Got Potholes? Road Maintenance High?

Longitudinal Joint Construction Problems Solved with Infrared Joint Heater

Poor longitudinal joint construction in asphalt pavements is recognized as one of the major problems in pavement construction internationally. Considerable research has been done over the years with no recognized solution other than eliminating the joint. This solution to the problem, as dictated by many authorities, is pave wider lanes with no joints, or pave in echelon (with pavers side by side to eliminate a joint) but this solution is not always possible and cost effective. It means closing entire roads for paving, or straining capacities for asphalt spreaders, rollers, and asphalt plants.
Other solutions include limiting the length of paving in one run so that the pavement can be matched up with a hot joint, but this puts a severe strain on traffic control, costs, and paving coordination.

The joint problem has been well defined, the outer edge of the first lane is not well compacted because of lack of edge support. When the second hot lane is applied, there is insufficient heat to soften and allow re-compaction of this edge, and depending on ambient conditions, insufficient heat to even form a good sealing bond with the cold edge. This situation allows subsequent water penetration, and the edge deteriorates prematurely, causing the infamous centerline joint crack everyone recognizes. This problem is even accelerated in northern climates with freeze thaw action and turns into early pothole formation, and eventually early replacement of the entire pavement surface. The overall costs of this problem are tremendous, and a strain on our ever increasing transportation budget. The problem is typical on roads, airports and parking lots.

However, new technology in full surface infrared heaters with no flame, combined with the ability to fully control the degree of infrared emission through better technology optimizes use under construction conditions. This provides engineers and contractors a tool to ensure better compaction on the asphalt joint and longer life pavements.

In 1995, Transport Canada, and the Province of Quebec Canada, decided to specify a reheated joint if the joint were allowed to cool below 85C (175F) on their airport pavements and high volume roads respectively. Although they have maintained these specifications over the years, there has been no real research study on the effect and efficiency of re-heating the joint. Other agencies have included joint heating as part of their specification, including the FAA which mandates removing the cold un-compacted edge or re-heating the joint, but have never enacted a study on joint heating.

In 2006 the State of Tennessee "**determined that poor HMA longitudinal joint construction and premature longitudinal joint failures were affecting the overall life of HMA pavements in Tennessee"** In 2007 TDOT funded a research project by the University of Tennessee to determine the causes and solutions of premature longitudinal joint failure.

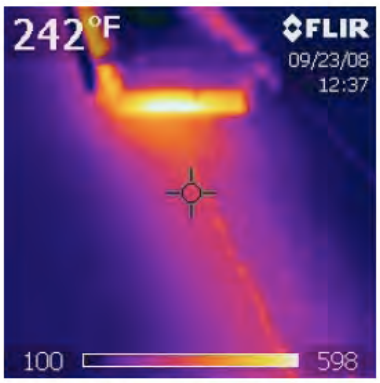
TENNESSEE RESEARCH

The research was led by Dr. Baoshan Huang of the University of Tennessee and the results will be published in the Journal of Materials in Civil Engineering, but was posted ahead of print on May 8, 2010. The study is available on the American Society of Civil Engineering website http://www.ascelibrary.org/. Search longitudinal joint.

The project entitled "Evaluation of Longitudinal Joint Construction Techniques for Asphalt Pavements in Tennessee" focused on defining the problem, then evaluating several joint making techniques, using voids and permeability results of cores extracted on and near the joint after paving on a test project on Hwy 70 near Sparta, TN. Each technique was used for an approximate distance of 1000 feet with two control sections each of 1000 feet.

A Canadian company, Heat Design Equipment Inc. of Kitchener, ON www.asphaltheater.com, supplied the 100% infrared joint heating equipment for one of the techniques evaluated. HDE has been supplying joint heaters in Canada using their patented infrared heaters since 1995, and other asphalt recycling equipment including joint heaters internationally since 2002.

Preliminary information on the study were presented at the Tennessee Quality Asphalt Institute annual conference in Nashville in January 2009. In the presentation given by Mark Woods PE of TDOT it was stated that the HDE JMH400



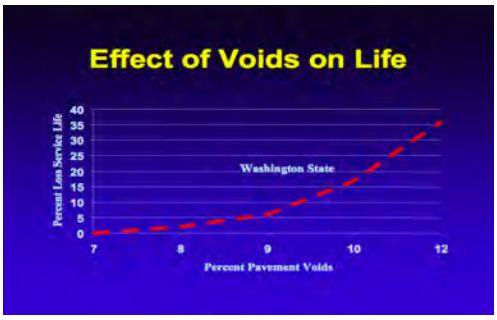
(c) Infrared Photo of Joint Heater

joint heater heated the existing asphalt to a temperature of 230 degrees F. The attached infrared photo out of Dr Boashan's report shows a temperature of 243F behind the heater. This is considerably lower than the (175C) 275F range where light oils are burned off due to overheating of asphalt.

Over 100 cores were taken on the test project for physical tests on density/air voids and permeability.

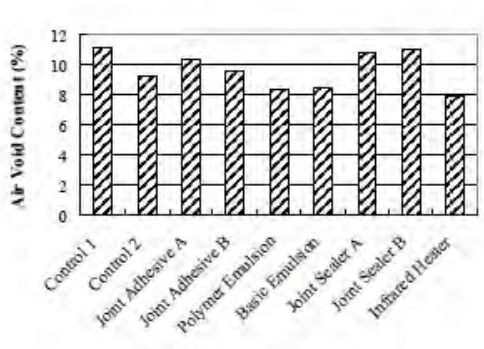
The overall results of the study are summarized on the last line of the abstract provided by ASCE :

"The infrared heater exhibited the best effectiveness in improving joint quality among all the joint construction techniques used in this study."



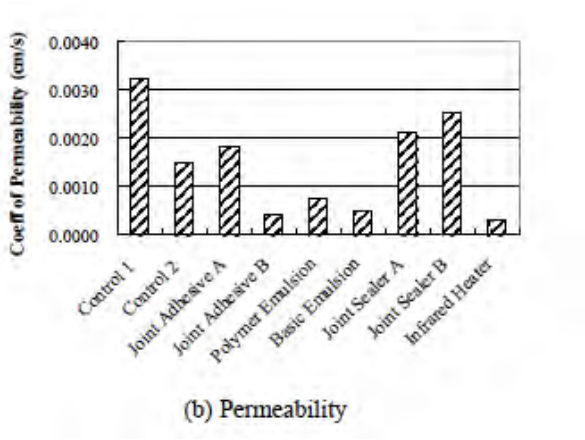
The voids on the joint for the heated area were in the 8% range, compared to the control tests of 9 to 11%. This represents an improvement of 2.5% to 25% in the service life of the pavement surface based on previous research by Washington State University.

Secondary to the relationship between heated and control cores, the joint heated cores had the lowest voids of all techniques evaluated.



(a) Air Void Content

The other property evaluated in the study was permeability. The chart below shows the joint heated cores to have the lowest permeability.



(b) Permeability

The report states: **"Compared to other test sections , the section of infrared heater exhibited much lower permeability coefficient around the joint area. Since water infiltrating into longitudinal joint plays a significant role in cracking or raveling failure of longitudinal joint, the lower permeability coefficient achieved through infrared heater would help longitudinal joint perform better and last longer."**

The report also evaluated indirect tensile strength (IDT) which was a measure of the adhesion between the cold and hot lane,and reported the infrared heater was very effective in increasing the IDT strength. This property would be very important in handling load transfer across the joint.

A final test was done only on the joint heater cores. This was an x-ray CT scan of voids in a horizontal direction from top to bottom of the core. Results showed a reduction in voids from top to bottom which verified that the infrared heater was effective in heating to depth to allow re-compaction.

ARKANSAS RESEARCH

typical joint problem

HDE joint heater

A similar research study comparing joint making techniques was done in Arkansas by the University of Arkansas conducted by Dr. Stacy G Williams and reported at the TQAI January 2010 conference in Nashville. The joint heater traded top spot for density with a notched wedge and joint bond in four test areas.

With permeability, the joint heater traded least permeable with joint bond in two test areas. Overall, the joint heater, notched wedge and joint bond were classified as the best techniques in that order.

Recommendations by Dr Williams was to use density as a measure of quality, require a minimum density for joints, and allow the contractor to make informed decision regarding specific joint construction methods.

ACTUAL PROJECTS PROVE SUCCESS IN INFRARED HEATING

Some well documented projects have been reported showing the success of the joint heater without any detrimental affects to the asphalt, nor slowing the paving operation.

SHEARWATER HELIPORT, NOVA SCOTIA , CANADA

A 2007 reconstruction of a heliport in Nova Scotia, Canada was documented by the consulting engineers for the project, Hatch, Mott, MacDonald. at the 2008 Swift Airport Conference in Calgary, Alberta. Title of the presentation was 'Techniques for Improving Longitudinal Joint Performance in Asphalt Pavements.'

The original specifications called for cutting and removing the cold edge, but the contractor, LaFarge Construction, requested a change to use a joint heater. The results were joint densities averaging 94.1 with no failures at all, The cut joints averaged 92.6 with several failures that were later corrected. The work was completed in late October and November and all the joints were **"well bonded and tight"** according to Robert McClure P. Eng. M. Eng of Hatch, Mott, MacDonald.

The contractor reported a usage cost (not including asphalt savings) as 15 cents per meter (less than 5 cents per foot)

The consultant included joint heating in the next phase of construction.

CITY OF HAMILTON, ONTARIO , Canada

A presentation by Golder Associates at the TAC Annual conference in Vancouver, October 2009, entitled 'Construction of Durable Longitudinal Joints-The Courage to Use Innovations Pays Off' documented projects in Hamilton, ON,Canada where echelon paving or joint heaters were specified. Tests resulted in joint density being 94-95%, 1 or 2 % lower than mat density.

Since Hamilton enacted their hot joint specification, several other Ontario municipalities have followed suit.

A new model of paver attached heaters was developed for the tight quarters of municipal roads, but have become popular for highway paving as well. Shown here is the first unit sold in Tennessee an HDE JMH 400PA, sold to Blalock & Sons, of Severeiville, TN.

WASHINGTON DC, USA

A joint heater was used on a special pavement surface on Pennsylvania Ave in front of the White House, Washington DC in 2005. The paving contractor, Aggregate Industries and the General Contractor, Lane Construction were stymied with a problem with 1000 feet of poor longitudinal joint in the special $800 per ton asphalt recently laid. An HDE JMH 400PA was used to reheat the ravelled joint and an HDE MR75 asphalt recycler used to reheat supplementary material for addition to the joint, so that re-compaction could be done. The repair to the joint was satisfactory to engineers from Federal Highways, the jurisdictional authority. In 2009 an HDE P200 heater patcher and an HDE MR75 recycler were once again used on other surface cracks that needed repair for the upcoming inauguration and the original repairs found to be in excellent condition.

The reheating of the special asphalt consisting of colored aggregate and a synthetic resin binder with a low burning point was considered successful, and is a testimony to reheating asphalt with flameless infrared without deterioration occurring.

SUMMARY AND CONCLUSIONS

The use of a joint heater has proven to be an economical efficient tool to assist paving contractors in improving on longitudinal joint quality. Agency maintenance budgets could be reduced by a tighter specification on joint quality, either by specifying a hot joint by echelon paving or re-heating the joint and/or requiring a minimum density on the joint.

Research projects by the University of Tennessee and University of Arkansas demonstrate that joint heating is the best technique for improving on the construction of the longitudinal joint.

Sufficient contractor experience on projects where the joint density was evaluated has indicated that costs of joint heating are minimal, especially considering the cost of maintenance down the road, and premature failure of the joint such that the entire pavement surface is replaced.

Use of the joint heater on high profile reheating and repairs such as at the White House are an assurance that this equipment can be used as a safe tool to ensure a sustainable pavement.

If enacted, the requirement for better joint construction would save considerable costs in maintenance and replacement of asphalt pavement surfaces. It would also reduce the experience of that dreadful bump when a pothole is struck, possibly causing loss of control of the vehicle, damage of the vehicle, or just plain anger.

1. Journal of Materials in Civil Engineering, Posted ahead of print 8 May, 2010 by Baoshan Huang, Xiang Shu,Jingsong Chen and Mark Woods and presented at TQAI , Nashville, TN,USA

2.

3. Techniques for Improving Longitudinal Joint Performance in Asphalt Pavements by Rob McClure, Hatch, Mott MacDonald, presented at 2008 Swift Conference, Calgary, Alberta, Canada

4. Construction of Durable Longitudinal Joints-The Courage to Use Innovations Pays Off" by Dr. Ludomir Uzarowski Golder Associates, presented at TAC Conference, Vancouver BC, Canada