The Use of Infrared Joint Heaters to Improve HMA Longitudinal Joint Density

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ASPHALT PAVEMENT TECHNOLOGIES

TEXTBOOK PROBLEMS

- CANNOT OBTAIN JOINT DENSITY
- MIX TENDER; DRY; HARSH
- RAPID COOLING OF MAT
- LACK OF MATERIAL AT THE JOINT
- POOR COMPACTION TECHNIQUES
- NOT ROLLING JOINT SOON ENOUGH
- ROLLING TOO FAST
- SEGREGATION OF HMA
- OPERATIONAL CONSTRAINTS

Importance of Compaction Cannot be Overstated

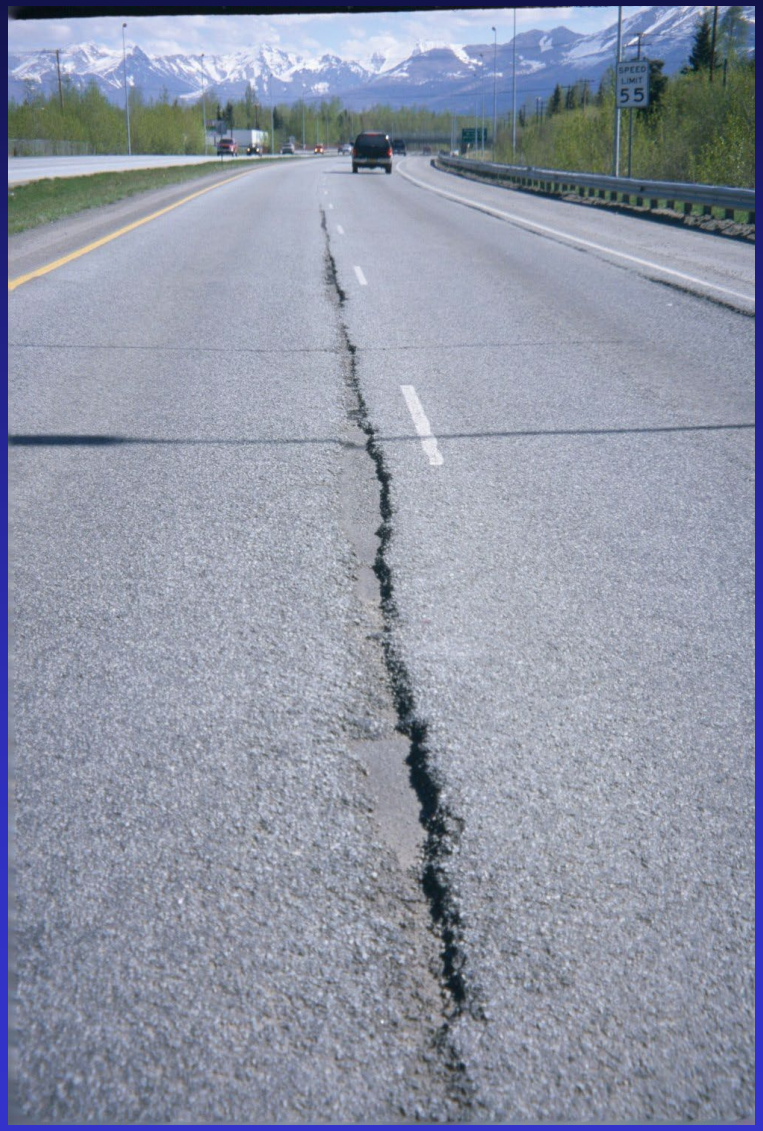
Compaction is critical for long-term performance and durability

It is estimated that every 1% increase in air voids from the target of 7 % can lead to 10% decrease in the life of the pavement

Conversely every 1 % decrease in air voids improves fatigue life by about 10 %

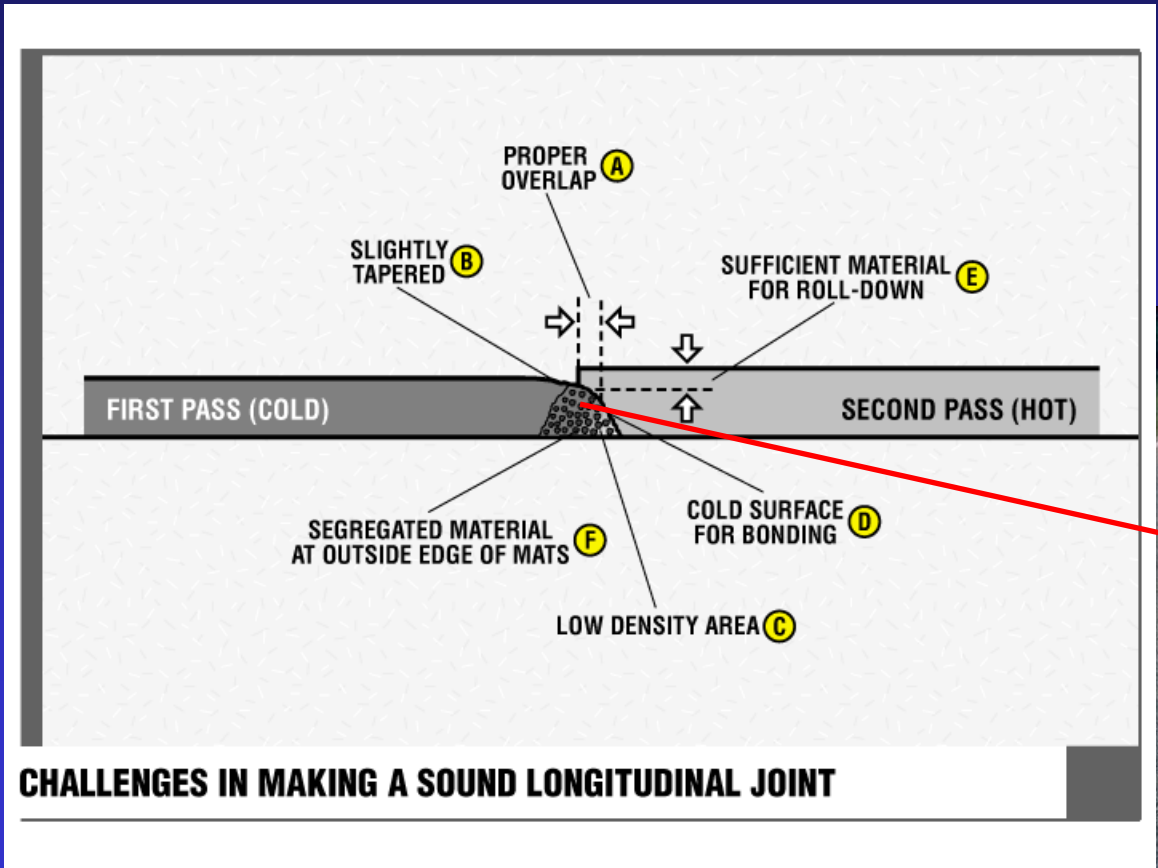
Study by H. Bahia Wisconsin shows
44 % of joints need repair within 4-6 years

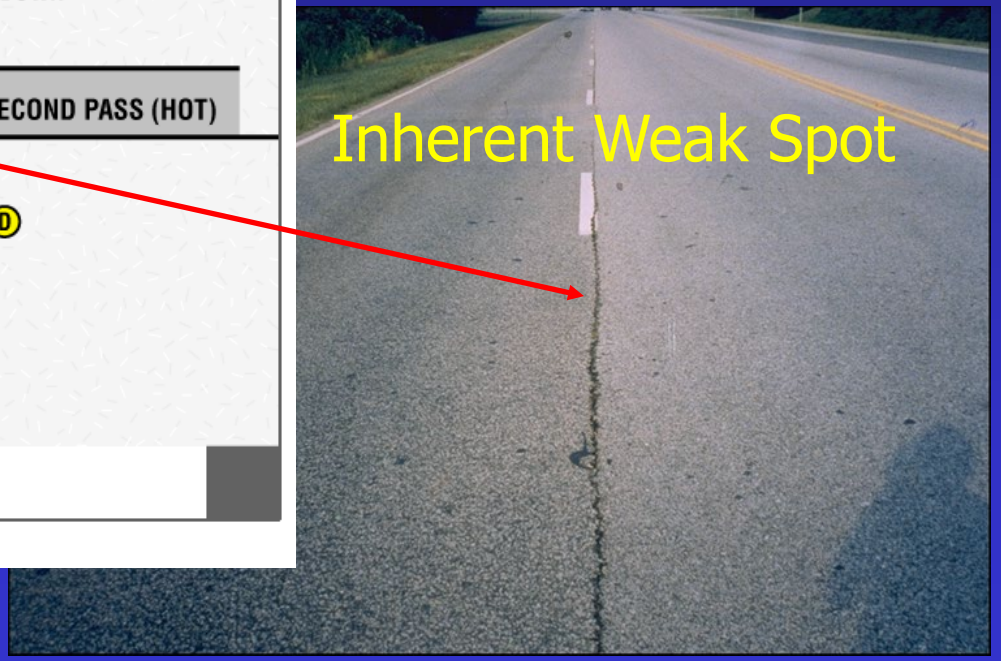
Robert McLure
SWIFT (HATCH)



What is the Problem?

The first pull of the paver generally leaves an area of low density along the unconfined longitudinal edges of the mat.





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Longitudinal Joint Research Case Studies

Michigan
Wisconsin
Colorado
Pennsylvania
Notched Wedge Joint Projects
Tennessee
Alabama

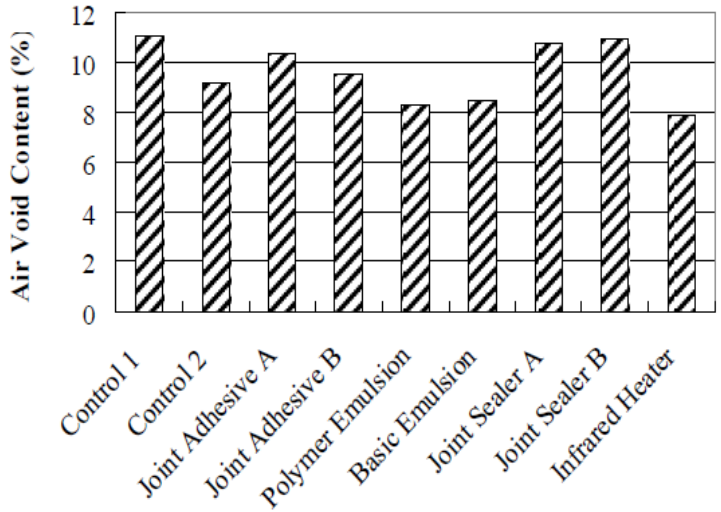
Quality Workmanship
Longitudinal Joint Solutions

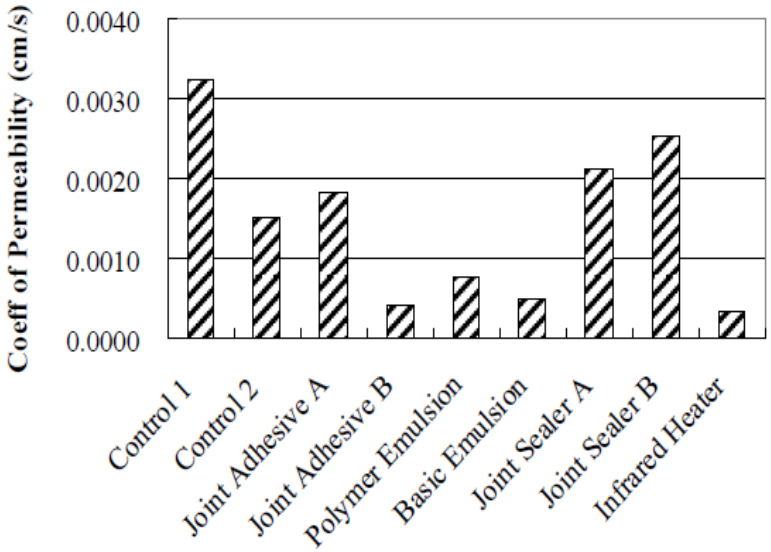
- Hot joint construction
  - Echelon paving
  - Infrared Joint Heaters
- Rolling methods
  - Rolling from hot side, cold side, pinch, etc.
- Construction methods and materials
  - Tapered joints (3:1, 12:1 w/ notch, etc.)
  - Cutting wheel
  - Edge restraining device
  - Joint adhesives

Poor Longitudinal Joints

- Inadequate Compaction

Tennessee DOT Results





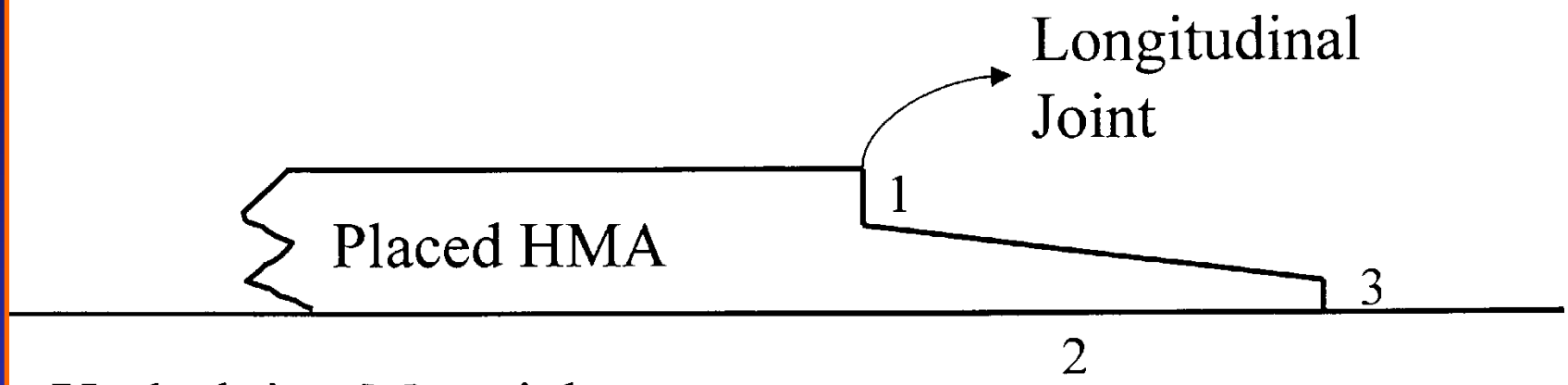
Huang, Baoshan et al
2010 Study

Longitudinal Joint Solutions

- Echelon Paving
  - Hot joint construction provides best joint density.

Notched Wedge Joint

Notched Wedge Joint



(1) Vertical Notch Depth = 0.5 to 0.75 inches

(2) Length of Wedge = 12 inches

(3) Wedge Thickness at Edge = Nominal Maximum Aggregate Size of Mix

Longitudinal Joint Problems

- One of the biggest problems is a “crooked” mat.
  - Impossible to consistently match with the hot mat.

Don’t Touch The Joint!

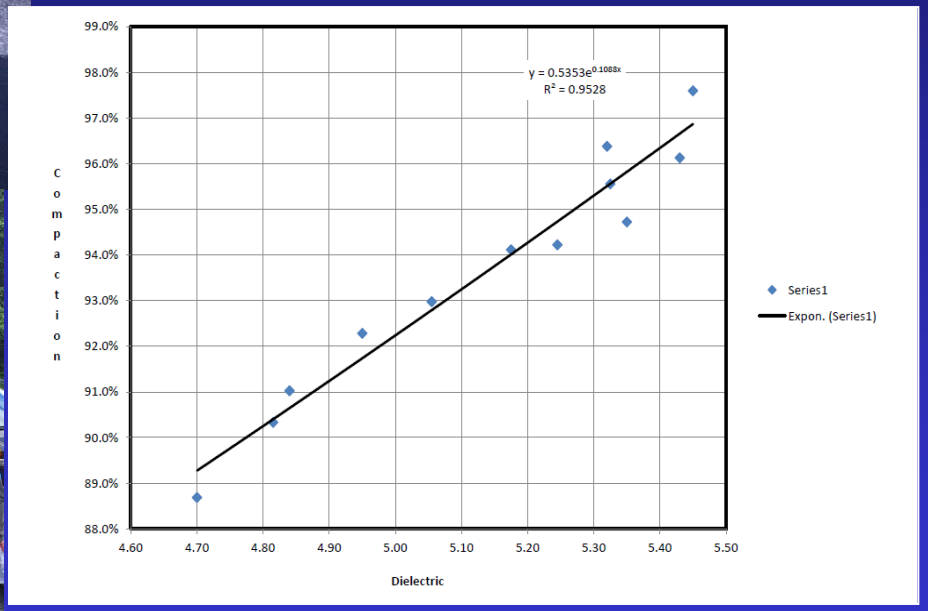
Full Width Paving

- Low volume rural roads, highways, airfields etc.

ALASKA DOT EXPERIENCE

Compaction Summary - 2017 Data		
	% Compaction	
	Bulk/MSG Panel	Bulk/MSG Joint
SB-L1 Average Panel Density (20 Cores)	94.8	
NB-L1 Average Panel Density (17 Cores)	95.4	
SB-L2 Average Panel and Joint Densities (33 Cores)	94.9	94.1
SB-L3 Average Panel and Joint Densities (3 Cores)	95.5	93.4
NB-L2 Average Panel and Joint Densities (28 Cores)	94.7	95.0
Project Averages	**94.9**	**94.5**
Max	97.6	97.8
Min	92.3	90.9
Note:		
50 of 101 (50%) of Panel Cores 95.0% or Higher		
26 of 64 (41%) of Joint Cores 95.0% or Higher		

Measuring Density with GPR



Specifications

Alaska DOT specification required:

- Minimum joint compaction of 92 %
- Bonus increases linearly from 92.0% to 96.0% in 0.1% increments
- Full bonus of 5 % ($2.00/ft.) is achieved at 96 % compaction. Joint sealant is required for all sections with lower than 92 % compaction, including bridge decks.

MTO Requirements

Infrared Joint Heater

The Contractor shall use an infrared joint heater at the time of paving *, at the longitudinal paving joint between lanes of this Contract when paving in echelon is not being used.

The longitudinal paving joint shall be heated using an infrared joint heater capable of heating the HMA at the joint to a sufficiently hot temperature. The joint will be considered sufficiently hot if the joint HMA retains a temperature of 90° C +/- 10° C immediately prior to placement of the adjacent lane material. When the joint HMA is not sufficiently hot, the paving operation shall be adjusted to reach the required temperature. The Contractor shall stop paving if at any time the existing pavement or adjacent lane pavement at the joint:

a) reaches a temperature exceeding 150° C
b) burns
c) chars.

MTO Specification Limits

Excerpt from Table 5 NSSP BITU0024

Lane Compaction	Superpave 37.5, 25.0, 19.0,12.5, 9.5 and 12.5FC 1	92.0	97.0
	Superpave 12.5FC 2	92.0	98.0
	SMA	93.0	98.0
Edge Compaction	Superpave 12.5, 9.5 and 12.5FC 1	90.5	97.0
	Superpave 12.5FC 2	90.5	98.0
	SMA	91.5	98.0

HDE TECHNOLOGY

- HDE Infrared Heater Patent –
  - Best IR efficiency & intensity / No cold spots

- Venturi Pipe
  - Adjustable Regulators / Adjustable Pressures / Adapt to Conditions
  - No Batteries No Blower Motors

- Vaporizer
  - For uniform gas pressure
  - Eliminate Tank Freeze up
  - Maximize Fuel
  - Work up to -15 Deg C without losing pressures

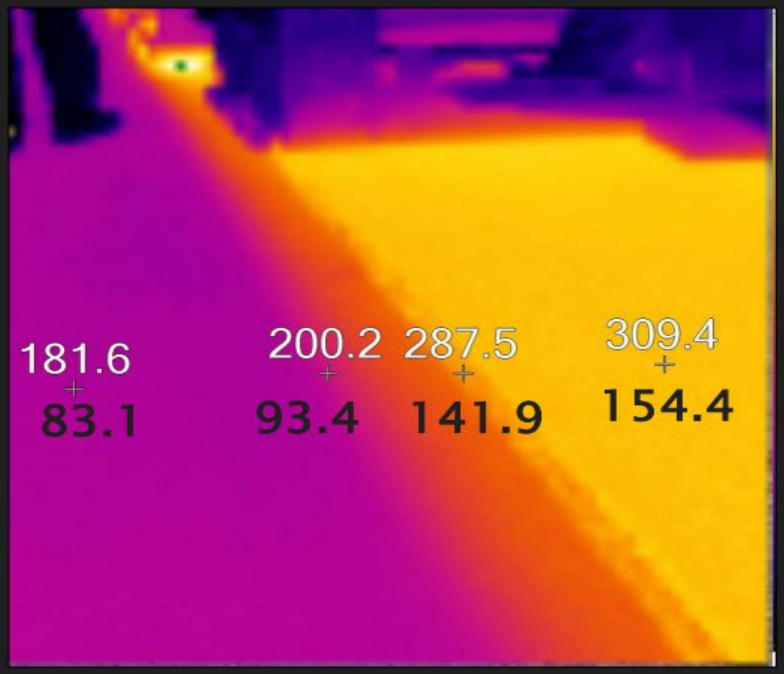
Joint Heater in Action

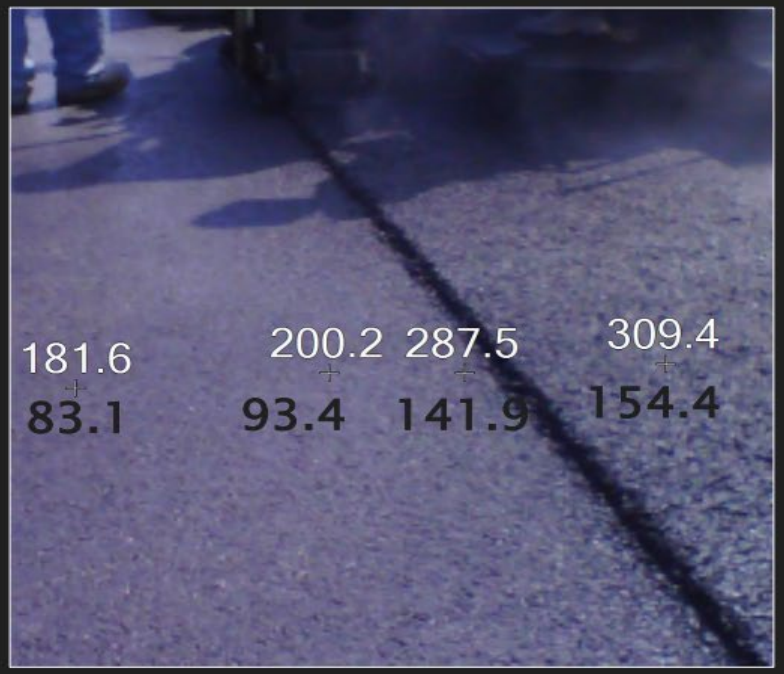
What's happening at the joint……

White = degrees F

Black = degrees C

INFRARED DATA





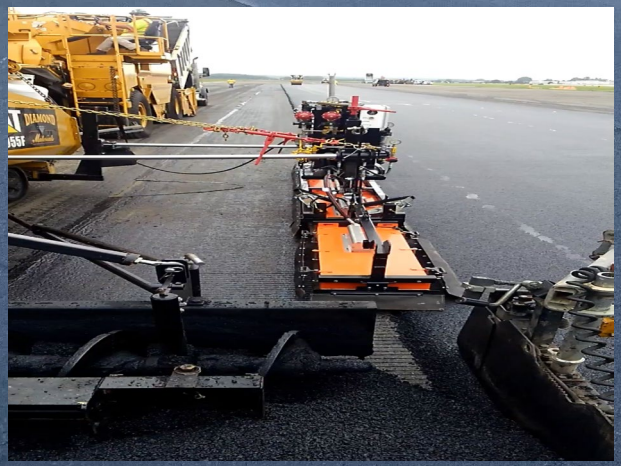
Diamond – Case Study

Project:

Delaware River and Bay Authority, New Castle County Airport

Scope:

Rehabilitation of Runway 1-19, Runway 9-27 intersection and associated Taxiway Tie-ins



New Castle County Airport – Runway Rehabilitation – 2020 FAA Project

- Eliminated the need for saw cutting and preparing the joints.
- Reduced the need to export and dispose of asphalt generated from saw cutting. Environmental footprint reduction.
- No impact on production, when switching unit from one side of paver to the other.
- Allowed for continuous paving operations, for both the leveling course and the final surface course, increasing our estimated daily productions.

New Castle County Airport

- All density testing on cores were well within the required specifications.
- No corrective actions required on the project.
- The joint heater visually produced a better joint.
- The Heat Design Infrared joint heater played an in important role in achieving good join density.

Chris Vogel Diamond Material

DND CFB Trenton Specifications

Cut back or re-heat the cold joint in accordance with this Specification.

Table 10 – Longitudinal Joint Compaction (Nearest 0.1 %)

Sublot	Lot	Action	Lot Pay Factor, F_x (% Payment)
92.0 or greater	92.5 or greater	Acceptable	100
91.5 to 91.9	92.0 to 92.4	Minor Borderline	95
91.0 to 91.4	91.5 to 91.9	Major Borderline	90
Less than 91.0	Less than 91.5	Rejectable	Remove and replace

"The percent compaction of each core will be determined by dividing the bulk relative density of the core by the average theoretical maximum relative density of the laboratory compacted hot-mix asphalt representative of the lot."

Courtesy of Myron Thiessen

CFB Trenton Compaction Results

Lot	Mat Compaction	Joint Compaction	Paving Date	Design Lift Thickness
1	93.4	92.8	23-Aug	40
2	93.8	91.6	25-Aug	40
3	94.2	92.9	27-Aug	40
4	94.7	93.5	31-Aug	40
5	94.6	93.4	02-Sep	40
6	96.2	92.8	08-Oct	60
7	94.9	92.8	14-Oct	60
8	94.9	92.9	15-Oct	60
9	93.4	92.7	18-Oct	60
10	94.0	93.3	19-Oct	60
11	94.2	92.1	20-Oct	60
12	94.4	92.1	22-Oct	60
13	93.9	93.9	27-Oct	60
14	94.2	93.3	28-Oct	60
15	93.5	92.4	29-Oct	60
16	93.9	91.4	01-Nov	60
Average	94.2	92.7		

Conclusions

- Workmanship is critical to quality
- Variety of techniques
- Specify Joint Density – Compaction is Essential!
  - Echelon Paving
  - Cutting Wheel, milling etc.
  - Notched Wedge Joint
  - Rolling from the hot side
  - Joint heaters are being utilized more and more…

Doing it Right!

HEAT DESIGN EQUIPMENT INC.
The Infrared People

Thank You!