NEW PHILOSOPHY IN STEEL BRIDGE DESIGN AND FABRICATION

Presented by
David Henkle, P.E.
Acknowledgements

- Wayne Preskar, P.E.                NMSHTD US 70 Project Director
- Jim Camp, P.E.                        NMSHTD State Bridge Engineer
- Prof. Dennis Mertz, P.E.        University of Delaware
- Lynn Iaquinta, P.E.              NSBA
New Philosophy in Steel Bridge Design and Fabrication

Simple for Non Composite Dead Loads
Continuous for Composite Dead Loads & Live Load
Steel Girder Bridges
(The SEBD System)
SEBD System
(Simple Economical Bridge Design)

Who Benefits From the SEBD System?

- Mill
- Fabricator
- Engineer
- Contractor
- State of Indiana
Structural Steel Costs

- **Material Costs**: 35% - 40% (36% - 42%)
- **Fabrication Costs**: 50% - 55% (49% - 55%)
- **Erection Costs**: 10% - 15% (9% - 13%) (2001) (2013)
US 70 Over Del Rey Blvd
Las Cruces, NM
Simple For Non Composite Dead Load
Continuous For Composite Dead Load Live Load

Simplified Girder Details

1. Penetration Welds Optional For Fabricator
2. Field Splices Not Required At Recommended Span Lengths
3. Simplified Fabrication & Erection
4. Reduced Cross Frame Requirements
5. Simple Curvature Camber in Lieu of Reverse Curvature Camber

Conventional Steel Girder vs. SEBD System

Competitive Bidding

- SEBD Steel System vs. Concrete Girders
Simple For Non Composite Dead Load
Continuous For Composite Dead Loads & Live Load

Connection Over Interior Supports ~
(Concrete Diaphragm)

1. Top Flange Continuity Plate
2. Gusset Plates To Stiffen Bearing Plates
3. Concrete Diaphragms
4. Additional Reinforcement Over Supports
5. Girders – Non-Composite Over Supports
Simplified Girder Details

Diagram Connection Plate Detail

No Scale

Diagram Bearing Stiffener Detail

No Scale
Pier Diaphragm Details

TYPICAL SECTION AT PIER DIAPHRAGM

SCALE – 1:20
Simple For Non Composite Dead Load
Continuous For Composite Dead Loads & Live Load

- Connection Over Interior Supports (Steel Connection)
  1. Top Flange Continuity Plate
  2. Bottom Flange Splice Plate
  3. Support Cross Frames
  4. Additional Reinforcement Over Supports
  5. Girders – Non-Composite Over Supports
Pier Connection Details
Splice Plate Details - Bottom Flange

CONTINUITY PLATE DETAILS
NO SCALE
Cross-Frames

INTERMEDIATE DIAPHRAGM DETAIL

ALTERNATE INSTALLATION

3/8" PLATE

BOLT OR WELD AS NECESSARY

3 3/8" x 3 3/8" x 3/8"

3/8" FILL PLATE

20° MIN.

6" MIN.

INTERMEDIATE DIAPHRAGM DETAIL

ALTERNATE INSTALLATION

3/8" PLATE

3" (TYP.)

3/8" CONNECTION PLATE

DETAIL E FOR WELDING (TYP.)

3" (TYP.)

6" MIN. (TYP.) WHEN BOLTED

3/4"

6" MIN. (TYP.) WHEN WELDED

L 3 3/8" x 3 3/8" x 3/8"
Simplified Cross Frame Details

TYPICAL CROSS FRAME – OPTION #1

SCALE – 1:50
Simplified Cross Frame Details
Cross-Frames

Cross-Frame Spacing

Where did 25 feet come from? Why are we still using it?

LRFD has no limit
Allows the Engineer to determine spacing
New Steel Girder Concept vs.

Conventional Continuous Steel Girder

- 20% - 30% Savings in Steel Fabrication and Erection Costs
  - AASHTO M 270 Grade 345W / No Painting
    - Painting Of Exterior Face of Exterior Girder Optional
  - Fewer Connection Details
  - Better Distribution of Dead Loads to Substructure
  - Larger Percentage of Deck in Compression
  - Larger Cross Frame Spacing
  - Better Fatigue Details / No Penetration Welds
  - Less Fabrication Cost
  - Fewer Shop Drawing / Fewer Details
  - Easier Constructability / Erection
New Steel Girders vs. Concrete Girders

- No Long Term Creep Problems
- No Elastic Shortening
- Eliminates Camber Growth
- Not Limited To Stock Girder Sizes and Depths
- Constructability / Erection Costs
- Less Transportation Costs
- Lighter Superstructure (Seismic Consideration)
# Steel Bids
## Del Rey Blvd. Bridge

### Option A - Steel Bridge

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<th>Item Number</th>
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<th>Sundt Corporation</th>
<th>J.D. Abrams</th>
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*Total Cost of Bridge: 1,753,614, 1,642,945, 1,699,431, 1,677,726, 1,978,421*

### Cost of Steel per lbs

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Concrete Bids
Del Rey Blvd. Bridge

Option B - Concrete Bridge

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Total Cost of Bridge: 1,440,607, 1,625,885, 1,793,100, 1,785,605, 2,000,576
Competitive Bids

- Four of Seven Contractors Bid Steel Bridge Option
  - One Contractor Only Bid Steel Option (Not Shown)
  - A. S. Horner's Bid Options Differed By Approx. 1 Percent Of Total Bridge Cost

- Steel Price Comparison (Per Lb.)
  - $1.22 Average Price For Steel Girders In The Region Typically
  - $0.99 Average Price For Steel Girders With New Concept
  - Average Delivered Price Of Steel Girders Ranged From $0.78 to $1.18
Steel Girder vs. Precast Concrete Girder

- **Girder Cost per Foot:**

  - **Mesa Grande Blvd.**
    - Reiman Corp.
      - Concrete: $174.00
      - Steel: $159.80
        - ($0.89/lb.)
  
  - A.S. Horner
    - Concrete: $169.00
    - Steel: $152.50
      - ($0.85/lb.)
Steel Girder vs. Precast Concrete Girder

- Normal Cost per Square Foot: $65 (2001)
  - Mid-West Region: $120 – $140 (2013)

- Mesa Grande Blvd.
  - Reiman Corp.
    - Concrete: $51.20
    - Steel: $52.20
  - A.S. Horner
    - Concrete: $46.60
    - Steel: $45.20

Price per Square Foot: $98.40 – $114.90 (2013)
(SEBD Option – Midwest Region)
Limitations

- **Span Length Exceed Maximum Length of Shipping**
  - Field Splices Can Be Added
    - Increases Fabrication Costs
    - Increases Erection Costs
Future Applications

- Use of High Performance Steel (70 KSI)
- Curved Bridges
  - Skews Of Less Than 15 Degrees
  - Shorter Maximum Span Lengths (Limited by Shipping)
- Rolled Girder Bridges
  - Spans Less Than 60 Feet
SEBD System
(Simple Economical Bridge Design)

Who Benefits From the SEBD System?

- Mill - Some configurations use more material
- Fabricator - Can produce more within same timeframe
- Engineer - Designs Dual Bridges
  (Concrete and Steel Options)
- Contractor - Less liability due to ease of MOT, can build more (quicker bridge)
- State of Indiana - Money goes farther; 10-15 percent less for SEBD bridges than conventional continuous bridges
Sonoma Ranch Road

Questions?