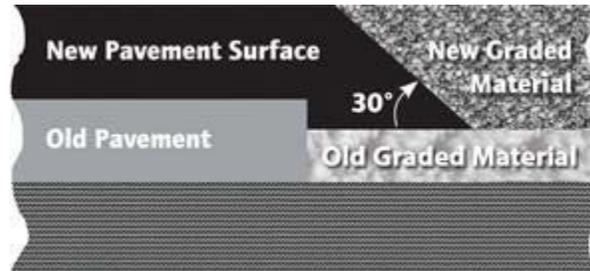




6-70.1 General

Safety edge is an approximately 30-degree sloped wedge of pavement added to the outside edge of a lane with no shoulder or the outside edge of a paved shoulder.

Figure 1 Typical Cross Section



Background information and guidance on safety edge is available on the FHWA safety edge website at:

<http://www.fhwa.dot.gov/everydaycounts/technology/safetyedge/intro.cfm>

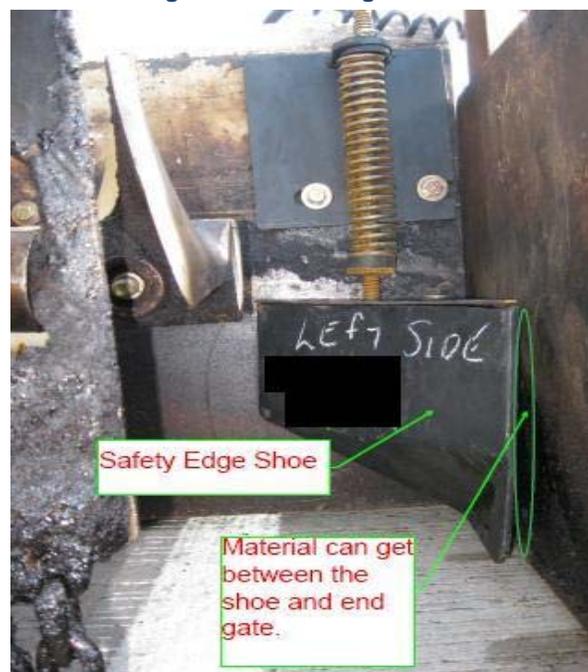
Safety edge is used to mitigate run-off-the-road crashes due to edge drop. Edge drops as little as 2.5 inches can cause a driver to over steer in an attempt to reenter the pavement. At some point the vehicle's tires suddenly climb the edge drop and the vehicle abruptly shoots across its' lane into oncoming traffic or leaves the roadway.

Besides the safety benefit of the safety edge, many states are reporting better pavement performance near the safety edge. Some of the benefits are: reduced edge line cracking, better compaction, less damage to pavement edge due to construction traffic.

Safety edge can be installed on HMA and concrete pavements. At this time WisDOT is only using safety edge on HMA.

Safety edges are created by adding a wedge maker to the paver. Different manufactures have different types of wedge makers that attach to pavers in different locations. Typically on HMA pavers wedge makers are attached to the end plate or the screed of the paver.

Figure 2 HMA Wedge Maker



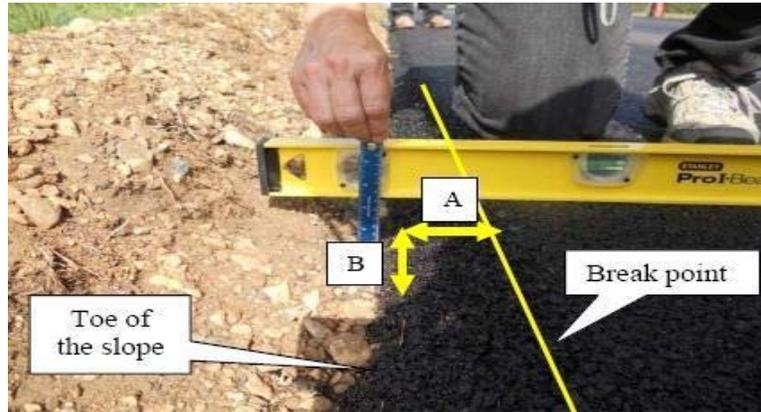
Material trapped between wedge maker and end plate can affect the slope of the finished edge.

6-70.2 Measuring Safety Edge Angle

The contract standard detail describes the required angle in terms of the horizontal run to the vertical rise of the sloped portion of the safety edge. The target angle of 30 degrees is equivalent to about 1.7:1. The contract limits of 1.8:1 and 1.2:1 are equivalent to an allowable range of about 29 degrees to about 40 degrees.

[Figure 3](#), borrowed from the FHWA's Safety Edges_{SM} Design and Construction Guide, shows how to measure the required angle in the field. Distance A divided by distance B needs to be within the range the contract specifies.

Figure 3 Field Check of the Required Angle



B is the vertical distance from the toe to an extension of the pavement surface cross slope. The toe is where the sloped surface contacts the ground or intersects a vertical edge. It may be useful to use a straightedge to better define the plane of the sloped surface otherwise single aggregate particle can have a meaningful effect on the resultant measurement.

A is the distance from the point where a straight edge laid on the pavement surface deviates from the surface, the break point, to a vertical projection from the toe or edge of the sloped portion.

6-70.2.1 When to Measure Safety Edge Angle

To get an accurate angle measurement at a given location at least two angle measurements are needed. The first measurement should be made as soon as practicable behind the paver. Angle measurements taken near the paver are likely to be near the 30-degree angle or flatter. This measurement helps the contractor to quickly adjust the safety edge to the correct angle.

The second angle measurement is made after the finished roller. In some situations the rolling process can steepen the angle of the safety edge. The second measurement is for final acceptance of the safety edge.

During the initial start of pavement operations, or if there is a change in pavement operations, a contractor may wish to measure the angle of the safety edge during each stage of the rolling process. This will help determine how the rolling pattern is influencing the angle of the safety edge.

Each layer with safety edge needs to have the angle of the safety edge measured.

6-70.2.2 How Often to Measure Safety Edge Angle

At a minimum, safety edge angle should be measured at the following locations:

- Within 200 feet of the start of the paving the safety edge.
- At the start/end of a curve's superelevation.
- Approximately midway between PC/PT and start/end of a curve's superelevation.
- PI of a horizontal curve.
- Once every 1000 feet on a tangent section.

If a final acceptance angle is steeper than the acceptable range of angles, more frequent measurement is required.

6-70.3 Acceptable Angles

For final acceptance safety edge angles may range from about 29 to 40 degrees (inclusive). Angles flatter than 29 degrees are safe but may require more material or can be difficult to match into later. Angles of 40-degrees or steeper require corrective action by the contractor.

Corrective action includes but is not limited to the following:

- Adjust the angle of wedge maker.
- Adjust the amount of material reaching the wedge maker.
- Remove material trapped between the wedge maker and the end plate (see [Figure 2](#)).
- Increase or decrease the amount of downward force being applied to the wedge maker.
- Remove objects that can snag on the wedge maker.
- Review firmness or grade of the shoulder below the safety edge.
- Change the rolling pattern.

6-70.4 Where Not to Install Safety Edge

Safety edge is not intended for the following applications:

- Centerline pavement joint.
- Joint between paved side road and mainline.
- Bridge decks.
- Adjacent to concrete barrier.
- Adjacent to curb and gutter.
- Edges between adjoining pavements.
- Centerline pavement joint.
- Mainline and taper joint.
- Mainline and turning joints.

Depending on the project, if a driveway is paved a safety edge may or may not be installed. Some examples:

- On a mill and overlay project, the mainline pavement adjacent to a paved driveway would not get a safety edge.
- On a mill and overlay project, the mainline pavement adjacent to a gravel driveway would get a safety edge.

Depending on contractor's equipment it may be difficult to install safety edge near beam guard.

6-70.5 Lessons Learned

The following lessons have been learned:

1. For proper performance the wedge maker needs to be adjusted periodically.
 - Too much pressure on the wedge maker can cause the wedge maker to snag on material below it.
 - Too much pressure can damage wedge maker or wedge maker's adjustment mechanisms.
 - Too little pressure on the wedge maker can prevent the wedge maker from forming proper edge or reduces the compaction provided by the wedge maker.
 - Too little pressure on the wedge maker can allow too much of a gap between the base and the wedge maker. This may allow material to spill out from the wedge maker. Depending on the amount of vertical adjustment a wedge maker has, a contractor may have to install safety edge with multiple layers to prevent material from spilling out from under the wedge maker. It may not be possible to place a 5-inch tall safety edge in one layer with a Carlson Paving Products wedge maker.
2. Insure base aggregate foundation is proper graded and compacted when placing safety edge.
 - If the wedge maker loses contact with foundation material, HMA can spill out under the wedge maker and allow a crack to form later during the paving process (see [Figure 4](#)).
 - If placing safety edge on a final layer, the wedge maker may need more adjustment than 5 inches to compensate for variations in mat thickness and gravel profile. The contractor may have to use multiple layers to install the safety edge properly. It may not be possible to place a 5-inch tall safety edge in one layer with a Carlson Paving Products wedge maker.

Figure 4 Cracked Edge



Safety edge cracked because wedge maker lost contact with base aggregate.

3. Too little HMA by the wedge maker can:
 - Prevent the proper angle from being extruded.
 - Prevent the safety edge from forming a smooth surface texture.
 - Allow the material to get between the wedge maker and the end plate. Material in this location can cause the wedge maker to pivot. If the wedge maker pivots, the angle of safety edge can become too steep.
 - Make it difficult to get a smooth face to the safety edge.
4. Variations in mix design and ambient temperatures can have an impact on the construction of the safety edge.
 - Tender mixes have a tendency to move more during rolling causing the angle to steepen.
 - The angle of the wedge maker must be reduced to compensate for HMA movement.
5. On multiple layer applications of safety edge it is not necessary to get a perfect match between layers. A stair step look is acceptable. However, these variations will impact the roadway width. Added width to lower layers may be needed to allow for proper location of edge of pavement.
6. The top of the safety edge is at the edge of the lane line if no paved shoulder is present or at the edge of paved shoulder. Properly locate the top edge of safety edge. Add width to lower layers to allow for proper location of edge of pavement.
7. Safety edge typically adds less than 1 to 2 percent of the overall tonnage of HMA being paved. For most construction projects, the quantities have been adjusted by the designer. If construction staff is unsure if the quantities have been adjusted for the safety edge, contact the designer.
8. Discuss construction of the safety edge during the preconstruction or prepaving meeting. Discuss the following:
 - What wedge maker will be used.
 - Amount of vertical adjustment a wedge maker will have.
 - Number of layers and layer thicknesses used to construct safety edge.
 - Quality of grade.
 - Compaction.
 - Profile.
 - Offsets.
 - Rolling patterns used.