

DRAINAGE -- MAINTENANCE

By

L. L. Allen, Maintenance Engineer,  
Minnesota State Highway Department

\* \* \*

Trends

Trends in modern highway design have been toward deeper cuts and higher fills with a resulting need for eliminating the hazard caused by ditches. Surface drainage is best accomplished by a wider and shallower ditch cross section, including the use of lip curbs where possible. Raising the highway grade or lowering the subgrade water table by use of drainage structures is demanded when lands adjacent to the road may be subject to occasional flooding.

Subgrade drainage is frequently more important than surface drainage, particularly where ground water is intercepted by construction in subgrade soils of low stability. Here either the ground water level must be reduced or a "stabilized base" must be provided above the existing natural subgrade soil.

Frost Damage

Because of inadequate or partial sub-drainage in early pavements, frost heave was of frequent occurrence. Addition of tons of gravel was required to repair frost damage, and temporary methods such as thawing of frozen subgrades on heaved sections were not satisfactory. Permanent elimination of frost heaving could be affected only by complete subsurface drainage.

French Drain

Originally the French drain was the model used in sub-surface drainage, using a trench back-filled with stone or gravel. These and later drainage methods are based upon the principle of cutting off capillary moisture from the subgrade.

Capillary Water

Capillary water is increased in subgrades which consist of two or more soils of contrasting texture. Frost heaving is more frequent in silty or clayey soils of fine texture than in more permeable sands or gravels, because fine textured soils encourage capillary action which brings water from unfrozen lower strata to the upper frozen zone. Freezing in coarse textured soils merely fills the pores with ice and does not create expansion pressure.

Frost Protection

To remedy frost damage to pavements, fine subgrade soils can be removed and replaced by coarser sands and gravels, topsoil, broken stone or other "unweathered" materials, or capillary water may be cut off by an oil application at the bottom of the excavation below subgrade. Excavation of the subgrade should as a rule be carried under the full width of the pavement or road surface. The depth of needed excavation varies with the depth of probable frost penetration. Excavation and replacement with permeable or granular soil material is usually confined to areas where frost heave occurs.

It is necessary to prevent a too abrupt transition from the artificial back fill to the natural subgrade soil when they differ in essential character.

Narrow trenches back-filled with gravel have been tried with or without underlying tile. Such trenches were found effective only in proportion to their width. Deep drainage trenches have been attempted to cut off ground water, but capillary action has not been controlled.

Lifting the highway grade by the use of gravel or topsoil has been effective in eliminating frost heave in proportion to the depth of new material placed over the old road surface.