Getting a Grip on Railing Codes

by David Frane

With recent code changes, baluster spacing is tighter and handrails are getting closer scrutiny

CAROLYN BATES

The model codes have rules for both guardrails and handrails. This stair railing serves as both. The top rail must comply with the regulations for stair handrails, while the balustrade must meet the regs for guardrails.

It's Friday afternoon. The custom home you've been working on for the last eight months is finally done. A moving van full of the owners' possessions is scheduled to arrive tomorrow. The owners have been hard to deal with since that delay in the move-in date, but they love the final product, especially the stairs in the foyer. With the building inspector halfway through the final inspection, you begin to muse that with the last check in hand you can straighten out that mess at the lumberyard and head off for your first free weekend in months. But your daydream is soon interrupted. "The place looks great," you hear the inspector say, "but there's no way I can pass the railing on this stair."

If you don't think this could happen to you, think again. Stair safety has drawn heavy scrutiny from building inspectors and code-making authorities over the past few years. That has led to research into how to design railings that prevent falls. The research, in turn, has spawned a number of proposed and actual code changes, leaving some builders confused about what's still acceptable. In this article, I'll outline

what the current codes say about residential railings and consider what's on tap for the future.

How Codes Are Made

Most state and local building codes are based on national or regional model codes. When the model codes change, it's usually just a matter of time before the state and local codes follow. The organizations that write model codes are Building Officials and Code Administrators International (BOCA), the International Conference of Building Officials (ICBO), and the Southern Building Code Congress International (SBCCI). The Council of American Building Officials (CABO) is an umbrella organization to which the other groups belong. The CABO code, in effect, acts as a model for the other model codes.

Each model code is independent, so each has its own set of railing requirements (see "Code Reguirements," at right). While there's no guarantee that every provision in a model code will make its way into your state or local code, it's generally true that today's model codes reflect tomorrow's state and local codes.

Handrails and Guardrails

All codes require railings on stairs and ramps. Railings come in two varieties: handrails and guardrails.

Handrails are meant to be held onto; they help people steady themselves while traversing dangerous areas like stairs and ramps, and act as a guide for elderly, handicapped, and visually impaired people. They usually consist of a single rail installed at a specified height.

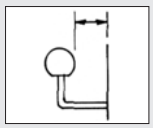
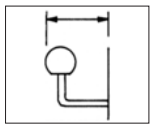
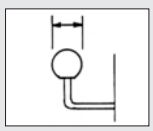
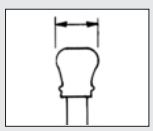
Guardrails, on the other hand, keep people from going places they shouldn't, such as over the edge of a balcony or off the side of a staircase. As such, guardrails must extend from the code-mandated height down to a specified distance off the floor. They may or may not be topped by a handrail. Balconies and decks require guardrails only, while stairs and ramps require handrails and guardrails. The guardrail is formed by the vertical balusters beneath the handrail.

Rail Placement

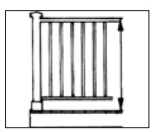
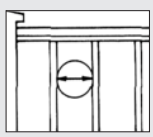
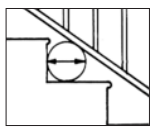
Handrails are used by people of all ages and heights, so building codes set

Code Requirements* for Handrails and Guardrails

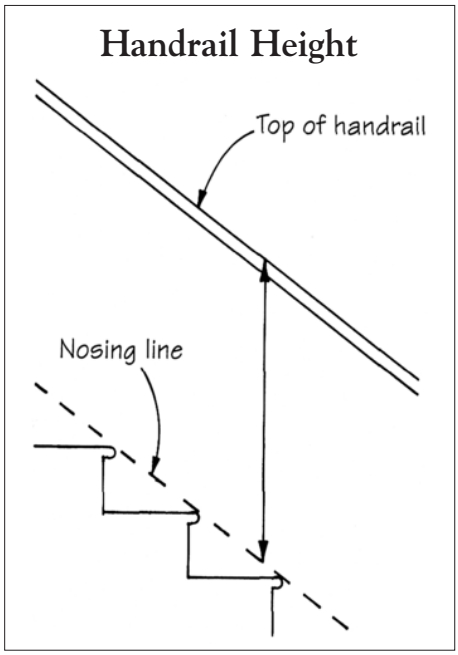
Stair Handrails

Where required:		On stairs with three or more risers
Height above tread nosing:		30" to 38"
Minimum finger space:		1 1/2"
Maximum projection into stair width:		3 1/2"
Maximum handrail size:		1 1/4" to 2" diameter for circular shape
		Any other shape with a perimeter dimension of 4" to 6 1/4", with largest cross section not exceeding 2 1/4" Any approved rail of equivalent graspability†
Design strength:		200-lb. concentrated load applied at any point in any direction

Guardrails

Where required:		On stairs and landings more than 30" above grade
Minimum height:		36"
Baluster spacing, opening limitations:		Guard built so that a 4" sphere cannot pass between any opening; no decorative patterns that provide a ladder effect
Maximum space below lower stair rail:		Built so a 6" sphere cannot pass through
Design strength:		200-lb. concentrated load applied at any point in any direction along top railing; 200-lb. horizontal concentrated load applied on a one-sq.-ft. area of guard infill

*This chart is based on the BOCA *National Building Code* (1993), and gives requirements for dwelling units only. There are slight variations between the model codes on handrail and guardrail design and construction. Be sure to consult the code that applies in your jurisdiction.
†All the model codes allow the "equivalent graspability" standard.



ILLUSTRATIONS BY WENDY BLAKEMAN

Figure 1. *Codes figure handrail heights from the nosing line, an imaginary line drawn across the tread nosings.*

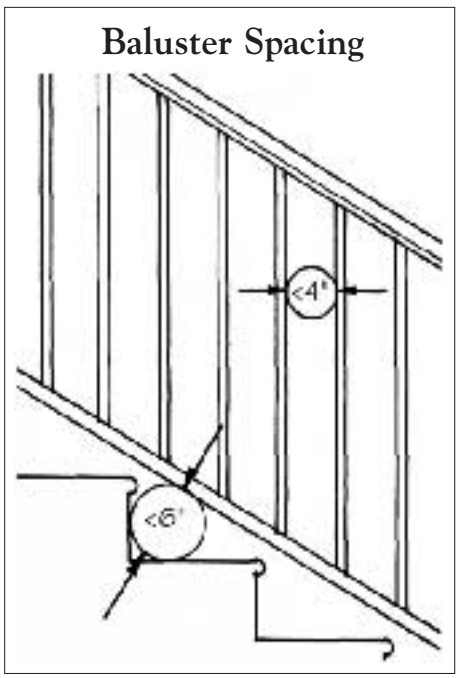


Figure 2. *Most codes agree on baluster spacing. The space between balusters should be small enough that a sphere 4 inches in diameter won't pass through them. The triangular space beneath the bottom rail should not be able to fit a 6-inch sphere.*

minimums and maximums (usually between 30 and 38 inches) rather than a fixed height. Handrail heights on stairs are measured from the nosing line, an imaginary line that would exist if a string were stretched across the tread nosings on a run of stairs (Figure 1).

With guardrails there are minimum heights, but no maximums. Most codes require that residential guardrails be at least 36 inches high, and commercial ones at least 42 inches. Of course, there's nothing wrong with building guardrails higher than this.

A guardrail may consist of a set of balusters or some other open gridwork. Tempered glass panels can also be used. The glass panels run from the floor to a wood or metal support rail. Clear glass provides an open feeling that's not possible with closely spaced balusters. I've also seen glass panels with decorative patterns sandblasted into them.

On balconies, parapet walls of the proper height may also function as guardrails. These are often plastered and capped with a piece of hardwood. Short parapet walls can be brought up to the required height by mounting rails on top of them. The same goes for stairs that are enclosed on either side by half-height walls.

Baluster Spacing

The codes seem to be reaching a consensus on baluster spacing (Figure 2). CABO, BOCA, and ICBO limit the space between balusters to less than 4 inches. As of January 1994, SBCCI allowed 6-inch spaces, though a change to 4 inches is imminent. In general, where balusters run between a top and bottom rail, the openings below the bottom rail must be sized to prevent a 6-inch sphere from passing through.

Elliot Stephenson, a structural engineer from Arizona, has been involved in the code-revision process at ICBO and BOCA. Stephenson's research on baluster spacing and guardrail geometry played an important role in the move to tighten baluster spacing. His research included tests in which children of varying ages were asked to climb through or over mockups of guardrails. He found that almost all children under 6 years old, and half of all kids under 10 years old, could pass through balusters spaced 6 inches apart. When the baluster spacing was decreased to 5 inches, it was still possible for half of all 13- to 18-month-olds to fit through them.

Even if a child can't fit all of the way through such a space, that doesn't mean it's safe. There are cases where children have gotten their bodies through a baluster but were strangled when they got their heads stuck. The 4-inch rule should alleviate this.

Some guardrails are made up of horizontal balusters. To a child, these look a lot like what they are — a ladder. Stephenson performed tests to see what things kids could and couldn't climb. While his tests showed that balusters with a 4-inch spacing were harder for most kids to climb than those with 6-inch spacing, Stephenson contends that there's no such thing as a safe guardrail with horizontal components. However, the model codes don't distinguish between horizontal and vertical balusters; the only requirement is that they be spaced according to code.

Handrail Projections

One of the changes being considered by BOCA is to increase the required handrail finger space — the space between a handrail and the wall (Figure 3). To prevent accidents, this space should be wide enough so that anyone can fit their hand around the rail. If the finger space is too narrow, a hand can become wedged between the rail and the wall, or people who need a rail to steady themselves can fall because they can't get their hand around it. The current BOCA finger space requirement is $1\frac{1}{2}$ inches, but there's a proposal on the table to increase that space to 2 inches for interior railings and $2\frac{1}{4}$ inches for exterior railings. (The wider exterior spacing is needed to accommodate a gloved hand in winter.)

Along with the proposal at BOCA to increase required finger space is another proposal to let wall-mounted handrails project farther into the minimum stair width. Current rules permit a $3\frac{1}{2}$-inch projection. The proposal would increase it to 4 inches.

Shape Limitations

Once you know that you need a handrail and that it must be a certain height and distance off the wall, about all that's left is to choose the shape of the rail itself. The answer may seem obvious — just choose the one that looks the best. But it's not so easy.

All of the model codes require that the part of the rail you grip should have rounded corners. This makes sense — holding a handrail should be pleasant, not painful. The maximum

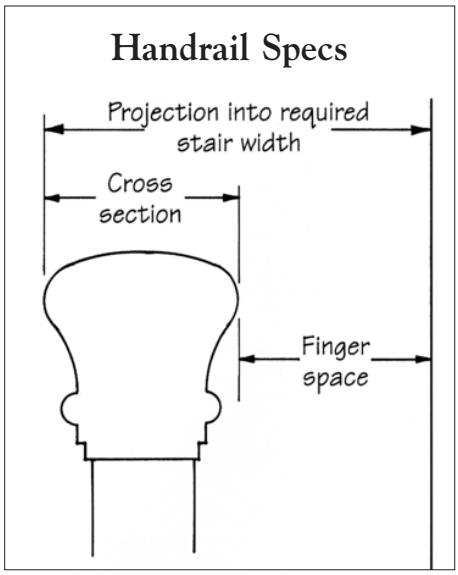


Figure 3. *All codes regulate the space between a handrail and the wall (the finger space), the cross section of the railing, and the distance the railing can project into the required stair width.*

cross section varies from code to code. CABO's *One and Two Family Dwelling Code* restricts the grip portion of handrails to a width of 2 5/8 inches. BOCA says that handrails may have a maximum cross section of 2 1/4 inches and a maximum perimeter circumference between 4 and 6 1/4 inches.

The code people could have left it at that by declaring that all handrails must be round. But few people want the railings in their home to look like broom handles; instead, they want the freedom to invent new rail profiles or to pick from traditional ones. (In fact, it's easy to find rails that are larger than the code minimums in stair parts catalogs.) Fortunately, various code bodies permit exceptions for traditional handrail shapes (those with wide rails or a large perimeter circumference). BOCA allows rails if they have "equivalent graspability" (Figure 4). SBCCI, CABO, and ICBO also allow rails that have "equivalent gripping surfaces."

If you think this sounds complicated and confusing, you're not alone. Bob Elliot, Construction Technology and Code Specialist at the National Association of Homebuilders, participated in hearings of BOCA's ad-hoc committee on stair safety. There were people who spoke before the committee who "didn't like the equivalent graspability wording because it's very subjective," says Elliot. "An inspector in one jurisdiction may find that a handrail has equivalent graspability, while a different inspector may find the same handrail unacceptable." In the end, the committee voted to keep the language allowing rails of equivalent graspability. This is good news for builders and architects who want the freedom to use wide traditional or custom rails.

If you're unsure about a particular rail profile, ask the inspector if he will approve it before you make or install it. This is especially important for custom-made rails. Trying to slip a questionable rail by the inspector is like playing chicken with someone driving a Mack truck while you're driving a Yugo. If the rail is in place and the inspector decides it doesn't meet code, you have a problem. Telling him that you were just doing what the client and the architect wanted will not get you much sympathy.

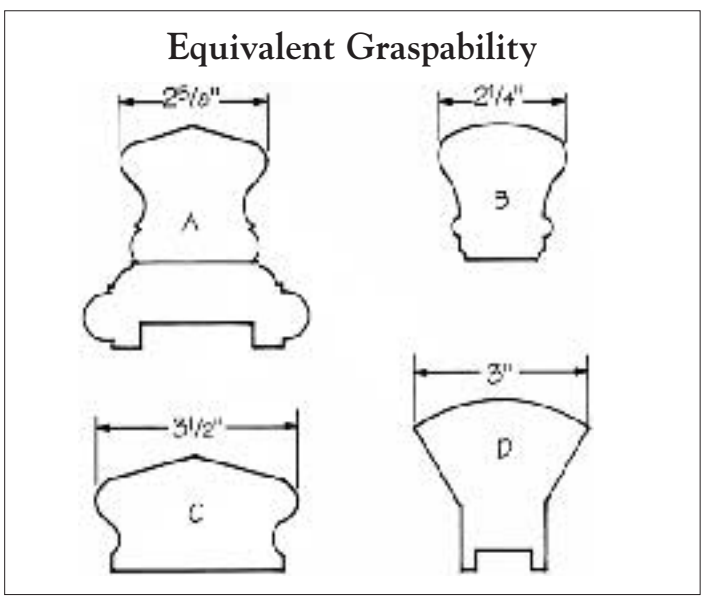


Figure 4. *All the model codes let the building inspector make exceptions for railings that are wider than the minimum but that can be easily grasped to prevent a fall. In a jurisdiction with a 2 5/8-inch maximum rail cross section, railings A and B would both pass without an exception, while C and D would only be acceptable if the inspector deemed them to have equivalent grasping surfaces.*

Strength Requirements

Handrails and guardrails must also pass minimum strength requirements. Think back to the old TV westerns. Picture the balcony rail in the saloon that some cowboy always fell through during a brawl. That's not what you want. BOCA requires residential handrails and the top member of guardrails to be able to withstand concentrated loads of 200 pounds in any direction (one large cowboy). The infill part of guardrails (the balusters or gridwork) must be able to withstand a concentrated force of 200 pounds applied over an area of one square foot. The fact that building inspectors don't actually test rails to see if they meet strength requirements is beside the point. Rails are supposed to perform a specific function. A scrawny rail, or one that's fastened to the wall with a couple of finish nails, won't perform that function.

What to Expect

Based on what's currently happening at the code organizations, what can you expect to see in the local codes over the next few years?

The wording regarding handrail shapes will probably change, but unless someone succeeds in radically redefining equivalent graspability, handrails themselves will continue to look about the same. Also, the maximum projection of rails into required stair widths may increase, along with the required finger space behind them. Guardrail and handrail heights shouldn't change very much, but the maximum allowable distance between balusters and guard components will probably decrease to 4 inches.

Keep in mind that the provisions in most building codes are minimum requirements. There's nothing to prevent safety-minded builders from building to a stricter standard, especially where the cost of doing so is minimal. This might include using taller guardrails or tighter baluster spacing. Remember, the safety of what you build is ultimately your responsibility. ■

David Frane is a foreman with Thoughtforms Corp., a construction company in West Acton, Mass.