Joints Webinar – Questions and Answers

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

Additional resources are available at http://www.acpa.org/wp-content/uploads/2017/11/IS006E-Intersection-Joint-Layout.pdf

1. Do you believe mobile GPR may replace MITScan? Florida

   BC

   I would rather say "complement" than "replace." In New York, we've had "the best" results with the MIT Scan, but we have encountered some limitations. Specifically, determining dowel alignment in An unbonded overlay atop a reinforced pavement, A pavement on a slag aggregate subbase, Baskets without the shipping wires being cut, and Dowels closest to longitudinal joint ties

   Contractors have used GPR in some of those situations, but it was not quite as precise. I think it's reasonable to assume that technology will develop and improve to determine dowel alignment and any method that can provide accurate and precise results will help the concrete industry and provide our agency-owner partners with great data.

   KWM

   I do not believe that ground penetrating radar will be used as a tool to replace MIT Scan. MIT Scan builds a three dimensional model of the dowel bar that allows for a very accurate idea on the position of the dowel. I have not seen a GPR device and data output that can do what the MIT

   In addition, the MIT Scan device has been endorsed by the Federal Highway Administration, the American Concrete Pavement Association and many state DOTS and tollway authorities as the tool for use in measuring the accuracy of the dowel placement.

   See FHWA CPTP Tech Brief FHWA-HIF-07-021, published in January 2007 and Guide to Dowel Load Transfer Systems for Jointed Concrete Pavements published by the NCPTC in September 2011

2. Which dowel bar translation is most critical? Florida

   BC

   The one that's farthest out of spec. That said, probably vertical tilt and horizontal skew because they will lock the joint. Longitudinal translation of an 18" long dowel needs to be severe to increase bearing stress to the point it will damage the joint. Upward vertical translation is more critical than downward. New York is +0", -1" on vertical translation.

   KWM

   Horizontal skew and vertical tilt are the key parameters. Side Shift and vertical deviation still allow for the concrete pavement to expand and contract around the

dowel. Horizontal skew and vertical tilt can lock the joint up completely and prevent movement. See http://www.acpa.org/wp-content/uploads/2020/07/18-11-15-ACPA-Dowel-Alignment-Guide-Spec.pdf

3. Why do they still make dowels 18 inches long? Shorter dowels should work just as well and would save cost, Florida

   BC

   Agree fully. In fact, New York uses 14-inch long dowels in precast slabs and pavement repairs. It is quite easy to see that they are properly placed in those applications. They are still 18" long because agencies fear too much longitudinal translation and/or misplaced saw cuts. 18 inches is a big, entrenched factor of safety.

   KWM

   AS I mentioned in the presentation 18 -inch dowels are nothing but history and tradition. Research going back as far as the 1920s established the 18-inch length. In more recent times this dowel length provides a good factor of safety that there is enough embediment length for performance. I also indicated that MN is currently using 15 inches and I see more companies and DOTs looking at this.

4. Bill, can you please expand on the material that you used to fill the joints? California, Dulce Rufino Feldman

   BC

   The material is a hot-applied, asphalt-based sealant meeting ASTM D 6690 Type IV. ASTM D 6690 Type II is the old D 3405. Seems like everyone who had a "3405" material also had a "modified 3405" for concrete joints. D 6690 Type IV is the "modified D 3405." Type IV has a greater extension than Type II at -29°C.

   KWM

   Wisconsin specifications require the use of hot pour asphalt joint sealer meeting the requirements of ASTM D6690, type II.

5. On the joint design for the gore area where you tied on one the most loaded side only, did you have simply a construction joint without tie bars OR did you specify an isolation joint to prevent sympathy cracks? California

   BC

   It is a butt joint. No key, ties, or board. We apply form oil or plastic sheeting to the first placement and let the second placement shrink ever so slightly away from the first. We typically do not use expansion board (isolation board), except in cold weather closure pours. In the cold weather, we need the board to take up a little space. In the cold, the surrounding concrete shrinks a little, so the "hole" is gets little bigger. So we end up putting in a touch more concrete in the hole than we would in warmer weather. Then, come warm weather, if there's no board, there isn't enough room for expansion, and we get blow ups.

When we've used board in the warm weather, we seem to end up with wide joints. The hole is smaller, a little less concrete goes in, and what goes in shrinks. That shrink is on top of the ½" or ¾" board width.

6. What is your recommendation for maximum transverse and longitudinal joint width? California

BC

I'm assuming you mean sealant reservoir width. For NYSDOT sealing with ASTM D 6690 Type IV, we just need a reservoir that's wide enough to accept the sealant. A typical ⅛" wide first stage will not accept sealant. ¼" seems to do the trick.

When we used silicone sealant, we chose ⅜" (10 mm) based on our typical aggregates and slab lengths. That allowed 100% expansion. Then, we'd bevel the reservoirs ⅛" (3 mm) on each side to get the silicone beneath the surface of the pavement to protect it from traffic. So the entire width was ⅝" (15 mm), which, with joint activation, became just enough for tire slap.

KWM

Maximum joint width is nothing more than the width of the saw blade cutting the joints. So, approximately 3/16 to ¼ of an inch

7. You talked about filling the joints right at the end and did not spend much time on it. It seems you simply "filled" the joints to avoid other "evil" material to penetrate..., California

BC

When you get a guy from Wisconsin and a guy from New York together, you shouldn't ask too many questions about joint sealing. Sparks can fly 😉.

Seriously, joint sealing has a lot of opinion and empiricism associated with it. California's experience with sealant is going to be quite different from New York or Wisconsin.

When NYSDOT used silicone, we also used backer rod. This left a void under the backer rod that had the potential to hold water and salts. If there is enough water to saturate the concrete, freezing and thawing can deteriorate the joint. If we fill the entire joint, there is less room for water and less potential to saturate the concrete. Also, if we fill the joint, there is less room for incompressibles.

My experience in New York is that any space taken by D 6690 Type IV is better than space filled by water or road debris. The adhesion in our method is only in the top 1" deep reservoir. And it may very well be that we do not have adhesion on both sides of the joint. But the sealant, when it is in the first stage cut, stays in there with the adhesion we do get in the clean, dry reservoir.

Plus, the self-leveling silicones just didn't seem to stick as well as the ones that had to be tooled into place.

Finally, we can grind through the D 6690 material, but grinding through silicone was certain loss of sealant.

KWM

Our approach in Wisconsin is that we are filling the joints for the sole purpose of keeping incompressibles out. We do not believe that we can seal joints to keep water out. Filling also provides the reduce capacity for water to enter the joints.

8. "Not tied" and adjacent is also isolated to avoid sympathetic cracking or truly adjacent, not tied and not isolated but a plastic bond breaker or form oil avoids bonding? North Carolina

BC

Yes. Please refer to number 5 above. The plastic or form oil both seem to be sufficient to stop bonding. Plastic is for sure effective. The second placement will shrink ever so slightly away from the first if we ensure they do not bond. And that seems sufficient to stop the sympathy cracks. If they bond, it is more likely that they will crack each other.

KWM

I am consistent with Bill Cuerdon on this one. A construction joint is all that is needed in many cases. The introduction of expansion joint material seems to introduce the potential for wide joints and water/durability issues with the concrete.

9. What is your opinion on reducing the number of dowel bars across the 12-ft lane? In particular, removing the centerline dowel? Or another option of only using 4 dowels per wheelpath? Pennsylvania

BC

Well, I know those Pennsylvania truckers really stay exactly where they're supposed to. But up here, it seems like our truckers drive like they're in a scene from Terminator. Seriously, and it's strictly opinion, but I'm reluctant to remove the center dowels. I'm old and slow to change. It seems like trucks weave. It seems like we'd need to know how many truck wheels are over those center dowels, or lack thereof, to do a proper design.

KWM

I think this is absolutely an approach to load transfer system designs that we should be looking at and evaluating. There has been a number of research efforts that have looked at this and concluded that some of the dowels in the center of the lane are not doing any work or a small amount of the work transferring the load. A great tool for analyzing this is the ACPA DowelCAD software. It is a very simple and good visual tool of some of the most popular approaches to this in the past. Key is that we do it with knowledge. None of us wants to put something out there that reduces the life of the pavement. But, we should be optimizing our design approach. Significant dollars could be saved.

10. What type of subbase do you use below your PCC pavement and what impact have you found it has on dowel misalignment when using baskets, Illinois

BC

New York uses dense graded aggregate base and I presume that it has no effect on dowel alignment.

KWM

The vast majority of the concrete pavements in Wisconsin are on top of 6 inches of dense graded base aggregate. In many cases, there are additional layers of granular bases underneath. The key is the dense graded base and the ability to anchor baskets for good alignment of dowel bars. Unfortunately, the longtime policy of the Wisconsin Department of Transportation is to allow the contractors to keep the shipping wires intact. We had research back in the late 80s and early 90s that showed the dowels were more accurately placed when they were kept intact. Keeping the wire uncut distorts the accuracy of the MIT Scan device, so we have no modern day data on the accuracy of placement of dowel bar baskets.

11. How effective is Corrosion Resistant Alloy Steel (MMFX, or ChromX) for rebars? Are they better than epoxy coated rebars in terms of corrosion resistance? New York

BC

I would direct you to Willie Feliciano in the NYSDOT Materials Bureau.

KWM

I do not have any direct knowledge of this product. And, this question underscores the need for the revision of AASHTO T253 and M254 standards. Upon completion of the effort we would be able to reference all dowel products on their ability to transfer load and their corrosion resistance properties.

12. I often see highway concrete pavement densely reinforced longitudinally & horizontally. Concrete itself has shear strength enough to support vehicular wheel load as far as I know. Also, once a tiny micro crack started, then nothing can stop it from growing effectively, which means that rebars in a concrete pavement does not help anything. New York

BC

Thank you. I have to disagree that deformed bars do not help anything regarding cracking in a pavement. Even if it keeps a crack tightly together to maintain aggregate interlock, it's done something.

KWM

I would refer you to the AASHTO Guide on the Design of Pavements. In particular, the section on continuously reinforced concrete pavements. Steel in this design does not prevent cracking , but instead hold the crack tightly together.

13. Can Kevin comment on if Neenah is marketing their telescoping manholes? Minnesota

KWM

The Wisconsin Concrete Pavement has for quite some time been encouraging Neehah, WI based Neenah Foundries to complete and implement their new designs on

telescoping manholes. Please join me in reinforcing to them that this product is needed and would benefit the performance of concrete pavements.

14. How soon after the concrete is placed should the contractor saw the concrete? North Carolina

    BC

    That's a big "it depends." Depends on the mix, the weather, and the equipment. Early entry saws can cut sooner that wet cuts. Old timers will scratch the concrete with a nail and when it's sufficiently white, they cut. Some states use Hiperpave to identify the saw cut window. In the cooler weather, you have more time than warmer weather.

    KWM

    Timing of sawing is one of the true arts of concrete pavements. Temperature of concrete, ambient temperature, sun exposure, time of placement, cementitious material types and content are all part of the art of determining when it is time to start sawing. Then you introduce the type of saw and adjust your timing to meet the ability and weight of the equipment. Begin sawing when the saw produces no or an acceptable amount of raveling of the joint, but sooner than the time in which cracking would start.

15. Bill, what are you sealing your joints with in New York? Nevada

    BC

    I think that's covered in 4, 6, and 7 above. Nevada is going to be different from New York.

16. What is meant by "High Performance" dowel bars? Nevada

    KWM

    Dowels bar designed to perform for the performance life of the high performance concrete pavement in which it has been installed. In Wisconsin and several other states, these are pavements that have been designed for 50 years of traffic and performance. So, in simple terms they are dowels that have higher scrutiny in testing to show that they have corrosion resistance for 50 years and can provide load transfer for 50 years. As you saw in my slides all of the alternatives given were corrosion resistant materials.

17. Need to mention when sawing, sometimes the contractor does not cut all the way through side of pavement, sometimes due to metal forms. But, once forms are moved and crack has not form, they should go back and saw edges. I also, make a point to tell my inspectors to go through to visualize a crack under the saw, quick way to identify if contractor is sawing at proper depth. Missouri

    BC

    Agree 100%. We allow demo saws for that touch up.

    KWM

Agree with your concern. We have seen a higher frequency of spalling and joint distress when they are not sawed through the edge.

18. Do you recommend using transfer dowel bars in circular concrete truck aprons within roundabouts? Indiana

BC

Each truck apron should be designed on its own merits. How many trucks and what axle configurations can provide insights. For our roundabouts, I would say it's 50-50, but we don't have a roundabout that I feel requires dowels in the entire radial joint of the truck apron. We typically have 2 "lanes" in our aprons (1 longitudinal joint) and I would only do the outer "lane," if at all.

KWM

Agree with Bill, each truck apron should be designed on its merit for requiring dowels. To date all of them built in Wisconsin have been built with dowels in the traffic lanes, but not necessarily in the truck apron. We have seen cracking in roundabouts that I can contribute to too much steel and the geometry of the slab challenges that we can have in roundabouts.

19. In intersection joint layout where two adjacent slabs are intended to remain unbonded due to different directions of movement, is it recommended to place a "sleeper slab" (unbonded) under the pavement slabs to prevent joint faulting? Indiana

BC

I hate sleeper slabs. Just my opinion. We used to use sleeper slabs at structural approach slab/pavement interfaces under the pressure relief joint. Here are my thoughts in no particular order.

It seems like we get more cracking in concrete on sleeper slabs.

I like good compaction and consistent support. I see no reason we can't get good compaction in any intersection we've ever done. And if the cross street is asphalt, we wouldn't consider a sleeper slab.

Generally, I'd have to say the truck traffic and speed of traffic do not warrant a sleeper slab in an intersection.

I do like to make any first slab off of a free edge go down to our "Lmin." Especially where we abut HMA. HMA will hump adjacent to PCC and making that first slab as stout (less slender) as possible will increase loads to failure. I think Lmin is also preferable to a thickened edge. I really like consistency in a cross section. You make that first slab 10' long instead of 15' and it'll take more to crack it.

The sleeper slab can present a compaction problem itself.

They cost money and take time.

KWM

Interesting question. The only sleeper slabs we build is in the concrete pavement approach slabs for bridges. We have done this since 2014. We want the joint to handle the majority of the expansion. We have seen improved performance of the

approach slabs with this policy. I know of no engineering document from FHWA or ACPA that promotes the use of a sleeper slab in the application you mention. Everything in the ACPA jointing documents IS006 and TB019 is traditional jointing practices with a predominant roadway given the ability to expands and contract and the “side road” accommodating expansion with the proper use of these joints at the intersection radiuses.