BRIDGE FACTORS GROUP CHAIRMAN'S FACTUAL REPORT

Miami, FL

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NATIONAL TRANSPORTATION SAFETY BOARD
OFFICE OF HIGHWAY SAFETY
WASHINGTON, D.C.

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BRIDGE COLLAPSE SUMMARY

For a summary of the bridge collapse, refer to the Preliminary Reports and Updates that have been issued for this investigation.

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1. Background of UniversityCity Prosperity Project

1.1. Transportation Investment Generating Economic Recovery (TIGER) grant

The Transportation Investment Generating Economic Recovery (TIGER) grant program provided a unique opportunity for the U.S. Department of Transportation (USDOT) to invest in surface transportation infrastructure. The grant program awards projects on a competitive basis that will have a significant local or regional impact. TIGER funding supported investments in roads, bridges, transit, rail, ports or intermodal transportation. Since 2009, the TIGER program has provided a combined $5.6 billion to 463 projects in all 50 states, the District of Columbia, Puerto Rico, Guam, and the Virgin Islands. In FY2018, the TIGER grant program was replaced with the Better Utilizing Investments to Leverage Development (BUILD) transportation discretionary grants program.[2] The eligible costs and project types have not changed between the two programs.

On September 5, 2013, the USDOT notified the Florida International University (FIU) that they were selected as a recipient of a 2013 TIGER grant for the UniversityCity Prosperity Project in the amount of $11,397,120. The project description, highlights, and benefits of the 2013 TIGER grant included the following:

> *"**Project Description***
>
> *TIGER funds will be used to support an innovative package of technology, streetscaping and transit improvements to connect the town of Sweetwater with Florida International University (FIU). Together they will increase access to jobs on the FIU campus and link two portions of campus that are currently disconnected. TIGER funds will also be used to construct a new pedestrian bridge over a busy arterial road. These infrastructure improvements will support the economic growth of a major public research university and an adjacent small city.*
>
> ***Project Highlights***
>
> - *Utilizes innovative Intelligent Transportation System features to assist students, university staff, and community members to move efficiently to and through the FIU campus.*
> - *Creates a complete street connection between two portions of the campus currently disconnected, including a new pedestrian bridge over a major street.*
> - *Constructs complete streets improvements and campus walkways with a Boardwalk and Entry Plaza and Pavilion Project on campus.*
>
> ***Project Benefits***

[2]The USDOT BUILD Discretionary Grants website https://www.transportation.gov/BUILDgrants was accessed on June 7, 2018.

The project will facilitate transit use and safe pedestrian-oriented transit access via an advanced and comprehensive electronic wayfinding system. This unique and innovative combination of computing technology, transit station improvements, and pedestrian-oriented infrastructure will increase transit ridership and reduce congestion. This innovative approach to campus connectivity is a first-of-its-kind effort that serves as a model for other communities throughout the nation."

Figure 1 is a bridge rendering of what the new UniversityCity Prosperity Project signature pedestrian bridge (pedestrian bridge) would look like as submitted by FIU as part of the 2013 TIGER grant application. The conceptual plans show the new bridge location to be east of the SW 8th Street / SW 109th Avenue intersection and spanning over the historically designated footbridge.[3]

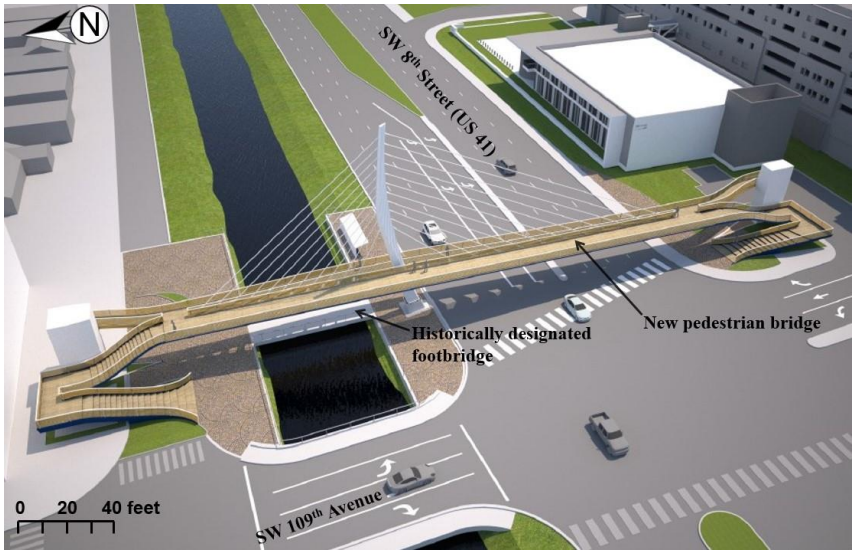


Figure 1 – Bridge rendering of what the new signature pedestrian bridge would look like as submitted by FIU as part of the 2013 TIGER grant application (Source: FIU modified)

Figure 2 illustrates the final location of the new pedestrian bridge west of the SW 8th Street / SW 109th Avenue intersection. FIU indicated in an email to NTSB investigators that the State of Florida Historic Preservation Office had ruled, as part of the National Environmental Policy Act (NEPA), the location of the new pedestrian bridge east of the SW 8th Street / SW 109th Avenue intersection would detract from the historic designation of the footbridge, such as casting a shadow over the footbridge.[4] Hence, FIU decided to shift the location of the new pedestrian bridge to the west side of the SW 8th Street / SW 109th Avenue intersection. The design of the new pedestrian bridge west of the SW 8th Street / SW 109th Avenue intersection will be discussed later in the Bridge Factors Factual Report.

[3]The conceptual plans for the new pedestrian bridge were developed by T.Y. Lin International as part of the 2013 TIGER grant application. The scope of work was included in a letter to FIU from T.Y. Lin International dated April 29, 2013.
[4]Email from Mr. Kenneth Jessell of FIU to Mr. Dan Walsh of NTSB dated June 8, 2018.

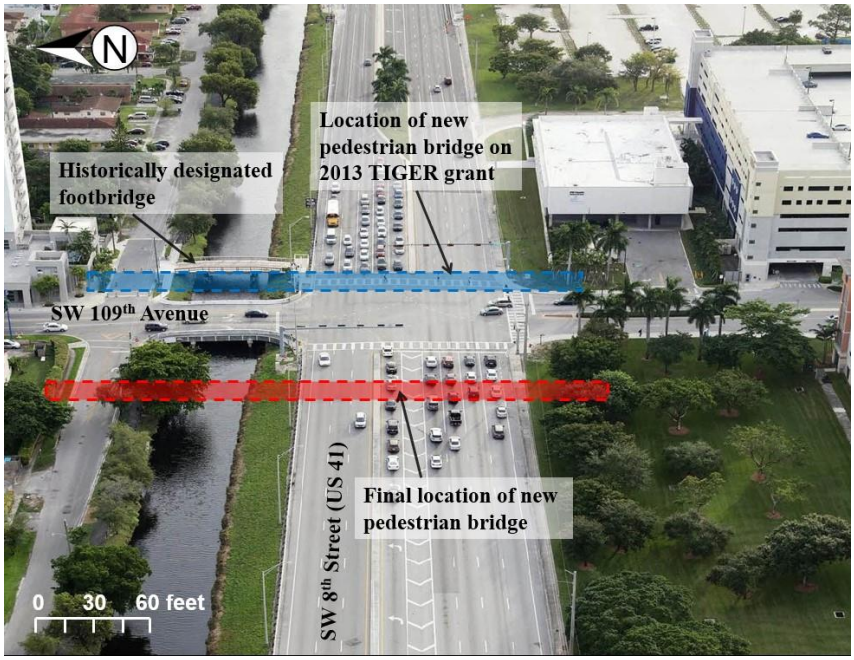


Figure 2 – Final location of the new pedestrian bridge west of the SW 8th Street / SW 109th Avenue intersection (Source: Munilla Construction Management (MCM) modified, Date of Photograph: 10/26/2016)

1.2. Transportation Alternatives Program (TAP) grant

In addition to the 2013 TIGER grant, the UniversityCity Prosperity Project received a Transportation Alternatives Program (TAP) grant from the USDOT in the amount of $1,000,000. The TAP program invests in smaller-scale transportation projects such as pedestrian and bicycle facilities, recreational trails, safe routes to school projects, community improvements such as historic preservation and vegetation management, and environmental mitigation related to stormwater and habitat connectivity. The Fixing America's Surface Transportation (FAST) Act replaced the former Transportation Alternatives Program (TAP) with a set-aside of funds under the Surface Transportation Block Grant Program (STBG). For administrative purposes, the Federal Highway Administration (FHWA) refers to these funds as the TA Set-Aside.[5]

2. Agreements

2.1. TIGER Grant Agreements

The terms and conditions of the 2013 TIGER grant were set forth in an original agreement executed on June 5, 2014 between the FHWA, FIU Board of Trustees, and FDOT.[6] The grant was

[5]The FHWA Transportation Alternatives website https://www.fhwa.dot.gov/environment/transportation_alternatives/ was accessed on June 8, 2018.

[6]Grant Agreement under the Consolidated and Further Continuing Appropriations Act, The Florida International University (FIU) Board of Trustees, UniversityCity Prosperity Project, FHWA FY 2013 TIGER Grant No. 12, 24 pages.

for a total not-to-exceed amount of $11,397,120. The grant requires that at least twenty percent (20%) of the project costs are funded by non-Federal sources. Funds under the agreement were made available on or before September 30, 2014 with a grant termination date of September 30, 2019. The agreement acknowledges the FDOT agrees to act as a limited agent for the FIU to assist in the receipt and disbursement of the TIGER grant and to perform other administrative and oversight duties with respect to the grant and the project as the FIU and FDOT shall agree upon between themselves. The agreement also acknowledges the FDOT will comply with all applicable Federal laws, regulations, executive orders, policies, guidelines, and requirements as they relate to the duties it assumes under this agreement in compliance with the terms and conditions contained herein.

The 2013 TIGER grant agreement indicated the following regarding the statement of work:

"The 2013 UniversityCity Prosperity Project consists of the following four components:

i. Pedestrian-Oriented Transit Access Infrastructure Improvements (Infrastructure)
ii. Community Transit Service Development Enhancements (Community Transit)
iii. Informed Traveler Program and Applications (ITPA)
iv. Design/ Engineering Services and Construction Management (DES&CM)

Specifically, these project improvements will consist of:

***Infrastructure:** This part of the Project focuses on pedestrian-oriented transit access infrastructure improvements, that provide for two narrowed traffic lanes and wider sidewalks with landscaping, and pedestrian-oriented streetscaping elements, such as enhanced shade trees, street furniture, street signage, street lighting, a Memorial Plaza in Sweetwater, and an entry plaza located on FIU 's Modesto A. Maidique Campus (Maidique Campus); and a signature pedestrian-oriented shared-use bridge across US 41 (a major arterial roadway located between Sweetwater and Maidique Campus).*

***Community Transit:** Community transit will be enhanced through deploying three community transit vehicles that are: 1) rebuilt, repaired, and enhanced ten passenger Small Hybrid-Electric Rubber Tire Trolley to be owned by Sweetwater and operated within UniversityCity between Sweetwater and FIU crossing US 41 on a high frequency; 2) a rebuilt, repaired, and enhanced community transit Back-Up Circulator Bus to accommodate ten or more passengers that is owned by Sweetwater; and, 3) acquiring a multipurpose, ten passenger, outreach vehicle which will also serve as a community transit back-up vehicle.*

***ITPA:** The 2013 TIGER funds allocated for the ITPA will be used to deliver a platform to support the first phase of the overall ITPA vision. The ITPA is based on a plan developed in a separate effort led by Miami-Dade Expressway Authority (MDX) to ensure interoperability among the various locally deployed technology*

systems. The ITPA will develop software that will provide personalized, timely information and advice regarding the most efficient and cost effective travel paths for users in advance of their travel decision points. The ITPA will also provide information to selected members of the traveling public who agree to optimize their trips to and from UniversityCity by using ITPA to secure available parking spaces and to timely access community transit and express transit services. These first ITPA effort will be focused on: FIU transit vehicle and passenger movements in and between the FIU's Maidique Campus, the Biscayne Bay Campus and the Engineering Center; Sweetwater community transit vehicle and passenger movements within UniversityCity and Sweetwater; a smart parking feature at certain FIU Maidique Campus, Sweetwater, and remote locations connected to FIU by express transit; and, data aggregation and feeds to reduce any traffic delays along US 41 and SW/NW 107th Avenue adjacent UniversityCity.

***DES&CM :** This component consists of design and engineering services and construction management.*

Infrastructure Staff Support and Professional Services for Construction, Design and CEI, including: managing development of design; permitting; right-of-way acquisition/approvals and easements; design-build advertisement and competitive selection award process; construction oversight and approvals activities; code administration (FIU is permitting authority); construction accounting, billing, and payment management; and risk management."

Table 1 summarizes the overall project budget summary for each TIGER grant agreement executed by the FHWA, FIU Board of Trustees, and FDOT. Addendum #1 primarily focused on modifications to the scope and schedule for the UniversityCity Prosperity project. Amendment #2 primarily focused on modifications to the schedule and budget for the UniversityCity Prosperity project.

Table 1 – Overall project budget summary for each TIGER grant agreement executed by the FHWA, FIU Board of Trustees, and FDOT

Agreement	Date Executed	Total Project Budget	TIGER	Other Federal Funds (TAP)	FIU	City of Sweet-water	FDOT
Original TIGER Agreement	6/5/14	$15,505,663	$11,397,120	$1,000,000	$1,057,482	$1,991,061 (Note 1)	$60,000 (Note 2)
Addendum #1 (Note 3)	1/12/16	$15,505,663	$11,397,120	$1,000,000	$1,057,482	$1,991,061 (Note 1)	$60,000 (Note 2)
Amendment #2	12/11/17	$19,391,196	$11,397,120	$2,214,002 (Note 4)	$3,729,013 (Note 5)	$1,991,061 (Note 1)	$60,000 (Note 2)

Note 1: Local funds include $1,745,800 in donated City of Sweetwater right-of-way.

Note 2: FDOT Infrastructure staffing support.

Note 3: Addendum #1 was requested in order to shift the location of the new pedestrian bridge to the west side of the SW 8th Street / SW 109th Avenue intersection without the need to increase the project budget.

Note 4: Increase of $1,214,002 – See Local Agency Program (LAP) supplemental agreement between FIU and FDOT executed on 6/2/17. Includes $402,724 FDOT construction cost associated with 11-foot shift of entire pedestrian bridge to the north to accommodate a future express bus lane currently under FDOT project development and environment study.

Note 5: Increase of $2,671,531 – FIU is contributing new non-matching funds in the amount of $2,102,016 for Additive Alternative 1 that consists of expanding the walkways leading from the south bridge plaza into the center of the FIU campus in order to encourage greater pedestrian movement between FIU and the City of Sweetwater; and $569,515 for titanium dioxide concrete that uses white concrete instead of gray concrete as well as titanium dioxide concrete additive that, as a result of photocatalytic properties, produces a long-lasting self-cleaning effect that will reduce maintenance costs as well as reducing pollution, resulting in a cleaner and more attractive bridge. The titanium dioxide concrete is for the bridge project only, which includes the staircases, elevators, pylons, bridge deck, and canopy.

A discussion of the 11-foot shift to the north of the entire pedestrian bridge to accommodate a future express bus lane will be discussed later in the Bridge Factors Factual Report.

2.2. Local Agency Program (LAP) Agreements

The purpose of a Local Agency Program (LAP) agreement is to establish consistent and uniform practices for authorizing other Local Agencies to use Federal-Aid funds provided through FDOT for project planning, project development, design, right-of-way relocation and acquisition, and construction. The FDOT Local Agency Program (LAP) Manual indicated the following:[7]

> *"**3.1 GENERAL***
>
> ***3.1.1** The Federal Highway Administration (FHWA) provides authority to the Florida Department of Transportation (Department) to approve project development and construction administration on delegated projects. The Department assigns some of this authority to qualified Local Agencies through the Local Agency Program (LAP). A Local Agency is defined as a unit of government with less than statewide jurisdiction or any officially designated public agency or authority of such a unit of government that has the responsibility for planning, construction, operation or maintenance of, or jurisdiction over a transportation facility. The term Local Agency includes, but is not limited to, a county, an incorporated municipality, a metropolitan planning organization (MPO), an expressway or transportation authority, a special road and bridge district or a regional governmental unit. Certification is limited to the Local Agency and cannot be granted to a subunit or department of a Local Agency such as a Department of Public Works. Additionally, certification cannot be granted to a private corporation or nonprofit organization. State and federal agencies are generally exempt from the certification requirements of this section. However, a District may request a state or federal agency obtain certification or recertification as needed. A Local Agency whose expenditure of federal aid funds is limited to planning studies and activities that will not lead to construction do not need to be LAP certified.*

[7]Florida Department of Transportation Local Agency Program (LAP) Manual, Chapter 3 – Local Agency Certification and Performance Management, January 2007, Revised: September 18, 2013, pages 3-1 through 3-8.

3.1.2 *The Department uses the LAP Certification process to determine that Local Agencies are qualified to administer federal-aid projects. The Department serves as the prime recipient of federal transportation funds. In accordance with 23 Code of Federal Regulation Part 635.105, the Department is the supervising agency; as such, it is responsible for authorizing performance of the work by the Local Agency of all Federal-aid projects. The Department is not relieved of supervision responsibility by certifying a Local Agency. The Department ensures LAP projects receive adequate supervision and inspection and are developed according to approved plans and specifications. The Department final inspects and accepts all LAP projects.*

3.1.3 *A Local Agency benefits from certification by gaining the ability to obtain federal reimbursement for eligible project activities. The Local Agency may administer the project with its own forces or hire a consultant or contractor as appropriate. In either case, the Local Agency controls the day to day management and operations of the project.*

3.1.4 *Each District is responsible for certification, recertification and certification removal. The District LAP Administrator may, on an as needed basis, assemble and consult with Department employees with expertise in the areas where LAP Certification is requested by the Local Agency. The District LAP Administrator will review the Local Agency's request and interview each Agency. The District LAP Administrator and Department employees with expertise in the areas where LAP Certification is requested will consider the Local Agency's past performance in delivering projects, current staffing, overall capability, and ability to comply with State and Federal requirements. Additionally, the District LAP Administrator will work with the District Title VI representative to conduct a sub-recipient compliance non-discrimination review of the Local Agency. Upon consideration of the input and advice from the Department's experts, the District LAP Administrator will make a recommendation to the District Secretary concerning the Local Agency's certification.*

3.2 TYPES OF CERTIFICATION AND REQUIREMENTS

3.2.1 *The Department grants two types of certification: full and project specific. Full certification is granted to Local Agencies with in-house staff that has five or more years experience in the project phases where certification is requested. Agencies with full certification are eligible to administer enhancement and transportation alternative projects and projects with more complex scopes. A full certification will remain in effect for a period of three years or until either party modifies or rescinds the certification. If the expiration date of the certification occurs during the course of a project, the certification will be considered to remain in effect until the project has been final accepted by the Department and FHWA. Only Local Agencies with full certification status may construct federal aid projects using force account. Force account work is limited to off-system projects, which are projects that are not located on the State or National Highway System.*

However, for projects on the State or National Highway System with costs up to $500,000.00, construction work may be done via force account with a recommendation from the District Construction Engineer and the approval of the Director, Office of Construction. Local Agencies interested in force account should review ***Chapter 24*** *of this* ***Manual*** *and* ***23 CFR 635.201-205, Subpart B - Force Account Construction.***

3.2.2 *Project-specific certifications are granted to Local Agencies that do not have a continuous stream of projects and that have limited in-house staff expertise. This certification is limited to low risk enhancement, transportation alternative projects, or other less complex projects with District approval. The project specific certification is limited to the specific project or projects for which certification is granted and requires a recertification each time the Local Agency requests an additional project. Additionally, this certification is limited to work on off system highways, unless approval is provided by the District Program Management Engineer.*

3.2.3 *The following areas of certification are available to Local Agencies:*

- *Planning*
- *Design*
- *Construction/Construction Administration*

3.2.4 *Local Agencies seeking certification in these areas must demonstrate their level of knowledge, skills, ability, and project experience. The required experience referenced in* ***Table 1*** *is necessary whether the services will be performed by the Local Agency's own forces or by a consultant or contractor. In the case of projects produced by consultants and contractors, contract management, administration and procurement skills, knowledge and processes are critical. These skills and processes are necessary to secure and ensure adequate oversight of consultants and contractors. In either case, a public employee must be in responsible charge for each project. This person is expected to be able to perform the following duties and functions:*

- *Administer governmental project activities, including those dealing with cost, time, adherence to contract requirements, construction quality and scope of Federal-aid projects*
- *Maintain familiarity and control of day to day project operations, including project safety issues*
- *Make or participate in decisions concerning changed conditions or scope changes that require change orders or supplemental agreements*
- *Visit and review the project on a frequency that is commensurate with the magnitude and complexity of the project*
- *Review financial processes, transactions and documentation to ensure that safeguards are in place to minimize fraud, waste, and abuse*

- *Direct project staff (including both Local Agency or consultant staff) to carry out project administration and contract oversight, including proper documentation*
- *Monitor the qualifications, assignments and on-the-job performance of the agency and consultant staff at all times during the project*

3.2.5 *The Local Agency's certification package may include consultant staff used to augment Local Agency forces; however, this does not relieve the Local Agency of its responsible charge obligations. It should be noted the services of a consultant in this capacity are not eligible for federal reimbursement.*

3.2.6 ***Table 1*** *describes the certification areas the Local Agency staff must meet to be certified in the area indicated.*

Table 1: Certification Areas and Requirements	
Certification Area	***Minimum Qualifications***
Planning	*Employees with knowledge of the Metropolitan Planning Organization planning processes; experience with planning studies; and projects of a nature similar to those the agency intends to develop. American Institute of Certified Planners certification is accepted, but not required.*
Design	*Experience in design with various types of projects, particularly projects of a nature similar to those the Local Agency intends to design with federal funds. Professional Engineer registration is required if the Local Agency intends to design a project with its own forces.*
Construction/ Construction Administration	*Local Agency staff with experience in providing construction oversight. The Local Agency has a quality assurance process in place and a process for contract compliance, Equal Opportunity, Disadvantage Business Enterprise wages and payrolls. An approved design-build procedure is required if the Local Agency will administer a design-build project. Any inspection and oversight work on the State Highway System and National Highway System must comply with the qualifications of work group 10 of* ***Chapter 14-75 of the Florida Administrative Code****.*

3.3 APPLICATION DEVELOPMENT AND REVIEW PROCESS

3.3.1 *The Local Agency will complete the* ***Local Agency Certification Qualification and Administrative Operations Checklist (Form No. 525-010-43)****. This form serves as the table of contents for the Local Agency's certification submittal. The form contains a list of the policies and procedures the Local Agency provides for certification. If the Local Agency elects to use the Department's procedures as its own, the Local Agency must provide the District LAP Administrator with an approval from its Board documenting this action. The Local Agency should review the Department's procedures to identify where specific references to Department staff and structures exist. These references represent conflicts that must be addressed by the Local Agency. Where these conflicts exist*

the Local Agency will provide the District LAP Administrator with its process for addressing these conflicts.

3.3.2 *The Local Agency will only submit an update of its staffing to the District LAP Administrator when it seeks recertification. The District LAP Administrator and the necessary Department experts will review the application and interview the Local Agency to determine the Local Agency's level of certification. If any information is missing from the application or additional details are needed, the Local Agency will submit this documentation in the timeframe requested by the District LAP Administrator.*

3.4 NOTIFYING THE LOCAL AGENCY OF CERTIFICATION AND ALTERNATIVES

3.4.1 *The District LAP Administrator will notify the Local Agency of the certification decision by letter or by e-mail. If the Local Agency has been certified, the letter should state the certification type and any special conditions. If certification has been denied, the letter should state the reasons. A Local Agency denied certification can reapply after correcting the stated deficiencies. The reapplication will only contain information addressing the deficiencies, unless there have been changes in the previously submitted information.*

3.4.2 *The following options are available to Local Agencies that cannot meet certification requirements associated with the project. A Local Agency may enter into an inter-local agreement with a certified Local Agency to administer a project on its behalf. The Local Agency may also request the Department to enter into a Memorandum of Agreement to administer a project on its behalf. The request does not obligate the Department or other Local Agency to administer the project.*

3.5 RECERTIFICATION AND CERTIFICATION REMOVAL

3.5.1 *Each Local Agency is required to recertify after a period of three years. During the recertification process, the District LAP Administrator and the Task Team shall focus evaluation on the Local Agency's past performance and staffing changes. As part of the recertification process, the Local Agency completes a sub-recipient compliance non-discrimination review. Recertification provides an opportunity for the Department and the Local Agency to evaluate their partnership. Additionally, as a part of the recertification review process a Local Agency may be recertified to a different certification type or have the certification removed. The Department and the Local Agency should determine what aspects of the Local Agency's efforts are working well, what needs to be improved and whether the LAP certification should continue.*

3.5.2 *A Local Agency's certification may be removed for failure to comply with State and Federal regulations, the requirements of this Manual, and the Local Agency Program Agreement. The certification removal may also occur for*

unsatisfactory performance, which includes, but is not limited to: failure to deliver projects, and failure to meet the commitments of the LAP program. The District LAP Administrator and District Program Administrator/Engineer will recommend certification removal to the District Secretary. The recommendation will include performance reports and documentation of any factors relevant to the decision. A Local Agency may review the certification removal by requesting a meeting with the District Secretary.

3.6 PERFORMANCE MANAGEMENT

3.6.1 *Performance management is a tool used to enhance the efficiency and effectiveness of the Local Agency Program. Performance management is used to assess risk, track performance, and acknowledge exemplary performance. When the Department certifies a Local Agency and enters a LAP Agreement, a commitment is made to deliver the subject project. The Department is a results-driven organization and measures the progress made towards this commitment. Consequently, Local Agencies are evaluated in the following areas:*

- *Overall Performance*
- *Project cost, scope, and schedule*
- *Communication and Cooperation*
- *Invoicing*
- *Each Project Phase*
- *Construction/Administration*
- *Equal Opportunity Contract Compliance*

3.6.2 *Local Agencies are evaluated on a project-by-project basis. The evaluations are used to provide information about oversight needs and aid in determining the outcome of the recertification process. The District LAP Administrator completes the evaluation based on input from the project managers. Once the District LAP Administrator completes the evaluation, the evaluation is reviewed and signed by the District Program Management Administrator/Engineer. Evaluations are submitted to the Local Agency's Responsible Charge or designee as part of the project closeout process. The Department provides the evaluation to the Local Agency no more than 30 days after final acceptance. Performance evaluations are completed using the* ***Local Agency Project Administration Evaluation Form (525-010-29)****.*

3.6.3 *Each evaluation will result in one of three ratings. A rating of Unsatisfactory Performance means the Local Agency failed to develop the project in accordance with applicable federal and state regulations, standards and procedures, required excessive District involvement/oversight, or the project was brought in-house by the Department. A rating of Satisfactory Performance means the Local Agency developed the project in accordance with applicable federal and state regulations, standards and procedures, with minimal District involvement/oversight. A rating of Above Satisfactory Performance means the*

Local Agency developed the project in accordance with applicable federal and state regulations, standards and procedures, without District involvement/oversight.

3.6.4 *The District should determine which functions can be further delegated to Local Agencies that continuously earn Satisfactory and Above Satisfactory evaluations. The delegation process should be linked to a program level quality assurance review. The District LAP Administrator and District Program Administrator/Engineer in consultation with the Local Agency will agree to which functions can be further delegated and the frequency of review during the quality assurance review process.*

3.6.5 *Efforts should be made to assist a Local Agency earning an unsatisfactory evaluation to improve its performance to a satisfactory level. If the District exercises due diligence in assisting the Local Agency improve its performance and the Local Agency continues to earn Unsatisfactory results, the District should change the Local Agency's certification type if applicable or initiate certification removal.*

2.3. Specific LAP Agreement Information related to the UniversityCity Prosperity project

FDOT's LAP Administrator provided the following information regarding FIU's certification:[8]

"***NTSB Question:*** *When did FIU get initially certified?*

Answer: *May 14, 2014.*

NTSB Question: *What certification option did FIU receive (Full certification or Project-Specific certification)?*

Answer: *Full certification.*

NTSB Question: *Was certification for 3 years?*

Answer: *"Full certification expires three years from the initial certification date." However, "if the expiration date of the certification occurs during the course of a project, the certification will be considered to remain in effect until the project has been final accepted by the Department and FHWA". Expiration was anticipated February 15, 2019, which is the project's contract end date.*

NTSB Question: *Who was the person from FIU that was in "responsible charge"?*

Answer: *Roberto M. Gutierrez, Director, Pre-Awards, Division of Research.*

[8]Email from Ms. Xiomara Nunez of FDOT to Mr. Dan Walsh of NTSB dated August 17, 2018.

NTSB Question: *Was FIU given a performance evaluation rating after the pedestrian bridge collapse on March 15, 2018 (Unsatisfactory Performance, Satisfactory Performance, or Above Satisfactory Performance)?*

Answer: *No action has been taken pending the outcome of the NTSB investigation.*

NTSB Question: *Was FIU's LAP certification removed after the pedestrian bridge collapse on March 15, 2018?*

Answer: *No action has been taken pending the outcome of the NTSB investigation."*

The procedures for preparing a LAP project that include design criteria, standards, and specifications will be discussed later in the Bridge Factors Factual Report. **Table 2** summarizes the Local Agency Program (LAP) agreements executed by FIU and FDOT.

Table 2 – Local Agency Program (LAP) agreements executed by FIU and FDOT

Agreement	Date Executed	Amount	Reason
Original Local Agency Program (LAP) Agreement	6/23/14	$11,397,120 (TIGER) $1,000,000 (TAP)	Notice of Approved Authorization
Local Agency Program (LAP) Supplemental Agreement	6/2/17	$1,214,002 (Note 1)	Notice of Approved Modification
Local Agency Program (LAP) Amendment Extension Request	1/2/18	None	Request extension of time from current end date of 3/31/18 to requested end date of 2/15/19

Note 1: Includes $402,724 FDOT construction cost associated with 11-foot shift of entire pedestrian bridge to the north to accommodate a future express bus lane currently under FDOT project development and environment study.

The Local Agency Program (LAP) agreement executed on June 23, 2014 by FIU and FDOT indicated the following general requirements:

*"**2.01 General Requirements:** …The Project will be performed in accordance with all applicable Department procedures, guidelines, manuals, standards, and directives as described in the Department's Local Agency Program Manual, which by this reference is made a part hereof as if fully set forth herein…"*

3. FIU Request for Proposal - UniversityCity Prosperity Project

FIU issued a Request for Proposal (RFP) in June 2014 to solicit qualifications, competitive bids, and technical proposals from a design-build[9] firm to implement the infrastructure improvements associated with the UniversityCity Prosperity Project. FIU established a maximum bid price of $9,388,076 for the entire scope of the project as described in the RFP.

The RFP indicated the following regarding FIU's (Owner's) intent and other related criteria:[10]

> *"**I. INTRODUCTION***
>
> ***Owner's Intent***
>
> *The OWNER seeks America's best designers and builders as members of a design-build team to design and build an innovative signature bridge that will become a respected and valued design landmark in Miami. It will serve as the critical element of a pedestrian-oriented shared-use corridor between FIU and Sweetwater, igniting the development of UniversityCity. We envision a wide pedestrian bridge (20' minimum width to perhaps even more than 30') that would serve not only as a means to cross from one side to the other, but would become a destination in its own right where community members might linger, gather, and create an urban social space -- a linear park. We expect that the bridge might even be used as an event venue. For those reasons, it should be equipped with furniture, shading, protection from the elements, and state of the art safety features such as LED lighting, video surveillance and emergency call boxes.*
>
> *The OWNER expects to engage a design-build team with the expertise to deliver an exceptional bridge, both in terms of aesthetic form and practical function. Our commitment to design excellence and design innovation is neither veneer nor luxury. It is an integral feature of this project's culture. This project's success depends on an outstanding pedestrian bridge. While the plazas and walkways are important, the top priority is the bridge design. In other words, if we get the bridge right, everything else can fall into place. If we get the bridge wrong, nothing else will matter.*
>
> *Seeking to continue a pattern of outstanding architectural and open space design on the campus, the OWNER seeks to commission a talented design-build team to design and build an iconic bridge and associated open spaces of outstanding architectural value that will connect Sweetwater and FIU, facilitating access to inter- modal transit options. The design of the bridge should demonstrate and*

[9]Design-build is a project delivery system used in the construction industry. It is a method to deliver a project in which the design and construction services are contracted by a single entity known as the design-builder or design-build contractor.

[10]FIU Design-Build Maximum Price Request for Proposal for UniversityCity Prosperity Project, Miami-Dade County, Florida, 55 pages.

exemplify the value of innovative design; balance contemporary aesthetics, cost, and constructability; balance the requirements of being environmentally responsible and beautiful; communicate the bridge's role as a public asset for our community; and finally, give contemporary form and meaning to the values and vision of the University.

VI. DESIGN AND CONSTRUCTION CRITERIA

A. General

The Design-Build Firm shall be responsible for: detailed plan checking as outlined in the Plans Preparation Manual (PPM); as described in the RFP; and the Design and Construction criteria package. This includes a checklist of the items listed in the PPM for each completed phase submittal. Bridge submittals may be broken into architecture, foundation, substructure, superstructure, approach spans and main channel spans…

… Prior to submittal to the OWNER, bridge plans shall have a peer review analysis by an independent engineering firm not involved with the production of the design or plans, prequalified in accordance with Chapter 14-75. The peer review shall consist of an independent design check, a check of the plans, and a verification that the design is in accordance with AASHTO, FDOT, and other criteria as herein referenced. The cost of the peer review shall be incurred by the Design-Build Firm. The independent peer review engineer's comments and comment responses shall be included in the 90% plans submittal. At the final plans submittal, the independent peer review engineer shall sign and seal a cover letter certifying the final design and stating that all comments have been addressed and resolved.

G. Structure Plans

1. Bridge Design Analysis

e. The Engineer of Record for bridges shall analyze the effects of the construction related loads on the permanent structure. These effects include but are not limited to: construction equipment loads, change in segment length, change in construction sequence, etc. The Engineer of Record shall review all specialty engineer submittals (camber curves, falseworks systems, etc.) to ensure compliance with the contract plan requirements and intent.

2. Criteria

a. All plans and designs are to be prepared in accordance with AASHTO LRFD Bridge Design Specifications, Department Standard Specifications, Structures Manual, Plans Preparation Manual, Department Standard Drawings, Supplemental Specifications, Special Provisions, and directions from the State

Structures Design Engineer, Temporary Design Bulletins, Structures Design Office and / or District Structures Design Engineer.

H. Specifications

FDOT Specifications may not be modified or revised. The Design-Build Firm shall also include all Technical Special Provisions, which will apply to the work in the proposal. Technical Special Provisions shall be written only for items not addressed by Department Specifications, and shall not be used as a means of changing Department Specifications."

4. FIU - UniversityCity Prosperity Project – Pedestrian Bridge Design Criteria

T.Y. Lin International prepared a report for FIU that documented the criteria for the analysis and design of the signature pedestrian bridge spanning over SW 8th Street and access structures.[11] The design criteria in the report was intended to provide general guidance for the architectural and structural elements of the pedestrian bridge. The report indicated the following:

*"**1.1 Architectural Vision***

Located on the west side of the intersection of SW 8th Street and 109th Avenue, the FIU pedestrian bridge will serve as a critical piece of infrastructure to allow safe student transit across one of the region's busiest highways (60,000 Annual Average Daily Traffic). While safety is of the utmost importance, providing the students and public at large with a bridge that will encourage and sustain its use is of equal value. Achieving a design that will promote its own use is inherently connected to how well it ties into the context of the site, how intriguing it appears from afar, the experience of using it and how the design survives the test of time. The structure is also an opportunity to be a landmark for the campus and serve as a gateway into western Miami- Dade County from the Florida Turnpike.

This structure should function as more than just a path for circulation; it should be a place to be and a place to be experienced, and the FIU campus and its students must be proud of it. It should be a destination in its own right where community members might linger, gather, and create an urban social space -- a linear park. We expect that the bridge might even be used as an event venue. For those reasons, it should be equipped with furniture, shading, protection from the elements, and state of the art safety features such as LED lighting, video surveillance and emergency call boxes.

This sense of satisfaction is intrinsically associated with the uniqueness of the bridge's geometry, materials, and space. A thorough study has been conducted that

[11]FIU - UniversityCity Prosperity Project – Pedestrian Bridge, Design Criteria, June 2014, T.Y. Lin International, 80 pages.

analyzed the practicality of multiple structural typologies including cable stayed, arched, stress ribbon, tensile nets, trusses, typical box girders, and various others. In the end it was been determined that a truss or a hybrid of sorts was the best typology for the site given the budget, site constraints, and desired aesthetic level. One of the major parameters governing the selection of a truss typology was the ability to seamlessly integrate the required 8 foot missile fence over the roadway into the structure and skin of the bridge. The missile fence should not stick out as its own discrete component but should contribute as a feature that is woven into the holistic design and as such function for the sake of providing shade, safety, reinforcement the geometry, and so forth.

Due to the rapid development of housing north of SW 8th Street an anticipated influx of students will rely on this pedestrian bridge as their primary means to cross over SW 8th Street. Based upon current volumes and known future developments, it is estimated that upwards of 8,000 students will utilize this structure daily within the next decade. In order to accommodate this level of traffic the bridge's useable width has been set at 20 feet minimum (up to 30' if possible) and the bottom of structure needs to maintain a minimum of 18ft clear over any roadway. Due to the roadway clearance and length of ramp necessary to satisfy ADA requirements it has been determined that the primary means of access onto the deck will be via staircases and elevators. The northern elevator tower and staircase shall be located northwest corner of the intersection south of the canal to avoid crossing over it. The southern departure is located on the southwest corner of the intersection north of the parking structure and east of the future multiuse building. In keeping with Ambulatory Care Clinic to the East and all the development eastward on US41 a minimum setback of 35 feet is required between the FIU north property line located from the south side of the existing sidewalk (back of sidewalk) for all bridge supports, the elevator tower, and staircase.

In comparison to the north point of departure that occupies a small sliver between SW 8th Street and the canal, the southern point of departure has a much larger area that allows for the landscape and structure's design to synthesize as one comprehensive design. What occurs on the bridge in plan and section should directly affect the landscape plan and vice versa. The intended effect should entice users to congregate and occupy the space interdependent of those whose interests lie solely in the bridge as a means for circulation over SW 8th Street. With the exception of paths of circulation to gain access to the bridge and other relevant points of interest the landscape plan should incorporate minimal hardscape features and instead focus on softscape and native plant selections that require minimal maintenance. Existing stormwater detention capacity in the areas north of the parking garages must be maintained while providing increased capacity for bridge runoff and new hardscape/impervious surfaces.

1.2 Description of Bridge Requirements

The selection criteria will be weighed heavily towards an innovative design that represents the intentions of this project, creating a distinctive landmark for the region. See Conceptual Plans for general plan layout of bridge.

1.3 General Structural Requirements

The service life of the structure shall be 75 years except as outlined in the following table for replaceable components.

2 Specifications and References

All work shall conform to current versions of the following documents. The lists below are in order of precedence.

2.1 FDOT References

- *Standard Specifications for Road and Bridge Construction (Specifications)*
- *Structures Manual (SDG)*
- *Plans Preparation Manual (PPM)*

2.2 AASHTO Specifications

- *LRFD Guide Specification for the Design of Pedestrian Bridges*
- *AASHTO LRFD Bridge Design Specifications (LRFD)*
- *AASHTO/AWS D1.5M/D1.5:2002 Bridge Welding Code*
- *AASHTO Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals*
- *AASHTO Guide Design Specifications for Bridge Temporary Works*

2.3 FHWA References

- *FHWA-NHI-05-046, Earth Retaining Structures.*
- *FHWA-HI-99-007, Rock Slopes.*
- *FHWA-NHI-01-023, Shallow Foundations.*
- *FHWA-IF-99-025 Drilled Shafts: Construction Procedures and Design Methods Manual, 1999.*

4.12 Redundancy and Operational Importance

The operational importance factor[12] shall be 1.00 for all limit states. Redundancy factors shall be determined in accordance with SDG Section 2.10.

[12]The operational importance factor has to do with the importance of the structure to the roadway system that includes traffic volumes, detour route lengths, military relevance, and location along major trucking routes.

5.18 Accelerated Bridge Construction (ABC)[13]

For bridges constructed in a staging area and launched, slid, or otherwise transported into final location, provide the following items to the OWNER, stamped by a professional engineer licensed to practice in the State of Florida:

A. Bridge Staging Area (BSA): Design Builder clears the BSA. Provide allowable ground pressures on the plans and geotechnical calculations of the designed ground pressures during all phases of construction at the BSA. Include areas of influence beneath the foundation of the temporary abutments and beneath the permanent foundations;

B. Temporary Support Structures: Provide design of all temporary structures meeting AASHTO Design Guide for Bridge Temporary Works. Show dimensions, alignments, and elevations of temporary supports relative to those of the permanent supports;

C. Permanent Superstructure: Design permanent superstructure including the maximum anticipated and maximum allowed deflections of the ends relative to mid-span as a result of any temporary support conditions necessitated by the chosen method of moving the bridge;

D. Bridge Movement System: Provide the following information in the design of the movement system:

i. When transporting the bridge using barges, indicate the configuration of the barges and the number of barges. Include details of any support structures used to elevate or lower the structure.

ii. When sliding the bridge, indicate the type of equipment used including but not limited to jacks, winches, rollers, bearing pads, and slide shoes. Provide a system that allows the structure to be backed up and meets the placement tolerances shown on the plans.

E. Bridge Movement Plan: Detail the sequence and procedures for attaching the Bridge Movement System to the superstructure and actively engaging the load. Show inspection access points under or around the superstructure at lift locations and attachment points. Provide anticipated height change limitations or stroke limits of the

[13]Accelerated bridge construction (ABC) is bridge construction that uses innovative planning, design, materials, and construction methods in a safe and cost-effective manner to reduce the onsite construction time that occurs when building new bridges or replacing and rehabilitating existing bridges.

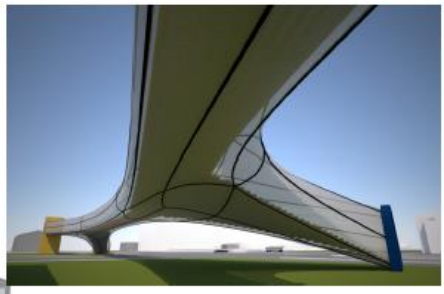
jacking systems for the bridge movement systems. Include all scheduling and Traffic Control Plans;

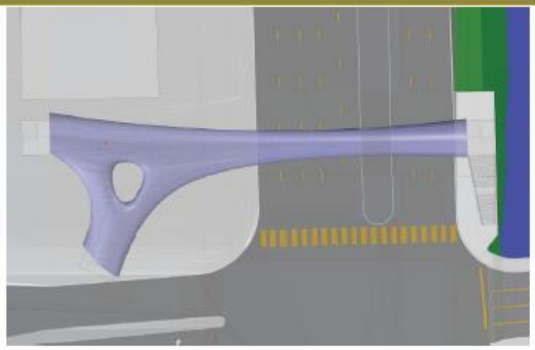
F. *Monitoring Plan: Provide a plan for monitoring structure deflections during the move. Include details of all instrumentation, locations of benchmarks, and locations of reference points in the BSA and at the final bridge location. Include details for measuring the deflections of the structure immediately after lifting and immediately before setting the structure.*

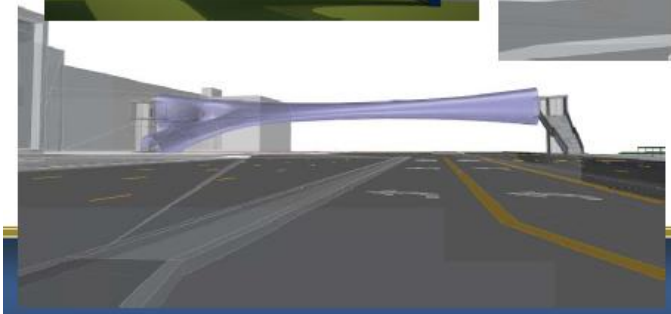
G. *Utility Agreements and Mitigation Plans: Provide binding agreements to cross all affected above and below ground utilities and include in this agreement a plan to mitigate utility issues via partial shut-down of utility, complete shut- down of utility, redistribution of load, etc.*

Appendix A – Examples of Pedestrian Bridge Concept Precedents

Examples of Signature Pedestrian Bridge Design Concept Precedents







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Examples of Signature Pedestrian Bridge Design Concept Precedents

9

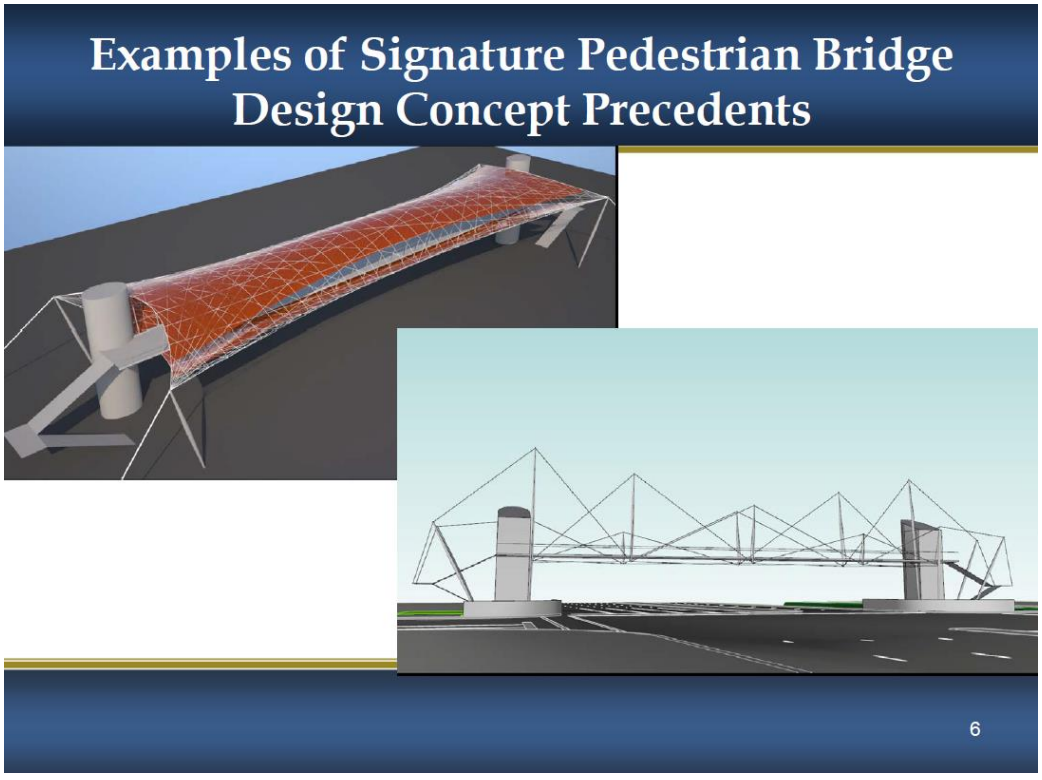
Examples of Signature Pedestrian Bridge Design Concept Precedents

12

Examples of Signature Pedestrian Bridge Design Concept Precedents

14

Truss examples from FIU RFP Design Criteria



5. Concurrence Letters

5.1. Design-Build Concurrence Letter

FDOT sent a letter dated November 10, 2015 to the FHWA recommending that the contract for the FIU UniversityCity Prosperity Project in the proposed amount of $9,388,034 be awarded to Munilla Construction Management, LLC (MCM) based on FIU's bid process recommendation.[14] FHWA concurred with the award on November 16, 2015.

FIU Facilities received 5 eligible Design-Build Qualification submittals on July 30, 2014. They were from the following firms:

1. GLF Construction Corp.
2. OHL-Arellano Construction Company
3. Condotte America, Inc.
4. Munilla Construction Management, LLC (MCM)
5. Facchina Construction

The Selection Committee conducted a Shortlist Meeting on August 13, 2014.[15] The meeting was open to the public. Three firms were short-listed during that meeting:

1. Facchina Construction
2. GLF Construction Corp.
3. Munilla Construction Management, LLC (MCM)

FIU Facilities received a letter dated July 10, 2015 from GLF Construction Corporation in which they withdrew from the selection process. Interviews were held in closed sessions in the morning on November 5, 2015 with Facchina Construction and MCM. Deliberations and scoring were held in the afternoon of November 5, 2015 in a session that was open to the public.

MCM was ranked number 1 and Facchina Construction was ranked number 2. The President, on behalf of the FIU Board of Trustees accepted the recommendation of the Selection Committee and FDOT and FHWA issued letters of concurrence on November 16, 2015.

5.2. Construction Engineering and Inspection (CEI) Concurrence Letter

On April 12, 2016, three CEI firms (Bolton Perez & Associates, Atkins North America, and Metric Engineering) presented their proposals before the selection committee. The committee members consisted of 2 members representing FIU, 1 member representing the City of Sweetwater, and 1 member representing FDOT.

Each firm had the opportunity to present, followed by a Question and Answer period with the selection committee. The committee deliberated in open session and each member ranked each firm according to the approved scoring areas of Understanding of the Program and Project

[14]Letter to Mr. Jorge J. Rivera, District VI Transportation Engineer, FHWA, from Mr. Aiah Yassin, District Local Program Administrator, FDOT, dated November 10, 2015.
[15]T.Y. Lin served as a Technical Advisor to the Committee.

Requirements, Program and Approach and Method, and Ability to Provide Service. The results of the scoring ranked Bolton Perez & Associates as the highest, followed by Atkins North America and Metric Engineering.

On the basis of the recommendation of the committee, the Senior Vice President for Finance and Chief Fiscal Officer for FIU concurred with the recommendation to select Bolton Perez & Associates as the construction engineering and inspection (CEI) firm for the project and FIU's President approved the selection.

FDOT sent a letter dated August 23, 2016 to the FHWA recommending that the contract in the proposed amount of $1,121,681.19 be awarded to Bolton Perez and Associates Consulting Engineers for the construction engineering and inspection (CEI) services on the UniversityCity Prosperity Project based on FIU's selection process recommendation.[16] FHWA concurred with the award on September 12, 2016.

6. Flow Chart and Contractual Relationship

Figure 3 illustrates the flow chart and contractual relationship for the UniversityCity Prosperity Project. FIU entered into a contract with Munilla Construction Management (MCM), the design-build firm for the project. FIU also entered into a contract with Bolton Perez & Associates (BPA) who performed the construction engineering and inspection (CEI) services for the project. MCM entered into a contract with FIGG Bridge Engineers, Inc. (FIGG), the designer and engineer of record for the project. FIGG entered into a contract with Louis Berger who conducted the independent peer review for the project. MCM also entered into contracts with Structural Technologies, LLC (VSL)[17] who conducted the post tensioning for the project and Barnhart Crane & Rigging[18] who moved the main span from the adjacent casting yard onto an abutment and pier on the south and north sides of SW 8th Street, respectively. BPA entered into a contract with The Corradino Group who performed the post tensioning inspection.

Other firms that participated in the UniversityCity Prosperity Project in which contracts were entered with either MCM, BPA, FIGG, or FIU are shown in **Figure 3**.

[16]Letter to Mr. Jorge J. Rivera, District VI Transportation Engineer, FHWA, from Mr. Aiah Yassin, District Local Program Administrator, FDOT, dated August 23, 2016.
[17]See MCM's Attachment Submission MCM-5 and MCM-6 for Structural Technologies, LLC (VSL) Scope of Work.
[18]See FIGG's Attachment Submission FCA-A5 for Barnhart Crane & Rigging Scope of Work.

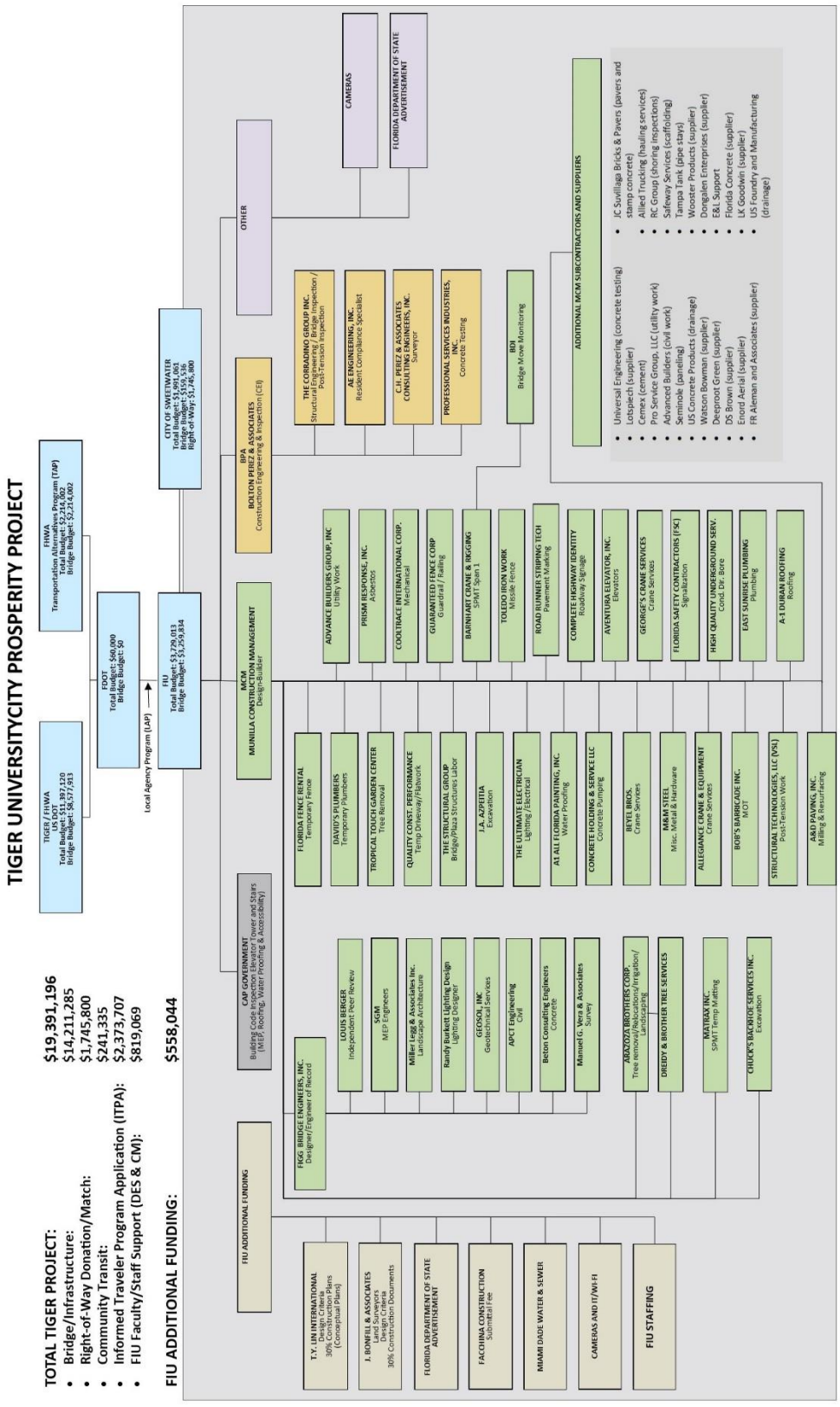


Figure 3 – Flow chart and contractual relationship for the UniversityCity Prosperity Project (Source: FIU)

6.1. Design-Build Contract between FIU and Munilla Construction Management (MCM)

The Florida International University Board of Trustees and Munilla Construction Management (MCM) entered into a Design-Build contract on January 14, 2016 for MCM to do all of the work and furnish all of the materials, equipment, supplies and labor necessary to construct the UniversityCity Prosperity Project as set forth in the Request for Proposal (RFP) and Pedestrian Bridge Design Criteria, both of which were incorporated by reference into the contract. The January 14, 2016 contract between FIU and MCM indicated the following:[19]

> *"The undersigned Proposer, having visited the site of the proposed Project and having become familiar with the local conditions, nature and extent of the Work, and having examined carefully the Drawings, Design Criteria, FHWA 1273, FDOT Standard Specifications, General Specifications, Special Provisions, FIU Building Standards; and all other documents, forms and requirements listed in the Request for Proposals and/or on the FIU Web Page for this Project, proposes to furnish all labor, materials, equipment and other items, facilities, and services for the proper execution and completion of the Project and if awarded the Contract, to complete said Work within the time limits specified for the following bid price: $9,388,034."*

6.2. General Specifications for the Design-Build Contract

The General Specifications incorporated by reference into the Design-Build contract between FIU and MCM indicated the following:[20]

> *"**SECTION 1 - GENERAL REQUIREMENTS AND COVENANTS***
>
> ***1-1 GENERAL***
>
> *These Design-Build General Specifications replace Division I, General Requirements and Covenants, of the Florida Department of Transportation (FDOT) Standard Specifications for Road and Bridge Construction, latest edition in effect on the date of the Solicitation Documents (FDOT Standard Specifications) in its entirety. No reference to any portion of Division I of the FDOT Standard Specifications in any of the Contract Documents or in any other Division or section of the FDOT Standard Specifications shall re-establish Division I or any portion thereof. Sentences that direct the Design-Build Firm to perform Work may be written in the active voice imperative mood. These directions to the Design-Build Firm are written as commands.*
>
> *Division II, Construction Details, and Division III, Materials, of the FDOT Standard Specifications for Road and Bridge Construction, latest edition in effect on the date of the Solicitation Documents, as revised and as amended herein (and*

[19] Florida International University Design-Build Contract, entered into by the Florida International University Board of Trustees and Munilla Construction Management (MCM) dated January 14, 2016.
[20] FIU General Specifications for Design-Build Contract between FIU and MCM, Revised 6-9-2014, 176 pages.

as might be amended on the Plans) and the Florida Department of Transportation Design Standards, latest edition in effect on the date of the Solicitation Documents, are incorporated by reference and made a part of these General Specifications. Any reference in Division II or Division III of the FDOT Standard Specifications to Division I of the same document, shall not apply unless the referenced section exists in the Florida International University (FIU) General Specifications with the same meaning. Any reference in the Contract Documents to the FDOT Standard Specifications shall be assumed to only mean Division II and Division III…

…For purposes of determining the responsible party or decision-making entity, in the FDOT Standard Specifications (Division II and Division III), or other FDOT referenced documents, except for FIU General Specifications for Design-Build:

(1) Wherever the words "Department," "Department - State of Florida Department of Transportation," "Department's Contract Office at Tallahassee," "State," "FDOT," appear, such words shall be taken to mean Florida Department of Transportation.

(2) Wherever the words, "Director," "Director-Division of Road Operations," "Department's Engineer of Estimates," "Secretary," "Secretary of Transportation, State of Florida," "Department's Engineering Director" or "State Treasurer" appear, such words shall be taken to mean the President of Florida International University or his/her duly authorized representative specifically authorized to act in his/her behalf.

(3) Wherever the words "District Engineer," "Engineer," "Department's Engineer of Materials," "State Estimates Engineer," or "Final Estimates Engineer" appear, it shall be taken to mean Associate Vice President of Facilities Management of Florida International University or his/her duly authorized representative specifically authorized to act in his/her behalf.

(4) Wherever the FDOT Standard Specifications indicate a mailing address for a State office or agency, the office or agency and the address shown are hereby deleted and replaced by the following: Associate Vice President of Facilities Management, FIU Facilities Management 11555 SW 17TH ST, Miami, FL 33199

Any conflict or discrepancy between the FDOT Standard Specifications and the other Contract Documents shall be brought to the attention of FIU by the Design-Build Firm. The Design-Build Firm shall be solely responsible for any consequences arising from any reliance by the Design-Build Firm on any such conflict or discrepancy without notifying FIU, as required above.

SECTION 4 - SCOPE OF THE WORK

4-1 INTENT OF CONTRACT

The intent of the Contract is to bind the Design-Build Firm to furnish all engineering and all of its associated direct and indirect costs, construction labor, Materials, Equipment, supervision, tools, transportation, and supplies required to complete the Work in accordance with the requirements of the Design and Construction Criteria Package, the Specifications, and the terms of the Contract Documents. The terms and conditions of this Contract are fixed price and fixed time. The Design-Build Firm's submitted Proposal (time and cost) is to be a lump sum proposal for completing the Work detailed in the Contract.

SECTION 5 – CONTROL OF THE WORK

5-12.1 Observation of the Work:

FIU or its designee shall have free access to the Materials and the Work at all times for measuring or observing the same, and the Design-Build Firm shall afford all necessary facilities and assistance for so doing.

After the Notice to Proceed has been issued, the Engineer will:

(1) Make visits to the Project Site at intervals appropriate to the various stages of Construction to observe the progress and quality of the executed Work and to determine in general if the Work is proceeding in accordance with the Plans and Specifications. The Engineer will not be required to make exhaustive or continuous on-site observations to check the quality or quantity of the Work, will not be responsible for the Construction means, methods, procedures, techniques and will not be responsible for the Design-Build Firm's failure to perform the Construction Work in accordance with the Contract Documents. The Engineer will not be responsible for safety precautions and procedures in connection with the Work. During such visits and on the basis of on-site observations, the Engineer may disapprove Work as failing to conform to the Contract Documents.

5-12.2 Examination of the Work:

The duties of the Engineer include examining the Material furnished, enforcing the requirements of the Contract Documents (inclusive of the Work and administrative aspects) reporting its findings, and review, approving and recommend payment of partial and final Invoices. Neither FIU nor the Engineer underwrite, guarantees or ensures the Work done by the Design-Build Firm.

It is the Design-Build Firm's responsibility to perform the Work in all details in accordance with the Contract Documents. Failure by the Engineer or any representative of FIU engaged in on-the-site observation to discover defects or deficiencies in the Work of the Design-Build Firm shall never, under any circumstances, relieve the Design- Build Firm from the Design-Build Firm's liability therefore.

FIU Project representatives shall have no authority to permit deviation from, or to modify any of the provisions of, the Contract Documents without the written permission or instruction of the Engineer, or to delay the Design-Build Firm by failure to observe the Materials and Work with reasonable promptness.

The Engineer shall not have authority to supervise, direct, expedite or otherwise control and instruct or order the Design-Build Firm or Design-Build Firm's employees in the fulfillment of the Design-Build Firm's obligation. The Engineer may only advise the Design-Build Firm when it appears that the Work and/or Materials do not conform to the requirements of the Contract Documents. Should the direction of the Engineer not be properly addressed by the Design-Build Firm the Engineer shall reserve the right to suspend work wholly or in part as detailed in section 5.12.

5-13 AUTHORITY AND DUTIES OF ENGINEER'S ASSISTANTS

The Associate Vice President of Facilities Management may appoint such assistants and representatives as desires. These assistants and representatives are authorized to observe all Work done and all materials furnished. Such observation may extend to all or any part of the Work and to the manufacture, preparation, or fabrication of the materials to be used. Such assistants and representatives are not authorized to revoke, alter, or waive any requirement of the Specifications. Rather, they are authorized to call to the attention of the Design-Build Firm any failure of the Work or materials to meet the Contract Documents, and have FIU to reject materials or suspend the Work until any questions at issue can be referred to and decided by the Engineer.

The Engineer will immediately notify the Design-Build Firm in writing of any such suspension of the Work, stating in detail the reasons for the suspension. The presence of the Engineer's assistants in no way lessens the responsibility of the Design-Build Firm.

5-15 QUALIFICATIONS OF DESIGN-BUILD FIRM'S PERSONNEL

The Design-Build Firm shall ensure that all of its employees are competent, careful, and reliable. All workers shall have the skills and experience necessary to properly perform the Work as required by the Contract Documents. Provide workmen engaged on special Work, or skilled work, such as bituminous courses or mixtures, concrete bases, pavements, or structures, or in any trade, with sufficient experience

in such Work to perform it properly and satisfactorily and to properly and safely operate the Equipment involved. Provide workmen that shall make due and proper effort to execute the Work in the manner prescribed in the Contract Documents, or the Engineer may take action as prescribed below.

5-15.2.1 Design-Build Firm's Project Manager:

The Design-Build Firm shall maintain a competent Project Manager during the duration of the Project regardless of the amount of Work sublet. The Project Manager assigned by the Design-Build Firm must be proficient with the English language, and shall possess a Registered Professional Engineer License in the State of Florida and three (3) years of specific experience in construction management on limited access facilities or have a minimum of five (5) years of specific work experience providing construction management in limited access highway facilities. The Project Manager shall be the point of contact for correspondence and all Project issues. The Project Manager shall attend all weekly, monthly and Project meetings deemed necessary by FIU or its designee.

5-16 GENERAL INSPECTION REQUIREMENTS

5-16.1 Cooperation by Design-Build Firm:

The Design-Build Firm shall provide the Engineer with every reasonable facility for ascertaining whether the Work performed and Materials used are in accordance with the requirements and intent of the Contract Documents. If the Engineer so requests, the Design-Build Firm shall, at any time before Final Acceptance of the Work, remove or uncover such portions of the finished Work as may be directed. After examination, the Design-Build Firm shall restore the uncovered portions of the Work to the standard required by the Specifications. If the exposed or examined Work is determined to be unacceptable, the cost of uncovering and/or removal and replacement of the covering or making good of the parts removed shall be at the Design-Build Firm's expense.

The Design-Build Firm shall revise and upgrade both Construction and testing procedures to prevent a recurrence of the conditions that contributed to the unacceptable Work. If the exposed or examined Work is determined to be acceptable, the cost of uncovering and/or removal and replacement of the covering or making good of the parts removed shall be paid for as Extra Work.

5-16.2 Failure of Engineer to Reject Work During Construction:

If FIU or its designee should fail to reject defective Work or Materials, whether from lack of discovery of such defect or for any other reason, such failure to reject will not prevent FIU or its designee from later rejecting defective Work or Materials when such defective Work or Material is discovered, or obligate FIU to

Final Acceptance of the defective Work. The Design-Build Firm shall make no Claim for losses suffered due to any necessary removals or repairs of such defects.

5-16.3 Failure to Remove and Renew Defective Materials and Work:

If, within the time frame indicated in writing from FIU or its designee, the Design-Build Firm fails or refuses to remove and renew any defective Materials used or Work performed, or fails or refuses to make necessary repairs in an acceptable manner, FIU shall have the right to repair or replace, or have repaired or replaced, the unacceptable or defective Materials or Work. Costs incurred by FIU for repairs or replacements shall be paid for from moneys due, or which may become due, the Design-Build Firm, or may be charged against the Design-Build Firm's Contract Bond.

Continued failure or refusal by the Design-Build Firm to make necessary repairs promptly, fully, and in an acceptable manner shall be sufficient cause for FIU, at its sole discretion and option, to perform the Work with its own forces, or to contract with any individual, firm or corporation to perform the Work. Costs incurred by FIU shall be paid for from moneys due, or which may become due, the Design-Build Firm, or may be charged against the Design-Build Firm's Contract Bond.

5-17.2 Inspection for Acceptance:

If any or all of the Work is found to be unsatisfactory, the Engineer will detail in writing the remedial work required to achieve Partial/Final Acceptance. At the time of delivery of a certificate of Partial Completion, the Engineer will deliver to the Design-Build Firm a written recommendation as to division of responsibilities pending final payment between FIU and Design-Build Firm with respect to security, operation, safety, maintenance, utilities, insurance and warranties and guarantees. The Design-Build Firm shall immediately perform such remedial work and subsequent inspections will be made on the remedial work until the Engineer accepts all the Work.

5-20 HIERARCHY FOR ISSUE RESOLUTION

In order to properly and expeditiously resolve all matters related to the Contract, whether technical or administrative in nature, FIU has established the hierarchy to be followed. The Design-Build Firm shall direct all matters to the Construction Engineering & Inspection (CE&I) Consultant for the Project. If the matter cannot be resolved at this level, the CE&I Consultant shall elevate the matter to the General Engineering Consultant (GEC), whom shall in turn elevate to FIU if necessary. The President, if the matter has escalated to his/her level, will have final authority on all decisions.

SECTION 6 – CONTROL OF MATERIALS

6-1.7 FIU Minimum Warranty Provisions:

6-1.7.1 Warranty

The Design-Build Firm shall provide a warranty covering workmanship and Materials, as a minimum, for the following features: bearings, expansion joints, roadway pavement, lighting, retaining walls, approach slabs, drainage systems, concrete defects, structural steel defects, post-tensioning systems, foundation elements, elevators and elevator equipment, high performance material finishes, roofing, sealants and waterproofing, signage, railings and metal work. Other products or features the Design-Build Firm offered to warrant as part of the technical proposal.

The Design-Build Firm shall develop the warranty criteria, measurable standards, and remedial work plans identified in the Design-Build Firm's Proposal, including associated type of distress and threshold values defining the extent and magnitude of such distresses that will necessitate remedial Work for each warranted feature. The warranty in Section 6-1.7.4 illustrates an example of the format that may be used for each warranted item.

The minimum warranty period for all structural items is five (5) years, and three (3) years for all roadway items. Structural items include, but are not limited to, bridges, buildings, canopies, overhead and cantilever sign assemblies, gantries, mast arm assemblies and bridge mounted sign assemblies. The Design- Build Firm shall assume responsibility for the performance of all associated warranty Work for the proposed warranty period. The warranty period begins at Project Final Acceptance.

6-1.7.3 Warranty Work

During the warranty period, the Design-Build Firm shall perform all necessary remedial Work at no cost to FIU. All remedial work as authorized in writing by FIU shall be performed in accordance with the terms and conditions of the Contract. Approval by FIU of remedial work will not be issued prior to receiving a certificate of insurance with the same limits of coverage under the Contract and a Contract Bond for no less than the value, as determined by FIU, of the remedial work and all costs associated with the completion of the remedial work…

… During the warranty period, the Design-Build Firm may monitor the Project using nondestructive procedures. The Design-Build Firm shall not conduct any coring, milling or other destructive procedures without prior approval by FIU.

If a measured distress value indicates remedial action is required in accordance with the Contract, the Design-Build Firm shall begin remedial Work within forty-

five (45) Calendar Days for the remedial action required to correct the measured distress. The Design-Build Firm shall begin remedial Work within seventy-two (72) hours for any warranted feature deemed by FIU as an immediate danger to the traveling public. FIU will determine the allowable duration for the completion of the remedial Work.

In the event remedial action is necessary and forensic information is required to determine the source of the distress, then FIU may investigate using appropriate methods including, but not limited to, destructive techniques. The Design-Build Firm shall obtain approval from FIU prior to starting any forensic activities. All forensic activities shall be at no additional cost to FIU, and FIU will not be responsible for damages to the warranted features as a result of any forensic activities conducted by the Design-Build Firm.

The Design-Build Firm has the first option to perform all remedial Work. If, in the opinion of the Engineer, the feature showing distress poses an immediate danger to the traveling public and the Design-Build Firm cannot, or will not, begin remedial Work within seventy-two (72) hours, the Engineer has the authority to have the remedial Work performed by other forces. The Design- Build Firm shall be responsible for all incurred costs of the Work performed by other forces. Remedial Work performed by other forces does not alter any of the requirements, responsibilities or obligations of the warranty.

The Design-Build Firm shall complete all remedial Work to the satisfaction of the Engineer. Approval of remedial Work does not relieve the Design-Build Firm from the provisions of the warranty.

FIU will seek reimbursement from the Design-Build Firm for all expenses it may incur due to review/inspection of activities under Warranty Work. These expenses may include, but are not limited to, assessment of conditions requiring Warranty Work, review and concurrence from Specialty Engineer(s) for proposed remedial work submitted by the Design-Build Firm, legal expenses, and field inspection for the implementation of any and all remedial actions performed by FIU and/or its designee.

6-5 INSPECTION TO ASSURE COMPLIANCE WITH ACCEPTANCE CRITERIA.

6-5.1 General:

The Engineer is not obligated to make an inspection of Materials at the source of supply, manufacture, or fabrication. The Design Build Firm shall provide the Engineer with unrestricted entry at all times to such parts of the facilities that concern the manufacture, fabrication, or production of the ordered Materials. The Design-Build Firm shall bear all costs incurred in determining whether the Material meets the requirements of these Specifications.

6-5.2 Quality Control (QC) Inspection:

The Design Build Firm shall provide all necessary inspection to assure effective QC of the operations related to Materials acceptance by FIU. This includes but is not limited to sampling and testing, production, storage, delivery, construction and placement. Ensure that the equipment used in the production and testing of the Materials provides accurate and precise measurements in accordance with the applicable Specifications. The Design Build Firm shall maintain a record of all inspections, including but not limited to, date of inspection, results of inspection, and any subsequent corrective actions taken.

6-6 INSPECTION AND TESTS AT SOURCE OF SUPPLY.

6-6.1 General:

FIU, at its expense, may perform Quality Assurance inspections and material certifications for plant material or off-site manufactured items. The Design-Build Firm is responsible for the Design-Build Firm's Quality Control inspections to assure the quality of the material being produced and its conformity with the Specifications.

The Design-Build Firm shall submit three (3) copies of its plant or shop QA/QC plans to the Engineer for review and concurrence within sixty (60) days after the date of the Notice to Proceed for the Project. The Engineer will review the plans and return comments to the Design-Build Firm.

If a resubmittal is required by the Engineer, the Design-Build Firm shall make the required changes and resubmit three (3) copies of the corrected version to the Engineer within fifteen (15) days after receipt of the Engineer's comments. The Design-Build Firm's QA/QC plan shall address the methods and frequencies of testing and inspection. All QC Plans shall be in accordance with FIU Standards and Procedures.

6-7 QUALITY CONTROL (QC) PROGRAM.

6-7.1 General:

The Design-Build Firm shall meet the requirements of the FDOT's approved Quality Control Program for the production and Construction of Asphalt Mix, Portland Cement Concrete (Structural), Earthwork, Cementitious Materials, Timber, Prestressed and/or Precast Concrete Products and Drainage Products. This also includes transportation, storage, placement and other related Construction operations required by the Contract Documents.

An Independent Testing and Inspection Firm must be responsible for the implementation of the Quality Control Program. The Quality Control Manager must be an employee of this firm, not be associated with the Design Build Firm, either as an employee or shareholder of the Company, and have full authority to act as the Design- Build Firm's agent to institute any and all actions necessary for the successful implementation of the QC Program.

6-7.6 Design-Build Firm's Quality Control Program:

The Design-Build Firm shall have an approved Quality Control Program meeting the requirements of Section 105 of the FDOT Standard Specifications for the transportation, storage, placement, and other related Construction operations required by the Contract Documents.

6-10 DEFECTIVE MATERIALS.

The Engineer will consider the following Materials as defective: all Materials not meeting the requirements of the Specifications; segregated Materials, even though previously tested and approved; Materials that are or have been improperly stored; and Materials that are mixed with an excess of clay, coal, sticks, burlap, hay, straw, loam or earth, or other debris. The Engineer will reject all such Materials, whether in place or not. Remove all rejected material immediately from the site of the Work and from storage areas, at no expense to FIU. Do not use rejected material, the defects of which have been subsequently corrected, until the Engineer has approved the material's use. Upon failure to comply promptly with any order of the Engineer made under the provisions of this Article, the Engineer will remove and replace defective material and deduct the cost of removal and replacement from any moneys due or to become due the Design-Build Firm.

SECTION 7 - LEGAL REQUIREMENTS AND RESPONSIBILITY TO THE PUBLIC

7-1 LAWS TO BE OBSERVED

7-1.1 General:

The Design-Build Firm shall comply with all Federal, State, and local laws and regulations which control the action or operation of those engaged or employed in the Work or which affect Materials used…

… The Design-Build Firm shall indemnify, defend and save harmless FIU and all of its officers, agents and employees, in the amount of the Contract, against any claims or liability arising from or based on the violation of any such laws by the Design-Build Firm or its Subcontractors and Suppliers.

7-7.5 Design-Build Firm's Equipment on Bridge Structures:

A completed bridge structure is a bridge structure in which all elemental components comprising the load carrying assembly have been completed, assembled, and connected in their final position. The components to be considered shall also include any related members transferring load to any bridge structure.

7-13 INDEMNIFICATION/INSURANCE.

7-13.1 Indemnification:

The Design-Build Firm shall be required to indemnify and hold harmless, Owner (FIU), and all of Owner's Officers, Agents, Employees, and Successors from any claim, loss, damage, cost, charge, judgment or expense, to the extent arising out of any negligence, recklessness, or intentionally wrongful conduct by the Design-Build Firm, its agents, employees, or subcontractors during the performance of the Contract, whether direct or indirect, and whether to any person or property to which Owner or said parties may be subject.

The Design-Build Firm shall also be required to indemnify and hold harmless, the Florida Department of Transportation (in its capacity as titleholder of the FIU System), and all of FDOT's officers, agents, employees, and successors from any claim, loss, damage, cost, charge, judgment or expense, to the extent arising out of any negligence, recklessness, or intentionally wrongful conduct by the Design-Build Firm, its agents, employees, or subcontractors during the performance of the Contract, whether direct or indirect, and whether to any person or property to which Owner, FDOT or said parties may be subject.

7-15 DESIGN-BUILD FIRM'S RESPONSIBILITY FOR WORK.

Until acceptance by FIU, the Work shall be under the charge and custody of the Design-Build Firm. The Design-Build Firm shall take every necessary precaution against injury or damage to the Work by the action of the elements or from any other cause whatsoever arising either from the execution or non-execution of the Work and shall rebuild, repair, restore and make good, without additional compensation, all injury or damage to any portion of the Work.

7-16 OPENING SECTIONS OF HIGHWAY TO TRAFFIC.

Whenever any bridge or section of roadway is in an acceptable condition for travel, the Engineer may direct the Design-Build Firm to open it to traffic. FIU's direction to open a bridge or roadway does not constitute an acceptance of the bridge or roadway, or any part thereof, or waive any Contract provisions. Perform all necessary repairs or renewals, on any section of the roadway or bridge thus opened to traffic under instructions from the Engineer, due to defective material or Work or to any cause other than ordinary wear and tear, pending completion and the

Engineer's acceptance of the roadway or bridge, or other Work, at no expense to FIU.

SECTION 9 – MEASUREMENT AND PAYMENT

9-2.2 Deviation from Plan Dimensions:

If the Design-Build Firm fails to construct any item to Plan or authorized dimensions within the Specifications tolerances, FIU, at its sole discretion, may:

1) require the Design-Build Firm to reconstruct the Work to acceptable tolerances at no additional cost to FIU;

2) accept the non-conforming Work without payment to the Design-Build Firm; or,

3) accept the non-conforming Work at a reduced price.
Refer to FIU form "Construction Compliance with Specifications and Plans."

9-5.3 Withholding Payment:

Should any defective Work or Materials be discovered prior to Final Acceptance, or should a reasonable doubt arise prior to Final Acceptance as to the integrity of any part of the completed Work, the Engineer will not authorize payment for such defective or questioned Work until the defect has been remedied and causes of doubt removed."

6.3. Contract between FIU and Bolton Perez & Associates (BPA)

The Florida International University Board of Trustees and Bolton Perez & Associates (BPA) entered into a Standard Professional Services Agreement on September 23, 2016 for BPA to administer, monitor, and inspect the UniversityCity Prosperity Project such that the project was constructed in reasonable conformity with the plans, specifications, and special provisions of the construction contract. BPA was required to observe MCM's work to determine the progress and quality of the work and identify discrepancies, report significant discrepancies to FIU, and direct MCM to correct such observed discrepancies. The September 23, 2016 Standard Professional Services Agreement indicated the following:[21]

*"**EXHIBIT A – AGREEMENT TERMS***

4. INDEMNITY AND INSURANCE:

A. The Consultant hereby indemnifies and holds harmless FIU, and its officers and employees, from liabilities, damages, losses, and costs, including, but

[21]Florida International University Standard Professional Services Agreement, entered into by the Florida International University Board of Trustees and Bolton Perez & Associates (BPA) dated September 23, 2016, 58 pages.

not limited to, reasonable attorneys' fees, to the extent caused by the negligence, recklessness, or intentionally wrongful conduct of the Consultant and other persons employed or utilized by the Consultant in the performance of the contract…

C. …Under the terms of this Agreement, the plans, reports and recommendations of the Consultant will be reviewed by FIU for conformity with FIU standards and agreement terms. However, review by FIU does not constitute detailed review or checking of design components and related details, or the accuracy with which designs are depicted on the plans.

D. Acceptance of the work by FIU or Agreement termination does not constitute FIU approval and will not relieve the Consultant of the responsibility for subsequent corrections of any errors and/or omissions and the clarification of any ambiguities. The Consultant shall make all necessary revisions or corrections resulting from errors and/or omissions on the part of the Consultant without additional compensation. If these errors and/or omissions are discovered during the construction of the project, they shall be corrected without additional compensation.

5. COMPLIANCE WITH LAWS:

A. All final plans, documents, reports, studies and other data prepared by the Consultant shall bear the professional's seal/signature, in accordance with the applicable Florida Statutes, Florida Administrative Rules, and guidelines published by FIU, in effect at the time of execution of this Agreement. In the event that changes in the Statute or Rules create a conflict with the requirements of FIU's guidelines, requirements of the Statute and/or Rules shall take precedence.

6. TERMINATION AND DEFAULT

A. FIU may terminate this Agreement in whole or in part at any time the interest of FIU requires such termination, as follows:

(1) If FIU determines that the performance of the Consultant is not satisfactory, FIU may notify the Consultant of the deficiency with the requirement that the deficiency be corrected within a specified time, but not less than ten (10) days, otherwise the Agreement will be terminated at the end of such time or thirty (30) days whichever is sooner.

7. ASSIGNMENT

A. The Consultant will maintain an adequate and competent professional staff so as to enable Consultant to timely perform under this Agreement and must

be authorized to do business within the State of Florida and may associate with it such subconsultants, for the purpose of its services hereunder, without additional cost to FIU, other than those costs negotiated within the limits and terms of this Agreement. The Consultant is fully responsible for satisfactory completion of all subcontracted work. The Consultant, however, will not sublet, assign or transfer any work under this Agreement to other than subconsultants specified in the Agreement without the written consent of FIU.

9. TERMS FOR FEDERAL AID CONTRACTS:

The following terms apply to all contracts in which it is indicated in Section 6.B of the Standard Professional Services Agreement that the services involve the expenditure of federal funds:

F. Information and Reports: The Consultant will provide all information and reports required by the Regulations, or directives issued pursuant thereto, and shall permit access to its books, records, accounts, other sources of information, and its facilities as may be determined by FIU, the Florida Department of Transportation, Federal Highway Administration, Federal Transit Administration, Federal Aviation Administration, and/or Federal Motor Carrier Safety Administration to be pertinent to ascertain compliance with such Regulations, orders and instructions. Where any information required of the Consultant is in the exclusive possession of another who fails or refuses to furnish this information, the Consultant shall so certify to FIU, the Florida Department of Transportation, Federal Highway Administration, Federal Transit Administration, Federal Aviation Administration, and/or the Federal Motor Carrier Safety Administration, as appropriate, and shall set forth what efforts it has made to obtain the information.

EXHIBIT B – CEI COMPREHENSIVE SCOPE OF SERVICES

2.0 SCOPE:

The Consultant shall provide services as defined in the Request for Qualifications (RFQ), the Agreement, once awarded, this Scope of Services and the referenced Department manuals and procedures. The Consultant's scope of services also includes compliance with applicable FIU standards and procedures. An essential CEI service for this project will also be to perform, manage and give administrative support for various compliance activities required as part of the FHWA TIGER funding for this project…

…The Consultant shall exercise its independent professional judgment in performing its obligations and responsibilities. Pursuant to Section 4.1.4 of the Construction Project Administration Manual (CPAM), the authority of the

Consultant's lead person, such as the Consultant Senior Project Engineer and the Consultant Project Administrator, shall be identical to the Department's Resident Engineer and Department Project Administrator, respectively, and shall be interpreted as such. Similarly, the Consultant Senior Project Engineer and the Consultant Project Administrator shall be identical to the FIU Construction Project Manager.

Services provided by the Consultant shall comply with Department and FIU manuals, procedures, and memorandums in effect as of the date of execution of the Agreement unless otherwise directed in writing by the Department or FIU, as applicable. Such Department and FIU manuals, procedures, and memorandums are found at the State Construction Office's website and the FIU Facilities website, respectively.

Note: The Consultant shall be FDOT prequalified in the following work categories: Work Type 10.1-Roadway Construction Engineering and Inspection (CEI), Work Type 10.4-Minor Bridge and Miscellaneous Structures CEI, Work Type 10.5-Major Bridge CEI in those 10.5 sub- categories appropriate to the Design-Build bridge proposed for this Project including 10.5.l - Major Bridge CEI Concrete as well as experience with inspection of suspension or cable-stayed and post-tensioned bridges.

For this Project Categories 10.1 and 10.4 are considered to be the major type of work and 10.5.1 is considered to be the minor type of work. The primary/prime Consultant must be prequalified in the major type of work. The Consultant shall also be prequalified, on its own or through FDOT- approved sub-consultant(s), in the following work categories: 10.5-Major Bridge CEI and Vertical Building Construction and CPTED.

4.0 DEFINITIONS:

A. *Agreement: The Standard Professional Services Agreement between FIU and the Consultant setting forth the obligations of the parties thereto, including, but not limited to, the performance of the work, furnishing of services, and the basis of payment.*

B. *Contractor: The design-build firm contracting with FIU for performance of work or furnishing of materials under the Construction Contract.*

C. *Construction Contract: The written design-build agreement between FIU and the Contractor setting forth the obligations of the parties thereto, including, but not limited to, the performance of the work, furnishing of labor and materials, and the basis of payment.*

D. *Construction Project Manager: The FIU employee assigned to manage the Agreement and represent FIU during the performance of the services covered under this Agreement.*

E. *Construction Training/Qualification Program (CTQP): The Department program for training and qualifying technicians in Aggregates, Asphalt, Concrete, Earthwork, and Final Estimates Administration. Program information is available at CTQP website.*

F. *Consultant: The consulting firm under contract with FIU for administration of CEI services.*

G. *Consultant Proiect Administrator: The Consultant's administrator assigned by the Consultant to be in charge of providing Construction Contract administration services for the Project.*

H. *Consultant Senior Proiect Engineer: The leading engineer assigned by the Consultant to be in charge of providing Construction Contract administration for the Project.*

I. *Department Local Agency Program (LAP) Administrator: The Department employee responsible for coordinating the TIGER program between the District offices and sections and with the local agency (FIU) to develop and deliver the project through this program. The District LAP Administrator works closely with planning, project development, environmental, design, right of way acquisition, and construction staff in the District to obtain all approvals, assurances, and certifications required for those respective areas. All project specific responsibilities are included throughout the FDOT LAP Manual (FDOT Form 525-010-300). Any changes in project schedule, budget and/or scope will need to be approved by Administrator prior to commencement of work.*

J. *Department Production Project Coordinator: Project manager responsible for the coordination between the FIU, FDOT and FHWA for the design review and approval from the different disciplines. Also responsible for overseeing contract compliance with Federal regulation and approval for any contract modification.*

K. *District: Florida Department of Transportation District Six.*

L. *District Construction LAP Compliance Auditor: Department employee in charge of auditing, reviewing and providing oversight assistance with contract compliance of Equal Employment Opportunity (EEO), Affirmative Action (AA), Disadvantage Business Enterprise (DBE), federal Wage rate provisions, On-the-Job-Training Program and other civil rights related areas, as applicable to Florida Statutes and FHWA funding.*

M. District Construction Engineer: The administrative head of the District's Construction Offices.

N. District Contract Compliance Manager: The administrative head of the District Contract Compliance Office.

0. District Construction LAP Auditor: Department employee assigned by the Construction Unit to provide construction oversight of the Construction Contract Administration of the project.

P. District Consultant CEI Manager (or CCEI): The Department employee assigned to administer the Consultant Construction Engineering and Inspection (CCEI) Program in the District.

Q. District Construction Manager/Construction LAP Coordinator: Administrative head of the District Construction Department assigned to manage overall construction oversight of LAP Contracts in the District.

R. District Professional Services Administrator: The Administrative Head of the Professional Services Office.

S. District Secretary: The Chief Executive Officer in each of the Department's eight (8) Districts.

T. Operations Engineer: The engineer assigned to a particular County or area to administer construction and maintenance contracts for the Department.

U. Public Information Office: The Department's office assigned to manage the Public Information Program.

V. Resident Compliance Specialist: The employee assigned by the Consultant to oversee project specific compliance functions.

W. Resident Engineer: The engineer assigned to a particular County or area to administer Construction Contracts for the Department.

X. Supplemental Agreement: A written agreement modifying the Construction Contract.

8.0 PERFORMANCE OF THE CONSULTANT:

During the term of this Agreement and all supplemental amendments thereof, the Department and/or FIU will review various phases of Consultant operations, such as construction inspection, materials sampling and testing, and administrative activities, to determine compliance with this Agreement. The Consultant shall

cooperate and assist representatives in conducting the reviews. If deficiencies are indicated, remedial action shall be implemented immediately. Recommendations and Consultant responses/actions are to be properly documented by the Consultant. No additional compensation shall be allowed for remedial action taken by the Consultant to correct deficiencies.

9.0 REQUIREMENTS OF THE CONSULTANT:

9.1 General:

It shall be the responsibility of the Consultant to administer, monitor, and inspect the Construction Contract such that the Project is constructed in reasonable conformity with the plans, specifications, and special provisions for the Construction Contract.

The Consultant shall observe the Contractor's work to determine the progress and quality of work. The Consultant shall identify discrepancies, report significant discrepancies to FIU, and direct the Contractor to correct such observed discrepancies.

The Consultant shall advise the Construction Project Manager of any significant omissions, substitutions, defects, and deficiencies noted in the work of the Contractor and the corrective action that has been directed to be performed by the Contractor. Work provided by the Consultant shall not relieve the Contractor of responsibility for the satisfactory performance of the Construction Contract.

9.3 On-site Inspection:

The Consultant shall monitor the Contractor's on-site construction activities and inspect materials entering into the work in accordance with the plans, specifications, and special provisions for the Construction Contract to determine that the Project is constructed in reasonable conformity with such documents. The Consultant shall maintain detailed accurate records of the Contractor's daily operations and of significant events that affect the work. The Consultant will also monitor off-site activities and fabrication unless otherwise stipulated by this Agreement.

9.5 Engineering Services:

The Consultant shall coordinate the Construction Contract administration activities of all parties other than the Contractor involved in completing the construction Project. Notwithstanding the above, the Consultant is not liable to the Department or FIU for failure of such parties to follow written direction issued by the Consultant.

Services shall include maintaining the required level of surveillance of Contractor activities, interpreting plans, specifications, and special provisions for the Construction Contract, maintaining complete, accurate records of all activities and events relating to the Project and properly documenting all Project changes.

10.0 PERSONNEL:

10.1 General Requirements

The Consultant shall staff the Project with the qualified personnel necessary to efficiently and effectively carry out its responsibilities under this Agreement.

10.2 Personnel Qualifications:

The Consultant shall utilize only competent personnel qualified by experience and education. The Consultant shall submit in writing to the Construction Project Manager the names of personnel proposed for assignment to the Project, including a detailed resume for each containing at a minimum: salary, education, and experience. The Consultant Action Request form for personnel approval shall be submitted to the Construction Project Manager at least two weeks prior to the date an individual is to report to work.

Personnel identified in the Consultant technical proposal are to be assigned as proposed and are committed to performing services under this Agreement. Personnel changes will require written approval from the Department and/or FIU. Staff that have been removed shall be replaced by the Consultant within one week of Department and FIU notification…

…Minimum qualifications for the Consultant personnel are set forth as follows. Exceptions to these minimum qualifications will be considered on an individual basis. The District Construction Engineer or designee and FIU will have the final approval authority on such exceptions.

NOTE: Refer to the following in reviewing the minimum qualifications for the Consultant personnel referenced below:

> *<u>Complex Category Two (CC2) Bridge Structures</u>: Bridge structures that are complex and require advanced designs and construction engineering and inspection. The following structures are classified as CC2 bridge structures:*
>
> - *Concrete Post-Tensioned Segmental Box Girder (CPTS)*
> - *Concrete Post-Tensioned Continuous Beam (CPTCB)*
> - *Movable Bridges (MB)*
> - *Post-tensioned Substructures (PTS)*

11.0 QUALITY ASSURANCE (QA) PROGRAM:

11.1 Quality Assurance Reviews:

The Consultant shall conduct semi-annual reviews to ensure compliance with the requirements of the Agreement and in this Scope of Services. Quality Assurance (QA) reviews shall be conducted to evaluate the adequacy of materials, processes, documentation, procedures, training, guidance, and staffing included in the execution of the Agreement. QA reviews shall also be developed and performed to achieve compliance with specific QA provisions contained in the Agreement. The semi-annual reviews shall be submitted to the Construction Project Manager in written form no later than one (1) month after the review.

11.2 Quality Assurance Plan:

Within thirty (30) days after receiving award of an Agreement, the Consultant shall furnish a QA plan to the Construction Project Manager. The QA plan shall detail the procedures, evaluation criteria, and instructions of the Consultant's organization for providing services pursuant to this Agreement. Unless specifically waived, no payment shall be made until the Department and/or FIU approves the Consultant QA plan.

Significant changes to the work requirements may require the Consultant to revise the QA plan. It shall be the responsibility of the Consultant to keep the plan current with the work requirements.

12.0 AGREEMENT MANAGEMENT:

12.1 General:

(1) With each monthly invoice submittal, the Consultant will provide a reviewed and approved status report for the Agreement. This report will provide the Consultant's accounting of the additional Agreement calendar days allowed to date, an estimate of the additional calendar days anticipated to be added to the original schedule time, an estimate of the Agreement completion date, and an estimate of the Consultant funds expiration date per the Agreement schedule for the prime Consultant and for each subconsultant."

The Post-Tensioning Institute (PTI) certification for Mr. Alexis Molina who performed the post-tensioning inspection from The Corradino Group is summarized below:

Mr. Molina received Construction Training Qualification Program (CTQP) qualification that was granted by PTI on April 7, 2017 (see BPA's Attachment Submission BPA-3). The PTI certification grants the candidate the qualifications necessary to perform the grouting and post-tensioning inspections. The FDOT

CTQP qualifications are automatically granted once the PTI course is taken, passed and the application submitted. The candidate registers this information with FDOT CTQP to be listed within the FDOT CTQP program. Mr. Molina did not register his PTI certification with FDOT CTQP until recently (December 14, 2018) when requested, however based on the CTQP training requirements Mr. Molina was fully qualified to perform the grouting and post-tensioning inspections on the project once he passed the PTI course and was issued the certification on April 7, 2017 (see BPA's Attachment Submission BPA-4).

6.4. Contract between MCM and FIGG Bridge Engineers, Inc. (FIGG)

MCM and FIGG Bridge Engineers, Inc. (FIGG) entered into a Standard Form of Agreement between Design-Builder and Design Consultant on April 28, 2016 for FIGG to provide professional design and engineering services to MCM for bridge engineering associated with the UniversityCity Prosperity Project. FIGG acted as the lead designer for the design team and was responsible for the coordination of all design team members and was the single point of contact with MCM for design. FIGG provided final design, Release for Construction (RFC) drawings and specifications associated with the new pedestrian bridge over SW 8th Street, in accordance with a scope of services. FIGG also developed the design for MCM with all information necessary to construct the project as a complete and fully operational system in accordance with the provided FIU requirements and contract documents. Specific language of the Agreement and services are on the following pages. The April 28, 2016 Standard Form of Agreement between Design-Builder (MCM) and Design Consultant (FIGG) indicated the following:[22]

*"**ARTICLE 1 – GENERAL***

1.5 Mutual Obligations and Acknowledgments.

1.5.1 *Design-Builder and Design Consultant commit at all times to cooperate fully with each other, and proceed on the basis of trust and good faith, to permit each party to realize the benefits afforded under the Contract Documents. Design-Builder and Design Consultant shall perform their respective responsibilities, obligations and services in a timely manner to facilitate the other's timely and efficient performance and so as not to delay or interfere with the other's performance of its obligations under the Contract Documents.*

1.5.2 *Design-Builder and Design Consultant acknowledge that they have cooperated with each other in the procurement of the Design- Build Agreement, and that Design-Builder and Design Consultant have met to review, discuss, and familiarize themselves with the Design-Build Agreement, including the Basis of Design Documents.*

1.5.4 *Design-Builder and Design Consultant mutually agree that time is of the essence with respect to the dates and times set forth in the Design Schedule, Project*

[22]Standard Form of Agreement between Design-Builder and Design Consultant, entered into by MCM and FIGG Bridge Engineers, Inc. dated April 28, 2016, 34 pages.

Schedule and Contract Documents. Each party agrees to provide the other party with information in a timely fashion and in the form and manner as reasonably required.

ARTICLE 2 – DESIGN CONSULTANT'S SERVICES AND RESPONSIBILITIES

2.1 General.

2.1.1 *Design Consultant shall, consistent with applicable state licensing laws, provide the Services, including engineering and other professional services, required by the Contract Documents as per Exhibit A. Design Consultant agrees that such Services shall be provided through qualified, licensed professionals who are either (i) employed by Design Consultant or (ii) procured by Design Consultant from qualified, licensed Design Sub-Consultants.*

2.2 Standard of Care

2.2.1 *The standard of care for all design professional services performed by Design Consultant and its Design Sub-Consultants pursuant to the Agreement shall be the care and skill ordinarily used by members of the design profession practicing under similar conditions at the same time and locality of the project.*

2.6 Design Development Services.

2.6.2 *In accordance with the Contract Document and the times set forth in the Design Schedule, Design Consultant shall submit to Design-Builder Construction Document setting forth in detail drawing and specifications describing the requirements for construction of the Work. The Construction Documents shall be consistent with the latest set of interim design submissions, as such submissions may have been modified in a design review meeting. Design Consultant shall provide the Construction Documents in the form and quantity call for in the Contract Documents. Design Consultant shall perform agreed upon revisions and submit revised Construction Document to Design-Builder for Design-Builder's and Owner's approval.*

2.6.5 *Design-Builder's and Owner's review and/or approval of interim design submissions and the Construction Documents are for the purpose of mutually establishing a conformed set of Construction Documents compatible with the requirements of the Contract Documents. The review and/or approval by either Design- Builder or Owner of any interim design submission or the Construction Documents shall not be deemed to transfer any design liability from Design Consultant to Design-Builder or Owner.*

2.6.6 *Design Consultant will, at its own cost, revise any interim design submission or the Construction Documents to correct any of its errors, mistakes or*

omissions. Such revisions shall be performed timely and so as not to jeopardize the Design Schedule and/or the Project Schedule.

2.7 Construction Phase Services.

2.7.5 *Design Consultant shall, if requested by Design-Builder, review any inspection reports or tests involving the construction of the Project and provide its comments to Design-Builder. Design Consultant is not responsible for the accuracy or completeness of the tests or inspections performed by others.*

2.7.6 *Unless otherwise provided, Design Consultant is not providing full-time resident services. Nevertheless, Design Consultant shall at appropriate intervals visit the Site to determine if the construction is proceeding in accordance with the Construction Documents. If Design-Builder and Design Consultant have agreed to a specific frequency of Design Consultant's Site visits, such frequency shall be set forth as an exhibit to this Agreement. Design Consultant shall promptly notify Design-Builder of any defects, deficiencies, deviations, omissions, or violations observed by Design Consultant in the construction of the Project, and make recommendations to Design-Builder on how to proceed.*

2.7.7 *At the request of Design-Builder, Design Consultant shall attend meetings with Design- Builder and Owner and/or Subcontractor(s) and Sub-Subcontractors to discuss design issues which may arise during construction.*

2.7.9 *Design Consultant's provision of the Construction Phase Services shall not be construed to make Design Consultant responsible for (i) the acts or omissions of Design-Builder, any Subcontractors, or any Sub- Subcontractors, (ii) the means, methods, sequences, and techniques of construction of the Project or (iii) safety precautions and programs in connection with the construction of the Project. Nothing in this agreement shall create any legal or contractual relationship between Design Consultant and any Subcontractor or Sub-Subcontractor.*

ARTICLE 3 – DESIGN-BUILDER'S SERVICES AND RESPONSIBILITIES

3.2 Design-Builder's Representative

3.2.1 *Design-Builder's Representative shall be responsible for providing Design-Builder supplied information and approvals in a timely manner to permit Design Consultant to fulfill its obligation under the Contract Documents.*

3.4 Notification of Errors.

3.4.1 *Design-Builder shall notify Design Consultant of any errors, inconsistencies, or omissions Design-Builder discovers in the Services, including Basis for Design Documents, any interim design submissions, Construction Documents or other Services. Notwithstanding anything to the contrary in this*

Agreement, nothing in this Agreement shall relieve Design Consultant of responsibility for errors, inconsistencies, or omissions in the Services.

ARTICLE 10 – INDEMNIFICATION

10.2 Design Consultant's General Indemnification

10.2.1 *Design Consultant, to the fullest extent permitted by law, shall indemnify and hold harmless Owner, Design-Builder and their officers, directors, employees and agents from and against losses, and damages, including attorneys' fees and expenses, for bodily injury, sickness or death, and property damage or destruction (other than to the Work itself) to the extent resulting from the negligent acts or omissions of Design Consultant, anyone employed directly or indirectly by any of them or anyone for whose acts any of them may be liable.*

10.3 Design-Builder's General Indemnification

10.3.1 *Design-Builder, to the fullest extent permitted by law, shall indemnify and hold harmless Design Consultant and its officers, directors, employees and agents from and against losses and damages, including attorneys' fees and expenses, for bodily injury, sickness or death, and property damage or destruction (other than to the Work itself) to the extent resulting from the negligent acts or omissions of Design-Builder, anyone employed directly or indirectly by Design-Builder or anyone for whose acts Design-Builder may be liable.*

EXHIBIT A TO AGREEMENT - SCOPE OF WORK

General

FIGG Bridge Engineers, Inc. (FIGG) will provide professional design and engineering services to Munilla Construction Management (MCM) for bridge engineering associated with the Pedestrian Bridge Design-Build Project for Florida International University (FIU). FIGG will act as the lead partner for the Design Team and be responsible for the coordination of all team members and is the single point of contact with MCM.

FIU has provided conceptual design drawings for the new bridge, landing areas, rail, elevator structures and coordination of the general civil design items. FIGG will provide final design, construction drawings and specifications associated with the new FIU Pedestrian Bridge. FIGG will develop the design for MCM with all information necessary to construct the project as a complete and fully operational system in accordance with the provided FIU requirements and contract documents.

Project Team Responsibilities

The general contractor is MCM. As a consultant to MCM, FIGG will be responsible for managing the design team, coordinating between the design team and contractor, and performing final design.

Prime:
FIGG Bridge Engineers, Inc. (FIGG) - *Design Team Management, Bridge Design*
Subconsultants:
A&P Consulting Transportation Engineers, Corp. (APCTE) *- Roadway, Drainage, Utility Coordination, Maintenance of Traffic, Environmental/Permitting, Signing and Pavement Marking, Signalization*
Miller Legg *- Landscape and Hardscape Design*
Manuel G. Vera & Associates, Inc. (MGV) *– Survey*
GEOSOL, Inc. (GEOSOL) *- Geotechnical Engineering*
SGM Engineering, Inc. (SGM) *- Mechanical and Electrical Design*
Randy Burkett Lighting Design, Inc. (RBLDI) *- Bridge and Landscape Lighting*

Project Description

The Project consists of an innovative package of technology, streetscape, and transit improvements to develop an urban connection between the City of Sweetwater and FIU. The Design-Build team is tasked to design and build an innovative signature bridge that will become a respected and valued design landmark in Miami. Design-Build services include only the Urban Design & Infrastructure component of the project. These infrastructure improvements consist of: 1) A signature pedestrian-oriented shared-use bridge across US 41(S.W. 8th Street) that as a major arterial roadway located between Sweetwater and the FIU Modesto Maidique Campus (MMC) obstructs pedestrian movements between Sweetwater and MMC; 2) A pedestrian plaza at both the bridge landing on the FIU MMC and the landing within Sweetwater; 3) Pedestrian-oriented streetscape enhancements to be created by narrowing 109th Avenue between SW 7th Terrace and SW 6th Street reducing the existing 3 traffic lanes to 2 traffic lanes. The enhancements will include upgraded sidewalk paving materials, enhanced shade trees, appropriate upgrades to street furniture, street signage, street lighting and landscaping; 4) Improvements on the FIU MMC will include new pedestrian walkways, plazas, pavilions, bike paths, landscaping, and 5) Advanced lntermodal & Multimodal Station (AIMS) elements on the North side of FIU's MMC. As part of these improvements the following engineering design services are included in the scope:

- *Bridges Structure - Signature Pedestrian Bridge crossing S.W. 8th Street*
- *Roadway - reconstruction, and milling, resurfacing, and widening of S.W. 109th Avenue*
- *Drainage/Storm water management*
- *Miscellaneous Structures - Bulkhead wall*
- *Signing and Pavement Markings*

- *Signals*
- *Lighting*
- *Utility relocation*
- *Landscaping/Hardscaping*
- *Additive Alternative 1 (PENDING AWARD) - On Campus improvement from northeast corner of PG-4 to Green Library*

Design Management and General Tasks (FIGG):

1. *Prepare and update design schedule, including monthly updates and two-week look- ahead*
2. *Prepare and submit Design Quality Management Plan (DQMP)*
3. *Coordination with Contractor, including:*
    - *Conference call update meetings once a week, and face to face once a month during design only*
    - *Responding to calls/correspondence (e-mails)*
    - *Maintaining an Open Issues Log*
    - *Maintaining project correspondence and submittals on project FTP site*
4. *Design Team Coordination*
    - *Conduct weekly conference call team meetings and monthly face to face meetings during design only*
    - *Provide general oversight of FIGG staff (manage resources)*
    - *Respond to calls/correspondence (e-mails)*
    - *Maintain project design files (Microstation) on project FTP site.*
5. *Project Manager (PM) Coordination with Discipline Leads*
    - *FIU and FDOT PM's once a month during design phase only.*
    - *Meet with FDOT District 6 for SW 8th Street*
    - *Meet with City of Sweetwater for SW 109th Avenue*
    - *Coordinate with adjacent projects in MDC and on FIU Campus*
6. *Quality Assurance*
    - *Perform QA/QC of plans, calculations, and documents*
    - *QA review subconsultants submittals for compliance with QC*
    - *Interdisciplinary review meetings (2 max)*
    - *Constructability reviews to be performed by MCM staff*
    - *Maintain QA/QC documents and check prints*
    - *Review and respond to FIU's and FDOT's review (Electronic Review Comment (ERC)*
    - *Attend review meetings for initial (Technical Proposal), 30% Page Turn Meeting with Owners, 90% Design, 100% Design, and Construction Set submittals*
7. *Contract Administration*
    - *Review expenditures vs. deliverables/progress*
    - *Review invoices from subconsultants*
    - *Prepare FIGG invoices that include invoices from subs*
    - *Provide notices for out-of-scope work*

8. Documentation

- *Prepare minutes for all design related meetings*
- *Document critical design decisions*

9. Public Involvement

- *FIGG will supply support data and plans as needed. Public Involvement activities to be led by MCM.*

10. Specification Package and Technical Special Provisions (TSPs)

- *Submit package with Final Phase (100%) submittal for review and final for signed and sealed with Construction (RFC) Set.*

Design General Considerations:

Bridge will be designed using the following design criteria:

1. AASHTO LRFD 7th edition, with 2015 interims
2. FDOT Structures Design Manual, January 2015
3. AASHTO LRFD Guide Specifications for Design of Pedestrian Bridges, 2th edition (2009)

Work on this project including calculations, plans, specifications, and estimates will be produced with English units. Deliverables for the project will be provided in both hardcopy and the following FIU compatible electronic formats:

- *Text documents will be developed in Microsoft Word (.doc) format and submitted as electronically scanned Adobe Acrobat (.pdf) format files.*
- *Spreadsheets will be developed in Microsoft Excel (.xls) format and submitted as electronically scanned Adobe Acrobat (.pdf) format files.*
- *Project CADD drawings will be developed in Microstation (.dgn) format and submitted as electronically scanned files in the Adobe Acrobat (.pdf) format as well as dgn format to MCM.*

Final Bridge Design (FIGG):

FIGG will perform the final structural design and contract document preparation for the new FIU Pedestrian Bridge, including analysis and design of the bridge superstructure, substructure, and foundations related to preparation of final construction contract documents. This work includes:

1. Coordinating the final bridge design, with a focus on ensuring timely submittals consistent with the project construction schedule, and coordination between design disciplines, to ensure the integration of individual components into the overall project. FIGG will participate in sixteen (16) design progress meetings with MCM for this coordination.

2. Design of the pedestrian bridge which includes foundations, piers, pylon and superstructure.

3. Design of landing areas including the elevator structures.

4. *Application of design loads under scour conditions for two cases: 100-year scour and 500 year scour.*

5. *Analysis and design the structure for anticipated construction loads after finalizing necessary construction phasing in coordination with MCM. The bridge construction transport system and temporary falsework system are not included in FIGG's scope of work.*

6. *Preparation of construction drawings for the bridge components such that shop drawings will not be required. The Construction Drawing deliverable will include dimensions, reinforcement, bar bending diagrams, post-tensioning and other embedded items.*

7. *Preparation of construction schematics illustrating the stages and design loads of the construction for which the structure has been designed.*

8. *Design quality control and quality assurance in accordance with the project Professional Service Quality Control Plan, including independent design check of bridge.*

9. *Shop drawing review associated with the temporary support system.*

10. *Participation in twelve (12) review meetings with FDOT and FIU during the review of the 90% and 100% drawing submittals.*

Construction Phase Services (FIGG):

1. *FIGG will provide design office support services including response to Request for information (RFl's), minor Notice of Design Changes (NDC's), non-conformance reports (NCR's) and other routine assistance as needed.*

2. *FIGG will prepare an erection manual detailing step-by-step construction coordinated with MCM to represent their proposed means and methods. The manual will include each step of the superstructure erection.*

3. *FIGG design support engineers will make site trips for field reviews. These trips are for the purpose of attending construction meetings, discussing the design, general construction related communications, advice related to special construction operations and procedures, and evaluating unexpected issues that may arise during construction. Twelve (12) such trips are included in this scope.*

4. *Technical support related to design during construction of the project to answer questions from the field related to the design.*

5. *Review of shop drawings for concrete formwork, elevators, expansion joints, bearings, railings, post-tensioning systems and stay cable tubes for conformance with the design intent.*

6. *Coordination with the Geotechnical Engineer (GEOSOL) during construction including review and evaluation of load testing results for foundations. Consultation will be provided by the geotechnical subconsultant as required to interpret the testing results and suggest changes to foundations depths, as may be required to develop the foundation design capacities.*

7. *Production of as-built drawings for the bridge main structures and landing areas based on records maintained by MCM during construction.*

Other Engineering Services:

Scope of Services for engineering subconsultants are included in the Attachment to this Exhibit A.

Exclusions:

The following activities are excluded from this scope of work:

1. *Geometry control for the bridge construction will be performed by others and is not be part of this scope.*

2. *The design of any erection equipment and falsework is not included in this scope.*

3. *Subsurface utility engineering (SUE) services are not included in this scope of work.*

4. *Geotechnical construction phase services are not included in this scope of work, such as:*
    - *Spread footing inspection services during the spread footing construction*
    - *Drilled shaft/driven pile inspection services during the installation of the foundations*
    - *CSL testing at each drilled shaft foundation location*
    - *Foundation certification reports*

Schedule for Final Design

Engineering services described by this Scope of Work are based on a design phase duration of eight (8) months starting immediately upon receipt of the information noted herein and formal Notice-to-Proceed from MCM. The formal FIU Notice-to-Proceed was received on January 21, 2016.

The schedule for Final Design is included as Exhibit C.

Schedule of Values for Final Design

The schedule of values for Final Design is included as Exhibit D."

6.5. Contract between FIGG Bridge Engineers, Inc. (FIGG) and Louis Berger

See FIGG's Attachment Submission FCA-A3 for Independent Peer Review Coordination Timeline.

FIGG Bridge Engineers, Inc. (FIGG) entered into an Agreement with Louis Berger on September 16, 2016 for Louis Berger to perform an independent peer review for the concrete pedestrian bridge plans in accordance with the project and RFP requirements and FDOT Plans Preparation Manual (Chapter 26). The September 16, 2016 Agreement between FIGG (CONSULTANT) and Louis Berger (SUBCONSULTANT) indicated the following:[23]

*"**ARTICLE I – SCOPE OF WORK***

Section 1 – Obligation of Subconsultant to Consultant

The CONSULTANT hereby retains SUBCONSULTANT who agrees to proceed, upon written authorization by the CONSULTANT, with all services necessary to the performance, in proper sequence and in the times specified, of the items of work as outlined in Exhibit B, for the project as required of the CONSULTANT in the Prime Agreement between the CONTRACTOR and CONSULTANT for the project. SUBCONSULTANT also agrees that all work completed by them shall be in accordance with the applicable requirements of the Prime Agreement between the CONTRACTOR and the CONSULTANT for the project.

ARTICLE V – INDEMNIFICATION

SUBCONSULTANT shall indemnify and save harmless CONSULTANT, its agents, representatives and employees, from and against any and all suits, actions, legal proceedings, claims, demands, damages, liabilities, costs and expenses, including attorney's fees, arising out of or in connection with or claimed to arise out of or in connection with any error, omission or negligent act of SUBCONSULTANT or anyone acting in his/its behalf in connection with or incident to the Agreement. SUBCONSULTANT shall also indemnify and defend CONSULTANT and its agents, representatives, and employees from any claims, demands and damages, including costs and attorney's fees, arising from any injury or death to any employee of SUBCONSULTANT.

[23]Agreement entered into by FIGG Bridge Engineers, Inc. and Louis Berger dated September 16, 2016, 43 pages.

ARTICLE VI – COMMUNICATION WITH THE CONTRACTOR

SUBCONSULTANT agrees that the principal method of communication with the CONTRACTOR is through the CONSULTANT's Project Manager.

EXHIBIT B – DESIGN SERVICES SCOPE OF WORK FIU UNIVERSITYCITY PROSPERITY PROJECT FOR MCM – PROVIDED BY LOUIS BERGER – SEPTEMBER 13, 2016

The Louis Berger Group, Inc. (Louis Berger) will provide independent peer review services for the FIU UniversityCity Prosperity Project in accordance with the RFP.

Independent Peer Review Scope

1. Louis Berger will perform Independent Peer Review for the concrete pedestrian bridge plans in accordance with the project and RFP requirements and FDOT Plans Preparation Manual (Chapter 26).
2. The Independent Peer Review will include the following activities:

Item #	*Item Description*
1	*Develop finite element model for the bridge and estimation of demands on all elements due to different load combinations*
2	*Peer review of foundation plans*
3	*Peer review of substructure plans*
4	*Peer review of superstructure plans*

3. The Independent Peer Review will be performed for the following submittals:

a) Final Foundation and Substructure Plan Submittals
b) Final Superstructure Plan Submittals

4. This Independent Peer Review scope of work is for the pedestrian bridge structure components only. The elevator structures and stairways/landings are not included in this scope of work."

7. Signature Pedestrian Bridge Description

The signature pedestrian bridge designed by FIGG was an innovative design that was composed of a walkway and a canopy connected by a single row of diagonal supports that extended down the center of the bridge. The bridge also featured an upper pylon and steel pipes, as well as a grand staircase and elevators. The signature pedestrian bridge was designed with the look of a cable-stayed bridge, where the deck is suspended from cables fanning out from a tall mast. The steel pipe supports were functional structural members that were designed to increase the natural frequency of the pedestrian bridge, which dampens vibrations from pedestrian traffic. According to the Project Design Criteria, the bridge vibrations shall be investigated in accordance with

Section 6 of AASHTO Guide Specifications for Design of Pedestrian Bridges. To obtain the cable-stayed bridge look, it was selected that the diagonal members lined up with the steel pipes from the upper pylon. Each of the diagonal members were of different angles and lengths. The upper pylon was designed to extend approximately 109 feet tall, which happened to mark the location of the cross street, SW 109th Avenue. The resulting signature pedestrian bridge included 10 steel pipes that could be dramatically lit up at night, with an upper pylon capped with a beacon of light.

The signature pedestrian bridge consisted of a walkway that was approximately 30 feet wide. The single row of diagonal supports was centered in the middle of the walkway. The canopy, which partially covered the walkway, was approximately 16 feet wide. The vertical distance from the walkway to the canopy was approximately 15 feet. The concrete deck was post-tensioned in the longitudinal and transverse directions to maximize durability and achieve a design life that exceeded 100 years. The signature pedestrian bridge was designed to withstand a Category 5 hurricane.

Figure 4 illustrates a rendering of what the signature pedestrian bridge would look like when completed looking to the east. The main span located to the right is the span that collapsed on March 15, 2018 on SW 8th Street (or US 41) during construction. The main span extended from the upper pylon to the south pier for a distance of approximately 174 feet. The back span over the Tamiami Canal, which had not been constructed, extended from the upper pylon to the north pier for a distance of 99 feet. The upper pylon and steel pipes also had not been constructed. The vertical distance from SW 8th Street to the bottom of the main span was approximately 18.5 feet.

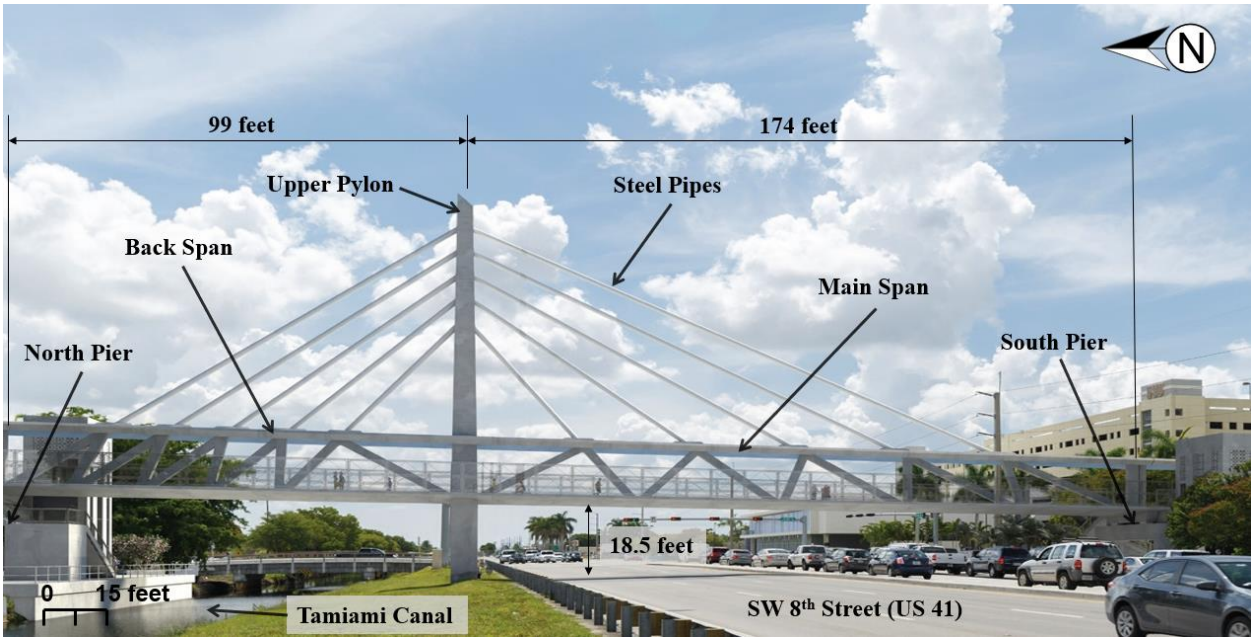


Figure 4 – Rendering of what the signature pedestrian bridge would look like when completed looking to the east (Source: FIU modified) Note: Figure 4 does not illustrate 11-foot shift to the north of the entire pedestrian bridge to accommodate a future express bus lane in westbound direction of SW 8th Street (US 41) and construction of the bulkhead wall on the south Tamiami Canal bank that will be discussed later in the Bridge Factors Factual Report.

Figure 5 illustrates the main span being moved on March 10, 2018 prior to placement on the south pier and pylon pier looking to the west. The canopy, diagonal supports, and walkway are highlighted on **Figure 5**. The main span collapsed five days later, on March 15, 2018.

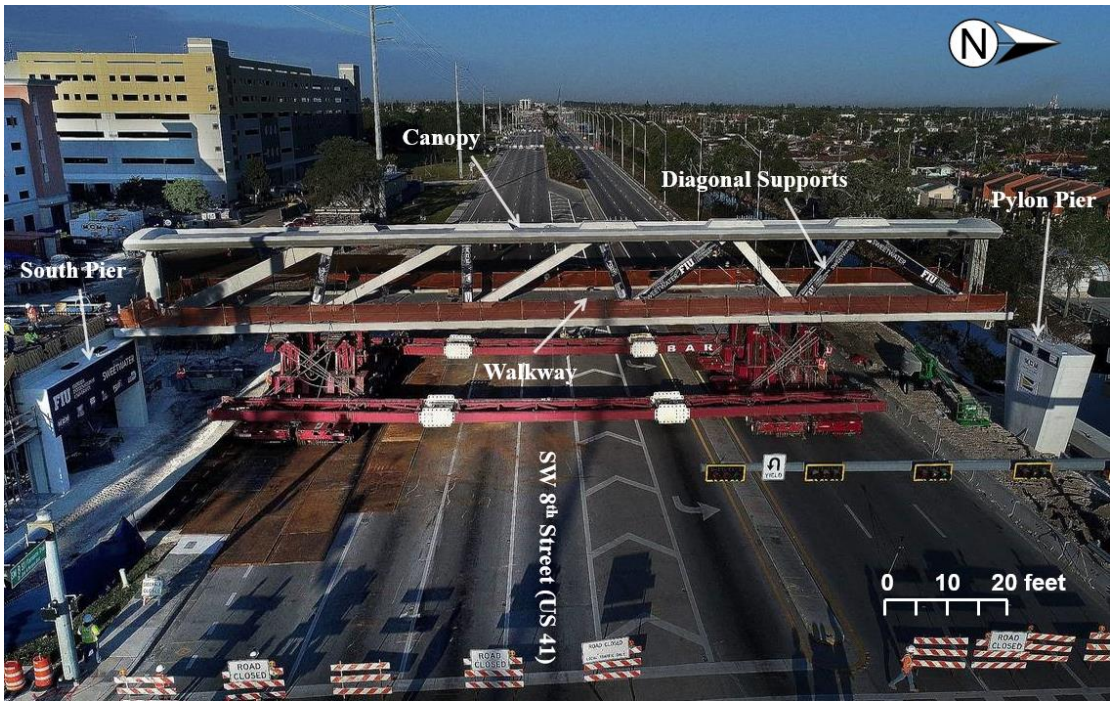


Figure 5 – Main span being moved on March 10, 2018 prior to placement on the south pier and pylon pier looking to the west (Source: Miami Herald modified)

Figures 6 through 8 illustrate other renderings of what the signature pedestrian bridge would look like when completed.

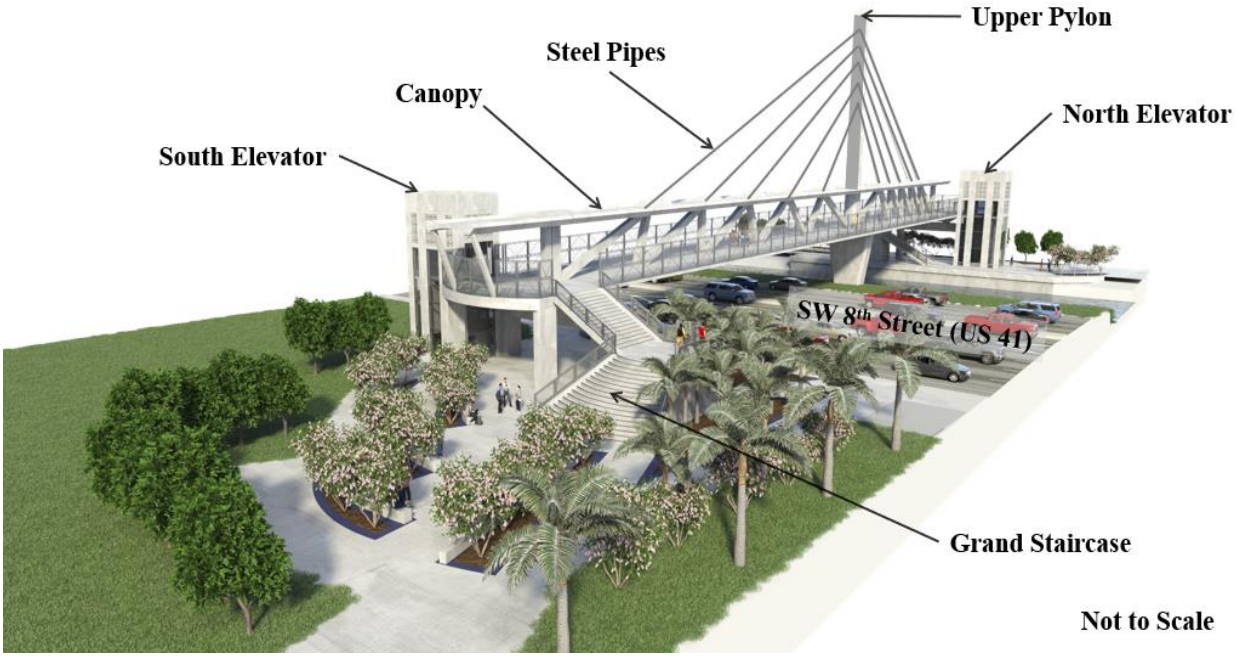


Figure 6 – Rendering of what the signature pedestrian bridge would look like when completed looking to the northwest (Source: FIU modified)

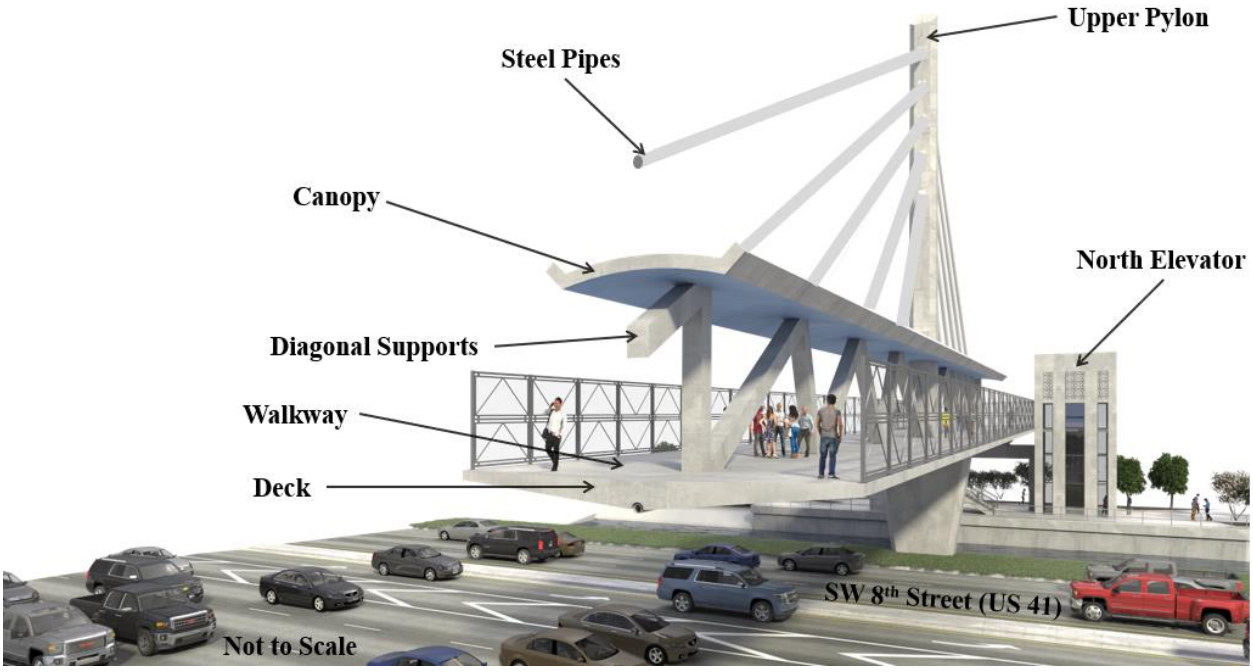


Figure 7 – Rendering of what the cross section of the pedestrian bridge deck would look like when completed looking to the northwest (Source: FIU modified)

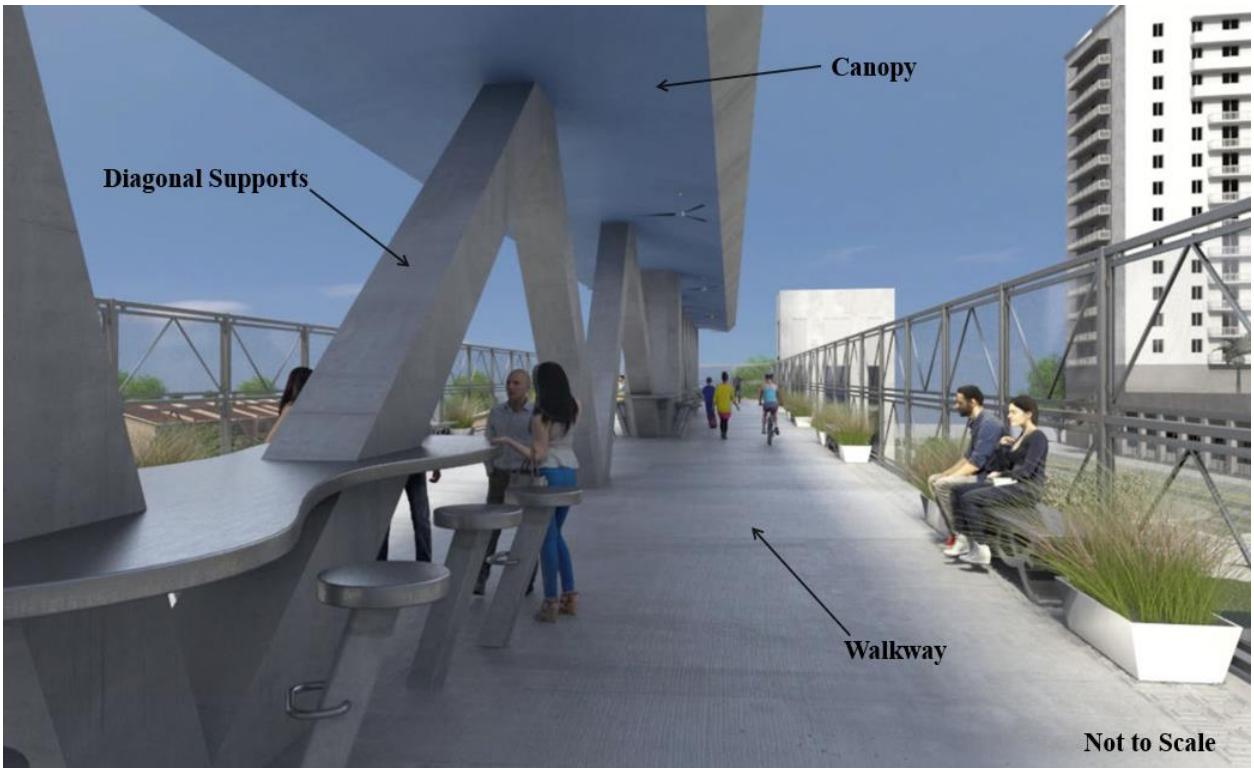


Figure 8 – Rendering of what the pedestrian bridge walkway would look like when completed looking to the north (Source: FIU modified)

8. SW 8th Street Description

SW 8th Street, also known as U.S. Highway 41 (US 41), is a highway maintained by the FDOT. US 41 runs 479 miles through the state of Florida from Miami to the Georgia border. The southern terminus of US 41 is at Brickell Avenue in downtown Miami. **Figure 9** illustrates the pedestrian bridge collapse occurred approximately 11 miles west of downtown Miami.

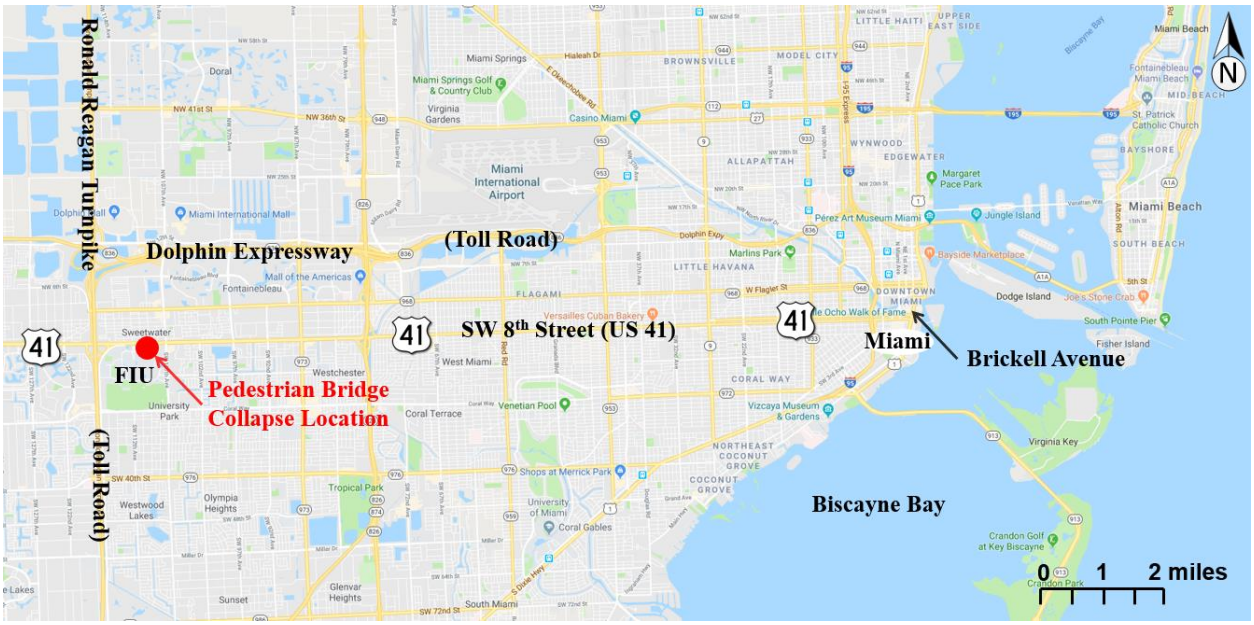


Figure 9 – Map illustrating pedestrian bridge collapse occurred approximately 11 miles west of downtown Miami (Source: Google Street Maps modified)

In the vicinity of the pedestrian bridge collapse, SW 8th Street consisted of an 8-lane highway. In the eastbound direction, SW 8th Street consisted of 4 through travel lanes; a lane closed with striping; and a left turn lane. In the westbound direction, SW 8th Street consisted of 3 through travel lanes. The eastbound and westbound lanes were separated by an approximate 4-foot wide raised concrete monolithic median. The total distance from the south curb line to the north curb line was approximately 115 feet.

The speed limit for SW 8th Street in the vicinity of the pedestrian bridge collapse was 45 miles per hour (mph).

Table 3 summarizes the average annual daily traffic (AADT) on SW 8th Street in the vicinity of the pedestrian bridge collapse from 2007 through 2017.

Table 3 – Average annual daily traffic (AADT) on SW 8th Street in the vicinity of the pedestrian bridge collapse from 2007 through 2017

Year	Average Annual Daily Traffic (AADT)
2017	60,000
2016	66,500
2015	55,000
2014	61,000
2013	60,000
2012	60,000
2011	58,500
2010	62,000
2009	68,500

2008	66,000
2007	64,500

9. Nomenclature of Diagonal and Vertical Members on Main Span of Signature Pedestrian Bridge

Figure 10 illustrates the nomenclature of the diagonal and vertical members on the main span of the signature pedestrian bridge. There was a total of 12 diagonal and vertical members. **Figure 10** also illustrates the location of the canopy, blisters, walkway, and deck diaphragms[24] located at the south and north end of the main span.[25]

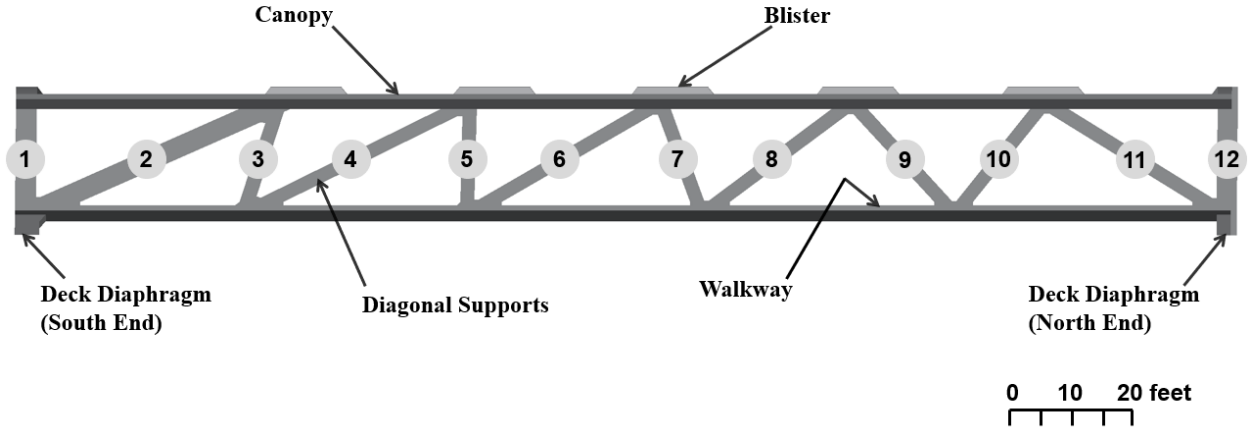


Figure 10 – Map illustrating nomenclature of the diagonal and vertical members on the main span of the signature pedestrian bridge looking to the west (Source: NTSB Research and Engineering modified)

10. Timeline of Construction to the Main Span Including Copies of Correspondence Documents and Photographs of Cracks

Figure 11 illustrates the location of the adjacent casting yard and MCM trailers in relation to the location of the signature pedestrian bridge over SW 8th Street and Tamiami Canal.

[24] A diaphragm is a structural element that transmits lateral loads to the vertical resisting elements of a structure.
[25] A blister is a concrete block cast on top or the side of a concrete member that provides the space for additional reinforcement needed to tie the main body of concrete together.

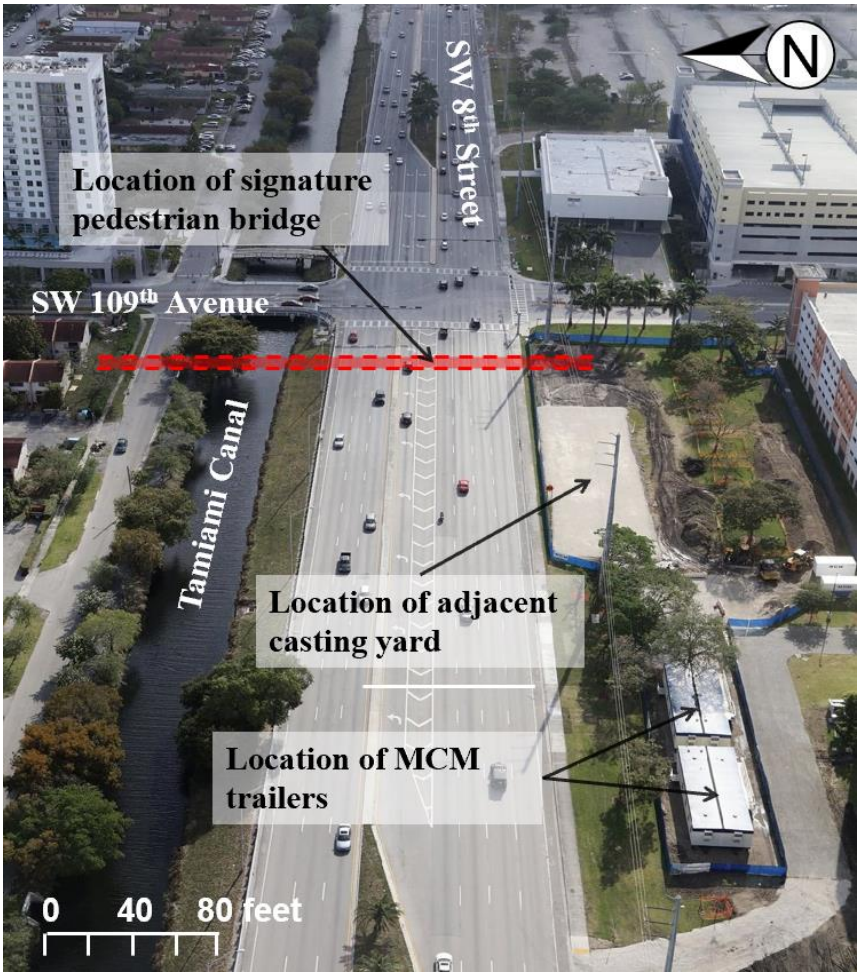


Figure 11 – Location of the adjacent casting yard and MCM trailers in relation to the location of the signature pedestrian bridge over SW 8th Street and Tamiami Canal looking to the east (Source: Munilla Construction Management (MCM) modified, Date of Photograph: 3/26/2017)

Table 4 summarizes the timeline of construction to the main span including copies of correspondence documents and photographs of cracks.

Table 4 – Timeline of construction to the main span including copies of correspondence documents and photographs of cracks

Date	Time	Source or Bates Number	Description of Photograph or Document	Photograph / Attachment Number
9/26/16	10:08:06 a.m.	MCM-NTSB-OSHA 003821	Aerial view of SW 8th Street looking to the west prior to any construction.	Bridge Factors Photo 1
4/17/17	1:41:47 p.m.	MCM-NTSB-OSHA 003661	View of falsework being set up in adjacent casting yard for construction of main span. Concrete footings being poured in background at south end.	Bridge Factors Photo 2
5/30/17	9:32:28 a.m.	MCM-NTSB-OSHA 003653	View of falsework being set up in adjacent casting yard for construction of main span.	Bridge Factors Photo 3
6/15/17	8:39:58 a.m.	MCM-NTSB-OSHA 003930	View of forms being set for concrete pour of main span deck.	Bridge Factors Photo 4
6/23/17	8:29:07 a.m.	MCM-NTSB-OSHA 003939	View of initial formwork being set up for diagonal supports of main span.	Bridge Factors Photo 5
7/7/17	9:21:08 a.m.	MCM-NTSB-OSHA 004013	View of post tensioning bars and rebar being placed for diagonal supports of main span.	Bridge Factors Photo 6
7/24/17	2:04:38 p.m.	MCM-NTSB-OSHA 004056	View of longitudinal tendons in deck encased in white plastic duct and post tensioning bars in diagonal supports encased in white plastic duct.	Bridge Factors Photo 7
7/25/17	5:24:15 p.m.	MCM-NTSB-OSHA 004077	View of nodal region including vertical #12 support and diagonal #11 support (background) and deck end region including bridge deck and diaphragm II (foreground) including reinforcing and conduits before concrete placement.	Bridge Factors Photo 8

8/5/17	11:06:51 a.m.	MCM-NTSB-OSHA 004113	View of post tensioning bars and rebars shown in diagonal supports.	Bridge Factors Photo 9
8/24/17	2:04:02 p.m.	MCM-NTSB-OSHA 004171	View of longitudinal and transverse tendons encased in white plastic duct in deck.	Bridge Factors Photo 10
9/1/17	1:18:58 a.m.	MCM-NTSB-OSHA 004223	The first attempt to pour the deck with concrete was aborted because of a plant malfunction, all concrete was removed and the formwork, ducts and rebar were cleaned and/or replaced in the poured part.	MCM's Photo Submission MCM-1
9/1/17	1:23:01 p.m.	MCM-NTSB-OSHA 004233	The first attempt to pour the deck with concrete was aborted because of a plant malfunction, all concrete was removed and the formwork, ducts and rebar were cleaned and/or replaced in the poured part.	MCM's Photo Submission MCM-2
10/19/17	00:07:33 a.m.	MCM-NTSB-OSHA 004463	The second attempt to pour the deck with concrete was successfully made on 10/19/17.	Bridge Factors Photo 11
10/26/17	10:24:33 a.m.	MCM-NTSB-OSHA 004492	View of poured section of deck with concrete.	Bridge Factors Photo 12
11/3/17	8:59:28 a.m.	MCM-NTSB-OSHA 004534	View of setting forms for diagonal supports prior to pouring of concrete.	Bridge Factors Photo 13
11/6/17	7:47:01 a.m.	MCM-NTSB-OSHA 004577	View of pouring of concrete in vertical #12 support.	Bridge Factors Photo 14
11/8/17	9:54:28 a.m.	MCM-NTSB-OSHA 004603	View of forms removed from vertical #12 support.	Bridge Factors Photo 15
11/9/17	10:07:49 a.m.	MCM-NTSB-OSHA 004619	View of forms removed from diagonal supports.	Bridge Factors Photo 16

11/12/17	8:41:12 a.m.	MCM-NTSB-OSHA 004662	View of falsework being set up for construction of canopy.	Bridge Factors Photo 17
11/15/17	7:27:11 a.m.	MCM-NTSB-OSHA 004689	View of forms being set for canopy looking from ground level.	Bridge Factors Photo 18
11/16/17	11:09:55 a.m.	MCM-NTSB-OSHA 004713	View of forms being set looking on top of canopy.	Bridge Factors Photo 19
11/17/17	8:19:40 a.m.	MCM-NTSB-OSHA 004738	View of humped forms being set on top of canopy.	Bridge Factors Photo 20
11/20/17	8:22:50 a.m.	MCM-NTSB-OSHA 004744	View of humped forms are completely set on top of canopy.	Bridge Factors Photo 21
11/27/17	1:30:04 p.m.	MCM-NTSB-OSHA 004784	View of reinforcement bars being set on top of canopy.	Bridge Factors Photo 22
11/30/17	11:14:35 a.m.	MCM-NTSB-OSHA 004807	View of longitudinal tendons in canopy encased in white plastic duct and canopy end region including reinforcing and conduits before concrete placement.	Bridge Factors Photo 23
12/1/17	11:21:04 a.m.	MCM-NTSB-OSHA 004822	View of rebar for blister located on top of canopy.	Bridge Factors Photo 24
12/14/17	2:04:13 a.m.	MCM-NTSB-OSHA 004919	View of concrete being poured on top of canopy.	Bridge Factors Photo 25
1/3/18	7:49:26 a.m.	MCM-NTSB-OSHA 004962	View of finished poured concrete section of canopy.	Bridge Factors Photo 26
1/16/18	8:35:52 a.m.	MCM-NTSB-OSHA 005035	View of stressing deck longitudinal tendons D1.	Bridge Factors Photo 27
1/16 – 1/23/18	Unknown	VSL / Structural Technologies Stressing Logs	D1 longitudinal tendons in the bridge deck stressed.	FIGG's Attachment Submission FCA 10-1
1/23/18	Unknown	VSL / Structural Technologies Stressing Logs	C2 longitudinal tendons in the canopy stressed.	FIGG's Attachment Submission FCA 10-1

1/30/18	2:04 p.m.	MCM-NTSB-OSHA 005129	View of stressing post tensioning bar in diagonal support #2 on top of canopy.	Bridge Factors Photo 28
1/30/18	2:23 p.m.	MCM-NTSB-OSHA 005137	View of stressing canopy longitudinal tendons C2 completed.	Bridge Factors Photo 29
1/30/18	Unknown	VSL / Structural Technologies Stressing Logs	Truss member 2 and 11 temporary PT bars stressed.	FIGG's Attachment Submission FCA 10-2
1/31/18	2:00:13 p.m.	MCM-NTSB-OSHA 005146	View of stressing deck longitudinal tendons D2 through D6.	Bridge Factors Photo 30
1/31/18	Unknown	VSL / Structural Technologies Stressing Logs	D2, D3, D4, D5 and D6 longitudinal tendons in the bridge deck stressed.	FIGG's Attachment Submission FCA 10-3
2/6/18	11:25:27 a.m.	MCM-NTSB-OSHA 005170	View of stressing deck transverse tendons.	Bridge Factors Photo 31
2/6/18	Unknown	Bolton – Perez and Associates	BPA performs visual inspection that was documented in BPA Report #1 dated 2/13/2018.	None
2/8 – 2/12/18	Unknown	VSL / Structural Technologies Stressing Logs	Transverse tendons in the bridge deck stressed.	FIGG's Attachment Submission FCA 10-4
2/13/18	9:50 a.m.	Bolton – Perez and Associates	Report #1 – Email from Jose Morales of Bolton – Perez to Rodrigo Isaza of MCM requesting the engineer of record (EOR) to provide a response and determine if cracks were expected during the bridge stressing.	Bridge Factors Attachment 21
2/13/18	9:56 a.m.	MCM	Email from Rodrigo Isaza of MCM to Erika Hango of FIGG forwarding BPA's crack inspection report #1 and requesting review and comment.	Bridge Factors Attachment 21

2/15/18	7:29 a.m.	MCM	Email from Rodrigo Isaza of MCM to Erika Hango of FIGG providing MCM's comments on BPA's crack inspection report #1.	Bridge Factors Attachment 21
2/16/18	10:05 a.m.	MCM	Email from Manuel Feliciano of FIGG to Rodrigo Isaza of MCM providing FIGG's comments on BPA's crack inspection report #1.	Bridge Factors Attachment 21
2/16/18	12:00:28 p.m.	MCM-NTSB-OSHA 005250	View of stressing post tensioning bars in diagonal supports on top of canopy.	Bridge Factors Photo 32
2/16 – 2/17/18	Unknown	VSL / Structural Technologies Stressing Logs	Truss member 3, 10, 5, 8, 6 and 7 PT bars stressed.	FIGG's Attachment Submission FCA 10-7
2/17/18	9:09:21 a.m.	MCM-NTSB-OSHA 005262	View of stressing canopy longitudinal tendon C3.	Bridge Factors Photo 33
2/17 – 2/18/18	Unknown	VSL / Structural Technologies Stressing Logs	C3 longitudinal tendons in the canopy stressed.	FIGG's Attachment Submission FCA 10-7
2/22/18	2:23:44 p.m.	MCM-NTSB-OSHA 005290	View of falsework removed under canopy.	Bridge Factors Photo 34
2/23/18	3:31:24 p.m.	MCM-NTSB-OSHA 005301	View of falsework being removed under deck from middle to outward megashores.	Bridge Factors Photo 35
2/24/18	12:23:23 p.m.	MCM-NTSB-OSHA 005303	View of crack at the bottom of diagonal support #2 on north side looking to the south in casting yard.	Bridge Factors Photo 36
2/24/18	12:24:14 p.m.	MCM-NTSB-OSHA 005304	View of cracks at the bottom of diagonal support #2 on south side looking to the north in casting yard.	Bridge Factors Photo 37
2/24/18	12:29:38 p.m.	MCM-NTSB-OSHA 005305	View of crack at the bottom of diagonal	Bridge Factors

			support #11 on north side looking to the south in casting yard.	Photo 38
2/24/18	12:30:23 p.m.	MCM-NTSB-OSHA 005306	View of crack at the bottom of diagonal support #11 on south side looking to the north in casting yard.	Bridge Factors Photo 39
2/24/18	12:53:47 p.m.	MCM-NTSB-OSHA 005311	View of continued falsework removal under deck from middle to outward mega shores.	Bridge Factors Photo 40
2/25/18	8:01:38 a.m.	MCM-NTSB-OSHA 005330	View of all falsework removed under deck, only mega shores at each end holding main span.	Bridge Factors Photo 41
2/26/18	8:38:16 a.m.	MCM-NTSB-OSHA 005336	View of crack at the bottom of diagonal support #11 on north side looking to the south in casting yard.	Bridge Factors Photo 42
2/26/18	8:38:58 a.m.	MCM-NTSB-OSHA 005337	View of crack at the bottom of diagonal support #11 on south side looking to the north in casting yard.	Bridge Factors Photo 43
2/26/18	8:39:52 a.m.	MCM-NTSB-OSHA 005338	View of cracks at the bottom of diagonal support #2 on south side looking to the north in casting yard.	Bridge Factors Photo 44
2/26/18	8:40:08 a.m.	MCM-NTSB-OSHA 005339	View of crack at the bottom of diagonal support #2 on north side looking to the south in casting yard.	Bridge Factors Photo 45
2/26/18	3:23:29 p.m.	MCM-NTSB-OSHA 005346	View of finished walkway of main span.	Bridge Factors Photo 46
2/28/18	3:32 p.m.	Bolton – Perez and Associates	Report #2 – Email from Jose Morales of Bolton – Perez to Rodrigo Isaza of MCM requesting the engineer of record (EOR) to provide a response and determine if cracks were	Bridge Factors Attachment 22

			expected during the bridge stressing. The one that Bolton-Perez believes needs special attention are the cracks in the Node #11/#12 region.	
2/28/18	6:07 p.m.	MCM	Email from Rodrigo Isaza of MCM to Manuel Feliciano of FIGG forwarding BPA's crack inspection report #2 and requesting review and comment.	Bridge Factors Attachment 22
3/2/18	5:19:44 p.m.	MCM-NTSB-OSHA 005399	View of Barnhart Crane and Rigging equipment arriving on-scene.	Bridge Factors Photo 47
3/6/18	1:55:31 p.m.	MCM-NTSB-OSHA 005480	View of main span with partial set up of SPMT units located in foreground.	Bridge Factors Photo 48
3/7/18	7:44 a.m.	MCM	Email from Rodrigo Isaza of MCM to Manuel Feliciano of FIGG asking if FIGG had any comments on cracking photos in BPA's crack inspection report #2.	Bridge Factors Attachment 22
3/7/18	2:17 p.m.	FIGG	Email from Manuel Feliciano of FIGG to Rodrigo Isaza of MCM summarizing FIGG's review of BPA Report #2. FIGG recommended that the area of truss member 1 noted in the report should be repaired after the main span is moved into its final position. FIGG recommended that the area of truss member 11 would be sealed in accordance with FDOT Standard Specifications.	Bridge Factors Attachment 22
3/7/18	10:42:24 a.m.	MCM-NTSB-OSHA 005497	View of main span with set up of unattached	Bridge Factors Photo 49

			SPMT units located underneath.	
3/7/18	3:00 p.m.	BPA	Pre-activity meeting agenda for Span 1 movement with associated meeting minutes in italic text conducted on March 7, 2018. The pre-activity meeting outlines specific responsibilities of the parties involved with the movement of Span 1 and specifies the parties authorized for removing and returning the SPMT equipment to the staging area.	BPA's Attachment Submission BPA-1
3/8/18	10:06 a.m.	MCM	Email from Rodrigo Isaza of MCM to Jose Morales of BPA forwarding FIGG's comments on BPA's crack inspection report #2.	Bridge Factors Attachment 22
3/8/18	Unknown	Barnhart Crane & Rigging	Looking at Type II diaphragm, west end of main span, south side of vertical member #12, looking down before bridge move, taken from staging area.	FIGG's Photo Submission FCA 10-9
3/9/18	7:38:03 a.m.	MCM-NTSB-OSHA 005508	View of unattached SPMT with oak crane mats with a taper to match the profile of the bottom flange of the bridge span.	Bridge Factors Photo 50
3/9/18	1:11 p.m.	MCM-NTSB-OSHA 005513	View of strain transducer and rotation sensor on main span during move.	Bridge Factors Photo 51
3/9/18	9:00 p.m.	FIGG	SW 8th Street closed to vehicular traffic. The documents submitted to FDOT on behalf of MCM for the General Use Permit to close SW 8th Street from 3/9/18 – 3/12/18 (see FIGG's	

			Attachment Submission FCA-A6) was provided to show that the bridge movement was planned by MCM and Barnhart Crane & Rigging to be performed over a weekend closure of SW 8th Street starting from 9 p.m. on Friday night and reopen by 5 a.m. on Monday. The dates of January 26 and 29 were subject to change and the approved General Use Permit required the work to be completed by 4/1/2018 (see Bridge Factors Attachment 60).	
3/10/18	12:29:33 a.m.	MCM-NTSB-OSHA 005525	View of test move to transport main span on SPMT units. Actual move began approximately 4:30 a.m.	Bridge Factors Photo 52
3/10/18	5:09 a.m.	MCM-NTSB-OSHA 005530	View of main span being transported on SPMT units across travel lanes of SW 8th Street.	Bridge Factors Photo 53
3/10/18	6:38 a.m.	MCM-NTSB-OSHA 005536	View of main span being transported on SPMT units west of permanent piers looking to the west.	Bridge Factors Photo 54
3/10/18	10:10 a.m.	MCM-NTSB-OSHA 005538	View of main span being transported on SPMT units immediately west of permanent piers looking to the northwest.	Bridge Factors Photo 55
3/10/18	Not Available	Structural Technologies, LLC ST000021	View of main span being transported on SPMT units immediately west of permanent piers looking to the southeast toward north face of Diaphragm II.	Bridge Factors Photo 56
3/10/18	10:23 a.m.	MCM-NTSB-OSHA 005539	View of Diaphragm I, south end of main span, just prior to placement on	Bridge Factors Photo 57

			south pier looking to the west.	
3/10/18	10:26 a.m.	MCM-NTSB-OSHA 005540	View of Diaphragm I, south end of main span, just prior to placement on south pier looking to the east.	Bridge Factors Photo 58
3/10/18	10:26 a.m.	MCM-NTSB-OSHA 005541	View of Diaphragm II, north end of main span, just prior to placement on pylon pier looking to the northeast.	Bridge Factors Photo 59
3/10/18	12:29:13 p.m.	MCM-NTSB-OSHA 005542	View of main span on permanent piers with chains detached from SPMT units. Actual move complete approximately 12:30 p.m.	Bridge Factors Photo 60
3/10/18	From approximately 4:30 a.m. to approximately 12:30 p.m.	FIU	Video looking down on Node #12 and #11during transport of main span showing no cracks along west side of Diaphragm II.	FIU Video.mp4
3/10/18	Approx. 12:29 p.m. to 12:31 p.m.	FIGG	Photo taken by FIGG personnel (Franklin Hines) prior to leaving the site on 3/10/18. View of crack at the bottom of diagonal support #2 on west side looking to the east. Transfer of white paint in chamfer region obscures some markings.	FIGG's Photo Submission FCA-S6
3/10/18	Approx. 12:29 p.m. to 12:31 p.m.	FIGG	Photos taken by FIGG personnel (Franklin Hines) prior to leaving the site on 3/10/18. View of crack at the bottom of diagonal support #11 on east side looking to the west. Transfer of white paint in chamfer region obscures some markings.	FIGG's Photo Submission FCA-S7
3/10/18	Unknown	BPA	View along west side of Diaphragm II looking to the east.	MCM's Photo Submission MCM-3

3/10/18	Unknown	BPA	View of bottom of diagonal support #11 on east side looking to the west.	MCM's Photo Submission MCM-4
3/10/18	Approx. 1:32 p.m. to 1:44 p.m.	FIU Construction Web Cam	View of main span where truss member 11/12 nodal area and Type II diaphragm is being inspected by field personnel. FIGG personnel left the site approximately 12:30 p.m.	FIGG's Photo Submission FCA 23-1
3/10/18	2:00 p.m.	Structural Technologies, LLC ST000014 – ST000020	Texts from Kevin Hanson mobile device indicating "We are just getting started" – destressing diagonal supports #2 and #11.	Bridge Factors Attachment 23
3/10/18	Approx. 2:34 p.m.	FIU Construction Web Cam	View of main span where equipment mobilized to top of canopy to destress temporary PT bars in truss member 11.	FIGG's Photo Submission FCA 10-11
3/10/18	3:00 p.m.	Structural Technologies, LLC ST000014 – ST000020	Texts from Kevin Hanson mobile device indicating "No oil. What kind does it take?"	Bridge Factors Attachment 23
3/10/18	3:09 p.m.	MCM-NTSB-OSHA 005543	View of main span on permanent piers with SPMT units removed below. Personnel working on top of canopy with crane hovered over diagonal support #11.	Bridge Factors Photo 61
3/10/18	Approx. 3:12 p.m. to 3:30 p.m.	FIU Construction Web Cam	View of main span where truss member 11/12 nodal area is being inspected.	FIGG's Photo Submission FCA 23-2
3/10/18	3:16 p.m.	MCM-NTSB-OSHA 005549	View of cracks at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 62
3/10/18	3:16 p.m.	MCM-NTSB-OSHA 005550	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 63

3/10/18	3:16:32 p.m.	Corradino Group	Looking at Type II diaphragm, West side, North face looking down after bridge move.	FIGG's Photo Submission FCA 10-10
3/10/18	3:17 p.m.	MCM-NTSB-OSHA 005551	View of cracks at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 64
3/10/18	3:17 p.m.	MCM-NTSB-OSHA 005553	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 65
3/10/18	3:18 p.m.	MCM-NTSB-OSHA 005555	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 66
3/10/18	Approx. 4:17 p.m. to 4:30 p.m.	FIU Construction Web Cam	View of main span where temporary PT bars in truss member 11 have been destressed.	FIGG's Photo Submission FCA 10-12
3/10/18	Approx. 4:33 p.m. to 5:25 p.m.	FIU Construction Web Cam	View of main span where temporary PT bars in truss member 2 have been destressed.	FIGG's Photo Submission FCA 10-13
3/10/18	Approx. 5:49 p.m. to 6:00 p.m.	FIU Construction Web Cam	View of main span where truss member 11/12 nodal area and Type II diaphragm is being inspected by field personnel.	FIGG's Photo Submission FCA 23-3
3/10/18	Approx. 6:01 p.m.	FIU Construction Web Cam	View of main span where SW 8th Street is opened to vehicular traffic under the pedestrian bridge. MCM opens roadway and emails FDOT at approximately 6:53 p.m. The documents submitted to FDOT on behalf of MCM for the General Use Permit to close SW 8th Street from 3/9/18 – 3/12/18 (see FIGG's Attachment Submission FCA-A6) was provided to show that the bridge movement was planned by	FIGG's Photo Submission FCA 23-6 and FIGG's Attachment Submission FCA 23-7

			MCM and Barnhart Crane & Rigging to be performed over a weekend closure of SW 8th Street starting from 9 p.m. on Friday night and reopen by 5 a.m. on Monday. The dates of January 26 and 29 were subject to change and the approved General Use Permit required the work to be completed by 4/1/2018 (see Bridge Factors Attachment 60).	
3/10/18	Approx. 6:16 p.m.	FIU Construction Web Cam	View of main span and staging area. SPMTs fully assembled in staging area.	FIGG's Photo Submission FCA 10-14
3/10/18	6:30 p.m.	Structural Technologies, LLC ST000014 – ST000020	Texts from Kevin Hanson mobile device indicating "We're done" – destressing diagonal supports #2 and #11.	Bridge Factors Attachment 23
3/10/18	7:08 p.m.	Structural Technologies, LLC ST000014 – ST000020	Texts from Kevin Hanson mobile device indicating "It cracked like hell".	Bridge Factors Attachment 23
3/11/18	5:10 p.m.	FIU Construction Web Cam	View of main span and staging area. SPMT pull up gantries and transverse bents disassembled. All SPMT equipment remain on site.	FIGG's Photo Submission FCA 10-15
3/12/18	9:46 a.m.	MCM-NTSB-OSHA 005571	View of cracks on north face of Diaphragm II on west side.	Bridge Factors Photo 67
3/12/18	9:49 a.m.	MCM-NTSB-OSHA 005573	View of cracks on north face of Diaphragm II on west side.	Bridge Factors Photo 68
3/12/18	10:01 a.m.	MCM-NTSB-OSHA 005575	View of cracks on north face of Diaphragm II on east side.	Bridge Factors Photo 69
3/12/18	10:20 a.m.	MCM-NTSB-OSHA 005576	View of cracks on south face of Diaphragm II on east side.	Bridge Factors Photo 70
3/12/18	10:20 a.m.	MCM-NTSB-OSHA 005577	View of crack in cut-out for drain pipe under deck.	Bridge Factors

				Photo 71
3/12/18	10:23 a.m.	MCM-NTSB-OSHA 005578	View of cut-out for drain pipe under deck looking to the south.	Bridge Factors Photo 72
3/12/18	10:35 a.m.	MCM-NTSB-OSHA 005579	View of top of canopy looking to the south and chiseled concrete in blister for destressing diagonal support #11.	Bridge Factors Photo 73
3/12/18	4:51:53 p.m.	FIGG Bridge Engineers, Inc. FBE000126 – FBE000144	Email from Rodrigo Isaza of MCM to Dwight Dempsey of FIGG transmitting photographs of cracks at Diaphragm II and Node #11/#12 region.	Bridge Factors Attachment 24
3/12/18	7:01 p.m.	FIU Construction Web Cam	View of main span and staging area. SPMT pull up gantries removed from site. All SPMT trailers, power packs, and transverse bents remain on site.	FIGG's Photo Submission FCA 10-16
3/13/18	9:45 a.m.	FIGG Bridge Engineers, Inc. FBE000145 – FBE000146	Email from Dwight Dempsey of FIGG to Rodrigo Isaza of MCM in response to email dated 3/12/18 at 4:51:53 p.m. indicating cracks are not a safety issue but recommend MCM place plastic shims underneath Diaphragm II at the centerline.	Bridge Factors Attachment 25
3/13/18	10:59 a.m.	Bolton – Perez and Associates	Report #3 – Email from Jose Morales of Bolton – Perez to Rodrigo Isaza of MCM recommending the cracks at Diaphragm II and Node #11/#12 region be monitored and documented for growth to determine if they are active and developing further or dormant.	Bridge Factors Attachment 26
3/13/18	11:16:50 a.m.	MCM-NTSB-OSHA 005582	View of cracks along west side of Diaphragm II	Bridge Factors

			looking to the north showing crack is approximately 4 inches deep.	Photo 74
3/13/18	11:17:04 a.m.	MCM-NTSB-OSHA 005583	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 75
3/13/18	11:17:57 a.m.	MCM-NTSB-OSHA 005585	View of cracks along west side of Diaphragm II looking to the north showing crack is approximately 3 inches deep.	Bridge Factors Photo 76
3/13/18	11:18:50 a.m.	MCM-NTSB-OSHA 005588	View of crack along bottom of diagonal support #11 on west side showing crack is approximately 6 inches deep.	Bridge Factors Photo 77
3/13/18	11:20:19 a.m.	MCM-NTSB-OSHA 005589	View of crack along bottom of diagonal support #11 on east side.	Bridge Factors Photo 78
3/13/18	11:25:33 a.m.	MCM-NTSB-OSHA 005593	View of crack in Node #11/#12 region on west side showing crack is approximately 1 inch deep.	Bridge Factors Photo 79
3/13/18	11:26:36 a.m.	MCM-NTSB-OSHA 005594	View of cracks at the bottom of diagonal support #11 on west side looking to the east showing folding rule inside crack.	Bridge Factors Photo 80
3/13/18	1:02:14 p.m.	MCM-NTSB-OSHA 005595	View of crack at the bottom of diagonal support #11 on east side looking to the west showing crack is 1 inch wide at one location.	Bridge Factors Photo 81
3/13/18	1:11:16 p.m.	MCM-NTSB-OSHA 005598	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 82
3/13/18	1:17:46 p.m.	MCM-NTSB-OSHA 005604	View of cracks at the bottom of diagonal	Bridge Factors

			support #11 on west side looking to the east.	Photo 83
3/13/18	1:29:15 p.m.	MCM-NTSB-OSHA 005614	View of cracks at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 84
3/13/18	1:44:38 p.m.	FIGG	Email from Dwight Dempsey to Denney Pate stating, "Rodrigo said that the cracks were observed prior to destressing then grew slightly once pt bars were destressed."	FIGG's Attachment Submission FCA 10-17
3/13/18	4:13 p.m.	FDOT	Voice mail message from Denney Pate (engineer of record) of FIGG to Tom Andres of FDOT indicating cracking had been observed on the north end of the span. Mr. Pate further indicated that repairs will need to be done to the cracking "but from a safety perspective we don't see that there's any issue there so we're not concerned about it from that perspective..." Per FDOT, the voice mail message was not retrieved until 3/16/18 at 9:15 a.m. after the collapse. Mr. Andres, to whom the voice mail message was directed, was out of the office on assignment.	 FIGG voice mail message.m4a
3/13/18	1:44:41 p.m.	MCM-NTSB-OSHA 005629	View of cracks at the bottom of diagonal support #2 on west side looking to the southeast.	Bridge Factors Photo 85
3/13/18	1:44:53 p.m.	MCM-NTSB-OSHA 005632	View of cracks at the bottom of diagonal support #2 on west side looking to the east.	Bridge Factors Photo 86

3/13/18	4:32:54 p.m.	MCM-NTSB-OSHA 005638	View of cracks on south face of Diaphragm II above shim plates.	Bridge Factors Photo 87
3/13/18	5:18:22 p.m.	FIGG Bridge Engineers, Inc. FBE000147 – FBE000151	Email from Dwight Dempsey of FIGG to Rodrigo Isaza of MCM in further response to email dated 3/12/18 at 4:51:53 p.m. indicating cracks are not a safety issue and recommending diagonal support #11 be restressed.	Bridge Factors Attachment 27
3/13/18	6:41 p.m.	FIU Construction Web Cam	View of main span and staging area. One of two transverse bents removed from site. All SPMT trailers and power packs remain on site.	FIGG's Photo Submission FCA 10-18
3/14/18	10:43 a.m.	Structural Technologies, LLC ST000006 – ST000013	Email from Sam Nunez of Structural Technologies to Rodrigo Isaza of MCM indicating cracking was observed on the bridge on 3/10/18 during destressing of diagonal support #11 and the engineer of record (EOR) needs to analyze the cracking before any additional work is done. Please check with the EOR if work is to be completed prior to the stressing such as epoxy injection to fill any voids and avoid further cracking when we implement 560,000 lbs of force on this area. After the EOR reviews the area, we can schedule the appropriate crew weather [whether] being epoxy injection crew first or the stressing crew.	Bridge Factors Attachment 28
3/14/18	10:50 a.m.	Structural Technologies, LLC	Email from Rodrigo Isaza of MCM to Sam Nunez of	Bridge Factors

		ST000006 – ST000013	Structural Technologies indicating "you misunderstood our conversation of yesterday. FIGG has further evaluated and confirmed that the cracks encountered on the diaphragm do not pose a safety issue … What I mentioned to you yesterday was that truss member #11 needed to be restressed as indicated by the EOR."	Attachment 28
3/14/18	1:38 p.m.	FIGG Bridge Engineers, Inc. FBE000152 – FBE000165	Email from Rodrigo Isaza of MCM to Dwight Dempsey of FIGG transmitting additional photographs of the cracks at Diaphragm II and confirming tomorrow's meeting at 9:00 a.m. with FIGG's team.	Bridge Factors Attachment 29
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 88
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 89
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 90
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 and vertical support #12 on east side looking to the west.	Bridge Factors Photo 91

3/14/18	1:45 p.m.	Bolton – Perez and Associates	View of cracks being monitored at the bottom of diagonal support #11 and vertical support #12 on west side looking to the east.	Bridge Factors Photo 92
3/14/18	1:46 p.m.	Bolton – Perez and Associates	View of cracks at the bottom of diagonal support #11 and vertical support #12 on west side looking to the east.	Bridge Factors Photo 93
3/14/18	1:47 p.m.	Bolton – Perez and Associates	View of cracks being monitored at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 94
3/14/18	1:47 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 95
3/14/18	1:50 p.m.	Bolton – Perez and Associates	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 96
3/14/18	1:50 p.m.	Bolton – Perez and Associates	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 97
3/14/18	1:51 p.m.	Bolton – Perez and Associates	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 98
3/14/18	1:51 p.m.	Bolton – Perez and Associates	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 99
3/14/18	1:51 p.m.	Bolton – Perez and Associates	View of crack being monitored on the west side of vertical support #12 looking to the east.	Bridge Factors Photo 100
3/14/18	1:51 p.m.	Bolton – Perez and Associates	View of crack being monitored on the west side of vertical support #12 looking to the east.	Bridge Factors Photo 101
3/14/18	2:58 p.m.	Structural Technologies, LLC ST000006 – ST000013	Email from Sam Nunez of Structural Technologies to Rodrigo Isaza of MCM transmitting attached change order for rushed	Bridge Factors Attachment 28

			request to restress diagonal support #11. Mr. Nunez requests approval of change order in order to send Structural Technologies personnel to travel and arrive on-site tomorrow between 9:30 a.m. and 10:00 a.m.	
3/14/18	5:49 p.m.	FIU Construction Web Cam	View of main span and staging area. Last of two transverse bents and half of SPMT trailers and three power packs removed from site. Half of SPMT trailers and one power pack remain on site.	FIGG's Photo Submission FCA 10-19
3/15/18	Approx. 8 a.m.	FIGG	View of cracks at the bottom of diagonal member #11 on west side looking to the northeast.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	Top view of cracks along west side of Diaphragm II.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	Top view of cracks along west side of Diaphragm II.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	View of cracks at the bottom of diagonal member #11 on west side looking to the northeast.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	View of cracks at the bottom of diagonal member #11 on west side looking to the north.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	View of cracks at the bottom of diagonal member #11 on east side looking to the northwest.	FIGG's Photo Submission FCA-A1
3/15/18	Approx. 8 a.m.	FIGG	Top view of cracks along bottom of diagonal member #11 on east side.	FIGG's Photo Submission FCA-A1
3/15/18	9:00 a.m.		A meeting requested by BPA took place on March 15, 2018 at 9:00 a.m. at the MCM field office	

			between FIGG, MCM, FDOT, FIU and BPA to discuss the temporary construction loading condition (structure cracks) and the temporary mechanism to capture the nodal zone at member 11 and 12. BPA developed hand written meeting minutes during the meeting and circulated the typed document for comment on March 20, 2018, five days after the collapse. Having received no comments from any of the parties present at the meeting, the meeting minutes were incorporated into the project documentation. BPA and MCM have since revised the meeting minutes accordingly and they are included in this report as Attachment 30 - "BPA 3/15/18 Meeting Minutes". FIGG provided meeting minutes directly to NTSB sometime later that included review comments to the BPA 3/15/18 Meeting Minutes and their understanding of the discussion at the meeting. These minutes are included in this report as Attachment 31 - "FIGG 3/15/18 Meeting Minutes". The power point presentation given by FIGG at the March 15, 2018 meeting is included as Attachment 32 –	

			"FIGG 3/15/18 Power Point Presentation".	
3/15/18	10:53 a.m.	FIU Associate Vice-President of Facilities Management	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the northwest.	Bridge Factors Photo 102
3/15/18	10:55 a.m.	FIU Associate Vice-President of Facilities Management	View of cracks at the bottom of diagonal support #11 on west side looking to the northeast.	Bridge Factors Photo 103
3/15/18	10:55 a.m.	FIU Associate Vice-President of Facilities Management	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 104
3/15/18	11:24 a.m.	FIU Construction Webcam	View of main span where equipment is mobilized for restressing the temporary PT bars in truss member 11.	FIGG's Photo Submission FCA 10-20
3/15/18	Approx. 2 hours before collapse	Tom Andres NTSB Interview dated March 22, 2018	Message recorded on Tom Andres voice mail from Alfredo Reyna, FDOT, reporting cracking following meeting. Per FDOT, message was retrieved by Tom Andres around 9:15 a.m. on 3/16/18.	
3/15/18	11:50 a.m.	FIU Construction Webcam	View of main span where stressing operations for truss member 11 temporary PT bars commenced.	FIGG's Photo Submission FCA 10-21
3/15/18	Not Available	Bolton – Perez and Associates	Video taken by Carlos Chapman of Bolton – Perez showing Structural Technologies personnel performing restressing of diagonal support #11.	Video of Restressing.mp4
3/15/18	From 11:51 a.m. to 1:47 p.m.	FIU Construction Webcam	View of main span where stressing operations continue for the truss member 11 temporary PT	FIGG's Photo Submission FCA 10-22

			bars using alternate stressing sequence.	
3/15/18	11:51 a.m.	MCM-NTSB-OSHA 005642	View of two of the three westbound lanes closed looking to the east to allow for a crane to be used during the restressing of diagonal support #11.	Bridge Factors Photo 105
3/15/18	1:33 p.m.	FIU Construction Webcam	View of main span and staging area. Last of SPMT trailers removed from site.	FIGG's Photo Submission FCA 10-23
3/15/18	About 1:47 p.m.	FIU	View of collapsed pedestrian bridge looking to the southwest.	Bridge Factors Photo 106

11. Tension and Compression Members of the Main Span

Figure 12 illustrates the tension and compression members of the main span simply supported at each end before the move and on the permanent piers after the move. **Figure 12** represents the main span truss forces as the following:

- After casting but prior to the move in the staging area on the south side of SW 8th Street with the falsework removed[26], and
- After the move with the truss in place on the permanent piers spanning over SW 8th Street.

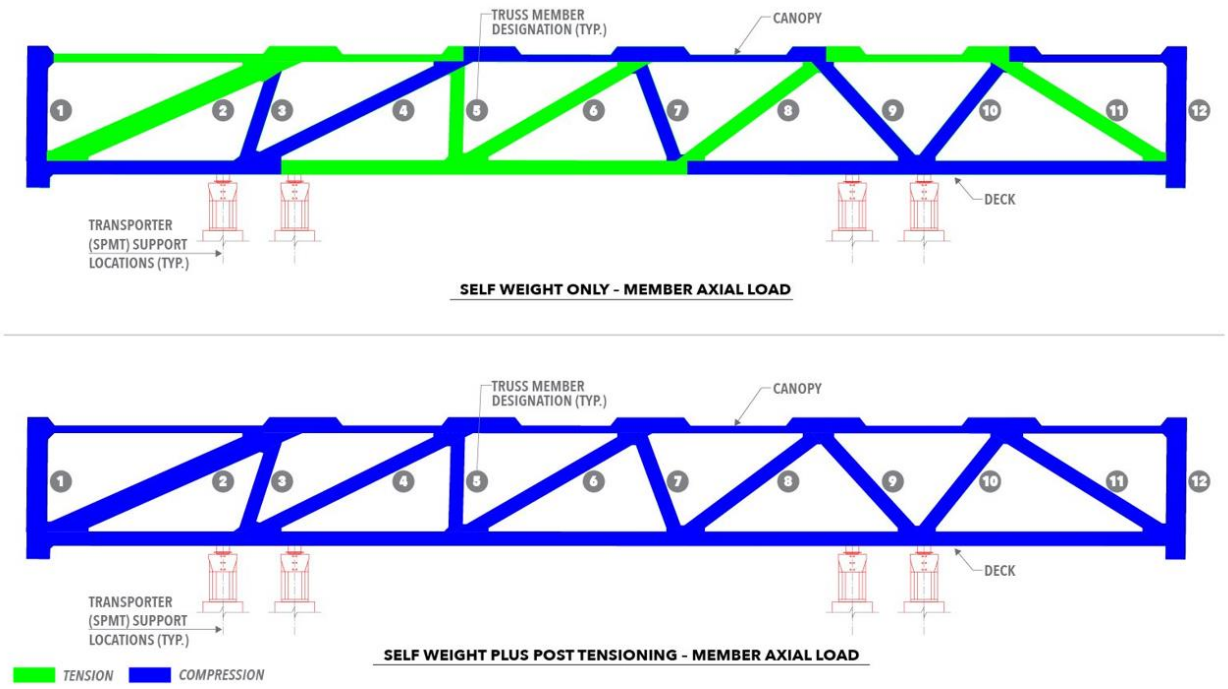
[26]The stressing of all longitudinal and transverse tendons in the deck and canopy, including the post tensioning bars in the diagonal supports, was completed before the falsework was removed under the deck from the middle to the outward megashores.

Note: The top diagram is shown without post-tensioning for illustration purposes only. The bottom diagram is shown with actual loads.

Figure 12 – Map illustrating the tension and compression members of the main span simply supported at each end before the move and on the permanent piers after the move (Source: FIGG Bridge Engineers, Inc. modified)[27]

Figure 13 illustrates the tension and compression members of the main span during the truss move while supported on the self-propelled modular transporter (SPMT) vehicles.

[27]Top diagram illustrates self-weight axial forces only, which are combined with post-tensioning forces concurrently acting on the span to produce the net axial forces shown in the bottom diagram.



Note: The top diagram is shown without post-tensioning for illustration purposes only. The bottom diagram is shown with actual loads.

Figure 13 – Map illustrating the tension and compression members of the main span during the truss move while supported on the self-propelled modular transporter (SPMT) vehicles (Source: FIGG Bridge Engineers, Inc. modified)[28]

Figures 12 and 13 illustrate two diagrams. The top diagram illustrates the self-weight forces only (gravity loads), and the bottom diagram illustrates the self-weight plus the forces from the post tensioning tendons and bars. NTSB investigators inquired with FIGG Bridge Engineers, Inc. as to why the self-weight plus post tensioning creates a situation in which all truss members are in compression. FIGG Bridge Engineers, Inc. responded in an email to NTSB investigators:[29]

> *"The truss is designed as a prestressed concrete element. As such, prestressing steel is used in members subject to tension forces to limit the net tension in the member under full design loads. Loads that the truss was designed for that were not applied at the time include pedestrian live load, wind loads and thermal loads, which would result in tension in certain members. The compression provided by the prestressing counteracts the tension from the loads."*

[28]Top diagram illustrates self-weight axial forces only, which are combined with post-tensioning forces concurrently acting on the span to produce the net axial forces shown in the bottom diagram.
[29]Email from Mr. Alan Phipps of FIGG to Mr. Dan Walsh of NTSB dated July 12, 2018.

12. Eleven-foot (11) shift to the north of the entire pedestrian bridge to accommodate a future express bus lane

On October 12, 2016, FDOT notified FIU by email that the current pedestrian bridge design plans did not meet FDOT's Plans Preparation Manual (PPM) requirements.[30] The October 12, 2016 email indicated that bridge piers and abutments should provide a minimum of 16 feet horizontal clearance from the edge of travel lane. The email also indicated that lateral offsets must account for future widening plans of the roadway below. The project design by MCM and FIGG complied with all design criteria and requirements as included in the RFP, contract documents, and FDOT PPM. This included horizontal clearances and lateral offsets for future widening plans of the roadway below. During the design process, FDOT requested that the pedestrian bridge design have flexibility to accommodate a future express bus lane for which FDOT was starting to study corridor alternatives.

On October 31, 2016, representatives from FDOT, MCM, FIGG, BPA, FIU, and the City of Sweetwater met to discuss the need to accommodate a future express bus lane currently under FDOT project development and environment study.[31] The future express bus lane would be located on the north side of SW 8th Street and would require an additional through lane determined to be approximately 12 feet wide. The current location of the pylon pier would be in direct conflict with the additional through lane.

Over the course of 2 months, agreement was reached between representatives from FDOT, MCM, FIGG, BPA, FIU, and the City of Sweetwater that the future widening plans to accommodate a future express lane could be achieved by shifting the entire pedestrian bridge structure (i.e. main span, back span, pylon pier, south and north piers, grand staircase, stairs and landings, and elevator towers) 11 feet to the north. This proposal was deemed the simplest option with minimal impacts to the design and construction. The new proposal would increase the horizontal clearance from the edge of pavement to the face of the pylon pier from 5 feet – 6 ¼ inches to 16 feet – 6 ¼ inches, a difference of 11 feet.

As a result of shifting the entire pedestrian bridge structure 11 feet to the north, revisions to the General Plan and Elevation, General Notes (2 of 2), Bridge Hydraulics Recommendation Sheet and Foundation Layout drawings were revised to show the new location of the pylon and the North and South Plaza Landing Areas. A new bulkhead wall on the south side of Tamiami Canal was introduced due to the shifting of the bridge. In addition, redesign and relocation was necessary to water and sewer lines at the north landing in the City of Sweetwater.[32] The Miami Dade Water and Sewer Department required the relocation of the water and sewer lines be accessible because the new location of the north landing would be on top of the existing utilities. Based on the scope of shifting the bridge structure 11 feet to the north, FDOT Structures Design

[30]Email from FDOT to FIU dated Wednesday, October 12, 2016.
[31]Minutes of meeting prepared by Bolton Perez & Associates (BPA) with sign-in sheet attached dated October 31, 2016.
[32]The scope of work to the sanitary sewer line consisted of removal and disposal of 2 sanitary manholes, removal and disposal of approximately 150 linear feet of 8-inch sanitary sewer line, installation of 1 new sanitary manhole, and installation of new 6-inch lateral sanitary sewer line. The scope of work for the water line consisted of replacement of a portion of the existing 8-inch water main.

Office did not require an Independent Peer Review of the revised documents. An Independent Peer Review was not required because the bridge structural design was not affected by the shifting of the bridge.

The construction costs associated with the new bulkhead containment wall on the south side of Tamiami Canal and relocation of the water and sewer lines was estimated at $402,724 and the design cost was estimated at $204,540.25. FDOT accepted the design changes and agreed to cover the construction cost of $402,724 but not the design cost of $204,540.25.

As discussed earlier in the Bridge Factors Factual Report, a Local Agency Program (LAP) Supplemental Agreement reflecting the $402,724 additional funding was executed by FDOT on June 2, 2017. Also, a TIGER Grant Agreement (Amendment #2) reflecting the $402,724 additional funding was executed by FHWA on December 11, 2017.

The funding of the design cost estimated at $204,540.25 had not been resolved at the time of the pedestrian bridge collapse on March 15, 2018. MCM had filed a Request for Equitable Adjustment for design costs dated January 16, 2017 which currently has not been approved by either FIU or FDOT.

13. Destressing post-tensioning bars in diagonal members #2 and #11 on March 10, 2018

The following paragraphs discuss the equipment, sequence and procedure for destressing temporary PT bars on March 10, 2018, and correspondence following the destressing of the temporary PT bars.

13.1. Equipment

Post tensioning bars are like large threaded rods with nuts and washers (bearing plates) on each end. Because the forces are so large it is not practical to stress post tensioning bars by simply tightening the nuts with a wrench as you would do with smaller threaded rods. For this reason, special hydraulic equipment is used to apply the force necessary to stress post tensioning bars. It consists of:

- An electric powered hydraulic pump with a 4-way valve to control oil flow.
- A hydraulic pressure gauge which has been calibrated with the stressing ram as a set.
- Hydraulic hoses.
- Stressing ram assembly which includes:
    1. Hollow double acting hydraulic cylinder.
    2. Nosepiece to transfer the force from the stressing ram to the bearing plate.
    3. Integral socket/ratchet assembly to turn the nut as the post tensioning bar is being stressed or destressed.
- Pull rod with coupler to extend the post tensioning bar through the nosepiece and hydraulic cylinder.
- Stressing nut and plate which is threaded onto the pull rod to transfer the force in the bar to the hydraulic cylinder.

Figure 14 illustrates the north end of the main span with the equipment used to destress the post tensioning bars in diagonal member #11.

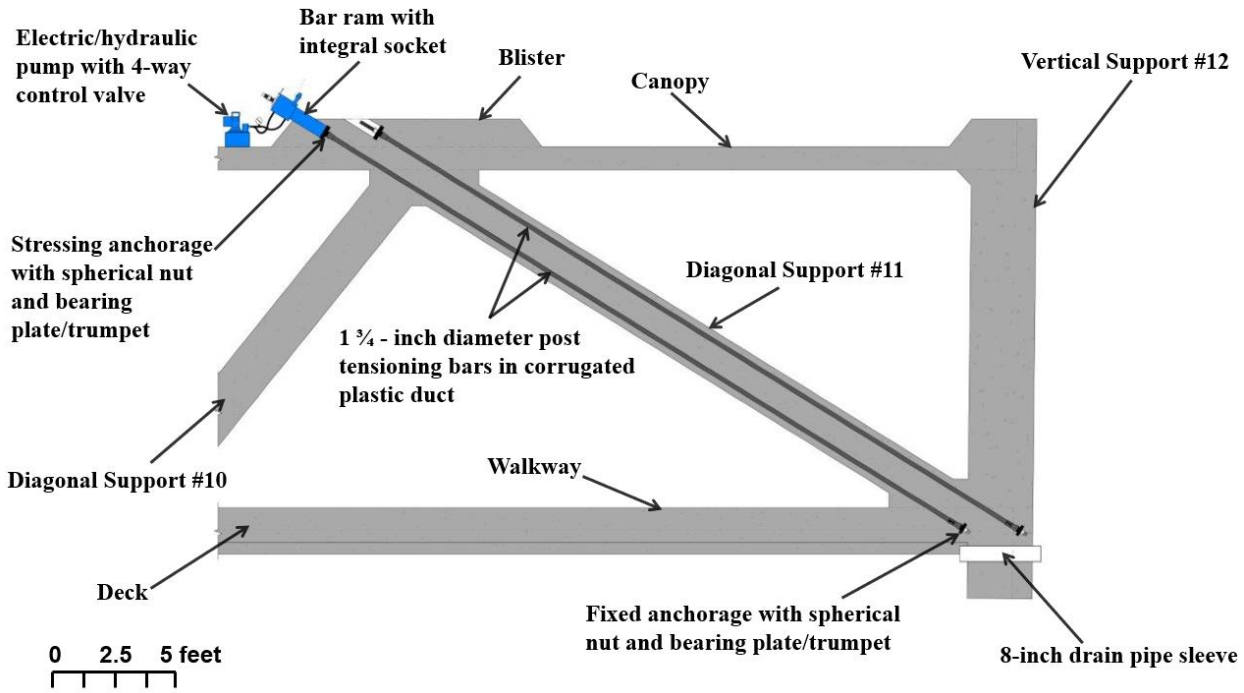
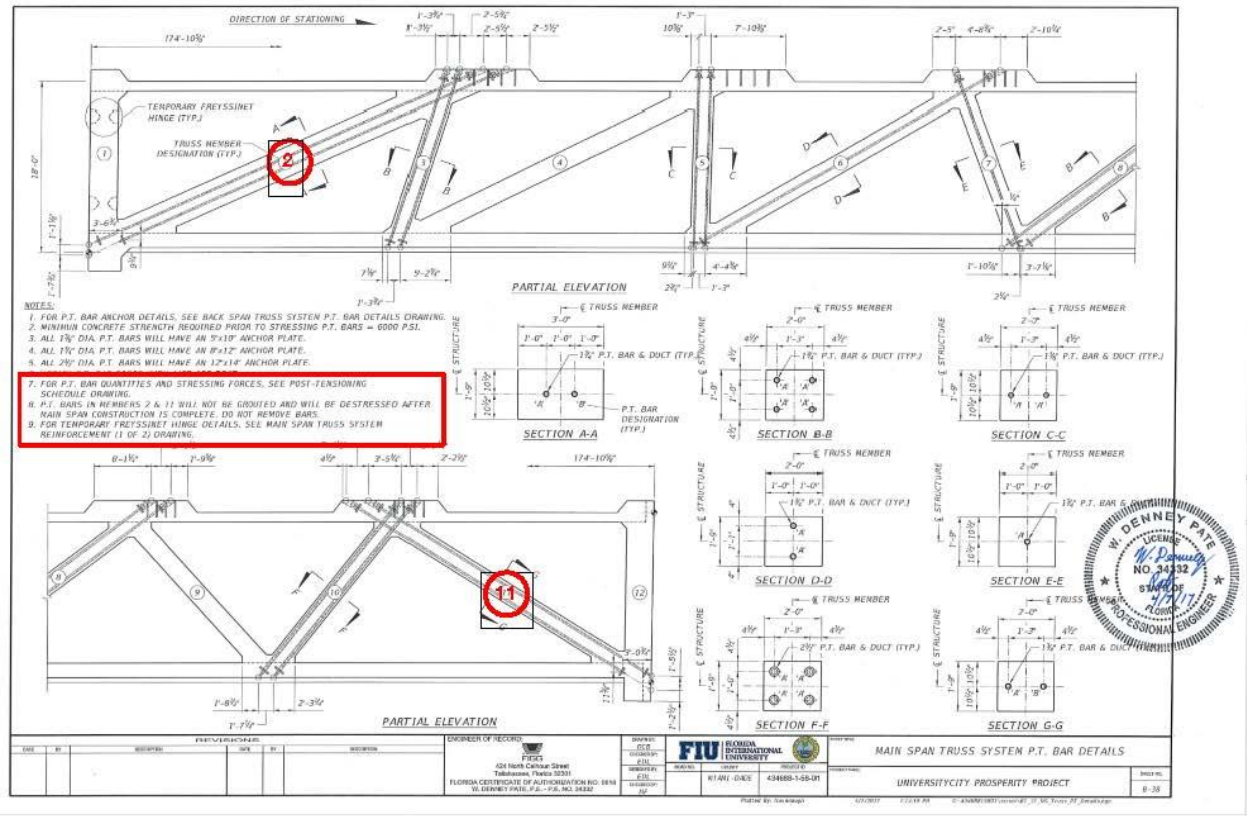


Figure 14 – Map illustrating the north end of the main span with the equipment used to destress the post tensioning bars in diagonal support #11 (Source: Structural Technologies, LLC modified)

13.2. Sequence and procedure for destressing temporary PT bars on March 10, 2018

The diagonal members in the main span were prestressed with post tensioning bars ranging in diameter size from 1 ⅜ inches to 2 ½ inches. There were two – 1 ¾ inch diameter post tensioning bars used in diagonal member #11. These bars were used to introduce compressive force into diagonal member #11 when they were stressed to counteract the tensile force resulting from the position of the SPMT vehicles which moved the main span from the adjacent casting yard on March 10, 2018. Once the main span was placed into position on its permanent piers over SW 8th Street, the post tensioning bars in diagonal member #11 and diagonal member #2 were destressed.

Bridge Plan Sheet B-38 shows the temporary PT bar layout in truss members 2 and 11. Per Note 8 on that plan sheet, the "P.T. bars in members 2 & 11 will not be grouted and will be destressed after main span construction is complete. Do not remove the bars."



Bridge Plan Sheet B-38 Showing Temporary PT Bar Layout in Truss Members 2 and 11

Per email from FIGG (Manuel Feliciano) to MCM (Rodrigo Isaza) on March 6, 2018, it was specified that *"The PT bars in members 2 and 11 are only required for the temporary support condition during the movement of the span. Therefore, the PT bars can be distressed after span 1 is supported on the permanent supports (pylon and end bent 1)."* (see FIGG Attachment Submission FCA 13.2-1)

Although there was not a specific procedure issued on for the destressing operation, destressing PT bars is a common post-tensioning operation.

At the time of the temporary PT bar destressing operations, the following entities were on site and are listed with their roles/responsibilities: Structural Technologies (VSL) performed the PT bar destressing equipment and operators, George's Crane Service provided the crane and operator, MCM performed construction management, Bolton Perez and Associates performed the CEI oversight with The Corradino Group performing the CEI post-tensioning inspection.

The observations and pictures noted before and after stressing the temporary PT bars in truss members 2 and 11 are discussed in Section 10 of this Factual Report. The destressing of truss members 2 and 11 in accordance with the approved RFC plans, occurred on March 10, 2018, after positioning the truss over SW 8th Street and receiving approval from FIGG field representatives to remove the transporter supports from below. SW 8th Street was reopened to traffic at approximately 6:53 p.m.

13.3. Correspondence following destressing of temporary PT bars

MCM (Rodrigo Isaza) first notified FIGG via email on Monday, March 12, 2018 at 4:51 p.m. of the cracks that had developed at the northern end of the precast main span (see Bridge Factors Attachment 24), in follow up to correspondence discussing preexisting cracks prior to destressing of the temporary PT bars. Sixteen (16) photographs were provided, focusing on the Type II diaphragm except for two (2) photos of the node #11/#12 region. Per FIGG, no phone calls or other correspondence was made to FIGG on March 10-12, 2018 regarding this matter.

On Tuesday, March 13, 2018 at approximately 7:45 a.m., FIGG opened this email and began reviewing. At approximately 9:30 a.m., FIGG (Dwight Dempsey) spoke to Rodrigo Isaza (MCM) over the phone to discuss the timeline of the observed cracking and how they evolved when destressing the PT bars of Member 11. MCM stated that the cracking depicted in the photographs was present before de-tensioning the bars and the cracking got somewhat worse when the bars were de-tensioned.

The following email was sent at 9:45 a.m. that same day by Dwight Dempsey to Rodrigo Isaza that summarized this conversation (see Bridge Factors Attachment 25):

> *"As you and I just discussed, Figg is evaluating this situation as a top priority and will be making recommendations as a result of this evaluation. As of right now, we do not see this as a safety issue, but we do recommend that MCM place plastic shims (same as currently being used) underneath the Type 2 diaphragm at the centerline of bridge (this is a 2'-10.5" x 21" area). The shim stack height should be sized to bear against both the top of lower pylon and the bottom of the type 2 diaphragm. Below is a list of facts and other coordination items from our discussion;*
>
> *1. MCM observed cracks in the Type 2 diaphragm on Saturday afternoon after the SPMT were driven back to the staging area and before the temporary PT bars were destressed. It was noted that Figg Inspection of the main span in this area after the bridge move did not observe this behavior. It is not clear as to when this behavior occurred.*
> *2. MCM has destressed the temporary PT bars in the main span.*
> *3. Since Saturday afternoon, MCM has been monitoring the cracks and they have not grown in size.*
> *4. This behavior is only being observed on the north face of the type 2 diaphragm. It is not seen on the south face. MCM to send Figg pictures of the south face of the Type 2 diaphragm and label pictures.*
> *5. MCM will take pictures of the bottom face of the Type 2 diaphragm from both north face (east and west side), south face (east and west side) and east and west face. These pictures are to show the condition of the bottom face and also show the location of the shim stacks to the diaphragm.*
> *6. MCM is to place plastic shims under the Type 2 diaphragm/vertical strut. This is a 2'-10.5" x 21" area to be shimmed. Shims to be placed tight against the top of lower pylon and bottom of type 2 diaphragm. No jacking of bridge is required. These shims need to be placed right away.*

Figg will be back in contact with MCM to give updates and recommendations from evaluations."

Per FIGG, all discussion was focused on the Type II diaphragm area and no discussion about the node #11/#12 region took place.

At approximately 5:00 p.m. on Tuesday, March 13, 2018, FIGG (Dwight Dempsey) spoke to MCM (Rodrigo Isaza) over the phone to provide an update on the FIGG evaluation. Based on MCM's statement that the cracks at the north end of the precast main span had not grown in size since first observed on Saturday, March 10, 2018 after de-tensioning the temporary PT bars in truss members 2 and 11, and that the cracking had gotten worse when the bars were destressed, FIGG recommended to go back and restress the temporary PT bars in truss member 11 to return to the prior state of the structure when cracking conditions were known by MCM to have been smaller. This conversation was summarized in an email with instructions for restressing.

The following excerpt was taken from the NTSB Interview of Dwight Dempsey (FIGG) on April 10, 2018 that further describes the reasoning for restressing the temporary PT bars in truss member 11.

"CEI and MCM had observed some cracking there at that north end region. And they said that after destressing the bars, it was observed that the cracking had gotten slightly worse after de-tensioning those PT bars."

"But as part of the recommendations coming out of the end of the day Tuesday was to - based on the observations from MCM and CEI that the cracks got a little bit worse when they de-tensioned the PT bars, the direction from the design team was, well, let's go back one step backwards, you know, from the design standpoint and go ahead and reinstall those PT bars on the north side only for truss member 11. Not truss member 2; only truss member 11."

FIGG Bridge Engineers, Inc. confirmed that there was no specific sequence for the order of stressing the post-tensioning bars in the diagonal supports in the casting yard and the destressing of the bars in members 2 and 11 after the move in an email to NTSB investigators dated August 27, 2018. The email indicated the following:[33]

"*A specific sequence for the order of stressing the PT bars within a given member was not provided as no specific order was required. There was no specific order for destressing the temporary PT bars in members 2 and 11, just that they could be destressed after the precast Span 1 was placed on the bearings/supports at end bent 1 and the lower pylon."*[34]

[33]Email from Mr. Alan Phipps of FIGG to Mr. Dan Walsh of NTSB dated August 27, 2018.
[34]No limit was specified on the maximum force that could be applied at the beginning of de-stressing.

14. Restressing post tensioning bars in diagonal support #11 on March 15, 2018

The following paragraphs discuss the sequence, equipment, procedure, and instructions used for restressing the post tensioning bars in diagonal support #11 on March 15, 2018.

14.1. Sequence

The diagonal supports in the main span were prestressed with post tensioning bars ranging in diameter size from 1 ⅜ inches to 2 ½ inches. There were two – 1 ¾ inch diameter post tensioning bars[35] used in diagonal support #11. These bars were used to introduce compressive force into diagonal support #11 when they were stressed to counteract the tensile force resulting from the position of the SPMT vehicles which moved the main span from the adjacent casting yard on March 10, 2018. Once the main span was placed into position on its permanent piers over SW 8th Street, the post tensioning bars in diagonal support #11 and diagonal support #2 were destressed. Subsequently, diagonal support #11 was restressed on March 15, 2018 back to the original stressing force as follows:

1. Stress the top bar to 50,000 lbs. (or 50-kips)[36]
2. Stress the bottom bar to 50,000 lbs.
3. Stress the top bar to 100,000 lbs.
4. Stress the bottom bar to 100,000 lbs.
5. Stress the top bar to 150,000 lbs.
6. Stress the bottom bar to 150,000 lbs.
7. Stress the top bar to 200,000 lbs.
8. Stress the bottom bar to 200,000 lbs.
9. Stress the top bar to 250,000 lbs.
10. Stress the bottom bar to 250,000 lbs.
11. Stress the top bar 280,000 lbs. – Final Force
12. Stress the bottom bar to 280,000 lbs. – Final Force
13. Record the elongation of the bars

The pedestrian bridge collapsed a short time after step 12 was completed but before the jack was removed.

14.2. Equipment

Post tensioning bars are like large threaded rods with nuts and washers (bearing plates) on each end. Because the forces are so large it is not practical to stress post tensioning bars by simply tightening the nuts with a wrench as you would do with smaller threaded rods. For this reason, special hydraulic equipment is used to apply the force necessary to stress post tensioning bars. It consists of:

[35]The two – 1 ¾ inch diameter post tensioning bars were Grade 150.
[36]1,000 lbs. = 1 kip.

- An electric powered hydraulic pump with a 4-way valve to control oil flow.
- A hydraulic pressure gauge which has been calibrated with the stressing ram as a set.
- Hydraulic hoses.
- Stressing ram assembly which includes:
    1. Hollow double acting hydraulic cylinder.
    2. Nosepiece to transfer the force from the stressing ram to the bearing plate.
    3. Integral socket/ratchet assembly to turn the nut as the post tensioning bar is being stressed or destressed.
- Pull rod with coupler to extend the post tensioning bar through the nosepiece and hydraulic cylinder.
- Stressing nut and plate which is threaded onto the pull rod to transfer the force in the bar to the hydraulic cylinder.

Figure 14 illustrates the north end of the main span with the equipment used to restress the post tensioning bars in diagonal support #11.

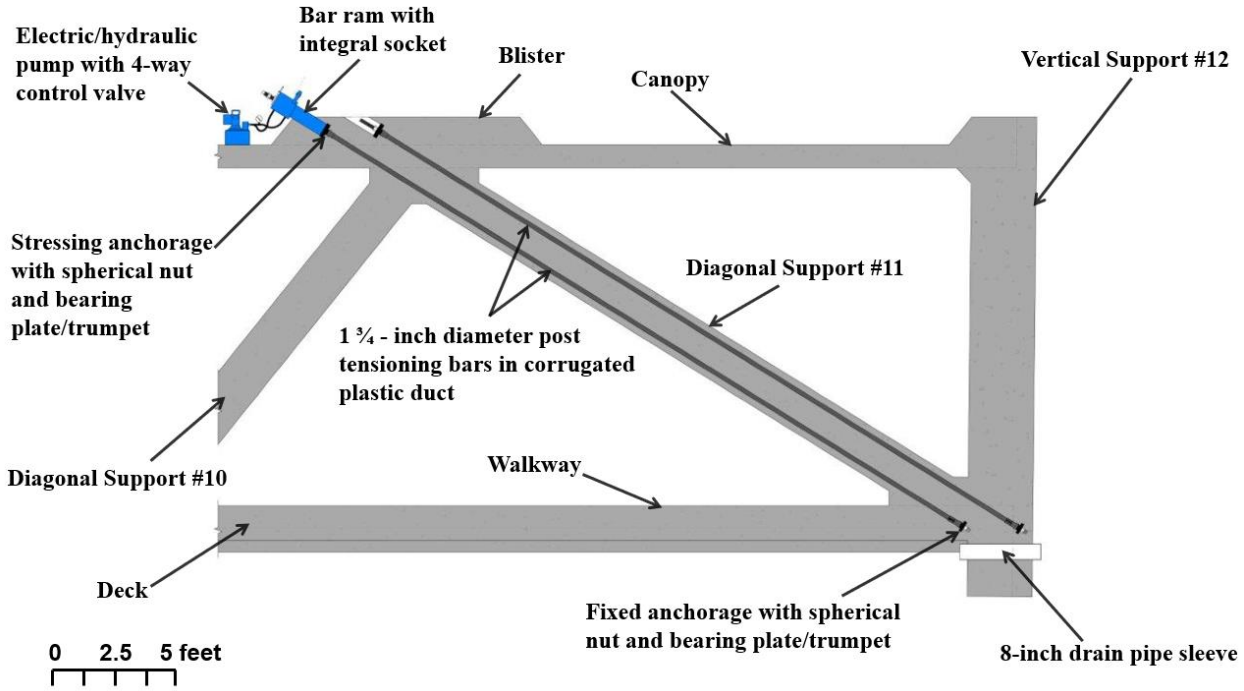


Figure 14 – Map illustrating the north end of the main span with the equipment used to restress the post tensioning bars in diagonal support #11 (Source: Structural Technologies, LLC modified)

14.3. Procedure

The following discusses the procedure for restressing the post tensioning bars. Steps 4 through 12 were performed multiple times (12 times) during the restressing of diagonal support #11 on March 15, 2018 due to the 50-kip force increment required by the engineer of record (EOR). The estimated weight of the bar stressing ram was approximately 325 pounds which required a crane to hoist it and hold it during the restressing procedure. On March 15, 2018, the crane located

on the west side of the pedestrian bridge, was positioned within two of the three westbound lanes closed to traffic.

1. Obtain the required jacking force, provided by the engineer of record (EOR).
2. Convert the required jacking force to gauge pressure using the ram - gauge calibration curve.
3. Confirm that the permanent nut is installed.
4. Thread the pull rod with coupler fully onto the post tensioning bar projection.
5. Slide the stressing ram over the pull rod until it is seated against the bearing plate.
6. Install the stressing plate and stressing nut on the pull rod.
7. Connect the hydraulic pump, hoses and gauge to the stressing ram.
8. Connect the pump to an electric power source.
9. Extend the ram using the pump while monitoring the pressure gauge.
10. As the bar is being stressed keep the nut snug against the plate using the socket/ratchet assembly.
11. Once the required jacking force (gauge pressure) is reached confirm that the nut is snug using the socket ratchet and release the jack by reversing the hydraulic flow.
12. Retract the ram, remove the stressing nut, stressing plate, stressing ram and pull rod.

14.4. Instructions

The instructions for restressing the post tensioning bars in diagonal support #11 on March 15, 2018 were given by Mr. Dwight Dempsey of FIGG to Mr. Rodrigo Isaza of MCM by email dated March 13, 2018. The email indicated the following:[37]

> "*As you and I just discussed, please find the additional recommendations and requests below that FIGG thinks will be beneficial for the structure. Again, we have evaluated this further and confirmed that this is not a safety issue.*
>
> *1. It is recommended to reinstall the (2) 1-3/8" temporary pt bars in truss member 11 as shown on plan sheet B-38. These are oriented with one bar at top and one bar at bottom of the member section. The temporary pt bars in truss member 2 do not need to be reinstalled or restressed.*
>
> *2. Both pt bars should be stressed to the 280 kips stressing force as listed on plan sheet B-69 and these bars should be stressed in 50 kip increments each, starting with the top pt bar, then bottom pt bar, then back to the top pt bar, etc. The type 2 diaphragm should be closely monitored during this pt bar stressing process to ensure that the crack size does not increase. Based on our evaluation, we anticipate that the crack size will either remain the same or more probably decrease in size. If the crack size increases, the pt bar stressing shall stop and FIGG be notified immediately.*

[37]Email from Mr. Dwight Dempsey of FIGG to Mr. Rodrigo Isaza of MCM dated Tuesday, March 13, 2018.

3. We understand that MCM was to contact VSL to see when they could be on site to perform pt bar stressing. FIGG recommends to stress these pt bars as soon as possible but again, this is not a safety concern.

4. We request to receive the concrete break reports from the lab for the bridge deck placement.

5. We understand that MCM is currently placing the shims under the Type 2 diaphragm at the centerline of bridge and will send pictures once complete. MCM will also send pictures of the existing shim stacks to show orientation of shim stack to Type 2 diaphragm."

The restressing of member 11 was not indicated on the approved RFC plans. These instructions were provided by FIGG to MCM via email dated March 13, 2018 and were later discussed at the end of the March 15, 2018 Meeting. At the time of the temporary PT bar restressing operations at truss member 11, the following entities were on site and are listed with their roles/responsibilities. Structural Technologies (VSL) provided the PT bar restressing equipment and operators, George's Crane Service provided the crane and operator, MCM performed construction management and quality control, and Bolton Perez and Associates performed the CEI oversight. The Corradino Group typically performed the CEI post-tensioning inspection but was not present on site during the restressing operations because the CEI had not been told about the restressing activity until shortly before concluding the meeting on the morning of March 15, 2018. Furthermore, all scheduled post-tensioning operations had been completed by March 10, 2018 and there was no need to have the post-tension inspector present on the job site. Although requested several times during the March 15, 2018 meeting, the CEI had not been provided with the restressing instructions from FIGG and was not aware of the request to monitor the north face of the Type II diaphragm. Jose Morales with BPA was on the bridge deck observing the behavior of the cracks in member 11/12 during the restressing of the bar tendons in member 11.

Bolton Perez & Associates (BPA), who performed the construction engineering and inspection (CEI) services for the project, indicated to NTSB investigators by email dated August 7, 2018 additional information regarding the stressing and destressing of the post tensioning bars in the diagonal supports. The email indicated the following:[38]

"*As shown on the contract plans, the vertical and diagonal members consist of one, two, or four bar-tendons each, depending on the member design.*

Members 2 and 11 consist of two bar-tendons each and are designated as A and B on the plans. There is no post-tensioning sequence for stressing each of the bar-tendons in each member. From our stressing records, it is not apparent which of the two bar-tendons were stressed first, only the date of stressing is shown. For Member 11, bar-tendons A and B were both stressed on 1/29/2018 and for Member 2, bar-tendons A and B were stressed on 1/30/2018. All bar-tendons in all members were each <u>stressed in a single step up to 280K</u>.

[38]Email from Mr. Joaquin (Jake) Perez of BPA to Mr. Dan Walsh of NTSB dated August 7, 2018.

Similarly, there is no sequence for de-stressing of the bar-tendons A and B in Members 2 and 11 after erection of the truss. The de-stressing or removal of the post-tensioning force occurred in one step for each of the bar-tendons and there is no record of which one of the bar tendons was de-stressed first or last.[39]

The re-stressing of bar-tendons A and B in Member 11 after erection was verbally communicated by the EOR during the meeting on the morning of March 15, 2018. We assume that the EOR and the contractor had exchanged information regarding the re-stressing operations before the meeting since we now know this work was being set up during the same time the meeting was taking place. The work was part of the Design/Build Team's remedial plan for correcting the cracking occurring at the joint between Members 11 and 12. In addition to the re-stressing work in Member 11, other aspects of the remedial plan was discussed by the EOR during the meeting, including adding additional longitudinal post-tensioning along the bottom of the truss, as well as, attaching steel stiffening elements along the top of the truss. This remedial work was not included in the contract plans and it was requested during the meeting that this remedial work be reviewed and approved for implementation, including peer reviewed, prior to performing the work.

During the meeting we were informed for the first time that preparations for re-stressing of bar-tendons A and B in Member 11 were on-going and that the work would be taking place immediately. Although we requested a written plan for the work, we were only told verbally that the re-stressing would take place incrementally. Each bar-tendon in member 11 would be stressed in 50K increments each, alternating between bar-tendon A and B, until the full 280K force was applied to each bar-tendon. Given that at this time Alex Molina (with The Corradino Group)*, our post-tensioning inspector was not on site, and that we had just been informed of the post-tensioning operations taking place immediately after the meeting, we dispatched Carlos Chapman* (with Bolton-Perez & Associates) *to <u>only observe</u> the re-stressing operations on the canopy and report the activities. Jose Morales* (with Bolton-Perez & Associates) *went on the bridge deck to observe the behavior of the cracks in Member 11 during the re-stress of the bar-tendons and did not observe any increase in length or size of the cracks in Member 11."*

FIGG Bridge Engineers, Inc. confirmed that there was no specific sequence for the order of stressing the post-tensioning bars in the diagonal supports in the casting yard and the destressing of the bars in members 2 and 11 after the move in an email to NTSB investigators dated August 27, 2018. The email indicated the following:[40]

"*A specific sequence for the order of stressing the PT bars within a given member was not provided as no specific order was required. There was no specific order for destressing the temporary PT bars in members 2 and 11, just that they could be*

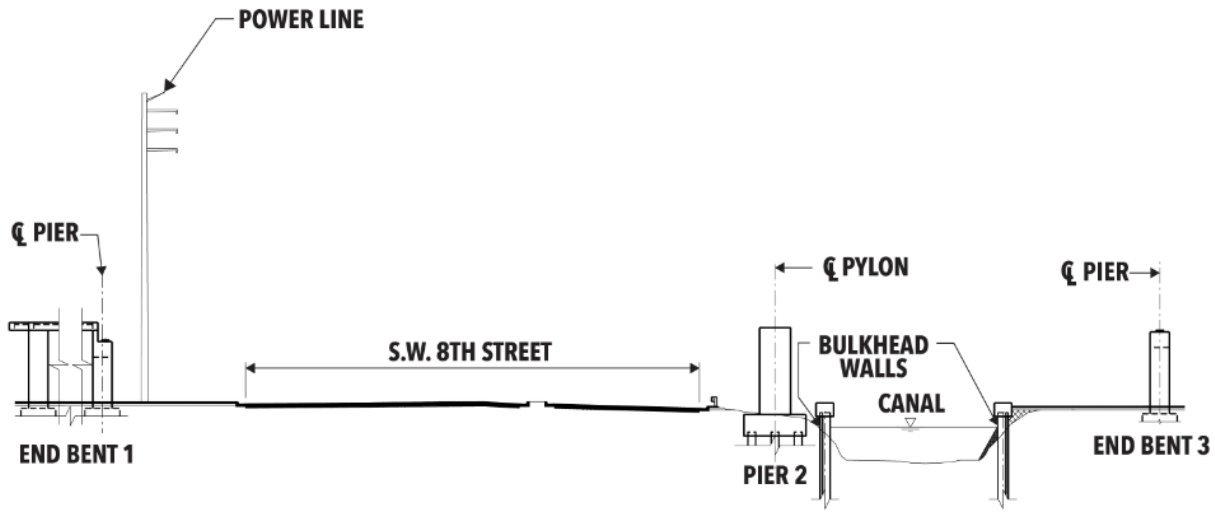
[39]There is no record of the maximum force applied during the de-stressing operation to free the contacting surfaces. Photos taken before and after de-stressing indicate that new cracks opened and spalling occurred only after de-stressing.

[40]Email from Mr. Alan Phipps of FIGG to Mr. Dan Walsh of NTSB dated August 27, 2018.

destressed after the precast Span 1 was placed on the bearings/supports at end bent 1 and the lower pylon."[41]

15. Construction Sequence for the Signature Pedestrian Bridge

The construction sequence for the signature pedestrian bridge consisted of 8 stages. The collapse occurred in the middle of Stage 3 – *Erection of Mainspan*. The following provides a graphic depiction and the sequences for each stage:

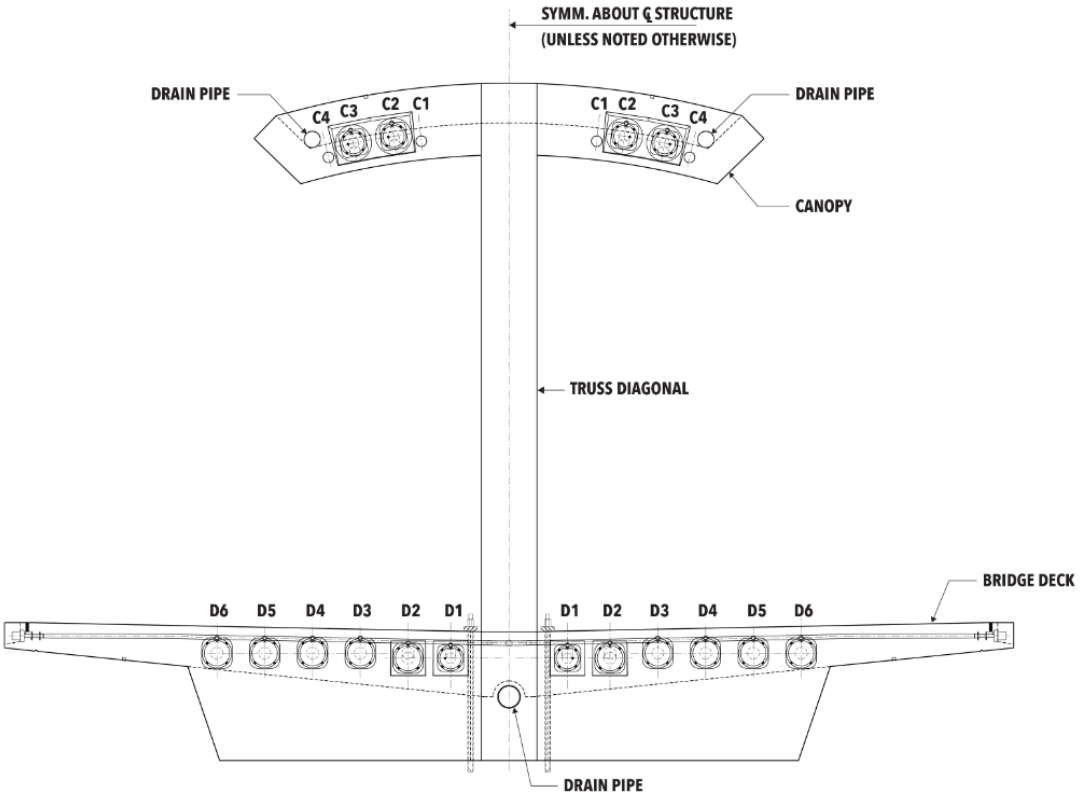


STAGE 1 – SUBSTRUCTURE CASTING

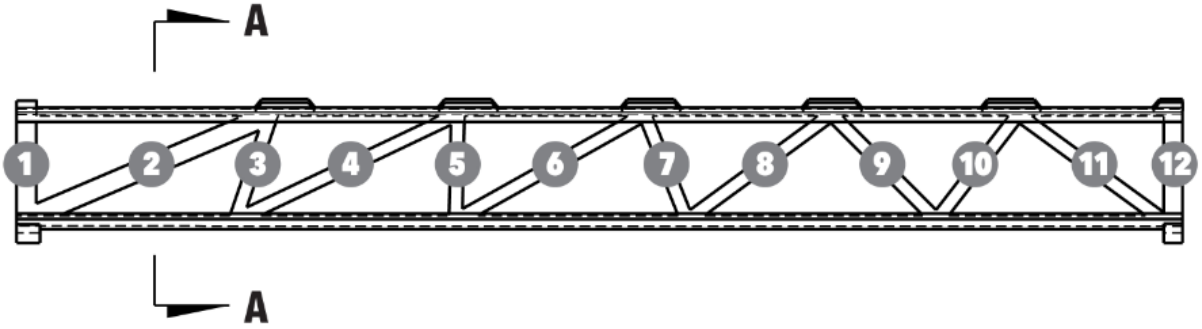
Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Build Pier 1 and Pier 3 footings at the south and north landings.
2. Build pylon footing and base of pylon.
3. Cast the end bents for both landings.

[41]No limit was specified on the maximum force that could be applied at the beginning of de-stressing.



SECTION A-A



MAINSPAN

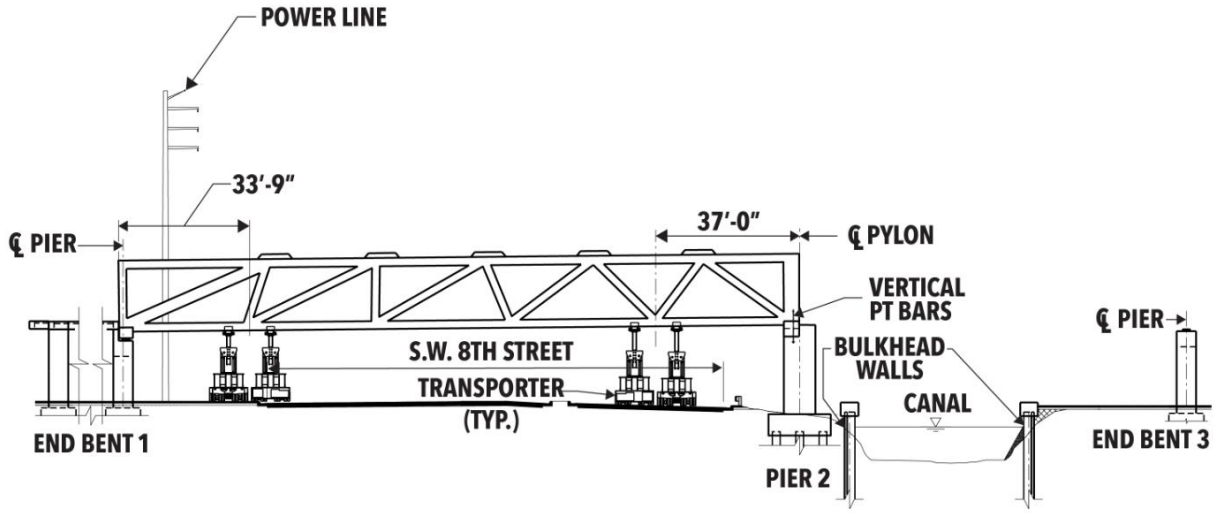
STAGE 2 – SUPERSTRUCTURE PRE-CASTING

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Cast main span superstructure as follows:
   A) Cast deck and diaphragms.
   B) Cast diagonal and vertical members.
      Install PT bars as shown in Sheet B-38.
   C) Cast canopy and top anchor blocks.
2. After concrete compressive strength has reached 6,000 psi, stress post-tensioning of the main span in the following sequence:
   I. Stress deck longitudinal tendons D1.

II. Stress canopy longitudinal tendons C2.
III. Stress PT bars in diagonal members 2 and 11.
IV. Stress deck longitudinal tendons in the following sequence: D2, D3, D4, D5 & D6.
V. Stress bottom slab transverse post-tensioning. Alternated end stressing is required for the transverse tendons.
VI. Stress PT bars in diagonal members 3 and 10.
VII. Stress PT bars in diagonal members 5 and 8.
VIII. Stress PT bars in diagonal members 6 and 7.
IX. Stress canopy longitudinal tendons C3.

3. Temporary supports of main span section shall stay in the middle of the cross section during SPMT transport.



STAGE 3 – ERECTION OF MAINSPAN

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Install bearing pads at Pier 1 and shim plate at the pylon base.
2. Move main span from the staging area to final position.

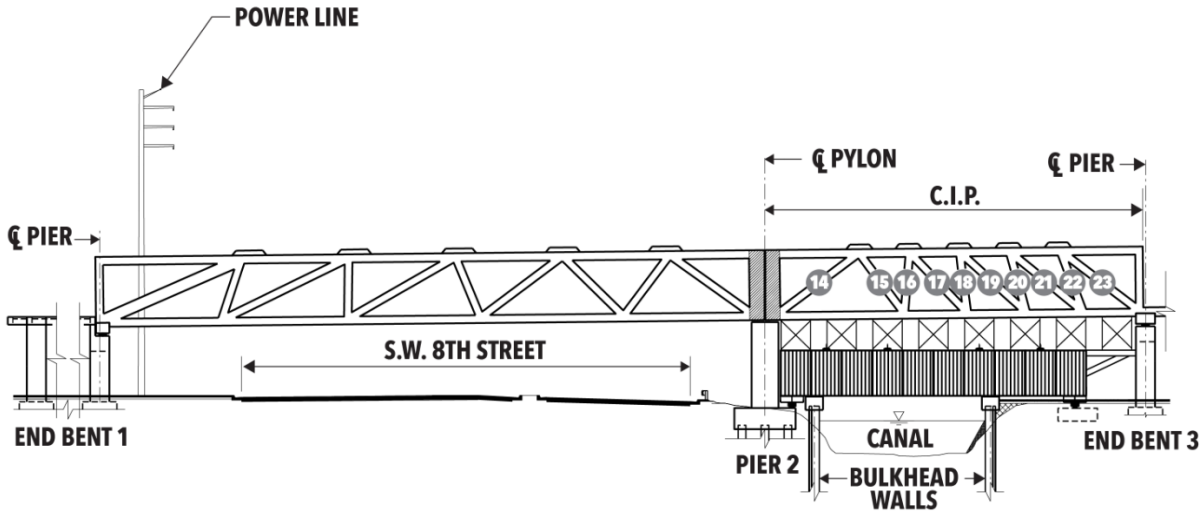
Note on Sheet B-38: PT bars in members 2 and 11 will not be grouted and will be destressed after main span construction is complete. Do not remove bars.

(No note appears on plans to restress PT bars in member 11. Collapse of signature pedestrian bridge occurred in the middle of Stage 3 – *Erection of Mainspan* between Sequence #2 and #3.)

Prior to destressing the PT bars in Member 11, the cracking of Member 11 and of the North End Diaphragm had been observed and noted by MCM and BPA representatives. In addition, two FIGG representatives had been on site assisting with the movement and erection of the span over SW 8th Street and were able to observe the cracks as well.

These cracks had been noted and documented in two previous reports issued by BPA and transmitted to FIGG via MCM. FIGG's evaluation of the cracking indicated no structural concern. Prior to providing the 3rd report informing FIGG of the progression of the previous cracking, MCM and VSL, with a BPA representative observing, proceeded with destressing the PT bars in Member 11 as indicated in the approved RFC plans. Subsequently, MCM representatives reported to FIGG (two days after observations on March 12, 2018 via email and again on the following day via phone call between MCM and FIGG) that the previously noted cracking had worsened when the PT bars were destressed.

3. Grout space between precast section diaphragm and pylon base.
4. Stress pylon vertical PT bars.



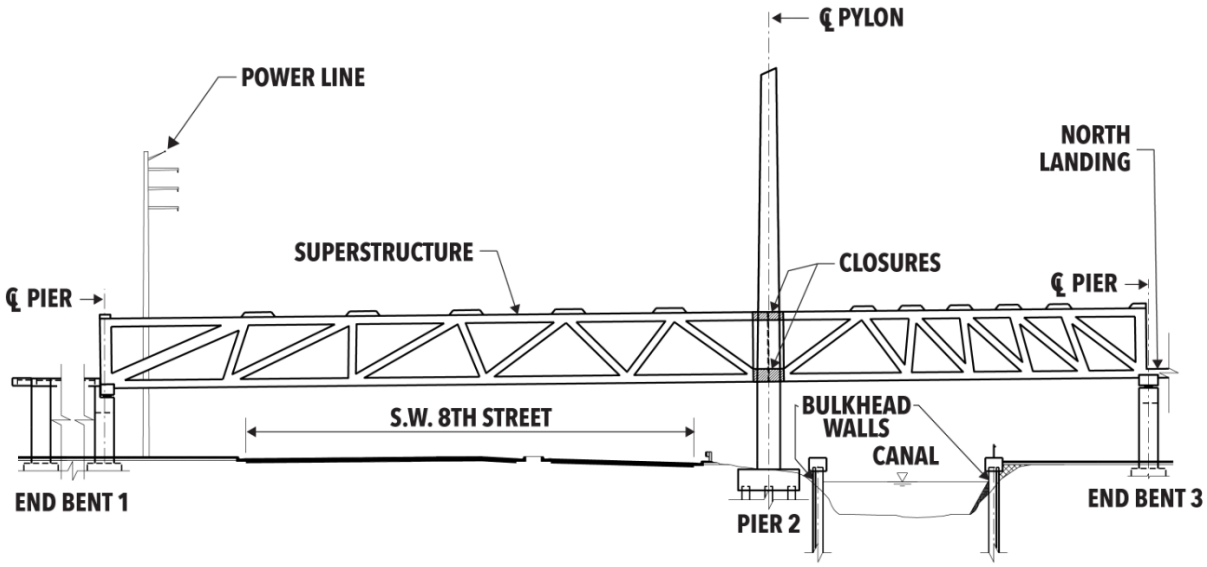
STAGE 4 – CASTING OF BACK SPAN

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Erect temporary beam and falsework.
2. Install bearing pads at end bent 3.
3. Cast intermediate section of the pylon.
4. Cast deck, diagonal member, vertical members, canopy and top anchor blocks.
5. After concrete compressive strength has reached 6,000 psi, stress post-tensioning of the back span in the following sequence:
    I. Stress deck longitudinal tendons D7.
    II. Stress canopy longitudinal tendons C5.
    III. Stress PT bars in diagonal members 15 and 23.
    IV. Stress PT bars in diagonal members 16 and 22.
    V. Stress PT bars in diagonal members 17 and 21.
    VI. Stress PT bars in diagonal members 18 and 20.
    VII. Stress PT bars in diagonal member 19.

VIII. Stress deck longitudinal tendons D8 and D9.

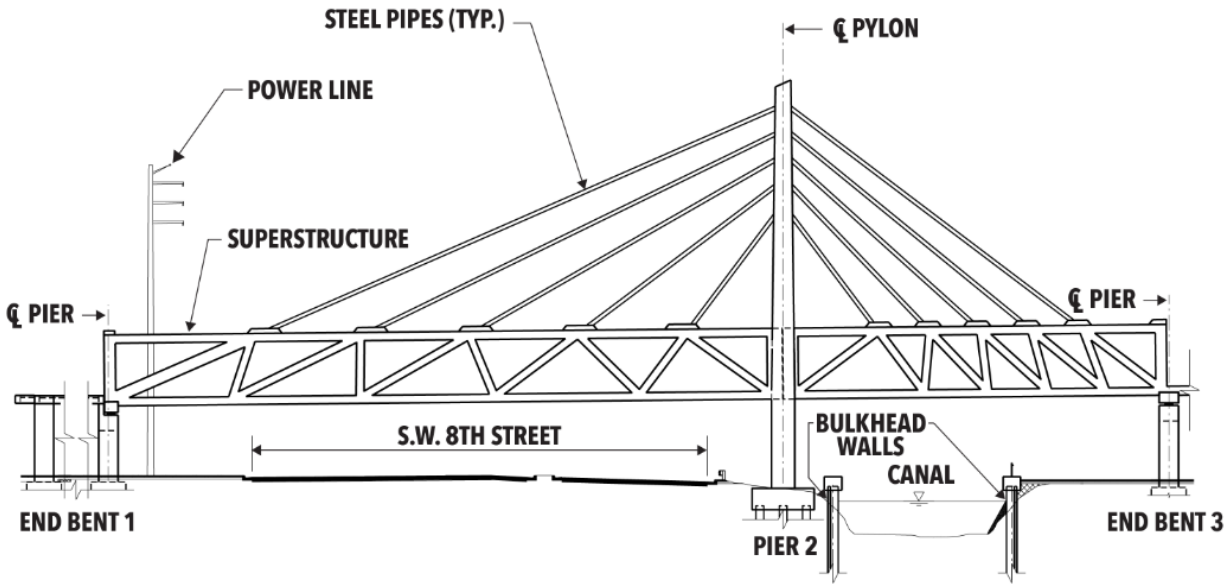
IX. Stress bottom slab transverse post-tensioning. Alternated end stressing is required for the transverse tendons.



STAGE 5 – CONTINUITY TENDONS AND CASTING OF UPPER PYLON

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

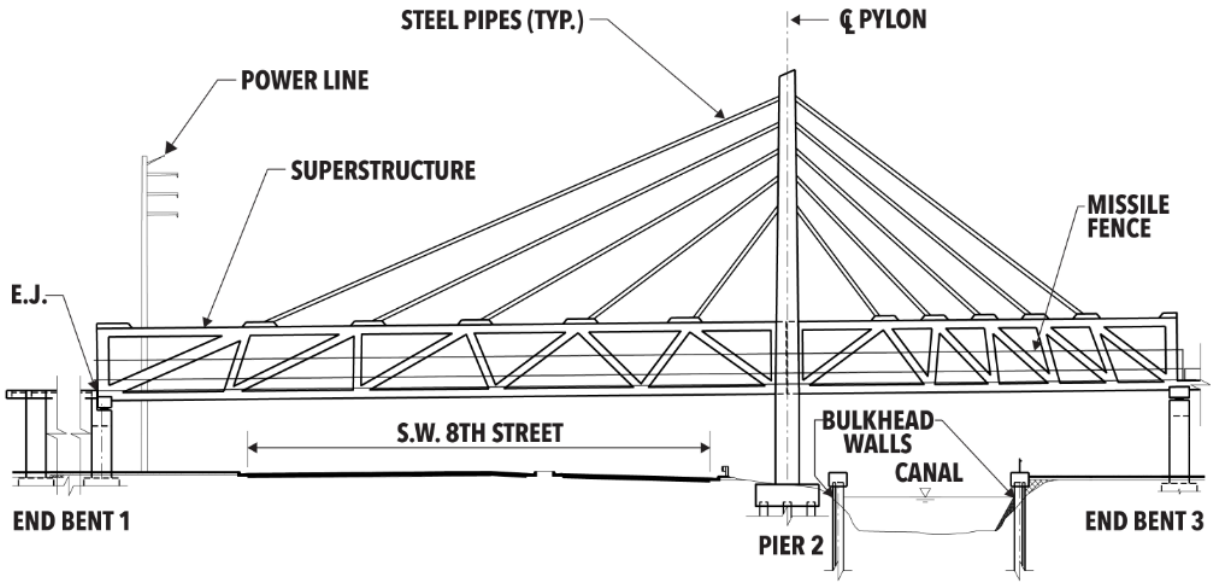
1. Install continuity tendons C1 and C4.
2. Cast closure pours in the deck and canopy.
3. After closure pours concrete compressive strength has reached 6,000 psi, stress continuity tendons C1 and C4.
4. Remove falsework over the canal.
5. Stress transverse tendon in the closure of the deck.
6. Cast upper pylon section and north landing deck.
7. Stress transverse tendons of the north landing.



STAGE 6 – INSTALL PIPE SUPPORT SYSTEM

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

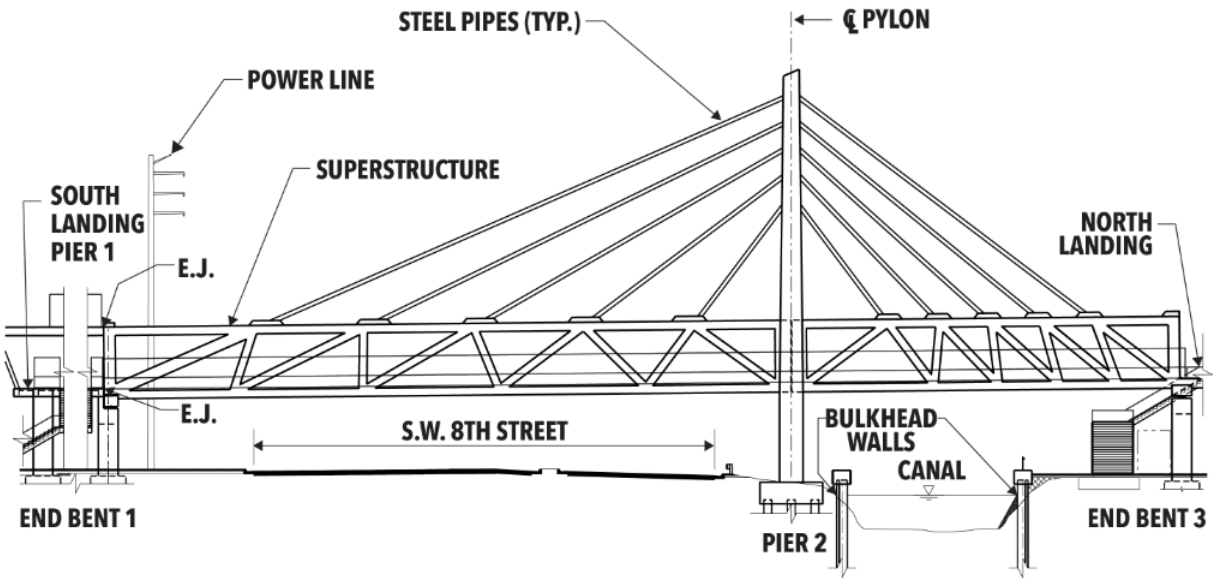
1. Connect steel pipes to the superstructure and upper pylon. Connect pipes adjacent to the pylon first.
2. Cast fence concrete curbs on both spans.



STAGE 7 – INSTALLATION OF BRIDGE COMPONENTS

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Install missile fence.
2. Install expansion joints at end bent 1 and north landing.
3. Install bridge lighting and drainage system.



STAGE 8 – INSTALLATION OF LANDINGS

Looking to the west (Source: FIGG Bridge Engineers, Inc. modified)

1. Build elevator structures and install elevator systems at both landings.
2. Construct stairways.
3. Install expansion joint at south landing canopy.

15.1. Percent Project Complete, Schedule, and Cost Overruns

As stated earlier, the collapse of the signature pedestrian bridge occurred in the middle of Stage 3 – *Erection of Mainspan* between Sequence #2 and #3. At the time of the collapse, the bridge was approximately 63% completed. The project was on-track to be completed and coincide with the revised close out end date of February 15, 2019 as stipulated in the Local Agency Program (LAP) Amendment Extension Request. There were no cost overruns on the project.

16. Move of Main Span by Barnhart Crane and Rigging on March 10, 2018

Accelerated Bridge Construction (ABC) is a broad term that refers to the method of bridge construction that focuses on minimizing impacts to traffic during construction. The primary objective of ABC is to minimize the duration of construction related traffic delays to the motoring public. A large portion of the construction activities associated with building the bridge span is typically done in a staging area within close proximity of the permanent bridge location. By constructing the bridge span at an offsite location, the underlying roadway remains open to traffic throughout this phase of work.

Not all bridge construction projects are conducive for this method of construction. Location, traffic volumes, bridge size/shape/composition, site constraints, and environmental conditions all must be evaluated when determining the appropriate construction method. Projects that are good candidates for ABC typically have the following characteristics: high traffic volumes, site has a sufficient area to pre-build the bridge span, bridge span is capable of being supported in a condition that is different from its permanent support condition, and there is access to an efficient detour route.

Barnhart Crane and Rigging, who performed the move of the main span on March 10, 2018 indicated the following in an email to NTSB investigators dated August 20, 2018:[42]

> "*The system utilized to transport the 950 Ton bridge consisted of two SPMTs[43] that were positioned at locations that were specified by FIGG, in a memorandum from Dwight Dempsey dated July 25, 2017, based on their structural evaluation of the bridge for the temporary support condition during transport. Located symmetrically about the longitudinal and transverse centerlines of each SPMT were four shoring stands (eight total), each stand supported a hydraulic jack assembly. The hydraulic jack assemblies were positioned symmetrically about the longitudinal centerline of the bridge, resulting in four pairs of hydraulic jack assemblies located at discrete locations along the length of the bridge. Each pair of hydraulic jack assemblies supported a beam, positioned transversely to the bridge span. Two wedge shaped hardwood mats (the angle of the wedge matched the angle of the tapered bottom flange of the bridge) were installed on top of each beam, symmetrically about the longitudinal centerline of the bridge. Two truss assemblies were installed at both ends of the SPMTs to connect them together to assure the two SPMTs maintained the proper spacing throughout the travel path. Figure* 15 *shows the transport system during the movement of the bridge on March 10, 2018. Transportation of the bridge began at approximately 4:30 am on March 10, 2018. Final placement of the bridge on the permanent supports concluded eight hours later at approximately 12:30 pm.*

[42]Email from Mr. John Engberg of Barnhart Crane and Rigging to Mr. Dan Walsh of NTSB dated August 20, 2018 and revised per Party Member Technical Review on December 11, 2018.

[43]A self-propelled modular transporter (SPMT) is a platform vehicle with a large array of wheels. SPMT's are used for transporting massive objects such as large bridge sections, oil refining equipment, motors and other objects that are too big or heavy for trucks.

Figure 15 – *Main span during move (Source: Barnhart Crane and Rigging)*

Jacking operations were performed utilizing two pumps and operators, one for each SPMT. Raising and lowering of the bridge was done by extending or retracting all eight hydraulic jack assemblies simultaneously. Loads to each jacking assembly were equalized through valves in the hydraulic control system.

Transportation operations were performed utilizing two operators. One operator controlled the steering and forward/reverse functions for the entire system, as well as leveling of the hydraulic suspension on the North SPMT. The second operator only controlled leveling of the hydraulic suspension for the South SPMT. Steel mats were placed in the gravel staging area, as well as adjacent to the curb and median where the SPMTs would travel over them. These mats were installed to provide a solid surface for the tires in the staging area to ensure adequate traction during transport, additionally they provided a means for the tires to smoothly transition over the curb and median along the travel path. Securement chains were installed, connecting the shoring system to the deck of the SPMTs, to resist forces due to motion associated with acceleration/deceleration of the system while it was moving.

Monitoring system criteria was specified by FIGG, in a memorandum from Dwight Dempsey dated January 5, 2018. The bridge was sensitive to forces due to torsion (i.e. twisting of the bridge about its longitudinal axis). The only limiting criteria specified, during the bridge move and final set, was the amount of twist applied to the bridge over the 95'-0" span located between the SPMTs. FIGG had initially established an allowable tolerance of ±0.17 degrees for the twist angle. Barnhart informed MCM/FIGG that the transport system could not accommodate a twist angle of less than 0.5 degrees. Subsequently, FIGG performed further analysis of the bridge, and revised the allowable twist angle tolerance to ±0.5 degrees. Therefore, a system was developed to monitor transverse rotation at three cross-sections; center of the two lift points (i.e. SPMTs) and at midspan. Twist was computed as the difference in rotation angle between the two lift point cross-sections. This data was calculated and displayed in real-time by the monitoring system so that corrective actions could be taken if the specified twist tolerance was approached. Strain measurements, at locations specified by FIGG, were recorded

for the duration of the bridge move. These values were not examined in real-time as there were no defined limits or stop criteria.

During the move, the ±0.5-degree tolerance was exceeded in two instances. This was a function of the rate at which twist was occurring, the time to make an "all stop" decision, and the time to execute the command. The first time the twist limit exceeded the specified tolerance, the peak static twist value was approximately 0.65 degrees.

The second and largest bridge twist exceedance occurred during the final alignment process just prior to the bridge being placed on the piers. A peak twist angle of 0.75 degrees occurred for approximately 4 minutes as the bridge came in contact with one of the bearing pads on the south pier. During this time the recorded strain changed by approximately 200 microstrain (με) at the top of member 12, and by approximately 30 microstrain at the bottom of member 12. For comparison, the change in strain in the same locations on member 12 were approximately 200-800 με according to Barnhart (at top) and 20-25 με according to Barnhart (at bottom) during the lift and set evolutions, respectively.[44] *Strains in member 11 and node 11-12 were not measured. During the bridge alignment process, the procedure was to align the south end of the bridge with the bearings and then set the north end. As the bridge was being aligned the bridge came in contact with the southwest bearing. This induced twist since only one bearing came in contact; the bridge was not yet oriented perfectly with the pier. As the bridge was lowered the induction of a new support condition at the southwest bearing caused the twist value to change quickly. An "All Stop" call was made, BCR immediately stopped movement and immediately adjusted the rotation to bring the twist back within specification. The correction was completed over approximately 10 minutes. At the end of this adjustment the bridge was no longer in contact with the bearing pads. During both occurrences, the north end of the bridge was floating and had not yet made contact with the pier support.*

Global deformation measurements in the form of span deflection and flexural rotation were performed at the time of the lift and for the final placement. All global deformations such as rotation, twist, and deflection indicated the condition of the span after the move was nearly identical to its initial state."

17. Design-Build Projects

Design-Build is a project delivery system used in the construction industry. It is a method to deliver a project in which the design and construction services are contracted by a single entity known as the Design-Builder or Design-Build contractor. The Design-Build relies on a single

[44]MCM's interpretation of the change in strain in the same locations on member 12 were approximately 500-1,000 με (at top) and 40-120 με (at bottom) during the lift and set evolutions, respectively.

point of responsibility contract and is used to minimize risks for the project owner and to reduce the delivery schedule by overlapping the design phase and construction phase of a project.

The traditional approach for construction projects consists of the appointment of a designer on one side, and the appointment of a contractor on the other side. The Design-Build procurement route changes the traditional sequence of work. It answers the client's wishes for a single point of responsibility in an attempt to reduce risks and overall costs. It is now commonly used in many countries, and the forms of contracts are widely available.

FDOT provided NTSB investigators with a comparison of LAP projects (local agencies use of Federal-Aid funds provided through FDOT), FDOT Design-Build Projects, and FDOT Conventional Design Bid Build (DBB) Projects for the last 5 years. The Conventional Design Bid Build Project consists of FDOT designing the project and assuming the risk associated with the design. Following the design, a bid/procurement occurs and finally an award to build the project. Hence, the words Design Bid Build that equates to the acronym DBB. **Table 5** summarizes the comparison of FDOT projects versus LAP projects for the last 5 years.

Table 5 – Comparison of FDOT projects versus LAP projects for the last 5 years

LAP Projects	FDOT Design-Build Projects	FDOT Conventional DBB Projects	Total
493 Projects (21.4%)	134 Projects (5.8%)	1,677 Projects (72.8%)	2,304 Projects (100%)
$705 Million (4.6%)	$6.1 Billion (39.9%)	$8.5 Billion (55.5%)	$15.3 Billion (100%)

Table 6 summarizes the FDOT LAP projects for the last 5 years.

Table 6 – FDOT LAP projects for the last 5 years

Non-Bridge LAP Projects	LAP Bridge Projects	Pedestrian LAP Bridge Projects	Total
483 Projects (98.0%)	7 Projects (1.4%)	3 Projects (0.6%)	493 Projects (100%)
$629 Million (89.2%)	$75 Million (10.6%)	$1 Million (0.2%)	$705 Million (100%)

The 3 Pedestrian LAP Bridge Projects listed in **Table 6** included the following:

- Canal Point Pedestrian Bridge over the L-10 Canal, Palm Beach County.
- SR 5 / Overseas Highway Pedestrian Bridge over Marvin D Adams Waterway, Monroe County.
- FIU University City Prosperity Project along SW 109th Avenue & SR 90 / SW 8th Street, Miami-Dade County.

18. Procedures for preparing a LAP Project

Chapters 19 and 20 of the LAP Manual provides information on the design criteria, standards, and specifications for preparing a LAP project.

18.1. LAP Manual, Chapter 19 – Preconstruction Engineering Procedures

Chapter 19 entitled *Preconstruction Engineering Procedures* provided the following information:[45]

"***19.4 ROADWAY AND STRUCTURES DESIGN***

19.4.1 Design criteria are established for transportation projects to ensure that they provide safe, economical, and fully-functional transportation facilities. For situations where specific design standards or criteria cannot be found in the FDOT publications, current approved technical publications, such as "A Policy on Geometric Design of Highways and Streets, American Association of State Highway and Transportation Officials," should be used as design guidelines. Local agencies must ensure that project designs meet or exceed the referenced design criteria and that the standards developed from acceptable guidelines are appropriate for the proposed facility.

19.4.2 Minimum criteria are avoided for the design of new construction or major reconstruction projects. Projects to preserve or extend the service life of a facility, such as Resurfacing, Restoration and Rehabilitation (RRR) projects may have some minimum standard elements left in place. However, all reconstructed elements should meet new construction standards, if practical. With District approval, local streets and highways (not on the State Highway System) may be designed according to the standards published in the ***Manual of Uniform Minimum Standards for Design, Construction and Maintenance for Streets and Highways****, commonly known as the* ***Florida Green Book (625-000-015)****. This manual should not be used for design of State Highway projects.*
http://www.dot.state.fl.us/rddesign/FloridaGreenbook/FGB.shtm

19.4.3 The Department and good engineering practice support the use of the highest level of criteria and standards that is practical for all facilities. Local agencies should determine and document which standards apply when preparing the project prospectus and application for federal funds. There are many local, state, and federal laws, rules, and executive orders that may impact the design of a project. These are referenced in the publications, when the Department is aware of them.

[45]Florida Department of Transportation Local Agency Program (LAP) Manual, Chapter 19 – Preliminary Engineering and Design, January 2007, Revised: March 28, 2008, pages 19-2 through 19-5. The 2008 LAP Manual, Chapter 19, remained in effect through 2014, with the exception of a minor change to Chapter 19.5.5 in 2009 which is noted in the chapter.

19.4.4 The following publications establish the criteria for the critical areas of Roadway and Bridge/Structure designs:

A. ***Roadway Plans Preparation Manual, Volume I - English (Topic No. 625-000-007) and Volume II - English (Topic No. 625-000-008)***. *Volume I contains criteria for new construction, reconstruction and RRR projects. Volume II provides guidance in plans, preparation, and assembly for these type projects. http://www.dot.state.fl.us/rddesign/PPMManual/PPM.htm*

P. *FDOT Standard Specifications for Road and Bridge Construction (with supplemental specifications). http://www.dot.state.fl.us/Specificationsoffice/2007BK/TOC.htm*

Q. *FDOT Structures Design Manual (625-020-018). http://www.dot.state.fl.us/Structures/StructuresManual/CurrentRelease/StructuresManual.htm*

S. *AASHTO LRFD Bridge Design Specifications (mandatory beginning 2007) (AASHTO Bookstore '4-LRFDUS-4')."*

18.2. Specific Information taken from Chapter 19 – Preconstruction Engineering Procedures related to the Signature Pedestrian Bridge

The minimum design criteria, standards, and construction specifications for the signature pedestrian bridge would be the following:

- The minimum design criteria and standards for the signature pedestrian bridge would be contained in the *FDOT Roadway Plans Preparation Manual, FDOT Structures Design Manual, and AASHTO LRFD Bridge Design Specifications*.
- The construction specifications for the signature pedestrian bridge would be contained in the *FDOT Standard Specifications for Road and Bridge Construction*.

18.3. LAP Manual, Chapter 20 – Plans, Specifications and Estimates

Chapter 20 entitled *Plans, Specifications and Estimates* provided the following information:[46]

"***20.1 GENERAL***

20.1.1 The final engineering design process produces contract plans, specifications, and cost estimates (PS&E). These documents contain all the construction details, contract provisions, permits, agreements, and certifications required to advertise, award, and administer a construction contract.

[46]Florida Department of Transportation Local Agency Program (LAP) Manual, Chapter 20 – Plans, Specifications and Estimates, January 2007, Revised: March 28, 2008, pages 20-1 through 20-2. The 2008 LAP Manual, Chapter 20, remained in effect through 2014.

20.1.2 The Local Agency and the District are responsible for the completeness of the contract plans package and the Contract File Index of documentation.

20.3 SPECIFICATIONS

20.3.2 The specifications part of the PS&E include all directions, provisions, and requirements contained in the specification book, together with all stipulations contained in the plans or in the contract documents. These stipulations set out or relate to the method and manner of performing the work, or to the quantities and qualities of materials and labor to be supplied under the contract.

20.3.3 The FDOT Standard Specifications should be used on all federal funded projects as much as possible. Project specific Special Provisions may be required:

A. For the control of work, measurement, payment, and materials of features on a project not covered by the Standard Specifications or other general contract provisions.

B. Where the FDOT Specifications are being amended or for a deviation from FDOT Specifications with regard to materials, construction details, measurement, and payment."

18.4. Specific Information taken from Chapter 20 – Plans, Specifications and Estimates related to the Signature Pedestrian Bridge

The construction specifications for the bridge project would require use of the *FDOT Standard Specifications for Road & Bridge Construction*. As discussed earlier in the Bridge Factors Factual Report under Section 6.2, General Specifications for the Design-Build Contract, a modification was made that replaced Division I – *General Requirements and Covenants*, of the *FDOT Standard Specifications for Road & Bridge Construction*. However, Division II – *Construction Details* and Division III – *Materials* of the *FDOT Standard Specifications for Road & Bridge Construction* remained in effect and were incorporated by reference and made a part of the General Specifications for the Design-Build Contract for the signature pedestrian bridge.

19. FDOT Plans Preparation Manual (PPM)

As discussed earlier in the Bridge Factors Factual Report under Section 18.2, the minimum design criteria and standards for the bridge would be contained in the *FDOT Plans Preparation Manual*. The following information was taken from the *FDOT Plans Preparation Manual* pertaining to the signature pedestrian bridge:[47]

"***26.1 General***

[47]Florida Department of Transportation Plans Preparation Manual (PPM), Volume 1, Chapter 26 – Bridge Project Development, January 1, 2014, pages 26-1 through 26-61.

All structural designs for new construction for the Florida Department of Transportation (FDOT) are developed under the direction of the Structures Design Office (SDO) and/or the District Structures Design Offices (DSDO).

Modification for Non-Conventional Projects:
Delete the above paragraph.

All designs are to be developed in accordance with the ***Structures Manual (Topic No. 625-020-018)*** *(which includes the* ***Structures Design Guidelines****, the* ***Structures Detailing Manual****), this Manual, the* ***Design Standards (Topic No. 625-010-003)****, and the* ***AASHTO Standard Specifications for Highway Bridges*** *or the* ***AASHTO-LRFD Bridge Design Specifications*** *as referenced in the Structures Manual, applicable FHWA Directives, and other criteria as specified by the Department.*

26.2 Organization

The Structures Design Office (SDO) is a subdivision of the Office of Design under the direction of the Chief Engineer and the Assistant Secretary for Engineering and Operations. The SDO is under the direction of the State Structures Design Engineer (SSDE). Each District, including the Turnpike, has a staff of structural design engineers that comprise the District Structures Design Office (DSDO), and which is under the direction of the District Structures Design Engineer (DSDE).

26.3 Definitions

All structures have been grouped into the following two categories based upon design difficulty and complexity:

26.3.1 Category 1 Structures

Category 1 Structures consist of box or three-sided culverts, short span bridges (continuous reinforced slabs and prestressed slabs), simple span non-post tensioned concrete girder bridges, continuous straight steel plate girder bridges with spans less than 170 feet, bridge widenings for these structure types, retaining walls, roadway signing, signalization and lighting supports, noise barriers, and overhead sign structures.

Pedestrian bridges consisting of steel bridge truss spans utilizing proprietary designs shall be classified as Category 1 Structures.

26.3.2 Category 2 Structures

A structure will be classified as a Category 2 Structure when any of the following are present: steel box girders, curved steel plate girders, continuous straight steel

plate girder bridges with spans greater than or equal to 170 feet, cast-in-place concrete box girder bridges, concrete segmental bridges, continuous and simple span post-tensioned concrete bridges with or without pretensioning, steel truss highway bridges, cable stayed bridges, movable bridges, depressed roadways, tunnels, non-redundant foundations, substructures containing post-tensioned components, straddle piers, integral caps, bridges designed for vessel collision, components designed using Fiber Reinforced Polymer (FRP) composite materials, or any design concepts, components, details or construction techniques with a history of less than five (5) years of use in Florida.

Pedestrian bridges consisting of steel bridge truss spans requiring custom nonproprietary designs shall be classified as Category 2 Structures. Cable stayed pedestrian bridge shall be classified as Category 2 Structures.

26.5 Responsibility

The District Structures Design Office has total project development and review responsibility for projects involving Category 1 Structures. The Structures Design Office has total project development and review responsibility for projects involving Category 2 Structures. This responsibility for Category 2 Structures extends to widening and rehabilitation projects and repairs of bridge components that qualify the structure as a Category 2 Structure. For large projects with multiple bridges, review responsibilities will be coordinated between the District Structures Design Office and the Structures Design Office based on the category of the individual bridge, work load demands and project make-up. Where the majority of the structures on a large multi-bridge project are Category 2, the Structures Design Office will have total project development and review responsibility for the entire project; where the majority of the structures are Category 1, the Structures Design Office will have project development and review responsibility for the Category 2 bridges only, and the District Structures Design Office will have project development and review responsibility for the Category 1 bridges.

The District Project Manager shall coordinate with the District Structures Design Engineer who shall review and concur with the bridge aspect of all projects during the PD&E process in accordance with ***Chapter 4*** *of the* ***PD&E Manual****.*

The District Structures Design Engineer or the State Structures Design Engineer, as appropriate, shall concur/approve all bridge related work after location design approval is granted.

To assure a uniform approach to a project, the engineer shall coordinate with the appropriate Structures Design Office to discuss structures related phase review comments and get concurrence on how to proceed.

Modification for Non-Conventional Projects:
Delete ***PPM*** *26.5 and replace with the following:*

26.5 Responsibility

RFP's on those projects where it is anticipated that Category 2 bridges will be designed and constructed shall be submitted to the State Structures Design Engineer for review and approval. RFP's on those projects where it is anticipated that Category 1 bridges will be designed and constructed shall be submitted to the District Structures Design Engineer for review and approval.

The District Structures Design Office has total component structure plan review responsibility for projects involving Category 1 Structures. The Structures Design Office has total component structure plan review responsibility for projects involving Category 2 Structures. This responsibility for Category 2 Structures extends to widening and rehabilitation projects and repairs of bridge components that qualify the structure as a Category 2 Structure. The District Structures Design Engineer or the State Structures Design Engineer, as appropriate, shall determine when structure component plans should be "Released for Construction."

The District Project Manager shall coordinate with the District Structures Design Engineer who shall review and concur with the bridge aspect of all projects during the PD&E process in accordance with Chapter 4 of the ***PD&E Manual****.*

26.7 Bridge Project Development

The following sections will define, clarify and list the information necessary to produce an acceptable and reproducible set of contract documents (special provisions, bridge contract drawings, etc.) ready for advertisement and construction.

Bridge project development normally includes five phases of development. The first phase of development, bridge analysis, occurs during the Project Development and Environment (PD&E) process. After location design approval is granted, the second phase, Bridge Development Report/30%Structures Plans, is initiated. After approval of the BDR, the final phases of work will begin. The third phase is the 60% Structures Plans that consists of the substructure foundation submittal for <u>all</u> projects and 60% Structures Plans for most Category 2 Structures. The fourth phase includes the 90% Structures Plans and specifications. The fifth phase includes the 100% Structures Plans and specifications. For efficiency, one engineering firm (one design team) should be responsible for the BDR and the final plans and specifications.

For Category 2 bridges and some Category 1 bridges, step negotiations are suggested. Step negotiations are desirable because the final bridge type cannot be determined until the BDR is complete. Utilizing this scenario, the first step of the negotiations would include the BDR/30% Structures Plans. After submittal of the BDR/30% Structures Plans, negotiations for final three phases of work (60% Structures Plans, 90% Structures Plans and 100% Structures Plans) would begin. Negotiations should not be finalized until the BDR/30% Structures Plans are approved by the DSDO or the SDO as appropriate.

Modification for Non-Conventional Projects:
*Delete **PPM** 26.7 and replace with the following:* ***26.7 Bridge Project Development*** *Bridge project development normally includes four phases of development. The first phase of development, bridge analysis, occurs during the Project Development and Environment (PD&E) process**.** The second phase includes the development of the bridge related project constraints based on project specific requirements and development of the bridge concept plans for inclusion into the RFP. A series of pre-scoping questions has been compiled and are available on the Office of Construction website to aid in the development of project specific constraints. Depending on the complexity of the project and at the discretion of the Department, this second phase may include a Bridge Feasibility Assessment for the purpose of developing the structures concept plans. The third phase involves the project procurement process. See **Procurement and Administration Procedure (Topic No. 625-020-010k)** for specific requirements. The fourth phase includes component structure plan reviews in accordance with the requirements of the RFP.*

26.11 Final Plans and Specifications Preparation

26.11.1 General

Within this phase of work, for both Category 1 and 2 Structures, there are three phases of work; viz., 60% Substructure submittal or 60% Structure Plans, 90% Structure Plans and 100% Structures Plans and Specifications. For projects where preapproved proprietary wall systems cannot be used and fully designed proprietary wall plans are required, approved control drawings shall be submitted to the appropriate proprietary wall companies as soon as possible and no later than the 60% substructure submittal. A copy of this submission shall be sent to the DSDO or SDO as appropriate. At any time during the project development, the reviewer may require submittal of design calculations.

After each of the phases, except the 100% Structures Plans Phase, review comments from the FDOT are sent to the EOR by letter and/or a marked-up set of prints. The

EOR must address each of the comments in writing and resolve each comment prior to the next submittal. The FDOT 100% Structures Plans review comments are to be handled in the same manner; except that unresolved comments may be handled by telephone, in some instances, if confirmed in writing. Also, for any phase, items and drawings from a preceding phase must be included. These drawings shall reflect the comments resolved from the previous phase as well as the accumulated design and drafting effort required of the current phase.

26.12 Independent Peer Review of Category 2 Bridges

For all Cost Savings Initiative Proposals involving a Category 2 bridge, an independent peer review is required. The Peer Review shall be performed by a single independent engineering firm other than the engineer responsible for the initial work that is designated by the contractor to conduct the review. The designated independent peer review firm shall have no involvement with the project other than conducting the peer review and shall be pre-qualified in accordance with ***Rule 14-75 of the Florida Administrative Code****. For bridges consisting of both Category 1 and Category 2 bridge spans only the Category 2 spans and corresponding substructure components require a peer review. Where the superstructure is Category1, but the substructure component is Category 2, only the substructure component has to be peer reviewed. For water crossings with vessel impact, the spans or superstructure units with spans over water require a peer review.*

Modification for Non-Conventional Projects:
Delete the above paragraph and replace with the following: *For all Category 2 bridges, an independent peer review is required. The Peer Review shall be performed by a single independent engineering firm other than the engineer responsible for the initial work and will be designated by the Contractor or Concessionaire (P3 projects) to conduct the review. The designated independent peer review firm shall have no other involvement with the project other than conducting the peer review and shall be pre-qualified in accordance with* ***Rule 14-75 of the Florida Administrative Code****. For bridges consisting of both Category 1 and Category 2 bridge spans only the Category 2 spans and corresponding substructure components require a peer review. Where the superstructure is Category 1, but the substructure component is Category 2, only the substructure component has to be peer reviewed. For water crossings with vessel impact, the spans or superstructure units with spans over water require a peer review.*

The peer review is intended to be a comprehensive, thorough independent verification of the original work. An independent peer review is not simply a check

of the EOR's plans and calculations; it is an independent verification of the design using different programs and independent processes than what was used by the EOR. All independent peer reviews shall include but not be limited to the independent confirmation of the following when applicable:

1. Compatibility of bridge geometry with roadway geometrics including typical sections, horizontal alignment, and vertical alignment. Minimum horizontal and vertical clearance requirements.
2. Compatibility of construction phasing with Traffic Control Plans.
3. Conflicts with underground and overhead utilities.
4. Compliance with AASHTO, Department and FHWA design requirements.
5. Conformity to Department Design Standards.
*6. Structural Analysis Methodology, design assumptions, and independent confirmation of design results.**
*7. Design results/recommendations (independent verification of the design).**
8. Completeness and accuracy of bridge plans.
9. Technical Special Provisions, and Modified Special Provisions where necessary.
10. Constructability assessment limited to looking at fatal flaws in design approach.

** When Category 2 superstructure elements are designed with software using refined analyses (e.g. Grid, Finite Element Method, etc.), the peer review consultant shall verify the design results by a different program/method.*

*In addition to the requirements of **PPM Sections 26.11.3** and **26.11.4**, the following documents shall be included with plan submittals for Category 2 bridges requiring an independent peer review:*

1. 90% Plan Submittals
a. A tabulated list of all review comments from the independent review engineer and responses from the originator of the design.
*b. A standard peer review certification letter following the format presented in **Exhibit 26-B** signed by the independent review engineer. All outstanding/unresolved comments and issues presented in this letter shall be resolved and implemented prior to the 100% plan submittal.*

2. 100% Plan Submittals
*a. A certification letter following the format presented in **Exhibit 26-C** signed and sealed by the independent review engineer stating that all review comments have been adequately addressed and that the design is in compliance with all Department and FHWA requirements.*

26.15 Review for Constructability and Maintainability

26.15.1 Purpose

The purpose of this review is to provide reasonable and practical use of fabrication and construction techniques and equipment without overloading and/or overstressing components, provide for proper material handling and transportation, provide safe maintenance of traffic and provide an appropriate construction sequence. Additionally, provide features which will retard bridge deterioration, permit reasonable access to all parts of the bridge for inspection and performance evaluation and provide features to facilitate replacement of damaged and/or deteriorated bridge components.

26.15.2 Responsibility

For Category 1 and 2 Structures, it will be the responsibility of the project manager or his designee to coordinate a review of both the 30% and 90% Structures Plans submittals by the appropriate District Construction and Maintenance personnel for constructability and maintainability. For Category 1 Structures, technical issues shall be resolved to the satisfaction of the appropriate DSDE. For Category 2 Structures, technical issues shall be resolved to the satisfaction of the SDO.

The Construction and Maintenance Offices should be given adequate time to perform these reviews. All comments from these reviews shall be addressed prior to the next submittal and its subsequent review.

Modification for Non-Conventional Projects:
Delete PPM 26.15 and see the RFP for requirements.

19.1. Specific Information taken from the 2017 FDOT's Plans Preparation Manual (PPM) related to the Signature Pedestrian Bridge (Clarification has been added to FDOT PPM for defining Category 2 Structures)

The signature pedestrian bridge would be classified as a Category 2 Structure for the following reasons:

- **A new bridge type** – the signature pedestrian bridge was a concrete truss configuration with a single line of diagonal and vertical supports.

- **New materials used to construct bridge components** – the signature pedestrian bridge was constructed using titanium dioxide concrete.

- **New bridge construction methods** – the signature pedestrian bridge was constructed using accelerated bridge construction (ABC) techniques.

- **Non-standard or unusual bridge component-to-component configurations and connection details** – the signature pedestrian bridge was constructed using an irregular pattern of diagonal support members, each with different angles and lengths.

- **Items not covered by the Department's Standard Construction Specifications** – a modification was made to the General Specifications for the Design-Build Contract that replaced Division I – *General Requirements and Covenants*, of the *FDOT Standard Specifications for Road & Bridge Construction*. However, Division II – *Construction Details* and Division III – *Materials* of the *FDOT Standard Specifications for Road & Bridge Construction* remained in effect and were incorporated by reference and made a part of the General Specifications for the Design-Build Contract for the signature pedestrian bridge.

Design Submittal Review and Approval Process

The design submittal review and approval process were managed through the FDOT Electronic Review Comments (ERC) system website. The following description was taken from the FDOT website:

> *"Electronic Review Comments (ERC) is an application used to track the entire review process (comments and responses) for plan reviews and project submittals in a database. All comments and responses reside in one location allowing any user easy access to all or partial review data on demand. The system allows Project Managers to easily track all comments and responses from all Reviewers and Consultants at anytime during the process."*

Sequence for the ERC System Process:

1. Plans Submittal to FIU/FDOT/Third-Party through ERC System by FIGG
2. FIU/FDOT/Third Party Review of Plans Submittal
3. FIU/FDOT/Third Party Reviewers Upload Comments ERC System
4. FIGG Reviews FIU/FDOT/Third-Party Comments and Uploads Responses to ERC System
5. FIU/FDOT/Third Party Reviewer Reviews FIGG Reponses and Either Approves/Closes Out Comments or Requests Comment Resolution Meeting
6. All FIU/FDOT/Third-Party Reviewer Comments in the ERC System must be Approved/Closed Out by the FDOT Reviewing Making the Comment Prior to Making a Subsequent Submittal or Release for Construction (RFC)

All comments were resolved to the FDOT Reviewer's satisfaction before the bridge could be built.

Design Submittal Reviewers

There was a total of thirty-seven individual reviewers for the pedestrian bridge plan submittals. These reviewers are categorized into three groups: 1) FIU and their subconsultant, 2) FDOT and their subconsultants and 3) Third Party reviewers. The names of the reviewers are provided below along with the category for their review.

Reviewing Party (No. of Reviewers)		Reviewers (Category of Review)
FIU Reviewers (2)	FIU	Stuart Grant (All Categories)
	BPA (Subconsultant to FIU)	Rafael Urdaneta (Construction)
FDOT Reviewers (32)	FDOT	Hugo Morales (Maintenance), Jose Guarrochena (Digital Delivery), Lillian Costa (Contamination), Maria Benavides (Estimates), Maria Colmenares (Other), Marlon Rivera (Right of Way, Survey), Nitin Dave (Geotech/Materials), Pedro Pelegrin (Drainage), Renato Marrero (Maintenance), Rita Timmens (Right of Way/Survey), Christopher Benitez (Other), Eman Gomaa (Other), Gustavo Firpi (Right of Way, Survey), Raj Shanmugam (Bicycle/Pedestrian), Adrian Viala (Geotech/Materials), Jesus Perez (Survey), Maria Carasa (Structures), Nicole Carter (Environmental Management Office), Barbara Russell (Maintenance)
	FDOT Structures Design Office (SDO)	Tom Andres (Structures)
	AECOM (Subconsultant to FDOT)	Ashley Mathews (Environmental Permits), Edgar Martinez (Signing & Marking), Eugene Sherman (Roadway), Saul Perez (Structures), Luis Vargas (Structures), Teodoro Tefel (Structures)
	Stantec (Subconsultant to FDOT)	Brook Wolfe (Environmental Management Office), Roberto Gutierrez (Other)
	Gannett Fleming (Subconsultant to FDOT)	Carlos Cejas (Transit, Access Management)
	AES Engineering (Subconsultant to FDOT)	Michel Rodriguez (ADA)
	Janus Research (Subconsultant to FDOT)	Adam Schieffer (Cultural Resources)
	HDR (Subconsultant to FDOT)	Kevin Might (Landscaping)
Other Third-Party Reviewers (3)	FHWA	Hector Laureano (Structures)
	Miami-Dade County	David Hays (Signing & Marking), Juan Pena (Other)

The FDOT Structures Design Office (SDO) located in Tallahassee, Florida had the responsibility for total component structure plan review of the signature pedestrian bridge because it was classified as a Category 2 Structure. The Structures Design Office provided electronic review and email comments on the submittal phases for the signature pedestrian bridge as summarized in **Table 7**.

Table 7 – Pedestrian Bridge Plans Submittal and Electronic Review Comment Timeline

Doc ID	Submittal Date	Description	Additional Comments on ERC
01	2/26/2016	**30% Preliminary Plans Submittal (3/8/2016 Uploaded to FDOT ERC)**	
02	3/25/2016	30% Preliminary Plans – All ERC Comments Uploaded	114 Total Comments 10 (FIU Reviewer Comments) 104 (FDOT Reviewer Comments) 4/22/2016 ERC Comments Responded to 8/31/2016 ERC Comments Approved/Closed Out
03	5/2/2016	**90% Foundation Plans Submittal (5/10/2016 Uploaded to FDOT ERC)**	
04	6/8/2016	90% Foundation Plans – All ERC Comments Uploaded	17 Total Comments 17 (FDOT Reviewer Comments) 6/29/2016 ERC Comments Responded to 9/19/2016 ERC Comments Approved/Closed Out
05	6/10/2016	**90% Substructure Plans Submittal (6/15/2016 Uploaded to FDOT ERC)**	
06	7/01/2016	90% Substructure Plans – All ERC Comments Uploaded	41 Total Comments 41 (FDOT Reviewer Comments) 8/01/2016 ERC Comments Responded to 8/03/2016 ERC Comments Approved/Closed Out
07	6/28/2016	FDOT SDO Provides Clarification on 30% Preliminary Plans Submittal Comments	
08	6/29/2016	FIGG Provides Responses to FDOT SDO 30% Preliminary Plans Submittal Comments	
	6/30/2016	FIGG Meeting with FDOT SDO to Discuss 30% Preliminary Plans Submittal Comments and 90% Foundation/90% Substructure Plans Submittals (Comment Resolution Meeting)	
09	7/5/2016	6/30/2016 FDOT SDO/FIGG Meeting Summary Finalized	
10	7/13/2016	**90% Foundation Plans Resubmittal (7/14/2016 Uploaded to FDOT ERC)**	

11	8/3/2016	90% Foundation Plans Resubmittal – All ERC Comments Uploaded	32 Total Comments 32 (FDOT Reviewer Comments) 8/17/2016 ERC Comments Responded to 9/14/2016 ERC Comments Approved/Closed Out
12	8/1/2016	**90% Substructure Plans Resubmittal (8/3/2016 Uploaded to FDOT ERC)**	
13	8/19/16	90% Substructure Plans Resubmittal – All ERC Comments Uploaded	21 Total Comments 20 (FDOT Reviewer Comments) 1 (Third Party Reviewer Comment) 9/22/2016 ERC Comments Responded to 9/28/2016 ERC Comments Approved/Closed Out
14	9/13/2016	**Final Foundation Plans Submittal (9/15/2016 Uploaded to FDOT ERC)**	
15	10/18/2016	Final Foundation Plans – All ERC Comments Uploaded	22 Total Comments 22 (FDOT Reviewer Comments) 11/29/2016 ERC Comments Responded to 12/15/2016 ERC Comments Approved/Closed Out
16	9/14/2016	FIGG Provides Updated Responses to FDOT SDO 30% Preliminary Plans Submittal Comments	
17	9/15/2016	FIGG Meeting with FDOT SDO to Review Updated Responses to FDOT SDO 30% Preliminary Plans Submittal Comments and Preview 90% Superstructure Plans Submittal	
18	9/16/2016	9/15/2016 FDOT SDO/FIGG Draft Meeting Summary Provided to FDOT for Review	
19	9/16/2016	FDOT Concurs with FDOT SDO/FIGG Draft Meeting Summary. In addition, SDO Comments on 90% Superstructure Plans Status Set are Provided to FIGG	
20	9/26/2016	**90% Superstructure Plans Submittal (9/28/2016 Uploaded to FDOT ERC)**	
21	10/17/2016	90% Superstructure Plans – All ERC Comments Uploaded	35 Total Comments 35 (FDOT Reviewer Comments) 11/11/2016 ERC Comments Responded to 12/14/2016 ERC Comments Approved/Closed Out
22	9/29/2016	**Final Substructure Plans Submittal (10/17/2016 Uploaded to FDOT ERC)**	

23	10/28/2016	Final Substructure Plans – All ERC Comments Uploaded	24 Total Comments 22 (FDOT Reviewer Comments) 2 (Third Party Reviewer Comments) 11/21/2016 ERC Comments Responded to 1/24/2017 ERC Comments Approved/Closed Out
24	12/9/2016	**RFC Foundation Plans Submittal**	
25	1/13/2017	**RFC Substructure Plans Submittal**	
26	2/10/2017	**Final Superstructure Plans Submittal (2/14/2017 Uploaded to FDOT ERC)**	
27	5/2/2017	Final Superstructure Plans – All ERC Comments Uploaded	36 Total Comments 32 (FDOT Reviewer Comments) 4 (Third Party Reviewer Comments) 5/23/2017 ERC Comments Responded to 6/13/2017 ERC Comments Approved/Closed Out
28	2/28/2017	**RFC Foundation Plans Resubmittal**	
29	2/28/2017	**RFC Substructure Plans Resubmittal**	
30	4/7/2017	**RFC Superstructure Plans Submittal**	

Notes:

1) Some FDOT comments referred to documents external to the FDOT ERC system with multiple comments. The actual number of FDOT comments was greater than the number of comments in the FDOT ERC system.
2) A few of the ERC comments refer to previous ERC comment documents that contained multiple previous comments. Examples include the 90% Foundation Design, Comment #15; and the 90% Structural Pylon & Landing Structures Design, Comment 1.
3) 30% Preliminary Comments created by Thomas Andres were marked "for information only"– no response required due to the preliminary nature of the submittal. All comments created by Thomas Andres on all subsequent submittals, however required a written response.
4) The FDOT ERC comment logs are included and labeled as FIGG's Attachment Submission FCA-A8.

The FDOT Structures Design Office (SDO) provided further clarification on why FDOT reviewed the FIGG pedestrian design plans in an email to NTSB investigators dated May 3, 2018:[48]

> "***NTSB Question:*** *Please send me an official response on why FDOT reviewed the FIGG design plans with limited involvement in the project?*
>
> ***Answer:*** *The FIU pedestrian bridge project was a local agency project, pursuant to a Local Agency Program Agreement between FIU and the Florida Department of Transportation (the "Department"). In this instance, the Department acted as a*

[48]Email from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated May 3, 2018.

pass-through of the federal monies coming in via the TIGER Grant to FIU, with the receipt and disbursement as to these grant funds.

Since the FIU pedestrian bridge goes over a State Road, it would be considered a "Class A" Project per the Local Agency Program Manual, TABLE 1: Project Classifications. Class A Projects utilize Design Criteria set forth in the Plans Preparation Manual. See attached excerpt. Plans Preparation Manual Section 26.3.2 defines Category 2 Bridges. Plans Preparation Manual Section 26.5 (blue box) sets forth the responsibility for reviewing "Category 2" bridges to the State Structures Design Office. See attached PPM excerpt. The review performed on this project by the State Structures Design Office was consistent with reviews performed on all projects; it consisted of a high-level review only. We did not perform calculations or review EOR calculations. This project, like all FDOT projects, require that the Firm performing the design follow a Quality Control / Quality Assurance Plan. In addition, this project, like all FDOT Design-Build Category 2 Bridge Projects, required an Independent Peer Review of the bridge design which consists of an independent design verification utilizing different computer software than was used for the design."

The following comments were provided by the FDOT Structures Design Office (SDO) on the 30% Preliminary Plans submittal. These comments were uploaded to the FDOT ERC website on March 25, 2016 (ERC Comment 110) and FIGG responded to these comments on April 22, 2016. FDOT SDO accepted the FIGG response and closed the comment on April 25, 2016.

On June 28, 2016, FDOT SDO (Tom Andres) provided a word document to FIGG containing additional information on their 30% Preliminary Plans submittal review comments. At the beginning of this document, it states:

"Comments 1 thru 22 below are for information only. No response is required. The comments are intended to assist in pressing the DBF's concept to 90%."

FIGG provided initial responses to these comments to FDOT SDO on June 29, 2016 (see FIGG's Attachment Submission FCA-A9).

On June 30, 2016, FIGG met with FDOT SDO to discuss the review comments on the 30% Preliminary Plans submittal and the FIGG responses. Based on this meeting and the information presented by FIGG, FDOT SDO requested for FIGG to resubmit the 90% Foundation and Substructure Plan submittals with the inclusion of the demand versus capacity ratios for various components for FDOT's review.

A copy of the draft minutes that were prepared by FDOT SDO are included as FIGG's Attachment Submission FCA 18-1.

"*b. The plans need to clearly show the sequence of all stressing. Maintaining stress limits throughout all intermittent phases to avoid cracking of the members will be extremely tricky and will likely necessitate stressing all web members along with some transverse/longitudinal stressing in increments such that members stay in compression. Also predicting where the PT stressing actually goes will be tricky.*

For instance any forces imposed on web joints affect all members framing into the joint. Longitudinal stressing of the canopy/walkway will tend to go into the stiff web element and not in the canopy/walkway. Also the design needs to pay particular shear lag affects and member interface shear (horizontal shear) through all phases of stressing.

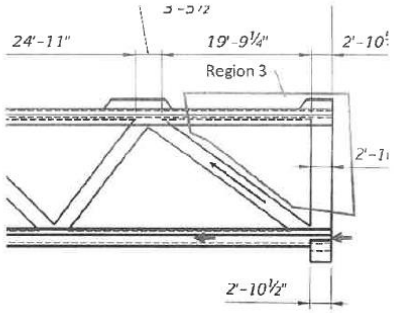
FIGG response uploaded to ERC on April 22, 2016 which was accepted and closed out by FDOT SDO on April 25, 2016:

It is our understanding that these comments were provided for information only and no response is required at this time. These comments are intended to assist in progressing the DBF's concept to 90% plans.

FIGG clarification provided to FDOT SDO on June 29, 2016:

The 90% superstructure submittal will show in detail, the stressing sequences of the post-tensioning. We agree that the incremental stressing sequence will be important and that the final superstructure design will verify stresses at each of the incremental steps. Shear lag and interface shear were discussed in the above comment clarifications. Relative to these comments, no changes will be made that would alter the 90% foundation design plans.

c. There is a concern with tension behind the compression zone due to longitudinal PT of the walkway at the member ends as the top of the web and canopy element gets dragged along (shear lag in region 3).



FIGG response uploaded to ERC on April 22, 2016 which was accepted and closed out by FDOT SDO on April 25, 2016:

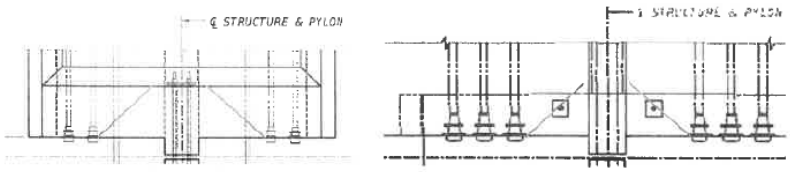
It is our understanding that these comments were provided for information only and no response is required at this time. These comments are intended to assist in progressing the DBF's concept to 90% plans.

FIGG clarification provided to FDOT SDO on June 29, 2016:

The tendons anchor at the edge of the member, thus a tension field cannot develop behind the compression zone in region 3 during stressing of the tendons. In region

3, the top slab and bottom slab are free to shorten independently. Any differential shortening in this region will result in minor bending moments in the vertical reinforced concrete member. These will be resisted with mild reinforcement in the conventional manner. Relative to this comment, no changes will be made that would alter the 90% foundation design plans.

d. There appears to be significant shear lag issues in both the canopy and walkway as the stiff web element is being dragged behind the compression zone. The designer needs to pay particular attention in these areas. Moving the canopy continuity tendon to the middle tendon spot may improve the issue. Consider adding additional longitudinal tendons in the added 2 ft. corner chamfers (Comment 4.c.i).”



FIGG response uploaded to ERC on April 22, 2016, which was accepted and closed out by FDOT SDO on April 25, 2016:

It is our understanding that these comments were provided for information only and no response is required at this time. These comments are intended to assist in progressing the DBF’s concept to 90% plans.

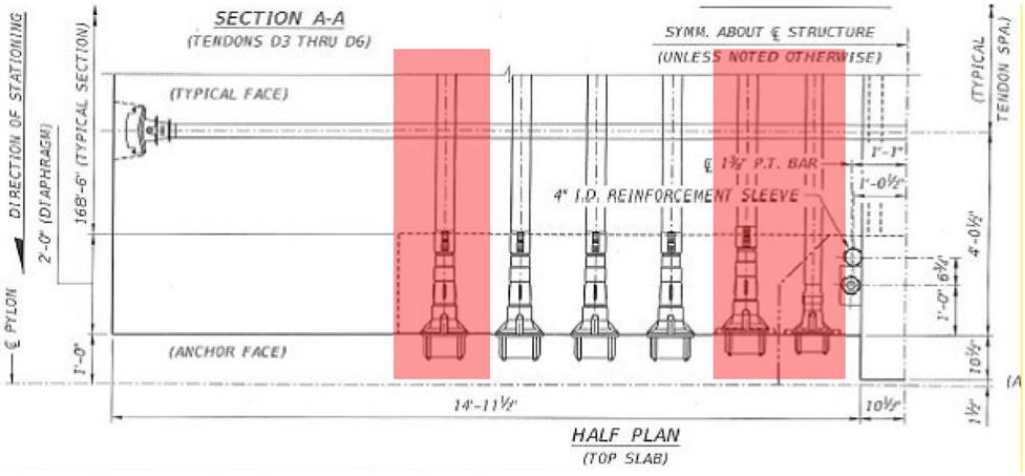
FIGG clarification provided to FDOT SDO on June 29, 2016:

Relative to the canopy section above (left), the PT bars shown were provisional for purposes of various erection methods and sequences. As shown on sheet B-27, the Contractor has elected to CIP the span over the canal, after the precast span is in place. As a result, these PT bars will be eliminated.

Relative to the floor section above (right), the local region bounded by the two “blue triangles” would receive minimal compression from the tendons of the CIP back span. The same location of the precast span includes tendons within this region (see Sheet B-11, Section B-B). During final design of the superstructure, the three tendons of the CIP (on each side of centerline) will be re-spaced to improve the distribution of stresses in this area. The chamfer item was previously addressed above.

Relative to these comments, no changes will be made that would alter the 90% foundation design plans.

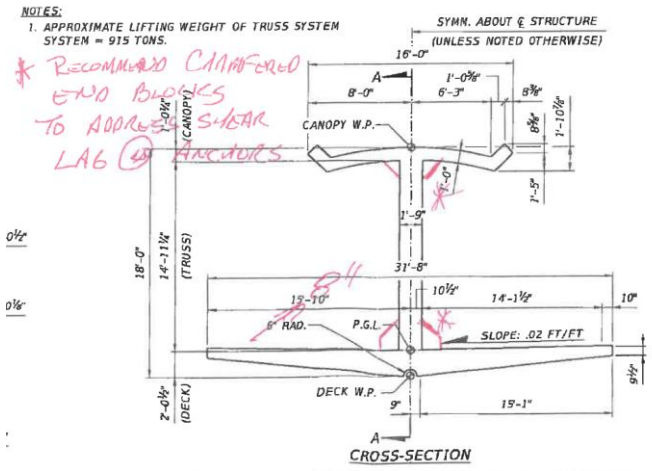
In the final RFC superstructure plans, additional longitudinal post-tensioning tendons in the bridge deck were incorporated that addressed FDOT’s review comments. These additional longitudinal post-tensioning tendons are shown below.



RFC Superstructure Plan Sheet B-44 That Shows Longitudinal Post-Tensioning Tendons in the Bridge Deck (The Post-Tensioning Tendons That Address FDOT Comment Are Identified)

The FDOT Structures Design Office (SDO) also recommended the following comment on the Main Span Truss System layout (Sheet No. B-36) in an email from FDOT to FIGG dated September 16, 2016:[49]

> "*Recommend chamfered end blocks to address shear lag at anchors* (where the truss members connect to the canopy and bridge deck at the end of the bridge span where the longitudinal PT terminates)*."*



FIGG reviewed this FDOT recommendation and determined that the chamfered end blocks were not required by the design analysis and would pose a safety/tripping hazard to pedestrians. This FDOT recommendation was not incorporated into the 90%, Final or RFC Superstructure Plan submittals and FDOT did not submit this as a formal review comment to be addressed during each of these review periods.

[49]Email from Mr. Tom Andres of FDOT to Mr. Dwight Dempsey of FIGG and others dated September 16, 2016.

19.2. Independent Peer Review performed by Louis Berger

The signature pedestrian bridge would require an independent peer review be conducted because it was classified as a Category 2 Structure. It was required that the independent peer review firm have no other involvement with the project other than conducting the peer review and be pre-qualified in accordance with **Rule 14-75 of the Florida Administrative Code**. A discussion of the pre-qualification of the firm, Louis Berger, to conduct an independent peer review will be discussed later in the Bridge Factors Factual Report. Louis Berger was required to provide the following documents with plan submittals for the signature pedestrian bridge:

- **90% Plan Submittal** – Louis Berger was required to provide a tabulated list of all review comments and responses. Louis Berger was also required to provide a standard peer review certification letter with all outstanding/unresolved comments and issues presented in the letter to be resolved and implemented prior to the 100% plan submittal.

  (Note: Based on communication with FDOT and Louis Berger Peer Review scheduling, it was accepted that the 100% Submittal was sufficient. See FIGG's Attachment Submission FCA 18-2 for documentation.)

- **100% Plan Submittal** – Louis Berger was required to provide a certification letter signed and sealed stating that all review comments have been adequately addressed and that the design is in compliance with all Department and FHWA requirements.

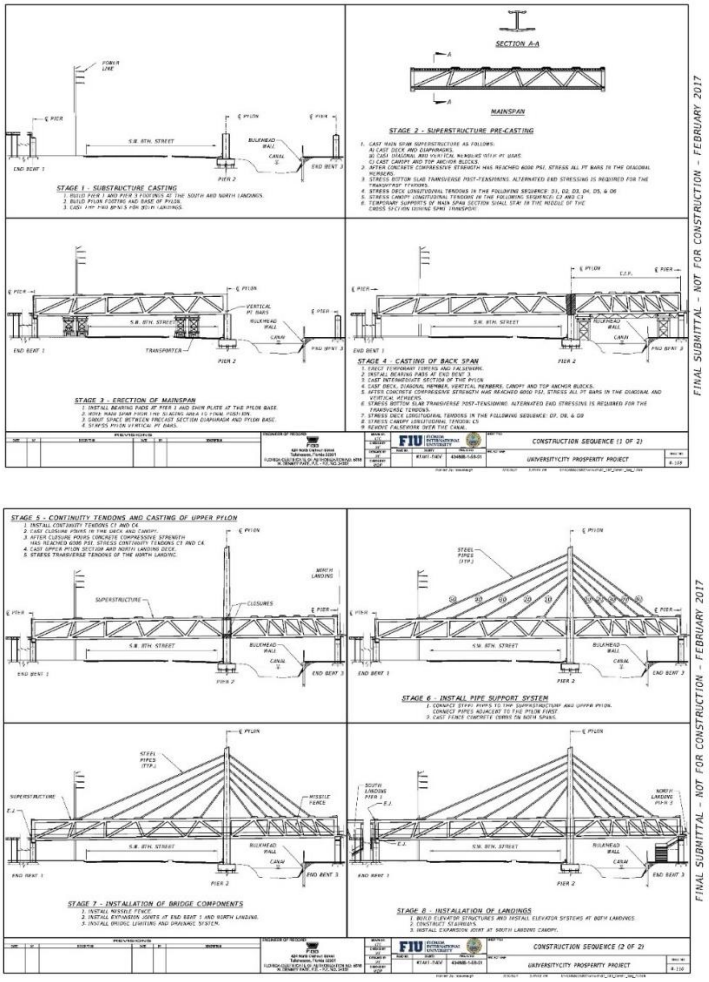
FDOT provided the following information regarding the peer review requirements in an email to NTSB investigators dated April 26, 2018:[50]

> "***NTSB Question:*** *Would the FIU bridge be considered a Category 2 superstructure element as described in the attached Peer Review Requirements?*
>
> ***Answer:*** *In response to your first question, yes, the FIU bridge would be considered to be a Category 2 superstructure.*
>
> ***NTSB Question:*** *Would it have required the consultant to verify the design results by a different program/method?*
>
> ***Answer:*** *As to your second question, yes, we would have a required the consultant to verify the design by a different program/method.*
>
> ***NTSB Question:*** *Also, would it have required a 90% standard peer review certification letter?*
>
> ***Answer:*** *And finally, as to your third question, the 90% certification was not provided, however, since it is an "in progress" certification and because we received the final certification which included the review of the 90% work, it would have been included in the 100% review. Therefore, the intent of the 90% was met."*

[50]Email from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated April 26, 2018.

The design plans reviewed by Louis Berger included the pedestrian bridge foundation, substructure (end bents and center tower) and superstructure. The design plans included construction sequencing, covering main span precasting, transport of main span and placement of the main span between Bent 1 and Pier 2. The design plans also included the post-tensioning stressing and destressing sequences and phases.

Examples of the construction sequence drawings that were included in the Final (100%) Superstructure Plans reviewed by Louis Berger are shown below.



In accordance with the FDOT PPM, Louis Berger submitted the following signed and sealed IPR certification letters:

- 100% Bridge Foundation Plans – September 13, 2016
- 100% Bridge Substructure Plans – September 29, 2016
- 100% Bridge Superstructure Plans – February 10, 2017

The certification letters state:

"Pursuant to the requirement of the Contract Documents, Louis Berger hereby certifies that an independent peer review of the above-referenced submittal has

been conducted in accordance with Chapter 26 of the Plans Preparation Manual and all other governing regulations."

These certification letters were all signed by Ayman A. Shama, Ph.D., P.E., Associate Vice President/Director of Seismic Engineering for Louis Berger with the following Certification Statement:

> *"I certify that the component plans listed in the letter has been verified by independent review, that all review comments have been adequately resolved, and that the plans are in compliance with Department and FHWA requirements presented in the Contract Documents."*

See Bridge Factors Factual Report Attachment 48 for the Independent Peer Review Certification Letters.

Louis Berger was obligated to check constructability considerations of the bridge by AASHTO LRFD Bridge Design Specification, Section 2.5.3, and by FDOT Structures Design Guidelines, Sections 2.13, 4.58, 4.59 and 6.10. Both of these documents are requirements of Louis Berger's scope and require investigations of the structure during various construction phases.

FDOT performed a Quality Assurance Review of the Independent Peer Review Documentation. FDOT requested the following documents as part of their Quality Assurance Review (QAR) on November 7, 2017:

1. Technical Proposal and associated
2. Independent Peer Reviewer's comments, comment responses and final signed and sealed cover letter

FIGG provided the requested documentation later that same morning on November 7, 2017. The requested files were uploaded to FIGG SharePoint site for FDOT to access. FDOT acknowledged receipt of the IPR documentation that same day. See FIGG's Attachment Submission FCA 18-3.

20. Specific Information taken from FDOT's Standard Specifications for Road and Bridge Construction related to the Signature Pedestrian Bridge

Specific Information taken from FDOT's Standard Specifications for Road and Bridge Construction, Division II – *Construction Details* related to the signature pedestrian bridge includes the following:[51]

[51]Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Division II – Construction Details, Structures, January 2015, pages 377, 391 and 392.

"***400-9 Construction Joints***

400-9.3 Preparation of Surfaces: *Before depositing new concrete on or against concrete which has hardened, re-tighten the forms. Roughen the surface of the hardened concrete in a manner that will not leave loosened particles, aggregate, or damaged concrete at the surface. Thoroughly clean the surface of foreign matter and laitance, and saturate it with water."*

The treatment of construction joints at the south abutment columns was discussed between CEI, MCM and FIGG between June 10 and June 13, 2017. Dwight Dempsey (FIGG) replied to Rafael Urdaneta (CEI) e-mail on June 13, 2017 at 7:56 am, stating "We have had previous communications with MCM regarding this topic [treatment of construction joints] and the FDOT specification referenced below [FDOT Standard Specifications for Road and Bridge Construction Section 400-9.3] was to be followed." This statement was in response to an email regarding the construction joint at the south abutment columns and that the treatment for these construction joints shall follow FDOT Standard Specifications for Road and Bridge Construction Section 400-9.3 for preparation of surfaces.[52] See BPA's Attachment Submission BPA-2 for emails between MCM, FIGG, and BPA concerning preparation of construction joints.

The June 13, 2017 email correspondence was specific for the construction joints at the columns on the south abutment. The construction joint requirements between the vertical truss members and the deck / canopy were never discussed among the CEI and Contractor / EOR. In addition, the vertical truss member and the deck/canopy joints are not detailed or noted with any specific requirements on the RFC plans. Therefore, the construction joints between the vertical truss members and the deck / canopy followed the requirements of Specification 400-9.3. This specification requires the surface of the hardened concrete be roughen, cleaned of loosened particles, and saturated prior to placement of the new concrete. This specification does not have any criteria for the roughened surface. If the design of these joints required a specific magnitude of roughened surface with a minimum amplitude, then this requirement should have been detailed or noted on the RFC plans or specified in the technical special provisions accordingly. For pylon diaphragm construction joints, FIGG did specify a ¼" amplitude for surface roughening in RFC plans (B-24B, B-25), but FIGG did not include this specification for the construction joints between the vertical truss members and the deck / canopy shown on Sheets B-37, B-38 and B-41.

*"**400-21.2 Investigation, Documentation and Monitoring:** The Engineer will inspect concrete surfaces as soon as surfaces are fully visible after casting, with the exception of surfaces of precast concrete products produced in offsite plants, between 7 and 31 days after the component has been burdened with full dead load, and a minimum of 7 days after the bridge has been opened to full unrestricted traffic. The Engineer will measure the width, length and depth of each crack and establish the precise location of the crack termination points relative to permanent reference points on the member. The Engineer will determine if coring of the concrete is necessary when an accurate measurement of crack depth cannot be determined by use of a mechanical probe. The Engineer will monitor and document*

[52]Email from Mr. Dwight Dempsey of FIGG to Mr. Rafael Urdaneta of BPA dated June 13, 2017 at 7:56 a.m.

the growth of individual cracks at an inspection interval determined by the Engineer to determine if cracks are active or dormant after initial inspection. The Engineer will perform all final bridge deck crack measurements once the deck is free of all debris and before transverse grooves are cut and after planing is complete for decks that require planing.

400-21.3 Classification of Cracks

The Engineer will classify cracks as either nonstructural or structural and determine the cause. In general, nonstructural cracks are cracks 1/2 inch or less deep from the surface of the concrete; however, the Engineer may determine that a crack greater than 1/2 inch deep is nonstructural. In general, structural cracks are cracks that extend deeper than 1/2 inch. As an exception, all cracks in concrete bridge decks that are supported by beams or girders will be classified as nonstructural and repair will be in accordance with 400-21.5.1. However, if the Engineer determines that repair under 400-21.5.1 is unacceptable, repair in accordance with 400-21.5.2.

400-21.5.2 Structural Cracks

Provide a structural evaluation signed and sealed by the Contractor's Engineer of Record that includes recommended repair methods and a determination of structural capacity and durability to the Engineer. Upon approval by the Engineer, repair the cracked concrete. Complete all repairs to cracks in a member inside a cofferdam prior to flooding the cofferdam."

The FIU General Specifications for Design-Build Contract between FIU and MCM replaced Division I, General Requirements and Covenants, of the FDOT Standard Specifications for Road and Bridge Construction, latest edition in effect on the date of the Solicitation Documents (FDOT Standard Specifications) in its entirety. The definition of "Engineer" in the FIU General Specifications for Design-Build Contract between FIU and MCM was the following:

Engineer.[53]

The FIU Associate Vice President of Facilities Management acting directly or through duly authorized representatives; such representatives acting within the scope of the duties and authority assigned to them.

Note: In order to avoid cumbersome and confusing repetition of expressions in these Specifications, it is provided that whenever anything is, or is to be done, if, as, or, when, or where "acceptable, accepted, approval, approved, authorized, condemned, considered necessary, contemplated, deemed necessary, designated, determined, directed, disapproved, established, given, indicated, insufficient, ordered, permitted, rejected, required, reserved, satisfactory, specified, sufficient, suitable, suspended, unacceptable, or unsatisfactory," it shall be understood as if

[53]FIU General Specification for Design-Build, Rev. 6-9-14, Section 1-3, Page 14 of 126.

the expression were followed by the words "by the Engineer," "to the Engineer," or "of the Engineer."

21. Pre-qualification of Louis Berger to conduct an independent peer review

FDOT requires the independent peer review firm to be pre-qualified in accordance with **Rule 14-75 of the Florida Administrative Code**. Rule 14-75 establishes minimum qualification standards by type of work for consultants who seek to provide professional services for FDOT. The sub-categories of qualification for bridge design under Rule 14-75 include the following work types:

- **4.1.1 Miscellaneous Structures -** This group type of work includes the design of sound barriers, structural supports for highway signals, luminaries, and traffic signals.

- **4.1.2 Minor Bridge Design -** This type of work includes the design of conventional, non-complex bridges and the structural design of other highway-related structures such as non-standard concrete box culverts and retaining walls.

- **4.2.1 Major Bridge Design – Concrete -** This group includes design for construction, rehabilitation, widening, or lengthening of structurally continuous concrete superstructures (longitudinally post-tensioned concrete beam bridges, etc.), reinforced concrete boxes, and post-tensioned substructures.

- **4.2.2 Major Bridge Design – Steel -** This group includes design for the construction, rehabilitation, widening, or lengthening of structurally-continuous steel superstructures (steel box girders, curved steel girder bridges, etc.).

- **4.2.3 Major Bridge Design – Segmental -** This group includes design for the construction, rehabilitation, widening, or lengthening of precast or cast-in-place concrete segmental superstructures or substructures.

- **4.3.1 Complex Bridge Design – Concrete -** This group includes design for the construction, rehabilitation, widening, or lengthening of concrete superstructures for the structure types that include estimated span(s) longer than 400 feet, tunnels, cable-stayed bridges, suspension bridges, truss spans, concrete arch bridges, and bridges requiring unique analytical methods or other design features not commonly addressed in AASHTO publications.

- **4.3.2 Complex Bridge Design – Steel -** This group includes design for the construction, rehabilitation, widening, or lengthening of steel superstructures for the structure types that include estimated span(s) longer than 400 feet, tunnels, cable-stayed bridges, suspension bridges, truss spans, concrete arch bridges, and bridges requiring unique analytical methods or other design features not commonly addressed in AASHTO publications.

- **4.4 Movable Span Bridge Design -** This type of work includes the design of bascule bridges and other movable bridges.

Qualification requirements for work types 4.2.1 Major Bridge Design – Concrete and 4.3.1 Complex Bridge Design – Concrete include the following:

- **Qualification requirements for work type 4.2.1 Major Bridge Design – Concrete -** This type of work requires at least two professional engineers, registered with the Florida State Board of Professional Engineers, having a minimum of five years each of structural bridge design experience in continuous span concrete bridges as defined for Work Group 4.2.1.

- **Qualification requirements for work type 4.3.1 Complex Bridge Design – Concrete -** This type of work requires at least three professional engineers, registered with the Florida State Board of Professional Engineers, having a minimum of five years each of structural concrete bridge design experience in categories as defined in Work Group 4.3.1.

For the signature pedestrian bridge, FDOT would require the independent peer review firm be qualified under work type 4.3.1 Complex Bridge Design – Concrete.[54] The signature pedestrian bridge was a complex truss bridge requiring unique analytical methods. According to FDOT records from 2013 through the present, neither Louis Berger U.S., Inc., nor its predecessor, Louis Berger Group, Inc., was ever qualified under 4.3.1 Complex Bridge Design – Concrete. FDOT's physical records indicate that Louis Berger Group, Inc. applied for Work Type 4.3.1 in 2013, and the FDOT did not approve the application. Neither Louis Berger Group, Inc. nor Louis Berger U.S., Inc. submitted an application for Work Type 4.3.1 subsequent to 2013, and the firm did not receive a prequalification letter for Work Type 4.3.1 during this period.

At the time of procuring the Independent Peer Review (IPR), the FDOT website listed Louis Berger as prequalified by FDOT for work type 4.3.1 – Complex Bridge Design Concrete (see FIGG's Attachment Submission FCA-S3 and FCA-S4). Subsequently, Louis Berger confirmed to FIGG via email from Jamey Barbas to Dwight Dempsey on July 6, 2016 (see FIGG's Attachment Submission FCA 6.5-4 and 6.5-5) that they were prequalified by FDOT for work type 4.3.1 – Complex Bridge Design Concrete.

FIGG's Attachment Submission FCA-S4 is undated, so it is unclear when the printout was downloaded from the FDOT website. At the request of NTSB investigators, FDOT reviewed its website and confirmed that it appeared the Louis Berger Group, Inc. was at one time listed on the Department's website-generated prequalification report for 4.3.1, Complex Bridge Design-Concrete due to a technical error processing the Department's physical records into the website generated report.

[54]Email from Ms. Latasha Johnson of FDOT to Mr. Dan Walsh of NTSB dated February 27, 2019. See FDOT's Attachment Submission FDOT-3.

The purpose of the FDOT website is informational and is not intended to be used as a substitute for due diligence in consultant teaming.[55] The FDOT issues a prequalification letter to prequalified consultants detailing the specific work types for which prequalification has been approved. To verify the prequalification status of potential peer review firms, consultants may request the prequalification letter directly from the firm being considered for peer review services, or from the FDOT. Prequalification in a particular Work Type is not the only consideration for consultant teaming. Experience relative to the specific project and structure type should also be weighed when procuring an Independent Peer Review. The ultimate burden of identifying work type capabilities is with the firm performing the work.

While a third-party may not have been aware of the actual prequalification's held by Louis Berger, the Louis Berger firm at all times would have known which Work Type prequalification's the firm held. Louis Berger lost their qualification for work type 4.2.1 Major Bridge Design – Concrete on December 30, 2016 due to several of the required qualifying staff no longer being with the firm. Prior to Louis Berger losing their qualification on December 30, 2016, the firm was qualified to perform work for FDOT under work type 4.2.1 Major Bridge Design – Concrete. According to FDOT, even though Louis Berger was qualified to perform work under 4.2.1 Major Bridge Design – Concrete prior to December 30, 2016, the qualification for 4.2.1 Major Bridge Design – Concrete was not appropriate for the signature pedestrian bridge.

The independent peer review is intended to be a comprehensive, thorough independent verification of the original work. An independent peer review is not simply a check of FIGG's plans and calculations; it is an independent verification of the design using different programs and independent processes than what was used by FIGG.

FDOT provided the status of Louis Berger's qualification in an email to NTSB investigators dated April 20, 2018 and May 22, 2018:[56]

> "*The firm The Louis Berger Group, Inc., is no longer qualified with FDOT. Qualification for The Louis Berger Group, Inc., expired on 12/30/2016. The firm The Louis Berger Group Inc.'s qualification expired due to transfer of staff to their affiliate entity Louis Berger U.S., Inc. The firm Louis Berger U.S., Inc., is currently qualified with FDOT, as of 1/17/2017 in other work types, but not Major Bridge Design- Concrete, nor Complex Bridge Design- Concrete. The Louis Berger Group, Inc., was formerly qualified with FDOT in Work Type 4.2.1 Major Bridge-Concrete up until 12/30/2016. They lost qualification in concrete bridge design on 12/30/2016, due to several of the required qualifying staff no longer being with the firm, as notified by Robin Malacrea, Vice President/Marketing Communications, with Louis Berger on 12/28/2016. The independent peer review received by the Department from Louis Berger is signed and sealed dated 2/10/2017, which is after the time-frame when The Louis Berger Group and Louis Berger U.S., Inc., were not qualified with FDOT in either 4.2.1 Major Bridge Design- Concrete nor 4.3.1 Complex Bridge Design- Concrete.*

[55]Email from Mr. Robert Robertson of FDOT to Mr. Dan Walsh of NTSB dated March 13, 2019. See FDOT's Attachment Submission FDOT-4.
[56]Emails from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated April 20, 2018 and May 22, 2018.

NTSB Question: *Is Louis Berger U.S., Inc. currently still not qualified with FDOT to perform the bridge work type "4.2.1 Major Bridge Design – Concrete" and "4.3.1 Complex Bridge Design – Concrete"?*

Answer: *That is correct. Louis Berger U.S., Inc. is currently not qualified with FDOT to perform the bridge work type "4.2.1 Major Bridge Design – Concrete". Also, Louis Berger U.S., Inc. is currently not qualified with FDOT to perform the bridge work type "4.3.1 Complex Bridge Design – Concrete".*

NTSB Question: *Provide a listing of the bridge work types Louis Berger U.S., Inc. is currently qualified to perform work on?*

Answer: *4.1.1, Miscellaneous Structures, 4.1.2 Minor Bridge Design, 4.2.2, Major Bridge Design - Steel."*

Ms. Robin Malacrea, Vice President / Marketing & Communications, indicated the following in an email to Ms. Carliayn Kell, FDOT's Professional Services Qualification Administrator, dated December 28, 2016:[57]

"*With regard to work type 4.2.1 – previous qualifiers are no longer with the firm. To keep it as simple as possible for now I omitted seeking this work type and will submit new qualifiers when we have this settled. We are currently not pursuing anything in concrete bridge design."*

Ms. Carliayn Kell, FDOT's Professional Services Qualification Administrator, indicated the following in a letter to Mr. Ernesto Polo, Associate Vice President of Louis Berger, dated January 17, 2017:[58]

"*The Florida Department of Transportation has reviewed your application for qualification package and determined that the data submitted is adequate to technically qualify your firm for the following types of work:*

Group 4 – Highway Design – Bridges

2.1.1 - Miscellaneous Structures
2.1.2 - Minor Bridge Design
4.2.2 - Major Bridge Design – Steel
4.3.2 - Complex Bridge Design – Steel"

[57]Email from Ms. Robin Malacrea of Louis Berger to Ms. Carliayn Kell of FDOT dated December 28, 2016.
[58]Letter from Ms. Carliayn Kell of FDOT to Mr. Ernesto Polo of Louis Berger dated January 17, 2017.

22. Redundancy

22.1. AASHTO Guidance on Redundancy

This section includes the general guidance from AASHTO and FDOT on redundancy for different bridge use types and bridge structure types. Redundancy factor tables shown in Factual Report Section 22.2 from FDOT Structures Design Guidelines (SDG), Section 2.10 are applicable to steel superstructure types and are not applicable to concrete superstructure types. Redundancy factors are included in the tables for "Concrete C–Piers, Straddle Piers, or Piers located over roadways." The FIU pedestrian bridge has a concrete superstructure. Although these tables are not applicable to concrete superstructure types, they are included to document that both AASHTO and the SDG recognize and discuss redundancy as a critical element of the design process which must be properly considered when designing such structure types.

For the design of Steel Structures, Section 6, of the American Association of State Highway and Transportation Officials (AASHTO) Load and Resistance Factor Design (LRFD) Bridge Design Specification defines Redundancy and Redundant Member as the following:[59]

"*Redundancy – The quality of a bridge that enables it to perform its design function in a damaged state.*

Redundant Member – A member whose failure does not cause failure of the bridge."

Both Sections 1 and 6 of LRFD discuss the importance of redundancy. However, neither the general Introduction (Section 1 of LRFD), nor LRFD Section 5 – design of Concrete Structures, include the above definitions.

The AASHTO LRFD Bridge Design Specifications Introduction Section 1 further discussed redundancy as the following:[60]

"***1.3.4 – Redundancy***

Multiple-load-path and continuous structures should be used unless there are compelling reasons not to use them.

For the strength limit state:

$\eta_R \geq 1.05$ *for nonredundant members*

$\eta_R = 1.00$ *for conventional levels of redundancy*

[59]AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014, with 2015 Interims, Section 6: Steel Structures, page 6-7.
[60]AASHTO LRFD Bridge Design Specifications, 7th Edition, 2014, with 2015 Interims, Section 1: Introduction, pages 1-4 through 1-7.

$\eta_R \geq 0.95$ for exceptional levels of redundancy beyond girder continuity and a torsionally-closed cross-section

For all other limit states:

$\eta_R = 1.00$"

Where η_R = a factor relating to redundancy as specified in Article 1.3.4.

The AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges does not provide a discussion regarding redundancy.[61]

22.2. FDOT Guidance on Redundancy

The FIU design criteria, as discussed earlier in the Bridge Factors Factual Report under 4. FIU - UniversityCity Prosperity Project – Pedestrian Bridge Design Criteria, was intended to provide general guidance for the architectural and structural elements of the pedestrian bridge and indicated the following regarding redundancy:[62]

"***4.12 Redundancy and Operational Importance***

The operational importance factor shall be 1.00 for all limit states. Redundancy factors shall be determined in accordance with SDG Section 2.10."

FDOT's Structures Design Guidelines (SDG) Section 2.10 was written primarily for vehicular bridges and indicated the following regarding redundancy:[63]

"***2.10 Redundancy and Operational Importance [1.3.4 and 1.3.5]***

A. Redundancy [1.3.4]

Delete the Redundancy Factors, η_R, in LRFD [1.3.4] and use $\eta_R = 1.0$ unless a revised value is established in the tables below.

Redundancy Factors, η_R for Flexural and Axial Effects	
Structure Type	***η_R Factor***
Welded Members in Two Truss/Arch Bridges	*1.20*
Floor beams with Spacing > 12 feet and Non-Continuous Stringers and Deck	*1.20*
Floor beams with Spacing > 12 feet and Non-Continuous Stringers but with Continuous Deck	*1.10*

[61]AASHTO LRFD Guide Specifications for the Design of Pedestrian Bridges, December 2009, 30 pages.
[62]FIU - UniversityCity Prosperity Project – Pedestrian Bridge, Design Criteria, June 2014, T.Y. Lin International, page 11.
[63]Florida Department of Transportation (FDOT) Structures Design Guidelines (SDG), Structures Manual Volume 1, January 2015, pages 2-19 through 2-20.

Steel Piers (Caps, columns, C-Piers, Straddle Piers, etc.)	*1.20*
Concrete C-Piers and Straddle Bents or Piers located over roadways	*1.05*

Redundancy Factors, η_R for Steel Girder Bridges						
Number of Girders in Cross Section	***Span Type***	***# of Hinges required for Mechanism***	***I-Girders***		***Box Girders***	
			With Cross-Frames *(Note 1)*	***Without Cross-Frames***	***With Exterior Diaphragms***	***Without Exterior Diaphragms***
2	*Interior*	*3*	*1.20*	*Not Permitted*	*1.00*	*1.20*
	End	*2*	*1.20*	*Not Permitted*	*1.00*	*1.20*
	Simple	*1*	*1.20*	*Not Permitted*	*1.05*	*1.20*
3 or 4	*Interior*	*3*	*1.00*	*Not Permitted*	*1.00*	*1.00*
	End	*2*	*1.00*	*Not Permitted*	*1.00*	*1.05*
	Simple	*1*	*1.00*	*Not Permitted*	*1.00*	*1.10*
5 or more	*Interior*	*3*	*1.00*	*Not Permitted*	*1.00*	*1.00*
	End	*2*	*1.00*	*Not Permitted*	*1.00*	*1.00*
	Simple	*1*	*1.00*	*Not Permitted*	*1.00*	*1.05*

Note 1 – With at least three evenly spaced intermediate cross-frames or floor beams (excluding end cross-frames) in each span.

B. Operational Importance [1.3.5]

Delete the operational importance factors, η_I, in LRFD [1.3.5] and use η_I = 1.0 unless otherwise approved by the Department."

The operational importance has to do with the importance of the structure to the roadway system. Guidelines for classifying critical or essential bridges are based on traffic volumes, detour route lengths, military relevance associated with security and defense, access by emergency vehicles, and span length.

FDOT's Structures Design Guidelines (SDG) Section 10 written for pedestrian bridges does not provide a discussion regarding redundancy, however, provided the following information:[64]

"***10.3 Designer Qualifications***

A. All design calculations and design details or any design changes must be signed and sealed by a Professional Engineer licensed in the State of Florida.

10.4 Design

A. All pedestrian bridge structures shall be designed in accordance with the following:

- *AASHTO LRFD Bridge Design Specifications (AASHTO)*
- *AASHTO Guide Specifications for the Design of Pedestrian Bridges (Guide Spec.)*
- *FDOT Plans Preparation Manual (PPM)*
- *FDOT Structures Manual*"

FDOT Structures Design Office (SDO) and their subconsultants (refer to Section 18 for list of plan submittal reviewers) reviewed the superstructure plans at the 30% Preliminary, 90%, Final and Released for Construction (RFC) stages. Documented ERC review comments from FDOT SDO or their subconsultants did not question redundancy, however, FDOT's recollection indicates the issue of redundancy was discussed as part of a general discussion of FIGG's proposed bridge concept in a meeting between FDOT, FIU and FIGG on 6/30/2016, and FIGG's recollection indicates the issue of redundancy was not discussed.

23. Meeting on March 15, 2018 before the collapse

A meeting requested by BPA took place on March 15, 2018 at 9:00 a.m. at the MCM field office between FIGG, MCM, FDOT, FIU and BPA to discuss the temporary construction loading condition (structure cracks) and the temporary mechanism to capture the nodal zone at member 11 and 12. BPA developed hand written meeting minutes during the meeting and circulated the typed document for comment on March 20, 2018, five days after the collapse. Having received no comments from any of the parties present at the meeting, the meeting minutes were incorporated into the project documentation. BPA and MCM have since revised the meeting minutes accordingly and they are included in this report as Attachment 30 - "BPA 3/15/18 Meeting Minutes". FIGG provided meeting minutes directly to NTSB sometime later that included review comments to the BPA 3/15/18 Meeting Minutes and their understanding of the discussion at the meeting. These minutes are included in this report as Attachment 31 - "FIGG 3/15/18 Meeting

[64]Florida Department of Transportation (FDOT) Structures Design Guidelines (SDG), Structures Manual Volume 1, January 2015, page 10-1.

Minutes". The power point presentation given by FIGG at the March 15, 2018 meeting is included as Attachment 32 – "FIGG 3/15/18 Power Point Presentation".

24. Structural damage identification and assessment communication

Table 8 summarizes the structural damage identification and assessment communication regarding the cracks in the Node #11/#12 region and north face of Diaphragm II after movement of the main span and destressing of the post tensioning bars in members 2 and 11 on March 10, 2018.

Table 8 – Structural damage identification and assessment communication

Date	Time	Description of Document	Notes on Structural Damage Identification and Assessment Communication	Attachment Number
3/10/18	1:32 p.m. to 1:44 p.m.	FIU Construction Webcam	Views of main span where truss member 11/12 nodal area and Type II diaphragm is being inspected by field personnel	FIGG's Photo Submission FCA 23-1
3/10/18	3:12 p.m. to 3:30 p.m.	FIU Construction Webcam	View of main span where truss member 11/12 nodal area is being inspected by field personnel	FIGG's Photo Submission FCA 23-2
3/10/18	3:16 p.m.	MCM-NTSB-OSHA 005549	View of cracks at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 62
3/10/18	3:16 p.m.	MCM-NTSB-OSHA 005550	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 63
3/10/18	3:17 p.m.	MCM-NTSB-OSHA 005551	View of cracks at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 64
3/10/18	3:17 p.m.	MCM-NTSB-OSHA 005553	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 65
3/10/18	3:18 p.m.	MCM-NTSB-OSHA 005555	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 66
3/10/18	5:49 p.m. to 6:00 p.m.	FIU Construction Webcam	View of main span where truss member 11/12 nodal area and Type II diaphragm is being inspected by field personnel	FIGG's Photo Submission FCA 23-3
3/10/18	6:01 p.m.	FIU Construction Webcam	View of main span when SW 8th Street was opened to vehicular traffic. The fully assembled SPMT was located in the staging area next to the bridge.	FIGG's Photo Submission FCA 23-6

3/10/18	6:48 p.m.	Email from MCM to Miami-Dade County	Email from Edwin Vega of MCM to Evelin Legcevic of Miami-Dade County stating “Lane closure on sw 8st is complete. Please have your team readjust the signals at your convenience.”	FIGG’s Attachment Submission FCA 23-4
3/10/18	6:49 p.m.	Email from MCM to FDOT	Email from Edwin Vega of MCM to Rulx Belizaire of FDOT stating “Lane closure on sw 8st is completed. Please remove advisory at your earliest convenience.”	FIGG’s Attachment Submission FCA 23-5
3/10/18	6:53 p.m.	Email from MCM to FDOT/FL Turnpike	Email from Edwin Vega of MCM to Karla Smith of FDOT FL Turnpike stating “Closure on sw 8st is complete. Please remove advisory at earliest convenience.”	FIGG’s Attachment Submission FCA 23-7
3/10/18	7:08 p.m.	Structural Technologies, LLC ST000014 – ST000020	Texts from Kevin Hanson mobile device indicating “It cracked like hell”.	Bridge Factors Attachment 23
3/12/18	9:46 a.m.	MCM-NTSB-OSHA 005571	View of cracks on north face of Diaphragm II on west side.	Bridge Factors Photo 67
3/12/18	9:49 a.m.	MCM-NTSB-OSHA 005573	View of cracks on north face of Diaphragm II on west side.	Bridge Factors Photo 68
3/12/18	10:01 a.m.	MCM-NTSB-OSHA 005575	View of cracks on north face of Diaphragm II on east side.	Bridge Factors Photo 69
3/12/18	10:20 a.m.	MCM-NTSB-OSHA 005576	View of cracks on south face of Diaphragm II on east side.	Bridge Factors Photo 70
3/12/18	10:20 a.m.	MCM-NTSB-OSHA 005577	View of crack in cut-out for drain pipe under deck.	Bridge Factors Photo 71

3/12/18	4:51:53 p.m.	FIGG Bridge Engineers, Inc. FBE000126 – FBE000144	Email from Rodrigo Isaza of MCM to Dwight Dempsey of FIGG transmitting photographs of cracks at Diaphragm II and Node #11/#12 region. Sixteen (16) photos were provided with all photos provided focusing on the Type II Diaphragm except for two photos of the Node #11/#12 region. First time FIGG says it learned of cracks at Diaphragm II after the move. No crack report was provided, however, photos of the cracks were provided.	Bridge Factors Attachment 24
3/13/18	9:45 a.m.	FIGG Bridge Engineers, Inc. FBE000145 – FBE000146	Email from Dwight Dempsey of FIGG to Rodrigo Isaza of MCM stating "FIGG is evaluating this situation as a top priority and will be making recommendations as a result of this evaluation. As of right now, we do not see this as a safety issue but we do recommend that MCM place plastic shims (same as currently being used) underneath the Type 2 diaphragm at the centerline of the bridge (this is a 2'-10.5" x21" area)." "1. MCM observed cracks in the Type 2 diaphragm on Saturday afternoon after the SPMT were driven back to the staging area and before the temporary PT bars were destressed. It was noted that FIGG inspection of the main span in this area after the bridge move did not observe this behavior. It is not clear as to when this behavior occurred." "3. Since Saturday afternoon, MCM has been monitoring the	Bridge Factors Attachment 25

			cracks and they have not grown in size." "4. This behavior is only being observed on the north face of the Type 2 diaphragm. It is not seen on the south face." "FIGG will be back in contact with MCM to give updates and recommendations from evaluations."	
3/13/18	10:59 a.m.	Bolton – Perez and Associates	Report #3 – Email from Jose Morales of BPA to Rodrigo Isaza of MCM recommending that cracks at Diaphragm II and Node #11/#12 region be monitored and documented for growth to determine if they are active and developing further or dormant.	Bridge Factors Attachment 26
3/13/18	11:16:50 a.m.	MCM-NTSB-OSHA 005582	View of cracks along west side of Diaphragm II looking to the north showing crack is approximately 4 inches deep.	Bridge Factors Photo 74
3/13/18	11:17:04 a.m.	MCM-NTSB-OSHA 005583	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 75
3/13/18	11:18:50 a.m.	MCM-NTSB-OSHA 005588	View of crack along bottom of diagonal support #11 on west side showing crack is approximately 6 inches deep.	Bridge Factors Photo 77
3/13/18	11:20:19 a.m.	MCM-NTSB-OSHA 005589	View of crack along bottom of diagonal support #11 on east side.	Bridge Factors Photo 78
3/13/18	11:25:33 a.m.	MCM-NTSB-OSHA 005593	View of crack in Node #11/#12 region on west side showing crack is approximately 0.5 inch deep.	Bridge Factors Photo 79
3/13/18	11:26:36 a.m.	MCM-NTSB-OSHA 005594	View of cracks at the bottom of diagonal support #11 on west side looking to the east showing folding rule inside crack.	Bridge Factors Photo 80

3/13/18	12:02 p.m.	Email from MCM to FIGG	Email from Rodrigo Isaza of MCM to Dwight Dempsey of FIGG stating "As just discussed, we are glad to hear that upon further evaluation by your team, this matter does not pose a safety issue and/or concern. We are also proceeding to install the temporary shims (plastic/metal), as recommended, later today and will provide you with the additional photos requested. Moreover, we will be monitoring the cracks to ensure these do not develop further."	FIGG's Attachment Submission FCA 23-8
3/13/18	1:02:14 p.m.	MCM-NTSB-OSHA 005595	View of crack at the bottom of diagonal support #11 on east side looking to the west showing crack is 1 inch wide at one location.	Bridge Factors Photo 81
3/13/18	1:11:16 p.m.	MCM-NTSB-OSHA 005598	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 82
3/13/18	1:17:46 p.m.	MCM-NTSB-OSHA 005604	View of cracks at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 83
3/13/18	1:29:15 p.m.	MCM-NTSB-OSHA 005614	View of cracks at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 84
3/13/18	1:44:41 p.m.	MCM-NTSB-OSHA 005629	View of cracks at the bottom of diagonal support #2 on west side looking to the southeast.	Bridge Factors Photo 85
3/13/18	1:44:53 p.m.	MCM-NTSB-OSHA 005632	View of cracks at the bottom of diagonal support #2 on west side looking to the east.	Bridge Factors Photo 86
3/13/18	4:13 p.m.	Voice mail message from Denney Pate of FIGG to Tom Andres of FDOT	"but from a safety perspective we don't see that there's any issue there so we're not concerned about it from that perspective"	

3/13/18	5:18:22 p.m.	FIGG Bridge Engineers, Inc. FBE000147 – FBE000151	Email from Dwight Dempsey of FIGG to Rodrigo Isaza of MCM stating "Please find the additional recommendations and requests below that FIGG thinks will be beneficial to the structure. Again, we have evaluated this further and confirmed that this is not a safety issue. 1. It is recommended to reinstall the (2) 1-3/8" temporary pt bars in truss member 11 as shown on plan sheet B-38. These are oriented with one bar at top and one bar at bottom of the member section. The temporary pt bars in truss member 2 do not need to be reinstalled or restressed. 2. Both pt bars should be stressed to the 280 kips stressing force as listed on plan sheet B-69 and these bars should be stressed in 50 kip increments each, starting with the top pt bar, then bottom pt bar, then back to the top pt bar, etc. The type 2 diaphragm should be closely monitored during this pt bar stressing process to ensure that the crack size does not increase. Based on our evaluation, we anticipate that the crack size will either remain the same or more probably decrease in size. If the crack size increases, the pt bar stressing shall stop and FIGG be notified immediately."	Bridge Factors Attachment 27
3/14/18	10:50 a.m.	Structural Technologies, LLC ST000006 –	"FIGG has further evaluated and confirmed that the cracks encountered on the diaphragm do	Bridge Factors Attachment 28

		ST000013	not pose a safety issue and/or concern"	
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 89
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the west.	Bridge Factors Photo 90
3/14/18	1:42 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 and vertical support #12 on east side looking to the west.	Bridge Factors Photo 91
3/14/18	1:45 p.m.	Bolton – Perez and Associates	View of cracks being monitored at the bottom of diagonal support #11 and vertical support #12 on west side looking to the east.	Bridge Factors Photo 92
3/14/18	1:46 p.m.	Bolton – Perez and Associates	View of cracks at the bottom of diagonal support #11 and vertical support #12 on west side looking to the east.	Bridge Factors Photo 93
3/14/18	1:47 p.m.	Bolton – Perez and Associates	View of cracks being monitored at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 94
3/14/18	1:47 p.m.	Bolton – Perez and Associates	View of crack being monitored at the bottom of diagonal support #11 on west side looking to the east.	Bridge Factors Photo 95
3/14/18	1:50 p.m.	Bolton – Perez and Associates	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 96
3/14/18	1:50 p.m.	Bolton – Perez and Associates	Top view of cracks along east side of Diaphragm II.	Bridge Factors Photo 97
3/14/18	1:51 p.m.	Bolton – Perez and Associates	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 98
3/14/18	1:51 p.m.	Bolton – Perez and Associates	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 99

3/14/18	1:51 p.m.	Bolton – Perez and Associates	View of crack being monitored on the west side of vertical support #12 looking to the east.	Bridge Factors Photo 100
3/14/18	1:51 p.m.	Bolton – Perez and Associates	View of crack being monitored on the west side of vertical support #12 looking to the east.	Bridge Factors Photo 101
3/14/18	2:58 p.m.	Structural Technologies, LLC ST000006 – ST000013	Email from Sam Nunez of Structural Technologies to Rodrigo Isaza of MCM transmitting attached change order for rushed request to restress diagonal support #11. Mr. Nunez requests approval of change order in order to send Structural Technologies personnel to travel and arrive on-site tomorrow between 9:30 a.m. and 10:00 a.m.	Bridge Factors Attachment 28
3/15/18	9:00 a.m.	Power point presentation given by Mr. Denney Pate (engineer of record) of FIGG at 9:00 a.m. meeting	"And therefore there is no safety concern relative to the observed cracks and minor spalls"	Bridge Factors Attachment 32
3/15/18	9:00 a.m.	BPA 3/15/18 Meeting Minutes	"FIGG assured that there was no concern with safety of the span suspended over the road"	Bridge Factors Attachment 30
3/15/18	9:00 a.m.	FIGG 3/15/18 Meeting Minutes	"Based on the discussions at the meeting no one expressed concern with safety of the span suspended over the road"	Bridge Factors Attachment 31
3/15/18	9:10 a.m.	Email from BPA to FDOT	Email from Rafael Urdaneta of BPA to Saud Khan of FDOT stating that MCM is required to close 2 lanes west bound on SW 8th Street on 3/15/2018.	FIGG's Attachment Submission FCA-S5

3/15/18	10:53 a.m.	FIU Associate Vice-President of Facilities Management	View of cracks and delamination at the bottom of diagonal support #11 on east side looking to the northwest.	Bridge Factors Photo 102
3/15/18	10:55 a.m.	FIU Associate Vice-President of Facilities Management	View of cracks at the bottom of diagonal support #11 on west side looking to the northeast.	Bridge Factors Photo 103
3/15/18	10:55 a.m.	FIU Associate Vice-President of Facilities Management	Top view of cracks along west side of Diaphragm II.	Bridge Factors Photo 104

25. Authority to close a bridge to protect the safety of the travelling public

FDOT has plenary authority over state right of way and state bridges in the state of Florida and may direct or authorize partial or complete road closures as necessary. Because the signature pedestrian bridge was a LAP project, FDOT had no inspector on site monitoring the construction of the bridge, nor was it required too. The contract between FIU and Bolton Perez & Associates, the Construction Engineering Inspector (CEI), that was discussed earlier in the Bridge Factors Factual Report under Exhibit B – CEI Comprehensive Scope of Services 2.0 Scope, and 8.0 Performance of the Consultant, summarized the Consultant (BPA) Scope of Services and Performance of the Consultant. Pursuant to Section 4.1.3 and 4.1.4 of the Construction Project Administration Manual (CPAM):[65]

> *"**4.1.3 Background***
>
> *The Department must ensure the Consultant CEI is performing services in accordance with the scope of services and the contract.*

[65]Construction Project Administration Manual (CPAM), Florida Department of Transportation State Construction Office, Effective: July 1, 2002, Revised: November 2, 2012, Section 4.1 Administration of Consultant CEI Contracts, pages 4-1-1 through 4-1-5.

4.1.4 Role of Consultant CEI

The Department has representation in administering construction projects through Professional Services contracts. Hence, the authority of the CCEI firm's lead person, such as the Senior Project Engineer, and the CCEI Project Administrator shall be identical to the Department's Resident Engineer and Project Administrator respectively and shall be interpreted as such. The Consultant is required to exercise their professional judgment in performing their obligations and responsibilities under the contract. However, the Consultant must seek input from the Construction Project Manager. Therefore, the Department vests the Consultant with the responsibility of administering the project(s) and to implement actions based on their authority, subject to the requirements of ***Section 4.1.6****."*

BPA's authority on a project is a collective effort between the Consultant and FDOT/FIU and the Consultant does not have the authority to act on its own. Additionally, Section 4.1 of the CPAM sets forth direction concerning the administration of the Consultant CEI contract and provides FDOT/FIU with procedures for evaluating the performance of the Consultant.

The following language was provided in the contract between FIU and Bolton Perez & Associates, Exhibit B – 8.0 Performance of the Consultant:

*"**8.0 PERFORMANCE OF THE CONSULTANT:***

During the term of this Agreement and all supplemental amendments thereof, the Department and/or FIU will review various phases of Consultant operations, such as construction inspection, materials sampling and testing, and administrative activities, to determine compliance with this Agreement. The Consultant shall cooperate and assist representatives in conducting the reviews. If deficiencies are indicated, remedial action shall be implemented immediately. Recommendations and Consultant responses/actions are to be properly documented by the Consultant. No additional compensation shall be allowed for remedial action taken by the Consultant to correct deficiencies."

This language is similar to the language in the CPAM Section 4.1.12 Consultant Performance:

*"**4.1.12 Consultant Performance***

Resident Level Responsibilities

During the early stages of the construction project, the Construction Project Manager shall thoroughly evaluate the performance of the CCEI Firm to ensure the CCEI Firm is demonstrating the necessary knowledge, skills and experience to make decisions in accordance with the Consultant's Contract. Any deficiencies in the performance of the CCEI Firm will necessitate remedial action, including but not limited to, reassignment of personnel, replacement of personnel, and increase in the frequency of monitoring and inspection activities, and increase the scope and frequency of training of the Consultant personnel."

The CPAM provided recommended actions to shut down a project due to maintenance of traffic (MOT) deficiencies:[66]

> *"**9.1.8 Recommended Action to Shut Down a Project Due to MOT Deficiencies***
>
> *(1) Any MOT deficiency noted that is considered a severe hazard and life threatening will require immediate corrective action by the Contractor. Failure to correct the hazard immediately is basis to shut down the project and obtain other means to correct the hazard."*

Although BPA's authority is identical to the FDOT Resident Engineer, the CEI does not have complete authority to act on its own, it acts collectively with FDOT/FIU providing recommendations and advise as stated in the CEI Scope of Work.

Further, the contract between FIU and Bolton Perez & Associates, indicated under 9.0 Requirements of the Consultant, that it was the responsibility of BPA to administer, monitor, and inspect the construction contract such that the project was constructed in reasonable conformity with the plans, specifications, and special provisions for the construction contract. BPA was required to observe MCM's work to determine the progress and quality of work and identify discrepancies, report significant discrepancies to FIU, and direct MCM to correct such observed discrepancies. BPA was also required to advise the FIU's Construction Project Manager of any significant omissions, substitutions, defects, and deficiencies noted in the work of MCM and the corrective action that had been directed to be performed by MCM. Work provided by BPA did not relieve MCM of responsibility for the satisfactory performance of the construction contract.

The contract between FIU and MCM, the Design-Build firm, that was discussed earlier in the Bridge Factors Factual Report under 5-13 Authority and Duties of Engineer's Assistants, stated FIU's Associate Vice President of Facilities Management may appoint Engineer's assistants who are authorized to call to the attention of MCM any failure of the work or materials to meet the contract documents, and have FIU to reject materials or suspend the work until any questions at issue can be referred to and decided by FIU's Associate Vice President of Facilities Management or his/her duly authorized representative. FIU's Associate Vice President of Facilities Management will immediately notify MCM in writing of any such suspension of the work, stating in detail the reasons for the suspension. The presence of the Engineer's assistants in no way lessens the responsibility of MCM.

Further, the contract between FIU and MCM, indicated under 7-15 Design-Build Firm's Responsibility for Work, until acceptance by FIU, the work shall be under the charge and custody of MCM. MCM shall take every necessary precaution against injury or damage to the work by the action of the elements or from any other cause whatsoever arising either from the execution or non-execution of the work and shall rebuild, repair, restore and make good, without additional compensation, all injury or damage to any portion of the work.

[66]Construction Project Administration Manual (CPAM), Florida Department of Transportation State Construction Office, Effective: July 1, 2002, Revised: April 11, 2014, Section 9.1.8 Recommended Action to Shut Down a Project Due to MOT Deficiencies, page 9-1-4.

The contract between MCM and FIGG, the Engineer of Record (EOR), that was discussed earlier in the Bridge Factors Factual Report under Article 2 – Design Consultant's Services and Responsibilities and Article 3 – Design-Builder's Services and Responsibilities, stated that FIGG will, at its own cost, revise any interim design submission or the construction documents to correct any of its errors, mistakes or omissions. Such revisions shall be performed timely and so as not to jeopardize the design schedule and/or the project schedule. FIGG shall promptly notify MCM of any defects, deficiencies, deviations, omissions, or violations observed by FIGG in the construction of the project, and make recommendations to MCM on how to proceed. At the request of MCM, FIGG shall attend meetings with MCM and FIU and/or Subcontractor(s) and Sub-Subcontractors to discuss design issues which may arise during construction. FIGG's provision of the construction phase services shall not be construed to make FIGG responsible for (i) the acts or omissions of MCM, any Subcontractors, or any Sub- Subcontractors, (ii) the means, methods, sequences, and techniques of construction of the project or (iii) safety precautions and programs in connection with the construction of the project. MCM shall notify FIGG of any errors, inconsistencies, or omissions MCM discovers in the services, including basis for design documents, any interim design submissions, construction documents or other services. Nothing in this agreement shall relieve FIGG of responsibility for errors, inconsistencies, or omissions in the services.

FDOT's Standard Specifications for Road and Bridge Construction, Division II – *Construction Details* indicated all contractors are required to have a traffic control plan as part of the project documentation that reflects needed lane closures and a Worksite Traffic Supervisor who "*immediately corrects all safety deficiencies and does not permit minor deficiencies that are not immediate safety hazards to remain uncorrected for more than 24 hours.*"[67]

Florida's Administrative Code provides the following definition of the Engineer of Record: "*A Florida professional engineer who is in responsible charge for the preparation, signing, dating, sealing and issuing of any engineering document(s) for any engineering service or creative work.*"[68] The Code further provides:[69]

> *"As used in Chapter 471, F.S., and in these rules where the context will permit the following terms have the following meanings:*
>
> *(1) "Responsible Charge" shall mean that degree of control an engineer is required to maintain over engineering decisions made personally or by others over which the engineer exercises supervisory direction and control authority. The engineer in responsible charge is the Engineer of Record as defined in subsection 61G15-30.002(1), F.A.C.*
>
> *(a) The degree of control necessary for the Engineer of Record shall be such that the engineer:*

[67]Florida Department of Transportation Standard Specifications for Road and Bridge Construction, Division II – Construction Details, Section 102 Maintenance of Traffic, 102-3.2 Worksite Traffic Supervisor, January 2015, page 108.
[68]Florida Administrative Code 61G15-30.002 Definitions Common to All Engineer's Responsibility Rules.
[69]Florida Administrative Code 61G15-18.011 Definitions.

1. Personally makes engineering decisions or reviews and approves proposed decisions prior to their implementation, including the consideration of alternatives, whenever engineering decisions which could affect the health, safety and welfare of the public are made. In making said engineering decisions, the engineer shall be physically present or, if not physically present, be available in a reasonable period of time, through the use of electronic communication devices, such as electronic mail, videoconferencing, teleconferencing, computer networking, or via facsimile transmission."

The Local Agency Program (LAP) agreement executed on June 23, 2014 by FIU and FDOT indicated the signature pedestrian bridge project will be performed in accordance with all applicable FDOT procedures, guidelines, manuals, standards, and directives.

FDOT's policy for Design-Build contracts mandates that if a firm does the design, they are prohibited from doing any CEI services during construction. This means the designer is not on site to review construction. See FDOT Professional Consultant Contract Administration Procedures and Guidelines 375-030-006 – Conflict of Interest Procedure for Department Contracts (See FIGG's Attachment Submission FCA 24-1).

FDOT has an automated system to facilitate lane closures with the corresponding municipalities and contractors. MCM, in accordance with its agreement with FIU, was responsible for all means and methods for the construction including road closing for construction (See FIU and MCM Contract).

- On January 31, 2018, MCM requested and FDOT issued a two-lane blanket road closure from January to April 27, 2018 for westbound traffic on SW 8th Street. The limits of the two-blanket road closure extended from SW 112th Avenue to 500 feet west of SW 107th Avenue. The purpose of the two-lane blanket road closure was on a as needed basis by MCM. The two-lane blanket road closure was approved by FDOT on February 6, 2018.

- MCM engaged FIGG to assist MCM with the application for one permit for closing SW 8th street in order to perform the span move. See Change Order No. 8 to the MCM and FIGG Agreement. On December 12, 2017, FIGG requested on behalf of MCM, and FDOT worked with local municipalities and permitted a full closure of SW 8th Street for the move of the precast concrete bridge main span to the final position over SW 8th Street. The general use permit included the bridge movement plans. The general use permit was approved by FDOT on February 5, 2018.

Table 9 summarizes the key personnel from BPA, MCM, FIGG, and FIU as it relates to the signature pedestrian bridge with a description of their titles and duties.

Table 9 – Summary of key personnel from BPA, MCM, FIGG, and FIU

Name	Firm	Project Title	Duties
Rafael Urdaneta	BPA	Project Administrator	Oversee the project was constructed according to all pertinent contract documents.
Jose Morales, P.E.	BPA	Senior Project Engineer	Manage inspection staff budget and hours. Manage CEI contract budget, invoicing and CEI contract changes.
Carlos Chapman	BPA	Senior Inspector	Field inspector; keep track and perform all pertinent testing for materials incorporated in the project.
Alex Molina	The Corradino Group, Inc.	Senior Inspector	Field inspector; verifying the stressing and destressing of post tensioning bars was done according to all pertinent contract documents.
Rodrigo Isaza	MCM	Senior Project Manager	Overall Project management and supervision; owner (FIU) correspondence; owner negotiations; owner coordination; subcontractor correspondence; and design coordination.
Ernesto Hernandez	MCM	Superintendent	Subcontractor coordination; survey coordination; pre-task checklists; and equipment coordination.
Pedro Cortes	MCM	Quality Control Technician	Maintaining material certifications and log maintenance; and general quality control duties.
Denney Pate, P.E.	FIGG	Engineer of Record (EOR)	Lead technical designer for the FIU pedestrian bridge working with the FIGG design team.
Dwight Dempsey, P.E.	FIGG	Design Manager	Supervised the FIGG design team services for the design of the FIU pedestrian bridge.
Manuel Feliciano, P.E.	FIGG	Project Engineer	Oversaw the design of the FIU pedestrian bridge working with the EOR, Design Manager, and FIGG design team.

Franklin Hines, P.E.	FIGG	Bridge Engineer	Assisted with the review of construction contractor submittals and provided assistance to the construction contractor upon request three times.
Eddy Leon, P.E.	FIGG	Bridge Engineer	Assisted with the design of the FIU pedestrian bridge.
Erika Hango, P.E.	FIGG	Bridge Engineer	Assisted with the design of the FIU pedestrian bridge.
Kenneth Jessell	FIU	Senior Vice President and CFO	Executive Sponsor. Provided senior executive university leadership throughout project, coordinating FIU efforts with local, state and federal agencies.
John Cal	FIU	Associate Vice President of Facilities Management	Responsible for the overall execution of the construction project from FIU's perspective.
Patrick Meagher	FIU	Director, Construction Management	Served as back-up to Project Manager; participated in most meetings and conference calls.
Alberto Delgado	FIU	Assistant Director, Construction	FIU Construction Project Manager. Acted as primary university representative/liaison for design and construction.

Although closing a bridge or other safety measures during construction on past FDOT projects due to safety concerns is somewhat rare, it has and does occur on FDOT projects. The more typical case is where the Construction Engineering Inspector (CEI) orders the Contractor to abandon an operation because of safety issues during nighttime operations requiring lane closures. Examples provided by FDOT in which the closure of a bridge had occurred to protect the safety of the travelling public included the following:

- Skyway Bridge Transition Pier Bearing Replacement, St. Petersburg, Florida, December 2015 – During existing bridge bearing pad replacements operations, where traffic was permitted on the bridge after jacking, spalling of the diaphragms occurred due to the jacking loads. The jacking and bearing replacement operation had to be abandoned at the direction of the Engineer of Record (EOR) and Construction Engineering Inspector (CEI) and the structure placed back onto the existing bearings for safety reasons.

- Memorial Causeway Bridge, Clearwater, Florida, January 2004 – On a balanced cantilever segmental bridge over the Intercoastal Waterway with fixed piers tables where severe pier cracking had occurred, required the Engineer of Record (EOR) and Construction Engineering Inspector (CEI) to direct emergency strong-backs and counterweights on the unfinished cantilever to reduce the out-of-balance pier stresses.

- I-4 Ultimate Project, Orlando, Florida, April 2018 – A c-pier[70] exhibited cracking and the Construction Engineering Inspector (CEI) directed the contractor to shore[71] the c-pier.

26. Videos

The following videos were obtained by NTSB investigators of the March 15, 2018 signature pedestrian bridge collapse and transmitted to the NTSB's Office of Research and Engineering (RE) Recorder Laboratory for further analysis and testing:

- Original video from a driver who was travelling eastbound on SW 8th Street (in the third lane from the right) that captured the bridge collapse on a GoPro camera.

- Original video from the owner of a cell phone that took the individual recording of the bridge collapse on the cell phone of the playback from the Miami Dade County camera located at the southeast corner of the SW 8th Street and SW 109th Avenue intersection. The original video taken from the owner of the cell phone was available, however, the original video from the Miami Dade County camera was not available since the rewind feature only allows play back for 30 minutes after which the video is automatically deleted. It was during this time of available playback when the cell phone video was taken.

- Original video from FIU that captured the bridge collapse from 3 cameras (2 cameras that sit on high parking garages and 1 camera that sits on a high dormitory). The cameras are named Camera 1 Parking Garage 6 (PG6), Camera 2 Parking Garage 5 (PG5), and Camera 3 109 Tower. The video is a compilation of 1-minute time lapse photographs and is not a continuous feed of live video taken over a 24-hour period of the day.

27. Interviews

NTSB investigators with the assistance of the Federal Highway Administration (FHWA) conducted witness interviews of employees affiliated with the following firms and organizations involved with the pedestrian bridge's security, design, inspection, and construction. A copy of the entire transcribed document for each witness interview can be found in the docket for this investigation.

- Sweetwater Police Department
- FIGG Bridge Engineers, Inc.

[70]A c-pier consists of a cantilevered cap that sits on a pier and the footing is also offset from the pier, in the same direction as the cap, to resist the overturning moments more efficiently. Thus, the final shape is a "C". These are used when an obstacle below, usually a roadway, would conflict with the normal placement of the pier.
[71]Shoring is the process of temporarily supporting a structure with shores (props) when in danger of collapse or during repairs or alterations.

- Munilla Construction Management
- Bolton Perez & Associates Consulting Engineers
- Structural Technologies LLC
- Former employee of Louis Berger Engineers
- Florida Department of Transportation
- The Corradino Group, Inc.
- George's Crane Service, Inc.

Table 10 summarizes the witness interview names, organization, date of interview, and whether the interview had been transcribed.

Table 10 – Summary of NTSB / FHWA witness interviews

Witness Interview Name	Organization	Date of Interview	Transcribed
Sgt Adrian Mesa	Sweetwater PD	3-17-18	Yes
Rodrigo Isaza	Munilla Construction Management	3-19-18	Yes
Linda Figg / Alan Phipps	FIGG Bridge Engineers, Inc.	3-20-18	Yes
Rafael Urdaneta	Bolton Perez & Associates	3-20-18	Yes
Denney Pate	FIGG Bridge Engineers, Inc.	3-20-18	Yes
Samuel Nunez	Structural Technologies LLC	3-21-18	Yes
Robert Robertson / Tom Andres	Florida Department of Transportation	3-22-18	Yes
John Jackson	Structural Group of South Florida (TSG)	3-22-18	Yes
Ernesto Hernandez	Munilla Construction Management	3-22-18	Yes
Ramoy Goulbourne	Structural Technologies LLC	4-9-18	Yes
Alex Molina	The Corradino Group, Inc.	4-9-18	Yes
Jose Morales	Bolton Perez & Associates	4-10-18	Yes
Dwight Dempsey	FIGG Bridge Engineers, Inc.	4-10-18	Yes
Carlos Chapman	Bolton Perez & Associates	4-11-18	Yes
Pedro Cortes	Munilla Construction Management	4-11-18	Yes
Ayman Shama	Former employee of Louis Berger	4-27-18	Yes
Franklin Hines	FIGG Bridge Engineers, Inc.	5-17-18	Yes
Manuel Feliciano	FIGG Bridge Engineers, Inc.	6-28-18	Yes
Eddy Leon	FIGG Bridge Engineers, Inc.	6-28-18	Yes
Erika Hango	FIGG Bridge Engineers, Inc.	6-28-18	Yes
Daniel Ruano	George's Crane Service, Inc.	6-29-18	Yes
David Hall	FIGG Bridge Engineers, Inc.	8-14-18	Yes
Jason Stauffer	FIGG Bridge Engineers, Inc.	8-14-18	Yes

Specific information taken from the witness interviews included the following:

"***John Jackson – Structural Group of South Florida (TSG) – Date of Interview: Thursday, March 22, 2018***

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A. Okay. So, we had a verbiage on how to strip the underside of the bridge. So, it as to take out a 30-foot swarth in the middle and then have them come out and look at everything. And he did. We felt the pressure on the shores, you know, it seemed extreme at the time after the stressing. Everybody thought the stressing was going to raise the bridge up off the scaffold to some degree. So, we kept monitoring it. Every day we monitored it four times, our guys, to see if there was any downward, upward. If there's any extra stress on the shores more than it should be because eventually it was supposed the stress -- the weight was supposed to go off to the ends, you know, after you start stripping. So, we did.We did. And then I went -- he gave us a green light to continue. So, we did some more on Friday.

Then Saturday we brought in -- actually, we had a double crew on Friday night. I can check the payroll book, yeah. I'm pretty sure it was a double crew Friday night. And then we had everybody, so we had two crews stripping. One in the morning. And then the other crew came in at 12:00 and worked to 8:00. That's right. I'm sorry. Then Saturday we brought everybody in and we blitz it.

As we were stripping it I looked out of the office and everybody was out from underneath the bridge. I said, oh, shit. So, I ran out there and everybody said, Awe, man, awe man, the bridge went whoop like that. It made a loud noise, just like

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that. They said it made a loud noise. I didn't hear it. I said, well, you guys stand down. I'll go up on top of the bridge to find out what's up.

So, I get up there and both trusses on each end cracked at the bottom where it meets the bridge. They cracked here and on the other one. So, I called Ernie on the radio and had Ernie come up and look with me. And he said, oh, that's normal because they haven't been -- there's no tension on those yet. Okay. So, we called -- I guess he called FIGG, whoever, and they said, no, go ahead and proceed.

So, then we proceeded very slowly because we were about half, maybe three-quarters -- we were very close to the end by that time. So, we finished stripping, monitoring everything with

lasers and instruments to make sure that there as no more further movement. We monitored the -- how much the bridge settled. And it ends up being an inch and three-eighths over all. I asked how much is it supposed settle and nobody had an answer. So, we just kept monitoring. And then once it was all stripped and cleaned out it sat on the shores for 2 weeks.

MR. WALSH: Dan Walsh.

BY MR. WALSH:

Q. What day was that?

A. That it popped, Saturday the 24th.

Q. Of?

A. February.

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Q. February 24th, Saturday?

A. Yes. I thought it was very unusual and we were very leery of the fact that now, you know, if that -- they said if that was the reaction it was supposed to have. They were significant. They were half inch, three-quarters.

Q. Dan Walsh continuing. So, on February 24th, you heard as you characterize a popping --

A. I didn't hear it. No, sir. It was told to me that it made a loud sound. That's why everybody was out from underneath the bridge, equipment too.

Q. And what -- specifically what members were they in the bridge structure?

A. The two very long ones on each end. Yes, sir.

Q. Was there any experience, did you hear of any other popping --

A. No, sir.

Q. -- or monitor any other cracking after February 24th?

A. No, sir. I didn't monitor any more cracking after that. But we did monitor any more movement from underneath the bridge.

Q. And what were the results of that movement?

A. It never went any more than an inch and three-eighths settlement.

Q. Is this documented anywhere?

A. I don't know, sir. I know that Ernie was -- he was the superintendent for MCM was aware of it. And I'm -- God, I hope he

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had called somebody to give us a green light because he gave me the green light.

Q. So, how did you convey this information?

A. I called Ernie and brought him up there, him and Pedro Cortez, the gentleman that got hurt on the thing was up there. Who is our quality control guy. He's been here since day one. And they all looked at it. And we all stood down for an hour while they came up with this is fine. Continue the stripping.
Q. So, you don't know if there was any documentation --
A. No, sir. I think there was pictures taken.
Q. There are some pictures?
A. Yes, sir.

Ayman Shama – Former employee of Louis Berger – Date of Interview: Friday, April 27, 2018

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Q. Dr. Shama, can you please take me through the steps of your independent review of FIGG's design plans?
A. Basically, the steps consisted, first, in order to check the design to make sure that the design is okay, basically to consideration that we are doing a peer review, I have to develop a model for the bridge, a simple model.I would say a stick, simple model for the bridge, simple but sufficient enough to determine the performance of the bridge under different kinds of loads and load combination.
And this model basically was developed with software or a program called ADINA, A-D as David-I-N as Nancy-A. ADINA is one of the most reliable finite element programs, and Caltran usually recommends ADINA for their, for the projects in California. And we have used -- I personally have used the ADINA in previous

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projects, like in the design, for example, of new Tacoma Narrows Bridge, A25 in Canada, several bridges, actually. So I used this computer program for this, in this position, or for this independent check.
The computer program was used actually to develop the demand on the structure due to different loads, different load combinations that are consistent with AASHTO LRFD and FDOT. We considered, or I considered dead load. I considered live load. I considered wind load. I considered temperature changes, and I considered all the load combinations, service load combinations, strength load combinations, that come for checking the design.
Basically, ADINA is -- you have to write, actually, a script with a program. The program takes it and develops a model. And after that, you can run the analysis and look at the results.

Q. Thank you, Dr. Shama. What components of the bridge did you independently review? Can you name the specific components?
A. Yes. I checked the foundation. I checked the pier bents of the substructure. I checked the substructure of the piling, as a substructure, because these are basically a critical element. And I checked all the diagonals of the superstructure, because these are also very critical element. Regarding the deck and the canopy, I went through them quickly by checking the plan, and by looking into the values that I obtained from the computer program.
Q. Thank you. Did -- you said you checked the diagonals. Did you check the nodes as well?

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A. I couldn't get the question. Can you repeat it again, please?
Q. Yes. Dr. Shama, you indicated that you checked all diagonals. Did you check the node members as well?
A. The node members?
Q. Correct.
A. When you say the node members, what do you mean by the node members?
Q. What I mean is the node area, where the, for instance, a diagonal would tie into the canopy or the diagonal would tie into the deck. Did you check those areas as well?
A. My model actually wouldn't handle this. I handled basically the forces in the members themselves, actually.
Q. Okay. So your program analyzed the forces and the members themselves, and not particularly the node area in which it ties into the canopy or the deck?
A. Yes. Doing this requires much more time and budget, which is going to exceed the budget and time agreed about with the designer. I -- in the beginning, I suggested to do this kind of analysis, to analyze the connections. I'm talking about the nodes, or the joints to analyze the connections. However, the budget and time to do this actually was not agreed upon with the designer.[72]
Q. And what -- tell me a little bit just about the time frame that you just indicated. What was your time frame in order to

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conduct the independent review?

[72]An email from Ms. Jamey Barbas of Louis Berger to Mr. Dwight Dempsey of FIGG dated August 11, 2016 indicated that there was "no reduction in scope" despite many back and forth exchanges regarding cost and timing. See FIGG's Attachment Submission FCA 6.5-24 through FCA 6.5-26.

A. The time frame actually, for the agreement with the designer was 7 weeks.
Q. All right. Seven-week time frame?
A. Yes.
Q. Okay. I'm going to ask you about the sequence of construction that is shown on the design plans. Did you review the structure in terms of the different sequence of construction, in particular, the different stages of construction? Or did you just review the entire structure as one structure?
A. My model was for the structure as one structure. Doing construction sequence staging analysis was not part of our scope. And again, doing such an analysis requires much more time than what we agreed about.
Q. I understand. So your analysis was for the entire structure?
A. Yes.
Q. And it did not include the breakdown of the different stages of construction?
A. Yes.

Denney Pate – FIGG Bridge Engineers, Inc. – Date of Interview: Tuesday, March 20, 2018

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Q. Okay. Thank you. Are you aware that the construction engineering inspector had noticed and was documenting the amount of cracking on Monday, Tuesday and Wednesday of that week and was monitoring the growth of that cracking?
A. In the meeting that we had, the BPA personnel noted that they had implemented some sort of, I'll call it, monitoring of those

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cracks. But I did not have any of that data at that time.
Q. At what time were you aware of the cracking of the day and time of the week -- in that week of the growth of the cracks, what time what day and time were you aware of them?
A. Well, we got, you know, the email with the pictures in it. That, obviously, was our first indication there on Tuesday morning when I saw that first thing. And while I was doing my assessment, there was some conversations between one of our individuals and the project manager and the question was what are you guys seeing out there basically. And what he was told and what was repeated to me when I got down here on Thursday morning was that they had been monitoring the cracks, there was some minor changes, but pretty much the same as it was on Saturday afternoon.

Q. So Tuesday morning, Tuesday morning was when you were
A. Well, Tuesday morning is when I saw the cracks --
Q. When you saw the cracks.
A. and verbally Figg was told by -- I'm not sure exactly who it was; I believe it was Rodrigo talking to Dwight, that he would that would have to be followed up on, but I believe that was the communication.
Q. How big were the cracks you saw
A. I don't have any direct records of those, just the photography. The data that BPA was collecting had not yet been provided.
Q. And that amount of cracks would not lend you to believe to

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close the bridge or to initiate any precautionary measures to immediately address those cracks?
A. No. At the time we saw the cracks, obviously the steps were taken to do a separate quick hand calculation type check to see, you know, if this crack pattern and the forces from the members that were known about in that -- I'll call it the nodal region, you know, did it meet, you know, the design criteria requirements in terms of amount of steel, that sort of thing. And as best I could tell from the analysis that I did at that time, which was intended to be a bit conservative and was using I'll call it forces a little bit bigger than what the computer models ended up, you know, had shown, just because that's how I got to it with hand calcs, I concluded that there was sufficient reinforcing steel and post-tensioning forces and all of that to properly confine the node.
Q. So there wasn't any consideration to close the bridge or to
A. In the meetings I had and in the conversations I was a part of, both here on-site and elsewhere, that was never discussed. None of the -- when we were all here together, you know, FIU didn't discuss it; FDOT didn't discuss it; MCM, Figg, no -- it just was not a discussion.
Q. Did you say at the meeting on the morning of -- where you had met with -- on the cracking issue, the morning of the collapse, did you indicate that the cracks were not a specific safety issue?

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A. What I said was that when we -- and the presentation was specifically to show what we had done and what those calculations were telling us or indicating, was that the nodal region appeared

to meet all the criteria and were therefore considered, you know, safe at that moment. There wasn't an imminent safety concern on my part. If there was, I would have said so.
Q. Absolutely. Thank you. Regarding the meeting -- and this was a change to the design plans, the restressing?
A. You could say that, but I would not. (Added correction on 6-13-18)
Q. This was not called for in the design plan. What is the normal process by which something like that is reviewed and the approval process that's given, if you can describe the approval process that's given to a change for something like that? What' s the process it goes through and --
A. We didn't really consider this as a change, because we were getting back to a preexisting condition. So it was not considered a change.
Q. But getting back to the preexisting condition was not something that was called for in the design plans.
A. Correct. It was a response to the observations of what had been seen on-site.
Q. And so, the observations that were seen on-site and the proposal for that, what approval process was done for that?
A. I don't know that I have specifics to give you on that. We made a recommendation to MCM based on judgment that was getting

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back to this preexisting condition, and based on what we had been told about the cracks and their history at that point, that getting back to that preexisting condition was the right thing to do. And so we advised them that that was, you know, what we were thinking.
Q. Did you reach out to anyone indicating that you were doing that, anyone else outside the meeting that you were -- did you contact the Florida Department of Transportation to indicate that you were doing that?
A. I attempted to. As I'm sure you all know, there's the voice mail that I had left for Tom Anders, and the intent was to sort of tell him what was going on and what we had done and what we had seen and what we had recommended.
Q. Did he respond to you -- did you get any response from him?
A. I did not.
Q. So was there an independent review done based on getting back to the preexisting condition?
A. No.
Q. And in your mind would that be something that would typically be done?
A. I would say no. Not if the structure was in a particular

22 state and you -- for some reason construction needed to step back
23 to a preexisting condition using -- basically reverting, you know,
24 what you had just done as an operation, I don't see it as a
25 change. You're simply getting back to that previous condition.

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1 Q. Was there any other issue that was tied to that in terms of a
2 any other decision-making processes that was tied to that? Was
3 it a time-sensitive issue? Was it something that needed to be
4 done quickly?
5 A. We expressed that its something that the contractor should
6 implement when they could. You know, if you're doing something to
7 try to make an improvement, that it seemed prudent to do those as
8 quickly as, you know, might could be implemented. But we did not
9 give specifics on that.

Dwight Dempsey – FIGG Bridge Engineers, Inc. – Date of Interview: Tuesday, April 10, 2018

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12 Q. Okay. And who at FIGG made the final decision that the
13 restressing number 11 PT bars and the observance of the cracks was
14 not a safety concern? Who made that ultimate decision?
15 A. That was collectively discussed as a team with Denney Pate
16 and Alan Phipps and myself, as well as, you know, Franklin Hines
17 and Eddy Leon since they were there on-site. Obviously they
18 didn't see any of this. But that was collectively decided on as a
19 team, that that was the right thing to do. And then that was
20 communicated by myself to MCM both over the phone and then
21 followed up with an email.
22 Q. Okay. Do you believe the restressing of the number 11 PT
23 bars was a change to the design plans?
24 A. Absolutely not. Absolutely not.
25 Q. Was it recommended in the design plans for restressing?

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1 A. It was, it was a statical scheme for the bridge. So that
2 statical scheme was represented in the bridge plans.
3 Q. But I -- the specific recommendation to restress the number
4 11 PT bar on Thursday, March 15, was that a recommendation that
5 was in the design plans?
6 A. Well, that -- I mean it was, it was a statical scheme. It's
7 almost like if I'm placing a girder on bearing supports and I

place it down the first time and it doesn't fall down exactly as intended, I'm going to pick it up, reposition it and then set it back down. It was -- in my mind, that's a similar occurrence here. So it was a statical scheme. It was basically a stage of construction that was detailed in the plans that we were going back to.

Q. Okay. Was it a similar recommendation as the destressing of the number 2 and number 11 bars that was specifically recommended in the design plans?

A. Could you say that again? I wasn't --

Q. Was the restressing of the number 11 PT bar that was conducted on Thursday, March 15 -- was that a similar recommendation as the recommendation to destress the number 2 and number 11 bars?

A. They were both -- if I understand your question correctly, they were both statical schemes or construction stages as outlined in the, in the bridge plans. Did that answer the question?

Q. No, I understand that the restressing of the number 11 bars

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was to address cracking that was observed. Was that part -- was the restressing of the number 11 bars called for in the design plans? Or was it a something that was, that was recommended as part of the cracks that were -- that you had obtained from MCM?

A. Well, if there was, if there was no cracks, I don't think the intent would be to go back in time to go ahead and restress the PT bars that are on the north side.

Q. Okay. So do you believe the restressing of the number 11 PT bars was a manipulation of loads on a member that was not called for in the design plans?

A. No, I do not agree with that.

Q. Was an independent review done of the restressing of the number 11 PT bars?

A. An independent review was done on the statical scheme where those PT bars, temporary PT bars, were stressed. So that -- again, we were -- this is not a new phase. This is not a new statical scheme or a phase that the structure was seeing. This was basically going back to Saturday when that span was in place. So this was not a new structural scheme, structural system. So that's -- I think that's the differentiator there."

28. Vehicles Impacted by the Collapsed Bridge

Figure 16 illustrates the vehicles impacted by the collapsed bridge.

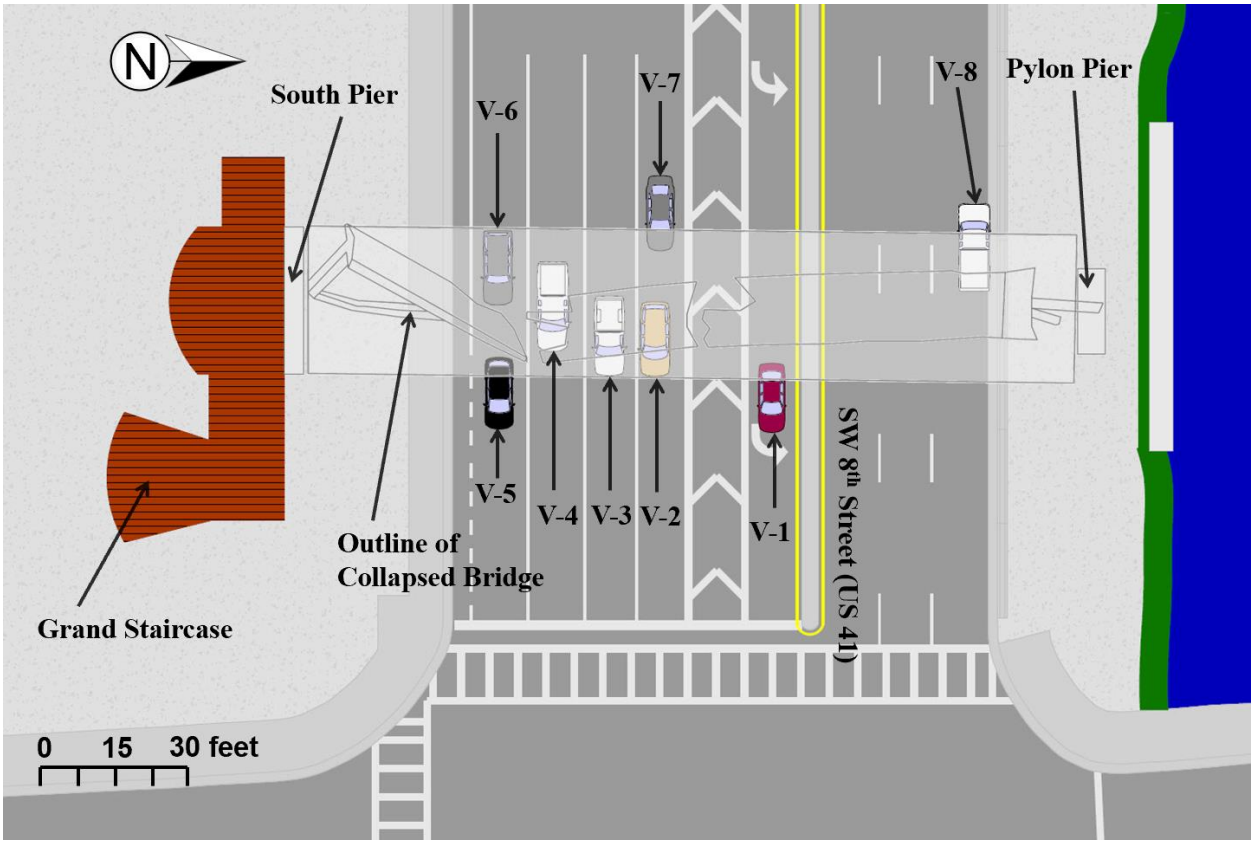


Figure 16 – Vehicles impacted by the collapsed bridge

Table 11 summarizes the vehicles impacted by the collapsed bridge that includes the year, make/model/color, and owner.

Table 11 – Summary of vehicles impacted by the collapsed bridge

Vehicle	Year	Make/Model/Color	Owner
V-1	2008	Honda Civic, Maroon	Joy Panagos
V-2	2015	Jeep Cherokee, Gold	Rolando Fraga Hernandez
V-3	2006	Chevrolet PU 1500, White	Alberto Arias
V-4	2014	Ford PU F250, White	Maxim Crane Works
V-5	2011	Nissan Rogue, Black	Katrina Collazo de Armas
V-6	2008	Toyota 4 Runner, Gray	D'Dago Inc
V-7	2015	Kia Optima, Gray	Carlos Diez
V-8	2014	Chevrolet PU 2500 HD, White	Structural Technologies

29. Diagonal Support #11 and Vertical Support #12 Nodal Zone Design

The Federal Highway Administration (FHWA) is supporting NTSB by providing resources and expertise to evaluate the bridge design and the construction process. This evaluation includes a review and assessment of the available design calculations and construction plans developed by FIGG Bridge Engineers, Inc. for conformance with the appropriate design and construction specifications as well as use of appropriate design and analysis processes.

29.1 AASHTO LRFD Bridge Design Specifications Provisions

The superstructure final design calculations (dated February 2017) for the FIU pedestrian bridge contained design calculations for the connections between the bridge truss elements and the bridge deck and canopy. These calculations followed the AASHTO LRFD Bridge Design Specifications (7th Edition), with interims through 2015 (referred to as AASHTO LRFD through this section). The design used the provisions in Article 5.8.4 titled *Interface Shear Transfer – Shear Friction* for these connections. The nominal interface shear resistance, V_{ni} is calculated using equation 5.8.4.1-3 (shown below).

$$V_{ni} = cA_{cv} + \mu\,(A_{vf}\,f_y + P_c) \qquad (5.8.4.1\text{-}3)$$

where:

A_{cv} = area of concrete considered to be engaged in interface shear transfer (in.^{2})

A_{vf} = area of interface shear reinforcement crossing the shear plane within the area A_{cv} (in.^{2})

b_{vi} = interface width considered to be engaged in shear transfer (in.)

L_{vi} = interface length considered to be engaged in shear transfer (in.)

c = cohesion factor specified in Article 5.8.4.3 (ksi)

μ = friction factor specified in Article 5.8.4.3 (dim.)

f_y = yield stress of reinforcement but design value not to exceed 60 (ksi)

P_c = permanent net compressive force normal to the shear plane; if force is tensile, $P_c = 0.0$ (kip)

The calculated nominal interface shear resistance, V_{ni}, cannot exceed values determined from AASHTO LRFD equations 5.8.4.1-4 and 5.8.4.1-5 (shown below). If these limiting values are exceeded by the calculated interface shear using AASHTO LRFD equation 5.8.4.1-3, the least of the three values shall be used in calculating the nominal interface shear resistance.

$$V_{ni} \le K_1 f'_c A_{cv}, \text{ or} \qquad (5.8.4.1\text{-}4)$$

$$V_{ni} \le K_2 A_{cv} \qquad (5.8.4.1\text{-}5)$$

in which:

$$A_{cv} = b_{vi} L_{vi} \qquad (5.8.4.1\text{-}6)$$

f'_c = specified 28-day compressive strength of the weaker concrete on either side of the interface (ksi)
K_1 = fraction of concrete strength available to resist interface shear, as specified in Article 5.8.4.3.
K_2 = limiting interface shear resistance specified in Article 5.8.4.3 (ksi)

The first term in equation 5.8.4.1-3 calculates a resistance contribution attributed to "cohesion and/or aggregate interlock" which depends "on the nature of the interface under consideration" [quotes are from LRFD 5.8.4.1]. The term is calculated by multiplying a cohesion factor by an area subjected to and assumed to resist interface shear. The design specification recognizes a cohesion factor of 0.24 ksi (Article 5.8.4.3) for "normal weight concrete placed against a clean concrete surface, free of laitance, with surface intentionally roughened to an amplitude of 0.25 in."

In the superstructure final design calculations, two decisions were made regarding this term in equation 5.8.4.1-3. First, the cohesion factor was set of 0.0 ksi [page 1283]. Second, the area subjected to interface shear was defined as the footprint immediately under member 11 at the plane where it met the deck [page 1283]. The design calculations did not use the entire footprint (interface surface) of the member 11 and 12 node.

Together, these design decisions restricted the area of the interface providing resistance to interface shear forces and caused the resistance calculation to rely on the second term in equation 5.8.4.1-3. This term calculates resistance as a function of the "net normal clamping force" crossing the interface plane multiplied by a friction coefficient. The "net normal clamping force" is composed of two elements: the area of interface shear reinforcement crossing the interface shear plane multiplied by the yield strength of the steel and the permanent compressive force normal to

the interface shear plane. The design calculations state that the calculations are being performed for "normal weight concrete placed against a clean concrete surface, free of laitance, with surface intentionally roughened to an amplitude of 0.25 in.". The design calculation used a friction coefficient of 1.0 which is specified in Article 5.8.4.3 for this case.

The AASHTO LRFD provisions require the nominal resistance calculated from the equation above be reduced by multiplying it by a resistance factor, ϕ. This reduced value is called the factored interface shear resistance and designated as V_{ri}. This factored interface shear resistance needs to be greater than the factored interface shear force (demand), designated as V_{ui} for the appropriate strength limit state as specified in AASHTO LRFD Article 5.8.4.1 (shown below).

The factored interface shear resistance, V_{ri}, shall be taken as:

$$V_{ri} = \phi V_{ni} \qquad (5.8.4.1\text{-}1)$$

and the design shall satisfy:

$$V_{ri} \geq V_{ui} \qquad (5.8.4.1\text{-}2)$$

where:

V_{ni} = nominal interface shear resistance (kip)
V_{ui} = factored interface shear force due to total load based on the applicable strength and extreme event load combinations in Table 3.4.1-1 (kip)
ϕ = resistance factor for shear specified in Article 5.5.4.2.1. In cases where different weight concretes exist on the two sides of an interface, the lower of the two values of ϕ shall be used.

29.2 Interface Shear Design Calculations

The superstructure final design calculations (dated February 2017) for the FIU pedestrian bridge contained design calculations for the connection between the bridge truss verticals and diagonals to the bridge deck and canopy. These calculations followed the AASHTO LRFD interface shear provisions described above.

Listed below are values used for multiple variables in the interface shear design calculations. A brief description and explanation for each variable selected is described below:

- **c = 0.0 ksi.** Cohesion factor; indicates that the computed capacity will not include the effects of cohesion.
- **μ = 1.0.** Friction factor; indicates that the interface surface is clean, free of laitance with surface roughened to an amplitude of 0.25-inch.
- K_1 **= 0.25.** Fraction of concrete strength; indicates either normal-weight or lightweight concrete placed monolithically or lightweight concrete placed nonmonolithically, against a clean concrete surface, free of laitance with surface intentionally roughened to an amplitude of 0.25-inch.
- K_2 **= 1.5 ksi.** Limiting interface shear factor; indicates normal-weight concrete placed monolithically.
- **ϕ = 0.90.** Resistance factor for shear; per AASHTO LRFD Article 5.5.4.2.1.
- f_y **= 60 ksi.** Yield strength of reinforcing; reinforcing steel yield strength for reinforcing that crosses the interface plane.
- f'_c **= 8.5 ksi.** Specified 28-day compressive strength; indicates the weakest concrete compressive strength on either side of the interface.

The interface shear design calculated the factored interface shear force (demand) at the deck and canopy to truss member interfaces using the AASHTO LRFD Strength I limit state as specified in AASHTO LRFD Article 3.4.1-1. The final design calculations used the load factors as shown below. The abbreviations shown below represent the following: dead load (DC), live load (LL), post-tensioning (PT) and uniform temperature (TU).

Load Factors:

- **DC = 1.25**
- **LL = 1.75**
- **PT = 1.0**
- **TU = 0.5**

Table 12 summarizes the interface shear calculations included in the superstructure final design calculations for each nodal zone connection to the bridge deck. Data shown in blue was calculation input data and data shown in black was computed data.

Table 12 – Page 1283, Superstructure Final Design Calculations

Truss Members	b_{vi} (in)	L_{vi} (in)	A_{cv} (in^2)	P_c (kips)	V_{DC} (kips)	V_{LL} (kips)	V_{PT} (kips)	V_{TU+TD} (kips)	V_{ui} (kips)	A_{vf} (in^2)	A_{vf_prov}
1 & 2	21.0	57.6	1210	1275	670	153	107	310	1368	4.09	4-2 legs of #7
3 & 4	21.0	85.6	1798	579	283	66	564	102	1084	10.43	9-2 legs of #7
5 & 6	21.0	79.3	1664	230	85	20	346	9	491	5.27	6-2 legs of #7
7 & 8	21.0	68.0	1428	449	291	65	-146	76	370	-0.62	6-2 legs of #7
9 & 10	21.0	67.0	1407	703	400	93	-772	-146	181	-8.36	6-2 legs of #7
11& 12	21.0	42.0	882	1233	589	131	-7	55	987	-2.28	4-2 legs of #7

Notes:
1. V_{DC}, V_{LL} and V_{PT} loads from LUSAS F.E. Model (See Finite Element Analysis Calculations)
2. P_c = vertical component of net compression force in diagonals (STRI)

The list below defines the data included in the calculation table shown in **Table 12**.

- The first column identifies the nodal zone by listing each truss diagonal connecting into the nodal zone.
- The second column identifies the width of the nodal zone (measured transverse to the bridge). It is labeled b_{vi}.
- The third column identifies the length of the nodal zone (measured longitudinally to the bridge). It is labeled as L_{vi}.
- The fourth column identifies the nodal zone interface surface area between the truss diagonals and the deck. This area is labeled as A_{cv} which is calculated by multiplying b_{vi} x L_{vi}.
- The fifth column identifies the permanent net compression force across the interface surface. It is labeled as P_C.
- The sixth column identifies the shear force (un-factored) acting across the interface surface due to component dead load. It is labeled as V_{DC}.
- The seventh column identifies the shear force (un-factored) acting across the interface surface due to live load. It is labeled as V_{LL}.
- The eighth column identifies the shear force (un-factored) acting across the interface surface due to post-tensioning. It is labeled as V_{PT}.
- The ninth column identifies the shear force (un-factored) acting across the interface surface due to uniform temperature. It is labeled as V_{TU+TD}.
- The tenth column is the computed factored shear force, V_{ui}, which was calculated by multiplying each shear force by the its load factor. The displayed value results from: 1.25 x V_{DC} + 1.75 x V_{LL} + 1.0 x V_{PT} + 0.50 x V_{TU+TD}.
- The eleventh column is the computed area of reinforcing steel needed to provide enough capacity so that the factored nominal resistance (ϕ V_{ni}) is greater than the factored interface shear demand.
- The twelfth column lists the reinforcing steel provided in the bridge plans. The syntax of the text is "[number of bars] – [number of legs of each bar] of [size of bar]". Multiplication of the [number of bars] times the [number of legs of each bar] will result in the number of bars of each size that were to be provided across the interface.

The data for the nodal zone that connects diagonal support #11 and vertical support #12 to the bridge deck is shown in the last row in **Table 12**. Descriptions and page numbers from the superstructure final design calculations for the inputted data for this nodal zone are listed below:

- b_{vi} = 21.0 inches; dimension shown multiple times on final bridge plans.
- L_{vi} = 42.0 inches; dimension shown multiple times on final bridge plans. This dimension does not include the length of vertical support #12.
- P_C = 1,233 kips; force calculated from the Larsa Longitudinal Model for the completed bridge (see section 28.3 for LARSA model definition). The P_C force was based on the Strength I load case identified as "STR 1/20" in the Larsa model (see below for STR 1/20 definition). The analysis results for diagonal support #11, identified as member 732 in the

LARSA model, were used to generate the P_C value by calculating the vertical component of this member force at the diagonal support #11 to deck connection (node 721). P_C was calculated using the force effects described below:

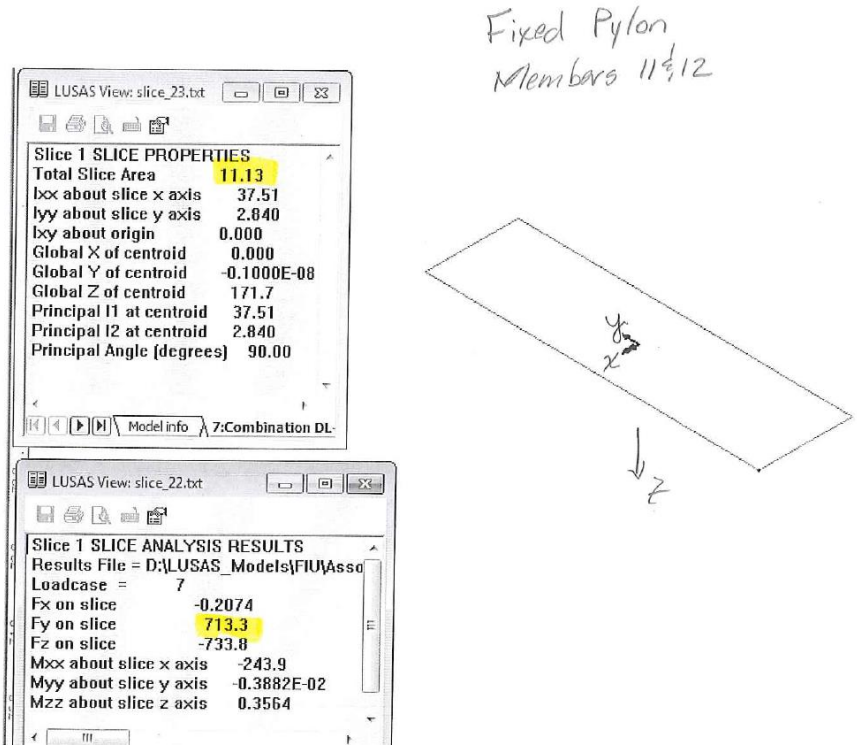
- Dead load of wearing surface and utilities; DW1 = 48.8 kips (page 934)
- Dead load of structural components; DC1 = 1,382 kips (page 934)
- Friction load; FR1 = 34.6 kips (page 934)
- Uniform temperature load; TU3 = 311.6 kips (page 938)
- Live load; LL2 = 200.0 kips (page 936)
- The factored axial force in diagonal 11 is computed using the AASHTO LRFD Strength I limit state (Article 3.4.1-1) which is identified as the STR 1/20 load case in the Larsa model (page 932) and results in: 1.50 x DW1 + 1.25 x DC1 + 1.0 x FR1 + 0.50 x TU3 + 1.75 x LL2 = 2,341.1 kips. P_C is the vertical component of this member force which can be calculated using the sine of the angle between diagonal 11 and the bridge deck (bridge plans show a 31.79 degree angle). Therefore, P_C = diagonal 11 axial force x sine (31.79) = 2,341.1 kips x sine (31.78) = 1,233 kips.

- $V_{DC} + V_{LL} + V_{PT}$ = 713 kips. These forces were generated by the LUSAS Fixed Pylon model which is shown below (see section 28.3 for LUSAS model definition).
- V_{TU+TD} = 55 kips. This force effect was generated by the Larsa Longitudinal Model for the completed bridge (page 938).
- V_{ui} is calculated by multiplying each shear force by the load factor (1.25 x V_{DC} + 1.75 x V_{LL} + 1.0 x V_{PT} + 0.50 x V_{TU+TD}).

Strength I Larsa load combination STR 1/20:

$$STR\ 1/20 = 1.00\ * (DW1 * 1.50 + DC1 * 1.25 + FR1 * 1.00 + TU3 * 0.50 + LL2 * 1.75)$$

From page 1398 – Superstructure Final Design Calculations:



29.3 Horizontal Shear Force Generation

The Superstructure Final Design Calculations (dated February 2017) utilized four analytical models for the FIU pedestrian bridge. The title identifying each model and the bridge configuration for each model is listed below. The names LARSA and LUSAS are proprietary names for the two software packages used in the calculations.

- LARSA Longitudinal Model - 2-D Larsa model of the complete structure.
- LARSA Main Span Erection Model - 2-D LARSA model of the main span supported at SPMT support locations.
- LUSAS Simple Support - LUSAS solids model of the main span simply supported at the south landing abutment and the pylon pier.
- LUSAS Fixed Pylon - LUSAS solids model of the main span simply supported at the south landing abutment and fixed at the pylon pier.

The designs of the nodal zones for the bridge main span used the results from the two LUSAS models for the V_{DC} , V_{LL} , and V_{PT} force effects. The larger of the interface shear forces generated by these two LUSAS models at each nodal zone was used in the nodal zone design. The LUSAS fixed pylon model generated the larger interface shear force effects for nodal zones at members 7-8 and at members 11-12. The LUSAS simple support model generated the larger interface shear force effects for the other nodal zones.

V_{TU+TD} force effects were taken from the Larsa longitudinal model for all the nodal zones. The values for the V_{TU+TD} force effects are located on pages 934 through 936 in the superstructure

final design calculations. A summary of the LUSAS model used and pages in the superstructure final design calculations for the LUSAS output for V_{DC}, V_{LL}, and V_{PT} are listed in **Table 13**.

Table 13 – Analysis Model / Calculation Output Location

Nodal Zone	Model used and LUSAS output page # for $V_{DC} + V_{LL} + V_{PT}$ force effects
1-2	LUSAS Simple Support (page 1382)
2-3	LUSAS Simple Support (page 1285, 1286, & 1287)
3-4	LUSAS Simple Support (page 1383)
4-5	Design not included in final calculations
5-6	LUSAS Simple Support (page 1384)
6-7	Design not included in final calculations
7-8	LUSAS Fixed Pylon (page 1396)
8-9	Design not included in final calculations
9-10	LUSAS Simple Support (page 1386)
10-11	LUSAS Simple Support (page 1288, 1289 & 1290)
11-12	LUSAS Fixed Pylon (page 1398)

The force effects identified in **Table 13** from the various models were multiplied by their load factor to calculate the factored interface shear demand V_{ui}. **Table 14** summarizes the factored interface shear demand calculated for each nodal zone and provides the page numbers in the superstructure final design calculations where this calculation was performed.

Table 14 – Interface Shear Summary

Nodal Zone	Factored interface shear demand V_{ui} and page calculation was performed
1-2	1368 kips (page 1283)
2-3	1474 kips (page 1284)
3-4	1084 kips (page 1283)
4-5	Design not included in final calculations
5-6	491 kips (page 1283)
6-7	Design not included in final calculations
7-8	370 kips (page 1283)
8-9	Design not included in final calculations
9-10	181 kips (page 1283)
10-11	133 kips (page 1284)
11-12	987 kips (page 1283)

As stated previously, the interface shear demands calculated for the main span in the superstructure final design calculations used the results from the LUSAS models for all force effects except for the uniform temperature force effect (V_{TU+TD}) which used the LARSA Longitudinal Model included in the calculations. Although not used in the superstructure final design calculations, interface shear demands can also be generated strictly from the LARSA Longitudinal Model.

The bridge configuration for the LARSA Longitudinal Model closely matches the bridge configuration for the LUSAS Fixed Pylon model. Recognize that, for nodal zone 11-12, the force effects generated from these models occur in the members but will not be primarily resisted by interface shear due to the resistance provided by the pylon and back span.

Recall that the final design calculations used the larger of the interface shear demand values produced by the LUSAS Fixed Pylon model and the LUSAS Simple Support model. Thus, the LARSA Longitudinal Model results should be similar to or less than the results from the LUSAS models presented in **Table 14.** **Table 15** contains the factored interface shear demands, V_{ui}, generated solely from the LARSA Longitudinal Model, for the Strength I load combination, STR 1/20, for each nodal zone in the main span and compares them to the factored interface shear demands used in the final design. Absolute values for V_{ui} are shown in **Table 15**.

Table 15 – Factored Interface Shear Demand Modeling Comparison

Nodal Zone	Factored interface shear demand V_{ui} used in final design. Calculated using LUSAS models*	Factored interface shear demand V_{ui} calculated using LARSA Longitudinal Model
1-2	1368 kips	2683 kips
2-3	1474 kips	2719 kips
3-4	1084 kips	893 kips
4-5	Design not included in final calculations	837 kips
5-6	491 kips	198 kips
6-7	Design not included in final calculations	4 kips
7-8	370 kips	347 kips
8-9	Design not included in final calculations	909 kips
9-10	181 kips	838 kips
10-11	133 kips	2077 kips
11-12	987 kips	1990 kips

* LARSA Longitudinal Model was used to generate V_{TU+TD} force effects. LUSAS models were used to generate all other force effects.

A breakdown of each force effect calculated for the LARSA Longitudinal Model is shown in **Tables 16** and **17**. The values for DW1, DC1, FR1, TU3 Diff and LL2 can be found on pages 934 through 936 in the superstructure final design calculations.

Table 16 – Lower Node Force Effects and Factored Interface Shear Calculations

Node	Member	Loads (kips)										
		DW1 (1.50)	DC1 (1.25)	FR1 (1.0)	TU3 Diff (0.5)	LL2 (1.75)	Factored axial Strength Limit State I/20	Compressive Force From PT bars (pg. 842)	Factored axial load with PT bars included	Angle between member and shear plane (deg)	V_{ui}	Sum V_{ui}
1 & 2	2 (Member 705 at Node 703)	82.2	1848.7	-285.8	338.8	352.3	2934.3	0	2934.3	23.9	2683	2683
3 & 4	3 (Member 708 at Node 705)	-34	-608.9	123.1	-58.7	-139.4	-962.325	1120	157.675	71.96	49	893
	4 (Member 711 at Node 707)	16.7	732.1	-229.3	133.9	93.4	941.275	0	941.275	26.24	844	
5 & 6	5 (Member 714 at Node 709)	-13.6	-243.2	120.1	-3.6	-58.8	-309	332	23	88.52	1	198
	6 (Member 717 at Node 711)	-19.8	27.8	-248.2	10.3	-53.5	-331.625	560	228.375	30	198	
7 & 8	7 (Member 720 at Node 713)	2	86	125.4	44.5	4.6	266.2	280	546.2	69.7	189	-347
	8 (Member 723 at Node 715)	-46.3	-587	-186	-75.7	-165.5	-1316.675	1120	-196.675	36.7	-158	
9 & 10	9 (Member 726 at Node 717)	22.2	599.6	108.2	121	89.8	1108.65	0	1108.65	47.44	750	-838
	10 (Member 729 at Node 719)	-55	-870.9	-108.6	-102.2	-209.3	-1697.1	1556	-141.1	51.234	-88	
11 & 12	11 (Member 732 at Node 721)	48.8	1382.1	34.6	311.6	200	2341.225	0	2341.225	31.79	1990	1990

Table 17 – Upper Node Force Effects and Factored Interface Shear Calculations

Node	Member	Loads (kips)										
		DW1 (1.50)	DC1 (1.25)	FR1 (1.0)	TU3 Diff (0.5)	LL2 (1.75)	Factored axial Strength Limit State I/20	Compressive Force From PT bars (pg. 842)	Factored axial load with PT bars included	Angle between member and shear plane (deg)	V_{ui}	Sum V_{ui}
2 & 3	2 (Member 705 at Node 704)	-82.2	-1839.2	285.8	-338.8	-352.3	-2922.4	0.0	-2922.4	23.9	-2672	-2719
	3 (Member 708 at Node 706)	34	614.4	-123.1	58.7	139.4	969.2	-1120	-150.8	71.96	-47	
4 & 5	4 (Member 711 at Node 708)	-16.7	-725.8	229.3	-133.9	-93.4	-933.4	0	-933.4	26.24	-837	-837
	5 (Member 714 at Node 710)	13.6	249.4	-120.1	3.6	58.8	316.8	-332	-15.3	88.52	0	
6 & 7	6 (Member 717 at Node 712)	19.8	-21.5	248.2	-10.3	53.5	339.5	-560	-220.5	30	-191	-4
	7 (Member 720 at Node 714)	-2	-79.5	-125.4	-44.5	-4.6	-258.1	-280	-538.1	69.7	-187	
8 & 9	8 (Member 723 at Node 716)	46.3	593.4	186	75.7	165.5	1324.7	-1120	204.7	36.7	164	909
	9 (Member 726 at Node 718)	-22.2	-593.2	-108.2	-121	-89.8	-1100.7	0	-1100.7	47.44	-744	
10 & 11	10 (Member 729 at Node 720)	55	877.5	108.6	102.2	209.3	1705.4	-1556	149.4	51.234	94	2077
	11 (Member 732 at Node 722)	-48.8	-1375.9	-34.6	-311.6	-200	-2333.5	0.0	-2333.5	31.79	-1983	

Figure 17 illustrates the factored interface shear demands on the nodal zones.

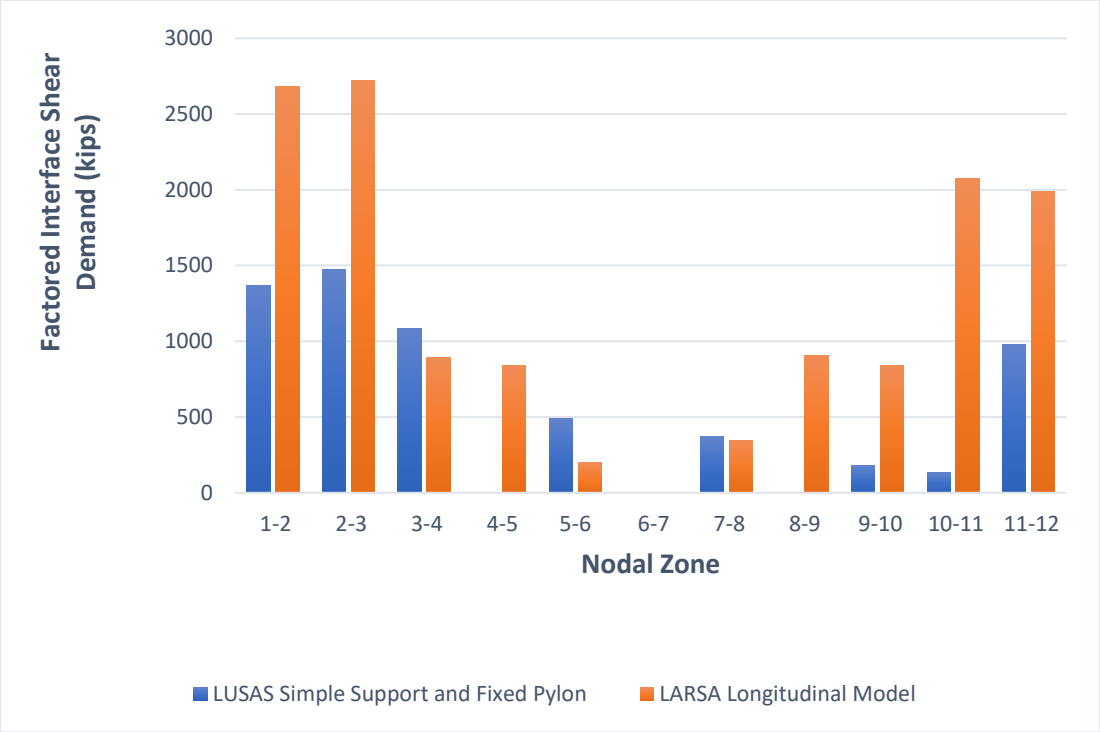


Figure 17 – Factored interface shear demand on nodal zones

29.4 FIGG Bridge Modeling

The pedestrian bridge was constructed in multiple stages. Each construction stage generated unique forces on the bridge structure, which had to be designed to withstand those forces.

Each analytical model generated multiple force effects for every structural component included. For the design of the truss member connections, the truss member axial forces were extracted from these analyses and were used in the design of each truss member connection. The axial force in the truss member was subsequently resolved into vertical and horizontal components. The vertical component is the compressive or clamping force that contributes to interface shear resistance as discussed later in the report. The horizontal component is the shearing force on the interface shear surface or the interface shear demand. **Figure 18** shows the interface (horizontal) shear demand results for each main span truss nodal region generated from the four models used in the FIGG Design. With regard to the results from the LUSAS Simple Support Model and LUSAS Fixed Pylon Model, the FIGG Design only included the forces identified by the designer as most critical between these two models. Therefore, the results shown in **Figure 18** only reflect the identified maximums between these two analytical models.

The interface shear forces shown in **Figure 18** are generated from the load combination and load factors prescribed in the AASHTO LRFD Strength I limit state. This limit state was the controlling limit state for the interface shear design of all truss cold joints in the nodal regions.

The two numbers shown on the horizontal axis of **Figure 18** identify each nodal region by the two truss member identification numbers that connect into that region.

Figure 18 shows that the interface shear demand generated for each nodal region can vary significantly. The forces generated from the LARSA Longitudinal Model (for the completed bridge structure) generated the largest forces for the nodal regions at the north and south ends of the main span. The FIGG Design exclusively used the results from the LUSAS Simple Support / LUSAS Fixed Pylon modeling combination for the design of every main span nodal region.

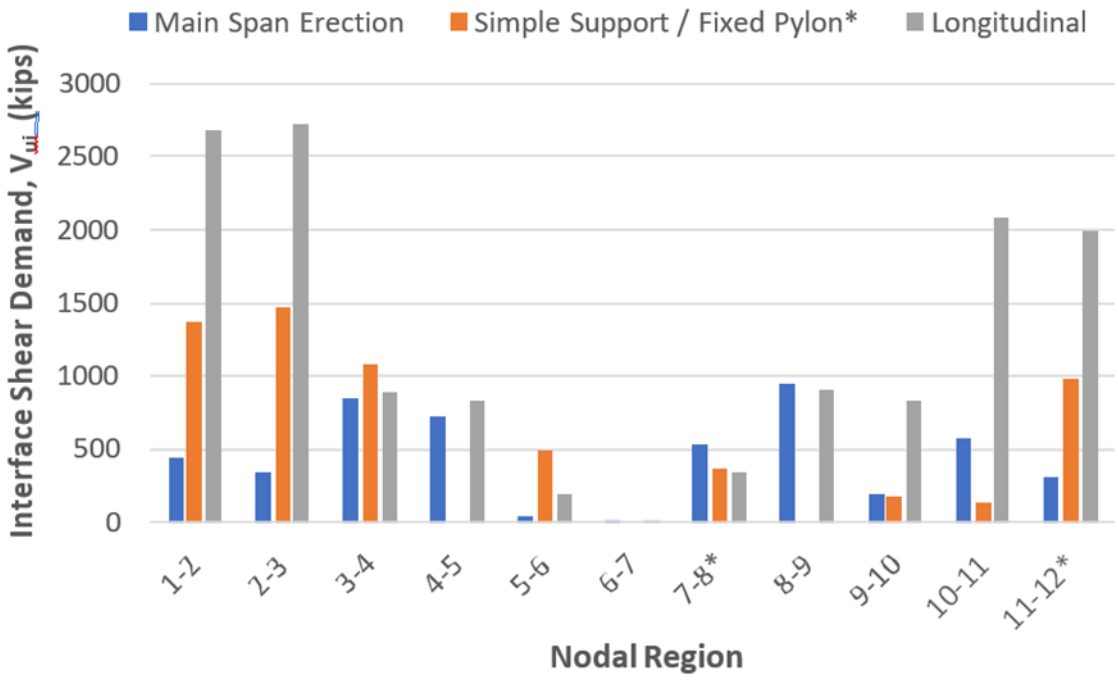


Figure 18 – Nodal zone interface shear demand results generated for FIGG bridge design, with horizontal axis showing two truss member identification numbers that connect into each nodal region

30. Large Sample Examinations

As part of its ongoing investigation, the NTSB had retained several large samples from the collapsed FIU pedestrian bridge in Miami, FL. These large samples were extracted from the collapsed structure for future investigation and were stored at the FDOT South Dade Maintenance Yard. A description including photographs of the large samples can be found in **NTSB Materials Laboratory Factual Report No. 18-082**. Table **18** summarizes the large samples stored at the FDOT South Dade Maintenance Yard.

Table 18 – Large samples stored at the FDOT South Dade Maintenance Yard

Large Sample Description	Estimated Dimensions
Bridge Deck in the Vicinity of Node #11 and #12	Bridge Deck Area: 20-ft x 6-ft Diaphragm II Depth: 4-ft
Vertical Support #12	2-ft x 3-ft x 15-ft
Diagonal Support #11	2-ft x 2-ft x 15-ft
Blister at Node #10 and #11	10-ft x 3-ft

On June 13, 2018 a contractor hired by the NTSB cut the bridge deck in the vicinity of Node #11 and #12 at select locations to allow observation of the sample's internal areas. The work included both cutting the sample at select locations as well as moving cut sections to facilitate viewing. All party members to the investigation were invited to attend the cutting operation on June 13, 2018 and view the cut section on June 14, 2018.

The protocol for cutting the bridge deck on June 13, 2018 consisted of placing additional blocking to provide support for the large sample due to the cutting and extraction of the center section. Blocking supporting the center section extended a distance long enough to facilitate sliding the center section forward. The center section was approximately 5 feet wide. Additional blocking, as well as pipes placed under the blocking, facilitated the movement of the center section out. The cutting operation started only after the center and outward sections of the bridge deck were properly supported. The contractor made two cuts through the entire section of the bridge deck between longitudinal tendons D1 and D2 using a diamond saw wire. Care was taken by the contractor to make clean cuts through the 5 feet wide section. Once the center section had been completely cut from the large sample, the section was slid forward approximately 3 feet for viewing.

On June 14, 2018, the center section was available for viewing by all party members present. FHWA personnel with the assistance of NTSB investigators began a forensic investigation to reconcile the reinforcing in the Node #11 and #12 region. This investigation also assessed the consolidation of the concrete along the cut faces. The forensic investigation began on June 14, 2018 and was completed on August 15 and 16, 2018 when FHWA personnel and NTSB investigators returned to the FDOT South Dade Maintenance Yard. No significant abnormalities were noted during the reinforcing reconciliation or concrete assessment.

On August 15 and 16, 2018, all party members were invited to attend the extraction of reinforcement bars from the upper portion of vertical support #12 and portions of the bridge deck. With the assistance of FDOT and FHWA personnel, NTSB investigators extracted the pieces of

reinforcement bars. In addition, a concrete core was extracted from the south end of the interface surface under diagonal support #11. Also, a portion of the delaminated concrete was collected as evidence on the portion of the interface on the southern end of the connection between diagonal support #11 and the bridge deck. NTSB investigators made arrangements for the samples to be shipped to the FHWA - Turner Fairbank Highway Research Center (TFHRC) in McLean, Virginia for further testing. A detailed discussion regarding the steel materials testing can be found in **NTSB Materials Laboratory Factual Report No. 18-082** that includes **Appendix A: Turner-Fairbank Highway Research Center Factual Report – Steel and Concrete Materials Testing**. A detailed discussion regarding the concrete interface under diagonal support #11 and vertical support #12 can be found in **Turner-Fairbank Highway Research Center Factual Report – Concrete Interface Under Members 11 and 12**.

On August 15, 2018, FHWA personnel conducted a forensic investigation of the cracking on the east and west face of the center section of Diaphragm II. No significant abnormalities were noted during the crack mapping procedure.

Listed below is a summary of the tests conducted at the TFHRC that includes the dates and purpose of the testing. FHWA personnel conducted the testing under the supervision and direction of NTSB investigators.

- May 23, 2018 – Testing of hydraulic jack and pressure gauges. No destructive testing was performed. A time lapse camera captured the testing procedure.
- June 19, 2018 – Testing of concrete core samples and steel post-tensioning rods. Destructive testing was performed. Party members to the investigation were present during the testing.
- September 13, 2018 – Testing of steel reinforcing bars and a steel post-tensioning rod. Destructive testing was performed. Party members to the investigation were present during the testing.

Listed below are the reports prepared by the NTSB Materials Laboratory and TFHRC in support of the investigation:

- **NTSB Materials Laboratory Factual Report No. 18-081** that includes **Appendix A: Turner-Fairbank Highway Research Center Factual Report – Post-Tensioning System Performance Testing**.
- **NTSB Materials Laboratory Factual Report No. 18-082** that includes **Appendix A: Turner-Fairbank Highway Research Center Factual Report – Steel and Concrete Materials Testing**.
- **Turner-Fairbank Highway Research Center Factual Report – Concrete Interface Under Members 11 and 12**.

31. Weather Information

At 1:53 p.m. EDT the Miami International Airport weather reporting system, located about 6 miles east-northeast of the bridge site, reported a temperature of 73° F, mostly clear skies, with winds from the north at 5 mph, and visibility unrestricted at 10 statute miles or more. The roadway surfaces were dry, with no precipitation being reported in the previous 24 hours.

32. Docket Material

The following attachments and photographs are included in the docket for this investigation:

32.1 List of Attachments

Bridge Factors Factual Report Attachment 1 – T.Y. Lin International Scope of Work for 2013 Grant Submission

Bridge Factors Factual Report Attachment 2 – Email from Mr. Kenneth Jessell of FIU to Mr. Dan Walsh of NTSB dated June 8, 2018

Bridge Factors Factual Report Attachment 3 – TIGER Original Grant Agreement dated June 5, 2014

Bridge Factors Factual Report Attachment 4 – TIGER Grant Addendum No. 1 dated January 12, 2016

Bridge Factors Factual Report Attachment 5 – TIGER Grant Amendment No. 2 dated December 11, 2017

Bridge Factors Factual Report Attachment 6 – FDOT Local Agency Program (LAP) Manual Chapter 3 dated September 18, 2013

Bridge Factors Factual Report Attachment 7 – Email from Ms. Xiomara Nunez of FDOT to Mr. Dan Walsh of NTSB dated August 17, 2018

Bridge Factors Factual Report Attachment 8 – FDOT Local Agency Program (LAP) Agreement dated June 23, 2014

Bridge Factors Factual Report Attachment 9 – FDOT Local Agency Program (LAP) Supplemental Agreement No. 1 dated June 2, 2017

Bridge Factors Factual Report Attachment 10 – FDOT Local Agency Program (LAP) Amendment Extension Request dated January 2, 2018

Bridge Factors Factual Report Attachment 11 – FIU Design Build Maximum Price Request for Proposals

Bridge Factors Factual Report Attachment 12 – FIU Pedestrian Bridge Design Criteria dated June 2014

Bridge Factors Factual Report Attachment 13 – Letter to Mr. Jorge J. Rivera, District VI Transportation Engineer, FHWA, from Mr. Aiah Yassin, District Local Program Administrator, FDOT, dated November 10, 2015

Bridge Factors Factual Report Attachment 14 – Letter to Mr. Jorge J. Rivera, District VI Transportation Engineer, FHWA, from Mr. Aiah Yassin, District Local Program Administrator, FDOT, dated August 23, 2016

Bridge Factors Factual Report Attachment 15 – FIU Design-Build Contract, entered into by the Florida International University Board of Trustees and Munilla Construction Management (MCM) dated January 14, 2016

Bridge Factors Factual Report Attachment 16 – FIU General Specifications for Design-Build Contract between FIU and MCM, Revised June 9, 2014

Bridge Factors Factual Report Attachment 17 – FIU Standard Professional Services Agreement, entered into by the Florida International University Board of Trustees and Bolton Perez & Associates (BPA) dated September 23, 2016

Bridge Factors Factual Report Attachment 18 – Standard Form of Agreement between Design-Builder and Design Consultant, entered into by MCM and FIGG Bridge Engineers, Inc. dated April 28, 2016

Bridge Factors Factual Report Attachment 19 – Agreement entered into by FIGG Bridge Engineers, Inc. and Louis Berger dated September 16, 2016

Bridge Factors Factual Report Attachment 20 – FDOT Average Annual Daily Traffic (AADT) and Lane Widths on SW 8th Street

Bridge Factors Factual Report Attachment 21 – BPA Cracks Report No. 1 - Email from Mr. Jose Morales of BPA to Mr. Rodrigo Isaza of MCM dated February 13, 2018

Bridge Factors Factual Report Attachment 22 – BPA Cracks Report No. 2 - Email from Mr. Jose Morales of BPA to Mr. Rodrigo Isaza of MCM dated February 28, 2018

Bridge Factors Factual Report Attachment 23 – Texts from Mr. Kevin Hanson of Structural Technologies on his mobile device dated March 10, 2018

Bridge Factors Factual Report Attachment 24 – Email from Mr. Rodrigo Isaza of MCM to Mr. Dwight Dempsey of FIGG dated March 12, 2018

Bridge Factors Factual Report Attachment 25 – Email from Mr. Dwight Dempsey of FIGG to Mr. Rodrigo Isaza of MCM dated March 13, 2018 at 9:45 a.m.

Bridge Factors Factual Report Attachment 26 – BPA Cracks Report No. 3 - Email from Mr. Jose Morales of BPA to Mr. Rodrigo Isaza of MCM dated March 13, 2018

Bridge Factors Factual Report Attachment 27 – Email from Mr. Dwight Dempsey of FIGG to Mr. Rodrigo Isaza of MCM dated March 13, 2018 at 5:18:22 p.m.

Bridge Factors Factual Report Attachment 28 – Email from Mr. Sam Nunez of Structural Technologies to Mr. Rodrigo Isaza of MCM dated March 14, 2018

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Bridge Factors Factual Report Attachment 33 – Email from Mr. Alan Phipps of FIGG to Mr. Dan Walsh of NTSB dated July 12, 2018

Bridge Factors Factual Report Attachment 34 – Email from Mr. Alfredo Reyna of FDOT to Mr. Alberto Delgado of FIU dated October 12, 2016

Bridge Factors Factual Report Attachment 35 – Minutes of Meeting prepared by Bolton Perez & Associates (BPA) with sign-in sheet attached dated October 31, 2016

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Bridge Factors Factual Report Attachment 42 – Comparison of FDOT projects versus LAP projects for the last 5 years

Bridge Factors Factual Report Attachment 43 – FDOT Local Agency Program (LAP) Manual, Chapters 19 and 20, dated March 28, 2008

Bridge Factors Factual Report Attachment 44 – FDOT Plans Preparation Manual (PPM), Volume 1, Chapter 26 – Bridge Project Development, January 1, 2014

Bridge Factors Factual Report Attachment 45 – FDOT Structures Design Office (SDO) electronic review and email comments on submittal phases for the signature pedestrian bridge

Bridge Factors Factual Report Attachment 46 – Email from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated May 3, 2018

Bridge Factors Factual Report Attachment 47 – Email from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated April 26, 2018

Bridge Factors Factual Report Attachment 48 – 100% Certification Letters signed and sealed by Louis Berger

Bridge Factors Factual Report Attachment 49 – FDOT Standard Specifications for Road and Bridge Construction, Division II – Construction Details, Structures, dated January 2015

Bridge Factors Factual Report Attachment 50 – Excerpts from Rule 14-75 of the Florida Administrative Code

Bridge Factors Factual Report Attachment 51 – Emails from Mr. Tom Andres of FDOT to Mr. Dan Walsh of NTSB dated April 20, 2018 and May 22, 2018

Bridge Factors Factual Report Attachment 52 – Email from Ms. Robin Malacrea of Louis Berger to Ms. Carliayn Kell of FDOT dated December 28, 2016

Bridge Factors Factual Report Attachment 53 – Letter from Ms. Carliayn Kell of FDOT to Mr. Ernesto Polo of Louis Berger dated January 17, 2017

Bridge Factors Factual Report Attachment 54 – AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 7th Edition, 2014, with 2015 Interims, Guidance on Redundancy

Bridge Factors Factual Report Attachment 55 – FDOT Structures Design Guidelines (SDG), Structures Manual Volume 1, dated January 2015

Bridge Factors Factual Report Attachment 56 – FDOT Standard Specifications for Road and Bridge Construction, Division II – Construction Details, Section 102 Maintenance of Traffic, dated January 2015

Bridge Factors Factual Report Attachment 57 – FDOT Construction Project Administration Manual, Section 9.1 Maintenance of Traffic, 9.1.8 Recommended Action to Shut Down a Project Due to MOT Deficiencies, dated April 11, 2014

Bridge Factors Factual Report Attachment 58 – Florida Administrative Code 61G15-18.011

Bridge Factors Factual Report Attachment 59 – FDOT Two-Lane Blanket Road Closure

Bridge Factors Factual Report Attachment 60 – FDOT General Use Permit

Bridge Factors Factual Report Attachment 61 – MCM and FIGG Bridge Engineers, Inc. Agreement, Change Order Request No. 1, dated February 6, 2017

Bridge Factors Factual Report Attachment 62 – MCM and FIGG Bridge Engineers, Inc. Agreement, Change Order Request No. 8, dated October 18, 2017

Bridge Factors Factual Report Attachment 63 – FIGG Bridge Engineers, Inc. Attachment Submission

Bridge Factors Factual Report Attachment 64 – Bolton Perez & Associates (BPA) Attachment Submission

Bridge Factors Factual Report Attachment 65 – FDOT's Attachment Submission

Bridge Factors Factual Report Attachment 66 – MCM's Attachment Submission

Bridge Factors Factual Report Attachment 67 – FDOT Construction Project Administration Manual, Section 4.1 Administration of Consultant CEI Contracts, dated November 2, 2012

Bridge Factors Factual Report Attachment 68 – FIU Pedestrian Bridge Pylon Diaphragm Dimensions and Reinforcement Plans

Bridge Factors Factual Report Attachment 69 – AASHTO Load and Resistance Factor Design (LRFD) Bridge Design Specifications, 7th Edition, 2014, with 2015 Interims, Guidance on Intentionally Roughened Surface

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Bridge Factors Photo 2 – View of falsework being set up in adjacent casting yard for construction of main span on 4/17/17 at 1:41:47 p.m. Concrete footings being poured in background at south end (Source: Munilla Construction Management, MCM)

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Bridge Factors Photos - FIGG Bridge Engineers, Inc. Photo Submission

Bridge Factors Photos - MCM's Photo Submission

END OF REPORT

Dan Walsh, P.E.

Senior Highway Factors Investigator