

Code-Compliant Guardrails

by Glenn Mathewson

Deck guardrails (referred to as “guards” in the International Residential Code) are an opportune place for architectural creativity. Manufacturers offer a wide variety of guard products, and carpenters are often eager to impress their customers with works of craftsmanship using various materials and methods. Creative expression in guard design can butt up against the building code, however, which has a lot to say about the height and strength of a guardrail as well as the size of the spaces between the parts that comprise one. Whether inside or outside, guards are expected to perform the same under the IRC.

Minimum Height

Guards are required on decks where a point 36 inches horizontally from the edge is more than 30 inches above the ground. The job of a guard is to keep people from falling off a deck or staircase, and the number one feature allowing a guard to perform this service is its height.

If stair balusters had to be less than 4 inches apart, three balusters would usually be needed on each tread. However, the International Residential Code allows 4³/₈-inch spacing for interior and exterior stair balusters, which means that the use of just two balusters per tread on most stairs will satisfy code.



In commercial facilities, guards must extend at least 42 inches above the floor (because 42 inches is an approximate height for a person’s center of gravity).

For residential work, guardrails need to be only 36 inches tall. The reason for the lower height is to allow people to see over the top of a railing when seated. When possible, it’s a good idea to design a 36¹/₂- or 37-inch-tall residential guard. The extra height gives you a little protection from a failed inspection resulting from typical construction tolerances.

Maximum Opening

The code used to allow openings of up to 6 inches in guardrails. Because the bodies of small children are narrower than their heads, that size opening contributed to fatal accidents by letting children slip partially through the guards with their heads still on the other side. Those accidents paved the way for the current rule that guards cannot allow the passage of a 4-inch sphere anywhere in the region from the deck up to the top of the guard at 36 inches. Inspectors generally

use a tape measure to spot-check spaces between parallel members that look like they might be greater than 4 inches.

On stairs, the 4-inch rule becomes the 4³/₈-inch rule. In order to satisfy a 4-inch rule on most stair runs, three balusters would be needed per tread — making them much closer together than 4 inches (see photo, below). The extra ³/₈-inch allowance was included in the IRC to allow the use of just two balusters per tread, whose spacing would then more closely match that of the guard at the adjacent level walking surfaces. Though derived from interior stair issues, the larger size applies to openings in exterior stair guards, such as those on decks, as well.

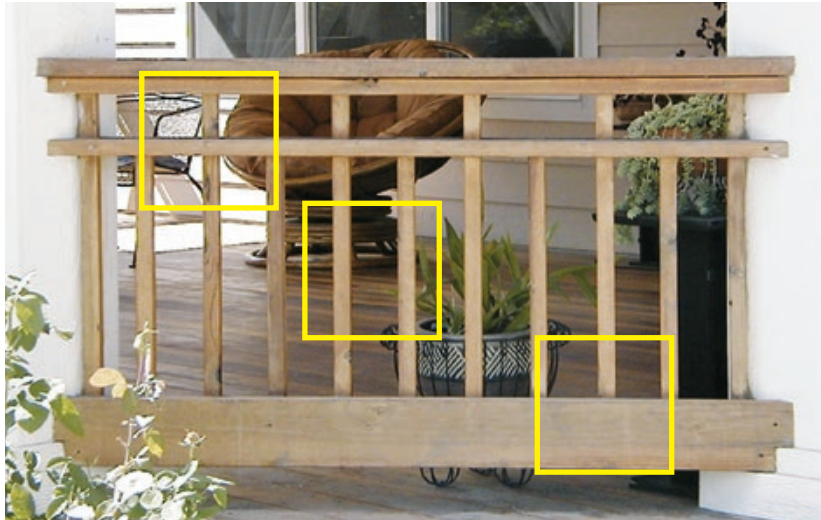
Strength

Along with regulating the height of guards and the size of openings in them, the IRC requires that they be strong enough to hold us back and hold us up. The code has separate load-resistance requirements for two areas of a guard: the top and the infill areas below the top.

Unlike guard height and the size of the openings — which are regulated only on required guards — load resistance is regulated on all guards, even those installed on ground-level decks by choice. Falling over or getting through a guard on a low-level deck is not considered a hazard. However, all guards invite leaning and sitting, and you don’t want optional ones on low decks to be booby-traps that could collapse. So, if you build a guard on a deck where it’s not required by code, you have leeway regarding the guard’s height and openings, but you still must satisfy the strength requirements.

The top of every guard assembly

STRUCTURE



Each of the yellow squares drawn on the photo above depicts one square foot. Guards must be able to resist a 50-pound load applied over any one-square-foot area between the guard's top and the deck floor. In practice, this means that no single baluster has to resist the load alone.

located at the edge of a deck must resist a concentrated load of 200 pounds applied at any point along the top and in any direction. As explained in more detail in “Safety Factor in Design” (September/October 2012), testing methods in the IBC build in a safety factor by at least doubling that 200 pounds. The thinking is that a guard's not really safe if it fails at 201 pounds. By applying a safety factor to tested assemblies and engineering analysis, less-than-perfect installations and materials are accounted for.

The code's language says that the load must be resisted in “any direction,” although outward forces from leaning and downward forces from sitting are generally the real-world concerns. (It's not often that railings are pulled inward.) Nonetheless, the message here is to build guards that are very, very strong.

The infill region — the area between the deck floor and the guard's top — is required to resist a load of 50 pounds applied over a one-square-foot area, as detailed in footnote f of Table R301.5 of the IRC and chapter 16 of the IBC. The load and area are based on the American

Society of Civil Engineers' Standard 7, which provides minimum design loads for buildings and structures. Similar to the safety factor built into the load testing at the top of a guard, a safety factor of 2 or 2.5 is applied to infill load testing, resulting in test loads that actually reach upward of 125 pounds.

The significance of the 12-inch-by-12-inch square is that a single baluster is not expected to withstand the load by itself, as that area will include at least two, if not more, balusters (see photo, above). Rumor has it that some inspectors have combined checking for 4-inch spacing with checking for load resistance by forcing balusters apart to see if the resulting opening measures more than 4 inches. I've heard other reports that a 50-pound force has been applied to a 4-inch sphere in an attempt to push it through guard infill, such as steel cable rails. But those practices are not supported by the IRC or IBC, as only the load resistance described above is required. ❖

Contributing editor Glenn Mathewson is a building inspector in Westminster, Colo., and the technical advisor to NADRA.