

# OHIO ASPHALT

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ON THE COVER: STONE MATRIX ASPHALT (SMA) PAVEMENT ON INTERSTATE 71 FORT WASHINGTON WAY IN CINCINNATI IS STILL PROVIDING EXCEPTIONAL SERVICE AND VALUE AFTER MORE THAN 10 YEARS. SEE STORY ON PAGE 6. (PHOTO BY JIM SCHEROCMAN)



*Flexible Pavements of Ohio is an association for the development, improvement and advancement of quality asphalt pavement construction.*

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## THE PRESIDENT'S PAGE



**CLIFFORD URSICH, P.E.**  
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**“‘Better, Faster, Cheaper’ is really a definition for value, isn’t it? ODOT is looking for the best value, and so is every other pavement owner. It wants the products it purchases to have attributes like high quality and speedy delivery (whether they are project plans, pavement construction, or other) and to be available at a price that is reasonable for the product delivered.”**

# ‘BETTER, *FASTER*, CHEAPER’

The recent Ohio Transportation Engineering Conference (OTEC) was a terrific success as approximately 2,800 folks were in attendance to learn the latest and greatest in transportation. Of course, FPO was there in force along with our friends from the Asphalt Institute. There was some terrific information shared that spoke to the value of transportation, and in particular the value of asphalt. Besides the Asphalt Pavement session that provided helpful information on the sustainable attributes of asphalt, there was another noteworthy session that included a presentation on the construction of a new, 10,000-foot asphalt runway at the Port Columbus International Airport. When the Q&A period brought a question about why the airport authority chose asphalt for the runway construction, the speaker responded that asphalt provided a perpetual pavement, and as such there would be no need for future reconstruction; instead, only minor restorative measures would be necessary.

This affirmed the validity of the perpetual pavement principles; that is to say, asphalt pavements can be designed for inexhaustible structural life, with only the need for replacing the wearing course. The long life and economy of Ohio’s heavy-duty asphalt pavements is another testimony to the value of designing for “perpetual” performance.

The opening session of OTEC included remarks from the Ohio Department of Transportation (ODOT) director, who in his address explained ODOT’s priorities to those industry groups

desiring to do business with them. He put it succinctly: By being “Better, Faster, Cheaper.” Being a “pavements guy” I take his use of the word “Better” as a call to better quality and better overall performance, which includes safer, longer life, and a smoother, quieter ride. “Faster” to mean, well, faster! “Get in, get out and stay out” is how the feds described it years ago. My interpretation is that FAST pavements are quickly constructed, use materials and methods that keep motorists moving through construction zones, and can be quickly maintained when time for such becomes necessary. This sounds like a job for asphalt.

That leaves us with “Cheaper.” I don’t want to be presumptuous, but I suspect the director’s use of the word “Cheaper” isn’t meant to suggest the department is interested in products that are faulty or will need repair sooner than they ought. He must be referring to the cost of the product; he wants less costly products. Tell me which is less costly, a product that may cost a bit more when initially purchased but lasts an extended period with minimal maintenance (sort of like your Maytag whose repairman patiently waits for the telephone to ring with a repair call) or a product that may be of lesser initial cost but requires extensive maintenance and ultimately gives out and is in need of replacement? What do you think? Which affords you the best value? I think you would agree that the product that delivers the long-term performance is best. Only asphalt provides this sustainable performance. History demonstrates that engineered asphalt

pavements have lasted with inexhaustible structural strength.

"Better, Faster, Cheaper" is really a definition for value, isn't it? ODOT is looking for the best value, and so is every other pavement owner. They want the products they purchase to have attributes like high quality and speedy delivery (whether they are project plans, pavement construction, or other) and to be available at a price that is reasonable for the product delivered. For those of us who are engineers, this sounds a lot like Engineering Economics 101 — benefits received for the dollars paid. Fortunately, for those of us in the asphalt business, these very attributes are our hallmark: long-term life, fast maintenance and at a cost that makes asphalt a good value. When we stack up the benefits of asphalt pavements and compare that to the cost paid, asphalt truly defines value.

Whether it's ODOT, a city or a business, asphalt contractors need to understand these folks are

still interested in "value." Even in this down economy, customers are purchasing pavement and they are doing so based on the value they perceive. The Port Columbus International Airport runway I spoke of earlier was chosen based on value. For that particular project, the initial cost of the asphalt pavement was higher than the competing alternative. What won the day was the historical performance of asphalt that demonstrated it was "Better, Faster, and Cheaper" over the long haul. The asphalt alternative was of higher quality, able to be more quickly constructed, and reconstruction was designed out of future maintenance through utilizing perpetual pavement design concepts. Opportunity exists for the contractor that can communicate

the value of their product. With asphalt, that communication is made easier since the historical performance of asphalt pavements speaks so profoundly.

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# SMA PAVEMENT OF I-71, CINCINNATI'S FORT WASHINGTON WAY –

# 10 YEARS LATER

*By Jim Scherocman, P.E. and Bill Fair, P.E.*

Stone Matrix Asphalt, or SMA (originally called Stone Mastic Asphalt), was first used in Europe in the 1970s to provide a surface-course mixture for high-traffic-volume roadways. Due to the great amount of coarse aggregate used in the mix, the “stone-on-stone” contact of the large particles provides increased strength and increased long-term durability.

SMA was first used in the United States in 1991, on a portion of Interstate Route 94 west of Milwaukee. The initial construction was a relatively short section, less than one mile in length, in the westbound driving lane. The first author of this article was actively involved in the mix design and pavement construction for the project. Four additional projects were also constructed in different states during the 1991 paving season.

An SMA pavement surface was first constructed in Ohio in 1992, on a portion of U.S. Route 33 between Dublin and Marysville. From that date through the end of the 1990s additional projects were constructed in the state, primarily in northern Ohio.

On July 31, 1998, a contract was let to reconstruct a portion of I-71 and U.S. 50 in downtown Cincinnati. This section of roadway, which locally was termed “The Trench Project,” was originally built in the 1960s. This contract consisted of complete reconstruction of the existing roadway, increasing the number of lanes in each direction from two to four.

Selected by the City of Cincinnati and its managing consultant Parsons Brinckerhoff, SMA was the preferred surface course mixture for this reconstruction job. The actual cross section used included:

- 1. Surface Course: 1-1/2 inches of SMA (SS 856)**
- 2. Leveling Course: 1-3/4 inches of 446 Type II**
- 3. Base Course: 5 inches of 301 HMA**
- 4. Base Course: 8 inches of 302 HMA**
- 5. Aggregate Base Course: 10 inches of 304**
- 6. Subgrade Soil**

The subcontractor for the construction of the asphalt pavement structure was the John R. Jurgensen Co. The SMA mix was produced by the Eaton Asphalt Corp. and placed on the I-71 project by the Valley Asphalt Corp., both subsidiaries of Jurgensen.

For the SMA mixture, the selected asphalt binder material was a PG 70-22 material modified with a SBS polymer. Based on the job mix formula, the design binder content was determined to be 6 percent by weight of mix. In addition, 0.3 percent cellulose fibers were added to the SMA mix to control any drain down that might occur due to the high binder content in the mix.



Prior experience has shown that the voids in mineral aggregate (VMA) content of the plant-produced SMA mix is often significantly lower than the VMA determined during the mix-design process. As a rule of thumb, a reduction of 1 percent VMA in the plant-produced mix will typically result in the loss of volume in the mix to fit about 0.4 percent asphalt binder. Too much binder in the mix will normally result in flushing or bleeding of the SMA mix on the roadway under traffic.

The job mix formula, submitted to the Ohio Department of Transportation (ODOT) by Valley Asphalt, was approved on July 28, 2000. It was determined that the design binder content was 6.0 percent of polymer modified asphalt material.

Before paving commenced on the I-71 project, several test sections with the SMA mix were constructed in the Eaton Asphalt yard in Kentucky. The accompanying photo shows the first test strip being placed in the Eaton Asphalt yard observed by the authors and ODOT and company personnel.

The primary purpose of the test sections was to determine if any modifications needed to be made to the asphalt binder content due to



differences in the VMA and the air voids (AV) content between the SMA mixture designed in the laboratory and the actual SMA mixture produced in the plant. It was determined based on the volumetric properties of the actual plant-produced mix that the asphalt binder content should be reduced by 0.4 percent to 5.6 percent for the SMA mix to be placed on this job.

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Placement of the SMA mix was performed June 9-10, 2001, by Valley Asphalt. The accompanying picture shows the construction of the SMA surface.



*Photo courtesy of John Deatrick*

On Sept. 29, 2011, the authors made a detailed survey of the present condition of the SMA surface course layer on this project. The latest average 24-hour traffic data from ODOT, dated 2009, shows a volume of 95,300 passenger cars and light trucks as well as 9,850 commercial trucks, for a total traffic count of 105,150 vehicles per day.

Overall, the pavement surface was in excellent condition. The surface texture of the mix was found to be as expected – no bleeding or flushing of the SMA mix was observed. In addition, no rutting of the SMA mix was observed. The accompanying picture shows the existing macrotexture of the SMA mix.



Minor deficiencies were observed. Those included slight opening of the longitudinal joints between adjacent traffic lanes in some locations. Those also included patching in one localized area in the westbound direction underneath one bridge – cause of the pothole is unknown. Further, those included a short length of longitudinal cracking within one traffic lane in the eastbound direction. Other than those very minor deficiencies, the SMA pavement surface was performing properly.

Three pictures of the current condition of this SMA pavement structure, after 10 years under traffic are shown in the accompanying photographs. Based on the observations of the authors, the pavement is performing similar to other Ohio deep-strength pavements showing perpetual-like performance, and the SMA wearing course should continue to serve the traveling public for years to come.



*Prior articles on the design and construction of this SMA paving project were published by Flexible Pavements of Ohio in December 1999 and June 2001, and archived on its website at <http://www.flexiblepavements.org/ohio-asphalt/Ohio-HMA-Newsletters>.*





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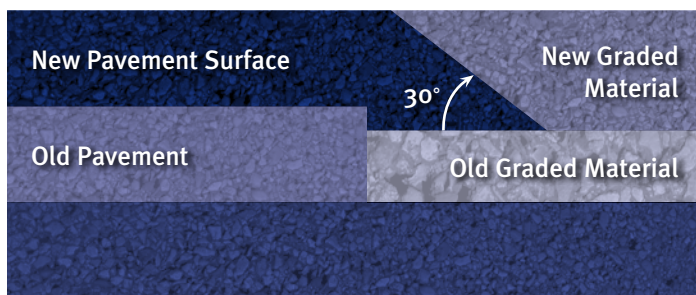
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# 'SAFETY EDGE' GOES TO RURAL AREAS USING THIS LOW-COST ROAD TREATMENT

Does your road need a Safety Edge? The answer is "Probably." Especially if it is a rural two-lane road without paved shoulders. A report issued by the Federal Highway Administration (FHWA) this year indicates that the Safety Edge is a low-cost treatment that is very likely to help prevent crashes involving pavement edge drop-offs (PEDOs).

The Safety Edge is a 30-degree beveled area formed on the edge of the pavement from the horizontal that prevents the exposure of a vertical edge when a PEDO exists.



FHWA graphic

The FHWA has been pushing the adoption of the Safety Edge through its "Every Day Counts" program since 2008. In its guidance memo FHWA states:

*"Each State should implement policies and procedures to incorporate the Safety Edge where pavement and non-pavement surfaces interface on all federal-aid new paving and resurfacing*

*projects with surface differentials of 2.5 inches or more. The differentials should be measured from the pavement surface to the adjacent non-pavement surface, accounting for grading along the pavement edge during construction and including existing drop-offs.*

*"In addition, divisions should work with federal, state and local agencies and tribal governments to determine how the Safety Edge can be installed on all routes with pavement edge drop-offs (i.e., surface differentials of 2.5 inches or greater) during resurfacing over time, based on highest priority by traffic volume, lack of paved shoulders, and historical presence of edge rutting or pavement edge drop-offs."*

FHWA reports that a vertical PEDO greater than 2.5 inches is a significant hazard from which many drivers and vehicles will have difficulty safely recovering; whereas, the 30-degree Safety Edge allows safe and smooth recovery for most vehicles.



FHWA photo

The Safety Edge is easily formed with asphalt paving by using a proprietary device attached to the paver screed.

Presently, devices for forming the Safety Edge are available from four manufacturers: Transtech Systems Inc., Advant-Edge Paving Equipment LLC, Carlson Paving Products and Troxler Electronic Laboratories Inc.



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These devices most importantly impart some compaction to make the Safety Edge and shape more durable.

The “best practice” procedure is to grade (clip) the unpaved shoulder to make way for the Safety Edge, pave the Safety Edge, and re-grade the shoulder material flush with the finished pavement surface.

In Ohio, Madison County Engineer David Brand, P.E., P.S., has resurfaced several roads using the Safety Edge. He is an advocate for its use and reported on his experience at the 2011 Ohio Asphalt Paving Conference. His presentation can be viewed at <http://www.flexiblepavements.org/sites/www.flexiblepavements.org/files/events/conferences/12Brand.pdf>.

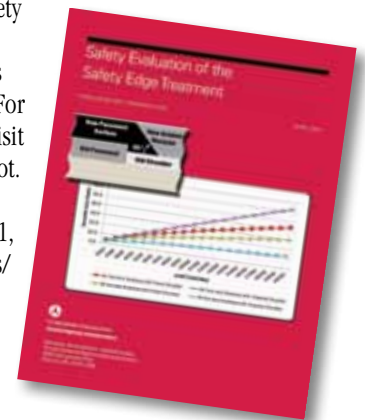
Extra costs of providing the Safety Edge include the use of the proprietary device, about 1- percent extra asphalt concrete and the shoulder grading. Other than the extra asphalt concrete, the cost of the Safety Edge has been in the order of a couple of thousand dollars per project.

The FHWA has a guide specification for the Safety Edge available at [http://safety.fhwa.dot.gov/roadway\\_dept/pavement/safedge/gsse.cfm](http://safety.fhwa.dot.gov/roadway_dept/pavement/safedge/gsse.cfm). ODOT is implementing the Safety Edge with a plan note and typical drawing. The ODOT LTAP office described the Safety Edge in an article in the January-March, 2011 issue of *The Ohio LTAP Quarterly* available

online at [http://www.dot.state.oh.us/Divisions/Quality/LTAP/Newsletters/Ohio\\_LTAP\\_Quarterly\\_Winter\\_2011.pdf](http://www.dot.state.oh.us/Divisions/Quality/LTAP/Newsletters/Ohio_LTAP_Quarterly_Winter_2011.pdf), and has been offering a free seminar on the federal “Every Day Counts” program that includes an introduction to the Safety Edge.

Where it is desired to incorporate the Safety Edge in a project, it is recommended that a lump sum item, “Special - Safety Edge,” be included in the bid items and that the item description include the information from the FHWA guide specification or the ODOT plan note.

In addition to the safety benefit, the Safety Edge is said to create a stronger and more durable pavement edge that is less susceptible to raveling or breaking-off. For more information on the Safety Edge, visit the FHWA website at [http://safety.fhwa.dot.gov/roadway\\_dept/pavement/safedge/](http://safety.fhwa.dot.gov/roadway_dept/pavement/safedge/) and view the full report, dated April 2011, at <http://www.fhwa.dot.gov/publications/research/safety/11024/>.



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# 2011 Asphalt Scholarship Awards Sustainability in the Classroom

**Sustainability has become a modern-day buzzword, just as going green is the new couture, but it's nothing new for Flexible Pavements of Ohio.**

Think about it: FPO represents an industry that is America's No.1 recycler, and the asphalt industry annually reuses and recycles nearly 100-million tons of its own products. Asphalt provides qualities that not only improve current lifestyles but also future lifestyles – such as smooth, fuel-saving, long-wearing pavement; noise reduction; traffic relief; stormwater management; and much more.

While the early 21st century has emphasized sustainability practices in an effort to take care of tomorrow's resources, FPO members have been providing pay-it-forward stewardship for their industry the past 16 years. Since 1995, the FPO Hot Mix Asphalt Scholarship Program has been literally and figuratively sustaining the training of tomorrow's industry leaders.

Prior to the scholarship program, none of Ohio's 10 universities offering Civil Engineering or Construction Management degrees provided coursework in HMA. FPO's 1994 Long-Range Strategic Plan changed all that with the inception of the program, which to date has awarded 335 scholarships totaling \$405,600.

For the current 2011-2012 academic year, the FPO Hot Mix Asphalt Scholarship Program is providing 24 traditional scholarships for undergraduate students and one graduate student scholarship. The FPO Graduate Scholarship is awarded to a post-graduate student whose major field of study is related to asphalt pavement technology and who has been recommended by his/her faculty advisor. Undergraduate awards are based on academic performance; potential leadership; participation in school, community and extracurricular activities; work experience; career and educational aspirations; and personal circumstances.

While individual students from six universities, Akron, Bowling Green State, Ohio, Ohio Northern, Ohio State and Toledo, are being assisted by this academic year's scholarships, many more students at these educational institutions are benefitting through FPO's 2011-2012 scholarship program, as coursework in asphalt is a requirement for a school's participation in the scholarship program.

*For further information on the FPO Hot Mix Asphalt Scholarships Program, as well as an application and information for the 2012-2013 program, visit <http://www.flexiblepavements.org/scholarships/bma-scholarships-program>.*



## FPO has Sustained Program's Goal set 16 Years Ago

Though they were established 16 years ago when the FPO Hot Mix Asphalt (HMA) Scholarship Program began, the association has sustained these four initial objectives and goals to propel the success of the program:

- Provide an incentive for students to gain knowledge in HMA by requiring each student receiving a scholarship to take at least one course in HMA
- Provide an incentive for colleges/universities to offer training in HMA by creating a student demand for the course
- Establish close ties between the asphalt industry and universities to raise the awareness of HMA in the academic community and foster HMA-related research
- Provide a workforce trained in asphalt technology

The FPO HMA Scholarship Program is administered through the National Asphalt Pavement Association's National Research and Education Foundation.

# 2011-2012 FPO Hot Mix Asphalt Scholarship Recipients

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# The Global Chemical Soil Stabilization with Lime

## Mainline Pavement Replacement at Ohio Turnpike



*Kamran Majidzadeh, Ph.D., P.E.*



*Dane Redinger, P.E.*

The Ohio Turnpike, a multilane mainline roadway with 982 miles of original pavement, has been serving northern Ohio and its neighboring states connecting to the major toll roads of eastern industrial states for more than half a century. The original pavement structure was built with the highest quality materials at the time, but after a half-century of service there are predominant signs of rapid deterioration and disintegration. The reconstruction of the Ohio Turnpike provides a unique opportunity to explore the benefits of soil stabilization in improving subgrade strength and project costs.

At the time the turnpike was completed in 1955, it was designed to carry 10 million vehicles annually. Throughout the past decades, the traffic composition has remained almost constant with about 30 percent commercial vehicles and 70 percent passenger vehicles. Today, the toll road carries more than 50 million vehicles annually with truck weights more than 127,400 pounds, and the design Equivalent Single Axle Loads (ESAL) ranging from 50 to 80 million.

The toll road traverses a variety of geological conditions, soil types and climatic regions. The original pavement design was composed of 10-inch reinforced concrete pavement with a 6-inch aggregate base course and designed for soil strength of CBR 4.0.

In 2009, a master plan of the turnpike pavement condition was undertaken. The study concluded that some sections of the original 982 lane miles have far exceeded their design life, are deteriorating very rapidly and in need of immediate reconstruction and replacement.

### **PRIORITY RANKING AND RECONSTRUCTION TIMELINE**

The Ohio Turnpike Commission (OTC) employed the Resource International Inc. (Rii) team to develop a master plan for replacement and reconstruction of the original pavement, and develop a priority ranking system and timeline for its replacement. The severity of deterioration would govern the sequence and priority of reconstruction and replacement.

*By Kamran Majidzadeh, Ph.D., P.E. - Resource International Inc.  
& Dane Redinger, P.E. - Resource International Inc.*

To implement the priority ranking and reconstruction timeline, the study divided the pavement into 48, five-mile sections. Eight performance indicators were used to assess each five-mile section for four quality levels. Both historical pavement data and new data of the in-situ condition were used in the evaluation. Rii used innovative technologies throughout the process, making it possible to meet the master plan's objectives in less than nine months.

A total of 15, five-mile sections were identified for replacement in the next five years. The first six, five-mile sections were designated and selected for immediate reconstruction and replacement. The results were summarized with the highest priority being MP 95.8 to 101.2 (PR1 Project).

### **PAVEMENT DESIGN CONSIDERATIONS FOR MP 95.8-101.2**

The pavement design was performed with full consideration of past performance, maintenance history and the recognition of poor soil condition. Additionally, the pavement was designed to lengthen the life cycle and work within the framework of sustainable solutions, which include:

- Pavement design in accordance with ASSHTO/MEPDG guidelines
- Lime soil stabilization to treat the entire pavement footprint (i.e. global stabilization) for the purpose of strengthening the subgrade

### **Subgrade Design Parameters**

The subgrade soil strength study was performed by reviewing historical data and conducting additional subgrade soil characterization. First, the subgrade soil strength was evaluated indirectly from back-calculation of deflection using a Falling Weight Deflectometer (FWD). Additionally, the subgrade soil strength was evaluated directly by an innovative and non-intrusive Automated Dynamic Cone Penetrometer (ADCP) method. ADCP provides direct and accurate shear strength results without the need for extensive laboratory testing.



In addition to the data collected from FWD and ADCP testing, a geotechnical investigation was carried out in accordance with ODOT Geotechnical Bulletin No.1 (GB-1). GB-1 recommended an average CBR of 4 for determining the pavement thickness and use of global soil stabilization for the entire five-mile segment. Chemical stabilization has shown to be an effective means for increasing soil strength. The results of various subgrade studies, the statistical distribution of data, and the GB-1 recommendations are summarized in Figure 1.

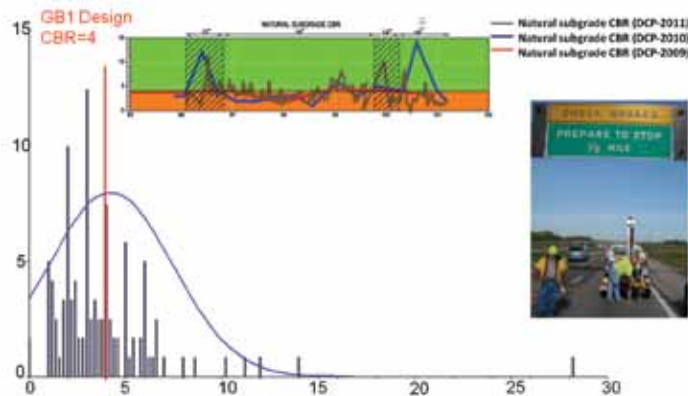


Figure 1

## GLOBAL SUBGRADE LIME SOIL STABILIZATION

### Soil Stabilization Alternatives

GB-1 recommends use of portland cement, lime-kiln dust or quicklime for chemical subgrade stabilization. Selecting the type of stabilization agent for the turnpike project was based on the soil classification data from the soil samples taken near the plan subgrade elevation. The soil encountered at the plan subgrade elevation consisted of soft, saturated cohesive soil with varying degrees of clay content. After reviewing the soil classification data, historical data and the recommendation from GB-1, quicklime was selected as the stabilization chemical for improvement of the subgrade strength. The GB-1 recommended for the in-situ soil conditions the thickness of the lime-stabilized layer to be 12 to 16 inches, as needed.

### Mix Design by Supplemental Specification 1120

The mix design for the quicklime as the subgrade stabilization chemical followed the required testing procedures as described in *ODOT Supplemental Specification 1120 Mixture Design for Chemically Stabilized Soils* (ODOT SS1120). The ODOT SS1120 required obtaining a 100 lb. bulk soil sample at each soil boring location for laboratory testing. pH testing of the soil-lime mixture was then performed at

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incremental quicklime percentages (by dry unit weight) to determine the minimum lime percentage (MLP) to increase the pH of the soil-lime mixture to 12.4. The soil-lime pH testing was done in accordance with ASTM D6276 Eades-Grim test. After determining the MLP for each soil sample, one-point Proctor tests were conducted at the MLP, MLP+2 percent and MLP+4 percent to determine the maximum dry unit weight and optimum moisture content of each soil-lime mixture. These tests were performed according to ODOTSS1015 and AASHTO T272.

### Laboratory Unconfined Compressive Strength (UCS)

The soil-lime expansion and UCS testing was performed in general conformance with ASTM D2166, D3551, D3877 and D5102 at 0 percent (untreated), MLP, MLP+2 percent and MLP+4 percent. Per ODOT SS1120, a minimum average eight-day unconfined compressive strength of 100 psi and a 50 psi increase in unconfined compressive strength from the untreated soil is required for all soil types. A summary of the unconfined compressive strength data is presented in Table 1.

**TABLE 1: LIME-SOIL STABILIZATION – LABORATORY MIX DESIGN STRENGTH RESULTS**

Soil Type	Average Minimum Lime Percentage per Soil Type	Average UCS as 8 days per Soil Type-Untreated (lbs./in. <sup>2</sup> )	Average UCS as 8 days per Soil Type-MLP (lbs./in. <sup>2</sup> )	Average $\sigma_{flex}$ at 5% Lime (lbs./in. <sup>2</sup> )	Average $M_R$ at 5% Lime (kips/in. <sup>2</sup> )
A-6a	3%	60	135	43.6	29.3
A-6b	4%	60	250	64.5	40.2
A-7-6	4%	60	220	62.7	39.2



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### Mix Design Parameters for Lime Stabilized Layer (STB)

Based upon the evaluation of the eight-day UCS test data and the minimum lime percentage to increase the pH of the soil-lime mixture to 12.4, an application of 5 percent quicklime by dry unit weight was specified as the Design Lime Content for the entire project length. The results of UCS values are presented in Table 1.

The Modulus of Resilience (Mr) of the Lime stabilized soils was estimated by:  **$E \text{ (ksi)} = 0.124 \text{ (UCS)} + 9.98$**

The results presented in Table 1 are within the range of 22,000 to 80,000 psi, as reported in the literature.

The flexural strength in psi was also estimated from UCS data, as reported in Table 1. The relationship is:  **$\sigma_{\text{flex}} = 0.51 \text{ (UCS)}$** .<sup>88</sup>

The flexural stresses in the stabilized layer are generally insignificant as compared to the flexural strength reported in Table 1.

### CONSTRUCTION PHASE



Figure 2

Construction documents for the MP 95.8-101.2 project required global subgrade lime stabilization on the entire five-mile section at a treatment depth of 16 inches. The exceptions were two small sections where 12-inch depth

was specified (Figure 2). Construction plans addressed the stabilization process, from initial mixing of the soil and lime to the final curing of the stabilized subgrade. Specifications also provided for a performance-based acceptance for determining if the lime stabilized soil subgrade strength has met the design requirements, thereby allowing for early acceptance of

the stabilized soil and, consequently, an acceleration of the construction schedule.

The contract documents were a mix of the conventional prescriptive-based specifications along with performance-based criteria for acceptance of the soil. During construction the lime application rate was checked by comparing the lime tonnage placed to that which was required over a given area. Additionally, the stabilization contractor performed test sections of the application rate by placing a square-yard container randomly on the natural soil subgrade and then driving a spreader truck filled with quicklime over the container. The stabilization contractor then weighed the container and determined the application rate in lbs. per square yard. The compaction requirements were performed in accordance with ODOT Item 206 and the curing process was allowed to be shortened, provided that the lime stabilized soil subgrade could achieve a target ADCP penetration rate.



Figure 3

During construction, field observations indicated that the lime-stabilized soil was not gaining sufficient strength after two days of curing to satisfy the required ADCP target penetration rate. As the project progressed, more data was obtained. After obtaining additional data, the penetration rate was modified to allow for the pavement placement to proceed in a manner that ensured the stabilized soil achieved sufficient initial strength and would continue to develop long-term, permanent strength.

### SUBGRADE DESIGN STRENGTH VERIFICATION

Subgrade quality is one of the critical elements of the design strategy and is highly dependent on the global soil stabilization process. The



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success of global chemical soil stabilization is dependent on the depth of treatment, the effective strength of the stabilized layer and the effective subgrade strength. The ADCP and Light Weight Deflectometer (LWD) were used as a quality management tool during the construction to measure the penetration rate and CBR values with depth at each test location and was repeated two and five days after compaction and curing, and in certain instances after the proof rolling. The ADCP measurements of the penetration rate with depth were recorded through the stabilized layer and through the natural subgrade. Results were converted to CBR for use in verifying design assumptions. A large majority of the ADCP and LWD results of the lime stabilized subgrade shown in this article were after two days of curing.

### Thickness of the Stabilized Layer

The ADCP penetration rate measurements were used to verify the effective depth for the 12- and 16-inch stabilized sections. The statistical distribution of the effective depth indicated that the design thickness for the stabilized layer was mostly satisfied after only two days of curing; however, about 20 percent of measurements fell short of the design depth by approximately 1 inch. A multilayer analysis indicated that the deviations from design depth up to 1 inch have insignificant effects on the induced strains.

### CBR of the Stabilized Layer

The ADCP was used to determine CBR values at various test locations to confirm the effectiveness of the lime stabilization process and verify that the Design CBR requirements have been satisfied; however, the ADCP penetration rate measurements indicated that the upper section of the stabilized layer had much higher CBR values than the lower portion. This was due to construction procedures, moisture and variation in the rate of hydration. The in-situ CBR profile was divided into two sub-layers with distinct CBR values and thicknesses. The in-situ profile was then replaced with an Effective CBR value as determined by a multilayer analysis program for a stabilized layer with design thickness of 12 or 16 inches.

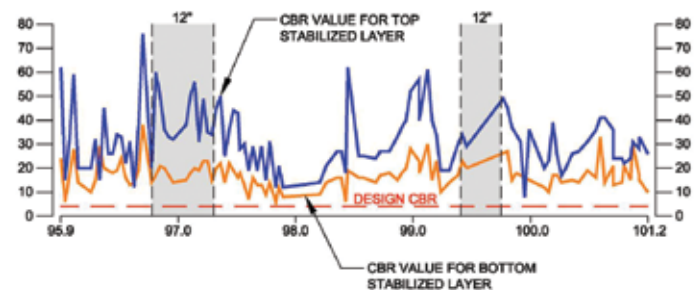


Figure 4

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The effective stabilized layer CBR, as a design parameter for the project, attained values as high as 50 with an average value of 18 in comparison with the lab data of 20 to 26.

### Effective Subgrade CBR

The GB-1 recommended a CBR of 4 to be used in the pavement thickness design. To demonstrate the chemical stabilization satisfied this design requirement, an Effective CBR was determined using the natural subgrade CBR and the effective stabilized layer CBR. As stated previously, a multi-layer analysis program was used to calculate an Effective subgrade CBR to represent the in-situ conditions.

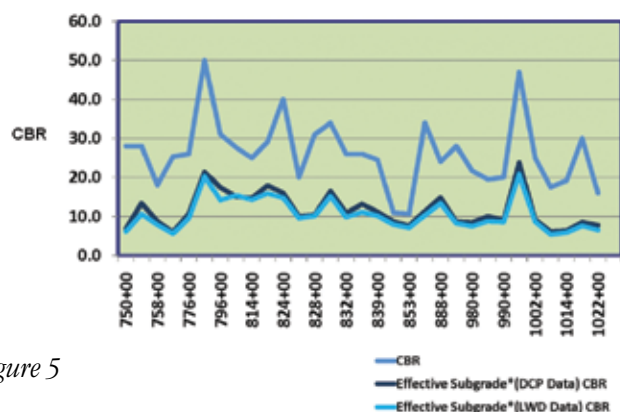


Figure 5

The deflection measurements from LWD testing were used to back-calculate the Effective subgrade modulus/CBR and Effective stabilized layer CBR. There was close agreement between LWD and ADCP calculated results (Figure 5). The Effective subgrade CBR values were as high as 20 and mostly in the range of 10 to 15 – substantially stronger when compared with the required CBR of 4.

### DESIGN IMPLICATIONS OF GLOBAL SOIL STABILIZATION FINDINGS

The global chemical soil stabilization process is regarded as an innovative cost saving and sustainable solution for pavement design, construction, and rehabilitation.

GB-1 provides guidelines for selecting a Design CBR for a project and when global soil stabilization is appropriate. Though GB-1 currently does not recognize using stabilized soil strength in determining pavement thickness designs, there remain long-term benefits; these being improved constructability and pavement performance. When the increased strength from stabilized soil is included in the thickness design, added benefits in the form of lower initial and lifecycle costs can also be attained. For this to be accomplished there must be site-specific engineering and strict quality management.

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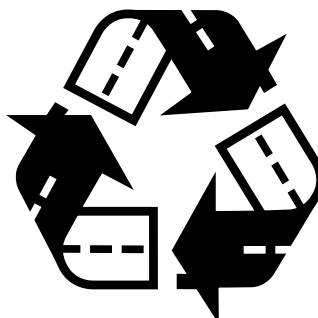
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Based upon experience from this project, the Rii team concluded the following guidelines and recommendations for future projects:

- The treatment depth, or thickness of the stabilized layer, should be determined by the design engineer based on the result of geotechnical investigation and GB-1 guidelines, and specified in the design and construction documents. The treatment depth generally ranges from 12 to 16 inches.
- As a result of field construction variability, it is recommended that design treatment depth be specified as the minimum thickness required for the adequate design. It is recommended that cumulative percent less than the specified design treatment depth should not exceed 10 percent.
- The consultant should utilize ADCP or other quantitative means to ascertain the specified design-treatment depth has been achieved.
- The consultant should develop a performance-based acceptance program for the chemically stabilized soil subgrade.
- The uniformity of CBR gain within the treatment depth should be measured and verified by ADCP and LWD testing procedures. If the variability of CBR with depth is significant, then an Effective modulus, or Effective CBR shall be determined for the stabilized layer using LWD and ADCP data.
- The Effective modulus or the CBR of the stabilized layer is generally expected to be 10 to 15 times of natural soil values.
- An Effective CBR or Effective modulus of the stabilized layer is calculated by elastic layer simulation. An Effective stabilized layer CBR as high as 50 and with an average of 18 to 20 was reported in this study when tested after two days of curing.
- An Effective subgrade modulus could be calculated to replace the natural subgrade modulus and the Effective stabilized layer modulus using the elastic analysis simulation. An Effective subgrade CBR of 10 to 20 was reported in this study when tested after two days of curing.

- The designer should consider a conservative increase of the design subgrade CBR, as a result of global soil stabilization and its benefits for reducing pavement thickness and costs.
- The presence of a stabilized layer is expected to increase the modulus or CBR of the unbound granular base course and improve the density and compaction of the granular layer.
- The design team, rather than the contractor, should perform the soil stabilization laboratory testing to quantify and confirm the increase in soil strength. Additionally, this will allow for better sampling and more thorough lab testing during the geotechnical investigation. This is in lieu of the time constraints imposed on the testing laboratory when the lab testing is performed during construction.



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# FLEXIBLE PAVEMENTS OF OHIO LAUNCHES NEW WEBSITE

Flexible Pavements of Ohio (FPO) launched a redesigned website, [www.flexiblepavements.org](http://www.flexiblepavements.org), in October. Built on a new software platform and designed for future growth, the new webpage embodies the commitment of the association to the needs of our members and customers.

The new webpage is streamlined and includes a robust search function to provide users with quick access to FPO's extensive electronic library of training materials, technical bulletins and construction specifications. "One of our main goals in the development of this webpage was to provide greater accessibility to the wealth of information maintained by the association," said FPO President/Executive Director Cliff Ursich. "Pavement owners, designers and contractors alike have come to rely on FPO as a credible technical resource and we wanted our new webpage to be as efficient as possible for accessing this information."

Featuring an improved registration system with enhanced data security, the webpage makes it easier than ever to safely register online for association events. Typically, FPO events have a diverse group of attendees ranging from members to non-members and government employees. The new system was developed with this in mind and can accommodate a broad range of registration options in a single process. The new webpage also meets all relevant data security standards so users can register for events secure in the knowledge their information is protected.

The site's homepage highlights current news relevant to Ohio's asphalt industry and includes improved integration with FPO's social media pages. "FPO has a growing social media following and we have found this to be a highly effective means of disseminating information," Ursich said. "This webpage more accurately portrays FPO's web presence and the variety of ways to stay connected with the association."



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Planning is currently underway for this must-attend event. For conference registration and additional information, go to [www.flexiblepavements.org](http://www.flexiblepavements.org) or visit FPO on Facebook.



A block of rooms have been reserved at the Columbus/Polaris Hilton for March 4-7, 2012, at a special conference rate of \$182 per night. The special room rate will be available until February 3rd or until the group block is sold-out. To make a room reservation at the conference rate, contact the Columbus/Polaris Hilton directly at (614) 885-1600, or visit [www.hilton.com](http://www.hilton.com) and enter event code PAVMNT.

# Mark Your Calendars



## Ohio Asphalt Paving Conference The Fawcett Center, Feb. 1, 2012

The 2012 Ohio Asphalt Paving Conference (OAPC) is scheduled for Feb. 1, 2012, at the Fawcett Center located on the campus of The Ohio State University.

Registration and conference information will be provided as it becomes available on FPO's website at [www.flexiblepavements.org](http://www.flexiblepavements.org), or visit us on Facebook.



## NEW MEMBER



Flexible Pavements of Ohio would like to welcome Lindy Paving Inc. as a new member of the association. Headquartered in New Castle, Pa., Lindy Paving operates Pennsylvania-based asphalt plants in Pittsburgh, Neville Island and Beaver

County, which produce asphalt for commercial, municipal and state projects and "will call" sales to independent contractors. In addition to asphalt production, Lindy's services include asphalt paving, pavement design and milling, seal coating and quality control and testing services.



## OBITUARIES

Flexible Pavements of Ohio (FPO) staff and members extend their sympathy to the family and friends of Bill Hamm and George Cross.

**William "Bill" Hamm** passed away July 22, 2011, at the age of 77. A veteran of the asphalt industry, Bill worked at Shelly & Sands Inc. for more than 40 years, where he retired as vice president. Bill was active in FPO's Technical Committee and a proponent of quality asphalt construction.

Bill was born on March 23, 1934, in Thornville, to the late Ivan and Idella Hamm and was a lifelong member of Grace Lutheran Church.

He is survived by his sons, Wade Hamm, James Hamm and Gary Hamm; his sister, Doris Saum; and brother, Lester Hamm; nine grandchildren; and 12 great grandchildren.

**George Cross** passed away Sept. 11, 2011, at the age of 78. George started with a single truck after serving in the U.S. Army during the Korean War and grew his business through hard work and determination. He entered the asphalt industry in the 1960s and became one of the largest HMA producers in Northeast Ohio. George was the founder of C&S Limestone, owner of Seville Sand & Gravel in Medina County, a Strongsville City Councilman and longtime member of Flexible Pavements of Ohio.

George is survived by his wife, Myrle; children, Linda Barbour, Cindy Cross, Mick Skowronsky, Mitch Skowronsky, Connie Ginter and George Cross II; 15 grandchildren; and six great-grandchildren.



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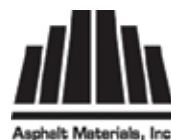
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