

DITCHES, SHOULDERS AND BACK SLOPES

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A discussion of any item of highway maintenance requires an understanding of the fundamental conditions which control the procedure to be followed, or standards to be adopted. Local factors indicate that certain details should be adopted which may or may not be controlling factors in other locations. The current practices in Massachusetts highway maintenance are the result of experience and analyses of general and specific conditions.

Ditches. Deep side ditches, parallel with the roadway, have nearly all been eliminated from State highways in Massachusetts. This development has resulted from the logical requirements characteristic of high speed and heavy traffic routes: that hazards should be eliminated and that traffic lanes should be provided with a safety strip as emergency leeway in acute driving conditions rather than a ditch which would cause overturning.

This requirement therefore necessitates the construction of underdrains to take care of surface water drainage. Also, certain locations have required a system of underdrains for the purpose of lowering the ground water level, and to prevent ground water from adjacent banks and higher levels from entering the sub-base. These drains consists of perforated corrugated iron or vitrified clay pipe, laid with open joints in trenches which are then filled with a pervious material, such as broken stone or gravel. The surface of the back fill is then sealed with a bituminous material in order to prevent silt or other fine material from filling the drain.

On some of the highways in the western part of the State, where traffic volumes are comparatively small, side ditches have been constructed. These, however, are formed with a 4 to 1 slope which extends from the shoulder of the road out to the back slope, the bottom of this ditch being at the same grade as the bottom of the sub-base, which is generally 18 in. below the grade of the shoulder. This design has the advantage of preventing stones and material, loosened from the slope by erosion or frost action, from falling upon the roadway. This widened area is also of considerable benefit in winter maintenance because it provides a place where snow may be disposed of in the plowing operations.

Shoulders. The shoulders are usually constructed of gravel about 3 to 5 ft. wide and 6 in. deep, and should be low enough to allow water to run off the pavement.

On the heavily traveled highways these shoulders are treated with about $1/3$ gal. of slow-curing asphaltic oil of from 20 to 40 viscosity, and with the asphalt content, at 100 penetration, of from 45 to 55. In

other locations a low viscosity tar and calcium chloride are applied to the shoulders. The shoulders are then dragged at various times throughout the year, and on the heavy traffic highways they are dragged as often as once a week.

On steep grades, to prevent erosion, the gravel shoulder is eliminated and the pavement section widened to the foot of the slope or to the grass line. From the standpoint of safety and appearance it is important that the soft shoulder receive proper maintenance. However, since this maintenance is costly, on heavily traveled highways the shoulder may be hardened with base and sub-base of the same design as the pavement section. While the first cost may be high, the final cost, which includes the upkeep, undoubtedly will be lower, and the result will be a safer and more pleasing highway.

Back Slopes. The most serious maintenance problem of back slopes is erosion. The accumulation of water on the top of the slope should be diverted by means of a ditch parallel with the top of the slope. Where necessary to dispose of such water down the face of a cut or embankment, paved gutters or underdrains are used.

The treatment of each slope, however, is a special problem, depending on such factors as type of subsoil, presence of underground water, location, cost, etc. Thus the conventional $1\frac{1}{2}$ to 1 slope, where fine sand is encountered, may be changed to the 2 to 1 slope, and where funds are available it may be sodded, or loamed and seeded. Partial success in wet clay slopes has been obtained by the planting of willows. In some cases underdrains are being installed to intercept the underground water before it lubricates and softens the subsoil.

In Palmer there is a slope, 100 feet in height which has caused a great deal of trouble. The subsoil is composed of clay and fine sand which, on becoming wet in the spring, has caused landslides that have partially blocked the highway. At the present time this slope is being terraced and sodded in order to prevent the downward wash. Also, an extensive system of underdrains and inlets from the terraces is being installed to take care of both surface and ground water.

The maintenance of slopes involves not only the attainment of conditions necessary to prevent loose material from falling to the roadway, or the gradual filling of drainage ditches at the foot of the slopes, but also the desirable effort to keep the roadsides neat and free from crude conditions. The endeavor is made to trim the top of a slope where the slope line intersects the original surface, in order to prevent the unsightly appearance of an over-hanging top soil. This is generally accomplished by rounding off the top of the cut with a vertical curve. A similar curve is often made at the foot of a slope. These details should be included as standard in the design for highways.

There are many maintenance details which have become standard. The effort is made to adhere to such ideals, but the performance may not be equal to the standard established. Physical conditions are often the factors which prevent attainment of this goal.