Summary

- Design
- Fabrication
- Construction
- NSBA/AASHTO
TxDOT Preferred Practices

Texas Steel Quality Council

- TxDOT
- FHWA
- Consultants
- Academics
- Fabricators
- Detailers
- Steel Mill reps
Material Selection
Unpainted Weathering Steel

- Preferred
- A 709 Grades 50W and HPS 70W
- More economical
- Consider location conditions before choosing
- Use details to prevent concrete staining
Prevent Concrete Staining

Weathering Steel

- Include drip tabs on all girders
- Additional options
  - Stainless steel trays
  - Paint area over Bent
Painted Steel

- System IV – non coastal new construction
- System III – coastal new construction
- More info - See Item 446 of TxDOT Spec Book
• 3 and 4 span continuous – Preferred
• Interior Spans 20-30% longer than End Spans
• Check uplift at the ends of continuous girders
• Avoid high skews or major differentials where possible
Girder Spacing

- **I-girders**
  - Limit CL-CL spa to 10 ft
  - Min of 4 girders for vehicular bridge span

- **Tub girders**
  - Limit web spacing to 10 ft
  - Min of 3 girders for vehicular bridge span

- Consider use of PCPs for straight girders
I-Shaped Plate Girders
Geometric Constraints for Straight Girders

Flange Width $\geq \frac{D}{4}$

Flange Width $\geq 15$ in

$\frac{3}{4}$ in $\leq$ Flange Thick $\leq$ 3 in

Web Thick $\geq \frac{1}{2}$ in
Geometric Constraints for Curved Girders

- Flange Width $\geq D/4$
- Flange Width $\geq 15$ in
- $1$ in $\leq$ Flange Thick $\leq 3$ in
- Web Thick $\geq \frac{1}{2}$ in

$D$:
- $0.25D$ Min.
- $0.50$ in Min.
- $1.00$ in Min.
- $3.00$ in Max.
Flange Criteria

- **Flange Width**
  - Constant
  - Transitions at field splices
  - Top = Bottom

- **Flange Thickness**
  - Use 10 ft min length
  - Use only a few sizes
  - In lieu of lateral bracing — ↑ flange thickness
  - Use similar thicknesses across girders
Flange Criteria

- Flange splices – extend thicker flanges beyond theoretical flange splice location
Web Criteria

• Web Depth
  – Whole inch increments
  – Dapped Ends: No more than 40% of web depth
  – Do not use haunched webs

• Web Thickness
  – Eliminate need for transverse stiffeners
  – Discourage use of fully stiffened web designs
  – Optimal designs have few sizes
Web Criteria

• Don’t use Longitudinal stiffeners unless web depth > 120 in

Present fabrication and fatigue problems
Field Splices

- Show in plans as welded
- Offer bolted splice option
- Locate at points of DL contraflexure
- Girder field length ~ 130 ft max
- Limit shipping width to 6 ft and height to 9 ft
- Web splice locations at least 10’ apart
Bolted Field Splices

• Galvanized bolts for painted steel
• 1”, 7/8”, ¾” Dia
• Class A surface conditions
• Splice PL thickness \( \geq \frac{1}{2}” \)
• Add 1/8” – ¼” to min edge distances in AASHTO LRFD
Splice Fill Plates

• Steel grade specified for girders – not available in thicknesses less than 3/8”
• Allow optional fill plate material (A 606, A 570, etc.)
• Spec Book 447.4.B
A325 vs. A490 Bolts

- Contractors prefer A325
- A325 bolts can be retightened
- A490 bolts are sensitive to tightening procedures
- A490 bolts require impact wrenches that might not be available
Diaphragms & X-Frames

- Max Spacing
  - Straight = 30 ft
  - Curved = 20 ft
- Provide at all end bearings
- Straight - Set parallel to skew up to 20°. Set radial beyond 20°
- Curved – set radial to girders
X-frame Half Pipe Stiffeners

Skewed Bridges

• Research Project 0-5701
• Gives girders higher buckling capacities
• Serves as a bearing stiffener
• Coming soon: Added to SGMD Standard
Lean On Bracing

Straight Bridges

- Research Project 0-1772
- Struts transfer forces to 1 or 2 X-frames
- Minimize LL induced brace forces
- Reducing number of braces
Stud Connectors

- Full length of girder
- Min longitudinal Spa ≤ 4d
- SGMD Standard
- Not required on top of flange splice plates
Bearings

- Select from TxDOT SGEB standard
- Triple check bearing seat elevations
- Avoid costly HLMR, disc, pot bearings
- Bent Cap geometry
Steel Tub Girders

- Only use if this is the best solution
- Consider for long, narrow, curved, bridges with tight radius
- NSBA “Practical Steel Tub Girder Design”
Tub Girders

- Constant shape
- Rotated with x-slope
- Top flange and Web – same requirements as I-girder
- Avoid details more critical than Cat. C
Bottom Tension Flange

- > \( \frac{3}{4} \)” thick
- \( w/t \leq 80 \)
- Classified as fracture-critical for 2-girder spans
- All bottom flange edges – extend 2 in + beyond web CL
Inspection Access
Slabbing and Stripping

Girder Elevation

Top View
Slabbing and Stripping

Multiple Head Cutting Bed - Strips Out Flanges From Wider Plates
Narrow Gap Electroslag Welding

Welding Time
Approx. = 10-20% of multiple pass weld

Minutes versus Hours
• Analyze girder system using grid analysis
• Predict the behavior of girder system once bridge is fully constructed
Critical Stages of Stability

- Girder Erection
- Before concrete deck placement
Research Study 0-5574

• Curved Plate Girder Design for Safe and Economical Construction
  – Justify recommendations in Preferred Practices
  – Create uniformity among analytical requirements of curved I-girders during early stages of construction
  – Girder erection and concrete slab placement
Research Study 0-5574

- Field Monitoring
- Parametric Finite Element Modeling
- Survey of Girder Erection Practices
- PC Based Analytical tools
Lifting Point Locations
Shoring Issues

• High costs
• Premature removal
• Site access issues
ANALYTICAL TOOLS

- Spreadsheet
- Behavior of girder segments during lifting
- Determines optimal lift locations
- Girder deformations
- Predicts girder twist
ANALYTICAL TOOLS

- 3D Finite Element Program
- Partially constructed girder systems
- Staged deck placement
National Steel Bridge Alliance
AASHTO/NSBA Steel Bridge Collaboration

AASHTO/NSBA Steel Bridge Collaboration. Steel bridge construction in the United States is generally performed in accordance with ...

www.aisc.org/workarea/linkit.aspx?linkidentifier=id... - Cached - Similar

NSBA : National Steel Bridge Alliance
Legislative Update  AASHTO/NSBA Steel Bridge Collaboration  Task Groups ...
www.aisc.org/contentNSBA.aspx?id=20074 - Cached - Similar

Collaboration Standards
The documents available here are standards developed by the AASHTO/NSBA ...
www.aisc.org/contentNSBA.aspx?id=20130 - Cached - Similar

AASHTO / NSBA Steel Bridge Collaboration : Meeting Schedule
Legislative Update  AASHTO/NSBA Steel Bridge Collaboration  Task Groups ...
www.aisc.org/contentNSBA.aspx?id=20904 - Cached - Similar

Steelbridge.org
Steel Bridge Design Handbook Steel Bridge Design Handbook  Bridge Design Bridge Design  Model Bridge Design Model Bridge Design  Steel Bridge Steel ... www.steelbridge.org/ - Cached - Similar

Steel Bridge Bearings
This document is a standard developed by the AASHTO/ NSBA Steel Bridge Collaboration. The primary goal of the Collaboration is to achieve steel bridges of ...
downloads.transportation.org/SBB-1.pdf - Cached - Similar

Integrated Bridge Project Delivery and Life Cycle
Standardized Specs and Approval Processes  NSBA/AASHTO Collaboration ... www.transportation.org/ - Cached - Similar
- Guidelines for Steel Girder Analysis
- Shop Detail Drawing Review
- Fabrication
- Sample Owners
- Quality Assurance Manual
- Erection Guide Spec
- Coating Systems Guide
Steel: The Bridge Material of Choice

The National Steel Bridge Material of Choice

NSBA: National Steel Bridge Alliance

Resources

Case Studies

Steel Bridge Design Handbook

NSBA Publications

MSC Articles

White Papers

Multimedia

Links of Interest

Calendar of Events

Newsroom

BRIDGE COMPETITIONS

AASHTO/NSBA

Have you seen what we do?

SteelDay 2011

Steel Day 9.23.2011

The Design and Construction Industry
Steel Bridge Design Handbook

The original Highway Structures Design Handbook was published by AISC Marketing. Now, with federal grant money available, the much-needed updating of this important book has commenced.

The chapters are being written by prominent engineers and consultants, compiled by NSBA, returned to the authors for review, and then compiled again. There are 23 chapters, the same number as in the previous handbook, with titles including:

- Analysis
- Load Combinations
- Splice Design
- Substructure Design
- Bearing Design
- Deck Design
- Design for Fatigue

The initial Chapters and Design Examples of the new Handbook are available on the website. Updates will be made periodically.

Chapters and Design Examples are current with new edition of AISC 360-10. The user should be aware that upgrades to the Design Handbook are available through the website.

Redundancy - NEW
Fabrication - NEW
Structural Analysis - NEW
Selecting the Right Bridge Type
Stringer Bridges
Loads and Load Combinations
Design for Constructability
Bearing Design — (downloadable spread sheets)
Corrosion Protection of Steel Bridges

Design Example 1: Three-Span Continuous Straight Composite I Girder
Design Example 2A: Two-Span Continuous Straight Composite I Girder
Design Example 2B: Two-Span Continuous Straight Wide Flange Beam
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