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Preventing and Correcting Corrugated Gravel Roads

Corrugated gravel roads generate more complaints than any other condition. Even a shallow "washboard" creates a bumpy ride. More severe corrugations can reduce driver control of vehicles.

Washboarding occurs when the surface gravel has too few "fines." These tiny particles will pass through a screen with 200 openings per square inch. They bind the larger particles together to distribute and support vehicle loads. With too few fines, vehicle tires easily move the larger particles into the washboard pattern shown here. Corrugated roads occur due to four factors.

1. Vehicle speed and related driving habits.
2. Vehicle volume.
3. Poor gravel quality.
4. Lack of moisture.

Vehicle speed, acceleration, and braking are the greatest causes. Of course, changing the public's driving habits is unrealistic. However, cities and towns can minimize the affects of vehicle volume, gravel quality, and moisture. This article will describe ways to control these factors.

Vehicle Volume

The NHDOT recommends a gravel wearing surface for new roads with less than 50 ADT (average daily traffic). The UNH T² Center recommends the NHDOT minimums for existing roads. Cities and towns should pave roads above 200 ADT. They should apply an asphalt surface treatment on roads between 50-200 ADT. Above 50 ADT, it becomes increasingly expense to maintain gravel roads adequately.

Gravel Quality

High quality gravel is a "graded" blend of stone, sand, and fines. Table 1 shows the recommended gradation by weight for both the base and surface courses. The base is NHDOT Specification 304.3 with a 2 inch maximum size. All surface course stones should pass the ¾ inch sieve. The surface gravel should have 10-15 percent fines.

Graded gravel greatly reduces washboarding, and the related maintenance expenses. Cities and towns should specify the Table 1 gradations and test materials.

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Table 1. Recommended Gravels		
Sieve Size	Base Course % passing	Surface Course % passing
2 inch	100	---
1 inch	55-85	
3/4 inch	---	100
No. 4	25-70	50-78
No. 8		37-67
No. 40	---	13-35
No. 200 in sand only	0-12	---
No. 200 in total	---	10-15
Plasticity Index	---	4-12

The stones provide strength. In the surface course, they transfer vehicle loads to the base course. In the base, stones support the load, and are therefore larger. Too much stone compacts poorly, allowing stones to move between wheel tracks and onto shoulders.

In the surface course, adequate fines form a crust on the surface. Too many fines can make a road slick in wet weather. The plasticity index (PI) ensures good binding characteristics. Fines with low PI will loosen and quickly erode.

Gravel pits have rounded stones, and few have graded aggregates. Crushed gravel performs better than natural, round stones. Blended, crushed gravel compacts into a dense, tight mass with an almost impervious surface. If a municipality uses native materials, it should test it and determine what is lacking. It should then mix clay or stone as needed for properly graded gravel.

Just blading and/or filling depressions remove washboarding for only a short time. Crews must add gravel for long term correction. Adding gravel is especially important if depressions are in the base course. A minimum surface course is 3 inches thick.

Before adding gravel, crews should cut and rework the existing surface. A grader should cut the existing surface to a depth 1 inch or more below the bottom of depressions. The grader then mixes new and existing materials and gives the road a proper crown and shape.

Crews should add gravel and grade corrugated roads with good moisture. Whenever possible, they should work on problem areas after a good rain.

If graded gravel is hard to obtain, crews should add the best materials on the trouble spots and use regular materials on the rest of the road. They can also improve gradation by pulling materials from shoulders and mixing it with the surface gravel. The end product will seldom be the best material, but it provides temporary benefits.

Some towns have successfully used a 50/50 mix of recycled asphalt and new gravel. The asphalt works as a binder, which resists washboarding. The mix should have a compacted depth of at least three inches.

Moisture

Even if the surface initially has adequate fines, wind and water will erode them off the road over time. In dry weather, wind quickly removes large quantities of "dust." On hills, or if the cross section is too steep, water erosion can be problematic.

Hauling and spreading water is usually expensive. Many find it cost effective to treat the gravel with calcium or magnesium chloride. These products pull moisture from the air and create a hard road surface. They work best if the gravel is well graded.

Conclusion

A corrugated road indicates that city or town managers need to take one or more of the actions described above. The most common needed action is to add graded gravel. Applying calcium or magnesium chloride is usually cost effective. Perhaps they should surface treat or pave the road.

Some will see these as expensive actions. In the long term, alternatives are more expensive.

Sources:
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