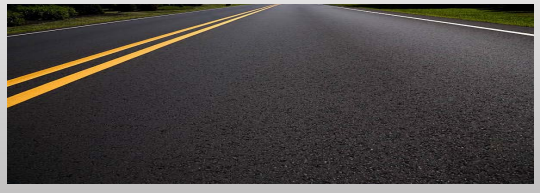
Thick Lift Paving
I-85, I-385
SC Hwy 544, and Holmestown Rd



I-85 Spartanburg
Mile Marker 56 to 68
2014-2015

- Left and Middle Lanes Only
- Near Surface Distress
- Average Depth of Asphalt 19 inches
- 16 of 18 Cores NB and 9 of 9 Cores SB distresses in upper 5 inches
- The surface conditions of the locations where distress was limited to the upper 5 inches was fair, with relatively low severity or, in limited cases, no longitudinal wheel path cracking

I-85 Spartanburg
Mile Markers 56 to 68
Right - Travel Lane Only

Failures within 8 inches:

- 9 of 18 SB and 5 of 9 cores NB exhibited similar variable material quality and failures extending to a depth of at least 8 inches.
- Surface conditions were fair to poor, with well-defined longitudinal wheel path cracking, often including multiple wandering cracks, lateral cracks spurring off and general fatigue cracking developing along the wheel path. **Areas prone to potholes**.

Failures greater than 8 inches:

- 7 of 18 SB cores exhibited cracking and distress extending below 8 inches to full depth cracking and deterioration
- 3 of 18 SB and 1 of 9 NB cores were noted as being significantly cracked and deteriorated full depth
- Surface conditions were similar to distresses within 8 inches and typically included 2 longitudinal wheel path cracks.

Design Limitations

- Structurally deficient. Existing SN was 7.45. Design required 8.20.
- Cant build up significantly for additional structure.
- Deterioration in upper 5 inches throughout.
- 50% or more of critical lane has distress 8 inches to full depth.
- Traffic control limited to nightly closures and extended weekend closure.
- Design was further altered post award (VE) working with contractor.
- Reduced to 1 lift of 450 psy in left and middle lanes and 2 lifts of 495 psy in right lane.
- Eliminated the need for Surface E – 4.75mm leveling course to address drop off restrictions of > 2".
- Required test strip to build confidence..
  - Numerous concerns about compaction and the amount of production.
  - Results turned out better than expected!

How Did it Ride?

- After Intermediate
  - Outside 99
  - Center 94
  - Inside 88
- After some repair (micro mill select areas) and 2" of Surface A
  - Right 51
  - Middle 53
  - Left 65

Intermediate B Special

Mix Design Objectives:

- Place a mix that would hold up under traffic (stiffness) and serve as a riding course and fine enough in gradation to seal out water if left exposed for several months, or until next construction season until final surface and OGFC could be placed on top.
- Make a mix that is easier to compact and obtain has much maximum density as possible.
- Return to heavy traffic the next morning prior to rush hour on a High Volume Interstate.

Intermediate B Special

1) What mix could we use that would be good under traffic (Strength and Durability) and would be fine enough to seal out water if left exposed for months-years?

- Use a older 12.5mm Superpave Surface, now called Intermediate B.
- Use PG 64-22 vs. PG 76-22
- Allows up to 30% Aged Binder (RAP)
- Current Intermediate B Mix is typically placed at 2"depth.

Intermediate B "Special"

2) How do we make the current Intermediate B mix to make it more durable and easier to compact?

- Lower Design / Field Air Void Targets
- 4.00% to 2.75% (increase binder content)
- Lower Gyrations 100 to 75 gyrations (increase binder content)
- Still allow RAP to increase stiffness – adding rut resistance
- Use WMA to aid in compaction process

Intermediate B "Special"

3) *How do we obtain the lowest return to traffic temperature, reducing the chance of premature rutting and pavement damage?*

- Use WMA Technology - WMA Chemical Process

Intermediate B "Special"

4) How do measure in place compaction and ensure we are confident in the contractor's efforts?

SCDOT Concerns:

a) We did not want to cut full depth cores every night and leave holes that could not be compacted properly full depth.
b) Concerns with requiring the contractor to stop early enough so QC could cool the pavement down and cut cores and fill holes prior to opening to morning traffic.
c) Concerns with vertical edges -joints getting enough compaction.

Require a Test Section….

Intermediate B "Special"

- ***Test Section Requirements….***
- Obtain full depth cores only in the test section and take gauges shots to establish offsets.
- Cores and gauge shots taken in mainline and on within 6-12" of vertical joints.
- Cores sliced into multiple layers to ensure density was obtained from bottom up..
- Several different gauges used in case of malfunction and in anticipation of starting two milling-paving operations.
- Nuclear and Electronic Gauges Used

Intermediate B "Special"

5) Require a Contractor QC Plan*

Required to make contractor come up with a approved plan ahead of paving that would address concerns with:

a) Lane Closure Restrictions – High Traffic
b) Milling Operations – Staging (stagger 1st and 2nd cut with milling to establish offset)
c) Backup asphalt plant - available in case of breakdown
d) Cleanup – sweeping operations – deep hole
e) Tack – Address concerns with break time - coverage
f) Paving – MTV and Trucks

* Ability to amend the QC plan nightly if needed to maximize production and quality.

Intermediate B "Special"

SECTION 411: WARM MIX ASPHALT – ASPHALT INTERMEDIATE COURSE TYPE B (SPECIAL)

Utilize specifications for Intermediate B with the following exceptions:

a. Use WMA Technology with a chemical process on QPL # 77 to achieve maximum reduction in temperature while improving constructability during field placement operations.

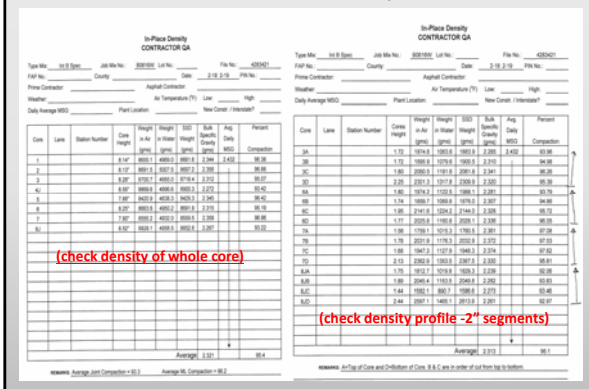
b. Ensure the mix design follows the same requirements of Intermediate Course Type B using SC-M-402 with the exception of a change in target air voids. Target air voids at 2.5-3.0% on the mix design to increase binder content and improve field compaction and fatigue resistance.

c. Use a nuclear gauge in lieu of roadway cores for measurement and acceptability of in place density. Prior to paving any mainline travel lanes, construct a test strip on the shoulder of the roadway to set up a roller pattern and establish target density. The test strip will be paid for with the contract quantities. Obtain 6 inch roadway cores at the end of the test strip to verify maximum compaction effort is acceptable to RCE. Additional coring and test strips may be required by the RCE for monitoring and acceptance of in place density. Ensure all other mix acceptance testing follows SC-M-400 using the same mixture acceptance criteria as the Intermediate Course Type B.

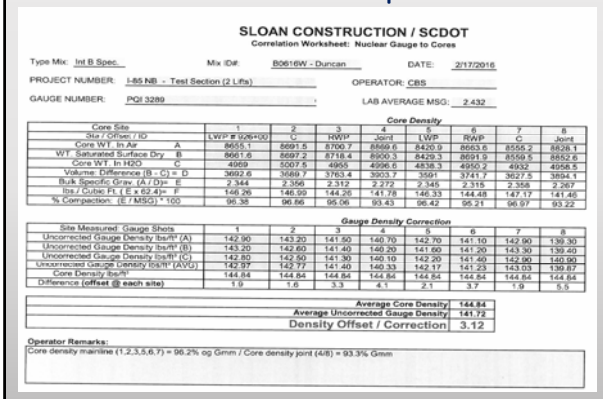
d. Submit a contingency plan to the RCE for approval prior to beginning work. The plan is required due to the complexity of the job including depth of asphalt removal, lane closure restrictions, high traffic volumes, and paving operations.

Item No.	Pay Item	Unit
4112321	WMA Intermediate Course Type B "Special"	TON

Intermediate B Special



Intermediate B Special



SLOAN CONSTRUCTION / SCDOT

Correlation Worksheet: Nuclear Gauge to Cores

Type Mix: Int B Spec Mix ID#: B0616W - Duncan DATE: 2/17/2016

PROJECT NUMBER: I-85 NB - Test Section (2 Lifts) OPERATOR: CBS

GAUGE NUMBER: PQI 3289 LAB AVERAGE MSG: 2.432

Core Density

Core Site	1	2	3	4	5	6	7	8
Sta / Offset / ID	LWP # 026+00	C	RWP	Joint	LWP	RWP	C	Joint
Core WT. In Air A	8655.1	8691.5	8700.7	8669.6	8420.9	8663.6	8555.2	8628.1
WT. Saturated Surface Dry B	8661.6	8697.2	8718.4	8680.3	8429.3	8691.9	8559.5	8652.6
Core WT. In H2O C	4959	5007.5	4955	4996.6	4838.3	4950.2	4932	4958.5
Volume: Difference (B - C) = D	3692.6	3689.7	3763.4	3903.7	3591	3741.7	3627.5	3894.1
Bulk Specific Grav. (A / D)= E	2.344	2.356	2.312	2.272	2.345	2.315	2.358	2.267
lbs./ Cubic Ft. (E x 62.4)= F	146.26	146.99	144.26	141.78	146.33	144.48	147.17	141.46
% Compaction: (E / MSG) * 100	96.38	96.86	95.06	93.43	96.42	95.21	96.97	93.22

Gauge Density Correction

Site Measured Gauge Shots	1	2	3	4	5	6	7	8
Uncorrected Gauge Density lbs/ft³ (A)	142.90	143.20	141.50	140.70	142.70	141.10	142.90	139.30
Uncorrected Gauge Density lbs/ft³ (B)	143.20	142.60	141.40	140.20	141.60	141.20	143.30	139.40
Uncorrected Gauge Density lbs/ft³ (C)	142.80	142.50	141.30	140.10	142.20	141.40	142.90	140.90
Uncorrected Gauge Density lbs/ft³ (AVG)	142.97	142.77	141.40	140.33	142.17	141.23	143.03	139.87
Core Density lbs/ft³	144.84	144.84	144.84	144.84	144.84	144.84	144.84	144.84
Difference (offset @ each site)	1.9	1.6	3.3	4.1	2.1	3.7	1.9	5.5

Average Core Density	144.84
Average Uncorrected Gauge Density	141.72
Density Offset / Correction	3.12

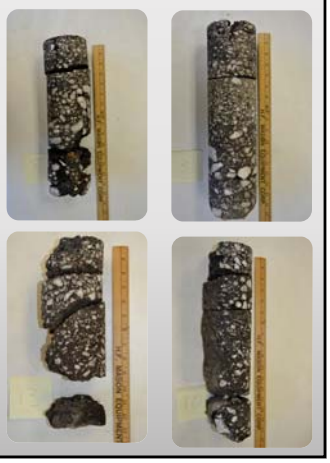
Operator Remarks:

Core density mainline (1,2,3,5,6,7) = 96.2% og Gmm / Core density joint (4/8) = 93.3% Gmm

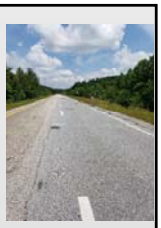
I-385 Greenville 2017-2018

Overlay and widening section were not performing..

Mill and Fill 10" and place two lifts in same night…



NCAT – S9 – 2018 Track



- Single 8" lift – 2018 Track
- Job was done during the day on track.
- Daytime temps were in the 70-80s.
- Instrumentation was installed to monitor stresses and temperature probes used to collect time to cool data.
- Very short section – difficult to level out production and laydown operations.
- Compaction met or exceeded expectations.
- Smoothness? – Had to perform some diamond grinding to achieve suitable ride.
- Holding up very well, continued trafficking for another test cycle in 2021..

SC Hwy 544 - 2020

- Single 5-6" lift.
- Job was set up as nighttime lane closure..
- Started in January – Nighttime temps were in the 30s-50s.
- The road was a curb and gutter section (5 lanes), so we had confinement.
- There was enough room for dual lane closure, so equipment could pull on and off without effecting new mixture.
- Ended up with ride being near 90-100"/mile, but decided to do a full diamond grind (first time we have done that full width and on entire project) and got the ride to 30's.
- Paving company won several awards – SCAPA and IGA

Holmestown Road – Horry County, SC - 2021

- Single 5-6" lift.
- Job was not set up as nighttime lane closure..
- Started in April into May – Daytime temps were in the 70-80s.
- The road was not completely curb and gutter, so not entirely confined section.
- Not enough room for dual lane closure, so not enough room to pull rollers off surface
- Ended up placing intermediate mix in two lifts and added a final thin lift surface to obtain satisfactory smooth ride.

Lessons Learned

- Must have confinement on road
- Need to place in the cold months and at night to aid in cool down and return to traffic.
- Really need dual lane closure, so you can keep trucks and MTV out of the cut and place for rollers to pull on and off.
- Need for more trucks and keep paver moving at all times.
- May need to perform some surface planning, diamond grinding, or place a thin lift surface to provide expected smoothness.

Thanks for Your Time!

Cliff Selkinghaus - SCDOT