GUSSASPHALT BRIDGE DECK

PROTECTIVE SYSTEM

REPORT 74-7

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VERMONT DEPARTMENT OF HIGHWAYS

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ABSTRACT

This report covers the production and application of Gussasphalt as an experimental bridge deck protective system. The material's ability to prevent penetration of de-icing chemicals to the deck surface will be compared with twenty-five other experimental bridge deck protective systems currently under field evaluation by the Vermont Department of Highways.

Information includes background data on the bridge deck construction and concrete test results, observations made during field application of the mastic asphalt and Gussasphalt, cost information, and data on mix design, aggregates and asphalt. Also included are discussions on the mastic asphalt and Gussasphalt production and field application, along with procedural changes which would be recommended with further use.

Initial observations and test results indicate that the production and application of the mastic asphalt and Gussasphalt were successful, considering the experimental nature of the application. The cost of this installation was excessive; however, potential modifications of the procedures and increased familiarity with the material should result in lower costs if any further applications are undertaken.

Introduction

Gussasphalt is a special, mastic-type paving mixture which can be poured or cast in place without the use of compaction equipment. The system consists of a fiberglass mesh, fiberglass cloth, 1/2-inch of mastic, 2 inches of Gussasphalt, and precoated chips which are seated into the top of Gussasphalt. (See typical on page 23). The fiberglass mesh and cloth form a vapor release layer which is designed to prevent blisters and air channels in the membrane. The mesh transmits any moisture which is drawn out of the concrete deck to the drain holes located near the curb line. This layer also provides a means for the dissipation of any vapor pressure without the formation of blisters. A fiberglass cloth is placed on top of the fiberglass mesh to prevent the mastic from impregnating the mesh. However, the fiberglass cloth does contain 3/4-inch circular holes on $\pm$ 3-inch centers so that the membrane will adhere to the bridge deck. The mastic, a voidless mixture, is the heart of the membrane since its purpose is to seal the bridge deck. The Gussasphalt is essentially voidless and does provide additional protection; however, its main purpose is to protect the mastic and provide a durable surface course. The precoated chips provide for the initial skid resistance of the system. The system has been used extensively in Germany and other European countries for the past twenty years.

This report covers the production and experimental application of Gussasphalt on a new four-lane median separated bridge deck on Vermont Route 62 in Barre, Vermont. The experiment was conducted in cooperation with the Federal Highway Administration, Region #15 Demonstration Projects Division, as part of Demonstration Project #22 "Demonstration of Paving Mastic Asphalt Protective Systems for Bridge Decks". The primary objective of the program

is to determine if the German designed mastic asphalt pavement can be adapted and used as a practical bridge deck membrane system, using to the maximum extent the conventional asphalt production and placement equipment normally available in this country.

Surveillance of the Gussasphalt Bridge Deck Protective System will continue until valid conclusions can be obtained on the effectiveness of the treatment. Follow-up reports shall include information on climatic conditions, de-icing chemical applications, traffic data, results of follow-up electrical resistance tests, copper foil strip readings, steel potential readings and chloride analysis of concrete core samples.

Materials

The mix design for the mastic asphalt and the Gussasphalt were established by the Asphalt Institute from materials supplied by the Vermont Department of Highways. Batch weights for the bituminous plant were then established from these designs.

The asphalt consisted of a blend of 75 percent 60-70 penetration asphalt supplied by Imperial Oil of Montreal, Quebec, and 25 percent Trinidad Epure' supplied by Lake Asphalt and Petroleum Company of Harrisburg, Pennsylvania. The resulting blend had an absolute viscosity of 5966 poises and a penetration of 45.

The aggregates met the requirements of the Vermont Department of Highways specification 406.02. The coarse aggregate consisted of 3/8" crushed granite supplied by Kelley Construction of Websterville, Vermont. The fine aggregate was a natural sand supplied by Cooley Asphalt Paving Corporation from their Websterville pit. Fine grind agricultural limestone was used as the mineral filler and was furnished by the Swanton Lime Company of Swanton, Vermont.

See Tables I & II, pages #16 & #17, for laboratory test results on the aggregates and asphalt.

Bituminous Plant and Placement Equipment

The mastic asphalt and Gussasphalt were produced in a fully automated Standard three-ton batch plant with bag house, operated by Cooley Asphalt Paving Corporation and located in Berlin, Vermont. Modifications were not made to the plant, since one of the objectives of the demonstration project was to use conventional asphalt production and placement equipment whenever possible.

The mixtures were transported from the plant to the project site in three cookers which were carried in the bodies of trailer rigs normally used to transport aggregates. The cookers were supplied by Stabler Construction Company of Harrisburg, Pennsylvania. Each contained a propane gas fired heating system designed to maintain or increase the heat of the mix, as well as a means of agitation to prevent settlement of the heavier materials.

A propane heated leveling screed was supplied by Stabler Construction Company. The screed moved along railroad rails which were placed on the bridge curbs. The actual movement was accomplished by workmen turning a set of gears on each side of the screed.

Bituminous Plant Production

The mastic asphalt was produced on Agugust 9, 1974. A trial drop was made using the cookers to preheat the mineral filler prior to adding the fine aggregate and asphalt from the pugmill. This method was discontinued when it was found that the mixing paddles in the cooker did not create sufficient agitation to mix the mineral filler with the fine aggregate and asphalt. As the plant did not have a separate hot-bin and elevator for mineral filler, it became necessary to introduce the material directly into the pugmill by hand after the fine aggregate had been drawn from the hot-bin. The batch weights were calculated to include whole eighty pound bags of mineral filler. The fine aggregate was heated as much as possible within the restrictions of the bag house as a means of offsetting the addition of the unheated mineral filler. In addition, several loads of the fine aggregate were drawn through the plant to preheat it above normal operating temperatures. The temperature of the material exceeded the 500°F maximum reading on the thermometer used.

The sequence of production began with the introduction of the heated fine aggregate into the pugmill. Approximately 25 percent of the 60-70 penetration

asphalt, which was heated to approximately 400°F, was then added to hold down the dust. The mineral filler was then added by emptying the eighty pound bags into a barrel and then dumping the contents of the barrel into the pugmill. This was followed by the addition of the remaining 60-70 penetration asphalt. The final addition to the mix consisted of ambient temperature Trinidad Epure' which was broken into ± 3-inch chunks and added to the mix by preweighed bucketfuls. The total sequence took 8 minutes, after which the material was mixed for 5 additional minutes before it was discharged into the heated cooker. The temperature of the mixed material was approximately 390°F. Two six-ton loads were made in this manner, using a two-ton batch in the three-ton capacity pugmill.

The Gussasphalt was produced on Saturday, August 10, 1974. It was accomplished in the same basic manner as was the mastic in that the heated aggregate was introduced into the pugmill along with a portion of the 60-70 penetration AC to hold down the dust. Then the mineral filler was added by hand, followed by the remainder of the AC and finally the chunk Trinidad Epure'. Total mix time after all ingredients were added was 5 minutes. Thirty-four tons were produced in 3 hours and 20 minutes, or approximately 12 minutes per two-ton batch. The finished material from the pugmill ranged from 350°F to 380°F.

Two cookers of 12 tons and one of 10 tons were sent to the bridge for application on the eastbound lane. Between the first and second round of cookers, the aggregate was held in the bins to keep them hot. Prior to loading, this aggregate was wasted and the bins recharged with hot aggregate.

The loading of the cookers for the westbound lane commenced at 1:30 P.M. and concluded at 4:10 P.M., with the time to load a two-ton batch averaging 10 minutes.

Field Application

Technical assistance was provided during the field application by Morrison-Knudsen Company, Inc. of Darien, Connecticut, Region #15 and Asphalt Institute personnel.

The application began with the installation of a vapor release system on the eastbound lane, using a material which was obtained from Smid & Hollander of Gromingham, Netherlands. The system consisted of a coarse woven fiberglass cloth (Loch-Glas-Ulies) with 1/4-inch square openings, followed by a fine fiberglass mesh (Nejh-Glas) with 3/4-inch circular holes spaced approximately 3 inches center-to-center. The fiberglass was kept 4-6 inches away from the curbs to reduce the possibility of lateral moisture migration in the event that leakage occurs between the system and the curb face. The exception to this placement was where 6-inch wide strips of the fiberglass were placed over deck drain tubes which had been cast in place at 10-foot intervals along the outside curbs. The fiberglass cloth was held in place with shovelfuls of mastic asphalt placed at 6-foot intervals along the 39-1/2-inch wide sheets.

The mastic asphalt was transported from the cooker to the point of application in wheelbarrows and was then leveled with squeegees. Low material temperatures in the range of 365°F to 395°F made it difficult for the workmen to level the mastic asphalt properly on the eastbound lane. This resulted in numerous holidays in the coating. Additional hot material was placed over the voids once the material had cooled enough to walk on. A smoother application with fewer voids was obtained on the westbound lane where the temperature of the mastic asphalt ranged up to 445°F.

Tracking of the mastic asphalt by the workmen and the wheelbarrow tires resulted in numerous wrinkles and tears in the fiberglass on the first span. Such problems were reduced significantly on the westbound span by placing strips of roll roofing for the workmen to transport the material over.

Coverage on the eastbound lane was approximately equal to the 6.25 ton requirement for a 1/2-inch thickness, while the westbound lane received slightly less. The entire application from the placement of the fiberglass to the touch-up of holidays took 6-1/2 hours, although the greater portion of the mastic asphalt was placed in approximately 1 hour per span.

The initial placement of the Gussasphalt was made with wheelbarrows along 2 x 4 stringers used as forms on the end of the easterly span. After a nominal amount of Gussasphalt had been placed and struck off by the propane heated screed, the truck-mounted cookers were backed across the deck and the material was poured directly from the cookers onto the mastic asphalt membrane. As the screed was cranked ahead on the curb mounted steel rails, precoated stone chips were manually cast onto the surface and seated with a hand roller.

The temperature of the material ranged between 420°F and 475°F, with one exception when a reading of 500°F was noted prior to cutting back the heating system on one of the cookers. Such temperatures resulted in a self-leveling condition whereby the heated leveling screed simply acted as a strike-off bar for maintaining the proper thickness. Segregation or settlement of the coarse aggregate may have occurred within the area heated in excess of 475°F. Although visual observation did not indicate such a condition had occurred, settlement of the stone chip surfacing was noted in this area.

Numerous air bubbles were noted in the Gussasphalt along the curb lines where the fiberglass had been omitted. The same condition had been observed in the mastic asphalt during application and would appear to indicate that the underlying material had softened enough to allow the release of additional moisture vapor from the concrete. Infinite electrical resistance readings obtained on the finished surface adjacent to the curb lines indicated that the bubbles were not interconnected and should not allow moisture migration through the system.

A total of 30.75 tons of material was placed on the 255 square yard eastbound deck in two hours, including the hand work at the start and finish. The tonnage amounted to an average thickness of 2-1/4 inches.

The application on the westbound lane resulted in problems with the material dragging beneath the leveling screed at various points on the westerly end of the deck. The condition was believed due to relatively low temperatures, eg. 380°F to 395°F, and the lack of sufficient heat at the screed bar, since the dragging occurred at points where a number of the screed heater jets were not functioning. Although a propane torch was used to soften and seal over the surface of such areas, depressions of up to 5/8-inch remained in the surface due to the lack of sufficient material. The most severe depressions were 12 to 18 feet in length and ranged from 10 to 15 inches in width. As the heating systems on the cookers increased the temperature of the Gussasphalt, the dragging problems gradually diminished. However, the increased flow of the material resulted in movement away from the leveling screed in a down grade direction. This resulted in less than the desired 2 inches of cover on the easterly half of the deck. The application had been made from west to east, on a vertical curve with a maximum grade of -2.933 percent, so that the end of the leveling screed traveling along the outside curb would not require physical cutting, as had been required on the eastbound lane.

The application of 21.75 tons of material was made on the 255 square yard westbound lane in 65 minutes, with the Gussasphalt averaging 1-9/16 inches in depth.

For additional comments on the field application, see "Observations Made During Field Application", on pages #20, 21 and 22.

Laboratory and Field Tests

Job control tests were conducted by Region #15 personnel in a mobile field laboratory. The tests included percent asphalt content, unit weight, percent air voids, indentation, gradation, extraction, Marshall stability and asphalt viscosity and penetration. Similar tests were conducted on samples forwarded to the Asphalt Institute Research Center in College Park, Maryland. See test results on Table II, page #17.

Electrical resistance tests were conducted on the mastic asphalt and Gussasphalt shortly after completion and again after thirty days had elapsed. The results were recorded at infinity, indicating that the system was initially impervious.

Readings on four sets of copper foil strips placed beneath the system have ranged from 9,000 to 95,000 ohms during the one hundred and twenty day period that recordings have been made. The presence of chloride solutions in the area of the strips, due to penetration through the system or leakage at the curb face, would result in readings of less than 500 ohms.

Cost of the Gussasphalt System

The in place cost of the system was $31,800 or $62.35 per square yard. Rental charges on the cookers and leveling screed (reported to be in excess of $10,000) and the cost of technical assistance were major factors influencing the overall cost. The contractor's lack of familiarity with the equipment, materials and procedures required to complete the application and the fact that the experiment was conducted on an active construction project by means of a change order also contributed to the high cost.

All costs in excess of the $2,978.00 initially specified for a protective membrane and bituminous pavement, were paid for by the Region #15 Demonstration Projects Division.

The production and application of the mastic asphalt and Gussasphalt were considered successful even though a number of problems occurred during the course of the experiment. The following comments refer to potential problems which could occur with the use of the materials and equipment, and to changes which would be recommended if the system was to be used again.

It would be advantageous to have a plant with a separate fines hot-bin with its own elevator. With this equipment, the mineral filler could be preheated in some manner and stored at an elevated temperature. Then the desired amount could be drawn into the weigh hopper. This would help to increase the mix temperature substantially as well as reduce the time to batch. If any amount of Gussasphalt is desired, doing things by hand is too costly. Use of the cookers to preheat the mineral filler and mix it with the aggregate and asphalt should not be considered as a practical method of production.

Workmen adding material into the pugmill by hand should have long sleeves, asbestos gloves, and at least goggles if not face shields, due to the high material temperature required. If the mineral filler is added by hand into the pugmill, breathing masks must be provided.

Determining the temperature of the mix in the cooker proved difficult. Readings varied by 30°F from front to back and a difference of approximately 30°F was noted between readings taken through the charging doors on top and that of material being discharged. Improving the mixing capability of the cookers, possibly by angling the tips of the mixing paddles, would produce a more uniform mix temperature in the cooker and at the time of discharge. Increased agitation of the mix would also lessen the potential for segregation of the materials.

The addition of moveable heated discharge shoots on the cookers would be helpful in placing the material.

The heating systems on the cookers are sufficient for maintaining or gradually increasing mix temperatures but are not efficient when used to raise the temperature of the mix from the 350°F to 390°F range to a desired 425°F level. Use of the cookers in that manner resulted in the use of 2.3 one hundred pound tanks of propane gas per cooker load and caused three to four hour delays in placement of some material. This extended heating period may have damaged some of the mix by hardening the asphalt, as indicated by variations in the viscosity and penetration values obtained on recovered asphalt samples, shown in Table II on page #17.

The application of mastic asphalt and Gussasphalt against a vertical curb face is not recommended due to the potential for leakage at this point. Extension of the mastic asphalt beneath the curb or some other modification in curb design would be preferred. If modifications are not made, consideration should be given to sandblasting and/or priming the curb face and adjacent deck concrete with an asphalt emulsion or cutback asphalt to promote adhesion of the mastic asphalt to the substrate.

Drain tubes designed to release vapor pressures which build up beneath the mastic asphalt should be spaced at five foot intervals and be placed 6 inches from the curb face.

The placement of 2" x 4"s beneath the screed to act as end dams resulted in uneven transverse joints. Forms used for this purpose should be firmly attached to the deck to insure that a satisfactory end joint will be obtained.

Workmen should keep the fiberglass free of wrinkles during the tacking operation by keeping the free end of the fiberglass taut. Shovelfuls of mastic should be placed in the center of each strip of fiberglass cloth, at approximately 5 foot centers, to tack it down. Then the edges should be spot tacked. If the center is not tacked, wrinkles and fishmouths will develop since the fiberglass mat will stretch and its shape will be distorted. Neat placement of the mastic

will reduce tracking of the material and pulling of the fiberglass during the application of the mastic layer.

Movement of the mastic from the cooker to the spreading point by wheelbarrow should be made over strips of roll roofing paper to prevent the wheelbarrow tire from pulling or tearing the fiberglass. Lateral movement of the wheelbarrows off the roofing paper can be reduced by applying the mastic in longitudinal strips rather than over the full width of the deck.

The temperature of the mastic asphalt should be a minimum of 400°F prior to application. Lower temperatures will make it difficult to obtain a uniform, void-free coating.

Trucks transporting the Gussasphalt should not be allowed to remain stationary on the mastic for long periods of time or the tires will indent the mastic layer.

Insufficient heat at the surface of the leveling screed may result in dragging or tearing of the mix. Maintenance of the leveling screed prior to its use should include cleaning the propane jets, lubrication of screed adjustment screws so they can be operated by hand and inspection of the sole plate for wear or surface deposits. Care must be taken to insure that the curb mounted steel rails are properly aligned or the movement of the leveling screed will be interrupted.

The use of Gussasphalt on a super-elevated structure or on grades in excess of 2-1/2 percent would not be recommended due to the material's flow characteristics at high temperatures. Placement of the system during periods of low ambient temperatures might also result in problems if material temperatures are not maintained near the maximum specified.

GUSSASPHALT BRIDGE DECK
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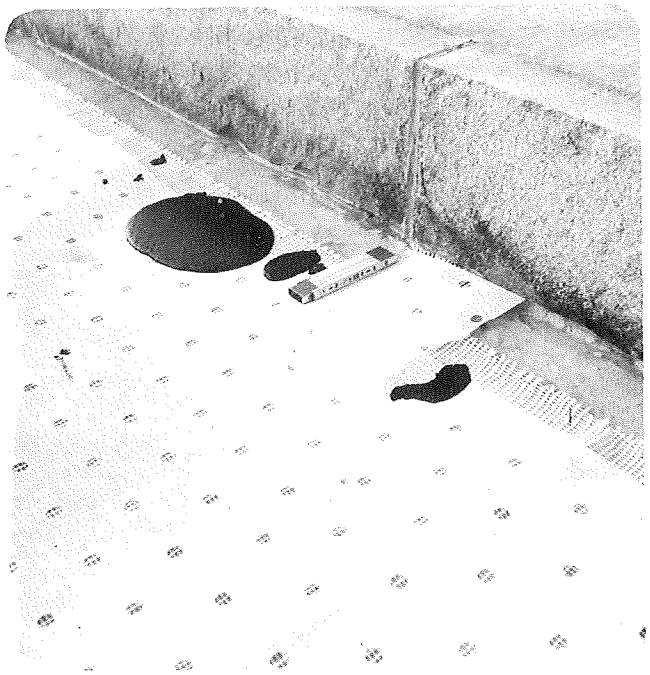
Adding the mineral filler into the pugmill by hand.



Fiberglass vapor release system. Note extension of system over drain tube near curb face.

Placing and spreading mastic asphalt with squeegees.

Voids in mastic asphalt prior to touch-up.

GUSSASPHALT BRIDGE DECK
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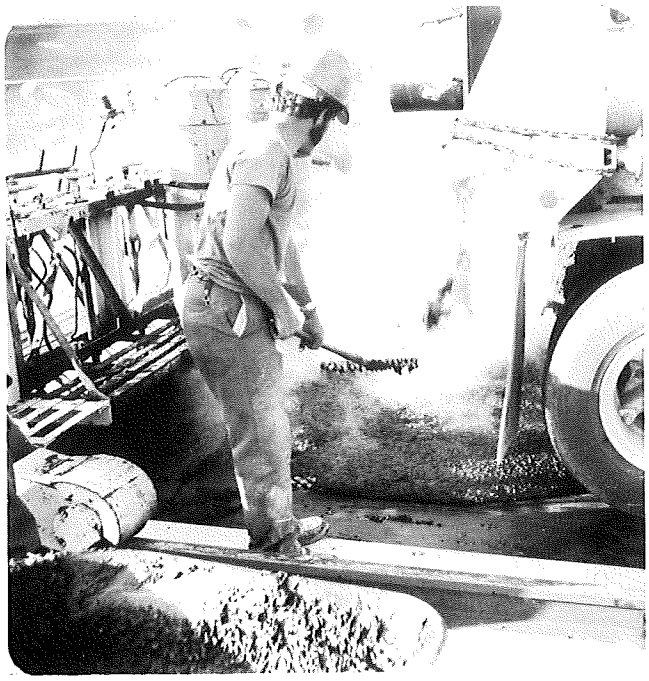


Placing the Gussasphalt directly in front of the leveling screed.

Eastbound lane complete. Note where stone chips penetrated into the Gussasphalt.

Difficulties with the leveling screed dragging the mix.

Depressions in the finished surface at locations where the mix was dragged.

TABLE I

MATERIALS

Aggregates: U.S. Std.Sieve	3/8" Granite	Natural Sand Percent Passing	Mineral Filler
1/2"	100		
3/8"	97	100	
No. 4	38	94	
No. 8	8	87	
No. 16	-	76	
No. 30	-	59	
No. 50	-	33	100
No. 100	-	14	98
No. 200	1	5	92
Fracture	100%	-	-
T & E	1%	-	-
L. A. Wear	36% "B"	-	-
Apparent Sp. Gr.	2.670	2.667	2.715
Asphalt:	60-70 pen.	Trinidad	
Viscosity 140° poises	2575	-	
Viscosity 275° Centistokes	468	-	
Pen. 77° 100 gm, 5 Sec.	75	-	
Sp. Gravity	1.014	1.407	

TABLE II

PROPERTIES OF PLANT AND FIELD RECOVERED SAMPLES

TYPE OF MASTIC	PAVING	PAVING	PAVING	PAVING	WATERPROOFING
FHWA IDENT.	G-1	G-2	G-4	G-5	M-1
UNIT WEIGHT, lbs/ft.^{3}	150.4	149.4	149.4	149.7	136.4
AIR VOIDS, Percent	0.2	0.4	0.4	0.4	0.3
INDENTATION, mm	3.9	7.2	7.2	4.8	22.6+
ASPHALT CONTENT, Percent	7.14	7.51	7.47	7.36	14.06
ASPHALT CONTENT, (corrected)[1] PERCENT	7.93	8.34	8.30	8.18	15.61
GRADATION					
SIEVE SIZE		PERCENT PASSING			
1/2 Inch	100.0	100.0	100.0	100.0	--
3/8 Inch	95.3	97.9	95.3	97.4	100.0
No. 4	63.4	66.1	66.6	65.3	99.9
No. 8	54.2	56.5	57.4	56.1	96.2
No. 16	49.4	53.3	53.3	52.1	89.0
No. 30	42.8	48.3	47.5	45.9	76.4
No. 50	34.7	39.7	39.0	37.1	58.5
No. 100	28.6	30.6	30.2	29.2	43.8
No. 200	24.8	24.6	24.6	24.9	36.2
PROPERTIES OF RECOVERED ASPHALT					
VISCOSITY					
140°F, Poises	19722	16550	7512	6367	7253
275°F, cS	1199	1063	1087	745	729
PENETRATION, 0.1 mm					
77°F, 5 sec., 100 g	33	38	47	51	51
ASH CONTENT, Percent	0.055	0.057	0.058	0.056	0.037

(1) Corrected for mineral matter in Trinidad Lake Asphalt.

Data furnished by the Asphalt Institute.

CONCRETE AND BRIDGE CONSTRUCTION DATA

PROJECT: **Berlin-Barre UF 026-1(4)**

Beginning at a point 0.246 miles northwest of the Berlin-Barre City line and extending southeasterly 1.832 miles.

WORK LOCATION:

Route 62 bridge over Blackwell Street at station 396 + 12.47 - 396 + 99.50, 0.17 miles northwesterly of the intersection with U.S. Rt. 302.

BRIDGE CONSTRUCTION DATA:

Type of Structure: **Simple Span**

Overall Length: **86'** Span Length: **84'**

Curb to Curb Width: **26'** (per lane) Skew: **9° -51'**

Horizontal Curvature: **Tangent**

Grade: **On vertical curve -2.933% Max.** Superelevation: **1/4" per foot**

DECK CONSTRUCTION DATA:

Deck Thickness: **8"** Concrete: **Class A**

Cement: **Type I** Retarding Admixture: **None**

Aggregate Size: **3/4" maximum**

Pour Sequence: **West to East** Surface Texture: **Burlap Drag**

Finishing Method: **Gomaco Finishing Machine**

Curing: **Continuous water with polyethlene**

SECTION I - (Eastbound):

Weather Condition: **Clear & Calm**

Temperature: **68°**

Concrete Cover over Reinforcing Steel: **2" to 3" 2-1/2" Average on 25 tests**

Concrete Test Results:

Percent Air: **5% - 7% 6% Average on 11 tests.**

Slump: **2" - 2-3/4" 2-1/2" Average on 11 tests.**

Compressive Strength: **4116 p.s.i. Average on 2 cylinders @ 28 days.**

SECTION II - (Westbound):

Weather Condition: Overcast & calm

Temperature: 43° - 65°

Concrete Cover over Reinforcing Steel: 2" - 2-3/4" 2.38" Average on 25 tests

Concrete Test Results:

Percent Air: 5-1/2 - 7-1/2% 6-1/4% Average on 11 tests.

Slump: 2-1/4" - 3-3/4" 2.9" Average on 11 tests.

Compressive Strength: 4226 p.s.i. Average on 2 cylinders at 14 and 28 days.

DECK CONDITION:

Surface Texture:

Light to moderately rough burlap texture, most areas. Smooth from curb face out approximately eighteen (18) inches, where concrete finished by hand.

Cracks:

None visible.

Laitance:

Little visible laitance, with the exception of a few concentrations along curb areas.

Steel Potential Readings:

Initial readings taken on the deck averaged 0.105 negative volts, indicating no active corrosion.

Average Initial Chloride Level:	Vt.	FHWA
WB Lane - parts per million	66	49
EB Lane - parts per million	68	62

Miscellaneous:

Cement mortar in joint between curb and deck recessed behind granite curb face at many locations.

DECK PREPARATION PRIOR TO GUSSASPHALT APPLICATION:

Bridge deck was washed clean the day before the mastic asphalt application began, and was then blown clean with a compressor the following day.

OBSERVATIONS MADE DURING FIELD APPLICATION

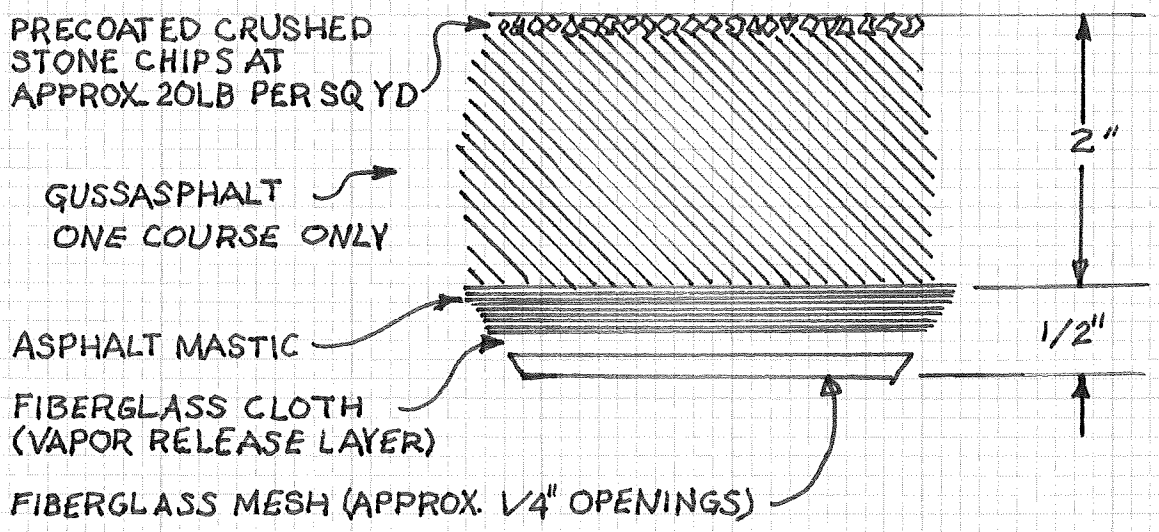
TIME	AIR TEMP.	% HUM	MATERIAL TEMP	
	8-9-74			Air temperatures recorded in shade. 35% to 65% cloud cover. 0-8 m.p.h. breeze.
11:30	72°	27		Cooker arrived on project with six (6) tons of mastic asphalt.
11:45	73°	25		Began placing fiberglass on southbound lane. Fiberglass placed 6-12 inches back from approach slab joints and 4-6 inches away from curb face, except for 6 inch wide strips which extended over drain tubes set at 10 foot intervals along curb face. 10 foot long copper foil strips placed longitudinally 2.5 feet from westerly curb, beginning at a point 3 feet north of southerly approach slab joint. Second set placed 1 foot from westerly curb, beginning at a point 3 feet south of northerly approach slab joint.
12:10	74°	21	340°	Tacking coarse and fine fiberglass cloth with a shovel full of mastic asphalt, at 6 foot intervals.
1:20	80°	19	365°	Began applying mastic asphalt on southerly end of deck. Material transported with wheelbarrows from cooker, them leveled and spread with squeeges. Workmen finding it difficult to obtain complete and even coverage, due to the relatively low temperature of the material.
1:50	80°	17	370°	Approximately 33 lineal feet of deck covered. Numerous bubbles, averaging 1/4 inch in diameter, visible in the surface of the mastic asphalt along the curb face, where the fiberglass underlayment was not placed. Occasional difficulty with asphalt on workmen's feet pulling fiberglass sheets out of place.
2:20	81°	16	395°	96° in sun. Temperature of mastic asphalt increased due to lessened volume of material in cooker and adjustment made in heating apparatus on cooker. Increased temperature is improving material workability, resulting in fewer voids in the system. Noting a few dry lumps of gritty black material, substance unknown.
2:35	82°	18		Six (6) tons of mastic asphalt placed. Approximately 120 square feet of deck remaining on northwesterly end of deck
3:15	79°	34		10 foot long copper foil strips placed 1 foot from median curb face, beginning at a point 2.5 feet from the easterly approach slab joint, on the westbound lane. Second set placed 4 inches from northerly curb, beginning at a point 4.5 feet from the easterly approach slab joint.
3:45	77°	34	315°	Second six (6) ton batch of mastic asphalt arrived on project. Completion of eastbound lane attempted, but not carried out, as material was not at all workable at 315°F.

TIME	AIR TEMP.	% HUM	MATERIAL TEMP	
4:20				Placing fiberglass on westbound lane.
4:55	75°	37	340°	Placing mastic asphalt over holidays in system, on eastbound lane.
5:15	74°	38	355°	Finishing up eastbound lane. Coverage approximately equal to theoretical requirement of 6.248 tons. Infinite resistance recorded on areas with approximately 1/2 inch of mastic asphalt cover.
5:35			390°	All fiberglass in place and tacked down. Began mastic asphalt application at westerly end of deck. Roll roofing placed over fiberglass near center line, to reduce tracking or pulling under wheelbarrow and foot traffic.
5:55	74°	42	415°	Half of span complete, from median curb to center line. Improved coverage and thickness is being obtained with higher material temperature.
6:25	72°	44	445°	Application complete except for touch-up of occasional holidays in coating. Coverage slightly under 6.248 ton requirements for 1/2 inch thickness.
	8-10-74			5% to 15% cloud cover.
9:40	60°	58	370°	Two (2) loads of Gussasphalt on project.
10:25	66°	42		Adjusting leveling screed for proper depth and cleaning inoperative gas jets, to insure that sufficient heat can be obtained. 2 x 4's used as end dams to contain the Gussasphalt.
11:45	71°	23	430°	Began pouring Gussasphalt directly onto eastbound deck simultaneously from both cookers.
12:05	72°	20		470°F temperature recorded on material supplied from cooker on median side of span, while material placed on southerly side of deck recorded at 400°F. Workmen manually casting precoated stone chips on the system within 20 feet of the leveling screed.
12:15	74°	17		Material on median side exceeding 500°F., while that placed on southerly side recorded at 415°F. Gussasphalt is flowing and leveling by itself, while the screed carries forward the excess material.
12:30	74°	14		Temperature reduced to 475°F on median side, with cut-back in cooker heat, and 425°F along southerly side. Approximately 30 lineal feet of span remain to be covered.
12:40	74°	14		Median side cooker replaced with third load, consisting of 360°F material. Compacting stone chips with an 18 inch x 30 inch lawn roller.
1:20			380°	Finishing application with wheelbarrows.
1:45	79°	5	415°	Eastbound lane complete. Third cooker sent back to plant for refill, after using about half of the load. 30.75 tons of mix placed, for an average thickness of 2-1/4 inches.
4:10	82°	5		Two cookers on project. Awaiting temperature increase, prior to starting application on westbound lane.
5:20	83°	10	375°	
5:40	82°	12	395°	Began application on westerly end of westbound lane.

TIME	AIR TEMP.	% HUM	MATERIAL TEMP	
6:00	82°	12	380°	Leveling screed is dragging the mix, at several locations, resulting in less than the desired 2 inch thickness. Condition is apparently due to insufficient heat at the screed bar, since it appears to be occurring at points where the heating jets are not operative.
6:20			430°	Using hand torch to soften and close open areas of mix. Still having difficulty with mix pulling, even though temperature is in satisfactory range.
6:30				Noting increased flow of the hot material, away from the screed, in the down grade direction.
6:45	79°	27	455°	Application complete. 21.75 tons of mix placed, for an average thickness of 1-9/16 inches.

7/31/74
R.H.Snow

TYPICAL
for
GUSSASPHALT BRIDGE DECK PROTECTIVE SYSTEM



SECTION 521 - GUSSASPHALT BRIDGE DECK PROTECTIVE SYSTEM

521.01 DESCRIPTION. This work shall consist of the application of a fiberglass vapor release layer, asphalt mastic, gussasphalt and precoated chips to serve as a waterproof barrier and wearing course on bridge decks in reasonably close conformity with the lines, grades, thicknesses and typical cross-sections shown on the plans or established by the Engineer.

521.02 MATERIALS.

(a) Materials shall meet the requirements of the following subsections of Division 700 - Materials.

Coarse Aggregate	704.13
Fine Aggregate	704.13
Mineral Filler	704.13
Asphalt Cement	702.01
Trinidad Epure	--
Fiberglass	--

The grade of asphalt cement shall be AC-40 or as directed by the Engineer.

The mineral filler shall be tested for compatibility by mixing at least 75 grams of filler with 15 grams of bituminous material and observing whether the resultant mixture is homogeneous.

Fiberglass shall conform to the following requirements:

The bottom mat shall be a coarse weave mesh of fiberglass with approximately 1/4-inch square openings. The top mat shall consist of a fine weave fiberglass cloth with 3/4-inch circular holes spaced at approximately 3 inches (center to center).

Chips for the surface of the gussasphalt shall be precoated with AC-40 or as directed by the Engineer.

Trinidad Epure shall conform to the requirements of the following table:

TABLE 521.02A - TRINIDAD EPURE

	Min.	Max.
Water	None	
Ductility at 77° F, 5 cm/min., cm	1	--
Penetration at 77° F (25° C) 100 g, 5 sec	0	10
Softening point, ° F	195	--
Bitumen soluble in trichloroethylene, percent by weight	99.0	--
Specific gravity at 77° F	1.4	--
Inorganic ash, percent by weight	30	50

The Trinidad Epure - Asphalt Cement mixture shall contain between 15 and 25 percent Trinidad Epure and shall conform to the requirements of the following table:

TABLE 521.02B - TRINIDAD EPURE - ASPHALT CEMENT MIXTURE

	Min.	Max.
Penetration at 77° F, 100 g, 5 sec	30	60
Ductility at 77° F, 5 cm/min., cm.	25	--
Softening point, ° F (R&B)	130	160
Inorganic ash, percent by weight	7	12
Specific gravity at 77° F	1.05	1.15
Viscosity, absolute at 140° F, poises	8,000	--

(b) Composition of Mixtures.

1. Gradation. The materials shall be combined and graded to meet the following composition limits by weight.

TABLE 521.02C - COMPOSITION OF MIXTURES

Sieve Designation	Percentage by Weight Passing Square Mesh Sieves GUSSASPHALT	ASPHALT MASTIC	PRECOATED CHIPS
1/2"	100		100
3/8"	85 - 100		90 - 100
No. 4	61 - 80	100	
No. 8	48 - 65	85 - 100	0 - 10
No. 16	38 - 54	64 - 80	
No. 30	32 - 45	49 - 62	
No. 50	26 - 37	38 - 50	
No. 100	22 - 31	30 - 40	
No. 200	18 - 27	25 - 30	
Total Agg.	91 - 93.5	84 - 86	99 - 99.5
Bitumen (% of Total Mix)	6.5 - 9.0*	14.0 - 16.0*	0.5 - 1.0**

* Trinidad Epure - Asphalt Cement mixture
** Asphalt Cement only

2. Job Mix. The composition limits given above are master ranges of tolerances to cover mixtures made from any raw materials meeting the specifications and they are the maximum and minimum for all cases. A closer control within these ranges is intended for any specific project.

No work shall be started until the Engineer has approved a mix design including cold feed and hot bin gradings, mixing times, and the percentage of each ingredient including bitumen and the job mix formula from such a combination.

The Contractor shall indicate and make available for sampling and testing stockpiles of all aggregates proposed for use. A minimum time of three weeks shall be allowed for testing prior to approval of the job mix formula. No change in this job mix formula shall be made without the approval of the Engineer.

3. Tolerances. Samples of the actual mixture in use will be taken as many times daily as necessary in the opinion of the Engineer. The gradations of the aggregate and bitumen content shall not vary from the job mix formula by more than the following tolerances:

	Plus or Minus Percent or Degrees
Aggregate passing No. 4 sieve and larger	6.0%
Aggregate passing No. 8 sieve and larger than No. 200	4.0%
Bitumen	0.4%
Temperature of Mixture	25° F.

521.03 WEATHER AND SEASONAL LIMITATIONS. Weather and seasonal limitations shall be in conformance with Subsection 406.03, "Weather Limitations", except that the work shall not be done in wet weather.

521.04 GENERAL. The mixing plant shall be in conformance with the applicable requirements of Section 406, "Bituminous Concrete Pavement", except as modified by this specification.

521.05 HAULING EQUIPMENT. Vehicles used for hauling asphalt mastic and gussasphalt shall be clean, heated or insulated or both, which will assure delivery of the mixture to the project within 15 degrees of the mixing temperature. Agitation of the mixture shall be required to prevent segregation during hauling and to maintain a uniform temperature.

521.06 PLACING EQUIPMENT. Gussasphalt may be placed by a suitable rubber tired paver or other devices such as a strike-off bar. Such devices shall be heated by appropriate means to prevent adhesion to the spreader and tearing of the mixture.

521.07 ROLLERS. Temperature, composition and placement of mixtures shall be such that after placement, the asphalt mastic and gussasphalt is voidless. No compaction equipment will be required except for a half-ton steel wheeled roller to seat the precoated cover chips.

521.08 SURFACE PREPARATION. The concrete surfaces which are to be waterproofed shall be reasonably smooth and free from projections or holes and shall be cleaned of dust and loose material. The surfaces shall be visibly dry prior to and during application of the fiberglass mats, asphalt mastic and gussasphalt.

521.09 PREPARATION OF BITUMINOUS MATERIALS. The temperature of the asphalt cement or mixture of Trinidad Epure - Asphalt Cement shall not exceed 450° F. The Trinidad Epure may be added directly to the pugmill if in liquid form. Provisions shall be made for agitation of the Trinidad Epure - Asphalt Cement mixture in the storage tanks if these materials are preblended.

521.10 MIXING. The mixing and heating of ingredients shall be accomplished by approved methods. The heated materials for gussasphalt or asphalt mastic shall be fed into the mixer in the following order: coarse aggregate, fine aggregate and filler. After dry-mixing for a minimum of 10 seconds, the Trinidad Epure - Asphalt Cement blend shall be introduced and the materials mixed until a homogeneous mixture is produced. If it is possible, the gussasphalt or asphalt mastic shall be mixed at a plant within the master range of 420° F to 450° F and within a tolerance of $\pm$ 15° F of the specified mixing temperature. Should certain physical limitations restrict the ability of a plant to produce the material to the desired temperature, other satisfactory means of obtaining the desired mix temperature at the discharge site shall be employed.

521.11 PLACING AND FINISHING. The coarse weave fiberglass mesh (bottom layer) will be placed directly on the concrete bridge deck. The fiberglass mesh will be lapped six inches. The fine weave fiberglass cloth (top layer) is to be placed directly on top of the coarse weave fiberglass mesh. It will also be lapped six inches. The fiberglass shall be installed in a shingled pattern so that water is permitted to drain to the low areas of the deck without accumulating against seams. Care shall be exercised to place the fiberglass top layer over the weep holes in the bridge deck. The fiberglass system shall be tacked down to the concrete with spot applications of asphalt mastic prior to the general application of the asphalt mastic.

The asphalt mastic shall be spread manually to the proper grade and elevation with trowels or squeegees, working from the high side to the low side.

Suitable side forms set to proper grade and elevation shall be used to contain the gussasphalt mixture and provide support for the paver screed or strike-off bar.

The surface of the gussasphalt shall be uniformly covered with precoated chips. The chips shall be spread manually or by appropriate spreading devices at a rate of approximately 20 lbs. per square yard. For good adhesion the chips shall be spread on the hot surface immediately after paving. Rolling with a half-ton steel wheeled roller will be required to properly seat the chips in the pavement surface. After cooling, the pavement surface shall be broomed to remove all loose cover chips.

521.12 TRAFFIC CONTROL. The surface of the hot gussasphalt shall not be walked upon nor disturbed by vehicles or any equipment other than the light roller until it has cooled completely to ambient temperature. Traffic shall not be permitted on the completed pavement until it can withstand traffic without distortion of the surface.

521.13 METHOD OF MEASUREMENT. The quantity to be measured for payment will be the number of square yards of the gussasphalt bridge deck protective system complete in place in the accepted work.

521.14 BASIS OF PAYMENT. The accepted quantity will be paid for at the contract unit price per square yard for the gussasphalt bridge deck protective system, including fiberglass, asphalt mastic and gussasphalt, which price shall be full compensation for furnishing, transporting, handling and placing the material specified and the furnishing of all labor, tools, equipment and incidentals necessary to complete the work.

Payment will be made under

	Pay Item	Pay Unit
521.20	Gussasphalt Bridge Deck Protective System	Square Yard