

# SUMMARY OF LOAD TEST PROCEDURES FOR HELICAL GUY ANCHORS

## 1.0 HELICAL GUY ANCHOR LOAD TESTS

The information contained in this document is primarily taken from the Chance Model Specifications and ASTM D3689 and amended for general procedures applicable for the guy anchor installation and testing. It is recommended that the Model Specification and applicable ASTM Standards be used to further clarify additional project requirements.

## 1.1 PRE-PRODUCTION TESTS (AKA Verification Tests)

Load tests shall be performed to verify the suitability and capacity of the proposed helical anchor, and the proposed installation procedures prior to installation of production helical anchors. The sacrificial test helical anchors shall be constructed immediately prior to the start of work on the production helical anchors. The Owner shall determine the number of pre-production tests, their location, acceptable load and movement criteria. Additional purpose of pre-production tests is to verify the empirical relationship between the ultimate uplift capacity and the average installing torque of the helical anchor for the project site soil conditions.

Pre-production helical anchor installation methods, procedures, equipment, and overall length shall be identical to the production helical anchors to the extent practical except where approved otherwise by the Owner. At the Contractors suggestion but with the Owners permission, uplift tests may be performed on non-production anchors installed vertically to the same vertical depth and torque requirements specified by the Owner.

The Contractor shall submit for review and acceptance the proposed helical anchor load testing procedure. The pre-production test proposal shall be in general conformance with ASTM D-3689, and shall provide the minimum following information:

- a. Type and accuracy of load equipment
- b. Type and accuracy of load measuring equipment
- c. Type and accuracy of anchor-head deflection measuring equipment
- d. General description of load reaction system (including description of reaction anchors, if used)
- e. Calibration report for complete load equipment, including hydraulic jack, pump, pressure gauge, hoses, and fittings. This calibration is to be for the exact equipment that will be used in the field for load testing.

The following test procedure shall be considered to meet the minimum requirements. It is not intended to preclude local building codes, which may mandate other requirements, such as full 24-hour load tests.

If the pre-production test fails to meet the design requirements, the Contractor shall modify the helical anchor design and/or installation methods and retest the modified anchor, as directed by the Owner. For prescriptive specifications, the Engineer will define the appropriate modifications

## 1.2 LOAD TEST EQUIPMENT

- 1.2.1 The load test equipment shall be capable of increasing or decreasing the applied load incrementally. The incremental



control shall allow for small adjustments, which may be necessary to maintain the applied load for a sustained, hold period.

1.2.2 The apparatus for applying and measuring loads including all structural members shall have sufficient size, strength and stiffness to safely prevent excessive deflection and instability up to 120% of the maximum anticipated test load. It should also be designed to prevent applying an eccentric load to the anchor head and the direction of the applied load shall be collinear with the helical anchor at all times.

1.2.3 At least two dial indicators shall be mounted on reference beams at axisymmetric points equidistant from the center of the test anchor to measure helical anchor movement. The dial gauge shall have an accuracy of at least  $\pm 0.001$ " (0.025 mm) and a minimum travel of 2 inches (50 mm). Dial indicators shall be in good working condition and shall have a full range calibration within three years prior to each test. The dial gauge shall be positioned so its stem is parallel with the axis of the helical anchor. The stem shall rest on a smooth plate located at the anchor head with the plate positioned perpendicular to the axis of the helical anchor. The dial gauge shall be supported by a reference apparatus to provide an independent fixed reference point. The reference apparatus shall be independent of the reaction system and shall not be affected by any movement of the reaction system.

1.2.4 The load test equipment including hydraulic jacks, pressure gages and pressure transducers shall be calibrated at least 1 year prior to the load test to at least the maximum anticipated jack load. The complete jacking and pressure measurement system, including the hydraulic pump should be calibrated as a unit. The load test equipment shall be recalibrated, if in the opinion of the Owner and/or Contractor reasonable

doubt exists as to the accuracy of the load or deflection measurements.

1.2.5 A secondary method of recording anchor head movement shall be provided as a redundant system. The secondary system will provide an additional data source in the event the primary recording system is moved or fails during the test. An acceptable redundant system is a surveyor's level and engineers scale attached to the center of the test anchor. The engineers scale shall be capable of recording to 1/64 inch (0.4 mm). Unless otherwise approved by the engineer verify that the secondary system did not move during the test by reading elevations at a permanent benchmark prior to and after the test.

### 1.3 TESTING PROGRAM

1.3.1 The hydraulic jack shall be positioned at the beginning of the test such that the unloading and repositioning of the jack during the test shall not be required. The jack shall also be positioned coaxially with respect to the anchor head so as to minimize eccentric loading. The hydraulic jack shall be capable of applying a load equal to 120% of the anticipated test load. The pressure gauge shall be graduated in 250 psi increments or less. The stroke of the jack shall not be less than the theoretical elastic shortening of the total helical anchor length at the maximum test load.

1.3.2 An alignment load (AL) shall be applied to the helical anchor prior to setting the deflection measuring equipment to zero or a reference position. The AL shall be no more than 10% of the anticipated design load (DL). After the AL is applied, the test setup shall be inspected carefully to ensure it is safe to proceed.

1.3.3 Axial tension load tests shall be conducted by loading the helical anchor in step-wise fashion as shown in Table 1 to the extent practical. Anchor head deflection shall



be recorded at the beginning of each step and after the end of the hold time. The beginning of the hold time shall be defined as the moment when the load equipment achieves the required load step.

- 1.3.4 Test loads shall be applied until continuous jacking is required to maintain the load step or until the test load increment equals 200% of DL, whichever occurs first. The observation period for this last load increment shall be 10 minutes. Displacement readings shall be recorded at 1, 2, 3, 4, 5 and 10 minutes (load increment maxima only).
- 1.3.5 The applied test load shall be removed in four approximately equal decrements per the schedule in Table 1. The hold time for these load decrements shall be 1 minute, except for the last decrement, which shall be held for 5 minutes.

This cyclic loading method will permit the analysis of the total, elastic, and net movements, since they can be separated and studied. For special test anchors not to be used later in service, further load cycles may be conducted to provide an estimation of the ultimate capacity.

**1.4 ACCEPTANCE CRITERIA for HELICAL GUY ANCHOR PRE-PRODUCTION (VERIFICATION) LOAD TESTS**

The Contractor shall perform pre-production load tests on a quantity of sacrificial helical guy anchors as determined by the Owner. The acceptance criteria stated herein may be altered by the Owner. It is suggested that both of the following criteria contained in Section 1.4.1 and 1.4.2 must be met for approval of pre-production load tests on helical guy anchors:

- 1.4.1 The helical guy anchor shall sustain the tension design capacities (1.0 DL) with no more than 1 in. (25.4 mm) total axial movement of the anchor head as measured relative to the top of the helical anchor prior to the start of testing.

- 1.4.2 Failure shall not occur at the 2.0 DL maximum tension test loads. The test should be discontinued when cumulative creep exceeds 4 inches (100 mm). An anchor is considered to have failed to sustain an applied load when creep/minute is uniform or increasing.

- 1.4.3 The Contractor shall provide the Owner copies of field test reports confirming helical anchor configuration and construction details within 24 hours after completion of the load tests. Formal copies shall be submitted per section 3.3. This written documentation will either confirm the load capacity as required on the working drawings or propose changes based upon the results of the pre-production tests.

Table 1: Steps for Pre-Production Load Testing

LOAD STEP	HOLD TIME (MIN)
AL	1.0 Min.
0.20 DL	4.0 Min.
0.40 DL	4.0 Min.
0.60 DL	4.0 Min.
0.80 DL	4.0 Min.
1.0 DL	4.0 Min.
0.75 DL	1.0 Min.
0.50 DL	1.0 Min.
0.25 DL	1.0 Min.
AL	1.0 Min.
0.5 DL	4.0 Min.
1.0 DL	4.0 Min.
1.2 DL	4.0 Min.
1.4 DL	4.0 Min.
1.6 DL	4.0 Min.
1.8 DL	4.0 Min.
2.0 DL	10.0 Min.
1.5 DL	1.0 Min.
1.0 DL	1.0 Min.
0.5 DL	1.0 Min.
AL = Alignment Load	
DL = Design Load	



1.4.4 When a helical guy anchor fails to meet the acceptance criteria, modifications shall be made to the design, the construction procedures, or both. These modifications include, but are not limited to, reducing the helical anchor load capacity, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the helical anchor material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. The cause for any modifications of design or construction procedures shall be decided in order to determine any additional cost implications.

the vicinity. For failed helical anchors, the Contractor shall modify the design, the construction procedure, or both. These modifications include, but are not limited to, installing replacement helical anchors, modifying the installation methods and equipment, increasing the minimum effective installation torque, changing the helix configuration, or changing the helical anchor material (i.e., central steel shaft). Modifications that require changes to the structure shall have prior review and acceptance of the Owner. Any modifications of design or construction procedures shall be at the Contractor's expense.

## 1.5 PRODUCTION HELICAL ANCHOR TESTING

Note: This may be the only type of load test conducted, depending on project conditions.

1.5.1 The Contractor shall perform proof tests on a percentage of the total production helical anchors as determined by the Owner. Minimum proof test quantities shall be the greatest of either 3% of the total guy anchors or 2 anchors. The helical anchors to be tested will be selected by the Owner. At the Contractor's suggestion, but with the Owner's permission, uplift tests may be performed on non-production screw anchors installed vertically to the same vertical depth and torque in the same general location as production anchors. The test sequence shall be as shown in Table 2 to the extent practical. The acceptance criteria for production helical anchors shall be per section 1.4.1.

1.5.2 If a production helical anchor that is tested fails to meet the acceptance criteria, the Contractor shall be directed to proof test another helical anchor in

Table 2: Steps for Production Proof Load Testing	
LOAD STEP	HOLD TIME (MIN)
AL	1.0 Min.
0.20 DL	4.0 Min.
0.40 DL	4.0 Min.
0.60 DL	4.0 Min.
0.80 DL	4.0 Min.
1.0 DL	4.0 Min.
0.60 DL	1.0 Min.
0.40 DL	1.0 Min.
0.20 DL	1.0 Min.
AL	1.0 Min.
AL = Alignment Load	
DL = Design Load	

