6-1-2001

2001 WisDOT Specifications - Construction Note

Marquette University, Transportation Research Center

WISCONSIN DEPARTMENT OF TRANSPORTATION

» 2001 CONSTRUCTIONOTES »

No.2 June 18, 2001

SUBJECT: PORTLAND CEMENT CONCRETE PAVEMENT TINING

Note: This Construction Note has been revised from last year to implement the recommendations of the WisDOT research study on pavement texturing recently completed by Marquette University. The 2001 Supplemental Specifications and the C & M Manual will also be modified to implement the WisDOT study.

Background:

Subsection 415.5.9.6.3 of the 1996 Standard Specifications for Highway and Structure Construction requires that the tining pattern required for concrete pavements having a design speed of 40 MPH (65 km/h) or more shall consist of corrugations that are not more than 1/8 inch (3 mm) wide, approximately 1/8 inch (3 mm) to 3/16 inch (5 mm) deep and spaced approximately 1 inch (25 mm) center to center. Tining is to be done transversely to pavement centerline.

The Problem:

The public perceives that concrete pavements tined under current WisDOT specifications produce objectionable tire/pavement whine. They find the whine to be more objectionable than the overall noise level.

The Solution:

For the past several years, Marquette University has been conducting a research study for WisDOT on tining patterns to reduce the objectionable tire/pavement whine. During the research study, WisDOT issued Construction Notes to implement the interim results of the research rather than tine the pavement according to Subsection 415.5.9.6.3 of the Standard Specifications.

In the completed study, Marquette University has determined that a skewed, randomly spaced, transversely tined surface results in the lowest levels of pavement whine while retaining the favorable friction characteristics achieved under the current specifications. The overall noise level is not reduced by skewed randomly tined surfaces.

The research study wasn't completed in time to include the recommended tining requirements in the bidding documents for 2001 construction projects. However, Wisconsin Concrete Pavement Association (WCPA) members are aware of the findings of the research study. All WCPA member contractors are intending to use the randomly spaced tining rake, meeting the study recommendations, during the 2001 construction season.

Therefore, WisDOT is implementing the research study recommendations on randomly spaced rake for the 2001 construction season with this Construction Note.

District construction personnel should require the use of the randomly spaced tining rake, meeting the requirements below, on concrete pavements placed during the 2001 construction season.

District construction personnel can expect no change in contract costs due to this revised tining process; however, the use of the random tining spacing should be documented with a no cost contract change order.

Tining Requirements for Pavements with a Design Speed of 65km/h Plus

The tining requirements are a combination of specification requirements and referenced C & M Manual information.

415.5.9.6.3 Design Speed-65 KM/H Plus
Replace the entire text with the following:

(1) Texture and tine freshly placed pavement as soon as it is practical after floating. Texture with an artificial turf drag as specified in 415.5.9.6.2. Tine with a self-propelled tining machine. Complete before the concrete is torn or unduly roughened by the tining.

(2) Tine with a 10-foot (3.022 m) rake constructed with individual 1/8 inch (3 mm) tines randomly spaced as specified in subsection 8.10 of the department's construction and materials manual. Draw the rake transversely across the full pavement width without overlapping passes. Produce uniformly deep grooves approximately 1/8 to 3/16 inch (3 mm to 5 mm) deep. Provide a finished surface free of defects caused by improper handling of the tining machine.

(3) For rural pavements, the contractor is encouraged to tine at a 1:6 skew, left side forward. Unskewed transverse tining is also acceptable. The contractor may select either skewed or unskewed tining, but must use that pattern exclusively throughout the project.

(4) For urban pavements use unskewed transverse tining.

(5) Where using a tining machine is not practical, randomly tine areas to a similar appearance by hand. Use a rake with individual 1/8 inch (3 mm) tines randomly spaced between 3/8 of an inch (10 mm) and 2 1/4 inches (57 mm).

(6) Restore rain-damaged pavement by redragging or retining if the concrete is still plastic.

8.10 TEXTURING

Subsection 415.5.9.6 of the standard specifications provides that pavements with a design speed of less than 40 MPH (65 km/h) receive an artificial turf drag texture. Pavements with a design speed of 40 MPH (65 km/h) or greater receive the turf drag texture, followed by a machine-applied transverse tining.

The finish imparted to the pavement by the turf drag and/or tining machine is very critical for safety. High skid resistance is necessary for motorists to maintain control of their vehicles under slippery conditions. Properly textured and tined pavements can help save lives.

Artificial turf is dragged longitudinally over the pavement behind the finishing machine. The drag should produce a good longitudinal microtexture, but should not tear the surface. If it is not producing a good microtexture due to slumping fresh concrete, the contractor should move the

drag away from the finisher. If the surface is tearing, the contractor should move the drag closer to the finisher.

Pressure on the concrete can be increased by lengthening the drag in contact with the pavement, or decreased by shortening the drag. Usually 3 feet (1 m) to 5 feet (1.5 m) are in contact with the surface. Check the drag material before paving and from time to time during finishing for tears, worn surface, or hardened concrete. The contractor should clean or replace the drag as often as necessary to maintain a well defined microtexture.

The turf drag should not be applied when the surface is so wet or plastic that the ridges formed flow back into the valleys when the drag has passed, nor should dragging be delayed until the concrete is so hard that sharp ridges cannot be formed by the drag. Surface conditions may not be fully uniform, however, and dragging should be timed to maximize skid resistance. The contractor should not pull the drag ahead with the finishing equipment

The inner and outer 6 inches to 12 inches (150 to 300 mm) of the slab should be hand dragged to prevent edge slumping or tearing. An acceptable broom finish can be applied to small areas of pavement or driveways where a turf drag cannot be operated.

The turf drag is followed by a tining machine that drags a steel rake transversely across the slab to produce macrotexture. This macrotexture improves wet pavement friction by providing escape channels for water trapped under vehicle tires. Transverse tined pavements, particularly those with uniform tine spacing, may however produce an objectionable tire/pavement whine.

A WisDOT research study conducted by Marquette University demonstrated that skewed transverse tining, with a random tine spacing, minimizes whine without sacrificing friction. The Marquette study also recommended using a 10-foot (3.022 m) rake with randomly placed tines to avoid repeating tine patterns over the typical passenger car's wheelbase. Based on the Marquette study, subsection 415.5.9.6.3 of the standard specifications requires the following computer generated random tine spacing for a 10-foot (3.022 m) rake:

Tine Spacing (Center to Center of Tines, mm):

34	36	47	54	48	43	32	31	27	36	29	46
21	43	23	42	52	24	18	28	40	34	27	26
25	27	20	37	38	52	51	45	37	43	53	14
27	37	42	41	29	43	14	45	44	30	37	33
40	28	31	50	34	45	15	20	45	50	16	53
51	29	25	18	16	53	18	38	51	40	17	15
49	50	39	51	36	36	38	46	29	38	50	24
33											

The specification also allows hand tining of areas such as ramps, gaps, intersections, etc. where machine tining is not practical. In these areas it may be difficult or impossible to maneuver the tining machine, or the machine may be in use elsewhere on the project when these areas are poured.

The contractor has the option of skewing or not skewing the tining. Because skewed tining is quieter, the contractor should be encouraged to use skewed tining. Whichever pattern the contractor selects, make sure that pattern is used consistently for all the areas requiring tining on the project. If joints are skewed, the tining must either be skewed in the opposite direction or not skewed at all.

The rake should be checked for missing, bent, or broken tines before tining. Also check the tine spacing and make sure the tines are clean. The specification is based on the dimensions of the rake not the spacing of the grooves created in the pavement. The flexibile tines cause variability in the spacing of the grooves created in the pavement and thus make it impractical to measure the groove spacing. If the rake is constructed as specified and well maintained, the pavement grooves should have the desirable random spacing between 3/8 of an inch (10 mm) and 2 1/4 inches (57 mm). If the pavement consistently shows spacing outside these limits, examine the rake for problems.

During the tining, check the concrete grooves for uniform depth within the limits specified in 415.5.9.6.3 of the standard specifications. If the surface is tearing, the contractor should decrease the transverse speed of tining or move the tining machine closer to the paver. If the groove is slumping, the concrete is not stiff enough, the contractor should move the tining machine away from the paver. If the grooves are not deep enough, the contractor should adjust the machine or move it closer to the paver.

The timing of the tining operation must be coordinated with the dragging operation and adjusted for conditions to produce a uniform depth of sharp, well defined grooves. The finished surface should be free from rough or porous areas, irregularities, and depressions resulting from improper handling of the tining machine.

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