Brian P. Keierleber P.E.
Iowa Freight Advisory Council
September 6, 2019

Buchanan County Iowa

BUCHANAN CO.

SECONDARY ROADS

- 259 Bridges over 20’
- 29-Railcar Bridges
- 6-GRA-IBS Abutments
- 2-Cast on Site Slabs
- 1-Press Brake Tub Girder
- 3-UHPC
- 3- Glue –Laminated Bridges
- 3 Internal Curing Concrete Bridges
- Working on UHPC
- Continue Using railcar bridges

Many of our bridges were old

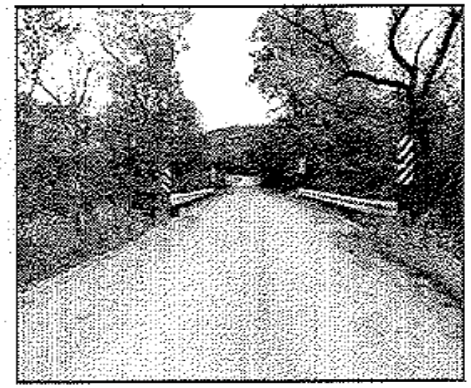
New Construction Costs

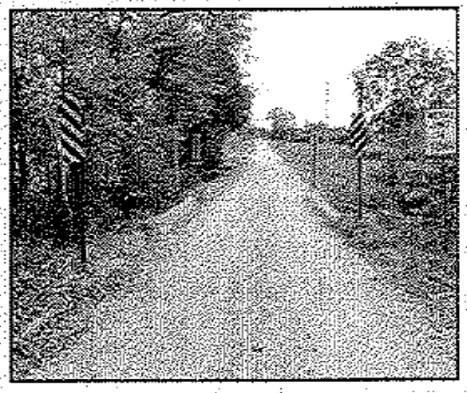
- Receives about $420,000/Yr. for BRS/BROS
- 30x100 slab x $150/sf. or $450,000.

Note the 3 ton posting

a 14 ton weight restriction. Sheriff’s officials say the semitrailer was 29 tons over that limit.

The driver, who was not injured, faces an $11,400 overload fine.
Officials say it will cost as much as $1 million to replace





Kansas
Department of Transportation

ECONOMIC IMPACT OF CLOSING LOW-VOLUME RURAL BRIDGES

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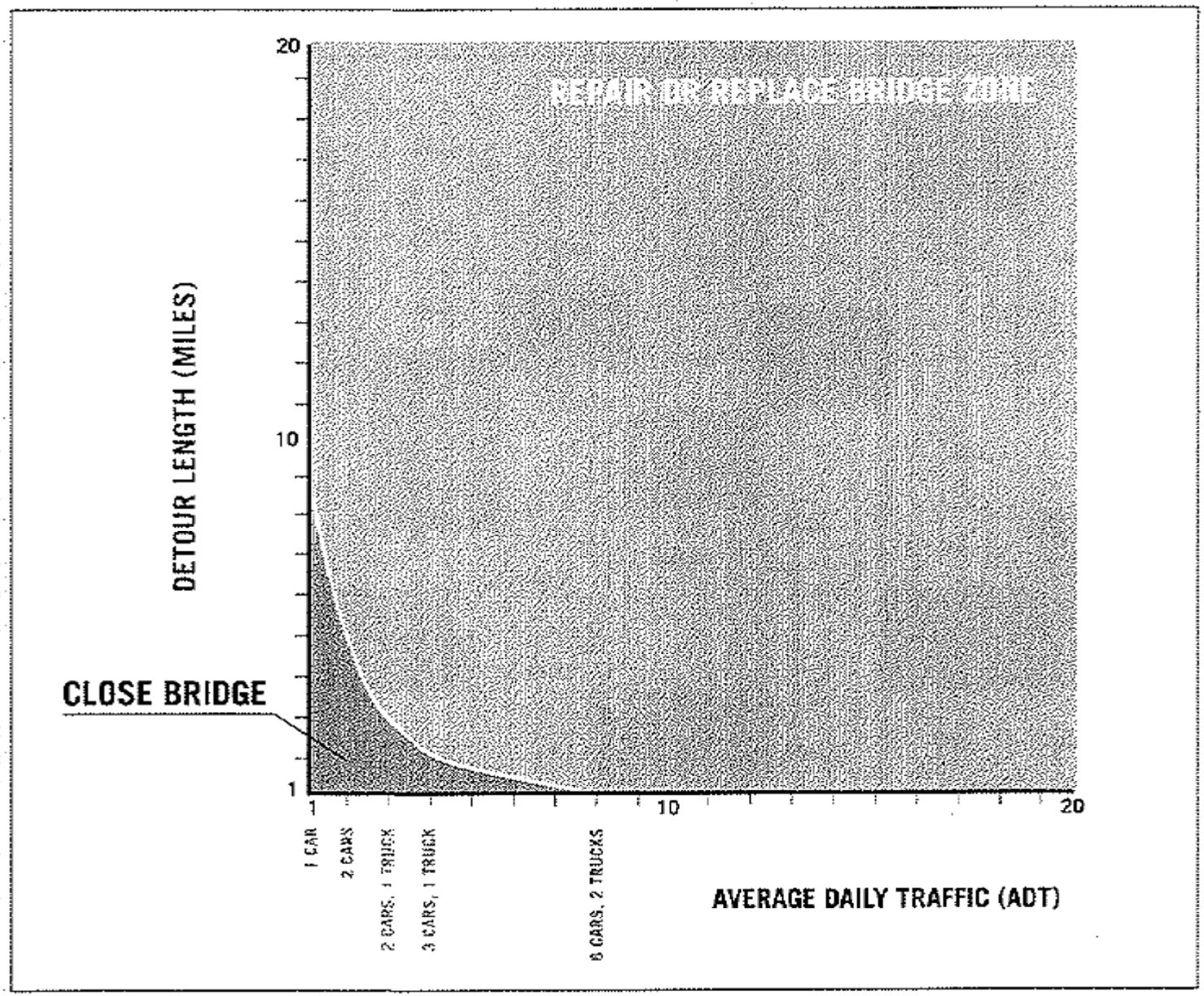


FIGURE 3. DETERMINING BRIDGE CLOSURE / REPAIR / REPLACE BASED ON ADT AND DETOUR LENGTH

Asphalt Over Concrete

Simplified Deck Overlaying

Over Time the backwall kicks out

A LONG TERM Solution

Current Repair Method

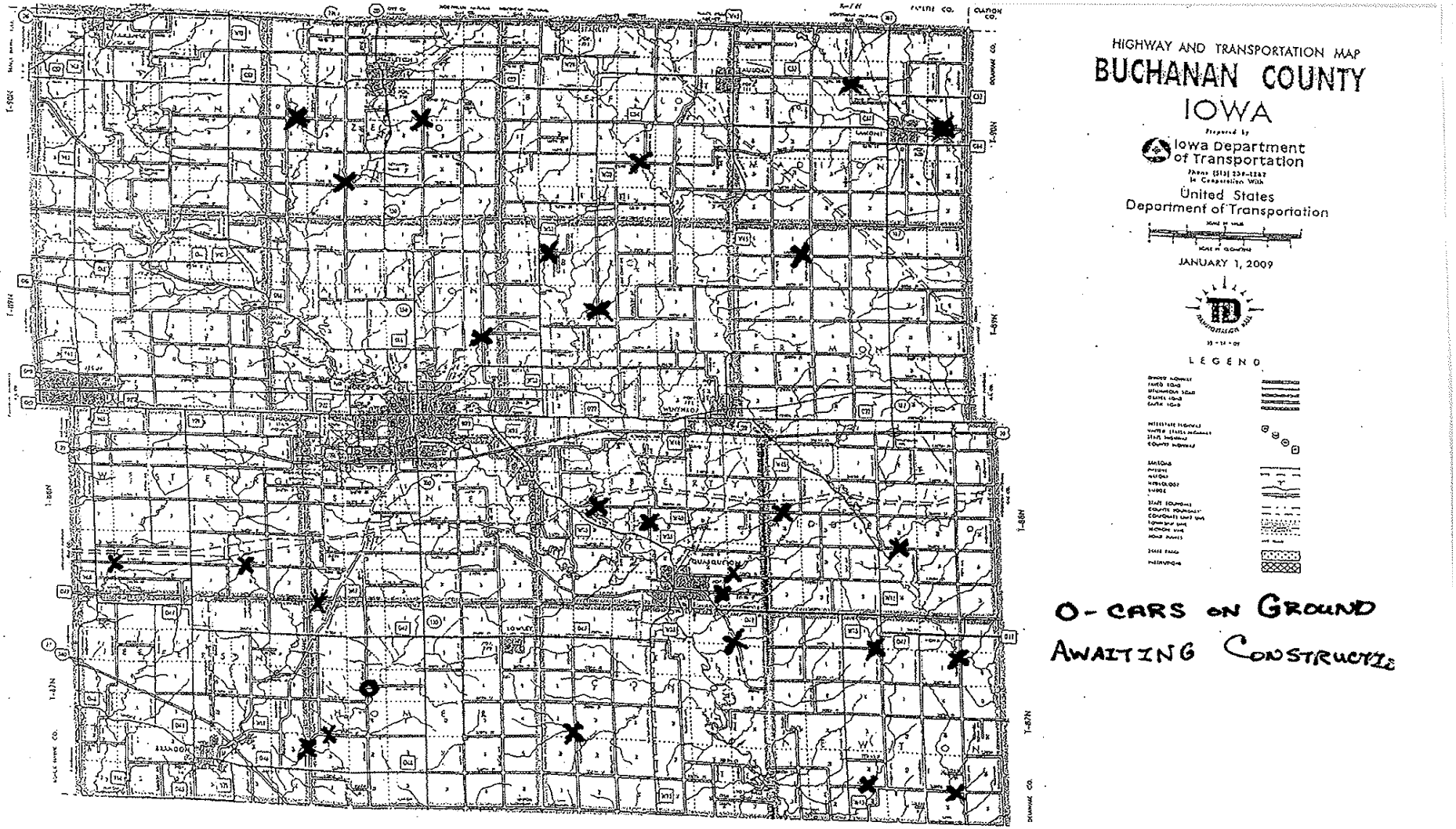
Encase to Beams $12,000+materials

Pier encasement

Sometimes there are no GOOD repairs

We have constructed 3 with open grated decks

We have constructed 29 Bridges from Railroad Flatcars



What Do They Look Like?

What They Look Like To Us

Flatcars Not Boxcars

68 Ft Railcar

89 Ft. Flatcars require a pier

Load Capacity

Figure 2. BCB5 RRFC Bridge Test (May 11, 2006)

- All our Bridges Carry LEGAL LOADS

Iowa State University has Load Tested all of our RRFC Bridge Designs

Figure 1. BCB5 RRFC Bridge Test Instrumentation (May 11, 2006)

Bowen Laboratory - Railroad Flatcar Bridge Fracture 2

Bowen Lab

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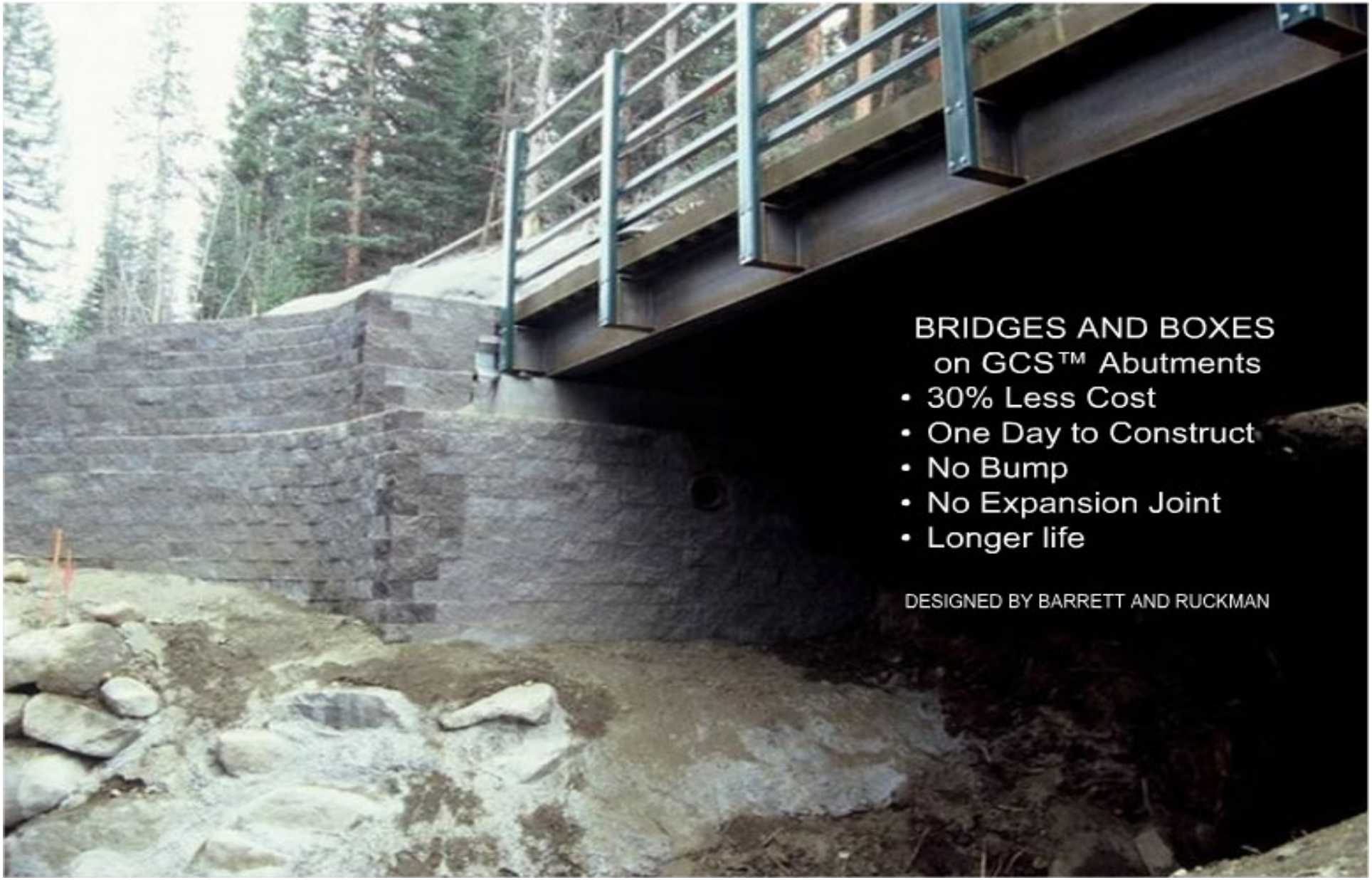
Published on Oct 16, 2013

A full-scale railroad flatcar (RRFC) bridge was constructed in Bowen Laboratory. One objective of the research project was to determine if the system displayed adequate load redundancy after fracturing a primary member. The bottom flange and a portion of both webs of one of BOTH main girders at midspan were fractured under a controlled setting. This video displays the fracture of the second main girder. With BOTH main girders of the RRFC bridge fractured, the bridge was loaded to 190 kips.

UTILIZE NEW TECHNOLOGIES



COMPLETE ONE SIDE

SET SUPERSTRUCTURE

CAST ON SITE SLABS with INTERNAL CURING CONCRETE

Compacted Concrete on GRS

1:1 Slopes

Roller Compacted Bridge Abutment.

Completed Bridge

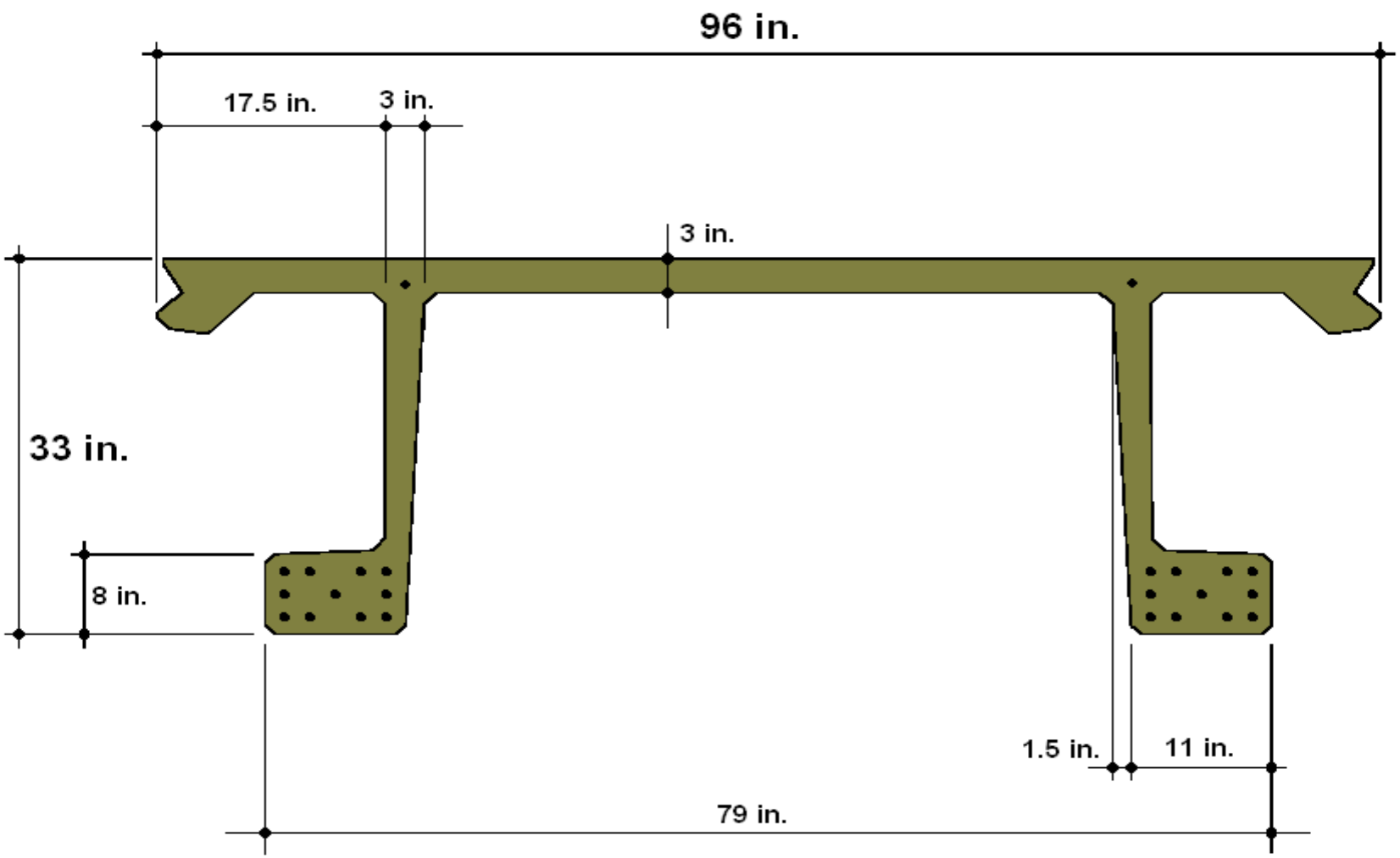
UHPC Bridges Jakway Park 2008

Design and Construction of Hawkeye UHPC Bridge

Timber String/multi-beam or girder
32 x 23.3 (0ºSkew) Built 1899
SR=30 Scour=5
Last Insp: Jan 2015
Next Insp: Jan 2016 (12 mo cycle)

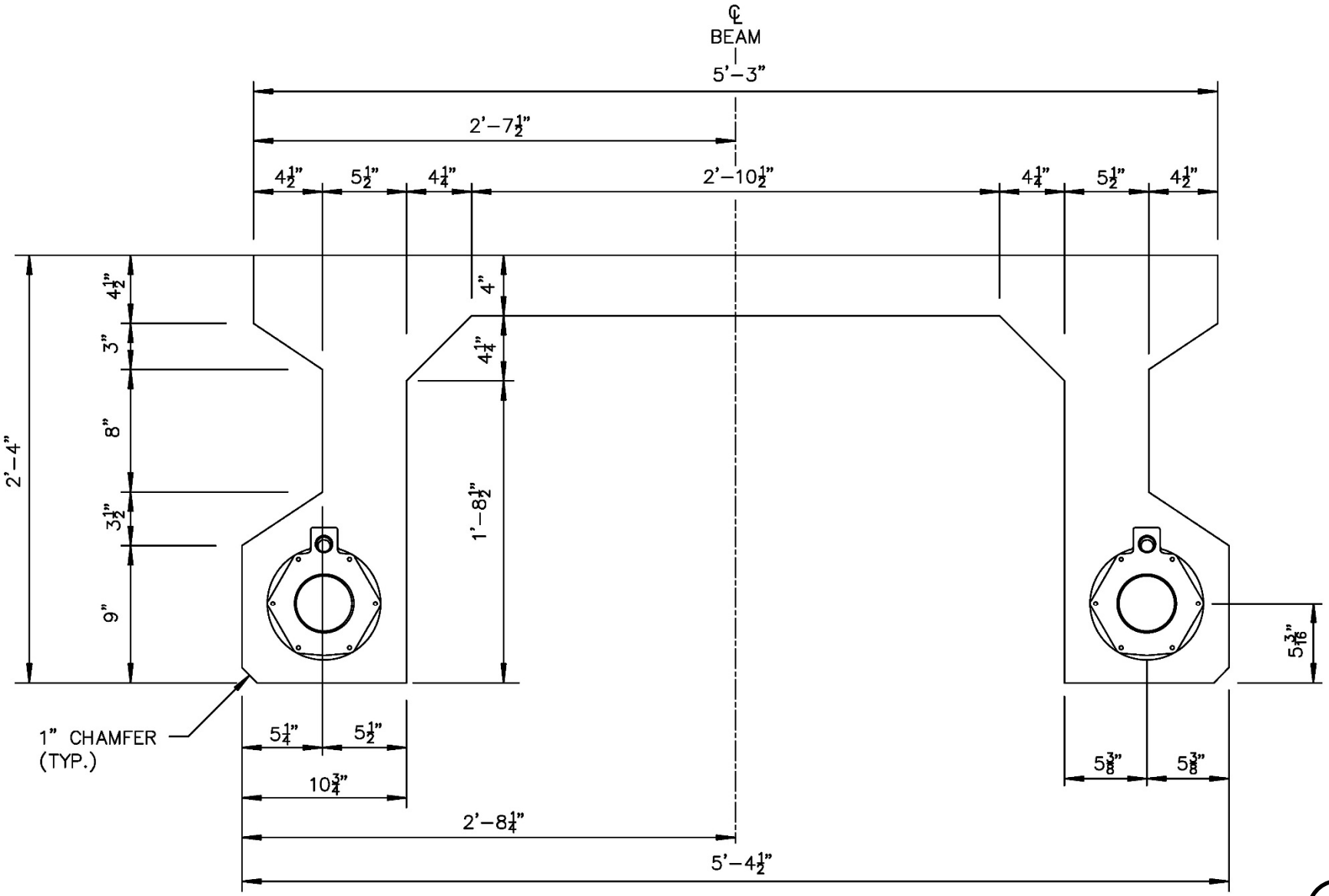
Dr. Joh, Mr. Keierleber, Dr. Kim ,Mr. Davis, Dr. Koh

Testing showed the Initial Designs Failed in Transverse Flexure and Local Stresses



Preliminary PI Girder Test Beam

Korean UHPC Design



Mixing Proportions and Process

Mixing orders	SC180 KICT MIX	Total (lb/5.5CY)	Location	Mixing instruction
1	Pre-mix	4386	County	
2	Cement	7310	Ready Mix Plant	Mix for 10 min
3	Wet Sand (MC = 4.2%)	8041	Ready Mix Plant	Mix for 5 min
4	Water	1710	Ready Mix Plant	Rotate at 10 RPM and move to county shop
5	SRA	73	County	**After adding all liquid additives, Mix for 5 min at 10 RPM then,**
6	Defoamer	5	County	**Mix for 5 min at Maximum speed**
7	Superplasticizer	140	County	
8	Steel Fiber (0.63 inch long)	362	County	Add for 7 min at 10 RPM
9	Steel Fiber (0.78 inch long)	723	County	**Add for 13 min at 10 RPM then, Mix for 2 min. st maximum speed**

Alex Building the forms (Dr. Joh, Dr. Ryu, Haena)

County Constructed Forms

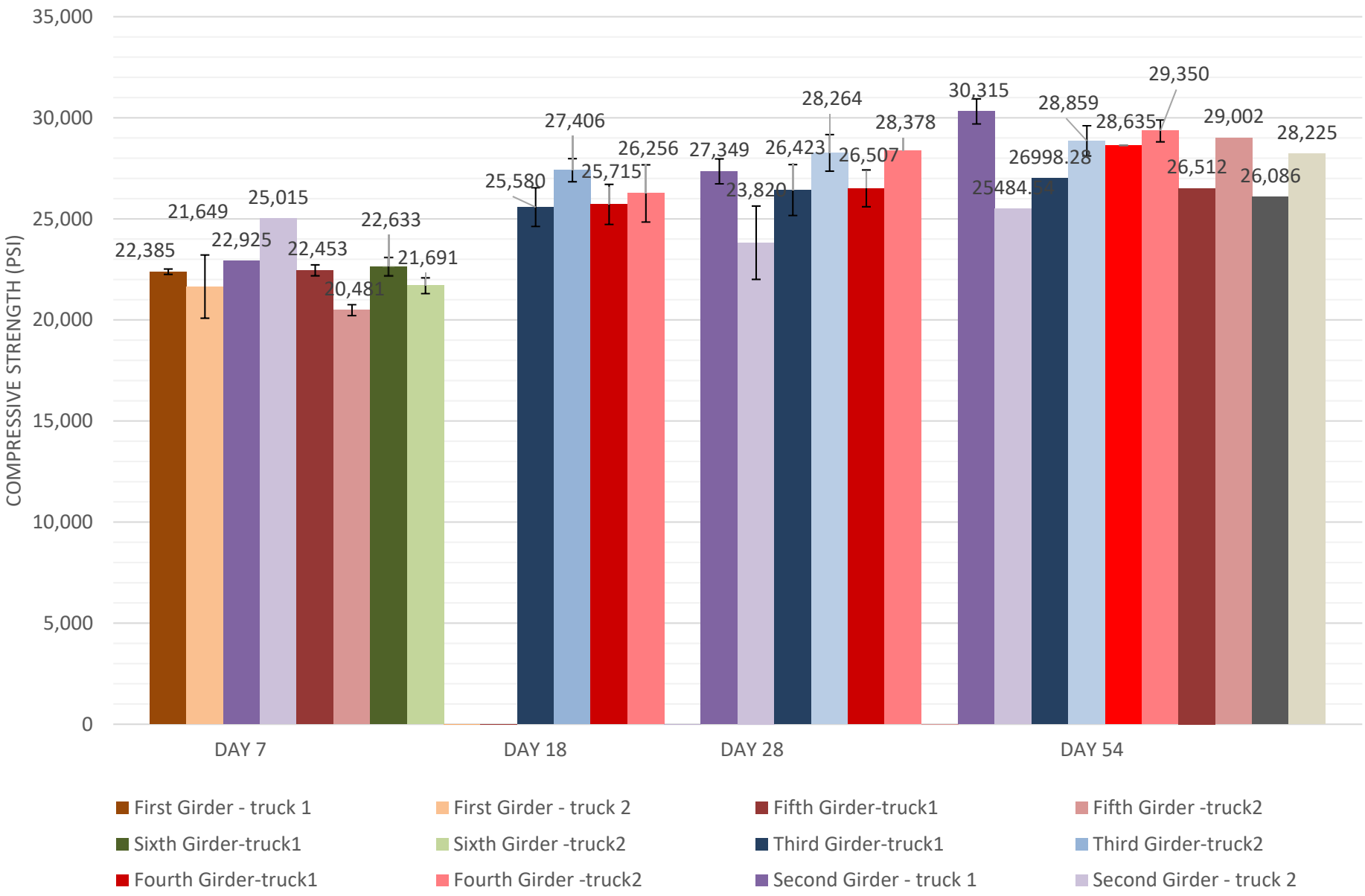
Pouring the Beams

K-UHPC

Steam Curing in our yard

K-UHPC

County Post Tensioning


35,000
30,000
25,000
20,000
15,000
10,000
5,000
0
COMPRESSIVE STRENGTH (PSI)
22,385
21,649
22,925
25,015
22,453
20,481
22,633
21,691
25,580
27,406
25,715
26,256
27,349
23,820
26,423
28,264
26,507
28,378
30,315
25484.54
26998.28
28,859
28,635
29,350
26,512
29,002
26,086
28,225
DAY 7
DAY 18
DAY 28
DAY 54
First Girder - truck 1
First Girder - truck 2
Fifth Girder-truck1
Fifth Girder -truck2
Sixth Girder-truck1
Sixth Girder -truck2
Third Girder-truck1
Third Girder-truck2
Fourth Girder-truck1
Fourth Girder -truck2
Second Girder - truck 1
Second Girder - truck 2

Limited Finish Work

Completed K UHPC Bridge

Bridge Deck Overlay-Strengthening

First in the Western Hemisphere UHPC Deck Overlay

Lessons Learned

- It Can be done on a 5% grade
- High Shear Mixers work well
- Grind After 4 days do not wait!!!
- Dump the Buggy perpendicular to the bridge

- What I did not try
- Would a bull float work if sprayed with Vegetable Oil?
- Would a roller screed work?
- Would a Bidwell Deck Paver work?

Public Private Partnership Donated materials Jesup South