IA-92 over Little Silver Creek

ACCELERATED BRIDGE CONSTRUCTION CONCEPT REVIEW

Iowa ABC Workshop

May 1, 2014

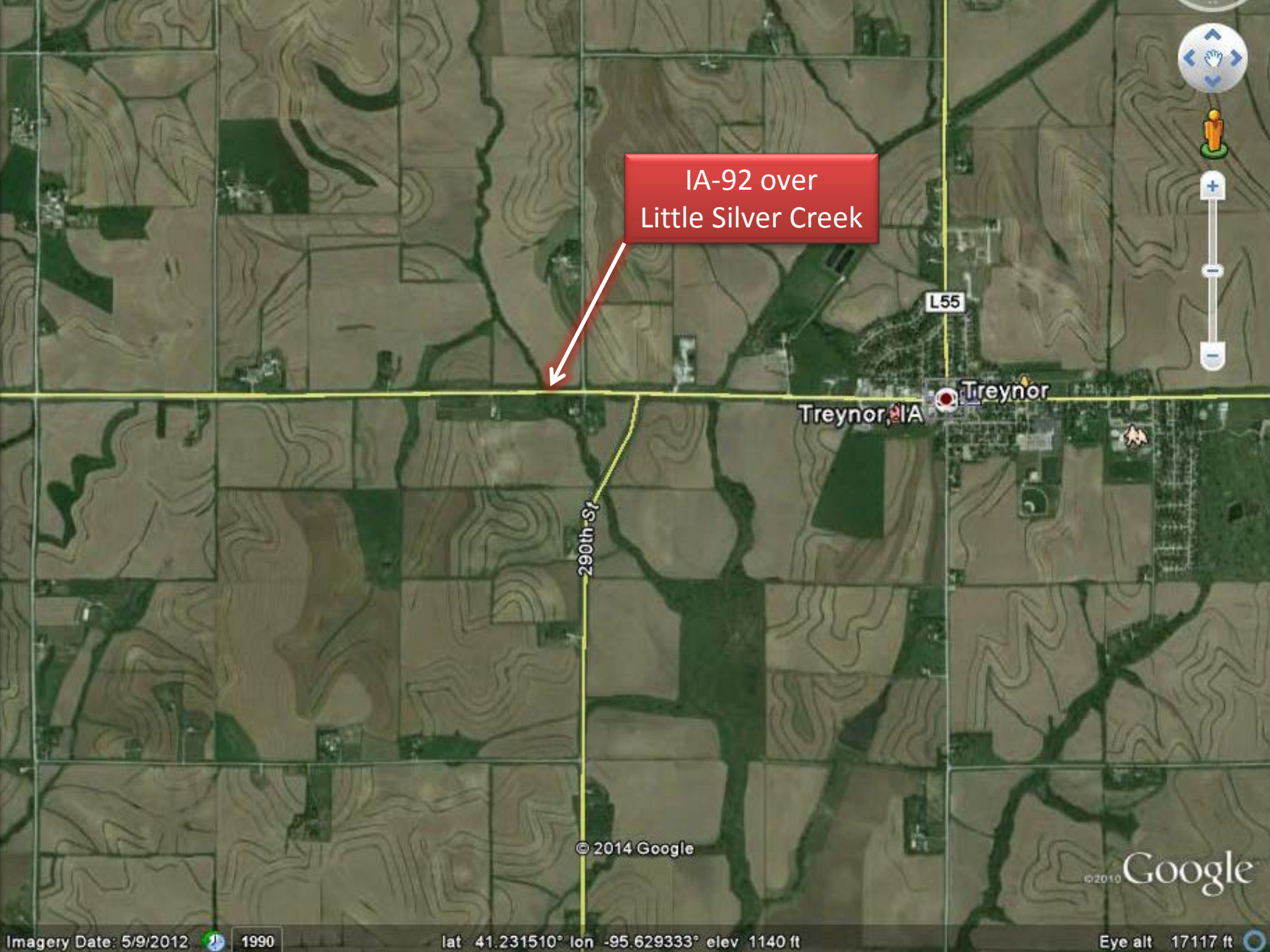
Presented by Curtis J. Carter, PE

PRESENTATION OBJECTIVES

- Discuss project concept
- Share preliminary construction details (60% plans)
- Solicit feedback from Workshop participants
- Precursor to upcoming meeting with Iowa Association of General Contractors

PROJECT OVERVIEW

OBJECTIVE:	In-House Design of ABC Bridge using PBES (Non-Slide)
SITE:	IA-92 over Little Silver Creek West of Treynor, IA (Rural)
GEOMETRY:	234’ x 44’ Bridge, 20° Skew, Sag Vertical Curve
SCHEDULE:	Road Closure Limited to 21 Days
LETTING:	December 16, 2014
CONSTRUCTION:	Fall, 2015
EST. COST:	$3.2M
STATUS:	60% Design Plans as of May 1, 2014


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
©2010 Google

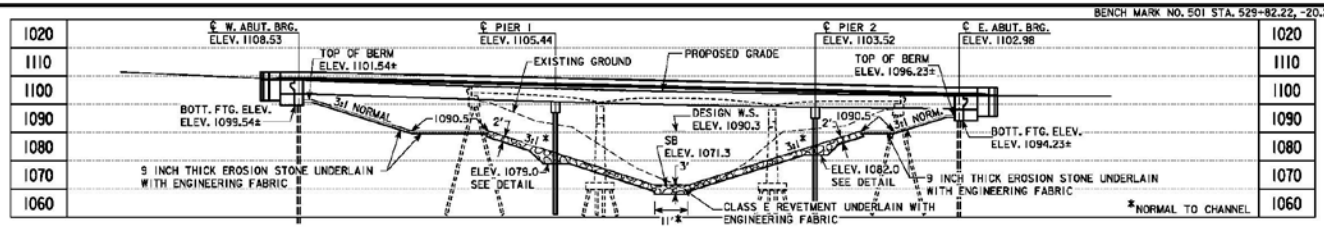
WATERWAY OPENING , SPAN 2 , LOOKING UPSTREAM
2/4/10
Looking North

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

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

Existing 150’-0 x 28’
Continuous Conc. Girder Bridge

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



NOTES:

1. TOP OF BRIDGE DECK CROWN 0.03 BELOW PROFILE GRADE.
2. CONTINUE THE EROSION STONE BERM SLOPE PROTECTION ALONG THE BENCH TO THE TOP OF REVETMENT.
3. STA. 529+00.06 150' X 28' CONT. CONC. GIRDER BRIDGE (DESIGN NO. 5152) TO BE REMOVED.
4. ANY ENCOUNTERED REMNANTS OF OLD BRIDGE WOOD SUBSTRUCTURE TO BE REMOVED AS NECESSARY TO COMPLETE THE WORK.

LONGITUDINAL SECTION ALONG ℄ APPROACH ROADWAY

NOTES TO FINAL DESIGNER:

1. CHECK WITH JIM SCHOENROCK TO VERIFY UTILITIES.
2. TL-4 BARRIER RAIL.
3. PILE BENT PIERS PROPOSED.

G1= -5.870% G2= +4.980%

VPI STA = 530+15.00 VC = 760.00'
VPI ELEV = 1092.60

PROPOSED PROFILE GRADE IA 92

HYDRAULIC DATA

DRAINAGE AREA = 16.6 SQ. MI.
STREAM SLOPE = 10.6 FT./MI.
AVG. LOW WATER STAGE = 1072.3

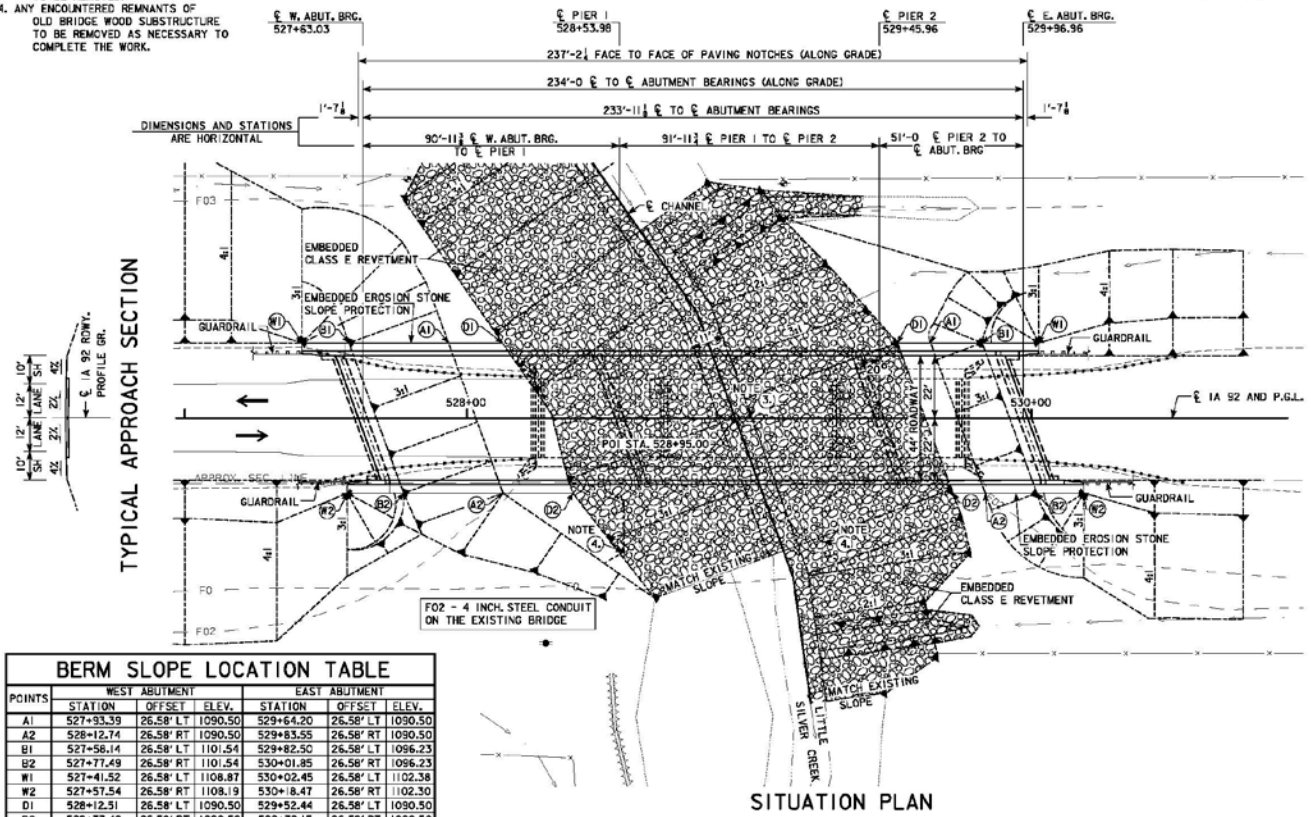
Q_{50} = 4530 CFS
STAGE = 1090.3
BACKWATER = 0.03 FT.
AVG. BRIDGE VELOCITY = 3.7 FPS

Q_{100} = 5460 CFS
STAGE = 1091.3
BACKWATER = 0.06 FT.

Q_{200} = 6290 CFS
STAGE = 1092.0
CALCULATED DESIGN SCOUR = 1068.3

Q_{500} = 7330 CFS
STAGE = 1092.7
CALCULATED CHECK SCOUR = 1068.3

ROADWAY OVERTOP 1102.84
STA. 530+46.17



TYPICAL APPROCH SECTION

UTILITIES LEGEND:

-POWER POLE - MIDAMERICAN ENERGY COMPANY
FO -FIBER OPTIC - AT&T TRANSMISSION
FO2 -FIBER OPTIC -MCI
FO3 -FIBER OPTIC - FRONTIER COMMUNICATIONS OF IOWA
NOT SHOWN- FIBER OPTIC -LIGHTCORE (DIGITAL TELEPORT-A)

LOCATION

IA 92 OVER LITTLE SILVER CREEK
T-74N R-42W
SECTION 28.11
KEG CREEK TOWNSHIP
POTTAWATTAMIE COUNTY
FHWA NO. 43821
BRIDGE MAINT. NO. 7816.6S092
LATITUDE 41.232779°
LONGITUDE -95.634139°

BERM SLOPE LOCATION TABLE

POINTS	WEST ABUTMENT STATION	WEST ABUTMENT OFFSET	WEST ABUTMENT ELEV.	EAST ABUTMENT STATION	EAST ABUTMENT OFFSET	EAST ABUTMENT 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

SITUATION PLAN

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

SITUATION PLAN

STA. 528+80.00 IA 92 ?, 2004

POTTAWATTAMIE COUNTY

IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. 2 OF 2 FILE NO. 30846 DESIGN NO. 115

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

SITE OBSTACLES

- Skew
  - Iowa has not previously applied decked module concept to skewed bridge
- Sag Vertical Curve
  - 4.0% deck grade at W. Abutment, 2.7% at Pier 1
  - Sag curvature complicates fit-up, requires more accuracy during fabrication/prefabrication
- Poor Soil Conditions
  - Long pile lengths with 2 or 3 field splices per pile
- Long Unbraced Length at Piers
  - Degraded channel plus design scour
  - Unsupported length exceeds Iowa design standards for pile bent piers

DESIGN STATUS

- Design Team
  - Curtis Carter
  - Mike Nop
  - Dean Bierwagen
- Design/Details under development, 60% complete
- Design concept may evolve based on:
  - Feedback from ABC Workshop
  - Feedback from Iowa Association of General Contractors
  - Possible research opportunities

DESIGN HIGHLIGHTS

CONCEPT

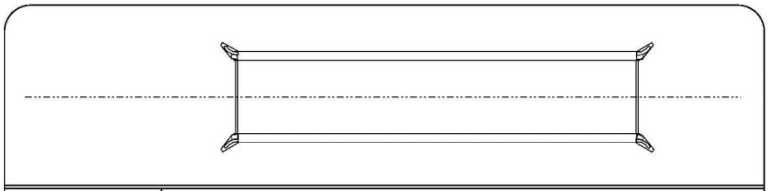
- Superstructure
  - Modular Decked Beams
- Substructure
  - Integral Abutments
  - Pile Bent Piers
- Details intended to:
  - Build on Proven Technology
  - Improve Accelerated Constructability
  - Ease Construction Tolerances
  - Facilitate Rapid Field Adjustment
  - Satisfy Performance Goals (Construction Schedule, Design Life)
  - Promote Contractor Involvement and Innovation

ACCELERATED CONST. SCHEDULE

21-DAY ROAD CLOSURE

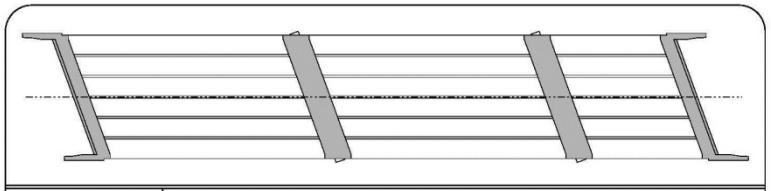
- Pre-closure activities:
  - Prefabricate superstructure modules
  - Prefabricate substructure caps/footings (optional)
- During closure:
  - Demolition
  - Grading and Revetment
  - Substructure Construction
  - Superstructure Construction
  - Approach Construction
- Post-closure activities (permissible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

PROPOSED CONST. PHASING



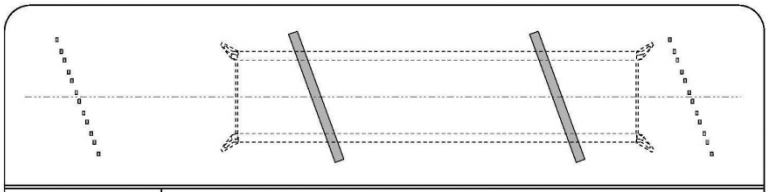
PHASE I

- CLOSE EXISTING BRIDGE TO TRAFFIC



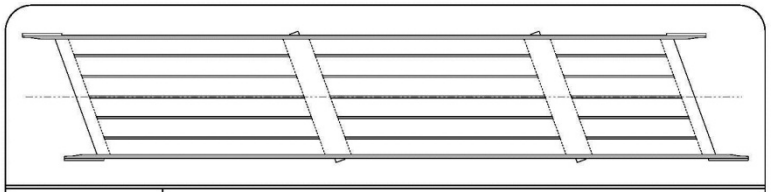
PHASE IV

- CONSTRUCT ABUTMENTS
- CONSTRUCT MONOLITHIC DECK CLOSURE AT PIERS



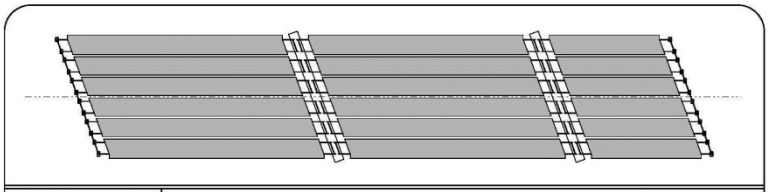
PHASE II

- DEMOLISH EXISTING BRIDGE
- INSTALL PILING
- INSTALL ABUTMENT & PIER BEAM SEATS



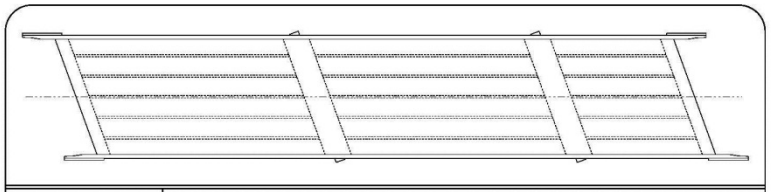
PHASE V

- CONSTRUCT LONGITUDINAL DECK CLOSURES
- CONSTRUCT BARRIER RAIL
- CONSTRUCT APPROACHES (NOT SHOWN)



PHASE III

- INSTALL DECKED BEAM MODULES



PHASE VI

- OPEN NEW BRIDGE TO TRAFFIC

CONSTRUCTION PHASING DIAGRAM

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

4/2/2014 10:34:52 AM ccarte1 pw:\\projectwise.dot.int.lan:PWMain\Documents\Projects\7809201010\BRFinal\WorkingDrawings-CJC.brg 780115S008 11x17_pdf.pltcfg

PROPOSED SCHEDULE

21 Day ABC Timeline

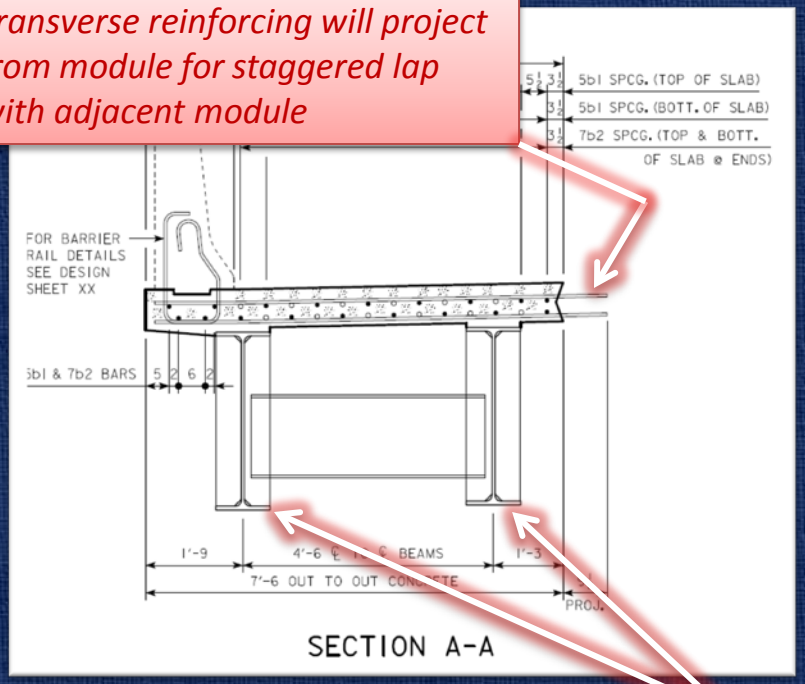
CONSTRUCTION ACTIVITY	21 DAY CLOSURE PERIOD																				
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21
CLOSE IA 92	■																				
BRIDGE DEMOLITION	■	■	■																		
GRADING & RIP-RAP PLACEMENT UNDER BRIDGE		■	■	■																	
DRIVE PIER PILING			■	■	■															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

MODULAR DECKED BEAMS

2-BEAM MODULAR UNITS

- Patterned after US-6 over Keg Creek
- ± 100,000 lbs Module Weight
- W40x149 Beams (Simple Span)
  - Prestressed concrete beams were considered but not implemented due to geometry complications (camber vs. grade) and heavier pick weights
- 4’-6 Beam Spacing, 7’-0 Deck Width
- 8¼” High Performance Concrete Deck
  - Deck includes additional sacrificial thickness to allow grade/crown adjustment by grinding
- Stainless Steel Deck Reinforcing
  - Improved joint performance and greater service life

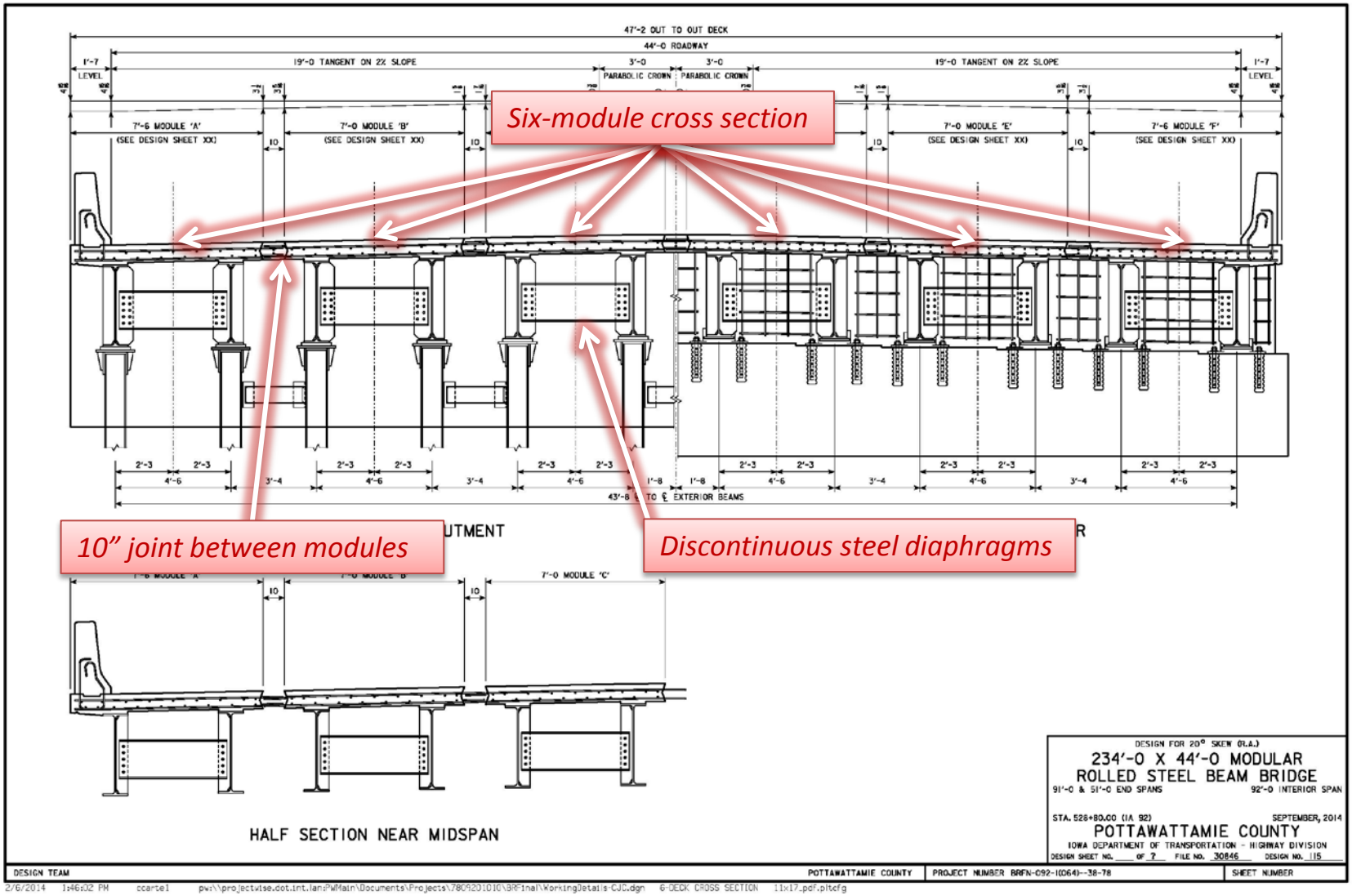
Transverse reinforcing will project from module for staggered lap with adjacent module



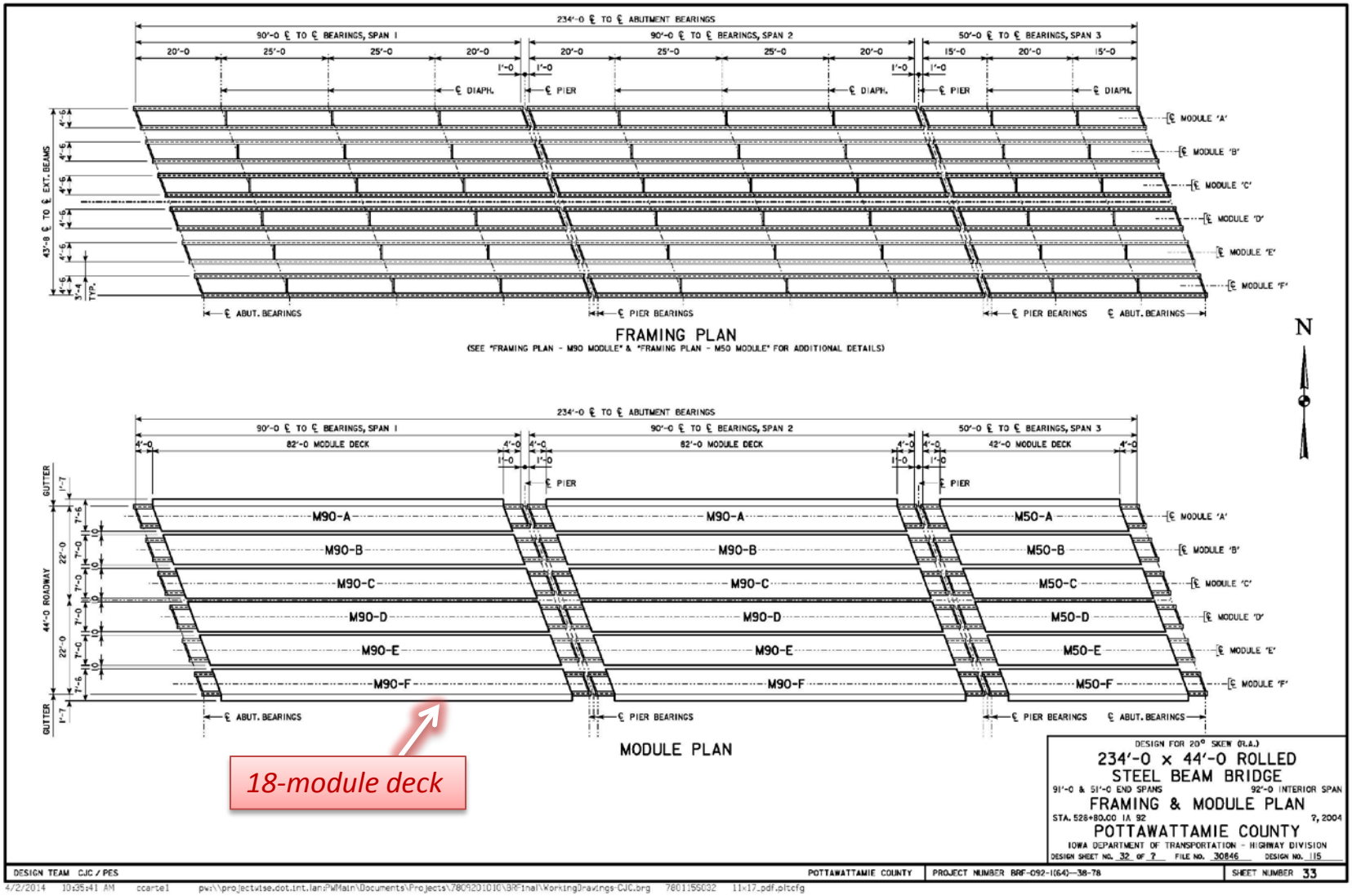
Typ. Module Detail

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

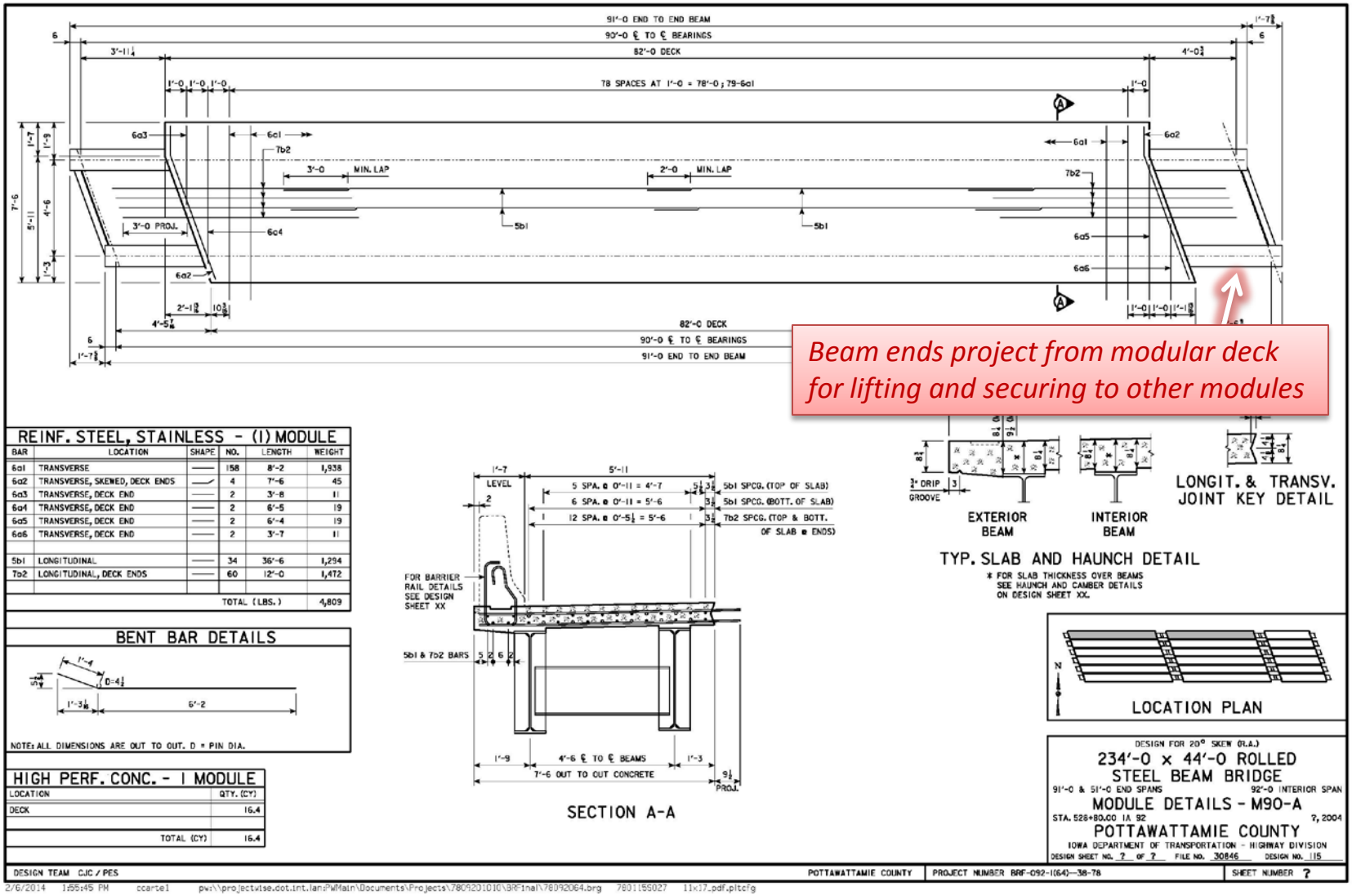
MODULAR DECKED BEAMS



MODULAR DECKED BEAMS



MODULAR DECKED BEAMS

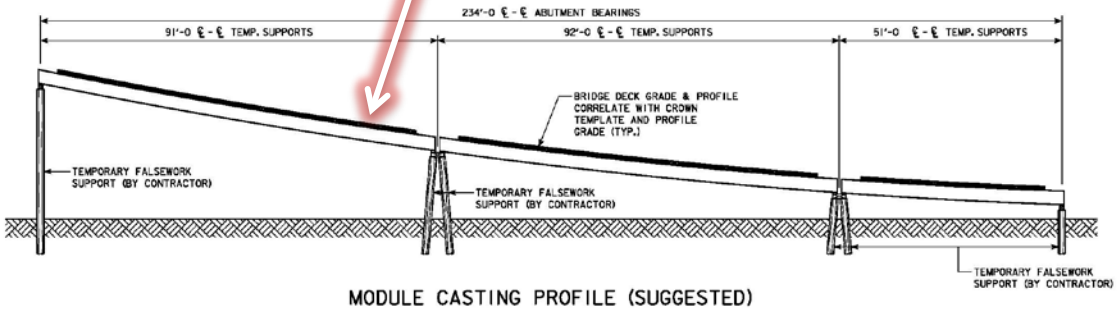


ALTERNATE SITE CASTING

- Due to complex geometry, accurate prefabrication of single individual modules at a fabrication shop/casting yard will likely be difficult and expensive.
- The recommended prefabrication procedure consists of using alternate site casting procedures to construct all modules simultaneously on temporary supports that match the relative location/elevation of the design bridge seats.
  - Constructing modules simultaneously in the correct relative position facilitates accurate bar placement (optimized bar stagger at longitudinal joints).
  - Minimizes post-assembly grinding/grade correction due to misaligned joint mating surfaces.
  - Deck joint locations could be blocked out to allow for concrete placement using a conventional paving machine.
  - Alternate site would be selected by the contractor and would be close to the project site, minimizing module transportation costs.

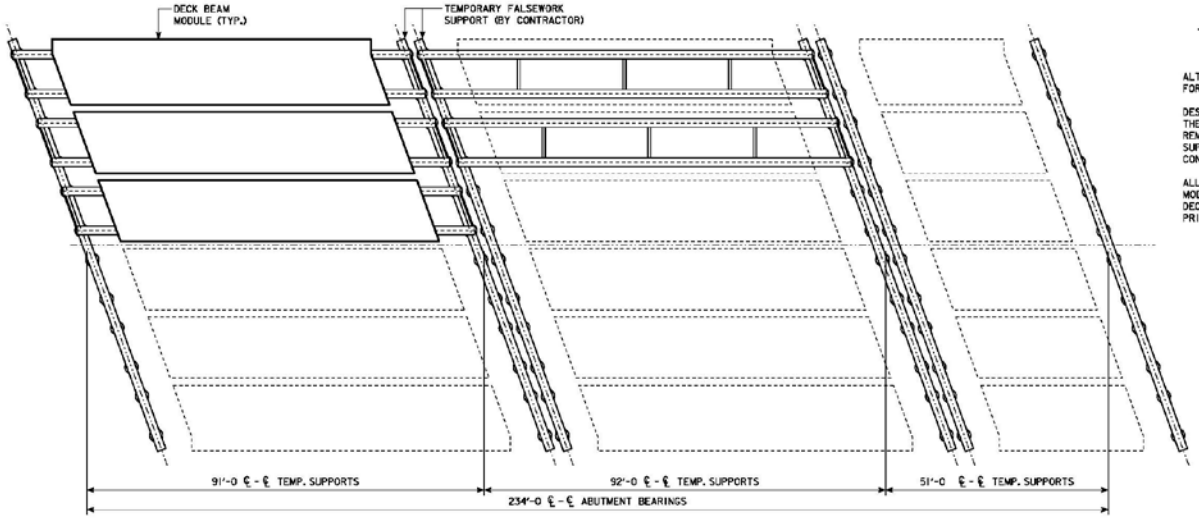
ALTERNATE SITE CASTING

Profile grade scale exaggerated 5X



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 III) 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

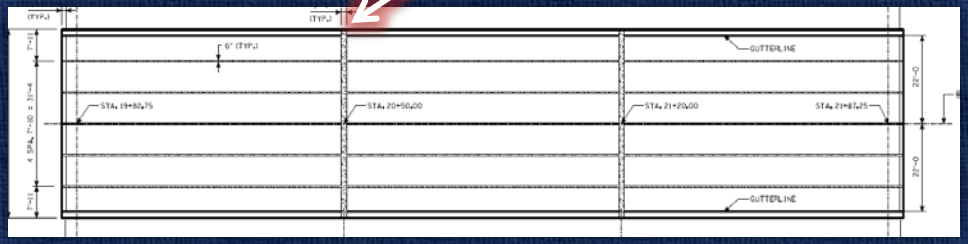
4/2/2014 10:34:54 AM ccarte1 pw:\\projectwise.dot.int.lan:PWMain\Documents\Projects\7809201010\BRFinal\WorkingDrawings-CJC.brg 7801155009 11x17_pdf.pltcfg

C.I.P. TRANSVERSE JOINTS

CONVENTIONAL CAST-IN-PLACE TRANSVERSE JOINTS

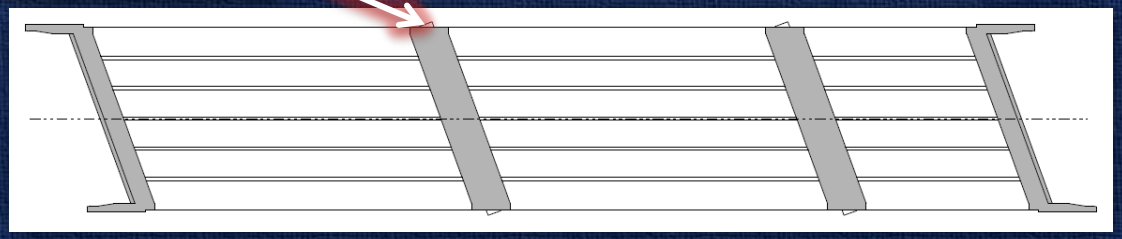
- Wider joint for improved constructability
- Allows joint(s) to be placed at lower-stress regions of deck
- Deck closure concrete is monolithic with abutment/pier diaphragms
- Conventional construction procedures with concrete maturity monitoring

Narrow UHPC joint



US-6 Over Keg Creek
Deck Plan

Wide C.I.P. joint



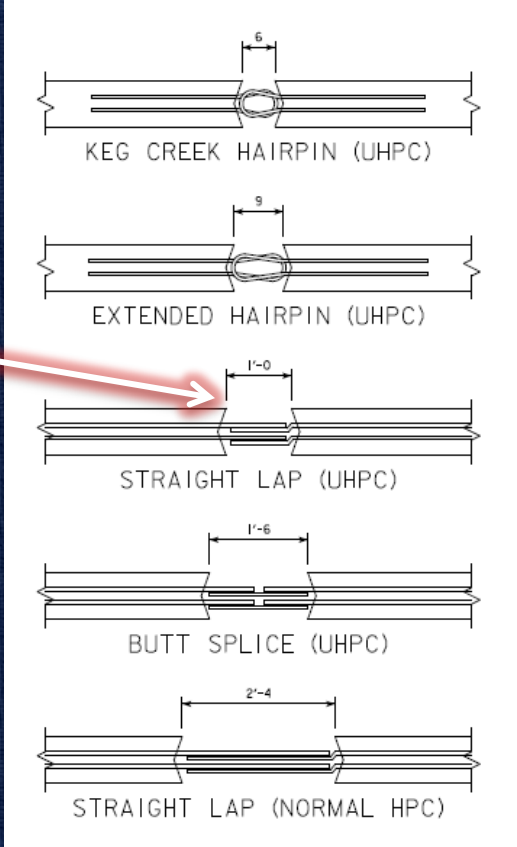
IA-92 Over L.S. Creek
Deck Plan

UHPC LONGITUDINAL JOINTS

ULTRA-HIGH-PERFORMANCE CONCRETE

- Performance Advantages
  - Better bond with precast module concrete
  - Improved durability compared with conventional concrete
  - Reduced development lengths for narrower joints
  - Placed after C.I.P. transverse closures to minimize UHPC forming requirements
- Design Considerations
  - Limited contractor experience
  - Special construction procedures
  - 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 Options

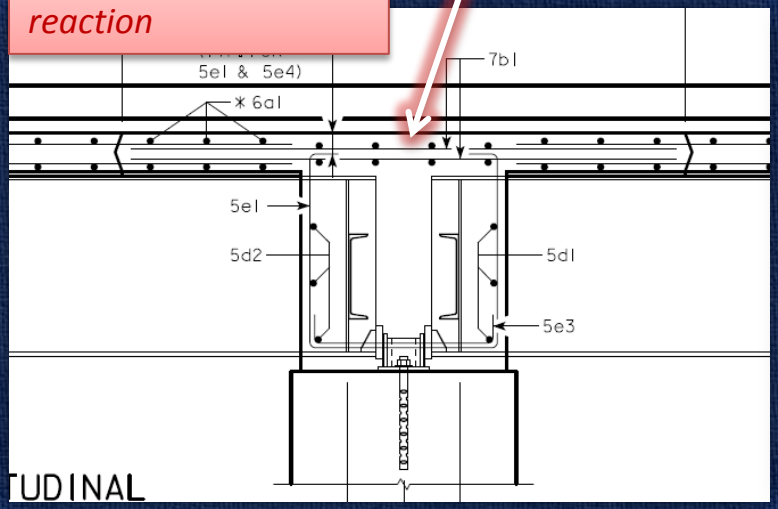
SIMPLE-MADE-CONTINUOUS

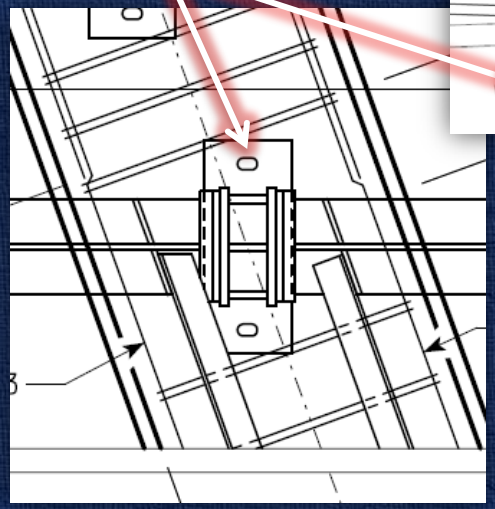
- Designed to support dead load and live load for simple span conditions
- Details will be implemented to allow structure to behave as continuous under live load
  - Additional deck reinforcing in negative moment region
  - Steel block used to transfer
    forces between beam botto

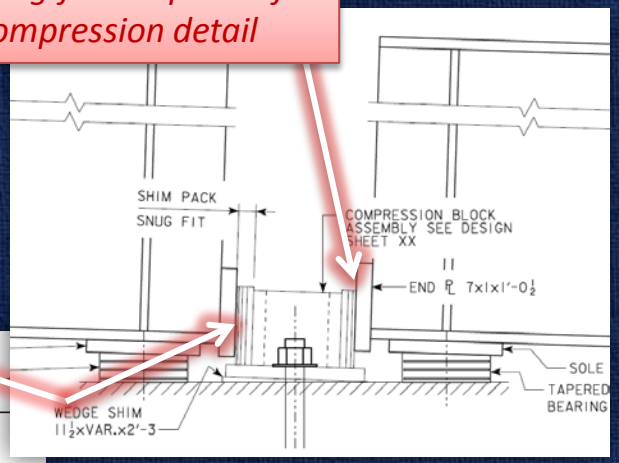
Snug-fit acceptable for compression detail

Slotted holes and shim packs facilitate constructability and field adjustment

Monolithic diaphragm encases full moment reaction

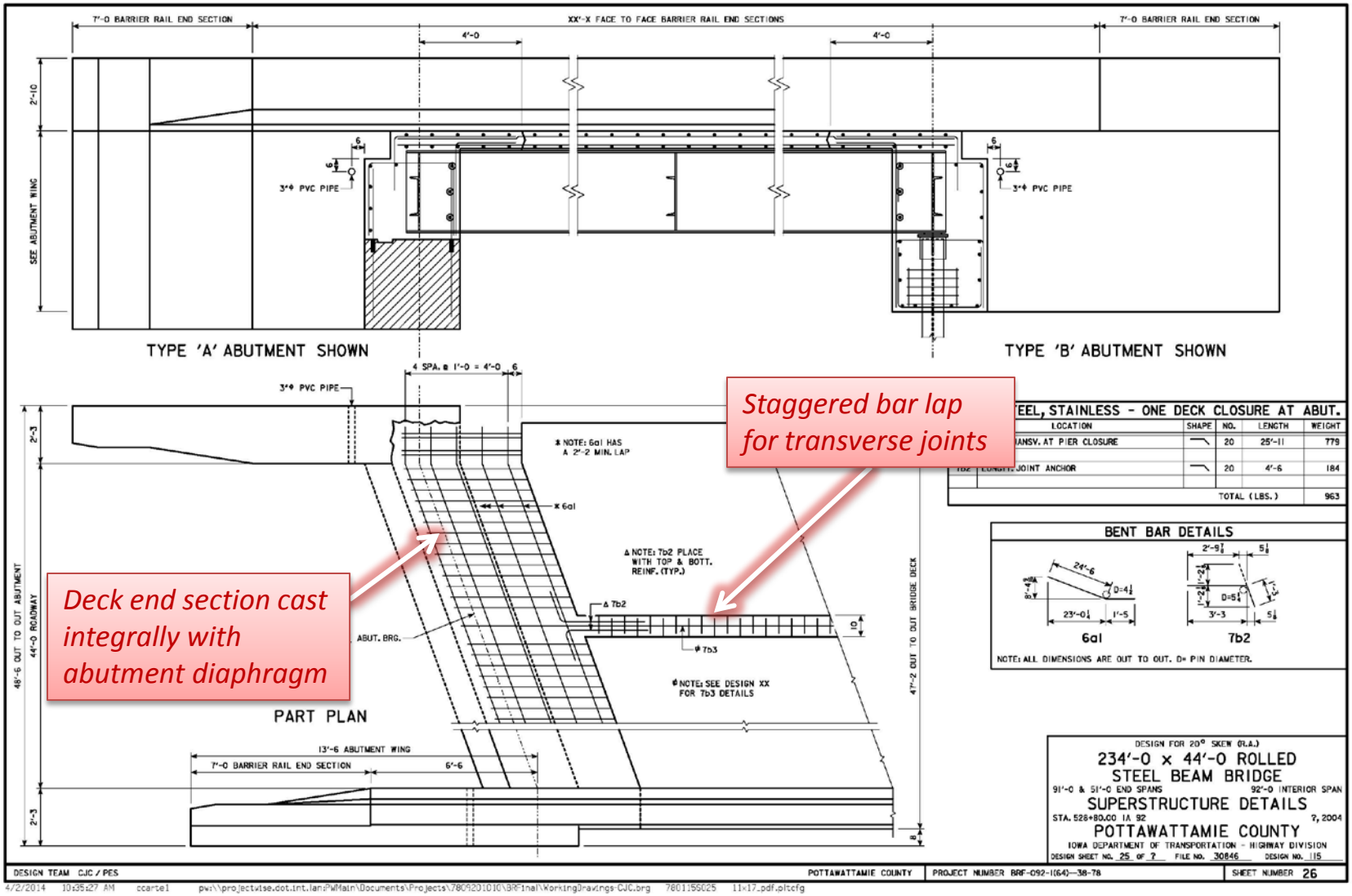




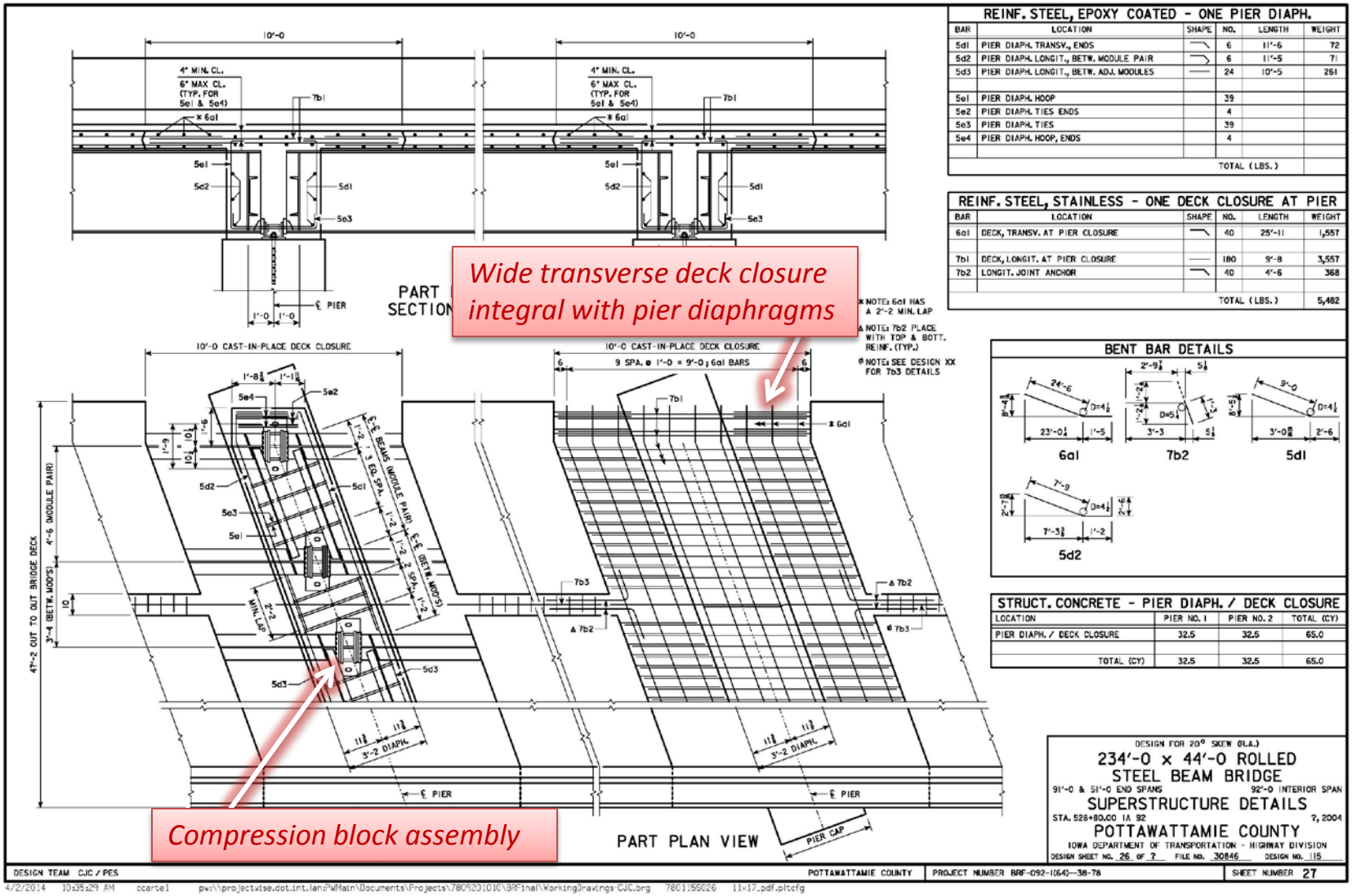


Proposed Pier Continuity Details

MODULAR SUPERSTRUCTURE

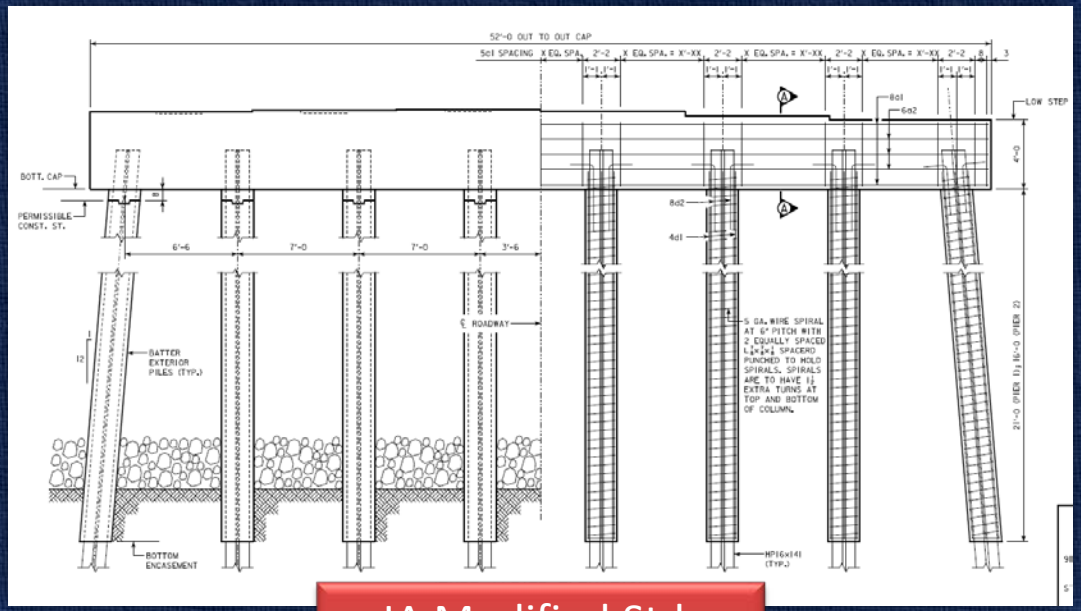


MODULAR SUPERSTRUCTURE



PILE BENT PIERS

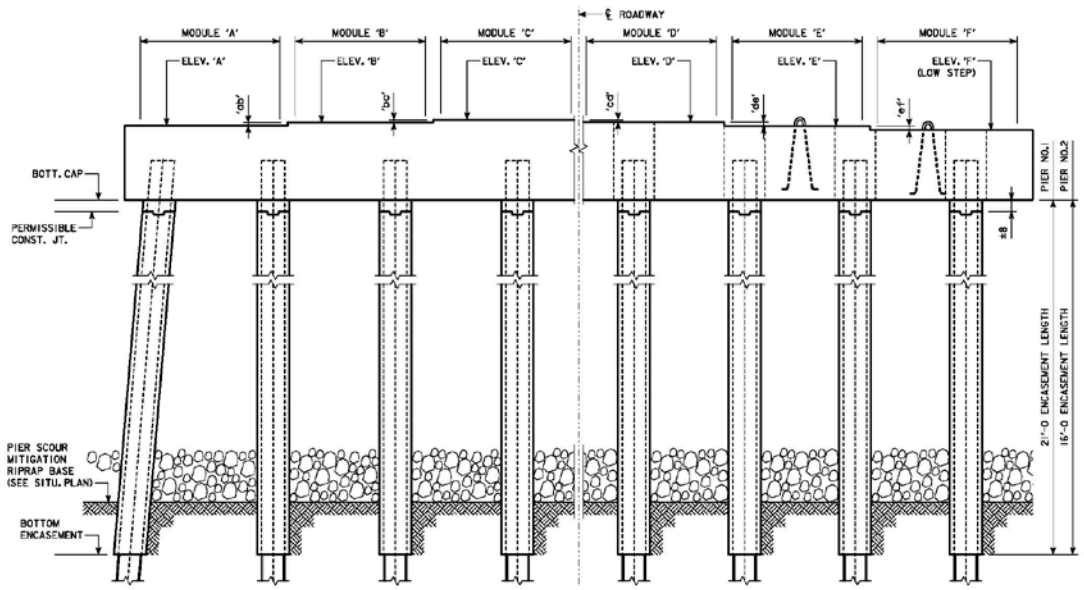
- Selected for economy/constructability
- Design considerations include scour and unsupported length
  - HP16x141 Piling (first use of HP16 section in Iowa)
  - Piling oriented for strong-axis bending (non-standard detail in Iowa)
- Design intent to include multiple construction options:
  - Precast cap option
  - Cast-in-place cap option
  - Option to construct concrete pile encasement after critical road closure
- C.I.P. diaphragm monolithic with deck
  - Provides simple and durable connection of deck modules at pier



IA Modified Std. Pile Bent Pier

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

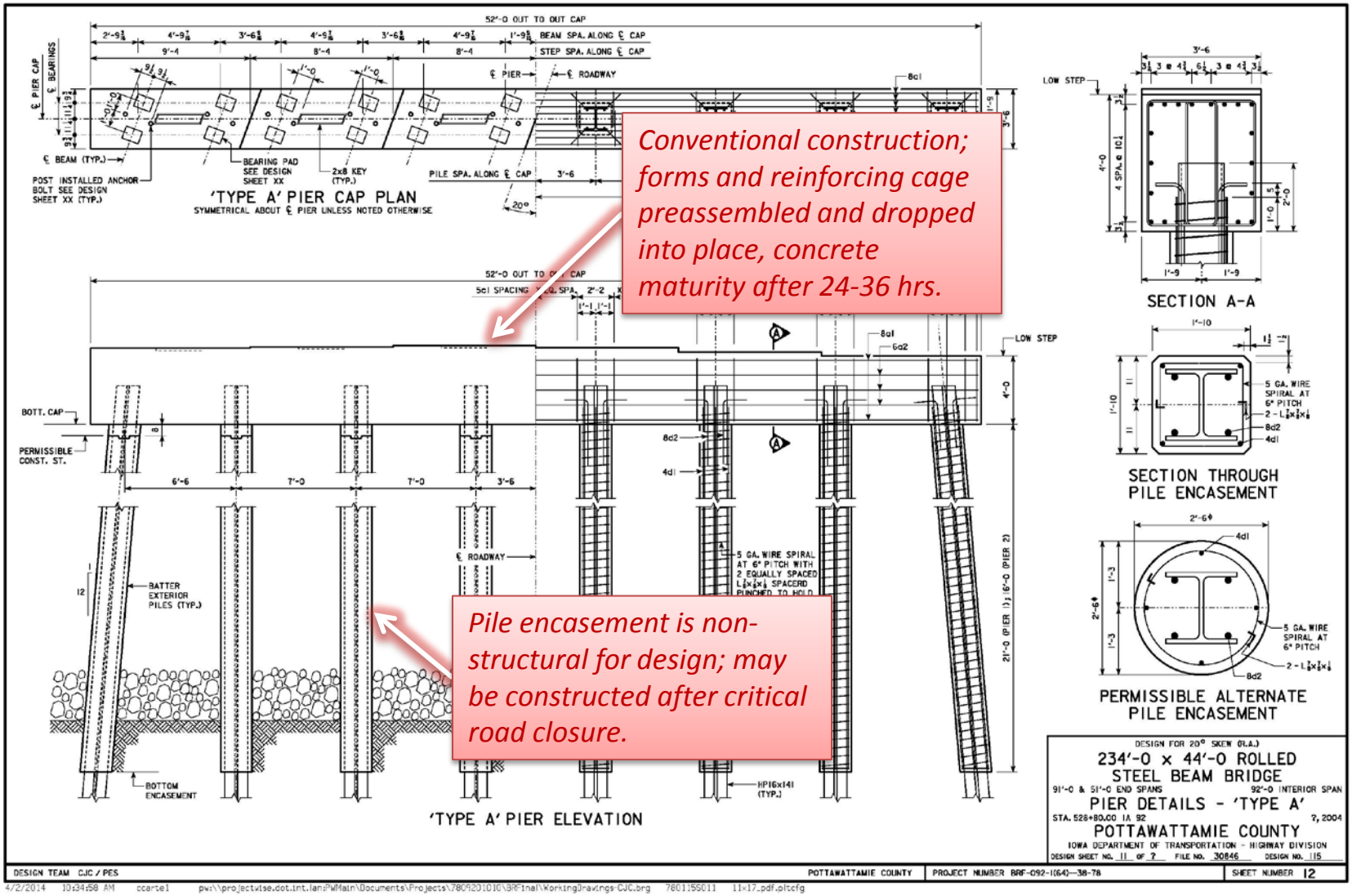
IOWA DEPARTMENT OF TRANSPORTATION - HIGHWAY DIVISION

DESIGN SHEET NO. 10 OF ? FILE NO. 30846 DESIGN NO. 115

DESIGN TEAM CJC / PES | POTTAWATTAMIE COUNTY | PROJECT NUMBER BRF-092-1(64)--38-78 | SHEET NUMBER 11

4/2/2014 10:34:56 AM ccarte1 pw:\\projectwise.dot.int.lan:PWMain\Documents\Projects\7809201010\BRFinal\WorkingDrawings-CJC.brg 7801155010 11x17_pdf.pltcfg

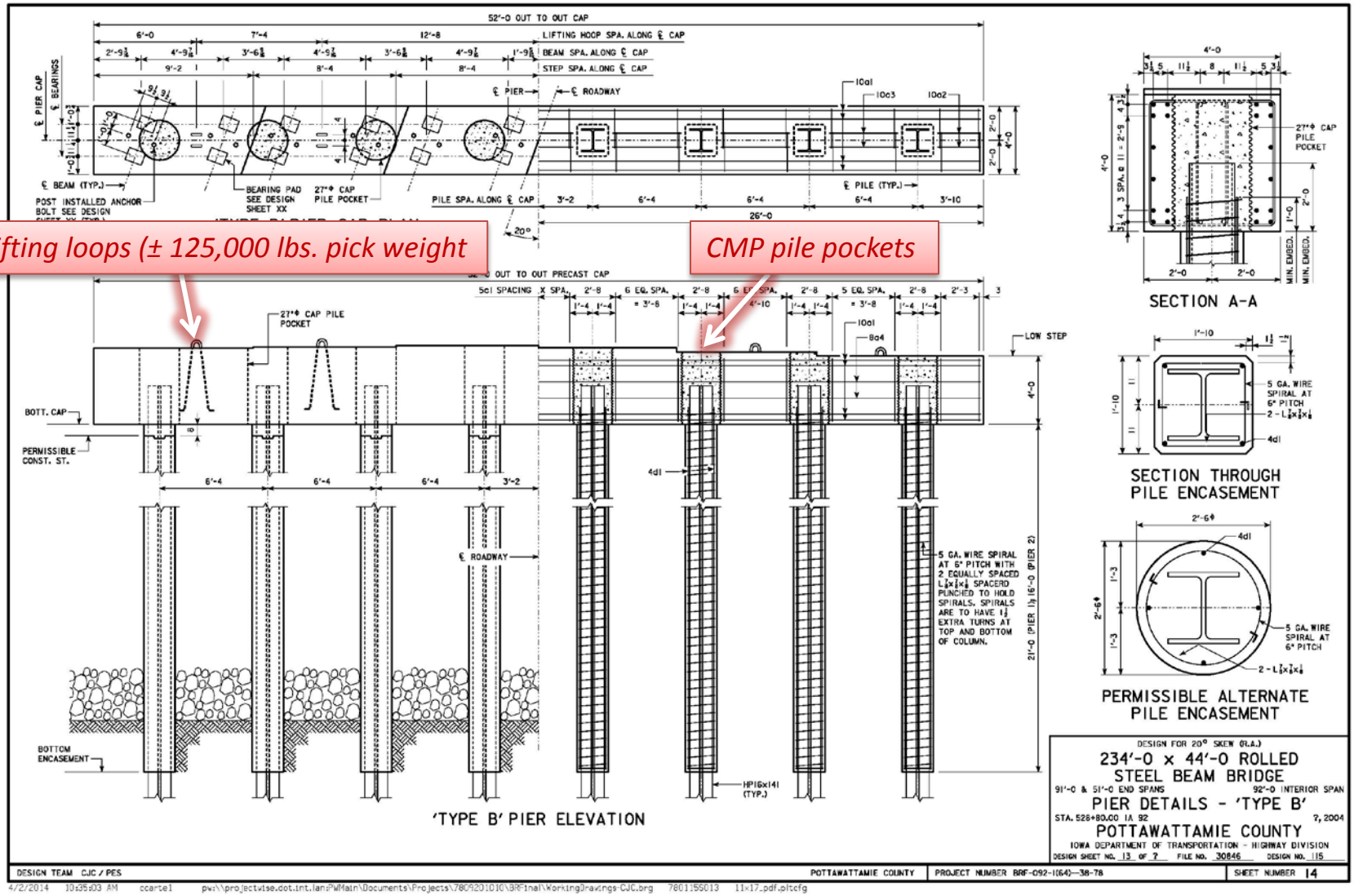
PILE BENT PIER (C.I.P. CAP)



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

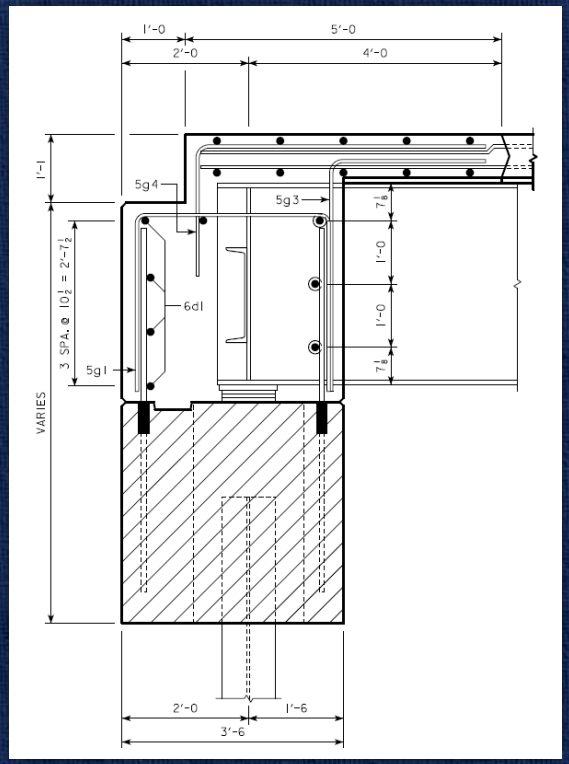
Pile encasement is non-structural for design; may be constructed after critical road closure.

PILE BENT PIER (PRECAST CAP)



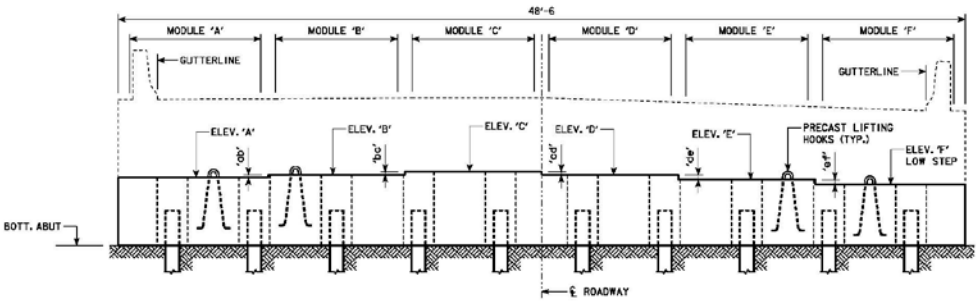
INTEGRAL ABUTMENTS

- Selected for constructability/durability
- Design considerations include stability during module placement
  - Prebored piles oriented for weak axis bending
  - Desire/need for piles to be braced during module placement
- Design intent to include multiple construction options
  - Precast cap option
  - Cast-in-place cap option
  - Capless option (beams supported directly on piling)
- C.I.P. diaphragm monolithic with deck
  - Provides simple and durable connection of deck modules at abutment



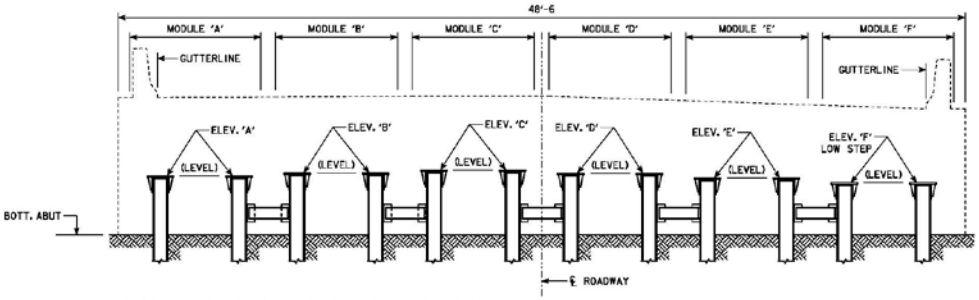
Integral Abutment with Precast Cap

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 ___".

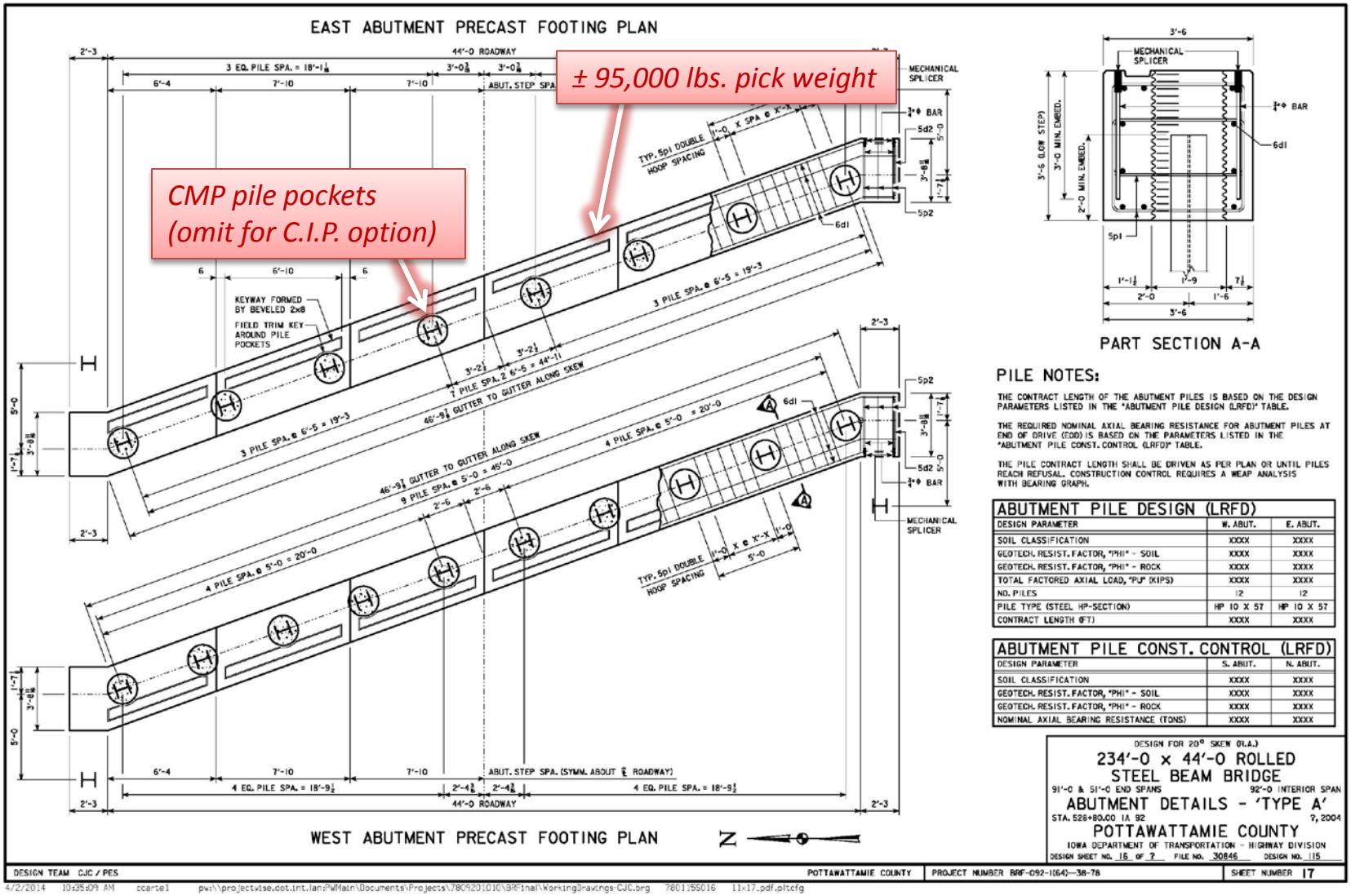
EST. QUANTITIES - TWO BRIDGE ABUT.				
ITEM	UNIT	PIER 1	PIER 2	TOTAL
BRIDGE ABUTMENT	LS	1.0	1.0	2.0
PILES, STEEL, HP 10 x 57	LF	XXX	XXX	XXX

DESIGN FOR 20° SKEW (F.L.)
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

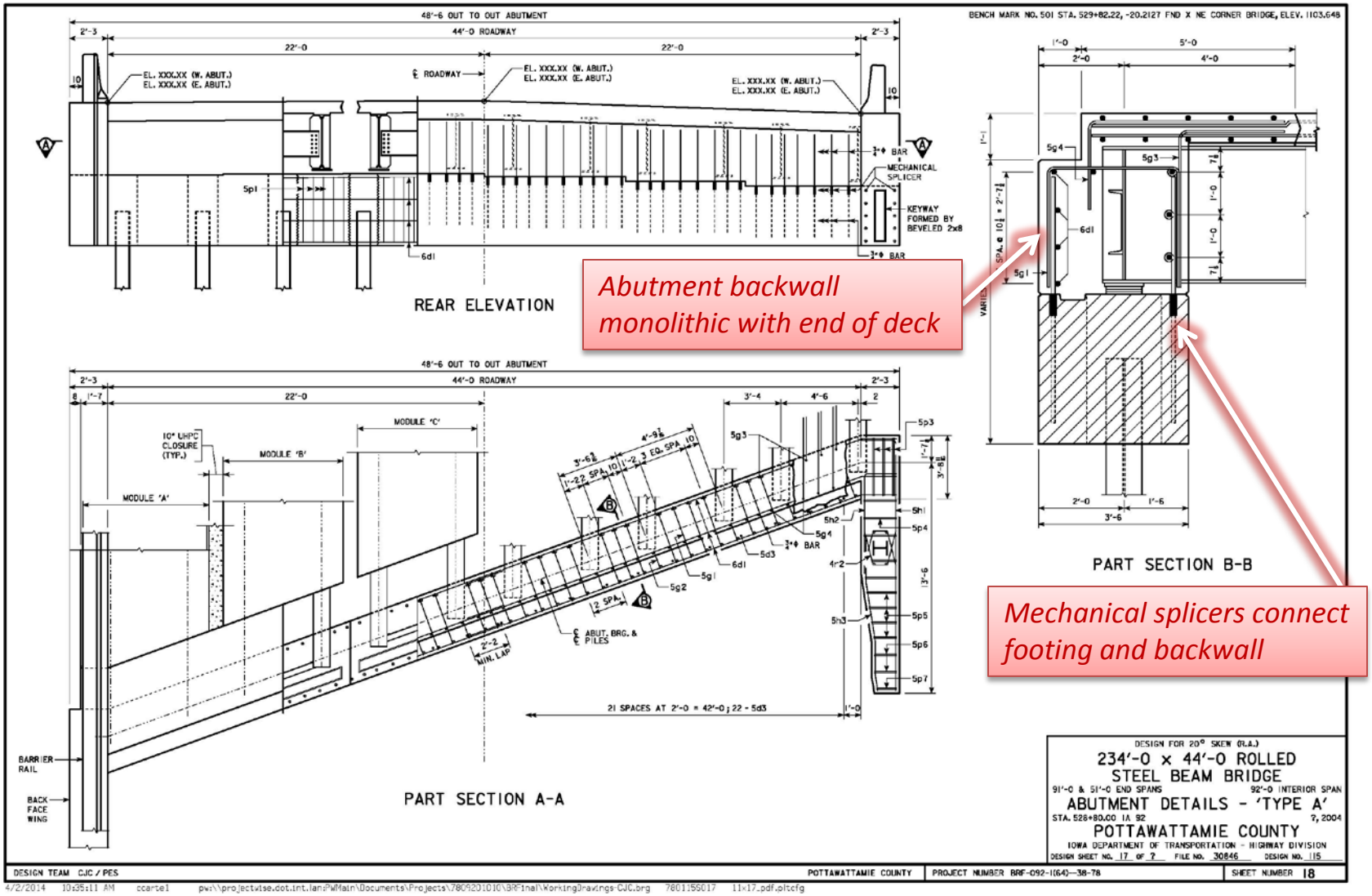
DESIGN TEAM CJC / PES | POTTAWATTAMIE COUNTY | PROJECT NUMBER BRF-092-1(64)--38-78 | SHEET NUMBER 16

4/2/2014 10:35:07 AM ccarte1 pw:\\projectwise.dot.int.lan:PWMain\Documents\Projects\7809201010\BRFinal\WorkingDrawings-CJC.brg 7801155015 11x17_pdf.pltcfg

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



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

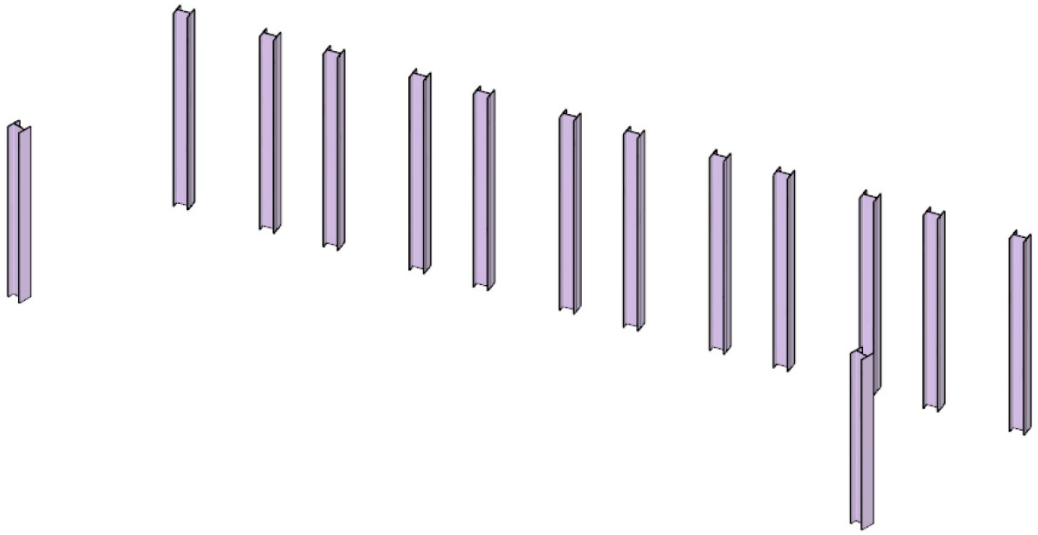


BEAM-ON-PILE ABUT. CONCEPT

- Concept has not been used on in-house IA DOT bridge designs, but other states have positive experience with this method.
- Concept is being considered as an option for this project, although Iowa is soliciting input/feedback from contractors and other states.
- Possible advantages for this project:
  - Removes abutment footing construction from the critical path for deck module placement
  - Could facilitate accurate placement of beam seats
  - More conservative design, but not necessarily more expensive
- Design considerations:
  - Applicability to modular ABC concept?? Construction Tolerance?? Can these details be constructed quickly and accurately??
  - Pile stability during module placement?? Module dead load reactions could exceed typical dead load reactions of single beams.
  - Pile bracing details??
  - Field welding concerns??

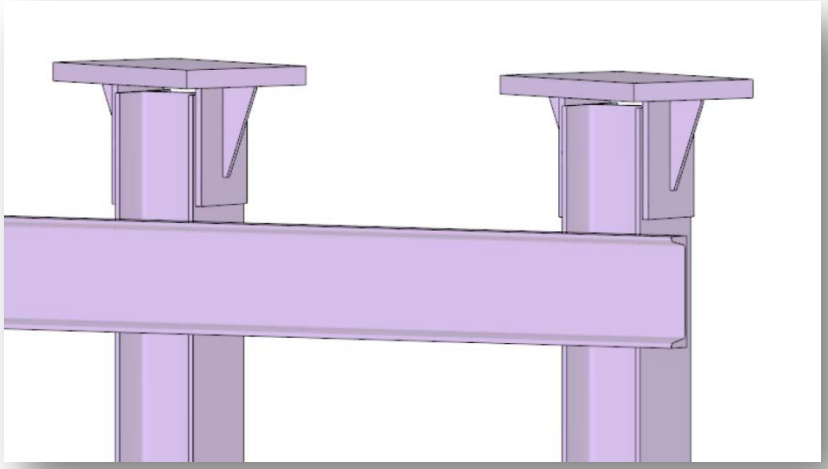
ABUTMENT CONCEPT: BEAM-ON-PILE

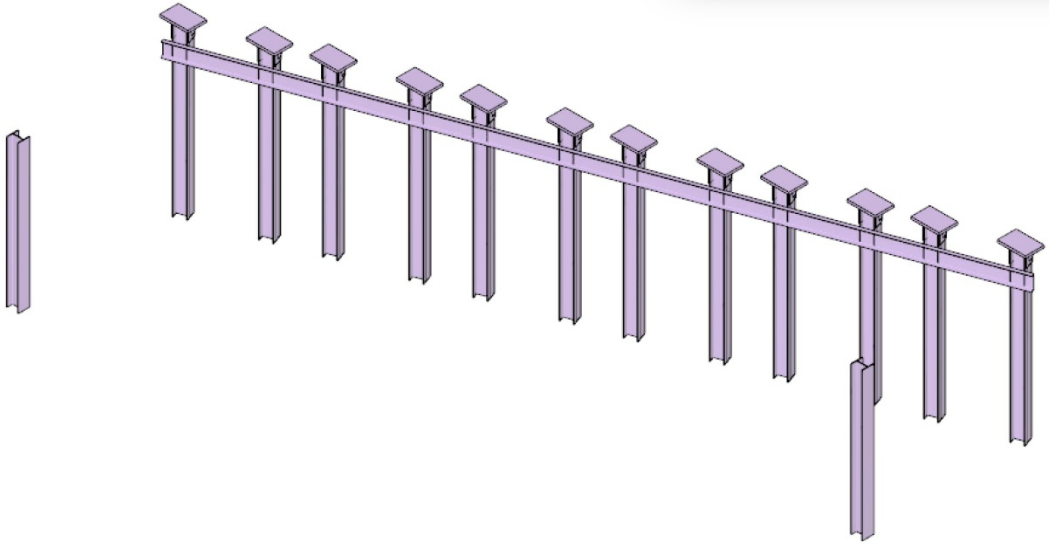
(1) INSTALL PILING



ABUTMENT CONCEPT: BEAM-ON-PILE

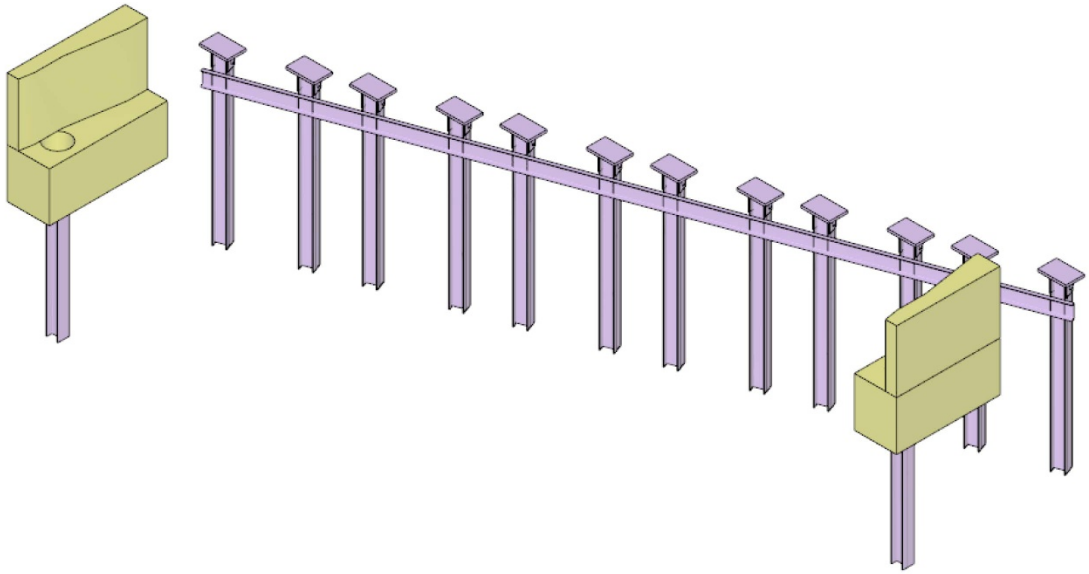
(2) INSTALL BRACING & BEAM SEATS





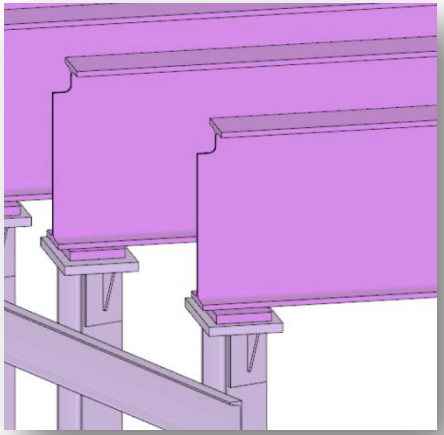
ABUTMENT CONCEPT: BEAM-ON-PILE

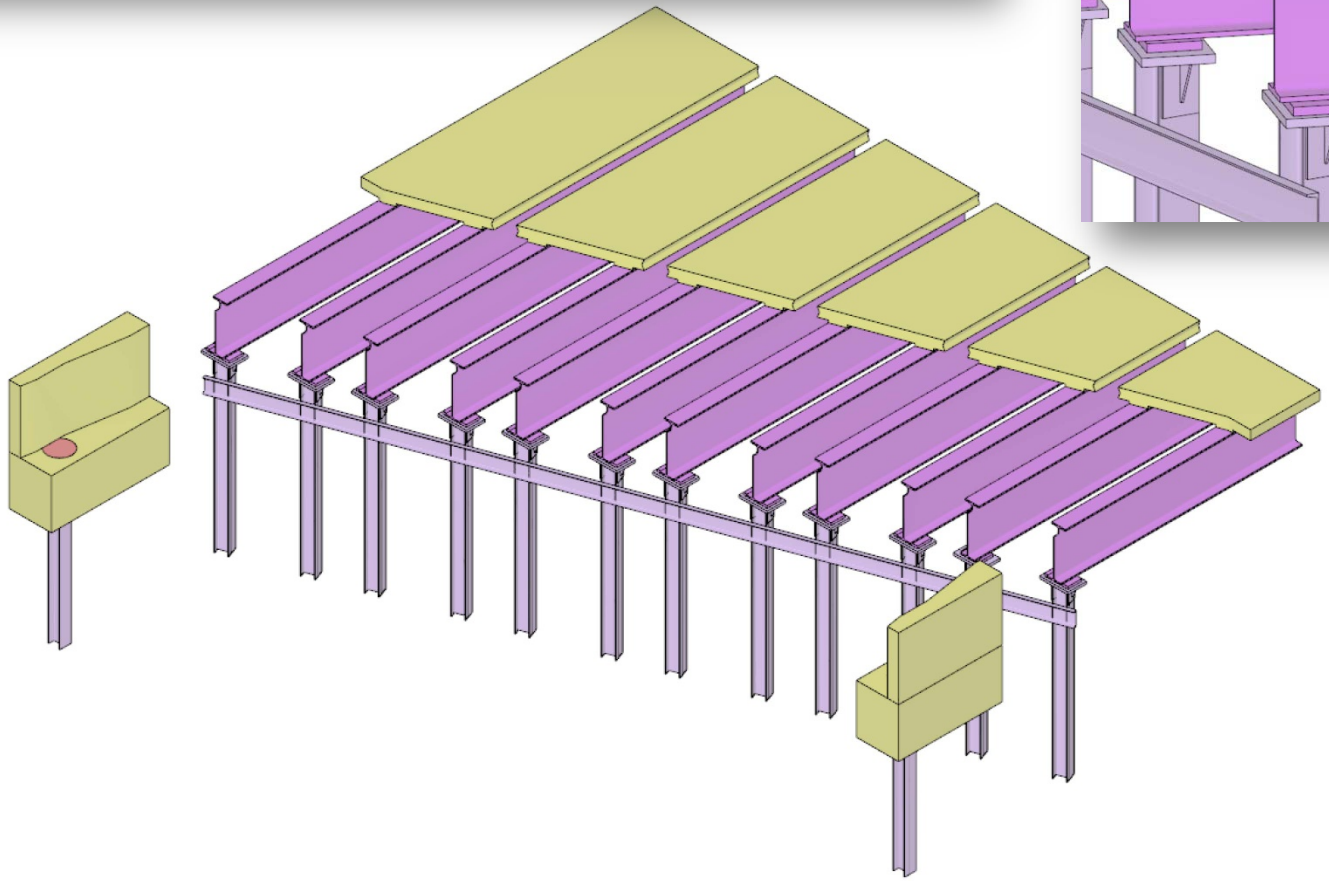
(3) INSTALL PRECAST WINGS



ABUTMENT CONCEPT: BEAM-ON-PILE

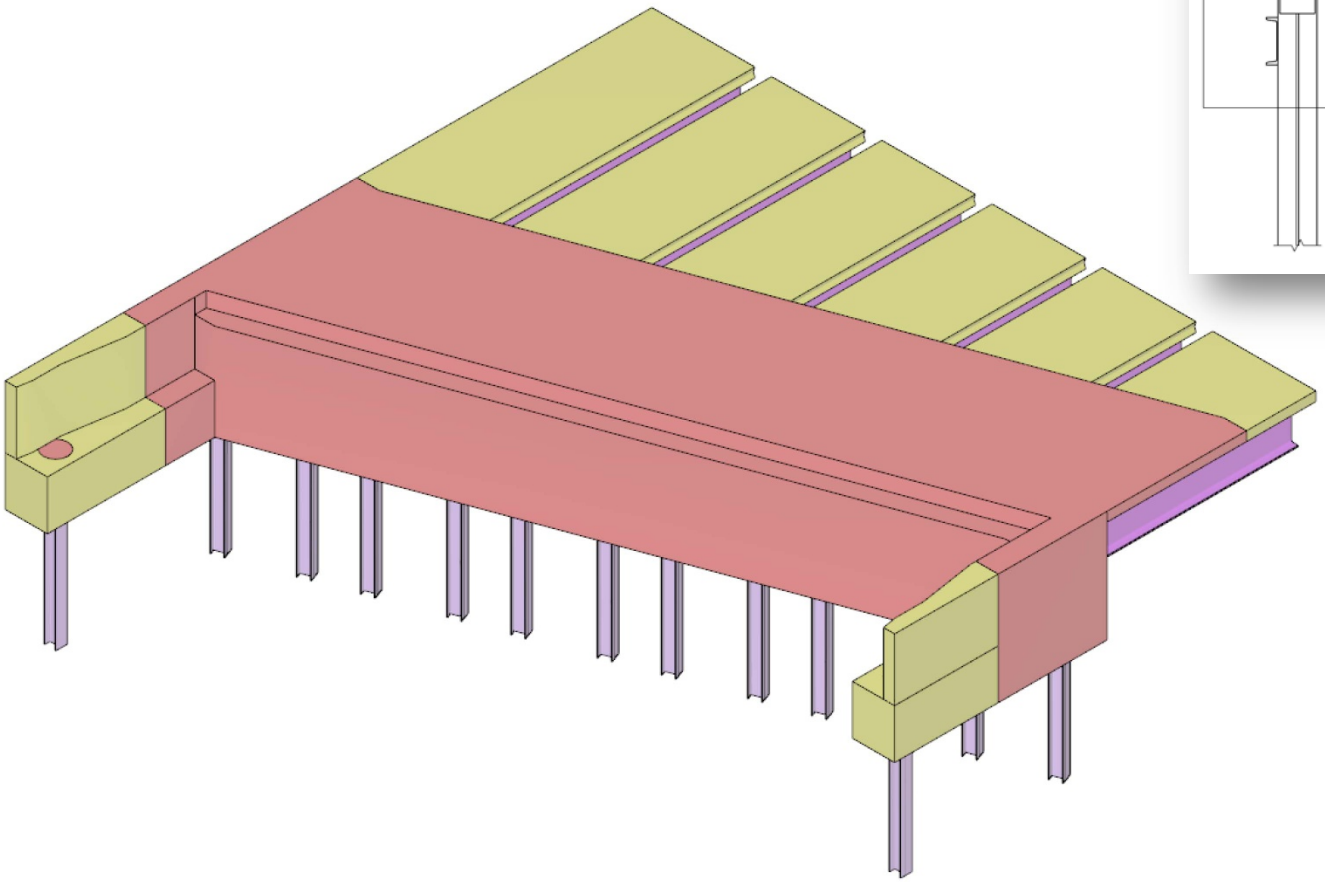
(4) INSTALL DECKED MODULES & WING POCKETS

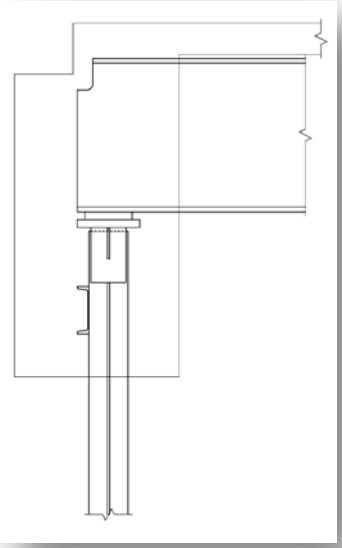




ABUTMENT CONCEPT: BEAM-ON-PILE

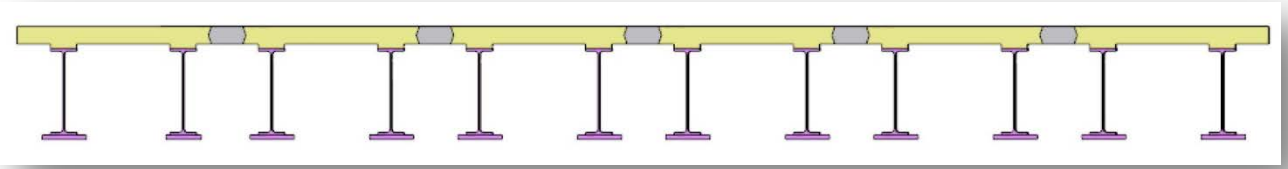
(5) PLACE ABUTMENT CONCRETE

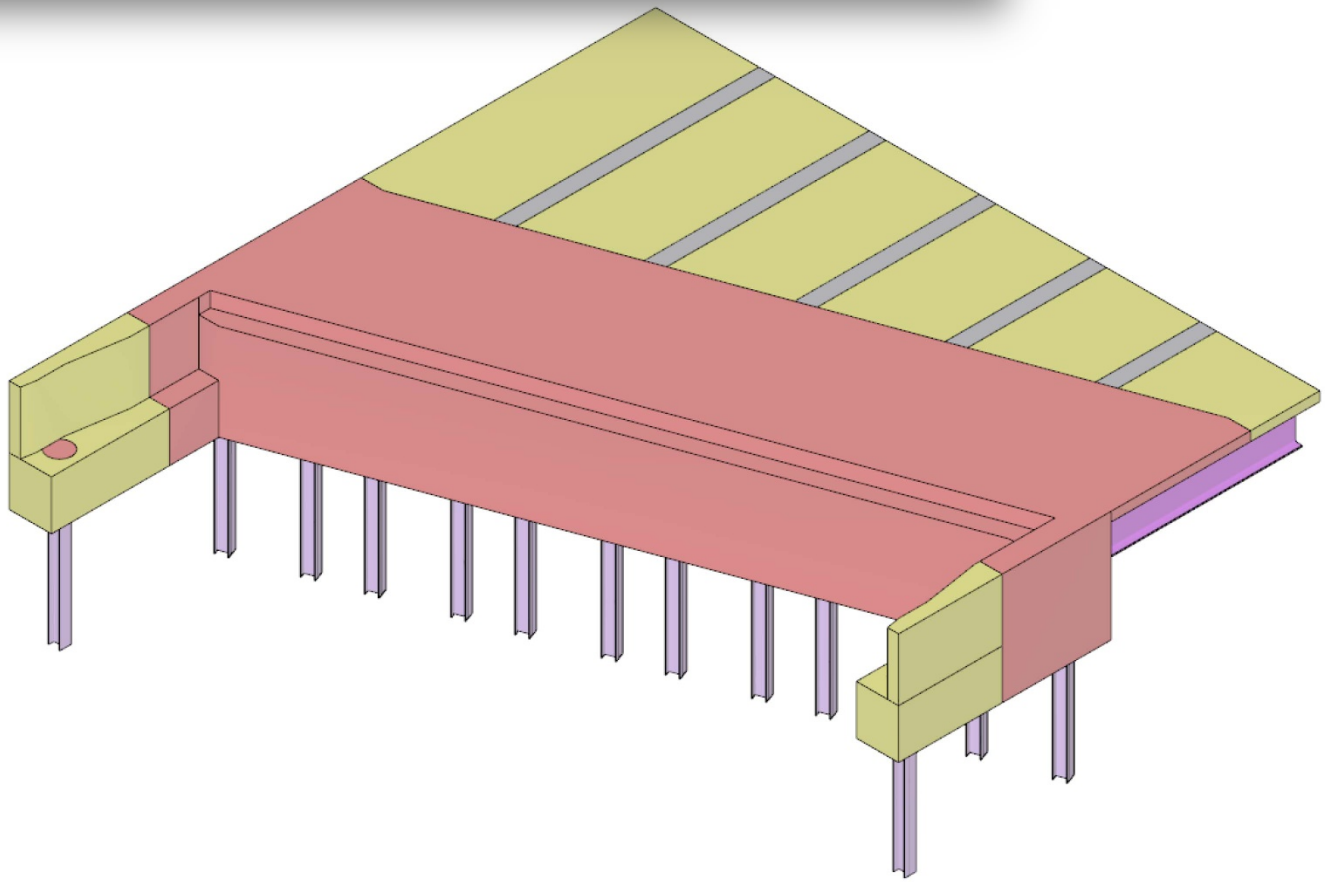




ABUTMENT CONCEPT: BEAM-ON-PILE

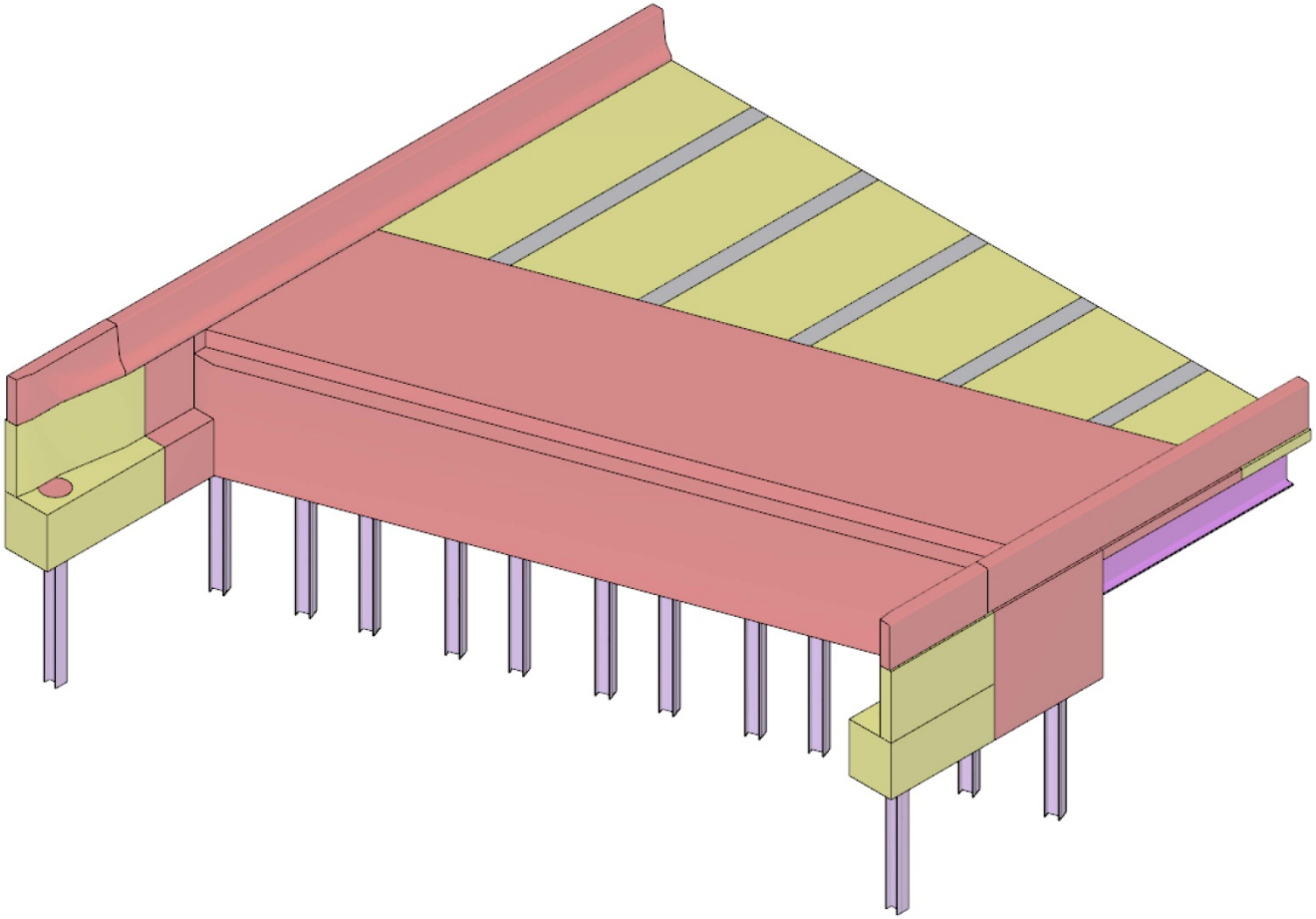
(6) PLACE UHPC LONGITUDINAL JOINTS



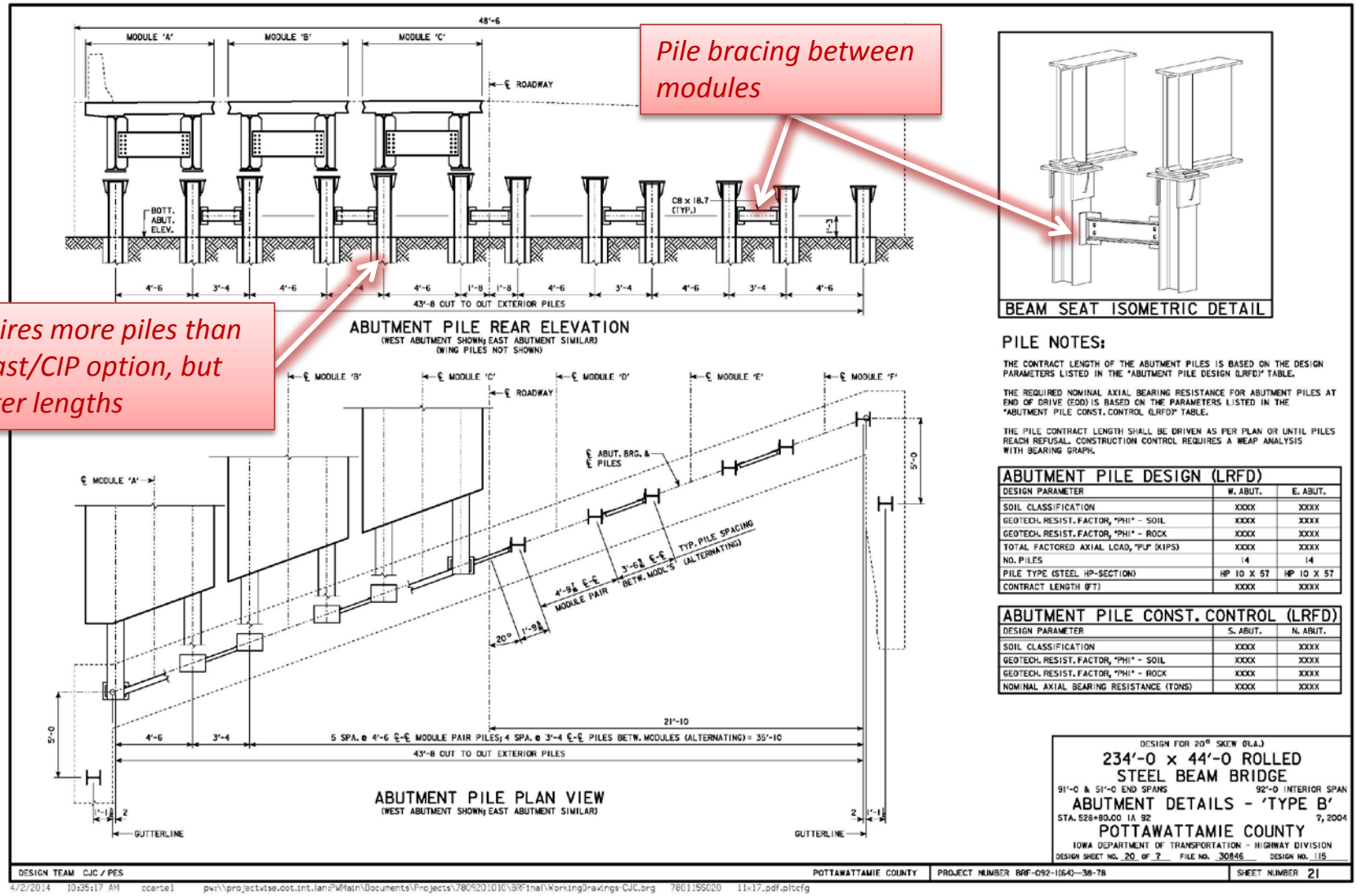


ABUTMENT CONCEPT: BEAM-ON-PILE

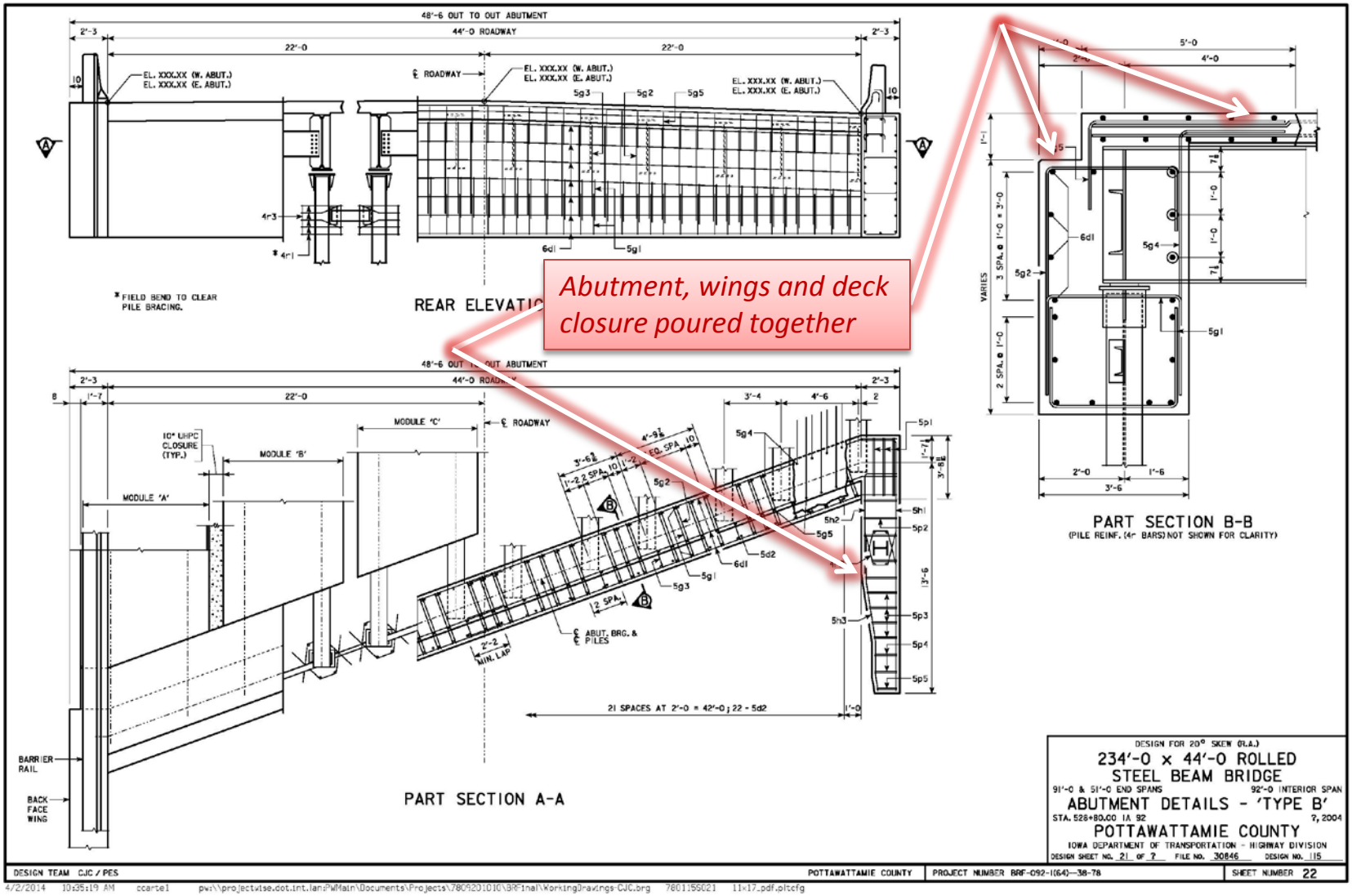
(7) INSTALL BARRIER RAIL



INTEGRAL ABUT. (BEAM-ON-PILE)



INTEGRAL ABUT. (BEAM-ON-PILE)



PROJECT SUMMARY

PROJECT OBJECTIVES

- Safe structure (during construction and service) with long service life
- Accelerated construction schedule
- Demonstrate application of modular construction concept at a more challenging site
- Demonstrate improvements upon previous experience with the modular construction concept
- Provide in-house design experience
  - Provides designers with a better understanding of the unique design/details/processes required for the modular construction concept, and for ABC projects in general.
  - Experience will benefit in-house designers of similar projects, and reviewers of consultant-designed projects.
- Expand agency experience
  - When combined with experience from the Keg Creek project, IA DOT can develop a better understanding of the costs, benefits, and limitations of the modular construction concept.
  - Experience with this project will assist the DOT in establishing policy and selecting the appropriate construction concept (modular construction, slide, etc.) for future ABC projects.

PROJECT INNOVATIONS (IOWA PERSPECTIVE)

- Integral abutments
  - Iowa's preferred abutment type, but hasn't previously been applied to ABC project
- Transverse deck closures monolithic with beam end diaphragms
  - Moves joint interface to lower-stress region of deck, provides secure connection of modules
- Simplified UHPC joint details
  - Wider joint, simpler bar lap, less bar congestion
  - UHPC application to longitudinal joints only should simplify forming
- Simplified continuity details
  - Faster construction, more liberal construction tolerance

PROJECT INNOVATIONS (IOWA PERSPECTIVE)

- Stainless steel deck reinforcing
  - New to Iowa, expected to provide better joint performance and longer service life
- Expanded application of pile bent piers
  - Long unbraced length requires larger pile size
- Fully detailed design alternates for substructure
  - Facilitates contractor involvement in the final design solution
- Greater opportunity/application of accelerated cast-in-place concrete
  - Counter-intuitive to some ABC philosophy, cast-in-place concrete can be a good design option if it can be placed quickly and accurately
  - Cast-in-place concrete is generally more forgiving than precast concrete with respect to construction tolerance

SCHEDULE, REVISITED

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								■	■												
ABUTMENT PILE BRACING & BEAM SEATS								■	■												
ERECT DECK MODULES										■	■	■									
CONSTRUCT ABUTMENTS & WINGS												■	■	■							
CONSTRUCT PIER CAP DIAPHRAGMS												■	■	■							
PLACE UHPC LONGITUDINAL JOINTS															■						
CONSTRUCT APPROACHES AND BARRIER RAIL																■	■	■			
GRINDING & LONGITUDINAL GROOVING OF DECK																		■	■	■	
FINISH GRADING & WING ARMORING																			■	■	
GUARDRAIL & PAINT																				■	■
OPEN IA 92																					■

SCHEDULE, REVISITED

- 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

WORKSHOP DISCUSSION OPPORTUNITIES

Opportunities for improvement??

- Schedule
- Decked module concept
- Transverse joint concept
- Longitudinal joint concept
- UHPC details
- Continuity details
- Pier details
- Abutment details
- General constructability

QUESTIONS??

THANK YOU!!