Accelerated Bridge Construction using Prefabricated Bridge Elements

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Roadblocks to Accelerated Construction

• The primary concerns that owner agencies have with respect to adopting accelerated construction techniques are:
  – Need for Quality Details
  – Durability
  – Design Methodologies and Training
  – Construction Methodologies
“Connections Details for Prefabricated Bridge Elements and Systems”

• FHWA initiated a project to develop this manual
• This publication is intended to provide information that will go a long way to answering all four of the previous concerns.
• Focus on details that have been used in the past.
Project Goals

• Gather details of Connections that have been used on accelerated bridge construction projects

• Investigate transfer of technology from other markets into the bridge market
  – Parking Garages
  – Stadiums
  – Buildings
Precast post-tensioned piers were used to speed up the construction. Due to smaller footprint at bottom, this type of pier can be used for viaducts or for elevated rail or expressways in the median of an existing roadway section. This approach is expensive for a small bridge, but it is less and economical for multiple span bridges with heavy traffic. The subject bridge had 8 bents with 3 piers each = 24 piers.

The detail shown is the connection between adjacent pier segments. Joints were sealed and bonded with epoxy adhesive. Embed was transferred between piers by means of shear keys in the precast pieces.

DT rods were embedded in the cast in place footing and Choiiced with couplers at several levels. Upon the completion of the installation of all segments, the entire pier was post-tensioned.
Precast Cantilever Abutments
Precast Piers
Precast Piers
Precast Decks on PS Beams
Total Bridge Element Prefabrication

Everything shown can be prefabricated
Complete Bridge Element Prefabrication

• New Hampshire Project
  – How fast can we build a bridge?
  – Experimental project
  – All components prefabricated
  – 115 foot span
  – Precast cantilever abutments
  – Clock started after old bridge was removed
  – Roadway was opened to traffic in 8 days
  – Time Lapse Video on Youtube™
    • Search “Epping Bridge Construction”
Manual Distribution

**Availability**
- Published June 2009
- DOT’s will receive copies
  - Others will be given out at conferences
- Website being developed
- Is available through Local FHWA offices
  - [www.fhwa.dot.gov/hfl/](http://www.fhwa.dot.gov/hfl/)
NEXT Beam

- Developed by NE PCI Bridge Tech Committee
  - Used for short span bridges (up to 80 feet)
  - Deck Version and Form version
  - Details available at www.pcine.org
Collier County (FL) Bridges

- Developed a standard bridge for numerous canal crossings
- Use accelerated bridge construction techniques to reduce user impacts
- Reduced environmental impacts
  - Top down construction
- Use all prefabricated elements
Collier County (FL) Bridges

• Typical Section
Deck Flange Connections

- Based on research at UTenn, FHWA and NYDOT
Precast parapets

6'-0" SIDEWALK

1'-1"

BICYCLE RAILING

4'-6" (BICYCLE RAILING)

2'-8"

PRECAST PARAPET

CAST-IN-PLACE CONCRETE SIDEWALK

CONSTRUCTION JOINT

2 3/4 FT/FT

1/2’ GROUT PAD

NEXT ‘D’ BEAM
Pier and abutment details
Construction Sequence

Step 1 – Pile Installation
Construction Sequence

Step 2 – Pile Cap Installation
Construction Sequence

Step 3 – Erect Beams
Construction Sequence

Step 4 – Install Approach Slabs and Backfill
Step 5 – Cast Closure Pours
Step 6 – Set Parapet in grout bed
Construction Sequence

Step 7 – Cast Sidewalks
Construction Sequence

Step 8 – Waterproofing, Paving and Railings
Construction Sequence

Final Bridge
Utah DOT Experience with ABC

- Department Goal in 2008
  - Make ABC standard practice by 2010
- Spent 2 years developing standards
- When on scanning tours to learn ABC methods
- Built pilot projects (approximately 25 bridges)
- Industry workshops held
  - Obtain consultant and contractor buy-in
  - Improve details
Utah DOT Experience with ABC

- It is 2010, where are they now?
  - Standards are complete
    - Abutments, Piers, Deck slabs, girders, culverts

- Implementation is underway

- ABC is considered on every project
  - User costs are calculated for each project

- Standards, Manuals, and specifications are available for download
  - www.udot.utah.gov

  search “Accelerated Bridge Construction”
Utah DOT Experience with ABC

Innovative Methods Learning Curve
Utah DOT Experience with ABC

CIP Construction cost
Utah DOT Experience with ABC

Typical Project:
1/3 Like it
1/3 hate it
1/3 don’t care

ABC Projects?

Stakeholders’ OVERALL Satisfaction With Project Results

(1=not satisfied, 7=very satisfied)
Costs Savings with ABC

- Ways to reduce bid prices with ABC
  - Standardization
  - Programmatic (not one of a kind)
  - Reduced project site costs (trailers, etc.)
  - Reduced Maintenance of Traffic Costs
  - Inflation
- Other Non- Bid Savings with ABC
  - Fewer Police Details
  - Reduced Resident Engineering time
- User Costs
  - Plus: $$$ Can be significant
  - Minus: $$$ Not in the budget
Quality

- Florida has had very good success with precast piers in very harsh environments
- Precast concrete beams require little or no maintenance
  - Use Integral abutments eliminate deck joints
- Precast Decks have been in place almost 20 years
Example of long-term durability

- Ct DOT bridge deck replacement project (1991)
- Curved structure (straight beams)
- 6 Span bridge with continuous spans
- Prestressed transversely and post tensioned longitudinally
- Details similar to UDOT
- 42 Day construction
  - No construction problems
After 19 years of service

- Excellent condition
- Used membrane waterproofing and Asphalt Wearing surface
- No leakage through joints
Conclusions

- It is possible to build entire bridges using prefabricated elements
- Typical bridges can be built in 30 days (or less)
- The FHWA manual provides a starting point for a complete bridge prefabrication project
- You do not need to sacrifice quality to get rapid construction
- You can save money on an accelerated bridge project by:
  - Standardization
  - Programmatic use of ABC
  - Reduce ancillary costs during construction
Questions

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