Segmental Bridge Construction Techniques

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2012 PTI Convention

Nashville, TN

May 7, 2012
Segmental Bridge Construction Techniques

- Cast In Place
  - Travelers
  - Incremental Launching

- Precast Segmental
  - Casting Yard
  - Cantilever Construction
  - Span by Span
  - Full Span
Cast in Place Segmental - Cantilever

- Span Length 300 to 800 ft
- Typical Segment Length 16 ft
- Non Linear Construction
- Minimal Crane Capacity
- Composite Crew - Efficiency
- Typical Cycle Time – 5 days
## Cast in Place Segmental - Cantilever

<table>
<thead>
<tr>
<th>Typical Construction Cycle</th>
<th>Duration: 5-day cycle, 12 hours per day</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Description</strong></td>
<td><strong>Day 1</strong></td>
</tr>
<tr>
<td>Removal of stop end form and form ties</td>
<td></td>
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<tr>
<td>Installation of strand</td>
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<tr>
<td>Stressing of cantilever P.T.</td>
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<tr>
<td>Stripping of outer, inner, bottom form</td>
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<tr>
<td>Launching and fixation of rail beam</td>
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<tr>
<td>Launching and fixation of main frame</td>
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<tr>
<td>Cleaning of form panels</td>
<td></td>
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<tr>
<td>Rolling back of inner web forms</td>
<td></td>
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<tr>
<td>Adjust / Close outer and bottom forms</td>
<td></td>
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<tr>
<td>Placing P.T. ducts / inserts for bottom slab / webs</td>
<td></td>
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<tr>
<td>Launch inner web forms, adjust / close inner web forms</td>
<td></td>
</tr>
<tr>
<td>Placing reinforcement / P.T. ducts / insert for upper deck and cantilever wing</td>
<td></td>
</tr>
<tr>
<td>Final survey / check of level / alignment</td>
<td></td>
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<tr>
<td>Pour concrete</td>
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<tr>
<td>Curing - Traveller #1</td>
<td></td>
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<tr>
<td>Curing - Traveller #2</td>
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</tr>
</tbody>
</table>

![Diagram showing construction process](image)
Cast in Place Segmental - Cantilever

4th Street Bridge – Pueblo, CO

Ilan Bridge, Taiwan
(Max. segment weight 120t, FT steel weight 55t)

H-3 North Halawa Valley Viaduct – Hawaii
(1990-1992)
Cast-in-Place – Incremental Launching

- Span Lengths 200’ – 350’
- Casting/launching from end of bridge working from the ground
- Relatively standard forming
- 7 day cycle per launch
Cast-in-Place – Incremental Launching

<table>
<thead>
<tr>
<th>Description</th>
<th>Duration: 8-Day Cycle (Days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
</tr>
<tr>
<td>Launch Segment</td>
<td></td>
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<tr>
<td>Strip and Clean Forms</td>
<td></td>
</tr>
<tr>
<td>Install Base and Web Rebar</td>
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<tr>
<td>Install Web Forms</td>
<td></td>
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<tr>
<td>Concrete Base and Webs</td>
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<tr>
<td>Install Inner Forms</td>
<td></td>
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<tr>
<td>Install Top Slab Rebar</td>
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<tr>
<td>Concrete Top Slab</td>
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<tr>
<td>Curing</td>
<td></td>
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<tr>
<td>Stress P.T.</td>
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</tbody>
</table>

**TYPICAL CONSTRUCTION SEQUENCE**

1. **Cast segment (A)**, install launching nose, install pulling units
2. Pull segment (A) forward using pulling jacks attached to reaction beam
3. Construct segment (B), repeat stage 2 and 3 for remaining segments
Precast Segmental

- Segment Casting
Precast Segmental

- Casting Yard

DUBAI METRO PROJECT

- One of the largest pre-casting yards in the world
- 9 tower cranes, 11 gantry cranes, 64 casting forms, 2,500 segment storage
- Camp for 3,500+ staff & crew
Precast Segmental – Cantilever
Erection with Launching Gantry

- Span up to 350 ft±
- Speed of Erection (up to 6 pairs of segments)
- Delivery from behind or below
- Overhead Construction
- Self Launching – min. crane support
- Parallel Structures Simultaneously
- Temp loads directly into Piers
- Limited horizontal curvature
Precast Segmental – Cantilever

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<table>
<thead>
<tr>
<th>Typical Erection Cycle</th>
<th>Duration: 6 Shifts</th>
</tr>
</thead>
<tbody>
<tr>
<td>Description</td>
<td>1</td>
</tr>
<tr>
<td>Span N-1</td>
<td></td>
</tr>
<tr>
<td>Curing of Stitch (Overnight)</td>
<td></td>
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<tr>
<td>Continuity P.T.</td>
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<tr>
<td>Span N</td>
<td></td>
</tr>
<tr>
<td>Launch Gantry to Span N</td>
<td></td>
</tr>
<tr>
<td>Segment Erection Span N</td>
<td></td>
</tr>
<tr>
<td>Stitch N to N-1</td>
<td></td>
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<tr>
<td>Span N+1</td>
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<tr>
<td>Erect Pier Segment</td>
<td></td>
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<tr>
<td>Align Pier Segment</td>
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<tr>
<td>Place Reinforcement</td>
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<tr>
<td>Place Formwork</td>
<td></td>
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<tr>
<td>Cast In situ Diaphragm</td>
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<tr>
<td>Curing Pier/Column Joint</td>
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</tbody>
</table>

Diagram showing the erection process with specific components labeled for clarity.
Precast Segmental – Cantilever
Erection with Lifting Frames

- Longer Span Lengths
- Larger Segments
- Deck Construction can be non-linear (multiple work fronts)
- Simple Erection Works
- Rapid Construction
Precast Segmental – Cantilever

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Precast Segmental – Cantilever
Erection with Cranes

- Longer Span Lengths
- Smaller Segments
- Deck Construction can be non-linear (multiple work fronts)
- Readily Available Equipment
- Rapid Construction
- Small Erection Crew
### Precast Segmental – Cantilever

**Erection with Cranes**

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- Smaller Segments
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#### Typical Erection Cycle

<table>
<thead>
<tr>
<th>Description</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation of Pier Segment Support Brackets</td>
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<tr>
<td>Installation of Pier Segment</td>
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<tr>
<td>Segment Erection - Pair 1-3</td>
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<tr>
<td>Segment Erection - Pair 4-6</td>
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<tr>
<td>Segment Erection - Pair 7-9</td>
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<tr>
<td>Segment Erection - Pair 10-12</td>
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</tbody>
</table>

*Duration: 8 Shifts*

#### Diagram Description
- **Stitching Beam**
- **Closure Stitch Formwork**
- **Alignment/Support Bracket**
- **Segment Delivery at Ground Level**
- **Stressing Platform**
- **Hanger Beams**
- **Pier Segment Erection by Crane**

1st pair of field segments erected by crane. Segments are suspended from hanger beams if there is a wet joint to be cast.
Precast Segmental – Span-by-Span

Erection with Launching Gantry (Overhead or Underslung)

- Spans typically < 170 ft
- Speed of Erection (1 span per day possible)
- Small Crew
- Delivery from behind or below
- Temp load directly into Piers
Precast Segmental – Span-by-Span
Erection with Launching Gantry (Overhead or Underslung)

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Precast Segmental – Span-by-Span

On Falsework

- Locally available equipment
- Multiple work fronts
- Typically smaller project
Precast Segmental – Full Span
Erection with Launching Gantry

- Typically short spans
- Very high rate of erection
- Factory casting environment - Very high quality
- Min follow up work
- Large temporary loads
Precast Segmental – Full Span

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Erection with Launching Gantry

- Typically short spans
- Very high rate of erection
- Factory casting environment - Very high quality
- Min follow up work
- Large temporary loads
- Limited storage (possible)
Precast Segmental – Full Span
Erection with Launching Gantry or Heavy Lift

- Marlins Stadium
- Seven Mile Bridge
- Jamestown Rhode Island
Segmental Construction

- Speed of erection
- Crew efficiency
- High quality
- Many options
- Top down erection possible minimal disruption to traffic and surface operations
- Efficient use of forms

All Possible Through the innovation of Post-Tensioning