

loads that the home was designed to withstand required by part 3280, subpart D of this chapter, as shown on the home's data plate. Exception: Manufactured homes that are installed in less restrictive roof load zone and wind zone areas may have foundation or anchorage systems that are capable of meeting the lower design load provisions of the Standards, if the design for the lower requirements is either provided in the installation instructions or the foundation and anchorage system is designed by a professional engineer or registered architect.

(d) The installation instructions are to include at least the following information and details for anchor assembly-type installations:

(1) The maximum spacing for installing diagonal ties and any required vertical ties or straps to ground anchors;

(2) The minimum and maximum angles or dimensions for installing diagonal ties or straps to ground anchors and the main chassis members of the manufactured home;

(3) Requirements for connecting the diagonal ties to the main chassis members of the manufactured home. If the diagonal ties are attached to the bottom flange of the main chassis beam, the frame must be designed to prevent rotation of the beam;

(4) Requirements for longitudinal and mating wall tie-downs and anchorage;

(5) The method of strap attachment to the main chassis member and ground anchor, including provisions for swivel-type connections;

(6) The methods for protecting vertical and diagonal strapping at sharp corners by use of radius clips or other means; and

(7) As applicable, the requirements for sizing and installation of stabilizer plates.

**§ 3285.402 Ground anchor installations.**

(a) *Ground anchor certification and testing.* (1) Each ground anchor assembly must be manufactured and provided with installation instructions, and must be labeled or otherwise identified and subject to an on-going quality assurance surveillance program in accordance with its listing or certifi-

cation (see 24 CFR 3285.5) by a nationally recognized testing laboratory. A registered professional engineer or architect must certify that each ground anchor assembly is capable of resisting all loads in paragraph (c) of this section based on the test methods in paragraph (b) of this section for use in soil(s) classified in accordance with § 3285.202.

(2) Each ground anchor assembly that has been listed prior to November 10, 2014 is not subject to paragraph (b) of this section, provided it has been previously tested in accordance with this paragraph. A professional engineer or registered architect must have certified the testing. The ground anchor must be listed by a nationally recognized testing agency and the listing or certification includes or has met all of the following requirements:

(i) A minimum of three tests meeting all of the requirements of this section were conducted for each ground anchor assembly design;

(ii) Each of the ground anchor assembly designs tested must have met or exceeded a working load of 3,150 pounds and sustained an ultimate load of 4,725 pounds in the weakest soil classification for which the anchors were tested and certified;

(iii) The soil in which the anchor was certified has been classified by one of the methods indicated in § 3285.202 of these Standards and the anchor is not listed for use in a weaker/higher soil classification than tested and identified in the Table to § 3285.202;

(iv) A test report was provided for each ground anchor assembly design that identifies the soil classification in which the ground anchor was tested and listed and includes complete specifications and dimensions for the ground anchor assembly;

(v) For each of the ground anchor assemblies tested, the maximum deflection at 3,150 pounds did not exceed two inches vertically or three inches horizontally;

(vi) For each of the ground anchor assemblies tested, the maximum deflection at 4,725 pounds did not exceed two inches vertically or three inches horizontally;

(vii) For the stabilizer plate test method, at least three tests were performed at the minimum angle of pull to the horizontal specified in the listing and the minimum angle of pull to the horizontal must have been at least 30 degrees. Any existing ground anchor assembly tests and certifications where the angle of pull was less than 30 degrees will need to be re-evaluated in accordance with paragraph (b) of this section; and

(viii) For the stabilizer plate test method, the minimum angle of pull to the horizontal is specified in the listing.

(b) *Standard test methods for establishing working load design values of ground anchor assemblies used for new manufactured home installations*—(1) *Scope.* (i) These testing procedures provide standard test methods for establishing both ultimate loads and load resistance design values.

(ii) Each assembly or component of an anchor assembly must be tested by the methods established by this section, and therefore be suitable, as listed or certified for installation in an appropriately classified soil, for installation of manufactured homes.

(iii) To secure approval of ground anchor assembly products and components, ground anchor manufacturers must have their products tested and listed by a nationally recognized testing laboratory, or tested and certified by an independent registered professional engineer.

(iv) The testing laboratory or independent registered engineer must be free from any conflict of interest from the product manufacturer and any of the product manufacturer's affiliates.

(2) *Definitions.* The definitions contained in this section apply to the terms used in subpart E of this part.

*Allowable displacement limits.* Criteria establishing the maximum amount of displacement of a material, assembly, or component under load.

*Certification test site.* A site used for the purpose of anchor assembly qualification testing in accordance with this section.

*Cohesive soil.* A soil with sufficient clay content to exhibit substantial plastic behavior when moist or wet (i.e., able to be readily molded or rolled

into a 1/8 -inch thread at a wide range of moisture contents).

*Ground anchor manufacturer.* Any person or company engaged in manufacturing or importing ground anchor assemblies.

*Non-Cohesive soil.* Sand, gravel, and similar soils that are predominantly granular and lack a sufficient quantity of fine, clay-sized particles to exhibit the behavior of cohesive soil as defined in this section.

*Ultimate anchor load.* The lower of either the highest load achieved during an individual test prior to failure due to exceeding allowable displacement limits or the load at failure of the anchoring equipment or its attachment point to the testing apparatus.

*Working anchor load.* The ultimate anchor load in pounds divided by a factor of safety of 1.5.

(3) *Determination of soil classification*—(i) *General description of soil classification.* The general description of soil classification is to be determined in accordance with the methods specified in the Table to §3285.202.

(ii) *Standards for identification of soil and soil classification.* The soil test torque probe method must be used at the certification test site for soil classification. At a minimum, the soil test torque probe must be used at three sample locations representative of the extent of the certification site test area. Soil characteristics must be measured at a depth below ground surface of not greater than the anchor helix depth and not less than 2/3 of the anchor helix depth for each ground anchor depth evaluated within the test area. The lowest torque probe value resulting in the highest soil classification number must be used. Additional guidance regarding the soil test torque probe method is available at the Appendix to this section and at §3282.202.

(iii) *Classification in non-cohesive soils.* Ground anchor assemblies must be tested and listed or certified, and labeled for use in non-cohesive soil. Ground anchor assemblies are permitted to be tested, listed or certified, and labeled for use in cohesive soil.

(4) *Field testing apparatus.* (i) The testing equipment for conducting tests to list or certify a ground anchor assembly for use in a classified soil must

be capable of meeting the requirements of paragraph (b)(7) of this section as determined by the testing agency.

(ii) The testing equipment shall be calibrated to meet the testing requirements of paragraph (b)(7) of this section as determined by the testing agency.

(5) *Test specimens details and selection.*

(i) Test specimens are to be examined by the independent testing, listing, or certifying entity for conformance with engineered drawings, specifications, and other information provided by the ground anchor manufacturer or producer including:

(A) Dimensions and specifications on all welds and fasteners;

(B) Dimensions and specifications of all metal or material;

(C) Model number and its location on the ground anchor; and

(ii) Necessary test specimens and products for the installed anchor assembly tests must be randomly selected by the independent testing, listing, or certifying entity.

(6) *Test requirements.* (i) Field tests must be performed on each anchor assembly installed in a classified soil as defined in paragraph (b)(3) of this section.

(ii) Field test apparatuses must be as specified in paragraph (b)(4) of this section, and must conform to the testing requirements of paragraph (b)(7) of this section.

(iii) Testing equipment shall be adequate for testing as determined by the testing agency.

NOTE TO PARAGRAPH (b)(6): As a recommended practice, the test rig soil reactions (bearing pads) should not be located closer to the center of the anchor assembly (anchor head) than the lesser of  $D$ ,  $4d$ , or 32 inches where  $D$  is the depth of the anchor helix and  $d$  is the diameter of the anchor helix, both in inches. However, experience with a particular test rig, types of anchors, and soil conditions may justify other acceptable dimensional tolerances.

(7) *Field tests of anchor assemblies.* (i) The soil characteristics at the certification test site must be identified and recorded according to paragraph (b)(3) of this section. The date, approximate time, and names of persons conducting and witnessing the anchor assembly tests must also be recorded at each certification test site.

(ii) Connection of the testing apparatus to the anchor assembly head must provide loading conditions to the anchor head, similar to actual site conditions. Adequacy of the connection must be determined by the testing agency or test engineer.

(iii) For soil classifications 3, 4A, and 4B, testing must be performed in the lower 50 percentile torque probe value of the soil classification being tested. For soil classifications 1 and 2 the torque probe value must not exceed 750 inch-pounds.

(iv) A minimum of three tests must be performed and the result of each test must meet or exceed 4,725 pounds pull ( $3,150 \times 1.5$  factor of safety) in the direction of pull.

(v) Special-purpose anchor assemblies, including those needed to accommodate unique design loads identified by manufacturers in their installation instructions, may be certified under this section or to more stringent requirements such as higher working loads, more restrictive anchor head displacements and/or tested angle limitations.

(vi) *Angle of pull.* Where the test apparatus configuration results in a changing angle of pull due to anchor assembly displacement during a lateral angle pull test, the angle of pull at the ultimate anchor load is to be recorded as the load angle for the test. Load angles are to be measured relative to the plane of the ground surface and shall be permitted to be rounded to the nearest 5-degree increment.

(vii) *Displacement measurement.* Vertical displacement (for all tests) and horizontal displacement (for lateral angle pull tests) must be measured relative to the centerline of the test apparatus' connection to the ground anchor assembly (anchor head) and the ground. A stable ground reference point for displacement measurements must be located independent of the test apparatus and not closer to the anchor assembly than the soil reaction points of the test apparatus. Displacement measurements shall be taken using a device with not less than  $\frac{1}{8}$ -inch reading increments. Measurements shall be permitted to be rounded to the nearest  $\frac{1}{8}$ -inch increment.

(8) *Anchor assembly field test methods.*

(i) An anchor assembly must be tested in accordance with one or more of the assembly configurations addressed in paragraphs (b)(8)(iii), (iv) and (v) of this section. The as-tested configuration of any anchor assembly is a condition of the listing or certification. Alternate configurations are acceptable provided test conditions appropriately simulate actual end-use conditions and the as-tested configuration is addressed in the manufacturer's installation instructions.

(ii) Anchor assemblies designed for multiple connections to the manufactured home must be individually tested as specified in paragraphs (b)(8)(iii) and (iv) of this section.

(iii) Anchor assembly/stabilizer plate method. The following anchor assembly installation and testing must be consistently applied for all tests:

(A) The ground anchor is to be installed at an angle of 10-15 degrees from vertical to a depth of one-half ( $\frac{1}{2}$ ) to two-thirds ( $\frac{2}{3}$ ) of the anchor length.

(B) A stabilizer plate is to be driven vertically on the side of the ground anchor shaft facing the tensioning equipment three inches (3") from the shaft and the top of the plate must be installed flush with the soil surface or not more than one inch below the soil surface.

(C) The ground anchor is to be driven to its full depth into the soil with the bottom of the anchor head not more than  $\frac{3}{4}$  inch ( $\frac{3}{4}$ ") above the stabilizer plate.

(D) The ground anchor head is to be attached to the tensioning equipment such that the tension load and displacement can be recorded. The tensioning equipment must be positioned to load the ground anchor and stabilizer plate at the minimum angle to the test site ground surface for which the anchor is being evaluated.

(E) The ground anchor is to be pre-tensioned to 500 pounds so that the anchor shaft contacts the stabilizer plate. If the anchor shaft does not come into contact with the stabilizer plate an anchor setting load not to exceed 1,000 pounds is permitted to be applied and then released prior to re-application of the 500-pound pre-tension force.

(F) The location of the ground anchor head is to be marked after it is pre-tensioned for measuring subsequent movement under test loading.

(G) Increase the load throughout the test. The recommended rate of load application must be such that the loading to not less than 4725 pounds is reached in not less than 2 minutes from the time the 500 pound pre-tension load is achieved.

(H) Record the load and displacement, at a minimum of 500-1000 pound increments, such that a minimum of five data points will be obtained to determine a load deflection curve. For each datum, the applied load and the ground anchor head displacement is to be recorded. In addition, the load and displacement is to be recorded at the Failure Mode identified in paragraph (b)(10) of this section. It is permissible to halt the addition of load at each loading increment for up to 60 seconds to facilitate taking displacement readings. The ultimate anchor load of the ground anchor assembly and corresponding displacement is to be recorded. The pre-tension load of 500 pounds should be included in the 4725 pound ultimate anchor load test. It is permissible to interpolate between displacement and load measurements to determine the ultimate anchor load.

(I) All ground anchor assemblies must be tested to the following:

(1) Failure due to displacement of the ground anchor assembly as established in paragraph (b)(9) of this section, or

(2) Failure of either the anchoring equipment or its attachment point to the testing apparatus, or to a minimum of 4725 pounds (when possible tests should be taken to 6000 pounds to provide additional data but this is not required).

(iv) Vertical in-line anchor assembly method. Anchor assembly installation and withdrawal procedures for test purposes are to be as follows, and be used consistently throughout all tests;

(A) The ground anchor must be installed vertically.

(B) The ground anchor must be driven to its full depth into the soil.

(C) The ground anchor head must be attached to the tensioning equipment such that the load and ground anchor head displacement can be recorded.

(D) The ground anchor must be pulled in line with the ground anchor shaft.

(E) The ground anchor shall be pre-tensioned to 500 pounds.

(F) The location of the ground anchor head must be marked after it is pre-tensioned for measuring subsequent movement under test loading.

(G) Increase the load throughout the test. The recommended rate of load application shall be such that the loading to not less than 4725 pounds is reached in not less than 2 minutes from the time the 500 pound pre-tension load is achieved.

(H) Record the load and displacement, at a minimum of 500-1000 pound increments, such that a minimum of five data points will be obtained to determine a load deflection curve. For each datum, the applied load and the ground anchor head displacement is to be recorded. In addition, the load and displacement is to be recorded at the Failure Mode identified in paragraph (b)(10) of this section. It is permissible to halt the addition of load at each loading increment for up to 60 seconds to facilitate taking displacement readings. The ultimate anchor load of the ground anchor assembly and corresponding displacement is to be recorded. The pre-tension load of 500 pounds should be included in the 4725 pound ultimate anchor load test. It shall be permissible to interpolate between displacement and load measurements to determine the Ultimate anchor load.

(I) All ground anchor assemblies must be tested to the following:

(1) Failure due to displacement of the ground anchor assembly as established in paragraph (b)(9) of this section, or

(2) Failure of either the anchoring equipment or its attachment point to the testing apparatus, or to a minimum of 4725 pounds (when possible tests should be taken to 6000 pounds to provide additional data but this is NOT required).

(v) In line ground anchor assembly method. Ground anchor assembly installation and withdrawal procedures for test purposes must be as follows, and must be used consistently throughout all tests.

(A) The ground anchor must be installed at an angle from the horizontal ground surface at which it is to be rated.

(B) The ground anchor must be driven to its full depth into the soil.

(C) The ground anchor head must be attached to the tensioning equipment such that tension and displacement can be recorded.

(D) The anchor must be pulled in line with the ground anchor shaft.

(E) The ground anchor shall be pre-tensioned 500 pounds.

(F) The location of the ground anchor head is to be marked after it is pre-tensioned for measuring subsequent movement under test loading.

(G) Increase the load throughout the test. The recommended rate of load application must be such that the loading to not less than 4725 pounds is reached in not less than 2 minutes from the time the 500 pound pre-tension load is achieved.

(H) Record the load and displacement, at a minimum of 500-1000 pound increments, such that a minimum of five data points will be obtained to determine a load deflection curve. For each datum, the applied load and the ground anchor head displacement is to be recorded. In addition, the load and displacement is to be recorded at the Failure Mode identified in paragraph (b)(10) of this section. It shall be permissible to halt the addition of load at each loading increment for up to 60 seconds to facilitate taking displacement readings. The ultimate anchor load of the ground anchor assembly and corresponding displacement must be recorded. The pre-tension load of 500 pounds should be included in the 4725 pound ultimate anchor load test. It is permissible to interpolate between displacement and load measurements to determine the Ultimate anchor load.

(I) All ground anchor assemblies must be tested to the following:

(1) failure due to displacement of the ground anchor assembly as established in paragraph (b)(9) of this section, or

(2) Failure of either the anchoring equipment or its attachment point to the testing apparatus, or to a minimum of 4725 pounds (when possible tests should be taken to 6000 pounds to

provide additional data but this is NOT required)

*Note to paragraph (b)(8).* Additional testing at angles of pull greater than the minimum angle of pull may be used to provide design values for specific angles of pull greater than the minimum angle for which evaluation is sought.

(9) *Failure criteria.* The following conditions constitute failure of the ground anchor test assembly:

(i) When the ground anchor head, or its attachment point, displaces 2 inches in the vertical or horizontal direction from its pre-tensioned measurement position prior to reaching a total load of 3150 pounds (including any pretension load).

(ii) When the ground anchor head, or its attachment point, displaces 2 inches (2") in the vertical direction or 3 inches (3") in the horizontal direction from its pre-tensioned measurement position prior to reaching a total load of 4725 pounds (including any pretension load).

(iii) When breakage of any component of the ground anchor shaft occurs prior to reaching a total load of 4725 pounds.

(10) *Use of ultimate anchor loads to establish the working load design value.* (i) The working load design value is the lowest ultimate anchor load determined by testing, divided by a 1.5 factor of safety.

(ii) The working load design value, for each installation method and soil classification, shall be stated in the ground anchor assembly listing or certification. An anchor tested in a given soil classification number must not be approved for use in a higher/weaker soil classification number. For example an anchor tested in soil classification 3 must not be approved for soil classification 4A or 4B unless it is also tested in those soils. The 500 pound pretension is included in the ultimate anchor load.

(11) *Test report.* The test report to support the listing or certification for each ground anchor assembly tested is to include all conditions under which the ground anchor assembly was tested, including the following:

(i) A copy of all test data accumulated during the testing.

(ii) The soil characteristics including moisture content and methods for de-

termining soil characteristics for each type of soil for which the ground anchoring assembly was evaluated.

(iii) The model of the ground anchor assembly tested.

(iv) The ground anchor assembly test method used.

(v) Detailed drawings including all dimensions of the ground anchor assembly and its components.

(vi) Method of installation at the test site.

(vii) Date of installation and date of testing.

(viii) Location of the certification test site.

(ix) Test equipment used.

(x) For each anchor specimen tested: For each load increment the load in pounds and resultant displacements in inches in chart or graph form.

(xi) The working load design value and ultimate anchor load determined in accordance with paragraph (b)(10) of this section.

(xii) If required, a description of the stabilizer plate used in each ground anchor assembly/stabilizer plate test, including the name of the manufacturer.

(xiii) Angle(s) of pull for which the anchor has been tested.

(xiv) Embedment depth of the ground anchor assembly.

(xv) The application and orientation of the applied load.

(xvi) A description of the mode and location of failure for each ground anchor assembly tested.

(xvii) Name and signature of the nationally recognized testing agency or registered professional engineer certifying the testing and evaluation.

(xviii) The soil classification(s) for which each ground anchor assembly is certified for use and the working load design value and minimum ultimate load capacity for those soil classification(s).

(12) *Approved ground anchor assemblies.* Each ground anchor manufacturer or producer must provide the following information for use of approved ground anchor assemblies and this information must also be included in the listing or certification for each ground anchor assembly:

(i) Drawings showing ground anchor installation.

(ii) Specifications for the ground anchor assembly including:

(A) Soils classifications listed or certified for use;

(B) The working load and minimum ultimate anchor load capacity for the anchor assembly in the soil classification(s) it is listed or certified for use;

(C) Model number and its location on the anchor;

(D) Instructions for use, including pre-tensioning;

(E) Angle(s) of pull for which the anchor has been listed and certified; and

(F) Manufacturer, size and type of stabilizer plate required.

(c) *Specifications for tie-down straps and ground anchors*—(1) *Ground anchors*. Ground anchors must be installed in accordance with their listing or certification, be installed to their full depth, be provided with protection against weather deterioration and corrosion at least equivalent to that provided by a coating of zinc on steel of not less than 0.30 oz./ft.<sup>2</sup> of surface coated, and be capable of resisting a minimum ultimate load of 4,725 lbs. and a working load of 3,150 lbs., as installed, unless reduced capacities are noted in accordance with note 11 of Table 1 to this section or note 12 of Tables 2 and 3 to this section. The ultimate load and working load of ground anchors and anchoring equipment must be determined by a registered professional engineer, registered architect, or tested by a nationally recognized third-party testing agency in accordance with a nationally recognized testing protocol.

(2) *Tie-down straps*. A 1¼ inch × 0.035 inch or larger steel strapping conforming to ASTM D 3953—97, Standard Specification for Strapping, Flat Steel and Seals (incorporated by reference, see § 3285.4), Type 1, Grade 1, Finish B, with a minimum total capacity of 4,725 pounds (lbs.) and a working capacity of 3,150 pounds (lbs.) must be used. The tie-down straps must be provided with protection against weather deterioration and corrosion at least equivalent to that provided by a coating of zinc on steel of not less than 0.30 oz./ft.<sup>2</sup> of surface coated. Slit or cut edges of coated strapping need not be zinc coated.

(d) *Number and location of ground anchors*. (1) Ground anchor and anchor strap spacing must be:

(i) No greater than the spacing shown in Tables 1 through 3 to this section and Figures A and B to this section; or

(ii) Designed by a registered engineer or architect, in accordance with acceptable engineering practice and the requirements of the MHCSS for any conditions that are outside the parameters and applicability of the Tables 1 through 3 to this section.

(2) The requirements in paragraph (c) of this section must be used to determine the maximum spacing of ground anchors and their accompanying anchor straps, based on the soil classification determined in accordance with § 3285.202:

(i) The installed ground anchor type and size (length) must be listed for use in the soil class at the site and for the minimum and maximum angle permitted between the diagonal strap and the ground; and

(ii) All ground anchors must be installed in accordance with their listing or certification and the ground anchor manufacturer installation instructions; and

(iii) If required by the ground anchor listing or certification, the correct size and type of stabilizer plate is installed. If metal stabilizer plates are used, they must be provided with protection against weather deterioration and corrosion at least equivalent to that provided by a coating of zinc on steel of not less than 0.30 oz./ft.<sup>2</sup> of surface coated. Alternatively, ABS stabilizer plates may be used when listed and certified for such use.

(3) *Longitudinal anchoring*. Manufactured homes must also be stabilized against wind in the longitudinal direction in all Wind Zones. Manufactured homes located in Wind Zones II and III must have longitudinal ground anchors installed on the ends of the manufactured home transportable section(s) or be provided with alternative systems that are capable of resisting wind forces in the longitudinal direction. See Figure C to § 3285.402 for an example of one method that may be used to

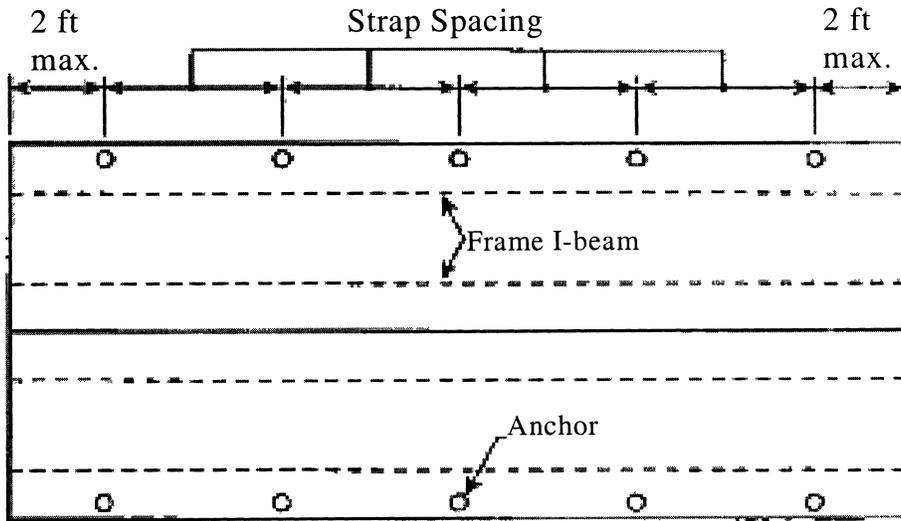
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provide longitudinal anchoring. A professional engineer or registered architect must certify the longitudinal anchoring method or any alternative sys-

tem used as adequate to provide the required stabilization, in accordance with acceptable engineering practice.

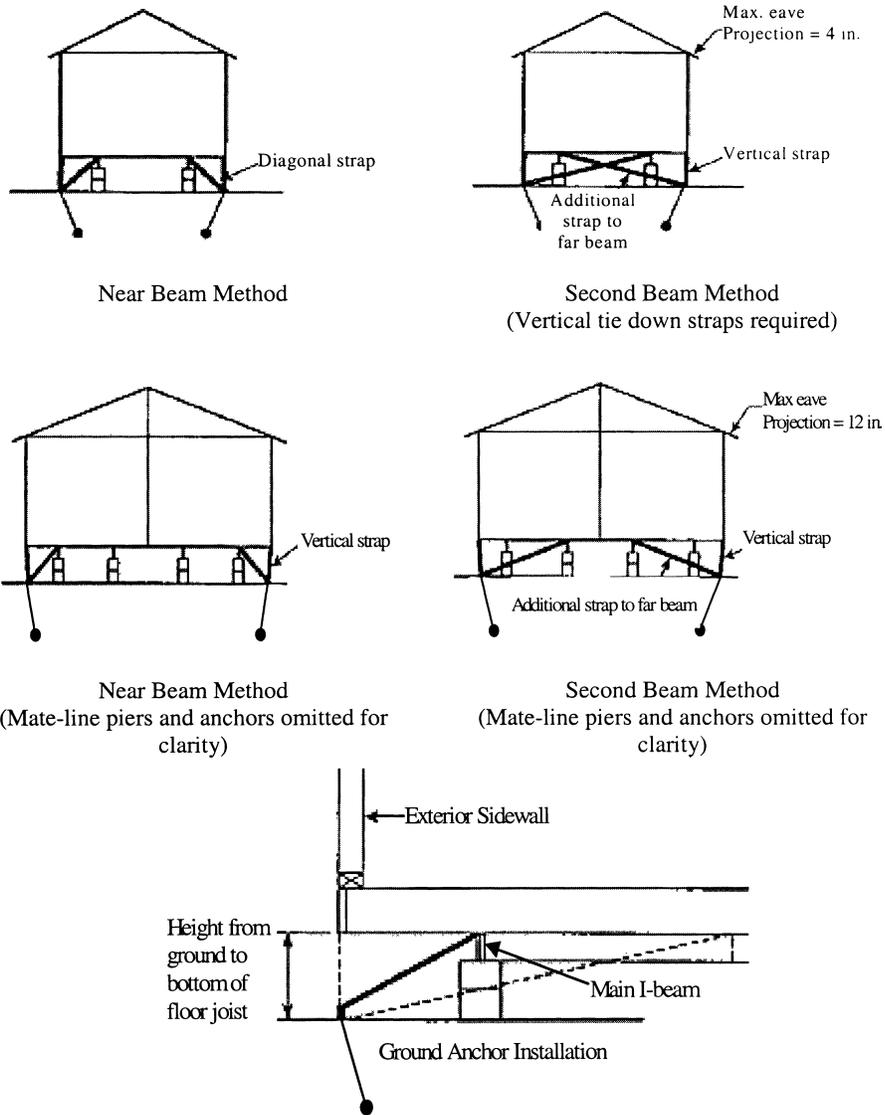
Figure A to § 3285.402 Ground Anchor Locations and Spacing – Plan View.



NOTES: 1. Refer to Tables 1, 2, and 3 to this section for maximum ground anchor spacing.

2. Longitudinal anchors not shown for clarity; refer to 3285.402(b)(2) for longitudinal anchoring requirements.

Figure B to § 3285.402 Anchor Strap and Pier Relationship.



NOTES: 1. Vertical Straps are not required in Wind Zone I.  
 2. The frame must be designed to prevent rotation of the main chassis beam, when the

diagonal ties are not attached to the top flange of the beam. See § 3285.401(d)(3).

Figure C to § 3285.402 Longitudinal Anchoring

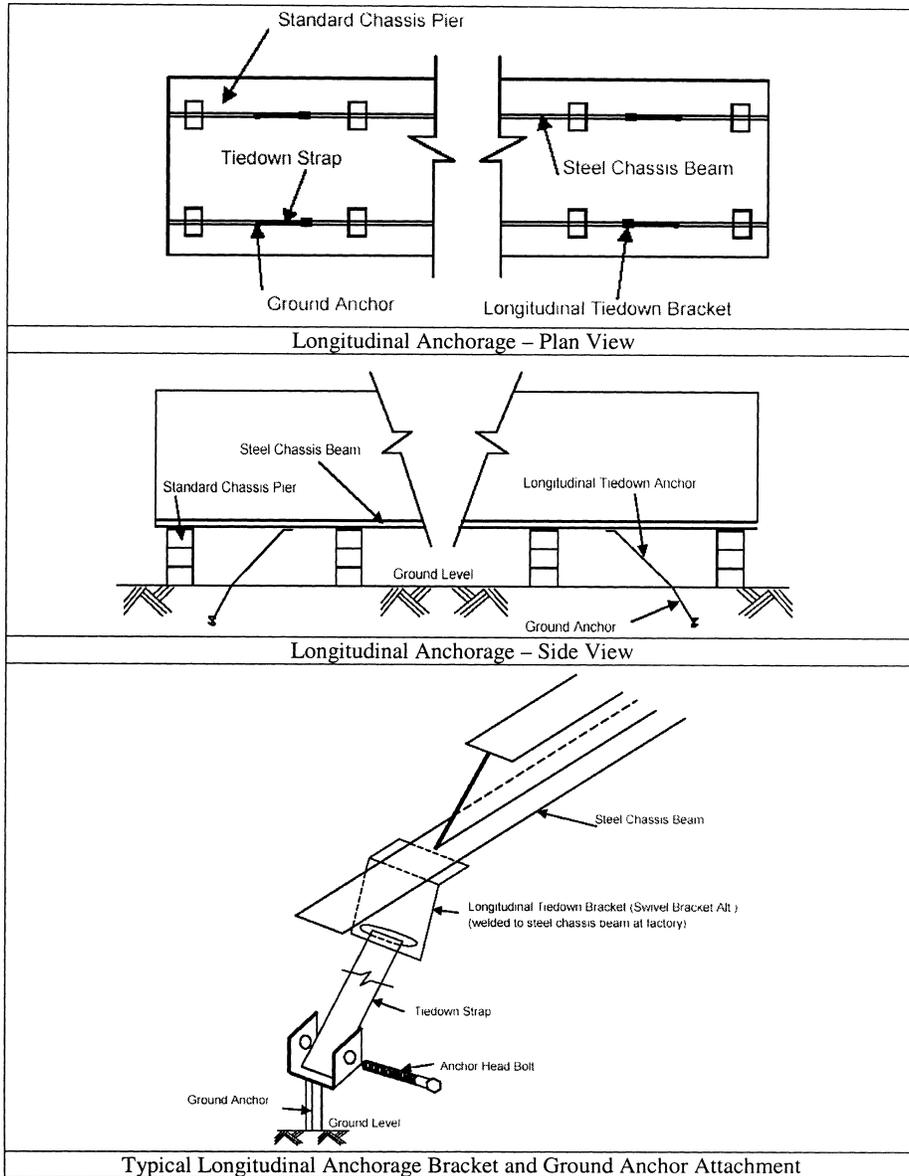


TABLE 1 TO § 3285.402—MAXIMUM DIAGONAL TIE-DOWN STRAP SPACING, WIND ZONE I

Nominal floor width, single section/multi-section	Max. height from ground to diagonal strap attachment	I-beam spacing 82.5 in.	I-beam spacing 99.5 in.
12/24 ft. 144 in. nominal section(s) .....	25 in .....	14 ft. 2 in .....	N/A.
	33 in .....	11 ft. 9 in .....	N/A.

TABLE 1 TO § 3285.402—MAXIMUM DIAGONAL TIE-DOWN STRAP SPACING, WIND ZONE I—  
Continued

Nominal floor width, single section/multi-section	Max. height from ground to diagonal strap attachment	I-beam spacing	
		82.5 in.	99.5 in.
	46 in .....	9 ft. 1 in .....	N/A.
	67 in .....	N/A .....	N/A.
14/28 ft. 168 in. nominal section(s) .....	25 in .....	18 ft. 2 in .....	15 ft. 11 in.
	33 in .....	16 ft. 1 in .....	13 ft. 6 in.
	46 in .....	13 ft. 3 in .....	10 ft. 8 in.
	67 in .....	10 ft. 0 in .....	N/A.
16/32 ft. 180 in. to 192 in. nominal section(s) ...	25 in .....	N/A .....	19 ft. 5 in.
	33 in .....	19 ft. 0 in .....	17 ft. 5 in.
	46 in .....	16 ft. 5 in .....	14 ft. 7 in.
	67 in .....	13 ft. 1 in .....	11 ft. 3 in.

NOTES: 1. Table is based on maximum 90 in. sidewall height.

2. Table is based on maximum 4 in. inset for ground anchor head from edge of floor or wall.

3. Table is based on main rail (I-beam) spacing per given column.

4. Table is based on maximum 4 in. eave width for single-section homes and maximum 12 in. for multi-section homes.

5. Table is based on maximum 20-degree roof pitch (4.3<sup>1</sup>/<sub>2</sub>).

6. Table is based upon the minimum height between the ground and the bottom of the floor joist being 18 inches. Interpolation may be required for other heights from ground to strap attachment.

7. Additional tie-downs may be required per the home manufacturer instructions.

8. Ground anchors must be certified for these conditions by a professional engineer, architect, or listed by a nationally recognized testing laboratory.

9. Ground anchors must be installed to their full depth, and stabilizer plates, if required by the ground anchor listing or certification, must also be installed in accordance with the listing or certification and in

accordance with the ground anchor and home manufacturer instructions.

10. Strapping and anchoring equipment must be certified by a registered professional engineer or registered architect, or listed by a nationally recognized testing agency to resist these specified forces, in accordance with testing procedures in ASTM D 3953-97, Standard Specification for Strapping, Flat Steel and Seals (incorporated by reference, see §3285.4).

11. A reduced ground anchor or strap working load capacity will require reduced tie-down strap and anchor spacing.

12. Ground anchors must not be spaced closer than the minimum spacing permitted by the listing or certification.

13. Table is based on a 3,150 lbs. working load capacity, and straps must be placed within 2 ft. of the ends of the home.

14. Table is based on a minimum angle of 30 degrees and a maximum angle of 60 degrees between the diagonal strap and the ground.

15. Table does not consider flood or seismic loads and is not intended for use in flood or seismic hazard areas. In those areas, the anchorage system is to be designed by a professional engineer or architect.

TABLE 2 TO § 3285.402—MAXIMUM DIAGONAL TIE-DOWN STRAP SPACING, WIND ZONE II.

Nominal floor width, single section/multi-section	Max. height from ground to diagonal strap attachment	Near beam method I-beam spacing		Second beam method I-beam spacing	
		82.5 in.	99.5 in.	82.5 in.	99.5 in.
12 ft/24 ft. 144 in. nominal section(s).	25 in .....	6 ft. 2 in .....	4 ft. 3 in .....	N/A .....	N/A
	33 in .....	5 ft. 2 in .....	N/A .....	N/A .....	N/A
	46 in .....	4 ft. 0 in .....	N/A .....	N/A .....	N/A
	67 in .....	N/A .....	N/A .....	6 ft 1 in .....	6 ft 3 in
14 ft/28 ft. 168 in. nominal section(s).	25 in .....	7 ft. 7 in .....	6 ft. 9 in .....	N/A .....	N/A
	33 in .....	6 ft. 10 in .....	5 ft. 9 in .....	N/A .....	N/A
	46 in .....	5 ft. 7 in .....	4 ft. 6 in .....	N/A .....	N/A
	67 in .....	4 ft. 3 in .....	N/A .....	N/A .....	N/A
16 ft/32 ft. 180 in. to 192 in. nominal section(s).	25 in .....	N/A .....	7 ft. 10 in .....	N/A .....	N/A

TABLE 2 TO § 3285.402—MAXIMUM DIAGONAL TIE-DOWN STRAP SPACING, WIND ZONE II.—  
Continued

Nominal floor width, single section/multi-section	Max. height from ground to diagonal strap attachment	Near beam method I-beam spacing		Second beam method I-beam spacing	
		82.5 in.	99.5 in.	82.5 in.	99.5 in.
	33 in .....	7 ft. 6 in .....	7 ft. 2 in .....	N/A .....	N/A .....
	46 in .....	6 ft. 9 in .....	6 ft. 0 in .....	N/A .....	N/A .....
	67 in .....	5 ft. 4 in .....	4 ft. 7 in .....	N/A .....	N/A .....

NOTES: 1. Table is based on maximum 90 in. sidewall height.

2. Table is based on maximum 4 in. inset for ground anchor head from edge of floor or wall.

3. Tables are based on main rail (I-beam) spacing per given column.

4. Table is based on maximum 4 in. eave width for single-section homes and maximum 12 in. for multi-section homes.

5. Table is based on maximum 20-degree roof pitch (4.3/12).

6. All manufactured homes designed to be located in Wind Zone II must have a vertical tie installed at each diagonal tie location.

7. Table is based upon the minimum height between the ground and the bottom of the floor joist being 18 inches. Interpolation may be required for other heights from ground to strap attachment.

8. Additional tie downs may be required per the home manufacturer instructions.

9. Ground anchors must be certified by a professional engineer, or registered architect, or listed by a nationally recognized testing laboratory.

10. Ground anchors must be installed to their full depth, and stabilizer plates, if required by the ground anchor listing or certification, must also be installed in accordance with the listing or certification and in accordance with the ground anchor and home manufacturer instructions.

11. Strapping and anchoring equipment must be certified by a registered professional engineer or registered architect or must be listed by a nationally recognized testing agency to resist these specified forces, in accordance with testing procedures in ASTM D 3953-97, Standard Specification for Strapping, Flat Steel and Seals (incorporated by reference, see § 3285.4).

12. A reduced ground anchor or strap working load capacity will require reduced tie-down strap and anchor spacing.

13. Ground anchors must not be spaced closer than the minimum spacing permitted by the listing or certification.

14. Table is based on a 3,150 lbs. working load capacity, and straps must be placed within 2 ft. of the ends of the home.

15. Table is based on a minimum angle of 30 degrees and a maximum of 60 degrees between the diagonal strap and the ground.

16. Table does not consider flood or seismic loads and is not intended for use in flood or seismic hazard areas. In those areas, the anchorage system is to be designed by a professional engineer or architect.

TABLE 3 TO § 3285.402—MAXIMUM DIAGONAL TIE-DOWN STRAP SPACING, WIND ZONE III.

Nominal floor width, single section/multi-section	Max. height from ground to diagonal strap attachment	Near beam method I-beam spacing		Second beam method I-beam spacing	
		82.5 in.	99.5 in.	82.5 in.	99.5 in.
12 ft./24 ft. 144 in. nominal section(s).	25 in .....	5 ft. 1 in .....	N/A .....	N/A .....	N/A .....
	33 in .....	4 ft. 3 in .....	N/A .....	N/A .....	N/A .....
	46 in .....	N/A .....	N/A .....	N/A .....	N/A .....
14 ft./28 ft. 168 in. nominal section(s).	25 in .....	6 ft. 2 in .....	5 ft. 7 in .....	N/A .....	N/A .....
	33 in .....	5 ft. 8 in .....	4 ft. 9 in .....	N/A .....	N/A .....
	46 in .....	4 ft. 8 in .....	N/A .....	N/A .....	N/A .....
16 ft./32 ft. 180 in. to 192 in. nominal sections.	25 in .....	N/A .....	6 ft. 3 in .....	N/A .....	N/A .....
	33 in .....	6 ft. 1 in .....	5 ft. 11 in .....	N/A .....	N/A .....
	46 in .....	5 ft. 7 in .....	5 ft. 0 in .....	N/A .....	N/A .....
	67 in .....	4 ft. 5 in .....	N/A .....	N/A .....	N/A .....

NOTES: 1. Table is based on maximum 90 in. sidewall height.

2. Table is based on maximum 4 in. inset for ground anchor head from edge of floor or wall.

3. Table is based on main rail (I-beam) spacing per given column.

4. Table is based on maximum 4 in. eave width for single-section homes and maximum 12 in. for multi-section homes.

5. Table is based on maximum 20-degree roof pitch (4.3/12).

6. All manufactured homes designed to be located in Wind Zone III must have a vertical tie installed at each diagonal tie location.

7. Table is based upon the minimum height between the ground and the bottom of the floor joist being 18 inches. Interpolation may be required for other heights from ground to strap attachment.

8. Additional tie downs may be required per the home manufacturer instructions.

9. Ground anchors must be certified by a professional engineer, or registered architect, or listed by a nationally recognized testing laboratory.

10. Ground anchors must be installed to their full depth, and stabilizer plates, if required by the ground anchor listing or certification, must also be installed in accordance with the listing or certification and per the ground anchor and home manufacturer instructions.

11. Strapping and anchoring equipment must be certified by a registered professional engineer or registered architect or must be listed by a nationally recognized testing agency to resist these specified forces, in accordance with testing procedures in ASTM D 3953-97, Standard Specification for Strapping, Flat Steel and Seals (incorporated by reference, see § 3285.4).

12. A reduced ground anchor or strap working load capacity will require reduced tie-down strap and anchor spacing.

13. Ground anchors must not be spaced closer than the minimum spacing permitted by the listing or certification.

14. Table is based on a 3,150 lbs. working load capacity, and straps must be placed within 2 ft. of the ends of the home.

15. Table is based on a minimum angle of 30 degrees and a maximum angle of 60 degrees between the diagonal strap and the ground.

16. Table does not consider flood or seismic loads and is not intended for use in flood or seismic hazard areas. In those areas, the anchorage system is to be designed by a professional engineer or architect.

#### APPENDIX TO § 3285.402

Torque Probe Method for determining soil classification: This kit contains a 5-foot long steel earth-probe rod, with a helix at the end. It resembles a wood-boring bit on a larger scale. The tip of the probe is inserted as

deep as the bottom helix of the ground anchor assembly that is being considered for installation. The torque wrench is placed on the top of the probe. The torque wrench is used to rotate the probe steadily so one can read the scale on the wrench. If the torque wrench reads 551 inch-pounds or greater, then a Class 2 soil is present according to the Table to 24 CFR 3285.202(a)(3). A Class 3 soil is from 351 to 550 inch-pounds. A Class 4A soil is from 276 to 350 inch-pounds, and a Class 4B soil is from 175 to 275 inch-pounds. When the torque wrench reading is below 175 inch-pounds, a professional engineer should be consulted.

[72 FR 59362, Oct. 19, 2007, as amended at 79 FR 53614, Sept. 10, 2014]

#### § 3285.403 Sidewall, over-the-roof, mate-line, and shear wall straps.

If sidewall, over-the-roof, mate-line, or shear wall straps are installed on the home, they must be connected to an anchoring assembly.

#### § 3285.404 Severe climatic conditions.

In frost-susceptible soil locations, ground anchor augers must be installed below the frost line, unless the foundation system is frost-protected to prevent the effects of frost heave, in accordance with acceptable engineering practice and § 3280.306 of this chapter and § 3285.312.

#### § 3285.405 Severe wind zones.

When any part of a home is installed within 1,500 feet of a coastline in Wind Zones II or III, the manufactured home must be designed for the increased requirements, as specified on the home's data plate (refer to § 3280.5(f) of this chapter) in accordance with acceptable engineering practice. Where site or other conditions prohibit the use of the manufacturer's instructions, a registered professional engineer or registered architect, in accordance with acceptable engineering practice, must design anchorage for the special wind conditions.

#### § 3285.406 Flood hazard areas.

Refer to § 3285.302 for anchoring requirements in flood hazard areas.