BY CHRIS DEBLOIS

Framing Trouble Spots

In my 30 years as a structural engineer, I've designed framing for hundreds of houses. The new houses and big renovations that come across my desk today are nothing like the colonials, ranches, and capes of years past, where things stacked nicely. Today's architects and designers seem to have decided that stacking and aligning is no fun and that span lengths can be almost unlimited.

The International Residential Code tells me what loads to design for and how much deflection I'm allowed under those loads, but it tells me almost nothing about framing layout. Which way should the joists run? How far is too far? Is it better to support a bearing wall with a beam parallel to the joists, or to sit that wall across a series of joists with all of them providing a little support? These can be tricky questions. Answer them wrong and you may end up with noticeable humps, sags, or slopes in your floors.

I've learned to avoid these problems by watching for four common pitfalls: changes in loads, changes in spans, changes in direction, and changes in support.

CHANGES IN LOADS

Anything heavy can cause problematic load changes. Kitchen islands are a common example. The joist next to an island might have a dead-load capacity of 10 pounds per square foot and a live load of 40 pounds per square foot, which means only 20% of the predicted deflection happens right away—the rest happens only when the kitchen fills with people.

The joists under the island will likely have the same code-mandated capacity, but in reality might have to support a dead load of 40 or 50 pounds per square foot, including that 20-pound-per-square-foot granite countertop. In other words, those joists will see a full 50% of their predicted total deflection before ever encountering the 40-pound live load.

If the kitchen joists span 20 feet and the allowable total deflection is 1 inch (if we were willing to design for that much movement), the aisle joist would deflect less than 1/4 inch and the island joist about 1/2 inch. That creates 1/4 inch of slope between two adjacent joists—way too much.

Bottom line: When you have heavy dead loads, provide more or stiffer joists than the code requires.

CHANGES IN SPANS

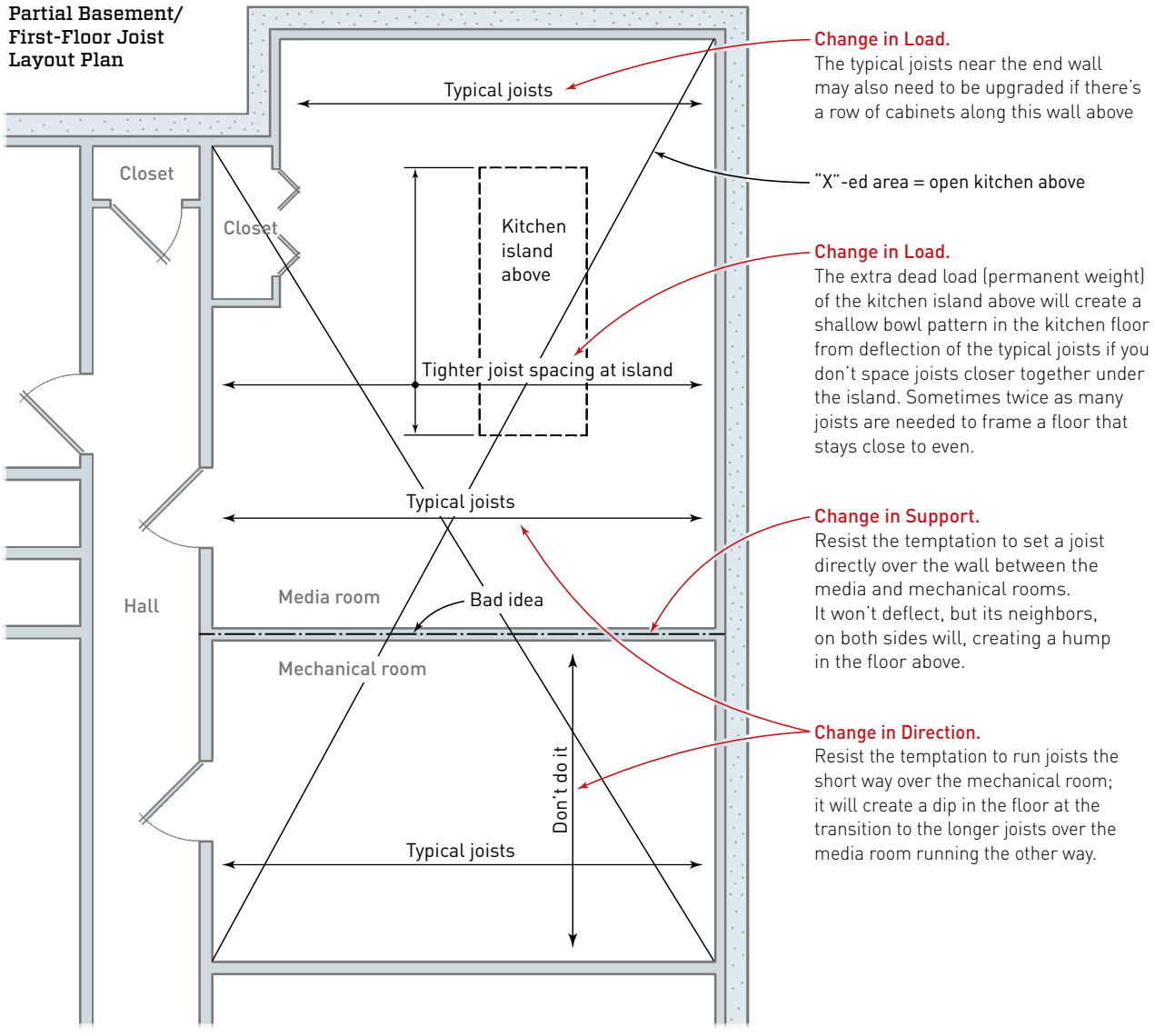
I see many examples where two adjacent joists have radically different spans, such as in a stairwell where the joists running parallel to the opening on either side might span 18 feet while those that end on the opening's header span only 10 feet. You need to keep the extra deflection on those longer joists from being noticeable. Options include extending the stairwell header to break up those longer spans or stiffening the long joists up by doubling them.

CHANGES IN DIRECTION

There are many reasons why running all your joists in the same direction is usually a good idea. I try not to change joist direction without a really good reason, especially under the middle of an open room or where walking through a door would drop me right at the mid-span of a long joist, as doing so could create a 1/4-inch or 1/2-inch slope over 16 inches.

A simple example is where you walk out of a second-floor room onto a balcony looking over a

Floor Framing Trouble Spots



Floor-framing challenges. The partial basement plan shown above poses a number of potential problems, depending on the joist layout. At the top of the drawing, there are two potential changes in load—from kitchen cabinets and from a kitchen island. Both might call for a tighter joist spacing to avoid extra deflection in the kitchen floor, depending on the extent of the loads. At the wall separating the media room from the mechanical room (middle of drawing), it's important to remember not to set a single joist directly over the wall. Doing so would create a hump in the floor along the line of the wall below. Finally, resist the temptation to change the direction of the joists over the mechanical room or you risk creating a dip in the floor.

Illustration: Tim Healey

two-story great room. If the walkway joists run the long way, you may be stepping out onto the mid-span and may feel a noticeable slope in the floor. I prefer to either cantilever the room joists out over the walkway or frame to a substantial beam running the length of the walkway. Either way provides much more gradual slopes and deflections.

CHANGES IN SUPPORT

Sometimes extra support can be a bad thing. I saw a good example of this once when I was doing a framing walk-through, as a favor to the builder, for a house I didn't design. It was a fairly open plan, with long spans on the left side of the first floor and with joists running side to side over the basement.

There were two bedrooms under the stair area with a wall between them that the framers had set one joist directly over. All but one of the joists were free to deflect under load, while that one joist on top of the basement studwall stayed proudly level. The result was a noticeable hump in the floor.

The International Residential Code tells me what loads to design for and how much deflection I'm allowed under those loads, but it tells me almost nothing about framing layout. Get the details wrong and you may end up with noticeable humps, sags, or slopes in your floors.

It would have been better if the builder had not set a joist on top of the basement bedroom wall—it wasn't a load-bearing wall, so the joists could have straddled it. To fix the problem, the builder chose to add more beams to reduce the span of the first-floor framing, rather than tearing out the wall and reframing the joists—both of which had already been plumbed and wired.

When you're laying out floor framing, of course you need good support for all spans and all bearing walls. But if you're also careful with changes in load, spans, and direction, you can avoid a lot of headaches.

Chris DeBlois, PE, is Principal of CFD Structural Engineering, in Roswell, Ga.