Staff summary

Prepared by
Organizational Results
Missouri Department of Transportation

January 2011
For more information, contact:
Jen Harper at (573) 526-3636

MTI Geotechnical Research Program

A program overview by Organizational Results

Background

The geotechnical load test program was the largest to date in the United States. Having a geotechnical research program of this magnitude would not have been possible without the commitment of funding to the Missouri Transportation Institute. The savings MoDOT will see could not have been achieved by doing several smaller projects through the typical research process. Initial calculations, based on just the drilled shaft research, put the savings at approximately $45,000 for a typical bridge. If these recommendations would have been available from 2005 to 2010 this would have amounted to over $1.7 million in savings from just drilled shaft projects. Based on the same timeframe, the spread footing research would have saved over $800,000.

In addition, funds outside the MTI umbrella also were leveraged. Over a half million dollars of geotechnical services and equipment were donated by the International Association of Foundation Drilling (also known as ADSC) and various contractors to perform the Drilled Shaft load test program within budget.

Project Findings

Task 1: Site Characterization

This task developed a process for determining the soil/rock strength to be used at each site of a new bridge foundation. Typically a minimum value for the entire site would be used for designing a bridge foundation. The project developed a process to determine the coefficient of variability (COV) for each structure location. This will provide a more accurate determination of soil/rock strength at each site, giving MoDOT the most economical design for each structure. In the past we have used a one size fits all approach. Information was also provided to help determine when more testing during the initial site investigation will lead to more efficient designs. This allows us to use a "practical design" approach to structure foundations.

Drilling soil samples

Project Findings (cont'd.)

Task 2: Drilled Shaft Load Test Program

MTI and MoDOT completed the most comprehensive load test program ever performed in weak rock. The International Association for Foundation Drilling and its local members donated time and drilling equipment. Load Test Inc. donated most of the load test equipment and used this program to test a few new prototypes. MTI paid approximately $500,000 and received over $1.2 million of services. This project produced local calibration factors for LRFD design. Results from the research determined it is appropriate to include both side friction and tip resistance for drilled shaft design, which could significantly decrease drilled shaft lengths. Initial calculations put the savings for a typical bridge at $45,000. The entire research program will be paid with the savings from only 23 bridges with drilled shafts.

MoDOT boom truck and Hayes drill rig

Task 3: Cost and Risk Analysis

This task formulated guidelines for design based on risk assessment for classifications of roadways and types of bridges. The basis of the research is that a small slope failure on a minor road with a few dozen cars a day has a much different risk level than a major roadway with thousands of cars using the roadway daily; yet similar factors are used. This research produced a practical design approach for foundations and slopes. Information from this task allowed the researchers to provide design criteria for major roadways, minor roadways, major bridges, etc. This task also determined MoDOT's current design of slopes is appropriate. However, options for steepening slopes were given using engineered systems.

O-cell and rim cell attached to rebar cage

Task 4: Develop LRFD Specifications

Results from tasks one through three were used to develop Load and Resistance Factor Design specifications as required by FHWA. The specifications were provided in EPG language to allow for quick implementation. Specifications were written for the design of drilled shafts, driven piles, spread footings and slope design.