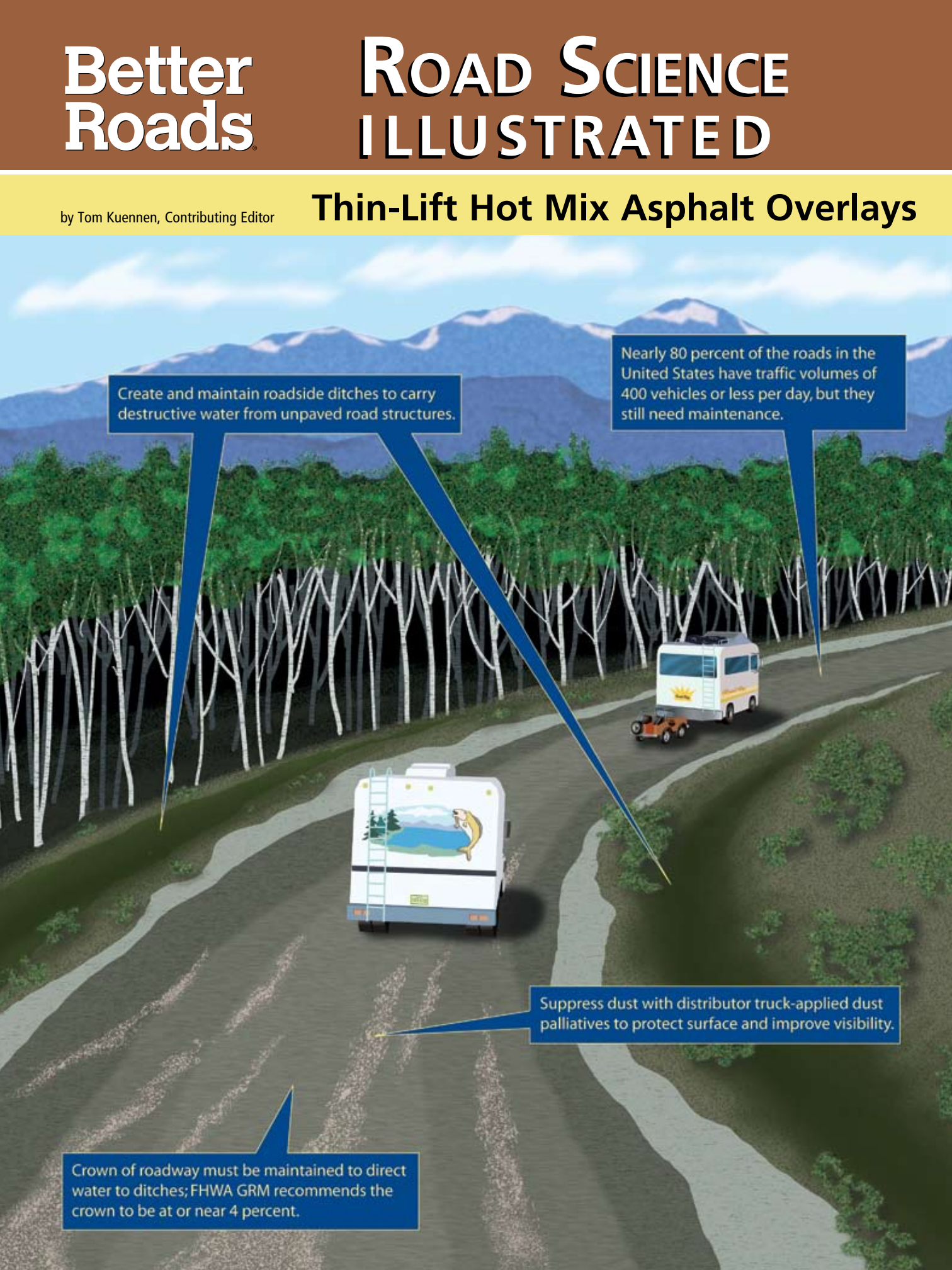


by Tom Kuennen, Contributing Editor

Thin-Lift Hot Mix Asphalt Overlays



Create and maintain roadside ditches to carry destructive water from unpaved road structures.

Nearly 80 percent of the roads in the United States have traffic volumes of 400 vehicles or less per day, but they still need maintenance.

Suppress dust with distributor truck-applied dust palliatives to protect surface and improve visibility.

Crown of roadway must be maintained to direct water to ditches; FHWA GRM recommends the crown to be at or near 4 percent.

Design, Maintain Unpaved Roads to Resist Erosion, Loss of Fines

Two-thirds of the road network system in the United States — and nearly 90 percent of the roads in the world — are unsurfaced or lightly surfaced low-volume roads. While unpaved roads are associated with rural areas, they're not just a rural affair. Unpaved city streets are still seen in the South, and unpaved alleys are found in nearly every municipality.

Unpaved roads may be surfaced with chip seals, gravel, or dirt, but they all need to be designed, constructed, and maintained to resist water and erosion. Erosion can't be eliminated, only tamed. But ironically, lack of water also can hurt an unpaved road — a lack of moisture combined with a troublesome aggregate mix is the cause of washboarding, in which the surface materials fail to cohere and fines are lost from the surface (see adjacent Panel 2).

To drain water into functioning side drainage ditches, gravel or unpaved roads need a higher crown than paved roads. Experts say gravel or unpaved roads generally perform best with a crown at or near 4 percent, as water simply won't drain well off an aggregate surface with only 2 percent. This crown is significantly higher than on-road structures with pavements, but the increased cross-slope is needed to get water into the all-important drainage ditches.

The way non-cohesive gravel moves about the surface of an unpaved road also will slow drainage from the road. Gravel roads will develop a "berm" or windrow of loose aggregate along the edge of the traveled way and that can restrict drainage. This can come from two sources: poor or careless use of a motor grader in maintenance, in which aggregate is lost off the toe of the moldboard, or poor surface aggregate in place, which keeps shifting to the sides of the roadway.

If unpaved roads must serve year-around traffic under all weather conditions, then aggregate surfacing is the best solution. The South Dakota Local Technology Assistance Program (LTAP) recommends a minimum of 3 inches of aggregate,

which won't provide much structural strength, but provides the minimum amount of aggregate for blade maintenance purposes that will permit an operator to shape and work the aggregate without getting into the earth subgrade.

In addition to erosion, the unpaved road manager must fight loss of fines from a road surface. Dust from unpaved roads can cause respiratory problems, enter living quarters, coat vegetation, and reduce visibility throughout distances.

Worse, the more dust that leaves your road surface, the less there is of a road surface that remains. As dust departs, aggregates and other fines loosen, leading to surface problems and costly replacement with new gravel.

Dust can be controlled by periodic distribution of water, by establishment of a dust-suppressive, moisture-absorbing crust on a road surface, and by best management practices.

Water is the traditional dust suppressant. Moisture increases the mass and cohesion of dust particles. Moisture helps fines adhere to each other and to aggregates, allowing for optimum compaction under traffic.

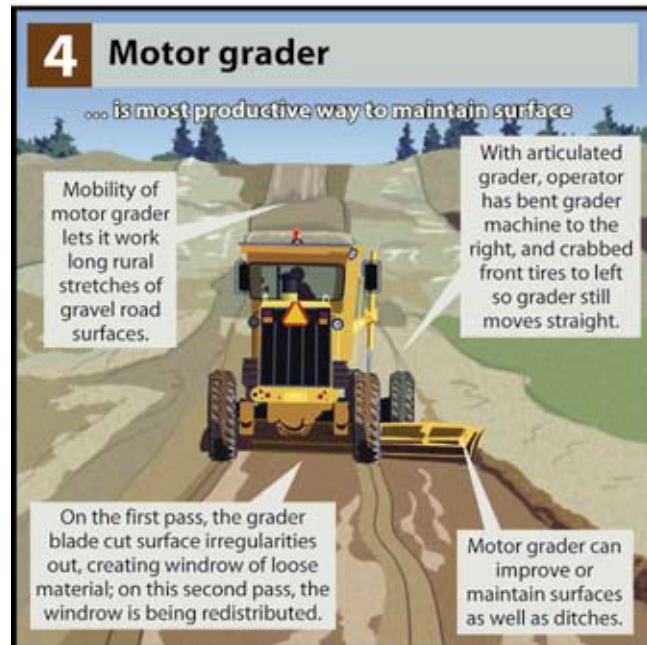
However, there aren't many agencies, if any, that can afford to send water tankers on daily rounds of its unpaved roads. Instead, dust palliatives are an alternative to water. Spread by a distributor truck, they suppress dust on a driving surface, keeping moisture in the road.

Some common dust palliatives, such as liquid calcium chloride (CaCl), absorb humidity from the ambient air, suppressing dust by keeping it relatively damp. CaCl absorbs water vapor from the air and moisture extant in the road structure. At 77 degrees Fahrenheit and 75 percent humidity — common conditions during summer in the Midwest and South — it absorbs more than twice its weight in water. In addition, CaCl solutions attract more moisture to the road than they give up in evaporation. Thus, a treated road surface can retain moisture even during the heat of summer.

ROAD Keeping U



When a gravel road is maintained properly, it will serve low volume traffic well. Too-heavy haul loads will destroy even well-maintained roads, and poor maintenance will lead to fast failures, as shown here.



Operating speed in blading operations must not be excessive, reports the South Dakota Local Technical Assistance Program's Gravel Roads Maintenance and Design Manual. It's almost impossible to do good work above a top speed of 3 to 5 mph, at which time the machine begins to "lope" or bounce, gouging depressions and making ridges in the road surface.

Unpaved Roads In Tip-Top Shape

2 'Washboarding'

... is an aggregate problem, not a grader problem

Washboarding is the result of lack of moisture and the wrong mix of aggregates on the surface.

With washboarding, surface materials fail to cohere in the absence of moisture.

Washboarding is started by the displacement of material by shock absorbers reacting to roughness.

Repetitive oscillation of shock absorbers of many vehicles create corrugated effect.

3 Keep ditches wide and clear

... for optimum drainage

Bank opposite shoulder channels water down ditch.

Shoulders must be shaped to encourage water flow.

It's rare that a road agency has the right-of-way to create a wide-bottomed ditch as seen here "Out West."

A-shaped crown on road surface drains water to shoulder and ditch.

Traffic at high speeds exacerbates washboarding, or corrugation. A good surface aggregate mix will have a higher percentage of plastic fines in the gradation, which in the presence of moisture will give the aggregate surface a "bound" characteristic. The bound surface will mitigate surface corrugation or "washboarding."

This well-shaped gravel road shoulder slopes away from the road surface and drains water into the ditch. But it depends on a road with a good cross-section and crown in driving surface.

5 Excavator indicated

... for badly clogged roadside ditches

Use of an excavator ultimately will require a haul truck.

Both unpaved and paved secondary roads need clear roadside ditches for optimum drainage.

Here a tracked excavator is used, but wheel excavators offer greater mobility.

If conditions are dry enough, and problem not extreme, a motor grader can keep ditches clear instead of expensive backhoe and truck.

6 Dust suppressants

... keep surfaces intact while quelling fugitive dust

Dust suppressants or palliatives such as liquid calcium chloride from distributor trucks absorb moisture from atmosphere to keep surface intact.

As strict PM10 particulate standards are enforced on metro areas, attention is focused on dust from unpaved roads.

Road dust is made up of fine particles that are important to the stability of the road.

Periodic blading of an unpaved road surface several times a year - while needed to maintain a crown and eliminate ruts and holes - has the effect of loosening aggregate and dust.

Clear ditches that become obstructed with eroded soil or detritus. Major projects call for excavators and haul trucks, but maintenance operators can do great things with a simple motor grader, so long as conditions aren't too wet.

A time-proven solution to fugitive dust from roads is use of a palliative or dust suppressant, which forms a hygroscopic - or moisture-absorptive - layer on an unpaved road surface which will suppress blowing dust. These palliatives do more than just improve air quality; they keep your unpaved road literally from blowing away.

ROAD SCIENCE ILLUSTRATED

Voices of Experience

by Ken Skorseth



Skorseth is program manager for the South Dakota Local Technology Assistance Program

Gravel Roads Very 'Forgiving' if Given Chance, Skilled Grader

Gravel roads are very forgiving. I've seen them fail and quickly develop into an unacceptable condition during prolonged wet weather, generally while carrying heavy loads. But given some sunshine, wind, and a reasonably skilled motor grader operator, they can be put back into a passable condition for a fraction of the cost of

failed paved roads.

The dramatic rise in construction costs is forcing many local agencies to delay paving and stay with gravel surfacing. A few agencies are even recycling aging pavements and going back to gravel surfacing if traffic volume is reasonably low. We need to learn more about gravel roads.

What is the perfect gravel road? We may not see it in real life too often, but we can think about it. It would consist of a coarse aggregate base with few fines, 6 to 12 inches thick above a prepared subgrade. The base course would be topped with a surface layer consisting of 3/4-inch top-size stone, a good overall gradation, and an especially good percentage of plastic fines that will allow the material to go into a bound state to carry traffic. The surface layer should be minimum or 3 inches thick.

An important design issue is crown on gravel road surfaces. Generally, a crown of 4 percent on gravel surfaces, which is double the crown used on pavements, is recommended. Water will not drain off an aggregate surface with only a 2-percent crown. This must be addressed in design and construction, and during maintenance thereafter.

I can't overemphasize the need for good surface gravel or aggregate. Good aggregate surfacing mixes differ from base and other construction aggregates. Unfortunately, many state Departments of Transportation do not have a surface aggregate specification, and many of the specs that do exist are quite loose and do not allow close enough control of gradation.

Surface aggregate differs from base aggregate in two fundamental ways: There is a need for more plastic fines, to serve as binder, and a need for smaller top-sized stone that will remain embedded in the surface. Corrugation or "washboarding" is a traffic-induced surface distress that is directly related to surface aggregate specification and lack of fines. This also contributes too excess aggregate accumulating on the surface and at the shoulder line.

by John Rasmussen, P.E.



Rasmussen is county engineer of Pottawattamie County, Iowa

Heavy Loads, Lack of Funding Take Toll on Unpaved County Roads

Many issues that I see in our rural road system are a result of agricultural loads and inadequate funding.

Agricultural loads create a significant problem for rural local government engineers who must

manage low-volume unpaved roads. In the past, more agricultural commodities were used on the farms, and the vehicles needed to transport the commodities were much more modest.

The roads were not intended or designed to carry the loads they now transport when they were built in the 1930s and 1940s. However, these roads are expected to meet today's needs. We try to maintain our roads to meet that expectation because the initial cost of reconstruction is beyond our ability to finance.

The heavy loads chew up our surfacing, rut our roads, and cause a great deal of dust complaints. However, there doesn't seem to be any alternatives for the agricultural industry if it wants to be successful, and we want our farmers to be successful.

We typically work to keep out the potholes and washboards, but in dry weather, they quickly return. Typically, we try to develop the crust in the spring and maintain it throughout the summer. Summer work includes ditch cleaning with a rubber-tired excavator. In the fall, we retrieve the shoulders back into the road surface to reestablish drainage from the crown. Winter snow removal is conducted to provide some bare gravel surfacing in the road centers with some snow left on the sides so we don't blade off as much gravel.

The county has gravel roads, which approach volumes of 500 vehicles per day (vpd) and oil-stabilized roads reach 1,100 vpd, according to a 2004 vpd survey. The oil-stabilized seal coat roads are embargoed for loads in the spring while the frost goes out and the subgrades stabilize. Oil stabilization and seal coat was a popular improvement until oil prices soared.

Funding for the road system is an industry-wide concern. The public demands a higher level of service, yet their demands go unfunded. With inflation, it is becoming increasingly difficult just to cover the maintenance on our existing infrastructure, let alone consider the initial costs of road reconstruction or improvement. We support the agricultural industry, and the heavy loads they carry are here to stay. The funding to support the ag industry and public demand is what is needed.