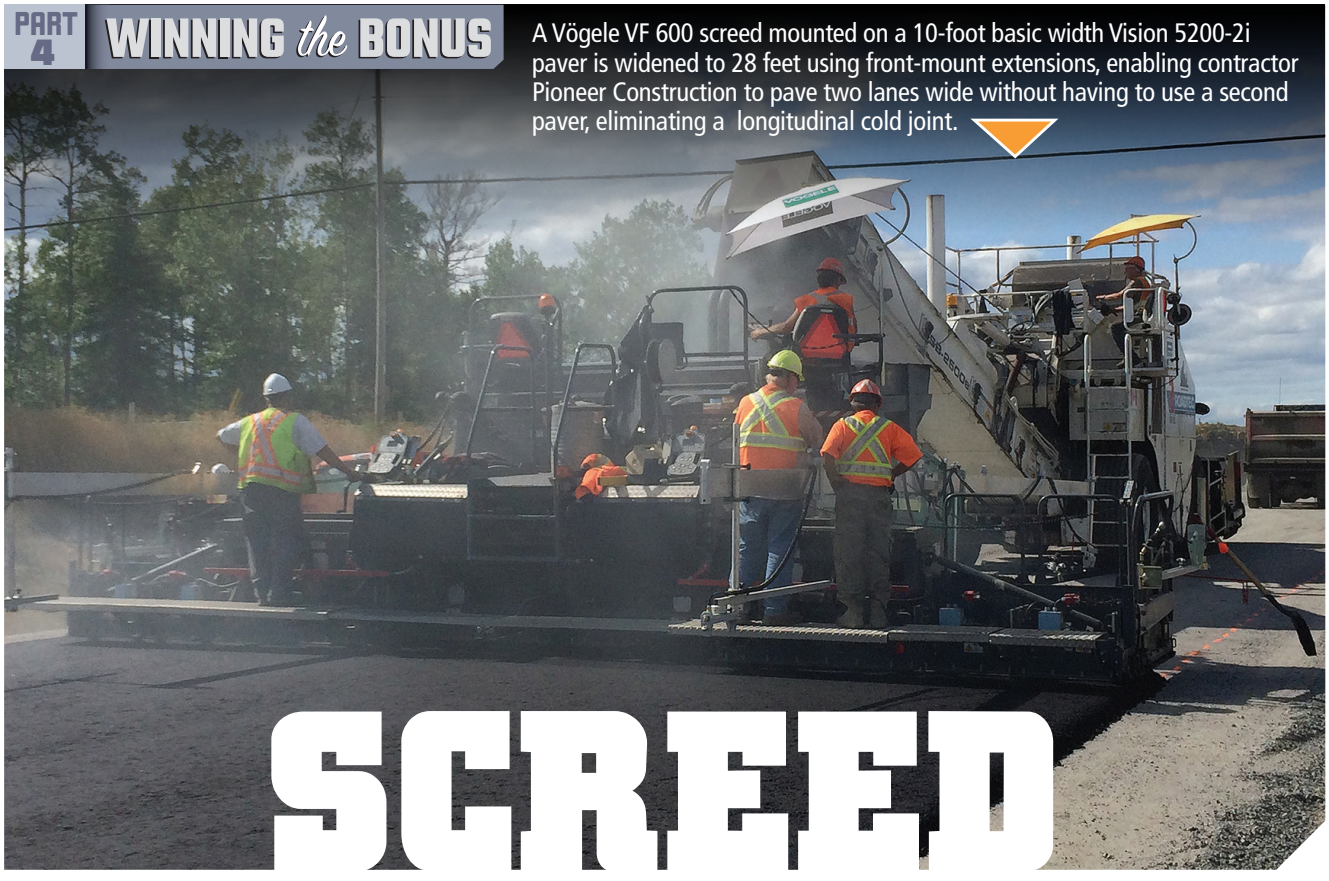
PART 4 WINNING the BONUS



A Vögele VF 600 screed mounted on a 10-foot basic width Vision 5200-2i paver is widened to 28 feet using front-mount extensions, enabling contractor Pioneer Construction to pave two lanes wide without having to use a second paver, eliminating a longitudinal cold joint.

Pioneer Construction

SCREED SUCCESS

When used with precisely milled asphalt surfaces and a material transfer vehicle, a high-performance screed – if paired with the right paver tractor – is the fourth element in the search for super-smooth, bonus-winning pavements.

Using the right tractor isn't enough. The tractor also must be paired with the right screed, since the screed performs on its own to provide smooth placement of bituminous pavement lifts.

An asphalt paver has two independent units – the tractor and the free-floating screed – plus automatic or manual leveling systems that link tractor systems to the screed to place level pavements.

The hopper-equipped tractor receives the hot, warm or cold asphalt mix from truck or material transfer vehicle (and via slats or rubber conveyors) moves it to the rear of the tractor through flow gates to a set of augers in front of the screed. At the front of the screed, the mix builds into a "head" as it's moved outward for distribution by the screed.

But it's not so simple. Ideally, the tractor will move a blended, homogenous, segregation-free mix from the hopper into the material head in front of the screed without segregating mix temperature or aggregate particles in the mix. That's important, as thermal or mix segregation vastly undermines pavement smoothness in the short term, and pavement durability in the long term.

This month, *Equipment World* continues its seven-part series on how to optimize pavement construction to win bonuses using screeds.

Part I: Smooth Pavements through Cold Milling
Part 2: Smooth Pavements and Material Transfer Vehicles
Part 3: Smooth Pavements and Asphalt Pavers
Part 4: Smooth Pavements and Asphalt Screeds
Part 5: Compaction for Super Smooth Asphalt Pavements
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Free-floating screeds

The free-floating screed – which forms smooth mats mostly independent of the paver tractor – is the epicenter of the search for super-smooth, bonus-winning

asphalt pavements.

"The free-floating screed was introduced in the 1930s," says Wayne Jones, senior regional engineer for The Asphalt Institute. "Free-floating means it will lay a uniform depth so long as all the forces affecting that screed are in balance."

The free-floating screed is not held to grade (the thickness of the mat) by the mechanical- or hydraulics-controlled set position of the paver. Instead, the free-floating screed is held to grade by five forces in balance or equilibrium, including:

- The force exerted by the tractor to pull the screed.
- The weight of the screed.
- The force created by the head of material in front of the screed.
- The frictional resistance of the material as it flows under the screed plate, and…
- The upward force induced by the paving material.

"When these forces are in balance, the screed is held to grade with an equilibrium angle of attack," says Laikram "Nars" Narsingh, product manager for Vögele asphalt pavers. "This angle of attack ensures that the trailing edge of the screed plate does the final screed compaction and sets the surface texture. Any changes in these forces will result in a change in the equilibrium angle of attack of the screed, hence the grade, resulting in roughness and mat blemish. So, it's important to ensure maximum stability of the five forces to optimize screed performance."

The head of the material provides a critical force. "The head of the material is the mix near the augers that the screed must plow through and level," Jones says. "If there's too much asphalt, the screed is forced to rise; the correct amount, the screed remains level; too little, the head diminishes and the screed will drop."

This can be achieved by maintaining the right ratio of feed by adjusting feed gate heights in conjunction with conveyor speed, he says. "We recommend 20 to 40 revolutions per minute for auger speed," Jones adds. "Too high or too low, and mat streaks will appear. If the speed is too fast, you can literally throw aggregate out of the area in advance of the screed, causing aggregate mix segregation."

Volvo Construction Equipment

An easily adjustable width extending screed is ideal for commercial or suburban paving.

The amount of mix at the screed is gauged by feed sensors, which can include sonic or infrared sensors. "They need be pointed, as much as possible, 90 degrees to the face of the live pile of material," Jones adds. "Otherwise, if it points at a dead spot, it never will send the right amount of material."

Paver propel speeds also impact screed performance. The faster the paver-tractor, the more the screed tends to drop, Jones said. "Be as constant as possible," he says. "Make sure the feeders match the paving speed, and if speed changes, that the feeders adjust."

Two tow arms attach the screed to tractor tow points on both sides of the tractor at its center of gravity. The arms are lifted hydraulically, and the screed pivots up and down around the tow arm. The tow points represent points of pull, so the tractor begins the leveling process as it moves forward, staying level despite any pavement roughness. "The height of the tow point relates to the height of the screed," Jones says. "A 1-inch change in the height of the tow point equates to a 1/8-inch change back at the screed."

21st Century screeds

Though the principle of the free-floating screed has remained unchanged since its inception, screed mat quality has improved for a number of reasons, including improved paver technologies, like use of a controller area network (CANbus), a vehicle systems connection standard that allows microcontrollers and devices to communicate with each other in applications without a host computer.

"Improved control technology, such as a CANbus with digital display, non-contact sensors and improved hydraulic controllability, has allowed better manipulation of the five forces to ensure stability," Narsingh says.

The Cat SE60 VT screed has a maximum paving width of 33 feet and depth of 12 inches. Designed for high-production jobs, the proportional extender control has two speed ranges.

Screed management has also been enhanced by improved material feed system controls, better propel controllability, and enhanced screed stability during stopping and starting, Narsingh says. "Ease of operation has dramatically improved with recent technology."

At least four modern standard or optional paver features are having a huge influence on mat quality:

• **Compaction screeds**: Compaction screeds use a tamper bar that is located in front of the screed to provide the initial screed compaction. This technology is making a comeback in North America mainly because of globalization of the paving industry, and the dominance of international paver manufacturers such as Volvo, Caterpillar and Wirtgen Group.

The compaction screed increases in-place density and reduces rolldown, resulting in smoother pavement. These screeds usually have the rigidity for wide paving, with the added ability to mitigate cold longitudinal joints, helping contractors win smoothness and density bonuses. And their use goes beyond asphalt; on larger Eurostyle pavers, compaction screeds are used to place roller compacted concrete and cement-treated bases.

Either way, heavier and more rigid compaction (and high compaction screeds) allow contractors to pave wider to eliminate joints, and increase in-place density to improve smoothness and surface texture. High compaction at the screed can also reduce the number of rollers on a job, where feasible, reducing costs and construction time.

Another version of the compaction screed is the vibrating screed, the effectiveness of which depends upon screed weight, vibration frequency and vibration amplitude.

• **Screeds and material feed systems**: Today's independent auger and conveyor designs allow better material flow under the auger drive box, and are part of the modern feeder systems that ensure material consistency. These auger and conveyor designs not only provide consistent feed, but also improved material consistency under the screed, all of which results in more uniform surface texture of the asphalt and smoother pavement.

Material deflector plates and strategically positioned auger flights also allow for better material consistency in front of the screed. Non-contact auger sensors and potentiometers (instead of flow gates) controlling material delivery to the augers – coupled with a digital display of the material height – give operators more control.

For example, on Volvo's new B-Series pavers, four standard ultrasonic sensors – two above the conveyor and two above the auger – automatically regulated the proper delivery and flow of material to match the paver's speed.

• **Precise propulsion capabilities**: On track pavers, precise propel controllability allows the operator to maintain the proper straight lines that improve smoothness and joint quality. A single-steering joystick – together with the ability of the operator to set his desired paving speed, guided with a digital display – can allow operators to significantly control the pull force. New technology also allows operators to automatically set the turning radius of the paver into turns, which is one of the most challenging maneuvers for operators.

• **Screed hold-and-freeze**: Asphalt lift smoothness is compromised by fast starts and stops. "Jackrabbit starts and stops will take the screed out of balance," Jones warns. "It will rise and fall on you. If you increase the forward speed, the screed will drop, and if you slow down, a pile of material will appear in front of the screed and pile up, causing the screed to climb on you."

Tom Kuennen

High-tech controls, like the Navitronic Plus system from Vögele, automate many screed adjustments and eliminate manual activity.

This can be obviated by the screed "hold and freeze" function – usually available as an option from manufacturers – which automatically engages with the propel function to prevent screed settling and humps in the mat due to stops and starts.

Tom Kuennen

The 10-foot Carlson EZ IV screed on the Roadtec RP-190e paver is extendable to 19 feet.

Understanding screed features

"Smoothness, and density relative-to-screed, are functions of screed weight, rigidity, and its ability to increase in-place density," Narsingh says. For example, a heavier screed gives more stability when there are fluctuations of the other four screed forces – such as head-of-material fluctuations and material consistency.

A heavier screed will also perform better with stiffer mixes like some warm mixes, mixes with high RAP content, stone-matrix asphalt mixes, or polymer modified asphalt mixes that are becoming more popular.

A rigid screed maintains screed adjustment to ensure consistent in-place density across the width of the mat, providing a smoother and more durable mat. But compacting screeds will provide higher in-place density in advance of compaction with vibratory rollers, likewise reducing roll-down and improving smoothness. On the other hand, vibratory screeds are more versatile.

Contractors may pave wider than their basic screed size by adding fixed or adjustable screed extensions to add lateral length. Rigid extensions can be bolted to a basic vibratory screed either at the front or rear of the screed. Alternatively, hydraulically extendable screeds can be adjusted on the fly.

A heavier rear-mount compaction or vibratory screed is typically ideal for mainline applications where smoothness and density are critical.

But for applications requiring constant width and grade changes – like fast movement in and out required by urban paving, or parking lots with concrete "islands" and curb cuts – an unequal width front-mount screed is more useful, Narsingh recommends. And when a contractor needs to combine main line and commercial work, and he doesn't have the flexibility to choose different screeds for different projects, the rigid unequal width front-mount screed also is the best choice.

Another thing to consider is the ability to quickly get a machine into paving mode. For example, Cat's F-Series pavers use an integrated generator connected to the paver engine that heats the screed plates to the proper temperature in around 15 minutes. And if a screed temperature sensor fails, the paver's screed-heating system diagnostics automatically compensates to allow consistent, uninterrupted paving. Cat also says its two-speed proportional control offers more precise operation of its screed extensions.

Leveling systems integral

The paver tractor and screed operate together for smooth pavements, but use of an automated leveling system that's fully integrated to a paver's grade and slope control system is essential for paving true-to-line, and level on any kind of base, outperforming manual adjustments.

Today's integrated automatic grade and slope control systems make it much easier for operators to implement automatic grade. These systems offer simple and user-friendly operation, with all settings made on the screed console

A wide variety of sensors should permit use of these systems in most applications, from parking lots to highways. All wiring and connections are integrated into the tractor and screed, thus eliminating any confusing cables and minimizing the risk of damage.

Future three-dimensional reference and machine controls will create accurate base and intermediate lifts. "There are several methods currently available to create 3D references to guide the paver in controlling one dimension of the pavement (1D), the depth," Narsingh says. These systems allow contractors the ability to automatically control the width of the pavement, as well as the direction of the pavement, by automatically steering the paver.

In addition to grade control, the screed can also be set to control pavement slope and crown. A slope sensor mounted on a transverse beam attached to the screed determines screed slopes, then adjusts screed slope to the desired amount. Screed crown can also be controlled with front and rear crown controls. EW