Harbor Blvd. OC (A Spliced Precast Bath-Tub Girder Structure)

Bartt Gunter, PE - Caltrans, Structure Design
Tony Tipton, PE - Caltrans, Structure Construction

Photo Courtesy Josh Burke - Caltrans Structure Construction
Existing Bridge: Typical Section

- 2 independent, side by side PC/PS bathtub girder bridges connected by transverse joint
Existing Bridge: Elevation View

- 2-139’ Spans
- Existing clearance 16’-6”
- Continuous for live load only

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Inverted-T Cap

 Existing bridge has Bathtub girders sitting on inverted-T cap
Advantages of PC/PS-PT Continuous Superstructure

- Fixed-pinned columns
- No moment into the footing means smaller footings, less piles.
- Continuity for all loads equates to smaller d/s and therefore, less DL.
- No Falsework Required
Constraints on PC Continuous bridge

- PC Girders were broken down into 2 sub-girders for transportation reasons.
- 55’-11” and 75’-5” sub-girder Lengths
Locate temporary supports

Locations for temporary supports were chosen by gore area locations in HWY 50.
CIP Fills

17.04 m girder; 23.00 m girder (typ)

#16 or #13 tot 3

Continuous girder reinforcement to be spliced

Top Pre-tension strands (typ)

Tensioning Duct

#13 tot 3

Pre-tension la (typ)

Terminate pre-tensioning strands at face of splice (typ)

Ultimate Splice continuous reinforcement

Note: Girder Reinforcement not shown for clarity.

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Tony Tipton, PE
Method of calculation

- Design was accomplished using a spreadsheet
- This spreadsheet incorporated time dependent staging.
PC/PS-PT Bathtub

Top Pre-tensioning Strand

Bottom Pre-tensioning Strand

Strands

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PS/PT Interaction

Bridge PT had to overcome effects of sub-girder PS.

Sub-girder Top Strand

Sub-girder Bottom Strand

Tensile stress at top due to bottom sub-girder PS.
Tensile stress at top reduced due to top sub-girder.
Tensile stress at top increased due to Settlement.

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Construction Sequence

**STEPS 2 & 3**

- Temporary Berm (typ)
- PC/PS Girders (typ)
- CIP End Diaphragm (typ)
- CIP Splice Diaphragm (typ)
- CIP Bent Cap (typ)

**STEP 4**

- 3355 Max Const Opening
- 4165 Max Const Opening
- 3365 Max Const Opening

Temporary Supports (typ)

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Construction Sequence

STEPS 5 & 6

Post-tensioning Path

STEP 7 & 8
Construction Sequence
Construction Sequence
Lessons Learned

Elimination of Greased Metal sheet in Bearing Pad Detail

- Greased metal sheets would have made PC girder erection more difficult.
- Movement was expected due to PT.
- Taller bearing pads were designed to compensate.
Lessons Learned

- **PC girders on a vertical curve**
  - Bridge has vertical curve
  - Girders are cast flat
  - Straight line segments are cast together to mimic vertical curve.
Lessons Learned

PC girders on a vertical curve

- The deck must be a variable thickness so that the roadway vertical curve can be transitioned into the flat girders.

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Lessons Learned

Camber Diagram

- PC structures typically have a table for camber.
- CI P structures have a camber diagram.
Lessons Learned

Camber Diagram

- This bridge used neither.
- Instead, calculations were made and submitted to construction to determine the correct camber.
- Control is necessary over the final placement of the girders.
- This is something the PC-Community (Primes, PC Subs, and CT) needs to discuss as a best practice.
Lessons Learned

Slope of Roadway and PS Profile

- Roadway slope was somewhat greater than that shown on the plans, had wing walls been constructed to plan, they would have been high.
- Prestress profile did not allow room for duct to fit below the deck in the bent cap. Keep in mind that spliced areas need a bit extra room (± 1 inch each.)
Lessons Learned

Bent Cap Reinforcement Congestion

- It is optimal for the seismic design to have girders and columns align.
- There is a more reinforcement in PC/PS-PT girders across the girder/bent cap interface.
Lessons Learned

Bent Cap Reinforcement Congestion

- To avoid congestion, try not align girders and columns.
Lessons Learned

Bent Cap Reinforcement Congestion

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Lessons Learned

Bent Cap Reinforcement Congestion

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Lessons Learned

Quality Control
Lessons Learned

Quality Control

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Lessons Learned

Minimum Construction Areas – Load Imposed On The Grade:

- Given areas for splice temporary supports had soil loads in excess of 2.5 TSF.
- On one side we were able to increase the area.
- On the other, we were required to obtain Geotechnical release for the load.
Questions?