THE FUTURE IS NOW

Successes in Bridge Construction

by

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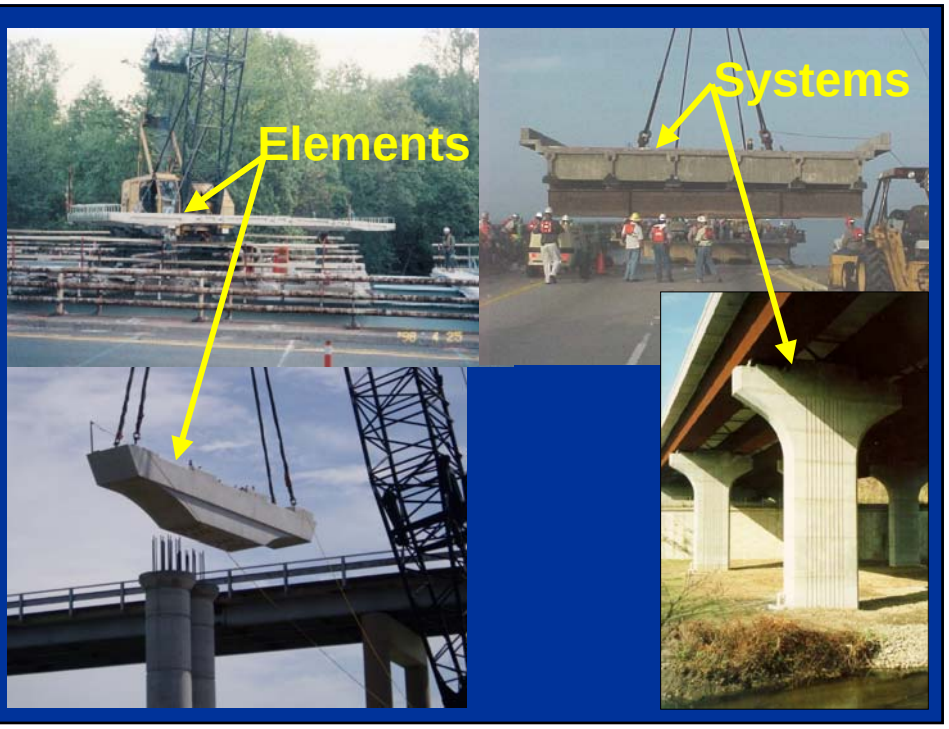
TRB 2005 Annual Meeting
Highways for LIFE, Session 628
January 12, 2005

Presentation Outline

- ✓ Prefabricated Bridges for Accelerated Construction
- ✓ Example Projects
- ✓ Related Issues
- ✓ Future Directions
- ✓ Your Role

Prefabricated Bridge Elements & Systems

- Bridge elements and systems constructed at a location other than the bridge's final location, then installed at the site
- Emphasis on innovative elements and systems



Why Change from Conventional Construction?

- The focus has moved from building the infrastructure to upgrading and maintaining the infrastructure
  - Work must be done in congested areas while maintaining traffic flow
    - Need to minimize traffic disruption
    - Need to improve work-zone safety

. . . it's like fixing a car with the engine running . . .

Why Change from Conventional Construction?

- The infrastructure is aging – needed now are innovative solutions that can be built quicker and that last longer
- Goal:
  - ➔ A minimum 75-yr service life
- Currently:
  - ➔ Average bridge age is 42 yrs
  - ➔ Average bridge deck life is 20-25 yrs

Moving more cast-in-place construction to offsite location

Prefabrication – Improved Quality & Lower Life-Cycle Costs – to "Stay Out"

➔Controlled environment

- Reduced dependence on weather
- Established materials suppliers for consistent quality of materials
- Standardized plant operations for consistent quality of production
- Optimum concrete curing

Potential Advantages of Prefabrication, depending on site constraints

- Minimized traffic disruptions
- Improved work-zone safety
- Minimized environmental impact
- Improved constructability
- Improved quality
- Lower life-cycle costs

Prefabrication Focus: Innovative Elements & Systems

- **Superstructures**
  - **Deck Panels**: Full-Depth
  - **Beams:** More Efficient Shapes
  - **Total Superstructure Systems**: Composite Units, Truss Spans
- **Substructures**
  - **Caps**
  - **Total Substructure Systems**: Abutments, Cap/Column(s), Pier(s)
- **Totally Prefabricated Bridges**

Typical Prefabricated Elements

Beams

Partial-depth Deck Panels

Reduced number of substructure supports by use of high performance materials

Reduced number of superstructure components by use of high performance materials

conventional 0.5-inch diameter strands & normal-strength concrete

7 conventional beams

Span No. 1
North Concho Westbound Mainlanes
San Angelo, Texas

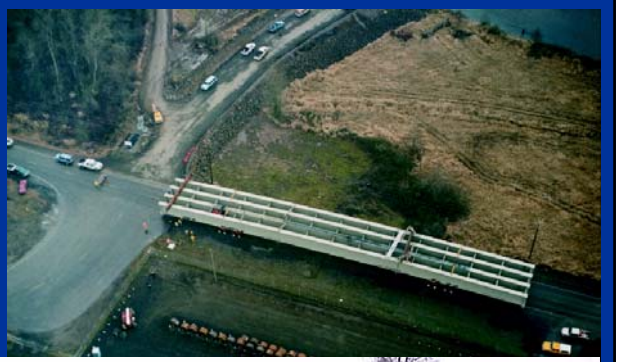
0.6-inch diameter strands & high-strength HPC concrete

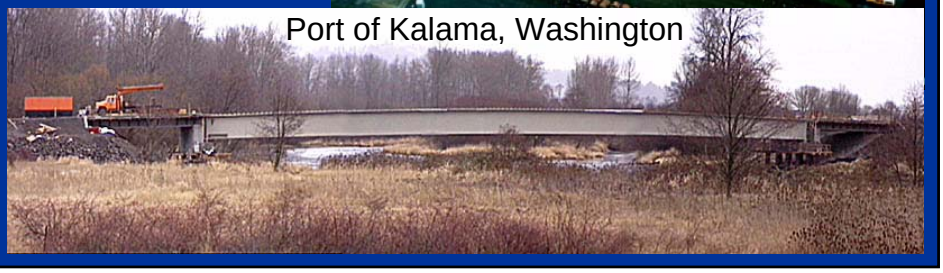
4 HPC beams

Span No. 1
North Concho Eastbound Mainlanes
San Angelo, Texas

Preassembled Girders

Preassembled girders to minimize environmental impact





Port of Kalama, Washington

Iowa River Bridge – 2003

Incremental launching to minimize environmental impact

Prefabricated Superstructures

George P. Coleman Bridge, Virginia - 1995

Wells Street Bridge, Chicago - 2002

111-ft long, 25-ft high, 425-ton truss span installed over a weekend

Church Street Bridge, Connecticut – 2003

Erection in hours over a weekend night minimized rail disruption

Third Avenue Bridge, New York - 2004

360-ft long truss was fabricated in Alabama and floated to the Bronx

Self-Propelled Modular Transporters (SPMTs)

Third Avenue Bridge, NYC

SPMTs – Top Implementation Recommendation from April 2004 Prefabricated Bridge Elements and Systems International Scan

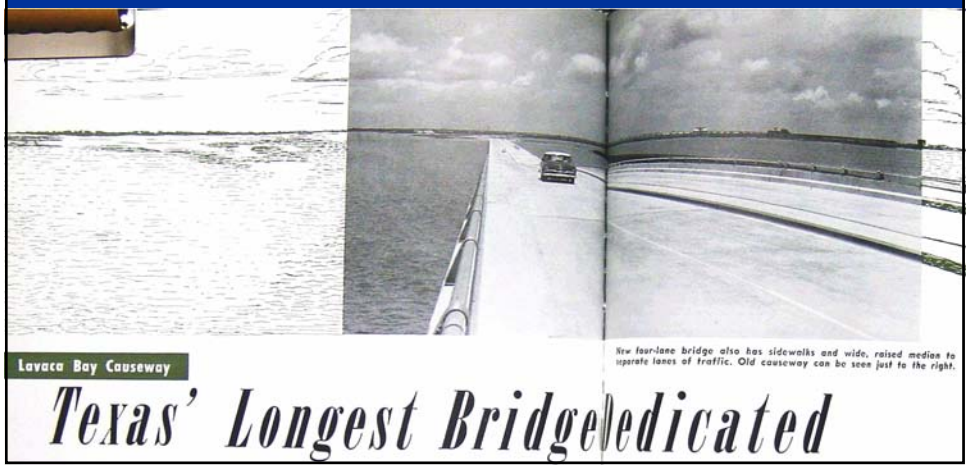
Badhoevedorp, Netherlands

April 2004 Prefabricated Bridges International Scan

Superstructure Roll-In:
390-ft Length,
3300 M Tons,
2 Hours to Move,
1 Weekend Road Closure

Lavaca Bay Causeway between Port Lavaca and Point Comfort (Gulf of Mexico) - 1961

Repetitive construction over water:
63-ft wide and over 2 miles long



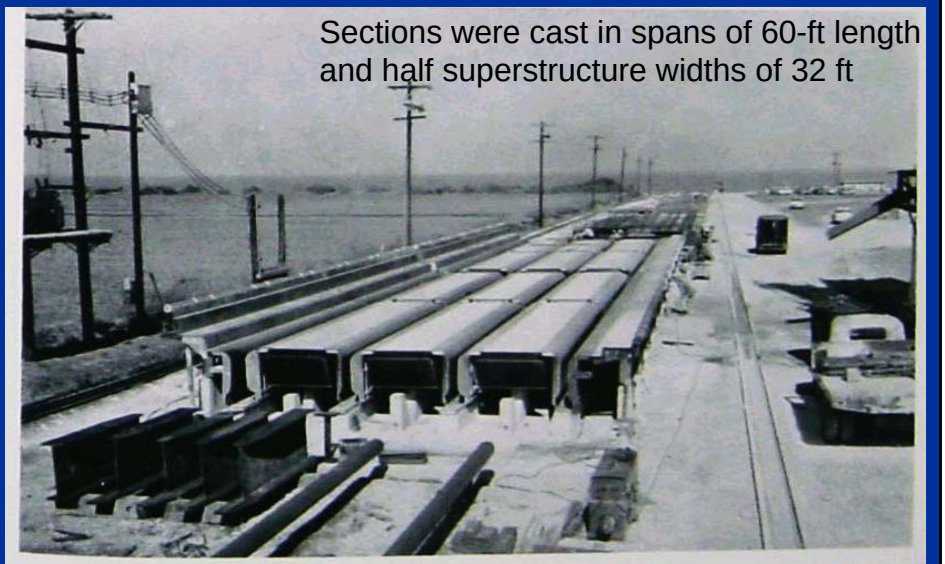
Lavaca Bay Causeway

New four-lane bridge also has sidewalks and wide, raised median to separate lanes of traffic. Old causeway can be seen just to the right.

Texas' Longest Bridge Dedicated

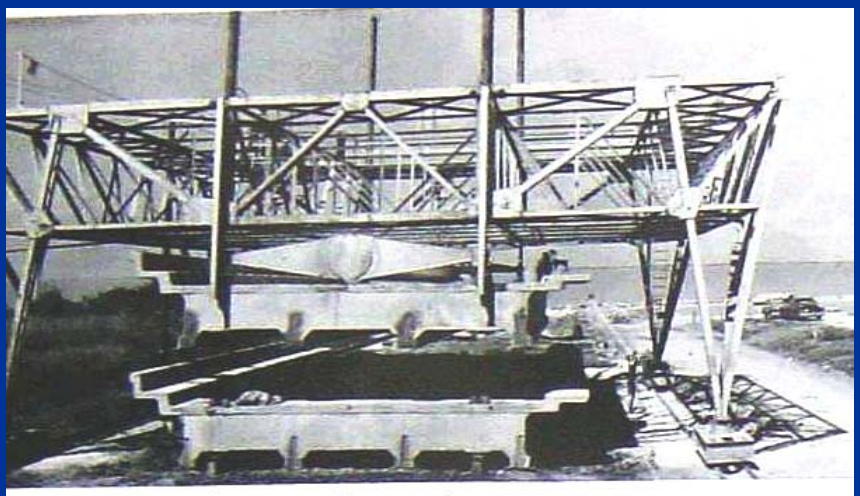
Lavaca Bay Causeway

Sections were cast in spans of 60-ft length and half superstructure widths of 32 ft



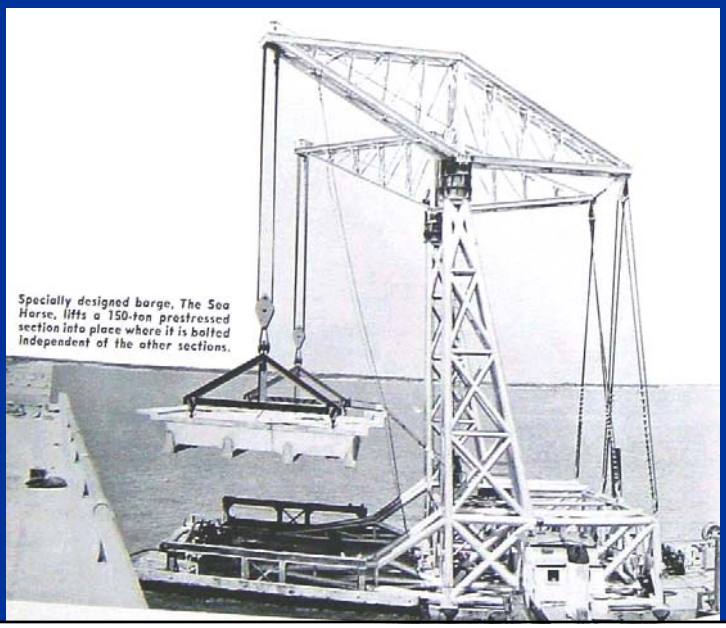
Twin tracks of the giant crane flank the casting yard. Steel forms for casting the concrete unit slab spans will remain in place until 192 roadway units are cast and moved to the bridge site.

Lavaca Bay Causeway



Giant steel crane carries one of the 388 prestressed concrete sections down to the edge of the bay where it is floated out and bolted into place.

Lavaca Bay Causeway



Specially designed barge, The Sea Horse, lifts a 150-ton prestressed section into place where it is bolted independent of the other sections.

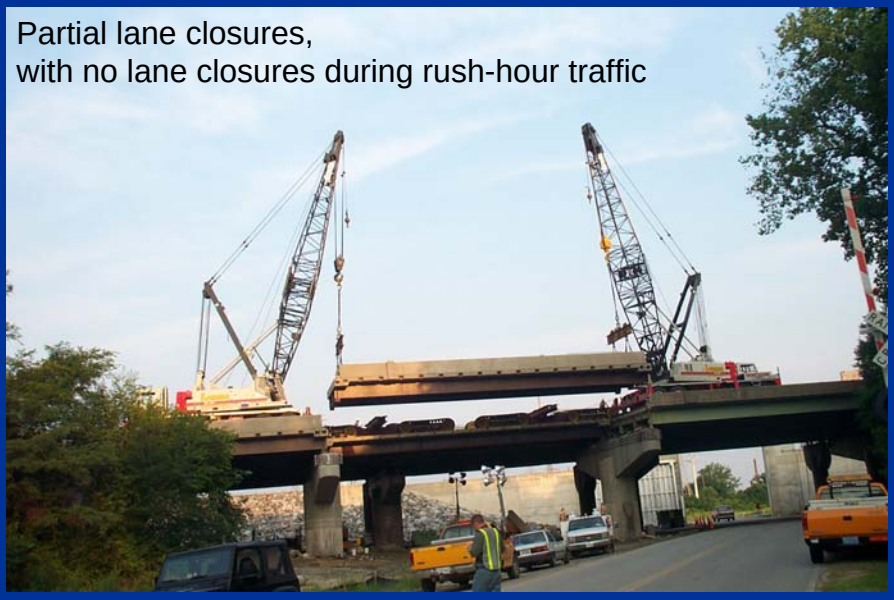
Lavaca Bay Causeway

I-10 over Lake Ponchartrain, Louisiana - 2002

Replaced 65-ft x 46-ft 350-ton span in less than 24 hours

James River Bridge, Virginia - 2002

Partial lane closures,
with no lane closures during rush-hour traffic



Virginia's Superstructure Replacement of
I-95 James River Bridge

Virginia's Superstructure Replacement of
I-95 James River Bridge

IH-10 Bridge over Escambia Bay, Florida – 2004

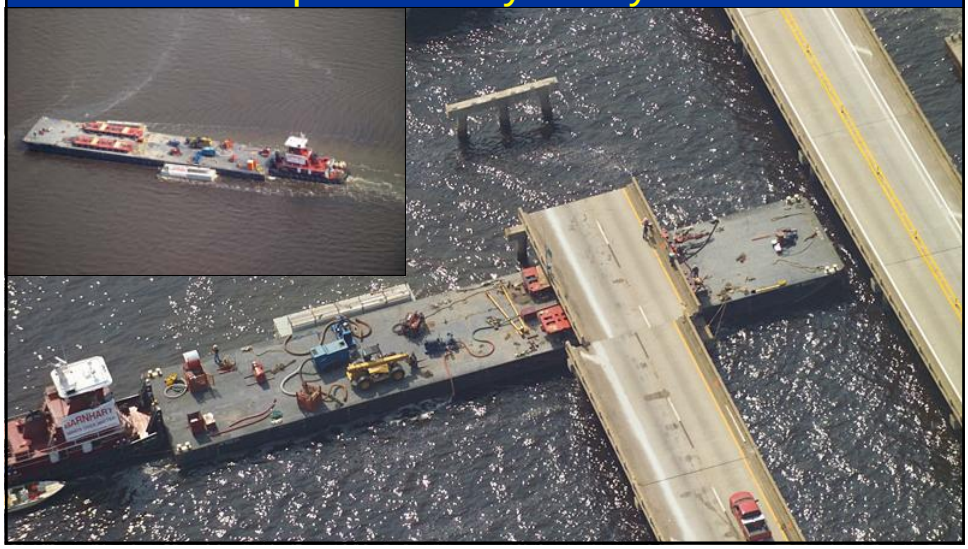
265-ton lifts to new pile bents

IH-10 Bridge over Escambia Bay, Florida – 2004

Used modular transporters and barges to realign bridge spans

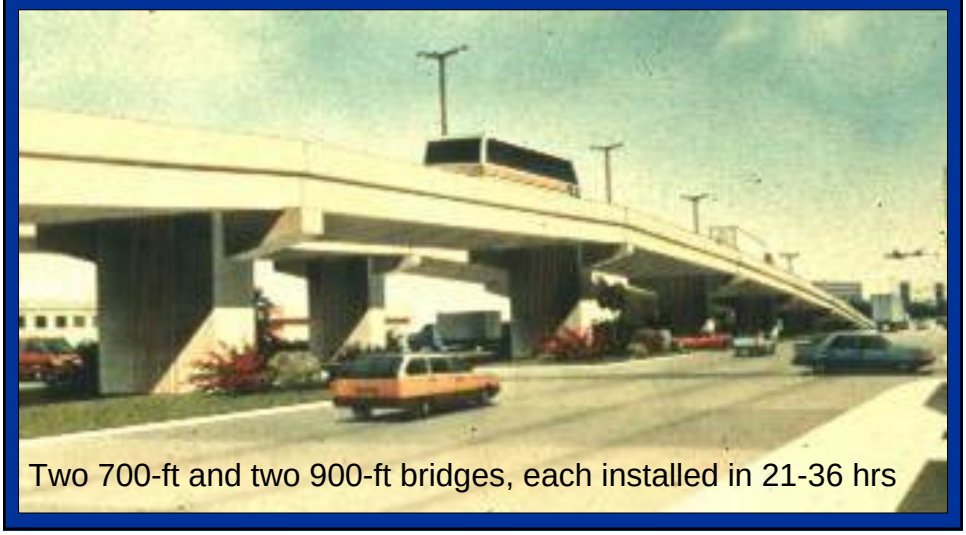
$250,000/day Phase I incentive/disincentive

Contract completed 7 days early



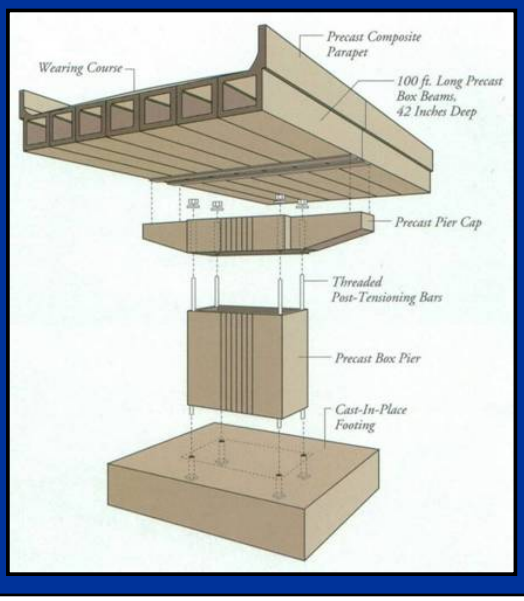
Totally Prefabricated Bridges

Baldorioty de Castro Avenue, San Juan, Puerto Rico



Two 700-ft and two 900-ft bridges, each installed in 21-36 hrs

Baldorioty de Castro Avenue



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SH 66 over Mitchell Gulch, Colorado – 2002

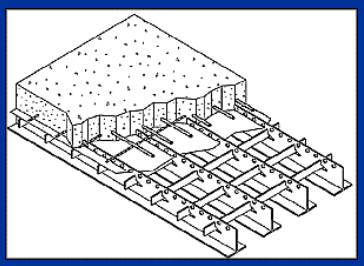
Mitchell Gulch

Prefabricated Decks

Tappan Zee Bridge, New York - 1998

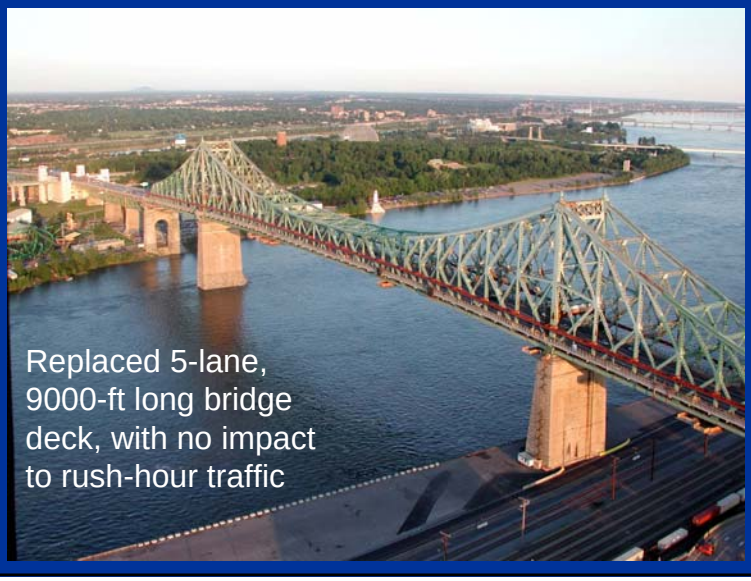
Replaced 250,000 sq ft
of deteriorated deck
with innovative deck system,
and no impact to rush-hour traffic

Tappan Zee Bridge Deck Replacement



1200 exodermic panels,
each 7 ½ in. thick,
typically 18-24 ft x 12-ft,
each weighing 6-9 tons

Jacques Cartier Bridge over St. Lawrence River, Montreal - 2002

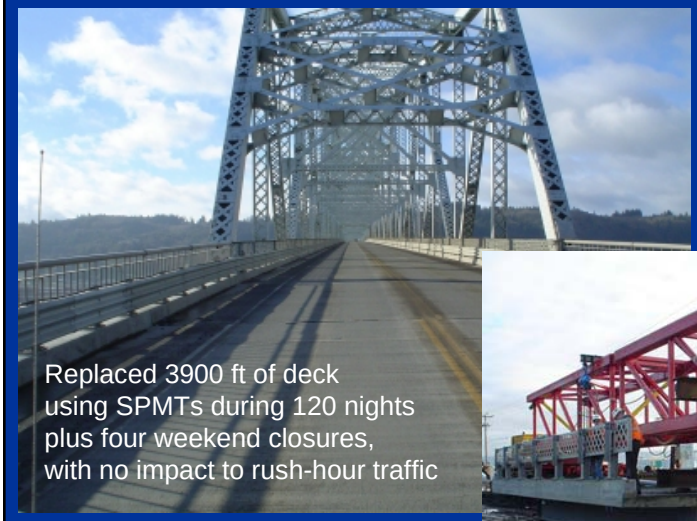


Replaced 5-lane, 9000-ft long bridge deck, with no impact to rush-hour traffic

Jacques Cartier Bridge Deck Replacement

1680 prefabricated deck units placed at night and occasional weekend from April to October during 2001 and 2002

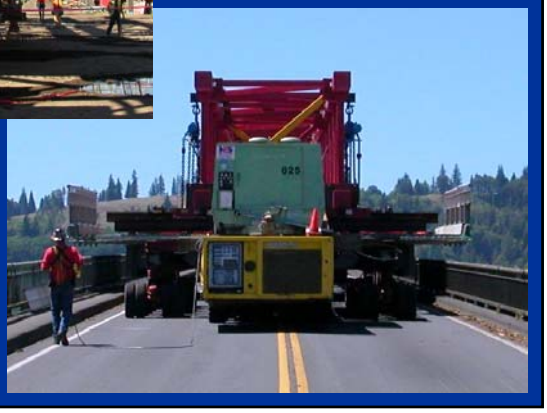
Lewis and Clark Bridge over Columbia River, Washington/Oregon – 2004



Replaced 3900 ft of deck
using SPMTs during 120 nights
plus four weekend closures,
with no impact to rush-hour traffic

Lewis and Clark Bridge, SR 433 over Columbia River

103 precast lightweight concrete panels,
each 36-ft wide x 20-45 ft long



MD Rt. 24 over Deer Creek, Maryland - 2001

Innovative materials used to address site constraints

MD Deck Replacement with FRP Panels

- 122.5-ft span, 30-ft roadway
- Lightweight FRP deck on steel through truss

Prefabricated Substructures

IH45 / Pierce Elevated, Texas - 1997

Use of prefabricated caps on existing columns resulted in 226 superstructure spans being replace in 190 days versus 1.5 yrs

IH 45 / Pierce Elevated in Houston

Both steel and concrete prefabricated caps

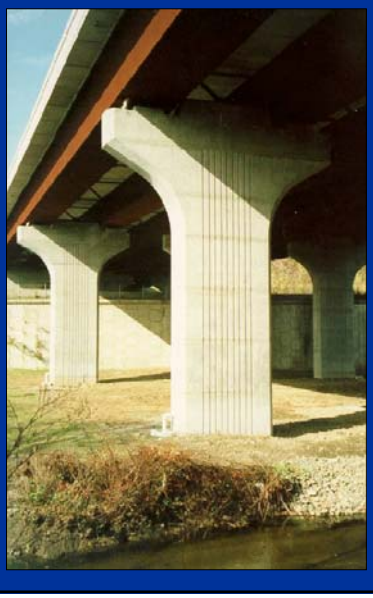
SH 36 over Lake Belton, Texas - 2004

Repetitive construction over water

Newark International Airport Monorail, New Jersey – 2001

I-287 Cross Westchester Expressway Viaducts, New York - 1999

Segmental Precast Columns on I-287 Cross Westchester Expressway Viaducts



Accelerated Construction – A Systems Approach

ACTT Workshop = A good model to include all stakeholders

- Multi-discipline team scopes out the corridor identified by the State
- Focus is on the process
- Systems approach
  - Time is collapsed for all disciplines
  - When this moves a bridge to the critical path, prefabrication is considered

ACTT Workshop – Team Skill Sets (Disciplines for Systems Approach)

- Innovative Financing/Innovative Contracting
- Right-of-Way/Utilities/Railroads
- Roadway/Geometric Design
- Geotechnical/Materials
- Structures
- Long Life Pavements
- Traffic Engineering/Safety/ITS
- Environment
- Construction
- Public Relations

Contracting Strategies for Early Delivery

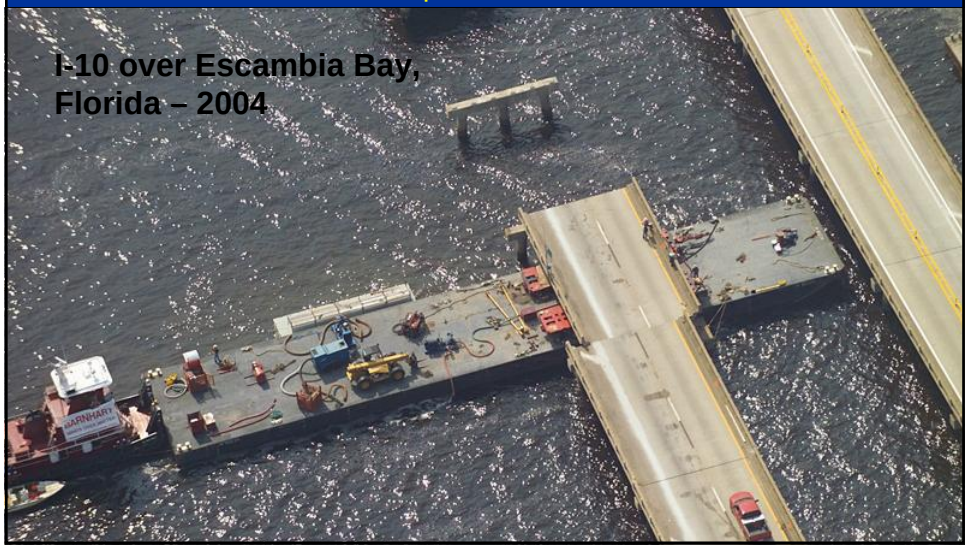
- Liquidated damages – financial penalties for late delivery
- A+B bidding – cost-plus-time bidding
- Incentive/disincentive – financial bonus or penalty for delivery before or after a set time
- No-excuse bonus – modified incentive with no time adjustment for problems
- Lane rental
- Calendar day – project schedule based on a number of days for completion

Disincentives for James River Bridge

Failure to Restore All Traffic Lanes by	Amount	Cumulative
6:00 A.M.	$5,000	$ 5,000
6:15 A.M.	$10,000	$ 15,000
6:30 A.M.	$35,000	$ 50,000
6:45 A.M.	$40,000	$ 90,000
7:00 A.M.	$25,000	$115,000
7:15 A.M.	$10,000	$125,000
7:30 A.M.	$10,000	$135,000
3:00 P.M.	$15,000	$200,000
4:00 P.M.	$20,000	$220,000
5:00 P.M.	$20,000	$240,000
6:00 P.M.	$10,000	$250,000

$250,000/day Phase I incentive/disincentive

Contractor received $1.75M incentive



I-10 over Escambia Bay, Florida – 2004

Future Directions

Future Directions

- **Widespread use of accelerated construction** (e.g., prefabrication) for vehicular bridges (e.g., in urban areas)
- In each case, **engineering the solution** to meet the unique constraints at that location, i.e.,
  - Reduced traffic disruption
  - Improved work-zone safety
  - Reduced environmental impact
  - Improved constructability
  - Improved quality
  - Lower life-cycle costs

Future Directions, cont'd.

- More elements combined off-site
- Development of more efficient, innovative prefabricated bridge systems that make use of the enhanced properties of high performance materials
- More prefabricated substructures
- Innovative methods of construction, for example, use of self-propelled modular transporters (SPMTs)

Future Directions, cont'd.

- Increased focus on durability to extend bridge service life
- More emphasis on rehabilitation of the existing infrastructure, with more public involvement
- More owner / industry / consultant / academia / public partnerships to find optimum solutions

What's Your Role?

- Insist on consideration of innovative technologies to accelerate construction
  - Be willing to specify the first use
  - Select a large project or multiple projects with repetitive sections for the first use
  - Use contracting strategies that are significant to the contractor
  - Include cost trade-offs in project estimate
- Ensure that all stakeholders are included and their input considered, from initial planning through construction

Available Resources

- http://www.fhwa.dot.gov/bridge/prefab/ for prefabricated bridge projects and contact information
- http://www.fhwa.dot.gov/construction/accelerated/ for Accelerated Construction Technology Transfer (ACTT) Workshop information
- FHWA technical workshops on innovative techniques

FHWA National Prefabricated Bridge Elements & Systems Workshop

December 12-14, 2005
San Diego, California

Mark your calendars!

Federal Funding Programs

- Innovative Bridge Research and Deployment (IBRD)
  - Accelerated construction techniques
  - High performance materials
- Highways for LIFE
  - Long Lasting
  - Innovative
  - Faster Construction
  - Efficient and Safe
- Federal Bridge Program

Superstructure segments

Larger systems are being installed …

Full-width, full-depth decks

including entire spans …

new techniques and equipment are being used ...

… to obtain quality accelerated construction.

HS/HPC girders

100 ksi HPS girders

… with advanced materials,

FRP Decks

The Future is Now:

Prefabricated Bridges

Thank You