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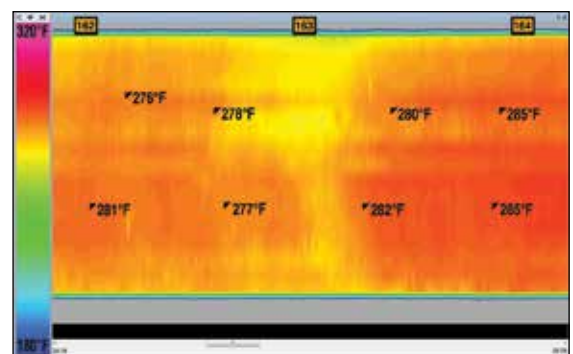
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ON THE COVER: THINLAY MADE ITS OHIO DEBUT IN FOUR COUNTIES ACROSS THE WESTERN AND SOUTHERN REGIONS OF THE STATE IN 2016. THE PROJECTS, SUCH AS THIS ONE ON U.S. ROUTE 50 IN VINTON COUNTY, DEMONSTRATED HOW A 3/4-INCH-THIN ASPHALT COURSE CAN BE A KEY FACTOR IN PAVEMENT PRESERVATION AND DURABILITY. SEE PAGE 8.



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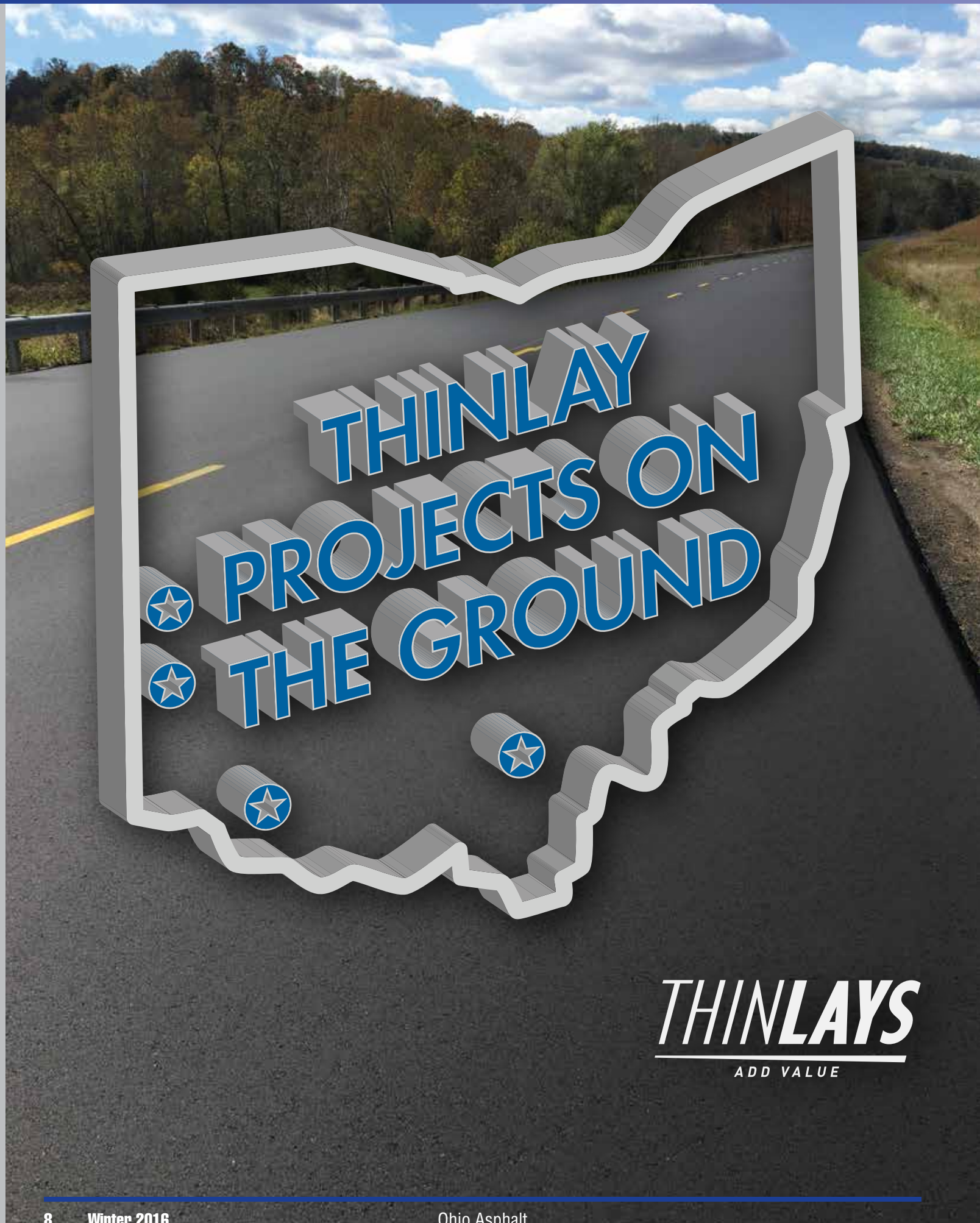
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THINLAYS
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Thinlay asphalt mixtures made their debut this construction season beginning with the placement of thinlay preservation treatments in Darke, Vinton, Clermont and Preble counties. The trials demonstrated Ohio's thinlay could be placed in a ¾-inch-thin course and with a consistently uniform texture – a factor important to pavement preservation and overall pavement durability.

The functions of thinlay are to seal a pavement, correct functional (non-structural) pavement distresses, provide (modest) structural strength improvement, true-up a pavement by restoring profile and cross-slope and improving smoothness. In accomplishing these preservation objectives the overall lifecycle cost of a pavement can be reduced and the prospects of future reconstruction become remote.

THINLAY PROJECT: Arnold Road, Darke County

The paving of Arnold Road, Darke County, in mid-August was the first thinlay placement in Ohio. Working in cooperation with Darke County Engineer Jim Surber P.E., P.S., the Walls Brothers Asphalt Company Inc. of Greenville placed a ¾-inch thinlay. The pavement is classified as

“light traffic” based on the relatively few vehicles that use Arnold Road. However, Arnold Road is subject to seasonal heavy traffic, as the time for harvest brings with it substantial agricultural traffic. The unique traffic condition provides a good test for thinlay durability.

Pavement condition is a factor in the selection of preservation treatments such as thinlay. Being lightly traveled, Arnold Road had all the signs of a pavement that was suffering from oxidation and minor cracking, the types of distresses thinlay preservation treatments were developed to fend.

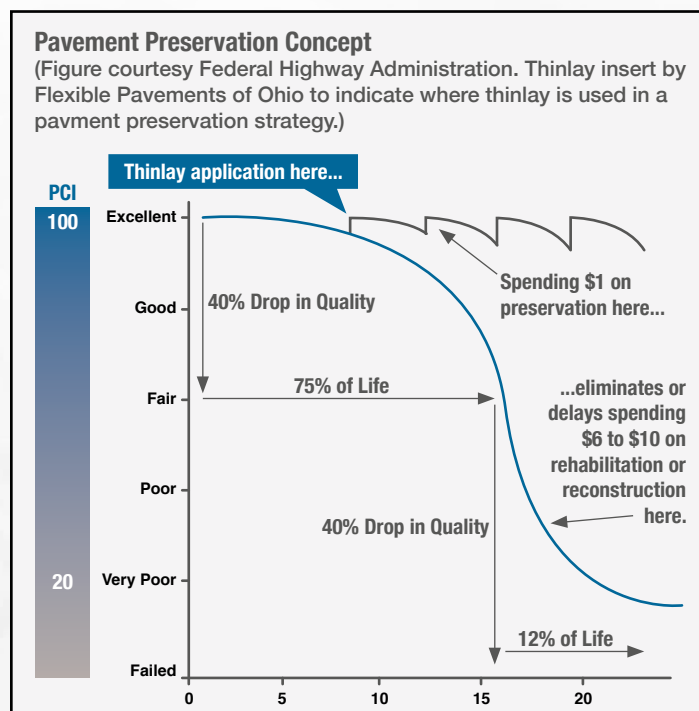


Photo 1: Fine-aggregate structure facilitates placement and compaction.

The Arnold Road mixture used 100-percent crushed coarse aggregate, and the fine-aggregate portion of the mix consisted of nearly equal portions of limestone sand and natural sand. Performance-graded Binder 58 minus 28 (PG 58-28) was specified for the traffic type, and 25-percent reclaimed asphalt pavement (RAP) also was incorporated. The RAP was processed according to ODOT specs, so it was sufficiently small to be incorporated in the mixture. Observed in Photo 1 is the aggregate structure that allows for thin asphalt layers. The fineness of the gradation facilitated compaction, though minor rutting in the existing pavement resulted in the course thickness having some variability (Photo 2). When tested to determine how well the mat was compacted, the pavement was found sufficient to resist permeability.



Photo 2: Cores obtained for testing.



Compaction equipment consisted of two, highway-class static (non-vibratory) steel wheel rollers. Vibratory compaction is not desirable on thinlay pavements, as potential for aggregate degradation rises under the force of such compaction equipment. For this reason, Ohio Department of Transportation Construction & Materials Specification (C&MS) Section 401.16 notes, “Do not use vibratory rollers on courses with a thickness under 1 ½ inches (38 mm).”

The thinlay specification controls compaction using the method prescribed by ODOT in C&MS Section 401.16. Rolling must be conducted using equipment specified in Section 401.13 and sufficient for the rate at which the thinlay pavement is spread. A three-wheel roller is required and is to be operated in the breakdown position of the roller train. The “break down” position is first roller and immediately behind the paver.

THINLAY PROJECT: Clermont County, State Route 743



Photo 3: Oxidation and minor cracking define CLE-743 pre-paving conditions.

ODOT let to contract Thinlay preservation field trials in districts 8 and 10. Combined, the trials took place on four state routes of which the first paved was Clermont County SR743 (CLE-743) located in the deep southwest part of Ohio, near the Ohio River. Road profile varies somewhat with the southern Ohio terrain. The pavement condition of SR743 can be seen in Photo 3. Oxidation, minor cracking with some sealing was typical. Pre-paving repairs were performed to address pavement conditions unsuited for using a pavement preservation treatment (Photo 4).

Making pavements ready to pave is a necessary effort — even for pavement preservation projects. Use of pavement condition rating scores to identify preservation projects does not preclude the need for examining a pavement to determine the need for isolated pavement repairs. Without field review, the life expectancy of a preservation treatment is at risk.



Photo 4: Pre-paving repairs were conducted to address structural weakness.

Thinlay paving of CLE-743 commenced on September 27 under cloudless skies and brisk temperature. John R. Jurgensen Co. did the paving and Valley Asphalt Corp. provided the asphalt mixture. Unique to this project was the use of PG Binder 52-28. This was ODOT’s first use of PG52-28. The binder could be described as “soft.” “Old timers” would liken this binder to AC-5. The pavement traffic condition warranted a soft grade, given the desire for improving crack resistance and pavement resilience. The CLE-743 traffic condition is described by the Flexible Pavements of Ohio (FPO) traffic designation “ultra-light.” The metric for the designation is ADT (average daily traffic). The ultra-light traffic threshold is 500 vehicles per day. ODOT has no such traffic class.

In developing Ohio’s thinlay there was discussion of the potential for PG 52-28 to result in pavement flushing and rutting. The asphalt mix design for CLE-743 incorporated 25-percent RAP, which tempered the effects of the soft binder. The mixture placed without blemish and without tenderness to rolling.

The fineness of thinlay’s mat texture is an important feature. As exhibited in Photo 5, the texture of the CLE-743 mat is consistently uniform. Fine-graded mixtures exhibit little tendency to segregate, leaving the pavement less prone to premature pavement distress and the



Photo 5: Fine-surface texture resists segregation and damaging effects of oxidation and moisture. (Note: safety edge treatment included as a project detail)

need for patching. Furthermore, such textures cause a pavement to take on a shingle-like effect; that is, shed stormwater rather than allowing it to permeate into the pavement – which can lead to stripping and resultant weakening.

THINLAY PROJECT: Preble County, State Routes 121 & 732

The PRE-732 thinlay stretches from milepost 4.69 to 9.46. A second Preble County project was placed on S.R. 121, from milepost 0.69 to 1.96. PRE-121 runs close to the Indiana state line and just north of Interstate 70. This project is identified as a light-traffic pavement.

PRE-732 has all the makings of a low-volume traffic pavement, complete with an aging pavement and random cracking. Some cracking in the existing pavement, however, is a bit excessive than one likes to see when applying a preservation treatment (See Photo 6). FPO notes in its Thinlay Technical Bulletin the following: “Thinlay should be used wherever pavement preservation is the

objective of a treatment. It should be placed on structurally sound pavements that are exhibiting only surface distress. Raveling and minor cracking due to oxidation are the types of distresses for which a thinlay is ideally suited.”



Photo 6: PRE-732 exhibited isolated areas of distress beyond capability of pavement preservation treatment.



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Photo 7: Thinlay placed on Vinton County U.S. Route 50 exhibited superior texture and riding quality.

THINLAY PROJECT: Vinton County, U.S. Route 50

The final thinlay placed this year was part of ODOT's Low-Volume Test Road research. VIN-US50 is located east of Chillicothe in ODOT District 10. Ohio University was contracted as the research team. Research goals of Phase 1 are to evaluate various asphalt strategies that will extend the performance life of asphalt mixtures used for low-volume traffic applications. Thinlay is

among the strategies being the pavement researched. The paving contractor was Shelly & Sands Inc. and the asphalt producer was Mar-Zane Inc.

VIN-50 is a composite pavement section (i.e. asphalt on concrete base). To ensure the pavement was suitable for preservation treatments, the contract included repairs to bring the pavement to a structurally sound condition. The thinlay was placed at a ¾-inch thickness.

Mixture composition used PG64-22 binder, binder content of 6.8 percent (eight tenths greater than the Type 1 control mix), and proportions of limestone coarse aggregate combined with manufactured and natural sands to meet the gradation requirements. Note that the thinlay aggregate gradation specifications were designed to ensure the proportions of coarse-to-fine aggregate are constant regardless of project location and aggregate mineralogy. This is what promotes a consistent gradation that is less prone to segregation – highly likely to be uniform in texture – wherever thinlay is used. The VIN-50 thinlay pavement exhibited exceptional surface texture uniformity.

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4 Keys to a Picture-Perfect Mat

By Dan Armanberg, Senior Technical Writer



By all accounts, 2016 was a good year for Ohio asphalt contractors. And the good times could stretch for years if the new administration moves forward with its promise to fund major infrastructure work around the country.

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ARE YOU READY FOR OSHA'S NEW SILICA RULE?

WHAT THE ASPHALT PAVEMENT INDUSTRY NEEDS TO KNOW TO COMPLY

By Chris Trahan, CPWR



In June 2016, OSHA's long-anticipated silica rule went into effect. The new rule is comprised of two standards, one for the construction industry and one for general industry and maritime. It replaces outdated exposure limits and by doing so is expected to protect more than 2-million workers, and prevent more than 600 deaths from silicosis, lung cancer and other diseases, and more than 900 new silicosis cases each year. While full compliance with the construction standard (paving operations) is required by June 2017, and by June 2018 for general industry (asphalt production facilities), now is the time to review what your company is doing and what you will need to do to comply.

(Editor's note: This article is being reprinted from the November/December 2016 issue of *Asphalt Pavement*, the bi-monthly magazine of the National Asphalt Pavement Association.)

The good news is that NAPA, through its leadership in the Silica/Asphalt Milling Machine Partnership with NIOSH researchers, has already taken important steps to help members comply. The next step is making sure that members understand the standard's requirements, and have ready access to the information and tools needed to reduce exposures for all asphalt paving and milling operations that have the potential to expose workers to airborne silica. These potential exposures include crushing aggregate, operating a front-end loader, transferring aggregate piles, hauling materials over gravel roads, baghouse and drum maintenance, and road brooming or sweeping activities.

While similar to other OSHA health and ASTM consensus standards, several of the provisions in the new silica construction standard offer employers greater flexibility in how they implement it and protect their employees. The following is a brief summary of key provisions that employers need to be aware of to comply with the new construction standard.

KEY PROVISIONS

PEL & Control Methods

The new standard includes a lower, more-protective permissible exposure limit (PEL) of 50 micrograms per cubic meter (calculated as an eight-hour, time-weighted average) and offers several methods employers can choose from to assess exposure and demonstrate compliance:

Table 1: One option is to rely on Table 1, which includes the engineering controls and work practices developed by the partnership for small- and large- drivable milling machines, as well as several other types of equipment commonly used in asphalt milling and paving operations. Employers who rely on Table 1 must make sure the equipment-control combinations and work practices are fully and properly implemented. This includes making sure the controls are maintained in proper working order and that employees “engaged” in the task understand how to properly use the equipment-control combinations. An employee is considered to be engaged in the task when they are operating the equipment, assisting with the task, or have some responsibility for completing the task. For example, Table 1 specifies that when a large-drivable milling machine (half-lane and larger) is used for cuts of any depth on asphalt, the employer must use “a machine equipped with exhaust ventilation on drum enclosure and supplemental water sprays designed to suppress dust ... [and] Operate and maintain machine to minimize dust.” If an employer follows the requirements listed, they will not have to implement the air monitoring requirements and, if no respirator requirement is listed, they will not have to comply with the standard's medical surveillance and respiratory protection requirements. The

“NAPA-CPWR Field Guide for Controlling Silica Dust Exposure on Asphalt Pavement Milling Machines” includes a dust-control checklist and tips for small- and large- drivable milling machines that can help employers comply with Table 1. The Field Guide is available through the NAPA Online Store at <http://goaspha.lt/2bUpCxi>. It is free to NAPA members.

TABLE 1 – EQUIPMENT

i.	Stationary masonry saws
ii.	Handheld power saws
iii.	Handheld power saws for fiber cement board
iv.	Walk-behind saws
v.	Drivable saws
vi.	Rig-mounted core saws or drills
vii.	Handheld and stand-mounted drills
viii.	Dowel drilling rigs for concrete
ix.	Vehicle-mounted drilling rigs for rock and concrete
x.	Jackhammers and handheld powered chipping tools
xi.	Handheld grinders for mortar removal (tuckpointing)
xii.	Handheld grinders for other than mortar removal
xiii.	Walk-behind milling machines and floor grinders
xiv.	Small drivable milling machines
xv.	Large drivable milling machines
xvi.	Crushing machines
xvii.	Heavy equipment and utility vehicles to abrade or fracture silica materials
xviii.	Heavy equipment and utility vehicles for grading and excavating

Alternate Exposure Assessment Methods: If a type of equipment or task is not listed on Table 1, or an employer chooses not to follow Table 1, exposure to workers must be assessed. Employers can choose to perform an exposure assessment using any combination of objective data or air-monitoring data to determine exposure levels and demonstrate the effectiveness of the controls. According to OSHA, **objective data** can include “air-monitoring data from industry-wide surveys or calculations” for employee exposures “associated with a particular product or material or a specific process, task or activity.” The objective data must “reflect workplace conditions closely resembling or with a higher exposure potential” than the current operation. If **air monitoring** is used and shows that exposures fall below the action level (AL) of 25 ug/m³ then no additional air monitoring is required for the task. However, if the air monitoring results are above the AL, then monitoring must be repeated every six months. If the results are above the PEL, then monitoring must be repeated within three months.

According to OSHA, “when two-consecutive, non-initial results, taken seven or more days apart, are below the AL,” the employer can discontinue monitoring. Since OSHA did not identify specific control technologies to be used during road brooming or sweeping activities, NAPA is working with its members and CPWR to identify the exposure potential during these operations, and the effectiveness and practicality of using water-spray control systems to minimize dust exposures.

Respiratory Protection

The standard’s respiratory protection requirements kick in if respiratory protection is specified in Table 1, or if air monitoring or objective data shows that employees are exposed above the PEL despite full and proper implementation of engineering and work practice controls. The employer’s respiratory protection program must comply with 29 CFR 1910.134.

It is important to note that Table 1 ties the need for respiratory protection to the length of time a worker performs a task.

Medical Surveillance

Employers are required to comply with the standard’s medical surveillance requirements if a worker is required to use a respirator for 30 or more days per year. If a worker wears a respirator for other purposes unrelated to the standard, that time would not count towards the 30 days. When medical surveillance is required, it must be provided at no charge. The medical surveillance requirement states that:

- All medical examinations should be done by a physician or other licensed health care professional (PLHCP).

- An initial exam must be provided within 30 days of being assigned a task requiring medical surveillance, unless the employee has received a medical examination that meets the standard’s requirements within the last three years.
- Required medical exams include 1) a medical and work history; 2) a physical exam with a focus on the respiratory system; 3) a chest X-ray interpreted and classified by a NIOSH-certified B Reader; 4) a pulmonary function test; 5) a latent TB test; and 6) any other test the PLHCP deems appropriate.

To ensure medical confidentiality, the PLHCP is required to provide a report with detailed medical findings to the worker and a separate report to the employer which, unless the worker authorizes further disclosure, only describes any limitations on respirator use and further exposure to respirable crystalline silica, and/or a recommendation to have a specialist examine the worker.

Housekeeping

The standard prohibits dry sweeping or brushing unless HEPA vacuums, wet sweeping, or other methods to control the dust are not feasible. Likewise, the standard doesn’t allow for use of compressed air to clean clothing or surfaces unless it is used in conjunction with an effective ventilation system that captures the dust.

Written Exposure Control Plan

All employers are required to have a written exposure control plan that describes 1) the silica-generating tasks; 2) the engineering controls, work practices and respiratory protection used to limit exposure for each task; 3) the housekeeping methods to clean up silica dust; and 4) the procedures used to restrict access to work areas, when necessary, to minimize the number of employees exposed and their level of exposure.



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This latter provision is in lieu of the regulated area requirements found in other standards.

The plan must also identify the competent person who will implement the plan. According to OSHA, this individual must be “capable of identifying existing and foreseeable respirable crystalline silica hazards” and have the authority to take prompt corrective measures, as well as make “frequent and regular” inspections of jobsites, materials and equipment.

The employer is required to review and evaluate the plan at least annually, update as necessary, and provide copies when requested to each employee, their designated representative and OSHA representatives. CPWR’s free online planning tool can help employers comply with the plan requirement. The tool takes the user through the planning process in three easy-to-follow steps, provides access to information on commercially available equipment-control options and results in a plan that can be printed, emailed, saved and edited for future use. To access the planning tool, visit www.silica-safe.org and click on Create-A-Plan.

Training & Hazard Communication

Employers are also required to comply with the Hazard Communication standard (29 CFR 1910.1200); including providing employees with access to safety data sheets (SDSs), labeling materials and training. The training must cover the health hazards, such as cancer, and other lung, immune system and kidney effects; specific work tasks that result in exposures; engineering controls, work practices and other workplace protections; the identity of the competent person; and the medical surveillance program, if one is required.

Recordkeeping

Similar to other standards, this new standard requires employers who perform air monitoring, use objective data and/or have a medical surveillance program to maintain records in accordance with 29 CFR 1910.1020.

NEXT STEPS

Between now and the June 23, 2017 compliance deadline for the construction standard, NAPA will be working to collect objective data for equipment and tasks not covered by Table 1, share compliance guidance documents and keep you apprised of new developments so all members and the industry are in compliance by the deadline.

To learn more about the standard, watch the NAPA webinar “Complying with OSHA’s New Silica Rule,” which is free to NAPA members, government and educators at <http://goaspha.lt/2cdv7oL>. For questions about the new Silica Rule, contact NAPA Vice President of Environment, Health & Safety Director Howard Marks at HMarks@AsphaltPavement.org.

Chris Traban is deputy director of The Center For Construction Research and Training (CPWR). Based in Silver Spring, Md., CPWR is dedicated to reducing occupational injuries, illnesses and fatalities in the construction industry. Through research, training and service programs, CPWR serves the industry in cooperation with key federal and construction industry partners nationwide.



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TECHNICAL BULLETIN: Porous Asphalt Pavement

Flexible Pavements of Ohio (FPO) updates its many technical bulletins as design specifications change or additional information on the subject is available to warrant a revision. This summer, FPO updated the technical bulletin on Porous Asphalt Pavement. It is reprinted here in its entirety and is available on the FPO website.

This document contains guidance on the structural build-up, materials selection, construction details and maintenance considerations for a good performing porous asphalt pavement. Of note to the revisions in

the technical bulletin is the recommendation of the inclusion of a simple infiltration test to ensure desired permeability has been obtained and a provision for a Field Quality Control Supervisor (FQCS) with a porous asphalt endorsement to be onsite and in control of the placement of the porous asphalt. FPO will be including the training for this endorsement in the upcoming 2017 FQCS trainings.

This and other useful design information and technical bulletins can be found on the FPO website at www.flexiblepavements.org.

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Technical Bulletin: **Porous Asphalt Pavement,** (Rev. 09June2016)

Porous asphalt pavements are being used to reduce or eliminate stormwater runoff from parking lots and other such facilities. A porous asphalt pavement is constructed over a stone-filled reservoir to collect and store stormwater and to allow it to infiltrate into the soil between rainfalls. Where low soil permeability is not conducive to infiltration, a similar design can be used as a detention facility or an exfiltration solution that filters pollutants from the first flush and improves the water quality of the runoff. These designs can reduce pollution and

replace expensive detention and treatment facilities. Porous pavement systems are rapidly gaining favor with designers and regulators as an economical approach to stormwater management for sustainable or low-impact development. As the National Pollutant Discharge Elimination System (NPDES) permit requirements have become more widely applicable, it has become necessary that developers find more innovative means of compliance. Porous pavement systems are commonly being used as part of a strategy to obtain Leadership for Energy and

Environmental Design (LEED®) certification for green building projects. Another benefit of porous pavement for parking lots is the absence of ponded water on the pavement during and after rainfall. Patrons never have to step in a puddle again!



Figure 1: Parking Facility of the Mansfield Art Center, Richland County, Ohio

While detention basins are often used to collect and slow the rate of runoff from the impermeable surfaces of roofs and pavements, and are effective, they require additional land. Especially on re-development sites, additional land may not be available or may be

prohibitively expensive. The porous pavement/recharge bed design may be the solution to the problem.

The “Porous Pavement” concept was conceived in the Franklin Institute Research Laboratories in 1968, and was developed there under a grant from the U.S. Environmental Protection Agency during 1970 and 1971. After the final report on the project was issued, interest in the concept prompted Edmund Thelen and Leslie Fielding Howe to prepare a book about its development that included a design guide. The publication, *Porous Pavement*, was published by the Franklin Institute Press in 1978. The book is out of print; but, is still available in some technical libraries and online (2). The Ohio Department of Natural Resources (ODNR) has developed a comprehensive guide for the use of porous asphalt pavement. It is contained in the ODNR, *Rainwater and Land Development Manual*

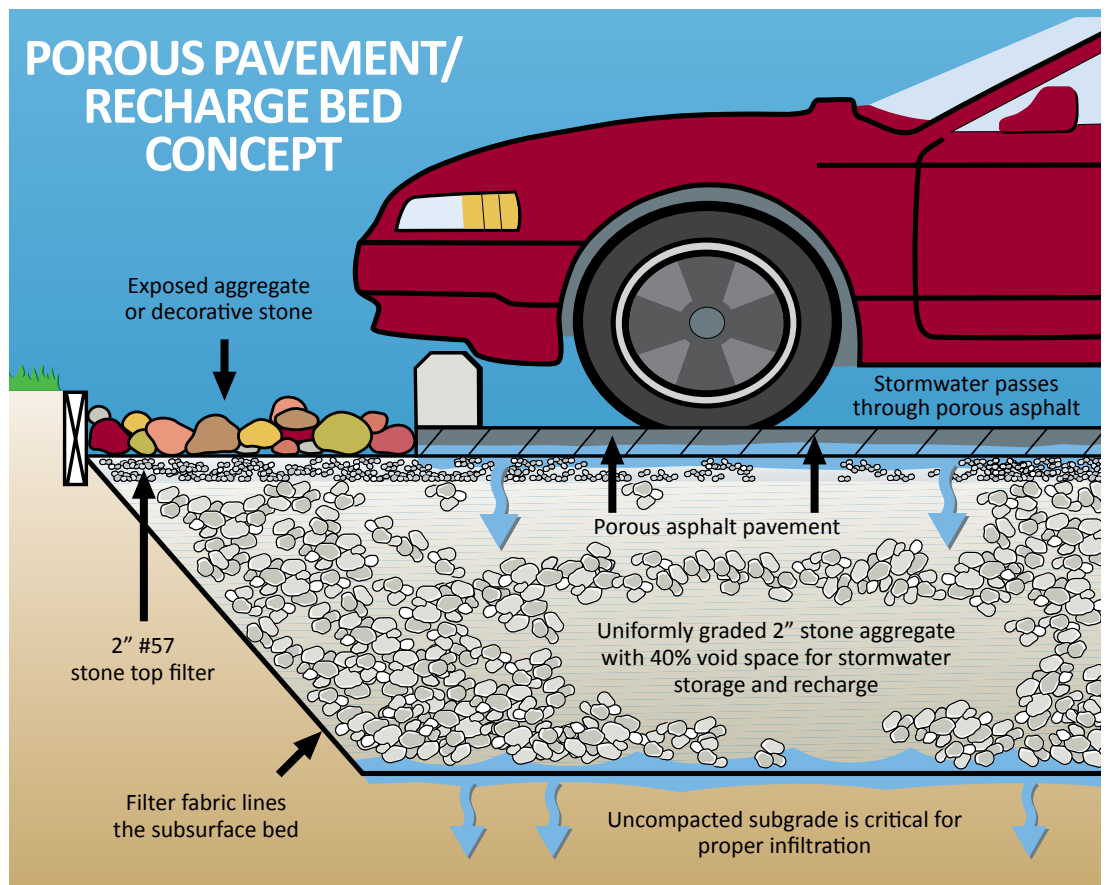
(4) and is recommended for its guidance on hydrologic design, construction and maintenance.

Design Considerations:

In considering a porous pavement recharge bed, designers must consider some key factors: soil percolation characteristics, local topography and climate, the proposed uses of the site, the traffic-loading factor, stormwater regulations, site runoff and stormwater quality requirements. Frost penetration depth is also a factor in determining reservoir course thickness.

The soils investigation will include a reconnaissance to determine the soil types on the site and standard percolation test(s) to determine the average permeability of the site.

A typical porous asphalt pavement recharge bed design consists of one or more porous asphalt courses, a top filter/stabilizing course, a reservoir course, filter fabric and existing soil or subgrade material. In the case of a detention or exfiltration design, this typical bed design may be modified by the inclusion of outlet or underdrain pipes as may be appropriate.



Stone-Filled Reservoir Recommendations

The reservoir for a porous pavement stormwater management facility is constructed by first excavating into undisturbed and uncompacted soil to the depth needed to contain the design storm volume. To ensure year-round operation, the bottom of the reservoir should be below 0.65 of the normal frost depth. The reservoir is lined with a geotextile fabric (Recommendation: geotextile material meeting ODOT Specification 712.09, Type B). The reservoir is then filled with No. 2 (1½ to 2½ inch) size stone and topped with a top filter/stabilizing course consisting of an approximately 2-inch-thick layer of No. 57 (½ to 1-inch) size stone to stabilize and provide a paving surface for the asphalt concrete

layers. Too thick of a top filter/stabilizing layer is detrimental and may distort under hauling and paving equipment. All aggregate must be 100-percent fractured material, and having quality to meet ODOT Specification 703.04.

Permeability Considerations

How permeable is the porous asphalt pavement (Open-Graded HMA)? Various values have been reported in the literature. All are so high relative to the percolation values of the soil as to not present any limitation, and are typically not considered in design. A permeability of 6,000 feet/day is attributed to W.R. Lovering and Harry R. Cedergren (1). Thelen and Howe report an asphalt

permeability of 176 inches/hour (352 ft/day) (2). Roseen is quoted as saying that, "if 99 percent clogging were to occur, the infiltration rate would still be greater than 10 inches per hour, which is greater than most sand and soil mediums." (6) In any case, these values are orders of magnitude higher than the best soil permeability of about 6 inches per hour. Figure 2 gives a visual indication of the porosity of a porous asphalt pavement surface course.



Figure 2: Permeability demonstrated

Asphalt Pavement Thickness & Material Recommendations

For light-duty pavements, intended primarily for cars, 3 inches of porous asphalt surface course is the minimum. FPO suggests using a total of 4-1/4 inches of porous asphalt placed in two courses; a 3-inch base course and a 1-1/4-inch surface course. For the base course, use materials and methods meeting the requirements of FPO specification *Porous Asphalt Pavement Base Course*,

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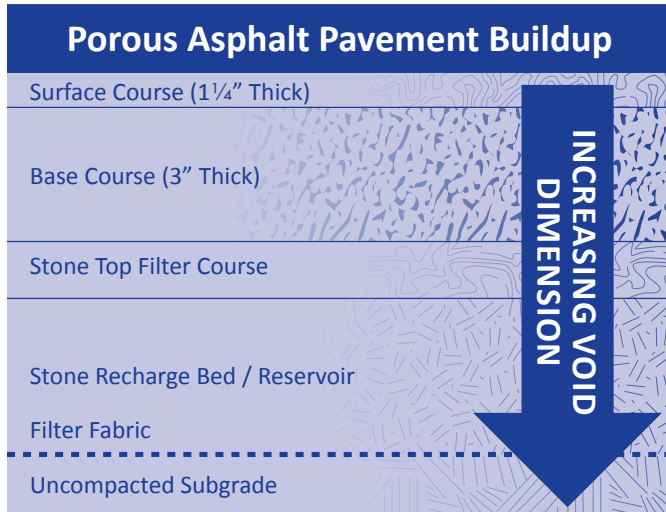


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dated June 9, 2016, or later. For the surface, use FPO specification *Porous Asphalt Pavement Surface Course* of the same date. These specifications can be downloaded from flexiblepavements.org on the "Sustainable Pavement" page. For pavements that will need to support heavier loads, FPO recommends using a structural thickness of asphalt concrete based on an accepted pavement-design protocol. The same porous asphalt materials can be used to make up the required structural thickness.



Cost

The cost of the porous surface material over conventional Type 1 material is estimated to be approximately 40% more. The porous base is approximately 30% more compared to a normal Type 2 material.

Construction

Construction methods for the excavation and placement of the stone-filled reservoir are detailed in the ODNr manual (4). Construction methods for the asphalt layers are called out in the FPO sample specifications. In general, construction equipment and methods used in placing porous asphalt pavement are the same as for conventional asphalt concrete construction with a couple of special considerations. As a result, users can expect the same levels of smoothness, speed of construction and use as with conventional asphalt pavement materials. The differences are that porous asphalt materials are not compacted to achieve maximum density and must be protected from contamination that would tend to plug the pores in the materials. Rolling is done using a minimum of two passes of a static tandem steel-wheel roller having a minimum weight of 8 tons to smooth the surface and to seat the stones in the mix so that it doesn't consolidate under traffic or ravel.

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The finished pavement must have 16 to 22 percent air-void content (80 to 84 percent density) and an observed average surface infiltration rate of 100 inches per hour. Surface infiltration rate is checked using a simple infiltration test (SIT) described in the FPO Porous Asphalt Surface Course specification.

Porous asphalt materials will cool more rapidly than conventional asphalt mixes, making it necessary for close monitoring that compaction is completed while the mix is within the compaction temperature range that facilitates compaction, typically when the binder viscosity is within $1,400 \pm 200$ centistokes. FPO recommends that specifications require that an approved Field Quality Control

Supervisor, having the porous asphalt endorsement, be onsite and in control of the placement of the porous asphalt concrete.

Care must be exercised in the scheduling of construction to protect the porous pavement from contamination that might tend to clog the pores of the system. It is best to build the porous pavement last, after grading and erosion-control measures are complete.

Maintenance

Porous asphalt pavements are generally maintained like conventional asphalt pavements, with a few exceptions.

Sometimes cleaning is needed to remove contamination that will plug the pavement and reduce its porosity. Methods may include blowing, vacuuming or sweeping with a vacuum-type street sweeper. Surface sealants should not be used, as they would tend to plug the pores in the asphalt. For snow and ice control, the owner should avoid placing abrasives or grits that would tend to plug the pores of the pavement. Otherwise, snow and ice control is similar to that for conventional asphalt pavement. Patching can be done with readily available materials without seriously impacting the operation of the porous asphalt pavement.

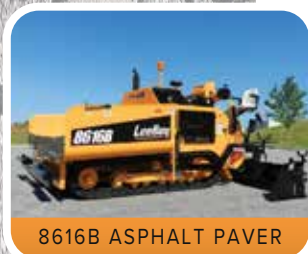
The owner will need to educate maintenance and groundskeeping staff on these differences, as the porous pavement will not look substantially different from conventional pavement. Posting of an informational sign (such as the example below) at the facility will help inform both customers and employees of the special features of the porous pavement.



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All reasonable care has been taken in preparation of this bulletin. However, Flexible Pavements of Ohio can accept no responsibility for the consequence of any inaccuracy that it may contain.

References: For more detailed information on design, construction and maintenance of porous asphalt pavements consult the following references:

- (1) *Structural Section Drainage, Proceedings, International Conference on the Structural Design of Asphalt Pavements*, 1962 in the NAPA publication, *Asphalt Treated Permeable Material – Its Evolution and Application*, QIP 117, Raymond Forsyth.
- (2) *Porous Pavement*, Franklin Institute, 1978, (ISBN Number 0-89168-010-1) http://www.hotmix.org/images/stories/porous_pavement-thelan.pdf

- (3) *Porous Asphalt Pavements*, NAPA, Information Series 131, 2003
- (4) *Rainwater and Land Development Manual*, Chapter 2, Section 2.11, Pervious Pavement, Ohio DNR, 2012, <http://water.ohiodnr.gov/water-use-planning/stormwater-management#RAI>
- (5) *UNHSC Design Specifications for Porous Asphalt Pavement and Infiltration Beds (Rev. 10/09)* http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/unhsc_pa_spec_10_09.pdf

View the many other linked documents, case studies and resources at <http://www.flexiblepavements.org/sustainability/porous-asphalt/porous-asphalt>, which includes charts outlining possible LEED credits.



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Porous Asphalt Pavement FAQs



Q: What is the lifecycle of a porous pavement? (This would apply to both permeability life and structural life.)

A: There are case studies of several examples of porous pavement installations that are still functioning well after 15 or 20 years. Dr. Robert Roseen, director of the University of New Hampshire Stormwater Center (UNHSC), has written that porous asphalt pavements, "will have a longer lifecycle from reduced freeze-thaw susceptibility and greater load-bearing capacity than conventional parking lot pavements." (See the article in *Stormwater* magazine, September, 2008, <http://www.unh.edu/unhsc/publications> and <http://foresternetwork.com/magazines/>)

If designed, constructed and maintained appropriately, porous pavements should have life spans at least comparable to conventional asphalt pavements.

Q: What is the rehabilitation strategy for a porous asphalt pavement?

A: Rehabilitation of a deteriorated porous asphalt surface will normally entail removing the deteriorated asphalt layer or layers to the depth necessary and repaving with new porous asphalt mixtures. Surface treatments of any kind that would tend to seal the pores in the pavement should not be used.

Q: How does porous asphalt stand up in a snow and ice climate? Or, perhaps better asked, how does snow and ice affect porous asphalt pavement?

A: Edmond Thelen and Leslie Fielding Howe stated in their guide (2) that "Cold weather does not damage porous pavement. Water could freeze in the aggregate, but the voids are relatively large and there is room for expansion without damage."

Studies performed at the UNHSC show that porous asphalt pavement performs well during sub-freezing weather and that frozen media does not reduce performance. Even the frozen pavement and infiltration bed retained a high level of permeability. (Seasonal Performance Variations for Stormwater Management Systems in Cold Climate Conditions, Robert M. Roseen, Ph.D., P.E., M.ASCE, et. al.) (<http://www.unh.edu/unhsc/publications>)

Structurally, porous asphalt pavement will be durable if the reservoir is provided with suitable drainage to prevent the asphalt layers from remaining flooded during freezing weather.

Q: What type of maintenance needs to be done on porous asphalt pavements?

A: Porous pavement must be inspected and cleaned regularly to maintain the hydrologic performance of the pavement system. Agencies have had success with blowers to remove debris, such as pine needles and leaves, with walk-behind-type vacuums and vacuum-type street sweepers for cleaning porous asphalt pavements. Some regulatory agencies may require the property owner to have a maintenance agreement approved by the local MS4.

Typical maintenance requirements:

- Avoid clogging with construction sediments during construction & long term
- Clean pavement to ensure pavement is free of debris and sediments as needed (at least twice a year)
- Check to see that pavement de-waters during large storms and does not pond into surface (check observation well for appropriate water levels) after large storms
- Inspect upland and adjacent vegetated areas. Seed and straw bare areas as needed
- Inspect pavement surface for structural integrity and areas in need of repair. Repair as needed annually
- Snow and ice removal should not incorporate sand or cinders on porous pavements. Instead, winter maintenance should focus on timely snow plowing and judicious use of de-icing materials as needed, See the UNHSC publication: Winter Maintenance Guidelines for Porous Pavements at http://www.unh.edu/unhsc/sites/unh.edu.unhsc/files/pubs_specs_info/winter_maintenance_fact_sheet.pdf
- Avoid sealing or repaving with non-porous materials long-term. Areas may be repaired using the same treatment as the original permeable pavement application or, small areas (not the lowest area on a sloping section) can be replaced with standard (impermeable) pavement. In that case, the stone bed of the entire pavement will continue to provide storage and infiltration as designed. Surface treatments of any kind that would tend to seal the pores in the pavement should not be used.

Q: Is maintenance of a porous asphalt pavement any more costly than that of conventional pavement?

A: A definitive answer is undetermined and may only be answerable on a case-by-case basis. As noted elsewhere in the Technical Bulletin, porous asphalt pavements will require periodic inspection and cleaning, which depending on the location and use, may not be required with conventional pavements. However, these extra costs, if any, may be offset by reduced snow and ice-control costs and decreased storm drainage maintenance. And, of course, the true total costs need to be compared not to just alternative pavements, but to the total costs associated with alternative stormwater management practices as well.

Q. Does the petroleum leach out of the porous pavement?

A. No. Study after study has shown no tendency for the petroleum asphalt to leach out of asphalt pavement. See the report of the study by Allan Brantley and Timothy Townsend at http://www.hinkleycenter.com/images/stories/publications/townsend_98-2.pdf

Q. What effect does clogging have on the functionality of the porous asphalt surface?

A. The porous asphalt is many times more permeable than any soil it may be constructed over. As a result, the functionality of the system is not compromised by less than total clogging of the surface. Dr. Robert Roseen is quoted as saying, "if 99 percent clogging were to occur, the infiltration rate would still

be greater than 10 inches per hour, which is greater than most sand and soil mediums."

Q. What is the cost of a porous asphalt pavement facility?

A. Special features such as the underlying stone bed are more expensive than conventional construction, but these costs are more than offset by the elimination of many elements of standard stormwater management systems. On those jobs where unit costs have been compared, a porous asphalt pavement is generally the less-expensive option. The cost advantage is even more dramatic when the value of land that might have been used for a detention basin or other stormwater management features is considered.

Q. Is an approved or certified applicator required to place a porous asphalt pavement?

A. Yes. FPO recommends specifications requiring that an approved Field Quality Control Supervisor, having the porous asphalt endorsement, be onsite and in control of the placement of the porous asphalt concrete to ensure proper quality control and placement. While porous asphalt does not necessitate proprietary ingredients, or require the contractor to have special paving equipment or skills, proper placement does require knowledge of the different construction requirements. With the proper information, most asphalt plants can easily prepare the mix and general paving contractors can install it.

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Tribute to James “Jim” Jenkins, 1955-2016

Flexible Pavements of Ohio gives tribute to the life of Jim Jenkins – an asphalt professional. Jim passed away this past October having established an asphalt legacy characterized by professionalism and partnership in the pursuit of quality.

Jim Jenkins began his career with the Ohio Department of Transportation (ODOT) in 1978, and served the department for 35 years until his retirement in 2013. In the early days his duties were as an asphalt technician testing mixtures by centrifuge extraction, aggregate gradation and 200 sieve “dust” corrections. Jim rose to the level of Material Controller Supervisor in ODOT’s Asphalt & Materials Section. Those days marked the advancement of industry initiatives such as contractor mix design and quality control, and the use of pavement density testing as a means of quality acceptance. With these initiatives came expanded testing protocols for asphalt technicians that required greater skills and depth of knowledge. Jim found himself in the midst of a changing industry in which he thrived and prospered.

In the late 1980s, ODOT was ramping up the use of asphalt as its primary material for rehabilitating failing interstate pavements. Strategies the likes of Crack-and-Seat, Break-and-Seat, and Rubblization had heavy dependence on asphalt tons. The ODOT Asphalt Materials Section rose to the challenge in ensuring the construction program went unabated. Now a Material Controller Supervisor, Jim was part of the leadership to ensure contractor mix designs met specification and were dispatched as approved.

The 1989 ODOT asphalt program nearly came to a screeching halt. Ohio EPA concerns with the transporting of spent solvent from asphalt extraction tests caused an immediate investigation into alternative methods for testing asphalt mixes. In an almost prophetic way, Jim Jenkins and his colleagues at the Central Lab, John Neenan and Sonny Solars, had years prior published a study on the comparison of the asphalt extraction method with nuclear asphalt content gauge, and computerized plant ticket as means of asphalt content acceptance. That work made for a near seamless transition of acceptance methods from extraction to the nuclear asphalt content gauge. Having accomplished a successful transition in 1990, Jim and John Neenan received an industry service



At the 1991 FPI Annual Meeting, Jim Jenkins (far right) was honored along with ODOT Lab associate John Neenan (left) and ODOT Chief Engineer Ron Zook for their seamless transition of acceptance methods from extraction to nuclear asphalt content gauge.

award from Flexible Pavements Inc. at its 1991 Annual Meeting for their tireless efforts in making the transition.

Among Jim’s other contributions to the industry involved educating up-and-coming asphalt technicians. Jim was in charge of the asphalt technician certification program. He often participated in the instruction of the asphalt technician plant quality-control training, the Comprehensive Asphalt Mix Design School, and provided guidance to district staff, among whom were the District Engineers of Tests. As anyone familiar with the asphalt production and construction program knows, the specifications have been dynamic, resulting from the relentless pursuit of continuous quality improvement. Jim was a part of that process and always an advocate for meaningful change.

In the words of his colleague John Neenan, “His best asset was working with the contractors, producers and suppliers to get the best job for ODOT and the taxpayer. He always was fair and honest with all contractors. The main thing Jim loved about the Asphalt business was the people.”

The members and staff of Flexible Pavements of Ohio extend their sincere sympathy to the family of Jim Jenkins.



Applications are now being accepted for Flexible Pavements of Ohio’s (FPO) Asphalt Scholarship Program for the 2017-2018 academic year. Undergraduate and graduate civil engineering and construction management students at participating Ohio universities are eligible to apply with qualifying coursework in asphalt pavement technology. The application period is Dec. 1, 2016 through Jan. 29, 2017.

Interested applicants should visit www.flexiblepavements.org for complete program eligibility information and to apply for this scholarship.



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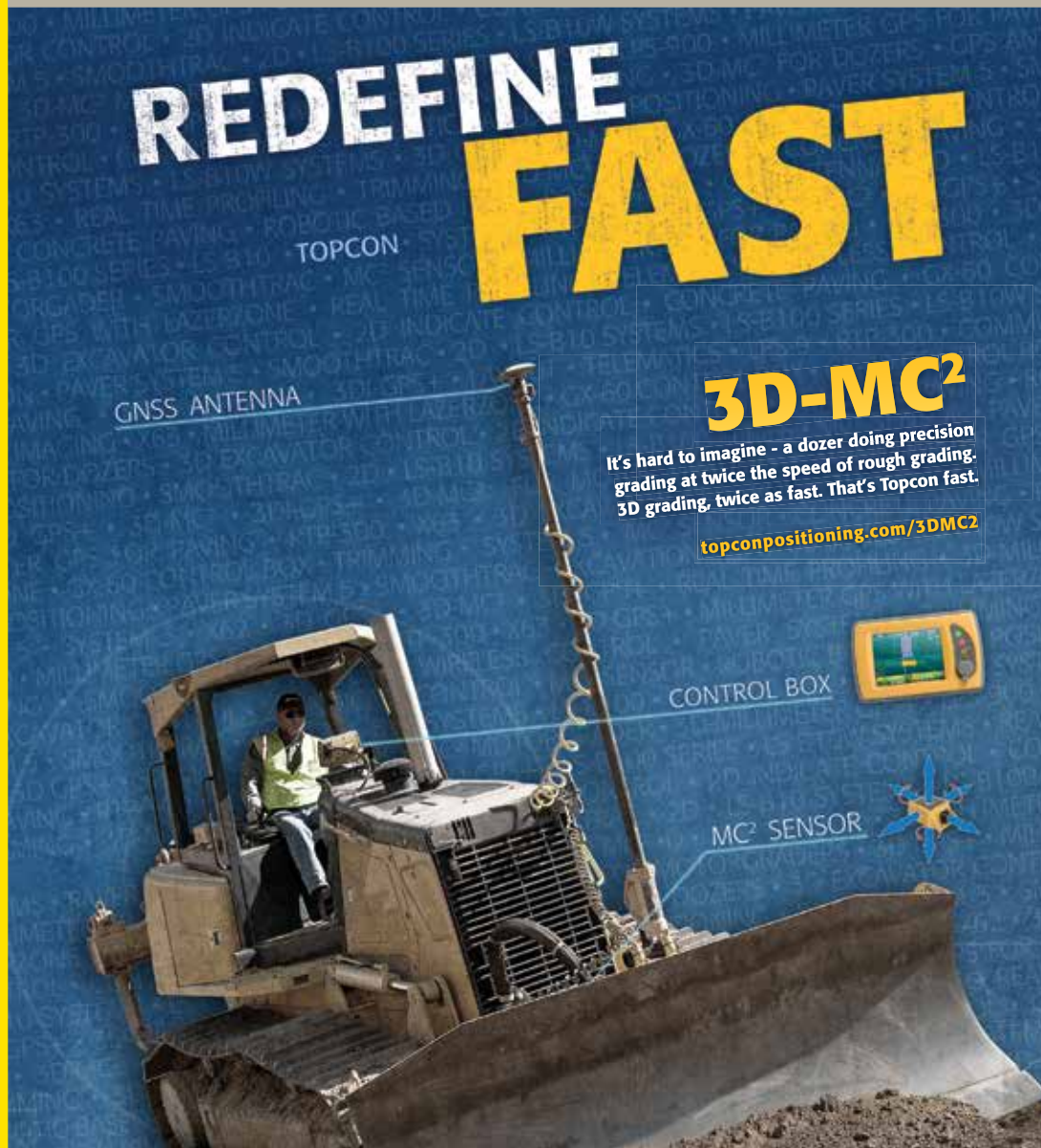
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