# SMOOTHNESS: A PAVING PRIORITY

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**For more than 70 years, nearly all pavers have utilized the free-floating, or self-leveling, screed to produce pavements with a level and smooth surface. Smooth and level pavement surfaces are critical. In fact, many paving projects awarded by agencies across the United States and Canada include bonuses for achieving acceptable smoothness or disincentives for failing to achieve specified pavement surface smoothness.**

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# VOLVO – SMOOTHNESS: A PAVING PRIORITY

During hot mix asphalt (HMA) paving, the free-floating screed extrudes the asphalt mix into a pavement panel of predetermined width, based on the screed's dimensions and extensions. The thickness of the asphalt mat is also specified. Thickness is controlled by the initial setup of the screed and by the expected roll-down by compaction.

For smoothness, the top surface of a new pavement layer should be flat and level. The profile of the underlying base may not be level, but smoothness is improved by up to 70 percent with each new layer of pavement. This improvement is made possible by the predictable, leveling performance of the free-floating screed. So long as the leveling system is permitted to operate without interference, the new pavement surface behind the screed will have improved smoothness compared to the base or pavement layer beneath it.

There are three primary factors that control the ability of the self-leveling screed to place a layer of HMA at a desired thickness with a level and smooth surface. The first is the angle of attack of the screed to the HMA being placed. Second is the head of HMA material in front of the screed. The third factor is paving speed. Arguably, the most important of these is the head of material.

## Angle of attack

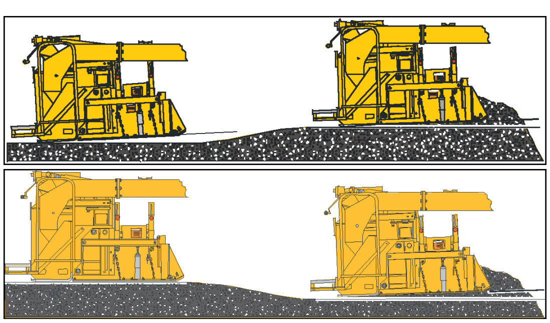
The free-floating screed moves up or down, depending upon the angle of attack, or extrusion angle, relative to the surface the screed is riding. Just like water-skiing, the angle of the skis to the surface of the water determines whether the skier rides high or is pulled into the water. Similarly, a free-floating screed with a steeper angle of attack will have the tendency to rise. A shallower angle of attack means the screed will drop.

The screed, towed by the paver's tractor, resists change in position unless acted upon by an external force. A distance equal to five lengths of the screed tow arm is necessary to fully complete any change in relative screed position. Adjustment to the angle of attack, whether by changing the tow point position for the screed side arms — called the line of pull — or by mechanical adjustment of the thickness control cranks, requires time to react. The average length of the screed tow arms for a highway-class paver is about 10 feet (3 meters). Any reaction of the screed to a change in angle of attack requires up to 50 feet (15 meters) to be completed.

## Head of material

If head of material fluctuates widely during the course of paving, it is impossible to produce a level and smooth pavement surface. The pavement will have dips and rises corresponding to screed level deviations created by the varying head of material.

A paver screed will change its height (relative position) due to the resistance from the material in the auger chamber. More material ahead of the screed will cause it to rise due to increased resistance to forward motion.



◂ **Height of paver screed varries with the head of material.**

Head of material is affected by many factors. Proper adjustment of the paver material feed system is important. Slat conveyors move material from the paver hopper back to the auger chamber. Speed of these conveyors and relative position of flow gates (if available) help regulate material flow. Most pavers utilize sensors to monitor movement of the mix to the augers. All of these components keep a consistent head of material in front of the screed to avoid fluctuations in screed position.

It is important to maintain a consistent head of material across the entire length of the auger chamber, including where the augers deliver material to the end gates. Having confinement of the mix through use of auger tunnel extensions, and continuously monitoring the head of material using mechanical or sonic sensors will assist with maintaining consistency. A best practice in paving keeps the augers turning at a slow, constant speed so that mix is uniformly distributed throughout the auger chamber, keeping the head of material consistent. Adjusting the height of the flow gates, if the paver is equipped with them, can also control the level of mix in the center portion of the auger chamber ahead of the main screed, and has an effect on the speed at which the augers turn for uniform mix delivery to the screed extensions.

## Paving speed

Paving speed is the third factor that has an impact on the ability of the screed to correctly place HMA. With no change to the angle of attack or head of material, a faster paving speed will cause a screed to drop. Slower paving speeds cause the screed to rise. This is due to the change in the shear factor — the resistance of the screed against the head of material in front of it. A slow-moving screed encounters more resistance and will rise. A faster-moving paver will encounter less resistance and will drop.

## Setting up the screed

For most highway paving applications, the screed should be kept in a level position to produce a smooth pavement surface. To accomplish this, a screed needs to be configured with the proper angle of attack for the application, the head of material in front of the screed needs to be maintained at a consistent level, and paving speed should be steady.

Most manufacturers recommend that a screed be set up with the nose slightly raised rather than level or parallel to the surface. Depending upon the screed, this can be accomplished with one or two turns of the depth cranks, located on the left and right sides of the screed. The paving crew can adjust these controls further if screed behavior is inconsistent. Once the paver is up to speed, with a consistent head of material in the auger chamber, further adjustment of angle of attack should not be necessary unless a problem occurs, such as a change in mix temperature.

The industry rule of thumb is to keep the head of material consistent within one inch (25 millimeters) either above or below a physical reference point established for that particular paver. Many times this reference point is the auger shaft inside the auger chamber. Screed and paver operators can look into the auger chamber and verify this reference point regularly during paving.

## The importance of temperature

A physical property of asphalt that requires attention during paving is temperature. Viscosity, or stiffness, of HMA is controlled by temperature. Cooler mixes are stiffer than hotter mixes. A cooler mix will cause the screed to rise due to a stiffer mix in the auger chamber. Hotter mixes will cause a free-floating screed to drop due to the reduced resistance by a material of lower viscosity.

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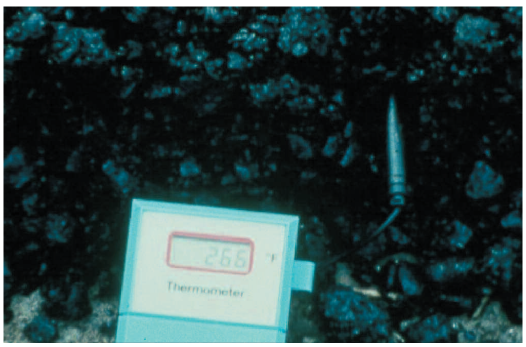
Temperature changes can result from plant operation, trucking operations and ambient conditions, among other reasons. Any variation in mix temperature needs to be minimized so that the screed level will remain consistent for the smoothest pavement possible.

A screed that is properly adjusted and that is provided HMA at a consistent rate will create a level and smooth pavement surface. The panel behind the screed will be of even density with no occurrences of temperature segregation. This makes the panel ideal for compaction to a uniform, high density. Any variations in panel density behind the screed may result in compaction and final density that will fall short of specifications. Even the best compaction equipment cannot compensate for poorly placed or nonhomogenous mixes. Paying attention to these details ensures a level and smooth pavement.




◂ **The importance of temperature.**