Bridging the Gap

Engineering

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Scope of Work

- Design 125’ of Highway Bridge
  - Spans Bryce Creek on Begley Road in Cabell Co., WV
    - Selection & sizing of bridge girders
    - Design of bridge deck & shear connectors
    - Lateral bracing design
    - Prepare plans, schedules, construction estimates

Alternatives Summary

- Comparison Criteria
  - Cost
    - Construction
    - Material
  - Shipping Limitations
    - 100 feet shipping limit
  - Scheduling
  - Manufacturing Availability
  - Capacity Requirements
- Alternatives
  - Steel Plate Girder
  - AASHTO Type V Concrete I-Beam
  - Steel Rolled Beam

Design Alt. #1

- Steel Plate Girder
  - AASHTO M 270 (ASTM 709M) – Grade 50 Steel
    - F_y = 50 ksi
    - F_u = 65 ksi
  - 4 plate girders
    - 9.0 feet spacing (center-to-center)
    - 2 ft – 10 in deck overhang
    - 18 in x 20 in x 5.875 in elastomeric bearing pad (e-Span 140)

Section Dimensions (in)		
Component	Thickness	Width
Top Flange	0.75	16.00
Web	55.00	0.50
Bottom Flange	1.25	16.00

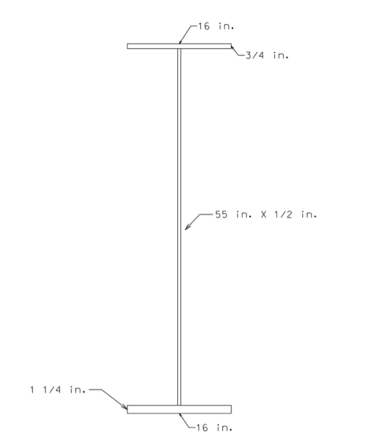
Design Alt. #1

- Steel Plate Girder
  - Field Splice at L = 100'
    - AASHTO M 164 Type 3 Bolts
      - 7/8 in diameter
      - 328 bolts/beam x 4 beams = 1312 bolts total

Splice Plate Dimensions (in)			
Component	Plate Thickness	Plate Dimensions	Number of Plates
Top Flange	0.5	16 x 39.5	1 (top)
	0.5	7.5 x 39.5	2 (bottom)
Web	0.5	45 x 34	2
Bottom Flange	1.0	69.5 x 8.5	2 (top)
	1.0	69.5 x 16	1 (bottom)

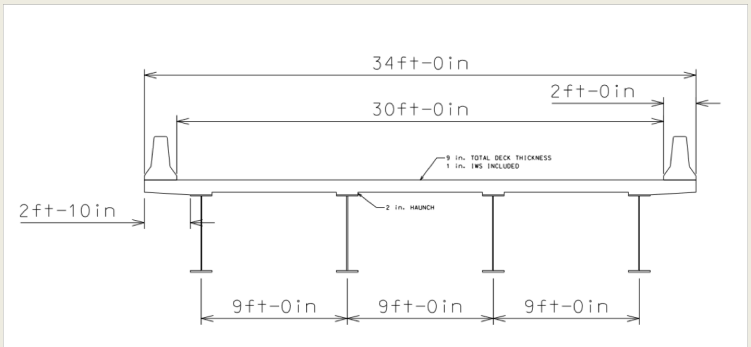
Plans

- Steel Plate Girder Detail - Section



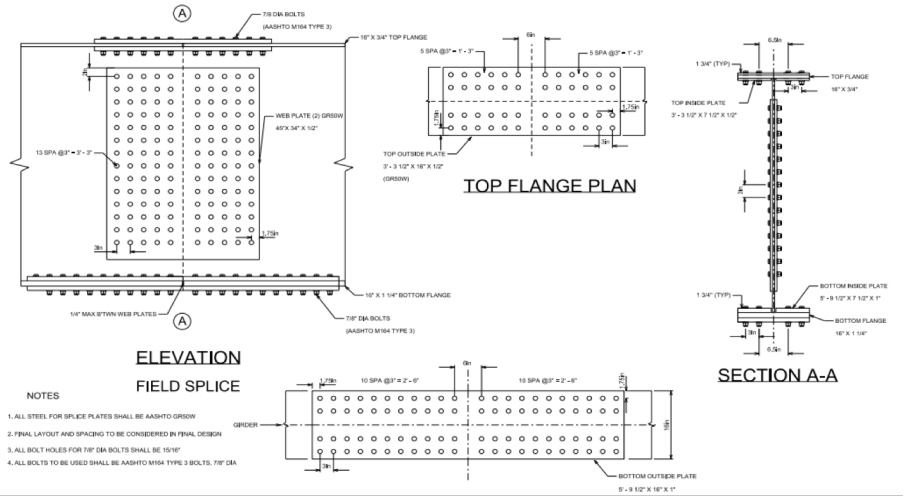
Plans

- Steel Plate Girder Bridge Section



Plans

- Connection Detail – Steel Alternatives

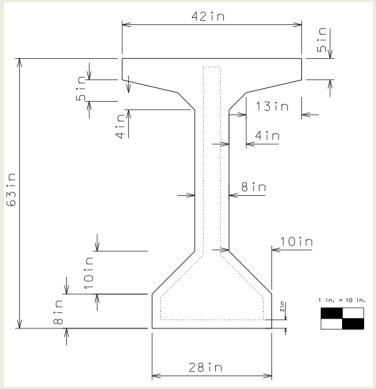


Design Alt. #2

- AASHTO Type V Concrete I-Beam
  - 4 girders
    - 8.0 feet spacing (center-to-center)
    - 125 feet span length
    - 18 in x 20 in x 5.875 in elastomeric bearing pad (e-Span 140)
    - 3’ – 3” deck overhang distance

Design Alt. #2

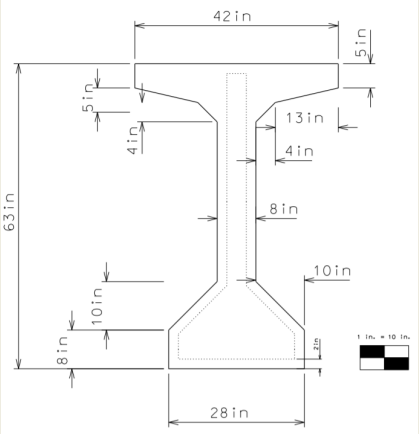
- AASHTO Type V Concrete I-Beam
  - Cross Section
    - 28 in bottom flange
    - 42 in top flange
    - 63 in total height
    - Reinforcement area shown



*Due to shipping limit (100’) the concrete alternative is not feasible

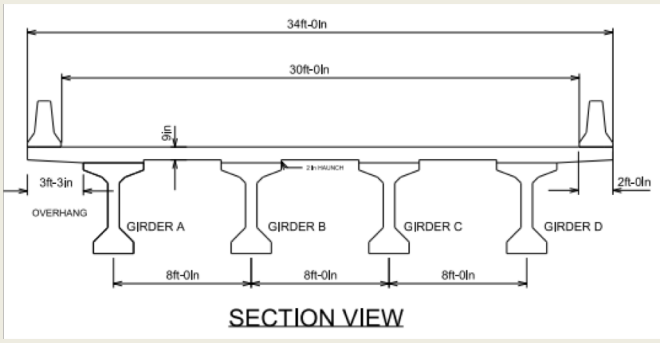
Plans

- Concrete Type V – I Beam



Plans

- Concrete Alternative – Bridge Section



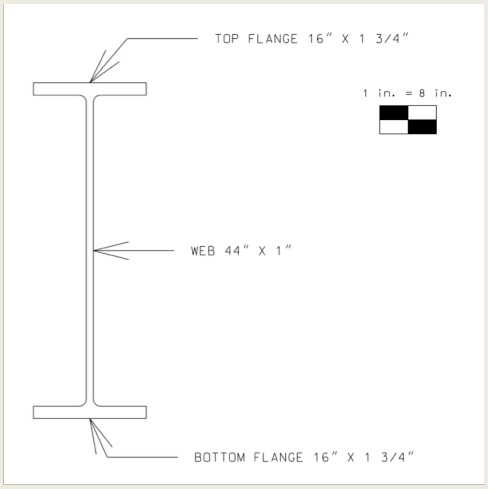
Design Alt. #3

- Rolled Steel Beam (W Shape)
  - W44x335 – ASTM A709 Grade 50 Steel
    - F_y = 50 ksi
    - F_u = 65 ksi
  - Beam dimensions (Largest Manufactured Beam)
    - 44in deep web
    - Top Flange 16” x 1 ¾”
    - Bottom Flange 16 x 1 ¾”

*Manufacturers limit on rolled W beams is a w44x335, which concluded to be insufficient for this project.

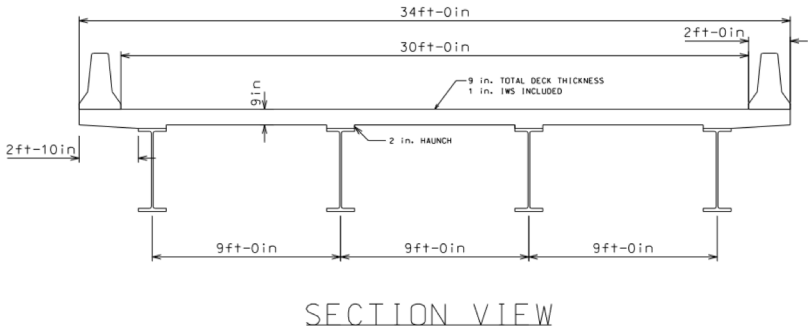
Plans

- Rolled Steel Beam



Plans

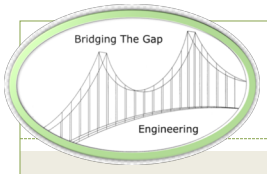
- Rolled Beam Alternative – Bridge Section



SECTION VIEW

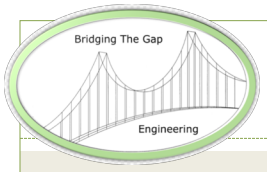
Cost Assumptions

- Overall
  - Excludes any features that have a consistent design & cost (deck, parapet wall, etc.)
  - Crane size calculated using an online crane calculator based off of weight and radius required.
  - Running percent of 15% on job office overhead (Primary Contractor), 15% on home office overhead (Primary Contractor), 10% on Profit (Primary Contractor), 2% on bond (Primary Contractor), and 6% on taxes (Project). 25% percent running percent for sub-contractor.
  - MII & RSMeans cost books used for any pricing that is not separately noted.
  - 10% of girder cost estimated for shipping



Cost Assumptions

- Steel Plate Girder
  - Quote that was given for the steel plate girders are for four 125 ft girders. Cost is still accurate since it is the same amount of steel.
  - 100 ton crane required for installation.
  - 5% lump sum used to account for elements that were not priced such as sheer studs, etc.



Cost Assumptions

- Concrete Type V I Beam
  - 400 ton crane needed for girders
  - Concrete girder shared from quote obtained by BRAHMS Design Group

Cost Assumptions

- Rolled Steel Girder
  - 100 ton crane was found to be needed
  - 5% lump sum used to account for elements that were not priced such as sheer studs, etc.

Steel Plate Girder

*Labor and Equipment are included in cost with further details included in MII Report

Steel Plate Girder Alternative Cost

Description	Quantity	UOM	Contractor	Direct Cost	Project Cost
Steel Plate Girders: grade 50, 125' long	4	EA	Prime	$178,080	$264,243
Steel Plate Girder Installation	80	HR	Prime	$69,291	$102,817
Shipping for Steel Plate Girder	1	LS	Sub	$19,130	$35,483
Steel Plate Girder Misc. (Bolts, Sheer Studs, etc.)	1	LS	Prime	$9,540	$14,156
M 164 Type 3 Bolts, 7/8" dia, incl nut & washer.	1,312	EA	Prime	$8,193	$12,157
Top Flange: Steel plate, structural, for connections & stiffeners, 1/2" T, shop fabricated, incl shop primer	4898	SI	Prime	$973	$1,444
Bottom Flange: Steel plate, structural, for connections & stiffeners, 1" T, shop fabricated, incl shop primer	9174	SI	Prime	$1,768	$2,623
Web: Steel plate, structural, for connections & stiffeners, 1/2" T, shop fabricated, incl shop primer	12,240	SI	Prime	$2,432	$3,609
Splice Connection Installation, Crane- 40 Ton	4	EA	Prime	$3,168	$4,701
Total	-	-	-	$295,000	$445,000

Concrete Type V I Beam

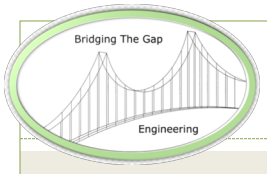
*Labor and Equipment are included in cost with further details included in MII Report

Concrete Type V I Beam Alternative Cost					
Description	Quantity	UOM	Contractor	Direct Cost	Project Cost
Prestressed Concrete Type V I-beam w/ Installation	263.75	TON	Prime	$290,158	$430,550
Shipping for Concrete I-Beam	1	LS	Sub	$37,110	$68,833
Total	-	-	-	**$330,000**	**$500,000**

Rolled Plate Girder

*Labor and Equipment are included in cost with further details included in MII Report

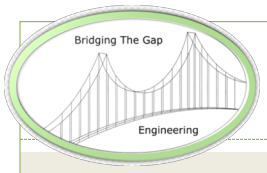
Rolled Steel Alternative Cost					
Description	Quantity	UOM	Contractor	Direct Cost	Project Cost
Rolled Steel Beam w/ Installation	52	TON	Prime	$288,411	$427,957
Shipping for Rolled Beam	1	LS	Sub	$20,194	$37,457
Rolled Steel Girder Misc. (Bolts, Sheer Studs, etc.)	1	LS	Prime	$12,296	$18,245
M 164 Type 3 Bolts, 7/8" dia, incl nut & washer.	1,312	EA	Prime	$8,193	$12,157
Top Flange: Steel plate, structural, for connections & stiffeners, 1/2" T, shop fabricated, incl shop primer	4,898	SI	Prime	$973	$1,444
Bottom Flange: Steel plate, structural, for connections & stiffeners, 1" T, shop fabricated, incl shop primer	9,174	SI	Prime	$1,768	$2,623
Web: Steel plate, structural, for connections & stiffeners, 1/2" T, shop fabricated, incl shop primer	12,240	SI	Prime	$2,432	$3,609
Splice Connection Installation, Crane- 40 Ton	4	EA	Prime	$3,168	$4,701
Total	-	-	-	$340,000	$515,000



Cost Comparison

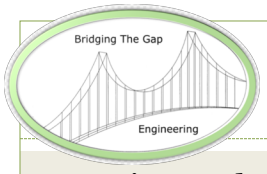
Cost Comparison of Alternatives			
Alternative	Direct Material Cost	Project Cost	Direct Cost
Steel Plate Girders	$215,000	$445,000	$295,000
AASHTO Type V Concrete I-Beam	$225,000	$500,000	$330,000
Steel Rolled Beam	$230,000	$515,000	$340,000

- Steel Plate Girder Alternative was determined to be the cheapest with the next closest being 12% higher in cost
- Difference between Steel Plate Girder and Rolled Steel Girder is significant enough ($45,000) to deem the Steel Plate Girder as a better choice from a cost perspective.



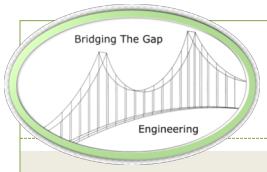
Summary

- Selected Alternative:
  - Alternative #1 - Steel Plate Girder
  - Justification for Alternative #1:
    - Shipping length made the AASHTO Type V Beam Concrete I-Beams not feasible
    - Cost of the Rolled Beam alternative compared to the Plate Girder alternative was too high



Conclusion

- Design Tasks Remaining:
  - Refined Shear & Moment Analysis
  - Lateral Bracing Design
  - Camber Design
  - Approach Slab Design
  - Shear Stud Design
  - Steel Reinforcement Analysis
  - Connection Design Refinement & Analysis
  - Girder optimization



Questions

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