Questions and Answers from Tech Tuesday Webinar on *Revisiting (early opening) strengths for pavement. What do you need, and how do you measure it?*

June 16, 2026

Q1 - I saw Wavelogix sensors in Todd's title slide. What has been the experience with these in Minnesota and Iowa? (Agency, NY)

> Iowa DOT: Iowa has used the Wavelogix on a couple of bridge decks and seems to work well. One of our district materials engineers did some work comparing cylinders to Wavelogix. He found that the early strength may be a bit lower than cylinders and he decided to add 10% to the Wavelogix for early opening strength.
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> CPAM: I know MnDOT has had some experience with Wavelogix. I know there was great hope.
>
> MnDOT: Minnesota has used the Wavelogix on 8 sensors/1 per test section at MnROAD during construction in 2024. We have also installed 4 sensors on 1 concrete paving project (I-90) and 4 sensors on 1 bridge deck project (494). Battery Life ranged from 5 to 16 days and 12 of the 16 sensors worked. No formal reports have been written on the use of these sensors, however we did provide the data to the vendor.

Q2 - With the conservative strength requirements potentially reducing the long-term durability would it be beneficial to add maximum strength requirements? Or I guess it would be a maximum cement content? (Contractor, SD)

> Iowa DOT: Maximum cement content is much easier to enforce than a maximum strength.
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> CPAM: I love the idea of maximum cement content. As noted during webinar, MN does not have a strength spec for pavements. We always get strength when we develop the right mix. I know there is a lot of talk around the country about over building/designing concrete strengths.
>
> MnDOT: I don’t know how someone could control the maximum strength of the concrete. Limiting the cement content would be easier to enforce, but it doesn’t mean you will get a lower strength. The primary concerns as the research indicates are that mixes were often over-cemented in order to achieve earlier opening times at the required strength, thus leading to increased shrinkage/cracking which can lead to less durable concrete.

Q3 - What types of Cement (1, 1L, or 3) is generally used for these early opening pavements? If all are used, do you see differences in the performance? (Agency, WV)

> Iowa DOT: In Iowa, we have used Type I,II, IP, IS, IL and IT cements with a 20% fly ash replacement. The more replacement the slower the strength gain, but for the most part it is still 24 hours or so for opening at 350 psi by maturity during summer conditions. It will be a bit longer (~48hrs?) as you get into the late fall paving.
>
> CPAM: Really all we have available anymore is 1L cement and we still do not have trouble achieving relatively early opening strengths, 24 hours +/-. Our contractors do a good job of understanding the benefits of using higher quality admixtures and the benefits that come along with them. Even in cooler weather construction we can get opening strengths in 3 days or so.
>
> MnDOT: In Minnesota, we have primarily used Type IL cement since 2022. On occasion (project mix design or time of year), we have seen opening strengths take longer than 1 day.

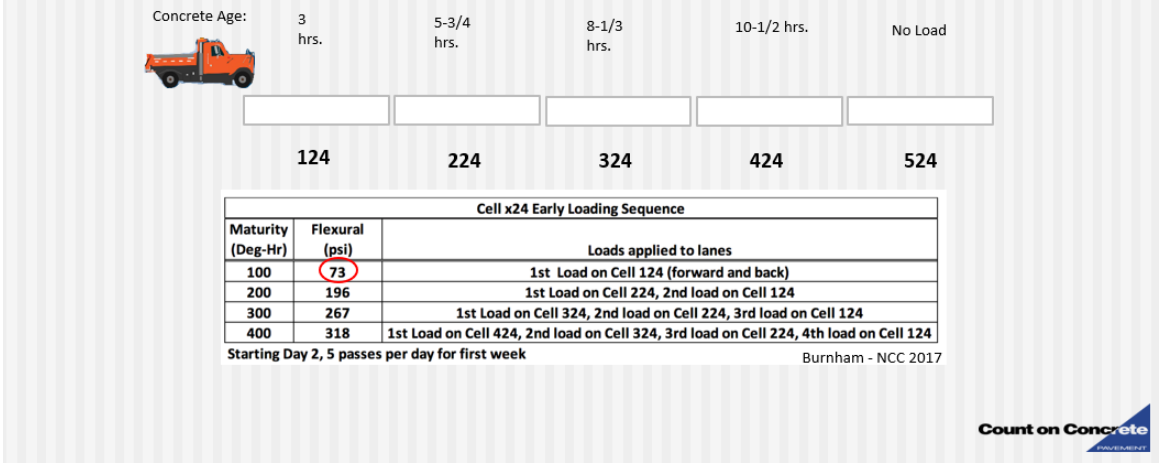
Q4 - What impact has Type IL cement had on your early flexural strength data? (Contractor, NC)

> MnDOT: As discussed in question 3, we have not seen a significant impact on early flexural strength data. The change to Type IL cement also coincided (within 1 year) of MnDOT reducing the opening strength requirements to 300 psi flexural for all concrete so the impact may be negligible.

Q5 - When you did the test using plow truck for 3, 5.. days, did accelerator agent add in the concrete? And what type of cement was used for the concrete? (Agency, MO)

> CPAM: We actually did the snow plow truck testing 3 and 5+ hours (not days). This experiment used a traditional ready mix concrete designed for pavements. It was designed to meet our traditional water-cement ratio of 0.40 maximum. This is generally achieved with only a good water reducer. The cement used was most likely a Type I/II cement.

The Experiment



Cell x24 Early Loading Sequence		
Maturity (Deg-Hr)	Flexural (psi)	Loads applied to lanes
100	73	1st Load on Cell 124 (forward and back)
200	196	1st Load on Cell 224, 2nd load on Cell 124
300	267	1st Load on Cell 324, 2nd load on Cell 224, 3rd load on Cell 124
400	318	1st Load on Cell 424, 2nd load on Cell 324, 3rd load on Cell 224, 4th load on Cell 124

Starting Day 2, 5 passes per day for first week

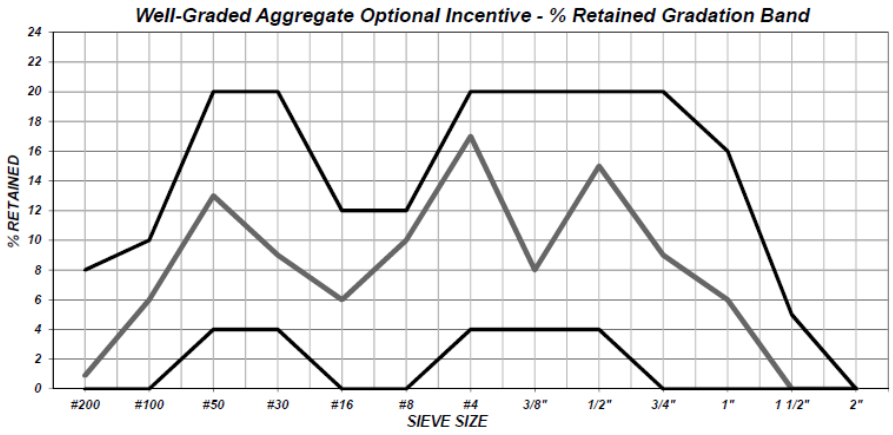
Burnham - NCC 2017

Count on Concrete PAVEMENT

MnDOT: The mix design was MR-3A21 as follows:
Maximum W/C Ratio: 0.40

Material	OD Weights (pounds/cubic foot)	Proportion of Cementitious/Aggregates
Type I/II Cement (Source: St. Gen, MO)	400	70%
Class F Fly Ash (Source: Coal Creek, ND)	170	30%
1-1/2" Natural Gravel	562	18%
#67 Natural Gravel	1015	33%
3/8" Natural Gravel	305	10%
Natural Sand (Coarse Graded)	1173	39%
Air Entraining Admixture	0.01-3 oz/cwt	Target 7.0% Air Content
Type A Water Reducer	1-3 oz/cwt	As needed
Type B Hydration Stabilizer	1-4 oz/cwt	As needed
Type S Viscosity Modifying Admix	1-5 oz/cwt	As needed

Optimized Gradation: Met tarantula curve consisting of 4 aggregate fractions



Coarse Sand % Retained (#8 through #30)
38
Greater than 15%, generally enhances cohesion of the mix.

Fine Sand % Retained (#30 through #200)
29
Between 24-34%, generally enhances workability of the mix.