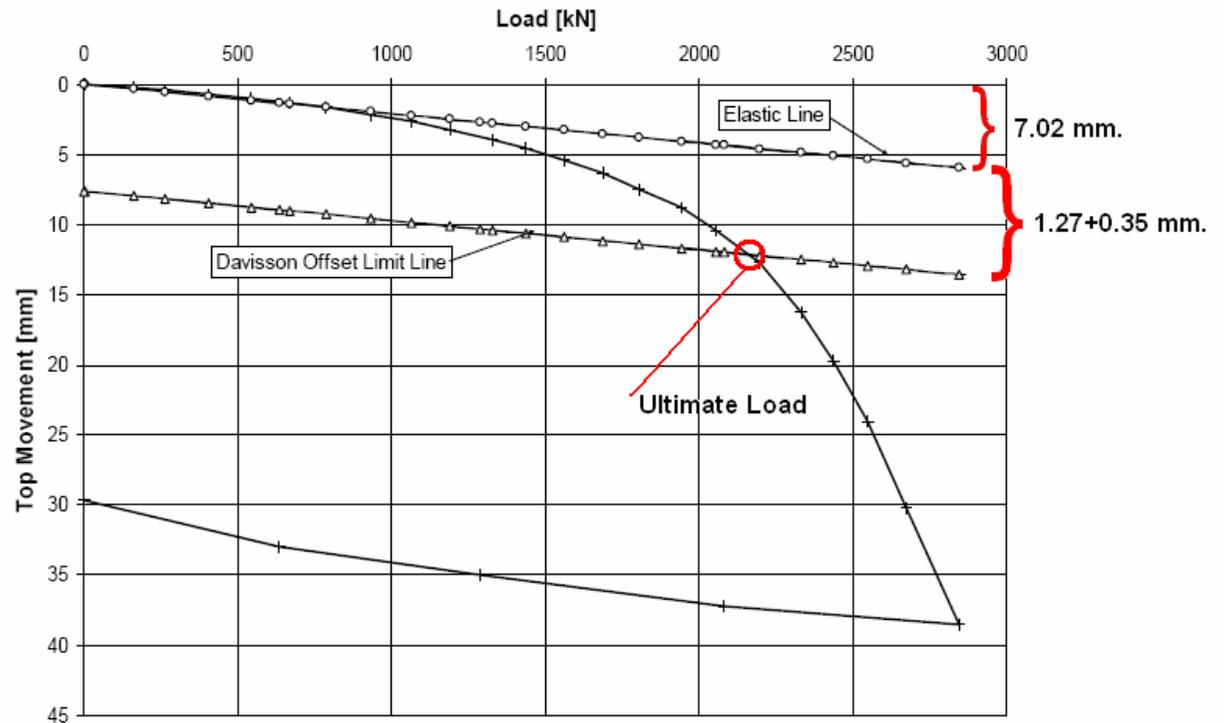


## ESTIMATION OF ULTIMATE LOAD FROM PILE LOAD TEST BY DAVISSON METHOD

|                             |          |            |
|-----------------------------|----------|------------|
| Fc'=                        | 400      | ksc.       |
| Pile Dia.=                  | 0.46     | m.         |
| Q=                          | 270      | Tons       |
| L=                          | 12.8     | m.         |
| A=                          | 0.16     | sq.m.      |
| Ec=                         | 29,427   | Mpa        |
| Ec=                         | 3.00E+06 | Tons/sq.m. |
| Settle-1=                   | 7.02     | mm.        |
| Settle-1=                   | 2.81     | inch       |
| Settle-2=                   | 0.50     | inch       |
| Settle-2=                   | 1.27     | mm.        |
| Settle-3=                   | 0.14     | inch       |
| Settle-3=                   | 0.35     | mm.        |
| Total Settle=               | 3.44     | inch       |
| Davidson Offset Line Limit= | 3.44     | inch       |
| Davidson Offset Line Limit= | 8.75     | mm.        |

- ◆ **Davidson (1973) Criteria** – The design load shall be  $\frac{1}{2}$  of the ultimate test load defined at a deformation equal to the gross elastic compression of the pile (PL/AE) plus 0.15 inch plus D/120 of the pile. Where D is pile diameter in inches.



### **1807.2.8.3 Compression Load Acceptance**

- ◆ **IBC 2000, Section 1807.2.8.3** – “The resulting load shall not be more than  $1/2$  of the test load, which produces a permanent net settlement of not more than 0.01 inch per ton, and not more than  $3/4$  inch.”
- ◆ **Davisson (1973) Criteria** – The design load shall be  $1/2$  of the ultimate test load defined at a deformation equal to the gross elastic compression of the pile (PL/AE) plus 0.15 inch plus  $D/120$  of the pile. Where D is pile diameter in inches.
- ◆ The IBC code is “the law” but is not as popular as using the Davisson criteria, which is more practical and conservative.
- ◆ See Section 1807.2.8.8 allows 110% overload on piles mislocated.

bearing plate is centered on top of the load cell and bears against the centered test frame. Clear space should be provided between the foundation cap and soil to eliminate any unwanted support from the soil surface during testing.

### Reaction Anchors

Typically, four helical tension anchors provide support for the test frame and resist the test load as it is applied. All reaction anchors should be installed to approximately the same depth and installation torque. The combined ultimate capacity of the reaction anchors should be twice the intended test pile load.

### Measuring Deflection

A minimum of two dial indicators with at least 2" inches of travel measure the deflection of the test pile. Each dial indicator is mounted on a separate reference beam. These reference beams are typically parallel and must be independent of the test frame and cribbing. The reference beams are placed on each side of the foundation to be tested so that the dial indicators can be mounted equidistant from the center and on opposite sides of the test foundation.

Other types of measuring systems may be used such as a wire-mirror-scale system, surveyor's level or laser beam. The measuring system must have proven reliability with an accuracy of 0.01" (0.25 mm). It is recommended to use a secondary deflection measuring system as a back-up.

### Reading for the Quick Load Test Method

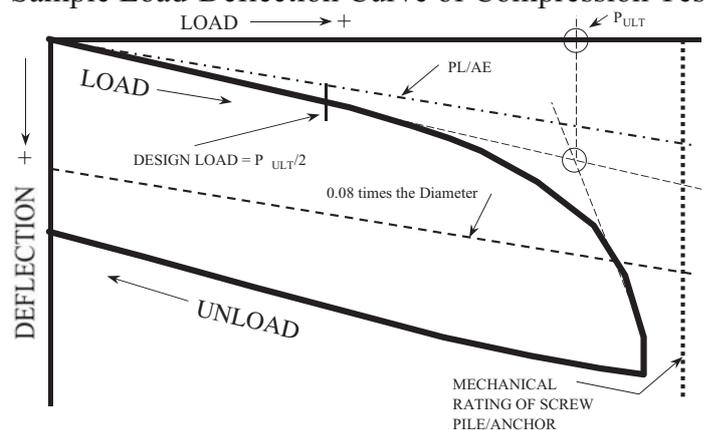
Record readings of load, time and settlement immediately before and after each load increment or decrement. All deflection devices should be read simultaneously or as close to simultaneously as possible.

### Acceptance Criteria

Acceptance of the load test results is generally governed by the building code for that jurisdiction and subject to review by the structural designer. The structural designer determines the maximum deflection the structure can withstand without undue loss of function or distress. The acceptance criteria must be defined prior to conducting the load test.

The load-deflection data may be plotted for a fast overview of the results. Figure 11.2 shows a sample test plot. Various building codes have their own acceptance criteria, generally a limit on deflection at the factored load. A fast way to determine the ultimate load is by use of a technique called the "intersection of tangents." This is accomplished by graphically constructing two tangent lines. One line is drawn tangent to the second "straight line" portion of the load curve. The other line is drawn tangent to the initial "straight line" portion of the load-deflection curve which is beyond the curved or non-linear portion of the load-deflection curve. The point where the two tangents intersect identifies

**Figure 11.2**  
Sample Load-Deflection Curve of Compression Test



an estimate of the ultimate load. An example of acceptance criteria is the New York City code which calls for the design load to be the lesser of:

1. 50% of the applied load causing a net settlement (total settlement less rebound) of the pile of 0.01" per ton of applied load
- or
2. 50% of the applied load causing a net settlement of the pile of 1/2". Net settlement is here defined as the gross settlement at the test load less the elastic compression.

Other acceptance criteria include:

1. Maximum total settlement under a specified load
2. Maximum net settlement after the test load
3. Maximum settlement under the design load, or various techniques such as defined by the Davisson Method (1973), and shown in Figure 11.3.

The recommended acceptance criteria for helical screw foundations is one-half of the applied test load causing a net settlement (gross settlement less the elastic compression) not to exceed 0.08 times the diameter of the largest helical plate.

When relatively low foundation capacities are required, the acceptance criteria for a helical screw foundation might be based on minimum depth and minimum torque criteria (see Step 9, Field Production Control). This is similar to what the New York City code for driven piles up to 30 tons requires, which is to define capacity by the minimum "blows per foot of set." The subject of load tests and acceptance criteria are discussed by Crowther (1988) and may be referred to for a more complete treatment of the subject.

Figure 11.4 is a plot of results from a "quick test" per ASTM D1143 of a 12 ft long 1 1/2" square shaft helical screw foundation having 10" and 12" helical plates. It was installed in the residual fine grained soils of Roanoke, VA and tested immediately after installation. The displacement curve is completely below the elastic compression line, indicating no skin friction was acting on the shaft during the test.

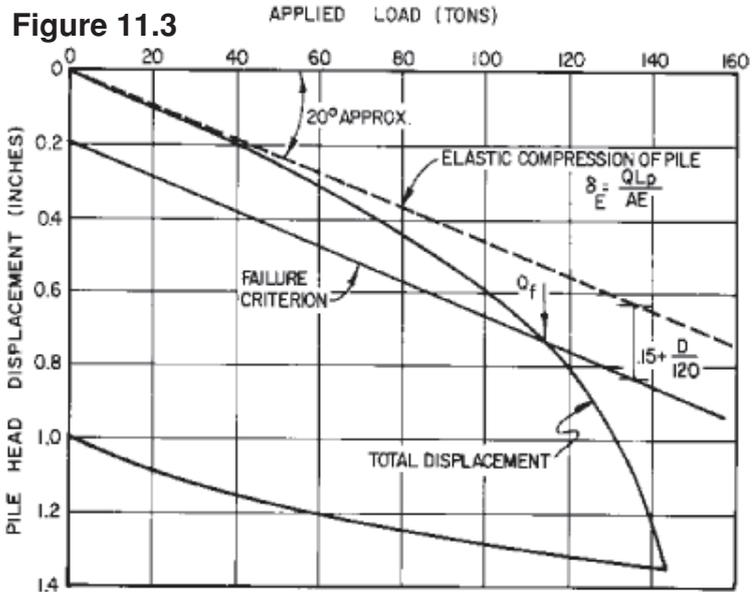


Figure 11.4

