Fire Separation Walls

These code-required assemblies can complicate construction, but they can also help the structural design

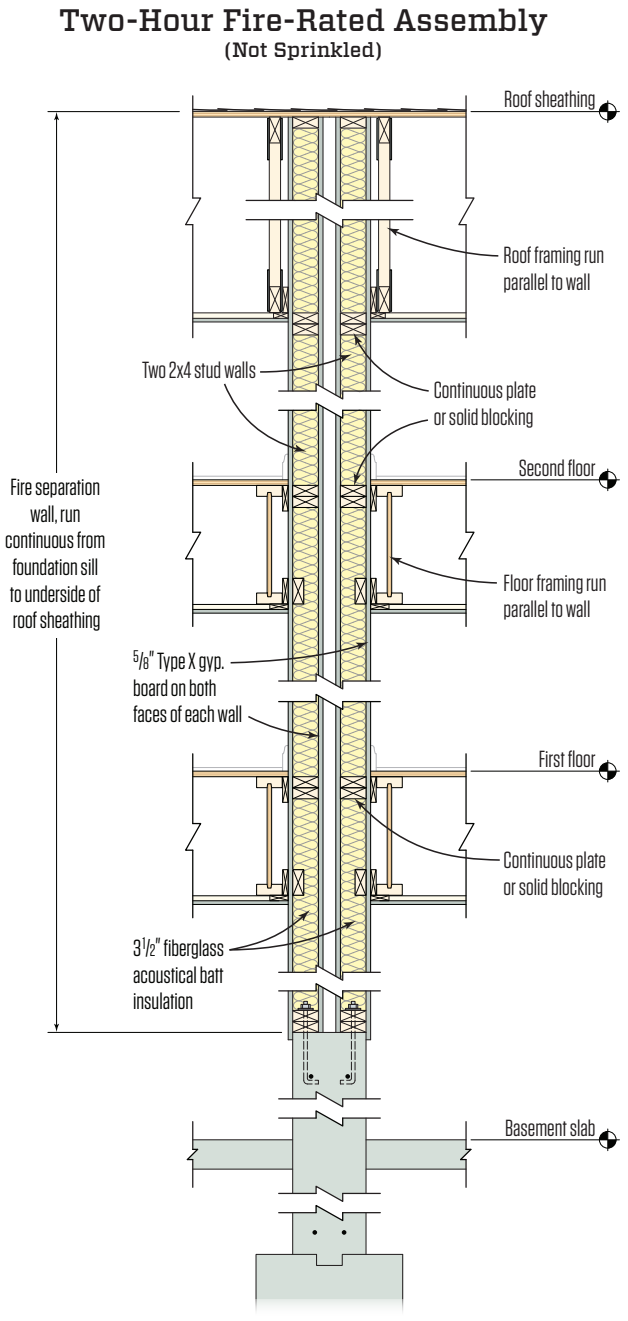
BY ANDREW P. DIGIAMMO

Photos by Ted Cushman; illustrations by Tim Healey

I'm an architect and builder working in coastal New England. As a design-build contracting firm, my company has the good fortune to be able to control both the designs for our projects and the process of construction. Of course, we have to comply with the same code requirements as everybody else. But with thoughtful design choices, we can sometimes turn those code requirements to our own advantage, or at least make sure they don't create unforeseen construction problems.

Fire-related code provisions are a good example of this. In wood-framed residential work, the requirements are fairly simple, but a few code rules do apply. If you build two-family or multifamily buildings, you have to provide what are called "fire-resistance-rated assemblies" for the walls that separate adjoining units. In the International Building Code (IBC), the wall between two condo units or apartments is referred to as a "fire partition." The term "fire partition" doesn't appear in the International Residential Code (IRC), but in practice it's the same thing: Whichever code applies to your building permit, walls between two adjoining units in a low-rise wood-framed multifamily structure generally need to be documented as having either a one-hour or a two-hour fire-resistance rating, depending on the case.

The requirements for fire partitions aren't as strict as they generally are for a "fire wall" as defined in the IBC. True fire walls serve to divide structures into pieces that the code treats as separate



This classic example of a two-hour fire-rated assembly has two independent stud walls, each with fiberglass in the stud bays and 5/8-inch gypsum board on both sides. Neither stud wall carries any floor load, but floor sheathing and ceiling wallboard are tied into furring secured to blocking in the wall.

buildings; and in fact, the classic example of a fire wall would be the wall of a building sited right on the property line and touching an adjacent building on the neighboring property, owned by somebody else. Fire partitions that separate two units in a single two-story wood-framed building with a common owner are quite a bit simpler. But they still need to be done right, and they can still make trouble for you.

Initial concept is important in design. You don't design the space first, and then figure out how to separate it. It's better to start the design work with the fire-protection considerations already in mind. That way, you don't have to resolve conflicts late in the design process (or worse yet, during construction).

DIGGING INTO THE CODE

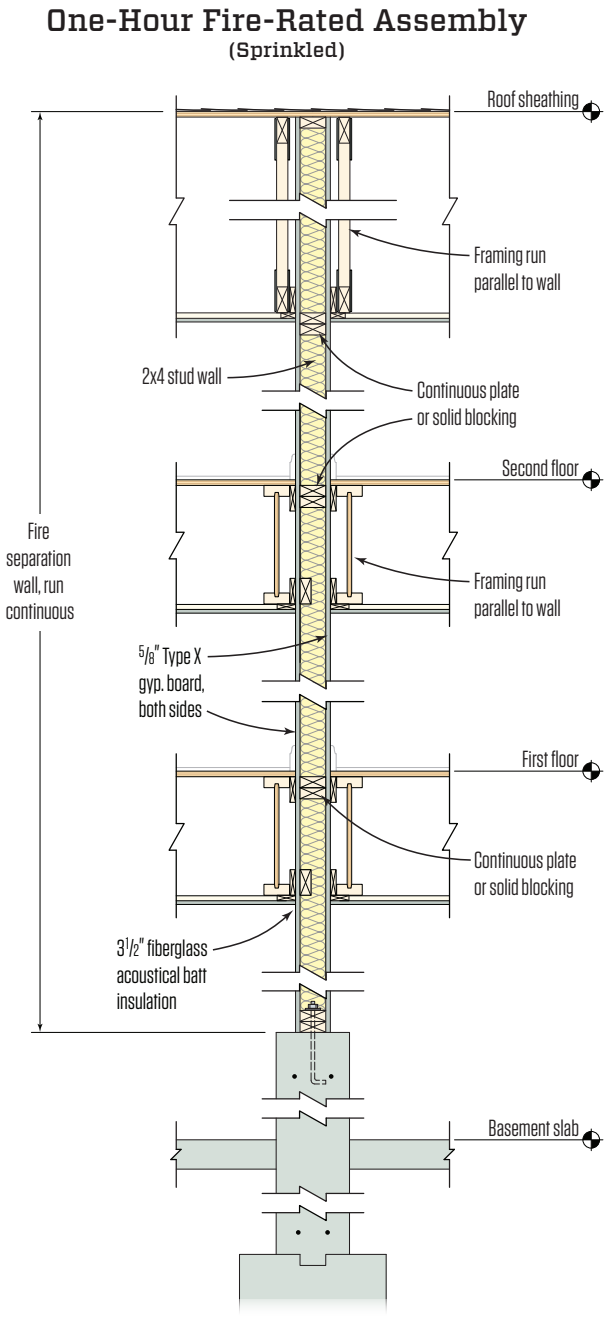
When it comes to fire-related aspects of the code (as with other kinds of requirements), there are huge differences that divide non-residential construction from typical one- and two-family projects. The code issues in commercial work are far more complicated, and the fire-related rules are much more demanding.

When I'm approaching a commercial project—even if it's just a small office or strip-mall building—I usually undertake a formal building code analysis using the International Building Code (IBC). I start with Chapter 3 (Use and Occupancy) and identify the project's "Use Group": Is it residential? Is it storage? Is it mercantile? Then I check Chapter 4 (Special Detailed Requirements Based on Use and Occupancy) to see if there are special requirements that apply. I'll also dig into Chapter 6 (Types of Construction) and consider the type of construction my project involves: Is it noncombustible (such as concrete and steel), or heavy timber construction, or something else? And then I look at Chapter 5 (General Building Heights and Areas) to make sure that my project fits within the allowable size for the type of construction I'm considering. When I submit my plans to the building department with my permit application, I usually include a sheet that lists and explains all the relevant code issues from my analysis (they like to see that).

You can build one- and two-family houses without consulting the IBC. Those projects fall plainly within the IRC. The scope of the IRC also covers "townhouses," which the IRC defines as single-family attached dwellings, three stories or less, with every unit having at least two exposed walls that provide fire egress into open space (typically, that's the front and back yards, but corner units could also qualify). But it's rare for a multi-family project to fall under the scope of the IRC; in Massachusetts, I never see it. If a residential design involves three or more attached dwellings, I always refer to the IBC.

Consulting the law. It is important to remember that your code analysis doesn't complete your due diligence for a project. You also have to consider local and state laws. According to Massachusetts state law, for example, multifamily buildings with three or more units must have fire sprinklers. That requirement isn't part of our building code, but it is part of our general law.

On the other hand, when you do sprinkle those buildings, the code, for its part, allows you to reduce the fire rating on the unit



This typical one-hour fire-rated wall assembly uses just a single 2x4 stud wall with fiberglass in the stud bays and 5/8-inch gypsum board on both faces. A one-hour fire-rated unit separation wall is allowed for duplexes, or for multi-unit buildings that are equipped with approved fire sprinklers.

separation walls from two hours to one hour. So when I build in Massachusetts, I can use just a one-hour fire-rated wall between condo units, but I have to install sprinklers. If I build the same project in other states, I might have to construct two-hour fire-rated walls between the units, but I might not have to install sprinklers.

Practicality and cost. As the builder, I need to control costs. That's why as the designer, I try to keep things simple. If you're a builder who doesn't control the design, you need to watch out for situations that can have an impact on your costs, your schedule, or even the feasibility of the project. Here are a few red flags:

- Offsets. If you see the party wall jog at all, instead of being a straight line, you could be looking at trouble. If a plan for a duplex, for instance, is laid out as two L shapes that come together to form a rectangle, it can be costly and difficult for the builder to detail the wall corners, as well as the intersections between the walls and the floor and roof framing.
- Horizontal separations. If two adjoining units are separated by a floor instead of by a wall—that is, one unit is upstairs from the other—you'll need a fire-rated floor assembly. Those are much tougher to build than fire-rated walls.
- Horizontal-to-vertical jogs. The king of them all is a horizontal separation that turns into a vertical separation. Constructing horizontal and vertical fire-rated assemblies that intersect out in the middle of nowhere could become a logistical nightmare on the job.

If I'm designing a row house, I avoid all those configurations. But if designers aren't thinking about the fire separation issues, they'll do that stuff all day long: They'll jog the wall between units or bring an upstairs room over a downstairs space belonging to the other unit, stepping the unit separation walls over from one story to the next, just to solve a floor-plan problem.

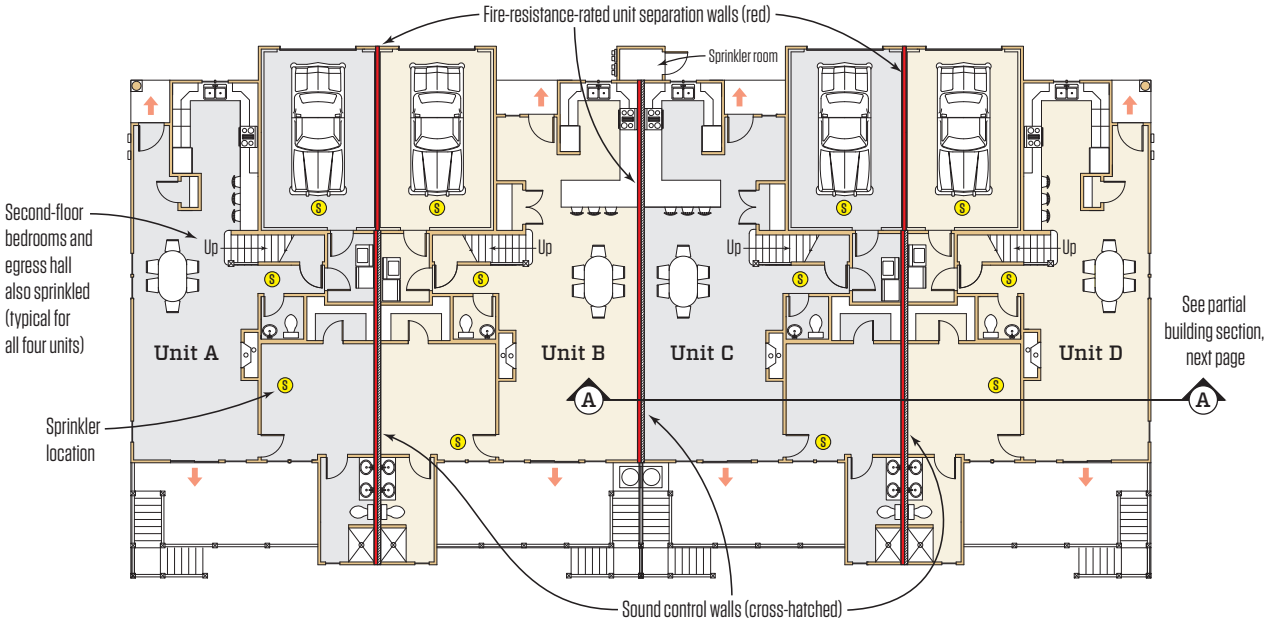
As the builder, if you see a plan with any of those situations, you need to get clarification from the designer right away. Even if the architect supplies a well-drawn detail, the builder will have increased costs and complications. And you definitely don't want to get into construction and then figure out how to deal with complex fire separation requirements, because when the inspector shows up, you'll be tearing something apart.

THE SIMPLE SOLUTION

Keeping the design concepts simple makes it easy to stick with listed fire-rated assemblies that have been laboratory tested for fire performance. When I design a building plan requiring a fire-rated assembly, I always choose a fire-rated assembly that's listed by Underwriters Laboratory (UL). I call out the UL number in the plans, and then we build the assembly the way it was drawn in the UL catalog. This is for prudence; it's an iron-clad solution that can't be second-guessed. If you're a builder who's not the designer on a project, you shouldn't hesitate to ask the architect for a UL number for any fire-rated assemblies in the scope of work, for your own protection.

The wall sections shown on the facing page and at left are two versions of a typical unit separation wall for a wood-framed

Simple Unit Separation Walls



To preserve views for other buildings in the development, the author designed several four-unit townhouses (see floor plan, above) with sloping rooflines at the building ends. Roof and floor loads are borne by the fire-resistance-rated unit separation walls. Because the building has fire sprinklers (mandated by Massachusetts law), the wall separating the dwelling units needs only a one-hour fire rating. The wall is constructed with 2x4 studs, fiberglass batts, and 5/8-inch Type X drywall on both faces. Engineered wood ledgers support the floor framing running from wall to wall.

multifamily building with three or more units. (These are conceptual sketches, of course, not working drawings—as I said, in the real world, it's best to strictly follow the details of a UL-listed assembly.) The "Two-Hour Fire Rated Assembly" illustration (on page 32) consists of two 2x4 stud walls side by side (or back to back), with ⅝-inch gypsum wall board on both faces of each wall and fiberglass batts in the stud cavities. The section illustration on page 33 is a typical one-hour fire-rated wall sufficient for a sprinklered building—just a single stud wall with ⅝-inch gypsum board on both sides, and batts in the cavities.

The batts in these assemblies, by the way, may have been included for sound control rather than fire resistance. UL-listed fire-rated walls usually carry a Sound Transmission Class (STC) rating as well as a fire rating. Regardless of that, I always include the batts in the actual wall in order to conform with the specification.

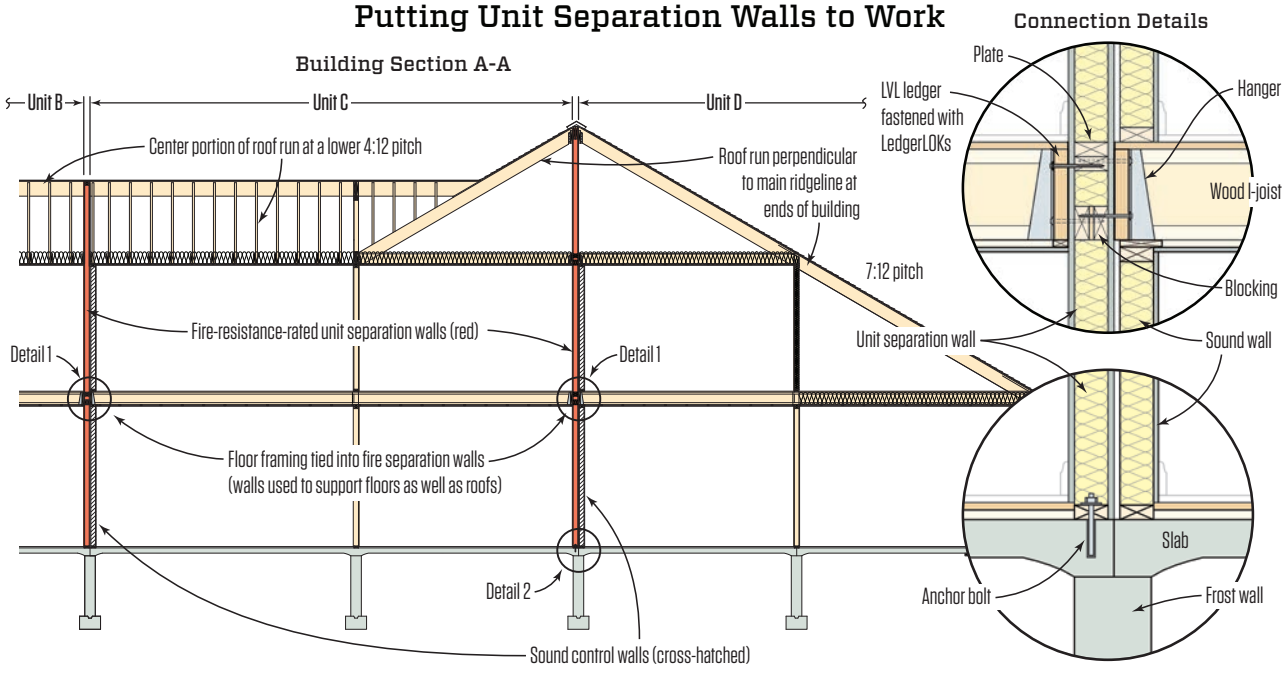
As required by code, the fire-rated walls are continuous from the foundation sill all the way up to the underside of the roof sheathing, and there's a continuous plate (or a line of solid blocking) at all floor levels.

In a typical scenario, the fire-rated separation walls don't do anything but provide fire and sound separation between the apartments or condo units in a building. They're not supporting the floor or roof system, and they're not handling any lateral load (that is, they're not shear walls, or "braced wall lines" as defined in the IRC). The floor framing for the building runs parallel to the fire separation wall, and it bears on the front and back walls of the building. This is the simplest and most economical way to build fire separation walls.

The floor is typically supported at mid-span locations by partition walls and girders. To stay on the safe side, I always design those mid-span girders and their supporting posts to be independent from the fire-rated wall, not buried into it.

I've seen cases where a builder has used posts framed into the fire-rated wall to support floor girders pocketed into the wall. To maintain the fire protection, they line the girder pocket with the same gypsum board used to cover the wall.

Your building official may allow it, but I wouldn't advise it, because if the floor were to collapse in an actual fire, the falling girder could tear a hole in the fire-rated wall and allow fire through into the unit next door. Recessing the beam end into the unit separation wall could also be considered a deviation from the UL specification for the fire-rated assembly.



Here's a section view of the same four-family building shown in the plan view on the facing page. The unit separation walls support gable roof framing that allows a "view triangle" between buildings for the units behind them and further up the hill, away from the water. Joist hangers attached to LVL ledgers lagged into the wall from each side support the wood I-joist floor framing. The weight of floors and roofs reduces the hold-down requirements for the unit separation walls (which function as shear walls in this design, resisting the high coastal wind loads).

WORKING WALLS

Properly detailed, however, a fire partition wall can be used for floor or roof bearing. A substantial fire separation wall in light wood-frame construction is typically beefy enough to be useful as a bearing wall. So, even though it's more complicated to build, I sometimes use the fire-rated wall between units to handle jobs in addition to fire separation. The illustrations above and on the facing page show an example where we built a unit separation wall to carry floor and roof loads, in order to help meet the design objectives of the project.

This building was sited in a coastal location with a 110-mph design wind speed, so it needed shear walls. The unit separation walls were about 60 feet long with no openings, so they supplied a lot of bracing. In fact, they had enough shear capacity to manage the wind loads without plywood, based only on the lesser shear capacity of the gypsum board.

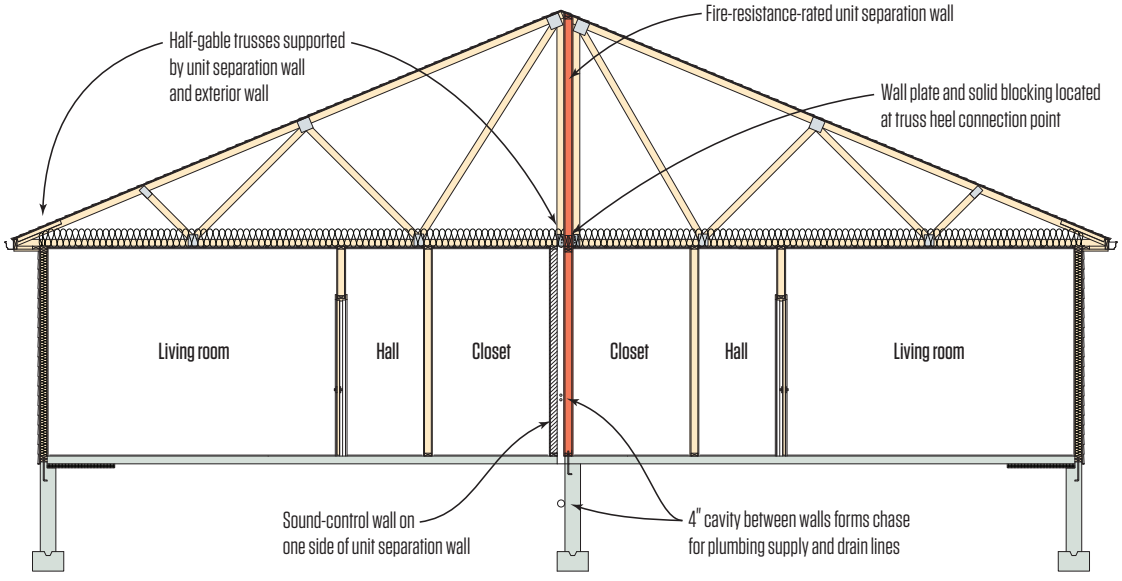
As is typical with a waterfront building, views were also a consideration. This building was one of eighteen on the site. Five were sited right on the waterfront, and the rest were positioned further back and a bit uphill. My concern was that the buildings closer to the water not block the view from the others on the site.

The design shown here is for the buildings that were closer to the water. If we had built a typical townhouse configuration, with trusses parallel to the unit separation wall, the ridgeline would have blocked the view from the buildings uphill. So instead, we stick-framed the end roofs at a 7/12 pitch with sloping gables perpendicular to the main ridgeline, facing the water, so the roofs for the units at the ends of the buildings formed a "view triangle" between the ends of the buildings. The center portions of the roof, over the two center units, were stick-framed at a lower 4/12 pitch. The low rooflines and the end gables allow residents of the uphill buildings to enjoy good views of the water.

Floor support. We also tied the floor systems into the unit separation walls, using those walls to support floors as well as roofs. This connected the floor diaphragms to the shear walls. Besides that, the weight of the floors and roofs partially counteracted the uplift forces on the shear wall that develop out of the wind load. That meant we didn't have to install expensive hold-downs in the shear wall—we could just use conventional anchor bolts.

The section drawing above shows the connection details where the floors tie into the fire separation wall. The wall needs to run continuously from the foundation to the underside of the roof

A Two-Family Solution



Duplex houses require only a one-hour fire-resistance rating in the wall separating the two units. In this example, because of the shape of the building lot, the author chose to run the unit separation wall down the length of the building. The wall was framed from slab to ridgeline, and supported a roof frame constructed with half-gable trusses. Following a UL-certified fire-rated assembly specification, the wall was framed with 2x4 studs and 5/8-inch Type X gypsum board on both faces. A second wall, framed from the slab to the ceiling in just one unit, provided enhanced sound control.

sheathing, protected by gypsum board the whole way. To carry the floor system, we attached engineered-wood ledger boards to the wall, fastening the ledgers to the walls with FastenMaster LedgerLok screws.

I have to perform a load calculation on the screws in this application, because there's a capacity reduction for the fasteners associated with the gypsum board that falls between the structural ledger and the framed wall. In principle, that gypsum board has no capacity to support the screw—so the screw is in effect cantilevering through the 5/8-inch thickness of the gypsum board, and it takes more screws to do the job than it would if they were applied through solid wood.

Sound-control walls. In the four-family building illustrated on pages 34 and 35, there are two walls dividing each pair of units—one that's continuous from foundation to roof sheathing, and one that only runs from floor to ceiling in each story. The second, shorter walls are there for sound control. Sound transmission can kill a multifamily project; if people can hear their neighbors through a common wall, they are not going to buy that unit—or they are going to be very unhappy. The second wall helps to dampen any sound.

Code allows ductwork, plumbing, and wiring to be located in fire partitions, but the requirements for specialized components and the restrictions on the location of penetrations get complicated (the rules are in Chapter 7, "Fire and Smoke Protection Features," of the IBC).

I like to avoid putting anything like that in these walls. But the walls do need electrical outlets—and even if they're installed in compliance with Chapter 7 of the code, outlets in common walls between rooms are a typical way for sound to get through a wall. By providing two back-to-back walls between the neighbors, we create separated wall cavities so that the receptacles don't create a connected path for sound.

The shorter walls in the four-family solution aren't necessary to support the floors, and the gypsum board on one face doesn't contribute any significant bracing. But it's easy enough to frame up a second wall, and it's well worth it for sound control. This extra wall also adds an extra layer of fire protection in the event of a fire, increasing the amount of time firefighters or sprinklers would have to suppress a fire before it spread to the unit next door. It's not a factor in code compliance, and it's nothing you could document, but it adds generally to the quality of the building.

The author's crew frames a duplex building with units arranged back-to-back (see illustration, facing page). Working from a rolling scaffold on the floor slab, the crew first attaches 5/8-inch Type X gypsum board to the unit separation stud wall (above left), then sets trusses for the roof (above right).

BACKBONE FOR A DUPLEX

By code, even a one-story duplex house needs a one-hour fire-rated separation wall between the two halves of the house. Usually that's a very simple structure to build. In a conventional side-by-side flat duplex, you simply frame a stud wall and set a pair of gable end trusses on top of it. It's easy to attach 5/8-inch Type X gypsum board to both faces of that wall and the trusses to achieve your one-hour rating. Then the trusses for the two halves of the flat—the two ends of the building—just span from the front wall to the back wall of the structure.

But in the example I show here, we were limited by the narrow dimensions of the lots. So instead of dividing the houses crosswise to the ridge, like a typical one-level duplex, we split them back to back down the spine of the building.

This made the process of framing more complicated. The fire separation wall had to continue up to the ridge of the building. So the crew had to frame the stud wall all the way to the ridge, brace the wall off, apply gypsum board, and then set roof trusses against the wall.

In the photos above (and also on page 31), my crew is at work on a rolling scaffold. Working their way along the wall, they hang the 5/8-inch Type X drywall from floor to ridge, and tape all the seams and screws. Then they set their trusses, move the staging, and start the next section of wall. We built these houses in 2001. If I were to build them again, I might do things very differently; but the principles haven't changed.

Like the previous four-family example, this fire-rated separation wall is just a single stud wall. But as in that case, we built a second wall on one side of it for purposes of soundproofing. The floor plan was also laid out with sound in mind: Along the common wall are hallways, utility rooms, closets, and baths (rooms that don't need a view). This helps to further isolate the main living spaces in each unit from sounds generated in the adjacent unit. At the same time, this layout affords all the main living areas a good view of the outdoors.

Details that block fire and smoke also help to prevent sound transmission. One of the ways I know that we did a good job on this fire separation wall is that we haven't had one noise complaint from the occupants of these buildings, 15 years later.

Architect and builder Andrew P. DiGiammo owns and operates Residential and Commercial Master Builders of New England, based in Assonet, Mass.