# Geotechnical Data Management Initiatives at Caltrans

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## Abstract

The California Department of Transportation (Caltrans) is taking advantage of and adopting innovative technologies to improve the management of its growing investment in geotechnical data. The GeoResearch Group (GRG) and the Geotechnical Data Management Committee (GDMC) are working to develop a comprehensive data management strategy for borehole, lab test, and insitu test data. Activities include the development of standardized data models and reporting formats for geotechnical information, standardization of software tools, evaluation of data collection technologies, and optimization of workflow practices. Caltrans' participation in international initiatives through COSMOS/PEER-LL and FHWA is helping to establish a global model for data interchange.

## Introduction

In conducting geotechnical site investigations, large volumes of subsurface information and associated test data are generated. The pressures to expedite project delivery only heightens the need for more efficient data management practices and more productive field data collection methods. In addition, existing geotechnical archives are a valuable resource. However, the currently used paper-based filing systems are often difficult and cumbersome to access by users (Figure 1). Misplaced files, deteriorated paper records, incomplete documentation, and a lack of awareness that certain data even exists have all contributed to inefficient or incomplete utilization of existing data.

**Figure 1.** Current geotechnical archive at Caltrans.

## Caltrans Initiatives

### *Borehole Logging Data*

The Geotechnical Data Management Committee (GDMC) was formed in October 2004 to address the needs of Caltrans geotechnical data management through the development and implementation of standards and technologies. Much of the GDMC's work to date has focused on defining geotechnical data standards and associated data dictionaries for implementation into *gINT* software, a commercially available software for borehole data capture and presentation. The software provides the framework for data capture and reporting; however, it requires the user to define and set up the data models and presentation formats specific to the user's practices. Since Caltrans is in the process of revising it's published borehole logging guidelines, the data model for the software is being revised to reflect this. Department-wide implementation of this data management software over the next 18 months will assure that data is captured consistently and stored digitally.

Efficiencies in processes are already being identified. For example, the practice of generating boring logs for contract documents and plans will be streamlined. Currently, a drafter is required to create the Log of Test Boring (LOTB) sheet in a CAD system using paper notes provided by the engineer. However, with the use of *gINT* software, the engineer can create a near-complete CAD drawing themselves with little additional effort. The drafter is then provided a CAD drawing, rather than notes on a paper, and need only perform minor editing and page layout tasks. The result is a significant reduction in the effort currently required by the drafting group.

### *Field Borehole Logging with Tablet PC's*

As part of a technology demonstration project, the GRG is evaluating the use of ruggedized tablet PCs to document and collect borehole logging data in the field. Four ruggedized tablet PCs are being deployed over the course of a year beginning in July 2005. The units can function as a standard laptop, or can be converted to a tablet, complete with pen stylus and handwriting recognition interface (Figure 2). A Caltrans-specific configuration of the *gINT* logging software is installed on each unit. Panasonic Toughbook model CF-18 tablets were selected for their durability in outdoor environments and sunlight readable display. These units also incorporate an integrated GPS receiver to provide positioning information. The combination of features and software provides field staff with the capability of generating near-complete borehole logs while still in the field. It is anticipated that the use of these units will minimize errors from multiple handling of data between field and office operations.

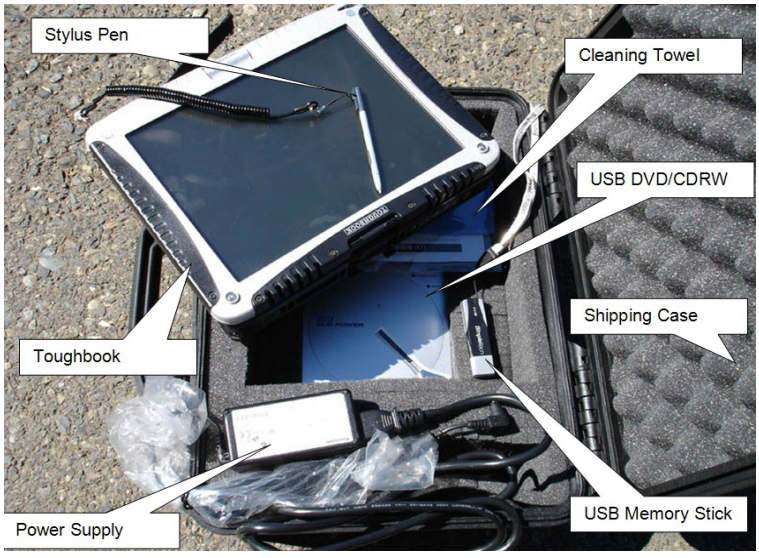


**Figure 2.** Ruggedized tablet PC for field logging.

### *Soils Laboratory Test Data*

Work is underway to develop and test deploy an advanced soils laboratory data management system. The system is intended to replace lab processes where test data had been logged by hand on paper forms and stored in ring binders. The system utilizes a network of touchscreen workstations located throughout the laboratory (Figure 3). Technicians use onscreen keypads to enter data during tests. As the user enters test data, the system validates the data and performs necessary calculations. For the lab managers the system automatically compiles test results and generates report products. It is anticipated that the eventual deployment of the system will result in substantial time savings from the elimination of multiple data handling, error checking, and reporting procedures currently required.

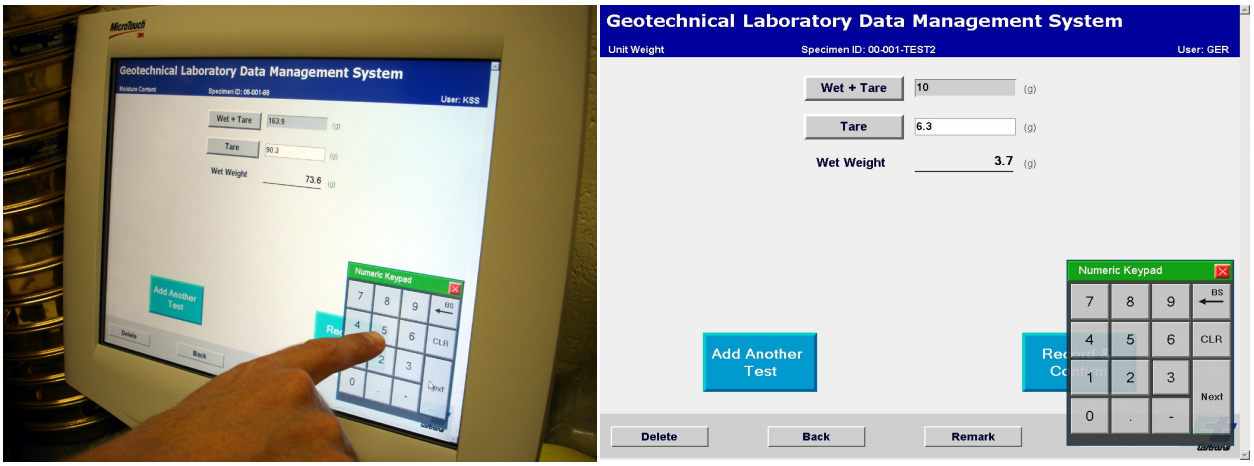


**Figure 3.** Soils laboratory touchscreen system.

***Insitu Test Data***

In early 2002 a pilot study was initiated to explore the feasibility and effectiveness of a web-based repository for Caltrans' Cone Penetration Test (CPT) data. The result of this work is a fully functional prototype data warehouse system which allows CPT operators to upload data files using a simple web browser tool, and allows clients to browse, preview, print, or download any Caltrans CPT data file generated back to 1994. ESRI's ArcIMS server software is used to create the web-based GIS interface to aid in the search for data (Figure 4). Adobe's Scalable Vector Graphics (SVG) technology is used to generate plots within a web browser on-demand.

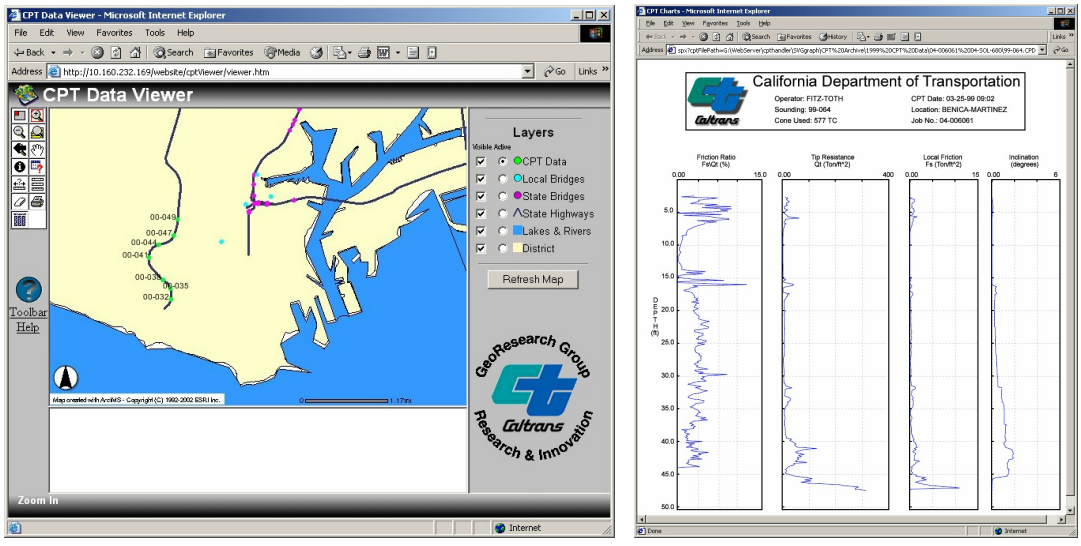


**Figure 4.** Web-based access to Caltrans CPT data.

***Enterprise Data Management***

Although many types of geotechnical data are currently collected and stored in some type of digital format, including those generated by the recent efforts described earlier, Caltrans does not have a central repository to maintain and curate the compilation of this digital information. As part of its research efforts, the GRG is examining technologies and system architectures that can bring together field and lab data into a centralized data repository. Ultimately, data from field logging activities, laboratory testing, and insitu testing will be collected, cross-referenced, and stored in databases on a central server.

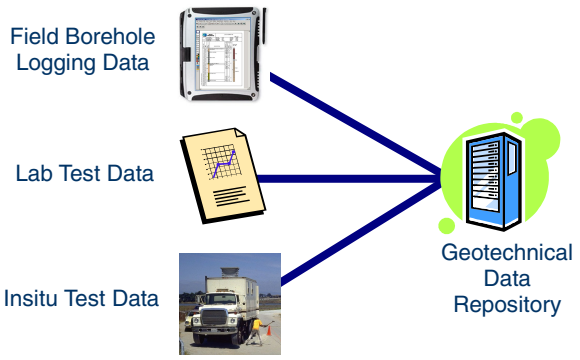


**Figure 5.** Creating a central repository of geotechnical data.

## Caltrans Participation in National and International Initiatives

### *Geotechnical Virtual Data Center*

In May 2002 the Consortium of Strong-Motion Observation Systems (COSMOS) in partnership with the Pacific Earthquake Engineering Research (PEER) Lifelines Program initiated a project to demonstrate improved methods of geotechnical data dissemination through use of the internet and data mining technologies. The result of the effort was the test deployment of the pilot Geotechnical Virtual Data Center (GVDC) (https://geodata.cosmos-data.org/index.asp) (Figure 6).

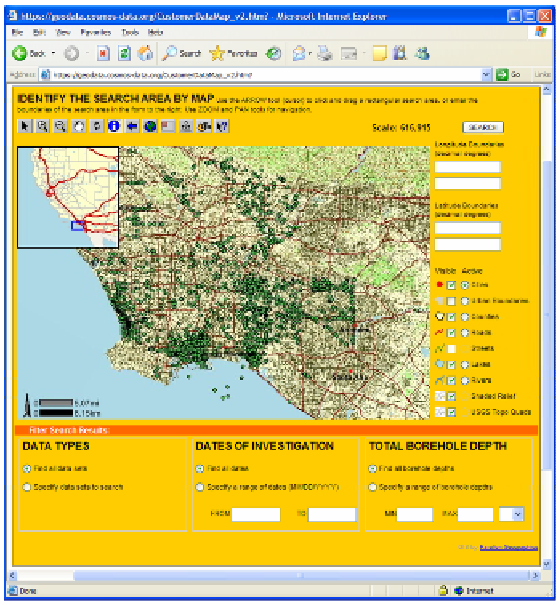


**Figure 6.** The COSMOS/PEER-LL Geotechnical Virtual Data Center.

The project involved the participation of a number of entities, including Caltrans, California Energy Commission, Pacific Gas & Electric, PEER-Lifelines Program, Pacific Earthquake Engineering Research Center, United States Geological Survey, California Geological Survey, University of Southern California, Consortium of Organizations for Strong-Motion Observations Systems. Many of the organizations, including Caltrans staff, made significant contributions to the project, participating as workgroup leaders, system developers, and data providers (Turner et.al. 2004).

Using a test region in the Southern California area, the GVDC successfully demonstrated to the geotechnical community the benefits that data exchange can bring. A number of innovative technologies were incorporated into the GVDC, including: database harvesting, XML geotechnical data interchange standards, web-GIS interface, and SVG on-demand previewers. The system was presented in a joint COSMOS/PEER-LL/FHWA workshop in June 2004 in Newport Beach.

***Transportation Pooled Fund Project***

Following the COSMOS/PEER-LL/FHWA workshop in June 2004, a group of state Departments of Transportation, led by the Ohio Department of Transportation and FHWA, formed a group to develop a Transportation Pooled Fund project. The focus of the project was to compile the standards development work of COSMOS, the Association of Geotechnical & Geoenvironmental Specialists (AGS) from the United Kingdom, and others to create a new international data exchange format. The resulting data interchange format would have global application and allow software vendors and users in the geotechnical community to easily exchange data. The COSMOS/PEER-LL GVDC development team intends to adopt the new international standard and incorporate an early version of the standard into the next generation GVDC, available in 2006.

## Conclusions

Caltrans has initiated a number of projects to improve its data management practices, working towards the goal of a long-term integrated data repository. Through partnerships with other agencies and organizations, Caltrans is helping to establish regional and global data exchange mechanisms and technologies.

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## References

Turner, L., M. Brown, D. Chambers, C. Davis, J. Diehl, C. Hitchcock, T. Holzer, R. Nigbor, C. Plumb, C. Real, M. Reimer, J. Steidl, J. Sun, J. Tinsley, D. Vaughn, (2004). "Baseline Practices and User Needs for Web Dissemination of Geotechnical Data," Proceedings of the COSMOS/FHWA Archiving and Web Dissemination of Geotechnical Data, Newport Beach, California, June 21-23, 13 p.