Gravel Roads Maintenance and Design

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Module 1: Routine Maintenance and Rehabilitation

Learning Objectives

By the end of this section, you will be able to:

- **Identify** the three essential components of a stable gravel road cross section.
- **Evaluate** motorgrader settings (angle, pitch, and speed) to optimize surface mixing and prevent road loping.
- **Select** appropriate rehabilitation strategies for secondary ditches, corrugation, and weak subgrades using geosynthetics.

Executive Summary: The performance of a gravel road is dictated by its ability to shed water. Proper routine maintenance requires the simultaneous preservation of a crowned driving surface, a functional shoulder, and an effective ditch system.

Understanding Road Cross Section

Maintaining a gravel road requires a fundamental understanding of the right-of-way geometry. Regardless of local right-of-way constraints, the basic shape must be correct to ensure performance under even low traffic volumes.

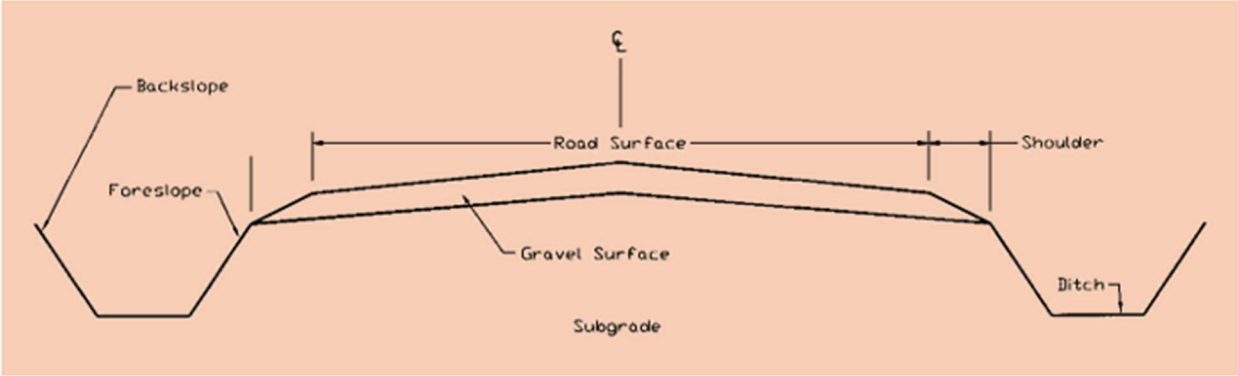

Figure 1: The components of the roadway cross section.

The Three Essentials of Maintenance

- **Crowned Driving Surface:** Facilitates immediate runoff from the centerline.
- **Sloped Shoulder:** Moves water away from the edge of the driving surface to the ditch.
- **Ditch:** Collects and carries water away from the road structure.

Unlike paved roads, which retain their shape for long periods, gravel roads are dynamic. Traffic displaces material, and wet weather leads to rutting. The equipment operator has the continual responsibility of keeping the roadway properly shaped to prevent standing water, which is the primary cause of road failure.

This road, located in Poland, has very poor cross section with no ditches. Consequently, water drains down the roadway itself and after many years of erosion, the roadway is several feet lower than its original elevation. (Courtesy of Mary O'Neill, Office of Remote Sensing, South Dakota State University)

This well-traveled road in Ecuador performs well in a region that receives approximately 200 inches average annual rainfall. (Courtesy of Ron Anderson, Tensar Earth Technologies, Inc.,USA)

Example of a gravel road with good shape of cross section. Notice crown in driving surface and proper shape of shoulder and ditch.

An example of a well shaped gravel road shoulder that slopes away from the driving surface and drains water to the inslope and ditch.

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Routine Shaping Principles

The motorgrader is the primary tool for shaping, though tractor attachments and road rakes are also utilized. The following operational parameters are critical for effective maintenance:

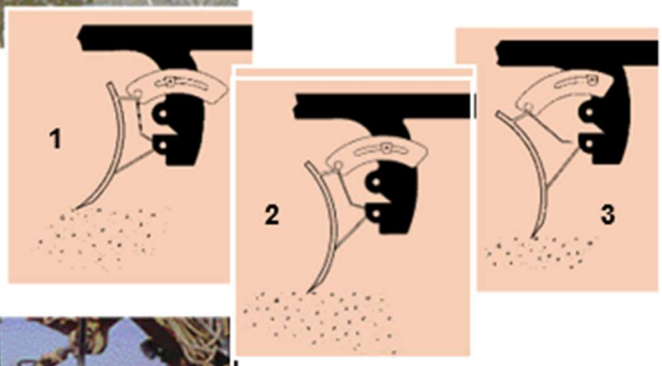
Operating Speed

Speed is the most common factor in poor blading results.

- **Recommended Range: 3 to 5 mph**.
- **Impact of High Speed:** Exceeding 5 mph causes the machine to "lope" or bounce, cutting depressions and leaving ridges in the surface.

This is an example of poor use of the grader. The moldboard is pitched back too far and is not angled enough.Notice the gravel builds up and does not fall forward to give a good mixing action.Also, the loss of material from the toe of the moldboard will create a high shoulder, which destroys good drainage across the shoulder to the ditch.

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.



This is the other extreme of pitching the moldboard too far forward.The material will not roll across the face of the moldboard and does not mix.In addition to this, the cutting edge will not easily penetrate a hard surface, making it hard to trim out even light depressions in the road surface. It simply tends to skip along the surface with no real benefit.

The distortion that was cut into this road surface is the result of operating a motorgrader too fast. The angle of the depressions which match the angle of the moldboard reveal this.

Moldboard Angle

- **Target Angle:** Between **30 and 45 degrees**.
- **Application:** Correct angling ensures material rolls and mixes across the blade. Insufficient angle causes material to spill around the leading edge (toe), creating high shoulders and destroying drainage.

Moldboard Pitch (Tilt)

Pitch refers to the fore-and-aft tipping of the moldboard.

- **Aggressive Cutting:** Pitched forward to penetrate hard surfaces.
- **Mixing/Spreading:** Vertical or slightly pitched back to allow material to fall forward and roll across the face.
- **Warning:** If pitched back too far, material builds up and does not mix, leading to stone separation and excessive material loss at the toe.

Notice these examples of good pitch and angle. The gravel falls forward and moves across the moldboard very well. The cutting edge is close to vertical from the road surface, which makes a nice light trimming action for routine maintenance, and the angle is good,not allowing material to spill from the toe of the moldboard.

from the shoulder of the roadway with-out spilling material around the leading edge (toe) of the moldboard. Operating without enough angle is a primary cause of this spilling.

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.

Purchase this course to see the remainder of the technical materials.