

717 - SILICA FUME OVERLAY

SECTION 717

SILICA FUME OVERLAY

717.1 DESCRIPTION

Construct the silica fume overlay as shown on the Contract Documents.

BID ITEMS

Silica Fume Overlay (*) (**)
Material for Silica Fume Overlay (Set Price)

* Denotes Thickness
**High Early Strength

UNITS

Square Yard
Cubic Yard

717.2 MATERIALS

Provide materials that comply with the applicable requirements.

| | |
|--------------------------------------|----------------------|
| Silica Fume Concrete | DIVISION 400 |
| Precure/Finishing Aid Material | DIVISION 1400 |
| Concrete Curing Materials | DIVISION 1400 |
| Concrete Masonry Coating | DIVISION 1700 |

717.3 CONSTRUCTION REQUIREMENTS

a. Equipment. Use a finishing machine consisting of a mechanical strike-off capable of providing a uniform thickness of concrete slightly above finish grade in front of an oscillating screed or screeds. The finishing machine will be inspected and approved by the Engineer before work is started on each project.

Use a minimum of 1 oscillating screed capable of consolidating the concrete by vibration to 100% of the vibrated unit weight with the following features:

- Install identical vibrators so a minimum of 1 vibrator is provided for each 5 feet of screed length;
- Bottom face a minimum of 5 inches wide with a turned up or rounded leading edge;
- Effective weight a minimum of 75 pounds for each square foot bottom face area;
- Positive control of vertical position, the angle of tilt and the shape of the crown;
- Design together with appurtenant equipment to obtain positive machine screeding of the plastic concrete as close as practical to the face of the existing curb line;
- Length sufficient to uniformly strike-off and consolidate the width of the lane to be paved;
- Forward and reverse motion under positive control;
- Supporting rails which are fully adjustable (not shimmed) to obtain the correct profile, unless otherwise approved by the Engineer. Provide supports which are sufficiently rigid and do not deflect under the weight of the machine. Anchor the supporting rails to provide horizontal and vertical stability; and
- Equip to travel on the completed lane when placing concrete in a lane abutting a previously completed lane.

Manufacturer's specifications or certification may be used as verification of the oscillating screed requirements.

A drum roller equipped to perform all functions outlined for the oscillating screed above, may be used for finishing the overlay concrete in lieu of an oscillating screed. Equip the drum roller to vibrate by either a factory or field adaptation. The drum roller must be able to compact the concrete to a minimum of 100% of the vibrated unit weight.

Provide an overall combination of labor and equipment with the capability for proportioning, mixing, placing and finishing new concrete at the following minimum rates shown in **TABLE 717-1**.

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| TABLE 717-1: SILICA FUME PRODUCTION REQUIREMENTS | |
|--|-------------------------------------|
| Total Placed Surface Area per Bridge (Square Yards) | Minimum Cubic Yards per Hour |
| 0-328 | 1.0 |
| 329-492 | 1.5 |
| 493-656 | 2.0 |
| Over 656 | 2.5 |

b. Preparation of Surface. Prior to final preparation for placement of new concrete, sand or shot blast the surface followed by an air blast to the bottom 3 inches of hubguard, and edges against which new concrete is to be placed to remove all dirt, oil and other foreign material, as well as any unsound concrete, laitance and curing material from the surface. Wet sand blasting may be used only with approval of the Engineer. It is desired that the surface be roughened by the sand or shot blast to provide satisfactory bond with the surfacing concrete. Protect metal floor drains and areas of the curb or railing above the proposed surface from the sand or shot blast.

Check the finish machine clearance above the prepared surface before concrete is placed to obtain the thickness specified in the Contract Documents.

A minimum of 2 hours before the placing of the concrete overlay, use clean water to thoroughly wet any concrete surfaces to which the concrete is to bond against. Blow or broom away all free water immediately ahead of the placing operation. Bonding surfaces should be maintained in a damp condition with no free water.

c. Placing and Finishing Concrete. The elapsed time between depositing the concrete on the floor and final screeding may not exceed 10 minutes, unless otherwise authorized by the Engineer.

Placing of silica fume concrete is prohibited when conditions on the bridge deck are such that the evaporation rate is estimated to equal or exceed 0.2 pounds per square foot per hour, or is predicted to exceed that rate during the course of the placement, unless corrective measures listed below are taken to reduce the evaporation rate to below 0.2 pounds per square foot per hour.

Just prior to and at least once per hour during placement of the concrete, the Engineer will measure and record the air temperature, concrete temperature, wind speed and humidity on the bridge deck. The Engineer will take the air temperature, wind and humidity measurements approximately 12 inches above the surface of the deck. With this information, the Engineer will determine the evaporation rate by using KDOT software or by using **FIGURE 710-1** (Figure 2.1.5 from the American Concrete Institute Manual of Concrete Practice 305R, Chapter 2).

When the evaporation rate is equal to or above 0.2 lb/ft²/hr, take actions (such as cooling the concrete, installing wind breaks, sun screens etc.) to create and maintain an evaporation rate less than 0.2 lb/ft²/hr on the entire area where the silica fume is to be placed.

Accomplish fogging by using high pressure equipment that generates a minimum of 1200 psi at 2.2 gpm, or with low pressure equipment having nozzles capable of supplying a maximum flow rate of 1.6 gpm. In either case, the fog spray is produced from nozzles which atomize the droplets, and are capable of keeping a large surface area damp without depositing noticeable water.

The evaporation rate will be rechecked with the measures in place, using the procedures outlined above.

Place and fasten the screed rails in position to obtain finished concrete at the required profile. Place the supporting rails upon which the finishing machine travels outside the area to be concreted. A hold-down device shot into concrete is prohibited, unless the concrete is to be subsequently overlaid. Hold-down devices of other types leaving holes in exposed areas will be approved provided the holes remaining are grouted full. Methods for anchoring and supporting the rails and the concrete placing procedure require approval by the Engineer.

Locate longitudinal joints along lane lines, or as approved by the Engineer. Keep the joints clear of wheel paths as much as practical.

Manipulate, mechanically strike off and mechanically consolidate new concrete to a minimum of 98% of the vibrated unit weight and screed to final grade. In irregular areas or along the curb where the finishing screed does not reach, hand tamp with a 6 inch by 6 inch metal plate device to assist in consolidation and bonding of the concrete. When concrete for partial depth patches is placed with the overlay, apply additional vibration or hand tamping in the patch areas to assist in consolidation and bonding of the concrete.

The Engineer will use an approved nuclear density measuring device to monitor in-place density. Hand floating operations may be required to produce a tight, uniform surface. Take every reasonable precaution to secure a smooth riding bridge deck. Correct surface variations exceeding 1/8 inch in 10 feet, unless directed otherwise by the Engineer.

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Silica fume concrete is prone to plastic shrinkage because it has no bleed water. To help reduce or eliminate shrinkage cracking, treat with fogging equipment and precure material immediately after strike-off of the surface. If fogging has not been required during placement, start at this point and continue throughout the finishing operation. When the evaporation rate is above 0.2 lbs. per square foot provide continuous fogging. When the evaporation rate is below 0.2 lbs. per square foot, use an intermittent pattern of fogging during the placing and finishing operation to maintain a visually damp surface on the concrete. Close observation of conditions and judgment should be used to maintain a damp surface on the concrete without flooding the surface with excessive water.

When a tight, uniform surface has been achieved, give the surface a suitable texture by transverse grooving with a finned float having a single row of fins. Make the grooving approximately $\frac{3}{16}$ inch in width on $\frac{3}{4}$ inch centers, with a groove depth of approximately $\frac{1}{8}$ inch. Perform this operation at such time and in such manner that the desired texture shall be achieved while minimizing displacement of the larger aggregate particles. For bridges having drains, the transverse grooving should terminate approximately 2 foot in from the gutter line at the base of the curb. Give the area adjacent to the curbs a light broom finish, longitudinally.

Using an edger having a $\frac{1}{4}$ inch radius, finish the exposed edges of the end spans of bridges which form a part of the road surface.

d. Curing. Apply Type 1-D liquid membrane forming curing compound immediately behind the tining float. The final cure shall be with wet burlap covered with polyethylene sheeting.

Continue fogging the entire placement to maintain a damp surface until the wet burlap can be applied.

Place the wet burlap as soon as possible without damaging the surface, and keep wet during the 7 day cure period, using soaker hoses or occasional spraying.

If the concrete surface temperature is above 90°F, and air temperatures are predicted to remain above 60°F, do not use polyethylene sheeting in direct sunshine during the day for the first 24 hours of the 7 day curing period. White polyethylene sheeting may be used at night to maintain the required damp condition of the burlap. When polyethylene sheeting is used over the burlap at night during the first 24 hours and the concrete surface temperature is above 90°F, place the polyethylene sheeting a maximum of 1 hour before sunset, and remove the polyethylene sheeting within 1 hour after sunrise. After the first 24 hours, the polyethylene sheeting may be left in place continuously for the remainder of the curing period provided the burlap is kept damp.

At air temperatures below 70°F, black or clear polyethylene sheeting may be used. However, the concrete temperature must not be allowed to exceed 90°F. If the concrete temperature exceeds 90°F, remove the polyethylene sheeting, or replace with white sheeting.

Perform cold weather curing as outlined in **subsection 710.3c.(4)**.

Adhere to **TABLE 710-2** for allowable concrete loads.

e. Weather Limitations. See **subsection 401.8**. Also, discontinue concreting operations when a descending air temperature in the shade and away from artificial heat falls below 45°F except with written approval from the Engineer. Do not start or resume operations until an ascending air temperature reaches 40°F, or if night time temperatures are expected to fall below 35°F.

f. Limitations of Operations. Provide a technical representative of the silica fume manufacturer on the job site during the initial placement of the concrete at no additional cost to KDOT. The representative is to provide technical expertise to the Contractor, concrete producer and the Engineer regarding batching, transport, placement and curing of silica fume concrete. This requirement may be waived for experienced contractors. Submit to the Engineer a request along with a list of silica fume concrete overlay projects completed.

A minimum of 1 day prior to the placement, make a trial placement to gain experience with all aspects of this construction. This requirement may be waived by the Engineer if the Contractor and concrete producer can show significant similar experience with silica fume concrete. Submit to the Engineer a request along with a list of silica fume concrete overlay projects completed by the Contractor and the concrete producer.

When a new deck is involved, do not commence work on the wearing surface until the lower course meets the time requirements of **SECTION 710**, unless specified otherwise.

Do not place concrete adjacent to a surface course, less than 36 hours old. This restriction does not apply to a continuation of placement in a lane or strip beyond a transverse joint in the same lane or strip.

In areas where there is no traffic, preparation of the area may be started in a lane or strip adjacent to newly placed surface the day following its placement. If this work is started before the end of the 7 day curing period, restrict the work as follows:

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- Sawing or other operations may interfere with the curing process in the immediate work area for the minimum practical time only;
- Resume the curing promptly upon completion of the work;
- Keep the exposed areas damp until such time as curing media is replaced; and
- Do not use power driven tools heavier than a 15 pound chipping hammer.

g. Construction Joints. Make construction joints (either longitudinal or transverse) by placing and finishing the silica fume concrete approximately 6 inches beyond the desired location of the construction joint. After the silica fume overlay is cured, make a vertical saw cut at the location of the construction joint and chip away the excess silica fume overlay.

h. Sealing Vertical Faces of the Silica Fume Overlay. Seal all construction joints and vertical faces (such as the edge at the curb line) of the silica fume overlay. Sand or shot blast the construction joints and vertical faces, and apply a concrete masonry coating to the cleaned vertical surfaces according to **SECTION 726**.

i. Correction of Unbonded Areas. If during construction of the project, newly overlain areas are discovered to be unbonded by tapping or chaining, outline the concrete from such areas by sawing, remove it with small air tools (15 pound maximum) and replace it at no additional compensation.

717.4 METHOD OF MEASUREMENT AND BASIS OF PAYMENT

The Engineer will measure silica fume overlay by the square yard.

The Engineer will measure material for silica fume overlay by the cubic yard according to the following:

(1) When approved by the District Engineer on repair of existing bridges, this pay item will be used to compensate the Contractor for the additional overlay material that will be required to fill the areas greater than the thickness of overlay shown in the Contract Documents. The Contractor is responsible for maintaining adequate quality control of the demolition process to minimize deviations from the plan grades.

(2) The Engineer will keep a running account of the volume of overlay material that is produced and delivered to the deck. When approved, the Contractor will be paid, at the set price per cubic yard, for all overlay material in excess of 110% of the theoretical volume to cover the deck area with the thickness of overlay shown in the Contract Documents.

Payment for "Silica Fume Overlay" at the contract unit price and "Material for Silica Fume Overlay" at the contract set unit price (when approved by the District Engineer), will be full compensation for the specified work.