

**H-1 ROAD CONSTRUCTION AND STABILIZATION****PURPOSE & APPLICATIONS**

Most of gravel roads' erosion and sedimentation problems originate with improper construction and maintenance. These erosion problems also create ruts, pumps and potholes that can destroy the suspension of a vehicle or construction equipment.

**CONSIDERATIONS**

Effective drainage is critical to road longevity and stability. Good drainage requires removing runoff from the road surface and preventing groundwater from infiltrating the road base. These two distinct drainage problems require an understanding of the difference between surface water and groundwater.

**Surface Water**

Surface water is water that is flowing or standing on the top of the ground. On gravel roads, the biggest concern is to get water off the road surface as quickly as possible and to direct it to a natural or constructed drainage channel that is capable of handling the flow without eroding. When surface water is not drained off the road, it can lead to washouts, muddy conditions, and potholes.

The following measures are used to help drain water off the road surface:

- a well-constructed road with proper crowning and grading;
- stable road ditches;
- diversions (e.g., water bars); and
- turnouts and buffers that return runoff as sheet flow to natural drainage areas, but well away from any surface waterbodies.

Any road (even properly constructed ones) will alter the natural surface water drainage pattern. The trick is to recognize these changes and to prevent them from causing problems.

**Groundwater**

Groundwater (subsurface water) flows and is stored under the earth's surface. With roads, the biggest concern is to keep groundwater out of the road base. Groundwater in the road base will make it soft (potentially impassable) and susceptible to tire rutting. Ideally, subsurface water should be drained from the road base and directed to a natural or constructed channel capable of handling the flow without eroding. Types of subsurface drainage include:

- Stable ditches that are dug sufficiently deep (below the water table) to drain water from the road base
- A well-constructed road foundation of coarse soil materials (i.e., sand and gravel with few fines to allow subsurface water to drain efficiently).
- And subsurface drains of either pervious (slotted) pipe or permeable soil material.

**SPECIFICATIONS****Road Material**

The specific composition of soil materials used in road construction will make a big difference in terms of performance and durability. Good road material should contain portions of the three basic types of soil that have specific properties that make it best for different aspects of road building: gravel, sand, and fines (silts and clays which are generally comprised of particles too small for the eye to see). Gravel is very durable and drains freely. Sand also drains efficiently. Fines pack and bind well, helping shed water as they do not drain well. Some general guidelines are as follows.

**Road base material** needs to be sturdy and drain freely. The gravel must be somewhat coarser than the road surface material (3"-4" maximum particle size); and have 0 to 7 percent fines (to subsurface drainage). The base layer should be 18 inches or thicker.

**Road surface material** needs to pack well, be durable, and shed water. It should have gravel with a maximum particle size of 2 inches (for a smooth ride) and 7 to 12 percent fines (to pack well and shed water). The surface layer should be about 4 to 6 inches thick. Loose surface material generally indicates a lack of fines. Soft roads are generally indicative of too many fines in the base material, or a base layer that is not thick enough to support the road.

### Alternative Road Surfacing Materials

There are certain situations where a typical gravel surface may not be sufficient to resist erosion or traffic wear such as in areas of steep slopes, sharp corners, or intersections with heavy volumes of turning traffic. Alternative materials generally cost more up front, but can be more cost effective, given their longer life cycle. Alternative materials can also lessen or eliminate some chronic maintenance problems.

**Reclaimed Pavement/Recycled Asphalt:** Reclaimed pavement is old pavement that has been ground up. It looks similar to road gravel, but it is more granular and darker because of the residual asphalt. The most common and effective use of this material is on steep road segments that have had problems with surface erosion. The residual asphalt in this material acts as a binder, which makes it more resistant to erosion.

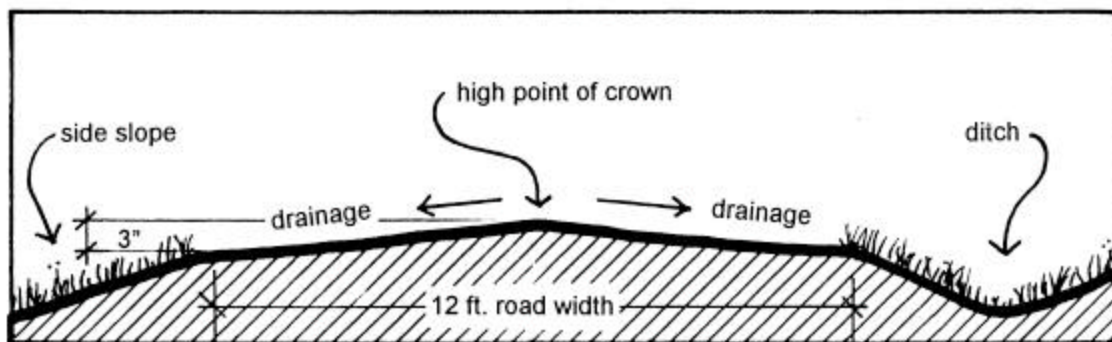
- Reclaimed pavement can be spread in the same way as gravel; no special equipment is required.
- When placing on problem slopes, start from just beyond the crest (top) of the hill and work down.
- The recommended depth is 3-4 inches. Anything less may be prone to erosion.
- Compact the recycled pavement, particularly on areas that are heavily traveled. Compacting with a roller or whacker is preferred.
- Verify the quality of the product before delivery so that it does not contain any waste products such as sheet rock and gravel making it less likely to bind together.

### Road Level

Properly constructed roads are built above the natural ground. This creates a high point, which is essential for effective surface drainage. Unfortunately, many older roads were built by pushing material away from the roadway, resulting in a road surface that is lower than the surrounding land, which is hard to drain and heavy runoff will tend to overflow and run over the road. This type of road is also prone to subsurface drainage problems, because the road base often consists of poor (native) soil materials that may be in the local water table.

### Crowning

Road crowning and grading are the primary means by which surface water is drained off a road surface. To crown a road means to create a high point that runs lengthwise along the center of the road. Either side of this high point is sloped gently away from the center toward the outer edge of the road. Crowning is the quickest way to get water off the road, preventing significant erosion of the road surface.



**Crown profile:  $\frac{1}{4}$ " of crown per foot of road width (e.g.,  $\frac{1}{4}$ " x 12' road = 3" crown).**

An insufficient crown will allow water to puddle on the road surface creating potholes or eroding the road surface. The potholes will continue to grow each time a vehicle splashes through them, resulting in the loss of fine clay particles that are necessary for a good road surface. Standing water will also seep into the roadbed, weakening the road and making it susceptible to tire rutting. Proper grading will prevent potholes from forming and provide a safer surface for travel. A general rule for level or gently sloping gravel roads is ¼-inch of crown per foot of total road width. A crown of ½-inch per foot of road width may be necessary for steeper sections to counteract the tendency of water to travel downhill over the road surface. Crowns greater than ¾-inch per foot are not generally recommended, as they can be difficult to maintain and difficult to drive over. Crowning should be done annually on gravel roads because snow plowing and normal use flattens the road over the course of a year.

### **Grading**

Grading is the process of smoothing and crowning a gravel road using a grader with a steel cutting blade to redistribute soil material. The grader is the most frequently used piece of equipment for general gravel road maintenance. It can be very versatile when used by an experienced operator.

In general, roads receiving heavier use will require more frequent grading. Trucks carrying heavy loads will flatten the crown and create wheel ruts much faster than typical passenger vehicle traffic. Cars traveling too fast will blow away light soil particles from the road surface causing wash boarding.

Regular grading of gravel roads or shoulders is an effective means of removing and redistributing ridges of road winter sand or material that has either been washed to the road edge or has been pushed to the edge by vehicle traffic. These little ridges will catch water before it can drain off the road, channeling it along the outer edge of the road surface potentially causing severe damage to a road surface during periods of heavy rain.

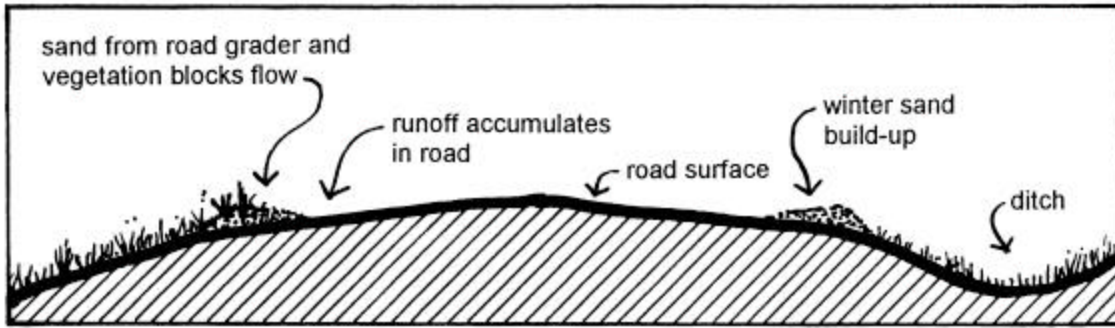
- Always make sure that water can get off the road by smoothing the edge of the road with the grading blade.
- Usually, gravel roads are regraded by scraping this material from the outer edge of the road, and pulling it back into the center.
- Bulldozers are not generally recommended for road grading as they tend to flatten the crown, which restricts effective surface drainage.
- Proper grading is also the most effective means of removing potholes. The grader should cut to the full depth of the potholes. Otherwise, they will tend to reform very quickly.

Grading is typically done at least once a year on seasonal roads and more often on year-round roads. The best time to grade a road is when the road is moist (in the spring, or after a rain). Water helps to loosen the gravel and fines and makes the road easier to reshape.

**Steel Tine Rake:** One affordable and effective piece of maintenance equipment is a steel tine rake, or York rakes. This device consists of a row of strong metal tines that work in much the same manner as a grader blade. It is made to be towed behind, or mounted in front of a pickup truck or tractor and can be used to:

- Remove potholes and washboarding;
- Maintain or establish proper road crown;
- Remove ridges of road material or vegetation from the road shoulder; and
- Mix road materials to achieve proper distribution of particle sizes.

### Sand and vegetation build-up prevent drainage to side of road



### **MAINTENANCE**

Effective erosion control and maintenance can be best accomplished by:

- Monitor and maintain the road on a regular basis. The best time to inspect a gravel road is on or following a rainy day.
- Thoroughly plan the construction and maintenance before starting the project.
- Keep runoff velocities slow
- Avoid concentrating runoff (promote dispersion).
- Discharge stormwater runoff into vegetated areas.
- Minimize areas of exposed soil on side slopes and ditches
- Stabilize and cover bare soils with vegetation or other protection (i.e., mulch or riprap).

Keep in mind that refilling a road that continues to wash out is a waste of time and money and does not effectively address the problem. Effective maintenance should prevent or minimize recurring problems.