



PCMA Webinar
November 12, 2020

Sargent Beach Bridge – Matagorda Bay



Presenter - Gregg A. Reese, P.E.

- Senior Technical Advisor - Modjeski and Masters
- 37 Year Career in Structural Engineering
- PCI Committee on Bridges, Chairman
- Design and Construction Engineer working primarily for Contractors
- Multiple Project Designs in
Non-Traditional Delivery Systems:
 - Value Engineering
 - Contractor Alternates
 - Design Build
 - CMGC

Accelerated Bridge Construction Prefabricated Bridge Elements and Systems (PBES)



“structural components of a bridge that are built offsite, or adjacent to the alignment - and includes features that reduce the onsite construction time and mobility impact”

“Lego Construction”



PRESENTATION FEATURES

PROJECT EXPERIENCES

Texas Projects

Other States

APPLICATIONS

ADVANTAGES

DESIGN FEATURES

ENHANCEMENTS

CONCEPTS

DELIVERY SYSTEMS

Design/Bid Build

Design/Build

Value Engineering





➤ PRECAST BRIDGE ELEMENTS

Substructures

Piers

Caps

Bents

Abutments

Superstructures

Girders

Decked Girders

Spliced Girders

Curved U Girders

Precast Decks

➤ PRECAST SUBSTRUCTURE Precast Bent Caps

Eliminates

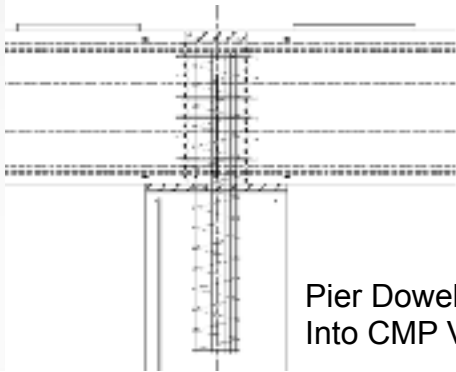
- Shoring & Forming
 - Tying reinforcing cages.
 - Casting and Finishing
 - Setup and Dismantle
- Reduces Traffic Impact



Comal County, Texas

November 12, 2020

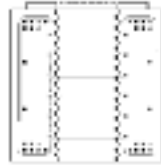
Fill Void w/ Concrete



Pier Dowels Extend
Into CMP Void

Detail

CMP Void in Cap



Section

➤ PRECAST SUBSTRUCTURE Multiple Column Bent Caps

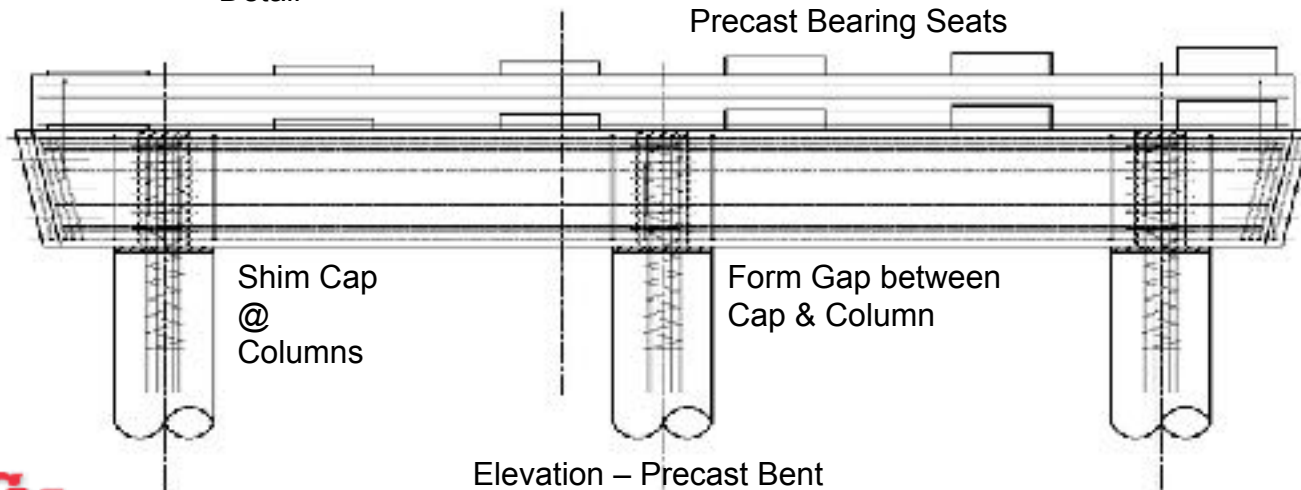
Pretensioned Bent Cap

Precast Bearing Seats

Circular Steel Dowel Pattern in CMP Voids

3" Tolerance for Placement

Void and Gap cast with Concrete (3/8" Agg.)



Elevation – Precast Bent

➤ PRECAST SUBSTRUCTURE Multiple Column Bent Caps Comal County, Texas

- Single Crane Pick, Multi Column Bent
 - Shipped like P/C Beams
 - Multiple Bents set in one Shift



➤ Setting Precast Bent

- Bent is Shimmed at Top of Column
- Column Forms at 3" Gap
- Void and Gap filled with Concrete

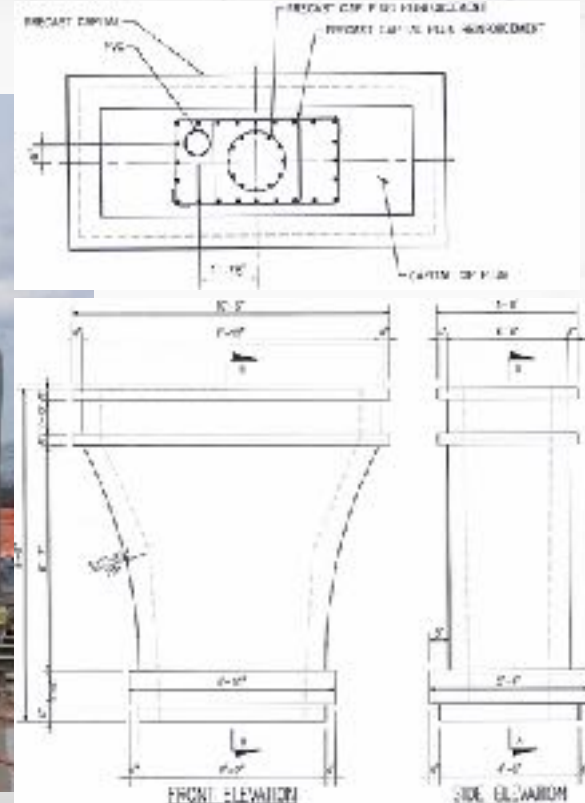
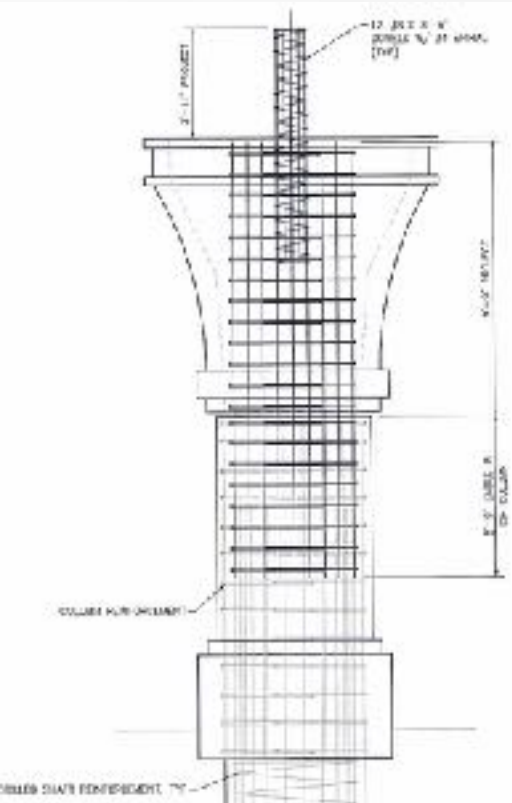


Webb County Texas
Precast Pier Capitals
and Cross Bents



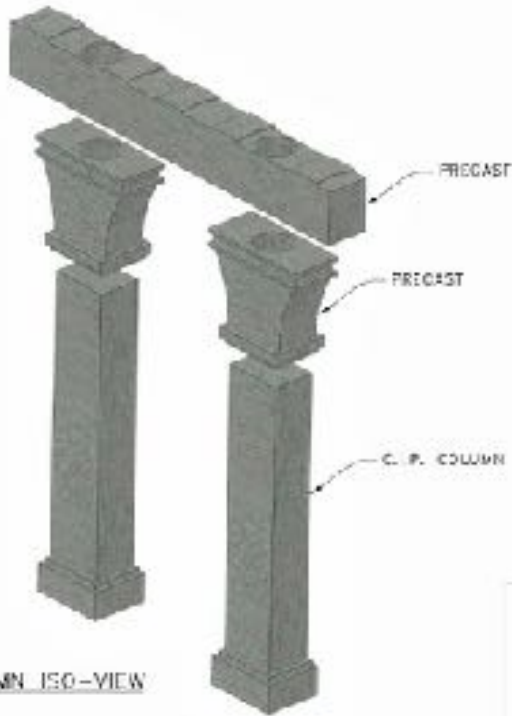
PRECAST SUBSTRUCTURE Multiple Column Bents

Webb County Texas
Precast Column Capitals conformed
to
Tight Architectural Criteria

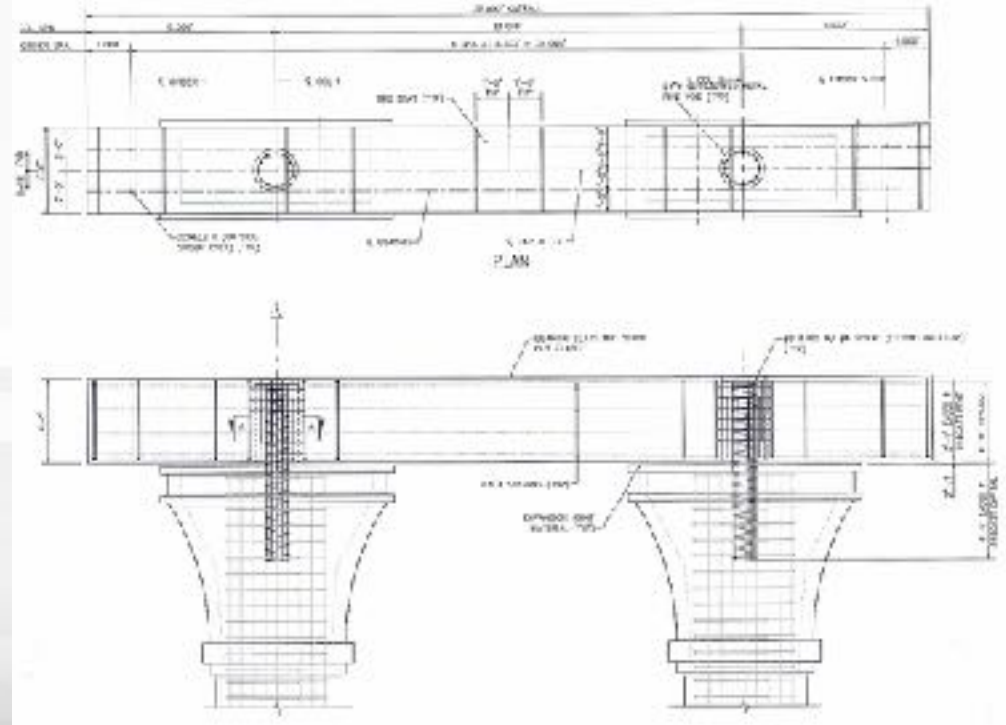


Webb County Texas

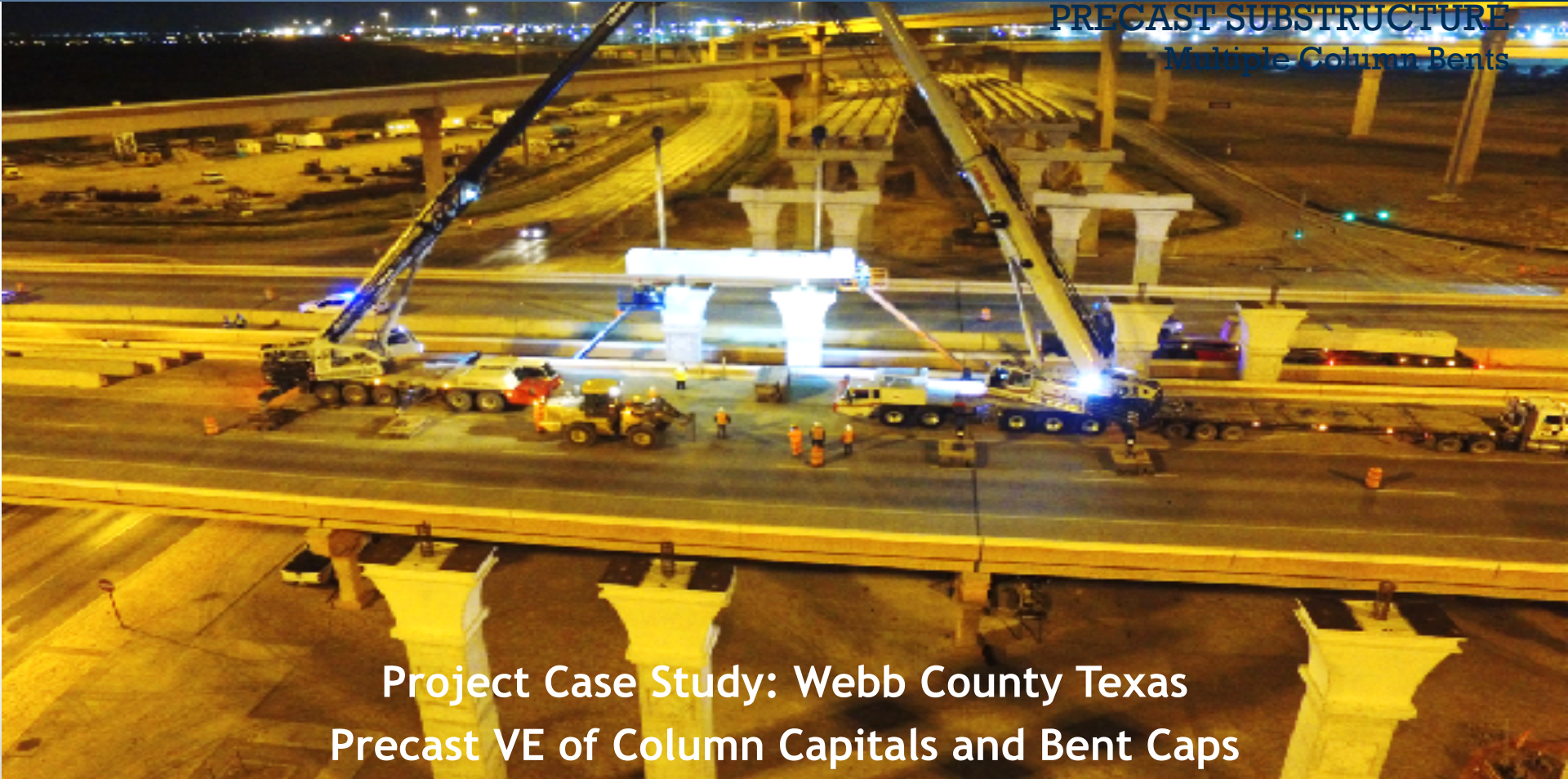
Hollow Precast Cap replaced CIP Design
Pier Reinforcing and Drain Piping fit into Capital
All Connections used Typical CIP Concrete



BENT CAP/COLUMN ISO-VIEW



November 12, 2020



Project Case Study: Webb County Texas
Precast VE of Column Capitals and Bent Caps

November 12, 2020

Zapata County Texas
Reinforced Concrete Caps
Shape designed to meet Architectural Standards

➤ **PRECAST SUBSTRUCTURE**
Hammerhead Caps



Zapata County Texas
Commercially Available Haul Trailer

PRECAST SUBSTRUCTURE
Hammerhead Caps

➤ Haul Weight = 120 kips



Zapata County, Texas

Large Corrugated Metal Pipe (CMP) Void

Dowels had 3"+ placement tolerance

Small Aggregate CIP Concrete Cast in Void, Typical

Class C, 4500 psi

➤ PRECAST SUBSTRUCTURE Hammerhead Caps



Zapata County Texas

40 Hammerhead Caps set across a Shallow Lake; 6 Caps sent in a single shift



➤ PRECAST SUBSTRUCTURE

Hammerhead Caps
Sargent Beach, Texas

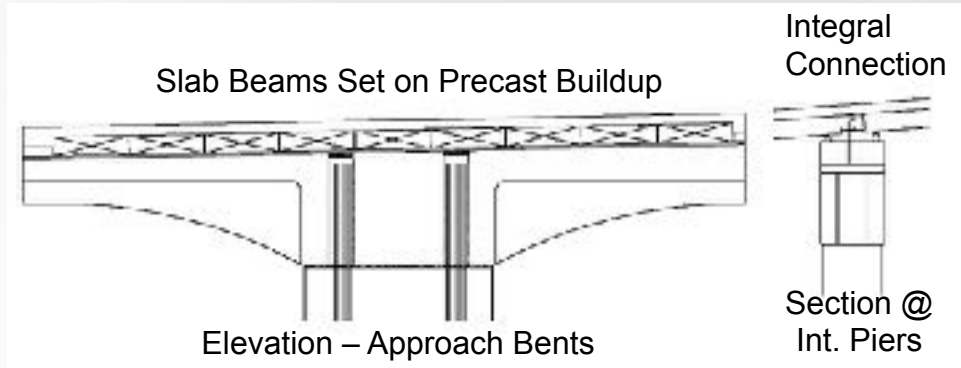
- Main Span Caps support 300' Spans
- Pretensioned Tee Cap Design
- Single Crane Pick



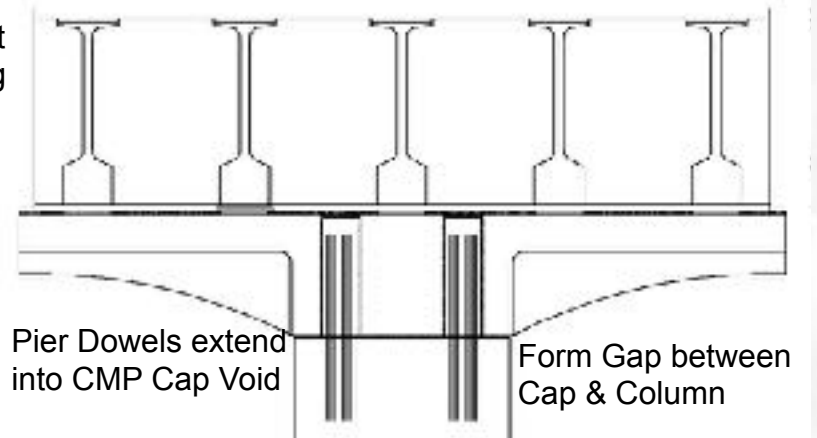
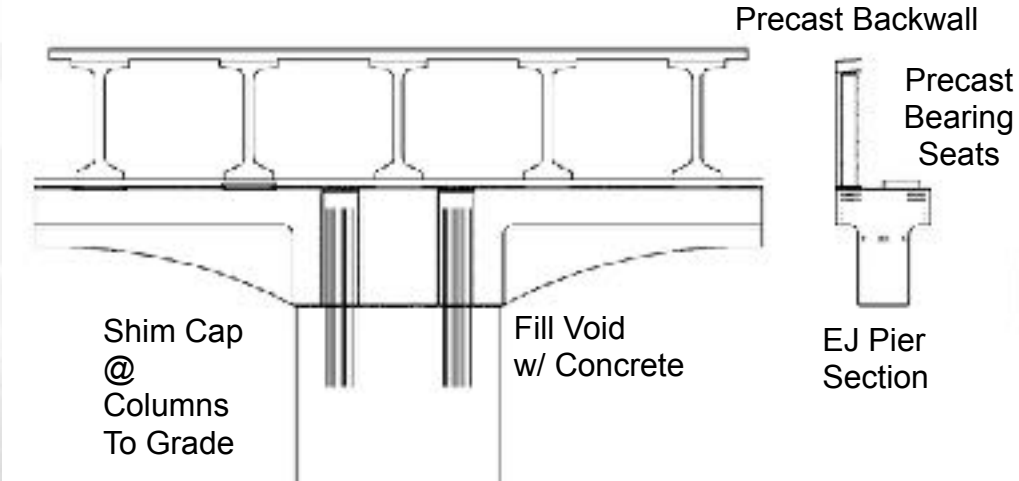
- Approach Span Caps
- Pretensioned Tee Cap Design
- Haul Weights from 150 kips to 250 kips



➤ SUBSTRUCTURE Sargent Beach Bridge Precast Bent Cap



No Bearings at Interior Piers
Precast Bearing Seats on EJ Piers
CMP Voids
3" Tolerance for Placement
Void and Gap cast with Concrete (3/8" Agg.)



PRECAST SUBSTRUCTURE - BENT FRAMES

Comal River Bridge, New Braunfels, TX

Restoration Project of 100 Year old Iconic Arch

Bridge

Including Widening, Reframing and Decking



➤ PRECAST SUBSTRUCTURE - BENT FRAMES

Existing deck and framing removed.
Arches and Spandrel Columns Remain
Not Load Bearing



November 12, 2020

PRECAST SUBSTRUCTURE – BENT FRAMES
Shipped to Jobsite from Precast Yard
Haul Weight = 100 kips.



Advancing Bridge Construction with Precast Concrete

Precast Frames replaced CIP Bents
Large Hydraulic Cranes used for demolition and Erection
Continuous erection of Frames and Slab Beams
.Completed in May 2020



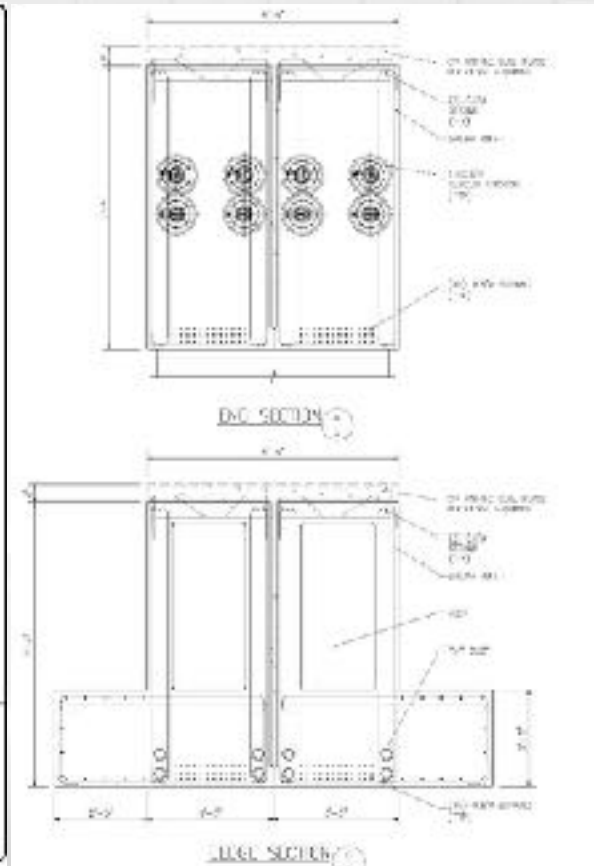
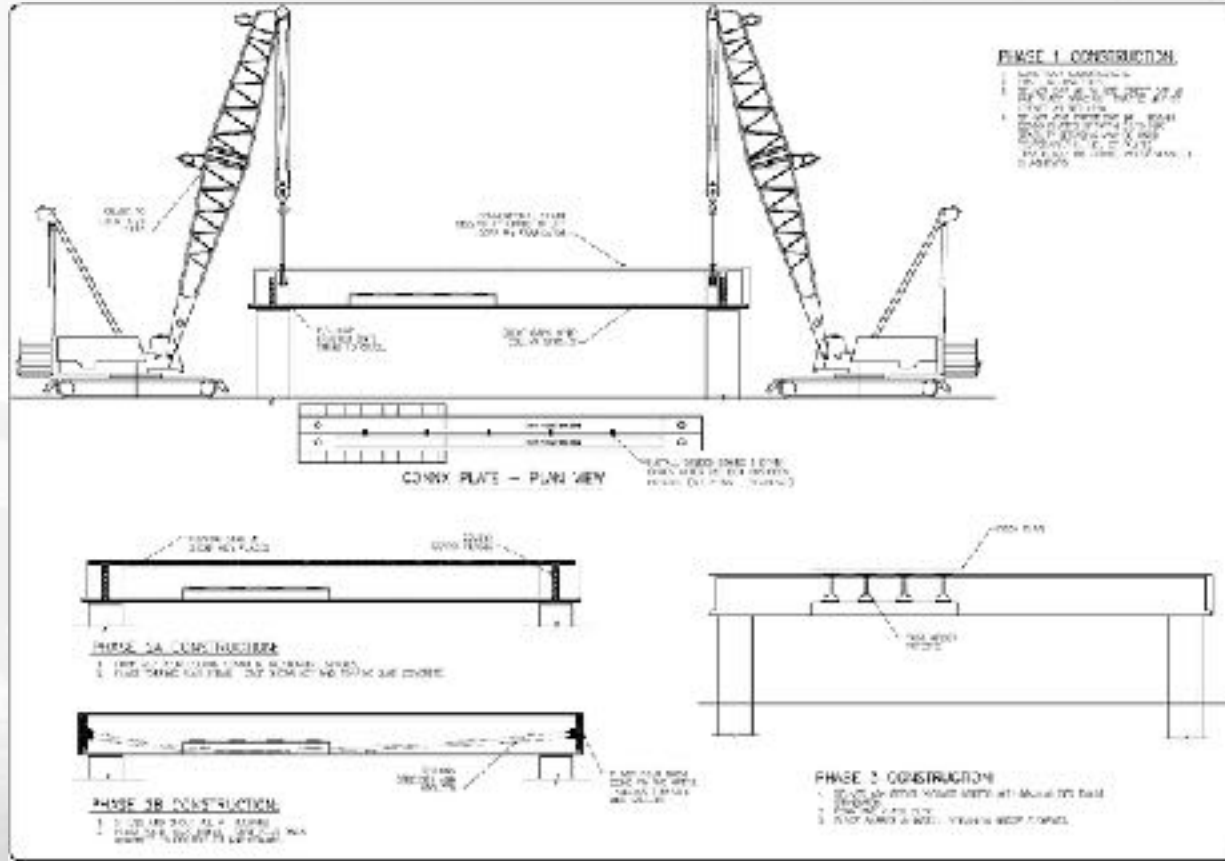


➤ **COMPLETED PROJECT**
Six Months ahead of schedule

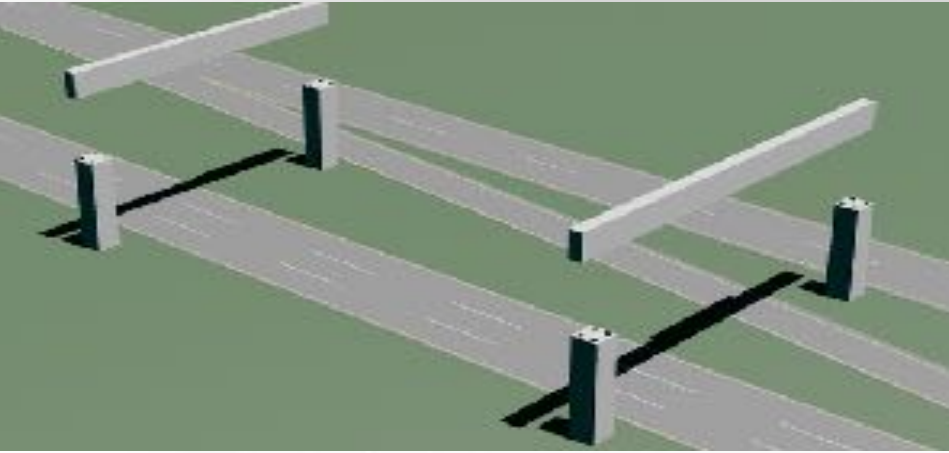
Precast Straddle Bent Concept Developed for SH288 / 610 D/B in Houston, TX



Precast Straddle Bent Concept - SH288 / IH610

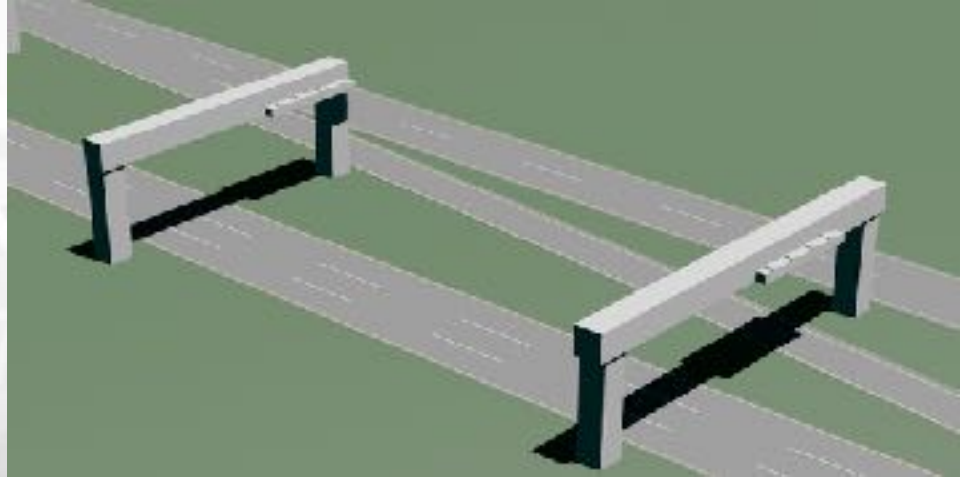
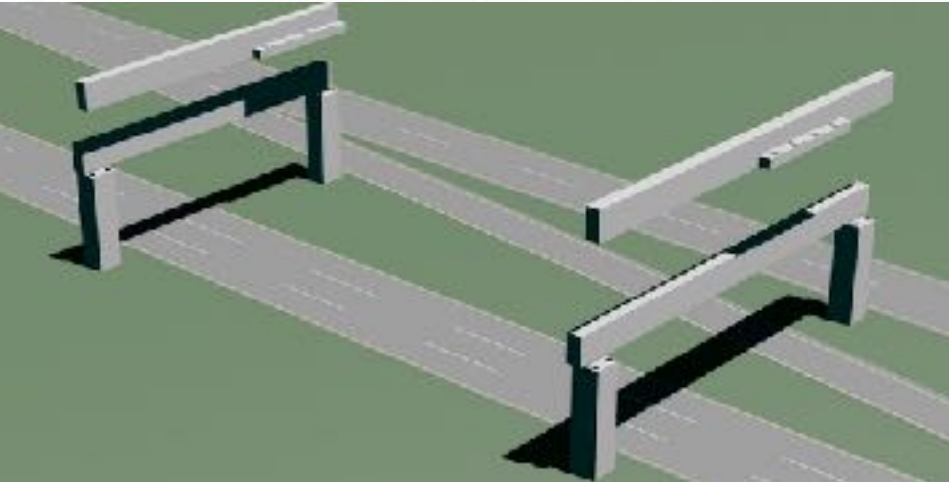


November 12, 2020



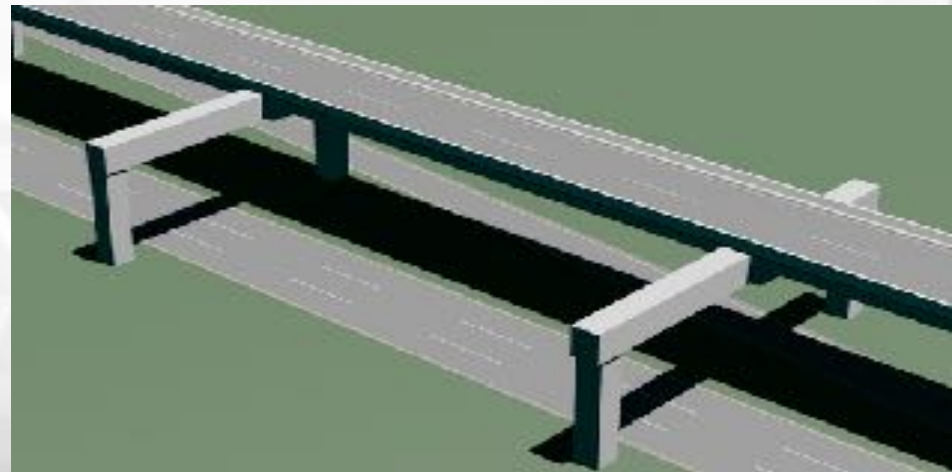
Straddle Bent Concept, Side by Side Precast Box Beams

- Piers Cast
- Cranes Mobilized on Site
- Straddle Bent Box Beams Set during evening closure, opened to traffic next day
- CIP Connections Cast



Straddle Bent Concept, Side by Side Precast Box Beams

- CIP Connections reach Strength
- P/C Girders Erected
- Deck Slab and Barriers Cast
- Minimal disruption to existing traffic.



Advancing Bridge Construction with Precast Concrete

PRECAST BRIDGE ELEMENTS
SUPERSTRUCTURE
SPliced CONSTRUCTION



November 12, 2020

PRECAST SUPERSTRUCTURE

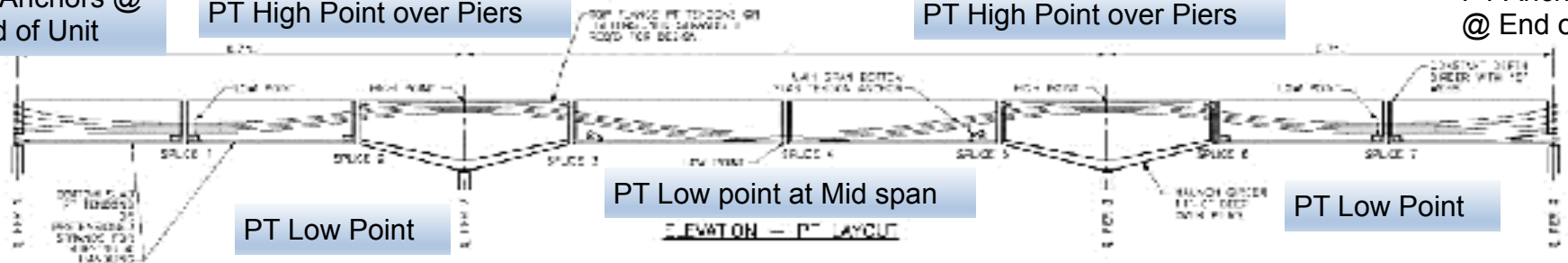
Spliced Girder Layout and Post Tensioning

PT Anchors @ End of Unit

PT High Point over Piers

PT High Point over Piers

PT Anchors @ End of Unit

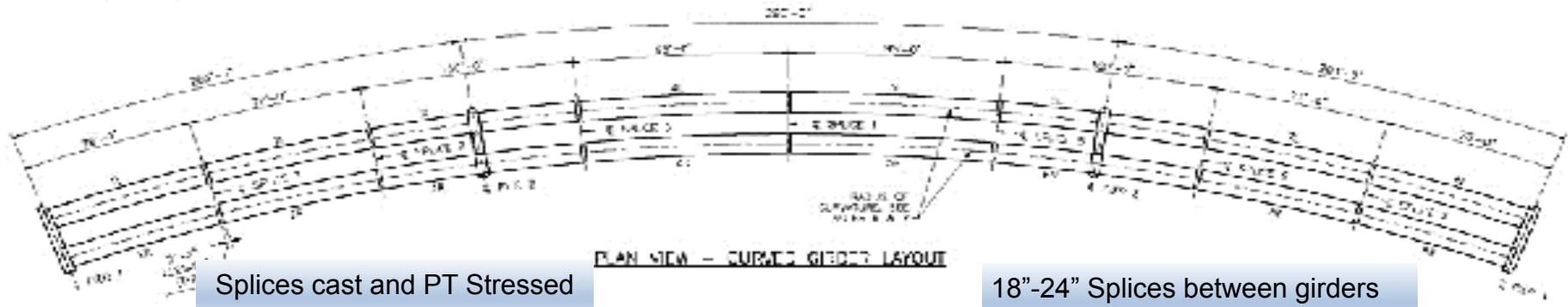


PT Low point at Mid span

PT Low Point

PT Low Point

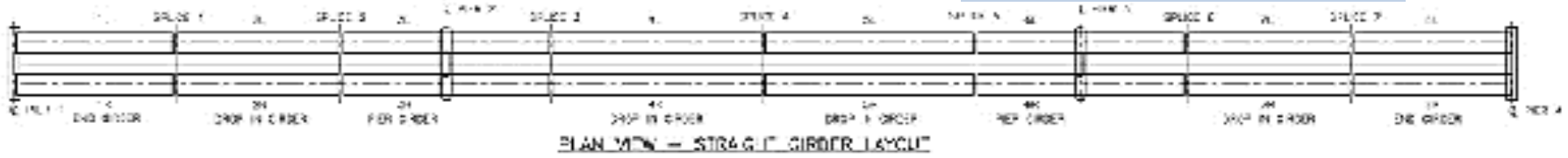
ELEVATION - PT LAYOUT



Splices cast and PT Stressed

18"-24" Splices between girders

PLAN VIEW - CURVED GIRDER LAYOUT



PLAN VIEW - STRAIGHT GIRDER LAYOUT

November 12, 2020

Spliced, Post Tensioned, Precast Girder Bridges in Texas

- 2009 – DART Light Rail Bridge over Trinity River Levee, Dallas, TX
- 2012 – Sylvan Avenue over the Trinity River, Bulb Tee, Dallas, TX
- 2013 – Clear Fork Bridge over the Trinity River, Ft. Worth, TX
- 2014 – Dallas Horseshoe Bridges over the Trinity River, Dallas, TX
- 2016 – IH10 Access Road over UPRR, Seguin, TX
- 2017 – IH35 Access Ramps over UPRR, Round Rock, TX
- 2019 – Sargent Beach Bridge, Sargent Beach Texas (Under Construction)
- 2020 – SH249 / Grand Parkway Interchange, Houston, TX (Under Construction)



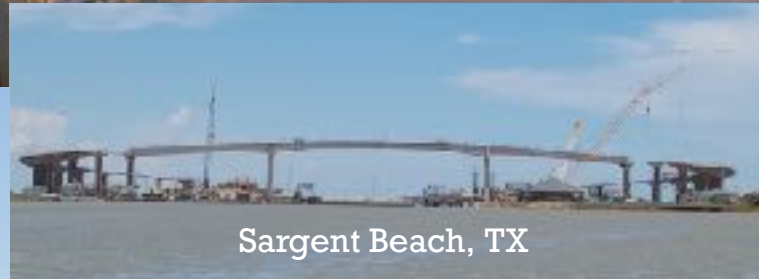
IH35 Access, Round Rock,
TX



Clearfork Bridge, Ft. Worth,
TX



Sylvan Avenue, Dallas, TX



Sargent Beach, TX



IH10 Seguin, TX

PRECAST SUPERSTRUCTURE

Spliced Girder Bridges
in Texas, 8 Total

6 projects are in Service

Project Delivery

- Design/Build – 1
- Value Engineering - 3

Owners

- TxDOT - 4
- Cities - 2
- Transit Agencies – 2



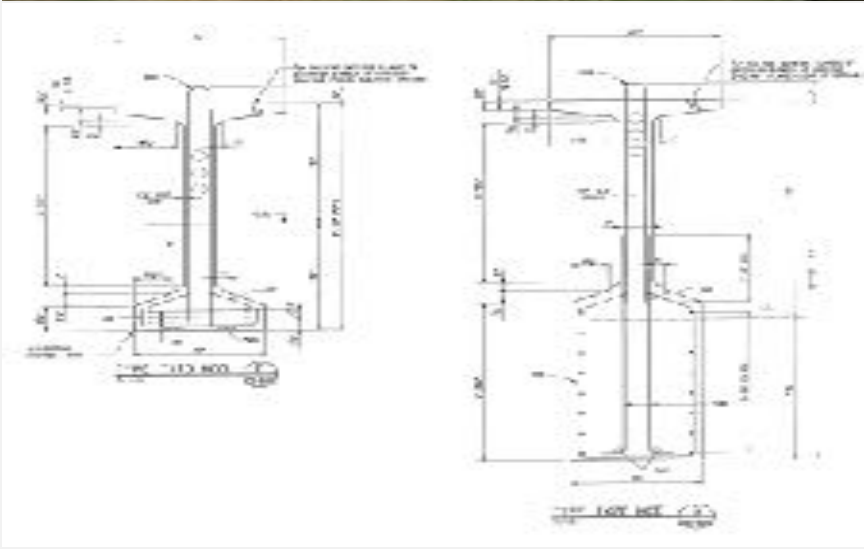
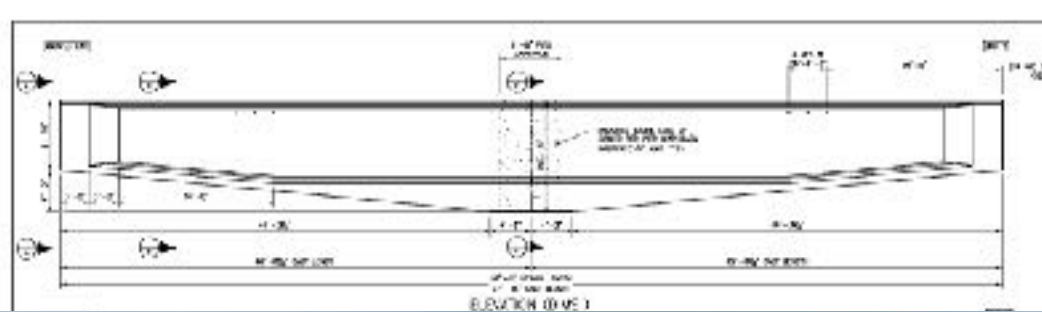
Dallas Horseshoe
IH30/35

November 12, 2020

Advancing Bridge Construction with Precast Concrete

DART Light Rail Bridge, Dallas Texas 2009

First Spliced, Post Tensioned, Long Span Bridge in Texas



Sylvan Avenue Bridge
over the Trinity River
Dallas Texas

Big Spliced Precast Project
3 – 3 Span Units
10 – 12 Girder Lines

250' Main Span over
the Trinity River

2013/07/21 21:23

Advancing Bridge Construction with Precast Concrete

Small Project
3 Span Bridge, 4 Girder Lines

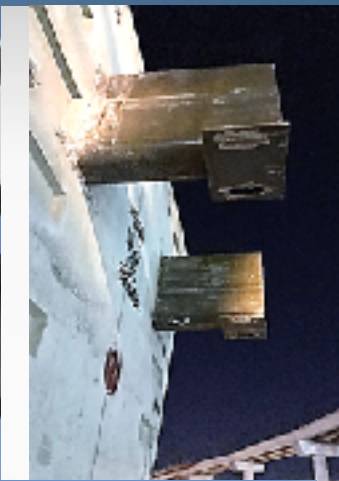
IH10 Access Road
over UP Railroad
Seguin Texas

200' Main Span

Embedded Brackets vs. Strongbacks during Erection



Embedded Erection Brackets



Conventional Erection Strongbacks



Sylvan Avenue Bridge
62 Splices, Brackets
Accelerated Erection

2013/07/21 21:23

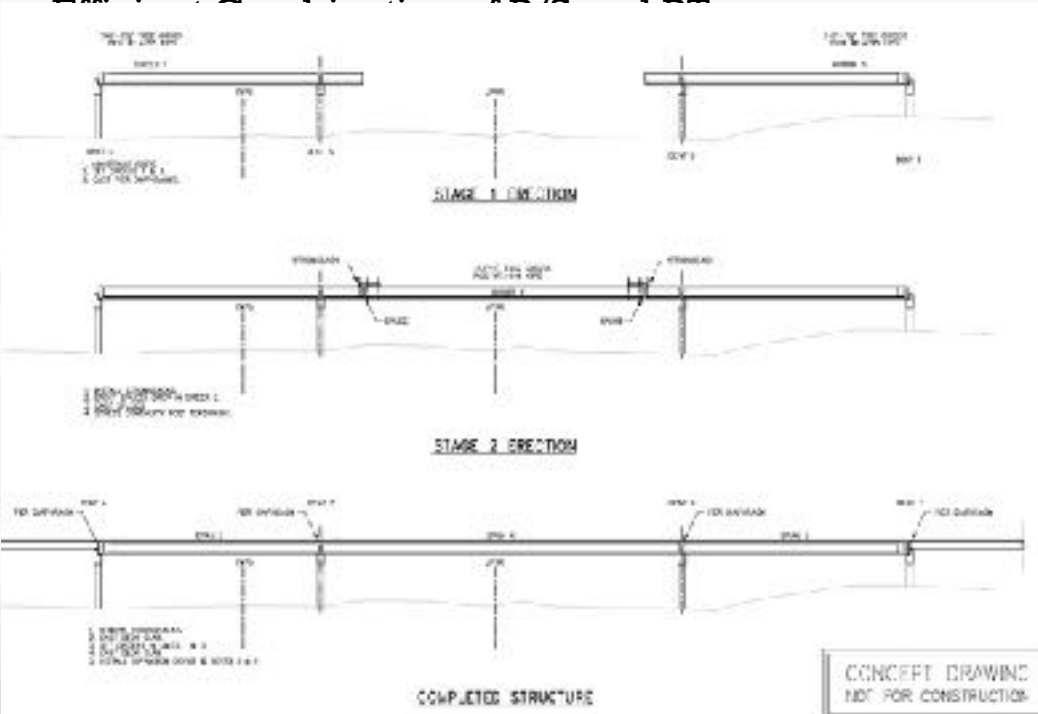
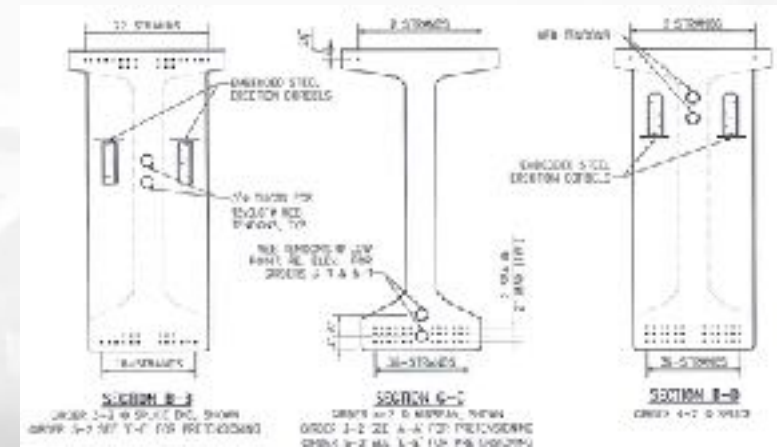
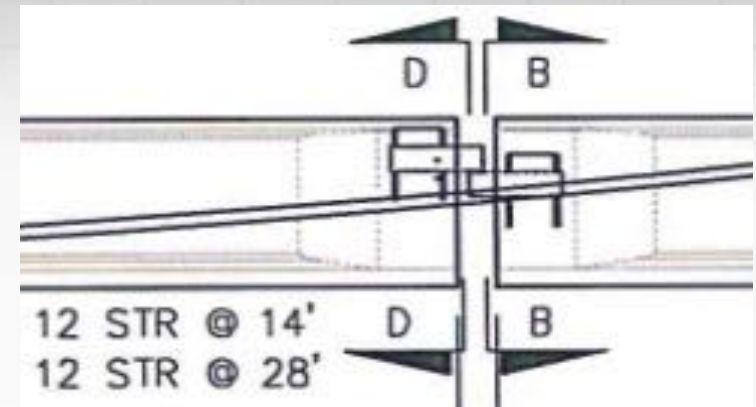


IH10 Access Road over UPRR, Seguin, Texas

Value Engineering Redesign

Main Span Girders Set on Embedded Steel Corbels

No Shoring Required During Construction



Advancing Bridge Construction with Precast Concrete



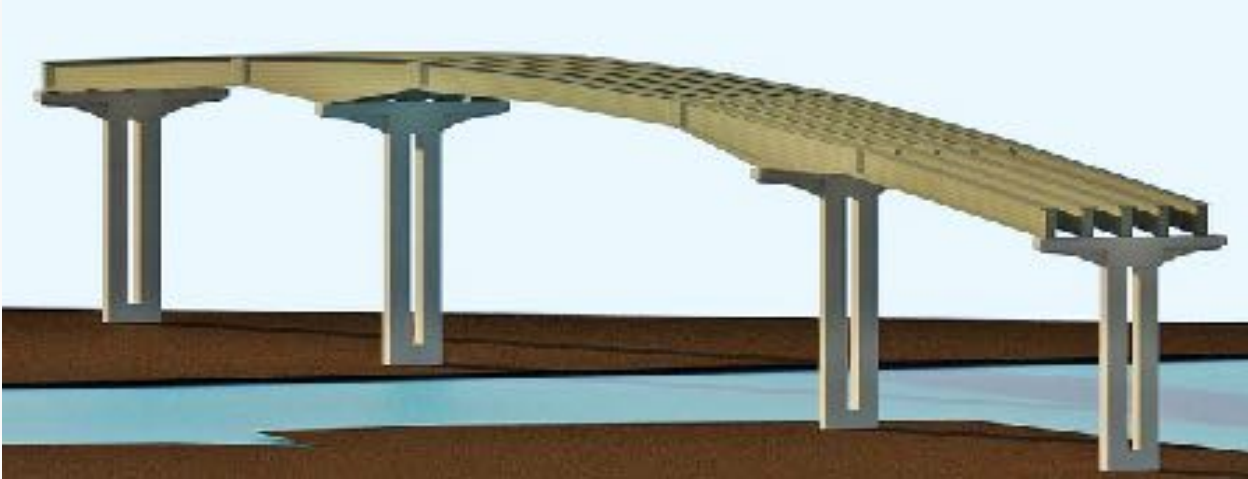
Girders Erected over UPRR in 3 hours
No disruption to rail traffic
Contractors love the embedded brackets



SUPERSTRUCTURE

Spliced Girder Bridges
Sargent Beach Bridge

Value Engineering Design
Record Setting 300' Span
Cast at a Land Based Plant



Advancing Bridge Construction with Precast Concrete

Major Challenge: Solve Shipping and Handling issues.

Variable Depth Pier Girder
8.00' to 12.50' Deep
Haul Weight 320 kips

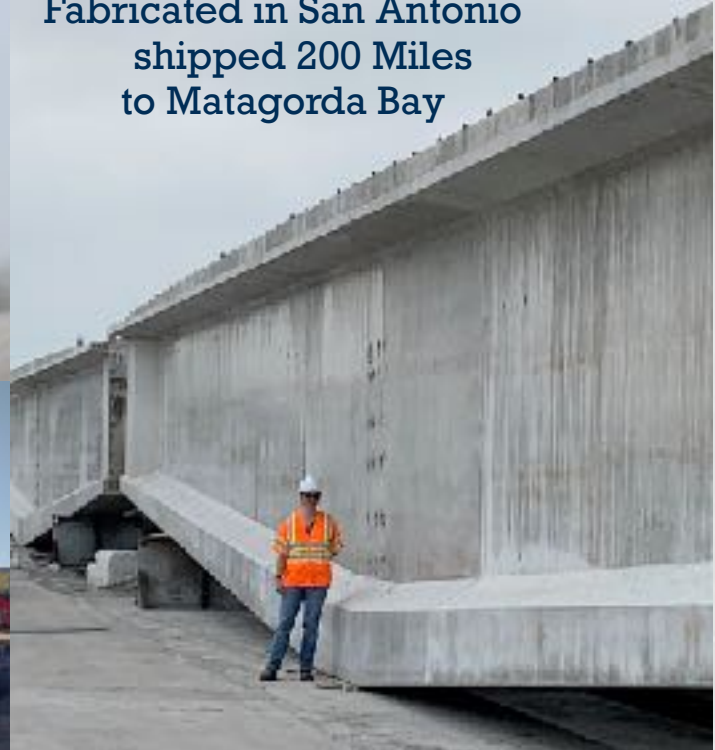
Long Span Precast Bridge did not require Barge
Access



PRECAST SUPERSTRUCTURE

Spliced Girder Bridges
Sargent Beach Bridge

Fabricated in San Antonio
shipped 200 Miles
to Matagorda Bay



PRECAST SUPERSTRUCTURE
Sargent Beach Bridge

Approach and End Span Erection



PRECAST SUPERSTRUCTURE

Pier Girder Erection
Sargent Beach Bridge





PRECAST SUPERSTRUCTURE

Pier Girder Erection
Sargent Beach Bridge

PRECAST SUPERSTRUCTURE
Sargent Beach Bridge
Main Span Erection



Girders Winched into Place
Over Intercoastal Waterway



Spliced Main Span Girders on Barge



Advancing Bridge Construction with Precast Concrete

PRECAST SUPERSTRUCTURE
Sargent Beach Bridge
Main Span Girder Erection Completed



Splices Cast, PT Stressed and Falsework
Removed
July 2020



➤ PRECAST SUPERSTRUCTURE Curved Precast U Girder Bridges

First Curved U Girder Bridge in Texas
FM 249 / Grand Parkway Interchange
Houston, Texas



➤ **PRECAST SUPERSTRUCTURE**
Curved Precast U Girder Bridges

First Curved U Girders Cast in Texas
Site Work and Falsework Fabrication in Progress



Advancing Bridge Construction with Precast Concrete

Project Case Study

Excellent Example of a Total Precast Bridge
Project Design was Driven by Construction Means and Methods



Richard Lawrence "Bronco" Bridge - IH25 over Platte River – Denver, CO

Advancing Bridge Construction with Precast Concrete



Steel Arches and Deck Slab were seriously deteriorated.

ADT > 200,000 Vehicles per day

CDOT feasibility study determined that replacement was more viable than restoration and widening the existing bridge.



November 12, 2020



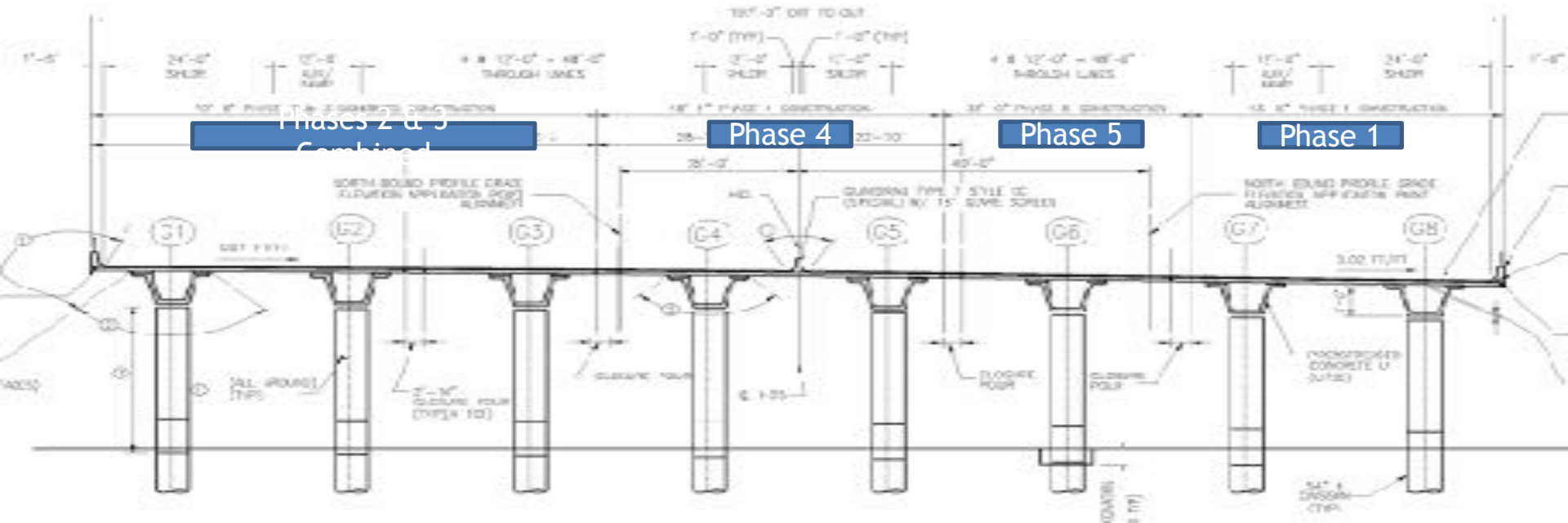
**New Bronco Bridge
Completed: Early Summer 2013
Rigid Frame Continuous Structure**

**Value Engineering Re Design
Full CDOT support of the VE**



**Total Precast Concrete Structure
Including Precast Columns, Girders and Deck
No Bearings**

November 12, 2020



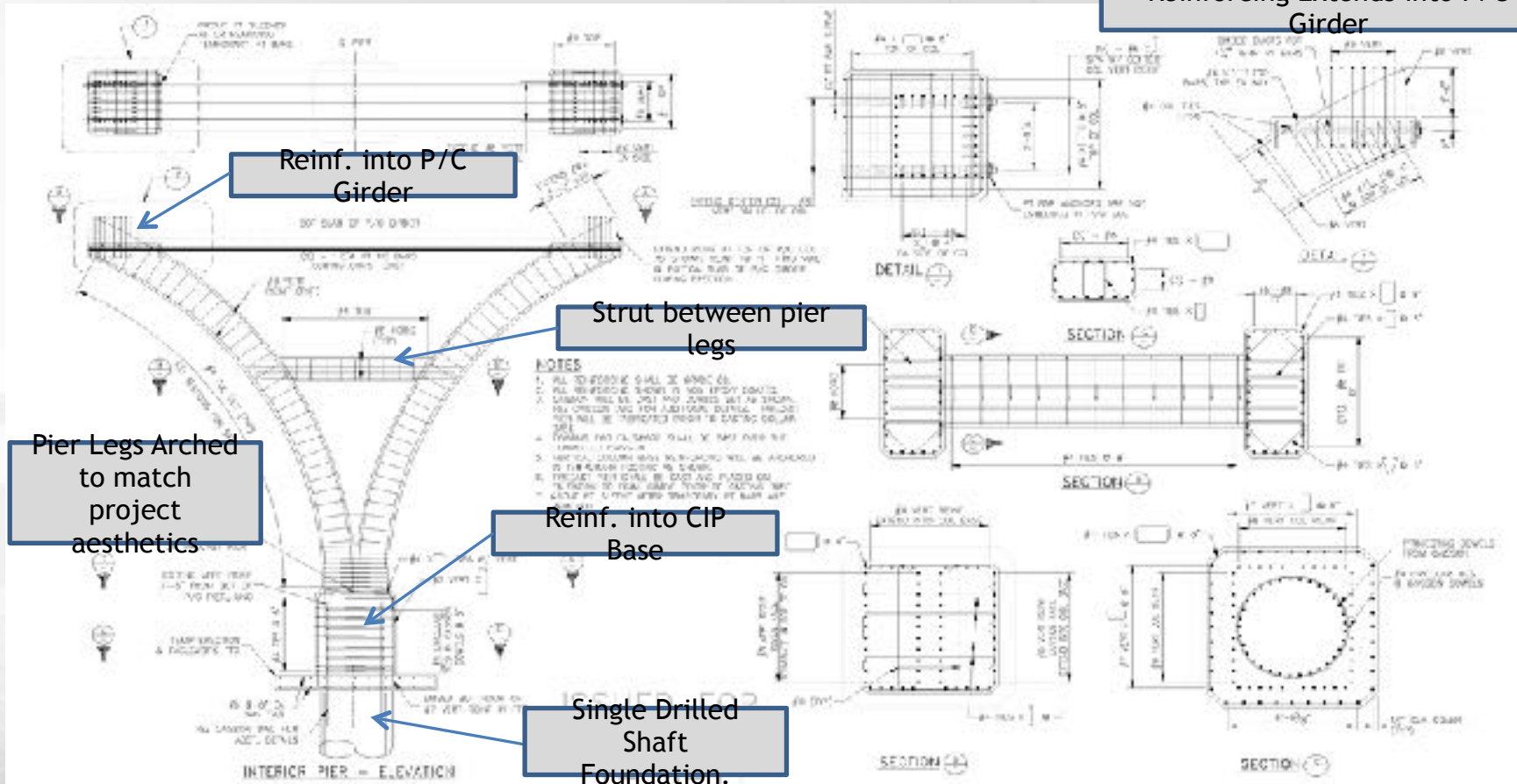
Bridge Cross Section at Interior Piers

- Existing lanes were maintained during construction.
- Originally Designed in 5 Phases, combined Phases 2 & 3. Each Phase includes all construction operations for a complete bridge

Advancing Bridge Construction with Precast Concrete

Redesign of Interior Piers – Fully Precast


Reinforcing Extends into P/C Girder




November 12, 2020

Advancing Bridge Construction with Precast Concrete

Bronco Bridge -



Piers Cast with Efcowall forms on mud slab.

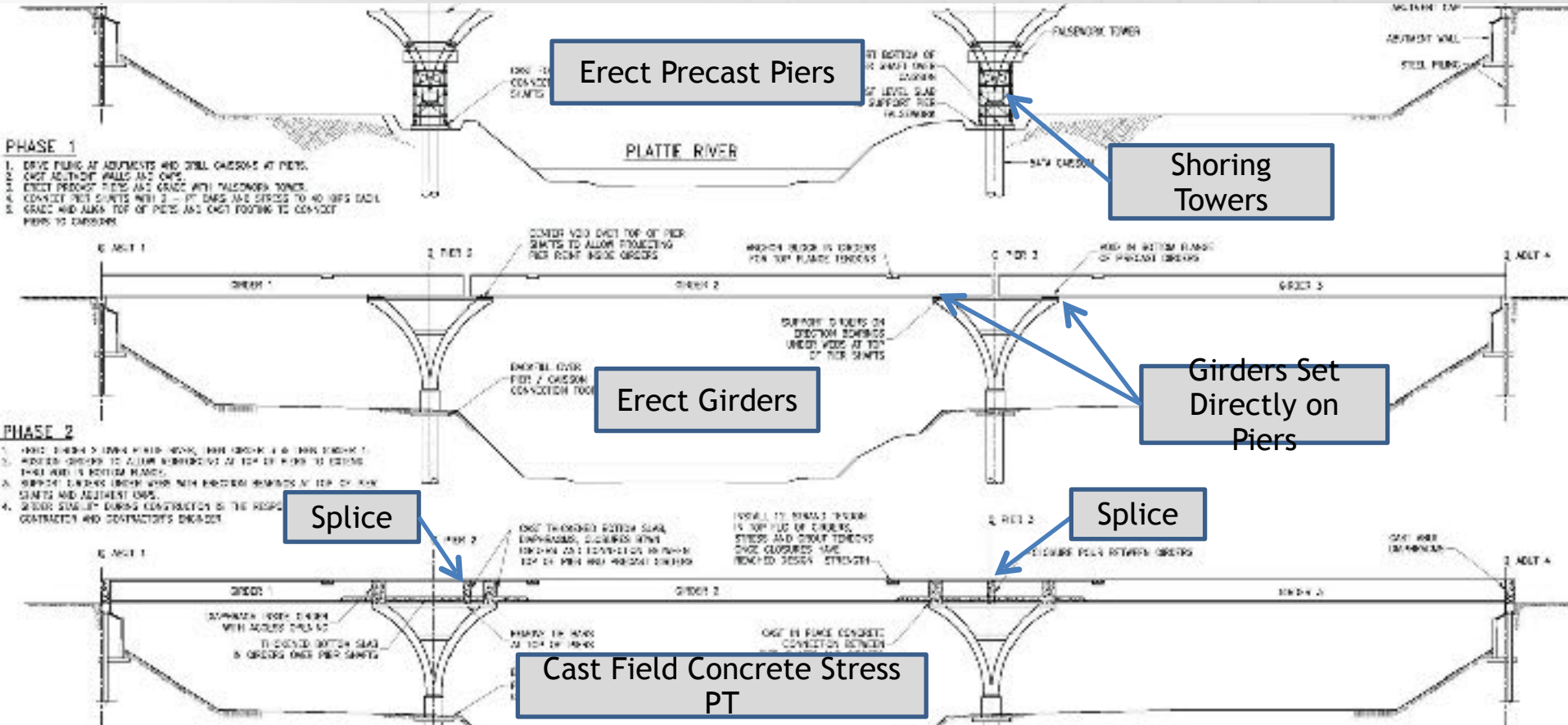


16 Identical Precast Piers Cast in Contractor's lay down yard at jobsite

Independent of all Other Operations
November 12, 2020

Advancing Bridge Construction with Precast Concrete

Redesign of Precast Girder Lines – Spliced, PS/PT and Continuous



November 12, 2020

Bridge Construction

➤ Four Phases of Construction

Each Phase includes:

- Demolition and Site Work
- Complete Bridge Construction
- Overlay
- Shifting of Traffic



Advancing Bridge Construction with Precast Concrete

Foundation Construction and Precast Pier Erection



Site Cleared after Demolition.
Drilled Shafts Installed

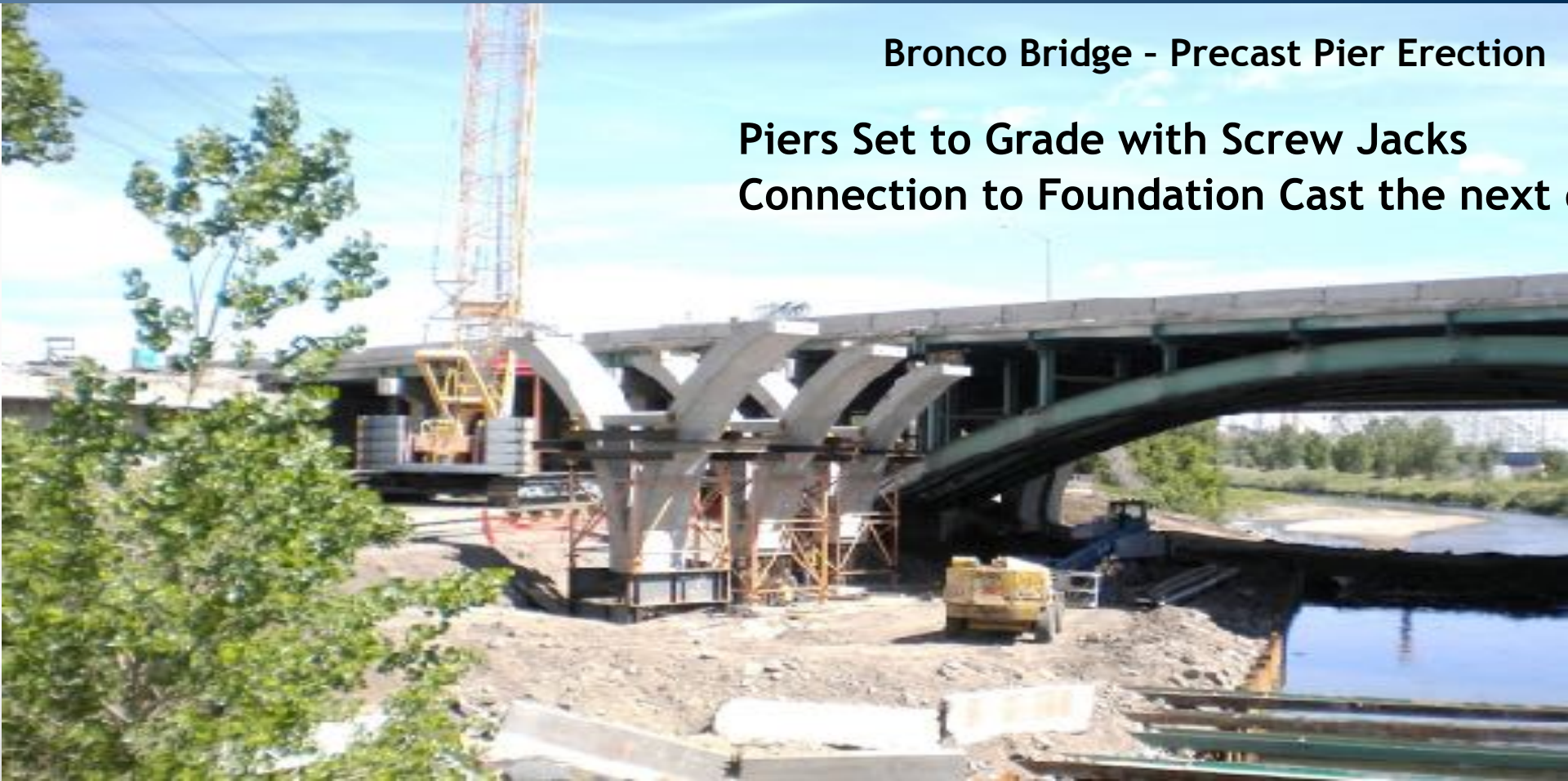


Precast Piers moved to Site
Erected in one shift with single crane.

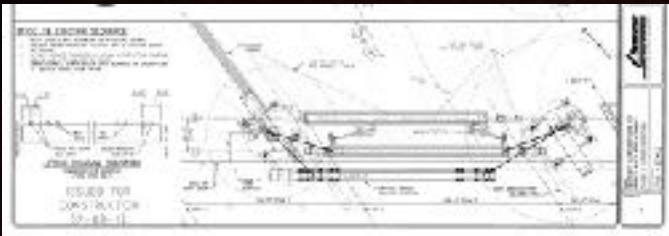
November 12, 2020

Bronco Bridge - Precast Pier Erection

Piers Set to Grade with Screw Jacks
Connection to Foundation Cast the next



November 12, 2020



Engineered Erection Plans

- Column Bases reach design strength, 48 hours
- Girders erected in three evening shifts
- Set directly on piers, no temporary shoring



Advancing Bridge Construction with Precast Concrete

Connections design for
Zone 1 Seismic
Requirements

Block out in
Girder Bottom
Flange

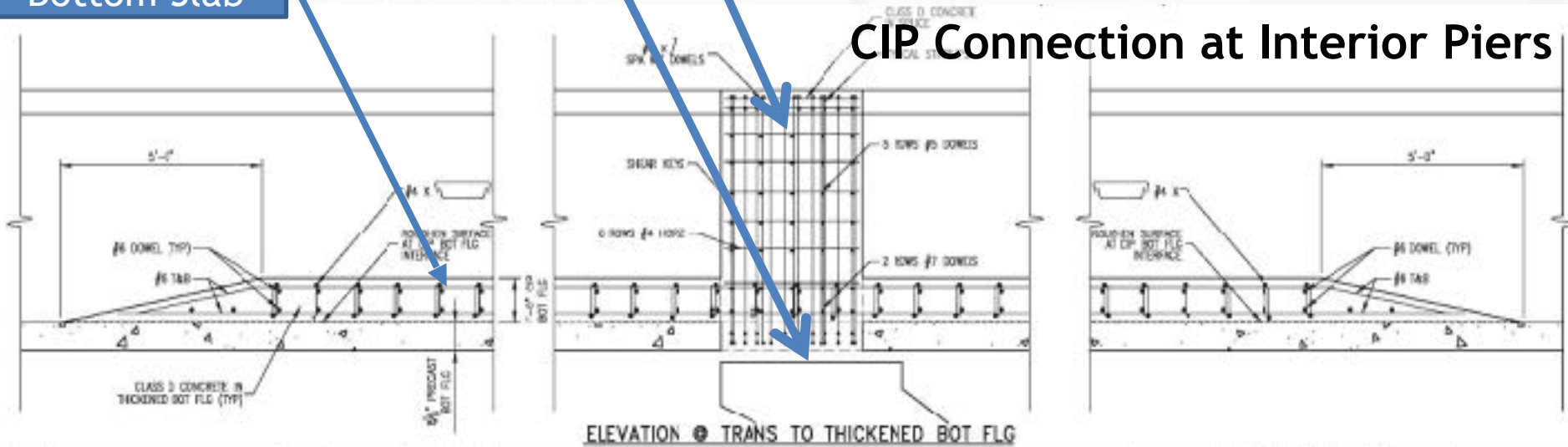
CIP Diaphragm

Top of
Pier

CIP Haunch in
Bottom Slab

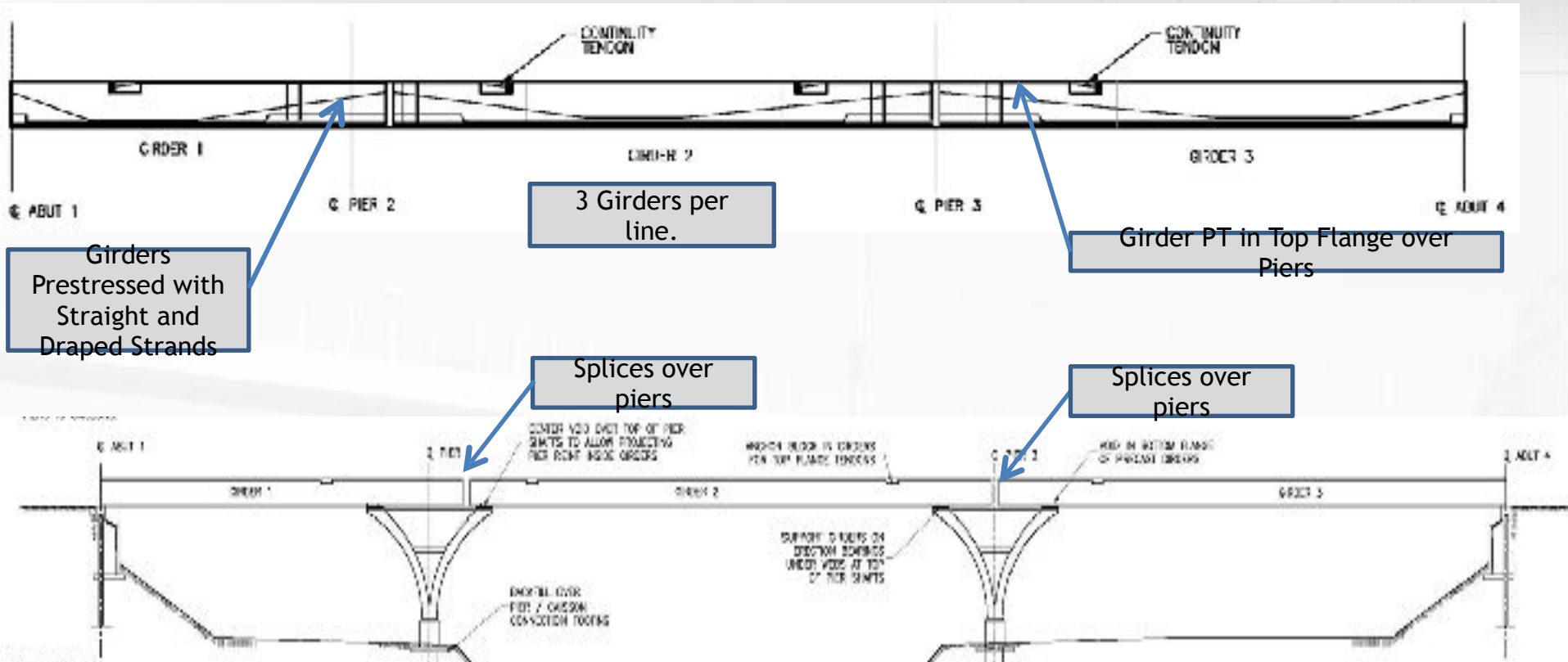


CIP Connection at Interior Piers



Advancing Bridge Construction with Precast Concrete

Redesign of Precast Girder Lines – Spliced, PS/PT and Continuous



Tendons stressed over the piers after CIP concrete cures.



Advancing Bridge Construction with Precast Concrete

Full Depth Precast



- Panels set from abutment to abutment
- Haunch and Transverse Joints Cast from End-to-End w/ CIP Concrete (7000 psi)

Precast Deck Panel Erection



Approach Slabs Cast Membrane and Asphalt Overlay Applied



Completed Project



- Built on Schedule and Under Budget.
- Close Cooperation Between Engineer, CDOT and Contractor a Key Factor resulted in delay free operations.
- Total Precast Designs based on Constructability
- Award Winning Project has been In Service for 8+ years and structure is performing well.

November 12, 2020

Middle Thorofare, Cape May, NJ
Bridge Concept

November 12, 2020



Spliced Curved U Girder Concept Girders Erected without Falsework

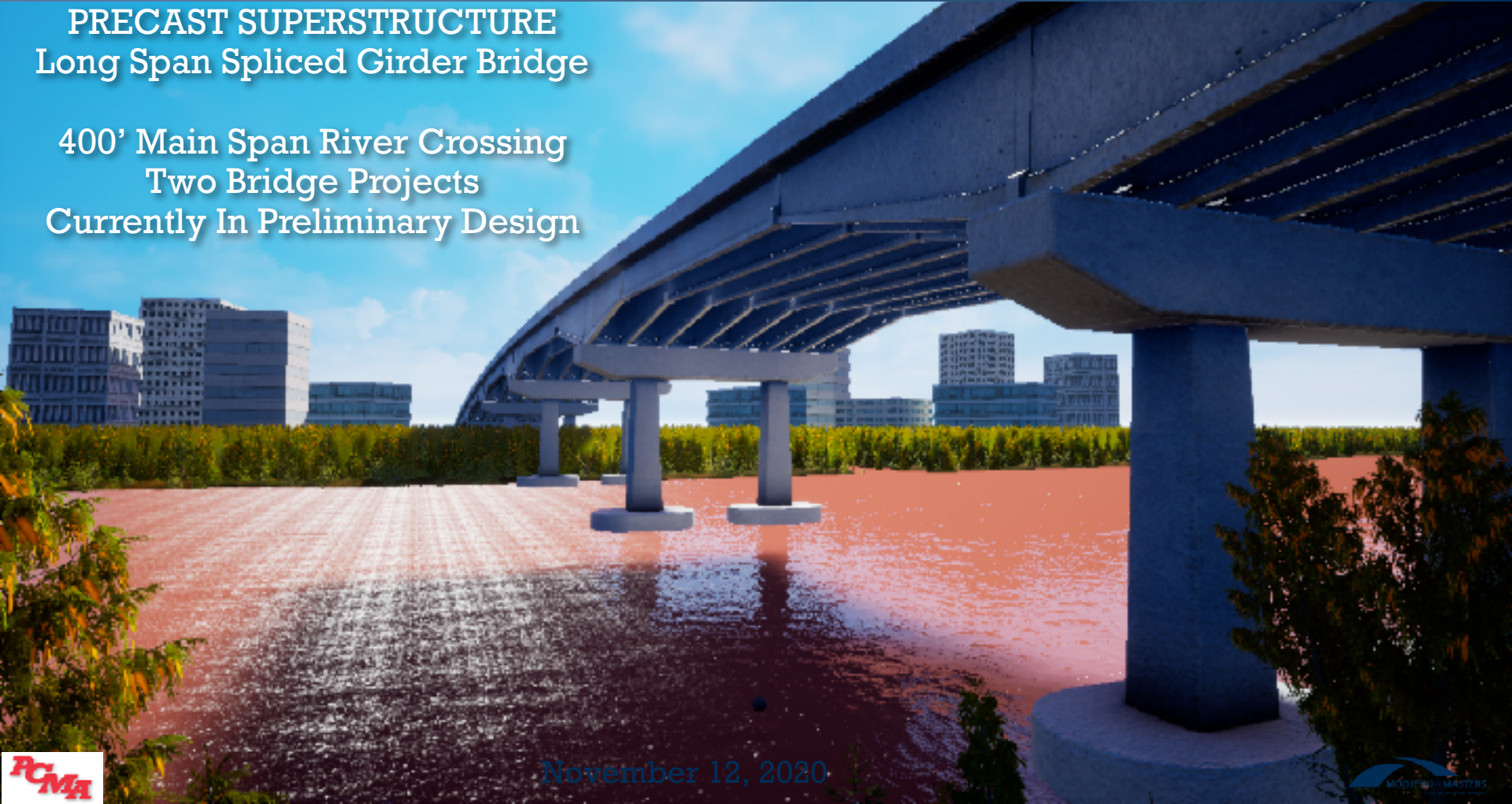
Spliced Curved U Girder
Bridge
Currently in Preliminary
Design

Construction Based Design
Economical, Durable
& Aesthetically Pleasing

November 12, 2020

PRECAST SUPERSTRUCTURE
Long Span Spliced Girder Bridge

400' Main Span River Crossing
Two Bridge Projects
Currently In Preliminary Design



Summary

Advancements in Precast Concrete Bridges still have a long way to go.

Using Precast in Bridge Construction:

- Improved Quality and Durability
- Reduces Construction Time
- Increases Safety for Workers and the Traveling Public



Advantages of Precast

Reduces Forming and Finishing at the jobsite.

Higher Quality Materials

Better Quality Control

Improved Safety

Reduces Site Operations

Reduces Interference with Existing Traffic and Facilities



Constructability Based Designs for Precast Bridges



Simple, repetitive details

Greater Tolerance at Connections

Reduced Erection Cycle Time

Less issues and rework

Reduced Labor Costs

Less Finish at Jobsite

Material Efficiency

Thank You!

Questions?

