# IA-92 OVER LITTLE SILVER CREEK

## ACCELERATED BRIDGE CONSTRUCTION PROJECT

**IOWA ASSOCIATION OF GENERAL CONTRACTORS**
**CONSTRUCTABILITY REVIEW – 05/29/14**

*Presented by Curtis J. Carter, P.E.*

# MEETING OBJECTIVES

- Share preliminary construction details (60% plans)
- Solicit feedback from Association of General Contractors
- Solidify design concept for final plan development

# PROJECT OBJECTIVES

- **Safe Project**
  - During construction
  - In service
- **Successful Project**
  - Completed on time, according to plan, and within budget
  - Positive experience for Owner, User and Contractor
- **Accelerated Construction Schedule**
  - 21 day critical road closure
- **Modular Construction**
  - Build on Iowa's experience with this specific construction concept
  - Apply concept to a more challenging site

# DEMONSTRATION PROJECT – FALL 2012

## US-6 over Keg Creek

Modular Construction with Accelerated Schedule

# USGS at Keg Creek
## Council Bluffs, Iowa

# CURRENT PROJECT – FALL 2015

## IA-92 over Little Silver Creek

Modular Construction with Accelerated Schedule

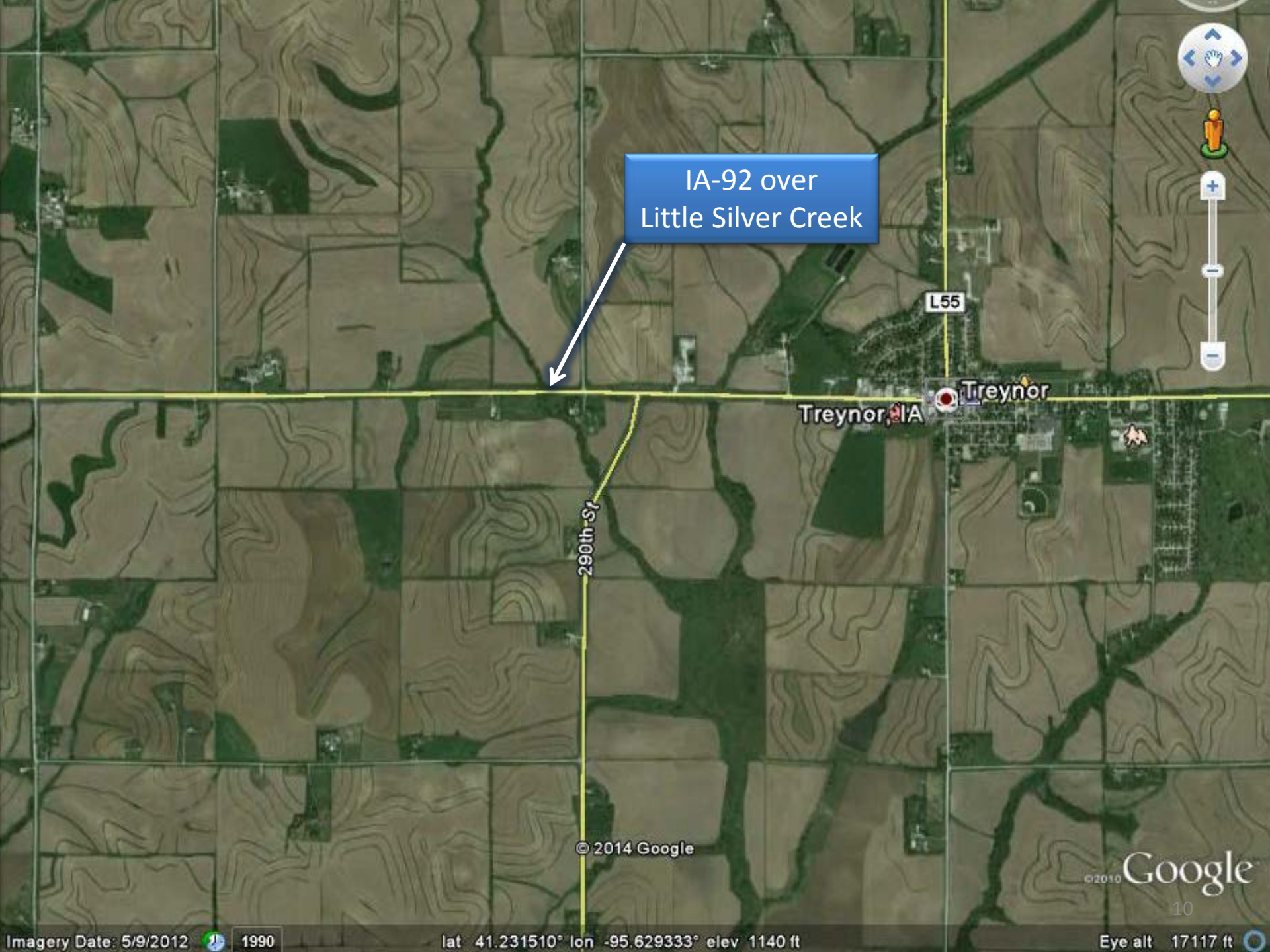
# LITTLE SILVER CREEK (vs. KEG CREEK)

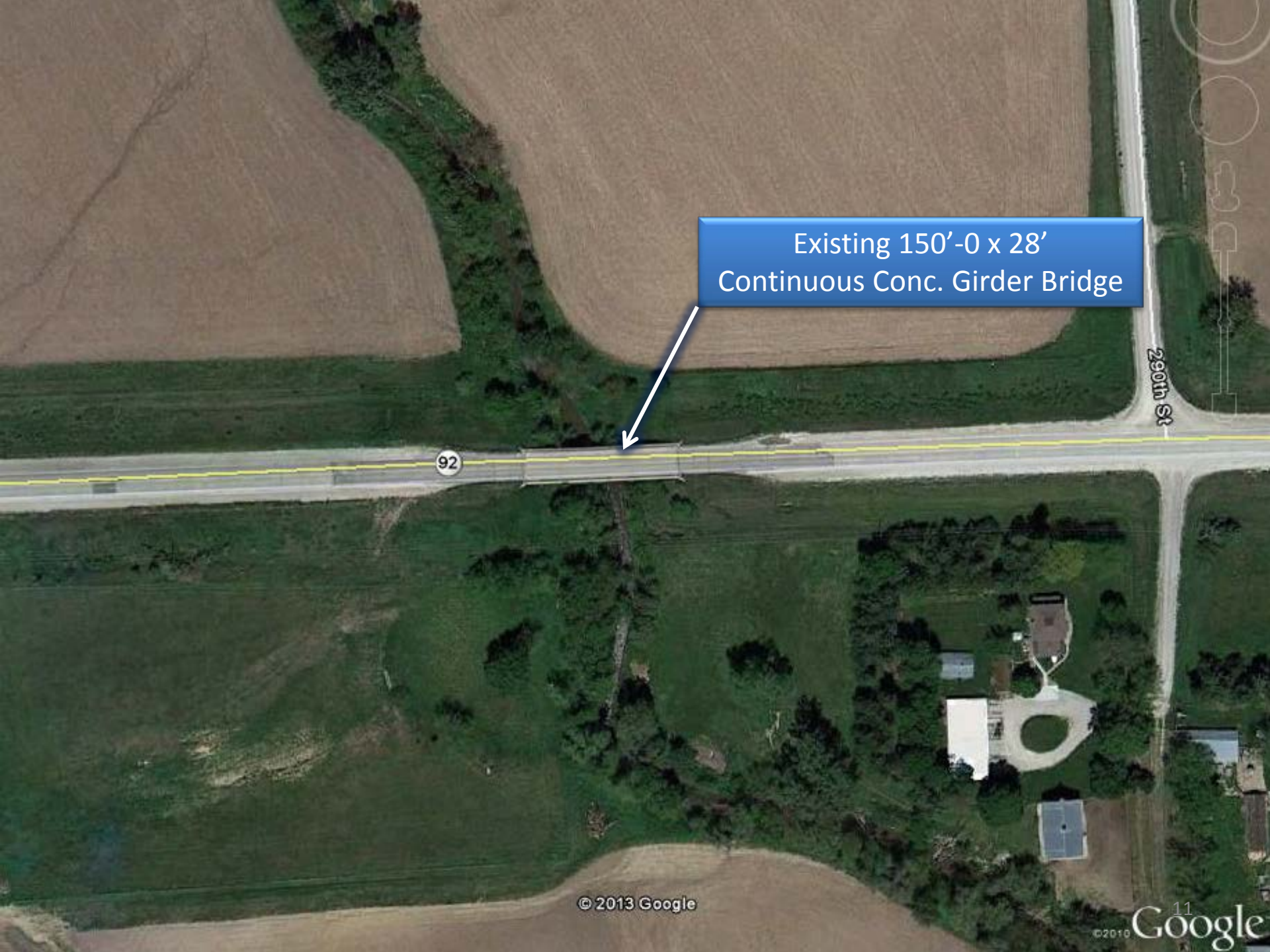
- **More Complex Geometry**
  - Vertical Curvature
  - Skew
- **Pile Bent Foundations**
  - 100% of Substructure to be completed during critical closure
- **Integral Abutments & Pier Diaphragms**
  - Revised abutment and pier connection details
- **More Conventional Cast-in-Place Concrete**
  - Abut. backwalls, wings, diaphragms, transverse deck closures, barrier
- **Lengthened Construction Schedule**
  - 21-days for current project vs. 14-days for Keg Creek

# PROJECT SITE

# SITE & EXISTING STRUCTURE

- **Site**
  - IA-92 over Little Silver Creek
  - Treynor, IA (15 miles east of Council Bluffs)
  - Silty clay soils, bedrock not encountered during drilling ( > 100’)
  - Sag vertical curve road alignment
  - Channel is skewed relative to roadway (20°)
- **Existing Structure**
  - Constructed in 1953
  - 150’ x 28’ Continuous Concrete Girder Bridge
  - 3-span, frame piers, timber piling


IA-92 over
Little Silver Creek
L55
Treynor
Treynor, IA
290th St
© 2014 Google
Google
Imagery Date: 5/9/2012
1990
lat 41.231510° lon -95.629333° elev 1140 ft
Eye alt 17117 ft


Existing 150'-0 x 28'
Continuous Conc. Girder Bridge
290th St
92
© 2013 Google
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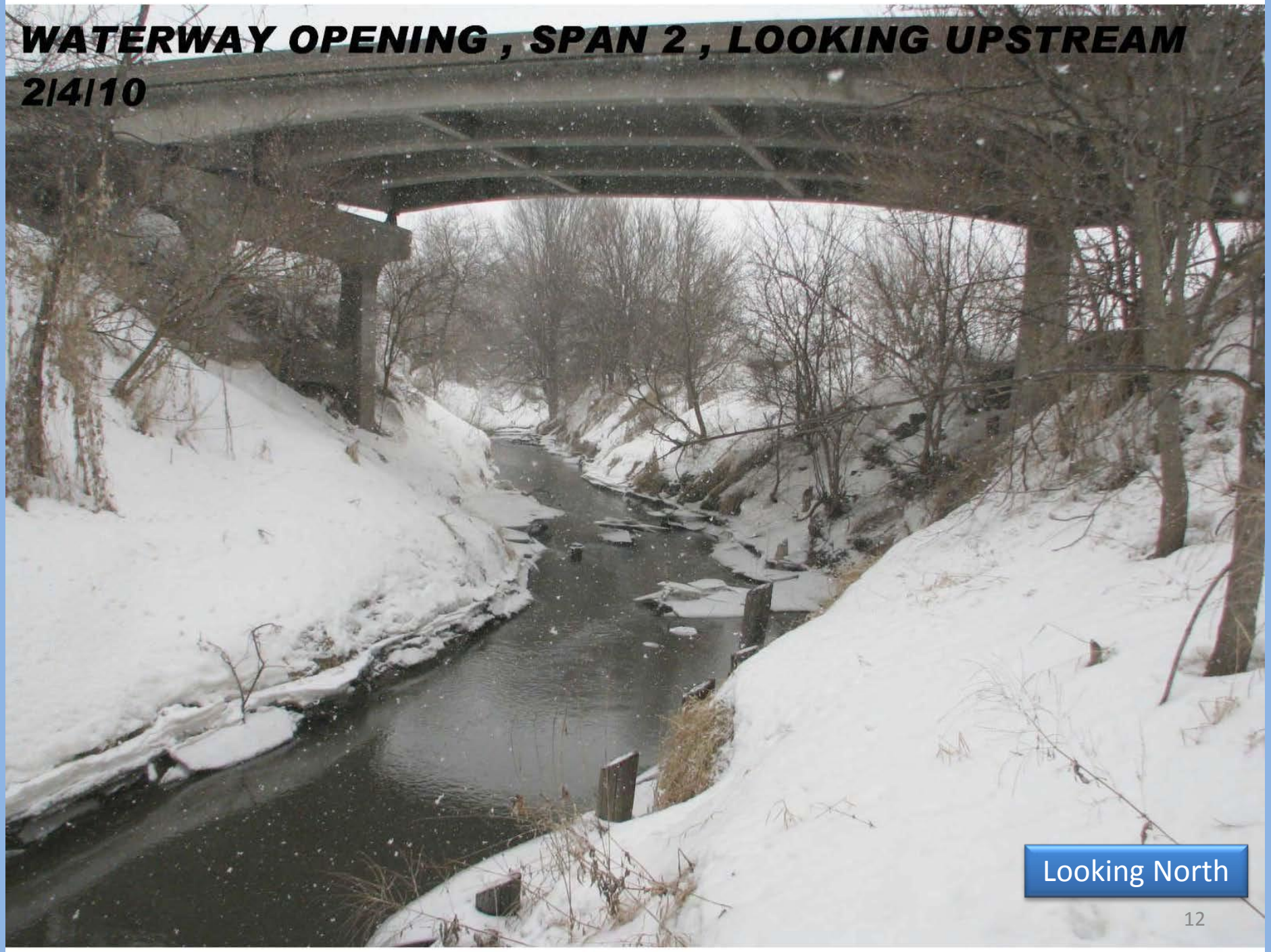
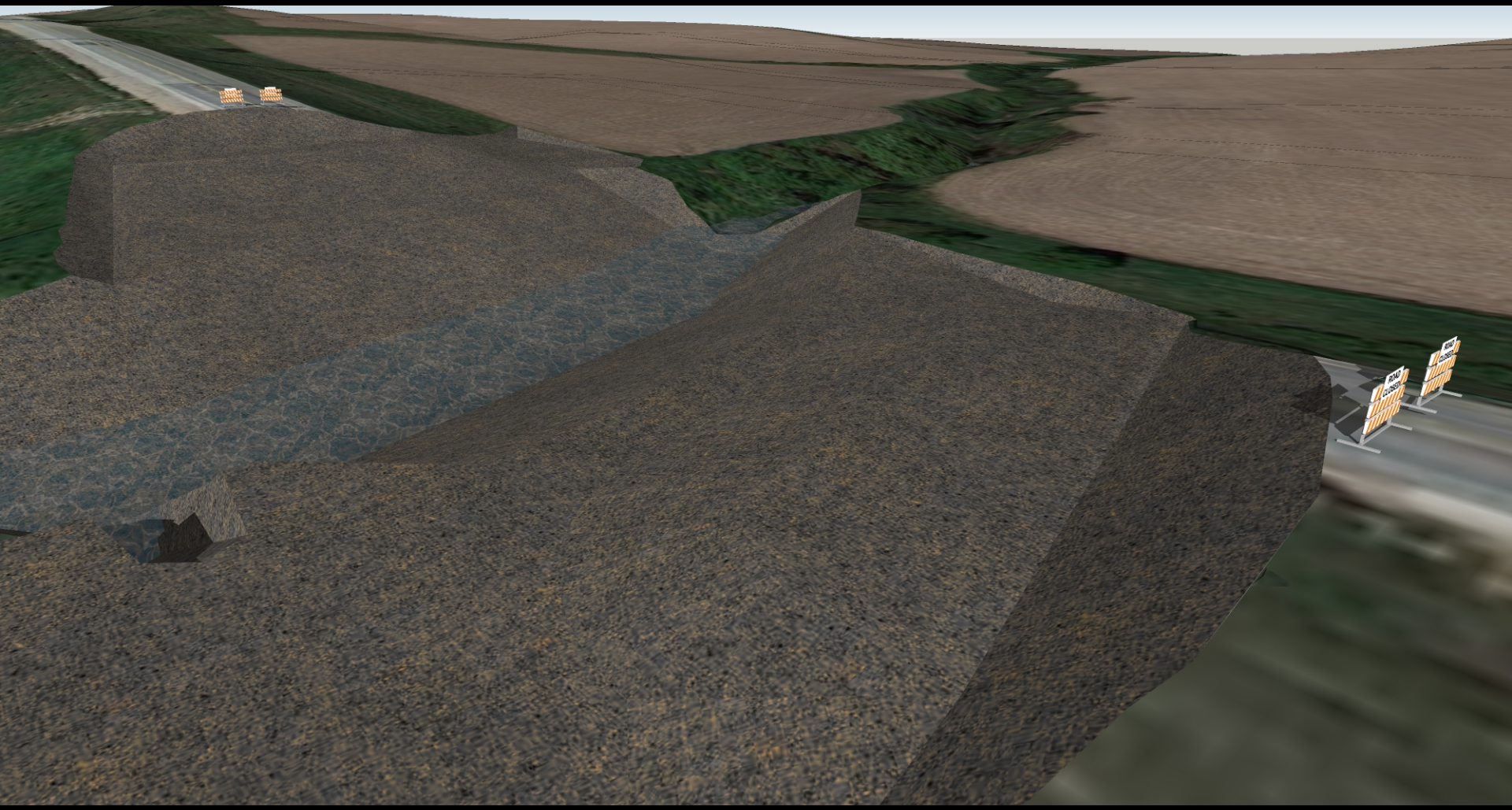

WATERWAY OPENING , SPAN 2 , LOOKING UPSTREAM
2/4/10
Looking North

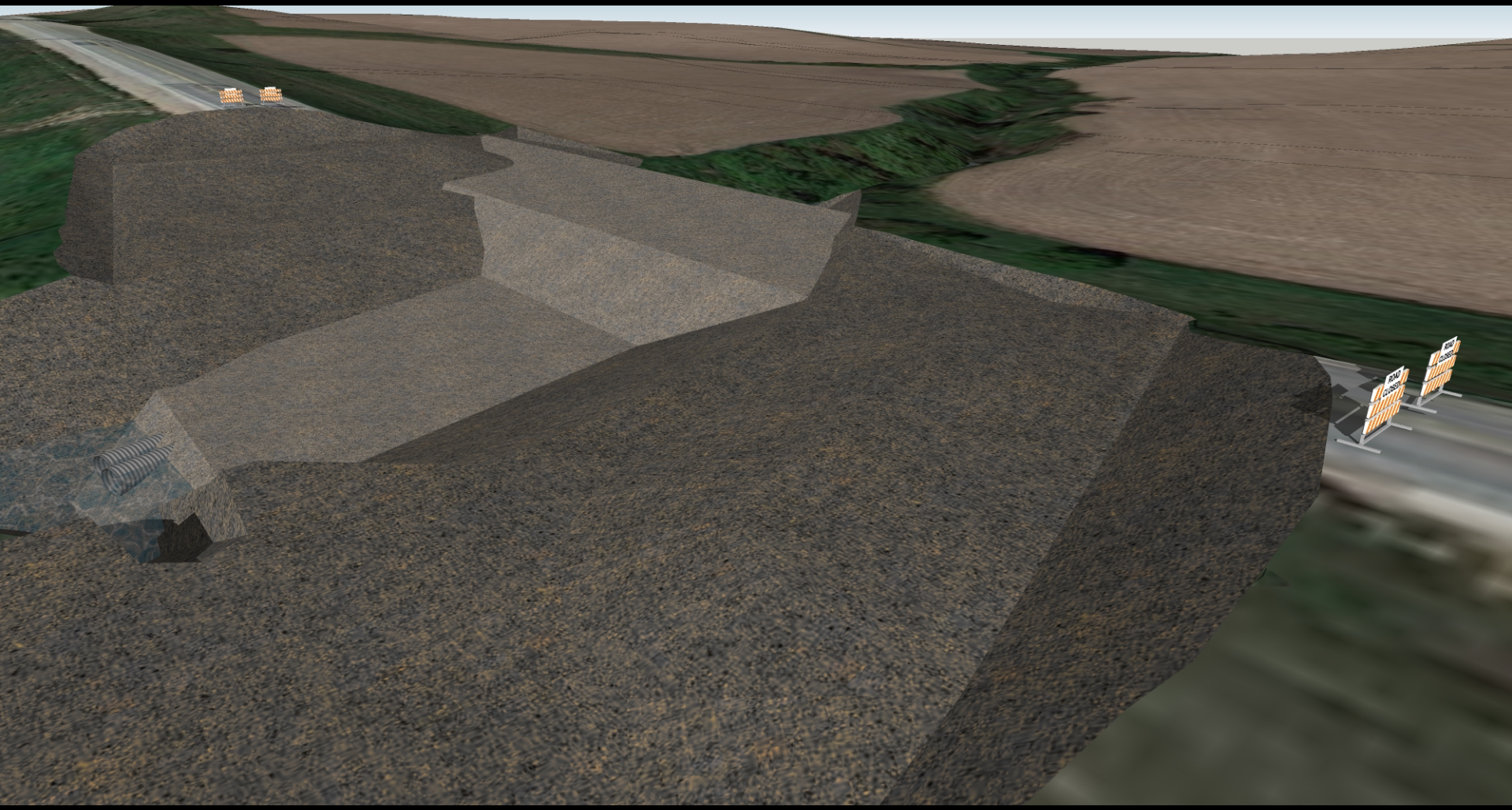
UPSTREAM CHANNEL FROM PIER 1
2/4/10
Looking North

DOWNSTREAM CHANNEL FROM MID SPAN 2
2/4/10
Looking South

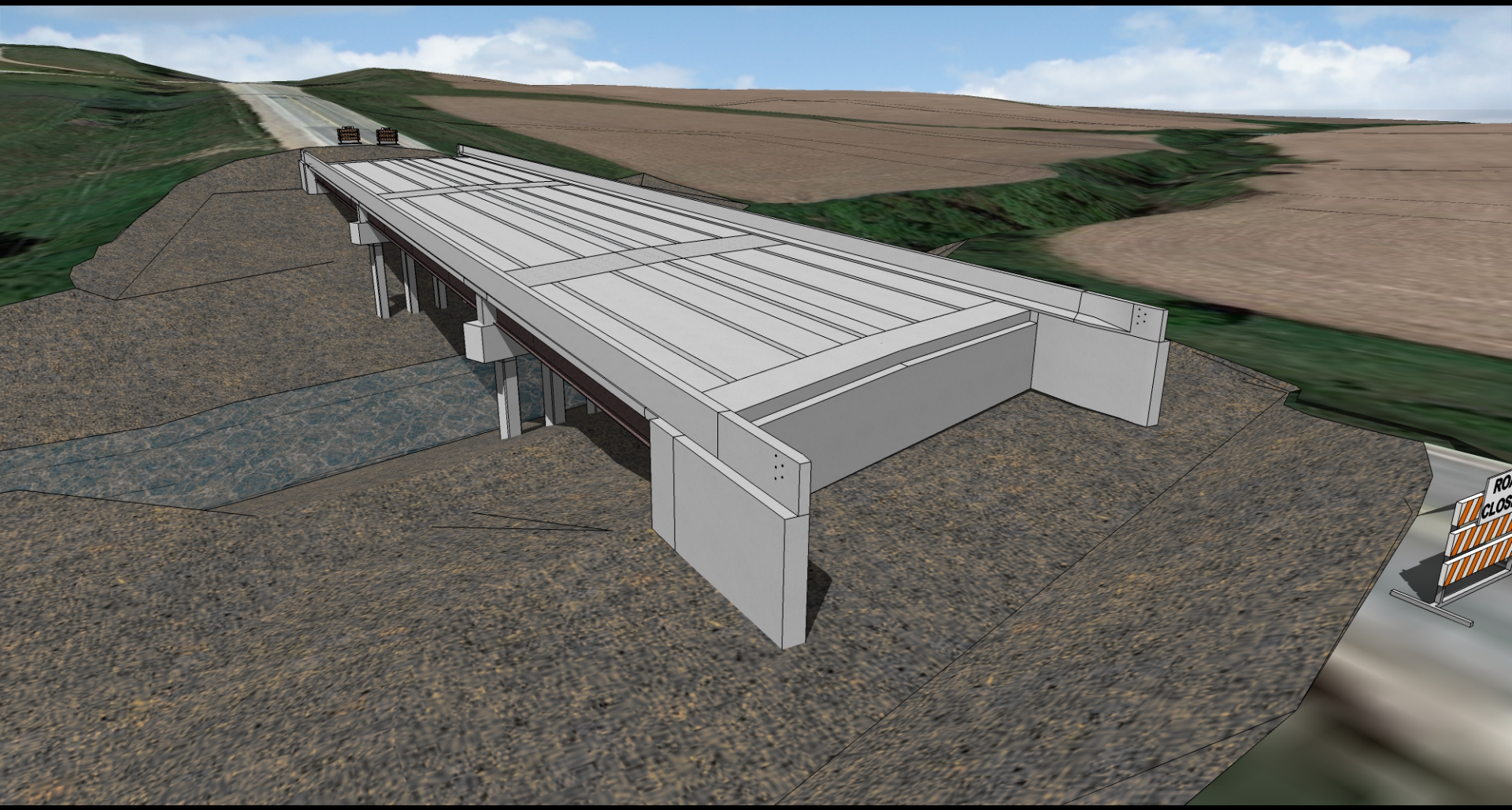
# EXISTING SITE



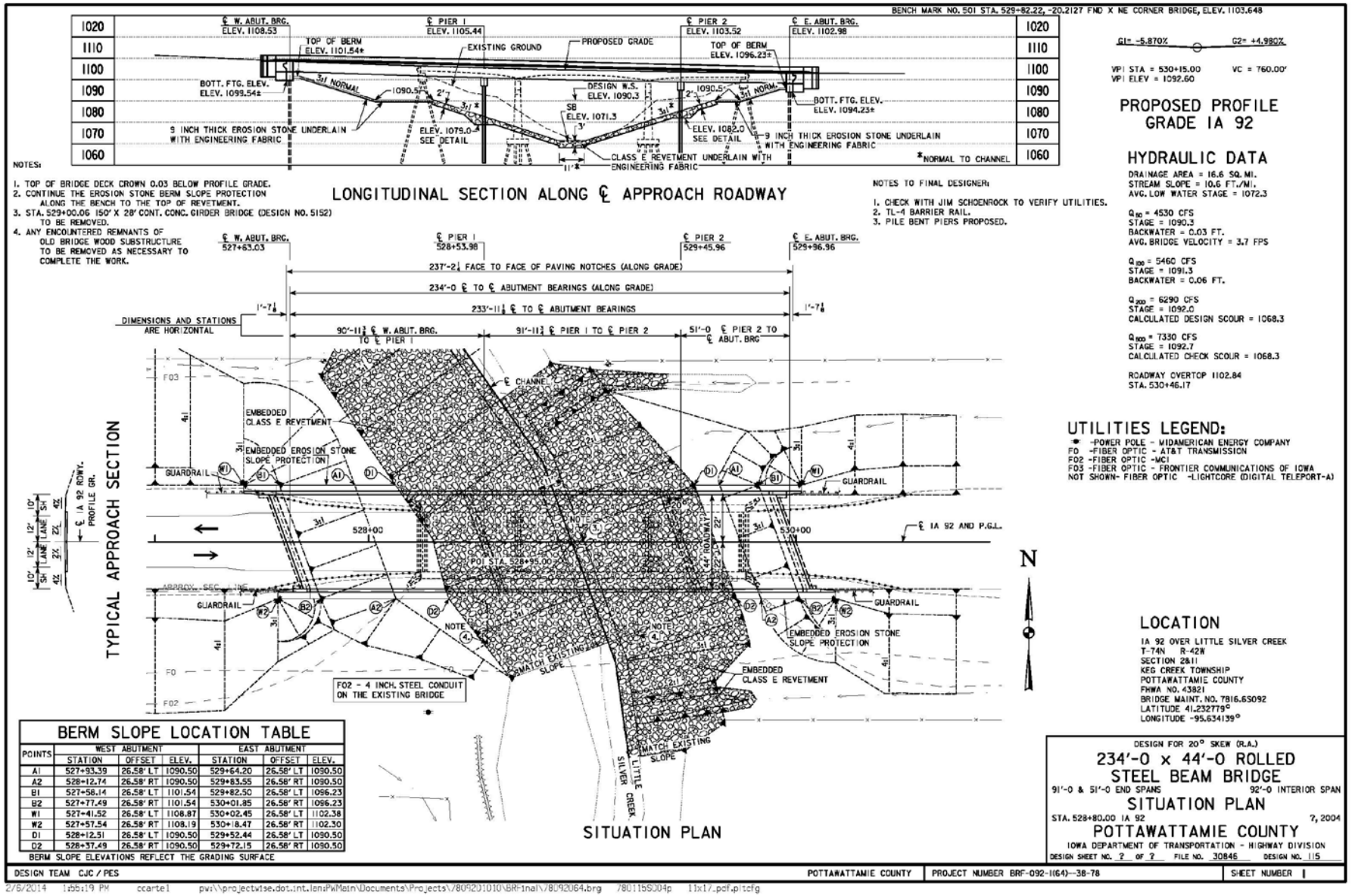

# GRADED CHANNEL




# TEMPORARY CAUSEWAY



# CONSTRUCTED BRIDGE




BERM SLOPE LOCATION TABLE

| POINTS | WEST ABUTMENT | | | EAST ABUTMENT | | |
|---|---|---|---|---|---|---|
| | STATION | OFFSET | ELEV. | STATION | OFFSET | ELEV. |
| A1 | 527+93.39 | 26.58' LT | 1090.50 | 529+64.20 | 26.58' LT | 1090.50 |
| A2 | 528+12.74 | 26.58' RT | 1090.50 | 529+83.55 | 26.58' RT | 1090.50 |
| B1 | 527+58.14 | 26.58' LT | 1101.54 | 529+82.50 | 26.58' LT | 1096.23 |
| B2 | 527+77.49 | 26.58' RT | 1101.54 | 530+01.85 | 26.58' RT | 1096.23 |
| W1 | 527+41.52 | 26.58' LT | 1108.87 | 530+02.45 | 26.58' LT | 1102.38 |
| W2 | 527+57.54 | 26.58' RT | 1108.19 | 530+18.47 | 26.58' RT | 1102.30 |
| D1 | 528+12.51 | 26.58' LT | 1090.50 | 529+52.44 | 26.58' LT | 1090.50 |
| D2 | 528+37.49 | 26.58' RT | 1090.50 | 529+72.15 | 26.58' RT | 1090.50 |

BERM SLOPE ELEVATIONS REFLECT THE GRADING SURFACE

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# CONSTRUCTABILITY DISCUSSION

## *--- SITE ---*

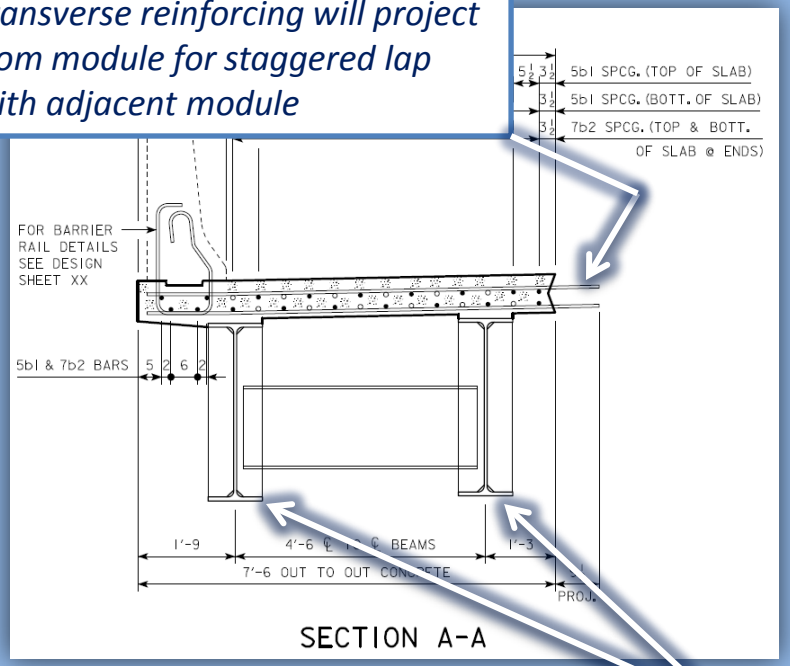
- **Grade and Skew**
  - Will complicate several aspects of construction
  - Final module geometry not conducive to plant fabrication
- **Site Access**
  - Steep, degraded channel
  - Temporary causeway will require borrow fill
- **Staging Yard**
  - Limited DOT Right-of-Way
  - Contractor to arrange Temporary Easement as required

# MODULAR DECKED BEAM UNITS

# MODULAR DECKED BEAMS

- **2-Beam Modular Units**
  - Patterned after US-6 over Keg Creek
  - W40 x 149 rolled steel beams
  - 4’-6 beam spacing, 7’-0 typical deck width
  - 8” high-performance deck, plus additional ¼” sacrificial thickness
  - Stainless steel deck reinforcing
  - ± 100,000 lbs. pick weight (M90 module)

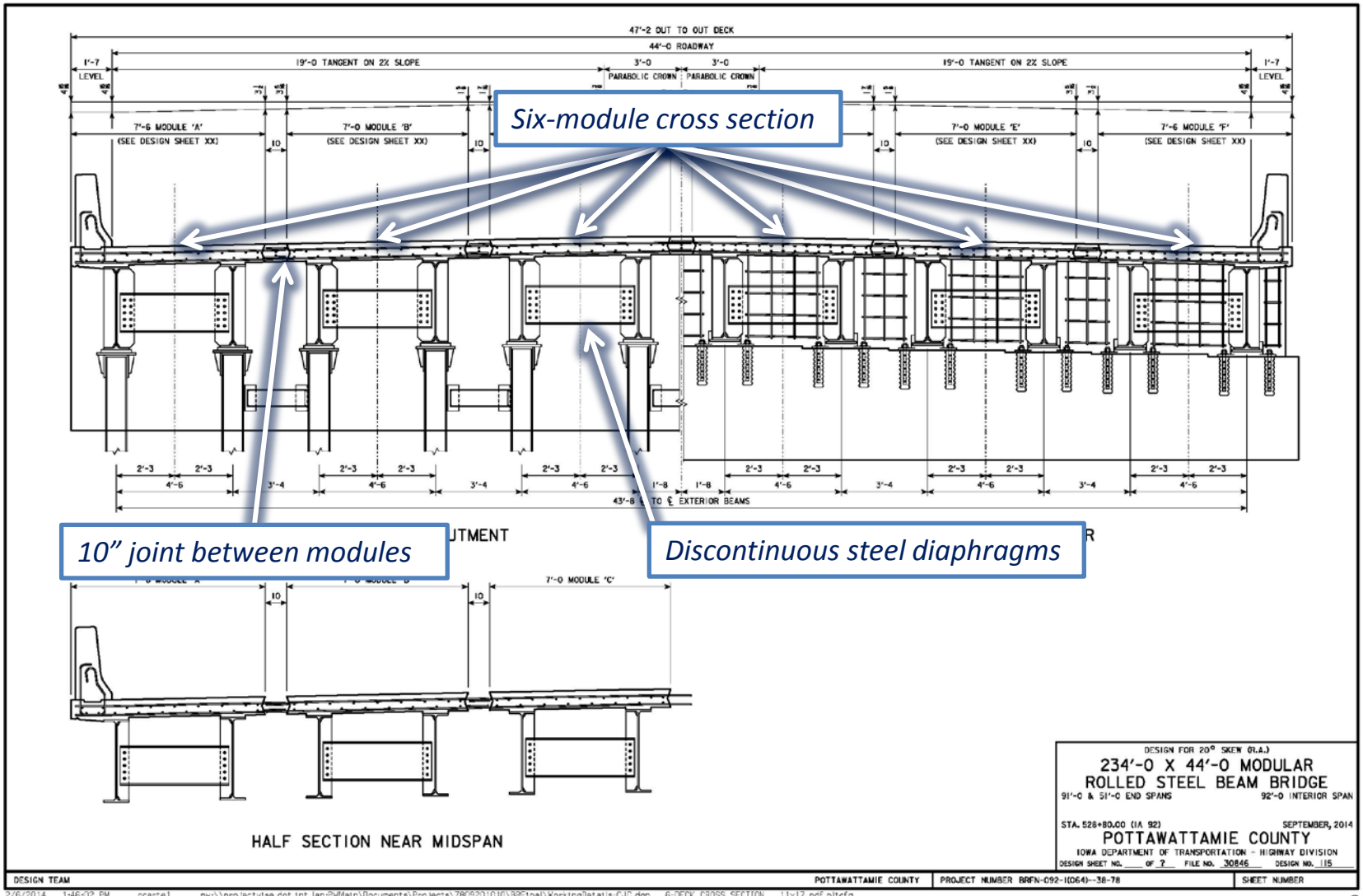
*Transverse reinforcing will project from module for staggered lap with adjacent module*




Typ. Module Detail

*Bottom of beams will be set level; crown will be established using variable haunch thickness*

# MODULAR DECKED BEAMS

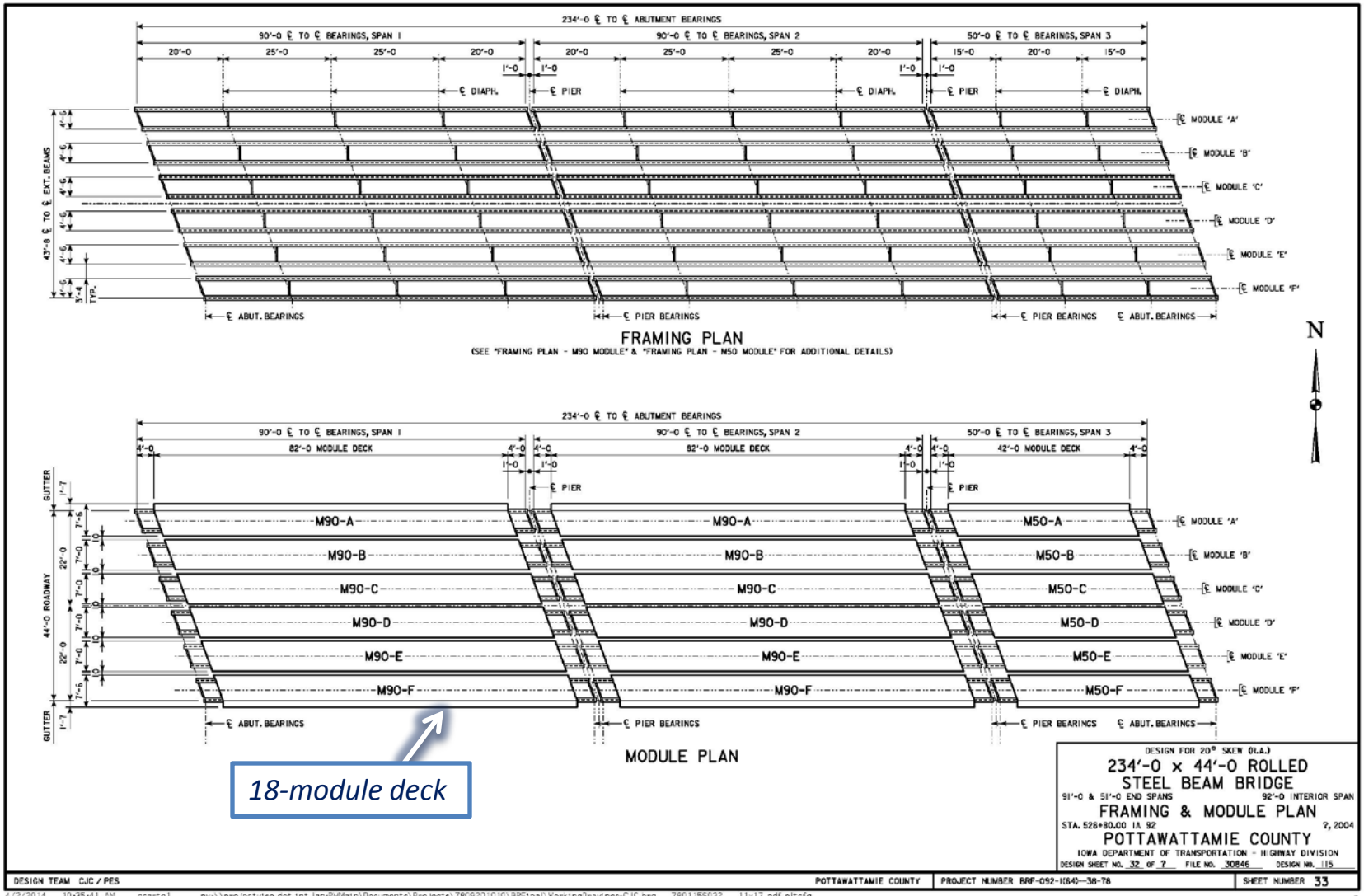



*Six-module cross section*

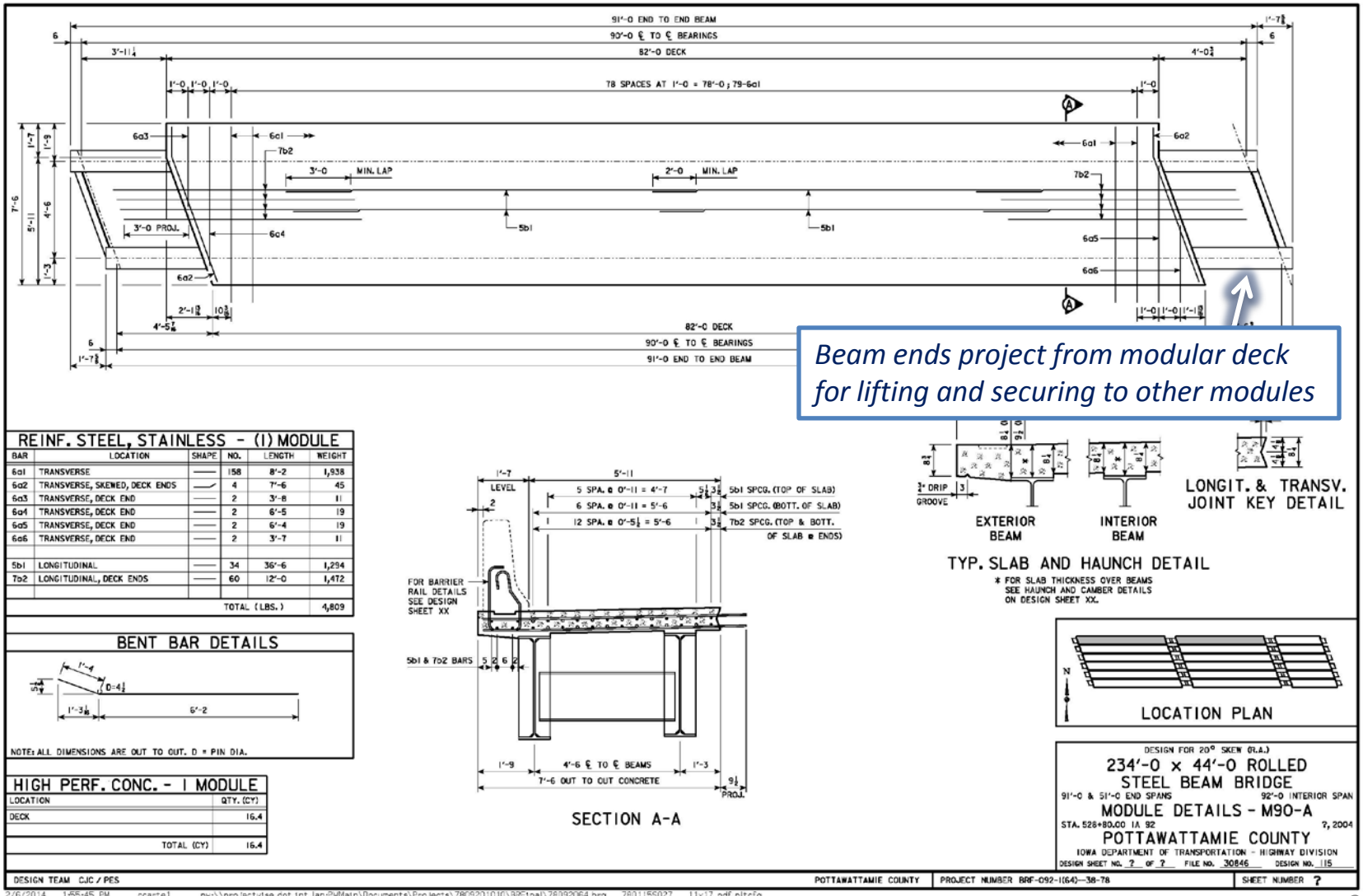
*10" joint between modules*

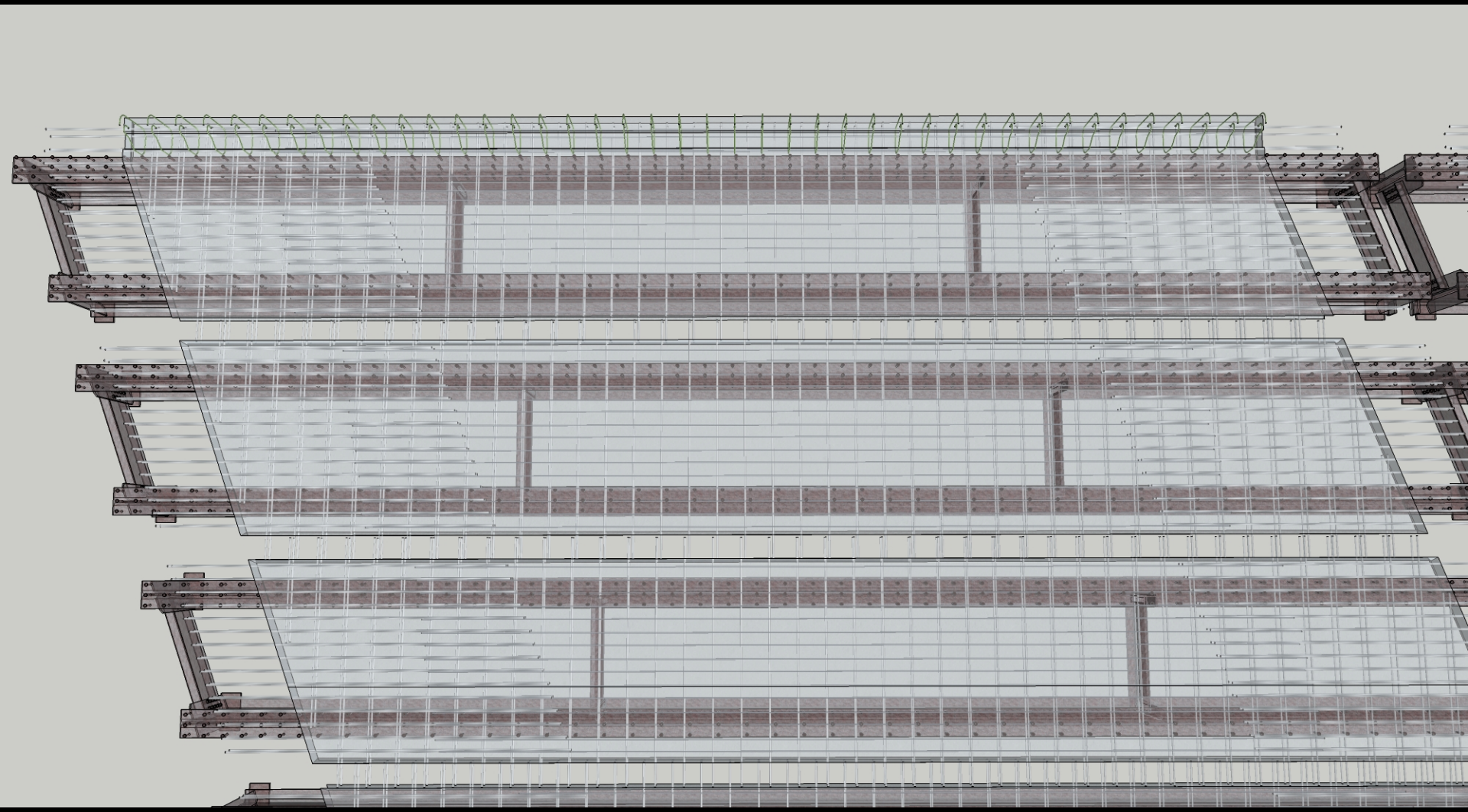
*Discontinuous steel diaphragms*

# MODULAR DECKED BEAMS

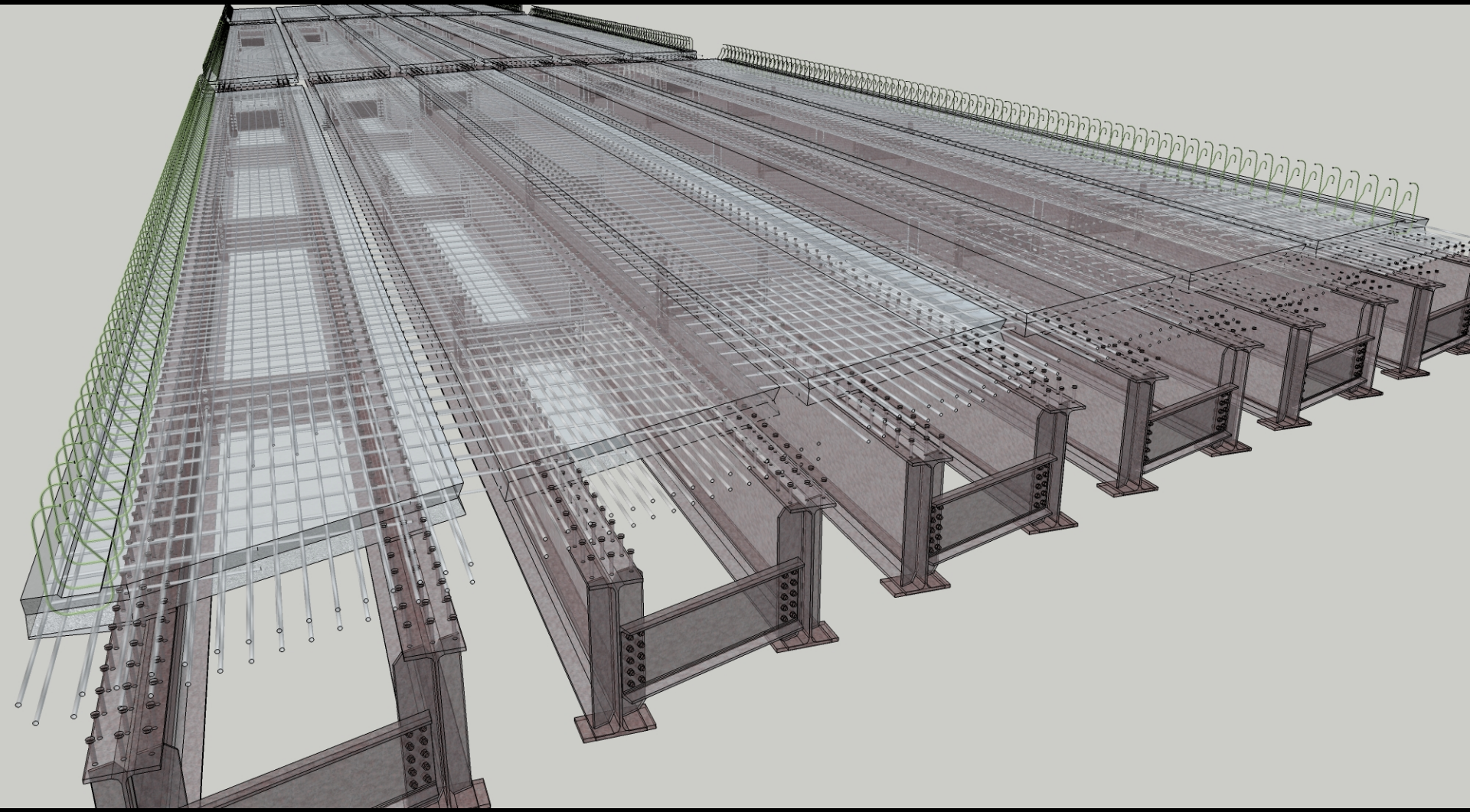


# MODULAR DECKED BEAMS





# MODULE X-RAY PLAN VIEW



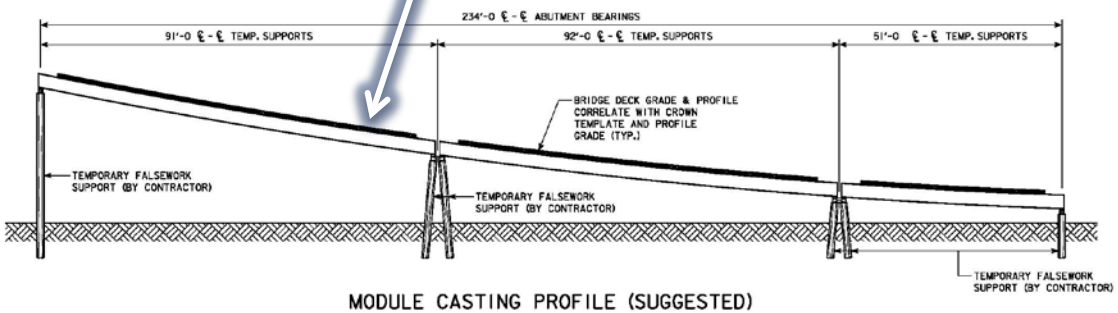
# MODULE X-RAY VIEW

# ALTERNATE SITE CASTING

- **Construction of modules at precasting plant will be difficult**
- **Anticipated construction approach includes Alt. Site Casting**
  - Construct superstructure off-alignment at nearby site (TBD by Contractor)
  - Temporary falsework to mimic final bearing seat elevations
  - Block-out deck joint locations to allow for use of conventional paving machine

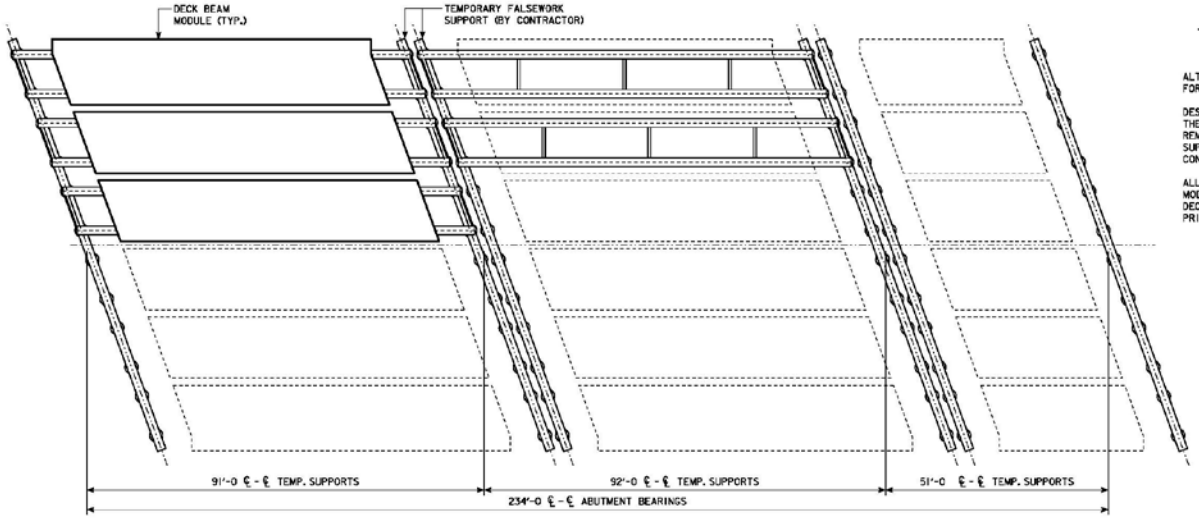
# ALTERNATE SITE CASTING

*Profile grade scale exaggerated 5X (grade change across bridge ± 5.5')*




MODULE CASTING PROFILE (SUGGESTED)

(PROFILE GRADE VERTICAL SCALE EXAGGERATED 5X FOR ILLUSTRATION)
(TEMPORARY SUPPORTS SHOWN FOR ILLUSTRATION ONLY)




MODULE CASTING PLAN (SUGGESTED)

(TEMPORARY SUPPORTS SHOWN FOR ILLUSTRATION ONLY)

## MODULE CASTING NOTES:

THE CONTRACTOR SHALL BE REQUIRED TO SUBMIT A MODULE CASTING PLAN FOR REVIEW AND APPROVAL BY THE ENGINEER. THE MODULE CASTING PLAN SHALL INCLUDE, BUT SHALL NOT BE LIMITED TO THE FOLLOWING:

- CASTING SITE LOCATION
- GENERAL SEQUENCE OF CASTING OPERATIONS
- DESCRIPTION OF TEMPORARY SUPPORTS
- QUALITY CONTROL AND GEOMETRIC CONTROL MEASURES PROPOSED TO FACILITATE PROPER FIT IN THE FINAL CONSTRUCTED CONDITION
- PROPOSED SCHEDULE INCLUDING MINIMUM WAITING PERIODS FOR CURING, FORM STRIPPING, TRANSPORTING, AND LOADING OF PRECAST COMPONENTS

THE CONTRACTOR IS STRONGLY ENCOURAGED COMBINE FRAMING / CASTING OPERATIONS FOR AS MANY ADJACENT MODULES AS PRACTICABLE, UNDER TEMPORARY SUPPORT CONDITIONS THAT CORRESPOND WITH THE RELATIVE POSITION (LOCATION AND ELEVATION) OF THE DESIGN BRIDGE SEATS. IOWA D.O.T. HAS SUCCESSFULLY COMPLETED A SIMILAR MODULAR BRIDGE PROJECT IN THE PAST (POTTAWATTAMIE DESIGN 111) WHERE CONSTRUCTION OF THE ENTIRE SUPERSTRUCTURE WAS SYNCHRONIZED AND THE MODULAR DECK SECTIONS WERE PLACED CONCURRENTLY WITH A PAVING MACHINE.

THE FOLLOWING IS A SUGGESTED CASTING PROCEDURE FOR CONSTRUCTION OF THE DECKED MODULES:

- POSITION ALL STRUCTURAL STEEL FRAMING COMPONENTS FOR ALL MODULES TO CORRESPOND WITH THE RELATIVE LOCATION(S) AND ELEVATION(S) OF THE FINAL CONSTRUCTED CONDITION. SUPPORT STRUCTURAL STEEL FRAMING COMPONENTS ONLY AT DESIGNATED BEARING LOCATIONS TO ALLOW FOR ACCURATE DEFLECTION OF THE MODULAR UNITS DURING PRECASTING OF THE DECK SECTIONS.
- POSITION TRANSVERSE DECK REINFORCING STEEL FOR OPTIMIZED BAR STAGGER BETWEEN ADJACENT MODULES.
- PLACE CONCRETE FOR ALL MODULES IN ONE COMBINED POUR, USING FORMED BLOCKOUTS AT THE LOCATIONS OF DESIGN CONSTRUCTION JOINTS. CONTROL FINISHED CONCRETE SURFACE TO ACCOUNT FOR THE DESIGN DECK THICKNESS, SKEW, CROWN PROFILE, AND PROFILE GRADE.
- IMPLEMENT OTHER QUALITY CONTROL / QUALITY ASSURANCE MEASURES AS NECESSARY TO ENSURE PROPER FIT OF DECKED MODULAR COMPONENTS IN THE FINAL CONSTRUCTED CONDITION.

ALTERNATE CASTING PROCEDURES MAY BE SUBMITTED BY THE CONTRACTOR FOR REVIEW.

DESIGN AND SAFETY OF ANY TEMPORARY SUPPORTS REQUIRED SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. TEMPORARY SUPPORTS SHALL REMAIN THE PROPERTY OF THE CONTRACTOR AND ALL TEMPORARY SUPPORTS WITHIN DOT RIGHT-OF-WAY SHALL BE REMOVED BY THE CONTRACTOR PRIOR TO COMPLETION OF THE PROJECT.

ALL COSTS ASSOCIATED WITH CONSTRUCTION OF PRECAST DECKED MODULES, INCLUDING TEMPORARY SUPPORT AND TRANSPORTATION OF DECKED MODULES, AS REQUIRED, SHALL BE INCIDENTAL TO THE INDIVIDUAL PRICE BIDS FOR "SUPERSTRUCTURE MODULE".

DESIGN FOR 20° SKEW (F.L.)

234'-0 x 44'-0 ROLLED STEEL BEAM BRIDGE

91'-0 & 51'-0 END SPANS 92'-0 INTERIOR SPAN

MODULE CASTING DETAILS

STA. 528+80.00 IA 92 ?, 2004

POTTAWATTAMIE COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. 9 OF ? FILE NO. 30846 DESIGN NO. 115

DESIGN TEAM CJC / PES | POTTAWATTAMIE COUNTY | PROJECT NUMBER BRF-092-1(64)--38-78 | SHEET NUMBER 10

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# EXAMPLE ALTERNATE SITE MODULE CONSTRUCTION

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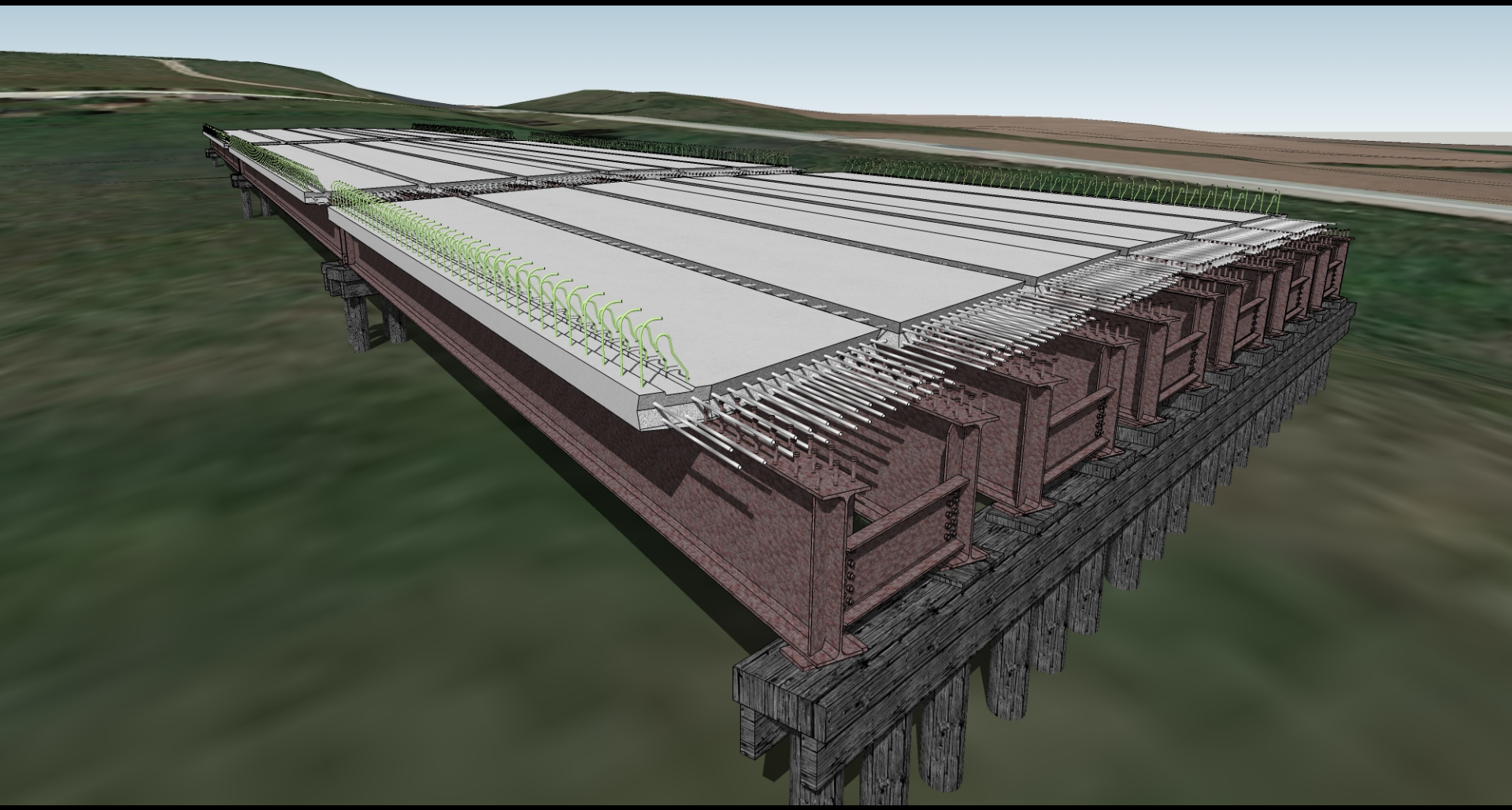
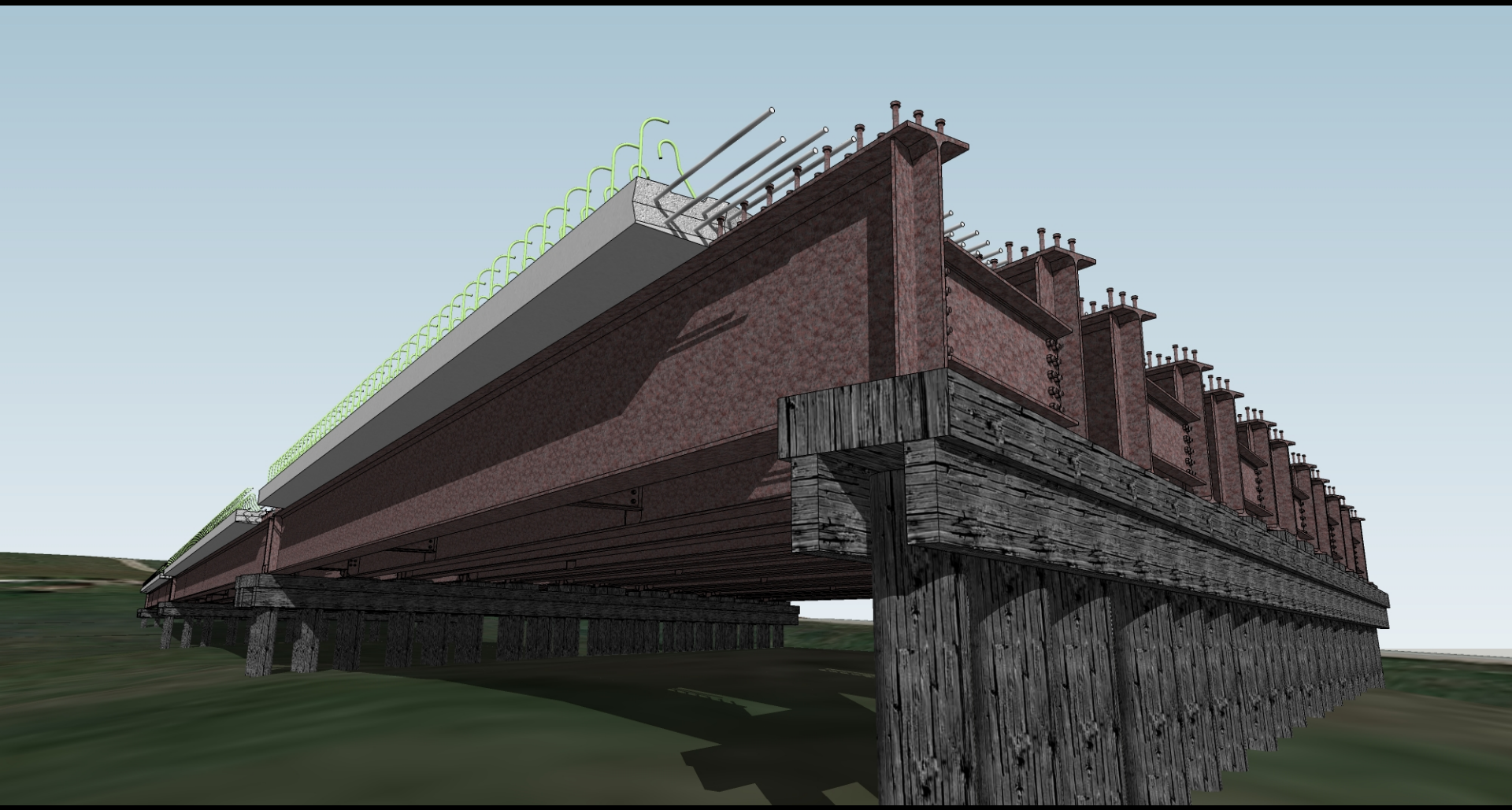


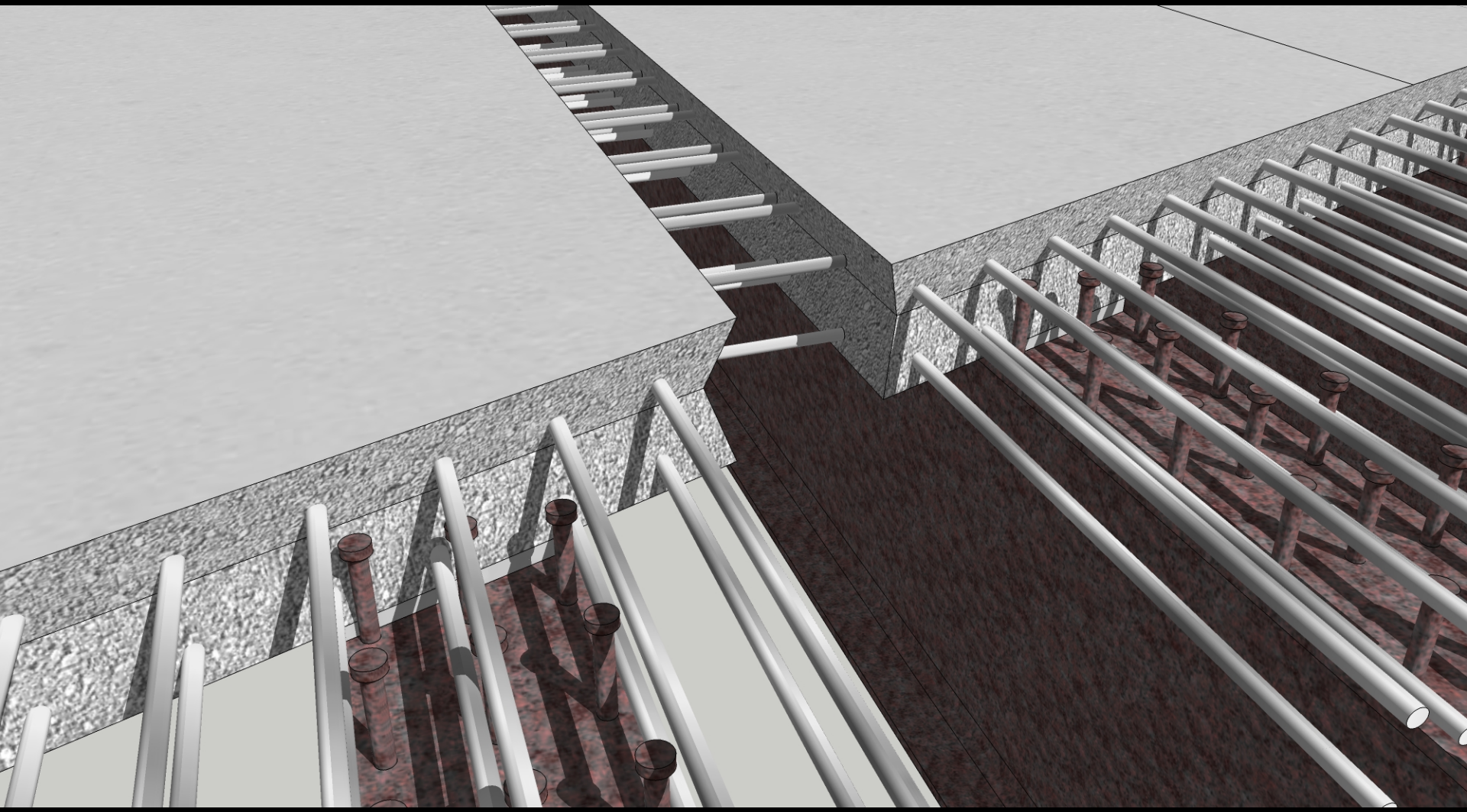
# EXAMPLE TEMPORARY FALSEWORK



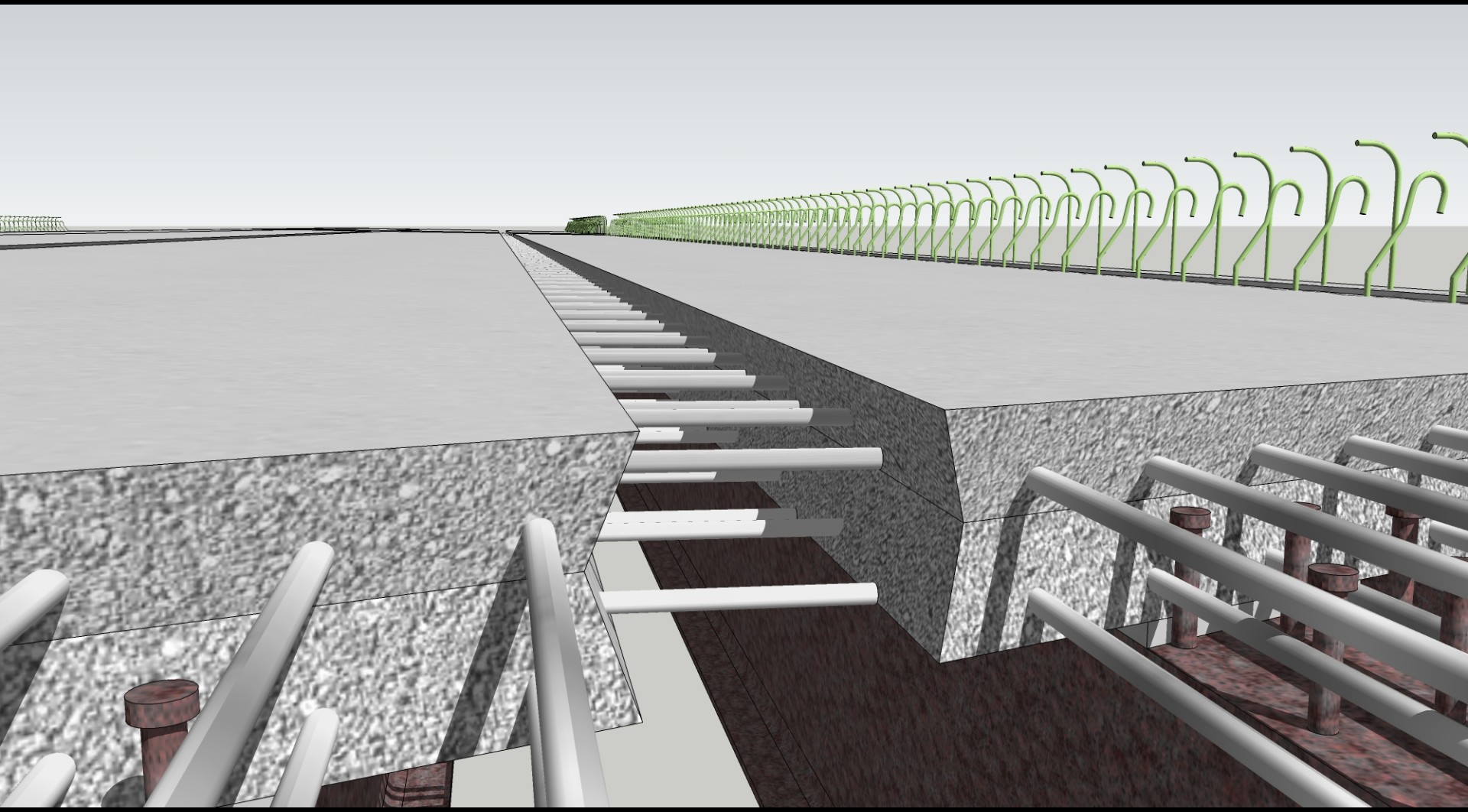
# EXAMPLE TEMPORARY FALSEWORK

# JOINT INTERFACE PREPARATION

- **Careful joint preparation is critical to performance and durability of superstructure**
- **Preferred approach – Exposed Aggregate Finish**
  - May be required in contract documents
  - Coat joint surface forms with form retarder
  - Remove joint forms after concrete set and pressure wash to expose aggregate (wash off concrete paste)
- **Alternate approach – Sandblasted Finish**
  - Not as desirable as Exposed Aggregate Finish, but allows more scheduling flexibility for form removal
  - Stainless steel deck reinforcing accommodates this approach



# VIEW OF JOINT INTERFACE SURFACE



# VIEW OF JOINT INTERFACE SURFACE

EXPOSED AGGREGATE FINISH
(PHOTO COURTESY OF BEN GRAYBEAL, FHWA)

# CONSTRUCTABILITY DISCUSSION

## *--- MODULAR DECKED BEAM UNITS ---*

- **Casting**
  - Alternate site TBD by Contractor
  - Temporary falsework design by Contractor
- **Joint Interface Preparation**
  - Formed blockouts
  - Formwork removal concerns for Exposed Aggregate Finish??
- **Transport & Handling**
  - Temporary causeway and working platform within channel
  - Crane placement and capacity need to be considered
- **Placement**
  - Bearing elevations, deck elevations and reinforcing locations are unique to each module

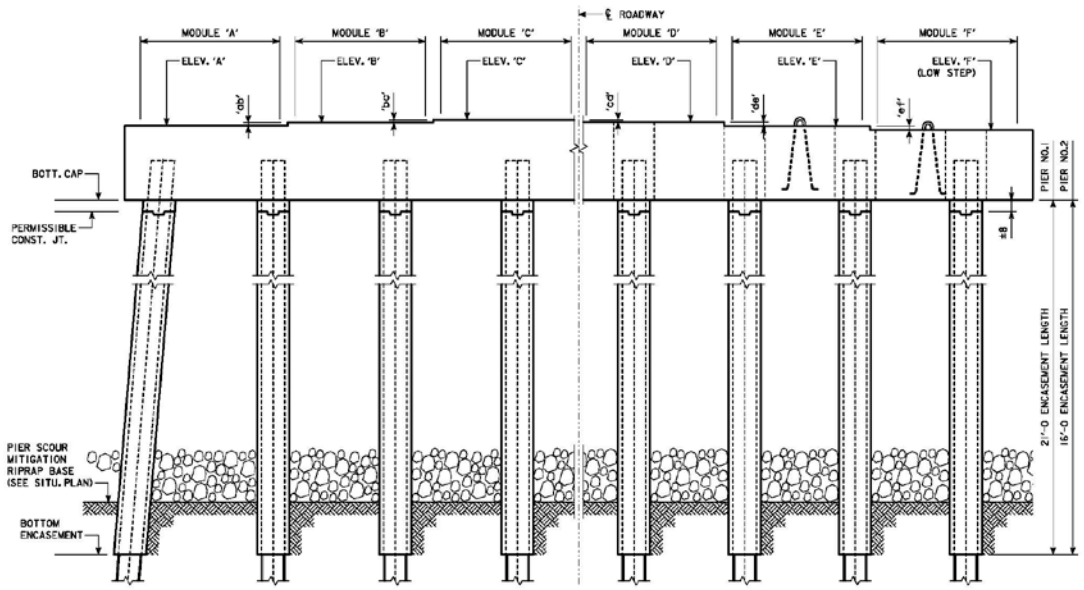
# PILE BENT PIERS

# PILE BENT PIERS

- **Long Pile Lengths**
  - ± 120’ (splices required)
- **Large Pile Section**
  - HP16x141
  - Welders for pile splices require special DOT certification
- **Piles Oriented for Strong-Axis Bending**
  - Rotated 90° compared to typical detail
- **Pile Cap:  Precast vs. Cast-in-Place**
  - Contractor preference??
  - ± 125,000 lbs. pick weight (precast cap)
- **Pile Encasement**
  - Assumed non-structural; may be constructed outside of critical closure

# PILE BENT PIERS

BENCH MARK NO. 501 STA. 529+82.22, -20.2127 FND X NE CORNER BRIDGE, ELEV. 1103.648




HALF ELEVATION - 'TYPE A' PIER
(CAST-IN-PLACE CAP; CAST-IN-PLACE PILE ENCASEMENT)
(LOOKING EAST)

HALF ELEVATION - 'TYPE B' PIER
(PRECAST CAP; CAST-IN-PLACE PILE ENCASEMENT)
(LOOKING EAST)

## PIER NOTES:

BRIDGE PIERS FOR THIS PROJECT SHALL CONSIST OF 'TYPE A' OR 'TYPE B' PIERS AS DETAILED IN THESE PLANS. THE SELECTED PIER TYPE SHALL BE THE SAME FOR PIER 1 AND PIER 2.

PILE DESIGN AND CONSTRUCTION CONTROL REQUIREMENTS SHALL BE THE SAME FOR 'TYPE A' AND 'TYPE B' PIER PILES. REFER TO PILE NOTES AND PIER PILE TABLES.

CONSTRUCTION OF PILE ENCASEMENT(S) SHALL BE PERMITTED AFTER PLACEMENT OF THE PIER CAPS. THE CONTRACTOR SHALL BE REQUIRED TO SUBMIT A TEMPORARY SUPPORT PLAN FOR PIER CAPS THAT ARE CONSTRUCTED PRIOR TO FULL MATURITY OF THE PILE ENCASEMENT CONCRETE, SUBJECT TO REVIEW AND APPROVAL BY THE ENGINEER. FIELD WELDING OF BRACKETS TO THE PILES SHALL BE DISCOURAGED AS A MEANS OF TEMPORARY PIER CAP SUPPORT.

MINIMUM CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR REINFORCING BAR IS TO BE 2 INCHES UNLESS OTHERWISE NOTED OR SHOWN.

REINFORCING IS TO BE SECURELY WIRED IN PLACE BEFORE CONCRETE IS POURED.

THE LUMP SUM PRICE BID FOR "BRIDGE PIER" SHALL INCLUDE ALL COSTS OF MATERIALS AND LABOR FOR CONSTRUCTION OF PIER CAPS AND PILE ENCASEMENT, INCLUDING EXCAVATION, CAST-IN-PLACE AND PRECAST STRUCTURAL CONCRETE, PORTLAND CEMENT GROUT, REINFORCING STEEL, STRUCTURAL STEEL, AND TEMPORARY SUPPORTS, AS REQUIRED.

MATERIALS AND LABOR FOR PIER PILES SHALL BE INCLUDED IN THE PRICE BID FOR "PILES, STEEL, HP 16 X 141".

## PILE NOTES:

THE CONTRACT LENGTH OF THE PIER PILES IS BASED ON THE DESIGN PARAMETERS LISTED IN THE "PIER PILE DESIGN (LRFD)" TABLE.

THE REQUIRED NOMINAL AXIAL BEARING RESISTANCE FOR ABUTMENT PILES AT END OF DRIVE (EOD) IS BASED ON THE PARAMETERS LISTED IN THE "PIER PILE CONST. CONTROL (LRFD)" TABLE.

PIER PILES SHALL BE DRIVEN UNTIL DESIGN BEARING IS ACHIEVED AND THE PILES EXCEED THE MINIMUM PENETRATION DEPTH NOTED IN THE PLANS. THESE REQUIREMENTS SUPERSEDE THE REQUIREMENTS NOTED IN SECTION 2501.03.0.2 OF THE STANDARD SPECIFICATIONS. CONSTRUCTION CONTROL REQUIRES A WEAP ANALYSIS WITH BEARING GRAPH.

### PIER PILE DESIGN (LRFD)

| DESIGN PARAMETER | PIER 1 | PIER 2 |
|---|---|---|
| SOIL CLASSIFICATION | XXXX | XXXX |
| GEOTECH. RESIST. FACTOR, "PHI" - SOIL | XXXX | XXXX |
| GEOTECH. RESIST. FACTOR, "PHI" - ROCK | XXXX | XXXX |
| TOTAL FACTORED AXIAL LOAD, "PU" (KIPS) | XXXX | XXXX |
| NO. PILES | 8 | 8 |
| PILE TYPE (STEEL HP-SECTION) | HP 16 X 141 | HP 16 X 141 |
| CONTRACT LENGTH (FT) | XXXX | XXXX |

### PIER PILE CONST. CONTROL (LRFD)

| DESIGN PARAMETER | PIER 1 | PIER 2 |
|---|---|---|
| SOIL CLASSIFICATION | XXXX | XXXX |
| GEOTECH. RESIST. FACTOR, "PHI" - SOIL | XXXX | XXXX |
| GEOTECH. RESIST. FACTOR, "PHI" - ROCK | XXXX | XXXX |
| NOMINAL AXIAL BEARING RESISTANCE (TONS) | XXXX | XXXX |

### PIER ELEVATIONS

| LOCATION | PIER 1 | PIER 2 |
|---|---|---|
| LOW STEP | XXX.xx | XXX.xx |
| BOTTOM CAP | XXX.xx | XXX.xx |
| BOTTOM ENCASEMENT | XXX.xx | XXX.xx |
| | | |

### BEAM SEAT ELEV.

| LOCATION | PIER 1 | PIER 2 |
|---|---|---|
| ELEV. 'A' | XXX.xx | XXX.xx |
| ELEV. 'B' | XXX.xx | XXX.xx |
| ELEV. 'C' | XXX.xx | XXX.xx |
| ELEV. 'D' | XXX.xx | XXX.xx |
| ELEV. 'E' | XXX.xx | XXX.xx |
| ELEV. 'F' | XXX.xx | XXX.xx |
| | | |

### CAP STEP HEIGHT

| STEP | PIER 1 | PIER 2 |
|---|---|---|
| 'ab' | XXX.xx | XXX.xx |
| 'bc' | XXX.xx | XXX.xx |
| 'cd' | XXX.xx | XXX.xx |
| 'de' | XXX.xx | XXX.xx |
| 'ef' | XXX.xx | XXX.xx |
| | | |
| | | |

NOTE: BEAM SEAT ELEVATIONS AND CAP STEPS HEIGHT ARE THE SAME FOR 'TYPE A' AND 'TYPE B' PIERS

### EST. QUANTITIES - TWO BRIDGE PIERS

| ITEM | UNIT | PIER 1 | PIER 2 | TOTAL |
|---|---|---|---|---|
| BRIDGE PIER | LS | 1.0 | 1.0 | 2.0 |
| PILES, STEEL, HP 16 x 141 | LF | XXX | XXX | XXX |
| | | | | |

DESIGN FOR 20° SKEW (F.L.)

234'-0 x 44'-0 ROLLED STEEL BEAM BRIDGE

91'-0 & 51'-0 END SPANS 92'-0 INTERIOR SPAN

PIER DETAILS - GENERAL

STA. 528+80.00 IA 92 ?, 2004

POTTAWATTAMIE COUNTY

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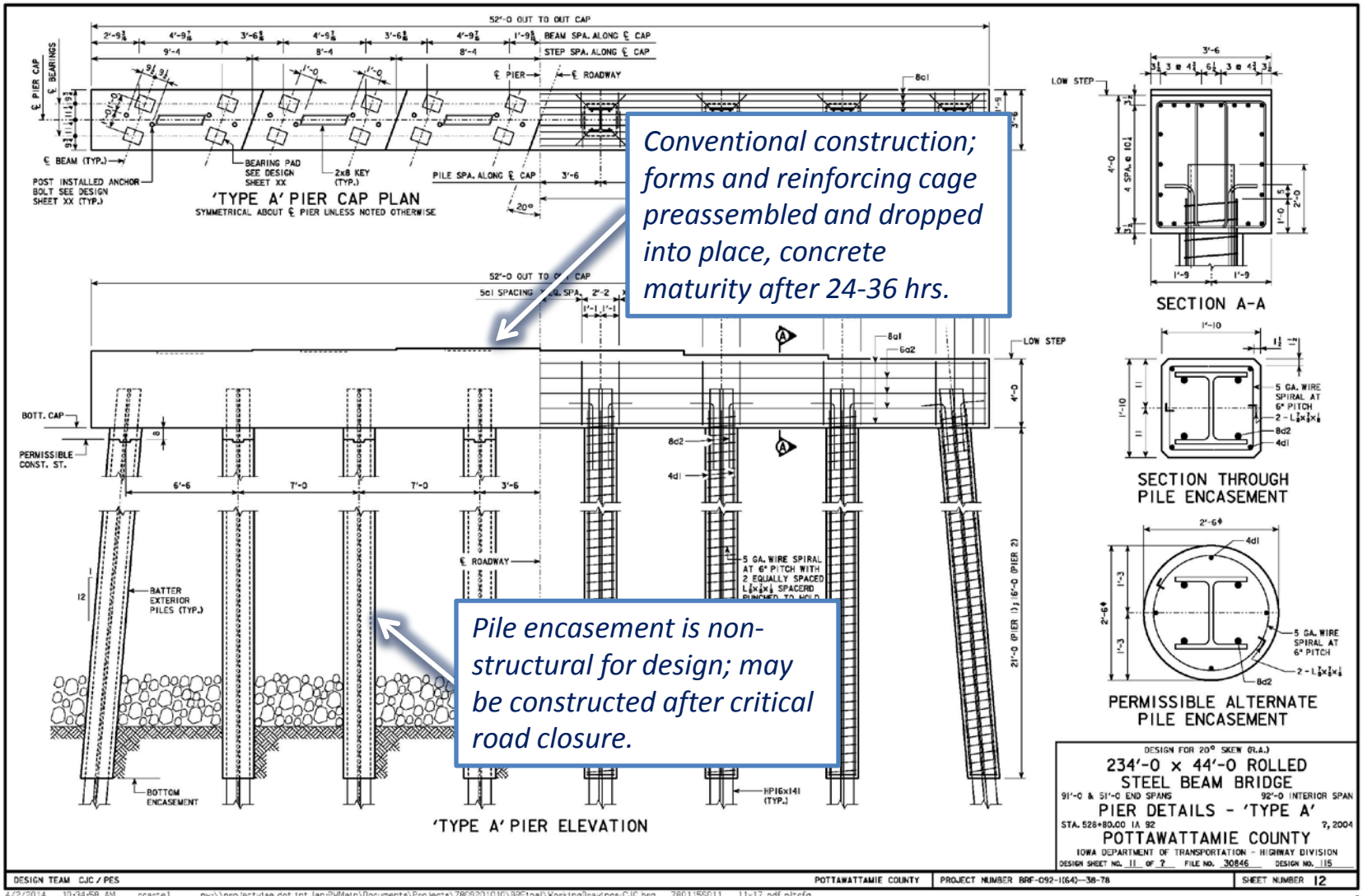
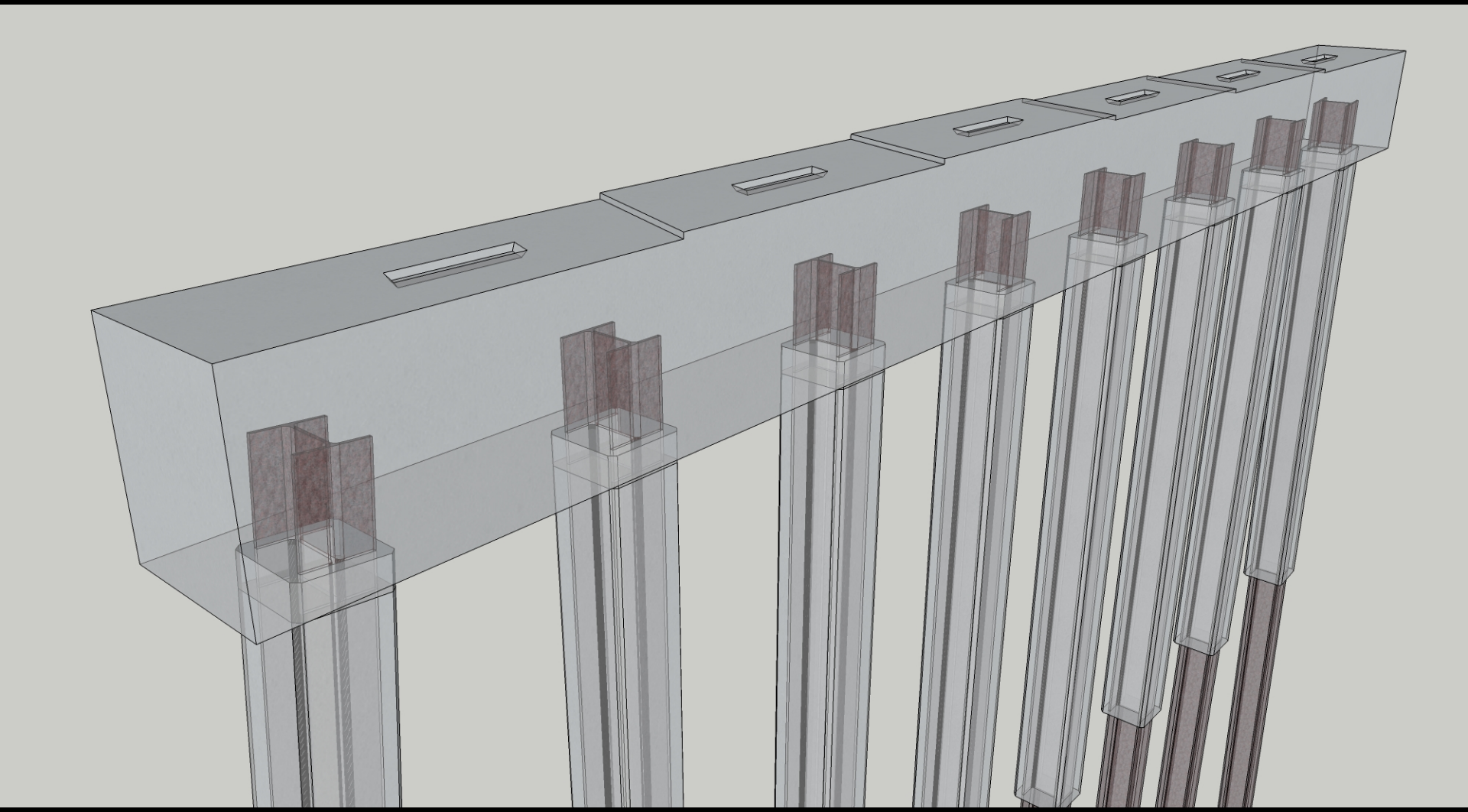
# PILE BENT PIER (C.I.P. CAP)



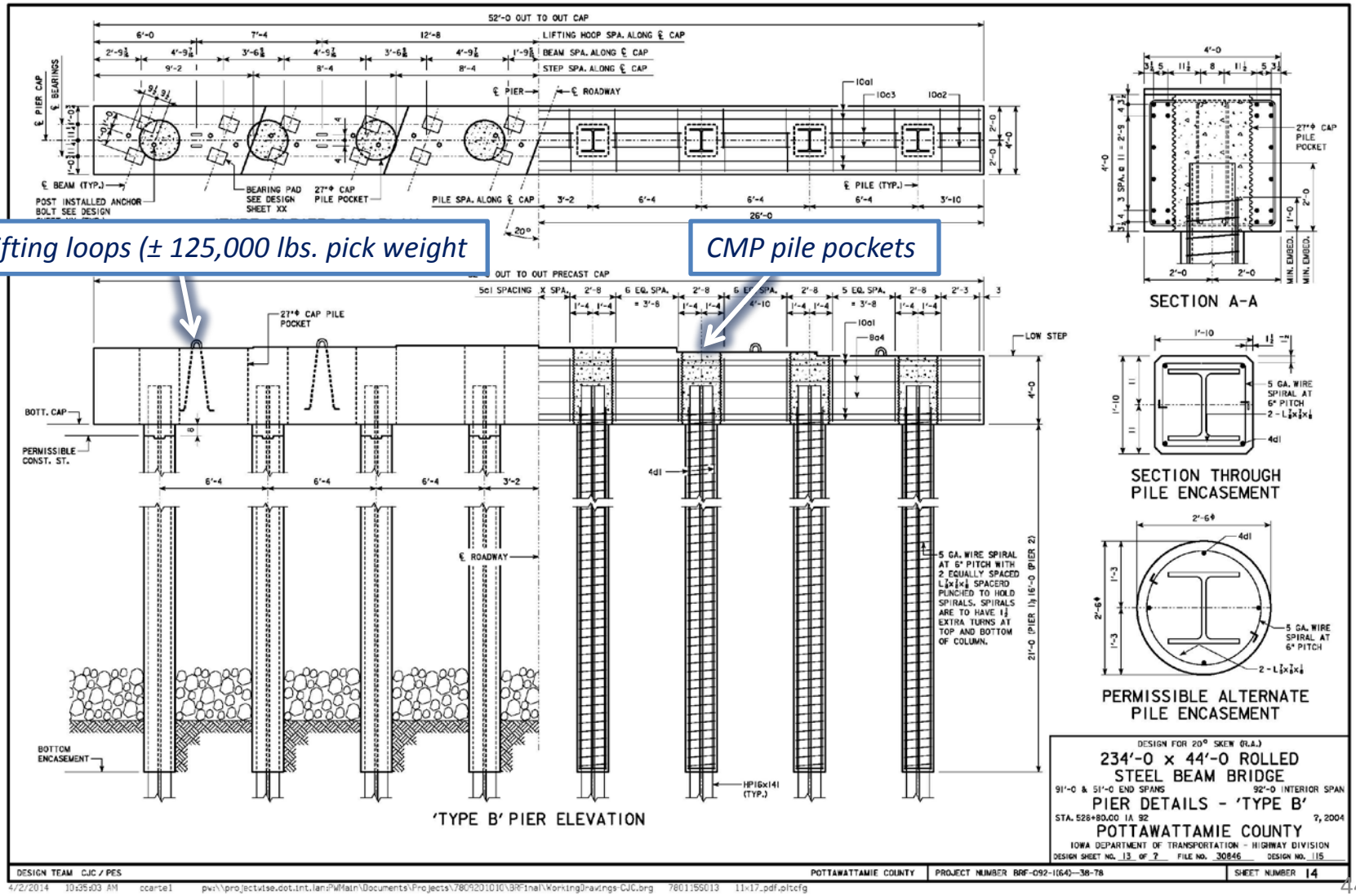

*Conventional construction; forms and reinforcing cage preassembled and dropped into place, concrete maturity after 24-36 hrs.*

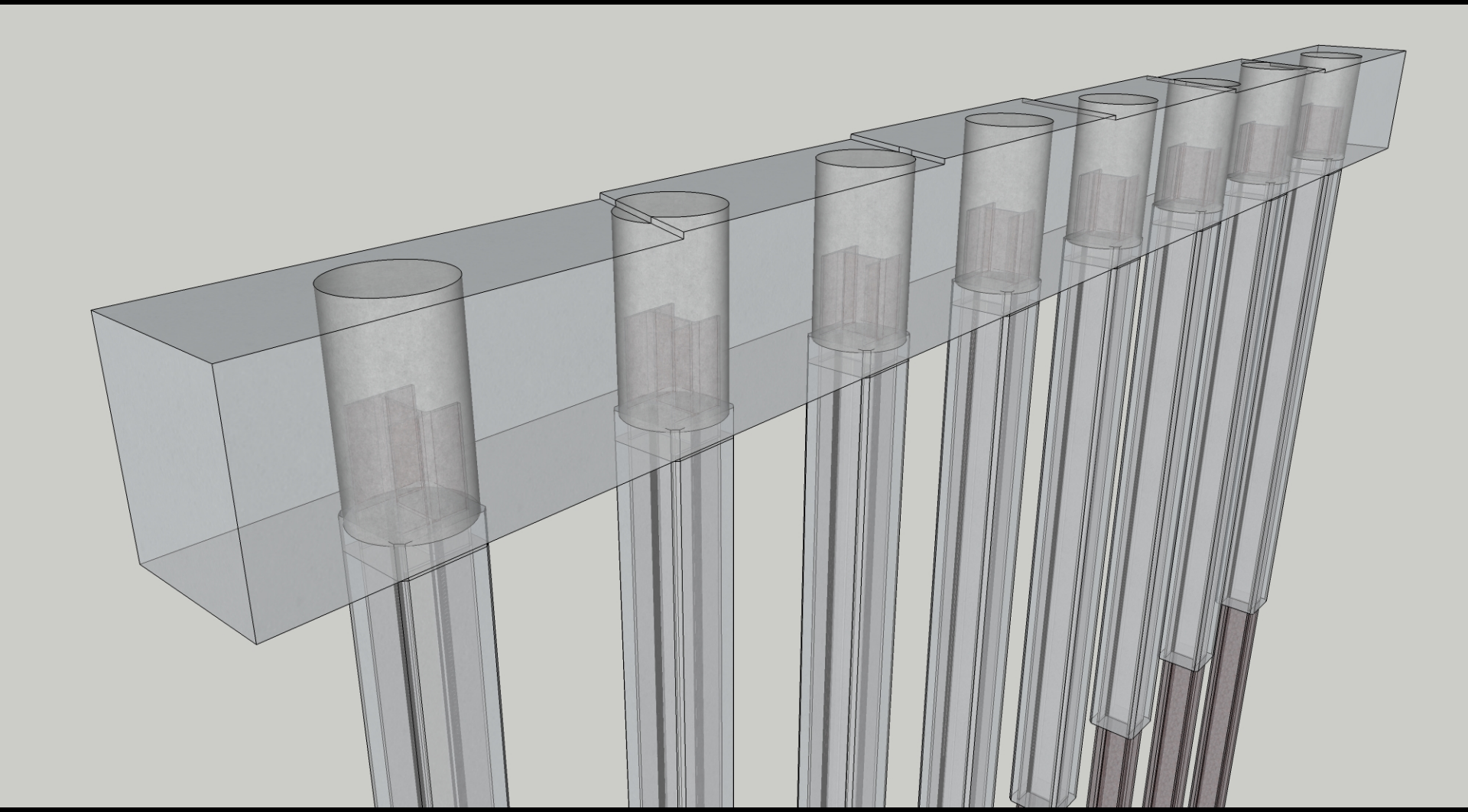
*Pile encasement is non-structural for design; may be constructed after critical road closure.*



# PILE BENT PIER (C.I.P. CAP)

# PILE BENT PIER (PRECAST CAP)





# PILE BENT PIER (PRECAST CAP)

# CONSTRUCTABILITY DISCUSSION

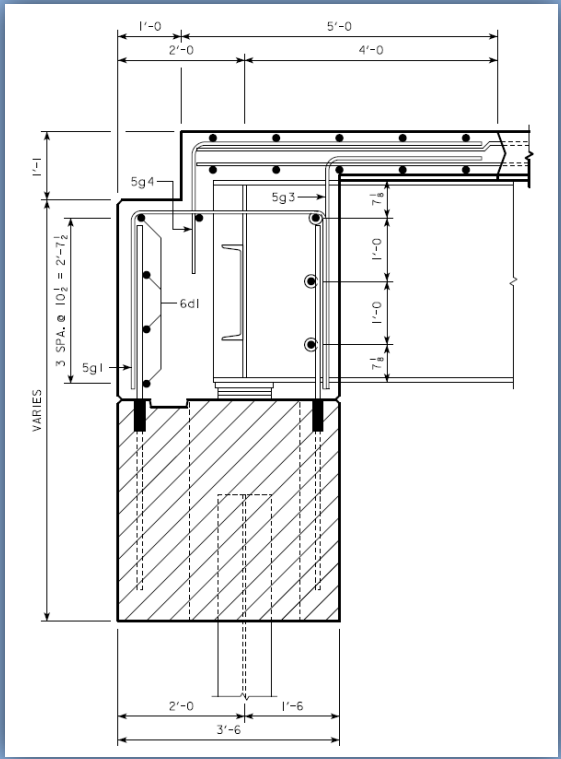
## *--- PILE BENT PIERS ---*

- **Pile Driving**
  - Hammer selection for larger pile size
  - Splices will be time consuming, require certified personnel
  - Accurate pile placement will be critical for precast cap option
- **Pier Cap Construction**
  - Do contractors prefer cast-in-place or precast cap??
  - Piles rotated 90°; implications on how cap / cap forms are supported??
- **Construction Bracing**
  - Increased unbraced length and eccentric loads during construction; temporary bracing options??
- **Pile Encasement**
  - Multiple forms required if constructed during critical closure

# INTEGRAL ABUTMENTS

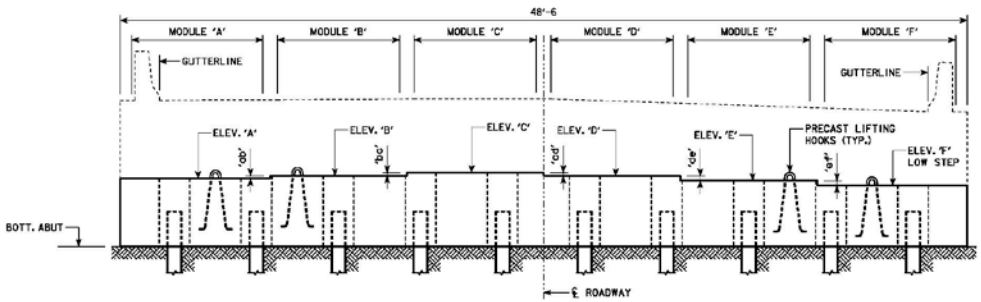
# INTEGRAL ABUTMENTS

- **Prebored Holes**
  - 10’ deep at each abutment pile
- **Long Pile Lengths**
  - ± 120’ (splices required)
- **Abutment Footing:  Precast vs.**
- **Cast-in-Place**
  - Contractor preference??
  - ± 95,000 lbs. pick weight (precast footing)
  - Mechanical splicers connect footing to C.I.P. backwall
- **Cast-in-Place Backwall and Wings**
  - Plan details intended to simplify formwork to accommodate C.I.P. construction



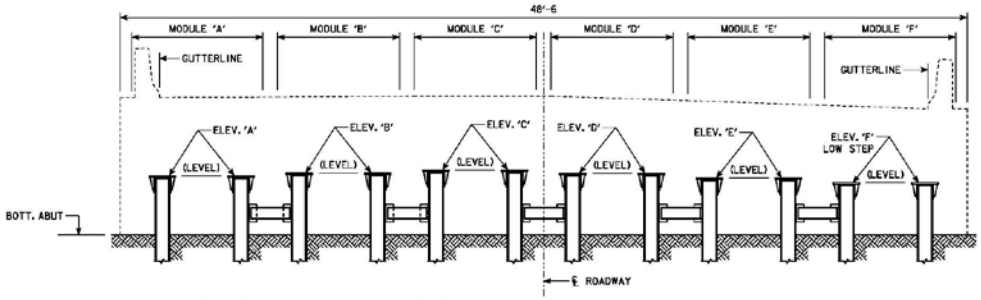

Integral Abutment with Precast Cap

# INTEGRAL ABUTMENTS




REAR ELEVATION - TYPE 'A' ABUTMENT
(PRECAST OR CAST-IN-PLACE FOOTING; CAST-IN-PLACE BACKWALL)
(WEST ABUTMENT SHOWN; EAST ABUTMENT SIMILAR)

| 'TYPE A' | | | | | |
|---|---|---|---|---|---|
| BEAM SEAT ELEV. | | | CAP STEP HEIGHT | | |
| LOCATION | PIER 1 | PIER 2 | STEP | PIER 1 | PIER 2 |
| ELEV. A | XXX.xx | XXX.xx | 'ab' | XXX.xx | XXX.xx |
| ELEV. B | XXX.xx | XXX.xx | 'bc' | XXX.xx | XXX.xx |
| ELEV. C | XXX.xx | XXX.xx | 'cd' | XXX.xx | XXX.xx |
| ELEV. D | XXX.xx | XXX.xx | 'de' | XXX.xx | XXX.xx |
| ELEV. E | XXX.xx | XXX.xx | 'ef' | XXX.xx | XXX.xx |
| ELEV. F | XXX.xx | XXX.xx | | | |




REAR ELEVATION - TYPE 'B' ABUTMENT
(CAST-IN-PLACE INTEGRAL ABUTMENT BACKWALL / DIAPHRAGM)
(WEST ABUTMENT SHOWN; EAST ABUTMENT SIMILAR)

| 'TYPE B' | | |
|---|---|---|
| BEAM SEAT ELEV. | | |
| LOCATION | PIER 1 | PIER 2 |
| ELEV. A | XXX.xx | XXX.xx |
| ELEV. B | XXX.xx | XXX.xx |
| ELEV. C | XXX.xx | XXX.xx |
| ELEV. D | XXX.xx | XXX.xx |
| ELEV. E | XXX.xx | XXX.xx |
| ELEV. F | XXX.xx | XXX.xx |

BENCH MARK NO. 501 STA. 529+82.22, -20.2127 FND X NE CORNER BRIDGE, ELEV. 1103.648

## ABUTMENT NOTES:

BRIDGE PIERS FOR THIS PROJECT SHALL CONSIST OF 'TYPE A' OR 'TYPE B' PIERS AS DETAILED IN THESE PLANS. THE SELECTED PIER TYPE SHALL BE THE SAME FOR PIER 1 AND PIER 2.

PILE DESIGN AND CONSTRUCTION CONTROL REQUIREMENTS SHALL BE THE SAME FOR 'TYPE A' AND 'TYPE B' PIER PILES. REFER TO PILE NOTES AND PIER PILE TABLES.

CONSTRUCTION OF PILE ENCASEMENT(S) SHALL BE PERMITTED AFTER PLACEMENT OF THE PIER CAPS. THE CONTRACTOR SHALL BE REQUIRED TO SUBMIT A TEMPORARY SUPPORT PLAN FOR PIER CAPS THAT ARE CONSTRUCTED PRIOR TO FULL MATURITY OF THE PILE ENCASEMENT CONCRETE, SUBJECT TO REVIEW AND APPROVAL BY THE ENGINEER. FIELD WELDING OF BRACKETS TO THE PILES SHALL BE DISCOURAGED AS A MEANS OF TEMPORARY PIER CAP SUPPORT.

MINIMUM CLEAR DISTANCE FROM FACE OF CONCRETE TO NEAR REINFORCING BAR IS TO BE 2 INCHES UNLESS OTHERWISE NOTED OR SHOWN.

REINFORCING IS TO BE SECURELY WIRED IN PLACE BEFORE CONCRETE IS POURED.

THE LUMP SUM PRICE BID FOR "BRIDGE PIER" SHALL INCLUDE ALL COSTS OF MATERIALS AND LABOR FOR CONSTRUCTION OF PIER CAPS AND PILE ENCASEMENT, INCLUDING EXCAVATION, CAST-IN-PLACE AND PRECAST STRUCTURAL CONCRETE, PORTLAND CEMENT GROUT, REINFORCING STEEL, STRUCTURAL STEEL, AND TEMPORARY SUPPORTS, AS REQUIRED.

MATERIALS AND LABOR FOR PIER PILES SHALL BE INCLUDED IN THE PRICE BID FOR "PILES, STEEL, HP 16 X ___".

| EST. QUANTITIES - TWO BRIDGE ABUT. | | | | |
|---|---|---|---|---|
| ITEM | UNIT | PIER 1 | PIER 2 | TOTAL |
| BRIDGE ABUTMENT | LS | 1.0 | 1.0 | 2.0 |
| PILES, STEEL, HP 10 x 57 | LF | XXX | XXX | XXX |

DESIGN FOR 20° SKEW (F.L.A.)
234'-0 x 44'-0 ROLLED STEEL BEAM BRIDGE
91'-0 & 51'-0 END SPANS 92'-0 INTERIOR SPAN
ABUTMENT DETAILS - GENERAL
STA. 528+80.00 IA 92 ?, 2004
POTTAWATTAMIE COUNTY
IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION
DESIGN SHEET NO. 15 OF ? FILE NO. 30846 DESIGN NO. 115

DESIGN TEAM CJC / PES | POTTAWATTAMIE COUNTY | PROJECT NUMBER BRF-092-1(64)--38-78 | SHEET NUMBER 16

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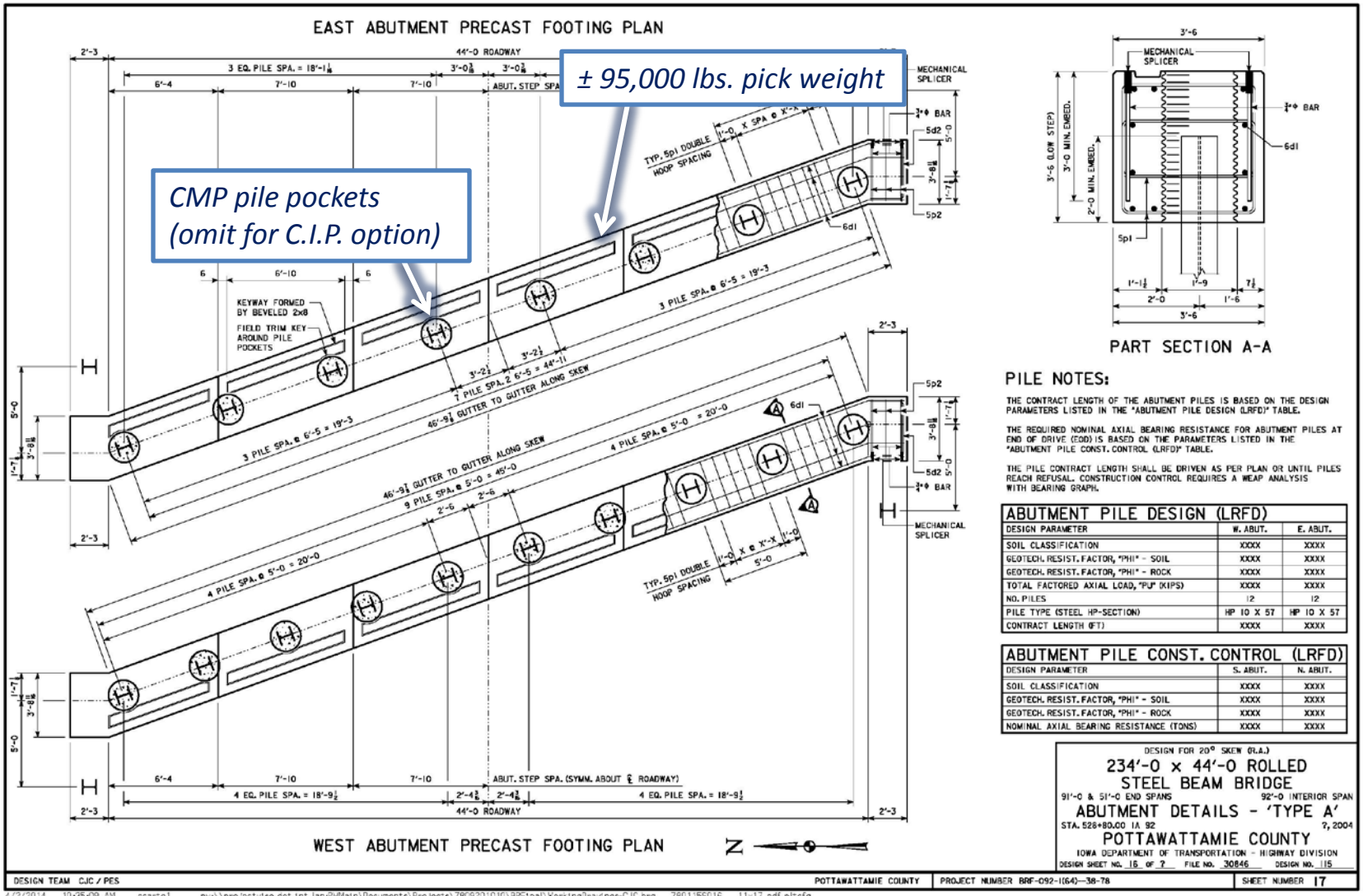
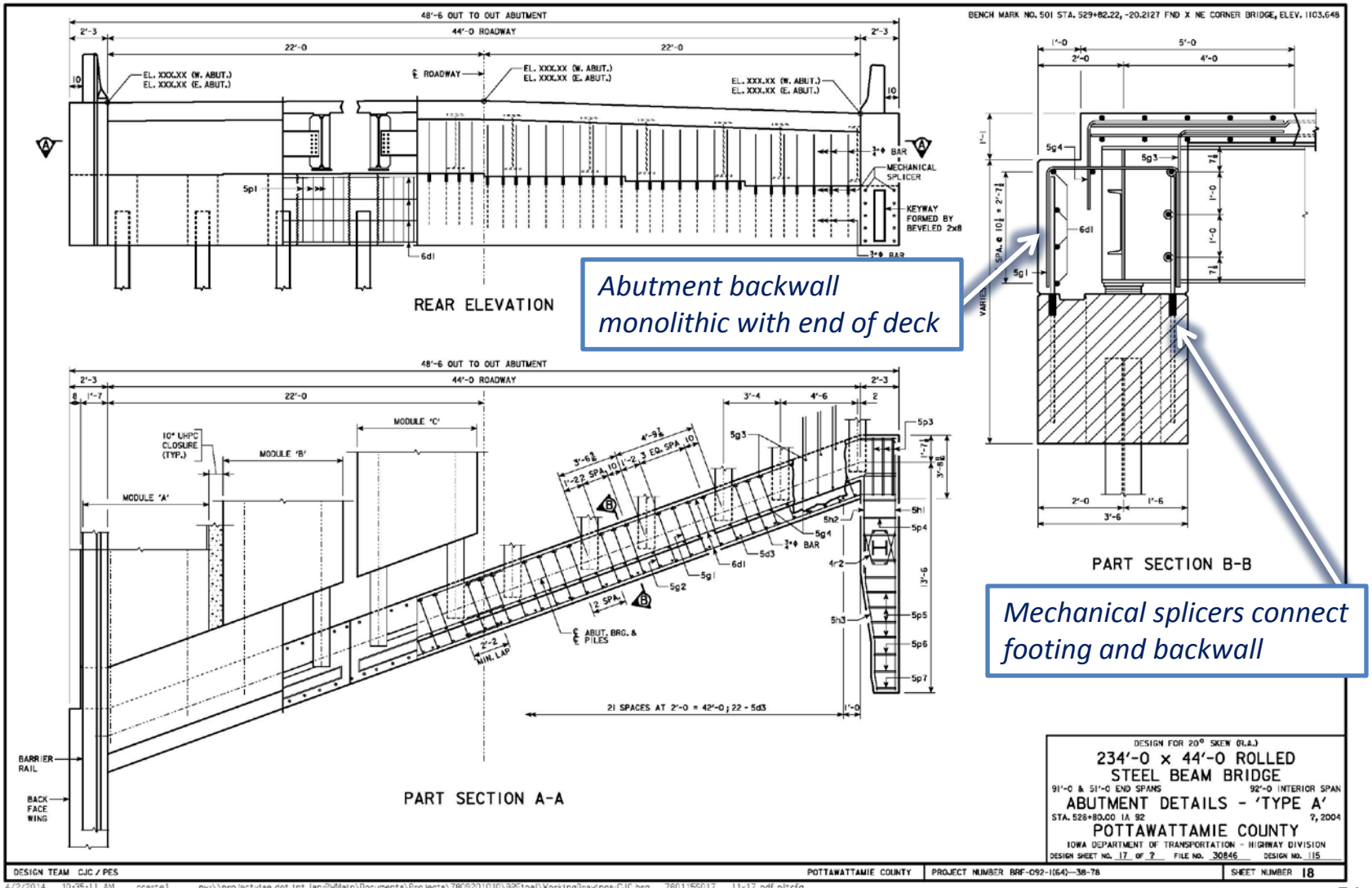
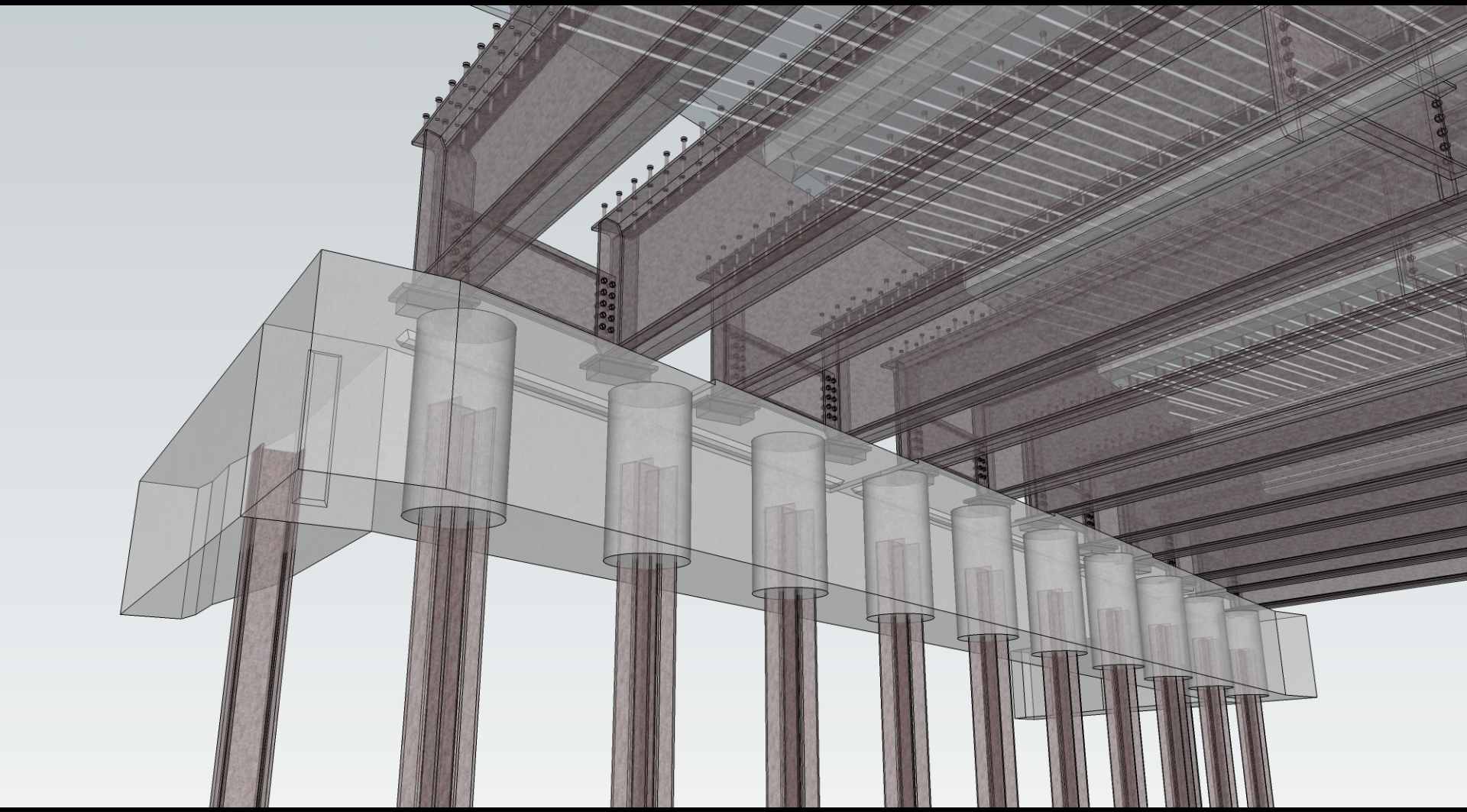
# INTEGRAL ABUT. (PRECAST/C.I.P.)



# INTEGRAL ABUT. (PRECAST/C.I.P.)



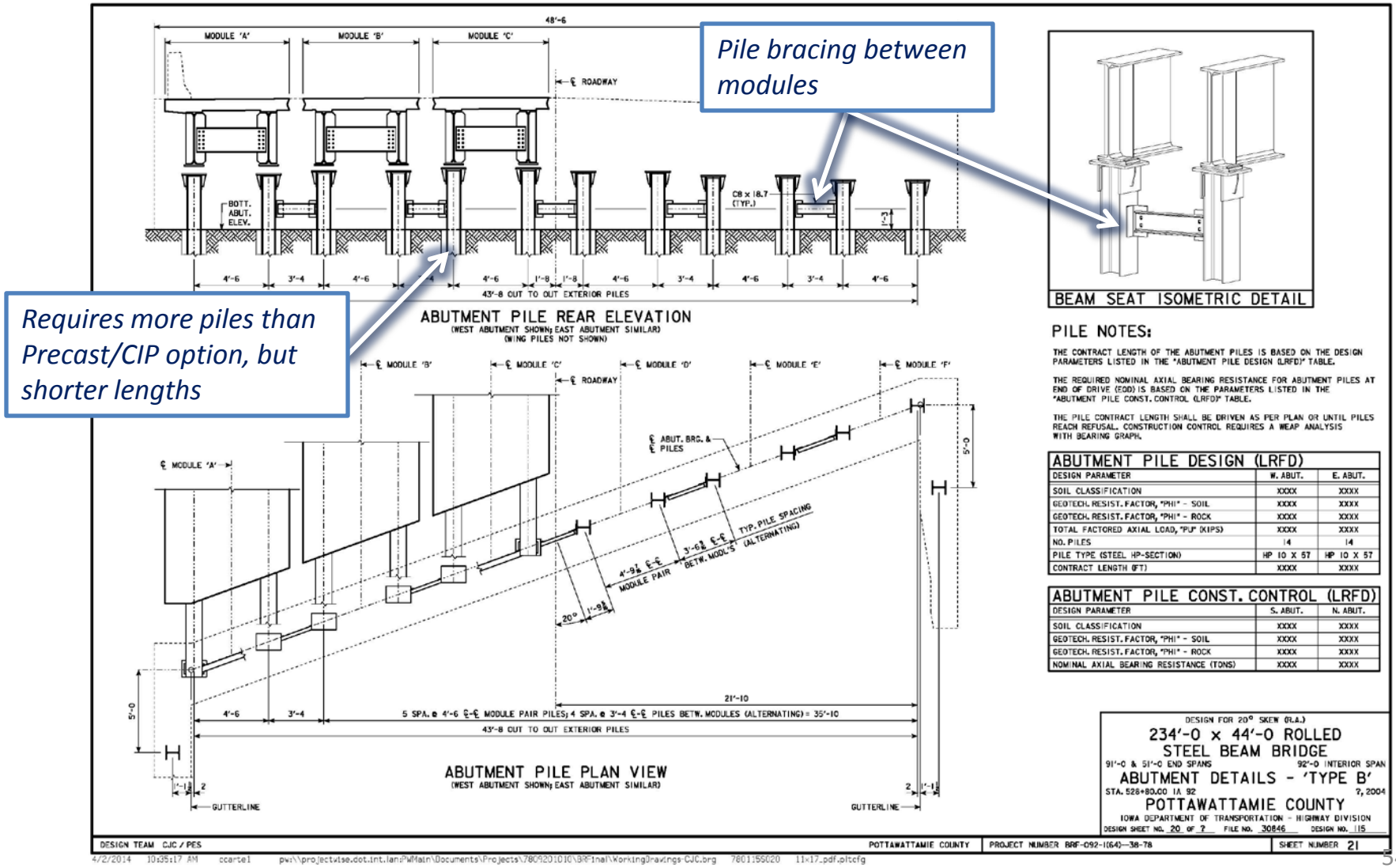


# INTEGRAL ABUTMENT X-RAY VIEW (PRECAST CAP)

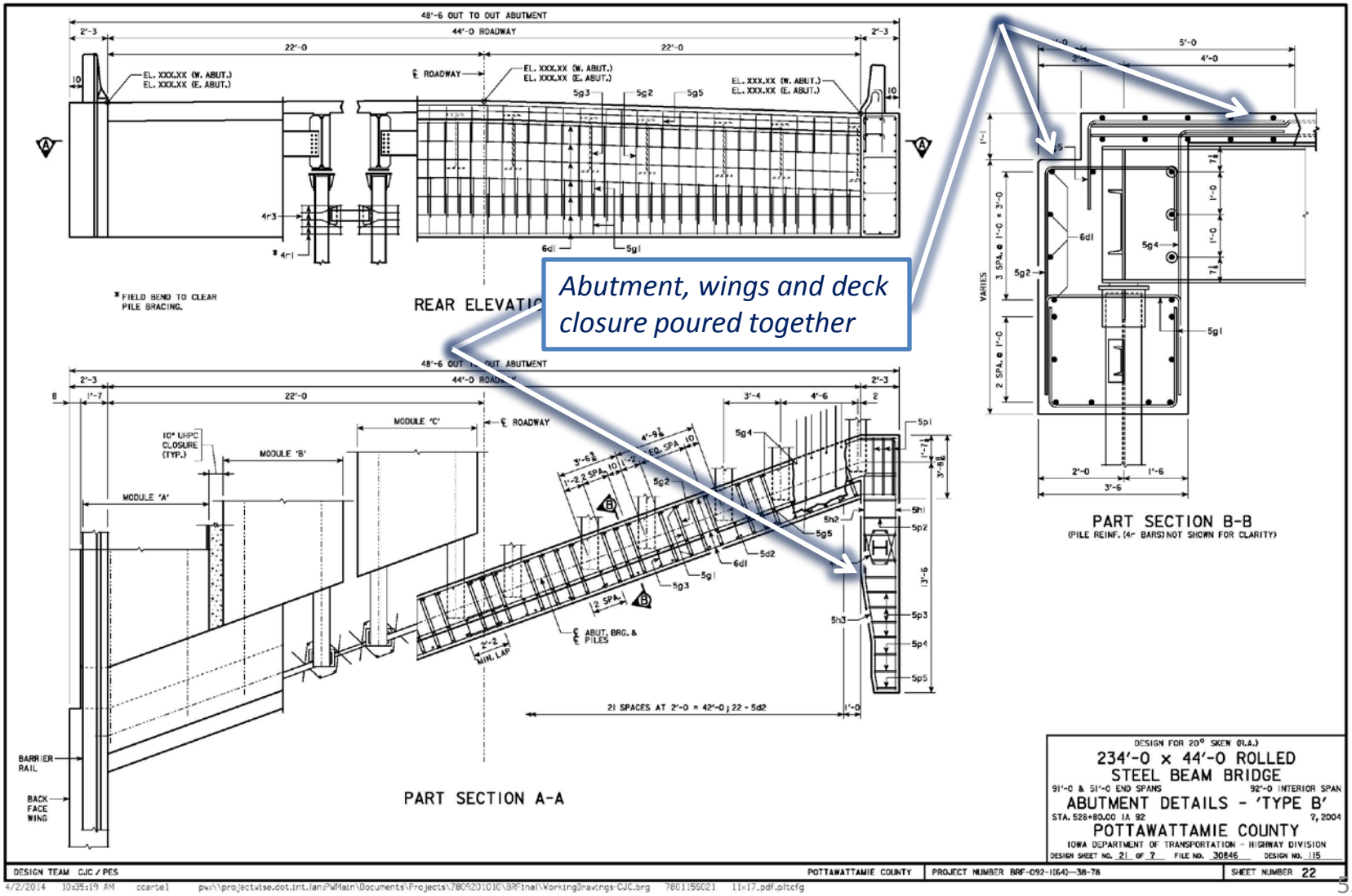
# BEAM-ON-PILE FRAMING (OPTIONAL)

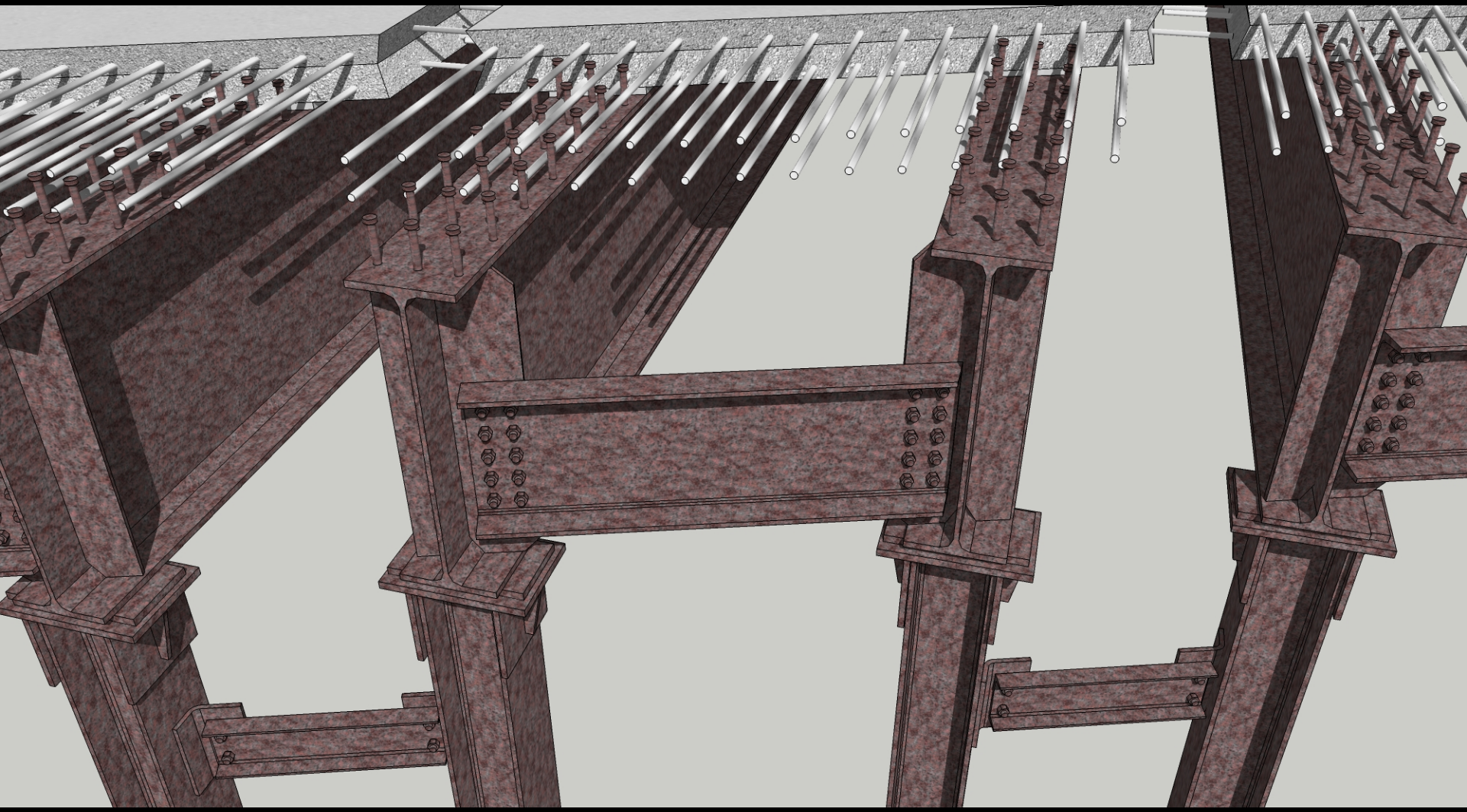
- **Any Contractor interest in pursuing this option??**
- **Detail successfully used in other states**
  - Preferred detail in SD and IN for steel superstructures
  - This detail has been used in SD to set beam pairs
- **Construction Details**
  - Requires more piles, but potentially shorter driven length
  - Eliminates footing construction from critical path
  - Requires considerable accuracy during pile placement
  - Requires accurate trimming/grinding of piles
  - Requires field welding
  - Various details available for beam seats and pile bracing

# INTEGRAL ABUT. (BEAM-ON-PILE)

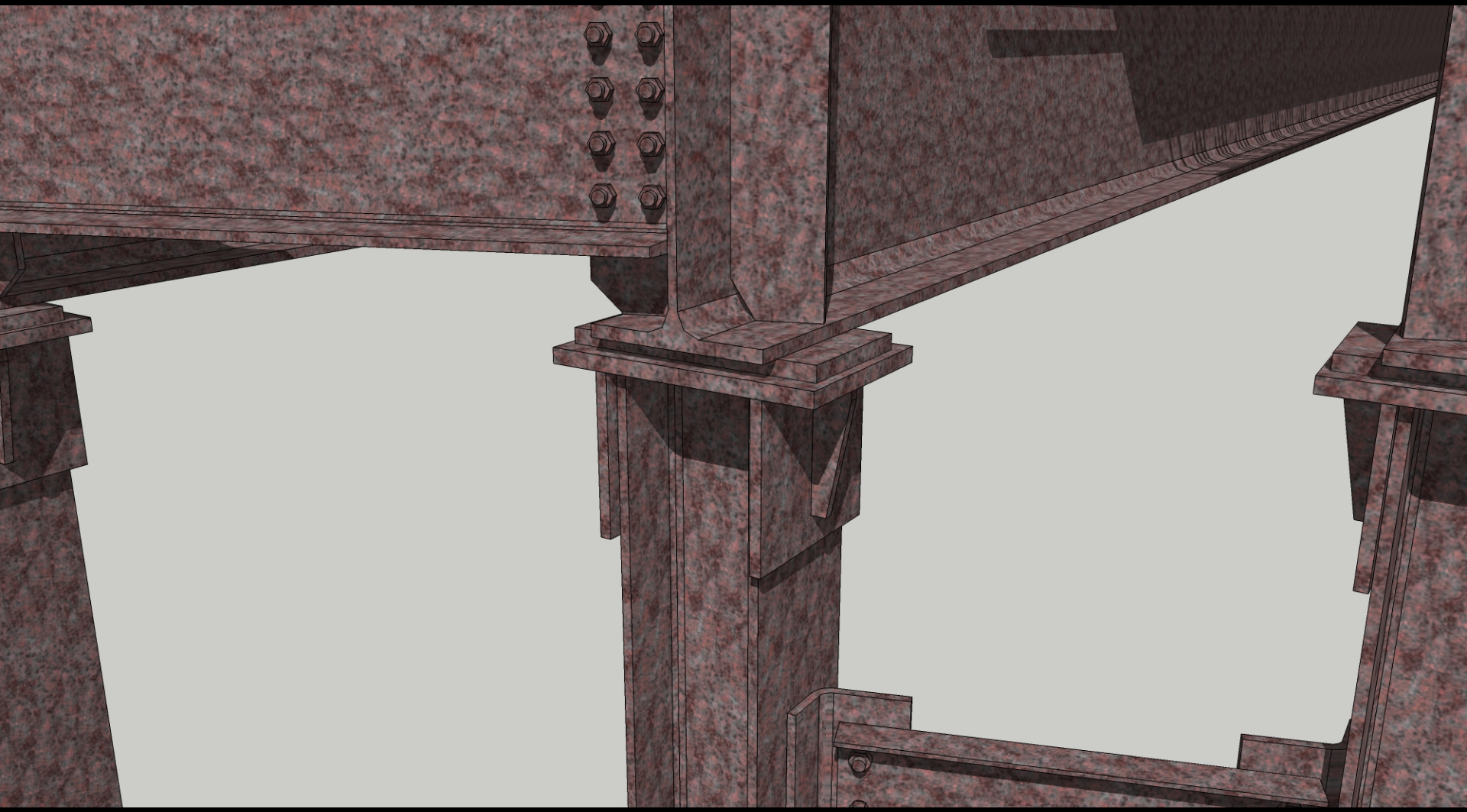


# INTEGRAL ABUT. (BEAM-ON-PILE)

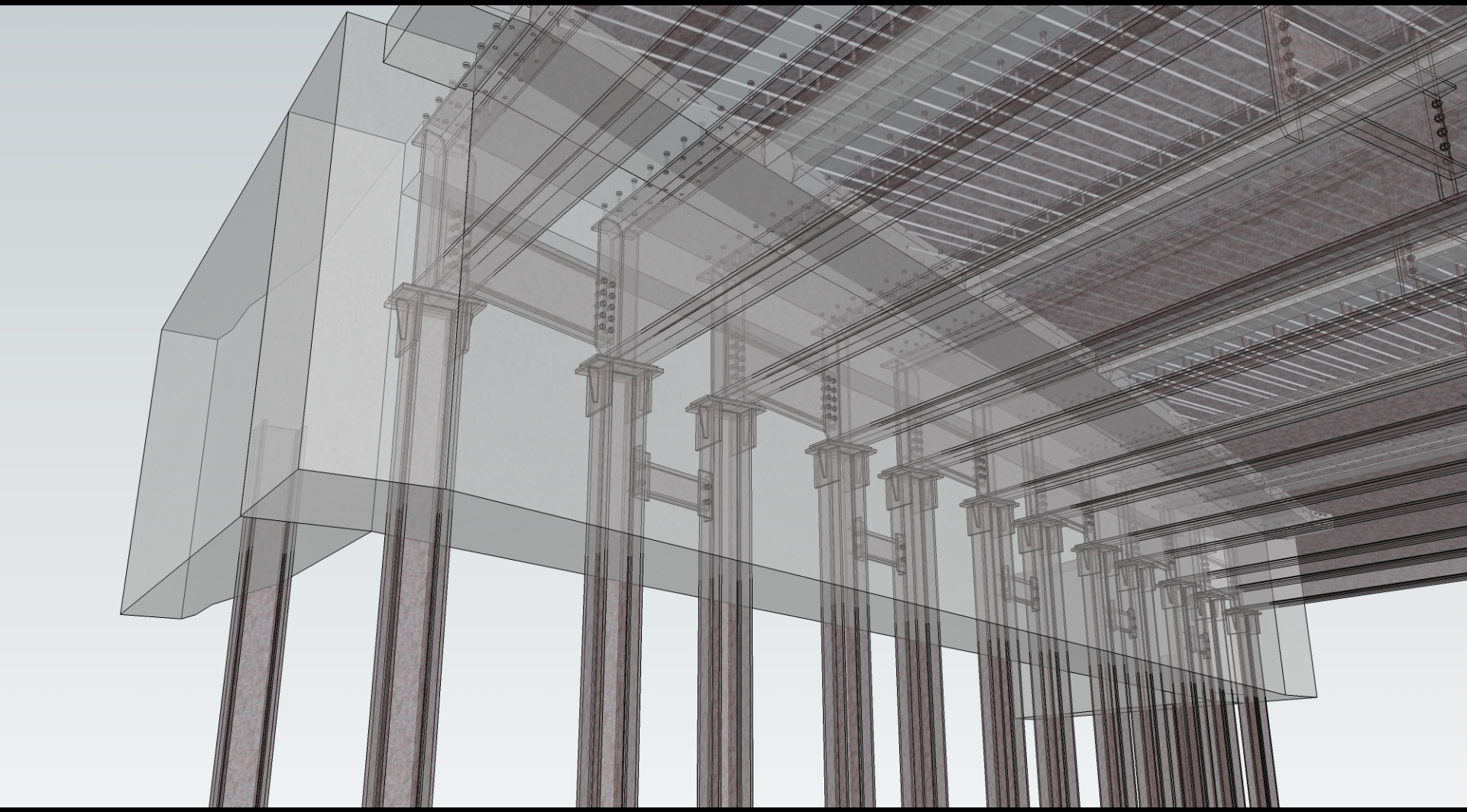




# EXAMPLE BEAM-ON-PILE FRAMING



# EXAMPLE BEAM-ON-PILE FRAMING



# INTEGRAL ABUTMENT X-RAY VIEW (BEAM-ON-PILE)

# SOUTH DAKOTA DETAIL: BEAM-ON-PILE

(PHOTO COURTESY OF STEVE JOHNSON, SD DOT)

# SOUTH DAKOTA DETAIL: BEAM-ON-PILE

(PHOTO COURTESY OF STEVE JOHNSON, SD DOT)

# SOUTH DAKOTA DETAIL: BEAM-ON-PILE

(PHOTO COURTESY OF STEVE JOHNSON, SD DOT)

# CONSTRUCTABILITY DISCUSSION

## *--- INTEGRAL ABUTMENTS ---*

- **Pile Driving**
  - Splices will be time consuming, require certified personnel
  - Accurate pile placement will be critical for precast cap and beam-on-pile options
- **Footing Construction**
  - Which abutment construction approach is preferred by contractors??
- **Cast-in-Place Backwall and Wings**
  - Schedule concerns related to forming, placing and curing C.I.P. components??
- **Construction Bracing**
  - Increased unbraced length and eccentric loads during construction; temporary bracing options??

# SUPERSTRUCTURE ASSEMBLY

# CAST-IN-PLACE TRANSVERSE JOINTS

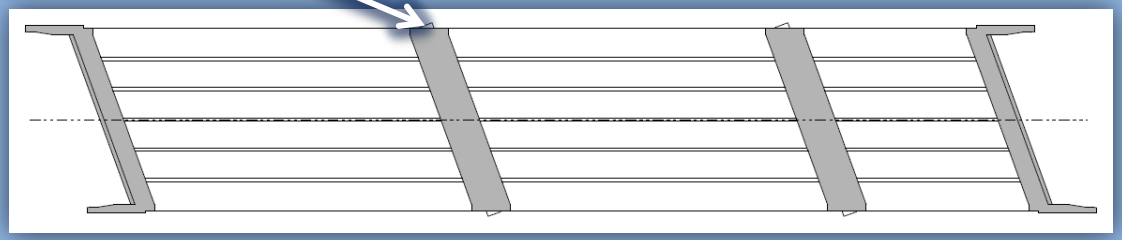
CAST-IN-PLACE TRANSVERSE JOINT CLOSURES

- Wider closure moves joint to lower stress region of deck
- Allows for simpler reinforcing details
- Reduces the complexity and quantity of U.H.P.C. placement
- Requires additional forming and concrete placement effort

*Narrow UHPC joint*

US-6 Over Keg Creek
Deck Plan

*Wide C.I.P. joint*



IA-92 Over L.S. Creek
Deck Plan

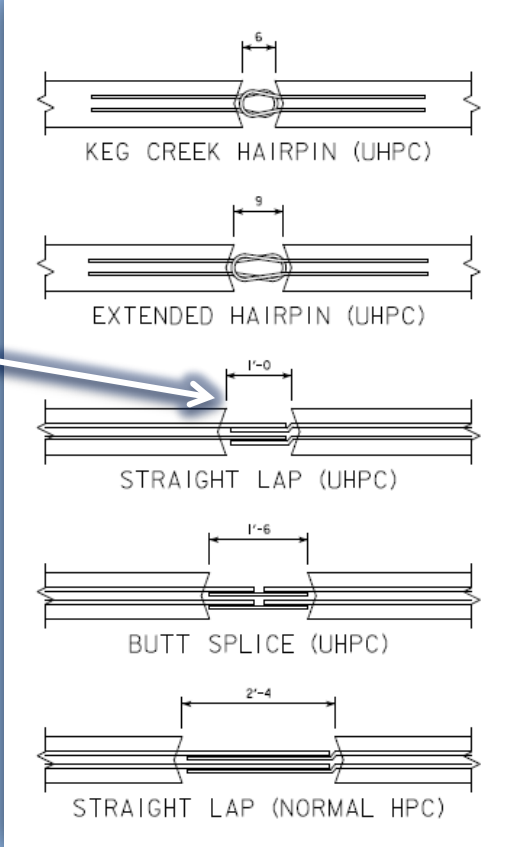
# UHPC LONGITUDINAL JOINTS

ULTRA-HIGH-PERFORMANCE CONCRETE

(± 20 YDS. REQUIRED)

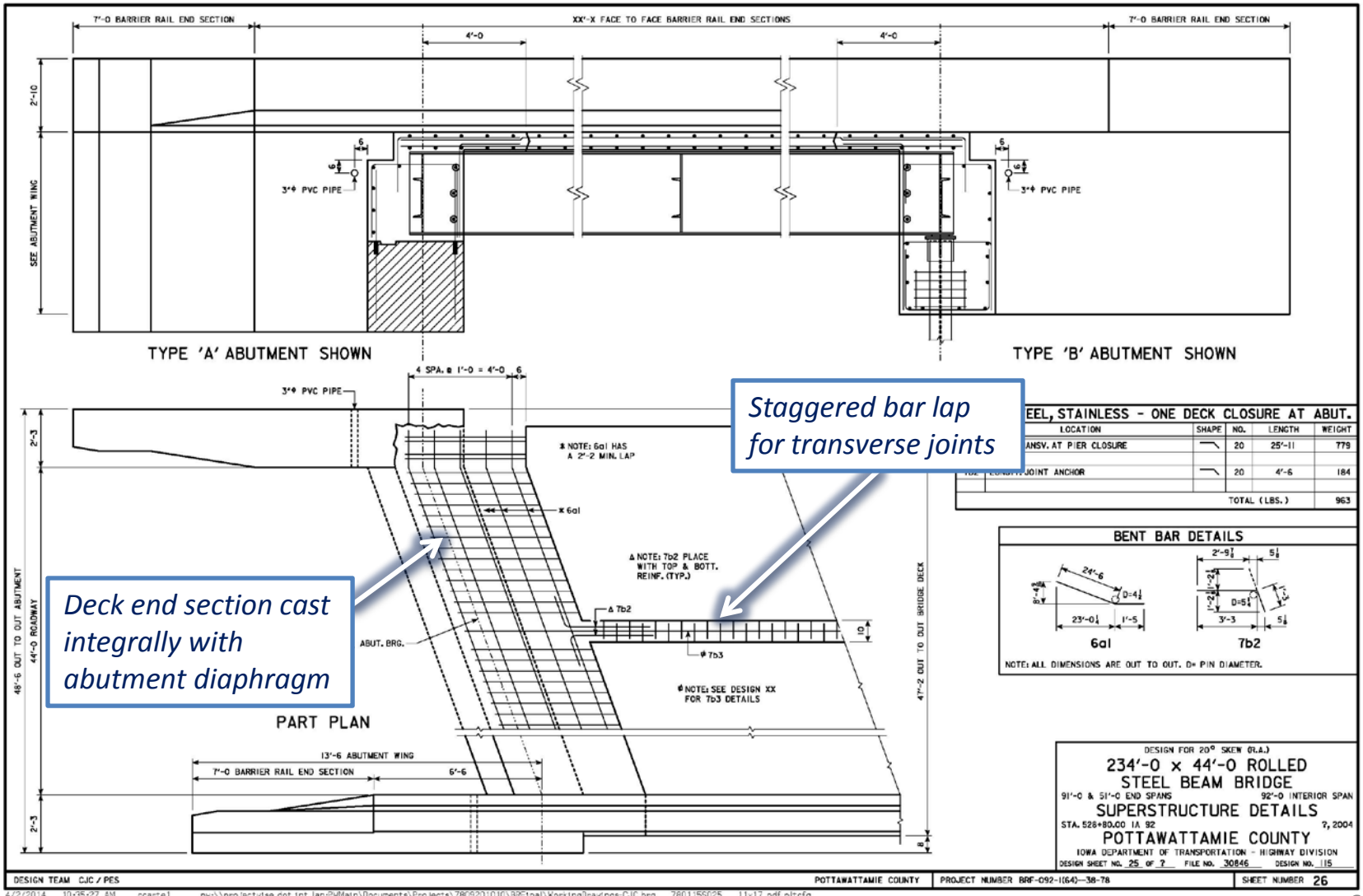
- Material Advantages
  - Better strength and durability compared to conventional concrete
  - Reduced development lengths for narrower joints
- Design Considerations
  - High flowability complicates forming and placement
  - Overfill and grinding required
  - On-site test pour will be required
  - Contractor will be required to coordinate with manufacturer and follow recommended procedures

*Version of this detail used for design*

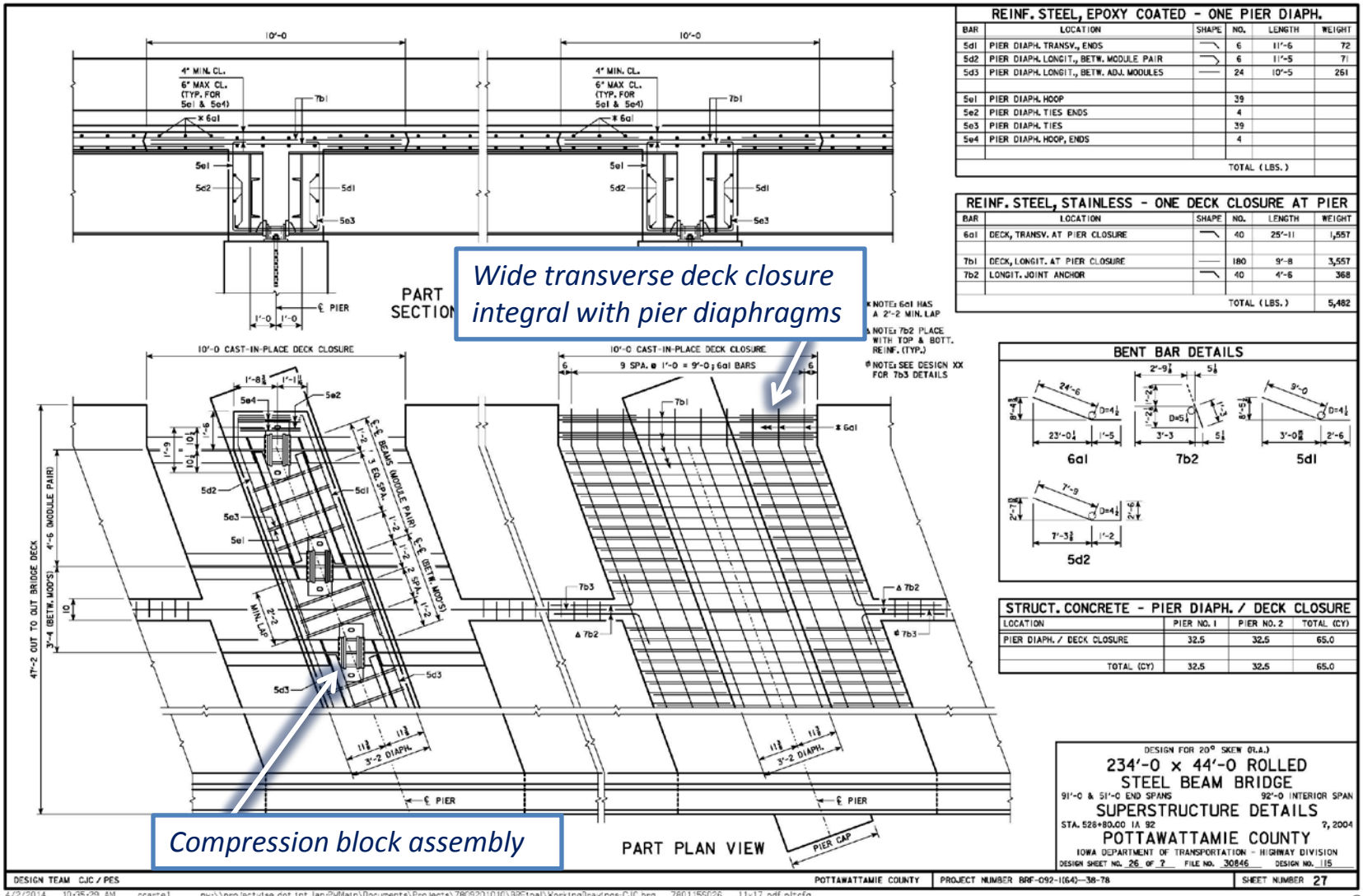


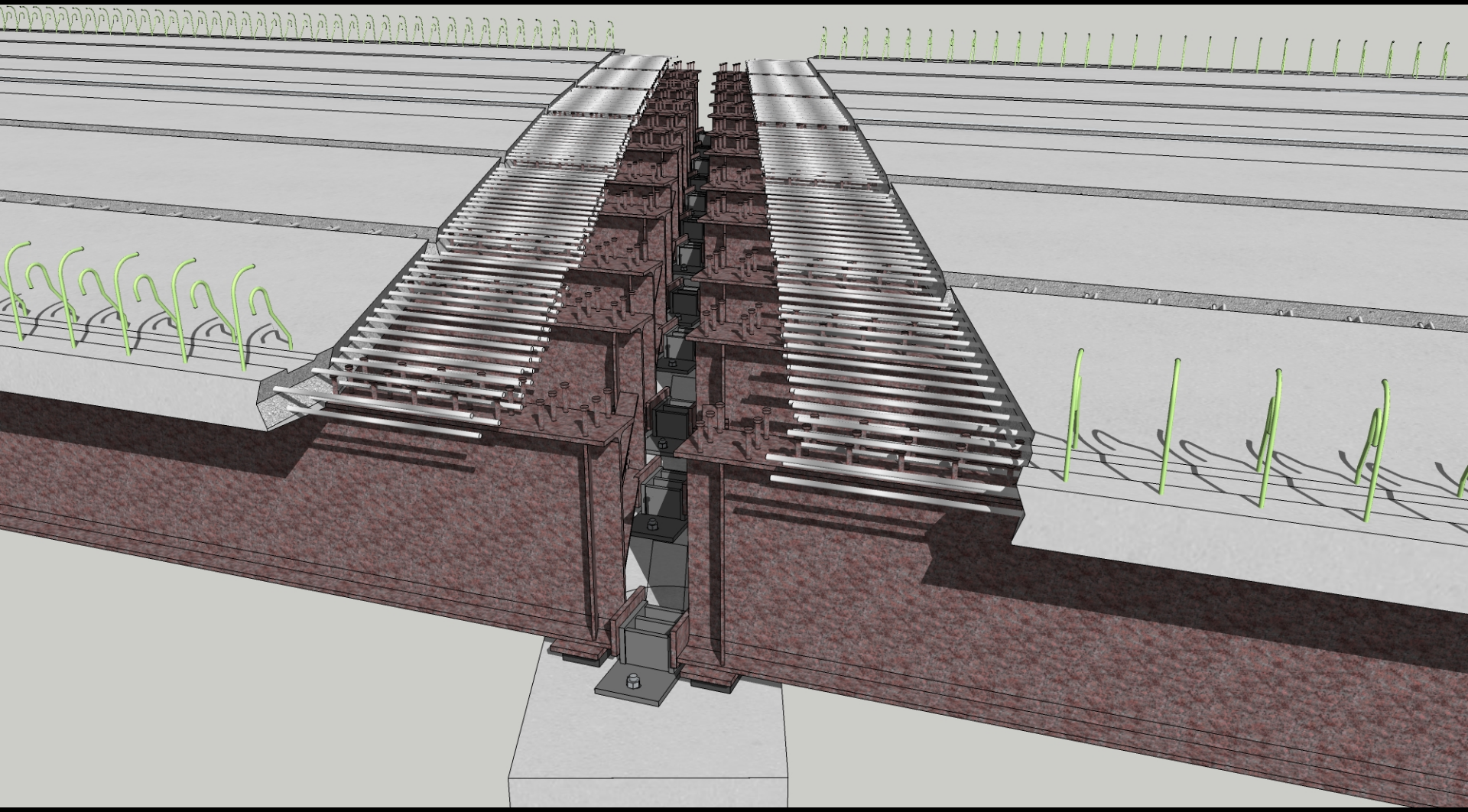

Example Deck Joint Configurations

# MODULAR SUPERSTRUCTURE

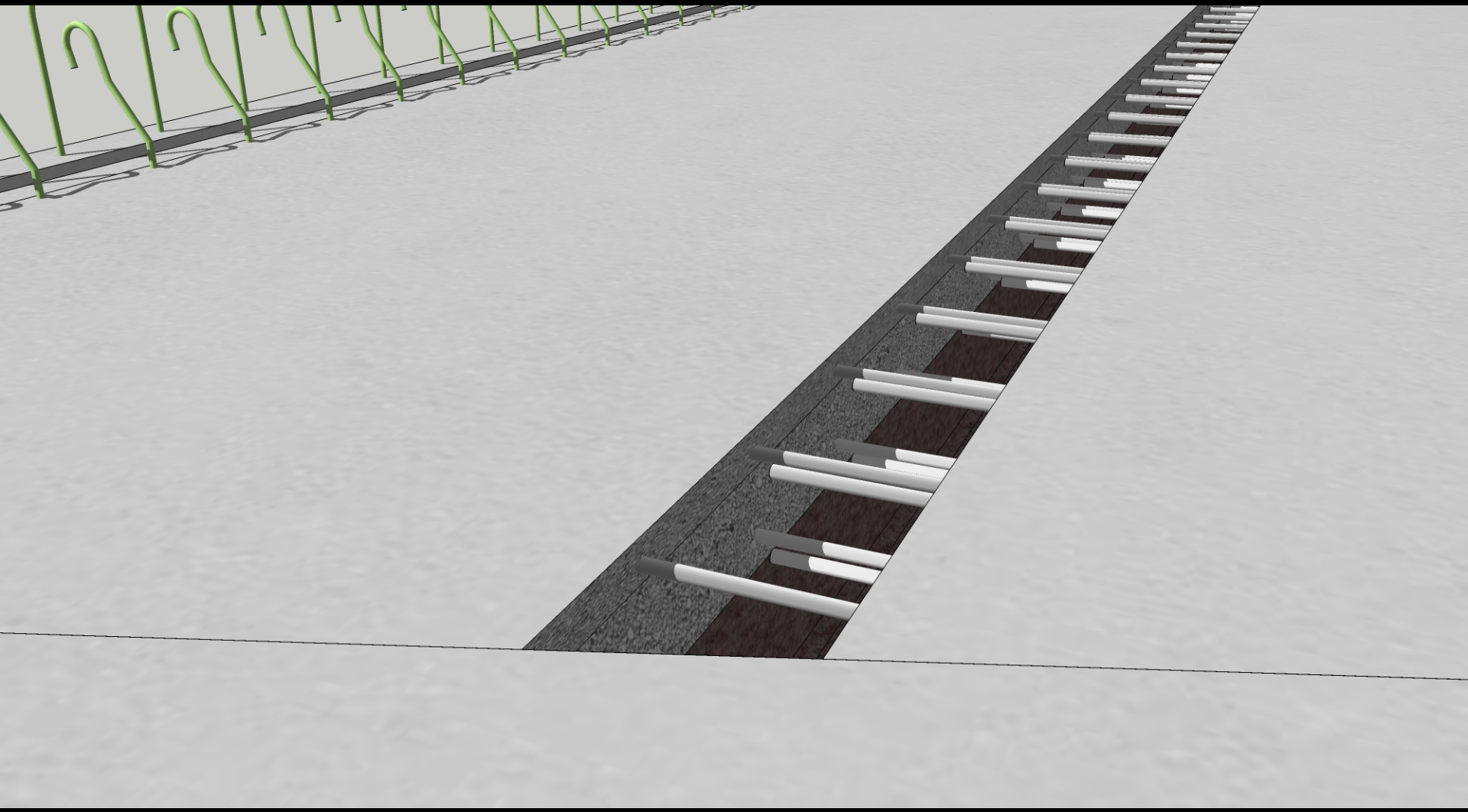


# MODULAR SUPERSTRUCTURE

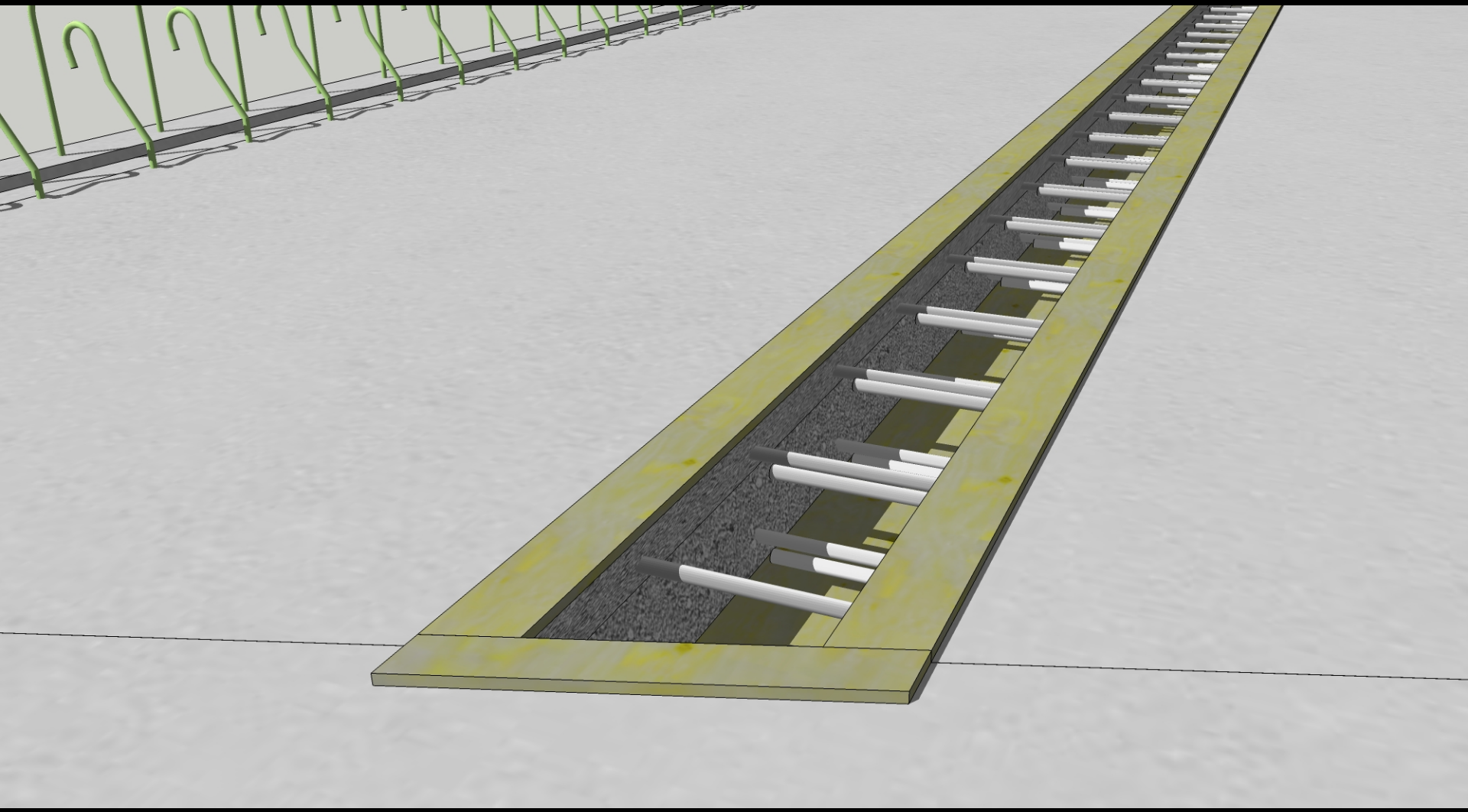




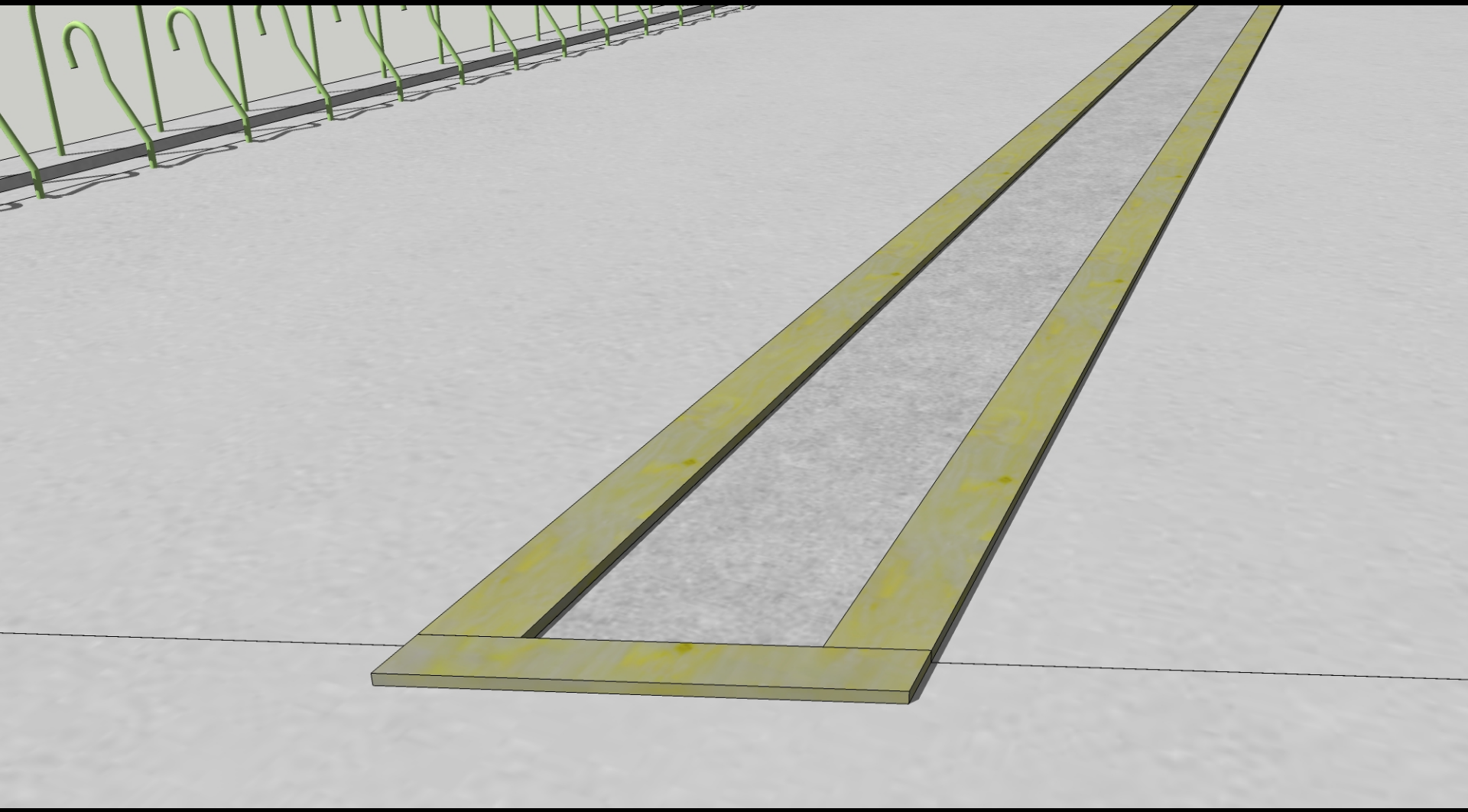
# TRANSVERSE JOINT OVER PIER



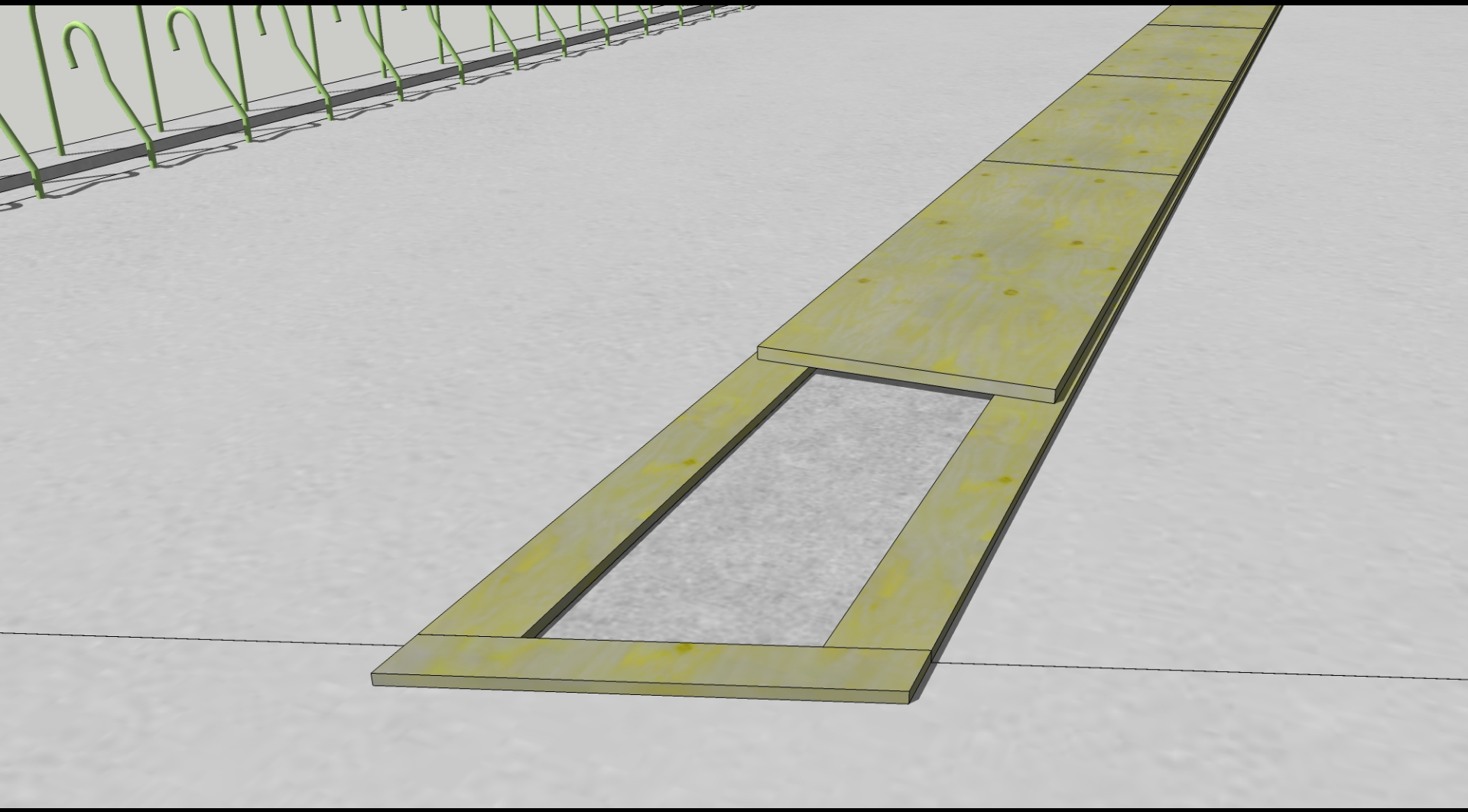
# LONGITUDINAL JOINT



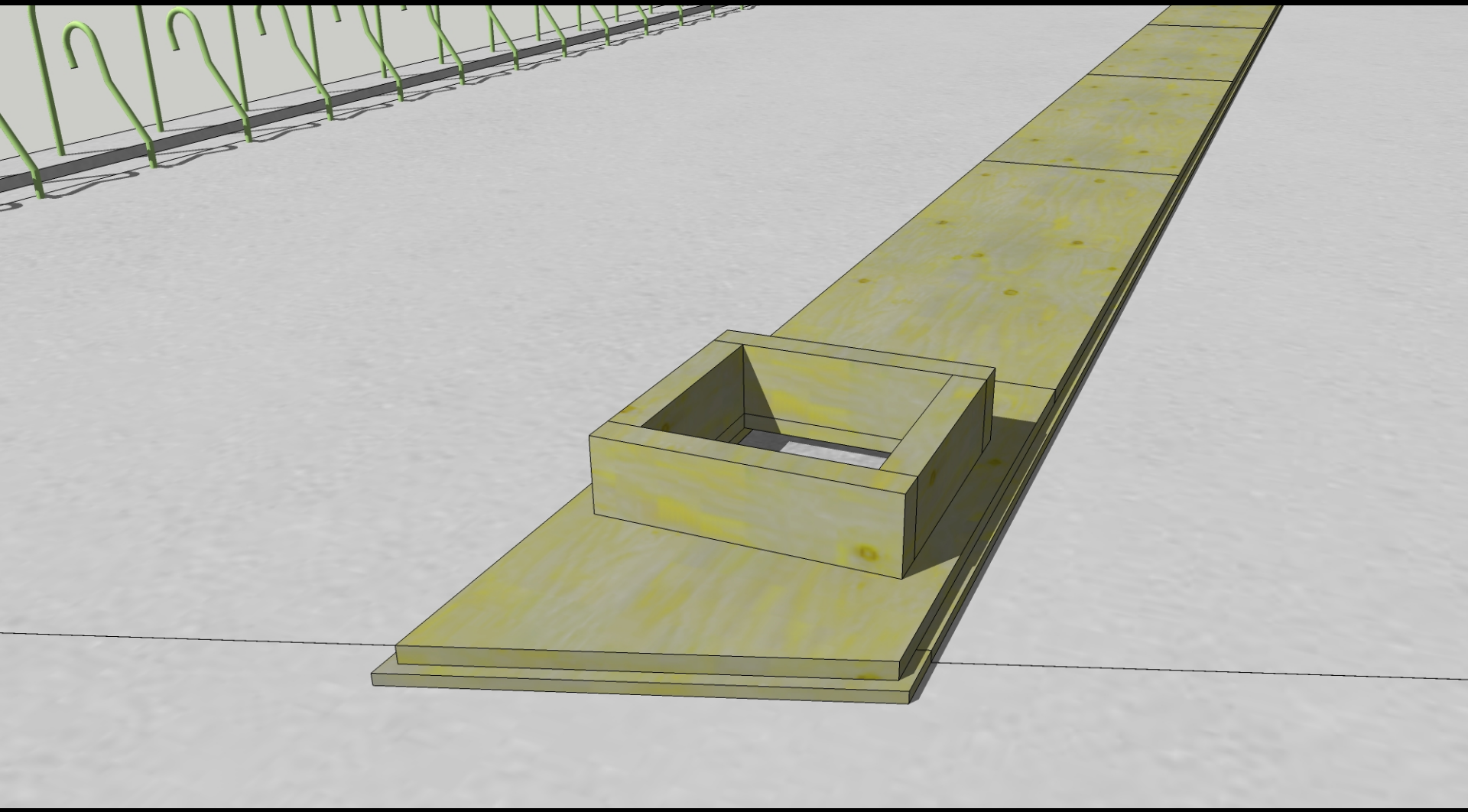
# LONGITUDINAL JOINT BOTTOM AND SIDE FORMS



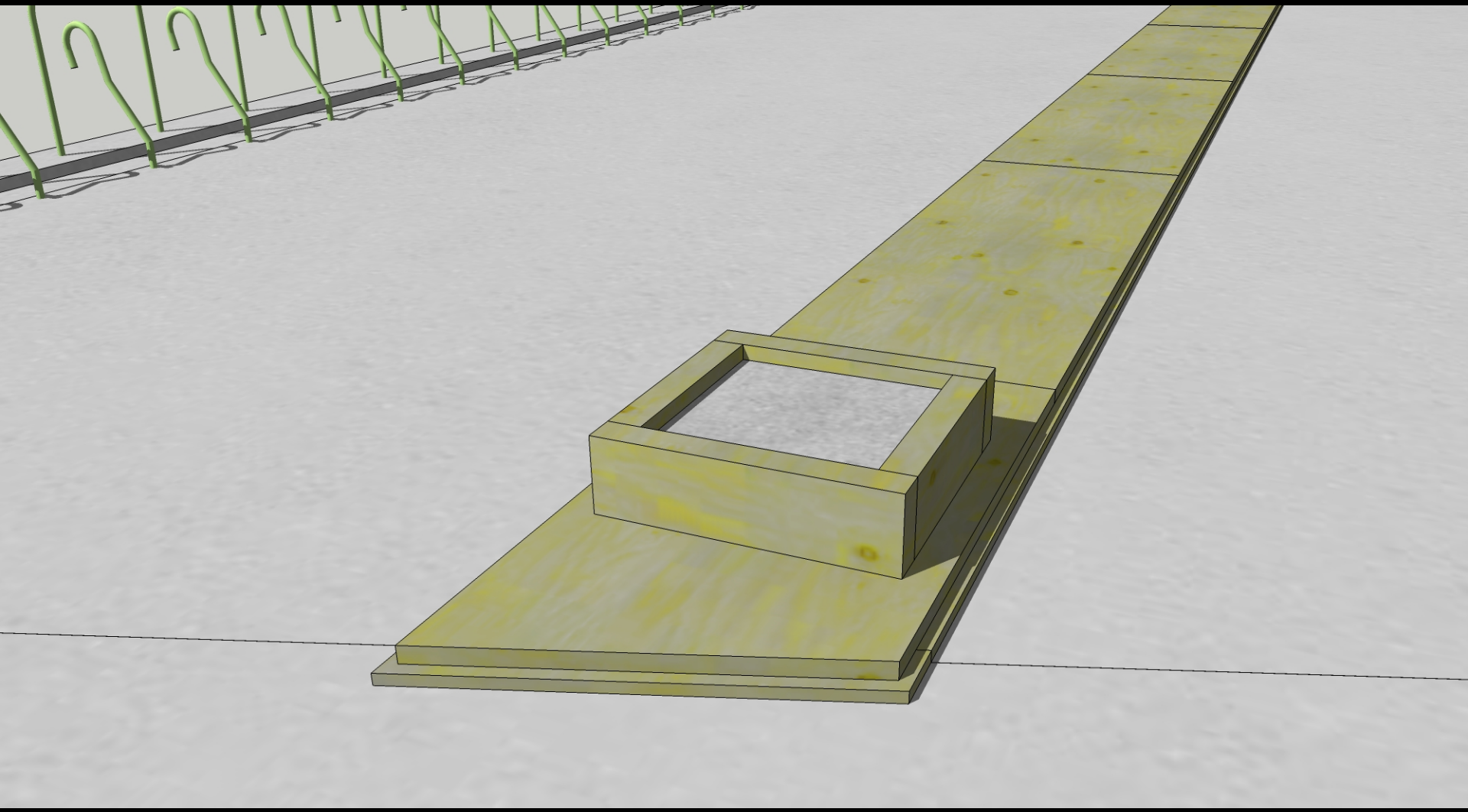
# U.H.P.C. FILLED LONGITUDINAL JOINT



# U.H.P.C. LONGITUDINAL JOINT WITH TOP FORMS



# FORMED CHIMNEY AT HIGH END LONGIT. JOINT



# U.H.P.C. SURCHARGE AT CHIMNEY

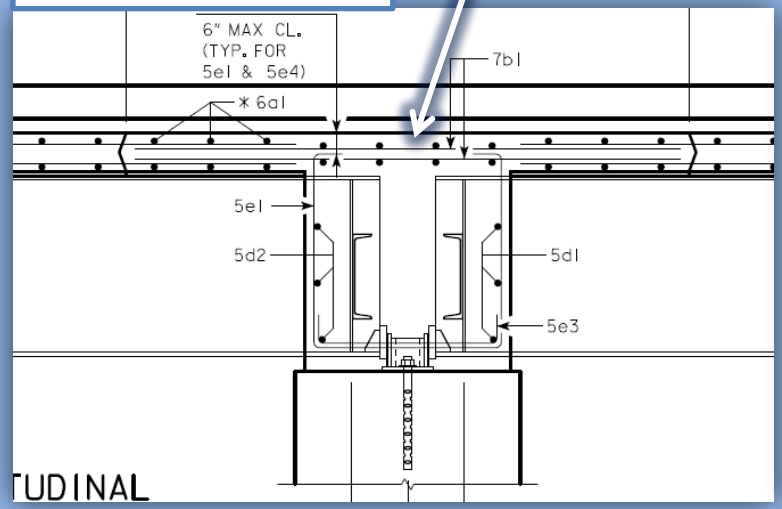
# PIER BEARING DETAILS

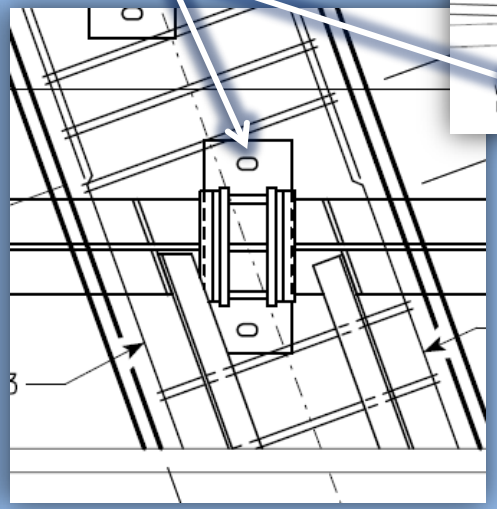
- Beams to be supported on tapered, laminated neoprene pads
- Steel compression block assembly anchored between beam ends
  - Provides load path for compressive forces
  - Snug-fit between beam bottom flanges
  - Limited shimming will be permissible

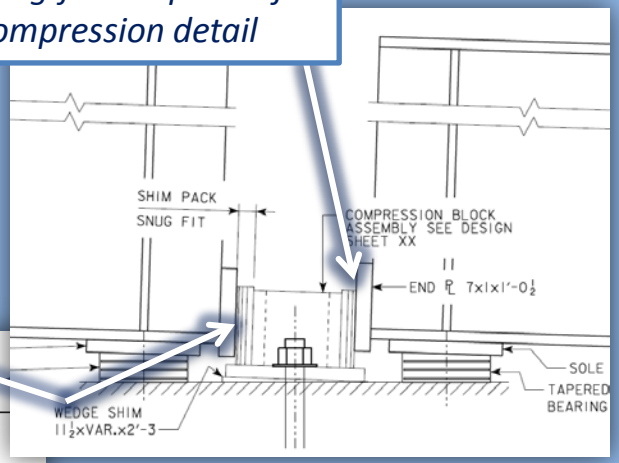
*Snug-fit acceptable for compression detail*

*Slotted holes and shim packs facilitate constructability and field adjustment*

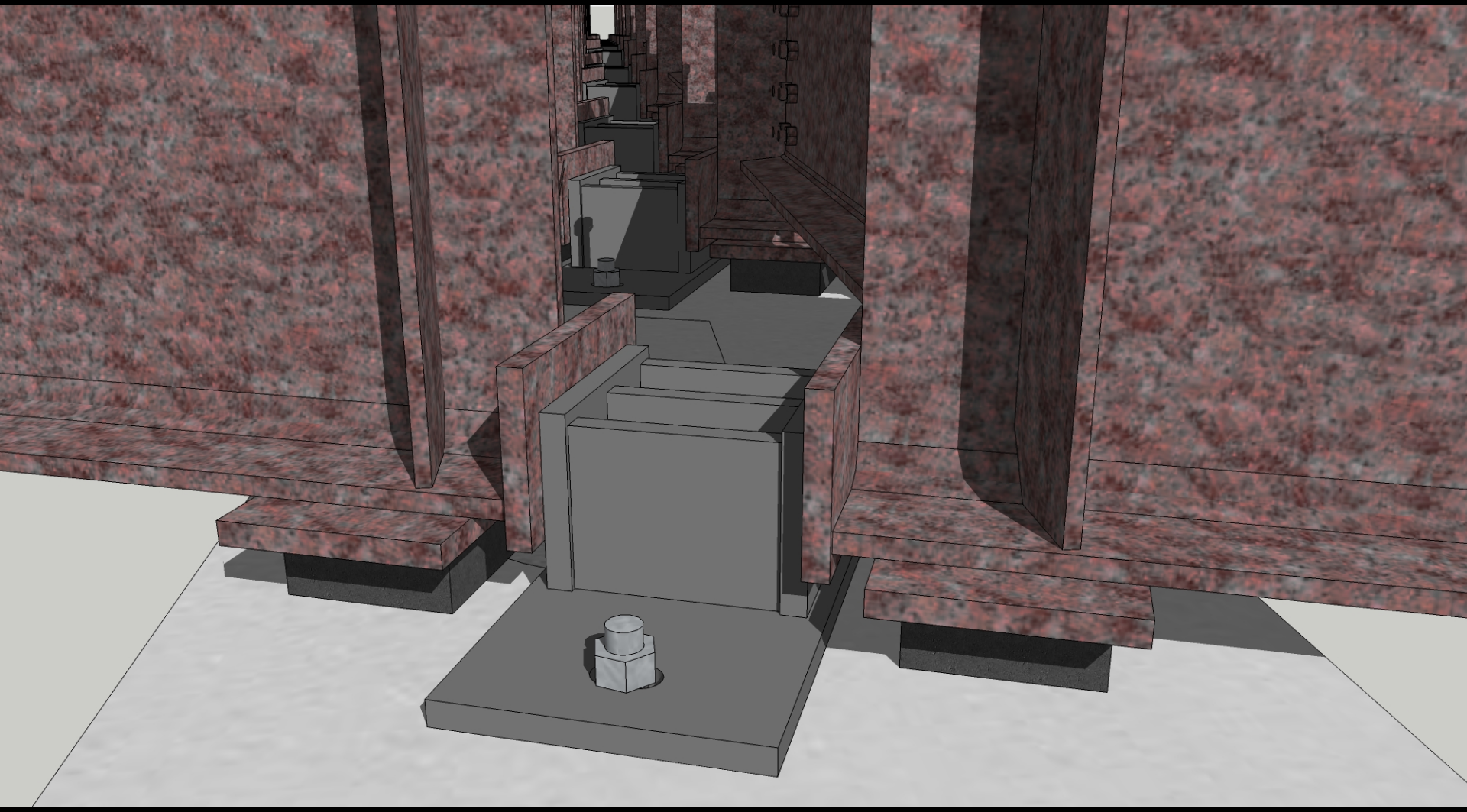
*Monolithic diaphragm encases module ends*






Pier Bearing Details



# SNUG-FIT COMPRESSION BLOCK AT PIER

# DECK GRINDING

- **Contract shall require diamond grinding of deck**
  - Smooth overfilled U.H.P.C. joints
  - Make minor corrections to grade profile (as required)
  - Provide smooth, uniform riding surface
- **Select proper grinding equipment for use with U.H.P.C.**
  - U.H.P.C. overfill and grind procedure commonly used by NY DOT

# CONSTRUCTABILITY DISCUSSION

## *--- SUPERSTRUCTURE ASSEMBLY ---*

- **Cast-in-Place Transverse Joints**
  - Schedule impacts related to forming and placing C.I.P. joint closures??
- **U.H.P.C. Longitudinal Joints**
  - Complexities associated with use of specialized material??
  - Forming considerations??
- **Bearing Details**
  - Fit-up and construction tolerance considerations??
- **Deck Grinding**
  - Schedule impacts??
  - Equipment selection consideration??

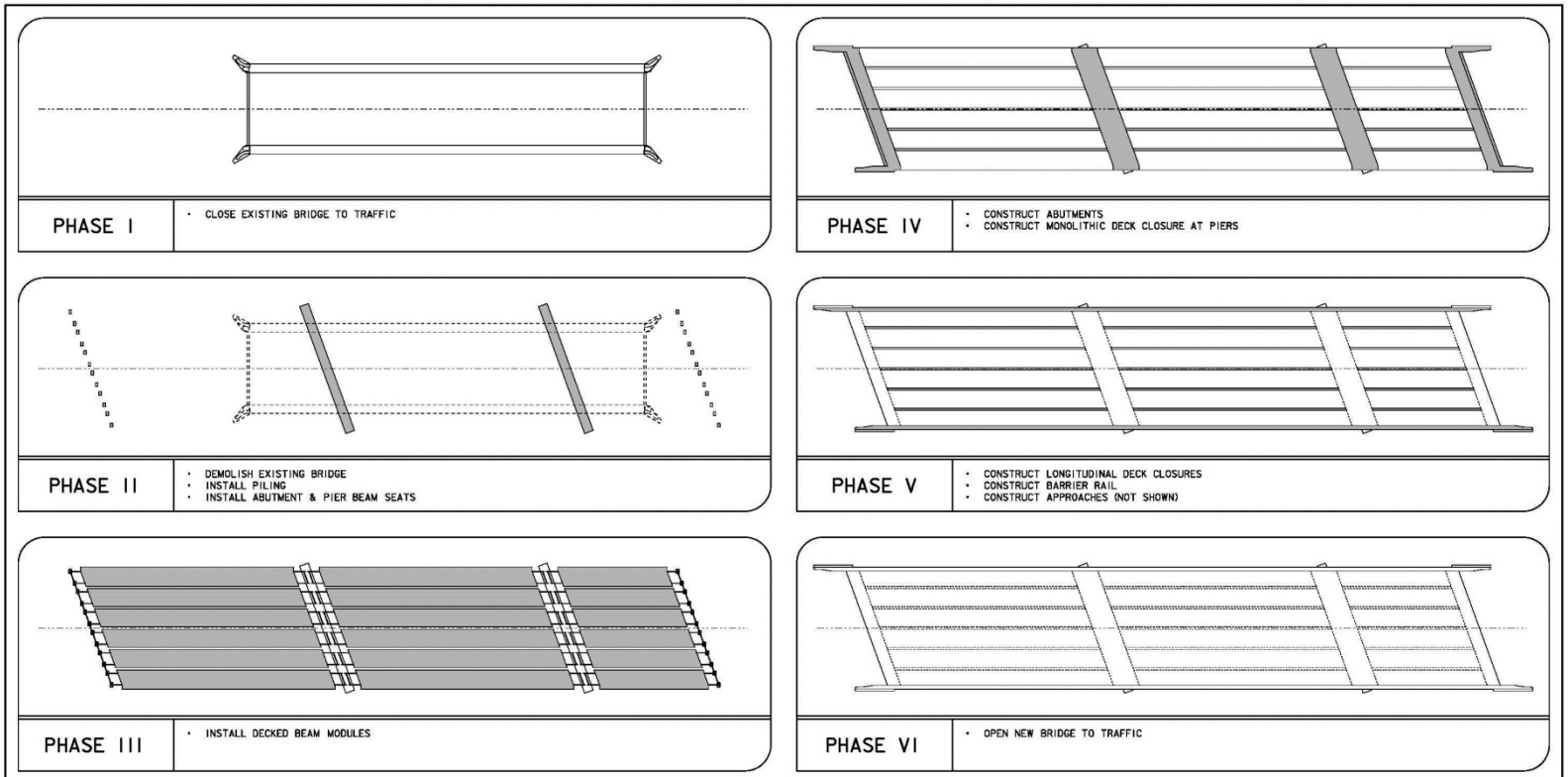
# SCHEDULE

# CONSTRUCTION SCHEDULE

## 21-DAY ROAD CLOSURE

- **Pre-closure activities:**
  - Prefabricate superstructure modules
  - Prefabricate substructure caps/footings (optional)
- **During closure:**
  - Demolition
  - Grading and Revetment
  - Substructure Construction
  - Superstructure Construction
  - Approach Construction
- **Post-closure activities (permissible single-lane closures as required):**
  - Shoulder Construction
  - Guardrail
  - Finish Grading and Seeding
  - Miscellaneous Non-Structural Construction Activities

# PROPOSED CONST. PHASING




DESIGN FOR 20° SKEW (R.A.)

234'-0 x 44'-0 ROLLED STEEL BEAM BRIDGE

91'-0 & 51'-0 END SPANS 92'-0 INTERIOR SPAN

CONSTRUCTION PHASING DIAGRAM

STA. 528+80.00 IA 92 ?, 2004

POTTAWATTAMIE COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. 8 OF 7 FILE NO. 30846 DESIGN NO. 115

DESIGN TEAM CJC / PES | POTTAWATTAMIE COUNTY | PROJECT NUMBER BRF-092-1(64)--38-78 | SHEET NUMBER 9

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# PROPOSED SCHEDULE

## 21 Day ABC Timeline

| CONSTRUCTION ACTIVITY | 21 DAY CLOSURE PERIOD | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 |
| CLOSE IA 92 | ■ | | | | | | | | | | | | | | | | | | | | |
| BRIDGE DEMOLITION | ■ | ■ | ■ | | | | | | | | | | | | | | | | | | |
| GRADING & RIP-RAP PLACEMENT UNDER BRIDGE | | ■ | ■ | ■ | | | | | | | | | | | | | | | | | |
| DRIVE PIER PILING | | | ■ | ■ | ■ | | | | | | | | | | | | | | | | |
| PIER PILE ENCASEMENT CONSTRUCTION | | | | | ■ | ■ | ■ | | | | | | | | | | | | | | |
| DRIVE ABUTMENT PILING | | | | | | ■ | ■ | ■ | | | | | | | | | | | | | |
| CONSTRUCT PIER CAP | | | | | | | | ■ | ■ | | | | | | | | | | | | |
| CONSTRUCT ABUTMENT SEAT | | | | | | | | ■ | ■ | | | | | | | | | | | | |
| ERECT DECK MODULES | | | | | | | | | | ■ | ■ | ■ | | | | | | | | | |
| CONSTRUCT ABUT. BACKWALLS & WINGS | | | | | | | | | | | | ■ | ■ | ■ | | | | | | | |
| CONSTRUCT PIER CAP DIAPHRAGMS | | | | | | | | | | | | ■ | ■ | ■ | | | | | | | |
| PLACE UHPC LONGITUDINAL JOINTS | | | | | | | | | | | | | | | ■ | | | | | | |
| CONSTRUCT APPROACHES | | | | | | | | | | | | | | | ■ | ■ | ■ | | | | |
| CONSTRUCT BARRIER RAIL | | | | | | | | | | | | | | | | | ■ | ■ | | | |
| GRINDING & LONGITUDINAL GROOVING OF DECK | | | | | | | | | | | | | | | | | | | ■ | ■ | |
| FINISH GRADING & WING ARMORING | | | | | | | | | | | | | | | | | | | ■ | ■ | |
| GUARDRAIL & PAINT | | | | | | | | | | | | | | | | | | | | ■ | ■ |
| OPEN IA 92 | | | | | | | | | | | | | | | | | | | | | ■ |

# CONSTRUCTABILITY DISCUSSION

## *--- SCHEDULE ---*

- DEMOLITION & GRADING – 4 DAYS
- PIERS – 7 DAYS
- ABUTMENT SEAT – 5 DAYS
- MODULE PLACEMENT – 3 DAYS
- TRANSVERSE CLOSURES – 3 DAYS
- UHPC JOINTS – 1 DAY
- APPROACHES – 3 DAYS
- BARRIER RAIL – 2 DAYS
- DECK GRINDING/GROOVING – 2 DAYS

# CLOSING COMMENTS

- Current design plan status about 60% complete
- Plan development scheduled for completion **October 2014**
- Project letting scheduled for **December 2014**
- Anticipated critical closure late **Summer / Fall 2015**

**WE APPRECIATE ANY FEEDBACK TO HELP MAKE THIS A BETTER PROJECT!!**

# ACKNOWLEDGEMENTS


- Design Team:
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  - Mike Nop
  - Curtis Carter
  - John Neiderhiser
- Detailing / Modeling:
  - Paul Sodahl
  - Kimball Olson
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  - Federal Highway Administration
  - South Dakota, Indiana and New York State DOT's
  - Iowa State University
  - US-6 over Keg Creek Design Team

# QUESTIONS??

**THANK YOU FOR YOUR TIME!!**