

## Advanced Framing Guide

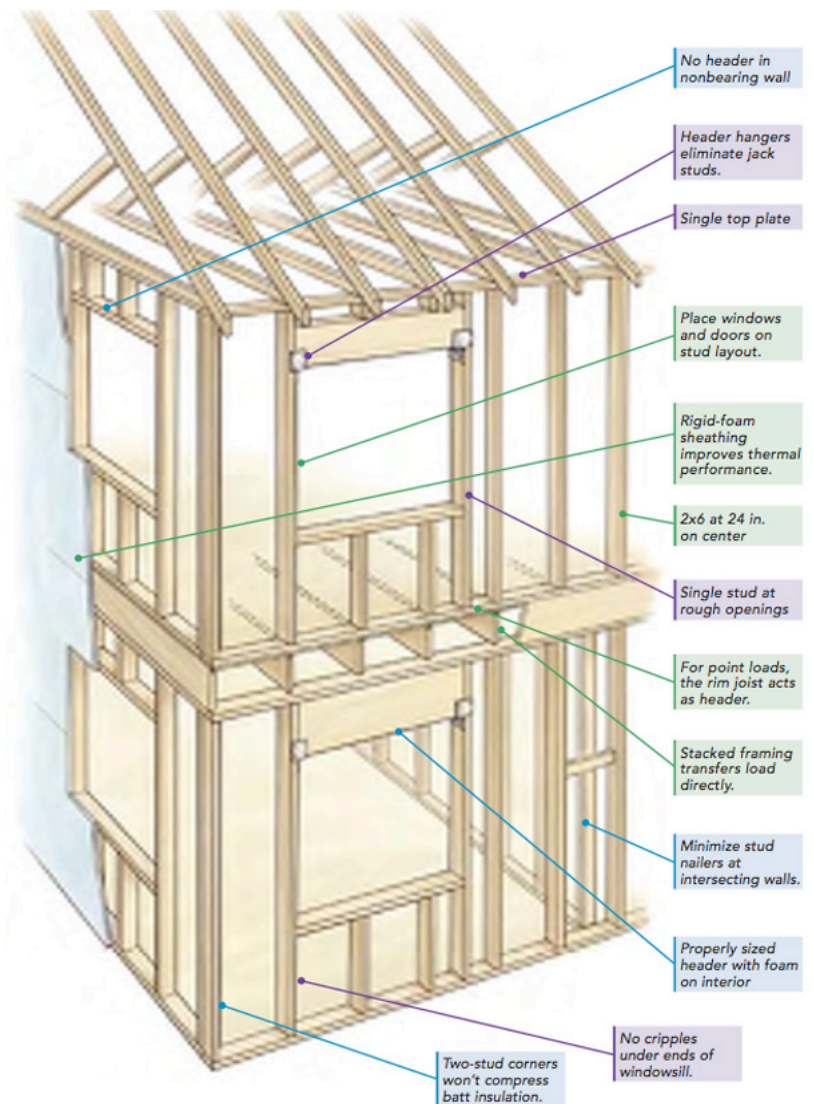
For the design, engineering & construction of wood-frame buildings that are:

- Cost-efficient
- Resource-efficient
- Energy-efficient
- Code-compliant and often structurally superior

*“The current industry standard wall – a 2x4 frame at 16-inch centers with double top plates, three stud corners, jack studs, cripples and double headers – is being replaced by a 2x6 frame at 24-inch centers with single top plates, two stud corners, no jack studs, no cripples and single headers (and in many cases no headers at all).*

*It is cheaper and faster to build and saves energy. It is cheaper because it uses 5 to 10 percent less lumber (board-feet) and it is faster because it uses 30 percent fewer pieces. It saves energy because it provides a 60 percent deeper cavity (which allows 60 percent more cavity insulation) and because it reduces the framing factor from 25 percent to 15 percent.*

*The framing elements are farther apart allowing easier installation of services – everything fits easier making the plumber and tinbasher happier – the electrician drills fewer holes and the insulator insulates faster because there are fewer cavities even though the cavities are wider and deeper. Everything lines up so the load paths are direct leading to fewer but stronger connections and the lines are cleaner so it just looks and feels better.” - Joe Lstiburek, Building Science Corporation*



Source: InHabit Modern Dwellings (adapted from Building Science Corp.)

### Introduction

Advanced Framing, or Optimal Value Engineering (OVE), boils down to using structural wood products only where necessary for: **1) structural performance, 2) long-term durability** (such as extended roof overhangs), **3) energy efficiency, or 4) serviceability** (such as blocking for cabinets). It's a collection of techniques that is most effective when implemented as part of a whole-systems design approach—however, many techniques can be adopted independently on any project. This guide provides a systematic approach for applying Advanced Framing measures to your light-frame wood buildings.

	Advanced Framing Measure	Primary Responsible Parties	Difficulty/Coordination Required	Related Considerations
Schematic Design	Compact shape (minimized envelope to volume or floor area ratio)	Architect	Low	Daylighting design
	Simplicity (roof lines, foundation & envelope articulations, dormers etc.)	Architect	Low	Daylighting design
	Exterior wall & roof dimensions on two-foot multiple (f.o. framing)	Architect	Low	Lot setbacks, ridge vent consideration in dimensioning
	Openings placed within standard stud spacing module	Architect	Medium	Aesthetics, standard window & door size options
	2x6 studs @24" o.c. instead of 2x4 studs @16" o.c.	Architect, Engineer	Low	Usable floor space, jamb extensions
	Roof framing, floor framing, & studs @24" o.c.	Architect, Engineer	Medium	Floor & wall cavity depths, sheathing & finish spans
	Roof framing, floor framing, & studs on largest spacing possible	Engineer	Low	
Engineering	Single top plate & stacked framing	Engineer, Builder	High	Stud length, plate splices, truss attachment, lateral loads
	Hung floor joists (top plate elimination or balloon framing)	Arch, Eng, Builder	High	Stud length, fire blocking, load transfer
	Raised heel trusses, oversized trusses, or raised rafter plate	Architect, Engineer	Medium	Raised roof & exterior finish height, shading, load transfer
	Structural rim joist as header	Engineer	Medium	Joist hangers
	Insulated headers	Engineer	Medium	
	Headers designed for load	Engineer	Medium	
	Engineered lumber headers	Engineer	Medium	
Construction	Header hangers in lieu of jack studs	Engineer, Builder	Medium	Thermal bridging of connectors
	Smaller or inset holdown posts	Engineer, Builder	Medium	
	No unneeded cripple studs	Builder	Low	
	Two-stud or open wall corners with ladder blocking or drywall backing	Builder	Medium	Backing selection, coordination with drywallers
	Cut/reuse piles	Builder	Medium	

### Mindset

Change isn't easy. But whatever your role on a project, you have the power to help overcome inertia and people's tendencies to do things the way they've been accustomed to doing them. You have the power to embrace change and the challenge to lead and educate, to create better buildings.

*"People with goals succeed because they know where they're going."  
- Earl Nightingale*

### Architect's Role

#### Goal setting

Establish the mission of your office to incorporate Advanced Framing principles into designs as standard practice. Determine resource- and energy-efficiency goals for a project at the start. Embed goals into design and construction documents, and weave them into every conversation and design decision. The architect holds the key to setting Advanced Framing in motion!

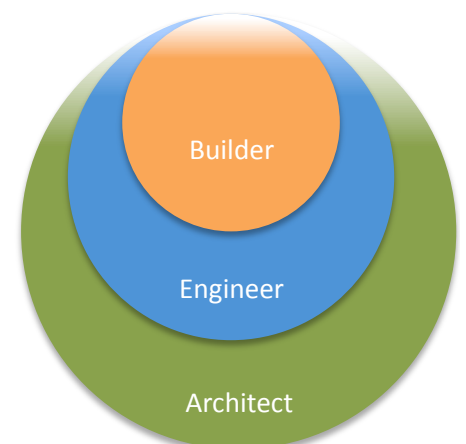
#### Design

Develop and follow a systematic design approach such as by using the tables in this worksheet. Collaborate with engineer, builder, and subs on framing and related issues including HVAC, plumbing and electrical equipment and distribution; air tightness detailing; thermal bypass locations; and insulation and thermal bridge detailing.

#### Project management

Assemble a quality team and clearly define expectations of engineer and builder. Advanced Framing experience isn't essential, but enthusiasm to collaborate and innovate will be invaluable!

1. Identify and assign "gray area" responsibilities. Who will be accountable for what?
2. Determine how successful performance will be verified. Require mockups for measures of concern.
3. Incorporate performance objectives into contracts and ensure they're understood:
  - a. Schedule a mandatory meeting or phone call to discuss
  - b. Bring in a consultant for initial projects if needed
4. Build in adequate construction administration
  - a. Educate
  - b. Enforce accountability
5. Communicate and collaborate
  - a. Maintain consistent communication with team
  - b. Consult with relevant parties throughout design and construction phases
  - c. Embed collaboration into the culture of office and project team



## Engineer's Role

### Goal setting

Establish the mission of your office to incorporate Advanced Framing principles into designs as standard practice. If your client doesn't bring up resource- and energy-efficiency goals for a project when discussing your work scope, take the initiative and ask them.

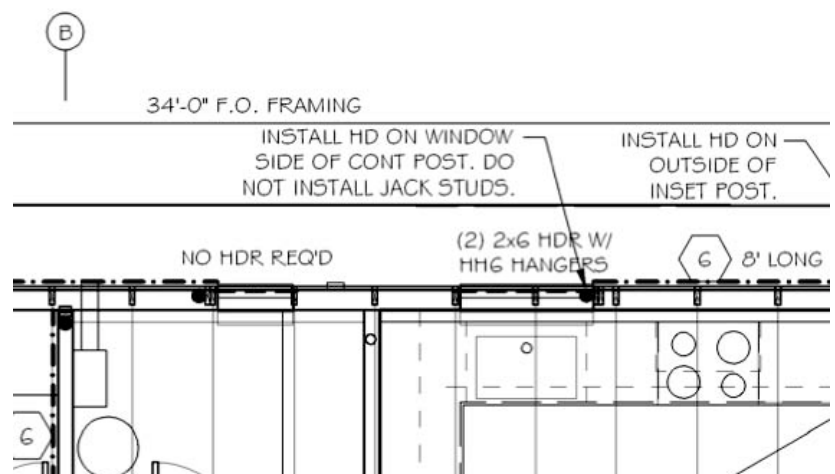
### Design

Develop and follow a systematic design approach such as by using the tables in this worksheet. Collaborate with architect, builder, and subs on framing and related issues including HVAC, plumbing and electrical equipment and distribution; air tightness detailing; thermal bypass locations; and insulation and thermal bridge detailing.

1. Design for specific conditions (within reason)
  - a. Calculate actual loads for headers, posts, framing etc.
  - b. Specify 3x sills only where needed
  - c. Use longer, deeper spans to potentially eliminate some bearing walls
  - d. Design perforated shear walls to minimize holdown posts and blocking
2. Provide detailed information on drawings
  - a. "Green" standard wood & concrete notes/specifications
  - b. Develop typical Advanced Framing details and framing elevations
  - c. Clearly reference applicable Code sections
  - d. Show every exterior wall stud and post on framing plans
  - e. Strategically place holdowns to maximize shear wall lengths
  - f. Clearly indicate where headers are not required

### Project management

1. Communicate and collaborate
  - a. Maintain consistent communication with architect
  - b. Consult with architect (and other relevant parties if possible) throughout design and construction
  - c. Embed collaboration into the culture of office and project team
2. Discuss with architect whether any mockups should be required of builder
3. Build into your scope:
  - a. Meeting with builder to discuss plans and details
  - b. Adequate quality assurance



## Builder's Role

### Goal setting

Establish the mission of your company to incorporate Advanced Framing principles into your structures as standard practice. If your client doesn't bring up resource- and energy-efficiency goals for a project when discussing your work scope, take the initiative and ask them. Most Advanced Framing measures need to be incorporated during schematic and engineering design; by the time construction documents are handed off to you, most potential decisions are already out of your hands.

### Design and collaboration

If you are brought on early enough, ask to review progress sets to look for opportunities for improved resource and labor efficiency, potential conflicts with subcontractors' work, etc. Collaborate with architect, engineer, and subs on framing and related issues including HVAC, plumbing and electrical equipment and distribution; air tightness detailing; thermal bypass locations; and insulation and thermal bridge detailing.

### Construction management

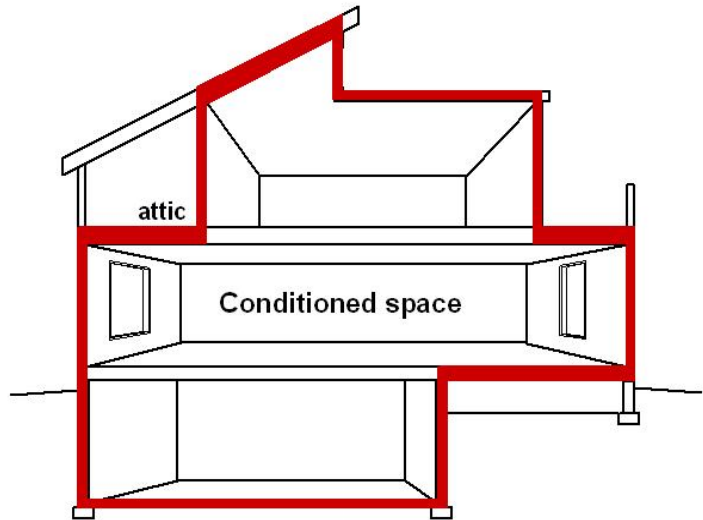
1. Plan and educate
  - a. Thoroughly review Advanced Framing plans
  - b. Meet with engineer to discuss plans and details and address concerns
  - c. Schedule pre-construction meetings with framers and subs to review plans, address concerns, and discover potential downstream issues
  - d. Develop wood waste management plan for cut/reuse piles for blocking
2. Ensure quality control
  - a. Adequately train framing crew on new practices
  - b. Establish crew leads and clearly define responsibilities
  - c. Build mockups of potentially challenging measures



Source: Beyond Efficiency Inc. – CLAM Blue2 House  
Stacked 24" framing, single top plate, header hangers, no trimmers,  
no unneeded cripple studs, no header on non-bearing wall

### Determine Design R-Values

Before designing the structure, ensure the building assemblies are suitable for achieving energy performance goals. First, identify the thermal boundary by drawing a continuous line at each unique building section. Then, complete this chart and discuss with your team:



Building Assembly	Total R-value	Cavity insulation R-value & type	Continuous insulation R-value & type
Attic floor			
Cathedral ceiling			
Attic knee walls			
Skylight shafts			
Exterior walls			
Raised floors: ambient (garage, exterior cantilevers, bay windows)			
Raised floors: crawlspace			
Slab on grade: heated			
Slab on grade: unheated			
Foundation walls: above-grade			
Foundation walls: below-grade			
Other:			
Other:			

### Calculate Framing Factors

Calculate “framing factors” and associated R-values for exterior wall elevations. These calculations are an excellent exercise to give you an idea of the reduction in thermal performance of the wall assembly due to framing.

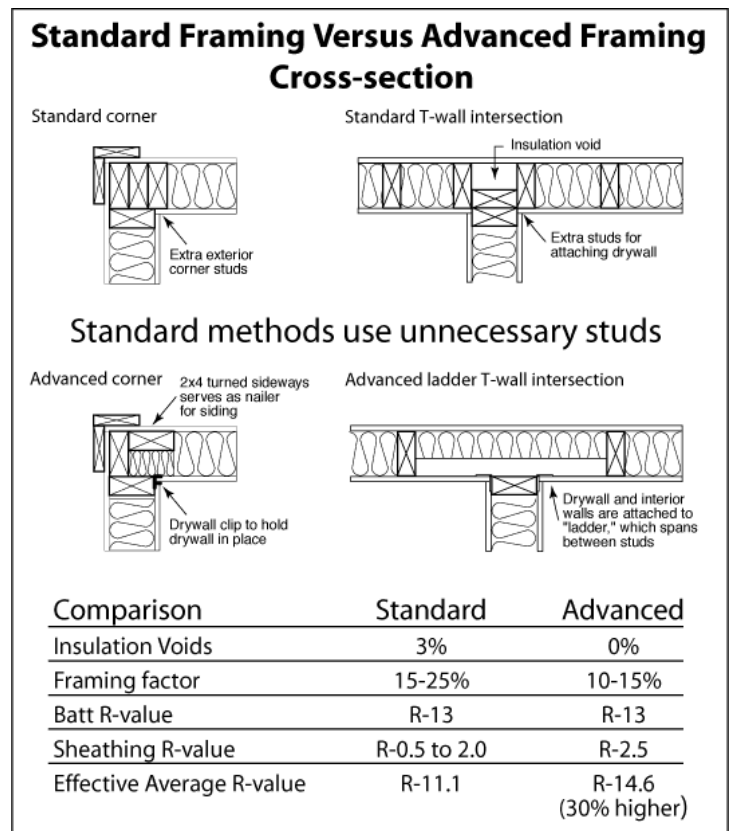
$$\text{Framing factor} = \frac{\text{Solid wood or inadequately insulated area}}{\text{Total area}}$$

$$\text{R-value rough assembly} = \text{Framing factor} \cdot \text{R-value framing lumber} + (1 - \text{framing factor}) \cdot \text{R-value of cavity insulation}$$

$$\text{R-value finished assembly} = \text{R-value rough assembly} + \text{R-value continuous finishes}$$

#### Framing factor calculation

1. Count surface area of wall taken up by solid wood or areas where less than 75% of typical cavity insulation R-value is provided:
  - a. Sole, sill and top plates
  - b. Studs, cripples and holdown posts
  - c. Full-depth wall bridging
  - d. 3x blocking or double header in 2x4 wall
  - e. Inaccessible voids at wall intersections
2. Do not count areas that are insulated to at least 75% of typical cavity insulation R-value, such as:
  - a. Fully insulated cavities
  - b. Single 2x header in 2x4 wall, insulated with XPS or better
  - c. Double 2x header in 2x6 wall, insulated with XPS or better
3. Calculate per above equations



Source: U.S. Department of Energy

A detailed study performed for the California Energy Commission in 2002 reported the average framing factor in residential California construction to be a whopping 27%. Strive for a framing factor under 15% to significantly reduce heat loss through the walls on your projects!