

# RB173-22

IRC: R502.11 (New), R502.11.1 (New), 502.11.2 (New), 502.11.3 (New)

## **Proposed Change as Submitted**

**Proponents:** David Cooper, representing Stairbuilders and Manufacturers Association (coderep@stairways.org)

### **2021 International Residential Code**

**Add new text as follows:**

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

**R502.11.1 Conventional edge framing.** The framing at the edge of the floor shall consist of a solid or built-up wood member 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 502.11.3 with a roll brace aligned with each guard post.

**502.11.2 Timber edge framing.** 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) glued laminated timber and shall be braced to resist rotation by roll bracing as described in Section 502.11.3 at intervals of 48 inches (1219 mm) or less.

**502.11.3 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.

#### **Reason: The Problem:**

Guards are required to transfer the outward and downward loads applied at the top of the guard to the structure. If the structure fails, the guard cannot perform its defined function to minimize the possibility of a fall. Many floor systems (both conventional and engineered) are not being designed and constructed to resist guard loads at the edge of walking surfaces where guards are required. Manufacturers and designers of engineered floor systems (e.g., trusses and I-joists) and plan reviewers are commonly unaware of guard attachment requirements and do not ensure that framing is adequate to support guards. Inadequate framing is commonly encountered with costly reinforcement (and possibly redesign) needed at the time of guard installation.

In current practice where inadequate framing is encountered, flooring or ceilings are ripped out to install blocking to harden the edge beam for attachment of the guard. Such fixes are not engineered and, in many cases, occur after the rough inspection. The problem will persist unless a solution can be codified.

#### **A Collaborative Formed:**

The SMA surveyed our membership and found the problem to be chronic across the nation and assembled a task group representing manufacturers of, trusses, I-joists, framing and post connection hardware, and guard components as well as, home builders, guard fabricators, guard installers, stairbuilders, and others from industry at large, some 18 participants in all. About half of the team are engineers, and about half have extensive involvement in code and standard development. Meeting biweekly since early fall of 2021 this team has worked together to develop consensus upon an engineered solution presented here with two prescriptive options suitable for inclusion in the 2024 IRC.

#### **A Prescriptive Solution:**

By recommendation of the manufacturers of I-joists and trusses and consensus of the entire task group this proposal prohibits the use of I-joists and trusses *as edge framing members supporting guards except where the effects of the guard loads are specifically considered in the design of the edge member*. This is based upon the limited embedment of fasteners in the thickness of the joist and truss materials, open areas/voids, and surfaces where fasteners cannot be used that would weaken the component or connections between the truss/I-joist components.

Both top mount and side mount guards are suitable provided there is sufficient material to engage threaded fasteners and the edge beam/joist is not subject to rotation or torsion. Based upon calculation of the loads transferred to the structure from the top of the guard, two options are provided. (Calculations may be reviewed at the link below.)

**R502.11.1 Conventional edge framing**, describes the minimal thickness to resist withdrawal of fasteners and height of the edge beam/joist as that of a common double 2 x 10. Blocking/roll bracing is aligned with the post locations to resist rotation and eliminate torsion induced by guard loads.

**R502.11.2 Timber edge framing**, provides specifications to allow use of a thicker timber or glulam which is sized to resist torsion allowing roll bracing to be spaced at a maximum distance of 48 inches on center to alleviate the need for precise alignment of the post with the roll bracing or a joist.

Although the minimum guard height in the IRC is 36 inches it is not unusual that portions of the guard, post caps, or finials extend above the guard height. We agreed that a height of 44 inches would be reasonably conservative to use for the purpose of calculating the edge beam size and roll bracing requirements. To restrict outward movement of the top of the edge beam, specific nailing of the floor sheathing is called out at the location of roll bracing. Floor sheathing must be continuous for a minimum distance from the open edge to assure the structural integrity of the bracing and edge beam. The nailing requirements for attachment of the blocking used as roll bracing to the joists prevents uplift of the blocking, and the minimum length allows it to fit into one joist bay where joist spacing is taken from the open edge of the edge beam. These details are specified in **R502.11.3 Roll Bracing**.

This proposal has been clearly and carefully constructed to be understood and enforced without figures referenced in the code text. We have included drawings to aid understanding among the many proposals to be considered in this cycle. The drawings submitted would however be suitable for inclusion in the commentary.

Engineering Calculations supporting this proposal can be found at this link: <https://stairways.org/guard-calculations/>



**Cost Impact:** The code change proposal will decrease the cost of construction

This proposal will decrease the cost of construction due to the elimination of necessary after-the-fact demolition and repair to install blocking at each post location. An average job with guards has three or more posts with 1 to 2 hours each for blocking plus repairs to finish surfaces estimated at approximately \$400 - \$800 in extra charges per 3 post job. This does not include any engineering fees if applicable.

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## **Public Hearing Results**

**Committee Action:**

**As Submitted**

**Committee Reason:** The committee concluded that the proposal provides a prescriptive solution to correct the requirements of guards transferring the outward and downward loads applied at the top of the guard to the structure and the effect of the structure failing on the guard. The committee encourages the proponent to look into adding clarifying diagrams and adding engineering products to the conventional edge framing during the public comment phase (Vote: 5-4).

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## **Individual Consideration Agenda**

### **Public Comment 1:**

**IRC: R502.11, R502.11.1, 502.11.2, 502.11.3**

**Proponents:** David Cooper, representing Stairbuilders and Manufacturers Association (coderep@stairways.org); Erik Farrington, representing myself (ewfarrington@sgh.com); Renda Barr, representing Stairbuilders and Manufacturers Association (rbarr@srg-ventures.com); Robert Aulicky, representing Stairbuilders & Manufacturers Association (acitizen@reagan.com); Marvin Strzyzewski, representing Truss Engineering Company (marvins@mii.com); Thomas Zuzik Jr, representing NOMMA (coderep@railingcodes.com); Daniel Obrien, representing Universal Building Systems, Inc. (dano@stairfasteners.com) requests As Modified by Public Comment

**Modify as follows:**

## **2021 International Residential Code**

**R502.11 Floor framing supporting guards.** The framing at the open edge of a floor supporting a required guard assembly ~~not exceeding 44 inches (1118 mm) in height~~ 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~~ ~~T~~-trusses and I-joists are ~~used~~ ~~prohibited~~ as edge framing members supporting guards, ~~except where~~ the effects of the guard loads ~~shall be~~ ~~are~~ specifically 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~~ ~~The~~ framing at the edge of the floor shall consist of a solid or built-up ~~wood~~ 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 ~~with a roll brace aligned with each guard post.~~

**R502.11.2 Timber edge framing.** ~~Where a roll brace is not aligned with each guard post, the~~ ~~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.

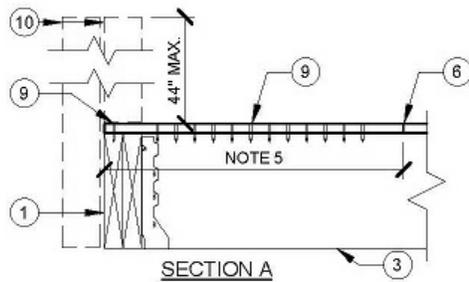
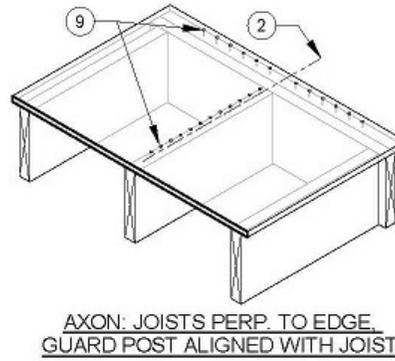
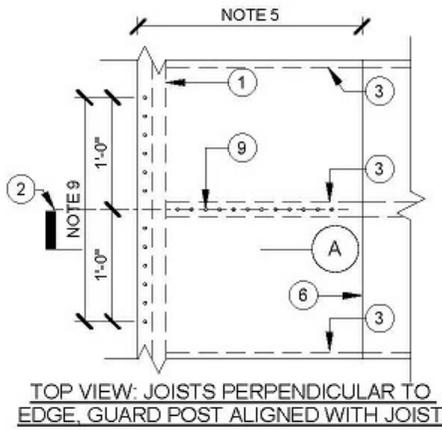
**Commenter's Reason:** The Committee approved this proposal because it provides a prescriptive solution for floor framing supporting guards that will resist required design loads applied to the top of the guard and **corrects a serious deficit** in the current requirements for floor framing **that void the warranties of engineered floor systems and allows the potential failure of the floor and connected guard assembly/system.** However the Committee specifically requested clarification by public comment. The changes included in this modification are described below. They address not only the Committee's request but also those issues raised in testimony, further collaboration of industry and editorial changes to aid in understanding.

1. Moving the text "*not exceeding 44 inches (1118 mm) in height*" and adding the words "*for guard assemblies*" to the moved phrase eliminates a possible interpretation that R502.11 would not allow engineered design for guards in excess of 44 inches in height, which is certainly not the intent.
2. Subsequent to the CAH, with recent input from truss and I-joist manufacturers participating in the task group, the inference of conditional prohibition was rephrased to more clearly state that "*Where trusses and I-joists are used as edge framing members supporting guards the guard loads shall be specifically considered in the design of the edge member.*"
3. Questions from the committee and testimony inquired as to the difference between the application of R502.11.1 and R502.11.2. The purposeful application of each section has been clarified by moving the text related to the *alignment of roll bracing with the guard posts* to the beginning of both sections to clearly establish and differentiate the dependent condition for use of each section.
4. Some of the Committee members questioned that it was not clear that R502.11.1 does not preclude the use of Structural Composite Lumber. To clarify this the phrase "*...member of lumber, structural glued laminated timber, or structural composite lumber*" has been substituted for "*wood*" to specifically include these options. Structural composite lumber would include: LVL, PSL, LSL, or OSL. The drawings included for the commentary have also been clarified.
5. Editorial changes include correction of the section titles and references to include "R" and adding "structural" prior to glued laminated timber to use the accepted terminology as in the code and related standard ANSI A190.1 *Product Standard for Structural Glued Laminated Timber*.
6. Please note the addition of many of the task group members as proponents of this public comment.

In the original published version of the monograph the drawings submitted with the proposal for inclusion in the commentary were not printed with the proposal. Although they were and continue to be accessed at the link provided in the reason statement they were requested by the committee to be included for the commentary. In the version of the proposal now available online the drawings have been included however the quality is poor. The drawings have been resubmitted with this proposal with the change to the drawing notes to clarify that of in addition to lumber, structural composite lumber is included as described in point 3 above.

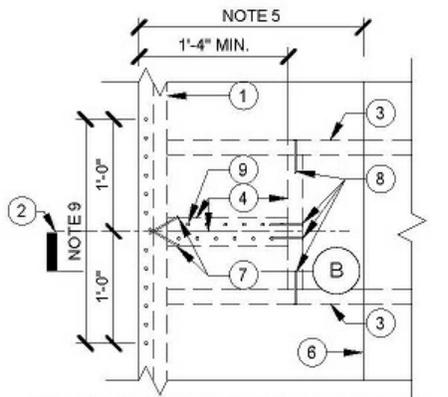
The committee requested a better understanding of only the cost differential between current deficient construction of floors supporting guards and one that complies with the proposal without consideration of the corrective measures cited in the original cost impact statement. Please see the revised cost impact statement included in this public comment. Related to cost it is worthwhile to note that 2 x 8 floor systems are not precluded however a prescriptive solution is not offered here. It was our intent to provide a prescriptive that could be simply done with available materials and nails. Special hardware options similar to those provided for the hardening of 2 x 8 deck systems are not excluded and could be used to resist the additional rotation.

It cannot be emphasized strongly enough that **this proposal corrects a dangerous deficit to building safety. Current code actually requires nullification of manufacturers' warranties** as it is not possible to connect guard posts to voids in in a floor system that has not been engineered for guard connection. Current code does not provide a hardened floor system that is capable of resisting the required guard design load applied to the top of the guard. Specifically when guards and or blocking are added subsequent to engineering of a floor system and are not included in the engineered design it not only nullifies the engineered solution and any warranty of serviceability but could result in the failure of the guard system to serve its defined purpose to "...minimize the possibility of a fall from the walking surface to a lower level".

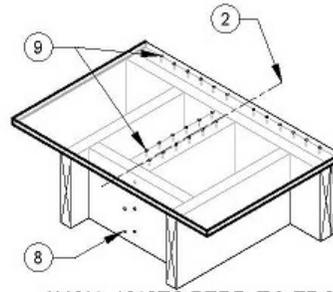


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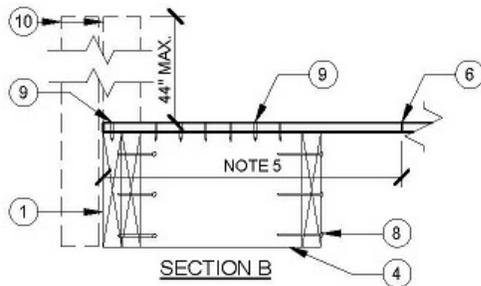
1. EDGE MEMBER WITH MIN. 3" NET WIDTH, MIN. 9-1/4" HEIGHT.
2. CENTER LINE OF TOP- OR SIDE-MOUNTED GUARD POST WITH 44" MAX HEIGHT.
3. TYPICAL JOIST (NOMINAL OR ENGINEERED LUMBER) WITH MIN. 9-1/4" HEIGHT.
4. FULL DEPTH BLOCKING WITH MIN. 9-1/4" HEIGHT.
5. FLOOR SHEATHING TO BE CONTINUOUS FOR A MIN. OF 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.



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

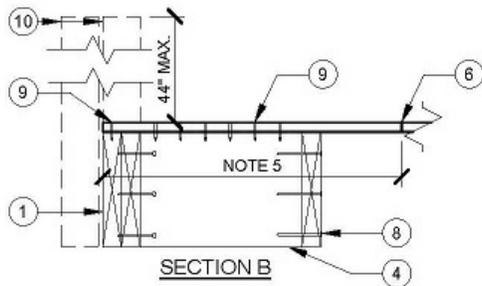
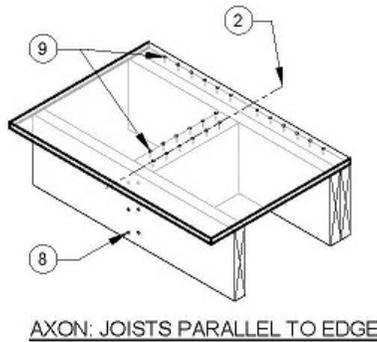
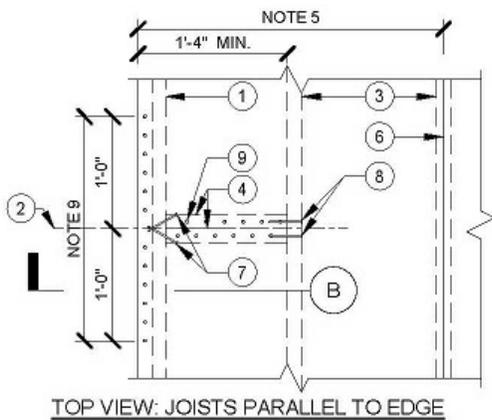


**AXON: JOISTS PERP. TO EDGE,  
GUARD POST OFFSET FROM JOISTS**



**NOTES:**

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10. TOP- OR SIDE-MOUNTED GUARD POST.

***Your approval of this public comment will correct a serious deficit in the code and improve building safety.***

**Cost Impact:** The net effect of the public comment and code change proposal will not increase or decrease the cost of construction. An edge member of 16 linear feet would be comparable to the 3 post example cited in the original cost impact statement.

Prices below are based on an internet search on 5/28/22 that provided the following prices for 16 foot members:

**2x10 Perpendicular Joist Header three Posts**

2x10x16 Double Header +\$28.00 (Single Joist Addition)

2x10 Bridging +\$0 (3- scrap cut-offs)

Nails for toenail Fasteners +\$2; Joist Hangers +\$58

SCL Substitution for 2x10x16 Double Header +\$250, Hangers +\$58

SLT Substitution for 2x10x16 Double Header +\$330, Joist Hangers +\$58

**2x10 Parallel Joist Header three Posts**

Open Web Truss = -\$75; I- Joist = -\$65

2x10x16 Double Header +\$56.00

2x10 Bridging +\$7.00

Nails for toenail Fasteners +\$2; Joist Hangers +\$0

SCL Substitution for 2x10x16 Double Header +\$250, Joist Hangers +\$0

SLT Substitution for 2x10x16 Double Header +\$330, Joist Hangers +\$0

The options underlined are the most expensive material substitutions. The labor differential is negligible when considered in the original design from the start. It would be conservative to assume less than a \$500.00 increase in materials. Compared to the costs of \$400 - \$800 to inadequately remedy the building safety deficit allowed in the code as identified in the proposal, **it would be conservative to indicate there would be no impact on the cost of construction.**

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Public Comment# 3052