

Bridge Replacement: Sugar Creek Bridges, I-80 Cedar County

ACEC + Iowa DOT + FHWA Transportation Conference | September 29, 2022 Dan Smith, PE – HR Green Sean Connor, PE – HR Green

Agenda

- Project History and Background
- Project Features

Unique Details
 3D Design Modeling

 Staged Roadway Construction Considerations

HRGtrapp, ACEC + Isas DOT + FAWA 7

 Bridge Replacement and Unique Design Aspects
 Staged Construction



Project History and Background

- Existing Bridges Built in 1960
- Both bridges identified for replacement
- I-80 PEL Study Roadmap for Future I-80 Expansion and Investment.



Project History and Background

 Bridge Replacement Project – 2013 +/-

- I-80 bridge approach pavements
- Roadway pavements to maintain traffic and accommodate staging
- Wider bridges to accommodate future expansion
- Preliminary design paused for further evaluation of I-80 needs



Bridge Replacement: Sugar Creek, I-80 Cedar Co





Project Features

- Bridge Replacements EB and WB
- Areas of Full Reconstruction to Address Sag Vertical Curvature
- Improvements to Rest Area ramps
 I-80 widening to the median for future expansion and construction needs
- Shoulder widening
- Accommodation of Future Expansion
 Project(s)



Bridge Replacement: Sugar Creek, I-80 Cedar Co ACEC + towa DOT + FHWA Transportation Conference







Staged Roadway Construction Challenges



Sugar Creek Bridges

- Background
- Bridge Staging
- Unique Design Elements

Bridge Replacement: Sugar Creek, I-80 Cedar Co

► 3D Modeling



Staging Location - Stage 1

- ▶ 30' wide portion of new bridge built on median side
- Built adjacent to the existing structure
- ▶ Partial removal of existing deck to allow room for construction







Stainless Steel Reinforcing

- Used in Stage 1 construction for any bar exposed over the winter into the next construction season
- Deck bars extending into the closure pour
- Few locations of abutment and pier vertical bars extending into the closure pour



Closure Pour Lap Length Since preliminary design, AASHTO updates to bar lap length 2'-5" min. lap 3'-7' 3'-7" Preliminary had 3' closure pour 5a11 min. lap min. lap Bridges and Structures Bureau now recommends 4' Epoxy lap would not fit Mech, Splice (T Used stainless steel bars out of 2nd stage of deck to achieve required lap length -5d22 c 5d42 HRG Replacement: Sugar Creek, H80 Cedar Co



Skewed Diaphragms

- Deck longitudinal joint for staged construction is parallel with the bridge alignment
- Abutment footings and pier cap skewed, so staged joint built normal the skew - square

Bridge Replacement: Sugar Creek, I-80 Cedar Co

 Same for abutment and pier diaphragms

STAGE I DECK	STAGE 2 DECK CONSTRUCTION
CONSTRUCTION	3'+0 DECK .
	CLOSUBE POUR
1	1
	- Do
	PUT MEL MILLING
	10 2 10 10 ¹⁰
- 2	STE ONSTRUCT
1000	* * * * * * * * * * * * * * * * * * *
ABUTAC	A 14-1 866894009
TAGE OUCTION	A V24/3220
50051 8911 T	
hereever	Sec. 1
1 200350000 L	
1900000000	
- 1 2000000 t	
- 1 600 000 b 1	
	V 8013
1 1	
1.	
	DETAIL A
NOTE	
8g11 & 8g13 S	TAINLESS BARS ARE USED WHEN STAGE I
DÍAPH, BARS EX	TEND INTO STAGE 2 DECK POUR.

Temporary Shoring

- Required to build abutments
- Partial abutment removal for staging includes wings
- Retains fill under existing approach pavement and allows excavation of stage 1 of abutment



IH33

Bridge Replacement: Sugar Creek, I-80 Cedar Co



Fiber Reinforced Concrete

- High Performance Concrete with Fiber Reinforcing
- Micro and macro non-metallic synthetic fibers
- Used for the Bridge DeckDOT beginning to used on
- projects across State
- Provides crack control and improved the long-term performance

Bridge Replacement: Sugar Creek, I-80 Cedar Co



Shallow Limestone

- Variable depth and highly weathered, sloping down from west to east
- Very shallow at west abutment of EB bridge, deeper at others
- Pier 1 (west pier) shallowPier 2 (east pier) about 20'

H33

below gradeCaused changes in final design

Bridge Replacement: Sugar Creek, I-80 Cedar Co



Opposite Image: Second Sec

Abutment Coring Rock Socket

- Shallow and variable rock at west abutment of EB bridge
- Existing bridge changed in field to be partially on spread footing and piles
- Decided to core out rock for integral abutment on pile
- Minimum of 10' of bentonite slurry with concrete socket to set pile

Bridge Replacement: Sugar Creek, I-80 Cedar Co

3D Modeling

- Iowa DOT Upgrading to Bentley Connect
 Iowa DOT requiring a
- lowa DOT requiring a model be created for new structures
 OpenBridge Designer,
- OpenBridge Modeler & ProStructures
 Pilot Project for DOT to test capabilities of 3D design and drafting software

H33 Bridge Replacement: Sugar Creek, I-80 Cedar Co



Basic 3D Model, EB Bridge Bridge laid out based on 3D alignment and profile Concrete Elements: Barriers, Deck, Haunch, Girders, Piers, Abutment, Wings Steel Piling, Intermediate Diaphragms, Deck Drains 2D Plans Created Independent of 3D Model

Bridge Replacement: Sugar Creek, I-80 Cedar Co

Fully Developed Model, WB Bridge

ment: Sugar Creek, I-80 Cedar Co

Started Basic Model

1433

1433

- ProStructures used to fully detail all reinforcing in the bridge
- Model was separated into Stage 1 & Stage 2
- 3D Reinforcing Details Referenced Back into Bridge Geometry File



Plan Production, WB Bridge

- 2D Cross-Sections Cut from 3D Model
- Numerous final plan details taken directly from the 3D model
 Attempted to create all details
- from the model
- Used Standard Details for several unclear 3D details
- Coordinated closely with Bridge & Structures Bureau

HAA Bridge Replacement: Sugar Creek, I-80 Cedar Co







