SECTION 308 - FOAMED ASPHALT TREATED BASE COURSE (FATB)
MOBILE COLD MIX PLANT
(FATB – Foamed Asphalt Treated Base)

308.01 DESCRIPTION. The work consists of stabilizing 100% Reclaimed Asphalt Pavement through a Mobile Cold Mix Plant with a metered quantity of foamed asphalt, while simultaneously adding Portland cement and moisture for compaction and or any other binders as determined by the mix design. Transport, spread, shape, and compact the mixed material according to these specifications and conforming to the dimensions shown on the Plans.

Provide a foamed asphalt technician, with a minimum of 3 years experience with FATB production and the related process control of the treated material produced by the Mobile Cold Mix Plant, on site to supervise the foamed asphalt process and to supervise the related process control testing.

At the Preconstruction Meeting, provide information on the equipment proposed for use, the name and resume of the foamed asphalt technician, and the location of the demonstration site.

308.02 MATERIALS.

Asphalt Cement (PG64-16)	**702.01**
RAP	
Aggregate for Hot Mix Asphalt Base Course	**703.09**
Portland Cement	**701.01**
Water	**712.01**
Filler	**703.15**

(A) GENERAL. FATB shall include mixture of RAP, asphalt cement, Portland cement, water, and may include aggregate or filler, or both.

RAP is defined as removed or reprocessed pavement materials containing asphalt and aggregates. Process RAP by crushing until 100 percent of RAP passes 1 ¼" sieve.

(B) JOB MIX DESIGN

1.Submittals. The Engineer will verify and indicate designated Job Mix Design. Design job-mix formula in accordance with procedures contained in current edition of Equipment Manufacturers Manual for Foamed Bitumen Mix Design Procedure. The Job Mix Design will provide the following:

a. The percent by weight of foamed asphalt cement to be added to the mix.
b. The optimum percent by weight of water to be added to the asphalt cement for the foaming process.
c. The minimum Foamed Asphalt Expansion Characteristics required.
d. The temperature of asphalt cement at the time of injection.
e. The percent by weight of Portland cement to be added to the mix.
f. The gradation of the reclaimed asphalt concrete pavement (RAP)
g. The optimum compaction moisture content.
h. Design dry indirect splitting tensile strength.
i. The maximum dry density.

(C) CONTRACTOR'S FOAMED ASPHALT TECHNICIAN. The Contractor shall provide a foamed asphalt technician, with a minimum of 3 years experience with FATB production and the related process control of the treated material produced by the Mobile Cold Mix Plant. The Technician shall be present during the construction of the test strip and for 5 days of production.

(D) CONTRACTOR PROCESS CONTROL AND ACCEPTANCE SAMPLING AND TESTING. The quantity of foamed asphalt treated base produced will be divided into lots and the lots evaluated individually.

A lot will normally be 16,000 square yards. The lot will be divided into sub-lots of 4,000 square yards or portion thereof per day. The Contractor shall randomly sample according to AASHTO T168 and test for density and Indirect Tensile Strength within each sub-lot. The Engineer will validate this test data for each lot through independent random testing before accepting it.

The Contractor shall provide the following:

1.Daily production records for each sub-lot, including the quantity of material Treated; the asphalt cement and Portland cement consumption; and in place compaction moisture content.

2. Provide independent accredited laboratory to perform strength (ITS) in accordance with Section (E) below and density testing using AASHTO T310. The Technician shall be responsible for random sampling according to AASHTO T168 and preparation of specimens for Indirect Tensile Strength testing for each sub-lot according to Equipment Manufacturer Foamed bitumen mix design procedure manual, using calibrated equipment. A minimum of 3 specimens shall be prepared for each sample and the average reported for each sub-lot.

3. Monitor and report in place field density, according to AASHTO T310, of the foamed asphalt treated base for each sub-lot. Determination of the field moisture content at time of testing is essential for the correction of the nuclear density gauge measurements. The nuclear density gauge reads the hydrocarbons in the asphalt as moisture and therefore the moisture reading recorded by the nuclear density gauge is incorrectly high and must be adjusted.

4. Report compaction process control data to the Engineer within 24 hours. Strength testing data shall be made available to the Engineer within 4 days of layer being processed.

(E) PREPARATION AND TESTING OF SAMPLES IN LABRATORY

The field samples shall be taken to the laboratory within two hours of sampling and the ITS briquettes shall be compacted within four hours of being sampled.

In the laboratory, ensure that the temperature of the material is between 71^{o}F and 77^{o}f. If the temperature of the material to be tested is not within these temperatures then place the material in an air cabinet or similar until the material is within the recommended temperature range and then the following tests shall be carried out.

DETERMINATION OF THE MAXIMUM DRY DENSITY AND OPTIMUM MOISTURE CONTENT

The Maximum Dry Density and Optimum Moisture Content (OMC) is determined from a representative sample as per the moisture-density relationship test, AASHTO T180 (generally one per day is required, unless a significant change in the material blend is noted whereby one per material blend is required)

INDIRECT TENSILE STRENGTH BRIQUETTES

The material for manufacture of the ITS briquettes shall be prepared as follows;

- Determine the moisture content of the remaining field sample;
- Weigh out 11 lbs. (for 3 briquettes) of the field sample;
- Sieve through the ¾ in. sieve and determine the mass of the material retained on the ¾ in. sieve;
- Using a portion of the remaining field sample extract the material retained on the ½ in. sieve but passing the ¾ in. sieve;
- Weigh out an amount equal to the mass of the material retained on the ¾ in. sieve from the original 11 lbs. sample and add to this sample such that the mass once again totals 11 lbs. ;
- The sample then adjusted to OMC and place in air-tight container;
- Ensure that the temperature of the material is between 71^{o}F and 77^{o}F and then manufacture 4 in. diameter briquettes for strength testing (ITS dry).

MANUFACTURE OF 4 IN. DIAMETER BRIQUETTE SPECIMENS

- Prepare the Marshall mould and hammer by cleaning the mould, collar, base-plate and face of the compaction hammer. Note: the compaction equipment must not be heated but kept at ambient temperature.
- Weigh sufficient material to achieve a compacted height of 2.5 in. ± .06 in. (usually 1150g is adequate). Precautions should be taken to ensure that the material does not lose moisture or segregate during placing in the mould. The remaining sample should remain sealed in the air-tight container.
- Poke the mixture with a spatula 15 times around the perimeter and 10 times on the surface, leaving the surface slightly rounded.
- Compact the mixture by applying 75 blows with the compaction hammer. Care must be taken to ensure the continuous free fall of the hammer.
- Remove the mould and collar from the pedestal, invert the briquette (turn over). Replace it and press down firmly to ensure that it is secure on the base plate. Compact the other face of the briquette with a further 75 blows.

- After compaction, remove the mould from the base-plate and extrude the briquette by means of an extrusion jack.

- After the compaction of all briquettes needed, the remaining sample shall be used to determine the compaction moisture content.

Note: With certain materials lacking cohesion, it may be necessary to leave the specimen in the mould for 24 hours, allowing sufficient strength to develop before extracting.

BRIQUETTE CURING PROCEDURE

Place the briquettes on a smooth flat tray and cure in a forced-draft oven at 104^{o}F to a constant mass, generally 72 hours. If a force-draft oven is not used the curing procedure (achieving constant mass) could be longer than 72 hours. Remove from oven after constant mass is achieved and allow cooling to 71 ^{o}F to 77^{o}F.

DETERMINATION OF BULK DENSITY

After cooling to ambient temperature, for each briquette:

- Determine the mass.

- Measure the height at four evenly-spaced places around the circumference and calculate the average height.

- Measure the diameter.

- Calculate the bulk density using equation 2:

Equation 2:
$$BD = \frac{4 * M_{Briq.}}{\pi * d^2 * h} * 1728$$

where:				
	BD	=	bulk density	[lb/ft^3]
	M_{briq}	=	mass of briquette	[lb]
	h	=	average height of briquette	[in]
	d	=	diameter of briquette	[in]

Exclude from further testing any briquette whose bulk density differs from the mean bulk density of the batch by more than 3 lb/ft^3.

DETERMINATION OF INDIRECT TENSILE STRENGHT (ITS)

The ITS is determined by measuring the ultimate load to failure of a briquette that is subjected to a constant deformation rate of 2 in./minute on its diametrical axis. Ensure that the temperature of the briquettes is between 71^{o}F and 77^{o}F and follow the procedure shown on next page:

- Place the briquette onto the ITS jig, which has steel loading strips with a concave surface having a radius of curvature equal to the nominal radius of the test specimen. For specimens 4 in. in diameter, the loading strips shall

be 0.5 in. wide. The length of the loading strips shall exceed the thickness of the specimens.

- position the sample such that the loading strips are parallel and centered on the vertical diametrical plane;
- place the transfer plate on the top bearing strip and position the jig assembly centrally under the loading ram of the compression testing device;
- apply the load to the briquette, without shock, at a rate of advance of 2 in. per minute until the maximum load is reached;
- record the maximum load P (in lb), accurate to 0.1 lb;
- break up briquettes and determine moisture content for each set of briquettes;
- calculate the ITS for each briquette to the nearest 1 PSI using equation 3:

Equation 3:

$$ITS = \frac{2 * P}{\pi * h * d}$$

ITS	=	Indirect Tensile Strength	[psi]
P	=	maximum applied load	[lb]
h	=	average height of the specimen	[in]
d	=	diameter of the specimen	[in]

(F) PRECONSTRUCTION MEETING. A minimum of 5 days before initiating operations, hold a meeting on the jobsite where the Contractor and Engineer outline a processing plan. This plan must address the sequence of operation, equipment to be used.

308.03 CONSTRUCTION REQUIREMENTS

(A) WEATHER LIMITATIONS. Placement of FATB will not be allowed under the following condition:

1. On wet surface determined by engineer.
2. When air temperature is below 50 ^{o}F and falling. Air temperature will be measured in shade away from artificial heat.
3. When weather conditions prevent proper method of construction.

(B) CONTROL SECTION. Before full production, the Contractor shall use the Mobile Cold Mix Plant equipment specified for the foamed asphalt operation to construct a control section at a location approved by the Engineer. The Processed material shall be placed in the control section 20 feet wide, 150 feet long and compacted to the depth shown on the Plans, and not less than 100% of maximum laboratory density determined by AASHTO T180.

(C) MOBILE COLD MIX PLANT

1. Basic design, the plant shall be a production built unit used specifically for the production of cold mixes. It shall operate independently of external power sources and as such can be easily moved around the site as required to meet construction requirements and to minimize the movement of truck traffic on site.

2. Power unit, the engine to have a minimum 175 H.P and comply with EPA Tier III requirements.

3. Proportioning Hopper, the Mobile Cold Mix Plant should have as a minimum 2 x 6 cubic yard capacity hoppers with oversize screening and vibrators on the hopper walls to assist the free flow of materials. The proportioning of materials to be controlled by means of mechanically adjustable gate valves at the point of discharge.

4. Belt conveyor, the proportioned material shall be carried on a variable speed conveyor belt. Belt scales equipped with maintenance free load sensors to determine the conveying rate, this measured value is an input variable for controlling the addition of binding agents and therefore an essential feature.

5. Continuous Mixer, a twin shaft continuous mixer with wear resistant mixing arms and adjustable mixing blades, mixing capacity of 200 tons per hour.

6. Plant control and switching system, control of the plant to be fully automatic via microprocessors. Control functions to include, batch production, automatic plant start up, monitoring of the individual drive systems, warning signals in case of material shortages, monitoring of filling levels, temperatures and pressures, pre-selection of tonnage, automatic plant shut down. **Precise adherence of mix quality to the required mix design specification by matching the target design values with actual values.** The plant shall be operated from a clearly structured main control console, which permits monitoring of the entire mixing process.

7.CGC (Cockpit Graphic Centre), showing all current setting of the mixing plant to be continuously shown on the CGC.

8. The foamed asphalt system on the Cold Mix Plant shall be identical to the foam system on the Laboratory to ensure that laboratory design standards can be replicated in the field during construction.

Two microprocessor controlled systems, complete with two independent pumping systems and spray bars, to regulate the application of foamed asphalt cement, separate from water that is used to increase the moisture content of the mixed material for compaction.

Both systems shall perform in relation to the required mix design parameters.

Two spray bars, one for foamed asphalt cement and one for compaction moisture, shall each be fitted with self cleaning nozzles at a maximum spacing of one nozzle for each 6 inch width of the mixing chamber. Provide a way to monitor the flow rate at each nozzle to verify that all nozzles are producing foamed asphalt at the same rate.

The foamed asphalt cement shall be produced at the spray bar in individual expansion chambers into which hot asphalt cement, water, and air are injected under pressure through individual and small orifices that promote atomization. The rate of addition of water into the hot asphalt cement shall be kept at a constant percent by mass of asphalt cement by the same microprocessor.

An inspection or test nozzle shall be fitted at one end of the spray bar that produces a representative sample of foamed asphalt cement.

An electrical heating system capable of maintaining the temperature of asphalt cement flow components above 300 ^{o}F.

Provide a submittal of the Mobile Cold Mix Plant specifications at the Preconstruction conference.

(D) ROLLERS. Provide the following types of rollers as required: All rollers shall meet the requirements of subsection 401.03(B)(4) as stated in Hawaii Standard Specification for Roads and Bridges.

(E) PREPARATION. Prepare area to be paved per construction documents.

(F) FOAMED ASPHALT TREATED BASE PLACEMENT. The recycled foamed asphalt treated base shall be placed by an approved method to achieve the compacted depths and grades shown on the plans. Measure the moisture content of recycled material before placing and adjust if necessary.

(G) COMPACTION. Immediately upon completion of the placing operations, the layer shall be thoroughly compacted.

The foamed asphalt treated base course shall be compacted to an average dry density of 100% of AASHTO T180. No individual density shall be below 98%.

Light applications of water may be required to maintain the moisture content at the surface during final compaction.

(H) FINISHING. The completed foamed asphalt treated base shall conform to the required lines, grades and cross section.

308.04 MEASUREMENT AND PAYMENT

Foam asphalt treated base shall be measured for payment by the square yard. Payment at the unit price shall be full compensation for furnishing the material, equipment, tools, labor and any incidental work necessary to construct the work in place.