Abbreviated Structure Type Study

Bridge NO. FRA-33-2900 L/R
US33 over GEORGE CREEK
August 11, 2025

Prepared For:

ODOT District 6
400 E. William Street
Delaware, Ohio 43015

Prepared By:

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6350 Presidential Gateway
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INTRODUCTION

The purpose of this project is to replace two existing bridges carrying US-33 over Georges Creek in Franklin County, Ohio. These structures, FRA-33-2900 L/R (SFN 2502194 & 2502224), have been identified as being in poor condition (BR-86 rating of 4). This study focuses on the full replacement of these twin structures to meet current design standards, accommodate future traffic needs, and minimize long-term maintenance liabilities.

Through discussions with ODOT, three (3) superstructure alternatives have been studied for these bridges. Foundation design is to be coordinated with ODOT Office of Geotechnical Engineering (OGE). Both structures are located in the George creek floodplain. All design considerations will adhere to the "no-rise" requirements for the 100-year flood event, which may influence the superstructure replacement alternative.

ALTERNATIVES

Three (3) superstructure alternatives have been studied for the full replacement of the FRA-33-2900 L/R bridges. Alternatives considered are:

1. Three-span continuous reinforced concrete slab bridge
2. Single-span steel beam bridge
3. Conspan arch culvert

EXISTING BRIDGE

- **Structure File Number:** 2502194 (Left), 2502224 (Right)
- **Bridge Number:** FRA-33-2900 L/R
- **Year Built:** 1963
- **Overall Length:** Approximately 78 feet (based on 24’, 30’, 24’ spans plus substructure)
- **Skew:** 7° Right Forward Skew
- **Spans:** 24’, 30’, 24’
- **Bridge Width (Existing):** 42 feet out-to-out of concrete deck (39' travel way).
- **Superstructure Type:** Three-span reinforced concrete slab beam bridge.
- **Condition:** The existing structures are twin three-span reinforced concrete continuous slab bridges on capped pile piers and abutments. The general appraisal from the March 29, 2024 inspection was rated **4 (poor)**. Isolated cracks, spalling, and exposed rebar were observed on the underside of the concrete slab. Approach slabs are in poor condition with spalling and cracks.
- **Substructure:** Concrete substructure consists of capped pile piers (14” diameter cast-in-place concrete piles inside steel casing pipe) and capped pile abutments (12” diameter cast-in-place concrete piles with straight wingwalls). Exposed steel casing around pier piles shows signs of corrosion at normal water level, but no significant section loss was

measured. Abutment stub walls exhibit heavy spalling, efflorescence, and delamination, with spalling, horizontal cracks, and exposed rebar at the slab-abutment connection.

- **Traffic:** The bridge carries US-33 traffic. 2025 ADT: 71761; ADTT: 5721.

Partial removal of the existing substructure (abutments, piers, piles) and total removal of the superstructure is proposed to accommodate the new structures.

ROADWAY AND HYDRAULICS

The existing bridge transverse section measures 42 feet wide. The proposed work involves removing the existing structures and replacing them with widened bridges to the middle grass median side to accommodate a new third lane (12’-0”) and paved shoulder. The overall bridge widths will be 62’-5” T/T of parapet, with a out-to-out deck width of 65’-5” for both the bridges. The final bridge transverse section will comprise three 12.0’ wide traffic lanes, one 10’-0” wide paved shoulder to the outside, and a 16’-5” shoulder to the inside.

The bridge profile will match the existing profile as much as possible. Any changes to the main roadway profile will utilize a graphical grade approach profile to match at each end of the bridge. The existing rehabilitation study for this bridge identified severe deterioration of abutment stub walls, suggesting that a full replacement is prudent to address these underlying structural issues comprehensively. For a full replacement, significant changes to the superstructure depth and foundation footprint will require careful coordination with hydraulic requirements for Georges Creek.

To maintain traffic flow on US-33 during construction, a part-width construction approach is anticipated for the replacement of these twin bridges. During Phase 1, traffic will be maintained in the outside lanes of both bridges while the inside sections are removed and reconstructed (refer to the attached drawings). During Phase 2, traffic will be shifted onto the newly completed portions of the bridges on the inside, allowing for the removal and reconstruction of the remaining outside sections. A minimum of 2 lanes (11’-6” each) in each direction will be maintained during the entirety of the project. This strategy minimizes disruption to the traveling public and is a standard practice for heavily trafficked corridors where full closure is not feasible.

Surface drainage on the bridge will be removed by existing and temporary scuppers during phase 1 and 2. Temporary scuppers will be installed during phase 1 construction and subsequently filled in after phase 2. Scuppers will not be required for the final bridge configuration.

The existing structures are located in the 100-year floodplain. Per discussions with ODOT, a rise in the Q100 headwater elevation is not permitted. This "no-rise" requirement will be a critical design constraint for all alternatives, potentially influencing the required opening size and superstructure depth.

ALT. 1: THREE-SPAN CONTINUOUS REINFORCED CONCRETE SLAB BRIDGE

- **Description:** This alternative proposes replacing the existing bridges with new three-span continuous reinforced concrete slab structures. The proposed span configuration for each bridge would be **28', 35' and 28'**. The slab thickness would be a constant **18"**. This design provides structural continuity and eliminates the need for expansion joints.
- **Superstructure Depth:** The 18" slab thickness for the proposed continuous concrete slab bridge is greater than the existing superstructure depth of approximately 12.5 inches. According to the HEC-RAS analysis (See hydraulic report), there is no rise in 100 year hydraulic flood level for the proposed three span structure.
- **Advantages:**
    - Excellent durability and very low long-term maintenance due to the monolithic nature and absence of expansion joints over intermediate piers.
    - The proposed 18" slab provides a relatively shallow superstructure depth, minimizing required roadway profile adjustments compared to deeper alternatives.
    - Familiar construction method for local contractors.
    - Closure pour can be located anywhere for the ease of part width construction.
    - The proposed configuration will also increase the hydraulic opening
- **Disadvantages:**
    - Requires extensive falsework and formwork, leading to longer on-site construction duration and potential impacts to Georges Creek during construction.
    - Requires two new intermediate piers within the creek, necessitating cofferdam costs and environmental mitigation for in-stream work.
    - Concrete curing time can extend the construction schedule and require careful traffic phasing.
- **Foundation:** Semi-integral capped pile type abutments & piers are anticipated. Detailed coordination with ODOT OGE will determine the most efficient foundation design, likely driven piles or drilled shafts, given the existing pile foundations. Existing abutments, and piers would be partially removed.
- **Environmental Considerations:** This alternative would involve in-stream work for two new piers, requiring environmental permitting and mitigation measures.

ALT. 2: SINGLE-SPAN STEEL BEAM BRIDGE

- **Description:** This alternative proposes replacing the existing bridges with single-span steel beam structures. The proposed superstructure would consist of parallel **W27x217** rolled steel beams acting compositely with an **8.5" reinforced concrete deck**, spanning the entire opening in a single span. The total span length would be 68’.
- **Superstructure Depth:** The superstructure depth (27" beam + 8.5" deck+2” Haunch = **37.5"** total depth) is significantly greater than the existing 12.5 inches.

  This alternative would raise the 100-year hydraulic flood level and therefore does not meet the “no-rise” floodplain requirement. As a result, this alternative will not be considered further. See detailed hydraulic report for analysis.

ALT. 3: CONSPAN ARCH CULVERT

- **Description:** This alternative involves replacing the existing bridges with precast concrete Conspan arch culvert system. This system consists of modular arch units assembled on prepared foundations, then backfilled, with the roadway pavement directly over the backfill. The clear span of the arch would be 48'.
- **Superstructure Depth:** The effective depth of a Conspan arch is influenced by its rise and the depth of cover. While the arch structure itself can be relatively shallow, the required depth of fill to develop proper soil–structure interaction and the minimum pavement cover needed for traffic loading can increase the overall structural depth. In addition, the arch geometry reduces the waterway opening compared to a vertical-walled structure, which can affect hydraulic performance and may require adjustments to the roadway profile.

  This alternative would raise the 100-year hydraulic flood level and therefore does not meet the "no-rise" floodplain requirement. As a result, this alternative will not be considered further. See detailed hydraulic report for analysis.

INITIAL CONSTRUCTION COST AND LIFE CYCLE COST ANALYSIS

Initial Construction Costs, including approach work and a 20% contingency are estimated below. Life cycle costs are also provided, based on a 60-year analysis period with a 3.0% real discount rate, assuming full superstructure replacement at 60 years. Anticipated maintenance includes sealing of concrete surfaces (estimated at $3.00 per square foot) and rigid overlays (estimated at $20.00 per square foot of deck and approach slab areas).

Event	Period (Years)	PWF (3.0% Discount Rate)	2025 Cost	PWF Cost
Initial Construction Cost	0	1	$2,482,366.84	$2,482,366.84
Sealing and Rigid Overlay	25	0.478	$271,998.00	$130,015.04
Sealing and Rigid Overlay	45	0.264	$271,998.00	$71,807.47
Superstructure Replacement	60	0.17	$1,465,896.70	$249,202.44
Total Life Cycle Cost				**$2,933,391.80**

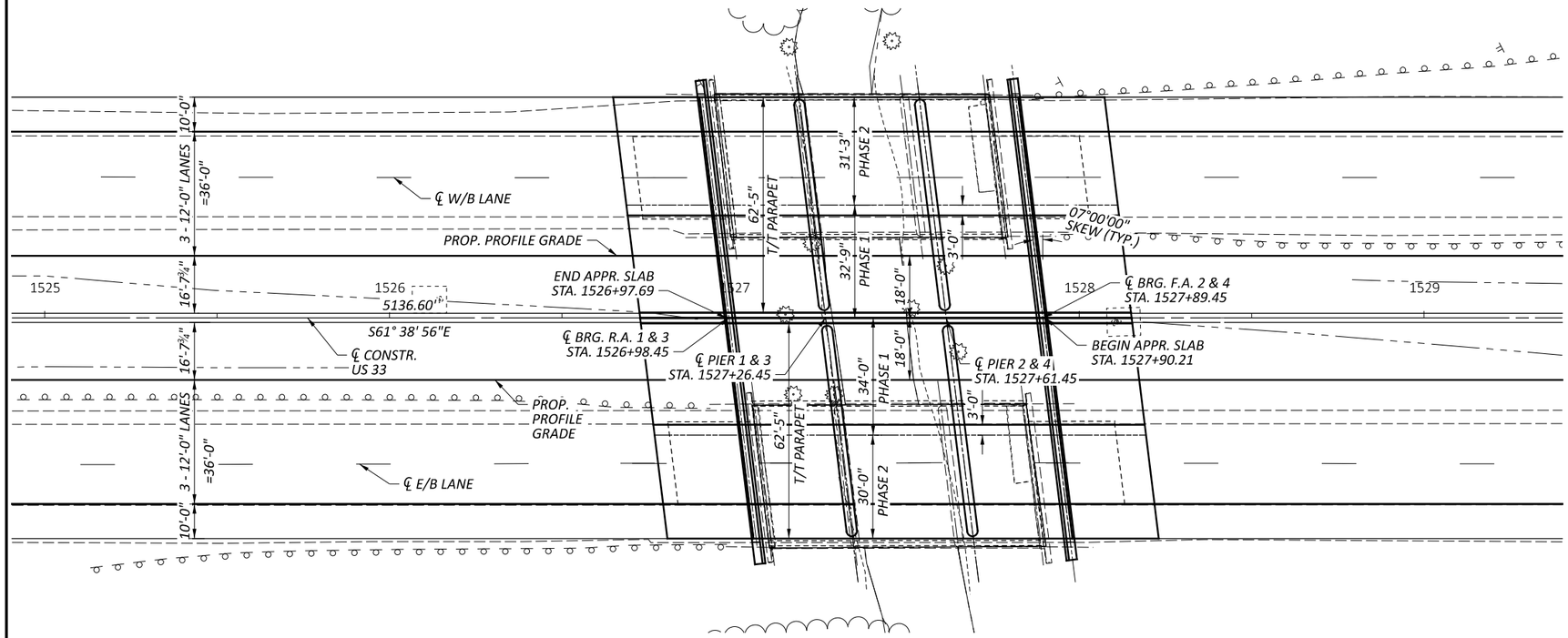
CONCLUSION

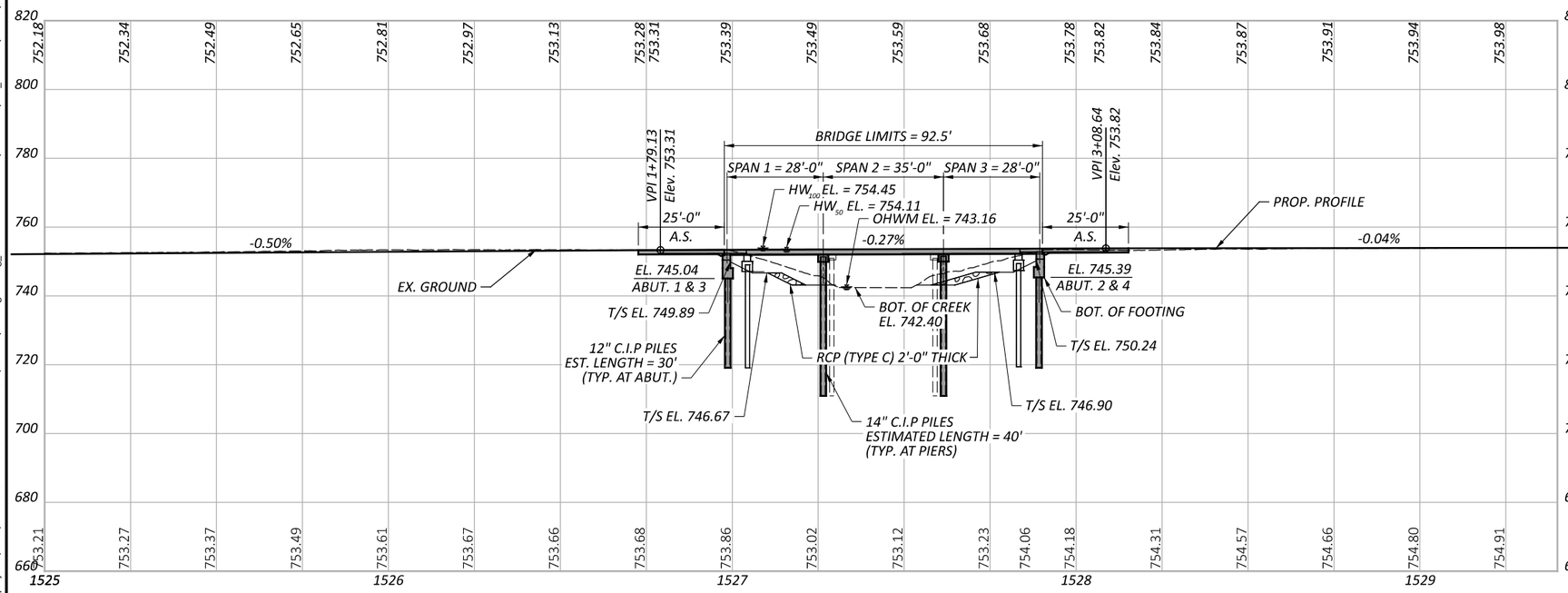
Three alternatives have been presented above for the full replacement of the twin bridges at FRA-33-2900 L/R carrying US-33 over Georges Creek: a three-span continuous reinforced concrete slab bridge, a single-span steel beam bridge, and a Conspan arch culvert.

Based on the presented alternative, and considering the critical "no-rise" floodplain requirement and the comprehensive scope of a full replacement:

Alternative 1, the three-span continuous reinforced concrete slab bridge, is the preferred alternative and should be selected as the proposed structure type for this site. This alternative offers the most favorable balance between initial construction cost, long-term maintenance, and constructability while minimizing negative impacts. Its shallow 18" superstructure complies with the "no-rise" floodplain requirements. While it involves in-stream piers, this is a known and manageable impact for which mitigation strategies are well-established.

The three-span continuous slab provides an efficient, durable, and cost-effective solution that effectively addresses the structural deficiencies and functional requirements of the replacement of the FRA-33-2900 L/R bridges. This alternative minimizes impacts to the roadway profile, utilities, right-of-way, and the floodplain.





BENCHMARK DATA

BM #1 STA.	,	ELEV.	,	OFFSET	,
BM #2 STA.	,	ELEV.	,	OFFSET	,
BM #3 STA.	,	ELEV.	,	OFFSET	,
BM #4 STA.	,	ELEV.	,	OFFSET	,

FOR ADDITIONAL BENCHMARK INFORMATION. SEE ROADWAY PLAN SHEET

NOTES

EARTHWORK LIMITS SHOWN ARE APPROXIMATE. ACTUAL SLOPES SHALL CONFORM TO PLAN CROSS SECTIONS.

DESIGN TRAFFIC:

2030 ADT = 91,000 2030 ADTT = 8,190
2050 ADT = 113,000 2050 ADTT = 10,170
DIRECTIONAL DISTRIBUTION = 58%

LEGEND

BORING LOCATION
- CHANNEL EXCAVATION

HYDRAULIC DATA

DRAINAGE AREA = 14.4 SQ. MILES
Q (50) = 4718 CFS V (50) = 2.41 FT/S
Q (100) = 5126 CFS V (100) = 2.27 FT/S

EXISTING STRUCTURE

TYPE: CONTINUOUS REINFORCED CONCRETE SLAB WITH CAPPED PILE SUBSTRUCTURE

SPANS: 24'-0", 30'-0", 24'-0" C/C BEARINGS
ROADWAY: 39'-0" F/F PARAPET
LOADING: HS/20-44 & ALTERNATIVE MILITARY LOADING
SKEW: 7° R.F.
WEARING SURFACE: 2¼" CONCRETE OVERLAY
APPROACH SLABS: 25'-0" LONG
ALIGNMENT: TANGENT
CROWN: 0.016
STRUCTURE FILE NUMBER: 2502194/2502224 (L/R)
DATE BUILT: 1963
DISPOSITION: REMOVAL & REPLACEMENT

PROPOSED STRUCTURE

TYPE: CONTINUOUS REINFORCED CONCRETE SLAB WITH CAPPED PILE SUBSTRUCTURE

SPANS: 28'-0", 35'-0", 28'-0" C/C BEARINGS
ROADWAY: 62'-5" TOE/TOE PARAPET
LOADING: HL-93 W/ FUTURE WEARING SURFACE
SKEW: 7° R.F.
WEARING SURFACE: 1" MONOLITHIC CONCRETE
APPROACH SLABS: 25'-0" LONG (AS-1-15, AS-2-15)
ALIGNMENT: TANGENT
CROWN: 0.016 FT/FT
DECK AREA: 5913 SF (L) & 5913 SF (R)

COORDINATES: LATITUDE 39°51'44.9"N (L), 39°51'44.1"N (R)
LONGITUDE 82°50'18.6"W (L), 82°50'19.0"W (R)

HORIZONTAL SCALE IN FEET
0 5 10 20

SITE PLAN
BRIDGE NO. FRA-33-29.00 L/R
OVER GEORGE CREEK

SFN 2502194
SFN 2502224
DESIGN AGENCY
RESOURCE INTERNATIONAL

DESIGNER	CHECKER
MMS	EDW

REVIEWER JWE 8-11-2025
PROJECT ID 119387
SUBSET 1 TOTAL 1
SHEET P.0 TOTAL 0

FRA-33-24.27

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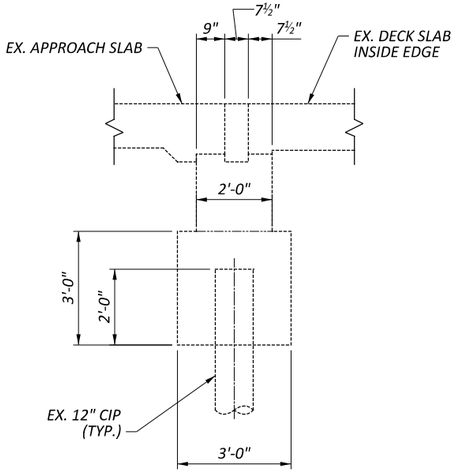

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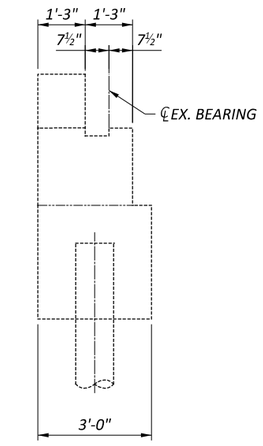

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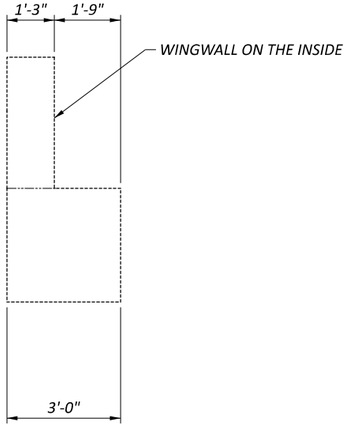

(AT WINGWALL)

EX. ABUTMENT SECTIONS

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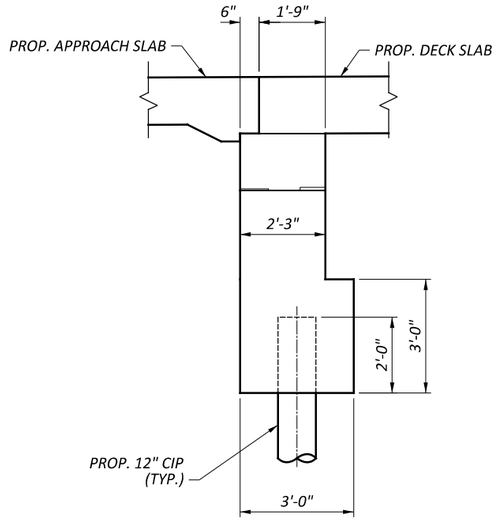

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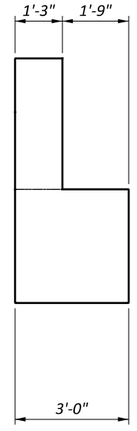
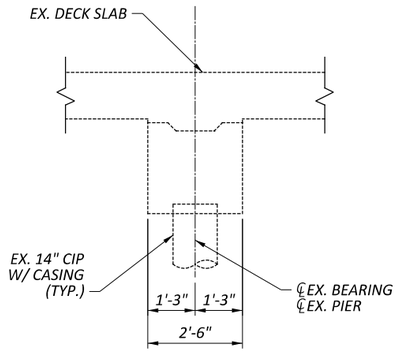


(AT WINGWALL)

PROP. ABUTMENT SECTIONS



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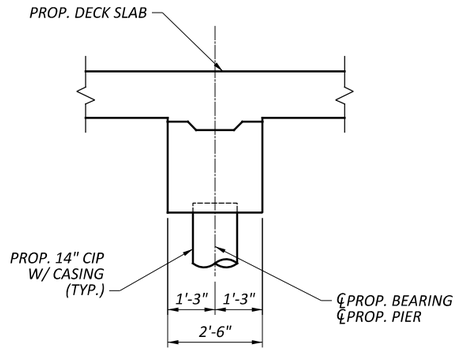

PROP. PIER SECTION

TYPICAL SECTIONS
BRIDGE NO. FRA-33-29.00 L/R
OVER GEORGE CREEK

SFN	2502194
SFN	2502224
DESIGN AGENCY	RESOURCE INTERNATIONAL
DESIGNER	MMS
CHECKER	EDW
REVIEWER	JWE 05-20-25
PROJECT ID	119387
SUBSET / TOTAL	4 / 4
SHEET / TOTAL	P.704 / 705

FRA-33-24.27

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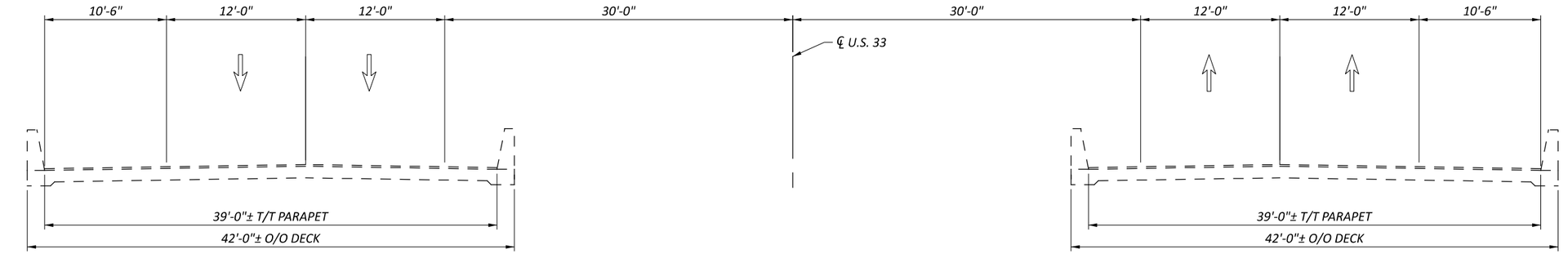

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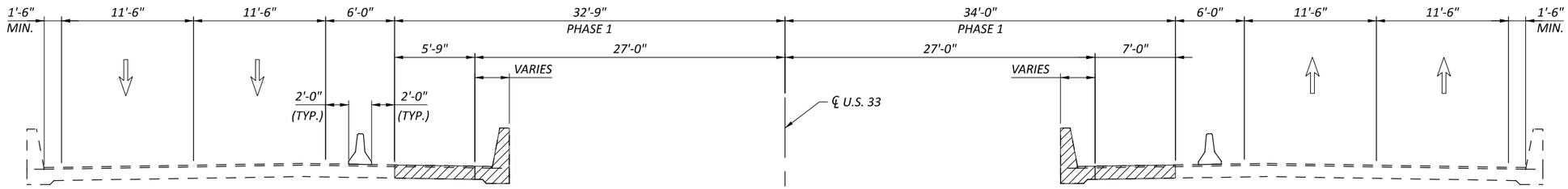

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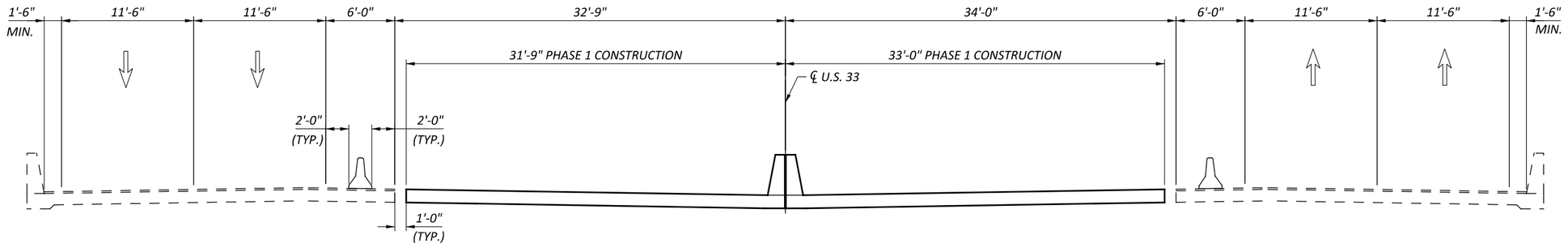

PHASE 1 CONSTRUCTION

- *ITEM 202- PORTIONS OF STRUCTURE REMOVED*

PHASE CONSTRUCTION
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OVER GEORGE CREEK

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SFN	2502224
DESIGN AGENCY	RESOURCE INTERNATIONAL
DESIGNER	MMS
CHECKER	EDW
REVIEWER	JEW 05-20-25
PROJECT ID	119387
SUBSET	2
TOTAL	4
SHEET	P.702
TOTAL	705

FRA-33-24.27

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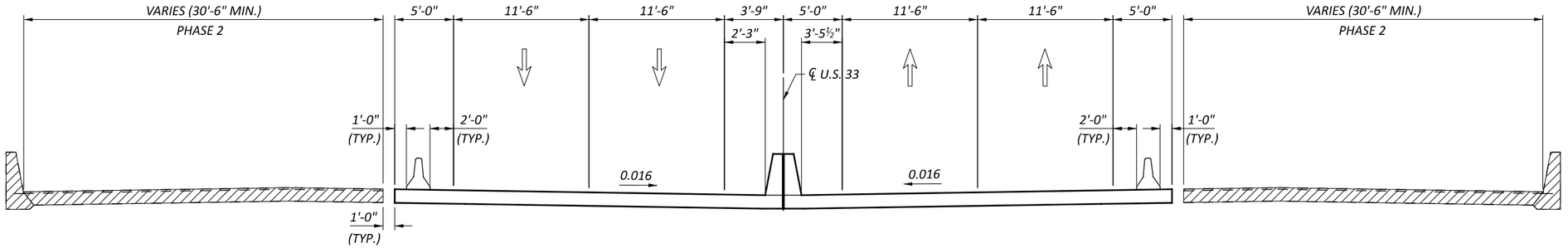

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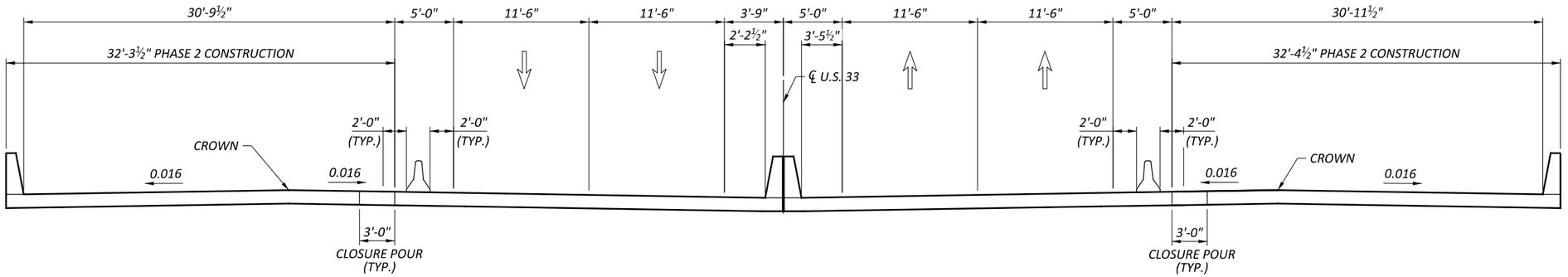

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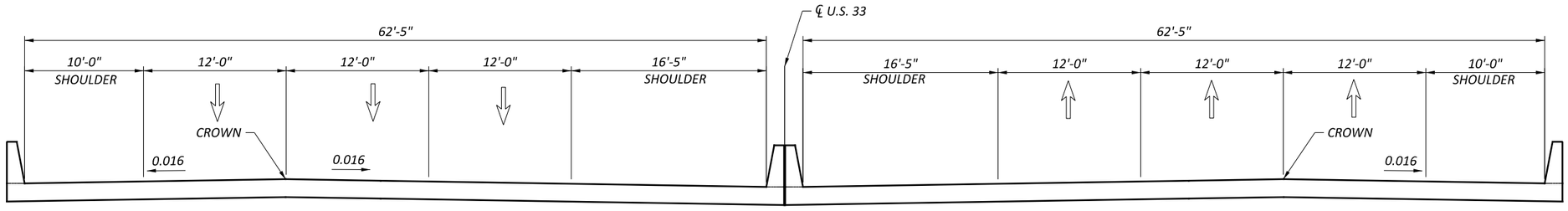

FINAL TRANSVERSE SECTION

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PHASE CONSTRUCTION
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OVER GEORGE CREEK

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SFN	2502224
DESIGN AGENCY	RESOURCE INTERNATIONAL
DESIGNER	MMS
CHECKER	EDW
REVIEWER	JWE 05-20-25
PROJECT ID	119387
SUBSET	3
TOTAL	4
SHEET	P.703
TOTAL	705

FRA-33-24.27

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