Development of eSPAN140 & Short-Span Steel Bridge Design Standards

Karl E. Barth, Ph.D.
West Virginia University, Wadsworth Department of Civil and Environmental Engineering
kebarth@mail.wvu.edu

NSBA / SSSBA Steel Bridge Essentials Webinar Series
June 16, 2021
Outline of Today’s Presentation

• Short Span Steel Bridge Design Standards
• eSPAN140 Example Project
• Questions & Answers
Short Span Steel Bridge Design Standards

Goals, Design Parameters, Weight Comparisons
Standards for Short Span Steel Bridge Designs

• Goals:
  o Economically competitive
  o Expedite & economize the design process
  o Simple repetitive details & member sizes.

• Bridge Design Parameters:
  o Span lengths: 40 feet to 140 feet (5-foot increments)
  o Girder spacing: 6 feet, 7.5 feet, 9 feet and 10.5 feet
  o For each of these increments, the following were designed:
    • Steel girders
    • Shear stud & stiffener layouts
    • Welding and fabrication details
    • Elastomeric bearings
    • Concrete deck design

Primary value is use as an estimating tool!

• Now have the ability to produce a valid steel bridge design in minutes
• Obtain a cost estimate from a fabricator within a day
• Can directly compete with concrete alternate
• Design can then be further optimized
Standards for Short Span Steel Bridge Designs (cont’d)

• Four types of girder types:
  
  o Homogeneous plate girders (50 ksi steel)
  o Hybrid plate girders
    • 50 ksi top flanges and webs, 70 ksi bottom flanges
  o Lightest weight rolled beams (50 ksi steel)
    • Utilizing the lightest weight girder necessary
  o Limited depth rolled beams (50 ksi steel)
    • Designed to meet a target L/D of 25

• In addition, girders were designed to accommodate commonly stockpiled plate thicknesses and rolled beam sizes.
Standards for Short Span Steel Bridge Designs (cont’d)

- Bridges were designed according to AASHTO LRFD Specs:
  - Strength I, Service II, Fatigue, Constructability, L/800 Deflection
  - HL-93 Vehicular Live Loading

- Additional Design Loads:
  - SIP Unit Weight = 15 psf
  - Future Wearing Surface = 25 psf
  - Concrete barriers = 520 lb/ft
  - Misc. Steel Wt. Increase = 5%
  - $f_c' = 4,000$ psi
  - Concrete Unit Weight = 150 pcf
  - Steel Unit Weight = 490 pcf
  - Concrete Haunch = 2 in
  - Constant Flange Width
  - Constant Web Height
## Resulting Economical Standard Selections

- Based on weight comparisons of resulting designs, the following solutions are recommended for the span ranges shown:

<table>
<thead>
<tr>
<th>Solution Type*</th>
<th>Bridge Span Length</th>
<th>Skew Angle</th>
<th>Overhang Width</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rolled Beam (40’ to 100’)**</td>
<td><img src="#" alt="Bar Chart" /></td>
<td>+/- 20 degrees</td>
<td>33’ or less</td>
</tr>
<tr>
<td>Homogeneous Plate Girder (60’ to 140’)**</td>
<td><img src="#" alt="Bar Chart" /></td>
<td>+/- 20 degrees</td>
<td>33’ or less</td>
</tr>
<tr>
<td>Hybrid Plate Girder (80’ to 140’)**</td>
<td><img src="#" alt="Bar Chart" /></td>
<td>+/- 20 degrees</td>
<td>33’ or less</td>
</tr>
</tbody>
</table>
eSPAN140 Example Project

Step-By-Step Process for Obtaining a Steel Solution
eSPAN140 provides:
- Standard designs and details for short span steel crossings
  - Rolled Beam and Plate Girders
  - Buried Soil Steel Bridge Structures
- Manufacturers' Steel Solutions (SSSBA Partners)
- Coatings Solutions
- Industry Contacts
  - Contacts can provide budget estimates and pricing information

One-stop shop for customized steel bridge and culvert solutions!

Free and easy to use!!!
https://www.espan140.com/

---

**Step 1.** Create a User’s Account

**Step 2.** Input Your Specific Project Details

**Step 3.** View Your Instant Customized Solutions Books
eSPAN140 Example Project

• Start new project:

My Projects

Welcome to eSPAN140. If this is your first time here, please click on “Start New Project” to begin.

If you have already created a project, please use the table below to view past projects, complete for existing inputs you provided, please click on “Duplicate”. This will allow you to create a new project I have multiple bridges to design and have only a few input values to change.

Start New Project
eSPAN140 Example Project (cont’d)

• Step 1: Project Information
eSPAN140 Example Project (cont’d)

• Step 2: Project Details (general dimensions)
eSPAN140 Example Project (cont’d)

- Step 2: Project Details (pedestrian access option)
eSPAN140 Example Project (cont’d)

• Step 2: Project Details (remaining details)
eSPAN140 Example Project (cont’d)

- Example output (sample plate girder elevation):

**COMPOSITE PLATE GIRDER WITH PARTIALLY STIFFENED WEB - 4 GIRDER AT 8’ 10” GIRDER SPACING, HOMOGENEOUS**

<table>
<thead>
<tr>
<th>SPAN (L) - FT</th>
<th>TOP FLANGE - IN</th>
<th>BOTTOM FLANGE (F)</th>
<th>BOTTOM FLANGE (G)</th>
<th>WEB PLATE - IN</th>
<th>DIAPHRAGM SPACING (G) - FT</th>
<th>SHEAR STIFFENERS</th>
<th>SHEAR CONNECTOR MAX. SPACING</th>
<th>INDIVIDUAL GIRDER WEIGHT</th>
</tr>
</thead>
<tbody>
<tr>
<td>85</td>
<td>14 x 3/4”</td>
<td>14 x 1”</td>
<td>17”</td>
<td>14 x 2”</td>
<td>51”</td>
<td>32 x 1/2”</td>
<td>21.25”</td>
<td>34 @ 6”</td>
</tr>
</tbody>
</table>
eSPAN140 Example Project (cont’d)

- Example output (typical fabrication details):
eSPAN140 Example Project (cont’d)

• Example output (typical fabrication details, cont’d):
eSPAN140 Example Project (cont’d)

• Buried Bridge Solutions
eSPAN140 Example Project (cont’d)

• Manufacturer Solutions

• Durability Solutions
  o Painted, galvanized, weathering
Questions & Answers

Thank You!

Karl E. Barth, Ph.D.
kebarth@mail.wvu.edu