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## Seal or No Seal?

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**The debates continues, but here are some tips to determine the most effective strategy for your agency, whether it's seal or no seal, for pavement performance and life-cycle cost.**

**I**n the long run, does it pay for an agency to seal sawed concrete expansion joints and maintain the seals throughout time?

Counterintuitively – given the initial expenditure and the cost to maintain the seals – not all engineers believe it's cost effective to seal concrete expansion joints in all applications, in all places and climates.

As it cures, standard concrete pavement cracks. The pavement always will crack as it cures. The purpose of the “control” joint sawed into curing or “green” slabs is to control where the concrete cracks as it cures, that is, along the path of least resistance, the sawed joint. Below the joint, though, base erosion can take place and slabs can fault, leading to spalled joint edges and massive slab cracking.

Because the sawed crack control joints offer a point of

ingress for water and incompressibles into the pavement structure and base, it's perceived by most road agencies that they should be sealed to keep water and debris out of the structure.

However, in 1990, the Wisconsin Department of Transportation (WisDOT) instituted a policy that eliminated all sealing of portland cement concrete (PCC) joints in new construction and maintenance.

The Wisconsin position on the negative cost effectiveness of sealing joints was summarized in a 2002 technical paper by WisDOT's Stephen E. Shober, P.E., titled, *The Great Unsealing: A Perspective on PCC Joint Sealing* (Google the title to view). The paper followed a presentation at the 1996 meeting of the American Concrete Institute (ACI) – *Effect of PCC Joint Sealing on Total Pavement Performance* by Shober and Terry Rutkowski –

which set off a firestorm of controversy that continues to this day, as there is an abundance of evidence to the contrary.

If when or where to seal or not to seal is the question, the concrete pavement preservation industry has been working overtime to give road-owning agencies the information they need to make that decision on their own.

“Part of our mission is getting a lot of basic information back out into the marketplace,” said Scott Eilken, owner of Bridgeview, Illinois-based Quality Saw & Seal Inc. and co-chair of the Seal/No Seal Group, an industry task force charged with investigating the efficacy of concrete expansion joint sealing.

Other Seal/No Seal co-chairs are Charlie Grady, director of Crafcro, Inc.’s International Group, and John Roberts, executive director of the International Grooving & Grinding Association (IGGA).

“All of the manufacturers do a great job of putting information on their websites, but for whatever reason, we get better results by consolidating impartial information in one location,” Eilken tells *Better Roads*. “We don’t want to beat on anyone as to whether or not they should be sealing joints. All we are trying to do is bring good, basic common-sense information back to the marketplace. This includes installation practice to make sure sealants are going in properly.”

Therefore, the Seal/No Seal Group serves as an information clearinghouse on PCC joint sealing. “We have been making great strides in that effort, and we will continue in the future,” Eilken says. “It’s our goal to get a lot of basic information together and distribute it to the industry.”

Much of the information the group provides is from research efforts undertaken by the group. “[T]he Seal/No Seal Group is working on determining the most effective strategy (i.e. seal or no seal), both in terms of pavement performance and life-cycle cost and the associated design, operational and environmental conditions,” its mission statement says.

An example of this early work was research by consulting engineers Wiss Janney Elstner, Northbrook, Illinois, which is under final review by Seal/No Seal stakeholders in advance of release. “They took a look and gave us parameters on how to properly install sealants,” Eilken says. “We’re trying to give the industry simple, easy tools to make sure sealants are going in dry enough and clean enough.”

## The Wisconsin story

Joint and sealant studies of PCC pavements must address in the following three issues, according to Shober in *The Great Unsealing*:

- Does joint sealing enhance total pavement performance?
- If so, is it cost-effective?
- And if it’s cost-effective, what sealant system should be used?

“[WisDOT] has been studying the effect of PCC joint/crack sealing on total pavement performance for 50 years,” Shober wrote in 2002. “By 1967 there was substantial documentation that filling and refilling of contraction joints had no beneficial effect on pavement performance. By 1984, it was concluded that pavements with unsealed joints had better overall performance (distress, ride, materials integrity) than pavements with sealed joints. In 1990, WisDOT passed a policy eliminating all PCC joint sealing (in new construction and maintenance).”

At that time, the “no-seal” policy saved Wisconsin \$6 million annually with no loss in pavement performance and with increased customer safety and convenience, Shober says. “The entire PCC sealing issue is beginning to be addressed at the national level, assuring no false assumptions, and with the customer’s needs in view.”

Shober concluded that PCC pavement contraction joints should be left unsealed and sawed as narrowly as possible and that future highway research must focus and concentrate on user needs. “This means the primary evaluation criteria for joint and sealant studies must be total pavement performance,” Shober says.

That Wisconsin doesn’t seal its PCC joints makes it an outlier from conventional practice. “Today, 96 percent of the state agencies building and maintaining concrete roadways, and all agencies building and maintaining concrete airport pavements, require joint sealing for new pavements,” estimates the American Concrete Pavement Association (ACPA).

## Debate has not ebbed

However, the controversy has been so keen, and the opportunity to cut costs by omitting sealants so tempting to agencies, that the question of sealing versus not sealing has not gone away.

“When the industry began reconsidering sealing concrete joints – some of which was an uninformed reaction or done with no information – we realized it was time to get information out in the field that once and for all would answer the question of whether or not there is value to the sealing of joints in our concrete pavements,” Eilken says. This led to the founding of the Seal/No Seal Group five years ago.





Diamond blade wet sawing widens and washes transverse crack control joints prior to sealing.

“A valid question within the industry regards how well sealants work to improve pavement performance,” APCA says. “That question remains largely unanswered and is the crux of the issue of whether to seal or not seal concrete pavement joints.”

State DOTs are “getting into the act” of placing no-seal test sites, APCA says. “Many are simply omitting sealant from portions of a project,” it reports. “These sections are candidates for [a] comprehensive study. After sufficient time and examination, the results will establish the link between sealing joints using modern materials and pavement performance.”

There is no such issue with asphalt pavements, Eilken says. “We know there are a thousand reports that show the value of crack sealing in extending the lives of flexible pavements,” he tells *Better Roads*. “We needed to answer that same question regarding concrete pavements.”

The missing link is research, APCA says. “For years, research associated with sealant technology has been predicated upon the assumption that sealants contribute to pavement performance,” APCA notes, and that’s colored the results. “Unfortunately, this assumption has directed research in a way that has left very little tangible evidence of the impact of sealants on overall pavement performance. Similarly, much of the evolutionary work with sealants was made on older pavement designs and with older sealing materials.”

Wisconsin DOT is the only agency to provide comprehensive information on the impact of sealing to overall performance, APCA says. However, APCA says no one knows

if WisDOT’s conclusions are valid elsewhere. “Their original research needs to be expanded to a national scale to quantify differences across various climatic conditions, soil conditions, concrete designs, pavement designs, applications, [and] modern sealing materials,” the association says.

## Sealing for thee, but not for me

While Wisconsin DOT does not seal its high-level, high-speed concrete pavement joints, it’s permitting matching funds for joint sealing on local, slower-speed,

lower-level pavements if the local agency so decides.

Research indicates that higher-speed traffic functions to suck fine aggregates, incompressibles and debris out of the joints but doesn’t work that way for slower-speed roads, Eilken says, and interest continues in sealing joints in slower-speed, local agency applications. To this end, Eilken traveled to Wisconsin in February to describe best practice for joint sealing at a workshop of the Wisconsin Concrete Pavement Association.

Wisconsin’s new spec, 4-21.6 *Cleaning and Sealing Joints*, dated July 2013, unequivocally precludes sealing concrete joints, except only on “projects on local highways where joint sealing has been requested by the local government and approved by WisDOT,” the specification provides.

“WisDOT no longer allows the curing, sealing or filling of joints in concrete pavement on highways under their jurisdiction,” the spec continues. “Local streets and roads for which WisDOT has project administration responsibility only (no project financing) may have joints sealed if the local government has expressed a preference for sealing and WisDOT has concurred.”

WisDOT’s rejection of joint sealing notwithstanding for local use the DOT provides a textbook elaboration of joint sealing best practice. “Proper cleaning of the joints is essential if a long lasting seal is to be obtained,” the DOT urges. “In all cases, the cut should be blown clear of dirt and should be dry before sealing. The saw cut is cleaned with compressed air or pressurized water. Be sure there is no oil



Photo courtesy of IGGA

Coring at deteriorated joints helps identify causes of failure.



Photo courtesy of IGGA

On a California airport runway, longitudinal joints were routed and filled with hot applied sealant in advance of polymer modified thin overlay.

in the air or water as a result of equipment leaks. The saw cut must be absolutely clean if the joint sealer is to adhere to the side walls of the cut.”

A backer rod may then be inserted into the clean saw cut and pushed down to the correct depth, WisDOT says, to form a base for the joint sealant. The backer rod should be tight against the sides of the cut and selection of the right size of rod be used.

“When cold-poured silicone joint material is used, the joint must be completely dry,” the state spec says. “If there is any moisture present in the joint at the time of sealing, a skin will form on the sides of the sealant, preventing adhesion to the concrete. Following rain or damp weather, all of the moisture must be removed from the joint before sealing. The contract special provisions will specify which type sealant is to be used. The plan may also contain a special detail drawing.”

Cold-poured silicone is most frequently used. “Although cold-poured silicone is an improvement over the old hot-poured sealers, frequent failures are experienced,” WisDOT says. “Most of these failures can be attributed to inadequate cleaning and drying of the joint or faulty installation procedures.”

A check of many joints sealed with cold-poured silicone indicates the sealant has adhered to only the upper edge of the joint and not to the sides, the spec says. Dirt or moisture on the sides of the joint prevents adhesion. Also, it is likely that insufficient pressure was used during the extrusion of the sealant into the joint to ensure full contact with the sides of the joint. To ensure positive contact, the joint must also be carefully “tooled” after extrusion. The surface of the sealant

after tooling must be concave upward and lie about 1/4 inch below the pavement surface.

## Researching joint seals

“The need to seal joints may depend on the region,” Eilken says. “When you are in a heavy rain/freeze/thaw region, to ensure longer life of our concrete pavements, we do believe that joints should be sealed.”

Thus, the jury still is out on sealants in arid, warm regions, but Seal/No Seal Group research on bases at the Texas Transportation Institute at College Station should clarify that.

“Probably the biggest effect of an unsealed control joint is its impact on the road base,” Eilken says. “We have many different design permutations of sealed and unsealed joints in various paving structures that are undergoing study right now. Much of that work is ongoing at TTI, where Dan Zollinger there has just concluded the Phase I report of *Evaluation of Joint Sealant Effectiveness on Moisture Infiltration and Erosion Potential*. They are measuring, testing and establishing a workshop model that could be shown to industry regarding how much damage is potentially being done to different types of bases with water running through.”

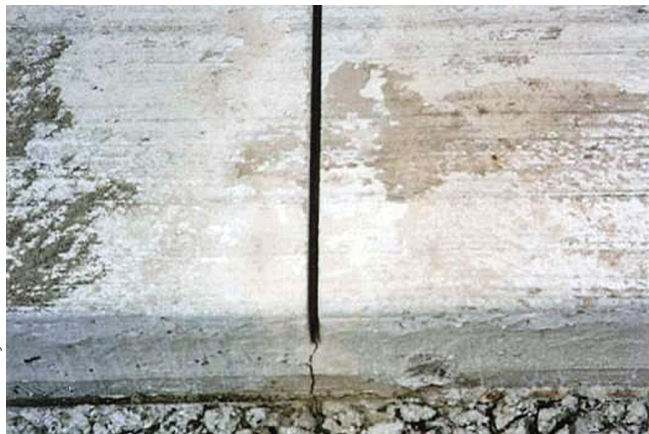
The tool will indicate that, depending on the type of base installed under a concrete pavement, what kind of erosion may be expected in the base under an unsealed joint.

“TTI did testing for us at Seal/No Seal’s test site at IL 59 near Joliet,” Eilken says. “They now are attempting to validate their model, which if successful, will be presented to the Federal Highway Administration. If validated, this could change the entire design guide FHWA uses. They also are traveling to different locations in the country, showing how





Following a grooving operation, a Tennessee transverse joint awaits sealing.



A successful sawed control joint, PCC pavement cracks along the joint sawed in green or curing concrete pavement.

the model may be validated and how it might work. So part of it will be training designers, consultants, engineers and road agencies how the model works and could be applied to their part of the country.”

For IL 59, Seal/No Seal cooperated with the Illinois Chapter of the ACPA on the test project for the Illinois DOT. Walsh Construction was the prime contractor and Quality Saw & Seal was the subcontractor for control joint sawing.

“We did 10 test sections – various types of sealed and unsealed joints – and TTI came out in September 2013 and conducted the first round of testing on those sections,” Eilken says. “They will come out a second time in 2014, and to make sure the model is validated properly, it will have to be visited periodically to measure the damage, or no damage, to the base material.” The work may be extended to other regions.

That field work complements work undertaken at TTI’s sprawling test facility at Bryan, Texas. There, the entire Phase I study centered on test sections. “We went in there and provided different joints, sawed and sealed,” Eilken says. “Dan also put in extendable anchoring systems in those test sections, in which he could pull joints apart and put them back together, measuring different types of infiltration. He measured against hot pours, neoprene, silicone and against sealed versus unsealed. The entire Phase I work just to see if continuing was an option was done at the TTI facility, and it paved the way for Phase II.”

Also, new research at the National Concrete Pavement Technology Center at Iowa State University at Ames is finding that keeping moisture and water out of concrete pavement is the most critical piece of the puzzle, Eilken tells *Better Roads*.

“But it doesn’t address whether the water is coming from the top-down, or in bases from the bottom-up,” he says. “It doesn’t matter; we are finding that much of the concrete joint deterioration is coming from the constant infiltration of water. Now the task becomes determining whether the cost of joint sealing offsets the value we are getting out of it at the other end.”

## Bringing answers to play

In the meantime, the Seal/No Seal Group is getting a lot of input from industry and the DOTs, Eilken says. “While there is a handful of people who are trying to make sure we are headed down the same road,” he adds, “we’ve been able to take a lot of parameters from the ACPA, the various state chapters and the state DOTs, so we think we’ve got a pretty good direction and will be able to finally bring some answers into play that can be applied to local regions.”

Time – and effective technology transfer – should clear these issues up for today’s highway-owning agencies and road contractors.

“Perhaps new research will once again change the expectations that pavement engineers place on joint sealing materials for new concrete pavements,” says the American Concrete Pavement Association (ACPA). “In the meantime, it appears that the current practice of sealing transverse joints with either hot-pour, silicone or compression seals will remain unchanged by most state agencies across the country.” ♦

For more information and additional resources, visit [sealnoseal.org](http://sealnoseal.org), [acpa.org](http://acpa.org), [cptechcenter.org](http://cptechcenter.org), [concrete.org](http://concrete.org) or [roadwaystandards.dot.wi.gov/standards/cmm/cm-04-21.pdf](http://roadwaystandards.dot.wi.gov/standards/cmm/cm-04-21.pdf).