MAINE DEPARTMENT OF TRANSPORTATION
HIGHWAY/BRIDGE PROGRAM
GEOTECHNICAL SECTION
AUGUSTA, MAINE

GEOTECHNICAL SUMMARY REPORT

For the Replacement of:

ROUTE 219 STRUT
HOOKER BROOK
LEEDS, MAINE

Prepared by:
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Senior Geotechnical Engineer

Androscoggin County Soils Report No. 2012-126

WIN 19257.00

June 13, 2012

GEOTECHNICAL SUMMARY

The purpose of this report is to present subsurface information for the replacement of a culvert which carries Hooker Brook under Route 219, 0.1 miles west of the western intersection of Route 106 in Leeds. Route 219 is a Priority 3 Highway Corridor, and the project is approximately 600 feet from tracks of the Maine Central Railroad. The proposed replacement structure will be an 8-foot diameter Reinforced Concrete Pipe (RCP) with 15-inch high weirs cast or placed into the bottom to prevent scour of the embedded soil. The culvert will be 80 feet long supporting 11-foot lanes and 4-foot shoulders. This provides 5-feet from edge of travelled way to the face of guardrail.

Native Soils and pavement – The culvert will be built in an existing embankment made of compacted fill soils. A hollow stem auger boring and three power auger probes were done at this site.

Soils encountered at this location included medium dense Sand with varying amounts of silt and gravel. Cobbles and boulders were encountered in several places in the borings. Wet soils were encountered at a depth of 8.5 feet.

A boring refusal at a depth of 15.7 feet may have been a boulder; all probe borings were extended to approximately elevation 264 feet. Existing Hot Mix Asphalt pavement was 6.5-inches thick in the boring.

Culvert Headwalls – Soil slopes steeper than 1h:1v will be built at the culvert inlet and outlet. We recommend the construction of rockery walls made of large, heavy stones to prevent gravel and fill soils from sliding or eroding from these slopes into the stream.

Attachments

Sheets

Sheet 1 - Location Map
Sheet 2 - Boring Location Plan and Interpretive Subsurface Profile

Appendices

Appendix A - Boring Logs
Appendix B - Laboratory Data
Appendix C - Calculations

Map Scale 1:24000

The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch. Road names used on this map may not match official road names.

Filename: ...\GEOTECH\MSTA\001_GP&ISCS1.dgn Division: GEOTECH Username: terry.white Date:6/15/2012

CURVE DATA #1
PI = 11+46.79
D = 1°08'07.9"
Δ = 3°19'57.3" Lt.
R = 5045.80'
L = 293.49'
T = 146.79'
E = 2.13'

PC = STA. 10+00.00
PT = STA. 12+93.49

MAG. 19XX

COFFERDAM
P-20.0NR
SB-LEED-101
P-9.5R
P-20.0NR
P-20.0NR
COFFERDAM

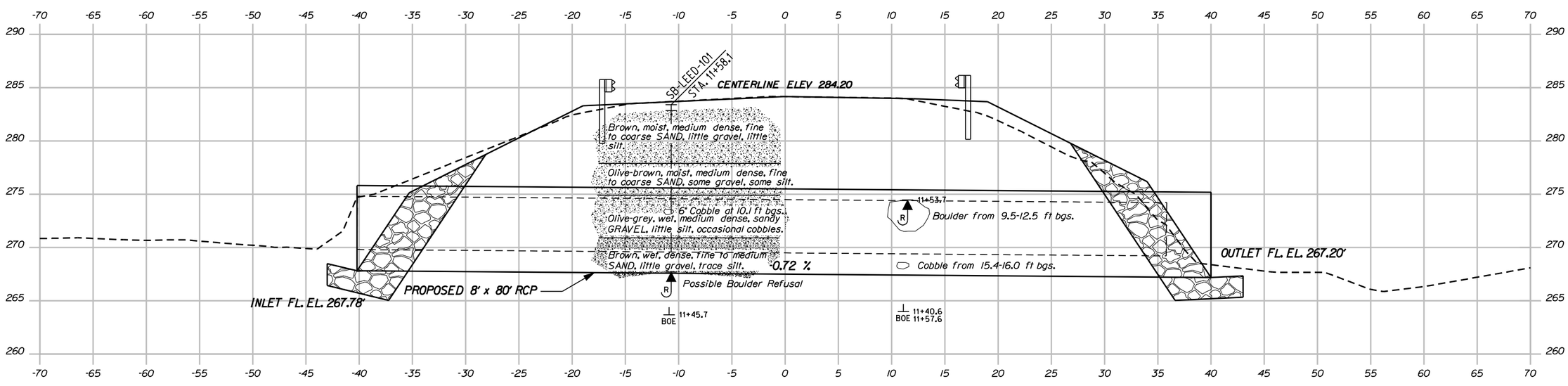
10+00 11+00 12+00 12+93

FIELD
SPEED LIMIT 50
RIVERBEND CAMPGROUND
26"R/18 CMP
MONITER DEVICE FOR WATER
RXRP CMP 33/8
12" CMP
FIELD ENTRANCE
WAYNE LEEDS CNT.
CMP 34/83
1" DIA IRON PIPE
24" MAPLE
14" MAPLE
12" MAPLE
24" MAPLE
24" MAPLE
RT. 219 106

LEGEND
HOLLOW STEM AUGER W/DESCRIPTIONS
POWER AUGER PROBE

PLAN

25 0 25 50
Scale in Feet



11+50.00

LEGEND
Boring No.
Station if shown
Pavement Thickness if applicable
Strata Interface
Boring
RQD= Rock Quality Designation for Rock Core Sample
BOE= Bottom Of Exploration
R Refusal
BOE No Refusal

CROSS SECTION
HORIZ 5 0 5 10
VERT 5 0 5 10
SCALE

Note: This generalized interpretive soil cross section is intended to convey trends in subsurface conditions. The boundaries between strata are approximate and idealized, and have been developed by interpretations of widely spaced explorations and samples. Actual soil transitions may vary and are probably more erratic. For more specific information refer to the exploration logs.

STATE OF MAINE
DEPARTMENT OF TRANSPORTATION

WIN
19257.00

HIGHWAY PLANS

	BY	DATE
PROJ. MANAGER	----------	---
DESIGN-DETAILED	----------	---
CHECKED-REVIEWED	-----	-----
DESIGN2-DETAILED2	K.BRESKIN	MAY 2012
DESIGN3-DETAILED3	----------	-----
REVISIONS 1	------	------
REVISIONS 2	------	------
REVISIONS 3	------	------
REVISIONS 4	------	------
FIELD CHANGES	------	------

SIGNATURE

P.E. NUMBER

DATE

LEEDS
ROUTE 219 STRUT

GEOPLAN & INTERPRETIVE SUBSURFACE CROSS SECTION

SHEET NUMBER
2
OF 2

Appendix A
Boring Logs

Maine Department of Transportation

~~Soil/Rock Exploration Log~~
~~US CUSTOMARY UNITS~~

Project: Route 219 Strut
Location: Leeds, Maine

Boring No.: SB-LEED-101
PIN: 19257.00

Driller:	MaineDOT	**Elevation (ft.)**	283.4	**Auger ID/OD:**	2.25/6.25"
Operator:	Giguere/Giles/Daggett	**Datum:**	NAVD88	**Sampler:**	Standard Split Spoon
Logged By:	B. Wilder	**Rig Type:**	CME 45C	**Hammer Wt./Fall:**	140#/30"
Date Start/Finish:	5/1/12; 08:30-12:00	**Drilling Method:**	Hollow Stem Auger	**Core Barrel:**	N/A
Boring Location:	11+58.1, 10.7 ft Lt.	**Casing ID/OD:**	N/A	**Water Level*:**	None Observed
Hammer Efficiency Factor:	0.84	**Hammer Type:**	Automatic ☒ Hydraulic ☐ Rope & Cathead ☐		

Definitions:
D = Split Spoon Sample
MD = Unsuccessful Split Spoon Sample attempt
U = Thin Wall Tube Sample
MU = Unsuccessful Thin Wall Tube Sample attempt
V = Insitu Vane Shear Test
MV = Unsuccessful Insitu Vane Shear Test attempt
R = Rock Core Sample
SSA = Solid Stem Auger
HSA = Hollow Stem Auger
RC = Roller Cone
WOH = weight of 140lb. hammer
WOR = weight of rods
WO1P = Weight of one person
S_u = Insitu Field Vane Shear Strength (psf)
T_v = Pocket Torvane Shear Strength (psf)
q_p = Unconfined Compressive Strength (ksf)
N-uncorrected = Raw field SPT N-value
Hammer Efficiency Factor = Annual Calibration Value
N_{60} = SPT N-uncorrected corrected for hammer efficiency
N_{60} = (Hammer Efficiency Factor/60%)*N-uncorrected
$S_{u(lab)}$ = Lab Vane Shear Strength (psf)
WC = water content, percent
LL = Liquid Limit
PL = Plastic Limit
PI = Plasticity Index
G = Grain Size Analysis
C = Consolidation Test

Depth (ft.)	Sample No.	Pen./Rec. (in.)	Sample Depth (ft.)	Blows (/6 in.) Shear Strength (psf) or RQD (%)	N-uncorrected	N_{60}	Casing Blows	Elevation (ft.)	Graphic Log	Visual Description and Remarks	Laboratory Testing Results/ AASHTO and Unified Class.
0							HSA	282.86		6½" PAVEMENT.	
										0.54	
	1D	24/5	1.00 - 3.00	5/6/7/12	13	18				Brown, moist, medium dense, fine to coarse SAND, little gravel, little silt.	G#264056 A-1-b, SM WC=5.1%
5	2D	24/17	5.00 - 7.00	5/7/8/9	15	21		277.90		5.50	
										Olive-brown, moist, medium dense, fine to coarse SAND, some gravel, some silt.	G#264057 A-2-4, SM WC=10.0%
								274.90		8.50	
10	3D	24/14	10.00 - 12.00	6/11/11/13	22	31				Olive-grey, wet, medium dense, sandy GRAVEL, little silt, occasional cobbles.	G#264058 A-1-b, GM WC=17.9%
								270.90		12.50	
15	4D	8.4/8	15.00 - 15.70	20/30(2.4")	---			267.70		Brown, wet, dense, fine to medium SAND, little gravel, trace silt.	
										15.70	
										Bottom of Exploration at 15.70 feet below ground surface.	
										POSSIBLE BOULDER REFUSAL	
20											
25											

~~Remarks:~~

Stratification lines represent approximate boundaries between soil types; transitions may be gradual.

* Water level readings have been made at times and under conditions stated. Groundwater fluctuations may occur due to conditions other than those present at the time measurements were made.

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Power Auger Probe Summary Sheet

Town(s): Leeds

Work Number: 19257.00

Station (Feet)	Offset (Feet)	Weathered Rock (Feet)	Refusal (Feet)	No Refusal (Feet)	Water Depth (Ft.)	Comments / Date 5/1/2012
11+45.7	10.9 Lt.			20.0		Similar soils and depth
						to SB-LEED-101
						6" Cobble at 10.1 ft bgs.
11+40.6	11.1 Rt.			20.0		Similar soils and depth
						to SB-LEED-101.
11+53.7	11.5 Rt.		9.5			9.5-12.5 ft bgs solid
						drilling, Boulder.
11+57.6	11.5 Rt.			20.0		Cobble from 15.4-16.0 ft
						bgs.

MaineDOT Drill Crew
Logged By: B. Wilder
Drill Rig: CME 45C

5" Solid Stem Auger

Appendix B
Laboratory Data

State of Maine - Department of Transportation

Laboratory Testing Summary Sheet

Town(s): Leeds Work Number: 19257.00

Boring & Sample Identification Number	Station (Feet)	Offset (Feet)	Depth (Feet)	Reference Number	G.S.D.C. Sheet	W.C. %	L.L.	P.I.	Classification		
									Unified	AASHTO	Frost
SB-LEED-101, 1D	11+58.1	10.7 Lt.	1.0-3.0	264056	1	5.1			SM	A-1-b	0
SB-LEED-101, 2D	11+58.1	10.7 Lt.	5.5-7.0	264057	1	10.0			SM	A-2-4	II
SB-LEED-101, 3D	11+58.1	10.7 Lt.	10.0-12.0	264058	1	17.9			GM	A-1-b	I

Classification of these soil samples is in accordance with AASHTO Classification System M-145-40. This classification is followed by the "Frost Susceptibility Rating" from zero (non-frost susceptible) to Class IV (highly frost susceptible). The "Frost Susceptibility Rating" is based upon the MaineDOT and Corps of Engineers Classification Systems.

GSDC = Grain Size Distribution Curve as determined by AASHTO T 88-93 (1996) and/or ASTM D 422-63 (Reapproved 1998)

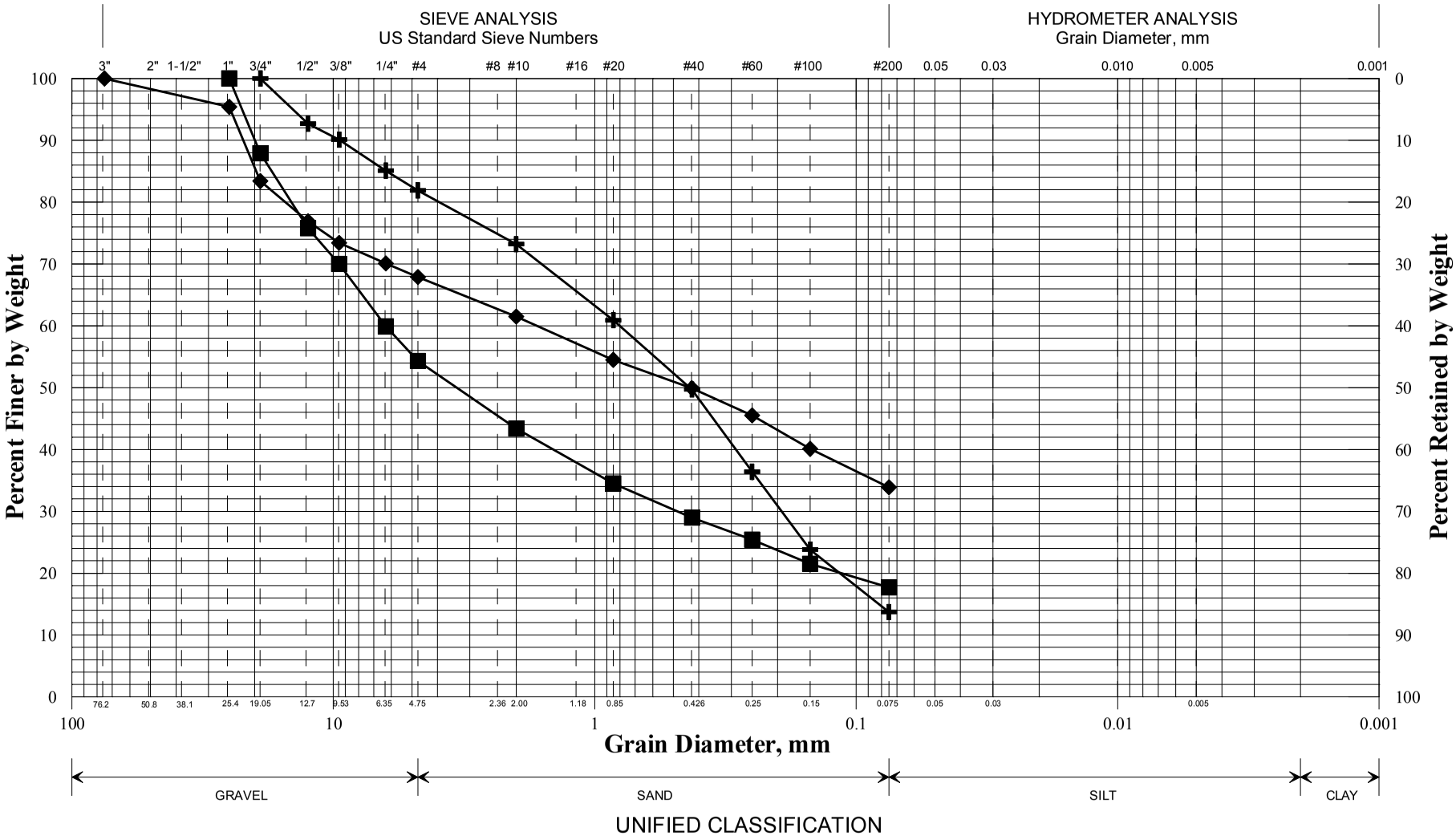
WC = water content as determined by AASHTO T 265-93 and/or ASTM D 2216-98

LL = Liquid limit as determined by AASHTO T 89-96 and/or ASTM D 4318-98 NP = Non Plastic

PI = Plasticity Index as determined by AASHTO 90-96 and/or ASTM D4318-98

State of Maine Department of Transportation

GRAIN SIZE DISTRIBUTION CURVE



	Boring/Sample No.	Station	Offset, ft	Depth, ft	Description	W, %	LL	PL	PI
✚	SB-LEED-101/1D	11+58.1	10.7 LT	1.0-3.0	SAND, little gravel, little silt.	5.1			
◆	SB-LEED-101/2D	11+58.1	10.7 LT	5.5-7.0	SAND, some silt, some gravel.	10.0			
■	SB-LEED-101/3D	11+58.1	10.7 LT	10.0-12.0	Sandy GRAVEL, little silt.	17.9			
●									
▲									
✕									

WIN
019257.00
Town
Leeds
Reported by/Date
WHITE, TERRY A 6/7/2012

Appendix C
Calculations

Headwall Active Earth Pressures:

Effective active earth pressure coefficient:

$\beta := 0 \cdot deg$ slope angle of backfill soils from horizontal

$\phi_f := 36 \cdot deg$ assumed effective friction angle for dense gravelly sand

$\theta := 90deg$ angle of the back face of wall to the horizontal

$\delta := 27deg$ friction angle of mass concrete to sand-gravel mixtures

$$\Gamma := \left(1 + \sqrt{\frac{\sin(\phi_f + \delta) \cdot \sin(\phi_f - \beta)}{\sin(\theta - \delta) \cdot \sin(\theta + \beta)}}\right)^2 \qquad \Gamma = 3.1211$$

$$K_a := \frac{\sin(\theta + \phi_f)^2}{\Gamma \cdot \left(\sin(\theta)^2 \cdot \sin(\theta - \delta)\right)} \qquad K_a = 0.2354$$

Service Limit State Bearing Resistance - Native Granular Soils:

Nominal and factored Bearing Resistance

Presumptive Bearing Resistance for Service Limit State ONLY

Reference: AASHTO LRFD Bridge Design Specifications 5th Edition
Table C10.6.2.6.1-1 Presumptive Bearing Resistances for Spread Footings at the Service Limit State Modified after US Department of Navy (1982)

Type of Bearing Material: gravelly SAND (Fill)

Consistency In Place: dense

Bearing Resistance: Ordinary Range (ksf)
8 - 14 medium dense to dense

Recommended Value of Use: 8 to 14 ksf

Recommended Value: $10 \cdot ksf = 5 \cdot tsf$ $\qquad tsf := g \cdot \left(\frac{ton}{ft^2}\right)$

Note: This bearing resistance is settlement limited (1 inch) and applies only a the service limit state.

Characteristics of Native Soils at foundation level

Gray-brown, wet, dense gravelly fine SAND (fill)

$wc := 0.179$ water content from lab testing

$e := 0.5$ estimated void ratio

$\gamma_w := 62.4pcf$ unit weight of water

$sp := 2.65$ estimated specific gravity

saturation $sat := \frac{(wc \cdot sp)}{e}$ $sat = 0.9487$

total unit weight $\gamma_t := \frac{(sp + sat \cdot e) \cdot \gamma_w}{(1 + e)}$ $\gamma_t = 130 \cdot pcf$

saturated unit weight $\gamma_{sat} := \frac{(sp + e) \cdot \gamma_w}{(1 + e)}$ $\gamma_{sat} = 131 \cdot pcf$

Strength Limit State Bearing Resistance - Native Granular Soils:

Nominal and factored Bearing Resistance for box culvert and wingwall base slab

Assumptions

1. Box culvert will be embedded 2.0 feet below streambed

$D_f := 2.0ft$

2. Assumed parameters based on granular fill

Moist unit weight $\gamma_m := 127pcf$

Saturated unit weight $\gamma_s := 131pcf$

Angle of internal friction $\phi_b := 34deg$

Undrained shear strength $c := 0$

Depth to groundwater $D_w := 0ft$

3. L > B, so use Terzaghi strip foundation equations

Terzaghi shape factors

$B := 8\text{ft}$

$s_c := 1.0$

$s_\gamma := 1.0$

Meyerhof bearing capacity factors

$N_c := 42.14$

$N_q := 29.4$

$N_\gamma := 31.1$

Effective stress at footing level

$$q_{eff} := D_w \cdot \gamma_m + \left(D_f - D_w\right) \cdot \left(\gamma_s - \gamma_w\right)$$

$$q_{eff} = 137 \cdot \text{psf}$$

Nominal Bearing Resistance

$$q_{nom} := c \cdot N_c \cdot s_c + q_{eff} \cdot N_q + 0.5 \cdot \left(\gamma_s - \gamma_w\right) \cdot B \cdot N_\gamma \cdot s_\gamma$$

$$q_{nom} = 12.568 \cdot \text{ksf}$$

Resistance Factor from LRFD Table 10.5.5.2.2-1, pg 10-32 $\Phi_b := 0.45$

$$q_{factored} := q_{nom} \cdot \Phi_b \qquad q_{factored} = 5.655 \cdot \text{ksf}$$

For this project, the Strngth limit state controls.
Factored Bearing Resistance of 5.7 ksf should be used.