



Soil Stabilization for Pavements

Course Number: GE-02-401

PDH: 2

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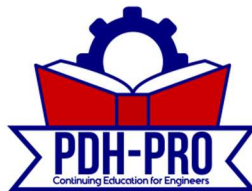
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CHAPTER 1

GENERAL

1-1. Purpose and scope. This course presents criteria for improving the structural quality and workability of soils used for base courses, subbase courses, select materials, and subgrades for pavements. It is applicable to all elements responsible for Army pavement construction at mobilization facilities.

1-2. Definitions. The following definitions are applicable to this course.

a. Soils. The term "soils" refers to naturally occurring materials that are used for the construction of all except the surface layers of pavements and that are subject to classification tests to provide a general concept of their engineering characteristics. Also included are the materials normally used for base courses, subbase courses, select material layers, and subgrades. The soil classification system to be used in evaluating these characteristics is described in MIL-STD-619.

b. Stabilization. Stabilization is the process of blending and mixing materials with a soil to improve the pertinent properties of the soil. The process may include the blending of soils to achieve a desired gradation or the mixing of commercially available additives that may alter the gradation, change certain properties, or act as a binder for cementation of the soil.

c. Modification. Modification refers to the stabilization process that results in improvement in some property of the soil but does not by design result in a significant increase in soil strength and durability.

d. Additive. Additive refers to a manufactured commercial product that, when added to the soil in the proper quantities, will improve the quality of the soil layer. This course is restricted to the use of port-land cement, lime, lime-cement-fly ash, and bitumen, alone or in combination, as additives to stabilize soils.

1-3. Methods of stabilization. The two general methods of stabilization presented are mechanical and additive. The effectiveness of stabilization is dependent upon the ability to obtain uniformity



in blending the various materials. Mixing in a stationary or traveling plant is preferred; however, other means of mixing, such' as scarifiers, plows, disks, graders, and rotary mixers, have been satisfactory.

a. Mechanical stabilization. Mechanical stabilization is accomplished by mixing or blending soils of two or more gradations to obtain a material meeting the required specification. The soil blending may take place at the construction site, at a central plant, or at a borrow area. The blended material is then spread and compacted to required densities by conventional means.

b. Additive stabilization. Two types of additive stabilization are chemical and bituminous. Chemical stabilization is achieved by the addition of proper percentages of cement, lime, fly ash, or combinations of these materials to the soil. Bituminous stabilization is achieved by the addition of proper percentages of bituminous material to the soil. The selection and determination of the percentage of additive to be added is dependent upon the soil classification and the degree of improvement in soil quality desired. Generally, smaller amounts of additives are required when it is simply desired to alter soil properties, such as gradation, workability, and plasticity, than when it is desired to improve the strength and durability sufficiently to permit a thickness reduction design. After the additive has been mixed with the soil, spreading and compaction are achieved by conventional means.



CHAPTER 2

PURPOSE OF STABILIZATION

2-1. Uses of stabilization. Pavement design is based on the premise that specified levels of quality will be achieved for each soil layer in the pavement system. Each layer must resist shearing within the layer, avoid excessive elastic deflections that would result in fatigue cracking within the layer or in overlying layers, and prevent excessive permanent deformation through densification. As the quality of a soil layer is increased, the ability of that layer to distribute the load over a greater area is generally increased enough to permit a reduction in the required thickness of the soil and surface layers.

a. Improve quality. The most common soil quality improvements through stabilization include better soil gradation, reduction of plasticity index or swelling potential, and increases in durability and in strength. It is also common to stabilize a soil by an additive in order to provide an all-weather working platform for construction operations. These types of soil quality improvement are referred to as soil modifications.

b. Reduce thickness. The tensile strength and stiffness of a soil layer can be improved through the use of additives and thereby permit a reduction in the thickness of the stabilized layer and overlying layers within the pavement system. Before a stabilized layer can be used to reduce the required thickness in the design of a pavement system, the stabilized material must meet the durability requirements given in paragraph 2-2 on various types of additive stabilization and the minimum strength requirements shown in table 2-1.

Table 2-1. Minimum Unconfined Compressive Strengths for Cement, Lime, and Combined Lime-Cement-Fly Ash Stabilized Soils

<u>Stabilized Soil Layer</u>	<u>Minimum Unconfined Compressive Strength, psi^a</u>	
	<u>Flexible Pavement</u>	<u>Rigid Pavement</u>
Base course	750	500
Subbase course, select material or subgrade	250	200

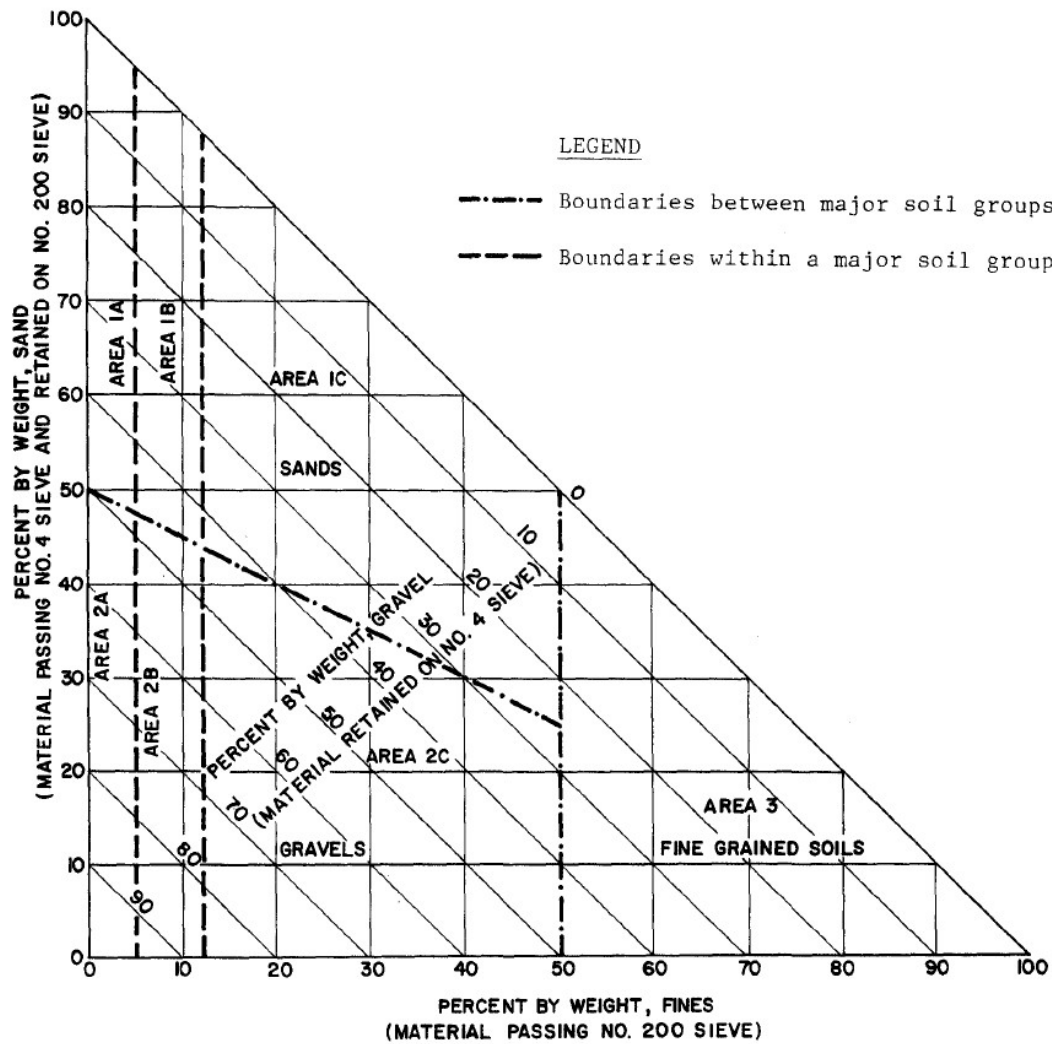
^a Unconfined compressive strength determined at 7 days for cement stabilization and 7 or 28 days for lime or lime-cement-fly ash stabilization (See chapter 4)



2-2. Selection of stabilizer additive. In the selection of a stabilizer additive, the factors that must be considered are the type of soil to be stabilized, the purpose for which the stabilized layer will be used, the type of soil quality improvement desired, the required strength and durability of the stabilized layer, and cost and environmental conditions.

a. The soil gradation triangle in figure 2-1 is based upon the pulverization characteristics of the soil that, when combined with certain restrictions relative to liquid limit (LL) plasticity index (PI), and soil gradation contained in table 2-2, provide guidance for the selection of the additive best suited for stabilization. Figure 2-1 is entered with the percentage of gravel (percent material retained on No. 4 sieve), sand (percent material passing No. 4 sieve and retained on the No. 200 sieve), and fines (percent material passing the No. 200 sieve) to determine the area in which the soil gradation falls. The area (1A, 2C, 3, etc.) indicated at the intersection of the three material percentages is used to enter table 2-2 to select the type of stabilizing additive considering the various restrictions and remarks. For example, a soil having a PI of 15 and containing 67 percent gravel 26 percent sand, and 7 percent fines falls in Area 2B of figure 2-1. Table 2-2 indicates that cement, lime, lime-cement-fly ash, or bitumen could be considered. However, the PI of 15 eliminates bitumen, and the fact that only 33 percent of the material passes the No. 4 sieve indicates that lime. or a combination of lime-cement-fly ash will be the better additive for stabilization.

b. The next consideration in the selection of an additive will be the use of the stabilized layer. If it is only desired to modify the properties of the soil (i.e., lower the PI and increase percent fines) so that it would qualify as a subbase or base course material, lime may well be the best additive. If, however, high strengths and good durability are required to affect a reduction in pavement thickness, the use of a lime-cement or lime-cement-fly ash combination may be the best additive. Actually, the best additive can only be determined by studies as outlined later in this course. The success of additive stabilization depends, to a large extent, upon attaining complete and uniform distribution of the additive in the soil. This step is most critical when using bitumen's or port-land cement as additives. These materials work well in coarse-grained soils that pulverize more easily. Generally, as the percent fines and the PI increase, pulverization becomes more difficult, and it is harder to obtain uniform distribution of the stabilizing additive. For these types of soils, pre-processing or pre-treatment with other additives may be necessary. For example, fine-grained soils may be pre-treated with lime to aid in their pulverization, making mixing of a bitumen or cement additive more successful.



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FIGURE 2-1. GRADATION TRIANGLE FOR AID IN SELECTING
A COMMERCIAL STABILIZING AGENT



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