Smoothness Webinar – Questions and Answers

The questions submitted during the webinar follow with answers that our speakers have provided.

Additional resources are available at https://cptechcenter.org/real-time-smoothness/

1. Any advice as to how to spec a lightweight grinding machine for restoring smoothness in an older local street that is in decent structural condition but rough and is too thin (~6") to support a large grinding machine? Oklahoma

   This is likely the machine you want to write your specifications around: https://www.diamondproducts.com/pc1500. You definitely want the slurry vacuumed by the grinder and so specifying a maximum weight for the water/slurry truck may be a good idea too; a tandem axle tank with no more than 2500 gallons of slurry should come in at less than 50,000 pound on three axles.

2. Are there any good guidelines for profiling and the impact of temperatures and seasonal variations on it? Michigan

   The only recommendation is to try and perform profiling operations at what would be an average ambient temperature for the area. It is very difficult to provide general guidelines as there are many different factors that can affect the amount of curling and warping that is present in a pavement, and it is different for every project and climate. The CP Tech Center has published a report that details the causes of curling and warping and provides some mitigation strategies, which can be found at https://intrans.iastate.edu/app/uploads/2018/03/curling_and_warping_impact_on_concrete_pvmt_w_cvr.pdf

3. Clearly, temperature at time of measurement of IRI/MRI drives the outcome. We need to overcome this somehow. There should be a means by which to measure a "mean temperature corrected" IRI for the geographic location that would provide the actual best results for the pavement user.

   The machinery measures the point elevations as I understand it. It could also be set up to do a point measurement of temperature at time of evaluation. Through some fancy math (Rob Rasmussen type stuff) I would think that we should be able to correct for the temperature gradient between temperature a couple of feet down and the surface assuming both were measured.

   This would involve some heat transfer calculations I would think along with knowing the coefficient of thermal expansion for the aggregate/concrete being used to take out the effective gradient or convert it to that of the localized mean temperature.

   This IS a complicated problem, but not impossible to solve within reasonable limits. I would think it would benefit the the industry by eliminating unnecessary grinding while still ensuring elimination of TRUE roughness problems. It would also eliminate "gaming" the system to only measure at the time of least curl which a contactor would be/should be always wanting to measure.

This would be an interesting research project! Illinois

The relative importance of slab curling and warping on measured IRI can vary a lot from project to project, depending on how the pavement is designed, constructed, and the environment it is in. In many cases, this cause-and-effect can be very significant. One of the more practical ways to overcome "gaming" the spec is to profile the pavement at least two times during the course of a 24-hour period (ideally at times corresponding to extremes in the temperature gradient in the slab). Compensating for irreversible slab warping (due to differential drying) is a bit trickier, but is a challenge that can still be overcome. I agree with the idea that a mathematical correction is possible. However, like many pavement models, a job-specific "correction factor" will be needed. With collection of a few extra profiles, along with some "fancy math", this "complicated problem" can be made simple enough to implement as the next generation of pavement specification. In doing so, we could strike a fair compromise that treats contractors fairly, while at the same time providing the traveling public with the good ride quality they reasonably expect.

4. Does grinding expose void structure in the paste or the aggregates that then are susceptible to oxychloride deterioration? Colorado

   In Colorado specifically, CDOT and many local agencies have moved to using performance engineered mixes focused on long term durability of the pavements. By requiring low permeability mixes, testing aggregates for ASR susceptibility and requiring a minimum 20% cement replacement with SCM's there are no concerns with grinding creating durability issues in new pavements.

   Some agencies are applying penetrating sealants to help address this.

5. To what extent can diamond grooving address rough pavement? Is there a way to tell if a certain element of the mix design may have contributed to prematurely rough pavement? Would appreciate answers both from individual and state experience and from best practice literature. Indiana

   Grooving does not effect roughness and is not the recommended solution. Guidance on the effects of mixture proportioning can be found in https://intrans.iastate.edu/app/uploads/2019/12/smooth_concrete_pvmt_guidelines_w_cvr.pdf

6. What are your recommendations for height of the slipform vibrators above rebar in a CRC Pavement? Colorado

   Minimum 1" clear of all steel. Use cylinder locks to assure that vibrators don't drop and catch the steel. Adjust up from that starting point as needed, but not above the front of the pan.