Decks

SPS 321.225 (1)
SPS 321.225 (2) AKA Appendix B & C
SPS 321.225 DECKS

(1) Decks attached to dwellings and any detached decks that serve an exit shall comply with the applicable provisions of subchs. II to X of ch. SPS 321, including all of the following:
(a) Excavation requirements under s. SPS 321.14;
(b) Footing requirements under s. SPS 321.15 (2) (f);
(c) Frost penetration requirements under s. SPS 321.16;
(d) Load requirements under s. SPS 321.02;
(e) Stair, handrail and guard requirements of s. SPS 321.04.
(f) Decay protection requirements of s. SPS 321.10.

(2) A deck that complies with the standards in ch. SPS 325 Appendix B, and ch. SPS 325 Appendix C, if applicable, shall be considered as complying with sub. (1).
What Will Be Covered

- Common Misconceptions
- Flashing
- SPS 321.225 (1)
- Calculate Footing Size (I.e. Sonotube®)
- SPS 321.225 (2)= Appendix B
- Deck Fails In The News (Time Permitting)
Common Misconceptions

- Ledger Board Attachment
- Ledger Board Connection
- Architect/Engineer Stamp
- Lateral Support
- Decks & Exit Path
- Detached Decks
- Treated Lumber

TRUE
FALSE
Ledger Board Attachment

SPS 321.02

“If I use the old method, I can attach my ledger board to a masonry veneer or chimney or a house overhang.”

NO

These items are not designed for additional loads.
Ledger Board Attachment

June 29, 2003
Inspections showed the lag bolts were actually bent (ASHI Reporter/ANNE W. WEST)
Ledger Board Connection

SPS 321.02

“Nailing a ledger board is fine, I’ve been doing this for years.”
Ledger Board Connection
Architect / Engineer Stamp

SPS 321.02
“All I need is my deck plan stamped by an architect or engineer & I’m good to go.”

Everyone must provide proper structural analysis along with the plans submitted.

You are not required to have an architect or engineer design your deck. SPS 320.09(6)(c)*
Lateral Support

SPS 321.02

“If I use the old method, I don’t need to provide lateral support!”
Decks in Exit Path

**SPS 321.03**

“I have my two required exits for my house, my deck doesn’t need to comply with the code for my third exit.”

SPS 321.03 does **not** say label 2 doors as exits & the rest of the doors are exempt! All exterior doors leading to decks must meet SPS 321.225.
Detached Decks

SPS 321.15(2) (f)

Detached decks which serve an exit shall be supported on a structural system designed to transmit and safely distribute the loads to the soil.
**Treated Lumber**

**SPS 321.10**

“As long as the lumber is treated I can use it anywhere on my deck!”

- **UC3B**-Exterior construction, above ground*
- **UC4A**-Ground contact

- **SPS321.10(1)(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.
- **SPS321.10(2)(j)** Any structural part of an outdoor deck, including the decking is applicable.
<table>
<thead>
<tr>
<th>Decks</th>
<th>Decking (Painted/Unpainted) Joists and Beams(^1) Railing Components</th>
<th>Above Ground, Exterior</th>
<th>UC3B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Joists and Beams(^1) Support Posts (Sawn)</td>
<td>Ground Contact or Fresh water</td>
<td>UC4A</td>
</tr>
</tbody>
</table>

\(^1\) Joists and beams shall be treated to requirements for UC4A when they are difficult to maintain, repair or replace and are critical to the performance and safety of the entire system/construction.
The following sawn components for exterior above ground use shall be treated to Ground Contact UC4A or higher requirements:

a) When there is a reasonable expectation that soil, vegetation, leaf litter or other debris may build up and remain in contact with the component.

b) When the construction itself, other structures or anticipated vegetation growth will not allow air to circulate underneath the construction and between decking boards.

c) When components are installed less than six inches above ground (final grade after landscaping) and supported on permeable building materials (e.g. treated wood or concrete).

d) When components are in direct contact with non-durable untreated wood, or any older construction with any evidence of decay.
The most dangerous phrase in the language is “we’ve always done it this way.”

United States Navy Rear Admiral Grace Hopper
One Deck, So Many Issues

-Attached to House overhang
-Ledger board nailed to house
-Hangers nailed w/ roofing nails
-Joists not nailed into hangers

-End joists not hangered at all
-Beam attached by nails next to posts
-Guess what was placed on top of it?
SPS 321.24 (3) FLASHING(d) 5. Where porches, decks or stairs attach to a wall or floor assembly of wood frame construction.
Sill Flashing at Sliding Glass Door

- Seal all penetrations through pan
- Caulk/sealant between frame and flashing
- Sill or pan flashing counter-flashes deck flashing and/or weather resistive-barrier protecting wall below
- Caulk/sealant or solder between pan flashing and deck flashing
- Deck flashing
No Flashing, Improperly Flashed

What could possibly go wrong?
SPS 321.225 (1)

(1) Decks attached to dwellings and any detached decks that serve an exit shall comply with the applicable provisions of subchs. II to X of ch. SPS 321, including all of the following:

(a) Excavation requirements under s. SPS 321.14;
(b) Footing requirements under s. SPS 321.15 (2) (f);
(c) Frost penetration requirements under s. SPS 321.16;
(d) Load requirements under s. SPS 321.02;
(e) Stair, handrail and guard requirements of s. SPS 321.04.
(f) Decay protection requirements of s. SPS 321.10.
Egress Windows

**321.03(6)(f)** An egress window under a deck or porch shall discharge through a clear path of at least 36 inches in height and 36 inches in width, and no more than 15 feet in length, to a yard or open space.

**Wisconsin Statute 182.0175**
Contact Diggers Hotline before any digging that disrupts the ground’s surface.
(Private lines are the owner’s responsibility)
Joist, Beams & Posts

SPS 321.02

- Joists and Beams
  - Proper documentation for sizing. “This is how we’ve always done it”, doesn’t work.
  - UDC, NDS 2015?
  - Adjustments for wet location, or incising as needed?

- Southern Pine most popular joists for decks in big box stores. Southernpine.com has their own wet location span chart.

- Posts
  - Post sized for deck height & load?
  - Lateral bracing needed?
Deck Loads
SPS 321.02

- Deck loads, need to include all concentrated loads.
  - Hot tubs, pools, planters, large grills, built-in seating, large gatherings, etc.?
  - Most hot tub MFRs will list the P.S.F. in their manuals, can range 75 - 150 P.S.F.

Sample from manufacturer

If you are installing your spa on an elevated wood deck or other structure, it is highly recommended that you consult a structural engineer or contractor to ensure the structure will support the weight of 150 pounds per square foot (732 kg / m²).

To properly identify the weight of your new spa when full, remember water weighs 8.33 lbs. per gallon, or 1 kg per liter. For example, an average 8’ spa holds approximately 500 gallons, or 1892 liters, of water. Using this formula, you will find that the weight of the water alone is 4,165 lbs, or 1892 kg. Combined with the dry weight of the spa you will note that this spa will weigh approximately 5,000 lbs, or 2267 kg, when full of water.
Stairs, Guards & Railings
SPS 321.04

- 3 or more stairs require a handrail.
- Decks over 24” require guards on all open sides.
Deck Design Programs

Internet sites & big box stores will “design” a deck for you.

Can/should they be used?
Calculating Footing Size

Tube form MFRs (Sonotube®, Quik tube®, etc.) do not supply what loads can be supported solely by their forms.

Tubes large enough for loads & soil conditions?

Will they require footings?
Sizing Footings

Footing Size

Deck Layout
Locate footings, beams, overhangs & dimensions

Tributary Area Example

Loading
Live load = 40 PSF
Dead load = 30 PSF
Other = ______ PSF
Total load = ______ PSF

Soil Bearing = ______ PSF
*Note: greater than 2,000 PSF must be verified
Pounds per square foot

Tributary Area
(See Example on Right)
Corner footing = ______ 
Intermediate footing = ______

Round footings:
$\sqrt{\text{area}} \times \pi = \text{diameter of footing}$
$\sqrt{\text{length of each side}} = \text{length of each side}$

Square footings:
$\text{Corner} = \frac{\text{diameter}}{2}$
$\text{Intermediate} = \frac{\text{diameter}}{2}$

Footing thickness:
$\left(\frac{\text{Diameter} - \text{length} - \text{post width}}{2}\right) = \text{thickness}$

Footings may be less than 5" thick

Footings Thickness
FOOTING THICKNESS CAN NOT BE SMALLER THAN THIS DIAMETER

Footings Thickness

Notes:
- Footings may be less than 5" thick
Label Plan

Label:
- Deck Size
- Beam(s)
- Post Location(s)
- Overhang(s)
Tributary Area Example

Split distance between the beam & the house in half

This half supported by the ledger

70  100  70

Split distance between the posts in half

2'-0"  10'-0"  10'-0"  2'-0"

Corner

Include Overhangs

2'-0"+8'-0"=10

7

2'-0"+5'-0"=7

Intermediate

2'-0"+8'-0"=10

10

5'-0"+5'-0"=10

= 70 Area

= 100 Area
**Tributary Load**

Any additional loads?

---

**Loading**

Live load = 40 PSF  
Dead load = 10 PSF  
Other = 50 PSF  
Total load = ___50___ PSF

Soil Bearing = ___2,000___ PSF

*Soils greater than 2,000 PSF must be verified*

PSF = pounds per square foot

---

**Tributary Area**

(See Example on Right)

Corner Footing

\[10 \times 7 = 70\]

Intermediate Footing

\[10 \times 10 = 100\]

---

**Tributary load**

Tributary area x total load = tributary load

Use this formula for tube forms, i.e. Sonotubes®

Tributary area x total load \[+150\left(\frac{\pi d^2h}{6912}\right)\] = tributary load

Corner footing

\[70 \times 50 \times 150\left(\frac{\pi 18^2 48}{6912}\right) = 4,560.3\]

Intermediate footing

\[100 \times 50 \times 150\left(\frac{\pi 18^2 48}{6912}\right) = 6,060.3\]
# Footing Size

## Footing Area

<table>
<thead>
<tr>
<th>Footing Area</th>
<th>[ \text{In}^2 = \text{inches squared} ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tributary load ÷ Soil bearing = Load PSF × 144 (change to square inches) = Area in [ \text{In}^2 ]</td>
<td></td>
</tr>
<tr>
<td>Corner footing</td>
<td></td>
</tr>
</tbody>
</table>
| \[
\frac{4560.3}{2000} = 2.28 \times 144 = 328.32 \text{ Area in } \text{In}^2
\] |
| Intermediate footing |
| \[
\frac{6060.3}{2000} = 3.03 \times 144 = 436.32 \text{ Area in } \text{In}^2
\] |

## Round Footings

<table>
<thead>
<tr>
<th>Round footings</th>
<th>[ \pi = 3.1416 ]</th>
</tr>
</thead>
<tbody>
<tr>
<td>[ 2 \times \sqrt{\text{area}} \div \pi = \text{diameter of footing} ] (round to nearest inch)</td>
<td></td>
</tr>
<tr>
<td>Corner</td>
<td></td>
</tr>
<tr>
<td>[ 2 \times \sqrt{328.32} \div \pi = 20 \text{ inches} ]</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
</tr>
<tr>
<td>[ 2 \times \sqrt{436.32} \div \pi = 24 \text{ inches} ]</td>
<td></td>
</tr>
</tbody>
</table>

## Square Footings

<table>
<thead>
<tr>
<th>Square footings</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>[ \sqrt{\text{area}} = \text{length of each side} ] (round to nearest inch)</td>
<td></td>
</tr>
<tr>
<td>Corner</td>
<td></td>
</tr>
<tr>
<td>[ \sqrt{328.32} = 18 \text{ inches} ]</td>
<td></td>
</tr>
<tr>
<td>Intermediate</td>
<td></td>
</tr>
<tr>
<td>[ \sqrt{436.32} = 21 \text{ inches} ]</td>
<td></td>
</tr>
</tbody>
</table>
Footing Thickness

Footing thickness²

\[(\text{Diameter or length} - \text{post width}) \div 2 = \text{thickness}\] (in inches)

\[\frac{24 - 18}{2} = 3.8\text{ inches}\]

Note: Footings may not be less than 8” thick

²Footing thickness formula from American Wood Council. 
Appendix B
A break down for the eyes of a novice

- **Considerations** (When using Appendix B)
- **Where to Start?** (Structural Features)
- **Deck Plan Checklist**
- **Construction** (Time Permitting)
- **Inspections** (Time Permitting)
Considerations

- Concentrated loads max 40 SPF
- Single span joists only
- Max Joist length for tables 16”-0”

*Table 1 footings only allows a maximum joist length of 16’ including overhangs. Joist spans exceeding this must be designed through structural analysis.

NOTE: Max Joist length = 27’*
Using 2x12 joists @ 12” o.c. w/overhangs & Deck is free standing
Where To Start?

Structural Features
1. Deck Size
2. Joists: size, length, spacing, overhang
3. Beam: size, length, overhang
4. Footing: size, spacing
5. Lateral Support
6. Decking

*Will deck be:
- Attached
- Free standing
Joists

- Pick the type of lumber you want to use
- Find Length or close to it on Table 4
- Need/want overhangs?
  \[ 0.25 \times \text{joist span} = \text{Max overhang per Figures 5 & 7} \]

<table>
<thead>
<tr>
<th>Joist Spacing (on center)</th>
<th>Joist Size</th>
<th>Douglas Fir/Larch, Hem/Fir, SPF$^2$</th>
<th>Southern Pine</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Without Overhang</td>
<td>With Overhangs</td>
</tr>
<tr>
<td>12''</td>
<td>2''x6''</td>
<td>9'–1''</td>
<td>8'–1''</td>
</tr>
<tr>
<td></td>
<td>2''x8''</td>
<td>12'–6''</td>
<td>9'–5''</td>
</tr>
<tr>
<td></td>
<td>2''x10''</td>
<td>15'–8''</td>
<td>13'–7''</td>
</tr>
<tr>
<td></td>
<td>2''x12''</td>
<td>18'–0''</td>
<td>18'–0''</td>
</tr>
<tr>
<td>16''</td>
<td>2''x6''</td>
<td>8'–3''</td>
<td>8'–0''</td>
</tr>
<tr>
<td></td>
<td>2''x8''</td>
<td>11'–1''</td>
<td>9'–5''</td>
</tr>
<tr>
<td></td>
<td>2''x10''</td>
<td>13'–7''</td>
<td>13'–7''</td>
</tr>
<tr>
<td></td>
<td>2''x12''</td>
<td>15'–9''</td>
<td>15'–9''</td>
</tr>
<tr>
<td>24''</td>
<td>2''x6''</td>
<td>6'–9''</td>
<td>6'–9''</td>
</tr>
<tr>
<td></td>
<td>2''x8''</td>
<td>9'–1''</td>
<td>9'–1''</td>
</tr>
<tr>
<td></td>
<td>2''x10''</td>
<td>11'–1''</td>
<td>11'–1''</td>
</tr>
<tr>
<td></td>
<td>2''x12''</td>
<td>12'–10''</td>
<td>12'–10''</td>
</tr>
</tbody>
</table>

1Spans are based on 40 psf live load, 10 psf dead load, normal loading duration, wet service conditions, and deflections of $\Delta = L/360$ for main span and $L/180$ for overhang with a 220 lb. point load.

2Incising is assumed.
Beam

- Table 3A & 3B
- Pick the type of lumber you want to use
- Locate your joist span & pick a beam size
- Need/want overhangs?
  \[ .25 \times \text{joist span} = \text{Max overhang} \] (Tables 3A & 3B)
  (The longer the span length the larger the footing)

<table>
<thead>
<tr>
<th>Joist Span</th>
<th>(Number of Plies)</th>
<th>Beam Size$^2$ – Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(2) 2x6</td>
<td>(2) 2x8</td>
</tr>
<tr>
<td>≤ 6’</td>
<td>6’–11”</td>
<td>8’–9”</td>
</tr>
<tr>
<td>≤ 8’</td>
<td>5’–11”</td>
<td>7’–7”</td>
</tr>
<tr>
<td>≤ 10’</td>
<td>5’–4”</td>
<td>6’–9”</td>
</tr>
<tr>
<td>≤ 12’</td>
<td>4’–10”</td>
<td>6’–2”</td>
</tr>
<tr>
<td>≤ 14’</td>
<td>4’–6”</td>
<td>5’–9”</td>
</tr>
<tr>
<td>≤ 16’</td>
<td>4’–3”</td>
<td>5’–4”</td>
</tr>
<tr>
<td>≤ 18’</td>
<td>4’–0”</td>
<td>5’–0”</td>
</tr>
</tbody>
</table>

$^1$Spans are based on 40 psf live load, 10 psf dead load, normal loading duration, wet service conditions, and deflections of $\Delta = L/360$ for main span and $L/180$ for overhang with a 220 lb. point load.

$^2$Beam depth must be equal to or greater than joist depth if joist hangers are used (see Figure 8, Option 3).
Footings

- Total joist length 16’-0”
- Posts @ 6’-0” apart

Table 1

<table>
<thead>
<tr>
<th>Footing Size</th>
<th>Post Spacing (Measured Center to Center)</th>
<th>4’</th>
<th>5’</th>
<th>6’</th>
<th>7’</th>
<th>8’</th>
<th>9’</th>
<th>10’</th>
<th>11’</th>
<th>12’</th>
<th>13’</th>
<th>14’</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corner Footing</td>
<td>8</td>
<td>9</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
</tr>
<tr>
<td>Intermediate Footing</td>
<td>10</td>
<td>11</td>
<td>12</td>
<td>13</td>
<td>14</td>
<td>15</td>
<td>16</td>
<td>17</td>
<td>18</td>
<td>19</td>
<td>20</td>
<td>21</td>
</tr>
<tr>
<td>Footing Thickness</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

1All footing sizes are base diameters.

2For square footings, insert the diameter (d) into the following formula: √(d/2² × p). This number will give you the square dimension & must be rounded up to the nearest inch.

3Joist length is the joist span plus any overhang beyond a beam. See section 5.4.
Lateral Support

- Decks over 24” above grade require lateral support*

*Exceptions to be discussed later
Decking

- Types of Decking:
  - 2x4s & 2x6s
  - five−quarter span−rated decking boards
  - Wood−plastic−composite
  - Plastic decking requires professional testing organization testing to support 40LL psf & installed per MFR

Decking: 45° or 90° To Joists?
Deck Example Summary

- Deck size: 20'-0" x 16'-0"
- Joists: Southern Pine 2x10 @ 16" o.c. w/ 2' overhangs
- Beam: Southern Pine (2) 2x10 w/ 1'-0" overhangs
- Footings: 19" diameter & 8" thick
- Posts: 6x6 @ 6'-0" apart
- Decking: 2x6 @ 45°
- Attached to house
- 4'-0" above grade
Typical Framing Plan

Can use this or make your own
Sample Framing Plan

Figure 35
TYPICAL DECK FRAMING PLAN

- ledger board
- tension-ties at end joist and first inside joist
- end joist
- rim joist
- diagonal bracing
- beam
- joist hanger
- footing

Dimensions:
- Joist span: 14'-0"
- Overhang: 2'-0"
- Beam span: 6'-0"
- Joist: 1'-0"
- Total width: 20'-0"
Sample Checklist

Decking:  □ 2x4  X 2x6  □ five-quarter board  □ wood-plastic composite (per ASTM D 7032)  □ Other decking, evaluation report number:____

Joists:  size:  □ 2x6  □ 2x8  X 2x10  □ 2x12  spacing:  □ 12 in.  X 16 in.  □ 24 in.
    joist span dimension:  14 ft. – 0 in.
    overhang:  X Yes  □ No  overhang dimension:  2 ft. – 0 in.
    rim joist:  □ 2x6  □ 2x8  X 2x10  □ 2x12

Beam(s):  number of plies:  X 2  □ 3  size:  □ 2x6  □ 2x8  X 2x10  □ 2x12
    overhang:  X Yes  □ No  overhang dimension:  1 ft. – 0 in.

Posts:  size:  □ 4x4  □ 4x6  X 6x6  height:  3 ft. – 6 in.

Footings:  size:  19 in.  □ square  X round  thickness:  8 in.

Ledger:  ledger board size:  □ 2x8  X 2x10  □ 2x12  □ Not applicable (free-standing deck)
    fastener:  □ Through bolt  X Lag screw  □ Wood screw
    □ Expansion anchor  □ Adhesive anchor

Lateral support:  □ Tension-tie  X Diagonal bracing, size:  □ 2x
    (not permitted for free-standing deck)

Deck size:  L= 16 ft. – 0 in.  W= 20 ft. – 0 in.
Construction

The Rest of Appendix B
Section 1: General requirements

- Lumber
- Wood-Plastic Components
- Fasteners
- Hardware
- Electrical Requirements
- Loading
- Safety Glazing

ASTM D7032

SPS 321.04(3)c.
SPS 321.05(3)

NEC 210.52(E)(3)
Lumber

- Douglas fir/larch
- Hemlock/fir
- Spruce/pine/fir (SPF)
- Southern pine,
- Must be grade #2 or better

Appendix C Adds:
- Ponderosa Pine
- Red Pine
- Redwood

Must be pressure treated & ground contact when needed
Hardware & Fasteners

- Nails must be threaded: Spiral-Grooved or Ring-Shanked
- Lag-Screws
- Carriage-Bolt w/ washer @ bolt head (substitute for through-bolts)
- Fasteners & hardware must be same material, galvanized steel or stainless steel
Section 2: Footings, & Post Connections

- Concrete
- Footings
- Attachments
- Connections

Concrete min. 3,000 pounds per in$^2$ (compressive strength)
Footings, & Post Connections

Post Attachment Figure 1, plus expansion anchors

1" min. base plate* unless ground contact lumber used

Expansion Anchors are permitted

*MFRs may require min. edge distance
Footings

- Post over middle 1/3 of footing
- Footings min 48” below grade or frost line whichever is greater
- Not on unprepared fill material, organic soil, alluvial soil, or mud
- Bearing capacity of the soil at least 2,000 PSF

Example:
12” footing
12/3 = 4” size of middle 1/3 of footing

Place anywhere in this circle
Free-Standing Deck Footings

Footings prohibited over utility lines or service pipes

existing house foundation wall

when less than 5’, footings must be at same elevation as existing house footing
Beam Splices Require Min. 6”x6” Posts

Table 2
MAXIMUM POST HEIGHT

<table>
<thead>
<tr>
<th>Post Size</th>
<th>Maximum Height</th>
</tr>
</thead>
<tbody>
<tr>
<td>4”x4”</td>
<td>6’</td>
</tr>
<tr>
<td>4”x6”</td>
<td>8’</td>
</tr>
<tr>
<td>6”x6”</td>
<td>14’</td>
</tr>
</tbody>
</table>
Post-Beam-Connection

• Toe-nailing prohibited
• Post caps per MFR specs
• Recommended to field-treat cut-ends of posts with wood preservative
Section 4: Beams

- Multiple 2x members for a beam, see Figure 4.
- Pressure-preservative-treated glulam beams require design and plan submission with permit application.

**Figure 4**

**BEAM ASSEMBLY**

If a beam is constructed with three-plies, attach each outside member to the inside as shown herein.

16d nails or #12 x 3” wood screws, staggered in 2 rows

2 fasteners at each end and at splice ends

16” typical fastener spacing
Section 5: Joists

Full Height 2x blocking/bridging for 2”x10” or deeper joists ≤ 8 feet apart.

Blocking above beam, can reduce up to 60% of height for drainage.

Attach blocking/bridging with (3)10d toe-nails at each end.
Rim Joists

- Continuous rim joist per Figures 5 and 7 unless blocking or bridging each joist at the beam where overhang begins.

- Attach rim joist to end of each joist with (3)10d nails or (3)#10 by 3-inch wood screws.
Section 6: Joist-To-Beam Connection

Figure 8
JOIST–TO–BEAM CONNECTIONS

OPTION 1
(3)8d toe nailed or
(3)#10 wood screws
(two on one side, one
on the other)

OPTION 2
mechanical
fastener or
hurricane clip

OPTION 3
top of beam and joist
must be at same
elevation

Joist hanger

Note: Option 1 is not allowed on free-standing decks.
Section 7: Joist Hangers

1. Joist–hanger depth, at least 60% of joist depth.
2. MFR width of joist hanger must match number of plies.
3. Do not bend hanger flanges to fit field conditions.

Hanger Min. 60% of Joist depth

![Figure 9: JOIST HANGERS](image)

<table>
<thead>
<tr>
<th>Table 5: JOIST HANGER DOWNLOAD</th>
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</thead>
<tbody>
<tr>
<td>Joist Size</td>
</tr>
<tr>
<td>2”x6”</td>
</tr>
<tr>
<td>2”x8”</td>
</tr>
<tr>
<td>2”x10”</td>
</tr>
<tr>
<td>2”x12”</td>
</tr>
</tbody>
</table>
Joist Hangers

- Flange bent for angle of deck
- Wrong hanger type
- 3 ply beam, 2 ply hanger
- Angles cannot be used instead of hangers
Section 8: Ledger Attachments

- Follow Section 8 & 9 for ledger board attachment to existing houses.
- Ledger-board depth $\geq$ joist depth & min. 2x8.
- Existing band board on house must be able to support deck. If not, free-standing deck or engineered design.
- Top of ledger board & top of deck joists must flush.
- Metal-plate-connected wood floor trusses used in house, see section 6 of Appendix C.
Figure 11

ATTACHMENT OF LEDGER BOARD TO BAND BOARD OR BAND JOIST

Note the Continuous flashing with drip edge.
Figure 12

ATTACHMENT OF LEDGER BOARD TO SOLID FOUNDATION

to resist corrosion and decay, this area should be caulked

deck joist

1/2" diameter expansion anchors with washers

edge distance per manufacturer

concrete or solid masonry wall

embedment distance per manufacturer

joist hanger

2x ledger board
Figure 13

ATTACHMENT OF LEDGER BOARD TO HOLLOW FOUNDATION

to resist corrosion and decay, this area should be caulked

dock joist

\(\frac{1}{2}\) diameter approved adhesive anchors with washers

edge distance per manufacturer

hollow masonry wall

embedment distance per manufacturer

8” block wall minimum

2x ledger board

joist hanger
Flashing

Remove exterior finish, before installing ledger board.

Continuous flashing with drip edge per Figure 11.
Flashing must be a corrosion-resistant metal such as:
- **galvanized steel** coated with zinc
- **copper** (attached using copper nails only)
- **stainless steel**
- **UV-resistant plastic** per MFR recommendations

Do not use aluminum in direct contact with lumber treated with preservatives that contain copper, I.e. ACQ, copper azole, or ACZA.
Section 9: Ledger-Board Fasteners

Figure 15
LEDGER BOARD FASTENER SPACING AND CLEARANCES

Lead anchors are prohibited

Prohibited Attachments
Through-Bolts

- 1/2” diameter with washers at bolt head & nut.
- Bolts should be tightened 6 to 12 months after construction due to drying and wood shrinkage.

With ½” stacked washers
Expansion Anchors

- Bolt or threaded rod of expansion anchors 1/2 inch, which in some cases may result in needing a 5/8 inch–diameter anchor.
- Expansion anchors installed in accordance with manufacturer’s instructions & have washers.
Adhesive Anchors

- Approved adhesive anchors with 1/2 inch–diameter threaded rod.
- Anchor examples: Epcon Acrylic 7 by ITW Ramset/Red Head, & HY–20 by Hilti.
- Adhesive anchors also permitted with concrete or solid masonry installations.
- Adhesive anchors installed in accordance with manufacturer’s instructions & have washers.
- Adhesive cartridges should remain on the jobsite for inspector verification.
Lag Screws

Lag screws must be equipped with washers.

Figure 16
LAG SCREW

- 1\(\frac{1}{2}\)" dia.
- 1\(\frac{1}{2}\)" shank (no threads)
- Length must extend through existing band board
- Screw must penetrate beyond band board a minimum of 1\(\frac{1}{2}\)"
Table 6
LEDGER BOARD FASTENER SPACING, ON CENTER$^{1,2,3}$

<table>
<thead>
<tr>
<th>Fastener</th>
<th>Band Board</th>
<th>Joist Span:</th>
<th>less than or equal to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>6’</td>
<td>8’</td>
</tr>
<tr>
<td>Lag screws</td>
<td>1” EWP</td>
<td>24”</td>
<td>18”</td>
</tr>
<tr>
<td></td>
<td>1 1/8” EWP</td>
<td>28”</td>
<td>21”</td>
</tr>
<tr>
<td></td>
<td>2x Lumber</td>
<td>30”</td>
<td>23”</td>
</tr>
<tr>
<td>Through-Bolts</td>
<td>1” EWP</td>
<td>24”</td>
<td>18”</td>
</tr>
<tr>
<td></td>
<td>1 1/8” EWP</td>
<td>28”</td>
<td>21”</td>
</tr>
<tr>
<td></td>
<td>2x Lumber</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>Through-Bolts with ½” stacked washers$^{4,5}$</td>
<td>2x Lumber</td>
<td>36”</td>
<td>36”</td>
</tr>
<tr>
<td>Adhesive anchors</td>
<td>—</td>
<td>32”</td>
<td>32”</td>
</tr>
</tbody>
</table>

1. These values are valid for deck ledgers consisting of douglas fir/larch, hem/fir, or southern pine; and for band boards consisting of douglas fir-larch, hem-fir, spruce-pine-fir, southern pine, or engineered wood product (EWP).

2. Where solid-sawn pressure-preservative-treated deck ledgers are attached to engineered wood products (minimum 1” thick wood structural panel band joist or structural composite lumber including laminated veneer lumber), the ledger attachment must be designed in accordance with accepted engineering practice. These tabulated values are in accordance with that practice and are based on 300 lbs and 350 lbs for 1” and 1 1/8” EWP rim board, respectively.

3. The thickness of the sheathing over the band board must not exceed 15/32”.

4. The maximum gap between the face of the ledger board and face of the wall sheathing is 1/2”.

5. Wood structural panel sheathing, gypsum board sheathing, or foam sheathing is permitted between the ledger board and the band board. Stacked washers are permitted in combination with wood structural panel sheathing, but are not permitted in combination with gypsum board or foam sheathing. The maximum distance between the face of the ledger board and the face of the band board is 1”. 
Section 11: Lateral Support

Decks over 24 inches above grade must resist lateral loads.

Individual diagonal braces may be omitted if less than 2' of vertical clearance.
Diagonal Bracing

- Diagonal bracing both parallel & perpendicular to beam at each post.
- When parallel to beam, bolt bracing to post & beam.
- When perpendicular to beam, bolt bracing to post & a joist or blocking between joists.
Lateral Support Exception 1

• Bracing is not required perpendicular to the house for a deck that is attached to the house with both a ledger board under sections 8 and 9 and the connection specified in either Figure 19 or 20.

Section 8: Ledger Attachments (includes flashing)
Section 9: Ledger-Board Fasteners
And either:
Figure 19: Tension-Tie Connection, W/ Ledger Board
Or:
Figure 20: Hold-Down Tension Device, W/ Ledger Board
Lateral Support Exception 2

- Free-standing deck attached to the house per Figure 21, bracing parallel to the house may be omitted at the beam adjacent to the house.

Figure 21
ATTACHMENT OF FREE-STANDING DECK TO HOUSE FOR LATERAL SUPPORT
Lateral Support Exception 3

- All bracing may be omitted for a deck which is attached to the house in accordance with sections 8 and 9 or Figure 21 and which has all of its decking installed at a 45 degree angle to the deck joists.

Either:

- Section 8: Ledger Attachments
- Section 9: Ledger-Board Fasteners with 45 Degree Angle Decking

Or

- Figure 21: Attachment of Free-Standing Deck To House with 45 Degree Angle Decking
Tension–Tie Requirements

- Minimum capacity of each tension–tie, 750 pounds.
- Tension ties not G–185 zinc coated require MFR recommended barrier membrane between tie & treated joist.
- Approved tension–ties include:
  - LTS19–TZ from USP
  - DTT1Z from Simpson Strong–Tie

Not for free-standing decks
For concrete walls, adhesive or expansion anchors & a 1/2 inch threaded rod, with a withdrawal capacity of at least 750 pounds per MFR specs may be used.
Hold-down tension devices, must be provided in at least 2 locations per deck, & each device must have an allowable-stress-design capacity of at least 1,500 pounds.
Section 12: Decking

- 45 to 90 degree angle to joists OK if per MFR.
- Wet decking, place it with no gap.
- Overhang decking up to 3 inches or per MFR.
- Max 24” o.c. for wood decking, max 16” o.c. for wood–plastic–composite decking or per MFR.
- Each wood decking piece shall bear on minimum of 4 joists or intermediate blocking.
All open sides of a deck area > 24 inches above grade, at any point within 36 inches beyond the edge of the deck must have a guard.
Guard Posts

-Hold-down anchors must have a minimum capacity of 1,800 pounds.

-Guard posts may be attached to either side of end joist or rim joist.
Section: 14 Stairs

SPS 321.04

- If the total vertical height of a stairway exceeds 12 feet, an intermediate landing is required and must be constructed as a free-standing deck with flush beams and with posts.
Stair Stringers

- Stringers sawn or solid 2x12s.
- Cut stringers max spacing 18” o.c.
- Remove all loose or organic material before placing solid surface.
- Stringer–span length measured horizontally between centerlines of bearing at each end.
- Max length of cut stringer 6’-0”, & throat size of cut stringers ≥ 5 inches, see Figure 29.

**Solid–stringer exception:** Stringers with a width of 36 inches may have a horizontally projected span of up to 13 feet 3 inches if the stairway is framed solely with 2 solid stringers.
**Figure 29**
STRINGER BEARING

- Cut post at bottom tread elevation when no stair guard is required.
- Use (2) 1/2" diameter thru-bolts with washers required only if guard is required; otherwise use (2) #8 wood screws ≥3-1/2" long or (2) 16d threaded nails.

- Attach 2x4 bearing block using (8) #8 wood screws ≥3-1/2" long or (8) 16d threaded nails.

**Figure 30**
STRINGER SPAN LENGTH

- 5" minimum throat.
- 6' maximum stringer span.
- 13'-3" maximum solid stringer exception.
Tread & Riser Material

1. Tread material must match the decking specified in section 12 & be attached per Figure 31, except wood–plastic composites must be attached per MFR.

2. Stairs using the solid–stringer exception must have treads constructed of 2x wood material only & be attached per Figure 31.

3. Risers not open (see Figure 27) must be framed with 1x lumber minimum or MFR recommended wood–plastic composite.
Tread & Riser Material

Figure 27
TREADS AND RISERS

Figure 31
STAIRWAY TREADS

Table 7
MINIMUM TREAD SIZES

<table>
<thead>
<tr>
<th>Species</th>
<th>Cut Stringer</th>
<th>Solid Stringer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Douglas Fir/Larch, Hem/Fir, SPF</td>
<td>2x4 or 5/4</td>
<td>2x8 or 3x4</td>
</tr>
<tr>
<td>Southern Pine</td>
<td>2x4 or 5/4</td>
<td>2x8</td>
</tr>
<tr>
<td>Redwood, Western Cedars, Ponderosa Pine, Red Pine</td>
<td>2x4 or 5/4</td>
<td>2x10 or 3x4</td>
</tr>
</tbody>
</table>

1 Assumes 300 lb concentrated load, L/288 deflection limit, No. 2 grade, and wet service conditions.
2 Incising assumed for refractory species including Douglas fir—larch, hem—fir, and spruce—pine—fir.
3 Design values based on northern species with no incising assumed.
Stair Guards

Guards must be provided on all open sides of stairs consisting of more than 3 risers. Stair guards must comply with section 13 and Figure 32.

**Figure 32**

STAIR GUARDS

- 6’ maximum
- 30” (measured from nosing of step to top of stair guard)
- Triangular opening shall not permit the passage of a 6” diameter sphere
- Provide blocking between stair stringers at guard post locations; toe nail with (2) 10d nails each side
A flight of stairs with more than 3 risers must have at least one handrail that complies with all of the following:

1. Located at least 30 inches, but no more than 38 inches above nosing of treads – except that a volute, turnout, starting easing, or transition fitting may vary. Measurement taken from nosing to top of rail.

2. Attached to a stair guard or exterior wall acting as a barrier per Figure 33.

3. Handrail and its hardware must be decay and corrosion resistant.

4. Must have a smooth surface, no sharp corners & graspable, per Figure 34. Recessed sections can use 2”x6” or five-quarter board, Per figures 33 & 34.

5. Must run continuously directly over lowest riser to highest riser.

6. May be interrupted by guard posts.
Figure 33
STAIR HANDRAILS

Figure 34
HANDRAIL GRASPABILITY
Spiral Stairs

Spiral stairs per SPS 321.04. Connection of spiral stairs & supporting load path designed with accepted engineering practices & with applicable provisions of the Uniform Dwelling Code.
*When writing notice of noncompliance use code section SPS321.225(2) for Appendix B & C
Footing Inspection

Yes  No

☐  ☐ Layout & locations of footings match the plan
☐  ☐ Post holes depth at least 48”
☐  ☐ Correct footing size
☐  ☐ Footing w/in 5’ of house match foundation depth
☐  ☐ Ledger board installed & ≥ joist size? Min. 2x8
☐  ☐ Ledger board correctly attached to house
☐  ☐ Flashing behind ledger board
Framing Inspection

Yes  No
☐  ☐ Post(s) correct size, in middle 1/3 of ftg & attached to ftg
☐  ☐ Beam correct size, connected to post, splice over post
☐  ☐ Beam overhang correct length
☐  ☐ Joists correct size & spacing & connected to beam
☐  ☐ Joist overhang(s) correct length
☐  ☐ If required, blocking or rim joist provided

[Images of framing details]
# Final Inspection

<table>
<thead>
<tr>
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Final Inspection

Make sure handrail is treated lumber
Deck Failures in The News & on The Job Site

- 2 people on 20 year old deck that collapsed, was recently refurbished with composite boards & rails. Ledger board attached to the back of the home with nails. June 2016

- 9 people on second-story deck that collapsed. Ledger board fastened to the home with nails and screws. July 2016
Deck Overloading

Large gatherings make the news across the country for deck collapses.

August 2, 2016
Roughly 40 people on deck
Fell about 10 Feet

July 4, 2016
Roughly 25 to 27 people on deck
Fell about 8.5 Feet
June 12, 2015
40 High School seniors on deck
“The deck, which ran nearly the width of the back of the house, had patio furniture, a barbecue, and a covered canopy area on it. The railing was made of panels of tempered glass, sections of which were broken on the ground after the collapse.” (Kings County News, Carla Allen & Tina Comeau)
July 24, 2016

“Six people were said to be on the deck when it pulled away from the house and collapsed in the mid-afternoon accident.”

“local newspaper shows a mostly intact deck structure tipping in toward the house, as if the connection between the house and deck was the problem.” (Sentinel and Enterprise/ Jim Marabello)
September 24, 2016
“at least 15 to 20 people were on the deck when it collapsed. They dropped roughly 15 feet.” (al.com/Carol Robinson)
August 29, 2016

“CBS New York/As many as 50 people were reportedly on the deck when it collapsed, WCBS 880’s Mike Xirinachs reported.” (CBS New York/ Jennifer McLogan)
• JUNE 1, 2004 Hughsonville, N.Y.
• Above ground “kiddie” swimming pool 2,500 gallons on the deck
Rotted Ledger Board & House Overhang
“Free-Standing” Deck
Post-Beam-Connection
Thank you!

For any questions please email: Alison.Humski@wisconsin.gov