Engineering Properties of Soil

After obtaining general information relating to the topography, depth to bedrock, and hydrologic character of the soils, the soil survey is conducted to determine the development capabilities of the soil. Grain size distribution is an important factor in how a soil will behave under different conditions. The variations caused by grain size distribution, clay mineralogy, and organic content in the presence of water are issues for engineers; therefore, there are different classifications used by geologists than are used by engineers. The Unified Soil Classification System was developed by the U.S. Army Corps of Engineers to provide a relatively simple and reasonably accurate description of the physical characteristics of soil that are important to site development (see Tables 3.1 and 3.2). The classification is based on grain size, from coarse to fine, or the amount of organic matter in the soil. There are 12 soil classifications: four coarse-grained soils, four fine-grained soils, and four combinations of fine- and coarse-grained soils. The classification also includes three organic soils. A *coarse-grained soil* is one in which over half of the soil is sand sized or larger. In a *fine-grained soil,* half of the soil is silt or clay. Within these categories there are subcategories according to the distribution of soil particle size.

Soil grain sizes are assessed under the Unified Soil Classification System using a series of sieves (see Table 3.3). Other tests such as the Atterberg limits contribute to understanding and classifying the soil. Classification is done in accordance with the ASTM 2488 Standard Practice for Description and Identification of Soils (Visual-Manual Procedure) and the ASTM 2487 Standard Test Method for Classification of Soils for Engineering Purposes. In general, coarse-grained soils (GW) are preferred for subgrade and base materials,

TABLE 3.1 Unified Soil Classification System Symbols

Soil type	Symbol	Description
Clay soils	C	—
Silts	M	—
Sands	S	—
Gravels	G	—
Organic soils	O	—
High liquid limit	H	Water content > 50%, high plasticity (very cohesive or sticky clay).
Low liquid limit	L	Water content < 50%, low plasticity.
Well-graded soils	W	Particles of all sizes.
Poorly graded	P	Grain distribution is important because it affects consolidation and settlement.

Adapted from Harlan C. Landphair and Fred Klatt, Jr., *Landscape Construction,* 2nd ed., Elsevier, New York, 1988.