ADVANCED WALL FRAMING

For more information, contact
Energy Efficiency and Renewable Energy
Office of Energy Efficiency
2500 E Street, NW
Washington, DC 20585
www.eren.doe.gov
Or visit the BTS Web site at www.bts.gov
Or call the Builder’s Guide Energy Efficiency Hotline, 1-800-926-2419
For copies of the BTS Regional Editions of this Guide, call the Building Technology Center at 1-800-926-2419.

ADVANCED FRAMING DESIGN CONSIDERATIONS

Two-Post Module - Design building height, width, and roof pitch in key increments to make the total use of common sheet good size. This technique will reduce material use, labor, and waste, as many products come in stock of multiples of 2x. For example, with proper planning, the entire cutout from a centerline sheet of drywall can be used, avoiding the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.

In-Line Framing - Aligned floor, wall, and roof framing members directly above or below one another so that studs are framed in a straight horizontal direction without the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.

ADVANCED WALL FRAMING

For more information, contact
Energy Efficiency and Renewable Energy
Office of Energy Efficiency
2500 E Street, NW
Washington, DC 20585
www.eren.doe.gov
Or visit the BTS Web site at www.bts.gov
Or call the Builder’s Guide Energy Efficiency Hotline, 1-800-926-2419
For copies of the BTS Regional Editions of this Guide, call the Building Technology Center at 1-800-926-2419.

ADVANCED FRAMING DESIGN CONSIDERATIONS

Two-Post Module - Design building height, width, and roof pitch in key increments to make the total use of common sheet good size. This technique will reduce material use, labor, and waste, as many products come in stock of multiples of 2x. For example, with proper planning, the entire cutout from a centerline sheet of drywall can be used, avoiding the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.

In-Line Framing - Aligned floor, wall, and roof framing members directly above or below one another so that studs are framed in a straight horizontal direction without the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.

ADVANCED WALL FRAMING

For more information, contact
Energy Efficiency and Renewable Energy
Office of Energy Efficiency
2500 E Street, NW
Washington, DC 20585
www.eren.doe.gov
Or visit the BTS Web site at www.bts.gov
Or call the Builder’s Guide Energy Efficiency Hotline, 1-800-926-2419
For copies of the BTS Regional Editions of this Guide, call the Building Technology Center at 1-800-926-2419.

ADVANCED FRAMING DESIGN CONSIDERATIONS

Two-Post Module - Design building height, width, and roof pitch in key increments to make the total use of common sheet good size. This technique will reduce material use, labor, and waste, as many products come in stock of multiples of 2x. For example, with proper planning, the entire cutout from a centerline sheet of drywall can be used, avoiding the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.

In-Line Framing - Aligned floor, wall, and roof framing members directly above or below one another so that studs are framed in a straight horizontal direction without the need for an additional cut and reducing scrap. When planning the roof, remember to allow space for a ridge and a valley if one is used.
Adapted from Building Science Corporation.

Instead of jack studs, header sized for actual load.

The first drywall sheet is installed against side with clip or backer outside and flush to the exterior of window opening to provide nailing surface for siding and window trim.

 headers 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 nailing area, they contribute to tie the top plate at joints, corners, and wall intersections and that they be nailed using three 8d nails at each side.

headers allows better insulation and saves wood. In some cases, simply doubling 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 garage walls and gable ends with only non-bearing trusses directly above. The table and accompanying text below address some header requirements from the 1995 International Code Council’s One-and Two-Family Dwelling Code. It is possible to install 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 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).

When structural headers are not used or when metal hangers support structural headers, however, elimination of joists reduces the available nailing area for siding and framing at the top and side of a window opening. This technique is an excellent way to make 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).

 headers are used in designing headers, consult local structural engineers, code officials, lumber suppliers, or organizations such as the Western Wood Products Association (www.wwpa.org).

The use of ladder blocking or a full-length 1x6 or 2x6 behind the first drywall sheet is installed against side with clip or backer outside and flush to the exterior of window opening to provide nailing surface for siding and window trim. Because of butt wall construction it is especially important in walls with bearing surfaces in which variations and does not exceed 10 percent of the total wall area. While with much more window and clear area may require much framing/trim or an unnecessarily framed ends with each other/operation can be added extra stud.

In addition, the added 2-inch nailing width requires the use of exterior grade joints at windows unless drywall returns are used.

 headers are used in designing headers, consult local structural engineers, code officials, lumber suppliers, or organizations such as the Western Wood Products Association (www.wwpa.org).

The use of ladder blocking or a full-length 1x6 or 2x6 behind the first drywall sheet is installed against side with clip or backer outside and flush to the exterior of window opening to provide nailing surface for siding and window trim. Because of butt wall construction it is especially important in walls with bearing surfaces in which variations and does not exceed 10 percent of the total wall area. While with much more window and clear area may require much framing/trim or an unnecessarily framed ends with each other/operation can be added extra stud.

In addition, the added 2-inch nailing width requires the use of exterior grade joints at windows unless drywall returns are used.

 headers are used in designing headers, consult local structural engineers, code officials, lumber suppliers, or organizations such as the Western Wood Products Association (www.wwpa.org).

The use of ladder blocking or a full-length 1x6 or 2x6 behind the first drywall sheet is installed against side with clip or backer outside and flush to the exterior of window opening to provide nailing surface for siding and window trim. Because of butt wall construction it is especially important in walls with bearing surfaces in which variations and does not exceed 10 percent of the total wall area. While with much more window and clear area may require much framing/trim or an unnecessarily framed ends with each other/operation can be added extra stud.

In addition, the added 2-inch nailing width requires the use of exterior grade joints at windows unless drywall returns are used.
Adapted from Building Science Corporation

Two stud corners - Two stud corners decrease lumber cost and increase possible insulation levels compared with typical practice. However, if reliable sheathing is not used, attachment of exterior trim and nailing of corners may be more difficult. For example, unreliable corners require attachment at a point several inches from the corner. Therefore, if corner or other non-nailbase sheathing is used, it may be necessary to add a nailing plate behind the sheathing. When drywall clips are used, they should be installed above the level at the interior trim so that 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.

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 nailable sheathing. However, when intermediate blocking is desired, it can be accomplished in a very flexible manner.

Single Top Plate - When used in conjunction with in-line framing designs, single top plates are usually acceptable as a structural component, and are accepted by model building codes such as the International Code Council (ICC) and Building Officials and Code Administrators (BOCA). These codes require that 2x6, 20-gauge galvanized steel plates be used to tie the top plate at joints, corners, and wall intersections and that they be nailed using 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.

MAXIMUM SPACINGS FOR DOUBLE HEADER DEPARTURES (in feet)

<table>
<thead>
<tr>
<th>Header Size</th>
<th>Supporting One Story Above</th>
<th>Supporting Two Stories Above</th>
<th>Not Supporting Walls</th>
<th>No Walls</th>
</tr>
</thead>
<tbody>
<tr>
<td>2x10</td>
<td>10</td>
<td>15</td>
<td>10</td>
<td>15</td>
</tr>
<tr>
<td>2x12</td>
<td>12</td>
<td>16</td>
<td>12</td>
<td>16</td>
</tr>
</tbody>
</table>

Modified header and window opening:

Insulation and increased insulation can be achieved by incorporating an insulated header with headers and by setting surfaces for siding placed outward toward the outside edge of studs.

The first drywall sheet is installed against side with clip or backer if needed. Align clip support for gypsum board so that it does not interfere with trim nailing. Roof framing/trusses - Two-story buildings in which the floor framing above can be 2x6 spaced up to 24 inches on-center rather than 2x4 spaced up to 16 inches on-center. In walls supporting only a roof and ceiling, 2x4 studs can be spaced up to 24 inches on-center except for 2x6 spaced at 2-foot intervals or at 10-foot-long centers for up to 24 inches on-center. In roofs supporting a roof and ceiling, 2x6 studs can be spaced up to 24 inches on-center except for 2x4 spaced at 2-foot intervals or at 10-foot-long centers for up to 24 inches on-center.

Two stud corners usually require more insulation and supports. Insulation can be incorporated by combining an insulated header with headers and by setting surfaces for siding placed outward toward the outside edge of studs.

INTERIOR WALL FRAMING

The use of ladder blocking or a full-length 1x6 or 2x6 blocking allows for increased insulation in the outer wall.
Adapted from Building Science Corporation.

**Drying Flats: Use of driers for wood in walls with 2x6 framing eliminates the need for exterior material in windows.**

**Concrete Foundations**

- Adapted from Building Science Corporation.

- **Use of Scrap Foam Sheathing and Reduced 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).

**Jack Studs (Stud Jockeys):** Jack studs can be utilized when structural headers are not used or when interior headers support structural headers. However, elimination of jacks de-

- **Steel 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 (I-C-C) One- and Two-Family Dwelling Code allows studs up to 10 feet long to be spaced up to 24 inches on-center. 2x4 studs can be spaced up to 24 inches on-center when 10-gauge grade studs are used. Steel in walls supporting a floor and roof above can be 2x6 spaced up to 24 inches on-center rather than 2x4 spaced at 16 inches on-center. Steel can material and subject to framing with 2x4 studs spaced 24 inches on-center is similar to that for framing with 2x6 studs spaced 10 inches on-center. The economies of butt wall construction is especially favorable in warm — in homes in which ventilation and doors occupy 10 percent or less of the total area. Multi-wall construction and windows one area may require as much framing lumber as an unvented 2x6 framed wall but each additional opening can add extra cost. In addition, the added 2-inch wall thickness requires the use of exterior material at windows unless drywall returns are used.

- **Headers:** Structural headers are often overlooked or installed where unnecessary, largely for convenience. Proper sizing of headers allows better insulation and sound control. In some cases, simply changing 2x4, 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 window headers with only non-bearing trusses above. The table and accompanying text below outlines some header requirements. The 1995 International Code Council’s One- and Two-Family Dwelling Code.

- **Framing Designs:** Use single top plates are usually acceptable from a structural standpoint, and are accepted by model building codes such as the International Code Council (I-C-C) and Building Officials Code Administrators (BOCA). These codes require that 2x6, 20-gauge galvanized steel plates be used to tie the top plate at joints, corners, and wall intersections and that they be nailed using 8d nails at each side.

- **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-inch CLT. 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 I-C-C framing designs, single top plates are usually acceptable from a structural standpoint, and are accepted by model building codes such as the International Code Council (I-C-C) and Building Officials Code Administrators (BOCA). These codes require that 2x6, 20-gauge galvanized steel plates be used to tie the top plate at joints, corners, and wall intersections and that they be nailed using 8d nails at each side.

**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-inch CLT. Therefore, intermediate blocking can be eliminated with platform framing because it is not required by the major building codes.
ADVANCED WALL FRAMING

Build efficiently, use less material, and save energy!

For more information, contact
Energy Efficiency and Renewable Energy
Office of Energy Efficiency (EERE)
EERE customer service line: 1-800-DOE-3732
www.eren.doe.gov

Also see the EERE site at www.eren.doe.gov/
Or see the Builder's Guide to Energy Efficiency from NREL:
www.nrel.gov

Written and prepared for the U.S. Department of Energy by
VNRW Research Center
401-266-2642
www.vnrwresearch.com

Southwest Energy Institute
401-266-5700
www.swenergyinstitute.com

U.S. Department of Energy's Oak Ridge National Laboratory
Building Technology Center
865-246-9770
www.ornl.gov/ORNL/RC

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

The International Residential Code
Codes and Standards
The International Code Council
703-603-5402
www.iccsafe.org

NOTICE: Neither the United States government nor any agency, funded by any agency, bears any responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. This document or any portion thereof may only be reproduced in connection with the International Code Council or any agency thereof."

... which also helps the environment.

Advanced framing improves energy efficiency by replacing lumber with insulation material. The whole-home 15% value is improved by reducing thermal bridging through the framing and maintaining the void area that is isolated. Advanced framing techniques can be implemented individually or as a complete package depending on the builder. High-performance advanced framing techniques can result in maximum savings of about $600 to $700 (for a 1200- and 2400-square-foot house, respectively), taking labor costs savings of between 3 and 5 percent, and annual heating and cooling cost savings up to 5 percent.

ADVANCED FRAMING DESIGN CONSIDERATIONS
Two-Pull Module - Design building length, width, and pull method to fit 36-inch framing members. For example, breaking the entire wall into a series of 36-inch framing members will allow for the most efficient use of 2x4 framing members. 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. With in-line framing, double 2x4 studs can be eliminated because the load is distributed internally through the top plate. Using this method, special 2x4 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 to the edge of an existing and the other side with a metal header. Windows with rough open sizes of 36 by 80 inches can be cut to fit between studs that are spaced 24 inches on-center. When the door size exceeds or is in competition with the framing, headers and sills are not necessary because studs need to be cut.

Other Notes - 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 so on. Omit stud 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.

Finish out walls with structural panel sheathing—OSB and plywood—resist wind. Properly insulated wall structure wall panels not only provide resistance to racking (lateral loading due to wind, seismic, etc.) but also improve the "stiffness" characteristic of many structures.

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

• Braced wall sheathing at corners and intermediate points with framer sheathing at all other locations.

• Use full frame sheathing over open-graded wall bracing (e.g., mineral striping, keel-on-keel framer). Specific requirements for these and other methods depends on wind and seismic zones, 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 buildings are increasingly incorporating more stringent wall bracing requirements. This should be carefully studied before selecting sheathing.

Use structural sheathing at corners and intermediate points with framer sheathing at all other locations.

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 so on.

Because wall height is changed when single top plates are used, sheathing and drywall needs are also increased. Thus, 5/8-inch (longer for interior walls) may not be needed to cut for use with single top plates, but they are not always available. Two-by-four stud members need to be cut to length or requires having a strip of dried at the bottom of the wall. Pre-cut 2x4 stud cuts will require "tripping" (approximately 1") from the sheathing and drywall. If 9x10-inch studs are not available, use 2x6-inch plastic sheathing that they require less labor and generate less waste.

ADVANCED FRAMING DESIGN CONSIDERATIONS

Two-Pull Module - Design building length, width, and pull method to fit 36-inch framing members. For example, breaking the entire wall into a series of 36-inch framing members will allow for the most efficient use of 2x4 framing members. 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. With in-line framing, double 2x4 studs can be eliminated because the load is distributed internally through the top plate. Using this method, special 2x4 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 to the edge of an existing and the other side with a metal header. Windows with rough open sizes of 36 by 80 inches can be cut to fit between studs that are spaced 24 inches on-center. When the door size exceeds or is in competition with the framing, headers and sills are not necessary because studs need to be cut.

Other Notes - 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 so on. Omit stud 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.

Finish out walls with structural panel sheathing—OSB and plywood—resist wind. Properly insulated wall structure wall panels not only provide resistance to racking (lateral loading due to wind, seismic, etc.) but also improve the "stiffness" characteristic of many structures.

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

• Braced wall sheathing at corners and intermediate points with framer sheathing at all other locations.

• Use full frame sheathing over open-graded wall bracing (e.g., mineral striping, keel-on-keel framer). Specific requirements for these and other methods depends on wind and seismic zones, 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 buildings are increasingly incorporating more stringent wall bracing requirements. This should be carefully studied before selecting sheathing.

Use structural sheathing at corners and intermediate points with framer sheathing at all other locations.

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 so on. Omit stud 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.


NOTICE: Neither the United States government nor any agency thereof, nor any of its employees, makers, or distributors, nor any of their agents, nor any other person or organization, assumes any liability for any loss or injury to any person arising out of the use, misuse, or inability to use this document. The contents of this publication are intended to provide a general overview of the subject matter and are not intended to substitute for professional advice, diagnosis, or treatment.

Energy Efficient Building Association, Inc.
651-268-7585
www.eeba.org

Benfits from advanced framing techniques include:
- Savings in material costs due to the use of less material and fewer waste pieces.
- Increased building energy efficiency due to reduced air leakage and improved thermal performance.
- Reduced building costs due to increased building efficiency and reduced heating and cooling costs.
- Increased comfort levels for building occupants due to improved indoor air quality and reduced noise levels.
- Reduced construction time due to the use of more efficient construction methods.
- Increased durability of buildings due to improved structural performance.
- Increased safety for building occupants during emergencies due to improved structural performance.
- Reduced maintenance costs due to improved building performance.
- Increased resale value of buildings due to improved energy efficiency and durability.

Office of Buildings Technology, State and Community Programs
Build energy efficiently, use less material, and save energy!

Framing DOE 770 MS.p6510/30/00, 9:36 AM 1
October 2000 DOE/GO-102000-0770

OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS

50% wastepaper, including 20% postconsumer waste.

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

Use full frame sheathing over exterior spandrel wall bracing (e.g., metal striping, lifeline or vinyl foil). Specify requirements for those and other methods designed to resist wind and seismic zones, as well as fire and 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, new building codes are incorporating increasingly stringent wall bracing requirements. These should be carefully studied before selecting sheathing.

Buildings of the 21st Century

Buildings that are energy efficient, comfortable, and affordable...that is the goal of DOE’s Office of Building Technology, State and Community Programs.

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, new building codes are incorporating increasingly stringent wall bracing requirements. These should be carefully studied before selecting sheathing.

Build energy efficiently, use less material, and save energy!

OFFICE OF BUILDING TECHNOLOGY, STATE AND COMMUNITY PROGRAMS

Build energy efficiently, use less material, and save energy!