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:		

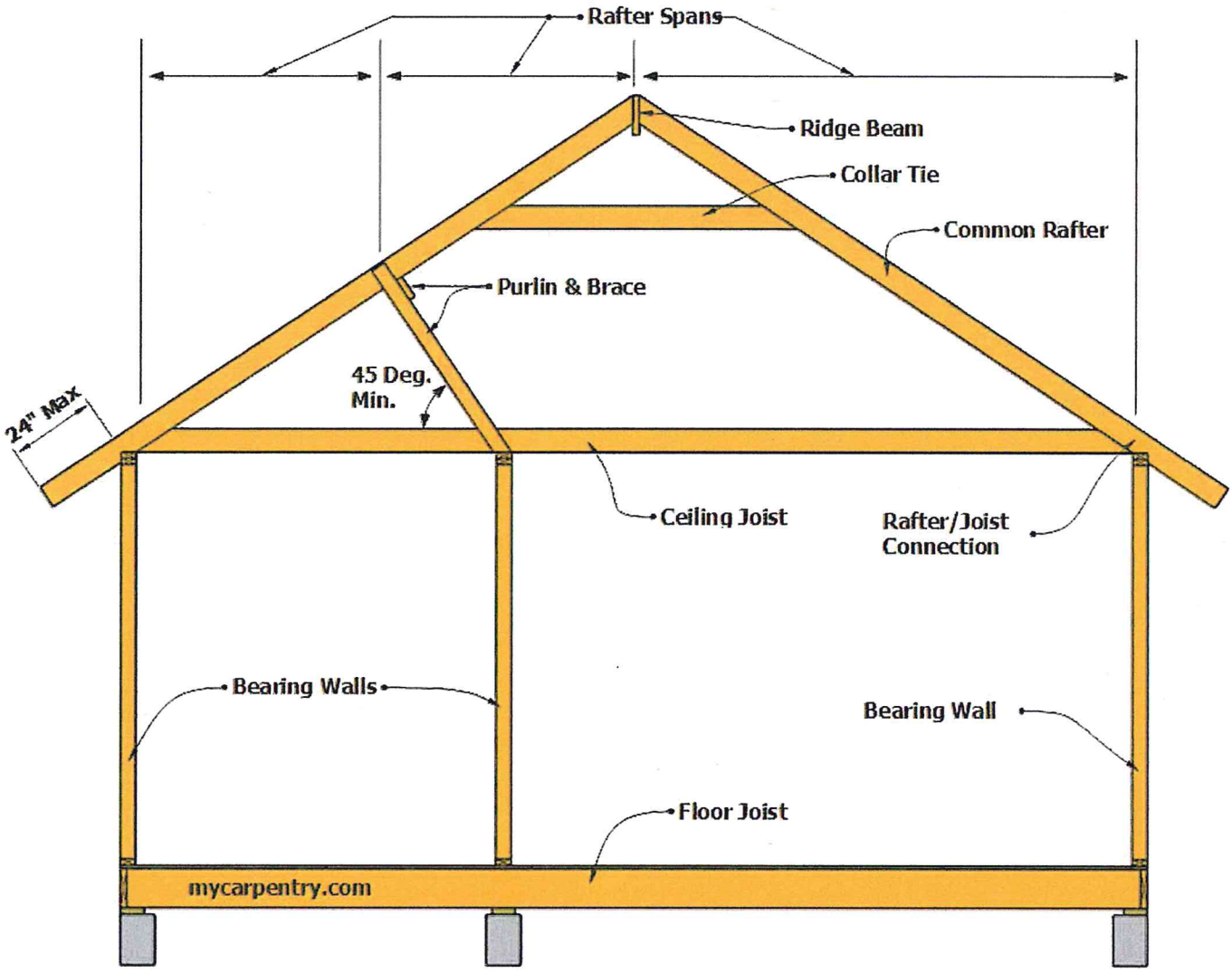
Wall Area	=	12,500 Sq. Ft.
Unit Face Size	=	8 x 16
12,500 x 1.125	=	14,063 Units

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)