Advanced Framing in Residential Construction and installation of engineered wood products

Niagara Frontier Building Officials

January 28, 2014

Agenda

1. Advanced Framing Techniques
   1. In relation to Energy code changes
2. Installation of I-joists, LVL,PSL,LSL
3. Hole charts-I-joists, SCL
4. Good, Bad, Ugly

Why Advanced Framing?

- **Codes, Customer Needs**, and **Competition** are all pushing for new, more efficient framing techniques
- Advanced Framing reveals the relationship of the **entire structural frame** as a 'system' rather than 'individual pieces'
- We're able to take advantage of products to serve **multiple purposes** within the structure (i.e. vertical and lateral load needs).

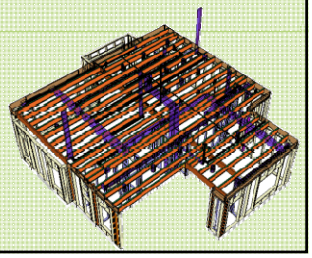
What is Advanced Framing?

Some combination of:

- Making **better use** of existing framing materials
- Identifying **new** framing **techniques** and **products**
- Recognizing the '**House** as a **System**'
- Identifying and understanding **process changes**
- Creating solid **communication** channels
- Inspecting for proper field **implementation**

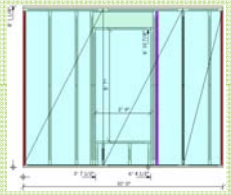
Opportunities/Challenges

- Identify framing Needs and Opportunities
- Framing Process and Collaboration needs
- Implementation and Training
- Documentation and scalability

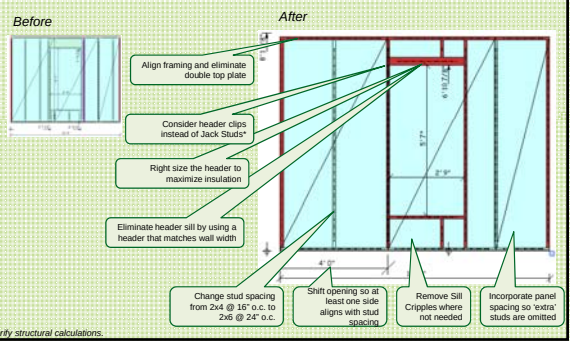


Wall Framing

Before

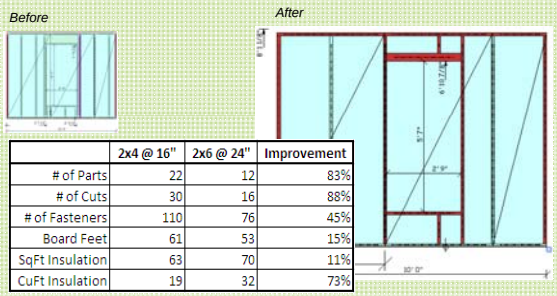


Wall Framing



* Verify structural calculations.

Wall Framing



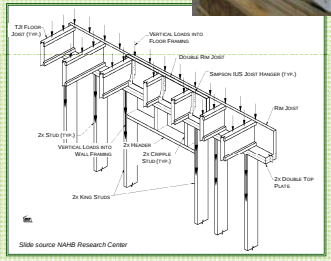
	2x4 @ 16"	2x6 @ 24"	Improvement
# of Parts	22	12	83%
# of Cuts	30	16	88%
# of Fasteners	110	76	45%
Board Feet	61	53	15%
SqFt Insulation	63	70	11%
CuFt Insulation	19	32	73%

* Verify structural calculations.

Integrated Rim Header

- Double rim member at openings

- Joist hangers at openings
- King studs carry gravity load and wind loading
- Eliminates need for jack studs

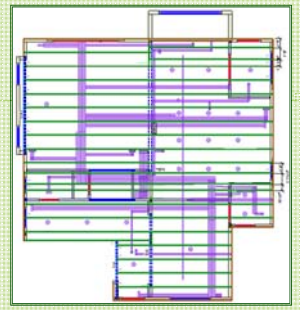


Slide source NAHB Research Center

Planning and Coordination of MEPS

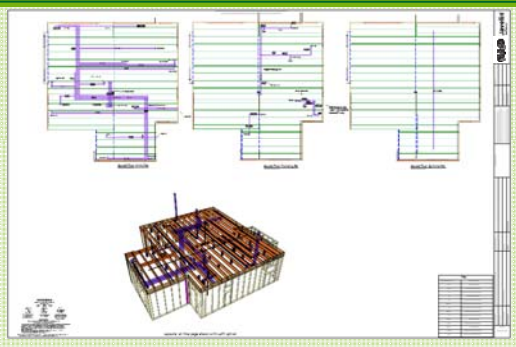
Using Javelin® software's 3D modeling and design capability, you can easily model and design obstructions in iLevel® products

Planning and coordination of mechanical, electrical, plumbing, and sprinkler systems ahead of construction enables conflict resolution, efficient system layout and design, and installation requirements



Slide source Winchester Homes

Implementation and Training



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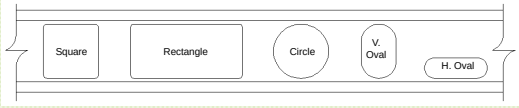
NextPhase® Site Solutions - Holes

HVAC

Plumbing

Electrical



NextPhase® Site Solutions

Implementation and Training

- All of the planning will only be valuable if the plan is executed properly on the jobsite
- Ahead of project framing – training should be provided on installation/use of new products and techniques.
  - Framing Company/Crew
  - All trade installers

Documentation

Properly document products, uses, and exceptions!

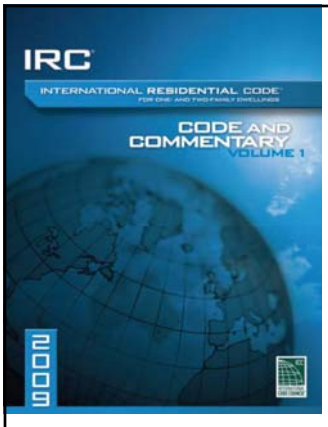
Use with:

- Designers (Architect/Engineer)
- Manufacturers
- Retail Dealers/Suppliers
- Installers

Slide source Winchester Homes

Scalability

- **Planning** is heavily weighted to the front-end rather than decisions being made on the jobsite
- Each project may require lot-specific **modifications** and installation **drawings**
- Tools such as **NextPhase® Site Solutions** and **Javelin® 3D** modeling and design software enable detailing, communication, and modifications to scale this process as required



2009 IRC®

Chapter 11,
Structural Framing
sealing & insulation

I need….

- "..to quit using your rim board. I've got to use an insulated rim board."
- "..to find a supplier of insulated headers. Don't bother switching them out to EWP."
- ".. to switch to 2X6 walls so I've got to cut costs somewhere…."

N1102.4.1 Building thermal envelope. The *building thermal envelope shall be durably sealed to limit infiltration. The sealing* methods between dissimilar materials shall allow for differential expansion and contraction. The following shall be caulked, gasketed, weatherstripped or otherwise sealed with an air barrier material, suitable film or solid material.

1. All joints, seams and penetrations.
2. Site-built windows, doors and skylights.
3. Openings between window and door assemblies and their respective jambs and framing.
4. Utility penetrations.
5. Dropped ceilings or chases adjacent to the thermal envelope.
6. Knee walls.
7. Walls and ceilings separating the garage from *conditioned spaces.*
8. Behind tubs and showers on *exterior walls.*
9. Common walls between *dwelling units.*
10. Attic access openings.
11. Rim joists junction.
12. Other sources of infiltration.

N1102.4.2 Air sealing and insulation. ***Building envelope air tightness and insulation installation shall be demonstrated to comply with one of the following options*** given by Section N1102.4.2.1 (Blower Door Test) or N1102.4.2.2 (Visual inspection)

This is the basic set of rules for sealing the structural frame.

To make sure the sealing is done properly, the code gives the builder two options:

1. Blower test
2. Visual inspection

TABLE N1102.4.2
AIR BARRIER AND INSULATION INSPECTION

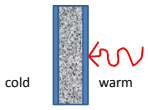
COMPONENT	CRITERIA
Air barrier and thermal barrier	Exterior thermal envelope insulation for framed walls is installed in substantial contact and continuous alignment with building envelope air barrier. Breaks or joints in the air barrier are filled or repaired. Air-permeable insulation is not used as a sealing material.
Ceiling/attic	Air barrier in any dropped ceiling/soffit is substantially aligned with insulation and any gaps are sealed. Attic access (except unvented attic), knee wall door, or drop down stair is sealed.
Walls	Corners and headers are insulated. Junction of foundation and sill plate is sealed.
Windows and doors	Space between window/door jambs and framing is sealed.
Rim joists	Rim joists are insulated and include an air barrier.
Floors (including above garage and cantilevered floors)	Insulation is installed to maintain permanent contact with underside of subfloor decking. Air barrier is installed at any exposed edge of floor.
Crawlspace walls	Insulation is permanently attached to walls. Exposed earth in unvented crawlspaces is covered with Class I vapor retarder with overlapping joints taped.
Shafts, penetrations	Duct shafts, utility penetrations, knee walls and flue shafts opening to exterior or unconditioned space are sealed.
Narrow cavities	Batts in narrow cavities are cut to fit, or narrow cavities are filled by spray/dribble insulation.
Garage separation	Air sealing is provided between the garage and conditioned spaces.
Recessed lighting	Recessed light fixtures are airtight, IC rated and sealed to drywall. Exception—fixtures in conditioned space.
Plumbing and wiring	Insulation is placed between outside and pipes. Batt insulation is cut to fit around wiring and plumbing, or spray/dribble insulation extends behind piping and wiring.
Shower/tub on exterior wall	Showers and tubs on exterior walls have insulation and an air barrier separating them from the exterior wall.
Electrical/phone box on exterior wall	Air barrier extends behind boxes or air sealed type boxes are installed.
Common wall	Air barrier is installed in common wall between dwelling units.
HVAC register boots	HVAC register boots that penetrate building envelope are sealed to subfloor or drywall.
Fireplace	Fireplace walls include an air barrier.

❖ This table contains the list of items that are required to be visually inspected if the visual inspection option for demonstrating building air tightness given in Section N1102.4.2.2 is chosen.

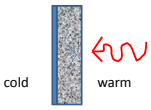
Places that will need to be sealed or insulated

Air barrier

- Air Barrier(s)
  - – Stop the movement of air and thus leakage.
    - Housewrap, sheathing, drywall, flooring



Air permeable insulation sealed between air barriers works. ***Just like a sleeping bag***.



Air permeable insulation loose to one side of a barrier allows air to flow right through. ***Would you stay warm if you piled a few Inches of down feathers on top of yourself?***

Insulated Rim Board

Batt insulation

Does not meet intent of the code.

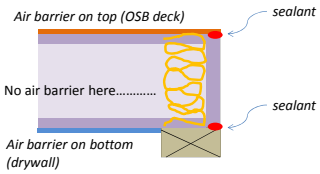
Pre -insulated Rim

Does meet intent of the code

Closed cell spray foam

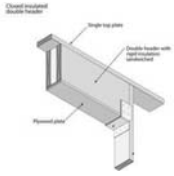
Does meet intent of the code

Good news on Rim



In a second floor – the insulation is "kinda" sealed. The floor cavity is all dead air space, so some building departments may give you a break and continue to allow loose batt insulation with no interior air barrier

Insulated Headers



U.S. D.O.E. example

Insulation thickness: 1" , 1 ½", 2"? **R** value?

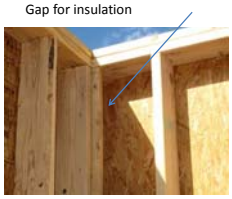
Rigid insulation generally satisfies both insulation & air barrier requirements

More on Headers

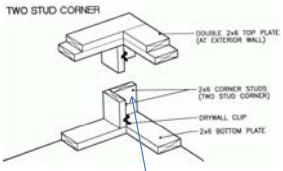
- What if (2) 2X10 headers are spec'd and..
  - We can replace this header with a smaller TimberStrand® header ?
- What if we can make a 3 ½" thick header work in a 2X6 wall?
- If the header is eliminated and pushed up into the rim..does this count as an "insulated header?"
- If the header is converted to a plank orientation (e.g. 5 ½" X 3 ½" TS)… does this count as an "insulated header?"

Insulated corners

Gap for insulation



3 stud corner



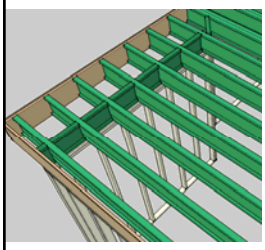
Gap for insulation

Good News On Corners

Stucture ALWAYS trumps insulation.

If you NEED a multiple stud column or solid column at a corner, no problemo.

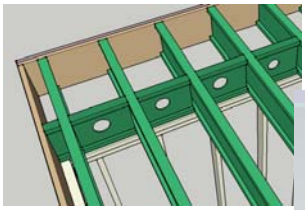
Floor Cantilever - Batt Insulation



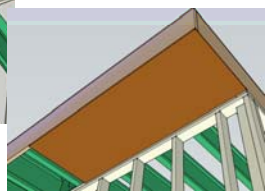
Framer should NOT cut holes in blocking
Leave soffit OFF for insulator

**Note insulation is wired tight to bottom of Floor deck.

Floor Cantilever – Blown Insulation



Framer cuts ROUND holes for insulator
Attach soffit.



***FYI – we quit the square hole thing quite a few years ago.*

Continuous Insulation…. Another Alternate

2X4 framing
R13 wall insulation
R5 Rigid insulation

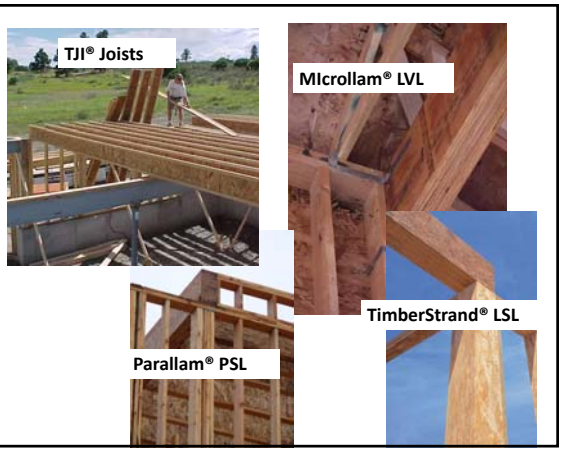
1" Rigid insulation = R5
Can use ½" rigid over 7/16" OSB**

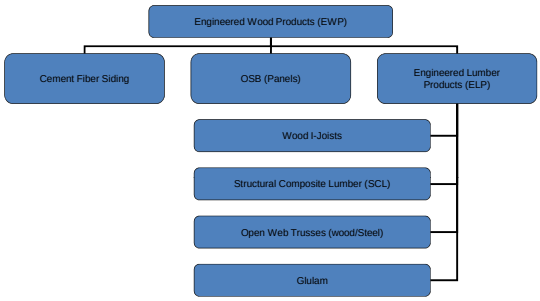
***Automatically* insulates Rim, Headers, Corners**

Summary

- The 2009 IRC® gives the Builder the flexibility to decide how they want to meet the code:
  - PERFORMANCE PATH: Build as normal (*no insulated headers, rim or corners*), seal like crazy and do the blower test
  - PRESCRIPTIVE PATH: Follow the visual inspection items
- **Insulated rim** – up to the Building Official.
  - Traditional stuffed batt insulation between joists is not code compliant.
- **Insulated headers** – up to the Building Official
  - R5 (1") minimum?, plank orientation? , rim as header options?
- **Insulated corners** – 2 or 3 stud corners
  - Don't worry about corners that need multiple studs for bearing, uplift, connections, etc.
- **Floor Cantilevers** – Need to insulate
  - Construction methods vary based on how it's insulated
  - R30 is 9 ½" thick, so no problem for any TJI® depth

Inspecting Engineered Lumber Framed Houses





Codes & Standards

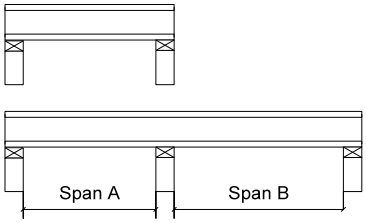
- WIJMA Wood I-Joist Manufacturers Assoc.
  - Optional
  - Define testing and protocol for properties
- APA-EWS Engineered Wood Systems
  - Optional
  - Define minimum critiera, standard span charts
- IRC
  - "…any materials permitted by code"
- Bottom Line: Need to know the manufacturer and follow their guidelines.

TJI® Joists in Floors

I - Joists

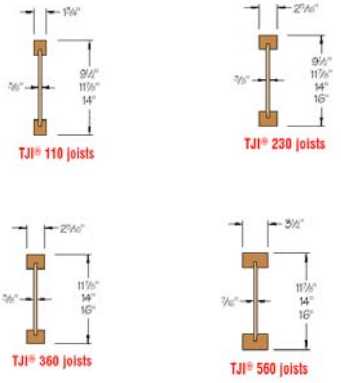
- Fixed property vs. variable property (truss)
- Flange size, orientation, materials differ
- Web material,thickness,orientation differ
- Depths… mostly the same.
- Nomenclature…all different
- Engineering standards… different

Simple vs. Continuous Spans

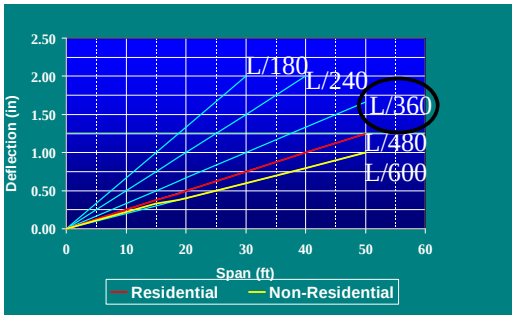


Span A = 40% Minimum of Span B

If not… Uplift occurs



Conventional Deflection



New Spans-2009

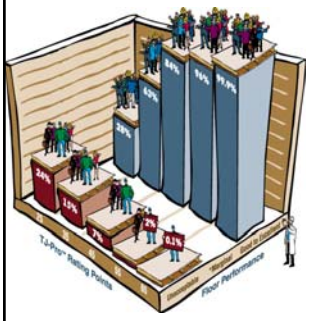
L/480 Live Load Deflection

Depth	TJI®	40 PSF Live Load / 10 PSF Dead Load				40 PSF Live Load / 20 PSF Dead Load			
		12" o.c.	16" o.c.	19.2" o.c.	24" o.c.	12" o.c.	16" o.c.	19.2" o.c.	24" o.c.
9½"	110	16'-11"	15'-6"	14'-3"	13'-7"	16'-11"	15'-6"	14'-3"	12'-8"
	210	17'-8"	16'-3"	15'-4"	14'-3"	17'-8"	16'-3"	15'-4"	14'-0"
	230	18'-3"	16'-8"	15'-9"	14'-8"	18'-3"	16'-8"	15'-9"	14'-8"
11⅞"	110	20'-2"	18'-5"	17'-4"	15'-9"(1)	20'-2"	17'-8"	16'-1"(1)	14'-4"(1)
	210	21'-1"	19'-3"	18'-3"	16'-11"	21'-1"	19'-3"	17'-8"	15'-8"(1)
	230	21'-8"	19'-10"	18'-8"	17'-5"	21'-8"	19'-10"	18'-3"	16'-7"(1)
	360	22'-11"	20'-11"	19'-8"	18'-4"	22'-11"	20'-11"	19'-8"	17'-10"(1)
	560	26'-1"	23'-8"	22'-4"	20'-9"	26'-1"	23'-8"	22'-4"	20'-9"(1)
14"	110	22'-10"	20'-11"	19'-3"	17'-2"(1)	22'-2"	19'-2"	17'-6"(1)	15'-8"(1)
	210	23'-11"	21'-10"	20'-0"	18'-10"(1)	23'-11"	21'-1"	19'-2"(1)	16'-7"(1)
	230	24'-8"	22'-6"	21'-3"	19'-9"(1)	24'-8"	22'-2"	20'-3"(1)	17'-6"(1)
	360	26'-0"	23'-8"	22'-4"	20'-9"(1)	26'-0"	23'-8"	22'-4"(1)	17'-10"(1)
	560	29'-6"	26'-10"	25'-4"	23'-6"	29'-6"	26'-10"	25'-4"(1)	20'-11"(1)
16"	210	26'-6"	24'-3"	22'-4"(1)	19'-11"(1)	26'-0"	22'-4"(1)	20'-7"(1)	16'-7"(1)
	230	27'-3"	24'-10"	23'-6"	21'-1"(1)	27'-3"	23'-9"	21'-8"(1)	17'-6"(1)
	360	28'-9"	26'-3"	24'-8"(1)	21'-5"(1)	28'-8"	26'-3"(1)	22'-4"(1)	17'-10"(1)
	560	32'-8"	29'-8"	28'-0"	25'-3"(1)	32'-8"	29'-8"	26'-3"(1)	20'-11"(1)

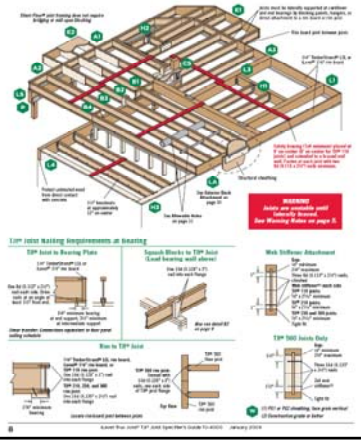
16’ Span Joists 16” o.c.

- 9-1/2” TJI® 110
  - How far does it span in literature?
  - Simple or continuous span
- What is the minimum adjacent span ?

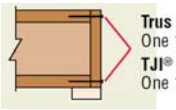
The TJ-Pro™ rating system



- ✓ The TJ-Pro™ Rating system is a model for predicting floor performance.



Rim to Joist



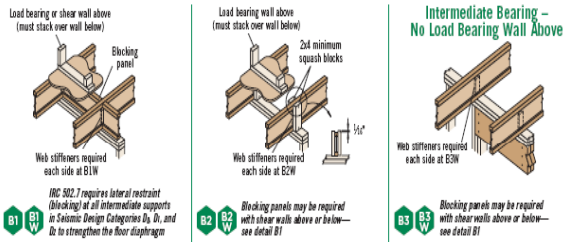
Trus Joist rim board or TJI® 110 rim joist:
One 10d (3") box nail into each flange
TJI® 210, 230, and 360 rim joist:
One 16d (3½") box nail into each flange

Plywood Rim was eliminated in 1992

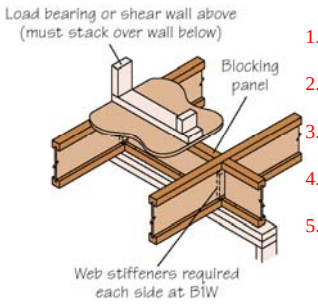
No lateral capacity

1-3/4” Bearing Required

Not!



TJI® Blocking Panel

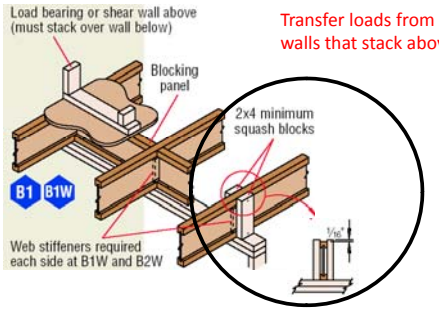


1. Carry load-bearing walls that stack
2. Transfer floor diaphragm Loads
3. Lateral support for cantilever joists
4. Lateral support for lapped joists
5. Draft stopping

Blocking

Carrying load bearing wall above

Squash Blocks



Transfer loads from bearing walls that stack above

Squash Blocks

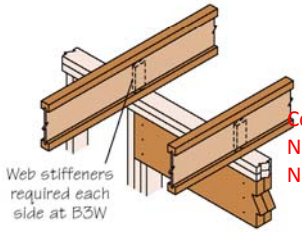
Transferring Concentrated (point loads) from above through the floor to the foundation or wall below.

Headers three feet or longer

Huh?

Intermediate Bearing

Intermediate Bearing – No Load Bearing Wall Above



Continuous Joist +
No load from above =
No blocking panels

Lap flush to wall. Blocking Panels Required

Blocking Panel / Squash Block Review

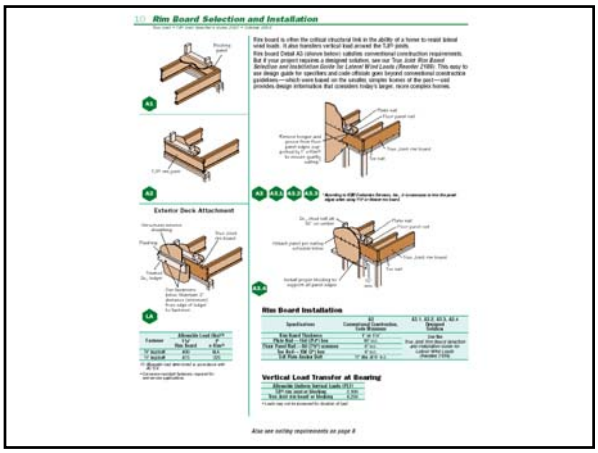
Blocking Panels

- Vertical load transfer from bearing walls above
- Diaphragm load transfer
- Lateral support of cantilever joists
- Lateral support of lapped or butted joists
- Draft stop

Squash Blocks

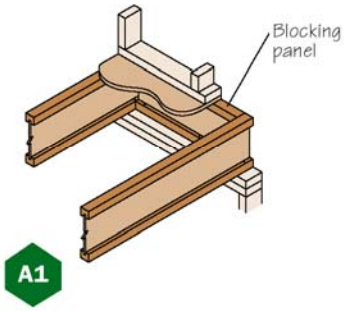
- Vertical load transfer from bearing walls above
- Vertical load transfer from concentrated loads above

This is on the test !!

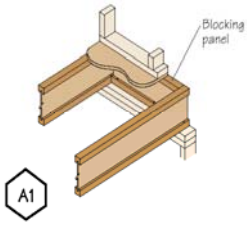


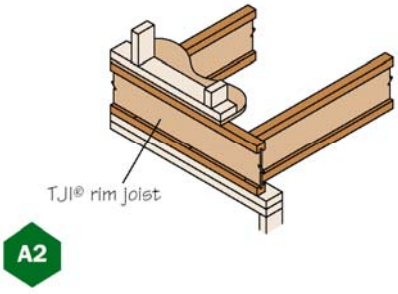
Rim Thickness

- 1” Minimum
- 1-1/4” equivalent to solid sawn
- Remove the T & G for rim < 1-1/4”



Alternate end detail





Alternate end detail

Double Rim

Do not need to double rim at 2X6 walls

RIM BOARD

- Matches depth of TJI® joists
- 1-1/4" thickness matches solid sawn nailing performance
- Consistent & dimensionally stable
- Recommended for use with the Silent Floor™ System

What's wrong with this picture ?

O.K. or Not O.K.?

Carrying load bearing wall- Add squash blocks

Carrying shear wall- Consult Engineer

Blocking Panels

Always required at the bearing point for cantilever joists for lateral stability and diaphragm transfer

Squash blocks will not work here.

O.K. or Not O.K.?

O.K. or Not O.K.?

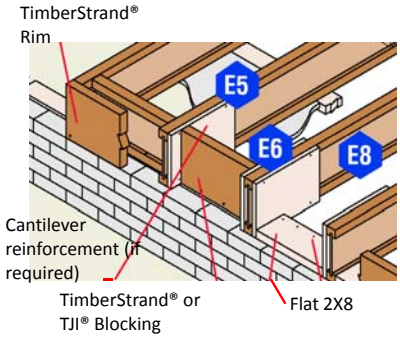
Not O.K.

O.K….. If squash blocks are added

O.K. or Not O.K?

Diaphragm Blocking

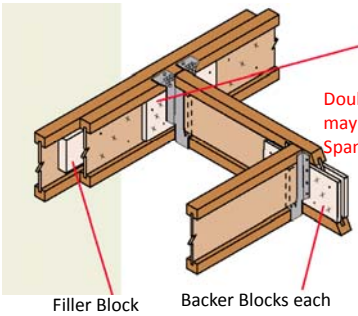
Brick Ledge Cantilever Joists



O.K. or Not O.K. ?

…Except in Texas

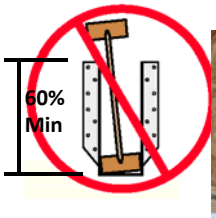
Header Framing



Double trimmers may or may not be required
Span and loads dictate

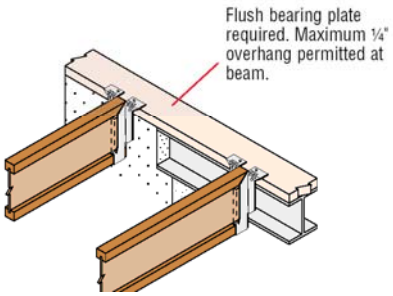
O.K. or Not O.K.?

Hangers



Hangers must restrain the top flange
And be 60% of the depth of the joist

Hangers



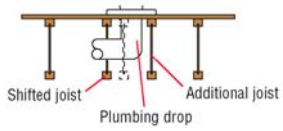
O.K. or Not O.K.?

O.K. or Not O.K.?

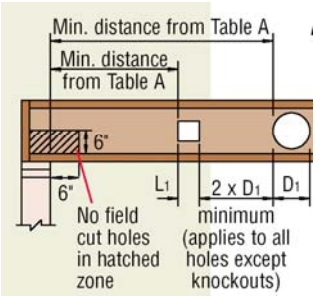
Be on the look out for hangers that do not fit the joist

Supporting Non-Bearing Walls

Joists can be separated or together.. Not fastened together



Holes in Joists



Do not cut holes larger Than 1-1/2" DIA. in cantilever

1. Larger holes near midspan
2. Two or more X larger hole diameter. between holes
3. No holes close to bearing

ALLOWABLE HOLES

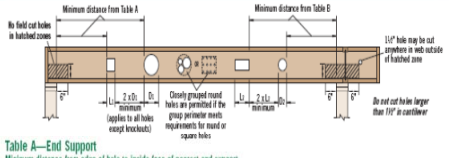


Table A—End Support

Minimum distance from edge of hole to inside face of nearest end support

Depth	TJI®	Round Hole Size 2"	3"	4"	5"	6½"	7"	8⅝"	11"	13"	Square or Rectangular Hole Size 2"	3"	4"	5"	6½"	7"	8⅝"	11"	13"
9½"	110	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"					1'-0"	1'-0"	1'-0"	1'-0"	1'-0"				
	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"					1'-0"	1'-0"	1'-0"	1'-0"	1'-0"				
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"					1'-0"	1'-0"	1'-0"	1'-0"	1'-0"				
11⅞"	110	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"			1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"		
	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"			1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"		
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"			1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"		
	360	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"			1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"		
	560	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"			1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"		
14"	110	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	360	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	560	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
16"	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	360	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"
	560	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"

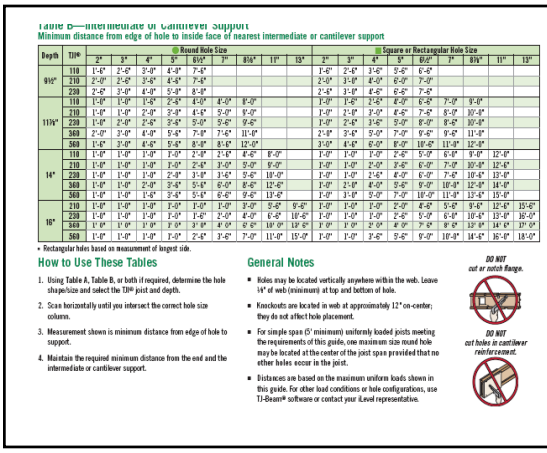


Table B—Intermediate or Cantilever Support

Minimum distance from edge of hole to inside face of nearest intermediate or cantilever support

Depth	TJI®	Round Hole Size 2"	3"	4"	5"	6½"	7"	8⅝"	11"	13"	Square or Rectangular Hole Size 2"	3"	4"	5"	6½"	7"	8⅝"	11"	13"
9½"	110	1'-6"	2'-0"	3'-0"	4'-0"	7'-6"					1'-0"	2'-0"	3'-0"	5'-0"	6'-0"				
	210	2'-0"	2'-0"	3'-0"	4'-6"	7'-6"					2'-0"	3'-0"	4'-0"	6'-0"	7'-0"				
	230	2'-6"	3'-0"	4'-0"	5'-0"	8'-0"					2'-6"	3'-0"	4'-0"	6'-0"	7'-6"				
11⅞"	110	1'-0"	1'-0"	1'-6"	2'-6"	4'-0"	4'-0"	8'-0"			1'-0"	1'-0"	2'-0"	4'-0"	6'-0"	7'-0"	9'-0"		
	210	1'-0"	1'-0"	2'-0"	3'-0"	4'-6"	5'-0"	9'-0"			1'-0"	2'-0"	3'-0"	4'-0"	7'-0"	8'-0"	10'-0"		
	230	1'-0"	2'-0"	3'-0"	3'-0"	5'-0"	5'-0"	9'-0"			1'-0"	2'-0"	3'-0"	5'-0"	8'-0"	8'-0"	10'-0"		
	360	2'-0"	3'-0"	4'-0"	5'-0"	7'-0"	7'-6"	11'-0"			2'-0"	3'-0"	5'-0"	7'-0"	9'-0"	9'-0"	11'-0"		
	560	1'-0"	3'-0"	4'-0"	5'-0"	8'-0"	8'-0"	12'-0"			3'-0"	4'-0"	6'-0"	8'-0"	10'-0"	11'-0"	12'-0"		
14"	110	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"	2'-0"	4'-0"	8'-0"		1'-0"	1'-0"	1'-0"	2'-0"	5'-0"	6'-0"	9'-0"	12'-0"	
	210	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"	5'-0"	9'-0"		1'-0"	1'-0"	2'-0"	3'-0"	6'-0"	7'-0"	9'-0"	12'-0"	
	230	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"	3'-0"	5'-0"	10'-0"		1'-0"	1'-0"	2'-0"	4'-0"	6'-0"	7'-0"	9'-0"	12'-0"	
	360	1'-0"	1'-0"	2'-0"	3'-0"	5'-0"	6'-0"	9'-0"	12'-0"		1'-0"	2'-0"	3'-0"	5'-0"	9'-0"	10'-0"	12'-0"	14'-0"	
	560	1'-0"	1'-0"	2'-0"	3'-0"	5'-0"	6'-0"	9'-0"	13'-0"		1'-0"	1'-0"	3'-0"	5'-0"	9'-0"	11'-0"	13'-0"	15'-0"	
16"	210	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	3'-0"	5'-0"	9'-0"	1'-0"	1'-0"	1'-0"	2'-0"	4'-0"	5'-0"	9'-0"	12'-0"	15'-0"
	230	1'-0"	1'-0"	1'-0"	1'-0"	1'-0"	2'-0"	4'-0"	6'-0"	10'-0"	1'-0"	1'-0"	1'-0"	2'-0"	5'-0"	6'-0"	10'-0"	13'-0"	16'-0"
	360	1'-0"	1'-0"	1'-0"	1'-0"	3'-0"	4'-0"	6'-0"	10'-0"	15'-0"	1'-0"	1'-0"	2'-0"	4'-0"	7'-0"	8'-0"	12'-0"	14'-0"	17'-0"
	560	1'-0"	1'-0"	1'-0"	2'-0"	3'-0"	5'-0"	11'-0"	15'-0"		1'-0"	1'-0"	3'-0"	5'-0"	9'-0"	10'-0"	14'-0"	16'-0"	18'-0"

▪ Rectangular holes based on measurement of longest side.

How to Use These Tables

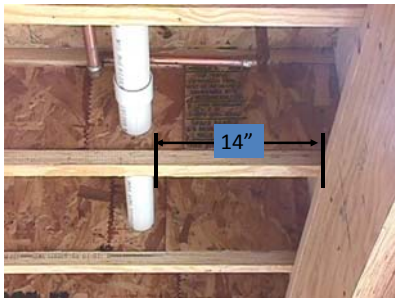
1. Using Table A, Table B, or both if required, determine the hole shape/size and select the TJI® joist and depth.
2. Scan horizontally until you intersect the correct hole size column.
3. Measurement shown is minimum distance from edge of hole to support.
4. Maintain the required minimum distance from the end and the intermediate or cantilever support.

General Notes

- Holes may be located vertically anywhere within the web. Leave ¼" of web (minimum) at top and bottom of hole.
- Knockouts are located in web at approximately 12" on-center; they do not affect hole placement.
- For simple span (5' minimum) uniformly loaded joists meeting the requirements of this guide, one maximum size round hole may be located at the center of the joist span provided that no other holes occur in the joist.
- Distances are based on the maximum uniform loads shown in this guide. For other load conditions or hole configurations, use TJ-Beam® software or contact your iLevel representative.

6-1/2”” DIA. Hole in 11-7/8” TJI®/210 for 6” rigid duct.

3” Hole in 11-7/8” TJI® 110



- Notches
- Holes

O.K. or Not O.K. ?

Must evaluate the left wall as bearing or non-bearing

Hammer Holes

Defer to the manufacturer or an engineer

Scarf Cuts

Cut can not extend beyond inside face of bearing

Damaged Products

Replace damaged joists Or sister another joist

Damaged Product

Summary of Recommendations

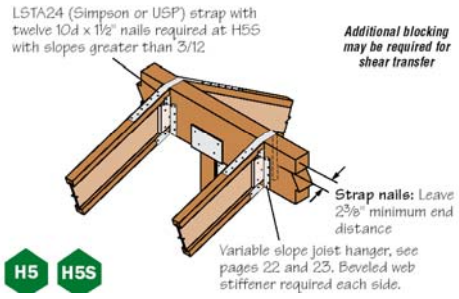
- Installation misapplications
  - Reference Manufacturer's literature
    - Hangers, blocking ,squash blocks, fastening, etc.
- Damage
  - Replace or add
    - Joists, beams, blocking, web stiffeners, hangers, etc.
  - Consult Manufacturer or local engineer

In all cases, there is no standard "fix"
And the manufacturer's warranty
should be considered.

TJI® Joists in Roofs

Ridge Board Vs. Ridge Beam

Ridge Beam



O.K. or Not O.K. ?

Birdsmouth Cut

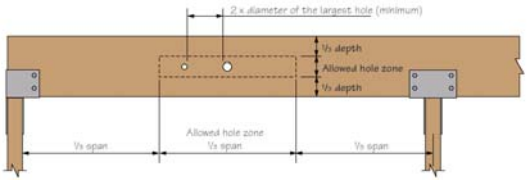
O.K. at low end
Must bear fully on the plate

O.K. or Not O.K. ?

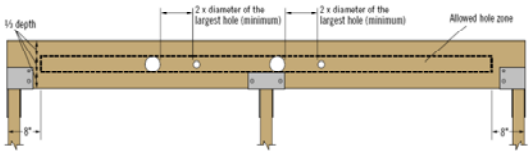
Blocking and Ventilation

SCL Beams & Columns

Hole Drilling Rules



- Center 1/3 of span
- Center 1/3 of depth
- Small holes



Header Depth	Maximum Round Hole Size
9¼"–9½"	3"
11¼"–11⅞"	3⅜"
14" to 16"	4⅝"

LVL, PSL, LSL

All products are intended for "dry-use"
Unless specifically treated

PSL & LSL are proprietary to Trus Joist

Strength Comparisons

Beam	Modulus of Elasticity (E) million psi
Parallam® PSL	2.0 E
Microllam® LVL	1.9 E
TimberStrand® LSL	1.3, 1.5, 1.7 E
Douglas Fir #2	1.6 E
A36 Steel	30.0 E
Glulam	1.8 – 2.2 E

Creep

- Generally, stiffness of WOOD products decrease by 2% for every 1% Increase in Moisture Content.
- 1991 NDS, For members under constant load and stable moisture content creep may result in an increased deflection of 50%
- 90-95% of Creep Occurs Within One Week

The Math for Creep

- Example:
  - Parallam® used at a 20% equilibrium MC
  - 20% - 10% = 10% increase from "design"
  - 10% x 2 = 20% REDUCTION in MOE
  - $E = 0.8 \times 2.0 \times 10^6$ psi = 1.6×10^6 psi

80%

Original MOE

Crawlspaces

Wetting = deflection
Drying = deflection
Don't expect a "return to flat state

O.K. or Not O.K. ?

O.K. or Not O.K. ?

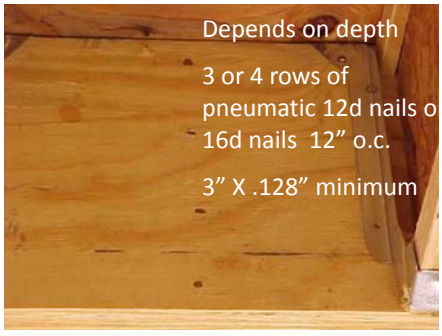
O.K. or Not O.K. ?

3½" bearing required

O.K. or Not O.K.?

Steel shim SCL beams
Not wood shims

Fastening – Top Loaded Beams



Depends on depth

3 or 4 rows of pneumatic 12d nails o 16d nails 12" o.c.

3" X .128" minimum

Fastening – Side Loaded Beams

Through bolts… Not lags

(4) 1-3/4" plies maximum

Upset Beam Bracing

Ends must be braced +
Bracing every 24" in the span

Was that enough?

New Things to Look For

Not on the Test

FRAMER SERIES LUMBER

Some pieces of standard framing lumber will warp as they season in the frame

- This is most pronounced in the first 120 days as the wood equalizes with the environment in which it is installed.
- The same piece that was perfectly straight in the mill or even when installed may not stay straight.
- A minority of the pieces create the majority of the frame problems.

FRAMER SERIES LUMBER

Framer Series™ Lumber uses a proprietary grading process to virtually eliminate warping

- Every board is selected to stay straight and true long after it's installed.
- Precision-tested for fiber strength and density to meet exacting design values (M-9 / M-12).
- 10 years of research and testing resulted in a proprietary, patented process.

FRAMER SERIES LUMBER

FRAMER SERIES Lumber

Traditional Lumber

Patented grading system goes far beyond visual grading capabilities to ensure that every piece starts straight and stays straight.

TimberStrand® Treated Sill Plate

TimberStrand® Tall Walls

TimberStrand® LSL Conventional Roof Framing

New England

TJ® Insulated Products

- **R-17* Insulated Structural Headers**
  - One-piece header for 2x6 wall framing combines 3 ½" Trus Joist® TimberStrand® LSL
  - Unique design allows for a direct load path.
  - OSB face makes drywall attachment fast and easy.
- **R-10* Insulated Rim Board**
  - 1 ¼" TimberStrand® LSL rim board, complete with 1" of insulation and a foil face
  - Reduce the labor and materials needed to insulate floor cavity
  - The rim product fits and fastens like a conventional rim board in one easy step
- **R-30* Insulated Structural Corners**
  - TimberStrand® LSL or Framer Series® lumber is combined with 4" of insulation to give you a better three-stud corner or interior wall (T) intersection that uses fewer structural materials.
  - The assembly is sized for 2x6 exterior walls, provides a nailing surface for drywall, and meets code requirements for insulated corner framing.

* Wall assembly R-value