

# Maintenance Costs of Highway Shoulders

S. E. RIDGE, Highway Engineer  
Bureau of Public Roads

● TO the maintenance engineer, the shoulders of a highway are similar to the eaves of a house. One of their prime purposes is to keep surface moisture from entering the base, subbase, and subgrade and destroying the surface support. The shoulder must have the ability to carry the water deposited on it and the adjacent pavement over the shoulder area into the ditch where it can have little or no effect on the stability of the surface support, and it must have this ability under all conditions. The shoulder surface must be impermeable.

The shoulder should also be built upon a base that will allow the subsurface water to move freely from beneath the pavement. The shoulder base should not act as a dam and trap water beneath the roadway surface.

This ability to shed surface water and carry subsurface water to the ditch must be present under all climatological conditions. The shoulder design should be such that surface thawing after a deep frost penetration occurs evenly over the surface and shoulder areas and such that thawing does not penetrate more rapidly under the surface areas and form a pocket in which moisture can accumulate. It is also important to the proper functioning of the shoulder that the ditch design be such that snow can be completely removed from the shoulder. Otherwise, snow melting on the pavement will be held on the shoulder and some will seep through into the base.

It is quite evident, therefore, that shoulder maintenance costs alone cannot be used to evaluate the over-all maintenance economy of different types and designs of shoulders. The effect of the shoulder type and design on surface maintenance costs must also be considered.

Another element that has an important effect on shoulder maintenance costs is the width of the adjacent surface. Shoulder maintenance costs are much higher on roads with narrow lane widths. A recent study of shoulder maintenance costs indicates that at traffic volumes of 3000 VPD, the annual cost of maintaining gravel shoulders on highway sections with 22-ft surfaces (two 11-ft lanes) is \$44.00 per mile less than the cost of maintaining the same type shoulders on sections with 20-ft surfaces (two 10-ft lanes). The effect would, of course, be much greater adjacent to narrower lanes and much greater at higher traffic volumes.

Another requisite of shoulders, insofar as the maintenance engineer is concerned, is the stability of the shoulder. Even on wide roads, vehicles will accidentally or through disability move off the pavement onto the shoulder. The shoulder should be able to support the vehicles without rutting or other damage under all weather conditions. If it cannot, pavement edge ruts soon develop. These ruts hold water which soon seeps into the subgrade and causes failure of the pavement. Obviously the ruts must also be repaired and this requires maintenance expenditures.

The engineer designing the shoulders of the new high speed, high traffic highways should keep in mind the fact that such shoulders are subjected to an entirely different type of traffic than a surface. If the pavement is sufficiently wide, the traffic on these shoulders will be infrequent. A large portion of that traffic, however, will be of a very damaging type — high speed vehicles which for one reason or another have accidentally left the surface. On leaving the surface, the driver of the vehicle reacts in one or both of two ways: he either applies his brakes suddenly or he attempts to regain the pavement by changing drastically the direction of the vehicle. Either of these two actions produces a tearing effect on the shoulder surface. This, combined with the fact that the normal traffic on the shoulder is very light, makes it very difficult to maintain anything but the most durable shoulder surfacing. The design of shoulder surfacing should be made with these facts in mind for, on this type of highway, shoulder maintenance is a most difficult, costly, and dangerous operation — dangerous both to the maintenance forces and to the traveling public. Safety often costs two to three times the cost of the actual maintenance.

The shoulder texture should be different from the texture of the roadway surface.

The driver should know both by sight and sound when he leaves the pavement surface or else he will use the shoulder as a riding surface and shoulder maintenance cost will rise.

In summary, from the maintenance cost viewpoint, the shoulder surfaces should be stable and impermeable. They should be tough enough to withstand the tearing effect of high-speed traffic. They should not accumulate dirt and debris. They should contrast with the roadway surface and they should be built upon a base that will allow moisture to drain. The maintenance engineer would also like to have the roadway surface built wide enough to minimize the accidental use of the shoulder or the deliberate use of the shoulder as the traveled way. The evaluation of the maintenance economy of different surface types should be based not only on the cost of maintaining the shoulder but also on the effect that the shoulder type has on the maintenance cost of the roadway surface. The evaluation should also take into account the possibility that the reported costs do not represent full maintenance. On the narrow older roads carrying high traffic volumes, it is often impractical to do the blading necessary to maintain a smooth surface on untreated gravel or soil shoulders. The reported costs are, therefore, only a partial indication of maintenance economy.