

## Straightedge - Pavement Application (SE-P)

### Target of Investigation

A straightedge is employed to measure the magnitude of rutting on asphalt pavements.

### Description

Rutting is vertical depression along the wheelpath of a pavement surface. It is caused by permanent deformation of the pavement surface or the subgrade under the traffic load. Ruts filled with water can cause hydroplaning. They will also affect ride quality when a vehicle is moving laterally in a lane or changing lanes because ruts tend to pull the vehicle toward the rut path. A straightedge (figure 1) can be used to measure the magnitude of rutting in millimeters, so that action can be taken when the rut depth exceeds a certain level.



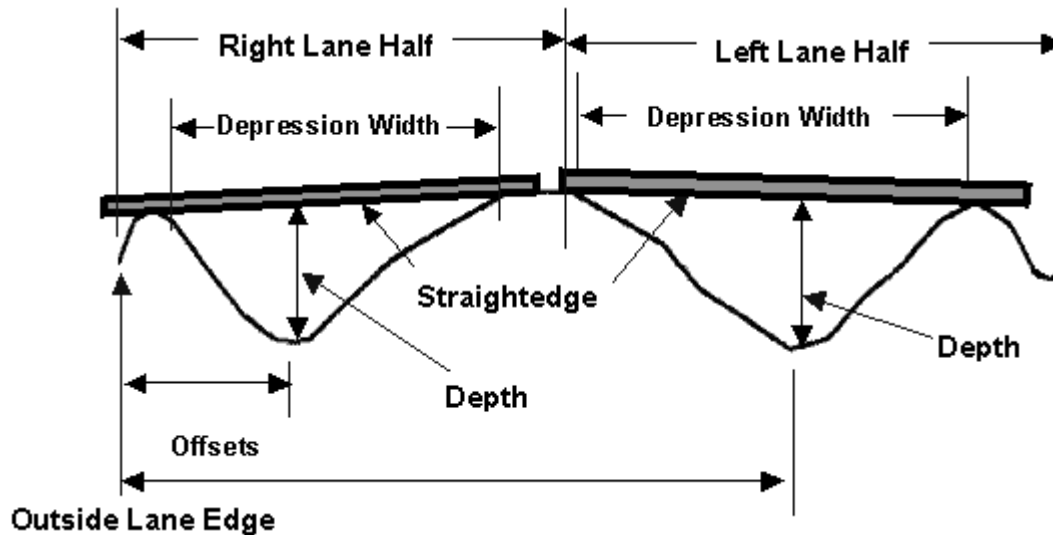
Source: FHWA.

Figure 1. Photo. Straightedge on a rutted asphalt pavement.<sup>(1)</sup>

*This photo shows a straightedge lying across two ridges, one on each side of a rut. A gap exists between the pavement surface at the bottom of the rut and the straightedge.*

### Physical Principle

The common method of measuring the magnitude of rutting on asphalt pavements is to place a 3- to 4-ft (0.9- to 1.2-m) straightedge across the wheelpath to measure its maximum rut depth. The straightedge works as a reference (figure 2). A tape measure (or ruler) is used to measure the maximum vertical distance between the pavement surface and the straightedge. The straightedge should be positioned at various locations on each half of the lane until the maximum displacement is found.



Source: FHWA.

Figure 2. Illustration. Measuring rut depth based on straightedge reference.<sup>(2)</sup>

This schematic is a two-dimensional, cutaway view of a lane in the transverse direction. The lane has two depressions (i.e., ruts): one on the left half of the lane and the other on the right. Each rut has a straightedge across it; the straightedges almost meet at the high point in the center of the lane. The depths of the ruts are the vertical distances from the straightedges to the bottoms of the ruts. The distance from the depth of each rut to the outside edgeline is labeled as the offset.

## Data Acquisition

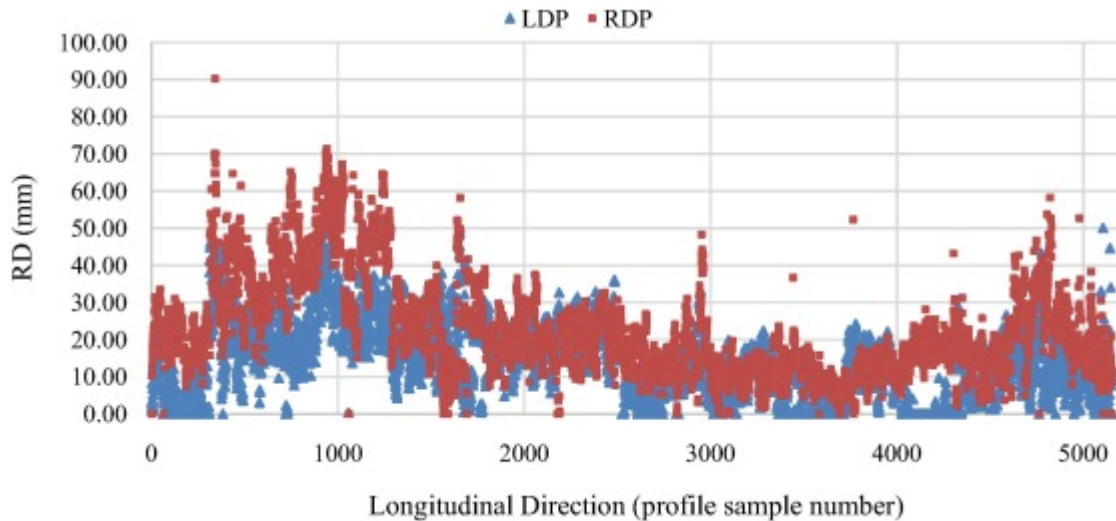
ASTM E1703/E1703M-10, *Standard Test Method for Measuring Rut-Depth of Pavement Surfaces Using a Straightedge*, lists the procedures for using the straightedge to measure rut depth.<sup>(3)</sup> The straightedge is placed across the rut in a plane perpendicular to the direction of traffic movement. The straightedge is allowed to rest upon the pavement at two contact areas such that sliding the straightedge along its length in both directions does not change the contact areas on the pavement. The bottom surface of the straightedge should be parallel to the longitudinal slope of the pavement. The measuring gauge is placed perpendicular to the reference plane created by the bottom of the straightedge and perpendicular to the longitudinal slope of the pavement. The bottom of the gauge should be in contact with the pavement at the time of measurement. The straightedge or gauge should not be placed on any discontinuities, such as potholes or loose debris, on the pavement surface. After the gauge has been placed, the distance between the bottom surface of the straightedge and the pavement is measured. A sufficient number of measurements should be made along the straightedge to determine the greatest distance between the straightedge and the pavement. Greater intervals between successive straightedge placements produce less precise results.

## Data Processing

Little data processing is needed. Statistical analysis can be performed for the road segment to decide if corrective actions are needed.

## Data Interpretation

The data are usually presented in tabular format. A rut depth larger than a certain value indicates heavy distress. Rut-depth data could also be presented in a graph (figure 3).



© 2016 Shi Qiu. LDP = left road pavement; RDP = right road pavement; RD = rut depth. 1 mm = 0.039 inches.

Figure 3. Graph. Longitudinal profiles of rut depths on US 65 North.<sup>(4)</sup>

This graph depicts rut depth data from US 65 North. The x-axis is longitudinal direction (profile sample number) and ranges from 0 to 5,000. The y-axis is rut depth in millimeters and ranges from 0 to 100. There are two plots on the graph. One plot is data from the left half of the lane, and the other plot is data from the right half of the lane. The graph depicts high rut depth for the sample numbers around 1,000. Generally, the rut depth of the right half of the lane is slightly larger than the rut depth of the left half of the lane.

## Advantages

Advantages of straightedges include the following:

- Low-cost equipment.
- Simple data collection and processing.

## Limitations

Limitations of straightedges include the following:

- Measurement is not continuous along the road.
- Traffic control and lane closure may be required.

## References

1. Miller, J.S. and Bellinger, W.Y. (2014). *Distress Identification Manual for the Long-Term Pavement Performance Program*, Report No. FHWA-HRT-13-092, Federal Highway Administration, Washington, DC.
2. Elkins, G.E., Schmalzer, P., Thompson, T., and Simpson, A. (2003). *Long-term Pavement Performance Information Management System Pavement Performance Database User Guide*, Report No. FHWA-RD-03-088, Federal Highway Administration, Washington, DC.
3. ASTM E1703/E1703M-10. (2015). "Standard Test Method for Measuring Rut-Depth of Pavement Surfaces Using a Straightedge." *Book of Standards 04.03*, ASTM International, West Conshohocken, PA.
4. Qiu, S., Han, Z., Wang, W., Wang, K.C.P., and Zhang, Z. (2016). "Application of AASHTO PP69-10 & PP70-10 based continuous rutting depth data." *International Journal of Pavement Research and Technology*, 9(1), pp. 37-48, Elsevier, Amsterdam, Netherlands.