Slipform Paving
Concrete Airfields – Construction Techniques

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Concrete slipforming paving of thick airfield pavements has been done successfully **without forms** for over 50 years.

Modern concrete paving equipment, with their built-in features and options, have made this art easier.

The concrete itself is extremely critical to successful concrete paving of thick airfield pavements.
Slipformed Airport Concrete Pavements - HISTORY

- The first slipformed concrete runway was with a G&Z paver at Orly Field, Paris in 1963. No forms were used.
- The first airport pavement done in the USA was with a G&Z slipform at Sacramento Airport (California) in 1965. No forms were used.
Concrete airport slabs have been successfully slipformed up to 50' (15M) wide and 26" (660mm) thick. The first slipformed concrete runway paved at 50' (15M) wide was the Dallas-Fort Worth Airport in 1972. The slab thickness was 21" (533mm).
Bagram Air Force Base - Afghanistan
Slipformed Airport Concrete Pavements

- Historically the single biggest argument against slipforming thick airport slabs was edge slump.
- Since the first airport slab was slipformed, contractors have learned methods and techniques to minimize, if not avoid edge slump.
- Concrete mix and uniformity play a big part in successful thick slab airfield paving.
Highway Slab 34” (857mm) Thick
Airport Slab LAX 30”  
(762mm) Thick
Factors Contributing to High Quality Slipformed Concrete Slabs

- Concrete
- Vibration
- Sideforms / Edge Support
- Edge Overbuild (thickened edge)
- Flow of Concrete to the Edges
- Concrete Finishing Devices
Concrete – Mix Design

We are trying to achieve a mix design which will yield high quality, durable and workable concrete:

- Finishes easily even at low slump
- Vibration is transmitted easily achieving better consolidation
- Smooth
- No Edge slump
- No joint or surface spalling
Well Graded Aggregate Mixtures
Segregation

“Segregation is caused by poor aggregate grading. Where there are gaps in the gradation, horrible segregation can occur at those sieve sizes.”

Shilstone
Segregated Concrete
Segregated Concrete
Segregated / Non-uniform Concrete – Passing Through Slipform
Segregated / Non-uniform Concrete – Passing Through Slipform
Segregated / Non-Uniform Concrete Plan View
Segregated / Non-Uniform Concrete
Section View – Concrete Pile

Section A-A
Before Slipform

Section A-A
After Slipform
Segregated / Non-Uniform Concrete
Section View – Slipform Pan
Only use well maintained vibrators which can maintain a preset speed when under load and when the oil warms up.

Proper placement of corner vibrator in liquification hopper is vital. Proper location is 6" (15 cm) from the sideform.

Adjust corner vibrator speed for best results. Corner vibrators must be slowed down sometimes to avoid pumping which can adversely impact edges.
Vibration

With most standard paving vibrators, vibrator speed must be set between 8,000 and 9,500 vpm. New heavier eccentric weight vibrators can be run at slower speed to supply the same vibration energy.

Vibrator spacing on thicker airfield pavements is typically an average center to center spacing of 14" (35 cm). On thinner airfield pavements 16" (40 cm) centers on an average is the norm.
Vibration

- Vibrator location (height) in the slab in the relationship to the bottom of the slipform pan should be varied to determine best results for a given mix. Depths from 0 to -6” (-15cm) have been used successfully.

- New vibrator monitoring systems are available to help paver operators monitor or automatically control and maintain preset hydraulic poker vibrator speeds.
Sideforms

- Sideforms must be supported top to bottom to assure a rigid mold and sideforms plates must be straight and not bent otherwise concrete edges will be adversely affected.

- Batter should be used sparingly to avoid acute angle cracking of the adjacent slab. Some specifiers do not allow any batter angle.
Sideforms
Guillotine Sideform

NOTE: It is critical that the slipform pan is flat with no localized bellies or localized extrusion can occur adversely impacting surface profile and edge slump measurements.
Sideforms

Do not extrude the edges from front to rear of the main sideforms. Keep the attack angle of the pan flat. Only a slight squeeze or no squeeze from front to rear of the trailing finishing pan fixed edger pan sideform yields the best results.

The less one touches the edge after slipforming the better. The trailing finishing pan edger/sideforms can help in finishing the edge better and more uniformly than by hand finishing.
Most people have the misconception that when slipform paving you are extruding. The secret to good edges is not to extrude. If you extrude you pump or accelerate concrete through the sideform which can cause edge slump.
Sideforms

Concrete Swell
Edge Overbuild

- Modern slipform pavers today are equipped with edge overbuild devices on any finishing device that touches the concrete. Edge overbuilds thicken the concrete edge to help compensate for edge slump.

- Edge overbuilds cannot compensate for varying concrete slump. *Keep the concrete slump constant!*

- Don’t overbuild too much! The lower the concrete slump, the less overbuild. Typically the maximum is ¼" to ⅜" (6 to 9mm.) The concrete mix will dictate how much overbuild.
Edge Overbuild
Flow of Concrete to the Edges

The end of the metering gate / strike-off should be far enough away from the sideform to allow an unobstructed flow of fresh concrete to fill the corner / edge on thick slabs. This also allows a place for grout build up in the corners to escape.
Flow of Concrete to the Edges

- The paver operator must always:
  - Keep fresh concrete fed to the corners of the liquefaction hopper (keep them full) to displace grout and fill the edge.
  - Maintain a constant concrete head height over the top of the vibrators using the metering gate.
- Most operators prefer to keep a high head height on thick slabs. Proper head management yields smoother pavements.
Finishing Devices for Airfield Paving

There are three common paver mounted concrete finishing devices used on airfield paving. One or more of these devices can be used if the concrete mix / slab surface is harsh or difficult to finish:

- Trailing Finishing Pan (TFP)
- Final Finisher (FF) – Longitudinal Oscillating Ski
- Oscillating Correcting Beam (OCB)
Finishing Devices for Airfield Paving

If a concrete mix needs excessive finishing, one should look at doing something to improve the mix design and aggregate gradations!
A Trailing Finishing Pan (TFP) is typically 4' (1.2m) wide and floats on the concrete surface. The pan is towed by the slipform’s paving kit. Most contractors attach and tow layers of burlap behind the TFP.

On thicker slabs, where low slump, well graded concrete is used, a Trailing Finishing Pan by itself provides enough finishing; however, on hot and windy days having a Final Finisher can be helpful especially on wide paving such as 37.5 to 40’.
Trailing Finishing Pan
Trailing Finishing Pan

Final Finisher On Standby
A Final Finisher is a device which includes a long, narrow magnesium ski that floats on the concrete surface. The ski oscillates fore and aft in the direction of travel AND transversely back and forth across the slab at the same time.
An Oscillating Correcting Beam (OCB) can be an effective means to finish low slump concrete but is typically not used unless a Dowel Bar Inserter is used to insert the dowels in the plastic concrete at the location of the transverse contraction joints.
Oscillating Correcting Beam (OCB)
Mechanical Dowel Bar Inserters (DBI)

- For nearly 30 years, mechanical Dowel Bar Inserters (DBI) have been successfully used on thick airfield pavements. **Not all DBIs are alike!**

- Do a test section to demonstrate to the owner that the DBI can insert the bars accurately and that homogeneous concrete is sufficiently consolidated around the bar.
New Fourth Runway at Dulles Airport, Virginia USA – 2007
Hamad International Airport, Doha Qatar – 2008
New Runway at Chicago-O’Hare Airport, Illinois USA – 2015
Conclusion

- Concrete
- Vibration
- Sideforms / Edge Support
- Edge Overbuild (thickened edge)
- Flow of Concrete to the Edges
- Concrete Finishing Devices