ADVANCED WALL FRAMING

Build efficiently, use less material, and save energy!

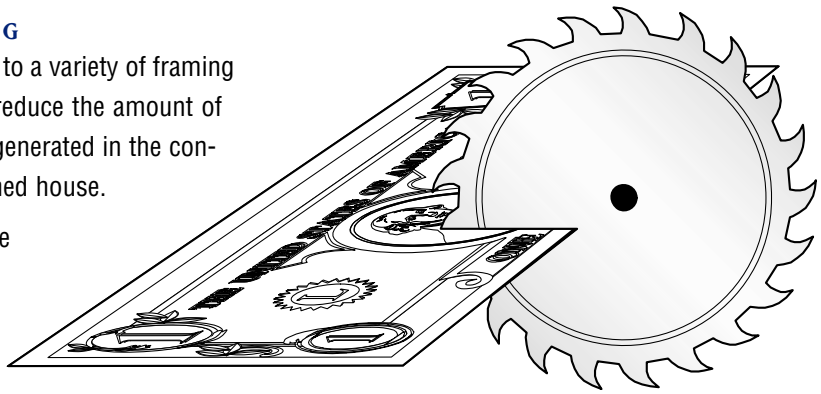
Buildings for the 21st Century

Buildings that are more energy efficient, comfortable, and affordable…that's the goal of DOE's Office of Building Technology, State and Community Programs (BTS). To accelerate the development and wide application of energy efficiency measures, BTS:

- Conducts R&D on technologies and concepts for energy efficiency, working closely with the building industry and with manufacturers of materials, equipment, and appliances
- Promotes energy/money saving opportunities to both builders and buyers of homes and commercial buildings
- Works with state and local regulatory groups to improve building codes, appliance standards, and guidelines for efficient energy use
- Provides support and grants to states and communities for deployment of energy-efficient technologies and practices

ADVANCED FRAMING

Advanced framing refers to a variety of framing techniques designed to reduce the amount of lumber used and waste generated in the construction of a wood-framed house.



These techniques include

- Designing homes on 2-foot modules to make the best use of common sheet good sizes and reduce waste and labor.
- Spacing wall studs up to 24 inches on-center.
- Spacing floor joists and roof rafters up to 24 inches on-center.
- Using two-stud corner framing and inexpensive drywall clips or scrap lumber for drywall backing instead of studs.
- Eliminating headers in non-load-bearing walls.
- Using in-line framing in which floor, wall, and roof framing members are vertically in line with one another and loads are transferred directly downward.
- Using single lumber headers and top plates when appropriate.

Advanced framing techniques, sometimes called Optimum Value Engineering (OVE), have been researched extensively and proven effective. However, some techniques may not be allowed under certain circumstances (i.e., high wind or seismic potential) or in some localities. Be certain to consult local building officials early in the design phase to verify or obtain acceptance of these techniques.

BENEFITS FROM ADVANCED FRAMING

Both builders and home owners can benefit from advanced framing. Advanced framing techniques create a structurally sound home that has lower material and labor costs than a conventionally framed house. Additional construction cost savings result from the generation of less waste that needs to be disposed of, which also helps the environment.

Advanced framing improves energy efficiency by replacing lumber with insulation material. The whole-wall R-value is improved by reducing thermal bridging through the framing and maximizing the wall area that is insulated.

Advanced framing techniques can be implemented individually or as a complete package, depending on the builder. Fully implementing advanced framing techniques can result in materials cost savings of about $500 or $1000 (for a 1,200- and 2,400-square-foot house, respectively), labor cost savings of between 3 and 5 percent, and annual heating and cooling cost savings of up to 5 percent.

ADVANCED FRAMING TECHNIQUES

Stud Spacing - In many cases, it is acceptable by code to increase stud spacing from 16 inches to 24 inches on-center. The 1995 International Code Council's *One- and Two-Family Dwelling Code* allows studs up to 10 feet long to be spaced up to 24 inches on-center. In walls supporting only a roof and ceiling, 2x4 studs can be spaced up to 24 inches on-center, except for Utility grade (No. 3) studs. For walls supporting one floor, such as non-bearing gable endwalls on the first floor of a 2-story house, 2x4s can be spaced up to 24 inches on-center when Utility grade studs are not used. Studs in walls supporting a floor and roof above can be 2x6 spaced up to 24 inches on-center rather than 2x4 spaced up to 16 inches on-center.

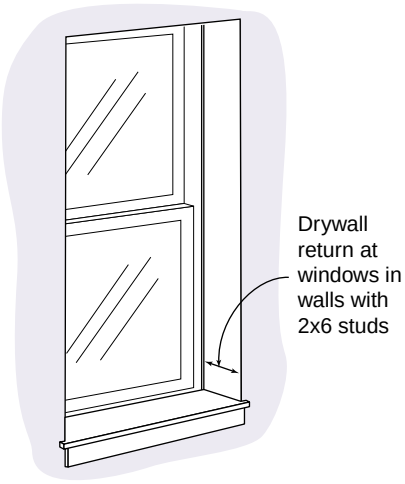
Total cost (material and labor) for framing with 2x6 studs spaced 24 inches on-center is similar to that for framing with 2x4 studs spaced 16 inches on-center. The economics of 2x6 wall construction is especially favorable in areas with significant winters and in homes in which windows and doors occupy 10 percent or less of the total wall area. Walls with much more window and door area may require as much framing lumber as conventially-framed walls because each additional opening can add extra studs. In addition, the added 2-inch wall thickness requires the use of extension jambs at windows unless drywall returns are used.

Headers - Structural headers are often oversized or installed where unnecessary, largely for convenience. Proper sizing of headers allows better insulation and saves wood. In some cases, single-ply (single 2x6, for example) headers can be used, allowing even better insulation around windows. Headers are not required in non-bearing walls, including most interior walls and gable endwalls with only non-bearing trusses directly above. The table and accompanying text below outlines some header requirements from the 1995 International Code Council's *One- and Two-Family Dwelling Code.*

It is possible to insulate headers by using foam sheathing as a spacer in place of plywood or oriented strand board (OSB), either between or on one side (preferably the exterior side) of doubled headers. This technique is an excellent way to make

DRYWALL RETURN

Use of drywall returns for windows in walls with 2x6 stud framing eliminates the need for extension jambs in windows



Maximum Spans For Two-Inch Double Headers (in feet) [a]
(Derived from Table 602.6 of the 1995 International Code Council's One- and Two-Family Dwelling Code)

Header Size	Supporting Roof Only	Supporting One Story Above	Supporting Two Stories Above	Not Supporting Walls Or Roofs
2x4	4	0	0	[b]
2x6	6	4	0	[b]
2x8	8	6	0	10
2x10	10	8	6	12
2x12	12	10	8	16

a Also applies to nominal 4-inch single headers. Based on No. 2 lumber with 10-foot tributary loads. Not to be used where concentrated loads are supported by headers.

b Load-bearing headers are not required in interior or exterior nonbearing walls. Single flat 2-inch-by-4-inch members may be used as headers in interior or exterior nonbearing walls for openings up to 8 feet in width if the vertical distance to the parallel nailing surface above is not more than 24 inches. For such nonbearing headers, no cripples or blocking are required above the header.

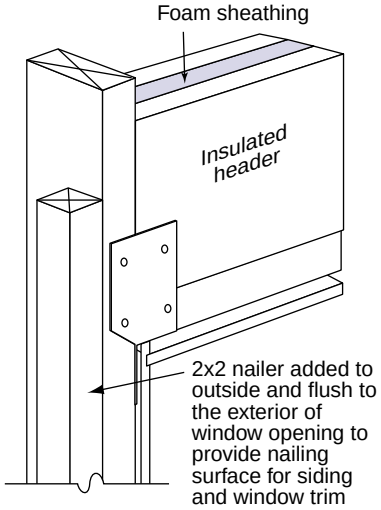
use of scrap foam sheathing and reduce waste. For assistance in designing headers, consult local structural engineers, code officials, lumber suppliers, or organizations such as the Western Wood Products Association (www.wwpa.org).

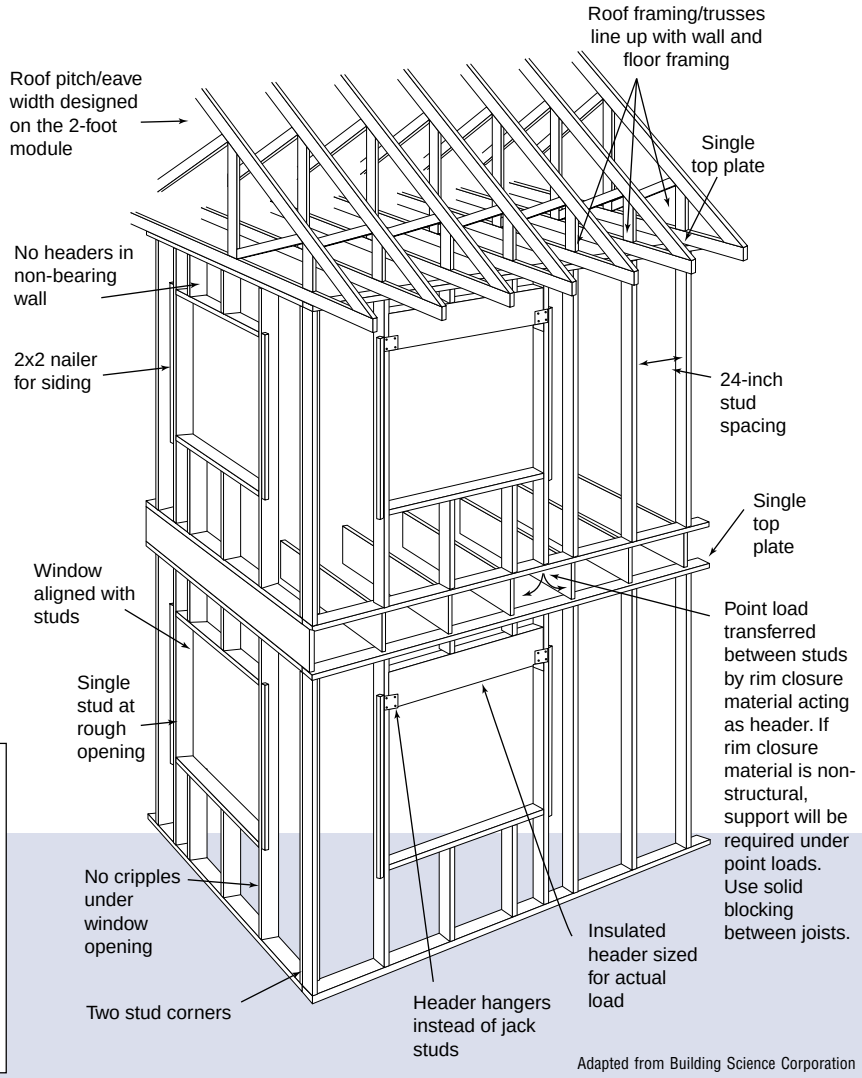
Jacks (shoulder studs/cripples) - Jacks can be eliminated when structural headers are not used or when metal hangers support structural headers. However, elimination of jacks reduces the available nailing area for siding and trim if nailable sheathing (e.g., plywood, OSB) is not used, and may leave as little as 1½ inches of nailable width next to a window. If needed, construct a modified window opening by installing a 2x2 wood nailer behind the sheathing for siding attachment.

Outside and Inside Corners - Two-stud corners decrease lumber use and increase possible insulation levels compared with typical practice. However, if nailable sheathing is not used, attachment of exterior trim and siding at corners may be more difficult. For example, vinyl-siding corners require attachment at a point several inches from the corner. Therefore, if foam or other non-nailbase sheathing is used, it may be necessary to add a wood nailer behind the sheathing.

When drywall clips are used, they should be installed above the level of the interior trim so trim nails will not interfere. The non-coped trim piece should be installed first, against the drywall that bears on the clip, so that the final coped trim piece can be nailed to the stud.

STACK FRAMING DETAILS





Adapted from Building Science Corporation

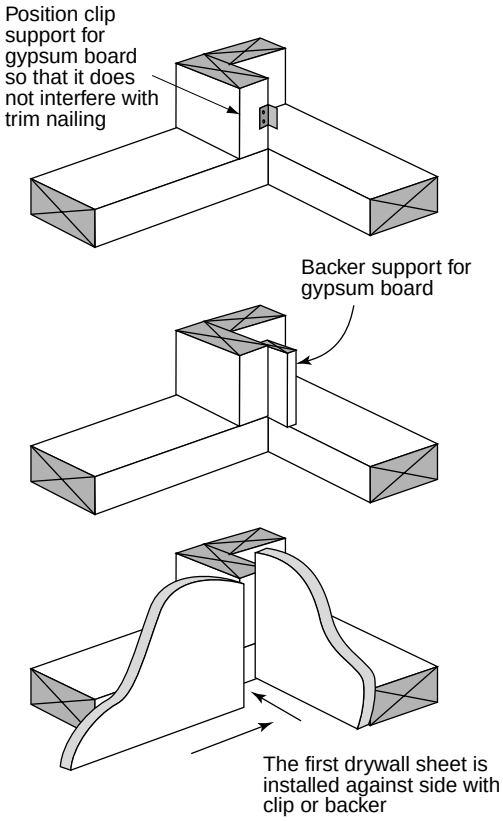
MODIFIED HEADER AND WINDOW OPENING

Reduced waste and increased insulation can be achieved by supporting an insulated header with hangers and by nailing surfaces for siding scabbed toward the outside edge of studs.

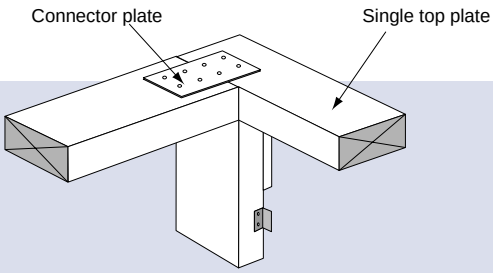
ADVANCED WALL FRAMING

Partition Connections to Exterior Walls (T-walls) - These are often made by adding studs at each side of a partition which serve only to provide a surface for attaching drywall. In addition to wasting wood, this type of connection creates an area that is difficult to insulate. Alternatives include installing "ladder blocks", drywall clips, or a full-length 2x6 or 1x6 behind the first partition stud.

INSIDE "TWO-STUD" CORNERS



SINGLE TOP PLATE

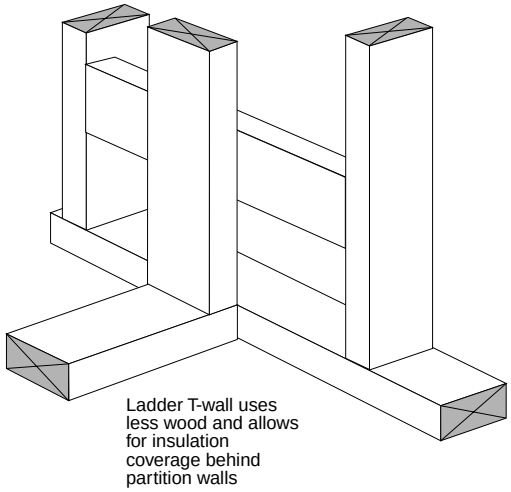


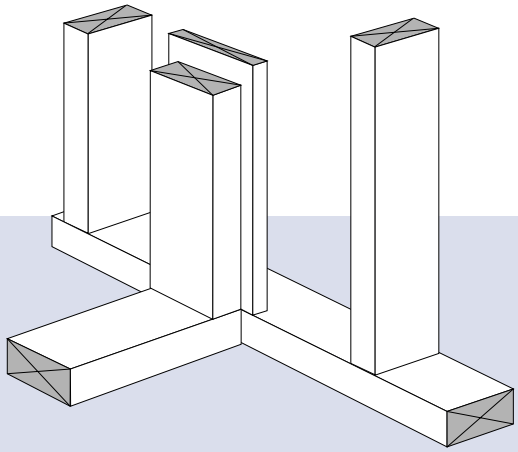
Intermediate Blocking - Horizontal blocks between studs are generally not required for structural strength or fire/draft stopping in platform framing, at least with standard 8-foot high walls. Therefore, intermediate blocking can be eliminated with platform framing because it is not required by the major building codes.

Single Top Plates - When used in conjunction with in-line framing designs, single top plates are usually acceptable from a structural standpoint, and are accepted by model building codes such as International Code Council (ICC) and Building Officials Code Administrators (BOCA). These codes require that 3x6 inch, 20-gauge galvanized steel plates be used to tie the top plate at joints, corners, and wall intersections and that they be nailed using three 8d nails at each side.

T-WALL ALTERNATIVES

The use of ladder blocking or a full-length 1x6 or 2x6 blocking allows for increased insulation in the outer wall





Because wall height is changed when single top plates are used, sheathing and drywall needs are affected. Studs that are 94¼ inches long (often used for interior walls) do not need to be cut for use with single top plates, but they are not always available. Ninety-six-inch lumber needs to be cut to length or requires having a strip of drywall added at the bottom of the wall. Pre-cut 92⅝-inch studs will require "ripping" approximately 1 inch from the sheathing and drywall. If 94¼-inch studs are not available, use 92⅝-inch studs rather than 96-inch lumber because they require less labor and generate less waste.

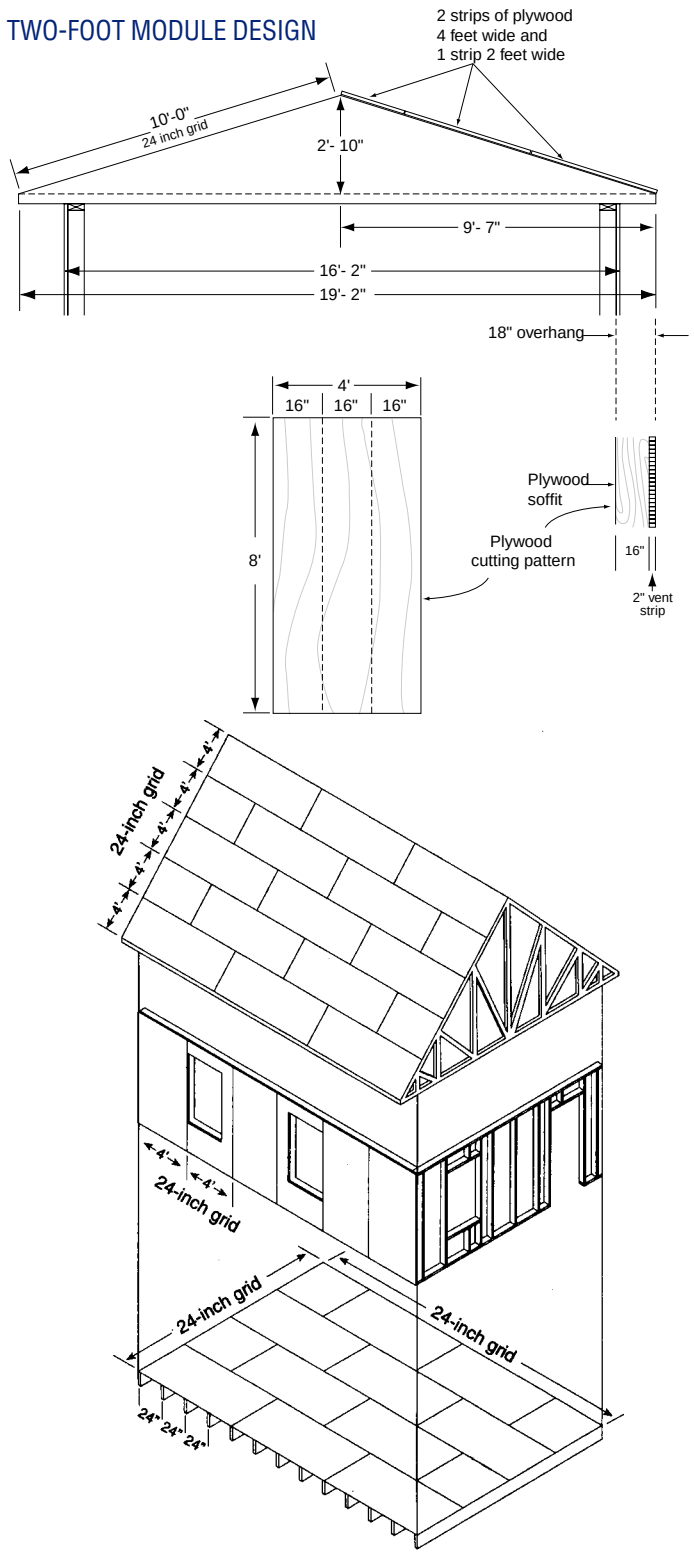
ADVANCED FRAMING DESIGN CONSIDERATIONS

Two-Foot Module - Design building length, width, and roof pitch in 2-foot increments to make the best use of common sheet good sizes. This technique will reduce material use, labor, and waste, as many products come in multiples of 2 feet. For example, with proper planning, the entire cutoff from a center-cut sheet of plywood can be used elsewhere, eliminating the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge vent if one is used.

In-Line Framing - Align floor, wall, and roof framing members directly above or below one another so that loads are transferred directly downward. With in-line framing, double top plates can be eliminated because the load is distributed evenly through the top plate. Using this method, studs that are 24 inch on-center are placed directly below roof trusses spaced 24 inches on-center.

Window and Door Layout - Align at least one side of each window and door in line with an existing stud and attach the other side with a metal hanger. Windows with rough openings of 22½ inches can fit between studs that are spaced 24 inches on-center. When this size window is used in conjunction with in-line framing, headers are not necessary because no studs need to be cut.

Other items - For maximum efficiency, detailed plans should show each piece of wood, cross bracing, and so on in the house and locations for all other items such as wiring, ducts, and pipes. Detailed plans will help eliminate conflicts over space, expedite installation, and eliminate the need to alter or move studs, joists, or other framing members later.



- Lay out and cut framing and sheet goods to take advantage of the full dimension of the material. This also reduces job site waste.

ADVANCED WALL FRAMING

For more information, contact:

Energy Efficiency and Renewable Energy Clearinghouse (EREC)
1-800-DOE-3732
www.eren.doe.gov

Or visit the BTS Web site at
www.eren.doe.gov/buildings

Or refer to the Builder's Guide
Energy Efficient Building Association, Inc.
651-268-7585
www.eeba.org

Written and prepared for the U.S. Department of Energy by:

NAHB Research Center
800-898-2842
www.nahbrc.org

Southface Energy Institute
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U.S. Department of Energy's Oak Ridge National Laboratory
Buildings Technology Center
423-574-5178
www.ornl.gov/ORNL/BTC

U.S. Department of Energy's National Renewable Energy Laboratory
303-275-3000
www.nrel.gov/buildings_thermal

The International Residential Code for One- and Two-Family Dwellings *can be obtained from the International Code Council*
703-931-4533
www.intlcode.org

SHEATHING

Nailbase wooden structural panel sheathing—OSB and plywood—dominate the market. Properly installed wood structural wall panels not only provide resistance to racking (lateral loading from wind, seismic, etc.), but also improve the "kickable" character of many structures.

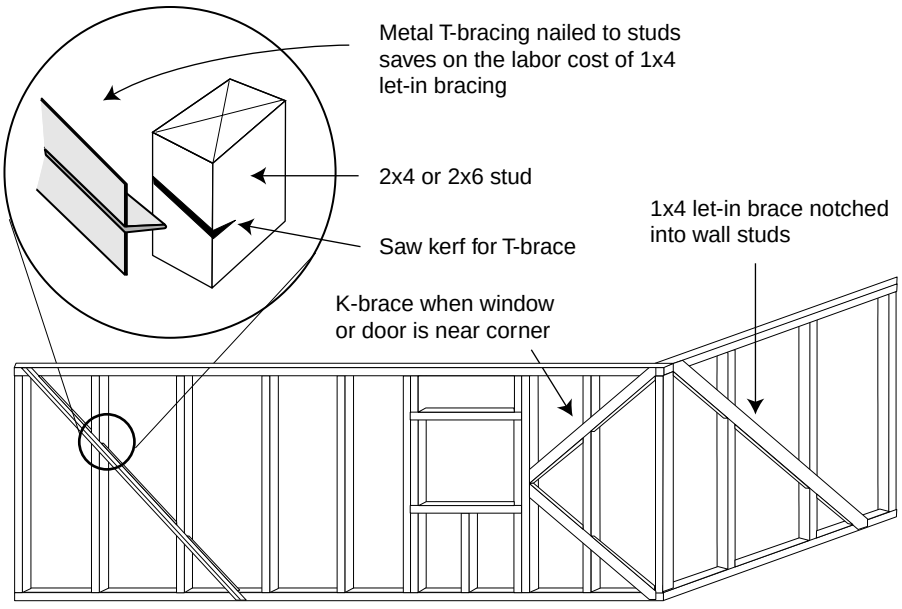
Use of non-structural insulating rigid foam wall sheathing is another option. It improves energy efficiency and reduces wood use but requires that the wall assembly be adequately braced. Codes outline various bracing options, such as the following

- Use structural sheathing at corners and intermediate points with foam sheathing at all other locations.
- Use full foam sheathing over other approved wall bracing (e.g., metal strapping, let-in wood 1x's).

Specific requirements for these and other methods depend on wind and seismic zone, as well as the number of stories in the structure.

The structural implications of sheathing make it a critical wall system component. Cladding installation guidelines and warranties may also affect the choice of sheathing. Finally, newer building codes are incorporating increasingly more stringent wall bracing requirements. These should be carefully studied before selecting sheathing.

LET-IN BRACING



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