Seattle Department of Construction and Inspections

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Tip 341

GREEN

Seattle Permits

— part of a multi-departmental City of Seattle series on getting a permit

Advanced Framing

December 6, 2009

Advanced framing refers to a series of building strategies that combine to create structurally sound wood framed houses that use less material, reduce labor costs, decrease the amount of material disposed and increase energy efficiency. A primary principle of advanced framing is to design buildings with conventional lumber and sheet good sizes to reduce lumber use. By designing buildings on a 24 inch grid and stacking structural members vertically, wood use can be greatly reduced and insulation values increased (Fig. 1). This advanced framing Tip outlines the regulatory process for advanced framing, when advanced framing methods are appropriate, the strategies that define advanced framing and the challenges and considerations specific to our region.

Does framing with more wood equal higher quality?

Increasing the amount of wood used in a building does not necessarily create better constructed, higher quality buildings. Unnecessarily increasing the size or decreasing the spacing of structural members such as wood studs, floor joists, roof rafters and sheathing can compromise the overall energy efficiency of the building by increasing the thermal bridging. Thermal bridging occurs where the low-insulative value of wood allows heat to flow more quickly through the assembly than through the adjacent insulation. Considering the environmental impact of harvesting, transporting, manufacturing and disposing of lumber, framing strategies that use wood more efficiently and thoughtfully result in better performing, more environmentally responsible structures.

Fig. 1: Advanced framing strategies include using a 24-inch grid for spacing and stacking structural members vertically.

How do regulatory requirements address advanced framing?

In Seattle, wood framed structures can be permitted two ways, prescriptive or engineered. Simpler, more conventional buildings, typically meet the prescriptive path parameters outlined in **Chapter 23 of the Seattle Building Code or Chapters 6 and 8 of the Seattle Residential Code**. The prescriptive path allows for advanced framing and does not require a licensed structural engineer. For projects that exceed the requirements of the prescriptive path, the engineered path is used. The engineered path requires structural calculations and plans stamped by a licensed

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structural engineer. Permitting advanced framed buildings is part of the standard permitting process for both paths.

Where can advanced framing be applied?

For prescriptive path projects, advanced framing can be used in one-and-two-story wood framed buildings. For wood framed buildings with three stories or greater, only the top two floors can use advanced framing. Cripple walls are treated like an additional story and could not be of advanced framing if there are two stories above. In certain cases, engineered buildings may be able to use advanced framing strategies for more than two floors. Advanced framing methods are most successfully implemented in buildings that do not have extensive glazing and maintain a simple overall form.

What are the strategies for advanced framing?

1. Design:
The decision to implement advanced framing techniques should be made during the initial design phase. Designs that avoid complex forms and irregular dimensions work best. When a structural engineer is part of the project team, they should be consulted early in the design process. This early communication and coordination is invaluable in identifying and troubleshooting limitations specific to a project such as site concerns or span constraints. Similarly, if a contractor has been selected, they should be included early in the design process.

2. Framing Layout:
Designing on a 24-inch or 48-inch module optimizes common lumber and sheet good sizes, specifically 4-feet by 8-feet sheets of plywood. Exterior and load bearing walls are typically framed with 2-inch by 6-inch wood studs at 24 inches on center. Structural floor and roof members are also set at 24 inches on center to align with wall studs above and below. Window and door openings should fall either within the 24-inch module or align at one edge. For a conventional two-story wood-framed house, 1/2 inch drywall is span rated for 24 inches. If deflection is a concern, 5/8 inch drywall can be used. Floor joists at 24 inches on center can be spanned with a 3/4 inch plywood subfloor. In areas where a rigid floor is a priority, such as for heavy or brittle floor finishes, a 1 and 1/8 inch plywood subfloor may be preferred. The structural members for exterior walls,

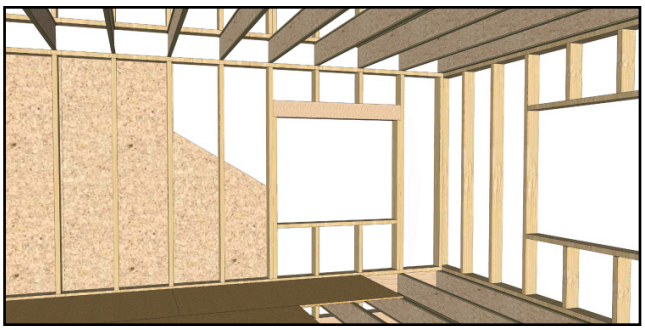

Fig. 2: Designing on a 24” or 48” module optimizes common lumber and sheet good sizes, specifically 4’x8’ sheets of plywood.

joists, and roof structure should align vertically from roof to foundation (Fig. 2).

3. Prefabricated Roof Trusses:
Prefabricated roof trusses are helpful in reducing wood waste and increasing the speed of roof construction. Designing trusses to include a minimum 12” heel provides adequate space for insulation at the edge of the building envelope. Installing wind baffles at the roof edge maintains the air space and increases insulation performance (Fig. 3). Clear communication with the truss

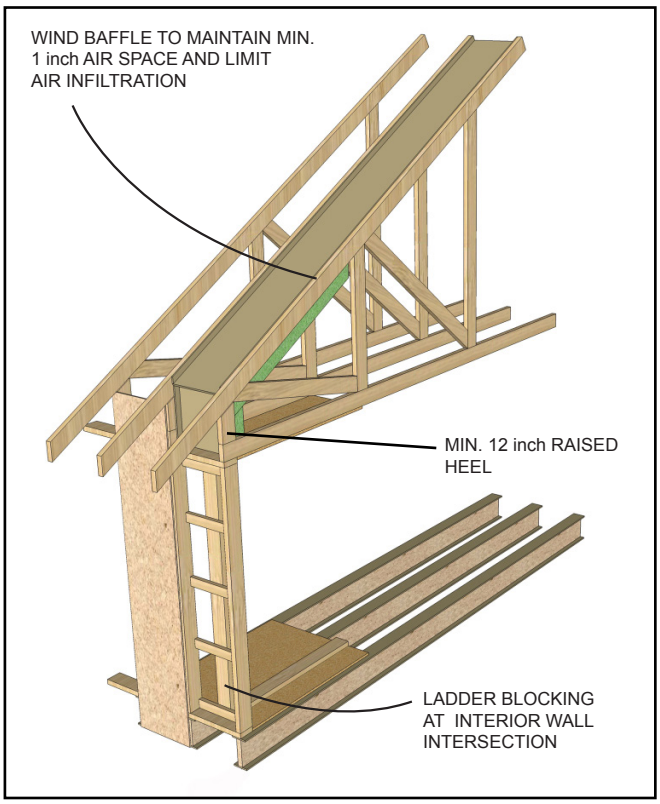

Fig. 3: Wind baffle installed between prefabricated roof trusses maintain air space and infiltration.

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manufacturer is required throughout the design and construction process to ensure the truss layout is coordinated with the overall framing strategy.

4. Exterior Sheathing:
Let-in 2x material and diagonal metal bracing, commonly illustrated in advanced framing literature, is usually inadequate in our seismic zone, especially for engineered designs. Using exterior sheathing simplifies the structural design and construction process by satisfying the lateral bracing requirements while providing a fastening surface for the building paper and exterior siding materials.

5. Framing Details:
Along with the overall framing layout, the framing details play a large role in determining the success of advanced framing a building. Two stud corners, ladder blocking at interior wall intersections and insulated headers increase the efficiency of the overall envelope performance (Fig. 3). Compressible gaskets and caulk at wood to wood connections limit air infiltration and increase envelope performance.

Top Plates:
If structural members align within one inch of each other, a single top plate may be used. Single top plates are connected end to end with steel plates or straps. Single top plates reduce the amount of lumber used and increase space for insulation in the wall (Fig. 4).

A double top plate allows for vertical stacking to fall within 5 inches of alignment. For more complex projects, a double top plate may be preferable to provide greater flexibility during design and construction for elements such as window locations

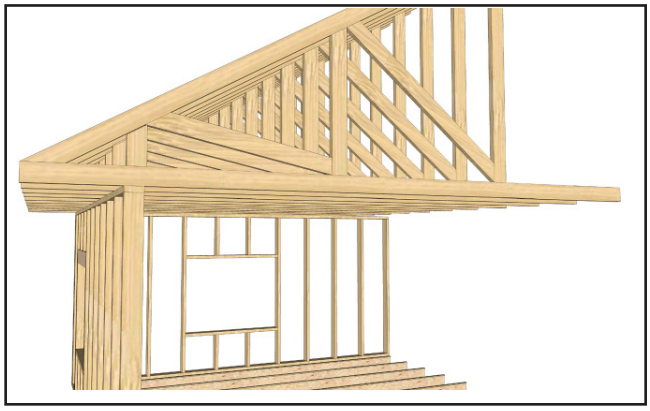

Fig. 4: Single top plates are acceptable when the structural member falls within 1-inch of vertical alignment.

and unforeseen challenges during construction that prohibit precise stud alignment.

Headers:
Window and door openings pose the greatest challenge in reducing material usage, thermal bridging and maintaining space for insulation. The first step is to size headers for the actual load at each opening and to eliminate headers at non-load bearing walls.

Conventional headers often use layers of dimensional lumber and plywood to fill the void over a window or door opening (Fig. 5). Box headers provide an alternative, sandwiching rigid insulation between dimensional lumber (Fig. 6). This approach increases insulation over standard methods while maintaining a fastening surface

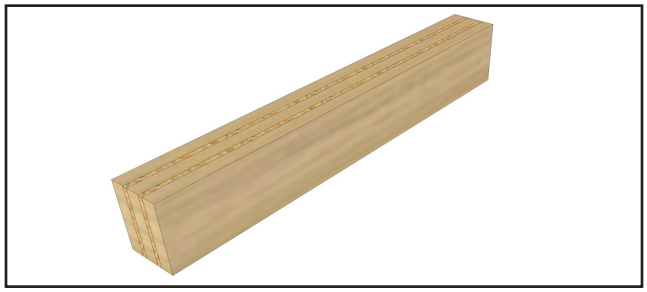

Fig. 5: Conventionally framed header

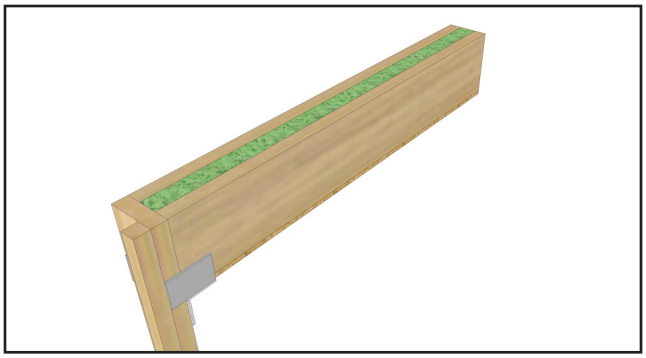

Fig. 6: Box header with header hanger

for drywall and casing. Using a single, deeper wood header also increases insulation but presents a challenge when interior casing is installed (Fig. 7).

Header hangers, commonly illustrated in advanced framing literature, can reduce lumber use by hanging the header directly from the king studs, thus eliminating the need for jack studs to support the header.

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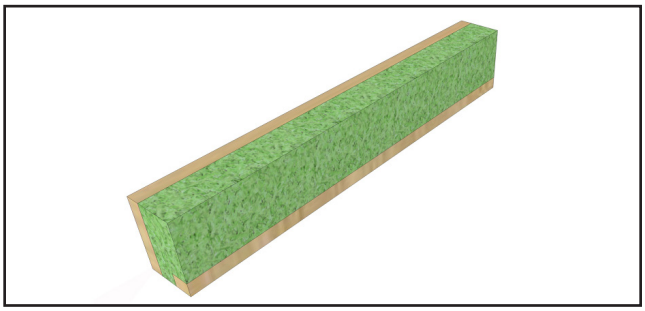

Fig. 7: Single, Deeper Header with 2 inch by 2 inch Nailer for interior casing

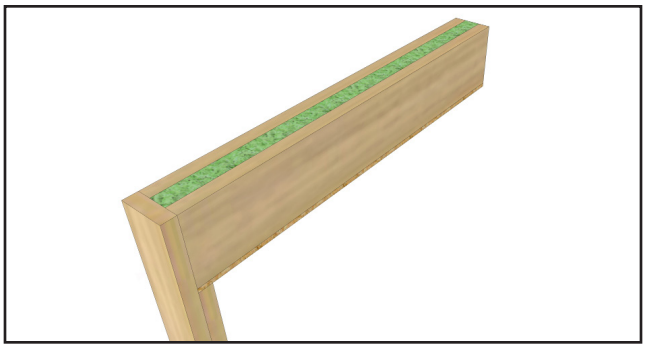

Fig. 8: Box header with jack stud

If interior casing is to be used, particularly casing that is wider than 2 inches, it may be better to install the jack and king stud and eliminate the header hanger (Fig. 8). The thickness of the header hanger can flare the drywall, which poses a challenge to finish carpenters.

Header hangers typically require 2 and 1/2 inches of fastener depth; therefore additional blocking is required behind the king stud (Fig. 6). This additional blocking is beneficial over a full jack stud in that it minimizes thermal bridging and provides more space for insulation.

A structural continuous rim joist at the floor or ceiling plane can be a useful framing strategy that eliminates the need for headers (Fig. 9). A structural engineer can aid in determining whether this is a viable option for your project. While a structural rim joist can simplify construction by eliminating headers, hangers will be needed for floor joists that run perpendicular to the rim joist over openings. A structural rim joist often needs to be slightly larger than a non-structural rim joist and may increase cost for that structural member.

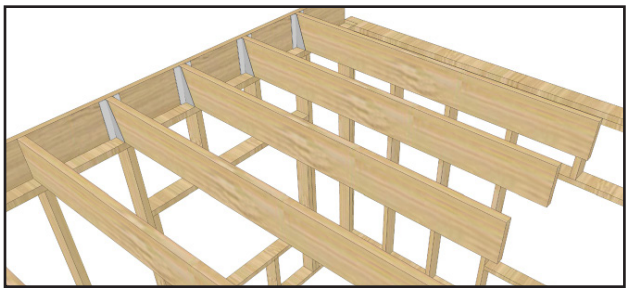

Fig. 9: A continuous structural rim joist eliminates the need for headers at each opening.

6. Framing Corners:
Two stud corners can be used where drywall wraps an inside corner (Fig. 10A). Drywall clips (Fig.10B) or wood scraps (Fig.10C) provide a system for securing the drywall and eliminate the need for a third stud. Drywall clips provide the drywall with a flexible connection at the corner. As wood shrinks and moves over time, the drywall clips allow the drywall to move independently from the wood, reducing drywall cracking at the corners.

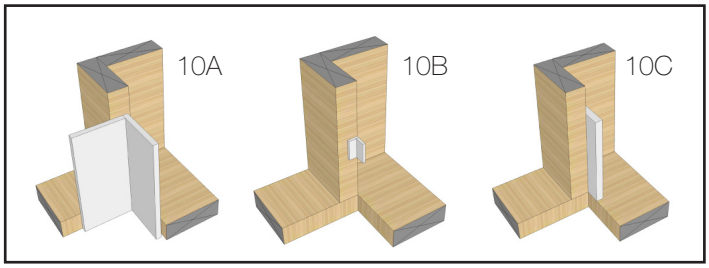

Fig. 10A: Two stud corner with drywall
Fig. 10B: Two stud corner with drywall clip
Fig. 10C: Two stud corner with wood scrap for drywall backer

Where drywall wraps an outside corner, three studs are required to properly secure the exterior sheathing. Arranging the studs as shown in Fig. 11 creates a void at the corner which can then be insulated.

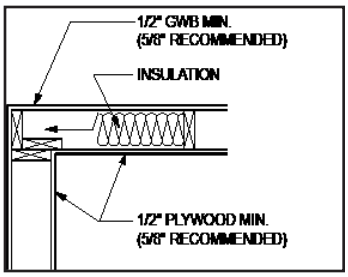

Fig. 11: Three stud corner to attach exterior sheathing

7. T-intersections:
Where interior walls intersect exterior walls, ladder bracing (Fig. 12A) or a single 1x turned parallel with the interior wall (Fig. 12B) provides ways

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to anchor the interior wall while reducing thermal bridging. Both options provide a fastening surface for drywall and increase space for insulation. Ladder blocking may be preferable in creating a stronger structural connection between the interior and exterior walls.

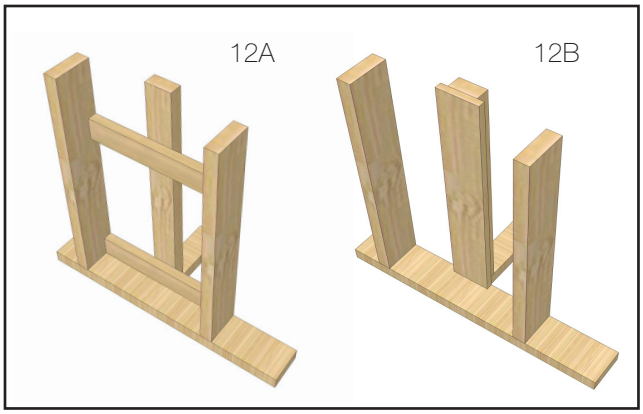

Fig. 12A: Ladder blocking connecting interior and exterior walls

Fig. 12B: 1x turned parallel to interior wall to provide nailing surface for drywall.

8. Shear Walls:
In our seismic zone, extra studs may be required at shear walls to provide additional fastening surface area for hold-downs. Designing sufficient non-glazed areas will aid in reducing the number and frequency of hold-downs and hangers, which typically require additional wood blocking. A structural engineer can aid in defining parameters early in the project for the amount of area needed for shear walls.

9. Preparing for Construction:
For many builders, advanced framing is not standard practice and therefore requires additional time to educate framers, drywallers and insulators on the various advanced framing strategies each building will use. A framing plan, particularly a three-dimensional framing model (such as that found in Fig. 13), will save money during framing by identifying layout start points, identifying header sizes and locations, and clarifying many of the details graphically that may otherwise result in incorrect or redundant framing. Builders who use the same framing crew on several advanced framing projects will see the financial benefits sooner than builders who change framing crews from project to project.
Once a crew is familiar with advanced framing strategies, builders should see a reduction in material usage, disposal costs and labor costs.

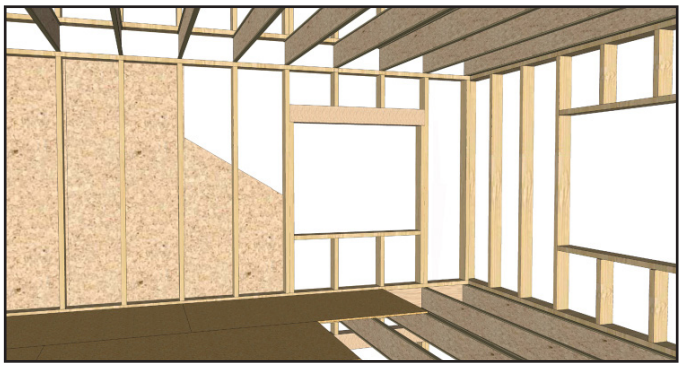

Fig. 13: Example of a digital framing model

Remodels and Other Considerations:

For a remodel project, or a building design that is not conducive to advanced framing strategies, consider applying the advanced framing principles where they work best. Through close collaboration with your structural engineer, architect and builder, these strategies can be applied where appropriate to increase the energy efficiency of your home and reduce material usage.

Additional Resources:

- Energy Star Homes Northwest. Residential New Construction Field Guide 1st Edition. Westborough, MA: Conservation Services Group, 2005.
- Department of Energy. Department of Energy Advanced Framing Fact Sheet. **http://www.eere.energy.gov/buildings/info/documents/pdfs/26449.pdf**.
- Building Science Corporation. **http://www.buildingscience.com**.
- Lstiburek, Joe. “The Future of Framing is Here.” Fine Homebuilding, October/November 2005.
- National Association of Home Builders Research Center Home Page. **http://www.nahbrc.org**

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