Geosynthetically Confined Soils (FABRIC) and other Technologies

Brian Keierleber P.E.

Regional Local Roads Conference

October 23, 2013

What we are faced with

Many of our bridges are old

Our System Cannot meet Today's Demands

We Have NOT kept up with Modern Agriculture

Postings Do Not Work unless I am there.

The sign says 3 ton Gross

WE KNOW WHAT THE RESULTS WILL BE!

10/09/10 & 10/14/10 & 10/10/18/10

Without Enforcement and legislation our problems will grow

Avalanche® Double-Auger Grain Carts - Brent Grain Handling

Product Specifications

Model	2094	1594	1394	1194
Capacity-bushels (mt)	2,000 (51)	1,500 (38)	1,300 (33)	1,100 (28
Unloading Speed - bu/mn	1,000	800	800	800
Appx. Empty Weight - lbs. (kg)	32,700 (14,832)	25,200 (11,430)	18,975 (8607)	15,950 (7233)
Appx. Loaded Tongue Weight - lbs. (kg)	6,000 (2722)	5,500 (2495)	5,375 (2438)	5,200 (2395)
Overall Width (m)	13'11" (4.24)	13' (3.96)	12' (3.66)	12' (3.66
Overall Length (m)	37'10" (11.53)	34'2" (10.41)	30'10" (9.40)	30'10" (9.4
Transport Height (m)	12' (3.66)	12'9" (3.89)	12'8" (3.86)	12'2" (3.7
Height Loading Side (m)	11' (3.35)	11'5" (3.48)	11'4" (3.45)	10'10" (3.3
Auger Height - Adj. (m)	10'9" - 16'6" (3.28-5.03)	10'5"-15'11" (3.18-4.85)	10'5"-15'11" (3.18-4.85)	10'5"-15'1 (3.18-4.8
Vertical				

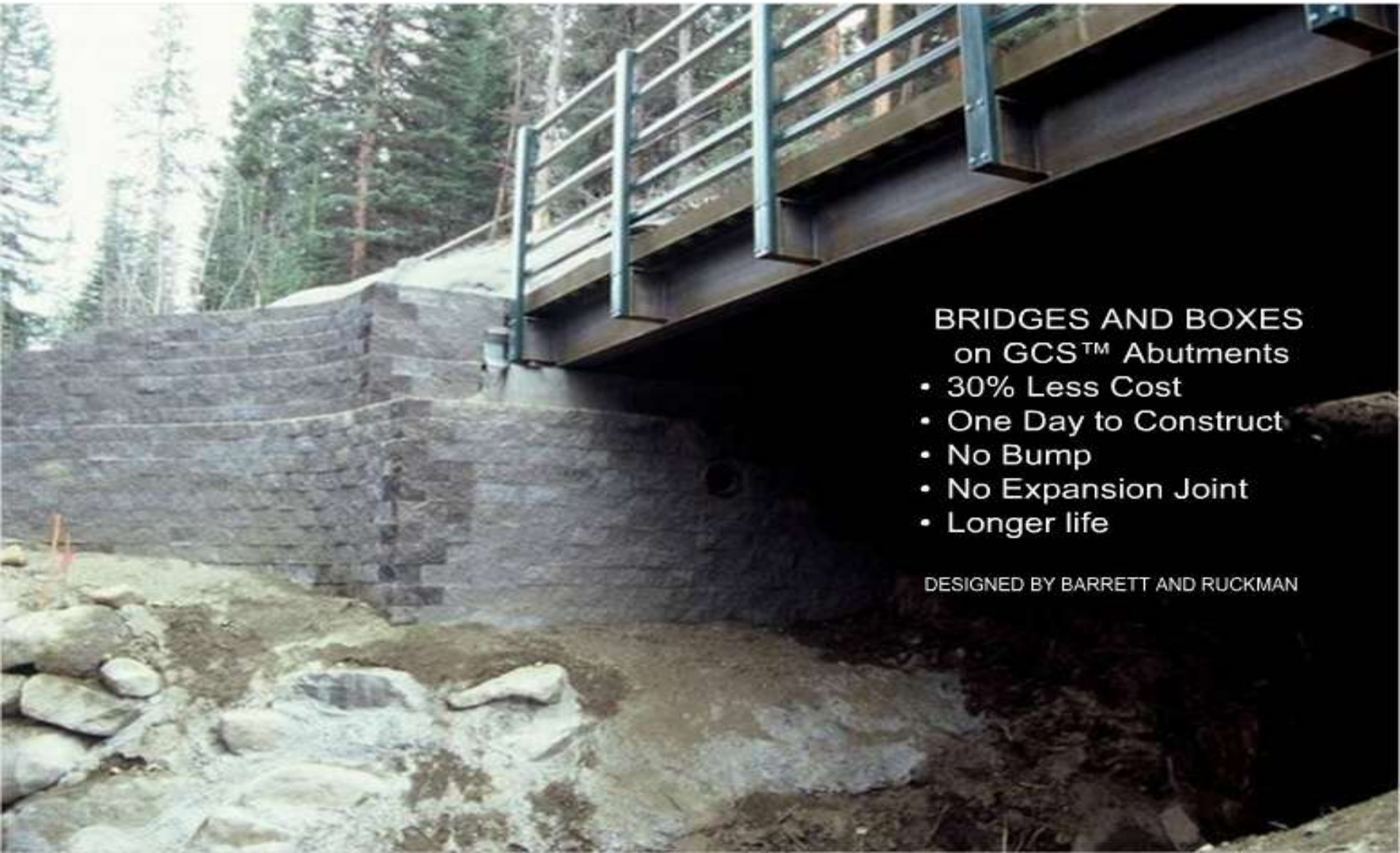
http://www.unverferth.com/brent/grainhandling/carts/avalanche.php?tab=specs 4/11/2011

- April 4, 2011
- Reports of 2-770 gal manure tanks crossing 22 ton bridge loaded
- April 7, 2011 reports of a semi crossing a 3 ton bridge

DUCT TAPE CANNOT FIX EVERYTHING

We MUST FIND NEW WAYS

UTILIZE NEW TECHNOLOGIES



ADAPT TO LOCAL CONSTRUCTION METHODS

START AT THE BASE

Start With 2 LAYERS 1 As A CURTAIN WALL

COMPACT 8” LIFTS
NOTE THE PILING WERE VIBRATED IN

COMPACT

LEVEL AND COMPACT AGAIN

COMPLETE ONE SIDE

EXCAVATE FOR CURTAIN WALL

RIPRAP

TIE RIPRAP UNDER STRUCTURE

COMPLETE BOTH ABUTMENTS

PLACE CURTAIN WALL PAST ABUTMENT

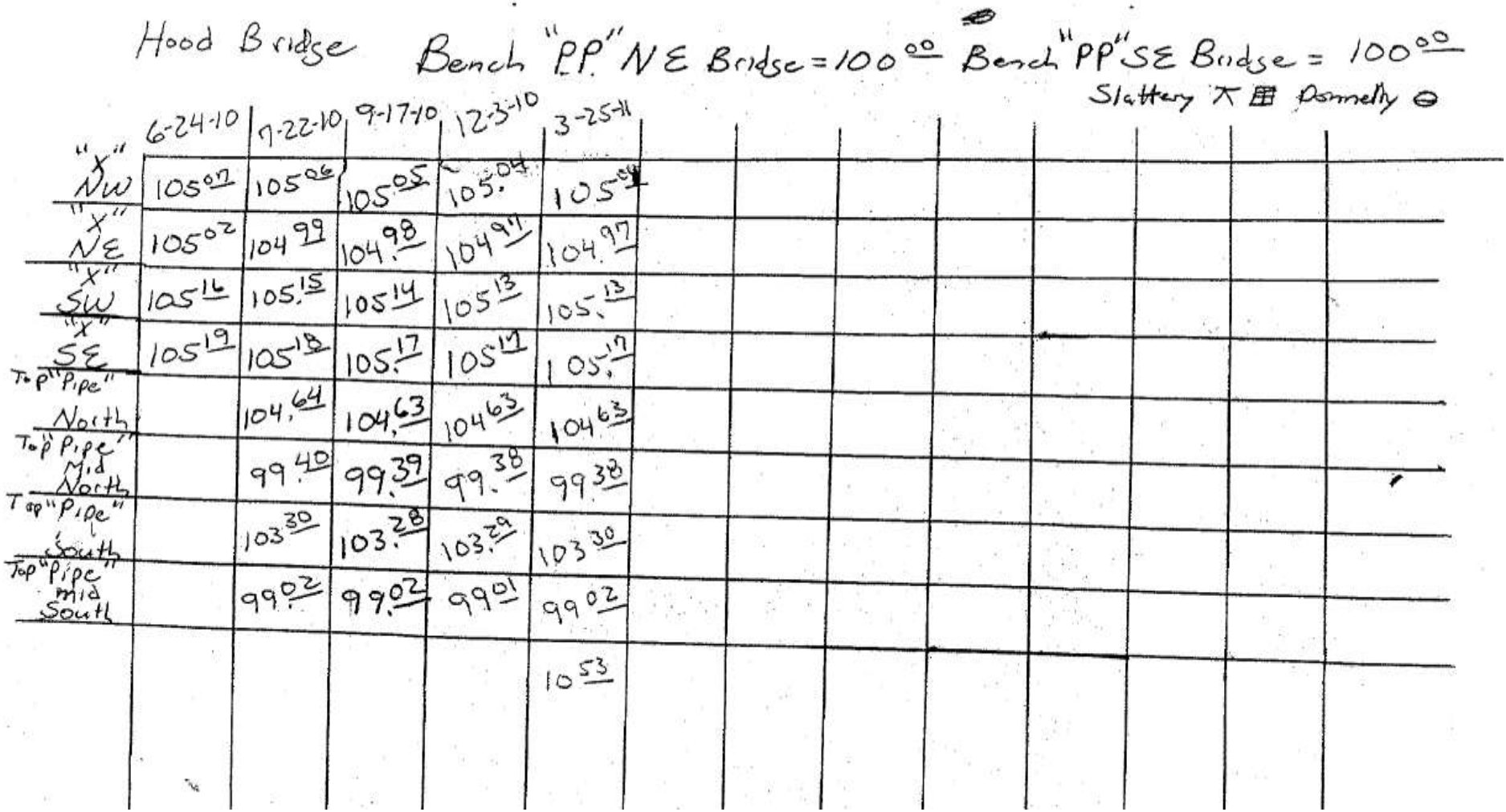
BUILD WINGS

SET SUPERSTRUCTURE

COMPLETE SUPERSTRUCTURE

COMPLETE BRIDGE

EVALUATE the PROCESS



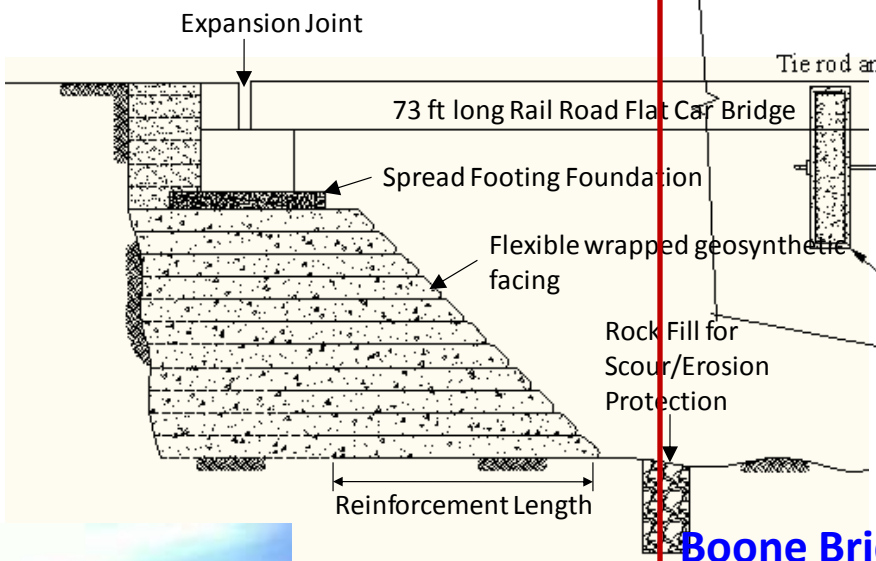
250 St Bridge

LETS LEARN MORE

Various options

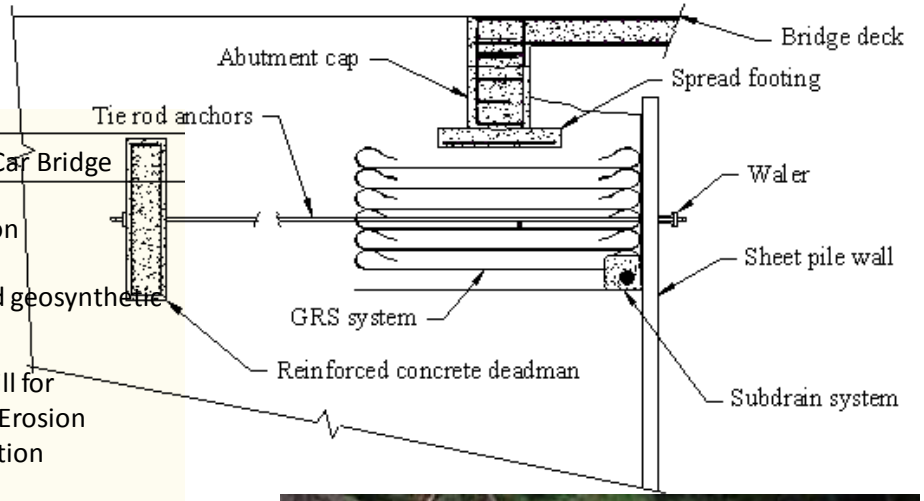
– Design for the Location

Flexible Facing –
Wrapped Geosynthetics, Concrete Blocks, Gabions, or Timber, etc.



Hoods Bridge, Buchanan County

Rigid Facing –
Sheet pile walls, Pre-Cast or Cast-In Place Concrete Walls

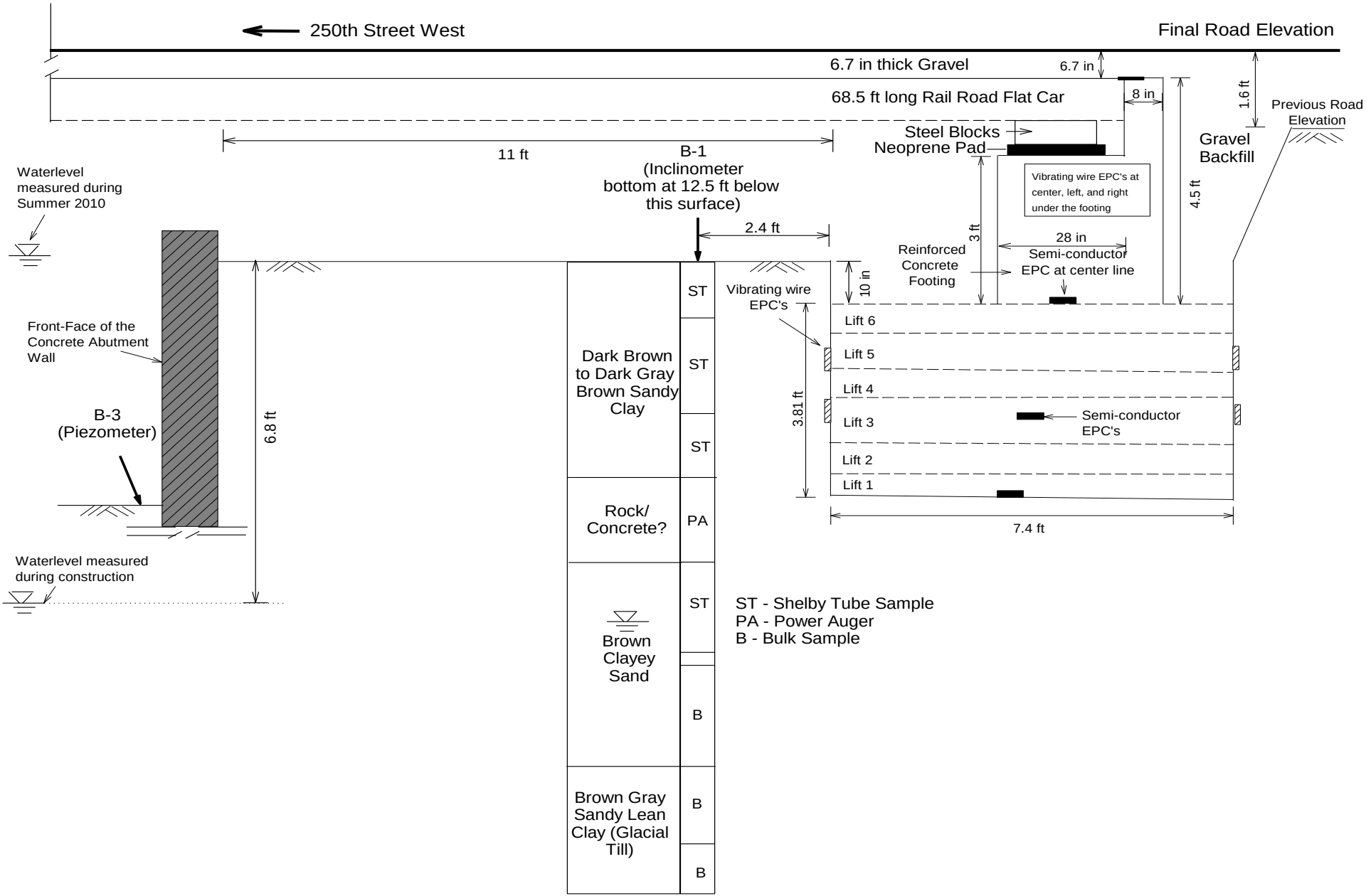


Boone Bridge, TR-568, IHRB Project

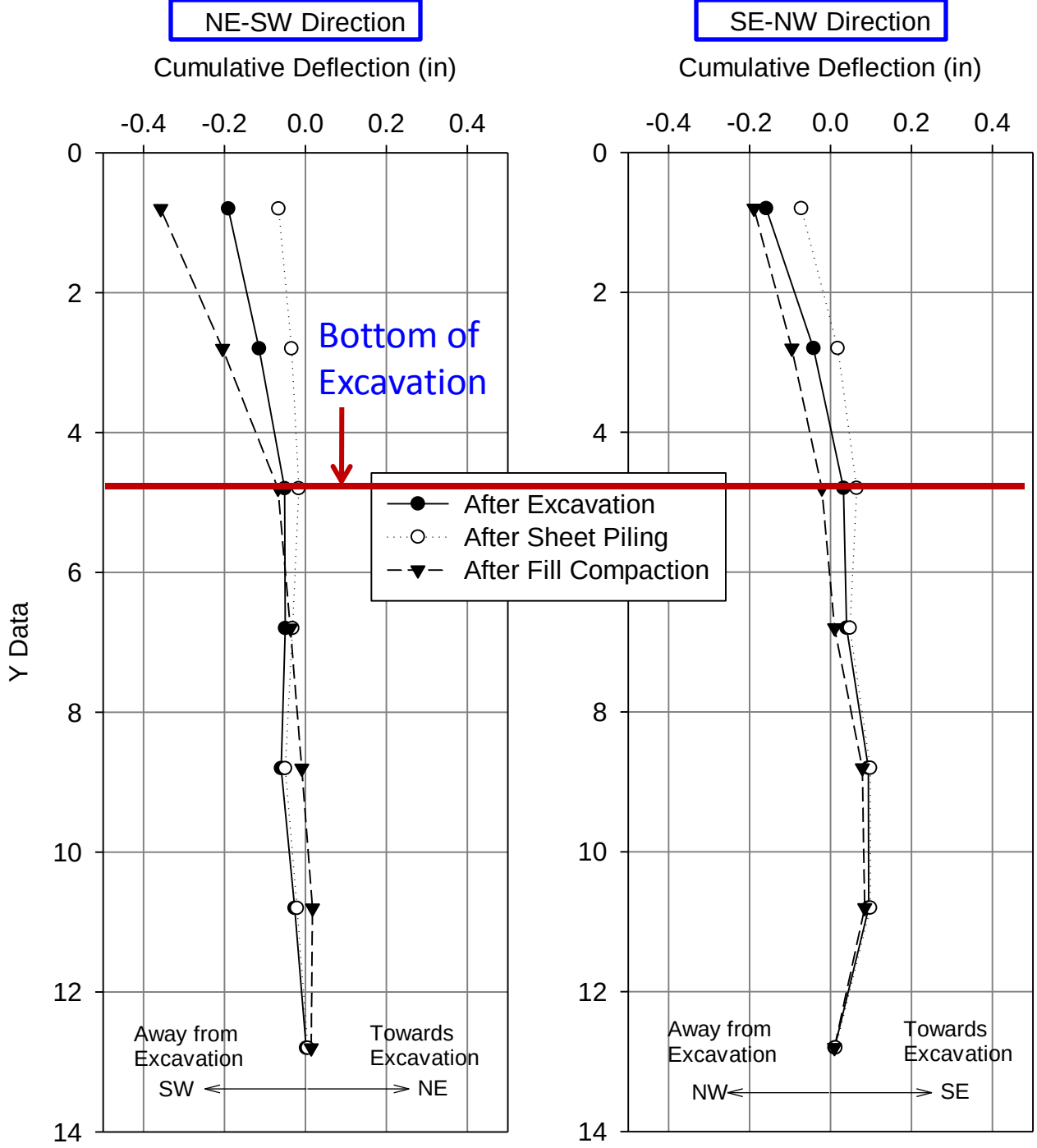
Iowa State University

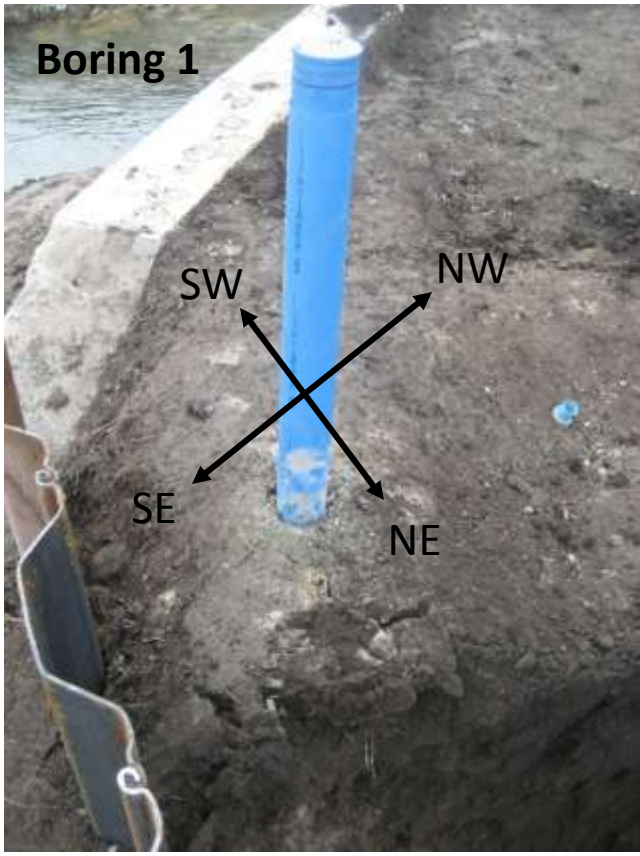
- PIEZOMETERS
- To Monitor water pressure
- INCLINOMETERS
- To monitor ground movement during excavation, sheet piling, fill compaction, and after bridge loading
- EARTH PRESSURE CELLS
- To monitor total stresses under the footing and at the ground at different elevations

Subsurface Conditions



Installation of Inclinometer





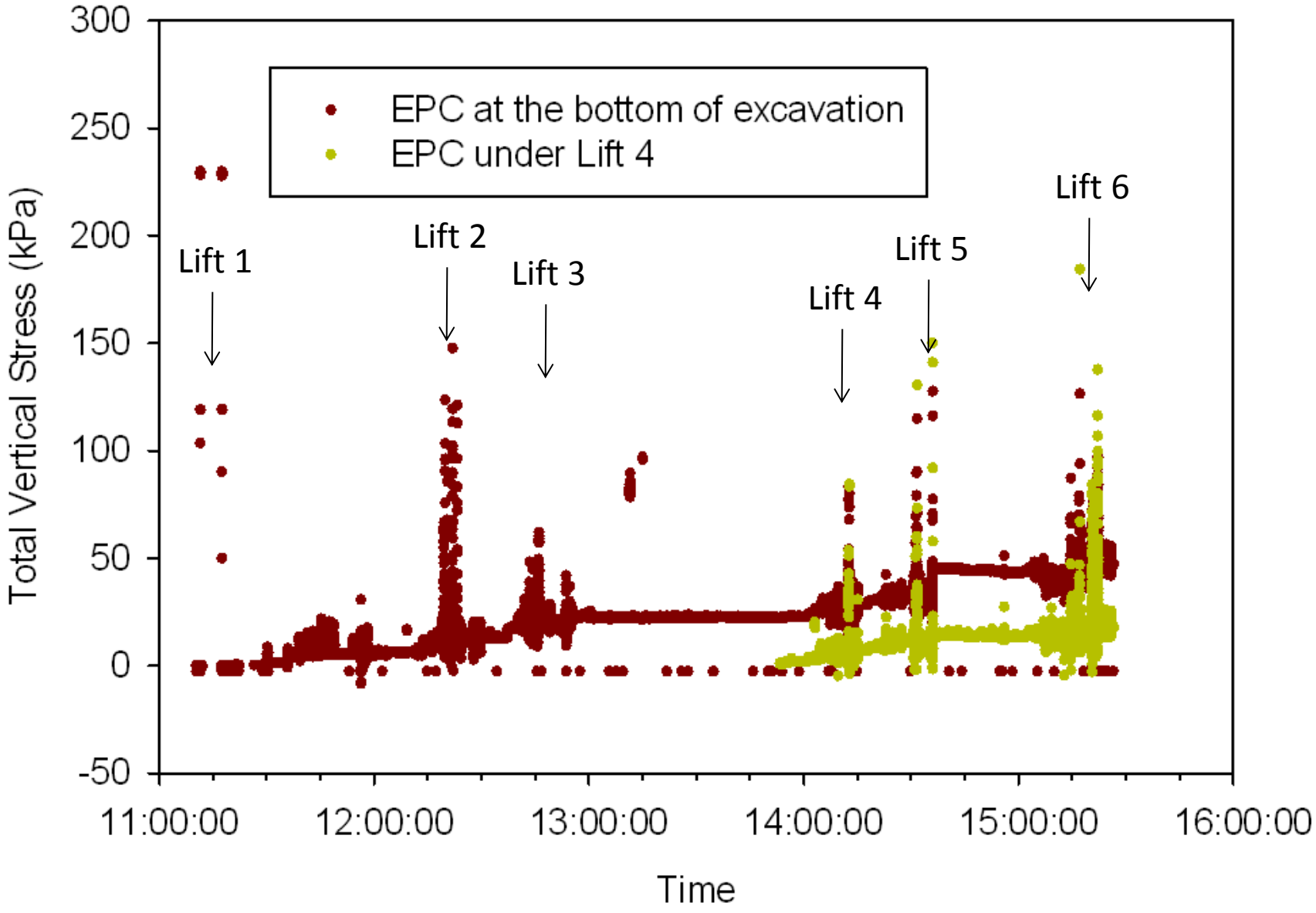
Inclinometer about
2 ft away from excavation

LOAD CELLS

LOADCELLS IN THE ABUTMENT

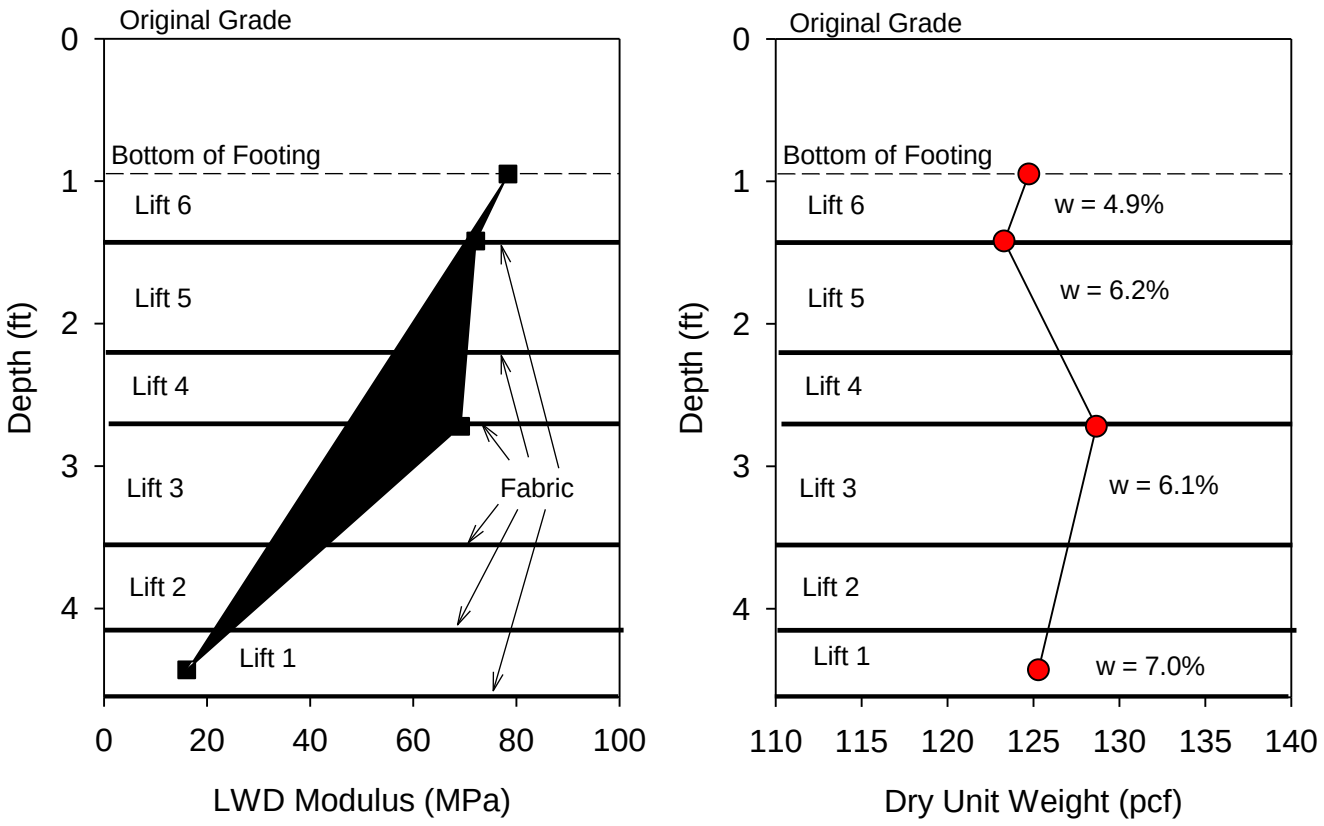
WIRES

In-Ground Stresses During Construction



Light Weight Deflectometer (LWD) Tests on each lift to measure Modulus

Modulus and Density Test Results



COMPLETED ABUTMENTS

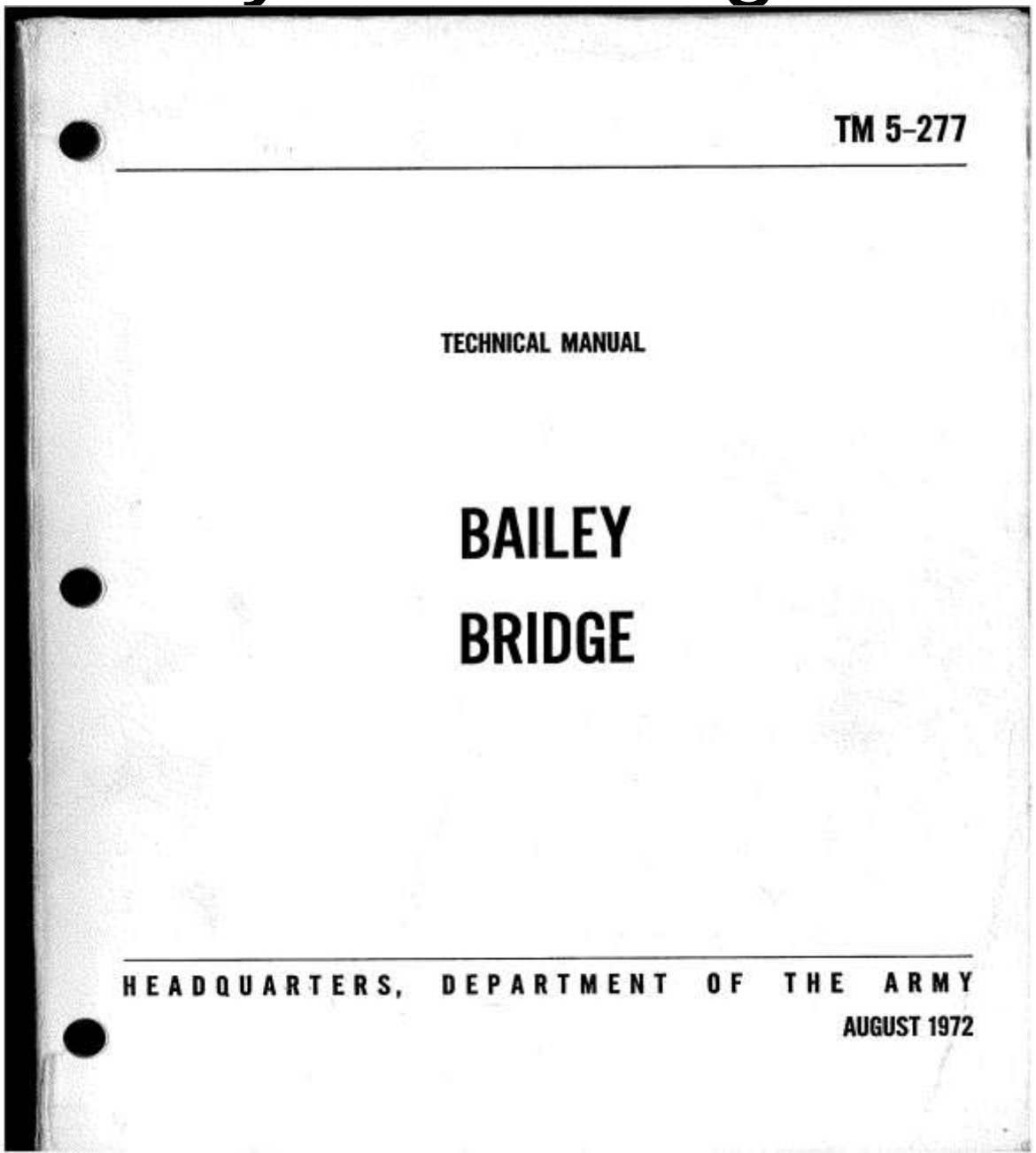
SETTING SUPERSTRUCTURE

TESTING

ON Site Data Logger with Wireless Modem

HIGH SPEED TESTING

My Knowledge



TM 5-277

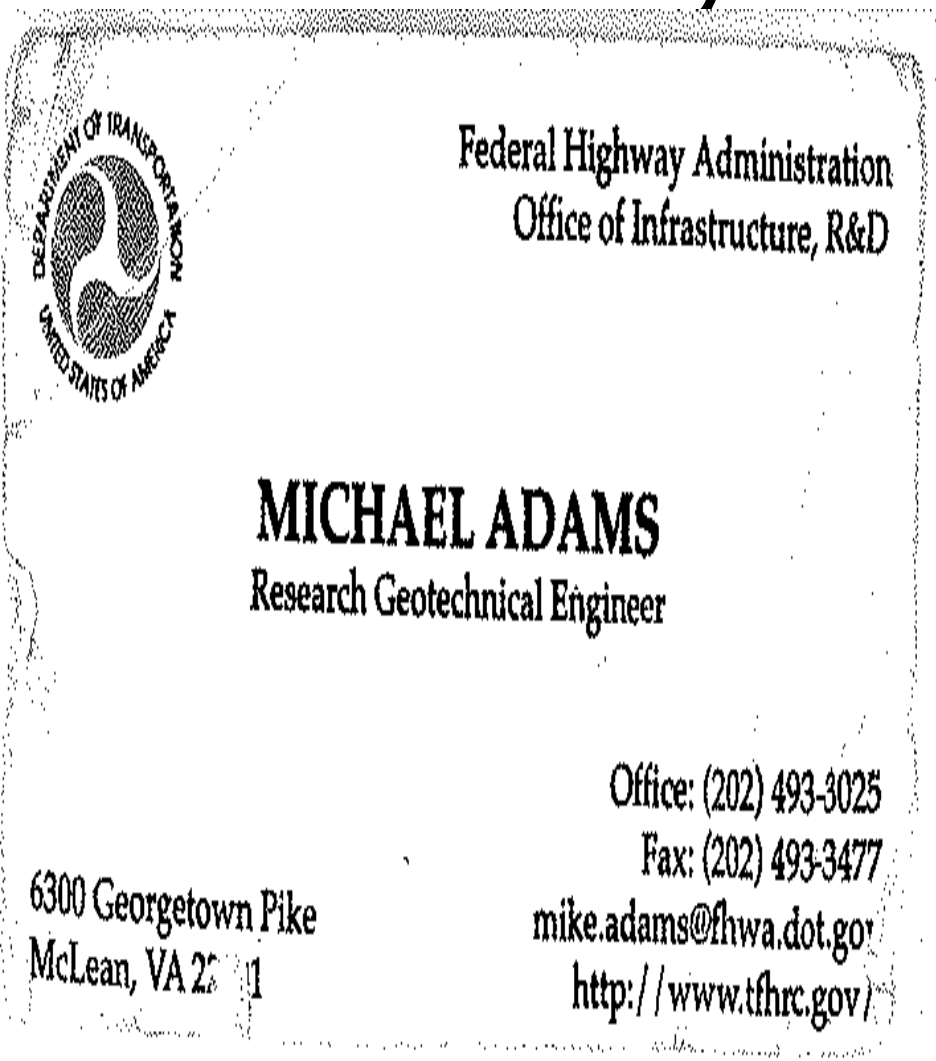
TECHNICAL MANUAL

BAILEY BRIDGE

HEADQUARTERS, DEPARTMENT OF THE ARMY

AUGUST 1972

My Resources

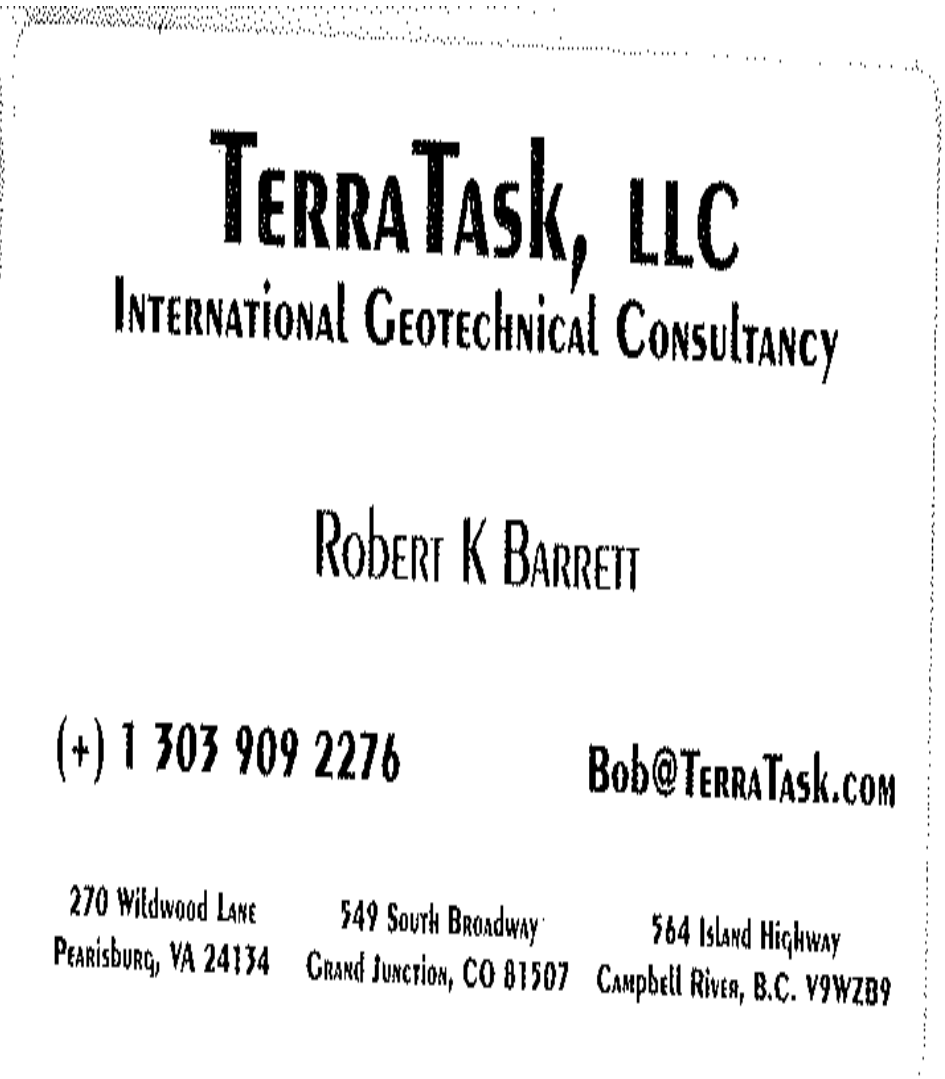


Federal Highway Administration
Office of Infrastructure, R&D

MICHAEL ADAMS
Research Geotechnical Engineer

6300 Georgetown Pike
McLean, VA 22101

Office: (202) 493-3025
Fax: (202) 493-3477
mike.adams@fhwa.dot.gov
http://www.tfhrc.gov/



TERRATASK, LLC
INTERNATIONAL GEOTECHNICAL CONSULTANCY

ROBERT K BARRETT

(+) 1 303 909 2276

Bob@TERRATASK.COM

270 Wildwood Lane
Pearisburg, VA 24134

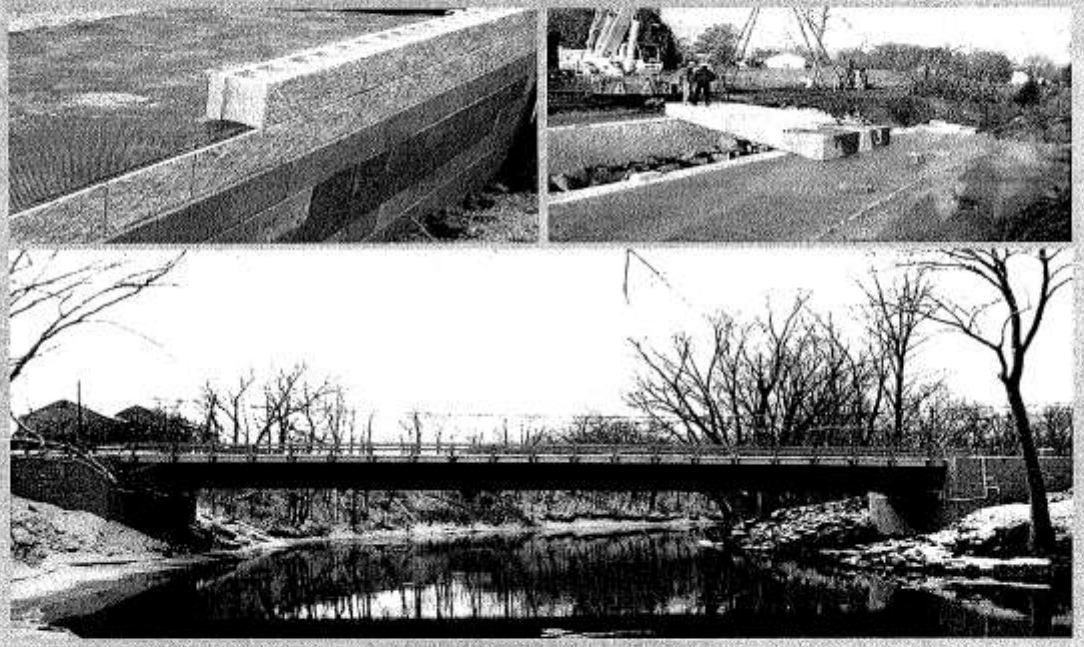
549 South Broadway
Grand Junction, CO 81507

564 Island Highway
Campbell River, B.C. V9WZB9

YOUR RESOURCES

Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide

PUBLICATION NO. FHWA-HRT-11-026 JANUARY 2011



U.S. Department of Transportation
Federal Highway Administration
Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

Acknowledgments

- Iowa Department of Transportation
- Buchanan County Staff
  - Randy Andrews, Phil Fangman, Jeff White, Chuck Kivell, Dick Lehs, Alex Davis, Tom Reidy, Andy Monaghan, Ron Crawford, Rick Wendling, Jerry Slattery, Brian Donnelly, and Ned Johnson
- Iowa State University Staff
- Pavana Venaposa Heath Gieselman, David White, Wayne Klaiber

GRS in Scott County Iowa

Scott Co. placing the lifts

Scott County Completed Bridge

Clayton County Bridge

Clayton County Standard Process

8” lifts using block

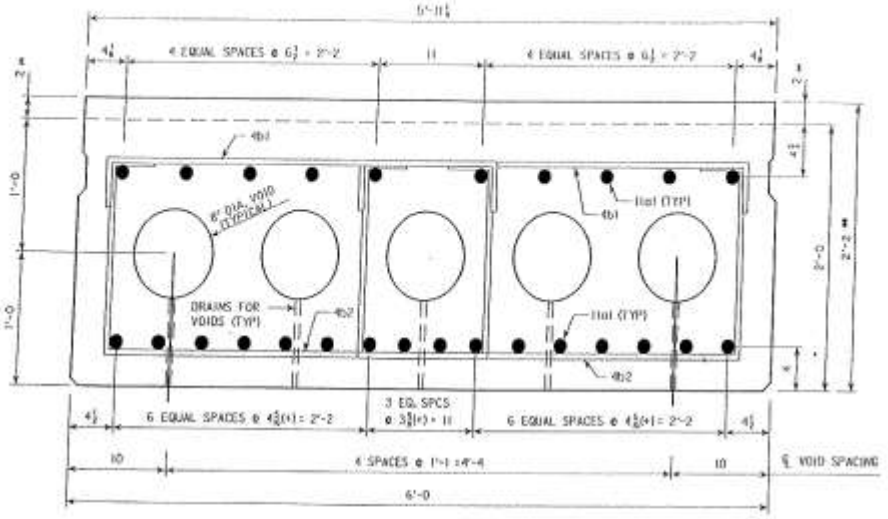
Steel Beam in Slab Design

Clayton County Construction in Progress

Beam in Slab on GRS

Clayton Co. Cherry Valley Rd Bridge completed

Launching was the concept



INTERIOR SPAN - SECTION AT MIDSPAN

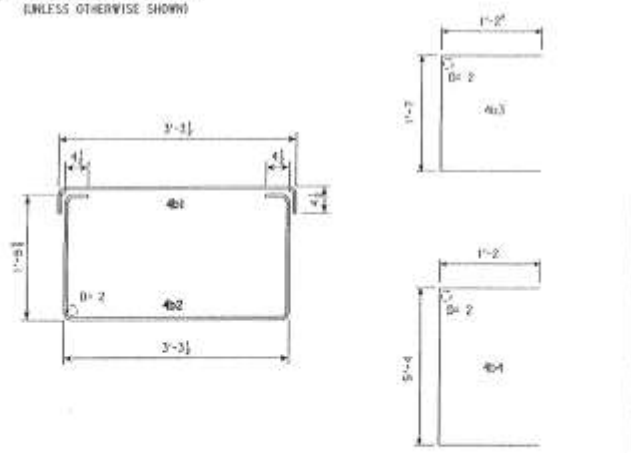
X 2 INCH BEAM THICKENING AT MIDSPAN TO ACCOMADATE BEAM LOAD DEFLECTION

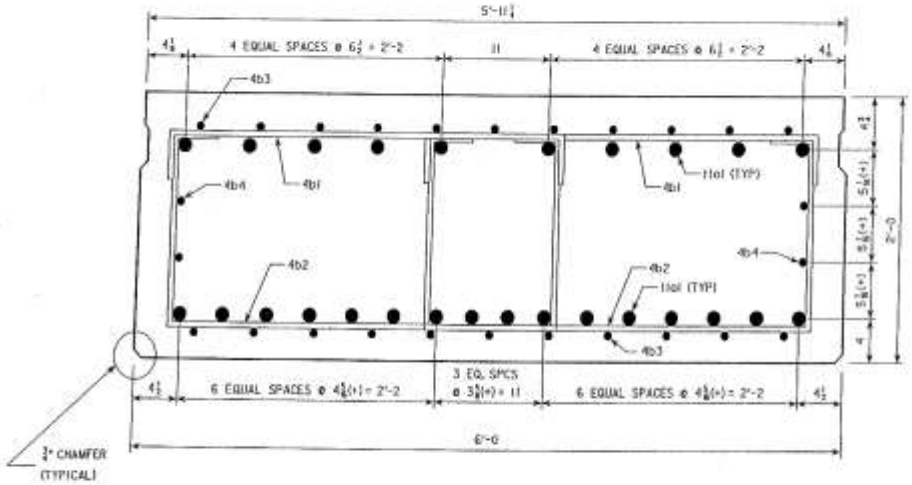
REINFORCING BAR LIST - ONE BEAM

BAR	LOCATION	SHAPE	NO.	LENGTH	WEIGHT
#6@1	LONGITUDINAL BARS	——	26	50'-8	1337
4b1	STIRRUP BARS	⊓	138	4'-1	376
4b2	STIRRUP BARS	⊔	138	7'-0	645
4b3	END BARS	⊓	22	3'-11	58
4b4	END BARS	⊓	4	7'-8	20
				TOTAL (LBS.)	8236

BENT BAR DETAILS

NOTE: ALL BAR DIMENSIONS ARE OUT TO OUT
D = PIN DIAMETER FOR BENDING
(UNLESS OTHERWISE SHOWN)





INTERIOR SPAN - SECTION AT ℄ BEARING

(4b3 SPACING SHOWN ON NEXT SHEET)

CONCRETE PLACEMENT SUMMARY

CONCRETE	TOTAL
ONE BEAM	22.0
TOTAL (CU YDS.)	22.0

50'-0 X 30' PRECAST CONCRETE BEAM BRIDGE

BEAM CROSS SECTION

50'-0 SPAN

BUCHANAN COUNTY

DESIGN SHEET NO. ___ OF ___ FILE NO. _____ DESIGN NO. _____

DESIGN TEAM | BUCHANAN COUNTY | SHEET NUMBER

Plans are through Iowa State and the IDOT

BUCHANAN COUNTY BEAM CONSTRUCTION

FARM TO MARKET SYSTEM

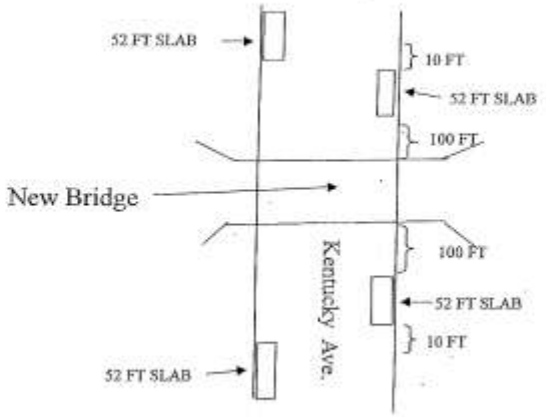
BUCHANAN COUNTY

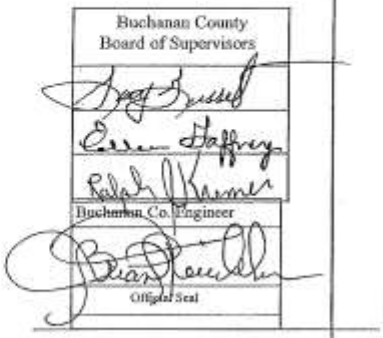
Secondary Road Dept.

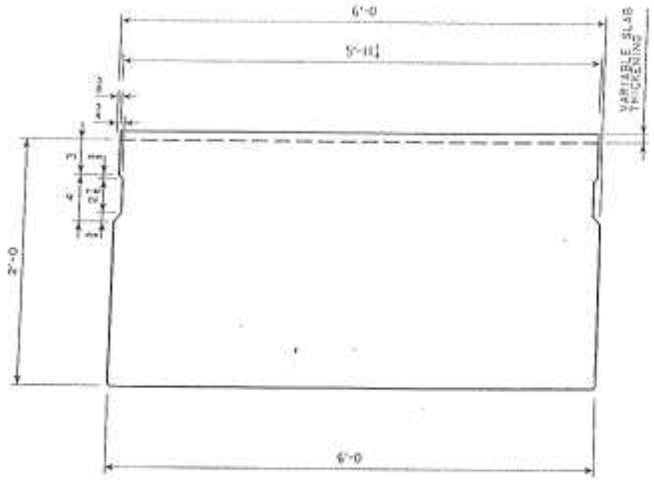
Local Letting

FHWA No. 083960

BEAM CONSTRUCTION

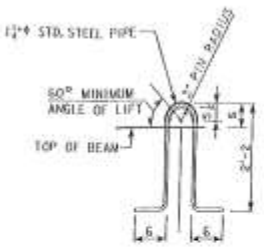






SECTION THRU BEAM

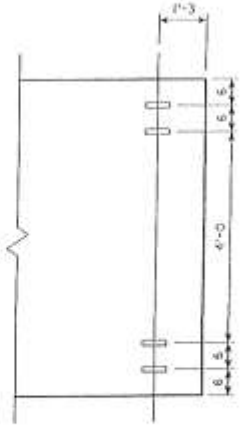
(REINFORCEMENT NOT SHOWN FOR CLARITY)



LIFTING LOOP DETAIL

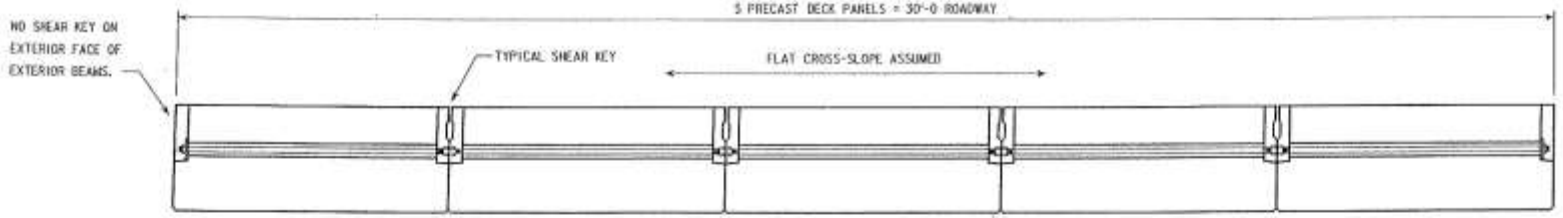
4 - ½" NOMINAL DIA. GRADE 270 KSI STRANDS THREADED THROUGH EACH PIPE SLEEVE BENT AS SHOWN AFTER THREADING. ALTERNATE LIFTING DEVICES MAY BE SUBMITTED FOR APPROVAL.

LIFTING LOOPS SHALL CARRY LOADS EQUALLY



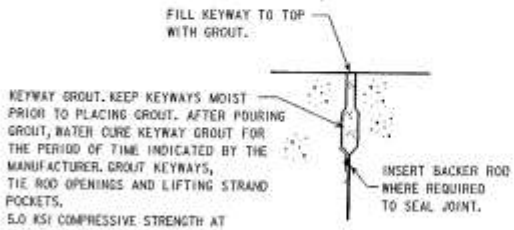
LIFTING LOOP DETAIL

(PLAN VIEW)

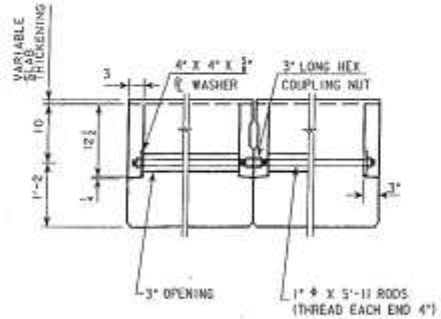


DECK CROSS-SECTION

(BARRIER RAIL AND ATTACHMENTS DESIGNED BY OTHERS)



KEYWAY GROUT



TRANSVERSE TIE ASSEMBLY

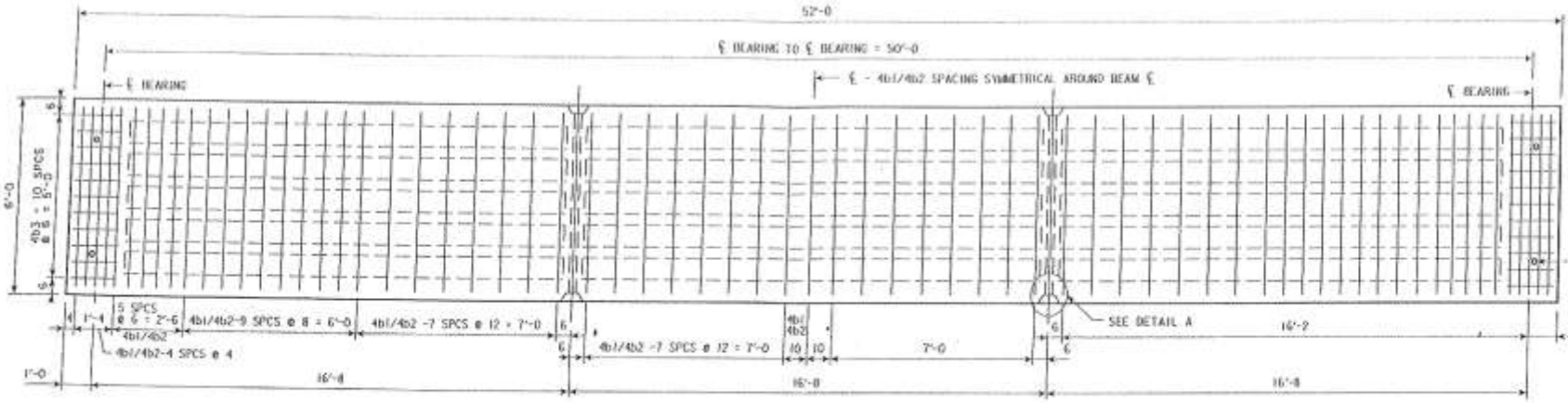
50'-0 X 30' PRECAST CONCRETE BEAM BRIDGE

BEAM DETAILS

50'-0 SPAN

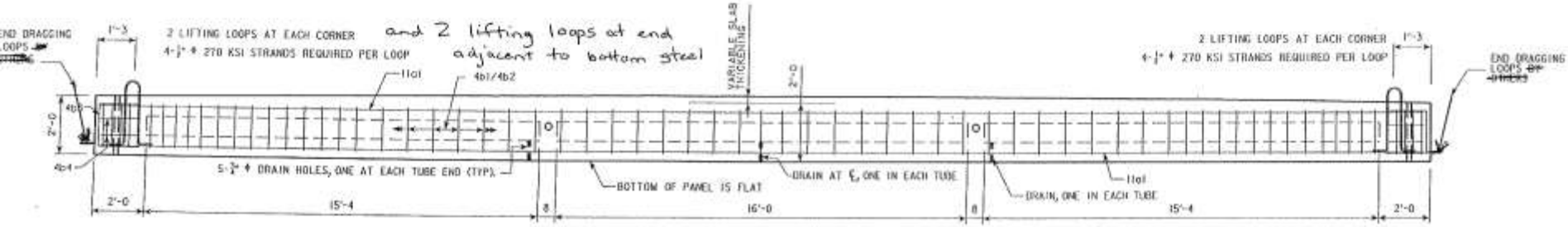
BUCHANAN COUNTY

DESIGN SHEET NO. ___ OF ___ FILE NO. _____ DESIGN NO. _____



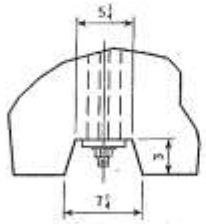
TOP VIEW

(LONGITUDINAL REINFORCEMENT NOT SHOWN FOR CLARITY)



ELEVATION VIEW

SLAB THICKENING TABLE											
TENTH POINT	0.0	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9	1.0
DISTANCE (FT)	0	5	10	15	20	25	30	35	40	45	50
SLAB THICKENING (IN)	0	⅜	1⅛	1⅜	1⅝	2	1⅝	1⅜	1⅛	⅜	0



DETAIL A

50'-0 X 30' PRECAST CONCRETE BEAM BRIDGE

BEAM DETAILS

50'-0 SPAN

BUCHANAN COUNTY

DESIGN SHEET NO. ___ OF ___ FILE NO. _____ DESIGN NO. _____

TEAM

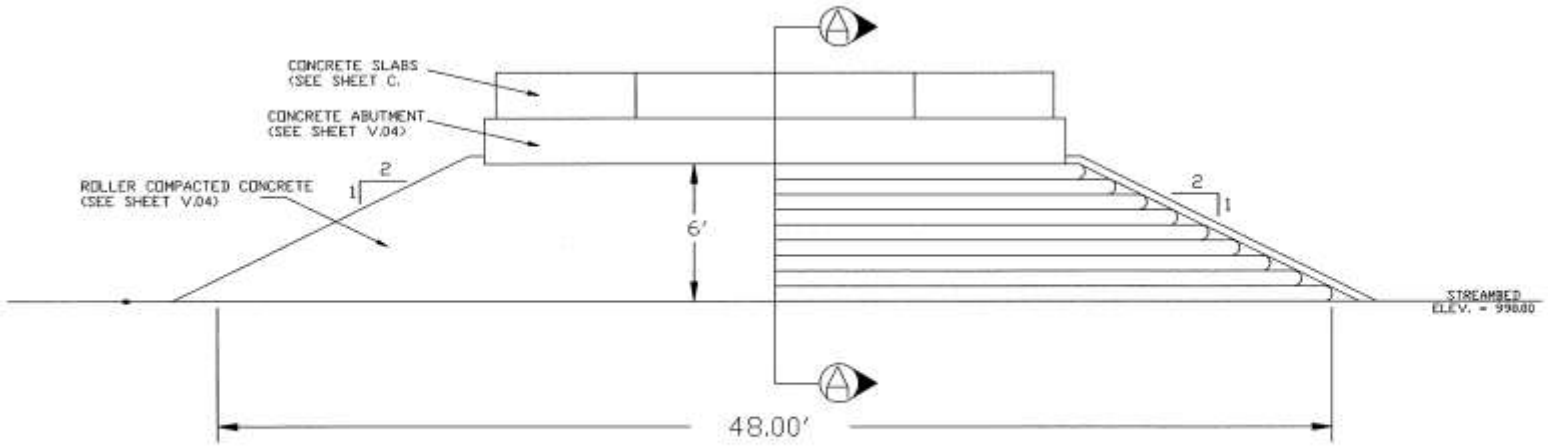
BUCHANAN COUNTY

SHEET NUMBER

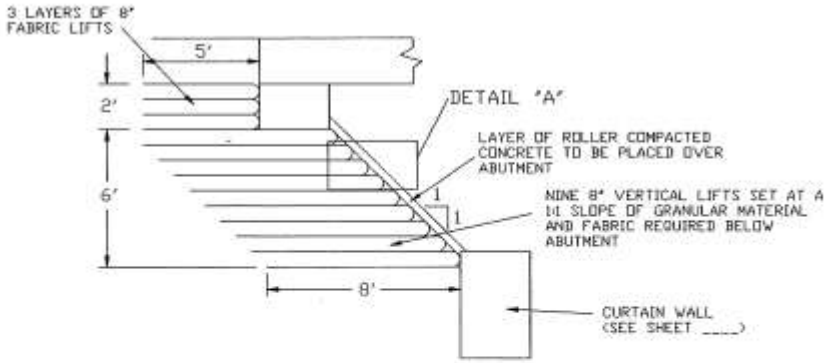
Gerstenbergers Bridge

Not all things work SAFETY rules

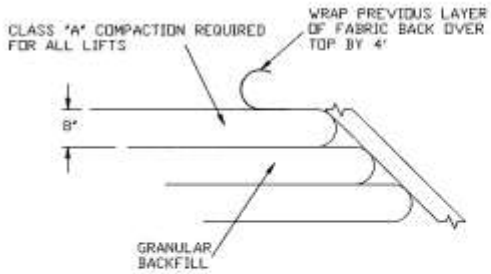
Constantly Improve The Methods



ELEVATION VIEW



SECTION A-A



DETAIL "A"

NOTES:
ALL COMPACTION SHALL MEET THE REQUIREMENTS OF CLASS "A" COMPACTION AS STATED IN THE 2009 STANDARD SPECIFICATIONS.

ROLLER COMPACTED CONCRETE IS TO BE PLACED OVER TOP OF FACES OF THE ABUTMENT AS WELL AS 10 FT BACK ON EITHER SIDE FROM THE ABUTMENT FACE.

GRANULAR BACKFILL TO CONSIST OF CLASS"A" CRUSHED STONE

52' 00" x 24' 00" C.O.S.S. Bridge
Located on Kentucky Ave. over Unnamed Creek
48' 00" SPAN

FOUNDATION DETAIL

STATION; 101+64.88
BUCHANAN COUNTY, IOWA

SKEW: 0° ahead
FHWA # 82520

AD | BUCHANAN COUNTY | PROJECT NO. | U.01

Compacted Concrete on GRS

Completed Abutment face on a 1:1

Even Concrete Deteriorates

New Technology through organizations like the Short Span Steel Bridge Alliance

- National Association of County Engineers is a founding member
- Provides counties with Innovative and cost-effective solutions for short span steel bridges.
  - **www.ShortSpanSteelBridges.org**
- **Free** web-based design tool available for short span steel bridges
  - eSPAN140 **(www.eSPAN140.com)**
  - Used to design a steel bridge in Buchanan County, Iowa

eSPAN140

New Technologies such as e-span 140 will impact how we do business

Steel

Concrete

Case Study Bridges: Side-by-Side Comparison

Audrain County, MO Bridge 411

Built 2012

Steel 4 Girders

47.5 ft Span, 24 ft Roadway Width

2 ft Structural Depth

No Skew

Audrain County, MO Bridge 336

Built 2012

Precast 6 Hollowcore Slab Girders

50.5 ft Span, 24 ft Roadway Width

2 ft Structural Depth

20^{o} Skew

Steel

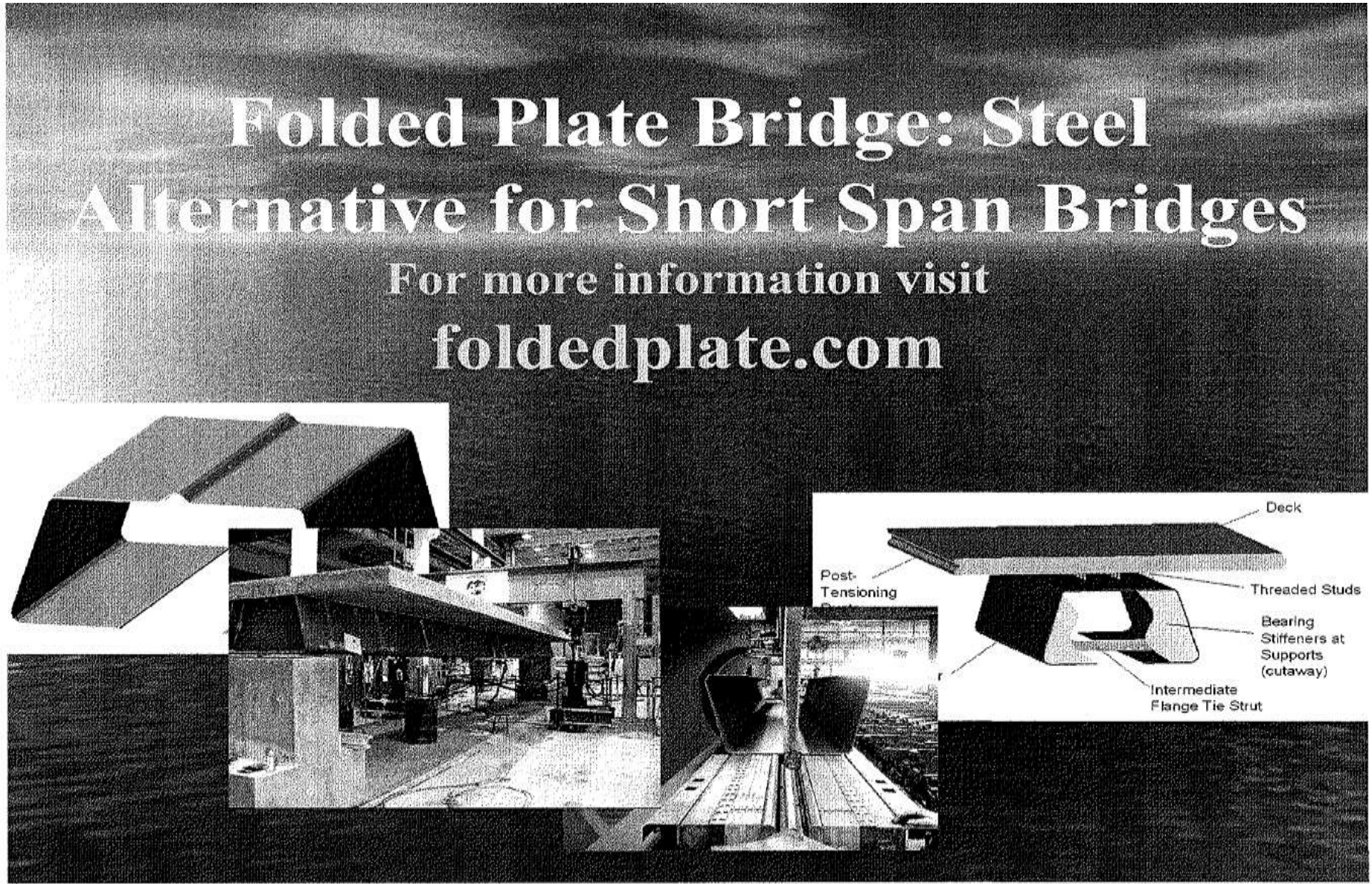
Concrete

Case Study Bridges: Side-by-Side Comparison

Total Bridge Costs	
Material	= $41,764
Labor	= $24,125
Equipment	= $21,521
GuardRail	= $ 7,895
Rock	= $ 8,302
Engineering	= $ 8,246
TOTAL	**= $111,853**

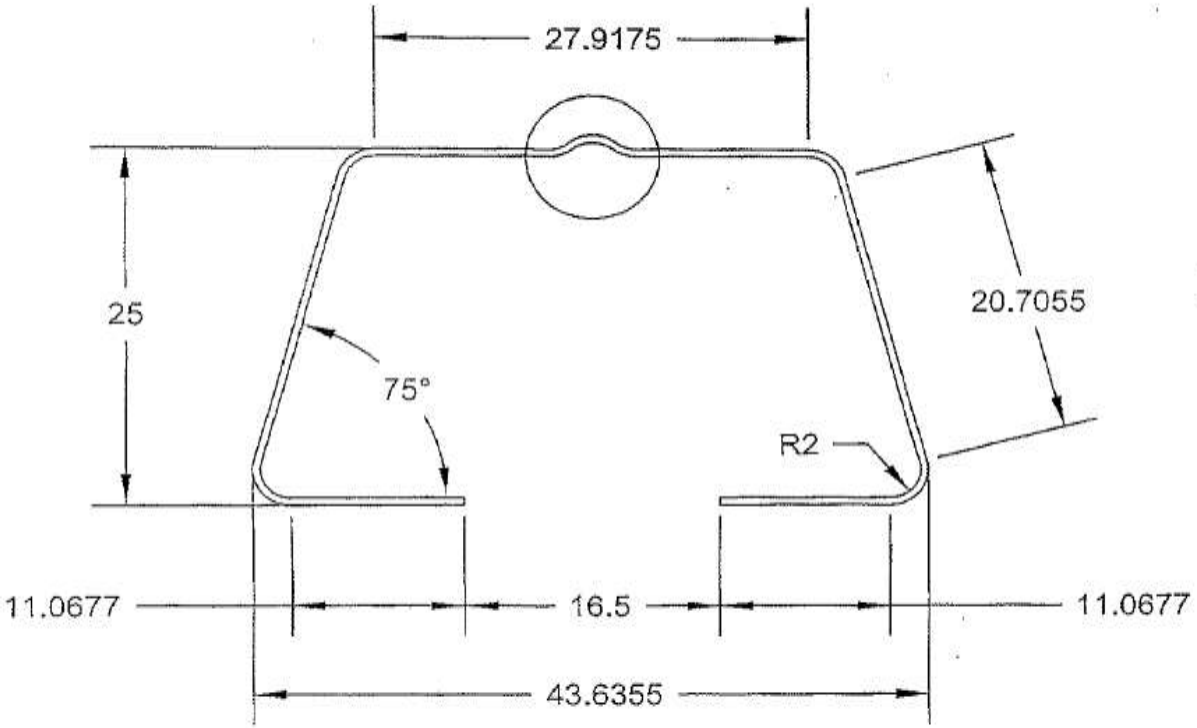
Total Bridge Costs	
Material	= $67,450
Labor	= $26,110
Equipment	= $24,966
GuardRail	= $ 6,603
Rock	= $ 7,571
Engineering	= $21,335
TOTAL	**= $154,035**

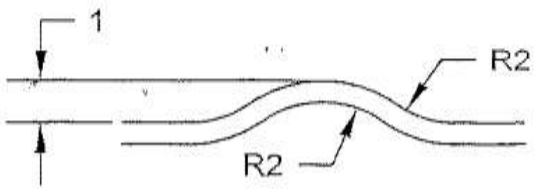
Folded Plate Steel Bridge Concepts



Atorod Azizinamini Process

Folded Plate Specime
Half Inch Plate



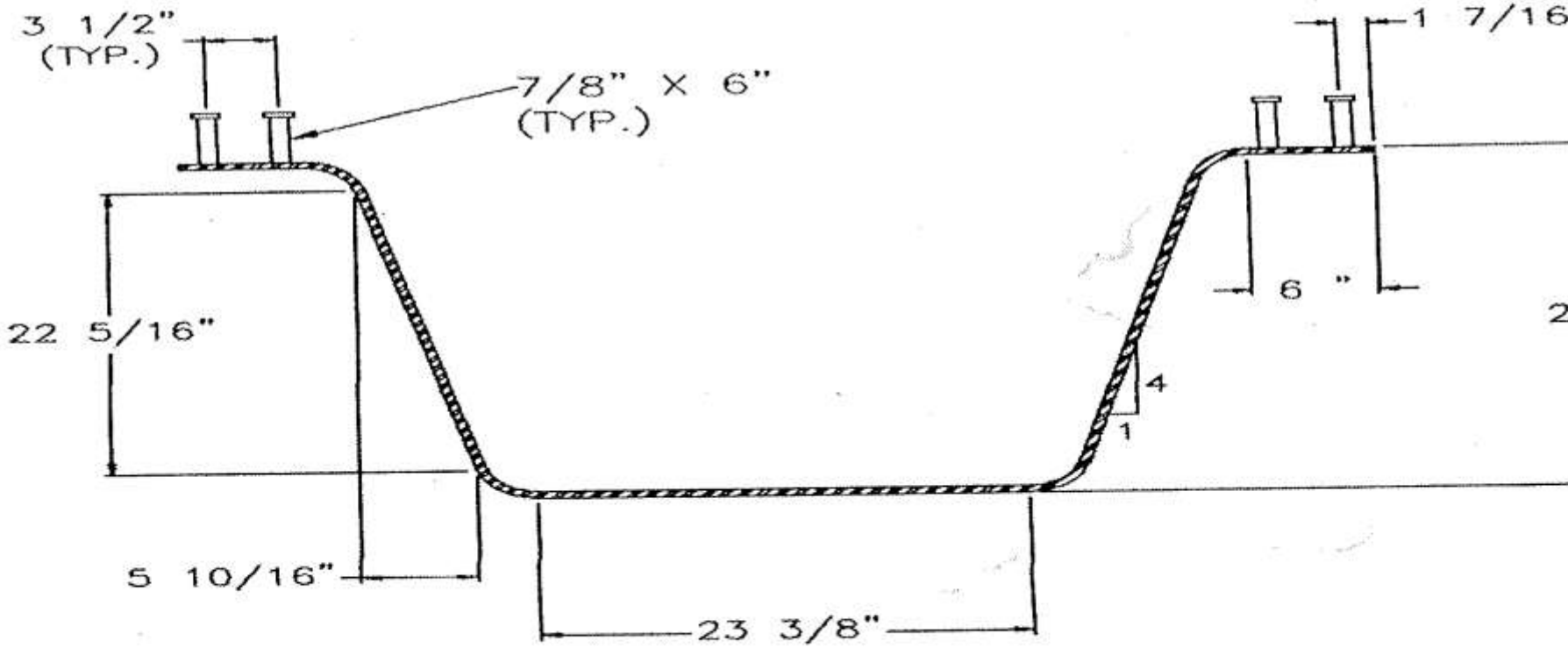


Detail A

Bending Dimensions

Total Plate Width = 105.6012

Dr.Karl Barth From
WestVirginiaUniversity
and Dr.Michael Barker From
The University of Wyoming

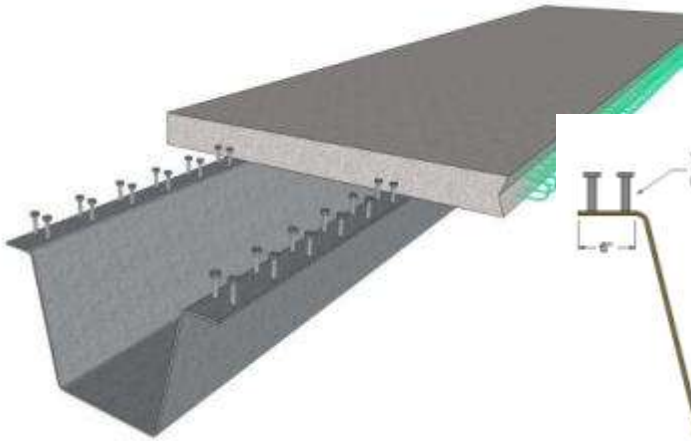


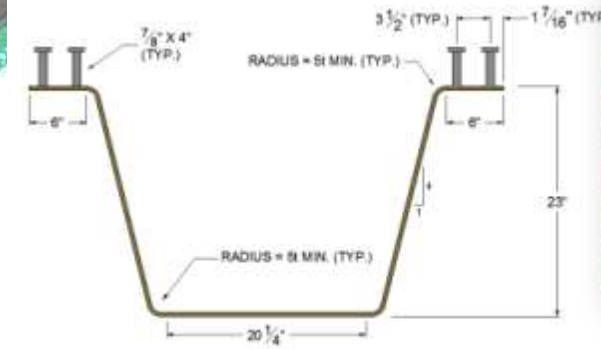
PRESS BRAKE TUB GIRDER

Initial tests are very promising

Press-Brake Tub Girder

- **Short Span Research Program – Press-Brake Tub Girders**
  - **IBRD Grant**
    - **$350,000**
      - Design – West Virginia University (Dr. Karl Barth)
      - Innovation Bridge Research and Development Program (IBRD)
      - Buchanan County, Iowa (Brian Keierleber)





The Bottom Line is the COST

Alternate FAX 785-472-3729

Quotation

Date: 5/13/2012
To: **Brian Keierleber @ Buchanan County**
From: Jeff Weesner

Quotation: J051212-3
Bridge Girder-52'

ESTIMATED SHIP DATE:	SHIPPED VIA:	FOB	TERMS:
6 to 8 weeks	Truck	Independence, IA	Net 30 days

QUANTITY	DESCRIPTION	UNIT PRICE	AMOUNT
4	Bridge Girder-With Hump (1/2"x 108"x 624") A572 Gr. 50	$ 10,514.00	$42,056.00
	Additional Service Freight (Per Legal Truck Load) $1,755.00		
	Additional Service Galvanizing (Per ASTM A123) $2,723.00		
	ALWAYS PROVIDE MY QUOTE # W/ ORDER		
	PRICE INCLUDES: Material (A572-Gr. 50) Plasma Cutting Bending	**PRICE EXCLUDES:** welding welding studs NDT bearing plates stiffeners hardware freight galvanizing	
			$42,056.00

Bridging Options

Cast on site slabs:

	2006	cost	2010	cost	2010+10%	cost
23.11 C.Y. of concrete	$267.83	$6189.55	$331.93	$7670.90	$8437.99	$8437.99
8236 lb. steel	$0.70	$5765.2	$0.77	$6341.72	$0.85	$7000.60
Total 4 beams		$47,819		$56,050.48		$61,655.53

Red Book (my Mistake 2006) Costs estimates are based on Structural Concrete for box Bridges and reinforcing steel.

Suckow Construction $86,564 - $16,771 IBRC reimbursable = $69,793

Oden Enterprises $76,618(includes neoprene pads and barrier rail)

OTHER EFFORTS

3-68 ft. railcars at $15,000 = $45,000

4 folded plates $42,056 (needs decking)

16'x8' precast box sections (limited locations) $68,912

ULTRA HIGH PERFORMANCE CONCRETE

UHPC Design Data

- Modulus of elasticity final = 7,500 ksi
- Compressive strength at release = 14.5 ksi
- Compressive strength final = 21.5 ksi
- Tensile strength ~ 1.20 ksi
  - **We actually broke cylinders at 32 ksi.**

Initial Cost

Inorganic Zinc	$1.35	$40,410
Hot-Dip Galvanizing	$1.60	48,000
Inorganic Zinc/Epoxy	$2.16	$64,800
Acrylic WB Primer/ Acrylic WB Intermediate/ Acrylic WB Topcoat	$2.55	$76,620
Inorganic Zinc Primer/ Epoxy/ Polyurethane Topcoat	$3.17	$94,950

Future Generations will Benefit

Internal Curing Concrete

Completed Roundabout

Pavements from BIO-OILS

Be Creative

ANY QUESTIONS?

THANK YOU