ALABAMA HOME BUILDERS TRAINING

Compliance with the Regulations of the Alabama Home Builders Licensure Board

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ALABAMA HOME BUILDERS TRAINING

Course Goal: To assist you in operating your business in a manner that will help you to comply with the applicable regulations, to provide your customers with a valuable service and to enhance your reputation as a professional.

2

MAYBE YOU BUILD TRADITIONAL HOMES OR MAYBE YOU BUILD MODERN ONES.

3

IN EITHER CASE, YOU WANT TO DO YOUR JOB RIGHT!

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ALABAMA HOME BUILDERS TRAINING

- A bit about me
- Born into a construction family
- Worked on the jobsite from age 12
- Job assignments included laborer, framing carpenter, trim carpenter, backhoe operator, welder, roofer, crane operator, truck driver, forklift operator, paper hanger, painter, concrete finisher, company pilot, etc

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ALABAMA HOME BUILDERS TRAINING

- 4 ½ years as Project Engineer for major chemical manufacturer (worked on projects in US, Canada, Mexico, Puerto Rico, Belgium and India)
- 8 years as Estimator and Project Manager for general contracting firm
- 8 years as President & CEO of engineering and construction firm

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ALABAMA HOME BUILDERS TRAINING

- 18 years on faculty of Department of Building Science at Auburn University
- Teach courses through NAHB University of Housing
- Provide expert witness services for numerous law firms
- Provide construction mediation services

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ALABAMA HOME BUILDERS TRAINING

- As a courtesy to others, please silence your cell phone
- Please feel free to ask questions or comment during the presentation
- I will stay after the session to grade the tests and answer the questions that you don't ask during the class

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COURSE OUTLINE

- Overview – Day 1
- 1. Site Preparation
- 2. Foundations
- 3. Framing
- 4. Moisture Control
- 5. Estimating

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COURSE OUTLINE

Day 2

- 6. Business Practices
- 7. Alabama Energy Code
- 8. Building Codes
- 9. HBLB Law and Rules

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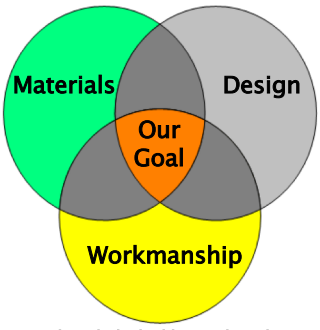
WHAT WE PROVIDE FOR OUR CUSTOMERS



All done to comply with the building code and HBLB regulations

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MATERIALS

- Who selects the materials?
  - The Architect or Designer?
  - The Owner?
  - The Builder?
- Who is responsible for the performance of the materials?
  - The Architect or Designer?
  - The Owner?
  - The Builder?
  - The Manufacturer of the materials?

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MATERIALS

- Do you use only materials with a proven track record?
- Do you use newer materials with a limited track record? If so, who takes the risk of failure of the material to perform?
- Do you use new materials with no track record? If so, who takes the risk then?

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DESIGN

- Who provides the design?
  - The Architect or Designer?
  - The Owner?
  - The Builder?
  - A Manufacturer?
- Who is responsible for the performance of the design?
  - The Architect or Designer?
  - The Owner?
  - The Builder?
  - The Manufacturer?

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WORKMANSHIP

- Who determines the quality of workmanship?
  - The Architect or Designer?
  - The Owner?
  - The Builder?
  - The NAHB Residential Construction Performance Guidelines?
- Who is responsible for providing the expected quality of workmanship?
  - The Architect or Designer?
  - The Owner?
  - The Builder?

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WORKMANSHIP

- What has your interaction with the owners led them to expect in terms of workmanship?
- What has your contract with the owners promised?
- Do you reference the NAHB Residential Construction Performance Guidelines in your contract?

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SECTION 1. SITE PREPARATION

- Purpose
  - Strip off topsoil and vegetation from beneath house footprint (slab or crawl space).
  - Install building pad (for slab on grade)
  - Provide for proper site drainage (and crawl space drainage if applicable).

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SECTION 1. SITE PREPARATION

- Method
  - Plan for proper site utilization (civil engineer may be required for drainage issues and surveyor may be required for zoning and/or covenant set backs and/or easements and setting/locating the lot pins).
  - Set grade stakes per the plan.
  - Perform the required cut and fill operations.
  - Compact the fill sections to prevent excessive/differential settlement.

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SECTION 1. SITE PREPARATION

- Easement – a limited right to a piece of property without ownership of that property
- Contour line – a line connecting points of equal elevation
- Excessive settlement – vertical movement to the extent that damage occurs
- Differential settlement – vertical movement that varies in magnitude at points within the structure

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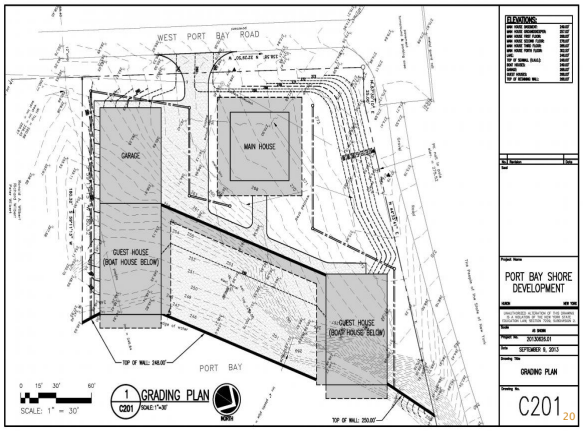

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SITE PREPARATION

- Plastic soils (AKA "gumbo", "prairie" etc.)
  - Soils swell with increasing moisture content and shrink with decreasing moisture content.
  - The volumetric changes crack walls, cause doors and windows to bind, etc. (can destroy the entire structure).
  - Can be handled by:
    - Undercutting and replacement
    - Lime stabilization
    - Deep foundations
    - Flexible design

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SITE PREPARATION

- Problem soils can be identified in advance.
  - Geotechnical services (soils engineers cost less than lawyers)
  - National Resources Conservation Service (formerly Soil Conservation Service)
  - Experience in the area
- Identification of problem soils can alleviate future problems.
  - Moisture Control – during and after construction
  - Removal and replacement
  - Foundation and superstructure construction
    - Deep Foundations
    - Flexible superstructure
    - Rigid foundation
    - Construction joints

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Unified Soil Classification (USC) System (from ASTM D 2487)

Major Divisions				Typical Names
Course-Grained Soils More than 50% retained on the 0.075 mm (No. 200) sieve	Gravels 50% or more of course fraction retained on the 4.75 mm (No. 4) sieve	Clean Gravels	GW	Well-graded gravels and gravel-sand mixtures, little or no fines
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines
		Gravels with Fines	GM	Silty gravels, gravel-sand-silt mixtures
			GC	Clayey gravels, gravel-sand-clay mixtures
	Sands 50% or more of course fraction passes the 4.75 (No. 4) sieve	Clean Sands	SW	Well-graded sands and gravelly sands, little or no fines
			SP	Poorly graded sands and gravelly sands, little or no fines
		Sands with Fines	SM	Silty sands, sand-silt mixtures
			SC	Clayey sands, sand-clay mixtures
Fine-Grained Soils More than 50% passes the 0.075 mm (No. 200) sieve	Silts and Clays Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock four, silty or clayey fine sands
			CL	Inorganic clays of low to medium plasticity, gravelly/sandy/silty/lean clays
			OL	Organic silts and organic silty clays of low plasticity
	Silts and Clays Liquid Limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
			CH	Inorganic clays or high plasticity, fat clays
			OH	Organic clays of medium to high plasticity
Highly Organic Soils			PT	Peat, muck, and other highly organic soils

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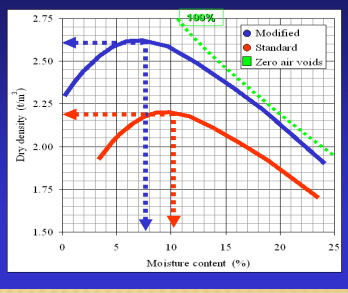
SOIL DENSITY vs. MOISTURE CONTENT

Results



CE 353 DR. TALAT BADER

SITE PREPARATION

- Erosion and sediment control
  - Required on sites of 1 acre or larger
  - Required on lots that are part of a developed site 1 acre or larger
  - Controls must be in place before land disturbance
  - Controls must be maintained during construction using "Best Management Practices"

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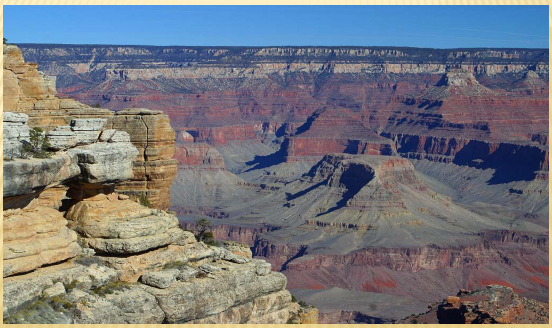
EROSION AND SEDIMENT CONTROL



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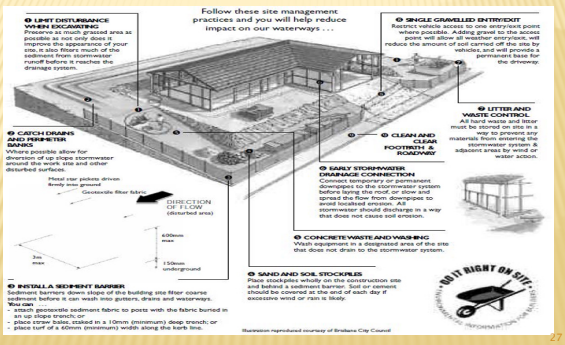
EROSION AND SEDIMENT CONTROL



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EROSION AND SEDIMENT CONTROL

- Check out www.cicacenter.org
  - Templates
  - Best Management Practices outlines
  - Compliance Tools
  - Resource Locators
  - Hazardous waste regulations
  - Endangered species regulations
  - Reporting requirements
  - Wetlands regulations, etc.

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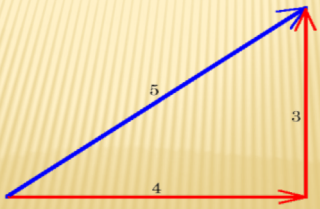
SITE PREPARATION

- Batter boards
  - Set the finish floor elevation
  - Set the house horizontal dimensions
  - Promote a "square" start



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BATTERBOARDS

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FOR ADDITIONAL HELP…

Take the NAHB Land Development, Site Planning and Zoning course available through the Home Builders Association of Alabama.

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SECTION 2. FOUNDATIONS

- Purpose
  - Set the finish floor elevation.
  - Support the superstructure.
  - Provide adequate strength to "bridge" over weak spots.
- Types
  - Strip footings around the perimeter with pier footings in the interior.
  - Slab with or without a brick shelf, and
  - Combination (strip footing around perimeter, block walls and floating or monolithic slab).

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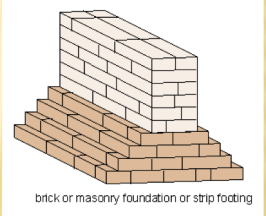
FOUNDATIONS

- Less common types
  - Driven pilings,
  - Drilled caissons,
  - Treated wood ,
  - Post tensioned, and
  - Brick.



brick or masonry foundation or strip footing

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WHAT KIND OF FOUNDATION HERE?

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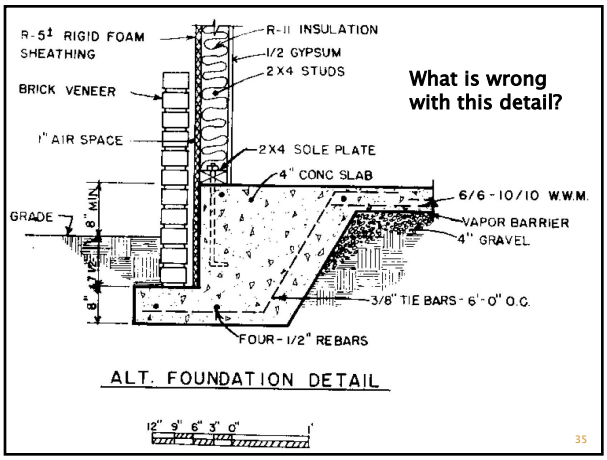

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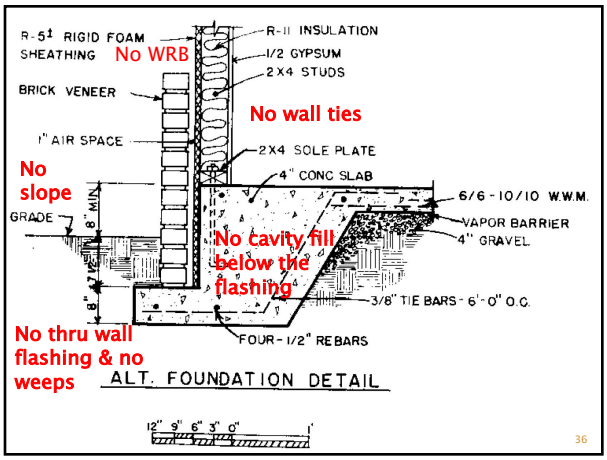

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Foundations can be complicated
37

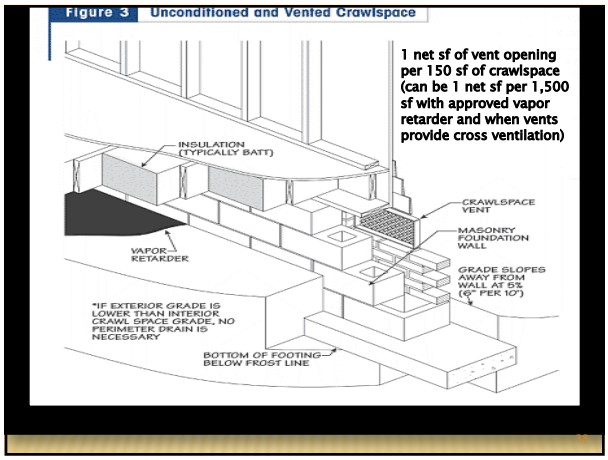
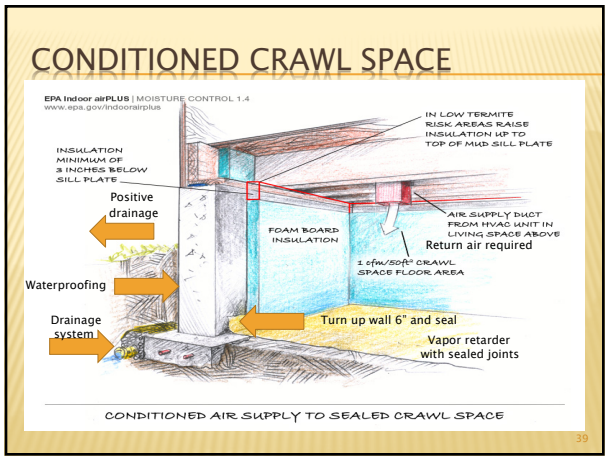


Figure 3 Unconditioned and Vented Crawlspace
1 net sf of vent opening per 150 sf of crawlspace (can be 1 net sf per 1,500 sf with approved vapor retarder and when vents provide cross ventilation)
INSULATION (TYPICALLY BATT)
CRAWLSPACE VENT
MASONRY FOUNDATION WALL
VAPOR RETARDER
GRADE SLOPES AWAY FROM WALL AT 5% (6" PER 10')
*IF EXTERIOR GRADE IS LOWER THAN INTERIOR CRAWL SPACE GRADE, NO PERIMETER DRAIN IS NECESSARY
BOTTOM OF FOOTING BELOW FROST LINE


CONDITIONED CRAWL SPACE
EPA Indoor airPLUS | MOISTURE CONTROL 1.4
www.epa.gov/indoorairplus
IN LOW TERMITE RISK AREAS RAISE INSULATION UP TO TOP OF MUD SILL PLATE
INSULATION MINIMUM OF 3 INCHES BELOW SILL PLATE
Positive drainage
FOAM BOARD INSULATION
AIR SUPPLY DUCT FROM HVAC UNIT IN LIVING SPACE ABOVE
Return air required
1 cfm/50ft² CRAWL SPACE FLOOR AREA
Waterproofing
Drainage system
Turn up wall 6" and seal
Vapor retarder with sealed joints
CONDITIONED AIR SUPPLY TO SEALED CRAWL SPACE
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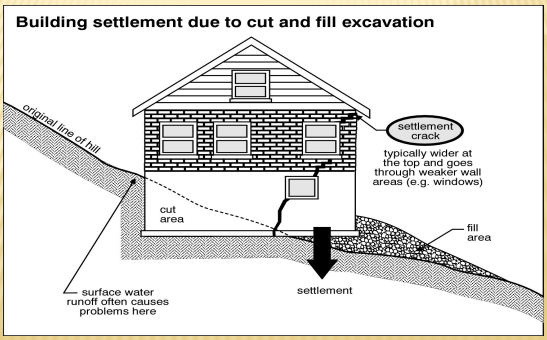
WATCH OUT FOR THIS SITUATION!



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FOR ADDITIONAL HELP…

Take the NAHB Building Technology: Structure and Exterior Finishes course available through the Home Builders Association of Alabama.

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SECTION 3. FRAMING

- Floor framing
- Wall framing
  - Platform framing
  - Balloon framing
- Roof framing
  - Stick framed
  - Truss framed
- Stair and railing details

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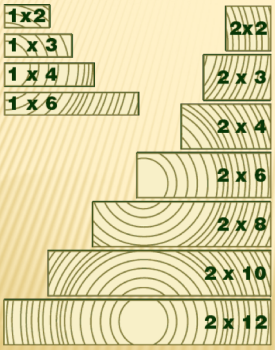
FRAMING MATERIALS



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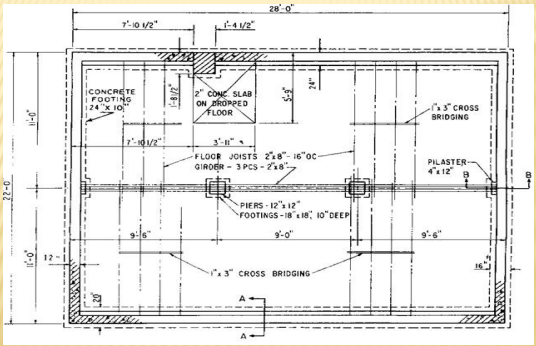
FLOOR FRAMING



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GIRDER SIZES

- A single story house is 24' wide (measured perpendicular to the ridge). The girders run parallel to the ridge. Size the girders that run along the centerline.
- See Table R502.5(1). Find the section "Roof, ceiling and one center-bearing floor. (Let's use the minimum ground snow load of 30 psf.)
- Note that this table is from the 2012 International Residential Code.

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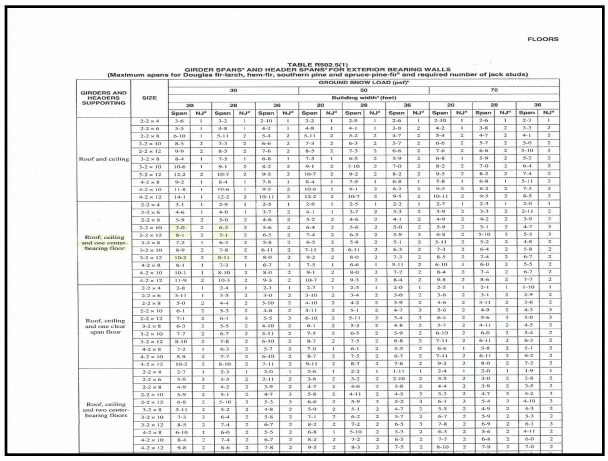

FLOORS

TABLE R502.5(1)
GIRDER SPANS* AND HEADER SPANS* FOR EXTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir† and required number of jack studs)

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf)‡															
		30				50				70							
		Building width§ (feet)															
		20		28		36		20		28		36		20		28		36	
		Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#
Roof and ceiling	2-2 × 4	3-6	1	3-2	1	2-10	1	3-2	1	2-9	1	2-6	1	3-10	1	3-6	1	2-3	1
	2-2 × 6	5-3	1	4-8	1	4-2	1	4-8	1	4-1	1	3-8	2	4-2	1	3-8	2	3-3	2
	2-2 × 8	6-10	1	5-11	2	5-4	2	5-11	2	5-2	2	4-7	2	5-4	2	4-7	2	4-1	2
	2-2 × 10	8-5	2	7-3	2	6-6	2	7-3	2	6-3	2	5-7	2	6-6	2	5-7	2	5-0	2
	2-2 × 12	9-9	2	8-5	2	7-6	2	8-5	2	7-3	3	6-6	2	7-6	2	6-6	2	5-10	3
	3-2 × 6	6-4	1	5-5	1	4-10	1	5-5	1	4-8	2	4-3	2	4-10	2	4-3	2	3-9	2
	3-2 × 8	8-5	1	7-3	1	6-6	1	7-3	1	6-3	2	5-7	2	6-6	1	5-7	2	5-0	2
	3-2 × 10	10-6	1	9-1	2	8-2	2	9-1	2	7-10	2	7-0	2	8-2	2	7-0	2	6-4	2
	3-2 × 12	12-2	2	10-7	2	9-5	3	10-7	2	9-2	2	8-2	2	9-5	2	8-2	2	7-4	2
	4-2 × 8	9-2	1	8-4	1	7-6	1	8-4	1	7-2	1	6-8	1	7-8	1	6-8	1	5-11	2
	4-2 × 10	11-8	1	10-6	1	9-5	2	10-6	1	9-1	2	8-3	2	9-5	2	8-3	2	7-5	2
	4-2 × 12	14-1	1	12-2	2	10-11	2	12-2	2	10-7	2	9-5	2	10-11	2	9-5	2	8-5	2
Roof, ceiling and one center-bearing floor	2-2 × 4	3-1	1	2-9	1	2-5	1	2-9	1	2-5	1	2-2	1	2-7	1	2-3	1	2-0	1
	2-2 × 6	4-6	1	4-0	1	3-7	2	4-1	1	3-7	2	3-3	2	3-9	2	3-3	2	2-11	2
	2-2 × 8	5-9	2	5-0	2	4-6	2	5-2	2	4-6	2	4-1	2	4-9	2	4-2	2	3-9	2
	2-2 × 10	7-0	2	6-2	2	5-6	2	6-4	2	5-6	2	5-0	2	5-9	2	5-1	2	4-7	3
	2-2 × 12	8-1	3	7-1	2	6-3	2	7-4	2	6-3	2	5-9	3	6-8	2	5-10	3	5-3	3
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	3-2 × 8	6-9	2	5-11	2	5-3	2	6-1	2	5-3	2	4-8	2	5-5	2	4-9	2	4-3	2
	3-2 × 10	8-3	2	7-3	2	6-6	2	7-5	2	6-6	2	5-9	2	6-7	2	5-9	2	5-2	2
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	4-2 × 10	9-5	2	8-3	2	7-5	2	8-7	2	7-5	2	6-7	2	7-8	2	6-7	2	5-11	2
	4-2 × 12	10-9	2	9-5	2	8-5	2	9-9	2	8-5	2	7-6	2	8-9	2	7-6	2	6-9	2
Roof, ceiling and two center-bearing floors	2-2 × 4	2-7	1	2-3	1	2-0	1	2-6	1	2-2	1	1-11	1	2-4	1	2-0	1	1-9	1
	2-2 × 6	3-9	2	3-3	2	2-11	2	3-6	2	3-2	2	2-10	2	3-3	2	2-10	2	2-8	3
	2-2 × 8	4-9	2	4-2	2	3-9	2	4-7	2	4-0	2	3-8	2	4-4	3	3-9	2	3-5	3
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	3-2 × 6	5-11	2	5-2	2	4-8	2	5-9	2	5-1	2	4-7	2	5-5	2	4-9	2	4-3	3
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	4-2 × 10	8-4	2	7-4	2	6-7	2	8-2	2	7-2	2	6-5	2	7-7	2	6-8	2	6-0	2
	4-2 × 12	9-8	2	8-6	2	7-8	2	9-5	2	8-3	2	7-5	2	8-10	2	7-9	3	7-0	3

GIRDER SIZES

- A double 2x10 girder is OK to 6'-7" pier spacing. (interpolate between the values for 20' and 28')
- A double 2x12 girder is OK to 7'-7" pier spacing.
- A triple 2x12 girder is OK to 9'- 5 1/2" pier spacing.
- Note that we would use the same table to size headers and determine the number of jack studs required at each end of the header.

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GIRDER CONSTRUCTION

- Wood girders must have at least 12" clearance above grade.
- Girder end joints must be located over supports.
- Girders supported on masonry or concrete must have at least a 3" bearing length measured along the girder.

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FLOOR JOIST SIZING

- Dimension lumber
  - Experience
  - Span tables (tables in the building code)
  - Engineering properties
- Engineered lumber & Steel joist
  - Span tables (tables by manufacturer)
  - Engineering properties
  - Sized by manufacturer or dealer

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DEAD LOADS AND LIVE LOADS

- Dead loads include the weight of the structure and anything fastened to it.
- Dead loads are relatively constant and fairly predictable.
- Live loads are all other loads including people, furnishings, wind, etc.
- Live loads are variable and more difficult to predict.

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FLOOR JOIST SIZING BY TABLES

- Determine live and dead loadings.
  - Typical dead load = 10 psf.
  - Increased dead load for brick floors, etc.
  - Live load 30 psf in sleeping rooms.
  - Live load 40 psf in other rooms.
  - Live load 100 psf for balconies and decks. (60 psf if not exceeding 100 sf in area)
- Make the appropriate selection(s) from the proper table in the code.

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FLOOR JOIST SIZING BY TABLES

- Example: Floor joist in a kitchen area span 12'-0" and are at 16" on center. If #2 southern pine is used, what is the minimum allowable member size?
- Find Table R502.3.1(2).
- At 16" on center and #2 southern pine, go across the table to the first value equal to or greater than 12'-0" in the 10 psf dead load section.
- Select 2x8 member size. (OK to 12'-10")

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TABLE R502.3.1(2)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
(Residential living areas, live load = 40 psf, L/Δ = 360)[a]

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2 × 6	2 × 8	2 × 10	2 × 12	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum floor joist spans							
			(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)
12	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-3
	Douglas fir-larch	#1	10-11	14-5	18-5	22-0	10-11	14-2	17-4	20-1
	Douglas fir-larch	#2	10-9	14-2	17-9	20-7	10-6	13-3	16-3	18-10
	Douglas fir-larch	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
	Hem-fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11
	Hem-fir	#1	10-6	13-10	17-8	21-6	10-6	13-10	16-11	19-7
	Hem-fir	#2	10-0	13-2	16-10	20-4	10-0	13-1	16-0	18-6
	Hem-fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
	Southern pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Southern pine	#1	10-11	14-5	18-5	22-5	10-11	14-5	18-5	22-5
	Southern pine	#2	10-9	14-2	18-0	21-9	10-9	14-2	16-11	19-10
	Southern pine	#3	9-4	11-11	14-0	16-8	8-6	10-10	12-10	15-3
	Spruce-pine-fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-6
	Spruce-pine-fir	#1	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10
	Spruce-pine-fir	#2	10-3	13-6	17-3	20-7	10-3	13-3	16-3	18-10
	Spruce-pine-fir	#3	8-8	11-0	13-5	15-7	7-11	10-0	12-3	14-3
16	Douglas fir-larch	SS	10-4	13-7	17-4	21-1	10-4	13-7	17-4	21-0
	Douglas fir-larch	#1	9-11	13-1	16-5	19-1	9-8	12-4	15-0	17-5
	Douglas fir-larch	#2	9-9	12-7	15-5	17-10	9-1	11-6	14-1	16-3
	Douglas fir-larch	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4
	Hem-fir	SS	9-9	12-10	16-5	19-11	9-9	12-10	16-5	19-11
	Hem-fir	#1	9-6	12-7	16-0	18-7	9-6	12-0	14-8	17-0
	Hem-fir	#2	9-1	12-0	15-2	17-7	8-11	11-4	13-10	16-1
	Hem-fir	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4
	Southern pine	SS	10-2	13-4	17-0	20-9	10-2	13-4	17-0	20-9
	Southern pine	#1	9-11	13-1	16-9	20-4	9-11	13-1	16-4	19-6
	Southern pine	#2	9-9	12-10	16-1	18-10	9-6	12-4	14-8	17-2
	Southern pine	#3	8-1	10-3	12-2	14-6	7-4	9-5	11-1	13-2
	Spruce-pine-fir	SS	9-6	12-7	16-0	19-6	9-6	12-7	16-0	19-6
	Spruce-pine-fir	#1	9-4	12-3	15-5	17-10	9-1	11-6	14-1	16-3
	Spruce-pine-fir	#2	9-4	12-3	15-5	17-10	9-1	11-6	14-1	16-3
	Spruce-pine-fir	#3	7-6	9-6	11-8	13-6	6-10	8-8	10-7	12-4

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FLOOR JOIST SIZING BY TABLES

- Example: A bedroom is supported by #2 2x8 floor joist with a span of 14'-0". What is the maximum allowable member spacing?
- Find Table R502.3.1(1).
- Follow down the 2x8 column with dead load = 10 psf until you find the maximum spacing for #2 southern pine with a span equal to or greater than 14'-0".
- Select a maximum spacing of 16". (OK to 14'-2")

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TABLE R502.3.1(1)
FLOOR JOIST SPANS FOR COMMON LUMBER SPECIES
(Residential sleeping areas, live load = 30 psf, L/Δ = 360)[a]

JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf				DEAD LOAD = 20 psf			
			2 × 6	2 × 8	2 × 10	2 × 12	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum floor joist spans							
			(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)	(ft - in.)
12	Douglas fir-larch	SS	12-6	16-6	21-0	25-7	12-6	16-6	21-0	25-7
	Douglas fir-larch	#1	12-0	15-10	20-3	24-8	12-0	15-7	19-0	22-0
	Douglas fir-larch	#2	11-10	15-7	19-10	23-0	11-6	14-7	17-9	20-7
	Douglas fir-larch	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Hem-fir	SS	11-10	15-7	19-10	24-2	11-10	15-7	19-10	24-2
	Hem-fir	#1	11-7	15-3	19-5	23-7	11-7	15-2	18-6	21-6
	Hem-fir	#2	11-0	14-6	18-6	22-6	11-0	14-4	17-6	20-4
	Hem-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
	Southern pine	SS	12-3	16-2	20-8	25-1	12-3	16-2	20-8	25-1
	Southern pine	#1	12-0	15-10	20-3	24-8	12-0	15-10	20-3	24-8
	Southern pine	#2	11-10	15-7	19-10	24-2	11-10	15-7	18-7	21-9
	Southern pine	#3	10-5	13-3	15-8	18-8	9-4	11-11	14-0	16-8
	Spruce-pine-fir	SS	11-7	15-3	19-5	23-7	11-7	15-3	19-5	23-7
	Spruce-pine-fir	#1	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#2	11-3	14-11	19-0	23-0	11-3	14-7	17-9	20-7
	Spruce-pine-fir	#3	9-8	12-4	15-0	17-5	8-8	11-0	13-5	15-7
16	Douglas fir-larch	SS	11-4	15-0	19-1	23-3	11-4	15-0	19-1	23-0
	Douglas fir-larch	#1	10-11	14-5	18-5	21-4	10-8	13-6	16-5	19-1
	Douglas fir-larch	#2	10-9	14-1	17-2	19-11	9-11	12-7	15-5	17-10
	Douglas fir-larch	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Hem-fir	SS	10-9	14-2	18-0	21-11	10-9	14-2	18-0	21-11
	Hem-fir	#1	10-6	13-10	17-8	20-9	10-4	13-1	16-0	18-7
	Hem-fir	#2	10-0	13-2	16-10	19-8	9-10	12-5	15-2	17-7
	Hem-fir	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6
	Southern pine	SS	11-2	14-8	18-9	22-10	11-2	14-8	18-9	22-10
	Southern pine	#1	10-11	14-5	18-5	22-5	10-11	14-5	17-11	21-4
	Southern pine	#2	10-9	14-2	18-0	21-1	10-5	13-6	16-1	18-10
	Southern pine	#3	9-0	11-6	13-7	16-2	8-1	10-3	12-2	14-6
	Spruce-pine-fir	SS	10-6	13-10	17-8	21-6	10-6	13-10	17-8	21-4
	Spruce-pine-fir	#1	10-3	13-6	17-2	19-11	9-11	12-7	15-5	17-10
	Spruce-pine-fir	#2	10-3	13-6	17-2	19-11	9-11	12-7	15-5	17-10
	Spruce-pine-fir	#3	8-5	10-8	13-0	15-1	7-6	9-6	11-8	13-6

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FLOOR DECK SELECTION

- Find Table R503.2.1.1(1).
- For the joist spacing that you use, select a deck that is equal to or greater than the thickness shown.
- Alternatively, read the markings on the panel itself.

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sanded plywood combination subfloor underlayment shall be as set forth in Table R503.2.1.1(2).

R503.2.3 Installation. Wood structural panels used as subfloor or combination subfloor underlayment shall be attached to wood framing in accordance with Table R602.3(1) and shall be attached to cold-formed steel framing in accordance with Table R505.3.1(2).

R503.3 Particleboard.

R503.3.1 Identification and grade. Particleboard shall conform to ANSI A208.1 and shall be so identified by a grade *mark* or certificate of inspection issued by an *approved agency*.

R503.3.2 Installation. Particleboard underlayment shall be installed in accordance with the recommendations of the manufacturer and attached to framing in accordance with Table R602.3(1).

SECTION R504
PRESSURE PRESERVATIVELY TREATED-WOOD FLOORS (ON GROUND)

R504.1 General. Pressure preservatively treated-wood *basement* floors and floors on ground shall be designed to withstand axial forces and bending moments resulting from lateral soil pressures at the base of the exterior walls and floor live

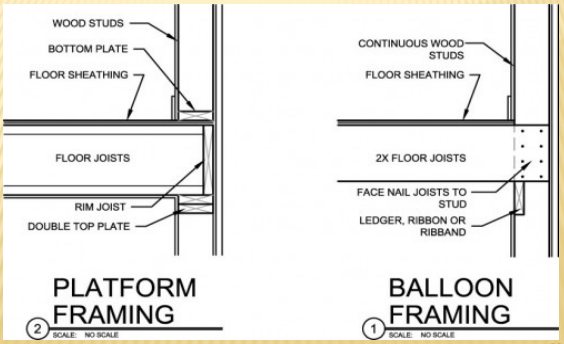
TABLE R503.2.1.1(1)
ALLOWABLE SPANS AND LOADS FOR WOOD STRUCTURAL PANELS FOR ROOF AND SUBFLOOR SHEATHING AND COMBINATION SUBFLOOR UNDERLAYMENT[a, b, c]

SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inch)	ALLOWABLE LIVE LOAD (psf)[d, e]		MAXIMUM SPAN (inches)		LOAD (pounds per square foot, at maximum span)		MAXIMUM SPAN (inches)
		SPAN @ 16" o.c.	SPAN @ 24" o.c.	With edge support[g]	Without edge support	Total load	Live load	
Sheathing[h]				Roof[i]				Subfloor[i]
16/0	5/16	30	—	16	16	40	30	0
20/0	5/16	50	—	20	20	40	30	0
24/0	3/8	100	30	24	20[j]	40	30	0
24/16	7/16	100	40	24	24	50	40	16
32/16	7/16, 15/32	180	70	32	28	40	30	16[k]
40/20	15/32, 1/2	305	130	40	32	40	30	20[k, l]
48/24	19/32, 5/8	—	175	48	36	45	35	24
60/32	23/32	—	305	60	48	45	35	32
Underlayment, C-C plugged, single floor[f]				Roof[i]				Combination subfloor underlayment[k]
16 o.c.	15/32, 1/2	100	40	24	24	50	40	16[l]
20 o.c.	19/32, 5/8	150	60	32	32	40	30	20[l]
24 o.c.	23/32, 3/4	240	100	48	36	35	25	24
32 o.c.	7/8	—	185	48	40	50	40	32
48 o.c.	1 1/8, 1 1/4	—	290	60	48	50	40	48

For SI: 1 inch = 25.4 mm, 1 pound per square foot = 0.0479 kPa.

a. The allowable total loads were determined using a dead load of 10 psf. If the dead load exceeds 10 psf, then the live load shall be reduced accordingly.
b. Panels continuous over two or more spans with long dimension (strength axis) perpendicular to supports. Spans shall be limited to values shown because of possible effect of concentrated loads.
c. Applies to panels 24 inches or wider.
d. Lumber blocking, panel edge clips (one midway between each support, except two equally spaced between supports when span is 48 inches), tongue-and-groove panel edges, or other approved type of edge support.
e. Includes Structural 1 panels in these grades.
f. Uniform load deflection limitation: $l/_{180}$ of span under live load plus dead load, $l/_{150}$ of span under live load only.
g. Maximum span 24 inches for $^{7}/_{16}$-and $^{15}/_{32}$-inch panels.
h. Maximum span 24 inches where $^{7}/_{16}$-inch wood finish flooring is installed at right angles to joists.
i. Maximum span 24 inches for panels without edge support if lightweight concrete or approved cellular concrete is placed over the subfloor.
j. Spans are permitted to be increased to 28 inches if tongue-and-groove joints or shall be supported with blocking unless minimum nominal $^{7}/_{16}$-inch thick underlayment with end and edge joints offset at least 2 inches or 1.5 inches of lightweight concrete or approved cellular concrete is placed over the subfloor, or $^{3}/_{4}$-inch wood finish flooring is installed at right angles to the supports. Allowable uniform live load at maximum span, based on deflection of $l/_{360}$ of span, is 100 psf.
k. Unsupported edges shall have tongue-and-groove joints or shall be supported by blocking unless nominal $^{3}/_{4}$-inch-thick underlayment with end and edge joints offset at least 2 inches or $^{3}/_{4}$-inch wood finish flooring is installed at right angles to the supports. Allowable uniform live load at maximum span, based on deflection of $l/_{360}$ of span, is 100 psf, except panels with a span rating of 48 on center are limited to 65 psf total uniform load at maximum span.
l. Allowable live load values at spans of 16" o.c. and 24" o.c taken from reference standard APA E30, APA Engineered Wood Construction Guide. Refer to reference standard for allowable spans not listed in the table.

WALL FRAMING



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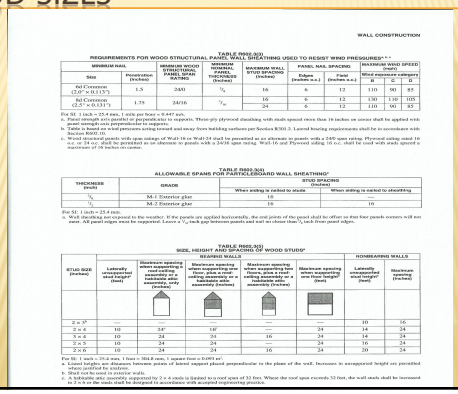
STUD SIZES



WALL CONSTRUCTION

TABLE R602.3(5)
REQUIREMENTS FOR WOOD STRUCTURAL PANEL WALL SHEATHING USED TO RESIST WIND PRESSURES[a, b, c]

MINIMUM NAIL		MINIMUM WOOD STRUCTURAL PANEL SPAN RATING	MINIMUM NOMINAL PANEL THICKNESS (inches)	MAXIMUM WALL STUD SPACING (inches)	PANEL NAIL SPACING		MAXIMUM WIND SPEED (mph)		
Size	Penetration (inches)				Edges (inches o.c.)	Field (inches o.c.)	Wind exposure category		
							B	C	D
6d Common (2.0" × 0.113")	1.5	24/0	7/16	16	6	12	110	90	85
8d Common (2.5" × 0.131")	1.75	24/16	7/16	16	6	12	130	110	105
				24	6	12	110	90	85

For SI: 1 inch = 25.4 mm, 1 mile per hour = 0.447 m/s.
a. Panel strength axis parallel or perpendicular to supports. Three-ply plywood sheathing with studs spaced more than 16 inches on center shall be applied with panel strength axis perpendicular to supports.
b. Table is based on wind pressures acting toward and away from building surfaces per Section R301.2. Lateral bracing requirements shall be in accordance with Section R602.10.
c. Wood structural panels with span ratings of Wall 16 or Wall 24 shall be permitted as an alternate to panels with a 24/0 span rating. Plywood siding rated 16 o.c. or 24 o.c. shall be permitted as an alternate to panels with a 24/16 span rating. Wall-16 and Plywood siding 16 o.c. shall be used with studs spaced a maximum of 16 inches on center.

TABLE R602.3(4)
ALLOWABLE SPANS FOR PARTICLEBOARD WALL SHEATHING[a]

THICKNESS (inch)	GRADE	STUD SPACING (inches)	
		When siding is nailed to studs	When siding is nailed to sheathing
1/2	M-1 Exterior glue	16	—
1/2	M-2 Exterior glue	16	16

For SI: 1 inch = 25.4 mm.
a. Wall sheathing not exposed to the weather. If the panels are applied horizontally, the end joints of the panel shall be offset so that four panels corners will not meet. All panel edges must be supported. Leave a 1/8 inch gap between panels and nail no closer than 3/8 inch from panel edges.

TABLE R602.3(3)
SIZE, HEIGHT AND SPACING OF WOOD STUDS[a]

STUD SIZE (inches)	BEARING WALLS					NONBEARING WALLS	
	Laterally unsupported stud height[b] (feet)	Maximum spacing when supporting a roof-ceiling assembly or habitable attic assembly (inches)	Maximum spacing when supporting one floor, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Maximum spacing when supporting two floors, plus a roof-ceiling assembly or a habitable attic assembly (inches)	Maximum spacing when supporting one floor only[c] (inch)	Laterally unsupported stud height[b] (feet)	Maximum spacing (inches)
2 × 3[d]	—	—	—	—	—	10	16
2 × 4	10	24[e]	16[e]	—	24	14	24
3 × 4	10	24	24	16	24	14	24
2 × 5	10	24	24	—	24	16	24
2 × 6	10	24	24	16	24	20	24

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 square foot = 0.093 m².
a. Listed heights are distances between points of lateral support placed perpendicular to the plane of the wall. Increases in unsupported height are permitted where justified by analysis.
b. Gable end walls and braced walls.
c. A habitable attic assembly supported by 2 × 4 studs is limited to a roof span of 32 feet. Where the roof span exceeds 32 feet, the wall studs shall be increased to 2 × 6 in the studs shall be designed in accordance with accepted engineering practice.

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STUD SIZES

- 2x4 @ 24” o/c – OK to support either a roof/ceiling or habitable attic.
- 2x4 @ 24” o/c – OK for interior bearing walls supporting only one floor.
- 2x4 @ 24” o/c – OK for interior non-bearing walls.
- 2x4 @ 16” o/c – OK to support one floor plus a roof/ceiling or a habitable attic.

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STUD SIZES

- 2x6 @ 24" o/c – OK to support either a roof/ceiling or habitable attic plus one floor.
- 2x6 @ 24" o/c – OK for interior bearing walls supporting only one floor.
- 2x6 @ 24" o/c – OK for interior non-bearing walls.
- 2x6 @ 16" o/c – OK to support two floors plus a roof/ceiling or a habitable attic.

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STUDWALLS

- Bottom plate same width as studs.
- Double top plate with joints staggered a minimum of 24".
- Single top plate with 3" x 6" x .036" steel plates at joints with six 8d nails per side. (joist or rafters must not land more than 1" off center of the studs)

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DRILLING STUDS

- Studs in load bearing walls (interior or exterior) may not be drilled with holes greater in diameter than 40% of their width. (40% of a 2x4 = 1.4 inches)
- Studs in load bearing walls (interior or exterior) may be drilled with holes between 40% and 60% of their width if the stud is doubled. (60% of a 2x4 = 2.1")

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DRILLING STUDS

- Studs in non load bearing walls may not be drilled with holes greater in diameter than 60% of their width. (60% of a 2x4 = 2.1")
- All drilled holes must have a minimum of 5/8" between the hole and the outer face of the stud.

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NOTCHING STUDS

- Studs in load bearing walls (interior or exterior) may not be notched more than 25% of their width. (25% of a 2x4 = .875" that's 7/8")
- Non bearing wall studs may not be notched more than 40% of their width.
- Studs may not be drilled and notched at the same location.

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HEADER SIZES

- A 24' wide single story house has an opening 9'-0" wide in an exterior bearing wall. Size the header and determine the number of jack studs required for each end of the girder.
- See Table R502.5(1). Find the section "Roof and ceiling".
- A double 2x12 header is OK for 9'-1" and requires 2 jack studs at each end.

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TABLE R502.5(1)
GIRDER SPANS* AND HEADER SPANS FOR EXTERIOR BEARING WALLS
(Maximum spans for Douglas fir-larch, hem-fir, southern pine and spruce-pine-fir† and required number of jack studs)

GIRDERS AND HEADERS SUPPORTING	SIZE	GROUND SNOW LOAD (psf)‡															
		30				50				70							
		Building width* (feet)															
		20		28		20		28		20		28		20		28	
		Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#	Span	NJ#
Roof and ceiling	2-2 × 4	3-6	1	3-2	1	2-10	1	3-2	1	2-9	1	3-6	1	3-10	1	3-6	1
	2-2 × 6	5-5	1	4-8	1	4-2	1	4-8	1	4-1	1	5-8	2	6-2	1	5-8	2
	2-2 × 8	6-10	1	5-11	2	5-4	2	5-11	2	5-2	2	4-7	2	5-4	2	4-7	2
	2-2 × 10	8-5	2	7-3	2	6-6	2	7-3	2	6-3	2	5-7	2	6-6	2	5-7	2
	2-2 × 12	9-9	2	8-5	2	7-6	2	8-5	2	7-3	3	6-6	2	7-6	2	6-6	2
	3-2 × 8	8-4	1	7-3	1	6-8	1	7-3	1	6-5	2	5-9	2	6-8	1	5-9	2
	3-2 × 10	10-6	1	9-1	2	8-2	2	9-1	2	7-10	2	7-0	2	8-2	2	7-0	2
	3-2 × 12	12-2	2	10-7	2	9-5	2	10-7	2	9-2	2	8-2	2	9-5	2	8-2	2
	4-2 × 8	9-2	1	8-4	1	7-8	1	8-4	1	7-5	1	6-8	1	7-8	1	6-8	1
	4-2 × 10	11-8	1	10-6	1	9-5	2	10-6	1	9-1	2	8-2	2	9-5	2	8-2	2
	4-2 × 12	14-1	1	12-2	2	10-11	2	12-2	2	10-7	2	9-5	2	10-11	2	9-5	2
Roof, ceiling and one center-bearing floor	2-2 × 4	3-1	1	2-9	1	2-5	1	2-9	1	2-5	1	2-2	1	2-5	1	2-5	1
	2-2 × 6	4-6	1	4-0	1	3-7	2	4-1	1	3-7	2	3-3	2	3-9	2	3-3	2
	2-2 × 8	5-9	2	5-0	2	4-6	2	5-2	2	4-6	2	4-1	2	4-9	2	4-2	2
	2-2 × 10	7-5	2	6-2	2	5-6	2	6-4	2	5-6	2	5-0	2	5-9	2	5-1	2
	2-2 × 12	8-1	3	7-1	3	6-5	2	7-4	2	6-5	2	5-9	3	6-8	2	5-10	3
	3-2 × 8	7-2	1	6-3	2	5-8	2	6-5	2	5-8	2	5-1	3	5-11	2	5-2	3
	3-2 × 10	8-9	2	7-8	2	6-11	2	7-11	2	6-11	2	6-3	2	7-3	2	6-4	2
	3-2 × 12	10-2	2	8-11	3	8-0	2	9-2	2	8-0	2	7-3	2	8-5	2	7-4	3
	4-2 × 8	8-1	1	7-3	1	6-7	1	7-3	1	6-6	1	5-11	3	6-10	1	6-0	2
	4-2 × 10	10-1	1	8-10	2	8-0	2	9-1	2	8-0	2	7-2	3	8-4	2	7-4	3
	4-2 × 12	11-9	2	10-3	2	9-3	2	10-7	2	9-3	2	8-4	2	9-8	2	8-6	2
Roof, ceiling and one clear span floor	2-2 × 4	2-8	1	2-4	1	2-1	1	2-7	1	2-3	1	2-0	1	2-5	1	2-1	1
	2-2 × 6	3-11	1	3-5	2	3-0	2	3-10	2	3-4	2	3-0	2	3-6	2	3-1	2
	2-2 × 8	5-0	2	4-4	2	3-10	2	4-10	2	4-2	2	3-9	2	4-6	2	3-11	2
	2-2 × 10	6-1	3	5-3	2	4-8	2	5-11	2	5-1	2	4-7	3	5-6	2	4-9	2
	2-2 × 12	7-1	3	6-1	3	5-5	3	6-10	2	5-11	3	5-4	3	6-4	2	5-6	3
	3-2 × 8	6-3	2	5-5	2	4-10	3	6-1	2	5-3	3	4-8	3	5-7	2	4-11	2
	3-2 × 10	7-7	2	6-7	2	5-11	2	7-5	2	6-5	3	5-9	3	6-10	2	6-0	3
	3-2 × 12	8-10	2	7-8	2	6-10	2	8-7	2	7-5	3	6-8	3	7-11	2	6-11	2
	4-2 × 8	7-2	1	6-3	2	5-7	2	7-0	1	6-1	2	5-5	3	6-6	1	5-8	3
	4-2 × 10	8-9	2	7-7	2	6-10	2	8-7	2	7-5	3	6-7	3	7-11	2	6-11	3
	4-2 × 12	10-2	2	8-10	2	7-11	2	9-11	2	8-7	3	7-8	3	9-2	2	8-0	2
Roof, ceiling and two center-bearing floors	2-2 × 4	2-7	1	2-3	1	2-0	1	2-6	1	2-2	1	1-11	1	2-4	1	2-0	1
	2-2 × 6	3-9	2	3-3	2	2-11	2	3-8	2	3-2	2	2-10	2	3-5	2	3-0	2
	2-2 × 8	4-9	3	4-2	2	3-8	2	4-7	2	4-0	2	3-8	2	4-4	2	3-9	2
	2-2 × 10	5-9	3	5-1	3	4-7	3	5-8	2	4-11	2	4-5	3	5-3	3	4-7	3
	2-2 × 12	6-9	3	5-10	3	5-3	3	6-6	2	5-9	3	5-2	3	6-1	3	5-4	3
	3-2 × 8	5-11	2	5-2	2	4-8	3	5-9	2	5-1	2	4-7	3	5-5	2	4-9	3
	3-2 × 10	7-3	3	6-4	2	5-8	2	7-1	2	6-2	2	5-7	2	6-7	2	5-9	2
	3-2 × 12	8-5	2	7-4	2	6-7	2	8-2	2	7-2	2	6-3	3	7-8	2	6-9	2
	4-2 × 8	6-10	1	6-0	2	5-3	2	6-8	1	5-10	2	5-3	3	6-3	2	5-6	3
	4-2 × 10	8-4	2	7-4	2	6-7	3	8-2	2	7-2	2	6-3	3	7-7	2	6-8	3
	4-2 × 12	9-8	2	8-6	2	7-8	2	9-5	2	8-3	2	7-3	3	8-10	2	7-9	3
Roof, ceiling, and two clear span floors	2-2 × 4	2-1	1	1-8	1	1-6	3	2-0	1	1-8	1	1-5	3	2-0	1	1-8	1
	2-2 × 6	3-1	2	2-8	2	2-4	2	3-0	2	2-7	2	2-3	2	2-11	2	2-7	2
	2-2 × 8	3-10	2	3-4	2	3-0	3	3-10	2	3-4	2	2-11	3	3-9	2	3-3	2

(continued)

CEILING JOIST SIZES

- The same 24' wide house has a bearing wall down the centerline. Size the ceiling joist assuming a 10 psf dead load and limited attic storage. Use #2 SYP joists.
- See Table R802.4(2).
- 2x6 joists at 12" o/c are OK to 15'-6"
- 2x6 joists at 16" o/c are OK to 13'-6"
- 2x6 joist at 19.2" o/c are OK to 12'-3" (not shown on your table)

68

TABLE R802.4(2)
CEILING JOIST SPANS FOR COMMON LUMBER SPECIES
(Uninhabitable attics with limited storage, live load = 20 psf, L/Δ = 240)

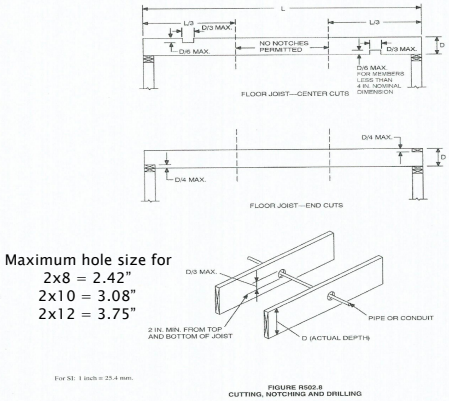
CEILING JOIST SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf			
			2 × 4	2 × 6	2 × 8	2 × 10
			Maximum ceiling joist spans			
			(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)
12	Douglas fir-larch	SS	10-5	16-4	21-7	Note a
	Douglas fir-larch	#1	10-0	15-9	20-1	24-6
	Douglas fir-larch	#2	9-10	14-10	18-9	22-11
	Douglas fir-larch	#3	7-8	11-2	14-2	17-4
	Hem-fir	SS	9-10	15-6	20-5	Note a
	Hem-fir	#1	9-8	15-2	19-7	23-11
	Hem-fir	#2	9-2	14-5	18-6	22-7
	Hem-fir	#3	7-8	11-2	14-2	17-4
	Southern pine	SS	10-3	16-1	21-2	Note a
	Southern pine	#1	10-0	15-9	20-10	Note a
	Southern pine	#2	9-10	13-6	20-1	23-11
	Southern pine	#3	8-2	12-0	15-4	18-1
	Spruce-pine-fir	SS	9-8	15-2	19-11	23-5
	Spruce-pine-fir	#1	9-5	14-9	18-9	22-11
	Spruce-pine-fir	#2	9-5	14-9	18-9	22-11
	Spruce-pine-fir	#3	7-8	11-2	14-2	17-4
16	Douglas fir-larch	SS	9-6	14-11	19-7	25-0
	Douglas fir-larch	#1	9-1	13-9	17-5	21-3
	Douglas fir-larch	#2	8-9	12-10	16-3	19-10
	Douglas fir-larch	#3	6-8	9-8	12-4	15-0
	Hem-fir	SS	8-11	14-1	18-6	23-8
	Hem-fir	#1	8-9	13-3	16-10	20-8
	Hem-fir	#2	8-4	12-8	16-0	19-7
	Hem-fir	#3	6-8	9-8	12-4	15-0
	Southern pine	SS	9-4	14-7	19-3	24-7
	Southern pine	#1	9-1	14-4	18-11	23-1
	Southern pine	#2	8-11	13-6	17-5	20-9
	Southern pine	#3	7-1	10-5	13-3	15-8
	Spruce-pine-fir	SS	8-9	13-9	18-1	23-1
	Spruce-pine-fir	#1	8-7	12-10	16-3	19-10
	Spruce-pine-fir	#2	8-7	12-10	16-3	19-10
	Spruce-pine-fir	#3	6-8	9-8	12-4	15-0

(continued)

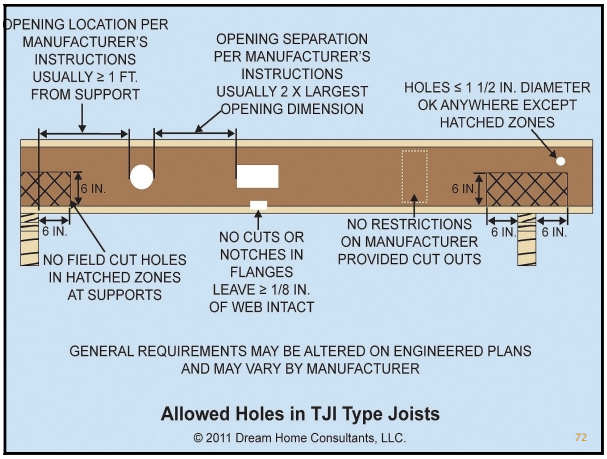
FLOOR AND CEILING JOIST NOTES

- Joists are to be lapped a minimum of 3" over supports and nailed together with a minimum of three 10d nails.
- Floor joists must have a rim joist or equal to keep them from turning over.
- Floor joists larger than 2x12 must have solid blocking or bridging every 8' along the span.

70



71



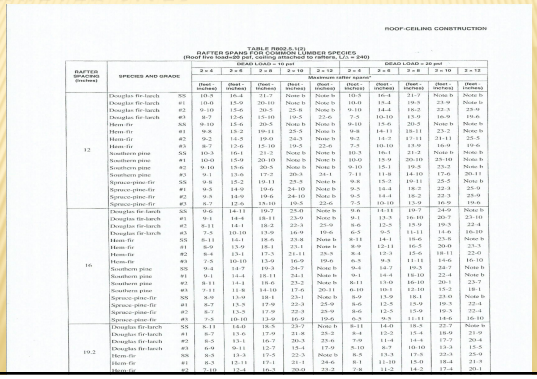
72

RAFTER SIZES

- For the same house, size the rafters assuming that the rafters will be braced off of the centerline bearing wall at a 45º angle.
- The rafter "span" (always measured horizontally regardless of the roof slope) is about 6'.
- From Table R802.5.1(2) select 2x4 at 16" o/c (OK to 8'-11")

73

RAFTER SIZES



ROOF-CEILING CONSTRUCTION

TABLE R802.5.1(2)
RAFTER SPANS FOR COMMON LUMBER SPECIES
(Roof live load=20 psf, ceiling not attached to rafters, $L/\Delta = 240$)

RAFTER SPACING (inches)	SPECIES AND GRADE		DEAD LOAD = 10 psf					DEAD LOAD = 20 psf				
			2 × 4	2 × 6	2 × 8	2 × 10	2 × 12	2 × 4	2 × 6	2 × 8	2 × 10	2 × 12
			Maximum rafter spans[a]									
			(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)	(feet - inches)
12	Douglas fir-larch	SS	10-5	16-4	21-7	Note b	Note b	10-5	16-4	21-7	Note b	Note b
	Douglas fir-larch	#1	10-0	15-9	20-10	Note b	Note b	10-0	15-4	19-5	23-9	Note b
	Douglas fir-larch	#2	9-10	15-6	20-5	25-8	Note b	9-10	14-4	18-2	22-3	25-9
	Douglas fir-larch	#3	9-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Hem-fir	SS	9-10	15-6	20-5	Note b	Note b	9-10	15-6	20-5	Note b	Note b
	Hem-fir	#1	9-8	15-2	19-11	25-5	Note b	9-8	14-11	18-11	23-2	Note b
	Hem-fir	#2	9-2	14-5	19-0	24-3	Note b	9-2	14-7	17-11	21-11	25-5
	Hem-fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
	Southern pine	SS	10-3	16-1	21-2	Note b	Note b	10-3	16-1	21-2	Note b	Note b
	Southern pine	#1	10-0	15-9	20-10	Note b	Note b	10-0	15-9	20-10	25-10	Note b
	Southern pine	#2	9-10	15-6	20-5	Note b	Note b	9-10	15-1	19-8	23-2	Note b
	Southern pine	#3	9-1	13-6	17-2	20-3	24-1	7-11	11-8	14-10	17-6	20-11
	Spruce-pine-fir	SS	9-8	15-2	19-11	25-5	Note b	9-8	15-2	19-11	25-5	Note b
	Spruce-pine-fir	#1	9-5	14-9	19-6	24-10	Note b	9-5	14-4	18-2	22-3	25-9
	Spruce-pine-fir	#2	9-5	14-9	19-6	24-10	Note b	9-5	14-4	18-2	22-3	25-9
	Spruce-pine-fir	#3	8-7	12-6	15-10	19-5	22-6	7-5	10-10	13-9	16-9	19-6
16	Douglas fir-larch	SS	9-6	14-11	19-7	25-0	Note b	9-6	14-11	19-7	24-9	Note b
	Douglas fir-larch	#1	9-1	14-4	18-11	23-9	Note b	9-1	13-3	16-10	20-7	23-10
	Douglas fir-larch	#2	8-11	14-1	18-2	22-3	25-8	8-6	12-5	15-9	19-3	22-4
	Douglas fir-larch	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Hem-fir	SS	9-3	14-1	18-6	23-8	Note b	8-11	14-1	18-6	23-8	Note b
	Hem-fir	#1	8-9	13-9	18-1	23-1	Note b	8-9	12-11	16-5	20-0	23-3
	Hem-fir	#2	8-4	13-1	17-3	21-11	25-5	8-4	12-3	15-6	18-11	22-0
	Hem-fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
	Southern pine	SS	9-4	14-7	19-3	24-7	Note b	9-4	14-7	19-3	24-7	Note b
	Southern pine	#1	9-1	14-4	18-11	24-1	Note b	9-1	14-4	18-10	22-4	Note b
	Southern pine	#2	8-11	14-1	18-6	23-2	Note b	8-11	13-0	16-10	20-1	23-7
	Southern pine	#3	7-11	11-8	14-10	17-6	20-11	6-10	10-1	12-10	15-2	18-1
	Spruce-pine-fir	SS	8-9	13-9	18-1	23-1	Note b	8-9	13-9	18-1	23-0	Note b
	Spruce-pine-fir	#1	8-7	13-3	17-9	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-pine-fir	#2	8-7	13-3	17-9	22-3	25-9	8-6	12-5	15-9	19-3	22-4
	Spruce-pine-fir	#3	7-5	10-10	13-9	16-9	19-6	6-5	9-5	11-11	14-6	16-10
19.2	Douglas fir-larch	SS	8-13	14-0	18-5	23-7	Note b	8-11	14-0	18-5	22-7	Note b
	Douglas fir-larch	#1	8-7	13-6	17-9	21-8	25-2	8-4	12-2	15-4	18-9	21-9
	Douglas fir-larch	#2	8-5	13-1	16-7	20-3	23-6	7-9	11-4	14-4	17-7	20-4
	Douglas fir-larch	#3	6-9	9-11	12-7	15-4	17-9	5-10	8-7	10-10	13-3	15-5
	Hem-fir	SS	8-5	13-3	17-5	22-3	Note b	8-5	13-3	17-5	22-3	25-9
	Hem-fir	#1	8-3	12-11	17-1	21-1	24-6	8-1	11-10	15-0	18-4	21-3
	Hem-fir	#2	7-10	12-4	16-3	20-0	23-2	7-8	11-2	14-2	17-4	20-1

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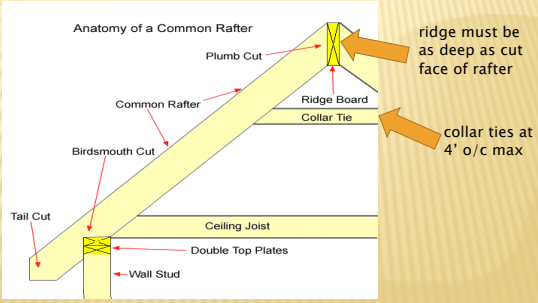
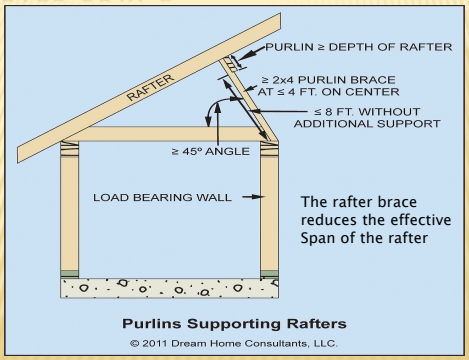
ROOF FRAMING



75

RAFTER BRACE

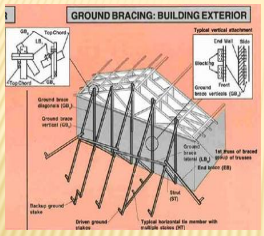


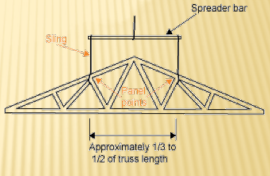
76

TRUSSES

- Do not cut or otherwise alter trusses.
- Follow the truss manufacturer's handling recommendations.
- Review the truss drawings to find out the temporary and permanent bracing requirements.
- Provide adequate bracing as the trusses are erected (sheathing makes the best truss bracing).

77





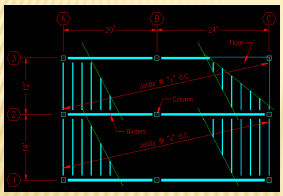
TRUSS ERECTION

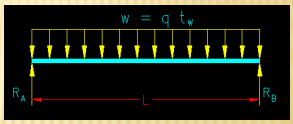
78

WHY WE BRACE TRUSSES

79

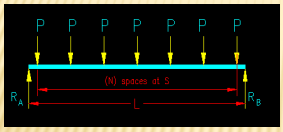
LOAD PATH CONCEPTS

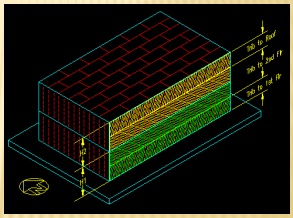




80

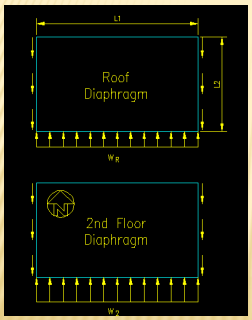
LOAD PATH CONCEPTS

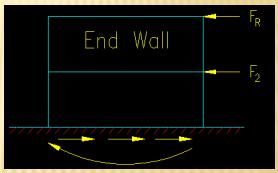




81

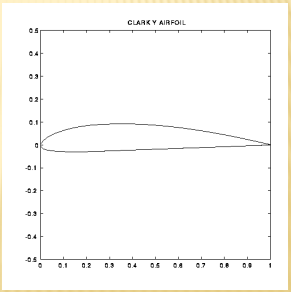
LOAD PATH CONCEPTS





82

LOAD PATH CONCEPTS



83

LOAD PATH CONCEPTS

- Wind blowing across the roof of a typical contemporary house (8 on 12 roof slope) increases the pressure on the upwind portion of the roof.
- Wind blowing across the roof of a typical contemporary house (8 on 12 roof slope) decreases the pressure on the downwind portion of the roof.

84

LOAD PATH CONCEPTS

- Wind moving across the roof of the structure creates lift.
- For stability, the lift forces must be resisted.
- Therefore, the entire structure from roof to foundation must be tied together.

85

LOAD PATH CONCEPTS

- I call this concept “vertical continuity”.
- The walls must be adequately tied to the foundation.
- The walls must be adequately tied together.

86

LOAD PATH CONCEPTS

- The roof decking must be adequately tied to the roof framing.
- The roofing must be adequately tied to the roof decking.

87

LOAD PATH CONCEPTS

- If the house has more than one story, the walls of the lower level must be adequately tied to the walls of the upper level.
- The roof framing must be adequately tied to the walls.

88

LOAD PATH CONCEPTS

- **The load path is like a chain, it is only as strong as its weakest link.**
- **The load path can travel through structural members or assemblies as tension, compression or shear forces.**
- **Members can have different types of forces at different times.**

89

FOR ADDITIONAL HELP…

Take the NAHB Building Technology: Structure and Exterior Finishes course available through the Home Builders Association of Alabama.

90

STAIR AND RAILING DETAILS

- **Stairways must have a minimum clear width of 36" exclusive of handrails.**
- **Stairways must have a minimum clear headroom of 6'-8" measured from the leading edge of the tread.**
- **The vertical rise of a stairway between levels or landings may not exceed 12'.**

91

STAIR AND RAILING DETAILS

- The maximum allowable height of risers is 7 ¾".
- Riser heights within a flight of stairs may not vary more than 3/8".
- The minimum tread depth is 10".
- Tread depths within a flight of stairs may not vary more than 3/8".
- Open risers are permitted if the space between treads will not pass a 4" sphere.

92

STAIR AND RAILING DETAILS

- Railings are required on at least one side of any stairway with 4 or more risers.
- The top of the handrails must be between 34" and 38" above the leading edge of the tread.
- The grasping surface of the handrail must have a perimeter of between 4" and 6 ¼" and with no dimension greater than 2 ¼".

93

SECTION 4. MOISTURE CONTROL

94

COMMON SOURCES OF MOISTURE

- Crawlspaces
- Roofs
- Roof/wall junctions
- Flashing issues
- Improper masonry details
- Wall openings
- Deck/wall junctions

95

CRAWLSPACE MOISTURE

96

CRAWLSPACE MOISTURE ISSUES

- Inadequate slope of exterior grade.
  - Minimum of 6" fall in 10' outside foundation.
- Crawlspace lower than exterior grade.
  - In areas with high groundwater, the interior level must be as high as the exterior or proper perimeter drainage must be provided.
- Missing/improper perimeter drains.
  - Drains generally must have a gravel pack and a geotechnical fabric wrap.
  - Drains must actually "drain".

97

CRAWLSPACE MOISTURE ISSUES

- Missing/improper foundation wall waterproofing.
  - Waterproofing is required for habitable spaces below grade.
- Plumbing/HVAC leaks.
  - Watch for condensate drains and T&P relief.
- Inadequate ventilation.
  - 1 sf of free air space per 150 sf of crawlspace or
  - 1 sf of free air space per 1,500 sf of crawlspace if vents within 3' of corners and proper vapor retarder.

98

ROOF ISSUES

99

ROOF ISSUES

- Shingle roofs require a minimum slope of 2/12.
- Shingle roofs between 2/12 and 4/12 require two layers of felt.
- All shingle roofs require drip edges at gables and eaves with the drip edge installed UNDER the felt at the eaves and OVER the felt at the gables.

100

ROOF ISSUES

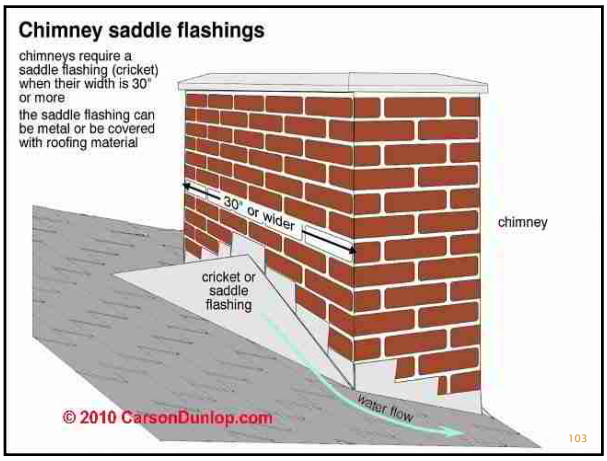
- Valleys may be “open” or “closed”.
- Open valleys must be lined with 24” minimum width corrosion resistant metal or one 18” wide and one 36” wide layer of roll roofing.
- Closed valleys must be lined with one 36” wide layer of roll roofing or “peel and stick”.

101

ROOF ISSUES

- Projections through the roof wider than 30” must have crickets.
- Shingles must be installed in accordance with the manufacturer’s application instructions.
- This includes starter course, hip and ridge shingles, nailing pattern etc.
- The nailing pattern is particularly important in high wind areas.

102



ROOF/WALL JUNCTIONS

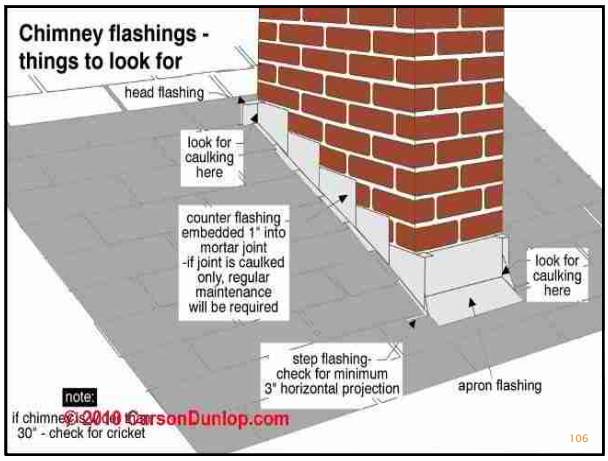
- Roof/wall junctions must have either continuous or step flashings.
- The flashing must have a minimum of 4" vertical and horizontal legs with a thickness of at least 26 gauge.
- Where the wall material is siding, the vertical leg of the flashing must extend behind the siding.

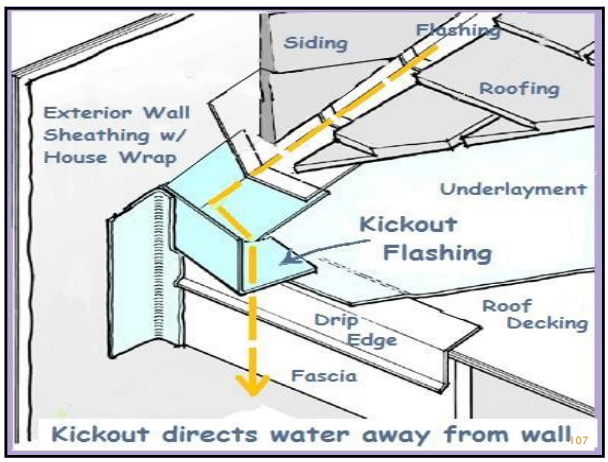
104

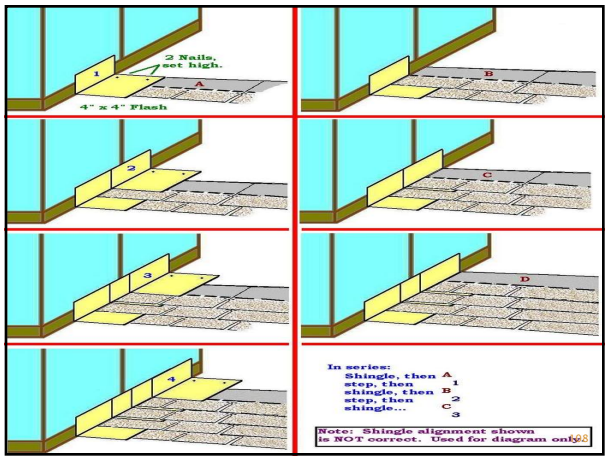
ROOF/WALL JUNCTIONS

- Where the wall extends past the eave line, install a kickout flashing.
- Where the wall material is brick, install step flashings.

105


Chimney flashings - things to look for
head flashing
look for caulking here
counter flashing embedded 1" into mortar joint -if joint is caulked only, regular maintenance will be required
look for caulking here
step flashing- check for minimum 3" horizontal projection
apron flashing
note:
if chimney is over 30" - check for cricket
©2010 CarsonDunlop.com
106

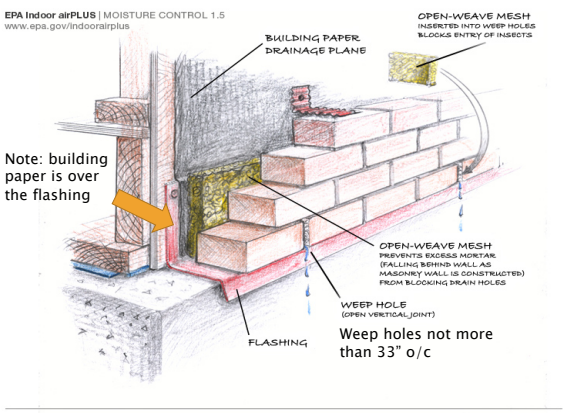

Siding
Flashing
Roofing
Exterior Wall Sheathing w/ House Wrap
Underlayment
Kickout Flashing
Roof Decking
Drip Edge
Fascia
Kickout directs water away from wall
107


2 Nails, set high.
4" x 4" Flash
In series:
Shingle, then step, then shingle, then step, then shingle...
Note: Shingle alignment shown is NOT correct. Used for diagram only
108

OTHER FLASHING ISSUES

- Base flashing at brick veneer walls
- Head flashing at doors and windows
- Sill flashing under windows

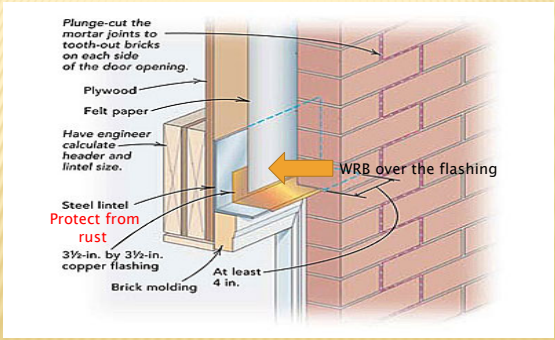
109



MASONRY WALL WITH DRAINAGE PLANE, FLASHING, AND WEEP HOLES

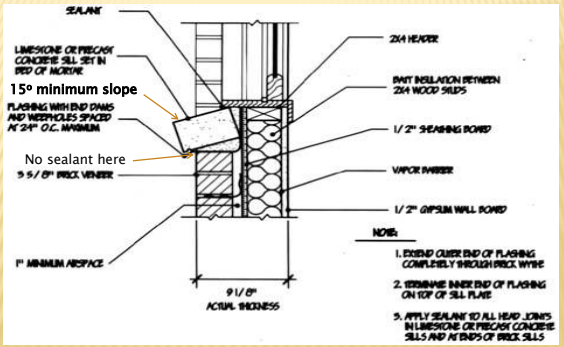
110

DOOR & WINDOW HEAD FLASHING



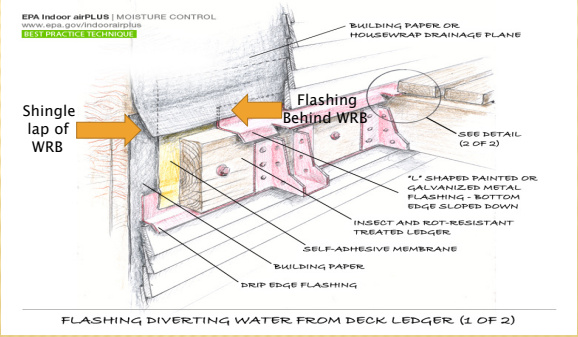
111

SILL FLASHING



112

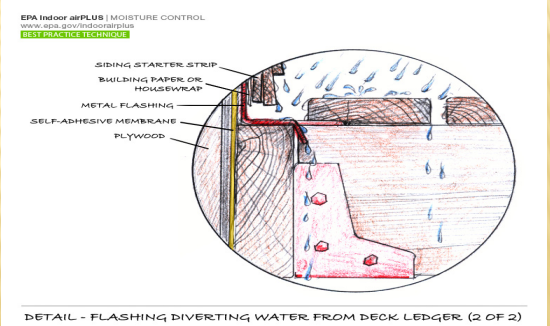
DECK/WALL JUNCTIONS



FLASHING DIVERTING WATER FROM DECK LEDGER (1 OF 2)

113

DECK/WALL JUNCTIONS



DETAIL - FLASHING DIVERTING WATER FROM DECK LEDGER (2 OF 2)

114

FOR ADDITIONAL HELP…

Take the NAHB Building Technology: Structure and Exterior Finishes course available through the Home Builders Association of Alabama.

115

SECTION 5. ESTIMATING

- One of the primary reasons that construction companies fail is their inability to produce accurate cost estimates.
- Estimating is part art and part science.
- In order to produce an accurate cost estimate, you have to be able to "build it in your mind".

116

ESTIMATING METHODS

- The "I'm thinking of a number" method,
- The Square Foot method,
- The Parametric method,
- The Assembly method,
- The Time and Materials method,
- The Detailed Quantity Survey and Pricing method, and
- The Combination method.

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ESTIMATE ASSEMBLY

- Manual – pad and pencil
- Computer aided – spreadsheet templates
- Computerized – full blown computerized

118

FOR ADDITIONAL HELP…

Take the NAHB Estimating course available through the Home Builders Association of Alabama.

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TEST FOR DAY ONE MATERIALS

- Mark your answers by circling the applicable letter.
- If you change your mind, carefully erase your previous choice.
- Any question with more than one answer will be graded as being wrong.
- If you don't understand a question, feel free to ask for clarification.
- You must get a minimum of 18 answers correct to pass this part of the course.

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