9.40 SURFACE FINISHING

The primary purpose for finishing concrete pavements is to remove any small surface imperfections and seal the surface of the slab. There is a balance that must be maintained between the amount of finishing that is necessary to seal the pavement surface versus the amount of finishing that can become a detriment to the pavement. Excessive finishing can cause loss of air entrainment in the mortar at the surface of the slab which can lead to scaling. Too much finishing can also add roughness to the surface of the slab which will affect the overall smoothness of the pavement.

As with many other aspects of concrete paving, one key to successful finishing is consistency. Interruptions in the batching, hauling, or placement processes can lead to a dry, unworkable mix which will make the finishing process much more difficult and result in substandard finishing of the pavement surface.

9.41 USE OF WATER IN FINISHING CONCRETE

Specification 2301.03, H does not allow concrete finishers to apply water to the surface of pavement to aid in finishing of concrete. Any additional water added to the surface of the fresh concrete increases the water/cement ratio of mortar and adversely affects air content. This results in a less durable matrix and the concrete surface is more prone to early scaling and general surface deterioration. However, a burlap drag is permitted and a small amount of water may be sprayed on the drag to aid in closing the pavement surface. A trail of slurry created by a V float or slurry drug to the edge of the slab by the hand floats and running down the edge of the pavement is not permitted. The contractor must reduce the amount and/or frequency of any water being sprayed on the burlap.

Should a void or low spot become evident during finishing or the finishers experience difficulty in closing an open pavement surface, fresh mix or mortar should be obtained from in front of paving train and added to the surface to facilitate finishing and produce a tight, closed pavement surface.

9.42 MICROTEXTURE AND MACROTEXTURE

Microtexture and macrotexture are applied to a pavement surface to improve frictional characteristics. Microtexture is placed by dragging artificial turf, coarse carpet, or burlap longitudinally over the surface. Macrotexture is placed by dragging tines either longitudinally or transversely over the plastic concrete to create grooves.

Specification 2301.03, H, 3 requires that all mainline pavement with speed limits over 60 km/h (35 mph) shall receive macrotexture, either transverse or longitudinal.

On projects with a widened lane, the outside 750 mm (2 1/2 feet) of 4.2 m (14 feet) driving lane are not intended to be tined. This aids the traveling public in recognizing it as an integral part of the shoulder area. It also allows for higher quality construction of the rumble pattern, which is required in this area.

Specification 2301.03, H, 3 allows macrotexturing to be done by hand methods for gapped mainline areas or during equipment breakdown. When placing longitudinal texture by hand, ensure that texture is placed as straight as possible. A wavy appearance in longitudinal texture is not acceptable and can be objectionable to motorists. The orientation of tining should be changed to the transverse direction if the contractor cannot demonstrate the ability to place straight longitudinal texture by hand methods.

Applying macrotexture to the pavement surface is somewhat more complicated than microtexture. Equipment, smoothness of pad line, length, spacing, thickness, resilience of spring steel tines, and properly coordinating the texturing with forward progress of the paving train all play an important part in producing a uniform, properly textured pavement surface. Timing is critical. Texturing of the surface too early may result in grooves filling up with mortar or surface tearing. Texturing too late results in a reduced groove depth. The tines should not be left in the concrete when the tining machine stops. The tines should be lifted up and then lowered down again when forward motion resumes. Leaving the tines in the fresh concrete can leave an indentation in the surface which can lead to the formation of a random crack.

Uniformity of the grooves and a smooth, troweled-like shape are important. Both lead to a quieter roadway surface. Be careful to avoid grooves that are deep, irregular or wavy. This can happen if the tines are set very upright. They then will plow through the surface like a bulldozer and should be avoided. Good practice seems to be to have the angle of the tine rack positioned back from vertical at some angle greater than 45º. The angle and the down pressure of the machine will need to be coordinated to obtain the light, uniform texture.

When a vehicle passes over a textured pavement, the interaction between the wheels and the pavement creates noise. This noise has been considered objectionable to some motorists. It has been found that macrotexture placed at the shallow limit of the specifications is considerably quieter than texture placed toward the deeper limit. Studies have also shown that on Iowa pavements, texture does not generally wear off of the pavement's surface over time.

When applying microtexture, weight is often placed on the turf or carpet drag to ensure that the surface of the pavement is marred by the drag. When weight is applied to the drag, the weight should be uniformly distributed throughout the width of the drag to provide a uniform texture. Try to avoid excessive weight on turf or carpet drags as this may result in deep texture and snagging or dragging of aggregate which will result in a noisy pavement surface.

To obtain a uniform tined pavement, inspector should check the following items:

- Texture machine operating properly and all control devices functioning correctly
- Pad line maintained in smooth and stable condition
- For transverse texture, tining rake carrier rails set to pavement crown, so uniform down pressure on tines maintained as comb sweeps across slab
- For transverse texture, four springs attached to carrier frame and to broom channel with a tension adjusting chain are identical and adjusted to obtain proper groove depth
- Tines of comb parallel. A bent tine, which narrows spacing at tips, undercuts adjoining groove.
- No build up of dry mortar near tips of tines. A build up of mortar widens groove at surface and may cause tearing or displacement of larger aggregate particles.
- Steel tines not worn and comb in good condition, to ensure sufficient groove depth

Should an unsatisfactory surface result for any reason, stop the paving operation and do not allow resumption until the problem is corrected.

9.43 GROOVE DEPTH DETERMINATION

Depth of the grooves will be determined by using a standard commercial tire tread depth gauge.

Depth of grooves shall be measured from the finished concrete surface. Any projections (crumbs) above the finished surface shall be removed by wire brushing or with a steel straightedge prior to taking a measurement on hardened concrete. To check measurements made on fresh concrete, depth gauge shall be pressed down until substantially at the level of the original concrete surface.

With depth gauge guides in contact with finished concrete surface, plunger is depressed until contact is made with bottom of groove. Make sure that the needle point falls in the middle of the groove. On plastic concrete, exercise care in depressing plunger down to prevent needle from penetrating into the fresh concrete and obtaining a false or misleading reading. Gauge is then removed from surface with care being taken to prevent plunger from being disturbed. Texture depth is then read to nearest 1 mm (1/32 inch) on calibrated plunger. Repeat above procedure until necessary measurements are completed.

A sufficient number of random check measurements shall be made throughout each day's run to ensure that required texture depth 1.5 to 4.5 mm (1/16 to 3/16 inch) is being obtained. Noncompliance notices are to be issued when texture depths under 1.5 mm (1/16 inch) or over 4.5 mm (3/16 inch) are found. The depth of texture shall be measured on hardened concrete at a minimum of two locations for each day's run. Five measurements shall be taken diagonally across the pavement surface. Individual readings and the average, calculated to the nearest 1 mm (1/32 inch), shall be recorded in the field book for each location. If the average measurement exceeds the minimum or maximum by 1.5 mm (1/16 inch), texturing shall be considered noncomplying. Determinations of compliance for depth shall be made on basis of average of five measurements made at each test location, as long as deficient readings are all high or all low, but not both.

Compliance of nonuniform locations that have texture depth readings both higher and lower than specification limits will be determined as follows:

- Take 7 readings diagonally across the pavement surface
- Determine average of readings that are complying and too high, and compare this average to 1.5 mm (1/16 inch) allowable deviation
- Determine average of readings that are complying and too low, and compare this average to 1.5 mm (1/16 inch) allowable deviation

When the surface is considered noncomplying, corrective action will be required on any area that does not have at least 1.5 mm (1/16 inch) of texture. Corrective action or price adjustment may be considered for texturing which exceeds 4.5 mm (3/16 inch). Refer to *Construction Manual 2.53* for price adjustment information.

9.44 PAVEMENT CROWN

A depression 300 to 600 mm (1 to 2 feet) in from the edge of the pavement prevents proper transverse drainage of slab during periods of rain and may cause maintenance problems during the winter. This may be due to one or more of the following reasons:

- Screed not set correctly
- Poor workmanship by finishers in manipulating straightedge
- Improper tension between ends of trailing forms

- Improper adjustment of edges attached to trailing forms

Check this deficiency by placing a straightedge or 1.2 m (4 feet) carpenters level transversely on pavement surface and noting trueness of surface with bottom of straightedge.

9.45 STRAIGHTEDGEING PAVEMENT SURFACE

The entire pavement surface needs to be checked with a 3 m (10 foot) straightedge. A random or selective type checking procedure may be used, provided previous checking with a straightedge and testing with a surface checker indicates that the surface is in compliance with the specified tolerance. Continuous checking with a 3 m (10 foot) straightedge shall be required if surface smoothness is consistently at or near the maximum specified tolerance.

9.46 PAVEMENT DATE AND STATION STAMPING

Placement date (MM-DD-YY) and station location of all PCC pavement shall be stamped in the plastic concrete. Placement date should be placed at the beginning and ending of each day's run near the day's work joint. Station locations should be placed on station or as close to on station as possible while avoiding pavement joint locations. The stamped date and station numbers shall be located on a troweled surface not closer than 300 mm (1 foot) to edge of pavement slab and face outward so as to be read from the near shoulder. On roadways with narrow shoulders, the numbers are often times placed so that they can be read from the roadway. An alternate method is to stamp the date transversely to be read as one is "looking down the road".