FARM Bridge Program

THE FARM DESIGN BUILD PROJECT

Fixing Access to Rural Missouri (FARM)

MoDOT identified 41 rural bridges in northern MO

MoDOT applied for a grant through the Competitive Highway Bridge Program

Project Overview

Four criteria were used to identify bridges

- In poor condition
- Weight-restricted
- One-lane but carry 2-way traffic
- On timber piles

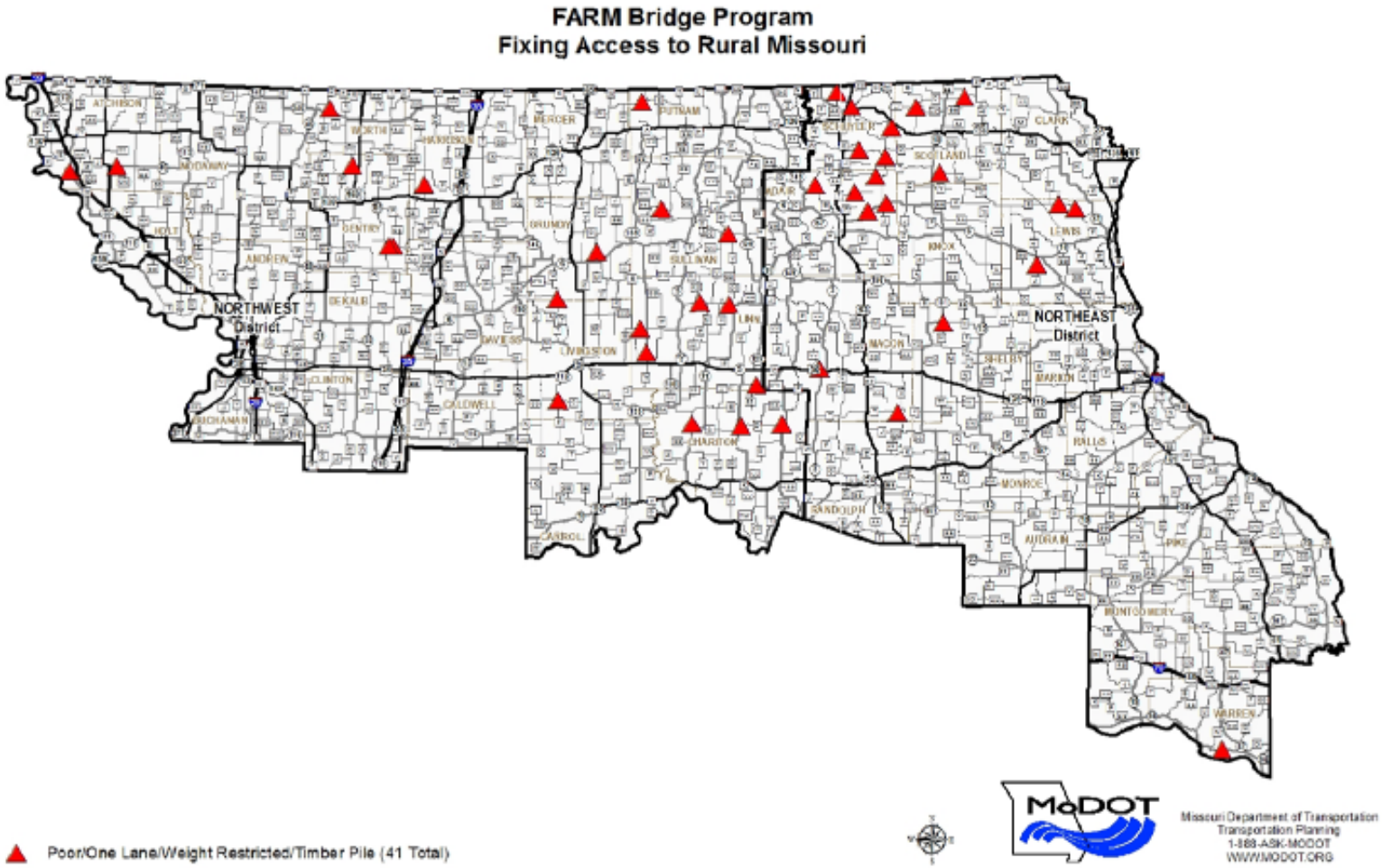
Additional Information

- Bridges located in 17 counties in the NE and NW Districts
- Bridges range in length from 198′ down to 28′
- AADT ranges from 1199 vpd down to 36 vpd
- Bridges were constructed between 1927 and 1955

Typical Bridge

Typical Bridge

THE FARM DESIGN BUILD PROJECT



THE FARM DESIGN BUILD PROJECT

Grant application submitted through USDOT Competitive Highway Bridge Program

- Only available to rural states
- Applied for $28 Million – Received $20.8 Million
- Minimum of 30 bridges to be constructed
- Minimum Benefit Cost Ratio of 23.7
- Project to be delivered using Design-Build

Project Goals

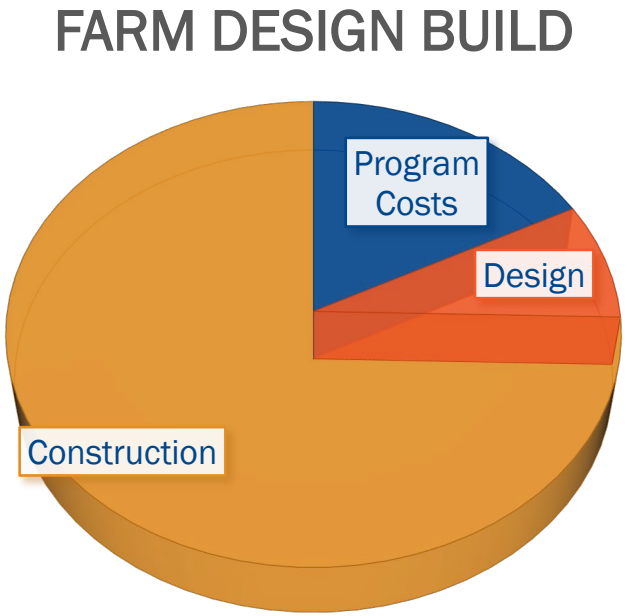
1. Safely deliver the project within the program budget of $25.99 million on or before October 31, 2023
2. Use innovation to maximize the number of locations to be addressed
3. Provide quality long-lasting structures
4. Minimize public inconvenience through increased construction speed and flexibility in scheduling

Budget

Total Program Budget is $25.99 million

- Project was awarded $20.794 grant through Competitive Highway Bridge Program
- Matching funds of $5.2 million will come from the NE and NW Districts

Design-Build Contract is $21.5 million



Project Requirements

All construction will consist of structure replacement

- No bridge rehabilitations will be allowed
- Alternative solutions related to structure type and structure elimination will be entertained

Proposal Evaluation
Technical Reviews

Proposals evaluated in 3 scoring categories

- Bridge Bundle Definition was scored from data entered into the DB-903a form
- Bridge Quality and Longevity was scored by a team of 8 technical experts.
- Location Completion and Maintenance of Traffic was scored by a team of 6 technical experts.

Category	Available Points
Bridge Bundle Definition	55
Bridge Quality and Longevity	30
Location Completion and Maintenance of Traffic	15
Total	100

Bridge Bundle Definition

Project Goal #2: Use innovation to maximize the number of locations to be addressed.

Category	Available Points
Bridge Bundle Definition	
Part 1 – DB-903a Bridge Definition Summary	40
Part 2 – Bonus Points	15
Total	55

DB-903a FORM

The DB-903a Form is a self scoring spreadsheet provided to the teams. The teams selected from allowable treatments and were self-scored according to the selections they proposed.

Bridge Treatment	Method Credits Points
No Treatment	0
Replacement	1
Alternative Treatment Method	*
*Method Credit to be determined by MoDOT after submission as ATM	

DB-903a FORM

- **Method Credit:** Based on Proposed work (None, Replacement, or ATM)
- **Size Factor:** Based on the size of the existing structure
- **Weighted Factor:** Based on the bridge condition ratings, ADT factor, and priority factor
- **Total Credit =** Method Credit * Size Factor * Weighted Factor
- **Sum Total:** Sum of Total Credit for locations completed

DB-903a FORM

When printing, set paper size to 11x17 landscape

Fields Completed by Proposer

Bridge Count	District	Bridge Number	Route	County	Year Built	Feature Crossed	Benefit / Cost Ratio (BCR)	ADT	Proposer's Choice Method of Work	Proposed Alternate Treatment Method	Method Credit	Size Factor	Weighted Factor	Total Credit
28	NE	P0251	E	LEWIS	1952	DERRAHS BR	44.2	201	Replacement		1	3.34	1.45	4.851
29	NE	X0769	J	LEWIS	1948	BIG GRASSY CR	16.3	192	Replacement		1	3.70	1.09	4.017
30	NE	P0315	Y	MACON	1953	HOOVER CR	35.1	362	Replacement		1	4.06	1.15	4.669
31	NE	P0233	C	SCHUYLER	1952	N FK MID FABIUS RV	25.5	254	Replacement		1	3.19	1.11	3.555
32	NE	P0398	M	SCHUYLER	1954	S FK N FABIUS RVR	4.8	52	Replacement		1	2.57	1.86	4.778
33	NE	S0911	A	SCHUYLER	1933	BRUSHY CR	28.3	290	Replacement		1	4.53	1.88	8.519
34	NE	T0891	E	SCHUYLER	1941	N FK S FABIUS RVR	11.4	117	Replacement		1	3.95	1.86	7.350
35	NE	X0097	A	SCHUYLER	1935	N FK MID FABIUS RV	40.0	408	Replacement		1	3.53	1.67	5.892
36	NE	S0414	W	SCOTLAND	1932	TOBIN CR	11.2	129	Replacement		1	5.08	1.50	7.629
37	NE	X0174	H	SCOTLAND	1949	N FK N WYACONDA RV	36.4	296	Replacement		1	3.84	1.51	5.788
38	NE	X0201	B	SCOTLAND	1949	N FK N FABIUS RVR	27.9	296	Replacement		1	4.21	1.51	6.334
39	NE	T0391	M	SHELBY	1932	BLACK CR	21.2	264	Replacement		1	4.53	1.86	8.447
40	NE	X0212	MO 94	WARREN	1947	TRELOAR CR	77.9	1460	Replacement		1	4.31	1.29	5.556

Total Number of Locations Completed=	40	Must be greater than 30
Average Benefit/Cost Ratio=	25.6	Must be greater than 23.7
Sum Total:	244.969	

Best Value Proposal

WILSON
&COMPANY
HIGHER RELATIONSHIPS

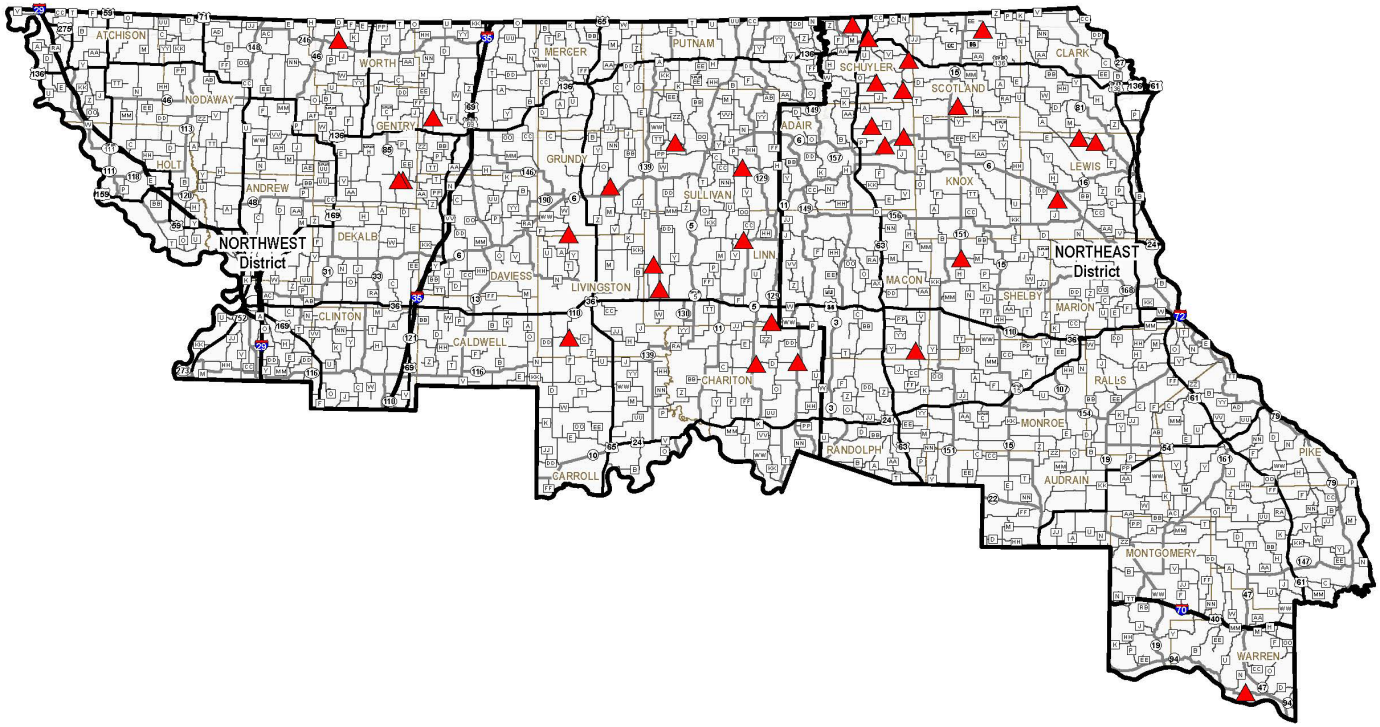
The Lehman-Wilson proposal includes:

- 31 structures replaced
- Low maintenance steel structures that allow for future re-deck and rehabilitation
- Added value of $760,000 over other Proposals (Based on MoDOT's original estimates)
- Additional 2321 SQFT of existing bridge deck replaced
- Highest average ADT for routes included of any proposal
- Highest average Benefit Cost Ratio of any proposal

FARM DESIGN BUILD PROJECT

Number of Bridge Replacements: 31 of 41 (30 minimum)

- 3 – RCB
- 3 – Single Span
- 25 – SDCL

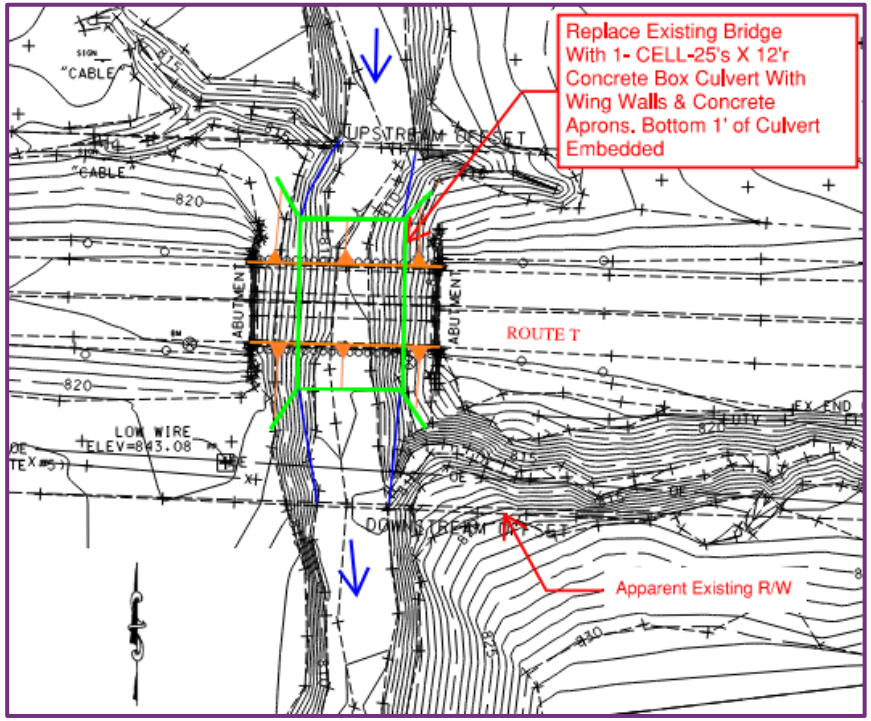


Design Build Innovation During Proposal

NUMBER	TITLE	DESCRIPTION	MoDOT RESPONSE
AAS-01	Continuous Approach Slab Placement	Details describing a technique to place the bridge approach slab monolithic with the bridge deck	Accepted
AAS-03	Simple for Dead Load-Continuous for Live Load (SDCL) Steel Girder Design Methodology	Details describing the advantages of this methodology compared to conventional methods for designing and constructing steel bridges	Accepted
ATM-01	Bridge S0386 Replacement	Describes approach to replace the bridge with a reinforced concrete box culvert	Accepted
ATM-02	Bridge S0050 Elimination	Describes approach to eliminate the bridge with a reinforced concrete box culvert	Accepted
ATM-03	Bridge P0521 Replacement	Describes approach to replace the bridge with a reinforced concrete box culvert	Accepted

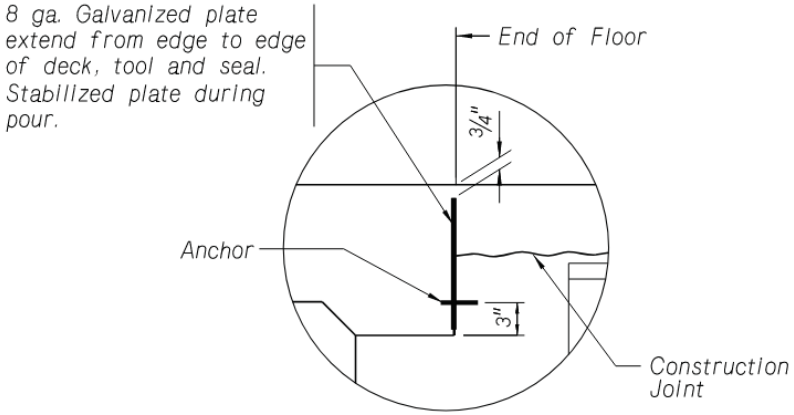
Alternate Treatment Methods

Concrete Box Culverts



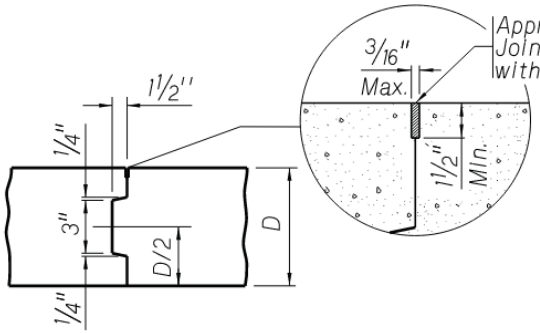
Alternate Treatment Methods

CONTINUOUSLY PAVED APPROACH SLAB



ALTERNATE JOINT DETAIL AT END OF FLOOR

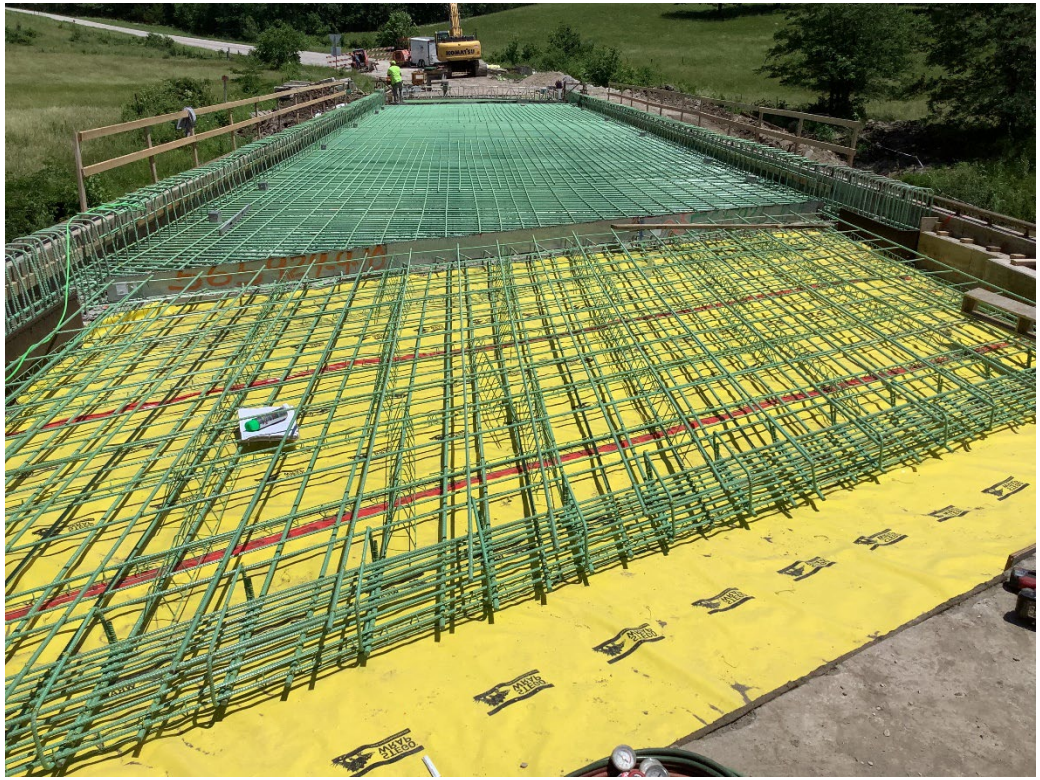
To be used if approach slab is poured continuous with bridge deck.
Not to Scale

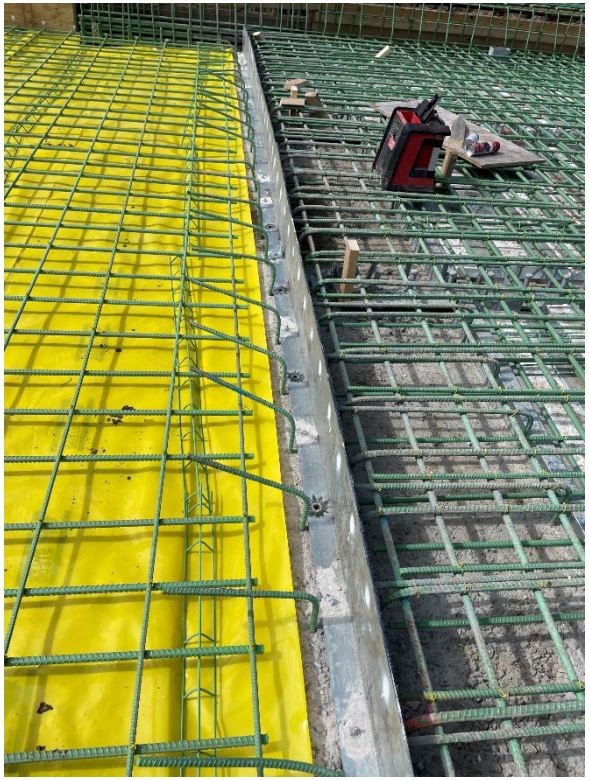


CONSTRUCTION JOINT
Not to Scale

The Contractor shall prepare and seal the joint according to the manufacturer's recommendation. Before sealing the joint wall surfaces shall be sandblasted to remove any deleterious material.
After sandblasting the entire joint shall be cleaned with compressed air having a minimum pressure of 90 psi. The compressed air shall be free of any contaminates. The joint shall be dry at the time of sealing.

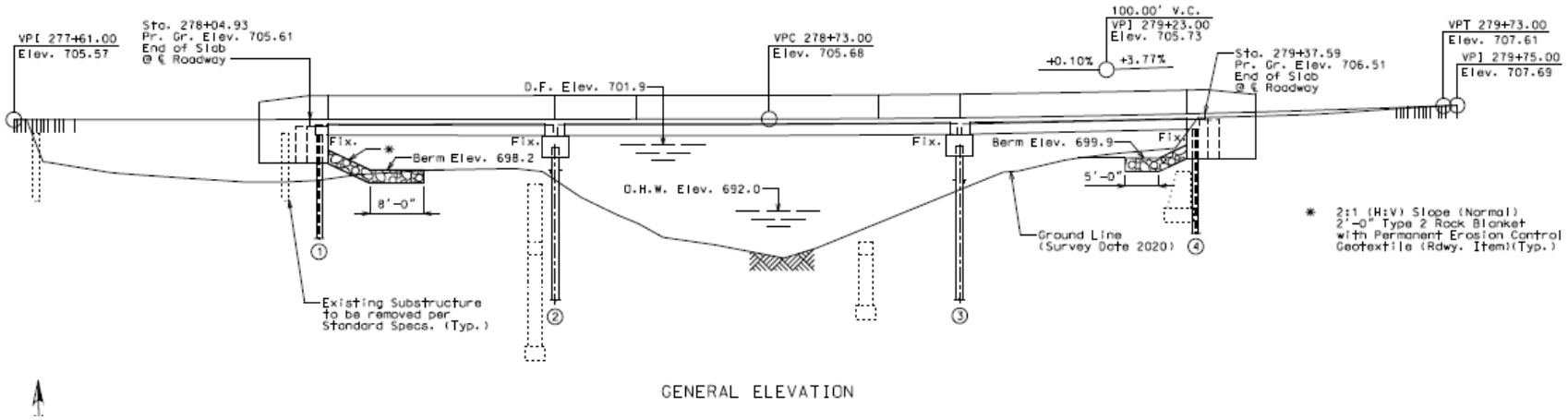
CONTINUOUSLY PAVED APPROACH SLAB





Simple for Dead Continuous for Live (SDCL)

Multi-span bridges using simple span wide flange beams, made continuous (like P/S I-girders)



Why SDCL

Ease of construction

Eliminates the use of traditional field splices

Advantageous span ratios

- 21′-44′-21′ or 23′-48′-23′
- Customize beams to the spans

Simple details make steel much more competitive

- Certified Bridge Fabricator – Simple (SBR) SDCL
- Certified Bridge Fabricator – Intermediate (IBR)
- Certified Bridge Fabricator – Advanced (ABR)

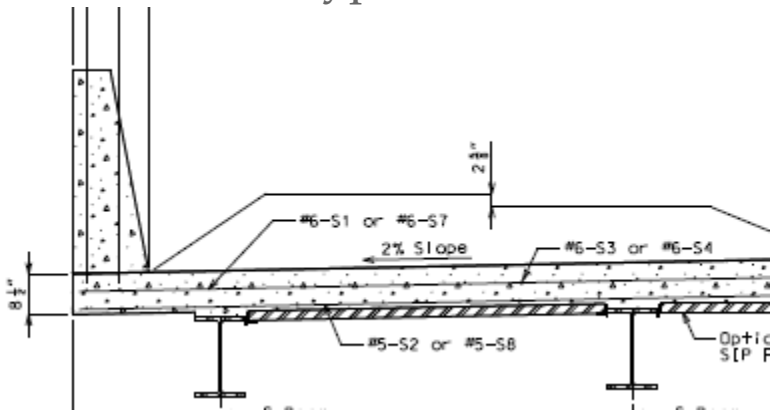
Why SDCL

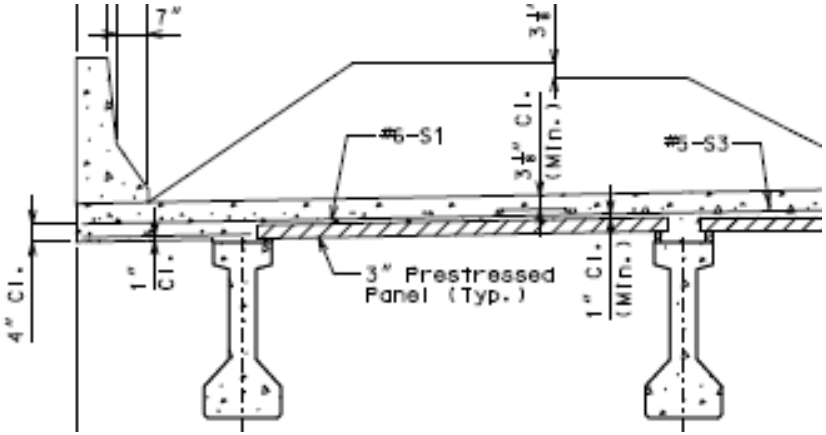
Beam Weights (steel vs. concrete)

- W18x158 @ 60′ = 9480 lbs.
- MoDOT Type 3 @ 60′ = 23,869 lbs.
- Easier to handle
- Cost effective foundation type

Thinner superstructure (no grade raise, “no-rise” cert.)

- W18x158 @ 60′ = 19.7″
- MoDOT Type 3 @ 60′ = 39″





SDCL Formulae

Calculate the required area of slab tension reinforcement (Strength Limit State)

$$A_s = \frac{M_u}{\phi f_y \left(d - H/2\right)}$$

Calculate the minimum height of the steel compression block

$$H_{\min} = \frac{1.7 A_s f_y}{b_f F_{ypl}}$$

H_{min} = minimum height of the bottom compression block, parallel to the depth of the girder, in.
F_{ypl} = yield strength of the steel block, ksi
b_f = width of the girder flange, in.

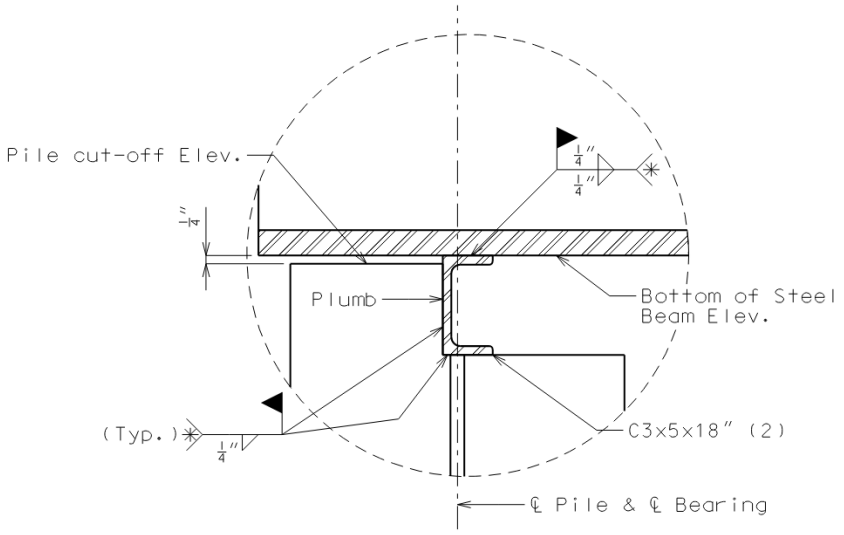
*Engineering Journal / Second Quarter / 2014

SDCL Connection

SDCL Connection

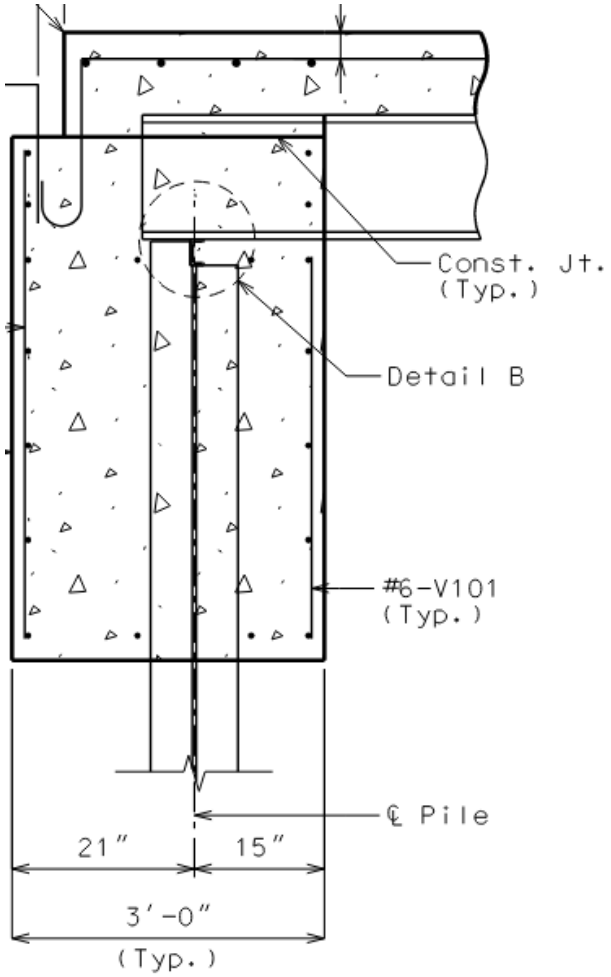
Innovation During Delivery

Single-Stage Abutment Caps



DETAIL B

* Galvanizing material shall be omitted or removed one inch clear of weld locations in accordance with Sec 702.



Innovation During Delivery

SDCL – How it's Constructed

SDCL – How it's Constructed

SDCL – How it's Constructed

SDCL – How it's Constructed

SDCL – How it's Constructed

SDCL – How it's Constructed

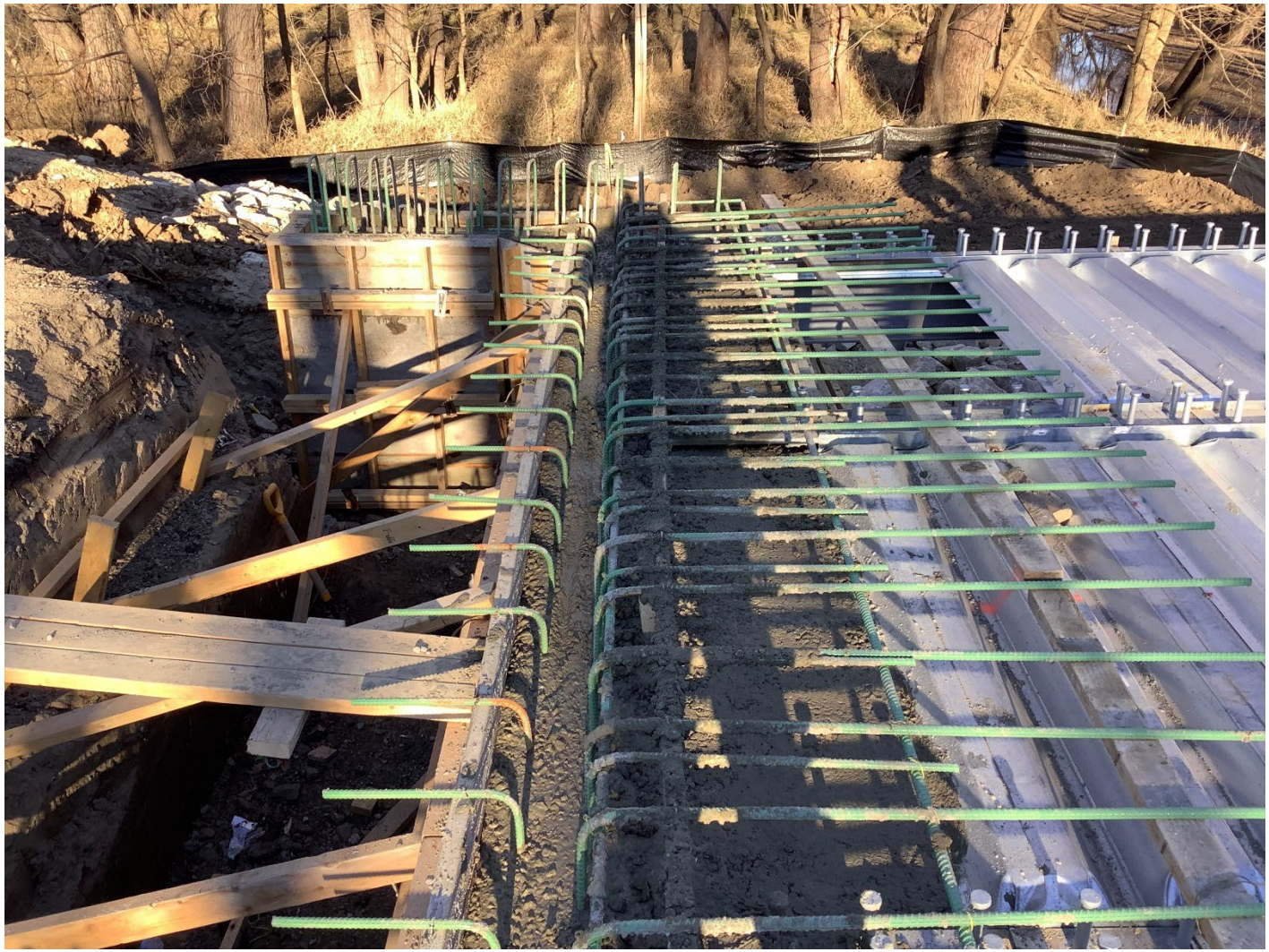
SDCL – How it's Constructed

SDCL – How it's Constructed

SDCL – How it's Constructed

Beams with webs greater than 18 inches allow the use of traditional C-49 overhang brackets

SDCL – How it's Constructed



SDCL – How it's Constructed

SDCL – How it's Constructed

COLD WEATHER CURING

Structured schedule to continue through winter



FARM DESIGN BUILD PROJECT

Where are we now?

- 15 bridges complete and open
- 5 currently under construction
- 4 more scheduled to close by the end March
- All construction to be completed by 9-15-2023

What do FARM Bridges look like?

What do FARM Bridges look like?

Any Questions?

Jeff Gander, FARM Project Director
Jeffery.Gander@modot.mo.gov
(660) 651-0057
www.modot.org/farm-bridge-program

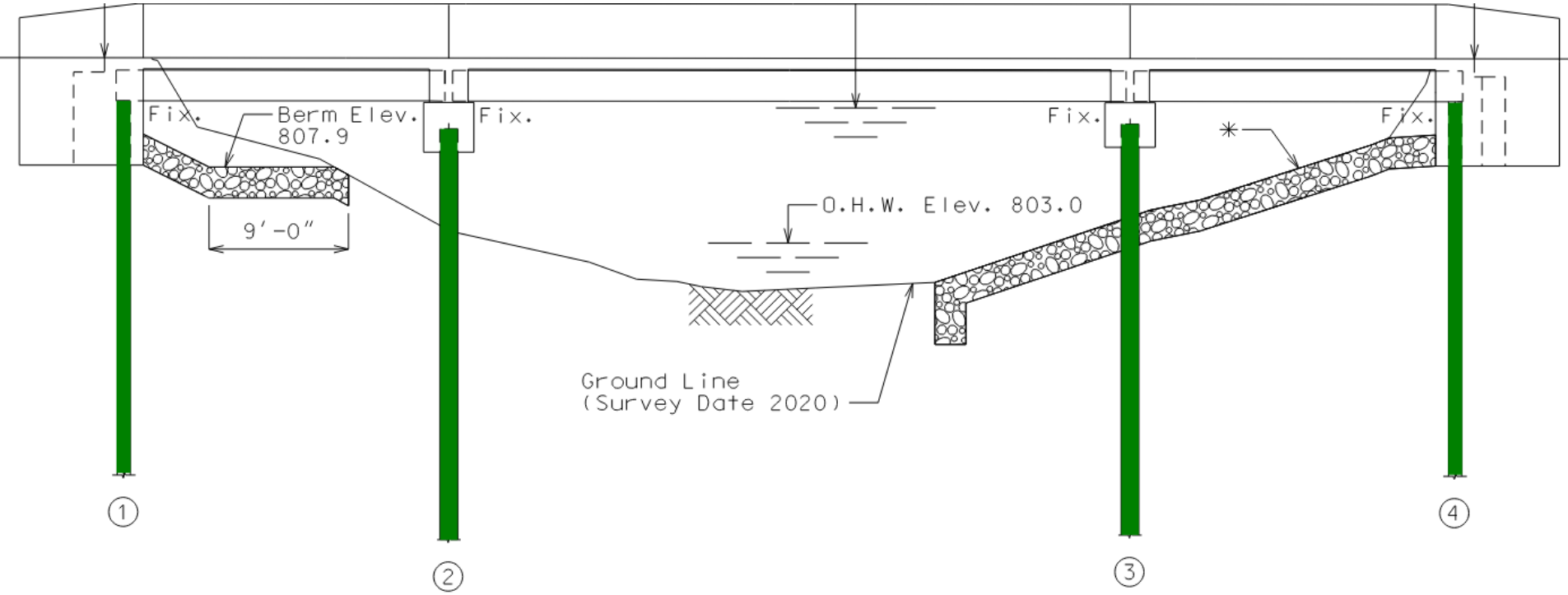
Garrett Hummel, Project Manager
Garrett.Hummel@wilsonco.com
(816) 701-3132

Wesley O'Neal, Structures Design
Wesley.O'Neal@wilsonco.com
(816) 701-3122

Bonus Slides for Q&A

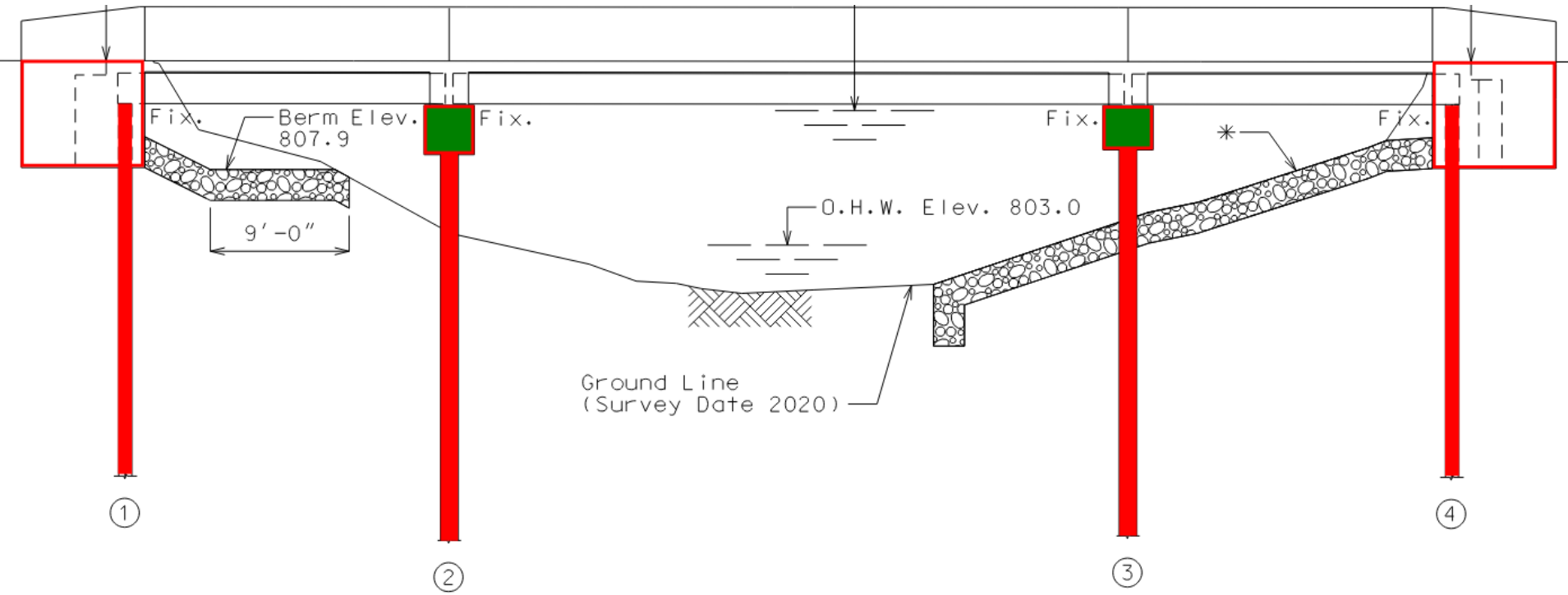
HOW IS SDCL CONSTRUCTED?

Week 2 - Drive pile at bents



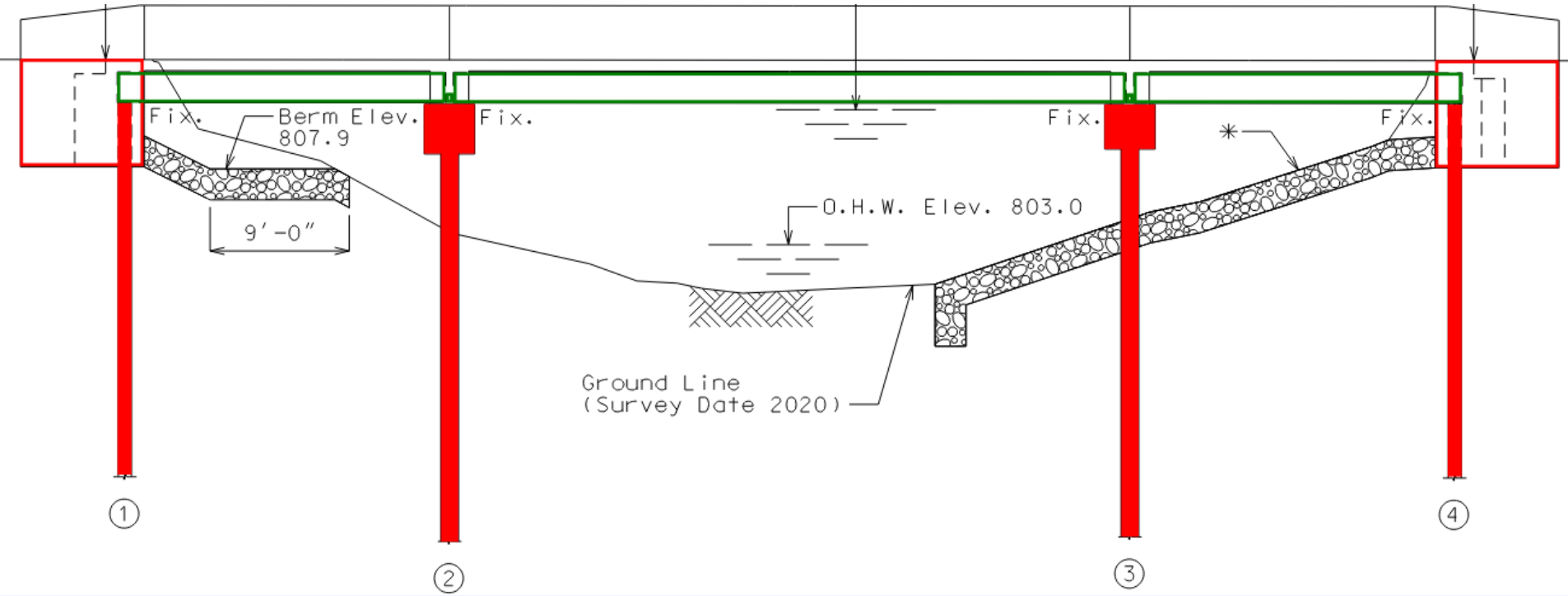
HOW IS SDCL CONSTRUCTED?

Week 3 - Place concrete at intermediate bents



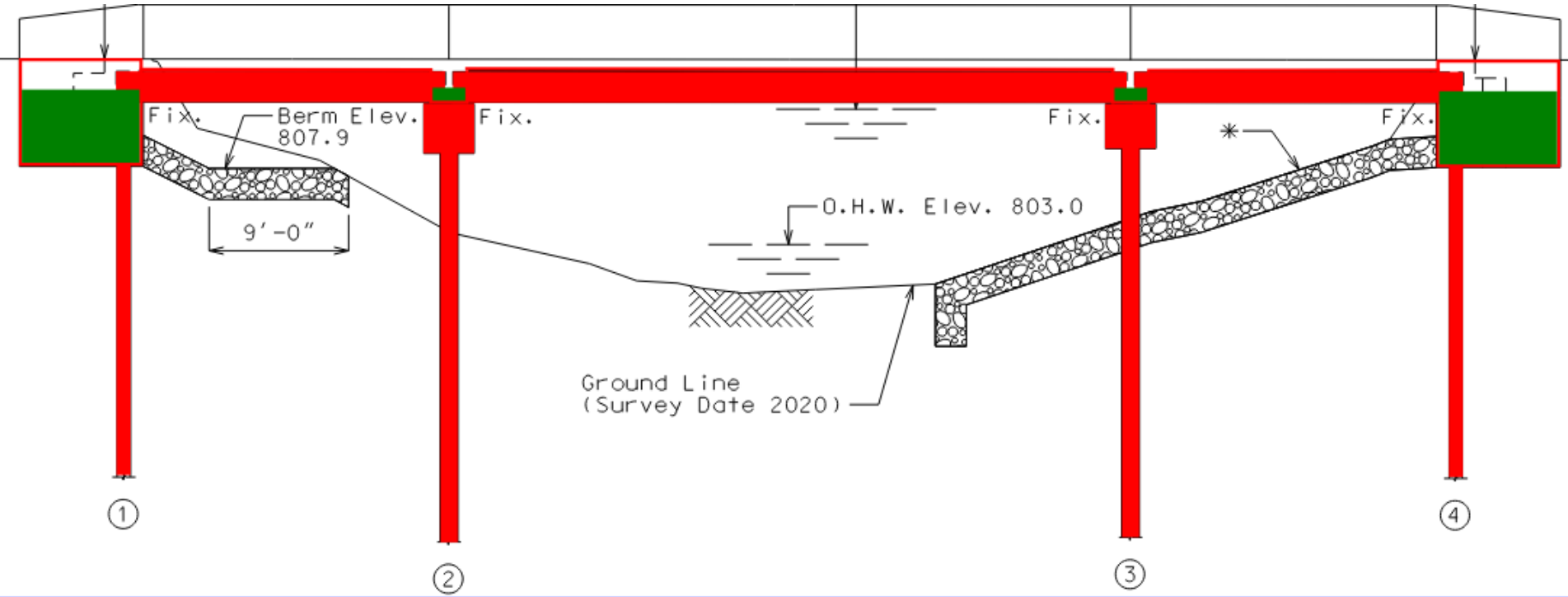
HOW IS SDCL CONSTRUCTED?

Week 4 - Place steel rolled beams



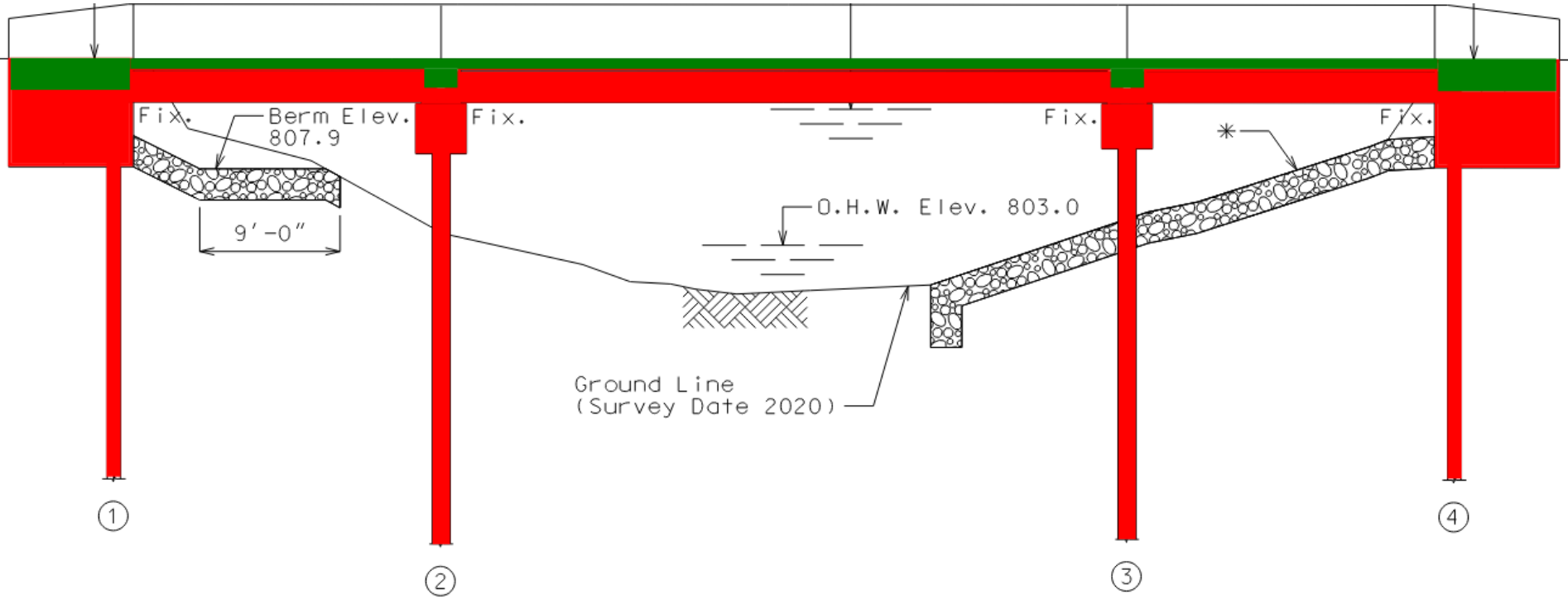
HOW IS SDCL CONSTRUCTED?

Week 5 - Place concrete diaphragms at bents



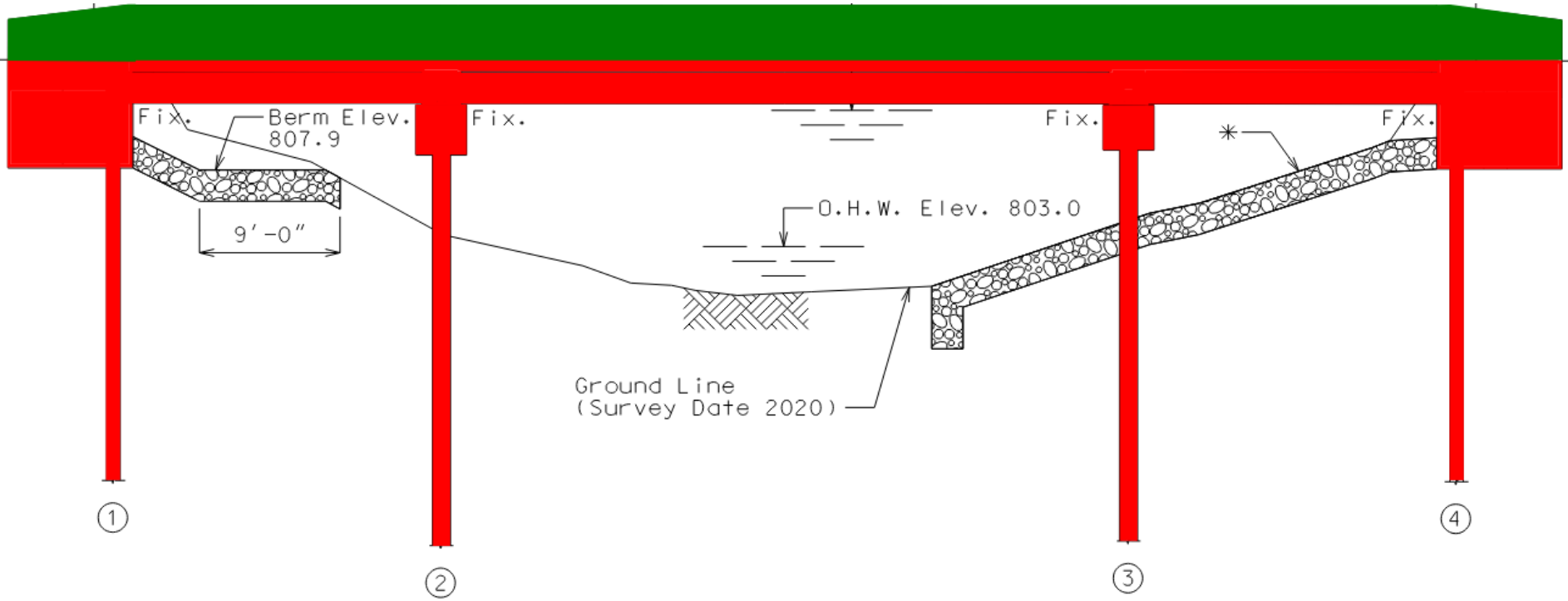
HOW IS SDCL CONSTRUCTED?

Place concrete slab



HOW IS SDCL CONSTRUCTED?

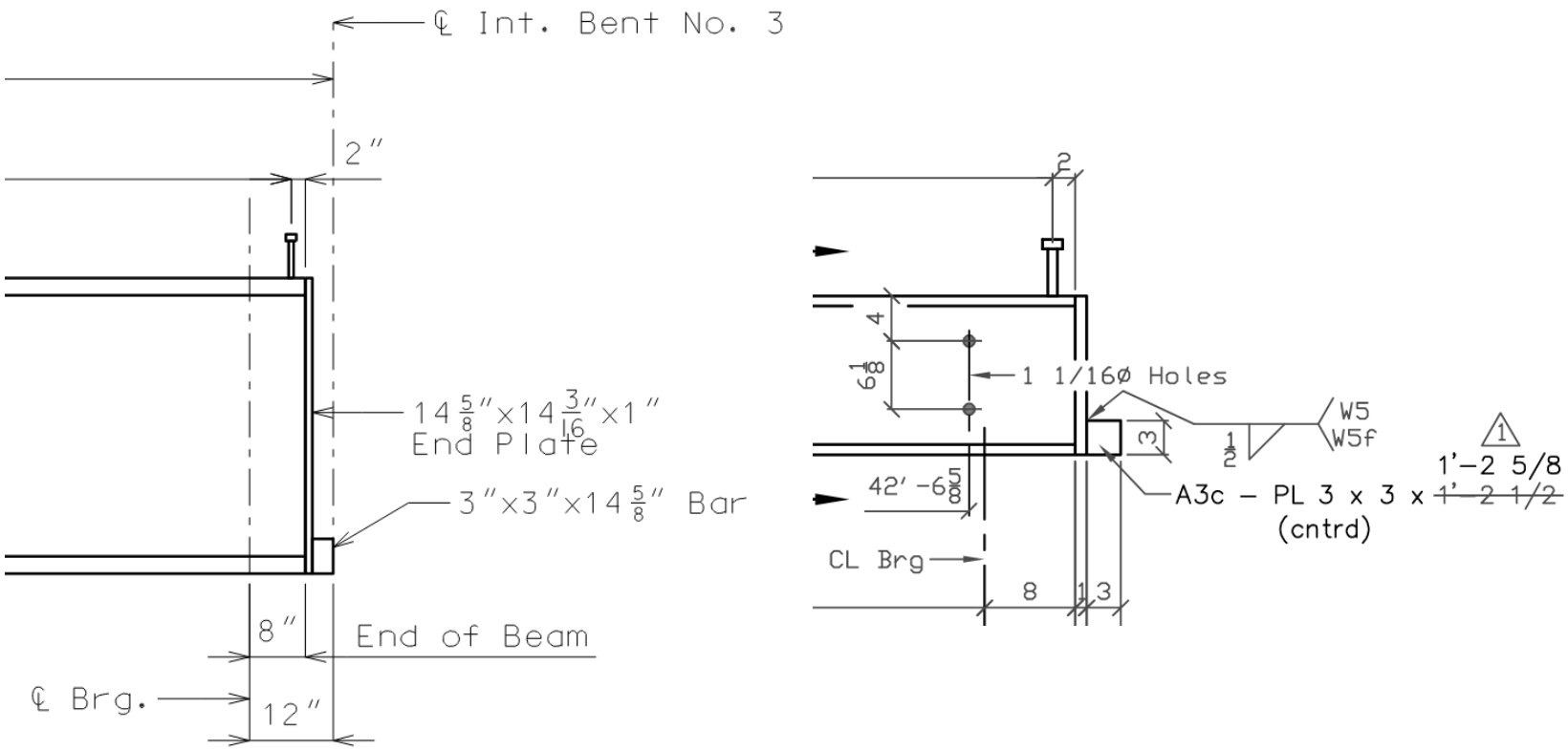
Slip form concrete barrier



DESIGN SDCL CONNECTION

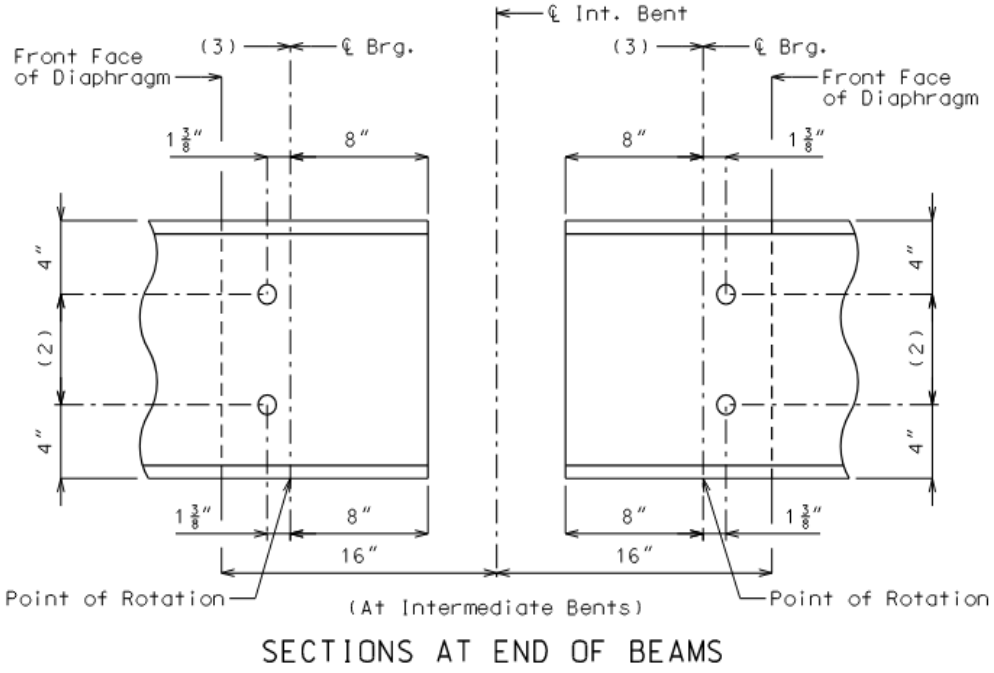
End plates welded to ends of beams

Steel compression block

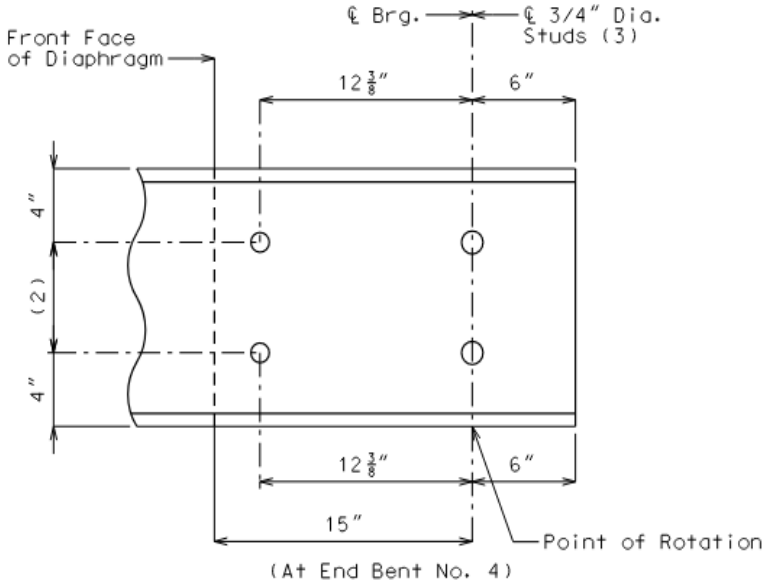


DESIGN SDCL CONNECTION

- Holes for reinforcement at interior bents
- Studs at end bents



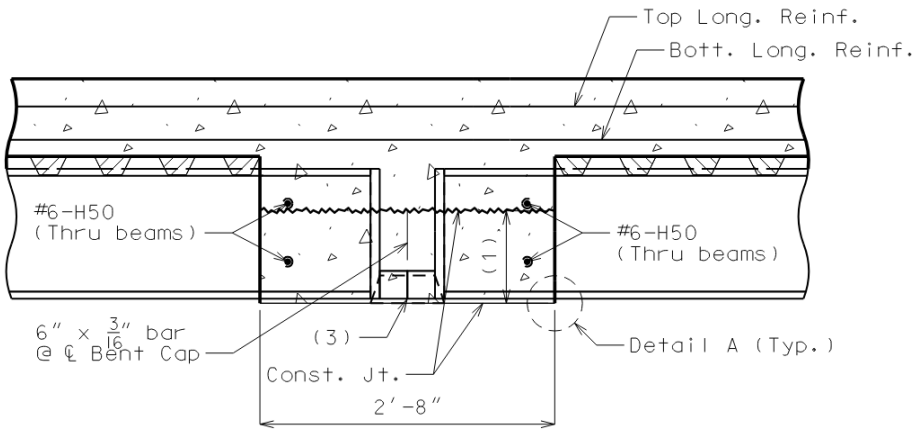
SECTIONS AT END OF BEAMS

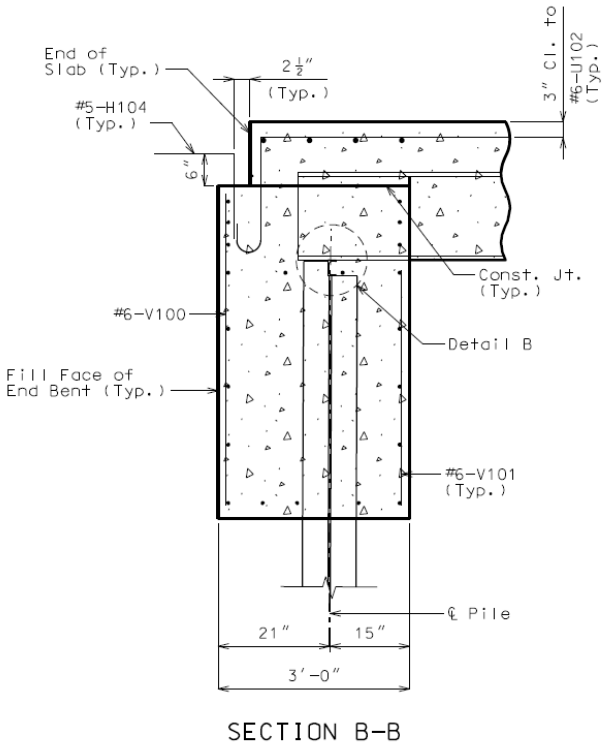


DESIGN SDCL CONNECTION

Concrete diaphragms cast prior to slab

Negative moment slab reinforcement to provide live load continuity

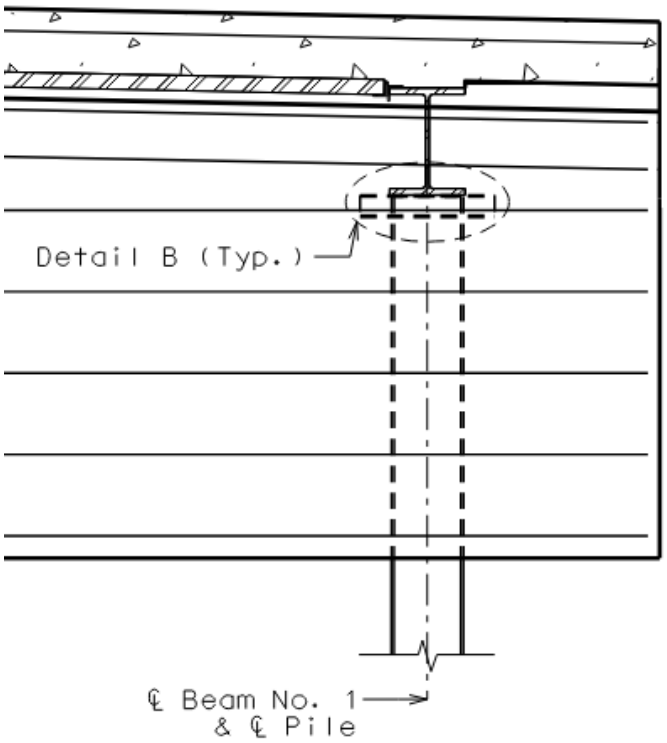


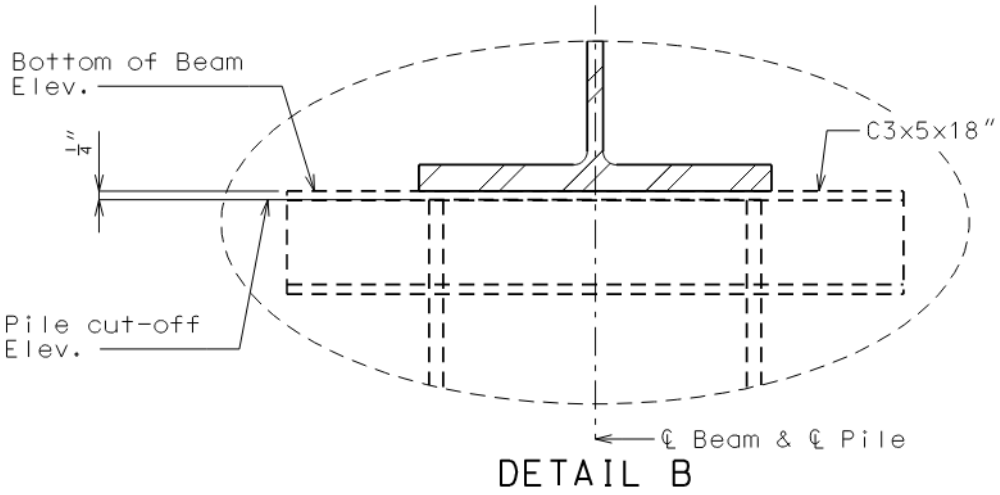


SECTION B-B

INNOVATION ON FARM

FARM standard end bent detail





BEAM COATING OPTIONS (PARTNERING)

Original plan for beam coating

- Weathering steel (when conditions allowed)
- Painted steel

Covid-19 caused issues with weathering steel and paint availability

- Warehouses had reduced inventory
- Paint availability was a challenge early on

BEAM COATING OPTIONS (PARTNERING)

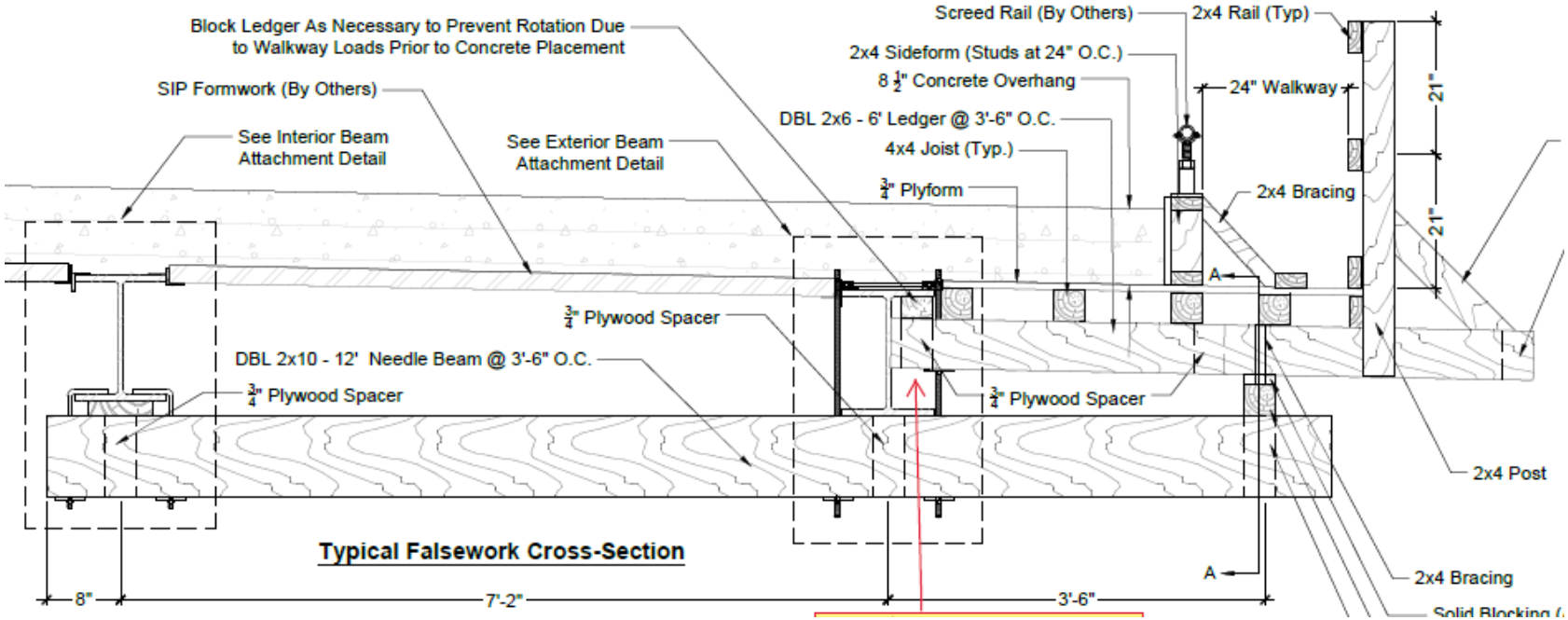
Equal or Better Change Proposal

- MoDOT expressed interest in galvanized beams
- Smaller beam sizes and shorter spans allowed galvanization to be a competitive option
- Maintenance of galvanized elements in rural environments is over 100 years, well exceeding the design life of these structures
- First maintenance of a painted steel beam is approximately 40 years with a design life of approximately 75 years

OVERHANG FALSEWORK

Shallow beam depths require alternate overhang construction methods

Needle beam overhang falsework is required for webs shallower than 18 inches



COLD WEATHER CURING

Portable Hydronic Heat Machine allows work to continue during winter months

Utilize Cellular Con Cure Nodes & Sensors to monitor and control internal concrete temperature