Section 300

Prescriptive Requirements
Area Inland of Established Dividing Line

301 Foundations

The foundation is a critical element in the wind resistance of a structure. It must be capable of transferring all of the loads on a structure to the ground. Foundations shall either be built to meet the following prescriptive requirements, or shall be designed, inspected, and certified by a Texas licensed professional engineer. Engineered foundations shall be designed to resist either the wind loads of ASCE 7-93, or the simplified wind loads of **Section 103**. The foundation shall be designed so that the overturning moment of the structure due to the wind load does not exceed ⅔ of the dead load stabilizing moment of the structure.

The foundation requirements specified in this section are minimum requirements for wind resistance of the structure. Other design conditions, such as soil conditions and surface drainage are not within the scope of this building code and, as such, are not addressed by the prescriptive construction requirements.

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

301.1 Monolithic Slab on Grade Foundation

301.1.1 Minimum Foundation Requirements

- The slab shall be a minimum of 4 inches thick.
- An interior footing shall be placed beneath every loadbearing wall.
- The slab shall have either a minimum 6x6 inch No. 10 welded wire fabric (W.W.F.); # 3 rebar spaced on a maximum 16 inch grid; or an equivalent material, such as a synthetic fiber reinforcement, provided at the mid-height of the slab. The equivalent reinforcement shall be accepted for use by the Texas Department of Insurance.
- A brick ledge shall be provided if brick veneer or stone veneer is applied. The brick ledge shall have a minimum depth of 1½ inches. The width shall be wide enough to completely support the veneer and to provide a minimum of 1-inch space between the veneer and the vapor barrier or wall sheathing.
- The minimum size and reinforcement requirements for uplift resistance of grade beams supporting wood stud walls shall be as specified in Table 301.1.1A. A minimum of 3 inches of cover shall be provided around the reinforcement.
- Refer to Figures 301.1.1A-B for monolithic slab on grade foundation details for wood stud walls.
- The minimum size and reinforcement requirements for uplift resistance of grade beams supporting masonry walls shall be as specified in Table 301.1.1B. A minimum of 3 inches of cover shall be provided around the reinforcement.
- Refer to Figures 301.1.1C-D for monolithic slab on grade foundation details for masonry walls.

301.1.2 Wood Stud Wall Anchorage

- Anchor bolts shall be placed in all exterior grade beams and those interior grade beams supporting walls subjected to uplift loads.
- Anchor bolts shall be a minimum of ⅝ inches diameter and shall be embedded a minimum of 6 inches into the grade beam. See Figure 301.1.2.

Table 301.1.1A
Minimum Dimensions and Reinforcement Requirements for Grade Beams Supporting Wood Stud Walls

Location Of Grade Beam	Building Type	Grade Beam Height, H	Grade Beam Width, W	Minimum Reinforcement
Exterior Grade Beam	One Story	20"	10"	2 - #5
	Two Story	20"	10"	2 - #5
	Three Story	20"	16"	2 - #5
Interior Grade Beam	One Story	10"	10"	2 - #5
	Two Story	10"	10"	2 - #5
	Three Story	10"	16"	2 - #5

Table 301.1.1B
Minimum Dimensions and Reinforcement Requirements for Grade Beams Supporting Masonry Walls

Location Of Grade Beams	Building Type	Grade Beam Height, H	Grade Beam Width, W	Minimum Reinforcement
Exterior Grade Beam	One Story	18"	12"	2 - #5
	Two Story	18"	16"	2 - #5
Interior Grade Beam	One Story	10"	12"	2 - #5
	Two Story	10"	16"	2 - #5

- A 2x2x⅛-inch washer shall be provided for each anchor bolt in exterior walls and in interior walls subjected to uplift loads.
- Other types of anchors, such as powder-actuated fasteners, drilled epoxy anchors, and mudsill anchors are acceptable. The spacing for the alternative anchors shall be determined using the shear capacity and uplift load for ⅝ inch diameter anchor bolts. Each ⅝ inch diameter anchor bolt has a shear capacity of 1,500 lb. The uplift load on the ⅝ inch diameter anchor bolt, which varies depending on the building type and wall height, is specified in Tables 301.1.2B-D. The maximum spacing for the alternative anchors shall not exceed the spacing for the ⅝ inch diameter anchor bolts specified in Table 301.1.2A. The alternative anchoring product shall be evaluated by the Texas Department of Insurance for shear load and uplift load resistance.
- An anchor bolt shall be provided within 6 to 12 inches of the end of each sole plate.
- Where holddown connectors are required as specified in **Section 303.4.5**, anchor bolts may be omitted.
- Anchor bolt spacing shall be as specified in Table 301.1.2A.

Table 301.1.2A
Maximum Spacing of Anchor Bolts

Building Type	Anchor Bolt Spacing
One Story	4'-0"
Two Story	3'-0"
Three Story	3'-0"

Table 301.1.2B
Uplift Loads on Anchor Bolts - One-Story Buildings

Wall Height (ft)	Uplift Load (lbs.)
8	1,450
9	1,430
10	1,400

Table 301.1.2C
Uplift Loads on Anchor Bolts - Two-Story Buildings

Wall Height (ft)	Uplift Load (lbs.)
8	1,070
9	1,030
10	990

Table 301.1.2D
Uplift Loads on Anchor Bolts - Three-Story Buildings

Wall Height	Uplift Load (lbs.)
8	820
9	750
10	680

301.1.3 Masonry Wall Anchorage

- Minimum #5 rebar (also known as dowel bars) shall be provided for all required vertical wall reinforcement specified in **Section 304.3**.
- Dowel bars shall be the same size as vertical reinforcement.
- Footing dowel bars shall use a standard 90-degree hook. See Figure 301.1.3 for dimensions of a standard 90-degree hook.
- Dowel bars shall be embedded a minimum of 7 inches into the footing for #5 bars and 10 inches into the footing for #7 bars.
- Dowel bars shall lap vertical wall reinforcement a minimum of 25 inches for #5 bars and 35 inches for #7 bars. It is not a requirement that the dowel bars be tied to the vertical reinforcement.

301.2 Piling Foundation

Buildings on piles shall be limited to one- and two-story structures, not including the height of the piles above natural grade. The floor to ceiling height of each story shall not exceed 10 feet. Overall mean roof height shall not exceed 33 feet. The maximum building dimension shall not exceed 40 feet in length. The roof slope shall not exceed 4:12, and the overhangs shall not exceed 2 feet.

The design of a pile foundation is frequently determined by guidelines established for federal flood insurance. The homeowner or contractor should verify the base flood elevation before settling on a foundation design. This information should be available through local sources, such as the City, County, or Corps of Engineers. The Federal Emergency Management Agency (F.E.M.A.) should be contacted for further information regarding federal flood insurance.

There is one federal guideline which must be noted because it can affect windstorm insurance. Federal flood insurance rules require that the enclosed space below the base flood elevation shall be built with non-supporting breakaway walls which will collapse under wind and water loads without damaging the rest of the structure. Since these breakaway walls cannot be built to withstand the wind loads of the T.W.I.A. Building Code for Windstorm Resistant Construction or ASCE 7-93, breakaway walls and any contents enclosed by breakaway walls will not be insured by the T.W.I.A.

301.2.1 Pilings

- Piles shall be wood and shall be treated with a wood preservative in accordance with either AWPA C3 for piles or AWPA C24 for Sawn Timber Piles.
- The cross section of the pile shall be either round or square.
- Pilings may be driven, jetted, or augered.
- The pile shall be notched at the top only enough to provide a shelf for supporting the beam. The notch length shall be long enough so that all required bolts pass through both the beam and the pile. No more than ½ of the pile thickness shall be removed. The piles shall not be notched at any other location. See Figure 301.2.1.
- Maximum pile heights (above natural grade) shall be determined from Tables 301.2.1 A-C.

301.2.2 Pile Embedment

- Refer to Figure 301.2.2 for an illustration of the terms used in this section.
- Soil evaluation should be performed before determining the pile embedment required.
- Minimum embedment for pilings in either the A Zone or the V Zone shall comply with Tables 301.2.2A-B.
- Piles in the V Zone shall have a minimum embedment depth of 5 feet below mean sea level (msl) if the base flood elevation is 10 feet above msl or less.
- Piles in the V Zone shall have a minimum embedment depth of 10 feet below mean sea level (msl) if the base flood elevation is greater than 10 feet above msl.
- For structures located in the V Zone, the minimum embedment depths determined above shall be increased by 4 feet for the first row of structures from the water with pilings in sand to accommodate scour.
- For structures located in the V Zone, the minimum embedment depths determined above shall be increased by 2 feet for structures other than those in the first row from the water with pilings in sand to accommodate scour.

301.2.3 Beams

- Beams shall be framed into the tops of pilings. The beams shall consist of a minimum of two 2x12's with a minimum grade of No. 2 wood.
- Beams shall be pressure treated with a wood preservative.
- Beams shall be framed into the pilings using either the double beam method, as shown in Figure 301.2.3A, or the spaced beam method as shown in Figure 301.2.3B.
- Beams on piles shall span in the direction parallel to the flow of potential flood water and wave action.
- The loadbearing portion of the beams may not extend past the end pilings further than the depth of the beam. See Figure 301.2.1.
- Splices in beams shall occur over pilings.
- If the beams are connected to the piles using the double beam method, a ¼ inch thick corrosion resistant steel plate shall be used on the notched side of the pile as shown in Figure 301.2.1.
- Bolt spacing shall be measured from the center of the bolt. The spacing between bolts shall be a minimum of 2¼ inches and located a minimum of 3 inches from the beam ends and edges. Where a splice occurs, bolts shall be located a minimum of 2 inches from the beam ends and edges. Bolts through a ¼ inch steel plate shall be located a minimum of 1¼ inches from the edges of the plate. See Figure 301.2.3C.

- Beams shall be connected to the piles using the minimum number of bolts shown in Table 301.2.3. Bolts shall be a minimum ¾ inch in diameter. Washers shall be used under all bolt heads and nuts. All fasteners shall be corrosion resistant.

Table 301.2.3
Required Bolts for Beam to Piling Connection

Building Type	Spaced Beam Method		Double Beam Method	
	Connection with Splice	Connection without Splice	Connection with Splice	Connection without Splice
1 Story	2 bolts through each beam and pile (4 total)	4 bolts through beams and pile	2 bolts through each beam and pile and 2 bolts through plate and pile (6 total)	3 bolts through beams and pile and 1 bolt through plate and pile
2 Story	3 bolts through each beam and pile (6 total)	6 bolts through beams and pile	2 bolts through each beam and pile and 2 bolts through plate and pile (6 total)	4 bolts through beams and pile and 2 bolts through plate and pile

301.2.4 Pile Bracing

- Knee braces shall be provided when determining the maximum braced height of pilings from Tables 301.2.1A-C. See Figures 301.2.3A-B. Knee braces are not required when determining the maximum unbraced height of pilings from Tables 301.2.1 A-C.

- Knee braces shall be pressure treated with a wood preservative, or wood of a natural decay resistance, and shall have a minimum grade of No. 2.

- Knee braces shall extend at a 45-degree angle from the beam or floor joist down to a point on the piling which is ¼ the height of the piling down from the top of the beam.

- Knee braces shall run from the piling to the beam (one on each available side) and from the piling to the floor joist (one on each available side).

- Knee braces up to 5 feet in length shall have minimum nominal dimensions of either 2x8 or 4x4.

- Knee braces over 5 feet in length shall have a minimum nominal dimension of 4x4.

- Knee braces with a minimum nominal dimension of 4x4 shall be framed directly into the piling. See Figure 301.2.3B. Braces shall be attached to the piling with either a minimum ⅝ inch by 10 inch lag bolt with a minimum embedment into the piling of 5 inches or a ⅝ inch through bolt. The bolt shall pass through at least 3 ½ inches of the knee brace and the area under the washer shall be beveled or counter bored so that the entire washer rests flat on the wood surface. Braces shall be bolted to the beams or floor joists with a minimum of two ⅝ inch through bolts. Any space between spaced beams and the braces shall be filled with block spacers.

- Knee braces with a minimum nominal dimension of 2x8 may be used with either the spaced beam method or the double beam method. See Figure 301.2.3A. Braces shall be bolted to the side of the piling with a minimum of two $\frac{5}{8}$ inch through bolts or two $\frac{5}{8}$ inch by 5 inch lag bolts. Braces shall be attached to spaced beams, double beams, or floor joists with a minimum of two $\frac{5}{8}$ inch through bolts.

301.2.5 Floor Joists

- Size, spacing, and maximum span of floor joists shall be in accordance with **Section 302.1**.
- Floor joists shall be fastened to beams in accordance with Appendix I.
- If the floor joists frame directly into the beams, then either a joist hanger or minimum 2x2 inch ledger strip shall be provided. See Figure 301.2.5A. If a ledger strip is used, then the joists shall be fastened to the beam in accordance with Appendix I. The required number of fasteners for the ledger strip shall be located below each floor joist and spaced as specified in Appendix I.
- If uplift loads are transferred from the wall to the floor or band joist, the floor or band joist shall be anchored to the beam against uplift. Otherwise, the uplift loads from the wall shall be transferred directly to the beam. If the floor joists are set on top of the beams, they shall be anchored to the beams with either an approved framing anchor, as shown in Figure 301.2.5B, capable of carrying the anchorage specified in **Section 303.2** or a wood block. If a wood block is used as shown in Figure 301.2.3B, then the block shall be anchored to the joist and to the beam in accordance with Appendix I.
- If the floor joists frame together to form a lap connection over a beam, then the lap shall be fastened together in accordance with Appendix I. The floor joist connection shall be anchored against uplift with either an approved framing anchor, as shown in Figure 301.2.5C, capable of resisting the uplift loads specified in **Section 303.2**, or a wood block fastened in accordance with Appendix I.

301.2.6 Holddown Connectors

A holddown connector shall be installed in accordance with **Section 303.4.5**. The holddown connector shall be anchored to the beam as shown in Figure 301.2.6.

Table 301.2.1A
Maximum Unbraced and Braced Piling Heights
Square Piles In Sand or Clay

Building Type	Building Dimension	Pile Spacing	Max. Unbraced Height (ft.)		Max. Braced Height (ft.)	
			8 x 8	10 x 10	8 x 8	10 x 10
One Story	20'	10'-0"	6	9	10	13
	22'	11'-0"	6	9	10	13
	24'	12'-0"	6	8	10	12
	24'	8'-0"	7	9	11	13
	26'	8'-8"	7	9	11	13
	28'	9'-4"	7	9	11	13
	30'	10'-0"	6	9	10	13
	32'	10'-8"	6	9	10	13
	32'	8'-0"	7	10	11	14
	34'	11'-4"	6	9	10	13
	34'	8'-6"	7	9	11	13
	36'	12'-0"	6	8	10	12
	36'	9'-0"	7	9	11	13
	38'	9'-6"	7	9	11	13
	40'	10'-0"	7	9	11	13
	40'	8'-0"	7	10	11	14
Two Story	20'	10'-0"	4	7	8	11
	22'	11'-0"	4	7	8	11
	24'	12'-0"	4	6	8	10
	24'	8'-0"	5	8	9	12
	26'	8'-8"	5	8	9	12
	28'	9'-4"	5	8	9	12
	30'	10'-0"	5	7	9	11
	32'	10'-8"	5	7	9	11
	32'	8'-0"	6	8	10	12
	34'	11'-4"	4	7	8	11
	34'	8'-6"	6	8	10	12
	36'	12'-0"	4	7	8	11
	36'	9'-0"	5	8	9	12
	38'	9'-6"	5	8	9	12
	40'	10'-0"	5	8	9	12
	40'	8'-0"	6	9	10	13

Notes: 1. "Building Dimension" is the length or width of the building segment being designed. The design shall satisfy the smaller unbraced or braced height required by the building width or length.
2. "Maximum Unbraced Height" is the greatest distance above natural grade for a pile without knee braces.
3. "Maximum Braced Height" is the greatest distance above natural grade for a pile with knee braces.

Table 301.2.1B
Maximum Unbraced and Braced Piling Heights
8" Round Piles In Sand

Building Type	Building Dimension	Pile Spacing	Max. Unbraced Height (ft.)		Max. Braced Height (ft.)	
			Dense Sand	Loose Sand	Dense Sand	Loose Sand
One Story	20'	10'-0"	8	9	12	13
	22'	11'-0"	8	9	12	13
	24'	12'-0"	8	9	12	13
	24'	8'-0"	8	10	12	14
	26'	8'-8"	8	10	12	14
	28'	9'-4"	8	10	12	14
	30'	10'-0"	8	10	12	14
	32'	10'-8"	8	10	12	14
	32'	8'-0"	9	10	13	14
	34'	11'-4"	8	10	12	14
	34'	8'-6"	9	10	13	14
	36'	12'-0"	8	10	12	14
	36'	9'-0"	9	10	13	14
	38'	9'-6"	9	10	13	14
	40'	10'-0"	9	10	13	14
	40'	8'-0"	9	10	13	14
Two Story	20'	10'-0"	6	8	10	12
	22'	11'-0"	6	8	10	12
	24'	12'-0"	6	8	10	12
	24'	8'-0"	7	9	11	13
	26'	8'-8"	7	9	11	13
	28'	9'-4"	7	9	11	13
	30'	10'-0"	7	9	11	13
	32'	10'-8"	7	9	11	13
	32'	8'-0"	7	9	11	13
	34'	11'-4"	7	9	11	13
	34'	8'-6"	7	9	11	13
	36'	12'-0"	7	9	11	13
	36'	9'-0"	7	9	11	13
	38'	9'-6"	7	9	11	13
	40'	10'-0"	7	9	11	13
	40'	8'-0"	8	10	12	14

Notes: 1. "Building Dimension" is the length or width of the building segment being designed. The design shall satisfy the smaller unbraced or braced height required by the building width or length.
2. "Maximum Unbraced Height" is the greatest distance above natural grade for a pile without knee braces.
3. "Maximum Braced Height" is the greatest distance above natural grade for a pile with knee braces.

Table 301.2.1C
Maximum Unbraced and Braced Piling Heights
8" Round Piles In Clay

Building Type	Building Dimension	Pile Spacing	Max. Unbraced Height (ft.)		Max. Braced Height (ft.)	
			Stiff Clay	Soft Clay	Stiff Clay	Soft Clay
One Story	20'	10'-0"	7	8	11	12
	22'	11'-0"	7	8	11	12
	24'	12'-0"	7	8	11	12
	24'	8'-0"	8	8	12	12
	26'	8'-8"	8	8	12	12
	28'	9'-4"	8	8	12	12
	30'	10'-0"	8	8	12	12
	32'	10'-8"	7	8	11	12
	32'	8'-0"	9	9	13	13
	34'	11'-4"	7	8	11	12
	34'	8'-6"	8	9	12	13
	36'	12'-0"	7	9	11	13
	36'	9'-0"	8	9	12	13
	38'	9'-6"	8	9	12	13
	40'	10'-0"	8	9	12	13
	40'	8'-0"	9	9	13	13
Two Story	20'	10'-0"	5	6	9	10
	22'	11'-0"	5	6	9	10
	24'	12'-0"	5	6	9	10
	24'	8'-0"	7	7	11	11
	26'	8'-8"	6	7	10	11
	28'	9'-4"	6	7	10	11
	30'	10'-0"	6	7	10	11
	32'	10'-8"	6	7	10	11
	32'	8'-0"	7	8	11	12
	34'	11'-4"	6	7	10	11
	34'	8'-6"	7	8	11	12
	36'	12'-0"	6	8	10	12
	36'	9'-0"	7	7	11	11
	38'	9'-6"	7	8	11	12
	40'	10'-0"	6	8	10	12
	40'	8'-0"	7	8	11	12

Notes: 1. "Building Dimension" is the length or width of the building segment being designed. The design shall satisfy the smaller unbraced or braced height required by the building width or length.
2. "Maximum Unbraced Height" is the greatest distance above natural grade for a pile without knee braces.
3. "Maximum Braced Height" is the greatest distance above natural grade for a pile with knee braces.

Table 301.2.2A
Minimum Depth of Embedment Below Natural Grade (ft.)
Wood Pilings In Sand

Building Type	Building Dimension	Pile Spacing	Medium Dense Sand			Loose Sand		
			8 x 8	10 x 10	8" Dia.	8 x 8	10 x 10	8" Dia.
One Story	20'	10'-0"	10	10	12	19	15	22
	22'	11'-0"	11	10	13	22	17	24
	24'	12'-0"	13	10	15	24	19	27
	24'	8'-0"	10	10	10	16	12	19
	26'	8'-8"	10	10	11	18	14	21
	28'	9'-4"	10	10	12	20	15	22
	30'	10'-0"	11	10	13	22	17	24
	32'	10'-8"	12	10	15	24	18	26
	32'	8'-0"	10	10	10	17	13	20
	34'	11'-4"	14	10	16	25	20	28
	34'	8'-6"	10	10	11	19	14	21
	36'	12'-0"	15	11	17	27	22	30
	36'	9'-0"	11	10	12	20	16	23
	38'	9'-6"	11	10	13	22	17	24
	40'	10'-0"	12	10	14	23	18	26
	40'	8'-0"	10	10	11	18	14	21
Two Story	20'	10'-0"	12	10	15	24	18	26
	22'	11'-0"	14	11	17	27	21	29
	24'	12'-0"	16	12	19	30	24	32
	24'	8'-0"	10	10	12	20	15	23
	26'	8'-8"	12	10	14	22	17	25
	28'	9'-4"	13	10	15	25	19	27
	30'	10'-0"	14	11	17	27	21	29
	32'	10'-8"	16	12	18	29	23	32
	32'	8'-0"	11	10	13	22	17	24
	34'	11'-4"	17	13	20	31	25	34
	34'	8'-6"	12	10	14	23	18	26
	36'	12'-0"	18	14	21	34	27	36
	36'	9'-0"	12	10	14	23	18	26
	38'	9'-6"	14	11	17	27	21	30
	40'	10'-0"	16	12	18	29	23	31
	40'	8'-0"	12	10	14	23	18	25

Note: "Building Dimension" is the length or width of the building segment being designed. The design shall satisfy the more demanding depth of embedment required by the building width or length.

Table 301.2.2B
Minimum Depth of Embedment Below Natural Grade (ft.)
Wood Pilings In Clay

Building Type	Building Dimension	Pile Spacing	Medium Stiff Clay			Soft Clay		
			8 x 8	10 x 10	8" Dia.	8 x 8	10 x 10	8" Dia.
One Story	20'	10'-0"	10	10	10	13	10	12
	22'	11'-0"	10	10	10	16	12	14
	24'	12'-0"	10	10	10	19	15	17
	24'	8'-0"	10	10	10	10	10	10
	26'	8'-8"	10	10	10	12	10	11
	28'	9'-4"	10	10	10	14	11	13
	30'	10'-0"	10	10	10	16	12	14
	32'	10'-8"	10	10	10	19	14	16
	32'	8'-0"	10	10	10	11	10	11
	34'	11'-4"	11	10	10	21	16	18
	34'	8'-6"	10	10	10	13	10	12
	36'	12'-0"	12	10	11	24	18	20
	36'	9'-0"	10	10	10	15	11	13
	38'	9'-6"	10	10	10	16	12	14
	40'	10'-0"	10	10	10	18	14	16
	40'	8'-0"	10	10	10	12	10	11
Two Story	20'	10'-0"	10	10	10	19	14	16
	22'	11'-0"	12	10	11	23	17	19
	24'	12'-0"	14	11	13	17	21	22
	24'	8'-0"	10	10	10	14	11	13
	26'	8'-8"	10	10	10	17	13	15
	28'	9'-4"	10	10	10	20	15	17
	30'	10'-0"	12	10	11	23	18	19
	32'	10'-8"	14	10	12	26	20	22
	32'	8'-0"	10	10	10	16	12	14
	34'	11'-4"	16	12	14	29	23	24
	34'	8'-6"	10	10	10	18	14	16
	36'	12'-0"	18	13	15	33	26	27
	36'	9'-0"	10	10	10	18	14	16
	38'	9'-6"	12	10	11	23	18	20
	40'	10'-0"	14	10	12	25	20	21
	40'	8'-0"	10	10	10	17	13	15

Note: "Building Dimension" is the length or width of the building segment being designed. The design shall satisfy the more demanding depth of embedment required by the building width or length.

301.3 Pier and Beam Foundation

The following guidelines shall apply to one- and two-story structures.

- A pier and beam foundation shall not be used in areas denoted as V Zones by the National Flood Insurance Program.
- The footings of the foundation shall be constructed of concrete. The piers shall be constructed of either concrete or hollow masonry units filled with grout.
- The minimum required dimensions and reinforcement for the footings and for the piers shall be as specified in Table 301.3A. For reinforcement in the footings, the term 'both ways' shall mean two-#5's shall be placed perpendicular to each other as shown in Figure 301.3A.
- The piers shall be spaced a maximum of 8 feet on center in all directions.
- The bottom of each footing pad shall be buried a minimum of 12 inches below natural grade. The maximum height of the piers above natural grade shall be 3 feet. The minimum height of the piers above natural grade shall be 12 inches.
- The piers shall be tied to the footings by extending the reinforcement for the piers into the footings as shown in Figure 301.3A. A standard 90-degree hook shall be provided in the footing of the pier as shown in Figure 301.3A.
- Beams shall be framed into the top of the piers. Beams shall be selected from Table 301.3B. Beams shall be minimum No. 2 grade Southern Pine lumber.
- The beams shall be pressure treated with a wood preservative.
- Beams shall be fastened to piers with either metal column base plates, metal framing connectors or metal anchors that are designed to be embedded into the pier. The metal base plate, framing connector or metal anchor shall have a minimum uplift anchorage capacity of 1,000 pounds. The metal base plate, metal anchor or framing connector shall be installed in accordance with the manufacturer's recommended installation instructions.
- At building corners, beams shall be fastened together with six fasteners. The fasteners shall be smooth shank nails with a minimum 0.120 inch diameter. The fasteners shall be long enough to penetrate a minimum of 1 ½ inches into the supporting member. See Figure 301.3C.
- Splices in beams shall occur over piers.
- Notching or boring of beams is not permitted.
- If it is not possible to anchor the beams to the piers, the following procedure shall be used. Place either a corrosion-resistant 2x2x¼-inch length of angle iron, or a 4x4 inch treated wood post into a 3 foot deep by 1 foot diameter hole. If the angle iron is used, make a 90 degree bend in the end placed into the hole. If the 4x4 wood post is used, place a dowel in the end placed into the hole. Fill the hole to the top with concrete. The angle iron or wood post shall be fastened to the beam with a minimum of two ½-inch diameter bolts. This anchor system shall be spaced a maximum of 6 feet on center. See Figure 301.3B for an illustration of this anchor system.

- A holddown connector shall be installed in accordance with **Section 303.4.5**. The holddown anchorage shall be continuous from the pier to the corner wall studs.
- The holddown anchorage shall be provided between the beam and the corner wall studs by using holddown connectors or metal framing connectors. The metal framing connectors or holddown connector shall have sufficient capacity to transfer the required holddown anchorage specified in Table 303.4.5A from the corner wall studs to the beam. See Figures 301.3C and 301.2.6.
- At building corners, the beam must be anchored to the pier to resist the required holddown anchorage from Table 303.4.5A in addition to the required 1,000 pounds for uplift.
- Size, spacing, and maximum span of floor joists shall be in accordance with **Section 302.1**.
- If the bottom of the floor joists are located closer than 18 inches to the exposed ground, then the floor joists shall be pressure treated with a wood preservative.
- Floor joists shall be fastened to beams in accordance with Appendix I.
- If the floor joists frame directly into the beams, then either a joist hanger or minimum 2x2 inch ledger strip shall be provided. See Figure 301.2.5A. If a ledger strip is used, then the joists shall fastened to the beam in accordance with Appendix I. The ledger strip shall be fastened to the beam in accordance with Appendix I. The required number of fasteners for the ledger strip shall be located below each floor joist and spaced as specified in Appendix I.
- If uplift loads are transferred from the wall to the floor or band joist, the floor or band joist shall be anchored to the beam against uplift. Otherwise, the uplift loads from the wall shall be transferred directly to the beam. If the floor joists are set on top of the beams, they shall be anchored to the beams with either an approved framing anchor, as shown in Figure 301.2.5B, capable of carrying the anchorage specified in **Section 303.2** or a wood block. If a wood block is used as shown in Figure 301.2.3B, then the block shall be anchored to the joist and to the beam in accordance with Appendix I.
- If the floor joists frame together to form a lap connection over a beam, then the lap shall be fastened together in accordance with Appendix I. The floor joist connection shall be anchored against uplift with either an approved framing anchor capable of resisting the uplift loads specified in **Section 303.2** or a wood block fastened in accordance with Appendix I.

Table 301.3A
Minimum Dimensions and Reinforcement for Footings and Piers

	Footing		Pier		Reinforcement	
	Width W x W	Thickness T	Height* (Max.)	Width (Min.)	Footing (Both ways)	Pier
One Story						
Exterior	30" x 30"	9"	3'-0"	8" x 8"	2-#5	2-#5
Interior	20" x 20"	9"	3'-0"	8" x 8"	2-#5	2-#5
Two Story						
Exterior	36" x 36"	9"	3'-0"	8" x 8"	2-#5	2-#5
Interior	24" x 24"	9"	3'-0"	8" x 8"	2-#5	2-#5

Notes: 1. '*' indicates the maximum height of the pier above finished grade.
2. Maximum spacing of footings shall be 8 feet both ways.

Table 301.3B
Maximum Allowable Beam Spans
Southern Pine No. 2 Lumber

Beams Supporting	Beam Size	Maximum Roof / Floor Span (ft)						
		20	24	28	32	36	40	44
One-Story Building	2-2x6	5'-6"	5'-3"	5'-0"	4'-10"	4'-8"	4'-6"	4'-4"
	2-2x8	7'-2"	6'-9"	6'-6"	6'-3"	6'-0"	5'-9"	5'-7"
	2-2x10	8'-0"	8'-0"	7'-9"	7'-5"	7'-2"	6'-11"	6'-8"
	2-2x12	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	7'-10"
	3-2x6	6'-9"	6'-5"	6'-2"	5'-11"	5'-8"	5'-6"	5'-3"
	3-2x8	8'-0"	8'-0"	7'-11"	7'-7"	7'-4"	7'-1"	6'-10"
	3-2x10	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"
	3-2x12	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"	8'-0"
Two-Story Building	2-2x8	5'-8"	5'-5"	5'-3"	5'-0"	4'-10"	4'-8"	4'-6"
	2-2x10	5'-11"	5'-7"	5'-4"	5'-1"	4'-10"	4'-8"	4'-6"
	2-2x12	7'-0"	6'-7"	6'-3"	6'-0"	5'-9"	5'-6"	5'-4"
	3-2x8	7'-0"	6'-8"	6'-5"	6'-2"	5'-11"	5'-9"	5'-6"
	3-2x10	8'-0"	6'-11"	6'-6"	6'-3"	6'-0"	5'-9"	5'-6"
	3-2x12	8'-0"	8'-0"	7'-8"	7'-4"	7'-0"	6'-9"	6'-6"

301.4 Post Tension Slab Foundation

Post tension slab foundations shall be designed, inspected, and certified by a Texas licensed professional engineer per **Section 107**.

302 Floor Framing

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4.**

302.1 Floor Joist Systems

302.1.1 Floor Joists

- Floor joists shall have a maximum span in accordance with Tables 302.1.1A-B.
- Floor joists shall have a maximum spacing of 24 inches on center.
- Floor joists shall bear directly on loadbearing walls, or shall be supported by joist hangers.
- If the floor joists bear directly on loadbearing walls, then the end of each floor joist shall have a minimum of 1½ inches bearing on wood or a minimum of 3 inches bearing on masonry.
- Floor joists shall be fastened to the beams or top plates in accordance with Appendix I.
- Exposed floor joists, located closer than 18 inches to the exposed ground, shall be pressure treated with a wood preservative.
- Notches on the ends of floor joists shall not exceed ¼ the joist depth. Bored holes shall not be within 2 inches of the top or bottom of the joist and the diameter of the hole shall not exceed ⅓ the depth. Notches in the top or bottom of the joist shall not exceed ⅙ the depth and shall not be located in the middle ⅓ of the joist span.
- Loadbearing walls parallel to floor joists shall be directly supported by beams, girders, or other loadbearing walls.
- Loadbearing walls perpendicular to floor joists shall not be offset from supporting beams, girders, or other loadbearing walls by more than the depth of the floor joists.
- If non-loadbearing walls are parallel to the floor joists, then the floor joist supporting the non-loadbearing wall shall be doubled.

302.1.2 Cantilevered Floor Joists

- The overhang length of cantilevered floor joists supporting a loadbearing wall at the end of the cantilever shall be limited to the depth of the floor joists.
- The overhang length of cantilevered floor joists supporting a non-loadbearing wall at the end of the cantilever shall not exceed one-fourth of the floor joist span.

Table 302.1.1A
Maximum Spans for Floor Joists

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	10'-11"	10'-9"	8'-11"	10'-11"	10'-9"	8'-3"
	16"	9'-11"	9'-9"	7'-8"	9'-11"	9'-6"	7'-2"
	19.2"	9'-4"	9'-1"	7'-0"	9'-3"	8'-8"	6'-7"
	24"	8'-8"	8'-1"	6'-3"	8'-3"	7'-9"	5'-10"
2 x 8	12"	14'-5"	14'-2"	11'-4"	14'-10"	13'-10"	10'-6"
	16"	13'-1"	12'-10"	9'-10"	12'-10"	12'-0"	9'-1"
	19.2"	12'-4"	11'-9"	8'-11"	11'-9"	11'-0"	8'-3"
	24"	11'-5"	10'-6"	8'-0"	10'-6"	9'-10"	7'-5"
2 x 10	12"	18'-4"	17'-8"	13'-5"	18'-1"	16'-11"	12'-10"
	16"	16'-9"	15'-4"	11'-7"	15'-8"	14'-8"	11'-1"
	19.2"	15'-7"	14'-0"	10'-7"	14'-4"	13'-5"	10'-1"
	24"	13'-11"	12'-6"	9'-5"	12'-10"	12'-0"	9'-1"
2 x 12	12"	22'-5"	20'-9"	15'-11"	21'-0"	19'-8"	14'-10"
	16"	20'-4"	18'-0"	13'-9"	18'-2"	17'-0"	12'-10"
	19.2"	18'-7"	16'-5"	12'-7"	16'-7"	15'-6"	11'-9"
	24"	16'-7"	14'-8"	11'-3"	14'-10"	13'-11"	10'-6"

Table 302.1.1B
Maximum Spans for Floor Joists

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	10'-6"	10'-0"	8'-3"	10'-3"	10'-3"	8'-3"
	16"	9'-6"	9'-1"	7'-2"	9'-4"	9'-4"	7'-2"
	19.2"	9'-0"	8'-6"	6'-7"	8'-8"	8'-8"	6'-7"
	24"	8'-1"	7'-8"	5'-10"	7'-9"	7'-9"	5'-10"
2 x 8	12"	13'-10"	13'-2"	10'-6"	13'-6"	13'-6"	10'-6"
	16"	12'-6"	11'-10"	9'-1"	12'-0"	12'-0"	9'-1"
	19.2"	11'-5"	10'-10"	8'-3"	11'-0"	11'-0"	8'-3"
	24"	10'-3"	9'-8"	7'-5"	9'-10"	9'-10"	7'-5"
2 x 10	12"	17'-8"	16'-8"	12'-10"	16'-11"	16'-11"	12'-10"
	16"	15'-3"	14'-6"	11'-1"	14'-8"	14'-8"	11'-1"
	19.2"	13'-11"	13'-2"	10'-1"	13'-5"	13'-5"	10'-1"
	24"	12'-6"	11'-10"	9'-1"	12'-0"	12'-0"	9'-1"
2 x 12	12"	20'-6"	19'-4"	14'-10"	19'-8"	19'-8"	14'-10"
	16"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
	19.2"	16'-2"	15'-4"	11'-9"	15'-6"	15'-6"	11'-9"
	24"	14'-6"	13'-8"	10'-6"	13'-11"	13'-11"	10'-6"

302.2 Wood I-Joist Systems

302.2.1 Wood I-Joists

- Single or continuous span wood I-joists shall be installed according to their manufacturer's code evaluation reports or installation literature. This shall include maximum span lengths for simple and continuous spans, nailing attachment to bearing plates, and web stiffener attachments. All rim material shall have equivalent dimensional stability as the I-joist and shall have the required stiffness to transfer all required lateral loads from the floor or roof diaphragm to the supporting structure below.
- Wood I-joists shall be fastened to the beams or top plates in accordance with Appendix I.
- Loadbearing walls parallel to wood I-joists shall be directly supported by beams, girders, or other loadbearing walls.
- Loadbearing walls perpendicular to I-joists shall not be offset from supporting beams, girders, or other loadbearing walls unless they are designed to carry the additional gravity load.
- If non-loadbearing walls are parallel to the I-joists, then the I-joist supporting the non-loadbearing wall shall be designed to carry the weight of the wall.

302.2.2 Cantilevered Wood I-Joists

- Cantilever I-joists supporting loadbearing walls shall not be permitted unless the I-joists are designed to carry the cantilevered floor load and the gravity load of the loadbearing wall at the end of the cantilever.
- Cantilever I-joists supporting non-loadbearing walls shall not be permitted unless the I-joists are designed to carry the cantilevered floor load and the weight of the non-loadbearing wall at the end of the cantilever.

302.3 Floor Deck

- Floor sheathing shall consist of wood structural panels.
- Floor sheathing shall have a minimum thickness of $^{19}/_{32}$ inch.
- Floor sheathing shall be fastened to the floor framing with minimum 10d common nails spaced 6 inches on center along panel edges and 12 inches on center along intermediate framing. As an alternative, either minimum 8d common nails or equivalent fasteners as specified in Appendix I may be used if the fasteners are spaced 4 inches on center along panel edges and 12 inches on center along intermediate framing.

303 Wood Stud Wall Framing

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

303.1 Wall Framing

303.1.1 Wood Stud Walls

303.1.1.1 Exterior Wood Stud Walls

- Exterior wall studs and plates shall be either Southern Yellow Pine, Douglas Fir-Larch, Hem-Fir, or Spruce-Pine-Fir lumber.
- Sole plates for all exterior walls shall be pressure treated with a wood preservative.
- Bottom plates shall be minimum Standard grade lumber.
- Sole and bottom plates for all exterior walls shall not be less than 2 inch nominal thickness and not less than the width of the wall studs.
- Bottom plates shall be nailed to band joists in accordance with Appendix I.
- Loadbearing studs (studs that carry vertical loads in addition to their own weight) shall be minimum Stud or No. 3 grade lumber and shall not exceed 10 feet in length.
- Non-loadbearing wall studs 10 feet in length or less shall be minimum Stud or No. 3 grade lumber.
- Non-loadbearing wall studs greater than 10 feet in length shall be sized and spaced in accordance with Table 303.1.1.1.
- Exterior wall stud spacing shall not exceed 16 inches on center for 2x4 lumber and 24 inches on center for 2x6 lumber.
- Exterior wall studs shall be 2x6 lumber or larger for the bottom story of three story buildings.
- Studs shall be placed with the wide face perpendicular to the wall.
- Exterior wall studs shall be continuous between horizontal supports.
- Notches in exterior wall studs shall be limited to 25% of the actual stud depth. See Figure 303.1.1.1
- Bored holes in exterior wall studs shall be limited to 40% of the actual stud depth. See Figure 303.1.1.1.
- The edge of a bored hole shall be a minimum of $\frac{5}{8}$ inch from the edge of the stud. See Figure 303.1.1.1.
- Notches and bored holes shall not occur in the same cross section.
- Bored holes in double studs of exterior walls shall be limited to 60% of the actual stud depth. See Figure 303.1.1.1.

Table 303.1.1.1
Minimum Required Grade of Lumber for Exterior Non-Loadbearing Stud Walls

			Southern Pine		Douglas Fir-Larch Hem-Fir Spruce-Pine-Fir	
Building Type	Length	Spacing	2 x 4	2 x 6	2 x 4	2 x 6
One-Story (Slab-on-grade; Piers)	12'	12"	No. 2	Stud	No. 2	Stud
		16"	No. 2	Stud	No. 2	Stud
		24"	-	Stud	-	No. 2
	14'	12"	No. 2	Stud	No. 1	Stud
		16"	No. 1	Stud	-	No. 2
		24"	-	No. 2	-	No. 1
	16'	12"	No. 1	Stud	-	No. 2
		16"	-	No. 2	-	No. 2
		24"	-	No. 1	-	No. 1
	18'	12"	-	No. 2	-	No. 2
		16"	-	No. 1	-	No. 1
		24"	-	-	-	-
	20'	12"	-	No. 2	-	No. 1
		16"	-	No. 1	-	-
		24"	-	-	-	-
Two-Story (Slab-on-grade; Piers) Or One-Story (Pile Foundation)	12'	12"	No. 2	Stud	No. 2	Stud
		16"	No. 2	Stud	No. 1	Stud
		24"	-	No. 2	-	No. 2
	14'	12"	No. 1	Stud	No. 1	Stud
		16"	-	No. 2	-	No. 2
		24"		No. 1		No. 1
	16'	12"	-	No. 2	-	No. 2
		16"	-	No. 2	-	No. 2
		24"	-	-	-	-
	18'	12"	-	No. 2	-	No. 2
		16"	-	No. 1	-	-
		24"	-	-	-	-
	20'	12"	-	No. 1	-	-
		16"	-	-	-	-
		24"	-	-	-	-
Three-Story (Slab-on-grade) Or Two-Story (Pile Foundation)	12'	12"	No. 2	Stud	No. 2	Stud
		16"	No. 2	Stud	No. 1	Stud
		24"	-	No. 2	-	No. 2
	14'	12"	No. 2	Stud	-	Stud
		16"	-	No. 2	-	No. 2
		24"	-	No. 1	-	No. 1
	16'	12"	-	No. 2	-	No. 2
		16"	-	No. 2	-	No. 2
		24"	-	-	-	-
	18'	12"	-	No. 2	-	No. 2
		16"	-	No. 1	-	-
		24"	-	-	-	-

Note: No. 3 grade wall studs can be used when table specifies Stud grade.

303.1.1.2 Interior Wood Stud Walls

- Interior wall studs and plates shall be either Southern Yellow Pine, Douglas Fir-Larch, Hem-Fir, or Spruce-Pine-Fir lumber.
- Sole plates for all interior walls shall be pressure treated with a wood preservative.
- Sole and bottom plates for all interior walls shall not be less than 2 inch nominal thickness and not less than the width of the wall studs.
- Bottom plates shall be nailed to the floor joists in accordance with Appendix I.
- Interior loadbearing wall studs and bottom plates supporting loadbearing walls shall be at least Standard grade lumber. The wall studs shall be spaced a maximum of 16 inches on center if 2x4 lumber is used and a maximum of 24 inches on center if 2x6 lumber is used.
- Interior non-loadbearing wall studs and bottom plates supporting non-loadbearing walls shall be at least Utility grade 2x4 lumber and shall be spaced a maximum of 24 inches on center.
- Interior loadbearing wall studs shall be continuous between horizontal supports.
- Notches in interior loadbearing wall studs shall be limited to 25% of the actual stud depth. Notches in interior non-loadbearing wall studs shall be limited to 40% of the actual stud depth. See Figure 303.1.1.1.
- Bored holes in interior loadbearing wall studs shall be limited to 40% of the actual stud depth. Bored holes in interior non-loadbearing wall studs shall be limited to 60% of the actual stud depth. See Figure 303.1.1.1.
- The edge of a bored hole shall be a minimum of $\frac{5}{8}$ inch from the edge of the stud. See Figure 303.1.1.1.
- Notches and bored holes shall not occur in the same cross section.
- Bored holes in double studs of interior loadbearing walls shall be limited to 60% of the actual stud depth. See Figure 303.1.1.1.

303.1.2 Gable Endwall Framing

The gable endwall shall be framed using either balloon framing in accordance with **Section 303.1.2.1** or platform framing in accordance with **Section 303.1.2.2**.

303.1.2.1 Balloon Framed Gable Endwall

- Balloon framing (wall framing which extends continuously from the sole or bottom plate to the roof line) should be used for all gable endwalls.
- Balloon framing shall be used on gable endwalls which support rooms with non-flat ceilings such as cathedral, vaulted, or coffer ceilings.
- Wall studs for balloon framing shall comply with the stud selection charts shown in Table 303.1.1.1. The length of the stud shall be the distance from the sole plate to the roof line.

- If the gable endwall overhang is framed using outlookers, then a dropped gable endwall shall be constructed as shown in Figure 303.1.2.1A. Corner framing for dropped gable endwall shall be constructed as shown in Figure 303.1.2.1B. Blocking shall be located between the corner stud pack and the first gable end wall stud. A single minimum 20 gauge, 1 ¼ inch wide galvanized steel strap shall wrap around the corner. Each end of the strap shall be fastened to the framing with five (5) fasteners with a minimum shank diameter of 0.131 inches and a minimum length of 1 ½ inches. The end of the double top plate shall be fastened to the blocking with either two (2) 16d common wire nails or three (3) fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.

- If the gable endwall overhang is constructed using a laddered soffit (lookout blocks), then a full-height gable endwall shall be constructed as shown in Figure 303.1.2.1C. Corner framing for the full-height gable endwall shall be constructed as shown in Figure 303.1.2.1D. Blocking shall be located between the corner stud pack and the first gable end wall stud. A single minimum 20 gauge, 1 ¼ inch wide galvanized steel strap shall wrap around the corner. Each end of the strap shall be fastened to the framing with five (5) fasteners with a minimum shank diameter of 0.131 inches and a minimum length of 1 ½ inches. The first rafter shall be nailed to the double top plate of the gable endwall with minimum 0.120 inch by 3 inch long fasteners spaced a maximum of 12 inches on center.

- A ceiling diaphragm and gable endwall bracing is not required.

303.1.2.2 Platform Framed Gable Endwall

- Gable endwalls that are not built using studs that extend completely from the sole or bottom plate to roof line shall be braced with a ceiling diaphragm and gable endwall bracing in accordance with **Section 305**.

- Wall studs for platform framing shall comply with **Section 303.1.1.1**.

- A ceiling diaphragm and gable endwall bracing is not required for hip roofs.

303.1.2.3 Gable Endwall Offset (Platform or Balloon Framing)

- The gable endwall shall be framed as specified in **Section 303.1.2.1** or **Section 303.1.2.2**. Offset of the gable endwall above the eve height to accommodate a brick or masonry veneer may be accomplished by building out the gable endwall using vertical L-shaped members.

- The vertical L-shaped members are formed by nailing a 2x member to a 2x4 in shear with 12d box nails, or equivalent as specified in Appendix I, spaced a maximum of 2" from each end and 18" on center. The 2x member may be of the appropriate size to accommodate the desired depth of offset or build out. See Figure 303.1.2.3.

- The vertical L-shaped member shall be attached to each gable stud on top of the structural sheathing through the 2x4 member of the L-shaped member with 16d common wire nails, or equivalent fastener as specified in Appendix I, spaced a maximum of 2" from each end and 5" on center.

- The gable studs and vertical L-shaped members shall have a maximum spacing of 16" on center. Where openings occur, the spacing of the L-shaped members shall be maintained above and below the opening.

303.1.3 Front Entryways

- A front entryway (an area along the front elevation that may or may not be inset from the remainder of the structure and which has an entryway or egress area) shall be constructed in accordance with this section.
- If the height of a loadbearing wall of a front entryway does not exceed 10 feet, then the wall framing shall be constructed in accordance with **Section 303.1.1.1**.
- If the front entryway is not constructed in accordance with **Section 303.1.1.1**, then the following guidelines shall be used:
  - The width of the front entryway shall not exceed 12 feet.
  - The loadbearing wall studs within the front entryway shall be minimum 2x6 lumber and shall be spaced a maximum of 12 inches on center.
  - The loadbearing wall studs within a front entryway shall be minimum No. 2 grade lumber.
  - The maximum loadbearing wall stud length for studs within the front entryway shall be as follows:
    - 20'-0" using Southern Pine lumber.
    - 16'-10" using either Douglas Fir-Larch, Hem-Fir, or Spruce-Pine-Fir lumber.
  - The roof span that the loadbearing wall studs within the front entryway support shall not exceed 40 feet.
  - Non-loadbearing wall studs within the front entryway shall be selected from Table 303.1.1.
- The provisions of **Section 303.3** shall be followed for all door and window openings within the front entryway.
- The provisions of **Section 303.4.1** shall be followed for sheathing requirements.

303.1.4 Corner Studs

- Studs shall be arranged at corners as shown in Figure 303.1.4.
- Where holddowns are located at corners, studs shall be added where necessary so that the holddown is fastened to two full length studs. The corner studs shall be nailed together as shown in Figure 303.1.4.
- Shearwalls shall be fastened to the corner studs as shown in Figure 303.1.4.

303.1.5 Top Plates

303.1.5.1 General

- Studs in both exterior and interior walls shall be capped with double top plates. The top plates shall be overlapped at corners and at intersections with loadbearing walls. See Figures 303.1.5A-B.
- Top plates shall be minimum Standard, Stud, or No. 3 grade lumber.
- Top plates shall not be less than 2 inch nominal thickness and not less than the width of the wall studs.
- The end joints in the double top plate shall be lapped. For exterior walls, the length of the lap shall be a minimum of 4 feet. For interior walls, the length of the lap shall be a minimum of 2 feet.
- The double top plates in both exterior and interior walls shall be fastened together in accordance with Appendix I.
- At the ends of laps at corners and at intersections, the top plates shall be nailed together in accordance with Appendix I.

303.1.5.2 Multi-Level Top Plates

Multi-level top plates shall be constructed in accordance with either **Section 303.1.5.2.1** or **Section 303.1.5.2.2**.

303.1.5.2.1 Multi-Level Top Plates Along Plane of Wall

- The wall shall be constructed as shown in Figure 303.1.5.2.1A.
- The height of the higher top plate shall not exceed the height of the lower top plate by more than 2 feet.
- The wall studs at the intersection shall be fastened together as specified in Appendix I.
- Blocking shall be installed between the first two studs of the taller wall segment at the height of the top plate for the shorter wall. The blocking shall consist of two 2x blocks. The blocking shall be fastened to the wall studs as specified in Appendix I.
- A single minimum 20 gauge 1 ¼" wide galvanized steel strap shall tie the top plate of the shorter wall to the blocking in the taller wall. See Figure 303.1.5.2.1A for the placement of the single steel strap. Each end of the strap shall be fastened with a minimum of five 8d common wire nails.
- The intersection shall be sheathed with a single piece of minimum 7/16 inch wood structural panel. The single piece sheathing shall extend one stud space to the left and to the right of the intersection. Along the top plate of the taller wall, along the first two studs of the taller wall, and along the upper member of the blocking between the first two studs of the taller wall, the sheathing shall be fastened to the framing members with minimum 8d common wire nails spaced a maximum of 4 inches on center. See Figure 303.1.5.2.1B. The remainder of the sheathing shall be fastened to the wall framing with minimum 8d common wire nails spaced a maximum of 6 inches on center along the perimeter and 12 inches on center in the field.

NOTE: If the width of the sheathing, measured from the point of the wall intersection, satisfies the minimum required shearwall segment width for that wall height, then the sheathing may be used for shearwalls, provided the appropriate perimeter edge fastener spacing for the sheathing is provided. Otherwise, the wall sheathing shall not count as part of the shearwall.

303.1.5.2.2 Multi-Level Top Plates Intersecting at a Corner

- The intersecting walls shall be constructed as shown in Figure 303.1.5.2.2A.
- The height of the higher top plate shall not exceed the height of the lower top plate by more than 2 feet.
- Blocking shall be installed between the first two studs of the taller wall segment at the height of the top plate for the shorter wall. The blocking shall consist of two 2x blocks. The blocking shall be fastened to the wall studs as specified in Appendix I.
- A single minimum 20 gauge 1 ¼" wide galvanized steel strap shall tie the top plate of the shorter wall to the blocking in the taller wall. See Figure 303.1.5.2.2A for the placement of the single steel strap. Each end of the strap shall be fastened with a minimum of five 8d common wire nails.
- Each wall at the corner shall be sheathed in accordance with the wall bracing requirements specified in **Section 303.4**. See Figure 303.1.5.2.2B. Along the top plate of the taller wall, along the first two studs of the taller wall, and along the upper member of the blocking between the first two studs of the taller wall, the sheathing shall be fastened to the wall framing members with minimum 8d common wire nails spaced a maximum of 6 inches on center as shown in Figure 303.1.5.2.2B. Note: A closer fastener spacing along the perimeter of the sheathing may be required for shear resistance in accordance with **Section 303.4**. The remainder of the sheathing shall be fastened to the wall framing as required for wall bracing as specified in **Section 303.4**.

303.2 Uplift Connections

- Uplift resistance shall be continuous from the roof to the foundation. Exterior walls and interior walls subjected to uplift loads shall be anchored in accordance with this section.
- Each wall stud shall be fastened to both plates of the double top plate and to the sole or bottom plate with framing anchors capable of carrying the anchorage specified in Tables 303.2A-B. Figures 303.2A-B illustrate several types of uplift connections.
- For two- and three-story buildings, the walls above shall be connected to the walls below with framing connectors capable of carrying the anchorage specified in Tables 303.2A-B. See Figure 303.2C.
- For two- and three-story structures where the floor above is offset from the floor below, the floors shall be connected with framing anchors as shown in Figure 303.2D and as shown in Figure 303.4.5.
- For houses on piles or piers, and for wood framed second floors built over masonry first floors, the wall studs shall be strapped to the bottom plate and to the floor framing with framing connectors capable of carrying the anchorage specified in Tables 303.2A-B. See Figures 301.2.5A and 304.6.3.

Table 303.2A
Uplift Loads - Stud to Plate Connection (lbs.)

Building Type	Roof Span (ft.)	Stud Spacing (inches o.c.)		
		12	16	24
One-Story (Slab-on-grade; Piers)	12	160	210	320
	16	190	250	380
	20	220	290	440
	24	250	330	500
	28	280	370	560
	32	310	410	620
	36	340	450	680
	40	370	490	740
	44	400	530	800
	48	430	570	860
Two-Story (Slab-on-grade; Piers) Or One-Story (Pile Foundation)	12	170	230	340
	16	200	270	400
	20	240	320	480
	24	270	360	540
	28	310	410	620
	32	340	450	680
	36	380	500	760
	40	410	550	820
	44	450	600	900
	48	490	650	980
Three-Story (Slab-on-grade) Or Two-Story (Pile Foundation)	12	190	250	380
	16	230	310	460
	20	270	360	540
	24	310	410	620
	28	350	470	700
	32	390	520	780
	36	430	570	860
	40	470	630	940

Table 303.2B
Uplift Loads at Gable Endwalls (One-, Two-, and Three-Story)

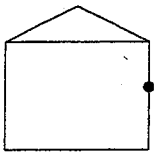
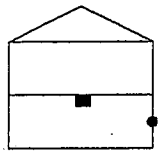
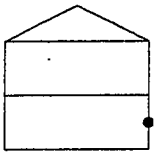
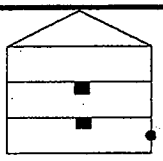
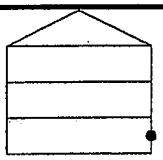
Wall Stud Spacing	Uplift Load (lbs./stud)
12"	90
16"	120
24"	180

303.3 Framing Around Openings

303.3.1 General Requirements

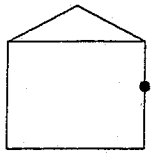
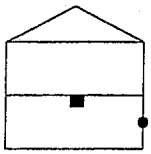
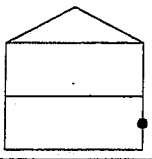
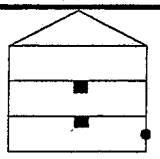
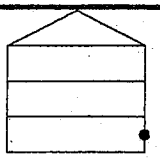
- A header shall be provided over each opening in exterior walls. See Figure 303.3.1.
- Headers shall be a minimum of two pieces of nominal 2 inch wide lumber set on edge and nailed together. Wood structural panel (plywood or OSB) spacers, nominal ½ inch thick, shall be nailed between the pieces to make the thickness of the header equal to that of the wall framing. The header may also be of solid lumber of equivalent size.
- Engineered wood products may be used as headers. The engineered wood product shall be evaluated by the Texas Department of Insurance to determine if the span of the header is adequate for the support condition. The engineered wood product shall be anchored against uplift in accordance with this section and shall be installed in accordance with the manufacturers installation instructions.
- The maximum spans for headers in exterior walls shall be as specified in Tables 303.3.1A-B.
- For exterior non-loadbearing gable endwalls (floor joists run parallel to gable endwall), a 2x4 header may be used for openings up to 6 feet in width. A 2x6 header may be used for openings up to 8 feet in width.
- For exterior gable endwalls supporting floor loads (floor joists frame into gable endwall), a 2x4 header may be used for openings up to 4 feet in width; a 2x6 header may be used for openings up to 6 feet in width; and a 2x8 header may be used for openings up to 8 feet in width.
- The header studs shall be fastened to the header and to the sole plate with anchors capable of carrying the anchorage specified in Table 303.3.1C.
- The number of full length and header studs required at each end of the header shall be as specified in Table 303.3.1D.
- At each end of the header, one of the full length studs shall be anchored at the top and at the bottom to achieve the anchorage specified in Tables 303.2A-B. See Figure 303.3.1.
- If the header does not extend completely to the double top plate, cripple studs shall be provided. Cripple studs shall be minimum Standard grade lumber. The spacing of the cripple studs shall match the spacing of the wall studs. Each cripple stud shall be anchored to the top plate and to the header with the anchorage specified in Tables 303.2A-B. The cripple studs located below the opening are not required to be anchored for uplift resistance. See Figure 303.3.1.
- If the header extends completely to the double top plate, then it shall be fastened to the top plate with framing anchors. The spacing of the framing anchors shall match either the spacing of the wall studs or the spacing of the rafters. The amount of anchorage of each connector shall be as specified in Tables 303.2A-B.

Table 303.3.1A
Maximum Allowable Header Span
Exterior Loadbearing Walls
Minimum No. 2 Lumber
(Douglas Fir-Larch, Hem-Fir, and Spruce-Pine-Fir)

Headers Supporting	Header Size	Roof/Floor Span (ft)			
		12	24	36	48
 Roof And Ceiling	2-2x4	5-1"	4'-2"	3'-5"	3'-0"
	2-2x6	7'-11"	6'-0"	5'-1"	4'-5"
	2-2x8	10'-1"	7'-8"	6'-5"	5'-7"
	2-2x10	12'-4"	9'-4"	7'-10"	6'-10"
	2-2x12	14'-4"	10'-10"	9'-1"	7'-11"
	3-2x12	17'-7"	13'-3"	11'-1"	9'-9"
 Roof, Ceiling, and One Center Bearing Floor	2-2x4	4'-1"	3'-3"	2'-9"	2'-5"
	2-2x6	6'-0"	4'-9"	4'-0"	3'-7"
	2-2x8	7'-8"	6'-0"	5'-1"	4'-6"
	2-2x10	9'-4"	7'-4"	6'-3"	5'-6"
	2-2x12	10'-10"	8'-6"	7'-3"	6'-5"
	3-2x12	13'-3"	10'-5"	8'-10"	7'-10"
 Roof, Ceiling, and One Clear Span Floor	2-2x4	3'-7"	2'-8"	2'-3"	2'-0"
	2-2x6	5'-3"	3'-11"	3'-3"	2'-11"
	2-2x8	6'-8"	5'-0"	4'-2"	3'-8"
	2-2x10	8'-1"	6'-1"	5'-1"	4'-6"
	2-2x12	9'-5"	7'-1"	5'-11"	5'-2"
	3-2x12	11'-6"	8'-8"	7'-3"	6'-4"
 Roof, Ceiling, and Two Center Bearing Floors	3-2x4	4'-0"	3'-2"	2'-8"	N/A
	3-2x6	5'-11"	4'-7"	3'-11"	
	3-2x8	7'-6"	5'-10"	4'-11"	
	3-2x10	9'-2"	7'-1"	6'-0"	
	3-2x12	10'-7"	8'-3"	7'-0"	
 Roof, Ceiling, and Two Clear Span Floors	3-2x4	3'-4"	2'-6"	2'-1"	N/A
	3-2x6	4'-10"	3'-8"	3'-0"	
	3-2x8	6'-1"	4'-7"	3'-10"	
	3-2x10	7'-6"	5'-7"	4'-8"	
	3-2x12	8'-8"	6'-6"	5'-5"	

■ BEARING WALL
● HEADER

Table 303.3.1B
Maximum Allowable Header Span
Exterior Loadbearing Walls
Minimum No. 2 Lumber
(Southern Pine)

Headers Supporting	Header Size	Roof/Floor Span (ft)			
		12	24	36	48
 Roof And Ceiling	2-2x4	5-5"	4'-6"	3'-9"	3'-3"
	2-2x6	8'-6"	6'-5"	5'-4"	4'-9"
	2-2x8	11'-0"	8'-4"	6'-11"	6'-1"
	2-2x10	13'-1"	9'-11"	8'-3"	7'-3"
	2-2x12	15'-4"	11'-7"	9'-9"	8'-6"
	3-2x12	18'-10"	14'-3"	11'-11"	10'-5"
 Roof, Ceiling, and One Center Bearing Floor	2-2x4	4'-6"	3'-6"	3'-0"	2'-8"
	2-2x6	6'-5"	5'-0"	4'-3"	3'-9"
	2-2x8	8'-3"	6'-6"	5'-6"	4'-11"
	2-2x10	9'-11"	7'-9"	6'-7"	5'-10"
	2-2x12	11'-7"	9'-1"	7'-9"	6'-10"
	3-2x12	14'-2"	11'-2"	9'-6"	8'-5"
 Roof, Ceiling, and One Clear Span Floor	2-2x4	3'-11"	2'-11"	2'-5"	2'-2"
	2-2x6	5'-7"	4'-2"	3'-6"	3'-1"
	2-2x8	7'-2"	5'-5"	4'-6"	4'-0"
	2-2x10	8'-7"	6'-6"	5'-5"	4'-9"
	2-2x12	10'-1"	7'-7"	6'-4"	5'-7"
	3-2x12	12'-4"	9'-3"	7'-9"	6'-9"
 Roof, Ceiling, and Two Center Bearing Floors	3-2x4	4'-5"	3'-5"	2'-11"	
	3-2x6	6'-3"	4'-11"	4'-2"	
	3-2x8	8'-1"	6'-4"	5'-4"	N/A
	3-2x10	9'-8"	7'-7"	6'-5"	
	3-2x12	11'-4"	8'-10"	7'-6"	
 Roof, Ceiling, and Two Clear Span Floors	3-2x4	3'-7"	2'-8"	2'-3"	
	3-2x6	5'-2"	3'-10"	3'-3"	
	3-2x8	6'-8"	5'-0"	4'-2"	N/A
	3-2x10	7'-11"	5'-11"	5'-0"	
	3-2x12	9'-3"	7'-0"	5'-10"	

■ BEARING WALL
● HEADER

Table 303.3.1C
Anchorage Required at Each End of Headers (lbs.)

Building Type	Roof Span (ft.)	Width of Opening (ft.)								
		0-3	4	6	8	10	12	14	16	18
One-Story (Slab-on-grade; or Piers)	12	160	240	400	560	720	880	1040	1200	1360
	16	190	290	480	670	860	1050	1240	1430	1620
	20	220	330	550	770	990	1210	1430	1650	1870
	24	250	380	630	880	1130	1380	1630	1880	2130
	28	280	420	700	980	1260	1540	1820	2100	2380
	32	310	470	780	1090	1400	1710	2020	2330	2640
	36	340	510	850	1190	1530	1870	2210	2550	2890
	40	370	560	930	1300	1670	2040	2410	2780	3150
	44	400	600	1000	1400	1800	2200	2600	3000	3400
	48	430	650	1080	1510	1940	2370	2800	3230	3660
Two-Story (Slab-on-grade; or Piers) Or One-Story (Pile Foundation)	12	170	260	430	600	770	940	1110	1280	1450
	16	200	300	500	700	900	1100	1300	1500	1700
	20	240	360	600	840	1080	1320	1560	1800	2040
	24	270	410	680	950	1220	1490	1760	2030	2300
	28	310	470	780	1090	1400	1710	2020	2330	2640
	32	340	510	840	1180	1520	1860	2200	2540	2880
	36	380	570	950	1330	1710	2090	2470	2850	3230
	40	410	620	1030	1440	1850	2260	2670	3080	3490
	44	450	680	1130	1580	2030	2480	2930	3380	3830
	48	490	740	1230	1720	2210	2700	3190	3680	4170
Three-Story (Slab-on-grade) Or Two-Story (Pile Foundation)	12	190	290	480	670	860	1050	1240	1430	1620
	16	230	350	580	710	940	1170	1400	1630	1860
	20	270	410	680	950	1220	1490	1760	1930	2030
	24	310	470	780	1090	1400	1710	2020	2330	2640
	28	350	530	880	1230	1580	1930	2280	2630	2980
	32	390	590	980	1370	1760	2150	2540	2930	3320
	36	430	650	1080	1510	1940	2370	2800	3230	3660
	40	470	710	1180	1650	2120	2590	3060	3530	4000
1 thru 3 Story	Gable Endwall	135	180	270	360	450	540	630	720	810

Table 303.3.1D
Number of Full-Length and Header Studs Required at Each End of Headers

Width of Opening (ft.)	Full-Length Studs	Header Studs
Span ≤ 3	1	1*
3 < span ≤ 6	1	1
Span > 6	2	2

Note: An '*' indicates that the header stud may be omitted if a framing anchor is used to connect the header to the wall stud.

303.3.2 Framing Around Garage Doors

303.3.2.1 General Requirements

- The minimum nominal depth of the garage door header shall be 8 inches.
- The maximum span for the garage door header may be determined using Table 303.3.1A.
- If the garage door header span cannot be achieved using Table 303.3.1A, then the maximum garage door header spans shall be as specified in Tables 303.3.2.1A-D.
- The perimeter of the opening shall be fully sheathed on the exterior side of the building. The thickness of the sheathing shall be the same as the sheathing thickness used for the shearwalls.

303.3.2.2 Garage Door Openings at Corner Locations

- The opening shall be inset from the corner to allow for wall bracing. The minimum inset at the corner shall be the minimum shearwall segment length specified in **Section 303.4.3**. The corner detail shall be as shown in Figure 303.3.2.2A.
- If a shorter return width at the corner is desired, then the corner detail shall be as shown in Figure 303.3.2.2C. The minimum return width at the corner shall be 18 inches. To use this corner detail, the header shall be a minimum of 10 inches in depth.

Table 303.3.2.1A
Maximum Allowable Garage Door Header Span
Exterior Loadbearing Walls
Southern Pine No. 2 Lumber
(Nominal ½ inch thick continuous wood structural panels nailed between each ply)

		Maximum Roof / Floor Span (ft)						
Header Supporting	Header Size	20	24	28	32	36	40	44
Roof and Ceiling	2-2x12 3-2x12	12'-11" 16'-2"	11'-11" 15'-0"	11'-2" 14'-0"	10'-6" 13'-3"	10'-0" 12'-6"	9'-6" 11'-11"	9'-2" 11'-5"
Roof, Ceiling, And One Center Bearing Floor	2-2x12 3-2x12	10'-0" 12'-7"	9'-4" 11'-9"	8'-10" 11'-1"	8'-4" 10'-6"	8'-0" 10'-0"	- 9'-7"	- 9'-2"
Roof, Ceiling, And One Clear Span Floor	2-2x12 3-2x12	8'-5" 10'-7"	- 9'-9"	- 9'-2"	- 8'-7"	- 8'-2"	- -	- -
Roof, Ceiling, And Two Center Bearing Floors	3-2x12	10'-0"	9'-4"	8'-9"	8'-4"	-	N/A	N/A
Roof, Ceiling, And Two Clear Span Floors	3-2x12	-	-	-	-	-	N/A	N/A

Note: "-" means that the span is less than 8 feet.

Table 303.3.2.1B
Maximum Allowable Garage Door Header Span
Exterior Loadbearing Walls
Glued-Laminated Beams[1]

Header Supporting	Header Size	Maximum Roof / Floor Span (ft)						
		20	24	28	32	36	40	44
Roof and Ceiling	3x9.625	13'-6"	12'-10"	12'-4"	11'-10"	11'-5"	11'-1"	10'-9"
	3x11.00	15'-6"	14'-8"	14'-1"	13'-6"	13'-1"	12'-8"	12'-3"
	3x12.375	17'-5"	16'-6"	15'-10"	15'-2"	14'-8"	14'-3"	13'-10"
	3x15.125	21'-3"	20'-2"	19'-4"	18'-7"	17'-11"	17'-4"	16'-11"
	5x9.625	16'-0"	15'-3"	14'-7"	14'-0"	13'-6"	13'-1"	12'-9"
	5x12.375	20'-8"	19'-7"	18'-9"	18'-0"	17'-5"	16'-10"	16'-4"
	5x15.125	25'-3"	23'-11"	22'-11"	22'-0"	21'-3"	20'-7"	20'-0"
Roof, Ceiling, And One Center Bearing Floor	3x9.625	11'-5"	10'-11"	10'-6"	10'-2"	9'-10"	9'-6"	9'-1"
	3x11.00	13'-1"	12'-6"	12'-0"	11'-7"	11'-2"	10'-7"	9'-11"
	3x12.375	14'-8"	14'-1"	13'-6"	13'-0"	12'-7"	12'-2"	11'-8"
	3x15.125	18'-0"	17'-2"	16'-6"	15'-11"	15'-5"	14'-10"	14'-3"
	5x9.625	13'-7"	12'-11"	12'-5"	12'-0"	11'-7"	11'-3"	11'-0"
	5x12.375	17'-5"	16'-8"	16'-0"	15'-5"	14'-11"	14'-6"	14'-1"
	5x15.125	21'-4"	20'-4"	19'-7"	18'-10"	18'-3"	17'-9"	17'-3"
Roof, Ceiling, And One Clear Span Floor	3x9.625	10'-2"	9'-8"	9'-1"	8'-6"	8'-1"	-[2]	-
	3x11.00	11'-8"	11'-0"	9'-10"	9'-0"	8'-3"	-	-
	3x12.375	13'-1"	12'-5"	11'-8"	11'-0"	10'-5"	9'-11"	9'-6"
	3x15.125	16'-0"	15'-2"	14'-3"	13'-5"	12'-9"	12'-1"	11'-7"
	5x9.625	12'-1"	11'-6"	11'-0"	10'-6"	10'-2"	9'-10"	9'-6"
	5x12.375	15'-6'	14'-9"	14'-1"	13'-7"	13'-1"	12'-8"	12'-3"
	5x15.125	19'-0"	18'-0"	17'-3"	16'-7"	16'-0"	15'-6"	15'-0"
Roof, Ceiling, And Two Center Bearing Floors	5x9.625	11'-8"	11'-1"	10'-8"	10'-3"	9'-11"	N/A	N/A
	5x11.00	13'-4"	12'-8"	12'-2"	11'-9"	11'-4"		
	5x12.375	15'-0"	14'-3"	13'-8"	13'-3"	12'-9"		
	5x15.125	18'-3"	17'-5"	16'-9"	16'-2"	15'-7"		
Roof, Ceiling, And Two Clear Span Floors	5x9.625	10'-0"	9'-5"	8'-9"	8'-3"	-	N/A	N/A
	5x11.00	11'-5"	10'-6"	9'-5"	8'-7"	-		
	5x12.375	12'-10"	12'-1"	11'-4"	10'-8"	10'-1"		
	5x15.125	15'-8"	14'-9"	13'-10"	13'-0"	12'-4"		

Note: [1] The following glued-laminated beam combinations are acceptable: 24F-V3 DF/DF; 24F-V4 DF/DF; 24F-V8 DF/DF; and 24F-V3 SP/SP.
[2] A "-" means that the span is less than 8 feet.

Table 303.3.2.1C
Maximum Allowable Garage Door Header Span
Exterior Non-Loadbearing Walls
Southern Pine No. 2 Lumber
(Nominal ½ inch thick continuous wood structural panels nailed between each ply)

Building Type	Header Size	Maximum Span
One Story	2-2x8	14'-11"
	2-2x10	19'-0"
	2-2x12	22'-4"
Two Story	2-2x8	9'-8"
	2-2x10	11'-6"
	2-2x12	13'-6"
Three Story	3-2x8	10'-0"
	3-2x10	11'-11"
	3-2x12	14'-0"

Table 303.3.2.1D
Maximum Allowable Garage Door Header Span
Exterior Non-Loadbearing Walls
Glued-Laminated Beams[1]

Building Type	Header Size	Maximum Span
One Story	3x9.625	19'-6"
	3x11.00	22'-4"
	3x12.375	25'-1"
Two Story	3x9.625	14'-10"
	3x11.00	16'-11"
	3x12.375	19'-1"
	5x9.625	17'-7"
Three Story	5x9.625	14'-7"
	5x11.00	16'-7"
	5x12.375	18'-8"

Notes: [1] The following glued-laminated beam combinations are acceptable: 24F-V3 DF/DF; 24F-V4 DF/DF; 24F-V8 DF/DF; and 24F-V3 SP/SP.

- If the garage door header detail is constructed as shown in Figure 303.3.2.2A, then the anchorage of the header studs to the header and the header studs to the sole plate and foundation shall be as specified in Table 303.3.1C. If the anchorage required is less than or equal to 2,050 lbs, then the header studs may be anchored to the sole plate with framing connectors. A ⅝-inch diameter anchor bolt with a 2x2x⅛-inch washer shall transfer the load to the foundation. If the anchorage required is greater than 2,050 lbs. but less than 4,800 lbs., then the header studs may be anchored to the sole plate with framing connectors. A ⅝-inch diameter anchor bolt with a 3x3x⅛-inch washer shall transfer the load to the foundation. As an alternative, a holddown connector may be used to transfer the loads from the header studs to the sole plate to the foundation. As long as the uplift anchorage is less than or equal to 4,800 lbs., a ⅝-inch diameter anchor bolt may be used to anchor the holddown to the foundation.

- If the garage door return detail is constructed as shown in Figure 303.3.2.2C, then the header studs shall be anchored to the sole plate and to the foundation with two holddown connectors. Each holddown connector shall have a minimum capacity of 4,800 lbs. No anchorage is required between the header studs and the header.

- If the return width at the corner is greater than or equal to the minimum shearwall segment length, then the corner shall be sheathed as shown in Figure 303.3.2.2B.

- If the return width at the corner is less than 28 inches, then the upper corner of the opening shall be sheathed with a single "L" shaped piece of structural panel. The single piece structural panel shall extend a minimum of 4 feet down from the top of the header and a minimum of 4 feet horizontally away from the end of the header. Figure 303.3.2.2D details the corner sheathing requirement.

- If the sheathing at the corner is not continuous from the sole plate to the top plate, then a 2x4 block shall be placed behind the panel edges.

- The sheathing material shall be fastened to the header, the wall studs, and to the sole plates with either minimum 8d common nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as specified in Figures 303.3.2.2B and 303.3.2.2D.

303.3.2.3 Garage Door Openings Not at Corner Locations

- The garage door header shall be as shown in Figure 303.3.2.3A.

- The anchorage of the header studs to the header and the header studs to the sole plate and foundation shall be as specified in Table 303.3.1B. If the anchorage required is less than 4,800 lbs., then the header studs may be anchored to the sole plate with framing connectors. A $\frac{5}{8}$-inch diameter anchor bolt with a 2x2x$\frac{1}{8}$-inch washer shall transfer the load to the foundation. If the anchorage required is greater than or equal to 4,800 lbs., then a holddown connector shall be used to transfer the loads from the header studs to the sole plate to the foundation.

- The sheathing material shall be fastened to the header, the wall studs, and to the sole plates with either minimum 8d common nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as specified in Figure 303.3.2.3B.

- If the sheathing is not continuous from the sole plate to the top plate, then a 2x4 block shall be placed behind the panel edges.

303.3.2.4 Supports for Multiple Garage Door Openings

- The support for the garage door headers shall be framed as shown in Figure 303.3.2.4A.

- The minimum depth of the headers shall be 10 inches.

- The header studs shall be anchored to the sole plate and to the foundation with two holddown connectors. Each holddown connector shall have a minimum capacity of 4,800 lbs. No anchorage is required between the header studs and the headers.

  EXCEPTION: If the support separates two single car garage door openings, then each holddown connector shall have a minimum capacity of 2,210 lbs.

- The upper portion of the support shall be sheathed with a single "T" shaped piece of wood structural panel. The single piece of wood structural panel shall be a minimum of 4 feet wide at the top and shall extend a minimum of 4 feet down from the top of the headers. Figure 303.3.2.4B details the sheathing requirement.

- All panel edges of the sheathing shall be fastened to framing members.

- The sheathing material shall be fastened to the headers, the walls, and to the sole plates with either minimum 8d common nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as specified in Figure 303.3.2.4B.

  EXCEPTION: If the support separates two single car garage door openings, then the fastening requirements shown in Figure 303.3.2.4B may be revised as follows: (1) The fastener spacing may be increased to 6 inches on center; (2) A single row of fasteners may be used; and (3) The grid pattern may be omitted.

303.4 Wall Sheathing

303.4.1 General Sheathing Requirements

- When wood structural panels are not used for shearwalls, the wood structural panels shall be minimum $\frac{3}{8}$ inch. The wood structural panels shall be attached to the wall framing with the minimum size fasteners specified in Appendix I. The fasteners shall be spaced a maximum of 6 inches on center along panel edges and 12 inches on center along interior framing.

- Other sheathing and panel products may be used for non-shearwall applications. These products may need to be evaluated by the Texas Department of Insurance for proper installation and for compliance with the wind loads specified in **Section 102** and **Section 103**.

- Wood structural panels used for shearwalls shall be in accordance with **Section 303.4.2**.

303.4.2 Shearwalls

- Exterior shearwalls shall be provided to transfer the lateral wind loads from the roof and floor systems down to the foundation.

- Tables 303.4.2A-D shall be used to determine the minimum lengths of full height wall sheathing required on each side of the building.

- The exterior surface of the wall shall be sheathed with minimum $\frac{7}{16}$ inch wood structural panels attached with minimum 8d common nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as specified in Tables 303.4.2A-D. An illustration showing the required nailing pattern is shown in Figure 303.4.2A.

- The interior surface of the wall shall be sheathed with minimum $\frac{1}{2}$ inch gypsum wallboard attached with one of the following:
  - 5d cooler nails (minimum shank diameter of 0.086 inches, a minimum length of $1\frac{3}{8}$ inches, and a minimum head diameter of 0.234 inches).
  - No. 6 x $1\frac{1}{4}$ screws.

- Wallboard nails (minimum shank diameter of of 0.086 inches, a minimum length of 1⅝ inches, and a minimum head diameter of 0.250 inches).
- 6d box nails (minimum shank diameter of 0.099 inches, a minimum length of 2 inches, and a minimum head diameter of 0.266 inches).

The fasteners shall be spaced a maximum of 7 inches on center along panel edges and along interior framing.

- The sheathing lengths specified in Tables 303.4.2A-D may be multiplied by the length adjustment factors shown in Table 303.4.2E if the interior surface of the walls are not sheathed with gypsum wallboard; if a thicker sheathing material and larger nail size is desired; or if double-sided shearwalls are used. The panel edge fastener spacing chosen from Table 303.4.2E shall match the panel edge fastener spacing chosen from Tables 303.4.2A-D in order to obtain the appropriate length adjustment factor.

- Sheathing lengths for structural panel siding nailed along shiplap edges shall be determined by multiplying the sheathing lengths specified in Tables 303.4.2A-D by a length adjustment factor shown in Table 303.4.2E. The panel edge fastener spacing chosen from Table 303.4.2E shall match the panel edge fastener spacing chosen from Tables 303.4.2A-D in order to obtain the appropriate length adjustment factor.

- Shiplap edges of structural panel siding shall be double nailed. One fastener shall be placed in the underlap and a second fastener shall be placed in the overlap. See Figure 303.4.2B.

- The sheathing material shall be nailed to the wall framing members along all four edges of the panel. Common panel edges shall occur over wall framing or over blocking. See Figure 303.4.2C for an illustration showing the different ways to apply wall sheathing. The sheathing material shall be nailed to the top member of the double top plate.

- If blocking is required, then the blocking shall be fastened to the wall studs in accordance with Appendix I.

- Each shearwall segment shall be solidly sheathed from the sole or bottom plate to the top member of the top plate. Openings are permitted in the shearwall segment as long as the sum of the openings do not exceed one square foot in area.

Table 303.4.2A
Shearwall Location Code for Tables 303.4.2B-D

Type of Construction	Roof Slope of Building	
	≤ 7:12	> 7:12
Walls Beneath Roof And Ceiling	A	B
Walls Beneath Roof, Ceiling, and One Floor	B	C
Walls Beneath Roof, Ceiling, and Two Floors	C	Not Applicable

Table 303.4.2B
Minimum Length of Shearwall Required (ft.) for Buildings With a Maximum Roof Span of 24 ft.
Applied to Exterior Walls Perpendicular to Windward Building Dimension[1]

Code for Location of Sheathing	Windward Building Dimension[1,2]	Panel Edge Nail Spacing[3]		
		6" on center	4" on center	3" on center
A	10' ≤ L ≤ 20'	4	3	3
	20' < L ≤ 30'	7	5	4
	30' < L ≤ 40'	9	7	6
	40' < L ≤ 50'	12	9	7
	50' < L ≤ 60'	15	11	9
	60' < L ≤ 70'	18	13	10
	70' < L ≤ 80'	20	15	12
B	10' ≤ L ≤ 20'	9	7	5
	20' < L ≤ 30'	15	11	9
	30' < L ≤ 40'	21	15	13
	40' < L ≤ 50'	27	20	16
	50' < L ≤ 60'	34	24	20
	60' < L ≤ 70'	40	28	23
	70' < L ≤ 80'	46	33	27
C	10' ≤ L ≤ 20'	13	10	8
	20' < L ≤ 30'	22	16	13
	30' < L ≤ 40'	31	22	18
	40' < L ≤ 50'	40	29	24
	50' < L ≤ 60'	49	35	29

Notes: [1] Limitations on building dimensions are specified in **Section 207**.
[2] The windward building dimension shall be the dimension of the building at the floor level where the wall sheathing is located.
[3] The nailing pattern along interior framing shall not exceed 12 inches on center.

Table 303.4.2C
Minimum Length of Shearwall Required (ft.) for Buildings With a Maximum Roof Span of 36 ft.
Applied to Exterior Walls Perpendicular to Windward Building Dimension[1]

Code for Location of Sheathing	Windward Building Dimension[1,2]	Panel Edge Nail Spacing[3]		
		6" on center	4" on center	3" on center
A	10' ≤ L ≤ 20'	6	4	3
	20' < L ≤ 30'	9	6	5
	30' < L ≤ 40'	12	8	7
	40' < L ≤ 50'	14	10	8
	50' < L ≤ 60'	17	12	10
	60' < L ≤ 70'	20	14	12
	70' < L ≤ 80'	23	16	14
B	10' ≤ L ≤ 20'	13	9	7
	20' < L ≤ 30'	19	14	11
	30' < L ≤ 40'	26	18	15
	40' < L ≤ 50'	32	23	19
	50' < L ≤ 60'	39	27	22
	60' < L ≤ 70'	45	32	26
	70' < L ≤ 80'	52	36	30
C	10' ≤ L ≤ 20'	19	13	11
	20' < L ≤ 30'	28	20	16
	30' < L ≤ 40'	38	27	22
	40' < L ≤ 50'	47	33	27
	50' < L ≤ 60'	55	39	32

Notes: [1] Limitations on building dimensions are specified in **Section 207**.
[2] The windward building dimension shall be the dimension of the building at the floor level where the wall sheathing is located.
[3] The nailing pattern along interior framing shall not exceed 12 inches on center.

Table 303.4.2D
Minimum Length of Shearwall Required (ft.) for Buildings With a Maximum Roof Span of 48 ft.
Applied to Exterior Walls Perpendicular to Windward Building Dimension[1]

Code for Location of Sheathing	Windward Building Dimension[1, 2]	Panel Edge Nail Spacing[3]		
		6" on center	4" on center	3" on center
A	10' ≤ L ≤ 20'	8	6	5
	20' < L ≤ 30'	14	10	8
	30' < L ≤ 40'	19	14	11
	40' < L ≤ 50'	24	18	14
	50' < L ≤ 60'	30	21	18
	60' < L ≤ 70'	35	25	21
	70' < L ≤ 80'	41	29	24
B	10' ≤ L ≤ 20'	13	9	8
	20' < L ≤ 30'	22	16	13
	30' < L ≤ 40'	31	22	18
	40' < L ≤ 50'	40	28	23
	50' < L ≤ 60'	48	35	29
	60' < L ≤ 70'	57	41	34
	70' < L ≤ 80'	66	47	39

Notes:
[1] Limitations on building dimensions are specified in **Section 207**.
[2] The windward building dimension shall be the dimension of the building at the floor level where the wall sheathing is located.
[3] The nailing pattern along interior framing shall not exceed 12 inches on center.

Table 303.4.2E
Sheathing Length Adjustments [1]

Exterior Wall Sheathing Material / Interior Wall Sheathing material	Nails and Spacing	Length Adjustment Factor
7/16" or thicker wood structural panels [2]	8d common; 6" o.c. perimeter	
No sheathing or Non-structural sheathing		1.40
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.00
7/16" or thicker wood structural panels [2]	8d common; 6" o.c. perimeter	0.69
7/16" or thicker wood structural panels [2]	8d common; 4" o.c. perimeter	
No sheathing or Non-structural sheathing		1.30
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.00
7/16" or thicker wood structural panels [2]	8d common; 4" o.c. perimeter	0.63
7/16" or thicker wood structural panels [2]	8d common; 3" o.c. perimeter	
No sheathing or Non-structural sheathing		1.20
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.00
7/16" or thicker wood structural panels [2]	8d common; 3" o.c. perimeter	0.60
15/32" or thicker wood structural panels [2]	10d common; 6" o.c. perimeter	
No sheathing or Non-structural sheathing		1.10
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	0.86
15/32" or thicker wood structural panels [2]	10d common; 6" o.c. perimeter	0.57
15/32" or thicker wood structural panels [2]	10d common; 4" o.c. perimeter	
No sheathing or Non-structural sheathing		1.06
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	0.87
15/32" or thicker wood structural panels [2]	10d common; 4" o.c. perimeter	0.53

Note: [1] When applying sheathing length adjustment factors, the resulting shearwall length shall be rounded up to the next whole number (Example: 8.4 ft should be rounded to 9 ft).

[2] Wood structural panels may be plywood, OSB, or panel siding without shiplap edges.

Table 303.4.2E (Continued)
Sheathing Length Adjustments[1]

Exterior Wall Sheathing Material Interior Wall Sheathing material	Nails and Spacing	Length Adjustment Factor
7/16" panel siding with shiplap edges	6d common; 6" o.c. perimeter	
No sheathing or Non-structural sheathing		1.94
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.26
7/16" panel siding with shiplap edges	6d common; 4" o.c. perimeter	
No sheathing or Non-structural sheathing		1.81
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.33
7/16" panel siding with shiplap edges	6d common; 3" o.c. perimeter	
No sheathing or Non-structural sheathing		1.69
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.32
19/32" panel siding with shiplap edges	8d common; 6" o.c. perimeter	
No sheathing or Non-structural sheathing		1.45
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.03
19/32" panel siding with shiplap edges	8d common; 4" o.c. perimeter	
No sheathing or Non-structural sheathing		1.39
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.09
19/32" panel siding with shiplap edges	8d common; 3" o.c. perimeter	
No sheathing or Non-structural sheathing		1.32
1/2" Gypsum Wallboard	5d cooler nails; 7" o.c. perimeter	1.08

Note: [1] When applying sheathing length adjustment factors, the resulting shearwall length shall be rounded up to the next whole number (Example: 8.4 ft should be rounded to 9 ft).

- All outside building corners and reentrant corners shall be sheathed to the minimum length specified in **Section 303.4.3**. Refer to Figure 303.4.2D for an illustration showing outside corners and reentrant corners.
  EXCEPTIONS:
  - If a wall is less than 4 feet in length, then corner sheathing is not required along that wall length. Refer to the wall labeled 'A' in Figure 303.4.2D for an example.
  - Garage door returns shall be sheathed as specified in **Section 303.3.2**. Corner sheathing may be counted as part of the total shearwall length.
  - If the minimum shearwall segment width specified in **Section 303.4.3** can not be achieved within the recessed front entryway, as specified in **Section 303.1.3**, then the recessed front entryway shall be fully sheathed on the exterior. No credit shall be given for shearwall resistance of the sheathing material used within the recessed area. The width of the recessed front entryway shall not exceed 12 feet.

- Holddown connectors are required as specified in **Section 303.4.5**.

- The shearwall can be divided into smaller shearwall segments so they may fit between openings in the wall. Refer to Figure 303.4.2E for an illustration of shearwall segments. The minimum length of a shearwall segment shall be as specified in **Section 303.4.3**. The sum of the shearwall segment lengths shall be at least the minimum required shearwall length.

- A minimum shearwall segment, as specified in **Section 303.4.3**, shall be required for each 20 feet of exterior wall length. In other words, the maximum unbraced wall length shall not exceed 20 feet. This sheathing may be counted as part of the total shearwall length.

- An example of how to apply the shearwall procedure is contained in Appendix H.

- Other structural sheathing products may be used for shearwalls. These sheathing products shall be evaluated by the Texas Department of Insurance for shear load resistance.

303.4.3 Minimum Shearwall Segment Widths

303.4.3.1 Shearwall Segment

- If the shearwall segment is constructed as specified in **Section 303.4.2**, then the minimum width of the shearwall segment shall be as specified in Table 303.4.3.1.

Table 303.4.3.1
Minimum Shearwall Segment Widths

Wall Height[1] (ft)	Minimum Segment Width
8	2'-4"
9	2'-7"
10	2'-11"
12	3'-6"
14	4'-0"
16	4'-7"
18	5'-2"
20	5'-9"

Note: [1] Wall heights greater than 10 feet are for non-loadbearing walls

- As an alternative, a narrow-width shearwall segment may be used if constructed as specified in **Section 303.4.3.2** or **Section 303.4.3.3**.

303.4.3.2 Narrow-Width Shearwall Segment Without an Integral Header

- This narrow-width shearwall segment shall not be used at building corners.
- This narrow-width segment may only be used on walls containing shearwalls with a panel edge fastener spacing of 6 inches on center.
- The shearwall segment shall be constructed as shown in Figure 303.4.3.2A.
- The minimum width of the shearwall segment shall be as specified in Table 303.4.3.2.
- A holddown connector is required at each end of the shearwall segment. Each holddown connector shall have a minimum capacity of 3,200 lbs.
- All panel edges of the sheathing shall be fastened to framing members.

Table 303.4.3.2
Minimum Widths for Narrow-Width Shearwall Segments

Wall Height (ft)	Minimum Segment Width
8	16"
9	18"
10	20"

- The sheathing material shall be fastened to the wall studs and to the plates with either minimum 8d common wire nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as shown in Figure 303.4.3.2B.

303.4.3.3 Narrow-Width Shearwall Segment With an Integral Header

- This narrow-width shearwall segment shall only be used at building corners.
- This narrow-width segment may be used on 9 and 10 ft high walls containing shearwalls with a panel edge fastener spacing as close as 4 inches on center or 8 foot high walls containing shearwalls with a panel edge fastener spacing as close as 3 inches on center.
- The shearwall segment shall be constructed as shown in Figure 303.4.3.3A.
- The minimum width of the shearwall segment shall be as specified in Table 303.4.3.2.
- The minimum depth of the header shall be 10 inches.
- A holddown connector is required at each end of the shearwall segment. Each holddown connector shall have a minimum capacity of 4,800 lbs.
- The minimum required capacity for the holddown closest to the corner shall be based on the more stringent holddown capacity requirement for each side of the building corner.
- All panel edges of the sheathing shall be fastened to framing members.

- The upper corner shall be sheathed with a single "L" shaped piece of wood structural panel. The single piece shall extend a minimum of 4 feet down from the top of the shearwall segment and 4 feet horizontally away from the end of the header. See Figure 303.4.3.3B.

- The sheathing material shall be fastened to the header, the wall studs, and to the plates with either minimum 8d common wire nails or equivalent fasteners as specified in Appendix I. The fastener spacing shall be as shown in Figure 303.4.3.3B.

303.4.4 Special Sheathing Conditions

303.4.4.1 Sheathing Around Bay Windows

- A bay window shall be defined as a window or group of windows, usually supported by a foundation, which extends beyond the plane of the exterior wall. Figures 303.4.4.1A-B represent two types of bay window constructions.

- For shearwall applications, the bay window shall be treated as an opening in the plane of the exterior wall, similar to openings for regular windows and doors. The width of the opening shall be as shown in Figures 303.4.4.1A-B. Shearwall segments shall be placed between the openings in the plane of the exterior wall as required in **Section 303.4.2**.

- The bay window itself is not required to be sheathed.

- If the exterior wall of a room is constructed in the shape of a bay window, as shown in Figure 303.4.4.1B, and the bay window is offset from the plane of the wall by a distance greater than 4 feet, then the top plates along the plane of the wall shall be joined by framing that extends across the width of the opening. The framing across the opening shall be minimum double top plates. If the framing across the opening will be supporting loads (gravity or uplift), then a header shall extend across the opening. Figure 303.4.4.1A shows an example of a bay window with a header extending across the opening.

303.4.4.2 Sheathing Around Rafters That Lap Top Plates

- If the slope of the roof is such that the birdsmouth connection of the rafters to the double top plate will cause the rafters to lap over the double top plate, then the wood structural panels used for shearwalls shall be installed using one of the following methods:

  - Apply the shearwalls before the rafters are installed.

  - Cut a notch out of the end of the birsdmouth so that the wood structural panels may be slipped underneath and fastened to the upper member of the double top plate.

  - Cut the wood structural panels so that the tops of the panels cover only the bottom member of the double top plate. Fasten the panels to the bottom member of the double top plate using the fastener spacing required in Tables 303.4.2B-D. Where the panels are located, face-nail the top plates together with fasteners as specified in Appendix I for double top plates. The spacing of these fasteners shall match the perimeter spacing of the fasteners required for the shearwalls. Note: This method shall not be used if the wood structural panels are used to resist uplift loads in accordance with **Section 303.4.7** and **Section 303.4.8**.

303.4.4.3 Sheathing Around Chimneys

- Sheathing applied to chimneys located on exterior walls may be used as part of the required shearwall length.

- The chimney shall be constructed as specified in **Section 303.5**.

- The width of the chimney shall be at least as wide as the minimum shearwall segment widths specified in **Section 303.4.3** in order for the sheathing to count as part of the required shearwall length.

303.4.5 Holddown Connectors

- Holddown connectors shall be required at all exterior building corners and reentrant corners and as required in **Section 303.3.2**. Refer to Figure 303.4.2D for an illustration of outside corners and reentrant corners. For two- and three-story buildings, holddown connectors shall be required between floors to ensure a continuous load path to the foundation. See Figures 303.1.4 and 303.4.5.

- Holddown connectors shall be fastened to double studs and to other construction in accordance with the manufacturer's installation instructions.

- The required holddown capacity shall be as specified in Table 303.4.5A. The capacity of the holddown is keyed to the wall height and to the wall sheathing nailing pattern.

- For gable endwalls (balloon and platform framing) and for open recessed front entryways, the required capacity of the holddown connector shall be based on the common wall height of the structure.

- Anchor bolts for holddowns shall be the size recommended by either the holddown connector manufacturer, the foundation engineer, or the anchor bolt manufacturer and shall have a capacity equal to or greater than the required capacity of the holddown. NOTE: If the required capacity of the holddown connector is less than the capacities specified in Table 303.4.5B, then the anchor bolts specified in Table 303.4.5B may be used to anchor the holddown connector to the foundation. The anchor bolt shall be embedded a minimum of 6 inches into the foundation. If the required capacity of the holddown connector is greater than the capacities specified in Table 303.4.5B, then an anchor bolt, as recommended by either the holddown connector manufacturer, the foundation engineer, or the anchor bolt manufacturer shall be required.

- For other wall sheathing configurations, the holddown capacities specified in Table 303.4.5A shall be divided by the length adjustment factor specified in Table 303.4.2E.

- Unless otherwise specified, only one holddown connector is required at the building corner. The minimum required capacity of the holddown connector shall be based on the more stringent (closer) panel edge nail spacing of the sheathing applied to the walls on each side of the corner.

Table 303.4.5A
Minimum Required Holddown Capacity (lbs.)

Wall Height (ft)	Sheathing Panel Edge Nail Spacing		
	6"	4"	3"
8	3580	4980	6040
9	4020	5600	6800
10	4470	6220	7550

Table 303.4.5B
Anchor Bolt Capacities

Anchor Bolt Diameter	Anchor Bolt Capacity (lbs.)
5/8	4,800
7/8	4,900

Note: Anchor bolt capacity based on a 6" embedment depth. For anchor bolts located at corners, the anchor bolt capacity will decrease with increasing embedment depth.

303.4.6 Shear Transfer

303.4.6.1 General Requirements

- Two- and three-story buildings shall have continuous shear transfer from the upper floors to the lower floors.
- Houses on piles or piers shall have continuous shear transfer from the wall framing to the band joists.
- Depending on the attachment of the wood structural panels to the wall framing and the nailing pattern required for wood structural panels, one of the methods presented in **Sections 303.4.6.2, 303.4.6.3**, or **303.4.6.4** may be used for shear transfer.

303.4.6.2 Shear Transfer Using Fasteners

- This method may be used when the wall sheathing is not fastened to the band joist.
- This method can only be used if the perimeter nailing pattern of the wood structural panels is 6 inches on center.
- The bottom plate shall be nailed to the band joist with two 16d common nails per foot and the band joist shall be nailed to the sill or top plate with two 16d common nails per foot. Equivalent fasteners as specified in Appendix I may be used. See Figure 303.4.6.2.

303.4.6.3 Shear Transfer Using Framing Connectors

- This method shall be used when the wall sheathing is not fastened to band joist and the perimeter nailing pattern of the wood structural panels is less than 6 inches on center.
- The bottom plate shall be nailed to the band joist with two 16d common wire nails per foot and the band joist shall be nailed to the sill or top plate with two 16d common wire nails per foot. Equivalent fasteners as specified in in Appendix I may be used. See Figure 303.4.6.2.
- The framing anchors shall be fastened to the wall framing as shown in Figures 303.2C-D, 303.4.5, 303.4.6.3, or 304.6.3. The framing anchors shall have a minimum capacity of 400 pounds. The framing connectors are required only where the wall sheathing for the shearwalls is used. The maximum spacing of the framing connectors shall be 4 feet on center. NOTE: If double-sided shearwalls are used, then the maximum spacing of the framing connectors shall be 2 feet on center.

303.4.6.4 Shear Transfer Using Wood Structural Panels

- This method may be used for all perimeter nailing patterns for the wood structural panels.
- The bottom plate shall be nailed to the band joist with two 16d common wire nails per foot and the band joist shall be nailed to the sill or top plate with two 16d common wire nails per foot. Equivalent fasteners as specified in in Appendix I may be used. See Figure 303.4.6.2.
- The panels shall be fastened to the wall framing as shown in Figures 303.4.6.4A and 303.4.6.4B. Using this method, the bottom plate may be nailed to the band joist with one 16d common nail per foot and the band joist may be nailed to the sill or top plate with one 16d common nail per foot. NOTE: If double-sided shearwalls are used, then shear transfer framing connectors shall also be used. The framing connectors are required only where the wall sheathing for the shearwalls is used. The maximum spacing of the framing connectors shall be 4 feet on center.

303.4.7 Wood Structural Panels Used for Wall Bracing and Uplift Resistance

- Wood structural panels may be used to resist a combination of lateral loads and uplift loads when installed in accordance with this section.
- This method shall not be used to replace the anchorage required for framing around openings.
- This method shall not be used if the roof framing consists of engineered wood trusses.
- Where windows and doors prevent the use of solid, full-height wood structural panels, framing anchors shall be used to resist uplift loads.
- Framing anchors are required to anchor the rafters to the double top plate.
- The minimum thickness of the wood structural panels shall be $\frac{7}{16}$ inch.
- All horizontal joints shall occur over wall framing. Blocking shall be required at horizontal panel joints.
- The horizontal panel edge fastening pattern specified in Tables 303.4.2B-D shall be replaced with the fastening pattern specified in Tables 303.4.7A-B. When the nailing pattern shown in Tables 303.4.7A-B is used along the horizontal edges of the wood structural panels, the uplift resistance of the wood structural panel, in terms of lbs/wall stud, shall be as specified in Tables 303.4.7A-B. In order to determine the appropriate horizontal edge nailing pattern for the wood structural sheathing, the minimum required uplift load from Tables 303.2A-B shall be compared to the allowable uplift loads specified in Tables 303.4.7A-B.
- The fastener spacing along the vertical panel edges and along intermediate framing members shall be as specified in **Section 303.4.2.**
- The minimum fastener size required for shearwalls, as specified in **Section 303.4.2** shall be used. If minimum 8d common wire nails or equivalent fasteners as specified in Appendix I are used, then the uplift capacity of the sheathing shall be determined using Table 303.4.7A. If 10d common wire nails are used, then the uplift capacity of the sheathing shall be determined using Table 303.4.7B.

- A double row of fasteners shall be required along all horizontal panel edges. The rows shall be a minimum of ½ inch apart. The minimum edge distance shall be ½ inch. Figure 303.4.7A illustrates the required panel edge fastening pattern.

- For one-story construction, the wood structural panels shall be fastened to the bottom or sole plate and to the upper member of the double top plate.

- On two- and three-story construction, the wood structural panels at the upper most floor shall be fastened to the upper member of the double top plate and to the band joist between floors. For intermediate floors, the wood structural panels shall be fastened to the band joists between the floors. For the lowest floor, the wood structural panels shall be fastened to the band joist between floors and to the bottom or sole plate.

Table 303.4.7A
Uplift Capacity of Wood Structural Panels When Used to Resist Lateral Loads and Uplift Loads Simultaneously (lbs/wall stud)
(8d Common Wire Nails or Equivalent Fasteners as Specified in Appendix I)

	Horizontal Panel Edge Nail Spacing Required For Shearwall Design (See Tables 303.4.2B-D)					
	6"			4"		3"
	Double Row Fastener Spacing Required Along Horizontal Panel Edges for Combined Shear and Uplift Load Resistance					
	6"	4"	3"	4"	3"	3"
Stud Spacing	Uplift Capacity of Wood Structural Panels (lbs/stud)					
12"	220	430	650	320	540	430
16"	290	570	870	430	720	570
24"	440	860	1300	640	1080	860

Note: The allowable uplift loads shall not exceed those values specified in Tables 303.2A-B.

Table 303.4.7B
Uplift Capacity of Wood Structural Panels When Used to Resist Lateral Loads and Uplift Loads Simultaneously (lbs/wall stud)
(10d Common Wire Nails)

	Horizontal Panel Edge Nail Spacing Required For Shearwall Design (See Tables 303.4.2B-D)					
	6"			4"		3"
	Double Row Fastener Spacing Required Along Horizontal Panel Edges for Combined Shear and Uplift Load Resistance					
	6"	4"	3"	4"	3"	3"
Stud Spacing	Uplift Capacity of Wood Structural Panels (lbs/stud)					
12"	260	520	770	390	650	520
16"	350	690	1030	520	870	690
24"	520	1040	1540	780	1300	1040

Note: The allowable uplift loads shall not exceed those values specified in Tables 303.2A-B.

- Blocking between wall studs shall be provided behind the horizontal panel edges of the wood structural panels in the following manner:

  - If gypsum wallboard is used as a shearwall material on the interior surface of the wall and the horizontal panel edges of the gypsum wallboard occur at the same location as the horizontal panel edges of the wood structural panel, then the blocking shall consist of two minimum 2x4 blocks with a piece of wood structural panel nailed to one of the blocks. The blocking shall be nailed flatwise with the side with the wood structural panel facing the exterior of the building. See Figure 303.4.7B. The blocking shall be nailed to the wall framing in accordance with Appendix I.

  - If gypsum wallboard is used as a shearwall material on the interior surface of the wall and the horizontal panel edges of the gypsum wallboard will not occur at the same location as the horizontal panel edges of the wood structural panels, then the blocking shall consist of a single 2x4 block nailed flatwise. See Figure 303.4.7C. The blocking shall be nailed to the wall framing in accordance with Appendix I. Blocking for the horizontal panel edges of the gypsum wallboard shall be in accordance with **Section 303.4**.

  - If gypsum wallboard is not used as a shearwall material on the interior surface of the wall, then the blocking shall consist of a single 2x4 block nailed flatwise. See Figure 303.4.7C. The blocking shall be nailed to the wall framing in accordance with Appendix I. The horizontal panel edges of the gypsum wallboard are not required to be fastened to blocking.

303.4.8 Wood Structural Panels Used Exclusively for Uplift Resistance

- Wood structural panels may be used to resist only uplift loads when installed in accordance with this section.

- This method shall not be used to replace the anchorage required for framing around openings.

- This method shall not be used if the roof framing consists of engineered wood trusses.

- Where windows and doors prevent the use of solid, full-height wood structural panels, framing anchors shall be used to resist uplift loads.

- Framing anchors are required to anchor the rafters to the double top plate.

- The minimum thickness of the wood structural panels shall be $\frac{3}{8}$ inch.

- All horizontal joints shall occur over wall framing. Blocking shall be required at horizontal panel joints.

- The uplift resistance of the wood structural panel, in terms of lbs/wall stud shall be as specified in Tables 303.4.8A-B when the nailing pattern shown is used along the horizontal edges of the wood structural panels. In order to determine the appropriate horizontal edge nailing pattern for the wood structural sheathing, the minimum required uplift load from Tables 303.2A-B shall be compared to the allowable uplift loads specified in Tables 303.4.8A-B.

- The fastener spacing along vertical panel edges shall be a maximum of 6 inches on center. The fastener spacing along intermediate framing members shall be a maximum of 12 inches on center.

- If the wood structural panels are fastened to the wall framing with fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 2 ½ inches, then the uplift capacity of the sheathing shall be determined using Table 303.4.8A. If the wood structural panels are fastened to the wall framing with fasteners with a minimum shank diameter of 0.131 inches and a minimum length of 2 ½ inches, then the uplift capacity of the sheathing shall be determined using Table 303.4.8B.

- If a single row of fasteners is used, then the fasteners shall be placed a minimum of ¾ inch from the panel edge. Figure 303.4.8A illustrates the required panel edge fastening pattern.

- If a double row of fasteners is used, then the rows shall be a minimum of ½ inch apart. The minimum edge distance shall be ½ inch. Figure 303.4.8B illustrates the required panel edge fastening pattern.

- For one-story construction, the wood structural panels shall be fastened to the bottom or sole plate and to the upper member of the double top plate.

- On two- and three-story construction, the wood structural panels at the upper most floor shall be fastened to the upper member of the double top plate and to the band joist between floors. For intermediate floors, the wood structural panels shall be fastened to the band joists between the floors. For the lowest floor, the wood structural panels shall be fastened to the band joist between floors and to the bottom or sole plate.

- Blocking between wall studs shall be provided behind the horizontal panel edges of the wood structural panels. The blocking shall consist of a single 2x4 block nailed flatwise. See Figure 303.4.8C for an example of the blocking required for the wood structural panel edges. The blocking shall be nailed to the wall framing in accordance with Appendix I.

Tables 303.4.8A
Uplift Capacity of Wood Structural Panels When Used Exclusively to Resist Uplift Loads (lbs/wall stud)
(Fasteners with a Minimum Shank Diameter of 0.120 Inches)

		Horizontal Panel Edge Nail Spacing		
Fasteners	Stud Spacing	6"	4"	3"
Single Row	12"	200	290	380
	16"	270	390	510
	24"	400	580	760
Double Row	12"	380	560	740
	16"	510	750	990
	24"	760	1120	1580

Note: [1] The allowable uplift loads shall not exceed those values specified in Tables 303.2A-B.
[2] If 7/16" wood structural panel sheathing is used, then the uplift values may be multiplied by 1.05.

Table 303.4.8B
Uplift Capacity of Wood Structural Panels When Used Exclusively to Resist Uplift Loads (lbs/wall stud) [1,2]
(Fasteners with a Minimum Shank Diameter of 0.131 Inches)

		Horizontal Panel Edge Nail Spacing		
Fasteners	Stud Spacing	6"	4"	3"
Single Row	12"	230	340	440
	16"	310	450	590
	24"	460	680	880
Double Row	12"	440	650	860
	16"	590	870	1150
	24"	880	1300	1720

Note: [1] The allowable uplift loads shall not exceed those values specified in Tables 303.2A-B.
[2] If 7/16" wood structural panel sheathing is used, then the uplift values may be multiplied by 1.05.

303.5 Chimneys

- For chimneys located along exterior walls, $\frac{5}{8}$-inch diameter anchor bolts shall be placed at the corners of each segment of the sole plate placed along the perimeter of the chimney. A 2x2x$\frac{1}{8}$-inch washer shall be used.
- Studs for the chimney shall be spaced a maximum of 16 inches on center. Studs shall be selected from **Section 303**.
- Studs shall be capped with double top plates at each ceiling height. The double top plates shall be connected to the top plates of the building at each floor. Refer to **Section 303.1.5**.
- Each stud shall be anchored to the top plate, and to the sole or bottom plate with the anchorage specified in **Section 303.2**.
- The entire exterior of the chimney shall be sheathed.
- If wood structural panel products are used as a non-shearwall application, then the wood structural panels shall be minimum $\frac{3}{8}$ inch. The wood structural panels shall be attached to the chimney framing with the minimum size fasteners specified in Appendix I. The fasteners shall be spaced a maximum of 6 inches on center along panel edges and 12 inches on center along interior framing.
- Other sheathing and panel products may be used for non-shearwall applications. These products may need to be evaluated by the Texas Department of Insurance for proper installation and for compliance with the wind loads specified in **Section 102** and **Section 103**.
- If the sheathing on the chimney will be used as part of the required shearwall length, then the sheathing application shall be in accordance with **Section 303.4.4.3**.
- If the chimney frames into the roof, then the bottom plate of the chimney shall be connected to the rafters with minimum $\frac{3}{8}$-inch diameter lag bolts spaced a maximum of 18 inches on center. The lag bolts shall be long enough to penetrate a minimum of 2 $\frac{1}{2}$ inches into the roof framing.

304 Masonry Walls

The following prescriptive requirements apply to one- and two-story structures.

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4.**

304.1 General Requirements

- Masonry units shall have a minimum nominal thickness of 8 inches.
- Running bond masonry shall be used.
- Type M or S mortar shall be used.
- Joint reinforcement shall be provided with a maximum vertical spacing of 16 inches. Cross wires on prefabricated joint reinforcement shall not be smaller than wire size W 1.7. The longitudinal wires shall be embedded in the mortar.
- A bond beam shall be provided at floor levels and at the roof level.
- All bar splices shall be lapped 25 inches for #5 bars and 35 inches for #7 bars. See Figure 301.1.3.

304.2 Bond Beam

- Bond beams shall be cast in place masonry or concrete and shall have a minimum nominal width of 8 inches and a minimum height of 8 inches. See Figure 304.2A.
- Bond beams shall be reinforced with a minimum of two #5 continuous bars, with one at the top of the bond beam and one at the bottom.
- Reinforcement shall be continuous around corners as shown in Figure 304.2B.

304.3 Vertical Reinforcement

- Vertical reinforcement shall be a minimum #5 bar.
- Cells or cavities containing vertical reinforcement shall be completely filled with grout.
- Vertical reinforcement shall be provided at all corners, at the ends of shearwall segments, and on each side of an opening greater than 6 feet. For openings greater than 12 feet, a minimum of one #7 bar (or two #5 bars) shall be provided on each side of the opening.
- All vertical reinforcement shall be connected to bond beams either by bending the vertical bar into a standard 90-degree hook or by splicing the vertical bar to a standard 90-degree hook in the bond beam. It is not a requirement that the reinforcement be tied together. See Figure 301.1.3 for illustrations of standard 90-degree hooks. See Figure 304.3A for a one story wall detail.

- For two story construction, vertical reinforcement shall be continuous though the bond beam and shall be spliced to vertical reinforcement for the second floor. See Figure 304.3B for two story wall connection reinforcement details.

- Maximum spacing of vertical reinforcement is 4 feet if one #5 bar is used or 8 feet if one #7 bar (or two #5 bars) is used.

- Vertical reinforcement is not additive. One bar can satisfy the requirements of this section and the shearwall requirements specified in **Section 304.4**.

- For continuous masonry gable endwalls, vertical reinforcement shall be spaced a maximum of 4 feet on center.

304.4 Shearwalls

- Shearwalls shall be provided to transfer the lateral wind loads from the roof and floor systems down to the foundation.

- Tables 304.4A-C shall be used to determine the minimum lengths of shearwall required on each side of the building.

- Shearwall lengths may be divided into smaller segments so they may fit between openings in the wall. The height of the opening adjacent to the shearwall segment is the pier height of the shearwall segment. See Figure 304.4 for a description of pier height and shearwall segment widths.

- The largest pier height adjacent to the shearwall segment shall be used to determine the minimum shearwall segment width.

- The minimum shearwall segment width shall be 2 feet if the pier height does not exceed 6 feet and the reinforcement at each end of the segment is a minimum of one #5 rebar.

- The minimum shearwall segment width shall be 4 feet if the pier height does not exceed 10 feet and the reinforcement at each end of the segment is a minimum of one #5 rebar.

- The minimum shearwall segment width shall be 2 feet if the pier height does not exceed 10 feet and the reinforcement at each end of the segment is a minimum of one #7 rebar or two #5 rebar.

- The shearwall segment width at all building corners, except for garage door openings located at corners, may be reduced to 8 inches. The reinforcement at the end of the 8 inch wide shearwall segment shall be one #7 or two #5 rebar.

- The minimum shearwall segment width for garage door openings located at building corners shall be 2 feet. The minimum reinforcement at the end of the shearwall segment shall be minimum one #7 or two #5 rebar.

- Cells or cavities containing the reinforcement shall be completely filled with grout.

- Openings are permitted in the shearwall segments as long as the sum of the openings in each shearwall segment do not exceed one square foot. See Figure 304.4.

- An example of how to apply the shearwall procedure is contained in Appendix H.

Table 304.4A
Shearwall Location Code for Tables 304.4.B-C

Type of Construction	Roof Slope of Building	
	≤ 7:12	> 7:12
Walls Beneath Roof and Ceiling	A	B
Walls Beneath Roof, Ceiling, and One Floor	B	C

Table 304.4B
Minimum Length of Masonry Shearwalls Required for Buildings With a Maximum Roof Span of 36 ft.
Applied to Exterior Walls Perpendicular to Windward Building Dimension[1]

Code for Location of Shearwall	Windward Building Dimension[1,2]	Reinforcement Required at Each End of Shearwall	
		1-#5	1-#7 or 2-#5
A	10' ≤ L ≤ 20'	4	2
	20' < L ≤ 30'	6	3
	30' < L ≤ 40'	7	4
	40' < L ≤ 50'	8	5
	50' < L ≤ 60'	10	6
	60' < L ≤ 70'	11	7
	70' < L ≤ 80'	12	8
B	10' ≤ L ≤ 20'	7	4
	20' < L ≤ 30'	10	6
	30' < L ≤ 40'	12	8
	40' < L ≤ 50'	14	10
	50' < L ≤ 60'	16	13
	60' < L ≤ 70'	18	15
	70' < L ≤ 80'	20	17
C	10' ≤ L ≤ 20'	10	6
	20' < L ≤ 30'	13	9
	30' < L ≤ 40'	16	14
	40' < L ≤ 50'	19	16
	50' < L ≤ 60'	22	19

Notes: [1] Limitations on building dimensions are specified in **Section 207**.
[2] The windward building dimension shall be the dimension of the building at the floor level where the shearwall is located.

Table 304.4C
Minimum Length of Masonry Shearwalls Required for Buildings With a Maximum Roof Span of 48 ft.
Applied to Exterior Walls Perpendicular to Windward Building Dimension[1]

Code for Location of Shearwall	Windward Building Dimension[1,2]	Reinforcement Required at Each End of Shearwall	
		1-#5	1-#7 or 2-#5
A	10' ≤ L ≤ 20'	6	4
	20' < L ≤ 30'	8	5
	30' < L ≤ 40'	10	6
	40' < L ≤ 50'	12	8
	50' < L ≤ 60'	13	10
	60' < L ≤ 70'	15	12
	70' < L ≤ 80'	17	14
B	10' ≤ L ≤ 20'	8	5
	20' < L ≤ 30'	11	7
	30' < L ≤ 40'	14	10
	40' < L ≤ 50'	17	14
	50' < L ≤ 60'	19	17
	60' < L ≤ 70'	21	19
	70' < L ≤ 80'	24	22

Notes: [1] Limitations on building dimensions are specified in **Section 207.**
[2] The windward building dimension shall be the dimension of the building at the floor level where the shearwall is located.

304.5 Lintels

- A lintel shall be used to span any opening. See Figure 304.5A.
- A lintel shall be precast concrete, cast-in-place masonry, or cast-in-place concrete.
- The lintel shall extend a minimum of 4 inches past the opening on each side of the opening.
- Precast lintels shall be designed to withstand the loads specified in Tables 304.5A-C.
- A bond beam can be used in combination with a lintel to span an opening. See Figures 304.5B-D.
- Maximum spans for combination bond beam and lintel are specified in Tables 304.5D-F.
- Reinforcement though the combination bond beam and lintel shall be continuous along the top and the bottom.
- The lintel is not required to have the same depth or consist of the same material as the bond beam.
- The reinforcement specified in Tables 304.5D-F shall be placed at the bottom of the lintel.
- The bottom reinforcement shall extend a minimum of 4 inches past each side of the opening.

Table 304.5A
Minimum Load for Precast Concrete Lintels
One Story or Top Floor of Two Story Building

Roof Span	Loads (plf)
Endwall[1]	220
12'	310
18'	380
24'	440
30'	510
36'	570
42'	640
48'	710

Note: [1] Refers to non-loadbearing gable endwall. Interpolation is permitted.

Table 304.5B
Minimum Load for Precast Concrete Lintels
Bottom Floor of Two Story Building - Second Story Wood Framed

Roof / Floor Span	Loads (plf)							
	Span of Opening							
	4'	6'	8'	10'	12'	14'	16'	18'
*	210	250	260	270	280	290	300	310
12'	430	470	478	490	500	510	520	530
18'	590	630	640	650	660	680	690	700
24'	760	800	810	820	830	840	850	860
30'	920	960	970	980	1000	1010	1020	1030
36'	1090	1130	1140	1150	1160	1170	1180	1190
42'	1260	1290	1300	1320	1330	1340	1350	1360
48'	1420	1460	1470	1480	1490	1500	1510	1520

Note: An '*' indicates wall parallel to floor joists. Interpolation is permitted.

Table 304.5C
Minimum Load for Precast Concrete Lintels
Bottom Floor of Two Story Building - Second Story Masonry

Roof / Floor Span	Loads (plf)							
	Span of Opening							
	4'	6'	8'	10'	12'	14'	16'	18'
*	210	260	310	360	410	460	510	560
12'	430	480	530	580	630	680	730	780
18'	590	640	690	740	790	840	890	940
24'	760	810	860	910	960	1010	1060	1110
30'	920	970	1020	1070	1120	1170	1220	1270
36'	1090	1140	1190	1240	1290	1340	1390	1440
42'	1260	1310	1360	1410	1460	1510	1560	1610
48'	1420	1470	1520	1570	1620	1670	1720	1770

Note: An '*' indicates wall parallel to floor joists. Interpolation is permitted.

Table 304.5D
Maximum Span of Combination Bond Beam and Lintel
One Story or Top Floor of Two Story Building

Lintel Height	Reinf.	Roof Span							
		Endwall[1]	12'	18'	24'	30'	36'	42'	48'
12" Concrete	1-#5	14'-5"	11'-9"	10'-7"	9'-8"	8'-11"	8'-4"	7'-9"	7'-4"
	1-#7/2-#5	16'-7"	15'-0"	14'-2"	13'-3"	12'-3"	11'-6"	10'-10"	10'-3"
16" Masonry	1-#5	14'-11"	12'-6"	11'-4"	10'-5"	9'-8"	9'-1"	8'-6"	8'-1"
	1-#7/2-#5	17'-6"	14'-10"	13'-5"	12'-4"	11'-6"	10'-10"	10'-3"	9'-4"
16" Concrete	1-#5	15'-10"	13'-4"	12'-1"	11'-1"	10'-4"	9'-8"	9'-0"	8'-7"
	1-#7/2-#5	19'-3"	17'-8"	16'-7"	15'-3"	14'-2"	13'-4"	12'-7"	12'-0"
24" Masonry	1-#7/2-#5	21'-8"	20'-2"	18'-6"	17'-3"	16'-3"	15'-4"	14'-7"	13'-11"
	1-#9/3-#5	23'-5"	21'-8"	20'-0"	18'-7"	17'-6"	16'-6"	15'-5"	14'-1"

Note: [1] Refers to non-loadbearing gable endwall.

Table 304.5E
Maximum Span of Combination Bond Beam and Lintel
Bottom Floor of Two Story Building - Second Story Wood Framed

Lintel Height	Reinf.	Roof / Floor Span							
		*	12'	18'	24'	30'	36'	42'	48'
12" Concrete	1-#5	11'-0"	8'-11"	7'-8"	6'-10"	6'-3"	5'-9"	5'-4"	5'-0"
	1-#7/2-#5	14'-10"	12'-0"	10'-5"	9'-4"	8'-4"	7'-2"	6'-3"	5'-7"
16" Masonry	1-#5	12'-5"	9'-7"	8'-5"	7'-6"	6'-9"	6'-1"	5'-0"	4'-7"
	1-#7/2-#5	14'-6"	11'-3"	9'-8"	7'-10"	6'-7"	5'-11"	6'-3"	4'-9"
16" Concrete	1-#5	13'-2"	10'-2"	8'-11"	8'-0"	7'-4"	6'-10"	6'-3"	5'-11"
	1-#7/2-#5	17'-3"	13'-9"	12'-1"	10'-11"	10'-0"	9'-3"	8'-8"	7'-9"
24" Masonry	1-#7/2-#5	19'-2"	15'-8"	13'-11"	11'-8"	10'-0"	8'-9"	7'-10"	7'-1"
	1-#9/3-#5	20'-5"	16'-9"	14'-1"	11'-8"	10'-0"	8'-9"	7'-10"	6'-11"

Note: An '*' indicates wall parallel to floor joists.

Table 304.5F
Maximum Span of Combination Bond Beam and Lintel
Bottom Floor of Two Story Building - Second Story Masonry

Lintel Height	Reinf.	Roof / Floor Span							
		*	12'	18'	24'	30'	36'	42'	48'
12" Concrete	1-#5	9'-3"	7'-9"	7'-0"	6'-5"	5'-11"	5'-6"	5'-2"	4'-10"
	1-#7/2-#5	11'-10"	10'-2"	9'-3"	8'-5"	7'-4"	6'-6"	5'-9"	5'-3"
16" Masonry	1-#5	9'-11"	8'-5"	7'-7"	6'-10"	5'-11"	5'-3"	4'-10"	4'-6"
	1-#7/2-#5	11'-3"	9'-5"	7'-11"	6'-10"	5'-11"	5'-3"	5'-0"	4'-9"
16" Concrete	1-#5	10'-5"	8'-10"	8'-1"	7'-5"	6'-11"	6'-5"	6'-0"	5'-8"
	1-#7/2-#5	13'-4"	11'-7"	10'-8"	9'-10"	9'-3"	8'-8"	7'-10"	7'-1"
24" Masonry	1-#7/2-#5	14'-10"	12'-9"	11'-1"	9'-9"	8'-8"	7'-9"	7'-2"	6'-6"
	1-#9/3-#5	15'-6"	12'-9"	11'-1"	9'-9"	8'-8"	7'-9"	7'-2"	6'-6"

Note: An '*' indicates wall parallel to floor joists.

304.6 Masonry Wall Connections

304.6.1 Floor Framing to Masonry Wall Connections

- Floor framing is specified in **Section 302.**
- Floor joists or trusses shall be connected to a masonry wall by a ledger as shown in Figure 304.6.1.
- The ledger shall be pressure treated Southern Pine.
- The minimum depth of the ledger shall be the same as the connecting floor joists.
- The ledger shall be connected to the masonry wall bond beam with minimum ½-inch diameter anchor bolts embedded a minimum of 6 inches.
- A standard washer shall be provided for each anchor bolt.
- The maximum spacing of anchor bolts for ledgers parallel to floor joists shall be 6 feet.
- The maximum spacing of anchor bolts for ledgers perpendicular to floor joists is specified in Table 304.6.1.

Table 304.6.1
Maximum Anchor Bolt Spacing for Ledgers

Ledger Size	Floor Span	Anchor Bolt Diameter		
		½"	⅝"	¾"
2" x *	8'	20"	25"	27"
	10'	16"	20"	22"
	12'	13"	17"	18"
	14'	11"	14"	16"
	16'	10"	13"	14"
	18'	9"	11"	12"
	20'	8"	10"	11"
2 - 2" x *	8'	25"	35"	43"
	10'	20"	28"	35"
	12'	17"	24"	29"
	14'	14"	20"	25"
	16'	13"	18"	22"
	18'	11"	16"	19"
	20'	10"	14"	17"

Note: An '*' indicates that the minimum depth of the ledger must be the same as the depth of the floor joists.

304.6.2 Roof Framing to Masonry Wall Connections

- Roof framing shall be connected either directly to the bond beam or to a top plate bolted to the bond beam.
- If the roof framing is connected directly to the bond beam, the portion of the wood members bearing directly on the bond beam shall be protected with a moisture barrier.
- The roof framing shall be anchored against uplift using framing anchors as shown in Figure 304.6.2A. The amount of anchorage shall be as specified in **Section 306.1.7**.
- If the roof framing is connected to a top plate, the top plate shall be a minimum 2x6 and shall be either pressure treated lumber or protected with a moisture barrier.
- The roof framing shall be anchored against uplift using framing anchors as shown in Figure 304.6.2B. The amount of anchorage shall be as specified in **Section 306.1.7**.
- The top plate shall be bolted to the bond beam with a minimum $\frac{5}{8}$-inch diameter anchor bolt embedded a minimum of 6 inches.
- A 2x2x$\frac{1}{8}$-inch washer shall be provided for each anchor bolt.
- An anchor bolt shall be provided within 6 to 12 inches of the end of each plate.
- The anchor bolts connecting the top plate shall be spaced a maximum of 3 feet on center.

304.6.3 Wall Connections for a Wood Framed Second Story

- A top plate shall be provided at floor level for a masonry building where the second story is wood framed. See Figure 304.6.3.
- The top plate shall be a minimum 2x6 and shall be either pressure treated lumber or protected with a moisture barrier.
- The top plate shall be bolted to the bond beam with a minimum $\frac{5}{8}$-inch diameter anchor bolt embedded a minimum of 6 inches.
- A 2x2x$\frac{1}{8}$-inch washer shall be provided for each anchor bolt.
- An anchor bolt shall be provided within 6 to 12 inches of the end of each plate.
- The anchor bolts connecting the top plate shall be spaced a maximum of 4 feet on center.
- The second story wood stud wall framing shall comply with **Section 303**.

304.7 Interior Walls

Interior walls may be either masonry or wood frame construction.

304.7.1 Interior Masonry Walls

- Construction of interior masonry walls shall be in accordance with **Sections 304.1, 304.2, 304.3, 304.5, and 304.6.**
- Interior shearwalls are not required or covered by this document.

304.7.2 Interior Wood-Framed Walls

Interior wood-framed walls shall be constructed in accordance with the applicable portions of **Section 303.**

305 Ceiling Framing

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

305.1 Ceiling Joists

- Ceiling joists should be installed parallel to rafters. Ceiling joists shall be nailed to rafters at exterior walls in accordance with Appendix I.

- If the ceiling joists run perpendicular to the rafters, then the foot of at least every other rafter shall be tied back to at least the first four adjacent ceiling joists with wood ties (strongbacks) attached to the rafters and ceiling joists. Refer to Figure 305.1. Ties shall be nailed to the rafters with either minimum three 16d common nails or equivalent fasteners specified in Appendix I. The ties shall be nailed to each ceiling joist they cross with minimum two 16d common nails or equivalent fasteners specified in Appendix I.

- As an alternative to the wood ties (strongbacks), rafter ties may be used in accordance with **Section 306.1.4**.

- The alternating rafters that are not tied back with either a wood tie or rafter tie shall either have a collar tie installed in accordance with **Section 306.1.4** or shall have a ridge strap in accordance with **Section 306.1.5**.

- Ceiling joists shall be continuous. If the ceiling joists require a lap to achieve the needed length, then the lap shall occur over an interior wall partition. The lap shall be fastened together in accordance with Appendix I.

- Notches on the ends of ceiling joists shall not exceed ¼ the joist depth. Bored holes shall not be within 2 inches of the top and bottom of the joist and the diameter of the hole shall not exceed ⅓ the depth. Notches in the top or bottom of the joist shall not exceed ⅙ the depth and shall not be located in the middle ⅓ of the joist span.

305.1.1 Strongbacks and Ceiling Joists Supporting Rafter Bracing

- Strongbacks supporting rafter bracing shall be constructed as an "L" shaped member comprised of a minimum 2 x 6 horizontal member and a minimum 2 x 4 vertical member. The strongback shall be nailed to each ceiling joist they cross with minimum three 16d common nails or equivalent fasteners specified in Appendix I.

- The maximum span of the ceiling joists supporting the strongbacks shall be as specified in Tables 305.1.1A-B. Note: Ceiling joist spans based on uninhabitable attics with limited storage. Ceiling is gypsum wallboard.

- The ceiling joists that support strongbacks shall be anchored at their first points of support on either side of the strongback. See Figure 305.1.1. The required anchorage is 200 lbs. The anchorage shall be carried down to the foundation. For bearing points located at exterior walls, the required anchorage shall be added to the uplift requirements from Tables 303.2A-B for exterior walls.

Table 305.1.1A
Maximum Allowable Span for Ceiling Joists Supporting Rafter Braces (ft.)
Minimum No. 2 Lumber
(Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir)

Ceiling Joist Size	Joist Spacing		
	16" o.c.	19.2" o.c.	24" o.c.
2 x 6	12'-8"	11'-7"	10'-3"
2 x 8	16'-0"	14'-8"	13'-1"
2 x 10	19'-7"	17'-10"	16'-0"
2 x 12	22'-8"	20'-9"	18'-6"

Table 305.1.1B
Maximum Allowable Span for Ceiling Joists Supporting Rafter Braces (ft.)
Minimum No. 2 Lumber
(Southern Yellow Pine)

Ceiling Joist Size	Joist Spacing		
	16" o.c.	19.2" o.c.	24" o.c.
2 x 6	13'-5"	12'-3"	11'-0"
2 x 8	17'-5"	15'-10"	14'-2"
2 x 10	20'-9"	18'-11"	16'-11"
2 x 12	24'-4"	22'-2"	19'-10"

305.2 Ceiling Diaphragm and Gable Endwall Bracing

- If platform framing is used at the gable endwall, then a ceiling diaphragm and gable endwall bracing shall be required.
- The ceiling diaphragm and gable endwall bracing is not required when the gable endwall is balloon framed (such as for cathedral ceilings); when the gable endwall consists of full-height masonry; or when a hip roof is used at the endwall.
- The ceiling diaphragm shall consist of sheathing material (either gypsum wallboard or wood structural panels) fastened to either the ceiling joists or bottom chords of trusses.
- In garages (detached or attached), if a gypsum wallboard ceiling diaphragm is not provided, then wood structural panels shall be used as an attic floor.
- The gable endwall bracing shall consist of strongbacks attached to the gable endwall framing.

305.2.1 Ceiling Diaphragm

305.2.1.1 Gypsum WallBoard Ceiling Diaphragm

- The gypsum wallboard shall be minimum ½-inch thick.
- The gypsum wallboard shall be attached to the bottom side of the ceiling framing (joists or bottom chords of trusses) as shown in Figures 305.2.2A-B and Figures 305.2.3A-B.
- The gypsum wallboard shall be attached to the ceiling framing with either minimum 5d cooler nails, No. 6 x 1¼ inch screws, GWB-54 1½ inch nails, or fasteners with a minimum shank diameter of 0.086 inches, a minimum length of 1⅝ inches, and a minimum head diameter of 0.234 inches.
- The fasteners shall be spaced a maximum of 7 inches on center along panel edges and a maximum of 10 inches on center along interior framing.

305.2.1.2 Wood Structural Panel Ceiling Diaphragm (Attic Floor)

- Note: A gypsum wallboard ceiling is not required.
- The wood structural panels (plywood or OSB) shall be minimum 7/16 inch thick.
- The wood structural panels shall be fastened to the topside of the ceiling framing (joists or bottom chords of trusses) to form an attic floor as shown in Figures 305.2.2C-D and Figures 305.2.3C-D.
- The wood structural panels shall be fastened to the framing members with either minimum 8d common wire nails or equivalent fasteners specified in Appendix I.
- The fasteners shall be spaced a maximum of 6 inches on center along panel edges and 12 inches on center along interior framing.
- The wood structural panels shall extended to a point within two feet away from where the rafters meet the ceiling joists. See Figure 305.2.1.2.
- If the roof slope is 7:12 or less, then the ceiling diaphragm (attic floor) shall extend at least 11 feet from the gable endwall. If the roof slope is greater than 7:12, then the ceiling diaphragm (attic floor) shall extend at least 14 feet from the gable endwall.

305.2.2 Gable Endwall Bracing: Roofs Framed with Rafters

- Lateral loads at the gable endwall shall be resisted by fastening the gable endwall studs to strongbacks spaced a maximum of 4 feet on center. Each strongback shall consist of two 2x4's fastened in an L-shape. See Figures 305.2.2A-D for an illustration of this method of bracing the gable endwall. A brace shall be located a maximum of 4 feet from each end of the roof span.
- The strongbacks shall be minimum 8 feet long and shall be nailed to each ceiling joist they cross with either two 16d common nails or equivalent fasteners specified in Appendix I.

- Each strongback shall have a 2x4 block nailed to them to fit between the first ceiling joist and the gable endwall. The 2x4 block shall be nailed to the brace with either minimum four 16d common nails or equivalent fasteners specified in Appendix I. NOTE: If an attic floor is used, then the 2x4 block may be omitted as shown in Figures 305.2.2C-D.

- The strongbacks shall be nailed to the gable studs with minimum three 16d common nails or equivalent fasteners specified in Appendix I.

305.2.3 Gable Endwall Bracing: Roofs Framed with Trusses

- Lateral loads at the gable endwall shall be resisted by fastening the gable endwall to 2x4 braces spaced a maximum of 6 feet on center. For masonry gable endwalls, the braces shall be installed as shown in Figure 305.2.3B. For wood stud walls, the braces shall be installed directly over the gable endwall studs as shown in Figure 305.2.3A and in Figures 305.2.3C-D.

- The 2x4 braces shall be minimum 8 feet long and shall be nailed to each ceiling joist they cross with either two 16d common nails or equivalent fasteners specified in Appendix I.

- Each brace shall have a 2x4 block nailed to them to fit between the first ceiling joist and the gable endwall. The 2x4 block shall be nailed to the brace with either minimum four 16d common nails or equivalent fasteners specified in Appendix I. NOTE: If an attic floor is used, then the 2x4 block may be omitted as shown in Figures 305.2.3C-D.

- For wood stud walls, a galvanized steel strap having a minimum thickness of 20 gauge (0.035 inch) and a minimum width of 1¼ inch shall be applied from the top of each brace to the top of the exterior gable endwall stud. The strap shall be nailed to the brace and to the gable endwall stud with either minimum ten 8d common nails (a total of twenty nails) or equivalent fasteners specified in Appendix I.

- For masonry walls, a galvanized steel strap having a minimum thickness of 20 gauge (0.035 inch) and a minimum width of 1¼ inch shall be applied to the top of the brace and embedded into the bond beam. The strap shall be nailed to each brace with either minimum ten 8d common nails or equivalent fasteners specified in Appendix I and embedded a minimum of 6 inches into the bond beam.

306 Roof Framing

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

306.1 Rafter Systems

306.1.1 Rafters

- Rafter spans are based on the horizontal projection of the rafter. The maximum allowable rafter spans shall be as specified in Tables 306.1.1A-P.
- Rafters shall be a minimum 2x6 and shall be spaced a maximum 24 inches on center.
- Hip and valley rafter spans are based on the horizontal projection of the rafter. See Figure 306.1.1A and Figure 306.1.1B. The maximum allowable hip and valley rafter spans shall be as specified in Tables 306.1.1A-P.
- Rafters shall have a minimum of 1½ inches bearing on wood or masonry.
- Rafters shall be toe nailed to the top plate in accordance with Appendix I.
- Rafters shall be anchored against uplift in accordance with **Section 306.1.7**.
- Notches at supports shall not exceed ¼ the rafter depth. Bored holes shall not be within 2 inches of the top and bottom of the rafter and the diameter of the hole shall not exceed ⅓ the depth. Notches in the top or bottom of the rafter shall not exceed ⅙ the depth and shall not be located in the middle ⅓ of the rafter span.

306.1.2 Rafter Braces and Splices

- If the required span of the rafters exceeds the allowable rafter spans specified in Tables 306.1.1A-P, then the rafters may be braced as specified in this section.
- A braced rafter may be either a single piece of lumber braced at specific points along its length as shown in Figure 306.1.2A or a spliced member with a brace located below the splice as shown in Figures 306.1.2B-C.
- The rafter span for braced rafters shall be the horizontal distance between supports. Refer to Figure 207.4A of **Section 207.4** for a definition of rafter span.
- The total rafter span shall not exceed the limitations specified in **Section 207.4**.
- Two members may be lapped together to form a rafter. The lap joint shall be a minimum of 4 feet in length. The lap joint shall be fastened together with a minimum of twenty-one 16d common nails (three rows of 7 nails) or equivalent fasteners specified in Appendix I. The rafter shall be braced directly below the lap joint. See Figure 306.1.2B.

- As an alternative, two members may be spliced together as shown in Figure 306.1.2C. A minimum 4 foot long piece of ½ inch thick plywood shall be fastened to each side of the splice. The splice shall be fastened together with a minimum of twenty-two 16d common wire nails (11 on each side of the splice) or equivalent fasteners specified in Appendix I. The rafter shall be braced directly below the splice.

- At the point of the brace, a minimum 2x4 purlin shall run perpendicular to the rafters. Every fourth rafter (every other rafter if rafters are spaced 24 inches on center) shall be supported by a minimum 2x4 support member. The support member shall form as close as possible to a 90-degree angle with the rafters.

- The support member shall be fastened to the rafter with a minimum of four 16d common nails or equivalent fasteners specified in Appendix I. The support member shall be notched so that the purlin can rest on the notch. The depth of the notch shall not exceed ½ the depth of the support member. The purlin shall be fastened to the support member with a minimum of two 16d common nails or equivalent fasteners specified in Appendix I. Refer to Figures 306.1.2A-C.

- As an alternative to notching the support member, a purlin brace may be fastened to the support member as shown in Figure 306.1.2D. The purlin brace shall be fastened to the support member with 16d common nails or equivalent fasteners specified in Appendix I. The fasteners shall be spaced a maximum of 12 inches on center.

- The support member shall frame into an interior wall. If possible, the support member shall be lap connected to the ceiling joists with a minimum of three 16d common nails or equivalent fasteners specified in Appendix I. The ceiling joists shall be anchored to the top plate with framing connectors capable of carrying 400 lbs.

- As an alternative, the support member may frame into a strongback that is supported by ceiling joists. The strongback shall be constructed and anchored in accordance with **Section 305.1.1**. The rafter brace shall be anchored to the strongback with framing connectors capable of carrying 400 lbs.

- If it is not possible for the support member to be lap connected to a ceiling joist, then the support member shall either be toe-nailed directly to the top plate of the interior wall or it shall be toe-nailed to a strongback which in turn is face-nailed to the ceiling joists over the top plate of the interior wall. The support member shall be toe-nailed with minimum three 16d common nails or equivalent fasteners specified in Appendix I. The support member shall be anchored to the top plate or strongback with framing connectors capable of carrying 400 lbs.

- Each wall stud of the interior wall that supports a rafter brace shall be anchored to the double top plate and to the sole or bottom plate with framing connectors capable of carrying 400 lbs. of anchorage. For two- and three-story structures, the anchorage shall be carried down to the foundation.

- The sole plate shall be anchored to the foundation with minimum ⅝ inch diameter anchor bolts with minimum 2x2x⅛ inch washers. The anchor bolts shall be spaced a maximum of 6 feet on center. Other types of anchors, such as powder-actuated fasteners, drilled epoxy anchors, and mudsill anchors are acceptable. The spacing for the alternative anchors shall be determined using the uplift load for ⅝ inch diameter anchor bolts. Each ⅝ inch diameter anchor bolt resists an uplift load of 1,200 lb. The maximum spacing for the alternative anchors shall not exceed the spacing for the ⅝ inch diameter anchor bolts. The alternative anchoring product shall be evaluated by the Texas Department of Insurance for uplift resistance.

Table 306.1.1A
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Not Attached to Rafters
Roof Slope ≤ 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	15'-11"	15'-7"	12'-7"	15'-11"	15'-6"	11'-9"
	16"	14'-5"	14'-1"	10'-11"	14'-4"	13'-5"	10'-2"
	19.2"	13'-7"	12'-10"	10'-0"	13'-1"	12'-3"	9'-3"
	24"	12'-7"	11'-6"	8'-11"	11'-9"	11'-0"	8'-4"
2 x 8	12"	20'-11"	20'-6"	16'-1"	20'-11"	19'-8"	14'-10"
	16"	19'-0"	18'-2"	13'-11"	18'-2"	17'-0"	12'-10"
	19.2"	17'-11"	16'-7"	12'-8"	16'-7"	15'-7"	11'-9"
	24"	16'-7"	14'-10"	11'-4"	14'-10"	13'-11"	10'-6"
2 x 10	12"	-	25'-1"	19'-0"	25'-8"	24'-0"	18'-2"
	16"	24'-2"	21'-9"	16'-5"	22'-3"	20'-10"	15'-9"
	19.2"	22'-1"	19'-10"	15'-0"	20'-4"	19'-0"	14'-4"
	24"	19'-9"	17'-9"	13'-5"	18'-2"	17'-0"	12'-10"
2 x 12	12"	-	-	22'-7"	-	-	21'-1"
	16"	-	25'-5"	19'-7"	25'-9"	24'-1"	18'-3"
	19.2"	-	23'-3"	17'-10"	23'-6"	22'-0"	16'-8"
	24"	23'-6"	20'-9"	16'-0"	21'-1"	19'-8"	14'-11"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1B
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Not Attached to Rafters
Roof Slope ≤ 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	15'-3"	14'-6"	11'-9"	14'-11"	14'-11"	11'-9"
	16"	13'-10"	13'-2"	10'-2"	13'-5"	13'-5"	10'-2"
	19.2"	12'-9"	12'-1"	9'-3"	12'-3"	12'-3"	9'-3"
	24"	11'-5"	10'-10"	8'-4"	11'-0"	11'-0"	8'-4"
2 x 8	12"	20'-1"	19'-2"	14'-10"	19'-7"	19'-7"	14'-10"
	16"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
	19.2"	16'-2"	15'-4"	11'-9"	15'-7"	15'-7"	11'-9"
	24"	14'-6"	13'-8"	10'-6"	13'-11"	13'-11"	10'-6"
2 x 10	12"	25'-0"	23'-8"	18'-2"	24'-0"	24'-0"	18'-2"
	16"	21'-8"	20'-6"	15'-9"	20'-10"	20'-10"	15'-9"
	19.2"	19'-9"	18'-9"	14'-4"	19'-0"	19'-0"	14'-4"
	24"	17'-8"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
2 x 12	12"	-	-	21'-1"	-	-	21'-1"
	16"	25'-2"	23'-9"	18'-3"	24'-1"	24'-1"	18'-3"
	19.2"	22'-11"	21'-8"	16'-8"	22'-0"	22'-0"	16'-8"
	24"	20'-6"	19'-5"	14'-11"	19'-8"	19'-8"	14'-11"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1C
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Attached to Rafters
Roof Slope ≤ 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-5"	14'-2"	12'-7"	14'-5"	14'-2"	11'-9"
	16"	13'-1"	12'-10"	10'-11"	13'-1"	12'-10"	10'-2"
	19.2"	12'-4"	12'-1"	10'-0"	12'-4"	12'-1"	9'-3"
	24"	11'-5"	11'-3"	8'-11"	11'-5"	11'-0"	8'-4"
2 x 8	12"	19'-0"	18'-8"	16'-1"	19'-0"	18'-8"	14'-10"
	16"	17'-3"	16'-11"	13'-11"	17'-3"	16'-11"	12'-10"
	19.2"	16'-3"	15'-11"	12'-8"	16'-3"	15'-7"	11'-9"
	24"	15'-1"	14'-9"	11'-4"	14'-10"	13'-11"	10'-6"
2 x 10	12"	24'-3"	23'-9"	19'-0"	24'-3"	23'-9"	18'-2"
	16"	22'-1"	21'-7"	16'-5"	22'-1"	20'-10"	15'-9"
	19.2"	20'-9"	19'-10"	15'-0"	20'-4"	19'-0"	14'-4"
	24"	19'-3"	17'-9"	13'-5"	18'-2"	17'-0"	12'-10"
2 x 12	12"	-	-	22'-7"	-	-	21'-1"
	16"	-	25'-5"	19'-7"	25'-9"	24'-1"	18'-3"
	19.2"	25'-3"	23'-3"	17'-10"	23'-6"	22'-0"	16'-8"
	24"	23'-5"	20'-9"	16'-0"	21'-1"	19'-8"	14'-11"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1D
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Attached to Rafters
Roof Slope ≤ 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	13'-10"	13'-2"	11'-9"	13'-6"	13'-6"	11'-9"
	16"	12'-7"	12'-0"	10'-2"	12'-3"	12'-3"	10'-2"
	19.2"	11'-10"	11'-3"	9'-3"	11'-7"	11'-7"	9'-3"
	24"	11'-0"	10'-6"	8'-4"	10'-9"	10'-9"	8'-4"
2 x 8	12"	18'-3"	17'-5"	14'-10"	17'-10"	17'-10"	14'-10"
	16"	16'-7"	15'-10"	12'-10"	16'-2"	16'-2"	12'-10"
	19.2"	15'-7"	14'-10"	11'-9"	15'-3"	15'-3"	11'-9"
	24"	14'-6"	13'-8"	10'-6"	13'-11"	13'-11"	10'-6"
2 x 10	12"	23'-3"	22'-2"	18'-2"	22'-9"	22'-9"	18'-2"
	16"	21'-2"	20'-2"	15'-9"	20'-8"	20'-8"	15'-9"
	19.2"	19'-9"	18'-9"	14'-4"	19'-0"	19'-0"	14'-4"
	24"	17'-8"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
2 x 12	12"	-	-	21'-1"	-	-	21'-1"
	16"	25'-2"	23'-9"	18'-3"	24'-1"	24'-1"	18'-3"
	19.2"	22'-11"	21'-8"	16'-8"	22'-0"	22'-0"	16'-8"
	24"	20'-6"	19'-5"	14'-11"	19'-8"	19'-8"	14'-11"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1E
Maximum Rafter Spans
Tile Roof; Ceiling Not Attached to Rafters
Roof Slope ≤ 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	15'-11"	14'-1"	10'-11"	14'-4"	13'-5"	10'-2"
	16"	14'-0"	12'-2"	9'-5"	12'-5"	11'-7"	8'-9"
	19.2"	12'-9"	11'-1"	8'-7"	11'-4"	10'-7"	8'-0"
	24"	11'-5"	9'-11"	7'-8"	10'-2"	9'-6"	7'-2"
2 x 8	12"	20'-4"	18'-2"	13'-11"	18'-2"	17'-0"	12'-10"
	16"	17'-7"	15'-9"	12'-0"	15'-9"	14'-9"	11'-2"
	19.2"	16'-1"	14'-4"	11'-0"	14'-4"	13'-5"	10'-2"
	24"	14'-4"	12'-10"	9'-10"	12'-10"	12'-0"	9'-1"
2 x 10	12"	24'-2"	21'-8"	16'-5"	22'-2"	20'-9"	15'-8"
	16"	20'-11"	18'-9"	14'-2"	19'-3"	18'-0"	13'-7"
	19.2"	19'-1"	17'-2"	13'-0"	17'-7"	16'-5"	12'-5"
	24"	17'-1"	15'-4"	11'-7"	15'-8"	14'-8"	11'-1"
2 x 12	12"	-	25'-5"	19'-6"	25'-9"	24'-1"	18'-2"
	16"	24'-11"	22'-0"	16'-11"	22'-4"	20'-10"	15'-9"
	19.2"	22'-9"	20'-1"	15'-5"	20'-4"	19'-0"	14'-5"
	24"	20'-4"	18'-0"	13'-10"	18'-2"	17'-0"	12'-10"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1F
Maximum Rafter Spans
Tile Roof; Ceiling Not Attached to Rafters
Roof Slope ≤ 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-0"	13'-3"	10'-2"	13'-5"	13'-5"	10'-2"
	16"	12'-1"	11'-5"	8'-9"	11'-7"	11'-7"	8'-9"
	19.2"	11'-1"	10'-6"	8'-0"	10'-7"	10'-7"	8'-0"
	24"	9'-11"	9'-4"	7'-2"	9'-6"	9'-6"	7'-2"
2 x 8	12"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
	16"	15'-4"	14'-6"	11'-2"	14'-9"	14'-9"	11'-2"
	19.2"	14'-0"	13'-3"	10'-2"	13'-5"	13'-5"	10'-2"
	24"	12'-6"	11'-10"	9'-1"	12'-0"	12'-0"	9'-1"
2 x 10	12"	21'-8"	20'-6"	15'-8"	20'-9"	20'-9"	15'-8"
	16"	18'-9"	17'-9"	13'-7"	18'-0"	18'-0"	13'-7"
	19.2"	17'-1"	16'-2"	12'-5"	16'-5"	16'-5"	12'-5"
	24"	15'-4"	14'-6"	11'-1"	14'-8"	14'-8"	11'-1"
2 x 12	12"	25'-1"	23'-9"	18'-2"	24'-1"	24'-1"	18'-2"
	16"	21'-9"	20'-7"	15'-9"	20'-10"	20'-10"	15'-9"
	19.2"	19'-10"	18'-9"	14'-5"	19'-0"	19'-0"	14'-5"
	24"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1G
Maximum Rafter Spans
Tile Roof; Ceiling Attached to Rafters
Roof Slope ≤ 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-5"	14'-1"	10'-11"	14'-4"	13'-5"	10'-2"
	16"	13'-1"	12'-2"	9'-5"	12'-5"	11'-7"	8'-9"
	19.2"	12'-4"	11'-1"	8'-7"	11'-4"	10'-7"	8'-0"
	24"	11'-5"	9'-11"	7'-8"	10'-2"	9'-6"	7'-2"
2 x 8	12"	19'-0"	18'-2"	13'-11"	18'-2"	17'-0"	12'-10"
	16"	17'-3"	15'-9"	12'-0"	15'-9"	14'-9"	11'-2"
	19.2"	16'-1"	14'-4"	11'-0"	14'-4"	13'-5"	10'-2"
	24"	14'-4"	12'-10"	9'-10"	12'-10"	12'-0"	9'-1"
2 x 10	12"	24'-2"	21'-8"	16'-5"	22'-2"	20'-9"	15'-8"
	16"	20'-11"	18'-9"	14'-2"	19'-3"	18'-0"	13'-7"
	19.2"	19'-1"	17'-2"	13'-0"	17'-7"	16'-5"	12'-5"
	24"	17'-1"	15'-4"	11'-7"	15'-8"	14'-8"	11'-1"
2 x 12	12"	-	25'-5"	19'-6"	25'-9"	24'-1"	18'-2"
	16"	24'-11"	22'-0"	16'-11"	22'-4"	20'-10"	15'-9"
	19.2"	22'-9"	20'-1"	15'-5"	20'-4"	19'-0"	14'-5"
	24"	20'-4"	18'-0"	13'-10"	18'-2"	17'-0"	12'-10"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1H
Maximum Rafter Spans
Tile Roof; Ceiling Attached to Rafters
Roof Slope ≤ 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	13'-10"	13'-2"	10'-2"	13'-5"	13'-5"	10'-2"
	16"	12'-1"	11'-5"	8'-9"	11'-7"	11'-7"	8'-9"
	19.2"	11'-1"	10'-6"	8'-0"	10'-7"	10'-7"	8'-0"
	24"	9'-11"	9'-4"	7'-2"	9'-6"	9'-6"	7'-2"
2 x 8	12"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"
	16"	15'-4"	14'-6"	11'-2"	14'-9"	14'-9"	11'-2"
	19.2"	14'-0"	13'-3"	10'-2"	13'-5"	13'-5"	10'-2"
	24"	12'-6"	11'-10"	9'-1"	12'-0"	12'-0"	9'-1"
2 x 10	12"	21'-8"	20'-6"	15'-8"	20'-9"	20'-9"	15'-8"
	16"	18'-9"	17'-9"	13'-7"	18'-0"	18'-0"	13'-7"
	19.2"	17'-1"	16'-2"	12'-5"	16'-5"	16'-5"	12'-5'
	24"	15'-4"	14'-6"	11'-1"	14'-8"	14'-8"	11'-1"
2 x 12	12"	25'-1"	23'-9"	18'-2"	24'-1"	24'-1"	18'-2"
	16"	21'-9"	20'-7"	15'-9"	20'-10"	20'-10"	15'-9"
	19.2"	19'-10"	18'-9"	14'-5"	19'-0"	19'-0"	14'-5"
	24"	17'-9"	16'-9"	12'-10"	17'-0"	17'-0"	12'-10"

Table 306.1.1I
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Not Attached to Rafters
Roof Slope > 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-7"	14'-3"	11'-11"	14'-7"	14'-3"	11'-1"
	16"	13'-3"	13'-0"	10'-4"	13'-3"	12'-9"	9'-7"
	19.2"	12'-5"	12'-2"	9'-5"	12'-5"	11'-7"	8'-9"
	24"	11'-7"	10'-11"	8'-5"	11'-1"	10'-5"	7'-10"
2 x 8	12"	19'-2"	18'-10"	15'-2"	19'-2"	18'-7"	14'-1"
	16"	17'-5"	17'-1"	13'-2"	17'-3"	16'-1"	12'-2"
	19.2"	16'-5"	15'-9"	12'-0"	15'-9"	14'-9"	11'-2"
	24"	15'-3"	14'-1"	10'-9"	14'-1"	13'-2"	9'-11"
2 x 10	12"	24'-6"	23'-9"	17'-11"	24'-4"	22'-9"	17'-2"
	16"	22'-3"	20'-7"	15'-7"	21'-1"	19'-8"	14'-11"
	19.2"	20'-11"	18'-9"	14'-2"	19'-3"	18'-0"	13'-7"
	24"	18'-8"	16'-10"	12'-8"	17'-2"	16'-1"	12'-2"
2 x 12	12"	-	-	21'-5"	-	-	19'-11"
	16"	-	24'-1"	18'-6"	24'-5"	22'-10"	17'-3"
	19.2"	24'-11"	22'-10"	16'-11"	22'-3"	20'-10"	15'-9"
	24"	22'-3"	19'-8"	15'-1"	19'-11"	18'-8"	14'-1"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1J
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Not Attached to Rafters
Roof Slope > 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-0"	13'-4"	11'-1"	13'-8"	13'-8"	11'-1"
	16"	12'-8"	12'-1"	9'-7"	12'-5"	12'-5"	9'-7"
	19.2"	11'-11"	11'-5"	8'-9"	11'-7"	11'-7"	8'-9"
	24"	10'-10"	10'-3"	7'-10"	10'-5"	10'-5"	7'-10"
2 x 8	12"	18'-5"	17'-7"	14'-1"	18'-0"	18'-0"	14'-1"
	16"	16'-9"	15'-11"	12'-2"	16'-1"	16'-1"	12'-2"
	19.2"	15'-4"	14'-6"	11'-2"	14'-9"	14'-9"	11'-2"
	24"	13'-9"	13'-0"	9'-11"	13'-2"	13'-2"	9'-11"
2 x 10	12"	23'-6"	22'-5"	17'-2"	22'-9"	22'-9"	17'-2"
	16"	20'-6"	19'-5"	14'-11"	19'-8"	19'-8"	14'-11"
	19.2"	18'-9"	17'-9"	13'-7"	18'-0"	18'-0"	13'-7"
	24"	16'-9"	15'-10"	12'-2"	16'-1"	16'-1"	12'-2"
2 x 12	12"	-	-	19'-11"	-	-	19'-11"
	16"	23'-10"	22'-6"	17'-3"	22'-10"	22'-10"	17'-3"
	19.2"	21'-9"	20'-7"	15'-9"	20'-10"	20'-10"	15'-9"
	24"	19'-5"	18'-5"	14'-1"	18'-8"	18'-8"	14'-1"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1K
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Attached to Rafters
Roof Slope > 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	13'-3"	13'-0"	11'-11"	13'-3"	13'-0"	11'-1"
	16"	12'-0"	11'-9"	10'-4"	12'-0"	11'-9"	9'-7"
	19.2"	11'-4"	11'-1"	9'-5"	11'-4"	11'-1"	8'-9"
	24"	10'-6"	10'-3"	8'-5"	10'-6"	10'-3"	7'-10"
2 x 8	12"	17'-5"	17'-1"	15'-2"	17'-5"	17'-1"	14'-1"
	16"	15'-10"	15'-6"	13'-2"	15'-10"	15'-6"	12'-2"
	19.2"	14-'11"	14'-7"	12'-0"	14'-11"	14'-7"	11'-2"
	24"	13'-10"	13'-7"	10'-9"	13'-10"	13'-2"	9'-11"
2 x 10	12"	22'-3"	21'-10"	21'-5"	22'-3"	21'-10"	17'-2"
	16"	20'-3"	19'-10"	18'-6"	20'-3"	19'-8"	14'-11"
	19.2"	19'-0"	18'-8"	16'-11"	19'-0"	18'-0"	13'-7"
	24"	17'-8"	16'-10"	15'-1"	17'-2"	16'-1"	12'-2"
2 x 12	12"	-	-	21'-5"	-	-	19'-11"
	16"	24'-7"	24'-1"	18'-6"	24'-5"	22'-10"	17'-3"
	19.2"	23'-2"	22'-0"	16'-11"	22'-3"	20'-10"	15'-9"
	24"	21'-6"	19'-8"	15'-1"	19'-11"	18'-8"	14'-1"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1L
Maximum Rafter Spans
Composition Shingle Roof; Ceiling Attached to Rafters
Roof Slope > 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	12'-8"	12'-1"	11'-1"	12'-5"	12'-5"	11'-1"
	16"	11'-6"	11'-0"	9'-7"	11'-3"	11'-3"	9'-7"
	19.2"	10'-10"	10'-4"	8'-9"	10'-7"	10'-7"	8'-9"
	24"	10'-1"	9'-7"	7'-10"	9'-10"	9'-10"	7'-10"
2 x 8	12"	16'-9"	15'-11"	14'-1"	16'-4"	16'-4"	14'-1"
	16"	15'-2"	14'-6"	12'-2"	14'-10"	14'-10"	12'-2"
	19.2"	14'-4"	13'-8"	11'-2"	14'-0"	14'-0"	11'-2"
	24"	13'-3"	12'-8"	9'-11"	13'-0"	13'-0"	9'-11"
2 x 10	12"	21'-4"	20'-4"	17'-2"	20'-10"	20'-10"	17'-2"
	16"	19'-5"	18'-6"	14'-11"	18'-11"	18'-11"	14'-11"
	19.2"	18'-3"	17'-5"	13'-7"	17'-10"	17'-10"	13'-7"
	24"	16'-9"	15'-10"	12'-2"	16'-1"	16'-1"	12'-2"
2 x 12	12"	25'-11"	24'-9"	19'-11"	25'-4"	25'-4"	19'-11"
	16"	23'-7"	22'-6"	17'-3"	22'-10"	22'-10"	17'-3"
	19.2"	21'-9"	20'-7"	15'-9"	20'-10"	20'-10"	15'-9"
	24"	19'-5"	18'-5"	14'-1"	18'-8"	18'-8"	14'-1"

Table 306.1.1M
Maximum Rafter Spans
Tile Roof; Ceiling Not Attached to Rafters
Roof Slope > 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	14'-7"	13'-2"	10'-2"	13'-5"	12'-7"	9'-6"
	16"	13'-1"	11'-5"	8'-10"	11'-8"	10'-10"	8'-3"
	19.2"	11'-11"	10'-5"	8'-1"	10'-7"	9'-11"	7'-6"
	24"	10'-8"	9'-4"	7'-3"	9'-6"	8'-11"	6'-9"
2 x 8	12"	19'-0"	17'-0"	13'-0"	17'-0"	15'-11"	12'-0"
	16"	16'-6"	14'-9"	11'-3"	14'-9"	13'-9"	10'-5"
	19.2"	15'-0"	13'-5"	10'-3"	13'-5"	12'-7"	9'-6"
	24"	13'-5"	12'-0"	9'-2"	12'-0"	11'-3"	8'-6"
2 x 10	12"	22'-7"	20'-3"	15'-4"	20'-9"	19'-5"	14'-8"
	16"	19'-7"	17'-7"	13'-3"	18'-0"	16'-10"	12'-9"
	19.2"	17'-10"	16'-0"	12'-2"	16'-5"	15'-4"	11'-7"
	24"	16'-0"	14'-4"	10'-10"	14'-8"	13'-9"	10'-5"
2 x 12	12"	-	23'-9"	18'-3"	24'-1"	22'-6"	17'-0"
	16"	23'-4"	20'-7"	15'-10"	20'-10"	19'-6"	14'-9"
	19.2"	21'-4"	18'-10"	14'-5"	19'-0"	17'-10"	13'-6"
	24"	19'-0"	16'-10"	12'-11"	17'-0"	15'-11"	12'-0"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1N
Maximum Rafter Spans
Tile Roof; Ceiling Not Attached to Rafters
Roof Slope > 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	13'-1"	12'-5"	9'-6"	12'-7"	12'-7"	9'-6"
	16"	11'-4"	10'-9"	8'-3"	10'-10"	10'-10"	8'-3"
	19.2"	10'-4"	9'-9"	7'-6"	9'-11"	9'-11"	7'-6"
	24"	9'-3"	8'-9"	6'-9"	8'-11"	8'-11"	6'-9"
2 x 8	12"	16'-7"	15'-8"	12'-0"	15'-11"	15'-11"	12'-0"
	16"	14'-4"	13'-7"	10'-5"	13'-9"	13'-9"	10'-5"
	19.2"	13'-1"	12'-5"	9'-6"	12'-7"	12'-7"	9'-6"
	24"	11'-9"	11'-1"	8'-6"	11'-3"	11'-3"	8'-6"
2 x 10	12"	20'-3"	19'-2"	14'-8"	19'-5"	19'-5"	14'-8"
	16"	17'-6"	16'-7"	12'-9"	16'-10"	16'-10"	12'-9"
	19.2"	16'-0"	15'-2"	11'-7"	15'-4"	15'-4"	11'-7"
	24"	14'-4"	13'-6"	10'-5"	13'-9"	13'-9"	10'-5"
2 x 12	12"	23'-6"	22'-2"	17'-0"	22'-6"	22'-6"	17'-0"
	16"	20'-4"	19'-3"	14'-9"	19'-6"	19'-6"	14'-9"
	19.2"	18'-7"	17'-7"	13'-6"	17'-10"	17'-10"	13'-6"
	24"	16'-7"	15'-8"	12'-0"	15'-11"	15'-11"	12'-0"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1O
Maximum Rafter Spans
Tile Roof; Ceiling Attached to Rafters
Roof Slope > 7:12

		Southern Pine			Douglas Fir-Larch		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	13'-3"	13'-0"	10'-2"	13'-3"	12'-7"	9'-6"
	16"	12'-0"	11'-5"	8'-10"	11'-8"	10'-10"	8'-3"
	19.2"	11'-4"	10'-5"	8'-1"	10'-7"	9'-11"	7'-6"
	24"	10'-6"	9'-4"	7'-3"	9'-6"	8'-11"	6'-9"
2 x 8	12"	17'-5"	17'-0"	13'-0"	17'-0"	15'-11"	12'-0"
	16"	15'-10"	14'-9"	11'-3"	14'-9"	13'-9"	10'-5"
	19.2"	14'-11"	13'-5"	10'-3"	13'-5"	12'-7"	9'-6"
	24"	13'-5"	12'-0"	9'-2"	12'-0"	11'-3"	8'-6"
2 x 10	12"	22'-3"	20'-3"	15'-4"	20'-9"	19'-5"	14'-8"
	16"	19'-7"	17'-7"	13'-3"	18'-0"	16'-10"	12'-9"
	19.2"	17'-10"	16'-0"	12'-2"	16'-5"	15'-4"	11'-7"
	24"	16'-10"	14'-4"	10'-10"	14'-8"	13'-9"	10'-5"
2 x 12	12"	-	23'-9"	18'-3"	24'-1"	22'-6"	17'-0"
	16"	23'-4"	20'-7"	15'-10"	20'-10"	19'-6"	14'-9"
	19.2"	21'-3"	18'-10"	14'-5"	19'-0"	17'-10"	13'-6"
	24"	19'-0"	16'-10"	12'-11"	17'-0"	15'-11"	12'-0"

Note: An "-" indicates that the horizontal span exceeds 26 feet in length.

Table 306.1.1P
Maximum Rafter Spans
Tile Roof; Ceiling Attached to Rafters
Roof Slope > 7:12

		Hem-Fir			Spruce-Pine-Fir		
Size	Spacing	#1	#2	#3	#1	#2	#3
2 x 6	12"	12'-8"	12'-1"	9'-6"	12'-5"	12'-5"	9'-6"
	16"	11'-4"	10'-9"	8'-3"	10'-10"	10'-10"	8'-3"
	19.2"	10'-4"	9'-9"	7'-6"	9'-11"	9'-11"	7'-6"
	24"	9'-3"	8'-9"	6'-9"	8'-11"	8'-11"	6'-9"
2 x 8	12"	16'-7"	15'-8"	12'-0"	15'-11"	15'-11"	12'-0"
	16"	14'-4"	13'-7"	10'-5"	13'-9"	13'-9"	10'-5"
	19.2"	13'-1"	12'-5"	9'-6"	12'-7"	12'-7"	9'-6"
	24"	11'-9"	11'-1"	8'-6"	11'-3"	11'-3"	8'-6"
2 x 10	12"	20'-3"	19'-2"	14'-8"	19'-5"	19'-5"	14'-8"
	16"	17'-6"	16'-7"	12'-9"	16'-10"	16'-10"	12'-9"
	19.2"	16'-0"	15'-2"	11'-7"	15'-4"	15'-4"	11'-7"
	24"	14'-4"	13'-6"	10'-5"	13'-9"	13'-9"	10'-5"
2 x 12	12"	23'-6"	22'-2"	17'-0"	22'-6"	22'-6"	17'-0"
	16"	20'-4"	19'-3"	14'-9"	19'-6"	19'-6"	14'-9"
	19.2"	18'-7"	17'-7"	13'-6"	17'-10"	17'-10"	13'-6"
	24"	16'-7"	15'-8"	12'-0"	15'-11"	15'-11"	12'-0"

306.1.3 Ridge Boards and Ridge Beams

- A ridge board is required at the roof peak if the slope of the roof is greater than 3:12. The ridge board shall be minimum Standard grade lumber and shall be at least one nominal size (in depth) larger than the rafters. The depth of the ridge board shall not be less than the cut end of the rafters. The rafters shall be placed directly opposite each other. The rafters shall be nailed to the ridge board in accordance with Appendix I.

- A ridge beam is required at the roof peak if the slope of the roof is less than or equal to 3:12. The ridge beam shall be selected from Table 306.1.3 and shall be supported by either posts, walls, or beams at distances not greater than the spans shown in this table.

Table 306.1.3
Maximum Ridge Beam Spans
Roof Slopes ≤ 3:12, Minimum No.2 Grade Lumber
Southern Pine, Douglas Fir-Larch, Hem Fir, Spruce-Pine-Fir

Ridge Beam Size	Roof Span (ft)				
	12	18	24	30	36
1 - 2 x 6	5'-5"	4'-5"	3'-10"	3'-5"	3'-1"
1 - 2 x 8	6'-11"	5'-8"	4'-11"	4'-5"	4'-0"
1 - 2 x 10	8'-4"	6'-10"	5'-11"	5'-3"	4'-10"
1 - 2 x 12	9'-8"	7'-11"	6'-10"	6'-1"	5'-7"
2 - 2 x 6	7'-7"	6'-3"	5'-5"	4'-10"	4'-5"
2 - 2 x 8	9'-9"	8'-0"	6'-11"	6'-2"	5'-8"
2 - 2 x 10	11'-9"	9'-7"	8'-4"	7'-5"	6'-10"
2 - 2 x 12	13'-8"	11'-2"	9'-8"	8'-8"	7'-11"
3 - 2 x 8	12'-0"	9'-9"	8'-6"	7'-7"	6'-11"
3 - 2 x 10	14'-5"	11'-9"	10'-2"	9'-2"	8'-4"
3 - 2 x 12	16'-9"	13'-8"	11'-10"	10'-7"	9'-8"
4 - 2 x 10	16'-8"	13'-7"	11'-9"	10'-6"	9'-7"
4 - 2 x 12	19'-4"	15'-9"	13'-8"	12'-3"	11'-2"

306.1.4 Collar Ties and Rafter Ties

- Minimum 1x6 or 2x4 collar ties shall be installed between every second pair of rafters. Collar ties shall be located in the upper third of the roof height. Collar ties shall be fastened to each rafter in accordance with Appendix I. See Figure 306.1.4A.

- If the ceiling joists run perpendicular to the rafters, then a rafter tie of minimum 2x4 lumber shall be provided in the lower third of the roof height. See Figure 306.1.4B. The rafter tie shall be continuous across the roof span and shall be provided for every other pair of rafters. The rafter tie shall be fastened to the rafters in accordance with Appendix I. If rafter ties are not used, then the foot of at least every other rafter shall be braced in accordance with **Section 305.1.**

306.1.5 Ridge Straps

- Ridge straps may be used in place of collar ties. The ridge strap shall be attached directly to each pair of opposing rafters. See Figure 306.1.5.
- The ridge strap shall be a minimum 1 ¼" x 20 gauge strap. The number of nails required at each end of the strap shall be as specified in Table 306.1.5. The fasteners shall be either minimum 8d common nails or nails with a minimum shank diameter of 0.131 inches and a minimum length of 2 ½ inches.

Table 306.1.5
Number of Nails Required on Each End of Ridge Strap

		Roof Span						
Rafter Spacing	Roof Slope	12'	18'	24'	30'	36'	42'	48'
12"	3:12	2	4	5	6	7	9	10
	4:12	2	3	4	5	6	7	8
	5:12	2	3	3	4	5	6	7
	6:12	2	2	3	4	5	5	6
	7:12	2	2	3	3	4	5	6
	> 7:12	2	2	3	3	4	5	5
16"	3:12	3	5	7	8	10	11	13
	4:12	2	4	5	6	8	9	10
	5:12	2	3	4	6	7	8	9
	6:12	2	3	4	5	6	7	8
	7:12	2	3	4	5	6	6	7
	>7:12	2	3	3	4	5	6	7
19.2"	3:12	4	6	8	10	12	14	16
	4:12	3	5	6	8	9	11	12
	5:12	3	4	6	7	8	10	11
	6:12	3	4	5	6	7	8	10
	7:12	2	3	5	6	7	8	9
	>7:12	2	3	4	5	6	7	8
24"	3:12	5	7	10	12	15	17	20
	4:12	4	6	8	10	12	14	15
	5:12	3	5	7	8	10	12	14
	6:12	3	4	6	8	9	11	12
	7:12	3	4	6	7	8	10	11
	>7:12	3	4	5	7	8	9	10

306.1.6 Cathedral Ceilings

- For cathedral ceilings where there are no collar ties or rafter ties to brace the rafters, ridge straps shall be attached to each pair of opposing rafters. See Figure 306.1.5.
- The ridge straps shall be installed in accordance with **Section 306.1.5.**
- Each rafter shall be anchored to the top plate to resist the thrust load specified in Table 306.1.6. Refer to Figure 306.1.6 for an illustration of the thrust load. NOTE: If a ridge beam is used or if the ridge board is supported by a loadbearing wall, then the thrust anchorage is not required.

Table 306.1.6
Thrust Load Anchorage Required for Cathedral Ceilings (lbs)
(Rafter to Top Plate Connection)

		Roof Span (feet)						
Rafter Spacing	Roof Slope	12	18	24	30	36	42	48
12"	3:12	320	510	700	880	1070	1250	1430
	4:12	240	380	520	660	800	940	1070
	5:12	190	310	420	530	640	750	860
	6:12	160	260	350	440	530	620	710
	7:12	140	220	300	380	460	530	610
	8:12	120	190	260	330	400	470	540
	9:12	110	170	230	290	360	420	480
	10:12	100	150	210	270	320	370	430
	12:12	80	130	170	220	270	310	360
16"	3:12	430	684	930	1180	1420	1670	1910
	4:12	320	510	700	880	1070	1250	1430
	5:12	260	411	560	710	850	1000	1140
	6:12	210	340	470	590	710	830	950
	7:12	180	290	400	500	610	710	820
	8:12	160	260	350	440	530	620	710
	9:12	140	230	310	390	470	550	640
	10:12	130	200	280	350	430	500	570
	12:12	110	170	230	290	360	420	480
19.2"	3:12	510	820	1120	1410	1710	2000	2290
	4:12	380	620	840	1060	1280	1500	1720
	5:12	310	490	670	850	1020	1200	1370
	6:12	260	410	560	710	850	1000	1140
	7:12	220	350	480	610	730	860	980
	8:12	190	310	420	530	640	750	860
	9:12	170	220	370	470	570	670	760
	10:12	150	250	340	420	510	600	690
	12:12	130	200	280	350	430	500	570
24"	3:12	640	1030	1400	1768	2130	2500	2860
	4:12	480	770	1050	1330	1600	1870	2140
	5:12	380	620	840	1060	1280	1500	1720
	6:12	320	510	700	880	1070	1250	1430
	7:12	270	440	600	760	910	1070	1230
	8:12	240	380	520	660	800	940	1070
	9:12	210	340	470	590	710	830	950
	10:12	190	310	420	530	640	750	860
	12:12	160	260	350	440	530	620	710

306.1.7 Uplift Connections - Rafter to Top Plate

At each connection from the rafter to both plates of the double top plate, the anchorage specified in Table 306.1.7 shall be provided. Figures 306.1.7A-B illustrate several types of uplift connections.

Table 306.1.7
Uplift Loads - Rafter to Top Plate (lbs.)

Building Type	Roof Span (ft.)	Rafter Spacing (inches o.c.)			
		12	16	19.2	24
One-Story (Slab-on-grade; Piers)	12	160	210	260	320
	16	190	250	300	380
	20	220	290	350	440
	24	250	330	400	500
	28	280	370	450	560
	32	310	410	500	620
	36	340	450	540	680
	40	370	490	590	740
	44	400	530	640	800
	48	430	570	690	860
Two-Story (Slab-on-grade; Piers) Or One-Story (Pile Foundation)	12	170	230	270	340
	16	200	270	320	400
	20	240	320	380	480
	24	270	360	430	540
	28	310	410	500	620
	32	340	450	540	680
	36	380	500	610	760
	40	410	550	660	820
	44	450	600	720	900
	48	490	650	780	980
Three-Story (Slab-on-grade) Or Two-Story (Pile Foundation)	12	190	250	300	380
	16	230	310	370	460
	20	270	360	430	540
	24	310	410	500	620
	28	350	470	560	700
	32	390	520	620	780
	36	430	570	690	860
	40	470	630	750	940

306.2 Truss Systems

306.2.1 Trusses

- The dimensions of the truss shall not exceed the limitations specified in **Section 207.1.1, Section 207.1.3** and **Section 207.4.**
- All wood trusses shall be designed and certified by a Texas licensed professional engineer.
- Where trusses are used to form a hipped roof, a step-down hip system shall be used. See Figure 306.2.1.
- Roof trusses shall be designed to withstand the wind loads specified in ASCE 7-93. As an alternate to the loads established by ASCE 7-93, the loads indicated in **Section 103** and **Section 208** of this Building Code may be used.
- Trusses shall be braced and anchored as specified on the truss certificate.
- If, along the length of a wall, the uplift load at each truss is equal, then the following guidelines shall be followed:
    - If the spacing of the wall studs match the spacing of the trusses, then each wall stud will carry the same anchorage as the connection of the truss to the top plate.
    - If the spacing of the wall studs do not match the spacing of the trusses, then the anchorage required at each end of the wall studs shall be determined from Table 306.2.1A.
- If the uplift load at each truss varies, then the maximum uplift load shall be used to determine the required anchorage at each wall stud.
- Anchorage of the truss shall be carried down to the foundation. If the truss to top plate anchorage exceeds the values listed in Table 306.2.1B, then the anchorage of the sill plate to the foundation shall be designed by a Texas licensed professional engineer.
- Trusses shall not be altered from their original design condition.
- Damaged trusses shall have an engineer designed repair, or shall be replaced.

Table 306.2.1A
Determination of Anchorage Required at Wall Studs

If the spacing of the wall studs are:	And the spacing of the trusses are:	Then, multiply the truss anchorage by:
12" o.c.	12" o.c.	1.00
16" o.c.	12" o.c.	1.33
24" o.c.	12" o.c.	2.00
12" o.c.	16" o.c.	0.75
16" o.c.	16" o.c.	1.00
24" o.c.	16" o.c.	1.50
12" o.c.	24" o.c.	0.50
16" o.c.	24" o.c.	0.67
24" o.c.	24" o.c.	1.00

Table 306.2.1B
Maximum Allowable Uplift loads for Trusses (lbs.)

	Truss Spacing (inches o.c.)			
Building Type	12	16	19.2	24
One-Story	430	570	690	860
Two-Story	490	650	780	980
Three-Story	470	630	750	940

306.2.2 Truss Design Submittal

- The truss installer shall furnish a sealed truss certificate to the Texas Department of Insurance prior to installation. The certificate shall include the following information:

    1. The design wind loads used to design the truss.
    2. The dead and live loads used to design the truss.
    3. The horizontal and vertical anchorage force required at each bearing point.
    4. The length, size, and grade of each piece of lumber in the truss.
    5. The location and type of any bracing which is necessary.
    6. A statement similar to the following: "This truss design meets or exceeds the wind load requirements of ASCE 7-93 as specified in the T.W.I.A. Building Code for Windstorm Resistant Construction. The wind speed used in this design was 95 miles per hour."
    7. The name and telephone number of the truss fabricator.
    8. The name and telephone number of the design engineer.
    9. As a minimum, the truss designer shall indicate that the anchorage shall be continuous down to the foundation.

- The Texas Department of Insurance reserves the right to request additional information and supporting calculations.
- The truss installation packet shall be on the job site for the inspector.

306.3 Overhangs at Gable Endwalls

The gable endwall overhang may be framed using either a laddered soffit or outlookers.

306.3.1 Laddered Soffits (Lookout blocks)

- If the gable endwall is balloon framed, then the overhang shall be constructed as shown in Figures 306.3.1A-B.
- If the gable endwall overhang is platform framed, then the overhang shall be constructed as shown in Figures 306.3.1C-D.
- The roof overhang at gable endwalls shall not exceed 16 inches.
- The lookout blocks shall be minimum 2x4 SPF lumber. The lookout blocks shall be spaced a maximum of 16 inches on center.
- For balloon framing, the lookout blocks shall be toe-nailed to the double top plate. For platform framing, the lookout blocks shall be toe-nailed to the rafter. The fasteners shall be minimum 3 inches long with a minimum shank diameter of 0.120 inches. A minimum of two fasteners shall be used for each lookout block.
- A fly (barge) rafter shall be secured to the ends of the lookout blocks. The fly rafter shall be minimum 2x4 SPF lumber. The rafter shall be end-nailed to the lookout blocks with minimum 3 inch long fasteners with a minimum shank diameter of 0.120 inches. A minimum of two fasteners shall be used for each lookout block.

306.3.2 Outlookers (Laid on end)

- If the gable endwall is balloon framed, then the overhang shall be constructed as shown in Figures 306.3.2A-B.
- If the gable endwall overhang is platform framed, then the overhang shall be constructed as shown in Figures 306.3.2C-D.
- The roof overhang at gable endwalls shall not exceed 24 inches.
- Outlookers shall be continuous from the fly (barge) rafter, across the gable endwall framing, and into the first rafter or truss in the interior of the structure.
- The outlookers shall be minimum 2x4 SPF lumber. The outlookers shall be spaced a maximum of 16 inches on center.
- Each outlooker shall be anchored to the top plate of the drop gable endwall. One of the following two methods shall be used: (1) Anchor the outlooker to the top plate with a framing anchor or strap capable of resisting an uplift load of 120 lbs. (2) Toe-nail the outlooker to the top plate with a minimum of three fasteners with a minimum length of 3 inches and a minimum shank diameter of 0.120 inches.

- Each outlooker shall be toe-nailed to the first rafter or truss in the interior of the structure with a minimum of two fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.

- Full-height blocking shall be provided between each outlooker. The blocking shall be toe-nailed to the rafter or top chord of the truss with a minimum of 4 fasteners. The fasteners shall be minimum 3 inches in length and have a minimum shank diameter of 0.120 inches. The blocking does not need to be fastened to the outlookers.

- A fly (barge) rafter shall be secured to the ends of the outlookers. The rafter shall be minimum 2x4 SPF lumber. The rafter shall be end-nailed to the outlookers with minimum 3 inch long fasteners with a minimum shank diameter of 0.120 inches. A minimum of two fasteners shall be used for each outlooker.

306.3.3 Outlookers (Laid Flat)

- This method shall only be used if the gable endwall is platform framed.

- The overhang shall be constructed as shown in Figures 306.3.3A-B.

- The roof overhang at the gable end shall not exceed 16 inches.

- Outlookers shall be continuous from the fly (barge) rafter, across the gable endwall framing, and into the first rafter or truss in the interior of the structure.

- The outlooker shall rest in a notch that has been cut into the gable endwall rafter or gable endwall truss.

- The outlookers shall be minimum 2x4 SPF lumber.

- The outlookers shall be spaced a maximum of 16 inches on center.

- Each outlooker shall be face-nailed to the notched gable endwall rafter or gable endwall truss with a minimum of three fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 3 inches. As an alternative, each outlooker may be anchored to the notched gable endwall rafter or gable endwall truss with a framing anchor capable of resisting 120 lbs.

- Each outlooker shall be toe-nailed to the first rafter or truss in the interior of the structure with a minimum of two fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.

- A fly (barge) rafter shall be secured to the ends of the outlookers. The rafters shall be minimum 2x4 SPF lumber. The rafter shall be end-nailed to the outlookers with minimum 3 inch long fasteners with a minimum shank diameter of 0.120 inches. A minimum of two fasteners shall be used for each outlooker.

306.4 Roof Deck

- The roof deck sheathing shall consist of wood structural panels.

- The minimum sheathing thickness of the roof deck shall be $\frac{7}{16}$ inch.

- Sheathing panels shall be oriented with their long dimension across the roof framing members. End joints shall occur over the centers of framing members. End joints of adjacent courses shall be staggered.

- A ⅛-inch space shall be provided between panel ends and edges during installation.

- The roof sheathing shall be fastened to the roof framing with either minimum 8d common nails or equivalent fasteners specified in Appendix I. The fasteners shall be spaced a maximum of 6 inches on center along panel edges and a maximum of 12 inches on center along intermediate framing members. See Figure 306.4.

- For roof sheathing within 4 feet of the perimeter edge of the roof, including 4 feet on each side of the roof ridge, the nail spacing at panel edges shall be a maximum of 4 inches on center and the nail spacing along intermediate framing members shall be a maximum of 6 inches on center. See Figure 306.4.

- At gable endwall framing, the fasteners used to secure the roof sheathing to the framing shall be spaced a maximum of 4 inches on center as shown in Figures 306.3.1B, 306.3.1D, 306.3.2B, 306.3.2D, and 306.3.3B.

- Blocking between roof framing members is not required except as shown in Figures 306.3.2A-B and 306.3.2C-D.

306.5 Dormers

306.5.1 General

- The dormer described in this section frames into the roof framing of the structure.
- The dormer shall be constructed as shown in Figure 306.5.1.

306.5.2 Attachment of Dormer to Roof Framing

- A double rafter shall be used on either side of the dormer to support dormer framing. See Figure 306.5.1. Note: If needed, either three rafters or a 2x4 ledger fastened to the rafters may be required to provide a nailing surface for the roof sheathing. If a ledger is used, then the ledger shall be fastened to the rafters with minimum 0.120" x 3" long smooth shank nails spaced a maximum of 6 inches on center.
- A double header shall be provided at the front and rear of the dormer. Roof framing shall frame into the sides of the double headers.
- A 2x4 bottom plate shall be fastened directly to the rafters and to the double header at the front of the dormer. See Figure 306.5.1. The bottom plate shall be fastened to the rafters and the double header with either lag bolts or nails. If lag bolts are used, the lag bolts shall be minimum $\frac{3}{8}$ inch diameter and spaced a maximum of 24 inches on center. The lag bolts shall penetrate a minimum of $1\frac{1}{2}$ inches into the framing members. A lag bolt shall be located at each corner of the dormer. If nails are used, then the nails shall be minimum 0.120" x 3" long smooth shank nails. The nails shall be spaced a maximum of 3 inches on center.

306.5.3 Wall Framing of Dormer

The walls of the dormer shall be constructed in accordance with **Section 303** and as specified in this section.

306.5.3.1 Top Plates of Dormer

- Along the sides of the dormer, a single top plate may be used. See Figure 306.5.1. The top plates shall be fastened to the roof framing with minimum two 0.120" x 3" long smooth shank nails.
- Along the front of the dormer, a double top plate shall be used. See Figure 306.5.1.

306.5.3.2 Framing Around Openings of Dormer

- Along the front of the dormer, the double top plate may be used as the window header if the opening is less than 4 feet in width. See Figure 306.5.1.
- If the opening along the front of the dormer is greater than 4 feet, but less than or equal to 6 feet, a double 2x4 header shall be used.

306.5.3.3 Wall Sheathing of Dormer

- The walls of the dormer shall be sheathed.
- If wood structural panels are used, then the wood structural panels shall be minimum $\frac{3}{8}$ inch. The wood structural panels shall be attached to the dormer framing with the minimum size fasteners specified in Appendix I. The fasteners shall be spaced a maximum of 6 inches on center along panel edges and 12 inches on center along intermediate framing.
- Other sheathing and panel products may be used. These products may need to be evaluated by the Texas Department of Insurance for wind load resistance.
- The sheathing material may not be used for shear resistance.

306.5.4 Roof Framing of Dormer

- The roof framing of the dormer shall be constructed in accordance with **Section 306**.
- The ridge board and valley rafters shall be fastened to the double header at the rear of the dormer with minimum three 0.120" x 3" long smooth shank nails.
- The valley rafters shall be fastened to the top plate of the dormers with minimum three 0.120" x 3" long smooth shank nails.

306.5.5 Roof Coverings of Dormer

The roof coverings of the dormer shall be installed in accordance with **Section 307**.

306.5.6 Exterior Openings of Dormer

The exterior openings of the dormer (windows and skylights) shall be installed in accordance with **Section 308**.

306.5.7 Exterior Coverings of Dormer

The exterior coverings of the dormer shall be installed in accordance with **Section 309**.

307 Roof Coverings

Wood decks shall be applied as specified in **Section 306.4**.

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

307.1 Composition Shingle Roof

307.1.1 Underlayment

- Underlayment shall comply with ASTM D 226, ASTM D 4869, ASTM D 1970, or as recommended by the manufacturer's installation instructions.
- For roof slopes greater than or equal to 4:12, a minimum of one layer of 30 pound felt shall be applied over the entire roof deck.
- For roof slopes greater than or equal to 2:12 but less than 4:12, two layers of 30 pound felt shall be applied over the entire roof deck.
- The felt shall be fastened to the deck using either 11 gauge (0.120 inch diameter) or 12 gauge (0.105 inch diameter) nails with minimum ⅜ inch diameter heads. The nails shall be of sufficient length to penetrate completely through the roof deck.
- For composition shingles that have passed Underwriters Laboratories test UL 997, and are rated at less than 95 mph, the underlayment shall be installed as follows:
    - If one layer of felt is used, it shall be lapped a minimum of 2 inches on the edges and 4 inches on the ends. One row of fasteners shall be spaced 12 inches on center along the laps, and one row of fasteners shall be spaced 24 inches on center in the field. See Figure 307.1.1A for single layer underlayment application.
    - If two layers of felt are used, they shall be installed in the following manner. Place a 19 inch wide starter strip of felt along the eaves. Next place a full 36 inch wide sheet along the eaves completely overlapping the starter strip. All succeeding courses shall be full width strips and shall overlap the proceeding strip by 19 inches. One row of fasteners shall be spaced 12 inches on center along the laps. End laps shall be lapped a minimum of 12 inches with the edges fastened to the deck 12 inches on center. See Figure 307.1.1B for double layer underlayment application.
    - The fasteners shall be applied through minimum 1½ inch diameter tin caps or equivalent corrosion resistant caps that have been accepted by the Texas Department of Insurance.
    - The felt shall be attached to the deck at the eaves and at the ridge with fasteners spaced 12 inches on center.
    - At a minimum, valleys shall have an extra layer of underlayment.
- For composition shingles that have passed Underwriters Laboratories UL 997, and are rated at 95 mph or greater, the underlayment shall be installed as follows:

- If one layer of felt is used, it shall be lapped a minimum of 2 inches on the edges and 4 inches on the ends.

- If two layers of felt are used, they shall be installed in the following manner. Place a 19 inch wide starter strip of felt along the eaves. Next, place a full 36 inch wide sheet along the eaves completely overlapping the starter strip. All succeeding courses shall be full width strips and shall overlap the proceeding strip by 19 inches. End laps shall be lapped a minimum of 12 inches.

- At a minimum, valleys shall have an extra layer of underlayment.

- Unless the underlayment manufacturer or shingle manufacturer has specific attachment requirements, the underlayment shall be fastened to the roof deck with an adequate number of fasteners to hold it in place until the composition shingles are applied.

307.1.2 Metal Drip Edge

- If a metal drip edge is used, then the drip edge shall be fastened to the roof deck with roofing nails specified in **Section 307.1.3** and spaced a maximum of 10 inches on center.

- At the eaves, the drip edge shall be applied directly to the deck. The felt shall be applied over the drip edge in accordance with **Section 307.1.1**.

- At the gable ends, the felt shall be applied first, then the drip edge shall be fastened over the felt.

307.1.3 Composition Shingles

- A composition shingle roof shall not be installed on a building with roof slopes less than 2:12.
- Composition shingles shall be only those products listed by Underwriters Laboratories as "Wind Resistant". This means they must have passed UL Standard 997.
- Composition shingles shall be applied using 6 nails per shingle.
- Composition shingles shall have self-seal strips or shall be interlocking.
- Roofing nails shall have a minimum shank diameter of 0.105 inch (12 gauge) and a minimum head diameter of ⅜ inch. Nails shall be long enough to penetrate completely through the shingle, felt, and at least ¾ inch into or through the roof sheathing.
- Fasteners shall be properly driven. See Figure 211.4.1.
- Nails shall be located on the correct fastener line.
- A starter course shall be applied at the eaves in an approved manner, using 6 nails per shingle, located 2 to 3 inches back from the roof edge. The starter course shall be staggered from the first course, unless a different type of shingle is used for the starter course. See Figure 307.1.3A for composition shingle application.
- The starter course and first course shall overhang the eave by ¼ to ⅜ inch, unless a drip edge is used, in which case less of an overhang will be acceptable.
- The first course of shingles shall be sealed to the starter course with asphalt plastic cement. The asphalt plastic cement shall be applied between the starter course and the first course using one of the following methods: application of a continuous bead of cement; placement of three dabs of cement, approximately 1" in diameter; or application of a 2" wide band of cement using a trowel with a ¼" notch. The asphalt plastic cement is applied to the starter strip using one of the above methods so that the overlying tab of the first course will be adhered. If using the continuous bead or band of cement to seal the first course to the starter course, provide gaps approximately 1 inch wide at about 12 inches on center to allow drainage of water that reaches the starter strip. See Figure 307.1.3B.
- Along the gable end (rake edges), if a metal drip edge is not used, then a bleeder strip or rake starter shall be used. Bleeder strips (rake starter) are cut from full-width self-sealing shingles by cutting the tabs (or bottom portion if no cut-outs) off of the shingle. The first bleeder strip (rake starter) may be installed full-length. Butt the first bleeder strip (rake starter) to the upslope edge of the starter course. The bleeder strip shall be applied with 6 nails per shingle.
- Shingles along the gable ends (rake edges) shall be sealed to each other and the metal drip edge or bleeder strip with asphalt plastic cement. The asphalt plastic cement shall be applied between the shingle and bleeder strip or metal drip edge and between the shingle and previous shingle tab using either a continuous bead of cement; two dabs of cement, approximately 1" in diameter; or a 2" wide band of cement using a trowel with a ¼" notch. The asphalt plastic cement shall be placed on the shingle about 1 inch from the rake edge. The next shingle shall be set in place and fasteners applied with the exception of the nail at the rake. The rake end of the shingle shall be pressed to set the shingle in the cement and the nail at the rake shall be applied. Nails shall be 1 to 1 ½ inches back from the rake. See Figure 307.1.3B.

- Asphalt plastic cement shall conform to ASTM D 4586.

- Closed cut valley shingles shall be sealed together with asphalt plastic cement. After the valley flashing has been installed, shingles from the roof plane with the lower slope or lesser height shall extend approximately 12 inches across the valley and onto the adjoining roof. The shingles shall be nailed no closer than 6 inches from the centerline of the valley. Shingles shall then be applied on the adjoining roof plane and trimmed at least 2 inches back from the valley centerline. Approximately 1 inch of the tip of the valley cut shall be trimmed back to leave a square edge on the valley end of the shingle. The valley cut on the end of each shingle shall then be embedded in a 3 inch wide strip of plastic asphalt cement.

- Open cut valley shingles shall be installed in the same manner as closed cut valley shingles with the exception that shingles on both roof planes are cut back 2 inches from the valley centerline. Shingles on both sides of the valley centerline are then sealed with asphalt plastic cement in the manner described above for closed cut valley shingles.

- The maximum overhang for shingles shall not exceed $\frac{3}{8}$ inch.

307.2 Wood Shingle or Shake Roof

Wood shingles or shakes shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

307.3 Tile Roofs

Tile roofs shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

307.4 Manufactured Metal Roofing

Manufactured metal roofing, similar to that used on metal buildings, shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

307.5 Built-Up Roofing

Built-up roofing shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

307.6 Single Ply and Modified Bitumen Roofing

Single ply and modified bitumen roofing shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

308 Exterior Openings

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4.**

308.1 Exterior Doors

- Exterior doors shall be capable of resisting the design wind pressures specified in Table 308.1.
- Exterior doors shall be installed in accordance with the manufacturer's installation instructions and in accordance with the manner in which they were tested for wind load resistance. The exterior doors shall be evaluated by the Texas Department of Insurance to determine if they meet the wind pressure requirements specified in this building code.
- For wood frame construction, headers above doors shall comply with **Section 303.3**. For masonry construction, lintels above doors shall comply with **Section 304.5.**
- Fasteners shall be properly driven. See Figure 211.4.1.
- For masonry construction, doors may be secured to a wood nailer that, in turn, is secured to the perimeter of the masonry wall opening. The wood nailer shall be minimum 2x pressure treated dimension lumber. The minimum grade and species of the wood nailer as well as the attachment of the door to the wood nailer shall be as specified in the Texas Department of Insurance's product evaluation report for the door. The wood nailer shall be secured to the perimeter of the masonry wall opening with minimum ¼ inch diameter concrete screws. As an alternative, masonry anchors may be used. The masonry anchors shall have a minimum design shear capacity of 84 lbs. The fasteners used shall be long enough to penetrate through the wood nailer and into the concrete masonry unit a minimum of 1 ¼ inches. An anchor shall be located within 2 inches of each end of the wood nailer. The anchors shall be spaced a maximum of 12 inches on center along the wood nailer. See Figure 308.1 for an illustration of the attachment of the wood nailer. The design wind pressure rating for the door shall not exceed 42 psf. The door opening shall not exceed 6 feet by 9 feet.

Table 308.1
Design Wind Pressure Requirements for Exterior Doors [1]

Mean Roof Height (ft)	Design Pressures (psf)	
	Positive	Negative
18	30	32
27	34	36
33	35	38

Note: [1] Design pressures are for both interior zones and corner zones.

308.2 Garage Doors

- Garage doors shall be capable of resisting the design wind pressures specified in Table 308.2.
- Garage doors shall be installed in accordance with the manufacturer's installation instructions and in accordance with the manner in which they were tested for wind load resistance. The garage doors shall be evaluated by the Texas Department of Insurance to determine if they meet the wind pressure requirements specified in this building code.

307.7 Roll Roofing

Roll roofing shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

307.8 Other Roofing Systems

Other roofing systems shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

- For wood frame construction, headers above garage doors shall comply with **Section 303.3**. For masonry construction, lintels above garage doors shall comply with **Section 304.5**.
- Fasteners shall be properly driven. See Figure 211.4.1.

Table 308.2
Design Wind Pressure Requirements for Garage Doors [1]

Mean Roof Height (ft)	Design Pressures (psf)	
	Positive	Negative
18	27	29
27	31	33
33	33	35

Note: [1] Design pressures are for both interior zones and corner zones.

308.3 Exterior Windows

- Exterior windows shall be capable of resisting the design wind pressures specified in Table 308.3.
- Exterior windows shall be installed in accordance with the manufacturer's installation instructions and in accordance with the manner in which they were tested for wind load resistance. The exterior windows shall be evaluated by the Texas Department of Insurance to determine if they meet the wind pressure requirements specified in this building code.
- For wood frame construction, headers above windows shall comply with **Section 303.3**. For masonry construction, lintels above windows shall comply with **Section 304.5**.
- Fasteners shall be properly driven. See Figure 211.4.1.
- For masonry construction, windows may be secured to a wood nailer that, in turn, is secured to the perimeter of the masonry wall opening. The wood nailer shall be minimum 2x pressure treated dimension lumber. The minimum grade and species of the wood nailer as well as the attachment of the window to the wood nailer shall be as specified in the Texas Department of Insurance's product evaluation report for the window. The wood nailer shall be secured to the perimeter of the masonry wall opening with minimum ¼ inch diameter concrete screws. As an alternative, masonry anchors may be used. The masonry anchors shall have a minimum design shear capacity of 84 lbs. The fasteners shall be long enough to penetrate through the wood nailer and into the concrete masonry unit a minimum of 1¼ inches. An anchor shall be located within 2 inches of each end of the wood nailer. The anchors shall be spaced a maximum of 12 inches on center along the wood nailer. See Figure 308.3 for an illustration of the attachment of the wood nailer. The design wind pressure rating for the window shall not exceed 42 psf. The window opening shall not exceed 6 feet by 9 feet.

Table 308.3
Design Wind Pressure Requirements for Exterior Windows [1]

Mean Roof Height (ft)	Design Pressures (psf)	
	Positive	Negative
18	30	32
27	34	36
33	35	38

Note: [1] Design pressures are for both interior zones and corner zones.

308.4 Skylights

- Skylights shall be capable or resisting the design wind pressures specified in Table 308.4.
- Skylights shall be installed in accordance with the manufacturer's installation instructions and in accordance with the manner in which they were tested for wind load resistance. The skylights shall be evaluated by the Texas Department of Insurance to determine if they meet the wind pressure requirements specified in this building code.
- Fasteners shall be properly driven. See Figure 211.4.1.

Table 308.4
Design Wind Pressure Requirements for Skylights [1]

Mean Roof Height (ft)	Roof Slope	Design Pressures (psf)	
		Perimeter [1]	Field [1]
18	< 3:12	-55; *	-29; *
	3 to 7:12	-52; *	-28; *
	> 7:12	-38; +31	-33; +31
27	< 3:12	-58; *	-30; *
	3 to 7:12	-59; *	-31; *
	> 7:12	-41; +33	-35; +33
33	< 3:12	-65; *	-34; *
	3 to 7:12	-63; *	-33; *

Notes: [1] The perimeter of the roof shall be those areas within 4 feet of the roof edge and within 4 feet on each side of the roof ridge. The perimeter shall also include all roof corners. The field shall consist of those areas lying outside of the perimeter.

Where an ' * ' occurs, ASCE 7-93 does not specify a positive wind pressure requirement. Recommend using the positive wind pressure requirement for roof slopes > 7:12. For mean roof heights of 33', recommend using +34 psf.

308.5 Protection of Exterior Openings

Protection of exterior openings is currently not required for the inland areas. See **Section 408.5** for requirements in the seaward areas.

309 Exterior Coverings

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4.**

309.1 Wood Structural Panel Siding

- All wood structural panel siding shall be properly rated by an approved agency for the application being used.
- Panel siding having a thickness of ½ inch or less shall be fastened to the studs in accordance with Table 309.1. Note: Sheathing greater than ½ inch thick shall be fastened to the studs using minimum 8d common nails.

Table 309.1
Minimum Common Nail Size for Wood Structural Panel Siding

Species of Studs	Spacing of Studs		
	12 in.	16 in.	24 in.
Southern Pine	6d	6d	8d
Douglas Fir-Larch	6d	8d	8d
Hem-Fir	8d	8d*	8d*
Spruce-Pine-Fir	8d	8d*	8d*

- Where minimum 6d common nails are required, an alternative fastener with a minimum shank diameter of 0.113 inches and a minimum length of 2 inches may be used. Where minimum 8d common nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 2 ½ inches may be used.
- The nails shall be spaced a maximum of 6 inches on center along all panel edges, and a maximum of 12 inches on center along intermediate framing, except where indicated by an '*', where nails shall be spaced a maximum of 6 inches on center along all panel edges and along all studs.
- If insulation is placed between the siding and the studs, then the required nail length shall be increased by the thickness of the insulation.
- Fasteners shall be properly driven. See Figure 211.4.1.
- Building paper, or an equivalent moisture barrier, shall be installed if panels are applied directly to studs unless panel edges are shiplapped, battened, or caulked.
- If wood structural panel siding is to be used as structural sheathing, then the siding shall be evaluated for shear load resistance by the Texas Department of Insurance. It may be necessary for the Texas Department of Insurance to develop a product evaluation report for the wood structural panel siding product.

309.2 Horizontal Board Siding

- Horizontal board siding shall be nailed to each stud in the locations shown in Figure 309.2.
- If wall studs are spaced 24 inches on center, then siding shall be applied over solid sheathing.
- Horizontal siding shall be nailed to each stud using either minimum 8d box nails or nails with a minimum shank diameter of 0.113 inches and a minimum length of 2½ inches. When siding is nailed to Hem-Fir or Spruce-Pine-Fir studs spaced 24 inches on center, a minimum of either 8d common nails or nails with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches shall be used.
- Where only one nail per stud is used for siding 8 inches or greater in width, a minimum of 10d common nails shall be used. When siding is nailed to Hem-Fir or Spruce-Pine-Fir studs spaced 24 inches on center, a minimum of 16d common nails shall be used.
- Fasteners shall be properly driven. See Figure 211.4.1.
- If insulation is placed between the siding and the studs, then the required nail length shall be increased by the thickness of the insulation.
- The installation instructions of the siding manufacturer shall be followed if additional nailing is specified.
- Horizontal siding shall not be used for lateral load resistance.

309.3 Vertical Board Siding

- Vertical board siding shall only be board on board, board and batten, drop, tongue and groove, channel rustic, or log cabin patterns.
- Vertical board siding shall be fastened to minimum 2x4 horizontal blocking, spaced a maximum of 24 inches on center vertically. Blocking shall be nailed to the studs in accordance with Table 309.3A. Where minimum 8d box nails are required, an alternative fastener with a minimum shank diameter of 0.113 inches and a minimum length of 2½ inches may be used. Where minimum 12d box nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 3 inches may be used.

Table 309.3A
Minimum Nailing at Each End of Blocking to Studs for Vertical Board Siding

Spacing of Studs	
12 in. and 16 in. o.c.	24 in. o.c.
1-8d box nail toe-nailed or 1-12d box nail end-nailed	2-8d box nails toe-nailed or 2-12d box nails end-nailed

- Siding shall be nailed to each horizontal member (blocking and plates) as shown in Figure 309.2.

- Nails shall be sized in accordance with Table 309.3B. Where minimum 8d common nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches may be used. Where one 10d common nail is required, two 8d common nails may be used. Where two 10d common nails are required, three 8d common nails may be used.

- The length of nails used to fasten batten boards shall be increased by the thickness of the batten board.

- If insulation is placed between the siding and the studs, then the required nail length shall be increased by the thickness of the insulation.

- Fasteners shall be properly driven. See Figure 211.4.1.

- Vertical board siding shall not be used for lateral load resistance.

Table 309.3B
Minimum Common Nail Size-Siding to Blocking for Vertical Board Siding

Species of Blocking	Width and Location of Siding	
	4 in. to 6 in.	8 in. to 12 in.
Southern Pine	1-8d	2-8d
Douglas Fir-Larch	1-8d	2-8d
Hem-Fir	1-8d	2-8d
Spruce-Pine-Fir	1-10d	2-10d

309.4 Diagonal Board Siding

- Diagonal board siding shall be nailed to each stud and to sole or bottom plates in accordance with Table 309.4. Where minimum 8d common nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches may be used. Where one 10d common nail is required, two 8d common nails may be used. Where either two 10d or 12d common nails are required, three 8d common nails may be used.

Table 309.4
Minimum Common Nail Size-Diagonal Siding to Studs and Plates

Species of Studs	Stud spacing and Width of Siding			
	12 in. and 16 in. o.c.		24 in. o.c.	
	4 in. to 6 in.	8 in. to 12 in.	4 in. to 6 in.	8 in. to 12 in.
Southern Pine	1-8d	2-8d	1-8d	2-8d
Douglas Fir-Larch	1-8d	2-8d	1-8d	2-8d
Hem-Fir	1-8d	2-8d	1-10d	2-10d
Spruce-Pine-Fir	1-8d	2-8d	1-10d	2-12d

- Nails shall be placed in locations shown in Figure 309.2.
- Fasteners shall be properly driven. See Figure 211.4.1.
- If insulation is placed between the siding and the studs, then the required nail length shall be increased by the thickness of insulation.
- Diagonal board siding shall not be used for lateral load resistance.

309.5 Brick Veneer or Stone Veneer

- This section applies only to non-loadbearing brick or stone veneer. Brick and stone veneer shall not be used for lateral load resistance.
- Brick veneer shall be applied over a solid wall (plywood, OSB, fiberboard, insulating board, etc.). See Figure 309.5 for brick veneer application. Sheathing for shearwalls shall be installed in accordance with **Section 303.4.**
- A moisture barrier shall be applied over the wall sheathing unless the sheathing is water repellent.
- A moisture barrier such as flashing or felt shall be applied to at least the lowest 12 inches of the wall studs and shall extend completely under the brick starter course.
- Weep holes shall be provided in the bottom course of brick at least every 4 feet.
- A minimum 1 inch air space shall be provided between the veneer and wall sheathing.
- The veneer shall be tied to the wood framing with corrosion-resistant metal brick ties.
- Veneer ties shall be either minimum 6 inch long, ⅞ inch wide, 22 gauge corrugated sheet metal; minimum number 6 gauge wire with a minimum 2 inch hook embedded in mortar; or other equivalent fastener.
- The ties shall be embedded a minimum of 2 inches into the bed joints of the veneer.
- Brick ties shall be spaced a maximum of 16 inches vertically along each stud when studs are spaced 12 and 16 inches on center, and 12 inches vertically along each stud when studs are spaced 24 inches on center.
- Each brick tie shall be nailed to each stud with a single common nail in accordance with Table 309.5. Where minimum 6d common nails are required, an alternative fastener with a minimum shank diameter of 0.113 inches and a minimum length of 2 inches may be used. Where minimum 8d common nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches may be used. Where minimum 10d common nails are required, an alternative fastener with a minimum shank diameter of 0.131 inches and a minimum length of 3 inches may be used if the vertical spacing of the ties is reduced to 12 inches on center for studs spaced 16 inches on center or less and 9 inches on center for studs spaced 24 inches on center.
- Type N or S mortar shall be used.

Table 309.5
Minimum Common Nail Size for Brick Ties

Species of Studs	Spacing of Studs		
	12 in.	16 in.	24 in.
Southern Pine	6d	6d	8d
Douglas Fir-Larch	6d	8d	8d
Hem-Fir	8d	10d	10d
Spruce-Pine-Fir	8d	10d	10d

309.6 Stucco

- Stucco shall be applied over wood structural panels, or other solid wall type, such as masonry.
- A moisture barrier shall be applied over the wood structural panels.
- Wall studs beneath stucco shall not be spaced more than 16 inches on center.
- Lath for stucco shall be galvanized or other approved corrosion resistant material.
- The lath shall be fastened to each stud in accordance with Table 309.6. Fasteners shall be either 8d common nails or nails with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches driven into the stud until ¾-inch is exposed, then clinched over, or 11 gauge (0.120 inch) x 2 inch long roofing nails with heads large enough to prevent the lath from slipping over the head.
- The finished stucco shall have a minimum thickness of ⅝ inch.

Table 309.6
Fastener Spacing Along the Studs for Lath to Studs or Solid Wood Sheathing

Species of Studs	Spacing of Studs	
	12 in.	16 in.
Southern Pine	16" o.c.	16" o.c.
Douglas Fir-Larch	16" o.c.	16" o.c.
Hem-Fir	12" o.c.	6" o.c.
Spruce-Pine-Fir	6" o.c.	6" o.c.

309.7 Vinyl, Aluminum, and Steel Siding

- Application methods for each manufacturer of vinyl, aluminum, or steel siding shall be established through testing by an approved, independent laboratory, using an approved test. Since each type of siding may be tested differently, there will be different application requirements for different kinds of siding. Contact the local field office or the Austin office for approved types and application instructions.
- Tests must establish an application which will comply with the components and cladding wind loads of **Section 102** or **Section 103**.

309.8 Exterior Insulation and Finish Systems

- Exterior Insulation and Finish Systems shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.
- Tests must establish an application which will comply with the components and cladding wind loads of **Section 102** or **Section 103**.

309.9 Attic Vents

For gabled and hipped roofs, ventilation shall be provided to furnish cross ventilation of each separate space with weather protected vents. Flat roofs shall be ventilated along the overhanging eaves. Equal vent areas should be placed on opposite sides of the structure to allow cross-ventilation.

309.10 Turbine and Ridge Vents

Turbine and ridge vents shall be installed as per the manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** and **Section 103**. Complete test reports, including the method of installation, shall be submitted.

310 Mechanical and Exterior Equipment

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

310.1 Exterior Air Conditioner Equipment

310.1.1 Air Conditioning Units Supported by a Pad on the Ground

- The air conditioning unit shall be supported by a concrete pad. The concrete pad shall have enough weight to prevent the air conditioning unit from either sliding along the ground or from tipping over during a high wind event. The concrete pad shall weigh a minimum of 90 lbs. If the air conditioning unit has an unusually high profile, then a heavier concrete pad may be required.

- The air conditioning unit shall be anchored to the concrete pad. As a minimum, square units shall be anchored at four locations and round units shall be anchored at three locations.

- The manufacturer or distributor of the air conditioning unit shall specify the method of anchoring the unit. If metal framing connectors are used to anchor the unit, then they shall be used in the manner that is consistent with their design. It is recommended that the manufacturer or distributor of the air conditioning unit submit to the Texas Department of Insurance a recommended method of anchoring the units to the pad.

- The anchorage provided shall prevent the air conditioning unit from racking or sliding on the concrete pad. The Texas Department of Insurance will determine if the unit has been securely anchored.

310.1.2 Air Conditioning Units Supported by a Cantilevered Platform

- If the air conditioning unit rests on a platform that extends less than four feet from the building, then the platform is not required to be supported by posts.

- The platform shall consist of joists that cantilever out from the building. The joists shall be minimum 2x8 No. 2 pressure treated lumber spaced a maximum of 16 inches on center. Each joist shall extend into the building a minimum distance of two times the distance they extend out from the building. Each of the cantilevered joists shall lap a floor joist. Joists shall be nailed together with either minimum 10d common nails or nails with a minimum shank diameter of 0.131 inches and a minimum length of 3 inches. The fasteners shall be spaced a maximum of 6 inches on center along each edge of the joists.

- The deck for the platform shall consist of nominal one inch thick pressure treated lumber. Each member shall be fastened to each cantilevered joist they cross with either two 8d common nails or two nails with a minimum shank diameter of 0.131 inches and a minimum length of 2½ inches.

- The air conditioning unit shall be anchored to the deck as specified in **Section 310.1.1**.

310.1.3 Air Conditioning Units Resting Upon a Supported Platform

- If the air conditioning unit rests on a platform that extends 4 feet or greater from the building, then the platform shall be supported by posts.
- Minimum 4x4 pressure treated wood posts shall be used. If a beam is used at the end of the deck and the posts are notched to provide a seat for the beam, then minimum 6x6 pressure treated wood posts shall be used. If a beam is used, it shall be a minimum of two 2x6 No. 2 pressure treated lumber.
- The posts shall be anchored in accordance with **Section 311.4**.
- Joists used to support the air conditioning unit shall be minimum 2x6 No. 2 pressure treated lumber. They shall be spaced a maximum of 16 inches on center. The joists shall be fastened to the band joist of the building and to the beam, if used, in accordance with Appendix I. If the joists frame into the band joist or a beam, if used, then they shall be supported by either a metal joist hanger or a ledger strip. The ledger strip shall be fastened to the band joist and beam, if used, in accordance with Appendix I.
- The joists shall be anchored against uplift in accordance with the Uplift per Rafter specified in Table 311.4.2.
- The deck shall be constructed as specified in **Section 310.1.2**.
- The air conditioning unit shall be anchored to the deck as specified in **Section 310.1.1**.

310.1.4 Air Conditioning Units Supported by a Flat Roof

- Air conditioner equipment on top of either a built-up or modified bitumen roof shall be anchored to a wood platform or wood blocking. The wood members shall be pressure treated.
- The platform shall be embedded into the built-up or modified bitumen roof.
- The manufacturer or distributor of the air conditioning unit shall specify the method of anchoring the air conditioning unit. If metal framing connectors are used to anchor the unit, then they shall be used in the manner that is consistent with their design. It is recommended that the manufacturer or distributor of the air conditioning unit submit to the Texas Department of Insurance a recommended method of anchoring the units to the pad.

310.2 Other Exterior Equipment

All other exterior equipment, such as floodlights, propane tanks, swimming pool filters, and water cooling towers, shall be sufficiently anchored to the structure or adequate foundation to resist applicable wind loads.

311 Miscellaneous Construction

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4.**

311.1 Alternative Forms of Construction

Manufactured metal buildings and other forms of construction that are built using building materials and/or construction methods not contained in the prescriptive sections of this code shall be designed by a Texas licensed professional engineer for the wind loads specified in **Section 102** or **Section 103.** The contractor shall furnish a certificate of design and installation instructions to the Texas Department of Insurance. Refer to **Section 107** for certification by engineers. Installation instructions shall be followed exactly. The foundation is considered to be part of the structure, and therefore must be part of the original approved design. Installation of mechanical and exterior equipment shall comply with **Section 310.** The local field offices or the engineering staff may be contacted for further information.

311.2 Post Frame Construction

This section applies to structures that have a frame consisting of vertical posts embedded into the ground and horizontal members called girts fastened to the posts.

311.2.1 General Framing Requirements

- The eave height of the structure shall be 16 feet or less.
- The maximum width of the structure shall be 20 feet.
- The roof slope shall be limited to 5:12 or less.
- Table 311.2.1A specifies the minimum size, spacing, and embedment depth for posts. This table applies to post frame construction with 3 rows of posts spaced 10 feet apart.
- Table 311.2.1B specifies the minimum size, spacing, and embedment depth for posts. This table applies to post frame construction with a clear span of 20 feet between posts.
- Posts may be either round or square.
- Posts shall be treated with an approved wood preservative.
- If 4-inch diameter posts are used, concrete shall be poured around the post a minimum of 3 feet below the ground surface.
- All exterior and interior posts shall be fastened to beams as specified in Table 311.2.1A and Table 311.2.1B.
- A post shall be notched only enough to provide a shelf for the supporting beams. No more than ½ of the post thickness shall be removed.

Table 311.2.1A
Post and Beam Requirements
(Three Rows of Posts 10 Feet on Center)

Height (ft.)	Post Size (in.)	Spacing (ft.)	Embedment Depth (ft.)		Beam Size	Beam to Post Connection
			Constrained	Unconstrained		
10	4	6	3	5	2-2x6	1 - ½" bolt
10	6	6	4	6	2-2x6	1 - ½" bolt
10	8	8	4	6	2-2x8	2 - ⅝" bolts
12	8	8	5	8	2-2x8	2 - ⅝" bolts
12	10	8	4	7	2-2x8	2 - ⅝" bolts
12	12	8	4	7	2-2x10	2 - ⅝" bolts
14	10	8	5	8	2-2x8	2 - ⅝" bolts
14	12	8	5	8	2-2x10	2 - ⅝" bolts
16	12	8	5	8	2-2x10	2 - ⅝" bolts

Notes: Constrained means that there is a slab poured around the posts. Unconstrained means that there is not a slab poured around the posts.

Table 311.2.1B
Post and Beam Requirements
(Two Rows of Posts 20 Feet on Center)

Height (ft.)	Post Size (in.)	Spacing (ft.)	Embedment Depth (ft.)		Beam Size	Beam to Post Connection
			Constrained	Unconstrained		
10	6	6	5	9	2-2x6	1 - ½" bolt
10	8	6	4	8	2-2x8	2 - ⅝" bolts
10	8	8	5	9	2-2x8	2 - ⅝" bolts
10	10	8	5	8	2-2x8	2 - ⅝" bolts
12	10	8	5	9	2-2x8	2 - ⅝" bolts
12	12	8	5	8	2-2x10	2 - ¾" bolts
14	12	8	6	9	2-2x10	2 - ¾" bolts
16	12	8	6	9	2-2x10	2 - ¾" bolts

Notes: Constrained means that there is a slab poured around the posts. Unconstrained means that there is not a slab poured around the posts.

- The spacing between bolts shall be a minimum of 1½ inches and shall be located a minimum of 2 inches from the beam -ends and edges.
- The size, the grade of lumber, and the maximum span for girts shall be as specified in Table 311.2.1C.
- Girts spaced 16 inches on center or less shall be fastened to the posts with minimum four 16d common nails. Girts spaced greater than 16 inches on center shall be fastened to posts with minimum five 16d common nails.

- The roof framing shall comply with the applicable portions of **Section 306**. Exception: If purlins are used as the roof deck, then the roof framing (rafters or top chord of roof trusses) shall be minimum Douglas Fir-Larch.

- Purlins may be used as a roof deck. The purlins shall be minimum 2x4 Spruce-Pine Fir Stud grade lumber. The spacing of the purlins shall not exceed 16 inches on center. The purlins shall be fastened to each rafter they cross with a minimum of two fasteners. Exception: A minimum of three fasteners shall be required within 4 feet of the perimeter edge of the roof, including 4 feet on either side of the roof edge. The fasteners shall have a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.

- As an alternative, a solid wood deck may be installed. The installation of the solid wood deck shall comply with **Section 306.4.**

Table 311.2.1C
Maximum Spans of Girts
(Southern Pine, Douglas Fir-Larch, Hem-Fir, Spruce-Pine-Fir)

Girt Size	Lumber Grade	Girt Spacing (inches)			
		8	12	16	24
2x4	#1	9'-3"	7'-7"	6'-6"	5'-4"
	#2	8'-9"	7'-2"	6'-2"	5'-1"
	#3	6'-9"	5'-6"	4'-9"	3'-10"
2x6	#1	10'-0"	9'-5"	8'-2"	6'-8"
	#2	10'-0"	8'-11"	7'-9"	6'-4"
	#3	8'-5"	6'-10"	5'-11"	4'-10"
2x8	#1	10'-0"	10'-0"	9'-10"	7'-4"
	#2	10'-0"	9'-10"	8'-6"	7'-0"
	#3	9'-3"	7'-7"	6'-7"	5'-4"

311.2.2 Siding for Post Frame Construction

Corrugated metal or structural panel siding may be used in accordance with the following guidelines:

311.2.2.1 Corrugated Metal for Siding

- The corrugated metal shall be a minimum of 26 gauge thickness.

- The corrugated metal shall be fastened directly to the girts.

- The corrugated metal shall be installed with a minimum of 4 inches end lap and 1 ½ corrugations side lap.

- The corrugated metal shall be fastened to the girts using either lead or neoprene washers and fasteners with a minimum shank diameter of 0.120 inches. The fasteners shall be long enough to penetrate a minimum of one inch into the wood girts.

- If the girts are spaced 16 inches on center or less, the fasteners shall be spaced a maximum of 6 inches on center along each girt.

- If the girt are spaced 24 inches on center, the fasteners shall be spaced a maximum of 4 inches on center.

311.2.2.2 Structural Panel Siding for Siding

- The siding material shall be a minimum of ⅜ inch thick.
- The siding material shall be nailed directly to the girts. Panel edges shall be supported by the girts.
- The siding material shall be fastened to the girts with fasteners with a minimum shank diameter of 0.120 inches. The fasteners shall be long enough to penetrate a minimum of 1½ inches into the wood girts.
- The panel edges of the siding material shall be fastened to the wood girts with fasteners spaced a maximum of 6 inches on center along the girts.
- If the girts are spaced 16 inches on center or less, the fasteners in the field shall be spaced a maximum of 6 inches on center along the girts.
- If the girts are spaced 24 inches on center, the fasteners in the field shall be spaced a maximum of 4 inches on center along the girts.

311.2.3 Corrugated Metal Roof for Post Frame Construction

- The corrugated metal roof may be installed on either a solid roof deck or a purlin roof deck. The construction of the roof deck shall be in accordance with **Section 311.2.1**.
- Underlayment may be installed over the roof deck, but is not required.
- The corrugated metal roofing shall be a minimum of 26 gauge thickness.
- The corrugated metal sheets shall be installed with a minimum of 8 inches end lap and 1½ corrugations side lap.
- If the corrugated metal sheets are installed on a purlin roof deck, then they shall be fastened to the purlins using neoprene washers and fasteners with a minimum shank diameter of 0.120 inches. The fasteners shall be long enough to penetrate a minimum of one inch into the wood purlins. The fasteners shall be spaced a maximum of 8 inches on center along each purlin. In locations within 4 feet of the perimeter edge of the roof, including 4 feet on each side of the roof ridge, the fasteners shall be spaced a maximum of 4 inches on center along each purlin.
- If the corrugated metal sheets are installed on a solid roof deck, then they shall be fastened to the solid deck using neoprene washers and fasteners with a minimum shank diameter of 0.120 inches. The fasteners shall be long enough to penetrate completely through the solid deck. The fasteners shall be spaced a maximum of 8 inches across the width of each metal sheet. Along the length of each metal sheet, the fasteners shall be spaced a maximum of 11 inches on center. In locations within 4 feet of the perimeter edge of the roof, including 4 feet on each side of the roof ridge, the fasteners shall be spaced a maximum of 6 inches on center along the length of the metal sheet.

311.3 Awnings and Patio Covers

Manufactured metal patio covers, awnings, and covered walkways shall be treated in the same manner as metal buildings. These structures shall be designed to meet the wind loads specified in **Section 102** or **Section 103**.

- The contractor shall furnish a certificate of design and installation instructions to the Texas Department of Insurance.
- Installation instructions shall be followed exactly.
- Wood patio covers shall comply with **Section 303.3**.

311.4 Supported Overhangs and Covered Porches

311.4.1 General

- Supported overhangs and covered porches shall be constructed as shown in Figures 311.4.2A-C and Figures 311.4.4A-C.
- The supported overhangs and covered porches shall not be enclosed with a solid wall covering. If a solid wall covering is desired, then the supported overhang or covered porch shall be constructed in accordance with **Section 303**.
- If the supported overhang or covered porch has a flat ceiling, then the ceiling joists shall be nailed to the wall framing of the building and to the rafters at the support beam in accordance with Appendix I.
- Rafter spans for the supported overhang and covered porch shall be selected from **Section 306.1**.
- The horizontal projection of the roof framing on any side of the supported overhang or covered porch shall not extend greater than 2 feet beyond the support beams.

311.4.2 Roof Framing for Monoslope Roofs

- The rafters shall frame into the main structure as shown in Figures 311.4.2A-C.
- If the rafters frame into the main structure as shown in Figure 311.4.2A (typical of new construction), then the rafters of the supported overhang shall be face-nailed to the rafters of the main structure with either a minimum of four 16d common wire nails or a minimum of five fasteners with a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.
- If the rafters frame into the main structure as shown in Figure 311.4.2B (typical of an addition), then a minimum 2x8 SPF Stud grade ledger shall be used to support the rafters. The ledger shall be anchored to each rafter of the main structure with minimum $\frac{3}{8}$ inch diameter lag bolts. The lag bolts shall be long enough to penetrate a minimum of 2 inches into the rafters. The ends of the rafters of the supported overhang shall be cut such that they rest on the ledger. A minimum 2x6 SPF Stud grade nailer shall be provided at the end of the rafters to prevent the rafters from splitting when applying the roof sheathing. The nailer shall be fastened to each rafter of the main structure with minimum 0.120 inch diameter by 3 inch long nails.

- The rafters shall be anchored to either the ledger strip (Figure 311.4.2B) or to the top plate of the main structure (Figure 311.4.2C) and to the support beams with the anchorage specified in Table 311.4.2.

- For new construction, each exterior wall stud of the main structure directly below the overhang or covered porch shall be anchored with the sum of the anchorage required for the rafters of the main structure plus the anchorage required for the overhang or covered porch.

311.4.3 Roof Framing for Gable or Hip Roofs

- The rafters shall be fastened to the roof framing (ridge board or hip jacks) and to the support beams in accordance with Appendix I.

- It may be necessary to attach a ledger strip to the roof framing of the main structure to support the rafters of the overhang or covered porch. The ledger strip shall be minimum 2x8 SPF lumber. The ledger shall be anchored to each rafter of the main structure with minimum $\frac{3}{8}$ inch diameter lag bolts. The lag bolts shall be long enough to penetrate a minimum of $2\frac{1}{2}$ inches into the rafters.

- The rafters shall be anchored to the ledger strip and to the support beams with the anchorage specified in Table 311.4.2.

311.4.4 Support Beams

- If the supported overhang or covered porch has a monoslope roof, then support beams shall be provided as shown in Figures 311.4.2A-C and in Figure 311.4.4A. The rafter span (which is also the roof span) shall be as shown in Figures 311.4.2A-C and in Figure 311.4.4A. The horizontal projection of rafters shall not extend more than 2 feet past the support beams. The minimum required size and the maximum spacing for the support beams shall be as specified in Tables 311.4.4A-B.

- If the supported overhang or covered porch has either a gable roof or a hip roof, then support beams shall be provided as shown in Figures 311.4.4B-C. The roof span shall be as shown in Figures 311.4.4B-C. The horizontal projection of the rafters shall not extend more than 2 feet past the support beams. The minimum required size and the maximum allowable span for the support beams shall be as specified in Tables 311.4.4A-B. For hip roofs, the roof span used in Tables 311.4.4A-B shall be the same as for gable roofs (See Figure 311.4.4C).

- If the supported overhang or covered porch has a gable roof, then support beams shall be provided parallel to the gable end. A roof span of 4 feet shall be used in Tables 311.4.4A-B to determine the required size and span for these support beams.

Table 311.4.2
Uplift Load Requirements

Roof Span (ft)	Uplift Load Along Support Beam (plf)	Uplift per Rafter (lb) Rafter Spacing (in.) 12	16	19.2	24
4	100	100	130	160	200
6	120	120	160	190	240
8	140	140	190	220	280
10	170	170	230	270	340
12	190	190	250	300	380
14	210	210	280	340	420
16	240	240	320	380	480
18	260	260	350	420	520
20	280	280	370	450	560
24	340	340	450	540	680
28	400	400	530	640	800
32	450	450	600	720	900
36	510	510	680	820	1020

Table 311.4.4A
Maximum Spans for Support Beams
Composition Shingle Roofs

Roof Span (ft)	Maximum Beam Span (ft) Beam Size 2-2x6 [1]	2-2x8 [1]	2-2x10 [2]	2-2x12 [2]
4	10'-0"	13'-2"	17'-8"	20'-8"
6	9'-3"	12'-2"	15'-10"	18'-6"
8	8'-9"	11'-2"	14'-5"	16'-11"
10	8'-2"	10'-4"	13'-4"	15'-8"
12	7'-7"	9'-8"	12'-6"	14'-8"
14	7'-2"	9'-1"	11"-9"	13'-10"
16	6'-10"	8'-8"	11'-2"	13'-1"
18	6'-6"	8'-3"	10'-8"	12'-6"
20	6'-3"	7'-11"	10'-2"	11'-11"
24	5'-9"	7'-4"	9'-5"	11'-1"
28	5'-5"	6'-10"	8'-10"	10'-4"
32	5'-1"	6'-5"	8'-4"	9'-9"
36	4'-10"	6'-1"	7'-11"	9'-3"

Notes: [1] Minimum No. 2 SYP, DF-L, Hem-Fir, SPF lumber
[2] Minimum No. 2 SYP lumber

Table 311.4.4B
Maximum Spans for Support Beams
Tile Roofs

Roof Span (ft)	Maximum Beam Span (ft)			
	Beam Size			
	2-2x6 [1]	2-2x8 [1]	2-2x10 [2]	2-2x12 [2]
4	9'-1"	11'-10"	15'-4"	17'-11"
6	8'-4"	10'-7"	13'-8"	16'-0"
8	7'-7"	9'-8"	12'-6"	14'-8"
10	7'-1"	8'-11"	11'-7"	13'-7"
12	6'-7"	8'-4"	10'-10"	12'-8"
14	6'-3"	7'-11"	10'-2"	11'-11"
16	5'-11"	7'-6"	9'-8"	11'-4"
18	5'-8"	7'-2"	9'-3"	10'-10"
20	5'-5"	6'-10"	8'-10"	10'-4"
24	5'-0"	6'-4"	8'-2'	9'-7"
28	4'-8"	5'-11"	7'-8"	9'-0"
32	4'-5"	5'-7"	7'-3"	8'-5"
36	4'-2"	5'-3"	6'-10"	8'-0"

Notes: [1] Minimum No. 2 SYP, DF-L, Hem-Fir, SPF lumber
[2] Minimum No. 2 SYP lumber

311.4.5 Posts for Support Beams

- If a support beam frames into the building, then the beam shall be supported by double studs. The double studs shall be located directly below the beam. The double studs shall be fastened together in accordance with Appendix I.

- Minimum 4x4 No. 2 lumber posts shall be used as columns. If cedar posts are used, then the posts shall be minimum 6x6 No. 2 lumber. If the posts are to be notched to support the beam, then minimum 6x6 posts shall be used. Post spacing shall not exceed 16 feet on center. Four by four (4x4) posts shall be spaced a maximum of 10 feet on center.

- Four by four (4x4) posts shall not exceed 10 feet in length. Six by six (6x6) posts shall not exceed 14 feet in length. Eight by eight (8x8) posts shall not exceed 20 feet in length. The length of the post shall be measured from the anchor point at the bottom (either the ground surface for posts embedded in a concrete-filled hole or the connection to a post base framing connector) to the anchor point at the top (connection point of the post to the structure).

- Post shall be pressure treated with a wood preservative.

311.4.6 Anchorage of Posts and Support Beams

- Each post and support beam shall be anchored to resist uplift loads. The anchorage shall be provided from support beam to post and from post to ground.

311.4.6.1 Anchorage of Posts and Support Beams Supporting a Monoslope Overhang or Covered Porch

- The anchorage for support beams and for posts supporting monoslope overhangs or covered porches, as shown in Figure 311.4A, shall be determined as follows:
    - For corner posts, the anchorage required (in pounds) shall be determined by multiplying the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, by one-half the distance between posts (measured in feet).
    - For non-corner posts, the anchorage required (in pounds) for each post shall be determined by multiplying the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, by the distance between the posts (measured in feet).

311.4.6.2 Anchorage of Posts and Support Beams Supporting a Gable Overhang or Covered Porch

- For support beams and corner posts located at the end of a gable overhang or covered porch, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be determined by adding the anchorage from:
    - Along the gable end, multiply the Uplift Load Along Support Beam from Table 311.4.2, using a roof span of 4 feet, by one-half the distance between the corner post and the next closest post (measured in feet).
    - Along the side of the overhang or covered porch, multiply the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, by one-half the distance between the corner post and the next closest post (measured in feet).
- For support beams and non-corner posts along the gable end, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using a roof span of 4 feet, multiplied by the distance between the posts (measured in feet).
- For support beams and non-corner posts supporting the rafters, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, multiplied by the distance between the posts (measured in feet).
- For the connection of the support beam to the existing structure or to a post located at the existing structure, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, multiplied by one-half the distance between the existing structure and the next closest post (measured in feet).

311.4.6.3 Anchorage of Posts and Support Beams Supporting an Overhang or Covered Porch with a Hip Roof

- For support beams and corner posts located at the end of the overhang or covered porch, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be determined by adding the anchorage from:
  - Along the end of the overhang or covered porch, multiply the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, by one-half the distance between the corner post and the next closest post (measured in feet).
  - Along the side of the overhang or covered porch, multiply the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, by one-half the distance between the corner post and the next closest post (measured in feet).
- For support beams and non-corner posts along the end of the overhang or covered porch, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, multiplied by the distance between the posts (measured in feet).
- For support beams and non-corner posts along the sides of the overhang or covered porch, as shown in Figure 311.4.4B, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, multiplied by the distance between the posts (measured in feet).
- For the connection of the support beam to the existing structure or to a post located at the existing structure, the anchorage required (in pounds) shall be the Uplift Load Along Support Beam from Table 311.4.2, using the roof span of the overhang or covered porch, multiplied by one-half the distance between the existing structure and the next nearest post (measured in feet).

311.4.7 Connection of Posts to Support Beams and to Ground

- If the support beam rests on top of the post, then the beam shall be anchored to the post with a framing connector, such as a post beam cap. The framing connector shall be capable of carrying the uplift anchorage determined in **Section 311.4.6**.

- If the support beam rests on a notch cut into the post, then the beam shall be anchored to the post with a minimum of two galvanized through bolts. Washers shall be used under all bolt heads and nuts. The uplift capacity of the connection shall be determined using Table 311.4.7A.

Table 311.4.7A
Uplift Capacity of Beams Anchored to Posts With Two Bolts (lbs.)

	Bolt Diameter		
Post Material	½"	⅝"	¾"
Cedar	1,560	2,060	2,480
Southern Pine	1,920	3,000	3,760

- If the posts are to be embedded into the soil, then each post shall be embedded into a hole filled with concrete. Table 311.4.7B shall be used to determine the maximum uplift capacity of each post for various hole dimensions.

- Posts 10 feet in length or less shall be embedded a minimum of 3 feet. Posts greater than 10 feet in length shall be embedded a minimum of 4 feet. Post dimensions greater than 6x6 shall be embedded in a 1.5 foot diameter hole.

- If the posts are not embedded into the ground, then a post base that is capable of carrying the required uplift load shall be used.

- Double studs supporting beams framing into the existing building shall be anchored against uplift. See Figure 311.4.7 for an example of the connection of a support beam to the existing structure. The anchorage required shall be determined in accordance with **Section 311.4.6**. Anchorage shall be provided at the top and bottom of the double studs.

Table 311.4.7B
Uplift Capacities of Posts Embedded in Concrete (lbs.)[1,2,3,4]

	Minimum Depth of Hole (ft)				
Hole Diameter	3	3.5	4	4.5	5
1'	1560	1860	2170	2470	2800
1.5'	2430	2890	3370	3850	4360

[1] Depth of hole is measured from the ground surface.
[2] The post shall be buried the entire depth of the hole.
[3] Rebar shall be placed horizontally through the bottom of the buried end of the post.
[4] The entire hole shall be filled with concrete.

311.5 Detached Garages

A detached garage may be constructed in accordance with the applicable requirements specified in **Section 200** and in **Sections 301** thru **309**. As an alternative, the detached garage may be constructed in accordance with the requirements specified in this section.

311.5.1 General Requirements

- The detached garage shall be one-story. The wall height shall not exceed 10 feet.
- The roof slope shall not exceed 12:12.
- The depth of the detached garage shall not exceed 25 feet. See Figure 311.5.1.
- The width of the detached garage shall not exceed 25 feet. See Figure 311.5.1.
- The depth – to – width ratio of the detached garage shall not exceed 1.0.

311.5.2 Foundation Requirements

- The foundation for the detached garage shall be constructed in accordance with **Section 301.1**.

311.5.3 Wall Framing Requirements

- The walls of the detached garage shall be constructed in accordance with **Section 303** and as specified in this section.

311.5.3.1 Framing Around Openings

- The front of the detached garage shall be framed in accordance with **Section 303.3.2**.

311.5.3.2 Wall Bracing

- Shearwalls shall be constructed in accordance with **Section 303.4.2** except as specified in this section.
- The minimum length of shearwall required on the rear wall of the detached garage shall be as specified in Table 311.5.3.2A. See Figure 311.5.1 for the location of the rear wall.
- The minimum length of shearwall required on the sidewalls shall be as specified in Table 311.5.3.2B. See Figure 311.5.1 for the location of the sidewalls.
- Sheathing shall be required at each corner of the front wall of the detached garage as specified in **Section 303.4.2**. The remainder of the front wall shall be sheathed with minimum $\frac{7}{16}$ inch wood structural panels using fasteners with a minimum shank diameter of 0.120 inches, a minimum length of $2\frac{1}{2}$ inches, and a pattern of 6 inches on center along panel edges and 12 inches on center along intermediate framing.

311.5.4 Ceiling Framing Requirements

- The ceiling of the detached garage shall be constructed in accordance with **Section 305**.

311.5.5 Roof Framing Requirements

- The roof of the detached garage shall be constructed in accordance with **Section 306**.

311.5.6 Roof Covering Requirements

- The roof coverings of the detached garage shall be installed in accordance with **Section 307**.

311.5.7 Exterior Opening Requirements

- The exterior openings of the detached garage (doors, windows, garage doors, and skylights) shall be installed in accordance with **Section 308**.

311.5.8 Exterior Covering Requirements

- The exterior coverings of the detached garage shall be installed in accordance with **Section 309**.

Table 311.5.3.2A
Minimum Length of Shearwall Required (ft.)
on Rear Wall[1] of Garage

Roof Slope	Depth Of Garage, D[2]	Panel Edge Nail Spacing[3]		
		6" on center	4" on center	3" on center
≤ 7:12	D ≤ 20'	11	8	7
	20' < D ≤ 25'	14	10	8
> 7:12	D ≤ 20'	25	18	15
	20' < D ≤ 25'	-[4]	22	18

Notes: [1] See Figure 311.5.1 for rear wall of garage.

[2] See Figure 311.5.1 for depth of garage.

[3] The nail spacing along interior framing shall not exceed 12 inches on center.

[4] A "-" denotes that the required sheathing length exceeds 25 feet.

Table 311.5.3.2B
Minimum Length of Shearwall Required (ft.) on Side Walls[1] of Garage

Roof Slope	Depth Of Garage, D[2]	Panel Edge Nail Spacing[3]		
		6" on center	4" on center	3" on center
≤ 7:12	D ≤ 20'	5	4	3
	20' < D ≤ 25'	7	5	4
> 7:12	D ≤ 20'	10	7	6
	20' < D ≤ 25'	16	11	9

Notes: [1] See Figure 311.5.1 for side walls of garage.

[2] See Figure 311.5.1 for depth of garage.

[3] The nail spacing along interior framing shall not exceed 12 inches on center

311.6 Boat Houses, Docks, and Piers (Over Water)

Boat houses, docks, piers, and other structures built over water are specifically excluded from the T.W.I.A. Windstorm insurance policy. However, for an additional cost they may be added to the policy. Therefore, if these structures are to be insured, they must be inspected and approved by the Texas Department of Insurance, and they should be built to the following guidelines.

- Pilings which support boat houses, docks, and piers shall be buried a depth below the ground (ocean floor or channel bottom) at least equal to the height the lowest structural member is above that ground level.
- The minimum bury depth shall be 5 feet.
- The remainder of the structure may be built by either conventional framing or post frame construction. All applicable previous guidelines shall be followed.
- Walkways or other structures which connect structures built over water to the main structure should be constructed so that if the structure over water should be destroyed by flooding, the part connected to the main structure will break away without causing damage.

311.7 Mobile Homes and Manufactured Housing

- Mobile homes and manufactured housing do not fall in the scope of the Texas Department of Insurance Windstorm Inspection program. Please contact T.W.I.A. concerning coverage for these types of structures.
- A mobile home is defined as a structure, transportable in one or more sections, which is eight body feet or more in width, and is 40 body feet or more in length, which is built on a permanent chassis and is designed to be used as a dwelling with or without a permanent foundation when connected to the required utilities, and includes the plumbing, heating, air conditioning, and electrical systems contained therein.

311.8 Industrialized Housing

Industrialized housing is a residential structure that is designed for the use and occupancy of one or more families. The building is constructed in one or more modules or constructed using one or more modular components that are built at a location other than the permanent resident site. The building is designed to be used as a permanent residential structure when the module or modular components are transported to the permanent residential site and are erected or installed on a permanent foundation system. Industrialized housing must be certified by a Texas licensed professional engineer in accordance with **Section 107**. This is required because the components of the building are usually constructed at a location other than the permanent residential site and in such a manner that the construction cannot be inspected for compliance with the prescriptive sections of this code.

311.9 Portable and Temporary Buildings

- Portable and temporary buildings shall be anchored by one of the methods outlined in **Section 301**.
- Conventionally framed portable and temporary buildings shall follow the guidelines set forth in **Section 303, Section 305.1** and **Section 306**.
- Metallic portable and temporary buildings shall follow the guidelines set forth in **Section 311.1**.
- Roofing of portable and temporary buildings shall follow the guidelines set forth in **Section 307**.
- Mechanical and exterior equipment for portable and temporary buildings shall follow the guidelines set forth in **Section 310**.

311.10 Other Miscellaneous Structures

Any other type or shape of structure not covered here or elsewhere should either be built to all other applicable guidelines, or should be designed and inspected by a Texas licensed professional engineer.

312 Re-Roofing and Repairs

Notes:

1. All fasteners shall be corrosion resistant as specified in **Section 211.4**.

2. When re-roofing, care shall be taken to ensure that the existing deck and other members are not damaged. Re-roofing over a damaged roof deck or roofing member will not be accepted. Replacement of damaged members shall comply with the applicable sections of this code.

3. If two or more roofing systems are already in place, they may not be roofed over. All layers shall be removed before re-roofing.

312.1 Re-Roofing a Composition Shingle Roof

- A maximum of one layer of composition shingles may be applied over a single layer of existing composition shingles.

- All existing shingles shall be removed if there are two or more layers of shingles already present.

- The manufacturer's installation instructions for re-roofing shall be followed.

- One layer of 15 pound felt shall be applied over the existing shingle roof. Felt shall be adequately fastened to hold it down until the shingles can be applied.

- Felt may be omitted if and only if all of the following three conditions are met:

    1. Existing shingles and deck must provide an adequate nailing surface.

    2. Existing shingles must be in a satisfactory condition so that new shingles can lay flat.

    3. Butts of new shingles must be butted directly against tabs of existing shingles (nested).

    The inspector's judgment shall be final as to whether felt is required. Consultation with the inspector prior to re-roofing is suggested if any questions exist regarding felt application.

- Shingles rated by Underwriter's Laboratories as being "wind resistant" shall be used. This means that the shingles must have passed UL Standard 997.

- Each shingle shall be applied as per their manufacturers published specifications, using a minimum of 6 nails per shingle.

- Roofing nails having sufficient length to penetrate into roof deck lumber a minimum of ¾ inch or completely through the roof deck. Roofing nails shall be a minimum of 1½ inches long for applying composition shingles over a single layer of composition shingles.

- For the case where the existing shingles and underlayment are removed, the composition shingles, underlayment, and metal drip edge (optional) shall be applied in accordance with **Section 307.1**.

312.2 Re-Roofing a Wood Shingle or Shake Roof

Composition shingles may not be placed over a wood shingle or shake roof.

312.2.1 Replacing Wood Shingles or Shakes With Same

- All shingles or shakes shall be removed.
- The rafters shall be spaced a maximum of 24 inches on center.
- A solid roof deck shall be installed in accordance with either **Section 312.2.1.1** or **Section 312.2.1.2**.

312.2.1.1 Replacing Spaced Boards With a Solid Deck

- All spaced boards and nails shall be removed. A new wood structural panel roof deck shall be installed in accordance with **Section 306.4**.
- Application of the wood shingles or shakes shall follow the guidelines set forth in **Section 307.2**.

312.2.1.2 Install Solid Deck Over Spaced Boards

- For structures with a mean roof height of 27 feet or less, a new wood structural panel roof deck may be installed over the spaced boards. Otherwise, a new deck shall be installed in accordance with **Section 312.2.1.1**.
- The spaced boards shall be spaced a maximum of 8 inches on center.
- The wood structural panels shall be in accordance with **Section 306.4**.
- The horizontal edges of the wood structural panels shall fall on spaced boards. Existing spaced boards may be moved to accomplish this, or new spaced boards may be added.
- The vertical edges of the sheathing panels may or may not fall on the rafters. As a minimum, the fasteners applied along the vertical edges shall penetrate through the sheathing and into the spaced boards. See Figures 312.2.1.2A-B.
- The wood structural panels shall be fastened to the rafters and/or spaced boards with 10d box nails, or equivalent fasteners specified in Appendix I, using one of the following methods:
    - **Method 1:**
        - The fasteners shall be spaced a maximum of 8 inches on center vertically along each rafter. See Figure 312.2.1.2A. Fasteners shall penetrate through the sheathing, through the spaced boards, and into the rafters.
        - Where the vertical edge of the sheathing panel does not fall on a rafter, the sheathing shall be fastened to the spaced board with fasteners spaced a maximum of 8 inches on center.

- NOTE: The spaced boards shall be fastened at each rafter with a minimum of one 8d common wire nail or equivalent fastener as specified in Appendix I.

- **Method 2:**

  - The fasteners shall be spaced a maximum of 8 inches on center vertically along each rafter.

  - Within the field of the sheathing panel, two fasteners shall be provided. Along panel edges, one fastener shall be provided. See Figure 312.2.1.2B.

  - The fasteners shall penetrate through the sheathing, through the spaced boards, and into the rafters.

  - Where the vertical edge of the sheathing panel does not fall on a rafter, the sheathing shall be fastened to the spaced board with fasteners spaced a maximum of 8 inches on center.

  - NOTE: For this method, the fastening requirements of the spaced board to the rafters may be omitted.

- Application of the wood shingles or shakes shall follow the guidelines set forth in **Section 307.2.**

312.2.2 Replacing Wood Shingles or Shakes With Composition Shingles

- All wood shingles or shakes shall be removed.

- If the existing roof was installed over spaced boards, all spaced boards and nails should be removed. A new wood structural panel roof deck should be installed in accordance with **Section 306.4.**

- As an alternative, solid roof deck sheathing may be installed over the spaced boards in accordance with the method specified in **Section 312.2.1.**

- Composition shingles shall be applied using the guidelines specified in **Section 307.1.**

312.3 Re-Roofing a Built-Up Roof

When re-roofing a built-up roof, the owner has two choices: Tear off the existing roof and install a completely new roof or recover the existing roof. The new or recover application shall be installed as per manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

312.4 Re-Roofing Roll Roofing

When re-roofing with roll roofing, the owner has two choices: Tear off the existing roof and install a completely new roof or recover the existing roof. The new or recover application shall be installed as per manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

312.5 Other Re-Roofing Systems

Other types of re-roofing shall be installed as per manufacturer's installation instructions, and in such a manner as to comply with the required wind loads of **Section 102** or **Section 103**. Complete test reports, including method of installation, shall be submitted.

313 Additions, Renovations, and Repairs

Note: All fasteners shall be corrosion resistant as specified in **Section 211.4**.

313.1 Additions

313.1.1 General

- All additions constructed after January 1, 1988, must be inspected and approved by the Texas Department of Insurance or by a Texas licensed professional engineer in order to maintain the insurability of the existing structure.
- The construction of additions shall comply with the applicable portions of this code.
- Where new additions are attached to the existing structure and rely upon that structure for support, the two structures shall be anchored at the point of connection.
- The portions of the existing structure which carry loads from the addition should be constructed in accordance with the applicable sections of this code. Also, any portions of the existing structure which becomes exposed due to the addition should be made to comply with the applicable sections of this code. The remainder of the existing structure will not be required to meet the construction guidelines specified in this code unless it is altered in some way.
- When a second story is being added to an existing single story structure, the addition and any other structural components of the existing structure which carry loads from the addition shall comply with all applicable sections of this code. Additional pilings or other foundation supports shall be installed if the original structure is not adequate to support the new addition.
- When a patio or porch is added to a structure, all applicable guidelines shall be followed. Please note that this will require the foundation of a porch, especially an elevated porch, to be built to the same guidelines as for a normal foundation.

313.1.2 Framing New Wall Additions to an Existing Structure

- The sole plate of the addition shall be anchored to the foundation in accordance with **Section 301**.
- Bottom plates for the addition shall be anchored to band joists in accordance with **Section 303**.
- The construction of the walls for the wood frame addition shall be in accordance with **Section 303**.
- Where the walls of the addition frame into the walls of the existing structure, the walls of the addition shall be secured to the walls of the existing structure.

313.1.2.1 Wall Addition Framing into Corner of an Existing Structure

- If the wall of the addition frames into the corner of an existing structure, then the wall of the addition shall be secured to the wall of the existing structure as shown in Figure 313.1.2.1.

- A single wall stud of the addition shall bear against the corner stud pack of the existing structure.
- The wall stud of the addition shall be secured to the corner stud pack of the existing structure in one of the following two ways:
  - Two rows of fasteners spaced a maximum of 12 inches on center along the length of the wall stud. The fasteners shall have a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.
  - Minimum $\frac{3}{8}$ inch diameter lag bolts spaced a maximum of 24 inches along the length of the wall stud. The lag bolt shall be long enough to penetrate a minimum of $1\frac{1}{2}$ inches into the wall studs of the existing structure.
- The first lag bolt or row of fasteners shall be located a maximum of 3 inches down from the top plate.

313.1.2.2 Wall Addition Framing into a Continuous Wall of an Existing Structure

- If the wall of the addition frames into a continuous wall of an existing structure, then the wall of the addition shall be secured to the wall of the existing structure as shown in Figure 313.1.2.2.
- At the point of where the walls intersect, a stud pack, consisting of three wall studs nailed together, shall be added to the existing structure, as shown in Figure 313.1.2.2, to provide support for the wall of the addition. The stud pack shall be fastened together with fasteners spaced a maximum of 12 inches on center. The fasteners shall have a minimum shank diameter of 0.120 inches and a minimum length of 3 inches.
- Two wall studs of the addition shall bear against the stud pack of the existing structure.
- The two wall studs of the addition shall be secured to the stud pack of the existing structure with minimum $\frac{3}{8}$ inch diameter lag bolts spaced a maximum of 24 inches along the length of the wall stud. The lag bolt shall be long enough to penetrate a minimum of $1\frac{1}{2}$ inches into the wall stud of the stud pack of the existing structure.
- The first lag bolt or row of fasteners shall be located a maximum of 3 inches down from the top plate.
- A holddown connector shall be provided at the intersection of the addition to the existing structure as shown in Figure 313.1.2.2. The capacity of the holddown connector shall be as specified in Table 303.4.2A. The holddown connector shall be secured to the double studs formed at the wall intersection.

313.1.3 Framing New Roof Addition to Existing Structure

- A new roof addition shall be attached to the existing structure as shown in Figure 313.1.3.
- The rafter span for the addition shall not exceed 36 feet.

- A ledger strip shall be secured to the rafters of the existing structure with minimum $\frac{3}{8}$ inch diameter lag bolts. The lag bolts shall be long enough to penetrate a minimum of $2\frac{1}{2}$ inches into the existing rafters. A lag bolt shall be provided at each rafter the ledger strip crosses. The ledger strip shall be minimum 2x8 SPF lumber. Note: The ledger strip shall be wide enough for the cut edge of the rafters to rest on the ledger strip and for the rafters to be anchored to the ledger strip.
- The roof addition shall be framed and anchored against uplift in accordance with **Section 306.1**.
- Each rafter that bears on the ledger strip shall be anchored to the ledger strip with uplift connectors in accordance with **Section 306.1.7**.

313.2 Renovations and Repairs

All repairs to any loadbearing portion of a structure or to any exterior component of a structure shall be inspected in order to maintain insurability of the entire structure, except as noted in **Section 313.2.1**. Renovations and repairs shall comply with the following guidelines.

313.2.1 Foundation

313.2.1.1 Slab on Grade Foundation

All but minor repairs of a slab on grade foundation shall be certified by a Texas licensed professional engineer. The Windstorm Inspection Section of the Texas Department of Insurance shall be consulted before proceeding.

313.2.1.2 Piling Foundation

Unless the guidelines outlined in **Section 301.2** can be followed exactly, renovation or repair of a piling foundation shall be certified by a Texas licensed professional engineer.

313.2.1.3 Pier and Beam Foundation

- All repairs to pier and beam foundations shall comply with **Section 301.3**.
- When replacing or repairing less than 25% of piers or beams on structures constructed prior to June 1, 1972, guidelines will not have to be followed as long as the member is being replaced with an equivalent member.

313.2.1.4 Post Tension Slab Foundation

All but minor repairs of a post tension slab foundation shall be certified by a Texas licensed professional engineer. The Windstorm Inspection Section of the Texas Department of Insurance shall be consulted before proceeding.

313.2.2 Framing

All framing repairs and renovations shall comply with the applicable sections of this code, or shall be certified by a Texas licensed professional engineer.

313.2.3 Exterior Coverings

All exterior covering repair and renovation shall comply with the applicable sections of this code, or shall be certified by a Texas licensed professional engineer.

313.2.4 Mechanical Equipment

All mechanical equipment related repair and renovation shall comply with any applicable previous guidelines, or shall be certified by a Texas licensed professional engineer.