Guards, Handrails, and the 2021 IRC

by Glenn Mathewson

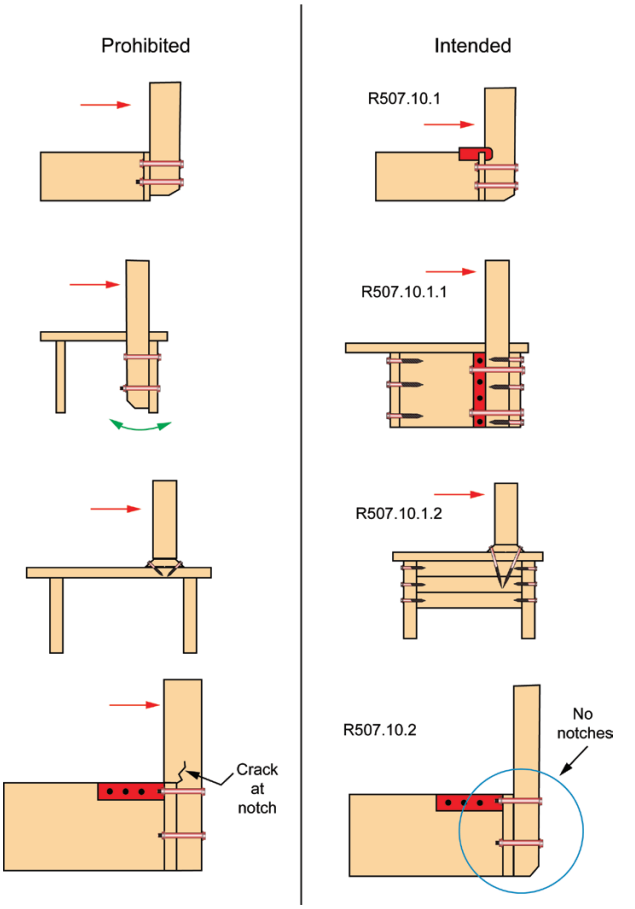
Guardrails, rails, guards, handrails ... these terms are often used interchangeably. In the International Residential Code, however, they are distinctly different features with distinctly different functions. A guard, for example, is designed to help prevent someone from accidentally falling off an elevated walking surface, while a handrail is provided for someone using a stairway or ramp to purposefully grasp for assistance and stability. In the code, a rail is referred to as a "handrail," while a guardrail is called a "guard" (see "Guardrails vs. Handrails," at jlconline.com).

While the architectural requirements for guards, such as minimum height and maximum opening size, are well understood and easy to satisfy in design and construction, validating a guard's structural capacity has only recently been formally discussed. For both interior stairs and deck stairs, inspectors typically have only one way to verify and approve the strength of a guard after completion: with a push and a pull. But research by Frank Woeste, Joseph Loferski, and others in the early 2000s brought attention to substandard deck guards and the insufficiency of typical notched guard-post attachments (see "Strong Rail-Post Connections for Wooden Decks," *JLC*, Feb/05). In response to their findings, the market focused more attention on the guard-post attachment, with deck guides and manufacturers recommending hold-down-type anchors to tie the post into the structure rather than to just the outer joist or beam.

Opinions vary on whether a prescriptive method of guard construction should be included in the IRC. The consumer market enjoys the variety of deck-guard designs that can be created, and some builders fear that if an approved structural design for guards came to be codified, it would become the single mandated design. On the other hand, the lack of any guidance in the code has led to dangerous ideas of how guards can be built. Understanding the need and realizing the stalemate, all stakeholders made compromises during the latest code modification cycle, and the 2021 IRC now offers some guidance on deck-guard construction.

Design loads. A critical first step in providing structural provisions in the code for guards was to address the design loads that must be resisted. Starting with the first version of the IRC, in 2000, guard and handrail design loads have been identical: 200 lb. in any direction at any point along the top. However, as the market began to discuss guard-post connections capable of resisting a 500-lb. design load (200 lb. x 2.5 safety factor), questions arose regarding the direction this test load must be applied. By the IRC requirement in Table R301.5, a guard must resist 200 lb. "in all directions"—which would include inward. Of course, a guard isn't there to protect an inward fall, and it doesn't require anything be attached to it for someone to grab, like a handrail. Consequently, the

Guard Post Connections



On the left are examples of incomplete guard load paths, while the examples on the right illustrate how blocking, structural screws, and metal hardware can be used to correct those defects by tying framing members connected to the post back into adjacent joists.

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The goal of the new guard-post provisions in the 2021 IRC is to avoid relying on fasteners loaded in end-grain withdrawal as part of the critical guard-post load path. Here, where blocking for the bolted guard-post connection is fastened to the joists, the end-grain connection should be reinforced with additional nails, structural screws, hardware, or some combination of all three.

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2021 IRC makes a distinction between guards and handrails in their minimum design loading. Now, a guard must resist the 200-lb. concentrated load only in the outward and downward direction, with the recognition that a guard capable of resisting such loads in those directions would be sufficiently stable if it were pulled inward.

The most notable and obvious guard provisions in the 2021 IRC are in the new section R507.10, Exterior guards, which contains four subsections covering support, posts, plastic composites, and other guards. R507.10.3 simply points back to R507.2.2, where the general requirements for testing and installation of composites are detailed. R507.10.4, Other guards, is specifically meant as a reminder that all types of guards and guard materials are permitted, provided they are installed per the manufacturer's instructions and in accordance with engineering principles. It is still the authority of the building official to request validation of either of these.

No notched posts. R507.10.2 is one compromise in the code that will make a big difference in reducing the number of dangerously built guards, but without dictating a specific design. Here, 4x4 guard posts are prohibited from being notched at the connection point when the posts support loads at the top. Though this is a common construction method in many parts

of the country, time and research has proven that in most applications, a notched post cannot support the minimum design loads. It's important to note that this prohibition was specifically written to address only the connection location. A turned 4x4 or one notched within its length is not universally prohibited.

Continuous load path. The most significant new provisions are in Section R507.10.1, Support of guards. A clear expectation is made in this section that "guard loads shall be transferred to the deck framing with a continuous load path to the deck joists." This requirement is general enough to allow for a variety of connection methods, yet descriptive enough to address the most problematic issue in guard construction: a connection only to the outer member of a deck frame. Two more subsections further address posts connected to the side of a deck frame and those connected to the top. When connected to the side, the post can be on the interior or exterior of the frame, but it must be connected to the adjacent joists in a manner that prohibits rotation of the joist or beam it is directly attached to. This can be achieved with a variety of metal hardware or by using blocking and standard fasteners. The IRC doesn't require a specific load to be resisted at this connection, as determining such a load would depend on many variables in the overall guard design that are not easily verified with engineering or product testing. When blocking and fasteners are used, the new provisions do make it clear that fasteners in end grain cannot be relied on for withdrawal resistance.

For connections to the top of the frame, the expectations are similar. Posts can be connected over the top of the decking, but the connection cannot be to the decking alone. Instead, it must be made to the frame or to blocking in accordance with the manufacturer's instructions. This connection method is intended only for designs using a manufactured and tested product for which there are installation instructions and that has been evaluated for load resistance.

For many deck builders, the new 2021 IRC deck guard post provisions won't be surprising, but for others, they should offer guidance for building stronger guards. For inspectors working daily with DIY homeowners and novice deck builders, these new codes provide something to lean on (other than the guards themselves) when evaluating guards or asking for remediation of questionable guards. While guards will still have to be validated with the same push/pull they have always been tested by, the visual observation of guard-post connections are now another means of evaluation. And remember, the "pull" part of testing guards may be easier and safer to do, but the "push" is what the code is interested in. ❖

Glenn Mathewson is a consultant and educator with BuildingCode College.com and a frequent presenter at JLC Live.