

STRUCTURE



Opening Up Space How much can you do without an engineer?

BY CHRIS DEBLOIS

As a structural engineer, I get questions from builders and remodelers about when I need to be involved and when they are safe specifying the work themselves. The most common context for this question is when a homeowner has asked the contractor to open up a load-bearing interior wall, maybe to replace a standard door with a large casied opening or to combine adjacent rooms into a single room with a flush ceiling.

In place of the wall, you will have to specify a new beam with support posts at each end to carry the load to the foundation. You will need to make connections from the existing framing to the new beam

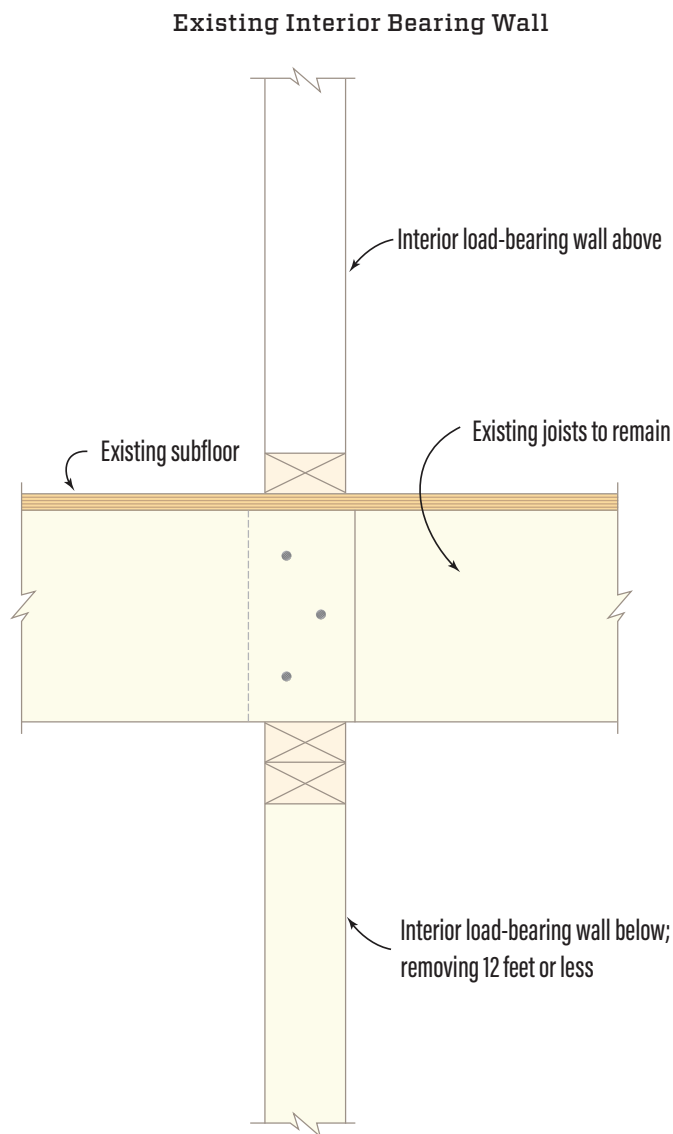
and, in some cases, from the beam to supports to the foundation.

You will also need to consider the details of how and where to frame temporary supports to hold everything up during demolition and installation.

Of course this is a common, bread-and-butter framing problem. And in most cases, a thoughtful builder can easily handle it. However, several structural issues need to be considered, and there are situations where getting an engineer's help is a smart call.

Please note that the advice here is only for standard wood or engineered wood beams. If you're installing something else, such as a flitch beam or a steel I-beam, you will need an engineer to specify it.

Photos by Roe Osborn; illustrations by Ola Kwiatkowska



Existing situation. This section drawing shows a bearing wall to be removed to open up space. The illustrations on pages 43 and 44 show different conditions that dictate whether this job could be handled by a competent builder alone or should include an engineer's input.

WHEN YOU (PROBABLY) DON'T NEED AN ENGINEER

If you've been in the business a while, you know how to specify structural wood beams

using span charts from the code or engineered lumber manufacturers. If the project is relatively simple, those charts (and your skills and experience) are all you'll need.

You likely will not have to call a structural engineer if most of the following conditions are met:

It's an interior wall. The loads that most interior walls have to support are less complex than those borne by exterior walls, and you rarely need to worry about lateral bracing for wind and earthquake loads.

It's a short span. A good guideline is 12 feet or less. The issue is deflection. Though 12 feet is not a magic number, anything shorter, in my experience, is rarely a problem.

The load will be uniform. The beam will not have to support perpendicular beams, braces, or other concentrated loads.

There's room for posts. If you can install jack and king studs at each end of the beam, and there's a clear and straightforward path to transfer those concentrated loads all the way to the foundation, you should be OK.

You don't have to cut the joists. If the new beam will be installed below the existing ceiling rather than embedded in it, the job is a lot simpler.

The foundation is stout. The posts that support the beam for the new opening will need to transfer their loads to existing grade beams or crawlspace piers.

There are no unusual restrictions. These could include limitations on beam depth or the fact that the homeowner or architect wants to use decorative materials, whether a non-rated wood species or some other material.

You're not drilling through the beam. Drilling should be limited to, at most, a few small holes for wiring.

There are no temporary support complications. Support should be a straightforward matter of building temporary walls on either side of the wall to be removed, as well as below them if there's a basement.

There are no non-technical demands. That means no permitting, zoning, or customer requirements for an engineer.

If nearly all those conditions are true,

then there's likely no need to call an engineer. Use the span charts to identify appropriate beam and support sizes, shore it up, cut it out, frame it in, and you're done.

WHEN IT'S WISE TO SEEK HELP

Although most jobs will be straightforward, there are situations where you will want to consult someone like me. Use the following complicating factors as a checklist to help you make that call.

This is a long list, but don't let it stress you. The most common situations that call for an engineer are the first two: long spans and flush beams with depth restrictions. The other ones are much less common, but you need the ability to identify them.

Long spans. For most beams exceeding 12 feet in length (and for all beams longer than 14 feet), you should run your plans by an engineer.

Depth-restricted flush beams. Say that you'll be recessing the beam into a floor system with 2x8 joists and that the span chart calls for an 11¹/₄-inch-deep LVL. If you're OK with 4 inches of beam protruding below the ceiling, there's likely nothing to worry about. But if you want to create a flush ceiling by using multiple 1³/₄-inch LVLs side by side or perhaps a flitch beam or steel beam, an engineer should specify them.

Concentrated loads. These include cases where there was a post embedded in the old wall that supported a perpendicular beam. The new beam will have to support concentrated loads, and the needed calculations will go beyond the scope of standard charts. An engineer needs to specify the beam as well as the connections.

Load path questions. You will need an engineer if you don't have room to install simple supports at either end of the beam extending continuously to the foundation.

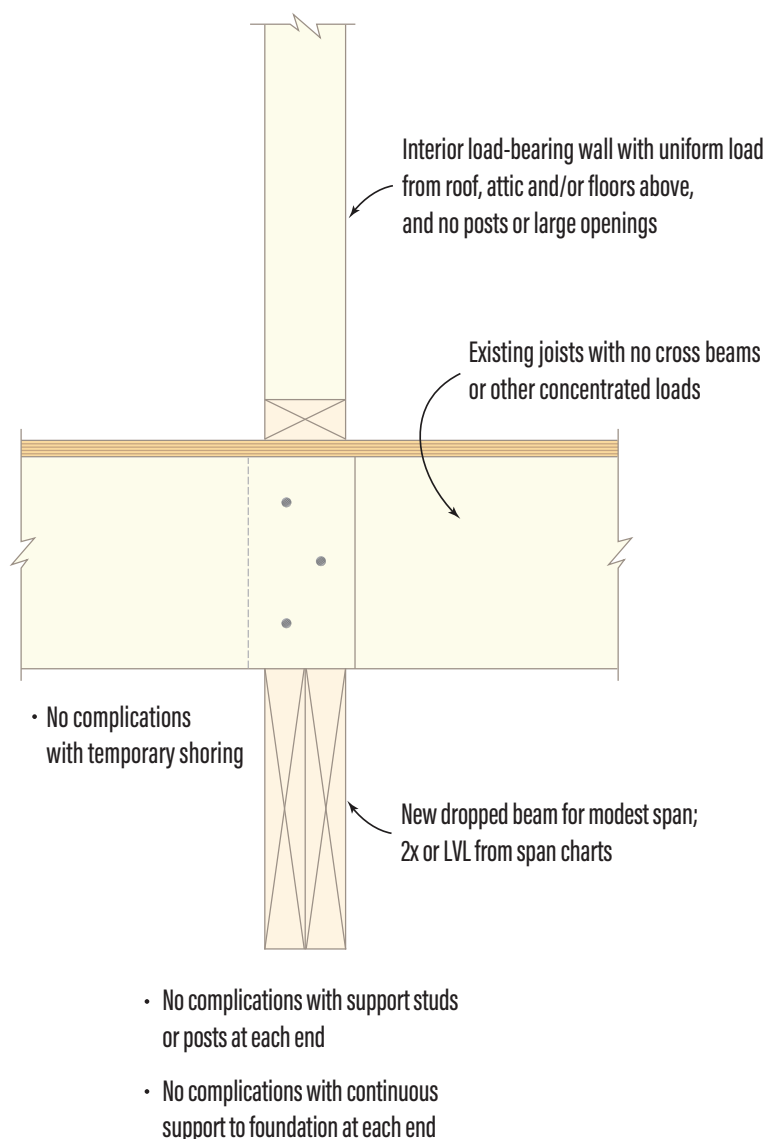
A simple load path is where the ends of the new beam sit directly on posts (whether solid posts or built-up 2-bys). To transfer

the posts' concentrated loads down to the foundation or footing, you will probably need to add blocking in the depth of the floor system. If you have any uncertainty

about how to do this, call an engineer.

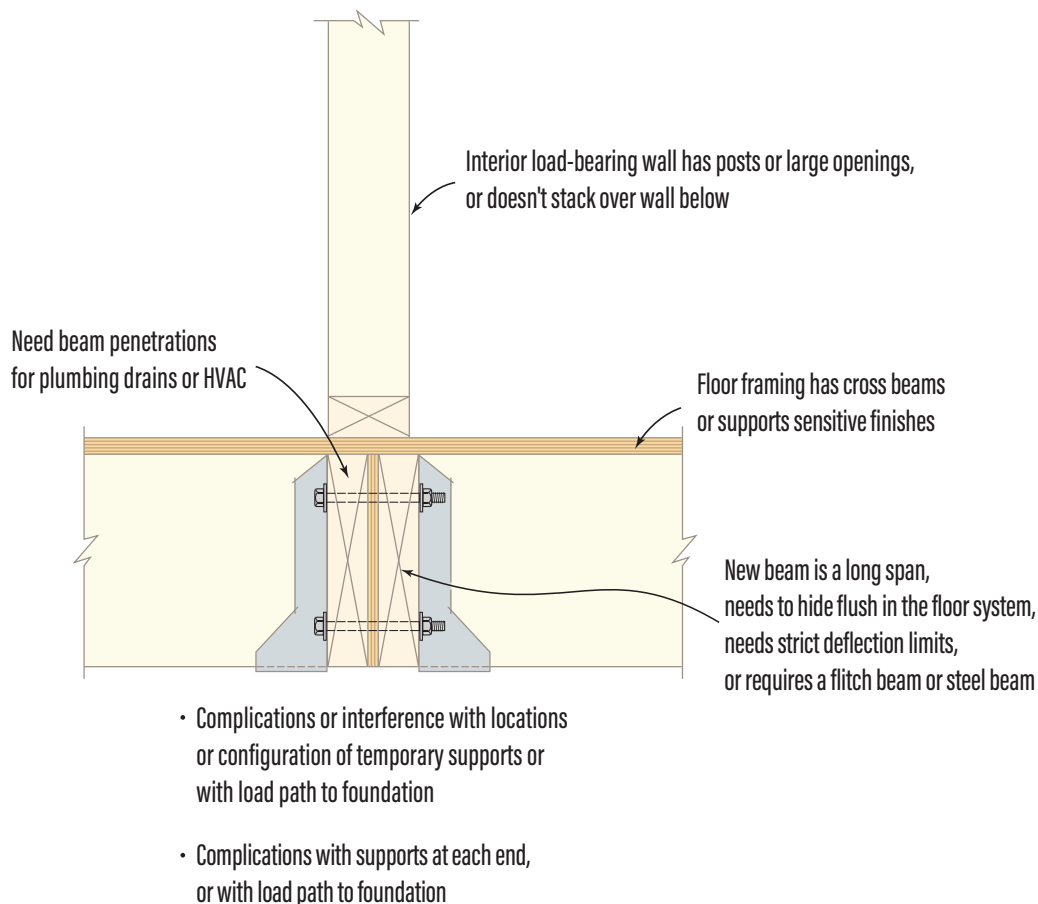
You should also seek help if the load path is complicated and less direct. An example is where one of the new posts

Conditions a Builder Can Handle



Simple load path and span under 12 feet. In the scenario shown above, conditions make it relatively straightforward to define a clear load path to the foundation. In this case, the job can probably be handled by a competent builder.

Conditions Requiring an Engineer



Call an engineer. In this second scenario, the beam is embedded in the floor joists (a flush beam), and creating a simple load path is not possible. In this case, the builder should seek guidance from an engineer.

lands directly above a basement feature—whether a furnace closet or a countertop in a finished space—which means you’ll need to install a beam down there to transfer the concentrated load.

You can’t get to the foundation. Let’s imagine that there’s no clear way to transfer a post’s load to the foundation and that your only option is to install a post below the floor system that bears on a 4-inch basement slab—or perhaps on dirt, in the case

of a crawlspace. Most contractors will dig and pour a new footing (which includes jackhammering a hole in the slab if there is one). It sounds straightforward, but you should consult an engineer on the required thickness and steel reinforcement.

Unusual restrictions. If the span charts specify a deep beam that won’t leave enough headroom, if there’s an architectural preference for an exposed timber beam, or if the clients want anything other than a

standard beam from code or from manufacturers’ span charts, call an engineer.

While we’re on the topic, do yourself a favor, and don’t let clients talk you into cedar beams. Cedar is a relatively weak structural material, and it definitely won’t last as long in an exposed environment as you hope it will. Instead, find better alternatives. Cedar is wonderful for decorative elements, but not for structural members that bear significant loads.

Holes may be needed. If you anticipate wanting to make plumbing or HVAC penetrations through the beam, my advice is this: Don't do it! Yes, the code and manufacturers' literature have guidelines for drilling through joists, but those guidelines don't work for beams. In fact, anything other than a 3/4-inch-diameter hole for wiring should be specified by an engineer.

Deflection limits. Standard span charts generally won't cover situations with stricter-than-usual deflection limits.

For instance, above the beam may be a bathroom with wall or floor tiles that you want to make sure won't crack. Or you may be installing an accordion or sliding door system with requirements for limited deflection in the supporting framing (these doors are rare on interior walls, but not unheard of). In either case, call an engineer.

It's an exterior wall. For new openings in exterior walls, you'll generally need to think about not only how to hold up the weight above the new beam but also how the new opening affects the lateral (wind and earthquake) bracing of the house as a whole. In this case, there's more to it than just the new beam and supports. Call an engineer.

Tricky shoring conditions. This is the same issue as I covered above in load path questions. On most jobs, you can just build temporary walls, sometimes stacked at multiple floor levels, to hold things up while you remove the existing bearing wall and install the new beam and supports. If for some reason you can't do that, such as when you have to bridge over an obstacle in the basement, call an engineer.

Non-technical considerations. Even if the construction issues are straightforward, you may still want or need to bring an engineer on board.

Your local building department may require an engineer's plan or report to specify the work. Or it may require an engineer's letter signing off on the completed work, in



Removing part of an interior bearing wall to create an opening less than 12 feet long with a direct load path to the foundation is a straightforward condition that most competent builders can handle on their own. However, on the job shown here, an engineer provided by the LVL supplier verified the beam size and bearing requirements—welcome guidance for the builder.

which case that engineer will almost certainly want to specify it in the first place.

Bringing in an engineer may also make sense to satisfy the owner's concerns. Owners often don't understand what's involved in specifying the new structure, and they sometimes imagine that the work is more complicated than it is. Bringing on an engineer can assuage that anxiety.

Sometimes, an owner or real estate agent will insist that you include an engineer so that when the house is sold, they can show a potential buyer that they've made the renovations in the most thorough way possible.

THE BOTTOM LINE

I want to repeat that there are a lot of projects where an engineer is not necessary. An experienced contractor can handle most

jobs that include removing an interior wall without seeking outside help. But if you've been through the checklist of potential complications above, and you find that one or more apply, call an engineer.

Finally, remember that homeowners call you because they want their projects done well and because you're someone who specializes in exactly the kind of work they need. For the same reasons, it may make sense to hand off the structural analysis to a specialist. This frees you to focus on those parts of the project you're really good at. Let the engineer take responsibility (and liability) for the parts he or she is trained for.

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