

**SUPERSEDED BY EB 23-024  
EFFECTIVE 8/3/23**



New York State  
Department of  
Transportation  
**ENGINEERING  
INSTRUCTION**

**EI**  
**04-037**

Title: **SPECIAL SPECIFICATION FOR HIGH-STRAIN DYNAMIC TESTS FOR NONDRIVEN FOUNDATIONS**

Distribution:

- |   |  |
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Approved:

  
Robert L. Sack, Deputy Chief Engineer  
(Research) 8. OCT. 04  
Date

**ADMINISTRATIVE INFORMATION:**

- This Engineering Instruction (EI) is effective beginning with projects submitted for the letting of May 5, 2005.
- Superseded issuance(s): This EI does not supersede any previous issuances.
- Disposition of issued materials: The information transmitted by this issuance will reside in the Special Specifications directory of the Toolbox Server.

**PURPOSE:** The purpose of this EI is to issue a new special specification for a high-strain dynamic test for nondriven foundations.

**TECHNICAL INFORMATION:** The transmitted special specification is for a high-strain dynamic test for nondriven foundations such as a bored-in pile, drilled shaft, or previously driven cast-in-place piles that cannot be tested with a conventional hammer.

- Actions by Geotechnical Engineering Bureau (GEB): The preliminary foundation report and the Foundation Design Report (FDR) will indicate the need for this type of test.
- Actions by Foundation Designers: The Foundation Designer, Structures Designer, Regional Designer, Regional Geotechnical Engineer (RGE) and GEB shall discuss the anticipated equipment for imparting the impact force to the test pile or shaft with respect to the available working area at the foundation location.
- PIN Approval: The special specification is to be approved on a project-by-project basis. The inclusion of this item in the Foundation Design Report prepared by Geotechnical Engineering Bureau will serve to release this specification for use on the subject project. The Foundation Engineer in the GEB is responsible for informing the Special Specification (SS) coordinator in the GEB, so that the proper notification may be sent to Design Quality Assurance Bureau (DQAB). The Regional Designer will incorporate the special specification into the PS&E submission to DQAB as outlined in HDM Chapter 21, 21.9.3.2 Submitted Materials.

The special specification is organized by mass as a function of the anticipated pile or shaft capacity.

| Item 551.55XX--17 M<br>(XX)= | Ram Weight<br>(kN) |
|------------------------------|--------------------|
| 02                           | 20                 |
| 05                           | 50                 |
| 07                           | 70                 |
| 14                           | 140                |
| 18                           | 180                |

**TRANSMITTED MATERIALS:**

Attached is the following special specification:

Item 551.55XX--17 M High-Strain Dynamic Tests for NonDriven Foundations.

**BACKGROUND:** The special specification was created to provide an additional test procedure for Bored-In Piles or Drilled Shafts. The test consists of imparting a sufficient impact force to a test pile or shaft and measuring strain and acceleration near the pile/shaft head. These measurements are then used to determine pile/shaft integrity and estimate static pile/shaft capacity. The pile/shaft used for the test will be instrumented and tested by New York State Department of Transportation (Testing Engineer). The Contractor will not be responsible for conducting the test but will be required to supply material and labor as needed by the Testing Engineer and apply the impact force. The testing procedures shall conform to AASHTO Standard T-298.

During an analysis of a foundation element on a recent project, a need to impart greater energy into a pile was identified. Several months after a Static Pile Load Test (SPLT), the Geotechnical Engineering Bureau took Pile Driving Analyzer (PDA) measurements on a pile while it was struck with conventional pile driving equipment. It took a large quantity of blows to generate one inch of pile set and Case Pile Wave Analysis Program (CAPWAP) analyses of the data showed that the operation only partially mobilized the soil resistance along the pile. In order to activate the full soil resistance in a single blow or a few blows, greater energy was to be imparted into the pile. It is important that sufficient hammer energy is imparted into the pile during the PDA testing in order to generate a load-movement curve that approaches the maximum movement measured from the SPLT. This can be accomplished by using a drop-weight system designed to activate full soil resistance in large diameter piles or drilled shafts.

**CONTACT:** Questions or comments regarding this issuance should be directed to Randy Romer of the Geotechnical Engineering Bureau at (518) 457-4714, [rromer@dot.state.ny.us](mailto:rromer@dot.state.ny.us). Questions or comments regarding the technical aspects of the special specification should be directed to Paul Bailey of the Geotechnical Engineering Bureau at (518) 457-5524, [pbailey@dot.state.ny.us](mailto:pbailey@dot.state.ny.us).

# **ITEM 551.55XX 17 M HIGH-STRAIN DYNAMIC TESTING OF NONDRIVEN FOUNDATIONS**

## **DESCRIPTION**

This work shall consist of furnishing and operating equipment for imparting a sufficient impact force, from a drop weight or ram, to the test pile or shaft in accordance with the contract documents and as directed by the Engineer. The pile or shaft used for the test will be instrumented and tested by New York State Department of Transportation (Testing Engineer). The Contractor will not be responsible for conducting the test, but will be required to supply material and labor as needed by the Testing Engineer and apply the impact force. Testing procedures shall conform to the AASHTO Standard T-298 unless as otherwise noted.

## **Definitions**

**Pile or Shaft** may be a Bored-In Pile, Drilled Shaft or a Cast-In-Place pile previously driven and concreted and no longer capable of being driven with conventional equipment on the project.

**Test Area** is the top of the shaft or pile measured two diameters from the top where the instruments will be attached.

**Permanent Set** is the permanent displacement of the pile or shaft after each impact. It is used as an integration constant in the analysis of the data.

**Pedestal** is a beam or pipe used to transfer the impact force from the drop weight to the top of the pile when reinforcing is protruding.

## **MATERIALS**

The Contractor shall provide the following materials:

A thin-walled casing or equivalent (optional, see construction details).

A drop weight in the range of one to two percent (1% - 2%) of the anticipated pile capacity. The cross section of the weight will be symmetrical. The area of the weight or the impact protrusion will be consistent with the striker plate (see below).

A guide allowing variable drop heights typically between 1 m and 2 m and maintaining drop weight alignment with the pile or shaft. The guide will be equipped with a release mechanism, such as hydraulic shears, hydraulic or mechanically actuated pin, or a pair of tongs, such that the weight will drop in free fall. The maximum height of the fall will not exceed three meters.

A cushion consisting of new sheets of plywood with total thickness between 50 mm and 150 mm to be placed on the pile or shaft top.

A steel striker plate shall have a thickness of at least 50 mm and a cross section area between 70% and 90% of pile or shaft top area, but not less than the area of the impacting surface of the drop weight.

One (1) kW of 115 Volt AC power.

Surveyor's transit, laser light level, or equivalent for measurements of pile set under each impact.

## **CONSTRUCTION DETAILS**

Unless delegated to the Testing Engineer the Contractor will be responsible for the following:

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Construct the test shaft using the approved techniques, creating a flat, level (perpendicular to the longitudinal axis of the pile or shaft), and solid concrete pile or shaft top.

The pile or shaft must extend a minimum of two pile or shaft diameters above the adjacent grade, to create a "test area". This may be accomplished by either excavating the required distance below grade or extending the pile or shaft above grade. If a permanent casing is not required and the extension method is chosen, then the "test area" must be cased in a thin-wall casing, tube, or equivalent. Casing of this test area must be made as a continuation of the construction of the shaft. There should not be soil contamination or nonuniformities in the concrete located within or below the test area. The pile or shaft top shall be made level to the casing and smoothed.

The testing instruments will be located approximately one and one-half diameter from the top of the pile or shaft. Prior to the testing of cased piles or shafts, four "windows" (approximate size of 150 mm by 150 mm) diametrically opposite of each other will be located and removed from the casing. On a pile or shaft where casing is not present, the Contractor shall smooth the concrete surface by grinding similar areas around the pile circumference such that proper gage attachment can be accomplished.

Establish reference point(s) on the pile or shaft for determining the elevation and permanent set.

Provide the Testing Engineer access to attach the gages to the exposed concrete and/or steel casing and examine the pile or shaft top to insure the concrete or grout is flush with or above the casing.

Apply plywood cushion and then striker plate to the pile or shaft top. If reinforcing protrudes from the pile or shaft top, then a pedestal should be secured in such a manner as not to move under impact. The impedance of the pedestal defined as the cross-sectional area times the modulus of elasticity divided by the wave speed of the respective material has to be at least 80% of the impedance of the pile or shaft being tested.

Position the guide and drop weight assembly and apply a minimum of two (2) drop weight impacts to the pile top. The first drop height should be minimal to allow the testing Engineer to assess the testing equipment, the driving system, and pile stresses. Subsequent impacts may then be applied by utilizing higher drop heights, not to exceed a maximum of ten impacts.

Before and after each of the impacts, the Contractor shall determine the elevation of the reference point(s) in order to calculate the set or net displacement of the pile or shaft from each impact.

Upon completion of the test, return the pile to acceptable production condition, as determined by the Engineer, if the pile or shaft is to be used in the finished work.

Requirements of the Testing Engineer:

The Testing Engineer or representative will drill the holes, set the attaching apparatus and attach the instruments for the test. This procedure will require a maximum of one hour.

After each impact, the Testing Engineer will evaluate the data and determine if the capacity has been mobilized. If the capacity has not been achieved, then a new drop height and/or a change in the cushion thickness will be ordered. This procedure will take 30 minutes.

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**METHOD OF MEASUREMENT**

This work will be measured as the number of High-Strain Dynamic Tests for piles or Drilled Shafts completed to the satisfaction of the Engineer.

**BASIS OF PAYMENT**

The unit price bid shall include the cost of furnishing all labor, materials, and equipment necessary to satisfactorily complete the test. The pile or shaft is to be paid under the item for that work.