ITEM 06557.57 M FIBER REINFORCED POLYMER (FRP) BRIDGE DECK

DESCRIPTION

The contractor shall furnish a pre-engineered ~~–~~ fiber reinforced composite bridge deck with an integral polymer concrete wearing surface (FRP deck system) and all necessary hardware for connecting the bridge deck to the concrete substructure in stages. The FRP deck system shall conform to the plans and be in accordance with these specifications. The FRP deck system proposed is part of an experimental research project and no substitutions will be allowed. The deck system shall be furnished by Kansas Structural Composites of Russell, Kansas ("the manufacturer"), (785)~~483-2589~~ 483-2589. The contact person is Dr. Jerry Plunkett.

MATERIALS

~~A.~~ A. *PROPERTIES*

The manufacturer shall submit all the properties of the face laminate and the core laminate used in the analysis and the design of the FRP deck system in a tabular format as shown. All the following minimum guaranteed properties shall be listed on the shop drawings.

PROPERTY	FACE LAMINATE VALUE	CORE LAMINATE VALUE	TEST METHOD
Ultimate tensile strength			ASTM D 3039M
Ultimate compressive strength			ASTM D 5379M
Ultimate shear strength			ASTM D 5379M
Tensile modulus of elasticity			ASTM D3039M
Shear modulus			ASTM C273
Coefficient of thermal expansion			ASTM D 696
Fiber content			ASTM D 3171
Density			ASTM D 792
Bearing Strength			ASTM D 953
Glass transition temp			ASTM D 4065
Water Absorption			ASTM D 570
~~—~~Interface shear strength between face sheet and core			As approved by DCES

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~~B)~~ B. *DECK DESIGN CRITERIA*

1~~)~~. The FRP design shall conform to the following:

Standards	N.Y. State Standard Specification for Highway Bridges dated June 1999 with current additions and modifications
Live Load	~~MS 23~~
Deflection Limit at Service Load	L/800
Design ~~s~~Service ~~l~~Life	75 Years
Environmental Reduction Factor	0.65
Warranty Period on FRP Deck	30 Years
Warranty Period on Wearing Surface	10 Years
Design ~~s~~Stress ~~l~~Limit of the Structure	~~20%~~30% of ~~U~~ultimate strain (after environmental reduction factor is applied)
Fatigue ~~c~~Cycles for ~~d~~Deck	2,000,000
Allowance for ~~f~~Future ~~o~~Overlay	0.96 KPa
Thermal loading	Temperature differential of 100°F between top and bottom face skim

2. The FRP deck system design, including attachments to the ~~superstructure~~substructure, must be certified by a registered professional engineer licensed to practice in the State of New York. Materials used during attachment to the substructure should be on the Department's approved list where applicable.

3. The bridge rail anchorages in the FRP deck shall incorporate details as shown on the plans. If an embedded plate is used, the anchorage must develop the full tensile strength of the anchor bolts. The manufacturer shall provide data from an independent testing agency that verifies that the pull-out strength compiles with AASHTO's LRFD specifications, Section 13 for a TL-4 level of service. Any steel hardware used that will be exposed to the elements shall be of the type and strength specified by the manufacturer and either stainless steel or galvanized steel.

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~~C.~~ C. *SUBMITTALS*

1. Three sets of shop drawings, installation procedure, and the design calculations for the entire FRP Bridge deck system shall be certified and signed by a professional engineer licensed to practice in New York State and provided to Deputy Chief Engineer Structures (DCES) at least 6 weeks prior to fabrication of any components. A finite element model of the FRP deck required to be used during the design shall be provided along with the shop drawings. The finite element analysis shall be performed using ~~STAAD software developed by Research Engineers, CA or~~ any commercial industry software~~. If any software other than STAAD is used, the software with appropriate licenses used during the analysis shall accompany the submittal~~ as approved by the DCES. The submission shall also include the material properties and design assumptions upon which the deck and connection design is based as well as detailed procedures for installation and materials used by the contractor during installation. A review will be provided within 3 calendar weeks of receipt by the DCES. The manufacturer should inform DCES and materials bureau at least ~~one~~two weeks before the fabrication of the panels. State reserves the right to inspect the facilities during the fabrication of the panels, and to install any sensors necessary for long-term monitoring and to measure residual stresses during the fabrication process.

2. During each day of fabrication of the deck, 2- 300m x 300m flat samples of the face laminate and the core laminate shall be taken. The manufacturer is to arrange for ~~these~~ 16 random samples to be tested by an independent laboratory approved by the materials bureau using the ASTM tests outlined in the tables provided under Materials section of this item. The objective of this test is to verify all the material property values used in the design and analysis process of the FRP deck. All test results shall be provided to the DCES or Engineer-in-Charge (EIC) at least two weeks prior to installation. If any test results do not confirm the minimum guaranteed values shown on the shop drawings and the design calculations, the FRP deck system shall be rejected.

3. Material safety data sheets and manufacturers control sheets for all materials and methods used in the fabrication and installation of the FRP deck shall be provided to the DCES ~~upon request~~.

4. Durability test data on the deck and the wearing surface from previous research/projects for effects of heat, humidity, freeze/thaw, saltwater, UV, diesel fuel spills, etc. must be supplied.

5. Within 30 days after installation, the manufacturer shall provide the DCES with two sets of as-built drawings certified by a professional engineer certified to practice in New York State. These shall include maintenance and inspection guidelines for the FRP deck system and a load rating table in accordance with New York's Uniform Code of Bridge Inspection.

6. Manufacturer shall provide a quality control manual/quality assurance plan to the

~~EIC~~materials bureau at least 6 weeks prior to fabrication. The manufacturer shall also provide adequate documentation of the use of the above plan for all aspects of the manufacturing process.

~~D)~~ D. *BASIS OF ACCEPTANCE*

1. *Deck System Warranty* - The supplier shall provide a 30 year warranty on the FRP deck system. The warranty shall protect the owner from direct financial loss due to manufacturing defects. Defects include: a) ~~s~~Stresses or deflections in excess of those specified in the design parameters under design load. b) ~~d~~Delamination or any material failure under normal service. The definition shall also include any other flaw that could reasonably be considered the result of faulty workmanship or failure to meet the design specifications. In case of a defect, the manufacturer's warranty shall contain provisions of repair, strengthening or replacement of the faulty component within 30 days of notification by the Regional Director that there is a defect. The decision to repair or replace the deck shall rest solely with the Regional Director. The warranty shall be transferrable to the new owner should there be a transfer of ownership during the warranty period.

2. *Warranty on the Wearing Surface* - A 10 year warranty shall be provided for the wearing surface. The wearing surface warranty shall protect the owner against delamination or loss of skid resistance during the entire warranty period. The wearing surface shall provide a wet skid resistance of 60 BPN according to the British Portable Pendulum Test (ASTM E303). The warranty shall also cover any other flaw that could reasonably be considered the result of faulty workmanship or failure to meet the design specifications. The state reserves the right to perform a standard test method for pull-off strength per ASTM D 4541-95 at any time during the warranty period. A wearing surface failing to meet the minimum design requirements will be considered as a defect. In case of a defect, the manufacturer's warranty shall contain provisions of repair, strengthening or replacement of the faulty component within 30 days of notification by the Regional Director that there is a defect. The decision to repair or replace the wearing surface shall rest solely with the Regional Director. The warranty shall be transferable to the new owner should there be a transfer of ownership during the warranty period.

3. *Level 1 Load Rating* - Upon delivery of the approved deck system, the manufacturer shall provide load rating calculations for the deck system and a summary table in accordance with New York's Uniform Code of Bridge Inspection. The load rating shall be certified by a professional engineer registered to practice in New York State.

4. *Initial Load Test* - After the installation is complete, an initial load test by an approved independent entity shall be conducted to verify that the design parameters have been satisfactorily met. The guidelines for the load test are specified in the NCHRP Research Results Digest dated Nov-98 No. 234. The load test summary report shall be certified by a professional engineer registered to practice in New York State and two copies with all raw

data provided to the EIC. The cost for the load testing is to be included in this item.

5. *Performance Tests* - The owner reserves the right to physically load the deck system at his expense any time during the warranty period to verify that the design parameters have been satisfactorily met. A deck failing to meet the performance requirements at any time during the warranty period shall be cause for exercise of the rights provided in the warranty.

CONSTRUCTION DETAILS

A. ~~*Dimensional tolerances*~~*DIMENSIONAL TOLERANCES* -

Unit dimensions shall not vary more than 5 mm from those shown on the approved working drawings. The flatness of the panels shall not vary more than 5 mm in 3 meter. The top surface of the construction joints between the deck panels shall be flush within a 3 mm tolerance. Regardless of tolerances the panels shall fit together and function per design.

B. ~~*Transportation and site handling*~~*TRANSPORTATION AND SITE HANDLING* -

This shall be performed with acceptable equipment and methods, and by qualified personnel and in accordance with the manufacturer's recommendations. The contractor is responsible until acceptance. The panels shall be lifted and supported during transportation, and erection operations only at lifting or supporting points as shown on the shop drawings, and with approved lifting devices. The panels shall be kept flat and true to prevent warping or twisting of the panels during lifting, transporting and storing. The panels shall not be turned or placed on their sides with the top surface down. All panels shall be stored off the ground and protected with covers that are impervious to sunlight in order to provide protection from ultraviolet light and precipitation. Panels damaged by improper handling, storing, transporting or lifting shall be repaired or replaced at the discretion of the EIC at no expense to the Department.

C. ~~*Installation*~~*INSTALLATION* -

An experienced technical representative employed by the manufacturer shall be present during the complete installation procedure to assure that the FRP deck panels are installed correctly. Upon completion the manufacturer's representative shall certify that the installation has been done correctly. Field measurements necessary to fabricate the deck and install it to the limits shown on the plans shall be the Contractor's responsibility.

METHOD OF MEASUREMENT

The unit price bid will be a lump-sum for the FRP deck system provided to the job site.

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BASIS OF PAYMENT

The lump sum price bid for this item shall include all costs necessary to provide the products as specified, provide adequate quality assurance that the deck system is manufactured according to the certified design, and all transportation expenses/permits/escort vehicles necessary to deliver and unload the deck system at the job site. Upon completion of each stage of construction, partial payments are to be made per Section 109-04 of the New York State Department of Transportation Standard Specification for Highway Bridges. 75% upon delivery of an undamaged superstructure system; 25% upon successful installation and receipt of all required submittals.

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WordPerfect Document Compare Summary

Original document: T:\Documents & Resources\Special Specifications\BYREGION\06\06557570.000
Revised document: C:\TEMP\frpspec.wpd
Deletions are shown with the following attributes and color:
~~Strikeout~~, Blue RGB(0,0,255).
Deleted text is shown as full text.
Insertions are shown with the following attributes and color:
Double Underline, Redline, Red RGB(255,0,0).

The document was marked with 45 Deletions, 54 Insertions, 0 Moves.

This Specification has been replaced by a version dated 11/29/2001

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--- Revision List ---

Location is Old Page:Old Paragraph New Page:New Paragraph.
Paragraph numbers shown as zero refer to the part of a paragraph that is carried over from the previous page. The {Hrt/Hpg/Tab/Spc} codes are generic symbols which refer to categories of end-of-line, tab/indent, or space codes.

1:1 1:1 Change {Bld}{Und}DESCRIPTION -To- {Bld}{Hrt}{Und}DESCRIPTION
1:2 1:2 Change engineered fiber -To- engineered fiber
1:2 1:2 Change), (785)483 -To-), {Hrt}(785) 483
1:2 1:2 Change (785)483-2589. -To- 483-2589.
1:3 1:4 Change {Hrt}{Hrt}A. -To-
{Hrt}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Tab}{Hrt}{Itl}PROPERTIES...
1:4 1:4 Change {Hrt}A. {Itl}PROPERTIES -To- PROPERTIES
1:4 1:5 Change PROPERTIES{Itl}{Hrt}{Hrt}The -To- PROPERTIES{Itl}{Hrt}The
1:32 1:33 Delete {Bld} {Bld}
1:32 1:33 Insert Interface shear strength ...
1:32 1:35 Change {Hrt}B) {Itl}DECK -To- {Hrt}{Itl}DECK
2:1 2:1 Change CRITERIA{Hrt}{Hrt} -To- CRITERIA{Itl}{Hrt}1.
2:2 2:1 Change {Hrt}{Itl}1) -To- 1.{Tab}The
2:2 2:1 Change 1) {Tab}The -To- The
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2:19 2:19 Change Fatigue cycles -To- Fatigue Cycles
2:19 2:19 Change for deck -To- for Deck
2:21 2:21 Change for future -To- for Future
2:21 2:21 Change future overlay -To- Future Overlay
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2:23 2:25 Change the superstructure, -To- the substructure{Bld},
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2:25 2:26 Change TL-4 -To- TL-4
2:26 2:27 Change {Hrt}C. {Itl}SUBMITTALS -To- {Hrt}{Itl}SUBMITTALS
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2:27 3:0 Change drawings. The -To- drawings. The

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3:5 3:5 Change the EIC at -To- the materials bureau at
3:6 3:6 Change {Hrt}D) {Itl}BASIS -To- {Hrt}{Itl}BASIS
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4:6 4:6 Change tolerances{Itl}{Und} - Unit -To- TOLERANCES{Itl}{Hrt}Unit
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5:1 5:2 Change handling{Itl}{Und} - This -To- HANDLING{Itl}{Hrt}This
5:1 5:3 Change Department.{Hrt} -To- Department.{Hrt}{Hrt}
5:2 5:4 Change {Itl}{Und}Installation{Itl} -To- {Itl}INSTALLATION{Itl}
5:2 5:4 Change Installation{Itl}{Und} - An -To- INSTALLATION{Itl}{Hrt}An
5:2 5:5 Change {Und}{Hrt}METHOD -To- {Und}{Hrt}{Hrt}METHOD
5:6 5:9 Change {Hrt}{Hrt}{Hrt} -To- {Hrt}