# Rustic Road Bridge:
# *Lessons Learned*


Presented by:

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Boone County

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Bartlett & West

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Bartlett & West

# Agency Involvement

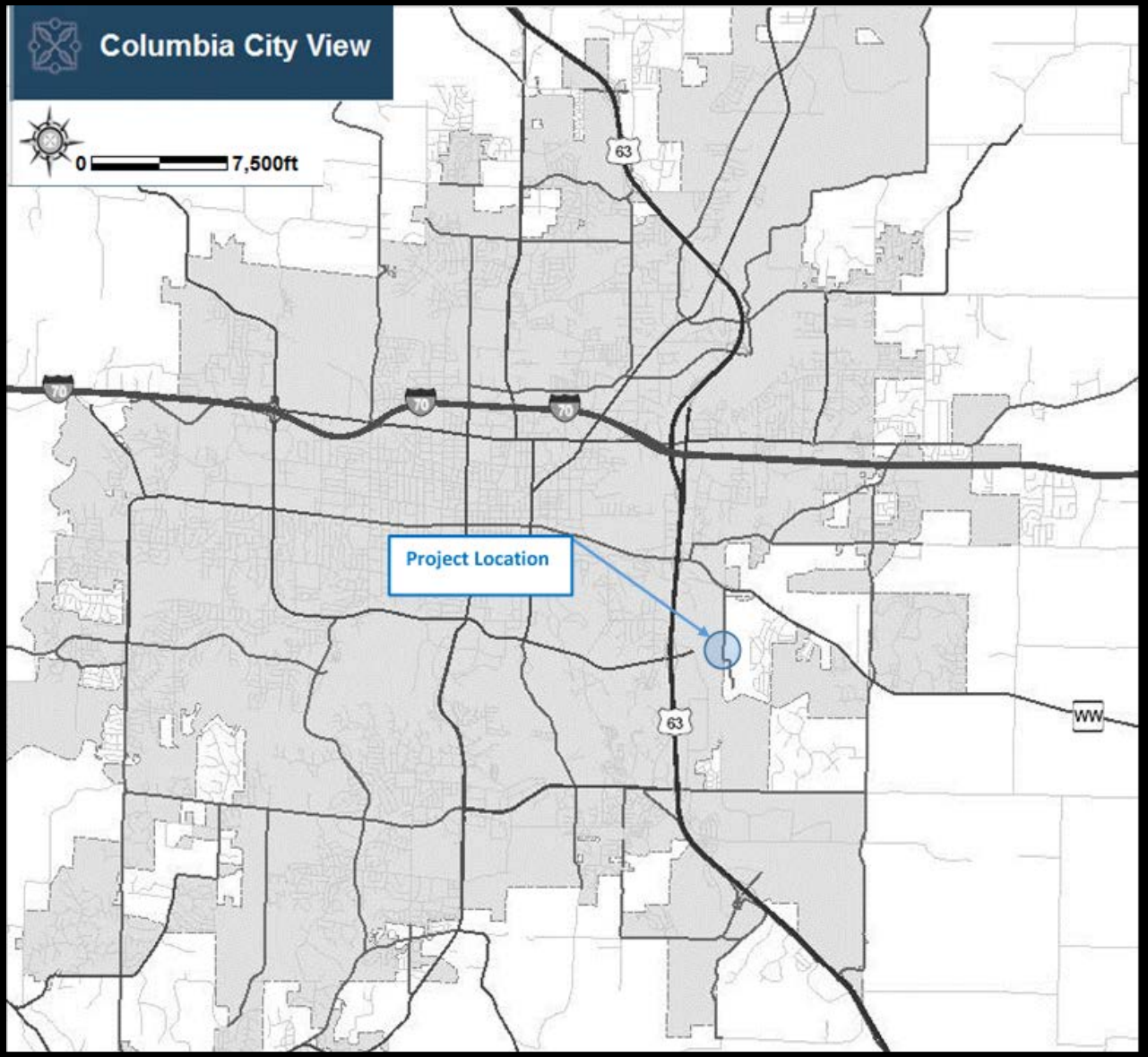
- FHWA
- MoDOT
- City of Columbia
- Boone County
- University of Missouri
- Bartlett & West
- McCann Concrete



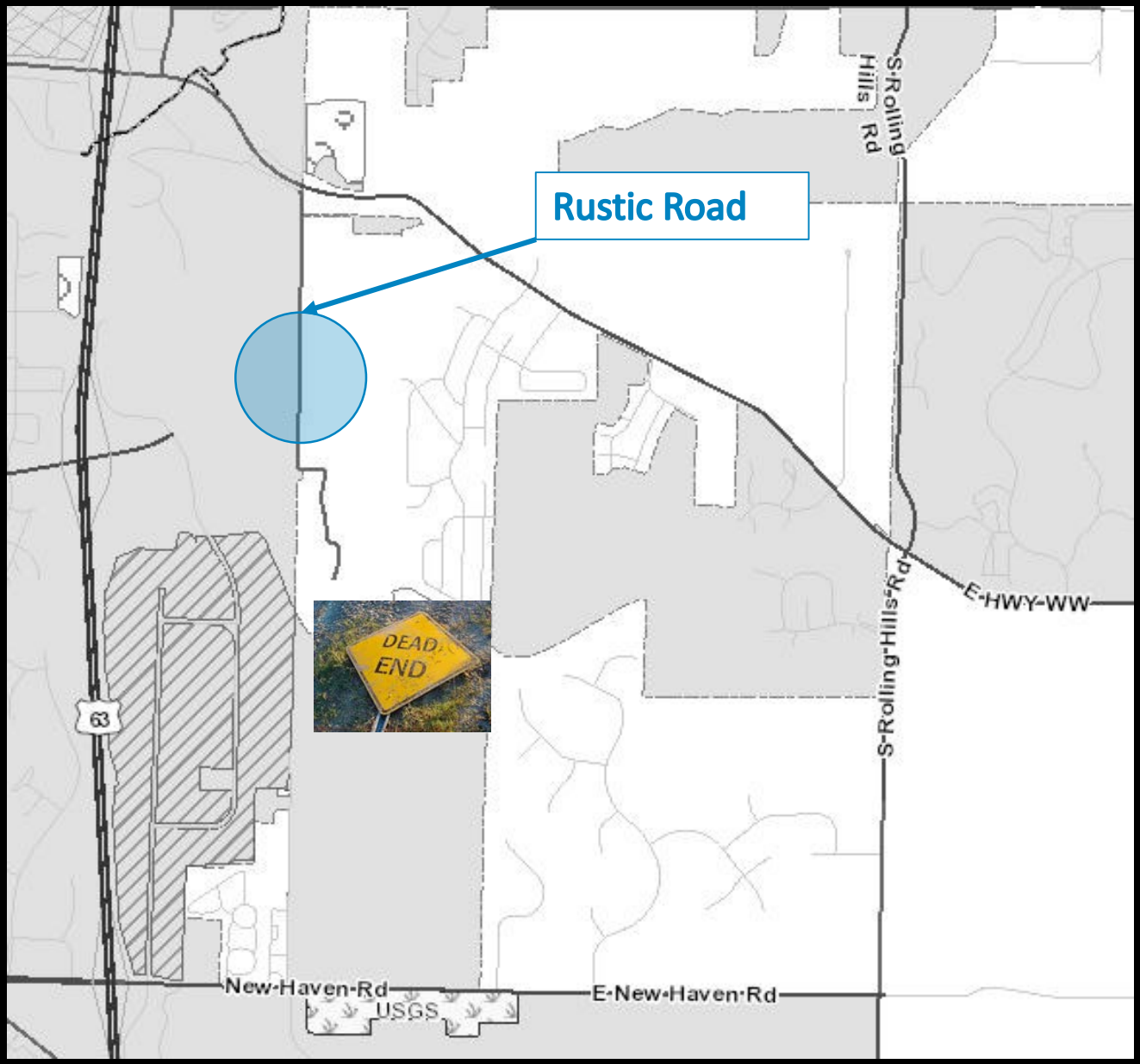




# Project Location

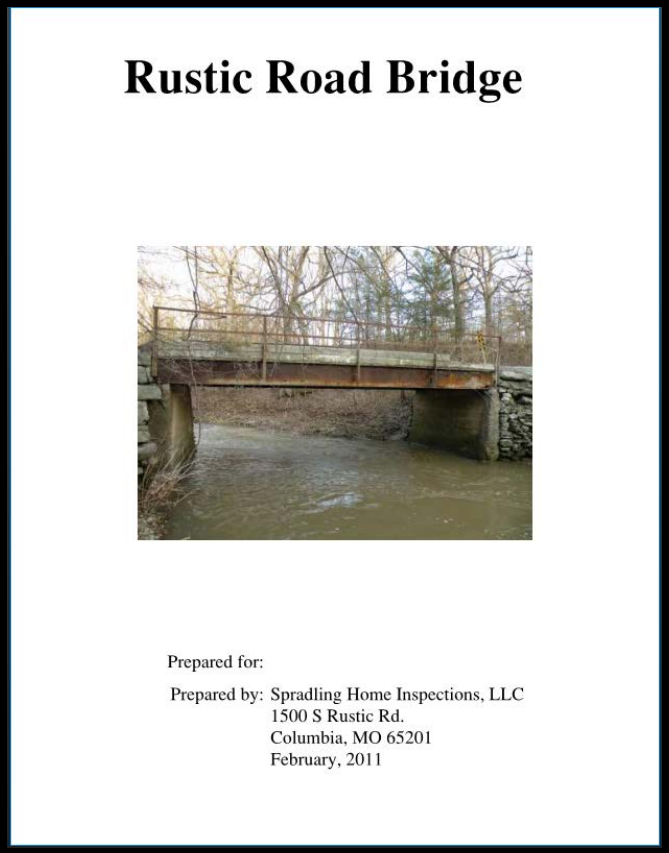


# City of Columbia/Boone County Border



# Public Pressure to Replace Bridge Quickly


*Screen Shot courtesy of KMIZ ABC 17 News*



**Rustic Road Bridge**

Prepared for:

Prepared by: Spradling Home Inspections, LLC
1500 S Rustic Rd.
Columbia, MO 65201
February, 2011

# Existing Bridge Condition

- Section loss
- Pot holes in the driving surface
- Railing (not crashworthy)
- **Load Posting is currently at 3 tons**
  - School bus – approx. 14 tons


  - Fire Truck – approx. 15 tons (w/o water)

  - Ambulance = 3-4 tons

# Rustic Road looking South

# Existing Structure

# Steel Web Section Loss

# Innovative Bridge Research and Deployment Funding (IBRD) Application

- Con-Struct Steel Tub Girder
- GRS-IBS
- Research

# IBRD Funding Breakdown

- Total Funds from FHWA = $204,255
  - Research - $40,000
  - Construction = $164,255

- City of Columbia/Boone County
  - 50/50 split of remaining costs

- Research Funding
  - MoDOT $45,000
  - FHWA (stated above) + $40,000
  - Total = $85,000

# Project Goals

1. Speed
2. Pilot Project
3. Research

# Geosynthetic Reinforced Soil Integrated Bridge System Interim Implementation Guide

PUBLICATION NO. FHWA-HRT-11-026

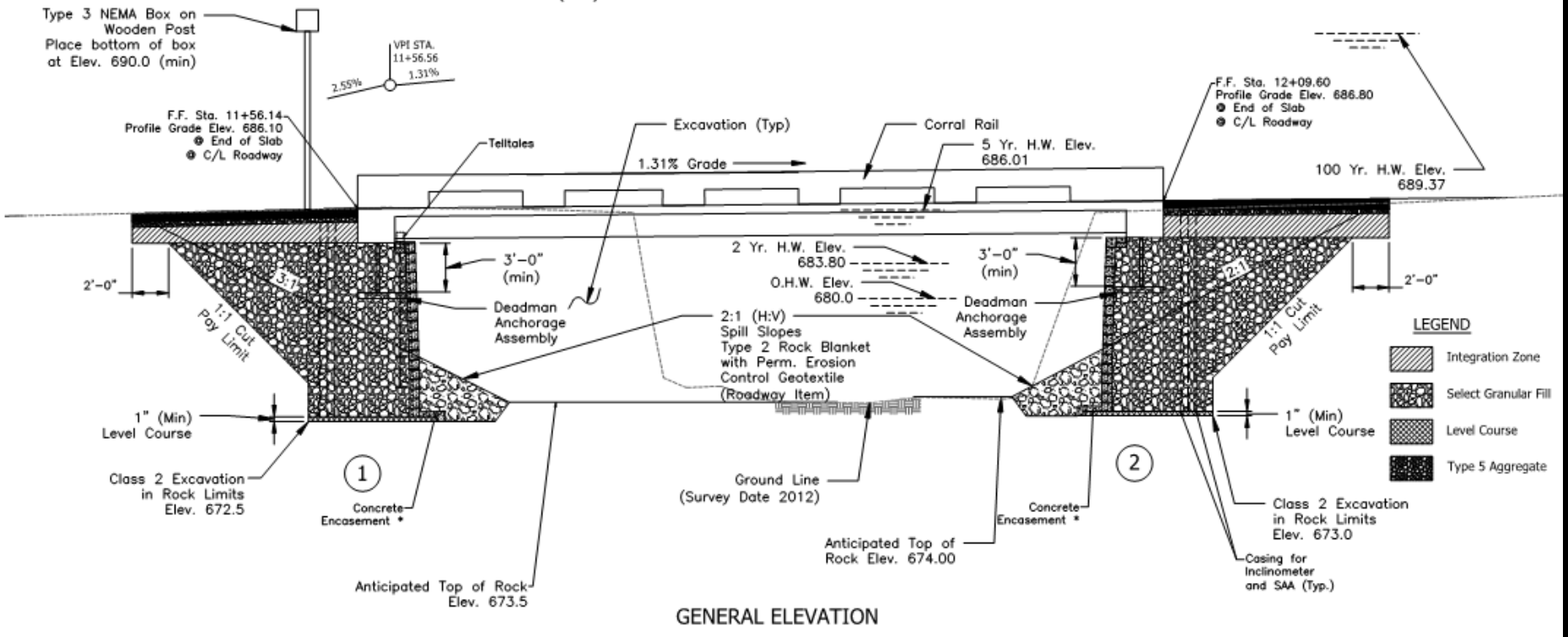
JANUARY 2011

U.S. Department of Transportation
**Federal Highway Administration**

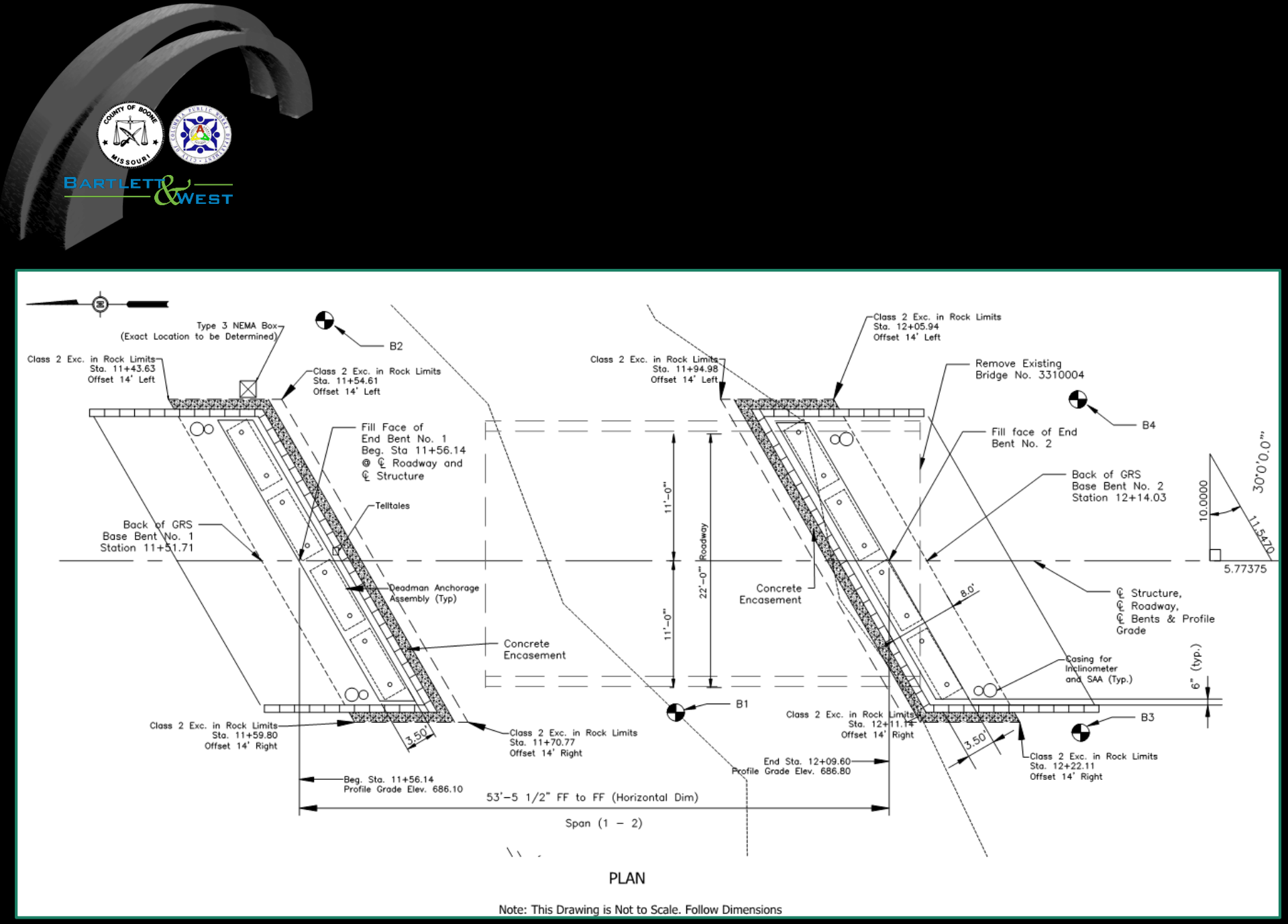
Research, Development, and Technology
Turner-Fairbank Highway Research Center
6300 Georgetown Pike
McLean, VA 22101-2296

# BRIDGE - RUSTIC ROAD OVER NORTH FORK GRINDSTONE CREEK

(50') STEEL TUB WITH PRECAST SLAB GIRDER SPAN



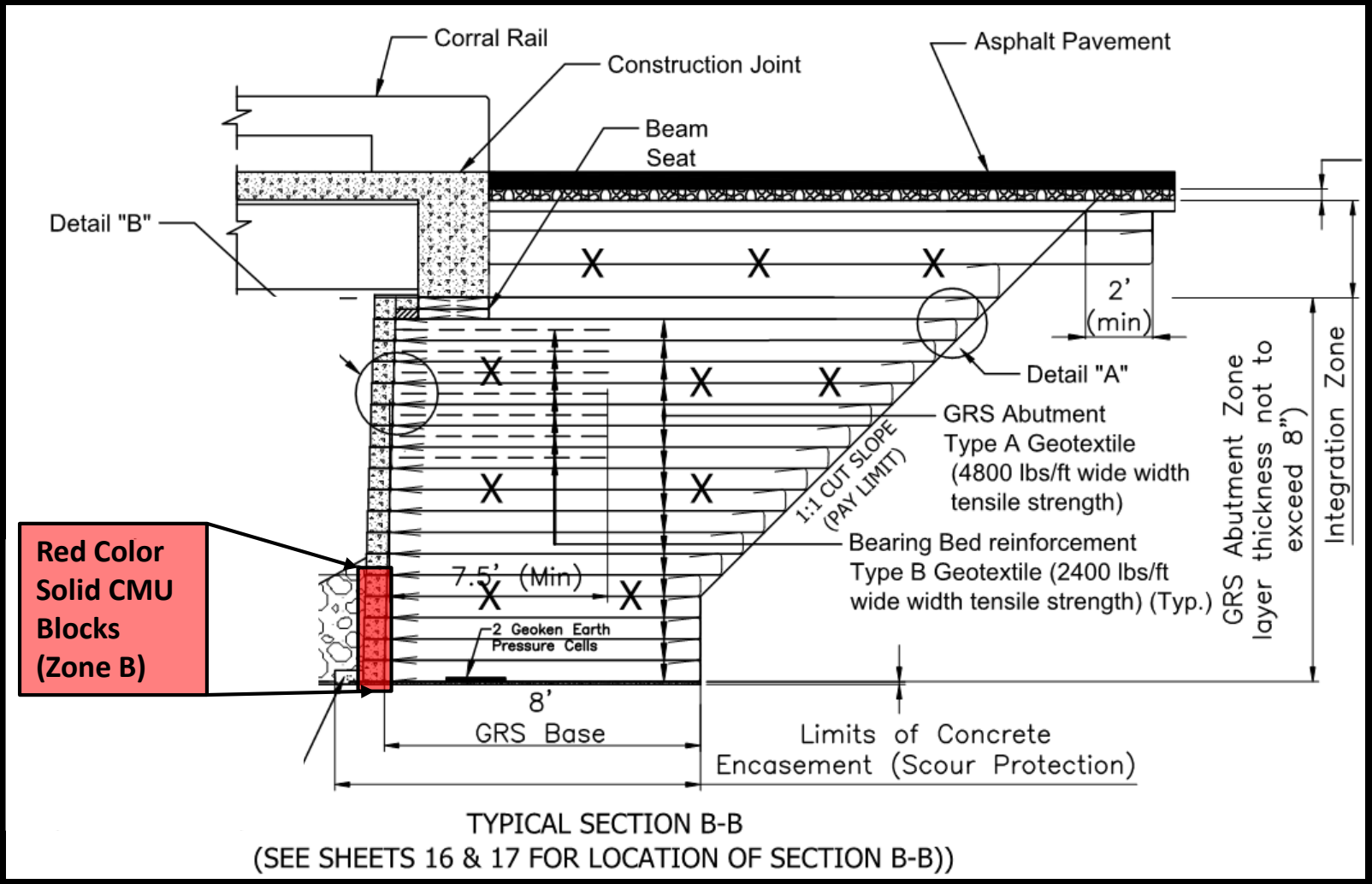

GENERAL ELEVATION




PLAN

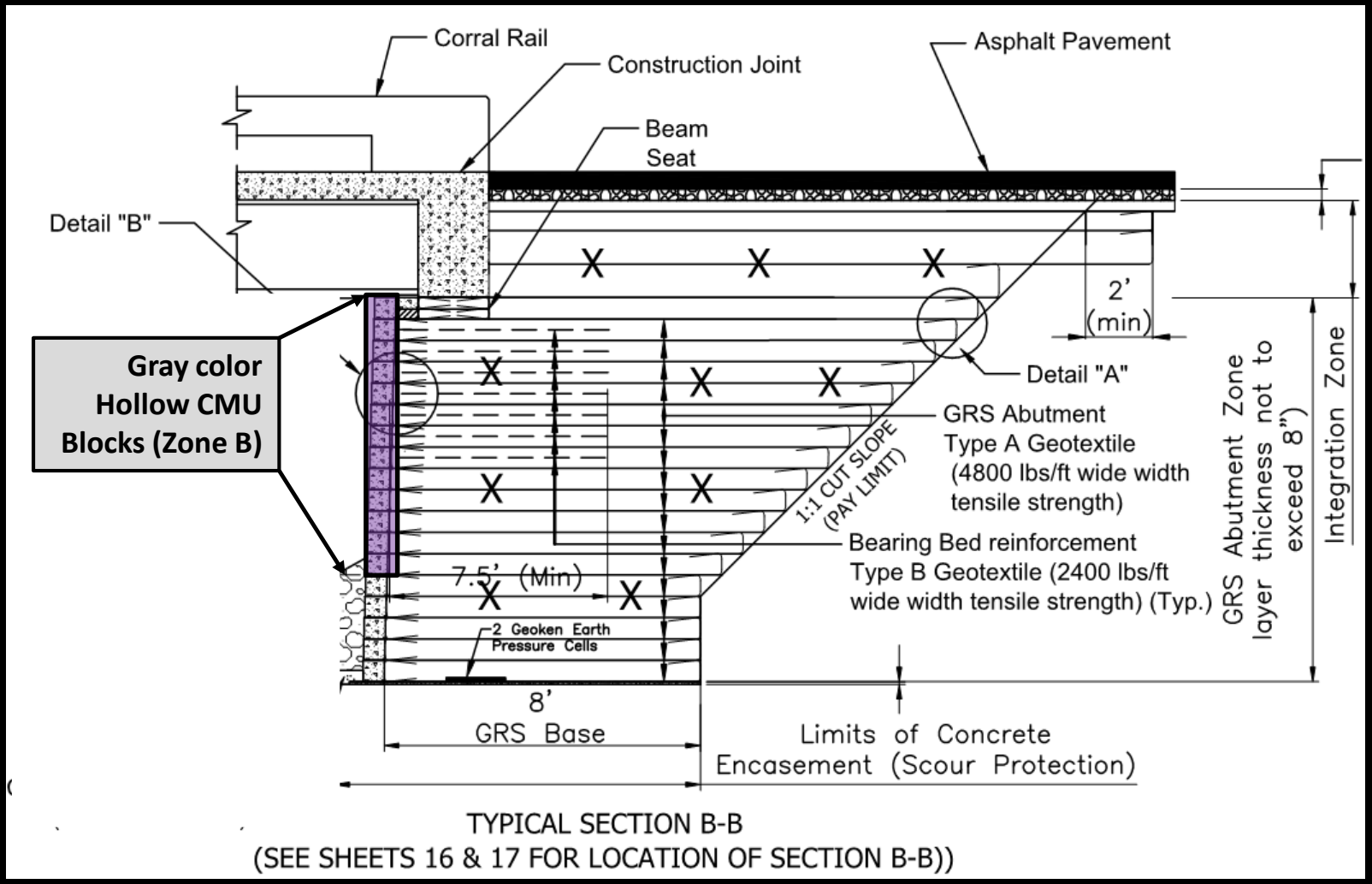
Note: This Drawing is Not to Scale. Follow Dimensions

# Solid Red Blocks on Bottom Rows



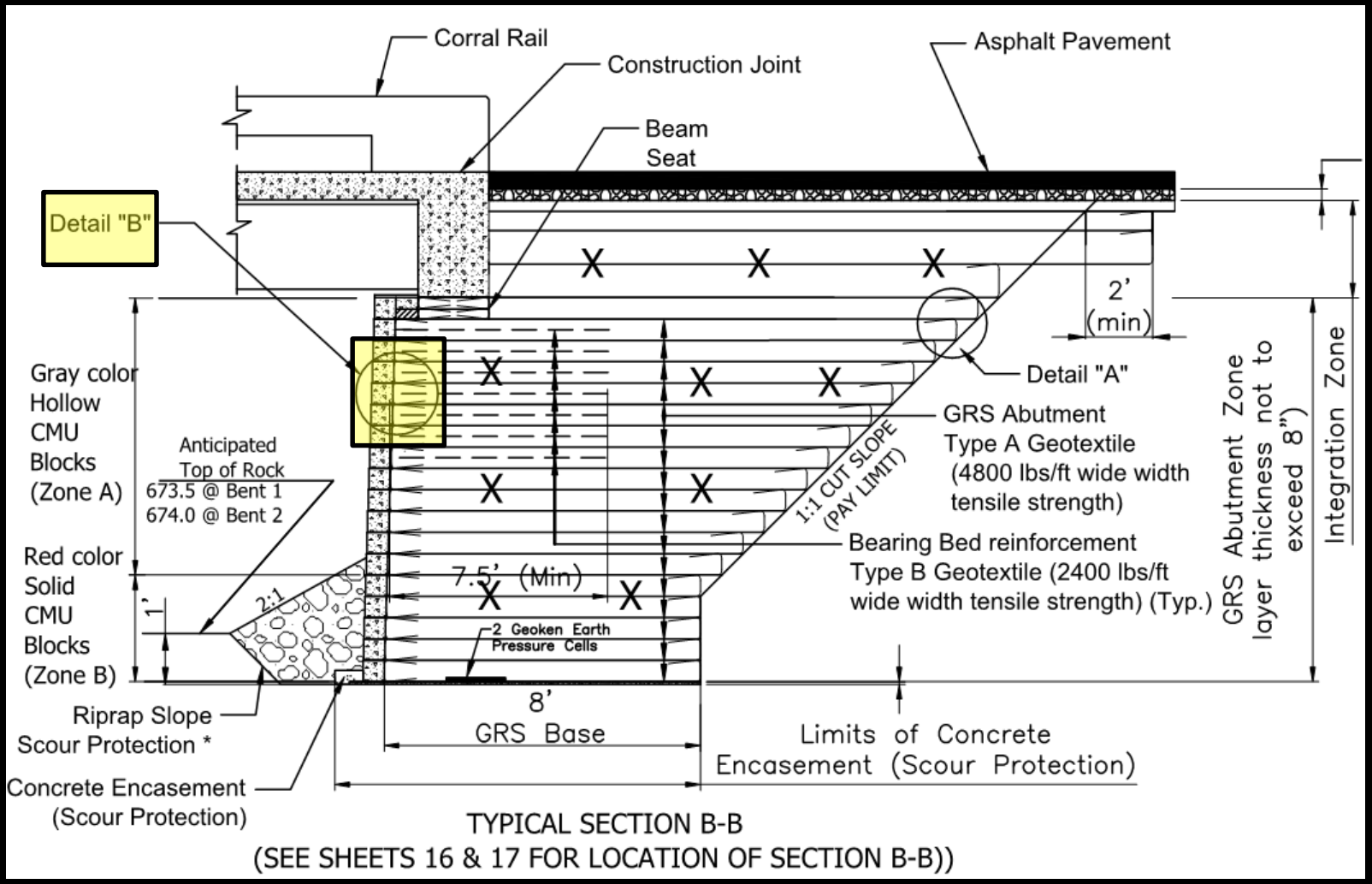

TYPICAL SECTION B-B
(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

# Hollow Gray Blocks Elsewhere



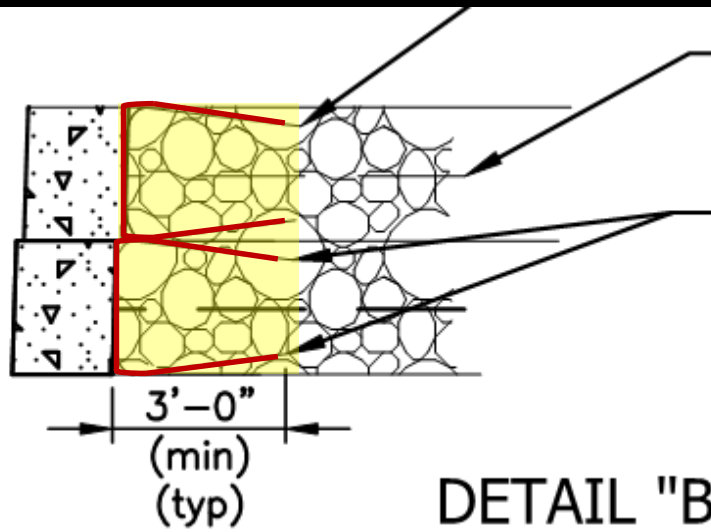

TYPICAL SECTION B-B
(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

# Geotextile behind facing blocks




TYPICAL SECTION B-B
(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

# Separation Geotextile behind facing blocks

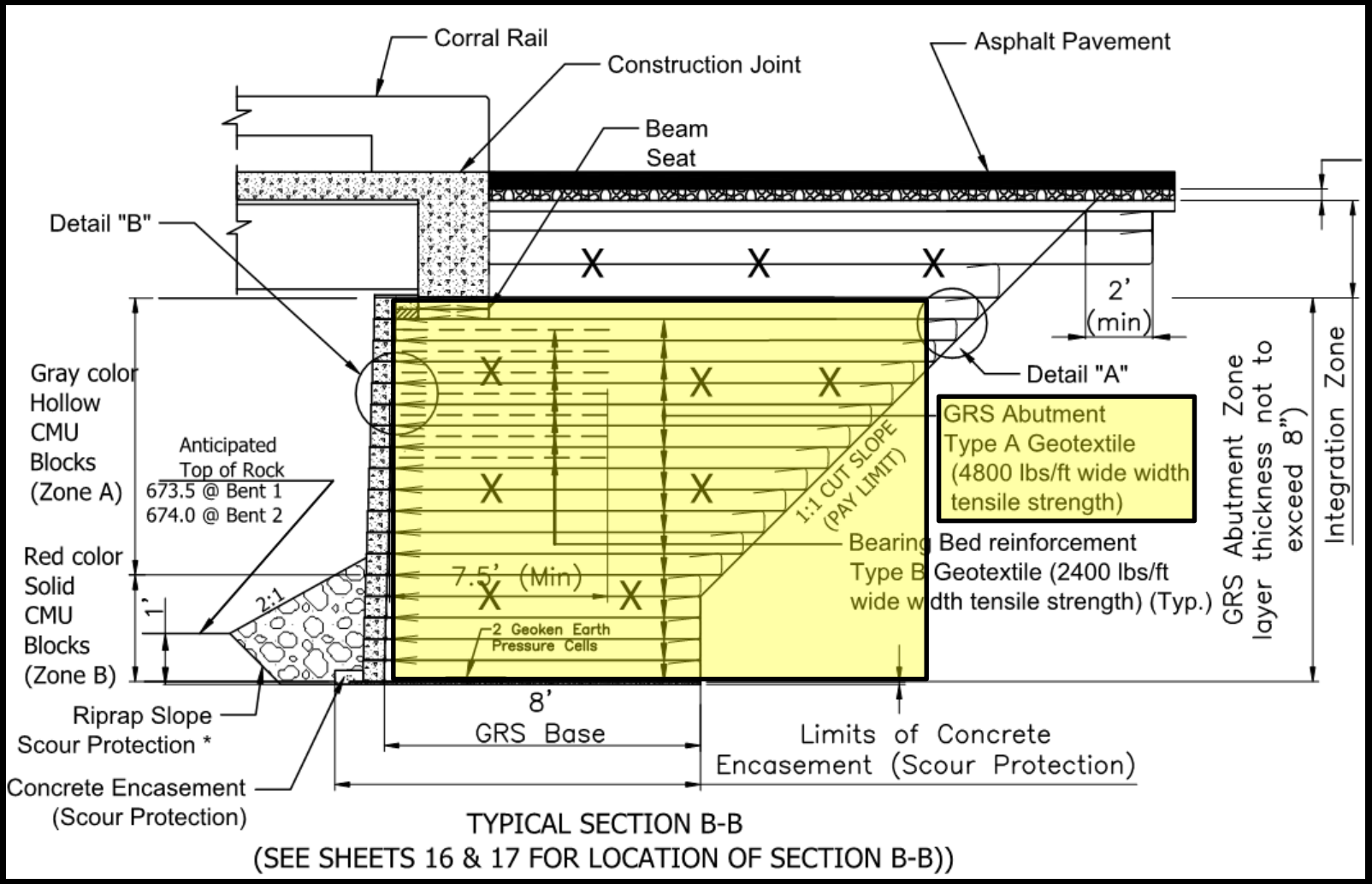



DETAIL "B"

Type B Geosynthetic placed to back of facing blocks

Add Separation Geotextile (Low Permittivity) and wrap behind the CMU blocks as shown (Front Face of Wall only (typ.))

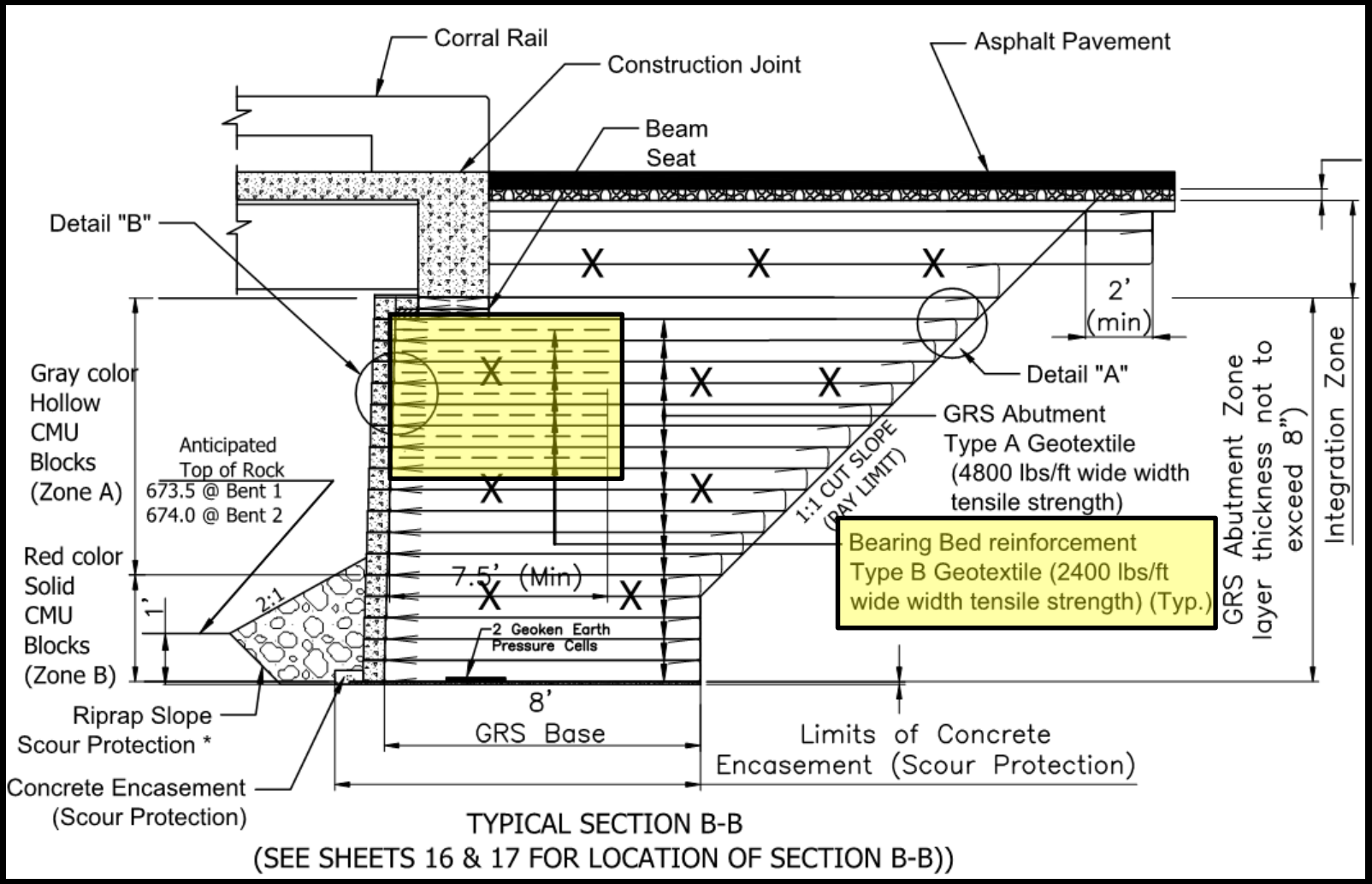
# Main Reinforcement (Type A)




TYPICAL SECTION B-B

(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

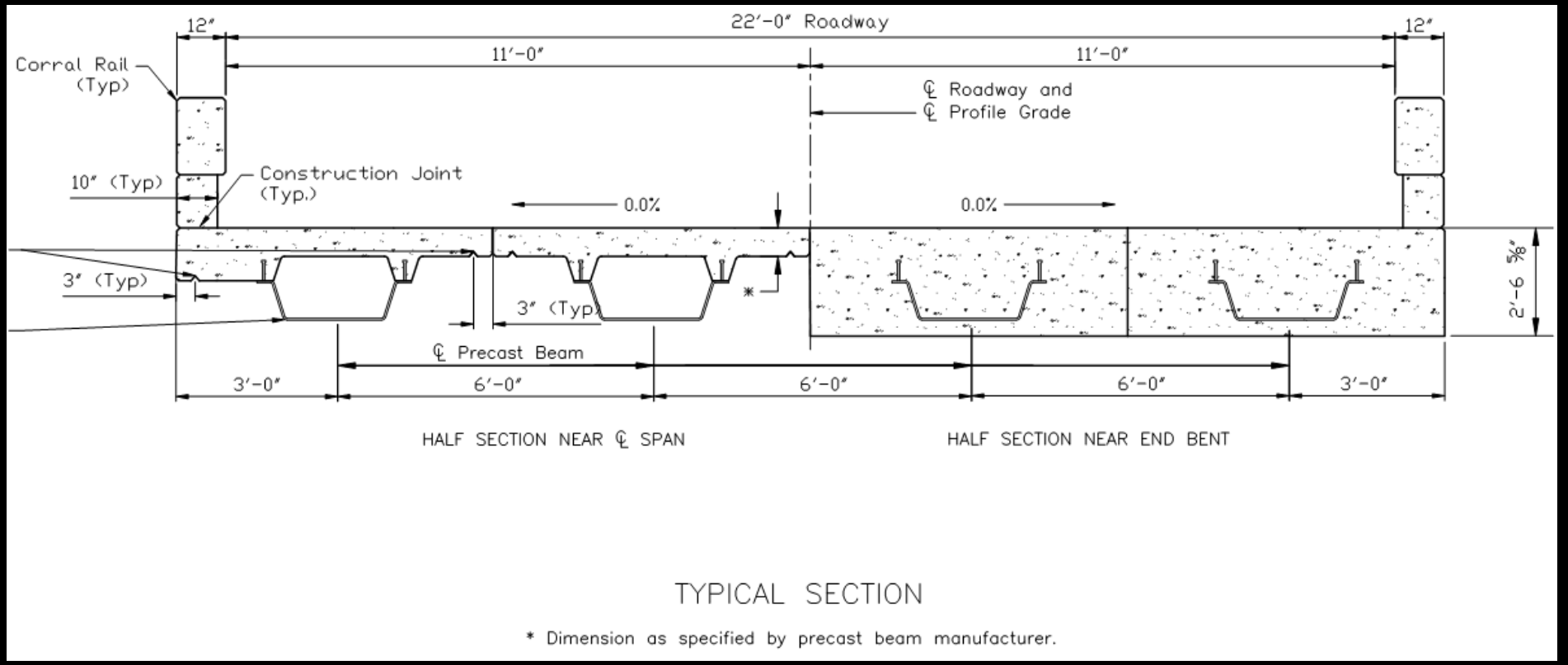
# Bearing Reinforcement (Type B)




TYPICAL SECTION B-B

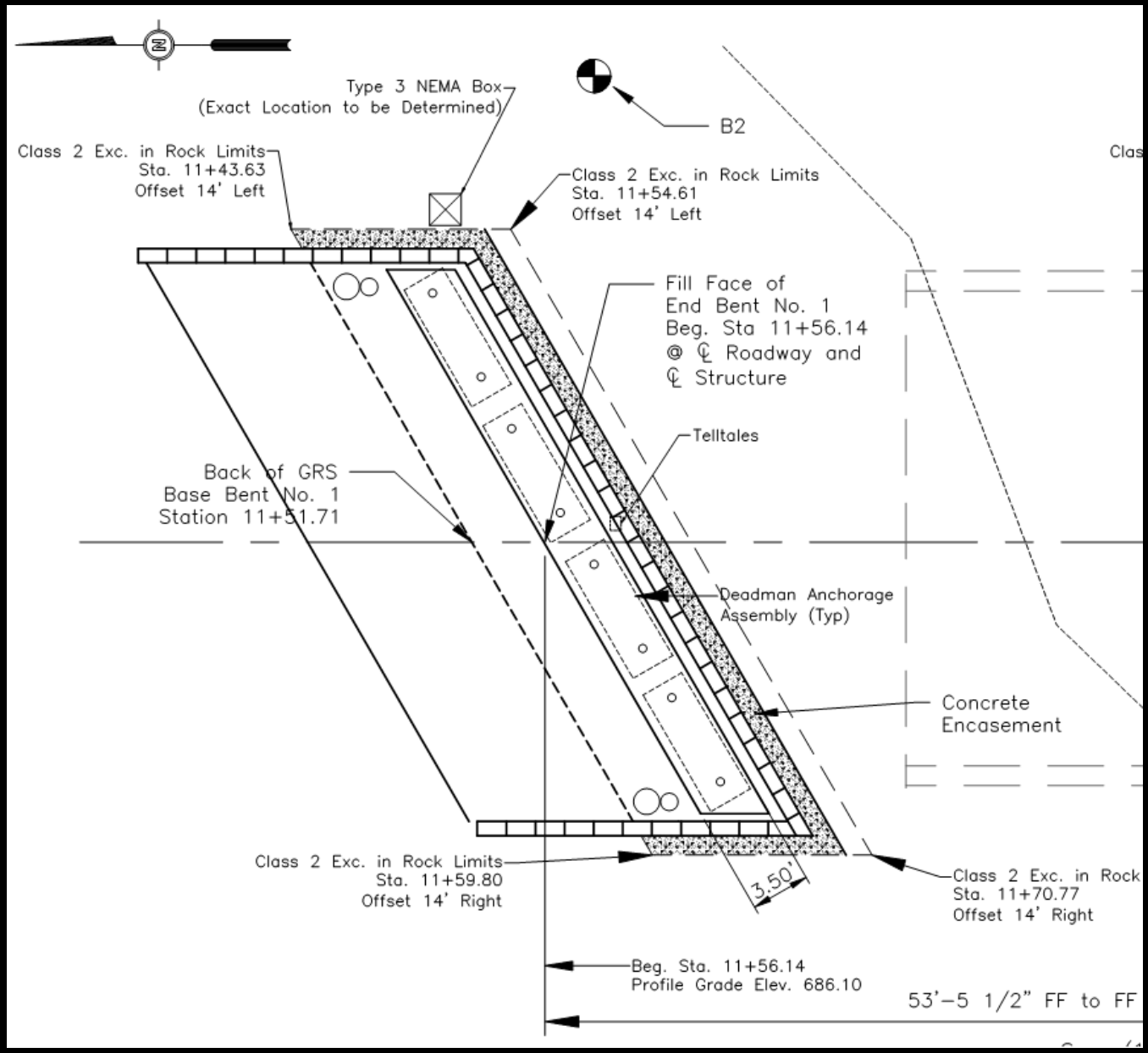
(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

# Section Showing Con-Struct Girders

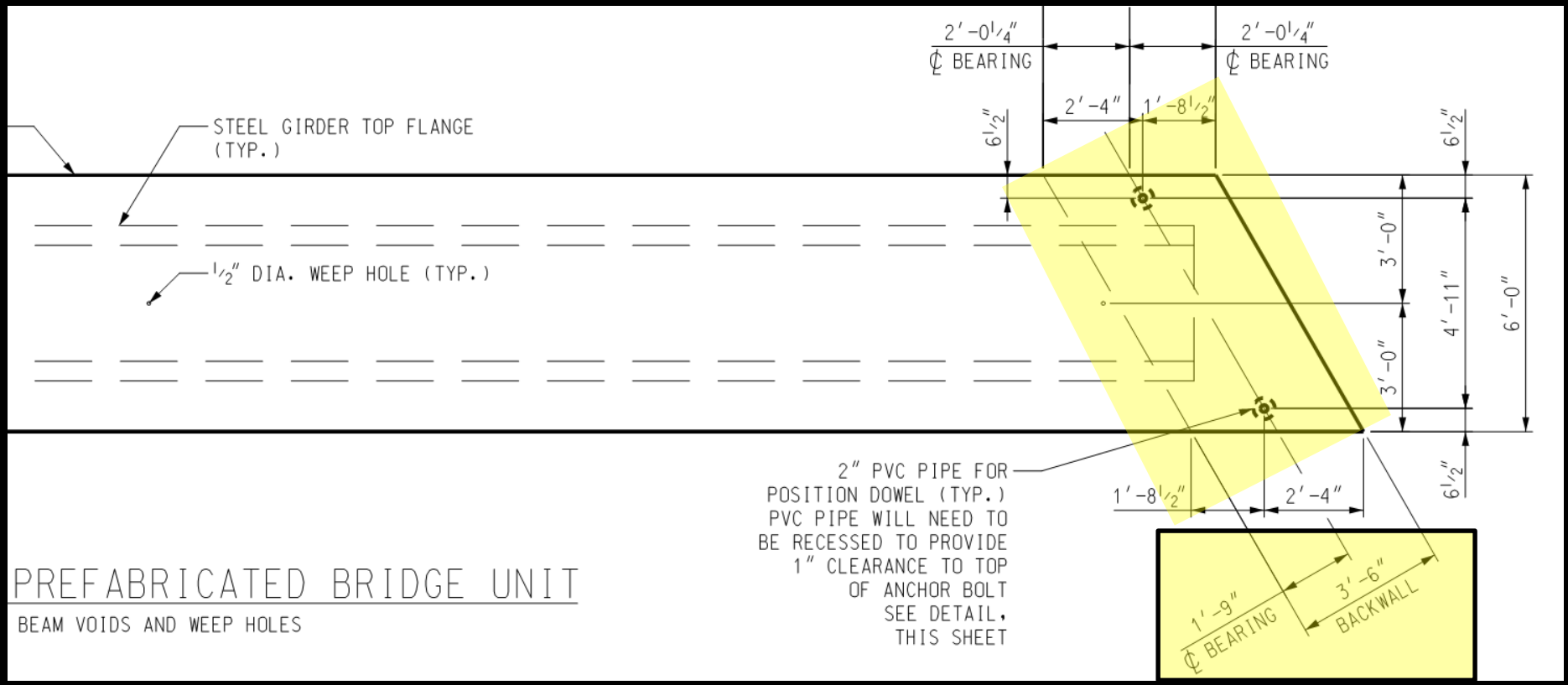



TYPICAL SECTION

* Dimension as specified by precast beam manufacturer.

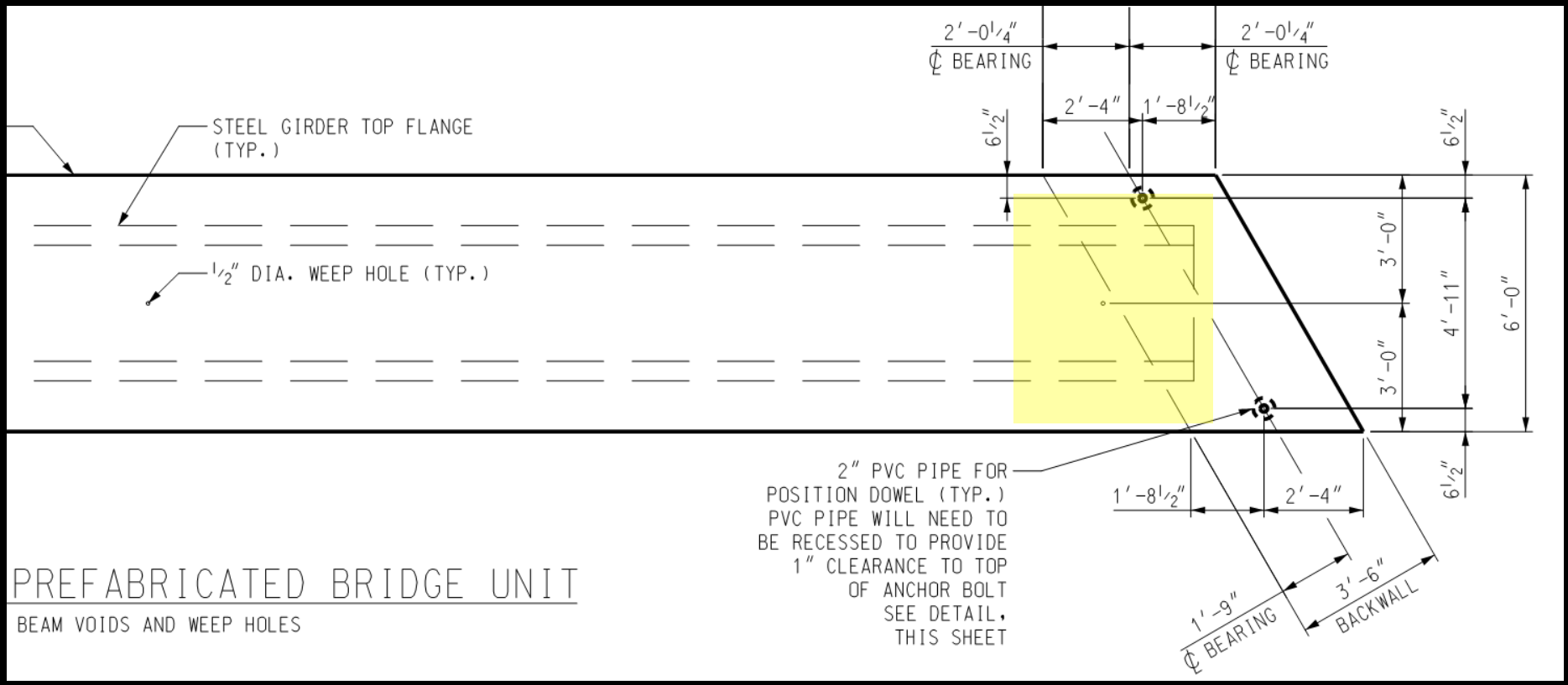

Type 3 NEMA Box
(Exact Location to be Determined)
B2
Class 2 Exc. in Rock Limits
Sta. 11+43.63
Offset 14' Left
Class 2 Exc. in Rock Limits
Sta. 11+54.61
Offset 14' Left
Fill Face of
End Bent No. 1
Beg. Sta 11+56.14
@ ℄ Roadway and
℄ Structure
Telltales
Back of GRS
Base Bent No. 1
Station 11+51.71
Deadman Anchorage
Assembly (Typ)
Concrete
Encasement
Class 2 Exc. in Rock Limits
Sta. 11+59.80
Offset 14' Right
3.50'
Class 2 Exc. in Rock
Sta. 11+70.77
Offset 14' Right
Beg. Sta. 11+56.14
Profile Grade Elev. 686.10
53'-5 1/2" FF to FF

# Modifications to Original Con-Struct Design



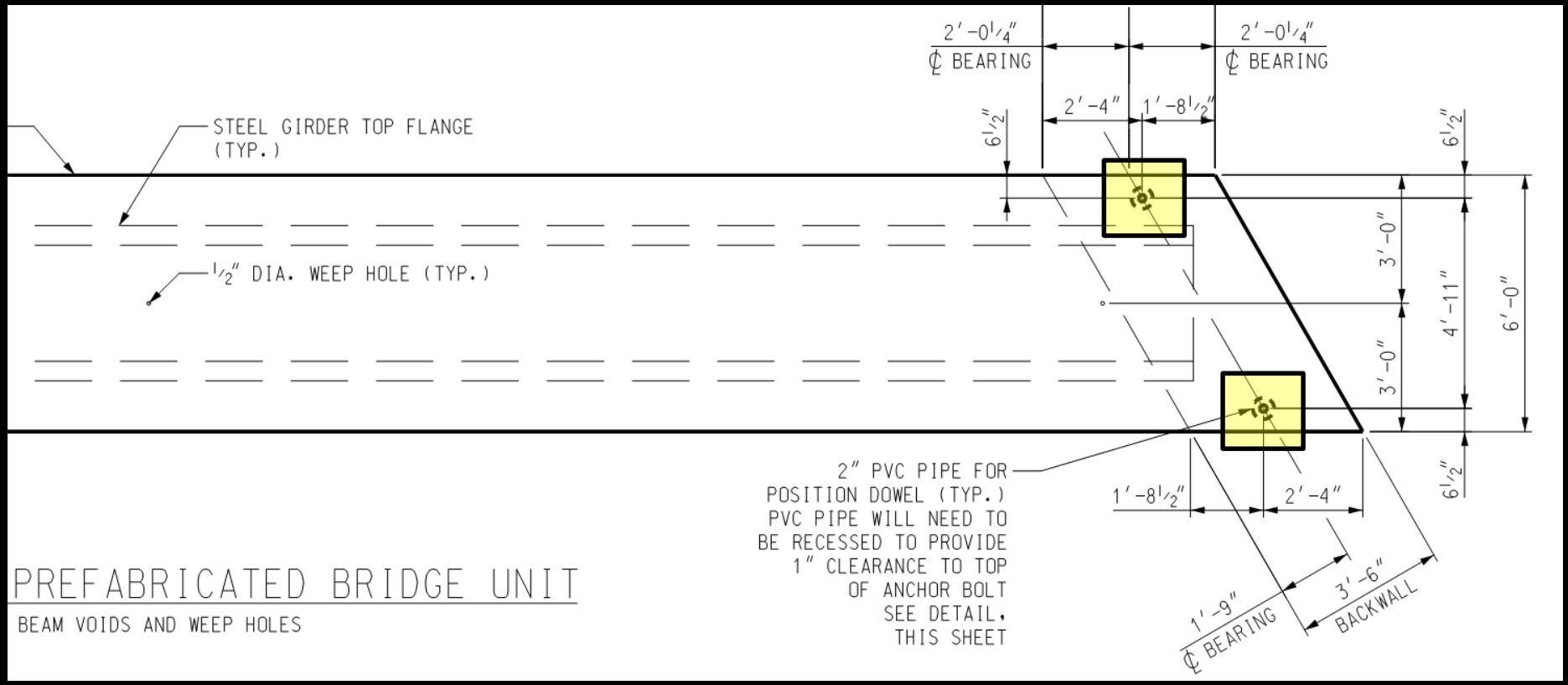

Wider backwall to distribute superstructure loads

# Modifications to Original Con-Struct Design



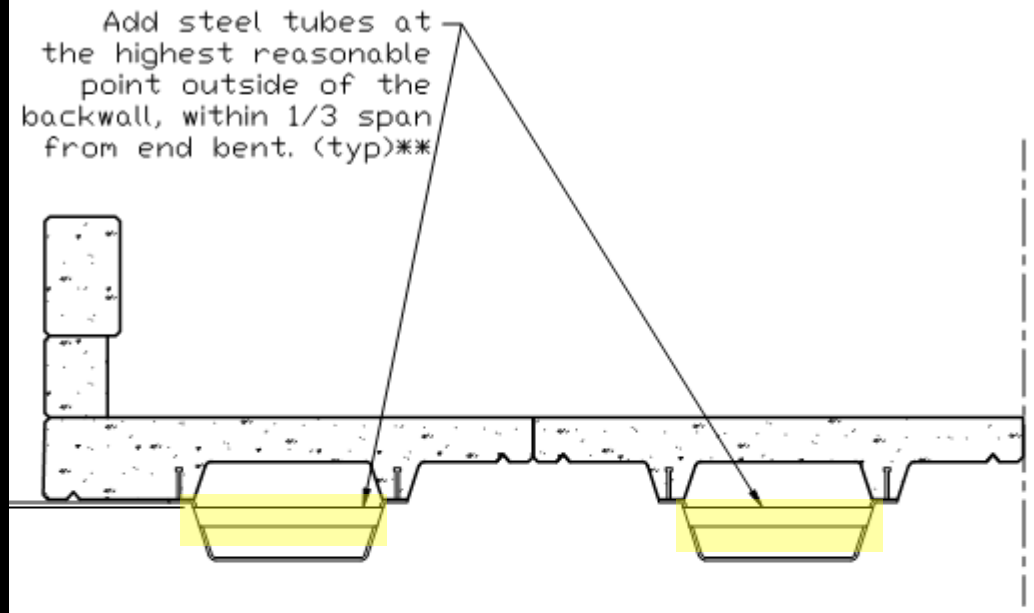

Square steel tub encased in skewed backwall

# Modifications to Original Con-Struct Design




Anchor bolts for vertical deadman

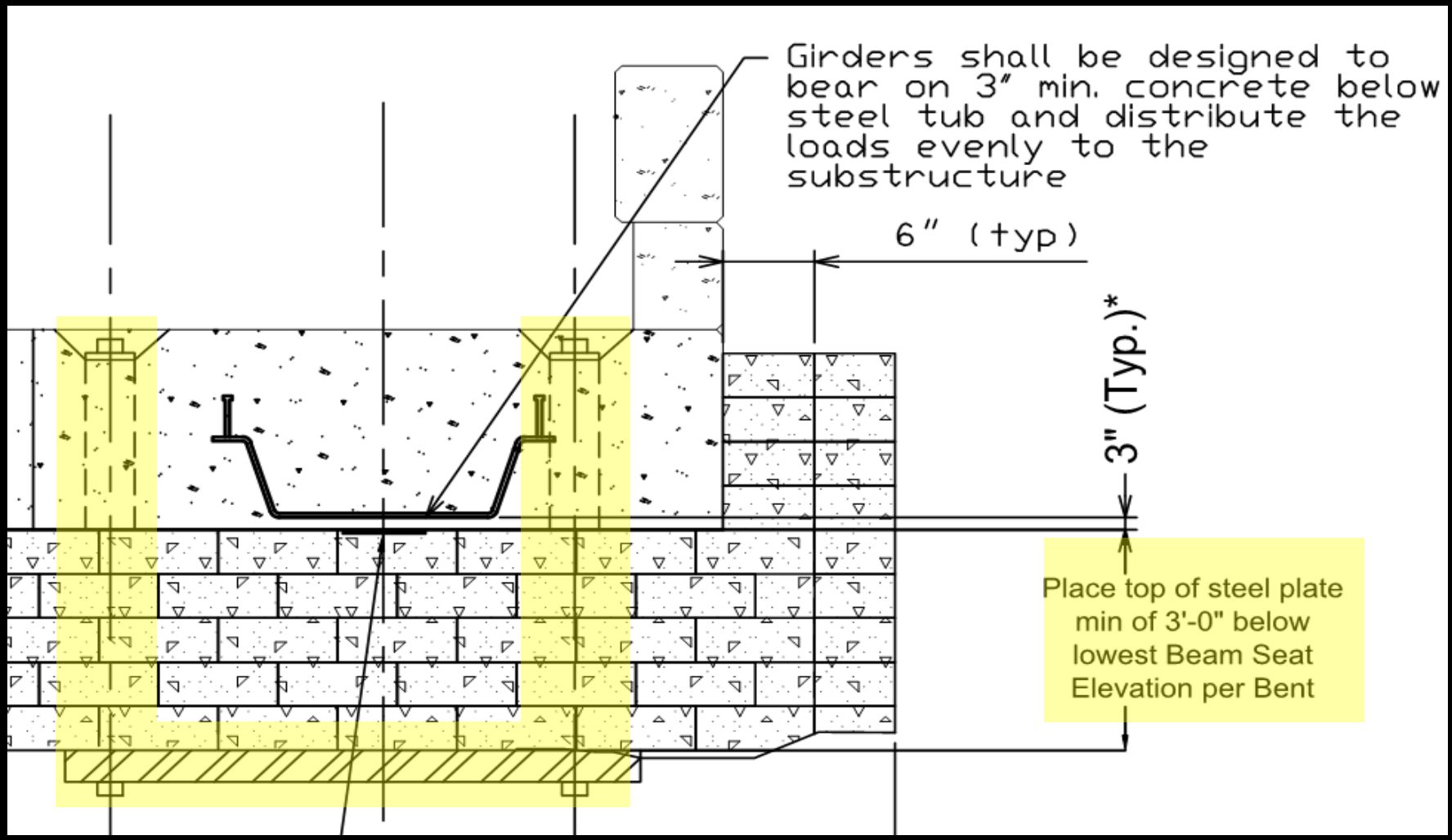
# Steel Vent Tubes




HALF SECTION SHOWING STEEL TUBE LOCATION

** Steel tubes are to allow for air to move between the girders during flood conditions. Tubes shall be a minimum of 3" inner diameter. Tubes are to be welded so as to create a watertight seal and not allow moisture to get inside the tub section of the girder. Any galvanizing damaged during manufacture of the girders shall be repaired. Any galvanizing repair will be incidental to the cost of the Pre-Engineered Superstructure.

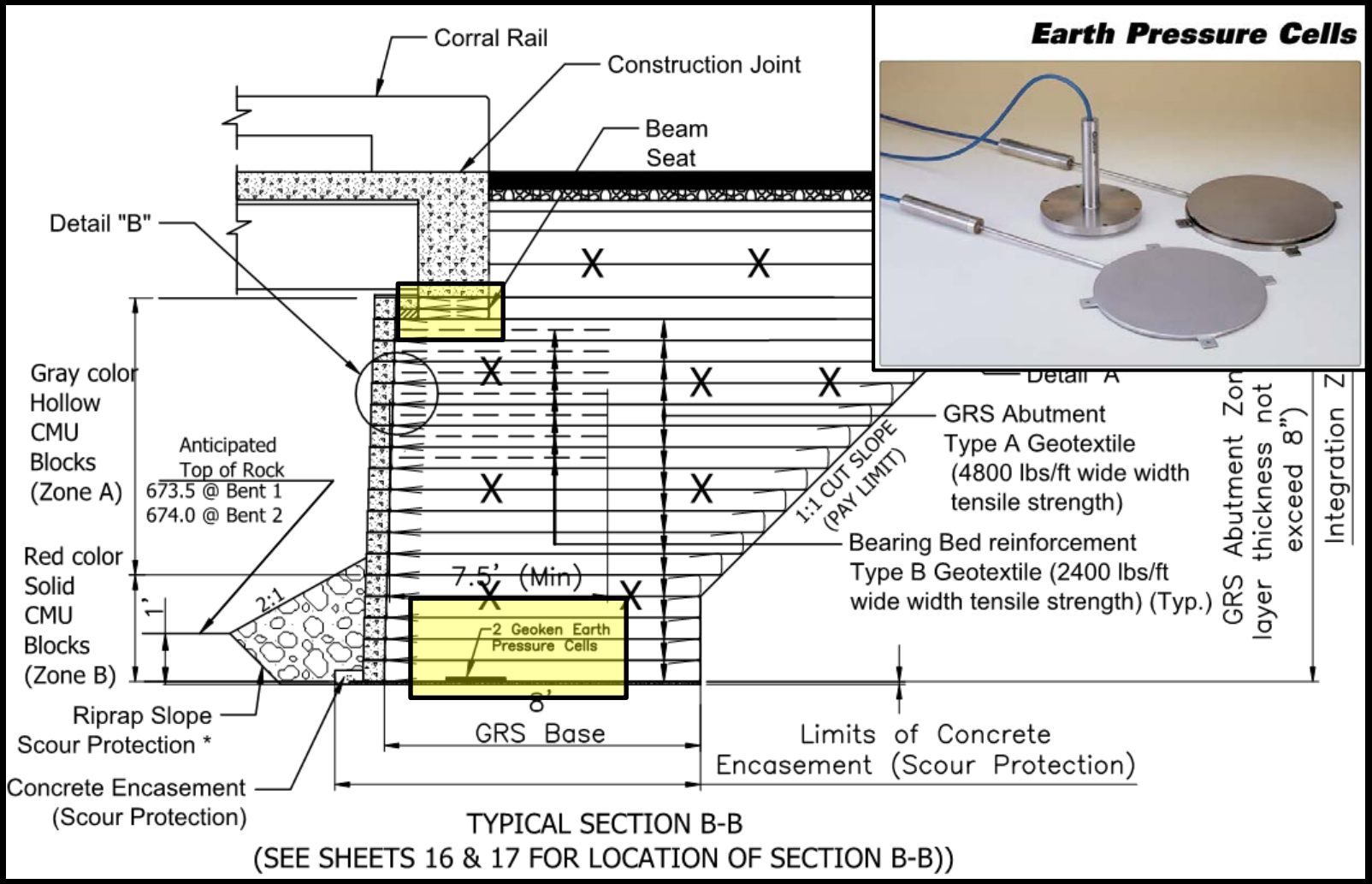
# Deadman Anchorage



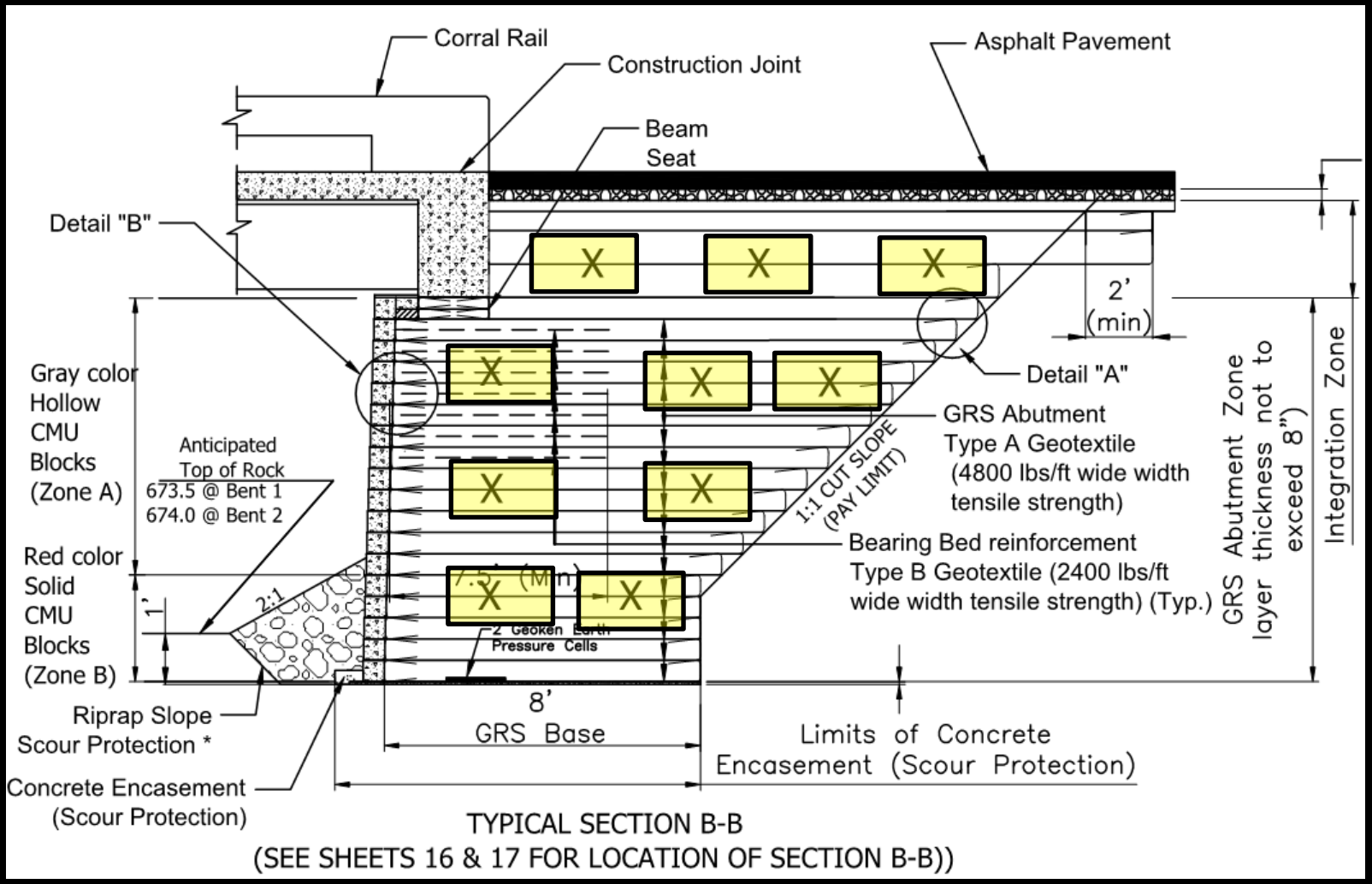
# Research Devices

1. Earth Pressure Cells
2. Tensiometers
3. Telltales
4. Inclinometers
5. Shape Accel Arrays (SAA)
6. Survey Markers

# Location of Pressure Sensors

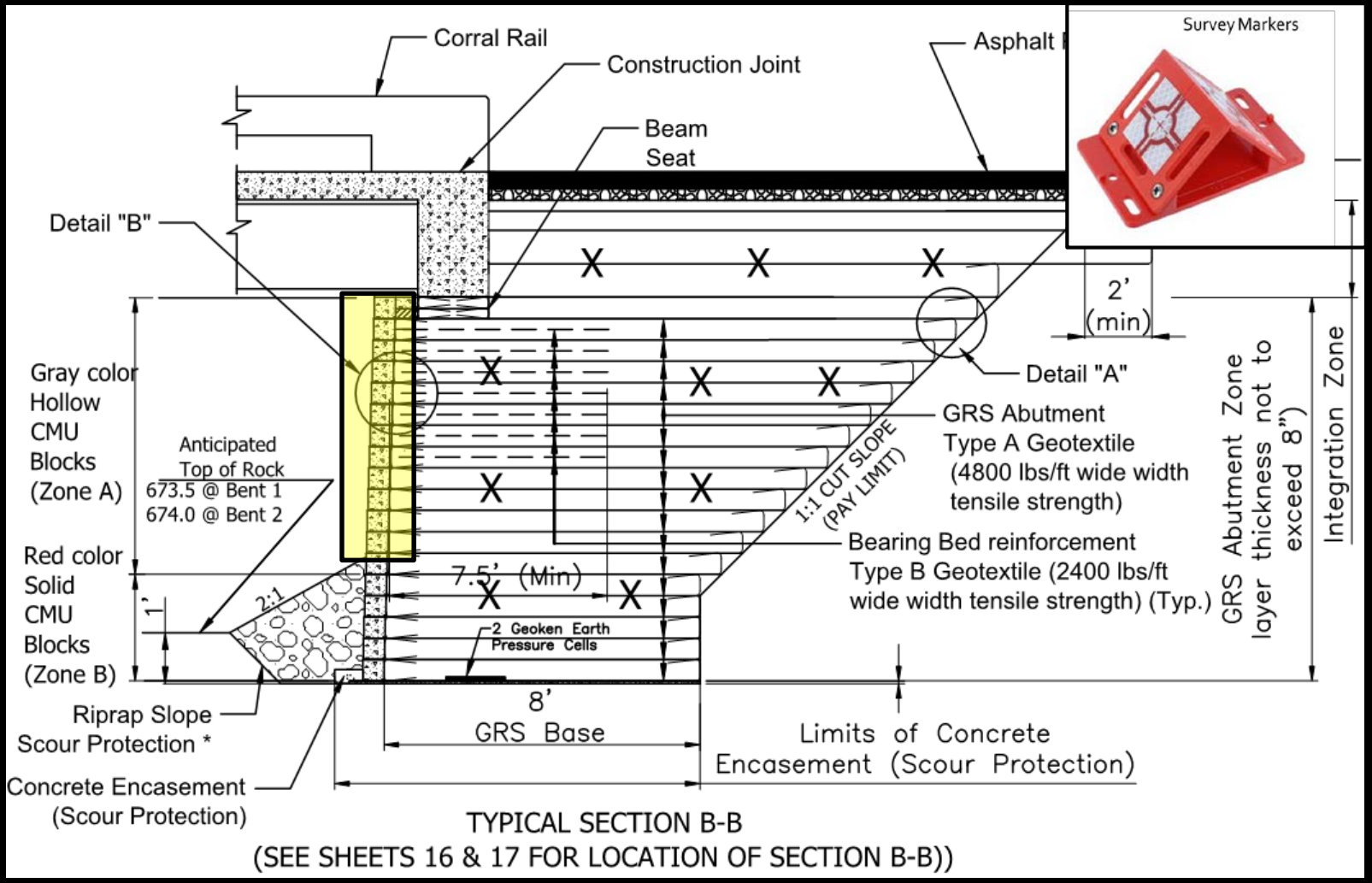


# Tensiometers (North Bent only)




TYPICAL SECTION B-B
(SEE SHEETS 16 & 17 FOR LOCATION OF SECTION B-B))

# Markers on outside of facing blocks



# Bidding History/Challenges

- Timeframe for Construction (1st attempt)
  - Strict Start and End Dates
    - Notice to Proceed: June 16th, 2014
    - Open to Traffic Date: July 16th , 2014
- Timeframe for Construction (2nd attempt)
  - Flexible Start Date
    - Bid Opening: September 4th, 2014
    - 25 Working Days
    - Open to Traffic Date: January 15th, 2015

# Lessons Learned

- Design Tips
  - FHWA Interim Implementation Guide
  - Material Availability
    - Biaxial geotextile
    - $\phi$ angle of backfill material
    - Open-graded vs. well-graded
    - Freeze-Thaw on facing blocks
  - Adaptations
    - Geotextile behind facing
    - Anchorage considerations
    - Skew

# Lessons Learned

- Bid Approach
  - Actively advertise to potential bidders
  - Educate bidders
  - Allow flexibility in the construction timeframe

# Questions/Comments?

## How Does It Work?

Rather than installing a deep foundation, this reinforced soil method builds up the substructure in a faster, simpler way. A GRS integrated bridge system is similar to a layer cake!

*Step 1: Lay a row of facing blocks.*

*Step 2: Add a layer of compacted fill to the height of the facing blocks.*

***Step 3: Add a layer of geosynthetic fabric (reinforcement). Repeat until desired height is achieved.***

*Photos courtesy of www.fhwa.dot.gov*

# Example of facing block color differentiation

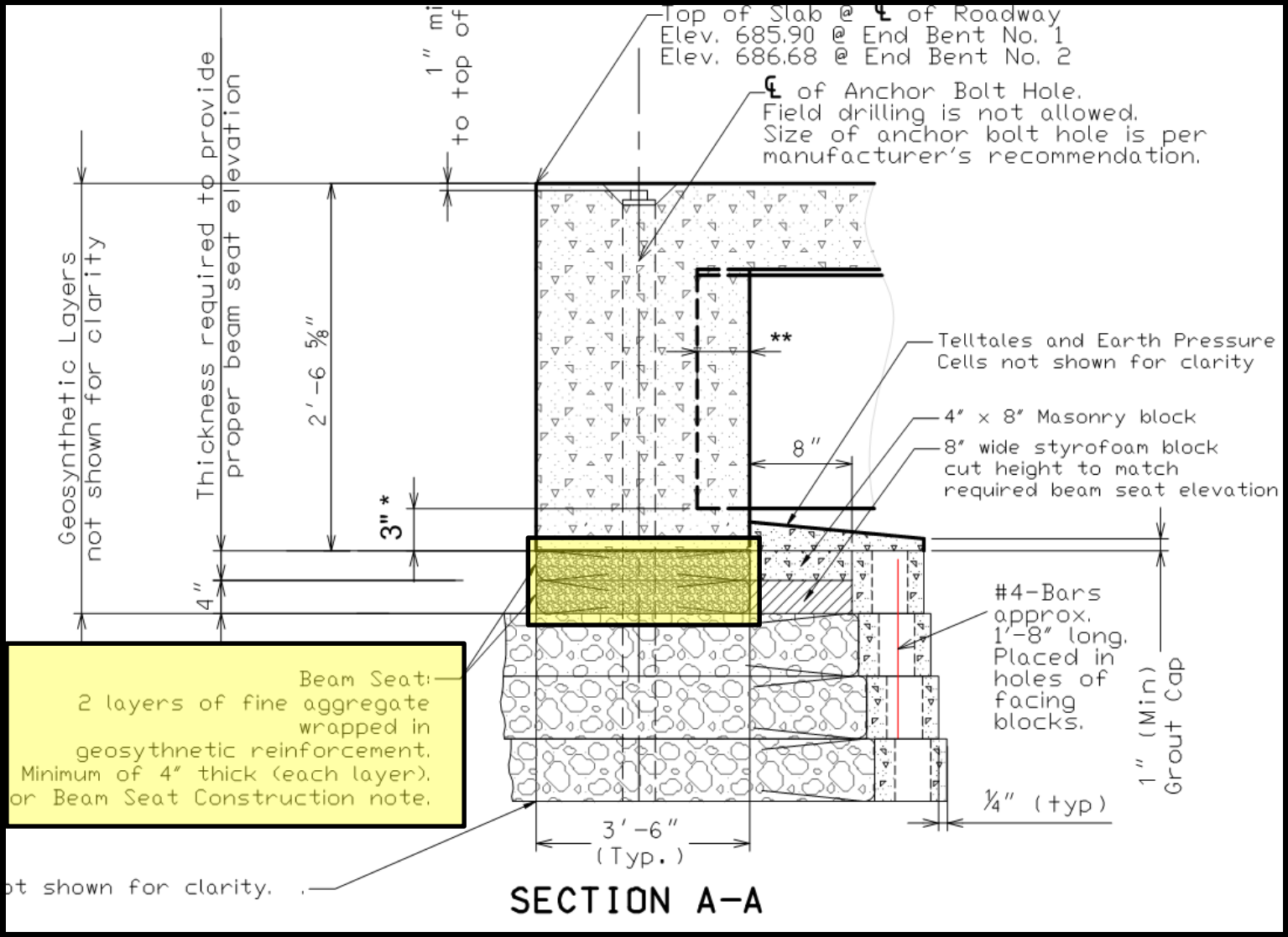
*Photos courtesy of www.fhwa.dot.gov*

Figure 60. Photo. Connecting the top courses of blocks.

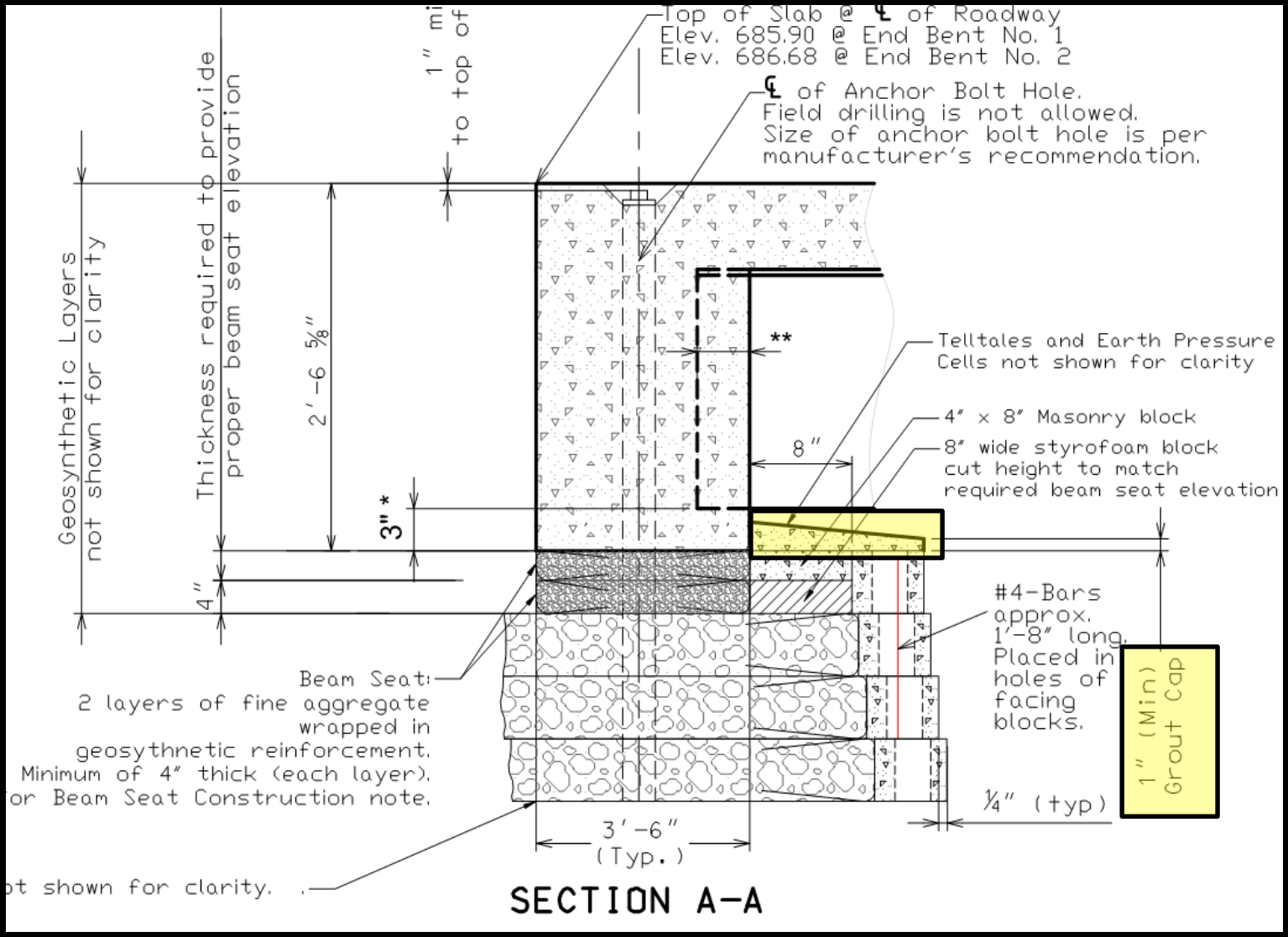
*Photos courtesy of www.fhwa.dot.gov*

# Example of Con-Struct Girder

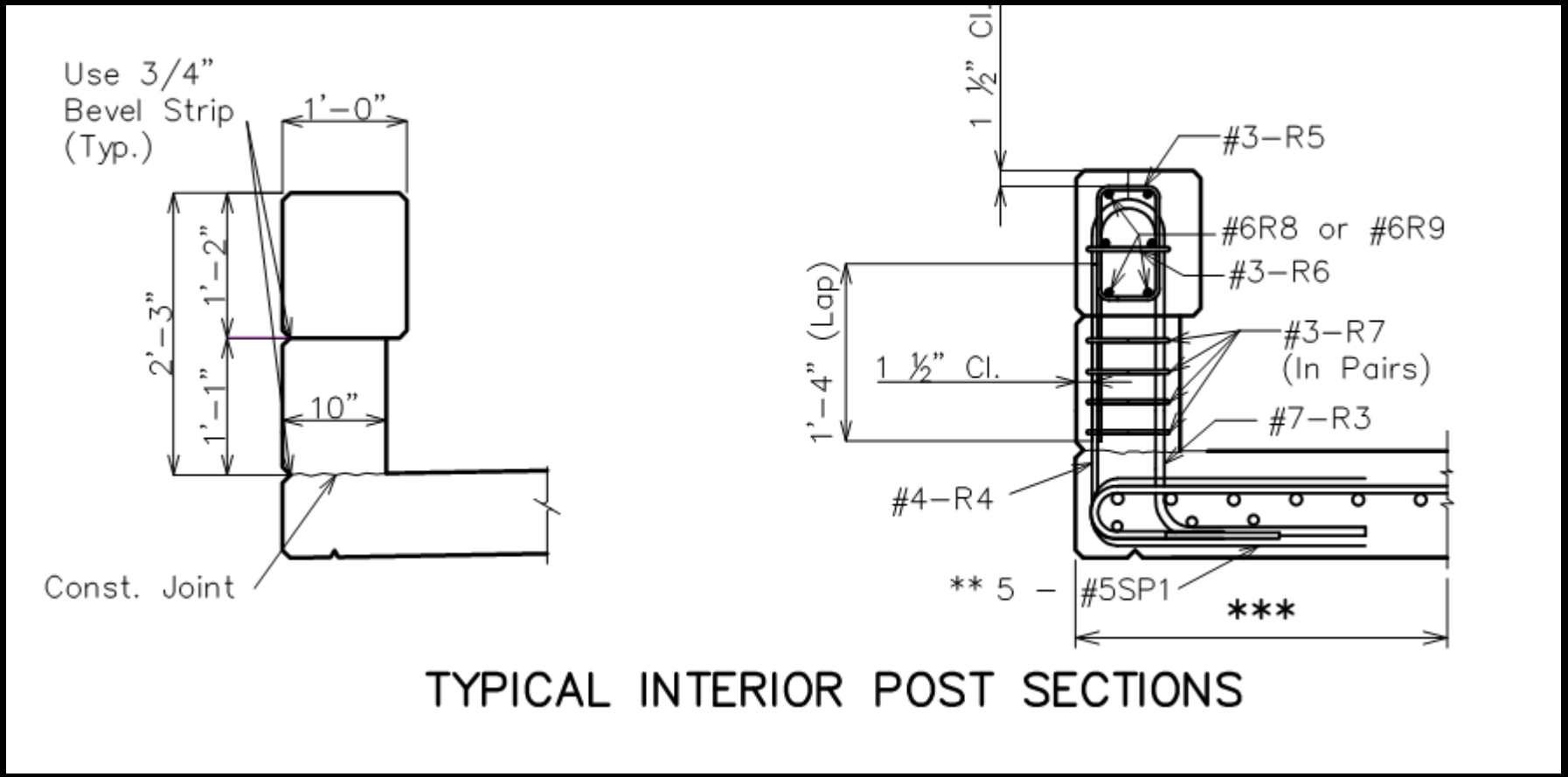
# Beam Seat


Top of Slab @ ℄ of Roadway
Elev. 685.90 @ End Bent No. 1
Elev. 686.68 @ End Bent No. 2
℄ of Anchor Bolt Hole.
Field drilling is not allowed.
Size of anchor bolt hole is per manufacturer's recommendation.
1" mi
to top of
Geosynthetic Layers not shown for clarity
Thickness required to provide proper beam seat elevation
2'-6 5/8"
3" *
4"
**
Telltales and Earth Pressure Cells not shown for clarity
4" x 8" Masonry block
8" wide styrofoam block cut height to match required beam seat elevation
8"
#4-Bars approx. 1'-8" long. Placed in holes of facing blocks.
1" (Min) Grout Cap
¼" (typ)
3'-6" (Typ.)
Beam Seat:
2 layers of fine aggregate wrapped in geosythnetic reinforcement. Minimum of 4" thick (each layer).
or Beam Seat Construction note.
ot shown for clarity.
SECTION A-A

# Grout (in lieu of aluminum flashing)

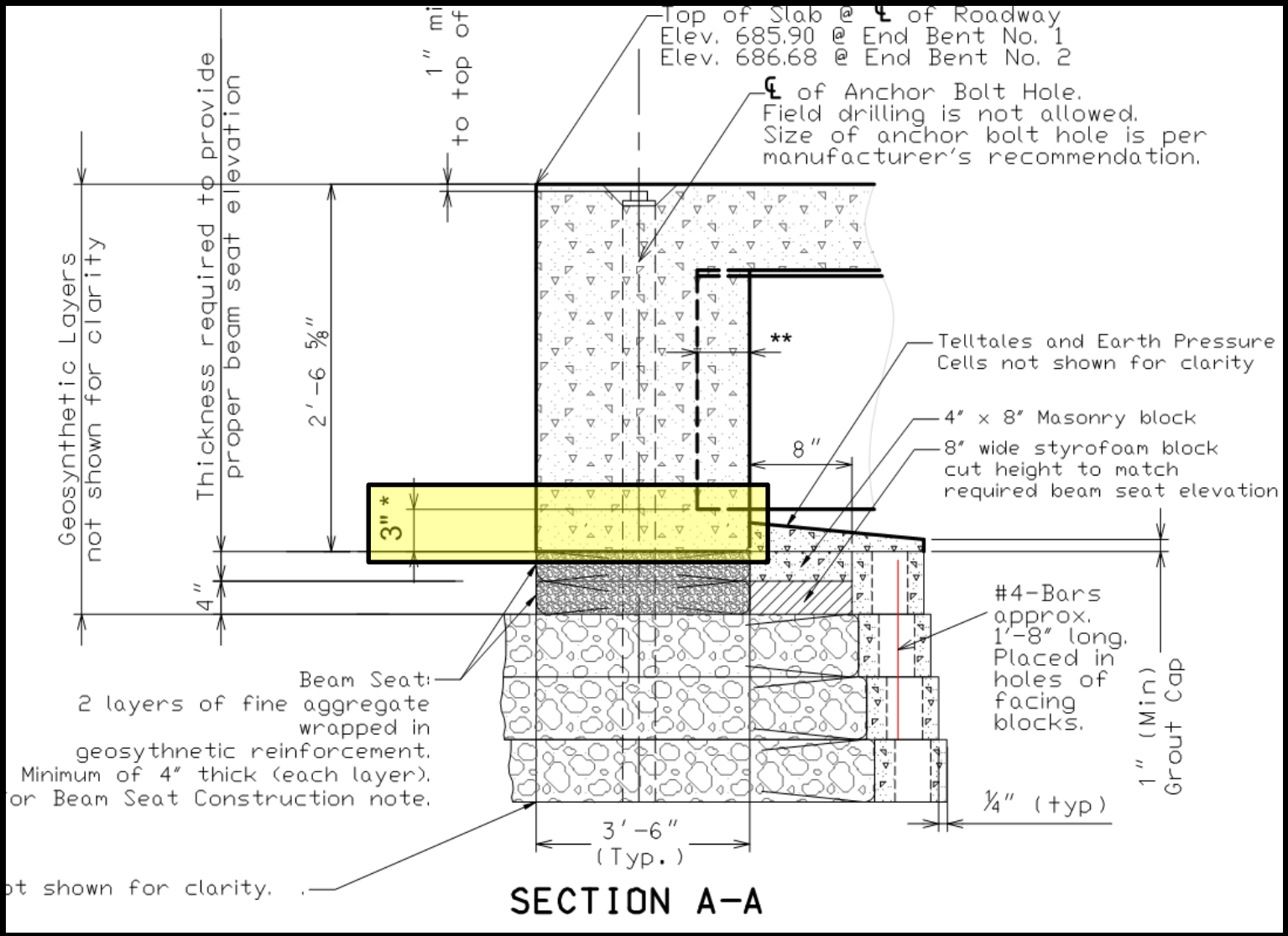


# Modifications to original CONSTRUCT design: Corral Rail reinforcement




TYPICAL INTERIOR POST SECTIONS

# Modifications to original CONSTRUCT design: Extra concrete beneath steel tub



# Innovative Bridge Research and Deployment Funding (IBRD) Application

- Con-Struct Steel Tub Girder
- GRS-IBS
- Instrumentation

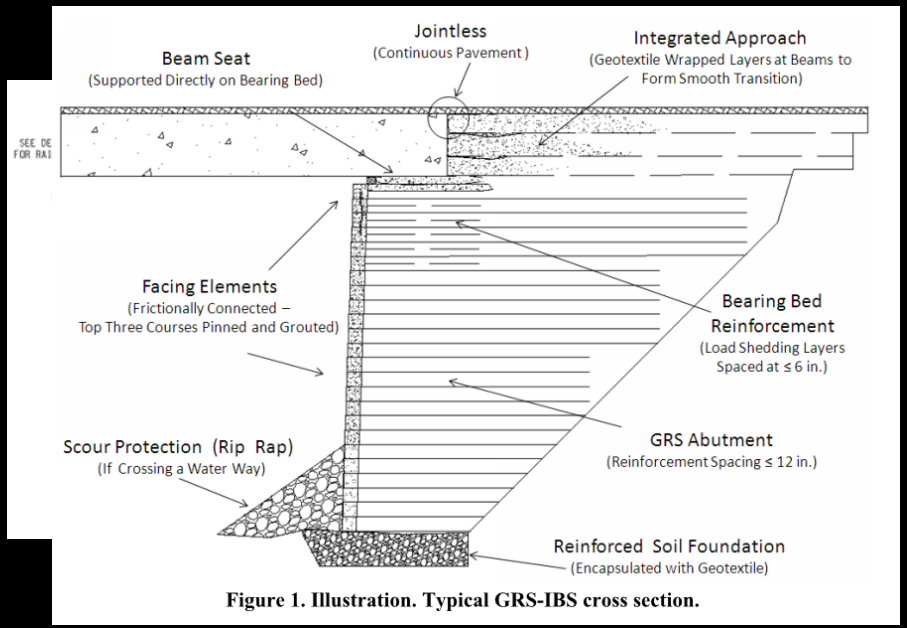


Figure 1. Illustration. Typical GRS-IBS cross section.