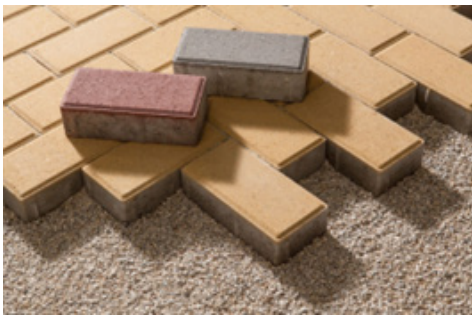
Face Mix Production

Best practices and guidelines for production crews



Face mix is now established in the North American concrete paver market, and many paver producers offer both traditional thru mix and face mix choices.

In contrast to traditional thru mix pavers that use the same concrete mix throughout the paver, face mix pavers incorporate a top layer, usually less than 3/8" (9 mm). Both types of pavers deliver beauty and durability to hardscapes, and either one can be used with confidence.

Face Mix Production Challenges

Two layer technology creates some production challenges:

- Cycle time increase
- Smaller concrete volumes than regular production
- Greater attention needed for production planning, batching, plant set up and packaging
- Dosing accuracy of pigment and water
- More demanding on operator knowledge and skills

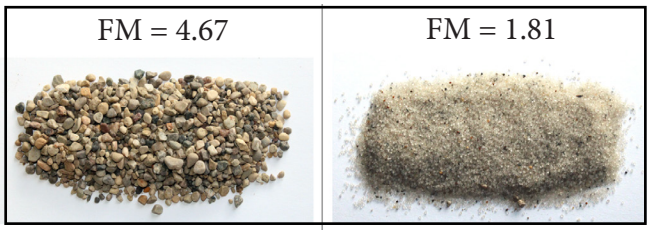
Raw Materials & Mix Design

Water Content: As always, it is important to maximize the water content in both face and base mix.

Cementitious Materials Content: This should increase as aggregate Fineness Modulus (FM) decreases. FM is an index number that represents the mean size of particles in an aggregate sample, and is used to get an idea of how coarse or fine an aggregate is. The higher the FM the coarser the aggregate. A lower FM indicates a finer aggregate.

Aggregates: When using aggregates with a lower FM (smaller particles) it may be necessary to increase cementitious fines to cover the greater aggregate surface area, and to effectively block the smaller void structure that results from finer aggregates. ACM can show you how to properly balance face mix proportions and aggregate blend curves to avoid overly fine mixes, while still achieving an attractive, smooth-textured surface. You can also find out more about aggregates and how to calculate FM on our ACM Academy Courses: Aggregates Part 1 and Part 2.

The higher the FM, the coarser the aggregate



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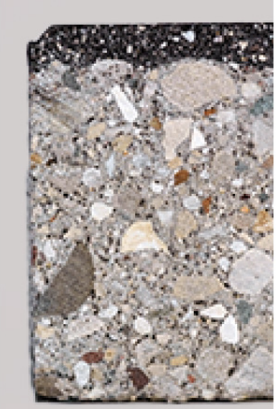


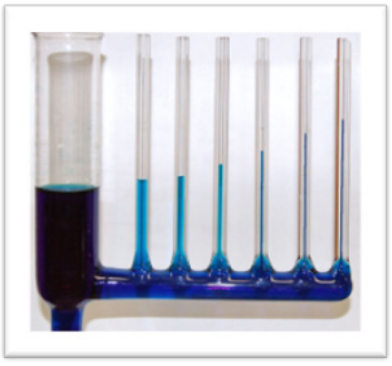
A note about unintended consequences: Increased portland cement and other cementitious materials content can deliver many positives for pavers, but there is an important downside to be aware of. Increased cement content may lead to an increased potential for efflorescence.

This happens for two reasons:

- Increased Portland cement means more calcium hydroxide is produced during the cement hydration reaction. Calcium hydroxide is an important contributor to efflorescence production.
- The second reason is that cementitious particles are very fine, and increased cementitious content may affect the capillary void structure in the concrete matrix, typically making voids or capillaries smaller. The laws of fluid dynamics dictate that the smaller the capillary the higher the suction, or wicking action, of moisture. Therefore, an unintended consequence of additional finer cement particles in a coarser aggregate blend may be that the unit experiences more frequent wetting and drying cycles as available moisture is more efficiently wicked into the unit through the smaller void structure. As always, the more moisture in the unit, the greater the potential for efflorescence. In summary: face mixes with coarser aggregate blends (higher FMs) should contain relatively lower cementitious contents than face mixes with finer aggregate blends (lower FMs).

Admixtures: Most producers find that using a plasticizer in combination with an efflorescence control admixture delivers best results for pavers. Typically, the same admixtures may be used in the face and base mix, but may need to be used at different dosage rates.

Consider the use of ProCast™ 710 retarding admixture in warm weather, with white cement, or varigated color blends. Retarders extend workability and allow more time for mixing and molding operations. Consult your ACM Technical Services Representative for optimal admixture addition rates and mix sequencing guidelines.



As demonstrated above, narrower openings allow capillary action to pull water through voids more efficiently

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Base Mix

The most important requirement for a good face is a good base.

- Targeting the maximum water in the base makes for easier compaction and a better face.
- Do not over-compact the base.
- To prevent delamination it is important that the face can key into the base.
- The general rule of thumb is to run the base mix as coarse as possible. This allows the base mix to fill the feed box more evenly and flow into the mold across the whole mold area. As always, there are some tradeoffs. If the base mix is too coarse and not properly graded, absorptions may be too high and pavers can look too coarse in appearance.
- Overly coarse mixes can be corrected by trying finer aggregate blends.
- The key is to aim for a balanced mix with as much coarse material as can be tolerated, but which will meet absorption and appearance requirements.

Face Mix

- Thickness: a face layer only needs to be 4 to 8 mm thick.
- To achieve a good consistent/even face mix:
  - Don't overfill the feed drawer.
  - Carefully target filling volumes, based on the volume of the face mix mold.

Contact

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Using angular fractured or manufactured aggregate in the base can help the base and face to key together

Mix Time: Final mix of up to 60 seconds is recommended.

Batch Size: Right size face mix batches to usage time. Many facilities install smaller face mix mixers to facilitate smaller batch sizes. Minimizing work time for blended colors helps ensure proper color distribution throughout the mix.

Vibration and Feed: Typically, we recommend vibration on the base mix is kept to a minimum. Once the face mix is added, use the main vibe to drive the face mix into the base. Following this process will help produce quality pavers that are homogeneous across the whole mold – front to back and side to side, and that have the optimum physical properties.

Pay attention to the amount of material in the feed drawer – adding too much material may result in clumps and restricted flow.

Wet Side, Inline Quality Checks

Using wet side, inline quality checks provides real time feedback on the quality of the concrete as it is being manufactured.

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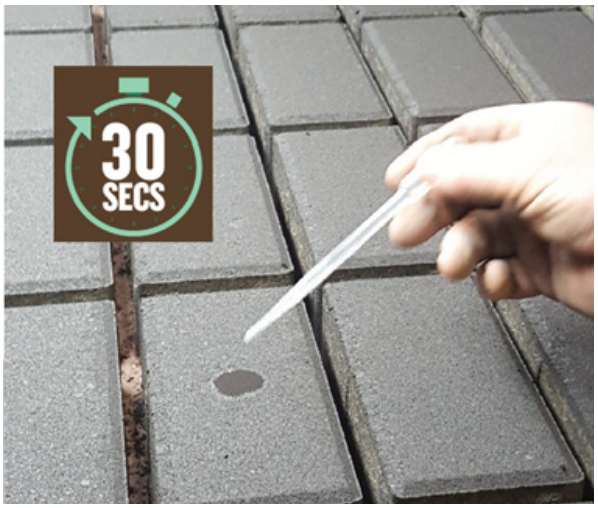
As noted previously, even if the face surface looks tight, appearances can be deceiving. Finer particles and associated finer void structure in a poorly designed face mix can be very efficient at wicking moisture. A water beading test offers a more reliable and objective measure of the absorptive qualities of the face than a visual inspection.

To perform the *Water Beading Test*:

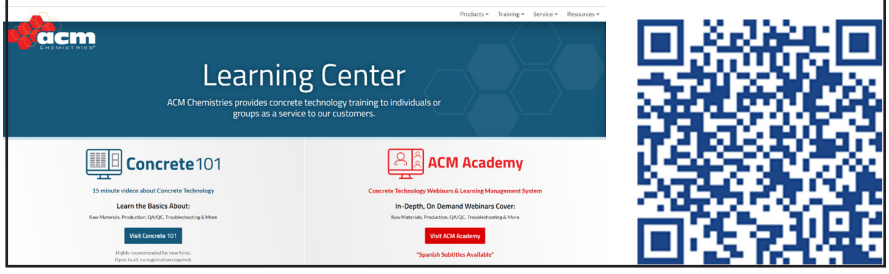
- Place a small bead of water on the paver surface.
- Time how long the water remains on the surface. If the water dissapears in a few seconds, this is a sign that corrective action may be required.
- The amount of time a bead needs to hold may vary by product. Consult with your Technical Services Representative to find the optimal timing for your needs.

The *Thumb Print Test*, and *Water Wicking Test* can also be used for real time quality checks. To find out more, check out Concrete 101 QA/QC Part 2.



Water beading tests done on the wet side, before curing, can provide instant feedback, and prevent a small problem from becomeing a large one

For more information on concrete technology, including aggregates, mix design and QA/QC, check out the ACM Learning Center on our website.



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