



SPR RESEARCH PROGRAM SECOND-STAGE PROBLEM STATEMENT FY 2009

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I. PROBLEM NUMBER

ST-09-03

II. PROBLEM TITLE

Calibration of LRFD Resistance Factor for the Wave Equation Analysis of Pile Driving Program

III. RESEARCH PROBLEM STATEMENT

Many Oregon bridges are supported by groups of steel and concrete piles driven deep into the underlying soils. The load bearing capacity of a pile depends on a complex interaction involving pile dimensions, pile structural capacity, the surrounding soil properties, time to loading and the depth of the pile.

The Wave Equation Analysis of Pile Driving program (WEAP) is a common computer algorithm used to estimate pile load bearing capacity while the pile is being driven. ODOT has used the WEAP program very successfully for pile driving operations over the last fifteen years in conjunction with the Allowable Design Stress (ASD) design method. Starting in 2007, the FHWA required states to use a new design method on structures called Load and Resistance Factor Design (LRFD). The LRFD design method, as described in AASHTO, has default resistance factors that are applied to the load bearing values generated by the WEAP program. It is known that by using the AASHTO LRFD default resistance factors with WEAP results in **significantly more conservative** pile designs than those prior to LRFD. In essence, the new design code forces ODOT to build foundations beyond the high level of safety achieved with the previous design method. This will result in much more expensive foundation costs for bridge construction.

The new AASHTO LRFD code allows recalibration of the resistance factors to account for standard of practice, site specific soil and pile conditions, and local judgment of transportation jurisdictions. The TRB Circular "*Calibration to Determine Load and Resistance Factors for Geotechnical and Structural Design*" documents the procedure for conducting the recalibration that assures the level of safety intended by LRFD. A preliminary study funded by ODOT and OTREC determined that most of the data needed to perform the recalibration are already available.

IV. RESEARCH OBJECTIVES

The objective of the research is to recalibrate the LRFD resistance factor for use with the WEAP program.

V. WORK TASKS, COST ESTIMATE AND DURATION

Task 1: Background Research

Conduct a review of the current procedures for calibrating LRFD resistance factors and adapt them to this study. Develop the calibration procedure and documentation process needed for ODOT and AASHTO approval of the results. Any current or proposed research efforts of other states to develop customized WEAP resistance factors will be documented and reviewed.

Cost: \$25,000

Task 2: Consolidate Pile Load Test Information and Prepare Data

The preliminary ODOT/OTREC effort obtained two national pile load test databases. Additional pile load test

