CORRECTING A SERIOUS DEFICIT TO BUILDING SAFETY

Reinforcement of Floor Systems Supporting Guards

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*SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 INTERNATIONAL RESIDENTIAL CODE (IRC).

EARLY ADOPTION

WHY REINFORCEMENT OF FLOOR SYSTEMS SUPPORTING GUARDS IS NEEDED **NOW!**

Stairbuilders and Manufacturers Association (SMA) members from across the nation recognized a serious deficit in the building code. The edge of floor structures, particularly those constructed of engineered joists and truss components were rotating when the top of the guard assembly was loaded in final inspection. A sound floor structure that could support the guard system when loaded was not provided even though the floor system was code compliant.

In the fall of 2021, the SMA formed an industry wide task group to address the problem. The task group included design professionals, truss and I-joist manufacturers, builders, hardware manufacturers, railing fabricators, and stairbuilders. A year later they successfully changed the International Residential Code (IRC) to require edge of floor details that can support guard assemblies. This change is now part of the 2024 IRC (full text below). It is scheduled to be published late in 2023 but will not be effective until adopted by local jurisdictions. **Unless we act NOW, this problem will not be resolved for 5 or more years.**

WHY WAIT?

The code is but a minimum standard of safety that can be exceeded. Your earnest effort in adopting this corrective action will assure wood floor structures supporting guards are sound, improving building safety for all.

The SMA has developed resources to aid you in promoting adoption of these important structural changes to floor framing NOW. In addition to the 2024 IRC requirements this document contains specifications and details for inclusion in your next project. The supporting engineering calculations are also included for both torsional checks of the floor edge member and the framing connections that resist rotation resulting from loads on the guard assembly. Educational resources for design, building construction, and building safety professionals are available at stairways.org. Contact your local SMA member or the SMA office to schedule a presentation, register for a webinar or download specifications to include in your next project.

The SMA has resolved to encourage early adoption of the 2024 IRC requirements for floor framing supporting guards. These requirements correct a serious oversight in the structural design of floor systems supporting guards and greatly improve building safety. Together the building community can emphasize to local building enforcement jurisdictions the need for early adoption. Please contact the SMA office to learn how you can participate in bringing early adoption to your community.

R502.11 Floor framing supporting guards. The framing at the open edge of a floor supporting a required guard assembly shall be constructed in accordance with Sections R502.11.1 or R502.11.2 for guard assemblies not exceeding 44 inches (1118mm) in height or shall be designed in accordance with accepted engineering practice to support the guard assembly. Where trusses and I-joists are used as edge framing members supporting guards, the effects of the guard loads shall be considered in the design of the edge member.

R502.11.1 Conventional edge framing. Where a roll brace is aligned with each guard post, the framing at the edge of the floor shall consist of a solid or built-up member of lumber, structural glued laminated timber, or structural composite lumber having a minimum net width of 3 inches (76mm) and a minimum net depth of 9-1/4 inches (235 mm) and shall be braced to resist rotation by roll bracing as described in Section R502.11.3.

R502.11.2 Timber edge framing. Where a roll brace is not aligned with each guard post, the framing at the edge of the floor shall consist of a minimum 6x10 sawn timber or a minimum 5-1/8 inch x 9-1/4 inch (130 mm x 235 mm) structural glued laminated timber and shall be braced to resist rotation by roll bracing as described in Section R502.11.3 at intervals of 48 inches (1219 mm) or less.

R502.11.3 Roll bracing. Each roll brace shall be a joist or blocking matching the depth of the edge member and extending perpendicular to the edge member a minimum of 16 inches (406 mm) from the edge. Blocking shall have end connections with a minimum of six (6) – 16d common nails. Floor sheathing shall be continuous for a minimum of 24 inches (610 mm) from the edge and shall be fastened to each roll brace with a minimum of twelve (12) – 10d common nails and shall be fastened to the edge member with a minimum of twelve (12) – 10d common nails within 12 inches (305 mm) of the roll brace.

SECTION 06 10
ROUGH CARPENTRY

Note to Specifier: This section is based on adopted International Residential Code (IRC) structural requirements for floor systems at edges supporting guards not exceeding 44”. Section R502.11 is included in the 2024 IRC code.

For additional information contact:

Stairbuilders and Manufacturers Association (SMA) | PO Box 448, Dalton, Ohio 44618
www.stairways.org | Phone: 877-500-5759

Note to Specifier: Delete any information below in Parts 1,2, or 3 which is not required or relevant for the project; add others as required.

1. General
   - A. Section Includes
     1. Floor Framing Supporting Guards (R502.11, IRC)
        - a. Conventional Edge Framing (R502.11.1, IRC)
        - b. Timber Edge Framing (R502.11.2, IRC)
        - c. Roll Bracing (R502.11.3, IRC)
   - B. Related Sections
     1. 05 52 Metal Railings
     2. 05 73 Decorative Metal Railings
     3. 06 43 Wood Stairs and Railings
     4. 06 63 Plastic Railings
     5. 06 81 Composite Railings
     6. 08 80 Glazing
   - C. References
     1. 2024 IRC Codes
        - a. R502.11 Floor framing supporting guards
        - b. R502.11.1 Conventional edge framing
        - c. R502.11.2 Timber edge framing
        - d. R502.11.3 Roll bracing
        - e. R301.5 Live load
     2. 2021 IRC Code
        - a. R301.5 Live load
     3. Stairbuilders and Manufacturers Association (SMA)
        - a. www.stairways.org/guard-connections

HOW TO SPECIFY

HOW TO SPECIFY

2. Requirements

Note to specifier: This specification provides for the construction of the edge of floor systems that will resist the transfer of the load applied to the top of the guard as required in the 2021 and 2024 editions of the IRC.

A. Guard requirements.
   1. Guard height shall not exceed 44".
   2. Guards shall be constructed to support a 200 lb single concentrated load applied at any point along the top of the guard, in the vertical downward direction and in the horizontal direction away from the walking surface. Loads are not applied concurrently.

B. Floor framing supporting guards (R502.11)
   1. The framing at the open edge of a floor supporting a required guard assembly shall be constructed in accordance with Sections R502.11.1 or R502.11.2 for guard assemblies not exceeding 44 inches (1118mm) in height or shall be designed in accordance with accepted engineering practice to support the guard assembly. Where trusses and I-joists are used as edge framing members supporting guards, the effects of the guard loads shall be considered in the design of the edge member

C. Conventional edge framing (R502.11.1)
   1. Where a roll brace is aligned with each guard post, the framing at the edge of the floor shall consist of a solid or built-up member of lumber, structural glued laminated timber, or structural composite lumber having a minimum net width of 3 inches (76mm) and a minimum net depth of 9-1/4 inches (235 mm) and shall be braced to resist rotation by roll bracing as described in Section R502.11.3.

D. Timber edge framing (R502.11.2)
   1. Where a roll brace is NOT aligned with each guard post, the framing at the edge of the floor shall consist of a solid or built-up member of lumber, structural glued laminated timber, or structural composite lumber having a minimum net width of 3 inches (76mm) and a minimum net depth of 9-1/4 inches (235 mm) and shall be braced to resist rotation by roll bracing as described in Section R502.11.3.t.

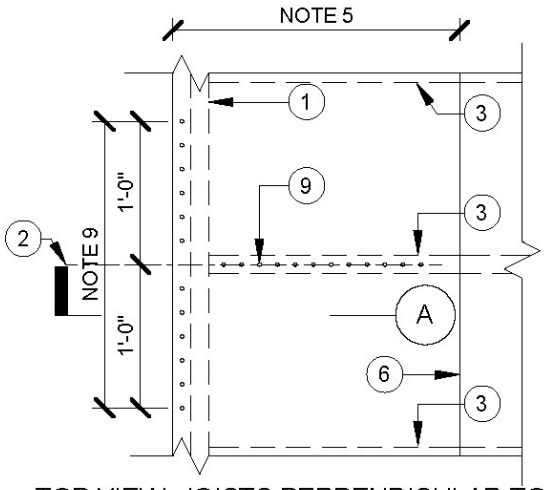
E. Roll Bracing
   1. Each roll brace shall be a joist or blocking matching the depth of the edge member and extending perpendicular to the edge member a minimum of 16 inches (406 mm) from the edge. Blocking shall have end connections with a minimum of six (6) – 16d common nails. Floor sheathing shall be continuous for a minimum of 24 inches (610 mm) from the edge and shall be fastened to each roll brace with a minimum of twelve (12) – 10d common nails and shall be fastened to the edge member with a minimum of twelve (12) – 10d common nails within 12 inches (305 mm) of the roll brace.

HOW TO SPECIFY

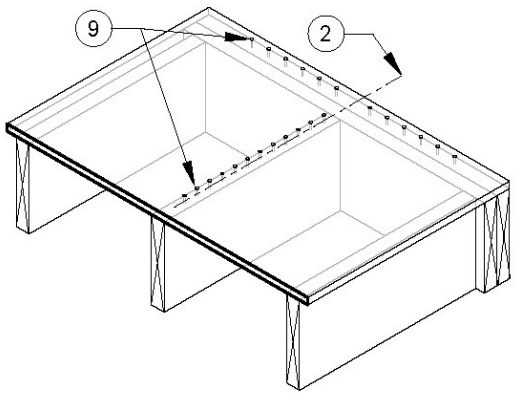
3. Execution
   A. At ALL floor edge conditions supporting guard assemblies not exceeding 44” in height.
      1. Floor framing supporting top or side mounted guard posts shall have roll bracing.
         a. Roll brace material shall be solid or built-up member of lumber, structural glued laminated timber, or structural composite lumber.
      2. Floor sheathing shall be continuous and without a joint parallel to floor edge minimum of 24” from the floor edge, typ. Sheathing shall be fastened with,
         a. 12 – 10d common (3” x 0.148”) nails through floor sheathing into edge beams at each roll brace, typ.
         b. 12 – 10d common (3” x 0.148”) nails through floor sheathing into the roll brace, typ.
   B. At floor edge conditions where roll brace is aligned with guard post connections
      1. Each roll brace shall be a joist or blocking matching the depth of the edge member (rim) and extending perpendicular to the edge member a minimum of 16” from the edge.
      2. Edge member (rim) shall be minimum 3” net width and minimum 9 ¼” in height.
      3. Typical joist (nominal or engineered lumber) shall be minimum 9 ¼” in height.
   C. At floor edge conditions where roll braces do not align with guard post connections.
      1. Edge member shall be minimum 6x10 sawn timber or minimum 5 1/8” x 9 ¼” structural glue laminated timber.
      2. Roll bracing shall be installed perpendicular to edge member and
         a. Shall be fastened with 6 – 16d common (3 ½” x 0.162”) nails staggered and toenailed through roll brace and into edge member, typ.
         b. Shall be secured to a roll brace (parallel to edge) to resist rotation.
         c. Roll brace shall be secured to end of blocking with 6 – 16d common (3 ½” x 0.162”) nails, nailed through roll brace and into end of blocking, typ.
         d. Shall be installed at intervals of 48” or less.

FLOOR EDGE ROLL BRACING

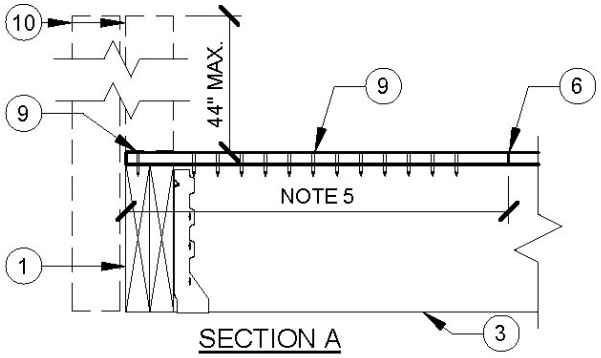
JOISTS PERPENDICULAR TO EDGE



TOP VIEW: JOISTS PERPENDICULAR TO EDGE, GUARD POST ALIGNED WITH JOIST



AXON: JOISTS PERP. TO EDGE, GUARD POST ALIGNED WITH JOIST



SECTION A

NOTES:

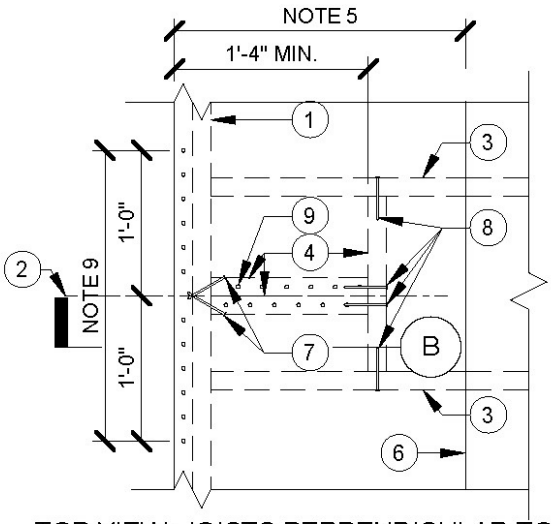
1. EDGE MEMBER WITH MIN. 3" NET WIDTH, MIN. 9-1/4" HEIGHT.
2. CENTER LINE OF TOP- OR SIDE-MOUNTED GUARD POST WITH 44" MAX HEIGHT.
3. TYPICAL JOIST (NOMINAL OR ENGINEERED LUMBER) WITH MIN. 9-1/4" HEIGHT.
4. FULL DEPTH BLOCKING WITH MIN. 9-1/4" HEIGHT.
5. FLOOR SHEATHING TO BE CONTINUOUS FOR A MIN. OF 2'-0" FROM EDGE, TYP.
6. JOINT IN FLOOR SHEATHING.
7. 6 - 16d COMMON (3 1/2" x 0.162") TOENAILS, STAGGERED, TYP.
8. 6 - 16d COMMON (3 1/2" x 0.162") NAILS, TYP.
9. 12 - 10d COMMON (3" x 0.148") NAILS BETWEEN FLOOR SHEATHING AND EDGE BEAM, JOIST OR BLOCKING, TYP.
10. TOP- OR SIDE-MOUNTED GUARD POST.

FRAMING DETAILS

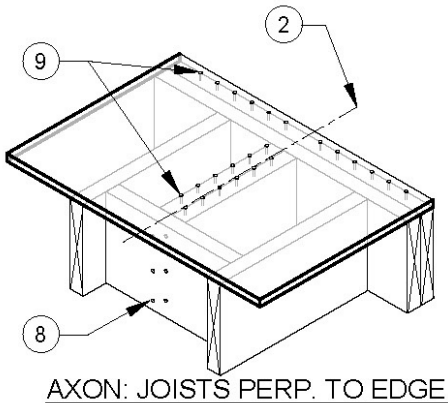
SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

FLOOR EDGE ROLL BRACING
JOISTS PERPENDICULAR TO EDGE

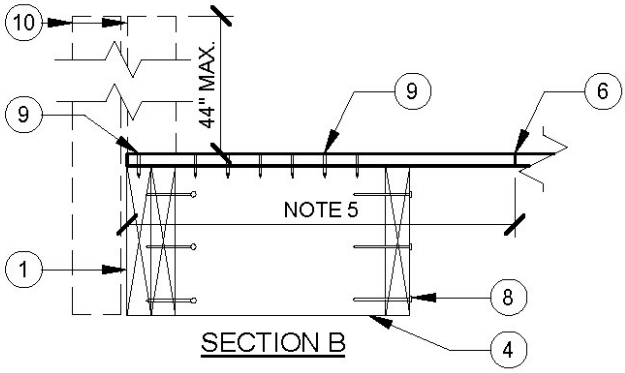
FRAMING DETAILS



TOP VIEW: JOISTS PERPENDICULAR TO EDGE, GUARD POST OFFSET FROM JOISTS



AXON: JOISTS PERP. TO EDGE, GUARD POST OFFSET FROM JOISTS



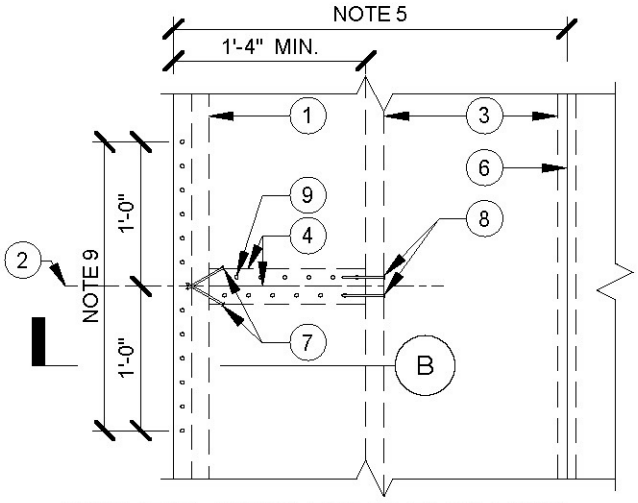
SECTION B

NOTES:

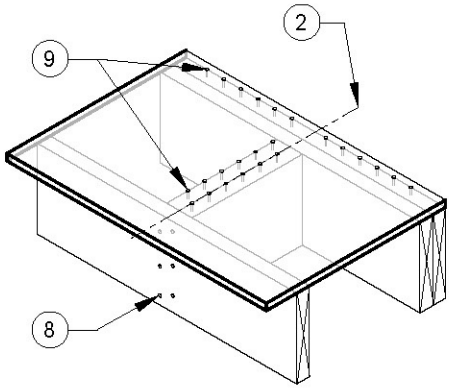
1. EDGE MEMBER WITH MIN. 3" NET WIDTH, MIN. 9-1/4" HEIGHT.
2. CENTER LINE OF TOP- OR SIDE-MOUNTED GUARD POST WITH 44" MAX HEIGHT.
3. TYPICAL JOIST (NOMINAL OR ENGINEERED LUMBER) WITH MIN. 9-1/4" HEIGHT.
4. FULL DEPTH BLOCKING WITH MIN. 9-1/4" HEIGHT.
5. FLOOR SHEATHING TO BE CONTINUOUS FOR A MIN. OF 2'-0" FROM EDGE, TYP.
6. JOINT IN FLOOR SHEATHING.
7. 6 - 16d COMMON (3 1/2" x 0.162") TOENAILS, STAGGERED, TYP.
8. 6 - 16d COMMON (3 1/2" x 0.162") NAILS, TYP.
9. 12 - 10d COMMON (3" x 0.148") NAILS BETWEEN FLOOR SHEATHING AND EDGE BEAM, JOIST OR BLOCKING, TYP.
10. TOP- OR SIDE-MOUNTED GUARD POST.

SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

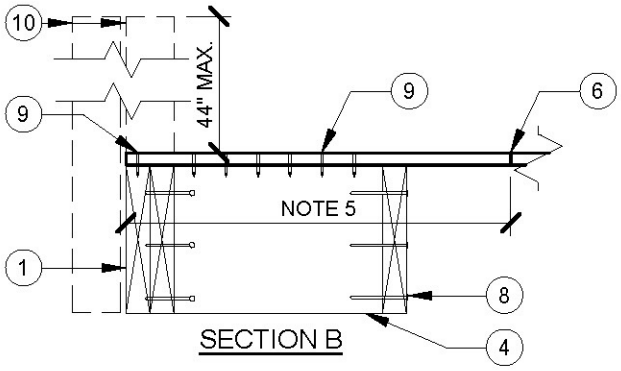
FLOOR EDGE ROLL BRACING
JOISTS PARALLEL TO EDGE



TOP VIEW: JOISTS PARALLEL TO EDGE



AXON: JOISTS PARALLEL TO EDGE



SECTION B

NOTES:
1. EDGE MEMBER WITH MIN. 3" NET WIDTH, MIN. 9-1/4" HEIGHT.
2. CENTER LINE OF TOP- OR SIDE-MOUNTED GUARD POST WITH 44" MAX HEIGHT.
3. TYPICAL JOIST (NOMINAL OR ENGINEERED LUMBER) WITH MIN. 9-1/4" HEIGHT.
4. FULL DEPTH BLOCKING WITH MIN. 9-1/4" HEIGHT.
5. FLOOR SHEATHING TO BE CONTINUOUS FOR A MIN. OF 2'-0" FROM EDGE, TYP.
6. JOINT IN FLOOR SHEATHING.
7. 6 - 16d COMMON (3 1/2" x 0.162") TOENAILS, STAGGERED, TYP.
8. 6 - 16d COMMON (3 1/2" x 0.162") NAILS, TYP.
9. 12 - 10d COMMON (3" x 0.148") NAILS BETWEEN FLOOR SHEATHING AND EDGE BEAM, JOIST OR BLOCKING, TYP.
10. TOP- OR SIDE-MOUNTED GUARD POST.

FRAMING DETAILS

SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

ENGINEERING CALCULATIONS

EDGE MEMBER TORSION CALCULATIONS

Torsion Member Assumptions:

200 lb outward load applied 45.5 in. above the top of the member.

Torsion moment = T = (45.5 in.)(200 lb) = 9100 in-lb

Following Section 4.6 of Timber Construction Manual (6th edition):

$$f_{vt} = \frac{T(3d + 1.8b)}{d^2 b^2}$$

For 6x10 SPF sawn lumber:

$F_{vt}' = 2/3 * F_v * C_D = 2/3 * (125\ psi) * 1.6 = 133\ psi$

$$f_{vt} = \frac{T(3d + 1.8b)}{d^2 b^2} = \frac{(9100\ \text{in-lb})(3(9.25\ \text{in.}) + 1.8(5.5\ \text{in.}))}{(9.25\ \text{in})^2 (5.5\ \text{in})^2} = 132\ \text{psi} \le F_{vt}' = 133\ \text{psi}$$

For 5-1/8 in. x 9-1/4 in., 16F-1.3E glued laminated timber:

$F_{vt}' = 2/3 * F_{vx} * C_{vr} * C_D = 2/3 * (195\ psi) * 0.72 * 1.6 = 150\ psi$

$$f_{vt} = \frac{T(3d + 1.8b)}{d^2 b^2} = \frac{(9100\ \text{in-lb})(3(9.25\ \text{in.}) + 1.8(5.125\ \text{in.}))}{(9.25\ \text{in})^2 (5.125\ \text{in})^2} = 150\ \text{psi} \le F_{vt}' = 150\ \text{psi}$$

CONNECTION CALCULATIONS

Variables and Assumptions

Post_Height := 44in

Flooring_thickness := 0.75in

Plywood_thickness := 0.75in

Joist_depth := 9.25in

Blocking_width := 1.5in

Blocking_length := 13in

Bottom_compression_zone := 1.7in

$$Fastener\_arm := Joist\_depth - \frac{Bottom\_compression\_zone}{2} = 8.4 \cdot in$$

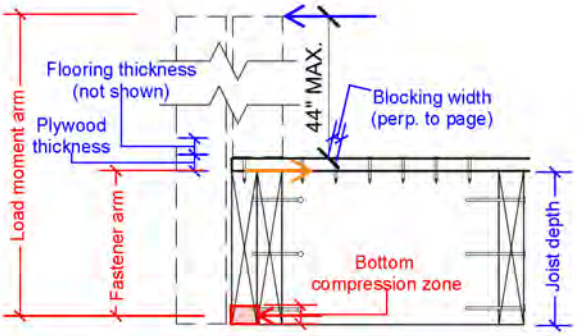


Diagram with least conservative moment arm

$$Load\_moment\_arm := Post\_Height + Flooring\_thickness + Plywood\_thickness + Fastener\_arm = 53.9 \cdot in$$

$$Fastener\_arm\_conservative := \frac{2 \cdot Joist\_depth}{3} = 6.17 \cdot in$$

$$Load\_moment\_arm\_conservative := Post\_Height + Flooring\_thickness + Plywood\_thickness \ldots + Fastener\_arm\_conservative = 51.67 \cdot in$$

$$Load\_moment\_arm\_blocking := Post\_Height + Flooring\_thickness + \frac{Plywood\_thickness}{2} = 45.13 \cdot in$$

Assume wood is SPF No. 2 or better (SG=0.42)

$F_{cperp} := 425psi$

$C_D := 1.6$

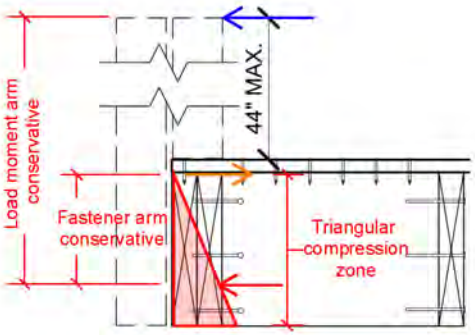


Diagram with conservative moment arm
(triangular compression zone)

Fastener Capacities (See AWC Connection Calculator Results)

10d Common Nail in single shear installed into floor joist through plywood (conservatively assume capacity for 15/32 in. plywood)

$z_{10plywood} := 131lbf$

16d Common Nail in single shear installed into floor joist through blocking, toe-nail

$z_{16} := 191lbf$

$C_{tn} := 0.83$

$z_{16tn} := C_{tn} \cdot z_{16} = 159lbf$

16d Common Nail in single shear installed into end grain of blocking through floor joist

$z_{16eg} := 128lbf$

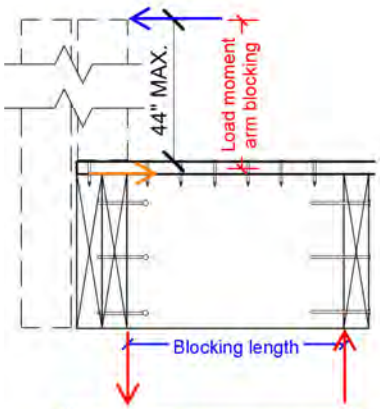


Diagram with blocking reactions

SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

ENGINEERING CALCULATIONS

CONNECTION CALCULATIONS

Outward Load on post

$Outward\_Load := 200lbf$ ←

$Shear_{plywood} := Outward\_Load \cdot \frac{Load\_moment\_arm}{Fastener\_arm} = 1283.333 \cdot lbf$ →

Determine shear in nails between plywood and joists or blocking using moment arm with compression zone at bottom of joist

$Compression := Shear_{plywood} - Outward\_Load = 1083\,lbf$ ←

Check compression in edge member

$Bottom\_compression\_zone\_check := \frac{Compression}{F_{cperp} \cdot Blocking\_width} = 1.7 \cdot in$

$Comp\_zone\_check := \frac{Bottom\_compression\_zone}{Bottom\_compression\_zone\_check} = 1$

Actual compression zone depth is approximately equal to assumed compression zone depth, so no need to iterate calculation again.

$Shear_{plywood\_conserv} := Outward\_Load \cdot \frac{Load\_moment\_arm\_conservative}{Fastener\_arm\_conservative} = 1676 \cdot lbf$

Determine shear in nails between plywood and joists or blocking using conservative moment arm with compression zone triangular distribution over height of joist.

Determine number of nails required between plywood and joist or blocking using the conservative and least conservative moment arms between the shear plane and center of compression zone

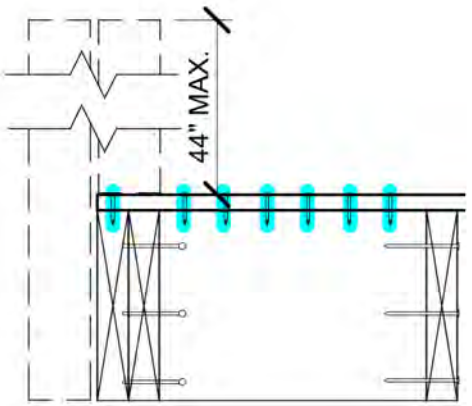
Using least conservative moment arm

$num\_plywood\_nails := \frac{Shear_{plywood}}{z_{10plywood}} = 9.8$

Using conservative moment arm

$num\_plywood\_nails\_conservative := \frac{Shear_{plywood\_conserv}}{z_{10plywood}} = 12.8$

Use (12) 10d nails between plywood and joist or blocking



SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

ENGINEERING CALCULATIONS

CONNECTION CALCULATIONS

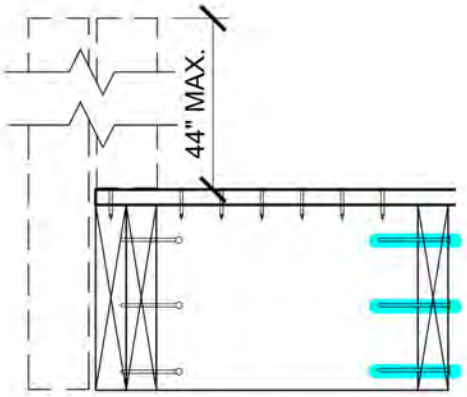
Determine number of nails required between blocking and joists, installed into end grain

$$\text{Blocking\_shear} := \frac{\text{Outward\_Load} \cdot \text{Load\_moment\_arm\_blocking}}{\text{Blocking\_length}} = 694\ \text{lbf}$$

$$\text{num\_blocking\_nails\_eg} := \frac{\text{Blocking\_shear}}{z_{16eg}} = 5.4$$

Note that shear in blocking from moment caused by outward load exceeds potential shear in blocking due to downward load

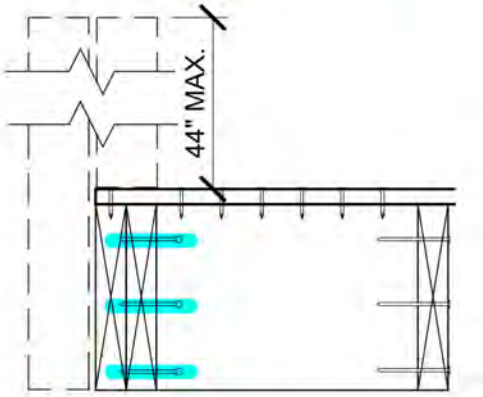
Use (6) 16d nails between blocking and joists, installed into end grain



Determine number of nails required between joist or blocking and edge member, installed as toe-nail

$$\text{num\_toenails} := \frac{\text{Blocking\_shear}}{z_{16tn}} = 4.4$$

Use (6) 16d nails between joist or blocking and edge member, installed as toe-nail, (3) on each side of blocking



SUBSTANTIATION AS SUBMITTED FOR ICC APPROVAL OF R502.11 IN THE 2024 IRC.

CONNECTION CALCULATIONS

2/16/22, 4:15 PM — Connection Calculator

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear

Main Member Type	Spruce-Pine-Fir
Main Member Thickness	-- Other (in inches) -- 9.25
Side Member Type	Plywood (Structural 1 grade)
Side Member Thickness	15/32 in.
Nail Type	Common Wire
Nail Size	10d (D = 0.148 in.; L = 3 in.)
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Z10plywood = Single shear capacity of 10d common nail installed from plywood into main member

Connection Yield Modes

Im	913 lbs.
Is	235 lbs.
II	321 lbs.
IIIm	335 lbs.
IIIs	131 lbs.
IV	172 lbs.

Adjusted ASD Capacity	**131 lbs.**

- Nail bending yield strength of 90000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.

While every effort has been made to insure the accuracy of the information presented, and special effort has been made to assure that the information reflects the state-of-the-art, neither the American Wood Council nor its members assume any responsibility for any particular design prepared from this on-line Connection Calculator. Those using this on-line Connection Calculator assume all liability from its use.

The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by American Wood Council.

CONNECTION CALCULATIONS

2/10/22, 10:55 AM Connection Calculator

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear

Main Member Type	Spruce-Pine-Fir
Main Member Thickness	-- Other (in inches) -- 9.25
Side Member Type	Spruce-Pine-Fir
Side Member Thickness	1.5 in.
Nail Type	Common Wire
Nail Size	16d (D = 0.162 in.; L = 3.5 in.)
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 1.0
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Z16 = Single shear capacity of 16d common nail installed from side member into main member

Connection Yield Modes

Im	789 lbs.
Is	592 lbs.
II	291 lbs.
IIIm	286 lbs.
IIIs	227 lbs.
IV	191 lbs.

Adjusted ASD Capacity	**191 lbs.**

- Nail bending yield strength of 90000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.

While every effort has been made to insure the accuracy of the information presented, and special effort has been made to assure that the information reflects the state-of-the-art, neither the American Wood Council nor its members assume any responsibility for any particular design prepared from this on-line Connection Calculator. Those using this on-line Connection Calculator assume all liability from its use.

The Connection Calculator was designed and created by Cameron Knudson, Michael Dodson and David Pollock at Washington State University. Support for development of the Connection Calculator was provided by American Wood Council.

CONNECTION CALCULATIONS

2/10/22, 10:53 AM — Connection Calculator

Design Method	Allowable Stress Design (ASD)
Connection Type	Lateral loading
Fastener Type	Nail
Loading Scenario	Single Shear

Main Member Type	Spruce-Pine-Fir
Main Member Thickness	-- Other (in inches) -- 9.25
Side Member Type	Spruce-Pine-Fir
Side Member Thickness	1.5 in.
Nail Type	Common Wire
Nail Size	16d (D = 0.162 in.; L = 3.5 in.)
Load Duration Factor	C_D = 1.6
Wet Service Factor	C_M = 1.0
End Grain Factor	C_eg = 0.67
Temperature Factor	C_t = 1.0
Diaphragm Factor	C_di = 1.0

Z16eg = Single shear capacity of 16d common nail installed from side member into end grain of main member

Connection Yield Modes

Im	529 lbs.
Is	397 lbs.
II	195 lbs.
IIIm	192 lbs.
IIIs	152 lbs.
IV	128 lbs.

Adjusted ASD Capacity	**128 lbs.**

- Nail bending yield strength of 90000 psi is assumed.
- The Adjusted ASD Capacity does not apply for toe-nails installed in wood members.
- Length of tapered tip is assumed to be two times the nail diameter for calculating dowel bearing length in the main member.
- The Adjusted ASD Capacity only applies for nails that have been driven flush with the side member surface. It does not apply for nails that have been overdriven into the side member.

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NOTES

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MORE INFORMATION, INCLUDING CAD FILES, IS AVAILABLE AT WWW.STAIRWAYS.ORG/GUARD-CONNECTIONS

WWW.STAIRWAYS.ORG

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