Determination of Unknown Bridge Foundations

Problem:

There are approximately 484,546 highway bridges over water in the National Bridge Inventory. The population of bridges over water with unknown foundations is about 86,133. These unknown bridge foundations pose a significant problem to the State Highway Agencies because of scour vulnerability concerns. The foundation depth information in particular is needed to perform an accurate scour evaluation at each bridge site, along with as much other information on foundation type, geometry, materials, and subsurface conditions as can be obtained. In addition, bridges undergo superstructure rehabilitation and/or widening and these bridges will be expected to perform adequately for another design life of at least 50 years. Currently there are no reliable means to inspect and evaluate the foundation integrity at anytime within the design life of a bridge. A complete foundation evaluation is absolutely necessary for safety concerns.

Putting it in Perspective:

Economic or other losses associated with a structure being out of service whether by scour or any other event can be staggering. There is a need for a strategy and procedure to manage the risk associated with not knowing the type, size, depth, configuration, condition or integrity of bridge foundations. The methodologies currently available to determine unknown foundations can be grouped as (1) Direct methods such as probing, augering, drilling or digging, (2) Deductive methods such as inference from borings alongside the foundation, seismic refraction or electrical resistivity methods and, (3) Emerging methods such as parallel seismic method and other wide variety of geophysical or Non Destructive Test methods The actual type of NDT method chosen is site specific depending on access, foundation configuration, nature of subsurface soils, etc.

It should be noted that the state of the art for NDT methods is still evolving and interpretation is still somewhat subjective based on the interpreter's judgment and experience. Better design and reduction in project costs can be achieved by providing knowledge and training to the State Highway Agencies so they can apply state of the art technologies in their determination of unknown foundations for bridge structures.

Solution:

There are two separate efforts currently in progress: (1) NCHRP project 24-25 *Guidelines for Risk Based Management of Bridges with Unknown Foundations* and (2) A problem statement *Unknown Foundations – Benchmarking Tests* has been developed to determine capability, reliability and probable cost of state-of-the-art geophysical techniques and procedures, at this point in time, for determining foundation conditions.

In the mean time there are three reference sources that that can be used in determining unknown foundations:

- FHWA Geotechnical Engineering Notebook, Geotechnical Guideline No. 16, "Summary of Interim Report for NCHRP Project 21-05 "Determination of Unknown Subsurface Bridge Foundations" by Olson, Jalinoos and Aouad."

- "Unknown Subsurface Bridge Foundation Testing" by Olson, Larry D. and Marwan F. Aouad, unpublished draft final report for NCHRP project 21-05 & 21-05(2), National Cooperative Highway Research Program, Washington D.C., Sept. 2000.

- Guideline for "Nondestructive Evaluation of Unknown Subsurface Bridge Foundation Depths", NCHRP Project 21-5(2), National Cooperative Highway Research Program, June 2001.

Benefits:

- Provides state-of-the-art tools to determine unknown bridge foundations.
- Improve design, increase safety and, reduce costs of transportation projects.

Additional Resources:

The Geotechnical Notebook Issuance No. 16 is available on the website **http://www.fhwa.dot.gov/bridge/gt-16.pdf**

Geophysics manual is available on the website **http://www.cflhd.gov/geotechnical**

For More Information, contact:
Sam Mansukhani, FHWA Resource Center
Phone: (708) 283-3550
E-mail: sam.mansukhani@fhwa.dot.gov

Dan Ghere, FHWA Resource Center
Phone: (708) 283-3557
E-mail: dan.ghere@fhwa.dot.gov