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Report on Soil Cement

Reported by ACI Committee 230

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Soil cement is a densely compacted mixture of portland cement, soil/aggregate, other cementitious materials (possibly), and water. Used primarily as a base material for pavements, soil cement has also been used for slope protection, low-permeability liners, foundation stabilization, and other applications. This report contains information on applications, material properties, mixture proportioning, construction, and quality-control inspection and testing procedures for soil cement. This report's intent is to provide basic information on soil cement technology with an emphasis on current practice regarding design, testing, and construction.

Keywords: aggregates; base courses; central mixing plant; compacting; construction; fine aggregates; fly ash; foundation stabilization; lime, linings; mixing; mixture proportioning; moisture content; pavements; permeability; portland cement; pulverization, slag cement; slope protection; soil cement; soils; soil stabilization; soil tests; tests; vibration.

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ACI 230.1R-09 supersedes ACI 230.1R-90 (Reapproved 1997) and was adopted and published July 2009.

CHAPTER 1—INTRODUCTION

1.1—Scope

This report contains information on applications, materials, properties, mixture proportioning, design, construction, and quality-control inspection and testing procedures for soil cement. The intent of this report is to provide basic information on soil cement technology with an emphasis on current practice regarding mixture proportioning, properties, testing, and construction.

This report does not provide information on fluid or plastic soil cement, which has a mortar-like consistency at the time of mixing and placing. Information on this type of material is provided by ACI Committee 229. Roller-compacted concrete (RCC), a type of no-slump concrete compacted by vibratory roller, is not covered in this report. ACI Committees 207 and 327 addressed the subject of roller-compacted concrete (ACI 207.5R and 325.10R).

CHAPTER 2—NOTATION, DEFINITIONS, AND ACRONYMS

2.1—Notation

C_w = weight of cement
R = flexural strength, psi
f'_c = unconfined compressive strength, psi
SN = structural number
a_1, a_2, and a_3 = layer coefficients of surface, base, and subbase, respectively
D_1, D_2, and D_3 = corresponding layer thicknesses

2.2—Definitions

The following terms are used throughout the report:

cement content—cement content is normally expressed in percentage on a weight basis. The cement content by weight is based on the oven-dry weight of soil according to the formula (PCA 1992a)

$$C_w = \frac{\text{weight of cement}}{\text{oven-dry weight of soil}} \times 100$$

cement-modified soil—a soil or aggregate treated with a relatively small proportion of portland cement with the objective of amending undesirable properties of problem soils or substandard materials so that they are suitable for use in construction. The amount of cement added to the soil is less than that required to produce a hardened mass (that is, soil cement), but is enough to improve the engineering properties of a soil (for example, plasticity index reduction, bearing strength improvement). Cement-modified soil is typically not required to achieve this high level of performance, and is normally used in lower load situations (for example, pavement subgrade improvement and plasticity reduction of a marginal aggregate with plastic fines). Cement-modified soil is beyond the scope of, and therefore not included in, this report.

cement-treated base—a form of soil cement that uses graded aggregate, rather than soil, to serve as the inert material bound by cement plus, possibly, pozzolans. Figure 2.1 illustrates the aggregate gradation band for minimum binder requirements. Cement-treated base is also referred to as cement-treated aggregate base, cement-stabilized aggregate base, or other similar terms.

optimum moisture—the water content at which the soil cement can be compacted to a maximum dry density by a given compactive effort.

recycled flexible pavement—recycled flexible pavement is a form of soil cement pavement base that is constructed using existing flexible pavement layers that might consist of a deteriorated bituminous wearing surface, granular base material, and underlying subgrade. Some or all of these materials are blended with cement and possibly other cementitious materials to produce a hardened, durable pavement base for a bituminous surface or subbase for a concrete pavement. This material is also referred to as recycled failed flexible pavement, recycled aggregate base, full-depth reclamation, full-depth recycling, or cement-stabilized recycled asphalt pavement.