Maintaining gravel roads

"More than half of the problems with gravel roads result from poor surface gravel, so make sure you use the right gravel."

GRAVEL ROADS need regular maintenance. Heavy rains and local heavy traffic can change surface condition literally overnight. Fortunately, one pass of a motor grader can usually restore the surface.

Restoring the proper crown and using good quality gravel are critical, says Ken Skorseth, a national expert on gravel roads. "Operators also need good technique. Improper maintenance can lead to very quick deterioration, especially in wet weather," he says. Skorseth, who is Field Services Director for the South Dakota LTAP Center, offered his expertise at four gravel-focused TIC pavement maintenance workshops held last March.

Roadway shape

Every road needs a center crown and a cross slope that directs water off the pavement. On asphalt pavements the shape is laid out once, during construction, and stays in place. On gravel roads, the grader operator must re-form the shape every time he maintains the surface.

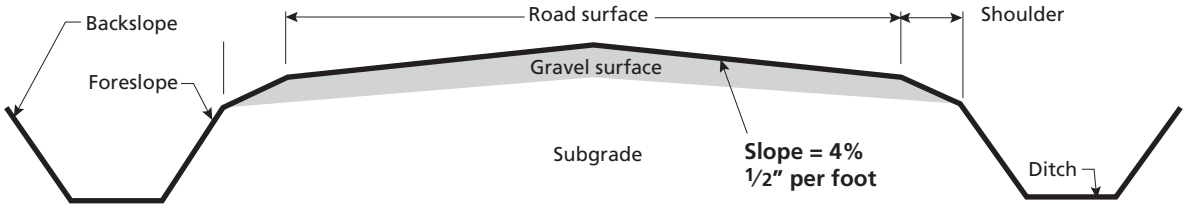
A proper crown keeps the gravel road safe, maintains the strength of its base, and helps preserve the surface condition. The slope on a gravel road needs to be at or near 4% or ½" per foot. On a 24'-wide road this equals a 6" drop in elevation from centerline to edge of the road.

Too little crown lets water stand on the road, causing damage. Too much crown and drivers will drive down the road's center because they are worried about sliding off the side of the road. This increases the potential for a head-on collision. "If you only see two wheel paths on your gravel road, the problem may be excess crown," says Skorseth.

Along the road the slope will need adjustments. At approaches to curves, provide a transition from a crown to a super-elevation – a banked section of roadway. At railroad crossings, bridge decks and intersections, match the slope to existing elevations.

The road surface should transition smoothly to the shoulder and ditch foreslope. Over time, though, secondary ditches can form. Traffic action, snow plowing, settlement, and improper maintenance will cause surface gravel to build up at the edges. This windrow or berm holds back water which softens the surface and forms secondary ditches.

Grade bridge approaches to eliminate potholes and provide a smooth ride on to deck.



Gravel roads need a crown to shed water. Grader operators must reform the shape with each maintenance operation.

Good gravel

"More than half of the problems with gravel roads result from poor surface gravel, so make sure you use the right gravel," Skorseth says.

Gravel that makes a good base course under asphalt produces a bad surface on a gravel road. It is too coarse and porous for use on the surface. Surface gravel needs to form a stable, water-shedding crust on the road. To achieve this, the mix must include 8%-15% fine material. The fines should be clay or a similar material that is both sticky and flexible. This will bind the aggregate together. Also, the stones are smaller — ¾" and under — and at least half should be crushed so the sharp, fractured faces can lock together.

Good surface gravel has smaller stones and more fines.

Percent of gravel passing through sieve by weight

Sieve size	3-inch	1¼-inch	¾-inch SURFACE GRAVEL SPEC
3 inch	90-100	—	—
1½ inch	60-85	—	—
1¼ inch	—	95-100	—
1 inch	—	—	100
¾ inch	40-65	70-93	95-100
⅜ inch	—	42-80	50-90
No. 4 (4.75 mm)	15-40	25-63	35-70
No. 10 (2 mm)	10-30	16-48	15-55
No. 40 (425 µm)	5-20	8-28	10-35
No. 200 (75 µm)	2-12	2-12	5-15

In general, use the "¾-inch" specification for aggregate material in the upper three inches of a gravel roadway; use the "1¼-inch" specification for material for lower layers. The ¾-inch material is easier to shape and will provide a more tightly bonded surface. Although the "1¼-inch" material will give better load distribution, the coarser-sized particles are more prone to raveling.

On any depth less than 5½ inches, WisDOT would call for all ¾-inch material since a minimum depth for a layer is twice the maximum particle size.

Sources ***WisDOT Facilities Development Manual,*** Section 305.2.2.1, and Bruce Pfister, Chief Geotechnical Engineer, WisDOT Technology Advancement Unit.

"When you squeeze a handful of moist surface gravel it will mostly stick together in a ball and your hand will be dirty," says Skorseth.

Grading tips

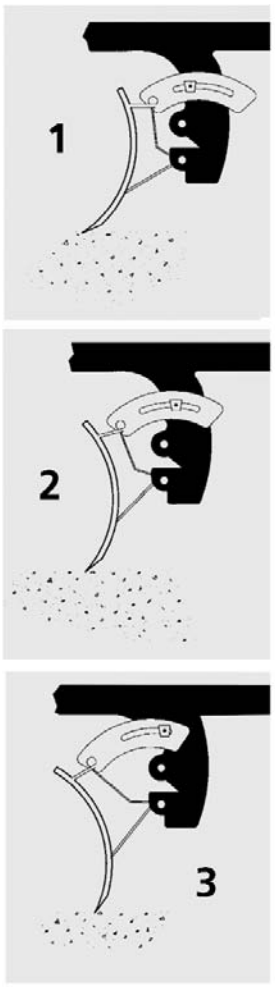
Good grading techniques are essential. Berm material needs to be brought back into the road in the grading operation and the correct cross slope needs to be reestablished. To get a good surface, operators need to manage speed, moldboard angle, moldboard pitch, and equipment stability.

Too much operating speed in blading has caused problems on many roads. When the machine begins to "lope" or bounce, it will cut depressions and leave ridges in the road surface. "It is virtually impossible to do good work above a top speed of 3 to 5 MPH," says Skorseth.

Keep the moldboard at an angle of 30-45° to recover gravel from the shoulder without spilling it off the toe. Operating without enough angle is a primary cause of this spilling.

Adjust the tilt or pitch of the moldboard depending on what you are trying to accomplish. The right pitch ranges from having the top of the blade tilted back for aggressive cutting, to a nearly vertical blade for spreading, to having the top of the blade tilted forward for light blading or dragging. For routine maintenance you want the cutting edge close to vertical. This will produce a light trimming action. Gravel will fall forward, mix, and move across the moldboard to the discharge end.

It can sometimes be hard to keep a machine stable while grading. Too much speed can cause bounce, while having the angle of the blade too similar to the angle of the rear tandems causes "duck walking" — rocking from side to side. "It takes experience to recognize the cause and find the right stability adjustments," says Skorseth.



Moldboard pitch or "tilt" refers to how much the moldboard is tipped forward or backward. The right pitch ranges from aggressive cutting (1), to spreading (2), to light blading or dragging action (3) for maintenance of gravel roads.

You can learn more about maintaining gravel roads and grader operation from video clips, photos, and text developed by Ken Skorseth. See ***Resources*** on page 10 for details.