CHAPTER 1.0

INTRODUCTION

1.1 SCOPE OF THIS MANUAL

All transportation systems are built either on earth, in earth, and/or with earth. To the transportation facility designer and builder, geomaterials (soil and rock) not only form the foundation for their structures but they also constitute a large portion of the construction materials.

Unlike manufactured construction materials, the properties of soil and rock are the results of the natural processes that have formed them, and natural or man-made events following their formation. The replacement of inferior foundation materials often is impractical and uneconomical. The large volume of soil and rock needed for construction of transportation facilities, as a rule, makes it prohibitive to manufacture and transport pre-engineered materials. The geotechnical engineer in designing and constructing transportation facilities is faced with the challenge of using the foundation and construction materials available on or near the project site. Therefore, the designing and building of such structures requires a thorough understanding of properties of available soils and rocks that will constitute the foundation and other components of the structures.

This manual presents the general state of the practice of subsurface exploration and focuses on the scope and specific elements of typical geotechnical investigation programs for design and construction of highways and related transportation facilities. The manual presents the latest methodologies in the planning, execution, and interpretation of the various exploratory investigation methods, and the development of appropriate soil and rock parameters for engineering applications. It is understood that the procedures discussed in the manual are subject to local variations. It is important, therefore, for the reader to become thoroughly familiar with the local practices as well.

It must be pointed out that the term structure in this course and manual is used to imply engineered & constructed facilities such as embankments, pavements, bridges, walls, and other built facilities.

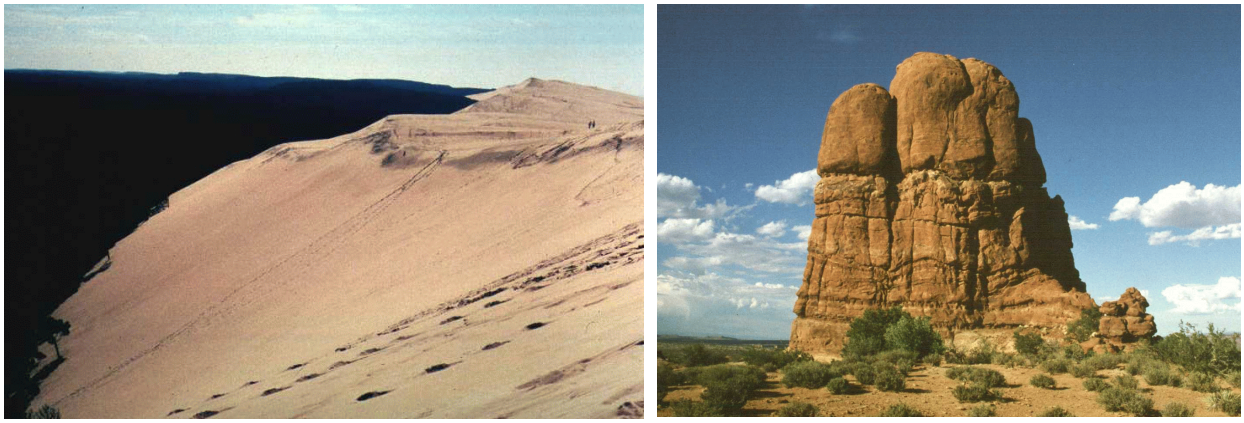

Figure 1-1. Natural Geomaterials: (a) Atlantic Dune Sand Deposits; (b) Sandstone in Moab, UT.

1.2 GEOTECHNICAL ENGINEER'S ROLE IN SUBSURFACE EXPLORATION

The role of the geotechnical engineer[1] in design and construction varies according to the distribution of responsibilities in an organization. Nevertheless, by definition, the geotechnical engineer, among others, is responsible for acquiring and interpreting soil, rock, and foundation data for design and construction of various types of structures. The proper execution of this role requires a thorough understanding of the principles and practice of geotechnical engineering, subsurface investigation techniques and principles, design procedures, construction methods and planned facility utilization supplemented with a working knowledge of geology and hydrology.

The proper discharge of the geotechnical engineer's duties requires that he or she be involved from the very beginning of the planning stage of a project. A geotechnical engineer may provide, based on prior knowledge and research for example, guidance in the location of a proposed tunnel or road which may result in reduced cost, improved constructibility and other advantages. When the services of the geotechnical engineer are introduced into the project after the final project location is determined, a very important value engineering benefit may be missed.

Once the project location, geometry and other attributes are determined, the geotechnical engineer and the design team should jointly define the subsurface exploration needs. The geotechnical engineer should be given the responsibility and the authority to make decisions involving the details of the subsurface investigation based on his or her knowledge of the site conditions and on information gathered during the construction. It is the responsibility of the geotechnical engineer to direct the collection of existing data, to conduct field reconnaissance, to initiate the subsurface investigation, and to review its progress. When unusual or unexpected conditions are encountered during the investigation, the field geotechnical engineer should communicate these findings to the design engineer, make recommendations and implement changes as needed.

Once the samples are obtained, the geotechnical engineer must visually examine all or a representative number of the samples to have a "feel" of the material properties as a tool for determining the adequacy of the investigative program. This is an often ignored practice that may lead to misunderstandings and costly errors. Once the field investigation has progressed sufficiently to define the general stratigraphy and subsurface materials at the site, a site-specific testing program for the project can be initiated.

Having obtained the data from the field investigation and laboratory testing program, the focus of the geotechnical engineer's efforts turn to the reduction and evaluation of these data, the definition of subsurface stratification and groundwater conditions, the development of appropriate soil and rock design parameters, and the presentation of the investigation findings in a geotechnical report. The geotechnical engineer uses this acquired subsurface information in the analysis and design of foundations and other geotechnical elements of a highway project.

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[1] The term geotechnical engineering in this manual also applies to engineering geologists who are involved in subsurface investigations for civil engineering applications.