2016 PTI Convention
Long Beach, California

Technical Session 1
Bridge Design and Construction
New Gerald Desmond Cable Stay Bridge Replacement

Ken Black-VSL
Presentation Goals:

- History of Existing Bridge
- Replacement Bridge
  - New vs. Old
  - Award, Schedule, Cost
  - Design Build
  - New Bridge Details
  - Various Construction Methods
    - Heavy Lifting - Pier Tables
    - Access - Deck & Pylon
    - Foundation Method – Tip Grouting
    - Balanced Cantilever Construction - Main Span
    - MSS (Mobile Scaffolding System) - Approaches
History of Existing Bridge

• Steel Arch Bridge
  – Ground breaking in 1965 & completed in 1968
  – Clearance is 155 Ft
  – Main Span is 410 Ft
• Key link connecting Port of Long Beach to surrounding area and 710 Freeway
• Approximately 15% of nations containerized water cargo crosses the bridge
• Has become unable to accommodate larger container ships underneath its span & the greater traffic across its deck
Building a New Bridge

• New vs. Old
• Ships are now 6 times larger than in 1968
• Affecting other bridges
  – Bayonne Bridge in NY
  – Panama Canal-
  • large containers
New Bridge Award, Schedule, Cost

- Owner - Port of Long Beach
- Design Build awarded to SFI in 2012
  - Shimmick Construction Co, Inc; FCC Construction; S.A. Impregilo S.P.A.
- Original Completion was 2016
  - Towers were redesigned
- New Completion is now 2018
- Final Cost is anticipated to be around 1.5 billion
New Replacement Bridge Design

• Design Build
• Cable Stays/Armor/Fire Protection
  – Awarded to VSL
    • Scope-
      – Furnish & Install VSL SSI 2000 Cable Stay System
      – Furnish & Install VSL Friction Dampers
      – Furnish & Install VSL/Hardwire Armor & Fire Protection
      – Stay Installation is schedule to begin in November 2016 with completion in June 2017
      – Armoring will begin in June 2017 with completion by Sept
Integrated Stay Cable Solution

Stays | Armor | Fire
Stays - SSI 2000 System
Armor/Fire Protection

- VSL will design, fabricate and install armor and fire protection on GDB
- This is becoming more of standard for cable supported bridges - 3 under contract presently
- PTI now requires fire protection on all cable stay bridges
- Protection starts at the roadway and terminates at a certain height above the deck
New Replacement Bridge Design

• Multi-strand Post-Tensioning
  – Awarded to DSI
  – Approaches
    • Longitudinal & Bent Cap Tendons- 27 x 0.6” strands
    • Transverse tendons in Deck – 4 x 0.6” strands
  – Main Span Precast Tendons – 12 x 0.6” strands
New Replacement Bridge Details

• Cable Stay Bridge Details
  – 205 Ft. of clearance off water
    • 40 Ft. higher than existing bridge
  – Main Span is 1000 Ft. long (two towers)
    • Stay support length is 2000 Ft
  – Longer approaches to accommodate increased height
  – Towers are 310 Ft high from deck
New Replacement Bridge Details

- 80 Stays Total
- Longest stay - 572 ft
- Shortest stay - 236 ft
- Sizes range from 6-43 to 6-85

• Bike & pedestrian path on one side of bridge
• Scenic overlook
• Six lanes vs. four lanes on existing bridge
• Main Span is steel box girder with steel floor beams with precast panels.
• Steel field sections to be fully assembled and brought in by barge and erected with lifters supplied by Deal
New Replacement Bridge Details

Features of the new bridge:
- Three traffic lanes in each direction
- Emergency shoulders in each direction
- Bike path
- Pedestrian walkway
- Scenic overlooks
- Two 150-ft. towers
- Elegant, cable-stayed design

Bridge Clearance

The aging Gerald Desmond Bridge, which opened in 1961 when ships were about one-sixth of today's size, provides just 155 feet of clearance above the Port of Long Beach's main channel. The bridge is being replaced by a taller span with a 205-ft. clearance, allowing ships to more safely access the Port's northernmost shipping terminals and increasing its ability to handle the largest ships in the world.
New Bridge Construction Methods

- Balanced cantilevered construction - Main Span – (one segment out of balance)
- Strand by Strand Installation
- AMS (Automatic Stressing)
New Bridge Construction Methods

- Heavy Lifting of Pier Tables
New Bridge Construction Methods

• Heavy Lifting of Pier Tables
New Bridge Construction Methods

- Heavy Lifting of Pier Tables

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- Reinforcement Steel:
  - 45.000 tons
- Tension Strand:
  - 40.000 tons
- Deck Slab/Concrete:
  - 50.000 tons
- Foundation/Support:
  - 55.000 tons
New Bridge Construction Methods

• Tower Crane at Each Pier - Access
New Bridge Construction Methods

• Fully Scaffold Towers - Access
  – with elevator for stay install
New Bridge Construction Methods

• Foundations
  – 3200 yards of concrete in pier foundations
  – Continuous pour for 24 hours
New Bridge Construction Methods

• Tip Grouting on Foundations
  • Not common on Caltrans Projects
  • Used on approximate 6 projects in US
    – John James Audubon Bridge
      » Article by Steven Dapp, Ph.D., P.E.
      » Dan Brown, Ph.D., P.E.

• Benefits of Tip Grouting
  – Increases the ultimate tip capacity
  – Tip is able to contribute to useful capacity
  – Provides proof load of capacity for all shafts on site
New Bridge Construction Methods

• When to Consider Tip Grouting
  – Sandy bearing stratum
  – Shaft tip is difficult to clean or keep clean
  – Increase reliability- proof load every shaft
  – Gaining acceptance in US

• Mass Concrete Pours
  – Majority of foundation and bent cap pours utilized a cooling system
New Bridge Construction Methods

• MSS (Mobile Scaffolding System)
New Bridge Construction Methods

- MSS – Used on E&W Approaches
New Bridge Construction Methods

- MSS

**MSS MAIN COMPONENTS**

- Suspension Gallows (SG)
- External Formwork (EF)
- Rear Nose (RN)
- Main Girder (MG)
- Front Nose (FN)
- Support Bracket (SB)
- Launching Wagon (LW)
- Transverse Beams (TB)
New Bridge Construction Methods

- MSS

Before
August, 2015

After
December, 2015
New Bridge Construction Methods

• **Movable Scaffolding System MSS**
• MSS replaces conventional falsework means and methods when constructing in unsuitable ground conditions and heights greater than 150 feet
• Approximately 50,000 bolts per MSS, 22,000 of the total are torqued
• Approximately 14,200 pieces, each marked with their own unique I.D.
New Bridge Construction Methods

- MSS – first time used in North America
- MSS Video for First Launch
Project Team

• Project Team:
  – Owner Port of Long Beach
  – General Contractor SFI JV
  – Design Engineer Arup
  – Construction Engineer Arup/McNary Bergeron
  – Stays VSL
  – PT DSI
Thank You!

Questions ?