September 22, 2009
Updated November 16, 2009

CROSS SLOPE VERIFICATION:

1. DESCRIPTION:

The cross slopes of the roadway are to be constructed as detailed in the plans and within the tolerances listed in this specification. It is the responsibility of the Contractor to ensure that the roadway cross slopes meet the requirements of the plans and this specification.

2. RESPONSIBILITIES:

Carefully review the plans to determine the amount of information that has been provided by SCDOT prior to bidding. The following paragraphs explain the Contractor responsibilities based on the information contained in the plans.

2.1 SURVEY CONTROL:

The Contractor shall be responsible for establishing the survey control information. This information will include control points, horizontal alignment, and stationing. Surveys shall be in accordance with the SCDOT Pre-Construction Survey Manual (Latest Edition). http://www.scdot.org/doing/survman.shtml

2.2 SUPERELEVATION:

The Contractor shall be responsible for establishing the superelevation transition points with station reference at the following points along horizontal curves: begin and end of superelevation, flat cross slopes within superelevation transition, remove crown, begin and end of maximum superelevation, PC's, PT's, and cross slopes on begin and end of bridges. The Contractor shall establish superelevation in accordance with the SCDOT Highway Design Manual (Latest Edition).

2.3 EXISTING CROSS SLOPE DATA:

The Contractor shall be responsible for obtaining existing cross slope data.

2.4 SUBMITTALS:

The Contractor shall ensure that all deliverable documents are signed and sealed by a Professional Engineer qualified to practice in South Carolina. The Contractor and/or Professional Engineer shall give depositions and testify in court to the methodology, the accuracy of obtained cross slope, and that all criteria stated in this provision were met upon the request of the Department.

3. CONTRACTOR PLANNING PROCESS:

3.1 INITIAL PAVEMENT DATA SURVEY:

The Contractor shall be responsible for collecting elevation data for the edge of each travel lane at even 100-foot stations in tangents and 50-foot stations in curves, begin and end of superelevation, flat cross slopes within superelevation transition, remove crown, begin and end of maximum superelevation, PC's, PT's, and cross slopes on begin and end of bridges. Record elevation data to the hundredth of a foot.

3.2 CALCULATING CROSS SLOPE:

The cross slope of a travel lane in the cross section view is the ratio or percent based on the change in horizontal compared to the change in vertical. Cross slope is calculated by subtracting the difference in elevation between the two edges of the travel lane and dividing this difference by the lane width. For example, a typical 48:1 Normal Crown (NC) pavement cross slope is calculated as -0.0208 ft/ft or -2.08% for a 12 foot lane (Figure 1). Figure 2 shows an example of a Remove Crown (RC) pavement cross slope which is calculated as +.0208 ft/ft or +2.08% for the 12 foot lane on the high side of superelevation.

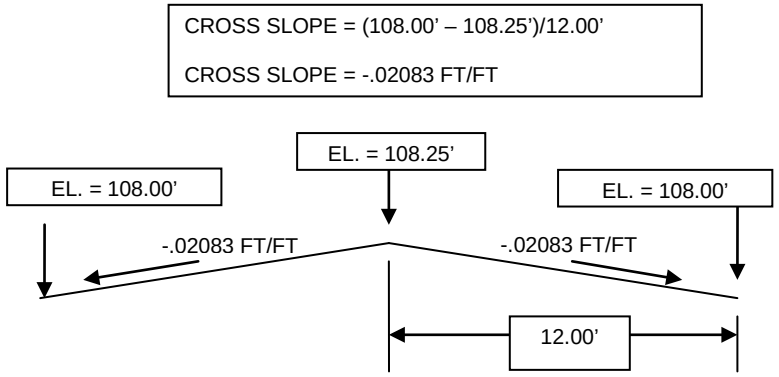

FIGURE 1
NORMAL CROWN

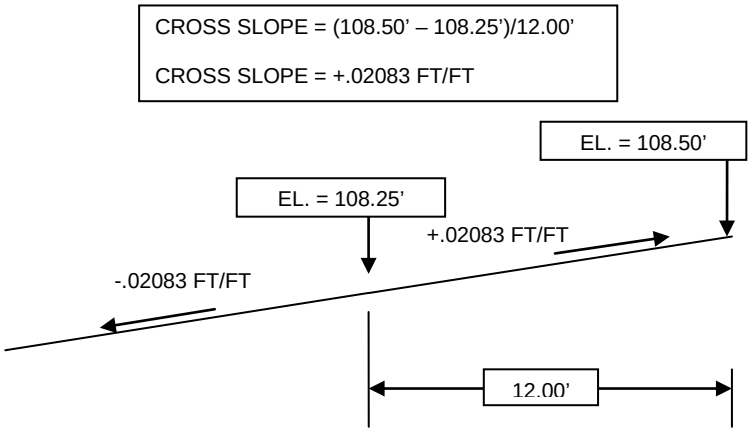

FIGURE 2
REMOVE CROWN

3.3 ACCEPTABLE TOLERANCES OF CROSS SLOPES:

Tolerance Level 1 for cross slopes shall be ± 0.00174 ft/ft of the design cross slopes.

Tolerance Level 2 for cross slopes shall be ± 0.00348 ft/ft of the design cross slopes.

3.4 INITIAL CORRECTIVE MEASURES PLAN:

Submit to the RCE a summary of the Initial Pavement Data Survey. The data submitted for review shall include the following information for each travel lane:

Station	LETL Elevation	RETL Elevation	Lane Width	Calculated X-slope	Plan X-slope	Deviation	Tolerance Level

- Station
- Left Edge of Travel Lane Elevation (LETL) in ft
- Right Edge of Travel Lane Elevation (RETL) in ft
- Lane width in ft
- Calculated cross slope in ft/ft
- Plan cross slope in ft/ft
- Deviation between calculated cross slope and plan cross slope
- Tolerance Level (1, 2, or Out of tolerance)

Prior to placing uniform overlays of HMA, the Contractor is required to prepare a plan to correct the cross slopes in the areas that are **outside of Tolerance Level 2**. The Contractor shall identify the areas that require milling and/or build-up. Submit an Initial Corrective Measures Plan to the Resident Construction Engineer for approval. The submittal will include the elevations, milling depths, and buildup thicknesses for each edge of the travel lane and shoulder break points including the face of concrete barrier wall required to achieve the plan cross slopes and proper superelevation. The Contractor shall include an estimated quantity of milling and buildup.

The RCE must approve the Initial Corrective Measures Plan prior to beginning corrective measures.

4.0 CONSTRUCTION PROCESS:

4.1 INITIAL CORRECTIVE MEASURES:

Perform all initial corrective measures prior to placing the first uniform overlay. Follow the plan that was approved by the RCE.

4.2 PROGRESS MEASUREMENTS:

The Contractor shall verify cross slope measurements after the following work activities:

- Completion of initial corrective measures (milling and/or build-up)
- After each uniform lift of pavement prior to the final surface overlay

Elevation data is to be collected at the edge of each travel lane perpendicular to the roadway centerline at the following locations:

- Minimum of one random location every 300 feet in tangent sections as determined by the Department
- Begin and end of superelevation, flat cross slopes within superelevation transition, remove crown, begin and end of maximum superelevation, PC's, and PT's
- Cross slopes on begin and end of bridges

Submit to the RCE a summary of the progress measurements for information only. The data submitted for review shall include the following information for each travel lane in the shown format:

Station	LETL Elevation	RETL Elevation	Lane Width	Calculated X-slope	Plan X-slope	Deviation	Tolerance Level

- Station
- Left Edge of Travel Lane Elevation (LETL) in ft
- Right Edge of Travel Lane Elevation (RETL) in ft
- Lane width in ft
- Calculated cross slope in ft/ft
- Plan cross slope in ft/ft
- Deviation between calculated cross slope and plan cross slope
- Tolerance Level (1, 2, or Out of tolerance)

4.3 CONSTRUCT UNIFORM LIFTS OF ASPHALT:

Construct uniform lifts of asphalt in accordance with the plan typical sections. Continue to monitor the construction process by conducting a Progress Measurement after each uniform lift of asphalt prior to the final lift (excluding Open Graded Friction Course (OGFC) if specified). For information only, submit the results to the RCE for each lift. Areas outside of Tolerance Level 2 will require correction prior to placing subsequent uniform lifts.

4.4 FINAL PAVEMENT MEASUREMENT:

Calculate the pavement cross slopes after placing the final surface course overlay (prior to OGFC if specified). Verify that the correct cross slopes have been obtained.

Elevation data is to be collected at the edge of each travel lane perpendicular to the roadway centerline at the following locations:

- Even 100-foot stations in tangent sections and even 50-foot stations in curves
- Begin and end of superelevation, flat cross slopes within superelevation transition, remove crown, begin and end of maximum superelevation, PC's, and PT's
- Cross slopes on begin and end of bridges

Submit to the RCE a summary of the final pavement measurements. The data submitted for review shall include the following information for each travel lane:

Station	LETL Elevation	RETL Elevation	Lane Width	Calculated X-slope	Plan X-slope	Deviation	Tolerance Level

- Station
- Left Edge of Travel Lane Elevation (LETL) in ft
- Right Edge of Travel Lane Elevation (RETL) in ft
- Lane width in ft
- Calculated cross slope in ft/ft
- Plan cross slope in ft/ft
- Deviation between calculated cross slope and plan cross slope
- Tolerance Level (1, 2, or Out of tolerance)

Areas outside of **Tolerance Level 1 and within Tolerance Level 2** will be subject to review by the RCE and the DCE. The DCE will either require corrective measures at the Contractor's expense, or will provide a memo of acceptance with a pay reduction.

Areas outside of **Tolerance Level 2** will be subject to review by the DCE and the Director of Construction. The Director of Construction will either require corrective measures at the Contractor's expense, or will provide a memo of acceptance with a pay reduction.

4.5. PERFORMANCE ADJUSTMENTS:

For Final Pavement Measurements within **Tolerance Level 1**, no pay adjustment will be made.

For Final Pavement Measurements outside of **Tolerance Level 1**, the DCE will either require corrective measures at the Contractor's expense, or will provide a memo of acceptance with a pay reduction of $200/100' for each travel lane over the length of the section. The section length(s) will be determined as follows:

The beginning of each section will be halfway between the first point outside Tolerance Level 1 and the previous (adjacent) point within full compliance. The end of each section will be halfway between the last point outside Tolerance Level 1 and the adjacent point which is within full compliance. The minimum section length will be 100 feet. This amount will be deducted from monies due for HMA mixes.

For Final Pavement Measurements outside of **Tolerance Level 2**, the DOC will either require corrective measures at the Contractor's expense, or will provide a memo of acceptance with a pay reduction of $300/100' for each travel lane over the length of the section. (This pay reduction will be in addition to the $200 pay reduction for being outside of Tolerance Level 1.) The section length(s) will be determined as follows:

The beginning of each section will be halfway between the first point outside Tolerance Level 2 and the previous (adjacent) point within Tolerance Level 2. The end of each section will be halfway between the last point outside Tolerance Level 2 and the adjacent point which is within Tolerance Level 2. The minimum section length will be 100 feet. This amount will be deducted from monies due for HMA mixes.

5. AS-BUILT PLAN SHEETS AND ELECTRONIC DELIVERABLES

After any Performance Adjustments have been settled, provide final pavement cross sections on full size (22" x 36") plans sheets and submit to the RCE for inclusion in the as-built plans. Include the final disposition of cross slopes outside of the specified tolerances (i.e. corrected survey data, memo of acceptance from DOC, etc).

The as-built construction plans should include the following:

- Control points, horizontal alignment, and stationing used to construct the project.
- Superelevation with horizontal curve data
- Cross sections at even 100-foot stations in tangents and 50-foot stations in curves
- Cross sections at the begin and end of superelevation, flat cross slopes within superelevation transition, remove crown, begin and end of maximum superelevation, PC's, PT's, and cross slopes on begin and end of bridges
- Corresponding electronic files on CD-ROM or DVD to include all files used to develop the survey for the project, all files used to verify the cross slopes for the project, superelevation calculations, and any Microstation CADD files that pertain to the cross sections

6. METHOD OF MEASUREMENT:

6.1 Measurement will be made for Cross Slope Verification after the RCE has reviewed and approved the work, including all submittals. Measurement is one lump sum.

6.2 No measurement will be made for any items of work required to make corrections to the final pavement cross slopes as deemed necessary by the Department.

7. BASIS OF PAYMENT:

7.1 Cross Slope Verification will include any costs for interpreting the data, electronic and hard copies of survey data for the Engineer, traffic control, and any and all, tools, labor, and equipment necessary to perform the cross slope verification. The RCE will approve payment based on the following schedule:

Approval of the Initial Corrective Measures Plan	40%
Submittal of Progress Measurement for First Uniform Lift	60%
Submittal of the Final Pavement Cross Slope Measurements	80%
Acceptance of the As-Built Plan Sheets and Electronic Data	100%

7.2 The bid item number and description is:

ITEM NUMBER	DESCRIPTION	UNIT
1055102	CROSS SLOPE VERIFICATION	LS