

FHWA GEOTECHNICAL ENGINEERING PROGRAM

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Abstract

The Federal Highway Administration (FHWA) Geotechnical Engineering Program has a rich 30-year history of leading the United States geotechnical community in the development and implementation of reference documents, training resources and new technology. FHWA Geotechnical Engineers are well recognized as National and International leaders in advancing the state of the practice in geotechnical design and construction. Geotechnical engineering is a highly specialized technical discipline within the FHWA that deals with design and construction issues related to bridge substructures, deep and shallow foundations, ground improvement systems, earth retaining systems, soil and rock slopes, earthquake engineering, instrumentation, geophysics, subsurface investigations, and earthworks. This paper provides an overview of current FHWA Geotechnical initiatives and available resources.

Introduction

Geotechnical Engineering is a critical component of highway planning, design and construction activities in the United States (US) and has a significant role in many areas such as bridges and other structures, seismic design, load resistance factor design (LRFD), pavements, materials, environment, contracting, construction and maintenance and highway safety. In addition, the geotechnical discipline is an important component for the FHWA high priority areas of accelerated construction, asset management, quality and innovative contracting. FHWA Geotechnical Engineers maintain active involvement on the national level with AASHTO committees, State Departments of Transportation (DOTs), industry, American Society of Civil Engineers (ASCE) and other professional groups. The agency's geotechnical specialists are located in Headquarters (HQ), Research and Development (R&D), Resource Center (RC), and Federal Lands Highway Divisions (FLHD). The Geotechnical Engineers within the agency operate as a national team and share resources across units as needed. The success of the FHWA Geotechnical Program is attributed to this team structure and the synergy between the units as they work to achieve team goals.

An example of how the units interact is best described by the following example of the implementation of Soil Nailing Technology in the US. Soil Nailing was identified as a viable technology for the US transportation community through an FHWA International Geotechnical Scan tour to Europe. Upon completion of the scan tour, the FHWA Geotechnical Team corporately designed a long-term implementation plan for Soil Nailing. As a first step, the Geotechnical Research unit conducted additional

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research and published the findings in a series of research publications. Upon completion of the research phase, the Headquarters Geotechnical Unit partnered with the former Regional Offices (now known as the Resource Center) to begin the work of field implementation through the development of a Demonstration Project and incorporation of the technology on Federal Lands Highway projects. Through the agency's demonstration projects program, a comprehensive design and construction manual was developed along with companion training workshop materials that were delivered to the 52 State DOTs (all 50 States plus the District of Columbia and Puerto Rico). The combination of experience gained with implementing the technology on Federal Lands Highway projects and incorporation of the technology on experimental State DOT projects quickly lead to the acceptance of Soil Nailing as a transportation technology. Upon completion of the Demonstration Project phase a final Design and Construction reference document was developed and now serves as the basis for Soil Nail Wall design and construction in the US.

Overview of the FHWA Geotechnical Units

Headquarters and Resource Center

The Headquarters and Resource Center units work very closely together to support the Federal-Aid Highway Program. Although each unit has distinct responsibilities, much of the work between the offices is shared and a true team approach to supporting the national program exists. The Headquarters and Resource Center Geotechnical units also provide direction and support to the Geotechnical Research Office. Support and training are also provided to the Federal Lands staff. A major function of the Headquarters unit is the development of technology packages and the transfer of this information to specialists at the Resource Center and Division Offices. The primary role of the Resource Center is technical assistance, technology deployment and training to the State DOTs through the Division Offices.

The Major functions of the Headquarters and Resource Center Geotechnical Engineers include the following broad categories:

- Develop program policy/guidelines/regulations
- Respond to Congressional requests
- Identify needs and develop training
- Build agency technical capacity
- Interact/collaborate with industry
- Interact with other Federal agencies
- Provide program/technical guidance to field offices
- Interface with AASHTO, TRB, NCHRP and other national organizations
- Deploy Technology
- Provide Technical Assistance
- Develop, Deliver and manage Training
- Develop Design and Construction Guideline Documents: Geotechnical

- Engineering Circulars (GECs); NHI Course Reference Manuals; Technical Advisories
- Conduct Comprehensive Geotechnical Program Reviews (Peer Reviews)
 - Develop Geotechnical Engineering computer applications

Federal Lands Highway Divisions

The Federal Lands Highway (FLH) program supports a unique service of providing highway transportation projects that lay lightly on the land and are otherwise context-sensitive. Primary customers of the Federal Lands Highway Divisions include the National Park Service, the Forest Service and other Federal agencies that require highway design and construction services. The primary organizational functions are:

- (1) deliver highway projects through design and construction; support federal land management agencies and assist them with emergency response and management of highway related resources;
- (2) deploy appropriate new and emerging technologies in ways to evaluate and demonstrate their effectiveness on federal lands projects and for broader application in the highway industry;
- (3) train and prepare engineers and professionals for promotion and advancement within the FHWA through mentoring and providing the hands-on experience offered through (1) and (2).

FLH Geotechnical Services, include site investigation, design and construction across the full spectrum of geographic, geologic, and environmental settings throughout the U.S., and for the full range of work, from gravel roads and parking lots, to innovative, precedent setting bridges, tunnels, walls, slopes, and embankments. Much of the work in the National Parks offers unique geotechnical challenges such as geo-thermal conditions in Yellowstone National Park, permafrost conditions in Alaska, and difficult access and steep terrain on a large percentage of National Park roadways.

Research and Development (R&D)

All highway infrastructure is founded on soil or rock and expertise and capabilities in all of the sub-disciplines of Geotechnical Engineering are critical to the mission of the Office of Infrastructure R&D (Turner-Fairbank Highway Research Center, TFHRC). Current research projects include deep soil mixing for excavation support, micropiles for seismic retrofit of existing bridge foundations, the evaluation of an alternative instrument to measure soil stiffness rather than density, and evaluation of a torsional shear measurement device to evaluate liquefaction potential of soils. This office also manages a laboratory support contract providing professional, technical and logistic support of the on-site geotechnical laboratories. The team also manages several research projects primarily related to deep foundations. Current projects include a study of thermal methods to detect drilled shafts for defects at an early enough stage to correct during initial construction, the development, maintenance and promotion of a deep foundation

database, a project to improve dynamic and Statnamic pile load testing methods. Finally, the team also serves as a research project manager for projects dealing primarily with shallow foundations and retained earth structures. Current projects include a study of the durability of segmental wall blocks and a study of geosynthetic fabric reinforced soil foundations for bridges.

The on-site geotechnical laboratories consist of an outdoor facility capable of doing small scale testing and experiments of shallow and deep foundations in different soils. This facility includes test pits, load frames and measurement and data acquisition equipment. In addition to the outdoor geotechnical laboratory, several full scale experiments on mechanically stabilized soil structures have been conducted at a special test site at the TFHRC campus. There are also two indoor laboratory spaces assigned to the geotechnical program. The first is a large space suitable for foundation experiments and large scale testing. The second is a smaller space intended for soil characterization and small scale laboratory testing.

R&D also plays an important supporting role in program delivery, technical assistance and technology deployment for the agency. Primary responsibility for these functions rest with the Headquarters Office and the Resource Center, but TFHRC is frequently called upon to provide assistance when highly specialized expertise or the laboratory or testing capabilities of TFHRC are needed. It is also sometimes the case where a failure or problem occurs when the cause or mechanism is unknown. In such cases it is essential to involve research to ensure that the gaps in existing knowledge and understanding are fully understood and opportunities to fill these gaps are not missed.

Technical Resources

The FHWA Geotechnical Team has a wealth of technical resources available to the Engineering Community. The team develops and maintains numerous training courses, engineering software applications and a comprehensive technical library. Easy access to these resources is available through our website at the following addresses: www.fhwa.dot.gov/bridge; www.fhwa.dot.gov/resourcecenter; www.nhi.fhwa.dot.gov.

Training

The National Highway Institute (NHI) is the training arm of the FHWA. The FHWA Geotechnical Team is proud of its efforts in this area and the development, delivery and management of 20 NHI geotechnical courses. The NHI Geotechnical Training program is one of the most active training areas within the agency. The associated references are nationally recognized as premier guidance documents and are often referred to in State Design guidelines and specifications. A full list of the currently available NHI training courses is available at our NHI website at: www.nhi.fhwa.dot.gov. The courses listed are available upon request through the National Highway Institute. Instructors for the courses include FHWA Geotechnical staff as well as consultant

instructors that are nationally recognized experts in specific technical areas.

Publications

The FHWA maintains a comprehensive Geotechnical Library of over 100 publications that covers a broad range of geotechnical topics that relate to transportation design and construction. A complete list of available publications is available at our website at: www.fhwa.dot.gov/bridge/geopub. Ordering information is also provided on the website. Many of the more recent publications are available for free downloading.

Software

Software development for geotechnical design is a limited service that FHWA provides to the engineering community. The extent of involvement is limited to the development of first-generation software design tools for geotechnical areas that have been identified as priority candidates. Enhancements to the first-generation products are left to private sector software developers. FHWA's role in software development is strictly limited to filling the need for software products where none currently exists and providing training and technical assistance for the first-generation software. The full list of currently available FHWA Geotechnical software is available at our website at www.fhwa.dot.gov/bridge/geosoft.htm. Many of the more recent computer applications are available for download, ordering information is also provided on the website.

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References

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