# 2015 Michigan Residential Code Structural Review

presentation by russell thornburg

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Building Contractor
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## Field Issue vs. Plan Details

**Field Issue**

- Connections.
- Bridging.
- Floor and roof sheathing.
- Drilling and notching.
- Concrete covers.

**Plan details**

- Foundation and framing plans.
- Materials specifications.
- Wall bracing.
- Wall framing.

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## Class Assumptions

- Typical wood-framed construction.
- Typical CMU or concrete foundation construction.
- Guidance and "rules of thumb" are given for the review of non-prescriptive elements, (i.e.) steel beams, LVLs.
- I am not a P.E. or AIA of any degree, just a simple plans examiner in the back corner.

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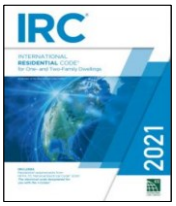
## International Residential Code

- Prescriptive Code.
- "Cookbook" with ingredients.
- Limits.
- It is the worst possible house you can build by law!

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## Structural Review

- Objective:
  Perform and Recognize International Residential Code Structural Review & Field

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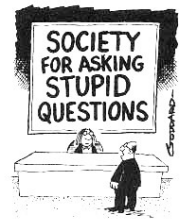
## Questions?

SURE– Go ahead and ask your question!

***There are no stupid questions!***




"Excuse me, but is this The Society for Asking Stupid Questions?"

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## Basic Understanding

- Types of loads
- Applying the code
- Tributary width, area
- Load path
- Modulus of Elasticity
- Calculating loads
- Use span tables

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## Objectives

- Determine the difference between plan details and field issues.
- Define prescriptive code.
- Complete a simple interpolation.
- Identify steps to take when a design falls outside IRC limits.
- Identify typical wood species and wood products seen on the plan.

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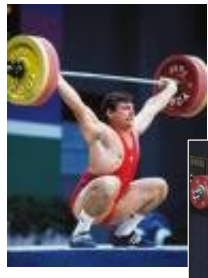
## Types of Loads



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## Types of Loads

| Application | Dead loads | Live loads |
|---|---|---|
| Vertical loads | | |
| Horizontal loads | | |

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## Definitions

**Dead load:**

Weight of all materials of construction, including walls, floors, ceilings, stairways, built-in partitions, finishes, cladding, and fixed services (HVAC, etc)

**Live load:**

Loads produced by the occupants using the building, or environmental loads.

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## Applying the code

### Table R301.2

### Climatic criteria

Table R301.2
Climate and Geographic Design Criteria

| GROUND SNOW LOAD[a] | WIND DESIGN | | | | SEISMIC DESIGN CATEGORY[f] | SUBJECT TO DAMAGE FROM | | | ICE BARRIER UNDERLAYMENT REQUIRED[h] | FLOOD HAZARDS[i] | AIR FREEZING INDEX[j] | MEAN ANNUAL TEMP[k] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Speed[d] (mph) | Topographic effects[k] | Special wind region[l] | Windborne debris zone[m] | | Weathering[a] | Frost line depth[b] | Termite[c] | | | | |
| | | | | | | | | | | | | |

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
|---|---|---|
| Uninhabitable attics without storage[b] | 10 | — |
| Uninhabitable attics with limited storage[b, g] | 20 | — |
| Habitable attics and attics served with fixed stairs | 30 | — |
| Balconies (exterior) and decks[e] | 40 | — |
| Fire escapes | 40 | — |
| Guards | — | 200[a, i] |
| Guard in-fill components[i] | — | 50[h] |
| Handrail[h] | — | 200[h] |
| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[c] | 300[c] |

### Table R301.5

### Live loads

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## Types of Loads

### Dead loads

- Vertical loads
  - Self weight of the building components
    - Concrete, wood
    - MEP systems
    - Finishes, etc

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## Section R301.4

### Dead loads

#### Self weight of members

- Joists
- Sheathing

- Rule of thumb

**10 PSF**

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## Table R301.2

### Dead loads

- Interior wall loads

- Rule of thumb
  5 # / foot
  of vertical height

or **50 PLF**

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## Table R301.2

### Dead loads

- Exterior wall loads - wood

- Rule of thumb
  8 # / foot
  of vertical height

or **80 PLF**

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## Table R301.2

### Dead loads

- Exterior wall loads -masonry

- Rule of thumb

**40 PLF/foot**

Example:
6' tall brick = 240PLF

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## Types of Loads

### Live loads

- Vertical loads
  - Snow
  - People
  - Moveable "things"
- Horizontal loads
  - Wind
  - Seismic

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## Table R301.2

### Live loads

- "Ground Snow Load"

**30 - 70 PLF**

Table R301.2
Climate and Geographic Design Criteria

| GROUND SNOW LOAD[a] | WIND DESIGN | | | | SEISMIC DESIGN CATEGORY[f] | SUBJECT TO DAMAGE FROM | | | FLOOD HAZARD[g] | AIR FREEZING INDEX[h] | MEAN ANNUAL TEMP[i] |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Speed[d] (mph) | Topographic effects[k] | Special wind region[l] | Windborne debris zone[m] | | Weathering[a] | Frost line depth[b] | Termite[c] | | | |
| | | | | | | | | | | | |

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## Types of Loads

### Live loads

- Vertical loads (Interior)
  - People
  - Moveable things
    - Furniture
    - Storage

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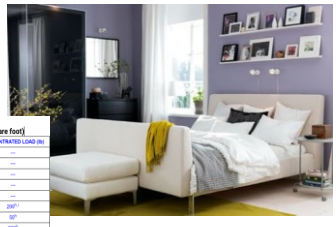
## Table R301.5

### Live loads (psf)

- Bedrooms

**30 PSF**



Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
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| Balconies (exterior) and decks[e] | 40 | — |
| Fire escapes | 40 | — |
| Guards | — | 200[j] |
| Guard in-fill components[f] | — | 50[f] |
| Handrail[d] | — | 200[f] |
| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |

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## Table R301.5

### Live loads (psf)

- Rooms - other than sleeping rooms

**40 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
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| Uninhabitable attics without storage[b] | 10 | — |
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| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |

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## Table R301.5

### Live loads (psf)

- Attics – very limited storage (a hatch)

**10 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
|---|---|---|
| Uninhabitable attics without storage[b] | 10 | |
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| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |

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## Table R301.5

### Live loads (psf)

- Attics –limited storage (a pull down ladder)

**20 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
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| Uninhabitable attics without storage[b] | 10 | — |
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| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |



## Table R301.5

### Live loads (psf)

- Attics – with fixed stair (bedroom)

**30 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
|---|---|---|
| Uninhabitable attics without storage[b] | 10 | — |
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| Fire escapes | 40 | — |
| Guards | — | 200[c] |
| Guard-in-fill components[i] | — | 50[i] |
| Handrail[i] | — | 200[i] |
| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |

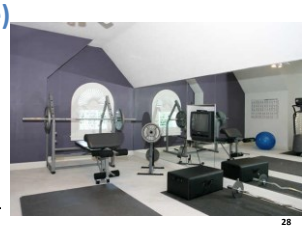


## Table R301.5

### Live loads (psf)

- Attics – with fixed stair (habitable space)

**40 PSF**



Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

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| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |



## Table R301.5

### Live loads (psf)

- Attics – with fixed stair (potentially habitable space)

**40 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
|---|---|---|
| Uninhabitable attics without storage[b] | 10 | — |
| Uninhabitable attics with limited storage[b, g] | 20 | — |
| Habitable attics and attics served with fixed stairs | 30 | — |
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| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |



## Table R301.5

### Live loads (psf)

- Decks

**40 PSF**

Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

| USE | UNIFORM LOAD (psf) | CONCENTRATED LOAD (lb) |
|---|---|---|
| Uninhabitable attics without storage[b] | 10 | — |
| Uninhabitable attics with limited storage[b, g] | 20 | — |
| Habitable attics and attics served with fixed stairs | 30 | — |
| Balconies (exterior) and decks[e] | 40 | — |
| Fire escapes | 40 | — |
| Guards | — | 200[c] |
| Guard-in-fill components[i] | — | 50[i] |
| Handrail[i] | — | 200[i] |
| Passenger vehicle garages[a] | 50[a] | 2,000[a] |
| Areas other than sleeping areas | 40 | — |
| Sleeping areas | 30 | — |
| Stairs | 40[f] | 300[f] |

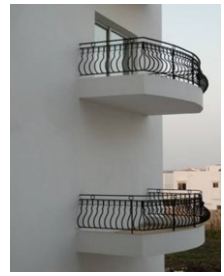


## Table R301.5

### Live loads (psf)

- Exterior balconies

**40 PSF**



Tables R301.5
Minimum Uniformly Distributed Live Loads (in pounds per square foot)

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| Areas other than sleeping areas | 40 | — |
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| Stairs | 40[f] | 300[f] |

## Types of Loads

### Live loads

- Horizontal loads
  - Wind

90 mph

Table R301.2
Climate and Geographic Design Criteria

| GROUND SNOW LOAD | WIND DESIGN | | | | SEISMIC DESIGN CATEGORY | SUBJECT TO DAMAGE FROM | | | ICE BARRIER UNDERLAYMENT REQUIRED | FLOOD HAZARDS | AIR FREEZING INDEX | MEAN ANNUAL TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Speed (mph) | Topographic effects | Special wind region | Windborne debris zone | | Weathering | Frost line depth | Termite | | | | |
| | | | | | | | | | | | | |

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## Types of Loads

### Live loads

- Horizontal loads
  - Seismic

For the most part, AR is in SDC A-D

Table R301.2
Climate and Geographic Design Criteria

| GROUND SNOW LOAD | WIND DESIGN | | | | SEISMIC DESIGN CATEGORY | SUBJECT TO DAMAGE FROM | | | ICE BARRIER UNDERLAYMENT REQUIRED | FLOOD HAZARDS | AIR FREEZING INDEX | MEAN ANNUAL TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Speed (mph) | Topographic effects | Special wind region | Windborne debris zone | | Weathering | Frost line depth | Termite | | | | |
| | | | | | | | | | | | | |

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## Types of Loads

### Live loads

- Horizontal loads
  - Floods (water surge)

Refer to Section R324 for flood-resistant construction

Table R301.2
Climate and Geographic Design Criteria

| GROUND SNOW LOAD | WIND DESIGN | | | | SEISMIC DESIGN CATEGORY | SUBJECT TO DAMAGE FROM | | | ICE BARRIER UNDERLAYMENT REQUIRED | FLOOD HAZARDS | AIR FREEZING INDEX | MEAN ANNUAL TEMP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Speed (mph) | Topographic effects | Special wind region | Windborne debris zone | | Weathering | Frost line depth | Termite | | | | |
| | | | | | | | | | | | | |

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## Complete Q1 on the worksheet

36

Q1: Fill in the blanks

| | | |
|---|---|---|
| Live load – all spaces except bedrooms | 40 | psf |
| Live load - bedroom | 30 | psf |
| Live load – attics with light storage (pull down) | 20 | psf |
| Live load - attics without storage (hatch) | 10 | psf |
| Dead load – floors | 10 | psf |
| Dead load - exterior walls | 80 | PLF |
| Dead load – interior walls, | 50 | PLF |
| Deck live load | 40 | psf |
| Balcony live load | 40 | psf |
| Snow load (horizontal projection) | 20 | psf |

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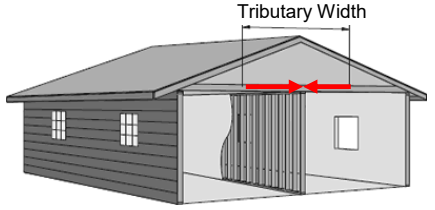
## How loads are distributed

### Tributary loads

#### Tributary width (length)

is the portion of the span that is supported by a structural member.

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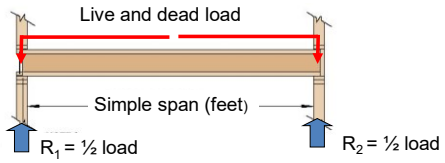
## How loads are distributed

### Tributary width (length)

is half the distance between adjacent walls (single span).




Example: 10' span = 5' tributary width`

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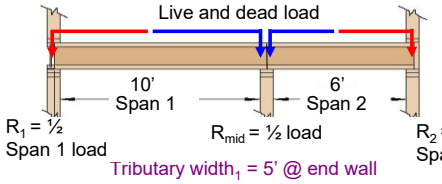
## How loads are distributed

### Tributary width

or half of the distance between adjacent walls (multiple span)




Tributary width$_1$ = 5' @ end wall

Tributary width$_2$ = 3' @ end wall

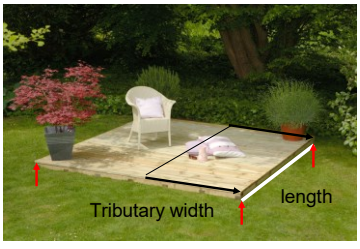
Tributary width $_{mid}$ = 8' @ middle wall

40

## How loads are distributed

### Tributary area

Tributary width x length




Tributary area carried by this girder

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## Worksheet handout Q2-Q5

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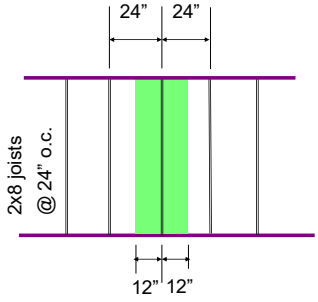
Q2. A floor system under a kitchen is made up of 2x8 @ 24" o.c. What is the tributary width of a single floor joist member?

**24** inches

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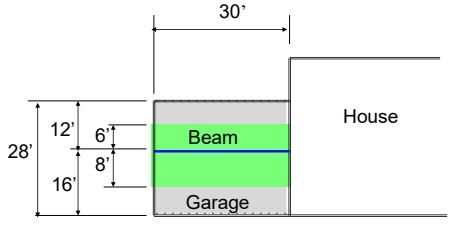
Q3. The floor over a garage is supported by a beam and the perimeter walls. If the joists are 16" o.c.:

1. What is the tributary width on the beam? **14'** ft
2. What is the tributary width on the front wall? **8'** ft
3. What is the tributary width on the rear wall? **6'** ft
4. If the joists are 12" o.c.? **Doesn't make any difference**

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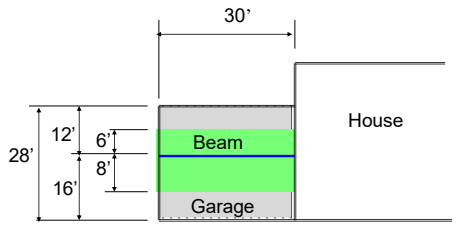
Q4. What is the tributary area carried by the beam in Q3?

**420** sqft

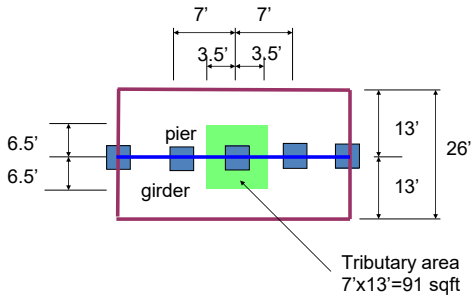



Tributary width x length of the beam
14' x 30' = 420 sqft

45

Q5. The crawl space girder is supported on piers spaced 7' o.c. What is the tributary area carried by one of the middle girders?

**91** sqft

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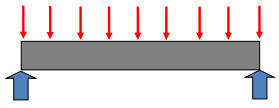
## How loads are applied

### Uniform load

is a load spread over some or all portion(s) of the structural member



Note: the load is expressed in PLF

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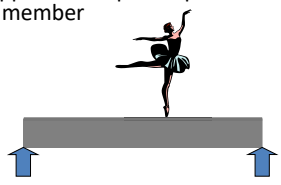
## How loads are applied

### Concentrated (point) load

is a load applied to a specific place on the structural member



Note: the load is expressed in # (lbs)

"Kip" = one "kilo" pound = 1000# = 1K

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## How loads are applied

### Axial load

is a point load applied at the end of a structural member

Note: the load is expressed in #

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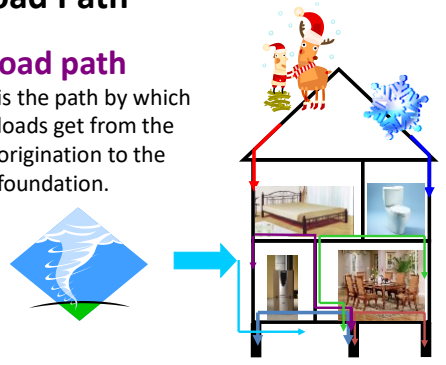
## Load Path

### Load path

is the path by which loads get from the origination to the foundation.



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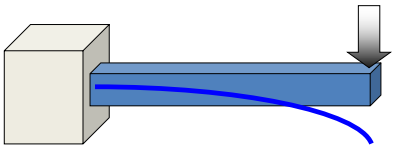
## Modulus of Elasticity

**Modulus of Elasticity (Young's Modulus)**
is the measure of the stiffness of a given material.

In layman's terms: the amount of load (weight) that can be placed on a structural member before it will permanently deform

(in millions of pounds per square inch (example E=2.0))



51

## Quantifying the loads

**3 step procedure to quick check structural integrity:**

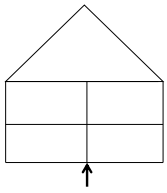
1. Identify all loads
2. Quantify loads into "PLF"
3. Look them up in a span table, or use engineering software like StruCalc®

52

## Quantifying the loads

**Procedure**

1. Identify design loads



**Example #1: Crawl space girder**

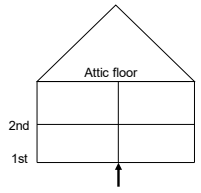
- First floor load
- Interior wall load
- Second floor load
- Interior wall load
- Attic floor load

53

## Quantifying the loads

**Procedure**

1. Identify design loads
2. Quantify "PLF"




**Example #1: Crawl space girder**

- **First floor load** [40 psf (LL) + 10 psf (DL)] x 10 ft (trib width) = 500 PLF
- **Interior wall load** = 50 PLF
- **Second floor load** [30 psf (LL) + 10 psf (DL)] x 10 ft (trib width) = 400 PLF
- **Interior wall load** = 50 PLF
- **Attic floor load** [40 psf (LL) + 10 psf (DL) x 10 ft (trib width) = 500 PLF

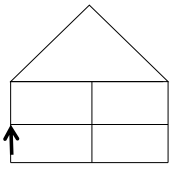
Total load 1500 PLF

54

## Quantifying the loads

**Procedure**

1. Identify design loads
2. Quantify "PLF"



**Example #2: Door header**

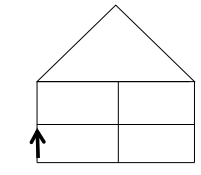
- Second floor load
- Exterior wall load
- Roof load

55

## Quantifying the loads

**Procedure**

1. Identify design loads
2. Quantify "PLF"



**Example #2: Door header**

- **Second floor load** [30 psf (LL) + 10 psf (DL)] x 5 feet (trib width) = 200 PLF
- **Exterior wall load** = 80 PLF
- **Truss load** 1200 # @ 2' o.c. = 600 PLF

Total load 880 PLF

56

## Quantifying the loads

### Procedure

1. Identify design loads
2. Quantify "PLF"

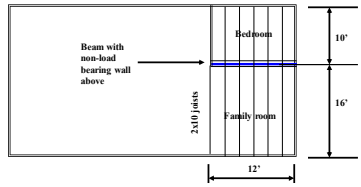
**Complete Q6, of the worksheet.**

57

Q6: What is the total uniform loading (plf) on the following LVL beam? List and quantify the loads.

- 12' long LVL beam above the basement,
- carrying 2x10 floor joists spanning 16' for family room (above) on one side
- and 10' on the other side supporting a bedroom,
- plus a non-load bearing interior wall

650 PLF




| | | |
|---|---|---|
| Family room | [40psf (LL) + 10psf (DL)] x 8' | = 400 plf |
| Bedroom | [30psf (LL) + 10psf (DL)] x 5' | = 200 plf |
| Interior wall | | = 50 plf |
| | Total uniform load | 650 plf |

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## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look them up in a span table
   - 2x joist span tables (table 1)
   - I-joist span tables (table 2)
   - 2x beam span tables (table 3)
   - LVL beam span tables (table 4)
   - Column load tables (tables 5-6)

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## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - 2x joist span tables

Table 1:
- Species,
- Depth of member,
- Live load
- Spacing,
- Span length

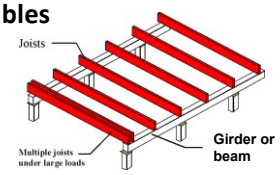


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**Table 1**
**Span Table for Floors - Ceilings - Rafters**

Southern Pine #2

| APPLICABLE CODE SECTION | | IRC R802.5.1(1) | IRC R802.5.1(2) | IRC R502.3.1(1) | IRC R502.3.1(2) | IRC R802.4.1(1) | IRC R802.4.1(2) |
|---|---|---|---|---|---|---|---|
| | Spacing (inches) | Ceiling Joists w/o storage access hole LL 10 DL 5 L/240 | Ceiling Joists w/ pull down stair LL 20 DL 10 L/240 | Floor Joists sleep areas LL 30 DL 10 L/360 | Floor Joists living areas LL 40 DL 10 L/360 | Rafters w/o ceiling living areas LL 20 DL 10 L/180 | Rafters w/ ceiling living areas LL 20 DL 10 L/240 |
| 2x4 | 12 | 11-10 | 9-3 | | | 10-4 | 9-5 |
| | 16 | 10-9 | 8-0 | | | 9-0 | 8-7 |
| | 19.2 | 10-2 | 7-4 | | | 8-2 | 8-1 |
| | 24 | 9-3 | 6-7 | | | 7-4 | 7-4 |
| 2x6 | 12 | 18-8 | 13-11 | 11-3 | 10-3 | 15-7 | 14-9 |
| | 16 | 16-11 | 12-0 | 10-3 | 9-4 | 13-6 | 13-5 |
| | 19.2 | 15-7 | 11-0 | 9-6 | 8-6 | 12-3 | 12-3 |
| | 24 | 13-11 | 9-10 | 8-6 | 7-7 | 11-0 | 11-0 |
| 2x8 | 12 | 24-7 | 17-7 | 14-11 | 13-6 | 19-8 | 19-6 |
| | 16 | 21-7 | 15-3 | 13-3 | 11-10 | 17-1 | 17-1 |
| | 19.2 | 19-8 | 13-11 | 12-1 | 10-10 | 15-7 | 15-7 |
| | 24 | 17-7 | 12-6 | 10-10 | 9-8 | 13-11 | 13-11 |
| 2x10 | 12 | >26-0 | 20-11 | 18-1 | 16-2 | 23-5 | 23-5 |
| | 16 | 25-7 | 18-1 | 15-8 | 14-0 | 20-3 | 20-3 |
| | 19.2 | 23-5 | 16-6 | 14-4 | 12-10 | 18-6 | 18-6 |
| | 24 | 20-11 | 14-9 | 12-10 | 11-5 | 16-6 | 16-6 |
| 2x12 | 12 | | | 21-4 | 19-2 | >26-0 | >26-0 |
| | 16 | | | 18-6 | 16-6 | 23-10 | 23-10 |
| | 19.2 | | | 16-10 | 15-1 | 21-9 | 21-9 |
| | 24 | | | 15-1 | 13-6 | 19-6 | 19-6 |

** length usually not available
** already takes into account ***repetitive members factor*** of 115%
(based on values from various tables in IRC)

61

**Q7. What is the max span length of a 2x8, @16" o.c. for kitchen?** **11'-10" ft**

Kitchen live load = 40 psf.

**Table 1**
**Span Table for Floors - Ceilings - Rafters**

Southern Pine #2

| APPLICABLE CODE SECTION | | IRC R802.5.1(1) | IRC R802.5.1(2) | IRC R502.3.1(1) | IRC R502.3.1(2) | IRC R802.4.1(1) | IRC R802.4.1(2) |
|---|---|---|---|---|---|---|---|
| | Spacing (inches) | Ceiling Joists w/o storage access hole LL 10 DL 5 L/240 | Ceiling Joists w/ pull down stair LL 20 DL 10 L/240 | Floor Joists sleep areas LL 30 DL 10 L/360 | Floor Joists living areas LL 40 DL 10 L/360 | Rafters w/o ceiling living areas LL 20 DL 10 L/180 | Rafters w/ ceiling living areas LL 20 DL 10 L/240 |
| 2x4 | 12 | 11-10 | 9-3 | | | 10-4 | 9-5 |
| | 16 | 10-9 | 8-0 | | | 9-0 | 8-7 |
| | 19.2 | 10-2 | 7-4 | | | 8-2 | 8-1 |
| | 24 | 9-3 | 6-7 | | | 7-4 | 7-4 |
| 2x6 | 12 | 18-8 | 13-11 | 11-3 | 10-3 | 15-7 | 14-9 |
| | 16 | 16-11 | 12-0 | 10-3 | 9-4 | 13-6 | 13-5 |
| | 19.2 | 15-7 | 11-0 | 9-6 | 8-6 | 12-3 | 12-3 |
| | 24 | 13-11 | 9-10 | 8-6 | 7-7 | 11-0 | 11-0 |
| 2x8 | 12 | 24-7 | 17-7 | 14-11 | 13-6 | 19-8 | 19-6 |
| | 16 | 21-7 | 15-3 | 13-3 | 11-10 | 17-1 | 17-1 |
| | 19.2 | 19-8 | 13-11 | 12-1 | 10-10 | 15-7 | 15-7 |
| | 24 | 17-7 | 12-6 | 10-10 | 9-8 | 13-11 | 13-11 |
| 2x10 | 12 | >26-0 | 20-11 | 18-1 | 16-2 | 23-5 | 23-5 |
| | 16 | 25-7 | 18-1 | 15-8 | 14-0 | 20-3 | 20-3 |
| | 19.2 | 23-5 | 16-6 | 14-4 | 12-10 | 18-6 | 18-6 |
| | 24 | 20-11 | 14-9 | 12-10 | 11-5 | 16-6 | 16-6 |
| 2x12 | 12 | | | 21-4 | 19-2 | >26-0 | >26-0 |
| | 16 | | | 18-6 | 16-6 | 23-10 | 23-10 |
| | 19.2 | | | 16-10 | 15-1 | 21-9 | 21-9 |
| | 24 | | | 15-1 | 13-6 | 19-6 | 19-6 |

** length usually not available
** already takes into account ***repetitive members factor*** of 115%
(based on values from various tables in IRC)

63

**Q8. What is the max spacing (tributary width) for bedroom if using 2x8 floor joists, spanning 15'?** **None** **oc**

Bedroom live load = 30 psf.

Table 1
Span Table for Floors - Ceilings - Rafters

Southern Pine #2

| APPLICABLE CODE SECTION | | IRC R802.5.1(1) | IRC R802.5.1(2) | IRC R502.3.1(1) | IRC R502.3.1(2) | IRC R802.4.1(1) | IRC R802.4.1(2) |
|---|---|---|---|---|---|---|---|
| | Spacing (inches) | Ceiling Joists w/o storage access hole LL 10 DL 5 L/240 | Ceiling Joists w/ pull down stair LL 20 DL 10 L/240 | Floor Joists sleep areas LL 30 DL 10 L/360 | Floor Joists living areas LL 40 DL 10 L/360 | Rafters w/o ceiling living areas LL 20 DL 10 L/180 | Rafters w/ ceiling living areas LL 20 DL 10 L/240 |
| 2x4 | 12 | 11-10 | 9-3 | | | 10-4 | 9-5 |
| | 16 | 10-9 | 8-0 | | | 9-0 | 8-7 |
| | 19.2 | 10-2 | 7-4 | | | 8-2 | 8-1 |
| | 24 | 9-3 | 6-7 | | | 7-4 | 7-4 |
| 2x6 | 12 | 18-8 | 13-11 | 11-3 | 10-3 | 15-7 | 14-9 |
| | 16 | 16-11 | 12-0 | 10-3 | 9-4 | 13-6 | 13-5 |
| | 19.2 | 15-7 | 11-0 | 9-6 | 8-6 | 12-3 | 12-3 |
| | 24 | 13-11 | 9-10 | 8-6 | 7-7 | 11-0 | 11-0 |
| 2x8 | 12 | 24-7 | 17-7 | 14-11 | 13-6 | 19-8 | 19-6 |
| | 16 | 21-7 | 15-3 | 13-3 | 11-10 | 17-1 | 17-1 |
| | 19.2 | 19-8 | 13-11 | 12-1 | 10-10 | 15-7 | 15-7 |
| | 24 | 17-7 | 12-6 | 10-10 | 9-8 | 13-11 | 13-11 |
| 2x10 | 12 | >26-0 | 20-11 | 18-1 | 16-2 | 23-5 | 23-5 |
| | 16 | 25-7 | 18-1 | 15-8 | 14-0 | 20-3 | 20-3 |
| | 19.2 | 23-5 | 16-6 | 14-4 | 12-10 | 18-6 | 18-6 |
| | 24 | 20-11 | 14-9 | 12-10 | 11-5 | 16-6 | 16-6 |
| 2x12 | 12 | | | 21-4 | 19-2 | >26-0 | >26-0 |
| | 16 | | | 18-6 | 16-6 | 23-10 | 23-10 |
| | 19.2 | | | 16-10 | 15-1 | 21-9 | 21-9 |
| | 24 | | | 15-1 | 13-6 | 19-6 | 19-6 |

** length usually not available
** already takes into account ***repetitive members factor*** of 115%
(based on values from various tables in IRC)

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**Q9. What is the min. size roof rafter (with an attached ceiling), if the rafters are 24"o.c. and span 16'?** **2 x 10**

Roof rafters with ceilings (L/240)

Table 1
Span Table for Floors - Ceilings - Rafters

Southern Pine #2

| APPLICABLE CODE SECTION | | IRC R802.5.1(1) | IRC R802.5.1(2) | IRC R502.3.1(1) | IRC R502.3.1(2) | IRC R802.4.1(1) | IRC R802.4.1(2) |
|---|---|---|---|---|---|---|---|
| | Spacing (inches) | Ceiling Joists w/o storage access hole LL 10 DL 5 L/240 | Ceiling Joists w/ pull down stair LL 20 DL 10 L/240 | Floor Joists sleep areas LL 30 DL 10 L/360 | Floor Joists living areas LL 40 DL 10 L/360 | Rafters w/o ceiling living areas LL 20 DL 10 L/180 | Rafters w/ ceiling living areas LL 20 DL 10 L/240 |
| 2x4 | 12 | 11-10 | 9-3 | | | 10-4 | 9-5 |
| | 16 | 10-9 | 8-0 | | | 9-0 | 8-7 |
| | 19.2 | 10-2 | 7-4 | | | 8-2 | 8-1 |
| | 24 | 9-3 | 6-7 | | | 7-4 | 7-4 |
| 2x6 | 12 | 18-8 | 13-11 | 11-3 | 10-3 | 15-7 | 14-9 |
| | 16 | 16-11 | 12-0 | 10-3 | 9-4 | 13-6 | 13-5 |
| | 19.2 | 15-7 | 11-0 | 9-6 | 8-6 | 12-3 | 12-3 |
| | 24 | 13-11 | 9-10 | 8-6 | 7-7 | 11-0 | 11-0 |
| 2x8 | 12 | 24-7 | 17-7 | 14-11 | 13-6 | 19-8 | 19-6 |
| | 16 | 21-7 | 15-3 | 13-3 | 11-10 | 17-1 | 17-1 |
| | 19.2 | 19-8 | 13-11 | 12-1 | 10-10 | 15-7 | 15-7 |
| | 24 | 17-7 | 12-6 | 10-10 | 9-8 | 13-11 | 13-11 |
| 2x10 | 12 | >26-0 | 20-11 | 18-1 | 16-2 | 23-5 | 23-5 |
| | 16 | 25-7 | 18-1 | 15-8 | 14-0 | 20-3 | 20-3 |
| | 19.2 | 23-5 | 16-6 | 14-4 | 12-10 | 18-6 | 18-6 |
| | 24 | 20-11 | 14-9 | 12-10 | 11-5 | 16-6 | 16-6 |
| 2x12 | 12 | | | 21-4 | 19-2 | >26-0 | >26-0 |
| | 16 | | | 18-6 | 16-6 | 23-10 | 23-10 |
| | 19.2 | | | 16-10 | 15-1 | 21-9 | 21-9 |
| | 24 | | | 15-1 | 13-6 | 19-6 | 19-6 |

** length usually not available
** already takes into account ***repetitive members factor*** of 115%
(based on values from various tables in IRC)

65

**Q10. Can a 10'-6" wide deck be constructed with 2x6 joists? Yes / No** **No**

**Dry**

Deck live load = 40 psf.

Table 1
Span Table for Floors - Ceilings - Rafters

Southern Pine #2

| APPLICABLE CODE SECTION | | IRC R802.5.1(1) | IRC R802.5.1(2) | IRC R502.3.1(1) | IRC R502.3.1(2) | IRC R802.4.1(1) | IRC R802.4.1(2) |
|---|---|---|---|---|---|---|---|
| | Spacing (inches) | Ceiling Joists w/o storage access hole LL 10 DL 5 L/240 | Ceiling Joists w/ pull down stair LL 20 DL 10 L/240 | Floor Joists sleep areas LL 30 DL 10 L/360 | Floor Joists living areas LL 40 DL 10 L/360 | Rafters w/o ceiling living areas LL 20 DL 10 L/180 | Rafters w/ ceiling living areas LL 20 DL 10 L/240 |
| 2x4 | 12 | 11-10 | 9-3 | | | 10-4 | 9-5 |
| | 16 | 10-9 | 8-0 | | | 9-0 | 8-7 |
| | 19.2 | 10-2 | 7-4 | | | 8-2 | 8-1 |
| | 24 | 9-3 | 6-7 | | | 7-4 | 7-4 |
| 2x6 | 12 | 18-8 | 13-11 | 11-3 | 10-3 | 15-7 | 14-9 |
| | 16 | 16-11 | 12-0 | 10-3 | 9-4 | 13-6 | 13-5 |
| | 19.2 | 15-7 | 11-0 | 9-6 | 8-6 | 12-3 | 12-3 |
| | 24 | 13-11 | 9-10 | 8-6 | 7-7 | 11-0 | 11-0 |
| 2x8 | 12 | 24-7 | 17-7 | 14-11 | 13-6 | 19-8 | 19-6 |
| | 16 | 21-7 | 15-3 | 13-3 | 11-10 | 17-1 | 17-1 |
| | 19.2 | 19-8 | 13-11 | 12-1 | 10-10 | 15-7 | 15-7 |
| | 24 | 17-7 | 12-6 | 10-10 | 9-8 | 13-11 | 13-11 |
| 2x10 | 12 | >26-0 | 20-11 | 18-1 | 16-2 | 23-5 | 23-5 |
| | 16 | 25-7 | 18-1 | 15-8 | 14-0 | 20-3 | 20-3 |
| | 19.2 | 23-5 | 16-6 | 14-4 | 12-10 | 18-6 | 18-6 |
| | 24 | 20-11 | 14-9 | 12-10 | 11-5 | 16-6 | 16-6 |
| 2x12 | 12 | | | 21-4 | 19-2 | >26-0 | >26-0 |
| | 16 | | | 18-6 | 16-6 | 23-10 | 23-10 |
| | 19.2 | | | 16-10 | 15-1 | 21-9 | 21-9 |
| | 24 | | | 15-1 | 13-6 | 19-6 | 19-6 |

** length usually not available
** already takes into account ***repetitive members factor*** of 115%
(based on values from various tables in IRC)

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**Q10. Can a 10'-6" wide deck be constructed with 2x6 joists? Yes / No** **NOPE**

Deck live load = 40 psf.

**Wet**

Table R507.6
Maximum Deck Joist Spans

| LOAD[b](psf) | JOIST SPECIES[b] | JOIST SIZE | ALLOWABLE JOIST SPAN[a, c] (feet-inches) | | | MAXIMUM CANTILEVER[d, f] (feet-inches) | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Joist spacing (inches) | | | Joist back span[e] (feet) | | | | | |
| | | | 12 | 16 | 24 | 4 | 6 | 8 | 10 | 12 | 14 | 16 | 18 |
| 40 live load | Southern pine | 2 × 6 | 9-11 | 9-0 | 7-7 | 1-0 | 1-6 | 1-5 | NP | NP | NP | NP | NP |
| | | 2 × 8 | 13-1 | 11-10 | 9-8 | 1-0 | 1-6 | 2-0 | 2-6 | 2-3 | NP | NP | NP |
| | | 2 × 10 | 16-2 | 14-0 | 11-5 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-4 | 3-4 | NP |
| | | 2 × 12 | 19-0 | 16-6 | 13-6 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-6 | 4-0 | 4-1 |
| | Douglas fir-larch[g] | 2 × 6 | 9-6 | 8-4 | 6-10 | 1-0 | 1-6 | 1-4 | NP | NP | NP | NP | NP |
| | | 2 × 8 | 12-6 | 11-1 | 9-1 | 1-0 | 1-6 | 2-0 | 2-3 | 2-0 | NP | NP | NP |
| | Hem-fir[g] | 2 × 10 | 15-8 | 13-7 | 11-1 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-3 | NP | NP |
| | | 2 × 12 | 18-0 | 15-9 | 12-10 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-6 | 3-11 | 3-11 |
| | Spruce-pine-fir[g] | 2 × 6 | 8-10 | 8-0 | 6-10 | 1-0 | 1-4 | 1-1 | NP | NP | NP | NP | NP |
| | Redwood[f] | 2 × 8 | 11-8 | 10-7 | 8-8 | 1-0 | 1-6 | 2-0 | 1-11 | NP | NP | NP | NP |
| | Western cedars[f] | 2 × 10 | 14-11 | 13-0 | 10-7 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-0 | NP | NP |
| | Ponderosa pine[f] | 2 × 12 | 17-5 | 15-1 | 12-4 | 1-0 | 1-6 | 2-0 | 2-6 | 3-0 | 3-6 | 3-6 | NP |
| | Red pine[f] | | | | | | | | | | | | |

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## Span table

## Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - **I-joist span tables**

**Table 2:**
- **Manufacturer's series #**
- **Depth**
- **Spacing,**
- **Span length**
- **Simple or multiple span**

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Table 2 I- joist span table

| Truss Joist 40 psf Live + 10 psf Dead (L/360) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | SINGLE SPAN | | | | MULTI-SPAN | | | |
| Depth | SERIES | 12" | 16" | 19.2" | 24" | 12" | 16" | 19.2" | 24" |
| 9-1/2 | 110 | 18-2 | 16-7 | 15-3 | 13-8 | 17-8 | 15-3 | 13-11 | 12-5 |
| | 210 | 19-1 | 17-5 | 16-6 | 15-0 | | | | |
| | 230 | 19-7 | 17-11 | 16-11 | 15-9 | 19-7 | 17-8 | 16-1 | 14-5 |
| 11-7/8 | 110 | 21-7 | 18-11 | 17-3 | 15-5 | 19-11 | 17-3 | 15-8 | 14-0 |
| | 210 | 22-8 | 20-8 | 18-11 | 16-10 | | | | |
| | 230 | 23-3 | 21-3 | 19-11 | 17-9 | 23-0* | 19-11 | 18-2 | 16-3 |
| | 360 | 25-4 | 23-2 | 21-10 | 20-4 | 25-4* | 23-2* | 21-0* | 17-10 |
| | 560 | 28-10 | 26-3 | 24-9 | 23-0 | 28-10* | 26-3* | 24-9* | 20-11 |
| 14 | 110 | 23-9 | 20-6 | 18-9 | 16-9 | 21-8 | 18-9 | 17-1 | 14-7 |
| | 210 | 25-8 | 22-6 | 20-7 | 18-4 | | | | |
| | 230 | 26-4 | 23-9 | 21-8 | 19-4 | 25-0* | 21-8 | 19-9 | 17-1 |
| | 360 | 28-9 | 26-3 | 24-9 | 21-5 | 28-9* | 26-3* | 22-4 | 17-10 |
| | 560 | 32-8 | 29-9 | 28-0 | 25-2 | 32-8* | 29-9* | 26-3* | 20-11 |
| 16 | 210 | 27-10 | 24-1 | 22-0 | 19-5 | | | | |
| | 230 | 29-2 | 25-5 | 23-2 | 20-7 | 26-9* | 23-2 | 21-2 | 17-1 |
| | 360 | 31-10 | 29-0 | 26-10 | 21-5 | 31-10* | 26-10 | 22-4 | 17-10 |
| | 560 | 36-1 | 32-11 | 31-0 | 25-2 | 36-1* | 36-1* | 26-3 | 20-11 |
| 18 | 360 | | 31-9 | 26-10 | 21-5 | | 24-9 | 20-7 | 16-6 |
| | 560 | | 35-11 | 31-6 | 25-2 | | 29-1* | 24-2 | 19-4 |

Spans are manufacturer-specific, and should be verified periodically. Span figures may change from time to time.

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## Span table

**Using Table 2, complete Q11-Q12**

Truss Joist 40 psf Live + 10 psf Dead (L/360)

| Depth | SERIES | SINGLE SPAN 12" | 16" | 19.2" | 24" | MULTI-SPAN 12" | 16" | 19.2" | 24" |
|---|---|---|---|---|---|---|---|---|---|
| 9-1/2 | 110 | 16-2 | 16-7 | 15-3 | 13-8 | 17-8 | 15-3 | 13-11 | 12-5 |
| | 210 | 19-1 | 17-5 | 16-6 | 15-0 | | | | |
| | 230 | 19-7 | 17-11 | 16-11 | 15-9 | 19-7 | 17-8 | 16-1 | 14-5 |
| 11-7/8 | 110 | 21-7 | 18-11 | 17-3 | 15-5 | 19-11 | 17-3 | 15-8 | 14-0 |
| | 210 | 22-8 | 20-8 | 18-11 | 16-10 | | | | |
| | 230 | 23-3 | 21-3 | 19-11 | 17-9 | 23-0* | 19-11 | 18-2 | 16-3 |
| | 360 | 25-4 | 23-2 | 21-10 | 20-4 | 25-4* | 23-2* | 21-0* | 17-10 |
| | 560 | 28-10 | 26-3 | 24-9 | 23-0 | 28-10* | 26-3* | 24-9* | 20-11 |
| 14 | 110 | 23-9 | 20-6 | 18-9 | 16-9 | 21-8 | 18-9 | 17-1 | 14-7 |
| | 210 | 25-8 | 22-6 | 20-7 | 18-4 | | | | |
| | 230 | 26-4 | 23-9 | 21-8 | 19-4 | 25-0* | 21-8 | 19-9 | 17-1 |
| | 360 | 28-9 | 26-3 | 24-9 | 21-5 | 28-9* | 26-3* | 22-4 | 17-10 |
| | 560 | 32-8 | 29-9 | 28-0 | 25-2 | 32-8* | 29-9* | 26-3* | 20-11 |
| 16 | 210 | 27-10 | 24-1 | 22-0 | 19-5 | | | | |
| | 230 | 29-2 | 25-5 | 23-2 | 20-7 | 26-9* | 23-2 | 21-2 | 17-1 |
| | 360 | 31-10 | 29-0 | 26-10 | 21-5 | 31-10* | 26-10 | 22-4 | 17-10 |
| | 560 | 36-1 | 32-11 | 31-0 | 25-2 | 36-1* | 36-1* | 26-3 | 20-11 |
| 18 | 360 | | 31-9 | 26-10 | 21-5 | | 24-9 | 20-7 | 16-6 |
| | 560 | | 35-11 | 31-6 | 25-2 | | 29-1* | 24-2 | 19-4 |

70

Q11. What is the max span length of a TJI-110, 9-1/2" @ 16" o.c. for Livingroom? **16'-7"** ft

Truss Joist 40 psf Live + 10 psf Dead (L/360)

| Depth | SERIES | SINGLE SPAN 12" | 16" | 19.2" | 24" | MULTI-SPAN 12" | 16" | 19.2" | 24" |
|---|---|---|---|---|---|---|---|---|---|
| 9-1/2 | 110 | ~~18-2~~ | 16-7 | 15-3 | 13-8 | ~~17-8~~ | 15-3 | 13-11 | 12-5 |
| | 210 | 19-1 | 17-5 | 16-6 | 15-0 | | | | |
| | 230 | 19-7 | 17-11 | 16-11 | 15-9 | 19-7 | 17-8 | 16-1 | 14-5 |
| 11-7/8 | 110 | 21-7 | 18-11 | 17-3 | 15-5 | 19-11 | 17-3 | 15-8 | 14-0 |
| | 210 | 22-8 | 20-8 | 18-11 | 16-10 | | | | |
| | 230 | 23-3 | 21-3 | 19-11 | 17-9 | 23-0* | 19-11 | 18-2 | 16-3 |
| | 360 | 25-4 | 23-2 | 21-10 | 20-4 | 25-4* | 23-2* | 21-0* | 17-10 |
| | 560 | 28-10 | 26-3 | 24-9 | 23-0 | 28-10* | 26-3* | 24-9* | 20-11 |
| 14 | 110 | 23-9 | 20-6 | 18-9 | 16-9 | 21-8 | 18-9 | 17-1 | 14-7 |
| | 210 | 25-8 | 22-6 | 20-7 | 18-4 | | | | |
| | 230 | 26-4 | 23-9 | 21-8 | 19-4 | 25-0* | 21-8 | 19-9 | 17-1 |
| | 360 | 28-9 | 26-3 | 24-9 | 21-5 | 28-9* | 26-3* | 22-4 | 17-10 |
| | 560 | 32-8 | 29-9 | 28-0 | 25-2 | 32-8* | 29-9* | 26-3* | 20-11 |
| 16 | 210 | 27-10 | 24-1 | 22-0 | 19-5 | | | | |
| | 230 | 29-2 | 25-5 | 23-2 | 20-7 | 26-9* | 23-2 | 21-2 | 17-1 |
| | 360 | 31-10 | 29-0 | 26-10 | 21-5 | 31-10* | 26-10 | 22-4 | 17-10 |
| | 560 | 36-1 | 32-11 | 31-0 | 25-2 | 36-1* | 36-1* | 26-3 | 20-11 |
| 18 | 360 | | 31-9 | 26-10 | 21-5 | | 24-9 | 20-7 | 16-6 |
| | 560 | | 35-11 | 31-6 | 25-2 | | 29-1* | 24-2 | 19-4 |

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Q12. What is the maximum spacing allowed if using Georgia Pacific, Series WI-40, 11-7/8", spanning 17'-0"? **19.2"** o.c.

Georgia Pacific 40 psf Live + 10 psf Dead (L/480)

| Depth | Series | SINGLE SPAN 12" | 16" | 19.2" | 24" | MULTI-SPAN 12" | 16" | 19.2" | 24" |
|---|---|---|---|---|---|---|---|---|---|
| 9-1/2 | GPI 40 | 18-0 | 16-6 | 15-7 | 14-6 | 19-8 | 18-0 | 16-6 | 14-9 |
| | WI-40 | 18-0 | 16-5 | 15-6 | 14-1 | 19-7 | 17-2 | 15-8 | 14-0 |
| 11-7/8 | GPI 40 | 21-6 | 19-8 | 18-7 | 17-1 | 23-6 | 20-10 | 19-0 | 17-0 |
| | WI-40 | 21-5 | 19-7 | 18-2 | 16-3 | 23-0 | 19-11 | 18-2 | 16.2 |
| | WI-60 | 22-7 | 20-8 | 19-6 | 18-2 | 24-8 | 22-6 | 21-2 | 19-1 |
| | WI 80 | 24-11 | 22-8 | 21-4 | 19-11 | 27-1 | 24-8 | 23-3 | 21-7 |
| 14 | GPI 40 | 24-4 | 22-3 | 21-0 | 18-11 | 26-8 | 23-1 | 21-1 | 18-10 |
| | WI 40 | 24-4 | 22-1 | 20-2 | 18-0 | 25-6 | 22-1 | 20-1 | 18-0 |
| | WI 60 | 25-9 | 23-6 | 22-2 | 20-8 | 28-0 | 25-7 | 23-8 | 19-9 |
| | WI 80 | 28-3 | 25-9 | 24-3 | 22-7 | 30-10 | 28-0 | 26-5 | 23-11 |
| 16 | WI 60 | 28-6 | 26-0 | 24-7 | 22-10 | 31-1 | 28-1 | 24-9 | 19-9 |
| | WI 80 | 31-4 | 28-6 | 26-10 | 25-0 | 34-2 | 31-1 | 29-3 | 23-11 |

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## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - **2x beam table**

**Table 3:**
- Species,
- Depth of member,
- Span length
- Quantity of members

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## Table 3 2x Members Used as Beams

Old Table

SYP#2 ALLOWABLE UNIFORM BEAM LOADING (PLF)

| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' | 15' | 16' | 17' | 18' | 19' | 20' |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| (1) 2x4 | 109 | 75 | 54 | 35 | 24 | | | | | | | | | | | |
| (2) 2x4 | 218 | 150 | 108 | 71 | 49 | 35 | | | | | | | | | | |
| (3) 2x4 | 376 | 260 | 162 | 107 | 74 | 53 | 39 | | | | | | | | | |
| (4) 2x4 | 502 | 347 | 217 | 143 | 99 | 71 | 52 | 39 | | | | | | | | |
| (1) 2x6 | 224 | 155 | 113 | 86 | 68 | 54 | 44 | 37 | | | | | | | | |
| (2) 2x6 | 449 | 311 | 227 | 173 | 136 | 109 | 89 | 74 | | | | | | | | |
| (3) 2x6 | 776 | 537 | 393 | 299 | 235 | 189 | 155 | 122 | 95 | | | | | | | |
| (4) 2x6 | 1036 | 717 | 524 | 399 | 314 | 252 | 207 | 163 | 126 | 99 | | | | | | |
| (1) 2x8 | 375 | 260 | 190 | 145 | 114 | 91 | 75 | 63 | 53 | | | | | | | |
| (2) 2x8 | 750 | 520 | 381 | 290 | 228 | 183 | 151 | 126 | 106 | 91 | 78 | 68 | | | | |
| (3) 2x8 | 1298 | 899 | 658 | 502 | 395 | 318 | 262 | 218 | 185 | 158 | 137 | 116 | | | | |
| (4) 2x8 | 1730 | 1198 | 878 | 669 | 527 | 424 | 349 | 291 | 246 | 211 | 182 | 154 | | | | |
| (1) 2x10 | 535 | 371 | 271 | 207 | 163 | 131 | 108 | 90 | 76 | 65 | 56 | 49 | 43 | 38 | 34 | 30 |
| (2) 2x10 | 1071 | 741 | 543 | 414 | 326 | 263 | 216 | 180 | 152 | 130 | 113 | 98 | 86 | 76 | 68 | 60 |
| (3) 2x10 | 1850 | 1281 | 939 | 716 | 564 | 455 | 374 | 312 | 265 | 227 | 196 | 170 | | | | |
| (4) 2x10 | 2465 | 1709 | 1252 | 955 | 751 | 606 | 499 | 416 | 353 | 302 | 262 | 228 | | | | |
| (1) 2x12 | 736 | 510 | 373 | 285 | 224 | 181 | 148 | 124 | 105 | 90 | 78 | 68 | 60 | 53 | 47 | 42 |
| (2) 2x12 | 1472 | 1020 | 747 | 570 | 449 | 362 | 297 | 248 | 210 | 180 | 156 | 135 | 120 | 106 | 94 | 84 |
| (3) 2x12 | 2542 | 1761 | 1291 | 986 | 776 | 626 | 515 | 431 | 365 | 313 | 271 | 236 | | | | |
| (4) 2x12 | 3386 | 2300 | 1722 | 1314 | 1035 | 835 | 687 | 574 | 487 | 417 | 361 | 316 | | | | |

Based on 2009 IRC and 2005 NDS. Chart was developed from StruCalc – Uniform Loaded Floor Beams.

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## Span table

**Using Table 3, complete Q13-Q14**

Old Table

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## Q13. How many 2x8s @ 13' long are required if carrying 165plf?

| SYP#2 ALLOWABLE UNIFORM BEAM LOADING (PLF) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' | 15' | 16' | 17' | 18' | 19' | 20' |
| (1) 2x4 | 109 | 75 | 54 | 35 | 24 | | | | | | | | | | | |
| (2) 2x4 | 218 | 150 | 108 | 71 | 49 | 35 | | | | | | | | | | |
| (3) 2x4 | 376 | 260 | 162 | 107 | 74 | 53 | 39 | | | | | | | | | |
| (4) 2x4 | 502 | 347 | 217 | 143 | 99 | 71 | 52 | 39 | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x6 | 224 | 155 | 113 | 86 | 68 | 54 | 44 | 37 | | | | | | | | |
| (2) 2x6 | 449 | 311 | 227 | 173 | 136 | 109 | 89 | 74 | | | | | | | | |
| (3) 2x6 | 776 | 537 | 393 | 299 | 235 | 189 | 155 | 122 | 95 | | | | | | | |
| (4) 2x6 | 1036 | 717 | 524 | 399 | 314 | 252 | 207 | 163 | 126 | 99 | | | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x8 | 375 | 260 | 190 | 145 | 114 | 91 | 75 | 63 | 53 | | | | | | | |
| (2) 2x8 | 750 | 520 | 381 | 290 | 228 | 183 | 151 | 126 | 106 | 91 | 78 | 68 | | | | |
| (3) 2x8 | 1298 | 899 | 658 | 502 | 395 | 318 | 262 | 218 | 185 | 158 | 137 | 116 | | | | |
| (4) 2x8 | 1730 | 1198 | 878 | 669 | 527 | 424 | 349 | 291 | 246 | 211 | 182 | 154 | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x10 | 535 | 371 | 271 | 207 | 163 | 131 | 108 | 90 | 76 | 65 | 56 | 49 | 43 | 38 | 34 | 30 |
| (2) 2x10 | 1071 | 741 | 543 | 414 | 326 | 263 | 216 | 180 | 152 | 130 | 113 | 98 | 86 | 76 | 68 | 60 |
| (3) 2x10 | 1850 | 1281 | 939 | 716 | 564 | 455 | 374 | 312 | 265 | 227 | 196 | 170 | | | | |
| (4) 2x10 | 2465 | 1709 | 1252 | 955 | 751 | 606 | 499 | 416 | 353 | 302 | 262 | 228 | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x12 | 736 | 510 | 373 | 285 | 224 | 181 | 148 | 124 | 105 | 90 | 78 | 68 | 60 | 53 | 47 | 42 |
| (2) 2x12 | 1472 | 1020 | 747 | 570 | 449 | 362 | 297 | 248 | 210 | 180 | 156 | 135 | 120 | 106 | 94 | 84 |
| (3) 2x12 | 2542 | 1761 | 1291 | 986 | 776 | 626 | 515 | 431 | 365 | 313 | 271 | 236 | | | | |
| (4) 2x12 | 3386 | 2300 | 1722 | 1314 | 1035 | 835 | 687 | 574 | 487 | 417 | 361 | 316 | | | | |

3



## Q14. Will (3) 2x10x10' carrying 400plf pass/fail? **PASS**

| SYP#2 ALLOWABLE UNIFORM BEAM LOADING (PLF) | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' | 13' | 14' | 15' | 16' | 17' | 18' | 19' | 20' |
| (1) 2x4 | 109 | 75 | 54 | 35 | 24 | | | | | | | | | | | |
| (2) 2x4 | 218 | 150 | 108 | 71 | 49 | 35 | | | | | | | | | | |
| (3) 2x4 | 376 | 260 | 162 | 107 | 74 | 53 | 39 | | | | | | | | | |
| (4) 2x4 | 502 | 347 | 217 | 143 | 99 | 71 | 52 | 39 | | | | | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x6 | 224 | 155 | 113 | 86 | 68 | 54 | 44 | 37 | | | | | | | | |
| (2) 2x6 | 449 | 311 | 227 | 173 | 136 | 109 | 89 | 74 | | | | | | | | |
| (3) 2x6 | 776 | 537 | 393 | 299 | 235 | 189 | 155 | 122 | 95 | | | | | | | |
| (4) 2x6 | 1036 | 717 | 524 | 399 | 314 | 252 | 207 | 163 | 126 | 99 | | | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x8 | 375 | 260 | 190 | 145 | 114 | 91 | 75 | 63 | 53 | | | | | | | |
| (2) 2x8 | 750 | 520 | 381 | 290 | 228 | 183 | 151 | 126 | 106 | 91 | 78 | 68 | | | | |
| (3) 2x8 | 1298 | 899 | 658 | 502 | 395 | 318 | 262 | 218 | 185 | 158 | 137 | 116 | | | | |
| (4) 2x8 | 1730 | 1198 | 878 | 669 | 527 | 424 | 349 | 291 | 246 | 211 | 182 | 154 | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x10 | 535 | 371 | 271 | 207 | 163 | 131 | 108 | 90 | 76 | 65 | 56 | 49 | 43 | 38 | 34 | 30 |
| (2) 2x10 | 1071 | 741 | 543 | 414 | 326 | 263 | 216 | 180 | 152 | 130 | 113 | 98 | 86 | 76 | 68 | 60 |
| (3) 2x10 | 1850 | 1281 | 939 | 716 | 564 | 455 | 374 | 312 | 265 | 227 | 196 | 170 | | | | |
| (4) 2x10 | 2465 | 1709 | 1252 | 955 | 751 | 606 | 499 | 416 | 353 | 302 | 262 | 228 | | | | |
| | | | | | | | | | | | | | | | | |
| (1) 2x12 | 736 | 510 | 373 | 285 | 224 | 181 | 148 | 124 | 105 | 90 | 78 | 68 | 60 | 53 | 47 | 42 |
| (2) 2x12 | 1472 | 1020 | 747 | 570 | 449 | 362 | 297 | 248 | 210 | 180 | 156 | 135 | 120 | 106 | 94 | 84 |
| (3) 2x12 | 2542 | 1761 | 1291 | 986 | 776 | 626 | 515 | 431 | 365 | 313 | 271 | 236 | | | | |
| (4) 2x12 | 3386 | 2300 | 1722 | 1314 | 1035 | 835 | 687 | 574 | 487 | 417 | 361 | 316 | | | | |



## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - **LVL beam table**

**Table 4:**
- **Manufacturer,**
- **E value**
- **Number of plies,**
- **Depth of member,**
- **Span**

Table 4 LVL beam span table

| Truss Joist 2 ply – PLF (E=1.9) 100% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7-1/4 | 9-1/4 | 9-1/2 | 11-1/4 | 11-7/8 | 14 | 16 | 18 | 20 | SPAN |
| 1,525 | 2,055 | 2,125 | 2,648 | 2,848 | 3,589 | 3,917 | 3,917 | 3,917 | 6 |
| 1,307 | 1,889 | 1,959 | 2,444 | 2,625 | 3,295 | 3,659 | 3,671 | 3,671 | 6.5 |
| 1,089 | 1,723 | 1,794 | 2,239 | 2,402 | 3,002 | 3,401 | 3,425 | 3,425 | 7 |
| 870 | 1,557 | 1,628 | 2,035 | 2,179 | 2,708 | 3,143 | 3,178 | 3,178 | 7.5 |
| 652 | 1,391 | 1,462 | 1,830 | 1,956 | 2,414 | 2,885 | 2,932 | 2,932 | 8 |
| 545 | 1,255 | 1,319 | 1,693 | 1,827 | 2,255 | 2,688 | 2,777 | 2,777 | 8.5 |
| 439 | 1,119 | 1,177 | 1,555 | 1,699 | 2,096 | 2,491 | 2,621 | 2,621 | 9 |
| 332 | 983 | 1,034 | 1,418 | 1,570 | 1,937 | 2,294 | 2,466 | 2,466 | 9.5 |
| 270 | 883 | 932 | 1,279 | 1,415 | 1,817 | 2,147 | 2,342 | 2,342 | 10 |
| 235 | 793 | 840 | 1,181 | 1,306 | 1,696 | 2,038 | 2,244 | 2,244 | 10.5 |
| 199 | 702 | 748 | 1,082 | 1,197 | 1,575 | 1,928 | 2,145 | 2,145 | 11 |
| 164 | 612 | 655 | 984 | 1,088 | 1,454 | 1,819 | 2,047 | 2,047 | 11.5 |
| 128 | 521 | 563 | 885 | 979 | 1,333 | 1,709 | 1,948 | 1,948 | 12 |
| 113 | 473 | 512 | 810 | 906 | 1,244 | 1,595 | 1,852 | 1,878 | 12.5 |
| 97 | 425 | 460 | 736 | 832 | 1,154 | 1,481 | 1,756 | 1,808 | 13 |
| 82 | 377 | 409 | 661 | 759 | 1,065 | 1,367 | 1,659 | 1,737 | 13.5 |
| 66 | 329 | 357 | 586 | 685 | 975 | 1,253 | 1,563 | 1,667 | 14 |
| | 303 | 329 | 541 | 632 | 917 | 1,182 | 1,474 | 1,607 | 14.5 |
| | 277 | 301 | 496 | 580 | 859 | 1,111 | 1,386 | 1,546 | 15 |
| | 252 | 273 | 450 | 527 | 800 | 1,039 | 1,297 | 1,486 | 15.5 |
| | **226** | **245** | **405** | **475** | **742** | **968** | **1,209** | **1,425** | **16** |
| | 200 | 217 | 360 | 422 | 684 | 897 | 1,120 | 1,365 | 16.5 |
| | 185 | 201 | 334 | 391 | 635 | 850 | 1,062 | 1,294 | 17 |
| | 170 | 185 | 307 | 361 | 586 | 804 | 1,004 | 1,224 | 17.5 |
| | 155 | 168 | 281 | 330 | 537 | 757 | 945 | 1,153 | 18 |



## Span table

**Using the four Table 4s, complete Q15-Q16**

| Truss Joist 2 ply – PLF (E=1.9) 100% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7-1/4 | 9-1/4 | 9-1/2 | 11-1/4 | 11-7/8 | 14 | 16 | 18 | 20 | SPAN |
| 1,525 | 2,055 | 2,125 | 2,648 | 2,848 | 3,589 | 3,917 | 3,917 | 3,917 | 6 |
| 1,307 | 1,889 | 1,959 | 2,444 | 2,625 | 3,295 | 3,659 | 3,671 | 3,671 | 6.5 |
| 1,089 | 1,723 | 1,794 | 2,239 | 2,402 | 3,002 | 3,401 | 3,425 | 3,425 | 7 |
| 870 | 1,557 | 1,628 | 2,035 | 2,179 | 2,708 | 3,143 | 3,178 | 3,178 | 7.5 |
| 652 | 1,391 | 1,462 | 1,830 | 1,956 | 2,414 | 2,885 | 2,932 | 2,932 | 8 |
| 545 | 1,255 | 1,319 | 1,693 | 1,827 | 2,255 | 2,688 | 2,777 | 2,777 | 8.5 |
| 439 | 1,119 | 1,177 | 1,555 | 1,699 | 2,096 | 2,491 | 2,621 | 2,621 | 9 |
| 332 | 983 | 1,034 | 1,418 | 1,570 | 1,937 | 2,294 | 2,466 | 2,466 | 9.5 |
| 270 | 883 | 932 | 1,279 | 1,415 | 1,817 | 2,147 | 2,342 | 2,342 | 10 |
| 235 | 793 | 840 | 1,181 | 1,306 | 1,696 | 2,038 | 2,244 | 2,244 | 10.5 |
| 199 | 702 | 748 | 1,082 | 1,197 | 1,575 | 1,928 | 2,145 | 2,145 | 11 |
| 164 | 612 | 655 | 984 | 1,088 | 1,454 | 1,819 | 2,047 | 2,047 | 11.5 |
| 128 | 521 | 563 | 885 | 979 | 1,333 | 1,709 | 1,948 | 1,948 | 12 |
| 113 | 473 | 512 | 810 | 906 | 1,244 | 1,595 | 1,852 | 1,878 | 12.5 |
| 97 | 425 | 460 | 736 | 832 | 1,154 | 1,481 | 1,756 | 1,808 | 13 |
| 82 | 377 | 409 | 661 | 759 | 1,065 | 1,367 | 1,659 | 1,737 | 13.5 |
| 66 | 329 | 357 | 586 | 685 | 975 | 1,253 | 1,563 | 1,667 | 14 |
| | 303 | 329 | 541 | 632 | 917 | 1,182 | 1,474 | 1,607 | 14.5 |
| | 277 | 301 | 496 | 580 | 859 | 1,111 | 1,386 | 1,546 | 15 |
| | 252 | 273 | 450 | 527 | 800 | 1,039 | 1,297 | 1,486 | 15.5 |
| | **226** | **245** | **405** | **475** | **742** | **968** | **1,209** | **1,425** | **16** |
| | 200 | 217 | 360 | 422 | 684 | 897 | 1,120 | 1,365 | 16.5 |
| | 185 | 201 | 334 | 391 | 635 | 850 | 1,062 | 1,294 | 17 |
| | 170 | 185 | 307 | 361 | 586 | 804 | 1,004 | 1,224 | 17.5 |
| | 155 | 168 | 281 | 330 | 537 | 757 | 945 | 1,153 | 18 |



## Q15. What is the max allowable uniform load for a TJ, E=1.9, 100%, (2ply) 14" @ 13'? 1154 plf

| Truss Joist 2 ply – PLF (E=1.9) 100% | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7-1/4 | 9-1/4 | 9-1/2 | 11-1/4 | 11-7/8 | 14 | 16 | 18 | 20 | SPAN |
| 1,525 | 2,055 | 2,125 | 2,648 | 2,848 | 3,589 | 3,917 | 3,917 | 3,917 | 6 |
| 1,307 | 1,889 | 1,959 | 2,444 | 2,625 | 3,295 | 3,659 | 3,671 | 3,671 | 6.5 |
| 1,089 | 1,723 | 1,794 | 2,239 | 2,402 | 3,002 | 3,401 | 3,425 | 3,425 | 7 |
| 870 | 1,557 | 1,628 | 2,035 | 2,179 | 2,708 | 3,143 | 3,178 | 3,178 | 7.5 |
| 652 | 1,391 | 1,462 | 1,830 | 1,956 | 2,414 | 2,885 | 2,932 | 2,932 | 8 |
| 545 | 1,255 | 1,319 | 1,693 | 1,827 | 2,255 | 2,688 | 2,777 | 2,777 | 8.5 |
| 439 | 1,119 | 1,177 | 1,555 | 1,699 | 2,096 | 2,491 | 2,621 | 2,621 | 9 |
| 332 | 983 | 1,034 | 1,418 | 1,570 | 1,937 | 2,294 | 2,466 | 2,466 | 9.5 |
| 270 | 883 | 932 | 1,279 | 1,415 | 1,817 | 2,147 | 2,342 | 2,342 | 10 |
| 235 | 793 | 840 | 1,181 | 1,306 | 1,696 | 2,038 | 2,244 | 2,244 | 10.5 |
| 199 | 702 | 748 | 1,082 | 1,197 | 1,575 | 1,928 | 2,145 | 2,145 | 11 |
| 164 | 612 | 655 | 984 | 1,088 | 1,454 | 1,819 | 2,047 | 2,047 | 11.5 |
| 128 | 521 | 563 | 885 | 979 | 1,333 | 1,709 | 1,948 | 1,948 | 12 |
| 113 | 473 | 512 | 810 | 906 | 1,244 | 1,595 | 1,852 | 1,878 | 12.5 |
| 97 | 425 | 460 | 736 | 832 | 1,154 | 1,481 | 1,756 | 1,808 | 13 |
| 82 | 377 | 409 | 661 | 759 | 1,065 | 1,367 | 1,659 | 1,737 | 13.5 |
| 66 | 329 | 357 | 586 | 685 | 975 | 1,253 | 1,563 | 1,667 | 14 |
| | 303 | 329 | 541 | 632 | 917 | 1,182 | 1,474 | 1,607 | 14.5 |
| | 277 | 301 | 496 | 580 | 859 | 1,111 | 1,386 | 1,546 | 15 |
| | 252 | 273 | 450 | 527 | 800 | 1,039 | 1,297 | 1,486 | 15.5 |
| | **226** | **245** | **405** | **475** | **742** | **968** | **1,209** | **1,425** | **16** |
| | 200 | 217 | 360 | 422 | 684 | 897 | 1,120 | 1,365 | 16.5 |
| | 185 | 201 | 334 | 391 | 635 | 850 | 1,062 | 1,294 | 17 |
| | 170 | 185 | 307 | 361 | 586 | 804 | 1,004 | 1,224 | 17.5 |
| | 155 | 168 | 281 | 330 | 537 | 757 | 945 | 1,153 | 18 |

Q16. How much more weight (plf) will a TJI, (3) 11-7/8" @ 15' carry if you change from E=1.9 to a E=2.0? **46** plf

| TJI LVL 3-ply (E=1.9) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| 7-1/4 | 9-1/4 | 9-1/2 | 11-1/4 | 11-7/8 | 14 | 16 | 18 | 20 | SPAN |
| 2,287 | 3,083 | 3,188 | 3,972 | 4,273 | 5,384 | 5,875 | 5,875 | 5,875 | 6 |
| 1,960 | 2,834 | 2,939 | 3,665 | 3,939 | 4,943 | 5,488 | 5,506 | 5,506 | 6.5 |
| 1,633 | 2,585 | 2,691 | 3,359 | 3,604 | 4,503 | 5,102 | 5,137 | 5,137 | 7 |
| 1,305 | 2,335 | 2,442 | 3,052 | 3,270 | 4,062 | 4,715 | 4,768 | 4,768 | 7.5 |
| 978 | 2,086 | 2,193 | 2,745 | 2,935 | 3,621 | 4,328 | 4,399 | 4,399 | 8 |
| 818 | 1,883 | 1,979 | 2,540 | 2,742 | 3,383 | 4,033 | 4,166 | 4,166 | 8.5 |
| 658 | 1,678 | 1,765 | 2,333 | 2,547 | 3,143 | 3,736 | 3,932 | 3,932 | 9 |
| 498 | 1,475 | 1,551 | 2,128 | 2,354 | 2,905 | 3,441 | 3,699 | 3,699 | 9.5 |
| 406 | 1,325 | 1,398 | 1,919 | 2,123 | 2,725 | 3,221 | 3,513 | 3,513 | 10 |
| 353 | 1,189 | 1,260 | 1,771 | 1,960 | 2,544 | 3,057 | 3,365 | 3,365 | 10.5 |
| 300 | 1,053 | 1,121 | 1,623 | 1,796 | 2,363 | 2,892 | 3,218 | 3,218 | 11 |
| 246 | 917 | 983 | 1,475 | 1,633 | 2,181 | 2,728 | 3,070 | 3,070 | 11.5 |
| 193 | 781 | 844 | 1,327 | 1,469 | 2,000 | 2,563 | 2,922 | 2,922 | 12 |
| 170 | 709 | 767 | 1,215 | 1,359 | 1,866 | 2,392 | 2,778 | 2,817 | 12.5 |
| 147 | 638 | 690 | 1,103 | 1,249 | 1,732 | 2,222 | 2,634 | 2,711 | 13 |
| 123 | 566 | 612 | 991 | 1,138 | 1,597 | 2,051 | 2,489 | 2,606 | 13.5 |
| 100 | 494 | 535 | 879 | 1,028 | 1,463 | 1,880 | 2,345 | 2,500 | 14 |
| 89 | 455 | 493 | 811 | 949 | 1,376 | 1,773 | 2,212 | 2,410 | 14.5 |
| 77 | 416 | 451 | 743 | 870 | 1,288 | 1,666 | 2,079 | 2,319 | 15 |

| 3-PLY (E=2.0) | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9-1/4 | 9-1/2 | 11-1/4 | 11-7/8 | 14 | 16 | 18 | SPAN |
| 2,204 | 2,275 | 2,792 | 2,985 | 3,683 | 4,400 | 4,400 | 8 |
| 2,008 | 2,099 | 2,617 | 2,798 | 3,441 | 4,108 | 4,167 | 8.5 |
| 1,810 | 1,905 | 2,440 | 2,605 | 3,197 | 3,800 | 3,933 | 9 |
| 1,614 | 1,720 | 2,265 | 2,416 | 2,955 | 3,500 | 3,700 | 9.5 |
| 1,395 | 1,505 | 2,130 | 2,271 | 2,772 | 3,276 | 3,514 | 10 |
| 1,252 | 1,351 | 1,959 | 2,113 | 2,634 | 3,109 | 3,366 | 10.5 |
| 1,109 | 1,197 | 1,788 | 1,955 | 2,496 | 2,942 | 3,219 | 11 |
| 965 | 1,042 | 1,617 | 1,797 | 2,358 | 2,774 | 3,071 | 11.5 |
| 822 | 888 | 1,446 | 1,639 | 2,220 | 2,607 | 2,923 | 12 |
| 747 | 807 | 1,316 | 1,500 | 2,075 | 2,484 | 2,815 | 12.5 |
| 671 | 726 | 1,186 | 1,361 | 1,930 | 2,360 | 2,707 | 13 |
| 596 | 644 | 1,055 | 1,221 | 1,784 | 2,237 | 2,598 | 13.5 |
| 520 | 563 | 925 | 1,082 | 1,639 | 2,113 | 2,490 | 14 |
| 479 | 519 | 854 | 999 | 1,527 | 1,993 | 2,371 | 14.5 |
| 438 | 475 | 782 | 916 | 1,415 | 1,873 | 2,252 | 15 |

916 plf – 870 plf = 46 plf

82

## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - **2x columns**

**Table 5:**
- Species
- Height
- Number of studs ganged together

83

## Span table

**Table 5**
**Stud capacity in sheathed walls**

**BRACED SYP#2**
**Allowable Axial Capacity for Columns (lbs)**
**for use with stud walls**
**(sheathed on at least one side)**

| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' |
|---|---|---|---|---|---|---|---|---|
| (1) 2x4 | 5,930 | 4,750 | 3,758 | 3,000 | 2,426 | 2,000 | 1,665 | 1,408 |
| (2) 2x4 | | 9,500 | 7,515 | 6,000 | 4,800 | 4,000 | 3,300 | 2,800 |
| (3) 2x4 | | 14,000 | 11,250 | 9,000 | 7,280 | 6,000 | 5,000 | 4,200 |
| (4) 2x4 | | 19,000 | 15,000 | 12,000 | 9,700 | 8,000 | 6,600 | 5,600 |
| (5) 2x4 | | | 18,600 | 15,000 | 12,200 | 10,000 | 8,300 | 70,000 |

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## Span table

Try Q17 using table 5

**BRACED SYP#2**
**Allowable Axial Capacity for Columns (lbs)**
**for use with stud walls**
**(sheathed on at least one side)**

| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' |
|---|---|---|---|---|---|---|---|---|
| (1) 2x4 | 5,930 | 4,750 | 3,758 | 3,000 | 2,426 | 2,000 | 1,665 | 1,408 |
| (2) 2x4 | | 9,500 | 7,515 | 6,000 | 4,800 | 4,000 | 3,300 | 2,800 |
| (3) 2x4 | | 14,000 | 11,250 | 9,000 | 7,280 | 6,000 | 5,000 | 4,200 |
| (4) 2x4 | | 19,000 | 15,000 | 12,000 | 9,700 | 8,000 | 6,600 | 5,600 |
| (5) 2x4 | | | 18,600 | 15,000 | 12,200 | 10,000 | 8,300 | 70,000 |

85

Q17. How many 2x4 x 10' studs are required to carry 6,600#? **4**

**BRACED SYP#2**
**Allowable Axial Capacity for Columns (lbs)**
**for use with stud walls**
**(sheathed on at least one side)**

| | 5' | 6' | 7' | 8' | 9' | 10' | 11' | 12' |
|---|---|---|---|---|---|---|---|---|
| (1) 2x4 | 5,930 | 4,750 | 3,758 | 3,000 | 2,426 | 2,000 | 1,665 | 1,408 |
| (2) 2x4 | | 9,500 | 7,515 | 6,000 | 4,800 | 4,000 | 3,300 | 2,800 |
| (3) 2x4 | | 14,000 | 11,250 | 9,000 | 7,280 | 6,000 | 5,000 | 4,200 |
| (4) 2x4 | | 19,000 | 15,000 | 12,000 | 9,700 | 8,000 | 6,600 | 5,600 |
| (5) 2x4 | | | 18,600 | 15,000 | 12,200 | 10,000 | 8,300 | 70,000 |

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## Span table

### Procedure

1. Identify design loads
2. Quantify "PLF"
3. Look in a span table
   - **PSL columns**

**Table 6:**
- Manufacturer
- Height of column
- Number of studs ganged together

87

## Span table

**Table 6**
**Manufactured columns**

| | TJ - PSL loads (#) (E=1.8) | | | | | Steel | |
|---|---|---|---|---|---|---|---|
| Effective column length (ft) | 3.5 x 3.5 | 3.5 x 5.55 | 3.5 x 7.25 | 5.25 x 5.25 | 5.25 x 7.25 | 3" dia steel | 3.5" dia |
| 6 | 10600 | 15900 | 21200 | 33300 | | | |
| 7 | 8700 | 13100 | 17500 | 30000 | | | |
| 8 | 7300 | 10900 | 14500 | 26600 | 35500 | | |
| 9 | 6100 | 9200 | 12200 | 23500 | 31300 | | |
| 10 | 5200 | 7800 | 10400 | 20700 | 27500 | 30000 | 35000 |
| 12 | 3900 | 5800 | 7800 | 16200 | 21600 | | |

88

## Span table

Try Q18 using Table 6

| | TJ - PSL loads (#) (E=1.8) | | | | | Steel | |
|---|---|---|---|---|---|---|---|
| Effective column length (ft) | 3.5x3.5 | 3.5x5.55 | 3.5x7.25 | 5.25x5.25 | 5.25x7.25 | 3" dia steel | 3.5" dia |
| 6 | 10600 | 15900 | 21200 | 33300 | | | |
| 7 | 8700 | 13100 | 17500 | 30000 | | | |
| 8 | 7300 | 10900 | 14500 | 26600 | 35500 | | |
| 9 | 6100 | 9200 | 12200 | 23500 | 31300 | | |
| 10 | 5200 | 7800 | 10400 | 20700 | 27500 | 30000 | 35000 |
| 12 | 3900 | 5800 | 7800 | 16200 | 21600 | | |

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Q18. How much weight will a TJ 3-1/2 x 7-1/4 x 10' PSL carry?
**10400** #

| | TJ - PSL loads (#) (E=1.8) | | | | | Steel | |
|---|---|---|---|---|---|---|---|
| Effective column length (ft) | 3.5 x 3.5 | 3.5 x 5.55 | 3.5 x 7.25 | 5.25 x 5.25 | 5.25 x 7.25 | 3" dia steel | 3.5" dia |
| 6 | 10600 | 15900 | 21200 | 33300 | | | |
| 7 | 8700 | 13100 | 17500 | 30000 | | | |
| 8 | 7300 | 10900 | 14500 | 26600 | 35500 | | |
| 9 | 6100 | 9200 | 12200 | 23500 | 31300 | | |
| 10 | 5200 | 7800 | 10400 | 20700 | 27500 | 30000 | 35000 |
| 12 | 3900 | 5800 | 7800 | 16200 | 21600 | | |

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## Calculating footing size (no table)

### Procedure

#### Footing size

**Size is a function of:**
- **Load (#)**
- **Soil bearing pressure (psf)**

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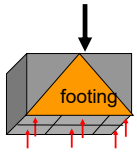
## Calculating footing size (no table)

### Procedure

#### Footing size




Load gets spread @ 45°

Soil bearing pressure (psf)

- Soil bearing pressure = $\frac{\text{Load (\#)}}{\text{Area (sqft)}}$
- Area required = $\frac{\text{Load (\#)}}{\text{Soil bearing pressure (psf)}}$

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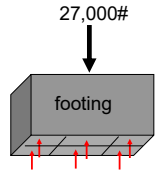
## Calculating footing size (no table)

**Try Q19**

93

**Q19. If the soil bearing pressure is 3,000 psf, what size square footing is required to carry 27,000#** ___3___(ft) x ___3___ (ft)




Soil bearing pressure
3,000 (psf)

Area = $\frac{\text{Load (27,000\#)}}{\text{Bearing pressure (3,000 psf)}}$ = 9 sqft = 3' x '3

94

## Interpolation

- IRC allows interpolation in many tables.
- No extrapolation.

TABLE R602.10.5.2
PARTIAL CREDIT FOR BRACED WALL PANELS LESS THAN 48 INCHES IN ACTUAL LENGTH

| ACTUAL LENGTH OF BRACED WALL PANEL (inches) | CONTRIBUTING LENGTH OF BRACED WALL PANEL (inches)[a] | |
|---|---|---|
| | 8-foot Wall Height | 9-foot Wall Height |
| 48 | 48 | 48 |
| 42 | 36 | 36 |
| 36 | 27 | N/A |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
N/A = Not Applicable.
a. Linear interpolation shall be permitted.

Show notes

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## How to Interpolate

*Making the most of IRC tables*

- Step 1: Using the starting value, x, identify upper and lower limits from your table.

| | |
|---|---|
| $x_u$ | $y_u$ |
| $x_l$ | $y_l$ |

- Step 2: Solve for unknown value, *y*:

$$y = \frac{(x - x_l) \times (y_u - y_l)}{(x_u - x_l)} + y_l$$

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## For Example

- Step 1: For an actual length of 39", what is the contributing length for an 8 ft. wall?
- From Table R602.10.5.2, the starting value, *x* is equal to 39, and the upper and lower limits are shown below.

| | | |
|---|---|---|
| $x = 39$ | $x_u$=42 | $y_u$=36 |
| | $x_l$=36 | $y_l$=27 |

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## For Example

- Step 2: Solve for unknown value, *y*:

$$\text{unknown} = \frac{(39 - 36) \times (36 - 27)}{(42 - 36)} + 27 = 31.5$$

- **Remember the sequence of operations in a formula:**

**P**lease **E**xcuse **M**y **D**ear **A**unt **S**ally

parentheses > exponent > multiply > divide > add > subtract

98

## How to Interpolate

Step 1: Identify upper and lower limits of table values.

For example, for a actual length of 39", what is the contributing length?

| | Known | Unknown |
|---|---|---|
| Upper limit: | 42" | 36" |
| Desired value: | 39" | ? |
| Lower limit: | 36" | 27" |

TABLE R602.10.5.2
PARTIAL CREDIT FOR BRACED WALL PANELS LESS THAN 48 INCHES IN ACTUAL LENGTH

| Actual Length of Braced Wall Panel (in) | Contributing Length of Braced Wall Panel (in) [a] | |
|---|---|---|
| | 8 ft Wall Height | 9 ft Wall Height |
| 48 | 48 | 48 |
| 42 | 36 | 36 |
| 36 | 27 | N/A |

For SI: 1 inch = 25.4mm
a. Linear interpolation shall be permitted.

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## How to Interpolate

Step 2: Find the difference between the upper limits and lower limits for the known values.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 42” | 36” |
| Lower limit: | -36” | -27” |
| | 6 | 9 |

100

## How to Interpolate

Step 3: Divide the known-difference into the unknown-difference.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 42” | 36” |
| Lower limit: | 36” | 27” |
| | 6 | 9 |

9 ÷ 6 = 1.5

101

## How to Interpolate

Step 4: Find the difference between the known-desired value and the known-lower limits.

| | Known |
|---|---|
| Upper limit: | |
| Desired value: | 39” |
| Lower limit: | - 36” |
| | 3 |

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## How to Interpolate

Step 5: Multiply the difference in Step 4 with the quotient of Step 3.

| | Known |
|---|---|
| Upper limit: | |
| Desired value: | 39” |
| Lower limit: | -36” |
| | 3 |

3 x 1.5 = 4.5

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## How to Interpolate

Step 6: Add the product from Step 5 to the unknown-lower limit.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 42” | 36” |
| Desired value: | 39” | **31.5** |
| Lower limit: | 36” | 27” |

27 + 4.5 = **31.5**

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## You Try It

Find the Maximum Cantilever Span for a 2 x 8 and a ground snow load of 45 psf.

TABLE R502.3.3(2)
CANTILEVER SPANS FOR FLOOR JOISTS SUPPORTING EXTERIOR BALCONY[a, b, e, f]

| MEMBER SIZE | SPACING | MAXIMUM CANTILEVER SPAN (uplift force at backspan support in lb)[c, d] | | |
|---|---|---|---|---|
| | | Ground Snow Load | | |
| | | ≤ 30 psf | 50 psf | 70 psf |
| 2 × 8 | 12" | 42" (139) | 39" (156) | 34" (165) |
| 2 × 8 | 16" | 36" (151) | 34" (171) | 29" (180) |
| 2 × 10 | 12" | 61" (164) | 57" (189) | 49" (201) |
| 2 × 10 | 16" | 53" (180) | 49" (208) | 42" (220) |
| 2 × 10 | 24" | 43" (212) | 40" (241) | 34" (255) |
| 2 × 12 | 16" | 72" (228) | 67" (260) | 57" (268) |
| 2 × 12 | 24" | 58" (279) | 54" (319) | 47" (330) |

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

a. Spans are based on No. 2 Grade lumber of Douglas fir-larch, Southern pine, hem-fir, and spruce-pine-fir for repetitive (three or more) members.
b. Ratio of backspan to cantilever span shall be not less than 2:1.
c. Connections capable of resisting the indicated uplift force shall be provided at the backspan support.
f. Linear interpolation shall be permitted for ground snow loads other than shown.

105

## Solution

Step 1: Identify upper and lower limits of table values.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 50 psf | 39” |
| Desired value: | 45 psf | **?** |
| Lower limit: | 30 psf | 42” |

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## Solution

Step 2: Find the difference between the upper limits and lower limits for the known values.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 50 psf | 39” |
| Lower limit: | -30 psf | -42” |
| | 6 | - 3 |

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## Solution

Step 3: Divide the known-difference into the unknown-difference.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 42” | 39” |
| Lower limit: | 36” | 42” |
| | 6 | - 3 |

- 3 ÷ 6 = -0.5

108

## Solution

Step 4: Find the difference between the known-desired value and the known-lower limits.

| | Known |
|---|---|
| Upper limit: | |
| Desired value: | 45 psf |
| Lower limit: | -30 psf |
| | 5 psf |

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## Solution

Step 5: Multiply the difference in Step 4 with the quotient of Step 3.

| | Known |
|---|---|
| Upper limit: | |
| Desired value: | 45 psf |
| Lower limit: | -30 psf |
| | 5 psf |

5 x -0.5 = -2.5

110

## Solution

Step 6: Add the product from Step 5 to the unknown-lower limit.

| | Known | Unknown |
|---|---|---|
| Upper limit: | 50 psf | 39” |
| Desired value: | 45 psf | **40.5** |
| Lower limit: | 30 psf | 42” |

42 + -2.5 = 40.5

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# Design Criteria

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# Design Criteria

Buildings shall be constructed to safely support all loads, including dead loads, live loads, roof loads, snow loads, wind loads and seismic loads … in accordance with the provisions of this code …

… shall result in a system that provides a complete load path … for the transfer of all loads from their point of origin through the load-resisting elements to the foundation.

Alternate material?
ZipSystem

R301.1

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# Alternative Provisions

- Don't want to use the IRC?
- Use the prescriptive provisions in the following:
  - *Wood Frame Construction Manual.*
  - *Standard for Cold-Formed Steel Framing.*
  - *Standard on the Design and Construction of Log Structures.*

R301.1.1

114

# Design Criteria

The International Residential Code is a prescriptive code.

The AWC (American Wood Council) National Design Specification (NDS) is an engineering standard for design of wood structures. The (AWC) Wood Frame Construction Manual (WFCM) is a "how to do it" prescriptive manual, based on engineering.

Both of these documents are referred to in the IRC as alternate provisions in a usable format this is beneficial to the engineer, builder and building official, especially for situations not addressed in the IRC.

R301.1.1

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# Design Criteria

Chapter 44 Referenced Standards

**AWC** — American Wood Council, 222 Catoctin Circle SE, Suite 201, Leesburg, VA 20175

| | |
|---|---|
| ANSI/AWC NDS—2018 | National Design Specification (NDS) for Wood Construction—with 2018 Supplement<br>R404.2.2, R502.2, Table R503.1, R507.2.1, R602.3, R608.9.2, R608.9.3, Table R703.15.1, Table R703.15.2, R802.2 |
| ANSI/AWC PWF—2021: | Permanent Wood Foundation Design Specification<br>R317.3.2, R401.1, R404.2.3 |
| ANSI/AWC WFCM—2018 | Wood Frame Construction Manual for One- and Two-family Dwellings<br>R301.1.1, R301.2.1.1, R802.10.6.2, Figure R608.9(9), R608.9.2, R608.9.3, R608.10 |
| AWC STJR—2021: | Span Tables for Joists and Rafters<br>R502.3, R502.4.1, R802.5.1 |

**TPI** — Truss Plate Institute, 2670 Crain Highway, Suite 203, Waldorf, MD 20601

| | |
|---|---|
| TPI 1—2014 | National Design Standard for Metal Plate Connected Wood Truss Construction<br>R502.11.1, R802.10.2 |

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R502 & R802

# Design Criteria

American Wood Council — www.awc.org

awc.org

AWC's mission is to increase the use of wood by assuring the broad regulatory acceptance of wood products, developing design tools and guidelines for wood …

Span Tables — American Wood Council. This website provides awareness level …

Deck Guide — This website provides awareness level information to the fire service …

Calculators — Online Calculators. American Wood Council (AWC) does not provide …

Contact Information — Contact Information. The American Wood Council is ready to assist …

NDS — This website provides awareness level information to the fire service …

WFCM — Design of Wood Frame Buildings for High Wind, Snow, and Seismic …

SBCA — Structural Building Components Association

Representing Manufacturers of Engineered Floor, Wall and Roof Structural Components

http://sbcindustry.com/technical/technical-publications

Building Component Safety Information (BCSI)

Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses

BCSI

**SBCA** — Structural Building Components Association, 6300 Enterprise Lane, Madison, WI 53719

| | |
|---|---|
| ANSI/SBCA FS100—2012(R2018): | Standard Requirements for Wind Pressure Resistance of Foam Plastic Insulating Sheathing Used in Exterior Wall Covering Assemblies<br>R316.6 |
| BCSI—2016: | Building Component Safety Information Guide to Good Practice for Handling, Installing, Restraining & Bracing of Metal Plate Connected Wood Trusses<br>R602.11.2, R802.10.3 |

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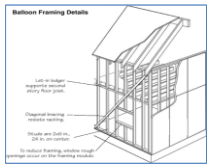
# Design Criteria

Construction systems.

The requirements of this code are based on platform and balloon-frame construction …

Other framing systems must have equivalent detailing to ensure force transfer, continuity and compatible deformations.




R301.1.2, comment R602.9

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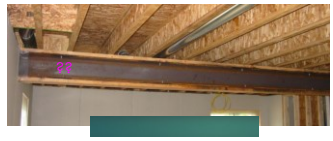
# Design Criteria



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# Design Criteria

Engineered design.
When …a building… contains structural elements exceeding the limits of section R301 … these elements shall be designed in accordance with accepted engineering practice.

Although not defined in the code, accepted engineering practice means the engineering analysis is based on well established principles of mechanics and conforms to accepted principles, tests or standards of nationally recognized technical or scientific authorities.

The building official has the authority to require the plan to be designed and certified by qualified an architect or engineer.

www.asce.org/asce-7

www.awc.org/sdpws-2015

www.iccsafe.org

R301.1.3

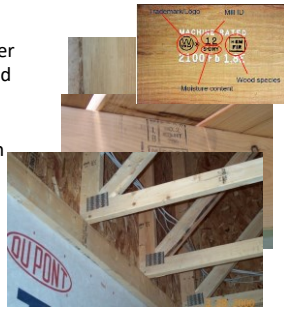
120

# Conventional Construction

121

# Floors, Walls, Ceilings & Roofs Construction

- All dimension lumber for shall be identified by a grade mark, certification or approved inspection agency.




R502.1, 602.1. 802.1 Identification

122

# Floors, Walls, Ceilings & Roofs Construction

**Lumber Grade**

- Blocking: floors & rafters – utility
- Floor joist- SS - #3
- Girders/Headers- # 2
- Studs - # 3 or NLB Utility
- Cantilever floor joist #2
- Rafters – SS - # 3

R502.1, 602.2. 802

123

# Stud Wall Species and Grades

BETTER

NOT AS GOOD

***SELECT STRUCTURAL***

***#1***

***#2***

***#3***

***STUD***

***CONSTRUCTION***

***STANDARD***

***UTILITY***

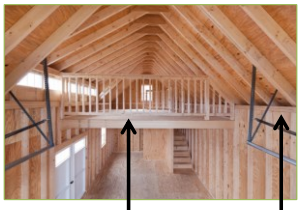
R602.2



## Stud - Size, Height, Spacing

Table R602.3(5)
Size, Height and Spacing of Wood Studs [a]

## Stud - Size, Height, Spacing



11'-7" MAX FLOOR - FLOOR HT

12-0" MAX STUD HT

UNLESS

**R301.3 Story height.**

The wind and seismic provisions of this code shall apply to buildings with story heights not exceeding the following:

1. For wood wall framing, the story height shall not exceed 11' 7" and the laterally unsupported bearing wall stud height permitted by Table R602.3(5).

**Exception:** A story height not exceeding 13' 7" is permitted provided that the maximum wall stud clear height does not exceed 12', the wall studs are in accordance with **Exception 2 or 3** of **Section R602.3.1** or an engineered design is provided for the wall framing members, and wall bracing for the building is in accordance with Section R602.10. Studs shall be laterally supported at the top and bottom plate in accordance with Section R602.3.

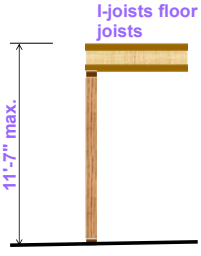
2. Where ground snow loads are less than or equal to 25 lb. psf, and the ultimate design wind speed is less than or equal to 130 mph, 2" x 6" studs supporting a roof load with not more than 6' of tributary length shall have a maximum height of 18' where spaced at 16" o.c., or 20' where spaced at 12" o.c. Studs shall be No. 2 grade lumber or better.

3. Exterior load-bearing studs not exceeding 12' in height provided in accordance with Table R602.3(6). The minimum number of full-height studs adjacent to openings shall be in accordance with Section R602.7.5. The building shall be located in Exposure B, the roof live load shall not exceed 20 psf, and the ground snow load shall not exceed 30 psf. Studs and plates shall be No. 2 grade lumber or better.



## R301.3 Story Height

- Maximum story height = 11'-7" - **Unless**






## Stud - Size, Height, Spacing

**Changed 2009 Table into 2012 and Again**

**R602.3.1 Stud size, height and spacing.**

The size, height and spacing of studs shall be in accordance with Table R602.3(5).

**Exceptions:**

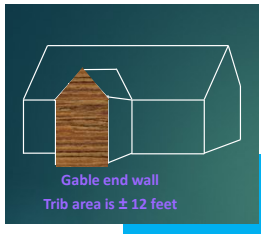
1. Utility grade studs shall not be spaced more than 16" o.c., shall not support more than a roof and ceiling, and shall not exceed 8' in height for exterior walls and load-bearing walls or 10' for interior nonload-bearing walls.

2. Where ground snow loads are less than or equal to 25 lb. psf, and the ultimate design wind speed is less than or equal to 130 mph, 2" x 6" studs supporting a roof load with not more than 6' of tributary length shall have a maximum height of 18' where spaced at 16" o.c., or 20' where spaced at 12" o.c. Studs shall be No. 2 grade lumber or better.

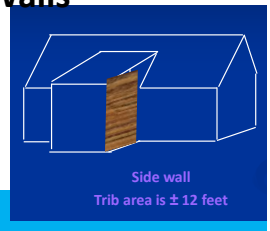
3. Exterior load-bearing studs not exceeding 12' in height provided in accordance with Table R602.3(6). The minimum number of full-height studs adjacent to openings shall be in accordance with Section R602.7.5. The building shall be located in Exposure B, the roof live load shall not exceed 20 psf, and the ground snow load shall not exceed 30 psf. Studs and plates shall be No. 2 grade lumber or better.



## Tall Walls



Gable end wall
Trib area is ± 12 feet



Side wall
Trib area is ± 12 feet

End wall
Trib area is ≤12 feet

## Tall Walls

- What if the tall walls are carrying more than 6’ of tributary area?

130

## Headers

131

## Headers

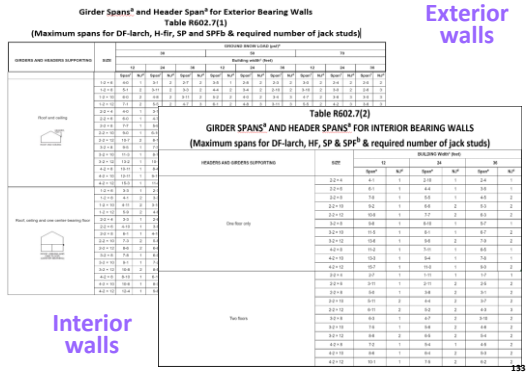
- Table R602.5(1) exterior bearing walls
- Table R602.5(2) interior bearing walls

132

## Headers

Exterior walls

Interior walls



Girder Spans[a] and Header Span[a] for Exterior Bearing Walls
Table R602.7(1)
(Maximum spans for DF-larch, H-fir, SP and SPFb & required number of jack studs)

Table R602.7(2)
GIRDER SPANS[a] AND HEADER SPANS[a] FOR INTERIOR BEARING WALLS
(Maximum spans for DF-larch, HF, SP & SPF[b] & required number of jack studs)

133

## Headers

- What size SP#2 header and number of jacks:
  - Interior wall on first floor of a two story house

9’

24’

134

## Headers - answer

Supports one floor

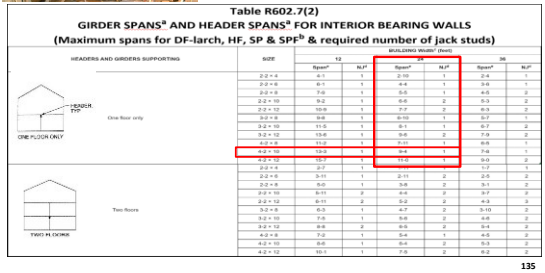


Table R602.7(2)
GIRDER SPANS[a] AND HEADER SPANS[a] FOR INTERIOR BEARING WALLS
(Maximum spans for DF-larch, HF, SP & SPF[b] & required number of jack studs)

135

# Header

- What size header do I need:
  - One-story, 36’ wide house in DeGray Resort, Arkansas
  - Header supports a roof and ceiling only
  - Window is 36” wide x 62 tall”
  - SP#2

136

# Header - answer

- One-story, 36’ wide house DeGray Resort Arkansas
- Header supports a roof and ceiling only
- Window is 36” wide x 62 tall”
- SP#2

Table R602.7(1)
Girder Spans[a] and Header Span[a] for Exterior Bearing Walls
(Maximum spans for DF-larch, H-fir, SP and SPFb & required number of jack studs)

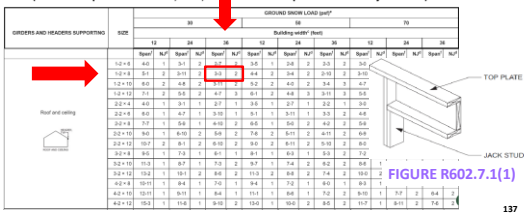



FIGURE R602.7.1(1)

137

# Headers for Porches

TABLE R602.7(3) GIRDER AND HEADER SPANS[a] FOR OPEN PORCHES (Maximum span for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir[a])

| SIZE | SUPPORTING ROOF Ground Snow Load (psf) 30 | | 50 | | 70 | | SUPPORTING FLOOR | |
|---|---|---|---|---|---|---|---|---|
| | Depth of Porch[c] (feet) 8 | 14 | 8 | 14 | 8 | 14 | 8 | 14 |
| 2-2 × 6 | 7-6 | 5-8 | 6-2 | 4-8 | 5-4 | 4-0 | 6-4 | 4-9 |
| 2-2 × 8 | 10-1 | 7-7 | 8-3 | 6-2 | 7-1 | 5-4 | 8-5 | 6-4 |
| 2-2 × 10 | 12-4 | 9-4 | 10-1 | 7-7 | 8-9 | 6-7 | 10-4 | 7-9 |
| 2-2 × 12 | 14-4 | 10-10 | 11-8 | 8-10 | 10-1 | 7-8 | 11-11 | 9-0 |

138

# Headers for Porches

- Size the header and girder for this porch that extends 8’ from the house

139

# Headers for Porches - answer

- Size the header and girder for this porch that is 8’ from the house

TABLE R602.7(3) GIRDER AND HEADER SPANS[a] FOR OPEN PORCHES (Maximum span for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir[a])

| SIZE | SUPPORTING ROOF Ground Snow Load (psf) 30 | | 50 | | 70 | | SUPPORTING FLOOR | |
|---|---|---|---|---|---|---|---|---|
| | Depth of Porch[c] (feet) 8 | 14 | 8 | 14 | 8 | 14 | 8 | 14 |
| 2-2 × 6 | 7-6 | 5-8 | 6-2 | 4-8 | 5-4 | 4-0 | 6-4 | 4-9 |
| 2-2 × 8 | 10-1 | 7-7 | 8-3 | 6-2 | 7-1 | 5-4 | 8-5 | 6-4 |
| 2-2 × 10 | 12-4 | 9-4 | 10-1 | 7-7 | 8-9 | 6-7 | 10-4 | 7-9 |
| 2-2 × 12 | 14-4 | 10-10 | 11-8 | 8-10 | 10-1 | 7-8 | 11-11 | 9-0 |

Table R602.7(3)

140

# Header & Girder

- What size header and girder:
  - Porch measures 6’x15’
  - Rafters run in opposite direction as deck joists
  - Columns are 5’ apart.

Table R602.7(3)

141

# Header - answer

- Porch measures 6'x15'
- Rafters run in opposite direction as deck joists
- Columns are 5' apart.

TABLE R602.7(3) GIRDER AND HEADER SPANS[a] FOR OPEN PORCHES (Maximum span for Douglas fir-larch, hem-fir, Southern pine and spruce-pine-fir[b])

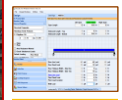
| SIZE | SUPPORTING ROOF | | | | | | SUPPORTING FLOOR | |
|---|---|---|---|---|---|---|---|---|
| | Ground Snow Load (psf) | | | | | | | |
| | 30 | | 50 | | 70 | | | |
| | Depth of Porch[c] (feet) | | | | | | | |
| | 8 | 14 | 8 | 14 | 8 | 14 | 8 | 14 |
| 2-2 × 6 | 7-6 | | | | | | 6-4 | 4-9 |
| 2-2 × 8 | 10-1 | 7-7 | 8-3 | 6-2 | 7-1 | 5-4 | 8-5 | 6-4 |
| 2-2 × 10 | 12-4 | 9-4 | 10-1 | 7-7 | 8-9 | 6-7 | 10-4 | 7-9 |
| 2-2 × 12 | 14-4 | 10-10 | 11-8 | 8-10 | 10-1 | 7-8 | 11-11 | 9-0 |

142

# Wall Header

16 spaces @ 19.2" (16 x 1.6 = 25.6)

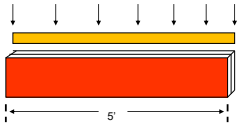
8' + 10' x 50 = 900



143

# Roof Truss 2' oc

Reaction load 2222 lbs per truss= **1111plf.**
2 – 2x10 Hem-Fir
$F_b$ 850




**Formula: use the uniform load formula: [plf x l x l x 12[ ÷ [8 x fb]=s³**
**l=Length in feet**

**[1111 x 5 x 5 x 12] ÷ [8 x 850] = 49s³**
**49 x .85 (snow load reduction) = 41.65s³**

**Formula 2 x 10 (H x H x W : 6)**

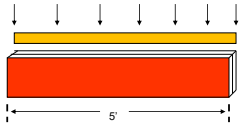
Uniform load -Continues

**(9.25 x 9.25 x 1.5) / 6 = 21.39s³**
**2 x 21.39 = 42.78s³ (passes)**

144

# Roof Truss 2' o.c.

Reaction load 2222 lbs per truss= **1111plf.**
2 – 2x12 SPF
$F_b$ 850




**Formula: use the uniform load formula: [plf x l x l x 12] ÷ [8 x fb]=s³**
**l=Length in feet**

**[1111 x 5 x 5 x 12] ÷ [8 x 850] = 49s³**
**49 x .85 (snow load reduction) = 41.65s³**

**Formula 2 x 12 (H x H x W ÷ 6)**

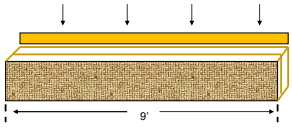
Uniform load -Continues

**(11.375 x 11.375 x 1.5) ÷ 6 = 32s³**
**2 x 32 = 64s³ (pass)**

145

# Roof Truss 2' oc

**Single Car Garage**




Reaction load 2222 lbs per truss= **1111plf.**
2 – 1.75 x 11.25 LVL
Louisiana Pacific Ganglam
$F_b$ 2400

**Formula: use the uniform load formula: [plf x l x l x 12[ ÷ [8 x fb]=s³**
**l=Length in feet**

**[1111 x 9 x 9 x 12] ÷ [8 x 2400] = 56.24s³**
**56.24 x .85 (snow load reduction) = 47.8s³**

**Formula 1.75 x 11.25 (H x H x W ÷ 6)**

Uniform load -Continues

**(11.25 x 11.25 x 1.75) ÷ 6 = 36.9s³**
**2 x 36.9 = 73.8s³ (passes)**

146

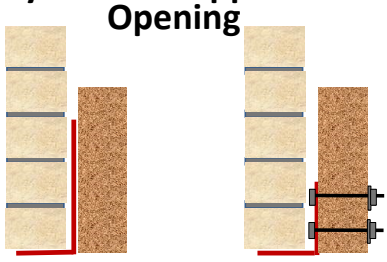
# Lintels

Brick support above opening

Brick support above roof

147

# Masonry Veneer Supported Above Opening



1. Lintel is independent of the wood header
2. Lintel is connected to wood beam

148

# Masonry Veneer Supported Above Opening

- Sizing steel lintel:
- Two options
  - Option 1:
    Use Table R703.8.3.1
  - Option 2:
    R703.8.3.2 – prescriptive

149

# Masonry Veneer Supported Above Opening - Option 1

- Size header:
  - Masonry veneer lintel over 8 foot garage door
  - Supporting gable wall only

150

# Masonry Veneer Supported Above Opening Option 1 - answer

- Size header:
  - Masonry veneer lintel over 8 foot garage door
  - Supporting gable wall only

TABLE R703.8.3.1 ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER[a, b, c, d]

| SIZE OF STEEL ANGLE[a, c, d] (inches) | NO STORY ABOVE | ONE STORY ABOVE | TWO STORIES ABOVE | NO. OF 1/2-INCH OR EQUIVALENT REINFORCING BARS IN REINFORCED LINTEL[b, d] |
|---|---|---|---|---|
| 3 × 3 × 1/4 | 6'-0" | 4'-6" | 3'-0" | 1 |
| 4 × 3 × 1/4 | 8'-0" | 6'-0" | 4'-6" | 1 |
| 5 × 3 1/2 × 5/16 | 10'-0" | 8'-0" | 6'-0" | 2 |
| 6 × 3 1/2 × 5/16 | 14'-0" | 9'-6" | 7'-0" | 2 |
| 2-6 × 3 1/2 × 5/16 | 20'-0" | 12'-0" | 9'-6" | 4 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

a. Long leg of the angle shall be placed in a vertical position.
b. Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.
c. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements shall be permitted to be used.
d. Either steel angle or reinforced lintel shall span opening.

151

# Lintel

- Size header using option 1:
  - Masonry veneer lintel over 16 foot garage door
  - Room trusses for second floor

152

# Lintel - answer

- Size header:
  - 16 foot garage door
  - Supporting gable wall only

TABLE R703.8.3.1 ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER[a, b, c, d]

| SIZE OF STEEL ANGLE[a, c, d] (inches) | NO STORY ABOVE | ONE STORY ABOVE | TWO STORIES ABOVE | NO. OF 1/2-INCH OR EQUIVALENT REINFORCING BARS IN REINFORCED LINTEL[b, d] |
|---|---|---|---|---|
| 3 × 3 × 1/4 | 6'-0" | 4'-6" | 3'-0" | 1 |
| 4 × 3 × 1/4 | 8'-0" | 6'-0" | 4'-6" | 1 |
| 5 × 3 1/2 × 5/16 | 10'-0" | 8'-0" | 6'-0" | 2 |
| 6 × 3 1/2 × 5/16 | 14'-0" | 9'-6" | 7'-0" | 2 |
| 2-6 × 3 1/2 × 5/16 | 20'-0" | 12'-0" | 9'-6" | 4 |

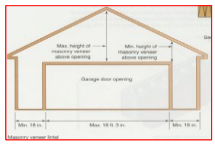
For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

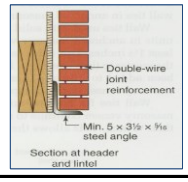
a. Long leg of the angle shall be placed in a vertical position.
b. Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.
c. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements shall be permitted to be used.
d. Either steel angle or reinforced lintel shall span opening.

153

## Brick Veneer Lintels – option 2

- **Prescriptive**
  - **Max header span: 18′-3″**
  - **18″ masonry on sides**
  - **Min L 5 x 3½ x $^{5}/_{16}$**
  - **Double wire joint reinforcement**
  - **Table R703.8.3.2**






154

## Brick Veneer Lintels – option 2

- Size header using option 2

155

## Brick Veneer Lintels – answer

- Size header using option 2

TABLE R703.8.3.2 HEIGHT OF MASONRY VENEER ABOVE OPENING

| MINIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (inches) | MAXIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (feet) |
|---|---|
| 13 | < 5 |
| 24 | 5 to < 12 |
| 60 | 12 to height above support allowed by Section R703.8 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.

156

## Brick Support Above Roof

- **How to support brick above roof:**
  - **Option 1: Brick supported by wall studs**
  - **Option 2: Brick supported by rafters**

157

## Brick Support Above Roof

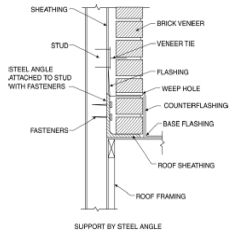



Figure R703.8.2.1
Exterior Masonry Veneer Support by Steel Angles

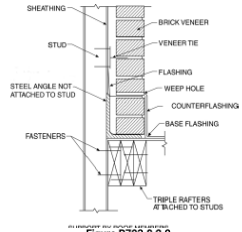


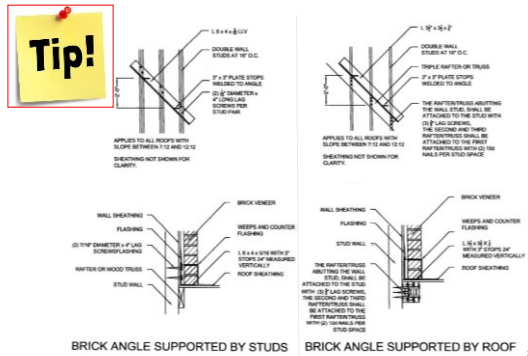

Figure R703.8.2.2
Exterior Masonry Veneer Support by Roof Members
EXTERIOR MASONRY VENEER SUPPORT BY ROOF MEMBERS

**Brick supported by wall studs**

**Brick supported by triple rafters**

158

## Brick Support Above Roof



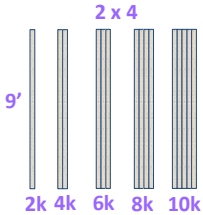

159

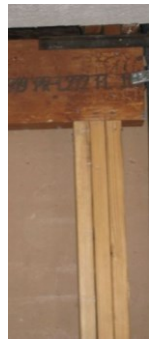
## Columns

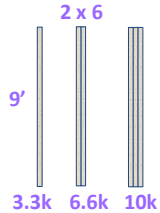
160

## Columns

Rule of thumb



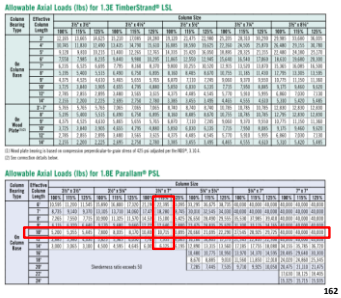






161

## Columns

> 10k use manufactured lumber




162

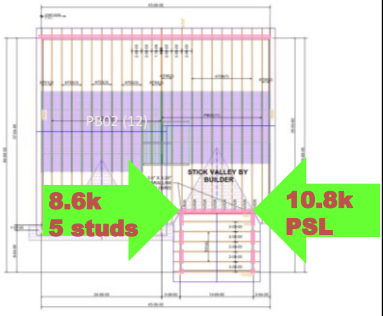
## Columns

- What size posts would I expect?

163

## Columns - answer

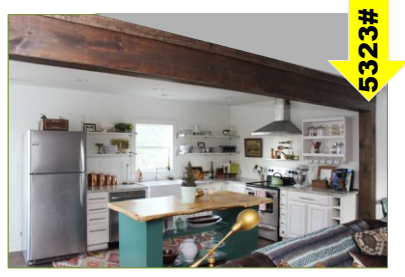
- What size posts would I expect?
  - 9’ column




164

## Columns

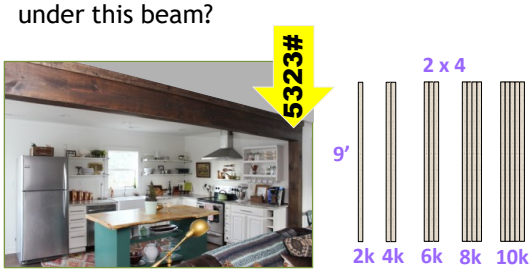
- How many 2x4 jack studs would I need under this beam?




165

## Columns - answer

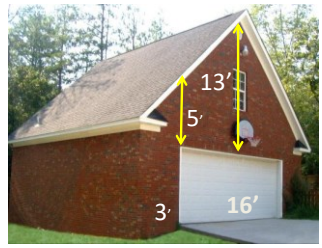
- How many 2x4 jack studs would I need under this beam?




166

## Lintel

- What is the minimum steel header
  - The garage has a truss roof.




167

## Steel Lintel -answer

- What is the minimum steel header
  - The garage has a truss roof.

TABLE R703.8.3.2
HEIGHT OF MASONRY VENEER ABOVE OPENING

| MINIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (INCH) | MAXIMUM HEIGHT OF MASONRY VENEER ABOVE OPENING (FEET) |
|---|---|
| 13 | < 5 |
| 24 | 5 to < 12 |
| 60 | 12 to height above support allowed by Section R703.8 |

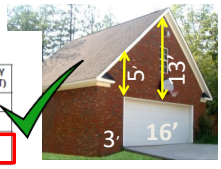



TABLE R703.8.3.1
ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER[a, b, c, d]

| SIZE OF STEEL ANGLE[c, d] (inches) | NO STORY ABOVE | ONE STORY ABOVE | TWO STORIES ABOVE | NO. OF ½-INCH OR EQUIVALENT REINFORCING BARS IN REINFORCED LINTEL[c, d] |
|---|---|---|---|---|
| 3 × 3 × 5/16 | 6'-0" | 4'-6" | 3'-0" | 1 |
| 4 × 3 × 5/16 | 8'-0" | 6'-0" | 4'-6" | 1 |
| 5 × 3½ × 5/16 | 10'-0" | 8'-0" | 6'-0" | 2 |
| 6 × 3½ × 5/16 | 14'-0" | 9'-6" | 7'-0" | 2 |
| 2.6 × 3½ × 5/16 | 20'-0" | 12'-0" | 9'-6" | 4 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm.
a. Long leg of the angle shall be placed in a vertical position.
b. Depth of reinforced lintels shall not be less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.
c. Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.
d. Either steel angle or reinforced lintel shall span opening.

168

## Header

- What is the minimum size header over the window?
  - House is 36' wide
  - The 2nd floor joists center wall
  - 25 psf snow load
  - Window is 8'wide

169

## Exterior Header -answer

Table R602.7(1)
Girder Spans[a] and Header Span[a] for Exterior Bearing Walls
(Maximum spans for DF-larch, H-fir, SP and SPFb & required number of jack studs)

170

## Roof Construction

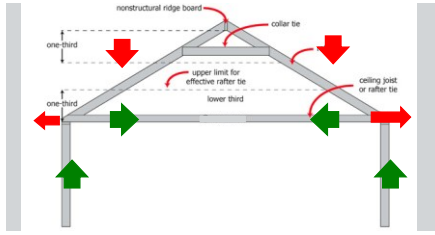
171

## Objectives

- Identify three roof system types and their components.
- Review plans, using IRC tables, ceiling joists and rafters.
- Review typical wood truss shop drawings.

172

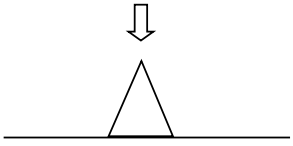
## Rafter/Ceiling Joist System




173

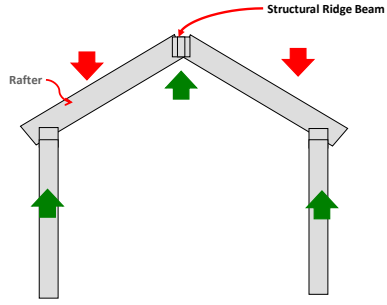
## Activity

- Fold some paper in half.
- Place it on your table/desk.
- Press downward at the peak.
- What happens?



174

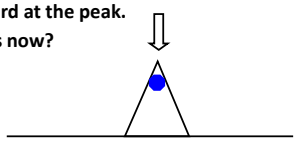
## Rafter/Ridge Beam System




175

## Activity

- Fold piece of paper in half.
- Place it on the table/deck.
- Place a pencil at the peak.
- Press downward at the peak.
- What happens now?



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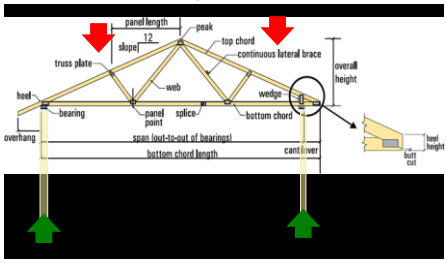
## Ridge Beam Load Path

- Follow ridge beam load path.
- Ensure columns, multi-ply studs support beam.
- Materials:
  - Large dimensioned lumber.
  - LVL, microlam.
  - Steel.
  - Flitch beam.

177

# Manufactured Truss System



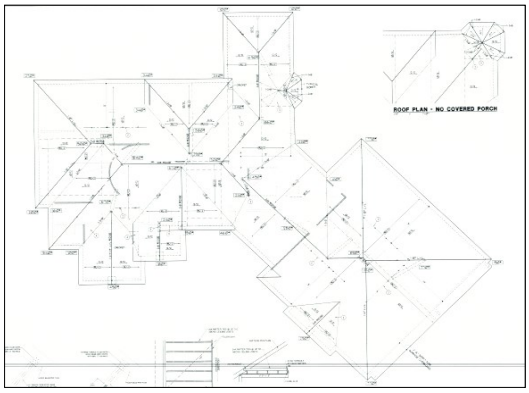

R802.10.1
R802.10.2.1

178

# Ceiling Joist Design Check

- Table R802.5.1(1) for no storage.
- Table R802.5.1(2) for limited storage.
- Known values:
  - Ceiling joist size and spacing.
  - Lumber species and grade.
  - Attic dead load.
  - Deflection limit.

179




180

# Ceiling Joist Design Check

Table R802.5.1(2)
Ceiling Joist Spans for Common Lumber Species
(Uninhabitable attics with limited storage, live load = 20 psf, L/D = 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) |
| 24 | Douglas fir-larch | SS | 8-3 | 13-0 | 17-2 | 21-3 |
| | Douglas fir-larch | #1 | 7-8 | 11-2 | 14-2 | 17-4 |
| | Douglas fir-larch | #2 | 7-3 | 10-8 | 13-6 | 16-5 |
| | Douglas fir-larch | #3 | 5-7 | 8-1 | 10-3 | 12-7 |
| | Hem-fir | SS | 7-10 | 12-3 | 16-2 | 20-6 |
| | Hem-fir | #1 | 7-7 | 11-1 | 14-0 | 17-1 |
| | Hem-fir | #2 | 7-1 | 10-4 | 13-1 | 16-0 |
| | Hem-fir | #3 | 5-5 | 7-11 | 10-0 | 12-3 |
| | Southern pine | SS | 8-1 | 12-9 | 16-10 | 21-6 |
| | Southern pine | #1 | 7-8 | 11-5 | 14-6 | 16-11 |
| | Southern pine | #2 | 6-7 | 9-10 | 12-6 | 14-9 |
| | Southern pine | #3 | 5-1 | 7-5 | 9-5 | 11-5 |
| | Spruce-pine-fir | SS | 7-8 | 12-0 | 15-10 | 19-5 |
| | Spruce-pine-fir | #1 | 7-2 | 10-6 | 13-3 | 16-3 |
| | Spruce-pine-fir | #2 | 7-2 | 10-6 | 13-3 | 16-3 |
| | Spruce-pine-fir | #3 | 5-5 | 7-11 | 10-0 | 12-3 |

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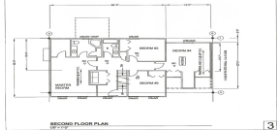
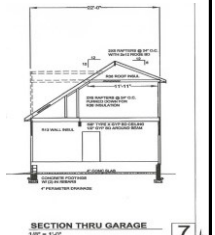
# You Try It

- Lets look at this plan.
- What size and spacing of ceiling joists in the garage roof comply?
- Width of garage is 22'0"

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# Solution

- Use Table R802.5.1(2) for limited storage and 10 PSF dead load.
- Maximum span = 12'- 06" < 11'-11", OK!

Table R802.5.1(2)—continued
Ceiling Joist Spans for Common Lumber Species
(Uninhabitable attics with limited storage, live load = 20 psf, L/D = 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) |
| 24 | Douglas fir-larch | SS | 8-3 | 13-0 | 17-2 | 21-3 |
| | Douglas fir-larch | #1 | 7-8 | 11-2 | 14-2 | 17-4 |
| | Douglas fir-larch | #2 | 7-3 | 10-8 | 13-6 | 16-5 |
| | Douglas fir-larch | #3 | 5-7 | 8-1 | 10-3 | 12-7 |
| | Hem-fir | SS | 7-10 | 12-3 | 16-2 | 20-6 |
| | Hem-fir | #1 | 7-7 | 11-1 | 14-0 | 17-1 |
| | Hem-fir | #2 | 7-1 | 10-4 | 13-1 | 16-0 |
| | Hem-fir | #3 | 5-5 | 7-11 | 10-0 | 12-3 |
| | Southern pine | SS | 8-1 | 12-9 | 16-10 | 21-6 |
| | Southern pine | #1 | 7-8 | 11-5 | 14-6 | 16-11 |
| | Southern pine | #2 | 6-7 | 9-10 | 12-6 | 14-9 |
| | Southern pine | #3 | 5-1 | 7-5 | 9-5 | 11-5 |
| | Spruce-pine-fir | SS | 7-8 | 12-0 | 15-10 | 19-5 |
| | Spruce-pine-fir | #1 | 7-2 | 10-6 | 13-3 | 16-3 |
| | Spruce-pine-fir | #2 | 7-2 | 10-6 | 13-3 | 16-3 |
| | Spruce-pine-fir | #3 | 5-5 | 7-11 | 10-0 | 12-3 |

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# Rafter Design Check

- Table R802.4.1(1) – (8) for various live load or ground snow load.
- Known values:
  - Roof live load (when ground snow load ≤ 30 PSF).
  - Ground snow load (when > 30 PSF).
  - Dead load.
  - Rafter size and spacing.
  - Lumber species and grade.
  - Span length.
  - Finish material on rafters (deflection).

184

# Rafter Design Check

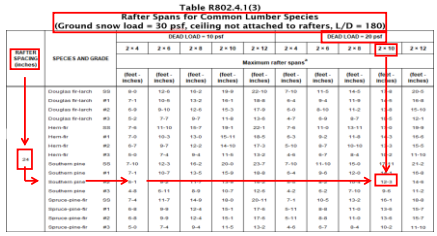

Table R802.4.1(3)
Rafter Spans for Common Lumber Species
(Ground snow load = 30 psf, ceiling not attached to rafters, L/D = 180)

| 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* | | | | | | | | | |
| 24 | Douglas fir-larch SS | 6-0 | 9-6 | 12-6 | 15-11 | 18-9 | 4-10 | 7-6 | 9-10 | 12-6 | 14-9 |
| | Douglas fir-larch #1 | 5-9 | 9-1 | 12-0 | 15-3 | 18-0 | 4-7 | 7-2 | 9-5 | 12-0 | 14-2 |
| | Douglas fir-larch #2 | 5-7 | 8-11 | 11-9 | 14-11 | 17-7 | 4-5 | 7-0 | 9-3 | 11-9 | 13-10 |
| | Hem-fir SS | 5-7 | 8-9 | 11-6 | 14-6 | 17-1 | 4-4 | 6-10 | 9-0 | 11-5 | 13-5 |
| | Hem-fir #1 | 5-6 | 8-7 | 11-3 | 14-3 | 16-10 | 4-3 | 6-8 | 8-10 | 11-3 | 13-3 |
| | Hem-fir #2 | 5-6 | 8-7 | 11-3 | 14-3 | 16-10 | 4-3 | 6-8 | 8-10 | 11-3 | 13-3 |
| | Hem-fir #3 | 5-3 | 8-3 | 10-10 | 13-9 | 16-3 | 4-1 | 6-5 | 8-6 | 10-10 | 12-10 |
| | Southern pine SS | 5-10 | 9-2 | 12-1 | 15-4 | 18-1 | 4-6 | 7-2 | 9-6 | 12-1 | 14-3 |
| | Southern pine #1 | 5-7 | 8-10 | 11-7 | 14-8 | 17-4 | 4-5 | 6-11 | 9-1 | 11-7 | 13-8 |
| | Southern pine #2 | 5-7 | 8-10 | 11-7 | 14-8 | 17-4 | 4-5 | 6-11 | 9-1 | 11-7 | 13-8 |
| | Southern pine #3 | 5-3 | 8-3 | 10-10 | 13-9 | 16-3 | 4-1 | 6-5 | 8-6 | 10-10 | 12-10 |
| | Spruce-pine-fir SS | 5-5 | 8-5 | 11-0 | 14-0 | 16-6 | 4-2 | 6-7 | 8-8 | 11-0 | 13-0 |
| | Spruce-pine-fir #1 | 5-3 | 8-3 | 10-10 | 13-9 | 16-3 | 4-1 | 6-5 | 8-6 | 10-10 | 12-10 |
| | Spruce-pine-fir #2 | 5-3 | 8-3 | 10-10 | 13-9 | 16-3 | 4-1 | 6-5 | 8-6 | 10-10 | 12-10 |
| | Spruce-pine-fir #3 | 4-11 | 7-9 | 10-2 | 12-11 | 15-3 | 3-10 | 6-1 | 8-0 | 10-2 | 12-0 |

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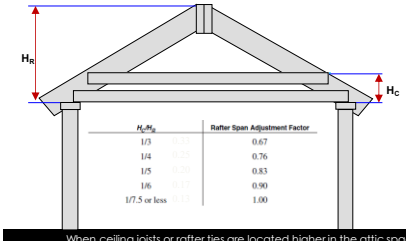
# Rafter Span Adjustment

- **Raise ceiling joist/rafter tie.**
- **Maximum 1/3 height of rafter.**
- **$H_C$ = height of rafter tie above bearing point.**
- **$H_R$ = height of rafter above bearing.**
- **Use table to determine adjustment.**
- **Multiply tabular span length with adjustment.**

186

# Rafter Span Adjustment




| $H_C/H_R$ | Rafter Span Adjustment Factor |
|---|---|
| 1/3 | 0.67 |
| 1/4 | 0.76 |
| 1/5 | 0.83 |
| 1/6 | 0.90 |
| 1/7.5 or less | 1.00 |

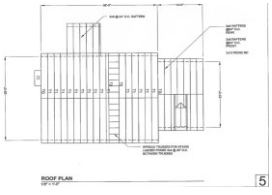
**Rafter Span Tables**

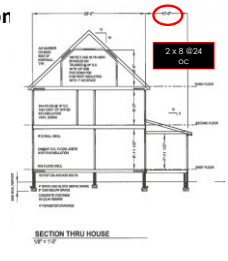
When ceiling joists or rafter ties are located higher in the attic space, these rafter spans shall be multiplied by the following factors:

187

# You Try It

- **Look at these plans.**
- **Do the rafters in the sunroor**

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# Solution – Tabular Span

Table R802.4.1(1)—continued
Rafter Spans for Common Lumber Species
(Roof live load = 20 psf, ceiling not attached to rafters, L/D = 180)

| 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* | | | | | | | | | |
| 24 | Douglas fir-larch SS | 9-1 | 14-4 | 18-10 | 23-9 | Note b | 9-1 | 13-3 | 16-10 | 20-7 | 23-10 |
| | Douglas fir-larch #1 | 8-7 | 12-6 | 15-10 | 19-5 | 22-6 | 7-5 | 10-10 | 13-9 | 16-9 | 19-6 |
| | Douglas fir-larch #2 | 8-4 | 11-11 | 15-1 | 18-5 | 21-4 | 7-0 | 10-4 | 13-0 | 15-11 | 18-6 |
| | Douglas fir-larch #3 | 6-2 | 9-1 | 11-6 | 14-1 | 16-3 | 5-4 | 7-10 | 10-0 | 12-2 | 14-1 |
| | Hem-fir SS | 8-7 | 13-6 | 17-10 | 22-9 | Note b | 8-7 | 12-10 | 16-3 | 19-10 | 23-0 |
| | Hem-fir #1 | 8-0 | 12-4 | 15-8 | 19-2 | 22-2 | 7-4 | 10-8 | 13-7 | 16-7 | 19-3 |
| | Hem-fir #2 | 8-0 | 11-7 | 14-8 | 17-10 | 20-9 | 6-10 | 10-0 | 12-8 | 15-6 | 17-11 |
| | Hem-fir #3 | 6-7 | 9-10 | 11-3 | 13-8 | 15-11 | 5-3 | 7-8 | 9-9 | 11-10 | 13-8 |
| | Southern pine SS | 8-11 | 14-1 | 18-6 | 23-8 | Note b | 8-11 | 13-10 | 17-6 | 20-10 | 24-8 |
| | Southern pine #1 | 8-7 | 12-9 | 16-2 | 19-11 | 22-6 | 7-5 | 11-1 | 14-0 | 16-5 | 19-6 |
| | Southern pine #2 | 8-4 | 11-0 | 13-11 | 16-6 | 19-6 | 6-4 | 9-6 | 12-1 | 14-4 | 16-10 |
| | Southern pine #3 | 6-6 | 9-4 | 10-6 | 12-9 | 15-1 | 6-11 | 7-3 | 9-1 | 11-0 | 13-1 |
| | Spruce-pine-fir SS | 8-5 | 13-3 | 17-5 | 21-8 | 25-2 | 8-4 | 12-2 | 15-4 | 18-9 | 21-9 |
| | Spruce-pine-fir #1 | 8-0 | 11-9 | 14-10 | 18-2 | 21-0 | 6-11 | 10-2 | 12-10 | 15-8 | 18-3 |
| | Spruce-pine-fir #2 | 8-0 | 11-9 | 14-10 | 18-2 | 21-0 | 6-11 | 10-2 | 12-10 | 15-8 | 18-3 |
| | Spruce-pine-fir #3 | 6-1 | 8-10 | 11-3 | 13-8 | 15-11 | 5-3 | 7-8 | 9-9 | 11-10 | 13-9 |

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## Solution - Adjustment

- Actual span = 5'-2".
- Span from table = 7'-11".
- $H_C/H_R$ = 1/3.
- Adjustment = 0.67.
- Adjusted value = 7.9167' x 0.67 = 5.28'
- 5.28' > 5.167' (5'-2"), OK!

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## Rafter Opposing

- Does the IRC require rafters to be directly opposing one another when framed to the ridge board?
- **A:** Yes. Section R802.3 requires the rafters to be framed to each other (directly opposing) with a gusset plate or framed to a ridge board.
- In the picture is this a ridge board or ridge beam?

R802.3

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## Collar tie??

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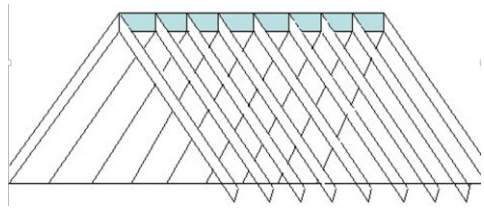
Ridge must be designed as a beam: R802.3.1:
Given: 14 foot ridge for a roof that is 22 feet wide:
Plf=(35+10) x 11 = 495 Use LP-LVL at 2,400 fb
[495 x 14 x 14 x 12] ÷ [8 x 2,400] = $S^3$
Snow load reduction .85 x 279 = 60.6$S^3$ required

Assume 2 – 11.25 x 1.75
[11.25 x 11.25 x 1.75 x 2] ÷ 6 = 73.8$S^3$ provided ok



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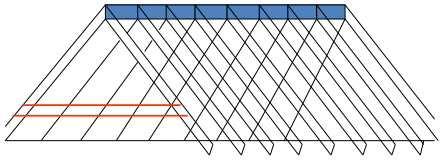
Beam 14' long Rafters are 24 inches on center
Room 22' wide
Pitch 10/12



Rafter tie has been raised 2 x 10 @ 24 inches.
Ridge height is 11 x 10 = 110 inches.
Ratio equals 24/110=.21>.20 so use ¼ adjustment=.76
Table 802.5.1(6) span for DFL #2 = 12-4
12.3 x .76 = 9.3 foot span (fails)

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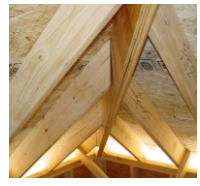
## Framing Details

- Minimum nominal thickness of 2"
- Minimum depth equal to rafter cut
- Must be designed as beams for >3:12 slope.



R802.4.3, R802.4.4

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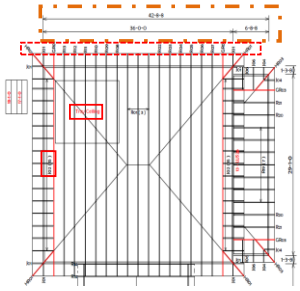
# Truss Layout



- Section R802.10.1
- Dimensions: span, spacing of trusses.
- Truss identification.
- Girder truss identification.
- Ceiling requirements.

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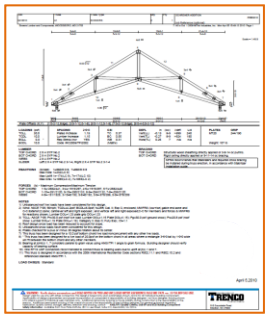
# Truss Specs



- Sections R802.10.1 and R802.10.2.
- Submitted prior to erection/installation or with permit application.
- Design and signed/sealed by RDP.
- Minimum requirements for drawings.

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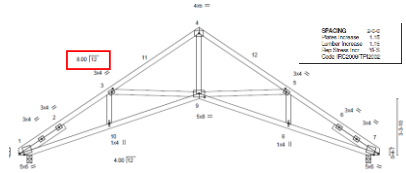
# Truss Shop Drawings

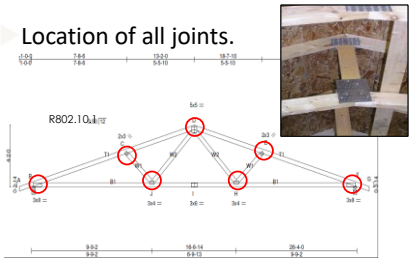
- Slope or depth, span and spacing.



198

# Truss Shop Drawings

- Location of all joints.



R802.10.1

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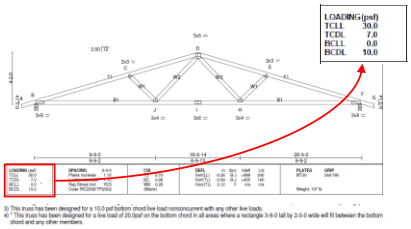
# Truss Shop Drawings

- Loading of all chords.



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# Truss Shop Drawings

- Reactions and forces.

| | | |
|---|---|---|
| LOADING (psf)<br>TCLL 30.0<br>TCDL 7.0<br>BCLL 0.0 *<br>BCDL 10.0 | SPACING 2-0-0<br>Plates Increase 1.15<br>Lumber Increase 1.15<br>Rep Stress Incr YES<br>Code IRC2009/TPI2002 | CSI<br>TC 0.75<br>BC 0.96<br>WB 0.28<br>(Matrix) |

LUMBER
TOP CHORD 2 X 4 SYP No.2
BOT CHORD 2 X 4 SYP No.2
WEBS 2 X 4 SYP No.3

REACTIONS (lb/size) B=1309/0-1-9 (input: 0-3-8), F=1309/0-1-9 (input: 0-3-8)
Max Horz B=47(LC 4)
Max Uplift B=-144(LC 6), F=-144(LC 7)

FORCES (lb) - Max. Comp./Max. Ten. - All forces 250 (lb) or less except when shown.
TOP CHORD B-C=-3197/493, C-D=-2777/414, D-E=-2777/414, E-F=-3197/493
BOT CHORD B-J=-410/2994, I-J=-227/2085, H-I=-227/2085, F-H=-410/2994
WEBS C-J=-587/200, D-J=-65/812, D-H=-65/812, E-H=-587/200

R802.10.1

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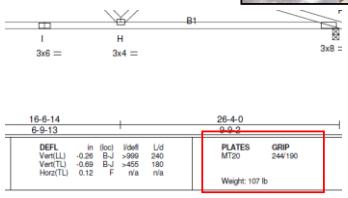
# Truss Shop Drawings

- Joint connector (proprietary product).

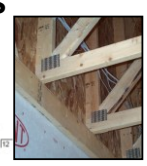


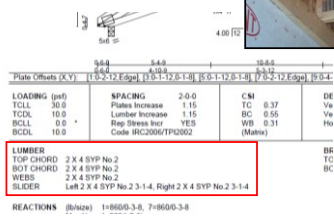

R802.10.1



# Truss Shop Drawings

- Lumber size, species and grade.

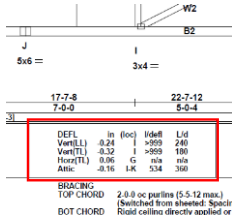







# Truss Shop Drawings

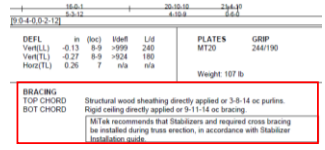
- Calculated deflection.






# Truss Shop Drawings

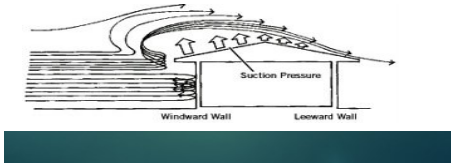
- Permanent bracing locations.
- Permanent bracing responsibility of building designer.
- Temporary bracing responsibility of truss designer.






# Roof Tie-down

- At truss/rafter-to-wall connection.
- Prescribed connection strength per Table R802.11.
- Show connection on plans?
- Required when uplift pressure ≥ 200 psi?




R802.11.1



# Roof Tie-down

Table R802.11—continued
Rafter or Truss Uplift Connection Forces from Wind (ASD) [Pound PER Connection] [a, b, c, d, e, f, g, h]

| RAFTER OR TRUSS SPACING | ROOF SPAN (feet) | EXPOSURE C — Ultimate Design Wind Speed $V_{ULT}$ (mph) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 110 | | 115 | | 120 | | 130 | | 140 | |
| | | Roof Pitch | | Roof Pitch | | Roof Pitch | | Roof Pitch | | Roof Pitch | |
| | | < 5:12 | ≥ 5:12 | < 5:12 | ≥ 5:12 | < 5:12 | ≥ 5:12 | < 5:12 | ≥ 5:12 | < 5:12 | ≥ 5:12 |
| 24" o.c. | 12 | 190 | 176 | 220 | 204 | 252 | 236 | 322 | 302 | 396 | 372 |
| | 18 | 242 | 222 | 282 | 262 | 326 | 302 | 416 | 390 | 514 | 484 |
| | 24 | 296 | 272 | 346 | 320 | 400 | 370 | 512 | 478 | 634 | 596 |
| | 28 | 332 | 304 | 390 | 358 | 450 | 416 | 578 | 538 | 716 | 670 |
| | 32 | 368 | 336 | 432 | 398 | 498 | 462 | 642 | 598 | 796 | 746 |
| | 36 | 404 | 370 | 474 | 438 | 548 | 508 | 706 | 658 | 876 | 822 |
| | 42 | 458 | 420 | 538 | 496 | 624 | 578 | 804 | 750 | 998 | 936 |
| | 48 | 512 | 468 | 604 | 556 | 698 | 646 | 900 | 840 | 1120 | 1048 |

# Uplift

**R602.3.5 Braced wall panel uplift load path.**

Braced wall panels located at exterior walls that support roof rafters or trusses (including stories below top story) shall have the framing members connected in accordance with one of the following:

1. Fastening in accordance with Table R602.3(1) where:
   1.1. The ultimate design wind speed does not exceed 115 mph (51 m/s), the wind exposure category is B, the roof pitch is 5:12 or greater, and the roof span is 32 feet (9754 mm) or less.
   1.2. The net uplift value at the top of a wall does not exceed 100 plf (146 N/mm). The net uplift value shall be determined in accordance with Section R802.11 and shall be permitted to be reduced by 60 plf (86 N/mm) for each full wall above.
2. Where the net uplift value at the top of a wall exceeds 100 plf (146 N/mm), installing *approved* uplift framing connectors to provide a continuous load path from the top of the wall to the foundation or to a point where the uplift force is 100 plf (146 N/mm) or less. The net uplift value shall be as determined in Item 1.2.
3. Wall sheathing and fasteners designed to resist combined uplift and shear forces in accordance with accepted engineering practice.

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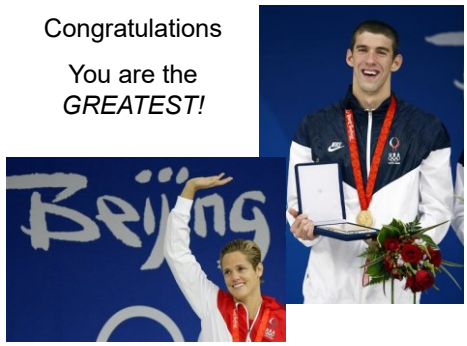
Congratulations

You are the *GREATEST!*

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