

# SHOULDER HARDENING TREATMENT IN CONNECTICUT

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## SYNOPSIS

In order to make possible greater utilization of many miles of old narrow roads in Connecticut which could not be rebuilt immediately, experiments in shoulder treatment were conducted. This work resulted in the adoption of standard practice for the bituminous treatment of shoulders, consisting essentially in a priming treatment with light bodied, slow curing asphaltic oil followed by a surfacing coat of light tar. On bituminous roads the finished shoulder is indistinguishable from the main surface and maintenance methods appropriate for the whole surface thus formed are used.

Increase in the amount and speed of traffic in Connecticut during recent years has resulted in an insistent demand for the widening of existing highways for its accommodation.

Many miles of the existing roads, particularly those of the secondary or feeder type, were constructed 20 and more years ago, in a manner to take care of conditions reasonably well at that time, but now they are woefully lacking in the facilities that present day travel demands. The necessity for the reconstruction of through trunk line highways to serve traffic between New York State on the west and various New England cities on the north and east, as well as local travel, precluded the possibility of reconstructing many of these connecting highways. It became necessary to develop a method of treatment which would provide or assure greater use of these older types of highways at all times of the year if travel were to be satisfactorily served. To resurface the total mileage, even to a minimum thickness, was impracticable on account of lack of funds, for each mile of such resurfacing would require the expenditure of several thousand dollars.

The original travel path width of the older roads rarely exceeded 16 ft, and through the years this had been further reduced by breaking down at the edges of the shoulder. During the spring

periods, with frost leaving the ground, the shoulders became soft and furnished little opportunity for safe use. Continual dragging of the shoulders and replacement of material washed from grades after each period of wet weather was required to restore a reasonable degree of smooth surface and even contour. Study showed that with the necessity for this continuous maintenance eliminated, the funds so expended could be used in the treatment of these shoulder areas, thus reducing the almost daily maintenance cost and increasing the traffic potentialities without appreciably increasing the total expenditure.

While the surface treatment of the shoulder with ordinary types of bituminous material gave a measure of relief during the dry summer seasons, this treatment frequently broke during wet and freezing periods so that very little value remained at the beginning of the next season. This was believed to be due to certain characteristics of the bitumens, if the character of the shoulder material in which a great variation existed was not too largely considered. Where a rapid curing bitumen was used the proper depth of penetration was not obtained and a thin surface formed which broke readily under traffic at times when the supporting value of the shoulder material was the least. With a slow curing bitumen greater penetration was obtained but the resulting plastic mix-

ture was easily displaced by traffic and did not have the desired hard, smooth water resisting surface. Field experiments were made to determine the correct combination of these two types of bitumen to obtain the desired results, and from these experiments a rather definite system of shoulder treatment has been adopted in Connecticut.

A slow curing bitumen is utilized in the first treatment, a sufficient quantity being applied, depending on the character of shoulder material, to result in a treated depth of three to four inches. This bitumen must be of a light nature to secure the required depth of penetration, and must be one which retains its plastic nature for considerable time, and has satisfactory binding qualities. The surfacing bitumen must be of a medium or rapid curing material which forms within a short time a surface resistant to wheel loads and results in a satisfactory shoulder contour for the proper discharge of water from the travel path to the gutters. It is desirable that both of these bitumens be standard specification material which can be bought in competition from any manufacturer.

In practice, methods are about as follows:

The shoulders are dragged to obtain the proper contour and longitudinal grade. This dragging operation also breaks up any glazed surfaces which may prevent the proper absorption of the first coat of bitumen. The dragged shoulder is then given an application of light asphaltic oil in the amount which the material will absorb. This will vary from one-quarter gallon per square yard in heavier soils to possibly three-eighths or one-half gallon in light sandy soils. Within the next 24 to 48 hours, after the bitumen has become thoroughly incorporated with the shoulder material, the shoulders are again honed to even the material distribution and preserve the shoulder contour. A second applica-

tion of approximately one-quarter gallon of the light asphaltic oil is then applied, the amount varying again with the character of the shoulder material, to obtain a uniform mix and the desired depth of three to four inches of treated material. The shoulder is again honed and the material allowed to set. Additional light honing in succeeding days is required only to preserve the desired contour where displaced by traffic. When the shoulder has become reasonably stable, but before the evaporation of the light oils has proceeded to too great a degree, final honing is done after which light surface tar is applied at the rate of about one-quarter gallon per square yard. Sufficient sand cover is used to absorb any excess tar and to form a mulch for final honing. This completes the work, and the shoulders are then turned over to the local foreman for future maintenance.

In Connecticut it has been possible to defer the reconstruction of lighter travelled highways through this method. It does not compete with a newly constructed modern highway, but attempts to offer a method of increasing the usability of the older type of highway when funds are insufficient to permit reconstruction. It has been found that shoulders treated by this method have resisted the annual spring break-up to an unexpected degree, and are satisfactory for travel even through the spring months. Added advantage lies in the protection of the edge of the travel path which may break seriously against an untreated shoulder. Such breaks are rarely found with the treated shoulder. Water conditions, formerly found at the junction of the travel path and the inner shoulder edge, are transferred to the actual gutter at the outside edge of the shoulder.

Subsequent reoling of the surface of a macadam or gravel road includes the treatment of the travel path and shoul-

ders as a unit, and no line of demarcation is generally noticeable to define their junction

Experience shows that the use of slow curing bitumen in the priming of the shoulder material tends to retard the oxidization of the faster curing surface bitumen when exposed to the weather, and that the sealing surface bitumen also retards the evaporation of the lighter oils in the priming bitumen

Costs necessarily vary with different types of shoulder materials, but in general only to the extent of the amount of bitumen required for obtaining the required results. Usually the treatment consists of about one-half to three-quarter gallon of light asphaltic oil in two applications, and one-quarter gallon of light surface tar, the cost of these materials approximating four to five cents per gallon for asphaltic oil and seven to eight cents per gallon for surfacing tar, F O B delivery point. Freight varies from one to one and one-half cents per gallon. Application of bitumen to several miles of shoulder is a day's work for one distributor. The honing operation requires the use

of one truck with a crew of two men, including the driver, for part of a day

In general the cost of the finished shoulder will average eight to ten cents per square yard. Subsequent renewal treatments consist of the application of approximately one-eighth gallon per square yard of light surface tar in connection with the travel path treatment, and shoulders are honed integrally with the travel path. The additional labor involved in the shoulder treatment consists of one extra passage of the hone in this area. It is estimated the shoulder retreatments will cost approximately about one and one-half cents per square yard, and that one treatment a year will be sufficient on a well travelled highway and two treatments in three years on a lighter travelled highway. It is now customary to apply this treatment to the shoulders of all types of newly constructed roads, preferably after a full winter settlement, to furnish additional safe travel width under emergency conditions. Expenditures show that total maintenance costs have been considerably reduced by treating the shoulders even though traffic has increased in the same period

#### DISCUSSION ON SHOULDER TREATMENT

MR C N CONNOR, *Bureau of Public Roads*. I am particularly interested in this full width treatment of the roadway because of the good results obtained at low cost. Besides reducing maintenance costs the increased width of traveled way presumably should also tend to reduce accidents. I would appreciate Mr Hamlin's observations on accident reduction. It also would be interesting to know why tar was selected for the seal coat instead of asphalt which has been used in the body of the shoulder stabilization.

MR HAMLIN. I have no definite figures of comparative accident records, but from

available general information widening of the road by shoulder treatment has tended to reduce traffic hazards. The older type of road, with its frequently broken and rough shoulders, limited traffic to a width of about 14 ft. This was inadequate for increasing speed and volume of traffic. The road with improved shoulders furnishes a travelable width of 24 to 26 ft and is in condition for use at all times of the year. There is no doubt but that shoulder stabilization has increased the safe speed of traffic and has also reduced accidents.

There are two reasons for the use of tar for the second application or seal coat

First, a tar treated surface seems to provide more tractive resistance than one treated with asphalt, particularly under unfavorable weather conditions. In general a priming application of 45 asphaltic oil, following by an asphaltic seal, is satisfactory except at curves and grades where skidding generally occurs. Second, the use of the light asphaltic oil for priming tends to prevent oxidation of the tar seal coat, and the tar seal coat retards evaporation of the lighter oils in the priming coat. Traffic on tar surfaces also assists in retarding oxidation. From experiments with both materials it has been determined that the use of asphaltic oils for priming and tars for sealing gives the best results. The same general method is used in treating shoulders and a gravel type of stage constructed travel path.

MR. C M NOBLE, *Pennsylvania Turnpike Commission*. I would like to ask Mr Hamlin what his experience has been with grass sod shoulders adjacent to pavement composed of two 12-ft lanes and whether he would consider such grass sod shoulders to be safe for speeds of 60 or 70 miles per hour.

MR. HAMLIN. In Connecticut we have eliminated the use of sod shoulders, principally for the reason that this type of shoulder attracts moisture and consequently the outer edge of the traveled path becomes unstable through variable water conditions. One of the results desired was to guard against moisture at the junction of the traveled path and shoulder. We found in hardening the shoulder and transferring the water area from the inside edge to the outside edge of the shoulder that what had been considered poor subgrade drainage conditions in many cases was found to be largely caused by surface drainage and was eliminated by sealing the shoulder surface at its junction with the traveled path. The

grass shoulder had been a source of continual expense and accident hazard. There are in Connecticut nearly 3000 miles of State road. Shoulder stabilization has been an attempt to increase the available width of these roads up to the time that reconstruction funds were available. The grass shoulder did not seem to be adapted to the full use of highways either from a usable width or economical maintenance standpoint. The treated shoulder has partially at least solved both of these requirements.

MR. F C LANG, *Minnesota Highway Department*: I have noticed where narrow pavements were widened and given a bituminous treatment so that the old shoulder line of the pavement was obliterated that there was considerable breakage along the edge due to the fact that the heavy wheel loads ran out on a treated shoulder that was not as strong as the original pavement. You are getting traffic on a weak portion of the roadway.

MR. HAMLIN. That result was expected, however the contrary has been found to be the case. On narrow roads with untreated shoulders opposing travel resulted in concentration of wheel loads in the same narrow area of the pavement at all times. With an additional available treated shoulder width of 5 or 6 ft, distribution is more uniform over the entire surface and concentration in narrow widths avoided.

MR. W H ROOT, *Iowa Highway Commission*. I should like to say a word in defense of the sod shoulder. We have thousands of miles of sod shoulders in the middle west. I think the whole question is a matter of traffic. The sod shoulder is no good to travel on but if the traffic lane is not wide enough and it is necessary to get out on the edge of the pavement it is very necessary, and it is

the cheapest shoulder that can be maintained

I should also like to ask one question—you mention that you get a penetration of 3 in before the surface treatment is put on. Are these shoulders largely earth or do they have some gravel in them? Do you get that 3-in penetration as straight penetration or do you have to scarify it in?

MR. HAMLIN Characteristics of material vary considerably, from a small amount of clay through ordinary soil to sand and gravel. Treatment of the different kinds of material varies with their ability to absorb the priming coat. This should penetrate to a depth of approximately three inches. The shoulder is first honed to make the surface uniform and break up any non-porous sections, and to furnish a receptive condition for uniform penetration of bitumen.

MR. J. J. FORRER, *Virginia Highway Department* I should also like to say a word in defense of grass covered shoulders, which I think we still need to keep down erosion. It may not be necessary in a low-lying country but where you have a rapid run-off you need grass.

CHAIRMAN MARSH On about how much mileage in Connecticut has this type of treatment been utilized?

MR. HAMLIN We treat shoulders on practically all new roads by this method. There are some 2600 miles so treated at the present time.

CHAIRMAN MARSH How long has your experience been?

MR. HAMLIN About 15 years, including different phases of experimentation.

CHAIRMAN MARSH Are these shoulders holding up on the older roads?

MR. HAMLIN Perhaps that may be answered by referring to the section of the State where the hurricane was most severe this year. In the Connecticut and Thames River valleys the actual damage to shoulders amounted to less than \$1000 except in those locations where a bridge was destroyed or a stream overflowed the highway. The same condition existed in the Connecticut River flood three years ago. The road from Springfield to Hartford was under water for several days and emerged covered with debris. Replacement of treated shoulders on this road required an expense of less than \$100. With increased traffic total, maintenance costs have been reduced since the shoulder treatment was adopted.