Pavement Design for Roads, Streets, Walks, and Open Storage Areas

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Chapter 1
Introduction

Purpose

This course provides criteria for the design of pavements for roads, streets, walks, and open storage areas at vehicle storage and maintenance installations.

Scope

This course provides criteria for plain concrete, reinforced concrete, flexible pavements, and design for seasonal frost conditions. These criteria include subgrade and base requirements, thickness designs, and compaction requirements, criteria for stabilized layers, concrete pavement joint details, and overlays.

References

Appendix A contains a list of references used in this course.

Selection of Pavement Type

Rigid pavements or composite pavements with a rigid overlay are required for the following areas.

a. Vehicle Maintenance Areas.
b. Pavements for All Vehicles with Nonpneumatic Tires.
c. Open Storage Areas with Materials Having Nonpneumatic Loadings in Excess of 200 psi.
d. Covered Storage Areas.
e. Organizational Vehicle Parking Areas.
f. Pavements Supporting Tracked Vehicles.
g. Vehicle Wash Racks.
h. Vehicle Fueling Pads.

Except for architectural or special operational requirements, all other pavements will be designed based upon life-cycle cost analysis.

Basis of Design

a. *Design Variables.* The prime factor influencing the structural design of a pavement is the load-carrying capacity required. The thickness of pavement necessary to provide the desired load-carrying capacity is a function of the following five principal variables-

(1) Vehicle wheel load or axle load.

(2) Configuration of vehicle wheels or tracks.

(3) Volume of traffic during the design life of pavement.

(4) Soil strength.

(5) Modulus of rupture (flexural strength) for concrete pavements.

b. *Rigid Pavements.* The rigid pavement design procedure presented herein is based on the critical tensile stresses produced within the slab by vehicle loading. Correlation between theory, small-scale model studies, and full-scale accelerated traffic tests have shown that maximum tensile stresses in the pavement occur when the vehicle wheels are tangent to a free or unsupported edge of the pavement. Stresses for the condition of the vehicle wheels tangent to a longitudinal or transverse joint are less severe because of the use of load-transfer devices in these joints to transfer a portion of the load to the adjacent slab. Because of their cyclic nature, other stresses will sometimes be additive to the vehicle load stresses and include restraint stresses resulting from thermal expansion and contraction of the pavement and warping stresses resulting from moisture and temperature gradients within the pavement. Provision for those stresses not induced by wheel loads is included in design factors developed empirically from full-scale accelerated traffic tests and from the observed performance of pavements under actual service conditions.

c. *Flexible Pavement.* The design procedure used by the Corps of Engineers and the Air Force to design flexible pavements is generally referred to as the California Bearing Ratio (CBR) design procedure. This procedure requires that each layer be thick enough to distribute the stresses induced by traffic so that when they reach the underlying layer they will not overstress and produce excessive shear deformation in the underlying layer. Each layer must also be compacted adequately so traffic does not produce intolerable added compaction. Use ASTM D 1557 compaction effort procedures to design against consolidation under traffic.

Chapter 2
Preliminary Investigations

2.1 General

The subgrade provides a foundation for supporting the pavement structure. As a result, the required pavement thickness and the performance obtained from the pavement during its design life will depend largely upon the strength and uniformity of the subgrade. Therefore, insofar as is economically feasible, a thorough investigation of the sub-grade should be made so that the design and construction will ensure uniformity of support for the pavement structure and the realization of the maximum strength potential for the particular sub-grade soil type. The importance of uniformity of soil and moisture conditions under the pavement cannot be overemphasized with respect to frost action.

2.2 Investigations of Site.

Characteristics of subgrade soils and peculiar features of the site must be known to predict pavement performance. Investigations should determine the general suitability of the subgrade soils based on the classification of the soil, moisture-density relation, the degree to which the soil can be compacted, expansion characteristics, susceptibility to pumping, and susceptibility to detrimental frost action. Such factors as groundwater, surface infiltration, soil capillarity, topography, rainfall, and drainage conditions also will affect the future support rendered by the subgrade by increasing its moisture content and thereby reducing its strength. Past performance of existing pavements over a minimum of 5 years on similar local subgrades should be used to confirm the proposed design criteria. All soils should be classified according to the Unified Soil Classification Systems (USCS) in ASTM D 2487.

2.3 Soil Conditions.

a. *General survey of subgrade conditions.* Sources of data should include the landforms, soil conditions in ditches, and cuts and tests of representative soils in the site. The survey should be augmented with existing soil and geological maps. Both natural and subsurface drainage of the sub-grade must be considered.