Steel Bridge Constructability

*Keys to a good project*

5 December 2008

Ronnie Medlock
High Steel Structures, Inc.
High Steel Structures

1931 - Sanford H. High purchased King Welding Company (Later named High Welding Company)
High Steel Structures

- Steel bridge fabricator and erector
- Four facilities
- 50,000+ ton capacity
- ISO 9001 Certified
- 14 state market area
- AISC certified
  - Bridges
  - Building
  - Erection
Steel Prices

CRU - Index

ASMT A36 1/2" plate

Steel Prices

$200

$400

$600

$800

$1,000

$1,200

$1,400

$1,600

1/1/07 2/1/07 3/1/07 4/1/07 5/1/07 6/1/07 7/1/07 8/1/07 9/1/07 10/1/07 11/1/07 12/1/07

1/1/08 2/1/08 3/1/08 4/1/08 5/1/08 6/1/08 7/1/08 8/1/08 9/1/08 10/1/08 11/1/08 12/1/08
Fabrication Cycle Time

<table>
<thead>
<tr>
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<th>Original Duration</th>
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</tr>
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<tbody>
<tr>
<td>Schedule Conestoga Creek Bridge</td>
<td>11.9w</td>
<td>4/10/07</td>
<td>7/3/07</td>
</tr>
<tr>
<td>Schedule Engineering</td>
<td>5.0w</td>
<td>4/10/07</td>
<td>5/14/07</td>
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<tr>
<td>Bid Date</td>
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<td></td>
</tr>
<tr>
<td>Notice To Proceed</td>
<td>1.0w</td>
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</tr>
<tr>
<td>Drawing Prep</td>
<td>2.0w</td>
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<td>Generate Adv. Bills</td>
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<tr>
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<td>6/19/07</td>
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<tr>
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<td>6/26/07</td>
</tr>
<tr>
<td>Ship</td>
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“Design Intent” Drawing Package for Drawing Review
Modeling

- Parametric 3D models created for girder parts
- One associative part model shared by all disciplines
- Reduces redundant efforts

CAD/CAM/CNC Interface

CNC Code

CAM Toolpath

Part Model

CAD Drawings

BOM
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Material lead times

• A709 grade 50 and 50W
  – Most sizes 8 to 10 weeks
  – Ingot size 12 to 16 weeks
• HPS-50 & 70 12 weeks
• HPS-50 & 70 Q & T 18 to 24 weeks
• Large shapes 2 to 3 rollings/year
Design Economy

- Standard or Special?
Design Economy

• Standard
  – Understood details, readily available materials, known connections, proven processes

• Special
  – Mysterious details, hard to find materials, difficult (or impossible) connections to fabricate, unproven processes
AASHTO / NSBA Steel Bridge Collaboration Standards

- G1.1 Shop drawing review and approval
- G1.2 Contract drawing detailing
- G1.3 Shop drawing detailing
- G1.4 Standard details
- S2.1 Fabrication
- S4.1 Shop inspection
- S8.1 Coatings
- G9.1 Bearings
- G10.1 Erection
- G12.1 Constructability
- G13.1 Bridge analysis (future)
Collaboration

• Standards: AASHTO approved
  – All balloted by T14 / SCOBS
• Download from AASHTO or the Collaboration website:
  www.steelbridges.org
• Join the listserver
Design Economy

Opportunity to Influence Project Quality and Cost

- Seek detailing input during design phase
- Design / build offers improved opportunities for improved quality and cost

from: AISC MANUAL
Fabrication Cost

Economy = least weight?
Fabrication Cost

Economy = least weight?
Fabrication Labor

• Cutting
• Drilling
• Welding
• Painting
• Handling
  – Moving plates
  – Moving girders
Plate Moving
Assembly
No Assembly Required
ESW-NG
Orthotropic Deck Bridges
- Automatic SAW
- Single pass
- 80% penetration

- No melt-through
- No burn-through

\[ 60\degree \]
- No melt-through
- No burn-through

80% penetration
- SAW
- No bevel
- Single pass
- 87% penetration
- No melt-through, burn-through
- No melt-through
- No burn-through

80% penetration

GMAW
- 30° bevel
- 1/8" beveling
Shipping/Fabrication Piece Limits

• Most competitive:
  - Length < 125 feet
  - Weight < 35 tons
  - Height < 9 feet tall

• Maximum (by truck):
  - Length ~ 175 feet (rules vary)
  - Weight ~ 80 tons (rules vary)
  - Height < 13.5 feet (on side) or 9.5 feet (upright)
Skewed Bridge Erection
Stiffness and Flexibility
Stiffness and Flexibility
Stiffness and Flexibility
No load
Steel load

No load
All dead load
Skewed Bridge Erection

Complete Dead Load
Skewed Bridge Erection

Steel Dead Load
Skewed Bridge Erection

Tighten bolts before pouring deck
Skewed Bridge Erection

Steel Dead Load
Skewed Bridge Erection

Complete Dead Load
Cross Frame Connections

preferred (by fabricators)  

20° maximum skew
Keys

• Consider cycle time
• Consider availability
• Be aware of recent prices – steel is an improving value
• Use standard detailing
  – Use Collaboration standards
• Consider the state of the art
  – Improved welding
  – Less assembly
Keys

• Facilitate weldability
  – Accessibility
  – Don’t be too prescriptive

• Consider what can be readily shipped

• Understand skewed bridges
  – Expect plumb in the final condition
  – Allow layover
  – Tighten connections

• Talk to your fabricator
Thank you