NCAT FINAL REPORT

Compactasphalt (Twin Paver)

February 8,9,10,11, 2009

The following is a summary report by Bob Nittinger, of the NCAT meeting held at the Marriott Hotel in Auburn , Alabama. This particular meeting was the final meeting of the test track results where all the sections that were placed in the year 2006 are evaluated with a conclusive result. These test sections were subjected to ten million (10,000,000) ESAL's (Equivalent Single Axle Load) where the results are the approximate equivalent of twelve (12) years of highway wear and tear and punishment.

The above photo is the location of the laboratory and staff, of the NCAT facility. This is part of Auburn University and is located in Auburn, Alabama.

Attendee's of the meeting are as follows:
Personnel from the various DOT's such as Texas, Oklahoma, Missouri, Indiana, South Carolina, Florida, Alabama, North Carolina, Georgia, Mississippi, Tennessee, FHWA. In addition personnel from Old Castle, Volvo, Roadtec, and several other different contractors groups were in attendance.

Similar to past NCAT meetings there was a great deal to cover and the findings once again were outstanding for Dynapac. The sections that were placed in August of 2006 have all been subjected to *ten million* (10,000,000) ESAL's. An ESAL is known as the Equivalent Single Axle Load. Each axle on the test vehicles is carrying approximately *twenty thousand pounds* (20,000 lbs.). The test vehicle consists of a truck towing three trailers with loads over the axles and traveling at a speed of 45 mph. See photo on page 2.

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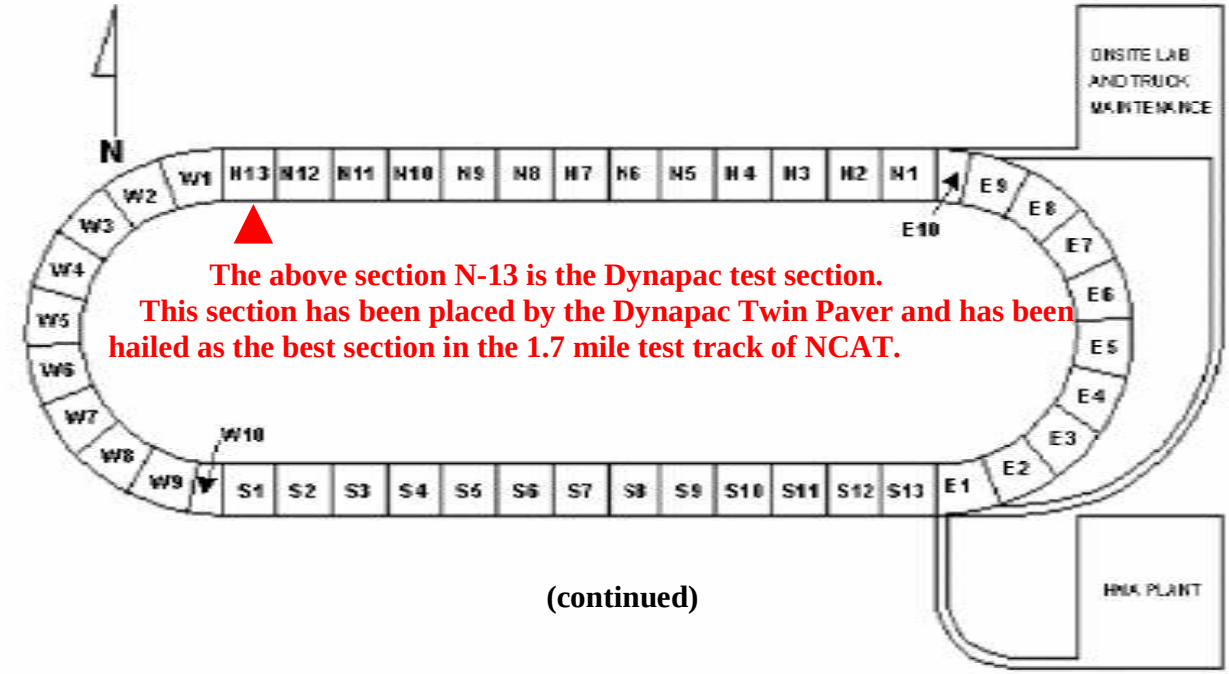
The above photo is displaying the test vehicle that places wear and tear on each section of the test track as it makes its continue runs around the track traveling at 45 mph. Each axle is carrying a load of approximately 20,000 lbs. After completing *ten million* (10,000,000) ESAL's on each section of the track this is the equivalent of 12 years of punishment on a highway section.



The above section N-13 is the Dynapac test section.
This section has been placed by the Dynapac Twin Paver and has been hailed as the best section in the 1.7 mile test track of NCAT.

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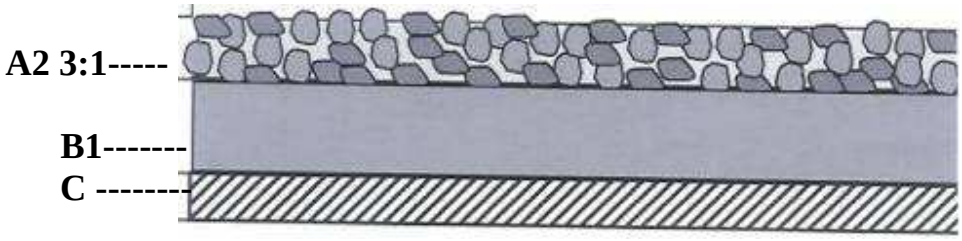
Each section is identified by the sponsor. In this case N-13 by Georgia DOT. This section is the Dynapac Compactasphalt (Twin Paver) section.

Ms. Sheila Hines; Construction Engineer of the Georgia DOT gave a presentation before the group regarding the three test sections that were placed by them. These three sections were numbered:

<u>N-11</u>– Conventional paving techniques used. Consisting of 12.5 mm aggregate top course of a porous European mix placed at a thickness of 1 ¼ inches and a binder course consisting of 12.5 mm placed at a thickness of 1 ½ inches. Both courses were superpave mixes with polymer modified AC and the aggregates were of cubicle dimensions with 3:1 flat and elongated in accordance with their present specification.

N-11



A2 = 1 ¼" 12.5 mm PEM –with PMA & FE 3:1
B1 = 1 ½" 12.5 mm Superpave (SP) w/PMA
C = Existing base 1 ¼" 19 mm Superpave (SP)

<u>N-12</u> – Conventional paving techniques used. Which consisted of a porous European mix top course 1 ¼ inches thick with 12.5 mm aggregates and flat and elongated particles of 5:1 ratio and a binder course 1 ½ inches thick with a 12.5 mm aggregate meeting the 3:1 ratio spec. and using a polymer modified AC.

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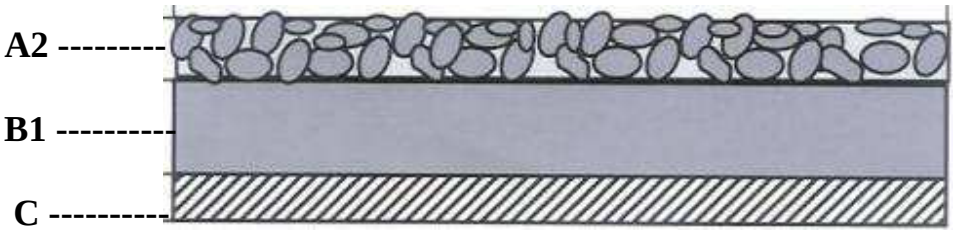
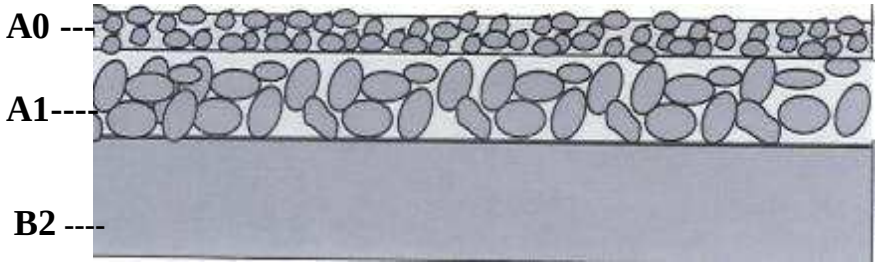
N-12



A2 = 1 ¼" 12.5 mm PEM – w/PMA FE 5:1 (conventional SP stone)
B1 = 1 ½" 12.5 mm SP – w/PMA
C = 1 ¼" 19 mm SP existing

<u>N-13</u> – Dynapac Twin Paver section. Consisted of a top course with an open graded friction mix ¾ inches thick utilizing a 9.5 mm aggregates that were flat and elongated at a 5;1 ratio. The top course was placed on top of the porous European mix binder course with 12.5 mm aggregates which was placed to a thickness of 1 ¼ inches, also using flat and elongated 5:1 ratio material.

N-13



A0 = ¾" 9.5 mm OGFC – w/PMA FE 5:1 (conventional stone)
A1 = 1 ¼" 12.5 mm PEM –w/PMA FE 5:1 (conventional stone)
B2 = 2" 12.5 mm SP –w/PMA

Ms. Hines finalized her presentation before the audience with the following statement. Taken from the NCAT CD dated February 9 to 11, 2009

1) **Reinforced Georgia's decision to continue to use FE (flat and elongated aggregates) of 5:1 for Open Graded Mixtures.**
2) **Proved that twin lift (Dynapac Twin Paver) Open Graded Mixtures provided better mitigation of roadway surface water and achieved exceptional noise reduction characteristics.**
3) **At this time, GDOT has not implemented this practice due to funding constraints.**

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<u>Pavement Gouging:</u>

In statements made by NCAT personnel the N-13 test section is practically indestructible. It is like a plate of armor. This particular section has had a wheel fly off just prior to the test vehicles arrival to the N-13 section and the axle came down on the section. This took place around 2,300,000 ESAL's. It gouged and grooved the pavement section, and the section is holding up like nothing has happened. Then somewhere around 9,000,000 ESAL's a tire blew and came off. It gouged the pavement section with two more grooves and the pavement is holding up like an armor plate. See photo below.

The above photo is displaying the excellent durability of the N-13 Dynapac "Twin Paver" test section. The NCAT staff along with personnel from Georgia DOT are stating that this section is practically indestructible.

There has been nothing but complements regarding the N-13 test section and its ability to withstand just about anything that has been thrown at it. Not only has it stood up under the severe conditions of axle and tire rim gouging but the rain water drains off thereby eliminating truck back spray during rain storms.

Another big item that has brought a lot of attention to this N-13 test section is its quietness. It is regarded the quietest stretch of pavement in the USA.
This section is superior in just about every major category of pavement design and placement.

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Section N-11

Cubicle Aggregate DOT approved 12.5 mm mix. Water accumulated retained puddles. Normal highway truck back spray.

Section N-12

Flat & Elongated aggregates used. Section placed 12.5 mm mix. Some water retention. Slight truck back spray.

Section N-13
Dynapac Twin Paver

Flat and Elongated aggregates used placing 9.5 mm top and 12.5 mm binder. Zero water accumulation. No truck back spray. Great visibility behind truck.

Drainage and Truck back spray:

The above photo's clearly show that the best section for suppressing water retention and eliminating truck back spray to the automobile traveling behind the truck on a rainy day is section N-13. The other two sections N-11, and N-12 above displayed a reduction in water accumulation on a rainy day; but still displayed back spray when raining. These photo's above were all taken at the same time with a video in a car traveling directly behind the ESAL test truck. The video showed section N-11 which was minimal, N-12 even less and none for test section N-13. Please note that all three sections were designed to minimize water accumulation through the open graded mix design.

Pavement Noise Level (dBA):

Past NCAT reports have shown that the Dynapac test section has developed and maintained the lowest pavement noise level section of the entire test track. Statements by personnel of State and NCAT officials both have stated that these noise levels are by far the lowest that they have seen. According to Andre' Smit an increased noise level difference of only three (3) dBA appears to be twice as loud to the human ear. It is so exceptionally quiet that everyone has taken notice. Over the past two years and some ten million (10,000,000) ESAL's the noise level of test section N-13 has not wavered in the least and has maintained its status from day one as the quietest section on the test track.

Pavement noise level and open graded mixes:

It is also believed that the aggregates play an important part in conjunction with higher void contents. The flat and elongated aggregates with the 20% plus void

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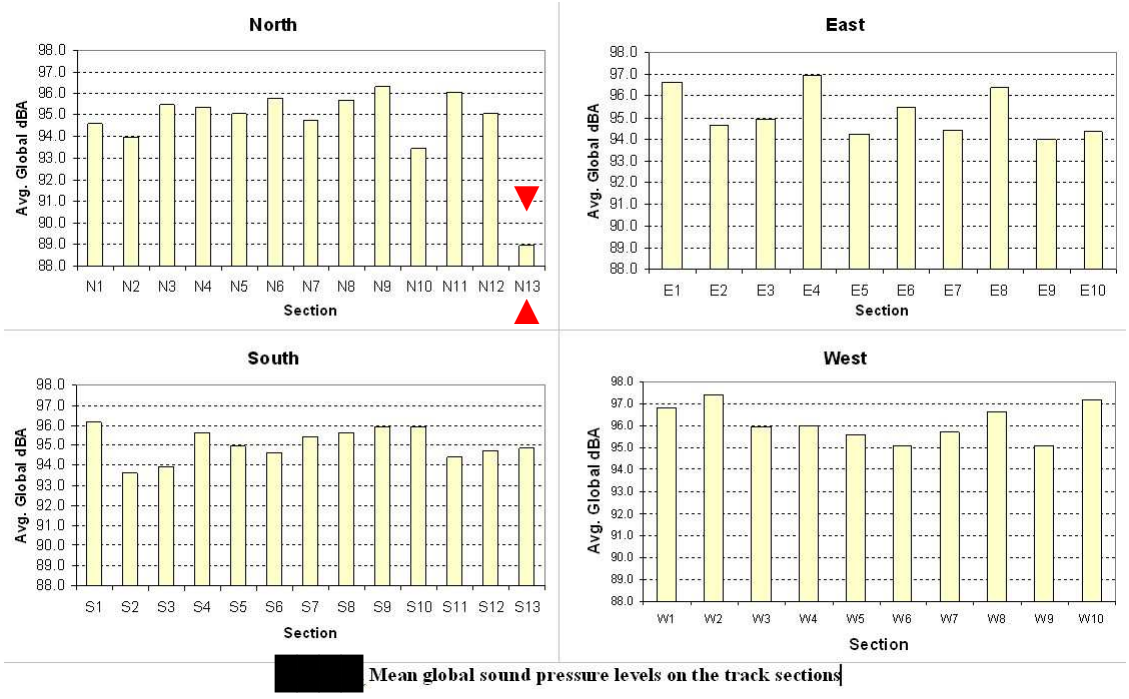
contents of the open graded mixes produce a sponge like atmosphere in the pavement. In addition to the open graded mix design a normally rejected type aggregate (flat and elongated) have become a noise absorbent similar to a sponge to water. See graph I below.

Graph - I



Mean global sound pressure levels on the track sections

As can be seen on the North sector of Graph-I section N-13 excels in lower noise pollution. With a noise level of less than 89 dBA , which can be identified with the red arrows in the north sector, the findings prove that it is more than twice as quiet as the next closes test sections which are N-10 and S-2, both at 93.5 dBA . This is extremely significant.

<u>Rutting, Smoothness, and Texture depth:</u>

The Dynapac test section is rated superior in all three categories. There are no ruts in the pavement after 10 million ESAL's. The N-13 section has maintained its smoothness since day one. In other words it is the same after all tests as it was the day it was placed. Not only are there no wheel ruts, but the section has maintained its smoothness, along with its texture depth. Graph-II, Graph III, and Graph IV display this data

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8/25/2008

Quadrant: N
Section: 13

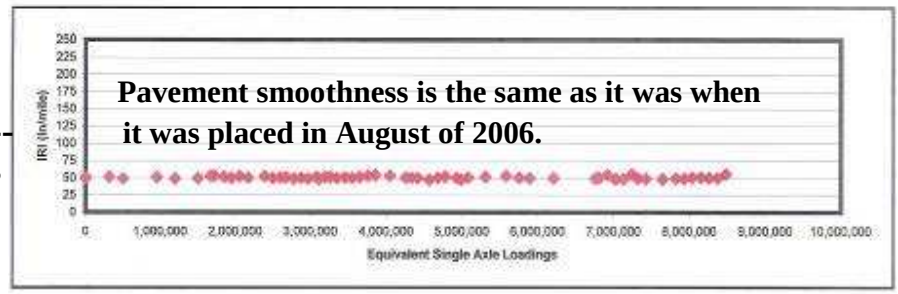
Surface Mix and Materials		Structural Buildup Information	
Year of Completion:	2006	Study HMA (in):	4
HMA Design Methodology:	OGFC	Total HMA (in):	24
Specified Binder:	PG76-22	Base Material:	Granite
Surface Mix Stockpile Materials:	Georgia Granite	Subgrade:	Stiff

Research Objective: Twin Layer Drainable Mix w/ F&E Aggs

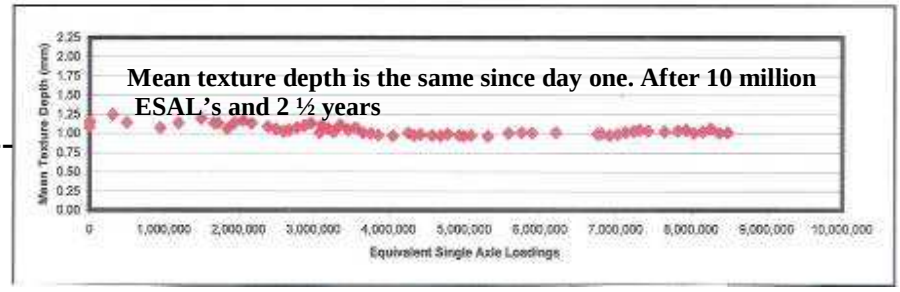
Preliminary Field Performance Data

Graph II ----------
Rutting effects

Graph III ----------
Pavement Smoothness



Graph IV ----------
Texture Depth



The graphs above are displaying once again the superior quality of the Dynapac "Twin Paver" and the mix design that it placed. The Dynapac test section is outstanding, and displays a significantly lower macrotexture in lower nominal aggregate. Furthermore there is no pavement cracking in section N-13.
Nothing has changed since the last report. All of the above observations are exactly the same as they were in November, 2008.

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Other Studies:

Other studies that were investigated and discussed, and may relate to Dynapac in the future.

1) **RAP – recycled asphalt pavement**
2) **ER ---- Energy Ratio in Pavement**
3) **MEPDG – Mechanistic Empirical Pavement Design Guide**
4) **Thiopave—Additive from Shell Oil for Rap.**
5) **Perpetual Pavement**
6) **Warm Mix – Placing asphalt at lower temperatures**

1) RAP (Recycle Asphalt Pavement):

With the cost of asphalt becoming more and more of a budget problem the move towards recycling asphalt pavements is also becoming essential. The highway dollar is being stretch to the limits. For example, by using RAP the budget can be stretch from approximately 3 miles of highway to 5 miles of highway for the same dollar amount, depending on the percentage of RAP.

1a) RAP additive –(Sasobit)

When constructing a RAP test section no problems were encountered with compaction. However; the RAP additive Sasobit which is designed to assist in workability, and compaction, did not appear to help the workability or compactibility. The sections containing Sasobit reacted the same way as the sections without Sasobit. It appears as if the additive did not help nor harm the mix.

Six RAP sections and one control section were placed as a 2-inch mill and fill.

1) **Virgin Control mix with PG 67-22**
2) **20% RAP with PG 67-22 virgin binder**
3) **20% RAP with PG 76-22 virgin binder**
4) **45% RAP with PG 52-28 virgin binder**
5) **45% RAP with PG 67-22 virgin binder**
6) **45% RAP with PG 76-22 virgin binder**
7) **45% RAP with PG 76-22 + Sasobit**

There were two 15% RAP sections placed in 2006 using a PG 76-22 binder. One section was sponsored by Tennessee -- section S-6) and the other was sponsored by Mississippi -- section (S-2). After 10 million ESAL's the findings were:

1) **No rutting**
2) **No raveling**
3) **No cracking on S-6**
4) **Some reflection cracking on S-2.**

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All in all the results were exc ellent. It is becoming apparent that more and more RAP use is becoming requirement to stretch the highway dollar. The price differences when compared to virgin mixes that are using a PG 67-22 are as follows:

1) **20% RAP with PG 67-22 ---------- cost 14.9% less**
2) **20% RAP with PG 76-22 ---------- cost 11.3% more**
3) **45% RAP with PG 52-28 ----------cost 36.2% less**
4) **45% RAP with PG 67-22 ----------cost 41.4% less**
5) **45% RAP with PG 76-22 ----------cost 11.9% less**
6) **45% RAP with PG 76-22 + Sasobit ----------cost 1.0% less**

In above examples, the only item that cost more than all virgin mixes was item 2 which was PG 76-22 with 20% RAP. All the rest cost less.

2) <u>Energy Ratio (To be used as a forensic tool in predicting pavement cracking):</u>

In a joint study by the University of Florida, Florida DOT and NCAT an effort is being made to predict pavement cracking and failure when it is first placed.
It has tentatively proven to be effective when using the Energy Ratio concept for predicting top down cracking in the pavements.
In the State of Florida 90% of the pavement cracking is from the top down. This is looked upon as a complex phenomenon. After much research and a number of massive formulas they have reduced the prediction to a simple less complicated formula below. This includes, resilient modulus, creep compliance, indirect tension, which all include pavement stress, strain and temperature.

$$ER = \frac{DCSE_f \cdot \left[7.294 \cdot 10^{-5} \cdot \sigma^{-3.1}(6.36 - St) + 2.46 \cdot 10^{-8}\right]}{m^{2.98} \cdot D_1}$$

It has been determined that the higher the Energy Ration number the better the pavement will hold up. These factors also include:

- **interaction of load**
- **thermal conditions**
- **Aging**

An analysis has been drawn on the mixture Energy Ratios. Two test sections have been installed, section N-1 and section N-2 with each test section covering two lifts.. Furthermore the energy ratio for the mix design has been determined. The higher the energy ratio the better the pavement in preventing top down cracking, and simply holding up under all conditions.

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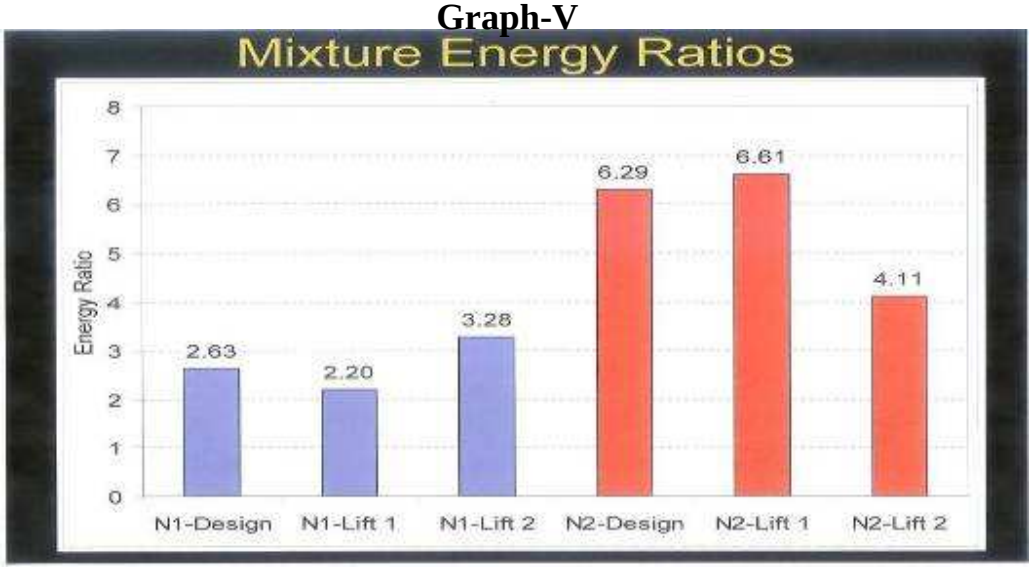
Graph-V



As can be seen in the above Graph-V, the N-1 section produced a lower ER than the N-2 section and the results of these ratios proved that the lower numbers did in fact display early cracking.

<u>Sections after 1,900,000 ESAL's</u>:
The N-1 section developed map cracking throughout the pavement surface after 1,900,000 ESAL's on April 9, 2007. The N-2 section showed no cracking.

<u>Sections after 2,900,000 ESAL's:</u>
The N-1 section had massive cracking on the surface of the pavement, and N-2 was just beginning to surface crack after 2,900,000 ESAL's on June 18, 2007.

<u>Sections after 5,600,000 ESAL's:</u>
The entire N-1 surface was covered in cracks and it had penetrated to the 2nd lift. This section had to be milled and inlaid with new material after 5,600,000 ESAL's on February 1, 2008. The N-2 section was displaying spotted map cracking, but becoming noticeable.

<u>Sections after 7,100,000 ESAL's:</u>
Section N-1 was starting to develop serious map cracking again while N-2 section was showing circular map cracking but holding up after 7,100,000 ESAL's on May 19, 2008.

<u>Energy Ratio conclusion:</u>

- **Strain data confirmed both sections tested at similar intensity.**
- **Top down cracking confirmed**
- **No difference in interface bond strength**
- **ER used to successfully predict field cracking performance.**

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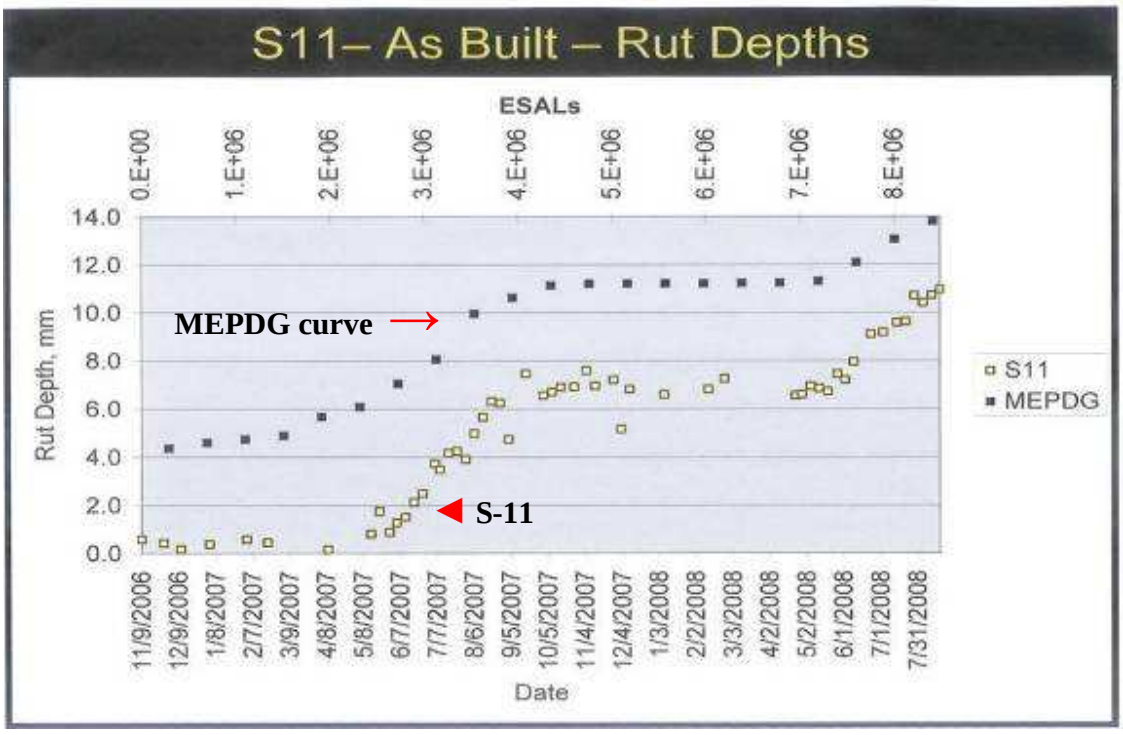
3 – MEPDG – Represents; Mechanistic Empirical Pavement Design Guide
4 – Thiopave – additive produced by Shell Oil which can add life to the pavement
5 – Perpetual Pavement- Pavement designed to last at least fifty (50) years

The above three terms are all in conjunction with one another. The MEPDG is still in the study phase and they are coming closer to a conclusion. As stated these three terms overlap one another and are all being studied with the desire to assist in designing pavements accurately.
However; MEPDG has been correlated with pavement rutting. Although the rutting effects by MEPDG displayed a higher rutting prediction it appears to follow the same pattern as actual rutting. Also a quantity of fatigue cracking (not trend). See Graph VI below.

Graph VI



Graph VI above displays two curves. The <u>black dotted curve</u> is the MEPDG curve and shows higher rutting. The S-11 section is identified by the <u>yellow dotted curve</u>. Although they are separated the curves follow the same pattern.

The above curves could be coordinated to predict future rutting. More studies and investigation is required before a conclusive result can be found.

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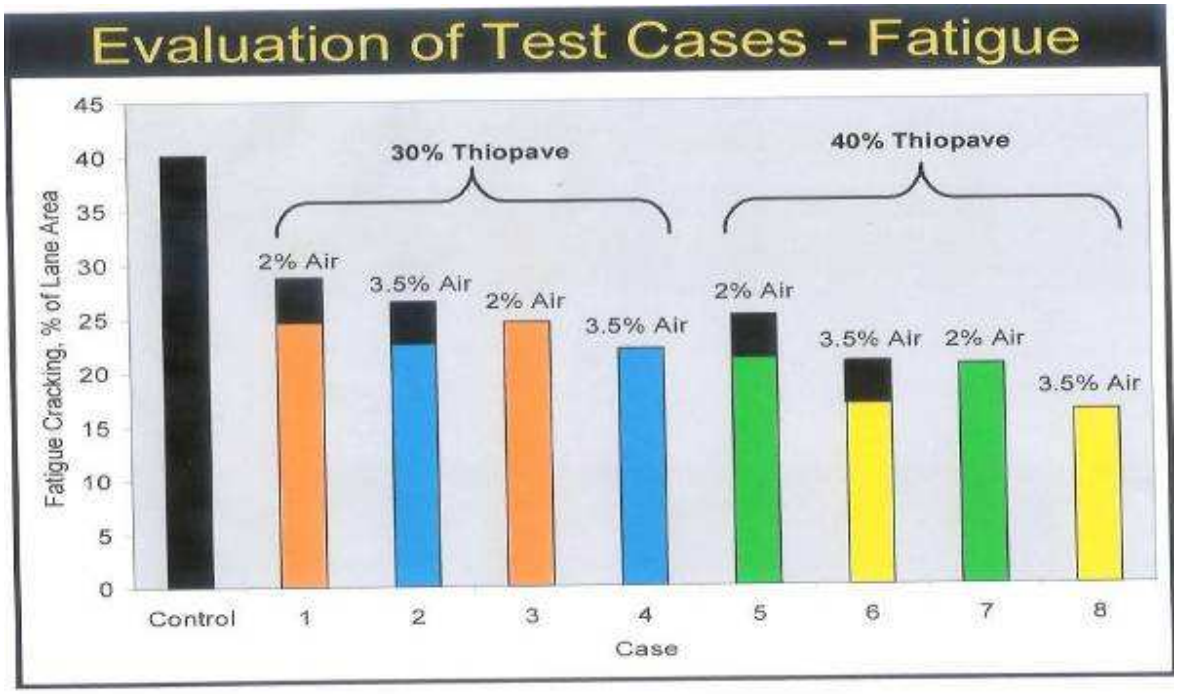
4) <u>Thiopave</u>: This is a by product from producing asphalt cement. It is basically a sulfur type material that Shell Oil is trying to convert into a saleable item that can be used to assist in making bituminous pavement and using less A/C in the mix. After eight (8) test cases; four (4) at 30% and four (4) at 40% where Thiopave was introduced into the mix in place of the A/C by the aforementioned percentages several different results were found including those for Perpetual Pavement.

<u>Results and findings for Thiopave:</u>

Using the MEPDG it has been found that Thiopave significantly reduces fatigue cracking and rutting predicted vs. control.

Graph VII



The above Graph VII clearly illustrates that the Thiopave additive displays a significantly better resistance to pavement fatigue.

It was however found that Thiopave has a greater effect on tensile strains than compressive strains. This is consistent with MEPDG evaluation. Thiopave significantly reduces both sets of strain levels. Effect is dependent on amount of Thiopave and mix design.

5) <u>Perpetual Roadways; The fifty (50) year pavement highway:</u>
Seven inch (7")Thiopave sections may be perpetual; there is however concern over

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rutting. The control section displayed approximately 370 micro strains while the worst case for 30% Thiopave was 275 microstrains and the best case for 30% was 240 micro strains. The worst case for 40% Thiopave was 275 micro strains while the best case for 40% was 225 microstrains. This is the beginning of the perpetual highway. Making hot asphalt with the additive Thiopave the highway system may have the opportunity to last many more years over and above the so called normal pavements that we are placing today. Combine these new ideas with open graded mixes and twin pavers and the possibility can become very realistic.
Based on the results of the NCAT test track the following combination can contribute to perpetual highways.

1) **Open graded mixes 20 to 25% void content**
2) **Placing the top and binder course simultaneously with the twin paver**
3) **The use of Thiopave as an additive in the mix**

6) Warm Mix:

There is a great deal of interest in warm mix asphalt (WMA). It is much cheaper to produce and if RAP can be added the cost reduction will be truly significant. Warm mix asphalt is mixed at temperatures ranging between 200^0F. and 240^0F. Normal HMA is usually mixed between 290^0F. and 330^0F. There were many cases of "Superpave" being mixed as hot as 380^0F. This is a tremendous savings to the budget in the production of warm mix asphalt.

There are several test sites involving warm mix asphalt and the early results a favorable. They are now looking at introducing RAP to warm mix which as stated previously would be a very significant savings and would stretch the highway dollar and achieve many more miles of highway repair on a tight highway budget.

Discussions are now in progress to introduce minus 3/16-inch RAP into the warm mix asphalt. There are concerns however; that this process of using RAP always required high heat as an accelerator to stimulate the old asphalt cement in addition to adding a rejuvenator. It is a known fact that asphalt cement consists of four main groups with some sub groups, but the main groups are key:

- **Asphaltenes**
- **Maltenes**
- **Acidifins**
- **Paraffins**

In the laboratory the rejuvenator would stimulate the maltene phase of the A/C which in turn would give new life to the asphaltenes and along with the heat would bring the old asphalt cement back to life like new. So there is concern that the low heat and the lack of a rejuvenator may be harmful to the warm mix RAP asphalt. That's why many tests are needed to be sure that warm mix asphalt and RAP can go together without a stimulant or rejuvenator. The idea is great but time will tell.

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As this is the ten million ESAL report this author will recap the placement of the first Dynapac test site at NCAT section N-13 and bring this final report to the present.

DYNAPAC F-300-CR TWIN-PAVER
NCAT TEST TRACK INFORMATION
Opelika, Alabama
August 10, 2006

The following is a Synopsis of the placement an open graded top course and the binder course of pavement being placed simultaneously for the first time in USA history.
Testing the Dynapac F-300-CR Twin-paver on a special test section sponsored by the State of Georgia Department of Transportation, where two different courses of pavement were placed simultaneously for the first time in the USA. The objective was to place two open graded mixes (top and binder) without placing a tack coat. This test section shall be evaluated by the National Center of Asphalt Technology (NCAT) over a period of at least two years.

Detailed specifics:
The test section was designed to place two courses of pavement simultaneously for a distance of 200 feet in length and 17-feet 7-inches wide. There was an additional special start up section 25-feet long by 18-feet 4-inches wide devised prior to the actual test section. This additional start up section was needed in order to establish the desired thickness of the actual test section.

Due to the fact that Dynapac did not bring over the transfer vehicle from Europe a Roadtec Model 2500 Shuttle buggy was used. The upper bin height of the Dynapac F-300-CR paver could not be reached with the shuttle buggy, so a ramp was built out of milled asphalt pavement by utilizing a median barrier and placing the millings from behind the median barrier from a height of approximately four feet tapered to three inches on the lower end. The Roadtec Shuttle buggy was then driven up the temporary ramp to reach the upper holding bin of the Dynapac F-300-CR paver.

Ambient Temperature at the test site was approximately 95^0F. (35^0C.). No wind clear and sunny. Humidity was unknown but extremely high.
Attendance: Approximately 52 people from various locations. Alabama DOT, Georgia DOT, several Contractors and the Asphalt Paving Association in conjunction with the Association of General Contractors, NCAT, University of Auburn, Etc.
a) 10:10 am –1st truck arrives carrying 27-tons of top course pavement at a temperature of 305^0 F. (152^0C.). This top course haul vehicle was held and did not discharge its material until the binder truck arrived. (continued)

b) 10:50 am – 2nd truck arrives carrying 27-tons of binder material at a temperature of 275^0 (135^{0}C.) Once the binder truck was in sight the truck hauling the top course was discharged into the Roadtec Shuttle Buggy, then transferred to the Dynapac paver.
c) 10:58 am – Binder material is being loaded into the lower bin of the Dynapac F-300-CR twin-paver. The binder course can now be loaded while the paving operation begins. The lower bin is reachable with the Roadtec Shuttle Buggy. There is no longer a height problem.
d) 11:00 am – Paving operation begins and is very slow moving due to the short span for adjustments. Mistakes can not be allowed. No room for errors.
e) 11:25 am -- After paving approximately 64-feet tamper screeds are increased to 700. Paving speed is increased to 3.75 feet per minute. The primary reason for this speed was for show. To prolong paving
f) 11:40 am – 3rd truck arrives carrying 23 tons of binder material. Temperature of material 260^{0}F. (127^{0}C.)
g) 12:04 pm – Paving operation is completed.

Adjustments had to be made due to the fact the top course ran short. Actual paving length including start-up section was 206-feet 5-inches. The length of the actual test section was 180-feet 6-inches. The last 19-feet 6-inches of the test section was finished with all binder course material.

The concentrated area of the test section will be considered approximately the 2/3 mark. This is estimated to be between 90-feet to 140-feet of the actual test site. Lay down temperatures readings taken in this area utilizing a temperature gun were -- binder course (lower lift)—260^{0}F. (127^{0}C.) and top course (upper lift) --- 290^{0}F. (143^{0}C.).

Initial rolling: Started at 12:10 pm and was completed at 12:12 pm with a nine (9) ton roller, the Dynapac model CC-322 operating in the static mode, traveling at a speed of 5-mph and delivering a static lineal load of 145 pounds per lineal inch (25 kilograms per centimeter). The initial pass was taken after paving was completed and only one pass was made with the roller overlapping the previous lap by approximately six to ten (6-10) inches. The pavement temperature at the time of initial rolling was approximately 248^{0}F. (120^{0}C.)

Finished rolling: Started at 1:35 pm and was completed by 1:38 pm also utilizing the Dynapac model CC-322 roller operating in the static mode and traveling at a speed of 5-mph and delivering a static lineal load of 145 pounds per lineal inch (25 kilograms per centimeter) and overlapping the previous lap by approximately 6-10 inches. Only one pass was made in this rolling procedure.The pavement temperature at the time of finished rolling was 180^{0}F. (82^{0}C.)

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Table I
Mix Design for Top and Binder course for N-13 test section
At the NCAT test track located in
Opelika, Alabama

Top Course (OGFC) 9.5 mm		Binder Course (PEM) 12.5 mm	
Sieve Size	% Passing Q/C	Sieve Size	%Passing Q/C
1"	100	1"	100
¾"	100	¾ "	100
½"	100	½ "	96
3/8"	100	3/8"	58
# 4	41	# 4	12
# 8	12	# 8	9
#16	8	#16	8
#30	7	#30	7
#50	6	#50	6
#100	5	#100	5
#200	4.2	#200	3.9
Asphalt Content	5.4%	Asphalt Content	6.2%

The Dynapac "Twin Paver" known in Europe as the "Compactasphalt Paver" and in the USA as the "Twin Paver". The upper hopper can hold 28-tons of wearing course material and the lower bin has a capacity of 45-tons for holding binder course material. Placement of the test section took place August, 2006

(continued)

The binder screed (first screed in the photo) has a capability of achieving 97% density. It is a combination dual tamper and vibratory screed. The top screed has the capability of achieving 92% density. Due to the specification calling for a high void content of 20% to 25% the binder screed was set at 500 vpm and the top screed was run in the static mode.

The final results of the Dynapac Test section N-13 after 2 ½ years and ten million (10,000,000) ESAL's. This is the equivalent of twelve (12) years of wear and tear type punishment on this test site.

Conclusions for Compactasphalt Paver (USA Twin Paver) at NCAT test site:

1) **The desired void content of 20 to 25% for top & binder was achieved.**
2) **Absolutely no rutting whatsoever. The pavement is the best on the test track.**
3) **Completely smooth. It appears the same as it did the day it was placed.**
4) **The mean depth texture is perfect. Looks the same as it did the first day.**
5) **Zero water retention. Absolutely no truck back spray on rainy days.**
6) **The modulus of elasticity is great. Cores removed from the pavement and it passed shear test with excellent results.**
7) **Classified the quietest pavement on the test track noise level of less 89dBA.**
8) **DOT personnel have stated it is like a plate of armor. It is indestructible. After a wheel flew off at two million three hundred thousand (2,300,000) ESAL's and the axle dug into the pavement gouging the section, and it held up like nothing happened. Then a tire came off the rim at nine million (9,000,000) ESAL's and placed a double gouge into the section. No problem.**
9) **NCAT personnel are calling it an amazing section. It is indestructible.**

The Dynapac N-13 section is in a class of its own. Nothing else can compare to it. It has definitely proven that the combination Dynapac Twin Paver and mix design have found the answer for a long lasting pavement that can take all kinds of punishment and remain smooth, without ruts and maintain its integrity.

By Robert (Bob) Nittinger; Dynapac Consulting Technical Director.