Pavement Subsurface Drainage Design Procedure for Iran

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Abstract

Providing adequate drainage to a pavement system is an important design consideration to prevent premature failure due to water related problems such as pumping action, loss of support and rutting. This study focuses on subsurface drainage issues in Iran. Evaluation parameters for subdrainage are traffic load, permeability coefficient of subgrade, freezing index and annual precipitation. The last two are climatic parameters used in the procedure proposed in this paper. The time-to-drain method was used to evaluate subdrainage efficiency. SH-DRAIN' Software was developed to facilitate pavement subsurface drainage design

Keywords: Freezing index, subsurface drainage, Permeability coefficient

1. INTRODUCTION

Excess water content in a pavement base, subbase, and subgrade soils can cause early distress and lead to structural or functional failure if counter measures are not taken. Water-related damage can cause reduced subgrade and base/subbase strength, differential swelling in expansive subgrade soils, stripping of asphalt in flexible pavements, frost heave and reduced strength during frost melt, and movement of fine particles into the base or subbase course materials resulting in a reduction of the hydraulic conductivity [1]. Laboratory and field tests indicate that the moduli of base and subgrade materials are strongly affected by moisture content. Furthermore, a relatively rapid decrease in the level of serviceability can occur because the pavement's ability to transmit dynamic loads imposed by traffic is weakened. [2, 4]

The movement of a wheel on pavement with a saturated subgrade can produce a moving pressure wave, which in turn can create large hydrostatic forces within the structural section. These pulsating pore pressures significantly influence the load-carrying capacity of all parts of the pavement structure. [4]

Freeze-thaw cycles can also cause moisture-induced pavement damage when the moisture migrates through the capillary fringe toward the freezing front to increase ice lenses. The presence of water in the pavement is mainly caused by infiltration through the pavement surfaces and shoulders, melting of ice during freezing/thawing cycles, capillary action, and seasonal changes in the water table. Sources of moisture in pavement systems are shown in Figure 1 [2].

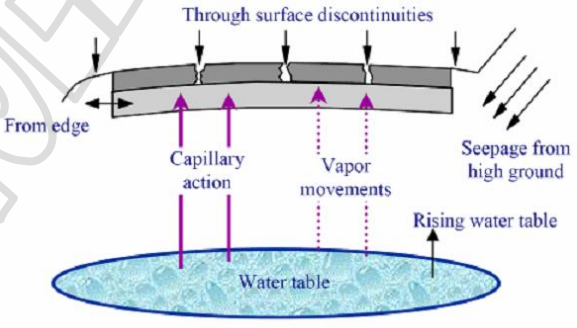

Figure 1. Sources of moisture in pavement systems [2].

2. STEP 1: ASSESSING THE NEED FOR DRAINAGE

Identifying the need for subdrainage for a given project situation is an important step in the pavement design process. Ideally, the need for subdrainage should be based on a cost/benefit analysis where the benefit (extended life, reduced maintenance) is greater than the added cost of installing and maintaining the system. In the absence of a universally acceptable procedure to perform such analysis, the practical approach outlined in Table 1. Subgrade permeability ($K_{subgrade}$) was determined using AASHTO T 215 for coarse-