

April 24, 2026

Project B2409525

Mark Dell

Iowa Department of Transportation

800 Lincoln Way

Ames, IA 50010

	I hereby certify that this plan, specification, or report was prepared by me or under my direct supervision and that I am a duly Licensed Profes: <i>Xinyi Jiang</i> the laws of the State of Iowa.	
	Signature	Date 4/24/2026
Xinyi Jiang License number: P29458 My license renewal date is December 31, 2026 Pages or sheets covered by this seal: ALL		

Re: Geotechnical Supporting Letter
H-pile design parameters for Structurally Supported Approach Slab
US Highway 71 Over Lone Tree Creek
Cass County, Iowa
Iowa DOT Project: BRFN-071-3(060)—39-15

Dear Mr. Dell:

We are pleased to present this Geotechnical supporting letter addressing the H-pile design parameters for the structurally supported approach slab at US Highway 71 over Lone Tree Creek. This report summarizes the H-pile design parameters of the proposed structurally supported approach slab.

Introduction

Our Understanding of Project

We understand that the bridge on US highway 71 over Lone Tree Creek, 0.1 mile South of Jct. SR G35, has been programmed for a repair to be let on December 18, 2029. We understand that the south abutment is severely undermined on the right side with standing water noted. Soil loss appears to be coming from water flowing from behind and underneath the abutment. We understand that a pile-supported approach slab is planned as the repair to the southern bridge approach. We further understand that no new borings have been performed and that design parameters are to be estimated by utilizing the nearby existing by borings performed for the previous bridge improvements.

Purpose

The purpose of this letter is to provide the design parameters and recommendations for the proposed H-piles estimated by utilizing the existing soil information provided by the Iowa Department of Transportation (Iowa DOT).

Scope of Service

We performed our scope of services under the terms of Contract 141BA and Agreement authorized by Iowa Department of Transportation Design Bureau.



Background Information

To facilitate our evaluation, we reviewed the following information:

- Soil Plan Sheets at Station 565+36.18 in Cass County, Project Number NHSN-071-3(59)—2R-15, dated December 18, 2017, provided by Iowa DOT.
- Boring logs from B-01 through B-12 for the project 698 AV SA#19 Cass County, Iowa, Iowa DOT Project Number: NHSN-071-3(59)—2R-15, dated February, 2017, prepared by Olsson Associates and provided by Iowa DOT.
- Situation Plan for US 71 over Lone Tree Creek om Cass County, project number NHSN-071-3(59)—2R-15, dated August, 2018, provided by Iowa DOT
- Cass 130 Final Concept plan and Approach Spans Exhibit, dated December 16, 2025, provided by Iowa DOT Bridge and Structures Bureau.

Foundation Recommendations

Deep Foundations

Based on our review of the subsurface strata, we concur with driven piles being the preferred foundation option to support the proposed slab. We evaluated driven pile foundations for the proposed structurally supported approach slab in general accordance with the procedures outlined in Section 6.2 of the Iowa DOT Load and Resistance Factored Design (LRFD) Bridge Design Manual (BDM).

Driven Pile Nominal Resistances

Table A-1 attached to this report contains our recommended nominal unit resistances for soil layers and bedrock encountered below the bottom-of-pile-cap (BOPC) for use in H-pile design. We based BOPC elevations on the marked-up Sheet 2 of Iowa DOT Standard Plan BR-205. Based on the encountered concrete at B-06 and driller note about concrete at B-11, we recommend pre-drill below the encountered concrete layer as indicated in Table A-1. We estimated the nominal foundation unit resistances using Tables 6.2.7-1 to 6.2.7-2 in the BDM.

Based on the nominal foundation unit resistance values estimated in Table A-1 and the presence of the shale and limestone encountered, we anticipate the construction will likely encounter pile refusal. Section 6.2.4.2 of the BDM suggested if end bearing is to be considered, pile embedment should be at least eight feet into the shale or firm shale layer.

We summarized the bottom-of-pile-cap (BOPC) elevation and glacial till surface elevations in [Table 1](#).



Table 1. Estimated Depth to the Glacial Clay

Design Number	Substructure Location	BOPC (feet)	Top Elevation of Glacial Clay (feet)
0218	Structurally Supported Approach Slab	1178.2	1137.1

By evaluating the B-06 and close by borings (B-11), we recommend using Structural Resistance Level 2 (SRL-2) for pile design. SRL-2 allows a total stress of 9 kips per square inch (ksi).

We recommend the bottom elevation of the pile cap be at least 42 inches below the lowest grade, for frost protection.

We recommend that we review the pile capacities, lengths, and associated bridge plans prior to finalization of construction documents to confirm they are consistent with our recommendations.

Driveability

Based on the thickness and stiffness of the shale soil we encountered in our borings, we anticipate that refusal during driving may occur. We recommend that the full length of the piles be driven within 48 hours to prevent set up within the shale and potential decomposed limestone layer. Full length pile driving should be ceased immediately, once capacity has been achieved. Overdriving the piles could overstress the piles and cause pile damage.

We recommend a drivability analysis be performed based on the subsurface profile and driving hammer proposed by the foundation contractor. Due to the stratigraphy encountered, we recommend end bearing resistance within the shale or limestone be included in the drivability analysis. Additionally, we recommend the contractor review the boring logs to assess the potential problems with completing the pile driving in the subsurface materials encountered at this site. The contractor should submit the results of the drivability analysis and boring log review for review and approval prior to construction beginning. For continuity of professional responsibility, we recommend Braun Intertec Corporation be retained to perform these reviews on behalf of the Iowa DOT.

Resistance Factors – Driven Pile

The soil profiles at the foundation locations of the bridges consist of cohesive soils in accordance with BDM Section 6.2.8. [Table 2](#) summarizes the pile resistance factors in compression and tension at the Strength Limit as given in Tables 6.2.9-1 and 6.2.9-2 of the BDM, respectively. The resistance factors shown in compression apply to the friction and end resistance of the pile.



Table 2. Strength Limit Resistance Factors for Friction and End Resistance of Driven Piles

Construction Control	Axial Compression	Axial Tension
IDOT ENR Formula Only	0.60	0.45
WEAP Only	0.65	0.50
WEAP + PDA/CAPWAP	0.70	0.55
WEAP + PDA/CAPWAP +72-hour Restrike	0.80	0.60
WEAP + Static Pile Load Test	0.80	0.80

For the Service Limit cases in compression and tension, the resistance factor is 1.0.

For the Extreme Limit case in compression, the resistance factor is 1.0. For the Extreme Limit case in tension, the resistance factor is 0.75.

Qualifications

We developed our evaluation, analyses, and recommendations from a limited amount of site and subsurface information that was provided to us by others. It is not standard engineering practice to retrieve material samples from exploration locations continuously with depth. Therefore, we must infer strata boundaries and thicknesses to some extent. Strata boundaries may also be gradual transitions, and project planning should expect the strata to vary in depth, elevation, and thickness, away from the exploration locations.

Variations in subsurface conditions present between exploration locations may not be revealed until we perform additional exploration work or the start of construction. If future activity for this project reveals any such variations, you should notify us so that we may re-evaluate our recommendations. Such variations could increase construction costs, and we recommend including a contingency to accommodate them.

Use of Summary Amendment

This summary amendment is for the exclusive use of the parties to which it is addressed. Without written approval, we assume no responsibility to other parties regarding this report. Our evaluation, analyses, and recommendations may not be appropriate for other parties or projects.

Standard of Care

In performing its services, Braun Intertec used that degree of care and skill ordinarily exercised under similar circumstances by reputable members of its profession currently practicing in the same locality.

No warranty, express or implied, is made.



Technical References

Iowa Department of Transportation. (2017, December 28). *LRFD Bridge Design Manual*. Updated July 20, 2025

Iowa Department of Transportation, *Engineering Properties of Soil and Rock*, Modified May 19, 2015

American Association of State Highway and Transportation Officials (AASHTO) (2017). *AASHTO LRFD Bridge Design Specifications*.

Federal Highway Administration (FHWA), *Design and Construction of Driven Pile Foundations*, FHWA-NHI-16-0409, September 2016.

General Remarks

If you have any questions concerning this report, please feel free to call us at 319.365.0961.

Sincerely,

Braun Intertec Corporation

Xinyi Jiang, Ph.D., P.E.
Project Engineer

Roch S.V. Player, P.E., BC.GE, PMP
Vice President, Principal Engineer

Attachments

Driven Pile Resistance Table (Table A-1)

Table A-1. Piles Resistances for Design 218 (US 71)

Boring	Substructure	Soil Classification	Soil Type	Top Elevation (ft)	Bottom Elevation (ft)	Thickness (ft)	H-Pile Unit Resistance for Skin Friction (kips/ft)			H-Pile Unit Resistance for End Bearing (ksi)		
							10-inch	12-inch	14-inch	10-inch	12-inch	14-inch
B-06 and B-11	Structurally Supported Approach Slab (Approximate bottom of footing at 1178.2 ft)	Pre-Drill Length	–	1178.2	1172.6	5.6	–	–	–	–	–	–
		Fill, Loose Loamy Sand	Non-Cohesive	1172.6	1171.6	1.0	1.2	1.6	2.0	–	–	–
		Fill, Clay, Firm	Cohesive	1171.6	1162.6	9.0	1.2	1.6	2.0	–	–	–
		Alluvial, Clay, Firm to Very Stiff	Cohesive	1162.6	1146.1	16.5	1.2	1.6	2.0	–	–	–
		Alluvial, Sand, Loose	Non-Cohesive	1146.1	1142.1	4.0	1.2	1.6	2.0	–	–	–
		Alluvial, Clay, Firm	Cohesive	1142.1	1137.1	5.0	1.2	1.6	2.0	–	–	–
		Glacial Till, Clay, stiff	Cohesive	1137.1	1115.4	21.7	3.2	4.0	4.4	–	–	–
		Bedrock, Shale, Hard	--	1115.4	1107.9	7.5	–	–	–	12	12	12
		Bedrock, Limestone, Hard	--	1107.9	1105.6	2.3	–	–	–	12	12	12
		Bedrock, Shale, Hard	--	1105.6	1102.2	3.4	–	–	–	12	12	12
		Bedrock, Limestone, Hard	--	1102.2	1083.4	18.8	–	–	–	12	12	12
		Bedrock, Shale, Hard	--	1083.4	1082.9	0.5	–	–	–	12	12	12
		Bedrock, Limestone, Hard	--	1082.9	1077.9	5.0	–	–	–	12	12	12
		Bedrock, Shale, Hard	--	1077.9	1074.4	3.5	–	–	–	12	12	12
		Bedrock, Limestone, Slightly Weathered, Hard	--	1074.4	1073.9	0.5	–	–	–	12	12	12
		Bedrock, Shale, Moderately cemented, Hard	--	1073.9	1067.9	6.0	–	–	–	12	12	12

End Bearing for Glacial Till is calculated based on the Note 7 on Table 6.2.7-1

For glacial clay material, where the pile extends to 30 feet below the natural ground surface, use the higher value in the chart.

Layer below 1129.1 feet properties are interpolated from B-11