

# ARCH 2331

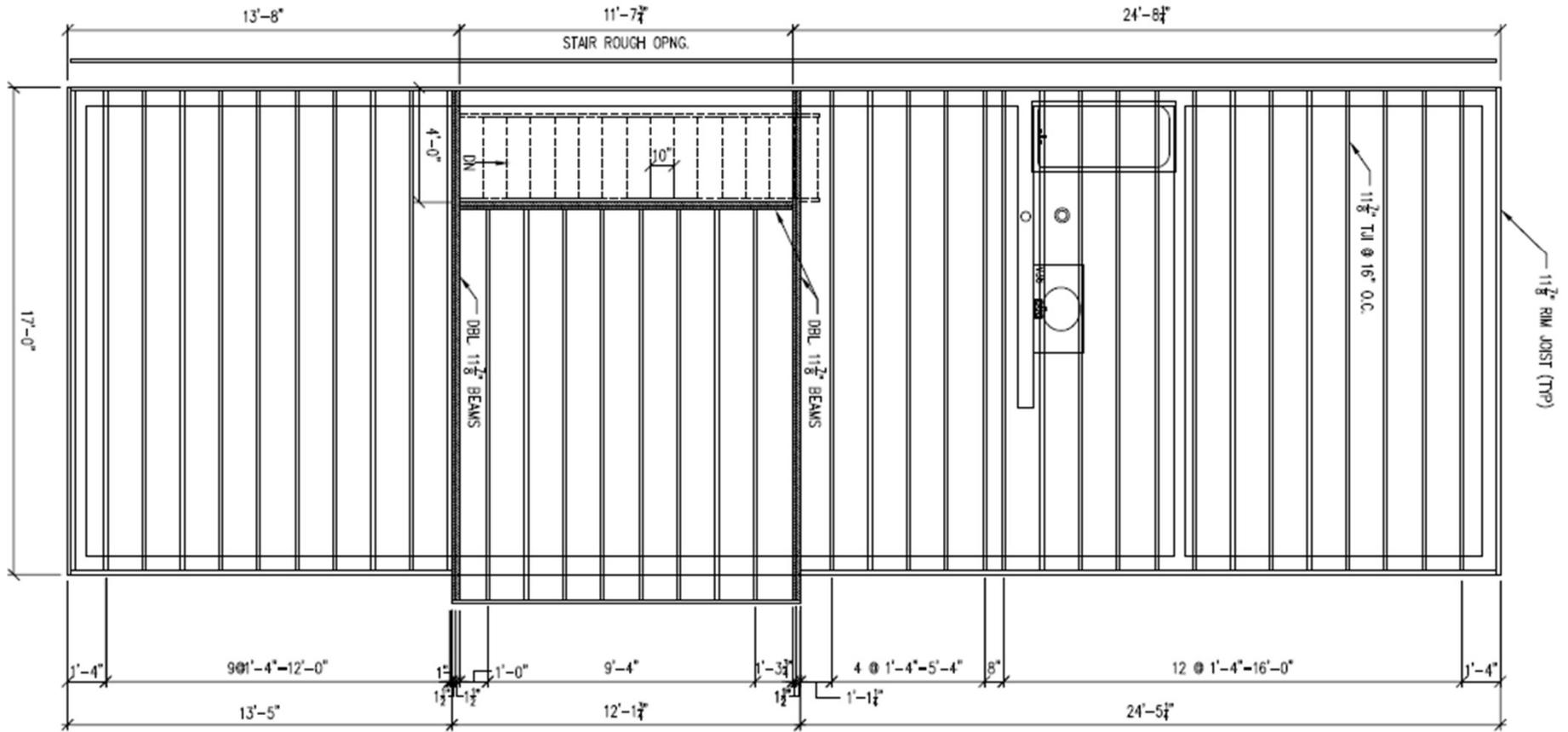
## BUILDING TECHNOLOGY II

### Joist Layout Plans

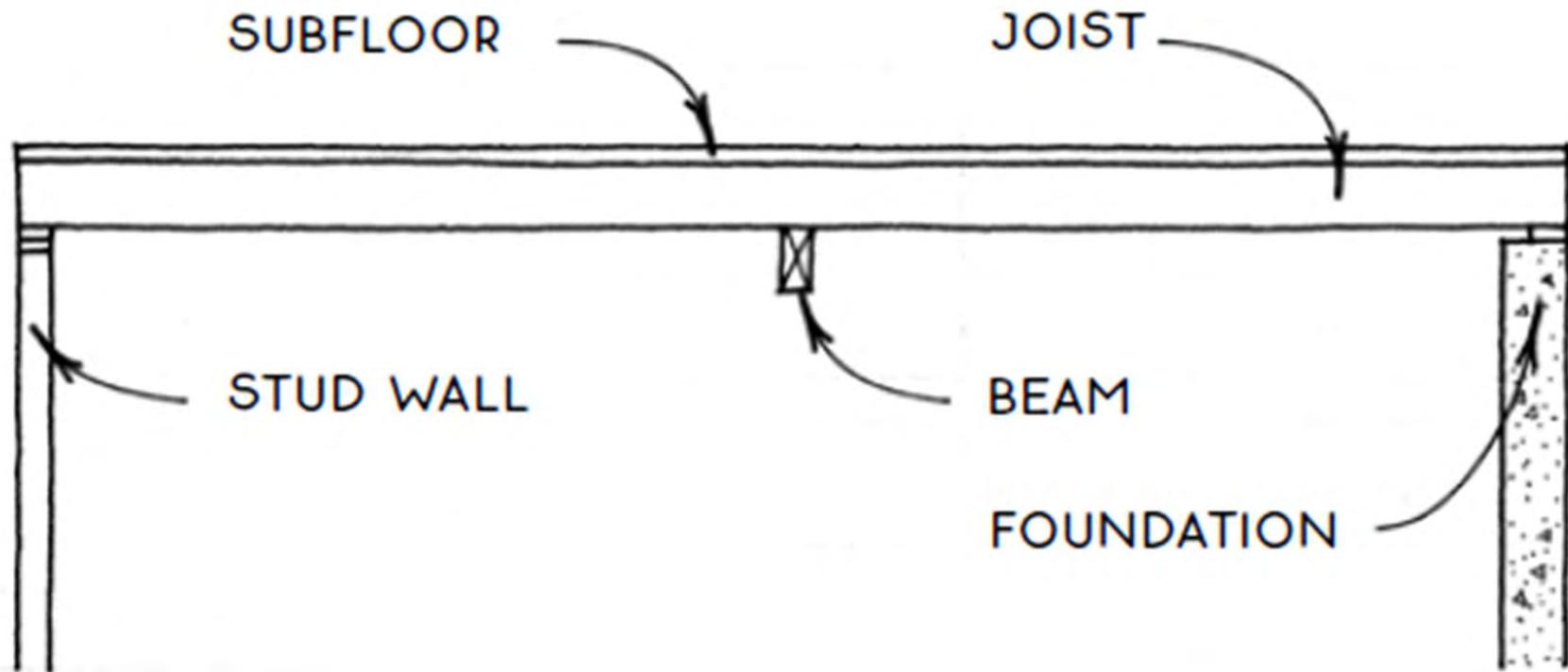


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<<https://www.archdaily.com/904328/passive-house-blanden-hasa-architects/>> ISSN 0719-8884

# Joist Layout Plan



## ELEMENTS OF A FLOOR SYSTEM





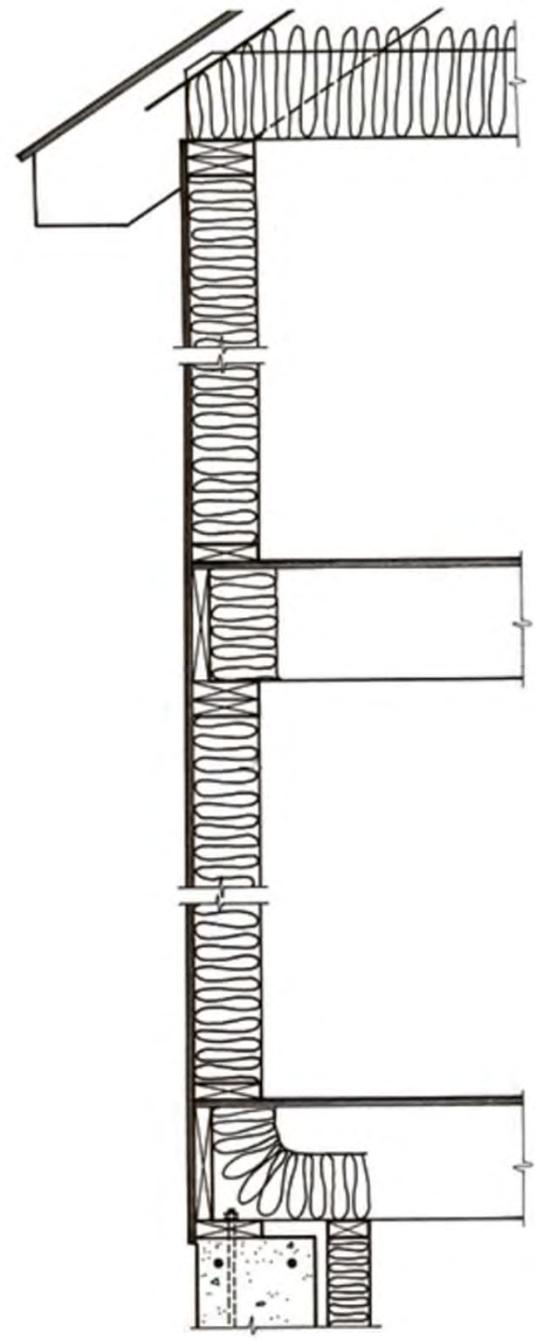
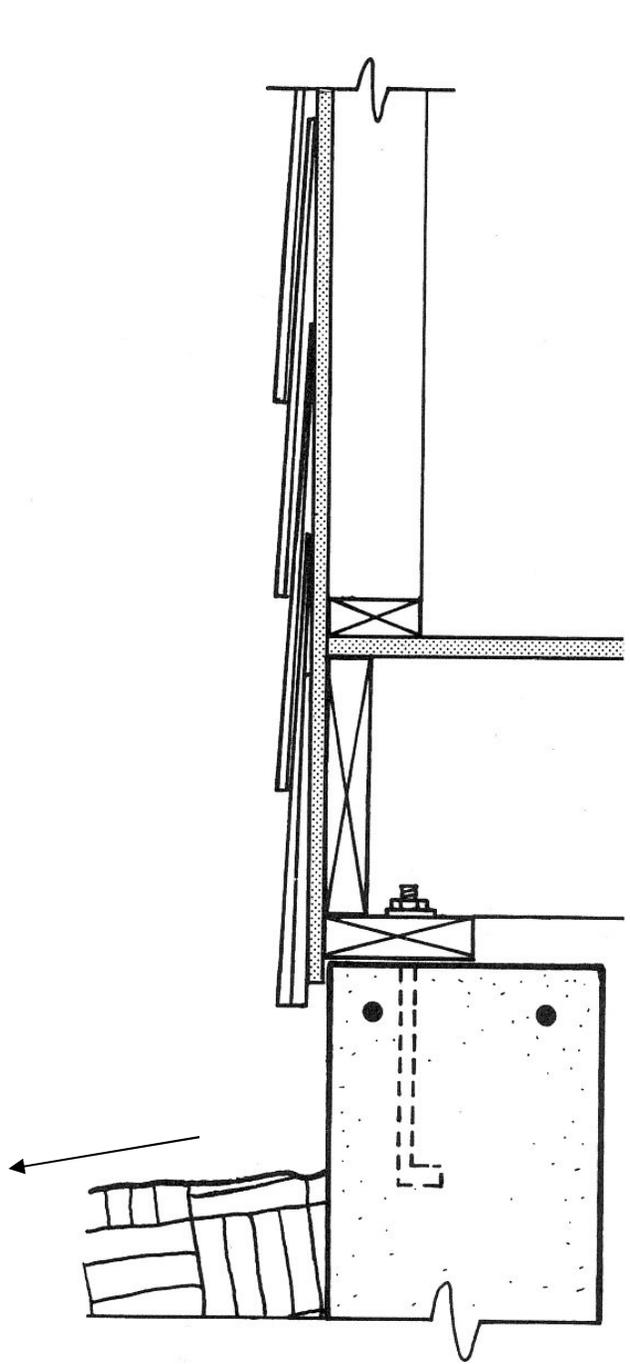
Crushed stone drainage fill has been placed within this foundation wall of a full basement. The vapor barrier and a concrete slab will be added to provide the basement floor. Pockets to receive first floor beams have been blocked out at the top of the wall.

Note, the lightwells in this photograph.

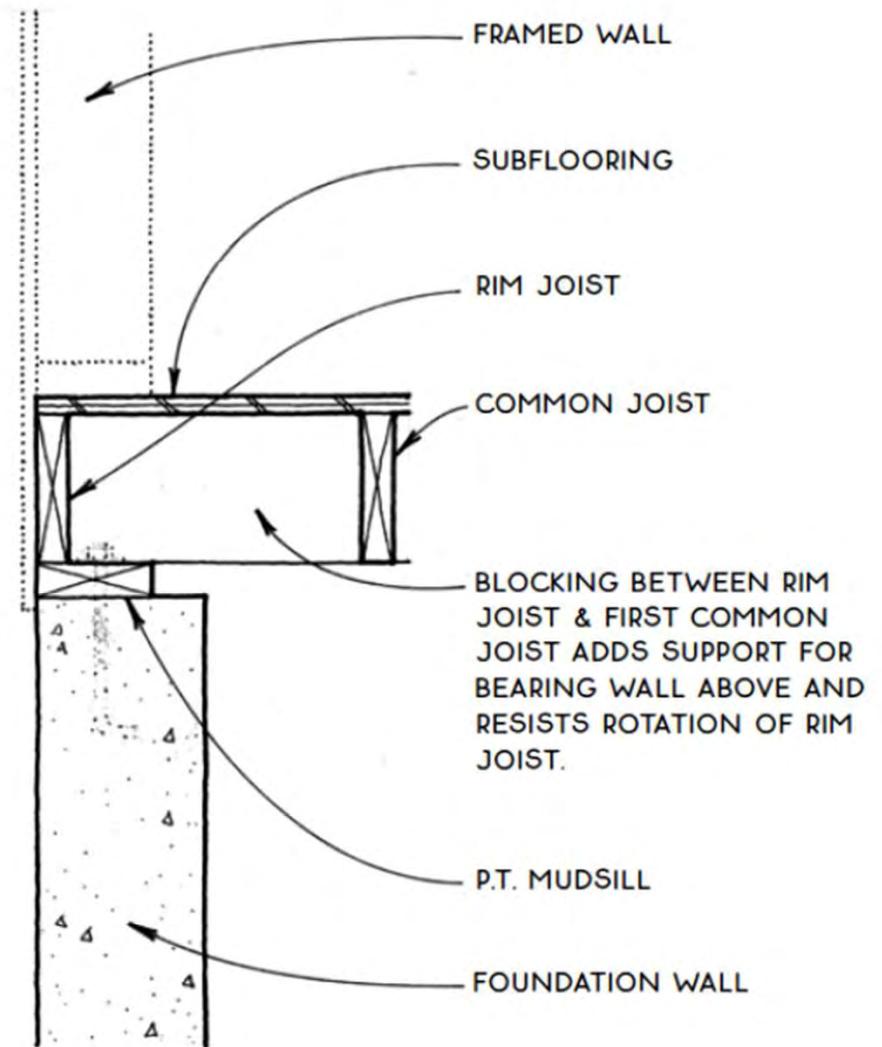
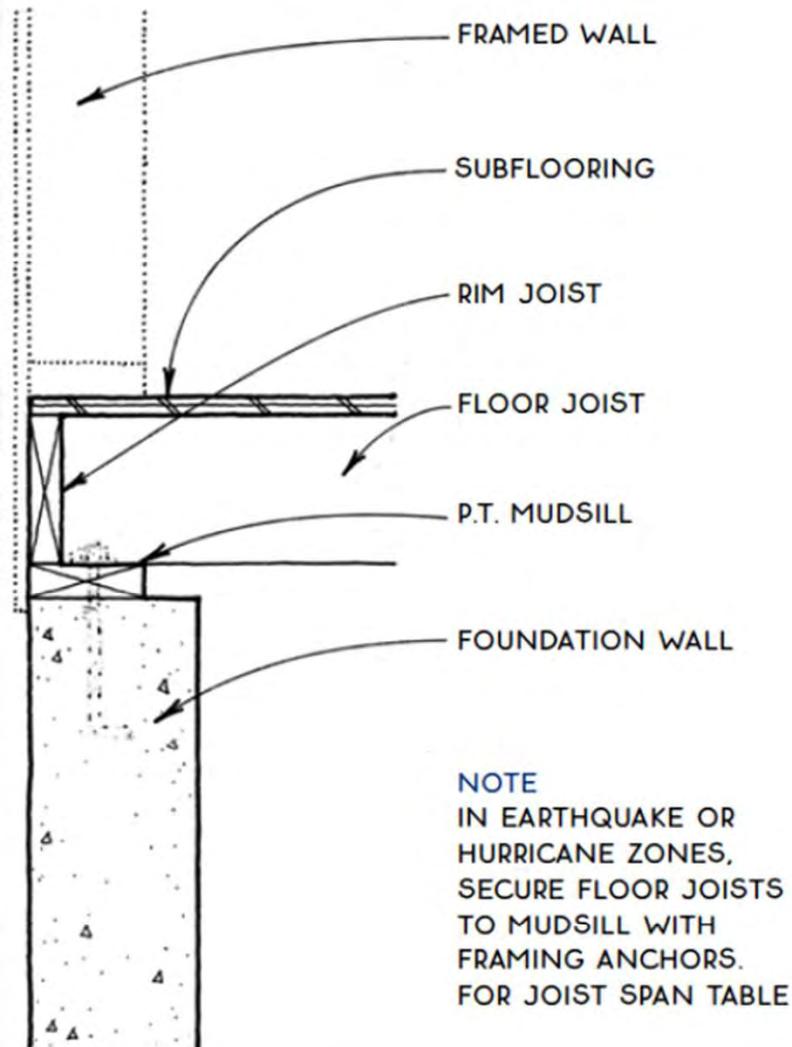




A crawl space isolates the first floor wood platform from the earth and provides space for electrical and plumbing lines. A concrete "rat slab" has been poured over the vapor barrier. The headroom is just sufficient for a small person to stand up.

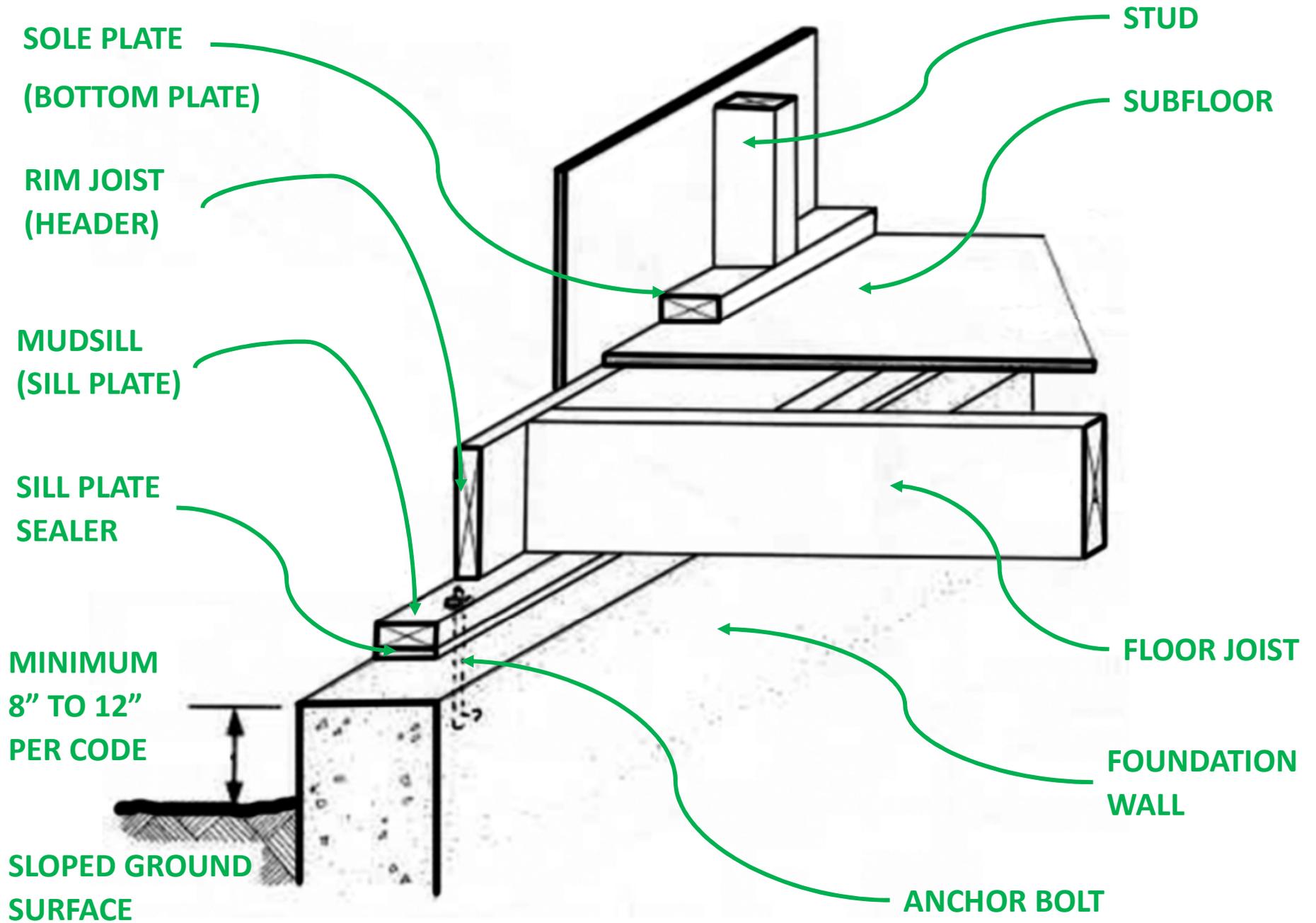


**TYPICAL WOOD FRAME CONSTRUCTION**



**A** JOISTS ON MUDSILL  
 Perpendicular to Wall

**B** JOISTS ON MUDSILL  
 Parallel to Wall

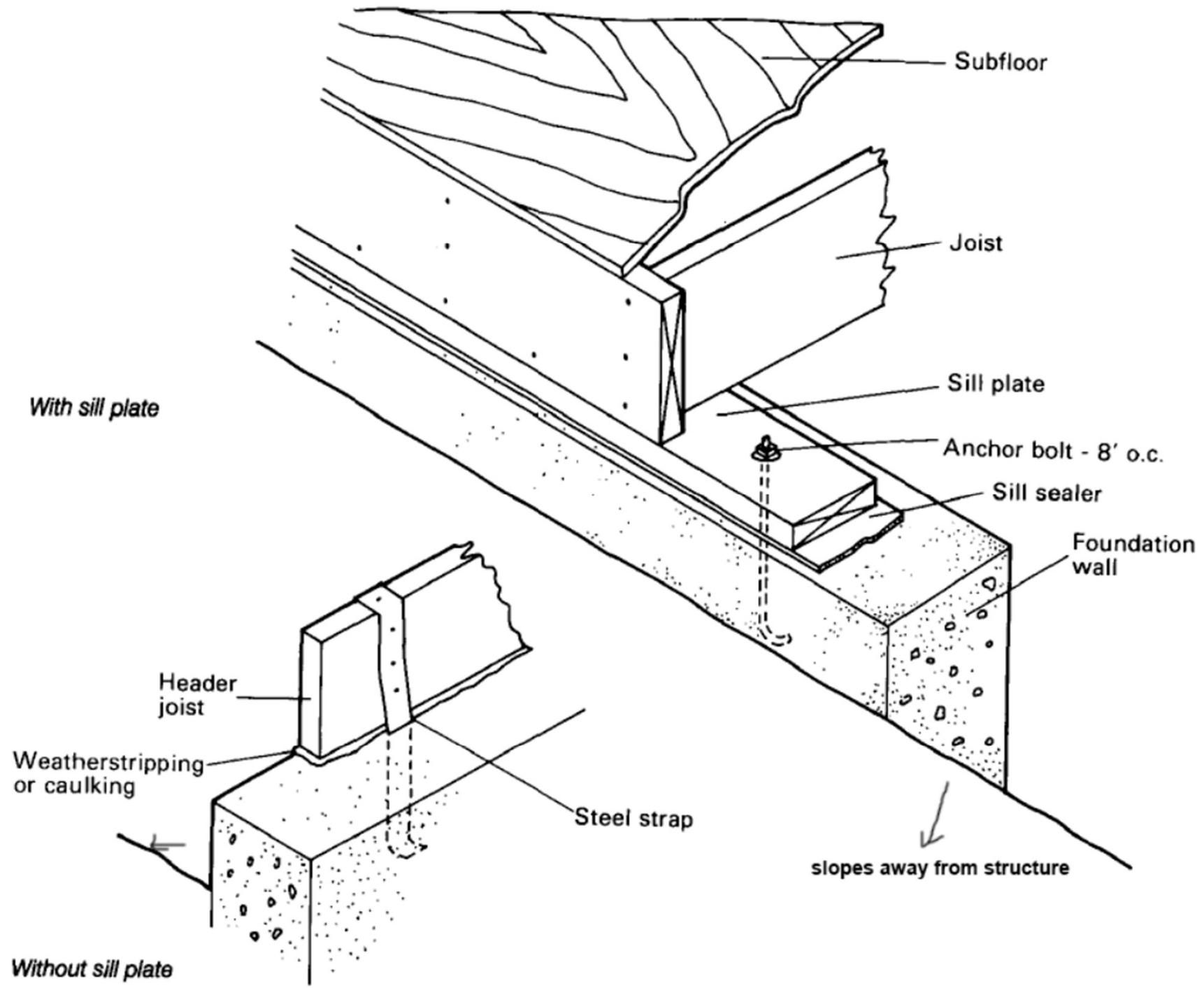


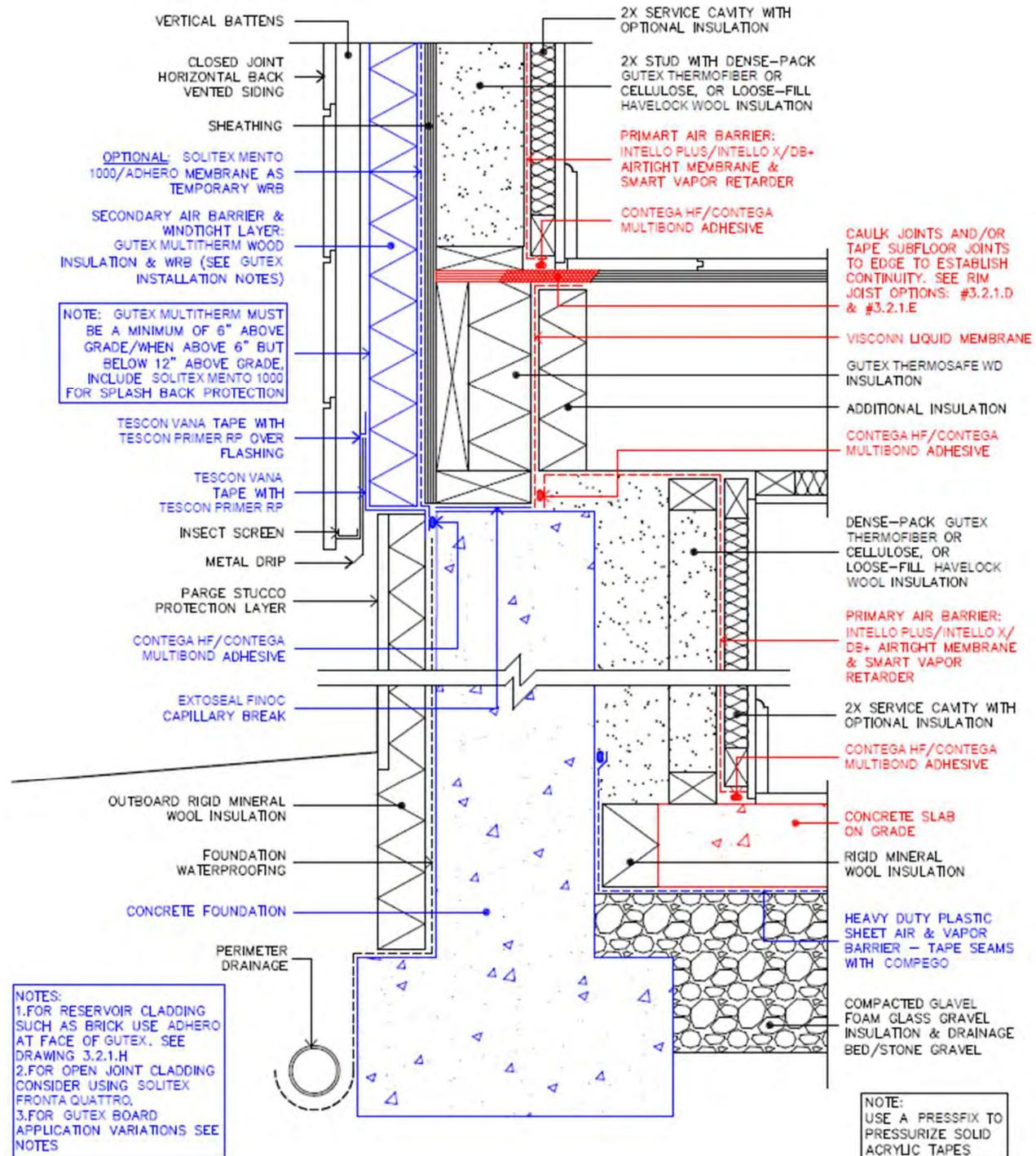


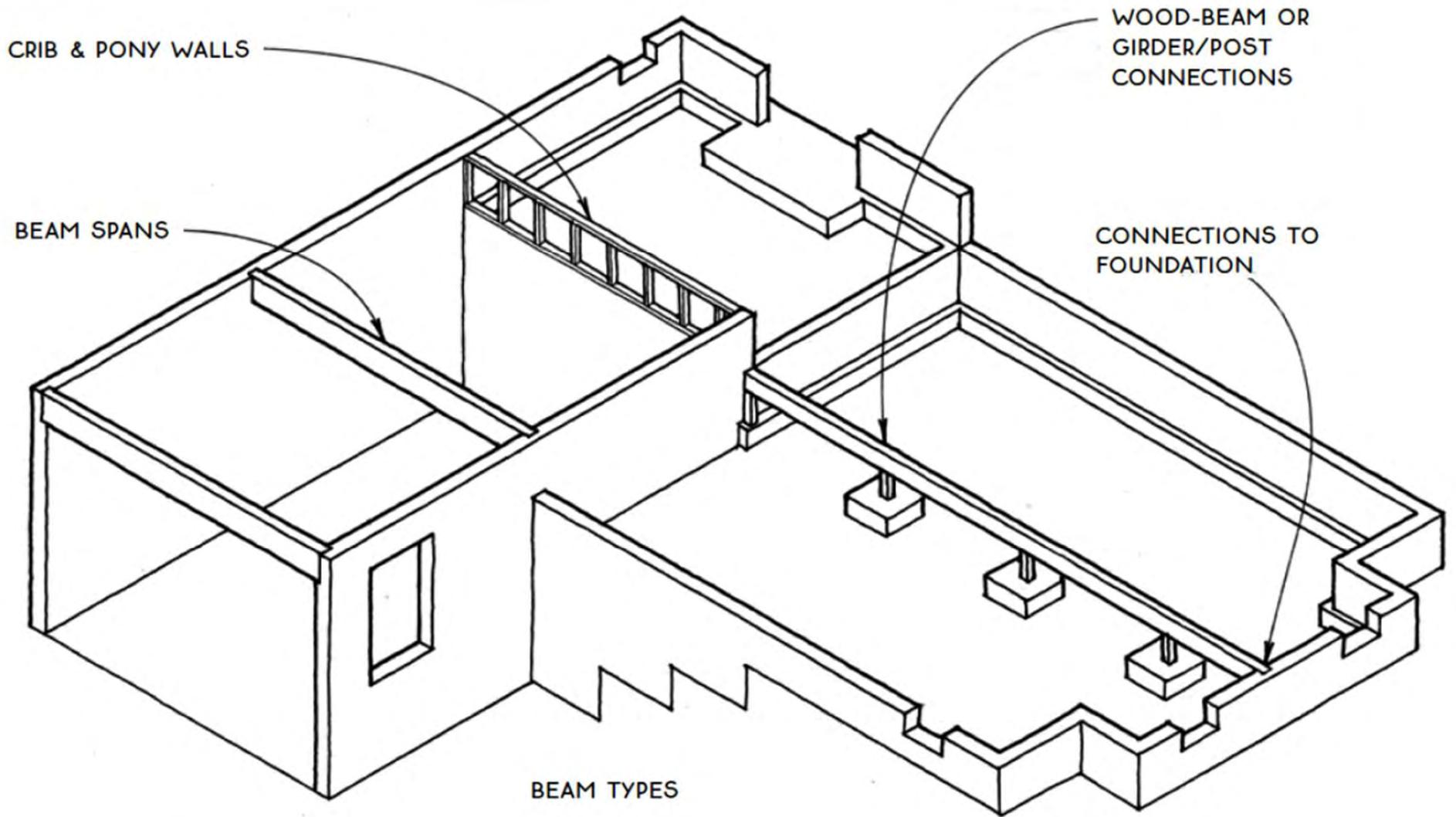
A double 2X6 sill has been secured with anchor bolts and the 2X10 floor joists - 16" o.c. are toe-nailed to them. A strip of sealant is seen between the wood and concrete. Back-filling is not done on the outside of the basement wall until the floor framing is in place to serve as bracing.

Sill sealer being applied and pressed straight through the anchor bolts.



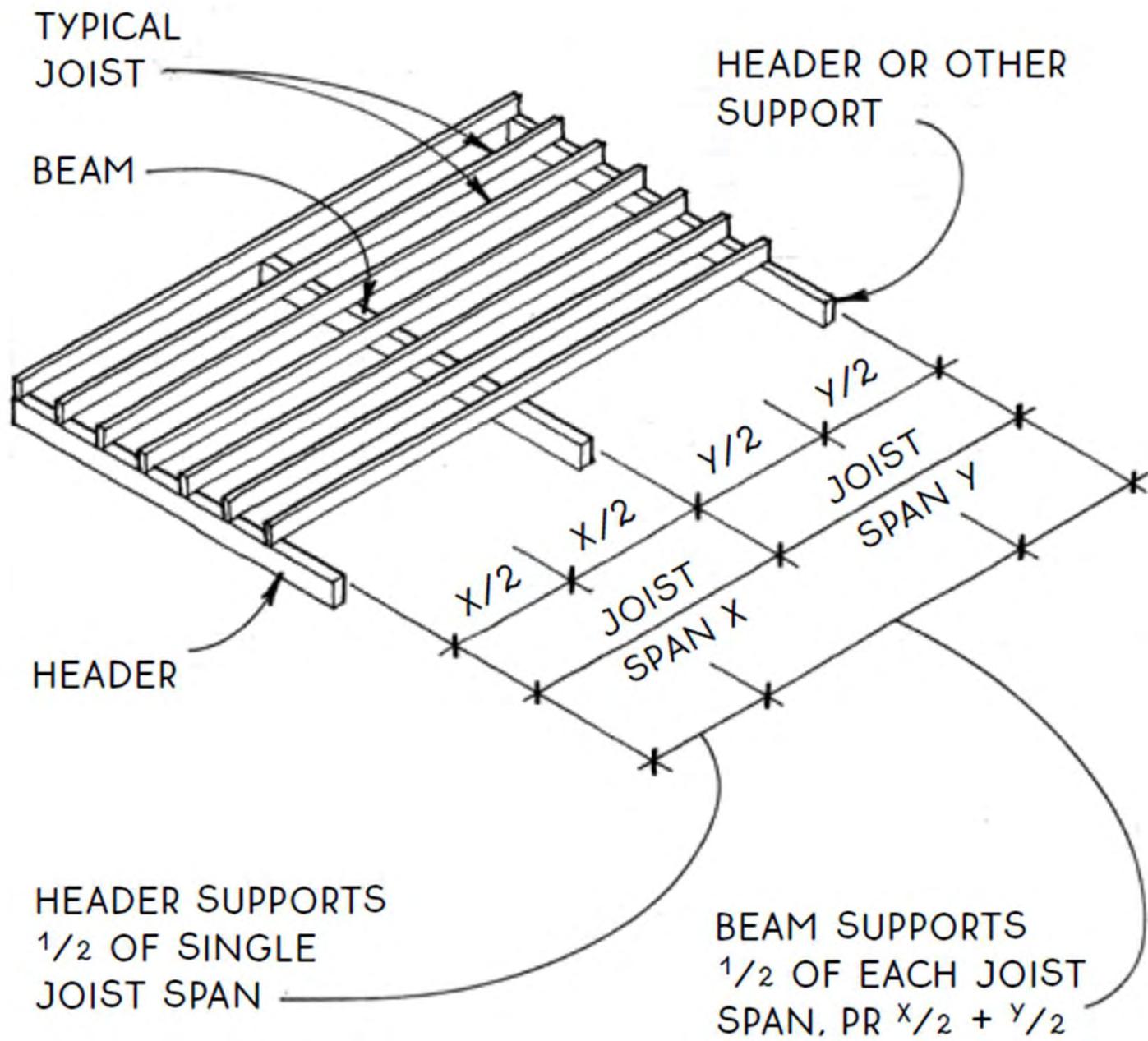








This foundation wall is forming a crawl space. Porous gravel or crushed stone fill is placed on its floor to assure good drainage and a sheet plastic as a vapor barrier is laid on top. Steel beams may support the first floor wood joists.







**Plywood:** Plywood subflooring should be installed with its long dimension and face grain perpendicular to the joists. Installing plywood with the subfloor parallel to the joists makes the flooring weaker.



**Some of the interior support for the floor framing is provided by the CMU interior walls of the basement space. Beams made up of triple joists provide other support. Where a partition will fall parallel to the floor joists, and around an opening for a stairway, the joists are doubled.**



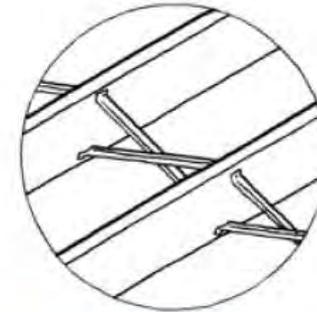
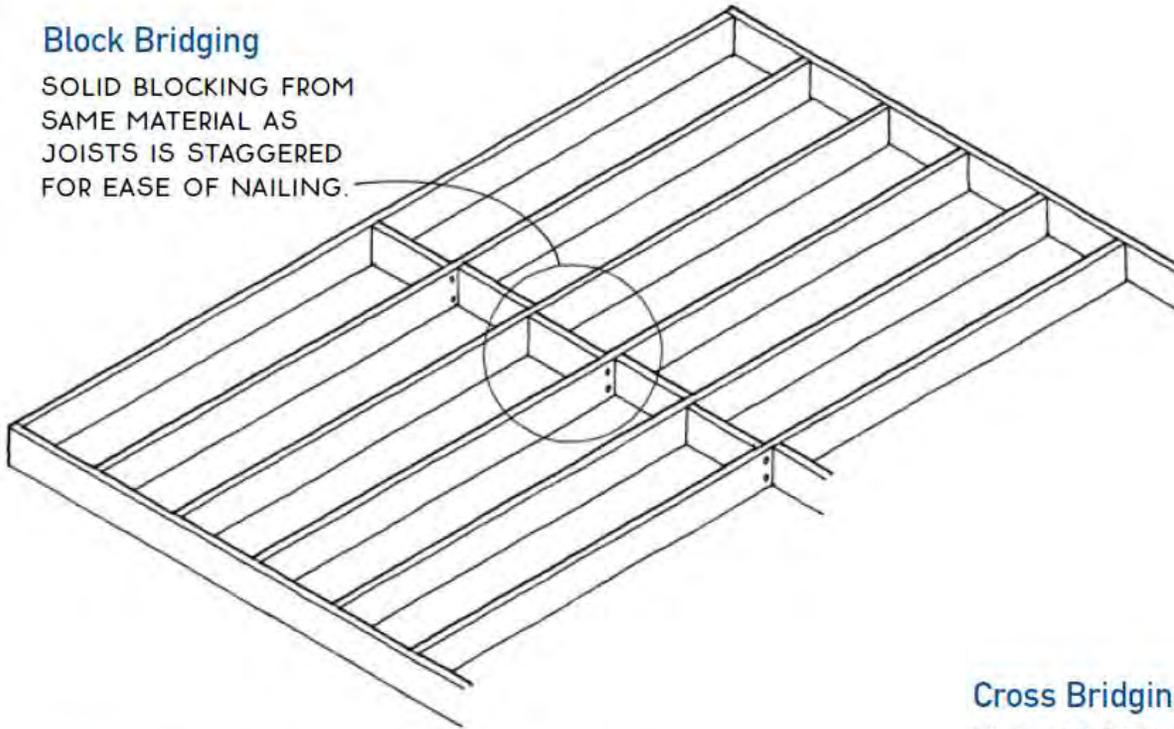
It is necessary to brace long joist at midspan against twisting or buckling. The method being used here is solid blocking with short pieces of floor joist. The blocking is staggered so that the pieces may be end nailed to the joists.



Bridging consists of wood or metal crossbracing or full-depth blocking between each joist at 8' (2440) intervals. Bridging may be required by some building codes if the joist depth is 6 or more times its thickness. However, it is usually not necessary if the joist ends are supported laterally against rotation and their top compression edges are restrained by sheathing or subflooring.

### Block Bridging

SOLID BLOCKING FROM SAME MATERIAL AS JOISTS IS STAGGERED FOR EASE OF NAILING.

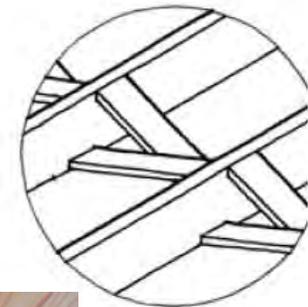


### Metal Bridging

METAL PIECES SHOULD NOT TOUCH EACH OTHER.

### Cross Bridging

$5/4 \times 3$  OR  $5/4 \times 4$  OR  $2 \times 2$  OR  $1 \times 4$  BOARDS ARE NAILED IN A CROSS PATTERN BETWEEN JOISTS. PIECES SHOULD NOT TOUCH EACH OTHER.



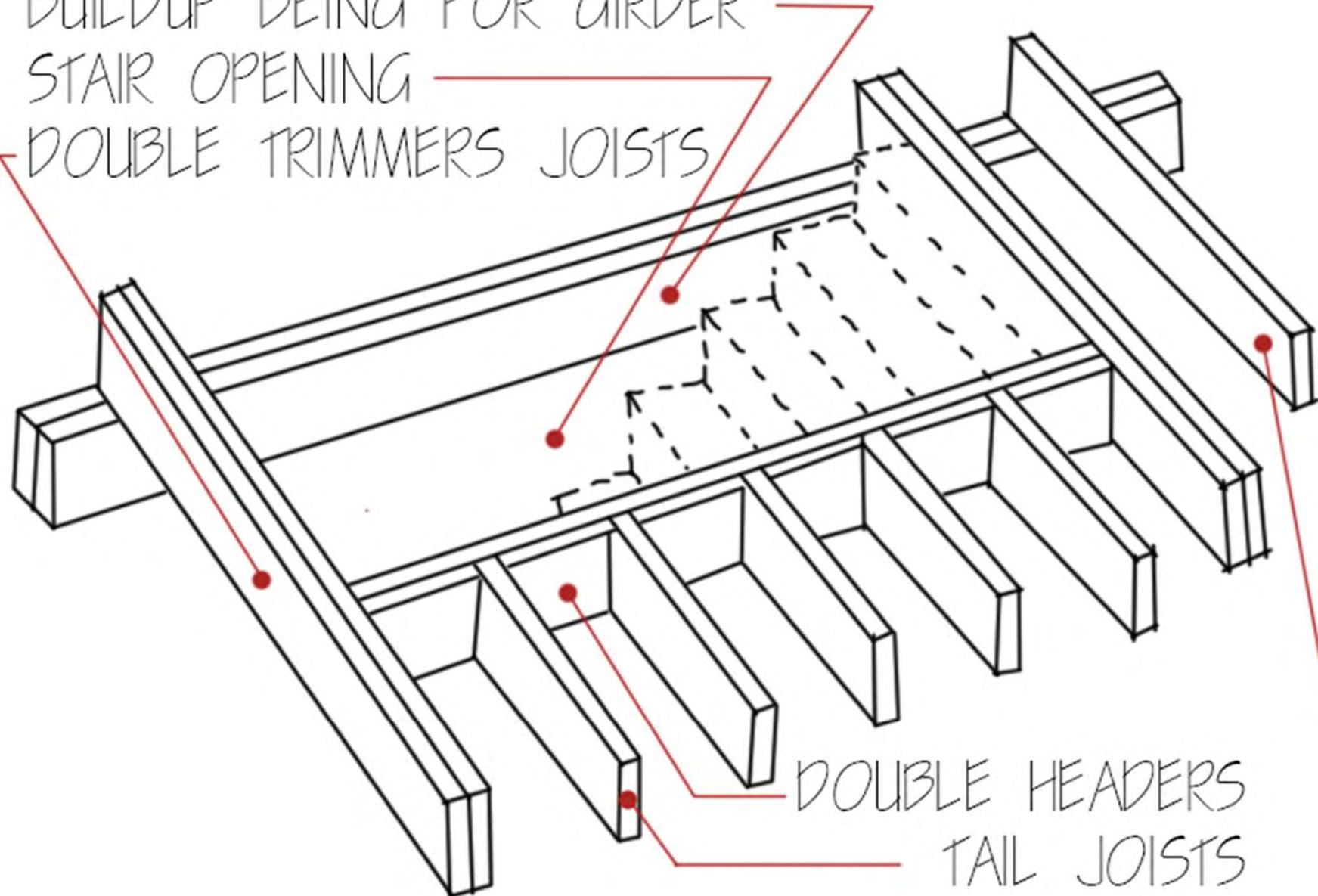
#### NOTE

FOR DEEP JOISTS WITH LONG SPANS (OVER 10 FT.), LOCAL CODES MAY REQUIRE BRIDGING TO PREVENT ROTATION & TO DISTRIBUTE THE LOADING.

## A BRIDGING



BUILDUP BEING FOR GIRDER  
STAIR OPENING  
DOUBLE TRIMMERS JOISTS



DOUBLE HEADERS  
TAIL JOISTS  
JOIST



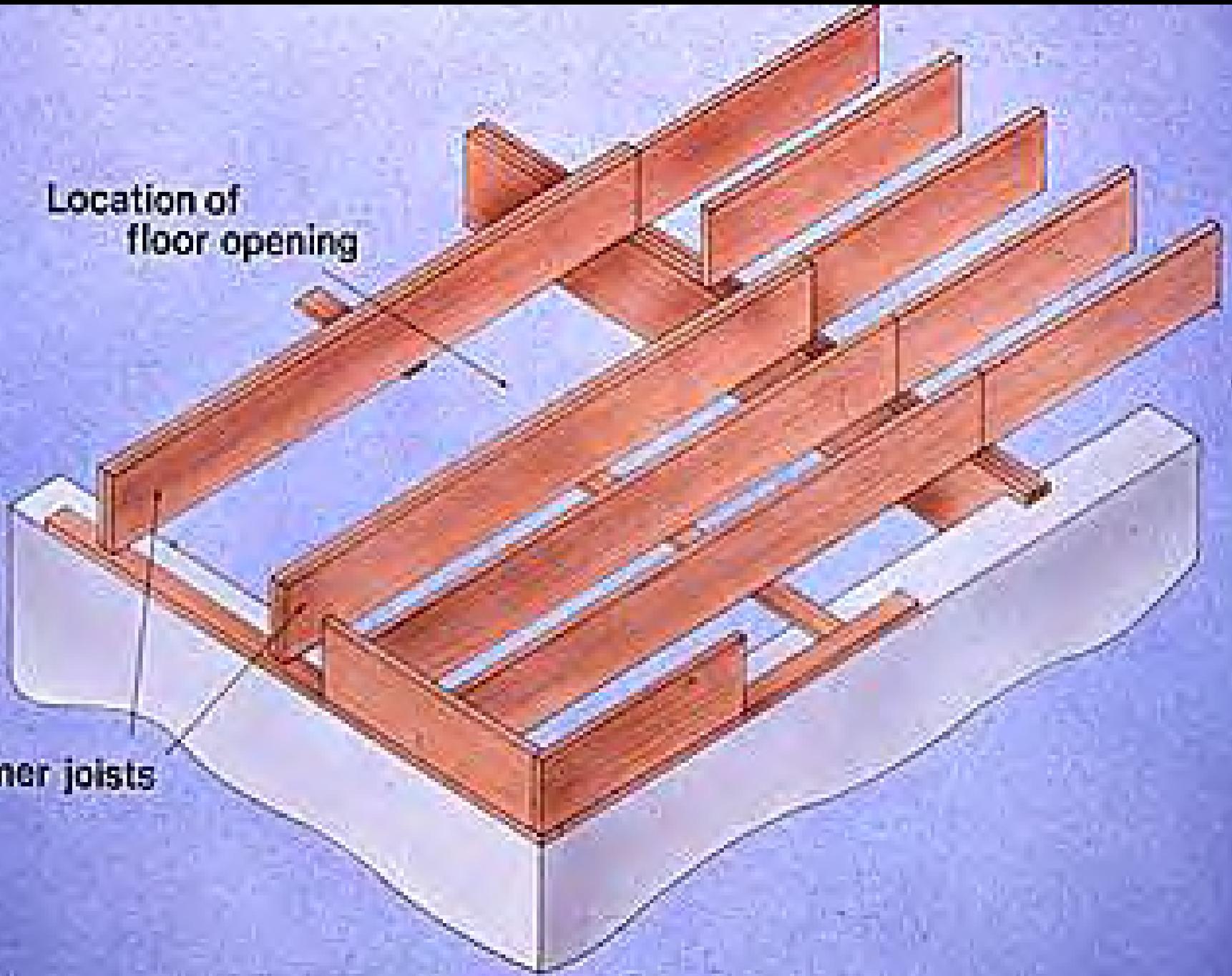
After the floor joist are in place plywood deck is installed on top of them. A mastic adhesive is gunned onto each joist just before the plywood is put down to increase the ridgity of the floor and to prevent squeaks.

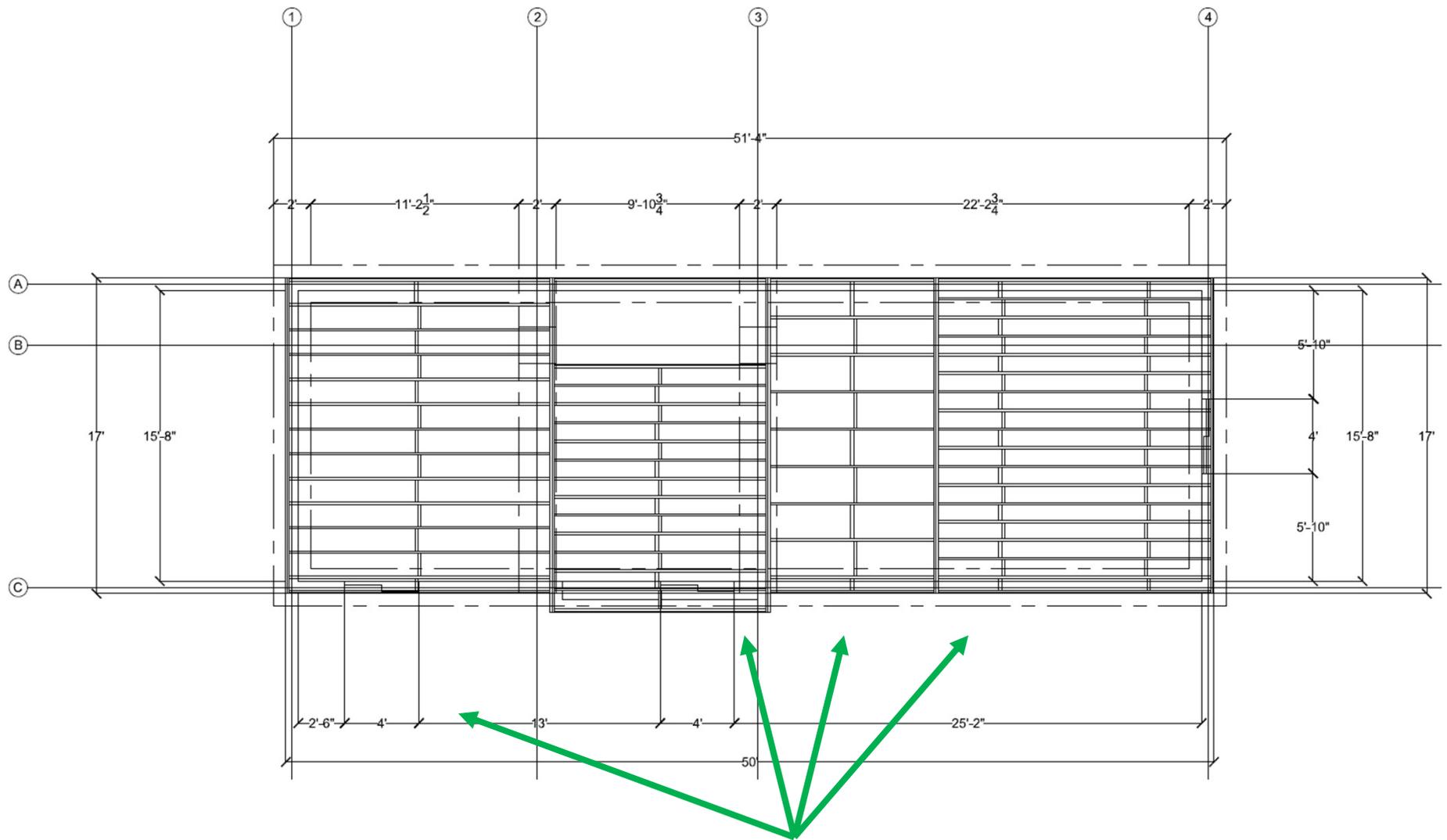


The plywood sheets form the subfloor of the house. The sheets are placed with their long dimension at right angles to the joists and their ends are supported at the mid-line of a joist. An air or electrically powered nailer is used for the nailing.

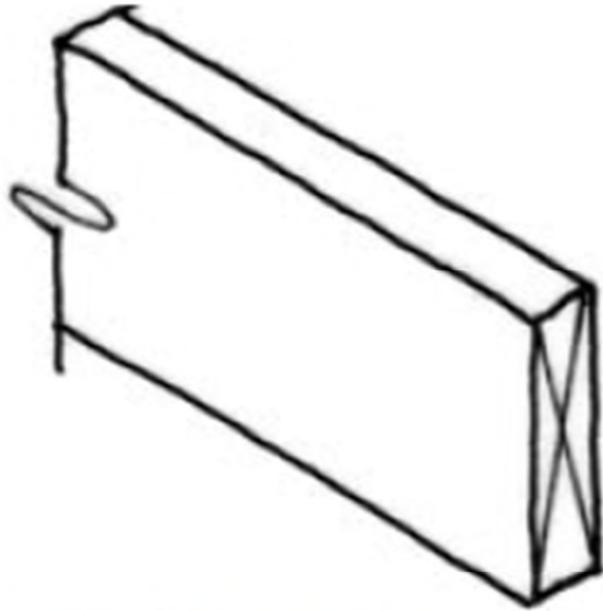
Location of floor opening

Trimmer joists

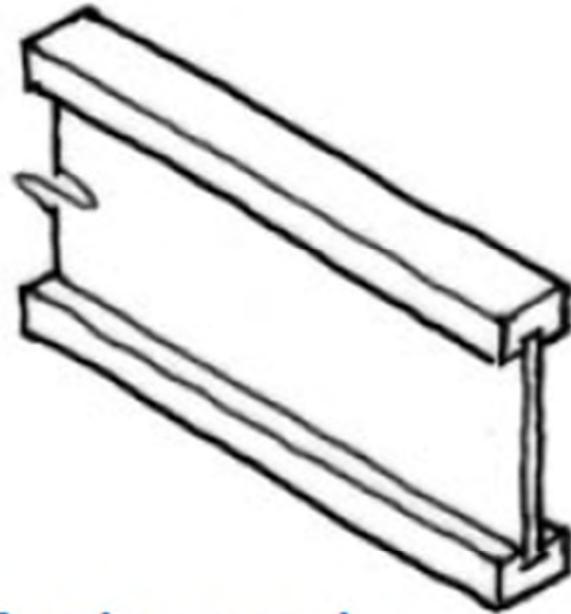




In this preliminary layout, different bays have different joist spacing.

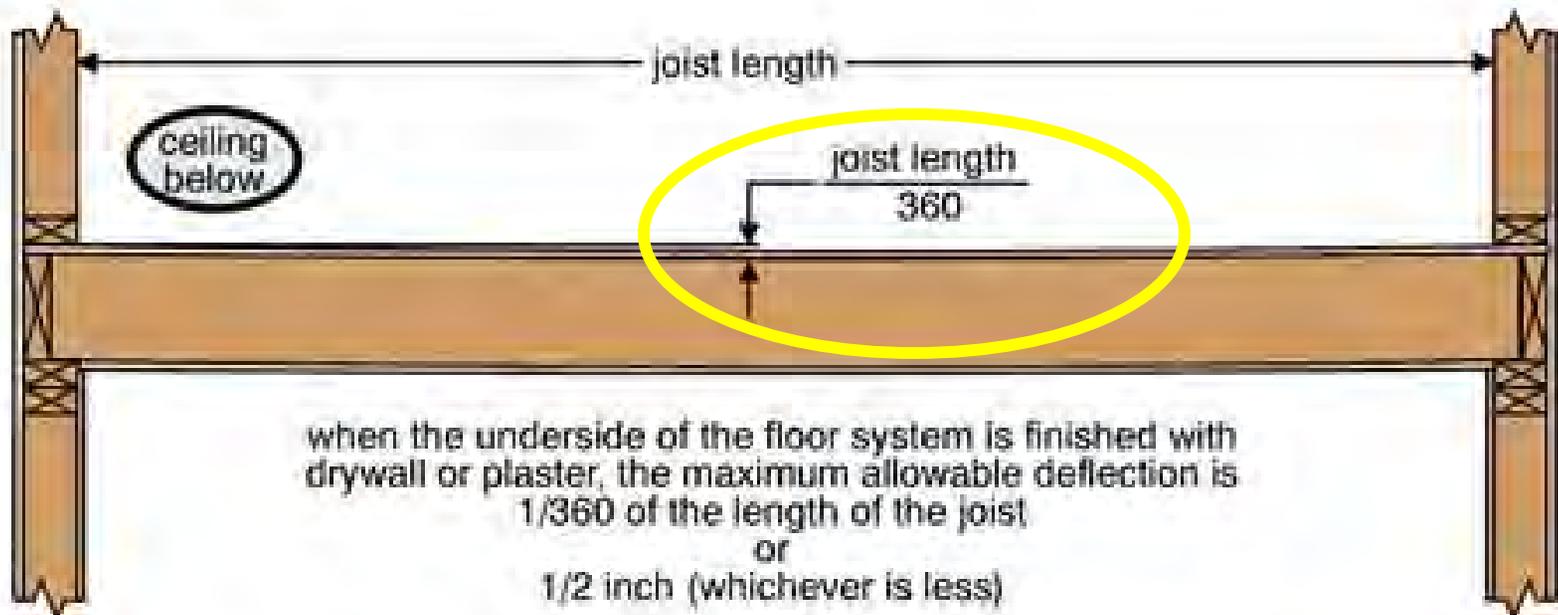
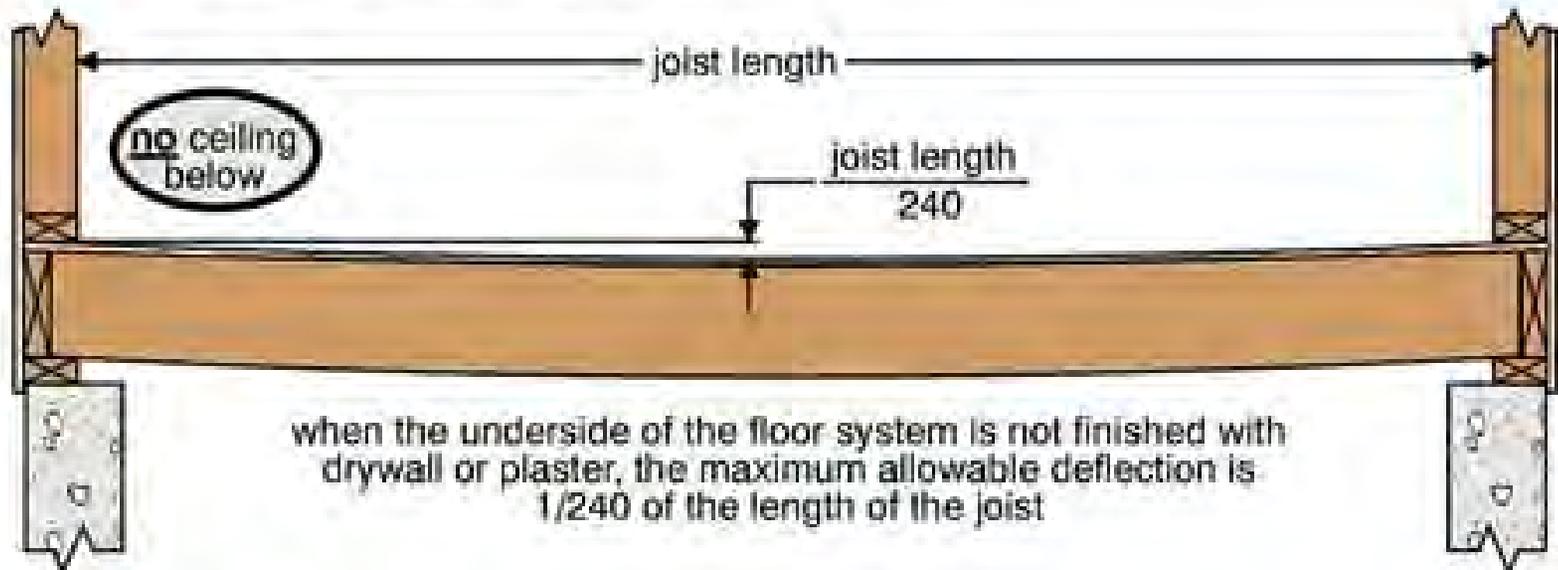


Solid-Sawn  
Joist



Engineered  
I-Joist

# Allowable floor deflections

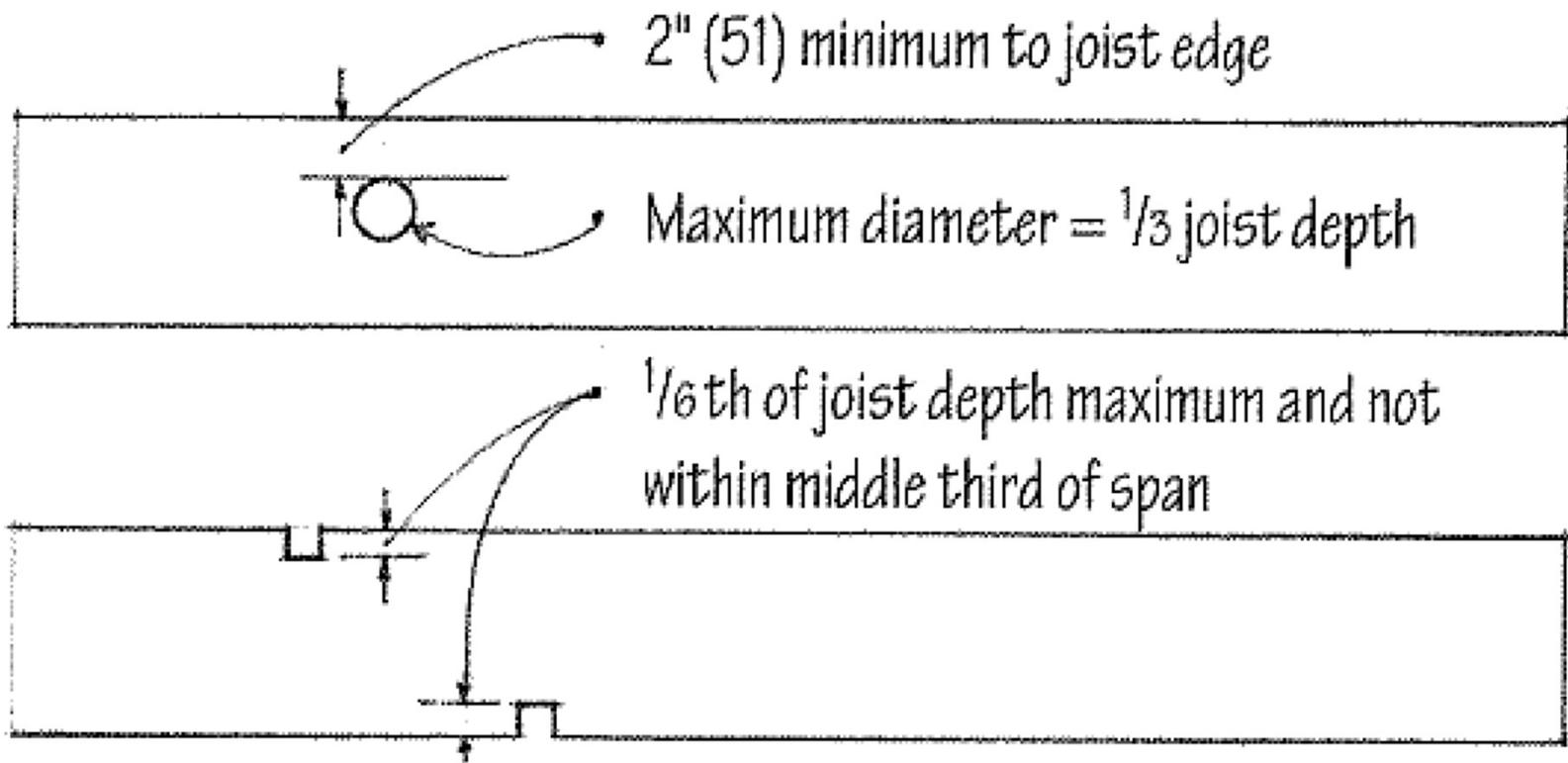


**TABLE R301.7**  
**ALLOWABLE DEFLECTION OF STRUCTURAL MEMBERS<sup>b, c</sup>**

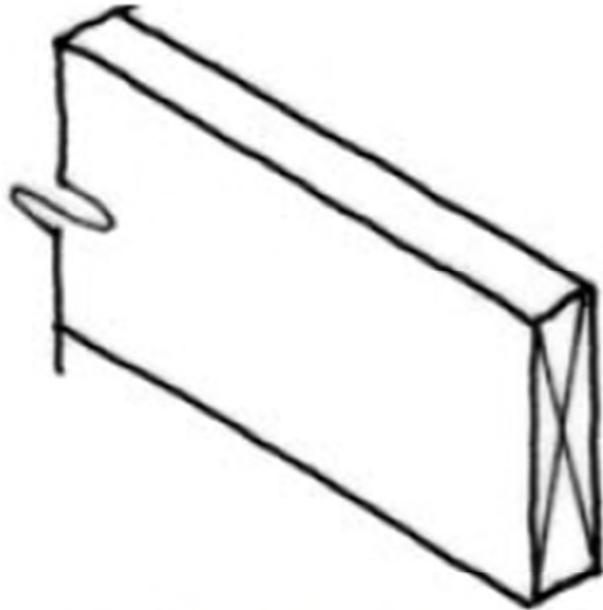
STRUCTURAL MEMBER	ALLOWABLE DEFLECTION
Rafters having slopes greater than 3:12 with finished ceiling not attached to rafters	<i>L/180</i>
Interior walls and partitions	<i>H/180</i>
Floors	<i>L/360</i>
Ceilings with brittle finishes (including plaster and stucco)	<i>L/360</i>
Ceilings with flexible finishes (including gypsum board)	<i>L/240</i>
All other structural members	<i>L/240</i>
Exterior walls—wind loads <sup>a</sup> with plaster or stucco finish	<i>H/360</i>
Exterior walls—wind loads <sup>a</sup> with other brittle finishes	<i>H/240</i>
Exterior walls—wind loads <sup>a</sup> with flexible finishes	<i>H/120<sup>d</sup></i>
Lintels supporting masonry veneer walls <sup>e</sup>	<i>L/600</i>

**Note:** *L* = span length, *H* = span height.

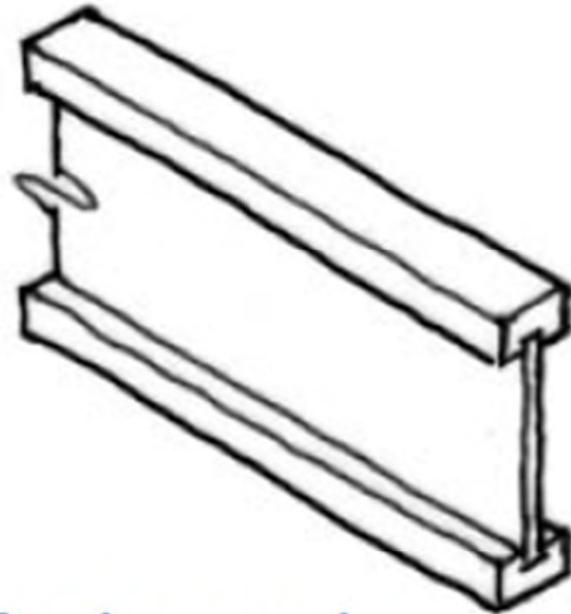




To allow plumbing and electrical lines to pass through floor joists, cuts may be made according to the guidelines illustrated above.

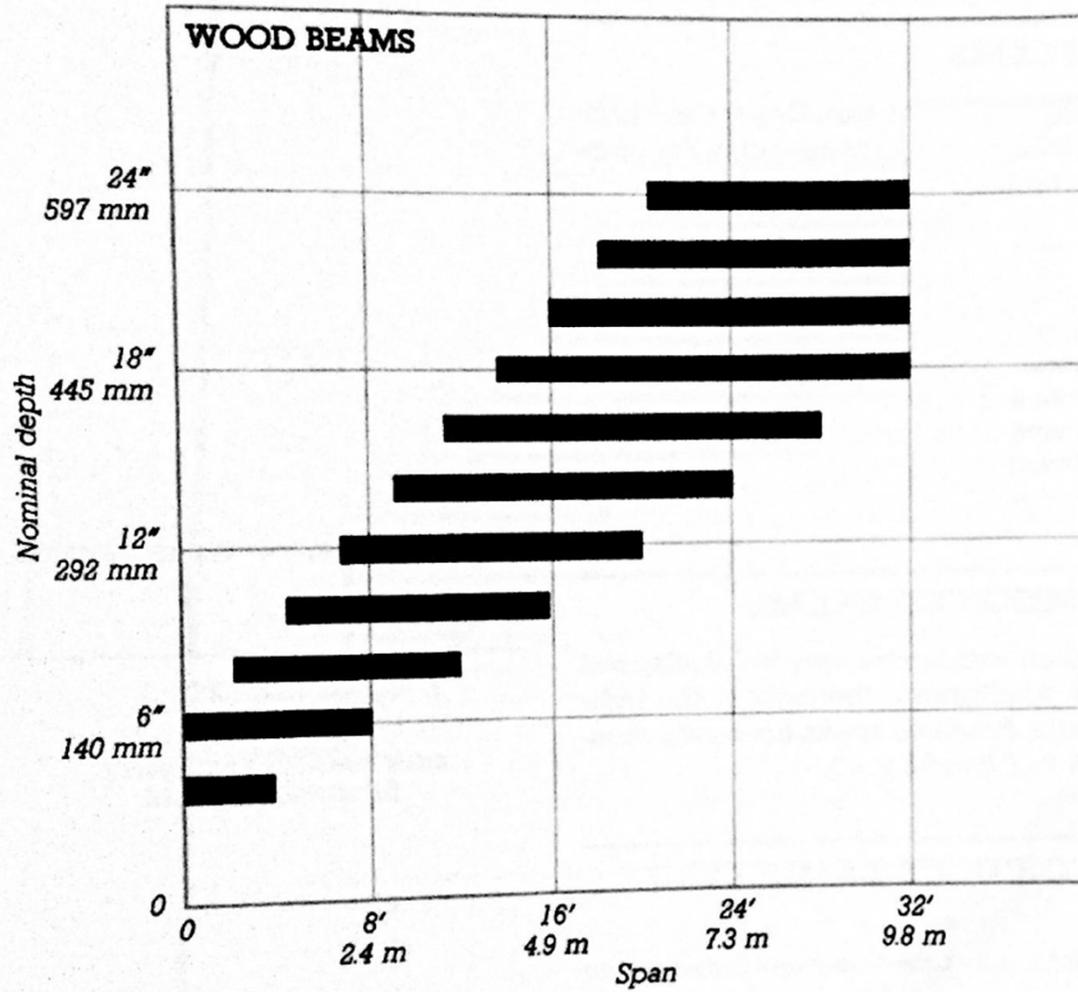


Solid-Sawn  
Joist



Engineered  
I-Joist

Half the class will design with TJI or  
engineered I Joists the other will design with  
Solid-Sawn Joists.



**SOLID BEAM**



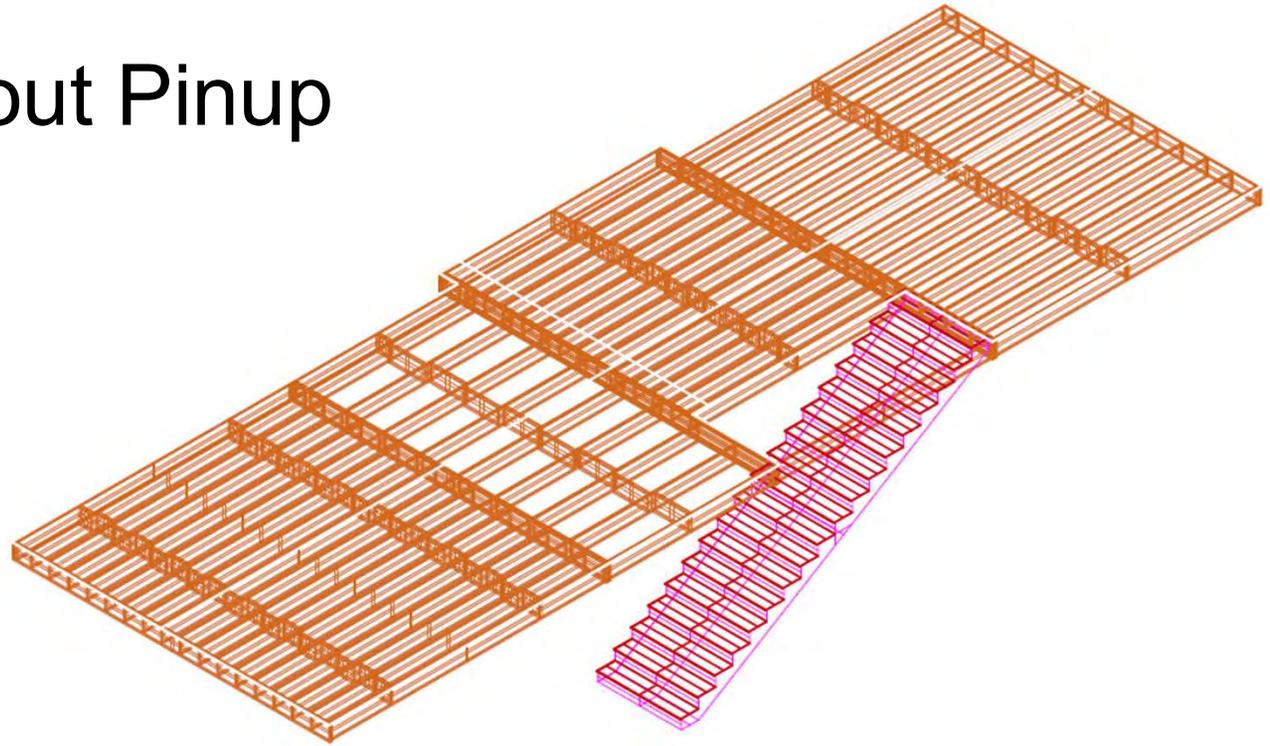
**BUILT-UP BEAM**

This chart is for solid and built-up wood beams. For girders, or for beams carrying large loads, read toward the left in the indicated areas. For light loads or strong woods, read toward the right. For typical beam conditions, read from the middle of the indicated areas.

- Strong woods include Douglas Fir, Larch, Southern Pine, and Oak.
- Practical widths for solid beams range from one-fourth of the depth of the beam to equal to the depth of the beam.
- A girder should be at least 2 in. (50 mm) deeper than the beams it supports.

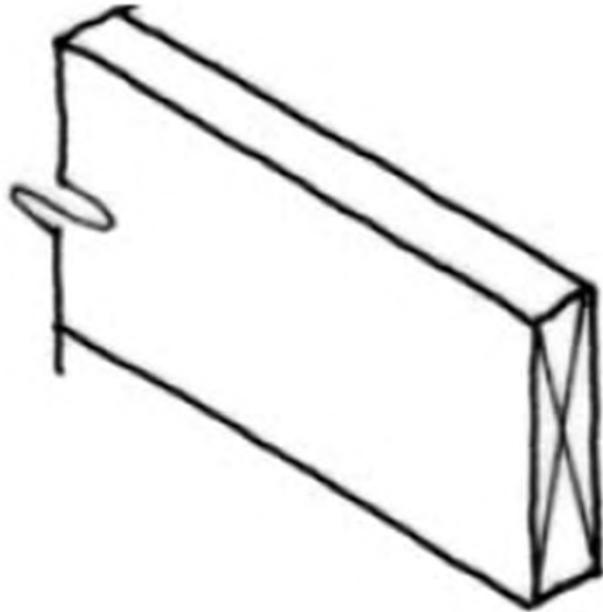
# For next class:

- Joist Layout plan
- Joist layout Pinup



## Links:

- **American Wood Council (AWC)**  
<https://awc.org/codes-standards/calculators-software/spancalc>
- **Forest Products Supply**  
<http://www.fp-supply.com/st-louis-trusjoist-tji-i-joists.html>
- **The Engineered Wood Association (APA)**  
[\*Advanced Framing Guide\*](#)
- **Span Tables Tutorial**  
<https://www.awc.org/codes-standards/spantables/tutorial>



Solid-Sawn  
Joist



AMERICAN WOOD COUNCIL

### **Floor Joist Spacing and Layout**

<https://awc.org/codes-standards/calculators-software/spancalc>

## Maximum Span Calculator for Wood Joists and Rafters

<https://awc.org/codes-standards/calculators-software/spancalc>

### Assume:

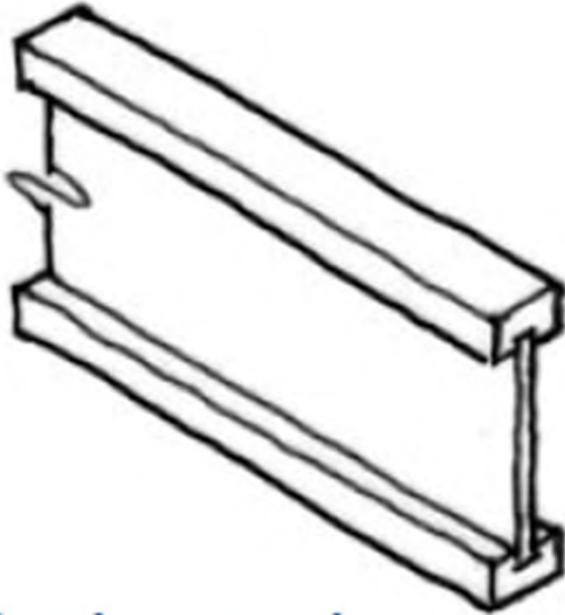
- Species: Douglas Fir-Larch
- Size: **PER YOUR DESIGN**
- Grade: No. 1
- Member Type: Floor Joists
- Deflection Limit: L/360
- Spacing: 12" or **16"** or 24" **PER YOUR DESIGN**
- Live Load (psf): 40
- Dead Load (psf): 20

Species	Douglas Fir-Larch (North)
Size	2x12
Grade	Select Structural
Member Type	Floor Joists
Deflection Limit	L/360
Spacing (in)	16
Exterior Exposure	Wet service conditions? No
	Incised lumber? No
Live Load (psf)	40
Dead Load (psf)	15

[Calculate Maximum Horizontal Span](#)

[Go to Span Options Calculator for Wood Joists & Rafters](#)

[LIMITS OF USE](#) [HELP](#) [RESTART](#)



Engineered  
I-Joist or TJI's

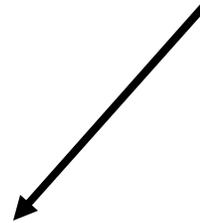
## Floor Joist Spacing and Layout

•Forest Products Supply

<http://www.fp-supply.com/st-louis-trusjoist-tji-i-joists.html>

# Assume:

- Deformation limit L/360
- 40-psf live load
- 20-psf dead load
- 12" or **16"** or 24"



**L/360 Live Load Deflection (Minimum Criteria per Code)**

Depth	TJI®	40 PSF Live Load / 10 PSF Dead Load				40 PSF Live Load / 20 PSF Dead Load			
		12" o.c.	16" o.c.	19.2" o.c.	24" o.c.	12" o.c.	16" o.c.	19.2" o.c.	24" o.c.
9½"	110	18'-9"	17'-2"	15'-8"	14'-0"	18'-1"	15'-8"	14'-3"	12'-9"
	210	19'-8"	18'-0"	17'-0"	15'-4"	19'-8"	17'-2"	15'-8"	14'-0"
	230	20'-3"	18'-6"	17'-5"	16'-2"	<b>20'-3"</b>	18'-1"	16'-6"	14'-9"
11⅞"	110	22'-3"	19'-4"	17'-8"	15'-0" <sup>(1)</sup>	20'-5"	17'-8"	15'-1" <sup>(1)</sup>	14'-4" <sup>(1)</sup>
	210	23'-4"	21'-2"	19'-4"	17'-0" <sup>(1)</sup>	<b>22'-4"</b>	19'-4"	17'-8"	15'-9" <sup>(1)</sup>
	230	24'-0"	21'-11"	20'-5"	18'-3"	<b>23'-7"</b>	20'-5"	18'-7"	16'-7" <sup>(1)</sup>
	360	25'-4"	23'-2"	21'-10"	20'-0" <sup>(1)</sup>	<b>25'-4"</b>	<b>23'-2"</b>	<b>21'-10"<sup>(1)</sup></b>	17'-10" <sup>(1)</sup>
	560	28'-10"	26'-3"	24'-9"	23'-0"	<b>28'-10"</b>	<b>26'-3"</b>	<b>24'-9"</b>	20'-11" <sup>(1)</sup>
14"	110	24'-4"	21'-0"	19'-2"	17'-0" <sup>(1)</sup>	22'-2"	19'-2"	17'-0" <sup>(1)</sup>	15'-0" <sup>(1)</sup>
	210	26'-6"	23'-1"	21'-1"	18'-0" <sup>(1)</sup>	24'-4"	21'-1"	19'-2" <sup>(1)</sup>	16'-7" <sup>(1)</sup>
	230	27'-3"	24'-4"	22'-2"	19'-0" <sup>(1)</sup>	<b>25'-8"</b>	22'-2"	20'-3" <sup>(1)</sup>	17'-6" <sup>(1)</sup>
	360	28'-9"	26'-3"	24'-9" <sup>(1)</sup>	21'-0" <sup>(1)</sup>	<b>28'-9"</b>	<b>26'-3"<sup>(1)</sup></b>	22'-4" <sup>(1)</sup>	17'-10" <sup>(1)</sup>
	560	32'-8"	29'-9"	28'-0"	25'-0" <sup>(1)</sup>	<b>32'-8"</b>	<b>29'-9"</b>	<b>27'-3"<sup>(1)</sup></b>	20'-11" <sup>(1)</sup>
16"	210	28'-6"	24'-8"	22'-6" <sup>(1)</sup>	19'-0" <sup>(1)</sup>	26'-0"	22'-6" <sup>(1)</sup>	20'-7" <sup>(1)</sup>	16'-7" <sup>(1)</sup>
	230	30'-1"	26'-0"	23'-9"	21'-0" <sup>(1)</sup>	<b>27'-5"</b>	23'-9"	21'-8" <sup>(1)</sup>	17'-6" <sup>(1)</sup>
	360	31'-10"	29'-0"	26'-10" <sup>(1)</sup>	21'-0" <sup>(1)</sup>	<b>31'-10"</b>	<b>26'-10"<sup>(1)</sup></b>	22'-4" <sup>(1)</sup>	17'-10" <sup>(1)</sup>
	560	36'-1"	32'-11"	31'-0" <sup>(1)</sup>	25'-0" <sup>(1)</sup>	<b>36'-1"</b>	<b>31'-6"<sup>(1)</sup></b>	26'-3" <sup>(1)</sup>	20'-11" <sup>(1)</sup>

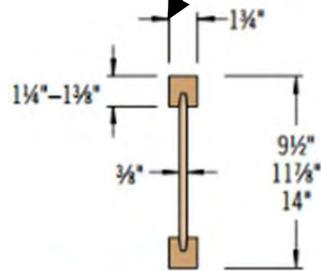
(1) Web stiffeners are required at intermediate supports of continuous-span joists when the intermediate bearing length is *less* than 5¼" and the span on either side of the intermediate bearing is greater than the following spans:

## L/360 Live Load Deflection (Minimum Criteria per Code)

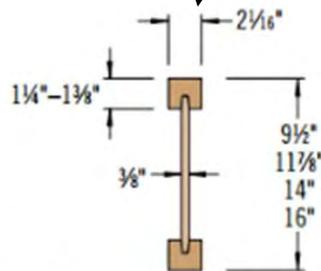
Be consistent on your project use only one size of TJI (110 or 210 joists)

Depth	TJI®	40 PSF Live Load / 10 PSF Dead Load				40 PSF Live Load / 20 PSF Dead Load			
		12" o.c.	16" o.c.	19.2" o.c.	24" o.c.	12" o.c.	16" o.c.	19.2" o.c.	24" o.c.
9½"	110	18'-9"	17'-2"	15'-8"	14'-0"	18'-1"	15'-8"	14'-3"	12'-9"
	210	19'-8"	18'-0"	17'-0"	15'-4"	19'-8"	17'-2"	15'-8"	14'-0"
	230	20'-3"	18'-6"	17'-5"	16'-2"	<b>20'-3"</b>	18'-1"	16'-6"	14'-9"
11⅝"	110	22'-3"	19'-4"	17'-8"	15'-9" <sup>(1)</sup>	20'-5"	17'-8"	16'-1" <sup>(1)</sup>	14'-4" <sup>(1)</sup>
	210	23'-4"	21'-2"	19'-4"	17'-3" <sup>(1)</sup>	<b>22'-4"</b>	19'-4"	17'-8"	15'-9" <sup>(1)</sup>
	230	24'-0"	21'-11"	20'-5"	18'-3"	<b>23'-7"</b>	20'-5"	18'-7"	16'-7" <sup>(1)</sup>
	360	25'-4"	23'-2"	21'-10"	20'-4" <sup>(1)</sup>	<b>25'-4"</b>	<b>23'-2"</b>	<b>21'-10"<sup>(1)</sup></b>	17'-10" <sup>(1)</sup>
	560	28'-10"	26'-3"	24'-9"	23'-0"	<b>28'-10"</b>	<b>26'-3"</b>	<b>24'-9"</b>	20'-11" <sup>(1)</sup>
14"	110	24'-4"	21'-0"	19'-2"	17'-2" <sup>(1)</sup>	22'-2"	19'-2"	17'-6" <sup>(1)</sup>	15'-0" <sup>(1)</sup>
	210	26'-6"	23'-1"	21'-1"	18'-10" <sup>(1)</sup>	24'-4"	21'-1"	19'-2" <sup>(1)</sup>	16'-7" <sup>(1)</sup>
	230	27'-3"	24'-4"	22'-2"	19'-10" <sup>(1)</sup>	<b>25'-8"</b>	22'-2"	20'-3" <sup>(1)</sup>	17'-6" <sup>(1)</sup>
	360	28'-9"	26'-3"	24'-9" <sup>(1)</sup>	21'-5" <sup>(1)</sup>	<b>28'-9"</b>	<b>26'-3"<sup>(1)</sup></b>	22'-4" <sup>(1)</sup>	17'-10" <sup>(1)</sup>
	560	32'-8"	29'-9"	28'-0"	25'-2" <sup>(1)</sup>	<b>32'-8"</b>	<b>29'-9"</b>	<b>26'-3"<sup>(1)</sup></b>	20'-11" <sup>(1)</sup>
16"	210	28'-6"	24'-8"	22'-6" <sup>(1)</sup>	19'-11" <sup>(1)</sup>	26'-0"	22'-6" <sup>(1)</sup>	20'-7" <sup>(1)</sup>	16'-7" <sup>(1)</sup>
	230	30'-1"	26'-0"	23'-9"	21'-1" <sup>(1)</sup>	<b>27'-5"</b>	23'-9"	21'-8" <sup>(1)</sup>	17'-6" <sup>(1)</sup>
	360	31'-10"	29'-0"	26'-10" <sup>(1)</sup>	21'-5" <sup>(1)</sup>	<b>31'-10"</b>	<b>26'-10"<sup>(1)</sup></b>	22'-4" <sup>(1)</sup>	17'-10" <sup>(1)</sup>
	560	36'-1"	32'-11"	31'-0" <sup>(1)</sup>	25'-2" <sup>(1)</sup>	<b>36'-1"</b>	<b>31'-6"<sup>(1)</sup></b>	26'-3" <sup>(1)</sup>	20'-11" <sup>(1)</sup>

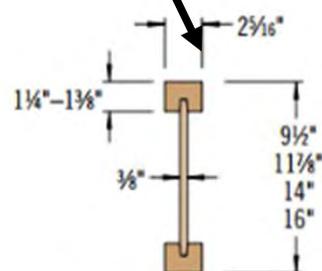
(1) Web stiffeners are required at intermediate supports of continuous-span joists when the intermediate bearing length is **less** than 5¼" and the span on either side of the intermediate bearing is greater than the following spans:



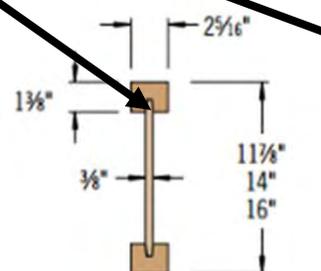
TJI® 110 Joists



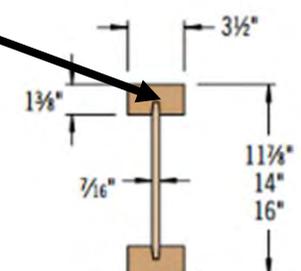
TJI® 210 Joists



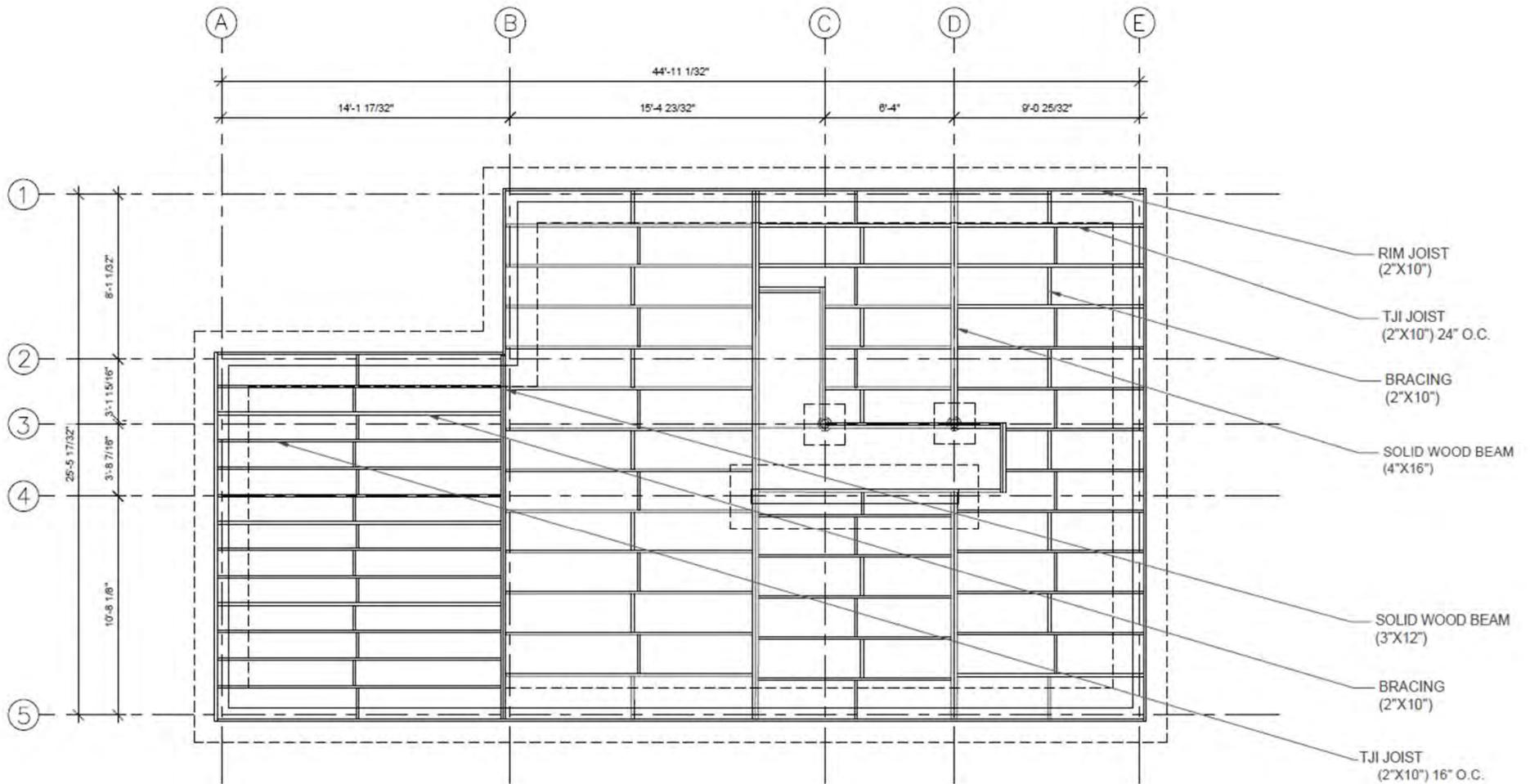
TJI® 230 Joists



TJI® 360 Joists

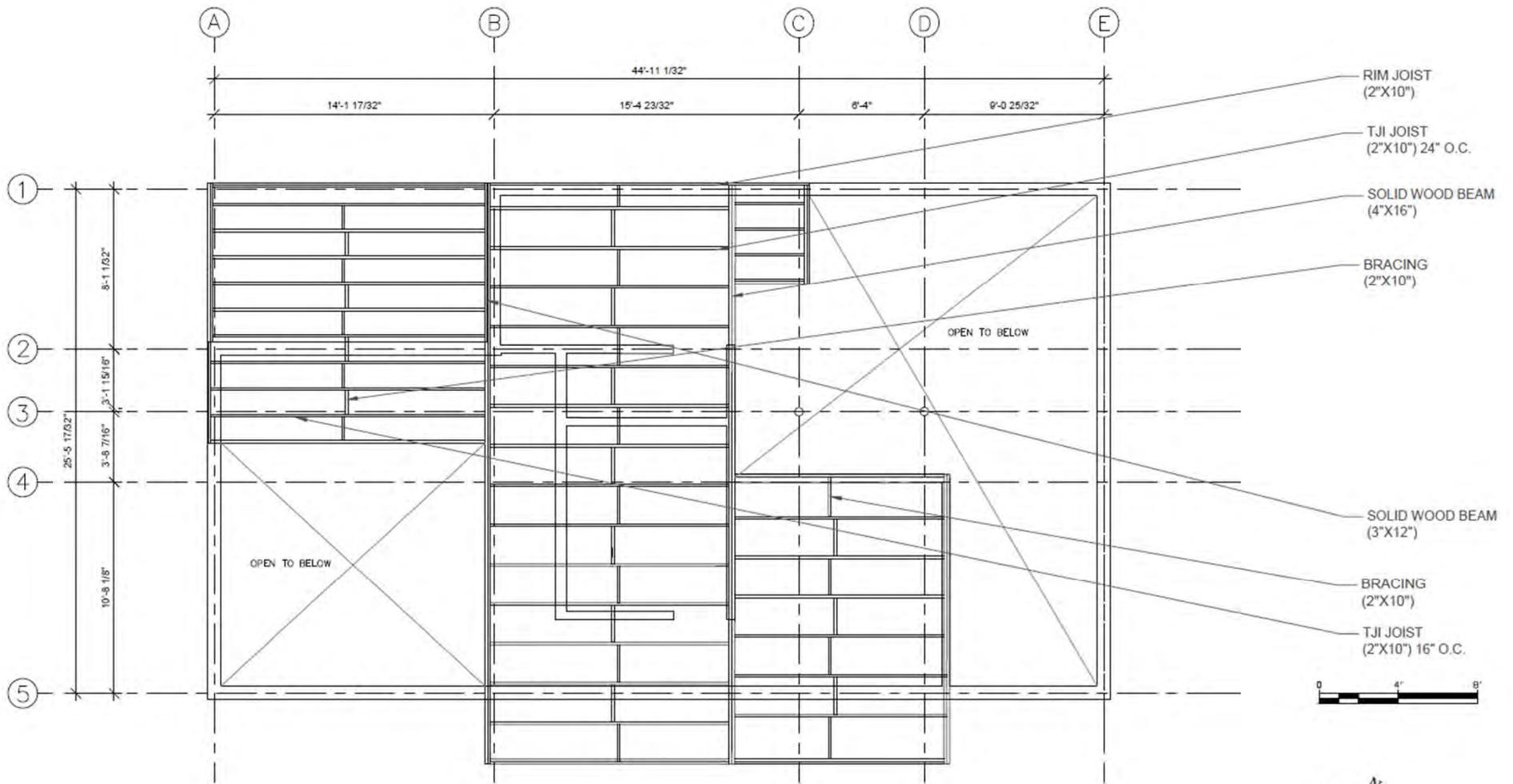


TJI® 560 Joists



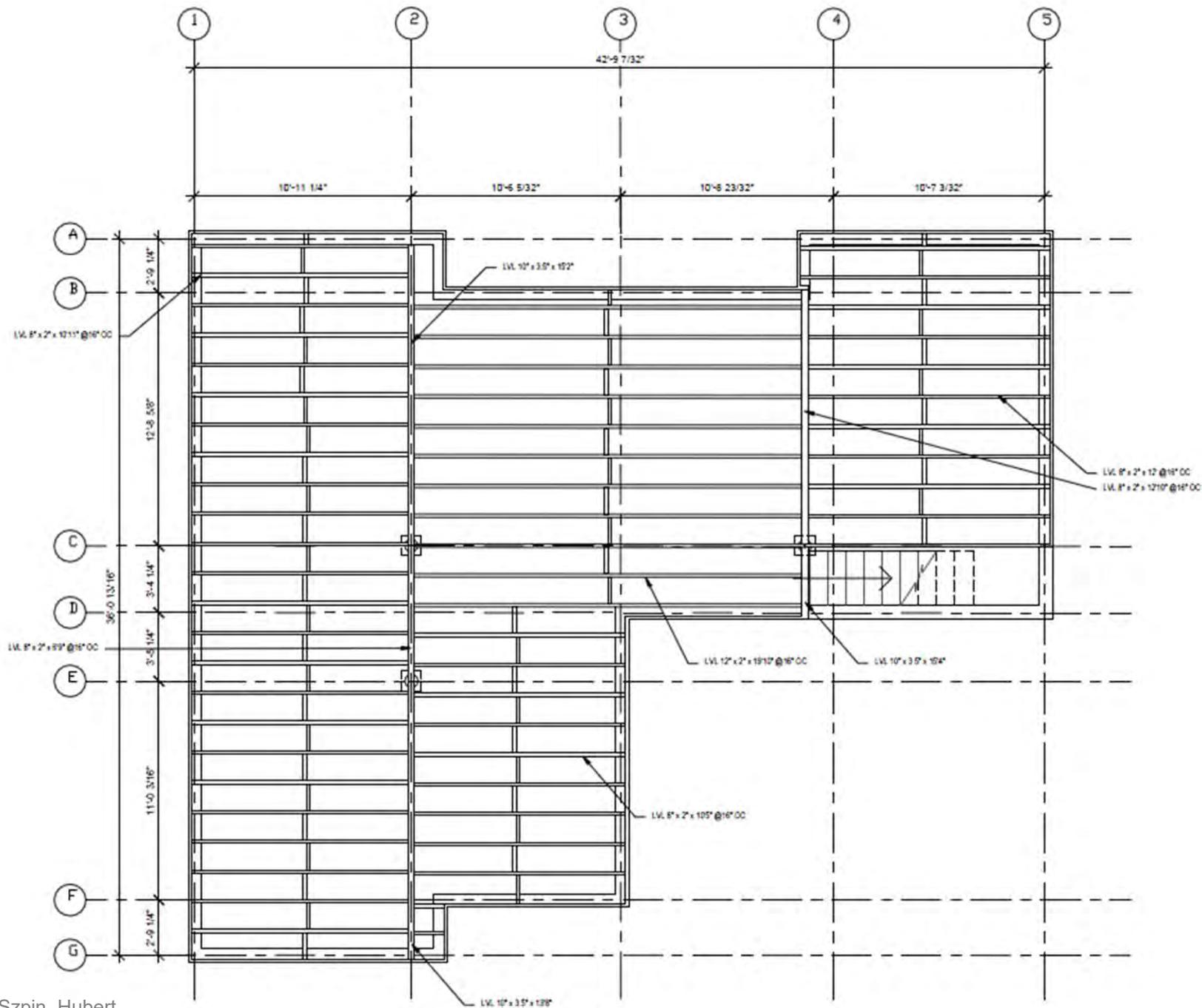
1 FIRST FLOOR JOIST PLAN  
 S102  $\frac{1}{4}'' = 1'-0''$

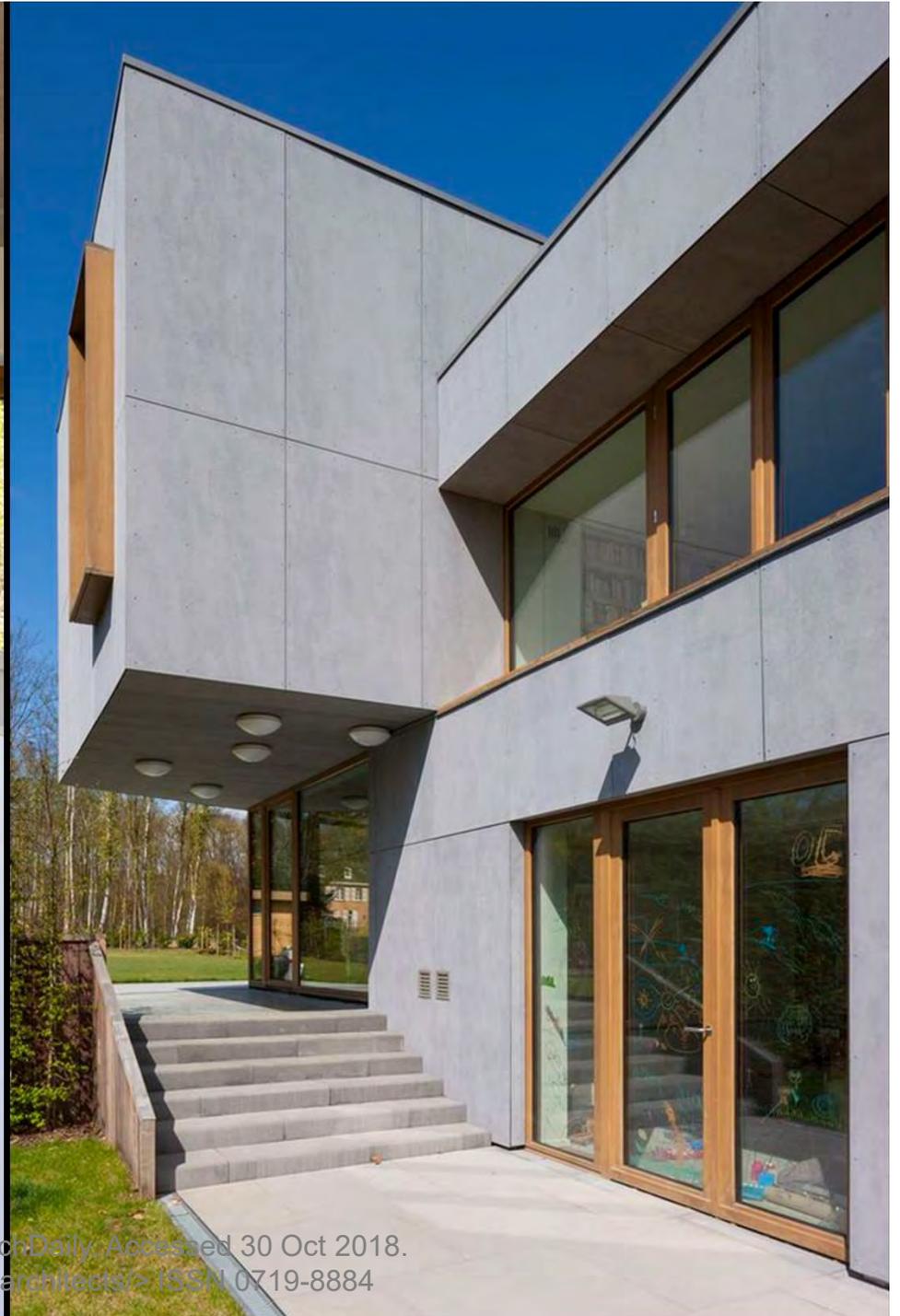




1 SECOND FLOOR JOIST PLAN  
 S202 1/4" = 1'-0"







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