On The Road

By Norm Bowers, Local Road Engineer

Gravel Road Washboards

Spring is the season for potholes in our gravel roads, but the summer is approaching and in Kansas summer is the season for washboards. Like potholes, we are always going to have trouble with washboards unless we keep people from driving our roads. All country people know about washboards, but for the city folks let me explain. Washboards are uniform undulations in gravel roads; they are usually the full width of the main travelled section and are perpendicular to the direction of travel. Washboards are a worldwide problem on gravel roads. In some places they are called corrugations, corduroy, ridges, or ripples. In Kansas the common word is "washboard," named after the corrugated area of an old laundry washboard. Those of you younger than 60 may not remember the laundry washboard so it is shown in Figure 1.

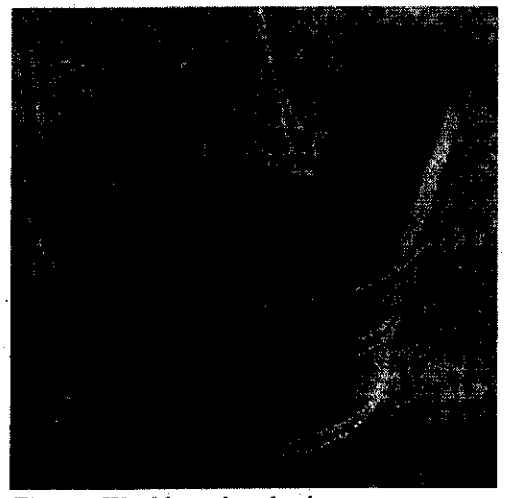

Figure: Washboard and tub

Washboards are actually similar to waves with valleys and ridges. In wave terminology the height from the crest to the bottom is the *amplitude*. The distance from crest to crest is the *pitch*. The amplitude can be as much as 3 inches and the pitch is usually 7 to 12 inches. Figure 2 illustrates the wave characteristics.

Some people think that the blade operator causes washboards by blading too fast, which causes the grader to bounce. A grader operator cannot cause washboards as a grader cannot bounce that fast, and most washboards are near intersections where the grader goes the slowest. Sometimes it looks like the grader operator caused the washboards because he did not cut them all the way out and they reappear the next day.

Actually the cause of washboards has been studied quite extensively. Washboards are caused by the repeated small horizontal forces from the tires interacting with the surface of the road. The most common location for washboards is near intersections where traffic frequently starts and stops. This starting and stopping imposes horizontal forces on the gravel and will start dislodging particles resulting in washboards. Other common places are curves and up steep hills where tires exert more horizontal force on the road surface. A gravel road with a very high traffic count can develop washboards along the entire length of the road.

Although driving characteristic like speed and rapid starts and stops cause washboards, drivers usually blame the road agency for the problem. This is challenging as drivers do not like washboards, so washboards become a public-relations problem. Washboards do cause some personal discomfort and loss of driving control while bouncing over the washboards. So the real key to stopping the resulting vehicle damage would be drivers slowing down, and since this is unlikely to happen, it is important to learn how to limit washboards.

Washboards are more prevalent in dry weather for two reasons. First, we don't have moisture to make blading the road effective so there are longer periods of time between blading for tires to form the washboards. Second, during dry weather the road surface dries out and does not have moisture to hold the particles together, which makes it easier for the abrasion of the tires to displace material. Some washboards are inevitable, especially during dry weather and on high traffic roads. But if your agency has more than your share of washboards there may something you can do about it.

The first thing to consider is the material on the road surface. The surfacing has to be cohesive when dry. For dry cohesion we need fine clay like particles or a chemical. In the east where we use limestone for surfacing some

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of the pure limestone doesn't have enough clay. For limestone we don't want any clay in base rock, but we need a little in road rock, at least where we have washboard problems. Usually the browner rock, which may be caused by a little overburden mixed in, will be better near intersections than what we usually think of as good rock. The measure of the cohesiveness of fines in limestone is the plastic index also called P.I. If you have your rock tested usually a P.I. is included. For road rock we should be in the 5-12% range. For base rock we don't want clay as it will be somewhat spongy and the P.I. should be 0-6%. We also need adequate fines for cohesion and for those of you familiar with gradations we should have 5-15% passing the 200 sieve. The material passing the 200 sieve is the dust that we test the P.I., and is material smaller than 1/200th of an inch.

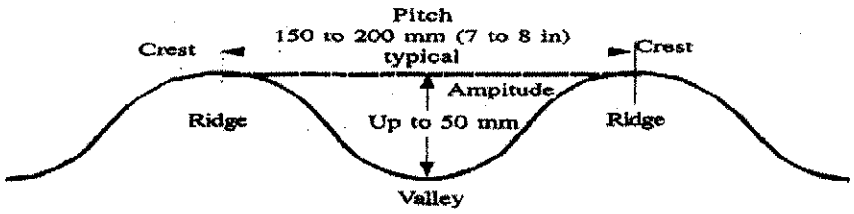

Figure: Shape of washboards

Sand roads seem to have many more washboards than gravel roads. There are two reasons for this, western Kansas, where it is drier, is where we predominantly have sand. Also there is not much clay in sand to bind the material together. If you test the material, the percentage passing the 200 sieve and P.I. needs to be the same as for crushed rock. Most pit sand will not meet these specs as it lacks the real fine material. Mixing caliche or white rock with sand adds the needed fines and clay to make the sand more cohesive in dry weather. Most counties mix the caliche and white rock by seat of the pants method based on experience rather than testing.

There are some chemicals that will make the surfacing more stable during dry weather. Calcium chloride and magnesium chloride hold moisture which helps dry weather stability. There are some patented enzymes that seem to cement the particles together. These chemicals need to be mixed into the top few inches to work properly for washboards. All these chemicals need adequate material passing the 200 sieve to work properly, so it's a good idea to test the amount of material passing the 200 sieve and then check with your supplier before spending a lot of money. I am not an advocate of chemical additives, but they do have a role, especially in problem areas.

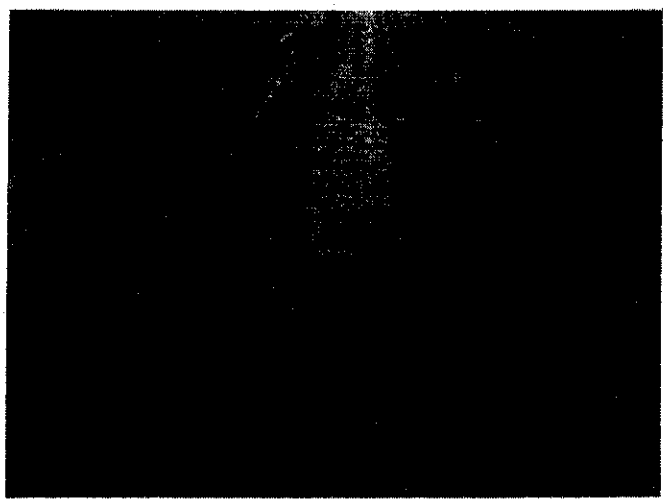

Figure: Washboards with water

Once the washboards are developed they are hard to fix, and water is a must for recompaction. Cutting out the washboards in dry weather just results in a lot of loose material and dust. Cutting off the tops and windrowing the loose material works a little better, the depth of the washboards are at least reduced for a while, but they will redevelop. The only real cure during dry weather is to cut out the washboards clear to the bottom of the valley, adjust the gradation and P.I. or add chemical then water and recompact. The cure is a time-consuming process, and with limited staff may not be possible except at the worst locations.

Prevention of washboards is always the best approach. If the washb6oards are not too deep, sometimes right after a rain a blade can rough up the surface and let traffic recompact it. Bullet blades work the best for this though there has to be adequate moisture in the surfacing, so the time after the rain is really critical.

We will always have a few washboards. But if they are a major issue it would be a good idea to experiment on what works best with the available materials in your area. ■

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