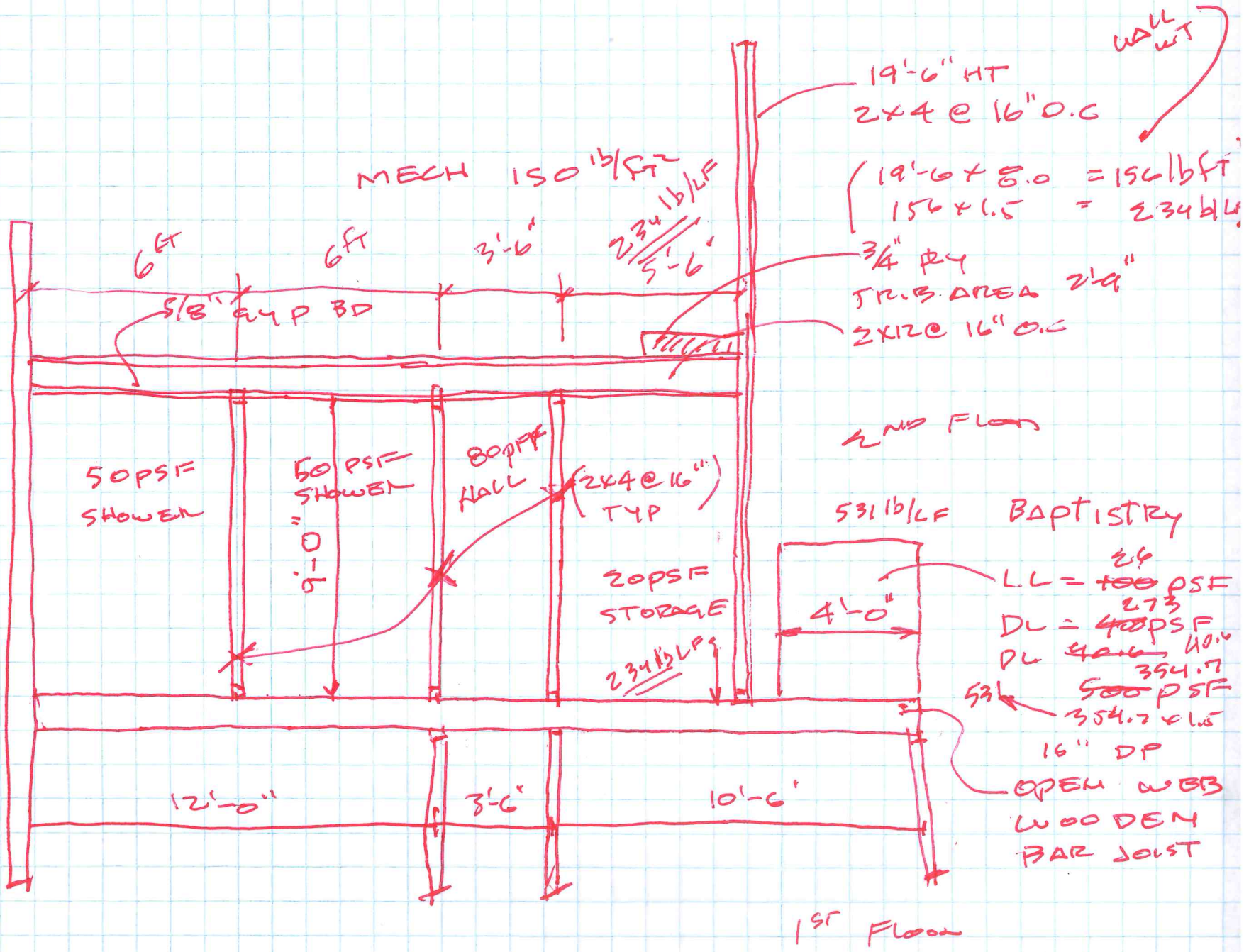
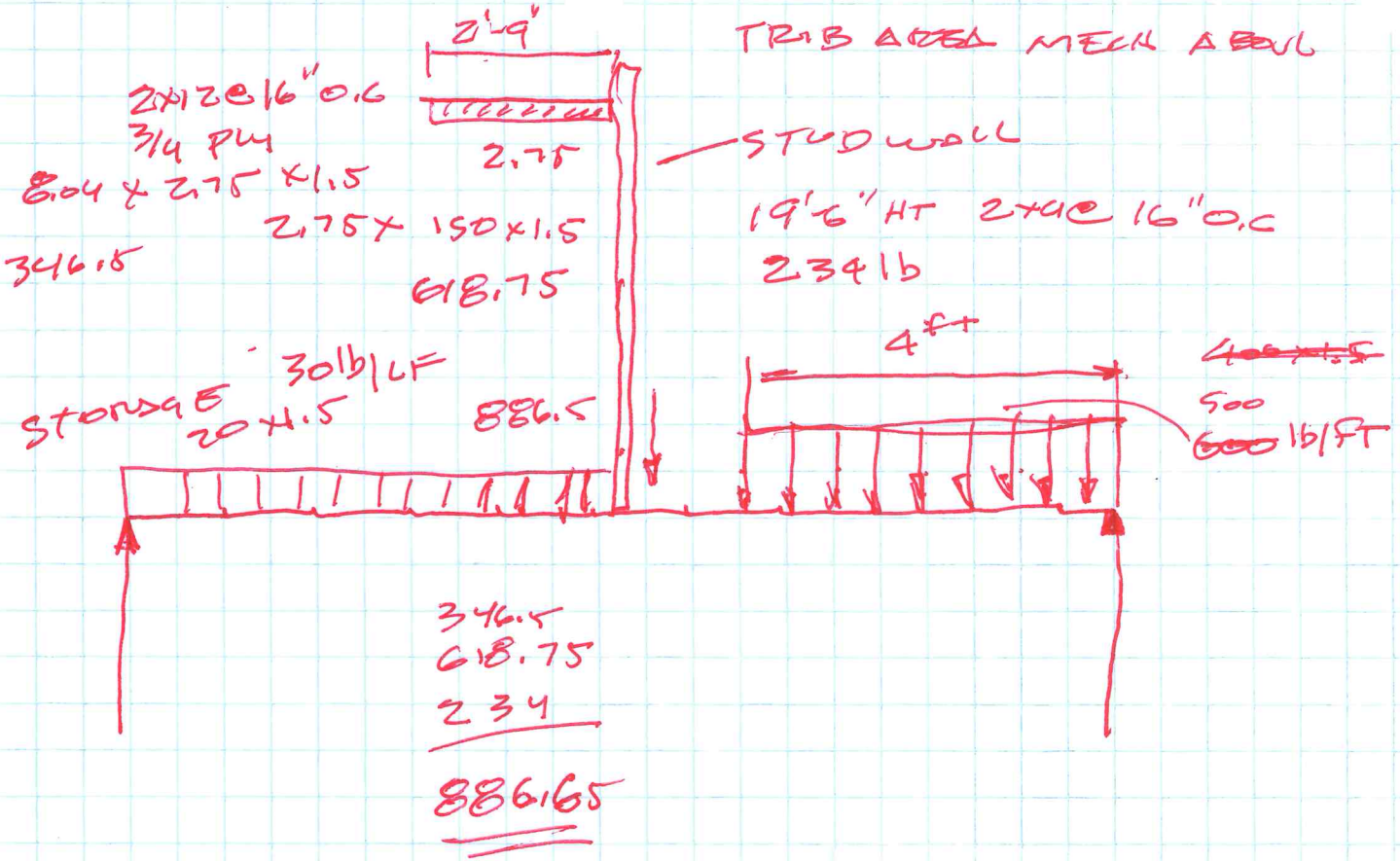

WALL WT
19'-6" HT
2x4 @ 16" O.C
(19'-6 x 8.0 = 156 lb/ft
156 x 1.5 = 234 lb/ft
MECH 150 lb/ft²
234 lb/LF
5'-6"
6FT
6FT
3'-6"
3/4" PLY
TRIB. AREA 2'-9"
2X12 @ 16" O.C
5/8" PLYP BD
2ND FLOOR
50PSF SHOWER
50 PSF SHOWER = 0.0
80PSF HALL
(2x4 @ 16") TYP
20PSF STORAGE
234 lb/LF
531 lb/LF
BAPTISTRY
4'-0"
LL = 40 PSF
DL = 400 PSF
DL 40.0
354.7
500 PSF
354.7 x 1.5
16" DP
OPEN WEB WOODEN BAR JOIST
12'-0"
3'-6"
10'-6"
1ST FLOOR



TRIB AREA MECH ABOVE

OPEN WEB WOOD TRUSS WORST CASE

SPACED @ 16" O.C

600 x 8.4 = 5040 lb

5090 - 1614 lb/ft =

5'-0" x 44" x 3'-0" = 3425.76 lb - 5040

5 @ 3.66 x 3 = 54.9 SQ 55 FT² - 55

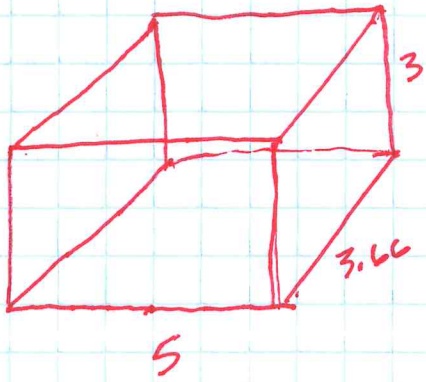
18.33 lb/ft²

WT OF MATERIALS

2x12 @ 16" O.C.			5.75 lb/ft²
3/4 PLY			2.34
2x4 @ 16" O.C.			8.0
H_2O	GAL/ft³		7.48 GAL
H_2O	WEIGHT		8.4 lb/GAL
H_2O	WT ft³		62.4 lb/ft³
LL	SHOWER		50 PSF
LL	STORAGE		20 PSF
LL	COORIDOOR		80 PSF
LL	BAPTISTRY	2x250 / 18.3	27.3 PSF
LL	SHELL WT	260 / 18.3	14.2 PSF
DL	H_2O	600x 8.4 / 18.3	275.4 PSF
MECH ROOM LL			150 PSF

600 GAL CAPACITY

NEGLECT SIDE STAIRS



VOLUMN
5x3.66x3 =
54.9 cuft

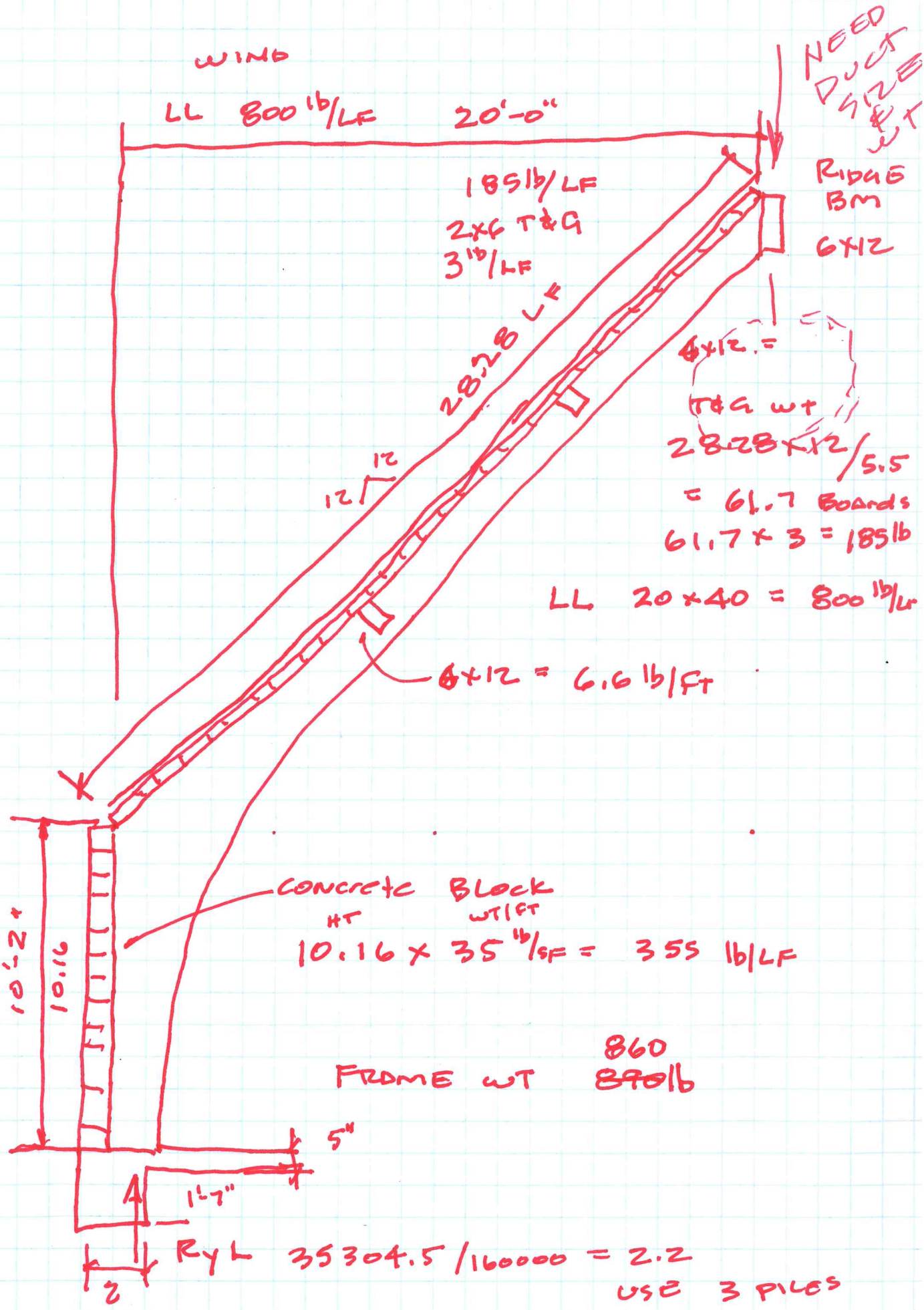
FLOOR AREA
5x3.66 = 18.3

TAMIC WT + LL + DL

Joist @ 16" O.C.

14.2 + 27.3 + 275.4 = 316.9 lb ft² x 1.5

475.35 ~~lb ft²~~ lb LF


WIND
LL 800 lb/LF
20'-0"
NEED DUCT SIZE & WT
RIDGE BM
6x12
185 lb/LF
2x6 T&G
3 lb/LF
28.28 LF
12
12
6x12 =
T&G wt
2828x12/5.5
= 61.7 Boards
61.7 x 3 = 185 lb
LL 20x40 = 800 lb/LF
6x12 = 6.6 lb/FT
CONCRETE BLOCK
HT
WT/FT
10.16 x 35 lb/SF = 355 lb/LF
10'-2"
10.16
860
FRAME WT 890 lb
5"
1'-7"
RyL 35304.5/160000 = 2.2
USE 3 PILES

FRAME REACTION to pile cap
ASSUME SPAN 15 FT

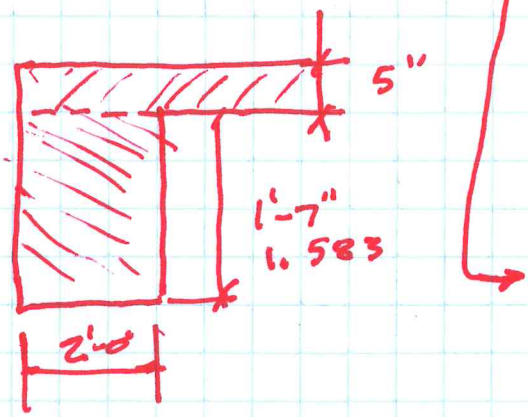
LL = 800 x 15	=	12,000
DL ROOF 185 x 15	=	2775
6 x 12 PURLIN 6.6 x 2 x 15	=	198
6 x 12 RIDGE BM 6.6 x 15	=	99
ARCH WT	=	860
		15932

SLAB REACTION TO pile cap

TRIB AREA 7' x 9' = 63 SF

LL = 63 x 100 = 6300

GRD BM WT



2 x 1.583 = 3.16 cu ft
150 x 3.16 = 475 lb/LF

7 + 7 = 14 x 475
6650

WT concrete TRIB

SLAB WT 5/12 x 150 x 63 = 3937.5
.4166

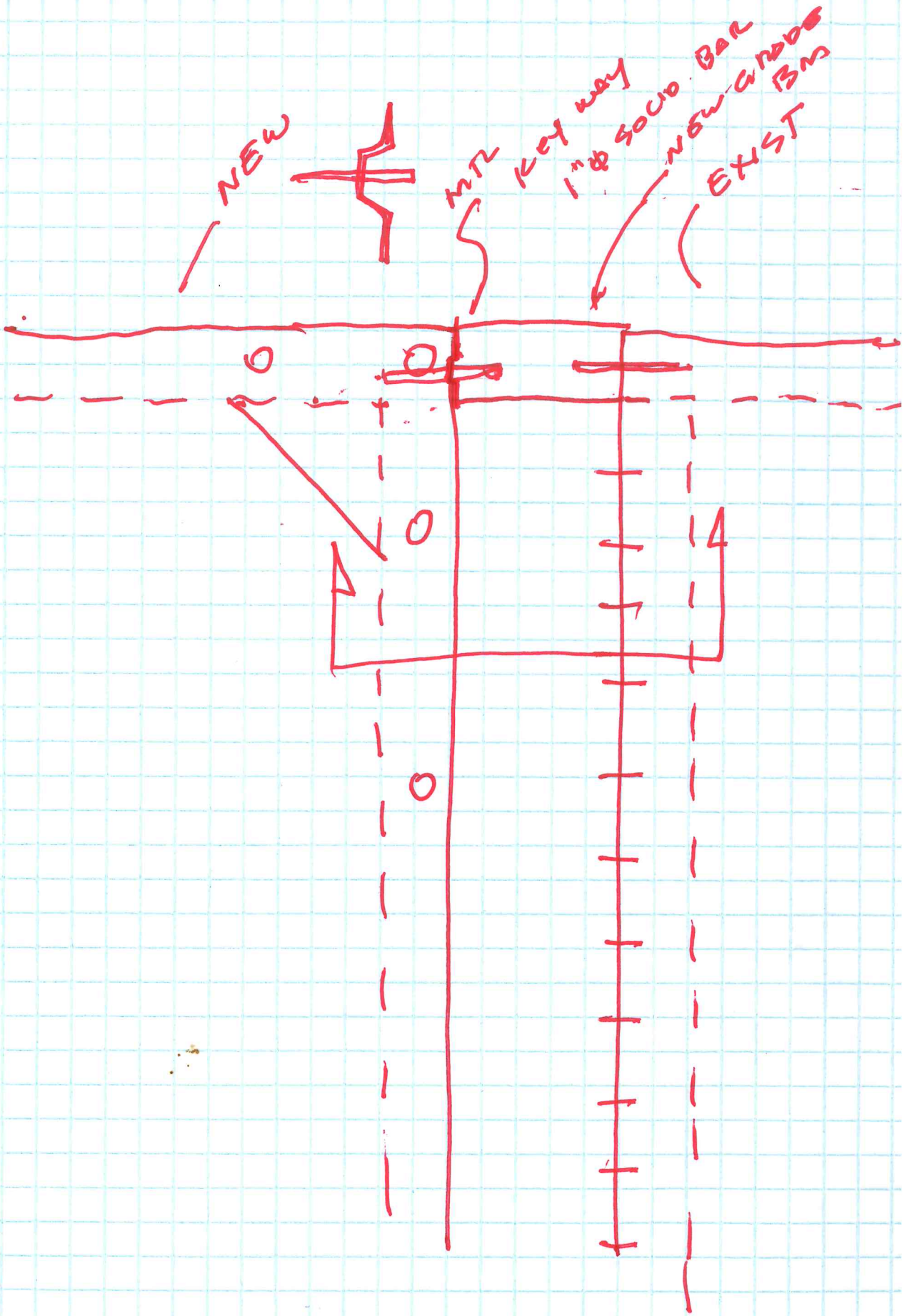
CONCRET BLOCK 355 lb/LF x 7 = 2485

19372.5

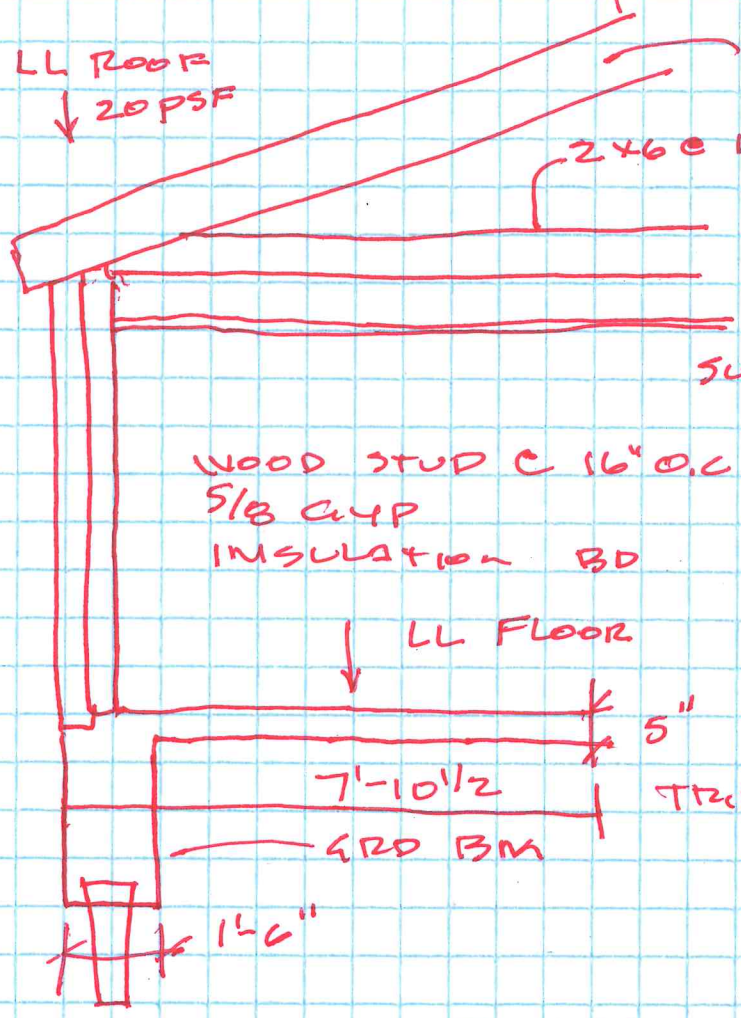
35304.5 / 16000 = 2.2 pile

USE 3 PILES

19372.5
15932
35304.5


NEW
MTL
KEY WAY
1"Φ SOLID BAR
NEW-GANDER BAR
EXIST

EXTERIOR GRADE BM
ASSUME 10ft PILE SPACING



SLAB WT
150 (5/12) = 62.5

GRD BM
1,583 x 1.5 x 150
= 356 lb/LF

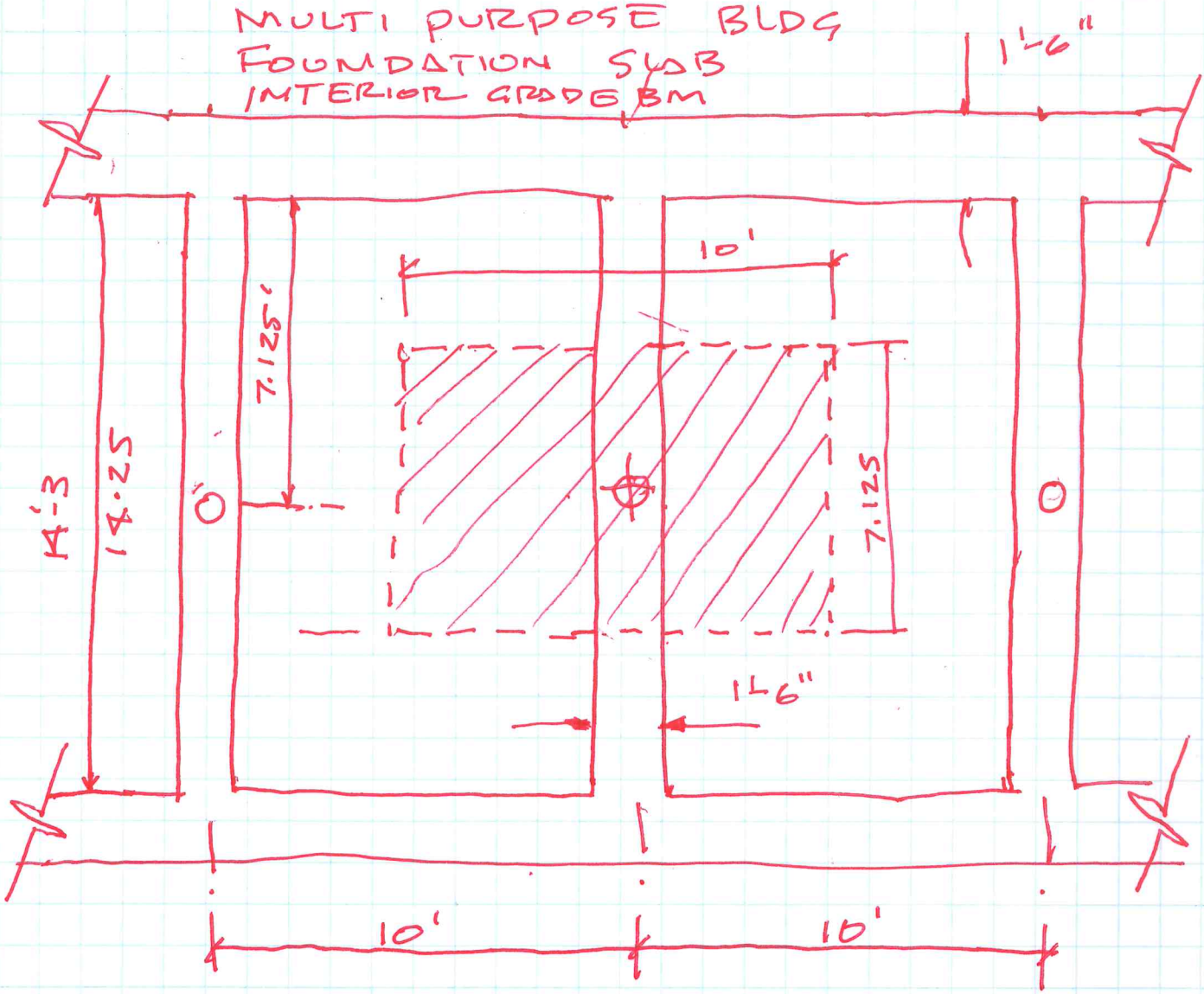
	WT	W	HT		
BRICK	38	x 10 x	9	=	3420
EXT FRAME	11	x 10 x	9	=	990
ROOF FRAME	11	x 10 x	9	=	990

	WT	W	SPAN		
SLAB	62.5	x 10 x	7.83	=	4893.7
FLOOR LL	106	x 10 x	7.83	=	7830
ROOF LL	20	x 10 x	7.83	=	1566

GRD BM — 356 lb/LF TOTAL LENGTH
~~62.5~~ x 15 = -5340

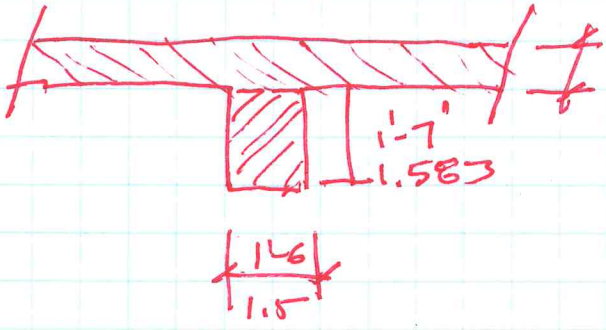
NG USE PILE @ 5'-0" CTR 25029.7

PILE LOAD
MULTI PURPOSE BLDG
FOUNDATION SLAB
INTERIOR GRADE BM



SLAB WT $150\left(\frac{5}{12}\right) = \underline{62.5}$ PSF

GRADE BM WT



TRIB AREA

$7.125 \times 10 =$

$\underline{71.25}$ SF

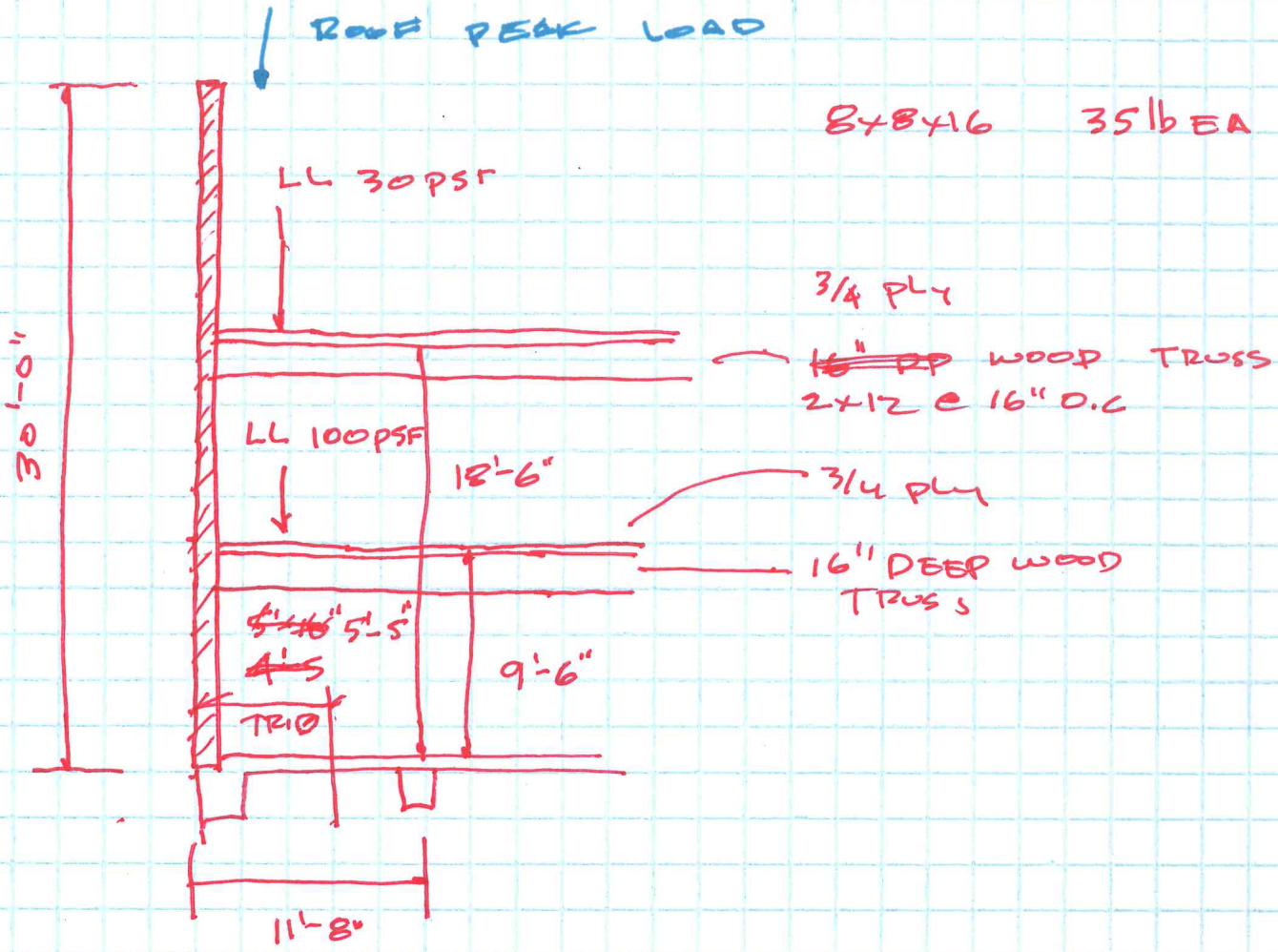
to $1.583 \times 1.5 \times 150 = \underline{356.175}$ PLF

WT SLAB	71.25 × 62.5 psf	=	4453.1
GRADE BM WT	356.175 × 7.125	=	2537.7
LL PER ASCE 7-05	100 × 71.25 psf	=	7125
			14115.8

14115.8 < 16 K OK

USE SINGLE PILE CTR SPAN INTERIOR GRADE BM

EXTERIOR WALL
CMU & FLR LOADS
pile spacing 4'-5"



8x8x16 35lb EA

BLOCK SURFACE AREA

W Ht

4.416 x 30 = 132 SF

SF x UNIT WEIGHT

132.48 x 1.25 = 165.6 BLOCK

TOTAL WT

~~156~~ 165.6 x 35 = ~~5746~~ ~~5775~~ lb

5775 lb

LL ATTIC = 30 psf
TRIB AREA 4.516 x 5.416 = 24.3

24.3 x 30 = 731

LL FLOOR = 100 psf

24.3 x 100 = 2430

FLR FRAMING = 20 SF
20 x 24.3 = 486

CLG FRM = 11 PSF
11 x 24.3 = 267.3

GRD BM WT
~~SLAB~~ = 356 lb/SF
4.53 1612.58
356 x ~~24.3~~ = ~~8650.8~~

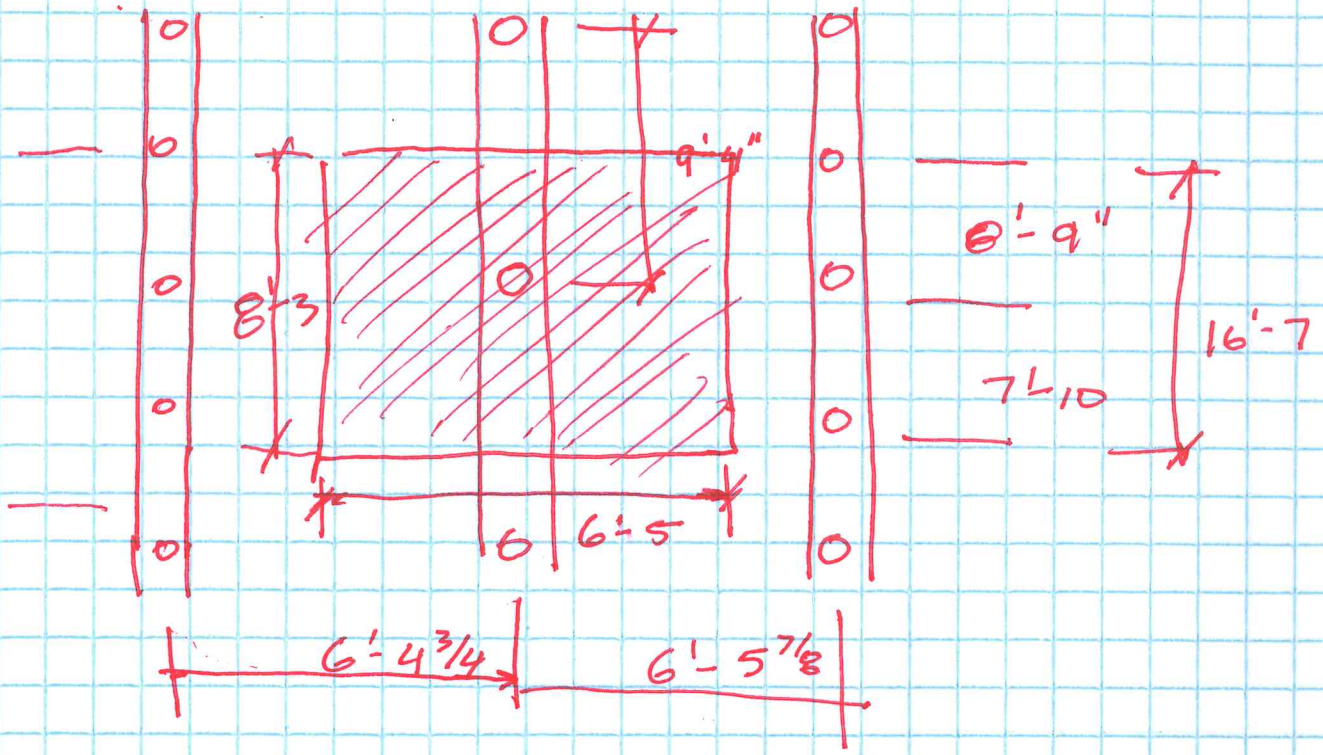
~~GRD BM~~
SLAB WT 62.5 SF

24.3 x 62.5 1518.75

BLOCK	5775
LL ATTIC	731
LL 2ND FLR	2430
FLR FRAMING	486
CLG FRAMING	263
GRD BM	1612.58
SLAB	1518.75
	12815

12815 < 16K
USE 4.5 PILE SPACING

INTERIOR SLAB
MAIN BLDG



SLAB WT 62.5 x 8'-3 x 6'-5 = 3305
8.25 x 6.41

LL SLAB 60 x 8.25 x 6.41 = 3172
~~100~~ ~~5288~~

GRD BM 356 x 8.25 = 2937

9414

SINGLE PILE CTR SPANS

OK

WEIGHT OF BUILDING MATERIAL (Appx.)

ITEM	Weight, lbs/ sq. ft.	Item	Weight, lbs/ sq. ft.
ROOFING		**CEILINGS**	
Wood Shingles	3.0	**Gypsum Board**	
Wood Shakes	4.5	1/2"	3.3
Roman Tile	12.0	5/8"	4.2
Spanish Tile	19.0	3/4"	5.0
Lightweight Conc. Tile (consult manufacturer data)	10.0- 15.0 psf		
Copper	1.5	**PLASTER**	
COMPOSITION		1/2" sand on 3/8" gyp. lath	8.0
2- 45# cap sheets	1.5	Lt. Wt. on 3/8" gyp. lath	5.0
2- 15# & 90 cap sheets	2.0	Sand Plaster on metal lath	10.0
2- 15# & 400 pea gravel	5.8	Metal Suspension Sys.	2.0
2-15# & 300 slag	4.7	**ACOUSTIC FIBERBOARD**	
Asphalt Shingles	2.5	1/2"	0.7
SHEATHING		1"	1.5
1", DF	2.5	1 1/2"	2
2", DF	5.5	2"	2.6
Lumber, per 1" thickness	3.0	Sprinkler System	1- 1.5
PLYWOOD SHEATHING		**FLOOR SURFACING**	
3/8"	1.2	1 1/2" Elastizell	13
1/2"	1.6	Carpet & Pad	1.5
5/8"	2.0	**WALLS**	
3/4"	2.5	Exterior 7/8" Stucco & 1/2" Gyp. Board at inside face	16.0
7/8"	2.7	Exterior Siding, R-11 & 1/2" Gyp. Board at inside face	10.0
1"	3.0	Interior Walls with 1/2" Gyp. Board	10.0
1 1/8"	3.5	Layer of 1/2" Gypsum Board	5.00
FRAMING MEMBERS		7/8" Stucco	9
2X4 @12", 16", 24" o.c.	1.65, 1.3, 0.82	**FRAMED WALLS- 8 ft high**	
2X6 @12", 16", 24" o.c.	2.54, 1.9, 1.27	2x4 @ 16" o.c.	10.6 PLF
2X8 @12", 16", 24" o.c.	3.39, 2.54, 1.7	2x4 @ 24" o.c.	8.9 PLF
2X10 @12", 16", 24" o.c.	4.29, 3.21, 2.15	2x6 @ 16" o.c.	16.7 PLF
Wood Trusses (2x4 T & B chords) @ 24" o.c.	2.5	2x6 @ 24" o.c.	14.0 PLF
MISC.			

Concrete (sand & gravel aggregate)	150 pcf	Brick, 4" thick	40 psf
Concrete (per 1" thickness)	12.5 psf	**LIGHTWEIGHT CMU**	
Mineral wool or fiberglass (1" thick)	0.05 psf	6", no grout	31 psf
Rigid roof insulation (1" thick)	1.5 psf	8", no grout	35 psf
Gypsum (1" thick)	2.0 psf	12", no grout	50 psf
		6", vertical cells solidly grouted	56 psf
		8", vertical cells solidly grouted	77 psf
		12", vertical cells solidly grouted	118 psf
		6", cells grouted @ 16" o.c.	46 psf
		8", cells grouted @ 16" o.c.	60 psf
		12", cells grouted @ 16" o.c.	90 psf
		6", cells grouted @ 24" o.c.	42 psf
		8", cells grouted @ 24" o.c.	53 psf
		12", cells grouted @ 24" o.c.	79 psf
		6", cells grouted @ 32" o.c.	40 psf
		8", cells grouted @ 32" o.c.	50 psf
		12", cells grouted @ 32" o.c.	73 psf

Wood based on Douglas Fir, 36 pcf for plywood; 40 pcf for OSB
Southern Pipe, 40 pcf for plywood; 44 pcf for OSB

Wall Weights and Areas

(Excerpted from *2015 Design of Reinforced Masonry Structures*, published by CMACN)

Average Weight of Completed Wall[1] (psf) and Equivalent Solid Thickness (in)

		Hollow Concrete Block			
		Lightweight 103 pcf			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		52	75	93	118
vertical cores grouted at	16" o.c.	41	60	69	88
	24" o.c.	37	55	61	79
	32" o.c.	36	52	57	74
	40" o.c.	35	50	55	71
	48" o.c.	34	49	53	69

	Hollow Concrete Block			
	Medium Weight 115 pcf			
Wall Thickness	6"	8"	10"	12"
Solid grouted wall	58	78	98	124

vertical cores grouted at	16" o.c.	47	63	80	94
	24" o.c.	43	58	72	85
	32" o.c.	42	55	68	80
	40" o.c.	41	53	66	77
	48" o.c.	40	51	64	75

		Hollow Concrete Block			
		Normal Weight 135 pcf			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		63	84	104	133
vertical cores grouted at	16" o.c.	52	66	86	103
	24" o.c.	48	61	78	94
	32" o.c.	47	58	74	89
	40" o.c.	46	56	72	86
	48" o.c.	45	55	70	83

		Equivalent Solid Thickness[2] Inches			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		5.6	7.6	9.6	11.6
vertical cores grouted at	16" o.c.	4.5	5.8	7.2	8.5
	24" o.c.	4.1	5.2	6.3	7.5
	32" o.c.	4.0	4.9	5.9	7.0
	40" o.c.	3.8	4.7	5.7	6.7
	48" o.c.	3.7	4.6	5.5	6.5

NOTE: The pcf values as shown above are examples, and are not intended as exact criteria for specifications. CMU must meet ASTM C90, which provides density ranges for each weight classification.

[1] The above table gives the average weights of completed walls of various thickness in pounds per square foot of wall face area. An average amount has been added into these values to include the weight of bond beams and reinforcing steel. Weight of grout is assumed at 140 pcf.

[2] Equivalent solid thickness means the calculated thickness of the wall if there were not hollow cores, and is obtained by dividing the volume of solid material in the wall by the face area of the wall. This Equivalent Solid Thickness (EST) is for the determination of area for structural design only, e.g. fs = P/(EST)b. It is NOT to be used to obtain fire ratings. Fire rating thickness is based either on equivalent solid thickness of ungrouted units only or solid grouted walls.

CMU per Square Foot of Wall Area

		Unit Length		
Unit Height		16	18	24
	4	2.25	2.00	-
	6	1.50	1.33	-
	8	1.125	1.00	.75

Example:		

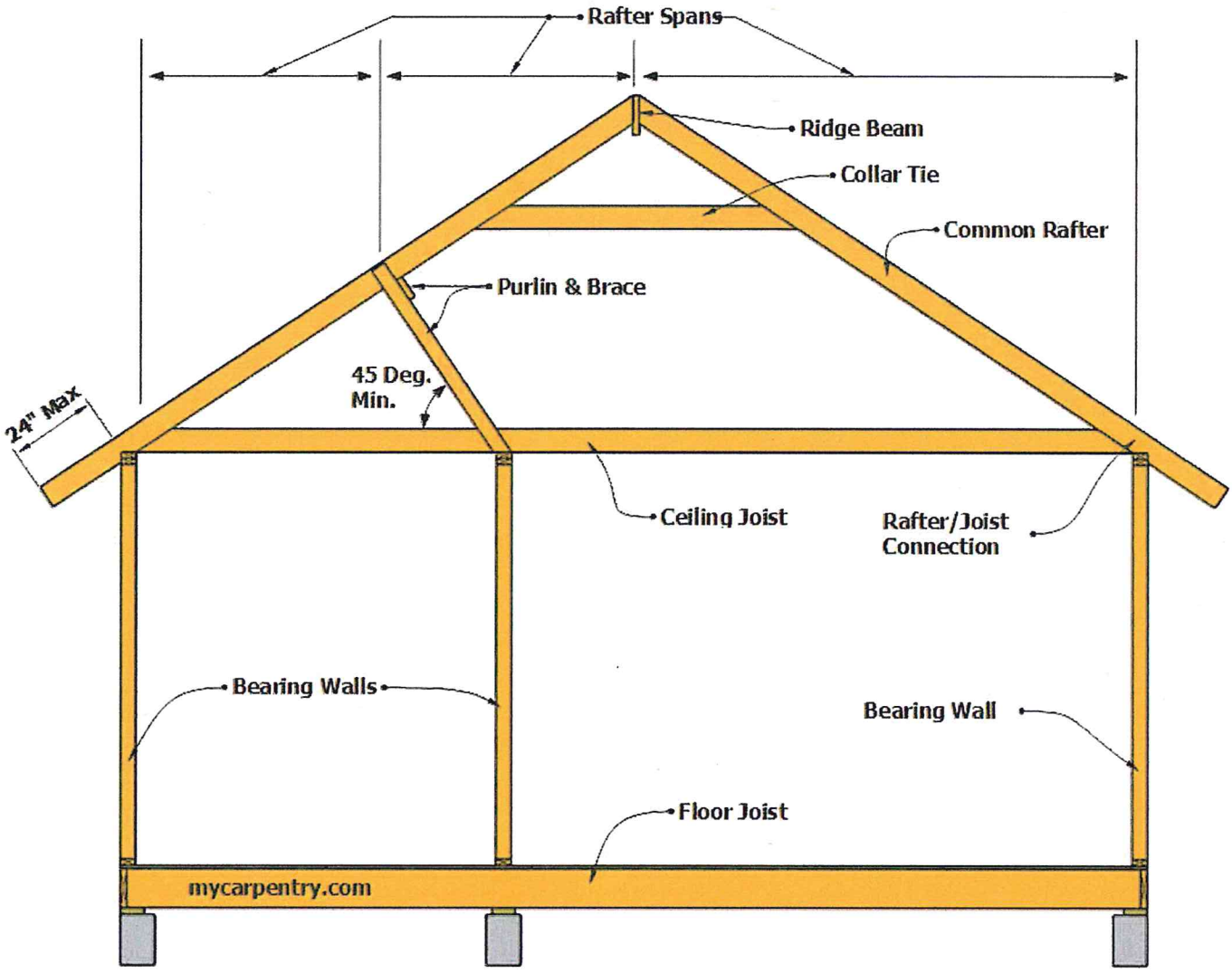
Wall Area	=	12,500 Sq. Ft.
Unit Face Size	=	8 x 16
12,500 x 1.125	=	14,063 Units

Angelus Block Co., Inc. supplies this information as an educational aid in understanding the benefits of concrete masonry construction and our products. It is the responsibility of the user to obtain engineering or other advisory services from licensed professionals as the basis for incorporating into any project any information, detail, or product offered herein.

◀

Noise Control (technical_articles_noise_control.cfm)

The first span table is for roofs where the ceiling is not attached to the rafters (with no snow load), a live load of 20 psf, a dead load of 20 psf and a deflection limit of L/180. The second span table is the same as the first, except that it assumes a ground snow load of 50 psf.



Rafter Span Diagram

When calculating the maximum span of a rafter, use the horizontal distance between two vertical supports. Note also that you can break up the span of a rafter by adding a purlin and bracing to the underside. The braces need to be supported by a bearing wall, as shown in the diagram above.

Example: In the rafter span table below, the highlighted cell (13-0), indicates

Rafter Span Tables

Rafters with ceiling not attached to rafters, live load = 20 psf, dead load = 20 psf, deflection limit L/180

Nominal Size	Spaced (o.c.)	Species/Grade			
		S. Pine	Doug. Fir	Hem-fir	S.P.F.
		#2 grade	#2 grade	#2 grade	#2 grade
2" x 4"	12	9-0	10-0	9-8	9-10
	16	7-9	8-7	8-5	8-6
	24	6-4	7-0	6-10	6-11
2" x 6"	12	13-6	14-7	14-2	14-4
	16	11-8	12-7	12-3	12-5
	24	9-6	10-4	10-0	10-2
2" x 8"	12	17-1	18-5	17-11	18-2
	16	14-9	16-0	15-6	15-9
	24	12-1	13-0	12-8	12-10
2" x 10"	12	20-3	22-6	21-11	22-3
	16	17-6	19-6	18-11	19-3
	24	14-4	15-11	15-6	15-8
2" x 12"	12	23-10	26-0	25-5	25-9
	16	20-8	22-7	22-0	22-4
	24	16-10	18-6	17-11	18-3

Note: Snow load can be very specific to the actual location of a structure. Consult your local building code authority to determine the snow load in your area. The following span table uses a moderate snow load of 50 psf, but yours could be more or less.

Rafters with ceiling not attached to rafters, ground snow load = 50 psf, dead load = 20 psf, deflection limit L/180

Nominal Size	Spaced (o.c.)	Species/Grade			
		S. Pine	Doug. Fir	Hem-fir	S.P.F.
		#2 grade	#2 grade	#2 grade	#2 grade
2" x 4"	12	6-6	7-3	7-0	7-1
	16	5-8	6-3	6-1	6-2
	24	4-7	5-1	4-11	5-0
2" x 6"	12	9-9	10-7	10-3	10-5
	16	8-5	9-2	8-11	9-0
	24	6-11	7-6	7-3	7-4
2" x 8"	12	12-4	13-4	13-0	13-2
	16	10-9	11-7	11-3	11-5

Wall Weights and Areas

(Excerpted from *2015 Design of Reinforced Masonry Structures*, published by CMACN)

Average Weight of Completed Wall[1] (psf) and Equivalent Solid Thickness (in)

		Hollow Concrete Block			
		Lightweight 103 pcf			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		52	75	93	118
vertical cores grouted at	16" o.c.	41	60	69	88
	24" o.c.	37	55	61	79
	32" o.c.	36	52	57	74
	40" o.c.	35	50	55	71
	48" o.c.	34	49	53	69

	Hollow Concrete Block			
	Medium Weight 115 pcf			
Wall Thickness	6"	8"	10"	12"
Solid grouted wall	58	78	98	124

vertical cores grouted at	16" o.c.	47	63	80	94
	24" o.c.	43	58	72	85
	32" o.c.	42	55	68	80
	40" o.c.	41	53	66	77
	48" o.c.	40	51	64	75

		Hollow Concrete Block			
		Normal Weight 135 pcf			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		63	84	104	133
vertical cores grouted at	16" o.c.	52	66	86	103
	24" o.c.	48	61	78	94
	32" o.c.	47	58	74	89
	40" o.c.	46	56	72	86
	48" o.c.	45	55	70	83

		Equivalent Solid Thickness[2] Inches			
Wall Thickness		6"	8"	10"	12"
Solid grouted wall		5.6	7.6	9.6	11.6
vertical cores grouted at	16" o.c.	4.5	5.8	7.2	8.5
	24" o.c.	4.1	5.2	6.3	7.5
	32" o.c.	4.0	4.9	5.9	7.0
	40" o.c.	3.8	4.7	5.7	6.7
	48" o.c.	3.7	4.6	5.5	6.5

NOTE: The pcf values as shown above are examples, and are not intended as exact criteria for specifications. CMU must meet ASTM C90, which provides density ranges for each weight classification.

[1] The above table gives the average weights of completed walls of various thickness in pounds per square foot of wall face area. An average amount has been added into these values to include the weight of bond beams and reinforcing steel. Weight of grout is assumed at 140 pcf.

[2] Equivalent solid thickness means the calculated thickness of the wall if there were not hollow cores, and is obtained by dividing the volume of solid material in the wall by the face area of the wall. This Equivalent Solid Thickness (EST) is for the determination of area for structural design only, e.g. fs = P/(EST)b. It is NOT to be used to obtain fire ratings. Fire rating thickness is based either on equivalent solid thickness of ungrouted units only or solid grouted walls.

CMU per Square Foot of Wall Area

		Unit Length		
Unit Height		16	18	24
	4	2.25	2.00	-
	6	1.50	1.33	-
	8	1.125	1.00	.75

Example:		

Considering the subsurface soil conditions encountered in the deep boring, the piles at the site will generally derive their support through "skin friction" along their embedded lengths along with some "end bearing" when embedded in the dense sand stratum encountered around 25 to 30 feet. The small timber piles should have minimum tip and butt diameters of 6 inches and 8 inches, respectively. The large timber piles should have a minimum tip diameter of 7 inches and butt diameter of 12 inches. The piles should conform to ASTM D25 and the American Wood Preservers Institute (AWPI) Standards for quality and treatment, respectively.

The recommended pile lengths and corresponding capacities are from the existing ground surface and additional pile length should be provided to account for the fill thickness. The recommended pile lengths and the estimated corresponding allowable capacities are presented in the following table:

Estimated Allowable Single Pile Load Capacity in Tons* F.S. = 2.0 in Compression F.S. = 3.0 in Tension				
Pile Penetration in feet**	Small Treated Timber Pile (6" Tip – 8" Butt)		Large Treated Timber Pile (7" Tip – 12" Butt)	
	Compression	Tension	Compression	Tension
±30	8+	5	14	6

***Capacities are soil/pile related capacities and consideration should be given to the structural integrity of the pile member.**
****Additional pile length should be provided to account for the fill thickness.**

The pile capacities include a factor of safety of two (2) in compression and three (3) in tension or uplift. Provided the piles are tipped in the dense sand, the effect of drag loads on the piles capacities should be insignificant.

Floor Slab

The new floor slabs, including sidewalks, landings, and ramps immediately adjacent to the additions, should be pile supported. The floor slabs should have an adequate number of joints to reduce cracking resulting from any differential movement and shrinkage. It is also recommended that a polyethylene sheeting vapor barrier be provided at the floor slab/fill soil interface to reduce the potential problems commonly associated with moisture migration through floor slabs in a controlled environment.

Pile Settlement

It is estimated that long term settlement of piles loaded to their allowable capacities will not exceed one (1) inch. This assumes the piles are tipped in sand and the average fill thickness will not exceed 1 foot. Differential settlement is expected to be on the order of 50 percent of the total settlement.

WEIGHT OF WALL AND PARTITIONS IN (psf)

	Material	Weight
FRAME PARTITIONS	Movable Steel Partitions	4
	Wood or Steel Studs, 1/2" Gyp Board Each Side	8
	Wood Studs, 2x4, Unplastered	4
	Wood Studs, 2x4, Plastered One Side	12
	Wood Studs, 2x4, Plastered Two Sides	20
FRAME WALLS	**Exterior Stud Walls: 2x4 16" O.C., 5/8" Gypsum, Insulated, 3/8" Siding**	11
	Exterior Stud Walls: 2x6 16" O.C., 5/8" Gypsum, Insulated, 3/8" Siding	12
	Exterior Stud Walls With Brick Veneer	48
	Windows, Glass, Frame, Sash.	8
MASONRY PARTITIONS	4" Brick	38
	8" Brick	80
	12" Brick	120
	17" Brick	160
	4" Brick, 8" Tile Backing	75
	9" Brick, 4" Tile Backing	100
	4" Concrete Block	30
	4" Cinder Concrete Block	20
	8" wall Tile	35
	12" Wall Tile	45
	3" Clay Tile	18
	4" Clay Tile	19
	6" Clay Tile	25
	4" Glass Block	18
	3" Gypsum Block	11
	4" Gypsum Block	13
	4" Limestone	55
	4" Terra-Cotta Tile	25
	4" Stone	55
WALL MATERIALS	Glass Block, 4"	18
	Glass Plate, 1/4.	3.3
	Glazed Tile	18
	Marble or Marble Wainscoting	15
	Plaster, 1"	8
	Plaster, I" on Wood Lath	10
	Plaster, I. on Metal Lath	8.5
	Porcelain-Enameled Steel	3
	Stucco,7/8.	10
	2X4 Wood Studs 12" O.C	2.1
	2X4 Wood Studs 16" O.C.	1.7
	2X4 Wood Studs 24" O.C	1.3
	2X6 Wood Studs 12" O.C	3.3
	2X6 Wood Studs 16" O.C	2.7
	2X6 Wood Studs 24" O.C	2.1

ROOF DEAD LOADS IN (psf)

	Material	Weight
BUILT UP ROOF	Felt, per ply	.5
	Gravel	4
	Roll Roofing	1
	235 lb Shingles and Paper	2.5
	(2) 15 lb and (I) 90 lb	1.7
	(3) 15 lb and (I) 90 lb	2.2
	3-ply Ready Roofing	1
	3-ply Felt and Gravel	5.6
	4-ply Felt and Gravel	6
	5-ply Felt and Gravel	6.5
DECKING, POURED (1" THICK	Concrete Plank	6.5
	Insulrock	2.7
	Petrical	2.7
	Porex	2.7
	Poured Gypsum	6.5
	Tectum	2.0
	Vermiculite Concrete	2.6
INSULATION BOARDS (1" THICK)	Cellular Glass	.7
	Fibreboard	1.5
	Fibreglass, Rigid	1.5
	Fibrous Glass	1.1
	Perlite	.8
	Polystyrene Foam	.2
	Rigid Insulation	1.5
	Urethane Foam with Skin	.5
METAL ROOFING	14 U.S. Std. Ga.	3.6
	18 U.S. .Std. Ga	2.4
	22 U.S. Std. Ga.	1.5
	24 U.S. Std. Ga.	1.3
	26 U.S. Std. Ga.	1
Skylight, 3/8" Glass in Galv. Iron Frame		7.5

FLOOR DEAD LOADS IN (psf)		
Material		Weight
FLOOR FINISHES	Board Flooring, 1”	3
	Ceramic or Quarry Tile, 3/4" (w/o Mortar Bed)	10
	Concrete, Lightweight, 1"	6-10
	Concrete, Reinforced, 1"	12.5
	Floor Tile, 1"	10
	Hardwood Flooring, 7/8"	4
	Linoleum or Asphalt Tile, 1/4"	1
	Plywood, 1"	3
	Slate, 1”	15
	Stone, 1"	12
	Terrazo Finish, 11/2"	19
	Wood Block, 1"	4
FLOOR TRUSS @ 24” O.C 4x2 Truss Chords, Webs and Plates* * accounts for 1/2 of truss weight		1.9
WOOD JOISTS	2X6	1.1
	2X8	1.5
	2X10	1.9
	2X12	2.2

CEILING DEAD LOADS IN (psf)

	Material	Weight
CEILING	Acoustical Fiber Tile	1
	Gypsum Board, 1/2"	2
	Gypsum Board, 5/8"	2.5
	Mechanical Duct Allowance	4
	Plaster on Tile or Concrete	5
	Plaster, 1", on Wood Lath	8
	Suspended Steel Channel System	2
	Suspended Metal Lath and Cement Plaster	15
	Suspended Metal Lath and Gypsum Plaster	10
	Wood Furring Suspension System	2.5
FLOOR TRUSS @ 24" O.C4x2 Truss Chords, Webs & Plates* * Accounts for 1/2 of truss weight		1.9
INSULATION	Rock Wool, 1"	.2
	Glass Wool, 1"	.3
	Alpol	.1
Roof Truss or Ceiling joists at 24" O.C	2x4 Bottom Chord*	.7
	2x6 Bottom Chord*	1.1
	2x8 Bottom Chord*	1.5
	2x10 Bottom Chord*	1.9
	2x12 Bottom Chord*	2.2
	2x4 Webs and Plates**	.8
	2x6 Webs and Plates**	1.3
	* Measure along rake ** accounts for 1/2 truss weight	
SPRINKLER SYSTEM Without Ceiling		1.0

WEIGHTS OF CONSTRUCTION MA TERIALS IN pcf		
MATERIAL		Weight
CONCRETE	Cinder	108
	Haydite	90
	Slag	132
	Stone (Incl. Gravel)	144
	Light Aggregate, Non-Load Bearing	25-50
	Light Aggregate, Load Bearing	70-105
	Reinforced Cinder	111
	Reinforced Slag	138
	Reinforced Stone (Incl. Gravel)	150
COVERING	Fiberboard, 1/2"	.75
	Gypsum Wallboard.- 1/2"	2
	Particleboard, 1/2"	2
	Plywood, 1"	3
EARTH	Clay	63-110
	Gravel	104-120
	Sand	90-106
	Silt	78-108
	Sand and Gravel	100-120
INSULATION	Rock Wool, 1" (Roll or Bat)	.2 (psf)
	Glass Wool, 1" (Roll or Bat)	.3 (psf)
	Alpol (Roll or Bat)	.1 (psf)
	Temlock (Rigid 1" Thick)	1.2 (psf)
	Cork (Rigid 1" Thick)	.7 (psf)
	Gold Bond (Rigid 1" Thick)	1.5 (psf)
	Styrofoam (Rigid 1" Thick)	.2 (psf)
	Foam glass (Rigid 1" Thick)	.8 (psf)
	Rigid Fiberglass (Rigid 1" Thick)	1.5 (psf)

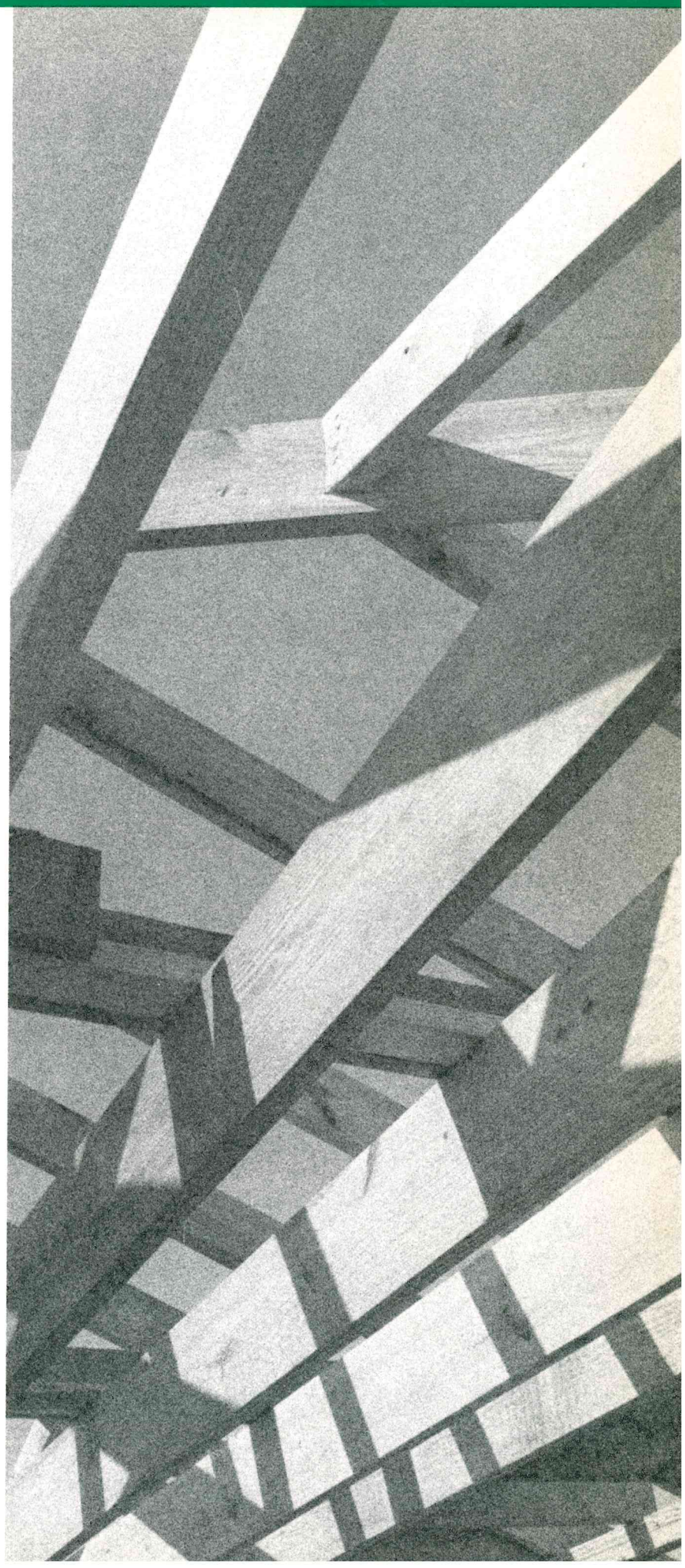
MAXIMUM SPANS

Southern Pine Joists & Rafters

EMPIRICAL DESIGN VALUES

FOR DIMENSION LUMBER

Based on full-size In-Grade test results



Southern Pine Marketing Council

Contents

Southern Pine Marketing Council

The Southern Pine Marketing Council (SPMC) is a joint promotional body coordinated and supported by members of the Southern Forest Products Association (SFPA) and Southeastern Lumber Manufacturers Association (SLMA). For more information, contact either association.

SOUTHERN FOREST
PRODUCTS ASSOCIATION
P.O. Box 641700 Kenner, LA 70064-1700
Phone (504) 443-4464 FAX (504) 443-6612

SOUTHEASTERN LUMBER
MANUFACTURERS ASSOCIATION
P.O. Box 1788 Forest Park, GA 30051
Phone (404) 361-1445 FAX (404) 361-5963

Acknowledgment

The Southern Pine Marketing Council gratefully acknowledges the assistance of the American Forest & Paper Association (formerly National Forest Products Association) and the Southern Pine Inspection Bureau in reviewing this publication.

Table Number	Live Load (psf)	Dead Load (psf)	Deflection Limit	See Page
Floor Joists				
1	30	10	360	8
2	40	10	360	8
3	50	10	360	9
4	60	10	360	9
5	40	20	360	10
6	50	20	360	10
7	60	20	360	11
Ceiling Joists				
8	10	5	240	12
9	20	10	240	12
Rafters (Snow Load, C_D = 1.15)				
10	20	10	240	13
11	30	10	240	13
12	40	10	240	14
13	50	10	240	14
14	20	15	240	15
15	30	15	240	15
16	40	15	240	16
17	50	15	240	16
18	20	20	240	17
19	30	20	240	17
20	40	20	240	18
21	50	20	240	18
22	20	10	180	19
23	30	10	180	19
24	40	10	180	20
25	50	10	180	20
26	20	15	180	21
27	30	15	180	21
28	40	15	180	22
29	50	15	180	22
30	20	20	180	23
31	30	20	180	23
32	40	20	180	24
33	50	20	180	24
Rafters (Construction Load, C_D = 1.25)				
34	20	10	240	25
35	20	15	240	25
36	20	20	240	26
37	20	10	180	26
38	20	15	180	27
39	20	20	180	27
Wet-Service Floor Joists (MC > 19%)				
40	40	10	360	28
41	60	10	360	28
Heavy Live-Load Floor Joists				
42	75	10	360	29
43	80	10	360	29
44	90	10	360	30
45	100	10	360	30
46	125	10	360	31
47	150	10	360	31

The Southern Pine Marketing Council does not grade or test lumber; and accordingly, does not assign design values to Southern Pine lumber. The design values contained herein are based on the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition,* published by the Southern Pine Inspection Bureau, and modified as required by the *1991 National Design Specification® (NDS®) for Wood Construction* published by the American Forest & Paper Association (AFPA), formerly NFPA.

The primary purpose of this publication is to provide a convenient reference for joist and rafter spans for specific grades of Southern Pine lumber. The maximum spans provided herein were determined on the same basis as those in the *Span Tables for Joists and Rafters, 1993 Edition,* published by AFPA. Accordingly, the Southern Pine Marketing Council, its principals and/or members, do not warrant in any way that the design values on which the span tables for Southern Pine lumber contained herein are based are correct, and specifically disclaim any liability for injury or damage resulting from the use of such span tables.

The conditions under which lumber is used in construction may vary widely, as does the quality of the lumber and workmanship. Neither the Southern Pine Marketing Council, nor its principals and/or members, have any knowledge of the construction methods, quality of materials and workmanship used on any construction project; and accordingly, cannot and do not, warrant the performance of the lumber used in completed structures.

Southern Pine—An Abundant Resource

Southern Pine is a general group of four principal species: longleaf, shortleaf, slash, and loblolly grown in a region that stretches from Virginia through eastern Texas. With nearly 200 million acres of forestland, the southern United States offers a potential for timber growth uncommon to other regions. And the continued practice of wise forest management, including prolific reforestation efforts, assures a bountiful supply of quality wood for generations to come.

Today's Versatile Building Material

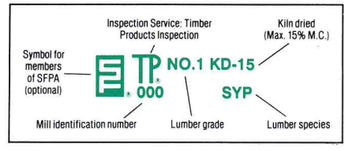
Southern Pine has long been a preferred species for residential and nonresidential structures, because of its high strength, durability, and fastener holding power.

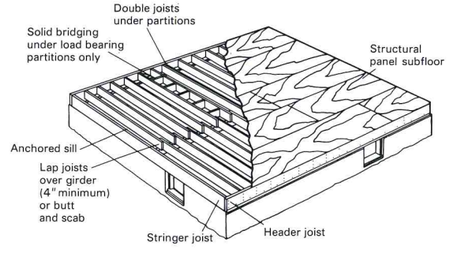
Kiln-dried Southern Pine lumber is ideal for joists and rafters. New, empirical design values for Southern Pine dimension lumber, published in the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition,* confirm Southern Pine's stature as the strongest structural lumber species for engineered and framing applications. This booklet presents a simplified system for determining allowable spans for joists and rafters, using Southern Pine lumber under a variety of loading conditions.

Lumber Identification

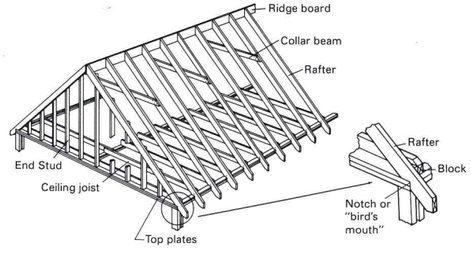
The maximum spans in these tables apply to lumber identified by the grade mark of an agency certified by the Board of Review of the American Lumber Standards Committee, and manufactured in accordance with *Product Standard PS 20-70* published by the U.S. Department of Commerce. A certified grade mark on Southern Pine lumber (2" or less in thickness) indicates that the lumber has been properly seasoned and that it meets the structural and appearance requirements established for the grade.

Two Typical Lumber Grade Marks:





Typical floor joist construction



Typical rafter framing for pitched roof

SPAN COMPARISONS BY SPECIES*

Maximum Spans given in feet and inches

Size	Grade	Southern Pine	Douglas Fir-Larch	Hem-Fir	Spruce-Pine-Fir	Spruce-Pine-Fir South
2 x 10s *16" o.c.*	No. 1	16-9	16-5	16-0	15-4	14-11
	No. 2	16-1	15-4	15-2	15-4	14-3
	No. 3	12-2	11-8	11-8	11-8	10-9
2 x 12s *16" o.c.*	No. 1	20-4	19-1	18-7	17-10	17-7
	No. 2	18-10	17-10	17-7	17-10	16-7
	No. 3	14-5	13-6	13-6	13-6	12-5

*Based on a 40 psf live load, 10 psf dead load and ℓ/360 deflection limitation. These spans were calculated using published design values and are for comparison purposes only. They include the repetitive member factor, C_r = 1.15, but do not include composite action of adhesive and sheathing. Spans may be slightly different than other published spans due to rounding.

PROPER LUMBER STORAGE

Using proper storage techniques is essential to the efficient and economical use of lumber. Proper storage also:

- Protects lumber from fungi and insects.
- Prevents defects that may result from alternate wetting and drying.
- Helps maintain appearance and dimensional stability.
- Helps to safeguard against costly callbacks for builders.

Dimensional Stability

Proper seasoning and storage helps provide optimal dimensional stability of lumber in service. The cellular structure of wood has a sponge-like effect. The material absorbs or loses moisture depending on the humidity and temperature of the surrounding air.

To minimize shrinkage, Southern Pine grading rules require that dimension lumber 2" or less in thickness be kiln-dried or seasoned to a moisture content not exceeding 19%. This will result in an average moisture content of 15%. Additional conditioning will take place as lumber is stored, or used where it will reach equilibrium moisture content. For interior items such as flooring, millwork and furniture, the moisture content will average between 6% and 11%. (See U.S. map.) For exterior items such as framing, siding and sheathing, the moisture content will average 12% in most areas of the U.S., with a range of 7% to 14%.

Proper storage helps maintain dimensional stability before and after delivery to the job site. It is a safeguard against costly and unsightly problems such as:

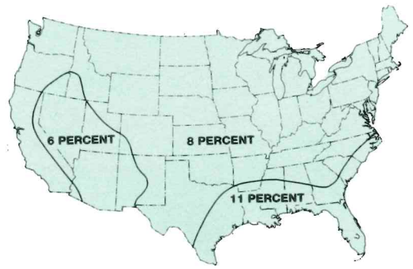
- *Warp, etc.* – it reduces warp, twist, stain and crook.
- *Nail Popping* – which results when wood shrinks, causing the heads of nails to protrude. Spiral shank and annularly grooved nails also help to prevent this problem.
- *Baseboard Pull-Away* – which occurs when floor or ceiling joists are installed with excessive moisture content. As the lumber shrinks, the floor or ceiling is pulled away from mouldings.

Job Site Storage

Regardless of where lumber is stored at the job site, a few simple precautions should be observed:

- Lumber should be unloaded in a dry place – not in water or muddy areas.
- Lumber should not be in direct contact with the ground. It should be elevated on stringers to allow air circulation.
- Lumber stored in an open area should be covered with a material that will give protection from the elements but be porous enough to allow moisture to escape. Polyethylene or similar covers may not allow the passage of moisture.
- Framing lumber should be enclosed and under roof as soon as possible for protection from the elements.
- Exterior siding and finish should be stored in a closed unheated area.
- Interior items such as millwork, flooring, and cabinet work should be stored in a closed area where heat can be applied during damp weather to maintain the desired moisture content.
- Stock rotation is important when dealing with large deliveries. Lumber should be used in the order in which it is received.

The builder, building contractor, licensed contractor, erector or erection contractor is responsible for the proper unloading, receiving, storage, handling, installation and bracing of lumber at the job site.



Average moisture content for interior wood products

PRESSURE-TREATED LUMBER

Southern Pine has long been a preferred species when pressure treatment with preservatives is required, because of its ease of treatability. The unique cellular structure of Southern Pine permits deep, uniform penetration of preservatives, rendering the wood useless as a food source for fungi, termites and microorganisms.

Most wood species do not readily accept preservatives, and must first be "incised", or perforated with a series of small slits along the grain of the wood's surface. Southern Pine is one of the few wood species that does not require incising to meet American Wood Preservers' Association (AWPA) standards.

Waterborne preservatives are preferred for most framing applications. These treatments are clean, odorless and paintable, plus they are approved by the Environmental Protection Agency (EPA) for both interior and exterior use without a sealer. The most commonly used waterborne preservative is known as CCA, or Chromated Copper Arsenate.

Generally, building codes require pressure-treated or naturally durable wood for the following applications:

- Wood joists or the bottom of structural floors without joists closer than 18 inches to exposed soil.
- Wood girders closer than 12 inches to exposed soil.
- Plates, sills and sleepers on concrete or masonry which is in direct contact with soil.
- Wood in permanent structures closer than 6 inches to soil.
- Wood supporting moisture-permeable roofs and floors exposed to weather unless separated by an impervious moisture barrier.
- Wood framing members including sheathing which rest on foundation walls and are less than 8 inches from soil.

Note: When used in enclosed locations, wood moisture content shall be 19% or less at time of permanent enclosure.

Observing the following points will aid in the successful use of CCA-treated Southern Pine.

Retentions *(lbs./cu. ft.)*	Uses/ Exposure
.25	Above ground
.40	Ground contact and fresh water
.60	Wood foundation and sawn timber building posts
2.50	Salt water

- Published design values apply to treated lumber, but must be multiplied by the appropriate wet service factor, C_M, when the moisture content will exceed 19% for an extended period of time.
- Hot-dipped galvanized or stainless steel 304 or 316 nails and fasteners should be used to resist corrosion.
- Treated lumber should be stacked and stored in the same manner as untreated wood. Treating does not prevent normal shrinking and swelling of wood.
- Where possible, all cuts and holes should be completed before treatment. However, when on-site fabrication is necessary, all cuts and holes should be liberally brushed with a solution of copper naphthenate.

Special Applications

PWF – The Permanent Wood Foundation, or PWF, is a load-bearing lumber-framed foundation wall sheathed with plywood. All lumber and plywood used in the PWF is specially pressure treated to withstand decay from moisture and termite attack. Southern Pine lumber used in a PWF is CCA-treated to a retention level of .60 lbs./cu.ft., in accordance with *AWPA Standard C22.* Pressure treated lumber to be used for PWF's should be stamped "FDN," or "PWF Foundation."

Once the foundation walls are in place, standard framing construction practices are followed for the structure above. Typically, floor joists are installed on the top plate of the foundation wall. Subflooring and wall framing follow.

Construction of the PWF involves special fastener requirements. Refer to the *PWF Design Manual,* available from SPMC, for details.

Plen-Wood – The Plen-Wood system utilizes a sealed, insulated cavity to create an underfloor plenum. This system provides uniform, efficient distribution of warm or cool air from a centrally located HVAC unit. Plen-Wood walls are basically crawl space versions of the PWF.

PIRF – The Perimeter-Insulated Raised Floor, or PIRF, is another engineered foundation floor system for crawl space construction. Insulation is applied only to the inside of the perimeter foundation wall, eliminating the need for under-floor insulation. This configuration allows the thermal mass of the earth to assist in heating and cooling.

High Moisture Areas – Although not required by code, treated Southern Pine is ideal for bath, kitchen and utility areas where the possibility of decay due to water leakage exists. Using treated wood in these areas will provide a framing system that meets or exceeds the buyer's expectations for long-term, solid performance. Treated Southern Pine also provides extra protection for high-moisture exterior applications, such as soffits and fascia.

Southern Pine lumber properly treated with CCA in accordance with AWPA standards and used within the guidelines of the EPA is safe to use and poses no threat to people or pets.

For more detailed pressure-treated information, see *Pressure Treated Southern Pine.*

USING THESE TABLES

The primary purpose of this publication is to provide a convenient reference of joist and rafter spans for specific grades of Southern Pine lumber. The maximum spans provided in these tables were determined on the same basis as those given in the code-recognized *Span Tables for Joists and Rafters, 1993 Edition,* published by the American Forest & Paper Association (AFPA), formerly National Forest Products Association (NFPA). Southern Pine design values used in the calculations are based on the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition,* published by the Southern Pine Inspection Bureau (SPIB).

There are three general categories of span tables:

General Requirements

The quality of wood products and fasteners and the design of load-supporting wood members and connections shall conform to the *National Design Specification*® (NDS®) published by AFPA (NFPA). All members shall be so framed, anchored, tied, and braced to have the necessary strength and rigidity. Adequate bracing and bridging to resist wind and other lateral forces shall be provided.

Design Loads

Assumed loading conditions are stated in the heading for each table. Live and dead loads are shown in psf (pounds per square foot). The provided range of loads accommodates the most common design loads used. Structures in heavy snow load areas should be analyzed thoroughly using accepted engineering practice. For rafters with roof live loads less than 20 psf, see AFPA's *Span Tables for Joists and Rafters* for adjustments.

The estimated dead loads for rafters are based on the type or amount of roof covering material. Tables are included for three common coverings:

Light roofing *(10 psf dead load)*
Up to 2 courses of asphalt shingles, or wood shakes/shingles

Medium roofing *(15 psf dead load)*
2" clay book tile

Heavy roofing *(20 psf dead load)*
3" clay book tile

All listed dead loads include the weight of the framing members.

Lumber Sizes

Computations for these span tables are based on net lumber dimensions (actual sizes), provided by the *American Softwood Lumber Standard PS 20-70*:

Nominal Size, *inches*	Actual Dry Size, *inches*
2 x 4	1-1/2 x 3-1/2
2 x 6	1-1/2 x 5-1/2
2 x 8	1-1/2 x 7-1/4
2 x 10	1-1/2 x 9-1/4
2 x 12	1-1/2 x 11-1/4

Spans

The maximum spans in these tables were computed using standard engineering design formulas for simple span beams with uniform loads. They assume installation of at least three joists or rafters spaced not more than 24" on center. The calculated spans assume fully supported members, properly sheathed and nailed on the top edge of the joist or rafter. They do not, however, include composite action of adhesive and sheathing.

Tabulated maximum spans are the distance from face to face of supports, and are given in feet and inches of horizontal projection of the member. This represents the actual length of horizontal members such as floor and ceiling joists. For sloping rafters, the span is also measured along the horizontal projection, with the chart on page 32 providing a convenient tool for calculating the corresponding sloping rafter length.

These span tables were calculated considering three design conditions:

Bending (flexure)
Deflection
Compression perpendicular-to-grain.

For live loads greater than 60 psf, an additional check for **shear parallel-to-grain** (horizontal shear) was included. Only the controlling length rounded to the nearest inch is shown in the tables. Listed spans in this publication have been limited to 26'–0" based on material availability. Southern Pine is commonly available in lengths up to 20'. Check sources of supply for longer lengths.

Almost all of the spans in these tables are intended for use in covered structures or where the moisture content in use does not exceed 19% for an extended period of time. Two wet-service floor joist tables, tables 40 and 41, are included for structures where the moisture content exceeds 19%.

Load Duration

Wood has the ability to carry substantially greater maximum loads for short durations than for long durations. Tabulated design values apply to normal loading conditions, and may be multiplied by a load duration factor, C_D, permitted by established engineering design criteria and building code regulations. This factor is covered in detail in the *NDS,* and summarized in the *Southern Pine Use Guide* available from the Southern Pine Marketing Council.

Floor and ceiling joists are based on the normal ten-year load duration which implies a load duration factor, C_D, of 1.0. For rafters, the load duration factor, C_D, is typically either 1.15 for two-month snow loads, or 1.25 for 7-day construction loads. Snow loads are presented in rafter tables 10-33, while construction loads are presented in rafter tables 34-39. All of these rafter tables are labeled to indicate the load duration factor used.

Deflection

Deflection may be the controlling factor in determining the member size required when appearance or rigidity is important. Control of floor vibration is another important reason to limit deflection.

Deflection limits are expressed as a fraction of the span length in inches, and consider only the live load in accordance with established engineering practice for the design of joists and rafters. The most generally used deflection limits are summarized below:

Application	Deflection Limit
Floor joists	ℓ/360
Ceiling joists	ℓ/240
Rafters: Drywall ceiling	ℓ/240
Rafters: No finished ceiling	ℓ/180

In cases where a stricter deflection limit is desired, and the length is controlled by the ℓ/360 deflection limit, the tabulated span lengths may be multiplied by the factors shown below.

Deflection Limit	Adjustment Factor
ℓ/480	0.91
ℓ/600	0.84

Bending

Bending design values used assume a fully supported member, properly sheathed and nailed on one edge of the joist or rafter. The repetitive member use factor, C_r, of 1.15 was included, as allowed in the *NDS.* The load duration factor, C_D, was also applied as appropriate.

Compression Perpendicular-to-Grain

The compression perpendicular-to-grain check assumed a 2.0" bearing length and rarely controlled the maximum spans. An additional check should be made for shorter bearing lengths, such as for 1.5" ledgers.

Shear Parallel-to-Grain

For live loads greater than 60 psf, an additional check for shear parallel-to-grain was included. All loads within a distance from supports equal to the depth of the members were neglected when calculating the shear force, as allowed in the *NDS.*

Design Values

Spans in this publication are based on Southern Pine design values published in the *SPIB Standard Grading Rules for Southern Pine Lumber, 1991 Edition.* The stress values and modulus of elasticity values assigned to dimension lumber in those rules are based on tests of full-size lumber conducted by SPIB in cooperation with the U.S. Forest Products Laboratory. The procedures set forth in the listed ASTM standards were followed in assigning these design values:

Standard Practice for Establishing Properties for Visually Graded Dimension Lumber from In-Grade Tests of Full Size Specimens, ASTM D1990-91.

Standard Test Methods for Establishing Clear Wood Strength Values, ASTM D2555-88.

Standard Practice for Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber, ASTM D245-88.

Adjustment Factors

Tabulated SPIB design values were multiplied by appropriate adjustment factors to determine allowable design values. Adjustment factors used for these tables are:

Repetitive Member Factor, C_r: The bending design value, F_b, for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor, C_r = 1.15, when such members are used as joists, truss chords, rafters, studs, planks, decking or similar members which are in contact or spaced not more than 24" on centers, are not less than 3 in number and are joined by floor, roof or other load distributing element adequate to support the design load.

Load Duration Factor, C_D: Tabulated design values apply to normal load duration. Normal load duration contemplates a load that fully stresses a member to its allowable design value by the application of the full design load for a cumulative duration of approximately ten years. When the cumulative duration of the full maximum load does not exceed the specified time period, all tabulated design values except modulus of elasticity, E, and compression perpendicular-to-grain, $F_{c\perp}$, based on a deformation limit shall be multiplied by the appropriate load duration factor.

Wet Service Factor, C_M: When dimension lumber is used where moisture content will exceed 19 percent for an extended time period, design values shall be multiplied by the appropriate wet service factors.

The resulting allowable design values used to determine these Southern Pine maximum spans are listed in the table on page 7.

Allowable Southern Pine Design Values Used to Calculate Maximum Spans[1]

Based on 1991 SPIB Grading Rules • Values in pounds per square inch (psi)

Property	Size	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
Floor and Ceiling Joists												**Tables 1 to 9 and 42 to 47**
F_b[2]	2 x 4	3510	3280	3050	2300	2130	1950	1960	1720	1550	980	720
	2 x 6	3100	2930	2700	2010	1900	1720	1670	1440	1320	865	
	2 x 8	2820	2650	2420	1900	1730	1550	1610	1380	1260	805	
	2 x 10	2470	2360	2130	1670	1500	1380	1380	1210	1090	690	
	2 x 12	2360	2190	2010	1550	1440	1320	1320	1120	1040	660	
E	All	1,900,000	1,800,000	1,700,000	1,800,000	1,700,000	1,600,000	1,700,000	1,600,000	1,400,000	1,400,000	1,300,000
$F_{c\perp}$	All	660	565	480	660	565	480	660	565	480	565	565
F_v	All	90	90	90	90	90	90	90	90	90	90	
	(except 2 x 4)	100	100	100	100	100	100	90	90	90	90	90
Rafters: Snow Load (C_D = 1.15)												**Tables 10 to 33**
F_b[3]	2 x 4	4030	3770	3500	2650	2450	2250	2250	1980	1790	1120	825
	2 x 6	3570	3370	3110	2310	2180	1980	1920	1650	1520	990	
	2 x 8	3240	3040	2780	2180	1980	1790	1850	1590	1450	925	
	2 x 10	2840	2710	2450	1920	1720	1590	1590	1390	1260	795	
	2 x 12	2710	2510	2310	1790	1650	1520	1520	1290	1190	760	
E	All	1,900,000	1,800,000	1,700,000	1,800,000	1,700,000	1,600,000	1,700,000	1,600,000	1,400,000	1,400,000	1,300,000
$F_{c\perp}$	All	660	565	480	660	565	480	660	565	480	565	565
Rafters: Construction Load (C_D = 1.25)												**Tables 34 to 39**
F_b[4]	2 x 4	4380	4100	3810	2880	2660	2440	2440	2160	1940	1220	900
	2 x 6	3880	3670	3380	2520	2370	2160	2080	1800	1650	1080	
	2 x 8	3520	3310	3020	2370	2160	1940	2010	1720	1580	1010	
	2 x 10	3090	2950	2660	2080	1870	1730	1730	1510	1370	865	
	2 x 12	2950	2730	2520	1940	1800	1650	1650	1400	1290	825	
E	All	1,900,000	1,800,000	1,700,000	1,800,000	1,700,000	1,600,000	1,700,000	1,600,000	1,400,000	1,400,000	1,300,000
$F_{c\perp}$	All	660	565	480	660	565	480	660	565	480	565	565
Wet-Service Floor Joists (MC > 19%)												**Tables 40 & 41**
F_b[5]	2 x 6	2640	2490	2300	1710	1610	1470	1420	1220	1320	865	
	2 x 8	2390	2250	2050	1610	1470	1320	1370	1170	1270	805	
	2 x 10	2100	2000	1810	1420	1270	1170	1170	1210	1090	690	
	2 x 12	2000	1860	1710	1320	1220	1320	1320	1120	1040	660	
E[6]	All	1,710,000	1,620,000	1,530,000	1,620,000	1,530,000	1,440,000	1,530,000	1,440,000	1,260,000	1,260,000	
$F_{c\perp}$[7]	All	440	380	320	440	380	320	440	380	320	380	

1 Listed allowable bending, F_b, and modulus of elasticity, E, design values are from AFPA's Span Tables for Joists and Rafters supplement on design values. The allowable shear parallel-to-grain, F_v, and compression perpendicular-to-grain, $F_{c\perp}$, design values are from AFPA's National Design Specification supplement on design values. The general procedure followed was to multiply tabulated design values by appropriate adjustment factors (i.e. repetitive members, load duration, and/or wet service uses), and then round to the nearest 5 or 10 psi.

2 Bending values were multiplied by the repetitive member use factor, C_r = 1.15. (F_b x 1.15). The repetitive member use factor assumes installation of at least three members spaced not more than 24" on center, and joined by sheathing adequate to support the design load.

3 Bending values were multiplied by the repetitive member use factor, C_r = 1.15, and by the two-month load duration factor for snow, C_D = 1.15. (F_b x 1.15 x 1.15). The load duration factor recognizes wood's ability to carry substantially greater maximum loads for short durations than for long durations.

4 Bending values were multiplied by the repetitive member use factor, C_r = 1.15, and by the seven-day load duration factor for construction, C_D = 1.25. (F_b x 1.15 x 1.25).

5 Bending values were multiplied by the repetitive member use factor, C_r = 1.15, and by the wet service factor, C_M = 0.85, except if $F_b \leq$ 1150 psi, then C_M = 1.0. (F_b x 1.15 x 0.85 or 1.0). The wet service factor assumes lumber is used where the moisture content will exceed 19% for an extended period of time.

6 Modulus of elasticity values were multiplied by the wet service factor, C_M = 0.90. (E x 0.90).

7 Compression perpendicular-to-grain values were multiplied by the wet service factor, C_M = 0.67. ($F_{c\perp}$ x 0.67).

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 1 Floor Joists – 30 psf live load, 10 psf dead load, ℓ/360

Sleeping rooms and attic floors

Size (inches)	Spacing (inches on center)	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
		Grade									
2 x 6	12	12-6	12-3	12-0	12-3	12-0	11-10	12-0	11-10	11-3	10-5
	16	11-4	11-2	10-11	11-2	10-11	10-9	10-11	10-9	10-3	9-1
	24	9-11	9-9	9-7	9-9	9-7	9-4	9-7	9-4	8-11	7-5
2 x 8	12	16-6	16-2	15-10	16-2	15-10	15-7	15-10	15-7	14-11	13-3
	16	15-0	14-8	14-5	14-8	14-5	14-2	14-5	14-2	13-6	11-6
	24	13-1	12-10	12-7	12-10	12-7	12-4	12-7	12-4	11-9	9-5
2 x 10	12	21-0	20-8	20-3	20-8	20-3	19-10	20-3	19-10	19-0	15-8
	16	19-1	18-9	18-5	18-9	18-5	18-0	18-5	18-0	17-1	13-7
	24	16-8	16-5	16-1	16-5	16-1	15-8	15-8	14-8	13-11	11-1
2 x 12	12	25-7	25-1	24-8	25-1	24-8	24-2	24-8	24-2	23-1	18-8
	16	23-3	22-10	22-5	22-10	22-5	21-11	22-5	21-1	20-3	16-2
	24	20-3	19-11	19-7	19-11	19-6	18-8	18-8	17-2	16-7	13-2

Table 2 Floor Joists – 40 psf live load, 10 psf dead load, ℓ/360

All rooms except sleeping rooms and attic floors

Size (inches)	Spacing (inches on center)	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
		Grade									
2 x 6	12	11-4	11-2	10-11	11-2	10-11	10-9	10-11	10-9	10-3	9-4
	16	10-4	10-2	9-11	10-2	9-11	9-9	9-11	9-9	9-4	8-1
	24	9-0	8-10	8-8	8-10	8-8	8-6	8-8	8-6	8-2	6-7
2 x 8	12	15-0	14-8	14-5	14-8	14-5	14-2	14-5	14-2	13-6	11-11
	16	13-7	13-4	13-1	13-4	13-1	12-10	13-1	12-10	12-3	10-3
	24	11-11	11-8	11-5	11-8	11-5	11-3	11-5	11-0	10-6	8-5
2 x 10	12	19-1	18-9	18-5	18-9	18-5	18-0	18-5	18-0	17-3	14-0
	16	17-4	17-0	16-9	17-0	16-9	16-5	16-9	16-1	15-3	12-2
	24	15-2	14-11	14-7	14-11	14-7	14-0	14-0	13-2	12-6	9-11
2 x 12	12	23-3	22-10	22-5	22-10	22-5	21-11	22-5	21-9	20-11	16-8
	16	21-1	20-9	20-4	20-9	20-4	19-11	20-4	18-10	18-2	14-5
	24	18-5	18-1	17-9	18-1	17-5	16-8	16-8	15-4	14-10	11-10

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 3 Floor Joists – 50 psf live load, 10 psf dead load, ℓ/360

Office space (concentrated load checks may be required)

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	10-6	10-4	10-2	10-4	10-2	9-11	10-2	9-11	9-6	8-6
	16	9-7	9-5	9-3	9-5	9-3	9-1	9-3	9-1	8-8	7-5
	24	8-4	8-3	8-1	8-3	8-1	7-11	8-1	7-9	7-5	6-0
2 x 8	12	13-11	13-8	13-5	13-8	13-5	13-1	13-5	13-1	12-7	10-10
	16	12-7	12-5	12-2	12-5	12-2	11-11	12-2	11-11	11-5	9-5
	24	11-0	10-10	10-8	10-10	10-8	10-5	10-8	10-0	9-7	7-8
2 x 10	12	17-9	17-5	17-1	17-5	17-1	16-9	17-1	16-9	16-0	12-10
	16	16-1	15-10	15-6	15-10	15-6	15-2	15-6	14-8	13-11	11-1
	24	14-1	13-10	13-7	13-10	13-4	12-10	12-10	12-0	11-5	9-1
2 x 12	12	21-7	21-2	20-9	21-2	20-9	20-4	20-9	19-10	19-1	15-3
	16	19-7	19-3	18-10	19-3	18-10	18-6	18-8	17-2	16-7	13-2
	24	17-1	16-10	16-6	16-6	15-11	15-3	15-3	14-0	13-6	10-9

Table 4 Floor Joists – 60 psf live load, 10 psf dead load, ℓ/360

Corridors

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	9-11	9-9	9-7	9-9	9-7	9-4	9-7	9-4	8-11	7-11
	16	9-0	8-10	8-8	8-10	8-8	8-6	8-8	8-6	8-2	6-10
	24	7-10	7-9	7-7	7-9	7-7	7-5	7-7	7-2	6-11	5-7
2 x 8	12	13-1	12-10	12-7	12-10	12-7	12-4	12-7	12-4	11-10	10-0
	16	11-11	11-8	11-5	11-8	11-5	11-3	11-5	11-3	10-9	8-8
	24	10-5	10-2	10-0	10-2	10-0	9-10	10-0	9-4	8-11	7-1
2 x 10	12	16-8	16-5	16-1	16-5	16-1	15-9	16-1	15-8	14-11	11-10
	16	15-2	14-11	14-7	14-11	14-7	14-4	14-6	13-7	12-11	10-3
	24	13-3	13-0	12-9	13-0	12-4	11-10	11-10	11-1	10-6	8-5
2 x 12	12	20-3	19-11	19-7	19-11	19-7	19-2	19-7	18-4	17-8	14-1
	16	18-5	18-1	17-9	18-1	17-9	17-3	17-3	15-11	15-4	12-3
	24	16-1	15-10	15-6	15-3	14-9	14-1	14-1	13-0	12-6	10-0

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 5 Floor Joists – 40 psf live load, 20 psf dead load, ℓ/360

All rooms except sleeping rooms and attic floors (maximum 1.5" lightweight concrete)

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	11-4	11-2	10-11	11-2	10-11	10-9	10-11	10-9	10-3	8-6
	16	10-4	10-2	9-11	10-2	9-11	9-9	9-11	9-6	9-1	7-5
	24	9-0	8-10	8-8	8-10	8-8	8-6	8-5	7-9	7-5	6-0
2 x 8	12	15-0	14-8	14-5	14-8	14-5	14-2	14-5	14-2	13-6	10-10
	16	13-7	13-4	13-1	13-4	13-1	12-10	13-1	12-4	11-9	9-5
	24	11-11	11-8	11-5	11-8	11-3	10-8	10-10	10-0	9-7	7-8
2 x 10	12	19-1	18-9	18-5	18-9	18-5	18-0	18-1	17-0	16-1	12-10
	16	17-4	17-0	16-9	17-0	16-4	15-8	15-8	14-8	13-11	11-1
	24	15-2	14-11	14-7	14-1	13-4	12-10	12-10	12-0	11-5	9-1
2 x 12	12	23-3	22-10	22-5	22-10	22-5	21-7	21-7	19-10	19-1	15-3
	16	21-1	20-9	20-4	20-3	19-6	18-8	18-8	17-2	16-7	13-2
	24	18-5	18-1	17-9	16-6	15-11	15-3	15-3	14-0	13-6	10-9

Table 6 Floor Joists – 50 psf live load, 20 psf dead load, ℓ/360

Office space (concentrated load checks may be required; maximum 1.5" lightweight concrete)

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	10-6	10-4	10-2	10-4	10-2	9-11	10-2	9-11	9-6	7-11
	16	9-7	9-5	9-3	9-5	9-3	9-1	9-3	8-10	8-5	6-10
	24	8-4	8-3	8-1	8-3	8-1	7-10	7-9	7-2	6-11	5-7
2 x 8	12	13-11	13-8	13-5	13-8	13-5	13-1	13-5	13-1	12-7	10-0
	16	12-7	12-5	12-2	12-5	12-2	11-11	12-2	11-5	10-11	8-8
	24	11-0	10-10	10-8	10-10	10-5	9-10	10-0	9-4	8-11	7-1
2 x 10	12	17-9	17-5	17-1	17-5	17-1	16-9	16-9	15-8	14-11	11-10
	16	16-1	15-10	15-6	15-10	15-2	14-6	14-6	13-7	12-11	10-3
	24	14-1	13-10	13-7	13-1	12-4	11-10	11-10	11-1	10-6	8-5
2 x 12	12	21-7	21-2	20-9	21-2	20-9	19-11	19-11	18-4	17-8	14-1
	16	19-7	19-3	18-10	18-9	18-0	17-3	17-3	15-11	15-4	12-3
	24	17-1	16-10	16-6	15-3	14-9	14-1	14-1	13-0	12-6	10-0

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 7 Floor Joists – 60 psf live load, 20 psf dead load, ℓ/360

Corridors (maximum 1.5" lightweight concrete)

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	9-11	9-9	9-7	9-9	9-7	9-4	9-7	9-4	8-11	7-5
	16	9-0	8-10	8-8	8-10	8-8	8-6	8-8	8-3	7-11	6-5
	24	7-10	7-9	7-7	7-9	7-7	7-4	7-3	6-9	6-5	5-3
2 x 8	12	13-1	12-10	12-7	12-10	12-7	12-4	12-7	12-4	11-9	9-5
	16	11-11	11-8	11-5	11-8	11-5	11-3	11-5	10-8	10-2	8-2
	24	10-5	10-2	10-0	10-2	9-9	9-3	9-5	8-8	8-4	6-8
2 x 10	12	16-8	16-5	16-1	16-5	16-1	15-8	15-8	14-8	13-11	11-1
	16	15-2	14-11	14-7	14-11	14-2	13-7	13-7	12-9	12-1	9-7
	24	13-3	13-0	12-9	12-2	11-7	11-1	11-1	10-5	9-10	7-10
2 x 12	12	20-3	19-11	19-7	19-11	19-6	18-8	18-8	17-2	16-7	13-2
	16	18-5	18-1	17-9	17-6	16-11	16-2	16-2	14-11	14-4	11-5
	24	16-1	15-10	15-6	14-4	13-9	13-2	13-2	12-2	11-9	9-4

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 8 Ceiling Joists – 10 psf live load, 5 psf dead load, ℓ/240

Drywall ceiling; No attic storage

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	13-2	12-11	12-8	12-11	12-8	12-5	12-8	12-5	11-10	11-7	9-11
	16	11-11	11-9	11-6	11-9	11-6	11-3	11-6	11-3	10-9	10-0	8-7
	24	10-5	10-3	10-0	10-3	10-0	9-10	10-0	9-10	9-5	8-2	7-0
2 x 6	12	20-8	20-3	19-11	20-3	19-11	19-6	19-11	19-6	18-8	17-1	
	16	18-9	18-5	18-1	18-5	18-1	17-8	18-1	17-8	16-11	14-9	
	24	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-6	14-9	12-1	
2 x 8	12	26-0*	26-0*	26-0*	26-0*	26-0*	25-8	26-0*	25-8	24-7	21-8	
	16	24-8	24-3	23-10	24-3	23-10	23-4	23-10	23-4	22-4	18-9	
	24	21-7	21-2	20-10	21-2	20-10	20-5	20-10	20-1	19-2	15-4	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-7	
	16	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	22-2	
	24	26-0*	26-0*	26-0*	26-0*	26-0*	25-7	25-7	24-0	22-9	18-1	

Table 9 Ceiling Joists – 20 psf live load, 10 psf dead load, ℓ/240

Drywall ceiling; No future room development, but limited attic storage available

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	10-5	10-3	10-0	10-3	10-0	9-10	10-0	9-10	9-5	8-2	7-0
	16	9-6	9-4	9-1	9-4	9-1	8-11	9-1	8-11	8-7	7-1	6-1
	24	8-3	8-1	8-0	8-1	8-0	7-10	8-0	7-8	7-3	5-9	4-11
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-6	14-9	12-1	
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-4	13-6	12-11	10-5	
	24	13-0	12-9	12-6	12-9	12-6	12-0	11-10	11-0	10-6	8-6	
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	20-1	19-2	15-4	
	16	19-7	19-3	18-11	19-3	18-11	18-5	18-9	17-5	16-7	13-3	
	24	17-2	16-10	16-6	16-8	15-11	15-1	15-4	14-2	13-7	10-10	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	25-7	25-7	24-0	22-9	18-1	
	16	25-0	24-7	24-1	24-5	23-2	22-2	22-2	20-9	19-9	15-8	
	24	21-10	21-6	21-1	19-11	18-11	18-1	18-1	17-0	16-1	12-10	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 10 Rafters – 20 psf live load, 10 psf dead load, ℓ/240, C_D=1.15

Light roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-6	14-9	12-11
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-4	14-1	13-5	11-2
	24	13-0	12-9	12-6	12-9	12-6	12-3	12-6	11-9	11-4	9-1
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	20-5	19-6	16-5
	16	19-7	19-3	18-11	19-3	18-11	18-6	18-11	18-6	17-9	14-3
	24	17-2	16-10	16-6	16-10	16-6	16-2	16-5	15-3	14-7	11-7
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0	26-0*	25-8	24-6	19-5
	16	25-0	24-7	24-1	24-7	24-1	23-8	23-10	22-3	21-2	16-10
	24	21-10	21-6	21-1	21-4	20-3	19-5	19-5	18-2	17-4	13-9
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	23-1
	16	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-1	20-0
	24	26-0*	26-0*	25-7	25-1	24-1	23-1	23-1	21-4	20-5	16-4

Table 11 Rafters – 30 psf live load, 10 psf dead load, ℓ/240, C_D=1.15

Light roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	14-4	14-1	13-9	14-1	13-9	13-6	13-9	13-6	12-11	11-2
	16	13-0	12-9	12-6	12-9	12-6	12-3	12-6	12-3	11-9	9-8
	24	11-4	11-2	10-11	11-2	10-11	10-9	10-11	10-2	9-9	7-11
2 x 8	12	18-10	18-6	18-2	18-6	18-2	17-10	18-2	17-10	17-0	14-3
	16	17-2	16-10	16-6	16-10	16-6	16-2	16-6	16-2	15-5	12-4
	24	15-0	14-8	14-5	14-8	14-5	14-0	14-3	13-2	12-7	10-1
2 x 10	12	24-1	23-8	23-2	23-8	23-2	22-9	23-2	22-3	21-2	16-10
	16	21-10	21-6	21-1	21-6	21-1	20-7	20-7	19-3	18-4	14-7
	24	19-1	18-9	18-5	18-6	17-6	16-10	16-10	15-9	15-0	11-11
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-1	20-0
	16	26-0*	26-0*	25-7	26-0*	25-7	24-6	24-6	22-7	21-8	17-4
	24	23-3	22-10	22-5	21-9	20-10	20-0	20-0	18-5	17-9	14-2

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 12 Rafters – 40 psf live load, 10 psf dead load, ℓ/240, C_D=1.15

Light roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	13-0	12-9	12-6	12-9	12-6	12-3	12-6	12-3	11-9	10-0
	16	11-10	11-7	11-5	11-7	11-5	11-2	11-5	11-2	10-8	8-8
	24	10-4	10-2	9-11	10-2	9-11	9-9	9-10	9-1	8-9	7-1
2 x 8	12	17-2	16-10	16-6	16-10	16-6	16-2	16-6	16-2	15-6	12-9
	16	15-7	15-3	15-0	15-3	15-0	14-8	15-0	14-5	13-10	11-0
	24	13-7	13-4	13-1	13-4	13-1	12-6	12-9	11-10	11-3	9-0
2 x 10	12	21-10	21-6	21-1	21-6	21-1	20-8	21-1	19-11	18-11	15-1
	16	19-10	19-6	19-2	19-6	19-2	18-5	18-5	17-3	16-5	13-0
	24	17-4	17-0	16-9	16-7	15-8	15-1	15-1	14-1	13-5	10-8
2 x 12	12	26-0*	26-0*	25-7	26-0*	25-7	25-1	25-4	23-4	22-5	17-11
	16	24-2	23-9	23-3	23-9	22-10	21-11	21-11	20-2	19-5	15-6
	24	21-1	20-9	20-4	19-5	18-8	17-11	17-11	16-6	15-10	12-8

Table 13 Rafters – 50 psf live load, 10 psf dead load, ℓ/240, C_D=1.15

Light roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	12-1	11-10	11-8	11-10	11-8	11-5	11-8	11-5	10-11	9-1
	16	11-0	10-9	10-7	10-9	10-7	10-4	10-7	10-2	9-9	7-11
	24	9-7	9-5	9-3	9-5	9-3	9-1	9-0	8-4	8-0	6-5
2 x 8	12	15-11	15-7	15-4	15-7	15-4	15-0	15-4	15-0	14-4	11-7
	16	14-5	14-2	13-11	14-2	13-11	13-8	13-11	13-2	12-7	10-1
	24	12-7	12-5	12-2	12-5	12-0	11-5	11-7	10-9	10-3	8-3
2 x 10	12	20-3	19-11	19-7	19-11	19-7	19-2	19-5	18-2	17-4	13-9
	16	18-5	18-1	17-9	18-1	17-6	16-10	16-10	15-9	15-0	11-11
	24	16-1	15-10	15-6	15-1	14-4	13-9	13-9	12-10	12-3	9-9
2 x 12	12	24-8	24-3	23-9	24-3	23-9	23-1	23-1	21-4	20-5	16-4
	16	22-5	22-0	21-7	21-9	20-10	20-0	20-0	18-5	17-9	14-2
	24	19-7	19-3	18-10	17-9	17-0	16-4	16-4	15-1	14-6	11-7

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 14 Rafters – 20 psf live load, 15 psf dead load, ℓ/240, C_D=1.15

Medium roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-5	14-9	11-11
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-4	13-4	12-10	10-4
	24	13-0	12-9	12-6	12-9	12-6	11-11	11-9	10-11	10-6	8-5
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	19-11	19-1	15-3
	16	19-7	19-3	18-11	19-3	18-11	18-4	18-8	17-3	16-6	13-2
	24	17-2	16-10	16-6	16-6	15-9	15-0	15-3	14-1	13-6	10-9
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	25-5	25-5	23-10	22-8	18-0
	16	25-0	24-7	24-1	24-3	22-11	22-1	22-1	20-7	19-7	15-7
	24	21-10	21-6	21-1	19-9	18-9	18-0	18-0	16-10	16-0	12-9
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	21-5
	16	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	24-2	23-2	18-6
	24	26-0*	26-0*	25-7	23-3	22-4	21-5	21-5	19-9	18-11	15-2

Table 15 Rafters – 30 psf live load, 15 psf dead load, ℓ/240, C_D=1.15

Medium roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	14-4	14-1	13-9	14-1	13-9	13-6	13-9	13-6	12-11	10-6
	16	13-0	12-9	12-6	12-9	12-6	12-3	12-6	11-9	11-4	9-1
	24	11-4	11-2	10-11	11-2	10-11	10-6	10-4	9-7	9-3	7-5
2 x 8	12	18-10	18-6	18-2	18-6	18-2	17-10	18-2	17-7	16-10	13-5
	16	17-2	16-10	16-6	16-10	16-6	16-2	16-5	15-3	14-7	11-7
	24	15-0	14-8	14-5	14-7	13-11	13-2	13-5	12-5	11-11	9-6
2 x 10	12	24-1	23-8	23-2	23-8	23-2	22-5	22-5	21-0	20-0	15-10
	16	21-10	21-6	21-1	21-4	20-3	19-5	19-5	18-2	17-4	13-9
	24	19-1	18-9	18-5	17-5	16-6	15-10	15-10	14-10	14-2	11-3
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	24-7	23-7	18-10
	16	26-0*	26-0*	25-7	25-1	24-1	23-1	23-1	21-4	20-5	16-4
	24	23-3	22-10	22-5	20-6	19-8	18-10	18-10	17-5	16-8	13-4

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 16 Rafters – 40 psf live load, 15 psf dead load, ℓ/240, C_D=1.15

Medium roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	13-0	12-9	12-6	12-9	12-6	12-3	12-6	12-3	11-9	9-6
	16	11-10	11-7	11-5	11-7	11-5	11-2	11-5	10-8	10-3	8-3
	24	10-4	10-2	9-11	10-2	9-11	9-6	9-5	8-8	8-4	6-9
2 x 8	12	17-2	16-10	16-6	16-10	16-6	16-2	16-6	15-11	15-2	12-2
	16	15-7	15-3	15-0	15-3	15-0	14-7	14-10	13-9	13-2	10-6
	24	13-7	13-4	13-1	13-2	12-7	11-11	12-2	11-3	10-9	8-7
2 x 10	12	21-10	21-6	21-1	21-6	21-1	20-4	20-4	19-0	18-1	14-4
	16	19-10	19-6	19-2	19-4	18-3	17-7	17-7	16-5	15-8	12-5
	24	17-4	17-0	16-9	15-9	14-11	14-4	14-4	13-5	12-9	10-2
2 x 12	12	26-0*	26-0*	25-7	26-0*	25-2	24-2	24-2	22-3	21-4	17-1
	16	24-2	23-9	23-3	22-8	21-9	20-11	20-11	19-3	18-6	14-9
	24	21-1	20-9	20-4	18-6	17-9	17-1	17-1	15-9	15-1	12-1

Table 17 Rafters – 50 psf live load, 15 psf dead load, ℓ/240, C_D=1.15

Medium roofing; Drywall ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	12-1	11-10	11-8	11-10	11-8	11-5	11-8	11-4	10-10	8-9
	16	11-0	10-9	10-7	10-9	10-7	10-4	10-7	9-10	9-5	7-7
	24	9-7	9-5	9-3	9-5	9-2	8-9	8-8	8-0	7-8	6-2
2 x 8	12	15-11	15-7	15-4	15-7	15-4	15-0	15-4	14-8	14-0	11-2
	16	14-5	14-2	13-11	14-2	13-11	13-5	13-8	12-8	12-1	9-8
	24	12-7	12-5	12-2	12-1	11-7	11-0	11-2	10-4	9-11	7-11
2 x 10	12	20-3	19-11	19-7	19-11	19-5	18-8	18-8	17-6	16-8	13-2
	16	18-5	18-1	17-9	17-9	16-10	16-2	16-2	15-1	14-5	11-5
	24	16-1	15-10	15-6	14-6	13-9	13-2	13-2	12-4	11-9	9-4
2 x 12	12	24-8	24-3	23-9	24-1	23-2	22-3	22-3	20-6	19-8	15-8
	16	22-5	22-0	21-7	20-10	20-0	19-3	19-3	17-9	17-0	13-7
	24	19-7	19-3	18-10	17-1	16-4	15-8	15-8	14-6	13-11	11-1

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 18 Rafters – 20 psf live load, 20 psf dead load, ℓ/240, C_D=1.15

Heavy roofing; Drywall ceiling; Snow load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-7	14-5	13-10	11-2
	16	14-11	14-7	14-4	14-7	14-4	13-8	13-6	12-6	12-0	9-8
	24	13-0	12-9	12-6	12-1	11-9	11-2	11-0	10-2	9-9	7-11
2 x 8	12	21-7	21-2	20-10	21-2	20-10	19-10	20-2	18-8	17-10	14-3
	16	19-7	19-3	18-11	18-11	18-0	17-2	17-5	16-2	15-5	12-4
	24	17-2	16-10	16-6	15-5	14-9	14-0	14-3	13-2	12-7	10-1
2 x 10	12	26-0*	26-0*	26-0*	26-0*	24-9	23-10	23-10	22-3	21-2	16-10
	16	25-0	24-7	24-1	22-8	21-5	20-7	20-7	19-3	18-4	14-7
	24	21-10	21-6	20-11	18-6	17-6	16-10	16-10	15-9	15-0	11-11
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-1	20-0
	16	26-0*	26-0*	26-0*	26-0*	25-7	24-6	24-6	22-7	21-8	17-4
	24	26-0*	25-9	24-8	21-9	20-10	20-0	20-0	18-5	17-9	14-2

Table 19 Rafters – 30 psf live load, 20 psf dead load, ℓ/240, C_D=1.15

Heavy roofing; Drywall ceiling; Snow load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	14-4	14-1	13-9	14-1	13-9	13-6	13-9	12-11	12-5	10-0
	16	13-0	12-9	12-6	12-9	12-6	12-3	12-1	11-2	10-9	8-8
	24	11-4	11-2	10-11	10-10	10-6	10-0	9-10	9-1	8-9	7-1
2 x 8	12	18-10	18-6	18-2	18-6	18-2	17-9	18-0	16-8	15-11	12-9
	16	17-2	16-10	16-6	16-10	16-2	15-4	15-7	14-5	13-10	11-0
	24	15-0	14-8	14-5	13-10	13-2	12-6	12-9	11-10	11-3	9-0
2 x 10	12	24-1	23-8	23-2	23-5	22-2	21-4	21-4	19-11	18-11	15-1
	16	21-10	21-6	21-1	20-3	19-2	18-5	18-5	17-3	16-5	13-0
	24	19-1	18-9	18-5	16-7	15-8	15-1	15-1	14-1	13-5	10-8
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	25-4	25-4	23-4	22-5	17-11
	16	26-0*	26-0*	25-7	23-10	22-10	21-11	21-11	20-2	19-5	15-6
	24	23-3	22-10	22-1	19-5	18-8	17-11	17-11	16-6	15-10	12-8

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 20 Rafters – 40 psf live load, 20 psf dead load, ℓ/240, C_D=1.15

Heavy roofing; Drywall ceiling; Snow load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	13-0	12-9	12-6	12-9	12-6	12-3	12-6	11-9	11-4	9-1
	16	11-10	11-7	11-5	11-7	11-5	11-2	11-0	10-2	9-9	7-11
	24	10-4	10-2	9-11	9-10	9-7	9-1	9-0	8-4	8-0	6-5
2 x 8	12	17-2	16-10	16-6	16-10	16-6	16-2	16-5	15-3	14-7	11-7
	16	15-7	15-3	15-0	15-3	14-9	14-0	14-3	13-2	12-7	10-1
	24	13-7	13-4	13-1	12-7	12-0	11-5	11-7	10-9	10-3	8-3
2 x 10	12	21-10	21-6	21-1	21-4	20-3	19-5	19-5	18-2	17-4	13-9
	16	19-10	19-6	19-2	18-6	17-6	16-10	16-10	15-9	15-0	11-11
	24	17-4	17-0	16-9	15-1	14-4	13-9	13-9	12-10	12-3	9-9
2 x 12	12	26-0*	26-0*	25-7	25-1	24-1	23-1	23-1	21-4	20-5	16-4
	16	24-2	23-9	23-3	21-9	20-10	20-0	20-0	18-5	17-9	14-2
	24	21-1	20-9	20-2	17-9	17-0	16-4	16-4	15-1	14-6	11-7

Table 21 Rafters – 50 psf live load, 20 psf dead load, ℓ/240, C_D=1.15

Heavy roofing; Drywall ceiling; Snow load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	12-1	11-10	11-8	11-10	11-8	11-5	11-8	10-11	10-6	8-5
	16	11-0	10-9	10-7	10-9	10-7	10-4	10-2	9-5	9-1	7-4
	24	9-7	9-5	9-3	9-1	8-10	8-5	8-4	7-9	7-5	6-0
2 x 8	12	15-11	15-7	15-4	15-7	15-4	15-0	15-3	14-1	13-6	10-9
	16	14-5	14-2	13-11	14-2	13-8	13-0	13-2	12-3	11-8	9-4
	24	12-7	12-5	12-2	11-8	11-2	10-7	10-9	10-0	9-6	7-7
2 x 10	12	20-3	19-11	19-7	19-9	18-9	18-0	18-0	16-10	16-0	12-9
	16	18-5	18-1	17-9	17-2	16-3	15-7	15-7	14-7	13-11	11-0
	24	16-1	15-10	15-6	14-0	13-3	12-9	12-9	11-11	11-4	9-0
2 x 12	12	24-8	24-3	23-9	23-3	22-4	21-5	21-5	19-9	18-11	15-2
	16	22-5	22-0	21-7	20-1	19-4	18-6	18-6	17-1	16-5	13-1
	24	19-7	19-3	18-8	16-5	15-9	15-2	15-2	13-11	13-5	10-8

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 22 Rafters – 20 psf live load, 10 psf dead load, ℓ/180, C_D=1.15

Light roofing; No finished ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade										
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-10	10-4	8-9	7-6
	16	10-5	10-3	10-0	10-3	10-0	9-10	10-0	9-10	9-5	7-7	6-6
	24	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-3	7-10	6-2	5-4
2 x 6	12	18-0	17-8	17-4	17-8	17-4	17-0	17-4	16-8	16-0	12-11	
	16	16-4	16-1	15-9	16-1	15-9	15-6	15-7	14-5	13-10	11-2	
	24	14-4	14-1	13-9	13-11	13-6	12-11	12-8	11-9	11-4	9-1	
2 x 8	12	23-9	23-4	22-11	23-4	22-11	22-5	22-11	21-7	20-7	16-5	
	16	21-7	21-2	20-10	21-2	20-10	19-10	20-2	18-8	17-10	14-3	
	24	18-10	18-6	18-2	17-10	17-0	16-2	16-5	15-3	14-7	11-7	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-8	24-6	19-5	
	16	26-0*	26-0*	26-0*	26-0*	24-9	23-10	23-10	22-3	21-2	16-10	
	24	24-1	23-8	23-2	21-4	20-3	19-5	19-5	18-2	17-4	13-9	

Table 23 Rafters – 30 psf live load, 10 psf dead load, ℓ/180, C_D=1.15

Light roofing; No finished ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade										
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	10-0	9-10	9-8	9-10	9-8	9-6	9-8	9-6	9-1	7-7	6-6
	16	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-7	8-3	6-7	5-7
	24	7-11	7-10	7-8	7-10	7-8	7-6	7-7	7-1	6-9	5-4	4-7
2 x 6	12	15-9	15-6	15-2	15-6	15-2	14-10	15-2	14-5	13-10	11-2	
	16	14-4	14-1	13-9	14-1	13-9	13-6	13-6	12-6	12-0	9-8	
	24	12-6	12-3	12-0	12-1	11-9	11-2	11-0	10-2	9-9	7-11	
2 x 8	12	20-9	20-5	20-0	20-5	20-0	19-7	20-0	18-8	17-10	14-3	
	16	18-10	18-6	18-2	18-6	18-0	17-2	17-5	16-2	15-5	12-4	
	24	16-6	16-2	15-10	15-5	14-9	14-0	14-3	13-2	12-7	10-1	
2 x 10	12	26-0*	26-0	25-6	26-0	24-9	23-10	23-10	22-3	21-2	16-10	
	16	24-1	23-8	23-2	22-8	21-5	20-7	20-7	19-3	18-4	14-7	
	24	21-0	20-8	20-3	18-6	17-6	16-10	16-10	15-9	15-0	11-11	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 24 Rafters – 40 psf live load, 10 psf dead load, ℓ/180, C_D=1.15

Light roofing; No finished ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade										
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-7	8-3	6-9	5-10
	16	8-3	8-1	8-0	8-1	8-0	7-10	8-0	7-9	7-5	5-10	5-0
	24	7-3	7-1	7-0	7-1	7-0	6-9	6-9	6-4	6-1	4-9	4-1
2 x 6	12	14-4	14-1	13-9	14-1	13-9	13-6	13-9	12-11	12-5	10-0	
	16	13-0	12-9	12-6	12-9	12-6	12-3	12-1	11-2	10-9	8-8	
	24	11-4	11-2	10-11	10-10	10-6	10-0	9-10	9-1	8-9	7-1	
2 x 8	12	18-10	18-6	18-2	18-6	18-2	17-9	18-0	16-8	15-11	12-9	
	16	17-2	16-10	16-6	16-10	16-2	15-4	15-7	14-5	13-10	11-0	
	24	15-0	14-8	14-5	13-10	13-2	12-6	12-9	11-10	11-3	9-0	
2 x 10	12	24-1	23-8	23-2	23-5	22-2	21-4	21-4	19-11	18-11	15-1	
	16	21-10	21-6	21-1	20-3	19-2	18-5	18-5	17-3	16-5	13-0	
	24	19-1	18-9	18-5	16-7	15-8	15-1	15-1	14-1	13-5	10-8	

Table 25 Rafters – 50 psf live load, 10 psf dead load, ℓ/180, C_D=1.15

Light roofing; No finished ceiling; Snow load

Size (inches)	Spacing (inches on center)	Grade										
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	8-5	8-4	8-2	8-4	8-2	8-0	8-2	8-0	7-8	6-2	5-4
	16	7-8	7-6	7-5	7-6	7-5	7-3	7-5	7-1	6-9	5-4	4-7
	24	6-8	6-7	6-6	6-7	6-5	6-2	6-2	5-10	5-6	4-4	3-9
2 x 6	12	13-3	13-1	12-10	13-1	12-10	12-6	12-8	11-9	11-4	9-1	
	16	12-1	11-10	11-8	11-10	11-8	11-2	11-0	10-2	9-9	7-11	
	24	10-6	10-4	10-2	9-10	9-7	9-1	9-0	8-4	8-0	6-5	
2 x 8	12	17-6	17-2	16-10	17-2	16-10	16-2	16-5	15-3	14-7	11-7	
	16	15-11	15-7	15-4	15-5	14-9	14-0	14-3	13-2	12-7	10-1	
	24	13-11	13-8	13-5	12-7	12-0	11-5	11-7	10-9	10-3	8-3	
2 x 10	12	22-4	21-11	21-6	21-4	20-3	19-5	19-5	18-2	17-4	13-9	
	16	20-3	19-11	19-7	18-6	17-6	16-10	16-10	15-9	15-0	11-11	
	24	17-9	17-5	17-1	15-1	14-4	13-9	13-9	12-10	12-3	9-9	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 26 Rafters – 20 psf live load, 15 psf dead load, ℓ/180, C_D=1.15

Medium roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-9	10-3	8-1	6-11
	16	10-5	10-3	10-0	10-3	10-0	9-10	9-11	9-4	8-10	7-0	6-0
	24	9-1	8-11	8-9	8-10	8-5	8-1	8-1	7-7	7-3	5-9	4-11
2 x 6	12	18-0	17-8	17-4	17-8	17-4	16-11	16-8	15-5	14-10	11-11	
	16	16-4	16-1	15-9	15-10	15-4	14-8	14-5	13-4	12-10	10-4	
	24	14-4	14-1	13-9	12-11	12-6	11-11	11-9	10-11	10-6	8-5	
2 x 8	12	23-9	23-4	22-11	23-4	22-3	21-2	21-6	19-11	19-1	15-3	
	16	21-7	21-2	20-10	20-3	19-3	18-4	18-8	17-3	16-6	13-2	
	24	18-10	18-6	18-2	16-6	15-9	15-0	15-3	14-1	13-6	10-9	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	25-5	25-5	23-10	22-8	18-0	
	16	26-0*	26-0*	26-0*	24-3	22-11	22-1	22-1	20-7	19-7	15-7	
	24	24-1	23-6	22-4	19-9	18-9	18-0	18-0	16-10	16-0	12-9	

Table 27 Rafters – 30 psf live load, 15 psf dead load, ℓ/180, C_D=1.15

Medium roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	10-0	9-10	9-8	9-10	9-8	9-6	9-8	9-6	9-0	7-2	6-1
	16	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-3	7-10	6-2	5-4
	24	7-11	7-10	7-8	7-9	7-5	7-2	7-2	6-8	6-4	5-0	4-4
2 x 6	12	15-9	15-6	15-2	15-6	15-2	14-10	14-8	13-7	13-1	10-6	
	16	14-4	14-1	13-9	13-11	13-6	12-11	12-8	11-9	11-4	9-1	
	24	12-6	12-3	12-0	11-5	11-1	10-6	10-4	9-7	9-3	7-5	
2 x 8	12	20-9	20-5	20-0	20-5	19-8	18-8	19-0	17-7	16-10	13-5	
	16	18-10	18-6	18-2	17-10	17-0	16-2	16-5	15-3	14-7	11-7	
	24	16-6	16-2	15-10	14-7	13-11	13-2	13-5	12-5	11-11	9-6	
2 x 10	12	26-0*	26-0	25-6	24-8	23-4	22-5	22-5	21-0	20-0	15-10	
	16	24-1	23-8	23-2	21-4	20-3	19-5	19-5	18-2	17-4	13-9	
	24	21-0	20-8	19-8	17-5	16-6	15-10	15-10	14-10	14-2	11-3	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 28 Rafters – 40 psf live load, 15 psf dead load, ℓ/180, C_D=1.15

Medium roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-7	8-2	6-5	5-6
	16	8-3	8-1	8-0	8-1	8-0	7-10	7-11	7-5	7-1	5-7	4-10
	24	7-3	7-1	7-0	7-0	6-9	6-6	6-6	6-1	5-9	4-7	3-11
2 x 6	12	14-4	14-1	13-9	14-1	13-9	13-6	13-3	12-4	11-10	9-6	
	16	13-0	12-9	12-6	12-7	12-3	11-8	11-6	10-8	10-3	8-3	
	24	11-4	11-2	10-11	10-3	10-0	9-6	9-5	8-8	8-4	6-9	
2 x 8	12	18-10	18-6	18-2	18-6	17-9	16-11	17-2	15-11	15-2	12-2	
	16	17-2	16-10	16-6	16-2	15-5	14-7	14-10	13-9	13-2	10-6	
	24	15-0	14-8	14-5	13-2	12-7	11-11	12-2	11-3	10-9	8-7	
2 x 10	12	24-1	23-8	23-2	22-4	21-1	20-4	20-4	19-0	18-1	14-4	
	16	21-10	21-6	21-1	19-4	18-3	17-7	17-7	16-5	15-8	12-5	
	24	19-1	18-9	17-10	15-9	14-11	14-4	14-4	13-5	12-9	10-2	

Table 29 Rafters – 50 psf live load, 15 psf dead load, ℓ/180, C_D=1.15

Medium roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	8-5	8-4	8-2	8-4	8-2	8-0	8-2	7-11	7-6	5-11	5-1
	16	7-8	7-6	7-5	7-6	7-5	7-3	7-3	6-10	6-6	5-2	4-5
	24	6-8	6-7	6-6	6-5	6-2	5-11	5-11	5-7	5-4	4-2	3-7
2 x 6	12	13-3	13-1	12-10	13-1	12-10	12-5	12-2	11-4	10-10	8-9	
	16	12-1	11-10	11-8	11-7	11-3	10-9	10-7	9-10	9-5	7-7	
	24	10-6	10-4	10-2	9-6	9-2	8-9	8-8	8-0	7-8	6-2	
2 x 8	12	17-6	17-2	16-10	17-2	16-4	15-6	15-9	14-8	14-0	11-2	
	16	15-11	15-7	15-4	14-10	14-2	13-5	13-8	12-8	12-1	9-8	
	24	13-11	13-8	13-5	12-1	11-7	11-0	11-2	10-4	9-11	7-11	
2 x 10	12	22-4	21-11	21-6	20-6	19-5	18-8	18-8	17-6	16-8	13-2	
	16	20-3	19-11	19-7	17-9	16-10	16-2	16-2	15-1	14-5	11-5	
	24	17-8	17-3	16-5	14-6	13-9	13-2	13-2	12-4	11-9	9-4	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 30 Rafters – 20 psf live load, 20 psf dead load, ℓ/180, C_D=1.15

Heavy roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-9	10-9	10-1	9-7	7-7	6-6
	16	10-5	10-3	10-0	10-1	9-8	9-3	9-3	8-8	8-3	6-7	5-7
	24	9-1	8-11	8-9	8-3	7-11	7-7	7-7	7-1	6-9	5-4	4-7
2 x 6	12	18-0	17-8	17-4	17-1	16-7	15-10	15-7	14-5	13-10	11-2	
	16	16-4	16-1	15-9	14-9	14-4	13-8	13-6	12-6	12-0	9-8	
	24	14-4	14-1	13-9	12-1	11-9	11-2	11-0	10-2	9-9	7-11	
2 x 8	12	23-9	23-4	22-11	21-10	20-10	19-10	20-2	18-8	17-10	14-3	
	16	21-7	21-2	20-10	18-11	18-0	17-2	17-5	16-2	15-5	12-4	
	24	18-10	18-3	17-5	15-5	14-9	14-0	14-3	13-2	12-7	10-1	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	24-9	23-10	23-10	22-3	21-2	16-10	
	16	26-0*	26-0*	25-7	22-8	21-5	20-7	20-7	19-3	18-4	14-7	
	24	22-6	22-0	20-11	18-6	17-6	16-10	16-10	15-9	15-0	11-11	

Table 31 Rafters – 30 psf live load, 20 psf dead load, ℓ/180, C_D=1.15

Heavy roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	10-0	9-10	9-8	9-10	9-8	9-6	9-7	9-0	8-7	6-9	5-10
	16	9-1	8-11	8-9	8-11	8-8	8-4	8-4	7-9	7-5	5-10	5-0
	24	7-11	7-10	7-8	7-4	7-1	6-9	6-9	6-4	6-1	4-9	4-1
2 x 6	12	15-9	15-6	15-2	15-3	14-10	14-2	13-11	12-11	12-5	10-0	
	16	14-4	14-1	13-9	13-3	12-10	12-3	12-1	11-2	10-9	8-8	
	24	12-6	12-3	12-0	10-10	10-6	10-0	9-10	9-1	8-9	7-1	
2 x 8	12	20-9	20-5	20-0	19-7	18-8	17-9	18-0	16-8	15-11	12-9	
	16	18-10	18-6	18-2	16-11	16-2	15-4	15-7	14-5	13-10	11-0	
	24	16-6	16-2	15-7	13-10	13-2	12-6	12-9	11-10	11-3	9-0	
2 x 10	12	26-0*	26-0	25-6	23-5	22-2	21-4	21-4	19-11	18-11	15-1	
	16	24-1	23-8	22-11	20-3	19-2	18-5	18-5	17-3	16-5	13-0	
	24	20-1	19-8	18-8	16-7	15-8	15-1	15-1	14-1	13-5	10-8	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 32 Rafters – 40 psf live load, 20 psf dead load, ℓ/180, C_D=1.15

Heavy roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-3	7-10	6-2	5-4
	16	8-3	8-1	8-0	8-1	7-11	7-7	7-7	7-1	6-9	5-4	4-7
	24	7-3	7-1	7-0	6-9	6-5	6-2	6-2	5-10	5-6	4-4	3-9
2 x 6	12	14-4	14-1	13-9	13-11	13-6	12-11	12-8	11-9	11-4	9-1	
	16	13-0	12-9	12-6	12-1	11-9	11-2	11-0	10-2	9-9	7-11	
	24	11-4	11-2	10-11	9-10	9-7	9-1	9-0	8-4	8-0	6-5	
2 x 8	12	18-10	18-6	18-2	17-10	17-0	16-2	16-5	15-3	14-7	11-7	
	16	17-2	16-10	16-6	15-5	14-9	14-0	14-3	13-2	12-7	10-1	
	24	15-0	14-8	14-3	12-7	12-0	11-5	11-7	10-9	10-3	8-3	
2 x 10	12	24-1	23-8	23-2	21-4	20-3	19-5	19-5	18-2	17-4	13-9	
	16	21-10	21-6	20-11	18-6	17-6	16-10	16-10	15-9	15-0	11-11	
	24	18-4	17-11	17-1	15-1	14-4	13-9	13-9	12-10	12-3	9-9	

Table 33 Rafters – 50 psf live load, 20 psf dead load, ℓ/180, C_D=1.15

Heavy roofing; No finished ceiling; Snow load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	8-5	8-4	8-2	8-4	8-2	8-0	8-1	7-7	7-3	5-9	4-11
	16	7-8	7-6	7-5	7-6	7-4	7-0	7-0	6-7	6-3	4-11	4-3
	24	6-8	6-7	6-6	6-3	6-0	5-9	5-9	5-4	5-1	4-1	3-6
2 x 6	12	13-3	13-1	12-10	12-11	12-6	11-11	11-9	10-11	10-6	8-5	
	16	12-1	11-10	11-8	11-2	10-10	10-4	10-2	9-5	9-1	7-4	
	24	10-6	10-4	10-2	9-1	8-10	8-5	8-4	7-9	7-5	6-0	
2 x 8	12	17-6	17-2	16-10	16-6	15-9	15-0	15-3	14-1	13-6	10-9	
	16	15-11	15-7	15-4	14-4	13-8	13-0	13-2	12-3	11-8	9-4	
	24	13-11	13-8	13-2	11-8	11-2	10-7	10-9	10-0	9-6	7-7	
2 x 10	12	22-4	21-11	21-6	19-9	18-9	18-0	18-0	16-10	16-0	12-9	
	16	20-3	19-11	19-4	17-2	16-3	15-7	15-7	14-7	13-11	11-0	
	24	17-0	16-7	15-10	14-0	13-3	12-9	12-9	11-11	11-4	9-0	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.15 for snow loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 34 Rafters – 20 psf live load, 10 psf dead load, ℓ/240, C_D=1.25

Light roofing; Drywall ceiling; Construction load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-6	14-9	13-6
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-4	14-1	13-5	11-8
	24	13-0	12-9	12-6	12-9	12-6	12-3	12-6	12-3	11-9	9-6
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	20-5	19-6	17-2
	16	19-7	19-3	18-11	19-3	18-11	18-6	18-11	18-6	17-9	14-10
	24	17-2	16-10	16-6	16-10	16-6	16-2	16-6	15-10	15-2	12-2
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0	26-0*	26-0	24-10	20-3
	16	25-0	24-7	24-1	24-7	24-1	23-8	24-1	23-2	22-1	17-7
	24	21-10	21-6	21-1	21-6	21-1	20-3	20-3	18-11	18-1	14-4
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	24-1
	16	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	20-10
	24	26-0*	26-0*	25-7	26-0*	25-2	24-1	24-1	22-2	21-4	17-0

Table 35 Rafters – 20 psf live load, 15 psf dead load, ℓ/240, C_D=1.25

Medium roofing; Drywall ceiling; Construction load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-6	14-9	12-6
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-4	13-11	13-4	10-10
	24	13-0	12-9	12-6	12-9	12-6	12-3	12-3	11-5	10-11	8-10
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	20-5	19-6	15-11
	16	19-7	19-3	18-11	19-3	18-11	18-6	18-11	18-0	17-3	13-9
	24	17-2	16-10	16-6	16-10	16-5	15-7	15-10	14-8	14-1	11-3
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0	26-0*	24-10	23-8	18-9
	16	25-0	24-7	24-1	24-7	23-11	23-0	23-0	21-6	20-6	16-3
	24	21-10	21-6	21-1	20-7	19-6	18-9	18-9	17-6	16-8	13-3
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	22-4
	16	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-2	24-2	19-4
	24	26-0*	26-0*	25-7	24-2	23-3	22-4	22-4	20-6	19-9	15-9

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 and is based on live load only. The load duration factor, C_D, is 1.25 for construction loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 36 Rafters – 20 psf live load, 20 psf dead load, ℓ/240, C_D=1.25

Heavy roofing; Drywall ceiling; Construction load

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-1	14-5	11-8
	16	14-11	14-7	14-4	14-7	14-4	14-1	14-0	13-1	12-6	10-1
	24	13-0	12-9	12-6	12-7	12-3	11-8	11-5	10-8	10-2	8-3
2 x 8	12	21-7	21-2	20-10	21-2	20-10	20-5	20-10	19-5	18-7	14-10
	16	19-7	19-3	18-11	19-3	18-10	17-10	18-2	16-10	16-1	12-11
	24	17-2	16-10	16-6	16-1	15-5	14-7	14-10	13-9	13-2	10-6
2 x 10	12	26-0*	26-0*	26-0*	26-0*	25-10	24-10	24-10	23-2	22-1	17-7
	16	25-0	24-7	24-1	23-7	22-4	21-6	21-6	20-1	19-2	15-2
	24	21-10	21-6	21-1	19-3	18-3	17-7	17-7	16-5	15-8	12-5
2 x 12	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	20-10
	16	26-0*	26-0*	26-0*	26-0*	26-0*	25-7	25-7	23-6	22-7	18-1
	24	26-0*	26-0*	25-7	22-7	21-9	20-10	20-10	19-3	18-5	14-9

Table 37 Rafters – 20 psf live load, 10 psf dead load, ℓ/180, C_D=1.25

Light roofing; No finished ceiling; Construction load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-10	10-4	9-1	7-10
	16	10-5	10-3	10-0	10-3	10-0	9-10	10-0	9-10	9-5	7-11	6-9
	24	9-1	8-11	8-9	8-11	8-9	8-7	8-9	8-7	8-2	6-5	5-6
2 x 6	12	18-0	17-8	17-4	17-8	17-4	17-0	17-4	17-0	16-3	13-6	
	16	16-4	16-1	15-9	16-1	15-9	15-6	15-9	15-1	14-5	11-8	
	24	14-4	14-1	13-9	14-1	13-9	13-6	13-3	12-4	11-9	9-6	
2 x 8	12	23-9	23-4	22-11	23-4	22-11	22-5	22-11	22-5	21-5	17-2	
	16	21-7	21-2	20-10	21-2	20-10	20-5	20-10	19-5	18-7	14-10	
	24	18-10	18-6	18-2	18-6	17-9	16-10	17-2	15-10	15-2	12-2	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	25-6	20-3	
	16	26-0*	26-0*	26-0*	26-0*	25-10	24-10	24-10	23-2	22-1	17-7	
	24	24-1	23-8	23-2	22-3	21-1	20-3	20-3	18-11	18-1	14-4	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 240 or 180 and is based on live load only. The load duration factor, C_D, is 1.25 for construction loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 38 Rafters – 20 psf live load, 15 psf dead load, ℓ/180, C_D=1.25

Medium roofing; No finished ceiling; Construction load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-10	10-4	8-5	7-3
	16	10-5	10-3	10-0	10-3	10-0	9-10	10-0	9-9	9-3	7-4	6-3
	24	9-1	8-11	8-9	8-11	8-9	8-5	8-5	7-11	7-6	6-0	5-1
2 x 6	12	18-0	17-8	17-4	17-8	17-4	17-0	17-4	16-1	15-5	12-6	
	16	16-4	16-1	15-9	16-1	15-9	15-3	15-0	13-11	13-4	10-10	
	24	14-4	14-1	13-9	13-6	13-1	12-6	12-3	11-5	10-11	8-10	
2 x 8	12	23-9	23-4	22-11	23-4	22-11	22-0	22-5	20-9	19-11	15-11	
	16	21-7	21-2	20-10	21-1	20-2	19-1	19-5	18-0	17-3	13-9	
	24	18-10	18-6	18-2	17-3	16-5	15-7	15-10	14-8	14-1	11-3	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	26-0*	24-10	23-8	18-9	
	16	26-0*	26-0*	26-0*	25-3	23-11	23-0	23-0	21-6	20-6	16-3	
	24	24-1	23-8	23-2	20-7	19-6	18-9	18-9	17-6	16-8	13-3	

Table 39 Rafters – 20 psf live load, 20 psf dead load, ℓ/180, C_D=1.25

Heavy roofing; No finished ceiling; Construction load

Size	Spacing	Grade										
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3	Standard
2 x 4	12	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-6	9-11	7-11	6-9
	16	10-5	10-3	10-0	10-3	10-0	9-8	9-8	9-1	8-7	6-10	5-10
	24	9-1	8-11	8-9	8-7	8-3	7-11	7-11	7-5	7-0	5-7	4-10
2 x 6	12	18-0	17-8	17-4	17-8	17-3	16-6	16-2	15-1	14-5	11-8	
	16	16-4	16-1	15-9	15-5	15-0	14-3	14-0	13-1	12-6	10-1	
	24	14-4	14-1	13-9	12-7	12-3	11-8	11-5	10-8	10-2	8-3	
2 x 8	12	23-9	23-4	22-11	22-9	21-9	20-7	21-0	19-5	18-7	14-10	
	16	21-7	21-2	20-10	19-9	18-10	17-10	18-2	16-10	16-1	12-11	
	24	18-10	18-6	18-2	16-1	15-5	14-7	14-10	13-9	13-2	10-6	
2 x 10	12	26-0*	26-0*	26-0*	26-0*	25-10	24-10	24-10	23-2	22-1	17-7	
	16	26-0*	26-0*	26-0*	23-7	22-4	21-6	21-6	20-1	19-2	15-2	
	24	23-6	22-11	21-9	19-3	18-3	17-7	17-7	16-5	15-8	12-5	

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 180 and is based on live load only. The load duration factor, C_D, is 1.25 for construction loads. Check sources of supply for availability of lumber in lengths greater than 20'-0".

*The listed maximum span has been limited to 26'-0" based on material availability.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 40 Wet-Service Floor Joists – 40 psf live load, 10 psf dead load, ℓ/360

Decks; Moisture content exceeds 19%

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	11-0	10-9	10-7	10-9	10-7	10-4	10-7	10-4	9-11	9-4
	16	10-0	9-9	9-7	9-9	9-7	9-5	9-7	9-5	9-0	8-1
	24	8-8	8-7	8-5	8-7	8-5	8-3	8-5	7-10	7-10	6-7
2 x 8	12	14-5	14-2	13-11	14-2	13-11	13-8	13-11	13-8	13-1	11-11
	16	13-2	12-11	12-8	12-11	12-8	12-5	12-8	12-5	11-10	10-3
	24	11-6	11-3	11-1	11-3	11-1	10-9	10-11	10-1	10-4	8-5
2 x 10	12	18-5	18-1	17-9	18-1	17-9	17-5	17-9	17-5	16-8	14-0
	16	16-9	16-5	16-2	16-5	16-2	15-10	15-10	15-10	15-2	12-2
	24	14-8	14-4	14-1	14-3	13-5	12-11	12-11	13-2	12-6	9-11
2 x 12	12	22-5	22-0	21-7	22-0	21-7	21-2	21-7	21-2	20-3	16-8
	16	20-4	20-0	19-8	20-0	19-8	19-3	19-8	18-10	18-2	14-5
	24	17-10	17-6	17-2	16-8	16-1	16-8	16-8	15-4	14-10	11-10

Table 41 Wet-Service Floor Joists – 60 psf live load, 10 psf dead load, ℓ/360

Decks; Moisture content exceeds 19%

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	9-7	9-5	9-3	9-5	9-3	9-1	9-3	9-1	8-8	7-11
	16	8-8	8-7	8-5	8-7	8-5	8-3	8-5	8-1	7-10	6-10
	24	7-7	7-6	7-4	7-6	7-4	7-2	7-2	6-8	6-10	5-7
2 x 8	12	12-7	12-5	12-2	12-5	12-2	11-11	12-2	11-11	11-5	10-0
	16	11-6	11-3	11-1	11-3	11-1	10-10	11-1	10-6	10-4	8-8
	24	10-0	9-10	9-8	9-10	9-7	9-1	9-3	8-7	8-11	7-1
2 x 10	12	16-1	15-10	15-6	15-10	15-6	15-2	15-5	15-2	14-7	11-10
	16	14-8	14-4	14-1	14-4	13-11	13-4	13-4	13-7	12-11	10-3
	24	12-9	12-7	12-4	12-0	11-4	10-11	10-11	11-1	10-6	8-5
2 x 12	12	19-7	19-3	18-10	19-3	18-10	18-6	18-10	18-4	17-8	14-1
	16	17-10	17-6	17-2	17-3	16-7	16-10	17-2	15-11	15-4	12-3
	24	15-7	15-3	13-9	14-1	13-7	13-9	14-1	13-0	12-6	10-0

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules. They are intended to apply where the moisture content in use will exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only. Check sources of supply for availability of lumber in lengths greater than 20'-0".

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans
given in feet and inches

Table 42 Floor Joists – 75 psf live load, 10 psf dead load, ℓ/360

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	9-2	9-1	8-10	9-1	8-10	8-8	8-10	8-8	8-4	7-2
	16	8-4	8-3	8-1	8-3	8-1	7-11	8-1	7-11	7-7	6-2
	24	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-6	6-3	5-1
2 x 8	12	12-2	11-11	11-8	11-11	11-8	11-6	11-8	11-6	11-0	9-1
	16	11-0	10-10	10-8	10-10	10-8	10-5	10-8	10-4	9-10	7-11
	24	8-11	8-11	8-11	8-11	8-11	8-11	8-11	8-5	8-1	6-5
2 x 10	12	15-6	15-2	14-11	15-2	14-11	14-7	14-11	14-3	13-6	10-9
	16	14-1	13-10	13-7	13-10	13-7	13-2	13-2	12-4	11-9	9-4
	24	11-4	11-4	11-4	11-4	11-3	10-9	10-9	10-1	9-7	7-7
2 x 12	12	18-10	18-6	18-2	18-6	18-2	17-9	18-1	16-8	16-1	12-10
	16	17-1	16-10	16-6	16-10	16-4	15-8	15-8	14-5	13-11	11-1
	24	13-9	13-9	13-9	13-9	13-4	12-10	12-10	11-9	11-4	9-1

Table 43 Floor Joists – 80 psf live load, 10 psf dead load, ℓ/360

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	9-0	8-10	8-8	8-10	8-8	8-6	8-8	8-6	8-2	7-0
	16	8-2	8-0	7-11	8-0	7-11	7-9	7-11	7-9	7-5	6-0
	24	6-5	6-5	6-5	6-5	6-5	6-5	6-5	6-4	6-1	4-11
2 x 8	12	11-11	11-8	11-5	11-8	11-5	11-3	11-5	11-3	10-9	8-10
	16	10-10	10-7	10-5	10-7	10-5	10-2	10-5	10-0	9-7	7-8
	24	8-5	8-5	8-5	8-5	8-5	8-5	8-5	8-2	7-10	6-3
2 x 10	12	15-2	14-11	14-7	14-11	14-7	14-4	14-7	13-10	13-2	10-5
	16	13-9	13-6	13-3	13-6	13-3	12-10	12-10	12-0	11-5	9-1
	24	10-9	10-9	10-9	10-9	10-9	10-5	10-5	9-9	9-4	7-5
2 x 12	12	18-5	18-1	17-9	18-1	17-9	17-5	17-7	16-2	15-7	12-5
	16	16-9	16-5	16-2	16-5	15-11	15-3	15-3	14-0	13-6	10-9
	24	13-1	13-1	13-1	13-1	13-0	12-5	12-5	11-5	11-0	8-10

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules, but include an additional check for shear. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans
given in feet and inches

Table 44 Floor Joists – 90 psf live load, 10 psf dead load, ℓ/360

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	8-8	8-6	8-4	8-6	8-4	8-2	8-4	8-2	7-10	6-7
	16	7-10	7-9	7-7	7-9	7-7	7-5	7-7	7-5	7-1	5-9
	24	5-10	5-10	5-10	5-10	5-10	5-10	5-10	5-10	5-9	4-8
2 x 8	12	11-5	11-3	11-0	11-3	11-0	10-9	11-0	10-9	10-4	8-5
	16	10-5	10-2	10-0	10-2	10-0	9-10	10-0	9-6	9-1	7-3
	24	7-9	7-9	7-9	7-9	7-9	7-9	7-9	7-9	7-5	5-11
2 x 10	12	14-7	14-4	14-0	14-4	14-0	13-9	14-0	13-2	12-6	9-11
	16	13-3	13-0	12-9	13-0	12-8	12-2	12-2	11-5	10-10	8-7
	24	9-10	9-10	9-10	9-10	9-10	9-10	9-10	9-3	8-10	7-0
2 x 12	12	17-9	17-5	17-1	17-5	17-1	16-8	16-8	15-4	14-10	11-10
	16	16-1	15-10	15-6	15-8	15-1	14-5	14-5	13-4	12-10	10-3
	24	12-0	12-0	12-0	12-0	12-0	11-10	11-10	10-10	10-6	8-4

Table 45 Floor Joists – 100 psf live load, 10 psf dead load, ℓ/360

Size	Spacing	Grade									
inches	inches on center	Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	8-4	8-3	8-1	8-3	8-1	7-11	8-1	7-11	7-7	6-4
	16	7-7	7-6	7-4	7-6	7-4	7-2	7-4	7-0	6-9	5-5
	24	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	5-5	4-5
2 x 8	12	11-0	10-10	10-8	10-10	10-8	10-5	10-8	10-5	10-0	8-0
	16	10-0	9-10	9-8	9-10	9-8	9-6	9-8	9-1	8-8	6-11
	24	7-2	7-2	7-2	7-2	7-2	7-2	7-2	7-2	7-1	5-8
2 x 10	12	14-1	13-10	13-7	13-10	13-7	13-3	13-5	12-6	11-11	9-5
	16	12-9	12-7	12-4	12-7	12-1	11-7	11-7	10-10	10-4	8-2
	24	9-1	9-1	9-1	9-1	9-1	9-1	9-1	8-10	8-5	6-8
2 x 12	12	17-1	16-10	16-6	16-10	16-6	15-11	15-11	14-8	14-1	11-3
	16	15-7	15-3	15-0	14-11	14-5	13-9	13-9	12-8	12-3	9-9
	24	11-1	11-1	11-1	11-1	11-1	11-1	11-1	10-4	10-0	7-11

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules, but include an additional check for shear. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only.

☐ These grades are the most commonly available.

SOUTHERN PINE SPAN TABLES

Maximum Spans given in feet and inches

Table 46 Floor Joists – 125 psf live load, 10 psf dead load, ℓ/360

Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	7-9	7-8	7-6	7-8	7-6	7-4	7-6	7-4	7-0	5-8
	16	6-5	6-5	6-5	6-5	6-5	6-5	6-5	6-4	6-1	4-11
	24	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-7	4-0
2 x 8	12	10-3	10-1	9-10	10-1	9-10	9-8	9-10	9-6	9-1	7-3
	16	8-5	8-5	8-5	8-5	8-5	8-5	8-5	8-2	7-10	6-3
	24	6-0	6-0	6-0	6-0	6-0	6-0	6-0	6-0	6-0	5-1
2 x 10	12	13-1	12-10	12-7	12-10	12-7	12-1	12-1	11-4	10-9	8-6
	16	10-9	10-9	10-9	10-9	10-9	10-5	10-5	9-9	9-4	7-5
	24	7-8	7-8	7-8	7-8	7-8	7-8	7-8	7-8	7-7	6-0
2 x 12	12	15-11	15-7	15-4	15-7	15-0	14-4	14-4	13-3	12-9	10-2
	16	13-1	13-1	13-1	13-1	13-0	12-5	12-5	11-5	11-0	8-10
	24	9-4	9-4	9-4	9-4	9-4	9-4	9-4	9-4	9-0	7-2

Table 47 Floor Joists – 150 psf live load, 10 psf dead load, ℓ/360

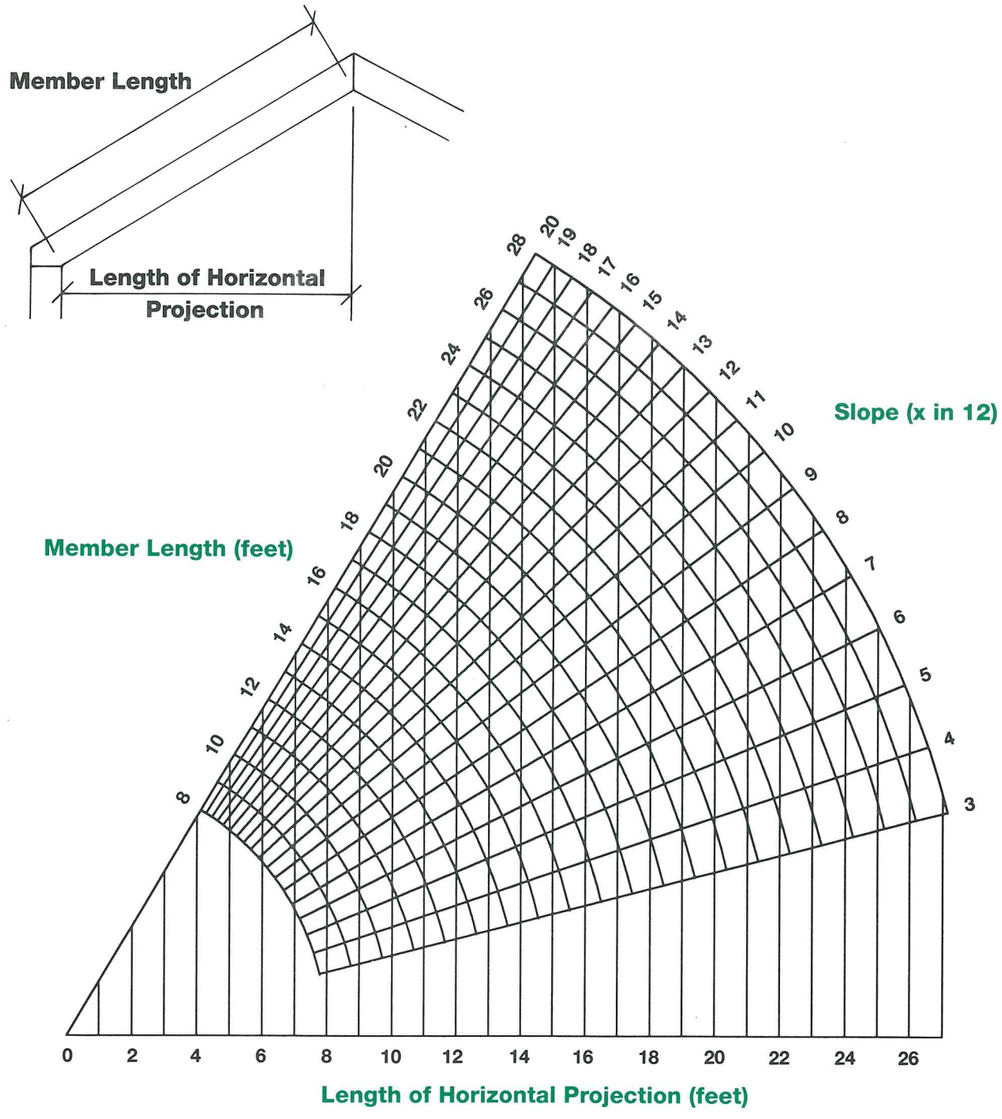
Size (inches)	Spacing (inches on center)	Grade									
		Dense Select Structural	Select Structural	NonDense Select Structural	No. 1 Dense	No. 1	No. 1 NonDense	No. 2 Dense	No. 2	No. 2 NonDense	No. 3
2 x 6	12	7-1	7-1	7-1	7-1	7-1	6-11	7-1	6-9	6-5	5-3
	16	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	5-7	4-6
	24	4-0	4-0	4-0	4-0	4-0	4-0	4-0	4-0	4-0	3-8
2 x 8	12	9-4	9-4	9-3	9-4	9-3	9-1	9-3	8-8	8-4	6-8
	16	7-4	7-4	7-4	7-4	7-4	7-4	7-4	7-4	7-2	5-9
	24	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	5-3	4-8
2 x 10	12	11-11	11-11	11-10	11-11	11-7	11-1	11-1	10-5	9-10	7-10
	16	9-4	9-4	9-4	9-4	9-4	9-4	9-4	9-0	8-6	6-9
	24	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	6-9	5-7
2 x 12	12	14-6	14-6	14-5	14-4	13-9	13-2	13-2	12-2	11-9	9-4
	16	11-4	11-4	11-4	11-4	11-4	11-4	11-4	10-6	10-2	8-1
	24	8-2	8-2	8-2	8-2	8-2	8-2	8-2	8-2	8-2	6-7

These spans are based on the 1993 AFPA (formerly NFPA) Span Tables for Joists and Rafters and the 1991 SPIB Grading Rules, but include an additional check for shear. They are intended for use in covered structures or where the moisture content in use does not exceed 19 percent for an extended period of time. Loading conditions are expressed in psf (pounds per square foot). Deflection is limited to span in inches divided by 360 and is based on live load only.

☐ These grades are the most commonly available.

CONVERSION DIAGRAM FOR RAFTERS

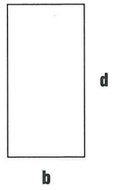
Courtesy of the American Forest & Paper Association

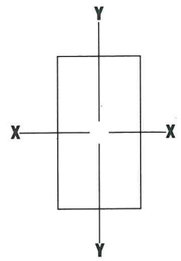


To use the diagram, select the known horizontal distance and follow the vertical line to its intersection with the radial line of the specified slope. Then proceed along the arc to read the sloping distance. In some cases it may be desirable to interpolate between the one-foot separations. The diagram also may be used to find the horizontal distance corresponding to a given sloping distance, or to find the slope when the horizontal and sloping distances are known.

Example: With a roof slope of 8 in 12, and a horizontal distance of 20 feet, the sloping distance may be read as 24 feet.

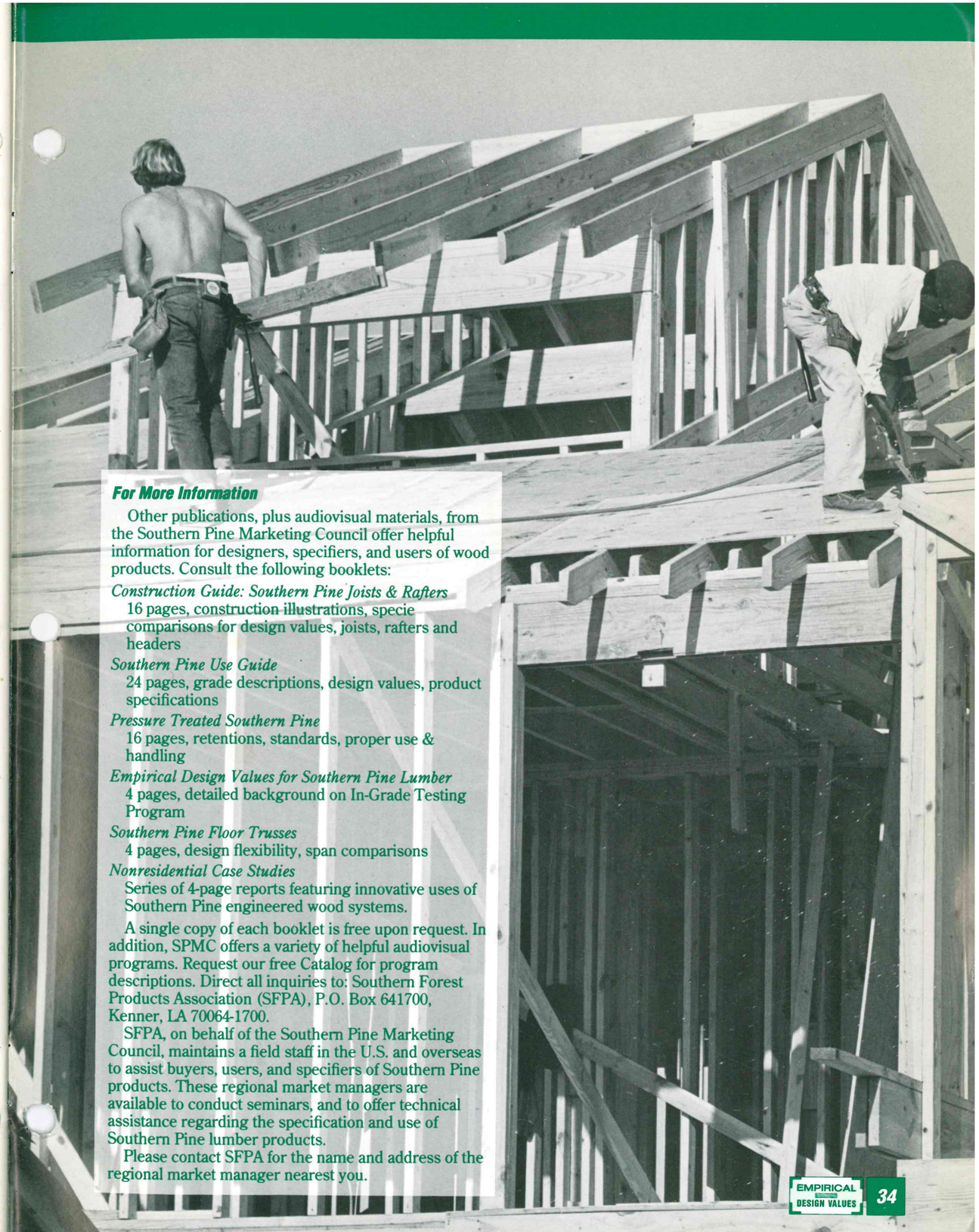
PROPERTIES OF SECTIONS





Nominal Size (inches) b	d	Actual Size (inches) b	d	Area (in²)	AXIS XX S (in³)	AXIS XX I (in⁴)	AXIS YY S (in³)	AXIS YY I (in⁴)	Board Measure per Lineal Foot	Weight per Lineal Foot (lbs.)
2	2	1-1/2	1-1/2	2.250	0.563	0.422	0.563	0.422	0.33	0.73
	3		2-1/2	3.750	1.563	1.953	0.938	0.703	0.50	1.10
	4		3-1/2	5.250	3.063	5.359	1.313	0.984	0.67	1.47
	5		4-1/2	6.750	5.063	11.391	1.688	1.266	0.83	1.83
	6		5-1/2	8.250	7.563	20.797	2.063	1.547	1.00	2.20
	8		7-1/4	10.875	13.141	47.635	2.719	2.039	1.33	2.93
	10		9-1/4	13.875	21.391	98.932	3.469	2.602	1.67	3.84
	12		11-1/4	16.875	31.641	177.979	4.219	3.164	2.00	4.60
	14		13-1/4	19.875	43.891	290.775	4.969	3.727	2.33	5.59
3	3	2-1/2	2-1/2	6.250	2.604	3.255	2.604	3.255	0.75	1.80
	4		3-1/2	8.750	5.104	8.932	3.646	4.557	1.00	2.30
	6		5-1/2	13.750	12.604	34.661	5.729	7.161	1.50	3.45
	8		7-1/4	18.125	21.901	79.391	7.552	9.440	2.00	4.60
	10		9-1/4	23.125	35.651	164.886	9.635	12.044	2.50	6.00
	12		11-1/4	28.125	52.734	296.631	11.719	14.648	3.00	7.20
	14		13-1/4	33.125	73.151	484.626	13.802	17.253	3.50	8.40
4	4	3-1/2	3-1/2	12.250	7.146	12.505	7.146	12.505	1.33	3.19
	6		5-1/2	19.250	17.646	48.526	11.229	19.651	2.00	5.00
	8		7-1/4	25.375	30.661	111.148	14.802	25.904	2.67	6.68
	10		9-1/4	32.375	49.911	230.840	18.885	33.049	3.33	8.33
	12		11-1/4	39.375	73.828	415.283	22.969	40.195	4.00	10.00
	14		13-1/4	46.375	102.411	678.476	27.052	47.341	4.67	11.68
*6	6	5-1/2	5-1/2	30.250	27.729	76.255	27.729	76.255	3.00	11.40
	8		7-1/2	41.250	51.563	193.359	37.813	103.984	4.00	15.20
	10		9-1/2	52.250	82.729	392.964	47.896	131.714	5.00	19.00
	12		11-1/2	63.250	121.229	697.068	57.979	159.443	6.00	22.80
	14		13-1/2	74.250	167.063	1127.672	68.063	187.172	7.00	26.60
*8	8	7-1/2	7-1/2	56.250	70.313	263.672	70.313	263.672	5.33	20.25
	10		9-1/2	71.250	112.813	535.859	89.063	333.984	6.67	25.35
	12		11-1/2	86.250	165.313	950.547	107.813	404.297	8.00	30.40
	14		13-1/2	101.250	227.813	1537.734	126.563	474.609	9.33	35.45
*10	10	9-1/2	9-1/2	90.250	142.896	678.755	142.896	678.755	8.33	31.65
	12		11-1/2	109.250	209.396	1204.026	172.979	821.651	10.00	38.00
	14		13-1/2	128.250	288.563	1947.797	203.063	964.547	11.67	44.35
*12	12	11-1/2	11-1/2	132.250	253.479	1457.505	253.479	1457.505	12.00	45.60
	14		13-1/2	155.250	349.313	2357.859	297.563	1710.984	14.00	53.20
*14	14	13-1/2	13-1/2	182.250	410.063	2767.922	410.063	2767.922	16.33	62.05

**Note:* Properties are based on minimum dressed green size which is 1/2 inch off nominal in both b and d dimensions.



For More Information

Other publications, plus audiovisual materials, from the Southern Pine Marketing Council offer helpful information for designers, specifiers, and users of wood products. Consult the following booklets:

Construction Guide: Southern Pine Joists & Rafters
16 pages, construction illustrations, specie comparisons for design values, joists, rafters and headers

Southern Pine Use Guide
24 pages, grade descriptions, design values, product specifications

Pressure Treated Southern Pine
16 pages, retentions, standards, proper use & handling

Empirical Design Values for Southern Pine Lumber
4 pages, detailed background on In-Grade Testing Program

Southern Pine Floor Trusses
4 pages, design flexibility, span comparisons

Nonresidential Case Studies
Series of 4-page reports featuring innovative uses of Southern Pine engineered wood systems.

A single copy of each booklet is free upon request. In addition, SPMC offers a variety of helpful audiovisual programs. Request our free Catalog for program descriptions. Direct all inquiries to: Southern Forest Products Association (SFPA), P.O. Box 641700, Kenner, LA 70064-1700.

SFPA, on behalf of the Southern Pine Marketing Council, maintains a field staff in the U.S. and overseas to assist buyers, users, and specifiers of Southern Pine products. These regional market managers are available to conduct seminars, and to offer technical assistance regarding the specification and use of Southern Pine lumber products.

Please contact SFPA for the name and address of the regional market manager nearest you.

WEIGHTS OF CONSTRUCTION MATERIALS IN pcf

	MATERIAL	Weight
MISCELLANEOUS	Gypsum, Loose	70
	Hay, Moist	12
	Ice	57.2
	Masonry, Ashlar	140-165
	Masonry, Brick	100-140
	Paper	50
	Slate	172
	Stone, Quarried	82-107
	Terra Cotta	72-120
	Tin	459
	Water, Fresh	62.4
	Water, Sea	64
WOOD SEASONED	Douglas Fir	34
	Hemlock Fir	28
	S. Yellow Pine	37
	Redwood	28
	Western Hemlock	32
ROOF TRUSS OR RAFTER @ 24" O.C	2x4 Top Chord*	.7 (psf)
	2x6 Top Chord*	1.1 (psf)
	2x8 Top Chord*	1.5 (psf)
	2x10 Top Chord*	1.9 (psf)
	2x12 Top Chord*	2.2 (psf)
	2x4 Webs and Plates**	.8 (psf)
	2x6 Webs and Plates**	1.3 (psf)
	* Measure along rake ** Accounts for 1/2 truss weight	
SHEATHING	Decking, 2"	5 (psf)
	Gypsum, ½	2 (psf)
	Plywood, 3/8"	1.1 (psf)
	Plywood, 1/2"	1.5 (psf)
	Plywood, 5/8"	1.8 (psf)
	Plywood, 3/4"	2.3 (psf)
	Plywood, 1"	3 (psf)
	Plywood, 11/8"	3.4 (psf)
	Wood, 1"	3 (psf)
SHINGLES & TILES	Asbestos-Cement	4 (psf)
	Asphalt, 1/4"	2 (psf)
	Wood, 1"	3 (psf)
	Cement (Tile)	15- 20 (psf)
	Cement Asbestos, 3/8" (Tile)	4 (psf)

WEIGHTS OF CONSTRUCTION MATERIALS IN psf

	MATERIAL	Weight
Tile, Clay	Book Tile, 3" 20 *	20
	Ludowici 10 *	10
	Roman 12 *	12
	Shingle Type 12-14 *	12-14
	Spanish 19 *	19
	Slate, 3/8" 12-15 *	12-15
	* (Add 10 psf for mortar to listing above)	
WATERPROOFING MEMBRANES	Gravel Covered	5.5
	Bituminous, Smooth Surface	1.5
	Liquid Applied	1
	Single-Ply, Sheet	.7

CHAPTER 2

WELDED WIRE FABRIC (WWF)

2.1. Introduction

This chapter presents information for specifying and estimating welded wire fabric (WWF) used in building construction. Discussion of epoxy-coated WWF, and handling, shipping, unloading and placing of WWF are also included.

2.2. ASTM Specifications

Welded wire fabric consists of wires arranged in a square or rectangular configuration. The wires are welded at their intersections. WWF must conform to ASTM A185 if made of plain wire or to ASTM A497 if made of deformed wire or a combination of deformed and plain wire. These specifications require tensile, reduction of area and bend tests on the fabric, and shear tests on the welded intersections. A minimum yield strength of 65,000 psi [450 MPa] is required for plain WWF (A185) and a minimum of 70,000 psi [485 MPa] for deformed WWF (A497). ASTM A82 (plain wire) and A496 (deformed wire) are companion specifications that prescribe the requirements for the wire used for manufacturing welded wire fabric.

Unless otherwise specified by the Architect/Engineer, welded wire fabric conforming to ASTM A185 will be furnished.

Welded wire fabric can be produced with high-strength wires of minimum yield strengths to 80,000 psi [550 MPa]. Higher minimum yield strengths allow the use of less material in certain applications.

Welded wire fabric can be fabricated to make beam stirrups and column ties.

2.3. Style Identification

Plain wire is denoted by the letter "W" ["MW"] and deformed wire by the letter "D" ["MD"]. The letter is followed by a number indicating cross-sectional area in hundredths of a square inch [square millimeters].

Welded wire fabric is usually shown on project drawings with the abbreviation WWF followed by spacings of longitudinal wires and then transverse wires and last by the sizes of longitudinal and transverse wires.

An example style designation (see Figure 2-1) is: WWF 6 × 12—W16 × W8 [152 × 305 – MW103 × MW52]. This designation identifies a style of plain welded wire fabric in which:

Spacing of longitudinal wires	= 6 in.	[152 mm]
Spacing of transverse wires	= 12 in.	[305 mm]
Longitudinal wire size	= W16	[MW103]
Transverse wire size	= W8	[MW52]

A deformed WWF style would be designated in the same manner with the appropriate D [MD] number wire spacings and sizes.

It is important to note that the terms "longitudinal" and "transverse" are related to the method of WWF manufacture and have no reference to the orientation of the wires with respect to the orientation of the reinforced concrete structure.

2.4. Specifying Welded Wire Fabric

The Architect/Engineer's selection of welded wire fabric styles should include production considerations as well as steel area requirements. Maximum economies in production and handling can be achieved by utilizing repetition of styles and duplication of sheet and/or roll dimensions to the fullest extent possible.

Welded wire fabric is manufactured in the form of sheets and rolls. Rolls are generally stocked in W1.4 to W4 [MW9 to MW26] wire sizes only. Roll widths vary from 5 to 8 feet [1.5 to 2.4 m]. Lengths vary with application and convenience of handling and shipping. Rolls should be straightened. Standard widths of sheets vary between 7 to 10 feet [2.1 to 3.1 m] for building construction and up to 13 feet [4 m] for pavement.

The maximum sheet size (width and/or length) may be limited by shipping restrictions as well as manufacturing limitations.

Development lengths and lap splice lengths for welded wire fabric must be specified by the Architect /Engineer in accordance with the ACI 318 Building Code. Lap splice lengths are usually a minimum of one wire space plus 2 in. [50 mm] for plain wire and 8 in. [200 mm] for deformed wire.

Certain styles of welded wire fabric as shown in Table 2-1 have been recommended by the Wire Reinforcement Institute as common styles. Manufacturers of WWF can meet specific steel area requirements when ordered for designated projects, or in some localities, may be available from inventory.

2.5. Detailing Welded Wire Fabric

The quantity of welded wire fabric detailed and supplied should include the net area shown on the project drawings or required in the project specifications plus sufficient material to include lap splices.

2.5.1 Width

Width is defined as the center-to-center distance between the outside longitudinal wires. Overall width is defined as the width plus side overhangs.

WELDED WIRE FABRIC (WWF)

The side overhangs of transverse wires should be no greater than one inch [25 mm] unless otherwise specified by the Architect/Engineer. Transverse wires may be specified to have a specific overhang or no overhang (flush sides).

2.5.2 Length

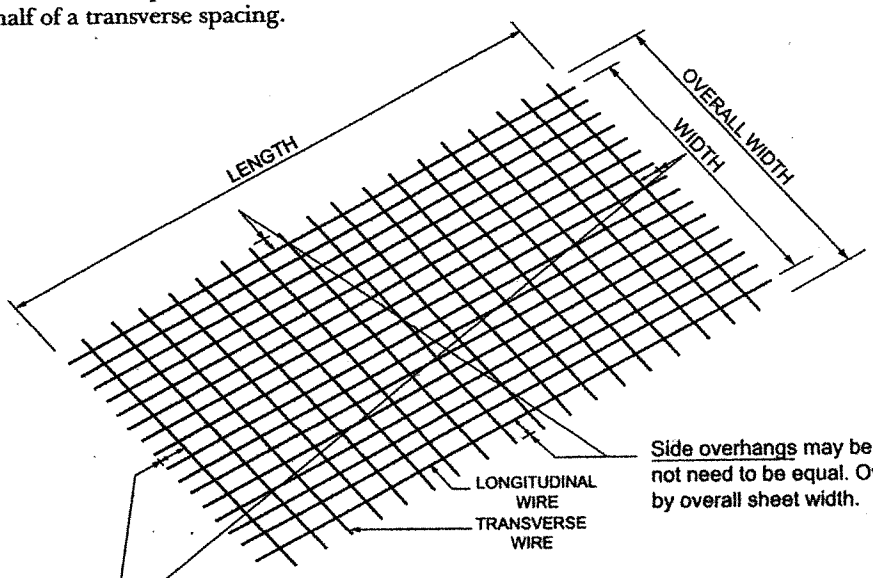
Welded wire fabric in roll form can be manufactured in various lengths, up to the maximum weight per roll convenient for handling. The lengths of rolls vary with the individual manufacturing practices of producers. Typical lengths are 100, 150 and 200 feet [31, 46 and 61 m]. Sheet or roll length is defined as the length, tip to tip, of longitudinal wires. This length should be a whole multiple of the transverse wire spacing.

The sum of the two end overhangs on either sheets or rolls should be equal to one transverse wire spacing. Unless otherwise specified, each end overhang equals one-half of a transverse spacing.

2.6. ASTM Specification for Epoxy-Coated Wire and Welded Wire Fabric

Epoxy-coated wire and welded wire fabric are used in reinforced concrete construction as a corrosion-protection system.

The ASTM specification A884/A884M covers the epoxy coating of plain and deformed steel wire, and plain and deformed steel welded wire fabric. The specification includes requirements for the epoxy-coating material; surface preparation of the steel prior to application of the coating; the method of application of the coating; limits on coating thickness; and acceptance tests to ensure that the coating was properly applied. All damaged areas of coating on the wires, which occur during manufacture and handling to the point of shipment to the job-site, have to be repaired (touched-up) with patching material.



Industry Method of Designating Style:
Example: WWF 6 x 12 — W16 x W8 [152 x 305 — MW103 x MW52]

Longitudinal wire spacing . . . . . 6 in. [152 mm]	Longitudinal wire size . . . . W16 [MW103]
Transverse wire spacing . . . . 12 in. [305 mm]	Transverse wire size . . . . . W8 [MW52]

FIGURE 2-1 STYLE IDENTIFICATION OF WELDED WIRE FABRIC

WELDED WIRE FABRIC (WWF)

TABLE 2-1 COMMON STYLES OF WELDED WIRE FABRIC SHEETS

Inch-Pound Units			Metric Units		
Style	Area ($in.^2/ft$)	Weight* ($lb/100\ ft^2$)	Style	Area (mm^2/m)	Mass* (kg/m^2)
4 x 4 – W1.4 x W1.4**	0.042	31	102 x 102 – MW9 x MW9**	88.9	1.51
4 x 4 – W2.0 x W2.0**	0.060	44	102 x 102 – MW13 x MW13**	127.0	2.15
4 x 4 – W2.9 x W2.9**	0.087	62	102 x 102 – MW19 x MW19**	184.2	3.03
4 x 4 – W3.1 x W3.1	0.093	65	102 x 102 – MW20 x MW20	196.9	3.17
4 x 4 – W4.0 x W4.0**	0.120	88	102 x 102 – MW26 x MW26**	254.0	4.30
6 x 6 – W1.4 x W1.4**	0.028	21	152 x 152 – MW9 x MW9 **	59.3	1.03
6 x 6 – W2.0 x W2.0**	0.040	30	152 x 152 – MW13 x MW13**	84.7	1.46
6 x 6 – W2.9 x W2.9**	0.058	42	152 x 152 – MW19 x MW19**	122.8	2.05
6 x 6 – W4.0 x W4.0**	0.080	58	152 x 152 – MW26 x MW26 **	169.4	2.83
6 x 6 – W4.2 x W4.2	0.084	60	152 x 152 – MW27 x MW27	177.8	3.08
6 x 6 – W4.4 x W4.4	0.088	63	152 x 152 – MW28 x MW28	186.3	3.22
6 x 6 – W4.7 x W4.7	0.094	68	152 x 152 – MW30 x MW30	199.0	3.32
6 x 6 – W7.5 x W7.5	0.150	108	152 x 152 – MW48 x MW48	317.5	5.52
6 x 6 – W8.1 x W8.1	0.162	116	152 x 152 – MW52 x MW52	342.9	5.66
6 x 6 – W8.3 x W8.3	0.166	119	152 x 152 – MW54 x MW54	351.4	5.81
12 x 12 – W8.3 x W8.3	0.083	63	305 x 305 – MW54 x MW54	175.7	3.08
12 x 12 – W8.8 x W8.8	0.088	66	305 x 305 – MW57 x MW57	186.3	3.22
12 x 12 – W9.1 x W9.1	0.091	69	305 x 305 – MW59 x MW59	192.6	8.25
12 x 12 – W9.4 x W9.4	0.094	71	305 x 305 – MW61 x MW61	199.0	3.47
12 x 12 – W15 x W15	0.150	113	305 x 305 – MW97 x MW97	317.5	5.52
12 x 12 – W16 x W16	0.160	120	305 x 305 – MW103 x MW103	338.7	5.61
12 x 12 – W16.6 x W16.6	0.166	125	305 x 305 – MW107 x MW107	351.4	9.72
12 x 12 – W17.1 x W17.1	0.171	128	305 x 305 – MW110 x MW110	362.0	6.25

* Weight [mass] based on 60-in. [1524-mm] wide sheets (c.-c.) with 1-in. [25-mm] side overhang and standard end overhang.

** These styles may be obtained in roll form. It is recommended that rolls be straightened and cut to size before placement.

ASSUME SOME SOIL SUPPORT

Example Calculations:

6 x 6 – W4.0 x W4.0
Long. Wires (Table 2-2(a)) = 29.92
Tran. Wires (Table 2-2(c)) = 28.11
Total = 58.03 = 58 $lb/100\ ft^2$

152 x 152 – MW52 x MW52
Long. Wires (Table 2-2(b)) = 2.92
Tran. Wires (Table 2-2(d)) = 2.74
Total = 5.66 kg/m^2

WELDED WIRE FABRIC (WWF)

TABLE 2-2(a) UNIT WEIGHT OF LONGITUDINAL WIRES FOR WELDED WIRE FABRIC (INCH-POUND)

Wire Size, W or D	Nom. Diam. (in.)	Weight (lb/100 ft²)* of Longitudinal Wires Per Spacing (in.)								
		2	3	4	5	6	8	9	10	12
45	0.757	948.60	642.60	489.60	397.80	336.60	260.10	234.40	214.20	183.60
31	0.628	653.40	442.68	337.28	274.04	231.88	179.18	161.68	147.56	126.48
30	0.618	632.40	428.40	326.40	265.20	224.40	173.40	156.46	142.80	122.40
28	0.597	590.24	399.84	304.64	247.52	209.44	161.84	146.03	133.28	114.24
26	0.575	548.08	371.28	282.88	229.84	194.48	150.28	135.60	123.76	106.08
24	0.553	505.92	342.72	261.12	212.16	179.52	138.72	125.17	114.24	97.92
22	0.529	463.76	314.16	239.36	194.48	164.56	127.16	114.74	104.72	89.76
20	0.505	421.60	285.60	217.60	176.80	149.60	115.60	104.31	95.20	81.60
18	0.479	379.44	257.04	195.84	159.12	134.64	104.04	93.88	85.68	73.44
16	0.451	337.28	228.48	174.48	141.44	119.68	92.48	83.45	76.16	65.28
14	0.422	295.12	199.92	152.32	123.76	104.72	80.92	73.01	66.64	57.12
12	0.391	252.96	171.36	130.56	106.08	89.76	69.36	62.58	57.12	48.96
11	0.374	231.88	157.08	119.68	97.24	82.28	63.58	57.37	52.36	44.88
10.5	0.366	221.34	149.94	114.24	92.82	78.54	60.69	54.76	49.98	42.84
10	0.357	210.80	142.80	108.80	88.40	74.80	57.80	52.15	47.60	40.80
9.5	0.348	200.26	135.66	103.36	83.98	71.06	54.91	49.55	45.22	38.76
9	0.339	189.72	128.52	97.92	79.56	67.32	52.02	46.94	42.84	36.72
8.5	0.329	179.18	121.38	92.48	75.14	63.58	49.13	44.33	40.46	34.68
8	0.319	168.64	114.24	87.04	70.72	59.84	46.24	41.73	38.08	32.64
7.5	0.309	158.10	107.10	81.60	66.30	56.10	43.35	39.11	35.70	30.60
7	0.299	147.56	99.96	76.16	61.88	52.36	40.46	36.51	33.32	28.56
6.5	0.288	137.02	92.82	70.72	57.46	48.62	37.57	33.90	30.94	26.52
6	0.276	126.48	85.68	65.28	53.04	44.88	34.68	31.29	28.56	24.48
5.5	0.265	115.94	78.54	69.84	48.62	41.14	31.79	28.69	26.18	22.44
5	0.252	105.40	71.40	54.40	44.20	37.40	28.90	36.08	23.80	20.40
4.5	0.239	94.86	64.26	48.96	39.78	33.66	26.01	23.47	21.42	18.36
4	0.226	84.32	57.12	43.52	35.36	29.92	23.12	20.87	19.04	16.32
3.5	0.211	73.78	49.98	38.08	30.94	26.18	20.23	18.26	16.66	14.28
3	0.195	63.24	42.84	32.64	26.52	22.44	17.34	15.65	14.28	12.24
2.9	0.192	61.13	41.41	31.55	25.64	21.69	16.76	15.11	13.80	11.83
2.5	0.178	52.70	35.70	27.20	22.10	18.70	14.45	13.04	11.90	10.20
2	0.160	42.16	28.56	21.76	17.68	14.96	11.56	10.44	9.52	8.16
1.4	0.134	29.51	19.99	15.23	12.38	10.47	8.09	7.29	6.66	5.71

*Weight based on standard end overhang.

Note: This table should be used for estimating purposes only. Actual weights of welded wire fabric will vary from those shown above, depending upon the width of rolls or sheets and lengths of overhangs. No allowance is made in this table for the extra weight of fabric required for lap splices.

WELDED WIRE FABRIC (WWF)

TABLE 2-2(c) UNIT WEIGHT OF TRANSVERSE WIRES FOR WELDED WIRE FABRIC (INCH-POUND)

Wire Size, W or D	Nom. Diam. (in.)	Weight (lb/100 ft²)* of Transverse Wires Per Spacing (in.)								
		2	3	4	5	6	8	9	10	12
45	0.757	948.57	632.38	474.29	379.43	316.19	237.14	210.79	189.72	158.10
31	0.628	653.48	435.65	326.74	261.39	217.83	163.37	145.22	130.70	108.91
30	0.618	632.40	421.40	316.20	252.96	210.80	158.10	140.53	126.48	105.40
28	0.597	590.24	393.49	295.12	236.10	196.75	147.56	131.17	118.05	98.37
26	0.575	548.08	365.38	274.04	219.23	182.70	137.02	121.80	109.62	91.34
24	0.553	505.92	337.28	252.96	202.37	168.64	126.48	112.43	101.18	84.32
22	0.529	463.76	309.17	231.88	185.50	154.59	115.94	103.06	92.75	77.29
20	0.505	421.60	281.06	210.80	168.64	140.53	105.40	93.69	84.32	70.26
18	0.479	379.44	252.96	189.72	151.78	126.48	94.86	84.32	75.89	63.24
16	0.451	337.28	224.85	168.64	134.91	112.43	84.32	74.95	67.46	56.21
14	0.422	295.12	196.76	147.56	118.05	98.37	73.78	65.58	59.02	49.19
12	0.391	252.96	168.64	126.48	101.18	84.32	63.24	56.21	50.59	42.16
11	0.374	231.88	154.59	115.94	92.75	77.29	57.97	51.53	46.38	38.65
10.5	0.366	221.34	147.56	110.67	88.54	73.78	55.34	49.19	44.27	36.89
10	0.357	210.80	140.53	105.40	84.32	70.27	52.70	46.84	42.16	35.13
9.5	0.348	200.28	133.51	100.13	80.11	66.76	50.07	44.50	40.05	33.38
9	0.339	189.72	126.48	94.86	75.89	63.24	47.43	42.16	37.94	31.62
8.5	0.329	179.18	119.45	89.59	71.67	59.73	44.80	39.82	35.84	29.86
8	0.319	168.64	112.43	84.32	67.46	56.21	42.16	37.48	33.73	28.11
7.5	0.309	158.10	105.40	79.05	63.24	52.70	39.53	35.14	31.62	26.35
7	0.299	147.56	98.37	73.78	59.02	49.19	36.89	32.79	29.51	24.59
6.5	0.288	137.02	91.35	68.51	54.81	45.68	34.26	30.45	27.41	22.84
6	0.276	126.48	84.32	63.24	50.59	42.16	31.62	28.11	25.30	21.08
5.5	0.265	115.94	77.30	57.97	46.38	38.65	28.99	25.77	23.19	19.33
5	0.252	105.40	70.27	52.70	42.16	35.13	26.35	23.42	21.08	17.57
4.5	0.239	94.86	63.24	47.43	37.95	31.62	23.72	21.08	18.97	15.81
4	0.226	84.32	56.21	42.16	33.73	28.11	21.08	18.74	16.86	14.05
3.5	0.211	73.78	49.19	36.89	29.51	24.60	18.45	16.40	14.76	12.30
3	0.195	63.24	42.16	31.62	25.30	21.08	15.81	14.05	12.65	10.54
2.9	0.192	61.13	40.75	30.56	24.45	20.38	15.28	13.58	12.23	10.19
2.5	0.178	52.70	35.13	26.35	21.08	17.57	13.18	11.71	10.54	8.78
2	0.160	42.16	28.11	21.08	16.86	14.05	10.54	9.37	8.43	7.03
1.4	0.134	29.51	19.67	14.76	11.80	9.84	7.38	6.56	5.90	4.92

* Weight based on 60-in. wide sheets (c.-c.) with 1-in. side overhang.

Note: This table should be used for estimating purposes only. Actual weights of welded wire fabric will vary from those shown above, depending upon the width of rolls or sheets and lengths of overhangs. No allowance is made in this table for the extra weight of fabric required for lap splices.

WELDED WIRE FABRIC (WWF)

TABLE 2-3(a) CROSS-SECTIONAL AREA AND WEIGHT OF WELDED WIRE FABRIC (INCH-POUND)

Wire Size, W or D	Nom. Diam. (in.)	Nom. Weight (lb/ft)	Area of Steel (in.²/ft) Per Wire Spacing (in.)						
			2	3	4	6	8	10	12
45	0.757	1.530	2.700	1.800	1.350	0.900	0.675	0.540	0.450
31	0.628	1.054	1.860	1.240	0.930	0.620	0.465	0.372	0.310
30	0.618	1.020	1.800	1.200	0.900	0.600	0.450	0.360	0.300
28	0.597	0.952	1.680	1.120	0.840	0.560	0.420	0.336	0.280
26	0.575	0.884	1.560	1.040	0.780	0.520	0.390	0.312	0.260
24	0.553	0.816	1.440	0.960	0.720	0.480	0.360	0.288	0.240
22	0.529	0.748	1.320	0.880	0.660	0.440	0.330	0.264	0.220
20	0.505	0.680	1.200	0.800	0.600	0.400	0.300	0.240	0.200
18	0.479	0.612	1.080	0.720	0.540	0.360	0.270	0.216	0.180
16	0.451	0.544	0.960	0.640	0.480	0.320	0.240	0.192	0.160
14	0.422	0.476	0.840	0.560	0.420	0.280	0.210	0.168	0.140
12	0.391	0.408	0.720	0.480	0.360	0.240	0.180	0.144	0.120
11	0.374	0.374	0.660	0.440	0.330	0.220	0.165	0.132	0.110
10.5	0.366	0.357	0.630	0.420	0.315	0.210	0.158	0.126	0.105
10	0.357	0.340	0.600	0.400	0.300	0.200	0.150	0.120	0.100
9.5	0.348	0.323	0.570	0.380	0.285	0.190	0.143	0.114	0.095
9	0.339	0.306	0.540	0.360	0.270	0.180	0.135	0.108	0.090
8.5	0.329	0.289	0.510	0.340	0.255	0.170	0.128	0.102	0.085
8	0.319	0.272	0.480	0.320	0.240	0.160	0.120	0.096	0.080
7.5	0.309	0.255	0.450	0.300	0.225	0.150	0.113	0.090	0.075
7	0.299	0.238	0.420	0.280	0.210	0.140	0.105	0.084	0.070
6.5	0.288	0.221	0.390	0.260	0.195	0.130	0.098	0.078	0.065
6	0.276	0.204	0.360	0.240	0.180	0.120	0.090	0.072	0.060
5.5	0.265	0.187	0.330	0.220	0.165	0.110	0.083	0.066	0.055
5	0.252	0.170	0.300	0.200	0.150	0.100	0.075	0.060	0.050
4.5	0.239	0.153	0.270	0.180	0.135	0.090	0.068	0.054	0.045
4	0.226	0.136	0.240	0.160	0.120	0.080	0.060	0.048	0.040
3.5	0.211	0.119	0.210	0.140	0.105	0.070	0.053	0.042	0.035
3	0.195	0.102	0.180	0.120	0.090	0.060	0.045	0.036	0.030
2.9	0.192	0.099	0.174	0.116	0.087	0.058	0.044	0.035	0.029
2.5	0.178	0.085	0.150	0.100	0.075	0.050	0.038	0.030	0.025
2	0.160	0.068	0.120	0.080	0.060	0.040	0.030	0.024	0.020
1.4	0.134	0.048	0.084	0.056	0.042	0.028	0.021	0.017	0.014

Notes:

1. The above listing of plain and deformed wire sizes represents wires normally selected to manufacture welded wire fabric to specific areas of reinforcement. Wire sizes other than those listed above, including larger sizes, may be available if the quantity required is sufficient to justify manufacture.
2. The nominal diameter of a deformed wire is equivalent to the diameter of a plain wire having the same weight per foot as the deformed wire.
3. The ACI Building Code requirements for tension development lengths and tension lap splice lengths of welded wire fabric are not included in this chapter. These design requirements are covered in *Reinforcement Anchorages and Splices* available from CRSI. For additional information, see *Manual of Standard Practice—Structural Welded Wire Fabric* and *Structural Detailing Manual*, both published by the Wire Reinforcement Institute.

WELDED WIRE FABRIC (WWF)

2.7. Handling, Shipping and Unloading Welded Wire Fabric

Welded wire fabric is shipped in two forms—rolls or sheets. If shipped in roll form, several rolls may be bundled together for efficient handling. Individual rolls are securely tied, so uncoiling will not occur when the bundles are cut.

Sheets are bundled in quantities depending on size and weight [mass] of sheets. Generally, bundles of rolls or sheets will weigh between 2,000 and 5,000 pounds [900 to 2300 kg]. Banding is used for shipping stability only. Bundles should never be lifted by the steel banding.

If required by the Buyer, bundles can be assembled by flipping alternate sheets, allowing the sheets to "nest." This arrangement allows for a greater number of sheets to be stacked in a given height and provides some benefit in added stability. Unless required by the Buyer, sheets are not flipped.

At the shipping destination (either job-site or storage facility), the bundles are unloaded with a forklift, or a front end loader equipped with lifting chains, or a crane.

Sheet bundles are usually placed on dunnage spaced every 3 to 4 feet [900 to 1200 mm] for unloading with either a forklift (from beneath the bundle) or a crane (with a sling chain hooked or threaded through the bundle).

At all times during unloading of materials, caution must be exercised and all safety regulations and practices must be observed.

TABLE 2-4 WIRE SIZE CONVERSION *

Inch-Pound Units				Metric Units			
W or D	Area ($in.^2$)	Diam. (in.)	Weight (lb/ft)	MW or MD	Area (mm^2)	Diam. (mm)	Mass (kg/m)
45	0.450	0.757	1.530	290	290	19.23	2.277
31	0.310	0.628	1.054	200	200	15.96	1.569
30	0.300	0.618	1.020	194	194	15.70	1.518
28	0.280	0.597	0.952	181	181	15.17	1.417
26	0.260	0.575	0.884	168	168	14.61	1.316
24	0.240	0.553	0.816	155	155	14.04	1.214
22	0.220	0.529	0.748	142	142	13.44	1.113
20	0.200	0.505	0.680	129	129	12.82	1.012
18	0.180	0.479	0.612	116	116	12.16	0.911
16	0.160	0.451	0.544	103	103	11.46	0.810
14	0.140	0.422	0.476	90	90	10.72	0.708
12	0.120	0.391	0.408	77	77	9.93	0.607
11	0.110	0.374	0.374	71	71	9.51	0.557
10.5	0.105	0.366	0.357	68	68	9.29	0.531
10	0.100	0.357	0.340	65	65	9.06	0.506
9.5	0.095	0.348	0.323	61	61	8.83	0.481
9	0.090	0.339	0.306	58	58	8.60	0.455
8.5	0.085	0.329	0.289	55	55	8.36	0.430
8	0.080	0.319	0.272	52	52	8.11	0.405
7.5	0.075	0.309	0.255	48	48	7.85	0.379
7	0.070	0.299	0.238	45	45	7.58	0.354
6.5	0.065	0.288	0.221	42	42	7.31	0.329
6	0.060	0.276	0.204	39	39	7.02	0.304
5.5	0.055	0.265	0.187	35	35	6.72	0.278
5	0.050	0.252	0.170	32	32	6.41	0.253
4.5	0.045	0.239	0.153	29	29	6.08	0.228
4	0.040	0.226	0.136	26	26	5.73	0.202
3.5	0.035	0.211	0.119	23	23	5.36	0.177
3	0.030	0.195	0.102	19.4	19.4	4.96	0.152
2.9	0.029	0.192	0.099	18.7	18.7	4.88	0.147
2.5	0.025	0.178	0.085	16	16	4.53	0.126
2	0.020	0.160	0.068	13	13	4.05	0.101
1.4	0.014	0.134 1	0.048	9	9	3.39	0.071

* Inch-Pound wire sizes were soft-metricated.

TABLE II—SCHEDULED UNIT WEIGHTS FOR ESTIMATING WELDED WIRE FABRIC*

(Approximate weights in pounds per 100 square feet)

Wire Size Number		Nominal Diameter, Inches.	Spacing and Weight of Longitudinal Wires					Spacing and Weight of Transverse Wires					
Plain	Deformed		2"	3"	4"	6"	12"	3"	4"	6"	8"	10"	12"
W20	D20	0.505	422	286	218	150	82	281	211	141	105	84	70
W18	D18	0.479	379	257	196	135	73	253	190	126	95	76	63
W16	D16	0.451	337	228	174	120	65	225	169	112	84	67	56
W14	D14	0.422	295	200	152	105	57	197	148	98	74	59	49
W12	D12	0.391	253	171	131	90	49	169	126	84	63	51	42
W11	D11	0.374	232	157	120	82	45	155	116	77	58	46	39
W10.5		0.366	221	150	114	79	43	148	111	74	55	44	37
W10	D10	0.357	211	143	109	75	41	141	105	70	53	42	35
W9.5		0.348	200	136	103	71	39	134	100	67	50	40	33
W9	D9	0.338	190	129	98	67	37	126	95	63	47	38	32
W8.5		0.329	179	121	92	64	35	119	90	60	45	36	30
W8	D8	0.319	169	114	87	60	33	112	84	56	42	34	28
W7.5		0.309	158	107	82	56	31	105	79	53	40	32	26
W7	D7	0.299	148	100	76	52	29	98	74	49	37	30	25
W6.5		0.288	137	93	71	49	27	91	69	46	34	27	23
W6	D6	0.276	126	86	65	45	24	84	63	42	32	25	21
W5.5		0.265	116	79	60	41	22	77	58	39	29	23	19
W5	D5	0.252	105	71	54	37	20	70	53	35	26	21	18
W4.5		0.239	95	64	49	34	18	63	47	32	24	19	16
W4	D4	0.226	84	57	44	30	16	56	42	28	21	17	14
W3.5		0.211	74	50	38	26	14	49	37	25	18	15	12
W3		0.195	63	43	33	22	12	42	32	21	16	13	11
W2.9	+ 3/16"	0.192	61	41	32	22	12	41	30	20	15	12	10
W2.5		0.178	53	36	27	19	10	35	26	18	13	11	9
W2.1		0.162	43	29	22	15	8	29	22	15	11	9	7
W2		0.160	42	29	22	15	8	28	21	14	11	8	7
W1.5		0.138	32	21	16	11	6	21	16	11	8	6	5
W1.4	+ 1/8"	0.134	30	21	16	11	6	20	15	10	7	6	5

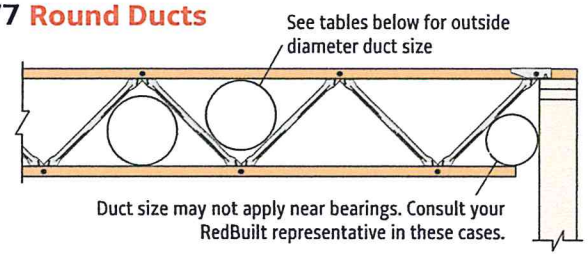
*Based on 60" width, 1" side overhang each side (62" overall width), and standard end overhangs.

Note: This table is to be used for estimating purposes only. Exact weights of welded wire fabric will vary from those shown above, depending upon width of rolls or sheets and lengths of overhangs. No allowance is made in this table for the extra weight of fabric required for laps or splices.

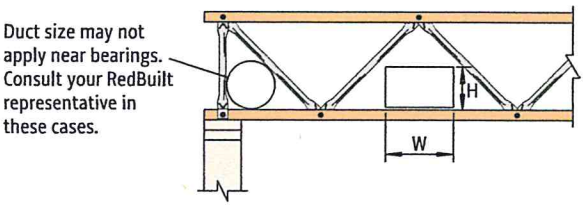
EXAMPLE: Approximate weight of 6x6 — W4xW4
Longitudinal = 30
Transverse = 28
58 lbs. per 100 sq. ft.

6x6 lbs/sqft
10/10 = 21
8/8 = 30
6/6 = 42
4/4 = 58

77 Round Ducts



78 Rectangular Ducts



Red-L™ and Red-W™ Trusses

Truss Depth	Round Duct Size	Rectangular Duct Height			
		4"	6"	8"	10"
		Rectangular Width			
14"	8"	9"	7"	4"	–
16"	8"	10"	8"	5"	3"
18"	9"	11"	9"	7"	5"
20"	10"	12"	10"	8"	6"
22"	10"	12"	10"	9"	7"
24"	10"	12"	11"	9"	8"
26"	11"	13"	11"	10"	8"
28"	12"	14"	12"	11"	9"
30"	13"	15"	14"	12"	11"
32"	14"	17"	15"	14"	12"
34"	15"	18"	17"	15"	14"
36"	16"	19"	18"	17"	15"
38"	17"	21"	19"	18"	17"
40"	18"	22"	21"	19"	18"

Red-S™ Trusses

Truss Depth	Round Duct Size	Rectangular Duct Height			
		4"	6"	8"	10"
		Rectangular Width			
16"	7"	7"	5"	3"	2"
18"	7"	8"	6"	4"	3"
20"	8"	8"	7"	5"	4"
22"	8"	9"	7"	6"	5"
24"	9"	10"	9"	7"	6"
26"	10"	12"	10"	9"	7"
28"	11"	13"	12"	10"	9"
30"	12"	14"	13"	12"	10"
32"	13"	16"	14"	13"	12"
34"	14"	17"	16"	14"	13"
36"	15"	18"	17"	16"	14"
38"	16"	20"	18"	17"	16"
40"	17"	21"	20"	18"	17"
42"	18"	23"	21"	20"	18"
44"	19"	24"	23"	21"	20"
46"	20"	25"	24"	23"	21"
48"	21"	27"	25"	24"	23"

Red-M™ Trusses

Truss Depth	Round Duct Size	Rectangular Duct Height			
		4"	6"	8"	10"
		Rectangular Width			
20"	7"	8"	6"	5"	3"
22"	8"	8"	7"	5"	4"
24"	8"	8"	7"	6"	5"
26"	8"	9"	8"	6"	5"
28"	9"	9"	8"	7"	6"
30"	9"	10"	9"	8"	7"
32"	10"	11"	10"	9"	8"
34"	11"	12"	11"	10"	9"
36"	12"	13"	12"	11"	10"
38"	13"	14"	13"	12"	11"
40"	13"	16"	14"	13"	12"
42"	14"	17"	16"	14"	13"
44"	15"	18"	17"	16"	14"
46"	16"	19"	18"	17"	16"
48"	17"	20"	19"	18"	17"
50"	18"	21"	20"	19"	18"
52"	18"	22"	21"	20"	19"

Red-H™ Trusses

Truss Depth	Round Duct Size	Rectangular Duct Height			
		4"	6"	8"	10"
		Rectangular Width			
24"	7"	7"	6"	5"	4"
26"	7"	8"	7"	5"	4"
28"	8"	8"	7"	6"	5"
30"	9"	9"	8"	7"	6"
32"	9"	10"	9"	8"	7"
34"	10"	11"	10"	9"	8"
36"	11"	12"	11"	10"	9"
38"	12"	14"	12"	11"	10"
40"	13"	15"	14"	12"	11"
42"	14"	16"	15"	14"	12"
44"	14"	17"	16"	15"	14"
46"	15"	18"	17"	16"	15"
48"	16"	19"	18"	17"	16"
50"	17"	20"	19"	18"	17"
52"	18"	21"	20"	19"	18"
54"	18"	22"	21"	20"	19"
56"	19"	23"	22"	21"	20"
58"	20"	24"	23"	22"	21"
60"	21"	25"	24"	23"	22"
62"	22"	26"	25"	24"	23"
64"	23"	27"	26"	25"	24"
66"	23"	29"	27"	26"	25"
68"	24"	30"	29"	27"	26"
70"	25"	31"	30"	29"	27"
72"	26"	32"	31"	30"	29"

General Notes

- Widths shown are the **minimum allowable openings based on heaviest loads (shortest panels).** Check with your RedBuilt representative for more precise sizing, including larger openings.
- Tables are applicable **only for uniform loads.**

For trusses designed for office floor conditions requiring concentrated loads, or for any other non-uniform loads, contact your RedBuilt representative.

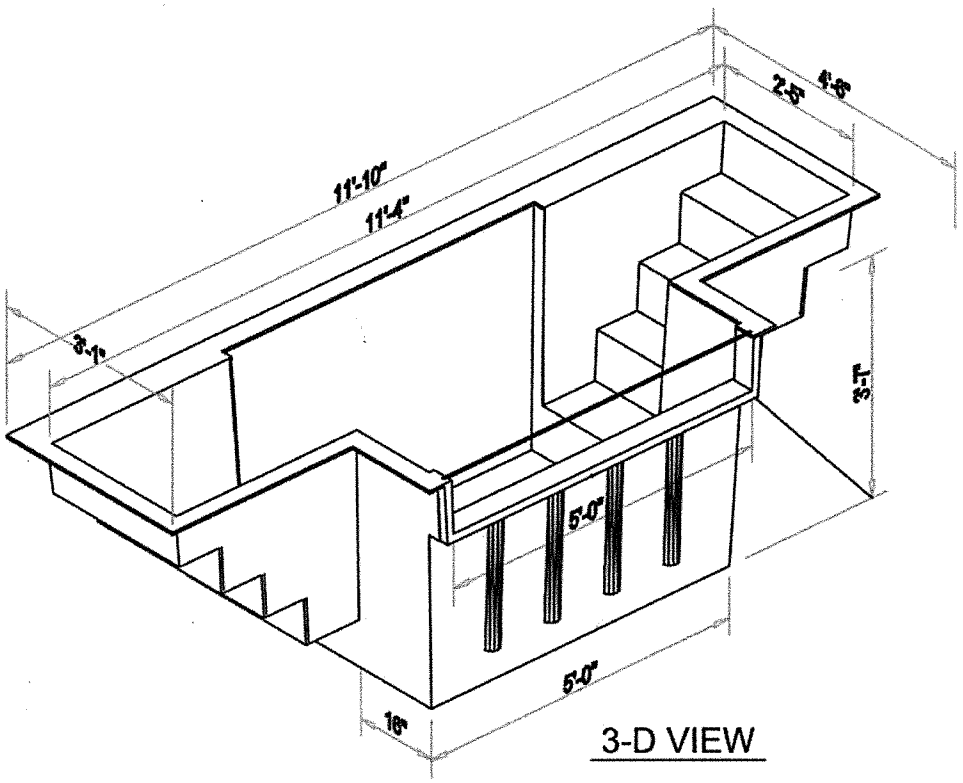
Baptistry Info.

Width:	4'-6"
Length:	11'-10"
Depth:	3'-6" Inside
Water Capacity:	600 gal.
Unit Weight:	270 lb. Dry

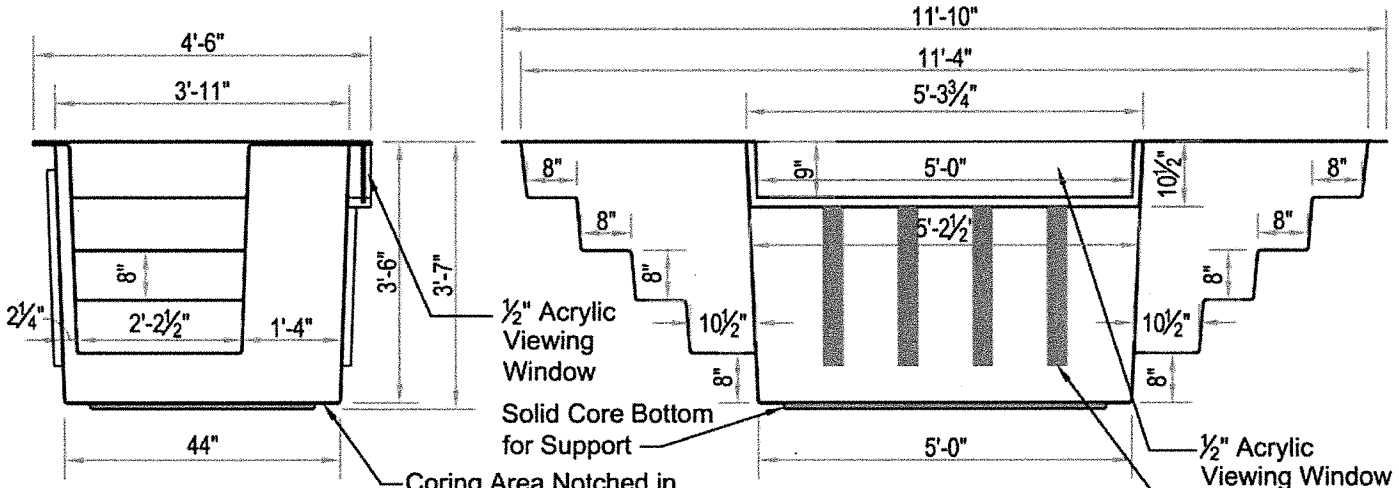
Recommended Heater:
PEB-A 11 kw / Af 2900 / AD 2900
Available In Blue, White or Bone

Window is Optional

Note:
All interior corners are rounded for safety.

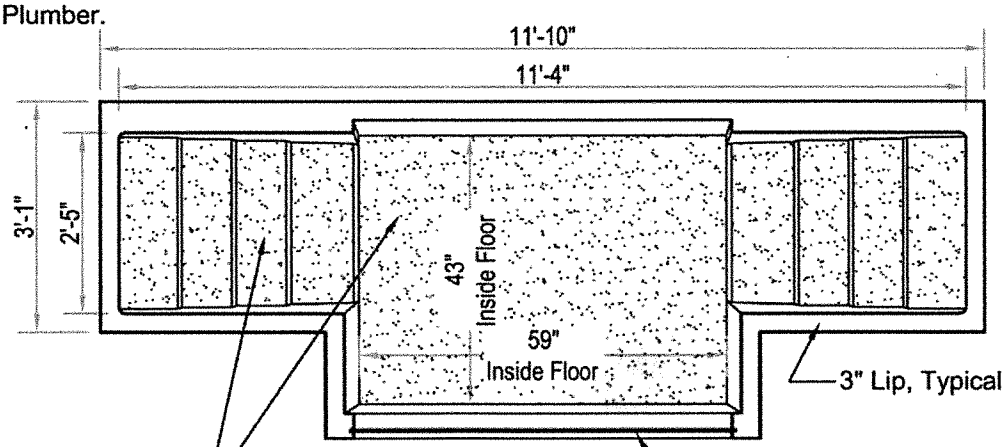


3-D VIEW



SIDE VIEW

FRONT VIEW



Drains can be Located in Either of the Four Corners

TOP VIEW

BAPTISTRIES Model 10-A	**Superior Church Furnishings** 1-800-975-2129	

FIBERGLASS
SPECIALTIES
INCORPORATED

IMPORTANT INFORMATION

HOW TO PROPERLY CARE FOR YOUR FIBERGLASS BAPTISTRY

THINGS YOU SHOULD KNOW ABOUT YOUR BAPTISTRY

FIBERGLASS SPECIALTIES, INC. has built into your baptistry a lustrous gloss finish for the purpose of adding another beauty spot to your church. It is our desire to help you make the sacred rite of baptism more attractive with pleasant, sanitary surroundings. Your baptistry is a quality item and can be kept sparkling clean and sanitary with a minimum amount of effort. It is with utmost care that we have produced your baptistry and it is our desire that this unit gives you good service for many years to come.

DURING CONSTRUCTION

Make an effort to see that your baptistry is well protected from building debris and falling objects during completion of your building or remodeling program. **REMEMBER** that no product is indestructible! Although unit molded fiberglass has lent itself well to baptistry design, fiberglass can be cut, punctured, drilled, fractured or scratched and although it is fairly easily repaired, a little precaution will prevent the need for this inconvenience.

INTERMEDIATE USAGE

When your baptistry is filled only occasionally, the baptistry should be wiped down after each usage. The floor of the baptistry is flat, so make sure it is dry before entering. Once or twice a year your baptistry should be cleaned with a fiberglass cleaner and waxed with any non-abrasive car wax. If the baptistry is left filled for more than 48 hours harmful bacteria may form and the water may need to be treated so it will be safe for human use. Fiberglass Specialties, Inc. does not sell filters or recommend chemicals necessary to keep water purity up to public standards. **IT IS RECOMMENDED TO EMPTY THE BAPTISTRY AFTER EACH USE. The wrong combination of chemicals may damage the surface of the baptismal pool.**

CONSTANT USAGE

Although we have chosen what we believe to be one of the most inert polyesters on the market in the production of your baptistry, all polyesters, if left in constant contact with certain alkalis, will in time react, causing a decomposition of the polyesters. Bacteria and certain algae grow rapidly in water at 95° F. Often an undesirable condition is produced due to this bacterial and plant growth. We strongly recommend the baptistry be emptied after each baptismal service and be cleaned with a cleaner/wax developed for fiberglass products at least twice a year. This care procedure is the best way to insure the beauty of the finish of your baptistry.

NOTE: IT IS EXTREMELY IMORTANT THAT YOUR BAPTISTRY BE KEPT CLEAN (FREE OF ANY FORM OF ALGEA) AND WAXED AT LEAST TWICE A YEAR. DECOMPOSITION OF THE POLYESTER BY ALGAE OR BY CHEMICAL CONTACT SHALL BE CONSIDERED MISUSE AND WILL NOT BE COVERED BY THE WARRANTY.

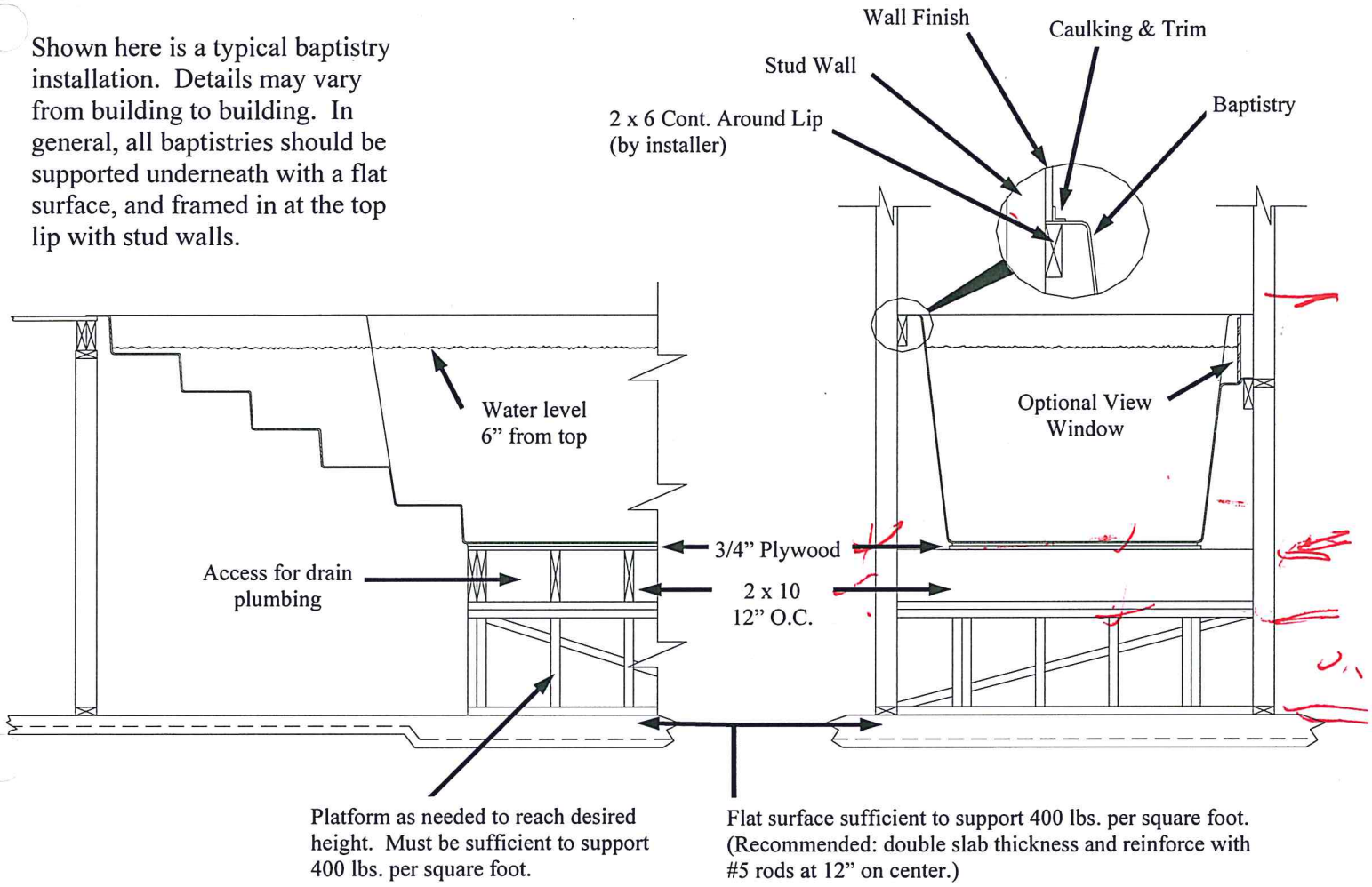
CAUTION! The use of strong detergents, highly caustic cleaners, strong acids and cleaning powders will automatically void your warranty. No water treatment for the prevention of bacterial growth should be used unless guaranteed in writing by the manufacturer to be harmless to polyester resins. Manufacturer's directions for usage should be followed carefully. Powdered or tablet forms should be thoroughly dissolved and liquids should be diluted before being put into the baptistry. FSI recommends usage of any cleaner approved for use with fiberglass. Such cleaners are available in the automotive or marine sections of any hardware, automotive, or Wal Mart store. Carnauba Wax is a recommended way to keep the baptistry surface polished.

CAUTION! All electrical outlets should be at least ten feet from your baptistry or as required by electrical codes. Under no circumstances should anyone within the baptistry touch a microphone or other electrical appliance while in the water.

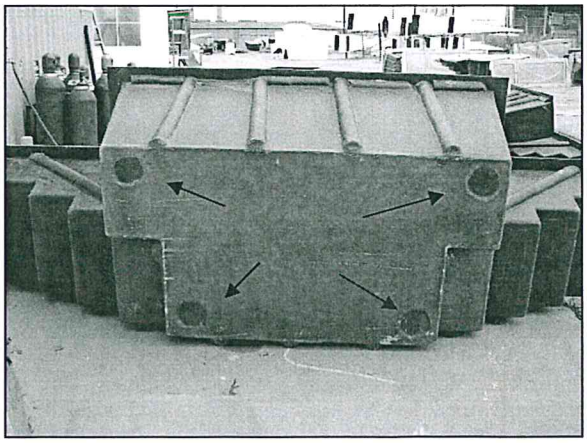
Fiberglass Specialties, Inc.
P.O. Box 1340, 500 Austin Ave.
Henderson, Texas 75653
903-657-6522

Baptistry Installation Instructions

Shown here is a typical baptistry installation. Details may vary from building to building. In general, all baptistries should be supported underneath with a flat surface, and framed in at the top lip with stud walls.

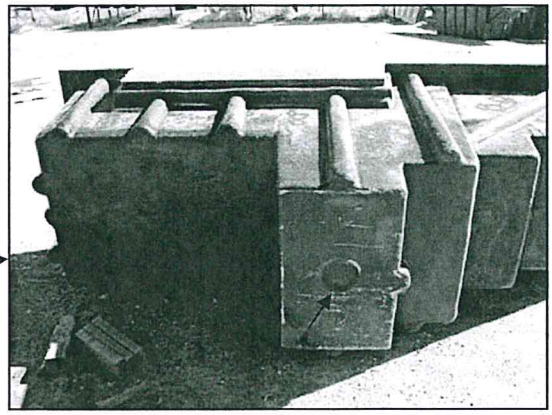


Important Note on Drain Installation:
The bottom reinforcement has been omitted in selected areas of your baptistry. Generally there are 4 locations, but on some models, like the EZ1, the locations are different. Other drain locations or recessed drain ports must be specified at time of order. **Do not penetrate the reinforced sections of the baptistry floor as this will void the warranty.**



Most pools

EZ-1



Special Note:

Every attempt is made to assure safe delivery of your order, but in the event an item is damaged by a freight company, the customer must be responsible for filing the claim. Fiberglass Specialties, Inc. will not be responsible for the filing or collection of freight claims for items damaged by common carrier.

Fiberglass
Specialties
Incorporated

Instructions For Baptistry Window Installation

Materials Needed:
1 – Tube sealant (factory provided)
1 – Knife or scissors and a nail (to open sealant tube)
1 – Caulking Gun
1 – Clean cloth rags or paper towels
1 – Acetone (hint: inexpensive fingernail polish remover is acetone)
1 – Pressure Blocks (between wall of baptistery & window)
2—Small clamps with pads

1. Prepare Surfaces
   A. Carefully remove protective paper from window.
   B. Using acetone and a rag, clean the channel where the window will seat.
   C. Using acetone and a rag, clean the edge of the window.
   D. The window and the seating area should now be free of dirt and wax.

2. Apply Sealant
   A. Cut 1" off the tip of the sealant tube. Use a nail to puncture the seal.
   B. Apply a bead 1/2" to 3/4" wide along the surface of the baptistry where the window will seat as shown in Figure A.

3. Install the Window
   A. Firmly press the window into place as shown in Figure A.
   B. View the sealant through the window. It should spread evenly over the entire contact surface. There should be few or no air bubbles.
   C. Apply firm pressure all along the contact area, working out any air bubbles.
   D. Use a clean rag to wipe away any excess.
   E. Maintain a constant pressure on the window for a minimum of 12 hours using pressure blocks as shown in Figure B.

4. Finish Out
   A. After 12 hours, remove the pressure blocks from the window.
   B. Run a small bead or sealant on the inside and outside of the window.
   C. Smooth out the bead for a clean, uniform appearance.
   D. Allow sealant to dry for 24 hours before filling.

1-800-527-1459 POST OFFICE BOX 1340 HENDERSON, TEXAS 75653 FAX: 903-657-2318

Fiberglass
Specialties
Incorporated

Instructions
For
Baptistry Window Installation

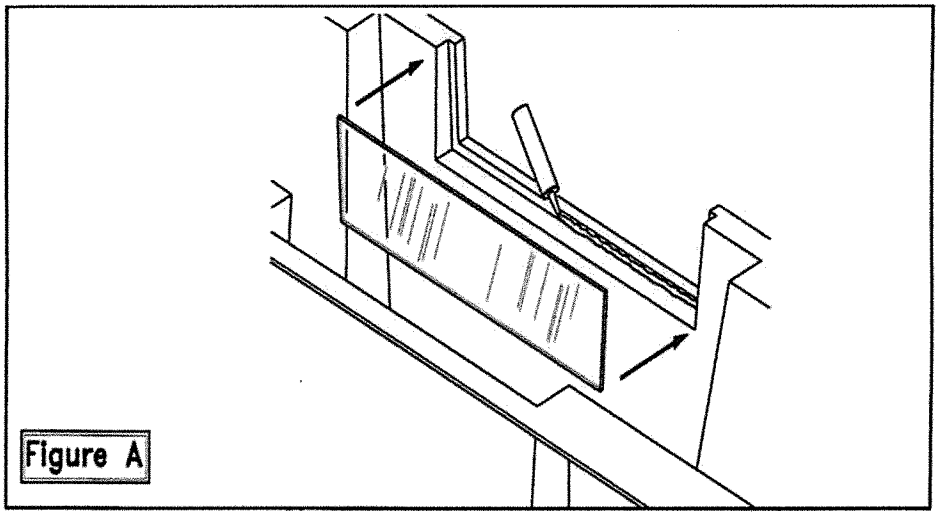


Figure A

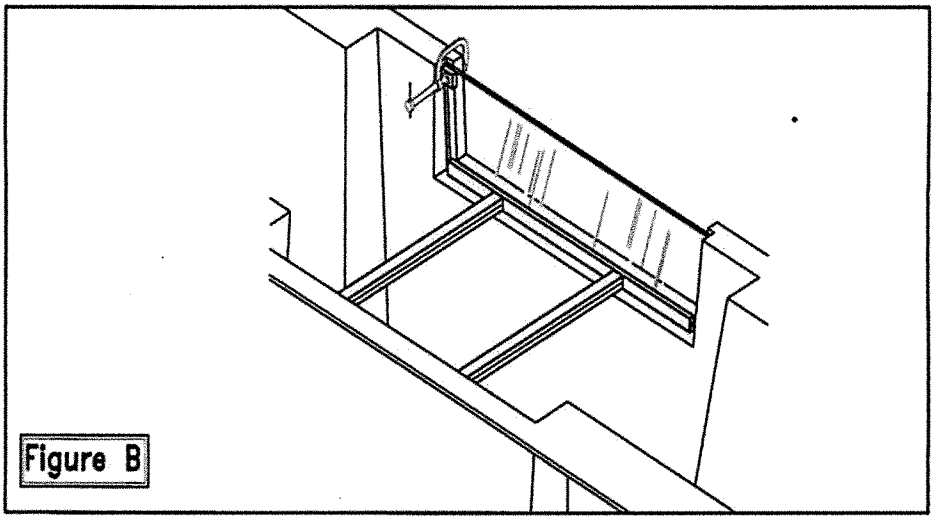


Figure B

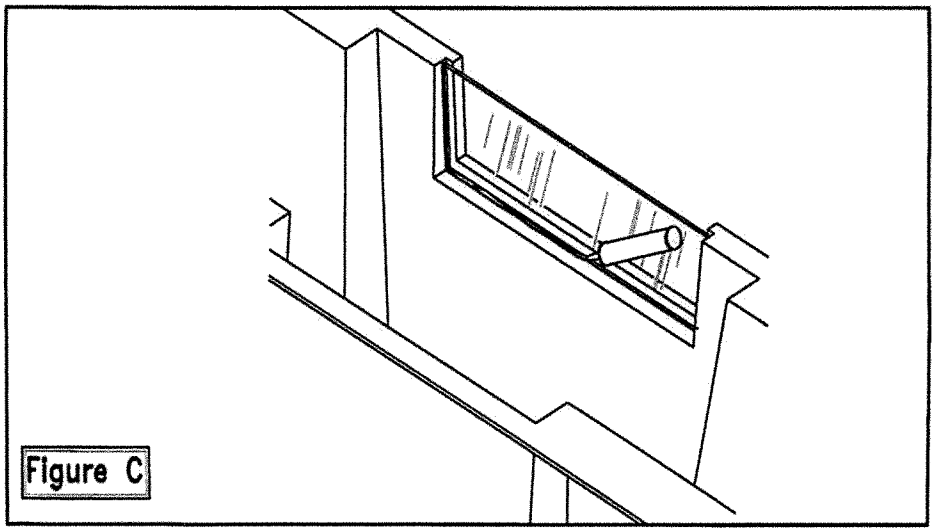
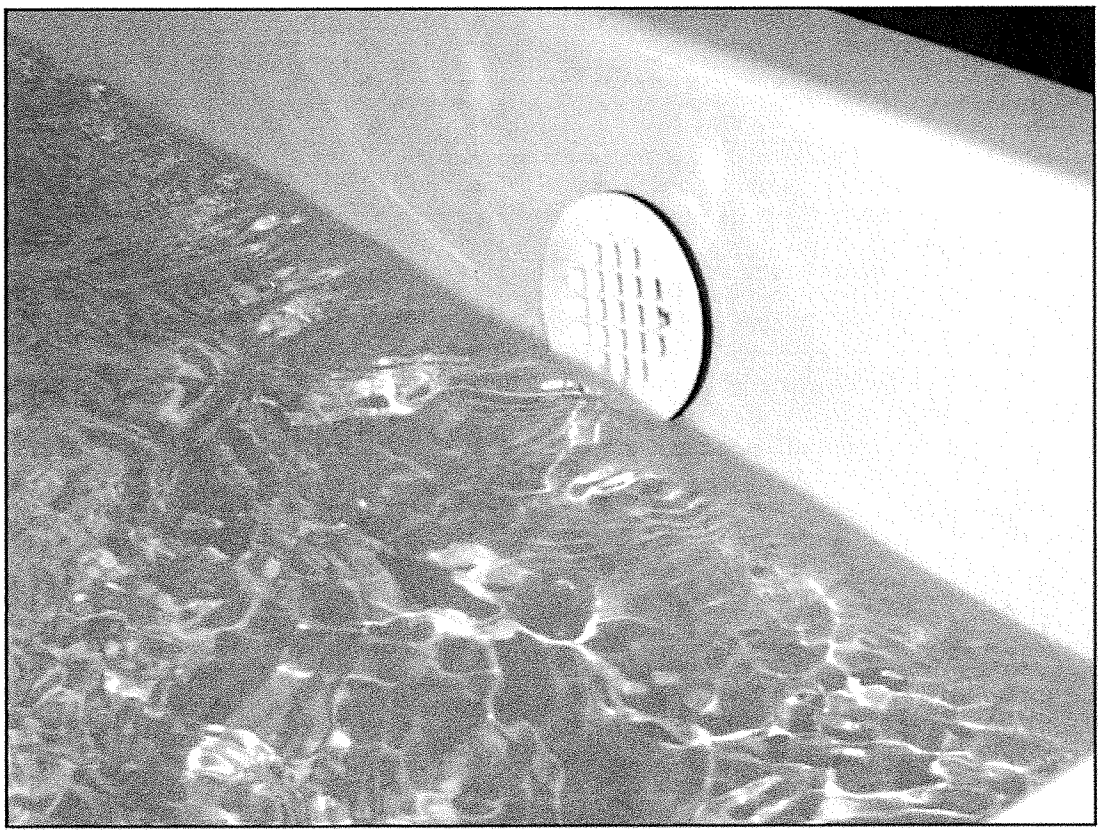


Figure C

Fiberglass Specialties, Inc.
500 Austin Avenue
Henderson, TX 75653
800-527-1459

Installation Instructions for Overflow Drain

1. In a convenient location, drill a 2 1/2" diameter hole 4" below the rim of the baptistry and above any accessories (like the pressure switch on the COM-1 System).
2. Smooth hole on both sides.
3. Put the Overflow Drain through the side of the baptistry and hand tighten.
4. Connect the Overflow Drain to the Main Drain outflow system.



FIBERGLASS SPECIALTIES INCORPORATED

Temperature Rise in a Baptismal Pool

To figure heater size required for a baptistry use the following formula. This is a mathematical equation and does not allow for heat escaping from the pool

Gallons in baptistry x 8.3 x temperature rise per hour desired / 3413 = KW of heater needed

Example: The tap water temperature in a building is **66** degrees and there is a need to heat the baptistry to **95** degrees in 4 hours for a EZ1 baptistry. The temperature has to increase *29* degrees **(95 – 66 = 29)** in *4* hours or 7.25 degrees per hour *(29 degrees / 4 hours)*. The EZ1 holds 350 gallons. 350 gallons x 8.3 x *7.25* degrees per hour rise / 3413 = 6.17 KW heater needed. The AT 55 is a 5.5 KW heater, so it will not heat the baptistry fast enough. The customer will need a CZ 11 heater.

==========

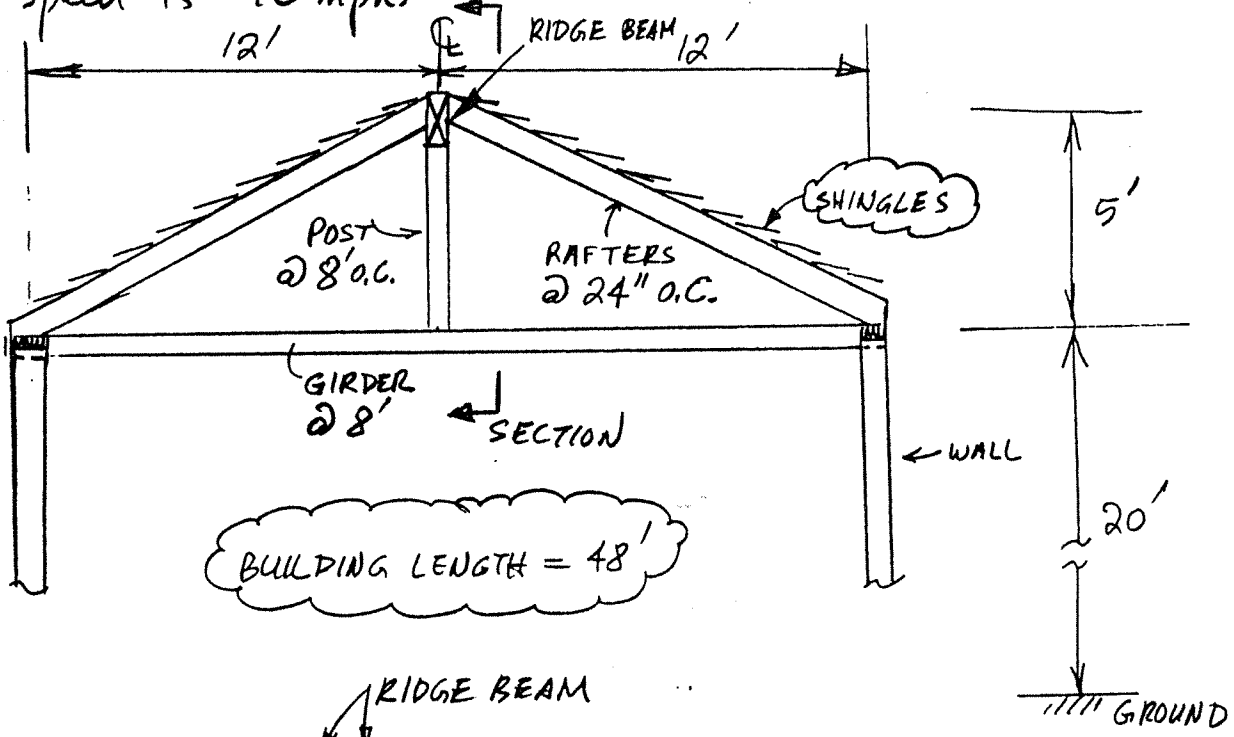
Following are pre-figured values for FSI baptistry models.

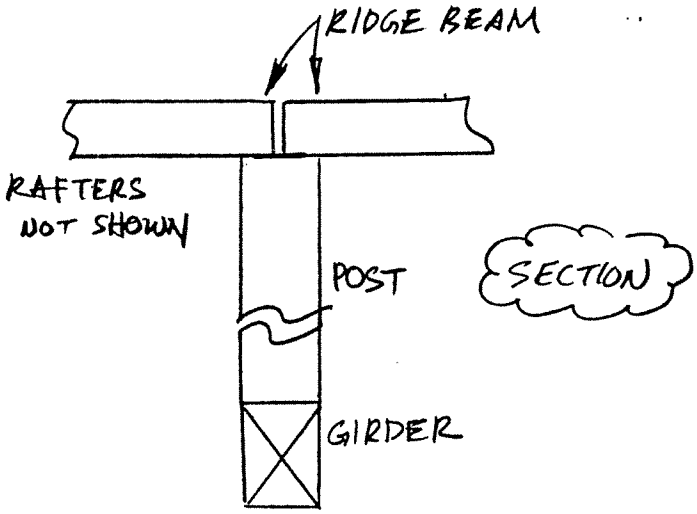
		EQAS H and S – 5KW		EQAS H and S – 11KW	
Model	Gallons	Hours 20 degree Rise	Hours 40 degree Rise	Hours 20 degree Rise	Hours 40 degree rise
T2S	800	6.67	14.29	3.56	7.14
T2M	865	7.21	15.45	3.84	7.72
T2L	1050	8.75	18.75	4.67	9.68
S1	590	4.92	10.54	2.62	5.67
S2	690	5.75	12.32	3.07	6.16
MX	705	5.88	12.59	3.13	6.29
M1	750	6.25	13.39	3.33	6.70
M2	795	6.63	14.20	3.53	7.10
MINI	490	4.08	8.75	2.18	4.38
R1	715	5.96	12.77	3.18	6.38
R2	850	7.08	15.18	3.78	7.59
EZ1	350	2.92	6.25	1.56	3.13
EZ2	465	3.88	8.30	2.08	4.15

EXAMPLE

The shown timber dwelling has a roof consisting of rafters placed at 24 inch intervals and supported at the centerline by a ridge beam. The ridge beam is supported by posts placed at 8 foot intervals. Each post is supported by a girder. All connections are simple, that is, they do not transfer moment.

Roof dead load = 20 psf (includes self weight of framing). The structure is located in an area that is densely forested with ground snow load of 40 psf. Basic wind speed is 70 mph.





Determine:

a) Maximum bending moment in rafters
b) Maximum axial load in post
c) Maximum bending moment in girder

Consider dead load, dead load + snow load, or dead load + wind load whichever dominates in each case.

Directions:

Load is collected by the rafters and transferred to the ridge beam and supporting wall. Ridge beam is supported by posts, which are supported by girders. This represents the load path. It will be useful in sequencing your analysis.

Note that different loading combinations may be critical for the various members. For example, dead plus unbalanced snow load may be critical for one member, whereas dead plus balanced snow load may be critical for another member.

You do not have to do calculations for every single case of loading and combination of loadings. Use engineering judgement to exclude some of these loadings (however, explain the rationale).

SNOW LOAD CALCULATIONS (PER ASCE 7-93)

$p_g = 40\ psf$, $C_e = 1.2$ (densely forested), $C_t = 1.0$ (dwelling)
$I = 1$ regular structure

$$p_f = 0.7\, C_e\, C_t\, I\, p_g = 0.7 \times 1.2 \times 1.0 \times 1.0 \times 40 = 33.6\ psf$$

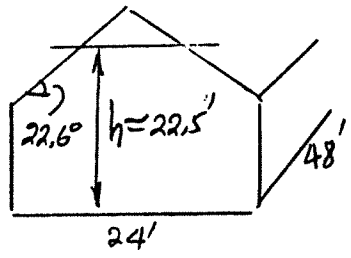
SLOPE 5 ON 12 OR 22.6° , NON-SLIPPERY - WARM ROOF $\Rightarrow C_s = 1.0$

BALANCED SNOW LOAD $p_s =$ 33.6 psf

UNBALANCED $1.5\, p_s / C_e = 1.5 \times 33.6 / 1.2 =$ 42 psf

WIND LOAD CALCULATIONS (PER ASCE 7-93)

CALCULATE ONLY ROOF PRESSURE/SUCTION



EXPOSURE B : WOODED AREA

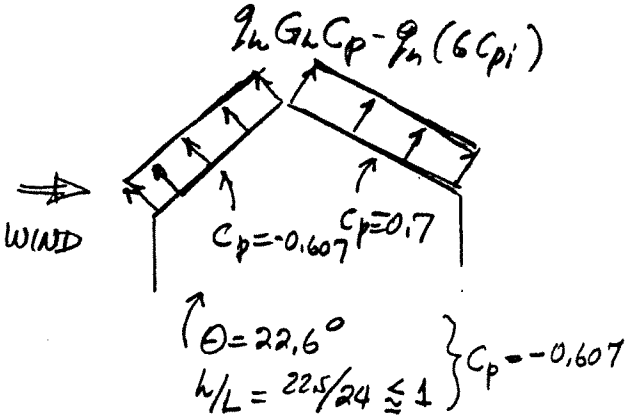
$I = 1$ (NO HURRICANES)

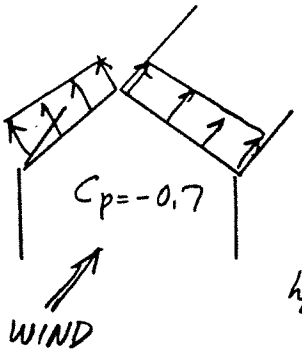
$$q_h = q_{z=h} = 0.00256\, K_z\, (I V)^2 = 5.52\ psf$$

(V = 70 mph, $K_z = 0.44$)

$G_h = 1.565$

$GC_{pi} = \pm 0.25 \rightarrow q_h (GC_{pi}) = \pm 1.38\ psf$





h/B , $h/L < 2.5$

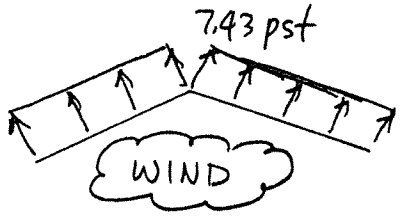
SINCE WIND LOADING ON ROOF IS SUCTION (THAT IS, IT COUNTERACTS EFFECT OF WEIGHT), OF INTEREST IS ITS MAXIMUM VALUE. IT MAY BE LARGE ENOUGH TO REVERSE MOMENT IN RAFTERS AND THUS DOMINATE OVER DEAD + SNOW LOAD (THOUGH UNLIKELY).

WORST CASE IS WIND BLOWING PARALLEL TO RIDGE WITH OVERPRESSU INTERNALLY:

$$\text{SUCTION} = q_h G_h C_p + q_h (GC_{pi}) = 5.52 \times 1.565 \times 0.7 + 1.38$$

C_p: $\uparrow 0.7$

$$= \underline{7.43 \text{ psf}}$$

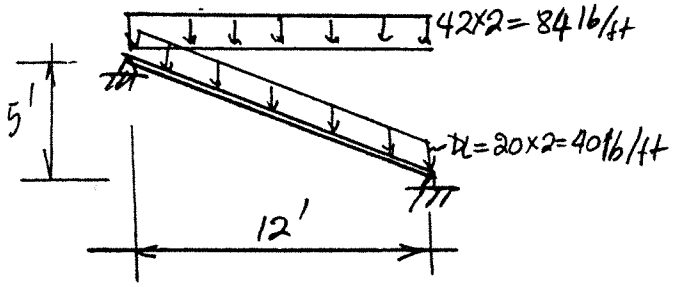


- THE MINIMUM 10 psf WIND LOADING CAUSED PRESSURE ON ROOF RAFTERS BUT THE EFFECT IS MUCH LESS THAN UNBALANCED SNOW LOAD ⇒ NO NEED TO CONSIDER.

RAFTERS

LOADINGS TO CONSIDER

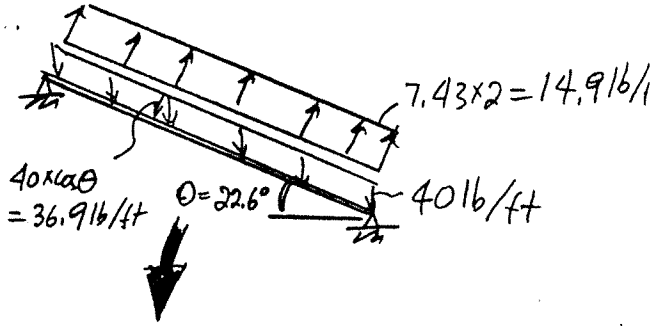
DL + UNBAL. SNOW



TRIBUTARY WIDTH = 2'

RAFTER LENGTH = 13'

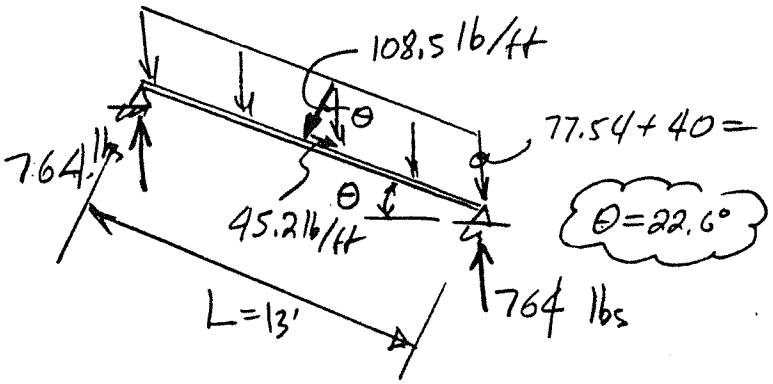
DL + WIND



NET EFFECT IS DOWNWARD LOAD ON RAFTER ⇒ LESS THAN DL+LN. SNOW.

DONOT CONSIDER WND.

UNBALANCED S.L. / ACTUAL LENGTH = $84 \times 12/13 = 77.54$ lb/ft



RAFTER SUBJECTED TO PERPENDICULAR LOAD OF 108.5 lb/ft = w

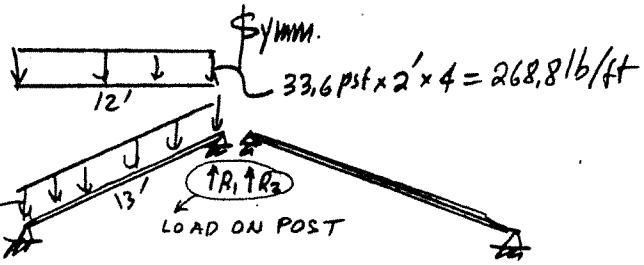
$$\Rightarrow M_{max} = M_{\ell} = \frac{wL^2}{8} = \frac{108.5 \times 13^2}{8} = \underline{2.3^{1-K}}$$

MAX. MOMENT IN RAFTER

POST

POST RECEIVES LOAD FROM 4 RAFTERS ON LEFT & 4 RAFTER ON RIGHT

↑ SPACED AT 8'



$20^{psf} \times 2' \times 4 = 160$ lb/ft

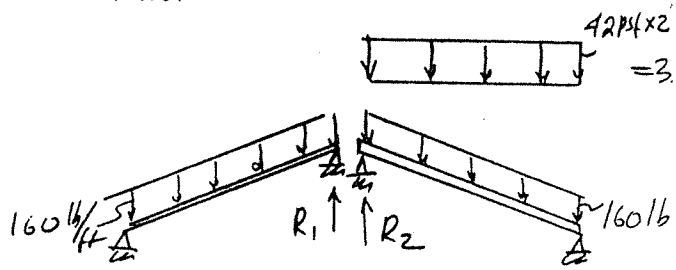
DL + BAL. SNOW LOAD

$R_1 = R_2 = 268.8 \times 12/2 + 160 \times 13/2$

$= 2652.8$ lbs

LOAD ON POST = $R_1 + R_2 = 5305.6$ lbs

↑ SPACED AT 2'



DL + UNBAL. SNOW LOAD

$R_1 = 160 \times 13/2 = 1040$ lbs

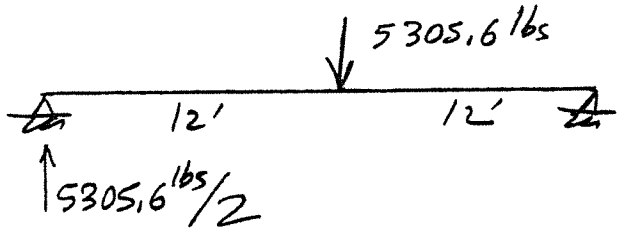
$R_2 = 160 \times 13/2 + 336 \times 12/2 = 2016$

LOAD ON POST = $R_1 + R_2 = 3056$ lbs.

$\Rightarrow$ AXIAL FORCE IN POST = 5305.6 lbs COMPR.

GIRDER

GIRDER IS LOADED BY POST AXIAL FORCE



$$\Rightarrow M_{max} = M_{\ell} = \frac{5305.6^{lb} \times 12'}{2} = 31.8^{1-K}$$

MAX. MOMENT IN GIRDER.

DAMMON ENGINEERING, INC.

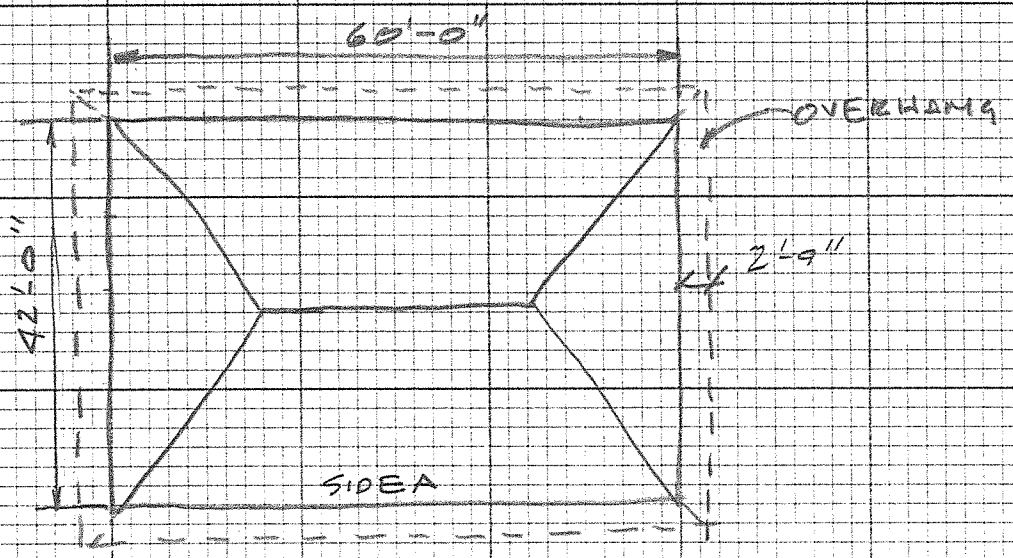
dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950

WIND LOAD CALCULATIONS:

GIVEN: RESIDENTAL 2 STORY
SLIDELL LA PALM LAKE
WOOD STUD
EAVE HT 18'-7"
ROOF SLOPE 4/12 = 18.4°
EXCLUDE PORCHES & DECKS



ASSUME: BLDG FULLY ENCLOSED

USE: ALTERNATE LOW RISE METHOD
ASCE 7-98 LOAD COMBINATION USED

GIVEN: WIND SPEED 95MPH
EXPOSURE B
IMPORTANCE II
Kz = .7
Kzt = 1.00
Kd = .85

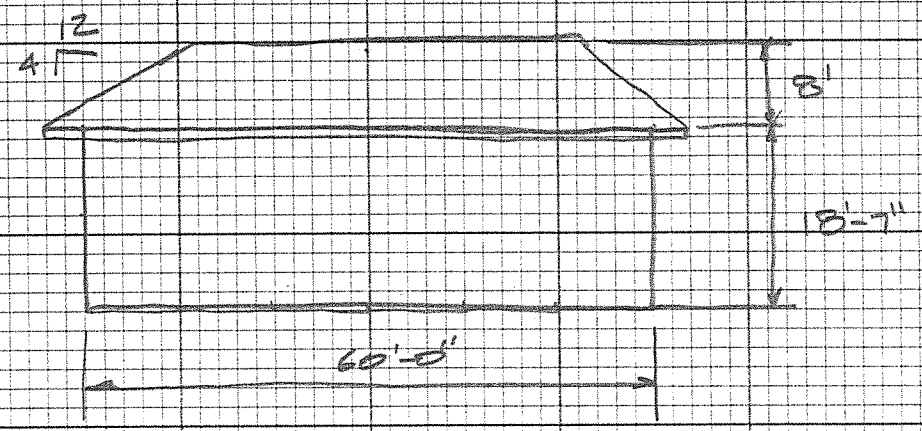
Notes:

DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950



FRONT ELEV

TOTAL ROOF HT 18'-7" + 8'-0" = 26'-7"

MEAN ROOF HT $\frac{18'-7" + 26'-7}{2}$ = 22'-7"

22.5833'

ROOF ANGLE 4/12 $\tan^{-1}(4/12) = 18.43°$

$q = .00256\, K_z\, K_{zt}\, K_d\, V^2 I$

$P = q[(G C_{pf}) + (G C_{pi})]$

$P = q_h[(G C_{pf}) - (G C_{pi})]$

$q = 13.75$

$GC_{pi} = \pm (.18)$

Notes:

DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950

DETERMINE EXTERNAL PRESSURE COEFFICIENTS Cp

ROOF NET DRAG h/L 22.583/60 = .376

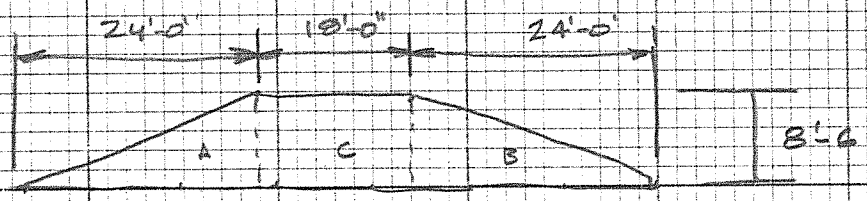
FIG 6-3 EXTERNAL PRESSURE

13.75 (.2-(-.6) = 11 PSF

WALL NET PRESSURE L/B 42/60 = .7

13.75 (.8-(-.5) = 17.875 PSF

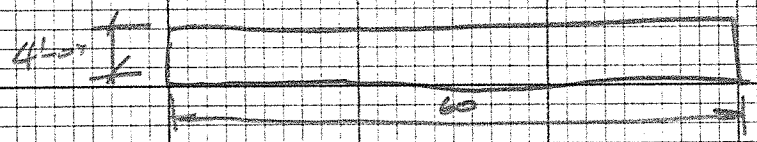
CALCULATE PROJECTED ROOF AREA



2 (24 Y.5') (8.5) + 18 x 8.5 =

204 + 153 = 357 SF

PROJECT AREA 2ND FLOOR



4' x 60' = 240 SF

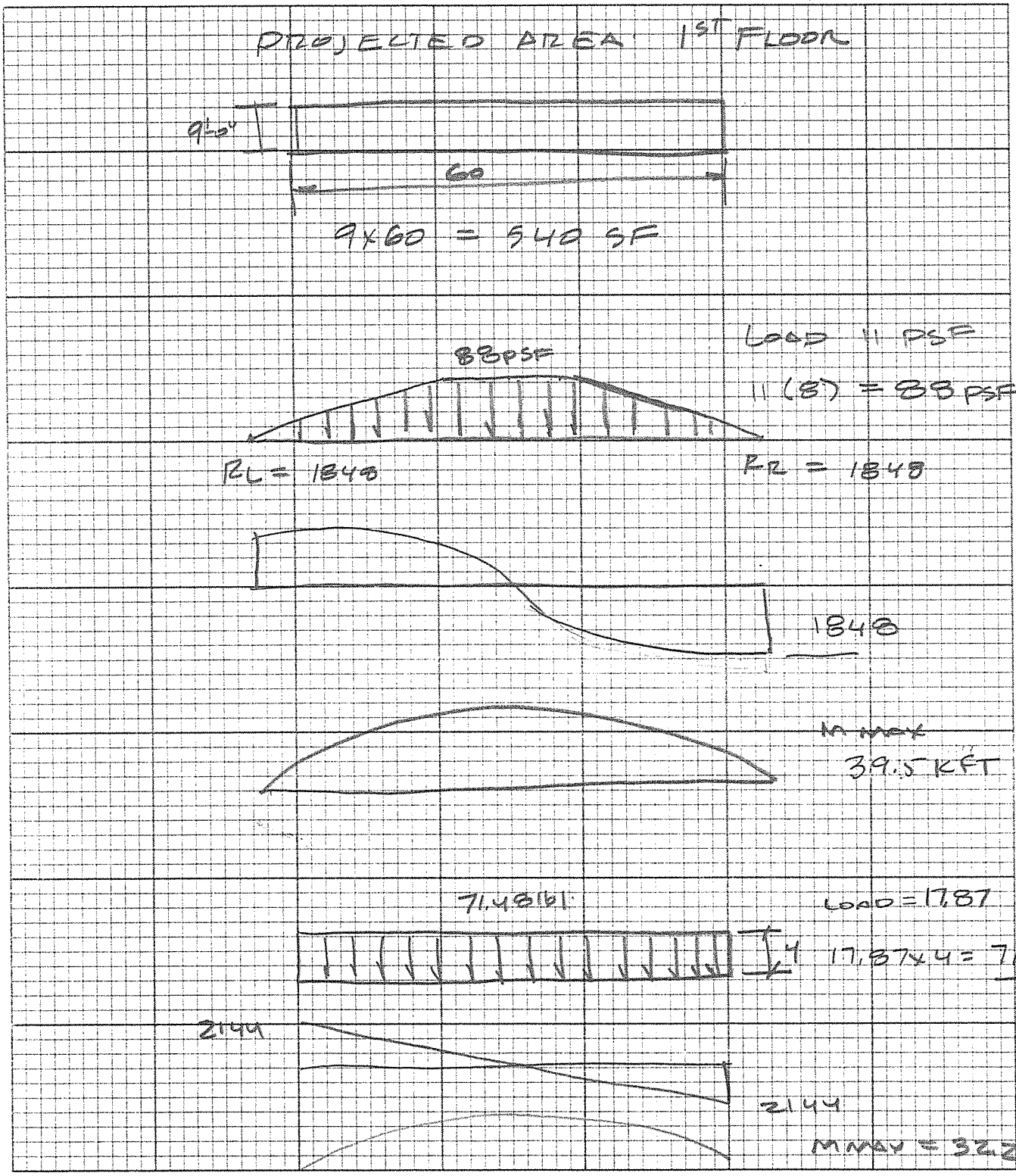
Notes:

DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950



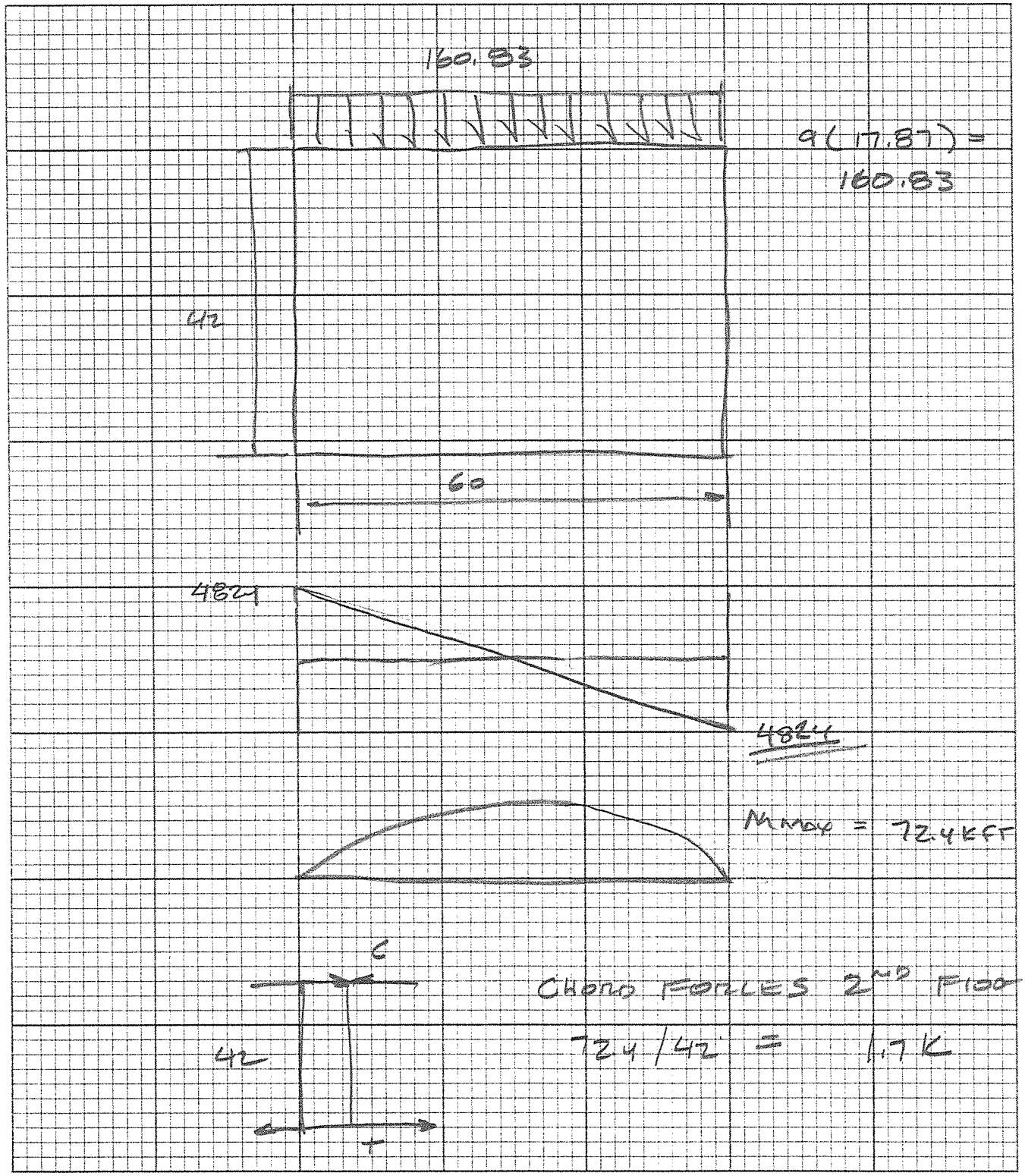
Notes: TOTAL SHEAR 2144 + 1848 = 3992

DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950



Notes:

DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950

CHECK ROOF DIAPHRAM FORCES

ASSUME 15/32 w/ 8d @ 6" O.C = 270

V = 3992 / 42 = 95 PLF

270 > 90 OK

CHECK 2ND FLOOR DIAPHRAM FORCES

8816 / 42 = 209

USE 19/32 w 8d @ 6" O.C = 310

310 > 209 OK

CHECK SHEAR CAPACITY END WALL

ASSUME 15/32 8d @ 6" O.C. = 280

ASSUME 50% OF WALL AVAILABLE FOR SHEAR

2ND FOR 280(1.4)(24) = 9408 > 3992 OK

1ST FOR 280(1.4)(24) = 9408 > 8816 OK

USE 15/32 8d @ 6" O.C.

Notes: LEFT SIDE 2nd FLOOR SHALL BE FULL SHEATHED w/ 15/32 FOR THE FLOOR WIDTH

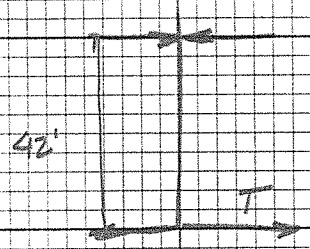
DAMMON ENGINEERING, INC.

dammonengineering.com

2000 Old Spanish Trail, Ste 100
Slidell, Louisiana 70458
Office: (985) 649-5832

P.O. Box 2830
Slidell, Louisiana 70459
Fax: (985) 641-5950

TOTAL MOMENT 39.5 + 32.2 = 71.7 K FT

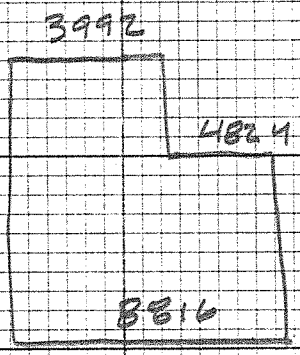


ROOF DIAPHRAM
CHORD FORCE

C = T 71.7 K F / 42' = 1.7K

TOTAL SHEAR - 1848 + 2144 = 3992

SHEAR DIAGRAM FOR TWO STORY WALLS

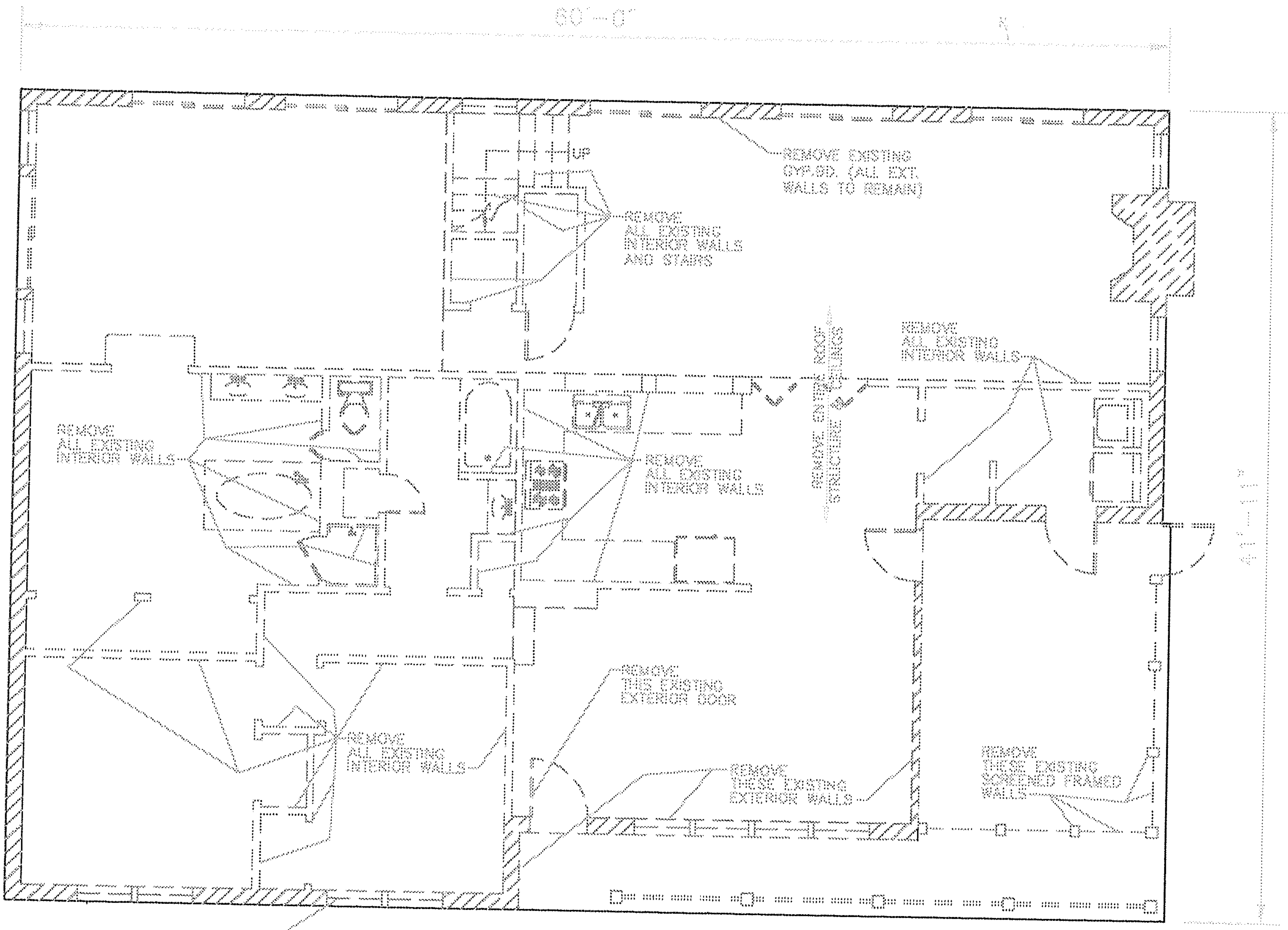


Notes:

KURZ
3048 PALM ~~lake~~ DRIVE
SLIDELL LA

< 18.4°

18.5833

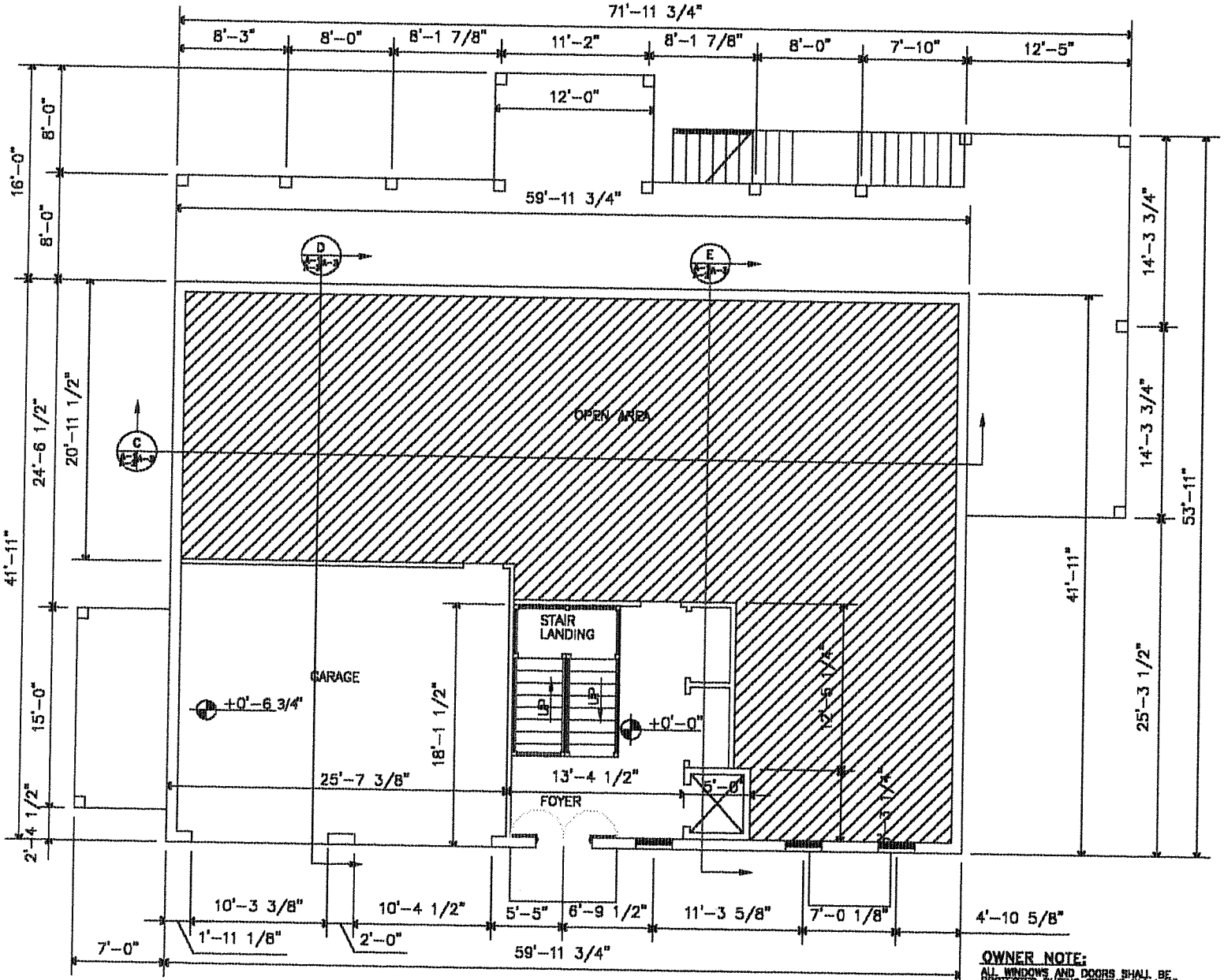


DEMOLITION PLAN

SCALE: 1/4"=1'-0"

LEGEND

- EXISTING WALL TO BE REMOVED
- EXISTING WALL TO REMAIN
- NEW WALL

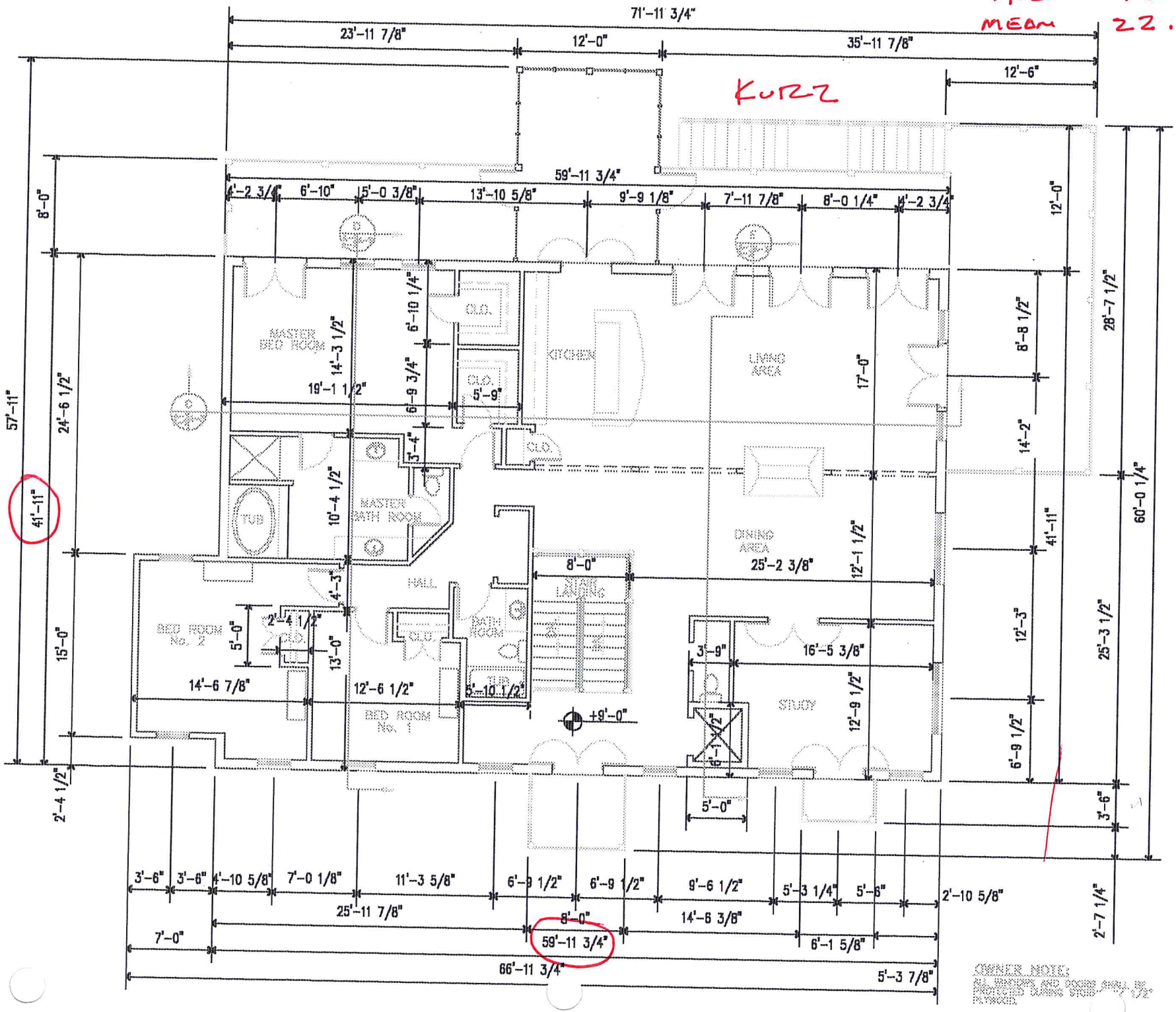


FIRST FLOOR PLAN
SCALE: 1/4"=1'-0"

OWNER NOTE:
ALL WINDOWS AND DOORS SHALL BE PROTECTED DURING STORMS W/ 1/2" PLYWOOD.

LEGEND

- EXISTING WALL TO BE REMOVED
- EXISTING WALL TO REMAIN
- NEW WALL
- NEW 5 1/2"W x 13 3/4"D ANTHONY POWER BEAM OR EQUAL (128 LBS/ LIN FT) W/ 3" SCHEDULE 80 PIPE COLUMN
- NEW VENT THROUGH WALL


4/12 = 18.4°
MEAN 22.91
KURZ
71'-11 3/4"
23'-11 7/8"
12'-0"
35'-11 7/8"
12'-6"
59'-11 3/4"
4'-2 3/4"
6'-10"
5'-0 3/8"
13'-10 5/8"
9'-9 1/8"
7'-11 7/8"
8'-0 1/4"
4'-2 3/4"
8'-0"
57'-11"
24'-6 1/2"
41'-11"
15'-0"
2'-4 1/2"
MASTER BED ROOM
14'-3 1/2"
19'-1 1/2"
6'-10 1/4"
6'-9 3/4"
3'-4"
C.B.
5'-9"
KITCHEN
LIVING AREA
17'-0"
8'-8 1/2"
12'-0"
28'-7 1/2"
14'-2"
41'-11"
60'-0 1/4"
MASTER BATH ROOM
TUB
10'-4 1/2"
DINING AREA
25'-2 3/8"
12'-1 1/2"
8'-0"
HALL
4'-3"
LANDING
BED ROOM No. 2
5'-0"
2'-4 1/2"
C.B.
13'-0"
BATH ROOM
14'-6 7/8"
12'-6 1/2"
5'-10 1/2"
BED ROOM No. 1
+9'-0"
3'-9"
16'-5 3/8"
STUDY
12'-9 1/2"
6'-1 1/2"
12'-3"
25'-3 1/2"
6'-9 1/2"
5'-0"
3'-6"
3'-6"
3'-6"
4'-10 5/8"
7'-0 1/8"
11'-3 5/8"
6'-9 1/2"
6'-9 1/2"
9'-6 1/2"
5'-3 1/4"
5'-6"
2'-10 5/8"
2'-7 1/4"
25'-11 7/8"
8'-0"
14'-6 3/8"
7'-0"
59'-11 3/4"
6'-1 5/8"
66'-11 3/4"
5'-3 7/8"
OWNER NOTE:

- *Calculate the required loaded edge distance for* $C_\Delta = 0.83$ and $C_\Delta = 1.0$.

$$E_\alpha = \frac{E_C E_D}{\sqrt{E_C^2 \sin^2(90-\phi-\alpha_{arm}) + E_D^2 \cos^2(90-\phi-\alpha_{arm})}} \quad [2\text{-}19]$$

E_α = Required loaded edge distance

E_C = 5.5 in. for 2-5/8 in. shear plates and $C_\Delta = 1.0$
= 4.25 in. for 2-5/8 in. shear plates and $C_\Delta = 0.83$
= 7 in. for 4 in. shear plates and $C_\Delta = 1.0$
= 5.4 in. for 4 in. shear plates and $C_\Delta = 0.83$

E_D = 2.75 in. for 2-5/8 in. shear plates and $C_\Delta = 1.0$
= 1.5 in. for 2-5/8 in. shear plates and $C_\Delta = 0.83$
= 3.75 in. for 4 in. shear plates and $C_\Delta = 1.0$
= 2.5 in. for 4 in. shear plates and $C_\Delta = 0.83$

- *Determine the required spacing and loaded edge distance corresponding to the optimal geometry factor using linear interpolation.* If the optimal geometry factor is less than 0.83, use the minimum edge distance determined for $C_\Delta = 0.83$.

$$S_{\alpha,C_\Delta} = \left(\frac{C_\Delta - 0.5}{1-0.5}\right)\left(S_{\alpha,1.0} - S_{\alpha,0.5}\right) + S_{\alpha,0.5} \quad [2\text{-}20]$$

$$E_{\alpha,C_\Delta} = \left(\frac{C_\Delta - 0.83}{1-0.83}\right)\left(E_{\alpha,1.0} - E_{\alpha,0.83}\right) + E_{\alpha,0.83} \quad [2\text{-}21]$$

Choose spacing, S, and end distance, E, equal to or greater than those calculated. The chosen spacing and end distance should be rounded up to the nearest 1/16 in. or other practical unit of measure to facilitate fabrication.

- *Calculate the required depth based on connector spacing and edge distance:*

$$d_c' \geq d_{c\ shear\ plates}' = (n_y - 1)S_\alpha + 2E_\alpha \quad [2\text{-}22]$$

Required crown depth based on flexure in the arm and chosen arm taper angle:

Estimating that the point of inflection occurs near the upper tangent point of the loaded arch for the unbalanced snow loading and that the crown depth is approximated by the depth required for the shear plates, the location of the critical section in the upper arm of the loaded arch (measured from the crown) can be determined from the following relationship, which was derived for this case from

equation 4.32 of the AITC Timber Construction Manual (5th edition) (x is measured horizontally from the crown):

$$x \approx \frac{\cos(\phi)(L_R - x_2)\left(\frac{d'_c}{\cos(\alpha_{arm})}\right)}{2\left(d'_c \frac{\cos(\phi)}{\cos(\alpha_{arm})}\right) + \frac{(L_R - x_2)}{\cos(\phi)} \tan \alpha_{arm}} \qquad [2\text{-}23]$$

The required depth at that section can be approximated as:

$$d_x > \sqrt{\frac{3(\omega_S + \omega_D)(L_R - x_2)x\left(1 - \frac{x}{L_R - x_2}\right)}{bF_{bx}C_D C_I C_M C_t}} \qquad [2\text{-}24]$$

For tapered arms, the reference flexural stress, F_{bx}, used in [2-24] should be reduced to account for the loss of high strength material at the surface due to tapering, unless the arch is laid up with a uniform-grade lay-up or the high grade material is maintained throughout the length of the arch (Appendix A). Either of these options may increase the cost of the arch. For standard arches with tapered arms, a 10% reduction is suitable for preliminary design purposes.

The corresponding depth at the crown can be estimated as:

$$d_c > d_x - \left(\frac{x}{\cos\phi}\right) \tan \alpha_{arm} \qquad [2\text{-}25]$$

$$d'_c = \frac{d_c \cos(\alpha_{arm})}{\cos\phi_t} \qquad [2\text{-}26]$$

The greater depth from connector requirements or from arm flexure is chosen as the minimum depth of the arch at the crown.

With the preceding steps completed, a trial arch geometry is defined. The trial geometry should be further adjusted to ensure that the upper and lower tangent point depths are within approximately 10% of each other. The trial arch should be drawn to scale and the geometry should be adjusted if necessary for aesthetic considerations.

At this point, the preliminary design of the arch is completed. The final design must include a thorough analysis of the arch subject to all applicable loads and load combinations by the procedures discussed in Chapters 3-5. An example including the preliminary design procedure described in this chapter follows.

Example 2-1: Design of Tudor Arch

Given: A building with outside dimension of 50 ft by 60 ft is to be constructed using Southern Pine Tudor arches spaced at 15 ft.

The arches will be subject to normal temperatures and dry-use conditions.

The arches will be symmetric with a maximum roof height of 24 ft. and a wall height of 12 ft as shown in Figure E4.1.

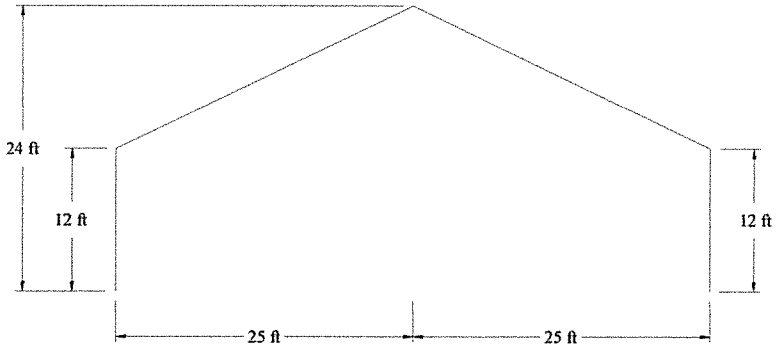


Figure E2.1. *Outside geometry of arch.*

The curved portion of the arches will have a radius of 10.5 ft at the inside face and a lamination thickness of ¾ in.

The arch has continuous lateral bracing along the wall and roof.

The building has no shear walls at the ends, so the arches will be assumed to support all vertical and lateral loads acting parallel to the planes of the arches.

Material Properties: $F_{bx}^{+} = 2000$ psi
$F_{vx} = 215$ psi

Loads: the loads have been determined as shown in Figures E2.2 through E2.4. The wall dead loads are assumed to act at the outer face of the arch.

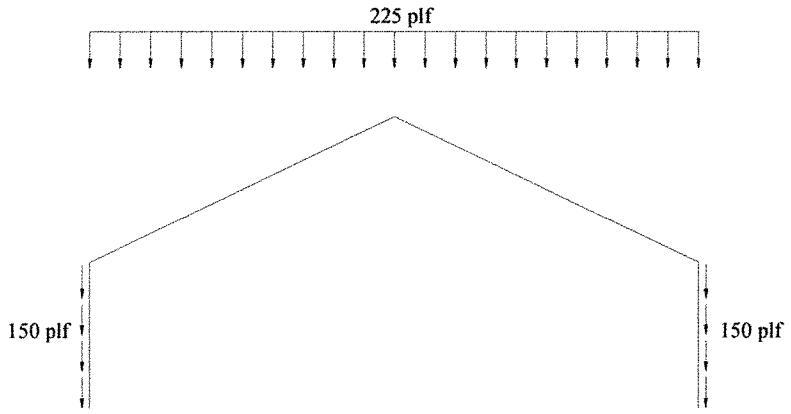


Figure E2.2. *Dead loads.*

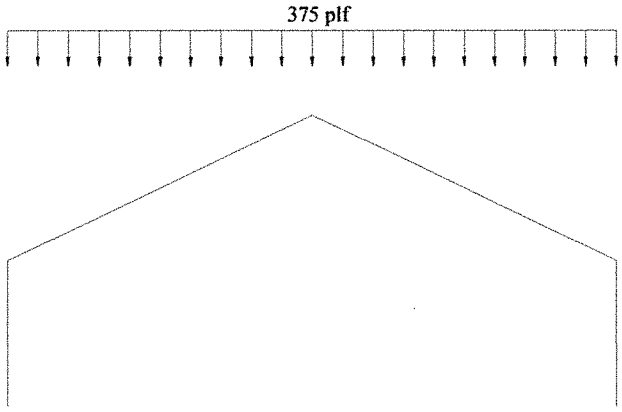


Figure E2.3. *Balanced snow load.*

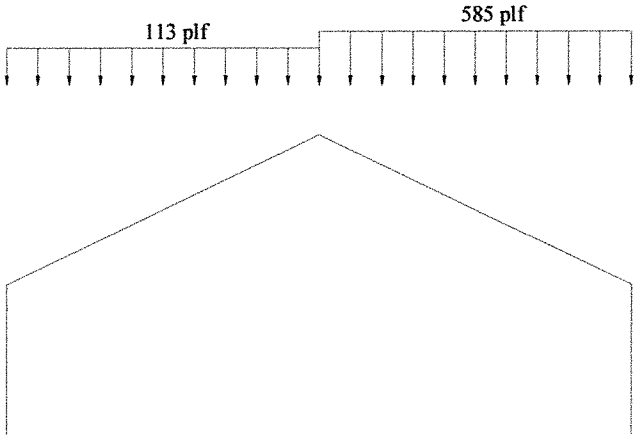


Figure E2.4. *Unbalanced snow load.*

Wanted: Perform preliminary design of a Tudor arch with a width of 6.75 in. based on the dead plus snow load combinations:

(1) D + S (balanced snow)
(2) D + S (unbalanced snow)

For final design, additional load combinations will need to be considered.

Solution:

The required depth at the lower tangent is commonly governed by the balanced snow loading. The depths in the arch arm are commonly controlled by the unbalanced snow loading.

Approximate reaction forces (using the outside arch geometry) for each considered snow load combination are included in Table E2.1.

Table E2.1. *Approximate reactions for* **D + S** *load combinations.*

Load	$R_{y,L}$	$R_{x,L}$	C_y	C_x	$R_{y,R}$	$R_{x,R}$
D+S (Balanced)	16800	7810	0	-7810	16800	7810
D+ S (Unbalanced)	13200	7470	-2950	-7470	19100	7470

Estimating the required depth at the crown based on connection requirements

The minimum depth at the crown will be estimated based on the vertical reaction force at the peak connection due to unbalanced snow loading and the number of shear plates required to transfer the load.

For 4 inch shear plates in Southern Pine:

$$P = 4360 \text{ lb}$$
$$Q = 3040 \text{ lb}$$
$$Q_{90} = 0.6Q = 0.6(3040 \text{ lb}) = 1824 \text{ lb}$$

The shear plates will be loaded at an angle to the grain of $90° - \phi - \alpha_{arm}$.

$$\phi = \arctan\left(\frac{12 \text{ ft}}{25 \text{ ft}}\right) = 25.64°$$
$$\alpha_{arm} = 2.5°$$
$$90° - \phi - \alpha_{arm} = 90° - 25.64° - 2.5° = 61.86°$$