during the first year of establishment.

J. Seeding should not be done when the soil is too wet.

K. Consider watering to help establish the seed. Water application rates shall be controlled to prevent runoff and erosion.

L. Prairie plants may not effectively provide erosion control during their establishment period without a nurse crop.

M. Topsoil originating from agricultural fields may contain residual chemicals. The seedbed should be free of residual herbicide or other contaminants that will prevent establishment and maintenance of vegetation. Testing for soil contaminants may be appropriate if there is doubt concerning the soil's quality.

N. Consider using mulch or a nurse crop if selected species are not intended for quick germination. When mulching refer to WDNR Conservation Practice Standard Mulching for Construction Sites (1058).

VII. Plans and Specifications

Plans and specifications for seeding shall be in keeping with this standard and shall describe the requirements for applying this practice.

All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. During construction areas that have been seeded shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period. Inspect weekly during the growing season until vegetation is densely established or permit expires. Repair and reseed areas that have erosion damage as necessary.

B. Limit vehicle traffic and other forms of compaction in areas that are seeded.

C. A fertilizer program should begin with a soil test. Soil tests provide specific fertilizer recommendations for the site and can help to avoid over–application of fertilizers.

IX. References

A. Seed Selection References

United States Department of Agriculture – Natural Resource Conservation Service Field Office Technical Guide Section IV, Standard 342, Critical Area Planting.

UWEX Publication A3434 Lawn and Establishment & Renovation.

WisDOT, 2003. State of Wisconsin Standard Specifications For Highway and Structure Construction. Section 630, Seeding.

B. General References

Association of Official Seed Analysts, 2003. Rules for Testing Seed. http://www.aosaseed.com.

Metropolitan Council, 2003. Urban Small Sites Best Management Practice Manual, Chapter 3, Vegetative Methods 3–85 – 3–91. Minneapolis.

The State of Wisconsin list of noxious weeds can be found in Statute 66.0407.

United States Department of Agriculture – Natural Resources Conservation Service. Engineering Field Handbook, Chapters 16 and 18.

UWEX Publication GWQ002 Lawn & Garden Fertilizers.

X. Definitions

Dense (V.A.2.b) A stand of 3–inch high grassy vegetation that uniformly covers at least 70% of a representative 1 square yard plot.

Dormant seed (V.B.4): Seed is applied after climatic conditions prevent germination until the following spring.

Introduced Species (VI.F) Plant species that historically would not have been found in North America until they were brought here by travelers from other parts of the world. This would include smooth bromegrass and alfalfa. Some of these species may have a wide distribution such as Kentucky bluegrass.

Nurse Crop (V.B.2.b): Also known as a companion crop; is the application of temporary (annual) seed with permanent seed.

Permanent seeding (II) Seeding designed to minimize erosion for an indefinite period after land disturbing construction activities have ceased on the site.

Soil Bioengineering (VI.D) Practice of combining mechanical, biological and ecological concepts to arrest and prevent shallow slope failures and erosion.

Temporary Seeding (II) Seeding designed to control erosion for a time period of one year or less that is generally removed in order to perform further construction activities or to permanently stabilize a construction site.

Topsoil (V.A.2.a) Consists of loam, sandy loam, silt loam, silty clay or clay loam humus–bearing soils adapted to sustain plant life with a pH range of 5.5 – 8.0. Manufactured topsoil shall through the addition of sand or organic humus material, peat, manure or compost meet the above criteria.

Silt Fence

1056 (03/06)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

Silt fence is a temporary sediment barrier of entrenched permeable geotextile fabric designed to intercept and slow the flow of sediment–laden sheet flow runoff from small areas of disturbed soil.

II. Purpose

The purpose of this practice is to reduce slope length of the disturbed area and to intercept and retain transported sediment from disturbed areas.

III. Conditions Where Practice Applies

A. This standard applies to the following applications:

1. Erosion occurs in the form of *sheet and rill erosion*[1]. There is no concentration of water flowing to the barrier (*channel erosion*).
2. Where adjacent areas need protection from sediment–laden runoff.
3. Where effectiveness is required for one year or less.
4. Where conditions allow for silt fence to be properly entrenched and staked as outlined in the Criteria Section V.

B. Under no circumstance shall silt fence be used in the following applications:

1. Below the ordinary high watermark or placed perpendicular to flow in streams, swales, ditches or any place where flow is concentrated.
2. Where the maximum gradient upslope of the fence is greater than 50% (2:1).

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of silt fence. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Placement

1. When installed as a stand–alone practice on a slope, silt fence shall be placed on the contour. The parallel spacing shall not exceed the maximum slope lengths for the appropriate slope as specified in Table 1.

Table 1.

Slope	Fence Spacing
< 2%	100 feet
2 to 5%	75 feet
5 to 10%	50 feet
10 to 33%	25 feet
> 33%	20 feet

2. Silt fences shall not be placed perpendicular to the contour.
3. The ends of the fence shall be extended upslope to prevent water from flowing around the ends of the fence.

B. Height – Installed silt fences shall be a minimum 14 inches high and shall not exceed 28 inches in height measured from the installed ground elevation.

C. Support – Silt fences shall be supported by either steel or wood supports as specified below:

1. Wood supports

a. The full height of the silt fence shall be supported by 1 1/8 inches by 1 1/8 inches air or kiln dried posts of hickory or oak.

b. The silt fence fabric shall be stapled, using at least 0.5–inch staples, to the upslope side of the posts in at least 3 places.

c. The posts shall be a minimum of 3 feet long for 24–inch silt fence and a minimum of 4 feet for 36–inch silt fence fabric.

2. Steel supports

a. The full height of the silt fence shall be supported by steel posts at least 5 feet long with a strength of 1.33 pounds per foot and have projections for the attachment of fasteners.

b. The silt fence fabric shall be attached in at least three places on the upslope side with 50 pound plastic tie straps or wire fasteners. To prevent damage to the fabric from fastener, the protruding ends shall be pointed away from the fabric.

3. The maximum spacing of posts for non–woven silt fence shall be 3 feet and for woven fabric 8 feet.

4. Silt fence shall have a support cord.

5. Where joints are necessary, each end of the fabric shall be securely fastened to a post. The posts shall then be wrapped around each other to produce a stable, secure joint or shall be overlapped the distance between two posts.

6. A minimum of 20 inches of the post shall extend into the ground after installation.

D. Anchoring – Silt fence shall be anchored by spreading at least 8 inches of the fabric in a 4 inch wide by 6 inch deep trench, or 6 inch deep V–trench on the upslope side of the fence. The trench shall be backfilled and compacted. Trenches shall not be excavated wider and deeper than necessary for proper installation.

On the terminal ends of silt fence the fabric shall be wrapped around the post such that the staples are not visible.

E. Geotextile Fabric Specifications – The geotextile fabric consists of either woven or non–woven polyester, polypropylene, stabilized nylon, polyethylene, or polyvinylidene chloride. Non–woven fabric may be needle punched, heat bonded, resin bonded, or combinations thereof. All fabric shall meet the following requirements as specified in Table 2.

Table 2

Test Requirement	Method	Value[1]
Minimum grab tensile strength in the machine direction	ASTM D 4632	120 lbs. (550 N)
Minimum grab tensile strength in the cross machine direction	ASTM D 4632	100 lbs. (450 N)
Maximum apparent opening size equivalent standard sieve	ASTM D 4751	No. 30 (600 µm)
Minimum permittivity	ASTM D 4491	0.05 scc^{-1}
Minimum ultraviolet stability percent of strength retained after 500 hours of exposure	ASTM D 4355	70%

(WisDOT Standard Specifications for Road and Bridge Construction, 2001)

[1] All numerical values represent minimum / maximum average roll values. (For example, the average minimum test results on any roll in a lot should meet or exceed the minimum specified values.)

Silt fence shall have a maximum flow rate of 10–gallons/minute/square foot at 50mm constant head as determined by multiplying permittivity in 1/second as determined by ASTM D–4491 by a conversion factor of 74.

F. Removal – Silt fences shall be removed once the disturbed area is permanently stabilized and no longer susceptible to erosion.

VI. Considerations

A. Improper placement as well as improper installation and maintenance of silt fences will significantly decrease the effectiveness of this practice.

Silt fences should be considered for trapping sediment where sheet and rill erosion may be expected to occur in small drainage areas. Silt fences should not be placed in areas of concentrated flow.

B. Silt fences should be installed prior to disturbing the upslope area.

C. Silt fences should not be used to define the boundaries of the entire project. Silt fence should be placed only in areas where it is applicable due to its cost and the fact that it is not biodegradable. For example, silt fence should not be placed in locations where the natural overland flow is from an undisturbed area into disturbed areas of the project. It should also not be used as a diversion.

D. Silt fence should not be used in areas where the silt fence is at a higher elevation than the disturbed area.

E. When placing silt fence near trees, care should be taken to minimize damage to the root system. Avoid compaction and root cutting within 1.5 feet multiplied by the inch diameter of the tree (for example: for 10–inch trees keep out a 15–foot radius from the trunk). Refer to UWEX publication Preserving Trees During Construction for more information.

F. To protect silt fence from damage in areas of active construction or heavy traffic, silt fence should be flagged, marked, or highlighted to improve visibility.

G. Silt fence effectiveness is generally increased when used in conjunction with other upslope erosion control practices. To further strengthen the silt fence, straw / hay bales can be placed on the down slope side.

H To help ensure effectiveness, silt fence should be inspected and repaired as necessary prior to forecasted rain events.

I. Where installation with wood posts is difficult, such as when hard or frozen ground is encountered, the use of steel post is recommended.

J. Silt fence can be mechanically installed with a plow type device provided that the silt fence is trenched in a manner such that equivalent performance is achieved to that specified in Section V.D.

VII. Plans and Specifications

A. Plans and specifications for installing silt fence shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of silt fence
2. Contributory drainage area
3. Schedules
4. Material specification conforming to standard
5. Standard drawings and installation details
6. Restoration after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Silt fences shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24 hour period.

B. Damaged or decomposed fences, undercutting, or flow channels around the end of barriers shall be repaired or corrected.

C. Sediment shall be properly disposed of once the deposits reach ½ the height of the fence.

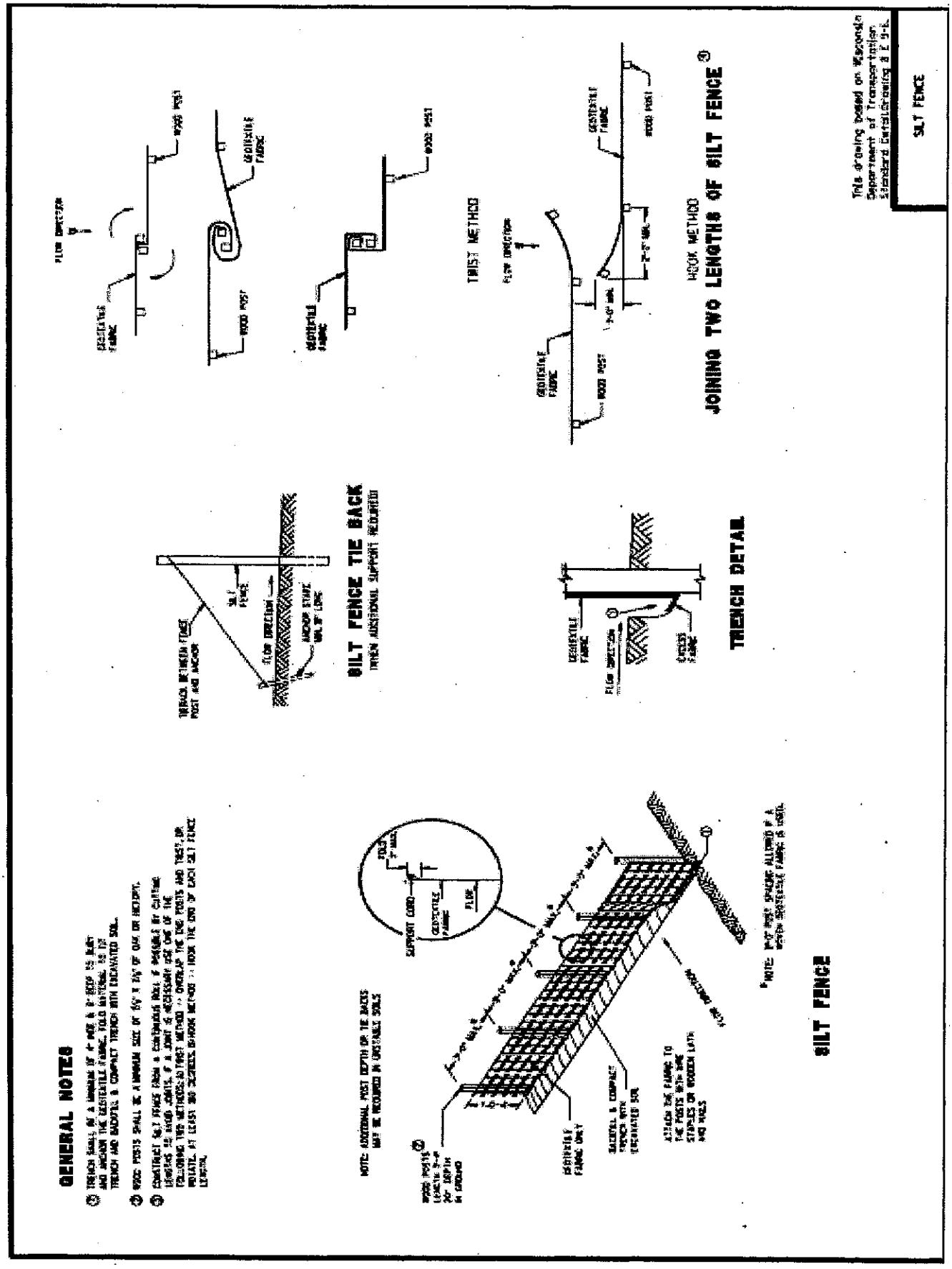
IX. References

UWEX Publication A0327 "Preserving Trees During Construction"

X. Definitions

Channel Erosion (III.A.1): The deepening and widening of a channel due to soil loss caused by flowing water. As rills become larger and flows begin to concentrate, soil detachment occurs primarily as a result of shear.

Sheet and Rill Erosion (III.A.1): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper forming gullies.


GENERAL NOTES
SILT FENCE TIE BACK
JOINING TWO LENGTHS OF SILT FENCE
TRENCH DETAIL
SILT FENCE
SILT FENCE

Silt Curtain

1070 (09/05)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary permeable fabric installed in a waterway or waterbody to minimize sediment transport. A silt curtain does not extend to the bottom of the channel and is placed parallel or perpendicular to the direction of flow.

II. Purposes

The purpose of this practice is to provide sediment containment while construction activities are occurring in or directly adjacent to a waterway or waterbody.

III. Conditions Where Practice Applies

This practice applies where construction activities intrude or are directly adjacent to a waterway or waterbody. This includes but is not limited to bridge construction, rip rap placement, utility work, streambank restoration, boat launches and dredging.

Silt curtain is intended for calm water conditions where it will not be subjected to wind, wave, or current. Silt curtains are appropriate to settle out coarse and granular soils where water depth at the time of construction is greater than or equal to 4 feet. For applications in finer sediment or moving water see WDNR Technical Standard 1069 Turbidity Barrier.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of silt curtains. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Installation – Details of construction not listed in the text shall conform to the pertinent requirements of Figure 1.

1. The silt curtain shall be installed before construction activities are initiated in or adjacent to the waterway or waterbody. Install the silt curtain as close to the construction as practical. The curtain shall remain in place and be maintained until the construction activity is completed and the disturbed area is *stabilized* [1].

2. The ends of the silt curtain shall be securely anchored and keyed into the shoreline to fully enclose the area where sediment may enter the water.

3. A 2–foot gap shall exist between the weighted lower end of the curtain and the bottom of the waterway or waterbody.

4. Bottom anchors shall be used to hold the silt curtain in the same position relative to the bottom the waterway or waterbody without interfering with the function of the curtain. Anchors shall either be driven into the bottom of the waterway or waterbody or be weighted and attached to the curtain floatation device via an anchor line. Manufacture's recommendations shall be followed for the number and spacing of anchors.

5. Danger buoys shall be used as directed by the Coast Guard or DNR permit when working in navigable waters.

B. Material:

1. Reusable components of the silt curtain system shall be clean and free of potential exotic species. Fabric cannot be reused.

2. The silt curtain shall be constructed from heavy woven filter fabric to allow water to pass through the barrier yet retain sediment. All fabric seams shall be heat sealed or sewn. Silt curtain fabric shall conform to the specifications in Table 1.

Table 1

Requirement	Value
Thickness	15 mils (0.38 mm)
Min. grab tensile strength (ASTM D 4632)	120 lb (550 N)
Min. equivalent opening	No. 170 sieve (90 µm)

3. Flotation devices shall be flexible, buoyant units contained in an individual floatation sleeve or collar attached to the curtain. Use expanded polystyrene logs or equivalent having a 49 square inch minimum end area. Do not use polystyrene beads or chips. Buoyancy provided by the floatation device shall be sufficient to support the weight of the curtain and maintain a freeboard of at least 3 inches above the water surface level.
4. Top load lines shall consist of 5/16 inch steel cable.
5. Bottom load lines shall consist of a minimum ¼–inch steel chain incorporated into the bottom hem of the curtain. Larger chain sizes may be used where additional weight to serve as ballast to hold the curtain in a vertical position is required.

VI. Considerations

A. Sediment that has settled out by the silt curtain should only be removed as directed by the regulatory authority because re–suspension of sediment will likely occur during the removal process. Use of polymers may help prevent resuspension of sediment. See WDNR Technical Standard 1051 Sediment Control Water Application of Polymers for further guidance.

B. Silt curtains are meant to manage sediment in the waterbody. The best way to prevent sediment from entering the waterbody is through the implementation of effective upland erosion control, stopping sediment transport at its source.

VII. Plans and Specifications

Plans and specifications for installing a silt curtain shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of silt curtain.

B. Material specification conforming to standard.

C. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Silt curtains shall be inspected daily and repaired if necessary.

B. Regardless of upland stabilization conditions silt curtains shall not be removed until the water behind the curtain has equal or greater clarity than the waterway or waterbody. Soil particles shall be allowed to settle for a minimum of 24 hours prior to removal of the curtain.

C. Care shall be taken when removing the silt curtain to minimize the release or re–suspension of accumulated sediment.

D. To prevent the spread of exotic species silt curtains shall not be reused on other sites. Buoys and chains can be reused but shall be either disinfected with vinegar or cleaned with hot water greater than 104 deg. F then allowed to completely dry for a minimum period of five days. If there are any questions about the occurrence of zebra mussels, Eurasian water–milfoil, or other aquatic invasive species in a waterbody that you are working in or intend to work in contact your local DNR staff.

IX. References

Virginia Erosion and Sediment Control Handbook, Third Edition, 1992

WisDOT Facilities Development Manual: Chapter 10, Section 10, Subject 43, Silt Screen

X. Definitions

Stabilized (V.A.1): Means that all land disturbing construction activities at the construction site have been completed, and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures, or that employ equivalent stabilization measures.

Stone Tracking Pad and Tire Washing

1057 (08/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

A stabilized pad of stone aggregate or tire washing station located at any point where traffic will egress a construction site.

II. Purpose

The purpose of this standard is to reduce off–site sedimentation by eliminating the tracking of sediment from construction sites.

III. Conditions Where Practice Applies

Either a stone tracking pad or tire washing station shall be used at all points of construction egress. This standard applies where construction traffic is likely to transport sediment off site.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of this practice. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Tracking Pad:

1. The tracking pad shall be installed prior to any traffic leaving the site.
2. The aggregate for tracking pads shall be 3 to 6 inch clear or washed stone. All material to be retained on a 3–inch sieve.
3. The aggregate shall be placed in a layer at least 12 inches thick. On sites with a high water table, or where saturated conditions are expected during the life of the practice, stone tracking pads shall be underlain with a WisDOT Type R geotextile fabric to prevent migration of underlying soil into the stone.
4. The tracking pad shall be the full width of the egress point. The tracking pad shall be at a minimum 50 feet long.
5. Surface water must be prevented from passing through the tracking pad. Flows shall be diverted away from tracking pads or conveyed under and around them by using a variety of practices, such as culverts, *water bars*[1], or other similar practices.

B. Tire washing: If conditions on the site are such that the sediment is not removed from vehicle tires by the tracking pad, then tires shall be washed utilizing pressurized water before entering a public road.

1. The washing station shall be located on–site in an area that is stabilized and drains into suitable sediment trapping or settling device.
2. The wash rack shall consist of a heavy grating over a lowered area. The rack shall be strong enough to support the vehicles that will cross it.

C. Rocks lodged between the tires of dual wheel vehicles shall be removed prior to leaving the construction site.

VI. Considerations

A. Vehicles traveling across the tracking pad should maintain a slow constant speed.

B. The best approach to preventing off–site tracking is to restrict vehicles to stabilized areas.

C. It is always preferable to prevent sediment from being deposited upon the road than cleaning the road later. Sediment on a road can create a safety hazard as well as a pollution problem.

D. Any sediment tracked onto a public or private road should be removed by street cleaning, not flushing, before the end of each working day.

VII. Plans and Specifications

A. Plans and specifications for installing tracking pads shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of all points of egress with tracking pad locations shown
2. Material specifications conforming to standard
3. Schedule for installation and removal
4. Standard drawings and installation details
5. Stabilization after removal

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Tracking pads and tire washing stations shall, at a minimum, be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. The tracking pad performance shall be maintained by scraping or top–dressing with additional aggregate.

C. A minimum 12–inch thick pad shall be maintained.

IX. Definitions

Water bar (V.A.5): A shallow trench or diversion dam that diverts surface water runoff into a dispersion area.

Storm Drain Inlet Protection For Construction Sites

1060 (10/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

I. Definition

A temporary barrier installed around a storm drain inlet, drop inlet or curb inlet.

II. Purposes

The purpose of this practice is to reduce sediment from entering storm drains before stabilizing the contributing drainage area.

III. Conditions Where Practice Applies

This practice applies where runoff from construction sites enters conveyance system structures such as drain inlets, drop inlets, and curb inlets. Inlet protection devices are for drainage areas of one acre or less. Runoff from areas larger than one acre should be routed through a properly designed sediment trapping or settling practice upstream of the inlet.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of storm drain inlet protection. This standard does not contain the text of federal, state, or local laws.

V. Design Criteria

This section establishes the minimum standards for design, installation and performance requirements.

The appropriate type of inlet protection barrier shall be installed once the drain, drop, or curb inlet can receive runoff. The device shall remain in place and be maintained until the disturbed area is stabilized.

A. General Criteria that is applicable to all inlet protection devices.

1. Ponding water to settle sediment is encouraged; however ponding shall not interfere with the flow of traffic, create a safety hazard, or cause property damage. All devices shall have provisions such as weep holes or "emergency spillways" to safely pass water if the device becomes clogged.

2. The contributing drainage area to the inlet protection device shall be one acre or less. In instances were a larger contributing drainage area exists, runoff shall be routed through a properly designed sediment trapping or settling device upstream of inlet.

3. Other than Type D inlet protection devices, no gaps shall be left in the material used that would allow the flow of water to bypass the inlet protection device.

4. All fabrics used as part of an inlet protection device must be selected from the list of approved fabrics certified for inlet protection, Geotextile Fabric, Type FF in the current addition of the WisDOT Product Acceptability List (PAL).

B. Criteria Applicable to Unpaved areas or the Pre–Paving Phase of Construction

1. Inlet Protection Barriers include, but are not limited to, straw bales, sandbags, other material filled bags and socks, and stone weepers. These devices can be used to either settle sediments or divert flows.

a. Manufactured bags, when used, shall conform to the standards in Table 1.

Table 1

Minimum Size	14 x 26 inches
Grab Tensile strength of fabric, ASTM D–4632	95 lb. min.
UV stability, ASTM D–4355	70 % min.
Note: To provide sufficient strength, fabric shall be sewn together with double stitching.	

b. Straw Bale installation shall conform to the criteria outlined in the WDNR Conservation Practice Standard (1055) Sediment Bale Barrier (Non–Channel).

c. Stone weeper installation shall conform to the criteria in WDNR Conservation Practice Standard (1063) Sediment Trap.

2. Filter Fabric Barrier Criteria – See Figure 1 Inlet Protection

a. Inlet protection Type A devices shall be utilized around inlets and unpaved areas until permanent stabilization methods have been established. Type A devices shall be utilized on inlets prior to installation of curb and gutter or pavement, and where safety considerations are not compromised on the site.

b. Type B shall be utilized after the casting and grate are in place.

c. Type D shall be utilized in areas where other types of inlet protection are identified as incompatible with roadway and traffic conditions, causing possible safety hazards when ponding occurs at the inlet. Type D shall only be used after castings are in place on top of the inlet boxes.

Type D inlet protection shall conform to the standard drawing as shown in the plans. There shall be a three–inch space between the bag and the sides of the inlet to prevent the inlet sides from blocking the overflow; and shall only be used in inlets deeper than 30 inches from the top of grate to bottom of the inlet. If such clearance is not available, cinch or tie the sides of the bag (with rope or ties) to provide clearance.

C. Criteria Applicable to the Post–Paving / Curbing Phase of Construction

1. Inlet protection Types B, C, and D are applicable to post paving construction. See Figure 1 Inlet Protection.

- Type B shall be utilized on inlets without curb box.
- Type C shall be utilized on street inlets with curb heads. A 1½" x 3 ½" (37mm by 87 mm) minimum, piece of wood shall be wrapped and secured in the fabric and placed in front of the curb head as shown in the plans. The wood shall not block the entire opening of the curb box and be secured to the grate with wire or plastic ties.
- Type D

VI. Considerations

A. When site conditions allow, inlets should be temporarily closed or sealed to prevent entrance of runoff and sediment.

B. The best way to prevent sediment from entering the storm sewer system is to stabilize the disturbed area of the site as quickly as possible, preventing erosion and stopping sediment transport at its source.

C. Storm drain inlet protection consists of several types of inlet filters and traps and should be considered as only one element in an overall erosion control plan. Each type differs in application with selection dependent upon site conditions and inlet type. Not all designs are appropriate in all cases. The user must carefully select a design suitable for the needs and site conditions.

D. Inlet protection is only as effective as the filter or barrier used around the inlet. Effectiveness decreases rapidly if the inlet protection is not properly maintained. In general, inlet protection provides relatively good removal of coarse and medium–sized soil particles from runoff however, most fine silt and clay particles will pass through the filtering mechanisms.

E. Properly maintaining inlet protection can be difficult and often inlets can become clogged. Field experience has shown that inlet protection that causes excessive ponding in an area of high construction activity may become so inconvenient that it is simply removed or bypassed, thus transmitting sediment–laden flows unchecked. In such situations, a structure with an adequate overflow mechanism should be utilized instead of simply removing the inlet protection device.

F. Inlet protection devices can be enhanced by additional excavation to increase the storage capacity around the inlet.

G. Good construction site housekeeping measures, such as keeping the gutters clean, and street sweeping are important.

VII. Plans and Specifications

Plans and specifications for installing inlet protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of inlet protection and type employed

B. Material spec conforming to standard

C. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Remove inlet protection devices once the contributing drainage area is stabilized with appropriate vegetation or impervious area.

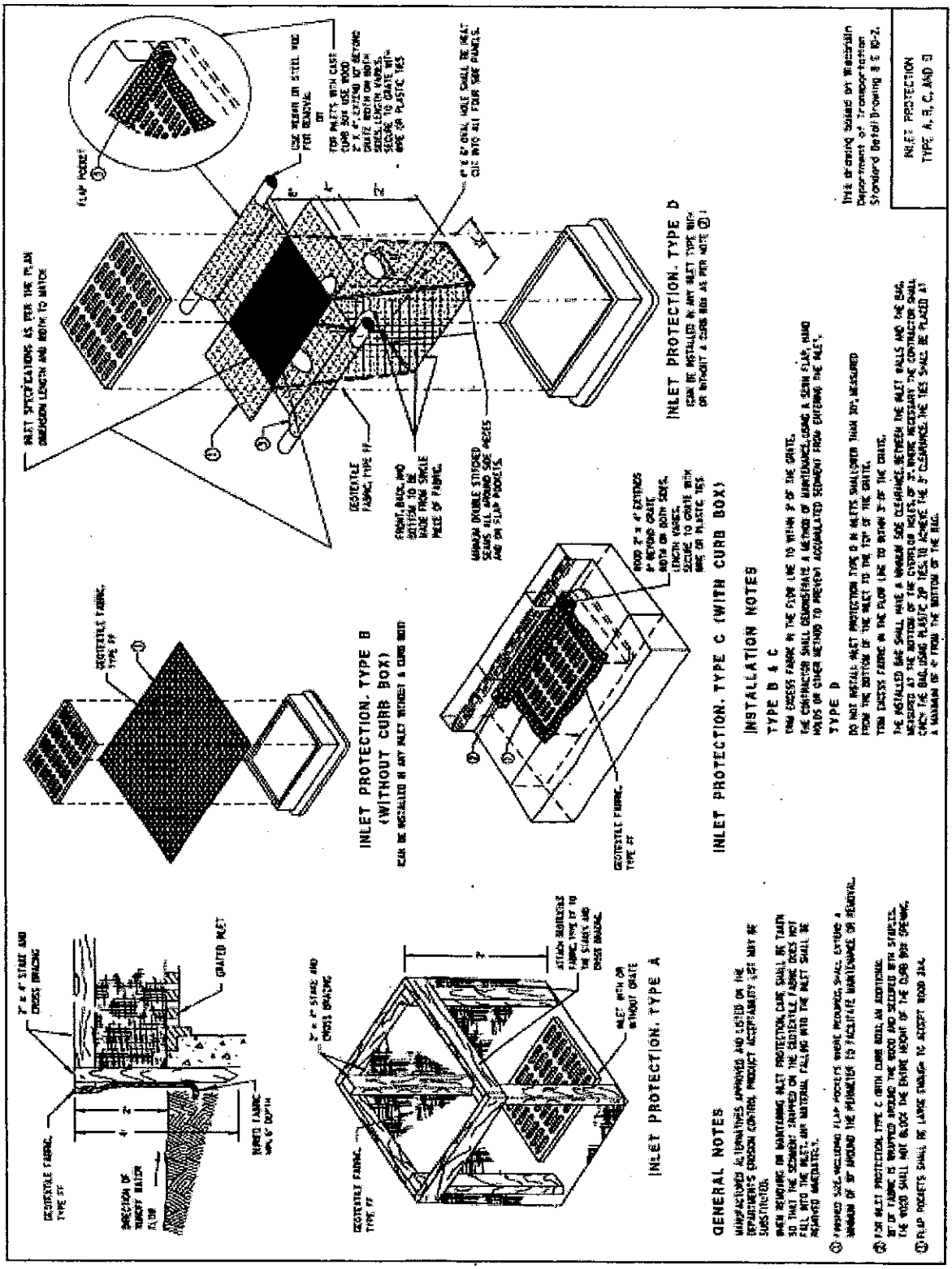
B. Inlet protection shall be at a minimum inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

C. Sediment deposits shall be removed and the inlet protection device restored to its original dimensions when the sediment has accumulated between 1/3 to 1/2 the design depth of the device, or when the device is no longer functioning as designed. Removed sediment shall be deposited in a suitable area and stabilized.

D. Due care shall be taken to ensure sediment does not fall into the inlet and impede the intended function of the device. Any material falling into the inlet shall be removed.

IX. References

WisDOT "Erosion Control Product Acceptability List" is available online at: http://www.dot.wisconsin.gov/business/engrserv/pal.htm. Printed copies are no longer distributed.


INLET PROTECTION, TYPE A
INLET PROTECTION, TYPE B (WITHOUT CURB BOX)
INLET PROTECTION, TYPE C (WITH CURB BOX)
INLET PROTECTION, TYPE D
GENERAL NOTES
INSTALLATION NOTES
TYPE B & C
TYPE D
INLET PROTECTION TYPE A, B, C, AND D

Turbidity Barrier

1069 (09/05)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in X. Definitions. The words are italicized the first time they are used.

I. Definition

A temporary fabric barrier with very low permeability, installed in or near the bed of a waterway or waterbody to minimize sediment transport and is installed parallel to flow. Turbidity barrier cannot be installed perpendicular to a moving channel.

II. Purposes

The purpose of this practice is to provide sediment containment while construction activities are occurring in or directly adjacent to a waterway or waterbody.

III. Conditions Where Practice Applies

This practice applies where construction activities intrude or are directly adjacent to a waterway or waterbody. This includes but is not limited to bridge construction, rip rap placement, utility work, streambank restoration, boat launches and dredging.

Use turbidity barriers in conditions with fine soils and flow velocities not exceeding 5 feet per second, unless additional reinforcement is installed.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of turbidity barriers. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.

A. Installation – Details of construction not listed in the text shall conform to the pertinent requirements of Figures 1 and 2.

1. The barrier shall be installed before construction activities are initiated in, or adjacent to the waterway or waterbody. Install the turbidity barrier as close to the construction as practical. The barrier shall remain in place and be maintained until the construction activity is completed and the disturbed area *stabilized* [1].

2. The ends of the barrier shall be securely anchored and keyed into the shoreline to fully enclose the area where sediment may enter the water.

3. Driven steel posts shall be used to hold the barrier in position. The maximum spacing between posts shall be 10 feet. When barrier height exceeds 8 feet, post spacing may need to be decreased.

   When bedrock prevents the installation of posts, float devices may be used. Flotation devices shall be flexible, buoyant units contained in an individual flotation sleeve or collar attached to the turbidity barrier. Use solid expanded polystyrene logs or equivalent having a 49 square inch minimum end area. Do not use polystyrene beads or chips. Buoyancy provided by the flotation devices shall be sufficient to support the weight of the turbidity barrier and maintain a freeboard of at least three inches above the water surface. Refer to Figure 1.

4. The barrier and steel posts shall extend from the bottom of the waterway or waterbody to an elevation 2 feet above the anticipated high water level during the time of year and duration the barrier will be in place. The elevation shall not exceed the top of bank.

5. Ballast shall be used to hold the barrier in a vertical position. Bottom load lines shall consist of a chain incorporated into the bottom hem of the screen, of sufficient weight to serve as ballast to hold the screen in a vertical position. Additional anchorage shall be provided if necessary.

6. Danger buoys shall be used as directed by the Coast Guard or DNR permit when working in navigable waters.

7. Turbidity barriers shall be installed parallel to the direction of flow and shall not be installed across channels.

B. Material

1. Reusable components of the turbidity barrier system shall be clean and free of potential exotic species. Fabric cannot be reused.
2. Top load lines shall consist of 5/16 inch steel cable.
3. Fabric shall be selected according to the specifications in Table 1.

Table 1

Requirement	Method	Value
Min. grab tensile strength	ASTM D 4632	200 lb (890 N)
Min. puncture strength	ASTM D 4833	90 lb (400 N)
Maximum permeability	ASTM D 4491	= $1X10^{-7}$ cm/s
Min. ultraviolet stability	ASTM D 4355	70%

Source: WisDOT Spec 628.2.10.

VI. Considerations

A. The 5 feet per second flow velocity specified in Section III can be the base flow of the stream or the base flow plus the addition of storm event runoff. Base flow can be used alone for short term projects (typically one day duration, i.e. culvert installation) when the chance of precipitation is low. Longer term projects (i.e. bridge work) should consider storm flow in addition to base flow (typically the two year event).

B. If the current exceeds 5 feet per second, other methods to divert flow away from the turbidity barrier such as temporary concrete traffic barriers, coffer dams, pumping, or sheet piling should be considered.

C. Sediment that has been settled out by the turbidity barrier should only be removed if so directed by the regulatory authority because re–suspension of sediment will likely occur during the removal process. Use of polymers may help prevent resuspension of sediment. See WDNR Technical Standard 1051 Sediment Control Water Application of Polymers for further guidance.

D. Turbidity barriers are meant to manage sediment in the waterbody. The best way to prevent sediment from entering the waterbody is through the implementation of effective upland erosion control, stopping sediment transport at its source.

E. Turbidity barriers should not be used to reduce the conveyance capacity of the channel. An example is use on bridge projects where the turbidity barrier is installed adjacent to each abutment simultaneously.

F. Turbidity barriers may be installed on the banks of a waterway or waterbody if higher water levels are anticipated during construction.

VII. Plans and Specifications

Plans and specifications for installing a turbidity barrier shall be in keeping with this standard and attached detail drawing and shall describe the requirements for applying the practice to achieve its intended purpose:

A. Location of turbidity barrier.

B. Material specification conforming to standard.

C. All plans, standard detail drawings, or specifications shall include schedule sequence or notes for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Turbidity barriers shall be inspected daily and repaired if necessary.

B. Turbidity barriers shall not be removed until the water behind the barrier has equal or greater clarity than the waterway or waterbody.

C. Care shall be taken when removing the barrier to minimize the release or re–suspension of accumulated sediment.

D. To prevent the spread of exotic species turbidity barriers shall not be reused on other sites. Buoys and chains can be reused but shall be either disinfected with vinegar or cleaned with hot water greater than 104 deg. F then allowed to completely dry for a minimum period of five days. If there are any questions about the occurrence of zebra mussels, Eurasian water--milfoil, or other aquatic invasive species in a waterbody that you are working in, or intend to work in, contact your local DNR staff.

IX. References

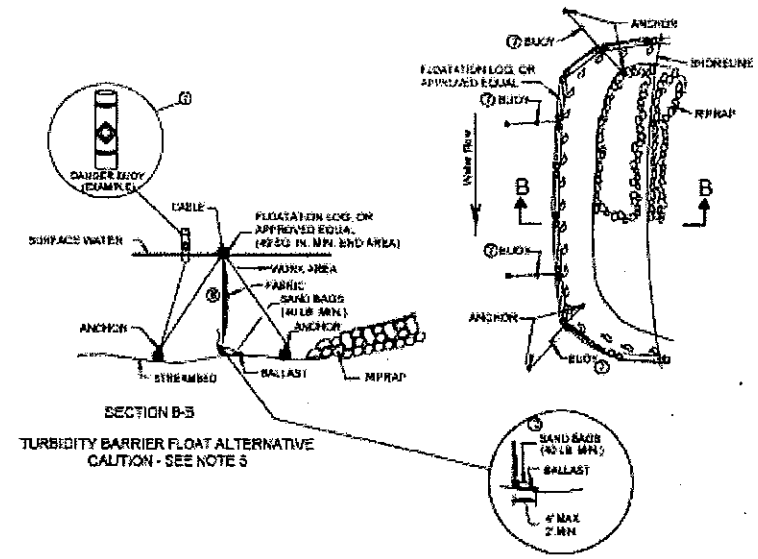
WisDOT Facilities Development Manual: Chapter 10, Section 10, Subject 45, Turbidity Barrier

X. Definitions

Stabilized (V.A.1): Means that all land disturbing construction activities at the construction site have been completed, and that a uniform perennial vegetative cover has been established with a density of at least 70% of the cover for the unpaved areas and areas not covered by permanent structures, or that employ equivalent stabilization measures.

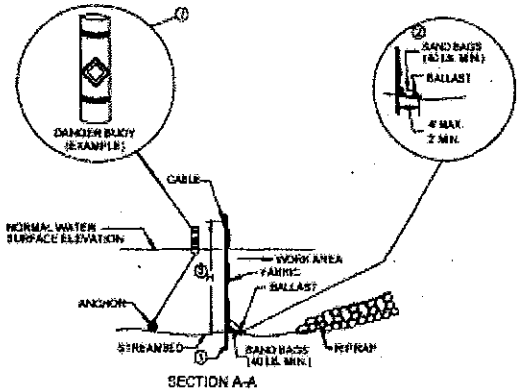
(Figures are available on DNR website.)

Figure 1. Turbidity Barrier Placement Details



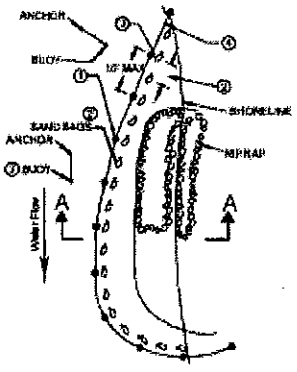
SECTION B-B

TURBIDITY BARRIER FLOAT ALTERNATIVE
CAUTION - SEE NOTE 5



SECTION A-A

TURBIDITY BARRIER STANDARD POST INSTALLATION



PLAN VIEW

GENERAL NOTES

DETAILS OF CONSTRUCTION, MATERIALS AND WORKMANSHIP NOT SHOWN ON THIS DRAWING SHALL CONFORM TO THE PERTINENT REQUIREMENTS OF THE STANDARD AND THE APPLICABLE SPECIAL PROVISIONS

TURBIDITY BARRIER MAY BE REMOVED AT THE ENGINEERS OR PROJECT MANAGERS DISCRETION WHEN PERMANENT EROSION CONTROL MEASURES HAVE BEEN ESTABLISHED

1. DRIVEN STEEL POSTS, PIPES OR CHANNELS. LENGTH SHALL BE SUFFICIENT TO SECURELY SUPPORT BARRIER AT HIGH WATER ELEVATIONS.
2. SANDBAGS TO BE USED AS ADDITIONAL BALLAST WHEN ORDERED BY THE ENGINEER OR PROJECT MANAGER TO MEET ADVERSE FIELD CONDITIONS. SPACE AS APPROPRIATE FOR SITE CONDITIONS.
3. WHEN BARRIER HEIGHT, H, EXCEEDS 6 FT., POST SPACING MAY NEED TO BE DECREASED.
4. IN WATERWAYS SUBJECT TO FLUCTUATING WATER ELEVATIONS, PROVISIONS SHOULD BE MADE TO ALLOW THE WATER TO EQUALIZE ON EACH SIDE OF THE BARRIER. THIS MAY BE ACCOMPLISHED BY LEAVING A PORTION OF THE BARRIER OPEN ON THE UPSTREAM END.
5. FLOAT ALTERNATIVE WILL ONLY BE ALLOWED WITH WRITTEN APPROVAL OF THE ENGINEER OR PROJECT MANAGER, AND IS MEANT FOR LOCATIONS WHERE BEDROCK PREVENTS THE INSTALLATION OF POSTS.
6. ALLOW SUFFICIENT SLACK VERTICALLY AND HORIZONTALLY SO THAT SEDIMENT BUILD UP WILL NOT SEPARATE OR LOWER THE TURBIDITY BARRIER.
7. USE AS DIRECTED BY COAST GUARD OR DNR PERMIT WHEN WORKING IN NAVIGABLE WATERWAYS.

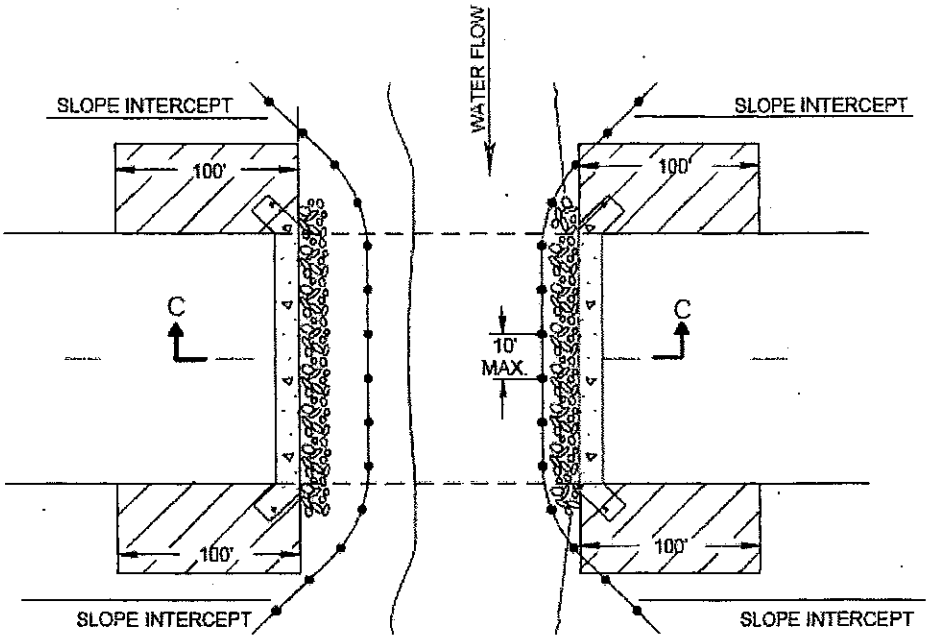
NOT TO SCALE

This drawing based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 11-2.

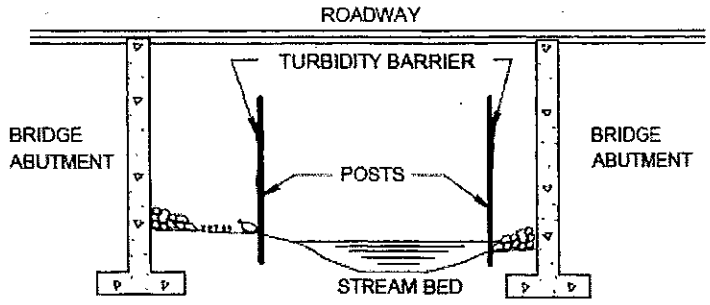
FIGURE 2. TURBIDITY BARRIER DETAIL SHOWING TYPICAL PLACEMENT AT STRUCTURES

GENERAL NOTE

FLOAT ALTERNATIVE WILL ONLY BE ALLOWED WITH WRITTEN APPROVAL OF THE ENGINEER OR PROJECT MANAGER AND IS MEANT FOR LOCATIONS WHERE BEDROCK PREVENTS THE INSTALLATION OF POSTS.



PLAN VIEW



SECTION C-C

NOT TO SCALE

This Drawing is Based on Wisconsin Department of Transportation Standard Detail Drawing 8 E 11-2.

Vegetative Buffer

For Construction Sites

1054 (05/03)

Wisconsin Department of Natural Resources

Conservation Practice Standard

Note: Words in the standard that are shown in italics are described in IX. Definitions. The words are italicized the first time they are used.

I. Definition

An area of *dense vegetation*[1] intended to slow runoff and trap sediment. Vegetative Buffers are commonly referred to as filter or buffer strips.

II. Purpose

The purpose of this practice is to remove sediment in *sheet flow* by velocity reduction.

III. Conditions Where Practice Applies

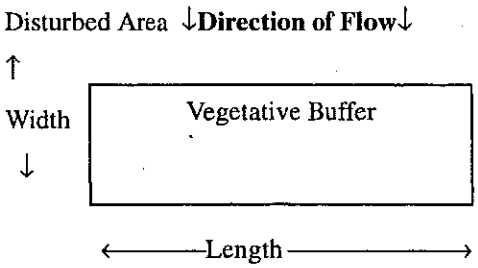
This practice applies to areas where sediment delivery is in the form of *sheet and rill erosion* from disturbed areas.

IV. Federal, State, and Local Laws

Users of this standard shall be aware of applicable federal, state, and local laws, rules, regulations, or permit requirements governing the use and placement of a vegetative buffer. This standard does not contain the text of federal, state, or local laws.

V. Criteria

This section establishes the minimum standards for design, installation and performance requirements.



A. The vegetative buffer shall be located along the entire length of the down slope edge of the entire disturbed area for which the practice is being applied.

B. The vegetative buffer shall be located on the contour.

C. The width of the vegetative buffer shall have slopes less than 5%.

D. The disturbed area draining to the vegetative buffer shall have slopes of 6% or less.

E. The vegetative buffer shall have a minimum *width* of 25 feet. 25 feet is adequate for disturbed areas up to 125 feet upslope from the vegetative buffer. An additional one foot of width shall be added to the buffer for every 5 feet exceeding 125 feet upslope of the disturbed area draining to the vegetative buffer.

F. To minimize compaction and destruction of the vegetative cover, designate the vegetative buffer as an area of no disturbance. Construction equipment shall be excluded from the designated area. Vegetative buffers shall be clearly shown on plans and marked in the field.

G. Vegetative buffers shall be densely vegetated prior to upslope soil disturbance.

VI. Considerations

A. Maintaining sheet flow is critical to the function of a vegetative buffer. In some conditions, a *level spreader* may need to be constructed at the upslope side of the vegetative buffer to minimize concentrated flow.

B. Vegetative buffers may require large land areas compared to other erosion control practices.

C. Trees should not be cut down to establish a vegetative buffer. Other erosion control measures are preferred.

VII. Plans and Specifications

A. Plans and specifications for vegetative buffers shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. The plans and specifications shall address the following:

1. Location of vegetative buffer.
2. Limits and slopes of disturbed area and any additional contributory drainage area.
3. Dimensions and slope of vegetative buffer.

B. All plans, standard detail drawings, or specifications shall include schedule for installation, inspection, and maintenance. The responsible party shall be identified.

VIII. Operation and Maintenance

A. Vegetative buffers shall be inspected for proper distribution of flows, sediment accumulation and signs of rill formation. Vegetative buffers shall at a minimum be inspected weekly and within 24 hours after every precipitation event that produces 0.5 inches of rain or more during a 24–hour period.

B. If the vegetative buffer becomes silt covered, contains rills, or is otherwise rendered ineffective, other perimeter sediment control measures shall be installed. Eroded areas shall be repaired and stabilized. Repair shall be completed as soon as possible with consideration to site conditions.

C. A stand of dense vegetation shall be maintained to a height of 3–12 inches.

D. Prior to land disturbance the perimeter of vegetative buffers shall be flagged or fenced to prevent equipment from creating ruts, compacting the soil and to prevent damage to vegetation.

IX. Definitions

Dense vegetation (I): is defined as an existing stand of 3–12 inch high grassy vegetation that uniformly covers at least 90 % of a representative 1 square yard plot. Woody vegetation shall not be counted for the 90% coverage. No more than 10% of the overall buffer can be comprised of woody vegetation.

Level Spreader (VI.A): Level spreaders disperse flows over a wide area, dissipating the energy of the runoff and creating sheet flow. Common types of level spreaders are weirs and stone trenches.

Sheetflow (II): Sheet flow is over plane surfaces, where runoff water flows in a thin uniform sheet across the land before it collects in a concentrated flow.

Sheet and Rill Erosion (III): Sheet and rill erosion is the removal of soil by the action of rainfall and shallow overland runoff. It is the first stage in water erosion. As flow becomes more concentrated rills occur. As soil detachment continues or flow increases, rills will become wider and deeper.

Width (V.E): Is measured in the direction of flow.

A–21.126 STORM WATER MANAGEMENT. The following examples are three exemptions to the requirements for a post construction stormwater management plan. This means the owners of these sites are **not** required to develop and implement a post construction stormwater management plan.

1. Redevelopment with no increase in area for exposed parking or roads. Redevelopment is defined as "areas where development is replacing older development."

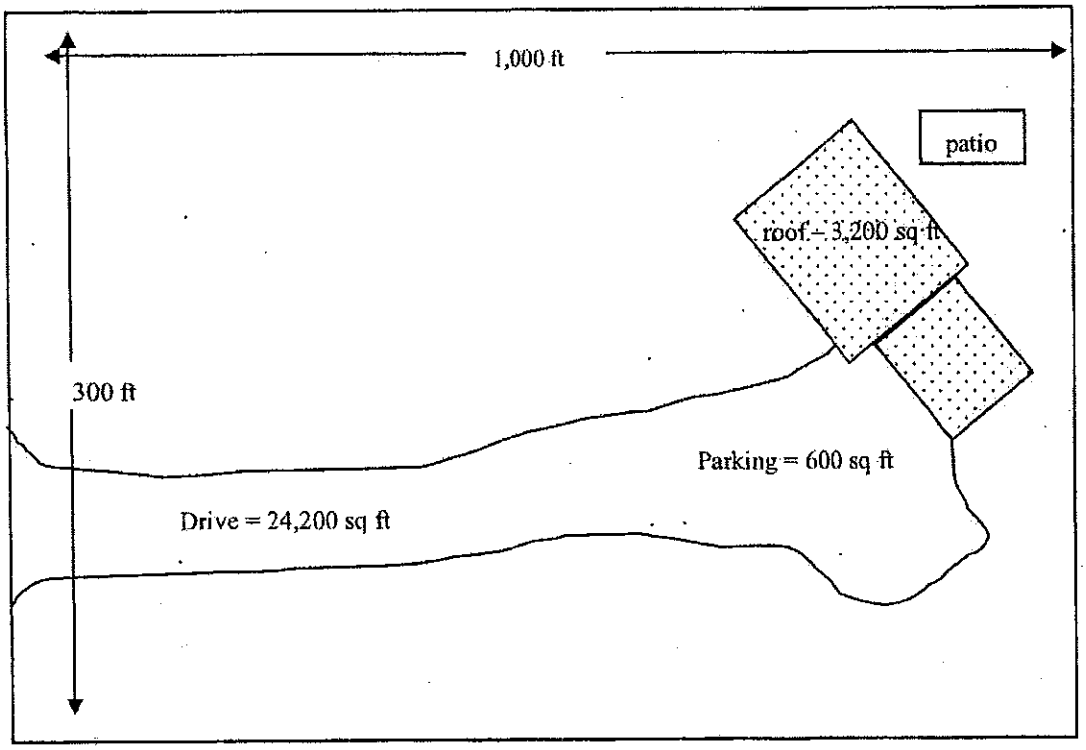
2. The installation of underground utilities such as sewers, water services, electrical services, etc.

3. Sites with less than 10% connected imperviousness when parking lots and roofs total an area of less than one acre. Following is an equation that may be used to evaluate a site for this exemption:

   Total area of a completed building site X 0.1 = Maximum area permitted to be connected via impervious flow path or sewer.

Following are design examples acceptable by the department which achieve compliance with the NR 151.12 (2) (d), Wis. Adm. Code exemption to the post–construction stormwater requirements. The following diagram illustrates a residential site that meets this exemption.

Figure A–21.126–1
Sample site plan that meets exemption for post construction stormwater plan



The total area of the site is 300,000 sq ft or 6.9 acres. Disturbed area = 2 acres.

The roof & parking is 3,800 sq ft which is less than 1 acre (43,560 sq ft)

300,000 sq ft X 0.1 = 30,000 sq ft allowable connected imperviousness

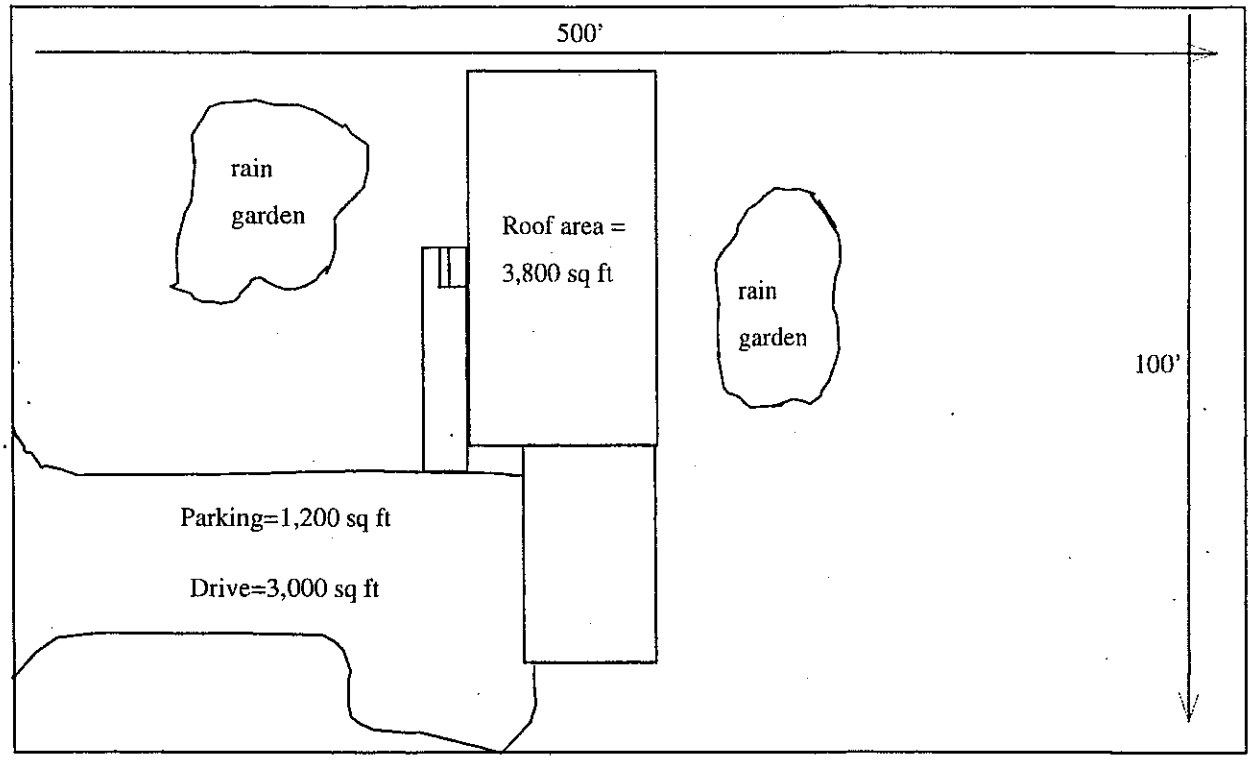
In this example the entire parking, drive and roof area is connected imperviousness via storm piping to the road and drive.

The patio is disconnected imperviousness. The connected imperviousness is 28,000 sq ft.

This example would not be required to develop a stormwater management plan because the exemption found in NR 151.12 (2) (d), Wis. Adm. Code applies.

The previous example was a long driveway on a very large rural lot. Following is a small site in an urban setting that would also meet the exemption for post construction stormwater management.

Figure A–21.126–2
Sample site plan that meets exemption for post construction stormwater plan



The lot is 50,000 sq ft or approximately 1.1 acres. The entire site (except for the rain garden areas) will be disturbed during construction.

The roof & parking is 5,000 sq ft which is less than 1 acre (43,560 sq ft)

50,000 sq ft X 0.1 = 5,000 sq ft allowable connected imperviousness

In this example the entire roof area discharges to two rain gardens. Only the parking and driveway is connected imperviousness via the road (parking 1,200 sq ft + drive 3,000 sq ft = 4,200 sq ft).

This example would not be required to develop a stormwater management plan because the exemption found in NR 151.12 (2) (d), Wis. Adm. Code applies.

An acceptable Stormwater Operation and Maintenance Plan should be based on the following outline:

I. Introduction and general information

A. Contact information

B. Overview of site

II. Practices (BMPs) utilized on the site

A. Construction

B. Plans and narrative of stormwater management

III. Normal Operating Procedures

A. Relationship of one practice to another

B. Effectiveness of functioning practices

IV. Maintenance

A. Contact information for responsible maintenance person or persons

B. Copies of any agreements for maintenance or easement

C. Description of routine maintenance

D. Sample inspection and monitoring protocol

E. Description of replacement plans or repair procedures for failed practices

s. Comm 21.16

Frost–Protected Shallow Footings

In lieu of frost walls, the code recognizes frost–protected shallow foundations designed per ASCE 32, "Design and Construction of Frost–Protected Shallow Foundations". The department also recognizes the similar design standards of U.S.HUD "Design Guide for Frost–Protected Shallow Foundations", available for free download from www.huduser.org/publications/destech/desguide.html and summarized below. Consult it or the ASCE standard for full design and installation information, including a more flexible, detailed design method that should be used for heated buildings with attached, unheated garages.

Note that both standards offer design methods for both heated and unheated buildings. For heated buildings, the designs rely upon containing the building's heat under the footings to avoid frost heaving. In the case of unheated buildings, the designs rely upon containing the earth's natural warmth under the footings and slab by the use of more extensive insulation. (For both design approaches, compliance with their frost–protection requirements is not necessarily the same as compliance with the ch. 22 Energy Conservation standards for slab–on–grade designs.)

Because the simplified heated building design methods rely upon buildings, including attached garages, with at least a 63 degree internal temperature, it is important the building designer consult with the owner regarding their intended use. Even if the initial owner plans to keep the building heated throughout the winter, future owners may use it otherwise. Therefore, the designer should be sure to communicate the operational needs of the building through means such as building placarding, notating the Rescheck Energy Report, and/or recording relevant information on the property deed. **Failure to do so may cause severe structural damage to the building if future owners do not keep the building heated.**

Unheated Building Design

Minimum Ground Insulation Requirements[1]

		Mean Annual Temperature [2, 6] (see map)			Minimum Footing Depth [7, 8]	
Air Freezing Index (°F–days) [3] (see map)	D_g–Insulation Width from Edge of Footing [4, 5]	38	40	≥41	D– Concrete & Insulation Depth	G–Granular Base Thickness
2,250 or less	63″	R–13.6	R–11.4	R–10.2	10″	6″
2,251–3,000	79″	R–18.2	R–15.3	R–14.2	10″	6″
3,001–3,750	91″	R–22.7	NA	NA	10″	6″

1 Also see s. Comm 22.26 for additional slab–edge insulation requirements.

2 Units are degrees Fahrenheit. See estimate provided on Mean Annual Temperature Contour Map.

3 Air freezing index shall be based on maximum year expected for a 100–year return period. See estimate provided on AFI Contour Map.

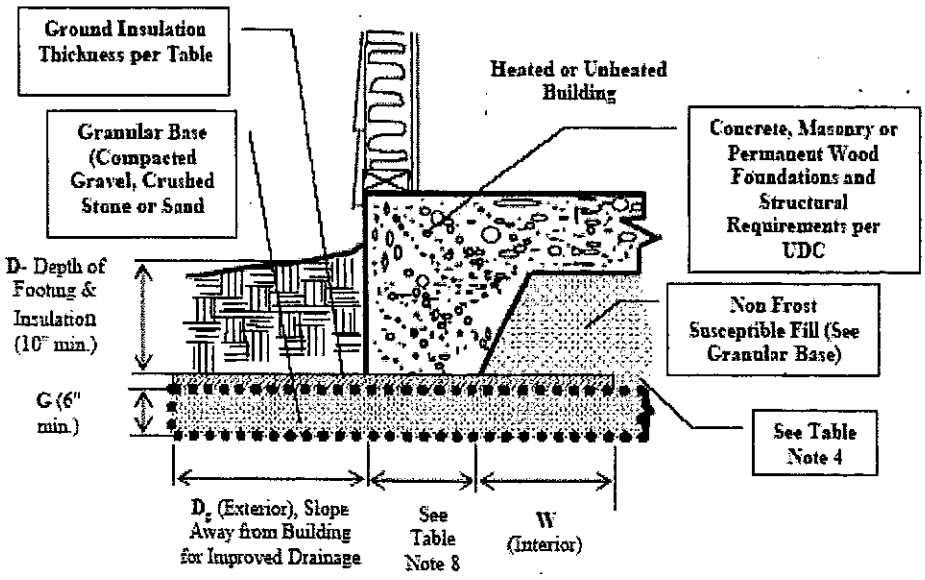
4 Ground insulation to the building interior can be extended beneath the entire slab where it is desired to protect the entire slab from frost heave action.

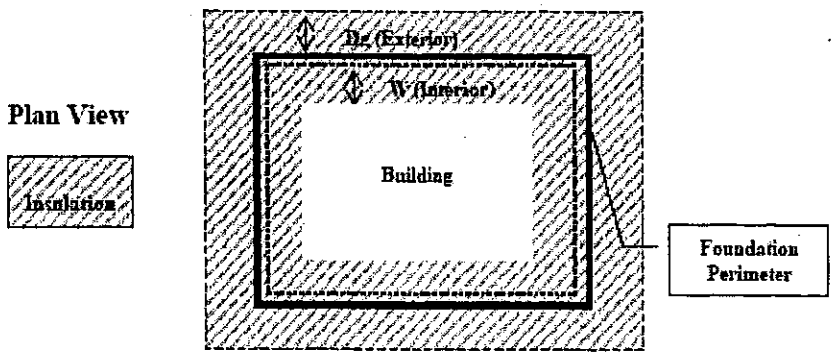
5 Ground insulation to the building interior can be in one horizontal plane (as shown in the detail) and covered with non frost–susceptible fill or the insulation maybe placed directly beneath the slab.

6 Insulation thickness recommendations are for extruded polystyrene (XPS) insulation.

7 The minimum depth of concrete footing and horizontal insulation is 10″. A 6″ drainage layer is required under the insulation.

8 Insulation placed directly beneath the footing shall be Type IV or Type VI XPS in accordance with ASTM C578. Maximum deadload placed on the Type IV insulation shall be 1200 pounds/square foot. Maximum deadload placed on Type VI shall be 1900 psf.





Heated Building Design

Minimum Insulation Requirements for Frost–Protected Footings in Heated Buildings[1]
(Simplified Method)

Air Freezing Index (°F days)[2] (see map)	Vertical Insulation R–Value[3, 4]	Horizontal Insulation R–Value [3, 5]		Horizontal Insulation Dimensions per Figure Below (inches)			Minimum Footing Depth (inches)
		Along walls	At corners	A	B	C	D
2,000 or less	5.6	NR	NR	NR	NR	NR	14
2,500 or less	6.7	1.7	4.9	12	24	40	16
3,000 or less	7.8	6.5	8.6	12	24	40	16
3,500 or less	9.0	8.0	11.2	24	30	60	16

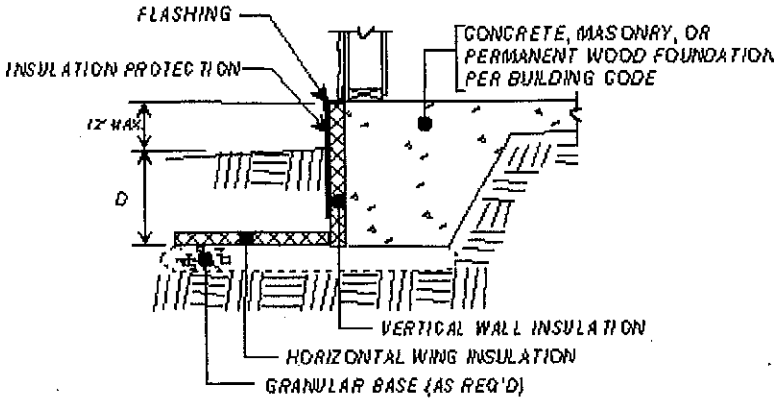
1 Insulation requirements are for protection against frost damage in heated buildings. Greater values may be required to meet energy conservation standards. Interpolation between values is permissible.

2 See AFI Contour Map for Air Freezing Index values.

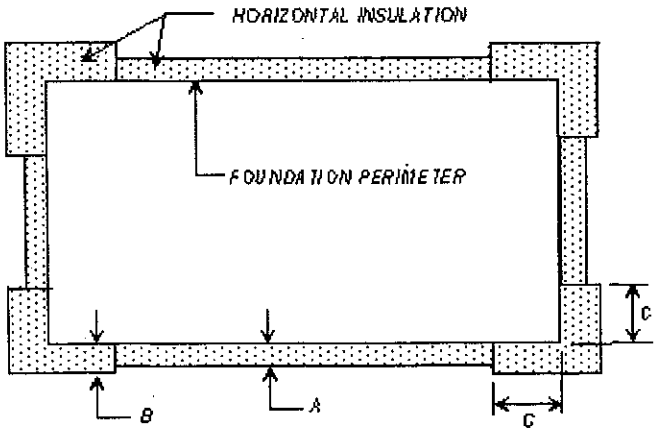
3 Insulation materials shall provide the stated minimum R–values under long–term exposure to moist, below–ground conditions in freezing climates. The following R–values shall be used to determine insulation thicknesses required for this application: Type II expanded polystyrene – 2.4R per inch; Types IV, V, VI, VII extruded polystyrene – 4.5R per inch; Type IX expanded polystyrene – 3.2R per inch. NR indicates that insulation is not required.

4 Vertical insulation shall be expanded polystyrene insulation or extruded polystyrene insulation.

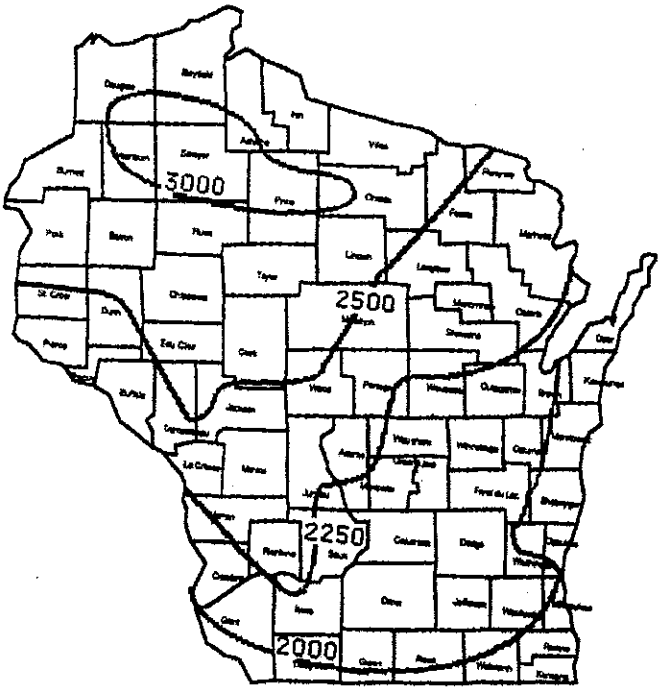
5 Horizontal insulation shall be extruded polystyrene insulation.



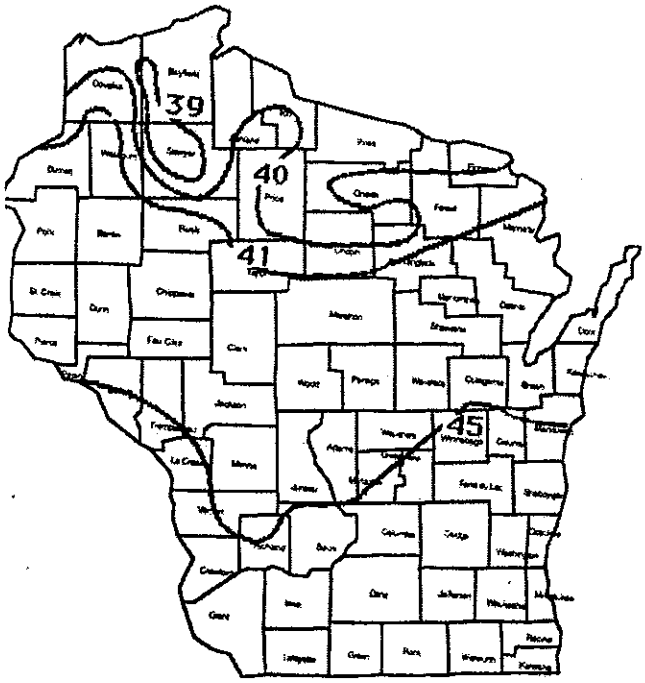
INSULATION DETAIL



INSULATION PLAN



Air-Freeze Index Contour Map

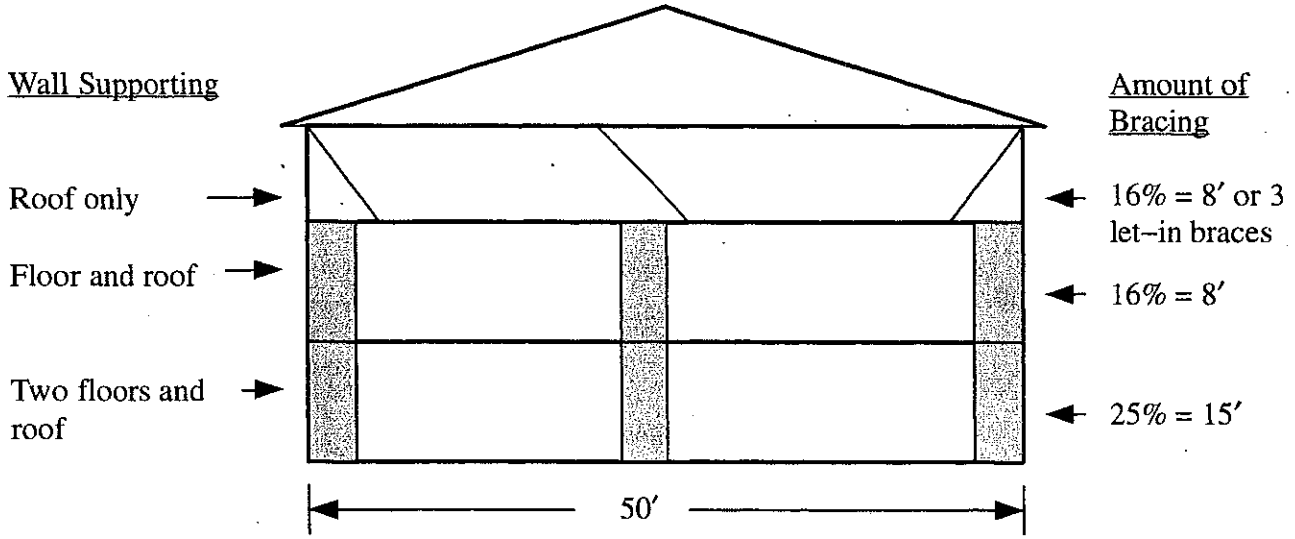


Mean Annual Temperature Contour Map

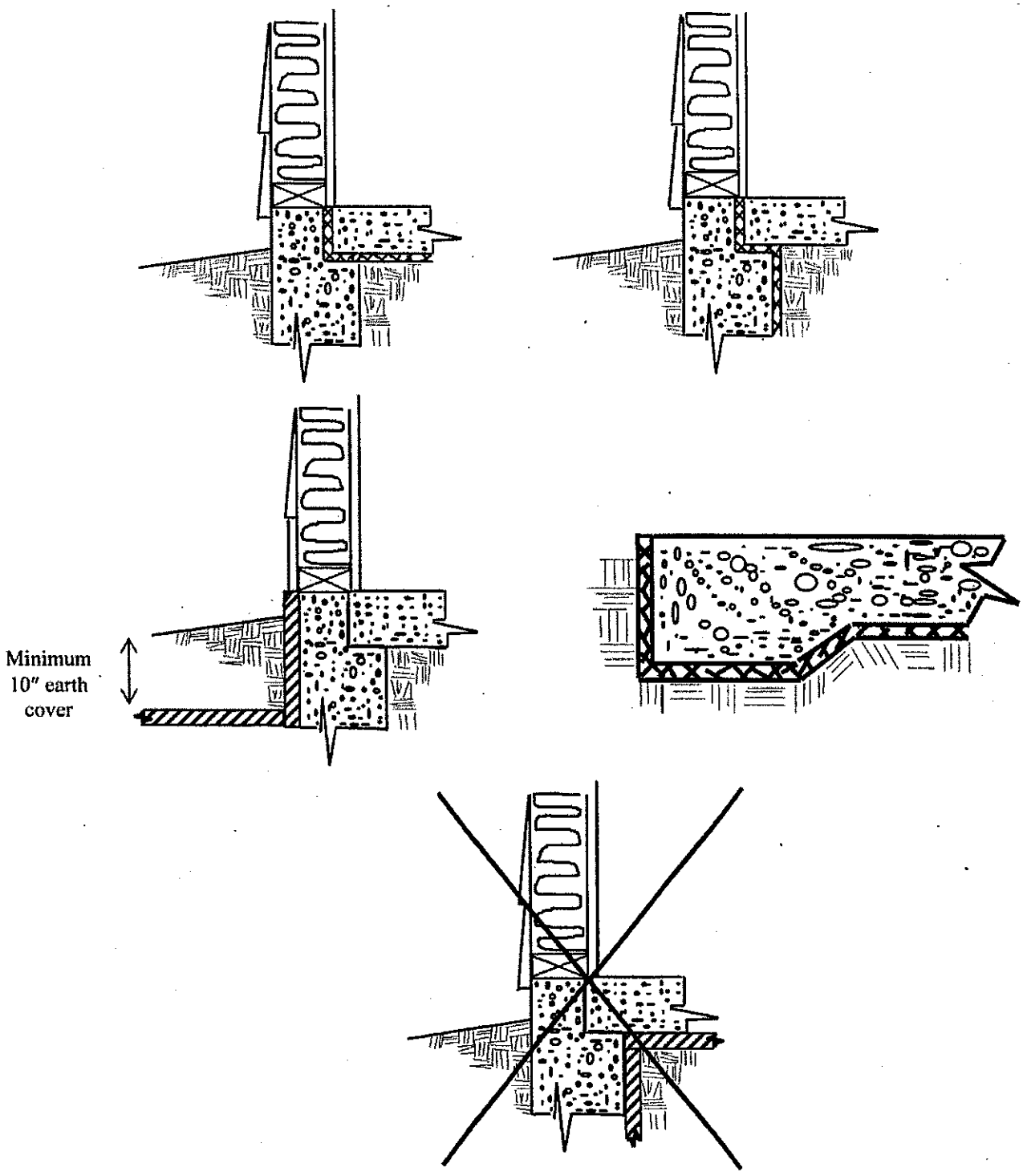
Appendix Fig. 21.25–E

Wall Bracing Example

(Wood Panel Sheathing and Let–in Bracing)



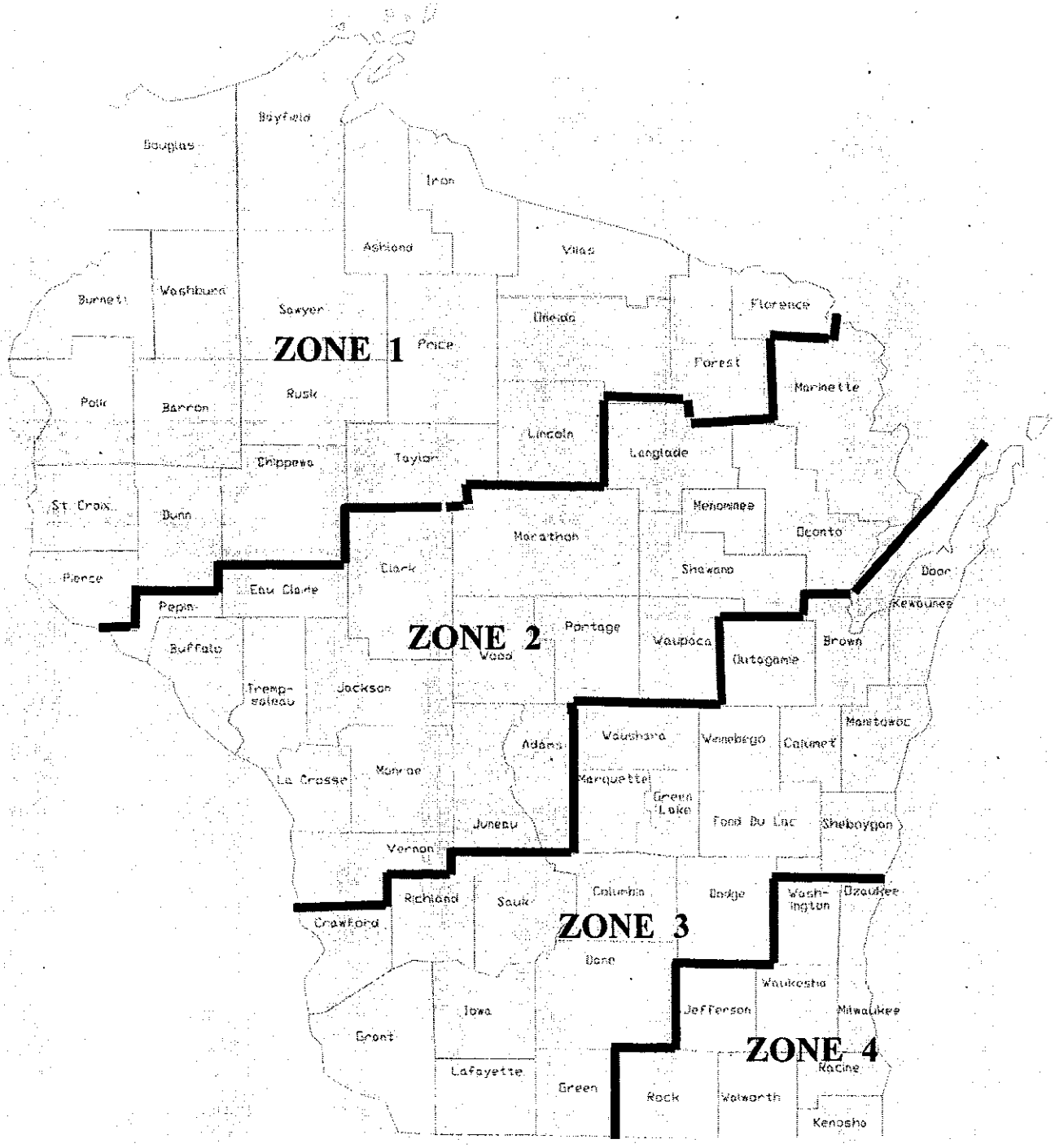
s. Comm 22.33
Slab-On-Grade Insulation Details



Insulation shall extend vertically and horizontally for a total of 48". In all cases the insulation shall insulate to the top edge of the floor perimeter. The last diagram is not an acceptable method. Additional insulation may be necessary to comply with the structural stability requirements of s. Comm 21.16 for frost-protected shallow foundations.

Comm 23.02 (1) Outdoor Design Temperatures

Zone 1	25° below zero F
Zone 2	20° below zero F
Zone 3	15° below zero F
Zone 4	10° below zero F



INDEX

See also first page of each chapter for listing of section headings

Comm Section(s) No.

A

ACCESS To crawl spaces 21.07
ACCESSORY BUILDING 20.05
Definition 20.07
ADMINISTRATION (Chapter Comm 20)
ADOPTION OF STANDARDS 20.24
AIR DISTRIBUTION SYSTEMS 23.07
AIR LEAKAGE 22.30
ALTERATIONS 20.04, 22.21
Definition 20.07
ALTERNATE MATERIALS 20.18
APPEALS 20.21
APPLICATION OF CODE 20.04
APPROVAL 20.09, 20.14, 20.15
Definition 20.07
ATTIC
Access 21.07
Definition 20.07
Insulation 22.32
Ventilation 21.05, 22.39

B

BASEMENT, Definition 20.07
BEAMS 21.22
Bearing (masonry) 21.26
Bond 21.26
BED AND BREAKFAST ESTABLISHMENTS . 20.04
BEST MANAGEMENT PRACTICES .. 20.07, 21.125
BOILER 23.04
BUILDING COMPONENTS 20.12, 20.13
Definition 20.07
BUILDING PERMIT 20.08, 20.09
Suspension/Revocation 20.11
BUILDING SYSTEM 20.12, 20.13
Definition 20.07

C

CEILING HEIGHT 21.06
CHIMNEYS 23.11
All–purpose 23.04
Connectors 23.15
Factory–built 21.32, 23.13
Masonry 23.12
CLEARANCES
Chimneys 21.30, 21.32, 23.12
Equipment 23.17
Fireplaces 21.29, 21.30, 21.32
Piping 23.10
Smoke pipes and stove pipes 23.15
Solid fuel–burning appliances 23.045

Comm Section(s) No.

COMBUSTION AIR 23.06
CONCRETE
Floors 21.20, 22.38
Footings 21.15
Foundations 21.18
Standards 20.24, 21.02
CONDENSATE DRAINS 23.156
CONTROLS
Fuel storage 23.16
Heating and ventilating equipment . 22.41, 22.45, 23.02
Safety 23.05
Temperature 22.41
Zone 22.41
COVERING
Dwelling envelope 22.10, 22.30, 22.31
Exterior wall 21.24, 22.10

D

DAMPERS 22.39, 23.09
DECAY (Protection against) 21.10
DECKS
Construction 21.225
Definition 20.07
DEFINITIONS 20.07, 22.10
DESIGN
Loads 21.02
Temperatures 22.40, 22.41
DOORS 21.03, 21.08
DRAINAGE
Drain tiles 21.17, 20.10
Garage 21.203
Grade 21.12
Roof 21.27
DUCT WORK 23.08
Insulation 22.42, 22.43, 22.44
DUMBWAITER 21.115
DWELLING, Definition 20.07

E

ELECTRICAL STANDARDS (Chapter Comm 24)
ELEVATOR 21.115
ENERGY CONSERVATION (Chapter Comm 22)
ENFORCEMENT ..... 20.06, Chapter Comm 5
ENVELOPE DWELLING ... 21.08, 22.20, 22.21, 23.08
EQUIPMENT (Heating, Ventilating & Air Conditioning)
Efficiencies 22.45
Heating 23.03, 23.04
Maintenance 23.065
Selection 22.41
EROSION CONTROL 20.07, 21.125

Comm Section(s) No.

EXCAVATIONS 21.13
EXEMPTIONS 20.05
EXHAUST 23.02
EXITS 21.03

F

FEES (See Chapter Comm 2)
FIREPLACES
Factory–built 21.32
Masonry 21.29
Stove 23.045
FIRE SEPARATIONS 21.08
FIRESTOPPING 21.08
FLASHING 21.25, 21.26
FLOORS
Concrete 21.20, 21.203
Loads 21.02
Precast 21.21
Slab 22.33
Wood floors in contact with ground 21.205
Wood frame 21.22
FLUE 23.11, 23.12, 23.15
Damper 23.15
FOOTINGS
Excavations 21.14
Size 21.15
Soil bearing 21.16
FOUNDATIONS 21.18
FROST PENETRATION 21.16
FUEL SUPPLY SYSTEMS 23.16
FURNACE Combustion air 23.06
Controls 23.05
Types 23.04, 23.045

G

GARAGES
Definition 20.07
Separations 21.08
GUARDRAILS 21.04

H

HABITABLE ROOM
Definition 20.07
HALLWAYS 21.03
HANDRAILS 21.04
HEADERS 21.25, 21.26
HEADROOM (Stairs) 21.04, 21.06
HEATING, VENTILATING & AIR CONDITIONING (Chapters Comm 22 & 23)

I

INNOVATIVE DESIGNS 20.02
Energy conservation 22.34, 22.36, 22.37, 22.41

Comm Section(s) No.

INSPECTION 20.10, 20.14
INSULATION 22.20, 22.21, 22.31, 22.32, 22.44, 23.08, 23.10
Foam plastic 21.11, 22.20

J

JOISTS 21.22
JURISDICTION 20.02, 20.06

L

LANDINGS 21.04
LANDSCAPING 20.02
LIGHT (Natural) 21.05
LINTELS 21.25, 21.26
LOADS (Structural) 21.02
LOCAL REGULATIONS 20.02, 20.06

M

MASONRY
Foundations 21.18
Walls 21.26
MODULAR HOMES AND COMPONENTS
Approval 20.14, 20.15
Insignia 20.14
Inspection 20.14
Installation 20.13
Reciprocity 20.14
Scope 20.12
Suspension/revocation of approval 20.16, 20.17
MOISTURE CONTROL 22.39

N

NOTCHING (Joists) 21.22, 21.27

P

PENALTIES 20.22
PERMIT TO START CONSTRUCTION 20.09
PIPING 23.10
Insulation 22.44, 23.10
PLANS 20.09, 20.14
PLUMBING (Chapter Comm 25)
PLYWOOD
Floors 21.22
Foundations 21.18
Roofs 21.28
Walls 21.25
PRECAST CONCRETE
Floors 21.21
Standards 21.02

R

RAFTERS 21.27
RAMPS 21.045
REGISTERS 23.09
RETROACTIVITY 20.02
RISERS 21.04

Comm Section(s) No.

ROOF
Designs 21.27
Loading 21.02
Wood framing 21.27

RULE VARIANCES 20.19

S

SAFETY GLAZING 21.05

SCOPE (Code) 20.02

SETBACK REQUIREMENTS 20.02

SMOKE DETECTION 21.09

SOIL BEARING 21.15

SOLAR DESIGN 22.35, 22.41

SOLID FUEL–FIRED WATER–HEATING APPLIANCE 23.04

SPIRAL STAIRS 21.04

STAIRS 21.04

STEEL
Beams 21.22
Standards 21.02

STRUCTURAL STANDARDS 21.02

T

TERMITES (Protection against) 21.10

TIES (Veneer) 21.26

Comm Section(s) No.

TREADS 21.04

TRUSSES 21.22, 21.27
Standards 20.24, 21.02

U

UNDER–FLOOR PLENUMS 23.08

V

VAPOR RETARDERS 22.34, 22.38

VARIANCES 20.19

VENTILATION 21.05, 22.39, 23.02
Mechanical 22.39

VENTS 21.05, 23.11, 23.13, 23.155

VIOLATIONS 20.22

W

WAIVERS 20.19

WALLS
Bracing 21.25
Design 21.23
Exterior covering 21.24
Foundation 21.18
Masonry 21.26
Water–resistive barrier 21.24
Wood frame 21.25

WINDERS 21.04

WINDOWS 21.05

WOOD–BURNING EQUIPMENT 21.29, 21.30, 21.32, 23.045