WSDOT/TxDOT
Bridge Practices and Innovations

Richard Pickings, P.E.,
BridgeSight Inc.
• Precast/Pretensioned I-Girder

• Design Practices
  – Envelope of Simple and Continuous Behavior
  – Moderately High Seismic Zones
  – Standard Intermediate Diaphragm Layout Rules
  – Design for Shipping and Handling
  – Compute LRFR Rating Factors for All LRFD Designs
Span Capabilities
Short/Medium Spans

• Solid or Voided Slab
  • To ~98 ft

• Decked Bulb Tee and Bulb Tee
  • To ~145 ft
Standard Precast Pretensioned Girders

Span Capability of Precast Wide Flange Girders

<table>
<thead>
<tr>
<th>Girders</th>
<th>110</th>
<th>125</th>
<th>140</th>
<th>165</th>
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Span Capability of Precast Trapezoidal Tub Girders

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<td>W180</td>
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Spliced/Post-Tensioned I-Girders

- WF##PTG Series
  - Splice for Handling/Hauling
  - Simple/Cont Span Design
  - PT Before/After Slab Casting
  - 7-7/8” Web Thickness
  - 24” Tapered End Block
Post-Tensioning For Continuity

- 250 ft Main Span
LRFR Load Rating

TxDOT

• ~ $50/sq ft. Avg. Unit Cost For I-Girder Bridge
• 2004 – Over 1,000,000 lin. ft of I-Girders
• Design Practices
  – Simple Span Design
  – Low Seismic Zone
  – No Intermediate Diaphragms
  – “Standard” Designs Via Parametric Plan Sheets
## FY 2009 Average % Breakdown of Overall Project Costs for Bridges

<table>
<thead>
<tr>
<th>System</th>
<th>Structure</th>
<th>Mobilization</th>
<th>Removal</th>
<th>Approach, etc.</th>
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<tr>
<td>Off-System Bridges</td>
<td>59.5%</td>
<td>7.4%</td>
<td>2.3%</td>
<td>30.7%</td>
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<tr>
<td>Off-System Culverts</td>
<td>49.0%</td>
<td>1.5%</td>
<td>3.4%</td>
<td>40.0%</td>
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<td>On-System Bridges</td>
<td>47.6%</td>
<td>10.6%</td>
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<td>On-System Culverts</td>
<td>49.9%</td>
<td>9.2%</td>
<td>3.9%</td>
<td>37.1%</td>
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## FY 2009 Average Unit Cost*

<table>
<thead>
<tr>
<th>System</th>
<th>Structure Type</th>
<th>Number Bridges</th>
<th>Deck Area (sq.ft.)</th>
<th>Adjusted Structure Cost**</th>
<th>Average Unit Cost ($/sq.ft.)</th>
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<tr>
<td>Off Culvert</td>
<td>Culverts</td>
<td>32</td>
<td>36,570</td>
<td>$3,574,054</td>
<td>$97.73</td>
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<td>Off Span</td>
<td>Concrete Girder &quot;Pan&quot; (CC-PN)</td>
<td>2</td>
<td>6,304</td>
<td>$260,688</td>
<td>$40.14</td>
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<td>Girder Prestressed &quot;Box&quot; Beam (GP-BX)</td>
<td>11</td>
<td>29,078</td>
<td>$3,581,523</td>
<td>$126.61</td>
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<td>Girder Prestressed Decked Slab Beam (GPDSB)</td>
<td>1</td>
<td>1,951</td>
<td>$174,576</td>
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<td>Girder Prestressed &quot;I&quot; Beam</td>
<td>26</td>
<td>183,079</td>
<td>$9,964,855</td>
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<td>Girder Prestressed &quot;I&quot; Beam &quot;Texas Shape&quot; (GPITX)</td>
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<td>1,820</td>
<td>$112,436</td>
<td>$61.78</td>
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<td>Prestressed Concrete Slab Beam (PCS)</td>
<td>68</td>
<td>186,130</td>
<td>$14,322,225</td>
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<td>Concrete Slab (SLAB)</td>
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<td>50,088</td>
<td>$2,931,359</td>
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<td>Structural Steel Truss (STRTR)</td>
<td>1</td>
<td>2,029</td>
<td>$256,669</td>
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<td>Girder Steel &quot;I&quot; Beam (GS-I)</td>
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<td>2,753</td>
<td>$427,740</td>
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<td>Off Span Totals</td>
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<td>120</td>
<td>462,241</td>
<td>$32,132,045</td>
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<td>On Culvert</td>
<td>Culverts</td>
<td>42</td>
<td>259,015</td>
<td>$17,173,705</td>
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<td>On Span</td>
<td>Girder Prestressed &quot;Box&quot; Beam (GP-BX)</td>
<td>15</td>
<td>92,831</td>
<td>$7,768,311</td>
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<td>Girder Prestressed &quot;I&quot; Beam (GP-I)</td>
<td>158</td>
<td>3,203,156</td>
<td>$156,434,885</td>
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<td>Girder Prestressed &quot;I&quot; Beam &quot;Texas Shape&quot; (GPITX)</td>
<td>18</td>
<td>522,839</td>
<td>$25,172,736</td>
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<td>Girder Prestressed &quot;U&quot; Beam (GP-U)</td>
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<td>229,100</td>
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<td>Prestressed Concrete Slab Beam (PCS)</td>
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<td>Concrete Slab (SLAB)</td>
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<td>Girder Steel &quot;I&quot; Beam (GS-I)</td>
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<td>Girder Steel Trapezoidal (GS-TR)</td>
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<td>221</td>
<td>4,521,484</td>
<td>$245,977,427</td>
<td>$54.40</td>
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Span Capabilities
Short/Medium Spans

Solid Slab
• To ~50 ft

AASHTO I-Girder or Decked Slab Beam
• 50-70 ft
• 40-60 ft
Span Capabilities

Longer Spans

TxDOT I Girder (Tx##)

- Tx28 to ~70 ft
- Tx85 to ~165 ft
## I Girders, Recommended Span Lengths for LRFD

<table>
<thead>
<tr>
<th>Beam Type</th>
<th>Beam Depth</th>
<th>1\textsuperscript{Approx Structure Depth}</th>
<th>Use</th>
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<tbody>
<tr>
<td>TX28</td>
<td>28 in.</td>
<td>38 in.</td>
<td>Economical span limit is 70 ft. Spans should not exceed 80 ft.</td>
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<tr>
<td>TX34</td>
<td>34 in.</td>
<td>44 in.</td>
<td>Economical span limit is 80 ft. Spans should not exceed 95 ft.</td>
</tr>
<tr>
<td>TX40</td>
<td>40 in.</td>
<td>50 in.</td>
<td>Economical span limit is 95 ft. Spans should not exceed 105 ft.</td>
</tr>
<tr>
<td>TX46</td>
<td>46 in.</td>
<td>56 in.</td>
<td>Economical span limit is 105 ft. Spans should not exceed 120 ft.</td>
</tr>
<tr>
<td>TX54</td>
<td>54 in.</td>
<td>64 in.</td>
<td>Economical span limit is 125 ft. Spans should not exceed 140 ft.</td>
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<tr>
<td>TX62</td>
<td>62 in.</td>
<td>72 in.</td>
<td>Economical limit is 135 ft. Spans should not exceed 150 ft.</td>
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<tr>
<td>TX70</td>
<td>70 in.</td>
<td>80 in.</td>
<td>Economical limit is 145 ft. Spans should not exceed 150 ft due to handling constraints.</td>
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1\textsuperscript{Approx Structure depth is Beam Depth plus 8\textquotedbl} minimum slab plus 2\textquotedbl estimated haunch.
TxDOT Optional Girder Analysis (TOGA)

- Value Engineering
  - Streamlined Evaluation of Fabricator Optional Designs
- Simplified UI can be Used by Technicians
- Utilizes PGSuper as Underlying “Engine”
Thank You!!

Questions?

• Special Thanks:
  – Doug Mooradian, PCMAC
  – Jim Ma, CalTrans
  – Rick Brice, WSDOT
  – Gregg Freeby, TxDOT