CHAPTER VI
PAVEMENT STRUCTURE DESIGN

SECTION 6-01 SUBGRADE

6-01.1 SOILS. Since the performance and durability of pavement primarily depends upon the support provided by the underlying subgrade materials, it might be said that soil is the most important of all materials used in highway construction. The achievement of an adequate pavement structure requires a close coordination of soil survey, design, and construction to produce the best possible combination of the most economically available materials. The engineering properties of soil, probably more than any other factor, except drainage, influence the service and performance of all types of roads.

6-01.1 (1) SOIL SURVEYS. In order that all pertinent soils information be made available for proper design use, soil surveys and cut classification investigations are made by district soils and geology technologists for most projects. Basic soils information which can easily be understood and used by those who have not specialized in soil science is furnished by the Materials and Research Division. Designers are impressed with the necessity of studying the soils information provided in order that this important subject be given due and proper consideration.

Specific recommendations for cut, fill, and bridge spill fill slopes are contained in soil survey reports. For those projects on which soil survey reports have not been made, such reports with specific slope recommendations are requested from the district operations engineer.

6-01.1 (2) EFFECTS OF SOILS ON PAVEMENT DESIGNS. For flexible types of pavement, bases and subbases provide uniformity of support and strength and serve to distribute the load to the underlying soil over an area greater than the contact area of the tire. The weaker or more unstable the underlying soil, the greater is the required area of load distribution, and consequently the greater the required pavement thickness. For rigid pavements, bases provide uniformity of support, an insulation blanket, and a means of preventing pumping.

6-01.1 (3) UNSUITABLE SOILS. Unsuitable soils are those which have unstable, non-uniform or otherwise undesirable subgrade support characteristics. Highly plastic clays may have detrimental volume change characteristics (shrink-swell) from removal of overburden or changes in moisture content. This may be a particular problem when encountered in pockets, in varying thicknesses and when transitioning from cuts to fills. Silts are susceptible to rutting and pumping if compacted wet or in proximity to available moisture and may remain susceptible to pumping and frost heave from capillary action after paving. Particular problem materials include the "underclays" found beneath coal beds in Pennsylvanian age strata and gleys or gumbotils often found associated with glacial tills. Warping and distortion of pavements is common when these materials are left in the subgrade.

The minimum standard treatment of clay soils of moderate plasticity and average volume change potential includes cut compaction and compaction at moisture contents in excess of the optimum in the upper part of the subgrade. Silty soils should be compacted at moisture contents below the optimum. The standard specifications now provide for both these measures.

Consideration may be given to various forms of subgrade modification using stabilizing agents or to capping or covering the problem materials with better material. However, extremely bad materials, such as underclay, gley or pockets of high plasticity clay, should be replaced after being undergraded and wasted or buried in non-critical areas.

6-01.1 (4) IMPORTANCE OF UNIFORMITY. Since one key to satisfactory pavement performance is uniformity of underlying support, it is important that subgrades be composed of materials of reasonably uniform characteristics. To achieve uniformity of subgrade support, selection of borrow areas, earthwork balancing, and cross hauling are items which are given consideration including use of contract furnished borrow (embankment in place). See Subsection 4-08.3 for further details.

6-01.1 (5) COMPRESSIBLE FOUNDATIONS. Com-pressible foundations, often encountered in stream bottoms, are normally detected during the soil survey and are referred to the Division of Materials and Research for detailed

investigation. This investigation will usually include undisturbed foundation soil sampling, testing and analyses to determine settlement and strength properties. Compressible foundations may be unstable or only marginally stable during the consolidation process and application of embankment loads must be carefully monitored and controlled. Use is often made of restricted loading rates, construction delays, embankment control stakes, pore pressure measurement devices, and flattened or bermed slopes. Where settlements are expected to be high and of very long term duration, vertical sand or wick drains may be used to accelerate settlement but must be used with great care since they may contribute to stability problems. Separate paving and grading projects may be especially helpful in mitigating some of the settlement and stability problems associated with compressible foundations.

6-01.1 (6) TRANSITION ZONES. Where subgrade support changes from a soil foundation to a solid rock foundation, special precaution is taken to guard against pavement failure. Transition zones of varying depth are feathered out in each direction longitudinally for a distance of approximately 30 to 40 ft. [9.0 to 12.0 m]. The transition zone is backfilled with materials specified in the standard specifications for backfilling of undergraded areas. This eliminates or minimizes uneven stresses which may result in pavement failure. Approximate station limits of transition zones are shown on the plans.

6-01.1 (7) POCKETS OF UNSUITABLE MATERIAL. Where pockets of heavy plastic clay or other unsuitable materials are encountered between pinnacles of solid rock, the unsuitable material is removed to required depth and backfilled with the material specified in the Standard Specification for backfilling of undergraded areas. If it is anticipated that such conditions will be encountered, approximate quantities for removal and backfill are shown on the plans. In areas known to have pinnacles of rock, it is extremely important to study the cut classification information in order to avoid large overruns of Class C excavation during construction.