Highlights

- Segmental Concrete Erection Girder Technology
- ASCE's SE Regional Conference at the University of South Florida, Tampa.

Items

- Erecting 3032 P/C Segments in 30 months
- 23 Universities and 700 Students Compete at USF for ASCE's SE Regional Tech Conference

SPANS

Hillsborough County Florida Bridge Team

The Quarterly Newsletter of Inspired Bridge Technologies *April 2004, 2, Volume 2*

CARAVAN AWAITS CARGO IN TAMPA

Figure 1: Cast-in-Place Substructure Anticipating Pre-Cast Superstructure

A partial view of downtown Tampa on the horizon reveals the 203, cast in place, reinforced concrete piers meandering in a westerly direction (Figure 1). These structures are reaching with anticipation for the 3032, 9'-4" long, pre-cast concrete segments that comprise the superstructure for this $350 million project. The Tampa-Hillsborough Expressway Authority, the lead agency for this elevated, three reversible lane, urban structure, connects the City of Tampa with the Hillsborough County Town Center of Brandon, Florida, fifteen miles to the east.

The $1.35 Billion being spent by the Authority and the Florida Department of Transportation (FDOT) includes this Expressway project and the FDOT EW, I-4 widening, the FDOT NS, I-275 widening and the I-4/ I-275 interchange improvements. An additional $35 million is committed to the design and right-of-way acquisition for a two-mile, elevated, NS structure connecting I-4, the Lee Roy Selman Expressway and the largest port in the state of Florida. A Federal Demonstration Grant of $135 million is being sought by the Partnership for the construction of this vital connection.

Mr. Patrick J. McCue, P.E., is the Authority. His Agency has engaged PCL Civil Constructors Inc. to build the viaduct. Their U.S. headquarters is in Denver, Colorado and they maintain a regional office here in Tampa, Florida. The structural design was contracted to the Figg Engineering Group of Tallahassee, Florida; the construction engineering went to Bridge Concepts Inc. and the erection system was done by DMJM-Harris.

Currently (3.29.04), the work has progressed to: 154/203 (76%) for the pier construction; 1801/3032 (59%) for segments manufactured and 64/202 (32%) for spans erected. The optimum rate of erection is four spans per week from two sets of launching girders both receiving the segments on trucks from the casting yard, just three miles south of the Expressway. The notice to proceed (NTP) date was 12.02, and the scheduled completion is 7.05.

The elevated, three lane superstructure segments are typically 59'-0" in their out to out, horizontal structural dimension and on the east end (Brandon) of the viaduct, where the Elevated Roadway crosses NS, I-75, the lanes reduce to two with the consequent structural segmental section width changing to 47'-0." These elements, varying in weight from 75 tons per 59' wide piece down to 68 tons for the 47' wide elements.

These segments are pre-cast at the casting yard and are delivered by 19 axel, flatbed trucks to the lifting point on the Lee Roy Selman Expressway. These superstructure

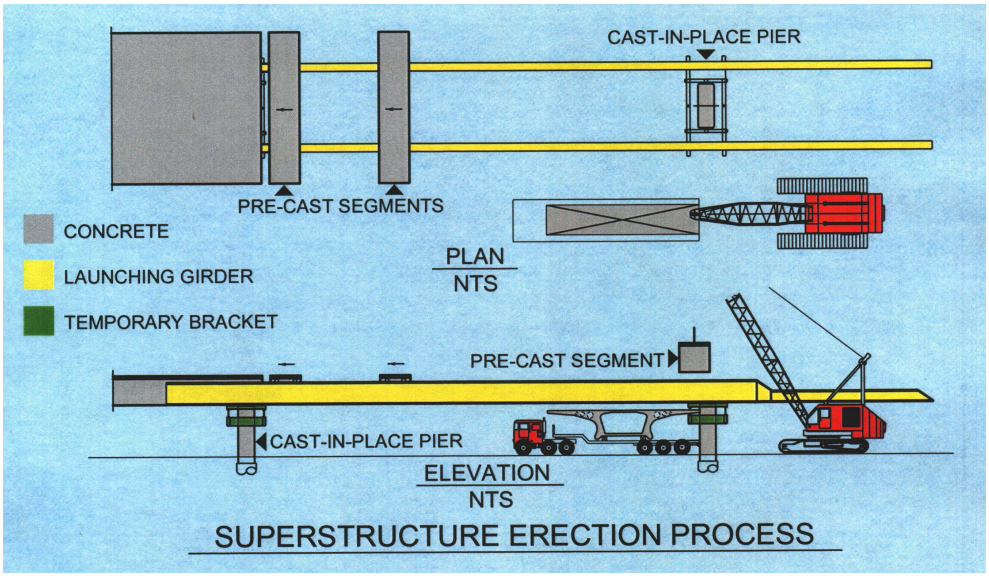

Figure 2: Diagram of Launching Girder-Bracket Erection System

embedments but, instead, use a square spreader with two slings around each cantilever, wing slab of the box girder segment. The crawler-crane moves into position, lifts the segment off the trailer-bed and swings the load over the launching girders where the element is positioned onto twin rails, which are under each wing. The segments are then individually tugged across the tops of the launching girders and into a contact position with previous spans and compressed into a monolithic beam by an array of post-tensioning cables that are threaded through all segments in the span. This process occurs between all of the 203 piers.

The beam is comprised of 16 segments per typical 142' span with: two 5'-0" pier segments; twelve 9'-4" typical segments, two 9'-0" segments, and the balance accommodated by a closure pour. The post-tensioning required per typical span includes 6-tendons of 27, 0.6" diameter strands, 2-tendons of 19, 0.6" diameter strands and 8-tendons of 12, 0.6" diameter strands for a total length of about six miles of strand per typical span. The supplier of the post tensioning system is the VSL Corporation.

This highly articulated, mechanized erection beam and bracket system (Figure 2) is on the critical path for the $350 MM construction program. PCL manages the confluence of technical input that is generated by two highly specialized consultants; one doing the Construction Engineering and the other for the Construction Equipment design. Mr. Boris Levintov, Candidate of Technical Science, P.E., came to this country in the early 80's from the former Soviet Union (Leningrad) with an advanced degree in Mechanical Engineering. Jobs were scarce and when the opportunity for a bridge engineering position came his way he took it. This position evolved to a point where he was providing equipment design for concrete form travelers on major cable stayed bridges and long span segmental box girder bridges. Levintov was responsible for the concept development and design for the segmental erection equipment on this PCL project for his company (Harris).

The erection sequence proceeds as the temporary steel brackets (Figure 3) are locked to three consecutive piers in order to support the superstructure erection activities in a sequential, span by span installation of the segments. When a span is closed and locked together by post-tensioning; succeeding, superstructure, segmental erection can continue. With a bracket in-place on the lead pier, the two launching girders are slightly lowered and pulled ahead. We once again have the girders empty and the next span between piers ready to receive segments. At this stage, the outside trailing bracket is removed and leapfrogged to the next pier ahead anticipating the advancing, launching girders.

PCL's Scott Updegrave, coordinates between his consultants and the client's General Consultant, FEG. These 59' wide segments may be a record for a wing cantilever length of more than 20' (Figure 4). Typically, cast-in-place segmental girders (all tendons with-in the cross-section) have an equivalent thickness of 2.5' whereas, the equivalent thickness for this 59' wide, pre-cast girder (with all tendons external to the cross-section) is 1.8' and the 47' wide, pre-cast girder (with all tendons external to the cross-section) is 2.0, both representing major economies.

Chris Stack, PCL's Project Manager, explains that the substructure is founded on drilled shafts that are typically 50' deep and have diameters of 4', 6' and 8' with the most common being of the 8' variety. They support the 203 piers that separate the added, reversible roadway

Figure 3: Erection Bracket Supporting Launching Girder

vertically from the existing Lee Roy Selman Expressway for about five miles of the contract length of 10 miles of new roadway. The supporting piers vary in height from a nominal dimension of 20' to a maximum height, over some intersected roadways, of 60'. The Hubbard Construction Co. is building the major portion of the at-grade roadway attendant to this elevated roadway.

The NS, two mile, elevated connection between I-4 and the Port of Tampa will cross the Lee Roy Selman Expressway at 22th St as it progresses south providing direct interstate access to the Port of Tampa. The Port is expanding heavily into the containership market and the existing bulk cargo market will certainly be enhanced by this new connection. Moreover, with the intersection at the Selman an alternate EW route will be provided that can shunt the congestion on the current, EW I-275 between the I-4/I-275 intersection and the seven mile long Tampa Bay crossings to the west. The traffic counts at the Port Connector location are 43.2 million vehicles per year, just south of the I-4/ I-275 intersection these counts swell to 68 million per annum and at the Westshore location, just before the Bay, these counts fall back to 43.8 million. Apparently, 24 million Interstate vehicles per year are absorbed into the local roadway network. The $1.35 Billion highway investment is needed and it is clear that these improvements will serve as considerable social and economic generators for the 2.3 million residents in the Tampa Bay Metropolitan Area.

The preponderance of gated communities and the lack of topography in the Bay area have contributed heavily to the absence of a network of through roadways. Local residents, currently seeking this mobility through the existing Interstate system may benefit from the technology at hand with an appropriate consideration for a new, Intra-Metropolitan expressway system.

Figure 4: Superstructure with 20'+ Cantilevered Roadway Deck

The American Society of Civil Engineers' 2004 Southeast Regional Conference

The University of South Florida, Tampa, played host to twenty-three Universities and more than 700 of their students in a technology competition. This event took place over a three-day period (March 18, 19 and 20). The wide ranging competition included Concrete Canoe races (presentation, final product and swamp test) on the clear, sparkling waters at the mouth of the Hillsborough River in downtown Tampa. Additionally, Technical Papers (writing and presentation), Plan Reading, Environmental, Cylinders, Civil Survivor, Transportation, Balsawood Bridge

ASCE Student Conference Committee led by Cheryl Spinks , President, her five associate members, a host of volunteers and with Faculty Advisor, Assistant Professor Alaa Ashmawy PhD, P.E., the general opinion is that the Conference was a resounding success. The Editor and Assistant Editor were privileged to serve as Judges for the Technical Paper and Balsawood Bridge competition, respectively.

The Awards Dinner Banquet that took place at Busch Gardens on Saturday, March 20th from 7:30 P.M. to 10:30 P.M. seated more than 1000 and, appropriately, the

schools. With the School's cheers echoing through the rafters, the University of Puerto Rico started a conga line with instruments. They got up and started to snake through the isles and the line grew and grew until it found its way up onto the stage. The place was vibrating with energy.

The editor was sitting at a table for the Judges and befriended an Iranian Civil Engineer and Professor who was here representing his students from KN Toosi University, Tehran, Iran. His students could not make it to the Conference but they won a Third Place Prize for their Balsawood Bridge that was shipped for the competition.

Louis A. Martin-Vega, PhD., P.E., Dean and Professor of Civil Engineering at the University of South Florida, took the stage

Guest Commentary

Building The Bridge To The Future

By Martin Stone

The Tampa Hillsborough Expressway Authority is building a unique, beautiful solution to daily traffic congestion on the Lee Roy Selmon Crosstown Expressway … a set of reversible lanes from Brandon and I-75 to Downtown Tampa that will more than double the Expressway's capacity, ensuring fast and safe commuter travel back and forth to downtown Tampa for well beyond the normal 20-year planning horizon.

Most of the project is a graceful concrete segmental bridge built entirely within existing right-of-way, dramatically reducing project costs and virtually eliminating impacts to the surrounding community and the environment.

Analysis during project planning in 1998 concluded that future traffic requirements could not be met by an at-grade facility without a substantial widening of the right-of-way. Purchasing the necessary additional land in this corridor was neither physically nor financially feasible. Consequently, the Authority created a unique, affordable solution that they call "six lanes in six feet" — an elevated, three-lane, reversible bridge requiring only six feet of land within the existing 46-foot wide Expressway median. The reversible nature of the bridge addresses the highly directional nature of the Expressway's rush-hour traffic while the six-foot wide bridge piers conserve the existing right-of-way, allowing the remainder of the median to be used for future transportation improvements.

To verify that the reversible, concrete segmental bridge would best meet the Authority's requirements for efficient, affordable, long-lasting, aesthetically pleasing structures that would maximize traffic capacity, minimize right-of-way requirements and minimize traffic and revenue impacts during construction, the Authority's Board of Directors authorized a professional peer review of the project. Seven independent, nationally recognized experts in roadway design, bridge design, traffic engineering, finance, and toll road operations were selected to evaluate the project. The peer group report to the Board "unanimously and enthusiastically" endorsed the Authority's solution.

The proof of this assessment, however, is being revealed by the reality of the construction. In late 2002, PCL Civil was selected as the prime contractor to build about six miles of reversible bridge as part of the overall nine-mile long project. Based on the PCL construction contract and FDOT's Structures Design Guidelines (the official methodology for uniformly calculating bridge costs) the construction cost for the segmental bridge portion of the project is $121.6 million, or $64.53 per square foot. This is an extremely economical project compared to all other major bridges in FDOT's database, which range from $76 to $120 per square foot. In fact, this bridge is the least expensive bridge built in the State of Florida in the past twenty years – validation for the planners and engineers who conceived, designed and fought for this unique transportation solution.

Note: References for the Jan '04 Guest Commentary were inadvertently omitted. They are: The West Point Atlas of American Wars, Vols I/II, Praeger Publishers, NY, 1959; Engineer Systems Handbook, Latest Edition, US Army Engineer School; www.eyewitnesstohistory.com/caesar.htm; and www.globalsecurity.org/military/ops/river.htm .

Coming Issues:

- **NASA's Pathfinder Aerobrake Truss for the Manned trip to Mars**
- **Jacksonville Florida's Steel, Cantilevered Truss Bridge Roadway Widening on Existing Foundations**

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