PRECAST SEGMENTAL BRIDGE

December 6, 2005

SPEAKER

Name: Kimio SAITO
Affiliation: Kajima Corporation
Academic Background: Master of Engineering from Waseda Univ.

SPEAKER

April 1989 – August 1992:
- Design Engineer
  Design Div. of Kajima Corp.
  Designed Concrete Cable-stayed Bridge

September 1992 – August 1994:
- Construction Engineer
  Osaka Branch of Kajima Corp.
  Constructed Concrete Cable-stayed Bridge

September 1994 – September 1996:
- Design Engineer
  Design Div. of Kajima Corp.
  Designed Concrete Box Girder Bridge Utilizing Entire External Tendon System

October 1996 – September 1998:
- Engineering Trainee
  LoBuono Armstrong and Associates, Florida
  Designed Precast Segmental Box Girder Bridge

October 1998 – March 2002:
- Senior Design Engineer
  Design Div. of Kajima Corp.
  Designed Railway Bridge with Light Weight Concrete
  Designed “Uchimaki Viaduct”

April 2002 – Present:
- Senior Construction Engineer
  Yokohama Branch of Kajima Corp.
  Constructed “Uchimaki Viaduct”

SCHEDULE

1. General Information (10min.)
2. History and Applications in U.S. (15min.)
3. Recent Applications in Japan (10min.)
4. Case Study about Uchimaki Viaduct (15min.)
5. Movie of Uchimaki Viaduct Project (15min.)
6. Discussions (15min.)
**Definitions**

Bridge girders are fabricated as a number of precast segments at a casting yard.

The precast segments are transported from the casting yard to an erection site.

The precast segments are erected and unified into a girder by applying longitudinal prestress.

**Advantage and Disadvantage**

- Shorten erection period
- Provide high quality members
- Reduce the number of labors
- Require large space for fabrication and storage
- Require effective transportation system
- Require special fabrication & erection machines
- Require enough scale of project (contract)

**Technical Aspects**

- Additional prestress
- Special care for geometry control
- Special care for joints and keys

**Fabrication & Erection**

- **Fabrication Method**
  - Short-line or Long-line Match Cast

- **Erection Method**
  - Balanced Cantilever (for long span)
  - Span-by-span (for short and medium span)

**Short-Line Match Cast**

1. Start
2. Hanging Soffit Form
3. Shifting Segments(n & n+1)
4. Hanging Soffit Form
5. Setting Soffit Form & Adjusting Segment(n+1)
6. Hanging Re-bar Cage
7. Setting Re-bar Cage & Taking Segment(n) out
8. Setting Side Form & Core Form
9. Concrete Pouring
10. Completion of Segment(n+2)
**SHORT-LINE MATCH CAST**

- Fixed Bulkhead & Movable Soffit Form
- Require small space for casting machine
- Suitable for girder with constant depth
- Correspond to alignment
- Require careful geometry control

**LONG-LINE MATCH CAST**

**LONGLINE MATCH CAST**

- Movable Bulkhead & Fixed Soffit Form
- Require large space for casting machine
- Suitable for girder with variable depth
- Suitable for straight bridge

**BALANCED CANTILEVER**

**SPAN-BY-SPAN**
PRECAST SEGMENTAL BRIDGE
History & Applications in U.S.

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Griffith Road Crossing

• Single 15m Span I-girder
• New York
• 1950 and 1951

Griffith Road Crossing

• 60m Center Span
• Texas
• 1972

JFK Memorial Causeway

• 60m Center Span
• Texas
• 1972

JFK Memorial Causeway

• 76m Interior Spans
• Illinois
• 1979

Kishwaukee River Bridges

• 76m Interior Spans
• Illinois
• 1979

Photo: Provided by ASBI
Kishwaukee River Bridges
- 76m Interior Spans
- Illinois
- 1979

Long Key Bridge
- Florida
- 1979

Long Key Bridge
- Florida
- 1979

Seven Mile Bridge
- Florida
- 1982

Seven Mile Bridge
- Florida
- 1982

Windward Viaduct
- Hawaii
- 1993
APPLICATIONS IN URBAN AREA

San Antonio Y Project
- Texas
- 1993

I-75 / I-95 Interchange
- Florida
- 1994

MARTA
- Georgia
- 1985

Boston Project
- Massachusetts
- 200X
STANDARD SEGMENT

Develop Standard Segment

Spans: 30.5m - 45.7m (Span by span)
30.5m – 61.0m (Balanced Cantilever)

Widths: 8.40m – 13.50m
Girder Height: 1.80m – 3.00m

Supplied by Precast Makers

Reduce Equipment Cost

Extend the Application to Smaller Projects
RECENT APPROACH

The weight of segments are reduced by dividing the cross section into several parts.

The segments can be transported through general highway by reducing the weight.

The cost of erection machines can be reduced by light weight segments.

The erection period can not be minimized.

Furukawa Viaduct

- U shape Segment + Rib
- Precast Panel

Reference: Bridge and Foundation Engineering

Kamikazue Viaduct

- Dual Segment

Reference: Bridge and Foundation Engineering
Yamakiri Viaduct

- Core Segment
- External Strut + Rib
- Precast Panel

Reference: Bridge and Foundation Engineering
PRECAST SEGMENTAL BRIDGE
Case Study about Uchimaki Viaduct

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UCHIMAKI VIADUCT (PROFILE)

STRUTTED WING SLAB

Concrete Struts

CROSS SECTION

A_c=11.910m² → 8.940m²

ERECTION SEQUENCE

Phase 3: Assembling Struts + C.I.P. Wing Slabs

ERECTION SEQUENCE

C.I.P. Wing Slab

Core Segment

Diagonal Strut
SEGMENT DELIVERY

STEP 1: セグメントの運搬・仮吊り
引寄せ・接着

SPAN-BY-SPAN ERECTION

STEP 1: セグメントの運搬・仮吊り
引寄せ・接着

SPAN-BY-SPAN ERECTION

STEP 2: 目地コンクリートの打設

SPAN-BY-SPAN ERECTION

STEP 3: 主方向PC鋼材の挿入・緊張
STEP 4: 次径間への架設桁の移動

ERECTION TRUSS

WEIGHT: 7,840kN

106m