innovative maintenance procedures in texas

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Innovative maintenance procedures and maintenance materials used by the Texas Highway Department and developed by district maintenance personnel are briefly presented. Procedures discussed involve maintenance methods and equipment associated with pavement and shoulder repair including rapid repair of bridge deck failures, maintenance equipment with hot storage capabilities, and unsurfaced shoulder repair with mechanized operations. The use of a one-man, truck-mounted herbicide sprayer; mechanized mulching and seeding operations for erosion control; mechanized litter gathering equipment; and a culvert cleanout process using a dog are also discussed. Specialized materials used in Texas maintenance operations include lightweight aggregate mixtures for seal coats, overlays, plant-mixed seals, bridge deck overlay, and hot-mixed, cold-laid patching materials. A brief description of these practices together with limited economic data is presented for comparison with other state highway department practices.

Funding for highway maintenance operations makes up a significant part of the total highway budget. As new roadways are constructed and existing roadways are reconstructed to handle the ever-increasing demands, maintenance expenditures must be increased to maintain these facilities at an acceptable level of service. Furthermore, as the highways in existence become older, their maintenance requirements will increase. Thus comprehensive decision-making systems have been developed and management studies have been performed by a number of state highway departments.

The Texas Highway Department and the Texas Transportation Institute initiated a maintenance study in 1970 to identify and develop maintenance methods, to develop a maintenance priority rating system, and to implement the study on a trial basis. Early work in the study has been aimed at the development of maintenance methods. Results from this phase of the research project indicate that certain innovative maintenance procedures exist in certain highway districts, which could be of benefit to all other districts.

District personnel in charge of maintenance and representatives from the Texas Highway Department Maintenance Operation Division and the Texas Transportation Institute formed five maintenance method panels. These panels are responsible for the development of maintenance methods and quality standards in the following general areas:

1. Base and subgrade repair,
2. Bituminous surfaces, shoulders, and approaches,
3. Portland cement concrete surfaces,

4. Roadside maintenance, and
5. Structures.

Innovative items from these general areas will be discussed in this paper.

It is recognized that the so-called innovative maintenance materials, equipment, and methods described in this paper may be standard practices in other states. However, certain other sections of the U.S. or even Texas maintenance forces are not aware of these ideas as applied to maintenance. The Texas Maintenance Practices Committee strongly encourages the exchange of information like that described in this paper at all levels of responsibility.

Selection of the innovative ideas presented in this paper is based on two primary factors.

1. Does the new practice reduce the total cost of roadway maintenance?
2. Does the new practice increase safety?

Total cost of roadway maintenance includes the initial cost of the material and operation and a monetary measure of how well the operation satisfies the needs of the driving public. Safety of both the driving public and the maintenance forces must be considered when maintenance operations are developed.

Specific maintenance materials, equipment, and methods will be briefly discussed. These discussions will include crew size, equipment requirements, and cost data where available.

MAINTENANCE PRACTICES

Pavement Maintenance

Materials—Both bloated (lightweight) and nonbloated synthetic aggregates have been used for seal coats in Texas since 1961. It is estimated that 10,000 lane-miles of this type of highway surface have been placed to date. In addition to the conventional full-lane-width seal coat, strip seals and smaller patches have been placed with synthetic aggregate in a sealing type of operation.

Hot-mixed asphalt concrete containing synthetic aggregate as the coarse fraction has been used since 1963. Field evidence exists that suggests that synthetic aggregate hot-mixed overlays and plant-mixed seals can be considered as premium materials because of their prolonged and initially high skid resistance and stability characteristics.

Recent research conducted in Texas established the methodology for the manufacture and placement of hot-mixed, cold-laid synthetic aggregate asphalt mixtures. Successful field trials have demonstrated that the material is a good winter and summer patching material that provides necessary skid resistance and stability.

Conventional maintenance practices can be used for the placement of all the synthetic aggregate-asphalt mixtures described. Certain precautions, however, should be taken under some conditions and are adequately described in references that can be obtained from the Texas Highway Department or the Texas Transportation Institute.

Edge Repairs—During the initial phases of the farm-to-market road-building program, many miles of 18- to 20-ft-wide pavement were constructed without surfaced shoulders. These roadways are now subject to much heavier loads and a higher traffic volume than originally expected. Also, farmers driving farm equipment often use these roadways and, in attempts to allow automobiles and trucks to pass, pull off to the edge. Thus

raveled pavement edges and pavement drop-off often result. Considerable difficulty has been experienced in maintaining the edges.

The cost of repairing pavement edges by the hand method involving hot-mixed, cold-laid bituminous patching materials averaged 18 to 24 cents per linear foot. A new procedure was developed that reduced the cost to 4.5 to 6.5 cents per linear foot. These costs include labor, equipment, and material.

The innovative maintenance method proceeds in the following way: The pavement edge is cleaned, and low areas are replaced with flexible base; RC-250 tack coat is applied at a rate of 0.07 gallon per square yard. A string line or pilot line is used to produce a straight edge. A slide box is used to spread the bituminous-treated mixture in the designated area. The slide box is attached to a dump truck by a hopper through which material is introduced (Fig. 1). A workman on the ground controls the flow of material into the slide box with a gate device while another workman breaks up lumps and clods that the raker teeth in the slide box do not break. The workmen are in a protected area beside the truck and somewhat away from traffic. Next a brooming operation is used to correct an over-width application of the bituminous-treated material applied outside of the area that has been tacked. The rolling operation is performed with a steel drum roller (Fig. 2).

Materials other than hot-mixed, cold-laid bituminous mixtures can be used in this operation; however, little bleeding has been noticed with this material and the heavy tack coat applied to the pavement edge.

Repair of pavement drop-off is another troublesome maintenance activity in which a more mechanized approach has been developed. A Hebbronville, Texas, maintenance construction foreman used a "hopper spout and strike-off box" assembly attached to a dump truck to perform in 3 hours with a seven-man crew a job that would normally take a 17-man crew 9 hours to perform. This innovative edge repair method using crushed base material prepared at a prescribed moisture content consists of two maintenance men, four truck drivers, and one loader operator.

The strike-off box is made primarily from old grader blades and contains an adjustable gate. Workmen are able to work in a relatively protected area, and compaction can be accomplished by using the loaded trucks or suitable compaction equipment.

The specialized equipment required for this operation can be built at a cost of $200 and requires about ½ hour to install. Use of this equipment effects a significant cost saving.

Pot Hole Repair—Repair of pot holes and other forms of localized distress can most successfully be accomplished with hot-mixed asphalt concrete materials. Use of these materials is limited by their availability and the requirement that they be kept at an elevated temperature for a prolonged period of time. To make use of hot-mixed asphalt concrete mixtures, some of the highway districts in the large metropolitan areas of Texas are making use of a "hot box." Automatically controlled burners keep the material at the desired temperature, if necessary overnight. Normal patching crews place the material at a cost of about $50 per ton.

The use of the "hot box" in cold or wet weather is especially beneficial, for the truck-mounted device can heat or dry the repair area prior to patching. Its use will increase in Texas.

Roadside Maintenance

Roadside maintenance operations include truck-mounted spraying, mulching operation, litter removal, and culvert cleanout.

Figure 1. Pavement edge repair.

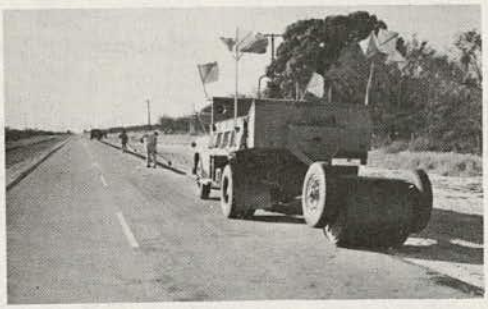

Figure 2. Steel drum roller used to repair pavement edge.

Figure 3. Herbicide sprayer.

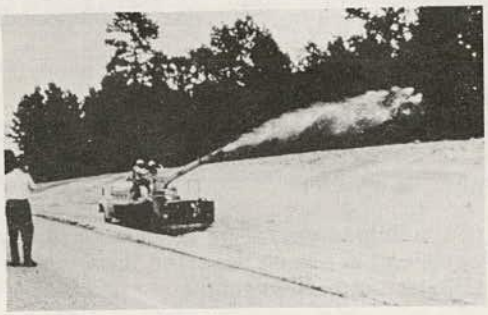

Figure 4. Mulching operation.

Herbicide Spraying—A truck-mounted herbicide spray rig with three spray bar attachments has been used effectively to spray 30 to 50 miles of farm-to-market roadways in an 8-hour day (Fig. 3). One operator is required to perform all duties and, once the operator becomes experienced, this device will have a greater production than a two-man crew using a trailer-mounted unit. Thus, use of this spray rig can reduce costs by 25 to 50 percent.

When spraying around expressway rails and delineator posts, the truck normally travels at 2 to 3 mph. The operator can spray the edges of paved shoulders, flip a master switch, and spray delineators as he passes by. If a hard-to-reach area requires spraying, the operator can reach the area with a hand boom from the truck cab. The boom is equipped with a squirt nozzle. This same boom has been used to spray riprap, culverts, drain ditches, and the like.

Ant beds may be treated by changing to a boom designed for that purpose and by applying an appropriate chemical.

Attachments that have been used successfully with this piece of equipment include curb spraying attachment, pavement edge spraying attachment, delineator spraying attachment, culvert spraying hose, bridge abutment spray hose, right-of-way post spraying hose, and shoulder spraying bar.

Because the operator is away from the spray bars and is not likely to come in contact with the spray materials, operator safety is improved. An amber revolving light and fluorescent flags mounted on high-level stands provide protection for the truck and operator.

Basic equipment on this 1- to 1½-ton stake-body truck includes a 550-gal fiberglass tank, pumps, pressure regulator, tachometer, strainers and filters, and electric control panel. The spray truck should be washed with water daily and with detergent twice weekly as part of a preventive maintenance program. Corrosion-inhibiting agents added to the spray are helpful in reducing equipment maintenance.

Seeding and Mulching Operation—A mechanized seeding and mulching operation that requires an eight- to 10-man crew has been used in Texas (Fig. 4). The area to be planted is cultivated to the desired depth (a recommended minimum of 4 inches), and a mixture of perennial grass seeds and fertilizer is applied with a truck-mounted hydroseeder or other device that distributes the seed and fertilizer in water through a pressure distribution system. The amount of fertilizer (16-8-8 or 16-20-0) depends on local conditions; however, quantities on the order of 400 pounds per acre are common.

The mulch consists of a mixture of hay and emulsified asphalt distributed pneumatically on the seeded area at a rate of approximately 2 tons per acre. Dry hay is introduced into the trailer-mounted mulching machine whereupon it is shredded. An emulsified asphalt is then added to the shredded hay at a rate of approximately 0.05 gallon per square yard to tack the hay to the slope.

The combined seeding and mulching operation is capable of covering 10 acres per day. A limited number of successes have been reported in which the seed, fertilizer, hay, and emulsion have been applied simultaneously.

Litter Removal—Comparative costs of litter removal using mechanized equipment versus hand methods have been obtained in Texas. Two mechanized devices, the "can gobbler" (Fig. 5) and "litter gitter" (Fig. 6), have been employed. Mechanized devices are capable of removing 6 cubic yards of litter during 8 hours of operation at a cost of $12 to $14 per cubic yard. One maintenance man is required for the operation of the mechanized equipment and an additional crew member may be required for traffic control, removal of litter from the mechanized device, and transport to disposal area.

Figure 5. Can gobbler.

Figure 6. Litter gitter.

Figure 7. Fido and his rope trick.

In general, the roadside is not cleaned so well by mechanized devices as by hand picking; however, an acceptable appearance is obtained. Often dead grass and loose rock may be picked up by these devices. They greatly reduce the capacity of the machines and, in the case of one of the machines, create a problem in the litter sacks that must be periodically removed and dumped.

Hand removal of litter with 1-, 2-, and 3-man crews costs $11, $18, and $22 per cubic yard respectively. Production per day for these crews is on the order of 4 to 5 cubic yards of litter depending on the density of the litter. Thus it would appear that, based on data collected in several trial areas of the state, a two-fold savings can be realized under certain situations, depending on the density of the litter.

Culvert Cleanout—Removal of silt and other materials from culverts is a major problem in many areas of Texas. The usual culvert cleaning operation requires stringing cables through these drainage channels and use of scoops or augers to remove the silt. Stringing of cables through these culverts is a major problem. Augering tools were tried with limited success; flooding techniques using blocks of wood to carry the cable were tried but required as many as 3 days to string a cable in a single culvert. Two workers placed only a few hundred feet of cable a day before they employed Fido, a dog belonging to one of the workers. Fido carries the cable through the cramped culverts (Fig. 7) and has increased production to as much as 7,800 feet per day. These cables are now routinely left in the culverts; however, occasionally some are stolen or washed away, and Fido is called on to perform his duties again.

Only on two occasions did Fido refuse to go through a culvert. It is suspected that rattlesnakes take shelter in the cool shady culverts during the summer months.

Maintenance of Structures

Bridge Deck Repair—On several occasions, parts of bridge decks have completely collapsed. These decks must be quickly repaired. A method using fast-setting cements has been developed; traffic can use the bridge in the afternoon following repair in the morning.

The method of repair includes the removal of damaged concrete if it is determined that breakout extends back to sound concrete in all directions. Pneumatic hammers can be used for this operation, and we sandblast to clean reinforcing steel. If it is determined that additional support under the bridge deck is desirable, short sections of 12-in. I-beams can be erected horizontally between beams or girders to support 8-in. longitudinal I-beams, on which ⅛-in. metal plates for bottom deck forms can be supported. If additional support under the bridge decks is not deemed necessary, a metal or wood bottom deck form can be secured to the deck reinforcing bars.

The concrete breakout area should be painted with an epoxy adhesive, and a rapid-setting special cement should be placed. This cement will set within a few hours. Approximately 1 cubic yard of concrete can be placed per day in 56 man-hours of labor.

For repair of smaller areas, certain epoxy materials have been used with some degree of success. This is a rapid repair type of operation.

Bridge Deck Overlay—Asphalt concrete overlays on bridge decks have been utilized in the Dallas-Fort Worth area for a number of years. This overlay system consists of the application of aggregate seal coat to the portland cement concrete bridge deck after areas of destruction have been repaired. The seal coat asphalt may or may not contain a natural rubber additive. The seal coat application is followed by about 2 inches of asphalt concrete overlay. This overlay material contains lightweight aggregate as its coarse fraction and may or may not contain asbestos fibers and rubber as an additive. These overlays have performed exceptionally well since installation in 1968.

CONCLUSIONS

Innovative maintenance materials, equipment, and methods have been briefly described. Detailed information on this operation can be obtained from the Texas Highway Department, Maintenance Operations Division, File D-18, Austin 78701. It is realized that improvement in the methods described in all probability is practiced in several states, and it is hoped that this paper will stimulate an interchange of ideas in all areas of highway maintenance.