Rutting: Causes, Prevention, and Repairs

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Rutting is a term for when permanent deformation or consolidation accumulates in an asphalt pavement surface over time; this is typically shown by the wheel path being engraved in the road. Asphalt roads are considered flexible, and this can be shown during summer months when the binder on the surface of older asphalt roads begins to stick to the bottom of shoes. Rutting occurs because the aggregate, and binder in asphalt roads can move. One might compare it to the tracks the wheels of a wagon might leave if one were to pull it through dirt; however, the vehicles riding on the road are not the reason for why rutting occurs.

IDOT has standards on asphalt pavement design, and construction to prevent rutting in most cases that an engineer might encounter in the state. Rutting can be caused by lack of compaction, insufficient pavement thickness, and weak asphalt mixtures (Walker). Specifications require that asphalt roads be constructed in a way such as to prevent rutting, and other deficiencies. These specifications can regulate construction such as, how the asphalt is rolled, the thickness of base, or the aggregate content in the hot mix asphalt (HMA). Through these specifications IDOT ensures that the public receives quality asphalt roads by stating a required minimum thickness of the subbase. When it comes to pavement thickness typically rutting occurs when the subbase is insufficiently thick or soft allowing for the material to be depressed. Keeping to a stiffer, stronger subbase is the key to reducing the chances of rutting occurring. Subbase is very important to road systems as it provides the support for which the road is built

on. This is why the design procedures set by IDOT must be followed, and the construction process should also follow the plans given by the engineer.

To construct a quality road that rutting will not occur in, the pavement must be monitored for quality control. Administration of the weight, and number of passes of the roller over a section of asphalt play a major role in ensuring the quality of the asphalt surface. Still uncommon but a growing practice is to use a combination of a GPS system, and sensors in the roller that tracks the path that the roller takes so that the number of passes can be kept track of. With the traditional method, passes are missed often resulting in sections of roads having never received the compaction that they were intended to obtain which often makes the risk of rutting in that area nearly inevitable. The typical range that a roller needs to pass over a HMA section is 3-4 times to ensure that the road is compacted effectively. This can be tough to achieve within the short period of time it takes for the asphalt to cool down. As temperature of the HMA decreases the potential for the aggregate to compact is lost (Smith, 2018). The temperature of HMA needs to be rolled roughly between 175 to 320 degrees Fahrenheit (Best). Temperature requirements during compaction is a major contributor to surface degradation, rutting included. The compaction that is not carried out during construction causes settlement in the subbase that ultimately causes the rutting. Though time is strenuous, contractors need to make sure to be thorough in the compaction process to avoid high risks of surface degradation and rutting. By

employing GPS, and temperature sensing technology inconsistent compaction may become a problem of the past therefore reducing the likelihood of rutting in future roads.

Another cause of rutting for asphalt roads is a poor asphalt mix. What really happens when a car drives over a road that is forming rutting is the mix lacks the internal strength to resist permanently deforming under the stress imposed by the loaded vehicle tires (Under). Rutting usually does not occur immediately, but as more cars drive over the asphalt, the asphalt continues to get depressed under the tires, and pushed out along the sides of the tire. In order to combat this more aggregate, particularly fine aggregate can be added which will increase the friction within the mix (Preventing). Additionally, angular aggregates can be used which are known to have more resistance to rutting. If excess asphalt is contained in the mixture the mix will be more prone to rutting. It is necessary to keep the measurements sharp and precise to cut back on the risk of adding excess asphalt. Thorough mixing of the HMA is also necessary to ensure that some sections of the road don't receive higher and lower concentrations of asphalt aside from the design mix. Finally, stiffer asphalt binders plays a role in resisting rutting during high temperatures. The necessary asphalt binder is usually selected off the grade performance table provided in the superpave mix design process (Superpave). If a binder is selected for a temperature above the actual recommended grade, then rutting will almost certainly occur for the pavement in that area. Accordingly, use the recommended grade binder to reduce the chances of rutting occurring.

Hazardous conditions on roads can occur because of rutting. The depressions are known to hold water, and can cause hydroplaning, increasing the chances of vehicular collisions. The costs of replacing roads that have developed ruts also showcases an economic loss. Repair of roads that have had rutting, due to the various reasons, usually involve cutting into the section of road and replacing it (Preventing). In some cases, replacing the road alone is not enough, requiring the replacement of the subbase too, which can be a hefty expense. Replacing the pavement won't do anything if the subbase is still insufficient or the mix inadequate, being insufficiently thick or soft. Combine rutting with other problems such as potholes, or cracking, and asphalt pavements can accrue substantial maintenance costs.

Although, some of the causes of rutting can be prevented with good construction practices, settlement will probably continue to play a part in causing rutting well into the future. Even with the breakthroughs in compaction technology, rutting will likely continue to be a challenge that engineers face into the future. With improved industry standards, quality control, and technology, the roads of the future might one day be, roads without ruts.

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