# CONCRETE ROAD PAVEMENT

# by

# WIRTGEN SP500 PAVER

## Index:



**Prepared By**: Dalo Group Engineering

**Reviewed By** :- Eng. Hamno Aziz

**Approved By** :- Eng. Hamno Aziz

# Concrete Pavement

# For

# Heavy Duty Pavement

## General Specification

**Prepared By**: Dalo Group Engineering

**Reviewed By** :- Eng.Hamno Aziz

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SECTION 32 13 11

CONCRETE PAVEMENT FOR HEAVY-DUTY PAVEMENTS

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PART 1 GENERAL

1.1 UNIT PRICES

1.1.1 Measurements

The quantity of concrete to be paid for will be the volume of concrete in cubic meters including thickened edges monolithic curb, where required, placed in the completed and accepted pavement. Concrete will be measured in place in the completed and accepted pavement only within the neat line dimensions shown in the plan and cross section. No deductions will be made for rounded or beveled edges or the space occupied by pavement reinforcement, dowel bars, tie bars, or electrical conduits, nor for any void, or other structure extending into or through the pavement slab, measuring 0.1 cubic meter or less in volume. No other allowance for concrete will be made unless placed in specified locations in accordance with written instructions previously issued by the Contracting Officer. The quantity of other materials specified herein, and used in the construction of the work covered by this section, will not be measured for payment, but will be considered a subsidiary obligation of the Contractor, covered under the price per cubic meter for concrete. Joint sealing materials are covered in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS or Section 32 13 73 COMPRESSION JOINT SEALS FOR CONCRETE

# PAVEMENTS.

1.2 REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to within the text by the basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS (AASHTO)

AASHTO M 182 (2005; R 2009) Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton MatsAMERICAN CONCRETE INSTITUTE INTERNATIONAL (ACI)

ACI 211.1 (1991; R 2009) Standard Practice for Selecting Proportions for Normal, Heavyweight and Mass Concrete

ACI 214R (2011) Evaluation of Strength Test Results of Concrete

ACI 305R (2010) Guide to Hot Weather Concreting

ACI 306R (2010) Guide to Cold Weather Concreting

ASTM INTERNATIONAL (ASTM)

Printed with FinePrint trial version - purchase at www.fineprint.com

ASTM A1064/A1064M (2013) Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for

## Concrete

ASTM A184/A184M (2006; E2011) Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement

ASTM A615/A615M (2014) Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement

ASTM A775/A775M (2007b; R2014) Standard Specification for Epoxy-Coated Steel Reinforcing Bars

ASTM A996/A996M (2014) Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

ASTM C1017/C1017M (2013) Standard Specification for Chemical Admixtures for Use in Producing Flowing Concrete

ASTM C1064/C1064M (2011) Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C1077 (2014) Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for Use in Construction and Criteria for Laboratory Evaluation

ASTM C117 (2013) Standard Test Method for Materials Finer than 75-um (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C123/C123M (2012) Standard Test Method for Lightweight Particles in Aggregate

ASTM C1240 (2014) Standard Specification for Silica Fume Used in Cementitious Mixtures

ASTM C1260 (2007) Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)

ASTM C131 (2006) Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine

ASTM C136 (2006) Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C138/C138M (2013a) Standard Test Method for Density ("Unit Weight"), Yield, and Air Content

**(Gravimetric) of Concrete**

ASTM C142/C142M (2010) Standard Test Method for Clay Lumps and Friable Particles in Aggregates

ASTM C143/C143M (2012) Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C150/C150M (2012) Standard Specification for Portland Cement

ASTM C1567 (2013) Standard Test Method for Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)

ASTM C1602/C1602M (2012) Standard Specification for Mixing Water Used in Production of Hydraulic Cement Concrete

ASTM C1646/C1646M (2008a) Making and Curing Test Specimens for Evaluating Frost Resistance of Coarse Aggregate in Air-Entrained Concrete by Rapid Freezing and Thawing

ASTM C172/C172M (2014) Standard Practice for Sampling Freshly Mixed Concrete

ASTM C174/C174M (2013) Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores

ASTM C192/C192M (2013a) Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory

ASTM C231/C231M (2010) Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method

ASTM C260/C260M (2010a) Standard Specification for Air-Entraining Admixtures for Concrete

ASTM C29/C29M (2009) Standard Test Method for Bulk Density ("Unit Weight") and Voids in Aggregate

ASTM C294 (2012) Standard Descriptive Nomenclature for Constituents of Concrete Aggregates

ASTM C295/C295M (2012) Petrographic Examination of Aggregates for Concrete

ASTM C309 (2011) Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM C31/C31M (2012) Standard Practice for Making and Curing Concrete Test Specimens in the Field

ASTM C33/C33M (2013) Standard Specification for Concrete Aggregates

ASTM C39/C39M (2014) Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens

ASTM C494/C494M (2013) Standard Specification for Chemical Admixtures for Concrete

ASTM C595/C595M (2013) Standard Specification for Blended Hydraulic Cements

ASTM C618 (2012a) Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete

ASTM C666/C666M (2003; R 2008) Resistance of Concrete to

**Rapid Freezing and Thawing**

ASTM C78/C78M (2012; E 2013) Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)

ASTM C88 (2013) Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C881/C881M (2013) Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete

ASTM C94/C94M (2014) Standard Specification for Ready-Mixed Concrete

ASTM C989/C989M (2013) Standard Specification for Slag Cement for Use in Concrete and Mortars

ASTM D1751 (2004; E 2013; R 2013) Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding

and Resilient Bituminous Types)

ASTM D1752 (2004a; R 2013) Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

ASTM D2995 (1999; R 2009) Determining Application Rate of Bituminous Distributors

ASTM D3665 (2012) Random Sampling of Construction Materials

ASTM D4791 (2010) Flat Particles, Elongated Particles, or Flat and Elongated Particles in Coarse Aggregate

ASTM D75/D75M (2013) Standard Practice for Sampling Aggregates

ASTM E1274 (2003; R 2012) Standard Test Method for Measuring Pavement Roughness Using a Profilograph

NATIONAL READY MIXED CONCRETE ASSOCIATION (NRMCA)

NRMCA QC 3 (2011) Quality Control Manual: Section

3, Plant Certifications Checklist:

Certification of Ready Mixed Concrete Production Facilities STATE OF CALIFORNIA DEPARTMENT OF TRANSPORTATION (CALTRANS) CTM 526 (2002) Operation of California Profilograph and Evaluation of Profiles U.S. ARMY CORPS OF ENGINEERS (USACE)

COE CRD-C 130 (2001) Standard Recommended Practice for Estimating Scratch Hardness of Coarse Aggregate Particles

COE CRD-C 143 (1962) Specifications for Meters for Automatic Indication of Moisture in Fine Aggregate

COE CRD-C 300 (1990) Specifications for Membrane-Forming Compounds for Curing Concrete

COE CRD-C 521 (1981) Standard Test Method for Frequency and Amplitude of Vibrators for Concrete

COE CRD-C 55 (1992) Test Method for Within-Batch Uniformity of Freshly Mixed Concrete

COE CRD-C 662 (2009) Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials, Lithium Nitrate Admixture and Aggregate (Accelerated Mortar-Bar Method)

## 1.3 SYSTEM DESCRIPTION

This section is intended to stand alone for construction of concrete pavement. However, where the construction covered herein interfaces with other sections, the construction at each interface shall conform to the requirements of both this section and the other section, including tolerances for both.

### 1.3.1 Surface Smoothness

Use the profilograph method for all longitudinal testing, except for paving lanes less than 60 m in length. Use the straightedge method for transverse testing, for longitudinal testing where the length of each pavement lane is less than 60 m, within 60 m on both the approach and departure sides of an aircraft arresting gear, and at the ends of the paving limits for the project. Where drawings show required deviations from a plane surface (crowns, drainage inlets, etc.) or existing rough or high PI pavement, finish the surface to meet the approval of the Contracting Officer. Detailed notes shall be kept of the results of the testing and a copy furnished to the Government after each day's testing.

a. Straightedge Testing: The finished surfaces of the pavements shall have no abrupt change of 6 mm or more, and all pavements shall be within the limits specified when checked with an approved 4 m straightedge. Roads, streets, tank hardstands, vehicular parking

areas, and open storage areas shall have a variation from the specified straight edge not greater than in either the longitudinal or transverse direction.

b. Profilograph Testing: The finished surfaces of the pavements shall have no abrupt change of 6 mm or more, and each 0.1 km segment of each pavement lot shall have a Pofile Index not greater than specified when tested with an approved California-type profilograph. Roads, streets, tank hardstands, vehicular parking areas and open storage areas shall have a Profile index not greater than 140 mm per km in the longitudinal direction.

c. Bumps ("Must Grind" Areas): Any bumps ("must grind" areas) shown on the profilograph trace which exceed 10 mm in height shall be reduced by diamond grinding in accordance with subparagraph "Diamond Grinding of PCC Surfaces" below until they do not exceed 7.5 mm when retested. Such grinding shall be tapered in all directions to provide smooth transitions to areas not requiring grinding.

d. Testing Method: After the concrete has hardened sufficiently to permit walking thereon, but not later than 48 hours after placement, test the entire surface of the pavement in each lot in such a manner as to reveal all surface irregularities exceeding the tolerances specified above. If any pavement areas are ground, these areas shall be retested immediately after diamond grinding. The entire area of the pavement shall be tested in both a longitudinal and a transverse direction on parallel lines. The transverse lines shall be 4.5 m or less apart, as directed. The longitudinal lines shall be at the centerline of each paving lane shown on the drawings, regardless of whether the Contractor is allowed to pave two lanes at a time, and at the 1/8th point in from each side of the lane. Other areas having obvious deviations shall also be tested. Longitudinal testing lines shall be continuous across all joints. Transverse testing lines for pilot lanes shall be carried to construction joint lines and for fill-in lanes shall be carried 600 mm across construction joints, and the readings in this area applied to the fill-in lane. Straightedge testing of the longitudinal edges of slipformed pilot lanes shall also be performed before paving fill-in lanes as specified below.

(1) Straightedge Testing: The straightedge shall be held in contact with the surface and moved ahead one-half the length of the straightedge for each successive measurement. Determine the amount of surface irregularity by placing the freestanding (unleveled) straightedge on the pavement surface and measuring the maximum gap between the straightedge and the pavement surface. Measurements shall be determined along the entire length of the straight edge.

(2) Profilograph Testing: Perform profilograph testing using approved California profilograph and procedures described in ASTM E1274. The equipment shall utilize electronic recording and automatic computerized reduction of data to indicate "must-grind" bumps and the Profile Index for each 0.1 km segment of the pavement lot. Grade breaks on aprons parking lots shall be accommodated by breaking the profile segment into short sections and repositioning the blanking band on each section. The "blanking band" shall be 5 mm wide and the "bump template" shall span 25 mm with an offset of 10 mm. The profilograph testing of the last 9.1 m of a paving lane in the longitudinal direction from each day's paving operation shall be counted on the following day's continuation lane. The profile index shall be computed for each pass of the profilograph (3 per lane) in each 0.1 km segment. The profile index for each segment shall be the average of the profile indices for each pass in each segment. Profilographs of unequal lengths shall be scaled and proportioned to an equivalent 0.1 km as outlined in the CTM 526.

A copy of the reduced tapes shall be furnished the Government at the end of each day's testing.

### 1.3.2 Edge Slump and Joint Face Deformation

a. Edge Slump: When slip-form paving is used, not more than 15.0 percent of the total free edge of each pavement panel shall have an edge slump exceeding 6 mm and none of the free edge of the pavement lot shall have an edge slump exceeding 9 mm. (A pavement panel is defined as a lane width by the length between two adjacent transverse contraction joints. The total free edge of the pavement will be considered to be the cumulative total linear measurement of pavement panel edge originally constructed as non-adjacent to any existing pavement; i.e., 30 m of pilot lane originally constructed

as a separate lane, will have 60 m of free edge; 30 m of fill-in lane will have no free edge, etc.,). The area affected by the downward movement of the concrete along the pavement edge shall not exceed 450 mm back from the edge.

b. Joint Face Deformation: In addition to the edge slump limits specified above, the vertical joint face shall have a surface within the maximum limits shown below:

| Offset from Straightedge Applied Logintudinally to Pavement Surface | Offset from Straightedge Applied Longitudinally to Vertical Face | Offset from Straightedge Applied Top to Bottom Against the Joint Face | Abrupt Offset in Any Direction | Offset of Joint Face from True Vertical |
|---|---|---|---|---|
| Airfield Pavement | | | | |
| 3 mm | 6 mm | 9 mm | 3 mm | 8 mm/100 mm |
| All Other Pavement | | | | |
| 6 mm | All other items same as airfield pavement | | | |

c. Slump Determination: Immediately after the concrete has hardened sufficiently to permit walking thereon, the pavement surface of each lot shall be tested by the Contractor. Testing shall be performed with a minimum 4 m straightedge to reveal irregularities exceeding the edge slump tolerance specified above. The vertical edge slump shall be determined at each free edge of each slipformed paving lane constructed. The straightedge shall be placed transverse to the direction of paving and the end of the straightedge located at the edge of the paving lane. Measurements shall be made at 1.5 to 4.5 m spacing's, as directed, commencing at the header where paving was started. Initially measurements shall be made at 1.5 m intervals in each lane. When no deficiencies are present, the Contracting Officer may approve an increase in the interval. When any deficiencies exist, the interval will be returned to 1.5 m. In no case shall the interval exceed 4.5 m. In addition to the transverse edge slump determination above, the Contractor, at the same time, shall check the longitudinal surface smoothness of the joint on a continuous line 25 mm back from the joint line using the 4 m

straightedge advanced one-half its length for each reading. Other tests of the exposed joint face shall be made to ensure that a uniform, true vertical joint face is attained. The measurements shall be made by the Contractor, shall be properly referenced in accordance with paving lane identification and stationing, and a report given to the Contracting Officer within 24 hours after measurement is made. The report shall also identify areas requiring replacement.

d. Excessive Edge Slump: When edge slump exceeding the limits specified above is encountered on either side of the paving lane, additional straightedge measurements shall be made, if required, to define the linear limits of the excessive slump. The concrete slabs having excessive edge slump or joint deformation shall be removed and replaced to the next transverse joint in conformance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Use of slip-form paving equipment and procedures that fail to consistently provide edges within the specified tolerances on edge slump and joint face deformation shall be discontinued and the pavements shall be constructed by means of standard paving procedures using fixed forms.

### 1.3.3 Plan Grade

Within 5 days after paving of each lot, the finished surface of the pavement area shall be tested, by running lines of levels at intervals corresponding with every longitudinal and transverse joint to determine the elevation at each joint intersection. The results of this survey shall be recorded and a copy given to the Government at the completion of the survey of each lot. The finished surfaces of airfield runway, taxiway, and apron pavements shall vary not more than 13 mm above or below the plan grade line or elevation indicated. The surfaces of other pavements shall vary not more than 19 mm. The above deviations from the approved grade line and elevation will not be permitted in areas where closer conformance with the planned grade and elevation is required for the proper functioning of appurtenant structures. The finished surfaces of new abutting pavements shall coincide at their juncture.

### 1.3.4 Flexural Strength

Submit certified copies of laboratory test reports and sources for cement, supplementary cementitious materials (SCM), aggregates, admixtures, curing compound, epoxy, and proprietary patching materials proposed for use on this project. All aggregate tests shall have been performed no earlier than 6 months prior to contract award. Each lot of pavement will be evaluated for acceptance in accordance with the following procedures.

a. Sampling and Testing: For acceptance, one composite sample of concrete from each sublot shall be obtained in accordance with ASTM C172/C172M from one batch or truckload.

b. Computations: Average the eight 14-day strength tests for the lot. The average strength shall be used in accordance with paragraph "Concrete Strength for Final Acceptance" in PART 2.

### 1.3.5 Thickness

Each lot of pavement will be evaluated for acceptance and payment adjustment in accordance with the following procedure. Two cores, between 100 and 150 mm in diameter, shall be drilled from the pavement, per sublot (8 per lot). The Contractor is responsible for drilling the cores within 3 days after lot placement, filling the core holes with an approved non-shrink concrete, respraying the cored areas with curing compound, and for measuring the cores. Each core shall be inspected for voids, thickness of paste on the surface, and depth of reinforcement (if required). Provide the results with the thickness measurement data. Eight measurements of thickness shall be made around the circumference of each core and one in the center, in accordance with ASTM C174/C174M, using calibrated calipers for specimens longer than 250 mm. The pavement thickness from the 8 cores for the lot shall be averaged and shall be evaluated as described in paragraph: PAYMENT ADJUSTMENT FOR THICKNESS above.

### 1.3.6 Diamond Grinding of PCC Surfaces

In areas not meeting the specified limits for surface smoothness and plan grade, high areas shall be reduced to attain the required smoothness and grade, except as depth is limited below. High areas shall be reduced by grinding the hardened concrete with an approved diamond grinding machine after the concrete is 14 days or more old. Grinding shall be accomplished by sawing with an industrial diamond abrasive which is impregnated in the saw blades. The saw blades shall be assembled in a cutting head mounted on a machine designed specifically for diamond grinding that will produce the required texture and smoothness level without damage to the concrete pavement or joint faces. The saw blades shall be 3 mm wide and there shall be a minimum of 55 to 60 blades per 300 mm of cutting head width depending on the hardness of the aggregate. Each machine shall be capable of cutting a path 0.9 to 1.2 m wide. Grinding equipment that causes ravels, aggregate fractures, spalls or disturbance to the joints will not be permitted. The area corrected by grinding the surface of the hardened concrete shall not exceed 10 percent of the total area of any sublot. The depth of diamond grinding shall not exceed 6 mm. All pavement areas requiring plan grade or surface smoothness corrections in excess of the limits specified above, shall be removed and replaced in conformance with paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.
In pavement areas given a wire comb or tined texture, areas exceeding 2 square meters that have been corrected by diamond grinding shall be retextured by transverse grooving using an approved grooving machine of standard manufacture. The grooves shall be 6 mm deep by 6 mm wide on 37 mm centers and shall be carried into, and tapered to zero depth within the non-corrected surface, or shall match any existing grooves in the adjacent pavement. All areas in which diamond grinding has been performed will be subject to the thickness tolerances specified in paragraph: Thickness, above.

## 1.4 SUBMITTALS

Government approval is required for submittals with a "G" designation; submittals not having a "G" designation are for Contractor Quality Control approval. Submit the following in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-03 Product Data

Equipment
Proposed Techniques; G
Dowels; G
Dowel Bar Assemblies; G

SD-05 Design Data
Proportioning Studies; G, ED
SD-06 Test Reports
Sampling and Testing; G, ED

SD-07 Certificates
Contractor Quality Control Staff; G, ED
Laboratory Accreditation; G, ED
NRMCA Certificate of Conformance; G, ED
Commercial Laboratory; G, ED

## 1.5 QUALITY ASSURANCE

1.5.1 Contractor Quality Control StaffSubmit American Concrete Institute certification for Contractor Quality Control staff. Qualifications and resumes for petrographer, surveyor, concrete batch plant operator, and profilograph operator. All Contractor Quality Control personnel assigned to concrete construction shall be American Concrete Institute (ACI) certified in the following grade (or shall have written evidence acceptable to the Contracting Officer's representative of having completed similar qualification programs):

a. CQC personnel responsible for inspection of concrete paving operations: ACI Concrete Transportation Inspector.

b. Lead Foreman or Journeyman of the Concrete Placing, Finishing, and Curing Crews: ACI Concrete Flatwork Technician/Finisher.

c. Field Testing Technicians: ACI Concrete Field Testing Technician, Grade I.

d. Laboratory Testing Technicians: ACI Concrete Strength Testing Technician and Laboratory Testing Technician, Grade I or II.

### 1.5.2 Other Staff

Submit for approval, the qualifications and resumes for the following staff:

a. Petrographer: Bachelor of Science degree in geology or petrography, trained in petrographic examination of concrete aggregate according to ASTM C294 and ASTM C295/C295M and trained in identification of the specific deleterious materials and tests identified in this specification. Resume shall detail the education, training and experience related to the project-specific test methods and deleterious materials and shall be submitted at least 20 days before petrographic and deleterious materials examination is to commence.

b. Licensed Surveyor: All survey work shall be performed under the supervision of a Licensed Surveyor.

c. Concrete Batch Plant Operator: National Ready Mix Concrete Association (NRMCA) Plant Manager certification at the Plant Operator level.

d. Profilograph Operator: Certification by equipment manufacturer or a state Department of Transportation.

### 1.5.3 Laboratory Accreditation

Laboratory and testing facilities shall be provided by and at the expense of the Contractor. Submit accreditation of the commercial laboratory by an independent evaluation authority, indicating conformance to ASTM C1077, including all applicable test procedures. The laboratories performing the tests shall be accredited in accordance with ASTM C1077, including ASTM C78/C78M and ASTM C1260. The accreditation shall be current and shall include the required and optional test methods, as specified throughout this Section. Onsite temperature-controlled concrete curing facilities shall be provided.

a. Aggregate Testing and Mix Proportioning: Aggregate testing and mixture proportioning studies shall be performed by a commercial laboratory.

b. Acceptance Testing: Furnish all materials, labor, and facilities required for molding, curing, testing, and protecting test specimens at the site and in the laboratory. Steel molds shall be used for molding the beam specimens. Furnish and maintain boxes or other facilities suitable for storing and curing the specimens at the site while in the mold within the temperature range stipulated by ASTM C31/C31M. Flexural loading equipment shall be in accordance with ASTM C78/C78M.

c. Contractor Quality Control: All sampling and testing shall be performed by an approved, onsite, independent, commercial laboratory, or for cementitious materials and admixtures, the manufacturer's laboratory. Submit USACE validation letter for commercial laboratory.

d. Laboratory Inspection: The Government will inspect the laboratory equipment and test procedures prior to the start of concreting operations for conformance to ASTM C1077. The laboratory shall maintain this certification for the duration of the project.

1.5.4 Preconstruction Testing of MaterialsAll sampling and testing shall be performed by, and at the expense of, the Contractor. Use an approved commercial laboratory or, for cementitious materials and chemical admixtures, a laboratory maintained by the manufacturer of the material. No material shall be used until notice of acceptance has been given. The Contractor will not be entitled to any additional payment or extension of time due to failure of any material to meet project requirements, or for any additional sampling or testing required. Additional tests may be performed by the Government at the discretion of the Contracting Officer; such Government testing will not relieve the Contractor of any testing responsibilities.

**1.5.4.1 Aggregates**

Aggregates shall be sampled in the presence of a GovernmentRepresentative. Samples shall be obtained in accordance with ASTM D75/D75M and shall be representative of the materials to be used for the project. Test results shall be submitted 7 days beforecommencing mixture proportioning studies.

1.5.4.2 Chemical Admixtures, Curing Compounds and EpoxiesAt least 30 days before the material is used, submit certified copies of test results for the specific lots or batches to be used on the project. Test results shall be not more than 6 months old prior to use in the work. Chemical admixtures that have been in storage at the project site for longer than 6 months or that have been subjected to freezing will be retested at the expense of the Contractor and will be rejected if test results are not satisfactory.

### 1.5.4.3 Cementitious Materials

Cement, ground granulated blast furnace (GGBF) slag, will be accepted on the basis of manufacturer's certification of compliance, accompanied by mill test reports showing that the material in each shipment meets the requirements of the specification under which it is furnished. Mill test reports shall be no more than 1 month old, prior to use in the work. No cementitious material shall be used until notice of acceptance has been given by the Contracting Officer. Cementitious material may be subjected to testing by the Government from samples obtained at the mill, at transfer points, or at the project site. If tests prove that a cementitious material that has been delivered is unsatisfactory, it shall be promptly removed from the site of the work. Cementitious material that has not been used within 6 months after testing shall be retested at the Contractor's expense and shall be rejected if test results are not satisfactory.

### 1.5.5 Testing During Construction

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials, and concrete as specified herein. The Government will sample and test concrete and ingredient materials as considered appropriate. Provide facilities and labor as may be necessary for procurement of representative test samples. Testing by the Government will in no way relieve the Contractor of the specified testing requirements.

### 1.5.6 Test Section

Up to 10 days, but not more than 60 days, prior to construction of the concrete pavement, construct a test section as part of the production paving area at an outer edge as indicated on the drawings. Use the test section to develop and demonstrate to the satisfaction of the Contracting Officer the proposed techniques of mixing, hauling, placing, consolidating, finishing, curing, initial saw cutting, start-up

procedures, testing methods, plant operations, and the preparation of the construction joints. Variations in mixture proportions, other than water, shall be made if directed. Vary the water content, as necessary, to arrive at the appropriate content. The mixing plant shall be operated and calibrated prior to start of placing the test section. Use the same equipment, materials, and construction techniques on the test section as will be used in all subsequent work. Base course preparation, concrete production, placing, consolidating, curing, construction of joints, and all testing shall be in accordance with applicable provisions of this specification. Three days after completion of the test section, provide eight cores at least 150 mm diameter by full depth cut from points selected in the test section by the Government. The cores will be evaluated for homogeneity, consolidation and segregation. Construct the test section meeting all specification requirements and being acceptable to the Contracting Officer in all aspects, including surface texture. Failure to construct an acceptable test section will necessitate construction of additional test sections at no additional cost to the Government. Test sections allowed to be constructed as part of the production paving which do not meet specification requirements shall be removed at the Contractor's expense. If the Contractor proposes to use slipform paving and is unable to construct an acceptable test section, the slipform paving equipment shall be removed from the job and the construction completed using stationary side forms and equipment compatible with them. Production paving shall not commence until the results on aggregates and concrete, including evaluation of the cores, and all pavement measurements for edge slump, joint face deformation, actual plan grade, surface smoothness and thickness have been submitted and approved by the Contracting Officer. Pavement accepted as a production lot will be evaluated and paid in accordance with Paragraph: ACCEPTABILITY OF WORK below.

#### 1.5.6.1 Pilot Lane

The test section shall consist of one paving lane at least 130 m long and shall be constructed to the same thickness as the thickest portion of pavement shown on the Drawings. The lane width shall be the same as that required for use in the project. The test section shall contain at least one transverse construction joint. If keyed or doweled longitudinal construction joints are required in any of the production pavements, they shall be installed full length along one side of the

test strip throughout the test section. If both keys and dowels are required, each shall be installed in half of the test section. Two separate days shall be used for construction of the test section.

#### 1.5.6.2 Fill-In Lane

The first 130 m of the initial production fill-in lane shall be considered a fill-in lane test section for purposes of testing and evaluation. All requirements for the test section are applicable, as appropriate. Obtain cores from the fill-lane lane side of the longitudinal construction joint with the pilot lane. The cores will be evaluated for homogeneity, consolidation, and segregation.

### 1.5.7 Acceptability of Work

The materials and the pavement itself will be accepted on the basis of tests made by the Contractor. The Government may make check tests to validate the results of the Contractor's testing. If the results of the Contractor tests vary by less than 2.0 percent of the Government's test results, the results of the Contractor's tests will be used. If the results of the Government and Contractor tests vary by 2.0 percent, but less than 4.0 percent, the average of the two will be considered the value to be used. If these vary by 4.0 percent or more, each sampling and testing procedure shall be carefully evaluated and both the Government and the Contractor shall take another series of tests on duplicate samples of material. If these vary by 4.0 percent or more, the results of the tests made by the Government shall be used and the Government will continue check testing of this item on a continuous basis until the two sets of tests agree within less than 4.0 percent on a regular basis. Testing performed by the Government will in no way at any time relieve the Contractor from the specified testing requirements.

### 1.5.8 Acceptance Requirements

#### 1.5.8.1 Pavement Lots

A lot will be that quantity of construction that will be evaluated for acceptance with specification requirements. A lot will be equal to one shift of production not to exceed 750 cubic meters. In order to evaluate thickness, each lot will be divided into four equal sublots. Grade determinations will be made on the lot as a whole. Surface smoothness determinations will be made on every 0.1 km segment in each lot. Location of all samples shall be selected on a random basis in accordance with ASTM D3665. When operational conditions cause a lot to be terminated before the specified four sublots have been completed, the following procedure shall be used to adjust the lot size and number of tests for the lot. Where three sublots have been completed, they shall constitute a lot. Where one or two sublots have been completed, they shall be incorporated into the next lot (except for the last lot), and the total number of sublots shall be used and acceptance criteria adjusted accordingly.

#### 1.5.8.2 Evaluation

Provide all sampling and testing required for acceptance and payment adjustment at the Contractor's expense. Individuals performing sampling, testing and inspection duties shall meet the required Qualifications. The Contracting Officer reserves the right to direct additional samples and tests for any area which appears to deviate from the specification requirements. Testing in these areas will be in addition to the sublot or lot testing, and the requirements for these areas will be the same as those for a sublot or lot. Provide facilities for and, where directed, personnel to assist in obtaining samples for any Government testing.

## 1.6 DELIVERY, STORAGE, AND HANDLING

### 1.6.1 Bulk Cementitious Materials

Furnish all cementitious material in bulk. The temperature of the cementitious material, as delivered to storage at the site, shall not exceed 65 degrees C. Sufficient cementitious materials shall be in storage to sustain continuous operation of the concrete mixing plant while the pavement is being placed. Provide separate facilities to prevent any intermixing during unloading, transporting, storing, and handling of each type of cementitious material.

### 1.6.2 Aggregate Materials

Store aggregate at the site of the batching and mixing plant avoiding breakage, segregation, intermixing or contamination by foreign materials. Each size of aggregate from each source shall be stored separately in free-draining stockpiles. Aggregate stored on ground shall have a minimum 0.6 m thick sacrificial layer left undisturbed. Fine aggregate and the smallest size coarse aggregate shall remain in free-draining storage for at least 24 hours immediately prior to use. Sufficient aggregate shall be maintained at the site at all times to permit continuous uninterrupted operation of the mixing plant at the time concrete pavement is being placed. Tracked equipment shall not be allowed on coarse aggregate stockpiles.

### 1.6.3 Other Materials

Store reinforcing bars and accessories above the ground on supports. All materials shall be stored avoiding contamination and deterioration.

## PART 2 PRODUCTS

### 2.1 CEMENTITIOUS MATERIALS

Cementitious materials shall be portland cement, blended cement or only portland cement in combination with supplementary cementitious materials (SCM), and shall conform to appropriate specifications listed below. New submittals are required when the cementitious materials sources or types change.

#### 2.1.1 Portland Cement

Provide portland cement conforming to ASTM C150/C150M, Type II , low alkali including false set requirements.

#### 2.1.2 Blended Cements

Blended cement shall conform to ASTM C595/C595M, Type IP or IS, including the optional requirement for mortar expansion . The pozzolan added to the Type IP blend shall be ASTM C618 Class F or Class N and shall be interground with the cement clinker. The manufacturer shall state in writing that the amount of pozzolan in the finished cement will not vary more than plus or minus 5 mass percent of the finished cement from lot to lot or within a lot. The percentage and type of mineral admixture used in the blend shall not change from that submitted for the aggregate evaluation and mixture proportioning. The requirements of Table 2 in paragraph SUPPLEMENTARY CEMENTITIOUS MATERIALS (SCM) CONTENT do not apply to the SCM content of blended cement.

### 2.1.3 Pozzolan

#### 2.1.3.1 Raw or Calcined Natural Pozzolan

Natural pozzolan shall be raw or calcined and conform to ASTM C618, Class N, including the optional requirements for uniformity and effectiveness in controlling Alkali-Silica reaction and shall have a loss on ignition not exceeding 3 percent. Class N pozzolan for use in mitigating Alkali-Silica Reactivity shall have a total equivalent alkali content less than 3 percent.

2.1.3.2 Ultra Fine Fly Ash and Ultra Fine PozzolanUltra Fine Fly Ash (UFFA) and Ultra Fine Pozzolan (UFP) shall conform to ASTM C618, Class F or N, and the following additional requirements:

a. The strength activity index at 28 days of age shall be at least 95 percent of the control specimens.

b. The average particle size shall not exceed 6 microns.

2.1.4 Ground Granulated Blast-Furnace (GGBF) SlagGround Granulated Blast-Furnace Slag shall conform to ASTM C989/C989M, Grade 100 or Grade 120.

### 2.1.5 Silica Fume

Silica fume shall conform to ASTM C1240, including the optional limits on reactivity with cement alkalis. Silica fume may be furnished as a dry, densified material or as a slurry. Provide at the Contractor's expense the services of a manufacturer's technical representative, experienced in mixing, proportioning, placement procedures, and curing of concrete containing silica fume. This representative must be present on the project prior to and during at least the first 4 days of concrete

production and placement using silica fume.2.1.6 Supplementary Cementitious Materials (SCM) ContentThe Contractor may elect to use one of the SCMs listed below, unless the SCM is required to mitigate ASR. The use of SCMs is encouraged in accordance with Section 01 62 35, Recycled/Recovered Materials.

TABLE 2
SUPPLEMENTARY CEMENTITIOUS MATERIALS CONTENT

| Supplementary Cementitious Material | Minimum Content (percent) | Maximum Content (percent) |
|---|---|---|
| Class N Pozzolan and Class F Fly Ash | | |
| SiO2 + Al2O3 + Fe2O3 > 70 percent | 25 | 35 |
| SiO2 + Al2O3 + Fe2O3 > 80 percent | 20 | 35 |
| SiO2 + Al2O3 + Fe2O3 > 90 percent | 15 | 35 |
| UFFA and UFP | 7 | 16 |
| GGBF Slag | 40 | 50 |
| Silica Fume | 7 | 10 |

## 2.2 AGGREGATES

### 2.2.1 Aggregate Sources

#### 2.2.1.1 Durability

Aggregate shall have a satisfactory service record in freezing and thawing of at least 5 years successful service in three concrete paving projects. The service record shall include a condition survey of the existing concrete and a review of the concrete-making materials, including coarse and fine aggregates, cement, and mineral admixtures. This review should consider the previous aggregate source and test results, cement mill certificate data, mineral admixture chemical and physical

composition, and the mix design (cement factor and water-cementitious material ratio). Aggregate not having a satisfactory demonstrable service record shall have a durability factor of 50 or more when subjected to freezing and thawing of specimens prepared in accordance with ASTM 1646/C1646M and tested in accordance with ASTM C666/C666M, Procedure A.

**2.2.1.2 Alkali-Silica Reactivity**

Fine and coarse aggregates to be used in all concrete shall be evaluated and tested for alkali-aggregate reactivity. Both coarse aggregate size groups shall be tested.

a. The fine and coarse aggregates shall be evaluated separately, using ASTM C1260. Test results of the individual aggregates shall have a measured expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Should the test data indicate an expansion of greater than 0.08 percent, the aggregate(s) shall be rejected or additional testing shall be performed as follows: utilize the Contractor's proposed low alkali portland cement, blended cement, and/or SCM, and/or Lithium Nitrate in combination with each individual aggregate. If only SCMs are being evaluated, the testing shall be in accordance with ASTM C1567. If Lithium Nitrate is being evaluated, with or without SCMs, the testing shall be in accordance with COE CRD-C 662. Determine the quantity that will meet all the requirements of these specifications and that will lower the expansion equal to or less than 0.08 percent after 28 days of immersion in a 1N NaOH solution. Mixture proportioning shall be based on the highest percentage of SCM required to mitigate ASR-reactivity

b. If any of the above options does not lower the expansion to less than 0.08 percent after 28 days of immersion in a 1N NaOH solution, reject the aggregate(s) and submit new aggregate sources for retesting. Submit the results of testing to the Contracting Officer for evaluation and acceptance.

### 2.2.1.3 Combined Aggregate Gradation

In addition to the grading requirements specified for coarse aggregate and for fine aggregate, the combined aggregate grading shall meet the following requirements:

a. The materials selected and the proportions used shall be such that when the Coarseness Factor (CF) and the Workability Factor (WF) are plotted on a diagram as described in d. below, the point thus determined shall fall within the parallelogram described therein.

b. The Coarseness Factor (CF) shall be determined from the following equation:
CF = (cumulative percent retained on the 9.5 mm sieve)(100)/(cumulative percent retained on the 2.36 mm sieve)

c. The Workability Factor WF is defined as the percent passing the 2.36 mm sieve based on the combined gradation. However, WF shall be adjusted, upwards only, by 2.5 percentage points for each 42 kg of cementitious material per cubic meter greater than 335 kg per cubic meter.

d. A diagram shall be plotted using a rectangular scale with WF on the Y-axis with units from 20 (bottom) to 45 (top), and with CF on the X-axis with units from 80 (left side) to 30 (right side). On this diagram a parallelogram shall be plotted with corners at the following coordinates (CF-75, WF-28), (CF-75, WF-40), (CF-45, WF-32.5), and (CF-45, WF-44.5). If the point determined by the intersection of the computed CF and WF does not fall within the above parallelogram, the grading of each size of aggregate used and the proportions selected shall be changed as necessary.)

### 2.2.2 Coarse Aggregate

#### 2.2.2.1 Material Composition

Coarse aggregate shall consist of crushed or uncrushed gravel, crushed stone, crushed adequately seasoned air-cooled iron blast-furnace slag; steel furnace slag will not be permitted, or a combination thereof. Coarse aggregate used for paving power check pads shall be limestone, dolomite, basalt or other approved low-silica content aggregate which will not cause thermal distress from jet blast. Aggregates, as delivered to the mixers, shall consist of clean, hard, uncoated particles meeting the requirements of ASTM C33/C33M except as specified herein. Coarse aggregate shall be washed. Washing shall be sufficient to remove dust and other coatings. . Coarse aggregate shall not show more than 40 percent loss when subjected to the Los Angeles abrasion test in accordance with ASTM C131. The sodium sulfate soundness loss shall not exceed 12 percent, or the magnesium sulfate soundness loss shall not exceed 18 percent after five cycles when tested in accordance with ASTM C88.

#### 2.2.2.2 Particle Shape Characteristics

Particles of the coarse aggregate shall be generally spherical or cubical in shape. The quantity of flat and elongated particles in any size group coarser than the 9.5 mm sieve shall not exceed 20 percent by weight as determined by the Flat Particle Test and the Elongated Particle Test of ASTM D4791. A flat particle is defined as one having a ratio of width to thickness greater than 3; an elongated particle is one having a ratio of length to width greater than 3.

#### 2.2.2.3 Size and Grading

The nominal maximum size of the coarse aggregate shall be 37.5 mm. Grade and furnish the individual aggregates in two size groups meeting the individual grading requirements of ASTM C33/C33M, Size No. 4 (37 mm to 19 mm) and Size No. 67 (19 mm to No. 4) to meet the coarseness and

workability factor criteria for the contractor-proposed combined gradation. A third aggregate size group may be required to meet the above mentioned coarseness and workability criteria of paragraph COMBINED AGGREGATE GRADATION.

### 2.2.2.4 Deleterious Materials - Airfield Pavements

The amount of deleterious material in each size group of coarse aggregate shall not exceed the limits shown in Table 5 below, determined in accordance with the test methods shown.

TABLE 5

LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR AIRFIELD PAVEMENTS

Percentage by Mass

| Materials (h) | Severe Weather | Moderate Weather | Negligible Weather |
|---|---|---|---|
| Clay lumps and friable particles ( ASTM C142/C142M) | 0.2 | .02 | 1.0 |
| Shale (a) (ASTM C295/C295M) | 0.1 | 0.2 | -- |
| Material finer than 0.075 mm (b) ( ASTM C117) | 0.5 | 0.5 | 1.0 |
| Lightweight particles (c) ( ASTM C123/C123M) | 0.2 | 0.2 | 1.0 |
| Clay ironstone (d) (ASTM C295/C295M) | 0.1 | 0.5 | -- |
| Chert and cherty stone (less than 2.40 Sp. Gr.) (e) (ASTM C123/C123M and ASTM C295/C295M) | 0.1 | 0.5 | -- |
| Claystone, mudstone, and siltstone (f) ( ASTM C295/C295M) | 0.1 | 0.1 | -- |
| Shaly and argillaceous limestone (g) ( ASTM C295/C295M) | 0.2 | 0.2 | -- |
| Other soft particles (COE CRD-C 130) | 1.0 | 1.0 | 1.0 |
| Total of all deleterious substances exclusive of material finer than 0.075 mm | 1.0 | 2.0 | 3.0 |

TABLE 5

LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR AIRFIELD PAVEMENTS

| Materials (h) | Percentage by Mass | | |
|---|---|---|---|
| | Severe Weather | Moderate Weather | Negligible Weather |
| (a) Shale is defined as a fine-grained, thinly laminated or fissile sedimentary rock. It is commonly composed of clay or silt or both. It has been indurated by compaction or by cementation, but not so much as to have become slate. | | | |
| (b) Limit for material finer than 0.075 mm will be increased to 1.5 percent for crushed aggregates if the fine material consists of crusher dust that is essentially free from clay or shale. | | | |
| (c) The separation medium shall have a density of Sp. Gr. of 2.0. This limit does not apply to coarse aggregate manufactured from blast-furnace slag unless contamination is evident. | | | |
| (d) Clay ironstone is defined as an impure variety of iron carbonate, iron oxide, hydrous iron oxide, or combinations thereof, commonly mixed with clay, silt, or sand. It commonly occurs as dull, earthy particles, homogeneous concretionary masses, or hard-shell particles with soft interiors. Other names commonly used for clay ironstone are "chocolate bars" and limonite concretions. | | | |
| (e) Chert is defined as a rock composed of quartz, chalcedony or opal, or any mixture of these forms of silica. It is variable in color. The texture is so fine that the individual mineral grains are too small to be distinguished by the unaided eye. Its hardness is such that it scratches glass but is not scratched by a knife blade. It may contain impurities such as clay, carbonates, iron oxides, and other minerals. Cherty stone is defined as any type of rock (generally limestone) that contains chert as lenses and nodules, or irregular masses partially or completely replacing the original stone. | | | |
| (f) Claystone, mudstone, or siltstone, is defined as a massive fine-grained sedimentary rock that consists predominantly of indurated clay or silt without laminations or fissility. It may be indurated either by compaction or by cementation. | | | |
| (g) Shaly limestone is defined as limestone in which shale occurs as one or more thin beds or laminae. These laminae may be regular or very irregular and may be spaced from a few inches down to minute fractions of an inch. Argillaceous limestone is defined as a limestone in which clay minerals occur disseminated in the stone in the amount of 10 to 50 percent by weight of the rock; when these make up from 50 to 90 percent, the rock is known as calcareous (or dolomitic) shale (or claystone, mudstone, or siltstone). | | | |
| (h) Perform testing in accordance with the referenced test methods, except that the minimum sample size shall be as specified below. | | | |

2.2.2.5 Testing Sequence/Deleterious Materials in Coarse Aggregate - Airfields Only

The Contractor will not be entitled to any extension of time or additional payment due to any delays caused by the testing, evaluation, or personnel requirements. The size of the coarse aggregate sample shall be at least 90 kg for the 19 mm and larger maximum size and 12 kg for the 4.75 to 19 mm coarse aggregate and 5 kg for the fine aggregate. Provide facilities for the ready procurement of representative test samples. The testing procedure on each sample of coarse aggregate for compliance with limits on deleterious materials shall be as follows:

**2.2.2.6 Deleterious Material - Road Pavements**

The amount of deleterious material in each size group of coarse aggregate shall not exceed the limits in the following table when tested as indicated.

| LIMITS OF DELETERIOUS MATERIALS IN COARSE AGGREGATE FOR ROAD PAVEMENTS | |
|---|---|
| Percentage by Mass | |
| Clay lumps and friable particles (ASTM C142/C142M) | 2.0 |
| Material finer than 0.075 mm (ASTM C117) | 1.0 |
| Lightweight particles (ASTM C123/C123M) | 1.0 |
| Other soft particles (COE CRD-C 130) | 2.0 |
| Total of all deleterious substances, exclusive of material finer than 0.075 mm | 5.0 |

The limit for material finer than the 0.075 mm sieve will be increased to 1.5 percent for crushed aggregates consisting of crusher dust that is essentially free from clay or shale. The separation medium for lightweight particles shall have a density of 2.0 specific gravity. This limit does not apply to coarse aggregate manufactured from blast-furnace slag unless contamination is evident.

### 2.2.3 Fine Aggregate

#### 2.2.3.1 Composition

Fine aggregate shall consist of natural sand, manufactured sand, or a combination of the two, and shall be composed of clean, hard, durable particles meeting the requirements of ASTM C33/C33M. Aggregate used for paving compass calibration hardstands shall be free of materials having undesirable magnetic properties, including magnetite in granite, high-iron minerals in traprock, and pyrite in limestone. Each type of fine aggregate shall be stockpiled and batched separately. Particles of the fine aggregate shall be generally spherical or cubical in shape.

#### 2.2.3.2 Grading

Grading of the fine aggregate, as delivered to the mixer, shall conform to the requirements of ASTM C33/C33M and shall have a fineness modulus of not less than 2.50 nor more than 3.40.

#### 2.2.3.3 Deleterious Material

The amount of deleterious material in the fine aggregate shall not exceed the following limits by mass:

Material Percentage by Mass

| Material | Percentage by Mass |
|---|---|
| Clay lumps and friable particles ASTM C142/C142M | 1.0 |
| Material finer than 0.075 mm ASTM C117 | 3.0 |
| Lightweight particles ASTM C123/C123M using a medium with a density of Sp. Gr. of 2.0 | 0.5 |
| Total of all above | 3.0 |

## 2.3 CHEMICAL ADMIXTURES

### 2.3.1 General Requirements

Chemical admixtures may only be used when the specific admixture type and manufacturer is the same material used in the mixture proportioning studies. The air-entraining admixture shall conform to ASTM C260/C260M. An accelerator conforming to ASTM C494/C494M, Type C, may be used only when specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES below and shall not be used to reduce the amount of cementitious material used. Calcium chloride and admixtures containing calcium chloride shall not be used. Retarding or water-reducing admixture shall meet the requirements of ASTM C494/C494M, Type A, B, or D, except that the 6-month and 1-year compressive strength tests are waived. ASTM C494/C494M, Type F and G high range water reducing admixtures and ASTM C1017/C1017M flowable admixtures shall not be used.

### 2.3.2 Lithium Nitrate

The lithium admixture shall be a nominal 30 percent aqueous solution of Lithium Nitrate, with a density of 1.2 kg/L, and shall have the approximate chemical form as shown below:

| Constituent | Limit (Percent by Mass) |
|---|---|
| $LiNo_3$ (Lithium Nitrate) | 30 +/- 0.5 |
| $SO_4^{-2}$ (Sulfate Ion) | 0.1 (max) |
| $Cl^-$ (Chloride Ion) | 0.2 (max) |
| $Na^+$ (Sodium Ion) | 0.1 (max) |
| $K^+$ (Potassium Ion) | 0.1 (max) |

Provide a trained representative to supervise the lithium nitrate admixture dispensing and mixing operations.

2.4 MEMBRANE FORMING CURING COMPOUND

Membrane forming curing compound shall be a white pigmented compound conforming to COE CRD-C 300. .

**2.5 WATER**

Water for mixing and curing shall be fresh, clean, potable, and free of injurious amounts of oil, acid, salt, or alkali, except that non-potable water, or water from concrete production operations, may be used if it meets the requirements of ASTM C1602/C1602M.

**2.6 JOINT MATERIALS**

**2.6.1 Expansion Joint Material**

Expansion joint filler shall be a preformed material conforming to ASTM D1752 Type II. Expansion joint filler shall be 19 mm thick, unless otherwise indicated, and shall be furnished in a single full depth piece.

**2.6.2 Slip Joint Material**

Slip joint material shall be 6 mm thick expansion joint filler, unless otherwise indicated, conforming to paragraph: Expansion Joint Material.

## 2.7 REINFORCING

All reinforcement shall be free from loose, flaky rust, loose scale, oil, grease, mud, or other coatings that might reduce the bond with concrete. Removal of thin powdery rust and tight rust is not required. However, reinforcing steel which is rusted to the extent that it does not conform to the required dimensions or mechanical properties shall not be used.

### 2.7.1 Reinforcing Bars and Bar Mats

Reinforcing bars shall conform to ASTM A615/A615M, billet-steel, Grade 60 . Bar mats shall conform to ASTM A184/A184M. The bar members may be billet rail or axle steel.

### 2.7.2 Welded Wire Reinforcement

Welded Wire Reinforcement shall be deformed or smooth, conforming to ASTM A1064/A1064M, and shall be furnished in flat sheets.

## 2.8 DOWELS AND TIE BARS

### 2.8.1 Dowels

Dowels shall be single piece bars fabricated or cut to length at the shop or mill before delivery to the site. Dowels shall be free of loose, flaky rust and loose scale and shall be clean and straight. Dowels may be sheared to length provided that the deformation from true shape caused by shearing does not exceed 1 mm on the diameter of the dowel and does not extend more than 1 mm from the end of the dowel. Dowels shall be plain (non-deformed) steel bars conforming to ASTM A615/A615M, Grade 40 or 60; ASTM A996/A996M, Grade 50 or 60. Dowel bars shall be epoxy coated in conformance with ASTM A775/A775M. Grout retention rings shall be fully circular metal or plastic devices capable of supporting the dowel until the epoxy hardens. Dowel sleeves or inserts are not permitted.

### 2.8.2 Dowel Bar Assemblies

Dowel bar assemblies shall consist of a framework of metal bars or wires arranged to provide rigid support for the dowels throughout the paving operation, with a minimum of four continuous bars or wires extending along the joint line. The dowels shall be welded to the assembly or held firmly by mechanical locking arrangements that will prevent them from rising, sliding out, or becoming distorted during paving operations.

### 2.8.3 Tie Bars

**Tie** bars shall be deformed steel bars conforming to ASTM A615/A615M, or ASTM A996/A996M, Grade 60 , and of the sizes and dimensions indicated. Deformed rail steel bars and high-strength billet or axle steel bars, Grade 50 or higher, shall not be used for bars that are bent and straightened during construction.

## 2.9 EPOXY RESIN

All epoxy-resin materials shall be two-component materials conforming to the requirements of ASTM C881/C881M, Class as appropriate for each application temperature to be encountered, except that in addition, the materials shall meet the following requirements:

a. Material for use for embedding dowels and anchor bolts shall be Type IV, Grade 3.

b. Material for use as patching materials for complete filling of spalls and other voids and for use in preparing epoxy resin mortar shall be Type III, Grade as approved.

c. Material for use for injecting cracks shall be Type IV, Grade 1.

d. Material for bonding freshly mixed portland cement concrete or mortar or freshly mixed epoxy resin concrete or mortar to hardened concrete shall be Type V, Grade as approved.

**2.10 EQUIPMENT**

All plant, equipment, tools, and machines used in the work shall be maintained in satisfactory working conditions at all times. Submit the following:

a. Details and data on the batching and mixing plant prior to plant assembly including manufacturer's literature showing that the equipment meets all requirements specified herein.

b. Obtain National Ready Mixed Concrete Association (NRMCA) certification of the concrete plant. The concrete plant shall be inspected by an engineer approved by the NRMCA. A list of NRMCA approved engineers is available on the NRMCA website at http://www.nrmca.org. All fees and costs associated with this inspection shall be paid by the Contractor. Submit a copy of the NRMCA QC Manual Section 3 Concrete Plant Certification Checklist, NRMCA Certificate of Conformance, and Calibration documentation on all measuring and weighing devices prior to uniformity testing.

c. A description of the equipment proposed for transporting concrete mixture from the central mixing plant to the paving equipment.

d. A description of the equipment proposed for the machine and hand placing, consolidating and curing of the concrete mixture. Manufacturer's literature on the paver and finisher, together with the manufacturer's written instructions on adjustments and operating procedures necessary to assure a tight, smooth surface on the concrete pavement. The literature shall show that the equipment meets all details of these specifications.

**2.10.1 Batching and Mixing Plant**

a. Location: The batching and mixing plant shall be located on project site as indicated on the drawings. Water and electrical power are available on the project site. There shall be operable telephonic or radio communication between the plant and the placing site at all times concreting is taking place.

b. Type and Capacity: The batching and mixing plant shall be a stationary-type central mix plant, including permanent installations or portable/relocatable plants installed on stable foundations. The plant shall be designed and operated to produce concrete within the specified tolerances, and shall have a capacity of at least 100 cubic meters per hour. The batching and mixing plant shall conform to the requirements of NRMCA QC 3 including provisions addressing:

1. Material Storage and Handling
2. Batching Equipment
3. Central Mixer
4. Ticketing System
5. Delivery System

c. Tolerances: The following tolerances shall apply.

| Materials | Percentage of Required Mass |
|---|---|
| Cementitious Materials | plus or minus 1 |
| Aggregate | plus or minus 2 |
| Water | plus or minus 1 |
| Admixture | plus or minus 3 |

For volumetric batching equipment for water and admixtures, the above numeric tolerances shall apply to the required volume of material being batched. Concentrated admixtures shall be uniformly diluted, if necessary, to provide sufficient volume per batch to ensure that the batchers will consistently operate within the above tolerance.

d. Moisture Control: The plant shall be capable of ready adjustment to compensate for the varying moisture contents of the aggregates and to change the quantities of the materials being batched. An electric moisture meter complying with the provisions of COE CRD-C 143 shall be provided for measuring of moisture in the fine aggregate. The sensing element shall be arranged so that

measurement is made near the batcher charging gate of the fine aggregate bin or in the fine aggregate batcher.

### 2.10.2 Concrete Mixers

a. General: Mixers shall be stationary or truck mixers. Mixers shall be capable of combining the materials into a uniform mixture and of discharging this mixture without segregation. The mixers shall not be charged in excess of the capacity recommended by the manufacturer. The mixers shall be operated at the drum or mixing blade speed designated by the manufacturer. The mixers shall be maintained in satisfactory operating condition, and the mixer drums shall be kept free of hardened concrete. Mixer blades or paddles shall be replaced when worn down more than 10 percent of their depth when compared with the manufacturer's dimension for new blades or paddles.

b. Stationary: Stationary mixers shall be drum or pan mixers. Mixers shall be provided with an acceptable device to lock the discharge mechanism until the required mixing time has elapsed.

c. Mixing Time and Uniformity for Stationary Mixers: For stationary mixers, before uniformity data are available, the mixing time for each batch after all solid materials are in the mixer, provided that all of the mixing water is introduced before one-fourth of the mixing time has elapsed, shall be 1 minute for mixers having a capacity of 0.75 cubic meter. For mixers of greater capacity, this minimum time shall be increased 20 seconds for each additional cubic meter or fraction thereof. After results of uniformity tests are available, the mixing time may be reduced to the minimum time required to meet uniformity requirements; but if uniformity requirements are not being met, the mixing time shall be increased as directed. The mixing time for full batch production shall be a minimum of 75 seconds. Mixer performance tests at new mixing times shall be performed immediately after any change in mixing time. The Regular Test sequence shall be conducted for initial determination of the mixing time or as directed. When regular testing is performed, the concrete shall meet the limits of any five of the six uniformity requirements listed in Table 1 below.

d. The Abbreviated Test sequence shall be conducted for production concrete verification at the frequency specified in Table 6. When abbreviated testing is performed, the concrete shall meet only those requirements listed for abbreviated testing. The concrete proportions used for uniformity tests shall be as used on the project. Regular testing shall consist of performing all six tests on three batches of concrete. The range for regular testing shall be the average of the ranges of the three batches. Abbreviated testing shall consist of performing the three required tests on a single batch of concrete. The range for abbreviated testing shall be the range for one batch. If more than one mixer is used and all are identical in terms of make, type, capacity, condition, speed of rotation, etc., the results of tests on one of the mixers shall apply to the others, subject to the approval of the Contracting Officer. All mixer performance (uniformity) testing shall be performed in accordance with COE CRD-C 55 and with paragraph titled TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3.

TABLE 1 UNIFORMITY REQUIREMENTS--STATIONARY MIXERS

| Parameter | Regular Tests Allowable Maximum Range for Average of 3 Batches | Abbreviated Tests Allowable Maximum Range for 1 Batch |
|---|---|---|
| Unit weight of air-free mortar | 32 kg/cubic m | 32 kg/cubic m |
| Air content | 1.0 percent | -- |
| Slump | 25 mm | 25 mm |
| Coarse aggregate | 6.0 percent | 6.0 percent |
| Compressive strength at 7 days | 10.0 percent | 10.0 percent |
| Water content | 1.5 percent | |

e. Truck: Truck mixers shall not be used for mixing or transporting slipformed paving concrete. The only truck mixers used for mixing or transporting paving concrete shall be those designed with extra large blading and rear opening specifically for low-slump paving concrete. Truck mixers, the mixing of concrete therein, and concrete uniformity and testing thereof shall conform to the requirements of ASTM C94/C94M. The number of revolutions between 70 to 100 for truck-mixed concrete and the number of revolutions for shrink-mixed concrete shall be determined by uniformity tests as specified in ASTM C94/C94M and in requirements for mixer performance stated in paragraph TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3. If requirements for the uniformity of concrete are not met with 100 revolutions of mixing after all ingredients including water are in the truck mixer drum, the mixer shall not be used until the condition is corrected. Water shall not be added after the initial introduction of mixing water except, when on arrival at the job site, the slump is less than specified and the water-cement ratio is less than that given as a maximum in the approved mixture. Additional water may be added to bring the slump within the specified range provided the approved water-cement ratio is not exceeded. Water shall be injected into the head of the mixer (end opposite the discharge opening) drum under pressure, and the drum or blades shall be turned a minimum of 30 additional revolutions at mixing speed. Water shall not be added to the batch at any later time.

### 2.10.3 Transporting Equipment

Slipform concrete shall be transported to the paving site in nonagitating equipment conforming to ASTM C94/C94M or in approved agitators. Fixed form concrete shall be transported in approved truck mixers designed with extra large blading and rear opening specifically for low slump concrete. All transporting equipment shall be designed and operated to deliver and discharge the required concrete mixture completely without segregation.

### 2.10.4 Transfer and Spreading Equipment

Equipment for transferring concrete from the transporting equipment to the paving lane in front of the paver shall be specially manufactured, self-propelled transfer equipment which will accept the concrete outside the paving lane and will transfer and spread it evenly across the paving lane in front of the paver and strike off the surface evenly to a depth which permits the paver to operate efficiently.

### 2.10.5 Paver-Finisher

The following items a through e apply to both fixed-form and slip-form paver-finishers. Item f is applicable to fixed-form paver-finishers and item g is applicable to slip-form paver-finishers.

a. General: The paver-finisher shall be a heavy-duty, self-propelled machine designed specifically for paving and finishing high quality pavement. The paver-finisher shall weigh at least 3280 kg/m of lane width, and shall be powered by an engine having at least 15,000 W/m of lane width. The paver-finisher shall spread, consolidate, and shape the plastic concrete to the desired cross section in one pass. The mechanisms for forming the pavement shall be easily adjustable in width and thickness and for required crown. In addition to other spreaders required by paragraph above, the paver-finisher shall be equipped with a full width knock-down auger or paddle mechanism, capable of operating in both directions, which will evenly spread the fresh concrete in front of the screed or extrusion plate.

b. Vibrators: Immersion vibrators shall be gang mounted at the front of the paver on a frame equipped with suitable controls so that all vibrators can be operated at any desired depth within the slab or completely withdrawn from the concrete, as required. The vibrators shall be automatically controlled so that they will be immediately stopped as forward motion of the paver ceases. The spacing of the immersion vibrators across the paving lane shall be as necessary to properly consolidate the concrete, but the clear distance between vibrators shall not exceed 750 mm. The outside vibrators shall not be more than 300 mm from the lane edge. Spud vibrators shall operate at a frequency of not less than 135 Hz and an amplitude of not less than 0.75 mm, as determined by COE CRD-C 521.

c. Screed or Extrusion Plate: The paver-finisher shall be equipped with a transversely oscillating screed or an extrusion plate to shape, compact, and smooth the surface and shall so finish the surface that no significant amount of hand finishing, except use of cutting straightedges, is required. The screed or extrusion plate shall be constructed to provide adjustment for crown in the pavement. The entire machine shall provide adjustment for variation in lane width or thickness and to prevent more than 200 mm of the screed or extrusion plate extending over previously placed concrete on either end when paving fill-in lanes. Machines that cause displacement of properly installed forms or cause ruts or indentations in the prepared underlying materials and machines that cause frequent delays due to mechanical failures shall be replaced as directed.

d. Longitudinal Mechanical Float: A longitudinal mechanical float may be used. If used, the float shall be specially designed and manufactured to smooth and finish the pavement surface without working excess paste to the surface. It shall be rigidly attached to the rear of the paver-finisher or to a separate self-propelled frame spanning the paving lane. The float plate shall be at least 1.5 m long by 200 mm wide and shall automatically be oscillated in the longitudinal direction while slowly moving from edge to edge of the paving lane, with the float plate in contact with the surface at all times.

e. Other Types of Finishing Equipment: Clary screeds, other rotating tube floats, or bridge deck finishers are not allowed on mainline paving, but may be allowed on irregular or odd-shaped slabs, and near buildings or trench drains, subject to the Contracting Officer's approval. Bridge deck finishers shall have a minimum operating weight of 3400 kg and shall have a transversely operating carriage containing a knock-down auger and a minimum of two immersion vibrators. Vibrating screeds or pans shall be used only for isolated slabs where hand finishing is permitted as specified, and only where specifically approved.

f. Fixed Forms: The paver-finisher shall be equipped with wheels designed to ride the forms, keep it aligned with the forms, and spread the load so as to prevent deformation of the forms. Paver-finishers

traveling on guide rails located outside the paving lane shall be equipped with wheels when traveling on new or existing concrete to remain.

g. Slipform: The slipform paver-finisher shall be automatically controlled and crawler mounted with padded tracks so as to be completely stable under all operating conditions. The paver-finisher shall finish the surface and edges so that no edge slump beyond allowable tolerance occurs. Suitable moving side forms shall be provided that are adjustable and will produce smooth, even edges, perpendicular to the top surface and meeting specification requirements for alignment and freedom from edge slump.

### 2.10.6 Curing Equipment

Equipment for applying membrane-forming curing compound shall be mounted on a self-propelled frame that spans the paving lane. The reservoir for curing compound shall be constantly mechanically (not air) agitated during operation and shall contain means for completely draining the reservoir. The spraying system shall consist of a mechanically powered pump which will maintain constant pressure during operation, an operable pressure gauge, and either a series of spray nozzles evenly spaced across the lane to give uniformly overlapping coverage or a single spray nozzle which is mounted on a carriage which automatically traverses the lane width at a speed correlated with the forward movement of the overall frame. All spray nozzles shall be protected with wind screens.
Calibrate the spraying system in accordance with ASTM D2995, Method A, for the rate of application required in paragraph: Membrane Curing. Any hand-operated sprayers allowed by that paragraph shall be compressed air supplied by a mechanical air compressor. If the curing equipment fails to apply an even coating of compound at the specified rate, it shall immediately be replaced.

### 2.10.7 Texturing Equipment

a. General: Texturing equipment shall be as specified below. Before use, the texturing equipment shall be demonstrated on a test section, and the equipment shall be modified as necessary to produce the texture directed.b. Burlap Drag: A burlap drag shall be securely attached to a separate wheel mounted frame spanning the paving lane or to one of the other similar pieces of equipment. Length of the material shall provide 600 to 900 mm dragging flat on the pavement surface. Width shall be at least equal to the width of the slab. The material shall be clean, reasonably new burlap, completely saturated with water before attachment to the frame, always resaturated before start of use, and kept clean and saturated during use. Burlap shall conform to
AASHTO M 182, Class 3 or 4.

c. Broom: Surface texture shall be applied using an approved mechanical stiff bristle broom drag of a type that will uniformly score the surface transverse to the pavement center line. The broom shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. The scores shall be uniform in appearance and approximately 1.5 mm in depth but not more than 3 mm in depth.

### 2.10.8 Sawing Equipment

Equipment for sawing joints and for other similar sawing of concrete shall be standard diamond-type concrete saws mounted on a wheeled chassis which can be easily guided to follow the required alignment. Blades shall be diamond tipped. If demonstrated to operate properly, abrasive blades may be used. Provide spares as required to maintain the required sawing rate. Wheel saws used in the removal of concrete shall be saws with large diameter tungsten carbide tipped blades mounted on a heavy-duty chassis which will produce a saw kerf at least 40 mm wide. All saws shall be capable of sawing to the full depth required.
Early-entry saws may be used, subject to demonstration and approval of the Contracting Officer. No change to the initial sawcut depth shall be permitted.

### 2.10.9 Straightedge

Furnish and maintain at the job site, in good condition, one 4 m straightedge for each paving train for testing the hardened portland cement concrete surfaces. These straightedges shall be constructed of aluminum or magnesium alloy and shall have blades of box or box-girder cross section with flat bottom, adequately reinforced to insure rigidity and accuracy. Straightedges shall have handles for operation on the pavement.

## 2.11 SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES

### 2.11.1 Specified Flexural Strength

Specified flexural strength, R, for concrete is 4.2 MPa at 28 days, as determined by Maximum allowable water-cementitious material ratio is 0.45. The water-cementitious material ratio will be the equivalent water-cement ratio as determined by conversion from the weight ratio of water to cement plus SCM by the mass equivalency method described in ACI 211.1. The concrete shall be air-entrained with a total air content of 4 plus or minus 1.5 percentage points, at the point of placement. Air content shall be determined in accordance with ASTM C231/C231M. The maximum allowable slump of the concrete at the point of placement shall be 50 mm for pavement constructed with fixed forms. For slipformed pavement, at the start of the project, select a maximum allowable slump which will produce in-place pavement meeting the specified tolerances for control of edge slump. The selected slump shall be applicable to both pilot and fill-in lanes.

### 2.11.2 Concrete Temperature

The temperature of the concrete as delivered shall conform to the requirements of paragraphs, Paving in Hot Weather and Paving in Cold Weather, in PART 3. Temperature of concrete shall be determined in accordance with ASTM C1064/C1064M.

### 2.11.3 Concrete Strength for Final Acceptance

, and no individual set (2 specimens per sublot) in the lot are 170 kPa or more below the equivalent 'Specified Flexural Strength'. If any lot or sublot, respectively, fails to meet the above criteria, the lot or sublot shall be removed and replaced at no additional cost to the Government. This is in addition to and does not replace the average strength required for day-to-day CQC operations as specified in paragraph: Average CQC Flexural Strength Required for Mixtures, below.

## 2.12 MIXTURE PROPORTIONS

### 2.12.1 Composition

Concrete shall be composed of cementitious material, water, fine and coarse aggregates, and admixtures. Supplementary Cementitious Materials (SCM) choice and usage shall be in accordance with paragraph: Supplementary Cementitious Materials (SCM) Content. The total cementitious material content shall be at least 310 kg/cubic meter. Admixtures shall consist of air entraining admixture and may also include, as approved, water-reducing admixture.

### 2.12.2 Proportioning Studies

Trial design batches, mixture proportioning studies, and testing requirements are the responsibility of the Contractor. Submit the results of the mixture proportioning studies signed and stamped by the registered professional engineer having technical responsibility for the mix design study, and submitted at least 30 days prior to commencing concrete placing operations. The results shall include a statement giving the maximum nominal coarse aggregate size and the weights and volumes of each ingredient proportioned on a one cubic meter basis. Aggregate quantities shall be based on the mass in a saturated surface dry condition. The recommended mixture proportions shall be accompanied by test results demonstrating that the proportions selected will produce concrete of the qualities indicated. Trial mixtures having proportions, slumps, and air content suitable for the work shall be

based on methodology described in ACI 211.1, modified as necessary to accommodate flexural strength. Submit test results including:

a. Coarse and fine aggregate gradations and plots.

b. Combined aggregate gradation and coarseness/workability plots.

c. Coarse aggregate quality test results, include deleterious materials.

d. Fine aggregate quality test results.

e. Mill certificates for cement and supplemental cementitious materials.

f. Certified test results for air entraining, water reducing, retarding, non-chloride accelerating admixtures.

g. Specified flexural strength, slump, and air content.

h. Documentation of required average CQC flexural strength, Ra.

i. Recommended proportions/volumes for proposed mixture and each of three trial water-cementitious materials ratios.

j. Individual beam breaks.

k. Flexural strength summaries and plots.

l. Correlation ratios for acceptance testing and CQC testing.

m. Historical record of test results, documenting production standard deviation (if available).

### 2.12.2.1 Water-Cement Ratio

At least three different water-cement ratios, which will produce a range of strength encompassing that required on the project, shall be used. The maximum allowable water-cement ratio required in paragraph: Specified Flexural Strength, above will be the equivalent water-cement ratio. Laboratory trial mixtures shall be proportioned for maximum permitted slump and air content.

### 2.12.2.2 Trial Mixture Studies

Separate sets of trial mixture studies shall be made for each combination of cementitious materials and each combination of admixtures proposed for use. No combination of either shall be used until proven by such studies, except that, if approved in writing and otherwise permitted by these specifications, an accelerator or a retarder may be used without separate trial mixture study. Separate trial mixture studies shall also be made for concrete for each placing method (slip form, fixed form, or hand placement) proposed. The temperature of concrete in each trial batch shall be reported. Each mixture shall be designed to promote easy and suitable concrete placement, consolidation and finishing, and to prevent segregation and excessive bleeding.

### 2.12.2.3 Mixture Proportioning for Flexural Strength

The following step by step procedure shall be followed:

### 2.12.3 Average CQC Flexural Strength Required for Mixtures

In order to ensure meeting the strength requirements specified in paragraph: SPECIFIED CONCRETE STRENGTH AND OTHER PROPERTIES above, during production, the mixture proportions selected during mixture proportioning studies and used during construction shall produce a required average CQC flexural strength exceeding the specified strength, R, by the amount indicated below. This required average CQC flexural strength, Ra, will be used only for CQC operations as specified in paragraph: TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL in PART 3 and as specified in the previous paragraph. During production, the required Ra shall be adjusted , as appropriate and as approved, based on the standard deviation of -day strengths being attained during paving.

a. From Previous Test Records: Where a concrete production facility has previous test records current to within 18 months, a standard deviation shall be established in accordance with the applicable provisions of ACI 214R. Test records from which a standard deviation is calculated shall represent materials, quality control procedures, and conditions similar to those expected, shall represent concrete produced to meet a specified flexural strength or strengths within 1 MPa of the 28 - day flexural strength specified for the proposed work, and shall consist of at least 30 consecutive tests. Perform verification testing, as directed by the Contracting Officer, to document the current strength. A strength test shall be the average of the strengths of two specimens made from the same sample of concrete and tested at 28 days. Required average CQC flexural strength, Ra, used as the basis for selection of concrete proportions shall be the value from the equation that follows, using the standard deviation as determined above:

Ra = R + 1.34S

Where: S = standard deviation
R = specified flexural strength
Ra = required average flexural strength

Where a concrete production facility does not have test records meeting the requirements above but does have a record based on 15 to 29 consecutive tests, a standard deviation shall be established as the product of the calculated standard deviation and a modification factor from the following table:

| NUMBER OF TESTS | MODIFICATION FACTOR FOR STANDARD DEVIATION |
|---|---|
| 15 | 1.16 |
| 20 | 1.08 |
| 25 | 1.03 |
| 30 or more | 1.00 |

b. Without Previous Test Records: When a concrete production facility does not have sufficient field strength test records for calculation of the standard deviation, the required average strength, Ra, shall be determined by adding 15 percent to the specified flexural strength, R.

## PART 3 EXECUTION

### 3.1 PREPARATION FOR PAVING

Before commencing paving, perform the following. If used, forms shall be in place, cleaned, coated, and adequately supported. Any reinforcing steel needed shall be at the paving site. All transporting and transfer equipment shall be ready for use, clean, and free of hardened concrete and foreign material. Equipment for spreading, consolidating, screeding, finishing, and texturing concrete shall be at the paving site, clean and in proper working order. All equipment and material for curing and for protecting concrete from weather or mechanical damage shall be at the paving site, in proper working condition, and in sufficient amount for the entire placement.

#### 3.1.1 Weather Precaution

When windy conditions during paving appear probable, equipment and material shall be at the paving site to provide windbreaks, shading, fogging, or other action to prevent plastic shrinkage cracking or other damaging drying of the concrete.

#### 3.1.2 Proposed Techniques

Submit placing and protection methods; paving sequence; jointing pattern; data on curing equipment and profilographs; demolition of existing pavements, as specified; pavement diamond grinding equipment and procedures. Submit for approval the following items:

a. A description of the placing and protection methods proposed when concrete is to be placed in or exposed to hot, cold, or rainy weather conditions.

b. A detailed paving sequence plan and proposed paving pattern showing all planned construction joints; transverse and longitudinal dowel bar spacing; and identifying pilot lanes and hand placement areas. No deviation from the jointing pattern shown on the drawings shall be made without written approval of the design engineer.

c. Plan and equipment proposed to control alignment of sawn joints within the specified tolerances.

d. Data on the curing equipment, media and methods to be used.

e. Data on profilograph and methods to measure pavement smoothness.

f. Pavement demolition work plan, presenting the proposed methods and equipment to remove existing pavement and protect pavement to remain in place.

## 3.2 CONDITIONING OF UNDERLYING MATERIAL

### 3.2.1 General Procedures

Underlying material, upon which concrete is to be placed shall be clean, damp, and free from debris, waste concrete or cement, frost, ice, standing or running water. Prior to setting forms or placement of concrete, the underlying material shall be well drained and shall have been satisfactorily graded by string-line controlled, automated, trimmer/fine grader and uniformly compacted in accordance with the applicable Section of these specifications. The surface of the underlying material shall be tested as to crown, elevation, and density in advance of setting forms or of concrete placement using slip-form techniques. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade, or filled with concrete monolithically with the pavement. Low areas filled with concrete shall not be cored for thickness to avoid biasing the average thickness used for evaluation and payment adjustment. Any underlying material disturbed by construction operations shall be reworked and recompacted to specified density immediately in front of the paver. If a slipform paver is used, the same underlying material under the paving lane shall

be continued beyond the edge of the lane a sufficient distance and shall be thoroughly compacted and true to grade to provide a suitable trackline for the slipform paver and firm support for the edge of the paving lane.

### 3.2.2 Traffic on Underlying Material

After the underlying material has been prepared for concrete placement, no equipment shall be permitted thereon. Subject to specific approval, crossing of the prepared underlying material at specified intervals for construction purposes may be permitted, provided rutting or indentations do not occur. The surface shall be reworked and reprepared to the satisfaction of the Contracting Officer before concrete is placed. Equipment shall be allowed to operate on the underlying material only if approved by the Contracting Officer and only if no damage is done to the underlying material and its degree of compaction. Any disturbance to the underlying material that does occur shall be corrected, as approved, before the paver-finisher or the deposited concrete reaches the location of the disturbance and the equipment shall be replaced or procedures changed to prevent any future damage.

## 3.3 WEATHER LIMITATIONS

### 3.3.1 Placement and Protection During Inclement Weather

Do not commence placing operations when heavy rain or other damaging weather conditions appear imminent. At all times when placing concrete, maintain on-site sufficient waterproof cover and means to rapidly place it over all unhardened concrete or concrete that might be damaged by rain. Suspend placement of concrete whenever rain, high winds, or other damaging weather commences to damage the surface or texture of the placed unhardened concrete, washes cement out of the concrete, or changes the water content of the surface concrete. All unhardened concrete shall be immediately covered and protected from the rain or other damaging weather. Any slab damaged by rain or other weather shall be completely removed full depth, by full slab width, to the nearest

original joint, and replaced at the Contractor's expense as specified in paragraph: REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS below.

### 3.3.2 Paving in Hot Weather

When the ambient temperature during paving is expected to exceed 32 degrees C, the concrete shall be properly placed and finished in accordance with procedures previously submitted, approved, and as specified herein. The concrete temperature at time of delivery to the forms shall not exceed the temperature shown in the table below when measured in accordance with ASTM C1064/C1064M. Cooling of the mixing water or aggregates or placing in the cooler part of the day may be required to obtain an adequate placing temperature. Steel forms and reinforcing shall be cooled as needed to maintain steel temperatures below 49 degrees C. Transporting and placing equipment shall be cooledor protected if necessary to maintain proper concrete placing temperature. The finished surfaces of the newly laid pavement shall be kept damp by applying a fog spray (mist) with approved spraying equipment until the pavement is covered by the curing medium.

| Maximum Allowable Concrete Placing Temperature | |
|---|---|
| Relative Humidity, Percent, During Time of Concrete Placement | Maximum Allowable Concrete Temperature in Degrees C |
| Greater than 60 | 35 |
| 40-60 | 30 |
| Less than 40 | 27 |

### 3.3.3 Prevention of Plastic Shrinkage Cracking

During weather with low humidity, and particularly with high temperature and appreciable wind, develop and institute measures to prevent plastic shrinkage cracks from developing. If plastic shrinkage cracking occurs, halt further placement of concrete until protective measures are in place to prevent further cracking. Periods of high potential for plastic shrinkage cracking can be anticipated by use of Fig. 4.2 of ACI 305R. In addition to the protective measures specified in the

previous paragraph, the concrete placement shall be further protected by erecting shades and windbreaks and by applying fog sprays of water, the addition of monomolecular films, or wet covering. Apply monomolecular films after finishing is complete, do not use in the finishing process. When such water treatment is stopped, curing procedures shall be immediately commenced. Plastic shrinkage cracks that occur shall be repaired in accordance with paragraph: REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS. Plastic shrinkage cracks shall never be troweled over or filled with slurry.

### 3.3.4 Paving in Cold Weather

Cold weather paving shall conform to ACI 306R. Special protection measures, as specified herein, shall be used if freezing temperatures are anticipated before the expiration of the specified curing period Placement of concrete shall not begin unless the ambient temperature is at least 2 degrees C and rising. Thereafter, placement of concrete shall be halted whenever the ambient temperature drops below 5 degrees C. When the ambient temperature is less than 10 degrees C, the temperature of the concrete when placed shall be not less than 10 degrees C nor more than 25 degrees C. Heating of the mixing water or aggregates will be required to regulate the concrete placing temperature. Materials entering the mixer shall be free from ice, snow, or frozen lumps. Salt, chemicals or other materials shall not be incorporated in the concrete to prevent freezing. If allowed under paragraph: MIXTURE PROPORTIONS in PART 2, an accelerating admixture may be used when the ambient temperature is below 10 degrees C. Covering and other means shall be provided for maintaining the concrete at a temperature of at least 10 degrees C for not less than 72 hours after placing, and at a temperature above freezing for the remainder of the curing period. Remove pavement slabs damaged by freezing or falling below freezing temperature to full depth, by full slab width, to the nearest original joint, and replace at the Contractor's expense as specified in paragraph REPAIR, REMOVAL, REPLACEMENT OF NEWLY CONSTRUCTED SLABS.

### 3.4 CONCRETE PRODUCTION

Batching, mixing, and transporting equipment shall have a capacity sufficient to maintain a continuous, uniform forward movement of the paver of not less than 0.8 m per minute. Concrete transported in non-agitating equipment shall be deposited in front of the paver within 45 minutes from the time cement has been charged into the mixing drum, except that if the ambient temperature is above 32 degrees C, the time shall be reduced to 30 minutes. Concrete transported in truck mixers shall be deposited in front of the paver within 90 minutes from the time cement has been charged into the mixer drum of the plant or truck mixer. If the ambient temperature is above 32 degrees C, the time shall be reduced to 60 minutes. Every load of concrete delivered to the paving site shall be accompanied by a batch ticket from the operator of the batching plant. Tickets shall be on approved forms and shall show at least the mass, or volume, of all ingredients in each batch delivered and the time of day. Tickets shall be delivered to the placing foreman who shall keep them on file and deliver them to the Government weekly, or as directed by the Contracting Officer.

#### 3.4.1 Batching and Mixing Concrete

Scale pivots and bearings shall be kept clean and free of rust. Any equipment which fails to perform as specified shall immediately be removed from use until properly repaired and adjusted, or replaced.

#### 3.4.2 Transporting and Transfer - Spreading Operations

Non-agitating equipment shall be used only on smooth roads and for haul time less than 15 minutes. Concrete shall be deposited as close as possible to its final position in the paving lane. All equipment shall be operated to discharge and transfer concrete without segregation. In no case shall dumping of concrete in discrete piles be permitted. No transfer or spreading operation which requires the use of front-end loaders, dozers, or similar equipment to distribute the concrete will be permitted.

## 3.5 PAVING

### 3.5.1 General Requirements

Pavement shall be constructed with paving and finishing equipment utilizing rigid fixed forms or by use of slipform paving equipment. Paving and finishing equipment and procedures shall be capable of constructing paving lanes of the required width at a rate of at least 0.8 m of paving lane per minute on a routine basis. Paving equipment and its operation shall be controlled, and coordinated with all other operations, such that the paver-finisher has a continuous forward movement, at a reasonably uniform speed, from beginning to end of each paving lane, except for inadvertent equipment breakdown. Backing the paver and refinishing a lane is not permitted. Remove and replace concrete refinished in this manner. Failure to achieve a continuous forward motion requires halting operations, regrouping, and modifying operations to achieve this requirement. Workmen with foreign material on their footwear or construction equipment that might deposit foreign material shall not be permitted to walk or operate in the plastic concrete. Where an open-graded granular base is required under the concrete, select paving equipment and procedures which will operate properly on the base course without causing displacement or other damage.

### 3.5.2 Consolidation

Concrete shall be consolidated with the specified type of lane-spanning, gang-mounted, mechanical, immersion type vibrating equipment mounted in front of the paver, supplemented, in rare instances as specified, by hand-operated vibrators. The vibrators shall be inserted into the concrete to a depth that will provide the best full-depth consolidation but not closer to the underlying material than 50 mm. Excessive vibration shall not be permitted. If the vibrators cause visible tracking in the paving lane, the paving operation shall be stopped and equipment and operations modified to prevent it. Concrete in small, odd-shaped slabs or in isolated locations inaccessible to the gang-mounted vibration equipment shall be vibrated with an approved hand-operated immersion vibrator operated from a bridge spanning

the area. Vibrators shall not be used to transport or spread the concrete. Hand-operated vibrators shall not be operated in the concrete at one location for more than 20 seconds. Insertion locations for hand-operated vibrators shall be between 150 to 400 mm on centers. For each paving train, at least one additional vibrator spud, or sufficient parts for rapid replacement and repair of vibrators shall be maintained at the paving site at all times. Any evidence of inadequate consolidation (honeycomb along the edges, large air pockets, or any other evidence) shall require the immediate stopping of the paving operation and approved adjustment of the equipment or procedures.

### 3.5.3 Operation

When the paver approaches a header at the end of a paving lane, a sufficient amount of concrete shall be maintained ahead of the paver to provide a roll of concrete which will spill over the header. The amount of extra concrete shall be sufficient to prevent any slurry that is formed and carried along ahead of the paver from being deposited adjacent to the header. The spud vibrators in front of the paver shall be brought as close to the header as possible before they are lifted. Additional consolidation shall be provided adjacent to the headers by hand-manipulated vibrators. When the paver is operated between or adjacent to previously constructed pavement (fill-in lanes), provisions shall be made to prevent damage to the previously constructed pavement. Screeds or extrusion plates shall be electronically controlled from the previously placed pavement so as to prevent them from applying pressure to the existing pavement and to prevent abrasion of the pavement surface. The overlapping area of existing pavement surface shall at all times be kept completely free of any loose or bonded foreign material as the paver-finisher operates across it. When the paver travels on existing pavement, approved provisions shall be made to prevent damage to the existing pavement. Pavers using transversely oscillating screeds shall not be used to form fill-in lanes that have widths less than a full width for which the paver was designed or adjusted.

### 3.5.4 Required Results

The paver-finisher, and its gang-mounted vibrators, together with its operating procedures shall be adjusted and operated and coordinated with the concrete mixture being used to produce a thoroughly consolidated slab throughout, true to line and grade within specified tolerances. The paver-finishing operation shall produce a surface finish free of irregularities, tears, voids of any kind, and any other discontinuities. The paver-finisher shall make only one pass across the pavement; multiple passes will not be permitted. The equipment and its operation shall produce a finished surface requiring no hand finishing other than the use of cutting straightedges, except in very infrequent instances. If any equipment or operation fails to produce the above results, the paving shall be stopped, the equipment shall be replaced or properly adjusted, the operation shall be appropriately modified, or the mixture proportions modified, in order to produce the required results before recommencing paving. No water, other than fog sprays (mist) as specified in paragraph: Prevention of Plastic Shrinkage Cracking above, shall be applied to the concrete or the concrete surface during paving and finishing.

### 3.5.5 Fixed Form Paving

Paving equipment for fixed-form paving and the operation thereof shall conform to the requirements of paragraph EQUIPMENT, and all requirements specified herein.

#### 3.5.5.1 Forms for Fixed-Form Paving

a. Straight forms shall be made of steel and shall be furnished in sections not less than 3 m in length. Flexible or curved forms of proper radius shall be used for curves of 31 m radius or less. Wood forms for curves and fillets shall be made of well-seasoned, surfaced plank or plywood, straight, and free from warp or bend. Wood forms shall be adequate in strength and rigidly braced. Forms shall have a depth equal to the pavement thickness at the edge. Where the project requires several different slab thicknesses, forms may be built up by bolting or welding a tubular metal section or by

bolting wood planks to the bottom of the form to completely cover the underside of the base of the form and provide an increase in depth of not more than 25 percent. The base width of the one-piece or built-up form shall be not less than eight-tenths of the vertical height of the form, except than forms 200 mm or less in vertical height shall have a base width not less than the vertical height of the form. Maximum vertical deviation of top of any side form, including joints, shall not vary from a true plane more than 3 mm in 3 m, and the upstanding leg shall not vary more than 6 mm.

b. Form sections shall be tightly locked and shall be free from play or movement in any direction. Forms shall be provided with adequate devices for secure settings so that when in place they will withstand, without visible spring or settlement, the impact and vibration of the consolidating and finishing equipment.

c. Set forms for full bearing on foundation for entire length and width
and in alignment with edge of finished pavement. Support forms during entire operation of placing, compaction, and finishing so that forms will not deviate vertically more than 3 mm from required grade and elevations indicated. Conformity to the alignment and grade elevations shown on the drawings shall be checked and necessary corrections shall be made immediately prior to placing the concrete. The forms shall be cleaned and oiled each time before concrete is placed. No concrete shall be placed until setting of forms has been checked and approved by the CQC team.

d. Do not anchor guide rails for fixed form pavers into new concrete or existing concrete to remain.

### 3.5.5.2 Form Removal

Keep forms in place at least 12 hours after the concrete has been placed. When conditions are such that the early strength gain of the concrete is delayed, leave the forms in place for a longer time, as directed. Remove forms by procedures that do not injure the concrete. Bars or heavy metal tools shall not be used directly against the concrete in removing the forms. Any concrete found to be defective after form removal shall be repaired promptly, using procedures specified or as directed.

### 3.5.6 Slipform Paving

#### 3.5.6.1 General

Paving equipment for slipform paving and the operation thereof shall conform to the requirement of paragraph EQUIPMENT, and all requirements specified herein. The slipform paver shall shape the concrete to the specified and indicated cross section, meeting all tolerances, in one pass. The slipform paver shall finish the surface and edges so that only a very minimum isolated amount of hand finishing is required. If the paving operation does not meet the above requirements and the specified tolerances, immediately stop the operation, and regroup and replace or modify any equipment as necessary, modify paving procedures or modify the concrete mix, in order to resolve the problem. The slipform paver shall be automatically electronically controlled from a taut wire guideline for horizontal alignment and on both sides from a taut wire guideline for vertical alignment, except that electronic control from a ski operating on a previously constructed adjoining lane shall be used where applicable for either or both sides. Automatic, electronic controls for vertical alignment shall always be used on both sides of the lane. Control from a slope-adjustment control or control operating from the underlying material shall never be used. Side forms on slipform pavers shall be properly adjusted so that the finished edge of the paving lane meets all specified tolerances. Dowels in longitudinal construction joints shall be installed as specified below. The installation of these dowels by dowel inserters attached to the paver or by any other means of inserting the dowels into the plastic concrete shall not be permitted.

#### 3.5.6.2 Guideline for Slipform Paving

Accurately and securely install guidelines well in advance of concrete placement. Provide supports at necessary intervals to eliminate all sag in the guideline when properly tightened. The guideline shall be high strength wire set with sufficient tension to remove all sag between supports. Supports shall be securely staked to the underlying material or other provisions made to ensure that the supports will

not be displaced when the guideline is tightened or when the guideline or supports are accidentally touched by workmen or equipment during construction. The appliances for attaching the guideline to the supports shall be capable of easy adjustment in both the horizontal and vertical directions. When it is necessary to leave gaps in the guideline to permit equipment to use or cross underlying material, provisions shall be made for quickly and accurately replacing the guideline without any delay to the forward progress of the paver. Supports on either side of the gap shall be secured in such a manner as to avoid disturbing the remainder of the guideline when the portion across the gap is positioned and tightened. The guideline across the gap and adjacent to the gap for a distance of 60 m shall be checked for horizontal and vertical alignment after the guideline across the gap is tightened. Vertical and horizontal positioning of the guideline shall be such that the finished pavement shall conform to the alignment and grade elevations shown on the drawings within the specified tolerances for grade and smoothness. The specified tolerances are intended to cover only the normal deviations in the finished pavement that may occur under good supervision and do not apply to setting of the guideline. The guideline shall be set true to line and grade.

### 3.5.6.3 Laser Controls

If the Contractor proposes to use any type of automatic laser controls, submit a detailed description of the system and perform a trial field demonstration in the presence of the Contracting Officer at least one week prior to start of paving. Approval of the control system will be based on the results of the demonstration and on continuing satisfactory operation during paving.

### 3.5.7 Placing Reinforcing Steel

The type and amount of steel reinforcement shall be as shown on the drawings.

### 3.5.7.1 Pavement Thickness Greater Than 300 mm

For pavement thickness of 300 mm or more, the reinforcement steel shall be installed by the strike-off method wherein a layer of concrete is deposited on the underlying material, consolidated, and struck to the indicated elevation of the steel reinforcement. The reinforcement shall be laid upon the prestruck surface, and the remaining concrete shall then be placed and finished in the required manner. When placement of the second lift causes the steel to be displaced horizontally from its original position, provisions shall be made for increasing the thickness of the first lift and depressing the reinforcement into the unhardened concrete to the required elevation. The increase in thickness shall be only as necessary to permit correct horizontal alignment to be maintained. Any portions of the bottom layer of concrete that have been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with newly mixed concrete without additional cost to the Government.

### 3.5.7.2 Pavement Thickness Less Than 300 mm

For pavements less than 300 mm thick, the reinforcement shall be positioned on suitable chairs or continuous mesh support devices securely fastened to the subgrade prior to concrete placement. Concrete shall be vibrated after the steel has been placed. Regardless of placement procedure, the reinforcing steel shall be free from coatings which could impair bond between the steel and concrete, and laps in the reinforcement shall be as indicated. Regardless of the equipment or procedures used for installing reinforcement, ensure that the entire depth of concrete is adequately consolidated.

### 3.5.8 Placing Dowels

The method used in installing and holding dowels in position shall ensure that the error in alignment of any dowel from its required horizontal and vertical alignment after the pavement has been completed will not be greater than 3 mm per 300 mm. Except as otherwise specified below, horizontal spacing of dowels shall be within a tolerance of plus or minus 15 mm. The vertical location on the face of the slab shall be within a tolerance of plus or minus 13 mmThe vertical alignment of the

dowels shall be measured parallel to the designated top surface of the pavement, except for those across the crown or other grade change joints. Dowels across crowns and other joints at grade changes shall be measured to a level surface. Horizontal alignment shall be checked perpendicular to the joint edge. The horizontal alignment shall be checked with a framing square. Dowels shall not be placed closer than 0.6 times the dowel bar length to the planned joint line. If the last regularly spaced longitudinal dowel is closer than that dimension, it shall be moved away from the joint to a location 0.6 times the dowel bar length, but not closer than 150 mm to its nearest neighbor. Dowel (tie bar) interference at a transverse joint-longitudinal joint intersection shall be resolved by deleting the closest transverse dowel (tie bar). Dowels shall be installed as specified in the following subparagraphs.

### 3.5.8.1 Contraction Joints

Dowels in longitudinal and transverse contraction joints within the paving lane shall be held securely in place, as indicated, by means of rigid metal frames or basket assemblies of an approved type. The basket assemblies shall be held securely in the proper location by means of suitable pins or anchors. Do not cut or crimp the dowel basket tie wires. At the Contractor's option, in lieu of the above, dowels in contraction joints shall be installed near the front of the paver by insertion into the plastic concrete using approved equipment and procedures. Approval will be based on the results of a preconstruction demonstration, showing that the dowels are installed within specified tolerances.

### 3.5.8.2 Construction Joints-Fixed Form Paving

Install dowels by the bonded-in-place method or the drill-and-dowel method. Installation by removing and replacing in preformed holes will not be permitted. Dowels shall be prepared and placed across joints where indicated, correctly aligned, and securely held in the proper horizontal and vertical position during placing and finishing operations, by means of devices fastened to the forms. The spacing of dowels in construction joints shall be as indicated, except that, where the planned spacing

cannot be maintained because of form length or interference with form braces, closer spacing with additional dowels shall be used.

### 3.5.8.3 Dowels Installed in Hardened Concrete

Install dowels in hardened concrete by bonding the dowels into holes drilled into the hardened concrete. The concrete shall have cured for 7 days or reached a minimum before drilling commences. Holes 3 mm greater in diameter than the dowels shall be drilled into the hardened concrete using rotary-core drills. Rotary-percussion drills may be used, provided that excessive spalling does not occur to the concrete joint face. Continuing damage shall require modification of the equipment and operation. Depth of dowel hole shall be within a tolerance of plus/minus 13 mm of the dimension shown on the drawings. Upon completion of the drilling operation, the dowel hole shall be blown out with oil-free, compressed air. Dowels shall be bonded in the drilled holes using epoxy resin. Epoxy resin shall be injected at the back of the hole before installing the dowel and extruded to the collar during insertion of the dowel so as to completely fill the void around the dowel. Application by buttering the dowel will not be permitted. The dowels shall be held in alignment at the collar of the hole, after insertion and before the grout hardens, by means of a suitable metal or plastic grout retention ring fitted around the dowel. Dowels required to be installed in any joints between new and existing concrete shall be grouted in holes drilled in the existing concrete, all as specified above.

### 3.5.8.4 Lubricating Dowel Bars

The portion of each dowel intended to move within the concrete or expansion cap shall be wiped clean and coated with a thin, even film of
lubricating oil or light grease before the concrete is placed.

## 3.6 FINISHING

Finishing operations shall be a continuing part of placing operations starting immediately behind the strike-off of the paver. Initial finishing shall be provided by the transverse screed or extrusion plate. The sequence of operations shall be transverse finishing, longitudinal machine floating if used, straightedge finishing, texturing, and then edging of joints. Finishing shall be by the machine method. The hand method shall be used only on isolated areas of odd slab widths or shapes and in the event of a breakdown of the mechanical finishing equipment. Supplemental hand finishing for machine finished pavement shall be kept to an absolute minimum. Any machine finishing operation which requires appreciable hand finishing, other than a moderate amount of straightedge finishing, shall be immediately stopped and proper adjustments made or the equipment replaced. Any operations which produce more than 3 mm of mortar-rich surface (defined as deficient in plus 4.75 mm size aggregate) shall be halted immediately and the equipment, mixture, or procedures modified as necessary. Compensation shall be made for surging behind the screeds or extrusion plate and settlement during hardening and care shall be taken to ensure that paving and finishing machines are properly adjusted so that the finished surface of the concrete (not just the cutting edges of the screeds) will be at the required line and grade. Finishing equipment and tools shall be maintained clean and in an approved condition. At no time shall water be added to the surface of the slab with the finishing equipment or tools, or in any other way, except for fog (mist) sprays specified to prevent plastic shrinkage cracking.

### 3.6.1 Machine Finishing With Fixed Forms

The machine shall be designed to straddle the forms and shall be operated to screed and consolidate the concrete. Machines that cause displacement of the forms shall be replaced. The machine shall make only one pass over each area of pavement. If the equipment and procedures do not produce a surface of uniform texture, true to grade, in one pass, the operation shall be immediately stopped and the equipment, mixture, and procedures adjusted as necessary.

### 3.6.2 Machine Finishing with Slipform Pavers

The slipform paver shall be operated so that only a very minimum of additional finishing work is required to produce pavement surfaces and edges meeting the specified tolerances. Any equipment or procedure that fails to meet these specified requirements shall immediately be replaced or modified as necessary. A self-propelled nonrotating pipe float may be used while the concrete is still plastic, to remove minor irregularities and score marks. Only one pass of the pipe float shall be allowed. If there is concrete slurry or fluid paste on the surface that runs over the edge of the pavement, the paving operation shall be immediately stopped and the equipment, mixture, or operation modified to prevent formation of such slurry. Any slurry which does run down the vertical edges shall be immediately removed by hand, using stiff brushes or scrapers. No slurry, concrete or concrete mortar shall be used to build up along the edges of the pavement to compensate for excessive edge slump, either while the concrete is plastic or after it hardens.

### 3.6.3 Surface Correction and Testing

After all other finishing is completed but while the concrete is still plastic, minor irregularities and score marks in the pavement surface shall be eliminated by means of cutting straightedges. Such straightedges shall be 4 m in length and shall be operated from the sides of the pavement and from bridges. A straightedge operated from the side of the pavement shall be equipped with a handle 1 m longer than one-half the width of the pavement. The surface shall then be tested for trueness with a straightedge held in successive positions parallel and at right angles to the center line of the pavement, and the whole area covered as necessary to detect variations. The straightedge shall be advanced along the pavement in successive stages of not more than one-half the length of the straightedge. Depressions shall be immediately filled with freshly mixed concrete, struck off, consolidated with an internal vibrator, and refinished. Projections above the required elevation shall also be struck off and refinished. The straightedge testing and finishing shall continue until the entire surface of the concrete is free from observable departure from the

straightedge and conforms to the surface requirements specified in paragraph: ACCEPTABILITY OF WORK in PART 1. This straightedging shall not be used as a replacement for the straightedge testing of paragraph: Surface Smoothness in PART 1. Long-handled, flat bull floats shall be used very sparingly and only as necessary to correct minor, scattered surface defects. If frequent use of bull floats is necessary, the paving operation shall be stopped and the equipment, mixture or procedures adjusted to eliminate the surface defects. Finishing with hand floats and trowels shall be held to the absolute minimum necessary. Extreme care shall be taken to prevent overfinishing joints and edges. The surface finish of the pavement shall be produced essentially by the finishing machine and not by subsequent hand finishing operations. All hand finishing operations shall be subject to approval and shall be modified when directed.

### 3.6.4 Hand Finishing

Use hand finishing operations only as specified below.

#### 3.6.4.1 Equipment and Template

In addition to approved mechanical internal vibrators for consolidating the concrete, provide a strike-off and tamping template and a longitudinal float for hand finishing. The template shall be at least 300 mm longer than the width of pavement being finished, of an approved design, and sufficiently rigid to retain its shape, and shall be constructed of metal or other suitable material shod with metal. The longitudinal float shall be at least 3 m long, of approved design, and rigid and substantially braced, and shall maintain a plane surface on the bottom. Grate tampers (jitterbugs) shall not be used.

#### 3.6.4.2 Finishing and Floating

As soon as placed and vibrated, the concrete shall be struck off and screeded to the crown and cross section and to such elevation above grade that when consolidated and finished, the surface of the pavement will be at the required elevation. In addition to previously specified complete coverage with handheld immersion vibrators, the entire surface shall be tamped with the strike-off and tamping template, and the tamping operation continued until the required compaction and reduction of internal

and surface voids are accomplished. Immediately following the final tamping of the surface, the pavement shall be floated longitudinally from bridges resting on the side forms and spanning but not touching the concrete. If necessary, additional concrete shall be placed, consolidated and screeded, and the float operated until a satisfactory surface has been produced. The floating operation shall be advanced not more than half the length of the float and then continued over the new and previously floated surfaces.

### 3.6.5 Texturing

Before the surface sheen has disappeared and before the concrete hardens or curing compound is applied, the surface of the pavement shall be given a texture as described herein. After curing is complete, all textured surfaces shall be thoroughly power broomed to remove all debris.

#### 3.6.5.1 Burlap Drag Surface

Surface texture shall be applied by dragging the surface of the pavement, in the direction of the concrete placement, with an approved burlap drag. The drag shall be operated with the fabric moist, and the fabric shall be cleaned or changed as required to keep clean. The dragging shall be done so as to produce a uniform finished surface having a fine sandy texture without disfiguring marks.

3.6.5.2 Artificial Turf Drag SurfaceArtificial turf texture shall be applied by dragging the surface of the pavement in the direction of concrete placement with an approved full-width drag made with artificial turf.

#### 3.6.5.3 Broom Texturing

Brooming should be completed before the concrete has hardened to the point where the surface will be unduly torn or roughened, but after hardening has progressed enough so that the mortar will not flow and reduce the sharpness of the scores. Successive passes of the broom shall be overlapped the

minimum necessary to obtain a uniformly textured surface. Brooms shall be washed thoroughly at frequent intervals during use. Worn or damaged brooms shall be removed from the job site. Hand brooming will be permitted only on isolated odd shaped slabs or slabs where hand finishing is permitted. For hand brooming, the brooms shall have handles longer than half the width of slab to be finished. The hand brooms shall be drawn transversely across the surface from the center line to each edge with slight overlapping strokes.

### 3.6.5.4 Wire-Comb Texturing

Surface texture shall be applied using an approved mechanical wire comb drag operated to comb the surface transverse to the pavement center line. The comb shall be capable of traversing the full width of the pavement in a single pass at a uniform speed and with a uniform pressure. Successive passes of the comb shall be overlapped the minimum necessary to obtain a continuous and uniformly textured surface. Texturing shall be completed before the concrete has hardened to the point where the surface and edges will be unduly torn, but after hardening has progressed to the point where the serrations will not close up. The serrations shall be 2 to 5 mm deep, 1.5 to 3 mm wide, and spaced 9.5 mm apart. Transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 13 mm of a true line.

### 3.6.5.5 Surface Grooving

The areas indicated on the drawings shall be grooved with a spring tine drag producing individual grooves 6 mm deep and 6 mm wide at a spacing between groove centerlines of 37 mm. These grooves shall be cut perpendicular to the centerline. Before grooving begins, the concrete shall be allowed to attain sufficient strength to prevent aggregate spalling. Grooves shall not be cut within 150 mm of a runway centerline, transverse joint, or crack; and they shall not be cut through neoprene compression seals. Transverse texturing shall produce grooves in straight lines across each lane within a tolerance of plus or minus 13 mm of a true line.

### 3.6.6 Edging

After texturing has been completed, the edge of the slabs along the forms, along the edges of slipformed lanes, and at the joints shall be carefully finished with an edging tool to form a smooth rounded surface of 3 mm radius. Tool marks shall be eliminated, and the edges shall be smooth and true to line. No water shall be added to the surface during edging. Extreme care shall be taken to prevent overworking the concrete.3.6.7 Outlets in PavementRecesses for the tie-down anchors, lighting fixtures, and other outlets in the pavement shall be constructed to conform to the details and dimensions shown. The concrete in these areas shall be carefully finished to provide a surface of the same texture as the surrounding area that will be within the requirements for plan rade and surface smoothness.

## 3.7 CURING

### 3.7.1 Protection of Concrete

Concrete shall be continuously protected against loss of moisture and rapid temperature changes for at least 7 days from the completion of finishing operations. All equipment needed for adequate curing and protection of the concrete shall be on hand and ready for use before actual concrete placement begins. If any selected method of curing does not afford the proper curing and protection against concrete cracking, the damaged pavement shall be removed and replaced, and another method of curing shall be employed as directed. Curing shall be accomplished by one of the following methods except that only moist curing shall be used for the first 24 hours.

### 3.7.2 Membrane Curing

A uniform coating of white-pigmented, membrane-forming, curing compound shall be applied to the entire exposed surface of the concrete as soon as the free water has disappeared from the surface after finishing. Along the formed edge faces, it shall be applied immediately after the forms are removed. Concrete shall not be allowed to dry before the application of the membrane. If any

drying has occurred, the surface of the concrete shall be moistened with a fine spray of water, and the curing compound applied as soon as the free water disappears. The curing compound shall be applied to the finished surfaces by means of an approved automatic spraying machine. The application of curing compound by hand-operated, mechanical powered pressure sprayers will be permitted only on odd widths or shapes of slabs and on concrete surfaces exposed by the removal of forms. When the application is made by hand-operated sprayers, a second coat shall be applied in a direction approximately at right angles to the direction of the first coat. If pinholes, abrasions, or other discontinuities exist, an additional coat shall be applied to the affected areas within 30 minutes. Concrete surfaces that are subjected to heavy rainfall within 3 hours after the curing compound has been applied shall be resprayed by the method and at the coverage specified above. Areas where the curing compound is damaged by subsequent construction operations within the curing period shall be immediately resprayed. Concrete surfaces to which membrane-curing compounds have been applied shall be adequately protected during the entire curing period from pedestrian and vehicular traffic, except as required for joint-sawing operations and surface tests, and from any other possible damage to the continuity of the membrane.

### 3.7.3 Moist Curing

Concrete to be moist-cured shall be maintained continuously wet for the entire curing period, or until curing compound is applied, commencing immediately after finishing. If forms are removed before the end of the curing period, curing shall be carried out as on unformed surfaces, using suitable materials. Surfaces shall be cured by ponding, by continuous sprinkling, by continuously saturated burlap or cotton mats, or by continuously saturated plastic coated burlap. Burlap and mats shall be clean and free from any contamination and shall be completely saturated before being placed on the concrete. Lap sheets to provide full coverage. Provide an approved work system to ensure that moist curing is continuous 24 hours per day and that the entire surface is wet.

## 3.8 JOINTS

### 3.8.1 General Requirements for Joints

Joints shall conform to the locations and details indicated and shall be perpendicular to the finished grade of the pavement. All joints shall be straight and continuous from edge to edge or end to end of the pavement with no abrupt offset and no gradual deviation greater than 13 mm. Where any joint fails to meet these tolerances, the slabs adjacent to the joint shall be removed and replaced at no additional cost to the Government. No change from the jointing pattern shown on the drawings shall be made without written approval of the Contracting Officer. Joints shall be sealed immediately following curing of the concrete or as soon thereafter as weather conditions permit. Joints shall be sealed as specified in Section 32 01 19 FIELD MOLDED SEALANTS FOR SEALING JOINTS IN RIGID PAVEMENTS.

### 3.8.2 Longitudinal Construction Joints

Dowels or tie bars shall be installed in the longitudinal construction joints, or the edges shall be thickened as indicated. Tie bars shall be installed as specified above. If any length of completed keyway of 1.5 m or more fails to meet the previously specified tolerances, dowels shall be installed in that part of the joint by drilling holes in the hardened concrete and grouting the dowels in place with epoxy resin. After the end of the curing period, longitudinal construction joints shall be sawed to provide a groove at the top for sealant conforming to the details and dimensions indicated.

### 3.8.3 Transverse Construction Joints

Transverse construction joints shall be installed at the end of each day's placing operations and at any other points within a paving lane when concrete placement is interrupted for 30 minutes or longer. The transverse construction joint shall be installed at a planned transverse joint. Transverse

construction joints shall be constructed by utilizing headers or by paving through the joint, then full-depth sawcutting the excess concrete. Pavement shall be constructed with the paver as close to the header as possible, and the paver shall be run out completely past the header. Transverse construction joints installed at a planned transverse joint shall be constructed as shown or, if not shown otherwise, shall be dowelled in accordance with paragraph: Dowels Installed in Hardened Concrete, or paragraph: Fixed Form Paving above.

### 3.8.4 Expansion Joints

Expansion joints shall be formed where indicated, and about any structures and features that project through or into the pavement, using joint filler of the type, thickness, and width indicated, and shall be installed to form a complete, uniform separation between the structure and the pavement. The filler shall be attached to the original concrete placement with adhesive or other fasteners and shall extend the full slab depth. After placement and curing of the adjacent slab, saw cut the sealant reservior depth from the filler. Adjacent sections of filler shall be fitted tightly together, and the filler shall extend across the full width of the paving lane or other complete distance in order to prevent entrance of concrete into the expansion space. Edges of the concrete at the joint face shall be finished with an edger with a radius of 3 mm.

### 3.8.5 Slip Joints

Slip joints shall be installed where indicated using the specified materials. Preformed joint filler material shall be attached to the face of the original concrete placement with adhesive or other fasteners. A19 mm deep reservoir for joint sealant shall be constructed at the top of the joint. Edges of the joint face shall be finished with an edger with a radius of 3 mm.

### 3.8.6 Contraction Joints

Construct transverse and longitudinal contraction joints by sawing an initial groove in the concrete with a 3 mm blade to the indicated depth. During sawing of joints, and again 24 hours later, the CQC team shall inspect all exposed lane edges for development of cracks below the saw cut, and shall immediately report results to the Contracting Officer. If the Contracting Officer determines that

there are more uncracked joints than desired, the Contractor will be directed to saw succeeding joints 25 percent deeper than originally indicated at no additional cost to the Government. The time of initial sawing shall vary depending on existing and anticipated weather conditions and shall be such as to prevent uncontrolled cracking of the pavement. Sawing of the joints shall commence as soon as the concrete has hardened sufficiently to permit cutting the concrete without chipping, spalling, or tearing. The sawed faces of joints will be inspected for undercutting or washing of the concrete due to the early sawing, and sawing shall be delayed if undercutting is sufficiently deep to cause structural weakness or excessive roughness in the joint. The sawing operation shall be carried on as required during both day and night regardless of weather conditions. The joints shall be sawed at the required spacing consecutively in the sequence of the concrete placement. Adequate lighting shall be provided for night work. Illumination using vehicle headlights will not be permitted. A chalk line or other suitable guide shall be used to mark the alignment of the joint. Before sawing a joint, the concrete shall be examined closely for cracks, and the joint shall not be sawed if a crack has occurred near the planned joint location. Sawing shall be discontinued when a crack develops ahead of the saw cut. Immediately after the joint is sawed, the saw cut and adjacent concrete surface shall be thoroughly flushed with water and vacuumed until all waste from sawing is removed from the joint and adjacent concrete surface. The surface shall be resprayed with curing compound as soon as free water disappears. Necessary precautions shall be taken to insure that the concrete is properly protected from damage and cured at sawed joints. The top of the joint opening and the joint groove at exposed edges shall be tightly sealed with cord backer rod before the concrete in the region of the joint is resprayed with curing compound, and shall be maintained until removed immediately before sawing the joint sealant reservoir. The exposed saw cuts on the faces of pilot lanes shall be sealed with bituminous mastic or masking tape. After expiration of the curing period, the upper portion of the groove shall be widened by sawing with ganged diamond saw blades to the width and depth indicated for the joint sealer. The reservoir shall be centered over the initial sawcut.

### 3.8.7 Thickened Edge Joints

Construct thickened edge joints as indicated on the drawings. Underlying material in the transition area shall be graded as shown and shall meet the requirements for smoothness and compaction specified for all other areas of the underlying material.

## 3.9 REPAIR, REMOVAL AND REPLACEMENT OF NEWLY CONSTRUCTED SLABS

### 3.9.1 General Criteria

New pavement slabs that are broken, have spalled edges, or contain cracks shall be removed and replaced or repaired, as specified at no cost to the Government. Removal of partial slabs is not permitted. Not more than 15.0 percent of each slab's longitudinal joint edge shall be spalled. Prior to fill-in lane placement, pilot lane slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth to remove the spalled face. All other slabs shall be removed, as directed. The Contracting Officer will determine whether cracks extend full depth of the pavement and may require cores to be drilled on the crack to determine depth of cracking. Such cores shall be at least 150 mm diameter, and shall be drilled and backfilled with an approved non-shrink concrete. Perform drilling of cores and refilling holes at no expense to the Government.

### 3.9.2 Slabs with Cracks

Clean cracks that do not exceed 50 mm in depth; then pressure injected full depth with epoxy resin, Type IV, Grade 1. Remove slabs containing cracks deeper than 50 mm.

### 3.9.3 Removal and Replacement of Full Slabs

Where it is necessary to remove full slabs, removal shall be in accordance with paragraph: Removal of Existing Pavement Slab below. Removal and replacement shall be full depth, by full width of the slab, and the limit of removal shall be normal to the paving lane and extend

to each original joint. Dowels of the size and spacing as specified for other joints in similar pavement shall be installed by epoxy grouting them into holes drilled into the existing concrete using procedures as specified in paragraph PLACING DOWELS, above. Original damaged dowels shall be cut off flush with the joint face. Protruding portions of dowels shall be painted and lightly oiled. All four edges of the new slab shall thus contain dowels. Placement of concrete shall be as specified for original construction. Prior to placement of new concrete, the underlying material shall be recompacted and shaped as specified in the appropriate section of these specifications, and the surfaces of all four joint faces shall be cleaned of all loose material and contaminants and coated with a double application of membrane forming curing compound as bond breaker. Care shall be taken to prevent any curing compound from contacting dowels. The resulting joints around the new slab shall be prepared and sealed as specified for original construction.

### 3.9.4 Repairing Spalls Along Joints

Where directed, spalls along joints of new slabs, along edges of adjacent existing concrete, and along parallel cracks shall be repaired by first making a vertical saw cut at least 25 mm outside the spalled area and to a depth of at least 50 mm. Saw cuts shall be straight lines forming rectangular areas. The concrete between the saw cut and the joint, or crack, shall be chipped out to remove all unsound concrete and into at least 13 mm of visually sound concrete. Spalls along joints to be sealed with compression seals shall be sawn, chipped out, and repaired to a depth to restore the full joint-face support. The cavity thus formed shall be thoroughly cleaned with high pressure water jets supplemented with oil-free compressed air to remove all loose material. Immediately before filling the cavity, a prime coat shall be applied to the dry cleaned surface of all sides and bottom of the cavity, except any joint face. The prime coat shall be applied in a thin coating and scrubbed into the surface with a stiff-bristle brush. Prime coat for Portland cement repairs shall be a neat cement grout and for epoxy resin repairs shall be epoxy resin, Type III, Grade 1. The prepared cavity shall be filled with: Portland cement concrete or latex modified mortar for larger cavities, those more than 0.009 cubic meter in size after removal operations; Portland cement mortar for cavities between 0.00085

cubic meter and 0.009 cubic meter; and epoxy resin mortar or epoxy resin or latex modified mortar for those cavities less than 0.00085 cubic meter in size. Portland cement concretes and mortars shall be very low slump mixtures, 13 mm slump or less, proportioned, mixed, placed, consolidated by tamping, and cured, all as directed. Epoxy resin mortars shall be made with Type III, Grade 1, epoxy resin, using proportions and mixing and placing procedures as recommended by the manufacturer and approved by the Contracting Officer. Proprietary patching materials may be used, subject to approval by the Contracting Officer. The epoxy resin materials shall be placed in the cavity in layers not over 50 mm thick. The time interval between placement of additional layers shall be such that the temperature of the epoxy resin material does not exceed 60 degrees C at any time during hardening. Mechanical vibrators and hand tampers shall be used to consolidate the concrete or mortar. Any repair

material on the surrounding surfaces of the existing concrete shall be removed before it hardens. Where the spalled area abuts a joint, an insert or other bond-breaking medium shall be used to prevent bond at the joint face. A reservoir for the joint sealant shall be sawed to the dimensions required for other joints. The reservoir shall be thoroughly cleaned and then sealed with the sealer specified for the joints.

### 3.9.5 Repair of Weak Surfaces

Weak surfaces are defined as mortar-rich, rain-damaged, uncured, or containing exposed voids or deleterious materials. Diamond grind slabs containing weak surfaces less than 6 mm thick to remove the weak surface. Diamond grinding shall be in accordance with paragraph DIAMOND GRINDING OF PCC SURFACES in PART 1. All ground areas shall meet the thickness, smoothness and grade criteria of paragraph ACCEPTANCE REQUIREMENTS in PART 1. Remove and replace slabs containing weak surfaces greater than 6 mm thick.

### 3.9.6 Repair of Pilot Lane Vertical Faces

Excessive edge slump and joint face deformation shall be repaired in accordance with paragraph EDGE SLUMP AND JOINT FACE DEFORMATION in PART

1. Inadequate consolidation (honeycombing or air voids) shall be repaired by saw cutting the face full depth along the entire lane length with a diamond blade. Obtain cores, as directed, to determine the depth of removal.

## 3.10 EXISTING CONCRETE PAVEMENT REMOVAL AND REPAIR

Existing concrete pavement shall be removed at locations indicated on the drawings. Prior to commencing pavement removal operations, inventory the pavement distresses (cracks, spalls, and corner breaks) along the pavement edge to remain. After pavement removal, the remaining edge shall again be surveyed to quantify any damage caused by Contractor's removal operations. Perform both surveys in the presence of the Contracting Officer. Repairs shall be made as indicated and as specified herein. All operations shall be carefully controlled to prevent damage to the concrete pavement and to the underlying material to remain in place. All saw cuts shall be made perpendicular to the slab surface, forming rectangular areas.

### 3.10.1 Removal of Existing Pavement Slab

When existing concrete pavement is to be removed and adjacent concrete is to be left in place, the joint between the removal area and adjoining pavement to stay in place shall first be cut full depth with a standard diamond-type concrete saw. Next, a full depth saw cut shall be made parallel to the joint at least 600 mm from the joint and at least 150 mm from the end of any dowels. This saw cut shall be made with a diamond saw as specified in paragraph: Sawing Equipment. All pavement to be removed beyond this last saw cut shall be removed in accordance with the approved demolition work plan. All pavement between this last saw cut and the joint line shall be removed by carefully pulling pieces and blocks away from the joint face with suitable equipment and then picking them up for removal. In lieu of this method, this strip of concrete may be carefully broken up and removed using hand-held jackhammers, 14 kg or less, or other approved light-duty equipment which will not cause stress to propagate across the joint saw cut and cause distress in the pavement which is to

remain in place. In lieu of the above specified removal method, the slab may be sawcut full depth to divide it into several pieces and each piece lifted out and removed. Suitable equipment shall be used to provide a truly vertical lift, and safe lifting devices used for attachment to the slab.

### 3.10.2 Edge Repair

The edge of existing concrete pavement against which new pavement abuts shall be protected from damage at all times. Slabs which are damaged during construction shall be removed and replaced as directed by the Contracting Officer at no cost to the Government. Repair of previously existing damage areas will be considered a subsidiary part of concrete pavement construction. All exposed keys and keyways shall be sawn off full depth.

#### 3.10.2.1 Spall Repair

Not more than 15.0 percent of each slab's edge shall be spalled as a result of the Contractor's actions. Unless otherwise directed by the Contracting Officer, damaged slabs with spalls exceeding this quantity, regardless of spall size, shall be sawn full depth on the exposed face to remove the spalled face. Repair materials and procedures shall be as previously specified in paragraph: Repairing Spalls Along Joints.

#### 3.10.2.2 Underbreak and Underlying Material

All underbreak shall be repaired by removal and replacement of the damaged slabs in accordance with paragraph: Removal and Replacement of Full Slabs above. The underlying material adjacent to the edge of and under the existing pavement which is to remain in place shall be protected from damage or disturbance during removal operations and until placement of new concrete, and shall be shaped as shown on the drawings or as directed. Sufficient underlying material shall be kept in place outside the joint line to completely prevent disturbance of material under the pavement which is to remain in place. Any material under the portion of the concrete pavement to remain in place which is disturbed or loses its compaction shall be carefully removed and replaced with concrete.

## 3.11 PAVEMENT PROTECTION

Protect the pavement against all damage prior to final acceptance of the work by the Government. Aggregates, rubble, or other similar construction materials shall not be placed on airfield pavements. Traffic shall be excluded from the new pavement by erecting and maintaining barricades and signs until the concrete is at least 14 days old, or for a longer period if so directed. As a construction expedient in paving intermediate lanes between newly paved pilot lanes, operation of the hauling and paving equipment will be permitted on the new pavement after the pavement has been cured for 7 days and the joints have been sealed or otherwise protected, the concrete has attained a minimum field cured flexural strength of 3.6 MPa. and approved means are furnished to prevent damage to the slab edge. All new and existing pavement carrying construction traffic or equipment shall be continuously kept completely clean, and spillage of concrete or other materials shall be cleaned up immediately upon occurrence. Special care shall be used where Contractor's traffic uses or crosses active airfield pavement. Power broom other existing pavements at least daily when traffic operates. For fill-in lanes, equipment shall be used that will not damage or spall the edges or joints of the previously constructed pavement.

## 3.12 TESTING AND INSPECTION FOR CONTRACTOR QUALITY CONTROL

### 3.12.1 Testing and Inspection by Contractor

During construction, the Contractor is responsible for sampling and testing aggregates, cementitious materials (cement, GGBF and pozzolan), and concrete to determine compliance with the specifications. Provide facilities and labor as may be necessary for procurement of representative test samples. Furnish sampling platforms and belt templates to obtain representative samples of aggregates from charging belts at the concrete plant. Samples of concrete shall be obtained at the point of delivery to the paver. Testing by the Government will in no way relieve the Contractor of the specified testing requirements. Perform the inspection and tests described below, and based upon the

results of these inspections and tests, take the action required and submit reports as required. This testing shall be performed regardless of any other testing performed by the Government, either for pay adjustment purposes or for any other reason.

### 3.12.2 Testing and Inspection Requirements

Contractor CQC sampling, testing, inspection and reporting shall be in accordance with the following table.

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

| Frequency | Test Method | Control Limit | Corrective Action |
|---|---|---|---|
| Fine Aggregate Gradation and Fineness Modulus | | | |
| 2 per lot | ASTM C136 sample at belt | 9 of 10 tests vary <0.15 from average | |
| | | Outside limits on any sieve | Retest |
| | | 2nd failure | Stop, repair, retest |
| Coarse Aggregate Gradation | | | |
| 2 per lot | ASTM C136 sample at belt | Outside limits on any sieve | Retest |
| | | 2nd failure | report to COR, correct |
| | | 2 consecutive avgs of 5 tests out | report to COR, stop ops, repair, retest |
| Workability Factor and Coarseness Factor Computation | | | |
| Same as C.A. and F.A. | see paragraph AGGREGATES | Use individual C.A. and F.A. gradations. Combine using batch ticket percentages. Tolerances: +/- 3 points on WF; +/- 5 points on CF from approved mix design values | Check batching tolerances, recalibrate scales |
| Aggregate Deleterious, Quality, and ASR Tests | | | |
| Every 30 days | see paragraph AGGREGATES | | Stop production, retest, replace aggregate. Increase testing interval to 90 days if previous 2 tests pass |
| Plant - Scales, Weighing Accuracy | | | |
| Monthly | NRMCA QC 3 | | Stop plant ops, repair, recalibrate |
| Plant - Batching and Recording Accuracy | | | |
| Weekly | Record/Report | Record required/recorded/actual batch mass | Stop plant ops, repair, recalibrate |
| Plant - Batch Plant Control | | | |
| Every lot | Record/Report | | Record type/amt of each material per lot |
| Plant - Mixer Uniformity - Stationary Mixers | | | |

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

| Frequency | Test Method | Control Limit | Corrective Action |
|---|---|---|---|
| Every 4 months during paving | COE CRD-C 55 | After initial approval, use abbreviated method | Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest |
| Plant - Mixer Uniformity - Truck Mixers | | | |
| Every 4 months during paving | ASTM C94/C94M | Random selection of truck. | Increase mixing time, change batching sequence, reduce batch size to bring into compliance. Retest |
| Concrete Mixture - Air Content | | | |
| When test specimens prepared + 2 random | ASTM C231/C231M sample at paving site | Individual test control chart: Warning +/-1.0 | Adjust AEA, retest |
| | | Individual test control chart: Action +/-1.5 | Halt operations, repair, retest |
| | | Range between 2 consecutive tests: Warning +2.0 | Recalibrate AEA dispenser |
| | | Range between 2 consecutive tests: Action +3.0 | Halt operations, repair, retest |
| Concrete Mixture - Unit Weight and Yield | | | |
| Same as Air Content | ASTM C138/C138M sample at paving site | Individual test basis: Warning Yield -0/+1 percent | Check batching tolerances |
| | | Individual test basis: Action Yield -0/+5 percent | Halt operations |
| Concrete Mixture - Slump | | | |
| When test specimens prepared + 4 random | ASTM C143/C143M sample at paving site | Individual test control chart: Upper Warning - 13 mm below max | Adjust batch masses within max W/C ratio |
| | | Individual test control chart: Upper Action - maximum allowable slump | Stop operations, adjust, retest |
| | | Range between each consecutive test: 38 mm | Stop operations, repair, retest |
| Concrete Mixture - Temperature | | | |
| When test specimens prepared | ASTM C1064/C1064M sample at paving site | See paragraph WEATHER LIMITATIONS | |
| Concrete Mixture - Strength | | | |

TABLE 6
CONTRACTOR TESTING AND INSPECTION REQUIREMENTS

| Frequency | Test Method | Control Limit | Corrective Action |
|---|---|---|---|
| 8 per lot | ASTM C31/C31M sample at paving station | See paragraph CONCRETE STRENGTH TESTING for CQC | |
| Paving - Inspection Before Paving | | | |
| Prior to each paving operation | Report | Inspect underlying materials, construction joint faces, forms, reinforcing, dowels, and embedded items | |
| Paving - Inspection During Paving | | | |
| During paving operation | | Monitor and control paving operation, including placement, consolidation, finishing, texturing, curing, and joint sawing. | |
| Paving - Vibrators | | | |
| Weekly during paving | COE CRD-C 521 | Test frequency (in concrete), and amplitude (in air), measure at tip/head and average. | Repair or replace defective vibrators. |
| Moist Curing | | | |
| 2 per lot, min 4 per day | Visual | | Repair defects, extend curing by 1 day |
| Membrane Compound Curing | | | |
| Daily | Visual | Calculate coverage based on quantity/area | Respray areas where coverage defective. Recalibrate equipment |
| Cold Weather Protection | | | |
| Once per day | Visual | | Repair defects, report conditions to COR |

### 3.12.3 Concrete Strength Testing for Contractor CQC

Contractor Quality Control operations for concrete strength shall consist of the following steps:

### 3.12.4 Reports

All results of tests or inspections conducted shall be reported informally as they are completed and in writing daily. Prepare a weekly report for the updating of control charts covering the entire period from the start of the construction season through the current week. During periods of cold-weather protection, make daily reports of pertinent temperatures. These requirements do not relieve the Contractor of the obligation to report certain failures immediately as required in preceding paragraphs. Such reports of failures and the action taken shall be confirmed in writing in the routine reports. The Contracting Officer has the right to examine all Contractor quality control records.

-- End of Section

# CONCRETE ROAD PAVEMENT

# by

# WIRTGEN SP500 PAVER

# Execution Plan

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# CONCRETE ROAD PAVEMENT by WIRTGEN SP500 PAVER

**MATERIAL :**

1. Concrete shall have a flexural strength not less than 4.2Mpa (42kg/cm2) standard specification (flexural and compressive strength test are required using Testing Beams (15x15x60)cm for flexural tests and standard cubes for compressive strength tests).
2. Dowels must be used and the spacing is according to the design drawings, and the dowels must be epoxy painted using "Steel Standard: STM A615 / 615M / Epoxy Paint Standard: ASTM A775 / 775mm".
3. Superplasticizer concrete admixture: ASTM C 494 Type F / stenmix Super 200" and " Air-entraining concrete admixture: ASTM C260 / stenmix Air", for hot weather concrete "Retarding Concrete Admixture: ASTM C 494 Type B / stenmix Retarder" must be used, and for pouring concrete in cold weather "Accelerating Concrete Admixture: ASTM C494-81 Type C / stenmix antifreeze" must be used.
4. The curing of this concrete must be done using "Concrete Curing Compound: ASTM C309 Type II and CRD C 300 / stencur White".
5. The item includes constructing of the expansion joints, contraction and construction joint according to the drawing and as directed by the Supervising engineer. All joints must be sealed using "Joint Sealant: EN 14188-2 2K StenSeal" and according to the drawings.
6. If there is any deficiency in the finished surface of the concrete it must be repaired and brushed to be rough and consistent with texture of the surrounding concrete, "Concrete Repair Materials: ASTM C881 - StenCare 2EP 310 / StenCare 2EP 311/230 StenCare 2EP" must be used for these repairing.

**METHODOLOGY :**

1. Steel fixed forms of appr. 3 meters each with dowelbar holes shall be placed at both sides of the lane to be poured. The height of the forms shall be adjusted to 2-3 mm lower than the approved concrete level.

2. Fixed forms shall be aligned as per the approved joint plan.
3. Dowelbars shall be placed into the holes of the fixed forms and secured tightly to these forms.

4. Offset wire line of the slipform paver shall be adjusted to the approved level of the concrete and the slipform paver shall have the elevation signal from this line.
5. Slipform paving shall be performed over the fixed forms at the approved level and approved alignment. Due to the vibration of the paver appr. 2 mm of this concrete portion shall be composed of fines.
6. Concrete shall be transported with dump trucks. At windy nights, special care shall be taken to prevent moisture loss of concrete.
7. Concrete shall be dumped in front of slipform paver and shall be spread utilizing a back-hoe loader.

8. Slipform paver shall be operated continuously at a speed of minimum 0.6 m per minute to prevent any possible cold joint in concrete. The floating pan at the back shall operate at such a speed not to cause accumulation of concrete paste at two ends of lane. This speed shall be adjusted depending on the amount of paste coming out from oscillating beam.

9. The edge correction and the finishing of the concrete shall be done as per SECTION 32 13 11 of the RFP. Minimum hand finishing operation shall be done. Straightedges of 4 meters length shall be used for eliminating irregularities and score marks. Long handled bullfloats shall be used very sparingly. The surface of the concrete will be at the required and approved elevation. Extreme care shall be taken to prevent over finishing joints and edges. At the edges of the expansion joints, joint faces shall be rounded with an edger at a radius of 3 mm.

10. All concrete pavements shall have a broom texture. The scoring of the surface shall be as uniform as possible. Brooms shall be washed thoroughly and frequently. Warn or damaged brooms shall not be used.
11. Edges will be finished after brooming with an edger with a radius of 3 mm. Tool marks shall be eliminated by brooming.
12. A uniform coating of a membrane forming curing will follow immediately after all hand works is

finished. Burlapping or polyethylene sheets or similar protection means may be used to protect the concrete against rain and exposure of direct sunlight after curing membrane is applied the concrete is hard enough to walk over.

13. Forms shall remain in place at least 10 hours after the concrete has been placed. No injuring of the edges of the concrete will be allowed when removing the forms.
14. Contraction joints shall be sawed as soon as possible after placing the concrete. It shall be noted that the concrete is hard enough not to have any marring on the edges of the joints when sawing.

**OPERATION :**

Any concrete pavement work should require a 24 hour operation. A sequence of formwork - concrete pouring – joint cutting – joint filling shall be repeated on daily routine. To perform this particular job, a sequence of pilot lanes and fill-in lanes shall be considered. The time interval between pilot lanes and fill-in lanes shall depend on how soon the required flexural strength will be achieved.

**POSSIBLE SCENARIOS :**

Actions to be taken are listed below in corresponding cases:

| No. | Description of case | Action |
|---|---|---|
| 1. | Concrete delivery stoppage | The location of the first contraction joint shall be determined. Steel forms shall be installed in this location and pavement shall be completed up to this first possible contraction joint. |
| 2. | Concrete delivery interruption | Concrete ready on trucks shall be used at minimum operation speed of paver. If concrete delivery could not start at least in 15 minutes after this amount of concrete is used, action #1 shall be taken. |
| 3. | Rain only damaging surface texture | Damaged surfaces shall be textured again and protected by being covered with a polyethylene sheet. |
| 4. | Heavy rain | Concrete trucks and fresh concrete surfaces shall be covered. If rain is so strong that the pavement operation cannot be handled, action #1 shall be taken. |
| 5. | Strong wind | Moisture loss of fresh concrete shall be prevented by covering concrete trucks. Time interval between paving and texturing&curing shall be adjusted to be very short. |

# CONCRETE ROAD PAVEMENT
# METHOD STATEMENT

## 1. INTRODUCTION

Concrete pavement at road projects is being preferred to provide a long-lasting road surface requiring less maintenance costs throughout its service life. This document summarizes means and methods to be used at paving a concrete road. Most recent technology has been chosen to ensure durability, driving comfort and low maintenance cost.

## 2. MATERIAL

Concrete pavements are designed to resist repeated loadings throughout the design service life. Main load considered is the vertical wheel load of the vehicle having largest load on its any wheel to be expected to move on the pavement. Concrete mix has to be designed considering characteristics of the designed underlying course (Crushed Aggregate Base Course, Stabilized Base Course etc.) and the vertical load.

More importantly, pavements have to be designed to transfer the vertical load on one slab to the adjacent slab. To provide this, dowel bars are utilized. (Fig. 01)

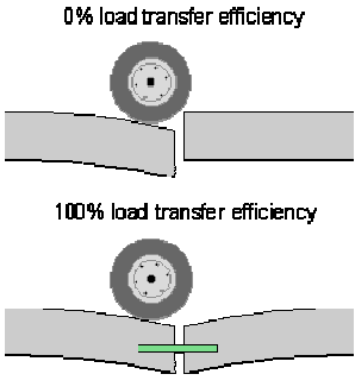



Fig. 01. Load transfer mechanism by dowels

Dowel bars shall be used at each transverse contraction joint. (Pic. 01.) More often steel dowels are used at pavement projects. However, recently GFRP (Glass fiber reinforced polymer) are also being manufactured to be used at pavements. (Pic. 02). DALO shall submit both dowel types for approval.

Pic. 01. Steel dowels at transverse contraction joint

Pic. 02. GFRP dowels at transverse contraction joint

Other supportive materials to be used at concrete pavement project are as follows:

| | | |
|---|---|---|
| Curing Compound | ASTM C309 Type II and CRD C 300 | StenCure White |
| Compressible Joint Filler | ASTM -D. 1751-83 | |
| Joint Sealant | Type M, Grade P, Class 25, Use T according to ASTM C920 | Stenseal 2K |

## 3. EQUIPMENT

Main equipment to be used to place and finish concrete is the slip-form paver, Wirtgen SP500 and/or SP1600 and their attachments. (Pic. 03. and 04.)

Pic. 03. Wirtgen SP500 Slipform Paver

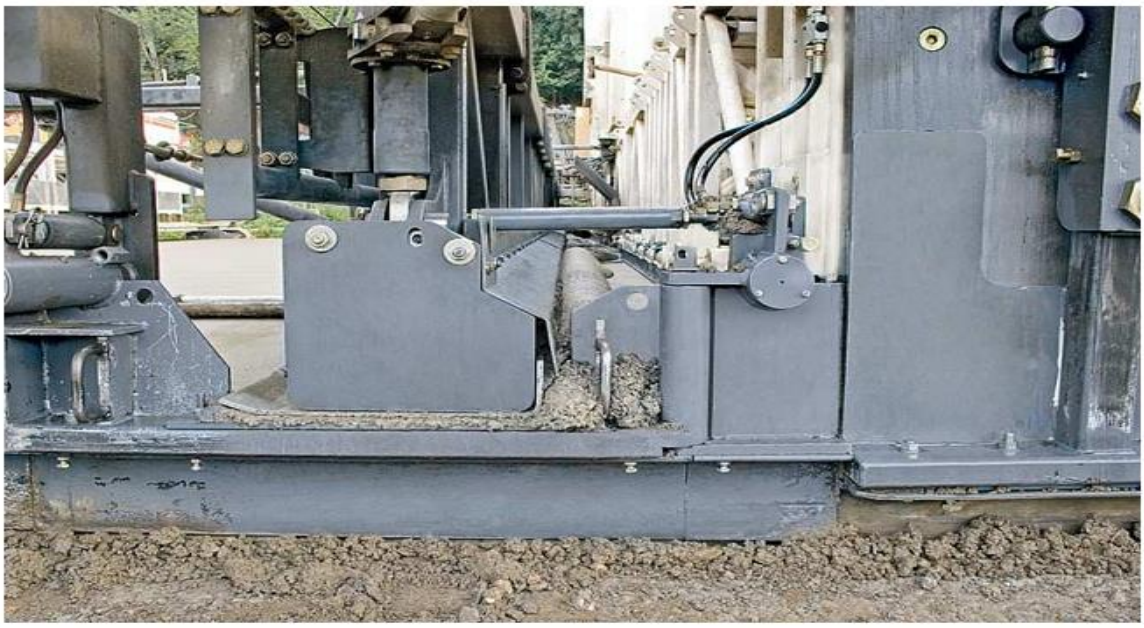
Pic. 04. Wirtgen SP1600 Slipform Paver

**These type of pavers are designed**

- to receive the concrete in the front,
- to spread the concrete throughout the width of the lane, (Pic. 05.)
- to consolidate concrete by vibrators, (Pic. 06.)
- to lay the concrete to the desired level,
- to finish the surface by an oscillating beam and an automatic floating pan. (Pic. 07. and Pic. 08.)

Pic. 05. Spreading Auger attached to the front of paver

Pic. 06. Vibrators

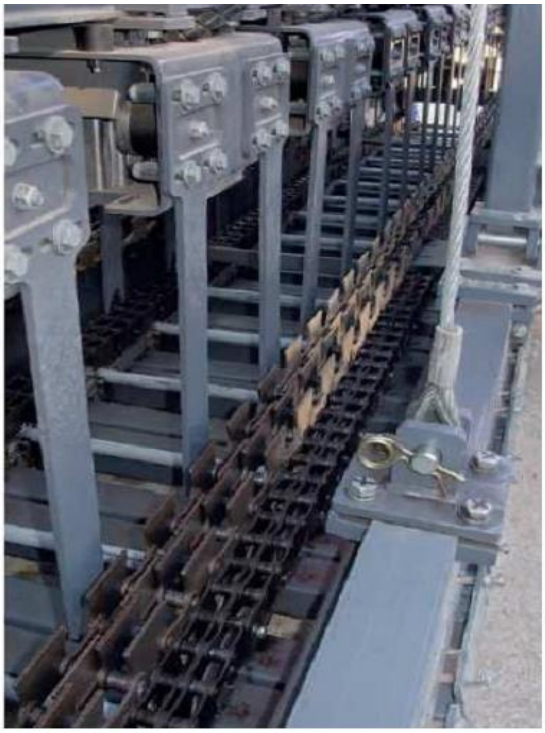


Pic. 07. Oscillating beam

Pic. 08. Supersmoother (Floating Pan)

Some paver are also equipped with automatic dowel bar inserters to place middle tie bars and transverse dowel bars into the fresh concrete as the paver is moving. Wirtgen SP1600 is one of those paver models able to insert dowels. (Pic. 09.a-b)

Pic. 09.b. Longitudinal Joint Bar Inserter



Pic. 09.c. Transverse Dowel Bar Inserter

At this project DALO may use one of these pavers.
Some other assisting equipment such as a rubber tire backhoe loader, a work bridge shall also be utilized during pavement operation. A rubber tire backhoe loader to spread the concrete in front of the paver,

## 4. PRELIMINARY WORKS

### 4.1. Surveying

According to the joint layout plan, all transverse joints shall be marked onto the base course. The surveyor will install two nails lines, on ground, which will give information to the pavement team about the project leveling and steering. The nails must be placed 1.00/1.50m distance parallel to the concrete level. This allows the pavement team to confirm the project elevations when required during pavement operation. Before starting paving concrete two stringlines at both sides of the lane shall be installed parallel to the finishing level of concrete. The guiding line at one side of the paver shall also serve to direct the steering of the paver.

### 4.2. Installing Dowels

Option 1. Wirtgen SP 500

Transvers dowel shall have been installed on plastic or steel chairs. (Pic. 01 and 02). Tie bars shall have been installed into the holes of steel forms (shall be described in detail later).
Option 2. Wirtgen SP1600 with Dowel Bar Inserter
Both transvers dowels and tie bars shall have been loaded onto the paver. Pavement team shall load them to the dowel inserters during pavement operation.
At both options, expansion dowel shall have been installed onto an assembly which shall be placed during paving operation. This assembly shall consist of a temporary form with compressible joint filler placed

### 4.3. Installing Steel Forms

This paragraph is only valid if Wirtgen SP500 is chosen for paving.

Since Wirtgen SP500 can pave upto 6 m, 12 m wide concrete road shall be paved in 2 lanes. An hybrid method of slipform and fixed-form shall be used. Steel fixed forms of appr. 3 meters each with dowelbar holes and fixation system shall be placed on the center line of the road. Tie bars shall be installed into the holes of steel forms. (Pic. 10).

Pic. 10. Fixed form with tie bars installed.

### 4.4. Other Preparations

Curing compound and burlap (or other synthetic covers) adequate for a day operation shall be located along the lane. Expansion dowel assemblies shall be located at each expansion joint lines, outside of the lane (Fig. 02).

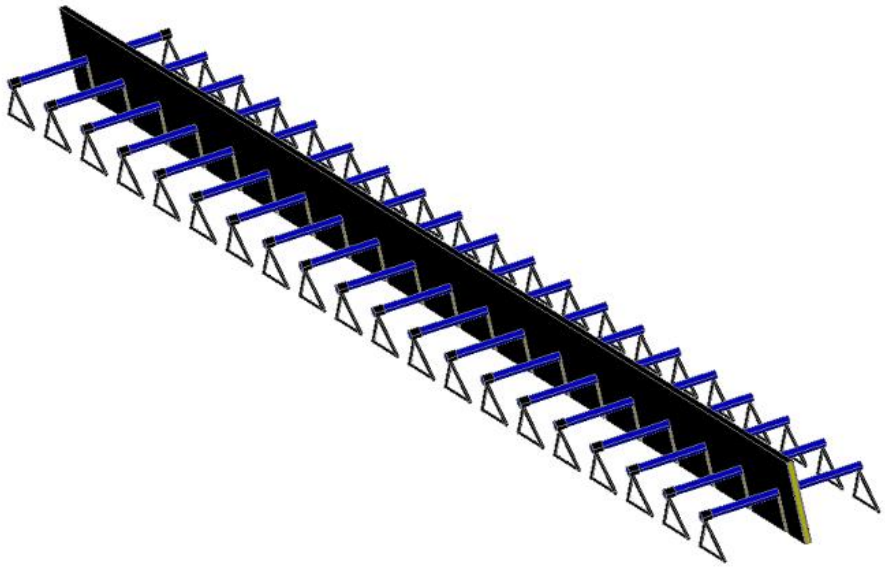


Fig. 02. Expansion Joint Assembly

Expansion joint assembly shall consist of double steel sheets 20 mm apart from each other and the compressible joint filler in-between. Steel sheet shall have U-shaped openings allowing installation of dowels and removal of the steel sheets when the concrete is hard enough.

## 5. OPERATION

Concrete paving operation requires a very well organized sequence of each step. Slipform pavers are preferred to move at constant speed without stopping. To provide this;

• Minimum 8 dump truck shall be ready for operation.

• Two batch plants shall be installed by DALO for this project. They will be located at 10th and 20th km of the road as close as possible.

• Depending on the distance from both batch plants, closer shall govern the day operation, other one shall support the operation.

### 5.1. Transportation of Concrete

Concrete shall be transported with dump trucks from the batch plant and shall be dumped onto ground in front of the paver. A rubber tired excavator shall be ready to spread the concrete dumped from the truck. (Pic. 11). Dump trucks shall be washed at batch plant after each travel so that no concrete hardens on the surface of the truck. Maximum travel time of each truck shall be 20 minutes.


Pic. 11. Truck dumping concrete and excavator ready to spread

### 5.2. Paving

Slipform paver shall be located at the beginning of the lane and the height of the mold shall be adjusted roughly to 30 cm. Levelling sensors shall be placed onto the guide line. The paver shall be passed to automatic control and the height of the mold shall be adjusted accurately by raising or lowering the sensor arms. Steering sensors shall also be adjusted providing that the side forms of the paver shall always follow the edge line of the road. When all automatic levelling and steering have been adjusted, the paver shall be raised by a known height (by lowering sensor arms by a known number of cycles) and the paver shall be moved 1-2 m back. This allows the excavator to spread the first load of concrete back to the beginning of the lane. When the beginning is filled with concrete the paver shall be moved again to its original position, lowered again and paving shall start. An adjustable metering gate in front of the paver allows the operator to adjust the height of the concrete before vibration. After that attachment vibrators are consolidating the concrete. The heavy and very rigid mold provides forming the concrete to desired width and level. An oscillating beam after the mold is doing screeding of the concrete surface all along the width of the lane and producing finer material allowing the state-of-art design Supersmoother to finish the concrete surface at the end. (Fig. 03).

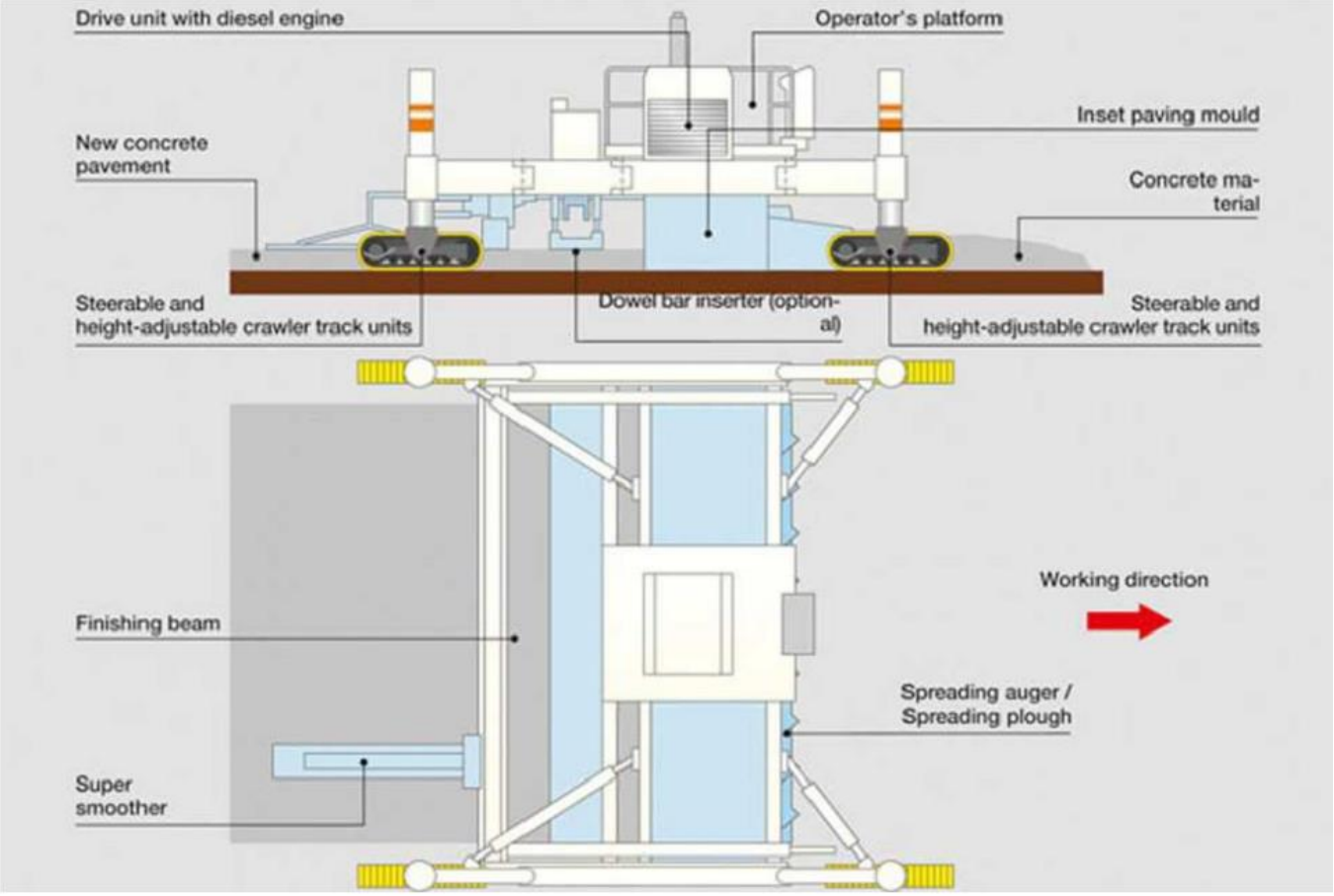



Fig. 03. Wirtgen SP 1600

When Wirtgen SP500 is used, one side of the 6 m lane shall be slipformed and the other side with dowels shall be fix-formed. Transverse dowels shall have been placed on preassembled chairs at every 4.5 m. Therefore dump trucks shall empty their loads from one or other side of the lane.

With Wirtgen SP1600 the whole width of 12 m can be paved at one pass and both sides shall be slipformed. Dowel Bar Inserter shall work between the mold and the oscillating beam. Minimum amount of handfinishing shall be used after supersmoother. Only the edges shall be finished by hand. A work bridge will be used behind the machine to allow any repair that might occur. This platform will be placed behind, moved by workers and will allow crossing over the just casted slab. Manual repair will be use for finishing whenever necessary and executed as soon as possible.
After the finishing is smooth, straight and leveled, the slab will be broom at the desire finishing look. (Pic. 12).

Pic. 12. Broom Finishing

### 5.3. Curing

After achieve the final brooming a uniform coating of curing compound will be spread evenly by a sprayer. The work bridge shall be use if necessary to reach all width of slab. After the concrete is hard enough to walk over, a Geotextile can be placed over the slab to avoid direct sunlight. (Pic. 13). Use of water is recommendable to keep humidity and decrease temperature, especially in very hot days. The geotextile cover shall be kept wet for at least 5 days.

Pic. 13. Laying geotextile to prevent evaporation

### 5.4. Saw Cutting

In maximum 24 hour after placing concrete, control joints shall be cut to a depth at least ¼ of the pavement thickness. A power full wet type saw cutting machine shall be used to provide 3000 rpm to prevent any spalls at joints. (Pic. 14)


Pic. 14. Sat Cutting Transverse Control Joint

### 6. EXECUTION PLAN

Slipform pavers are usually operation at a speed of 1 lm/min. This speed requires a batching capacity of 90 cu.m/hour when paving 6 m. With SP1600 a slower speed has to chosen, for example 0.75 lm/hour. In hot weather season, concrete shall be placed only at night shifts. Considering time losses at every expansion joints, a 10 hour shift shall give 6 hours of paving net. So;

1.0 lm / min * 60 min/hour * 6 hour/day * 6 m = 2160 sqm/day with SP500.

0.75 lm / min * 60 min/hour * 6 hour/day * 12 m = 3240 sqm/day with SP1600.

After getting a strength exceeding 65% of 28-day design strength, paver can operate on recently placed concrete. This is very likely expected to be at 7th day.

## 7. QUALITY CONTROL

A quality pavement requires keeping every stage of operation under control. It starts at stockpile of sand and gravel, and ends when the joints are sealed.
Below is a check list from start to end:

• Do not let crushed stone overheated under the sunlight. To prevent overheating, either keep it under a shed or spread and wet the daily amount of crushed stone.

• Keep the temperature of cement under $60_0$ C.

• When paving under sunlight, cover concrete trucks with a tent to prevent moisture loss.

• Keep the temperature of concrete under $32_0$C.

• Keep the paver moving at a constant speed as possible. If stopping required for any reason, minimize the number of stops.

• Keep people away from the guiding line.

• Keep people other than pavement team away from job site.

• Always check the level of placed concrete to be able to notice any error as earliest as possible.

• Finish brooming as earliest as possible. This is when the broom does not remove en stone from the surface.

• Spray curing compound as earliest as possible. This is when the sprayed curing compound does not flow down or bleed from the surface.

# CONCRETE ROAD PAVEMENT

# by

# WIRTGEN SP500 PAVER

# Chemical treatments Material

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# Chemical treatmentsMaterial

Dalo Group was one of Biggest Joint venture Company for Stenkim Construction Chemicals to provide highest specification of materials and technical support.

| No. | Materials | Product By |
|---|---|---|
| 1 | Expansion Join filler / TYPE II | STENKIM |
| 2 | STENAST®S / Silane Based Surface Conditioner | STENKIM |
| 3 | StenCare 2EP230 / Cold Applied Epoxy Based Repairing And Coating Materials | STENKIM |
| 4 | StenCare 2EP231/ Cold Applied, Epoxy Based, Repair and Coating Material | STENKIM |
| 5 | StenCare 2EP310 / Epoxy Based Self Leveling Repair and Coating Material | STENKIM |
| 6 | StenCare 2EP311 / Epoxy Based Thixotropic Repair and Coating Material | STENKIM |
| 7 | StenCare 3EP-FLEX / Epoksi Esaslı Esnekleştirilmiş Tamir ve Kaplama Malzemesi | STENKIM |
| 8 | StenCoat CR-Y / Alkyd Based Road Marking Paint | STENKIM |
| 9 | StenCure / Water Retentive Paraffinic Emulsion | STENKIM |
| 10 | Stenkim AER / Air Entraining Additive For Concrete | STENKIM |
| 11 | Stenkim Dowel / Bar | STENKIM |
| 12 | StenMix SUPA200 / High Range Water Reducer / Super Plasticizer | STENKIM |
| 13 | StenSeal 2K / Jet Fuel Resistant, Cold Applied, Polyurethane Based, Self Leveling Type Joint Sealant | STENKIM |

**Note :- Specification for All above Materials Attached below**

stenkim®
yapı kimyasalları

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# EXPANSION JOINT FILLER / TYPE II
# ( Conforming to ASTM D 1752)

| | | | | |
|---|---|---|---|---|
| **PRODUCT** | 8002 | | | |
| **SCOPE** | Describe product composition, characteristics and other valuable information. | | | |
| **PRODUCT DESCRIPTION** | Aglomerated composition cork produced with 2/4 mm granulated cork and a polyurethane binder to be used as Self Expansion Joint (Type II) | | | |
| **PHYSICAL CHARACTERISTICS** | CHARACTERISTICS | VALUES | NORM | |
| | Recovery (after 50% thickness compression) | > 90 % | ASTM D 1752 | |
| | Compression ( load to 50% ) | 50 – 1500 psi | ASTM D 1752 | |
| | Extrusion ( after 50 % of thickness compression) | ≤ 6 mm | ASTM D 1752 | |
| | Resistance to boiling in hydrochloric acid | No disaggregation | ASTM D 1752 | |
| **TOLERANCE DIMENSION** | | NOMINAL VALUE (mm) | TOLERANCE (mm) | |
| | Thickness | < 2 | ± 0.1 | |
| | | > 2 <6 | ± 0.2 | |
| | | > 6 <10 | ± 0.5 | |
| | | > 10 <20 | ± 0.3 | |
| | | > 20 | ± 1 | |
| | Width / Length | ± 0.5 % | | |

**STORAGE** We recommend storage the product at these conditions: 20 ±3°C / 60 ± 5% HR

# StenAst® S

## 1. Product Profile

StenAst® S, is a single component, silane based surface conditioner, prepared for all Stenkim® brand polymer based surface coating materials, top coats and joint sealants.

StenAst® S is available in **2.5 kg** packages.

## 2. Uses

StenAst® S is a single component, silane based surface conditioner, prepared for polyurethane materials such as StenFloor®, StenCoat®, StenSeal®, StenSport®, StenCare® to be applied especially on concrete, wooden, fiberglass surfaces. Unlike the film forming primers, it forms a few molecules thick layer. It reacts at one end of with the application surface and at the other end with the material and chemically strengthens adhesion. Therefore it ensures adhesion without forming a third layer between the surface and the material.

StenAst® S is applied by means of brush or roller in one or two layers depending on the porosity and texture of the application surface.

StenAst® S is very compatible with newly cut joint applications on concrete pavements. Since it does not stain when smeared outside the joint, it does not change the appearance. Due to short curing time, it allows fast application. It is not recommended in dusty environments and in cases where old joint sealant will be removed and a new one will be applied. In such environments layer forming primers like StenAst® PU provides better results than surface conditioners like StenAst® S.

## General Purpose, Single Component, Surface Conditioner

## Highlights

### StenAst® S

- It is silane based and single component.
- It is an excellent surface conditioner on concrete, wooden and fiberglass substrates for final coating applications.
- It does not form a film layer in contrast to polyurethane and epoxy primers.
- It enhances adhesion chemically.
- It is very compatible with newly cut joints.
- It does not stain when smeared out of the joint / application area.
- Short application time for the top coating enables fast work, saves work force and time.
- It can be applied via brush and roller.
- It is transparent.

## 3. Surface Preparation

**Concrete Surfaces**: Surface must be free from loose materials, oil, grease, paint and the concrete must be dry. Contaminants stuck on the surface must be removed by sandblasting or mechanical abrading. Contaminants penetrated into the concrete must be wiped with chemicals that can

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# StenAst® S

dissolve the contaminant and must be cleaned with detergent and water.

**Note:** Detailed information on surface preparation is provided in "Application Techniques: Surface Preparation" document.

## 4. Application

StenAst® S must not be applied at temperatures below 5°C. Sufficient amount of StenAst® S is taken to the application container and it is continuously applied on the surface using a brush or roller. It is enough to wet the surface. 15 to 25 $m^2$ area can be covered with a liter of StenAst® S depending on the surface texture of the concrete pavement and application conditions.

When used for joints, it must be applied on the joint before the backer rod is placed inside. Otherwise it can damage the backer rod since it contains high amount of solvent. Sufficient ventilation must be provided during applications for the same reasons.

## 5. Application Tools

Brush and Roller: Rollers and brushes to be used must be of professional quality. Brushes must be made of medium dense natural hair.

## 6. Cleaning

Mixing and application tools must be cleaned with a solvent right after being used. StenSolver CL can be used for this purpose.

## 7. Warnings

- StenAst® S does not leave any marks when cured; it does not form a visible film layer like other types of primer. This situation requires the applicators to be careful in identifying the application area.
- Since it contains high amount of solvent, it must not be considered for cleaning purposes. Contact with skin must be avoided.

## 8. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 9. Storage

Storage temperature must be between 5°C and 30°C. The packages must not be exposed to direct sunlight. Stored unopened in these conditions, the shelf life is 12 months.

## 10. Company Liability

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Stenkim® reserves the right to update all information contained in this document without notice.

# StenAst® S

## Technical Data

| Property | Result |
|---|---|
| Base Polymer | Silane |
| Solvent | Toluene |
| Density | 0.87±0.05g/ $cm^3$ |
| Application Thickness, at each Layer | At nano level |
| Color | Transparent |
| Minimum Curing Time for Top Layer @23$^0$C | 15 minutes |
| Maximum Curing Time for Top Layer @23$^0$C | 24 hours |

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# StenCare® 2EP230

## 1. Product Profile

StenCare® 2EP230 is a two component, cold applied, chemically curing, epoxy based, self leveling repair material. It has high mechanical resistance, flexibility and adhesion, and is suitable for heavy traffic conditions. It is resistant to organic and inorganic acids and alkalies, oils, fuels and antifreezes and many chemicals. It conforms to ASTM C 881/881 M, Type 3, Grade 1, Class C.

StenCare® 2EP230 is available in **5 kg** sets.

## 2. Uses

StenCare® 2EP230 is designed for applications that are subject to movement during or after the application. It can be used for outdoor repairs subject to thermal cycling, for production of epoxy concretes, bonding of aggregates of skid resistant coatings or for any repairs on surfaces subject to traffic or movement. It has excellent adhesion to concrete, metal and wooden surfaces, and provides a stable and durable repair. It is also used as filling or adhesive between two different surfaces. Due to its elasticity, it partially isolates movement of those two surfaces from each other.

**Cold Applied, Epoxy Based, Repair and Coating Material**

### Highlights

### StenCare® 2EP230

- It is epoxy based.
- It is designed for horizontal repairs.
- It has high mechanical strength along with high elasticity.
- It is heavy duty.
- It is thermally and chemically 100% compatible with concrete.
- It is a long lasting material convenient to use.

## 3. Surface Preparation

The surfaces where StenCare® 2EP230 will be applied must be dry, free from contaminants such as oil, grease, sealant remains and loose particles.

Metal surfaces must be cleaned by brush. StenCare® 2EP230 adheres excellent on many surfaces without primer; however primer must be used at places in contact with water and in applications on glass, plastic or rubber.

## 4. Application

StenCare® 2EP230 is a two component material. Components A and B are packed as sets to be completely mixed. Entire component B is poured on component A and they are mixed manually or by means of a low speed drill until a homogeneous mixture is obtained. Prepared mixture must be used within the pot life and thickened materials must not be thinned and used. Applying the material with sufficient pressure and avoiding air entrapment will improve adhesion.

For bonding skid resistant aggregates, the material should be laid on the surface and the aggregates should be broadcast on it

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# StenCare® 2EP230

without delay.

For dowel bar, tie bar installation, or similar anchorage applications, all installation steps should be completed within pot life of the product.

If complete set of StenCare® 2EP230 will not be used, contents of the container must be weighed and partitioned before mixing. Mix ratio by weight must be maintained during this process, otherwise material properties are affected negatively.

## 5. Cleaning

Mixing and application tools must be cleaned with an aromatic solvent right after being used. StenSolver CL can be used for this purpose.

## 6. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage

The material must be kept in dry indoor storages. Recommended storage temperature is 10 - 30ºC. Stored in these conditions, the shelf life is 12 months.

## 8. Company Liability

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## Technical Data

| Property | Method | Result |
|---|---|---|
| Base Polymer | | 2 Component Epoxy |
| Solids Content % | | 100 |
| Colors | | Grey |
| Density (A+B) | | 1,60 ± 0,1 g/cm$^3$ |
| Durometer Hardness (Shore) | ASTM D 2240 | D45±5 |
| Bonding Strength | ASTM C 882 | 20±2 MPa |
| Compressive Modulus | ASTM D 695 | 730 MPa |
| Thermal Compatibility | ASTM C 884 | Pass |
| Elongation at Break | ASTM D 638 | >%60 |
| Gelling time @30ºC | ASTM C 881 | 30 minutes |
| Cure Time For Heavy Trafficability @30°C | | 24 hours |
| Cure Time For Chemical Resistance @30°C | | 72 hours |

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# StenCare® 2EP231

## 1. Product Profile

StenCare® 2EP231 is a two component, cold applied, chemically curing, epoxy based anchorage and coating material which can be used in sloped, vertical or reverse joints, with high mechanical resistance and adhesion, suitable for heavy traffic conditions. It is resistant to organic and inorganic acids and alkalies, oils, fuels and antifreezes and many chemicals.

It conforms to ASTM C 881/881M Type 3, Grade 3, Class B and Class C.

StenCare® 2EP231 is available in **5 kg** sets.

## 2. Uses

StenCare® 2EP231 is designed for application that are subject to movement during or after the application. It can be used for dowel bar installation, bonding of aggregates of skid resistant coatings or for any repairs on surfaces subject to traffic or movement. It can be used for repairs at sloped, vertical and reverse surfaces. It has excellent adhesion to concrete, metal and wooden surfaces, and provides a stable and durable repair. It is also used as filling or adhesive between two different surfaces.

Due to its elasticity, it partially isolates movement of those two surfaces from each other.

## 3. Surface Preparation

The surfaces where StenCare® 2EP231 will be applied must be dry, free from contaminants such as oil, grease, sealant remains and loose particles.

Metal surfaces must be cleaned by brush. StenCare® 2EP231 adheres excellent on many surfaces without primer; however primer must be used at places in contact with water and in applications on glass, plastic or rubber.

**Cold Applied, Epoxy Based, Repair and Coating Material**

## Highlights

### StenCare® 2EP231

- It is epoxy based.
- It is designed for overhead, vertical and sloped repairs.
- It has high mechanical strength along with high elasticity.
- It is heavy duty.
- It is 100% compatible with concrete.
- It cures fast, does not delay traffic.
- It is a long lasting material convenient to use.

## 4. Application

StenCare® 2EP231 is a two component material. Components A and B are packed as sets to be completely mixed. Entire component B is poured on component A and they are mixed manually or by means of a low speed drill until a homogeneous mixture is obtained. Prepared mixture must be used within the pot life and thickened materials must not be thinned and used. Applying the material with sufficient pressure and avoiding air entrapment will improve adhesion. For bonding kid resistant aggregates, the material should be laid on the surface and

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# StenCare® 2EP231

the aggregates should be broadcast on it without delay. For dowel bar, tie bar installation, or similar anchorage applications, all installation steps should be completed within pot life of the product. If complete set of StenCare® 2EP231 will not be used, contents of the container must be weighed and partitioned before mixing. Mix ratio by weight must be maintained during this process, otherwise material properties are affected negatively.

## 5. Cleaning

Mixing and application tools must be cleaned with an aromatic solvent right after being used. StenSolver CL can be used for this purpose.

## 6. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage

The material must be kept in dry indoor storages. Recommended storage temperature is 10 - 30 °C. Stored unopened in these conditions, the shelf life is 12 months.

## 8. Company Liability

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## Technical Data

| Property | Method | Result |
|---|---|---|
| Base Polymer | | 2 Component Epoxy |
| Solids Content % | | 100 |
| Colors | | Grey |
| Density (A+B) | | 1,66± 0,05 g/cm$^3$ |
| Consistency | ASTM C 881 | 2 mm |
| Durometer Hardness (Shore) | ASTM D 2240 | D50±5 |
| Bonding Strength | ASTM C 882 | 17 MPa |
| Compressive Modulus | ASTM D 695 | 720 MPa |
| Thermal Compatibility | ASTM C 884 | Pass |
| Elongation at Break | ASTM D 638 | >%45 |
| Gelling Time @15°C | ASTM C 881 | 30 minutes |
| Gelling time @20°C | ASTM C 881 | 15 minutes |
| Cure Time For Heavy Trafficability @20°C | | 12 hours |
| Cure Time For Chemical Resistance | | 24 hours |

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# StenCare® 2EP310

## 1. Product Profile

**StenCare® 2EP310** is a heavy duty, solvent-free, pourable grade epoxy repair and coating material. It has high adhesion and abrasion resistance properties, and it is resistant to chemicals. It is resistant to weak organic and inorganic acids and alkalies, oils, fuels and antifreezes and many chemicals.

**StenCare® 2EP310** conforms to specification ASTM C881/C881 M Grade 2, Type I, IV, V and Class B and Class C.

**StenCare® 2EP310** is available in **10 kg** sets.

## 2. Uses

**StenCare® 2EP310** is used in repairing old concrete surfaces, broken slab and joint edges, as adherence promoter between old concrete and fresh concrete, for rigid anchorages and dowel bar fixing. It is used indoors and outdoors, in all kinds of repair where high elasticity is not required. It has excellent adhesion to concrete, metal and wooden surfaces, and provides a stable and durable repair.

**Epoxy Based Self Leveling Repair and Coating Material**

### Highlights

### StenCare® 2EP310

- It is epoxy based.
- It is heavy duty.
- Its curing speed can be adjusted to weather and job site conditions.
- It has high load bearing properties.
- It is 100% compatible with concrete.
- It is resistant to chemicals.
- It is a long lasting material convenient to use.

## 3. Surface Preparation

The surfaces where **StenCare® 2EP310** will be applied must be dry, free from contaminants such as oil, grease, sealant remains and loose particles. Metal surfaces must be cleaned by brush.

**StenCare® 2EP310** adheres excellent on many surfaces without primer; however primer must be used at places in contact with water and in applications on glass, plastic or rubber.

## 4. Application

**StenCare® 2EP310** is a two component material. Components A and B are packed as sets to be completely mixed. Entire component B is poured on component A and they are mixed manually or by means of a low speed drill until a homogeneous mixture is obtained. For areas that require early trafficability or under cold ambient conditions **StenQuick EP** may be used to speed up curing. **StenQuick EP** should be added to component B or if container size does not permit that, to the mixture of components B and A.

Prepared mixture must be used within the pot life and thickened materials must not be thinned and used. Applying the material with sufficient pressure and avoiding air entrapment will improve adhesion. For

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# StenCare® 2EP310

surface coating application, the material should be poured on the substrate and spread with a toothed trowel. Once the material is spread, it should left to self level and cure without too much disturbance. The coated area should be kept free from vehicle exhaust and flue gases for at least an hour.

For adhesion promotion, fresh concrete should be placed before the material that has been applied on to old concrete surface becomes tack free. If the material has cured to a tack free state, another coat of the material can be applied without removing the previous coat.

For repairs and anchorage jobs with aggregates, the aggregates should be added to mixture of A and B components without delay, and all should be mixed for at least two more minutes. The moisture present on aggregate particles may lead to unexpected changes in curing time. Inadequately graded particles may lead to poor strength and application time problems. For these reasons, either three component StenCare® 3EP should be used instead of StenCare® 2EP310, or adequately graded and dried StenSilica aggregates should be used.

For armature fixing and dowel bar installation, pot life must be observed closely. Special attention must be paid to ensure no voids are left under the material during dowel bar fixing. If complete set of StenCare® 2EP310 will not be used, contents of the container must be weighed and partitioned before mixing. Mix ratio by weight must be maintained during this process, otherwise material properties are affected negatively.

## 5. Cleaning

Mixing and application tools must be cleaned with an aromatic solvent right after being used. StenSolver CL can be used for this purpose.

## 6. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage

The material must be kept in dry indoor storages. Recommended storage temperature is 10 – 30°C. Stored in these conditions, the shelf life is 12 months.

## 8. Company Liability

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# StenCare® 2EP310

## Technical Data

| Property | Method | Result |
|---|---|---|
| Base Polymer | | 2 Component Epoxy |
| Solids Content % | | 100 |
| Colors | | Grey |
| Density (A+B) | | 1,60± 0,05 g/cm$^3$ |
| Durometer Hardness (Shore) | ASTM D 2240 | D80±5 |
| Bond Strength (2 days) | ASTM C 882 | 19 MPa |
| Bond Strength (14 days) | ASTM C 882 | >25 MPa |
| Tensile Strength | ASTM D 638 | 90 MPa |
| Compressive Modulus | ASTM D 695 | 1800 MPa |
| Elongation at Break | ASTM D 638 | %2.5 |
| Pot life @20ºC | ASTM C 881 | 30 minutes |
| Pot life @20ºC | ASTM C 881 | 15 minutes |
| Cure Time For Heavy Trafficability @20˚C | | 8 hours |
| Cure Time For Chemical Resistance | | 12 hours |

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# StenCare® 2EP311

## 1. Product Profile

StenCare® 2EP311 is a heavy duty, solvent-free epoxy based, thixotropic grade repair and coating material. It has high adhesion and abrasion resistance properties, and it is resistant to chemicals. It is resistant to weak organic and inorganic acids and alkalies, oils, fuels and antifreezes and many chemicals.

StenCare® 2EP311 conforms to specification ASTM C881/C881 M Grade 3, Type I, IV, V, Class B and Class C.

StenCare® 2EP311 is available in **10 kg** sets.

## 2. Uses

StenCare® 2EP311 is used for repairing old concrete surfaces, broken slab and joint edges, for rigid anchorages and dowel bar fixing. It is used indoors and outdoors, in all kinds of repair where high elasticity is not required. It has excellent adhesion to concrete, metal and wooden surfaces, and provides a stable and durable repair.

## 3. Surface Preparation

The surfaces where StenCare® 2EP311 will be applied must be dry, free from contaminants such as oil, grease, sealant remains and loose particles. Metal surfaces must be cleaned by brush.

StenCare® 2EP311 adheres excellent on many surfaces without primer; however primer must be used at places in contact with water and in applications on glass, plastic or rubber.

## 4. Application

StenCare® 2EP311 is a two component material. Components A and B are packed as sets to be completely mixed. Entire component B is poured on component A and they are mixed manually or by means of a low speed drill until a homogeneous mixture is obtained. For areas that require early trafficability or under cold ambient conditions StenQuick EP may be used to speed up curing. StenQuick EP should be added to component B or if container size does not permit .that, to the mixture of components B and A.

Prepared mixture must be used within the pot life and thickened materials must not be thinned and used. Applying the material with sufficient pressure and avoiding air entrapment will improve adhesion. In surface

**Epoxy Based Thixotropic Repair and Coating Material**

### Highlights

### StenCare® 2EP311

- It is epoxy based.
- It is designed for overhead, vertical and sloped repairs.
- It is heavy duty.
- Its curing speed can be adjusted to weather and job site conditions.
- It has high load bearing properties.
- It is 100% compatible with concrete.
- It is resistant to chemicals.
- It is a long lasting material convenient to use.

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# StenCare® 2EP311

coating applications the product is applied by a roller. The coated area should be kept free from vehicle exhaust and flue gases for at least an hour.

For repairs and anchorage jobs with aggregates, the aggregates should be added to mixture of A and B components without delay, and all should be mixed for at least two more minutes. The moisture present on aggregate particles may lead to unexpected changes in curing time. Inadequately graded particles may lead to poor strength and application time problems. For these reasons, either three component StenCare® 3EP should be used instead of StenCare® 2EP311, or adequately graded and dried StenSilica aggregates should be used.

For armature fixing and dowel bar installation, pot life must be observed closely. Special attention must be paid to ensure no voids are left under the material during dowel bar fixing. If complete set of StenCare® 2EP311 will not be used, contents of the container must be weighed and partitioned before mixing. Mix ratio by weight must be maintained during this process, otherwise material properties are affected negatively.

## 5. Cleaning

Mixing and application tools must be cleaned with an aromatic solvent right after being used. StenSolver CL can be used for this purpose.

## 6. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage

The material must be kept in dry indoor storages. Recommended storage temperature is 10 – 30°C. Stored unopened in these conditions, the shelf life is 12 months.

## 8. Company Liability

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# StenCare® 2EP311

## Technical Data

| Property | Method | Result |
|---|---|---|
| Base Polymer | | 2 Component Epoxy |
| Solids Content % | | 100 |
| Colors | | Grey |
| Density (A+B) | | 1,60± 0,05 g/cm$^3$ |
| Durometer Hardness (Shore) | ASTM D 2240 | D80±5 |
| Consistency | ASTM C 881 | 2 mm |
| Bond Strength (2 days) | ASTM C 882 | 19 MPa |
| Bond Strength (14 days) | ASTM C 882 | >25 MPa |
| Compressive Modulus | ASTM D 695 | 1800 MPa |
| Elongation at Break | ASTM D 638 | %2.5 |
| Pot life @20°C | ASTM C 881 | 30 minutes |
| Pot life @20°C | ASTM C 881 | 15 minutes |
| Cure Time For Heavy Trafficability @20°C | | 8 hours |
| Cure Time For Chemical Resistance | | 12 hours |

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# StenCare® 3EP-FLEX

## 1. Ürün Tanıtımı

StenCare® 3EP-FLEX ağır hizmet tipi, solvent ihtiva etmeyen, akıtılarak uygulanabilen, kaymazlık sağlayan özel boyutlandırılmış katı dolgularla taşıma gücü yüksek bir zemin oluşturan, epoksi esaslı kaplama ve onarım malzemesidir. İki veya üç bileşenli olarak kullanılır. Yüksek yapışma ve aşınma direnci ile kimyasal etkilere dayanım özelliklerine sahiptir. Polimerik karışım, portland çimentosundan yapılmış betonun ısıl genleşmelerine uyum gösterir ve betona çok iyi yapışır. Bağlayıcısı esnek olduğundan, termal ve mekanik hareketlere dirençlidir. Minör hareketlere maruz yerlerde derz gerektirmez. Zayıf organik ve inorganik asit ve alkalilere; yağ, yakıt ve antifirizlere ve birçok kimyasala karşı dayanıklıdır.

StenCare® 3EP-FLEX **15 kg**'lık takımlar halinde piyasaya sunulmuştur.

## 2. Kullanım Yerleri

StenCare® 3EP-FLEX eski beton yüzeylerin, kırık ano ve derz kenarlarının ve benzeri yerlerin onarımında kullanılır. Yaya yürüme yollarında, endüstriyel depolama tank sahalarındaki zeminlerde, hava alanı yaya yollarında, park yerlerindeki dönüş ve yavaşlama bölgelerinde ve bu mekanlardaki beton, mozaik, karo, ahşap, metal ve asfalt yüzeylerde kullanım için uygundur.

## 3. Sistem Tasarım Özellikleri

Sistem tasarımı yapılırken mevcut durumun ve uygulamadaki hedefin her yönü ile tanımlanması gerekir. Ağır trafik taşıyan zeminlerdeki onarımlarda derinliğin en az 5cm, orta trafik yükündeki yerlerde en az 3cm, hafif trafik yükündeki yerlerde en az 2cm olması önerilir. Yüzeysel kaplamalarda ise en az 2,5mm kalınlık gereklidir. Kullanılacak agreganın en büyük boyutu minimum uygulama yüksekliğinin yarısını geçmemelidir.

**Epoksi Esaslı Esnekleştirilmiş Tamir ve Kaplama Malzemesi**

## Avantajlar

### StenCare® 3EP-FLEX

- Epoksi esaslıdır.
- Ağır koşullara dayanıklıdır.
- Derz açılmaksızın kullanılabilir
- Harekete dirençlidir
- Kaygan değildir.
- Betonla %100 uyumludur.
- Küçük, büyük her türlü beton tamiri için idealdir.
- Kimyasallara karşı dirençlidir.
- Uzun ömürlü ve uygulaması kolay bir malzemedir.

## 4. Uygulama

### 4.1. Yüzey Hazırlama - Genel

Yüzeyin doğru ve uygun biçimde hazırlanması büyük öneme sahiptir. Zeminde yağ, kir, asfalt, eski yama malzemesi bırakılmamalıdır. Toz ve gevşek malzemeler temizlenmelidir. Uygulama sırasında çevre ve zemin sıcaklığı 15°C ile 30°C arasında, zemindeki bağıl nem oranı en fazla %75 olmalıdır.

Not: Yüzey hazırlama konusunda ayrıntılı bilgiler "Yüzey Hazırlığı: Kaplama Yapılacak Zeminlerdeki Yüzeyler" belgesinde

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# StenCare® 3EP-FLEX

sunulmaktadır.

**4.2. Astar**

Astar olarak temiz beton zeminlerde ve kapalı alanlarda malzemenin kendisi kullanılabilir. Bu durumda yüzey pürüzlülüğüne bağlı olarak 0,2-0,3kg StenCare® 3EP-FLEX uygulanır. Ancak yapışma gücünü iyice arttırmak üzere önce StenAst® S uygulamak yararlıdır. StenAst® S'in tüketim miktarı yaklaşık 50g/$m^2$' dir. StenAst® S uygulandıktan sonra 30 dakika içinde zemin üst katmanın (StenCare® 3EP-FLEX) uygulanmasına uygun hale gelir. StenCare® 3EP-FLEX uygulandıktan sonra 4 saat kurumaya bırakılır ve henüz bu katman yapışkan haldeyken asıl kaplama uygulanır. Yüzey özelliklerinin gerektirdiği başka tür bir astar kullanılacaksa astarın kullanma talimatına uyulur.

**4.3. Serpme Agregalı Kaplama Uygulaması**

Bu yöntem yüzeysel kaplama veya ince yüzey onarımı amacıyla kullanılır. A ve B bileşenleri karıştırıldığında kendiliğinden yayılma özelliğindedir. Bu malzemenin uygulanacağı yüzeyin gerektiği şekilde hazırlanmış olması büyük önem taşır. Böyle bir zemin üzerine kolay, çabuk ve hatasız sonuç veren bir uygulama mümkündür.

**Karıştırma ve Uygulama**

Önce A bileşeni 3-4 dakika karıştırılır. Daha sonra B bileşeni A bileşeninin bulunduğu kutuya katılarak homojen karışım elde edilinceye kadar karıştırılır. Karıştırma işi jiffy tipi mikser ve düşük devirli (300-500 rpm) güçlü bir makine ile yapılır. Kutunun dibinde ve çevresinde karışmamış malzeme kalmamasına dikkat edilir. Karıştırma işleminin uzatılmaması, 2 - 3 dk içinde bitirilmesi ve karıştırılan malzemenin kutusu içinde bekletilmemesi gerekir. Aksi halde sertleşme reaksiyonu ısı veren bir reaksiyon olduğu için kutu içindeki malzeme ısınır ve sertleşme hızı yükselir. Bu durumda kutudaki karışmış malzeme kısa sürede katılaşır ve uygulanmaz hale gelir. Ancak zemine dökülen malzeme zemin tarafından soğutulacağından, reaksiyon yavaşlar ve uygulama için gerekli zaman kazanılır.

Karışım zemine dökülerek çelik veya plastik gelberi mastarla ve fırça veya 25 - 50 mm' lik (nap) rulo ile 2,0 - 2,5 mm kalınlığında uygulanır.

Hemen sonra 1,5 ile 4 mm aralığında boyutlandırılmış kırma agrega serpilerek istenen yüzey granülasyonu sağlanır. Kullanılan agregalar yüksek sertlikte, aşınmaya dayanıklı malzemelerden seçilmelidir. Bu amaçla StenSilica #8-#9 uygundur. Prizini alan malzemenin üzerindeki serbest agregalar süpürülerek uzaklaştırılır. En üst katmanda kullanılacak agrega büyüklüğü istenen yüzey pürüzlülüğüne göre seçilir. Malzemenin gün ışığına direncini arttırmak için en son kat olarak StenCoat® AntiUV kullanılması tavsiye edilir.

**4.4. Agregalı Karışımla Onarım Uygulaması**

Bu yöntem daha çok beton kaplamaların onarımı amacıyla kullanılır. Kendiliğinden yayılma özelliğindeki bu malzemenin karıştırıldıktan sonra uygulanacağı yüzeyin gerektiği şekilde hazırlanmış olması büyük önem taşır. Yukarıda sözü edilen şekilde hazırlanan zemin üzerine kolay, çabuk ve hatasız sonuç veren bir uygulama mümkündür.

**Karıştırma ve Uygulama**

Bu amaçla yapılacak uygulamada hilti veya betoniyer tipi ağır hizmet harç karıştırıcıların kullanılması gereklidir. Bileşenlerin karıştırılması işlemi aşağıdaki gibi yapılır. A bileşeni miksere alınarak üzerine agrega ilave edilir ve homojen yapı elde edilene kadar 1-2 dakika karıştırılır. Bu karışımın üzerine B bileşeni katılarak 1-2 dakika daha karıştırılır ve beklenilmeksizin uygulama yerine dökülür; önce kabaca yayılır ve ardından mastarla düzlenir. Malzeme prizlenmeden önce isteğe bağlı olarak yüzeye ilave agrega serpiştirilebilir. Prizini alan malzemenin üzerindeki serbest agregalar süpürülerek uzaklaştırılır. Kullanılan agregalar yüksek sertlikte, aşınmaya

# StenCare® 3EP-FLEX

dayanıklı malzemelerden seçilmelidir. Bu amaçla StenSilica #5-#10 (0,25 - 7 mm) uygundur. Malzemenin gün ışığına direncini arttırmak için en son kat olarak StenCoat® Anti UV kullanılması tavsiye edilir.

**4.5. Uygulama Aletleri**
Mikser: Jiffy tipi ve tamburlu (betoniyer veya ağır hizmet harç mikseri).
Fırça ve Rulo: Kullanılacak rulo ve fırçalar profesyonel kalitede olmalıdır. Fırçalar orta sıklıkta doğal kıldan yapılmış olmalıdır.
Mastar/Mala: Çelikten yapılmış, düz mastarlar, düz ve dişli malalar kullanılır.

## 5. Temizlik
Karıştırma ve uygulama aletleri, işleri bittikten sonra aromatik bir solventle temizlenmelidir. StenSolver EP bu amaçla kullanılabilir.

## 6. Güvenlik
Malzeme Güvenlik Bilgi Formu (MSDS) uygulayıcılar ve denetleyiciler tarafından dikkatle okunmalı ve yazılan hususlara uygun davranılmalıdır. Boşalan ambalajlar konusunda bu hususlaki yönetmelik ve yasalara uygun şekilde davranılmalıdır.

## 7. Malzemenin Saklanması
Malzemeler sıcaklığı kontrol edilebilen ve 10-30°C'de tutulan depolarda saklanmalı, gün ışığından ve rutubetten korunmalıdır. Malzemeler açık alev ve yangın tehlikesi oluşturabilecek kaynaklardan uzakta tutulmalıdırlar. Bu koşullarda malzeme, açılmamış ambalajında üretim tarihinden itibaren 24 ay süre ile özelliklerini koruyacaktır.

## 8. Firma Sorumluluğu
Bu dokümandaki veriler genel bilgi verme amacıyla düzenlenmiş olup Stenkim®'in deneyimlerine ve laboratuvar testlerine dayanmaktadır. Uygulama alanındaki yeterliliğe ilişkin karar verme sorumluluğu alıcıya aittir. Stenkim® tüm ürünlerini belirttiği kalite ve koşullarda piyasaya sunar. Ancak alıcının taşıma, saklama, uygulama koşulları ve kullanımı hakkında hiçbir bilgiye sahip olamayacağı için kontrolü dışında yapılan uygulamalara ilişkin herhangi bir garanti vermez.
Stenkim® bu dokümandaki tüm verileri haber vermeksizin değiştirme hakkını saklı tutar.

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# StenCare® 3EP-FLEX

## Teknik Veriler (A+B Bileşenleri için)

| Aranan Özellik | Yöntem | Sonuç |
|---|---|---|
| Baz Polimer | | İki Bileşenli Epoksi |
| Katı Madde % | | 100 |
| Renk | | Gri |
| Uygulama Kalınlığı | | Min 5 mm |
| Sertlik (Shore) | ASTM D 2204 | D60-65 |
| Yoğunluk | | 1,20± 0,05 g/cm$^3$ |
| Alev Direnci | | Geçer, Alevlenmez |
| Aşınma Direnci (A+B+C) | ASTM D 4060, CS10, 1000 dev, 1 kg | 400 mg |
| Hareket aralığı | | Genleşmede %5<br>Büzüşmede %2,5 |
| Kimyasal Direnç; Jet Yakıtı, Motor Yağı, Antifiriz, Tuz @20°C | ASTM D -1308 | Geçer |
| Karışımın Uygulama Ömrü (Pot Life) @20°C | | 1 saat |
| Ön Sertleşme (Tack Free) @20°C | | 4 saat |
| Hafif Yaya Trafiğine Uygunluk Süresi @20°C | | 16 saat |
| Yoğun Trafiğe Uygunluk Süresi @20°C | | 48 saat |
| Kimyasal Direnç Kazanma Süresi @20°C | | 5 gün |

Stenkim® bu tablodaki değerlerle ilgili her an değişiklik yapma hakkına sahiptir.

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# StenCoat® CR-Y

## 1. Product Profile

StenCoat® CR-Y is an alkyd based road marking paint. It is a solvent borne, single component material. It is easy to apply and it dries quickly. Catalog colors are available. StenCoat® CR-Y is resistant to traffic and outdoor conditions.
StenCoat® CR-Y conforms to TS EN 1871 and A-A-2886.

StenCoat® CR-Y is available in **20 kg** sets.

## 2. Uses

StenCoat® CR-Y is used as a road marking paint on asphalt and concrete surfaces. It is preferred whenever economy and easy of application are prioritized.

## 3. Surface Preparation

Application surfaces must be as clean as possible. There shouldn't be standing water, oil or fuel on the surface. Application should not be done if it is below dew point or above 50°C.

## 4. Application

StenCoat® CR-Y is ready to use. It can be brushed or sprayed on the surface. If thinning is required, it is advised to thin the paint right before application and that the thinned material is used without delay.
Reflective glass spheres should be broadcast on to paint. They must not be mixed in. Excess glass beads can be removed after an hour.

## 5. Cleaning

Equipment used can be cleaned with StenSolver EP at the end of the job.

## 6. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage

Storage temperature must be 5-30ºC. The packages must not be exposed to direct sunlight. Stored in these conditions, the shelf life is 12 months. Packages to be used must be kept at 20-30°C for a couple of days before the application. It is combustible and inflammable. It must be stored away from open fire and sources of ignition.

## 8. Maintenance

The cleaning is carried out by normal methods like wiping and sweeping with water and detergent. Pressurized water can be used.

**Alkyd Based Road Marking Paint**

### Highlights

### StenCoat® CR-Y

- It is a single component material based on alkyd resin.
- It is resistant to outdoor conditions.
- It dries quickly.
- Its application is practical.
- It is economic.

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# StenCoat® CR-Y

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## Technical Data

| Property | Method | Result |
|---|---|---|
| Colors | | Color Catalog |
| Base Polymer | | Alkyd resin |
| Solids Content Weight % | ASTM D 2369 | 73±3 |
| Solids Content % Volume | ASTM D 2697 | 50±3 |
| Application Thickness | | 200-400 microns |
| Density (Dry Film) | | 1.75±0.1 g/cm$^3$ |
| Grind Fineness | ASTM D 1210 | 8±2 microns |
| Elasticity | ASTM D 522 | 6 mm |
| Adhesion | ASTM D 3359 | GT 1-2 |
| Viscosity | ASTM D 562 | 80±5 K.U. |
| Tack Free Time @ 20°C | TS 4317 | 10-15 minutes |
| Full Cure (300 micron)@20 °C | TS 4317 | 1 hours |

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# StenCure®

## 1. Product Profile

StenCure® is a ready made paraffin based membrane forming material that prevents water loss in fresh concrete. StenCure® meets the requirements of ASTM C309 and TSE 10966 class A/1.

StenCure® is available in **30 kg** plastic pales, **200 kg** drums and **1000 kg** IBCs.

## 2. Uses

StenCure® forms a protective membrane on new concrete surface and prevents water loss. It prevents resistance losses and shrinkage cracks that may be caused by premature water loss. The material makes it unnecessary to take any other precaution (watering or laying wet straw mat, wet sand and oilcloth) for the same purpose.
StenCure®, due to these properties, is used at places such as all types of large concrete surfaces exposed to outdoor conditions and especially at airports, runways, aprons and park areas, concrete access roads, bridges, dams, watering canals and concrete decks.

## 3. Application

StenCure® is supplied ready to use. After the fresh concrete surface becomes matte (1 to 2 hours after the application depending on the ambient temperature), it is sprayed on the concrete surface as a thin layer. Spraying can be carried out by means of a spray gun.

Concrete surfaces must be protected from rain for three hours as of the StenCure® application.

**Consumption:** 150-250 g/m$^2$ depending on wind, humidity and heat.
**Appearance:** Milk white liquid.

## 4. Application Tools

Atomizer, conventional or airless spray gun.

**Water Retentive Paraffinic Emulsion**

## Highlights

### StenCure®

- It is paraffin based.
- It is the most economical method in protecting fresh concrete.
- It prevents water loss in fresh concrete.
- It prevents shrinkage cracks.
- It prevents strength loss of the concrete.
- It is easy to apply.

## 5. Cleaning

After the application, tools can be cleaned by hot water.

## 6. Safety

Required safety measures must be observed during the application of the material and the applicators must use protective clothing, gloves and goggles. Applicators and supervisors must read Material Safety Data Sheet (MSDS) of the material.

## 7. Storage

Shelf life in unopened containers is 2 years. It must be protected against frost. Frozen material cannot be melted and reused.

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## Technical Details

| Property | Result |
|---|---|
| Appearance-Colour | White Liquid |
| Density | 0.98 gr/cm$^3$ |
| Chemical Structure | Paraffin Emulsion |
| Consumption | 150-250 g/m$^2$ |
| Solids Content | 30 % ± 5 |

Stenkim® reserves the right to make changes in the values in this table at any time .

# Stenkim® AER

## 1. Product Profile

**Stenkim® AER** is an air entraining additive for controlled dispersion of micro air bubbles in concrete which increases resistance to freeze thaw cycles.

**Stenkim® AER** conforms to requirements of **TS EN 934-2 T5** (Air Entraining Additive for Concrete) and **ASTM C260** (Standard Specification for Air-Entraining Admixtures for Concrete).

**Stenkim® AER** is available in **30 kg** plastic pales and **200 kg** drums and **1000 kg** tanks.

## 2. Uses

**Stenkim® AER** can be used at concrete highways, airports, runways and terminals, mass concrete structures such as dams and water reservoirs. Additionally it can be used with mass, reinforced or non-reinforced, light weight or normal weight concrete.

**Stenkim® AER** is especially suitable for;

- Obtaining concrete with high workability and durability
- Improve mass concrete's resistance to winter conditions and salt solutions
- Concrete subject to frequent freeze-thaw cycles

## 3. Application

**Stenkim® AER** is a ready to use admixture. It can be mixed with concrete directly. Depending on the desired amount of entrained air, it should be used between 0.03% to 0.15% based on weight of the portland cement. The exact amount must be determined by air meter tests in trial mixes, considering aggregate size distribution, water/cement ratio, type and particle size of cement and ambient temperature.

## Air Entraining Additive For Concrete

## Highlights

### Stenkim® AER

- It controls dispersion of micro air bubbles in concrete
- It can be used at concrete highways, airports, runways and terminals, mass concrete structures such as dams and water reservoirs
- It can be used with mass, reinforced or non-reinforced, light weight or normal weight concrete
- It improves workability
- It improves mass concrete's resistance to winter conditions and salt solutions
- It is suitable for concrete subject to frequent freeze-thaw cycles
- It is a ready to use admixture
- It can be used with other concrete admixtures

**Warning**: Increased air contents may have an adverse effect on strength of the concrete (it is generaly accepted that an additional 1% air content decreases the strength of concrete by 5%). This can be compensated by using water reducing and strengthening additive **Stenkim® SA1**.

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# Stenkim® AER

## 4. Storage
The material must be kept in dry indoor storage. Recommended storage temperature is 10 – 25ºC. Stored in these conditions, the shelf life is 12 months.

## 5. Safety
Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 6. Company Liability
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## Technical Data

| Property | Result |
|---|---|
| Appearance – Color | Light Color Liquid |
| Chemical Structure | Synthetic surface active agents |
| Density | 1.01 kg/l ± 0.01 kg/l |
| pH | 7.0 ± 0.5 |
| Chloride Content | None |
| Freezing Point | 0 °C |

Stenkim® reserves the right to make changes in the values in this table at any time.

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# Stenkim Dowel Bar

## 1. Product Description

Stenkim® Dowel Bar, is a plain carbon steel bar for used for concrete reinforcement in cut lengths and coils.

Stenkim® Dowel Bar conforms ASTM A 615 / A 615M Grade 60.

Stenkim® Dowel Bars coated by protective epoxy coaiting and conforms ASTM A 775/A 775M.

## 2. Uses

The use of appropriately sized Stenkim® Dowel Bars is highly recommended for jointed concrete pavements that are subjected to high volumes of heavy traffic. Stenkim® Dowel Bars provide positive load transfer across pavement joints to greatly reduce critical deflections and stresses, thereby reducing the potential for pumping and faulting at joints, as well as slab cracking.

## Technical Data of Dowel Bar

| Diameter (mm) | Perimeter (mm) | Cross-Sectional Area ($mm^2$) | Weight (kg/m) |
|---|---|---|---|
| 20 | 62,8 | 314 | 2,466 |
| 50 | 157 | 1963 | 15,413 |

*** For Length of Stenkim® Dowel Bar please contact with Stenkim®

## Chemical Data of Dowel Bar

| Standart | Quality Code | C | M | Si | S | P |
|---|---|---|---|---|---|---|
| TS 705 | BÇ III-a/1-3 | 0,3 - 0,40 | 1,10 - 1,40 | Max 0,15 | Max 0,05 | Max 0,05 |

# StenMix® SUPA 200

## 1. Product Profile

**StenMix® SUPA 200** is a ready to use naphthalene sulphonate based, high range, water reducing, superplasticising admixture for Portland cement concrete.

**StenMix® SUPA 200** conforms to requirements of **TS EN 934-2 Table 3** (High Range Water Reducer/Plasticizer Standard) and **ASTM C 494 Type F** (Standard Specification for Chemical Admixtures for Concrete – Water Reducing, High Range Admixtures).

**StenMix® SUPA 200** is available in **35 kg** plastic pales and **200 kg** drums and **1200 kg** tanks.

## 2. Uses

**StenMix® SUPA 200** is suitable for production of highly flowable concrete to improve surface finish and density. It is especially suitable for use with floor slabs, foundations, ceilings, walls, beams and columns with densely packed reinforcements. It can also be used with high early strength precast and prestressed concrete or when early removal of form work is required.

**StenMix® SUPA 200** substantially improves workability when added to premixed concrete. It eliminates the risk of segregation during concrete transport and placement. It reduces the amount of vibration required. It does not retard curing reaction of the concrete, so the curing time is not increased. It decreases the permeability of the concrete by decreasing amount of water required.

**StenMix® SUPA 200**, decreases the water requirement of the concrete by 15%-30% when dosage limits are observed.

**High Range Water Reducer / Super Plasticizer**

## Highlights

### StenMix® SUPA200

- Naphthalene Sulphonate based high range water reducing, superplasticising admixture
- It improves surface finish and density
- It can be used with high early strength precast and prestressed concrete
- It improves workability
- It eliminates the risk of segregation during concrete transport and placement
- It reduces the amount of vibration required
- It decreases the permeability of the concrete by decreasing amount of water required by 15% - 30% when dosage limits are observed

## 3. Application

The recommended dosage for **StenMix® SUPA 200**, is 0.8% to 3% based on weight of the cement.

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# StenMix® SUPA 200

StenMix® SUPA 200, should be added with the mixing water. Most preferably StenMix® SUPA 200, is added to the gauging water at the plant, it should not be added to dry cement. Exact dosage must be determined by laboratory trial considering required workability and strength of concrete.

## 4. Storage

The material must be kept in dry indoor storages. Recommended storage temperature is 0 – 30ºC. Stored in these conditions, the shelf life is 12 months.

## 5. Safety

Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 6. Company Liability

The information contained in this document is based on site experience of and laboratory tests done by Stenkim® and meant to give general information. It is the purchaser's responsibility to ensure applicability of products to their use. All Stenkim® products are available in specified quality and conditions. The company accepts no liability whatsoever unless the transportation, storage, application conditions and customer use are overseen by Stenkim®.
Stenkim® reserves the right to update all information contained in this document without notice.

## Technical Data

| Property | Result |
|---|---|
| Appearance – Color | Brown Liquid |
| Chemical Structure | Organic polymer based on naphthalene sulphonate |
| Density | 1.20 kg/l ± 0.05 kg/l |
| pH | 6.50 – 8.00 |
| Solids Content (weight) | 38 % |

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# StenSeal® 2K

## 1. Product Profile

StenSeal® 2K is a two component, cold applied, chemically curing, self leveling type, polyurethane based, coal tar modified, elastomeric material with high abrasion resistance and adhesion; suitable for heavy traffic conditions; resistant to jet fuels, hydraulic fluids and oils and dynamic movements. It is fully resistant to UV radiation.

StenSeal® 2K is classified as Type M, Grade P, Class 25, Use T according to ASTM C920.

StenSeal® 2K is available in **4 kg** and **10 kg** sets.

It has two types:
For machine applications: StenSeal® 2K MA
For hand applications: StenSeal® 2K HA

## 2. Uses

StenSeal® 2K is produced especially for runways, park areas, terminals and ramps, cargo fields and roads at airports. At the same time it is also a very compatible and economic joint sealant for highways subject to all types of traffic, secondary roads, bridge connections, ramps, stadium, industrial floors, pavements, fuel oil stations, roads and concrete fields at petrochemical and other industrial facilities. It is suitable for all kinds of horizontal outdoor joints.

## 3. Joint Design

Joint width must not be less than four times the expected movement or 6 mm. Up to 15 mm width, joint sealant depth must be equal to the width. Between 15 and 30 mm joint widths, sealant depth must be equal to 80% of the width. For wider joints, sealant depth must be set to 30 mm. For adjusting depth backer material must be used inside the joint.
For localizing the cracks caused by contractions that may occur during and after curing at new concrete pavements, design and sealing of the contraction joints left before cure or saw cut after cure are also important. It is recommended that you refer

**Jet Fuel Resistant, Cold Applied, Polyurethane Based, Self Leveling Type Joint Sealant**

## Highlights

### StenSeal® 2K

- It is polyurethane based, two component.
- It is cold applied.
- It cures chemically.
- It is self leveling.
- It has high abrasion resistance and excellent adhesion.
- It is resistant to dynamic movements.
- It is resistant to jet fuels, oils, diluted acids and bases, various chemicals.
- It can also be used in repairing cracks in concrete pavements.
- It is fully resistant to UV radiation.
- Faster or slower curing can be provided depending on the customer needs.

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# StenSeal® 2K

to our technical document on joint design.

## 4. Application

### 4.1. Surface Preparation

Joint surfaces must be clean and dry. Oil, grease, bitumen or sealant remains must be completely removed. Loose materials on the joint walls must be removed; broken joint walls must be repaired.

StenSeal® 2K is affected from water before curing like all other polyurethane materials. Therefore the joints must be dry and the sealant must not contact water until chemical curing occurs.

### 4.2. Primer

StenSeal® 2K can be used in concrete joints without primer. However, in any case primer application minimizes the negative effects of possible contamination, concrete moisture and loose materials. Therefore; StenAst® S is recommended for concrete, plastic, glass and all types of surfaces in permanent contact with water, StenAst® PU is recommended for wooden surfaces and polyurethane coatings, and StenAst® 2EP is recommended for metal surfaces.

### 4.3. Backer Material

A rod which preferably does not adhere to the sealant must be placed in the joint in order to attain the sealant depth determined according to the joint width. Closed cell polyethylene foam rods are suitable for this purpose. Diameter of the rod must be 10 - 25% larger than the joint width; the rod must be placed tight in the joint. Rods must not be damaged during placement. In wide joints, semi-rigid materials like polystyrene foam can be used instead of rod. In such cases, it is helpful to place a polyethylene tape over backing material in order to prevent adhesion to the sealant.

### 4.4. Mixing

StenSeal® 2K consists of two components, namely A and B, and these are packed in proportional mixing ratios.

StenSeal® 2K HA: First the container of component A is opened and it is homogenized for 2 - 3 minutes, then all of component B is poured onto component A and it is mixed via a low speed (100/500 rev/min) drill and a suitable paddle for 3 - 5 minutes. Longer mixing times are required to obtain a homogeneous mixture in manual mixing (not recommended). During mixing the mixer must be moved inside the container and it must be ensured that no air is trapped inside.

StenSeal® 2K MA: Machine type sealant is not suitable to be mixed by hand since it cures fast. However if the application machine has no separate mixer for homogenizing component A, component A must be homogenized by mixing alone for 2 - 3 minutes before it is poured in the machine.

### 4.5. Application

The amount of sealant that can be used within the pot life must be determined by considering the application place and the capacity of the application apparatus. Mixed material must be used within its pot life. Solvents can not be used for thinning the sealant at the end of its pot life. Material at the end of its pot life must not be used.

In machine applications pot life is important for the tip section where the components mix together. If the application is interrupted for any reason, that section must be cleaned immediately. In hand applications prepared mixture is filled into a refillable type application apparatus with piston (sealant gun - applicator). In both application types, a nozzle with a diameter enabling it to enter into the joint must be fitted to the apparatus and while the sealant is applied this tip must be moved forward by sliding over the backer rod in the joint. Thus it is ensured that no gap is left under the sealant

and sufficient amount of sealant is used. After the application sealant surface can be finished by means of a spatula. Application can be carried out directly with a spatula.

It is recommended to tape both sides of the joint before starting application on joints especially where the decorative look is important. In this manner material smeared outside of the joint during the application is removed by pulling off the tape after the application.

**Sealing cracks**
Repairing the cracks formed and ensuring impermeability is especially important on concrete pavements at airports and highways. StenSeal® 2K can be used for such purposes too. Generally it is helpful to saw the cracks to form a groove of minimum 10 mm depth and 6 mm width. Repair after saw cutting is sufficient at places where the cracks are infrequent. In case of severe cracking, coating for narrow cracks and combined sealing for wide cracks are recommended.

**4.6. Accelerated Curing**
In cases where curing is desired to be completed sooner, accelerator StenQuick PU supplied by the production company can be used. In order to attain a comfortable application time under very hot weather conditions, decelerating the curing may be desired; in such cases it is recommended to use inhibitor StenSlow PU.
For curing times in these cases, please contact the producer.

**4.7. Limitations**
It is not recommended for joints narrower than 5 mm. It must not be used in dirty, oily, bituminous and wet joints. In order to ensure a good adhesion, it is important to clean such joints before application. Despite its high mechanical resistance; studded tire, tire chain, high heeled shoes cause damage. During the application, ambient temperature must not be higher than 35°C and lower than 5°C. If the application has to be carried out in other conditions, get recommendations from Stenkim®.

**4.8.Application Tools**
Mixer, application gun, application machine, spatula. Professional quality tools must be used.

## 5. Cleaning
Application devices and other sealant smudged devices must be cleaned before the sealant cures. For that purpose, tools first wiped with cloth or oakum must be cleaned with StenSolver CL or aromatic solvents such as toluene and xylene.

## 6. Safety
Applicators and supervisors must read Material Safety Data Sheet (MSDS) carefully and observe the considerations written therein. Emptied packages must be handled in compliance with relevant regulations and laws.

## 7. Storage
The material must be kept in dry indoor storages. Recommended storage temperature is 10 - 25°C. Stored unopened in these conditions, the shelf life is 12 months.

## 8. Maintenance
Damaged parts should be repaired. If required, please refer to our Technical Support service regarding this matter.

## 9. Company Liability
The information contained in this document is based on site experience of and laboratory tests done by Stenkim® and meant to give general information. It is the purchaser's responsibility to ensure applicability of products to their use. All Stenkim® products are available in specified quality and conditions. The company accepts no liability whatsoever unless the transportation,

# StenSeal® 2K

storage, application conditions and customer use are overseen by Stenkim®.

Stenkim® reserves the right to update all information contained in this document without notice.

## Technical Data

| Property | Method | Result |
|---|---|---|
| Base Polymer | | 2 Component Polyurethane |
| Solids Content % | | 100 |
| Movement Capability | Expansion | 25% |
| Movement Capability | Contraction | 25% |
| Color | | Black |
| Elongation at Break | ASTM D 412 Die B | >400% |
| Density (A+B) | | 1.40±0.05 g/cm$^3$ |
| Durometer Hardness (Shore) | ASTM D 2240 | A25±5 |
| Resilience | TS 5926 EN 14188-2 | >98% |
| Penetration | | 0.5 mm |
| Pot life of the mixture @20°C HA | | 2 hours |
| Pot life of the mixture @20°C MA | | 10 minutes |
| Tack free time @20ºC HA/MA | TS 5926 EN 14188-2 | 8 hours / 1 hour |
| Cure Time For Light Trafficability @20°C HA/MA | | 24 hours / 6 hours |
| Cure Time For Heavy Trafficability @20°C HA/MA | | 2 days / 12 hours |
| Cure Time For Chemical Resistance @20°C | | 4 days |
| **RELATED STANDARDS:** TS 5926 EN ISO 14188-2, ASTM D 1854, ASTM C 920, MIL SS-S 200E, BS 5212 | | |

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# Typical Cross Section

# For

# Concrete Pavement

# Cross Section Design

**Prepared By**: Dalo Group Engineering

**Reviewed By** :- Eng. Hamno Aziz

**Approved By** :- Eng. Hamno Aziz

**Kirkuk Head Quarter – Almaz St.**
**Cheman Office,**
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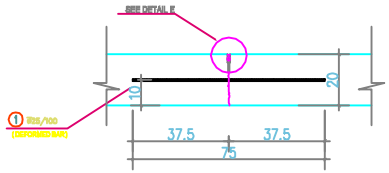
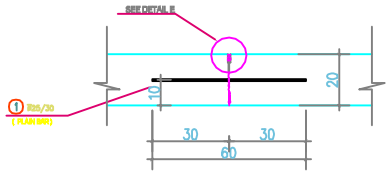
**00964 (0) 770 511 3700**

**Sulaimani Office,**
**Tel: 00964 (0) 770 511 1002**
**00964 (0) 770 156 4149**
**00964 (0) 750 355 1002**

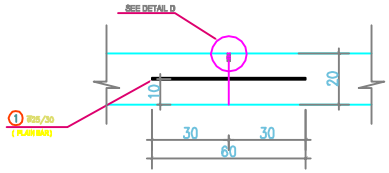
**Erbil OfficeEinkawa**
**Tel: 00964 (0) 770 511 1003**
**00964 (0) 750 777 1003**



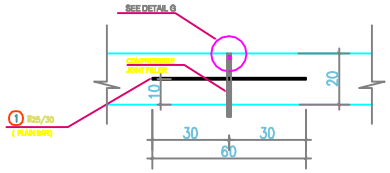

DETAIL A
LONGITUDINAL CONTRACTION JOINT
SCALE: 1/10



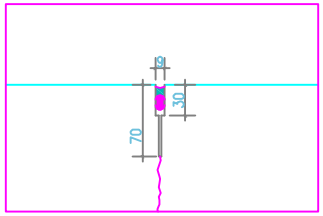

DETAIL B
TRANSVERSE CONTRACTION JOINT
SCALE: 1/10



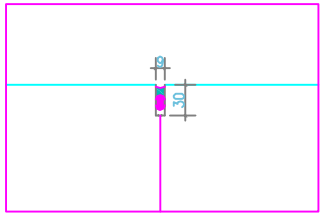

DETAIL C
TRANSVERSE CONSTRUCTION JOINT
(WHERE THE OPERATION STOPS)
SCALE: 1/10



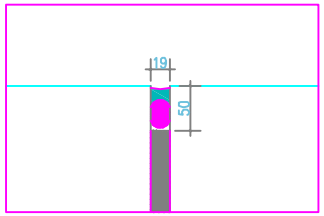

DETAIL D
EXPANSION JOINT
SCALE: 1/10




DETAIL C
T.C.J. / L.C.J. SAW CUT DETAIL
SCALE: 1/10




DETAIL D
C.J. SAW CUT DETAIL
SCALE: 1/10




DETAIL D
EXPANSION JOINT
SCALE: 1/10

BAR LIST (FOR 160m LENGTH)

| BAR NO | DIA. | NO. | LENGTH (m) | TOTAL LENGTH ø20 | TOTAL LENGTH ø25 |
|---|---|---|---|---|---|
| ① | 20 | 320 | 0.75 | | 240 |
| ② | 20 | 160 | 0.50 | | 80 |
| ③ | 25 | 1320 | 0.60 | 792 | |
| TOTAL LENGTH (m) | | | | 792 | 320 |
| TOTAL WEIGHT (kg) | | | | 3056 | 790 |
| ↑ TOTAL WEIGHT (kg) | | | | | 3846 |

NOTES :
1. SINCE THE LOCATION AND NUMBER OF THE CONSTRUCTION JOINTS ARE NOT KNOWN, ADDITIONAL REINFORCEMENT FOR C.J WAS NOT INCLUDED IN QUANTITY TABLE.
2. DESIGN WAS PERFORMED ACCORDING TO THE AASHTO GUIDE FOR DESIGN OF PAVEMENTSTRUCTURES,1993.
3. FOR LONGITUDINAL JOINTS, TWO TYPES WERE GIVEN, EITHER OF THEM CAN BE APPLIED.
4. APPLICATION SHALL BE DONE ACCORDING TO THE STANDARDS OR SPECIFICATIONS APPROVED BY THE CLIENT.
5. MAXIMUM AGGREGATE SIZE FOR CONCRETE SHALL NOT BE SMALLER THAN 25 mm AND SHALL NOT BE GREATER THAN 38mm.
6. LAP SPLICE PATTERN GIVEN MAY BE CHANGE BY AN APPROVED PATTERN.

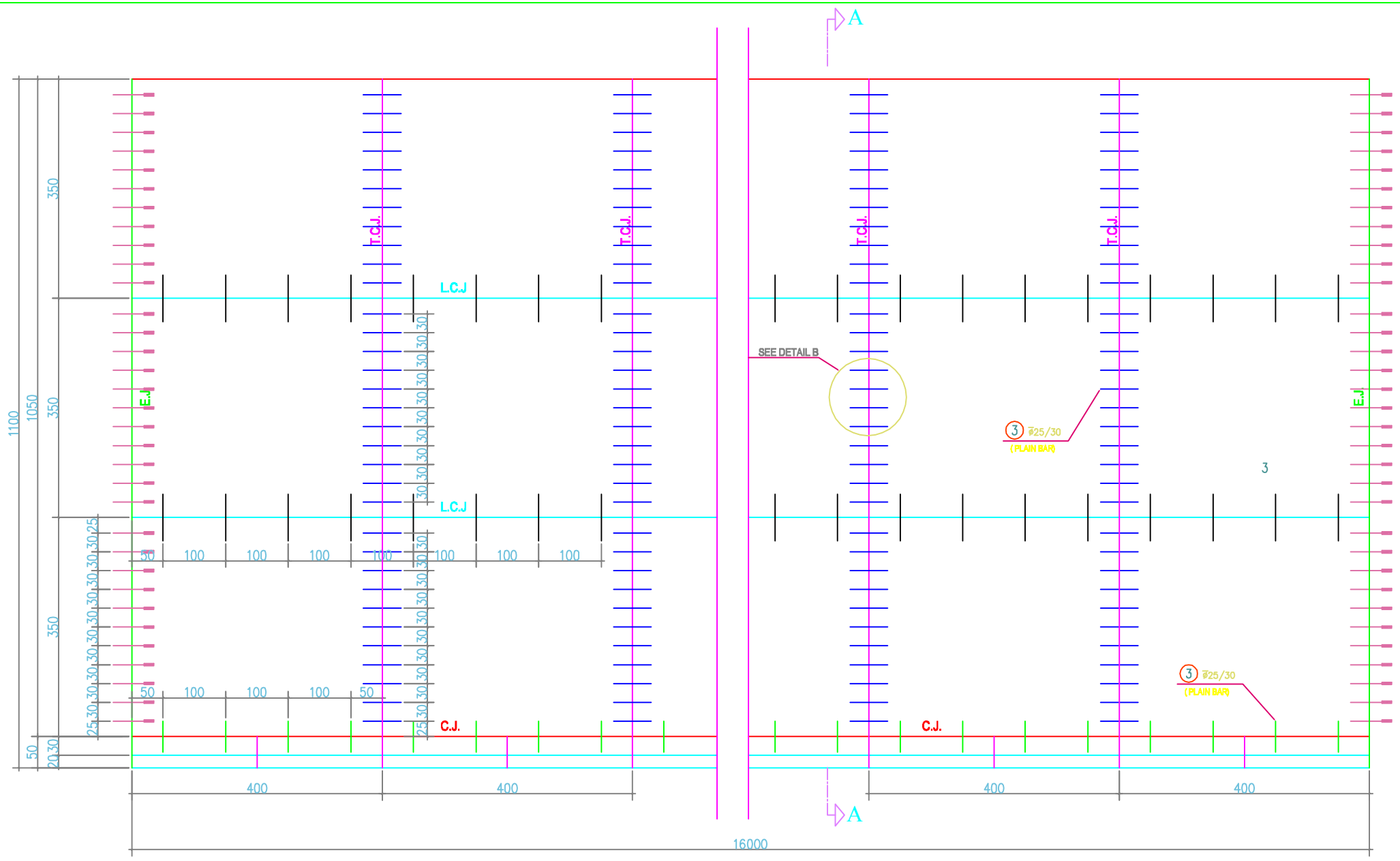
MATERIAL

1) CONCRETE

– ALL :(Ff=4.2 (MPA) (BEAM)

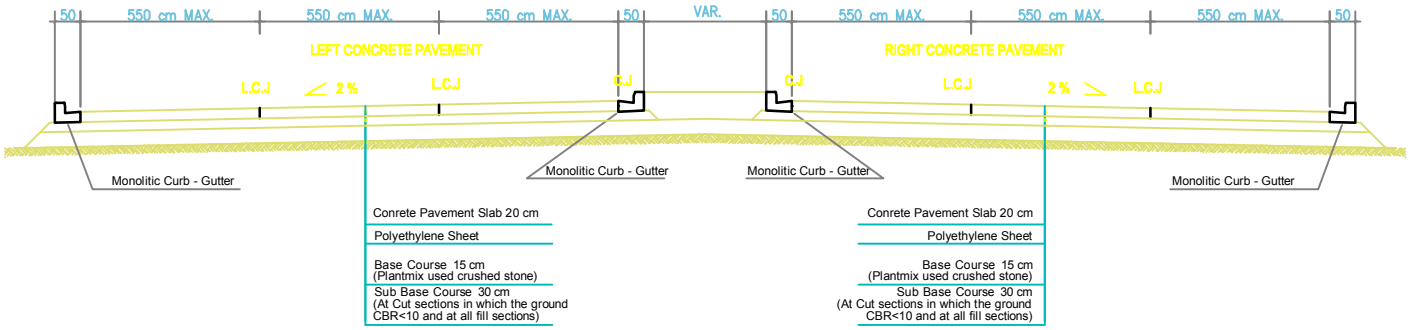
2) STEEL

– REINFORCED STEEL : GRADE 460/425



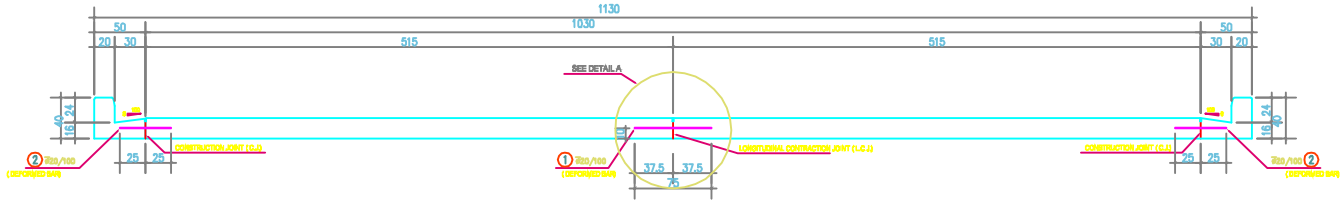

REINFORCEMENT PLAN

SCALE: 1/50




TYPICAL CROSS-SECTION

SCALE: 1/100




CROSS SECTION A-A / CONCRETE PAVEMENT

SCALE: 1/25