Research Notes

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Calibrating Pile Driving for ODOT Practice

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.

ODOT has used a commercial program, GRLWEAP, very successfully in the field over the last fifteen years to estimate the load bearing capacity of piles during driving and to finalize pile depth. Starting in 2007, states were required to use a new design method on structures called Load and Resistance Factor Design (LRFD). The LRFD design method required users to multiply the nominal load bearing capacity of piles estimated by the GRLWEAP program by a default resistance factor to conservatively account for unknowns. This default factor produced more conservative pile designs than those prior to LRFD. In essence, the new design code forced ODOT to build foundations beyond the high level of safety achieved with the previous design method resulting in more expensive bridge construction.

The LRFD code allowed state DOTs to calibrate resistance factors to account for local design and construction practices. Consequently, ODOT contracted with Portland State University to calibrate the LRFD resistance factor applied to GRLWEAP capacity estimates specifically for Oregon conditions.

The researchers built a comprehensive database of pile driving case histories by merging inputs from several existing databases and by incorporating additional cases from the literature. Wherever possible, cases were cross-checked and missing data were supplied from additional sources. The researchers then ranked each case into tiers based on the quality of the data for each case. The result was the most comprehensive, accurate database to date of pile driving case histories.

Cases from the highest quality tiers underwent a series of analysis procedures to generate new resistance factors. Pile driving variables were incorporated into the analyses to assure that the resistance factors were based on likely field conditions. The outcome of the analysis was a recommendation to increase Oregon's resistance factor compared to the default value for GRLWEAP.

ODOT's Bridge Engineering Section will use the research to review the resistance factor values it uses. It is anticipated that ODOT will elect to use a higher resistance factor where appropriate, which will reduce the cost of bridge foundation construction while maintaining the same high level of safety as in the past. The extensive database developed for this project will be useful for other states to conduct their own recalibration efforts.

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The final report for this project was published in February 2011 and is available on the Research web page:
http://www.oregon.gov/ODOT/TD/TP_RES/docs/Reports/2011/GRLWEAP_LRFD.pdf