

DRAFT MEMORANDUM

Date: January 27, 2020
To: Stephan Heimbarg, PE
From: Leo Rodriguez, PE
Subject: **Draft Bridge Aesthetics Memorandum**
FPID: 438547-1-22-01
Orlando South Ultimate Interchange Project Development and Environment (PD&E) Study

1. BACKGROUND

The Orlando South Ultimate Interchange Improvements includes reconstruction of the existing interchange, as well as construction of adjoining reliever interchanges on the Florida's Turnpike and the Beachline Expressway (SR 528). The properties adjoining the project are mostly industrial or commercial. However, the project is a gateway along the Beachline Expressway between Orlando International Airport and visitor destinations along International Drive and I-4. In addition, architectural lighting features, and tinted sidewalks have been constructed north of Landstreet Road within the project limits.

2. BRIDGE AESTHETICS

The Orlando South Ultimate Interchange will involve both complex and conventional structures of a variety of configurations to meet functional operation. The bridges in the interchange will also span over one another, magnifying the visual impact. The project aesthetic objective is to focus on a balance between form, function, color, texture, durability, and cost.

Per the Florida Design Manual (FDM) Section 121.9.3.3, the levels of aesthetics can be described as:

- Level One (1): baseline aesthetic treatment with minor cosmetic improvements such as concrete colors, texturing of surfaces and pleasing shapes for columns and caps. Structures following this criterion generally meet the surface treatment criteria established in Volume 1 of the Florida's Turnpike Supplement to the Florida Department of Transportation (FDOT) Structures Design Manual. **(Applicable)**
- Level Two (2): Level One plus full integration of efficiency, economy and elegance in all bridge components. This includes consideration of aesthetically enhanced piers shapes (i.e., hammerhead piers and oval columns), concrete texture through form liners; smooth superstructure shapes and transitions; as well as concealing pipes, conduits and any other utilitarian attachments. **(Applicable)**
- Level Three (3): Level Two plus providing a synergy with environment. This level includes historic or highly urbanized areas where landscaping or unique "neighborhood features" are to be considered. **(Not Applicable)**

3. APPROACH

In recognition of the overall project environmental context and costs, and the varying significance of each bridge site, we have identified Aesthetics Level One and Two as applicable throughout the project. Therefore, two key criteria are used in determining and maximizing the aesthetic levels per bridge site:

1. Structures Type, and
2. Surface Treatment (i.e. pier type and shapes, coating and retaining wall texture).

Table 1 summarizes the aesthetics analysis per bridge site.

3.1 Structures Type

The specific considerations in conceptual selection of structure types, span arrangements and layouts include:

- Structural advantage and continuity of structure type within a bridge,
- Minimizing abrupt changes in structure type or depth,
- Minimizing the number of different structure types in a viewshed,
- Proportioning span lengths to avoid visual clutter,
- Maximizing consistency in form, and
- Economy of the structure.

Level One Aesthetics – Structures Type

This category encompasses the bridge widenings or new bridges that will match adjacent bridge structures type i.e. Florida-I Beams (FIB) or Steel Plate Girders, and new bridges that are defined by their industrial context. The structures that fall under this category are:

- a) Bridge widenings and/or new bridges that will match adjacent bridge structures type i.e. Florida-I Beams (FIB) or Steel Plate Girders. These structures include:
 - Beachline Expressway over Landstreet Road and CSX spur,
 - Southbound (SB) Florida's Turnpike to Eastbound (EB) Ramp 306 over Landstreet Road,
 - EB Beachline Expressway widening over John Young Parkway (CR 423), and
 - Florida's Turnpike widening and parallel ramps over Orange Blossom Trail (US 441/17/92).

There is no additional cost for this approach. Changing the structures type within a group of adjacent structures would be detrimental to the desired aesthetic results.

- b) New bridges defined by an industrial context. These structures include:
 - Voltaire Avenue over Sky Lake Canal, Gills Drive and Beachline Expressway,
 - SB Florida's Turnpike exit to Taft Vineland Road (Ramp 304) over Consulate Drive SB entry Ramp 322,
 - EB Beachline Expressway exit to Northbound (NB) and SB Turnpike (Ramp 310) over John Young Parkway entry Ramp 324,
 - Beachline Expressway over Florida's Turnpike and Consulate Drive,
 - Beachline Expressway over Orange Blossom Trail, and
 - NB Turnpike to EB Beachline Expressway (Ramp 306).

There is no additional cost for this approach. Changing the structures type within a group of adjacent structures would be detrimental to the desired aesthetic results.

Level Two Aesthetics – Structures Type

One of the largest impacts on costs when considering Level Two aesthetics is the use of enclosed structures i.e. box sections in lieu of I-girders. From a strictly structural analysis point, box structures offer a superior advantage on curved structures over other structures types. These structures have been identified as box structures according to the following criteria:

- a) Structures with steel boxes based on structural advantages¹:
 - Westbound (WB) Beachline Expressway to SB Florida's Turnpike (Ramp 314) over Florida's Turnpike,
 - WB Beachline to NB Ramp 313 over the northbound CD, and
 - Taft Vineland to NB entry Ramp 203 over the Turnpike

There is no additional cost associated with this providing Aesthetic Level 2 structure type at these locations.

- b) Structures with steel boxes based on structural and aesthetic advantages¹:
 - All directional flyovers connecting the Beachline Expressway and Florida's Turnpike, including ramps parallel to the Beachline Expressway, east of the Florida's Turnpike

There is no additional cost associated with this providing Aesthetic Level 2 structure type at these locations.

Potential Candidates for Enhanced Structures Type

The non-box structure bridges below are possible candidates for enhanced structure type due to their proximity to Level Two aesthetic (structure type) bridges.

New structures over the Beachline Expressway will be designed to a Level Two aesthetic. These structures and the currently identified structures type include:

- Steel Plate Structures
 - NB Turnpike to EB Beachline Expressway (Ramp 306) over NB Florida's Turnpike to NB Orange Blossom Trail (Ramp 308) will be designed to Level Two Aesthetic based on its proximity to the WB Beachline Expressway to SB Florida's Turnpike flyover
- Florida-I Beam Structures
 - Voltaire Drive over the Beachline Expressway.

The additional cost to provide box structures is approximately \$15-\$30/ per deck sq. ft. higher than comparable Florida I-Beams or steel plate girders. The total deck area of these two potential candidate bridges is 27,129 sq. ft., resulting in \$0.45 -\$0.85 million in additional costs for these bridges.

3.2 Surface Treatment

Among the surface treatment considered are pier type and shapes, coating and retaining wall texture.

3.2.1 Coating

Historically, the FTE has used the following colors for structures in its inventory:

- Light Tan: Federal Standard 23717 for retaining walls,
- Dark Tan: Federal Standard 20475 for traffic railings, copings and slab overhangs, and
- Turnpike Green: Federal Standard 34090 for beams.

¹ Alternatives to steel box girders that may be evaluated in the BDR phase include segmental concrete box girders and curved precast spliced u-girders. In the more detailed analysis of the BDR, these may provide advantages in constructability and/or cost when compared to steel box girders. Aesthetically, these structures are at least equal to steel box girders. Use of these structure types would not increase project cost.

In early 2010s, FDOT recognizing the initial cost of coating structures in addition to the increased maintenance life-cycle cost, determined to limit the application of coatings based on strict environmental and aesthetic criterion.

Furthermore in discussion with the Florida's Turnpike Structures Engineer regarding surface treatment on this project, the preferred treatment for new structures and bridge widenings is to follow Volume 1 of the Florida's Turnpike Supplement to the FDOT Structures Manual. These guidelines, along with FDM Section 121.9.3 specify:

Steel Bridges

New steel bridges are to be fabricated using uncoated weathering steel where site conditions permit as described in the Structures Design Guideline (SDG) Section 1.3.2. Per this SDG criteria, uncoated weathering steel superstructures are used if the structure is located 4.0 miles or more from the coast or the intracoastal waterway (whichever is closer) regardless of the superstructure environmental classification. For this project, the default surface treatment for new steel structures is weathering steel regardless of the aesthetics level.

For steel bridge widenings where coating is present, the new elements are generally coated to match existing conditions per SDG Section 7.3.1.

In general where weathering steel is precluded or coating is required, structures are applied an Inorganic Zinc Coating System.

Recommendation:

- Provide uncoated weathering steel for all new steel structures, unless otherwise listed below,
 - Take measures to avoid staining substructure elements by properly channeling the iron oxide runoff.
- Provide coated steel for the widening of the Florida's Turnpike widening over Orange Blossom Trail (US 441/17/92) following these requirements:
 - Provide a coating to match a weathering steel appearance in lieu of using the historical FTE colors,
 - Do not re-coat existing superstructure elements,
 - Using weathering steel to widen coated steel structures is not recommended due to concerns of dissimilar material reactions.

These recommendations would not require approval from the District Design Engineer (DDE) or Chief Engineer. There is no additional cost associated with this approach. **Figure 1** exhibits the proposed uncoated weathering steel structures.

Figure 1
Uncoated Weathering Steel Bridge, Uncoated Concrete Surfaces and Retaining Walls
(I-75 SB Express Lanes Off-Ramp over I-75 SB General Purpose Lanes)



Concrete Bridges

Per SDG criteria, new concrete bridges are to be uncoated and without tints or stains. When approved by the DDE, Class 5 coatings, tints or stains may be used on bridges and noise, perimeter and retaining walls for which enhanced aesthetic treatments are required because of their close proximity to and/or high visibility from important or popular locations with the following land uses: historical, tourism, commercial, recreational or residential.

Recommendation:

- Provide uncoated concrete bridges for all new bridges and bridge widenings, unless otherwise listed below,
- See Voltaire Drive Extension over Beachline Expressway enhanced aesthetics suggestions below.

These recommendations would not require approval from the District Design Engineer (DDE) or Chief Engineer. There is no additional cost associated with this approach. **Figure 2** exhibits the proposed uncoated concrete surfaces.

Figure 2
Uncoated Concrete Surfaces and Retaining Walls



Common Concrete Elements (Traffic Railings, Substructure and Retaining Walls)

Recommendation:

- Do not provide coatings for traffic railings, substructure elements and retaining walls per SDG requirements, and
- For the Florida's Turnpike widening over Orange Blossom Trail (US 441/17/92), remove all Class 5 finish surfaces to provide a uniform appearance with the widened retaining walls and new adjacent ramps as recommended by SDG 7.3.1.

These recommendations would not require approval from the District Design Engineer (DDE) or Chief Engineer. There cost associated with this approach is significantly less than coating new retaining walls and traffic railings on new adjacent ramps. **Figure 3** exhibits the existing Florida's Turnpike bridge to be widened and where Class 5 is proposed to be removed from the concrete surfaces.

Figure 3
Existing SR 91 Steel Bridge over Orange Blossom Trail



Coated Structures Alternative (Not Recommended)

Alternatively, to the recommended uncoated structures, if FTE's decides to later include coatings as part of the design project, we have identified fourteen potential bridge sites where coating would maximize the aesthetic impacts of the projects. The additional initial cost to provide coated structures is approximately \$4.0-\$7.0/ per deck sq. ft. higher than comparable non-coated structures. The total deck area of these fourteen potential candidate bridges is 929,420 sq. ft., resulting in \$3.70-\$6.50 million in additional coating costs for these bridges. A life-cycle cost analysis has not been established.

3.2.2 Pier Type and Shapes

Based on discussions with the Florida's Turnpike Structures Engineer, the criteria for selecting Pier Type and Shapes should consider:

- Consistent Pier Shapes to economize construction cost with an efficient and repeatable formwork,
- Texturing of pier columns with the use of form liners or vertical rustications for identified structures in **Table 1**,
- Drainage collection and conveyance to avoid unsightly appearance, and

- Proper channelization of iron oxide from weathering steel structures.

These recommendations would not require approval from the District Design Engineer (DDE) or Chief Engineer. There is no additional cost associated with this approach. **Figure 4** exhibits a Pier Type and Shape alternative commonly found throughout the Florida's Turnpike from south of SR 417 to north SR 429.

Figure 1
Hammerhead Piers with Vertical Rustication
(Northbound Florida's Turnpike to Westbound SR 417 flyover)



3.2.3 Retaining Walls and Slope Protections

The standard FTE's retaining wall surfaces are Ashlar Stone (Type B) or Vertical Fractured Fin (Type G) texture per FDOT Standard Plans Index 534-200. Except at discrete locations, the Vertical Fractured Fin (Type G) texture is found throughout the Florida's Turnpike corridor from south of SR 417 to north of SR 429.

Recommendation:

- All proposed new mechanically stabilized earth (MSE) walls will be Vertical Fractured Fin (Type G) texture except as described below,
- At the Florida's Turnpike widening over Orange Blossom Trail and adjacent new ramps, match the front face wall texture (Granular) and transition to Vertical Fracture Fin (Type G) on the wrap around walls,
- For bridge widenings or new adjacent ramps where slope protection is present, match the slope protection where possible.

These recommendations would not require approval from the District Design Engineer (DDE) or Chief Engineer. There is no additional cost associated with this approach. **Figure 5** exhibits the standard FTE wall texture. **Figure 6** exhibits the proposed Vertical Fractured Fin wall texture.

Figure 5
Sample Wall Aesthetics – FTE Standard Wall Texture

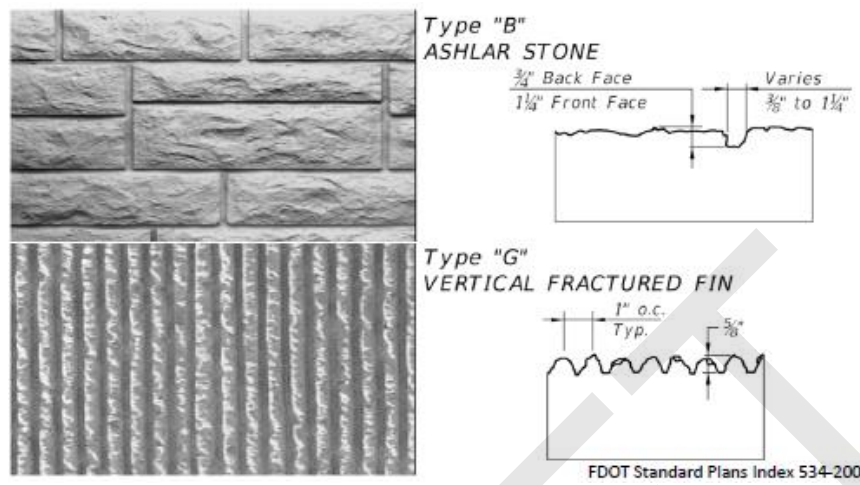


Figure 6
Sample Wall Aesthetics – Uncoated Vertical Fractured Fin Retaining Wall Texture (SR 91 Loop Ramps)



3.3 *Voltaire Drive Extension over the Beachline Expressway*

The proposed Voltaire Drive Extension bridge is the last structure of the Orlando South Interchange over the Beachline Expressway. Located about 1,500 feet west of the Beachline Expressway Signature Gantry, this structure is potential candidate to receive enhanced structures type and surface treatment aesthetics due to its proximity to and/or high visibility from important or popular tourist destinations.

The enhanced structures type is discussed under article 3.1.

3.3.1 *Surface Treatment*

Based on discussions with FTE, a low weight cladding could be attached to the fascia girders to create a weathering steel appearance which would maximize and homogenize the overall visual impact of this structure for drivers on the Beachline Expressway with the new steel structures. **Figures 7 and 8** exhibit examples of fascia cladding. Alternatively, Class 5 coatings, tints or stains to match a weathering steel

appearance may be considered for the superstructure elements. Using tints to colorize the superstructure elements is not recommended due to the uncertainty in sources of aggregates used for the prestressed and cast-in-place concrete elements, which could cause the tint colors to look uneven and adversely affect aesthetics.

Aesthetic Enhancement Suggestion:

At the discretion and approval from the District Design Engineer (DDE), we suggest installing a low weight fascia cladding to create a weathering steel appearance. Alternatively, we suggest applying a Class 5 coating to the fascia girders in order to replicate an uncoated weathering steel appearance. There is an additional initial cost of \$25,000 associated with this approach. A life-cycle cost analysis has not been established.

The FTE's Approval Letter for Concrete Surface Finishes has been attached to this document for DDE's signature if the suggested enhancements are approved.

Figure 7
Sample Fascia Cladding - SR 408 over Summerlin Avenue



Figure 8
Sample Fascia Cladding - I-4 over 40th Street



The proposed bridge aesthetics are displayed in **Table 1: Proposed Aesthetics Levels for Bridge in the Orlando South Interchange.**

Table 1
Proposed Aesthetic Levels for Bridges in the Orlando South Interchange

Proposed Bridge Aesthetics			
ID / No.	Description	Proposed Superstructure Material(s)	Proposed Aesthetic Level and Surface Treatment
1_3	SR 91 over OBT (Widening)	Coated Steel Plate	- Level One Aesthetics - Surface Treatment: Coated to match new adjacent weathered steel ramps
2A_3	EB SR 528 over SR 91	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
2B_3	EB SR 528 over OBT	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
3_3	WB SR 528 over SR 91	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
4_3	WB SR 528 over OBT	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
5_3	EB SR 528 over Landstreet Road (Widening)	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. Match existing substructure shapes
6_3	WB SR 528 over Landstreet Road (Widening)	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. Match existing substructure shapes
14_3	SR 528 over CSXRR (Widening)	Type II AASHTO	- Level One Aesthetics - Surface Treatment: Uncoated. Match existing substructure shapes
15_3	SR 528 over CSXRR (Widening)	Modified Type II AASHTO	- Level One Aesthetics - Surface Treatment: Uncoated. Match existing substructure shapes
A3 (Ramp 301)	SB SR 91 to WB SR 528 Ramp over Consulate Drive, Ramp 303, Ramp 5, SR 528	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
B3 (Ramp 302)	SB SR 91 to EB SR 528 Ramp over Consulate Drive, SR 528, SR 91, Bridges A3 and J3	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief

Proposed Bridge Aesthetics			
ID / No.	Description	Proposed Superstructure Material(s)	Proposed Aesthetic Level and Surface Treatment
C3 (Ramp 304)	SR 91 SB to OBT NB over Ramp 22	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated substructure with vertical rustication/relief
D3 (Ramp 304)	SR 91 SB to Taft Vineland Road over OBT	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief where applicable
E3 (Ramp 302)	Ramp 302 over Landstreet Road	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. Match adjacent substructure shapes
F3 (Ramp 310)	EB SR 528 to NB/SB SR 91 over JYP on-ramp	Weathering Steel Box or Plate / FIB	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
G3 (Ramp 305)	NB SR 91 to WB SR 528 Ramp over OBT, SR 91, SR 528, Consulate Drive	Weathering Steel Box / FIB	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
H3 (Ramp 306)	NB SR 91 to EB SR 528 over toll plaza area	Weathering Steel Plate	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
J3 (Ramp 309)	EB SR 528 to NB SR 91 over SR 528 & SR 91, Ramps 2, 5, & 23, Consulate Drive	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
K3 (Ramp 310)	EB SR 528 to SB SR 91 over Consulate Drive, Ramp 4	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
L3 (Ramp 314)	WB SR 528 to SB SR 91 over CSXRR	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. Match adjacent substructure shapes
M3 (Ramp 314)	WB SR 528 to SB SR 91 over SR 528 & SR 91, Ramp 5, 8, & 10	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
P3 (Ramp 203)	Taft Vineland Road to NB SR 91 over SR 91	Weathering Steel Box	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief

Proposed Bridge Aesthetics			
ID / No.	Description	Proposed Superstructure Material(s)	Proposed Aesthetic Level and Surface Treatment
R3 (Ramp 322)	Ramp 322 over OBТ	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief where applicable
T (Ramp 313)	WB SR 528 to NB SR 91 over CD, Ramp 325	Weathering Steel Box	- Level Two Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief
V	EB SR 528 over JYP (Widening)	FIB	- Level One - Surface Treatment: Uncoated. Match existing substructure shapes
W (Ramp 203)	Ramp 203 over OBТ	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief where applicable
X (Ramp 305)	Ramp 305 over OBТ	Weathering Steel Plate	- Level One Aesthetics - Surface Treatment: Uncoated. Substructure with vertical rustication/relief where applicable
Y	Voltaire Drive Extension over SR 528	FIB	- Level Two Aesthetics - Surface Treatment: Uncoated. substructure with vertical rustication/relief - Suggested Enhanced Treatment (at discretion of DDE): Low Weight Fascia Cladding to match weathering steel
Z	Voltaire Drive Extension over Gills Drive and Pond	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. No substructure rustication
AA	Voltaire Drive Extension over Skylake Canal	FIB	- Level One Aesthetics - Surface Treatment: Uncoated. No substructure rustication

Notes:

OBТ = Orange Blossom Trail (US 441/17/92)

SR 528 = Beachline Expressway

SR 91 = Florida's Turnpike

JYP = John Young Parkway

EL = Express Lane

GTL = General Toll Lane

DDI = Directional Diamond Interchange

NA = Not applicable

Approval Letter for Concrete Surface Finishes

To: **Patrick Muench, PE**
Turnpike Design Engineer

Date: **01/27/2020**

Financial Project ID: **438547-1-22-01**
Project Name: **Orlando South Ultimate Interchange PD&E Study**
Turnpike Project Manager: **Anil J. Sharma, PE**

Begin Project MP: **6.64** End Project MP: **10.34**
Site Location: Urban Rural
Land Use: Historical Tourism Commercial Recreational Residential
 Other -

Finish requested by:
 Florida's Turnpike Enterprise Other Agency -

Finishes:
 Class 5 Coating Tints/Stains Non-Standard Textures /Graphics
 Other -

Components:
 Bridge Retaining Wall Noise Wall Roadway Barriers
 Other -

Orlando South Ultimate Interchange (OSUI) Improvements include, among others, construction of reliever interchanges on the Turnpike and SR 528. The Voltaire Drive Extension over SR 528 is the last structure of the OSUI. About 1,500 feet west of a Signature Gantry, this bridge is potential candidate to receive enhanced surface treatment aesthetics due to its proximity to tourist destinations. We suggest applying a Class 5 coating to the fascia girders in order to replicate a weathering steel appearance.

Recommended by:

Stephan Heimburg, PE
Responsible Professional Date **01/27/2020**

Approvals:

Patrick Muench, PE Date
Turnpike Design Engineer

Will Watts, PE Date
Chief Engineer

Nicola Liquori Date
Turnpike Executive Director