Chapter V

GIME:
A Geotechnical Information Exchange Architecture
Using Web Services

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Abstract

We present an information architecture using Web services for exchanging and utilizing geotechnical information, which is of critical interest to a large number of municipal, state, and federal agencies as well as private enterprises involved with civil infrastructures. For example, in the case of soil liquefaction hazard assessment, insurance companies rely on the availability of geotechnical data for evaluating potential earthquake risks and consequent insurance premiums. The exchange of geotechnical information is currently hampered by a lack of a common data format and service infrastructure. We propose an infrastructure of Web services, which handles geotechnical data via an XML format. Hereafter we report on the design and some initial experiences.
Introduction

Geotechnical information on soil deposits is critical for our civil infrastructure. Local, state, and federal agencies, universities, and companies need this information for a variety of civil engineering and urban policy applications, including land usage and development, and mapping of natural hazards such as soil liquefaction and earthquake ground motions. Foremost examples of geotechnical information, geotechnical boreholes are vertical holes drilled in the ground for the purpose of obtaining samples of soil and rock materials and determining the stratigraphy, groundwater conditions, and/or engineering soil properties (Hunt, 1984). In spite of rather costly drilling operations, boreholes remain the most popular and economical means to obtain subsurface information. These types of data range from basic borehole logs containing a visual inspection report of soil cuttings to sophisticated composite boreholes combining visual inspection and in-situ, laboratory geotechnical and geophysical tests. Figure 1a shows an example transcript of the Standard Penetration Test (SPT), a particular type of geotechnical borehole test. Significant amounts of geotechnical borehole data are generated in the field from engineering projects each year. The data and results of boreholes are usually published and released as hardcopy reports, without the digital data from the field test. Naturally, sharing data via the traditional hardcopy reports is slow and results in errors when the data is converted back to digital form for further processing. With the recent ubiquity of communication networks, particularly the Internet, the trend toward electronic storage and exchange of geotechnical borehole data has accelerated. So far these efforts have often been uncoordinated and ad hoc.

Geotechnical borehole data is complex and sophisticated in that it contains both well-structured and semi-structured elements. In Figure 1a, for example, the Summary field contains free-form text, while some of the other columns are well defined. Therefore, an efficient data format for storage and exchange is required that is suitable for the diversity of geotechnical borehole data. Currently, there is no accepted common format for exchanging these data among researchers and practitioners. To date, the most commonly-used formats for representing geotechnical borehole data include the Association of Geo-technical and Geoenvironmental Specialists (AGS, 1999), the Log ASCII Standard (Heslop Karst, Prensky, & Schmitt, 2000) for well logging in petroleum engineering, and the National Geotechnical Experimental Site (Benoit & Lutenegger, 2000) format that adopts the AGS data dictionary and expands it to cover more research-oriented geotechnical tests. Another research project was initiated at the U.S. Army Engineer Waterways Experiment Station (U.S. Army, 1998) to establish a standard electronic data format for geotechnical and geological exploration in order to automate data interchange. In addition, the Pacific Earthquake Engineering Research Center at Berkeley (PEER) and the Consortium of Organizations Strong Motion Observation Systems (COSMOS) commence a