Idea 114: Detect nondocumented pile length of sign structures and highmast poles: Literature Search
Tuesday, June 20, 2017

Prepared for: Bruce Holdhusen

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Resources searched: Transport Database, Research in Progress, ASCE Civil Engineering Database, MnDOT Library Catalog, Google

Summary: Results are compiled from the databases named above. Links are provided for full-text, if applicable, or to the full record citation. I searched using the following terminology: dynamic load testing, dynamic pile testing, dynamic loads, pile length, bearing capacity.

Most Relevant Results

<table>
<thead>
<tr>
<th>Title</th>
<th>NYSDOT'S CONSTRUCTION CONTROL OF PILE FOUNDATIONS WITH DYNAMIC PILE TESTING.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Author</td>
<td>Bailey P F; Sweeney S E</td>
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<tr>
<td>Source</td>
<td>Transportation Research Record. 1988. (1169) p. 49-53</td>
</tr>
<tr>
<td>Abstract</td>
<td>New York State Department of Transportation tests piles dynamically, and the results are used to determine final pile-driving criteria. Approximately 20 percent of projects having piles include dynamic testing. Although the majority of the tests are specified for in design, a number of dynamic tests are needed each year to solve construction problems. The dynamic test is used to verify predictions made using static analysis and the wave equation analyses. The intent of the pile program is to avoid and control pile construction problems. Dynamic testing is done on special projects that have peculiar or unique soil conditions, or when it is difficult to estimate soil parameters in design or in preconstruction analyses. Testing is also done on projects with soil conditions that are found to be different from those assumed in design and to troubleshoot pile-driving problems. Examples from field tests demonstrate how the testing program is used to check on concerns for pile capacity, pile length, and pile driving stress, as well as hammer operation.</td>
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Publication Year 1988
Title MODERN SPECIFICATION OF DRIVEN PILE WORK.

Author CHENEY R S

Source Transportation Research Record. 1988. (1169) p. 62-69 (1 Figs.)

Abstract In the past 20 years, extensive research and implementation efforts have been directed at improved construction control of driven piles. The feasibility of techniques such as wave equation analysis, quick load testing, and dynamic pile testing has been thoroughly evaluated and generally accepted by the engineering profession. The mechanics of the pile-driving operation have been studied with results confirming the importance of controlling the properties of pile driving appurtenances such as hammer cushion, drive head, pile cushion, followers, and so on. Finally, the elements of risk in bidding pile work have been learned through numerous court of claims cases on topics such as estimated lengths, fixed-cost items bid as variable costs, delays in furnishing proper equipment, or required pile lengths. Modernization of current specifications for construction control of driven piling requires philosophical as well as technical changes. Five areas of potential improvement that need to be addressed in detail are specifying ordered pile lengths, using ultimate pile capacity, approving driving equipment, field verifying pile capacity, and devising a pile payment method.

Publication Year 1988


Abstract: Based on the measurements from strain or force, and acceleration, velocity, or displacement transducers, this test method obtains the force and velocity induced in a pile during an axial impact event (see Figs. 1 and 2). The Engineer may analyze the acquired data using engineering principles and judgment to evaluate the integrity of the pile, the performance of the impact system, and the maximum compressive and tensile stresses occurring in the pile.

If sufficient axial movement occurs during the impact event, and after assessing the resulting dynamic soil response along the side and bottom of the pile, the Engineer may analyze the results of a high-strain dynamic test to estimate the ultimate axial static compression capacity (see Note 1). Factors that may affect the axial static capacity estimated from dynamic tests include, but are not limited to the: (1) pile installation equipment and procedures, (2) elapsed time since initial installation, (3) pile material properties and dimensions, (4) type, density, strength, stratification, and saturation of the soil, or rock, or both adjacent to and beneath the pile, (5) quality or type of dynamic test data, (6) foundation settlement, (7) analysis method, and (8) engineering judgment and experience. If the Engineer does not have adequate previous experience with these factors, and with the analysis of dynamic test data, then a static load test carried out according to Test Method D1143/D1143M should be used to verify estimates of static capacity and its distribution along the pile length. Test Method D1143/D1143M provides a direct and more reliable measurement of static capacity.

Note 1—The analysis of a dynamic test will under predict the ultimate axial static compression capacity if the pile movement during the impact event is too small. The Engineer should determine how the size and shape of the pile, and the properties of the soil or rock beneath and adjacent to the pile, affect the amount of movement required to fully mobilize the static capacity. A permanent net penetration of as little as 2 mm per impact may indicate that sufficient movement has occurred during the impact event to fully mobilize the capacity. However, high displacement driven piles may require greater movement to avoid under predicting the static capacity, and cast-in-place piles often require a larger cumulative permanent net penetration for a series of test blows to fully mobilize the capacity. Static capacity may also decrease or increase over time after the pile installation, and
both static and dynamic tests represent the capacity at the time of the respective test. Correlations between measured ultimate axial static compression capacity and dynamic test estimates generally improve when using dynamic restrike tests that account for soil strength changes with time (see 6.8).

Note 2—Although interpretation of the dynamic test analysis may provide an estimate of the pile’s tension (uplift) capacity, users of this standard are cautioned to interpret conservatively the side resistance estimated from analysis of a single dynamic measurement location, and to avoid tension capacity estimates altogether for piles with less than 10 m embedded length. (Additional transducers embedded near the pile toe may also help improve tension capacity estimates.) If the Engineer does not have adequate previous experience for the specific site and pile type with the analysis of dynamic test data for tension capacity, then a static load test carried out according to Test Method D3689 should be used to verify tension capacity estimates. Test Method D3689 provides a direct and more reliable measurement of static tension capacity.

Note 3—The quality of the result produced by this test method is dependent on the competence of the personnel performing it, and the suitability of the equipment and facilities used. Agencies that meet the criteria of Practice D3740 are generally considered capable of competent and objective testing/sampling/inspection/etc. Users of this test method are cautioned that compliance with Practice D3740 does not in itself assure reliable results. Reliable results depend on many factors; Practice D3740 provides a means of evaluating some of those factors.

FIG. 2 Typical Arrangement for High-Strain Dynamic Testing of a Deep Foundation

Developed by Subcommittee D18.11 | Book of Standards Volume: 04.08
Historical Versions - previous version(s) of standard
Comparison of Five Different Methods for Determining Pile Bearing Capacities

DROP WEIGHT DYNAMIC TESTING OF DRILLED DEEP FOUNDATIONS
https://www.uml.edu/docs/SW%202004_Paikowsky_color_tcm18-106946.pdf

Dynamic Formulae
https://www.pile.com/about-dynamic-testing/

Title
A simplified field method for capacity evaluation of driven piles / [Samuel G. Paikowsky, John E. Regan and John J. McDonnell]

Date
1994

Browse Call Number
TA780 .P34 1994

Least Relevant Results

Title
An experimental study on static and dynamic bending behaviour of piles in soft clay.

Author
BOOMINATHAN,A; AYOTHIRAMAN,R

Source
GEOTECHNICAL AND GEOLOGICAL ENGINEERING. 2007/04. 25(2) pp177-189 (39 Refs.)

Abstract
Static and dynamic lateral load tests were carried out on model aluminium single piles embedded in soft clay to study its bending behaviour. Model aluminium piles with length to diameter ratios of 10, 20, 30 and 40 were used. Static lateral load tests were conducted on piles by rope and pulley arrangement unto failure and load-deflection curves were obtained. Dynamic lateral load tests were carried out for different magnitudes of load ranging from 7 to 30 N at wide range of frequencies from 2 to 50 Hz. The load transferred to the pile, pile head displacement and the strain variation along the pile length were measured using a Data Acquisition System. Safe static lateral load capacity for all piles is interpreted from load–deflection curves. Dynamic characteristics of the soil-pile system were arrived from the acquired experimental data. The soil-pile system behaves predominantly in nonlinear fashion even at low frequency under dynamic load. The displacement amplitude under dynamic load is magnified by 4.5-6.5 times the static deflection for all piles embedded in soft clay. But, the peak magnification factor reduces with an increase in the magnitude of lateral load mainly because of increase of hysteretic damping at very soft consistency. The maximum BM occurs at the fundamental frequency of the soil-pile system. Even the lower part of the pile affects the pile head response to the inertial load applied at the pile head. The maximum dynamic BM is magnified by about 1.5 times the maximum static BM for model piles in tested consistency of clay. The maximum dynamic BM occurs at a depth of about 1.5 times the depth of
maximum static BM for model piles, which indicates an increase of active pile length under dynamic load. (A)

Publication Year 2007

Title VIBRATORY LOADING OF PILE FOUNDATIONS.

Author Maxwell A A; Fry Z B; Poplin J K

Source Stp 444, pp 338-361, 17 FIG, 1 TAB

Abstract A UNIQUE INVESTIGATION IS DESCRIBED OF THE RESPONSE OF PILES SUBJECTED TO BOTH DYNAMIC AND STATIC LOADING, AND FINDINGS PRESENTED RELATIVE TO PERFORMANCE OF PILE FOUNDATIONS UNDER THESE CONDITIONS. PRELIMINARY LOAD TESTS WERE CONDUCTED AT NASA'S MISSISSIPPI TEST FACILITY PRIOR TO FINAL DESIGN OF MASSIVE STATIC TEST FIRING STANDS FOR SATURN V ROCKET BOOSTERS. FRICTION-TYPE, STEEL H-PILES AND POINT-BEARING, CONCRETE-FILLED PIPE PILES PRIMARILY SUPPORTED BY A DENSE SAND LAVER OVERLAIN BY FAT CLAY AND SILTY SAND WERE LOADED (1) STATICALLY UP TO 200 TONS AND (2) DYNAMICALLY WITH COMBINATIONS OF 50, 100, AND 200 TONS DEAD LOAD AND A VERTICALLY DIRECTED, STEADY-STATE LOADING OF DYNAMIC FORCE AMPLITUDES RANGING FROM 1 TO 10 TONS AND FREQUENCIES RANGING FROM 4 TO 16 HZ. ALSO, A CLUSTER OF FOUR H-PILES WAS TESTED UNDER COMBINED LOADING. TYPICAL DATA IN THE FORM OF STEADY-STATE DISPLACEMENT AND PHASE ANGLE VERSUS FREQUENCY PLOTS INDICATED THAT RESONANCE OCCURRED AT FREQUENCIES RANGING FROM 5 TO 10 HZ DEPENDING ON THE STATIC LOAD. THE EXPERIMENTAL DATA WERE COMPARED WITH A SINGLE DEGREE-OF-FREEDOM ANALYTICAL MODEL WITH LINEAR SPRINGS AND VISCOUS DAMPING. AT RESONANCE, DYNAMIC STIFFNESS WAS GREATER THAN STATIC STIFFNESS FOR COMPARABLE PILES, AND DAMPING WAS SLIGHT WITH COMPUTED DAMPING RATIOS OF 0.04 TO 0.05 FOR SINGLE PILES AND ABOUT 0.10 FOR THE FOUR-PILE CLUSTER. RESONANT FREQUENCIES COULD BE PREDICTED ON THE BASIS OF STATIC LOAD-SETTLEMENT CURVES, BUT RESONANT DISPLACEMENT COULD NOT BE RELIABLY EXTRAPOLATED FROM TEST DATA AT NONRESONANT FREQUENCIES. PERMANENT SETTLEMENTS OCCURRED AT RESONANCE AT HIGHER DYNAMIC FORCE LEVELS. SKIN FRICTION DISTRIBUTION ALONG THE PILE LENGTH AS DETERMINED BY STRAIN GAGES APPEARED SIMILAR IN DYNAMIC AND STATIC LOADING. /ASTM/

Publication Year 1900
Dynamic behaviour of laterally loaded model piles in clay.

BOOMINATHAN,A; AYOTHIRAMAN,R


Dynamic experiments in lateral mode were carried out on model aluminium single piles in a simulated elastic half-space filled with clay soil to determine dynamic constants of the soil-pile system and to study the bending behaviour of piles. Model piles with various lengths were subjected to steady-state harmonic vibrations with different magnitudes of force of 7-30 N applied over a wide range of frequencies from 2 Hz to 50 Hz. The load transferred to the pile, pile head displacement and strain gauge readings at different locations on the pile were measured. It is observed consistently that the magnitude of the applied force and the pile length significantly affect the natural frequency of the soil-pile system. It is found that rigid piles behave linearly even at the higher magnitudes of applied force, but that flexible piles behave non-linearly as the magnitude of the applied force increases, which leads to a substantial reduction of the lateral stiffness of the soil-pile system. Damping of the soil-pile system is found to increase with an increase in pile length and magnitude of the applied force, owing to the occurrence of radiation and hysteretic damping. Based on experiments carried out on model piles embedded in clay at low confining pressure, it is found that the maximum dynamic bending moment of long flexible piles is about four times higher than that of short rigid piles. The maximum bending moment under dynamic loads occurs at deeper depth than the corresponding depth for static loads, which indicates an increase of the active length of piles under dynamic load. (A)

INTERNATIONAL CONFERENCE ON THE PLANNING AND DESIGN OF TALL BUILDINGS 1972. TECHNICAL COMMITTEE NO.11. FOUNDATION DESIGN. SUMMARY REPORT.

BEER,E DE


THIS SUMMARY REPORT DISCUSSES SOME OF THE PAPERS PRESENTED IN SECTION II. THE PAPERS DISCUSSED ARE: (1) DESIGN OF COMPENSATED FOUNDATION, ZEEVAERT,L; IN WHICH PROBLEMS OF VISCO-PLASTIC HEAVE, ELASTIC HEAVES, HORIZONTAL DISPLACEMENTS OF THE SHEETING SURROUNDING THE EXCAVATION, AND SUBSIDENCES DUE TO GROUND-WATER LOWERING ARE STUDIED. (2) DISTRIBUTION OF WIND LOADS TO SOIL, SALVATORE V. DESIMONE. IN THIS REPORT THE AUTHOR Examines THE EFFECTS OF THE INCLINED AND ECCENTRIC TRANSIENT LOADING INDUCED IN THE SOIL BY THE WIND LOADS ON THE ULTIMATE BEARING CAPACITY OF THE
SOIL. (3) EFFECTS OF FOUNDATIONS ON ADJACENT STRUCTURES, HORVAT,E AND VEEN,C VAN DER. THIS PAPER DEALS WITH THE PROBLEM OF THE INFLUENCE OF FOUNDATION WORKS AND LOADS TRANSMITTED BY THE FOUNDATION OF NEW BUILDINGS ON THE BEHAVIOUR OF ADJACENT BUILDINGS. (4) DEEP FOUNDATIONS-PILES AND CAISSONS, CORNFIELD,GM. THIS REPORT CONSIDERS THE PROBLEMS OF SETTLEMENT, ULTIMATE BEARING CAPACITY AND FAILURE OF INDIVIDUAL PILES AND GROUPS OF PILES , THE ADVANTAGES AND DISADVANTAGES OF PRECAST AND CAST-IN-SITU PILES, PILE LENGTH AND BEARING CAPACITY, EFFECT OF THE NATURE OF THE SURROUNDING SOIL ON PILE MOVEMENTS, AND REASONS FOR SELECTING CAISSON FOUNDATIONS IN PREFERENCE TO DRIVEN PILES. (5) PRECAST CONCRETE PILES, FELLENIUS,BH AND (6) SOIL-STRUCTURE INTERACTION FOR TALL BUILDINGS, CHRISTIAN,JT, IN WHICH THE AUTHOR STUDIES BOTH CASES OF STATIC AND DYNAMIC LOADING

Publication Year 1900

Title Design and load testing of large diameter open-ended driven piles / consultants, Dan A. Brown and W. Robert Thompson III, Dan Brown and Associates, Sequatchie, Tennessee.


Summary "TRB’s National Cooperative Highway Research Program (NCHRP) Synthesis 478: Design and Load Testing of Large Diameter Open-Ended Driven Piles documents information regarding the current state of practice with respect to the selection, use, design, construction, and quality control of large diameter open-ended driven piles for transportation structures. This report may provide agencies with information to develop guidance and methods for technical guides and design codes, as well as to identify gaps in knowledge to guide future research." -- Publisher’s description


Title The Osterberg CELL for load testing drilled shafts and driven piles / [Jorj O. Osterberg]

Publisher [Washington, D.C.?] : Federal Highway Administration, [1995]