The Great Debate

STEEL

CONCRETE

Concrete
John Donaruma

Steel
Gauri Chandore

Example
Pre-Debate Poll

Prestressed Concrete

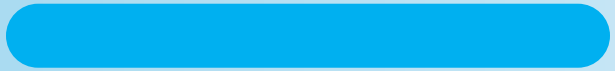
0%

Structural Steel

0%

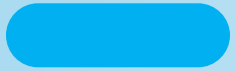
Example
Pre-Debate Poll

Prestressed Concrete



75%

Structural Steel

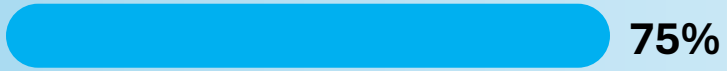


25%

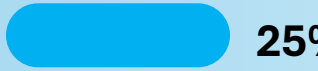
Example

Pre-Debate Poll

Prestressed Concrete

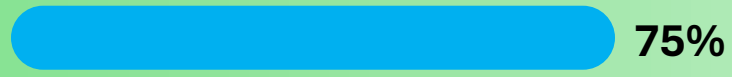


Structural Steel

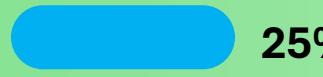


Post-Debate Poll

Prestressed Concrete

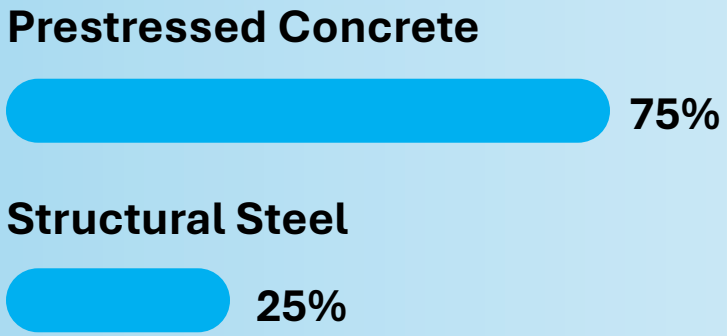


Structural Steel

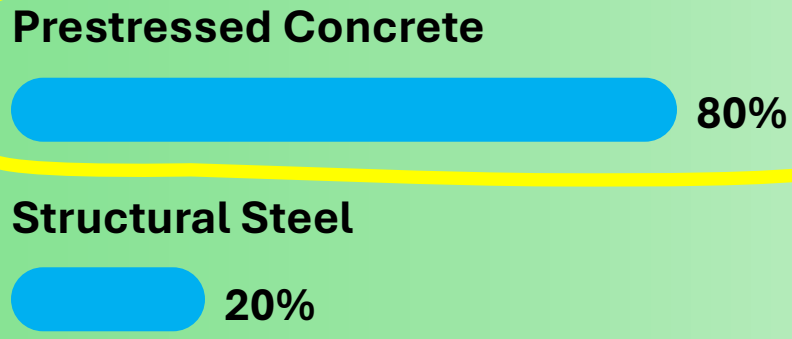


Example

Pre-Debate Poll

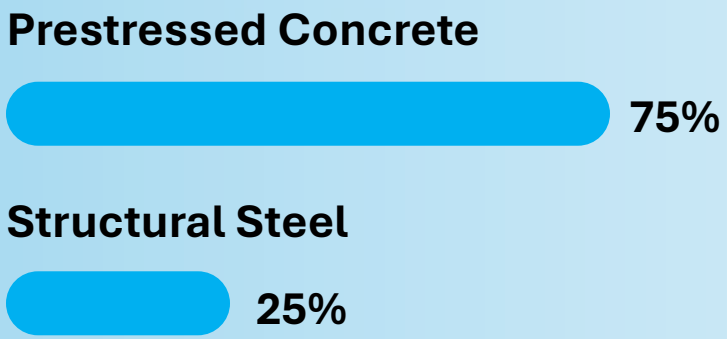


Post-Debate Poll

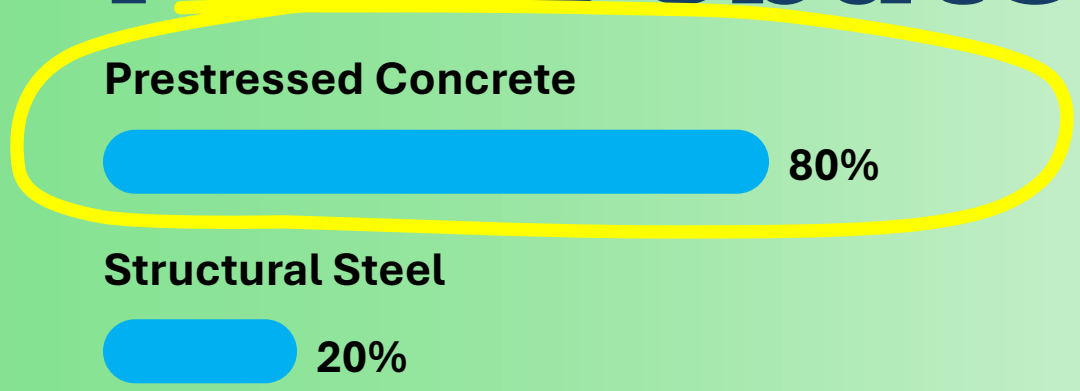


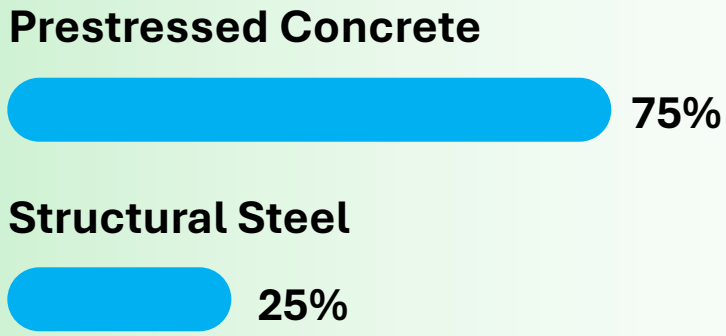
Example

Pre-Debate Poll



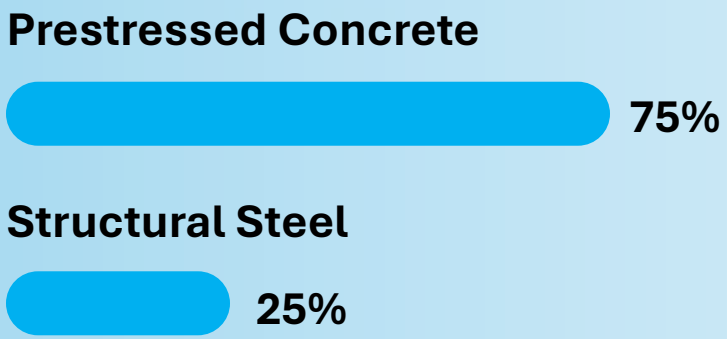
Post-Debate Poll



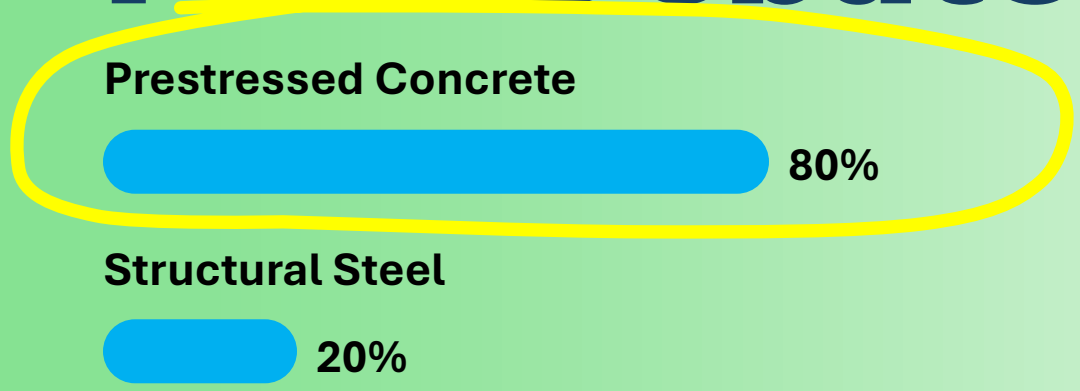


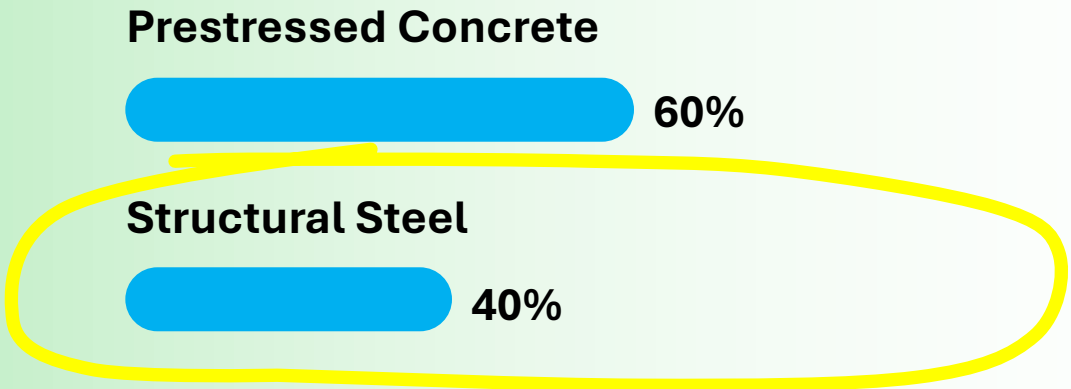
Example

Pre-Debate Poll

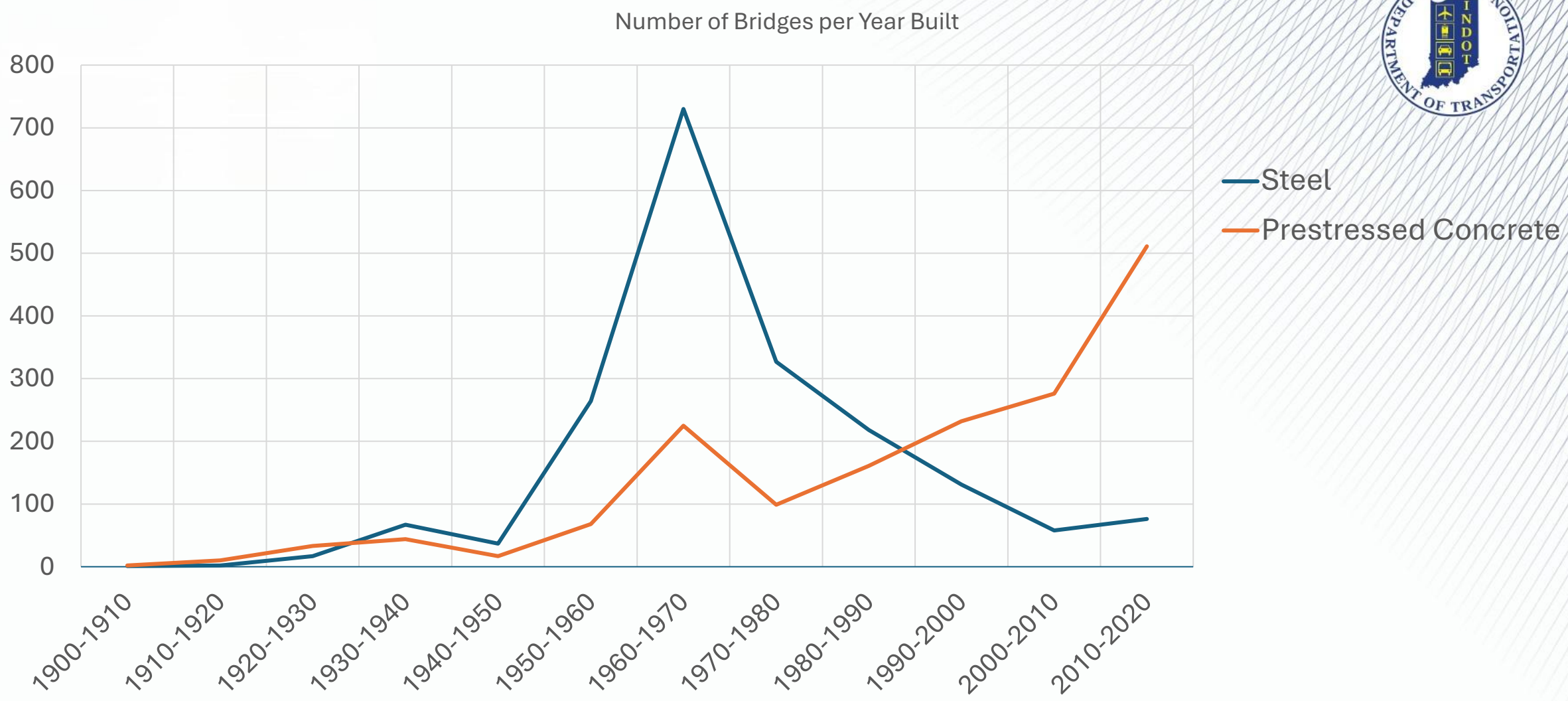


Post-Debate Poll





Pre-Debate: Which material is the best for Indiana bridges?


Number of Bridges per Year Built
800
700
600
500
400
300
200
100
0
1900-1910
1910-1920
1920-1930
1930-1940
1940-1950
1950-1960
1960-1970
1970-1980
1980-1990
1990-2000
2000-2010
2010-2020
Steel
Prestressed Concrete

Scenario #1

- Long-Span
- Grade Separation
- Curved Alignment

407-1.0 GENERAL

407-1.01 Economy

Factors that influence the cost of a steel-girder bridge include, but are not limited to, the number of girders, the type of material, type and number of substructure units, amount of material, fabrication, transportation, and erection. The cost of these changes periodically, in addition to the cost relationship among them. Therefore, the guidelines used to determine the most economical type of steel girder on one bridge must be reviewed and modified as necessary for another bridge.

Based upon market factors, the availability of steel can be an issue in satisfying the construction schedule. It is the responsibility of the bridge designer to verify the availability of the specified steel. The bridge designer should contact structural-steel producers to ensure the availability of rolled beams and plates.

A steel plate girder should be designed to optimize weight savings in correlation with fabrication and erection costs. The top flanges of a compositely-designed plate girder are typically smaller than their bottom flanges. The flange section is varied along the length of the bridge following the moment envelope to save cost by offsetting the increased fabrication costs of welded flange transitions with larger savings in material costs. To save in total costs, minimum web thicknesses are increased to avoid the use of stiffeners.

The load-carrying capacity of an exterior beam or girder shall not be less than that of the interior beams or girders as described in *LRFD* 4.6.2.2.1.

Weathering steel, uncoated Grades 50W and HPS70W should be used if possible to lower the initial construction costs and future maintenance costs. Aesthetic considerations limit the application of weathering steel in a high-visibility application, because the inherent staining of the substructures may not be desirable. See Section 407-2.01(01) for other factors limiting the use of weathering steel.

than their bottom flanges. The flange section is varied along the length of the bridge following the moment envelope to save cost by offsetting the increased fabrication costs of welded flange transitions with larger savings in material costs. To save in total costs, minimum web thicknesses are increased to avoid the use of stiffeners.

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Scenario #2

- Single-Span
- Waterway Crossing
- Schedule Constraints

407-2.01(01) Selection

The most common steel-grade choice is uncoated ASTM A709 Grade 50W weathering steel. Its initial cost advantage compared to coated high-strength steel, e.g., A 709 Grade 50, can range up to 15%. If compared to coated ASTM A709 Grade 36 steel, the cost advantage is approximately 20%. If future recoating costs are considered, the cost advantage is more substantial. This reflects, for example, environmental considerations in the removal of coating, which can make the use of coated steel prohibitive. Grade 36 steel is becoming less used and thus less available. The higher-strength ASTM A 709 Grade HPS 70W often carries a cost premium of approximately 10% compared to Grade 50W. *AASHTO Guide Specification for Highway Bridge Fabrication with HPS 70W Steel* should be used as a reference. A new high-performance steel with a minimum specified yield strength of 100 ksi has been introduced. It has yet to be proven cost-effective for girder bridge applications.

Despite its cost advantage, the use of weathering steel is not appropriate in every environment or at every location. The application of weathering steel and its potential problems are discussed in the FHWA *Technical Advisory: Uncoated Weathering Steel in Structures*, October 3, 1989. Also, the proceedings of the Weathering Steel Forum, July 1989, are available from the FHWA Office of Implementation, HRT-10. Weathering steel should not be used where the following adverse conditions exist.

1. Environment. Weathering steel should not be used in an industrial area where concentrated chemical fumes can drift onto the structure. Its suitability should be determined by a corrosion consultant.

2. Location. Weathering steel should not be used at a grade separation in a tunnel, which is produced due to a depressed roadway section with narrow shoulders between vertical retaining walls, with a shallow vertical clearance, with deep abutments adjacent to the shoulders, or with a wide bridge. This tunnel effect prevents roadway spray from being dissipated and spread by air currents. There is no evidence of salt-spray corrosion where the longitudinal extent of the vertical walls is limited to the abutment itself and roadway spray can be dissipated on both approaches.

3. Low-Level Water Crossing. Sufficient clearance over a body of water should be maintained so that water-vapor condensation does not result in prolonged periods of wetness on the steel. For weathering steel, clearance to the bottom flange should be at least 10 ft over sheltered, stagnant water and at least 8 ft above the average low-water level for a running stream.

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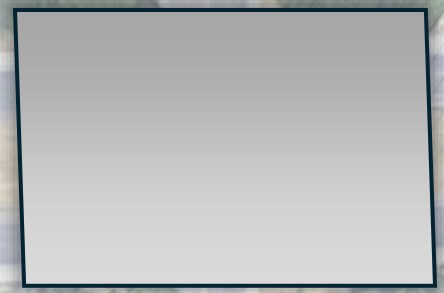
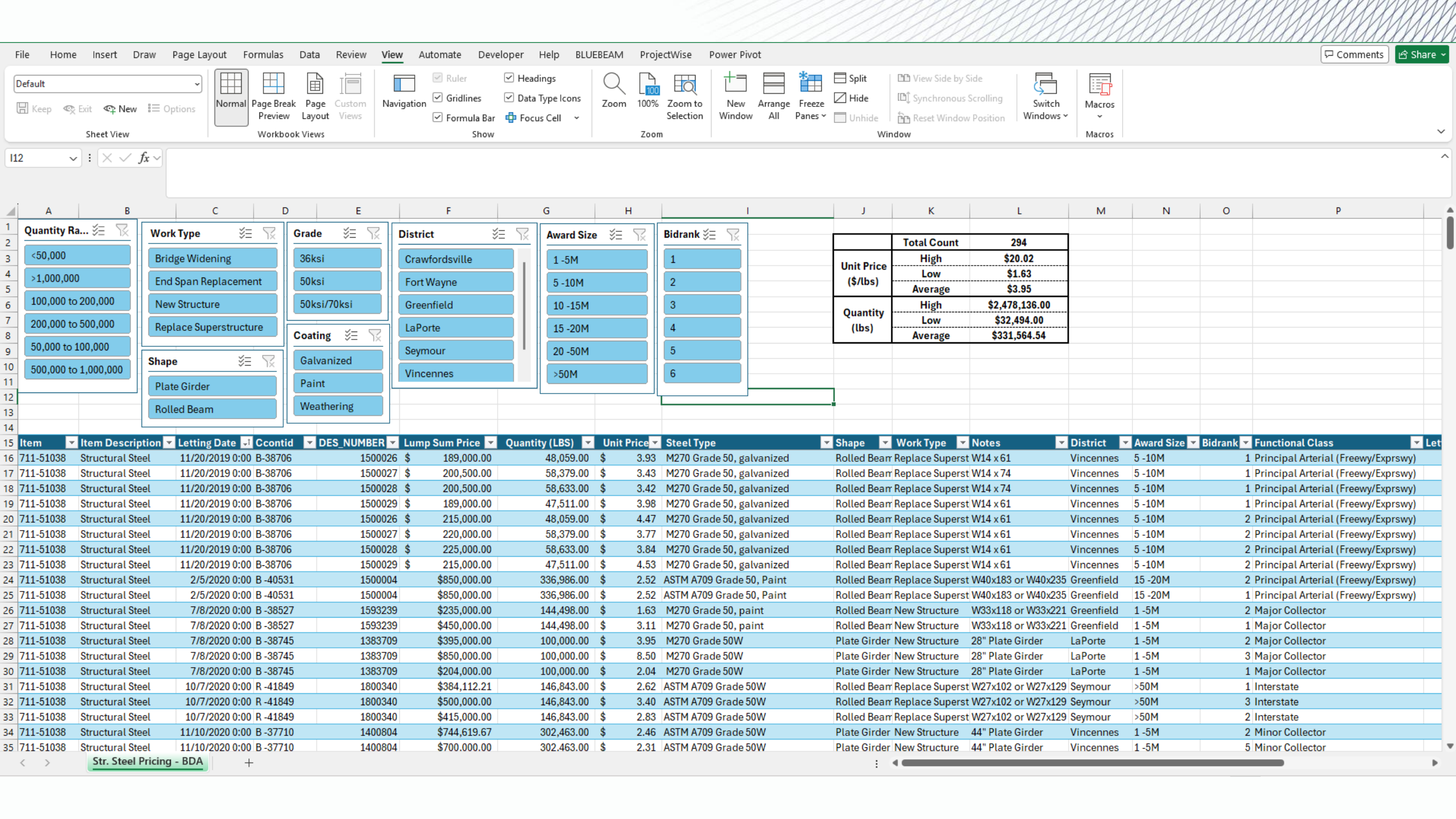
3. Low-Level Water Crossing. Sufficient clearance over a body of water should be maintained so that water-vapor condensation does not result in prolonged periods of wetness on the steel. For weathering steel, clearance to the bottom flange should be at least 10 ft over sheltered, stagnant water and at least 8 ft above the average low-water level for a running stream.

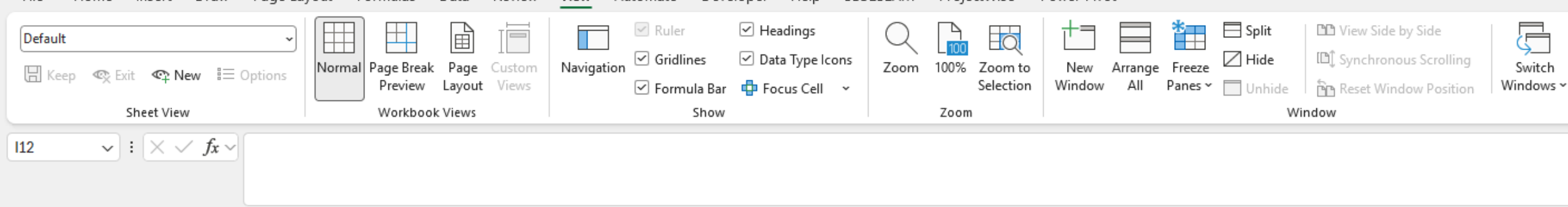
Scenario #3

- Three-Span
- Tangent Alignment
- Superstructure Replacement





Item	Item Description	Letting Date	Ccontid	DES_NUMBER	Lump Sum Price	Quantity (LBS)	Unit Price	Steel Type	Shape	Work Type	Notes	District	Award Size	Bidrank	Functional Class
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500026	$ 189,000.00	48,059.00	$ 3.93	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	1	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500027	$ 200,500.00	58,379.00	$ 3.43	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 74	Vincennes	5 -10M	1	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500028	$ 200,500.00	58,633.00	$ 3.42	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 74	Vincennes	5 -10M	1	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500029	$ 189,000.00	47,511.00	$ 3.98	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	1	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500026	$ 215,000.00	48,059.00	$ 4.47	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	2	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500027	$ 220,000.00	58,379.00	$ 3.77	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	2	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500028	$ 225,000.00	58,633.00	$ 3.84	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	2	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500029	$ 215,000.00	47,511.00	$ 4.53	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61	Vincennes	5 -10M	2	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	2/5/2020 0:00	B -40531	1500004	$850,000.00	336,986.00	$ 2.52	ASTM A709 Grade 50, Paint	Rolled Beam	Replace Superst	W40x183 or W40x235	Greenfield	15 -20M	2	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	2/5/2020 0:00	B -40531	1500004	$850,000.00	336,986.00	$ 2.52	ASTM A709 Grade 50, Paint	Rolled Beam	Replace Superst	W40x183 or W40x235	Greenfield	15 -20M	1	Principal Arterial (Freewy/Exprswy)
711-51038	Structural Steel	7/8/2020 0:00	B -38527	1593239	$235,000.00	144,498.00	$ 1.63	M270 Grade 50, paint	Rolled Beam	New Structure	W33x118 or W33x221	Greenfield	1 -5M	2	Major Collector
711-51038	Structural Steel	7/8/2020 0:00	B -38527	1593239	$450,000.00	144,498.00	$ 3.11	M270 Grade 50, paint	Rolled Beam	New Structure	W33x118 or W33x221	Greenfield	1 -5M	1	Major Collector
711-51038	Structural Steel	7/8/2020 0:00	B -38745	1383709	$395,000.00	100,000.00	$ 3.95	M270 Grade 50W	Plate Girder	New Structure	28" Plate Girder	LaPorte	1 -5M	2	Major Collector
711-51038	Structural Steel	7/8/2020 0:00	B -38745	1383709	$850,000.00	100,000.00	$ 8.50	M270 Grade 50W	Plate Girder	New Structure	28" Plate Girder	LaPorte	1 -5M	3	Major Collector
711-51038	Structural Steel	7/8/2020 0:00	B -38745	1383709	$204,000.00	100,000.00	$ 2.04	M270 Grade 50W	Plate Girder	New Structure	28" Plate Girder	LaPorte	1 -5M	1	Major Collector
711-51038	Structural Steel	10/7/2020 0:00	R -41849	1800340	$384,112.21	146,843.00	$ 2.62	ASTM A709 Grade 50W	Rolled Beam	Replace Superst	W27x102 or W27x129	Seymour	>50M	1	Interstate
711-51038	Structural Steel	10/7/2020 0:00	R -41849	1800340	$500,000.00	146,843.00	$ 3.40	ASTM A709 Grade 50W	Rolled Beam	Replace Superst	W27x102 or W27x129	Seymour	>50M	3	Interstate
711-51038	Structural Steel	10/7/2020 0:00	R -41849	1800340	$415,000.00	146,843.00	$ 2.83	ASTM A709 Grade 50W	Rolled Beam	Replace Superst	W27x102 or W27x129	Seymour	>50M	2	Interstate
711-51038	Structural Steel	11/10/2020 0:00	B -37710	1400804	$744,619.67	302,463.00	$ 2.46	ASTM A709 Grade 50W	Plate Girder	New Structure	44" Plate Girder	Vincennes	1 -5M	2	Minor Collector
711-51038	Structural Steel	11/10/2020 0:00	B -37710	1400804	$700,000.00	302,463.00	$ 2.31	ASTM A709 Grade 50W	Plate Girder	New Structure	44" Plate Girder	Vincennes	1 -5M	5	Minor Collector



I12

	A	B	C	D	E	F	G	H	I	J	K	L
1	Quantity Ra...		Work Type		Grade	District	Award Size		Bidrank			
2	<50,000		Bridge Widening		36ksi	Crawfordsville	1 -5M		1			
3	>1,000,000		End Span Replacement		50ksi	Fort Wayne	5 -10M		2			
4	100,000 to 200,000		New Structure		50ksi/70ksi	Greenfield	10 -15M		3			
5	200,000 to 500,000		Replace Superstructure			LaPorte	15 -20M		4			
6	50,000 to 100,000				Coating	Seymour	20 -50M		5			
7	500,000 to 1,000,000		Shape		Galvanized	Vincennes	>50M		6			
8			Plate Girder		Paint							
9			Rolled Beam		Weathering							
10												
11												
12												
13												
14												

		Total Count	294
Unit Price ($/lbs)		High	$20.02
		Low	$1.63
		Average	$3.95
Quantity (lbs)		High	$2,478,136.00
		Low	$32,494.00
		Average	$331,564.54

	Item	Item Description	Letting Date	Ccontid	DES_NUMBER	Lump Sum Price	Quantity (LBS)	Unit Price	Steel Type	Shape	Work Type	Notes
15												
16	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500026	$ 189,000.00	48,059.00	$ 3.93	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
17	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500027	$ 200,500.00	58,379.00	$ 3.43	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 74
18	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500028	$ 200,500.00	58,633.00	$ 3.42	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 74
19	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500029	$ 189,000.00	47,511.00	$ 3.98	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
20	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500026	$ 215,000.00	48,059.00	$ 4.47	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
21	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500027	$ 220,000.00	58,379.00	$ 3.77	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
22	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500028	$ 225,000.00	58,633.00	$ 3.84	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
23	711-51038	Structural Steel	11/20/2019 0:00	B-38706	1500029	$ 215,000.00	47,511.00	$ 4.53	M270 Grade 50, galvanized	Rolled Beam	Replace Superst	W14 x 61
24	711-51038	Structural Steel	2/5/2020 0:00	B -40531	1500004	$850,000.00	336,986.00	$ 2.52	ASTM A709 Grade 50, Paint	Rolled Beam	Replace Superst	W40x183 or W40x235
25	711-51038	Structural Steel	2/5/2020 0:00	B -40531	1500004	$850,000.00	336,986.00	$ 2.52	ASTM A709 Grade 50, Paint	Rolled Beam	Replace Superst	W40x183 or W40x235
26	711-51038	Structural Steel	7/8/2020 0:00	B -38527	1593239	$235,000.00	144,498.00	$ 1.63	M270 Grade 50, paint	Rolled Beam	New Structure	W33x118 or W33x221
27	711-51038	Structural Steel	7/8/2020 0:00	B -38527	1593239	$450,000.00	144,498.00	$ 3.11	M270 Grade 50, paint	Rolled Beam	New Structure	W33x118 or W33x221
28	711-51038	Structural Steel	7/8/2020 0:00	B -38745	1383709	$395,000.00	100,000.00	$ 3.95	M270 Grade 50W	Plate Girder	New Structure	28" Plate Girder
29	711-51038	Structural Steel	7/8/2020 0:00	B -38745	1383709	$850,000.00	100,000.00	$ 8.50	M270 Grade 50W	Plate Girder	New Structure	28" Plate Girder

Post-Debate: Which material is the best for Indiana bridges?

Audience Q&A