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# The IOWA ASPHALT

# REPORT

## Perpetual HMA Overlays?

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APAI Consultant

The perpetual Hot Mix Asphalt (HMA) pavement design concept for full-depth structures utilizes a flexible, fatigue resistant base and high quality intermediate and surface courses that need only periodic surface renewal for extended life. Although the full-depth "perpetual pavement" concept has been proven valid, can the "surface renewal only" theory be utilized for rehabilitation overlays?

Well, just ask The City of Des Moines - always a leader in Iowa paving innovations. They are at it again by implementing a new HMA technology strategy on a municipal street rehabilitation project.

Fleur Drive is the heaviest traveled municipal arterial street in the state of Iowa. It is predicted to carry over 50,000 vehicles per day and approximately 10 million Equivalent Single Axle Loads (ESALs).

In a 1985 effort to minimize future rehabilitation costs and obtain extended service life, Fleur Drive received a rehabilitation 3 inch HMA overlay on the existing PC base pavement. The 1985 HMA design utilized, for the first time in the city, 75% crushed ½ inch Type 4 aggregates with Type 2 (quartzite) required above the No. 4 sieve and a polymerized (SBS) asphalt cement binder. Seamless construction was also implemented at that time with pavers in tandem eliminating centerline or cold joints. The Department of Transportation was asked, and assisted the city, with mix design review and quality control testing.

Time has proven that the structure's surface was designed and built for durability, rut resistance, wear resistance, and long life.

But by 2001, time, weather and traffic caused noticeable distress to the Fleur Drive HMA surface. However, the oxidation, pitting and raveling, and rutting were confined to the top ½ inch of the surface. To evaluate surface reconstruction, 3-inch cores were taken through the HMA to the top of the PCC base. The cores clearly indicated that the existing HMA overlay was sound, intact, and alive just below the thin distressed surface. A 10-foot straight edge revealed less than ½ inch rutting and wear at the wheel tracks, in fact, measurements were predominately ¼ inch.

A city design team was formed to study the Fleur Drive 2002 rehabilitation project. The design team concluded that the conventional method of removing the entire existing asphalt surface, prior to new overlay, be rejected in lieu of a new perpetual overlay approach. Due to the condition of the

existing overlay the bottom 1½ inches would be considered perpetual and not removed. The extra ¼ inch in thickness on the new overlay would allow passage of the paving machine screeds without adjustment over the appurtenances and produce a smooth surface.

In June 2003, the second segment of the Fleur Drive rehabilitation project was constructed. Like the first, not only was the cost saving perpetual overlay concept utilized, but the city's standard fast track seamless construction was also implemented. The construction in June also consisted of cold milling the top 1½ inch layer of the existing surface, minor patching, crack sealing, cleaning, and placement of a new 1¾ inch HMA surface. All this work was performed under traffic with absolute



## From the Desk of the E.V.P.

This is one of the most exciting times in Iowa's engineering history for those involved with pavement design and/or determinations. I predict that in the next several years, engineers challenged with the task of providing their city councils, county board of supervisors, and commercial clients will become virtual heroes.



Mike Kvach,  
APAI Executive  
Vice President

Quality, Hot Mix Asphalt Pavements, either as a full depth - newly constructed pavement or an overlay in the rehabilitation of an existing, tired roadway, offers legitimate advantages over Portland Cement Concrete Pavements. Only HMA pavements can truly be perpetual, offering parking lot owners and the tax paying, motoring public substantial cost savings over the life of the pavement.

In this issue of the Iowa Asphalt Report we bring you two articles that challenge the traditional way of thinking about rehabilitating HMA overlays and a thought provoking look at the PCC industry's push on Ultra-thin Whitetopping. These articles are written by two individuals with nearly 90 years of combined, hands-on experience of PCC and HMA pavement design.

"HMA Notes" is something we'll be adding from time to time in prints of "The Asphalt Report". Written by one who is considered to be a pillar in Iowa's engineering society, Robert M. Nady, P.E. Mr. Nady received his BS in Civil Engineering at Iowa State University in 1949 and earned an MS Degree in Highway Engineering in 1952 with a thesis on Hot Mix Asphalt. Many of Iowa's current senior engineers received much of their education from Robert Nady as he taught in the BSCE program from 1952 until 1960 and was the Professor in Charge of Construction Technology at ISU until 1973.

Many young engineers have also received training from Mr. Nady when ISU called him back in 1996 to teach HMA and materials in the Civil Engineering Department through spring of 2002. Mr. Nady has spent numerous years further developing his knowledge while working for various engineering firms world wide from India to Haiti to Kuwait to Saudi Arabia and Turkey. He founded Nady Engineering Services in 1957 and sold that company in 2001 to Construction Materials Testing which to this day serves as consultant to their staff.

Over 94% of our nation's roadways and byways can't be wrong. Hot Mix Asphalt: smooth, quiet, economical, and durable. ■

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## HMA Notes

By: Bob Nady, P.E.

Resurfacing... HMA or UTW (Ultra Thin Whitetopping)? Let's discuss the Engineering properties of each material first.

The tensile strength of Portland Cement Concrete (PCC) is in the range of 1/7 - 1/10 of the compressive strength of a typical concrete mix. In buildings, this lack of significant tensile strength is compensated for by using steel reinforcement in the tension areas of the building members; i.e., beams, columns, and floor slabs. A balanced design is thereby achieved, taking advantage of the tensile strength of steel to make up the deficiency of concrete in tension.

Performance in pavements is no different. PCC is still weak in tension. Tension is the enemy of paving slabs because it is difficult to provide tensile steel in normal paving slabs. It is virtually impossible to provide this for UTW slabs. Simple engineering mechanics analysis shows that for a typical UTW slab (4 feet by 4 feet with thickness ranging from 3 - 4 inches) can have tensile stresses high enough to cause failure in tension. A simply supported slab will fail under a wheel load applied by one ESAL of legal limit intensity.

Of course, UTW, according to current design suggestions, is placed on a milled asphalt surface. It is milled to provide mechanical bond to the asphalt, thus, preventing a simply supported condition. But, is it? Slab curling can produce at least a partial unsupported area under the slab. Curling, caused by daily heating and cooling of the slab can raise the edges at night and raise the interior portions by day. Wetting and drying during wet weather intervals can produce the same results. Now, if the slab is in complete intimate contact with the substrate, simple linear shrinkage can cause tensile stresses since the slab is restrained from moving (which will prevent the stresses from being relieved).

Is UTW technology between a rock and a hard spot? It is well known that stresses can combine in slab members. Thus, curling, wheel loads, and shrinkage can all combine to raise tensile stresses in the layer where these stresses can cause failure. UTW mix design information suggests that synthetic fibers should be used in the mix. But fibers can only hold the slab pieces together after it has cracked. Fibers cannot mitigate tensile stresses to any significant degree.

It is interesting to note that curling from daily temperature cycles can also induce fatigue into the system. Fatigue is a factor in PCC pavement thickness design methods. However, once the slab has cracked, the fibers can only prevent the crack from opening farther; they cannot eliminate the crack. This is in sharp contrast to HMA, which has documented healing properties if a crack does occur.

So, when it comes to resurfacing; HMA or UTW? It's a no-brainer.

Hot Mix Asphalt, smooth, quiet, economic, and durable. ■

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and replacement methods, for the first minimum interruption to the abutting businesses and the international airport which fronted the west side of the project. It was accomplished in 8 hours with 2 laydown machines in tandem and one ahead placing turning lanes. The overlay paving project began at 5:30 a.m. and by 1:30 p.m. the street was totally completed with lane striping in place. The contractor for both the 2002 and 2003 projects was the experienced Des Moines Asphalt and Paving Company.

Due to a reduction of 7,500 tons, the perpetual overlay concept of partial depth HMA removal and replacement was estimated to save in construction costs over \$450,000, versus conventional complete removal

and replacement methods, for the first 14,000 feet (2.6 miles) of the Fleur Drive rehabilitation project.

The City of Des Moines' past investment in quality HMA pavements enables design of rehabilitation projects with advantageous life cycle cost analysis that includes not only user delay costs, but also a perpetual overlay theory. Future roadway funding uncertainties requires this type of innovative thinking. One look at the Fleur Drive rehabilitation project, together with the knowledge of the history of construction, maintenance, and traffic loads, is extremely convincing that this new perpetual overlay concept has great potential. ■

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## Consecutive Diamond Achievement Awards

A congratulations to those members who have applied for and received their Diamond Achievement for this year. The following member's plants have received the Diamond Achievement for the following locations for consecutive years.

### Cessford Construction Co.

Plant 2 - 2002-2003

### Des Moines Asphalt & Paving Co.

North Plant #2 - 1999-2003

Portable Plant #3 - 2003

South Plant #1 - 1999-2003

### Fred Carlson Co., Inc.

Decorah Plant - 1999 - 2003

### Grimes Asphalt & Paving Corp.

Grimes, Iowa Plant - 2002-2003

### L.L. Pelling Co., Inc.

Base 16 - 2001-2003

Plant 15, J Street - 2003

### Manatt's Inc.

Ames Division - 1999-2003

Newton Asphalt - 2002-2003

These companies have made the effort to become stellar examples of what an asphalt facility can be, and our hats go off to them for a job well done.

## Calendar of Events

### Golf Outings

The Asphalt Paving Association of Iowa has once again scheduled (3) three one day golf outings throughout Iowa. The dates, times, and locations are listed below. Each outing will be a Shot-Gun start and will have brats, burgers and beverages as well as team and individual golf prizes.

| Date              | Location                           | Shot-Gun Start |
|-------------------|------------------------------------|----------------|
| June 29th, 2004   | Lake Creek Golf Course / Alta, IA  | 10:00 AM       |
| July 27th, 2004   | Coldwater Golf Links / Ames, IA    | 10:00 AM       |
| August 24th, 2004 | Ottumwa Country Club / Ottumwa, IA | 10:00 AM       |

Additional Calendar of Events items can be seen online at [www.apai.net](http://www.apai.net)