Sample project special provision: 307cbpr

Date: 11/02/2016

1

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

Sections 307 and 406 of the Standard Specifications are hereby revised for this project as follows:

Subsection 307.01 shall include the following:

Lime for Cold Bituminous Pavement (Recycle). This work consists of producing and furnishing lime slurry for incorporation into the Section 406 item Cold Bituminous Pavement (Recycle). The Region Materials Engineer may elect to eliminate the requirement for lime. This decision will be made after the mix design is established and submitted, and may involve the deletion of the item.

Subsection 307.02 shall include the following:

Materials for lime slurry for use in Cold Bituminous Pavement (Recycle) shall conform to the following:

**Lime:** The lime shall conform to the requirements of ASTM C 977 for quicklime, and shall be the product of a high-calcium limestone as defined by ASTM C 51. Certificates of material compliance for the lime shall be submitted to the Engineer. The lime will be sampled and tested in accordance with the CDOT Field Materials Manual.

**Slurry:** The lime slurry shall be a uniform and pumpable suspension of solids in water.

**Water:** Water used for the lime slurry shall conform to the requirements of subsection 712.01.

Subsection 307.04 shall include the following:

Production and transportation of the lime slurry for Cold Bituminous Pavement (Recycle) shall conform to the following:

**Slurry Production Equipment:** The lime slurry shall be produced with a batching tank. The batching tank shall have mechanical agitation to thoroughly mix and react the quicklime with water and to keep the slurry homogeneous and prevent settlement. The tank shall have a calibrated water meter for proper control of the amount of water. The tank shall be vented for steam to escape and shall have a thermometer to determine the temperature of the slurry. The tank shall have a manhole at the top for observation and monitoring of the slurry production process.

**Slurry Production:** Quicklime shall be added to the required amount of water to provide a uniform lime slurry having a "dry solids content" of not less than 30% by weight. Prior to loading of the tank truck or trailer, the lime slurry in the batch or holding tank shall be thoroughly mixed. The time of mixing shall be sufficient to assure good slaking of the quicklime. For each batch of slurry, the date and time of production, amount of both quicklime and water used, and lime solids content shall be recorded by the Contractor and reported to the Engineer.

**Slurry Transport:** The lime slurry shall be transported to the cold recycle operation in a tank truck or trailer having mechanical agitation to maintain a homogeneous slurry and prevent settlement. While transporting or transferring the slurry to the cold in‑place recycling equipment, the slurry shall be continuously mixed.

Subsection 307.13, after the first sentence, shall include the following:

Quicklime incorporated into the Section 406 item, Cold Bituminous Pavement (Recycle), will be measured by the equivalent number of tons of Hydrated Lime, dry basis, to the nearest 0.01 ton, as calculated within this subsection.

2

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

Subsection 307.13 shall include the following:

An invoice for each load of quicklime delivered to the project shall be provided to the Engineer.

Payment for lime used in the Cold Bituminous Pavement (Recycle) operation will be full compensation for all work and materials required to complete the item, including mobilization of all processing and mixing equipment required in the paving train.

Section 406 of the Standard Specifications is hereby revised for this project as follows:

Delete subsection 406.02 and replace with the following:

* 1. The finished bituminous pavement shall be a homogeneous layer composed of in place bituminous pavement, 1.5 percent lime slurry, and asphalt recycling agent as determined by the mix design. The application rates of the additives shall be synchronized with the machine to provide uniform application.

1. **Mix Design.** Prior to starting Cold In-place Recycling operations, the Contractor shall furnish the Engineer with a proposed mix design and target values following the procedures of CPL 5111 with the project specific modifications and requirements as outlined within this revision.

The Contractor shall base the mix design on samples obtained by the Contractor in the presence of the Engineer, and shall include all elements listed in Table 406-1. The Region Materials Engineer will provide a Form #43 that sets the production targets based on the Contractor’s mix design. The Contractor shall submit any proposed changes to the mix design in writing, and a new Form #43 will be provided.

If after work has begun, the mixture properties do not correlate with the plan mix design, work shall be suspended until proper corrective actions or adjustments can be made. This may include but not be limited to changing the production rates, amount or type of recycling agent, or other additives. The Contractor shall submit proposed corrective actions or adjustments in writing for approval by the Engineer. The Contractor shall allow a minimum of two working days for the Engineer to approve the changes. The Contractor shall not resume work without the approval of the Engineer.

**(a)** **Sampling and Processing for Mix Design**

The Contractor shall obtain random core samples as required by CPL 5111. If cores show significant differences in various areas within the length of the project, such as different type or thickness of layers between cores, then separate mix designs shall be performed for each of these pavement segments. The gradation shall be determined by ASTM C117 and C136 (dried at no greater than 40 degrees C). The Contractor’s mix design shall be based on a blend of the crushed material using the medium gradation and either the fine or coarse gradations established in CPL 5111.

**(b) Recycling Agent**

The recycling agent shall meet the requirements of the Revision of Section 702, Recycling Agents, Asphalt Emulsion, CSS (Special).

3

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

**(c) Lime Slurry**

This project will require the addition of 1.5 percent Hydrated Lime for all mix designs. The Lime shall be added in to the mix design in accordance with CPL 5111. Unless deleted by the Region Materials Engineer, an amount of lime slurry equivalent to a minimum of 1.5% hydrated lime, based on the weight of the dry Cold Bituminous Pavement (Recycle) shall be added to the pulverized mixture for the limits indicated on the plans. The slurry shall be added to the pulverized material by use of a metering device which is capable of accurately measuring the amount of slurry being added to within + 0.2 percent by weight. This metering device shall be calibrated to and controlled by the weigh belt for the pulverized material being recycled. The slurry shall be added to the milled material by a spray bar located within the milling chamber of the milling equipment.

**(d) Thermal Cracking**

The required temperature for the specification is shown in Table 406-1. The Contractor shall perform Indirect Tensile Testing (IDT) as follows:

Perform the indirect tensile testing (IDT) according to AASHTO TP9-96 for CIR Design Specimens, with the following exceptions:

**(1)** Specimens using the medium gradation shall be 6 inches (150 mm) in diameter and at least 5.5 inches (115 mm) in height and compacted to air voids +/- 1 percent of design air voids at the design emulsion content. A trial specimen is suggested for this. Test specimens shall be cured at 60ºC no less than 48 hours and no more than 72 hours. Check specimen mass every 2 hours after 48-hour cure to verify compliance of no more than 0.05% change in mass in 2 hours. After curing, two specimens shall be cut from each compacted specimen to 2 inches (50 mm) in height. Perform bulk specific gravity after cutting.

**(2)** A minimum of two specimens at each temperature are required to be tested at the specified temperature, 10 ºC above the specified temperature, and 10 ºC below the specified temperature.

**(3)** The tensile strength test shall be performed on each specimen directly after the tensile creep test and at the same temperature as the creep test.

**(4)** The environmental chamber must be capable of maintaining a temperatures down to –40 ºC.

**(5)** The critical cracking temperature is defined as the intersection of the calculated pavement thermal stress curve (derived from the creep data) and the tensile strength line (the line connecting the results of the average tensile strength at the two temperatures).

**(e) Raveling** – Raveling Test (Standard Test Method for Raveling Test of Cold Mixed Bituminous Emulsion Samples ASTM D7196-06) will be a requirement of this mix design.

**(f) Emulsion Content Selection**

The properties of the specimens at design emulsion content shall be consistent with guidelines in CPL 5111 and shall meet the properties in Table 406-1. Target emulsion content may be adjusted by the Region Materials Engineer to optimize workability and design performance.

**(g) Report**

The report shall contain the following minimum information: Asphalt Content of the recycled pavement, target gradation of the recycled pavement, recommended water content range as a percentage of dry recycled pavement, optimum emulsion content as a percentage of dry recycled pavement, density corresponding to optimum emulsion content, air void level, absorbed water, Hveem stability, TSR with 1.5 percent lime at recommended moisture and emulsion contents, and thermal cracking initiation temperature. Include the emulsion designation and weight per gallon, company name, plant location, residue content, and percent raveling.

4

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

**(h) Mixture Design Criteria**

The proposed mix design, conforming to CDOT Procedures, shall be submitted to the Engineer for approval, and the Contractor shall allow 14 working days for approval prior to scheduling work on the recycling operation.

**TABLE 406-1**

|  |  |  |
| --- | --- | --- |
| **TEST** | **TEST PROCEDURE** | MIX DESIGN  **REQUIREMENTS** |
| Asphalt Content | CPL 5120 | Report for Existing RAP at design. |
| Sieve Analysis | CP 31 | 100% Passing 1.5” Sieve – Report Target Gradations in Mix design. |
| Max. Sp. Gr. of Mix | CP 51 | Report |
| Hveem Stability | CPL 5106 (25°C) as modified in CPL 5111 | Report |
| Bulk Specific Gravity | CP 44 (AASHTO T‑166) | Report |
| Air Voids | CPL 5115 (30 Gyrations) | 8%-16% - Report Mix design target |
| Lottman Test | CPL 5109 as modified in CPL 5111 (30 Gyrations) | 60% TSR for mix design with 1.5% Lime |
| Indirect Tensile Test | Modified Procedure Item (d) Above | –28ºC |
| Raveling Test | ASTM D7196-06 | 2% max. |

Delete subsection 406.05 and replace with the following:

* 1. **Mixing.** The Contractor shall ensure there is a representative experienced in cold bituminous recycling with solventless emulsion present on the project for the first three days of cold recycle work at a minimum and during recycling operations until an acceptable production sequence is established, or as determined by the Engineer. This individual may be a representative of the emulsion supplier, the cold recycle mixture designer, a private consultant or recycling contractor’s staff as necessary to ensure for documented experience with solventless emulsion cold bituminous recycling. This individual must have past experience with cold bituminous recycle with solventless emulsion on the basis of the support of at least three projects previously constructed in the United States. Representative name, qualifications, and previous experience, shall be provided to the Engineer for approval 5 working days before the recycle work commences. Any changes to the chemistry or blend of the recycling agent or to mixture proportions beyond the allowed tolerances during production shall be disclosed by this representative and submitted in writing by the Contractor as a change in mix design.

When commencing recycling operations, the recycling agent shall be applied to the pulverized material at the initial design rate determined in the approved mix design submitted by the Contractor. The application rate of the recycling agent shall be determined by the mix design and may be varied as required by existing pavement conditions. An allowable tolerance of plus or minus 0.2 percent of the emulsion design target rate shall be maintained at all times. The emulsion target will be documented by the Department on a Form #43 for each design that is accepted. Changes in amount of water, emulsion or other additives will be considered a change to the mix design. Changes in emulsion formulation will be considered a change in mix design.

5

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

The Contractor shall:

1. Arrange for supervisory personnel of the contractor crew, testing laboratory, Contractors Quality Control representative, emulsion supplier and Engineer, to meet a minimum of two weeks prior to beginning the CIR process to discuss methods of accomplishing all phases of the work.
2. Be prepared to discuss with the Department, the following:
3. Provide the department with a list of all equipment to be used in the CIR process, for their approval.
4. Names of the contractor’s CIR personnel on the project.
5. Names and experience of the contractor’s representative who will perform the field QC tests for the Department’s approval.
6. Step-by-step CIR process
7. Prepare contingency plans based on weather related issues.
8. Compaction and establishment of target density.
9. Field emulsion adjustments.
10. Release to traffic considerations.
11. Provide the names of their CIR construction management team, who will act for them during the CIR portion of the project and monitor the Contractors Quality Control.
12. Provide a copy of the medium/coarse or fine gradation table as part of the Contractors furnished CIR mix design for use in directing field adjustments during production.

The Contractor may add water to the pulverized material to facilitate uniform mixing with the recycling agent. Water may be added prior to or concurrently with the recycling agent, provided that this water does not adversely affect the recycling agent. The amount of water added in production should be identified as part of the initial design rate. The exact application rate of water added will be determined and may be varied as required by existing pavement conditions. The amount of water added in the recycle process shall be documented daily and deviations of greater than plus or minus 1 percent from the initial design target shall be submitted to the Engineer.

The Contractor shall, on a daily basis, provide to the Engineer the following information:

1. Date and production day number.
2. Direction of operation, location of start and finish for the production day.
3. Start time of work and finish time of work.
4. Air temperature at start of production and every two hours thereafter.
5. Gradation of material before addition of recycling agent, note location.
6. Depth of recycling (check and record at least every two hours)
7. Record rolling pattern and maximum wet density achieved for every rolling pattern throughout the day, note locations for each rolling pattern
8. Record production of the following mid-day and end of day at a minimum:
   1. Tons of recycled asphalt pavement processed
   2. Quantity of emulsion used in process (calculate percentage)
   3. Quantity of lime used in process (calculate percentage)
   4. Quantity of additional water used in process (if any) (calculate percentage)
9. Record any challenges encountered and breakdowns of equipment.
10. Attach windrow and finished mat moisture report

6

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE**)**

The Contractor shall calibrate the equipment after mobilization to the project site and before beginning the recycling process. The Contractor shall provide certified platform scales at the calibration site. A copy of the certification shall be provided to the Engineer prior to calibration. The Department will observe the calibration and will approve if the calibration standards are met. The Contractor shall record the results of the calibration and provide it to the Engineer prior to beginning recycling operations. The calibration shall include the following items. Any changes in recycling equipment will require re-calibration.

Aggregate Weigh Belt

* + - 1. Calibrate the aggregate weight belt at 3 different speeds (lowest, medium and highest speeds of anticipated operation).
      2. At least 10 tons shall be used for the aggregate tests.
      3. Calibrate the aggregate feed so the masses shown on the console indicators are within 1% of the actual mass as weighed on the certified platform scales.
      4. Verify the difference in the 3 runs is within 1% of each other.

Emulsion Metering Device

Introduce the emulsion into the mixer through a positive displacement metering device.

Equip the metering device with a ready means of varying the emulsion delivery rate.

Calibrate the feed at 3 different speeds using the percentage set in the approved mix design so the masses or gallons shown on the indicators are within 0.5% of the actual mass as weighed on the certified platform scales.

Lime Slurry Metering Device

* + - 1. Introduce the lime slurry into the mill head using a Mas Flow Coriolis effect type meter.
      2. Equip the metering device with a ready means of varying the lime slurry delivery rate.
      3. Calibrate the lime slurry feed at 3 different speeds using the percentage set in the approved mix design so the masses or gallons shown on the indicators are within 5% of the actual mass as weighed on the certified platform scales.

Delete Subsection 406.06 and replace with the following:

* 1. **Spreading and Placement.** Recycling and placing recycled material shall be at a rate sufficient to provide continuous operation of the paving machine. If paving operations result in being excessively behind or in excessive stopping of the paving machine, as determined by the Engineer, recycling operations shall be suspended. Recycling may resume when the Contractor can synchronize the rate of recycling with the capacity of the paving machine.

If segregation occurs during or after placement with a paving machine, the Contractor shall make changes in methods, equipment, or operations to eliminate the segregation. Segregated areas may require rework, as determined by the Engineer. Rework shall be at the expense of the Contractor.

In subsection 406.07 delete the second and third paragraphs and replace with the following:

Initial rolling shall be performed with pneumatic tire rollers, each with a 30 ton minimum weight. Initial rolling shall begin within 30 minutes of material placement and shall be continued until no additional displacement is observed. Final rolling to eliminate pneumatic tire marks shall be performed by steel wheel rollers. Static mode shall be used unless vibratory mode is approved by the Engineer. If vibratory mode is used, vibration shall be at low amplitudes to prevent transverse cracking. Final rolling shall be completed no more than two hours after paving is completed, unless otherwise approved by the Engineer.

7

REVISION OF SECTIONS 307 AND 406

COLD BITUMINOUS PAVEMENT (RECYCLE)

Subject to the above requirements, the Contractor shall determine what methods and procedures are to be used for the compaction operation to achieve the required density. The Contractor shall document these procedures on the first day of production in a Roller Pass Study. The Contractor shall record the following information and a copy of this data shall be furnished to the Engineer.

1. Type, size, amplitude, frequency, and speed of each roller.
2. Tire pressure for rubber tire rollers, and if the pass for vibratory rollers is vibratory or static.
3. Ambient and Surface temperature that rolling is being started and completed.
4. Production rates of the recycle train at time of compaction.
5. Sequence and distance from recycle train for each roller, and number of passes of each roller to obtain specified density.
6. Quality Control Testing for Density shall be at a minimum of 1 test per 1000 feet in this initial roller pass study section.

The recycled material shall be compacted to a minimum of 100 percent of the density of a laboratory specimen compacted in accordance with CP 53. The sample of material for testing shall be taken immediately prior to breakdown compaction. Samples to be used for acceptance testing shall be taken by the Contractor or his representative. An authorized representative of the CDOT shall be present during the sampling and will take immediate possession of all samples obtained. CDOT will determine the sampling method and locations of the samples. Acceptance testing will be conducted in accordance with the CDOT Field Materials Manual. The area shall meet the required density prior to being opened to traffic. If the area tested fails to meet the required density and must be opened to traffic to comply with working time or maximum delay time requirements, the area shall be reworked the following working day, until it attains 100 percent compaction. The Contractor shall not be allowed to proceed with additional recycling the following working day until the previous day’s recycled material meets density requirements. Rework shall include full four inch recycling. Re-rolling is not an acceptable alternative. For areas of retest, the initial target density will be determined by the original data established with CP 53 for the material taken immediately prior to breakdown compaction. Rework, including traffic control and all other equipment, materials, and labor necessary to complete the work, shall be at the expense of the Contractor.

Subsection 406.08 shall include the following:

The recycle train shall have an independent source of water to properly disperse emulsion in accordance with manufacturer’s recommendations. This source of water shall be independent of the lime slurry. This source of water will require a positive displacement pump with a flow capacity of up to 5% that is interlocked with the weight of measurement of the pulverized material. All water sources shall be equipped with calibrated flow meters. The Contractor shall supply positive means for calibrating the weight measurement and water-metering device.

Delete Subsection 406.10.

Delete Subsection 406.11 and replace with the following:

**406.11 Smoothness.** The longitudinal surface smoothness of the roadway prior to and after cold recycling shall be tested by the Contractor in accordance with the Revision of Section 105 – Hot Mix Asphalt Pavement Smoothness.

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INSTRUCTION TO DESIGNERS (delete before including in the project):

Use in conjunction with the sample project special provision, Revision of Section 702

Recycling Agents Asphalt Emulsion (CSS) (Special)