A2L02: Committee on Soil and Rock Properties
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Soil and Rock Properties

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Geotechnical engineers are concerned with the engineering properties of earth-related materials as determined by field, laboratory, and in situ and nondestructive tests. They are concerned as well with the analysis and interpretation of these tests in terms of design, construction, and performance applications.

It is widely recognized that those involved in the modern construction and maintenance of transportation facilities must address a number of new issues. These issues range from the importance of making better use of information technology to the need for effective reuse of recyclable materials and environmental mitigation. To advance understanding of soil and rock properties in relation to these issues and facilitate the transfer of this understanding in the new millennium, geotechnical engineering will need to focus on the following four areas:

- Enhanced utilization and assessment of soil improvement techniques;
- New approaches to the use of recycled materials;
- Redevelopment of unused or underused sites, or “brownfields”; and
- Development of a geomedia assessment and data archival and retrieval system.

The overall objective should be to stimulate interest in these areas through research need statements and sponsorship of appropriate technology transfer activities. There is already much information available in these and related areas, and this information should be collected in a logical manner suitable for dissemination.

SOIL IMPROVEMENT

The following specific topics are of particular interest in the area of soil improvement:

- Evaluation of improved and treated ground, along with development of evaluation methods, testing techniques, and means of determining the reliability of assessments. This topic has attracted particular attention, and some research and case studies have been reported. Yet these efforts have not been well coordinated and documented, nor has a general consensus on appropriate measures been achieved.
- Quality assurance/quality control (QA/QC) for ground improvement projects. Implementation of QA/QC in the field is too often left to contractors without sufficient

technical or engineering expertise. Methods for control of these aspects of soil modification projects need to be clearly defined.

- Development of standards and recognized guidelines on the above topics for use by both industry and the research community. This should be a collaborative effort with input from those who will be using these references for assessing the broad scope of projects and comparing and cross-referencing projects. Some standards already exist, and others are being developed. These efforts should be continued.
- Assessment of the time effects of treated soil and the longevity of various improvements. Both researchers and practitioners are aware of the sometimes critical deleterious time effects that can occur with soil improvement projects, most notably the effects of certain chemically treated soils and long-term degradation of treated ground. Some work is being done to address these problems, but much more is needed.

USE OF RECYCLED MATERIALS

Waste materials are being produced in larger quantities and varieties. Improved waste disposal practices that protect the environment are increasingly costly and time-consuming. Therefore, industry seeks alternative uses for these materials that can reduce disposal costs. Since many waste products are particulate, geotechnical uses have been explored. Current uses include embankment fill, road base, inclusion in portland cement and asphalt concrete cement, hydraulic barriers, and waste (landfill) covers. Most of these applications are more concerned with waste disposal than with improvements to existing facilities or procedures.

To encourage recycling and use of waste materials in civil engineering applications, including transportation, more work is needed to characterize these materials in a standard way. Improved methods of disposal will likely include the following:

- Incorporation of waste into structural components of engineering systems;
- Removal of currently impounded waste for use in projects to create landfill space for more hazardous materials;
- Creative blending of wastes with other wastes or virgin materials, including geosynthetics, to develop new products or applications;
- New field evaluation techniques (in situ) for evaluating the instability of waste;
- Expanded use of waste products in applications other than civil engineering; and
- Neutralization of wastes to allow less expensive, environmentally safe techniques.

Waste research may begin to focus on improving existing materials and techniques instead of simply providing a medium for waste disposal.

REDEVELOPMENT OF BROWNFIELDS

Greater mobility and consumer demands are making transportation increasingly important for delivering goods and services and allowing consumers to travel to points of supply. At the same time, growing urbanization (not least in the developing world) is common. Because of concerns for the natural environment, there is now strong pressure to redevelop unused or underused sites previously occupied by industry, or brownfields.

Urbanization necessitates the positioning of transportation corridors and service facilities in existing or expanding urban areas. Brownfields are obvious candidates for this purpose. Use of brownfields for transportation does not, in general, pose the risks that might be experienced with other uses, such as housing. Moreover, occupancy by a

government or government-controlled body provides greater assurance of proper cleanup, monitoring, and control.

The geotechnical community requires strong research support to ensure the timely, safe, cost-efficient, reliable, and demonstrably high-quality ground engineering of brownfields for transportation purposes. With increasing pressure on such land, the problems to be faced are likely to become more severe and the research needs more urgent. Specific areas in which better understanding is needed include the long-term mechanical and hydraulic behavior of contaminated ground, safe design parameters for disturbed ground, appropriate soil and rock testing regimes (in situ and in the laboratory), and the use of soil as a remedial agent for geoenvironmental problems.

Transportation also continues to be a key polluter (e.g., in road wash-off and spills). Geotechnical engineers need to determine the potential impacts of such sources on ground and groundwater conditions so the severity of those impacts and remedial measures can be determined.

GEOMEDIA ASSESSMENT AND DATA ARCHIVAL AND RETRIEVAL

Advanced knowledge about subsoil conditions and properties can provide vital information for the preliminary design of highway projects. However, this geotechnical information is usually maintained in paper files and thus is not readily accessible. Such information needs to be assembled into an electronic database and made available to design and construction organizations. Accomplishment of this objective will be quite feasible in the new millennium as further advances in computer technology make it possible to create, assemble, and query larger and larger databases for critical information and knowledge.

If such a database is to be assembled, the geotechnical information will have to be prepared and submitted according to fixed and established guidelines. The data will include field borehole and test-pit information, in situ test data, classifications, and a summary of all laboratory test results. The database model should also be able to handle changes, additions, and corrections as geotechnical practice continues to evolve. The following database features should be considered:

- File format—preferably a plain ASCII file instead of a proprietary database file.
- Data description—a clear and concise description of the database field names and example values in a numeric or natural-language format. To improve understanding, the field should be grouped into sensible subject areas for easier data preparation.
- Status of data fields—level of completeness of each group and field.

Once a standardized format has been established, the database can be assembled for general access. This process can be facilitated if consultants, contractors, and state and federal agencies are actively encouraged to prepare and submit an electronic mini-database for each project, along with the conventional geotechnical report. This project-specific data can then be added quickly to the central database.