

3.1 RIGID PAVEMENTS: CEMENT CONCRETE PAVEMENTS

A rigid pavement is constructed from cement concrete or reinforced concrete slabs. Grouted concrete roads are in the category of semi-rigid pavements.

The design of rigid pavement is based on providing a structural cement concrete slab of sufficient strength to resist the loads from traffic. The rigid pavement has rigidity and high modulus of elasticity to distribute the load over a relatively wide area of soil.

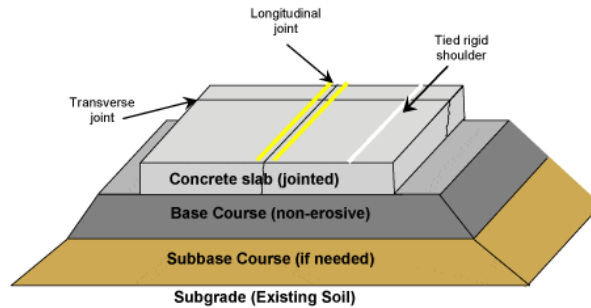


Fig: Rigid Pavement Cross-Section

Minor variations in subgrade strength have little influence on the structural capacity of a rigid pavement. In the design of a rigid pavement, the flexural strength of concrete is the major factor and not the strength of subgrade. Due to this property of pavement, when the subgrade deflects beneath the rigid pavement, the concrete slab is able to bridge over the localized failures and areas of inadequate support from subgrade because of slab action.

COMPOSITION AND STRUCTURE OF RIGID PAVEMENT-

Rigid pavements normally use Portland cement concrete as the prime structural element. Depending on conditions, engineers may design the pavement slab with plain, lightly reinforced, continuously reinforced, pre stressed, or fibrous concrete. The concrete slab usually lies on a compacted granular or treated subbase, which is supported, in turn, by a compacted subgrade. The subbase provides uniform stable support and may provide subsurface drainage. The concrete slab has considerable flexural strength and spreads the applied loads over a large area. Figure 1 illustrates a typical rigid pavement structure. Rigid pavements have a high degree of rigidity. Figure 2 show how this rigidity and the resulting beam action enable rigid pavements to distribute loads over large areas of the subgrade. Better pavement performance requires that support for the concrete slab be uniform. Rigid pavement strength is most economically built into the concrete slab itself with optimum use of low-cost materials under the slab.

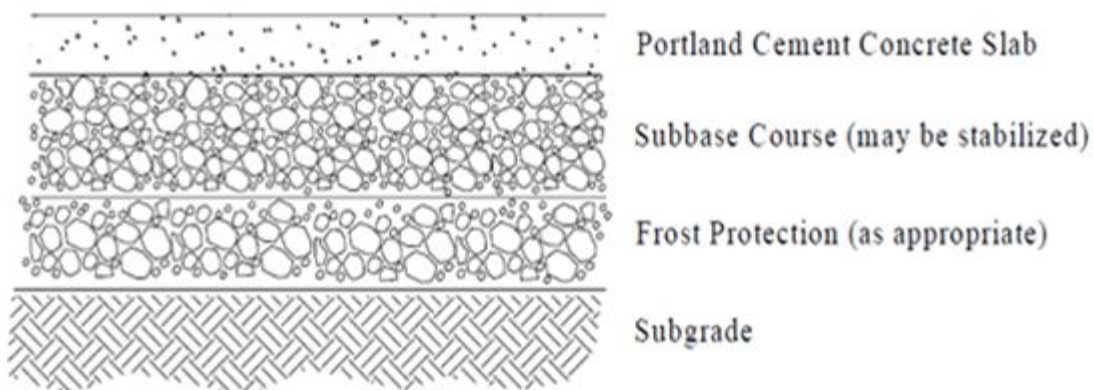


Fig : Typical rigid pavement structure

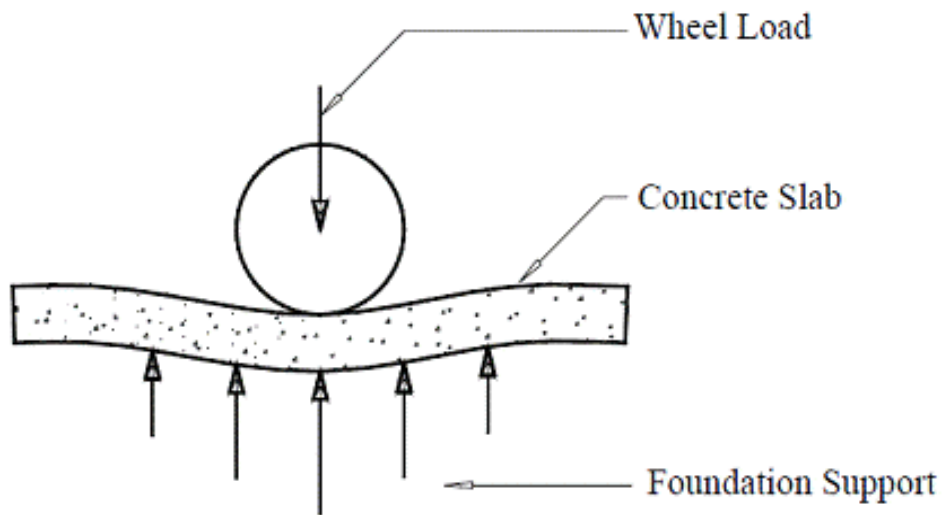


Fig: Transfer of wheel load to foundation in rigid pavement structure

a) Concrete Slab (Surface Layer).

The concrete slab provides structural support to the aircraft, provides a skid-resistant surface, and prevents the infiltration of excess surface water into the subbase.

b) Sub base.

The sub base provides uniform stable support for the pavement slab. The sub base also serves to control frost action, provide subsurface drainage, control swelling of subgrade soils, provide a stable construction platform for rigid pavement construction, and prevent mud pumping of fine-grained soils. Rigid pavements generally require a minimum sub base thickness of 4 inches (100 mm).

c) Stabilized Sub base.

All new rigid pavements designed to accommodate aircraft weighing 100,000 pounds (45,000 kg) or more must have a stabilized sub base. The structural benefit imparted to a pavement section by a stabilized sub base is reflected in the modulus of subgrade reaction assigned to the foundation.

d) Frost Protection Layer.

In areas where freezing temperatures occur and where frost-susceptible soil with a high ground water table exists, engineers must consider frost action when designing pavements. Frost action includes both frost heave and loss of subgrade support during the frost-melt period. Frost heave may cause a portion of the pavement to rise because of the non uniform formation of ice crystals in a frost-susceptible material (see Figure 3). Thawing of the frozen soil and ice crystals may cause pavement damage under loads. The frost protection layer functions as a barrier against frost action and frost penetration into the lower frost-susceptible layers.

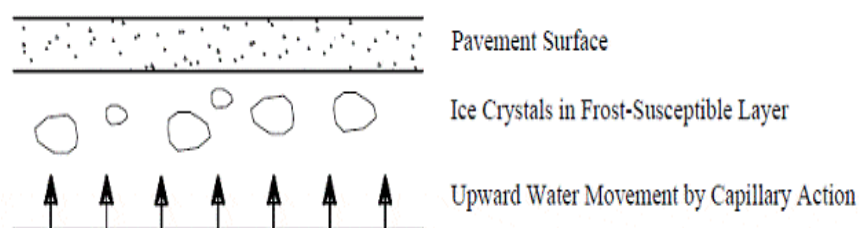


Fig: Formation of ice crystals in frost-susceptible soil

e) Subgrade.

The subgrade is the compacted soil layer that forms the foundation of the pavement system. Subgrade soils are subjected to lower stresses than the surface and subbase courses. These stresses decrease with depth, and the controlling subgrade stress is usually at the top of the subgrade unless unusual conditions exist. Unusual conditions, such as a layered subgrade or sharply varying water content or densities, may change the locations of the controlling stress. The soils investigation should check for these conditions. The pavement above the subgrade must be capable of reducing stresses imposed on the subgrade to values that are low enough to prevent excessive distortion or displacement of the subgrade soil layer.

Since subgrade soils vary considerably, the interrelationship of texture, density, moisture content, and strength of subgrade material is complex. The ability of a particular soil to resist shear and deformation will vary with its density and moisture content. In this regard, the soil profile of the subgrade requires careful examination. The soil profile is the vertical arrangement of layers of soils, each of which may possess different properties and conditions.

Soil conditions are related to the ground water level, presence of water-bearing strata, and the properties of the soil, including soil density, particle size, and moisture content, and frost penetration. Since the subgrade soil supports the pavement and the loads imposed on the pavement surface, it is critical to examine soil conditions to determine their effect on grading and paving operations and the need for under drains.

