Economical Framing

To conserve materials and save money, avoid overbuilding and design on 4-ft. modules

by E. Lee Fisher

Back in January 1973, the National Association of Home Builders' (NAHB) Research Center was commissioned by the Department of Housing and Urban Development (HUD) to devise a cost-effective framing system. I was the director of industrial engineering on that project, and what came out of it was the Optimum Value Engineered (OVE) house.

OVE is like a streamlined version of conventional wood framing. NAHB took a long, hard look at waste—materials that added nothing to the strength, durability or marketability of stick-framed houses. The OVE house was built without superfluous materials. With less material to put into the house, there was less work to do, so money was saved on both materials and labor.

The OVE house proved to be safe, marketable and inexpensive: everything HUD wanted in 1973. Nowadays, with the environment getting almost as much attention as the economy, DVE makes even better sense. Because the system reduces the amount of lumber products in a house, it conserves natural resources.

Most builders, regardless of production volume and price of their homes, will find the OVE approach to framing easy to incorporate. Many builders throughout the country have already instituted many of the lumber- and plywood-savings methods prescribed by OVE. Most OVE methods are accepted by the major model building codes, but you should check with your local building officials before trying these methods.

Less material, equal quality. **Many builders are now using a modified version of conventional wood framing called OVE (optimum value engineered), which was developed by the NAHB Research Center to make houses more affordable.**

Materials-based design—If you want to give OVE a try, start with design. A cost-effective floor plan has the most floor area enclosed by the least amount of exterior wall. For example, say you've got two homes, both of them with 1,200 sq. ft. of floor area. The first home has a 20-ft. by 60-ft. floor plan, so it's got 160 lineal ft. of exterior wall. The second home has a 30-ft. by 40-ft. plan; it's got 140 lineal ft. of exterior wall: 20 ft. less wall enclosing the same amount of floor area.

When designing a house, the goal should be to keep the floor-to-wall ratio as high as possible. In the example, the first home has a 7.5:1 floor-to-wall ratio; the second has a 8.5:1 ratio.

Lumber and sheet products—plywood, oriented strand board, particleboard, gypsum wallboard, etc.—are produced in 2-ft. increments. Minor adjustments on the plans can make more efficient use of lumber and sheet products, reducing waste and eliminating framing members.

The most cost-effective design places all exterior walls and as many interior walls as possible at 4-ft increments, or modules. This major module is divided into minor modules of 2 ft. (drawing facing page). This scale matches the width of most construction sheet materials and standard lumber lengths, thereby eliminating cutting labor and reducing scrap. Consider a wall that's 22 ft. 9 in. long. This wall takes just as much plate lumber and sheathing to build as a 24-ft. long wall (remember, lumber products are produced in 2-ft. increments). However, the shorter wall creates almost 4 ft. of scrap plate lumber and over 9 sq. ft. of scrap sheathing. In addition, at least one stud bay will be narrow, making the insulation contractor cut a batt to fit. The longer wall actually costs less to build.

Traditionally, roofs have been designed without much consideration for sizes of framing members and plywood sheathing. Plans are drawn for 4-in-12, 6-in-12 and 6-in-12 pitches without weighing the effect on efficient use of lumber and plywood. But there's nothing magical about whole-number roof pitches. Consider drawing a roof-sheathing layout that takes maximum advantage of the 4-ft. by 8-ft. dimensions of plywood and let the pitch fall where it may. This roof design eliminates plywood and lumber scrap plus the associated labor for cutting.

Designing around stud spacing—Window and door placement offer more opportunities for material savings during design. Placing at least one side of each opening so that it falls on a stud (photo above) eliminates up to half the studs used for framing openings, and sheathing can be placed without excessive cutting and fitting. Moving windows and doors only 2 in. or 3 in. can save as many as 20 studs per house, depending on the number of openings. Well-placed openings also reduce the number of very narrow stud bays, which are difficult to insulate.

Moving openings to fall on studs won't normally damage the house aesthetically, except if you move a large opening—a full bay window taking up nearly an entire wall, for example—where the small walls on both sides of the opening could be of obviously different widths.

In conventional wood framing, most builders use three studs or two studs and three blocks to form a partition post, or channel, where walls intersect other than at corners. But by designing interior walls to intersect exterior walls on 2-ft. modules, ends of the interior walls will hit exteri-

Photo this page: E. Lee Fisher

or wall studs (OVE employs 2-ft. o. c. spacing), eliminating extra nailer studs and blocking (left drawing, p. 48). When an interior wall butts into an exterior wall stud, you just need drywall clips, not blocking, to fasten drywall. And again, by placing interior walls to fall on normally occurring studs, insulation installation is easier. As far as interior trim is concerned, eliminating corner studs doesn't make it tough for carpenters to nail baseboard at a corner. Most baseboard can just be nailed to the bottom plate.

Sometimes the 2-ft. modular design isn't possible. Bathrooms, for instance, are normally 5 ft. wide to allow room for bathtubs. When a stud isn't available to catch an interior wall, the next best bet is to use a horizontal block (right drawing, p. 48). The block is nailed in the exterior wall between regular studs 4 ft. from the floor to catch the drywall edge. The abutting wall is toenailed to the top and bottom plates. Then it's spiked to the horizontal block, which is nailed on the flat to allow room for insulation. Horizontal blocks can easily eliminate another 12 to 15 studs in an average-size house.

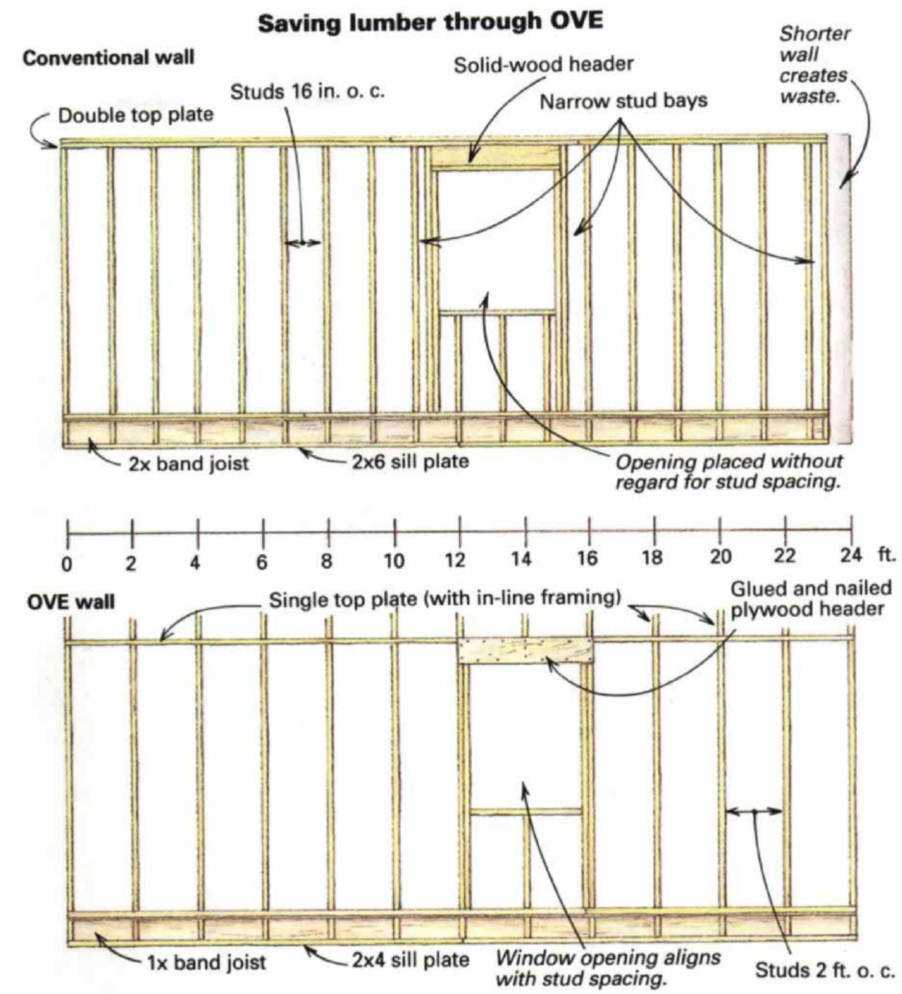
When the width of an interior wall is 4½ in., it's easy to see that the 2-ft. modular design won't eliminate the need to cut and fit drywall. OVE concentrates on saving exterior materials, which are more expensive than interior materials.

Overbuilt floors—Often, more wood products are used in floors than in any other part of the house. Floors in a 2,400-sq. ft. house can contain as much as 4,800 bd. ft. of lumber and as much as 4,800 sq. ft. of subflooring. Therefore, if you want to cut down on lumber and plywood use, pay close attention to the floors.

Consider eliminating all lumber and plywood on the first floor by switching to concrete slab-on-grade construction. Many builders will probably say they can't get away with concrete slabs in their markets. Buyers won't accept them. That's what Maryland builders said until Levitt and Sons moved into the state and built over 10,000 concrete-slab homes. One of the most successful builders of quality homes in the Cleveland area builds slab houses. Much of the large Chicago suburb of Hoffman Estates consists of slab homes. About half the homes built in the United States over the last 20 years are on concrete slabs. Slab-on-grade construction is worth considering because it can eliminate almost one-fourth of all lumber and up to one-third of the sheet wood products in a home. Because homes built on slabs have no basements, lost storage and work-space can be made up inexpensively with a larger garage or the addition of a storage room.

An easy way to reduce materials in floors is to eliminate midspan cross bridging. In the past, when wet lumber was often used, cross bridging helped keep joists from twisting as they dried. But tests on dry lumber conducted by the NAHB Research Center during the 1960s proved that cross bridging adds nothing to floor stiffness. Because of these tests, all major model codes consider cross bridging unnecessary for floors framed with lumber up to and including 2x12s.

Something that does add stiffness to the floor is structural adhesive. In some cases (depending



Even in load-bearing walls, 2-ft. o. c. stud spacing is possible. When rafters and floor joists align with studs (in-line framing), the second top plate is omitted. A glued and nailed plywood header saves lumber, won't shrink and provides space for insulation.

The window opening aligns with the stud spacing, eliminating extra framing and narrow stud bays. And the 24-ft. wall uses the same plate and sheathing material as the 22-ft. 9-in. wall but requires no cutting and produces no waste.

on the quality of the floor components and on the loads the floor supports), gluing and nailing a subfloor can reduce the size or grade of floor joists needed or increase joist spacing from 16 in. o. c. to 19.2 in. o. c., or even 2 ft. o. c. The technique involves applying a structural adhesive (on top of joists), preferably an elastomeric adhesive, which remains pliable and fills voids, then nailing or screwing down the floor deck.

Most builders use a 2x6 sill plate on the foundation wall. Although it takes more precise placement of anchors, a 2x4 sill plate provides adequate bearing for the ends of floor joists.

The primary function of band joists is to hold the floor joists erect until floor and wall sheathing are installed. The band joist normally doesn't need to be the same thickness as the regular joists because exterior-wall loads are transferred to the floor joists. Both 1x stock and ⅝-in. plywood are adequate for band joists.

Some builders install double floor joists under all interior walls that run parallel to the floor framing. Double joists aren't necessary under non-load-bearing walls, which typically weigh less than the furniture that will go in a room.

For load-bearing walls parallel to floor joists, span the joist bay with blocks 2 ft. o. c.; if the wall bears on a joist, slap on another floor joist.

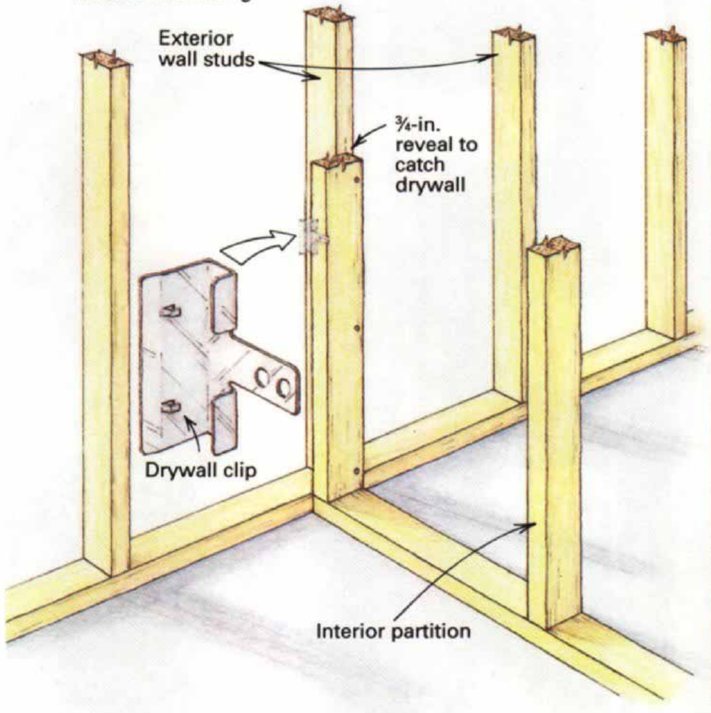
Lumber prices have just about caught up with those of engineered wood products, so consider substituting products, such as manufactured wood I-beam joists and other laminated-veneer lumber (LVL), for dimensional lumber. The quality of engineered wood products is consistently high, yet it takes less wood to make them, and the wood can be of lesser quality, so by using engineered wood products you're conserving higher-grade lumber.

Reducing excess lumber in walls—When combined, exterior walls and interior walls contain about the same board footage of lumber as the floors. Therefore, to frame economically, it makes sense to use wall lumber wisely.

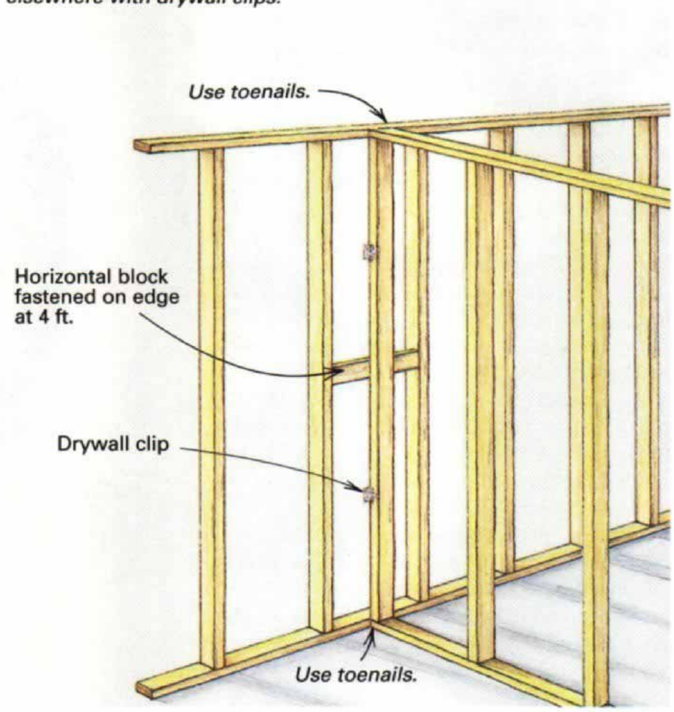
When your design is based on a 2-ft, module, it makes sense to use 2-ft. spacing between framing

Drawings: Christopher Clapp

Laying out partitions. *In OVE, many interior partitions are placed so that they can be attached to exterior wall studs. When drywall clips are used, this layout eliminates extra studs and blocking.*



Attaching partitions between studs. *Partitions that occur between studs are toenailed to top and bottom plates and nailed to a horizontal block spanning the stud bay 4 ft. from the floor. The block catches the edge of the drywall, which is fastened elsewhere with drywall clips.*



members. The major model building codes allow 2-ft. o. c. stud spacing under certain conditions, even in load-bearing walls. For example, the Uniform Building Code permits 2-ft. o. c. stud spacing in one-story dwellings and on the top floor of multistory dwellings, which reduces framing material. Even if you are hesitant to place load-bearing studs on 2-ft. centers, at least consider doing it in non-load-bearing walls.

Even in a relatively small house, it's not unusual to have 40 to 50 corners in the walls. Typically, each of these corners is built with three studs and three blocks (top photos, facing page). The third stud is installed as a drywall backup strip, and the three blocks act as spacers for the third stud. By using drywall clips, one stud and all the blocking can be eliminated (bottom left photo, facing page). Alternatively, a plywood cleat screwed onto the inside face of a corner stud also provides nailing or screwing surface for drywall (bottom right photo, facing page).

Drywall clips come in different styles and materials, but the ones I've used (Prest-On, 316 Lookout Point, Hot Springs, Ark. 71913; 501-5254683) slide onto the edge of drywall, then the clip is fastened to the corner stud. Just remember which piece of drywall goes on first; with Prest-On clips, the first sheet butts into the leading edge of the corner stud, and the second sheet butts into the first. The drywall itself shouldn't be fastened to the corner stud. A fastened corner is more likely to crack as the stud shrinks. Instead, fasten the drywall one stud away from the corner (2ft. in an OVE system).

Two-stud corners can save as many as 40 to 50 studs and 120 to 150 blocks in a house without affecting the structural integrity of the walls. Besides, with three studs and blocking, insulating is difficult and often skipped in the exterior corners, causing a number of 4½-in. wide cold spots.

If 2-ft. o. c. stud spacing is used in load-bearing walls, and walls in a home are designed to 2-ft. modules, framing layout is a snap; there are no odd dimensions to worry about. If floor and roof framing are also on 2-ft. centers, an opportunity for in-line framing exists. In-line framing, or stacking, means that rafters are located directly over wall studs, and wall studs are in turn located directly over floor joists. In-line framing directly transfers the load through the structure, which is much more efficient than the common zigzag route of load transfer.

For example, if in-line framing is used, the second top plate, or doubler, can be eliminated because its sole function is to help transfer loads to the nearest studs. To get a full 8-ft. ceiling height without using a doubler, studs must be 1½ in. longer than precuts. Precuts usually are priced at 8 ft., so the longer stud shouldn't cost any more than the old precuts.

Plywood headers—Headers are needed over windows and doors in load-bearing walls. However, many builders install solid or built-up wood headers over non-load-bearing openings, too, which is a waste of material and labor. Unnecessary headers are found not only in interior but also exterior walls, especially gable-end walls. Where headers are needed, an alternative to solid or built-up wood is a plywood box-beam header. Rough openings are framed as though the wall were non-load-bearing, and then ½-in. Group I exterior-grade plywood is glued and nailed above the rough opening—on one side of openings up to 3 ft. wide that carry no more than 500 lb. per lineal ft., and on both sides of openings up to 6 ft. wide that carry the same 500-lb. per lineal ft. maximum load.

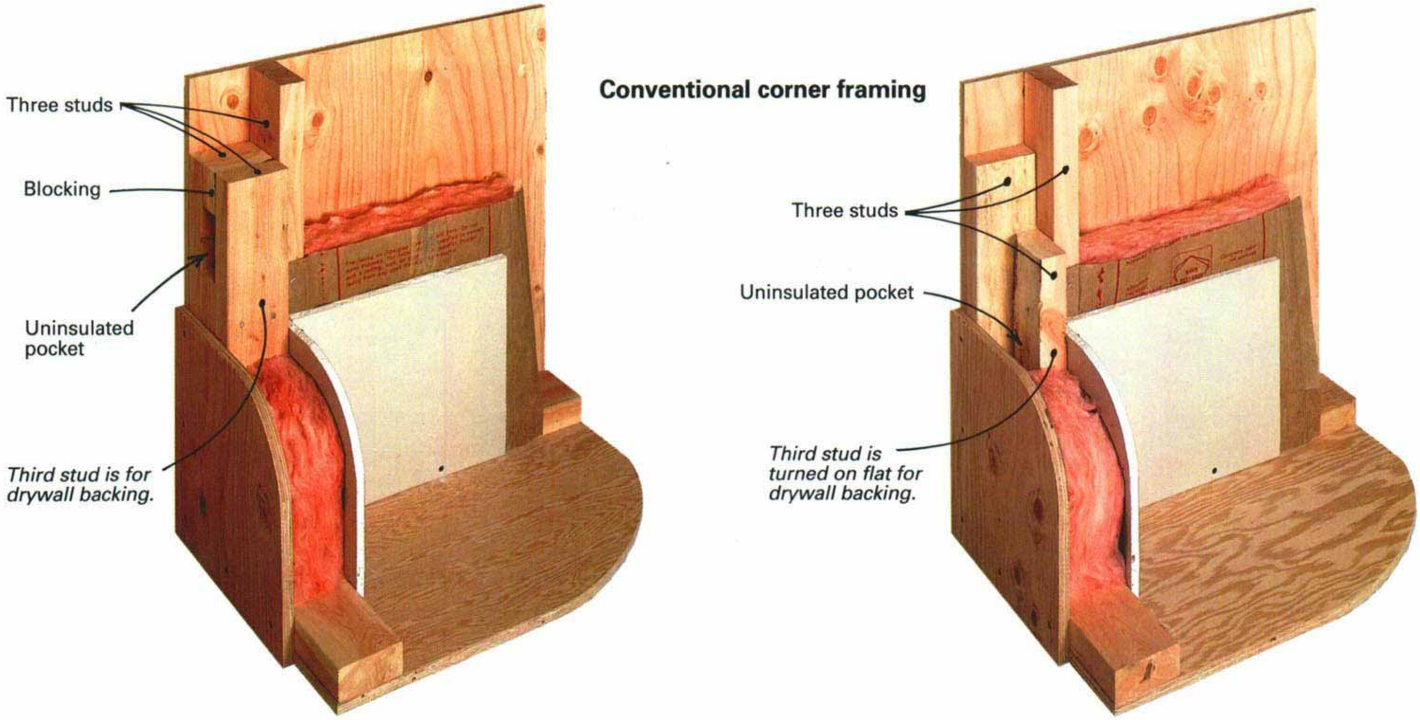
A good structural adhesive and a nailing pattern engineered to handle the load are required. If you install an interior plywood header, use ½-in. AC plywood with the A side (smooth side) facing the room; then tape and finish it with joint compound to match the drywall.

Solid-wood headers shrink, resulting in cracks in the drywall. But a plywood header is stable and won't cause cracks around the drywall. More importantly, plywood headers provide cavities for insulation.

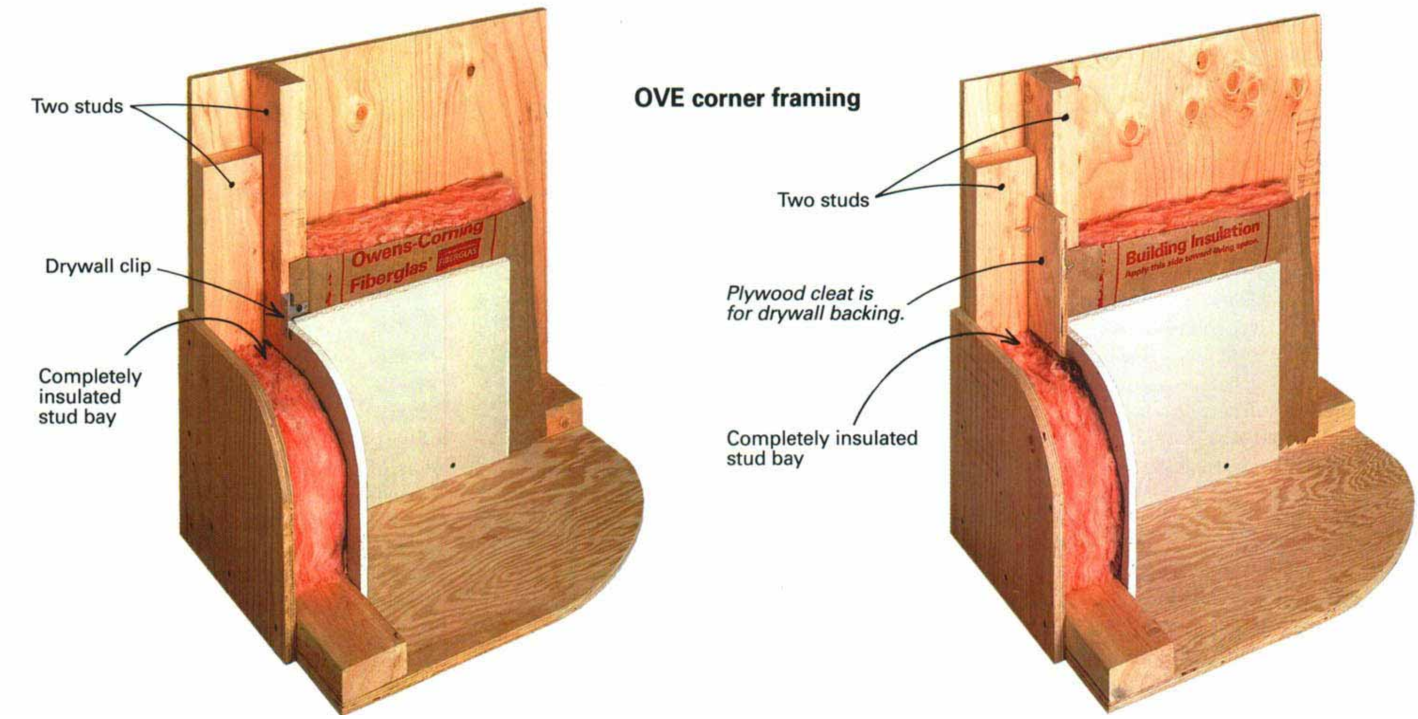
Hollow-core interior doors in non-load-bearing walls are lightweight and do not need a trimmer stud, or jack stud, on each side of the opening. It is still best to double the stud on the hinge side of heavier, solid-wood doors.

It's not shoddy construction—The OVE approach is not a substandard building method. It gets the most performance from the least amount of material. Some builders have said that OVE requires them to supervise workers more closely. True, OVE requires more discipline because it's not as forgiving of labor and material defects as traditional approaches. On the other hand, OVE is a simpler way of building that creates less opportunity for defects to occur in the first place.

The OVE approach is not an all-or-nothing system. You can pick and choose the parts of the



Eliminating a stud *Conventional wood framing uses three studs per corner. The third stud is either built out with blocks or turned on the flat to provide drywall backing. An OVE corner requires only two studs, with drywall backing provided by drywall clips or a plywood cleat. Open and accessible stud bays in OVE corners are easy to insulate.*



system that make sense to you. Say, for example, that you want to build two-stud corners, but your clients are concerned about wavy walls. I personally have never seen a wavy wall that was caused by 2-ft. o. c. studs, not even with drywall ceilings hung on 2-ft. o. c. rafters. Two-stud corners work just as well with 16-in. o. c. framing as with 2-ft. o. c. framing.

Maybe your drywall contractor wants to charge extra to work with drywall clips. You know that drywall clips are cheap and easy to use, but you can't convince your contractor. The heck with it. At least you can save on studs by using 2-ft. centers. I'm not suggesting that blocking be eliminated where it's needed, so make sure that things like handrails, closet poles and towel bars have the proper backing.

You can begin eliminating headers over non-load-bearing openings tomorrow without changing anything else. Or you can start gluing and nailing subfloors because it eliminates labor by reducing callbacks. Saving materials and labor without sacrificing building quality is what OVE is all about. □

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Further reading

The methods described in this article are detailed in two publications: *The Lumber and Plywood Saving Manual* and *Reducing Home Building Costs with OVE Design and Construction* (the OVE manual), both available from the NAHB Research Center, 400 Prince George's Blvd., Upper Marlboro, Md. 20772. The cost for each publication is $10 plus $2 for shipping and handling. An update of the OVE manual is currently in the works. *—E. L. F.*