CHAPTER 6

USE OF STABILIZED SOILS IN FROST AREAS

6-1. Stabilizers and stabilized layers.

a. Additives. Asphalt, portland cement, lime, and LCF are the most common additives used in stabilized soils. The limitations of use, the basic requirements for mixture design, and the stabilization procedures using bituminous and chemical stabilizers are set forth in EM 1110-3-137. Special or supplemental requirements related to frost areas are outlined in the following paragraphs.

b. Limitations of use. In frost areas, stabilized soil in most cases will be used only in a layer or layers making up one of the upper elements of a pavement system. Usually, it will be placed directly beneath the pavement surfacing layer, where the added cost of stabilization is compensated for by its structural advantage in effecting a reduction in the required thickness of the pavement system. However, a cement, lime, or LCF-stabilized base should not be placed directly beneath bituminous pavements because cracking and faulting will be significantly increased. Treatment with a lower degree of chemical stabilization in layers placed at lower levels within the pavement system should be used in frost areas only with caution and after intensive tests. This is because weakly cemented material usually has less capacity to endure repeated freezing and thawing without degradation than firmly cemented material. A possible exception is the use of a low level of stabilization to improve a soil that will be encapsulated within an impervious envelope as part of a membrane encapsulated soil layer (MESL) pavement system (app C). The limited experience to date suggests that a soil that is otherwise unsuitable for encapsulation, because moisture migration and thaw weakening are excessive, may be made suitable for such use by moderate amounts of a stabilizing additive. Materials that are modified by small amounts of chemical additive also should be intensively tested to make sure that the improved material is durable through repeated freeze-thaw cycles and that the improvement is not achieved at the expense of making the soil more susceptible to ice segregation.

c. Construction cut-off dates. For materials stabilized with cement, lime, or LCF, whose strength increases with length of curing time, it is essential that the stabilized layer be constructed sufficiently early in the season to allow development of adequate strength before the first freezing cycle begins. Research has shown that the rate of strength gain is substantially lower at 50 degrees F., for example, than at 70 degrees or 80 degrees F. Accordingly, in frost areas it is not always enough to protect the mixture from freezing during a 7-day curing period as required by the applicable guide specifications. A construction cut-off date well in advance of the onset of freezing may be essential. General guidance for estimating

reasonable cut-off construction dates that will allow time for development of frost-resistant bonds are presented in Transportation Research Records 442, 612, and 641.

6-2. Stabilization with lime and with LCF.

a. Bound base. Soils containing only lime as the stabilizer are generally unsuitable for use as base course layers in the upper layers of pavement systems in frost areas, except possibly in a MESL pavement system as mentioned above. Lime, cement, and a pozzolanic material such as flyash may be used in some cases to produce a cemented material of high quality that is suitable for upper base course and that has adequate durability and resistance to freeze-thaw action. In frost areas, LCF mixture design will be based on the procedures set forth in EM 1110-3-137, with the additional requirement that the mixture, after freeze-thaw testing as set forth below, should meet the weight-loss criteria specified in EM 1110-3-137 for cement-stabilized soil. The procedures of ASTM D 560 should be followed for freeze-thaw testing, except that the specimens should be compacted in a 6-inch diameter mold in five layers with a 10-pound hammer having an 18-inch drop and that the preparation and curing of the specimens should follow the procedures indicated in EM 1110-3-137 for unconfined compression tests on lime-stabilized soil.

b. Lime-stabilized soil. If it is economical to use lime-stabilized or lime-modified soil in lower layers of a pavement system, a mixture of adequate durability and resistance to frost action is still necessary. In addition to the requirements for mixture design of lime-stabilized and lime-modified subbase and subgrade materials set forth in EM 1110-3-137, cured specimens should be subjected to the freeze-thaw cycles of ASTM D 560 as modified by EM 1110-3-137 (but omitting wire-brushing) or other applicable freeze-thaw procedures.

6-3. Stabilization with portland cement. Cement-stabilized soil meeting the requirements set forth in EM 1110-3-137, including freeze-thaw effects tested under ASTM D 560, may be used in frost areas as base course or as stabilized subgrade. Cement-modified soil conforming with the requirements of EM 1110-3-137 also may be used in frost areas.

6-4. Stabilization with bitumen. Many different types of soils and aggregates can be successfully stabilized to produce a high-quality bound base with a variety of types of bituminous material. In frost areas, the use of tar as a binder should be avoided because of its high temperature-susceptibility. Asphalts are affected to a lesser extent by temperature changes, but a grade of asphalt suitable to the prevailing climatic conditions should be selected (app D). Excepting these special conditions affecting the suitability of particular types of bitumen, the procedures for mixture design set forth in EM 1110-3-137, EM 1110-1-131, and EM 1110-3-141 usually will insure that

the asphalt-stabilized base will have adequate durability and resistance to moisture and freeze-thaw cycles.