

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-1 DESCRIPTION

981-1.01 Scope

a. This work shall consist of placing a concrete overlay on the roadway surface of bridge deck in accordance with these specifications, and in conformity with the lines, grades, dimensions, details and notes shown on the contract documents or established by the Engineer.

b. Concrete for bridge deck overlays shall consist of a homogeneous mixture of cement, fine aggregates, coarse aggregates, water, and chemical admixtures. The concrete mix may also contain fly ash, silica fume, ground granulated blast-furnace slag (GGBS) or a combination thereof.

c. The works also includes the preparation of the surfaces of either existing or new bridge concrete decks that will be in contact with the concrete overlay.

d. The thickness of the overlay concrete shall be as shown on the plans.

e. Each word, sentence, section or article of this document is independent. Not applying parts of it does not imply that it cannot be enforced afterwards nor invalidates the remaining provisions.

981-2 MATERIALS

981-2.01 Materials shall conform to the applicable specifications of the Standard Specifications for Road and Bridge Construction and as required on the details and notes in the drawings. The following materials shall meet the applicable requirements specified as follows:

<u>MATERIAL</u>	<u>SPECIFICATION</u>
Hydraulic cement	701-1
Performance Specifications for Hydraulic Cements	ASTM 1157
Ground Granulated Blast-Furnace Slag	AASHTO M-302
Class F Fly Ash	AASHTO M-295
Silica Fume	AASHTO M-307
Curing materials	711-1
Air-entraining Admixtures	711-2
Chemical Admixtures	711-3
Water	712-1

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-2.02 Fine Aggregate – Shall be clean and conform to the requirements of Section 703-1 of Specification 703 – “Aggregates”. Manufactured sand may be used as a fine aggregate when it is produced from a pre-approved aggregate source that has a minimum polishing value of 48 as determined by ASTM D-3319.

981-2.03 Coarse Aggregate – Shall be clean and meet the requirements specified in Article 703-2 of Specification 703 Aggregates. In addition, the coarse aggregate shall have a minimum polishing value of 48 as determined by ASTM D-3319.

Table 981-1
REQUIRED COARSE AGGREGATE SIZE NUMBER

Overlay Concrete Thickness	Size(s) Number(s) (ASTM C-33)
2” (0.051 m)	7,8
3” (0.076 m)	6,67
4” (0.102 m)	57,5,56

981-2.04 Hydraulic Cement, Performance Hydraulic Cements and Supplementary Cementitious Material (SCM) requirements -

a. Hydraulic Cement - All hydraulic cement shall meet Specification 701 - "Hydraulic Cement" as modified in this Section.

b. Portland Cement – All Portland Cement shall meet AASHTO M-85 or blended Portland cement meeting AASHTO M-240 and the following requirements:

Provide cement that meets the requirements of AASHTO M-85 for Type II or Type V or AASHTO M-240, Type IP (MS) or Type IS (MS). As an alternative provide a combination of AASHTO M-85 Type I cement and an AASHTO M-295 Class F fly ash, an AASHTO M-307 Silica Fume and/or an AASHTO M-302 Ground Granulated Blast-Furnace Slag having a sulfate expansion at 180 days of less than 0.10 percent when tested according to ASTM C-1012 using cementitious materials from the same sources as those proposed for use in the project. The pozzolan constituent of Type IP (MS) shall be in the range of 15 to 25 percent by weight of the Portland-pozzolan cementitious material on an equal weight basis (1:1).

c. Performance Hydraulic Cements – Provide Hydraulic Cements meeting the requirements of ASTM 1157 “*Performance Specifications for Hydraulic Cements*” for one of the following types MS(R), HS(R), MH(R) or LH(R).

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

The Contractor shall furnish mill certificates of the cement with the requirements of these specifications. When Type IP (MS), Type IS (MS) or Performance Hydraulic Cements (ASTM 1157) cement is used, the mill certificates shall include the amount of SCM used expressed as percentage on weight basis. Cement may also be accepted from pre-tested and approved bins. However, the Authority may sample and test the cement at any time, at its discretion and require additional mill certificates. Cement shall be protected from rain and moisture by storing in suitable weatherproof bins or buildings. Any cement damaged by moisture or which fails to meet any of the specified requirements will be rejected and shall be removed from the work site.

Cement stored by the Contractor for a period longer than 60 days shall require the Engineer's approval before being used in the work. Stored cement shall meet the specification requirements at any time after storage when retesting is ordered by the Engineer.

Cement of different brands, types, or from different mills shall be stored separately.

d. Supplementary Cementitious Materials (SCM) - All Supplementary Cementitious Materials shall meet the requirements of this Section.

1. Silica Fume can be used in concrete as a cement replacement on an equal weight basis. Maximum amounts of silica fume are in the range of up to six percent (6%) of the total weight of the cementitious material. The SCM limits presented above include any Silica Fume present in ASTM 1157 cements.

1. Fly ash can be used in concrete as a cement replacement on an equal weight basis. Maximum amounts of fly ash are in the range of up to thirty percent (30%). The SCM limits presented above include any Fly ash present in AASHTO M240 Type IP (MS) and ASTM 1157 cements.

Fly Ash for use with Portland cement shall conform to the requirements of AASHTO M-295, Class F only. In addition, fly ash shall meet the following requirements:

- a) Loss on Ignition is limited to a maximum of 2 percent.
- b) Sulfur trioxide (SO₃) is limited to a maximum of 3 percent.
- c) Available alkalis (expressed as Na₂O equivalent) is limited to a maximum of 1.5 percent.
- d) The optional chemical requirements of AASHTO M-295 Table 1A shall apply in all cases.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

e) Fly Ash shall not be substituted for Type IP blended cements.

~~z.~~ Grade 100 or Grade 120 Ground Granulated Blast-Furnace Slag (GGBFS) can be use as a cement replacement on an equal weight basis. Maximum amounts of ground granulated blast-furnace slag are in the range of up to sixty five percent (65%) added as a cement replacement on an equal weight basis of the cement being replaced. The SCM limits presented above include any Slag present in AASHTO M240 Type IS (MS) and ASTM 1157 cements.

e. The Contractor shall submit notarized material certificates for each Supplementary Cementitious Materials proposed to be used in conformance with Section 106.06 of the General Provisions.

f. Ternary and quaternary systems using Cement, Class F fly ash, Slag and Silica Fume are encouraged. The individual amounts of Supplementary Cementitious Materials shall comply with previous sections. In ternary and quaternary systems the total combined amount of fly ash and silica fume as a cement replacement shall meet the limits for fly ash used alone for Cement replacement. The total combined amount of fly ash, silica fume, and slag as a cement replacement shall meet the limits for slag used alone for Cement replacement.

981-2.05 Chemical Admixtures - All chemical admixtures shall meet the requirements of Specification Section 711 - "Concrete Curing Materials and Admixtures" as modified in this section. Use all admixtures in accordance with manufacturers' recommendations. All admixtures must be submitted to the Engineer for approval prior to their use in the production of concrete. All chemical admixtures shall be protected from excessive temperature and direct sunlight according to Manufacturer specification.

a. Do not use admixtures which have not been incorporated and tested in accepted and approved mix designs.

b. Contractor shall submit the manufacturer's written certification of compliance with the specifications per Section 106.06 of the General Provisions.

c. Use only admixtures that are compatible with each other, and that produce the desired concrete properties.

d. Water Reducing and Set Controlling Admixtures shall meet the requirements of AASHTO M-194.

e. Use only admixtures containing less than 0.05 percent chloride ions.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

- f. The use of calcium chloride as an admixture shall not be permitted.

- g. When calcium nitrite is added to the overlay concrete mix a water reducing retarding admixture (Type D) and high range water reducing admixture (Type F) shall be used. Other corrosion inhibitors may be evaluated at the convenience of the Authority based upon the properties indicated below. Submit the following data and certification for the corrosion inhibitor:
 - 1. Test results and performance data for each of the Physical Requirements (Table 1) of AASHTO M-194 for any type of admixture.

 - 2. The contractor shall submit the corrosion inhibitor documentation, either in the form of literature or a letter from an authorized representative of the manufacturer, which documents that the chloride protection level meets or exceeds fifteen (15) lb/cy. Whenever used, the corrosion inhibitor shall be dosed at the required application rate to achieve the required level of chloride protection as stated above.

- h. Water reducing, set retarding, or superplasticizers chemical admixtures may be used at the option of the Contractor but subject to approval by the Engineer. The Contractor shall designate in advance the particular types, trade names and manufacturer of admixtures that he proposes to use and only such admixtures as are approved by the Engineer shall be incorporated into the concrete.

- i. Retarding admixtures may be used when the setting time of concrete must be retarded for proper placement. The quantity of admixture added to the mix shall be the minimum required for minimum retardation consistent with placing conditions. Retarding admixtures, when used, shall be added at the plant.

- j. Use high range water reducing admixture in concrete mixtures incorporating silica fume.

- k. Shrinkage reducing admixtures (SRA) may be used. The Contractor shall submit with the concrete mix proposal the particular type, trade name, manufacturer, proposed dosage rate, manufacturer's product data, and recommendations for use, test results, and performance data of the SRA. If approved, no other SRA as shall be incorporated into the concrete.

981-2.06 Intentionally Omitted

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-2.07 Structural Crack Healer / Sealer – The Structural Crack Healer / Sealer shall be a low-viscosity epoxy crack healer / sealer and high-strength adhesive for structures exposed to pneumatic tire traffic, water, chlorides, and chemical attacks. The Structural Crack Healer / Sealer shall meet the requirements specified in AASHTO M-235. The Contractor shall also submit to the Engineer the product technical data sheets and Manufacturer’s certifications. When required by the Engineer, the Contractor shall submit certified test reports for approval. The structural crack healer/sealer shall not be applied in the field or incorporated in to the work without prior approval of the Engineer.

a. The material properties shall meet the requirements specified in the following parameters and specifications:

Maximum Viscosity (low, Grade 1).....	90 cps	(ASTM D 2393)
Minimum Pot Life.....	25 minutes	
Minimum Bond Strength at 2 days in 73°F.....	1,300 psi	(ASTM C 882)
Minimum Compressive Strength at 7 days in 73°F.....	10,000 psi	(ASTM D 695)
Minimum Flexural Strength at 7 days in 73°F.....	9,000 psi	(ASTM D 790)
Minimum Tensile Strength at 7 days in 73°F.....	7,000 psi	(ASTM D 638)

b. Material shall be factory packaged in strong moisture proof containers capable of withstanding shipping, handling and storage without breakage. Material shall have a storage life of at least one year.

981-2.08 Corrosion Inhibitor (Impregnated to substrate) – The Corrosion Inhibitor shall be a low-viscosity. It shall protect or reduce the corrosion in reinforced concrete structures exposed to pneumatic tire traffic, water, chlorides, and chemical attacks. The product shall meet the requirements specified in ASTM G-109 with a viscosity less than 25 centipoises (CPS). The Corrosion Inhibitor shall not be slippery when the product dries. The Contractor shall submit the product technical data sheets and Manufacturer’s certifications for review and approval by the Engineer. When required by the Engineer, the Contractor shall also submit certified test reports for approval.

Material shall be factory packaged in strong moisture proof containers capable of withstanding shipping, handling and storage without breakage. Material shall have a storage life of at least one year.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-2.09 Types of Overlay Concrete - Various types of concrete are provided for in these specifications, based on their use, time required for opening to traffic adjacent lanes, time required for opening to traffic repaired lane and their specified compressive strength, except as noted below. The various types and their basic requirements are indicated in Table 981-2. Each type of overlay concrete shall be used as called for in the plans or other contract documents.

**Table 981-2
OVERLAY CONCRETE MIXTURES⁴**

Type of Concrete	Required Compressive Strength¹ (psi) at Specified Age	Permeability Maximum Charge Passed² (Coulombs)	Maximum Cementitious Content (lb/cy)³
A	3 days ⁵ : 3,000 and 7 days ⁶ : 4,000	2,500	800
B	1 day ⁵ : 1,500 and 3 days ⁶ : 3,000	2,500	800

- 1- *The compressive strength of the concrete at the specified time shall be determined using match-cured 4 in. diam. x 8 in. cylindrical specimens. The compressive strength testing for all samples in a concrete pour shall be performed based on the specific age of the last sample taken for that particular pour.*
- 2- *Permeability will be the electrical conductance of the concrete as measured at 28 days according to AASHTO T-277. The permeability of the concrete at 28 days shall be determined using the following accelerated curing procedure: specimens will be moist cured at 73 +/- 3 degrees F for the initial 7 days after casting followed by curing in water at 105 +/- 3 degrees F for 21 days until testing at 28 days.*
- 3- *The Maximum Cementitious Content (lbs. /cu. yd.) refers to the total weight of Portland cement, Performance Hydraulic Cements, Blended Hydraulic Cement, ground granulated blast-furnace slag, silica fume and fly ash added to the concrete expressed in lbs./cu. yd. When Table 981-1 requires coarse aggregate size #7 or #8, the maximum cementitious content (lbs. /cu. yd.) could be increased up to 15%.*

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

4- *Coarse Aggregate Size Number shall be as per Table 981-1*

5- *Time required for opening to traffic adjacent lanes.*

6- *Time required for opening to traffic repaired lane.*

981-2.10 Temperature of Fresh Concrete:

a. Maximum temperature of fresh concrete containing no set controlling admixtures shall not exceed 80 degrees F (27°C) at the time of placement.

b. Maximum temperature of fresh concrete containing set controlling admixtures shall not exceed 90 degrees F (32°C) at the time of placement.

c. The maximum temperature of fresh concrete containing calcium nitrite shall be 80 degrees F (27 °C).

981-2.11 Drying Shrinkage - The drying shrinkage of concrete shall not exceed 0.040 percent after 28 days of air storage following the initial 28 days curing period in accordance with AASHTO T-160, "Standard Test Method for Length Change of Hardened Hydraulic-Cement Mortar and Concrete" with the following modifications:

d. The initial curing period until the specimens have reached an age of 28 days, including the period in the molds, could be achieved either by storage in a moist cabinet or room in accordance with ASTM C-511, or storage in lime saturated water at 73 +/- 3 degrees F.

d. Slump of concrete for testing shall match job requirements and need not be limited to restrictions as stated in AASHTO T-160 Section 7.4.

d. Certified test report shall be submitted by an independent material testing laboratory before concrete is used. The Authority reserves the right to perform additional testing for verifying maximum drying shrinkage.

981-2.12 Proportioning of Concrete - The Contractor shall design the concrete mixes and determine the proportions of concrete to conform to these specifications and ensure that the concrete mix proportions are adequate to meet at least the minimum standards of practice for the concrete's intended use. The minimum required average compressive strength of concrete used as basis for selection of concrete proportions (f'_{cr}) shall conform to the requirements of American Concrete Institute, ACI-318 section 5.3 "Proportioning on the basis of field

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

experience or trial mixtures or both”. The volumetric proportioning methods such as outlined in the American Concrete Institute (ACI) Standard 211.1, “Recommended Practice for Selecting Proportions for Normal Weight Concrete”, or other approved volumetric proportioning methods, shall be employed in the design of mixes.

981-2.13 Mix Design Submittals – The Contractor shall submit for the record, prior to the start of concreting operations, the proposed mix ingredients and proportions certified by a professional engineer (legally authorized to practice engineering in Puerto Rico). Submit separate mix designs for each mix to be used or whenever a change in fine or coarse aggregates source occurs.

The Contractor shall submit a Certificate of compliance for all materials proposed to be used in the production of each type concrete mix for the project except for Hydraulic cement and Supplementary Cementitious Material (SCM). This certification shall be made by a professional engineer (legally authorized to practice engineering in Puerto Rico) and provide information identifying the source of raw materials, manufacturing facility and supplier of each material. Any changes in the source of raw materials, manufacturing facilities and/or suppliers of any of the materials shall require that the contractor conduct trial mixes to verify that the performance of concrete meets all specification requirements. The Contractor shall provide certified laboratory test results performed on the concrete trial mix to the Engineer prior to their use in the project.

The concrete mix design submittal shall contain as a minimum the following information:

- a. Contractor and PRHTA project identification.
- b. Intended location of pour and mix identification
- c. Plant location and identification
- d. Source of cement
- e. Amount, percent of cement replacement, for each supplementary cementitious material (SCM) in the mix (lbs/cy).
- f. Amount and source of each fine and coarse aggregate (lbs/cy).
- g. Report individual aggregate properties of individual aggregates per Specification 703-1 and 703-2
- h. Specific gravities of mix constituents
- i. Dry (AASHTO T-27 without T-11) and wet (AASHTO T-27 with T-11) aggregate gradings to be used (both individual and combined gradations). In addition, report combined grading on the FHWA 0.45 power chart and the percent retained graph. The following sieve sizes shall be used for reporting combined gradation: 2-inch, 1 1/2-inch, 1-inch, ¾-inch, ½-inch, 3/8-inch, #4, #8, #16, #30, #50, #100 and #200. Calculate and report the coarseness and workability factor of the combined gradation. The Coarseness factor (CF) and the workability factor (WF) will be calculated as follows:

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

CF = (% Retained above 3/8-inch sieve) / (% Retained above #8 sieve) x 100

WF = (% Passing #8 sieve + ((2.5 x amount of cementitious material – 564) / 94)

- j. Nominal Maximum Size of Aggregates and Size Number as per ASTM C-33
- k. Fineness modulus of fine aggregate.
- l. Dosage and source of chemical admixtures (oz/cw) and (oz/cy)
- m. Total water content (lb/cy)
- n. Water to cementitious ratio (w/cm)
- o. Cement Content (lb/cy)
- p. Cementitious Content (lb/cy)
- q. Slump (in.)
- r. Certified laboratory reports on the tests performed on trial mixes including:
 - 1. Slump (in.)
 - 2. Fresh Concrete temperature (F)
 - 3. Air Content (%)
 - 4. Compressive strength at specified time (psi), including the data used to determine the minimum required average compressive strength of concrete used as basis for selection of concrete proportions (f'cr).
 - 5. Split Tensile strength at specified time (psi) (AASHTO T-198)
 - 6. Permeability test at 28 days (coulombs)
 - 7. Unit weight (lbs/cy)
 - 8. Total air content (%)
 - 9. Drying shrinkage (%)

In the event that the proportions of concrete mixture designed by the Contractor does not produce overlay concrete meeting the performance requirements for strength and permeability level as well as the other requirements of this specification, the Contractor shall adjust the mix accordingly at no additional cost to the Authority. With this, the Contractor shall submit new certified test results for the adjusted overlay concrete mix. No concrete, shall be placed until the Contractor executes the corrective measures submitted to obtain the required strength and permeability.

Whenever the Contractor modifies the concrete mix, other than minor (3%) adjustment in the relative quantities of fine and coarse aggregates, he shall submit copy of the new mix design to the Engineer together with copies of test results of the new mix for approval before using the mix in the project.

In the event ready-mixed concrete from a commercial plant is used by the Contractor, such concrete and plant shall meet the requirements of AASHTO M-157 except as modified by these specifications and shall have been inspected and approved by the Authority for use on its projects within the last six months.

The concrete mix shall be of adequate fresh concrete properties to be placed, consolidated and finished without segregation or defects that will affect the performance of the concrete in

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

service.

981-2.14 Overlay Bond Strength - The bond strength of the overlay concrete to the substrate shall be, as a minimum, 200 psi in conformance with the requirements of ASTM C-1583.

981-2.15 Acceptance Sampling and Testing:

a. Compliance with the requirements included in the above articles will be determined in accordance with the following AASHTO or ASTM standards:

Sampling Fresh Concrete.....	T 141
Size of Aggregates.....	T 27
Consistency (Slump).....	T 119
Weight per Cu. Ft. and Air Content.....	T 121
Air Content of Freshly Mixed Concrete (Pressure Method).....	T 152
Air Content of Freshly Mixed Concrete (Volumetric Method).....	T 196
Making and Curing Concrete Test Specimens in the Field.....	T 23
Compressive Strength of Cylindrical Concrete Specimens.....	T 22
Permeability	T277
Sampling and Testing for Total Chloride Ion in Concrete and Concrete Raw Materials	T 260
Temperature of Fresh Concrete.....	C1064
Overlay Concrete Bond Strength.....	C1583
Random Sampling.....	D3665
Split Tensile Strength.....	T-198

b. Acceptance Sampling and Testing – Except for Overlay Concrete Bond Strength, acceptance and laboratory testing will be performed by the Authority.

c. Fresh Mix Properties - The following fresh concrete tests as described in this section shall be made by the Contractor from each lot of 15 cubic meters of Concrete or fraction thereof placed each day per bridge deck from which test cylinders are taken: Slump, Unit Weight, Air Content, and Temperature. The above described sampling tests shall be performed by a certified technician as determined by the Engineer and under his supervision. The certified technician shall possess an active Field Testing Technician Certification from the ACT Technician Training Certification Program or an active certification from American Concrete Institute as

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

Field Testing Technician Grade I. Additional tests could be required as determined by the Engineer to check the consistency of the concrete.

d. **Compressive Strength** - Sampling frequency for compressive strength tests of concrete will be taken at random locations as determined by the Authority as follows:

(1) Two sets of three match-cured cylinders shall be obtained for each 15 cubic meters of concrete or fraction thereof placed each day. Cylinders sets shall be tested at the following ages:

Type of Concrete	Testing Age (One Set - 3 Cylinders)	Testing Age (One Set - 3 Cylinders)
A	3 days	7 days
B	1 day	3 days

Additional sets of match-cured specimens may be taken as needed and as approved by the Engineer, in order to determine when to allow traffic on bridge lanes or when to proceed with the next construction phase. No additional cost to the Authority will be made for any additional set.

(2) Match-cured cylinders shall be four (4) inches in diameter by eight (8) inches long (4" x 8").

(3) The Contractor shall furnish and maintain all necessary molds and equipment to adequately perform match curing procedures to comply with the required frequency of sampling and testing. Thermocouple wires shall be installed in the geometric center of the overlay concrete represented by the lot being tested.

(4) The concrete for the test specimens will not be measured for payment but shall be furnished by the Contractor without additional compensation.

(5) In addition, the contractor shall cast one 3' x 3' x 6" element from each 15 cubic meters of concrete or fraction thereof placed each day for future re-testing. Concrete overlay specimen shall be cast next to the represented Overlay Area and shall be consolidated and cured under the same conditions. The concrete and forms for the 3' x 3' x 6" element will not be measured for payment but shall be furnished by the Contractor without additional compensation. The Contractor shall drill core samples of the hardened concrete element at his expense but under the direction and supervision of the Engineer, to be tested at the Authority's laboratory. The following criteria shall govern the coring program:

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

(i) The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24 and T 22.

(ii) The cores shall be drilled no earlier than 3 days and no later than 7 days after the pouring of the concrete element for mix A and no earlier than 1 day and no later than 3 days after the pouring of the concrete element for mix B.

(iii) A minimum of three cores shall be taken for each concrete element. Cores shall be taken at random locations selected by the Engineer.

(iv) The transportation of concrete core specimens is the responsibility of the Contractor and requires special handling by the Contractor. In addition, the transportation from the project site to the designated PRHTA Materials Testing Laboratory shall be performed under the direct supervision of the Engineer. It shall be the Contractor's responsibility to coordinate transportation at least 36 hours in advance of the proposed concrete pour with the Engineer and PRHTA Material Testing Office laboratory. As a minimum, the Contractor shall assure that core specimens are enclosed in a rigid container and that they be surrounded by a minimum of three inches of adequate padding material (for example, dry fine graded sand) around each core. The Contractor shall properly secure the transportation container in order to prevent excessive movement that may cause contact between the specimens. The Contractor shall furnish at no additional cost to the Authority all personnel, materials, and equipment necessary to comply with these requirements.

(v) The contractor shall properly remove and disposed the 3' x 3' x 6" element after coring operations at no additional cost to the Authority.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

e. **Permeability** - Sampling frequency for permeability of concrete will be taken at random locations as determined by the Authority as follows:

(1) One set of two cylinders shall be obtained for each 15 cubic meters of concrete or fraction thereof placed each day for permeability testing at 28 days by AASHTO T-277. The permeability of the concrete at 28 days shall be determined using the following accelerated curing procedure: specimens will be moist cured at 73 +/- 3 degrees F for the initial 7 days after casting followed by curing in water at 105 +/- 3 degrees F for 21 days until testing at 28 days. *At the option of the Authority, procedure PRHTA 934 T-10 may be used to estimate permeability in lieu of AASHTO T-277.*

(2) All cylinders for sampling and testing shall be four inches (4") in diameter by eight inches (8") long.

(3) The Contractor shall furnish at his expense all single use plastic molds with manufacturer provided lids, conforming to AASHTO M-205 and T-23 that are necessary to comply with the required frequency of sampling. As a subsidiary obligation, when using single use plastic molds, the Contractor shall furnish stripping tools such as Gilson HM160, Humboldt H-3041S/H-3041SM, Myers ST-1/ST-2, or approved equal for removing the sample from the mold. Cardboard molds shall not be accepted.

(4) The concrete for the test specimens will not be measured for payment but shall be furnished by the Contractor without additional compensation.

f. **Split Tensile Strength** - The Engineer, at his discretion, may require the Contractor to take a set of two cylinders from at random locations to perform Split Tensile Strength tests to compare results with the mix design submittals. The above described sampling test shall be performed by a certified technician as determined by the Engineer and under his supervision.

(1) All cylinders for sampling and testing shall be four inches (4") in diameter by eight inches (8") long.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

(2) The Contractor shall furnish at his expense all single use plastic molds with manufacturer provided lids, conforming to AASHTO M-205 and T-23 that are necessary to comply with the required frequency of sampling. As a subsidiary obligation, when using single use plastic molds, the Contractor shall furnish stripping tools such as Gilson HM160, Humbold H-3041S/H-3041SM, Myers ST-1/ST-2, or approved equal for removing the sample from the mold. Cardboard molds shall not be accepted.

(3) The concrete for the test specimens will not be measured for payment but shall be furnished by the Contractor without additional compensation.

f. **Polishing** - The Engineer, at his discretion, may require the Contractor to wash out the mortar from fresh concrete samples, to compare the mix aggregates with mix design sources or perform laboratory tests. The contractor shall provide all necessary equipment as subsidiary item of Overlay Concrete.

g. **Overlay concrete bond strength** - test one sample for each 35 square meters or fraction thereof.

h. **Handling and Transportation of Test Specimens** - The specimens shall be transported by the Contractor to the designated PRHTA laboratory under the supervision of the Engineer. The transportation of concrete specimens requires special handling by the Contractor. As a minimum, the Contractor shall assure that cylinder specimens are enclosed in a rigid container and that they be surrounded by a minimum of three inches of adequate padding material (for example, dry fine graded sand). The Contractor shall properly secure the transportation container in order to prevent excessive movement that may cause contact between the specimens. It shall be the Contractor's responsibility to coordinate 36 hours in advance of the proposed overlay pour with the PRHTA Material Testing Office laboratory. The Contractor shall furnish at no additional cost to the Authority all personnel, materials, and equipment necessary to comply with these requirements. All compressive strength and permeability testing for acceptance shall be based only on the concrete cylinder samples obtained from each lot during mix placement operation.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-3 CONSTRUCTION REQUIREMENTS

981-3.01 General - The works of Bridge Deck Concrete Overlay shall be accomplished as required in the contract documents and in coordination with other operations in progress within an area.

981-3.02 Overlay Pre-Construction Meeting – An overlay pre-construction meeting discussing surface preparation, concrete placement and curing shall be held at the jobsite at least 15 working days before beginning of the construction of the “*Test Section of Overlay Concrete Construction (Mock-up)*”. The contractor shall coordinate with the Engineer at least 10 working days in advance; the proposed meeting, the time, place, and agenda of the meeting to ensure the attendance of representatives of all subcontractors and suppliers involved in the overlay construction process. The engineer may require at his discretion the presence of any additional personnel.

At this meeting the contractor shall submit an overlay construction plan that includes all work related to surface preparation, concrete production, placement, and curing. The Contractor shall also discuss its quality control procedures as well as the contract quality assurance and acceptance requirements. The presence of the contractor, its subcontractors, concrete supplier, specialty material suppliers for; structural crack healer/sealer and corrosion inhibitor (impregnated) is mandatory. Also, the Engineer and the inspectors will attend this meeting.

The contractor shall submit to the Engineer a revised overlay construction plan that includes any changes, revisions made, agreements reached during the overlay pre-construction meeting and all revisions and adjustments required by the Engineer product of the execution of the “*Test Section of Overlay Concrete Construction (Mock-up)*.” The revised construction plan shall be submitted at least 5 working days before the proposed construction production operation. No overlay construction operations shall be conducted until the Engineer has accepted the plan. The overlay pre-construction meeting and the overlay construction plan are subsidiary work to the applicable concrete items in the project at no additional cost to the Authority. This plan shall include but shall not be limited to the following:

- a. All equipment to be used during the procedures, including contingency equipments.
- b. Procedures for surface preparation, placing, consolidating, finishing and curing. The procedures shall include a detailed CPM showing all the activities required to successfully construct the overlay and its interrelationships.
- c. Measures to effectively maintain the evaporation rate throughout the placement area below the limits required in this specification. Such procedures may include but are not limited to the following:

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

- 1) Produce, deliver, and place concrete at the lowest acceptable temperature to conform to evaporation rate limits.
- 2) Erecting windbreaks to effectively reduce the wind speeds throughout the placement area.
- 3) Fog spraying throughout the placement area to effectively increase the relative humidity.
- 4) Placing concrete at favorable ambient temperature conditions.
 - d. Use of vibrators
 - e. Concrete placing rate
 - f. Contingency measurements
 - g. Safety and security provisions
 - h. Use of retarding admixtures, setting time of concrete for proper placement. Minimum retardation consistent with placing conditions.
 - i. Compliance with PRHTA concrete plant inspection requirements
 - j. Contractor Quality Control Procedures
 - k. Contract Quality Assurance and Acceptance Requirements
 - l. MOT and speed control measurements
 - m. Other applicable requirements or procedures included in this specification.

Final acceptance of the plan will be based upon the successful completion of the test section as described below.

981-3.03 Test Section of Overlay Concrete Construction (Mock-up) – In accordance with all the requirements of this specification but not earlier than 10 working days before starting overlay construction production operation, the Contractor shall construct a test section. In the test section, the Contractor shall demonstrate that is capable of fulfill the following requirements:

- a) Produce and/or provide the required materials
- b) Apply materials properly
- c) Provide and operate the required equipment
- d) Provide experienced and properly educated personnel
- e) Execute methods of operation for scarifying in accordance with the specification
- f) Identify and correct unsound concrete as per section 3.05
- g) Preparing the surface in accordance with section 3.06
- h) Producing and placing, consolidating, curing, finishing and testing an overlay concrete in compliance with this specification
- i) Provide adequate bond strength in accordance with the requirements of this specification
- j) Compliance with the overlay construction plan that including any revisions made, agreements reached during the overlay pre-construction meeting
- k) Compliance with all the requirements of this specification

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

The concrete slab constructed as part of the test section shall have the same thickness and reinforcement (amount and position) of the bridge slab to be repaired. The unconfined compressive strength of the concrete slab constructed as part of the test section shall be as close as practical to the one of the bridge slab to be repaired. The concrete slab described above shall be at least 28 days old prior to the beginning of scarification and surface preparation. Any increase in the size of the concrete slab to provide for proper equipment operation shall be subsidiary item of Test Section of Overlay Concrete Construction (Mock-up).

The actual size and location of the test area shall be designated by the Engineer and shall consist of approximately 70 square meters.

The Contractor shall properly remove and disposed the Test Section of Overlay Concrete Construction (Mock-up) 84 days after casting the overlay or as determined by the Engineer. The above requirements shall be performed by the Contractor at no additional cost to the Authority.

If the procedures and results are satisfactory and acceptable to the Authority, a document notifying the acceptance will be generated and the overlay construction production operations may proceed.

If the procedures and results are not satisfactory to the Authority, the overlay construction plan shall be revised to reflect corrective measures to assure compliance with the specification requirements. At this point, the Authority will evaluate the need of a new test section or will notify the acceptance of the plan.

981-3.04 Equipment –

a. On site equipment used for the construction of the concrete overlay shall be free of oil leaks.

b. A lightweight power chipping hammer or hand tools shall be used for removal of minor defective concrete. The lightweight power chipping hammer shall be a pneumatic or electric hammer not heavier than 20 pounds and capable of producing the required International Concrete Repair Institute (ICRI) profile. Lightweight power hammers and chipping tools shall not be operated at an angle exceeding 60 degrees relative to the surface of the bridge deck or approach slabs. Such tools may be started in the vertical position but must be immediately tilted to a 60 degree operation angle.

c. Only power operated hydrodemolition equipment, diamond grinding equipment, power operated shotblasting equipment or combination of the previously mentioned equipments capable of producing the required International Concrete Repair Institute (ICRI)

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

profile shall be used for uniform scarification and removal in accordance with Article **981-3.06**. Pavement marking removal equipment shall not be used for the scarification of bridge deck.

d. The hydrodemolition equipment shall be in compliance with Specification 982 – “Hydrodemolition Method”. The hydrodemolition equipment requires the use of the vacuum cleanup system. The vacuum cleanup system shall be equipped with fugitive dust control devices and be capable of removing wet debris and water all in the same pass. Provide equipment capable of washing the bridge deck with pressurized water prior to the vacuum operation to dislodge all debris and slurry from the bridge deck surface.

e. The use of diamond grinding equipment shall assure no damage to the existing the bridge reinforcement. Any damage caused by the grinding process to the existing the bridge reinforcement shall be Contractors responsibility. The contractor shall repair damage reinforcement as requested by the Engineer. All labor and materials necessary for the damage repair shall be done at no cost for the Authority.

f. The shotblasting equipment shall be a self-contained cleaning system with dust collector. This equipment shall use steel shot or pellet. It must be able to discharge reused shots or pellets, and contaminants into a separator that automatically recycles the cleaned abrasive and discharges dust and surface contaminants into a dust collector. The size and hardness of the shot, the flow of the shots or pellets, the forward speed, and the number of passes shall be as recommended by the Equipment’s Manufacturer and approved by the Engineer. The cleaning residue shall be contained and removed by the shotblasting equipment.

g. The finishing machine shall be rail-mounted and equipped with adjustable strike-off and finishing screeds, the bottom surface of which shall be adjusted to produce the required contour of the finished surface. Machines out of adjustment shall not be used until proper adjustments have been approved by the Engineer. The finishing machine shall also be capable of consolidating the concrete by vibration and raising all screeds to clear the concrete for traveling in reverse.

h. A suitable work bridge shall be furnished for use, during reinforcement installation, cleaning and surface preparation, and placing and finishing the overlay, in as much as no personnel will be allowed to step on the work area once the overlay construction operation starts.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-3.05 Identification of unsound concrete deck areas

a. Prior to beginning construction operations, all surface of bridge concrete deck shall be sounded for identifying and measuring the unsound concrete, delaminations and damage areas following the ASTM D-4580. The operations of Sounding Test for identifying and measuring of unsound concrete, delaminations and damage areas shall be realized by the Contractor in the presence of the Engineer. The Engineer shall certify the areas of unsound concrete, delaminations and damage areas to be removed.

b. The equipment for Sounding Test shall be provided by the Contractor as specified by ASTM D-4580. The Sounding Test and Equipment shall be considered a subsidiary obligation of the Contractor with its cost included in the “Overlay concrete” pay item.

981-3.06 Concrete Surface Preparation

a. If the depth of scarification is not shown or specified on the plans or contract, a minimum of 1 inch (0.025 meter) of bridge concrete shall be removed as determined by the Engineer. If during scarification process reinforcement is exposed, additional concrete removal may be required. When more than half rebar diameter is exposed, or the Engineer deem necessary, concrete around rebar shall be removed to allow proper bonding of patching material to the reinforcement. The minimum mount or concrete around rebar to be removed shall be one inch (1”). After the completion of the scarification process, any additional contaminant, asphalt, oil, or laitance shall be removed as determined by the Engineer as subsidiary item of “*Partial-Depth Removal of Bridge Concrete Deck (Scarification)*”.

b. Prior to beginning scarification and until operations are completed, all bridge deck drains, bridge joint systems and other openings where damage could result, as determined by the Engineer, shall be temporarily covered or plugged to prevent entry of debris. Where bridge slab surface elevations are not provided or specified on the plans, the Contractor shall perform a detailed bridge slab surveying previous to the beginning of surface preparation. The bridge slab surveying shall be used as reference to determine the new bridge surface elevations. The previously described procedure shall be subsidiary item to “*Partial-Depth Removal of Bridge Concrete Deck (Scarification)*”.

c. As previously called for, the Contractor shall provide an independent movable platform in conform to Article 981-3.04 from which workers will prepare the surface, install reinforcement, apply treatments, place and finish the concrete overlay.

d. The air supply system for blast cleaning and blowing shall be equipped with an oil trap in the air line, and provisions shall be made to prevent oil or grease contamination of the surface by any equipment prior to placement of the Overlay concrete.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

e. Scarification operations shall be performed without damaging the underlying concrete.

f. The scarification operation shall result in an exposed concrete deck surface with an ICRI CSP 6 to 8. The contractor shall provide to the Engineer, as subsidiary item of Surface Preparation, one set of ICRI CSP evaluation specimens.

g. No surface scarification and chipping operations will be allowed within 6 feet of a new concrete overlay until 24 hours after its placement.

h. If deteriorated or unsound concrete is encountered during section 981-3.05 work extending below the specified scarification depth, the concrete shall be removed to a depth where sound concrete is encountered or as determined by the Engineer and in accordance with the requirements of Specification 937 – “Bridge Concrete Deck Repair” including the details for this work. In the case of the “*Test Section of Overlay Concrete Construction (Mock-up)*”, regardless of the results of the procedures required in section 981-3.05 “*Identification of unsound concrete deck areas*”, the contractor shall perform at least a full depth and partial depth repair in accordance with the requirements of Specification 937 – “Bridge Concrete Deck Repair” including the details for this work. The locations for the repairs shall be selected by the Engineer. Each repair shall be at least 1.5 square meters.

i. A Corrosion Inhibitor shall be impregnated in all surface of scarified bridge concrete deck per manufacturer recommendations.

j. A structural crack healer / sealer shall be applied for the full-depth repair of any crack in the scarified bridge concrete deck per manufacturer recommendations. This work shall be performed before placing the overlay concrete.

k. The surface deck shall be pressure water washed after the completion of the scarification process. Water pressure wash shall be performed using equipment capable to produce pressures of 3,000 psi.

l. Unless otherwise indicated in the contract documents, for specified final overlay concrete thickness greater or equal than 3 inches (0.075 meter), the overlay concrete shall be reinforced. The new steel reinforcement shall be installed 0.75 inch (0.019 meter) over scarified surface and it shall be as follows:

- a. For specified final overlay concrete thickness greater than 3 inches (0.075 meter) but less than 4 inches (0.102 meter), WWR 4 x 4 D11 / D11 Grade 70. Welded Wire Reinforcement shall be in compliance with ASTM A184, A496, A497

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

- b. For specified final overlay concrete thickness greater or equal than 4 inches (0.102 meter) No. 4 bars in both directions at 6 inches (0.152 meter) spacing (center-to-center).

The concrete clear cover for reinforcing steel shall be as shown in the contract plans or as determined by the Engineer. In no case concrete clear cover for reinforcing steel shall be less than 1.5 inches (0.038 meter) measured from the specified final overlay concrete surface.

- m. Before placing the overlay concrete, the contractor shall saturate all concrete surfaces that will become in contact with the overlay. The substrate shall be soaked in water for a period of 12 to 24 hours in advance of the placement.

- n. Temperature of the substrate surface shall not exceed 90 degrees F at the overlay concrete placing.

- o. The Contractor shall supply additional moisture to exposed surfaces of the substrate. A burlap or cotton mat system with white plastic or other suitable moisture retaining material shall be provided to protect the substrate from the sun and provide a system to maintain the substrate continuously and thoroughly saturated.

- p. The contractor shall remove any excess of water from substrate surface employing a high pressure air hose. The substrate surfaces shall be Saturated Surface Dry (SSD) before placing the overlay concrete. Care must be exercised to insure that all prepared surface areas have no excess of water. No excess of water is permitted to collect in pockets.

- q. The substrate must not be allowed to dry prior to placement of any portion of the Overlay concrete. Overlay concrete shall only be placed on Saturated Surface Dry (SSD) substrate surfaces.

- r. The use of the corrosion inhibitor and crack healer/sealer agent, shall be applied per the manufacturer recommendations and as required in this specification in a manner that permits the intended use of each product. The presence of an authorized manufacturer representative is required during the application of the above listed products.

981-3.07 Construction Joints

- a. Planned construction joints shall be formed by bulkheads set to grade. Before placing concrete against previously placed overlay material, the construction joint shall be sawed to a straight vertical edge. Saw cutting of joints may be omitted if the bulkhead produces a straight, smooth, vertical surface. The loose material in the face of the joint shall be removed with a lightweight power chipping hammer, hand tools or water blasting.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

b. Longitudinal construction joints will be permitted only at the centerline of roadway or at lane lines unless otherwise shown on the plans or permitted by the Engineer.

c. In case of delay in the placement operation exceeding one hour in duration, an approved construction joint shall be formed by removing all material not up to finish grade and saw cuts the edge in a straight line. During minor delays of one hour or less, the end of the placement may be protected from drying with several layers of clean, wet burlap.

981-3.08 Measuring and Batching - Measuring and batching of materials shall be done at a batching plant. The measuring equipment and batching plant, and the measuring and batching procedures followed shall be in accordance with the requirements of AASHTO M-157.

981-3.09 Mixing and Delivery - Concrete may be mixed at a central plant, in truck mixers or at the site as described in these specifications. The mixing and delivery of concrete shall be in accordance with the requirements of AASHTO M-157 as modified and supplemented by the following paragraphs of this article.

a. The Contractor shall supply concrete at a rate consistent with placement operations as determined by the Engineer. The intervals between deliveries of batches shall not be so great as to allow the concrete in place to harden partially.

b. The Engineer may order discontinuing the use of any type of concrete mixing or transporting units that fail to meet the specification requirements.

c. Volumetric batching and continuous mixing mobile equipment may be used if approved by the Engineer. In such case, the batching and mixing shall be in accordance with AASHTO M-241.

d. When an approved retarding admixture is authorized, the 1-hour limitation between the introduction of the cement to the aggregates and discharge at the site may be increased to the amount stipulated in the previously submitted certified mix design. This time limitation may be exceeded if the concrete is of such slump and workability that it can be placed and consolidated properly without the addition of water to the batch.

e. The entire contents of the mixer shall be removed from the drum before materials for another batch are placed therein. Upon cessation of mixing for a period exceeding one hour the mixer shall be thoroughly cleaned. The delivery unit shall also be completely emptied, cleaned and free from concrete and wash water before receiving the next load of concrete.

f. When a truck mixer or agitator is approved for mixing or delivery of

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

concrete, the addition of water shall be as per ASTM C-94.

g. Certification of Batches - Before unloading at the site of delivery, the concrete supplier shall furnish to the Engineer delivery tickets containing the following information concerning the concrete in the truck. The tickets shall be issued to the truck operator at the proportioning plant for each load.

- (1) Name and number of batch plant
- (2) Serial number of ticket
- (3) Date and truck number
- (4) Name of Contractor
- (5) Specific designation of job (name and location)
- (6) Specific class of concrete in conformance with job specifications
- (7) Volume of concrete (cubic yards)
- (8) Batching tickets with a list of all the constituents and the amount of each one used for the mix (target and actual weights)
- (9) For central mixed concrete, time when first mixing was completed at the central mix plant.
- (10) For transit mixed concrete and truck-mixed concrete, time when the cement was introduced to the aggregates
- (11) Name and quantity of admixtures, if any.
- (12) Spaces to indicate time when discharge commenced and when completed.

The Authority may, at its discretion, inspect the weights at the batch plant. The Contractor shall provide all necessary facilities to assist the inspector in performing this task.

h. Delivery - The organization supplying concrete shall have sufficient plant capacity and transporting equipment to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The methods of delivering and handling the concrete shall be such as will facilitate placing with the minimum of rehandling and without damage to the structure or the concrete.

i. Tempering - The concrete shall be mixed only in such quantities as are required for immediate use and any concrete which has developed initial set shall not be used. Tempering concrete by adding water or by other means will not be permitted.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-3.10 Placement of Overlay Concrete

a. **General** - Overlay concrete shall be properly protected from adverse hot weather conditions before, during and after placement as established in the approved overlay construction plan and the following requirements:

1. The initial overlay concrete placement temperature shall not exceed the values set in Article 981-2.10. All necessary precautions shall be taken to see that the overlay concrete is promptly placed on arrival at the job and immediately vibrated after placement. The overlay concrete shall be protected from excessive drying during finishing and curing operations which shall be performed without delay as soon as possible. The Contractor shall provide, at no cost to the Authority, the necessary equipment to perform relative humidity, - wind speed, air temperature and overlay concrete temperature testing. Said equipment shall be calibrated at least once a year.

2. Concrete shall only be placed when any combination of air temperature, relative humidity, concrete temperature and wind speed is expected to result in an evaporation rate as follows:

a) 0.2 pound per square foot per hour or less for concretes with total cementitious content below 564 (lb./cy)

b) 0.1 pound per square foot per hour or less for concrete with total cementitious content of 564 (lb./cy) or more

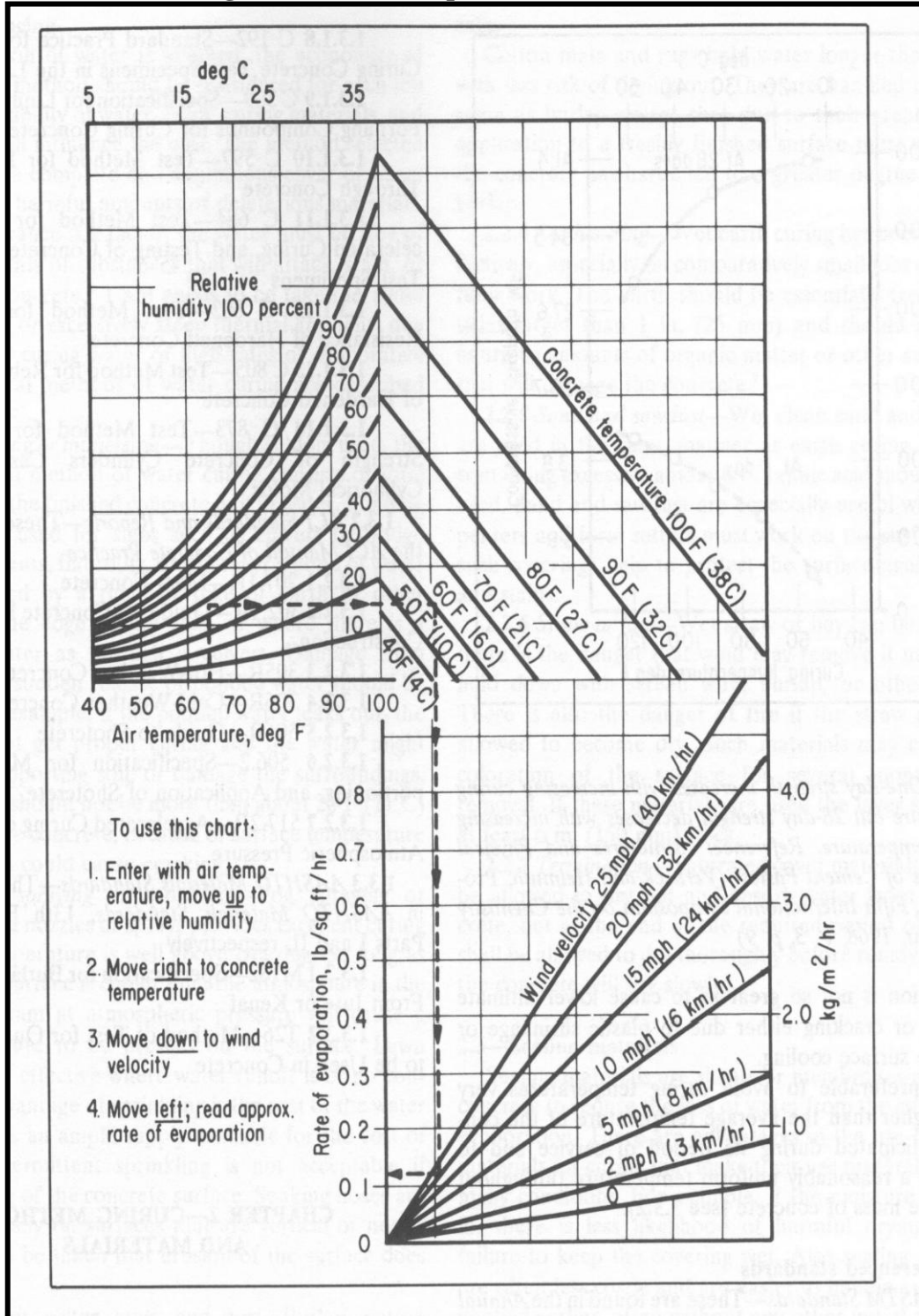
c) To determine the combination of air temperature, relative humidity, concrete temperature, and wind speed resulting in the critical evaporation rate, Figure 1 shall be employed.

3. If original placing procedures proved not effective, the Contractor shall implement appropriate corrective measures as established in the accepted Overlay Construction Plan per Section 981-3.02 at no extra cost to the Authority. In no case shall the concrete temperature exceed values stated elsewhere in this specification.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

Figure 1 Surface evaporation from Concrete



SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

4. The Contractor shall provide an independent movable platform in conform to Article 981-3.04 from which workers will place and finish the concrete overlay.

5. The concrete finishing machine shall be tested run over the entire area to each day before placement to ensure the required overlay thickness will be achieved.

6. All surfaces of scarified bridge concrete deck and steel reinforcement shall be dried, cleaned, free from all dust, laitance oil, and any foreign material before applying treatments and placing the Overlay concrete.

7. If not otherwise shown on the plans, the minimum thickness of Overlay concrete shall be 2 inches (0.050 meter) or as indicated by the Engineer.

8. Screed rails and construction bulkheads shall be separated from the newly placed material by passing a pointing trowel along their inside face. Expansion dams shall not be separated from the Overlay concrete. Care shall be exercised to ensure that this trowel cut is made for the entire depth and length of rails after the mixture has stiffened sufficiently.

9. Concrete shall be placed so as to avoid segregation of material and the displacement of reinforcement. All equipment used for conveying the concrete mix shall be capable of meeting this requirement and is subject to approval by the Engineer. In case any conveyance equipment results in an inferior quality of concrete, the Engineer may order discontinuance of its use and its substitution by a satisfactory method of placing. Concrete shall not come in contact with aluminum during conveyance and placing operations.

10. Open troughs and chutes shall be of metal or metal lined, except aluminum. Where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths that reverse the direction of movement. All chutes and pipes shall be kept clean and free from coating or hardened concrete by thoroughly flushing with water after each run.

11. Dropping concrete a distance of more than 1.0 meters or depositing a large quantity at any point and running or working it along the form shall not be permitted.

12. Special care shall be taken to fill each part of the form by depositing concrete directly into the forms at or as near to its final position as possible, to work the coarser aggregates back from the face of the concrete and to force the concrete under and around the reinforcement without displacing the reinforcement. After the concrete has taken its initial set, care shall be exercised to avoid jarring the forms or placing strain near the ends of reinforcement projecting out of the concrete.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

13. Overlay concrete shall be thoroughly compacted during and immediately after depositing. The compaction shall be done by mechanical vibration subject to the following provisions:

(a) The vibration shall be internal unless special authorization of other method is given by the engineer.

(b) Vibrators shall be of a type and design approved by the Engineer. They shall be capable of transmitting vibrations to the concrete at frequencies of not less than 6,000 impulses per minute. The Contractor shall have available at the job site a copy of the manufacturer's literature on the vibrators, showing that they comply with the above requirements.

(c) Application of vibrators shall be at points uniformly spaced and not farther apart than twice the radius over which the vibration is visible effective.

(d) The Contractor shall provide a sufficient number of vibrators to properly compact each batch immediately after placed. Extra vibrators shall be on hand for emergency use and for use when other vibrators are being serviced. All vibrators shall be in satisfactory working conditions.

(e) Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and imbedded fixtures and into corners and angles of the forms but with care not to cause segregation.

(f) Vibration shall be applied at the point of deposit and in the areas of freshly deposited concrete. The vibrators shall be inserted and withdrawn out of the concrete slowly. The vibration shall be of sufficient duration and intensity to thoroughly compact the concrete but shall not be continued at any one point to the extent that localized areas of grout or segregation of aggregates are created.

(g) Vibration shall not be applied directly or through the reinforcement to the sections or layers of concrete which have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow over distances so great as to cause segregation. Vibrators shall not be used to push or distribute concrete laterally. The vibrating element shall be inserted in the concrete mass a sufficient depth to vibrate the bottom of each layer effectively, in as nearly a vertical position as practicable. It shall be withdrawn completely from the concrete before being advanced to the next point of application.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

(h) To secure even and dense surfaces free from aggregate pockets or honeycombing, vibration shall be supplemented by such spading as is necessary to insure smooth surface and dense concrete along form surfaces and in corners and locations impossible to reach with vibrators while the concrete is plastic.

14. When the placing of concrete is temporarily discontinued, the concrete, after becoming firm enough to retain its form, shall be cleaned of laitance and other objectionable material to a sufficient depth to expose sound concrete.

15. Immediately following the discontinuance of placing concrete, all accumulation of mortar splashed upon the reinforcing steel and the surfaces of forms shall be removed. Dried mortar chips and dust shall not be puddle into the unset concrete. If the accumulations are not removed prior to the concrete becoming set, care shall be exercised not to injure or break the concrete-steel bond at and near the surface of the concrete, while cleaning the reinforcing steel.

16. The Contractor shall protect the Overlay concrete from the adverse effect of rain at all times during and immediately after placement. The Contractor shall have available adequate covering material to protect the exposed surfaces of unhardened concrete. If the adverse effect of rain occurs during placement, the placement shall be terminated and protected, and a straight construction joint formed.

17. For simple spans, concrete shall be deposited by beginning at the center of the span and working from the center toward the ends unless otherwise directed by the Engineer.

18. For multiple spans, concrete shall be deposited in one continuous operation unless otherwise provided for in the contract documents or directed by the Engineer.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-3.11 Curing

a. **General:** Curing shall be initiated during concrete overlay placing operations. It shall be done so that moisture is always present and shall be an integral part of the bridge concrete overlay construction. Improperly cured Overlay concrete will be considered defective.

b. **Curing Method** – Curing of concrete overlay shall be conducted as follows:

1. **Phase I** - Interim Curing: From the time of initial strike off of the concrete until finishing is completed and Phase II curing is in place, the unformed surfaces of overlay concrete shall be fogged at all times. Fogging equipment shall be capable of applying water in a fine mist, not a spray. The fog shall be produced using equipment which pumps water or water and air under high pressure through a suitable atomizing nozzle. The equipment shall be hand operated and sufficiently portable for use in the direction of any prevailing wind. It shall be adaptable for intermittent use as directed by the Engineer to prevent excessive wetting of the concrete surface.

2. **Phase II** – Initial Curing: The overlay concrete shall be cured by supplying additional moisture to exposed surfaces of the overlay concrete until Phase III curing is implemented. This work includes protecting the overlay concrete from the sun and providing a system to maintain the overlay concrete continuously and thoroughly wet for the required amount of time. This work shall be performed as soon as possible.

The Contractor shall use a burlap or cotton mat system with white plastic or other suitable moisture retaining material that achieves the requirements of paragraph above.

Any method which results in the concrete being alternately wet and dry will be considered improper curing procedure.

3. **Phase III** – Final Curing - This method shall consist of preventing moisture loss from the concrete by the use of a membrane forming, white pigmented, curing compound as approved by the Engineer. This membrane shall retard the loss of water and reduce the temperature rise in the concrete exposed to the sun's radiation. Final curing shall be performed following manufacturers recommendations before allowing traffic over the new concrete overlay. The Contractor shall provide the Engineer with all manufacturers technical specifications and application recommendations at the Overlay Pre-Construction meeting.

The liquid membrane-forming compound shall be delivered in the manufacturer's original, clean, sealed containers. No liquid membrane-curing compound shall be accepted in containers other than manufacturer's original.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

The curing compound shall be thoroughly mixed within an hour before use. It shall be of such character that the film will harden within 30 minutes after application.

The curing compound shall be applied by power-operated atomizing spray equipment to obtain a uniform coating in accordance with the manufacturer recommendations. The surface shall be sprayed in one direction and then followed within 30 minutes with a second application sprayed at right angles to the first one.

The rate of application of curing compound will be as recommended by the manufacturer but not less than one gallon of liquid coating for each 15 square meters of concrete surface.

If the contractor cannot obtain a uniform curing compound membrane throughout the entire surface by means of spraying equipment, then the membrane shall be applied by brush or roller.

981-3.12 Overlay Surface Testing

a. Immediately after curing is completed, the overlay concrete will be visually inspected for cracking or other damage, and inspected for delaminations by the use of a chain drag or other suitable device as specify by ASTM D-4580. This procedure shall be repeated before executing “*Final Finish*” described in section 981-3.14.

b. Delaminated or unbonded portions of the overlay concrete surface shall be removed and replaced. Concrete overlay surface damaged by rain shall be removed and replaced.

c. After completion of the “*Final Curing*” as described in section 981-3.11, the surface shall be tested for flatness and corrected.

d. All corrective work will be at the Contractor's expense including the bridge concrete deck corrections.

981-3.13 Sealing of Construction Joints

a. The surface of Overlay concrete, where the construction joints exist, shall be dried, cleaned, free from all dust, laitance oil, and foreign material for sealer treatment. The equipment for cleaning shall not produce microcracks in the Overlay concrete. The Contractor shall use a shot blasting equipment for the cleaning of surface of Overlay concrete.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

b. Any construction joints in Bridge Deck Concrete Overlay shall be sealed fully with a Structural Crack Healer / Sealer.

981-3.14 Final Finish

a. A sacrificing thickness for grinding shall be added in the placement of overlay concrete as indicated on the plans or established by the Engineer. The surfaces of overlay concrete shall be grinded following the requirements of Special Provision 506 – “Grinding Portland Cement Concrete Pavement”.

b. All work of bridge deck rehabilitation shall have been completed prior to the grinding operations, except the sealing of construction joints.

c. After the grinding operations have been finished and accepted, the sealing of construction joints shall be performed in the ground overlay concrete.

d. The final surface shall not vary more than 1/8 inch from a 10-foot straightedge placed longitudinally thereon. The final surface shall be evaluated for smoothness compliance with the requirements of Specification 680 – “Bridge Deck Smoothness”.

981 – 3.15 Traffic Considerations – The bridge shall be closed to the traffic during concrete placement operations and for the first- three (3) days after placing Type A concrete overlay or for the first (1) day after placing Type B concrete overlay. Speed control measurements shall be in place from when traffic is first allowed through the bridge and until final curing is completed. Speed control measurements are subsidiary item of Overlay concrete.

The overlay concrete shall be capable of gaining the required strength in a manner that allows the adjacent lanes to be opened to traffic while maintaining conformance with all overlay concrete quality, strength, and durability requirements. For Type A overlay concrete mix minimum strength to open at 72 hours after placement is 3,000 psi. For Type B mix minimum strength to open at 24 hours after placement is 1,500 psi. If the Contractor fails to open adjacent lanes to traffic as required herein, liquidated damages per Section 981-6.07 will be applied for every additional day the lane remains closed.

The Overlay concrete shall be capable of gaining the required strength in a manner that allows traffic loads over the new concrete overlay within 7 days for Type A mix and within 3 days for Type B mixes while maintaining conformance with all overlay concrete quality, strength, and durability requirements. For Type A mix minimum strength to allow traffic loads over new overlay is 4,000 psi. For Type B mix minimum strength to allow traffic loads over new overlay is 3,000 psi.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-4 BASIS OF ACCEPTANCE

a. Crack Healer / Sealer - Acceptance of this material will be based on a Manufacturer’s certification establishing that the material meets the contract requirements. Failure of the material to provide intended crack healing/sealing performance or impede bonding agent performance due to improper installation or placement shall be cause for rejection and removal of overlay concrete.

b. Corrosion Inhibitor - Acceptance of the material will be on the basis of certification by the Manufacturer that the material meets these requirements. However, failure by the material to perform adequately in actual use shall be just cause for rejection regardless of certification.

c. Acceptable deviations - The acceptability of the quality of the overlay concrete delivered to the job site will be based on the following tests and quality characteristics deviations:

Tests and Quality Characteristics	Acceptable deviation from Target Values
Slump of fresh overlay concrete	As per ASTM C 94
Temperature of fresh overlay concrete	3 degrees F over specified
Compressive strength of match-cured cylinders	100 psi

d. Polishing - Failure of the Coarse Aggregate to meet the polishing value requirements shall be cause for the rejection and removal of Overlay concrete.

e. Compressive Strength - The compressive strength of the overlay concrete placed and represented by one set of cylinders shall be determined as the average of the three cylinders comprising the set. If the Engineer determined that any cylinder shows evidence of improper sampling, molding, handling, curing or testing, the test result of such defective cylinder shall be discarded and the compressive strength of the Overlay concrete represented shall be determined from the test results of the remaining cylinders. Low strength alone shall not be basis for discarding a cylinder test result.

Liquidated damages per section 981-6.07 will be assessed for each additional day if any of the overlay concrete samples in the lane fails to attain the required compressive strength at 1 day for Type B or 3 days for Type A.

Acceptability of the compressive strength level of Overlay concrete will be evaluated at 3 days for Type B mixes or 7 days for Type A mixes as follows:

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

1. Overlay concrete will be considered acceptable if the compressive strength represented by one set of cylinders equals or exceeds the specified compressive strength or is within the acceptable deviation from target value.
2. When the compressive strength of one set of cylinders fails to meet the compressive strength requirement of the paragraph above, but is within 500 psi from specified the Overlay concrete will be considered acceptable at a reduced unit price as specified in Article 981-6.07.
3. All Overlay concrete represented by a cylinder set which shows a strength falling below the specified value by more than 500 psi will be considered deficient and will be rejected, removed and disposed of at the Contractor's expense.
4. When approved by the Engineer, the Contractor may elect to request re-testing of the Concrete Overlay Material classified as deficient under paragraph "3" above. The Contractor's request for retesting shall be submitted in writing to the Engineer within 14 days after placement of the Concrete Overlay Material represented by the failing lot.
5. The core strength shall be the average of all cores tested. The concrete represented by the core tests will be considered acceptable if the average of the cores is equal to at least 85 percent of the specified compressive strength and if no single core test is less than 75 percent of the specified compressive strength. If concrete represented by the cores fails to meet any of the above requirements will be considered rejected. No farther re-testing will be permitted
6. When the Contractor request re-testing of the Concrete Overlay Material as per paragraph "4" and the core strength values meet the acceptance criteria specified in paragraph "5", the core strength values will be used for acceptance computations. The resulting values divided by 0.85 will be substituted in the acceptance computations and will be subjected to the strength acceptance criteria specified computing the deficiency "D" and the applicable price reductions.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

c. **Permeability** - The permeability of overlay concrete represented by one cylinder shall be determined as the average of two 2-inch height specimens taken at the top and bottom of the cylinder. For this, two cylinders will be casted. One of the cylinders will be used for re-testing as requested by the Contractor.

Acceptability of the permeability level of overlay concrete will be evaluated as follows:

1. Overlay concrete will be considered acceptable if the permeability value from the first cylinder is equal or less than the value stated in table 981-2.

2. When the permeability level of the first cylinder fails to meet the requirement of the paragraph above, the Contractor may request re-testing of the overlay concrete within 56 days after placement in the structure. Re-testing will be performed on the second cylinder. The acceptance of the lot will be based upon the retested cylinder and no further testing will be permitted. If the Contractor fails to submit a request for re-testing following the guidelines presented herein, the test specimens representing the failing lot will not be tested and will be discarded.

3. When the permeability level fails to meet the requirement of the paragraph above, the overlay concrete will be considered acceptable at a reduced unit price as specified in Article 981-6.07b.

Overlay Bond Strength – The bond strength of the overlay concrete placed shall be a minimum of 200 psi as determined by pull out test of ASTM C1583 for each lot. Bond strength testing of the overlay concrete including all necessary equipments, labor or any other incidental cost shall be subsidiary item to de “*Overlay Concrete*” pay item. Failure of the overlay concrete placed to meet the bond strength requirements shall be cause for the rejection and removal of Overlay concrete. Bond strength testing shall be performed by a certified technician at locations determined by the Engineer and under his supervision.

d. Should the overlay concrete used in the work fail to conform to the requirements of this specification the Contractor shall, at his expense, make corrective changes, subject to the approval of the Engineer, in the material mix proportions or in the concrete fabrication and placement procedures, before placing additional concrete.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-5 METHOD OF MEASUREMENT

981-5.01 The overlay concrete will be measured by the cubic meter in accordance with the dimensions of each Case shown on the plans or ordered by the Engineer. The Contractor shall perform at least two detailed bridge slab surveying. The first one will be executed previous to the beginning of concrete surface scarification and the second one before placement of overlay concrete. The bridge slab surveying shall of such precision that could assist the Engineer in concrete overlay volume verifications when he deems necessary. The detailed bridge slab surveying as described above shall be subsidiary item to the “*Overlay Concrete*” item. No deductions in volume will be made for the volume of steel reinforcement, drainage holes, pipes and conduits less than 12 inches in diameter.

981-5.02 The *Partial-Depth Removal of Bridge Concrete Deck* (Scarification) will be measured by the square meter of surface removed and accepted of the bridge concrete deck (to create a rough surface) in accordance with the dimensions of each Case shown on the plans or ordered by the Engineer.

981-5.03 The removal of the existing bridge joint system and construction of the new bridge joint system will be measured and pay under the provisions on Specification 939 – “Bridge Joint System Repair”. The *Bridge Joint System* shall be of the following types as shown on plans or contract documents: *Concrete Bridge Joint System* or *Asphaltic Bridge Joint System*. The *Concrete Bridge Joint System* or *Asphaltic Bridge Joint System* will be measured by the linear meter in accordance with the dimensions shown on the plans or ordered by the Engineer.

981-5.04 The removal and repair or patching of unsound concrete, spallings and holes in bridge concrete deck will be measured and pay under the provisions on Specification 937 – “Bridge Concrete Deck Repair”. The *Deck Patching Material (Type)* will be measured by the cubic meter in accordance with the dimensions shown on the plans or ordered by the Engineer.

981-5.05 The impregnating of corrosion inhibitor in bridge concrete deck will be measured and pay under the provisions on Specification 937 – “Bridge Concrete Deck Repair”. The *Impregnating of Corrosion Inhibitor* will be measured by the square meter in accordance with the dimensions shown on the plans or ordered by the Engineer.

981-5.06 The sealing of cracks in bridge concrete deck will be measured and pay under the provisions on Specification 937 – “Bridge Concrete Deck Repair”. The *Sealing of Cracks in Bridge Concrete Deck* will be measured by the linear meter in accordance with the dimensions shown on the plans or ordered by the Engineer.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-5.07 The Overlay concrete for the test specimens will not be measured directly for payment but shall be considered as a subsidiary of the Contractor.

981-5.08 Match curing equipment shall be measured per lump sum. The price shall include full compensation for furnishing all necessary equipment, maintenance, material, labor, security and operations to comply with the requirements of match-curing all the compressive strength cylinders required according to section 981-2.15.

981-5.09 Overlay Construction Test section work will be measured directly for payment per square meters. The unit price shall include full compensation for furnishing all necessary equipment, material and labor to comply with the requirements of the test section.

981-6 BASIS OF PAYMENT

981-6.01 Overlay concrete

a. The completed and accepted quantities of each Case of *Overlay concrete*, measured as Article 981-5.01, will be paid for at the contract unit price per unit of measurement except as specified in Article 981-6.07. Such prices and payment shall constitute full compensation for all saw cutting, cleaning, placing, finishing and curing, including the furnishing of all required materials, and for all equipment, tools, labor, tests and incidentals necessary to complete each item as required by the plans and specifications.

b. The unit prices of each Case of overlay concrete include full compensation for furnishing, cleaning and placing or applying all subsidiary items necessary to complete the bridge deck concrete overlay such as new steel reinforcement, Structural Crack Healer / Sealer, and Miscellaneous Materials called for in the contract documents unless they constitute or are specifically covered by other pay items included in the contract.

c. The full compensation for furnishing of equipments, labor and operations for Bond Strength Test, Sounding Test, and Sealing of Construction Joints shall be included in the unit prices of each Case of overlay concrete.

d. The full compensation for furnishing, operating, and providing security for Match Curing equipment of compressive strength cylinders shall be covered by other pay items included in the contract.

e. No separate pay allowance will be made for any increased Cement, Cementitious content, for any admixtures, nor for any finishing of any description for concrete surfaces indicated in the contract plans or required by the specifications.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

f. No additional payment will be made for any Case of overlay concrete over dimensions stipulated neither in the contract documents nor for strength in excess of that specified. No payment will be made for the removal and disposal of any Case of Overlay concrete found deficient and not accepted.

981-6.02 Partial-Depth Removal of Bridge Concrete Deck (Scarification)

a. The completed and accepted quantities of each Case of *Partial-Depth Removal of Bridge Concrete Deck (Scarification)*, measured as Article 981-5.02, will be paid for at the contract unit price per unit of measurement. Such prices and payment shall constitute full compensation for all saw cutting, scarifying and cleaning, including the furnishing of all required materials, and for all equipment, tools, labor and incidentals necessary to complete each item as required by the contract plans and specifications.

b. The unit prices of each Case of Partial-Depth Removal of Bridge Concrete Deck (Scarification) include full compensation for furnishing and cleaning or applying all subsidiary items necessary to complete the bridge deck concrete overlay and Miscellaneous Materials called for in the contract documents unless they constitute or are specifically covered by other pay items included in the contract.

c. The full compensation for furnishing of equipments and operations for scarification of existing bituminous or concrete overlay on bridge concrete deck shall be included in the unit prices of each Case of Partial-Depth Removal of Bridge Concrete Deck (Scarification).

981-6.03 Bridge Joint System – The completed and accepted quantities of *Concrete Bridge Joint System* or *Asphaltic Bridge Joint System*, measured as Article 981-5.03 and the requirements of Specification 939 – “Bridge Joint System Repair”.

981-6.04 Deck Patching Material (Type), Partial-Depth and Full-Depth – The completed and accepted quantities of *Deck Patching Material*, measured as Article 981-5.04 and the requirements of Specification 937 – “Bridge Concrete Deck Repair”.

981-6.05 Impregnating of Corrosion Inhibitor in Bridge Concrete Deck – The completed and accepted quantities of *Impregnating of Corrosion Inhibitor*, measured as Article 981-5.05 and the requirements of Specification 937 – “Bridge Concrete Deck Repair”.

981-6.06 Sealing of Cracks in Bridge Concrete Deck – The completed and accepted quantities of *Sealing of Cracks in Bridge Concrete Deck*, measured as Article 981-5.06 and the requirements of Specification 937 – “Bridge Concrete Deck Repair”.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

981-6.07 Price Reduction

a. **Compressive Strength** - Overlay concrete found deficient in strength but which is accepted by the Authority under the provision of Article 981-2.09 of this specification will be paid for at a reduced unit price.

The reduction in unit price will be computed in accordance with the following formula:

$$R = 0.05 D$$

where R = Percentage reduction in unit price of the Overlay concrete.

D = Deficiency in psi from the specified strength.

No price reduction will be applied when the deficiency “D” does not exceed 100 psi.

Drilling and testing cores shall not be permitted for price reduction.

Liquidated damages will be assessed for each additional day (24 hours) the overlay concrete fails to attain the required compressive strength for opening to traffic adjacent lanes; 1 day for Type B or 3 days for Type A.

The liquidated damages will be computed in accordance with the following formula:

$$LD = D \times U \times V / 10,000$$

where LD = Liquidated damages applied to Overlay concrete in dollars.

D = Maximum deficiency in the lane in psi from the specified strength.

U = Unit price of the Overlay Concrete in dollars per cubic meter.

V = Total concrete volume poured in the lane in cubic meter.

No liquidated damages will be applied when the deficiency “D” does not exceed:

- i. Ten percent (10%) of the specified strength in psi for bridges located in the National Highways System, Primary Roads and Secondary Roads.
- ii. Twelve percent (12%) of the specified strength in psi for bridges located in other roads systems.

SPECIAL PROVISION

SPECIFICATION 981 – BRIDGE DECK CONCRETE OVERLAY

b. **Permeability** – The unit price of the concrete will be reduced in the amount of \$0.10 per coulomb per cubic meters in excess of the permeability level indicated in the contract. The Authority may reject and require the removal and replacement of any lot which exceeds 1,000 coulombs above the permeability level indicated in the contract. These deductions will be in addition to the deductions for compressive strength described in 981-6.07 a. The total deduction will never exceed 90 percent of the contract unit price.

981-6.08 Payment will be made under:

<u>Pay Item</u>	<u>Pay Unit</u>
Overlay concrete, Case ____, Type of Overlay Mix____.....	Cubic Meter
Partial-Depth Removal of Bridge Concrete Deck (Scarification), Case ____...	Square Meter
Match curing equipment.....	Lump Sum
Overlay Concrete Test Section.....	SqM