Design and Construction of Curved Precast Girder Bridge Projects in Colorado
Colorado Bridge Projects using Curved Precast Girders

1. IH25 / SH270 Ramp K, Denver - Complete
2. SH270 / IH76 Ramp Y, Denver - Complete
3. E470 / IH70, Ramp H, Denver - Complete
4. SH58 / IH70, Ramp A, Golden - Complete
5. Austin Bluffs, Colorado Springs - Complete
6. IH25 Viaduct Phase I, Trinidad - Complete
7. IH25 Viaduct Phase II, Trinidad - Design
Southbound IH25 / SH270 Ramp K

- Contractor Alternate Design to Steel Base Bid
- 200’ Spans, 800’ Horizontal Curve
- Designed by Summit Engineering, Littleton, CO and PBS&J, Denver
- Built by Sema Construction
IH70 / E470 Ramp H

- Contractor Design/Build Project.
- 100 to 195’ Spans
- 1400’ Horizontal Curve
- Designed by DMJM Harris, Denver
- Built by Lawrence Construction Co, Littleton, CO
IH76 / SH270 Ramp Y

- Span Lengths from 100’ to 230’.
- 760’ Radius horizontal curve.
- Colorado DOT Design.
- Value Engineering by Summit Engineering.
- Built by Edward Kraemer & Sons, Castle Rock CO.
IH70 / SH 58 Ramp A

- VE Design
- Span Lengths from 150’ to 235’.
- 820’ Horizontal Curvature.
- CH2M Hill Design.
- Value Engineering by Summit Engineering
- Built by Ames Construction Co, Denver, CO
Austin Bluffs Overpass

- VE Design.
- Span Lengths from 110’ to 210’.
- 700’ Radius Curve (2 – 900’ Compound)
- CH2M Hill Design.
- Value Engineering by Summit Engineering
- Lawrence Construction Co, Littleton, CO
IH25 Viaduct, Trinidad

- Contractor Alternate Design
- Base design, precast segmental.
- Elevated Viaduct through downtown Trinidad.
- Span Lengths from 100’ to 275’
- Value Engineering by TSH Engineers and Summit Engineering
- Lawrence Construction Co, Littleton, CO
# Curved Girder Bridge Quantities

<table>
<thead>
<tr>
<th>Project</th>
<th>Bridge S.F.</th>
<th>L.F. Curved Precast</th>
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</thead>
<tbody>
<tr>
<td>IH25 / SH270 Ramp K</td>
<td>66,740 s.f.</td>
<td>2,840 l.f.</td>
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<tr>
<td>IH76 / SH270 Ramp Y</td>
<td>77,248 s.f.</td>
<td>4,544 l.f.</td>
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<tr>
<td>IH70 / SH58 Ramp A</td>
<td>79,995 s.f.</td>
<td>4,095 l.f.</td>
</tr>
<tr>
<td>Austin Bluffs</td>
<td>57,715 s.f.</td>
<td>2,380 l.f.</td>
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<tr>
<td>IH25 Trinidad, Phase I</td>
<td>65,728 s.f.</td>
<td>4,141 l.f.</td>
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<tr>
<td>IH70 / E470 Ramp H</td>
<td>75,952 s.f.</td>
<td>3,232 l.f.</td>
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<tr>
<td><strong>Total</strong></td>
<td>414,378 s.f.</td>
<td>21,232 l.f.</td>
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### 270 Ramp Y Cost Comparisons

<table>
<thead>
<tr>
<th>Item</th>
<th>Steel Design</th>
<th>Curved Precast</th>
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<tbody>
<tr>
<td>Girder Cost</td>
<td>$5,125,000</td>
<td>$3,086,240</td>
</tr>
<tr>
<td>Erection Costs</td>
<td>$1,025,000</td>
<td>$890,000</td>
</tr>
<tr>
<td>Falsework</td>
<td>$50,000</td>
<td>$250,000</td>
</tr>
<tr>
<td>Post Tensioning</td>
<td>$0</td>
<td>$506,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$6,200,000</strong></td>
<td><strong>$4,732,240</strong></td>
</tr>
<tr>
<td><strong>Cost / Ft.</strong></td>
<td><strong>$1393 / lf</strong></td>
<td><strong>$1063</strong></td>
</tr>
</tbody>
</table>
Advantages

- Economy of Construction.
- Speed of Fabrication.
- Setup Costs amortized in initial projects.
- Vertical Shoring for temporary support.
- Design uses established techniques on new application.
- Pleasing Aesthetics.
- Low maintenance.
Challenges

- Engineered Temporary Works essential.
- Girders are heavy.
- Engineering support during construction a requirement.
- Girder Stability and Alignment.
- Torsional cracking must be avoided.
- Slower construction cycle during Erection.
- More complex multiple phase construction.
- Site conditions must be considered during design.
Typical Girder Cross Section – U84 Girder

(5) #6 (CONT.)
3-TOP & 2-BOTTOM

#4 x SPA, W/ STIRRUPS

RE: CONTRACT PLANS FOR STIRRUPS SIZE AND SPACING

3" TENDON DUCTS, TYP

3" TENDON DUCTS IN BOTTOM SLAB, TYP

3" 6 x #6 @ 8" (CONT.) TOP & BOTTOM 3"

TYPICAL GIRDER REINFORCING
Precast Panel Lid Slab
Installed after Girder Erection
Curved Girder Formwork
Girders in Storage Area
Erection of Girders with Hydraulic and Crawler Cranes
Girders erected on vertical shoring
Girders Spliced and Lid Slabs in Place
Post Tensioned Prior to casting Deck Slab
Deck Forms Placed
Deck slab and barriers cast
Solutions to Site Conditions
Straddle bents at Traffic Openings
Cantilevered Girders over existing bridges
Strong back support from previously erected girders
275’ Clear Opening over Rail Line
150' Long Field Spliced drop in Girders at RR crossing
Design Features
Notched Precast for CIP Anchor Blocks
Integral Diaphragms at Interior Piers
No manufactured bearings
Long Span Precast Panels
Notched Ends at Expansion Piers allow for double end stressing
CIP Diaphragm/Anchor Blocks at End of Unit
Summary

- Six Completed Projects currently under traffic
- Designs successfully used as alternates to steel and segmental bridges
- Two more projects under design.
- Opportunity for future applications is unlimited.