PREVENTIVE MAINTENANCE STRATEGY ADOPTED IN FRANCE

A Decade of Research Pays Off

Today more than 300 million square meters of surface dressings are applied each year to all types of roads in France as the result of a major research program initiated by the French Public Works Administration in the early 1970s. The program was designed to improve and extend the use of surface dressings for maintenance of the national road network.

Spearheaded by special groups such as the National Road Equipment Committee, which is made up of contractors, manufacturers, and government representatives who recommend the proper road equipment for the proper use, the research program has resulted in

- A preventive maintenance policy for rehabilitated roads,
- Major improvements in surface treatments,
- Graduate-level training for maintenance engineers, and
- Development of specialized maintenance equipment.

A national road maintenance conference held in 1983 stressed the need to radically rethink regular road maintenance practices for roads carrying light traffic to better understand maintenance costs and train personnel in applying modern maintenance methods. For old, underdesigned highways that carry heavy traffic in freezing climates, four maintenance strategies were discussed:

1. Localized repairs, requiring continual supervision and rapid, frequent, and nonprogrammable repairs.
2. Progressive overlays, involving thick (10 cm) asphalt concrete courses about every 5 years.
3. Rehabilitation, using a pavement design nearly equivalent to a new pavement, followed by preventive maintenance that consists of applying seal coats and asphalt concrete wearing courses.

Widely used in France, the patching truck transports personnel, aggregates and bitumen, and the equipment.

4. Rehabilitation, applying a curative maintenance policy that consists of repairs as defects appear. The initially high level of service decreases and further rehabilitation is required.

Preventive Maintenance Strategy

Preventive maintenance (Strategy 3) was chosen because it relies on strict follow-up of pavement condition, a computerized data bank, and the *Technical Guide to Preventive Maintenance*. The guide is considered to be the tool that allows this strategy to be effectively implemented because it provides answers to three key questions:

- When and where is maintenance needed?
- What job is to be carried out? and
- What is the degree of urgency of the work?

Since the program was implemented in 1972, it has been found that the present serviceability index is inadequate for assessing which roads are to be maintained and in what order. Instead, priorities are set on the basis of warning and intervention thresholds set for various parameters (e.g., bearing capacity, evenness, and skid resistance).

Although maintenance of rehabilitated roads costs about twice as much as maintenance of the same roads before rehabilitation, the preventive maintenance policy eliminates the need for a second rehabiliation program. Timing is crucial. Studies have shown that if structural work is delayed for 2 years, the thickness of the deferred overlay will have to be increased by 50 percent in order to avoid excessive fatigue in the base course.

Improved Surface Treatments

A new generation of surface dressings appeared in the 1980s. The binders used are modified bitumens or rubber bitumens containing little solvent, and the quantity applied may be double that used in the traditional technique. The chips are normally 10/14 coated or spread hot so they adhere well to the viscous binders. Mastics for sealing surface cracks have been developed since 1980. These products are usually applied by the firms that develop them because application is delicate. Surface preparation with heat guns is required to strip the overburden of bituminous concrete, and pretreated industrial microchipping is used. Also, thanks to "antirutting" mix design procedures and tests, rutting of asphalt mixes has not been a problem in France for 20 years, despite hot summers and a 13-ton-maximum legal axle weight for vehicles.

Graduate-Level Training for Maintenance Engineers

In France, graduate engineers selected to oversee maintenance must attend a 6-week advanced university course devoted to highway maintenance. During the next 6 months, they must prepare a special study and then report on some aspect of the maintenance area for which they will become responsible.

In the United States, it is normal practice to assign graduate engineers to oversee maintenance without their having had any formal education in the subject. Highway maintenance manuals exist but textbooks are, for all intents and purposes, nonexistent. An undergraduate civil engineering curriculum offers little information, and the subject receives practically no attention at the graduate level.

The bitumen distributor carries a tank ranging in capacity from 3,000 to 20,000 liters. The binder (bitumen or bitumen emulsion) is transferred from the tank to the road via a distribution spray bar fed by pressurization of the binder.

Specialized Maintenance Equipment

The National Road Equipment Committee has provided acceptance rules for equipment, including the type of work to be accomplished and the requirements the new equipment must meet. The Public Works Administration determines how many tasks are to be accomplished and the needs to be satisfied for each.

Specialized equipment developed includes a traffic cone dispenser that operates at 15 km (9 mi)/hr and can retrieve erect or overturned cones from either side of the vehicle; a mobile lane separator that picks up sections of rigid barrier on one side of the machine and puts down continuous sections on the other side, similarly to an Australian device now used in Oklahoma City; a multipurpose machine for mowing and brush cutting, digging, and other purposes; and a combined distributor/chip spreader/roller.

The automatic chip spreader "sees" painted lines with optical readers and automatically advances, opens, and closes asphalt spray heads and chip spreaders. Accuracy is improved but, above all, productivity is multiplied five times, reducing by 40 to 60 percent the cost per square meter of surface treated.

Finally, efforts to improve quality control have resulted in the development of ingenious field control techniques and sophisticated laboratory instruments. Asphalt distributors provide transverse regularity of sprays with a coefficient of variation of less than 5 percent, even though more than 50 percent of the equipment tested needed adjustment or maintenance of the spray bar to achieve that accuracy. Field control methods, initiated at the beginning of the job, include use of short-lived radioactive tracers, sampling in cupels or boxes, and continuous data collection while the distributor is running.

Chip spreaders are calibrated in the laboratory with an optoelectronic system composed of a light box and an electronic camera with a calibration curve data line array as a sensitive element working at ground level. The signals supplied by the camera are fed to a microcomputer. Average spread rate is determined by a scale installed on a chip return conveyor belt.

This article is based on papers presented at the 67th TRB Annual Meeting by a special delegation from France, Service d'études techniques des routes et autoroutes, coordinated by Michel Ray.