

Concrete Pavement Preservation Webinar 3 – 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/pavement-preservation/>

1. Can SCC be used for backfill of DBR slots?

We find the best results are achieved using proprietary fast setting cementitious products designed for the special needs of a DBR. Strength development is especially important, not as much for reopening to traffic as much as developing strength before the diurnal temperature swings begin to move the concrete slabs, stressing the newly placed DBRs. Durability is also a big factor. These materials and suppliers can be found on the IGGA website www.IGGA.net.

2. Can the AZ DOT presenter talk about any urban heat island impacts that uncovering and exposing the concrete may have?

The decision to remove the AR-ACFC was not based on climate impacts, but rather economics. With that said, concrete has a higher albedo and as such should reduce the urban heat island effect. However, urban island is a very complex phenomenon and the amount of exposed concrete as a result of the grinding will probably not impact this.

3. Can you please go into more details about how you removed the ARCP on the 4 miles of SR202 rehab project? I didn't quite understand the cutting strips to control milling head depth.

As you are most likely aware, a milling machine simply dials in an asphalt removal number (in our case 1”) and goes to work. Unfortunately, there are often inconsistencies in the PCC and the 1” rubber course (high points & low points) which are not taken into consideration in a regular milling operation, often causing the PCC to be badly marred. By cutting strips in the 1” rubber course, the milling operators can see the depth they are required to cut (instead of just dialing in 1”) and can provide a less damaging effect to the underlying PCC.

4. Can you provide a guide book on best practices for diamond grinding and when it can be used to improve faulting or uneven concrete surface and when it may be best to use another technique such as dowel bar retrofit?

There are numerous resources available on www.IGGA.net , www.ACPA.org , www.CPTechcenter.org ,and FHWA websites related to those topics. The following publication is a good starting point....

<https://intrans.iastate.edu/app/uploads/2018/08/MAPbrief4-1.pdf>

5. Can you suggest materials that could be used for PDR's?

This is a very broad topic in that there are a number of different products and classifications... cementitious, polymer resins, elastomeric, etc. all with varying attributes, performance and prices. I suggest that you explore the PDR manual developed by the CPTech Center at the following link as a start,

https://intrans.iastate.edu/app/uploads/2018/08/PDR_guide_Apr2012.pdf. The most widely used PDR materials and suppliers can be found on the IGGA website www.IGGA.net using the available search engine.

6. Could you please share treatments for ASR-related distresses and D-cracking,

Some guidance is available in

https://intrans.iastate.edu/app/uploads/2019/01/concrete_pvmt_distress_assessments_and_solutions_guide_w_cvr.pdf

7. Did the Arizona DOT get a lot of push back from the asphalt industry and how did they handle the political pressure with regard to that?

Great Question, we are in fact getting some push back from the asphalt industry for moving forward with our diamond grinding operations. We are handling this by explaining that we have to make educated decisions with the limited maintenance and capital improvement funding we receive and other options are always on the table to be explored. The asphalt industry is aware that we do have some sections of PCC that are quite aged in Phoenix and will most likely be overlaid with 1" rubber for many future years. It is a bit of a balancing act.

8. Does diamond grinding or just grinds for smoothing compromise the aggregates and make them susceptible to ASR or salt intrusions that increase the rate of deterioration?

AND

WRT ASR, the exposed rock surface (if igneous) is going to expose a paste silicon dioxide interface that may be reactive, no?

We are not aware of any authoritative research that shows that diamond grinding accelerates the onset of ASR deterioration or increases the rate of salt intrusion and have not encountered increased rates of materials related distresses due to the grinding process in the field. While it is true that the diamond grinding process removes the very thin paste fraction from the roadway surface, so does traffic over time exposing the coarse aggregates. Assuming that this concern is directed at older, existing pavements (since most newer pavements are not built with ASR-prone aggregates), it is likely that the coarse aggregates are already exposed. That said, pavements that are deteriorating rapidly due to severe materials related distresses are not likely candidates for grinding or significant preservation activities.

9. Does WsDOT have an average cost per SY of total pavement to do dowel retrofit?

This cost needs to be calculated based on individual project conditions such as: project size, project location, available working hours, wage rates, aggregate type, existing smoothness, required smoothness, joint spacing, etc. An average cost even from a single state would be misleading. Costs can vary widely from project to project even within the same state. A good range to use for the individual DBRs is \$35 to \$45 per bar installed on a project with 25,000 bars. Prices will come down on bigger jobs. Assume 3 or 4 bars per wheel path depending on traffic loading and multiply times the number of joints. Grinding will typically range from \$2.50 to

\$5.00 on average unless the aggregate is very hard and/or the required removal is excessive.

10. Fast setting concrete materials have been referred to frequently in this presentation. What is the track record on performance of these fast setting materials? Do they get the life that one would expect with a typical/normal concrete mixture? Has anyone tracked average life of slabs placed with fast setting (e.g. high early strength) materials?

The performance track record on fast setting concrete materials used in the highway market has been scattered over time. Many of the so-called fast setting concrete products may set quickly but cannot stand up to the constant pounding of roadway traffic. In recent years new fast setting concrete materials have been specially developed to endure the harsh roadway environment and have been documented as performing very well. Dr. Mike Darter has done some work in this area and I believe that he will be presenting some of his findings in next week's webinar series, Part 4 on Tuesday June 24, at noon CDT. These materials and suppliers can be found on the IGGA website www.IGGA.net.

11. For joint/crack sealing, we are hearing that it may be better to exclude the backer rod and just fill the joint/crack with sealant. The labor savings of installing the backer rod offsets the added material costs. The larger face also provides more opportunity for the sealant to bond with the concrete.

AND

I hear from others there is a concern about moisture trapped or attracted by backer rod. Should we consider sealing without backer rods?

Yes there are several state DOTs that fill rather than seal their joints and report that this process works well for them. Transverse joints are a system that require design and a careful look at geometry, materials, past performance, cost and local contractor proficiency. In the end it is a choice to be made that best suites the owners.

That is in fact true when using the improper backer rod. The use of backer rod NOT designed for use in roadway applications can hold water and result in premature deterioration at joint locations. This is not true when the proper backer rod is used.

Water trapped in the kerf below a backer rod has been shown to accelerate joint distress.

Further to the question, sealing without backer rod is essentially joint filling. There are a number of states that fill their joints rather than seal and report good performance. In the end this decision should be made based on local performance.

12. For the AZ diamond grinding projects, how are the slurry residuals handled? Shoulder applied or another process?

For both projects to date, the contractor deposited the slurry in a lined ponds and let it decant (water evaporate). The current project is using an active quarry where it is being decanted.

13. How did you prepare the longitudinal interface (ie., stepping) between the diamond ground lanes and the 1" thick asphalt lanes?

The contractor utilized a small grinding machine to taper the 1" asphalt to the ground PCC. The taper is approximately 8"-12" wide.

14. How does diamond grind impact the total lifecycle costing for concrete pavements? How will this impact your initial pavement selection moving forward?

The answer to this question is based on performance in a given local and there is no single answer that will suit all situations. Life cycle costing should be based on data obtained from local survival curves, which are refined over time through local experience and fed back into the analysis. In general it is widely accepted that smoother pavements last longer, meaning that diamond grinding can prolong the life of a concrete pavement.

15. How does noise level of diamond ground concrete surface compare with asphalt surface from overlay?

A conventionally diamond ground surface often times can be quieter than a dense graded asphalt surface. The Next Generation Concrete Surface (not discussed during the webinar) can outperform dense graded asphalt surface in terms of noise reduction.

Our limited testing to date shows that new rubberized asphalt surfaces have an approximate 97db level when new and increase to 103-107db at the end of their life (typically 10 years). The diamond ground surfaces typically have an approximate 102db level when new and keep to that db level throughout their 15 years of typical life.

16. How much concrete was removed in the diamond grinding of 4 miles of 202 that Randy talked about?

A good question and one I meant to answer in the presentation and neglected to. We typically ground approximately 3/8" to 1/4" off the PCC surface.

17. I am hearing that some thin concrete overlays with 6x6' jointing are not doing joint sealing on interstate highways within freeze thaw areas. Is this wise? Recommended?

While we continue to learn from each overlay built, it should be noted that the specific answer to the question about sealing or filling of joints for small panel overlays ranges widely from application to application and from agency to agency. Several states who did not seal joints early on have now revised standards to require sealing or filling. However, a number of states continue without sealing and have seen little reason to change that practice.

18. I had heard the term "next generation diamond grinding" a few years ago but never saw any samples. Was this term representing the diamond smoothing that was talked about earlier?

The Next Generation Concrete Surface (NGCS) is a diamond saw cut surface texture that was specifically designed to reduce tire pavement noise while providing a smooth

and safe exposed driving surface. The following file will provide some additional background. Visit IGGA.net for more information or:

<https://intrans.iastate.edu/app/uploads/2020/01/MAPbriefJanuary2020.pdf>

19. I love the diamond grinding on the 101 south valley. It is so smooth and quiet.

We are thrilled to hear that. One of the big factors for us, besides testing for noise and ride, is to gauge the reaction of the public who drive the roadway. The more comments like this, the more we will have support to continue these diamond grind projects.

20. Is DBR recommended anywhere a transverse crack occurs in a slab?

No. If a transverse crack occurs close to a transverse joint, it is recommended to use full depth repair in that location.

21. Is diamond grinding always done in the longitudinal direction?

Yes

22. Is it a common practice to do diamond grinding for new pavements, instead of tining?

Diamond grinding as a final surface texture in new pavement is commonly used across the country. This is especially true on large, complex design build projects where there are heavily phased sections constructed over the period of years making it very difficult to maintain surface smoothness. Grinding is several decibels quieter than tining, removes any existing curl and warp extending pavement life and provides significant macrotexture for safety.

23. Is your flush process similar to a fog seal?

It is the very same thing, just has a couple of different names.

24. Should curing compounds be used on partial and full depth repairs after the initial wet curing and prior to opening to traffic?

Curing is an essential part of patching, especially on repairs using fast setting materials. Wet curing is not a common practice today however. Often times on partial depth repairs double application of modern curing compounds are required due to the depth to surface area ratio of the patch. Proper curing is critical.

25. Should the joints be air cleaned or water flushed before applying a sealant?

Joint preparation specifications typically require sand blasting (follow by compressed air cleaning) or water blasting to clean the joint faces prior to sealant application. Both are effective provided the processes are carried out properly.

26. So do we have a LCCA of the 202 considering all the mitigations and follow up treatments? How does this revised estimate compare to the original LCCA to use concrete?

A LCCA was not conducted for the original PCCP construction nor was one conducted for the placement of the AR-ACFC overlays. As mentioned, the AR-ACFC was a politically motivated noise solution. However, initial construction costs were

recently used to develop network costs over time to compare the different options and their attendant costs.

27. So, is it no longer an accepted load transfer design tool to use large road stone >2.0" to create load transfer at control joints?

Most pavements today are built using 1" or 3/4" coarse aggregate and with dowels inserted for load transfer. Experience has shown that heavily trafficked systems without dowels may lose load transfer over time.

28. Using milling in partial-depth repairs does not provide straight-cut edges. Is it still recommended considering that feathering at the repair edges will be subject to quicker deterioration?

Experience has shown that milled, feathered edges of PDRs perform very well over time (20 years + in MN) provided the loose material is removed from the edges using a jackhammer and the patch is sandblasted clean. Bear in mind however, some repair materials require saw cut edges to be used.

https://intrans.iastate.edu/app/uploads/2018/08/PDR_guide_Apr2012.pdf

29. Was there a lip between the HOV and the diamond ground lane?

Yes, there is a 1" lip between the two surfaces. The contractor utilized a small grinding machine to taper the 1" asphalt to the ground PCC. The taper is approximately 8"-12" wide.

30. What about thin bonded overlays?

Overlays are an effective tool in the state's toolbox. See the webinar series on overlays at <https://cptechcenter.org/webinars-and-videos/>

31. What are your recommendations for success of joint resealing during the in-service phase of the concrete pavement (time interval to do and repeat) and design and material details to consider.

This is a question that is a function of the type of material used, quality of installation and inspection, rainfall rates, traffic, base type, drainage, etc. The following ACPA Tech Bulletin is a good starting point. <http://www.acpa.org/wp-content/uploads/2019/04/Joining-Sealing-Tech-Bulletin-TB010-2018.pdf>

32. What are your recommendations to address concrete pavement that has spalled and lost material at the edges (beyond sealing effectiveness) but the concrete still has structural capacity and there is still good support from the sub grade? Please give maintenance and capital work recommendations.

This is a perfect application for partial depth repair followed by resealing. The INDOT has done some work investigating the PDR process in state and I am sure there are some local resources available. The steps will include sounding, mark-out, removal, cleaning, materials placement, curing and resealing (unless non cementitious materials are used). Detailed information is available in https://intrans.iastate.edu/app/uploads/2019/01/concrete_pvmt_distress_assessments_and_solutions_guide_w_cvr.pdf and

https://intrans.iastate.edu/app/uploads/2018/08/preservation_guide_2nd_ed_508_final.pdf

33. What is a good rule of thumb for the minimum spacing between full depth concrete repairs with dowel bar retrofits?

If a transverse crack falls within 3 to 4 feet of a proposed full depth repair perimeter, it is best to incorporate the transverse crack repair as a part of the full depth rather than build a DBR so close. It is not cost efficient.

34. What is the average down time per mile to do dowel retrofit?

It depends. Contractors have been able to install 1000 to 2000 DBRs in a single, 12 hour day. There are several steps and several pieces of equipment required to construct a DBR so a contractor will bring in as many people as necessary to meet the schedule. Asking for too much production can increase costs however.

35. What is the difference between diamond grinding and longitudinal tining?

Diamond grinding is smoother, quieter and more uniform than longitudinal tining. Tining occurs while the concrete is still green and grinding occurs when the concrete is fully cured and at desired strength.

36. What is the life of preservation treatments?

The following guide can shed some light on this question.

https://intrans.iastate.edu/app/uploads/2018/08/preservation_guide_2nd_ed_508_final.pdf

37. What is the maximum (largest difference between slabs) amount of faulting between slabs that could be addressed using diamond grinding versus a different method like DBR?

Diamond grinding can remove any amount of slab faulting, although it can be a slow process when removing extreme amounts of section. Even if the faulting returns you can choose to regrind. The DBR process is used to PREVENT future faulting by enhancing the mechanical load transfer between the slabs. The DBR is an additional investment but it is the longer-term solution.

38. What is the reasoning behind the statement that PCCP that has joint sealant installed, must continue with joint sealant replacement? Is there a situation where the joint sealant could be removed and the joint remain unsealed or open?

Joints are an engineered system, from the drainage and dowel bars to the transverse saw cuts and sealant (or no sealant). Sealed joints typically are not tasked with transferring water to a drainable base ... they are there to keep the water and incompressibles out. Further, the joint reservoirs are typically widened to accommodate the sandblasting, backer rod, and sealant install operations. Conversely a no-seal system will likely have a different drainage design and will rely upon a much narrower saw cut, limiting the intrusion of incompressibles into the joint. A sealed (widened) joint reservoir that is switched to a no-seal system has greater potential to be impacted by incompressibles. The widened reservoir will also produce up to an additional 5dbA in noise when compared to a sealed system (assuming that

the unsealed reservoir is over a ½ inch wide). Finally, the drainage capability of the system may be overwhelmed if one chooses to not seal a previously sealed joint reducing the life of the pavement's foundation. In short there may be situations where the sealant can be removed and remain unsealed but one must be confident that the factors listed above are accounted for.

39. What is the status of the asphalt rubber paving program in Arizona? I know that at one time AZ had a large rubberized program, what is the status today?

The status of the asphalt rubber paving program in Arizona continues to be fairly strong. ADOT still utilizes the 1" rubber asphalt overlay on most sections of PCC that is over 20-25 years (I-10, I-17) in age because at that age, it is more susceptible to damage from diamond grinding. Diamond grinding is being strongly considered on the younger PCC surface layers (certainly those <20 years old).

40. What materials do they use for pavement markings on the diamond ground surface?

Typically, we use contrast stripe tape for all the center skip lines and thermoplastic for the edge lines, gore lines and the puppy skips adjacent to the auxiliary lanes.

41. What was the bonding technique used for the rubber 1" overlay. Why did this lead to delamination?

A tack coat is used as the bonding agent between the 1" rubber overlay and the PCC. Our information shows that some of the delamination is caused by poor tacking application and some is simply caused by the age of the rubber. In some cases where the rubber is 5 or more years older than its service life, the rubber has simply raveled away.

42. What was the cost per SY for diamond grinding both the pilot and the large scale efforts on the 202?

Our Maintenance procurement contract has a diamond grind price of \$5/SY. This is the price we paid for the work on the Loop 202 project. For our other two pilot projects on Loop 101 we have received prices from the contractors for \$5.50/SY and \$4.75/SY.

43. What was the MOT used for the 202 diamond grinding project and how did the travelling public react to the MOT? How long were lanes closed?

The entire Loop 202 EB was shut down for the milling operation and startup of the diamond grinding operation. As the diamond grinding operation progressed, the MOT changed to 2-lane closure scenarios. The traveling public complained very little about the MOT because they realized how deteriorated this section of freeway was and how much it needed attention. ADOT does a pretty good job of giving the traveling public plenty of up front information regarding closures.

44. When you say 'rubber mix', what do you mean? Is this a polymer or true recycled rubber asphalt blend?

We typically use a recycled asphalt rubber blend made literally from old tires. We are starting to look into polymer blends, but we have not used these on a wide scale at this time.

45. Why select diamond grinding only? What other treatments were considered in Phoenix area?

As the presentation showed, ADOT did consider and pilot other methods. We analyzed test sections of diamond grind, next generation grinding, skid abrading, and micro-milling. Ultimately, we settled on diamond grinding after considering a number of factors including cost, ride, sound, appearance, and public opinion.

46. Why did ADOT cover their concrete pavement with the rubber overlay to begin with?

As one of the slides showed, in 2003, the travelling public was complaining loudly about the noise level of transversely tined PCC. The political solution was to overlay all PCC in the Phoenix area with AR-ACFC rubber mix.

47. Why don't you seal the pavement surface?

If you are referring to sealing the asphalt rubber surface in Phoenix, keep in mind it is meant to be an open graded surface so we don't intentionally seal it. However, the flush or fog seal coat we apply to regenerate the rubber mix does have a tendency to fill some of the voids and cause some sealing of the asphalt. The fog/flush coats do extend the life of the 1" rubber mix, but only for so long.

48. Would you consider diamond grinding for panel warp or faulting without dowel retrofit?

Yes, but it depends on a number of factors. Age, base type, traffic etc. A number of states prefer to simply regrind if faulting reoccurs rather than invest in DBR to prevent future faulting. As for panel warp, grinding is almost always the go-to option. DBR is not a consideration in most cases when grinding out curl or warp.

49. Would you have recommendations on how to address longitudinal joint faulting (where new PCCP was placed against old PCCP and now there is an elevation difference)?

The structural deficiencies should be dealt with using either cross stitching or slot stitching to arrest the differential settlement. Once completed the pavement surface should be realigned utilizing diamond grinding for smoothness.

https://intrans.iastate.edu/app/uploads/2019/01/concrete_pvmt_distress_assessments_and_solutions_guide_w_cvr.pdf