SAMPLE SPECIFICATION for PILE INTEGRITY TESTING by the LOW STRAIN IMPACT METHOD

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Note: This sample specification contains recommended or typical quantities in parenthesis, in the format (quantity); the specifying Engineers can adapt these quantities for their particular construction projects.

1. General Remarks

Pile Integrity Testing (PIT) is a Non-Destructive integrity test method for foundation piles. It is a "Low Strain" Method (since it requires the impact of only a small hand-held hammer). The evaluation of PIT records is conducted either according to the Pulse-Echo (or Sonic Echo – a time domain analysis) or the Transient Response (frequency domain analysis) Procedure. This test is standardized by ASTM D5882 Standard Test Method for Low Strain Impact Integrity Testing of Deep Foundations.

2. Description of Method

Low Strain Integrity Testing may be applied to any concreted pile (e.g. concrete piles, drilled shafts, augered cast-in-place piles, concrete filled pipe piles). The test requires the impact of a small hand held hammer on the shaft top and the measurement of the shaft top motion (acceleration or velocity). The input compression wave from the hammer is reflected from pile toe (or a change in cross sectional area or pile material quality) and returns to the pile top at a time related to the speed of travel of the wave in the pile material.

The pile top velocity is displayed as a function of time with an exponentially increasing magnitude such that the pile toe reflection is enhanced. The averaged, amplified velocity, averaged for several impacts, is the standard result of the Pulse Echo Method. The force as a function of time, if available, provides additional information as to the pile quality near the pile top.

The Transient Response Method result shows the ratio of velocity to force transforms for all relevant frequencies in a plot called Mobility. It should be shown together with the related low frequency pile stiffness. Transient Response requires that hammer force is measured.

3. Test Equipment

Provide a Pile Integrity Tester (PIT) manufactured by Pile Dynamics, Inc., (30725 Aurora Road, Cleveland, OH 44139, USA; www.pile.com/pdi; email: sales@pile.com; phone: +1 216-831-6131; fax +1 216-831-0916,), or an equivalent equipment. The equipment shall have the following minimum requirements:

- The analog to digital resolution shall be at least 24 bits,
- The sampling frequency shall be at least 25,000 Hz.
- Data shall be stored such that additional processing or further wave analysis is possible.
- Data shall be displayed in the field for evaluations of preliminary data quality and interpretation.
- The equipment shall allow attachment of a motion sensing device capable of measuring acceleration, velocity or displacement due to the impact of the pile top with a hand held hammer.

4. Test Personnel

The field testing shall be performed by an experienced technician with at least ___ (one) year experience in integrity testing. The interpretation of the records, however, requires extensive experience by a graduated engineer with at least ___ (three) years experience in integrity testing.

5. Test Preparation

For cast in place piles, integrity testing shall not be performed until the concrete has cured for a minimum of seven (7) days unless otherwise approved by the engineer. The pile head shall be free from water, dirt or other debris. The concrete at the pile top surface must be relatively smooth and provide sufficient space for attaching the motion sensing device and for the hammer impact area.

_____% (20%, 50%, ___%, 100%) of all piles shall be integrity tested. The location of piles for designated for integrity testing shall be specified by the engineer ____ (after, prior to) pile installation. If less than 100% of piles are initially tested, additional piles may be selected for testing at the discretion of the engineer if circumstances either during or after pile installation should make a piles' integrity suspect, or if the initial tests reveal major defects.

6. Result Presentation

The testing engineer shall present a report within ___ (2, 5, 10) working days after performing the field test to provide the final test results and integrity evaluation. For each pile tested, the averaged, amplified velocity versus time record shall be included in the report, with a table summarizing results and conclusions. Additional plots and analyses can be included as required or suggested by the testing engineer.

7. Acceptance and Rejection

Shafts with no significant reflections from locations above the pile toe and with a clear pile toe reflection may be accepted. Where no clear toe reflection is apparent, the experienced test engineer shall state to which shaft depth the test appears to be conclusive. Where reflections from locations with significant reductions in pile area or pile material strength or stiffness above the pile toe are observed, the pile has a serious defect. If the record is complex, the results may be deemed inconclusive. Construction records (concrete usage, grout pressure records, soil borings) may be valuable in result interpretations or additional numerical analysis modeling may be used to quantify the record. The decision to reject and replace, or repair, any defective shaft is at the sole responsibility of the engineer-of-record for the foundation.

8. Remedial Action

Rejected or questionable piles may be replaced. Questionable piles may also be subjected to further testing, e.g., static load testing, dynamic load testing, core drilling, ultra-sonic logging, etc. Remedial action may include pressure grouting through core holes. If the pile top appears questionable, further pile top cut-off and retesting may be advisable. If a majority of piles diagnose as "inconclusive", partial or even complete pile excavation or another test method may be necessary for pile acceptance.