Advanced Framing for Architects & Engineers

Hosted by: AIA COTE & SEAONC
San Francisco, California

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Katy Hollbacher, P.E. | beyondefficiency.org
Topics for Today

- Typical structural approach & issues
- Advanced Framing benefits & techniques
- Implementation barriers
- Tips for getting started
What Is Advanced Framing?

- Systems approach to design, engineering, and construction of wood-framed structures that:
  - Reduces lumber use
  - Minimizes wood waste
  - Maximizes a structure’s thermal efficiency…

- While maintaining structural integrity and meeting building codes!
Why Not Advanced Framing?

- Level of potential cost savings not realized.
- Connection between structure & energy performance not understood.
Typical Engineering Approach

- Linear process: little or no collaboration
- Lack of understanding of each others’ issues
  - “Architect designs things that are expensive to engineer”
  - “Engineer doesn’t have any sense of aesthetics”
- Disregard of resource & energy implications
Framing Factor: percentage of surface area taken up with wood

What is the ‘framing factor’ for 16” framing?

Per 16” section,
\[
\frac{16 \times 3 \times 1.5 + 92.5 \times 1.5}{16 \times 97} = 13.6\%
\]

… right?
Resource Waste

- What is T24 ‘framing factor’?
  - 25% (!)
  - Wasted resources
  - Added cost: materials, labor & waste management
Delivery or Disposal?
Potential Cost Savings

- National Association of Homebuilders study from 1990’s:
  - Save $0.24 to $1.20 per square foot
  - Up to $2400 for a 2000 sq. ft. home
- Reduce labor & callback costs
Energy Loss

- More wood = less insulation
- More stuff =
  - Harder to insulate
  - Harder to air seal
- U.S. Department of Energy:
  - improve a wall’s effective R-value up to 30%
  - save 3-5% on heating and cooling costs
Impacts on Related Trades

- Structure isn’t designed to accommodate runs
- Duct & plumbing runs are long, full of bends, in unconditioned space or exterior walls
Consider energy efficiency when designing the structural system
Optimize layout for efficient material use
Use structural-rated wood materials to their full approved capacities
Eliminate structural materials where non-structural materials are adequate
Reduce structural redundancies inherent with conventional stick framing
Advanced Framing Measures

- Single top plate
- Point load transferred between studs by rim closure material acting as header. If rim closure material is non-structural, support will be required under point loads. Use solid blocking between joists.
- Single stud at rough opening
- No cripples under window opening
- Insulated header
- Two stud corners
- Header hangers instead of jack studs
Modular Layout

- Lay out building on two foot module:
  - Maximize efficiency of 24 inch framing and 4x8 sheet goods
  - Reduce materials, labor & waste
  - Increase energy performance
- Keep plans simple
- Place openings on module
- Provide detailed framing elevs.
Framing Greater than 16” o.c.

- 19.2” or 24”
CBC Table 2308.9.1

<table>
<thead>
<tr>
<th>Stud Size</th>
<th>Maximum stud spacing for laterally unsupported studs not exceeding 10 feet in height</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Supporting roof &amp; ceiling only</td>
</tr>
<tr>
<td>2x4</td>
<td>24</td>
</tr>
<tr>
<td>3x4</td>
<td>24</td>
</tr>
<tr>
<td>2x5</td>
<td>24</td>
</tr>
<tr>
<td>2x6</td>
<td>24</td>
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</tbody>
</table>

Adapted from CBC Table 2308.9.1
Headers Sized for Load

- Rather than one option for worst-case scenario
- None where there’s no load!
Quiz:

- Is header sized for load?

NO!
Insulated Headers

Provide insulated headers at all (n) exterior doors & windows, typ. SSD.
Single Open-Cavity Headers

- Are double headers always required?
- Get creative…
  - Structural rim joist?
  - Doubled rim?
Header Hangers

- Jack/trimmer studs typically used to carry header loads
- Replace with framing anchors when adequate (rule of thumb: when replacing one jack stud@ ea end)
Open Wall Corners

- 3 or 4 studs typically used!
- Use 2-stud detail with non-structural backing to support drywall per CBC 2308.9.2.
  - Backing can be wood, specified sheathing or panel materials, and “other approved devices”
Drywall Clips

- The Nailer
  - www.thenailer.com

- Prest-on Corner-backs
  - www.prest-on.com

- Simpson DS (Drywall Stop)
  - www.strongtie.com
Ladder Framing

- Allows for insulation
- Provides nailing surface
Single Top Plate

- CBC 2308.9.2.1
  - “A single top plate is permitted, provided the top plate is adequately tied at joints, corners and intersecting walls... provided the rafters, joists or trusses are centered over the studs with a tolerance of no more than 1 inch”
Energy-Efficient Trusses

- General rule-of-thumb:
  - Provide 75% of attic insulation height at outer edge of ext. wall

- Structural considerations

- Architectural considerations
Energy-Efficient Trusses

Oversized Roof Truss

Insulation baffle prevents wind blowing through insulation and maintains 2 in. clearance under roof sheathing.

Sealant, adhesive or gasket

Oversize roof truss provides increased depth of roof insulation at perimeter.

Raised Heel Roof Trusses
Energy-Efficient Trusses

- Roof trusses designed to accommodate ductwork

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HVAC DUCTWORK TO BE INSTALLED INSIDE CONDITIONED SPACE, USE DUCT MASTIC ON ALL DUCT JOINTS AND SEAMS, TYP. TOWER 131'
USDE study:

**Standard Framing Versus Advanced Framing Cross-section**

- **Standard corner**
  - Extra exterior corner studs

- **Standard T-wall intersection**
  - Insulation void
  - Extra studs for attaching drywall

- **Advanced corner**
  - 2x4 turned sideways serves as nailing for siding
  - Drywall clip to hold drywall in place

- **Advanced ladder T-wall intersection**
  - Drywall and interior walls are attached to "ladder," which spans between studs

**Comparison**

<table>
<thead>
<tr>
<th></th>
<th>Standard</th>
<th>Advanced</th>
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</thead>
<tbody>
<tr>
<td>Insulation Voids</td>
<td>3%</td>
<td>0%</td>
</tr>
<tr>
<td>Framing factor</td>
<td>15-25%</td>
<td>10-15%</td>
</tr>
<tr>
<td>Batt R-value</td>
<td>R-13</td>
<td>R-13</td>
</tr>
<tr>
<td>Sheathing R-value</td>
<td>R-0.5 to 2.0</td>
<td>R-2.5</td>
</tr>
<tr>
<td>Effective Average R-value</td>
<td>R-11.1</td>
<td>R-14.6 (30% higher)</td>
</tr>
</tbody>
</table>
Case Study

One Sky Homes – Cottle Zero Energy Home

HH6 @ TWO-STUD-BAY WINDOW OPENINGS TYP.

INSULATED HDR <= 4' SPAN TYP. (3" RIGID EPS BETW 1 1/4 LVL)

2x2 BLOCKING @ WINDOW OPENING PERIMETER FOR STUCCO LATH NAILING TYP. (NOT DISPLAYED)

2x4 FLAT BLOCKING @ SINGLE STUDS @ EDGE OF 46 1/2" WINDOW OPENINGS (SEE DETAIL W/CALCS)

46 1/2 in TYP.

2'-0" TYP.

22 1/2 in TYP.

DOUBLE STUDS @ OPENINGS AND WALL ENDS AS RQD. FOR SHEAR WALL HD'S OR STRAPS TYP.

TYP. (ADVANCED) EXT. WALL FRAMING
# Cottle ZEH Framing Summary

<table>
<thead>
<tr>
<th>Wall Type</th>
<th>L</th>
<th>H</th>
<th>Area (Sq Ft)</th>
<th>Plates</th>
<th>Studs</th>
<th>Cripples &amp; Sills</th>
<th>Headers</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L</td>
<td>H</td>
<td></td>
<td>L (LF)</td>
<td>FF ( % )</td>
<td>Qty (Bd Ft)</td>
<td>L (LF)</td>
<td>FF ( % )</td>
</tr>
<tr>
<td>2nd Flr - 9 Ft Ceiling, 2x10 Nom. Hdr Size</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2x6 Adv *</td>
<td>164</td>
<td>9</td>
<td>1476</td>
<td>492</td>
<td>4.2%</td>
<td>492</td>
<td>127</td>
<td>9.3%</td>
</tr>
<tr>
<td>2x4 Trad</td>
<td>164</td>
<td>9</td>
<td>1476</td>
<td>492</td>
<td>4.2%</td>
<td>328</td>
<td>218</td>
<td>16.0%</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td></td>
<td></td>
<td>0</td>
<td>0.0%</td>
<td>164</td>
<td>-91</td>
<td>-6.7%</td>
</tr>
<tr>
<td>% Difference</td>
<td></td>
<td></td>
<td></td>
<td>50.0%</td>
<td>-41.7%</td>
<td>-41.7%</td>
<td>-41.7%</td>
<td>-12.6%</td>
</tr>
</tbody>
</table>

*Note - 2x6 Adv For Headers: Lumber Qty included, Framing Factor % NOT included in Total since all Headers insulated to approx. wall R-Value

Note - 2x2 Stucco lath nailers and 3/4" Ply drywall backing strips not included in 2x6 Adv Framing Lumber calcs
Other Resource-Efficient Practices

- Keep it simple. Excerpt from NRDC’s Efficient Wood Use in Residential Construction handbook:
  - “Design simply and elegantly. A great deal of wood and money is wasted on excess, such as unnecessarily complex roofs and applique decoration, instead of being invested in the design of timeless structures whose appeal relies on beautiful proportions and fine craftsmanship.

- Yes, size matters…
The Not So Big House

Since 1949, the square footage of housing per person has jumped by 3.6 times from 214 to 769 in the U.S.!

Sarah Susanka, notsobighouse.com
- Typically calls for building one-third less in square footage than homeowners think they need
Market Trends: Small Is In?

- Living small: Defying trend, some homeowners make more of less square footage
  - MarketWatch.com: tinyurl.com/livingsmall
- 2009 Forecast: Smaller Single-family Home Trend Will Continue
  - Trulia.com: tinyurl.com/smallerntrend
Barriers to Advanced Framing

- **Architect:** it will limit my creativity and design options. Client won’t be interested.
- **Engineer:** I don’t want to do things a new way. I overdesign because I know what can go wrong in the field.
- **Builder:** I don’t want to introduce new techniques that might concern inspector and slow down the project. No time to train crew.
- **Client:** more wood is better. I don’t want to pay more for added design & planning.
How do I start?

- Read Building Science Corp’s *Using Wood Efficiently: From Optimizing Design to Minimizing the Dumpster* research report:
  - [www.buildingscience.com/documents/reports](http://www.buildingscience.com/documents/reports)

- Read NRDC’s *Efficient Wood Use in Residential Construction* handbook:
  - [www.nrdc.org/cities/building/rwoodus.asp](http://www.nrdc.org/cities/building/rwoodus.asp)

- Develop and discuss Advanced Framing goals in *initial meetings*
Successful Collaboration

- Identify project goals.
- Assemble quality team—and educate them.
- Identify & assign responsibility for ‘gray areas’.
- How will accountability by measured or verified?
Get Down to Business!

- “Green” your standard wood specs/notes
  - Reference code sections to smooth permit approval and building inspections
- Develop standard Advanced Framing details
- Clearly indicate which headers are NOT load-bearing (and reference arch. detail)
- Provide calculations for measures not aligned with Conventional Framing provisions
- … and?
Questions…