NORTHERN ARIZONA UNIVERSITY

ASCE
STEEL BRIDGE TEAM

Student Steel Bridge Competition

NORTHERN ARIZONA UNIVERSITY

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

AMERICAN INSTITUTE OF STEEL CONSTRUCTION AISC FOUNDED 1921

PROJECT DESCRIPTION

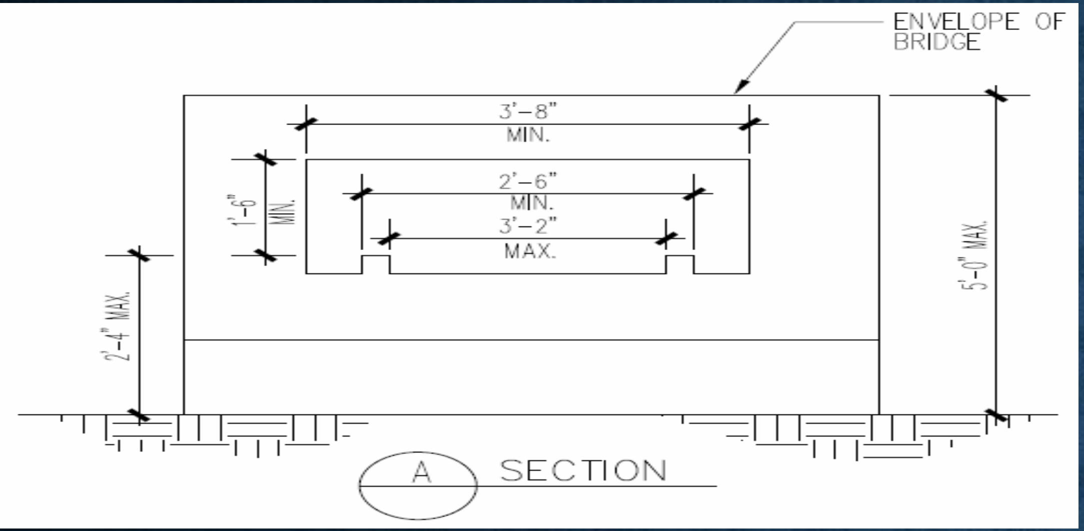
- Accelerate Bridge Construction methods

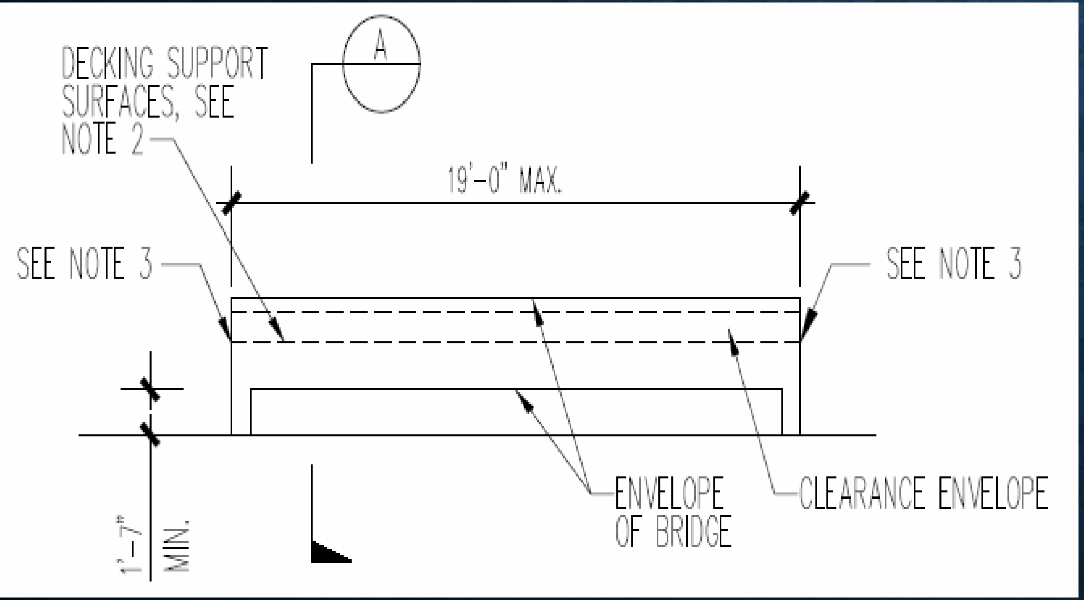
- Replace a bridge that currently spans a large river

- Develop a 1:10 scale model that will demonstrate the concepts presented by our company and erect this under replicated conditions

- Design will be constructed at the American Society of Civil Engineers (ASCE) Pacific South West Conference (PSWC)

BACKGROUND

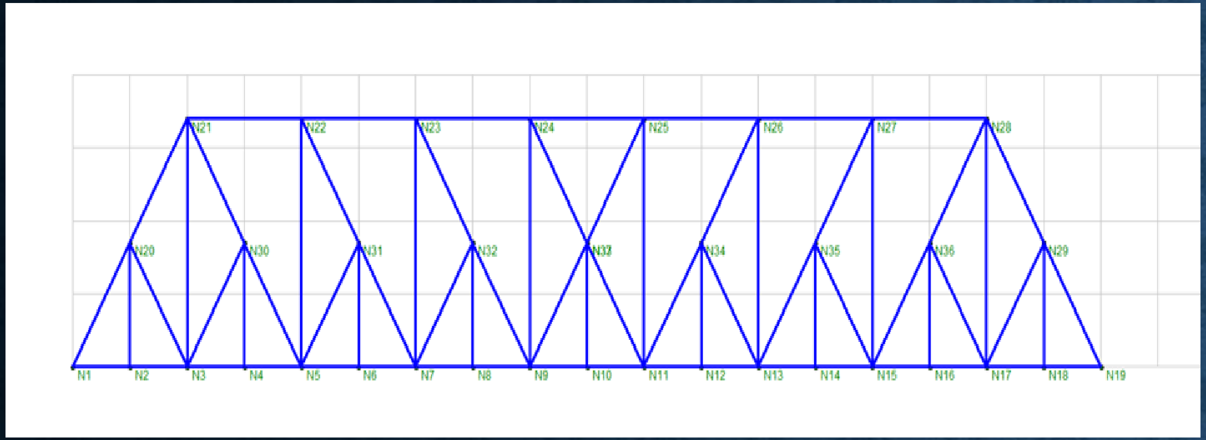




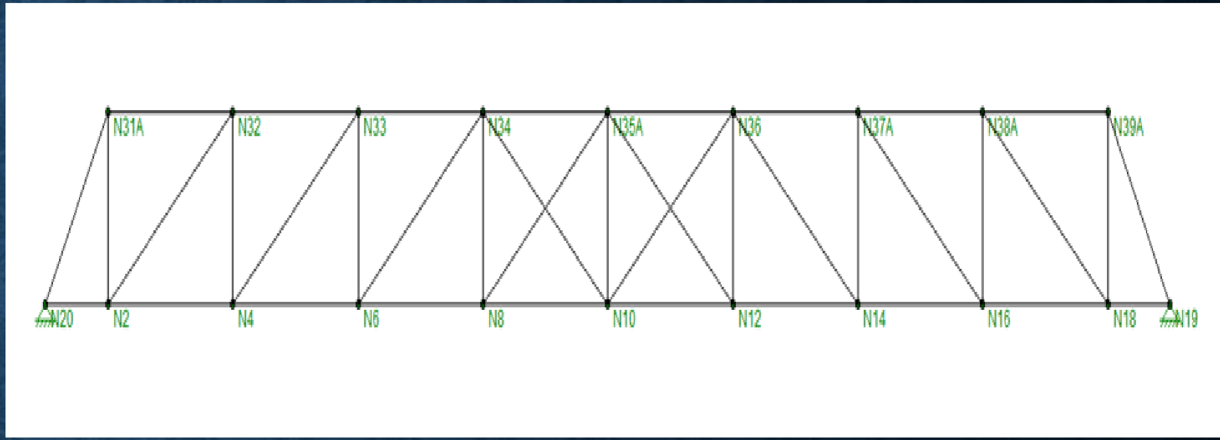
- Bridges are built to address specific rules and criteria
- Overall structure must fit into a cross-section and profile envelope
- Along with design criteria, scoring categories also considered when designing

ALTERNATIVES - TRUSS TYPES

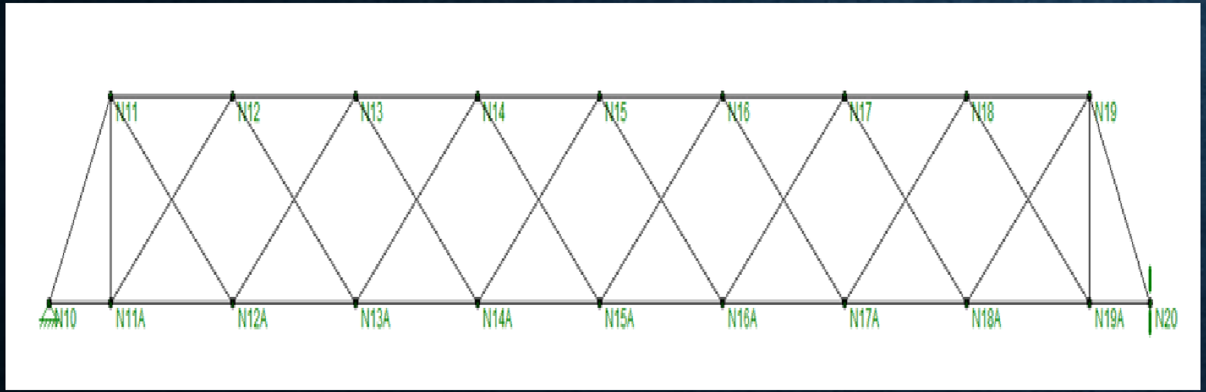
Baltimore



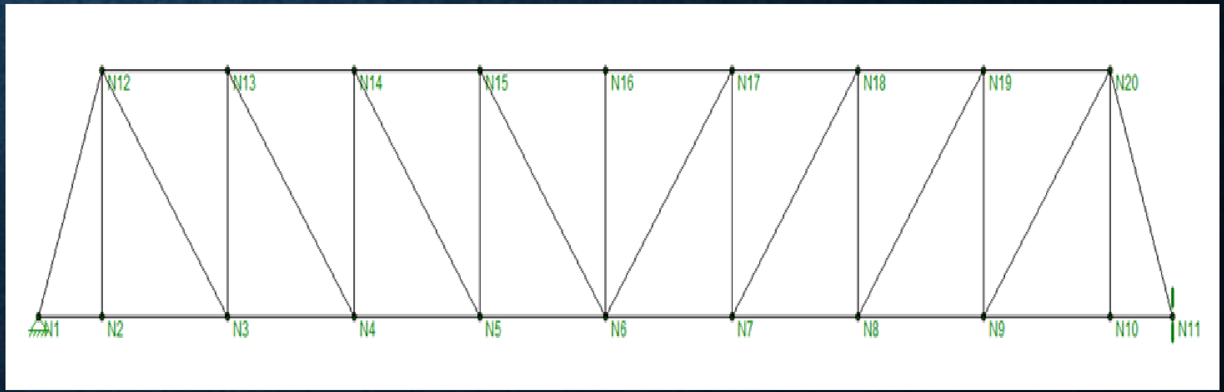
Howe



Double Warren



Pratt

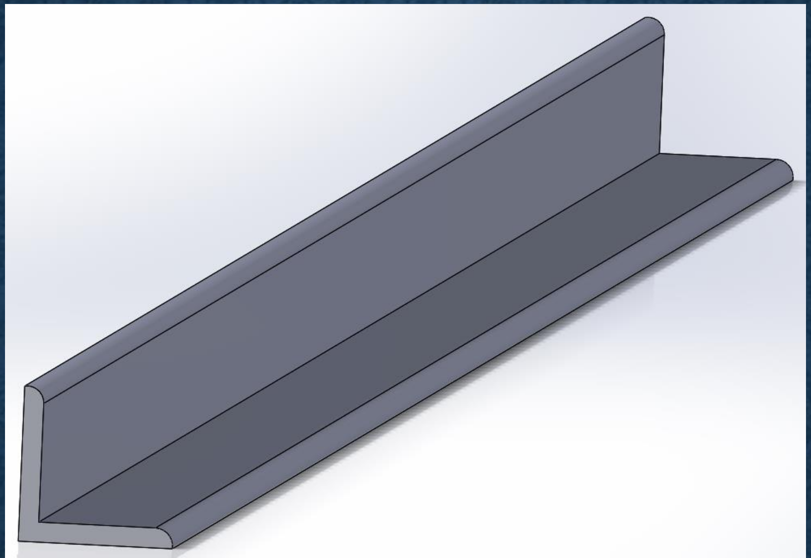


TRUSS DECISION MATRIX

	Weight	Pratt	Howe	Warren	Baltimore
Lightness	2	3 (6)	3 (6)	2 (4)	1 (2)
Deflection	3	2 (6)	2 (6)	3 (9)	1 (3)
Aesthetics	1	2 (2)	2 (2)	3 (3)	5 (5)
Time	3	2 (6)	2 (6)	2 (6)	1 (3)
Strength	2	3 (6)	2 (4)	1 (2)	1 (2)
Total		26	24	24	15

ALTERNATIVES – STEEL SHAPES

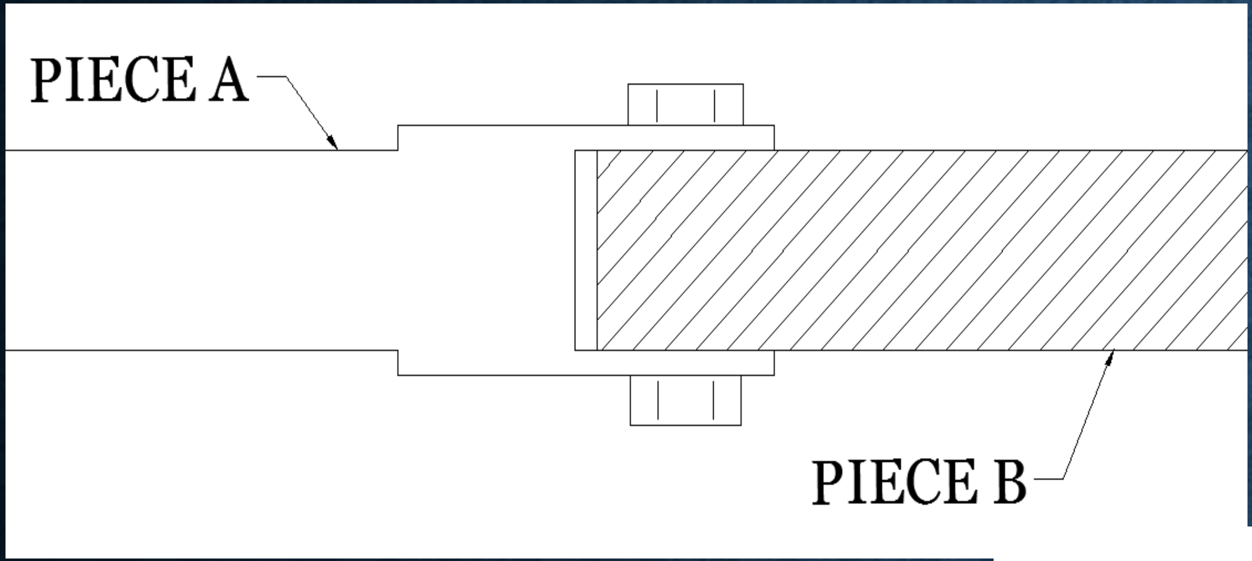
Angle Iron

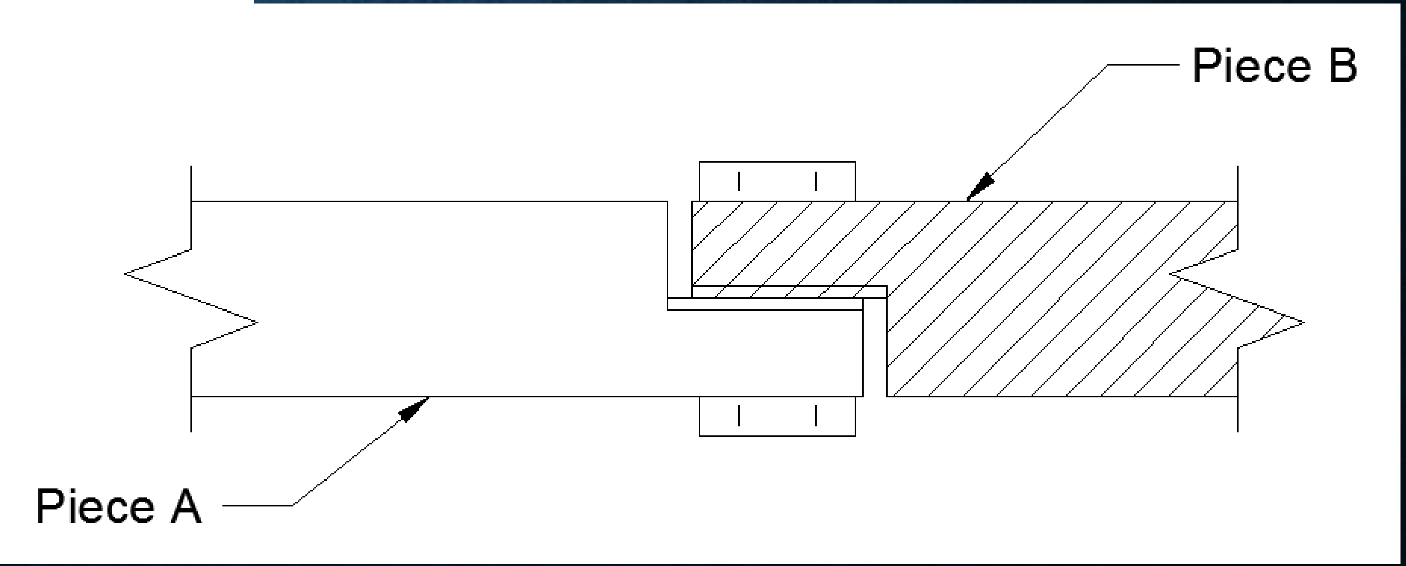


Cold Formed Shapes

Hallow Structural Section

CONNECTION DESIGN



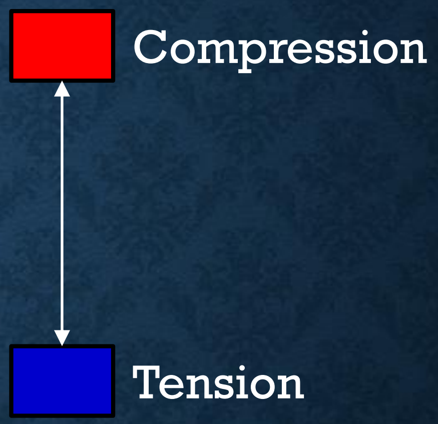


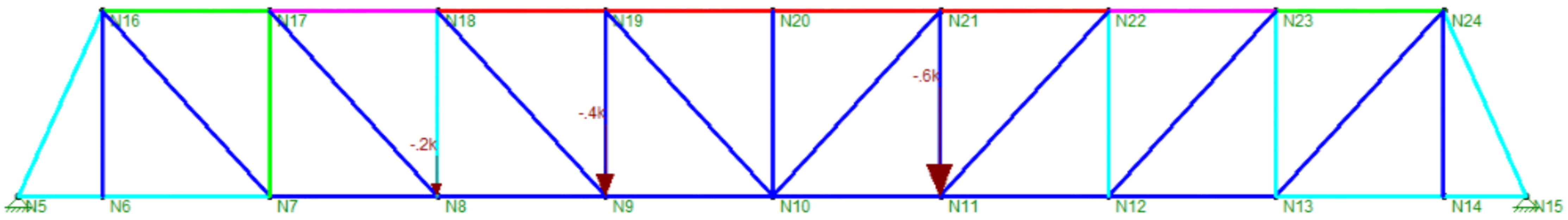
MATERIAL TESTING

- Testing of the material was done to confirm the material that was donated to us
- Tried to implement Brinell Hardness Test
- Ultimately the tests failed because of the shape of the material

RISA ANALYSIS

- 2D and 3D Analysis
- Joint Deflection
- Compressive and Tension Stress





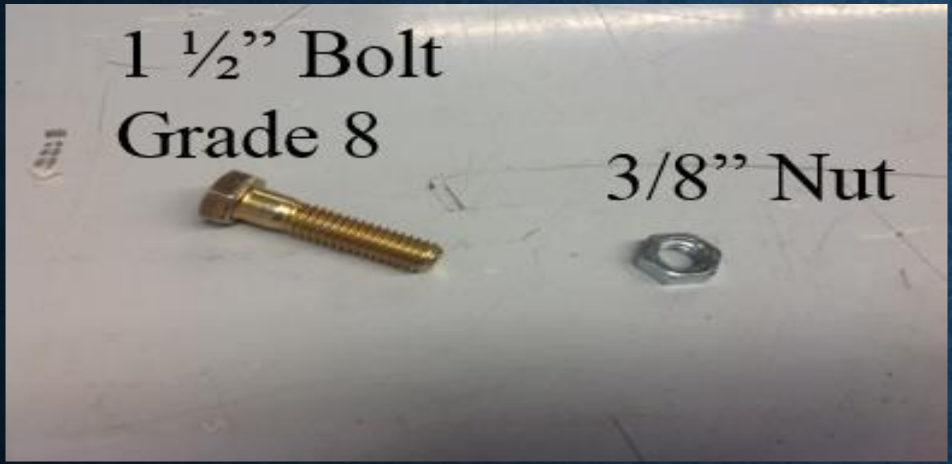
MATERIAL ANALYSIS

Check	Allowable	Actual	Conclusion
Compression Capacity	2.65 kip	1.4 kip	GOOD!
Yield Limit State	4.65 kip	4.61 kip	GOOD!
Fracture Limit State	3.4 kip	2.4 kip	GOOD!
Plate Tear Out	4.9 kip	4.61 kip	GOOD!
Shear Strength	2.23kip	0.7 kip	GOOD!

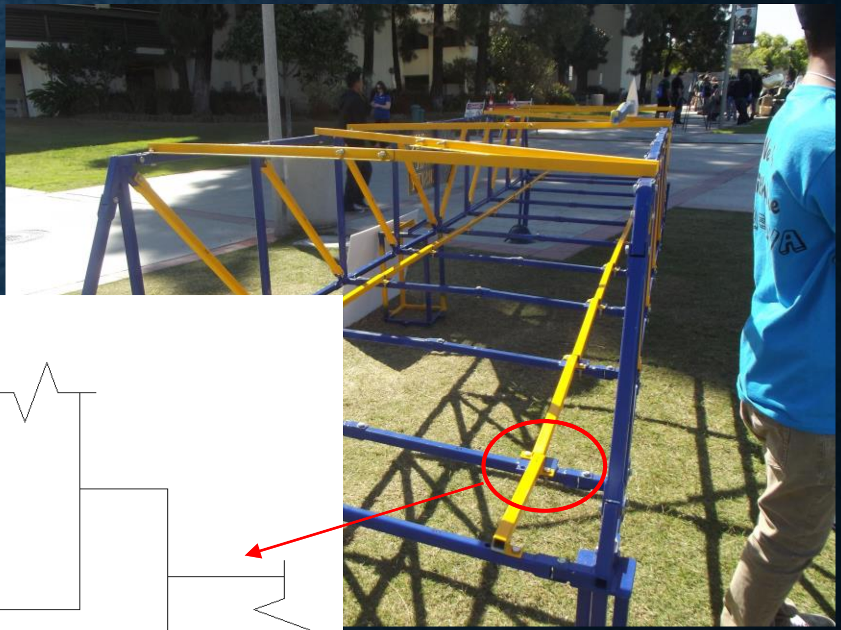
The analysis was done by using the AISC Steel Construction Manual 14th edition.

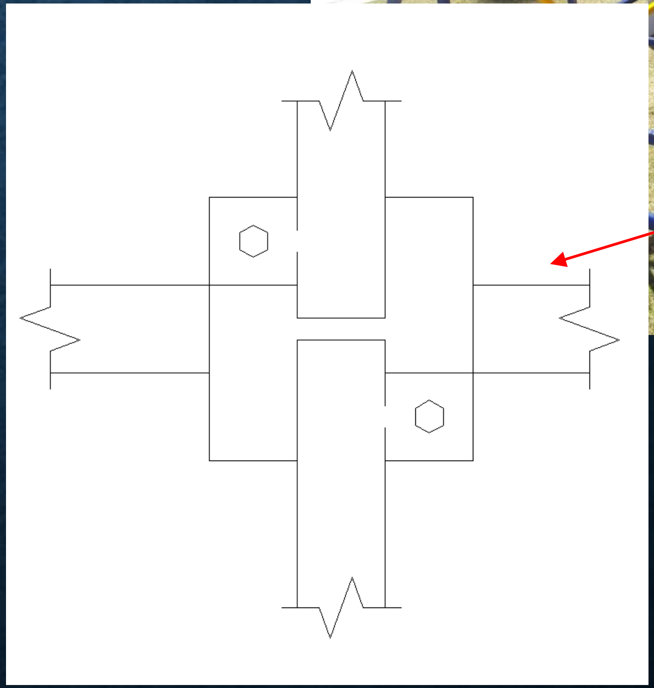
FINAL DESIGN

Bolts & Nuts Grade



Rail and Span Members





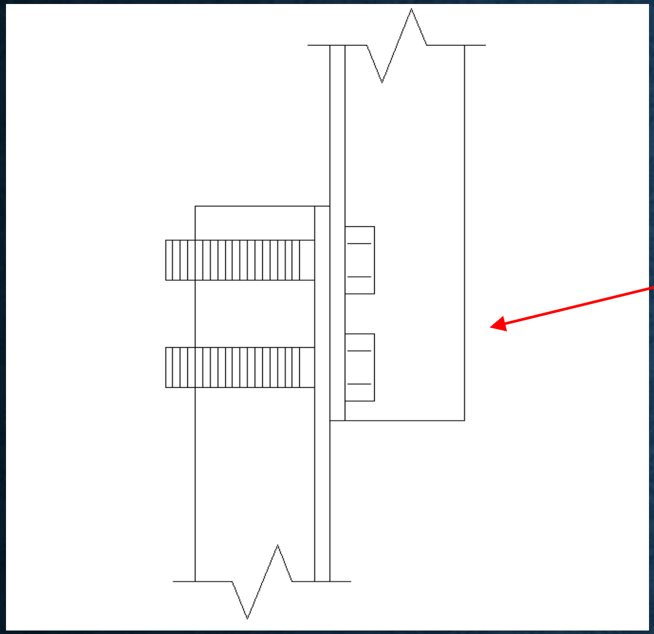
FINAL DESIGN

- Connection Design

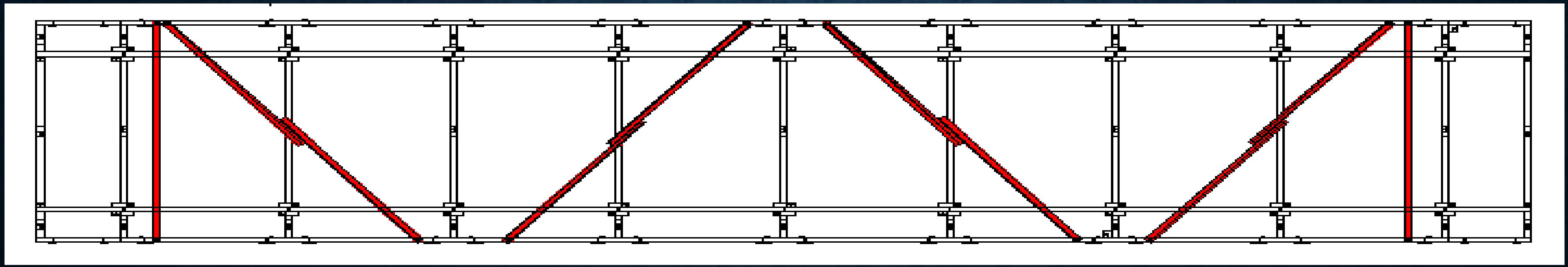
- Support Column

FINAL DESIGN

- Angle Iron Cross Bracing



Plan View



COST ANALYSIS

Donated Material

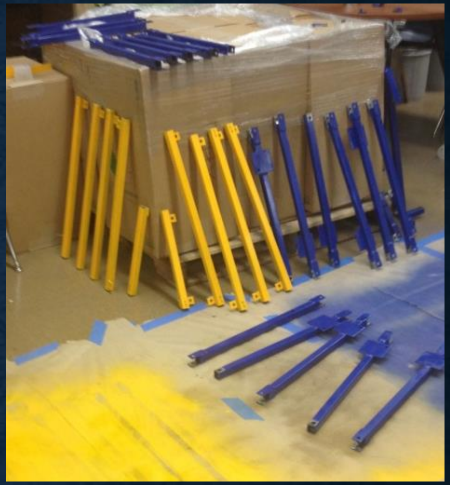
HSS Tubing 1x1x1/8 (500 ft)	$500
1/8” Plates (2-1/8” long) (300)	$300
Welding Labor (18 Hours)	$1600
Bridge Sign	$70
Angle Iron	$70
Nuts & Bolts (350 Ea.)	$60
Total	$2600

Non-Donated Material

Machine Shop Labor	$150
Paint	$115
Total	$265

PROJECT HOURS

- Design Hours
    - AutoCAD/Solid Works - 100
    - RISA - 120
    - Hand Calculations - 15
    - Brainstorming/Decision Matrix - 240
- **Total = 475 hours**
- Labor Hours
    - Team Members - 1000
    - Mentees - 300
- **Total = 1300 hours**



IMPACTS

Social

- Compete vs. other universities
- Offer design ideas to the future
- Work face to face with companies

Economical

- Paved the way for future students

COMPETITION PIC

DESIGN CATEGORIES

Display ~ **Lightness** ~ **Deflection** ~ **Construction Speed**

Construction Economy: *(Cc)*

= Time(minutes) x Build team members(persons) x $50,000($/person-minute) + load test penalties($)

Structural Efficiency: *(Cs)*

= Weight(squared) x $50($/pound(squared)) x deflection(inches) x $1,000,000($/inch) + load test penalties($)

Overall Performance: *Cc + Cs*

RESULTS

- All bridges were loaded with 2400 lbs
- Of 18 Schools, 13 bridges could not capacitate the load
- All DQ's resulted from deflection violations or catastrophic failure.
- Maximum deflection = 1.83 in.
- Construction time = 27m 38s
- 38 Violations

School	
ASU	DISQUALIFIED
CBU	
CPSLO	DISQUALIFIED
CPP	
CSUF	DISQUALIFIED
CSULB	DISQUALIFIED
CSULA	DISQUALIFIED
CSUN	DISQUALIFIED
LMU	DISQUALIFIED
NAU	
SDSU	DISQUALIFIED
UCI	DISQUALIFIED
UCLA	DISQUALIFIED
UCSD	DISQUALIFIED
UofA	DISQUALIFIED
UHM	
UNLV	DISQUALIFIED
USC	

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Thom ... ahn Jr.
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Dr. Ro ... aveer
Dr. John Tingerthal   Lauren Stadelmeier

CONCLUSIONS

- Third in Display
- Third in Construction Economy
- 5th overall