

Building a better mousetrap..... I mean bridge

Restoring CR 573 over the Sturgeon River

(The Post Construction Shear Stud Project)



1-Unit = 42 tons -> Legal
 2-Unit = 77 tons -> Legal
 3-Unit = 82 tons -> Legal

+Class A Overload



Definition of a Civil Engineer

Engineer (en-juh-nēr) - Noun

1. One who solves problems that you didn't know you had, using methods you don't understand.
2. One who does precision guesswork based on unreliable data provided by those of questionable knowledge.
3. One who get excited about things nobody else cares about.

• See also **wizard, magician**

Civil Engineer (sivil en-juh-nēr) - Noun

1. Someone who designs and builds stuff based on assumptions that make no sense at all but somehow work.
2. Like a regular engineer only way cooler.

• See also **sorcerer, awesome, exceptional**

CIVIL ENGINEERS



What my friends think I do.



What my mom thinks I do.



What society thinks I do.



What my boss thinks I do.



What construction contractors think I do.



What I think I do.



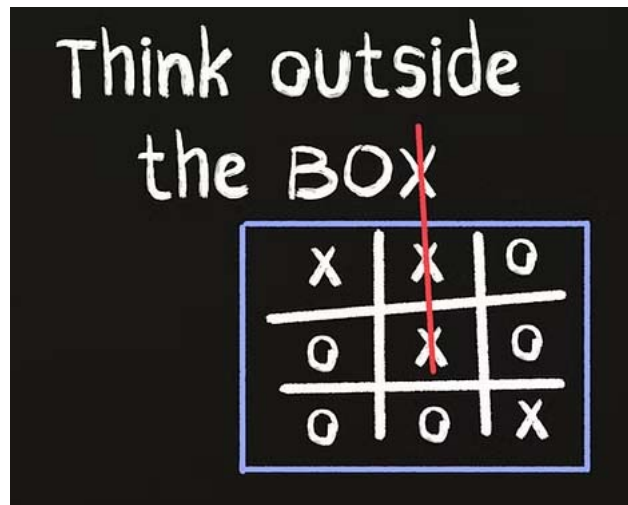
What I really do.

- **Engineer –**

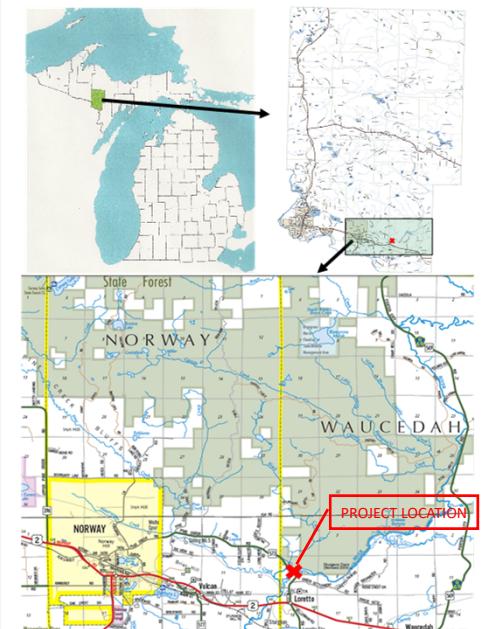
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2. One who does precision guesswork based on unreliable data provided by those of questionable knowledge.
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- **Civil Engineer -**

1. Someone who designs and builds stuff based on assumptions that make no sense at all but somehow work.
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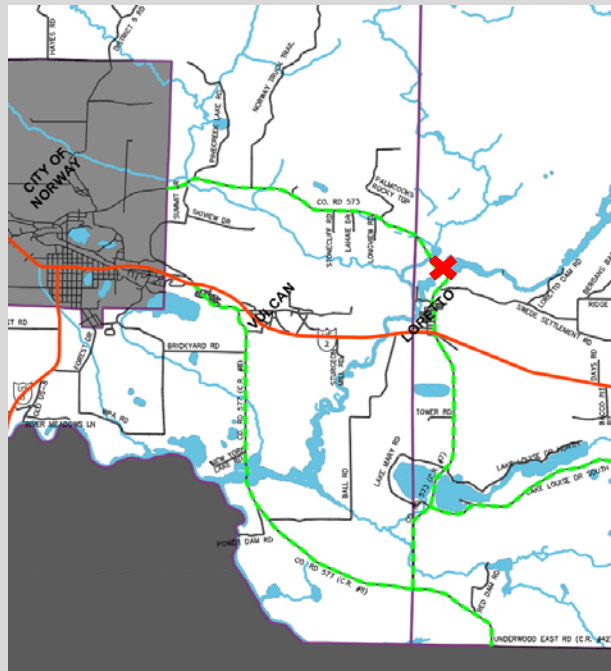


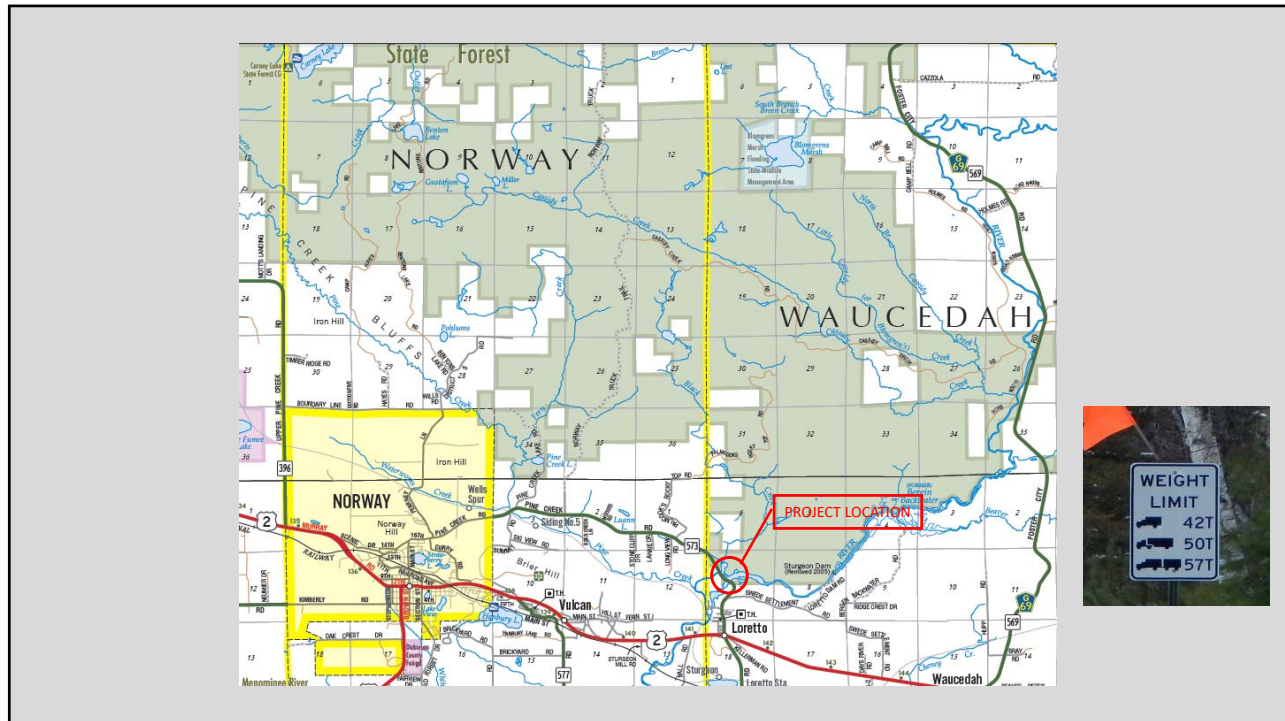
COUNTY ROAD 573 OVER THE STURGEON RIVER BRIDGE REHABILITATION
PROJECT, STRUCTURE 2194
In Dickinson County, Michigan



County Road 573 over the Sturgeon River

- County Road 573 runs from the City of Norway to County Road 577 and 577 south into Menominee County.
- It was the main road in the area, originally constructed prior to most of the state and federal highways in the area.
- It is a rural road with many farms along it.
- It is the logical route for the timber industry to get logs from the interior of Dickinson County to US-2 and beyond.
- With the bridge load posted, all logging trucks, agricultural loads, etc. are forced to travel through downtown Norway.

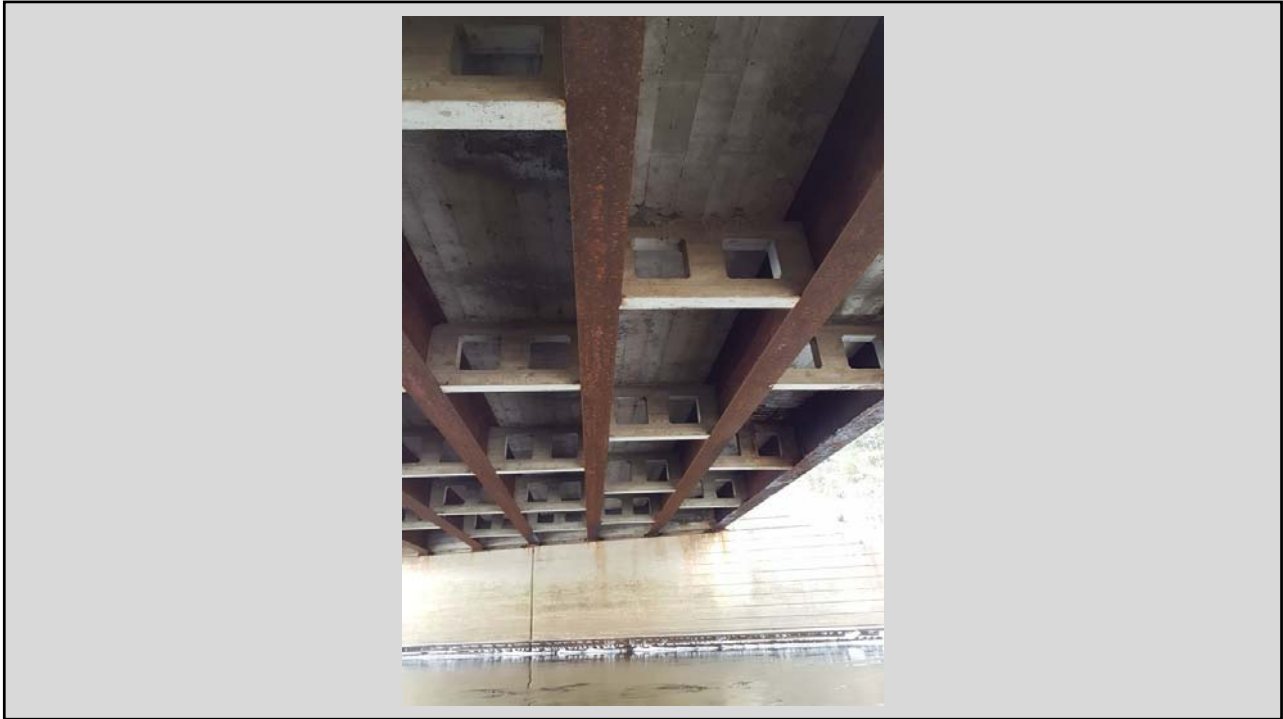




County Road 573 over the Sturgeon River

- Highway Bridge 573 over the Sturgeon River was constructed in 1945.
- It is a single span, steel beam superstructure with a concrete deck.
- There are seven W30x108 beams spanning approximately 55 feet supporting a 6 ½ - inch thick concrete deck.
- Minimal work since original construction
 - Only project- 2001 guardrail upgrades and remove and replace the asphalt surface as part of a roadway paving project







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BRIDGE ANALYSIS GUIDE**

load rating. This would include items such as beam flange or web section loss, deck deterioration, substructure unit section loss or being out of plumb.

In the final instance, a permit application may have been submitted for an overload vehicle to travel over a particular bridge or series of bridges along a proposed route. If a bridge has not been analyzed previously for this particular overload, that task must be completed before a answer to the permit application can be returned.

All load ratings should be performed based on the result of a recent inspection of the bridge and where possible the design and/or as-built plans for the structure must be reviewed.

Michigan's Heavy Trucks.

A key feature of Bridge Load Ratings in Michigan is the inclusion of all Michigan legal loads. Michigan law allows the use of trucks that far exceed the federal limit of 80,000 lb. Maximum total weights are not directly controlled by Michigan law; however, weights are indirectly controlled by a combination of maximum legal vehicle lengths, maximum legal axle loads and axle spacing. The combined effect of those items yields legal trucks that can weigh as much as 164,000 lb. Individual axle loads and tandem axle loads have a variety of legal limits based on spacing, but the overall maximums are limited to the federal limits for axle weights.

While it should be noted that a small percentage of commercial vehicles in Michigan operates at greater than the federal limit of 80,000 lb, the concentration of these heavy vehicles varies widely throughout the state. Some rural locations may rarely see a vehicle greater than 80,000 lb, while other areas, such as near an aggregate pit or manufacturing facility may experience frequent passage of heavy vehicles. As noted above, Operating Ratings are to be performed with the inclusion of all Michigan legal loads.

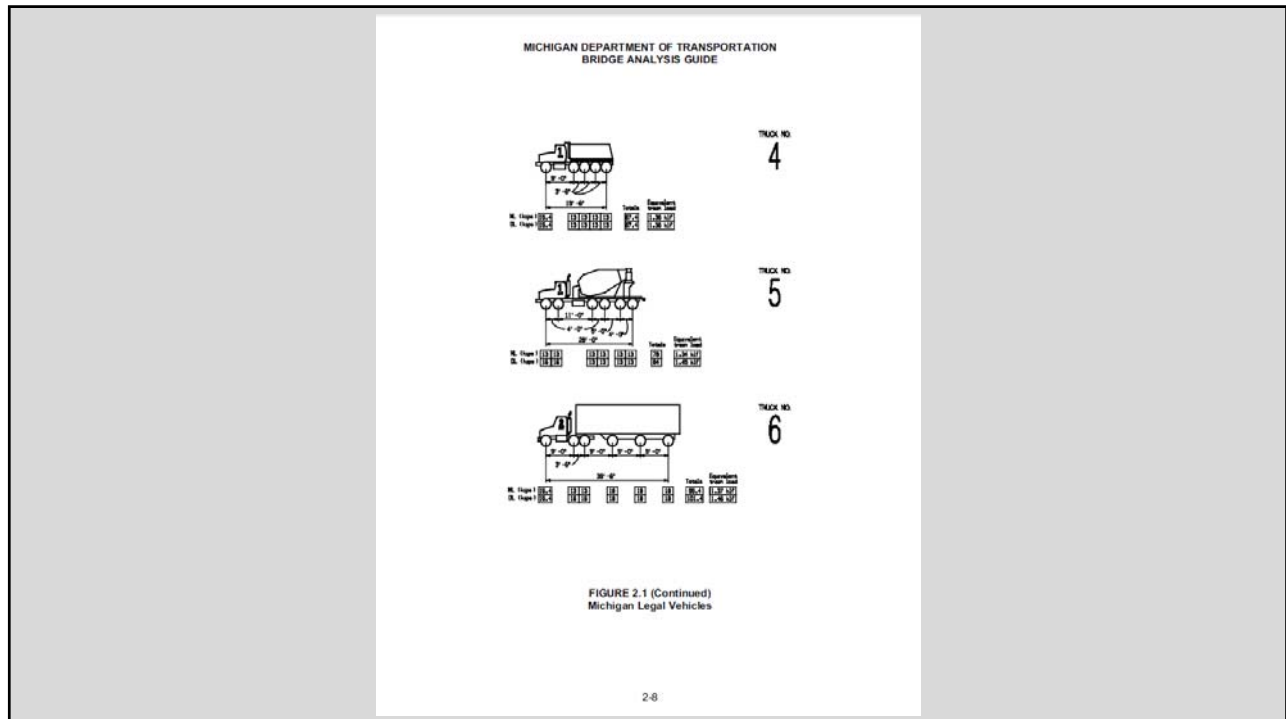
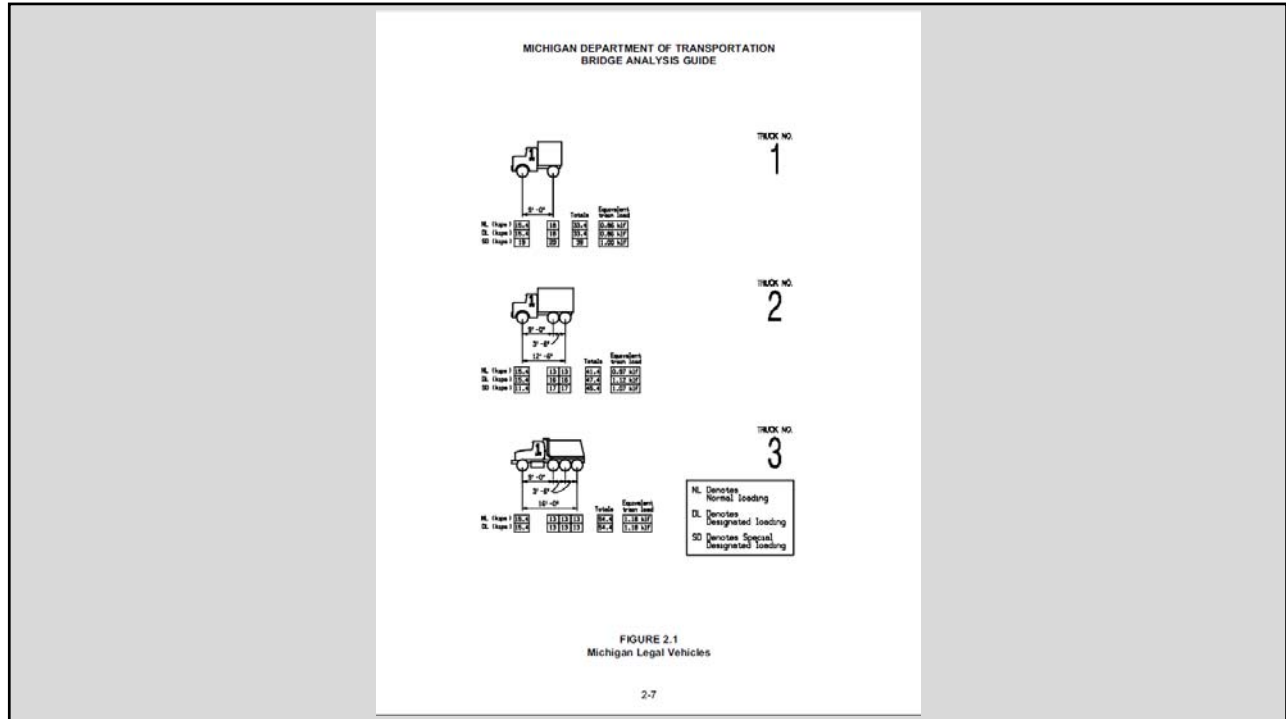
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Michigan Legal Vehicle Load Factors for Strength Limit States, 1000 ADTT						
Truck	Normal Loading		Designated Loading		Special Designated Loading	
	GWW (kips)	γ_{LL}	GWW (kips)	γ_{LL}	GWW (kips)	γ_{LL}
1	33.4	1.65	33.4	1.65	33.4	1.65
2	41.4	1.65	47.4	1.65	49.4	1.65
3	54.4	1.65	64.4	1.65	64.4	1.65
4	67.4	1.65	67.4	1.65	67.4	1.65
5	78.0	1.65	84.0	1.65	84.0	1.65
6	95.4	1.57	101.4	1.51	101.4	1.51
7	113.4	1.40	119.4	1.36	119.4	1.36
8	85.4	1.65	91.4	1.61	91.4	1.61
9	51.4	1.65	51.4	1.65	49.5	1.65
10	59.4	1.65	65.4	1.65	65.4	1.65
11	77.4	1.65	83.4	1.65	67.1	1.65
12	111.4	1.42	117.4	1.37	117.4	1.37
13	119.4	1.36	125.4	1.32	125.4	1.32
14	132.4	1.28	132.4	1.28	132.4	1.28
15	137.4	1.25	143.3	1.22	143.3	1.22
16	132.4	1.28	138.4	1.25	138.4	1.25
17	145.4	1.21	151.4	1.19	151.4	1.19
18	149.0	1.20	154.0	1.18	154.0	1.18
19	111.4	1.42	117.4	1.37	117.4	1.37
20	87.4	1.65	87.4	1.65	87.4	1.65
21	145.4	1.21	151.4	1.19	151.4	1.19
22	155.4	1.17	161.4	1.15	161.4	1.15
23	145.0	1.20	154.0	1.18	154.0	1.18
24	116.0	1.38	122.0	1.34	122.0	1.34
25	158.0	1.16	164.0	1.14	164.0	1.14
26	80.0	1.65	80.0	1.65	80.0	1.65
27	72.0	1.65	72.0	1.65	72.0	1.65
28	80.0	1.65	80.0	1.65	80.0	1.65

Table 4a-2

4a-7



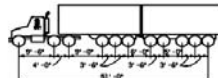
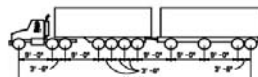


FIGURE 2.1 (Continued)
Michigan Legal Vehicles

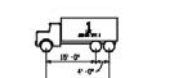
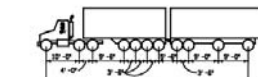
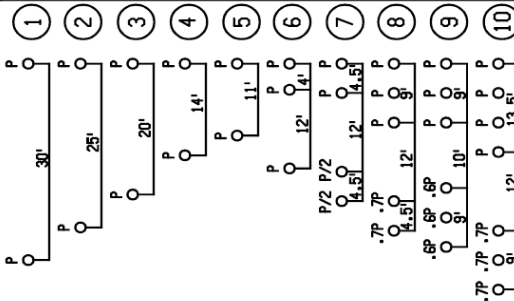
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FIGURE 2.1 (Continued)
Michigan Legal Vehicles

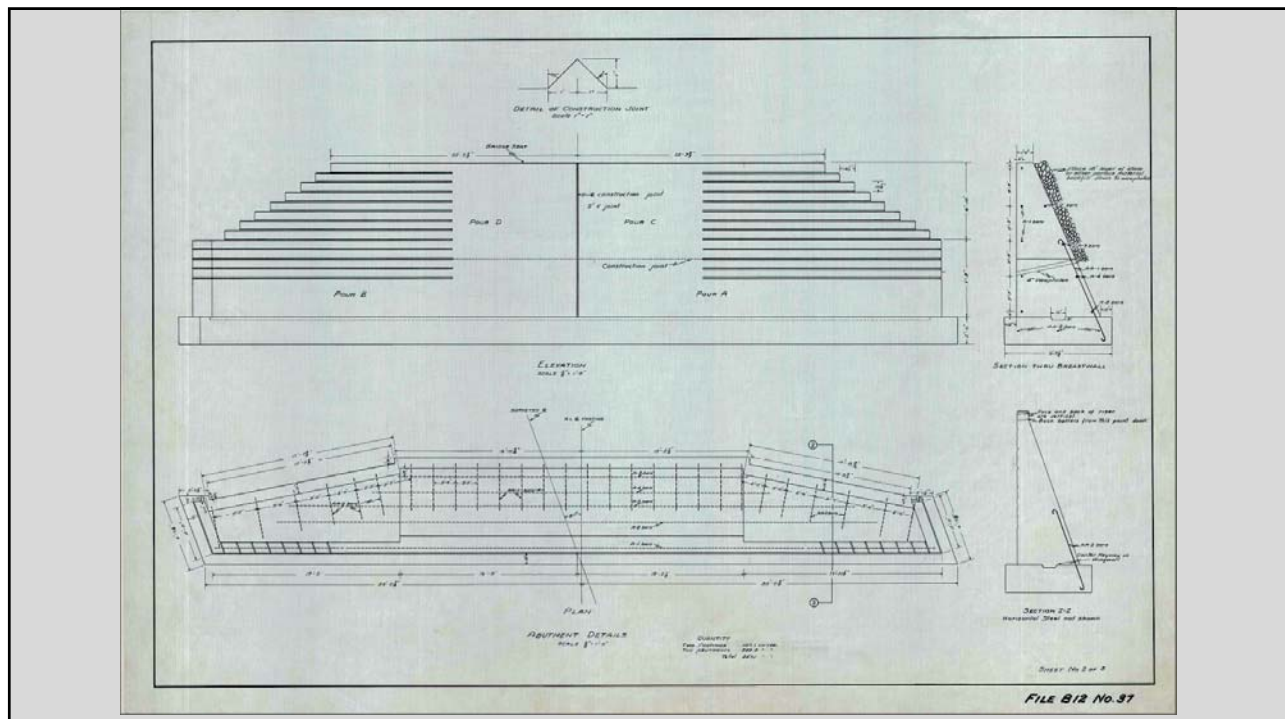
MICHIGAN DEPARTMENT OF TRANSPORTATION BRIDGE ANALYSIS GUIDE

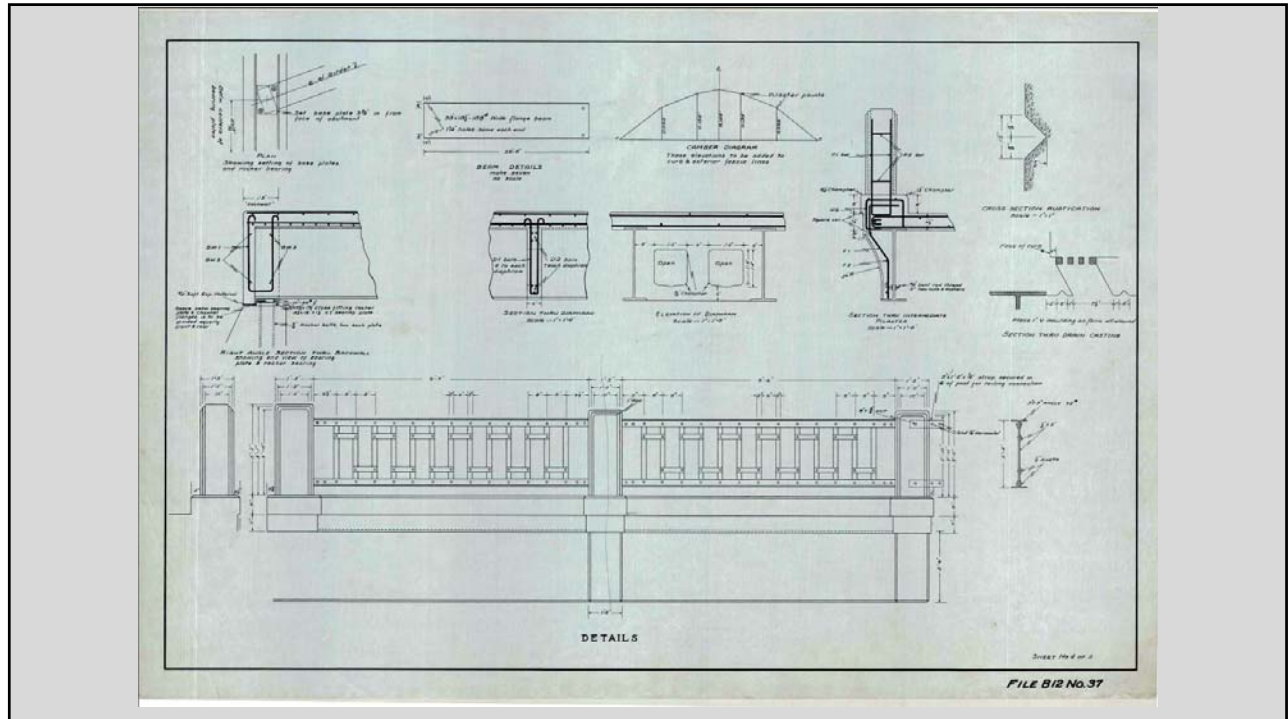
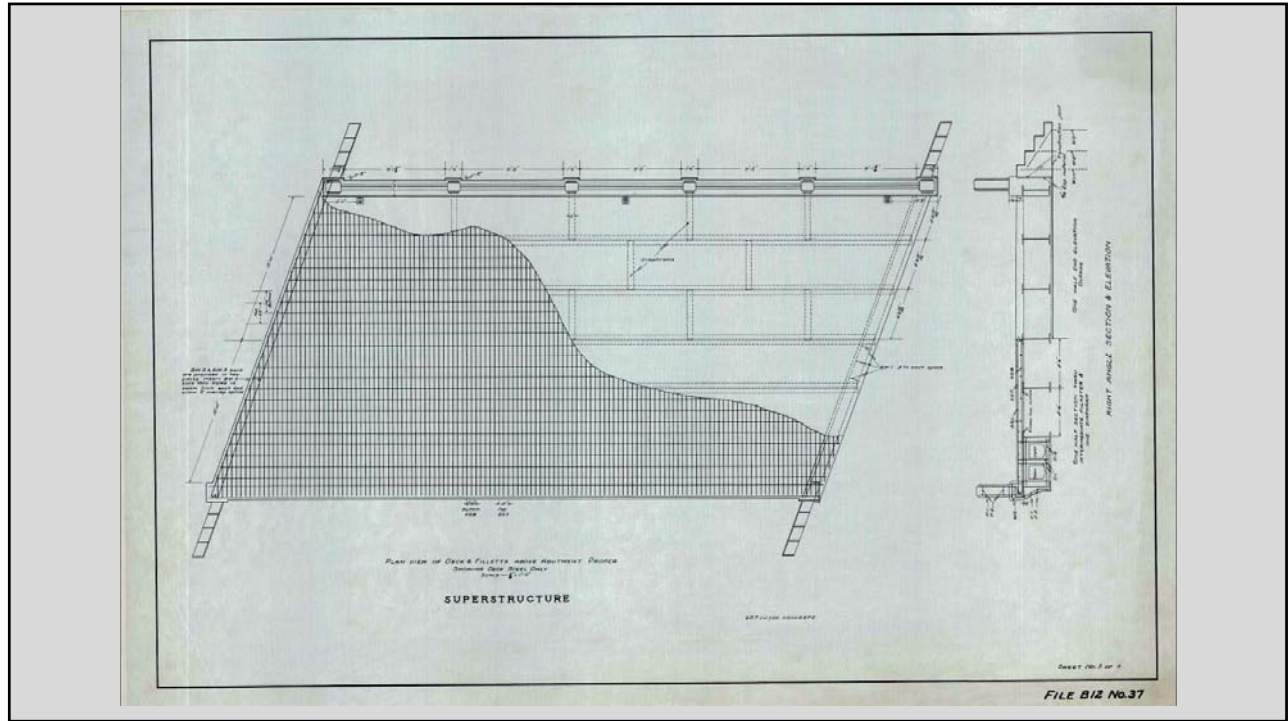
PERMISSIBLE AXLE LOADS (P) ¹					
CLASS A**		CLASS B**		CLASS C**	
Axle (kips)	Gross (tons)	Axle (kips)	Gross (tons)	Axle (kips)	Gross (tons)
60	60	60	60	60	60
60	60	60	60	60	60
60	60	59	59	57	57
60	60	54	54	49	49
60	60	52	52	44	44
42	63	36	54	30	45
46	69	38	57	31	46.5
34	74.8	29	63.8	24	52.8
33	79.2	27	64.8	22	52.8
29	88.5	24	73.2	20	61



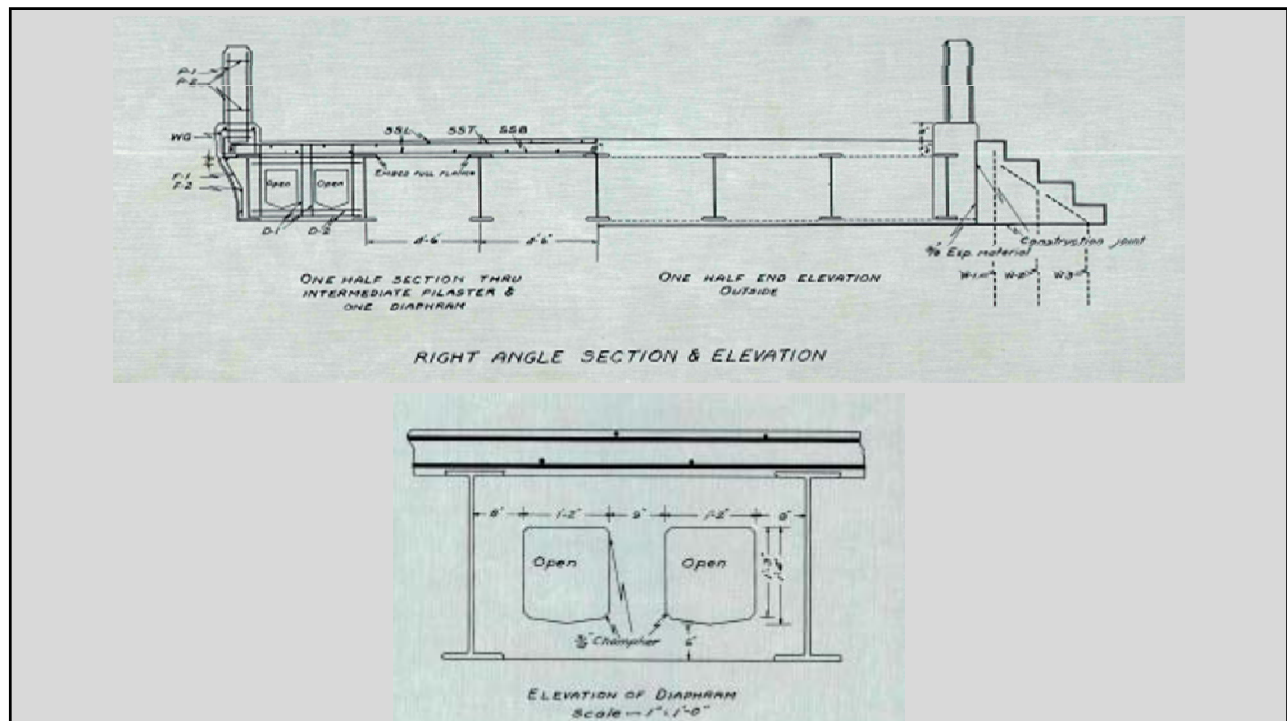
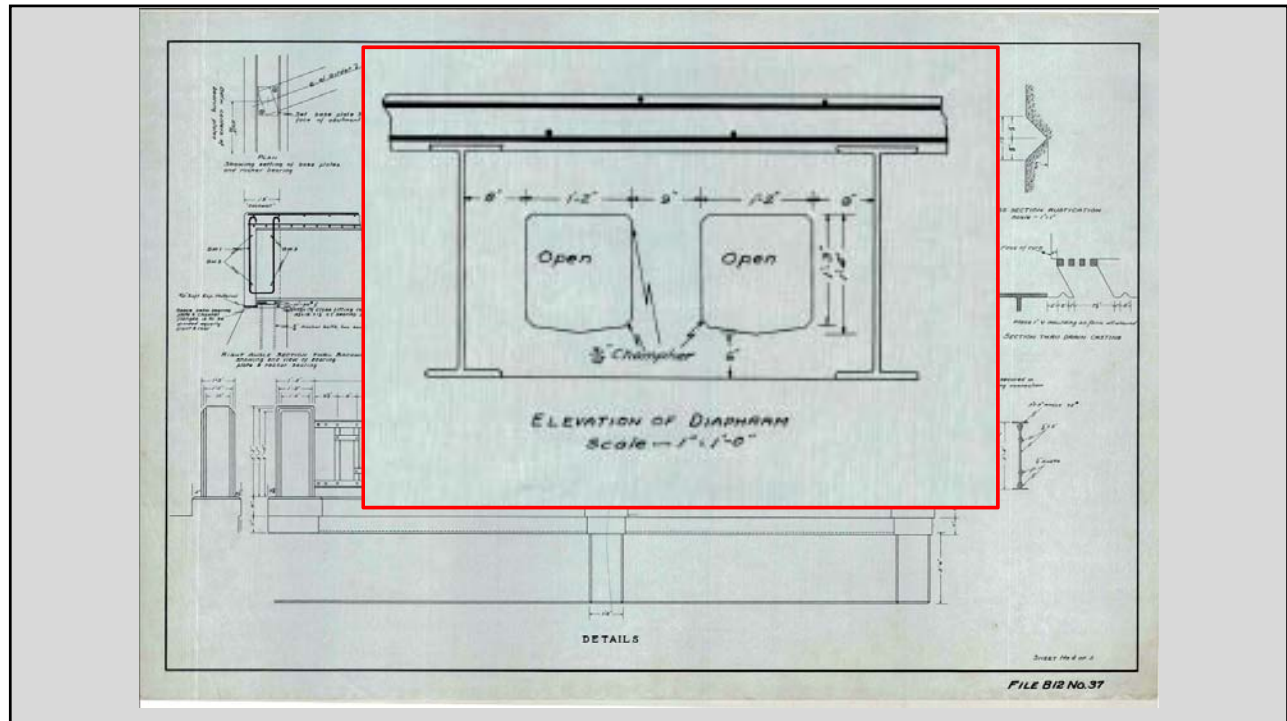
Project History

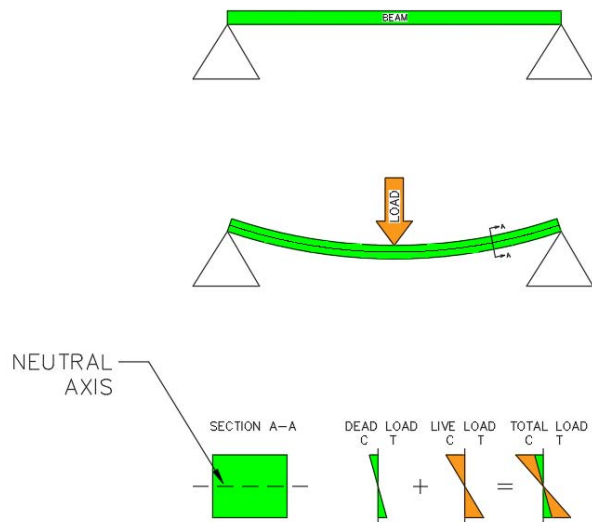
- After the 2014 bridge ratings, the question was asked why various county bridges were load rated.
- Many had as the reason deteriorated girder, rotting wood abutments, etc.
- But not CR 573 over the Sturgeon River. This bridge was different.
 - No noticeable materials deficiency
 - It was the design

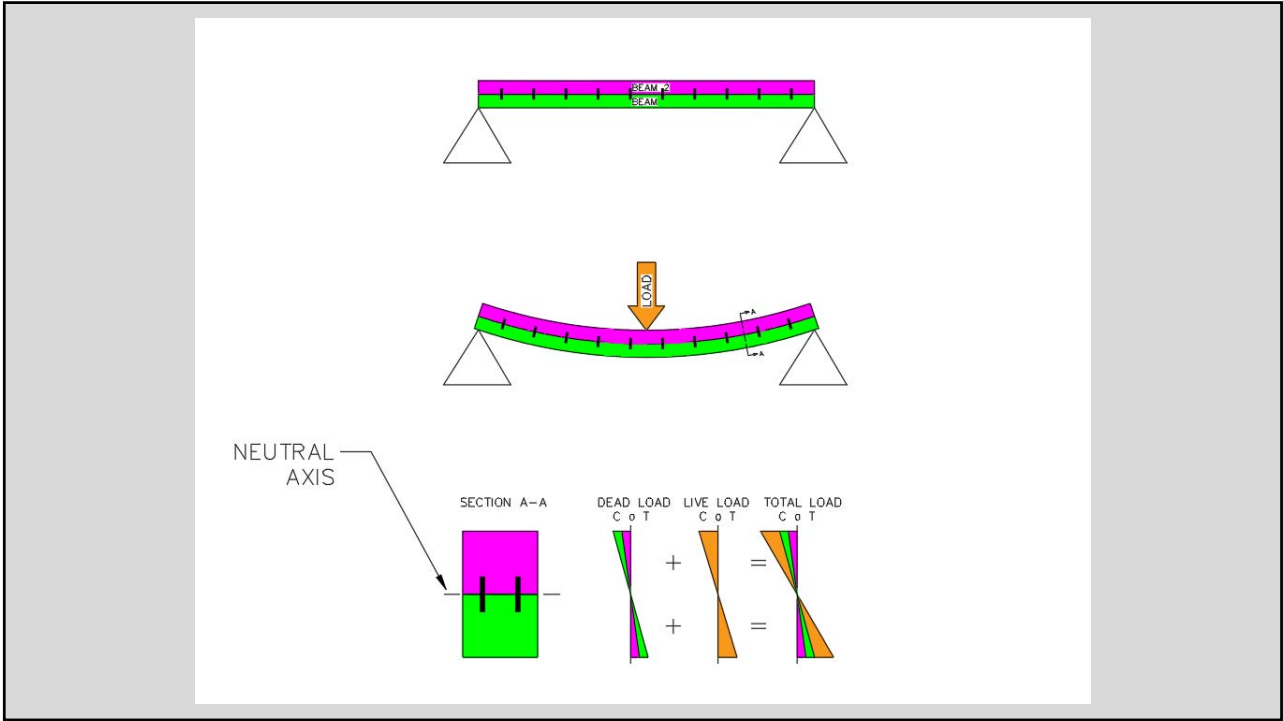
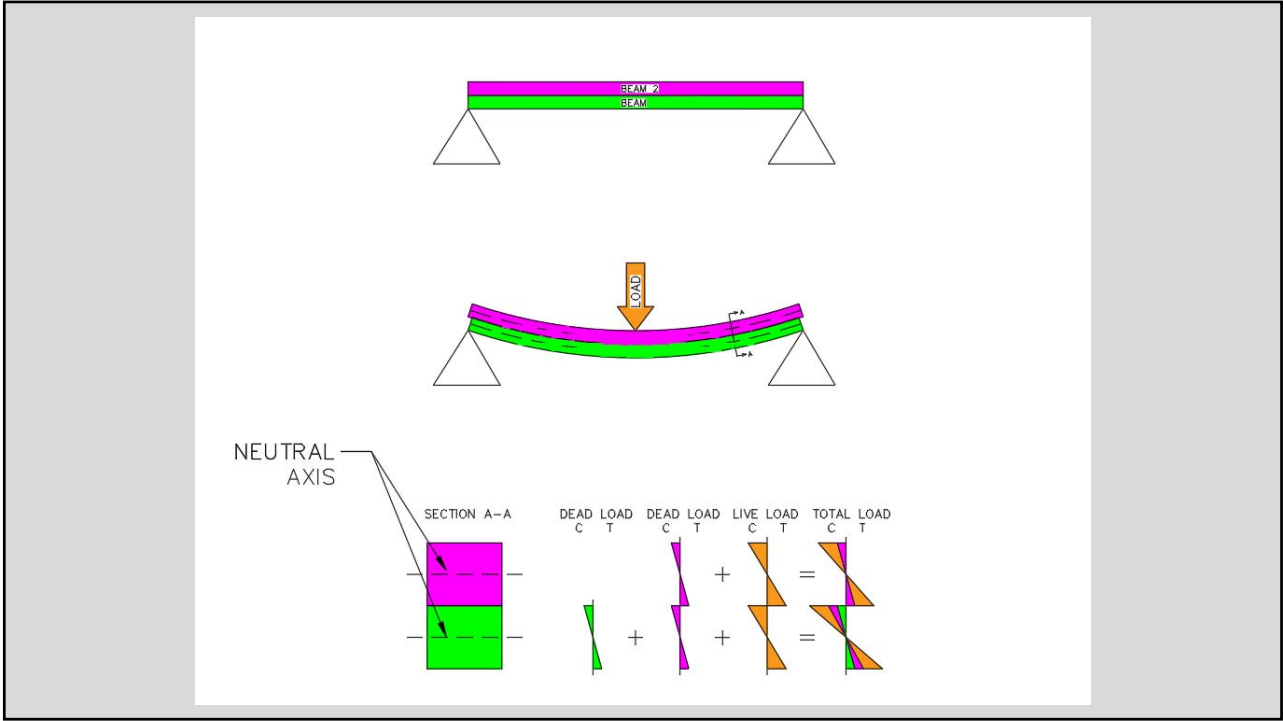


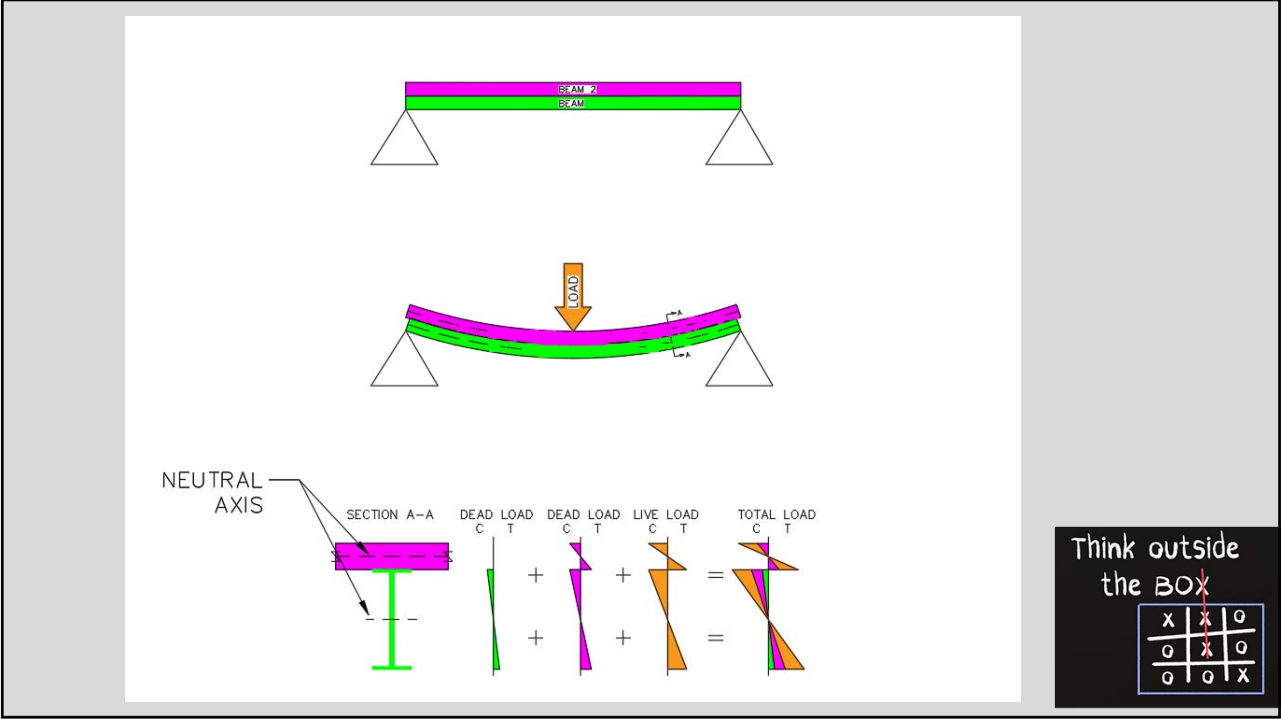






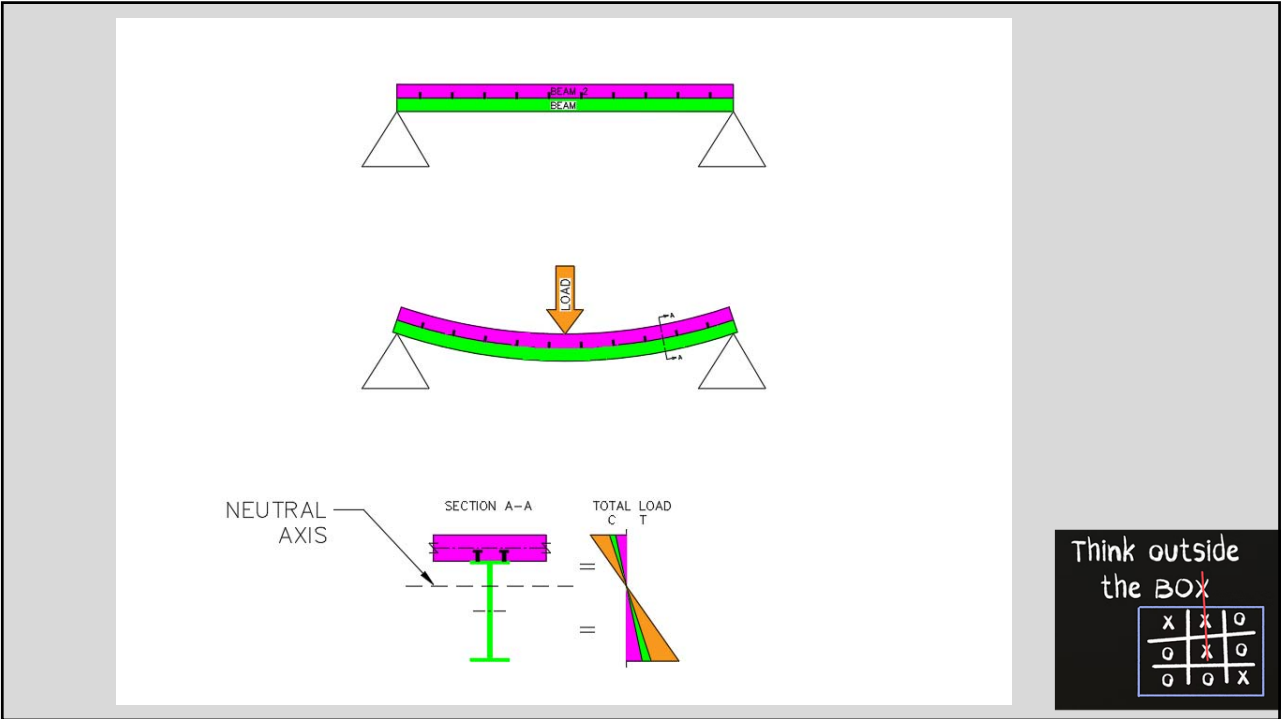






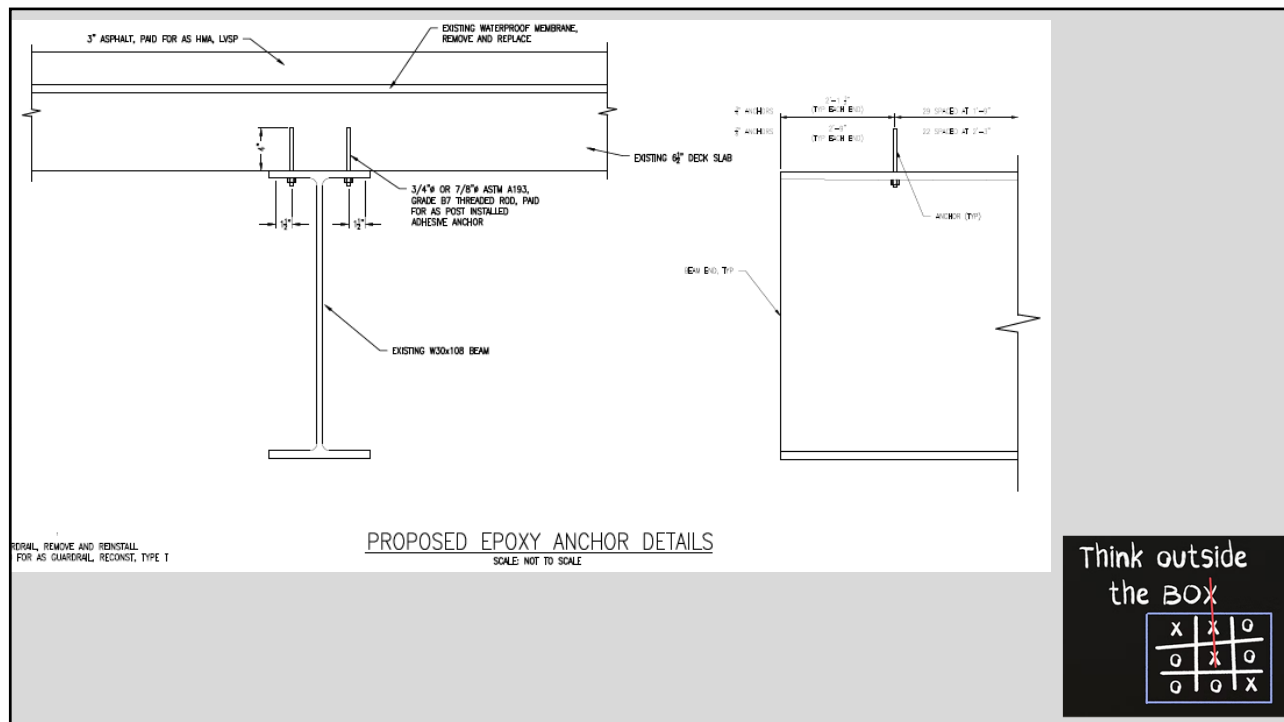
Think outside
the BOX

x	x	o
o	x	o
o	o	x



Think outside
the BOX

x	x	o
o	x	o
o	o	x



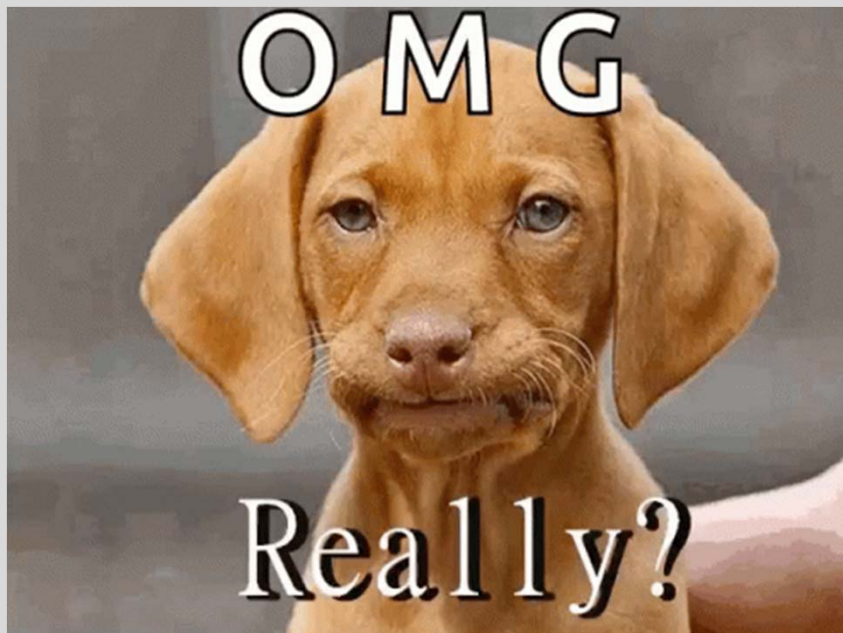
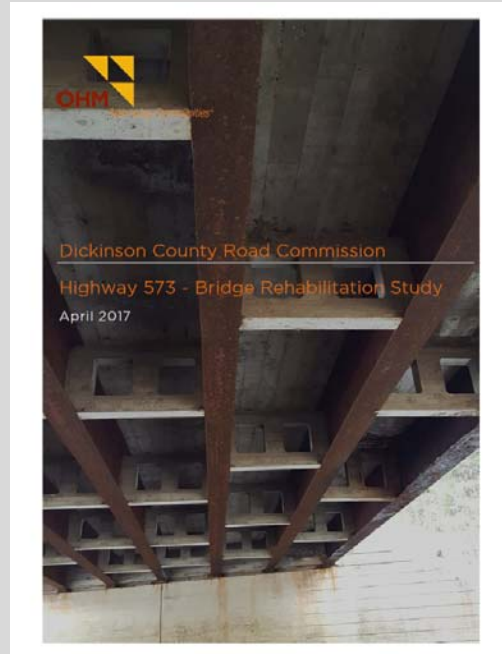
Project History

- The Dickinson County Road Commission saw it was just the shear studs missing, and asked why can't we add them and increase our load capacity?
 - Why can't we drill into the concrete add them?
- The road commission tried to get other opinions from consultants and others on retrofitting in shear studs.
 - Everyone said no, its not worth it. Tear down the bridge and rebuild it. Then you will have the load capacity to carry the log trucks
- But putting the numbers to it a new bridge was expensive.
 - Seemed like drilling in some studs would be cheaper. Also, a new bridge would need lots of permitting. There was a discussion the adding studs might be able to be a maintenance thing and not need all the permitting as not changing the weir flow, bottom cord elevation, waterway opening, or anything.

Project History

- In 2016, OHM came on board in support of the project
 - They saw this a something new and innovative.
- Funding was secured in 2018 (critical bridge)
- Bids were taken on 6/4/2021
 - And

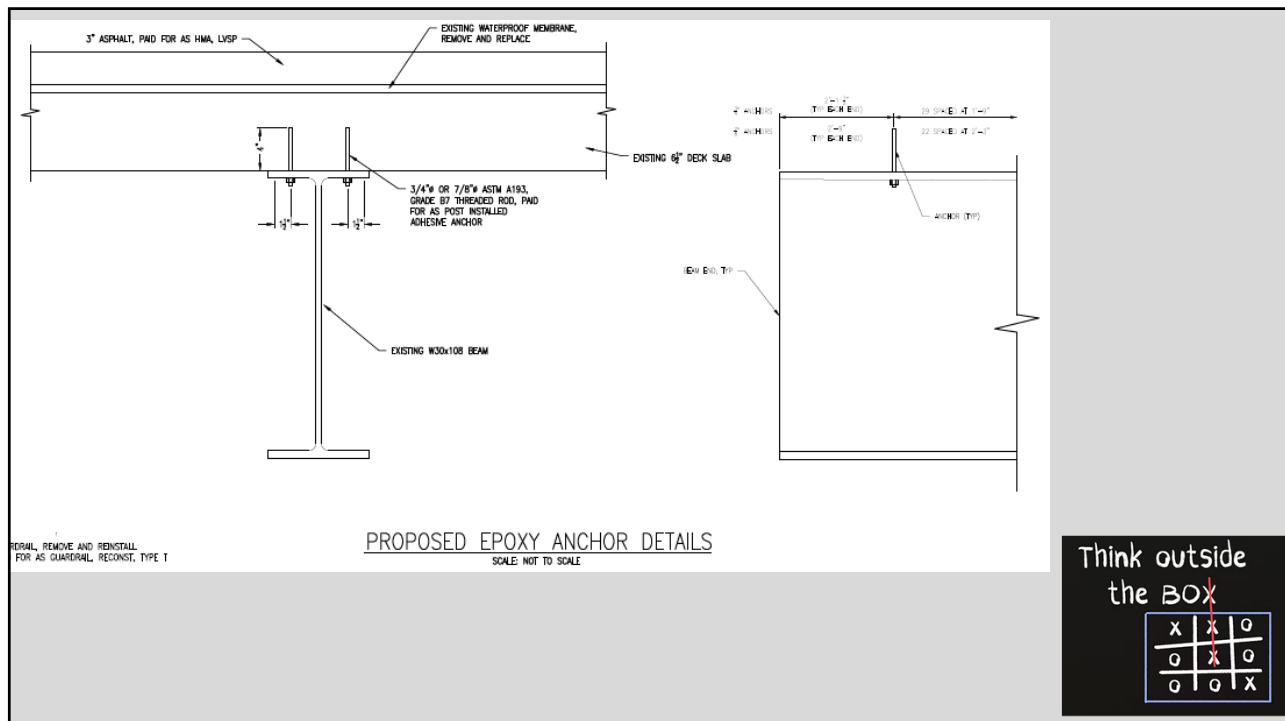
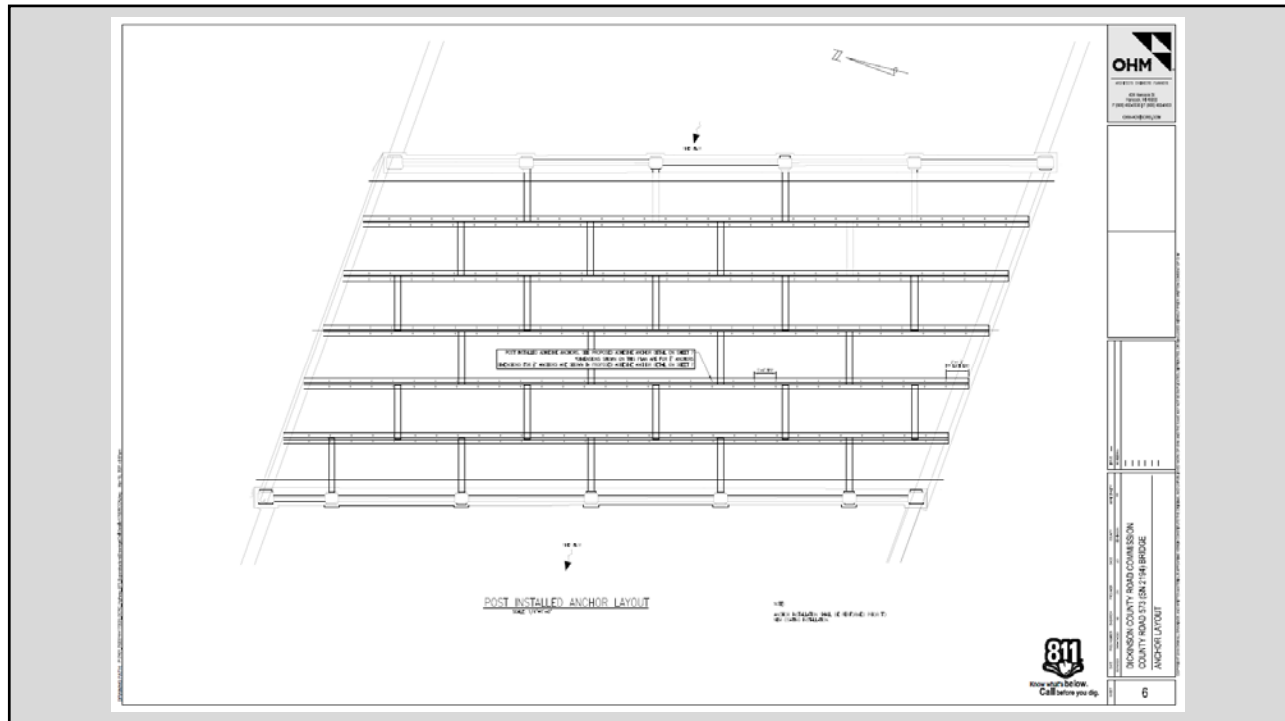
➤ **NO BIDS!!!!**





Project History

- Of course, we wanted to bid it again.
 - It is unethical to bid the same thing twice
 - Nothing to change the in the project. The only idea was adding some roadwork.
 - but estimates were over budget so adding more work was a no.
- In the same letting we had another bridge project –CR 577 over Sturgeon River
 - Catch was it was done with a different consultant- Coleman Engineering.
 - Only 1 bid which was 122.16% over the estimate on this bridge.
 - Didn't want to rebid that as fear prices would only go up.
- The idea was floated to combine the 2 bridges into a single bid.
 - Surprisingly, everyone agreed to do this
 - On February 4, 2022, the combined project had a bid opening.
 - This time 2 bids and the project went forward



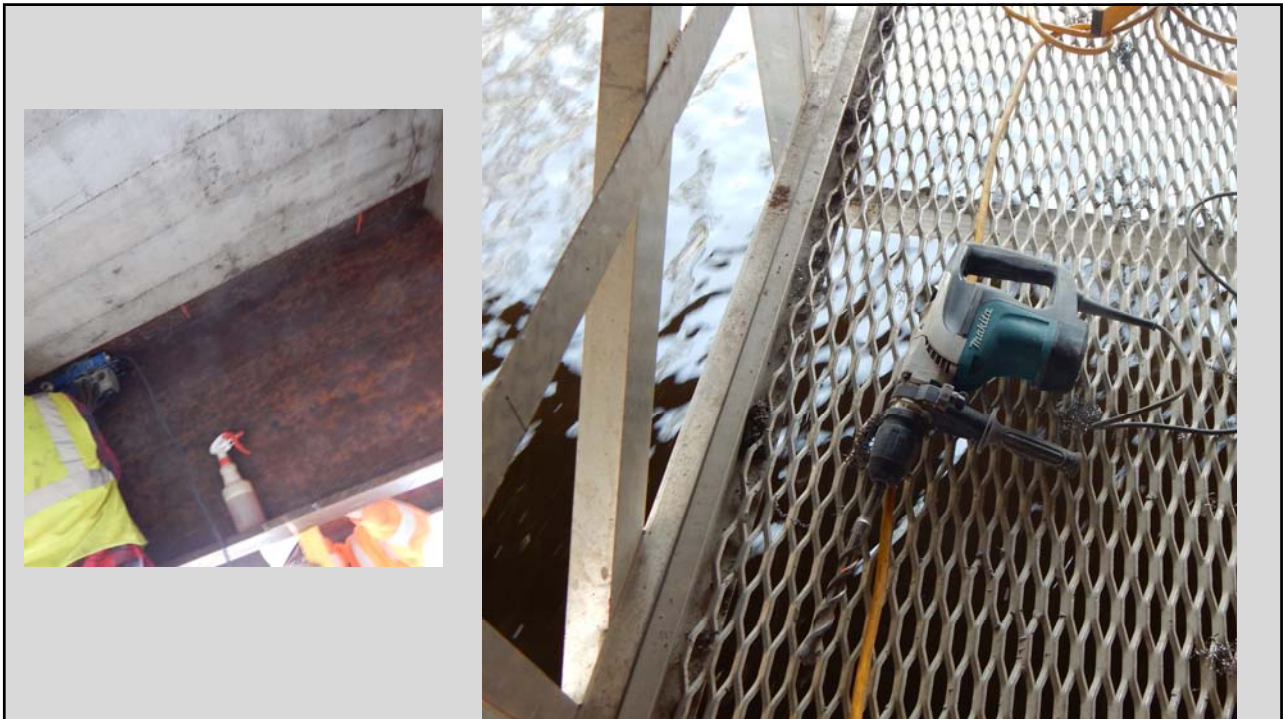
OHM
 PROJECT: COUNTY BRIDGE
 PROJECT NO.: 2020-001
 COUNTY ROAD 308 IN THE BRIDGE
 ANCHOR LAYOUT

Think outside
the BOX

x	x	o
o	x	o
o	o	x

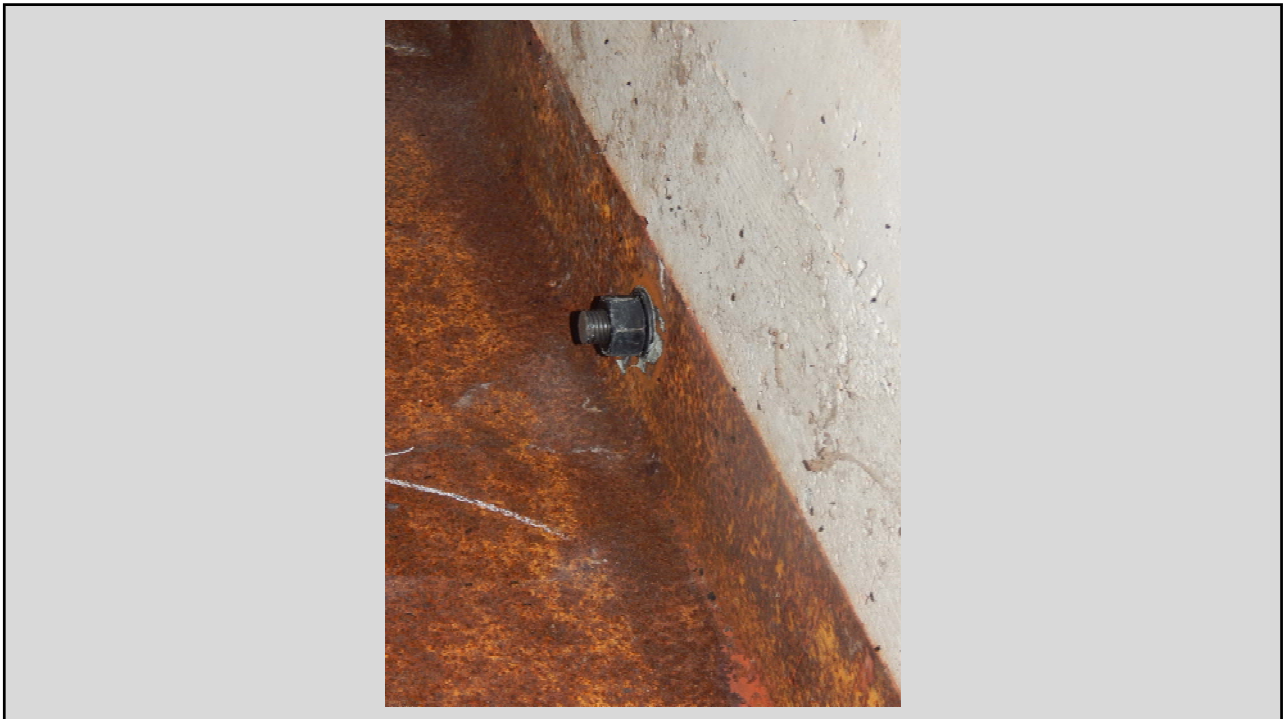
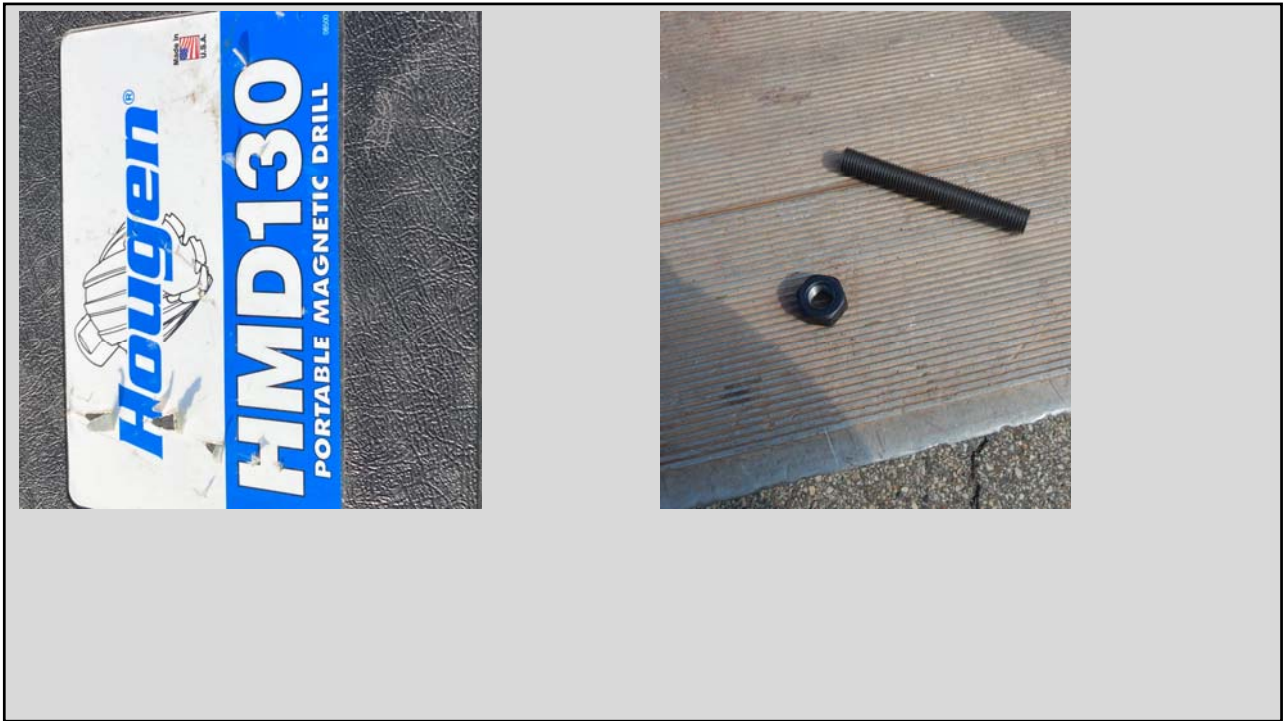
Think outside
the BOX

x	x	o
o	x	o
o	o	x





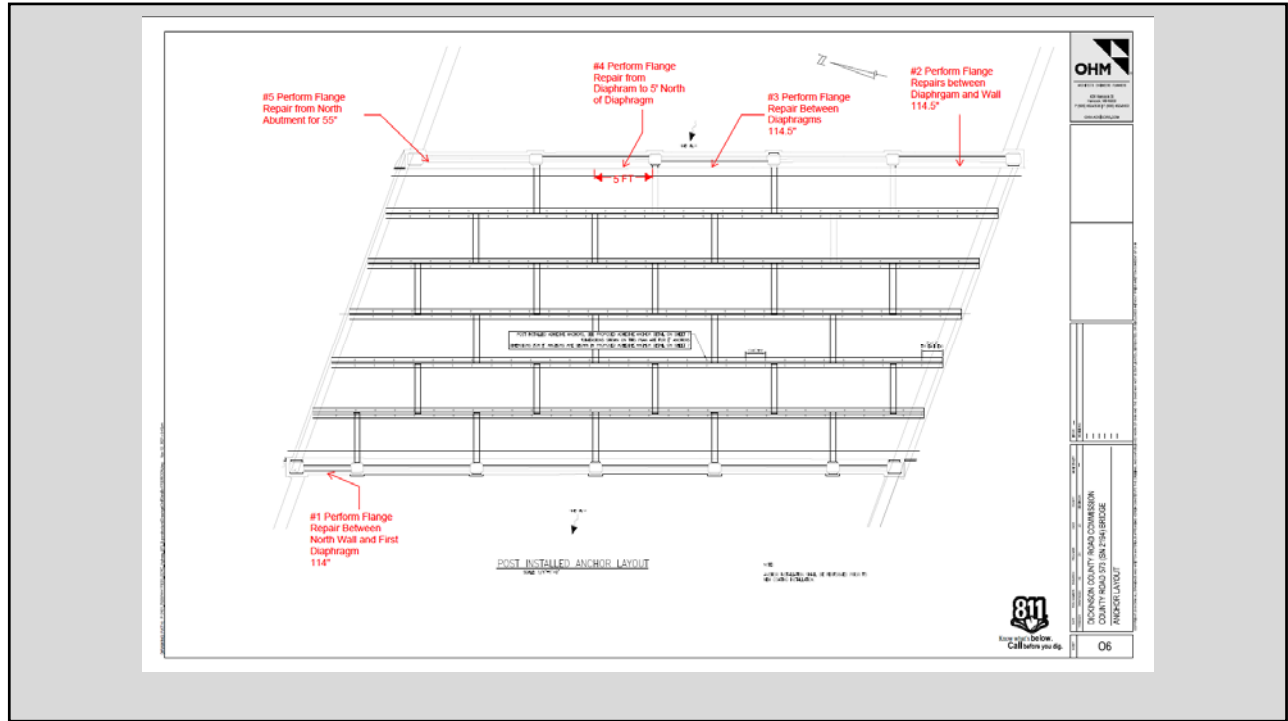












Conclusions

- Post construction shear studs is a way to improve load rating in select bridges.
 - Load rating went from 42 ton (1 unit), 50 ton (2 unit), 57 ton (3 unit) to 42 ton, 77 ton, 82 ton and allow Class A overload

Conclusions

- Post construction shear studs was far less expensive than a new bridge.
 - Actual project cost \$604,592.50 (\$407,505.90 structure, \$196,966.60 road)
 - Project also included some deep and shallow deck patching, remove and replace asphalt wearing surface with membrane, some structure steel repairs, and some guardrail repairs.
 - New bridge estimate at time of grant application (2017) was \$956,000
 - Using current pricing (2022) new bridge estimate is \$1,428,934 (\$1.4 million)

- We would like to thank our partners in making this happen
 - OHM Advisors, Coleman Engineering, Hebert Construction and MDOT



Questions?



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