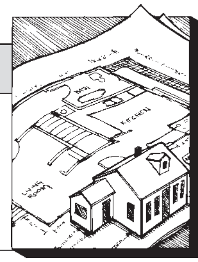

Generous Stairs For Tight Spaces

by Gordon Tully

In a small house, the stairway is a great place to create spatial drama, and needs room to breathe. On the other hand, reducing a stair to its minimum possible size makes room for other important spaces. These forces are not necessarily contradictory. My strategy is to make the stair as compact as possible, to save space; then bend the stair and leave some space around it, to create some drama.

This article deals with the first step, making a compact stair. Next month I will sketch out some ways to make a compact stair graceful and exciting.

Setting the Tread and Other Dimensions

The first step in designing a stair is to set the dimensions of the treads and risers for each run of the stair, based on code and comfort requirements. Just to remind you, a "tread" in the geometrical (and code) sense is the horizontal dimension from *nosing to nosing*, and not the actual dimension of the tread you put your foot on, which includes the overhang of the nosing (see Figure 1).

Tried and true. In public buildings, the BOCA code limits the riser height to 7 inches or less, and the tread width to 11 inches or more. Respecting tradition, for one- and two-family homes, BOCA allows risers up to $8\frac{1}{4}$ inches and treads down to 9 inches. Resist the temptation to save space by using these less generous standards, because they result in nasty, steep stairways. In practice, risers much higher than $7\frac{1}{2}$ inches or treads smaller than 10 inches create mingy stairs.

Comfortable interior stairways follow one of two time-honored and lab-tested rules of stair sizing. One says that the sum of two risers and one tread must be between 24 and 25 inches; another says that the product of tread and riser must be between 70 and 77 inches. Tread-riser relationships at the high end of these standards seem most comfortable: 7 and 11 inches, $7\frac{1}{4}$ and $10\frac{1}{2}$ inches, and $7\frac{1}{2}$ and 10 inches are good examples. (Outdoors, you need much bigger steps, because you're generally moving faster; I use a tread-riser product of at least 100 for porch steps.)

Making it work. In a new building, explore a variety of tradeoffs between riser number, riser height, and floor-to-floor height. Suppose you want an 8-foot, 6-inch ceiling downstairs. With 10-inch floor joists, the floor-to-floor height would be somewhere near 9 feet, 6 inches, or 114 inches. (This will vary depending on floor and ceiling finishes.) Dividing by $7\frac{1}{2}$ inches (the highest comfortable riser height) yields 15.2 risers of that size. Rounding to 15 risers, you divide 114 by 15 to get a 7.67-inch riser height (a strong $7\frac{5}{8}$ inches), which would pair well with an even 10-inch tread, making a pretty good stair. But if you or your client are very particular about riser height, you might try 15 risers at 7.5 inches and compromise on a ceiling height of 8 feet, $4\frac{1}{2}$ inches.

With existing buildings, of course, you simply have to choose the best even divisor of the actual height. For example, if the existing floor-to-floor height is 8 feet, 8 inches, or 104 inches, dividing by 7.5 yields 13.87. So try fourteen 7.43-inch risers, which will work well with a 10-inch tread. Or, if you are cramped for space and can live with an unpleasantly steep stairway, use thirteen 8-inch risers and a $9\frac{1}{2}$-inch tread — but only as a last resort.

Remember the finish. Take account of your eventual floor finishes. Remember that you are interested only in the height your foot must rise from step to step, so you must account for the thickness of the floor finish at each floor and on the stair itself. A thick carpet will be compressed by a person's foot, so figure in the actual compressed thickness. And don't allow individual risers in a run to vary by more than $\frac{3}{16}$ inch.

Working Out the Headroom

This step in stair design is very important, but often forgotten. You have to draw a section that shows where you run out of headroom. Some codes require only 78 inches (6 feet, 6 inches) of headroom over all points of a residential stair. But the 1990 BOCA Code requires 80 inches (6 feet, 8 inches); perhaps because I am tall, I have always liked to maintain 80 inches anyway. If you're close but not quite there, the inspector may not notice a violation of the headroom requirements, particularly over winders, but you shouldn't count on it.

So how to maintain this

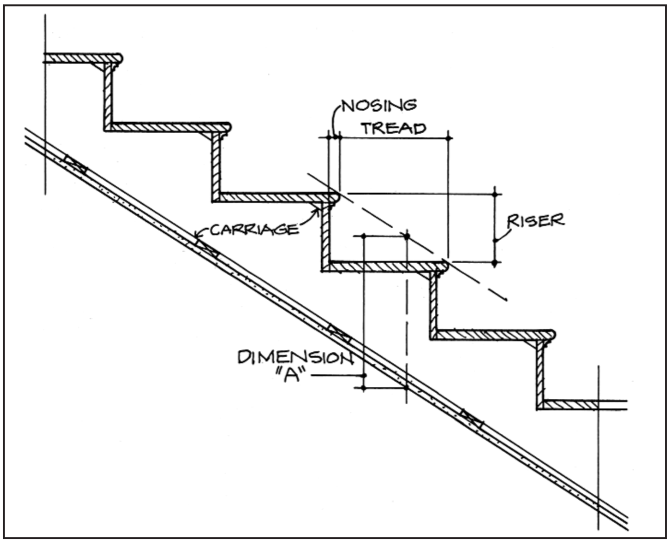

Figure 1. *Dimension A — the vertical depth of the staircase — is crucial for design purposes. It is determined by the steepness of the stair, the carriage thickness, and the thickness of the finish.*

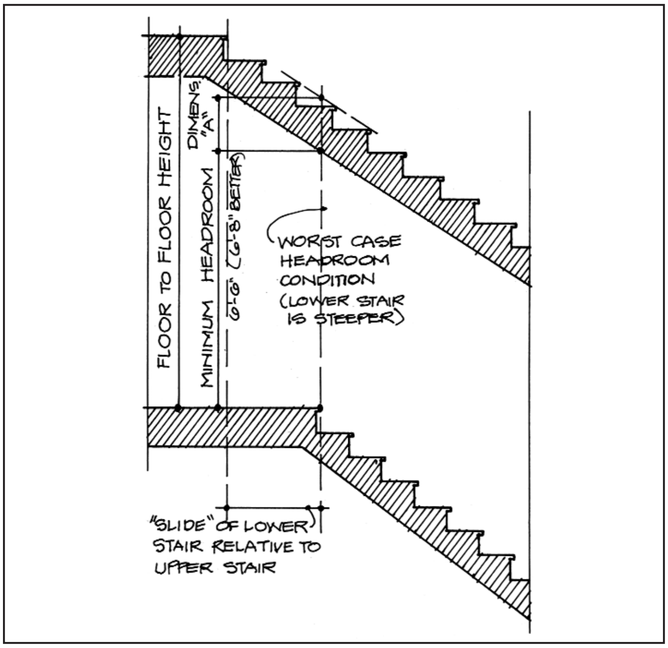

Figure 2. *If dimension A plus the minimum required headroom is less than the floor-to-floor height, you can "slide" the upper stair back over the lower stair to gain more headroom. This is often necessary when you have to stack the runs in a small space.*

headroom? Take a look at the cross-sectional detail (Figure 1) of a typical stairway supported by 2x10 stringers. Imagine there is a string stretched over the finished stair from nosing to nosing. Notice that the vertical distance between this string and the ceiling below the stair (dimension A) increases as the stair steepens. It also increases if you need a 2x12 stringer instead of a 2x10, and if you strap the ceiling below. It decreases if you build the stair without an undercarriage, using thick treads or boxed treads and risers that span from side to side.

Accounting for thickness. When you lay out a stair in section, your task is made much easier if you first calculate the overall thickness of this stair "box" (dimension A in Figures 1 and 2), then add the minimum headroom to come up with a fixed vertical dimension for the stair and headroom above it. In most cases, this fixed dimension will be less than the floor-to-floor height, giving you a few extra inches to work with. This fixed dimension will tell you how far you can jam a lower stair run under an upper one to save floor space. In plan, this translates into the number of risers you can offset one stair relative to another (see Figure 2).

Fooling around. The vertical dimension of the stair and headroom also helps you figure out how far you can extend a floor or landing over a stair. If you are

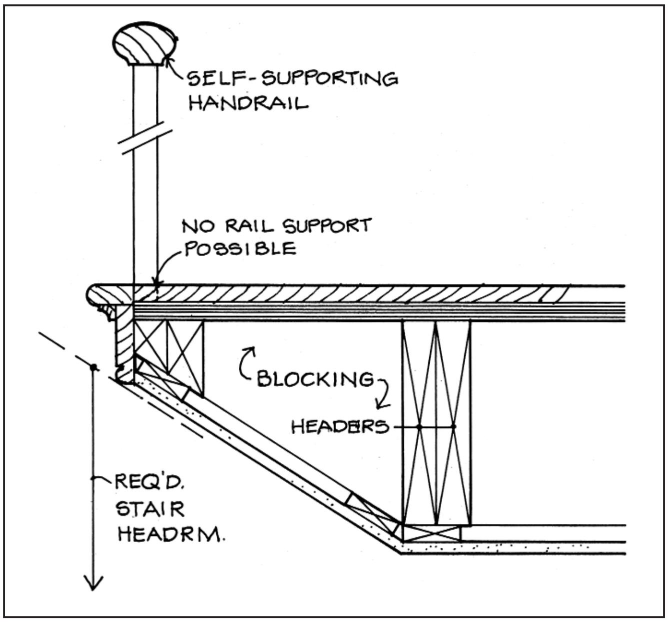

Figure 3. *To gain headroom under a landing, you can clip off the edge of the landing. This may look elegant in section, but be sure to work out the trim. In addition, the railing above the landing edge must anchor to a wall or another railing, since the thin floor edge won't be strong enough to resist horizontal forces.*

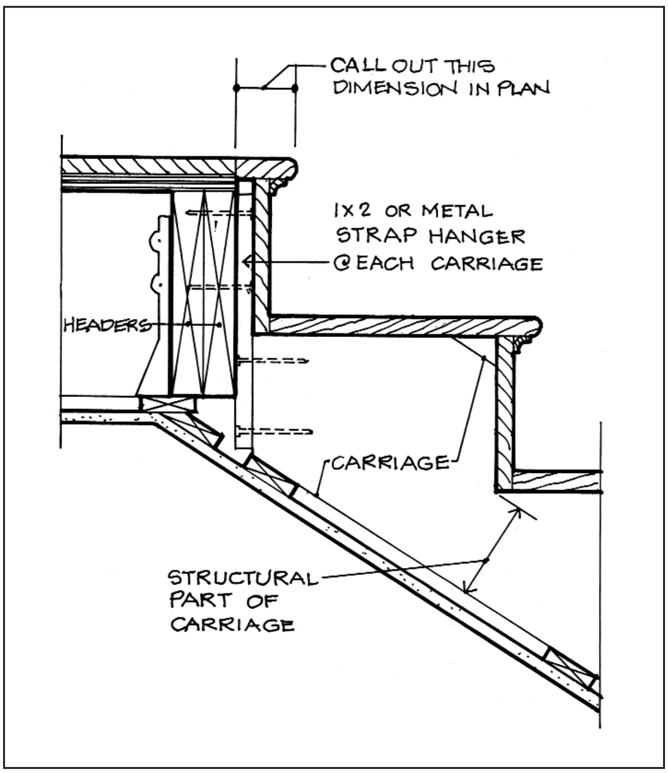

Figure 4. *I always show this stair framing detail in the plans to prevent confusion. The connection to the upper floor determines how the ceiling breaks below the stair. This arrangement avoids the little triangles and vertical drop-downs that can otherwise occur.*

stuck for space, consider cutting back the framing to create the required headroom. A common practice is to locate a closet with a raised floor above the top run of the stair; any built-in, such as a bench or platform bed, would serve the same purpose.

Cutting back the floor at a landing is a bit trickier (see Figure 3). There has to be enough framing left to support the floor, and possibly a railing, so 4 to 6 inches is a usual minimum floor edge dimension. Don't commit yourself to such a tapered floor at the landing edge without first exploring how you will trim it out: it might end up looking like a dog's dinner.

Work Out Details Before Final Plan

Armed with the sections, you can work out the plan. One key to planning is to count accurately. It is very easy to get confused because in each run of stair there is always one more riser than there are treads. In drawing the stair, write the number of each riser on the plan — 1, 2, 3, etc. — so you won't make a mistake. Also, keep careful track of the way the stair turns, and make sure it keeps turning the same way at each floor! (All sorts of difficult planning problems can be "solved" by drawing an impossible stair.)

I always detail a stairway, at least in a general way, before laying it out in plan. For instance, consider the inside corner of a landing: A 4x4 newel post will receive the risers and nosings and make detailing easy, but eliminating the newel might save precious inches. Then the question becomes: Can you work out the details so that the nosings at a corner form a sharp right angle and still maintain the required stair width (usually 3 feet)? Take account of the railing: a continuous railing requires room for sweeping turns, whereas a newel post will allow a sudden drop in the rail.

You can save space by using winders. I don't subscribe to the popular belief that winders are dangerous. If they're deep enough, I think they are safer than straight runs, because you can't get up any speed if you fall: you're always facing a rail. But be sure you read the code carefully before designing winders; requirements vary.

After all this careful planning, you'd best draw up a careful set of details and be on the job during construction. This will ensure that if changes have to be made, the space-saving advantages of your design will be retained.

Otherwise, the carpenter, who is probably used to a particular way of building stairs, may simply ignore the dimensions and frame it his or her own way — then you'll get that call that you put in too many risers or didn't include enough headroom, and you'll know the worst has happened. Such problems usually start with the framing around the stair, which can be the trickiest part (see Figure 4). It's best to be there with the carpenter to go over exactly how the framing relates to the finished stair. All this is easy if you *are* the carpenter — then you can have all these arguments with yourself. ■

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