GRAVEL ROAD BASICS

Good gravel road maintenance or rehabilitation depends on two basic principles:

1. The proper use of a motor grader (or other grading device) and;
2. The use of good surface gravel.

The use of the grader to properly shape the road is obvious to almost everyone, but the quality and volume of gravel needed is not well understood. It seems that most gravel road maintenance/rehabilitation problems are blamed on the grader operator when the actual problem is often material related.

This is particularly true when dealing with the problem of corrugation or “wash boarding”. The problem is often perceived as being caused by the grader but is primarily caused by the material itself.
In order to maintain a gravel road properly, operators must clearly understand the need for three basic items on the gravel road:

• A crowned driving surface.

• A shoulder area that slopes directly away from the edge of the driving surface.

• A ditch.
The shoulder area and the ditch of many gravel roads may be minimal. This is particularly true in regions with very narrow or confined right-of-ways. Regardless of the location, the basic shape of the cross section must be correct or a gravel road will not perform well, even under very low traffic conditions.
Paved roads are usually designed and then constructed with careful consideration given to the correct shape of the cross section. Once paving is finished, the roadway keeps its shape for an indefinite period of time.

Gravel roads are quite different. Unfortunately, many of them are not constructed well initially. In addition, gravel roads tend to rut more easily in wet weather.
Traffic also tends to displace gravel from the surface to the shoulder area and even to the ditch during dry weather. Managers and equipment operators have the continual responsibility of keeping the roadway properly shaped. The shape of the road surface and the shoulder area is the equipment operator’s responsibility and is classified as routine maintenance.
Keeping the fore slope and ditch established and shaped is often the maintenance operator’s responsibility as well. Obviously, the whole idea here is to keep water drained away from the roadway. Standing water at any place within the cross section is one of the major reasons for distress and failure of a gravel road.
When a gravel road is maintained properly, it will serve low volume traffic well. Unfortunately, most gravel roads will fail when exposed to heavy hauls even when shaped properly.
This is due to weak sub grade strength and marginal gravel depths which are often problems with gravel roads. The low volume of normal traffic does not warrant reconstruction to a higher standard.
However, improper maintenance can also lead to very quick deterioration of a gravel road, especially in wet weather. The equipment operators must always work at keeping the proper crown and shape.
OPERATING SPEED

Operating speed in blading operations must not be excessive. This has caused problems on many roads. It is virtually impossible to do good work above a top speed of 3 to 5 M.P.H.
When the machine begins to “lope” or bounce, it will cut depressions and leave ridges in the road surface. Conditions including moisture, material, and sub grade stability vary; therefore, the maximum speed for good maintenance can vary.
However, in virtually any condition, it is difficult to exceed 5 m.p.h. and still do a good job.
Moldboard Angle

The angle of the moldboard is also critical to good maintenance. This angle is fixed on some grading devices, but on motor graders it can be easily adjusted.

The angle should be adjusted between 30 and 45 degrees
Moldboard Pitch
Along with correct angle, it is important to understand proper pitch or “tilt” of a moldboard. If the moldboard is pitched back too far, the material will tend to build up in front of the moldboard and will not fall forward and move along to the discharge end of the blade.
This also causes material loss from the toe of the moldboard. It also reduces the mixing action of the gravel that is desirable when recovering material from the shoulder and moving it across the roadway, leveling and smoothing it in the process.
Crown

Establishing proper crown in the gravel surface probably generates more controversy than any other aspect of good maintenance. How much crown is enough? Can one get too much? What is a recommended crown?
First of all, problems develop quickly when a gravel road has no crown. Water will collect on the road surface during a rain and soften the crust. This will lead to rutting which can become severe if the sub grade begins to soften. Even if the sub grade remains firm, traffic will quickly pound out smaller depressions in the road where water collects and the road will develop potholes. A properly drained gravel road should have a crown.
An operator can also build too much crown into the road surface. This can lead to an unsafe condition in which the driving public does not feel comfortable staying “in their lane” or simply staying on the right side of the road. Because of the excessive crown, drivers begin to feel a slight loss of control of the vehicle as it wants to slide towards the shoulder.
There is an additional risk to driving on gravel roads with excessive crown in regions that experience snow and ice cover. Drivers will tend to drive down the middle of the road regardless of how wide it is.
What then is recommended crown?

Recommendations from supervisors and skilled operators across the country indicate that at least 1/2 inch of crown per foot (approximately 4%) on the cross slope is ideal. It is also recognized that it is virtually impossible for any operator to maintain an absolutely uniform crown. However, try to deviate as little as possible.
There are crown gauges available which can be used to determine existing crown.
Road Shoulder

The road shoulder serves several essential functions. It is there to support the edge of the traveled portion of the roadway, to act as a safety area for drivers to regain control of their vehicle if forced to leave to road surface, and to carry water away from the road to the fore slope and ditch.
In order for the shoulder to perform all of these functions, its shape is critical. First of all, the shoulder should meet the edge of the roadway at the same elevation. In other words, the shoulder should not be higher or lower than the edge of the roadway.
By maintaining this shape, the low shoulder or drop-off is eliminated which is a safety hazard and also reduces roadway edge support. But the other extreme, which is a high shoulder should also be avoided as to not trap water along the roadway edge.
Dealing with Corrugation

The technical term is corrugation, but virtually everyone in the field refers to the problem as wash boarding. This problem can bring more complaints than any other. It is very annoying to the driver and, when it becomes severe, can lead to loss of vehicle control.
It is impossible to deal effectively with this problem if you do not understand the causes. Motor graders are often blamed, but in reality, they seldom cause the problem.
There are three primary causes: the driving habits of people, lack of moisture, and poor quality of gravel.

Driving habits are clearly evident when you see wash boarding at intersections, going up or down steep hills, leading into or out of sharp curves and sometimes near driveways. These are all places where drivers tend to accelerate hard or brake aggressively. This is a major cause of wash boarding.
Lack of moisture will encourage washboard formation and prolonged dry weather can really aggravate the problem.

This is because the crust that forms on the surface of a good gravel road will tend to loosen in dry weather.

This allows the stone and sand sized particles to “float” and the material can easily align itself into the wash board pattern under traffic.
The two causes just mentioned are completely out of the control of the blade operators and managers.

The third primary cause, the quality of the gravel, is one we can have some control over.
Simply put, good gravel must have the right blend of stone, sand, and fines. The stone should be fractured and the fine-sized particles should have a binding characteristic, technically called "plasticity".

This type of gravel resists wash boarding. However, the blade operator must also do their part.
Virtually any gravel will develop some washboard areas under traffic. The key for the maintenance operator is to strive to keep the material blended. In dry conditions, the operator can only smooth the road temporarily.
When moisture is present, it pays to quickly get out and rework these areas.

The material should be cut to a depth of one inch or more below the depressions, mixed and relayed to the proper shape.

If time allows, using the machine to apply wheel compaction to the material will help to reform the crust.

If possible, use of a roller will improve the compaction.
With the best of maintenance, wash boarding can never be completely eliminated.

However, the key to reducing it is to work hard at obtaining quality gravel with a good binding characteristic.

The operator can then reshape trouble spots when moisture is present and most roads will perform quite well.
Conclusion

When proper shape is established and good surface gravel is placed, many gravel road maintenance problems may simply go away and road users are provided the best service possible from gravel roads.