Ent 161569 Bk 393 Pg 1312
Date: 28-JUL-2022 8:43:48AM
Fee: $40.00 Check Filed By: SM
BRENDA NELSON, Recorder
MORGAN COUNTY
For: COTTONWOOD TITLE

RECORDING REQUESTED BY AND
WHEN RECORDED RETURN TO:

Allison Phillips Belnap
Holland & Hart LLP
222 South Main Street, Suite 2200
Salt Lake City, UT 84101

Parcel #00-0077-9155, Serial #01-004-001-02
Parcel #00-0001-1435, Serial #01-004-002

(Space above this line for Recorder's use only)

NOTICE OF LICENSE AGREEMENT

THIS NOTICE OF LICENSE AGREEMENT (this "Notice") provides record notice that the United States of America, acting by and through the Bureau of Reclamation, Department of the Interior (the "BOR"), and Wasatch Peaks Ranch, LLC, a Delaware limited liability company ("WPR"), have entered into that certain License Agreement (Contract No 20-LM-41-0600) (the "License"), which authorizes WPR to install and maintain an asphalt roadway and bridge across the Gateway Canal, and to utilize the roadway and bridge for access to over 750 homes in a large residential/recreational development, all as set forth in the License.

The BOR executed the License on October 20, 2020.

The License affects a portion of the land described on Exhibit A attached hereto, as more particularly described in the License.

Attached hereto as Exhibit B is a true and correct copy of the License on file with the BOR.

[Signature Page Follows]

IN WITNESS WHEREOF, the undersigned has executed this Notice as of July 6th, 2022.

WASATCH PEAKS RANCH, LLC, a Delaware limited liability company

By: Wasatch Peaks Ranch Management, LLC, its Manager

By: _____
Name: Ed Schultz
Its: Authorized Signatory

STATE OF Colorado)
:ss
COUNTY OF Boulder)

The foregoing instrument was acknowledged before me this 6th day of July, 2022, by Ed Schultz, the authorized signatory of Wasatch Peaks Ranch Management, LLC, manager of Wasatch Peaks Ranch, LLC, a Delaware limited liability company.

_____
Notary Public
Residing at: Boulder, CO

My Commission Expires:

6/28/2024

GREG NABER
NOTARY PUBLIC
STATE OF COLORADO
NOTARY ID 20074039912
MY COMMISSION EXPIRES JUNE 28, 2024

Signature Page to Notice of License

Exhibit A

Legal Description

A portion of the following described real property located in Morgan County, Utah, as more particularly described in the License:

Township 4 North, Range 1 East, SLB&M
Section 1: SE¼NE¼

Parcel #00-0077-9155, Serial #01-004-001-02
Parcel #00-0001-1435, Serial #01-004-002

Exhibit B

Copy of the License

[Attached]

Contract No. 20-LM-41-0600

UNITED STATES
DEPARTMENT OF THE INTERIOR
BUREAU OF RECLAMATION
WEBER BASIN PROJECT
GATEWAY CANAL

LICENSE AGREEMENT
BETWEEN THE
UNITED STATES OF AMERICA
AND
WASATCH PEAKS RANCH, LLC

THIS LICENSE AGREEMENT, made this 20th day of October, 2020 in pursuance of the Act of Congress of June 17, 1902 (32 Stat. 388), and acts amendatory thereof or supplementary thereto, particularly the Reclamation Project Act of 1939 (53 Stat. 1187), between the UNITED STATES OF AMERICA, acting by and through the Bureau of Reclamation, Department of the Interior, hereinafter referred to as the United States, represented by the officer executing this agreement, hereinafter referred to as the Contracting Officer, and WASATCH PEAKS RANCH, LLC, hereinafter referred to as the Licensee,

WITNESSETH THAT:

WHEREAS, the Licensee proposes to install and maintain an asphalt roadway and bridge across the Gateway Canal (Canal); and

WHEREAS, the Licensee proposes to utilize, at its sole cost and expense, United States lands acquired for the Weber Basin Project, hereinafter referred to as Project lands, and the granting of a License Agreement to utilize a portion of Project lands in the manner and at the location hereinafter described will not be incompatible with Project purposes;

NOW, THEREFORE, in consideration of the mutual agreements and covenants herein contained, the United States, to the extent of its interest in the Project lands, hereby grants to the Licensee, upon the terms hereinafter provided, a license for the following purposes and in the location described below:

A. Purpose: To allow Licensee to install and maintain a new bridge and asphalt roadway crossing over the open channel Gateway Canal. The bridge and roadway will be constructed to the plans, designs and standards as shown on Exhibits C to K. If field changes are needed to the attached exhibits, those changes must be approved in writing by the District and Reclamation prior to installation or construction of said field changes. The construction of this bridge and roadway will provide secondary access to over 750 homes in a large residential/recreational development.

Note: The bridge and roadway licensed herein are required to be general public access. No private-exclusive rights or authorized use is meant to be given or granted under this agreement. All fencing, gates and/or structures which would deny and/or

hinder public use of this bridge and roadway are prohibited.

Included in the agreement is an authorize use for 10,873sqft of Temporary Workspace Area (TWA). The authorized use of the TWA shall expire at the completion of the initial construction of the bridge and roadway or no later than December 31, 2021. The TWA is required by licensee to be reclaimed to the pre-construction condition. The area and scope of the TWA is outlined and shown on Exhibit C

B. Period: 25 years from the date hereof, renewable for an additional 25 years if agreed upon by both parties.

C. Location: Approximately Canal Station 235+00. Location is about 2800 feet west of 4201 N. Morgan Valley Drive West Point City, Utah. Being in the SE ¼ of the SE1/4 of Section 1, Township 4 North, Range 1 East, Salt Lake Base and Meridian as shown on EXHIBIT B.

D. Plans, Drawings, and Maps (Attached hereto and made a part hereof): EXHIBITS B to K.

E. Land Status: Fee Title.

1. WORK SATISFACTORY. The Licensee shall perform all work under this License Agreement in accordance with the plans, drawings, and maps attached hereto and, in a manner, satisfactory to the United States and the Weber Basin Water Conservancy District (District).

2. RIGHTS RESERVED. This License Agreement and all rights hereunder shall be held by the Licensee at all times subject to the rights of the United States. United States jurisdiction and supervision over the concerned lands are not surrendered or subordinated by issuance of this License Agreement. The United States reserves the right to issue additional licenses, rights-of-way, or permits for compatible uses of the lands involved in this License Agreement; provided, however, any such license, right-of-way, or permit shall be conditioned on such licensee, grantee, or permittee paying the Licensee's expenses to relocate its facilities as may be required for such compatible use. There is also reserved the right of the United States, its officers, agents, employees, licensees, and permittees, at all proper times and places to have free ingress to, passage over, and egress from all of said lands for the purpose of exercising, enforcing, and protecting the rights reserved herein.

3. HOLD HARMLESS.

a. The United States, the District, and their officers, agents, employees, and assigns do not assume any liability resulting from the granting ofthis License Agreement or the exercise thereof and the Licensee agrees to indemnify and hold the United States, the District, and their officers, agents, employees, and assigns harmless for injury or damage to any persons or property that may result from the exercise of any of the privileges herein

conferred or the work performed hereunder.

b. The Licensee further agrees that the United States, the District, and their officers, agents, employees, and assigns, shall not be held liable for any damage to the Licensee's improvements or works by reason of the exercise of the rights herein reserved; nor shall anything contained in this paragraph be construed as in any manner limiting other reservations in favor of the United States contained in this License Agreement.

4. RELEASE FROM LIABILITY. The Licensee hereby releases the United States, the District, and their officers, employees, agents, or assigns, from liability for any and all loss or damage of every description or kind whatsoever, which may result to the Licensee from the construction, operation, and maintenance of Project works upon said lands, provided that nothing in this License Agreement shall be construed as releasing the United States and the District from liability for their own negligence. Nothing herein shall be deemed to increase the liability of the United States beyond the provisions of the Federal Tort Claims Act, Act of June 25, 1948, 62 Stat. 989 (28U.S.C. § 1346 (b), 2671 et seq.) or other applicable law.

5. INTERFERENCE PROHIBITED. The Licensee shall use, occupy, and maintain said facilities with due care to avoid damage to Project lands or works or any interference in any way with the operation and maintenance of the same.

6. ASSIGNMENT OR TRANSFER. This License Agreement shall not be assigned or transferred by the Licensee without the prior written consent of the United States.

7. TERMINATION OF AGREEMENT: REVOCATION/TERMINATION: This Agreement may be revoked by the United States upon thirty (30) days written notice to the Permittee: (a) For nonuse of the project lands by Permittee for a period of two (2) continuous years; or, (b) The United States determines that the Permittee's use of the land is no longer compatible with project purpose; or, (c) After failure of the Permittee to observe any of the conditions of this Agreement and on the tenth day following service of written notification on the Permittee of the termination because of failure to observe such conditions; or, (d) At the sole discretion of the United States.

8. SUCCESSORS IN INTEREST OBLIGATED. This License Agreement shall inure to the benefit of and be binding upon the successors and assigns of the parties hereto.

9. NO WARRANTY. The United States makes no warranty, expressed or implied, as to the extent or validity of the grant contained herein.

10. OFFICIALS NOT TO BENEFIT. No Member of or Delegate to Congress or Resident Commissioner shall be admitted to any share or part of this License Agreement or to any benefit that may arise herefrom, but this restriction shall not be construed to extend to this

License Agreement if made with a corporation or company for its general benefit.

11. ENVIRONMENTAL COMPLIANCE. The Licensees agree to abide by all applicable Federal, State, and local laws and regulations pertaining to pollution control and environmental protection.

12. LANDSCAPE PRESERVATION AND NATURAL BEAUTY.

a. The Licensee shall exercise care to preserve the natural landscape and shall conduct its construction operations so as to prevent any unnecessary destruction, scarring, or defacing of the natural surroundings in the vicinity of the work. Except where clearing is required for permanent works, all trees, native shrubbery, and vegetation shall be preserved and shall be protected from damage which may be caused by the Licensee's construction operations and equipment. Movement of crews and equipment within the area described in Article D hereof and over routes provided for access to the work shall be performed in a manner to prevent damage to grazing land, crops, or property.

b. Upon completion of the work, the construction site shall be smoothed and graded in a manner to conform to the natural topography of the landscape and shall be repaired, replanted, reseeded, or otherwise restored as directed by the Contracting Officer at the Licensee's expense.

13. EXTRAORDINARY MAINTENANCE OR REPAIR COSTS. The Licensee agrees that if the construction, reconstruction, maintenance, or repair of any or all Project structures and facilities located on such lands should be made more expensive by reason of the existence of improvements or works of the Licensee thereon, the Licensee will pay to the United States, the District, or their agents or assigns responsible for Project operation and maintenance, the full amount of such additional expense within 30 days of receipt of an itemized bill therefore.

14. SPECIAL PROVISIONS.

a. Any fences, ditches, drains, utilities or other improvements removed during construction must be restored in kind and to the satisfaction of the District.

b. The Licensee or its assignees will coordinate all construction, operation and maintenance activities with the District at least 48 hours in advance of when work begins so that a District Inspector may be present to coordinate protection measures for the Canal.

c. The allowable period of construction to be at the District sole discretion. In no case shall the duration of construction be permitted to exceed three months. All work must be coordinated with the District's Water Supply and Power Department Manager and Inspector. Construction may not begin until after October 15th of the year in which the permit is granted.

d. The Licensee is required to remove 20 feet of existing canal liner upstream and downstream of the new bridge and replace it with reinforced liner of the same thickness once the bridge work has been installed. It is required that before the new liner is installed the Licensee will verify with a report soil compaction data. Installation and liner replacement must be completed by November 24th of the same year.

e. Gateway Canal's "as-built" drawings are unclear as to whether there are under drains present beneath this section canal liner. The Licensee and its contractors shall treat the canal as if under drains are present. If under drains exist, and are damaged during construction, the developer will be responsible to repair the drains to the Districts satisfaction.

f. If, due to the construction and installation of bridge and/or asphalt roadway, water deliveries cannot be made, or power cannot be generated at the Gateway Power Plant, Wasatch Peaks Ranch, LLC or its assignees shall be responsible to compensate the United States and/or District for such losses.

g. Wasatch Peaks Ranch, LLC has stated that a Special Service District will be formed that will be responsible for all operation and maintenance (O&M) of the bridge and roadways licensed by this agreement. All are on notice that it is the intend of Licensee to assign and transfer the Authorized Use given by this agreement to future Special Service District. If in the event the Special Service District dissolves, files for bankruptcy, or fails to maintain the bridge Wasatch Peaks Ranch, LLC will be responsible for the costs associated with the O&M and if needed removal of the bridge, roadway and pre-construction restoration of Weber Basin Project lands affected by the scope of this agreement.

h. It is required that 4 (four) access gateways be installed along the new permanent bridge crossing to facilitate access in either direction on both sides of the canal. These gate openings must be 16 feet wide as shown in the attached Exhibit K, fencing details. Chain link fence, or another fence material submitted on and approved by the District and the BOR, must be installed on both sides of the bridge from gate post to gate posts. The gates must be 16-foot-wide single swing gates (double swing gates will not be allowed) mounted to gate posts properly sized and anchored to support the gates without sagging. Setback for the gates must be 25-feet from the edge of the roadway. From the outer gate posts, barbed wire field fence, or another fence material submitted on and approved by the District and Reclamation, shall be installed to the canal property edge. Any fencing damaged during construction or O&M must be repaired to the satisfaction of the District or Reclamation.

i. Licensee, or its Assignees is required to follow and abide by all guidelines and standards outlined in Bureau of Reclamation's "Engineering and O&M Guidelines for Crossings", a copy of which will be provided upon request or maybe acquired at: https://www.usbr.gov/pn/snakeriver/landuse/authorized/crossings.pdf

Contract No. 20-LM-41-0600

15. In accordance with 43 CFR 429.16, Subpart E, any applicant requesting a right-of-use over Reclamation land must remit a use fee which amount represents the appraised fair market value of the rights granted herein for the Fifty (25) year period. You are required to remit a use fee determined to be Four Thousand and Fifty Dollars ($4,050.00). Deposit and payments are to be made to the Bureau of Reclamation at 302 East 1860 South, Provo, Utah 84606.

IN WITNESS WHEREOF, the parties hereto have caused this License Agreement to be executed the day and year first above written.

UNITED STATES OF AMERICA

KENT KOFFORD Digitally signed by KENT KOFFORD Date: 2020.10.20 07:51:04 -06'00'

Name: Kent Kofford
Title: Area Manager

WASATCH PEAKS RANCH, LLC

Ed Schultz

Name: Ed Schultz
Title: Managing Director, Wasatch Peaks Ranch, LLC

CONCUR:
WEBER BASIN WATER CONSERVANCY DISTRICT

Name: Tage I. Flint
Title: Manager

Contract No. 20-LM-41-0600

EXHIBIT A

A. Prior to the expiration of the term of this License Agreement, and upon application in writing by the Licensee and approval by the United States and the District, this License Agreement may be renewed for such period as the parties hereto may agree upon. If so renewed, the consideration to be paid for renewal will be determined by reappraisal by the United States. Furthermore, the renewed License Agreement will be subject to the regulations existing at the time of renewal and such other terms and conditions as may be deemed necessary by the United States and the District to protect the public interest or its projects.

B. The installation of the crossings shall take place as agreed upon in this agreement. The Licensee shall notify the United States at (801) 379-1000 and the District at (801) 771-1677 five (5) days in advance of its intent to commence any construction operations associated with rights herein granted.

C. Existing gravity drainage of the United States rights-of-way must be maintained. No new concentration of surface or subsurface drainage may be directed onto or under the United States rights-of-way without adequate provision for removal of drainage water or adequate protection of the United States rights-of-way.

D. During construction, operation, and maintenance, the Licensee shall be particularly alert to take all reasonable and necessary precautions to protect and preserve historic or prehistoric ruins and artifacts on or adjacent to the lands herein described. Should sites, ruins, or artifacts be discovered during these operations, the Licensee will immediately suspend work involving the area in question, and advise the United States of suspected values. The Licensee shall promptly have the area inspected to determine significance of values and to consult with the United States on appropriate actions to follow (recovery, etc., and resumption of work). Cost of any recovery work shall be borne by the Licensee. The Licensee shall provide the United States with a copy of any cultural resources survey reports concerning sites located on the lands described herein and shall develop a mitigation plan acceptable to the Utah State Historic Preservation Officer (SHPO) for those significant sites subject to an adverse impact. All objects of antiquity recovered from public lands are the property of the United States and shall be turned over to the Bureau of Reclamation. The Licensee is responsible for obtaining required Utah SHPO clearance for any additional survey and report completed.

E. Prior to construction of <u>any</u> structure that encroaches within United States rights-of-way, an excavation must be made to determine the location of existing United States facilities. The excavation must be made by or in the presence of the District or the United States.

F. Any contractor or individual constructing improvements in, on, or along United States rights-of-way must limit his construction to the encroachment structure previously approved and construct the improvements strictly in accordance with approved plans or specifications.

G. All United States land areas where soils and surface materials are disturbed through actions incident to construction, operation and maintenance shall be restored to their natural state insofar as practical by water barring, scarifying, leveling and reseeding, or by other practices as prescribed by the United States and to its satisfaction.

H. The Licensee shall restore any damaged or disturbed improvements such as fences, roads, watering facilities, etc., encountered during construction, maintenance, and operation. Functional use of these improvements must be maintained at all times.

I. Within sixty (60) days after conclusion of construction operations, all construction materials and related litter and debris, including vegetative cover accumulated through land clearing, shall be disposed of in an appropriate manner (State of Utah approved sanitary landfill).

J. The owner of newly constructed facilities that encroach on United States rights-of-way shall notify the United States upon completion of construction and shall provide the United States with two copies of as-built drawings of actual improvements in, on, or along the rights-of-way.

K. Except in case of ordinary maintenance and emergency repairs, an owner of encroaching facilities shall give the District at least 10 days notice in writing before entering upon United States rights-of-way for the purpose of reconstructing, repairing, or removing the encroaching pipeline or performing any work on or in connection with the operation of the encroaching pipeline.

L. If unusual conditions are proposed for the encroaching pipeline or unusual field conditions within United States rights-of-way are encountered, the United States reserves the right to impose more stringent criteria than those prescribed herein.

M. All backfill material within United States rights-of-way shall be compacted to 95 percent of maximum density unless otherwise shown. Mechanical compaction shall not be allowed within 6 inches of Project works whenever possible. In no case will mechanical compaction using heavy equipment be allowed over Project works or within 18 inches horizontally of Project works.

N. The backfilling of any excavation or around any structure within the United States rights-of-way shall be compacted in layers not exceeding 6 inches thick to the following requirements: (1) cohesive soils to 90 percent maximum density specified by ASTM Part 19, D-698, method A; (2) noncohesive soils to 70 percent relative density specified by ANSI/ASTM Part 19, d-2049, par. 7.1.2, wet method.

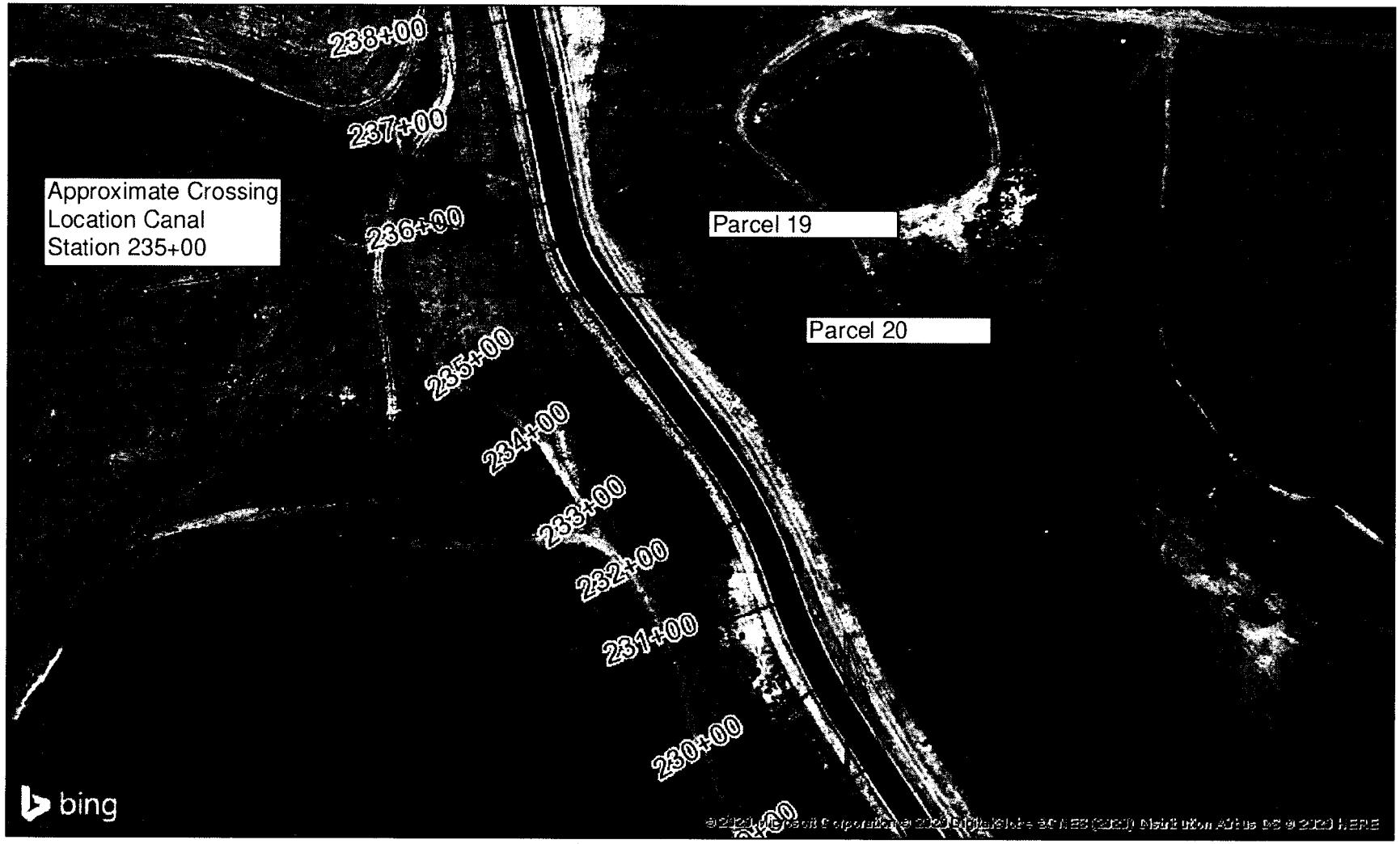
O. Any nonmetallic encroaching pipeline below ground level shall be accompanied with warning tape with a metallic strip. Metal pipe shall also be accompanied with warning tape. All tape shall be located 12 inches above the pipeline and extend throughout all right-of-way.

P. No use of United States land or right-of-way shall be permitted that involves the storage of hazardous material.

Q. Utility pipe crossing of Reclamation pipelines must be approved on an individual basis.

Metal pipes which do not have a dielectric coating will require a polyethylene plastic wrap for corrosion protection of Reclamation pipeline by induced current from utility crossings.

Q. For all utility crossings, a permanent placard shall be placed at each point that the utility enters or exits the right-of-way of the United States. This placard shall identify the type of utility located below it, the name of the utility company and a telephone number where the utility company can be reached.



Weber Basin Water Conservancy District

N
W E
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Weber Basin Water

Author:

Disclaimer: Information shown on this map is for planning and illustration purposes only. Weber Basin Water assumes no liability for any errors, omissions or inaccuracies in the information provided or for any action taken, or action not taken by the user in reliance upon any maps or information provided herein.

Date: 2/3/2020 Time: 1:56:20 PM

1 inch = 188 feet

Weber Basin Water Conservancy District

N
W E
S

Weber Basin Water

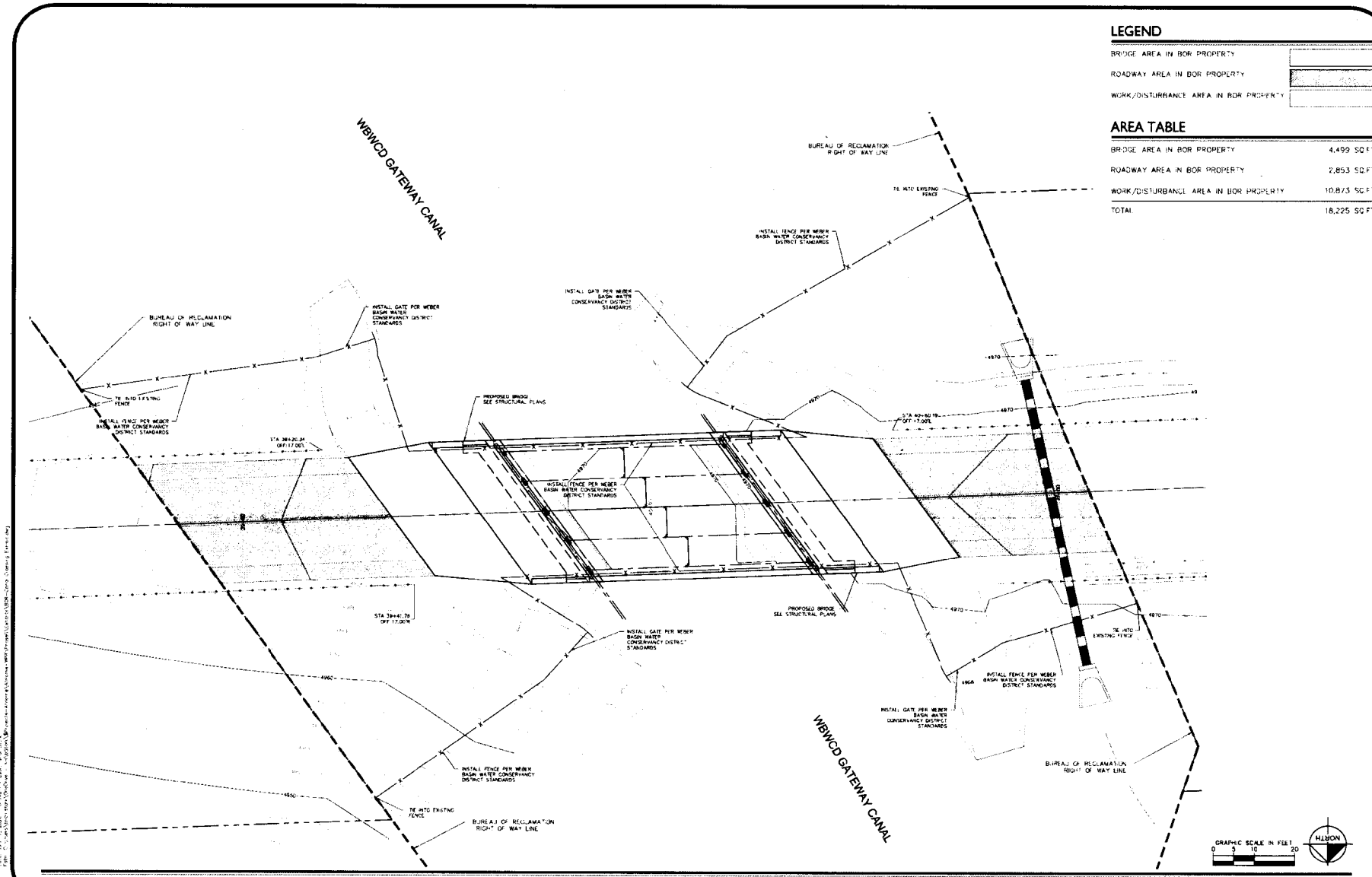
Author:

Disclaimer: Information shown on this map is for planning and illustration purposes only. Weber Basin Water assumes no liability for any errors, omissions or inaccuracies in the information provided or for any action taken, or action not taken by the user in reliance upon any maps or information provided herein.

Date: 2/3/2020 Time: 1:57:40 PM

1 inch = 752 feet

20-LM-41-0600



LEGEND

BRIDGE AREA IN BOR PROPERTY	
ROADWAY AREA IN BOR PROPERTY	
WORK/DISTURBANCE AREA IN BOR PROPERTY	

AREA TABLE

BRIDGE AREA IN BOR PROPERTY	4,499 SQ.FT.
ROADWAY AREA IN BOR PROPERTY	2,853 SQ.FT.
WORK/DISTURBANCE AREA IN BOR PROPERTY	10,873 SQ.FT.
TOTAL	18,225 SQ.FT.

WPR WBWCD - CANAL CROSSING AREA OF IMPACT EXHIBIT

July 17, 2020

Kimley»Horn

Exhibit C

20-LM-41-0800

Exhibit D - Page 1 of 16

	Kimley»Horn	CANAL BRIDGE GENERAL PLAN AND ELEVATION	WASATCH PEAKS RANCH MORGAN COUNTY, UTAH	SHEET S1.00

SHEET INDEX

S1.00	GENERAL PLAN AND ELEVATION
S1.01	TYPICAL SECTION
S1.02	FOUNDATION PLAN
S1.03	DRILLED SHAFT DETAILS
S1.04	ABUTMENT PLAN AND ELEVATION
S1.05	FRAMING PLAN
S1.06	GIRDER DETAILS
S1.07	INTERMEDIATE DIAPHRAGM DETAILS
S1.08	DECK DETAILS, END DIAPHRAGM DETAILS
S1.09	SUPERSTRUCTURE PLAN AND ELEVATION
S1.10	SUPERSTRUCTURE SECTIONS
S1.11	APPROACH SLAB PLAN
S1.12	APPROACH SLAB DETAILS
S1.13	PARAPET DETAILS
S1.14	CHAIN LINK FENCE DETAILS
S1.15	CONCRETE MIX DETAILS

FOR INFORMATION SHEETS NOT FOR CONSTRUCTION

EAST ACCESS ROAD PROFILE
TAKEN ALONG ℄ OF EAST ACCESS ROAD

NOTES:
1. ELEVATIONS SHOWN ARE ALONG ℄ OF EAST ACCESS ROAD
2. CANAL FLOW DATA TAKEN FROM CATTAIL CANAL SECTION AND LINING DETAILS WHICH ARE ATTACHED FOR INFORMATION ONLY
3. SEE SHEET C7.04 FOR WEMCO CANAL MAINTENANCE ROAD REALIGNMENT

PLAN

ELEVATION

NORTH

DESIGN SPECIFICATIONS

AASHTO LRFD BRIDGE DESIGN SPECIFICATIONS, EIGHTH EDITION, 2017.
AASHTO GUIDE SPECIFICATIONS FOR LRFD SEISMIC BRIDGE DESIGN, SECOND EDITION, 2011 WITH 2014 INTERIMS.

CONSTRUCTION SPECIFICATIONS

2017 AMERICAN PUBLIC WORKS ASSOCIATION STANDARDS AND SPECIFICATIONS

DESIGN LOADING
LIVE LOAD: HL-93 (LRFD)

DEAD LOAD INCLUDED ALLOWANCES OF 40 PSF FOR FUTURE WEARING SURFACE

THE SUPERSTRUCTURE IS DESIGNED AS A COMPOSITE SECTION WITH THE TOP ½" OF SLAB THICKNESS NOT INCLUDED IN THE DESIGN SECTION PROPERTIES TO ACCOUNT FOR GRINDING, GROOVING AND WEARING

SEISMIC DESIGN CRITERIA

SEISMIC DESIGN PARAMETERS FOR FOUNDATION DESIGN WERE OBTAINED FROM THE AASHTO GUIDE SPECIFICATIONS FOR LRFD SEISMIC BRIDGE DESIGN, 2ND EDITION, 2011
SITE CLASS D
BRIDGE CLASSIFICATION, NORMAL (LIFE SAFETY/NO COLLAPSE)

0.2 SECOND SPECTRAL RESPONSE ACCELERATION %G: S_s =0.815
1.0 SECOND SPECTRAL RESPONSE ACCELERATION %G: S_1 =0.290
PEAK GROUND ACCELERATION %G: PGA=0.359
SITE COEFFICIENTS: F_a=1.175 and F_{pga}=1.241

MATERIALS

STRUCTURAL WEATHERING STEEL	Fy = 50 KSI (GRADE 50W)
CAST-IN-PLACE CONCRETE	f'c = 4000 PSI
REINFORCING STEEL	Fy = 60 KSI (GRADE 60)

GENERAL NOTES

USE STRUCTURAL STEEL CONFORMING TO AASHTO M270 GRADE 50W UNLESS NOTED OTHERWISE. PROVIDE CHARPY V-NOTCH TESTING RESULTS FOR GIRDERS MEET THE ZONE 2 REQUIREMENTS.

USE BOLTS, CONFORMING TO ASTM A325 TYPE 3, NUTS CONFORMING TO ASTM A563 GRADE DH3, AND WASHERS CONFORMING TO ASTM F436 TYPE 3

USE REINFORCING STEEL CONFORMING TO ASTM A615 EXCEPT WHERE ASTM A706 IS SPECIFIED FOR WELDABILITY

USE EPOXY COATED REINFORCING STEEL IN THE PARAPETS, CURB, DECK, AND APPROACH SLABS UNLESS NOTED OTHERWISE.

MEET THE REQUIREMENTS OF AASHTO LRFD SECTION 5.10.2 FOR ALL BENDS AND HOOKS. ALL BEND DIMENSIONS FOR REINFORCING STEEL ARE OUT-TO-OUT OF BARS. ALL PLACEMENT DIMENSIONS FOR REINFORCING STEEL ARE TO CENTER OF BARS UNLESS NOTED OTHERWISE

PROVIDE 2 INCHES OF CLEAR COVER TO ALL REINFORCING STEEL UNLESS NOTED OTHERWISE

CHAMFER ALL EXPOSED CORNERS ¾" UNLESS NOTED OTHERWISE

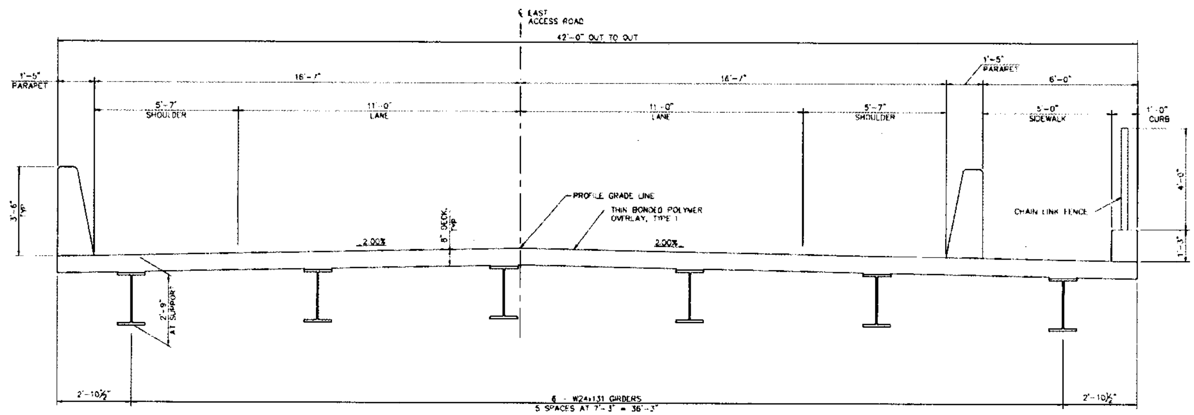
CONFORM TO THE REQUIREMENTS OF THE AMERICAN WELDING SOCIETY BRIDGE WELDING CODE D1.5, LATEST EDITION, UNLESS NOTED OTHERWISE

DO NOT FIELD WELD TO GIRDERS EXCEPT WHERE NOTED.

DO NOT SCALE DRAWINGS.

TRAFFIC DATA

DESIGN SPEED = 30 MPH



TYPICAL SECTION

ABBREVIATIONS

@	AT	MI	MILES
ABUT	ABUTMENT	MIN	MINIMUM
ADD'L	ADDITIONAL	MISC	MISCELLANEOUS
APPROX.	APPROXIMATE	MOD	MODIFIED
BM	BEAM	NB	NORTH BOUND
BOT	BOTTOM	NO #	NUMBER
BRG	BEARING	NTS	NOT TO SCALE
BTWN	BETWEEN	OC	ON CENTER
℄	CENTERLINE	OD	OUTSIDE DIAMETER
CIP	CAST-IN-PLACE	OPNG	OPENING
CY	CUBIC YARDS	P	PINNED
CLR	CLEAR	PGL	PROFILE GRADE LINE
COL	COLUMN	P	PLATE
CON	CONCRETE	PSI	POUNDS PER SQUARE INCH
CONT	CONTINUOUS	PVC	POLYVINYL CHLORIDE
CONST	CONSTRUCTION	PED	PEDESTRIAN
DIA	DIAMETER	R	RADIUS
DIAPH	DIAPHRAGM	R/W	RIGHT OF WAY
DTL	DETAIL	RDWY	ROADWAY
DWG	DRAWING	REINF	REINFORCEMENT
EA	EACH	REQ'D	REQUIRED
EB	EAST BOUND	RET	RETAINING
EF	EACH FACE	RT	RIGHT
ELEV	ELEVATION	SB	SOUTH BOUND
EMBED	EMBEDMENT	SCHED	SCHEDULE
EQ	EQUAL	SECT	SECTION
EW	EACH WAY	SF	SQUARE FOOT
EXIST	EXISTING	SHLDR	SHOULDER
EXP	EXPANSION	SHT	SHEET
EXT	EXTERIOR	SIM	SIMILAR
FIX	FIXED	SPA	SPACE
FTG	FOOTING	SPECS	SPECIFICATION
GALV	GALVANIZED	STA	STATION
GR	GRADE	STD	STANDARD
HS	HIGH STRENGTH	STL	STEEL
HK	HOOK	STR	STRUCTURAL
HORIZ	HORIZONTAL	SWLK	SIDEWALK
ID	INSIDE DIAMETER	SY	SQUARE YARD
INT	INTERIOR	SYM	SYMMETRICAL
JT	JOINT	TOW	TOP OF WALL
LB	POUNDS	TEMP	TEMPORARY
LF	LINEAR FOOT	TRANS	TRANSITION
LN	LANE	TYP	TYPICAL
LS	LUMP SUM	VERT	VERTICAL
LT	LEFT	W/	WITH
LONGIT	LONGITUDINAL	WB	WEST BOUND
MAX	MAXIMUM	WSE	WATER SURFACE ELEVATION

Kimley»Horn

CANAL BRIDGE
TYPICAL SECTION

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

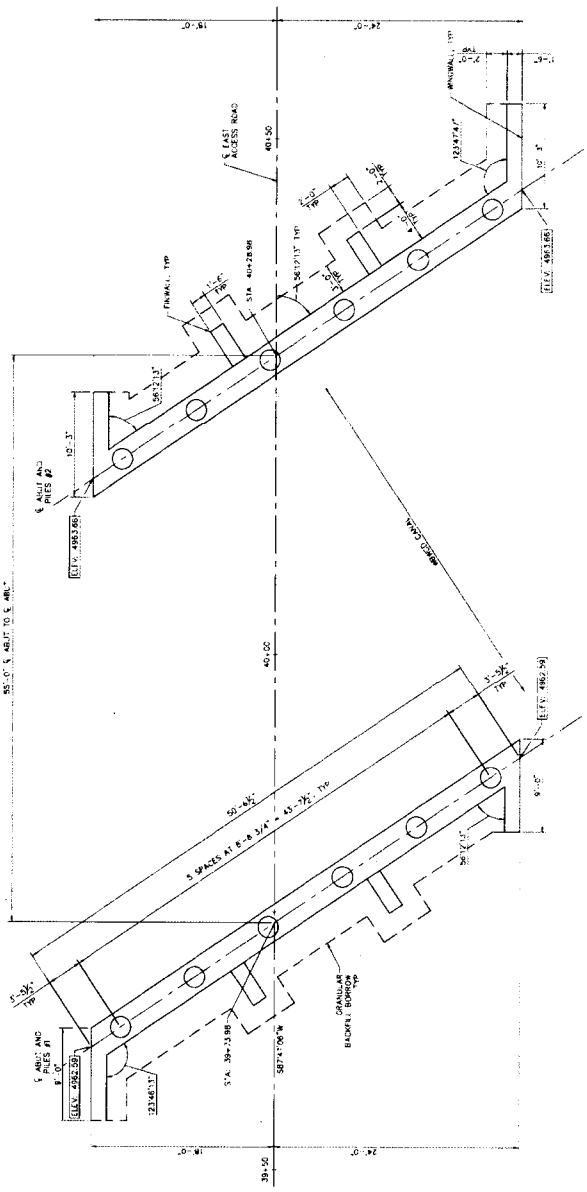
DRAWN BY:	DBB	1/20
DESIGNED BY:	DML	1/20
CHECKED BY:	ZAT	1/20
PROJECT No:	098360005	SCALE: AS SHOWN

SHEET
S1.01

20-LM-41-0600

Exhibit D - Page 3 of 16

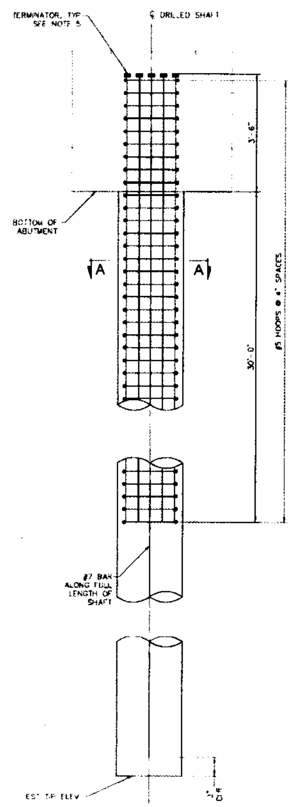
Kimley»Horn	WASATCH PEAKS RANCH MORGAN COUNTY, UTAH	CANAL BRIDGE FOUNDATION PLAN	SHEET S1.02



FOUNDATION PLAN

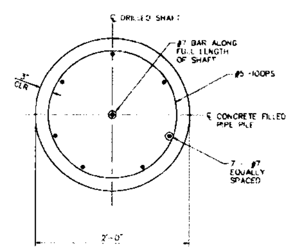
NOTES

1. ELEVATIONS ENCLOSED IN RECTANGLES INDICATE BOTTOM OF ABUTMENT ELEVATIONS
2. SEE TYPICAL SHAFT DETAIL FOR SIZE OF RAILS AND DRILLED SHAFT EXTENSION INTO THE FOUNDATION
3. LOCATE UTILITIES PRIOR TO CONSTRUCTION
4. GRANULAR BACKFILL BORROW EXTENDS FROM THE BOTTOM OF THE ABUTMENT AND WINGWALL TO THE BOTTOM OF APPROACH SLAB
5. BOTTOM OF ABUTMENTS ARE LEVEL



DRILLED SHAFT DETAIL

ABUTMENT REINFORCING NOT SHOWN FOR CLARITY



SECTION A-A

LOCATION	DRILLED SHAFT DIAMETER	NUMBER OF DRILLED SHAFTS	EST TIP ELEV	EST SHAFT LENGTH
	INCH		FEET	FEET
ABUTMENT #1	24 IN	6	4912	50
ABUTMENT #2	24 IN	6	4913	50

SETTLEMENT ≤ 1.00 INCHES

NOTES

1. ESTIMATED DRILLED SHAFT TIP ELEVATIONS SHOWN ARE APPROXIMATE. VERIFY TIP ELEVATIONS AT TIME OF CONSTRUCTION.
2. SEE GEOTECHNICAL REPORT FOR BORING LOG INFORMATION.
3. NO LAP SPLICES PERMITTED IN VERTICAL REINFORCING STEEL.
4. USE CLASS AA(AE) CONCRETE WITH f'c = 4.0 KSI FOR DRILLED SHAFTS.
5. TERMINATORS MUST BE CAPABLE OF DEVELOPING 100% OF THE TENSILE CAPACITY OF THE BAR.

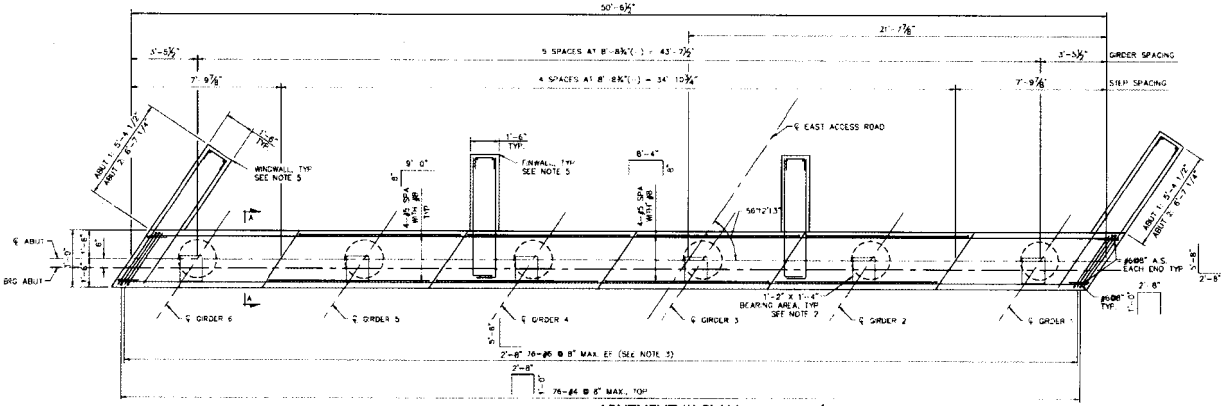
CANAL BRIDGE
DRILLED SHAFT DETAILS

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

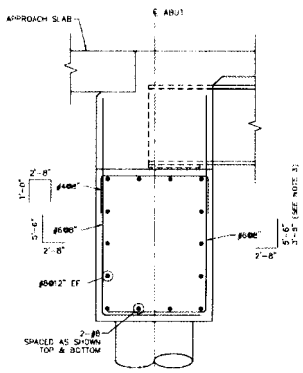
Kimley»Horn

DRAWN BY: DBW 10/19
DESIGNED BY: ZAT 10/19
CHECKED BY: KAS 10/19
PROJECT NO: 096360005
SCALE: AS SHOWN

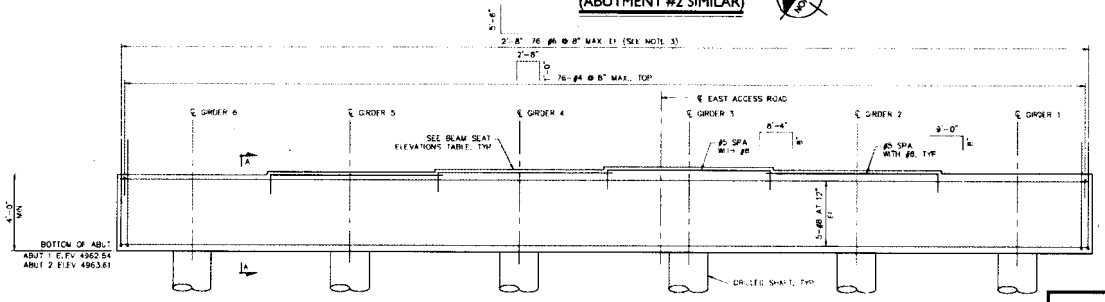
SHEET S1.03



ABUTMENT #1 PLAN
(ABUTMENT #2 SIMILAR)



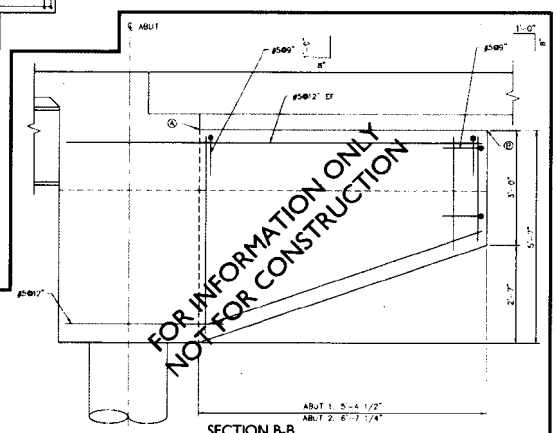
SECTION A-A



ABUTMENT #1 ELEVATION
(ABUTMENT #2 SIMILAR)

BEAM SEAT ELEVATIONS

GIRDER	ABUT #1	ABUT #2
1	4966.47	4967.54
2	4966.71	4967.78
3	4966.96	4968.03
4	4966.92	4968.00
5	4966.87	4967.95
6	4966.83	4967.90



SECTION B-B

ABUTMENT AND DIAPHRAGM REINFORCEMENT NOT SHOWN

FOR INFORMATION ONLY
NOT FOR CONSTRUCTION

WINGWALL ELEVATIONS

WINGWALL	A	B
NORTHWEST	XXXX.XX	XXXX.XX
SOUTHWEST	XXXX.XX	XXXX.XX
NORTHEAST	XXXX.XX	XXXX.XX
SOUTHEAST	XXXX.XX	XXXX.XX

NOTES

1. SEE "FOUNDATION PLAN" FOR DRILLED SHAFT LAYOUT.
2. FINISH BEARING SEAT HIGH AND RUB OR GRIND LEVEL TO ELEVATION SHOWN ± ⅛". NO GROUTING PERMITTED.
3. SHIFT OR CUT BARS 2 INCHES BELOW TOP OF ABUTMENT UNDER GIRDER AT FRONT FACE.
4. ADJUST BARS AS NECESSARY TO CLEAR DRILLED SHAFT REINFORCEMENT.
5. SEE "WINGWALL AND FINWALL DETAILS" SHEET FOR WINGWALL AND FINWALL REINFORCING.

DATE	DESCRIPTION
4	

Kimley»Horn
215 South State Street, Suite 500, Salt Lake City, UT 84111 | FAX 801.212.2275

CANAL BRIDGE
ABUTMENT PLAN AND ELEVATION

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

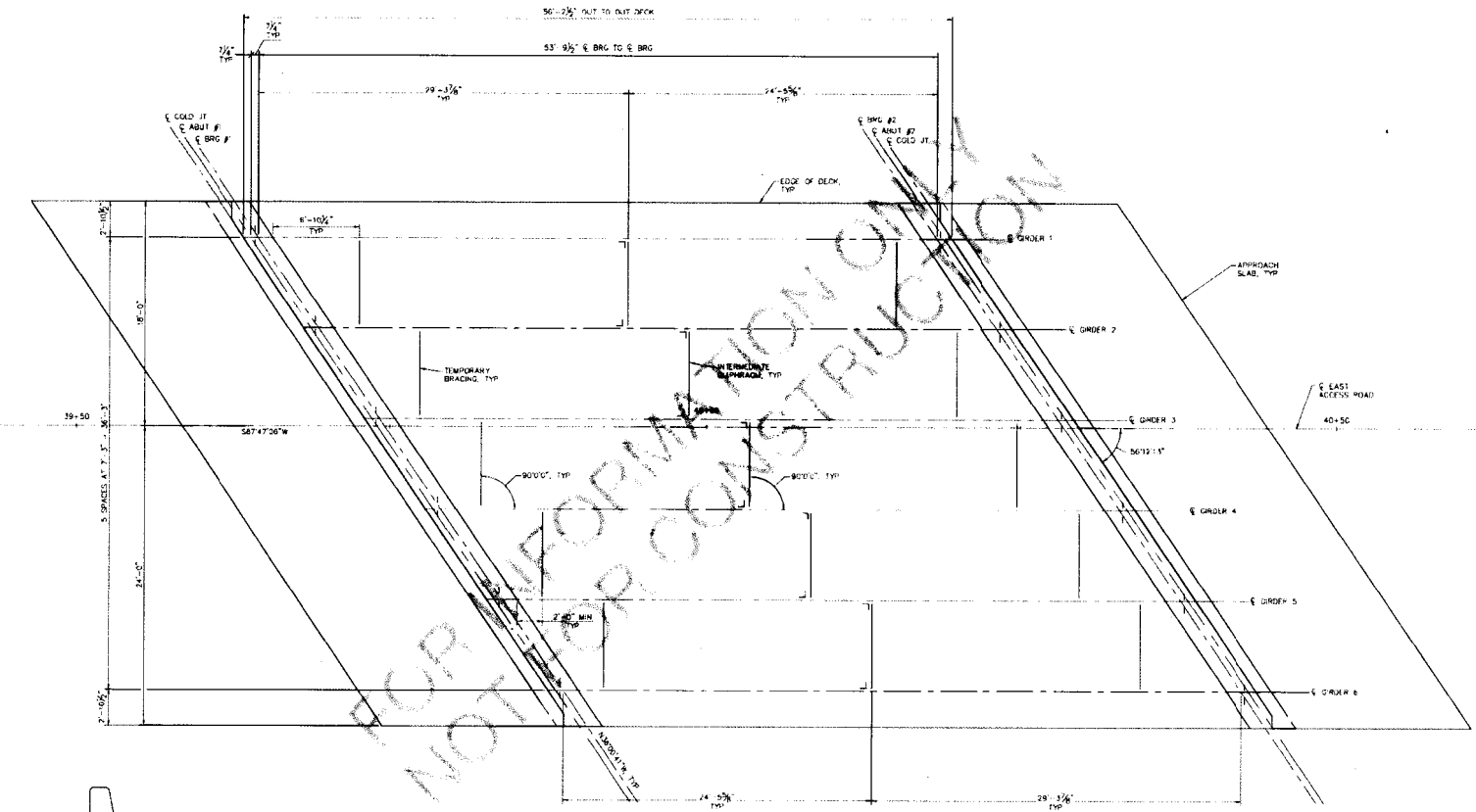
DRAWN BY: DBH 1/20
DESIGNED BY: DBH 1/20
CHECKED BY: JAT 1/20
SCALE: AS SHOWN
PROJECT No: 065360005

SEAL
THOMAS A. TAYLOR
8/30/2020

SHEET
S1.04

Exhibit D - Page 5 of 16

Ent 161569 Bk 393 Pg 1332



FRAMING PLAN

TEMPORARY BRACING DETAIL

NOTES

1. SEE "GIRDER DETAILS" AND "INTERMEDIATE DIAPHRAGM DETAILS" FOR ADDITIONAL INFORMATION

DATE	DESCRIPTION
1	

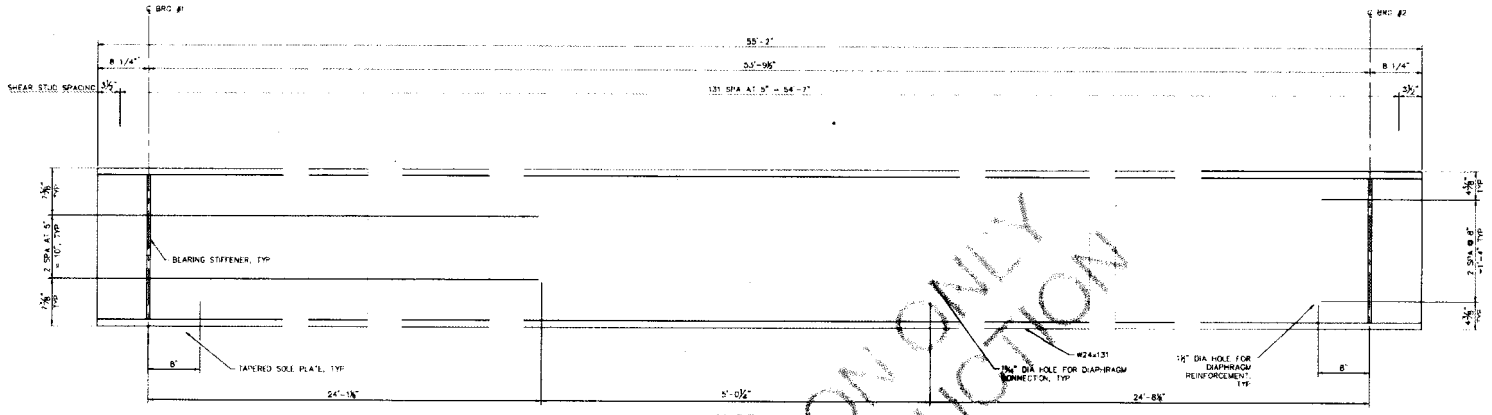
Kimley»Horn

CANAL BRIDGE
FRAMING PLAN

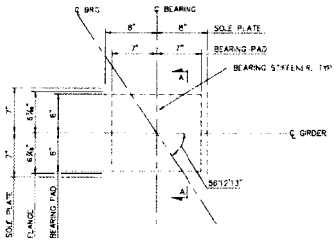
WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DESIGNED BY: DBK ../20..
DRAWN BY: DBK ../20..
CHECKED BY: JML ../20..
QA: ../20..
PROJECT No: 069380005
SCALE: AS SHOWN
SEAL

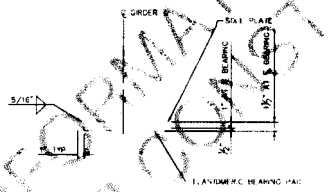
SHEET
S1.05



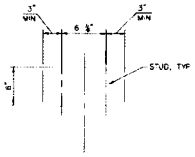
GIRDER ELEVATION



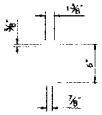
BEARING PLAN



SECTION A-A



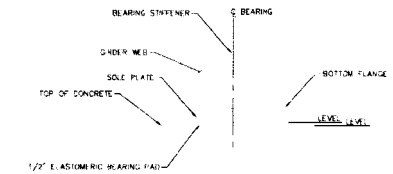
SHEAR STUD DETAIL



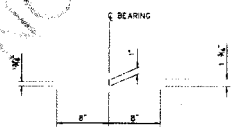
STUD DIMENSIONS

NOTES

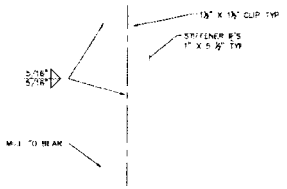
1. USE STRUCTURAL STEEL CONFORMING TO AASHTO M 270 GRADE 50W FOR GIRDER UNLESS NOTED OTHERWISE
2. PERFORM CHARPY V NOTCH TOUGHNESS TEST ON ALL MAIN LOAD CARRYING MEMBERS SUBJECT TO TENSION STRESS INDICATED BY * TEST RESULTS MUST MEET ZONE 2 REQUIREMENTS
3. PROVIDE WELDING, WELDER QUALIFICATIONS, PRE QUALIFICATION OF WELD DETAILS AND INSPECTION OF WELDS CONFORMING TO THE REQUIREMENTS OF THE AASHTO/AWS D1.5 BRIDGE WELDING CODE
4. ASSUME THE USE OF MANUAL SHIELDED METAL-ARC WELDING FOR THE METHOD OF JOINT PREPARATION FOR WELDING SHOWN ON THE PLANS. DO NOT USE THIS OR ANY OTHER WELDING PROCESS UNTIL APPROVED BY THE ENGINEER
5. PROVIDE MINIMUM SIZED WELDS REQUIRED BY AASHTO/AWS D1.5 BRIDGE WELDING CODE FOR THE THICKNESS OF THE MATERIAL JOINED UNLESS OTHERWISE SPECIFIED.
6. ASSUME A 60°F AMBIENT TEMPERATURE OF THE GIRDER FOR DIMENSIONS SHOWN ON THE PLANS CORRECT LENGTH USED IN FABRICATION AT THE RATE OF ½" PER EACH 100°F OF LENGTH FOR EVERY 10°F DIFFERENCE IN TEMPERATURE TO ALLOW FOR EXPANSION AND CONTRACTION
7. DO NOT FIELD WELD TO GIRDERS EXCEPT WHERE NOTED
8. PROVIDE HEADED SHEAR CONNECTOR STUDS CONFORMING TO THE DIMENSIONS SHOWN ON THE PLANS. MANUFACTURE FROM STEEL CONFORMING TO THE REQUIREMENTS OF AASHTO M 169. AUTOMATICALLY END WELD STUDS IN THE FIELD WITH EQUIPMENT DESIGNED FOR STUD WELDING OPERATIONS. PROVIDE EQUIPMENT WITH ADEQUATE CAPACITY FOR THE SIZE OF STUD BEING WELDED.
9. DO NOT WELD OVERHANG BRACKETS OR ANY PORTION OF OVERHANG ASSEMBLY TO THE GIRDERS. AVOID SYSTEMS REQUIRING BOLTS THROUGH THE WEB PLACE A325 BOLTS IN HOLES AFTER BRACKET IS REMOVED. PROVIDE A SYSTEM THAT PREVENTS GIRDER "TWIST" OR DISTORTION
10. ALL DIMENSIONS SHOWN ARE HORIZONTAL. LENGTHS USED IN FABRICATION MUST TAKE VERTICAL GRADE AND DEAD LOAD DEFLECTION INTO ACCOUNT
11. PROVIDE A CLASS A SURFACE CONDITION FOR BEARING SURFACES
12. OVERSIZED HOLES MAY BE USED AT THE DISCRETION OF THE FABRICATOR / CONTRACTOR AT DIAPHRAGM CONNECTIONS
13. USE ⅞" DIA. BOLTS CONFORMING TO ASTM A325 TYPE I WITH THREADS INCLUDED IN THE SHEAR PLANE. USE ASTM F436 WASHERS AND ASTM 563 NUTS.
14. USE GRADE 60 DUROMETER HARDNESS (SHORE A) GRADE 3 ELASTOMER MINIMUM AND MAXIMUM SHEAR MODULUS ARE 0.130 KSI AND 0.200 KSI RESPECTIVELY



BEARING ELEVATION



TAPERED SOLE PLATE



BEARING STIFFENER

NO.	DATE	DESCRIPTION
1		

Kimley»Horn
215 South State Street, Suite 200, Salt Lake City, UT 84111 | TEL no.

CANAL BRIDGE
GIRDER DETAILS

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DESIGNED BY: DEM 1/20
DETAILED BY: DNL 1/20
CHECKED BY: AAT 1/20
PROJECT No: 065380005
SCALE: AS SHOWN

SEAL

SHEET
S1.06

20-LM-41-0600

Exhibit D - Page 9 of 16

Kimley»Horn

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

CANAL BRIDGE
DECK DETAILS

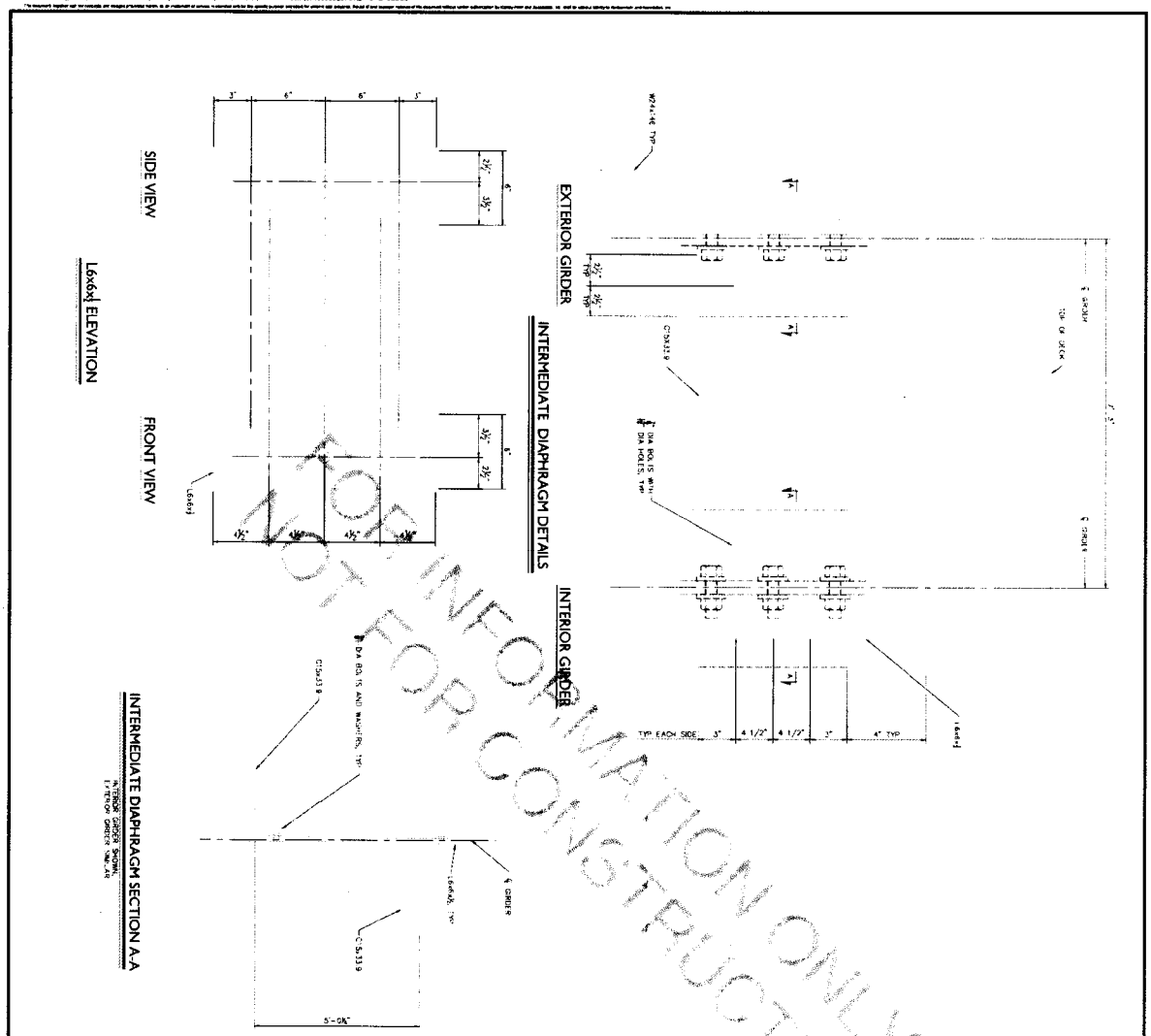
DRAWN BY: DBM 1/20
DESIGNED BY: DML 1/20
CHECKED BY: ZAL 1/20
PROJECT NO: 063560005
SCALE: AS SHOWN

SEAL

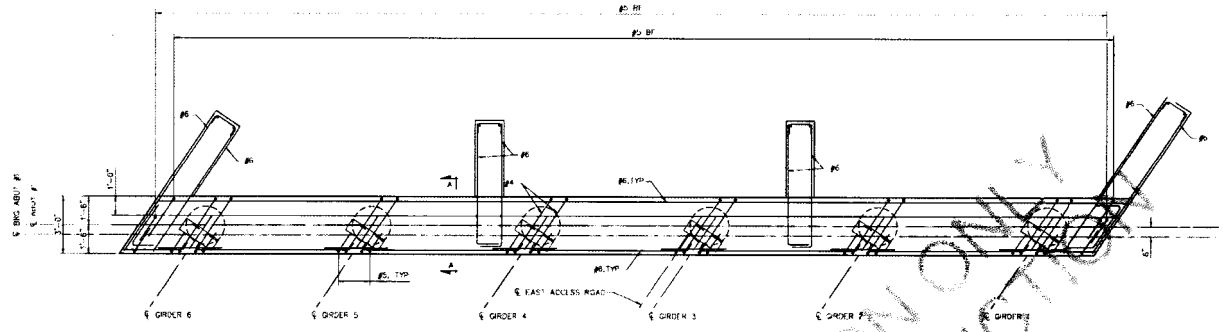
SHEET S1.08

DECK PLAN

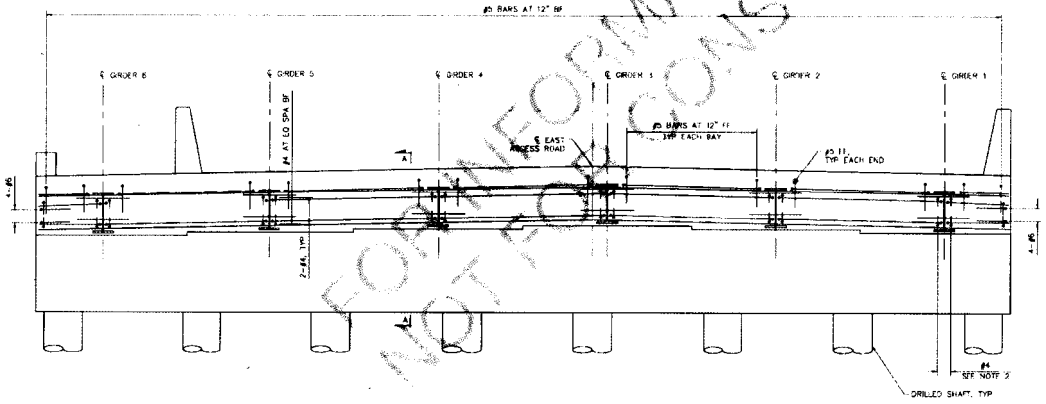
TYPICAL DECK SECTION



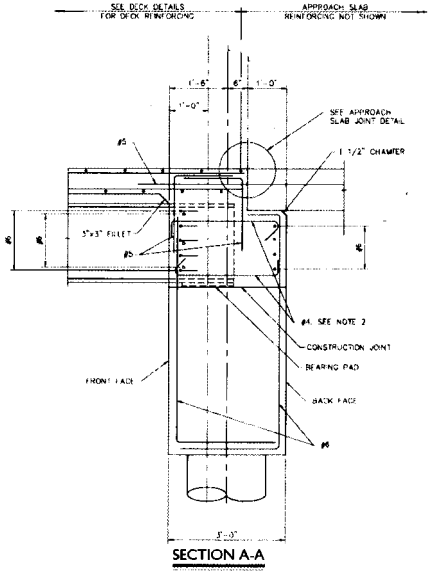
SHEET S1.07	DRAWN BY: DBW 1/20 DESIGNED BY: DNL 1/20 CHECKED BY: ZAT 1/20 PROJECT No.: 0963600005 SCALE: AS SHOWN	CANAL BRIDGE INTERMEDIATE DIAPHRAGM DETAILS WASATCH PEAKS RANCH MORGAN COUNTY, UTAH	Kimley»Horn 215 South State Street, Suite 400 | Salt Lake City, UT 84111 | Tel. No (385) 212-2176	DATE	DESCRIPTION



ABUTMENT #1 PLAN
(ABUTMENT #2 SIMILAR)



ABUTMENT #1 ELEVATION
(ABUTMENT #2 SIMILAR)



SECTION A-A

NOTES

1. SEE "ABUTMENT PLAN AND ELEVATION" FOR ABUTMENT REINFORCEMENT.
2. TIE BARS ON EACH SIDE OF GIRDER WEB.

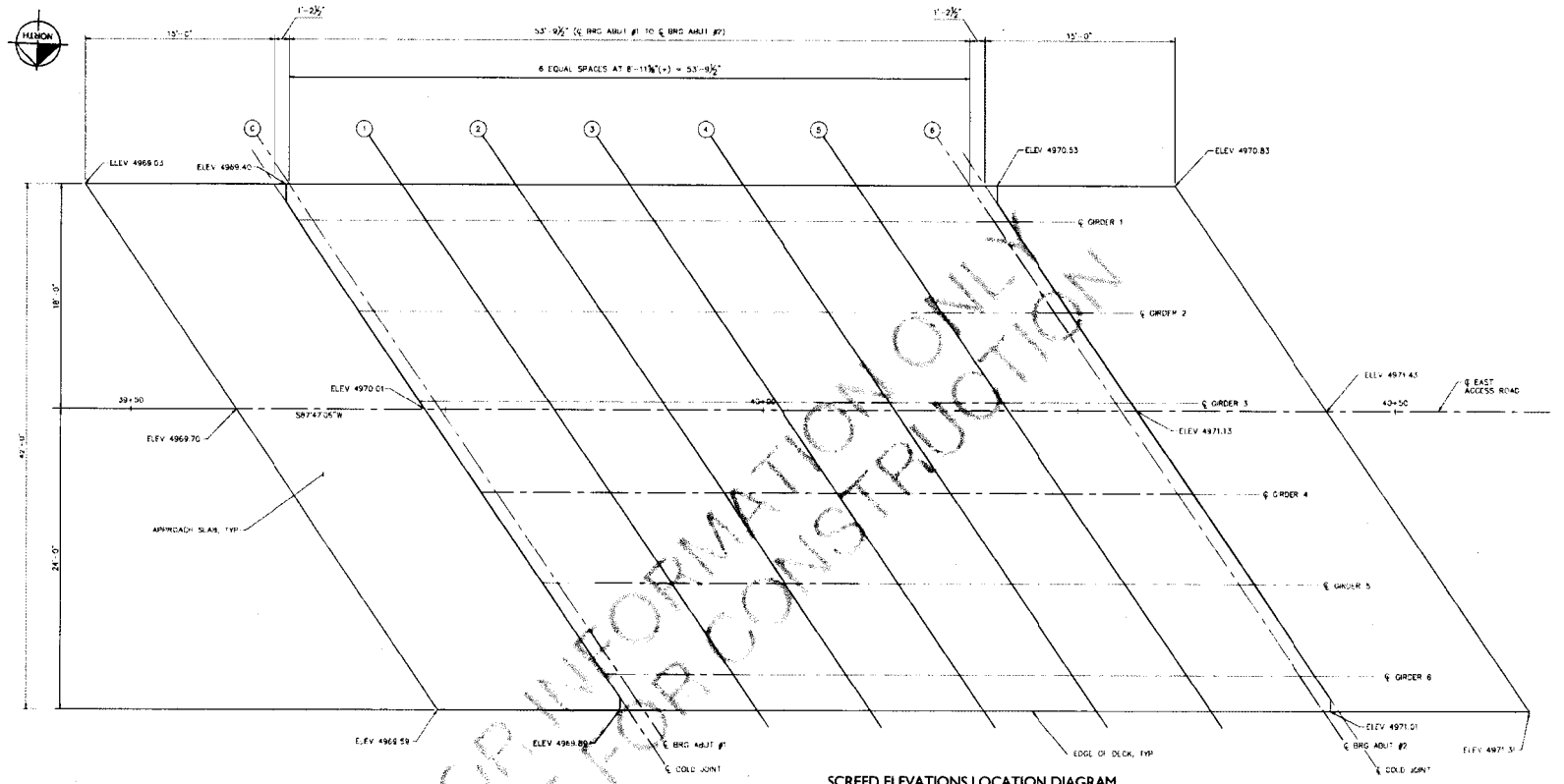
CANAL BRIDGE
DIAPHRAGM PLAN AND ELEVATION

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

Kimley»Horn

DRAWN BY: DBM 1/20
DESIGNED BY: DML 1/20
CHECKED BY: AAT 1/20
PROJECT No: 065800005
SCALE: AS SHOWN
SEAL

SHEET
S1.09



SCREED ELEVATIONS LOCATION DIAGRAM

Screed Elevation Table								
		0	1	2	3	4	5	6
GIRDER 1	ELEV	4969.53	4969.70	4969.88	4970.06	4970.24	4970.42	4970.60
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00
GIRDER 2	ELEV	4969.77	4969.95	4970.13	4970.31	4970.48	4970.66	4970.84
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00
GIRDER 3	ELEV	4970.01	4970.19	4970.37	4970.55	4970.73	4970.91	4971.09
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00
GIRDER 4	ELEV	4969.59	4970.17	4970.34	4970.52	4970.70	4970.88	4971.06
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00
GIRDER 5	ELEV	4969.94	4970.12	4970.30	4970.48	4970.66	4970.83	4971.01
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00
GIRDER 6	ELEV	4970.04	4970.21	4970.39	4970.57	4970.75	4970.93	4971.11
	DL DEFL	0.00	-0.10	-0.16	-0.19	-0.16	-0.10	0.00

SCREED TABLE

NOTES

1. FINAL TOP OF CONCRETE DECK ELEVATIONS ARE SHOWN. ADD DEAD LOAD DEFLECTIONS TO THE TOP OF CONCRETE DECK ELEVATIONS TO OBTAIN SCREED ELEVATIONS.
2. ALL ELEVATIONS AND DEAD LOAD DEFLECTIONS VALUES ARE SHOWN IN FEET.
3. SCREED ELEVATIONS ARE PROVIDED AT INTERSECTIONS OF CENTERLINE OF GIRDER AND SCREED LINE

NO.	DATE	DESCRIPTION
1		

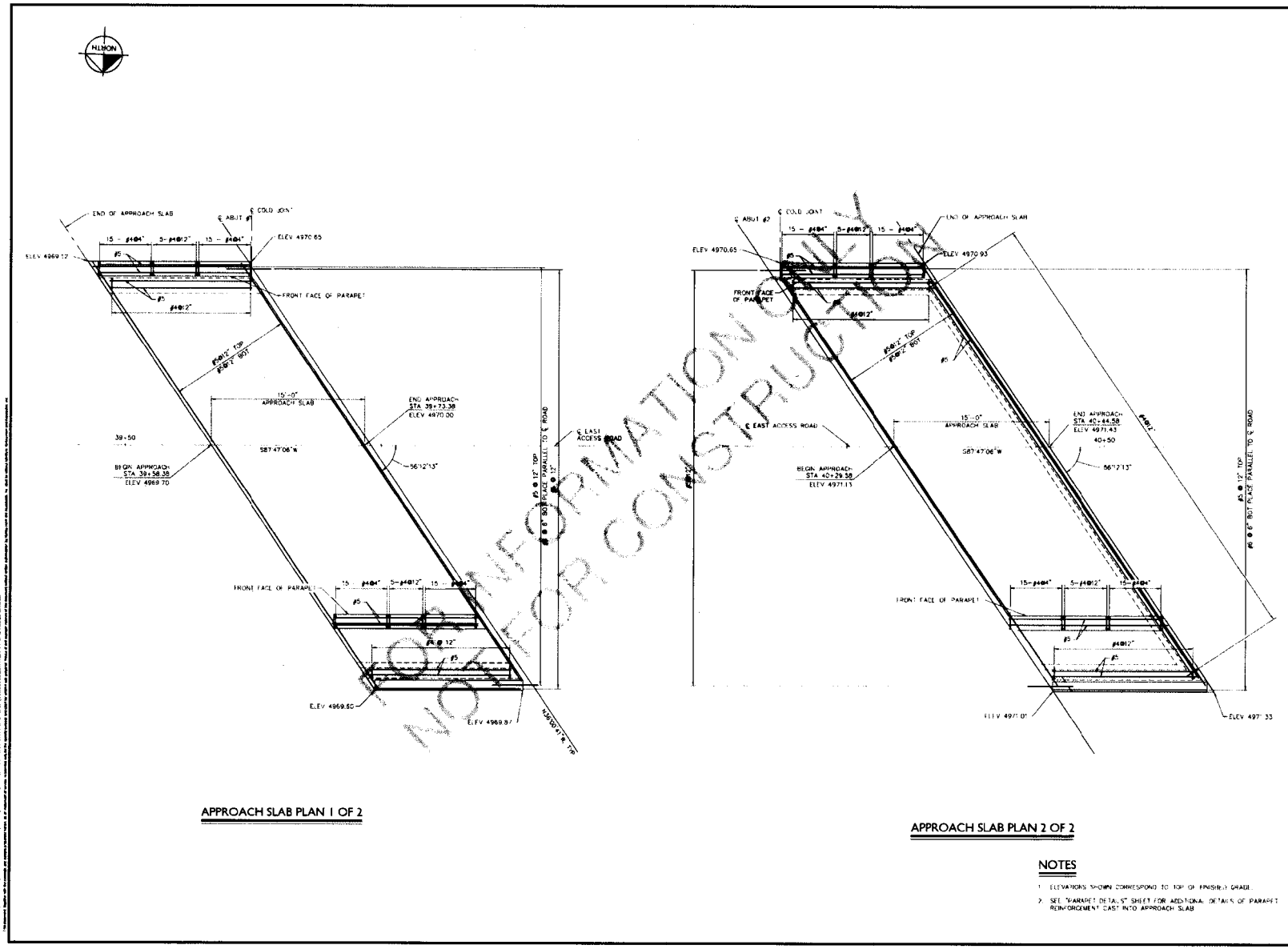
Kimley»Horn
215 South State Street, Suite 200, Salt Lake City, UT 84111 | No. [illegible]

CANAL BRIDGE
SCREED ELEVATION

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DRAWN BY: JSW 1/20
DESIGNED BY: JML 1/20
CHECKED BY: AAL 1/20
PROJECT No: 065800002
SCALE: AS SHOWN
SEAL

SHEET
S1.10



APPROACH SLAB PLAN 1 OF 2

APPROACH SLAB PLAN 2 OF 2

NOTES

1. ELEVATIONS SHOWN CORRESPOND TO TOP OF FINISHED GRADE.
2. SEE "PARAPET DETAILS" SHEET FOR ADDITIONAL DETAILS OF PARAPET REINFORCEMENT CAST INTO APPROACH SLAB

NO.	DATE	DESCRIPTION
1		

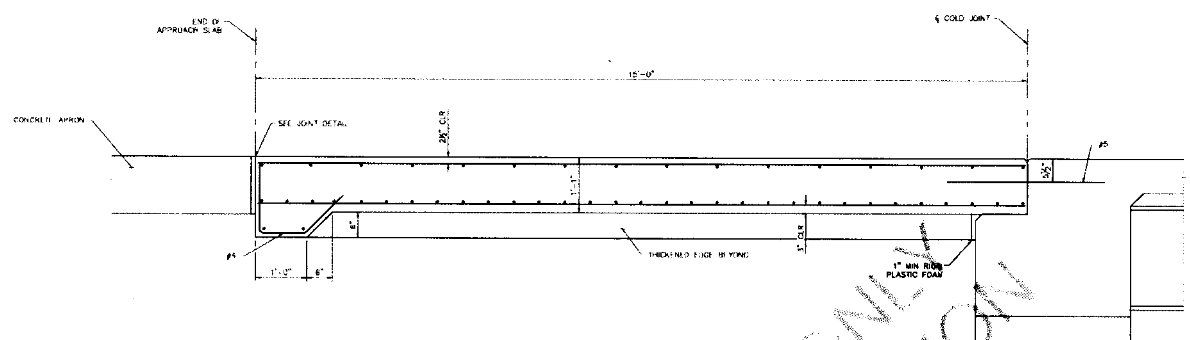
Kimley»Horn
215 South State Street, Suite 100 | Salt Lake City, UT 84111 Fax No
(801) 228-2078

CANAL BRIDGE
APPROACH SLAB PLAN

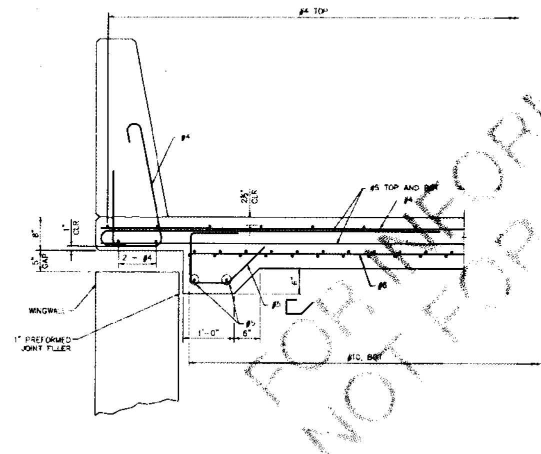
WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DRAWN BY: ____ 1/20
DESIGNED BY: DNL 1/20
CHECKED BY: CAT 1/20
PROJECT No. 065360005
SCALE: AS SHOWN
SEAL

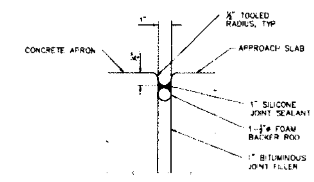
SHEET
S1.11



APPROACH SLAB SECTION



APPROACH SLAB SECTION AT PARAPET



JOINT DETAIL

NOTES

1. APPROACH SLAB SECTION TAKEN ALONG ℄ EAST ACCESS ROAD.

Kimley»Horn

CANAL BRIDGE
APPROACH SLAB DETAILS

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DRAWN BY: DDW
DESIGNED BY: DML
CHECKED BY: ZAT
PROJECT NO.: 098360005
SCALE: AS SHOWN

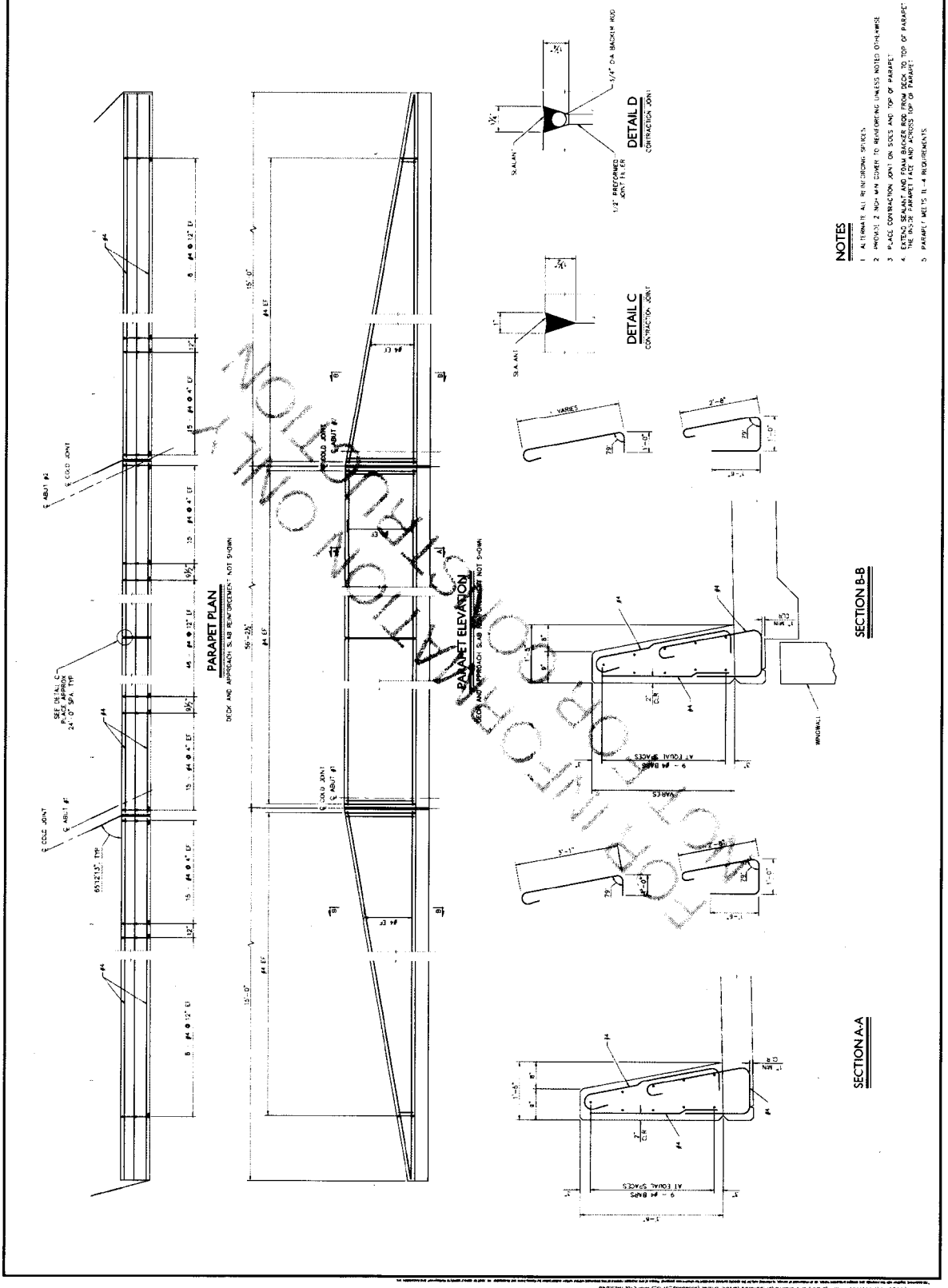
SHEET
S1.12

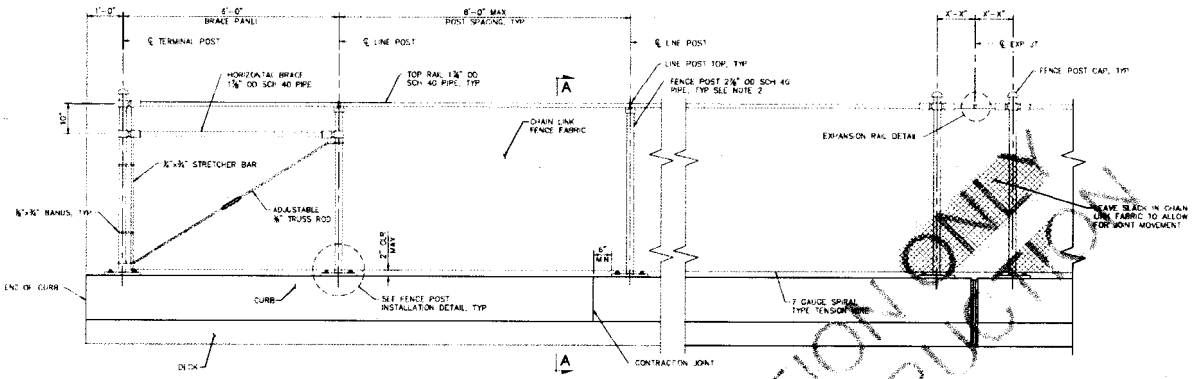
Kimley»Horn

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

CANAL BRIDGE
PARAPET DETAILS

SHEET
S1.13

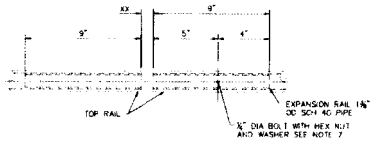




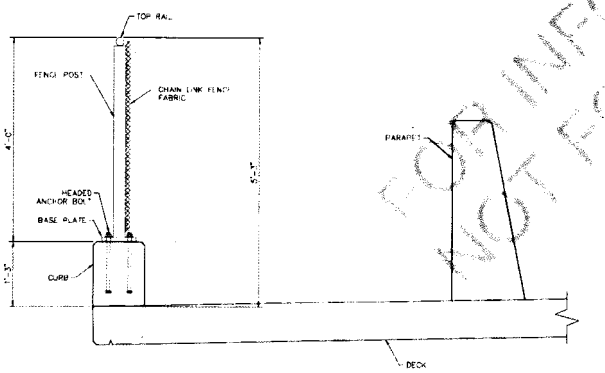
ELEVATION

NOTES

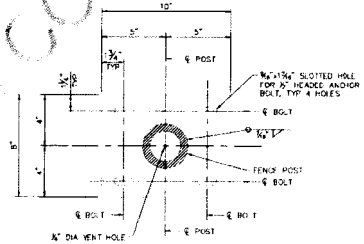
1. PLACE FENCE FABRIC ON TRAFFIC SIDE OF POST.
2. FENCE POSTS ARE PLUMB.
3. FOR DETAILS NOT SHOWN SEE UDOT STD DWG FG 6.
4. CONTRACTOR IS RESPONSIBLE FOR LOCATION AND PLUMBNESS OF ANCHOR BOLTS.
5. ADJUST ANCHOR BOLT LOCATIONS TO AVOID PARAPET REINFORCING STEEL. MAINTAIN MAXIMUM POST SPACING.
6. LOCATE TERMINAL POSTS AT DISCONTINUOUS ENDS OF FENCE AND AT LOCATIONS OF DISCRETE ANGLE CHANGE GREATER THAN 15° HORIZONTALLY OR VERTICALLY. PROVIDE BRACE PANELS ON BOTH SIDES OF TERMINAL POST AS APPLICABLE.
7. INSTALL NUTS FOR EXPANSION RAILS FINGER-TIGHT. NUTS FULLY ENGAGE BOLT WITH A MINIMUM OF ONE BOLT THREAD EXTENDING BEYOND THE NUT. DISTORT THE FIRST THREAD ON THE OUTSIDE OF THE NUT TO PREVENT LOOSENING.
8. PAINT FENCE COMPONENTS AFTER FABRICATION. FENCE COLOR ACCORDING TO FEDERAL STANDARD COLOR SYSTEM NO. 27038.
9. POWDER COAT FENCE COMPONENTS AFTER FABRICATION. FENCE COLOR ACCORDING TO FEDERAL STANDARD COLOR NO. 27038.



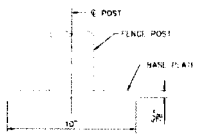
EXPANSION RAIL DETAIL



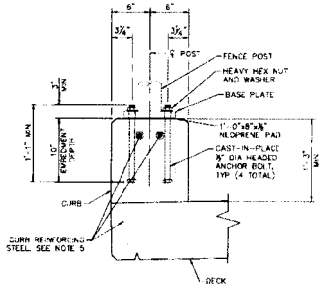
SECTION A-A



BASE PLATE PLAN



BASE PLATE ELEVATION



FENCE POST INSTALLATION DETAIL

NO.	DATE	DESCRIPTION
1		

Kimley»Horn
215 South State Street, Suite 200, Salt Lake City, UT 84111 | FAX 801-xxx-xxxx

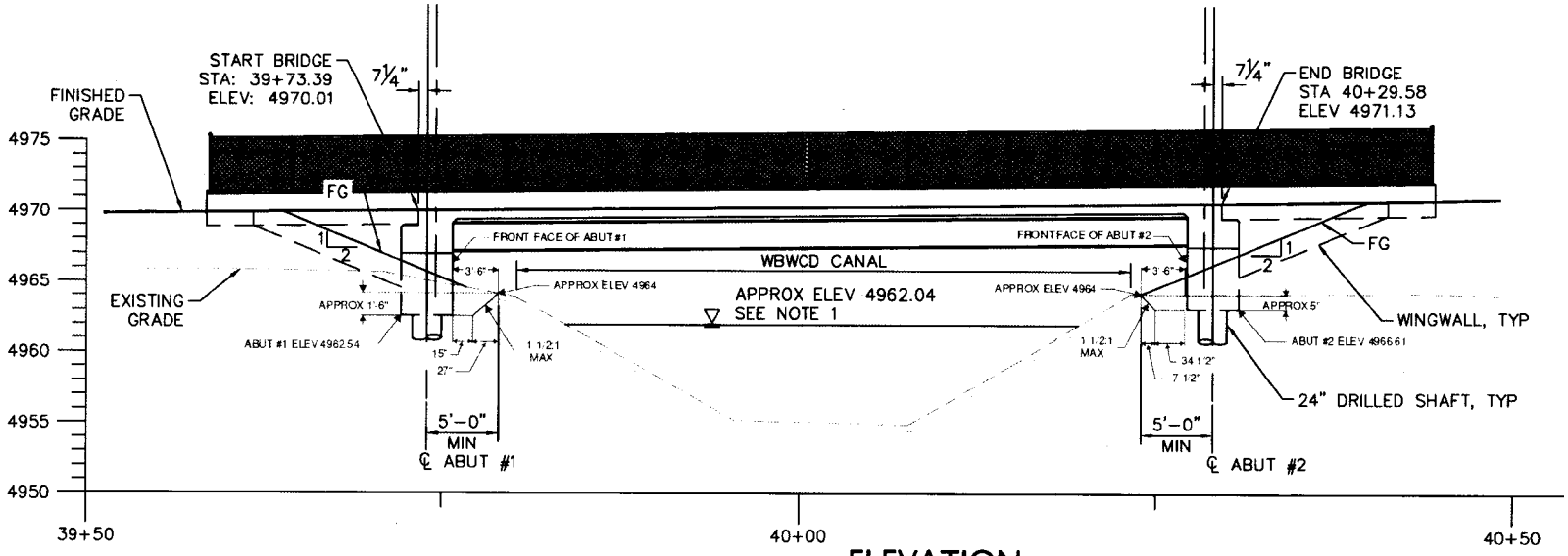
CANAL BRIDGE
CHAIN LINK FENCE DETAILS

WASATCH PEAKS RANCH
MORGAN COUNTY, UTAH

DRAWN BY:	DBW	10/28
DESIGNED BY:	ZAT	10/28
CHECKED BY:	KAS	10/28
SCALE:	AS SHOWN	
PROJECT No:	096388000	

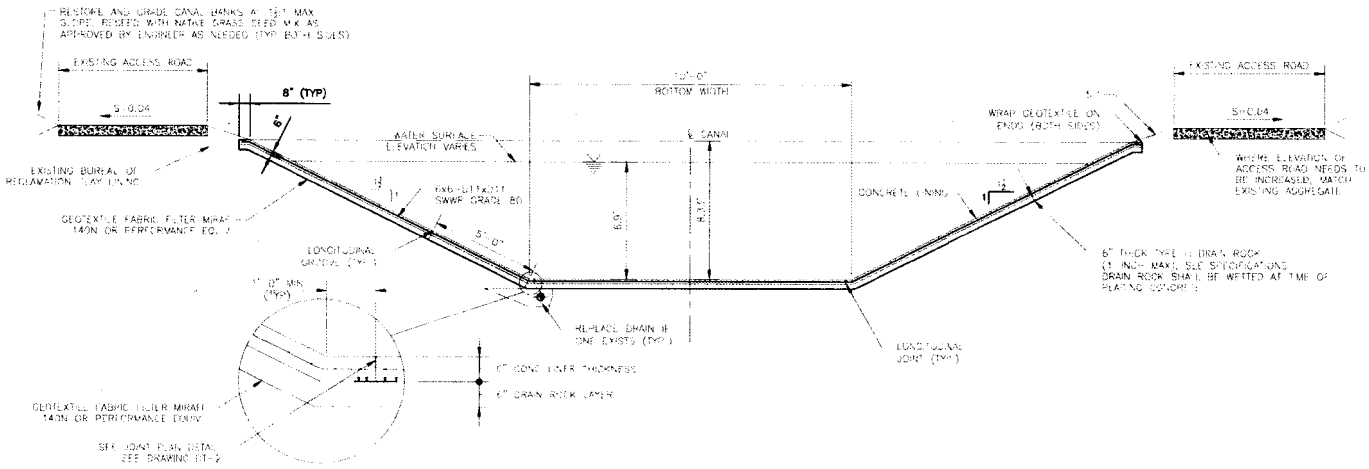
SEAL

SHEET
S1.14

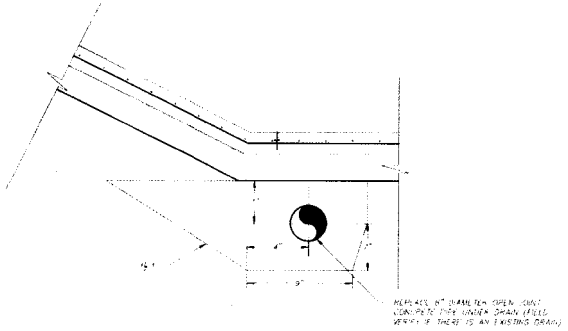


ELEVATION

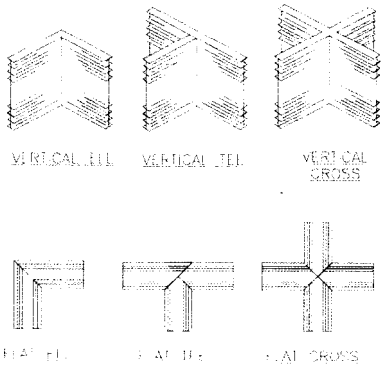
20-LM-41-0600



TYPICAL CHANNEL SECTION (A)
SCALE: 1:5



LONGITUDINAL UNDER DRAIN (B)
SCALE: NTS



FLATSTOP WATERSTOPS (C)
SCALE: NTS

REVISIONS			
Date	Description	Approved	

Designed	Date	
Drawn		
Checked		
Approved		

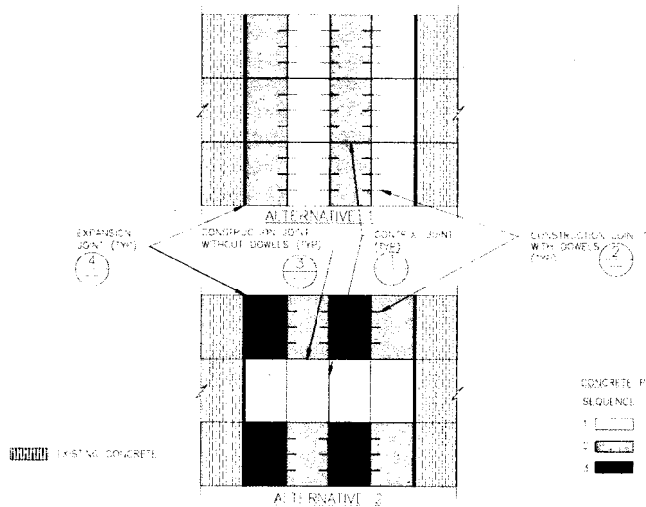
WEBER BASIN WATER CONSERVANCY DISTRICT
2837 East Highway 193
Layton, Utah 84040
(801) 771-1677

GATEWAY CANAL LINING
DETAIL 1

Drawing No.
DT-01
Sheet 1 of 2

PLOT DATE: 9/24/2020
FILE PATH: C:\Users\Corey\Desktop\OneDrive - Weber Basin Water Conservancy District\Engineering\1. Projects\WBR Development Group\CAD\Wasatch Peaks Gateway Canal Lining.dwg

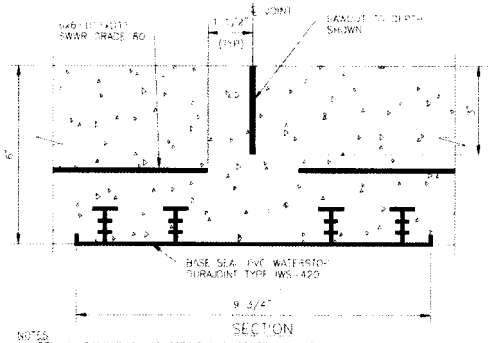
Ent 161569 Bk 393 Pg 1345



COUR SEQUENCING AND JOINT PLAN

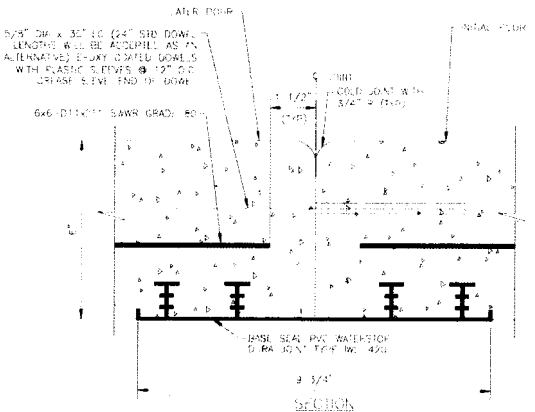
GENERAL NOTES:

1. WATERSTOP SHALL BE SUPPLIED TO SITE IN FLAT LENGTHS. ROLLED MATERIALS WILL NOT BE PERMITTED.
2. HEAT VULCANIZED TEE, CROSSED, AND ELBOW WATERSTOP JOINTS SHALL BE SHOP FABRICATED, SEE (2).
3. WATERSTOP TO BE ADEQUATELY ANCHORED TO FOUNDATION SO THAT THE WATERSTOP DOES NOT MOVE DURING CONCRETE PLACEMENT. METHOD OF ANCHORAGE TO BE APPROVED BY THE ENGINEER.
4. REINFORCEMENT TO BE ANCHORED SO THAT THE REINFORCEMENT MATS DO NOT MOVE DURING CONCRETE PLACEMENT. METHOD OF ANCHORAGE TO BE APPROVED BY THE ENGINEER. REINFORCEMENT SHALL NOT BE GROUNDED.
5. MINIMUM TIME BETWEEN ADJACENT POURS AS SPECIFIED IN 02353 ART. 3.7 PLACE CONCRETE CAN BE REDUCED TO 3 DAYS FOR DOWELED JOINTS WITH SLEEVES, SEE (3&4).
6. JOINT SPACING SHOULD MATCH EXISTING CANAL. APPROXIMATELY EVERY 15'-20FT (FIELD VERIFY).

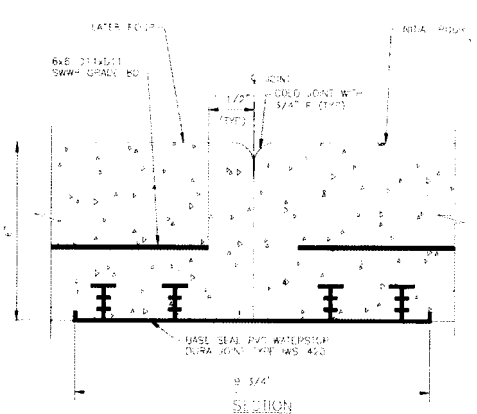


NOTES:
1. SPECIAL CARE SUCH AS STRING LINE CONTROL, KEEPING THE WATERSTOP WARM, FIRE CUTTING SECTIONS TO LENGTH AND STORING FLAT, USING HOG RINGS AND OTHER FASTENING DEVICES TO KEEP THE WATERSTOP IN A STRAIGHT LINE ETC.
2. MARK THE EXACT LOCATION OF THE WATERSTOP ON THE NEWLY PLACED CONCRETE CAN BE SAWCUT IN THE EXACT LOCATION AFTER THE CONCRETE SET AGES.
3. THE SUCCESS OF THIS JOINT IN LARGE PART WILL BE DETERMINED BY THE CONTRACTORS QUALITY CONTROL AND INSTALLATION PROCEDURES TO ASSURE THE WATERSTOP IS PLACED STRAIGHT AND THE SAWCUT CONTROL JOINT IS PARALLEL IN THE VERTICAL PLANE THIS WILL NEED TO BE DEMONSTRATED IN THE FIELD TO THE SATISFACTION OF THE ENGINEER AND THE DISTRICT.

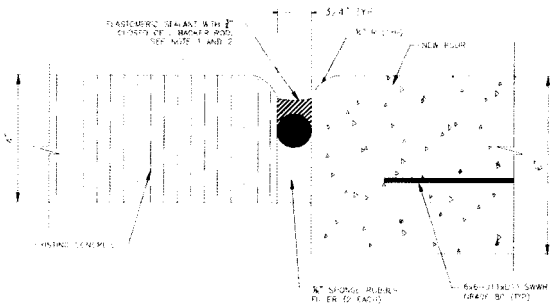
CONTROL JOINT DETAIL
SCALE: NTS



CONSTRUCTION JOINT WITH DOWELS DETAIL
SCALE: NTS



CONSTRUCTION JOINT WITHOUT DOWELS DETAIL
SCALE: NTS



NOTES:
1. THE ELASTOMERIC SEALANT SHALL BE SIKA FLEX 2C NON SAG SEALANT OR APPROVED EQUIVALENT.
2. BACKER ROD SHALL BE HIGHWAY BACKER ROD BY EMMACO, ZEELON, NORTH CAROLINA OR APPROVED EQUIVALENT. INSTALL BACKER ROD IN JOINT PER MANUFACTURERS INSTRUCTIONS.
3. THIS JOINT IS TO BE USED BETWEEN EXISTING CONCRETE AND NEW CONCRETE.

EXPANSION JOINT DETAIL
SCALE: NTS

WEBER BASIN WATER CONSERVANCY DISTRICT
2837 East Highway 193
Layton, Utah 84040
(801) 771-1677

Date	Designed	Drawn	Checked	Approved

REVISIONS			
Date	Description	Approved	

GATEWAY CANAL LINING
DETAIL 2

Drawing No.
DT-02
Sheet 2 of 2

PLOT DATE: 9/24/2020
FILE PATH: C:\Users\Casey\Desktop\OneDrive - Weber Basin Water Conservancy District\Engineering\1. Projects\WBR Development Group\CAD\Wasatch Peaks Gateway Canal Lining.dwg

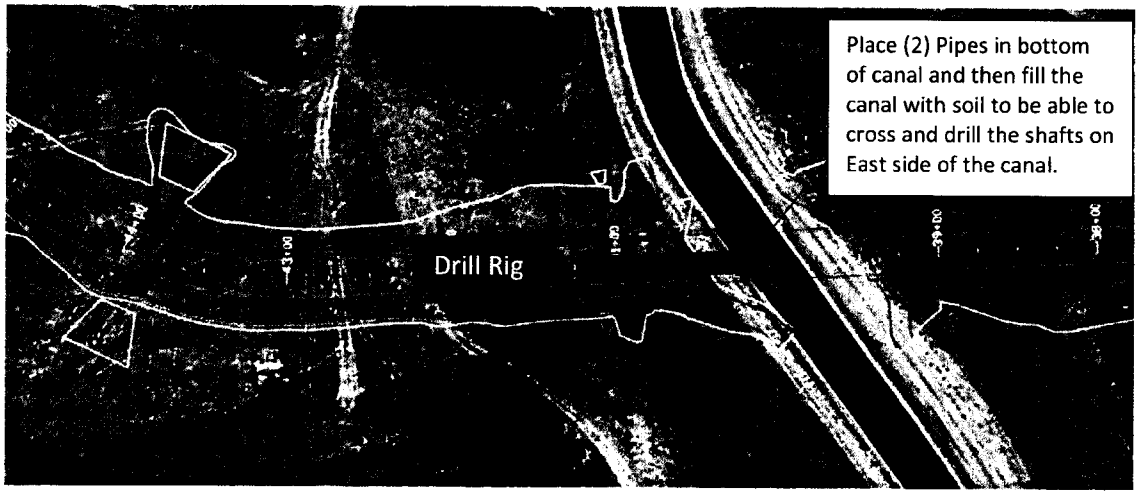
Ent 161569 Bk 393 Pg 1349

WPR Response – 09 18 20

1. Will the drill shaft be cased? If drill mud is used to keep 50ft shaft open more construction details need to be included. Along with construction details showing how rig will get in there and equipment used for the mud.

The piles will not require casing. The CFA piles will be augered all the way to depth (50 to 60 feet). The contractor will then start pumping concrete grout through the hollow stem in the auger bit to a pressure around 30 psi. This pressure is continually monitored as well as monitoring the quantity of concrete being pumped into the hole. As the bit is withdrawn the concrete replaces the void left by the removal of the soil. After the bit is fully withdrawn the rebar cage will be set into place.

The drill rig will be assembled on the west side of the canal and moved across the canal over temporary pipes. The canal panels in the area will be replaced after this effort.



2. Since the pile cap bottom elevation is lower than the top of the canal, need to see details on slope of trench for cap and width of trench to allow placement of framework. There will be limited room if the piles are located 5 feet from the top of the canal liner.

   See attached detail with redlines

3. Also need to show how soil will be finished between the top of the canal and pile cap. Would it just be leveled off?

   The area will be graded with a maximum of 2:1 and a minimum of 2% from the top of the canal to the front face of abutment. (see detail)

4. Looked through the calculations and they did a really good job analyzing the loading for the drilled shafts.

   Noted – Thank you.

5. Did the watermark call out "For Information Only, Not for Construction" get included by mistake on the drawings?

   The bridge plans were provided for reference only at this time. The immediate focus is the foundation / drilling effort to be completed during the upcoming dry up window.

6. It looks like a walkway and fence will be on one side of the bridge for access to pedestrians. (Private or Public?)

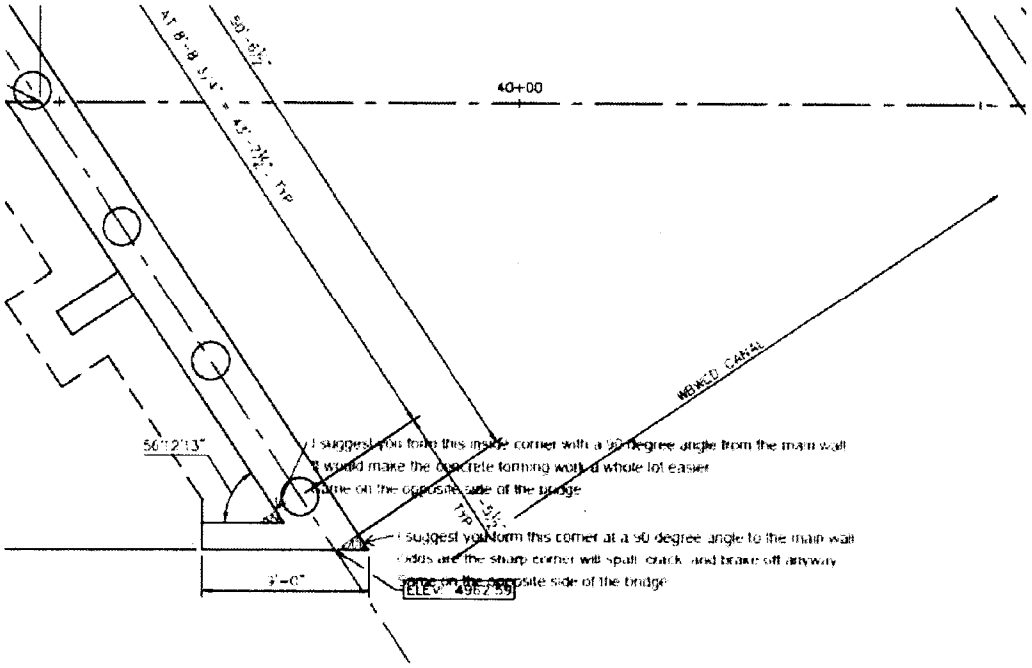
   We have added a 5' sidewalk area to the north side of the bridge – The bridge will not have restricted access however it will be privately maintained (not County maintenance)

7. The seismic loading for the drill shaft was examined in the report and identified there would be a 0.5 inch longitudinal movement during a seismic event. However, the transvers movement from the drill shaft was not provided. If this movement next to the canal lining ranges from 0 to 0.5 inch, it would be reasonable.

   On page 23 of 163 (see attached) in the calculations the transverse movement is shown. We calculated 0.52 inches. This calculation used conservative assumptions so the actual displacement will be less than calculated.

8. Suggest using 90 degree corners rather than sharp acute corners for all of the angles on the bridge. (see image below.)

   NOTED – The change will be reflected on the future bridge submittal for construction.



FOUNDATION PLAN

9. Comments from PDF "SECTION 316300 – CONTINUOUS FLIGHT AUGER PILES
    1. Indicates using the Continuous Flight Auger Piles (CFA) but need more clarification on this type and method used for the drilling of the piles. Is the plan to use the augers to drill the holes and then place mud down the holes to keep them open and then displace the mud with concrete and reinforcement?

       As discussed on the call, the CFA piles will be augered all the way to depth (50 to 60 feet). The contractor will then start pumping concrete grout through the hollow stem in the auger bit to a pressure around 30 psi. this pressure is continually monitored as well as monitoring the quantity of concrete being pumped into the hole. As the bit is withdrawn the concrete replaced the void left by the removal of the soil. After the bit is fully withdrawn the rebar cage will be set into place.

    2. Under "PART 1, Subpart 1.4 – Required Submittals" (Page 3): Reclamation would ask for a copy of all the submittals. Especially, all things related to the installation plan of the piles to ensure the canal won't be damaged during construction.

       Noted - A submittal will be provided prior to construction.

    3. Under "PART 3, Subpart 3.3 H-6 – "Installation" (Page 14, bulletin point 6): Comment says, "Do we want to allow compressed air during drilling? It's not an embankment core, but could it damage the canal?"

There will not be any compressed air used in the hole during this process. All soil spoils will be flushed from the hole with the concrete.

10. **Comment from WBWCD (9/14/2020): Contractor shall send to Weber Basin the final drawings that show the Maintenance Road Realignment.**

    Noted – This will be part of the full approval / bridge process to be completed this winter.

11. **Comment from WBWCD (9/14/2020): Weber Basin is preparing the Canal Lining Details that will be sent out to be included in the plans for the contractor. Once the details are given to Wasatch Peaks, Contractor shall submit the drawings that show the sections of Canal that will be replaced. Wasatch Peaks will pay for the replacement of the Canal lining 20ft upstream and downstream of the Bridge.**

    We are awaiting plans from WBWCD for the panel design but WPR understands that the expectation is to remove and replace panels adjacent (20' upstream / downstream) of the bridge. Whitaker has included a panel design similar to the Willard Bay project and will modify it as requested by WBWCD. All work will be completed prior to November 23rd.

SECTION 02200
EARTHWORK

PART 1 – GENERAL

1.1 THE REQUIREMENT

A. The Contractor shall perform all earthwork indicated and required for construction of the Work, complete and in place, in accordance with the Contract Documents.

1.2 REFERENCE SPECIFICATIONS, CODES, AND STANDARDS

A. Commercial Standards

29 CFR 1926	OSHA Safety and Health Regulations for Construction
ASTM C150	Portland Cement
ASTM D 422	Method for Particle-Size Analysis of Soils
ASTM D 1556	Test Method for Density of Soil in Place by the Sand-Cone Method
ASTM D 1557	Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3) (2,700 kN-m/m^3)
ASTM D 1633	Test Method for Compressive Strength of Molded Soil-Cement Cylinders
ASTM D 2419	Test Method for Sand Equivalent Value of Soils and Fine Aggregate
ASTM D 2487	Classification of Soils for Engineering Purposes
ASTM D 2901	Test Method for Cement Content of Freshly Mixed Soil Cement
ASTM D 2922	Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods
ASTM D 4253	Test Methods for Maximum Index Density of Soils using a Vibratory Table
ASTM D4254	Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density
ASTM D 4318	Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils

ASTM D4832	Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders
ASTM D 5971	Practice for Sampling Freshly Mixed Controlled Low Strength Material (CLSM)
ASTM D 6023	Test Method for Unit Weight, Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low Strength Material (CLSM)
ASTM D 6024	Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
ASTM D 6103	Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

1.3 Contractor SUBMITTALS

A. The Contractor's attention is directed to the provisions of Subpart P, 29 CFR 1926 of the OSHA Safety and Health Standards for Construction which relate to protection of employees in excavations. The Contractor shall submit, for information to the Engineer, the project excavation plan and the name of the Contractor's competent person, prior to commencing any excavation.

B. Submit samples of all materials proposed to be used in the work in accordance with the requirements in Section 01300 - Contractor Submittals. Sample sizes shall be as determined by the testing laboratory.

C. Submit dewatering and water removal plan prior to performing any dewatering or water removal.

PART 2 – PRODUCTS

2.1 SUITABLE FILL AND BACKFILL MATERIAL REQUIREMENTS

A. General: Fill, backfill, and embankment materials shall be suitable material.

B. Suitable Materials: Suitable material is defined as selected or processed clean, well graded earth material, sands and gravels free of excessive fines, less than 20 percent rock and boulders larger than 4 inches, grass, roots, brush, vegetation, or other deleterious materials.

C. Fill and backfill materials within 6 inches of any structure or pipe shall be smaller than 1 inch in any dimension.

D. Suitable materials may be obtained from onsite excavations, may be processed onsite materials, or may be imported. If imported materials are required by this Section or to meet the quantity requirements of the Project, provide the imported materials at no additional expense to the Owner, unless a unit price item is included for imported materials in the bidding schedule.

E. The following types of suitable materials are defined:

1. Type A (Granular Backfill): Crushed rock or gravel, and sand well graded and readily compacted, meeting the following gradation requirements:

Sieve Size	Percentage Passing
1-inch	100
No. 40	15 - 60
No. 200	0 - 15

2. Type B (Crushed Rock): Manufactured angular, crushed rock meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/8-inch	100
No. 4	30 - 50
No. 200	0 - 5

3. Type C (Sand Backfill): Sand meeting the following gradation requirements:

Sieve Size	Percentage Passing
3/4-inch	100
No. 4	80 - 100
No. 10	30-50
No. 40	10-30
No. 200	7 - 15

4. Type D (Select Backfill): Suitable material that can be readily compacted and meets the requirements of AASHTO M 145 classification A-1-a, well graded with a maximum particle size of 2 inches.

Sieve Size	Percentage Passing
2-inch	100
No. 10	30-50
No. 40	15-30
No. 200	0 - 15

5. Type E (Pea Gravel Backfill): Crushed rock or gravel with 100 percent passing a 1/2-inch sieve and not more than 10 percent passing a No. 4 sieve.

6. Type F: (Suitable Trench Backfill): Suitable material that can be readily compacted, with less than 35 percent passing the No. 200 sieve and a plasticity index of 10 or less.

7. Type G (Type II Aggregate Base): Crushed rock aggregate base material conforming to the following gradation requirements:

Sieve Size	Percentage Passing
3/4-inch	100
3/8-inch	75 - 95
No. 4	55 - 70
No. 16	30 - 40
No. 200	2 - 10

8. Type H (Drainrock): Crushed rock or gravel conforming to one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

	Percentage Passing			
Sieve Size	3-inch Max.	2-inch Max.	1-inch Max	3/4-inch Max.
3-inch	100			
2-inch	90 - 100	100		
1-1/2 inch	70 - 100	95 - 100		
1-inch			100	
3/4 inch	0 - 50	50 - 100	90 - 100	100
1/2-inch				95 - 100
3/8-inch	0 - 10	0 - 55	20 - 55	70 - 100
No. 4		0 - 25	0 - 10	0 - 70
No. 8	0 - 5	0 - 15		
No. 200	0 - 3	0 - 3		0 - 3

Minor gradation changes may be accepted, if in the judgment of the ENGINEER, workability and methods of consolidation are such that the drainrock can maintain its desired intent as a free draining subgrade foundation for the concrete canal liner.

9. Type I: Not used.

10. Type J (Cement-Treated Backfill): Material which consists of Type H material, or any mixture of Types B, C, G, and H materials which has been cement-treated so that the cement content of the material is not less than 5 percent by weight when tested in accordance with ASTM D 2901. The ultimate compressive strength at 28 days shall be not less than 400 psi when tested in accordance with ASTM D 1633.

11. Type K (Topsoil): Stockpiled topsoil material which has been obtained at the site by removing soil to a depth as defined in Section 02100 - Site Preparation. Removal of the topsoil shall be done after the area has been stripped of vegetation and debris.

12. Type M (Aggregate Subbase): Crushed rock aggregate subbase material that can be compacted readily by watering and rolling to form a stable base. The sand equivalent value shall not be less than 18 and shall meet one of the following gradation requirements, as shown on the Drawings or approved by the Engineer:

Sieve Size	Percentage Passing 3-inch Max.	2-inch Max.
3-inch	100	-
2-inch	90 - 100	100
1-1/2 inch	-	95 - 100
1-inch	70 - 90	-
No. 4	30 - 65	30 - 65
No. 16	15 - 40	15 - 40
No. 200	2 - 12	2 - 12

13. Type N (trench plug): Low permeable fill material, a nondispersable clay material having a minimum plasticity index of 10.

14. Type O (Controlled Low Strength Material (CLSM)): CLSM shall consist of a mixture of portland cement, aggregate, fly ash, water, and approved admixtures conforming to the following requirements:
    a. Portland Cement: ASTM C150, Type V.
        1) Aggregate: Clean imported sand and gravel or selected material from the excavation, imported material, or a combination thereof as approved by the Engineer. Maximum aggregate size shall be 1 to 3 inches. The soluble sulfate content of aggregate in the mixture shall not exceed 0.3 percent by dry weight.
        2) Water: Potable quality.
        3) Fly Ash: Class C, ASTM C 618 or approved alternate.
        4) The minus 200 sieve fraction shall be nonplastic, as defined by ASTM D 4318. By this standard, a soil is considered nonplastic if either the liquid or plastic limit cannot be determined, or if the plastic limit is equal to or greater than the liquid limit.
    b. Proportion the CLSM to be a flowable, nonsegregating, self-consolidating low shrink slurry. The Contractor shall determine the materials and proportions used to meet the requirements of these Specifications.
    c. The unconfined compressive strength at 7 days shall be a minimum of 100 psi and a maximum of 300 psi. Contractor shall form a minimum of six test cylinders with proposed materials to confirm design strength and mix design. Four of the cylinders shall be broken at 7 days in conformance with applicable concrete cylinder specifications and results provided to Engineer. The remaining two cylinders shall be broken by Contractor at discretion of Engineer. Initial mix design and cylinder breaks shall be completed at least 21 days prior to use of the material on the jobsite. Final mix approval and use of the material shall not occur prior to confirmation of strength by the cylinder breaks.
    d. The temperature of the CLSM discharged into the trench shall be below 90 degrees F.
    e. CLSM backfill under concrete structures shall be protected during curing as specified Section 03300 - Cast-in-Place Concrete.
    f. CLSM shall be tested in accordance with ASTM D 4832, ASTM D 5971, ASTM D 6023, and ASTM D6103

2.2 UNSUITABLE MATERIAL

A. Unsuitable materials include but are not limited to the materials listed below.

1. Soils which, when classified under ASTM D 2487 - Classification of Soils for Engineering Purposes, fall in the classifications of Pt, OH, CH, MH, or OL.
2. Soils which cannot be compacted sufficiently to achieve the density indicated for the intended use.
3. Materials that contain hazardous or designated waste materials including petroleum hydrocarbons, pesticides, heavy metals, and any material which may be classified as hazardous or toxic according to applicable regulations.
4. Soils that contain greater concentrations of chloride or sulfate ions, or have a soil resistivity or pH less than the existing onsite soils.
5. Topsoil, except as allowed below.

2.3 USE OF FILL, BACKFILL, AND EMBANKMENT MATERIAL TYPES

A. Use the types of materials as designated herein for all required fill, backfill, and embankment construction hereunder.

B. Where these Specifications conflict with the requirements of any local agency having jurisdiction or with the requirements of a pipe material manufacturer, notify the Engineer immediately. In case of conflict between types of pipe embedment backfills, use the agency-specified backfill material if that material provides a greater degree of support to the pipe, as determined by the Engineer. In case of conflict between types of trench or final backfill types, use the agency-specified backfill material if that material provides the greater in-place density after compaction.

C. Fill and backfill types shall be used in accordance with the following provisions:

1. Embankment fills shall be constructed of Type F material, as defined herein, or any mixture of Type F and Type A through Type H materials.
2. Pipe zone backfill, as defined under "Pipe and Utility Trench Backfill" below, shall consist of the following materials for each pipe material listed below.
   a. Mortar coated pipe, concrete pipe, and uncoated ductile iron pipe shall be provided with Type A or B material in the pipe zone.
   b. Coal tar enamel coated pipe, polyethylene encased pipe, tape wrapped pipe, and other nonmortar coated pipe shall be backfilled with Type C material in the pipe zone.
   c. Plastic pipe and vitrified clay pipe shall be backfilled with Type B material in the pipe zone.
   d. Where pipelines are installed on grades exceeding 4 percent, and where backfill materials are graded such that there is less than 10 percent passing a No. 4 sieve, trench plugs of Type J or N material shall be provided at maximum intervals of 200 feet unless indicated otherwise.
   e. Type O material shall be used in the pipe zone where shown on plans, specified, or required by the Engineer for special crossings or other locations, or where otherwise approved.
   f. Type E material will not be allowed for backfill within the pipe zone.

3. Trench zone backfill for pipelines as defined under "Pipe and Utility Trench Backfill" shall be Type D backfill material.
4. Final backfill material for pipelines under paved areas, as defined under "Pipe and Utility Trench Backfill" shall be Type G backfill material. Final backfill under areas not paved shall be the same material as that used for trench backfill.
5. Trench backfill and final backfill for pipelines under structures shall be Type A or B, except where concrete encasement is required by the Contract Documents.
6. Aggregate base materials under pavements shall be Type G material constructed to the thicknesses indicated. Aggregate subbase shall be Type M material.
7. Backfill around structures shall be Type F material, or Types A through Type H materials, or any mixture thereof, except as shown.
8. Backfill materials beneath structures shall be as follows:
   a. Drainrock materials under hydraulic structures or other water retaining structures with underdrain systems shall be Type H material.
   b. Under concrete hydraulic structures or other water retaining structures without underdrain systems, Types G or H materials shall be used.
   c. Under structures where groundwater must be removed to allow placement of concrete, Type H material shall be used. Before the Type H material is placed, filter type geotextile fabric shall be placed over the exposed foundation.
   d. Under all other structures, Type G or H material shall be used.
9. Backfill used to replace pipeline trench overexcavation shall be a layer of Type H material with a 6-inch top filter layer of Type E material or filter fabric to prevent migration of fines for wet trench conditions or the same material as used for the pipe zone backfill if the trench conditions are not wet.

2.4 PIPELINE MARKING TAPE

A. Metallic Tape: Tape shall be minimum 5.5 mils thick aluminum foil imprinted on one side, encased in high visibility inert polyethylene jacket. Tape shall be a minimum of 6 inches wide. Imprinted lettering shall be 1 inch tall, permanent black, as indicated. Joining clips shall be manufacturer's standard tin or nickel coated. Tape shall be as manufactured by Reef Industries (Terra "D"), Allen (Detectatape), or equal.

B. Plastic Tape: Tape shall be minimum 4-mil thick polyethylene which is impervious to alkalais acids, and chemicals and solvents which are likely in the soil. Tape shall be a minimum of 6 inches wide and lettering shall be 1-inch tall permanent black on a colored background. Tape shall be manufactured by Reef Industries (Terra Tape), Allen (Markline), or equal.

C. Warning Tape: Warning tape manufactured for marking and identifying underground utilities continuously inscribed with a description of utility, colored as follows:

1. Red; Electric.
2. Yellow; Gas, oil, steam, and dangerous materials.
3. Orange: Telephone and other communications.
4. Blue: Water Systems.
5. Green: Sewer Systems.

2.5 MATERIALS TESTING

A. All soils testing of samples submitted by the Contractor will be done by a testing laboratory of the Owner's choice and at the Owner's expense. At its discretion, the Engineer may request that the Contractor supply samples for testing of any material used in the work.

B. Particle size analysis of soils and aggregates will be performed using ASTM D 422 - Method for Particle-Size Analysis of Soils.

C. Determination of sand equivalent value will be performed using ASTM D 2419 - Test Method for Sand Equivalent Value of Soils and Fine Aggregate.

D. Unified Soil Classification System: References in this Section to soil classification types and standards shall have the meanings and definitions indicated in ASTM D 2487. The Contractor shall be bound by all applicable provisions of said ASTM D 2487 in the interpretation of soil classifications.

E. The testing for chloride, sulfate, resistivity, and pH will be done by a testing laboratory of the Owner's choice and at the Owner's expense.

PART 3 – EXECUTION

3.1 EXCAVATION – GENERAL

A. General: Except when specifically provided to the contrary, excavation shall include the removal of all materials of whatever nature encountered, including rock and all obstructions of any nature that would interfere with the proper execution and completion of the Work. The removal of said materials shall conform to the lines and grades indicated or ordered. Unless otherwise indicated, the entire construction site shall be stripped of all vegetation and debris, and such material shall be removed from the site prior to performing any excavation or placing any fill. Furnish, place, and maintain all supports and shoring that may be required for the sides of the excavations. Excavations shall be sloped or otherwise supported in a safe manner in accordance with safety requirements of the requirements of OSHA Safety and Health Standards for Construction (29CFR1926).

B. Maximum Length of Open Trench: The maximum length of open trench in urban and rural areas shall not exceed 500-feet at each pipe installation heading beyond the end of the installed pipeline, or the requirements of the agency with jurisdiction, whichever is lesser.

C. Construction Delays: In the case of any construction delay in excess of five calendar days, whether Contractor or Owner caused, the Contractor shall backfill the excavation, install temporary paving including temporary traffic markings, and restore traffic to pre-construction condition to minimize disruption to traffic and the community at no additional cost to the Owner.

D. Removal and Exclusion of Water: Remove and exclude water, including storm water, groundwater, irrigation water, and wastewater, from all excavations. Dewatering wells, well points, sump pumps, or other means shall be used to remove water and

continuously maintain groundwater at a level at least 2 feet below the bottom of excavations before the excavation work begins at each location. Water shall be removed and excluded until backfilling is complete and all field soils testing has been completed.

3.2 STRUCTURE, ROADWAY, AND EMBANKMENT EXCAVATION

A. Excavation Beneath Structures and Embankments: Except where otherwise indicated for a particular structure or ordered by the Engineer, excavation shall be carried to the grade of the bottom of the footing or slab. Where indicated or ordered, areas beneath structures or fills shall be overexcavated. The subgrade areas beneath embankments shall be excavated to remove not less than the top 6 inches of native material and where such subgrade is sloped, the native material shall be benched. When such overexcavation is indicated, both overexcavation and subsequent backfill to the required grade shall be performed. When such overexcavation is not indicated but is ordered by the Engineer, such overexcavation and any resulting backfill will be paid for under a separate unit price bid item if such bid item has been established; otherwise payment will be made in accordance with a negotiated price. After the required excavation or overexcavation has been completed, the exposed surface shall be scarified to a depth of 6 inches, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density.

B. Excavation Beneath Concrete Reservoirs: Excavation under reservoirs shall extend to the bottom of the drainrock layer. After such excavation has been completed, the exposed surface shall be rolled with heavy compaction equipment to 95 percent of maximum density and then graded to provide a reasonably smooth surface for placement of the drainrock. Areas under the reservoir upon which fill is to be placed shall be scarified to a depth of 6 inches, brought to optimum moisture content, and compacted to obtain 95 percent of maximum density with moisture content within plus and minus 2 percent of the optimum moisture content.

C. Excavation Beneath Paved Areas: Excavation under areas to be paved shall extend to the bottom of the aggregate base or subbase, if such base is called for; otherwise it shall extend to the bottom of the paving thickness. After the required excavation has been completed, the top 12 inches of exposed surface shall be scarified, brought to optimum moisture content, and rolled with heavy compaction equipment to obtain 95 percent of maximum density. The finished subgrade shall be even, self-draining, and in conformance with the slope of the finished pavement. Areas that could accumulate standing water shall be regraded to provide a self-draining subgrade.

D. Notification of Engineer: Notify the Engineer at least 3 days in advance of completion of any structure excavation and allow the Engineer a review period of at least 1 day before the exposed foundation is scarified and compacted or is covered with backfill or with any construction materials.

3.3 PIPELINE AND UTILITY TRENCH EXCAVATION

A. General: Unless otherwise indicated or ordered, excavation for pipelines and utilities shall be open-cut trenches with widths as indicated.

B. Trench Bottom: Except when pipe bedding is required, the bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe zone. Excavations for pipe bells and welding shall be made as required.

C. Open Trench: All trenches shall be fully backfilled at the end of each day or, in lieu thereof, shall be protected in accordance with Section 01530 – Protection of Existing Facilities. The Contractor shall provide temporary 6-foot chain link fencing panels for protection of all open excavations and trenches within public streets, residential areas, and all other locations with the exception of unimproved open areas where excavations and/or pipeline trenches that can be safely sloped in accordance with current OSHA standards to provide safe access without the use of shoring devices. Temporary fencing panels shall fully enclose open excavations and trenches, and shall remain in place during all non-working hours.

D. Trench Overexcavation: Where trenches are indicated to be overexcavated, excavation shall be to the depth indicated, and backfill shall be installed to the grade of the bottom of the pipe bedding.

E. Overexcavation: When ordered by the Engineer, whether indicated on the Drawings or not, trenches shall be overexcavated beyond the depth and/or width shown. Such overexcavation shall be to the dimensions ordered. The trench shall then be backfilled to the grade of the bottom of the pipe bedding. Overexcavation less than 6 inches below the limits on the Drawings shall be done at no increase in cost to the Owner. When the overexcavation ordered by the Engineer is 6 inches or greater below the limits shown, or wider, additional payment will be made. Said additional payment will be made under separate unit price bid items for overexcavation if such bid items have been established; otherwise payment will be made in accordance with a negotiated price.

F. Where pipelines are to be installed in embankments, fills, or structure backfills, the fill shall be constructed to a level at least one foot above the top of the pipe before the trench is excavated.

G. If a moveable trench shield is used during excavation operations, the trench width shall be wider than the shield so that the shield is free to be lifted and then moved horizontally without binding against the trench sidewalls. If the trench walls cave in or slough, the trench shall be excavated as an open excavation with sloped sidewalls or with trench shoring, as indicated and as required by the pipe structural design.

3.4 OVEREXCAVATION NOT ORDERED OR INDICATED

A. Any overexcavation carried below the grade ordered or indicated, shall be backfilled to the required grade with the indicated material and compaction. Such work shall be performed at no additional cost to the Owner.

3.5 EXCAVATION IN LAWN AREAS

A. Where excavation occurs in lawn areas, the sod shall be carefully removed, dampened, and stockpiled to preserve it for replacement. Excavated material may be placed on the lawn; provided, that a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 hours. Immediately after completion of backfilling and testing of the pipeline, the sod shall be

replaced and lightly rolled in a manner so as to restore the lawn as near as possible to its original condition. Provide new sod if stockpiled sod has not been replaced within 72 hours.

3.6 EXCAVATION IN VICINITY OF TREES

A. Except where trees are indicated to be removed, trees shall be protected from injury during construction operations. No tree roots over 2 inches in diameter shall be cut without express permission of the Engineer. Trees shall be supported during excavation by any means previously reviewed by the Engineer.

3.7 BACKFILL – GENERAL

A. Backfill shall not be dropped directly upon any structure or pipe. Backfill shall not be placed around or upon any structure until the concrete has attained sufficient strength to withstand the loads imposed. Backfill around water retaining structures shall not be placed until the structures have been tested, and the structures shall be full of water while backfill is being placed. Structures shall not be constructed on CLSM backfill until the CLSM has obtained a 7-day minimum cure.

B. Except for drainrock materials being placed in overexcavated areas or trenches, backfill shall be placed after all water is removed from the excavation, and the trench sidewalls and bottom have been dried to a moisture content suitable for compaction.

C. If a moveable trench shield is used during excavation, pipe installation, and backfill operations, the shield shall be moved by lifting the shield free of the trench bottom or backfill and then moving the shield horizontally. Do not drag trench shields along the trench causing damage or displacement to the trench sidewalls, the pipe, or the bedding and backfill.

D. Immediately prior to placement of backfill materials, the bottoms and sidewalls of trenches and structure excavations shall have all loose sloughing, or caving soil and rock materials removed. All materials disturbed from their intact condition that are 4 inches or larger in least dimension or aggregates of soil material thicker than 4 inches shall be removed from the excavation walls and base prior to placing pipe or any backfill material. Trench sidewalls shall consist of excavated surfaces that are in a relatively undisturbed condition before placement of backfill materials.

3.8 PLACING AND SPREADING OF BACKFILL MATERIALS

A. Backfill materials shall be placed and spread evenly in layers. When compaction is achieved using mechanical equipment, the layers shall be evenly spread so that the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness.

B. During spreading, each layer shall be thoroughly mixed as necessary to promote uniformity of material in each layer. Pipe zone backfill materials shall be manually spread around the pipe so that when compacted the pipe zone backfill will provide uniform bearing and side support.

C. Where the backfill material moisture content is below the optimum moisture content, water shall be added before or during spreading until the proper moisture content is achieved.

D. Where the backfill material moisture content is too high to permit the indicated degree of compaction the material shall be dried or mixed with drier material until the moisture content is satisfactory.

3.9 COMPACTION OF EARTH FILL, BACKFILL, AND EMBANKMENT MATERIALS

A. Each layer of Types A, B, C, D, F, G, H, and K backfill materials as defined herein, where the material is graded such that at least 10 percent passes a No. 4 sieve, shall be mechanically compacted to the indicated percentage of density. Equipment that is consistently capable of achieving the required degree of compaction shall be used and each layer shall be compacted over its entire area while the material is at the required moisture content.

B. Each layer of Type E and J backfill materials shall be compacted by means of at least 2 passes from a flat plate vibratory compactor. When such materials are used for pipe zone backfill, vibratory compaction shall be used at the top of the pipe zone or at vertical intervals of 24 inches, whichever is the least distance from the subgrade.

C. Fill on reservoir and structure roofs shall be deposited at least 30 days after the concrete roof slab has been placed. Equipment weighing more than 10,000 pounds when loaded shall not be used on a roof. A roller weighing not more than 8,000 pounds shall be used to compact fill on a roof.

D. Pipe zone backfill materials that are granular, shall be compacted by using vibratory compactors.

E. Equipment weighing more than 10,000 pounds shall not be used closer to structure walls than a horizontal distance equal to the depth of the fill at that time. Hand operated power compaction equipment shall be used where use of heavier equipment is impractical or restricted due to weight limitations.

F. Backfill around and over pipelines that is mechanically compacted shall be compacted using light, hand operated, vibratory compactors and rollers. After completion of at least 2 feet of compacted backfill over the top of pipeline, compaction equipment weighing no more than 8,000 pounds may be used to complete the trench backfill.

G. Compaction Requirements: The following compaction test requirements shall be in accordance with ASTM D 1557, method C. Compaction shall be obtained with the moisture content within plus or minus 2 percent of the optimum moisture content. Where agency or utility company requirements govern, the highest compaction standards shall apply.

Location or Use of Fill	Percentage of Maximum Density
Pipe embedment backfill for flexible pipe	90
Pipe bedding and overexcavated zones under bedding for flexible pipe, including trench plugs	90
Pipe embedment backfill for steel yard piping	---
Pipe embedment backfill for rigid pipe	90
Pipe zone backfill portion above embedment for rigid pipe	90
Pipe bedding and overexcavated zones under bedding for rigid pipe	90
Final backfill, beneath paved areas or structures	95
Final backfill, not beneath paved areas or structures	85
Trench zone backfill, beneath paved areas and structures, including trench plugs	95
Trench zone backfill, not beneath paved areas or structures, including trench plugs	90
Embankments and fills	90
Embankments and fills beneath paved areas or structures	95
Backfill beneath structures and hydraulic structures	95
Backfill and fill around structures on reservoir or structure roof	90
Topsoil (Type K material)	80
Aggregate base or subbase (Type G or M material)	95

3.10 PLACEMENT OF CLSM

A. Following placement and anchoring of the pipe, remove all loose soil from trench walls and floor. Remove any unstable soil at the top of the trench which might fall into the trench during placement of the CLSM.

B. Prior to placement of CLSM, the pipeline steel temperature shall be controlled as specified in Section 02570 - Steel Pipe.

C. Deliver the CLSM to the trench in ready mix trucks and utilize pump or chutes to place the CLSM in the trench. Direct CLSM to one side of the pipe, taking care not to displace the pipe at any time. Continue placing CLSM on one side of the pipe until CLSM has gone under the pipe and up the other side to a depth of 1.5 feet above the pipe bottom. Use at least two hand-held vibrators to continuously liquefy and move CLSM into all voids. Adjust water in mixture to maintain fluid consistency but maintain strength requirements. Continue placing CLSM on both sides of the pipe continuously using two vibrators for every 30 feet of pipe run.

D. Maintain stability of pipe throughout CLSM placement. CLSM will likely require placement in lifts to prevent pipe flotation. No movement of the pipe caused by flotation will be allowed. If any movement occurs, the CLSM material shall be removed and the pipe placed back on line and grade. Any damage to the pipeline system caused by movement of the pipe shall be removed and/or repaired in full conformance with these Contract Documents at no additional cost to the Owner. Remove all sloughed material or other debris from top of previously placed CLSM.

3.11 PIPE AND UTILITY TRENCH BACKFILL

A. Pipe Zone

1. The pipe zone is defined as that portion of the vertical trench cross-section lying between a plane 6 inches below the bottom surface of the pipe and a plane at a point 6 inches above the top surface of the pipe. The bedding is defined as that portion of pipe zone backfill material between the bottom of the trench and the bottom of the pipe. The embedment is defined as that portion of the pipe zone material between the bedding and a plane at a point 6 inches above the top surface of the pipe.
2. After compacting the bedding, perform a final trim using a string line for establishing grade, such that each pipe section when first laid will be continually in contact with the bedding along the extreme bottom of the pipe. Excavation for pipe bells and welding shall be made as required.
3. The pipe zone shall be backfilled with the indicated backfill material. Exercise care to prevent damage to the pipeline coating, cathodic bonds, and the pipe itself during the installation and backfill operations.
4. If a moveable trench shield is used during backfill operations the shield shall be lifted to a location above each layer of backfill material prior to compaction of the layer. Do not displace the pipe or backfill while the shield is being moved.

B. Trench Zone: After the pipe zone backfills have been placed, backfilling of the trench zone may proceed. The trench zone is defined as that portion of the vertical trench cross-section lying between a plane 12 inches above the top surface of the pipe and a

plane at a point 18 inches below the finished surface grade, or if the trench is under pavement, 18 inches below the roadway subgrade.

C. Marking Tape Installation

1. Continuously install metallic marking tape along the pipe at a depth of 3 feet below finish grade.
2. Continuously install plastic marking tape along the pipe at the elevation indicated on the Drawings.

D. Final Backfill: Final backfill is all backfill in the trench cross-sectional area within 18 inches of finished grade, or if the trench is under pavement, all backfill within 18 inches of the roadway subgrade.

3.12 FILL AND EMBANKMENT CONSTRUCTION

A. The area where a fill or embankment is to be constructed shall be cleared of all vegetation, roots and foreign material. Following this, the surface shall be scarified to a depth of 6 inches, moisture conditioned, and rolled or otherwise mechanically compacted. Embankment and fill material shall be placed and spread evenly in approximately horizontal layers. Each layer shall be moistened or aerated, as necessary. Unless otherwise approved by the Engineer, the depth of each uncompacted layer shall not exceed 8 inches of compacted thickness. The embankment, fill, and the scarified layer of underlying ground shall be compacted to 95 percent of maximum density under structures and paved areas, and 90 percent of maximum density elsewhere.

B. When an embankment or fill is to be made and compacted against hillsides or fill slopes steeper than 5H:1V, the slopes of hillsides or fills shall be horizontally benched to key the embankment or fill to the underlying ground. A minimum of 12 inches normal to the slope of the hillside or fill shall be removed and recompacted as the embankment or fill is brought up in layers. Material thus cut shall be recompacted along with the new material at no additional cost to the Owner. Hillside or fill slopes 5H:1V or flatter shall be prepared in accordance with Paragraph A, above.

C. Where embankment or structure fills are constructed over pipelines, the first 4 feet of fill over the pipe shall be constructed using light placement and compaction equipment that does not damage the pipe.

D. The finish graded surface of the drainrock immediately beneath hydraulic structures shall be stabilized to provide a firm, smooth surface upon which to construct reinforced concrete floor slabs. Where needed to protect slopes and prevent movement of the drainrock, spray asphalt on the finished drainrock surface in accordance with Section 02460 - A. C. Pavement and Base.

3.13 FIELD TESTING

A. General: All field soils testing will be done by a testing laboratory of the Owner's choice at the Owner's expense except as indicated below.

B. Where soil material is required to be compacted to a percentage of maximum density, the maximum density at optimum moisture content will be determined in accordance with Method C of ASTM D 1557. Field density in-place tests will be performed in accordance with ASTM D 1556 or by such other means acceptable to the Engineer.

C. In case the test of the fill or backfill show noncompliance with the required density, perform remedies as may be required to ensure compliance. Subsequent testing to show compliance shall be by a testing laboratory selected by the Owner, paid by the Contractor, at no additional cost to the Owner.

D. Provide test trenches and excavations including excavation, trench support, and groundwater removal for the Owner's field soils testing operations. The trenches and excavations shall be provided at the locations and to the depths required by the Owner. All Work for test trenches and excavations shall be provided at no additional cost to the Owner.

E. Frequency of Testing

1. Backfill around structures and in embankments shall be tested every 300 square ft of each lift of placement.
2. CLSM shall be tested each batch being placed or every 300 cubic yards that is placed.
3. Pipe backfill shall have one test every 80 feet (2 joints) of backfill placed.

END OF SECTION

SECTION 316300

CONTINUOUS FLIGHT AUGER PILES

PART 1 — GENERAL

1.1 GENERAL REQUIREMENTS

A. The requirements of the General Contract Documents, General Requirements, and Special Conditions.

B. The applicable provisions of the AASHTO LRFD Bridge Design Specification, 8th Edition

C. Structural Plans and Specifications where the structural requirements are more stringent than those requirements as specified herein.

1.2 SCOPE OF WORK

A. The General Plan and Elevation drawing for the Canal Bridge identifies Drilled Shafts (also referred to as Drilled Piles or Caissons) as the design deep foundation type. The geotechnical report and these specifications identify Continuous Flight Auger (CFA) piles, a.k.a. Augered Cast-In-Place (ACIP) piles, as the "Drilled" pile type for the 24-inch diameter foundation elements. The specifications for CFA or ACIP piles are included herein. ACIP Piles are defined as 24-inch diameter Bored Piles constructed by rotating continuous-flight, hollow-shaft augers into the ground to the specified pile depth, and then injecting grout through the auger shaft as the auger is withdrawn, in such a way as to exert a positive upward grout pressure as well as positive lateral pressure on the soil surrounding the grout-filled pile hole; steel reinforcement is installed after auger removal.

B. The work covered under this Section includes furnishing all materials, tools, labor, equipment and incidentals necessary to complete the installation of CFA piles at the locations shown on the Contract Drawings and as specified herein. The work of this Section shall include, but not be limited to:

1. Furnishing, transporting, storing, and installing CFA piles.

2. Drilling sockets into bedrock and setting and grouting the piles in-place.

C. Cutting and treating the cut ends of piles, as required

3. The installation and testing of CFA ACIP) piles.

1.3 REFERENCES

A. SS-C192 – Federal Specifications for Cements.

B. U.S. Corps of Engineers – CRD 619.

C. U.S. Corps of Engineers – CRD 611.

D. U.S. Corps of Engineers – CRD C556.

E. U.S. Corps of Engineers – CRD C79.

F. ACI 301 Specifications for Structural Concrete.

G. ACI 336.1 Standard Specifications for the Construction of Drilled Piers.

H. ACI 318 – Building Code Requirements for Structural Concrete.

I. ADSC Standards and Specifications for the Foundation Drilling Industry with latest revision dated 1999.

J. ASTM C31 – Standard Practice for Making and Curing Concrete Test Specimens in the Field.

K. ASTM C33 – Standard Specification for Concrete Aggregates.

L. ASTM C39 – Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.

M. ASTM C94 – Standard Specification for Ready-Mixed Concrete.

N. ASTM C937 – Standard Specification for Grout Fluidifier.

O. ASTM C109 - Standard Test Method for Compressive Strength of Hydraulic Cement Mortars.

P. ASTM C942 – Standard Test Method for Compressive Strength of Grouts for Preplaced-Aggregate Concrete in the Laboratory.

Q. ASTM C939 – Standard Method for Flow of Grout for Preplaced-Aggregate Concrete (Flow Cone Method).

R. ASTM C150 – Standard Specification for Portland Cement.

S. ASTM C192 - Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory.

T. ASTM C494 – Standard Specification for Chemical Admixtures for Concrete.

U. ASTM C618 – Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.

V. ASTM D1143 – Standard Test Method for Piles under Static Axial Compressive Load.

W. ASTM D3689 – Method of Testing Individual Piles under Static Axial Tensile Load.

X. ASTM D3966 – Standard Test Method for Piles under Lateral Loads.

Y. ASTM D5882 – Standard Test Method for Low Strain Integrity Testing of Piles.

Z. ASTM D5753 Standard Guide for Planning and Conducting Borehole Geophysical Logging.

AA. ASTM D6167 Standard Guide for Conducting Borehole Geophysical Logging: Mechanical Caliper.

BB. ASTM D6760 Integrity Testing of Concrete Deep Foundations by Ultrasonic Crosshole Testing.

CC. ASTM D7949 – Standard Test Methods for Thermal Integrity Profiling of Concrete Deep Foundations.

DD. Augered-Cast-In-Place Manual, 2016 Edition, prepared by Deep Foundation Institute.

EE. FHWA-HIF-07-03 / GEC 8 "Design and Construction of Continuous Flight Auger (CFA) Piles".

FF. FHWA-NHI-10-016 / GEC 10 "Drilled Shafts: Construction Procedures and LRFD Design Methods".

GG. Geotechnical Engineering Report, prepared by Langan Engineering and Environmental Services, Inc. (LANGAN) dated 1 September 2020 (Geotechnical Report).

HH. Utah Department of Transportation, 2020 Standard Specifications for Roads and Bridge Construction", Section 02466.

1.4 REQUIRED SUBMITTALS

A. Unless otherwise indicated, transmit all submittals to the Construction Manager for review by the Owner's Engineer before proceeding with ordering, fabricating, or any other work of this Section.

B. Submit qualifications of the Pile Contractor. The submittal shall include resumes of the project manager, superintendent, and field foreman in charge of the Work and details of their experience on at least 3 previous projects having similar scope and complexity as described in Article 1.5 C of this Section.

C. Submit shop drawings showing reinforcing steel including couplers, headed bars and reinforcement accessories in accordance with Section "Reinforcement". If

reinforcement is to be welded the submittal shall clearly document the weldability of the reinforcement for the proposed welding procedure.

D. Submit grout and concrete mix design. Mix designs shall be prepared or reviewed by an approved independent testing laboratory retained by the Contractor in accordance with requirements of ACI 301 and ACI 318, signed by a Civil Engineer registered in the State of Utah, and shall be coordinated with design requirements and Contract Documents. Data shall be from the same production facility that will be used for this Project. Mix Design data shall include but not be limited to the following:

1. Design Compressive Strength: As indicated on the Drawings.
2. Proportions: ACI 301 and ACI 318.
3. Gradation and quality of each type of ingredient including fresh (wet) unit weight, aggregates sieve analysis.
4. Water/cement material ratio.
5. Evaluate and classify fly ash in accordance with ASTM D 5759.
6. Report chemical analysis of fly ash in accordance with ASTM C 311.
7. Classify blast furnace slag in accordance with ASTM C 989.
8. Slump: ASTM C 143.
9. Certification and test results of the total water soluble chloride ion content of the design mix - AASHTO T260 or ASTM C 1218.
10. Air content of freshly mixed concrete by the pressure method, ASTM C 231, or the volumetric method, ASTM C 173.
11. Unit Weight of Concrete or Grout: ASTM C 138.

E. The Contractor shall submit, within 7 calendar days after the award of contract, a detailed construction program in the form of a work plan and schedule, for approval. When agreed, the work plan and schedule shall be considered the Construction Program and used by the Contractor for his detailed control of the works and for monitoring construction progress.

F. The Contractor shall furnish all required submittals, including but not limited to samples, calculations, test results, certification reports and shop drawings, at least 2 weeks prior to the start of work, unless specified otherwise.

G. CFA Piles:

1. Submit CFA Pile layout plan referenced to the drawings with a pile numbering system that identifies each pile.

2. Submit details regarding proposed means and methods of augering to meet the embedment presented subsequently in this specification and the referenced documents as well as the proposed grouting and reinforcing installation techniques. All installation equipment mobilized to the site shall be capable of installing the ACIP Piles to the maximum design length plus 10 feet (i.e., capable of installing ACIP Piles to a minimum depth of 60 feet below pile cut off).

3. Submit Automated Monitoring Equipment (AME) system details, Non-Destructive Testing (NDT) techniques and qualifications of NDT firm substantiating a minimum of five (5) years of NDT experience with interpretation of results specifically on CFA Piles.

4. Submit drilling records not later than twenty-four (24) hours after drilling for each pile. The drilling records submitted should include Automated Monitoring Equipment Records and at a minimum shall include pertinent information as it relates to the drilling and grouting phase for each pile. The AME information should be made available real-time in the field in addition to being submitted at the end of the day after drilling of each respective pile.

5. Shop Drawings: For reinforcement, detailing fabricating, bending, supporting, and placing.

H. Load Testing Equipment, Framing, Instrumentation, and Reporting:

1. Load Testing Equipment: Submit shop drawings showing load test set-ups (including bi-directional embedded jack (for example, O-Cell), static top down axial compression, and lateral load tests); bi-directional embedded jack equipment, calibration, and testing procedures, including tell-tale, digital extensometer, and strain gauge installations and monitoring methods; certificate of strain gauge and readout box calibration; data acquisition device(s) calibration, calibration curves for any jacks (not more than 12 months old) signed and sealed by a Utah Licensed Professional Engineer, load cell calibrations, gauge certificates by a recognized local testing laboratory.

2. Submit loading schedule at least 21 days before intended use for review and approval by Geotechnical Engineer.

3. A calibrated load cell shall be placed between the jack and the reference frame as a means of confirming the load during the test. A signed and sealed calibration sheet shall be provided by the Pile Contractor.

4. Load Test Report: For any tests performed using bi-directional embedded jack(s), the pre-approved load testing specialty subcontractor shall submit copies of test reports for each load test immediately (within 3 days) after completion of tests. The report shall include pile load test capacity, tabular and graphical presentation

of gross and net settlement of the pile top (equivalent top load curve), load distribution curves based upon the strain gauge measurements, end bearing versus tip deflection plots, and pile data as prescribed herein.

I. Production Pile Installation Recommendations Report: Based upon the results of the full-scale load tests (if required) and the subsurface information obtained to date, the Geotechnical Engineer will submit a report containing the production pile installation recommendations.

J. Post Construction Pile Location Survey: After completion of pile installation, the Contractor shall provide the Design Professional with an as-built survey showing the actual locations of the piles at cut-off elevations, pile cut-off elevations, and pile numbers determined by a licensed surveyor. The licensed surveyor shall be retained by the Contractor, unless otherwise indicated by the Owner. The results shall be submitted to the Owner, the Architect, the Structural Engineer, and the Geotechnical Engineer. No construction of superstructures shall commence until this survey has been reviewed and accepted by the Structural Engineer. In order to facilitate the progress of the Work, the Contractor shall submit partial pile surveys for approval as the Work proceeds.

K. Material Certificates: From manufacturer, for the following:

1. Cementitious materials.

2. Admixtures.

3. Steel reinforcement and accessories.

L. Material Test Reports: For each material below, by a qualified testing agency:

1. Aggregates: Include service record data indicating absence of deleterious expansion of concrete due to alkali aggregate reactivity.

M. Field quality-control reports.

N. Record drawings.

1.5 QUALITY ASSURANCE

A. The Geotechnical Engineer will log the installation of each pile and will determine when the pile has reached the required depth. No pile installation work shall be performed without the presence of the Geotechnical Engineer. In such instances where inclement weather interferes with the satisfactory installation of ACIP, as determined by the Geotechnical Engineer, the work shall be suspended until more favorable conditions exist. The Contractor shall notify the Geotechnical Engineer a minimum of 72 hours prior to start of pile installation. The Contractor shall cooperate with the Geotechnical Engineer to facilitate the progress of the Geotechnical Engineer's observation work. If the Contractor fails to cooperate with

the Geotechnical Engineer, the Geotechnical Engineer shall notify the General Contractor of the condition; the General Contractor shall take whatever measures are necessary to rectify the condition, including (if necessary) suspending work until any problem is rectified.

B. The Geotechnical Engineer will perform the following quality related items:

1. Review equipment to be used in installing the piles for conformance with the approved submittals.

2. Monitor the load tests.

3. Observe the installation of all piles for compliance with the Contract Documents. Record the depth to which each pile is placed and the amount of material used in each pile. Additionally, record the embedment criteria, the calibration factor, total grout/concrete factor including the number of grout/concrete strokes at 5-foot-intervals, grout return depth, depth of grout or concrete loss (if observed), reinforcing installed and any documented installation or reinforcing installation difficulties.

4. Record unusual conditions if encountered during pile installation.

C. Pile Contractor Qualifications: The Pile Contractor shall be an experienced installer that has specialized in bored pile work with at least five (5) years of experience and evidence of satisfactory completion of ten (10) projects where similar piles have been successfully installed in similar subsurface conditions.

D. Material Testing Agency Qualifications: Qualified, approved and in current status with the Morgan County Building Department.

E. For CFA Piles, the qualified Materials Testing Agency, retained by the Owner, shall prepare, store, and test specimens of pile grout for each shift and for every 50 cubic yards of grout placed, whichever is more frequent, using either of the test methods specified below:

1. Form one set of six (6) 4-inch x 8-inch cylinder molds in accordance with ASTM C39.

2. Perform two tests at 7-day and two 28-day compressive strength tests. Two (2) specimens shall be held in reserve for testing at 56-day should the required strength not be attained at the 28-day break. For each set molded, record:

   a. Flow cone rates utilizing a modified ¾-inch diameter orifice

   b. Spread, or slump flow

   c. Temperature, ambient, and concrete

d. Location of placement

e. Any pertinent information, such as addition of water, addition of admixtures, etc.

F. The Pile Contractor shall execute work in accordance with local and state regulations and codes and in accordance with the regulations of regulatory agencies having jurisdiction over the work.

G. The Pile Contractor shall engage a Utah Licensed Surveyor to perform surveys, layouts, and measurements for CFA Piles.

1.6 FIELD CONDITIONS

A. Site Survey: General Contractor will make available a survey of the site, existing utilities and existing construction. The survey represents all conditions known to the Owner. Other construction, of which no records are available, may be encountered. Contractor shall formulate his/her own conclusions as to the extent of such construction, and shall notify the General Contractor if the survey appears to be at variance with the actual conditions encountered.

B. Existing Utilities: Locate existing underground utilities before excavating for pile installation. If utilities are to remain in place, provide protection from damage during construction operations. Should uncharted or incorrectly charted piping or other utilities be encountered during excavation, adapt drilling procedure if necessary to prevent damage to utilities. Cooperate with Owner and utility companies in keeping services and facilities in operation without interruption. Repair damaged utilities to satisfaction of utility owner.

C. Interruption of Existing Utilities: Do not interrupt any utility to facilities occupied by Owner or others unless permitted under the following conditions and then only after arranging to provide temporary utility according to requirements indicated:

1. Notify Owner no fewer than two days in advance of proposed interruption of utility.

2. Do not proceed with interruption of utility without Owner's written permission.

D. Project-Site Information: General Contractor will make available the 1 September 2020 Geotechnical Engineering Report, prepared by LANGAN. The data is not intended as a representation of warranty of the continuity of such conditions. Owner will not be responsible for interpretation of conclusions drawn therefrom by the Pile Contractor. The data is made available for the convenience of the Pile Contractor and is not guaranteed to represent all conditions that may be encountered. Owner and Geotechnical Engineer are not responsible for interpretations or conclusions drawn from this data.

1. Make additional test borings and conduct other exploratory operations necessary for bored piles at locations and using methods pre-approved by the Owner.

2. Pile Contractor shall immediately, and before performing subsequent work, notify the General Contractor if the provided information appears to be at variance with the actual conditions encountered.

PART 2 — PRODUCTS

2.1 MATERIALS

A. Grout

1. Pile grout shall consist of a mixture of Portland cement, fine aggregate, water, and other approved additives so proportioned and mixed as to produce a grout capable of maintaining the solids in suspension without appreciable water gain and which may be pumped without difficulty.

2. Pile grout shall have a maximum water/cement ratio of 0.41. The grout shall be mixed in accordance with the applicable requirements of ASTM C94.

3. Minimum 28-day compressive strength shall be as indicated on the Contract Drawings.

4. The Contractor shall not use any grout older than the pre-approved maximum specified by the supplier. If the pre-approved maximum time limit is in excess of 90 minutes, the grout supplier shall provide adequate documentation indicating that the grout does not become detrimentally affected beyond this general local industry accepted time limit. The Contractor shall coordinate his grout delivery to meet the above requirement and to assure continuity of work.

5. Concrete Grout Materials and Mix: ASTM C 150 Type II Low Alkali Portland cement. Compressive strength requirement is based on cylindrical specimens made and cured in accordance with ASTM 31 and C 192 and tested in accordance with ASTM C 39 utilizing 4-inch x 8-inch cylinder molds. The mixture components shall be proportioned and mixed to produce a grout capable of maintaining the solids in suspension, which may be pumped without difficulty, which will penetrate and fill open voids in the adjacent soils, and which will allow for placement of reinforcing steel/access tubes within the fluid grout column prior to initial set.

6. Laboratory Trial Batches: When laboratory trial batches are used to select group proportions, prepare and test specimens in accordance with ASTM C 192.

7. Field Experience Method: When field experience methods are used to select group proportions, establish proportions as specified in ACI 301.

8. Strength data for establishing standard deviation will be considered suitable if the grout production facility has certified records consisting of at least 30 consecutive tests in one group or the statistical average for 2 groups totaling 30 or more tests representing similar materials or project conditions.

9. The Contractor may request mix design adjustments when characteristics of materials, job conditions, weather, test results, or other circumstances warrant, at no additional cost to the Owner and as accepted by the Geotechnical and Structural Engineer of Record. Laboratory test data for revised mix designs and strength test results must be submitted at least three working days prior to and accepted by the Geotechnical and Structural Engineer before using in the work.

10. Chemical Admixtures: Morgan County approved retarder, water reducer, hydration stabilizer, and/or superplasticizer, when allowed by the Engineer, conforming to ASTM C 494. Dosage rate shall not exceed manufacturer's recommendations.

11. The piling Contractor shall select and proportion the fine aggregate in the mix to provide a grout having the required strength and workability meeting the intent of this specification.

12. Pozzolan shall be, if used, a finely divided material composed essentially of compounds of amorphous silica, alumina, andiron, which possesses the property of combining lime liberated during the process of hydration of Portland cement, and shall conform to CRD-C262.

13. Fluidifier or other placement aids that inhibit early stiffening, decrease bleeding, eliminate setting shrinkage, increase fluidity, produce the effect of an air entraining agent with respect to freezing and thawing, shall conform to requirements of CRD-C566.

B. Reinforcement

1. CFA Piles shall be reinforced as indicated on the Drawings.

2. Minimum sizes and quantities of all steel reinforcements shall be as shown on the Contract Drawings.

3. Reinforcing steel shall be deformed bars in accordance with ASTM A615 Grade 60. If the reinforcement cage is to be welded, the contractor shall provide documentation that the reinforcement is weldable without adverse effects or use ASTM A706 Grade 60 reinforcing steel.

4. Bar-to-bar cover for all reinforcement shall be not less than 1.5 inches

5. Mechanical couplers shall be per structural drawings.

6. For tensile loading, bar couplers, if required, shall develop the ultimate tensile stress of the bar, without any evidence of failure. For compressive loading, the coupler shall be compatible with efficient load transfer and overall reinforcement performance requirements.

7. Headed bars shall be per structural drawings.

8. Reinforcing Centralizers shall be made from pre-approved fabricated plastic, or a material which does not adversely impact the grout or reinforcing steel. Wood is not permitted to be used. Centralizers shall be designed and installed to maintain the cover specified in the construction drawings. Additionally, centralizers shall be provided at the tip and at maximum 10 foot spacing along the reinforcement to centrally position the reinforcement within the grout filled shaft.

9. Steel cages shall be properly and securely fabricated such that the steel bars and ties maintain their designed locations and configurations. Reinforcement in the form of a cage shall be assembled with additional support necessary to form a cage, which must be lifted and placed without permanent distortion. Inner support links shall not be placed within 30 inches of the Bored Pile cut-off level. Intersection bars shall be fixed together by approved means. Hoops, links or helical reinforcement shall fit closely around the main longitudinal bars and be bound to them by approved wire, the ends of which shall be turned into the interior of the shaft. Alternate method of cage fabrication will be considered. Reinforcement shall be placed and maintained in position to provide the specification projection of reinforcement above the final cut-off level.

10. The number of laps in longitudinal steel bars shall be kept to a minimum. Joints in reinforcement shall be such that the full strength of the smaller of the bars being lapped is effective across the joint and shall be made so that there is no detrimental displacement of the reinforcement during the construction of the shaft. All splices shall be staggered so they do not occur at the same level within the shaft.

C. Water

1. Water shall be fresh, clean, and free from injurious amount of sewage, oil, acid, alkali, salts, or organic matter. The maximum water, which can be added on site per the mix design, shall be pre-agreed upon and shall be marked on each grout batch ticket delivered to the project site.

PART 3 — EXECUTION

3.1 PREPARATION

A. Protect the WBWCD canal liner, utilities, sidewalks, pavements, and other facilities from damage caused by settlement, lateral movement, vibration, and other hazards created CFA Pile operations.

B. The Contractor shall obtain and pay for all necessary permits to perform the work from the appropriate authorities and agencies prior to start of such work. Obey all applicable local and federal work safety rules and regulations.

C. Install all necessary protection equipment, structures such as fences, signs, scaffolding etc. prior to start of work.

D. Remove all existing structures, utilities, pavement in accordance with the Contract Documents.

E. CFA Piles shall be located as indicated on the Drawings or as otherwise directed by the General Contractor.

F. Contractor shall clearly mark the leads on the foundation drill rigs, to the satisfaction of the Geotechnical Engineer, in one foot intervals to facilitate manual logging of the pile installation versus depth.

3.2 WORKING PLATFORM

A. Piles may be constructed from a working platform above foundation level.

B. If the Piles are constructed from a working platform above foundation level and a temporary casing is used to support the soil, the temporary casing may not be extracted until the pile concrete has set to prevent collapse of soil into the fresh concrete. The minimum set time will be provided by the Geotechnical Engineer and Structural Engineer based on observed concrete set time.

3.3 CFA PILES

A. CFA piles shall be located as indicated on the Drawings or as otherwise directed by the General Contractor.

B. Piles shall not be installed within six pile diameters, measured center-to–center, of any pile filled with grout less than 12 hours old. This spacing requirement is a general industry and building code suggested provision; however, should additional distance be required so as not to adversely impact recently completed piles, the Pile Contractor shall implement the appropriate spacing in the sequencing of installing piles.

C. In the event that material is encountered which prevents placing of a pile to the depth required, the short pile shall be completed as described in this Specification, and if necessary, an additional adjacent pile shall be placed as directed by the General Contractor.

D. Pile diameter or bottom of pile elevation may be revised by the Geotechnical Engineer as a result of subsurface information obtained during pile installation or as a result of pile load tests, if completed.

E. Pile cut-off may be accomplished by cutting off grout down to final cut-off point after 7-days after initial set has occurred, and such that no damage to the pile to remain below cutoff occurs. Removal of grout upon completion from the ground surface via dipping or other means will not be permitted, unless pre-approved by the Geotechnical Engineer. Appropriate sleeves or other means shall be implemented to prevent soil from contaminating freshly placed grout at the approximate ground surface.

F. The pile contractor shall fabricate the reinforcement cage and tie the longitudinal bars to the spirals or ties so they remain in place, during lifting and installation.

G. Grout:

1. The grout volume shall be determined by pre-calibrating the pump and through the use of a flow meter, which is installed as part of an overall AME system on each piling installation rig. The grout volumes on the AME records shall utilize the results of the flow meter and shall not utilize the manual calibration factor. As a backup only, shall the AME records utilize the manual calibration factor along with the manual logging versus depth.

2. The quantity of water used shall be such as to produce a grout having a consistency of not less than 18 seconds but not more than 36 seconds when tested with a flow cone in accordance with Corps of Engineers Specifications CRD C79. Workability of the grout mix shall be such that the piles can be installed properly in accordance with this specification. Time of mixing shall be not less than one minute. If agitated continuously, the grout may be held in the mixer or agitator for a period not exceeding 90 minutes. If there is a lapse in the operation of grout injection, the grout shall be recirculated through the pump, or through the mixer drum (or agitator), and pump.

3. Hot Weather Placement: Grout shall not exceed a temperature of 90°F during mixing or pumping. The mixing water shall be cooled as required to maintain this temperature limit.

4. Cold Weather Placement: Outside air temperature shall be 40°F and rising for the grouting operation unless special precautions, as approved by the Material Testing Agency, are maintained to keep the grout at 55°F or higher.

H. Installation:

1. Only approved mixing and pumping equipment shall be used in the preparation and handling of pile grout. A screen to remove oversize particles shall be used between the mixer and pump, or between the mixer and agitator.

2. Oil or other rust inhibitors shall be removed from the mixing drums, stirring mechanisms, and other portions of the equipment in contact with the grout before the mixers are used.

3. Sufficiently high-powered augering equipment shall be provided as it relates to torque, crowd and dead weight in combination with appropriately designed augers, cutter heads, tooling, bits and installation techniques (i.e., compressed air, etc.) to comply with the installation embedment criteria. Auger refusal obtained prior to meeting the embedment will not be permitted as a means of terminating a particular pile at a higher level.

4. Augering shall be accomplished by the rotation of a continuous flight auger into the ground to the embedment as determined by the on-site Geotechnical Engineer or their designated representative at each pile location.

5. The piling rig shall be equipped with an Automated Monitoring Equipment to facilitate automated recording of at least the following: depth during augering, inferred torque, crowd, depth during grouting, grout volume per increment, total grout volume and grout return depth. Additionally, the grout injection equipment shall be provided with a grout pressure gage in clear view of the equipment operator and the grout pump shall be equipped with a stroke counter.

6. The hole in the bottom of the auger shall be plugged while the auger is advanced into the ground, unless compressed air drilling techniques are utilized. If compressed air drilling techniques are utilized, positive checks shall be provided to ensure compressed air injection is stopped prior to grout injection. The Pile Contractor shall also coordinate installation sequences and timing such that neither the compressed air nor the grouting pressures can cause heave of the ground surface or impact completed piles. Prior to grouting, if necessary, the auger may be raised a distance of 1 foot or less to facilitate removal of the plug in the tip of the auger. The auger shall be immediately lowered to the bottom of the hole to ensure contact between the fluid grout and the bottom of the augered hole prior to establishing the required initial grout head. The auger shall remain rotating when the grout is being pumped and shall have a positive rotation throughout the pumping process. Prior to extraction of the auger, a minimum grout head of 10 feet shall be established.

7. As the auger is withdrawn at a steady rate while maintaining positive rotation of the auger, grouting pressures shall be measured and maintained high enough at all times to offset hydrostatic and lateral earth pressures. The rate of grout injection and auger withdrawal shall be coordinated so as to maintain the minimum grout head at all times, and the total volume of grout to be at least 115% of the theoretical volume for each pile depth increment. After grout is flowing at the ground surface from the auger flighting, the rate of grout injection and auger withdrawal shall be coordinated so that there is at least 100% of the theoretical volume of each subsequent depth increment. If grout pumping is interrupted for any reason, or discontinued grout or slurry return at the ground surface is observed, the Pile Contractor shall lower the auger 5 feet below the level where the interruption occurred while continuously pumping grout. If for any reason the pile grouting operation is interrupted substantially, the auger is raised too fast or grout return/slurry return does not quickly return after lowering

the auger 5 feet, the auger shall be lowered to the bottom of the hole and the pile shall be regrouted, if deemed necessary by the on-site Geotechnical Engineer or their designated representative. The grout quantity and rate of auger withdrawal shall be determined utilizing both the AME equipment and manual logging utilizing the pre-determined grout volume per pump stroke.

I. The following post-installation items shall be adhered to:

1. Installed piles shall be periodically checked by the Pile Contractor to determine if the grout in the piles has settled. If the grout level drops more than about 1 foot, the top of the pile shall be purged and fresh grout added to the top of the pile prior to the grout reaching its initial set so as to maintain the proper elevation. At no time shall the Contractor allow the grout to settle below the cut-off elevation.

2. Any damage to the pile during excavation or pile cutting shall be the responsibility of the Pile Contractor unless otherwise indicated by the General Contractor. If the Structural Engineer determines that a damaged pile can be repaired, the Pile Contractor shall do so at his own expense and in accordance with the Structural Engineer's recommendations. If replacement piles are required as determined by the Structural Engineer, the Pile Contractor shall install the replacement piles at no additional cost to the Owner.

3. The Pile Contractor shall remove all materials excavated by augering and any excess grout from within the foundation area and dispose of the materials as directed by the General Contractor or the Owner.

4. The Pile Contractor shall not demobilize his equipment from the project site until all piles necessary are installed and accepted by the Geotechnical Engineer and Structural Engineer, or until directed to do so by the General Contractor or Owner.

3.4 TEST PILES AND LOAD TESTS

A. Indicator piles and test piles shall be installed and conducted by the Pile Contractor and at locations approved by the Geotechnical Engineer prior to the installation of production piles.

B. The indicator and test piles shall be installed with the same equipment and under the same placement conditions as will be used for the production piles.

C. A minimum of one (1) compression test pile shall be installed per each abutment and at locations approved by the Structural and Geotechnical Engineer. Compression load tests shall consist of a pre-approved and pre-calibrated instrumented bi-directional embedded jack (for example, O-Cell), or top down axial load tests. The locations shall be laid out by the project Surveyor to ensure future conflicts with production piles do not occur.

D. Post-Construction Integrity Testing shall be performed as specified in Article M of this Section.

E. The Pile Contractor shall provide a registered professional engineer in the State of Utah experienced in pile load testing to design and conduct the testing program.

F. The reaction system for the compression test piles shall be designed by the piling Contractor. The reaction piles must be installed to sufficient depths and shall have proper reinforcement or anchors to provide sufficient, uplift and compressive resistance to permit proper load transfer to the test piles. If the reaction piles fail during load testing, the Contractor shall bear the cost associated with that failed test and do whatever is necessary to conduct a successful test. No reaction piles shall be installed at production pile locations unless pre-approved by the Geotechnical and Structural Engineers.

G. Test loads shall not be applied to the test piles until the pile grout/concrete has attained sufficient strength as determined by the Structural and Geotechnical Engineers, based on their review of the grout/concrete strength test results. In no case shall the load test be done in less than 14 days after grout/concrete placement. A total of two supplemental grout/concrete samples shall be tested on the day of the compression load test to confirm the modulus of the grout/concrete for interpretation of the strain gauge data. The determination of the modulus shall be in accordance with ASTM C469.

H. The instrumented bi-directional embedded jack shall be aligned within the pile at a depth such that sufficient reaction can be provided to resist the maximum test loads.

I. Bi-directional load tests and embedded jack load tests shall be performed using quick loading procedures in accordance with ASTM D1143.

1. Test piles will be considered as having passed the load test based on the criteria described above for top down axial load tests.

2. Telltales and extensometers shall be installed in each test pile, such that plate movement, tip of pile and top of pile movements can be determined.

J. Bi-directional embedded loading jack(s) shall be configured in sufficient number and arrangement to achieve the minimum load applied in each direction as required by the Geotechnical Engineer. The top down loading (jack/pump/gauge) system shall be capable of achieving the minimum test loads as required by the Geotechnical Engineer.

K. Compression load tests shall be instrumented as follows:

1. Pile movement during load tests shall be measured with gauges accurate and readable to 0.001 inch shall be provided by the Pile Contractor for each test to determine the amount of movement during testing. An independent and stable

reference frame meeting the dimension and material requirements of ASTM for each respective test shall be provided by the Pile Contractor.

2. Test piles for the compression load test shall be instrumented with strain gauges to determine the load at selected depths within the pile at each load interval during testing as follows:

   a. The strain gauges shall be installed within the compression test piles shall be vibrating wire sister bar gauges, Model No. 4911 (sister bar gauges) as manufactured by Geokon, Inc. or equivalent, at a minimum of 3 levels. Each strain gauge shall be installed within the reinforcing cage as recommended by the manufacturer. The strain gauge wires shall be securely attached to the reinforcing cage to prevent movement during installation.

   b. The depths and locations of the gauges will be provided by the Geotechnical Engineer at a later date.

   c. The Pile Contractor shall provide a suitable data acquisition system or read out box and qualified personnel to obtain the data. The Pile Contractor shall be responsible for keeping the data acquisition system in working order at all times. The Pile Contractor shall confirm the initial readings and serial numbers of the strain gauges prior to insertion into each respective test pile.

L. Upon completion of the load test, the test piles shall be overloaded to a maximum test load of the maximum capacity of the jack/pump/gauge system. This overload should be at least 250% of the design load.

M. Post-Construction Integrity Testing

1. Post Construction Integrity Testing shall consist of Non-Destructive Testing (NDT). The post-construction integrity testing and analysis shall be performed by an experienced specialty Independent Testing Agency (ITA) contracted by the Contractor.

2. Frequency of Post-Construction Integrity Testing:

   a. All test piles shall be subject to integrity testing prior to performing the load tests. Depending on the results of the load test program, production piles may be subject to integrity testing. For bidding purposes, the contractor shall assume that integrity testing will be performed on 5 percent of the production CFA Piles. The first three production piles shall be subject to integrity testing. If all elements are accepted, the remaining piles shall be tested only at the discretion of the Geotechnical Engineer.

3. Non-Destructive Testing of CFA Piles:

a. NDT includes Thermal Integrity and Sonic Echo and Impulse Response Methods. The compression test piles shall be tested utilizing non-destructive, pre-attached thermal wires to accomplish thermal integrity testing and confirm the integrity of the constructed piles from the top of the pile to the tip of the pile. All NDT testing should be accomplished by firms experienced with thermal integrity testing techniques. A unit price should be provided for additional thermal integrity testing which may be required per the Geotechnical Engineer on production elements. A unit price shall also be provided for Sonic Echo and Impulse Response testing should top impact NDT be required by the Geotechnical Engineer on production elements.

4. Acceptance Criteria:

a. The Engineer will determine the acceptance of the NDT and CSL test results and will provide a response to the Contractor within three days after receiving the test results and analysis submittal from the ITA.

b. For all CFA Piles determined to be unacceptable, the Contractor shall submit a plan for remedial action to the Engineer for approval. All modifications to the dimensions of the piles, as shown in the Plans, required by the remedial action plan shall be supported by calculations and working drawings. All remedial correction procedures and designs shall be submitted to the Engineer for approval. The Contractor shall not begin repair operations until receiving the Engineer's approval of the remedial action plan. The design and construction of the remedial measures shall be at the Contractor's sole expense with no additional cost to the Owner.

c. At the Engineer's direction, the Contractor shall drill core holes in any pile of questionable quality (as determined from NDT or testing and analysis or by observation of the Engineer) to explore the shaft condition.

d. Prior to beginning coring, the Contractor shall submit the method and equipment proposed for use to drill and remove cores from the piles to the Engineer and receive the Engineer's written approval. The coring method and equipment shall provide for complete core recovery and shall minimize abrasion and erosion of the core.

3.5 TOLERANCES

A. Pile centers shall be located to an accuracy of within 3" of specified plan location.

B. Top of pile elevation shall be within plus or minus 2 inches of the elevation indicated on Contract Documents.

C. Deficient Piles: Piles with a drop in grout level, piles that failed to attain the maximum specified loading during load tests, or piles placed outside specified tolerances shall be reported to the Geotechnical Engineer and the Structural Engineer of Record by the Pile Contractor and the Material Testing Agency prior to installing new piles so that they may be evaluated and a possible redesign implemented. Cost of re-engineering shall be borne by the Pile Contractor.

3.6 DEVIATION FROM SPECIFICATION

A. If the contractor proposes any deviations from the above requirements or procedures outlined in the specified references, the contractor should detail the deviation requested and the reasons for the deviation for review by the Geotechnical Engineer.

3.7 CLEAN-UP

A. All excess material including, steel, concrete, grout, earth, rock, fill, lumber, forms, metal, etc. shall be removed from site and legally disposed of.

B. The Contractor shall be responsible for removal of all debris produced by work to this Section from the site.

C. The work area/site shall be cleaned and free of debris, rubbish, trash and obstructions of any kind caused by the work of this Section.

END OF SECTION

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WASATCH PEAKS RANCH

WBWCD Gateway Canal Crossing

Design Calculations

Prepared for:

WPR
WASATCH PEAKS RANCH

Wasatch Peaks Development Company

Prepared by:

Kimley»Horn

Kimley-Horn
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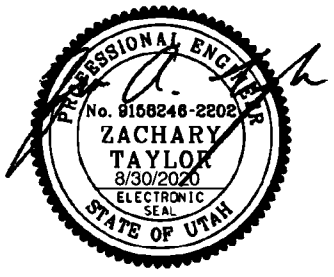
Salt Lake City, Utah 84111
08/26/2020



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GEOMETRY

Kimley»Horn

Job: Wasatch Peaks Ranch Canal Bridge
Sheet No. 1 of 4
Calculated by: JBG Date: 8/24/20
Checked by: ZAT Date: 8/27/20
Description: Bridge Geometry Input

Vertical Curve Data

The roadway section which the canal bridge is on has a 2% vertical rise.

	Station	Elevation	
PVC	39+63.59	4969.81	ft
PVI	40+47.48	4971.485	ft
PVT	41+31.37	4973.16	ft

L	167.78	ft
G1	2.00%	
G2	2.00%	

a	0
b	0.02
c	4969.81

Bridge Geometry

skew	56.2036	deg
Cross Slope	-0.02	ft/ft
Haunch Thickness	0.500	in
Tapered Sole Plate	1.000	in
Beam Depth	24.500	in
Bearing Thickness	1.250	in
Deck Thickness	8.000	in
Superstructure Depth	2.938	ft
CL Bent to CL Bent	55	ft
Beam Spacing	7.25	ft
Begin Bridge to CL Abut	6.00	in
CL Abut to CL Brg	6.00	in
Approach Slab L	15.00	ft

Beam 1 Offset	-15.1250	ft
Beam 2 Offset	-7.8750	ft
Beam 3 Offset	-0.6250	ft
Beam 4 Offset	6.6250	ft
Beam 5 Offset	13.8750	ft
Beam 6 Offset	21.1250	ft

Perp to CL Abut

Perp to CL Abut

Plan and Profile Data

	Station	x	PGL Elevations
Begin Approach Slab	39+58.39	-5.20	4969.71
Begin Bridge	39+73.39	9.80	4970.01
CL Abut 1	39+73.99	10.40	4970.02
CL Brg Abut 1	39+74.59	11.00	4970.03
CL Brg Abut 2	40+28.39	64.80	4971.11
CL Abut 2	40+28.99	65.40	4971.12
End Bridge	40+29.59	66.00	4971.13
End Approach Slab	40+44.59	81.00	4971.43

Bridge Length	56.2033
CL Bent to CL Bent	55.0000
CL Brg to CL Brg	53.7967

Beam Seat Elevations

	Station	x	PGL Elevations	Offset	Top of Deck El.	Beam Seat El.
Abut 1 - Girder 1	39+64.47	0.88	4969.83	-15.1250	4969.53	4966.59
Abut 1 - Girder 2	39+69.32	5.73	4969.92	-7.8750	4969.77	4966.83
Abut 1 - Girder 3	39+74.17	10.58	4970.02	-0.6250	4970.01	4967.07
Abut 1 - Girder 4	39+79.03	15.44	4970.12	6.6250	4969.99	4967.05
Abut 1 - Girder 5	39+83.88	20.29	4970.22	13.8750	4969.94	4967.00
Abut 1 - Girder 6	39+88.73	25.14	4970.31	21.1250	4969.89	4966.95
Abut 2 - Girder 1	40+18.27	54.68	4970.90	-15.1250	4970.60	4967.66
Abut 2 - Girder 2	40+23.12	59.53	4971.00	-7.8750	4970.84	4967.91
Abut 2 - Girder 3	40+27.97	64.38	4971.10	-0.6250	4971.09	4968.15
Abut 2 - Girder 4	40+32.82	69.23	4971.19	6.6250	4971.06	4968.12
Abut 2 - Girder 5	40+37.68	74.09	4971.29	13.8750	4971.01	4968.08
Abut 2 - Girder 6	40+42.53	78.94	4971.39	21.1250	4970.97	4968.03

Kimley»Horn

Job: Wasatch Peaks Ranch Canal Bridge
Sheet No. 1 of 4
Calculated by: JBG Date: 8/24/20
Checked by: ZAT Date: 8/27/20
Description: Bridge Geometry Input

Approach Slab Elevations

	Station	x	PGL Elevations	Offset	Top of Deck El.
AS 1 - Begin - Left	39+46.34	-17.25	4969.47	-18.0000	4969.11
AS 1 - End - Left	39+61.34	-2.25	4969.77	-18.0000	4969.41
AS 1 - Begin - Right	39+74.45	10.86	4970.03	24.0000	4969.55
AS 1 - End - Right	39+89.45	25.86	4970.33	24.0000	4969.85
AS 2 - Begin - Left	40+17.55	53.96	4970.89	-18.0000	4970.53
AS 2 - End - Left	40+32.55	68.96	4971.19	-18.0000	4970.83
AS 2 - Begin - Right	40+45.66	82.07	4971.45	24.0000	4970.97
AS 2 - End - Right	40+60.66	97.07	4971.75	24.0000	4971.27
AS 1 - CL Begin	39+58.39	-5.2	4969.71	0.0000	4969.71
AS 1 - CL End	39+73.99	10.40	4970.02	0.0000	4970.02
AS 2 - CL Begin	40+29.59	66.00	4971.13	0.0000	4971.13
AS 2 - CL End	40+44.59	81.00	4971.43	0.0000	4971.43

Kimley»Horn

Job: Wasatch Peaks Ranch Canal Bridge

Sheet No.	2	of	4
Calculated by:	JBG	Date:	8/24/20
Checked by:	ZAT	Date:	8/27/20

Description: Screed Elevations

Beam 1 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+64.47	39+73.44	39+82.40	39+91.37	40+00.33	40+09.30	40+18.27
PGL Elevations	4969.53	4969.70	4969.88	4970.06	4970.24	4970.42	4970.60

Beam 2 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+69.32	39+78.29	39+87.25	39+96.22	40+05.19	40+14.15	40+23.12
PGL Elevations	4969.77	4969.95	4970.13	4970.31	4970.48	4970.66	4970.84

Beam 3 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+74.17	39+83.14	39+92.11	40+01.07	40+10.04	40+19.01	40+27.97
PGL Elevations	4970.01	4970.19	4970.37	4970.55	4970.73	4970.91	4971.09

Beam 4 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+79.03	39+87.99	39+96.96	40+05.93	40+14.89	40+23.86	40+32.82
PGL Elevations	4969.99	4970.17	4970.34	4970.52	4970.70	4970.88	4971.06

Beam 5 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+83.88	39+92.85	40+01.81	40+10.78	40+19.75	40+28.71	40+37.68
PGL Elevations	4969.94	4970.12	4970.30	4970.48	4970.66	4970.83	4971.01

Beam 6 (bearing to bearing)							
Points	0	1	2	3	4	5	6
Stations	39+88.73	39+97.70	40+06.67	40+15.63	40+24.60	40+33.56	40+42.53
PGL Elevations	4970.04	4970.21	4970.39	4970.57	4970.75	4970.93	4971.11

Kimley»Horn

Job: Wasatch Peaks Ranch Canal Bridge

Sheet No.	3	of	4
Calculated by:	JBG	Date:	8/24/20
Checked by:	ZAT	Date:	8/27/20

Description: Beam Seat and Cap Elevations

Abutment 1 Ex. Grade Elevation	4964.0	ft
Abutment 2 Ex. Grade Elevation	4964.0	ft

Beam Seat Elevations		
Member	Abutment 1	Abutment 2
Girder 1	4966.59	4967.66
Girder 2	4966.83	4967.91
Girder 3	4967.07	4968.15
Girder 4	4967.05	4968.12
Girder 5	4967.00	4968.08
Girder 6	4966.95	4968.03

Cap Elevations		
	Abutment 1	Abutment 2
Top of Cap	4966.59	4967.66
Min Cap Depth	4.00	4.00
Bottom of Cap	4962.59	4963.66
Below Ex. Grade	1.41	0.34

Pedestal Heights (ft)		
Member	Abutment 1	Abutment 2
Girder 1	0.00	0.00
Girder 2	0.24	0.24
Girder 3	0.48	0.48
Girder 4	0.46	0.46
Girder 5	0.41	0.41
Girder 6	0.37	0.37

GIRDER SUPPORT REACTIONS

LEAP BRIDGE STEEL

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	3:45 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Support Reactions

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	3.596	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	55.00	---	0.000	3.596	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	3.596	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 04	55.00	---	0.000	3.596	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	55.00	---	0.000	3.596	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	3.596	0.000	0.000	0.000	0.000

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	0.064	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	0.00	---	0.000	0.111	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	0.127	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 04	55.00	---	0.000	0.127	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	55.00	---	0.000	0.111	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	0.064	0.000	0.000	0.000	0.000

Load Case: Stage 01 - Stage 01 - Self Weight Slab

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	3:45 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	18.039	0.000	0.000	0.000	0.000
Member 01	55.00	---	0.000	18.076	0.000	0.000	0.000	0.000
Member 02	0.00	---	0.000	19.667	0.000	0.000	0.000	0.000
Member 02	55.00	---	0.000	19.685	0.000	0.000	0.000	0.000
Member 03	0.00	---	0.000	20.024	0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	20.010	0.000	0.000	0.000	0.000
Member 04	0.00	---	0.000	20.010	0.000	0.000	0.000	0.000
Member 04	55.00	---	0.000	20.024	0.000	0.000	0.000	0.000
Member 05	0.00	---	0.000	19.685	0.000	0.000	0.000	0.000
Member 05	55.00	---	0.000	19.667	0.000	0.000	0.000	0.000
Member 06	0.00	---	0.000	18.076	0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	18.039	0.000	0.000	0.000	0.000

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	18.039	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	0.00	---	0.000	19.667	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	20.010	0.000	0.000	0.000	0.000
Member 04	0.00	---	0.000	20.010	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	55.00	---	0.000	19.667	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	18.039	0.000	0.000	0.000	0.000

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	7.407	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	3:45 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	55.00	---	0.000	7.648	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	7.671	0.000	0.000	0.000	0.000
Member 04	0.00	---	0.000	7.671	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	0.00	---	0.000	7.648	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	7.407	0.000	0.000	0.000	0.000

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	5.842	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	55.00	---	0.000	6.032	0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	6.050	0.000	0.000	0.000	0.000
Member 04	0.00	---	0.000	6.050	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	0.00	---	0.000	6.032	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	5.842	0.000	0.000	0.000	0.000

Load Case:

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
Member 01	0.00	---	0.000	1.201	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 02	55.00	---	0.000	1.240	0.000	0.000	0.000	0.000

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	3:45 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Location (ft)	Bearing Location	Fx (kip)	Fy (kip)	Fz (kip)	Mx (kip-ft)	My (kip-ft)	Mz (kip-ft)
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	---	0.000	1.244	0.000	0.000	0.000	0.000
Member 04	0.00	---	0.000	1.244	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
Member 05	0.00	---	0.000	1.240	0.000	0.000	0.000	0.000
	55.00	---	0.000		0.000	0.000	0.000	0.000
	0.00	---	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	---	0.000	1.201	0.000	0.000	0.000	0.000

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	4:15 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Support Reactions

Load Case:

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 01	0.00	0.000	21.804	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
Member 02	0.00	0.000	73.130	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
Member 03	0.00	0.000	34.990	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
Member 04	0.00	0.000	62.518	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 05	55.00	0.000	28.962	0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	0.000	5.065	0.000	0.000	0.000	0.000

Member	POI Loc. (ft)	Max. neg. Fx (kip)	Max. neg. Fy (kip)	Max. neg. Fz (kip)	Max. neg. Mx (kip-ft)	Max. neg. My (kip-ft)	Max. neg. Mz (kip-ft)
Member 01	0.00	0.000	-1.753	0.000	0.000	0.000	0.000
Member 01	55.00	0.000	-5.354	0.000	0.000	0.000	0.000
Member 02	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 02	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 03	0.00	0.000	-0.785	0.000	0.000	0.000	0.000
Member 03	55.00	0.000	-0.460	0.000	0.000	0.000	0.000
Member 04	0.00	0.000	-0.016	0.000	0.000	0.000	0.000
Member 04	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 05	0.00	0.000	-0.154	0.000	0.000	0.000	0.000
Member 05	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	0.00	0.000	-5.355	0.000	0.000	0.000	0.000
Member 06	55.00	0.000	-1.776	0.000	0.000	0.000	0.000

Load Case:

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	4:15 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 01	0.00	0.000	6.957	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
Member 02	0.00	0.000	37.241	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	0.000	10.194	0.000	0.000	0.000	0.000
Member 04	0.00	0.000	30.865	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 05	55.00	0.000	13.199	0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	0.000	1.420	0.000	0.000	0.000	0.000

Member	POI Loc. (ft)	Max. neg. Fx (kip)	Max. neg. Fy (kip)	Max. neg. Fz (kip)	Max. neg. Mx (kip-ft)	Max. neg. My (kip-ft)	Max. neg. Mz (kip-ft)
Member 01	0.00	0.000	-0.715	0.000	0.000	0.000	0.000
Member 01	55.00	0.000	-2.080	0.000	0.000	0.000	0.000
Member 02	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 02	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 03	0.00	0.000	-0.795	0.000	0.000	0.000	0.000
Member 03	55.00	0.000	-0.329	0.000	0.000	0.000	0.000
Member 04	0.00	0.000	-0.003	0.000	0.000	0.000	0.000
Member 04	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 05	0.00	0.000	-0.027	0.000	0.000	0.000	0.000
Member 05	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	0.00	0.000	-1.697	0.000	0.000	0.000	0.000
Member 06	55.00	0.000	-0.684	0.000	0.000	0.000	0.000

Load Case: HL-93 (Deflection per AASHTO)

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 01	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 01	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 02	0.00	0.000	0.000	0.000	0.000	0.000	0.000

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	4:15 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 02	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 03	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 03	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 04	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 04	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 05	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 05	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	55.00	0.000	0.000	0.000	0.000	0.000	0.000

Member	POI Loc. (ft)	Max. neg. Fx (kip)	Max. neg. Fy (kip)	Max. neg. Fz (kip)	Max. neg. Mx (kip-ft)	Max. neg. My (kip-ft)	Max. neg. Mz (kip-ft)
Member 01	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 01	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 02	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 02	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 03	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 03	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 04	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 04	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 05	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 05	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 06	0.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101
Member 06	55.00	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101	-1010.101

Load Case:

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 01	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 01	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 02	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 02	55.00	0.000	0.000	0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 03	55.00	0.000	0.001	0.000	0.000	0.000	0.000

Date:	8/26/2020	WBWCD Gateway Canal Crossing Bridge Girder Design W24x131_Two_Lane.lbsx	
Time:	4:15 PM	Bentley LEAP Bridge Steel [AASHTO LRFD 8th Ed. with 2017 Interims]	v19.01.00.10

Member	POI Loc. (ft)	Max. poz. Fx (kip)	Max. poz. Fy (kip)	Max. poz. Fz (kip)	Max. poz. Mx (kip-ft)	Max. poz. My (kip-ft)	Max. poz. Mz (kip-ft)
Member 04	0.00	0.000	0.444	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
Member 05	0.00	0.000	1.269	0.000	0.000	0.000	0.000
	55.00	0.000		0.000	0.000	0.000	0.000
	0.00	0.000		0.000	0.000	0.000	0.000
Member 06	55.00	0.000	7.661	0.000	0.000	0.000	0.000

Member	POI Loc. (ft)	Max. neg. Fx (kip)	Max. neg. Fy (kip)	Max. neg. Fz (kip)	Max. neg. Mx (kip-ft)	Max. neg. My (kip-ft)	Max. neg. Mz (kip-ft)
Member 01	0.00	0.000	-0.124	0.000	0.000	0.000	0.000
Member 01	55.00	0.000	-0.243	0.000	0.000	0.000	0.000
Member 02	0.00	0.000	-0.099	0.000	0.000	0.000	0.000
Member 02	55.00	0.000	-0.306	0.000	0.000	0.000	0.000
Member 03	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 03	55.00	0.000	-0.314	0.000	0.000	0.000	0.000
Member 04	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 04	55.00	0.000	-0.006	0.000	0.000	0.000	0.000
Member 05	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 05	55.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	0.00	0.000	0.000	0.000	0.000	0.000	0.000
Member 06	55.00	0.000	0.000	0.000	0.000	0.000	0.000

SEISMIC ANALYSIS

Design Response Spectrum

AASHTO Guide Specifications for LRFD Seismic Bridge Design

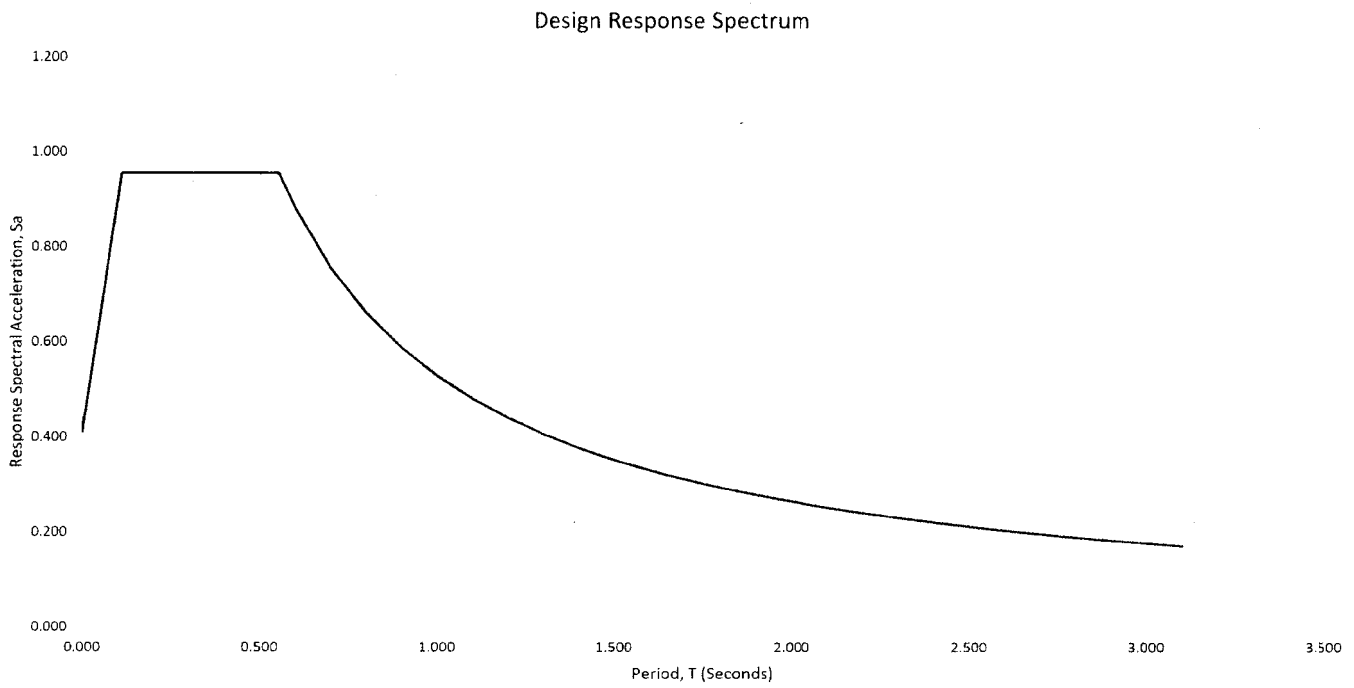
Wasatch Peaks Canal Bridge

PGA	0.359	*From Geotech Report*
S_S	0.813	*From Geotech Report*
S_1	0.290	*From Geotech Report*

Site Class	D	*From Geotech Report*
F_{PGA}	1.141	*AASHTO Table 3.4.2.3-1*
F_a	1.175	*AASHTO Table 3.4.2.3-1*
F_V	1.820	*AASHTO Table 3.4.2.3-2*

A_s	0.410	*AASHTO Eq. 3.4.1-1*
S_{DS}	0.955	*AASHTO Eq. 3.4.1-2*
S_{D1}	0.528	*AASHTO Eq. 3.4.1-3*
T_s	0.553	$= S_{D1}/S_{DS}$ *AASHTO Eq. 3.4.1-5*
T_O	0.111	$= 0.2 * T_s$ *AASHTO Eq. 3.4.1-6*

T	Sa
0.000	0.410
0.111	0.955
0.553	0.955
0.600	0.880
0.700	0.754
0.800	0.660
0.900	0.586
1.000	0.528
1.100	0.480
1.200	0.440
1.300	0.406
1.400	0.377
1.500	0.352
1.600	0.330
1.700	0.310
1.800	0.293
1.900	0.278
2.000	0.264
2.100	0.251
2.200	0.240
2.300	0.229
2.400	0.220
2.500	0.211
2.600	0.203
2.700	0.195
2.800	0.189
2.900	0.182
3.000	0.176
3.100	0.170



Backwall and Finwall Passive Pressure
AASHTO Guide Specifications for LRFD Seismic Bridge Design
Wasatch Peaks Canal Bridge

Backwall

H_w	7 ft		*Height of Backwall*
W_w	50.66 ft		*Width of Backwall*
p_p	4.67 ksf		*Passive lateral earth pressure behind backwall (AASHTO 5.2.3.3.1; Cohesionless nonplastic backfill)*
P_p	1654.931 kip		*Passive Capacity (AASHTO Eq. 5.2.3.3-1)*
Fw	0.03		*AASHTO LRFD Bridge Design Specifications Table C3.11.1-1*
K_{eff1}	656.72 kip/in		*AASHTO Eq. 5.2.3.3.2-1*
D_{eff}	2.52 in		
K_{actual}	656.71 kip/in		*Backwall stiffness used for analysis*
K_{long}	808.7 kip/in		*Local longituidal abutment stiffness*
F_{abut}	382.4 kip		*Total abutment force from analysis*
P_{actual}	310.5 kip		*Passive capacity*
p_{actual}	0.88 ksf		*Passive lateral earth pressure behind backwall*
Check	Backwall Stiffness OK		

Finwall

H_{fw}	5.5 ft		*Height of Finwall*
W_{fw}	4.00 ft		*Width of Finwall*
N_{fw}	6.00 each		*Number of Finwalls*
p_p	3.67 ksf		*Passive lateral earth pressure behind finwalls (AASHTO 5.2.3.3.1; Cohesionless nonplastic backfill)*
P_p	80.67 kip		*Passive Capacity (AASHTO Eq. 5.2.3.3-1)*

Fw	0.03		*AASHTO LRFD Bridge Design Specifications Table C3.11.1-1*
K_{eff1}	244.44	kip/in	*AASHTO Eq. 5.2.3.3.2-1*
D_{eff}	0.33	in	
K_{actual}	215	kip/in	*Finwalls stiffness used for analysis*
K_{trans}	244.44	kip/in	*Local Transverse abutment stiffness*
F_{abut}	382.4	kip	*Total finwall force from analysis*
P_{actual}	336.3	kip	*Passive capacity*
p_{actual}	2.55	ksf	*Passive lateral earth pressure behind finwalls*
Check	Backwall Stiffness OK		

Structure Stiffness
AASHTO Guide Specifications for LRFD Seismic Bridge Design
Wasatch Peaks Canal Bridge

Notes:
1) Assume only contributions to structure stiffness are abutment drilled shafts and backwall passive pressure.
2) Assume abutment piles have free-head condition in local longitudinal direction and fixed-head condition in local transverse direction.
3) Drilled Shaft Stiffness from L-Pile Analysis. See Appendix A for L-Pile Analyses.
4) Assume only one backwall engaged for passive pressure resistance at any given time.

Drilled Shaft Stiffness
Assume drilled shaft size and configuration consistant between both abutments.
Drilled shafts are continuous flight auger.

No. Piles	6		
$K_{pile\text{-}long}$	76.00	kip/in	*Total longitudinal pile stiffness per bent*
$K_{pile\text{-}trans}$	104.00	kip/in	*Total transverse pile stiffness per bent*

Total Stiffness

Local Longitudinal			
Drilled Shafts	152.00	kip/in	
Backwall	656.71	kip/in	*(See "Backwall Stiffness Calculation)*
Total	808.71	kip/in	

Local Transverse		
Piles	208.00	kip/in
Finwall	215.00	kip/in
Total	423.00	kip/in

Coordinate Transformation

Skew 33.7964 degrees

	L	T
L	808.71	0.00
T	0.00	423.00

Local

X

0.831	-0.556
0.556	0.831

Transformation Matrix

=

672.05	-449.84
235.29	351.52

Global

Equivalent Static Analysis (AASHTO 5.4.2)

AASHTO Guide Specifications for LRFD Seismic Bridge Design

Wasatch Peaks Canal Bridge

Structure (Global) Stiffness Matrix

K =

Long	*Trans*
672.05	-449.84
235.29	351.52

K^{-1} =

Long	*Trans*
0.0010	0.0013
-0.0007	0.0020

Longitudinal Analysis

po	1	kip/in	Assumed equally distrubuted load
L	660	in	Length of bridge
w(x)	1.451	kip/in	*Weight of superstructure per foot (1.0DC + 1.0DW)*

K^{-1} (in/kip)			F (kip)		Δ (in)
0.0010	0.0013	X	660	=	0.678
-0.0007	0.0020		0		-0.454

K =	973.15	kip/in	*Effective lateral bridge stiffness - AASHTO Eq. C5.4.2-1*
W =	957.66	kip	*Total weight of structure - AASHTO Eq. C5.4.2-2*
T_m =	1.10	sec	*Long. Period of the bridge - AASHTO Eq. C5.4.2-3*
S_a =	0.481	g	*Design response spectral acceleration coefficient from RSP*
pe =	0.697	kip/in	*Equivalent uniform static lateral seismic load - AASHTO Eq. C5.4.2-4*
Pe =	460.2	kip	Total longitudinal seismic force (global)
Δ =	0.47	in	Total longitudinal displacement
Pe_{long} =	382.4	kip	Total longitudinal seismic force (local)
Pe_{trans} =	256.0	kip	Total transvsere seismic force (local)

Transverse Analysis

po	1	kip/in
L	660	in
w(x)	1.451	kip/in

K^{-1} (in/kip)			F (kip)		Δ (in)
0.0010	0.0013	X	0	=	0.868
-0.0007	0.0020		660		1.297

K =	509.01	kip/in	*Effective lateral bridge stiffness - AASHTO Eq. C5.4.2-1*
W =	957.66	kip	*Total weight of structure - AASHTO Eq. C5.4.2-2*
T_m =	1.52	sec	*Trans. Period of the bridge - AASHTO Eq. C5.4.2-3*
A_s =	0.410	g	*Acceleration should not be taken less than A_s*
pe =	0.594	kip/in	*Equivalent uniform static lateral seismic load - AASHTO Eq. C5.4.2-4*
Pe =	392.3	kip	Total transverse seismic force
Δ =	0.52	in	Total transverse displacement
Pe_{long} =	218.2	kip	Total longitudinal seismic force (local)
Pe_{trans} =	326.0	kip	Total transvsere seismic force (local)

FOUNDATION LOADS

Kimley»Horn

Project No.: 096360005

Job: Wasatch Peaks Ranch Canal Bridge | **Designed by:** JBG | **Date:** 08/24/2020

Subject: Foundation Loads | **Checked by:** ZAT | **Date:** 08/24/2020

Foundation Loads

Define Geometry:

$skew := 56.2036deg$	Skew of abutment
$L_{span} := 56ft + 2in + \frac{1}{2}in$	Length of span (CL Abut to CL Abut)
$W_{span} := 42ft$	Width of bridge deck
$W_{Side} := 5ft$	Sidewalk Width
$W_{Road} := 33ft + 2in$	Roadway Width
$W_{abut} := 3ft$	Width of abutment
$H_{abut} := 7.60ft$	Height of abutment (includes backwall and cap; max. used)
$L_{abut} := 50ft + 6in + \frac{7}{16}in$	Length of abutment
$L_{appslab} := 15ft$	Length of approach slab
$Thick_{appslab} := 1ft + 1in$	Thickness of approach slab
$L_{ww} := 12.25ft$	Length of wingwalls (based on end bent 2 - worst case)
$H_{ww.beg} := 6.43ft$	Height of wingwalls at abutment face (based on end bent 2 - worst case)
$H_{ww.end} := 2ft$	Height of wingwalls at end
$Thick_{ww} := 12in$	Thickness of wingwalls
$N_{beams} := 6$	Number of girders
$N_{shafts} := 6$	Number of drilled shafts
$Spa_{bm} := 7.25ft$	Girder spacing
$A_{parapet} := 3.79ft^2$	Area of parapet on approach slab
$H_{curb} := 15in$	Height of Curb
$W_{curb} := 12in$	Width of Curb

Define Material Property:

$w_c := 150pcf$	Unit weight of reinforced concrete

Loads:

$Lane := 0.64klf$	Design lane load [AASHTO 3.6.1.2.4]
$Ped_{Live} := 0.075ksf$	Pedestrian Live Loading [AASHTO 3.6.1.6]
$Fence_w := 0.02klf$	Chainlink Fence Weight
$W_{truckaxle1} := 8kip$	Design truck axle load [AASHTO 3.6.1.2.2]
$W_{truckaxle2} := 32kip$	Design truck axle load [AASHTO 3.6.1.2.2]
$Dist_{axle1} := 14ft$	Truck axle-to-axle spacing 1
$Dist_{axle2} := 14ft$	Truck axle-to-axle spacing 2
$W_{tandemaxle} := 25kip$	Tandem axle load [AASHTO 3.6.1.2.2]
$Dist_{tandemaxle} := 4ft$	Tandem axle-to-axle spacing
$N_{lanes} := 2$	Number of design lanes
$MPF := 1.0$	Multiple presence factor [AASHTO Table 3.6.1.1.2-1]
$BM_{rxn.DC} := 31.050kip$	Beam reaction (DC)
$BM_{rxn.DW} := 7.953kip$	Beam reaction (DW)

Load Factors:

$DC_{str} := 1.25$	DC - Strength I	$DC_{ser} := 1.0$	DC - Service I
$DW_{str} := 1.5$	DW - Strengh I	$DW_{ser} := 1.0$	DW - Service I
$LL_{str} := 1.75$	LL - Strength I	$LL_{ser} := 1.0$	LL - Service I
$EE_I := 1.0$	EE - Extreme Event I		

Vertical Loads

Dead Loads (Unfactored DC):

Weight of Abutment:

$$wt_{abut} := \left(W_{abut} \cdot H_{abut} \cdot L_{abut}\right) \cdot w_c \qquad wt_{abut} = 172.83 \cdot kip$$

Weight of Approach Slab:

Note: Assuming half of approach slab weight is supported by end bent.

$$wt_{appslab} := 0.5 \cdot L_{appslab} \cdot Thick_{appslab} \cdot W_{span} \cdot w_c \qquad wt_{appslab} = 51.19 \cdot kip$$

Weight of Parapets on Approach Slab:

$$wt_{parapet} := 0.5 \cdot L_{appslab} \cdot A_{parapet} \cdot w_c \qquad wt_{parapet} = 4.26 \cdot kip$$

Weight of Wingwalls:

$$wt_{ww} := 0.5 \cdot \left(H_{ww.end} + H_{ww.beg}\right) \cdot \left(L_{ww} - \frac{W_{abut}}{\sin(skew)}\right) \cdot Thick_{ww} \cdot w_c \qquad wt_{ww} = 5.46 \cdot kip$$

Weight of Fence and Curb on Approach Slab:

Note: Assuming half of fence and curb weight is supported by end bent.

$A_{curb} := H_{curb} \cdot W_{curb} = 1.25\ ft^2$ Cross Area of Curb

$wt_{curb} := A_{curb} \cdot w_c = 0.19 \cdot klf$ Curb Weight per ft

$wt_{fence} := wt_{curb} + Fence_W = 0.21 \cdot klf$ Weight of Curb and Fence

$wt_{curb} := 0.5 \cdot L_{appslab} \cdot wt_{fence} = 1.56 \cdot kip$ $wt_{curb} = 1.56 \cdot kip$

Total DC Dead Load Reaction:

$wt_{DC} := wt_{abut} + wt_{appslab} + N_{beams} \cdot BM_{rxn.DC} + 2 \cdot wt_{ww} + 2 \cdot wt_{parapet} + wt_{curb}$ $\boxed{wt_{DC} = 431.33 \cdot kip}$

Dead Loads (Unfactored DW):

Total DW Dead Load Reaction:

$wt_{DW} := N_{beams} \cdot BM_{rxn.DW}$ $wt_{DW} = 47.72 \cdot kip$

Live Loads (Unfactored):

Truck Loading

Note: Calculation below assumes back axle of design truck or tandem are directly over end bent.

$$wt_{LL.abut} := N_{lanes} \cdot MPF \cdot \left[\begin{array}{l} \max\left[\dfrac{\begin{array}{l} W_{truckaxle2} \cdot L_{span} + W_{truckaxle2} \cdot (L_{span} - Dist_{axle1}) \cdots \\ + W_{truckaxle1} \cdot (L_{span} - 2 \cdot Dist_{axle1}) \end{array}}{L_{span}}, \dfrac{\begin{array}{l} W_{tandemaxle} \cdot L_{span} \cdots \\ + W_{tandemaxle} \cdot (L_{span} - Dist_{tandemaxle}) \end{array}}{L_{span}} \right] \\ + Lane \cdot 0.5 L_{span} \end{array} \right].$$

$wt_{LL.abut} = 156.06 \cdot kip$

$wt_{LL.appslab} := Lane \cdot L_{appslab} \cdot 0.5 \cdot N_{lanes} \cdot MPF$ $wt_{LL.appslab} = 9.6 \cdot kip$

PED Loading

$W_{Ped} := W_{Side} \cdot Ped_{Live} = 0.38 \cdot klf$ Sidewalk Pedestrian Live Loading

$wt_{Ped} := W_{Ped} \cdot \left(\dfrac{L_{span}}{2} + \dfrac{L_{appslab}}{2} \right) = 13.35 \cdot kip$ Total Pedestrian Live Loading $wt_{Ped} = 13.35 \cdot kip$

Total Live Load Reaction:

$wt_{LL} := wt_{LL.abut} + wt_{LL.appslab} + wt_{Ped} = 179.01 \cdot kip$ $wt_{LL} = 179.01 \cdot kip$

Vertical Drilled Shaft Reactions:

$Total_{vert.str} := DC_{str} \cdot wt_{DC} + DW_{str} \cdot wt_{DW} + LL_{str} \cdot wt_{LL}$ Total abutment strength reaction $Total_{vert.str} = 924.02 \cdot kip$

$Shaft_{vert.str} := \dfrac{Total_{vert.str}}{N_{shafts}}$ Strength reaction per pile $\boxed{Shaft_{vert.str} = 154 \cdot kip}$

$Total_{vert.ser} := DC_{ser} \cdot wt_{DC} + DW_{ser} \cdot wt_{DW} + LL_{ser} \cdot wt_{LL}$ Total abutment service reaction $Total_{vert.ser} = 658.06 \cdot kip$

$Shaft_{vert.ser} := \frac{Total_{vert.ser}}{N_{shafts}}$ Service reaction per pile $Shaft_{vert.ser} = 109.68 \cdot kip$

$Total_{vert.ee} := EE_1 \cdot wt_{DC} + EE_1 \cdot wt_{DW}$ Total abutment extreme event reaction $Total_{vert.ee} = 479.05 \cdot kip$

$Shaft_{vert.ee} := \frac{Total_{vert.ee}}{N_{shafts}}$ Extreme Event reaction per pile $Shaft_{vert.ee} = 79.84 \cdot kip$

Vertical Drilled Shaft Resistance:

$Shaft_{str.res} := 155kip$ Axial Compressive Strength Resistance

$Shaft_{ser.res} := 110kip$ Axial Compressive Service Resistance

$Shaft_{ee.res} := 110kip$ Axial Compressive Extreme Event Resistance

Check:

$Check_1 :=$ "OK" if $Shaft_{str.res} > Shaft_{vert.str}$ = "OK"; "NG" otherwise

$Check_2 :=$ "OK" if $Shaft_{ser.res} > Shaft_{vert.ser}$ = "OK"; "NG" otherwise

$Check_3 :=$ "OK" if $Shaft_{ee.res} > Shaft_{vert.ee}$ = "OK"; "NG" otherwise

ABUTMENT DESIGN

Kimley»Horn

Project: **WASATCH PEAKS RANCH** Subject: **ABUTMENT CAP DESIGN**

Designed by: **CHG** Date: **08/27/20** Checked by: ZAT Date: 8/29/20

Table of Contents

Defined Units

Defined Function (GetRebarProp)

Geometry

$h_{cap} := 4ft + 0in$ abutment cap height

$w_{cap} := 3ft + 0in$ abutment cap width

$spa_{DS} := 8ft + 9in$ drilled shaft spacing

$d_{cap.app} := 2ft + 0in$ distance from top of abutment cap to bottom of approach slab

Cracking Moment

The girders are located directly above the drilled shafts, minimizing the amount of flexure expected in the cap due to loads transferred through the superstructure. Cracking moment is expected to control the required reinforcing in the section.

$$M_{cr} := \gamma_3 \cdot \left[\left(\gamma_1 \cdot f_r + \gamma_2 \cdot f_{cpe} \right) \cdot S_c - M_{dnc} \cdot \left(\frac{S_c}{S_{nc}} - 1 \right) \right]$$ AASHTO Eq. 5.6.3.3-1

where:

M_{cr} = cracking moment

f_r = modulus of rupture of concrete per AASHTO 5.4.2.6

f_{cpe} = compressive stress in concrete due to effective prestress forces only (after allowance for all prestress losses) at extreme fiber of section where tensile stress is caused by externally applied loads

M_{dnc} = total unfactored dead load moment acting on the monolithic or noncomposite section

S_c = section modulus for the extreme fiber of the composite section where tensile stress is caused by externally applied loads

S_{nc} = section modulus for the extreme fiber of the monolithic or noncomposite section where tensile stress is caused by externally applied loads

The terms related to any prestress reinforcement and unfactored dead load moment are zero. The cracking moment will be different for the reinforcement along edges of the cap vs. the reinforcement along the top and bottom.

Front and Back Face Horizontals

$$S_{cap.y} := \frac{1}{6} \cdot h_{cap} \cdot w_{cap}^2 = 10368.00 \cdot in^3$$

$\gamma_1 := 1.60$ = 1.60 (for other concrete structures)

$\gamma_3 := 0.67$ = 0.67 (for ASTM A615 Grade 60 reinforcement)

$f'c := 4ksi$ compressive strength of concrete

$\lambda := 1.00$ concrete density modification factor (= 1.00 for normal weight concrete)

$f_r := 0.24 \cdot \lambda \cdot \sqrt{f'c \cdot ksi} = 0.48 \cdot ksi$ modulus of rupture of concrete

$M_{cr.y} := \gamma_3 \cdot (\gamma_1 \cdot f_r) \cdot S_{cap.y} = 444.58 \cdot kip \cdot ft$

Determine the factored capacity of the section using AASHTO Eq. 5.6.3.2.2-1:

$$\phi_f \cdot M_n := \phi_f \cdot A_s \cdot f_y \cdot \left(d - \frac{a}{2}\right)$$ (AASHTO Eq. 5.6.3.2.2-1)

Where:

M_n = nominal resistance

A_s = area of nonprestressed tension reinforcement (in^2)

f_y = stress in the mild steel tension reinforcement at nominal flexural resistance (ksi), as specified in AASTHO 5.7.2.1

d_s = distance from extreme compression fiber to the centroid of nonprestressed tensile reinforcement (in)

$a := c \cdot \beta_1$ = depth of the equivalent stress block (in)

c = distance from extreme compression fiber to the neutral axis assuming the tendon prestressing steel has yielded, given by AASHTO Eq. 5.7.3.1.2-4 (in)

β_1 = stress block factor specified in AASHTO 5.7.2.2

$bar_{M.pos.y} := 8$ flexure bar designation

$dia_{M.pos.y} = 1 \cdot in$ flexure bar diameter

$A_{bar.M.pos.y} = 0.790 \cdot in^2$ flexure bar area

$spa_{bar.y} := 12in$ flexure bar spacing

$$n_{bar.y} := Ceil\left[\frac{\left[h_{cap} - (4in)\right]}{spa_{bar.y}}, 1\right] + 1 = 5$$

$A_{s.beam.pos.y} := n_{bar.y} \cdot A_{bar.M.pos.y} = 3.95 \cdot in^2$

$f_y := 60ksi$

$\phi_f := 0.90$

$$d_y := w_{cap} - (2in) - \frac{dia_{M.pos.y}}{2} = 33.5 \cdot in$$

$$a_y := \frac{A_{s.beam.pos.y} \cdot f_y}{0.85 \cdot f'c \cdot h_{cap}} = 1.452 \cdot in$$

$$\phi M_{n.y} := \phi_f \cdot A_{s.beam.pos.y} \cdot f_y \cdot \left(d_y - \frac{a_y}{2}\right) = 582.56 \cdot kip \cdot ft$$

$$check_{M.cr.y} := \begin{cases} \text{"OK"} & \text{if } \phi M_{n.y} \geq M_{cr.y} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$\phi M_{n.y} = 582.556 \cdot kip \cdot ft$ > $M_{cr.y} = 444.58 \cdot kip \cdot ft$ $check_{M.cr.y} = \text{"OK"}$

Top and Bottom Longitudinal Bars

$S_{cap.x} := \frac{1}{6} \cdot w_{cap} \cdot h_{cap}^2 = 13824.00 \cdot in^3$

$f_r := 0.24 \cdot \lambda \cdot \sqrt{f'c \cdot ksi} = 0.48 \cdot ksi$ modulus of rupture of concrete

$M_{cr.x} := \gamma_3 \cdot (\gamma_1 \cdot f_r) \cdot S_{cap.x} = 592.773 \cdot kip \cdot ft$

Determine the factored capacity of the section using AASHTO Eq. 5.6.3.2.2-1:

$$\phi_f \cdot M_n := \phi_f \cdot A_s \cdot f_x \cdot \left(d - \frac{a}{2}\right)$$ (AASHTO Eq. 5.6.3.2.2-1)

Where:

M_n = nominal resistance

A_s = area of nonprestressed tension reinforcement (in^2)

f_x = stress in the mild steel tension reinforcement at nominal flexural resistance (ksi), as specified in AASTHO 5.7.2.1

d_s = distance from extreme compression fiber to the centroid of nonprestressed tensile reinforcement (in)

$a := c \cdot \beta_1$ = depth of the equivalent stress block (in)

c = distance from extreme compression fiber to the neutral axis assuming the tendon prestressing steel has yielded, given by AASHTO Eq. 5.7.3.1.2-4 (in)

β_1 = stress block factor specified in AASHTO 5.7.2.2

$bar_{M.pos.x} := 8$ flexure bar designation

$dia_{M.pos.x} = 1 \cdot in$ flexure bar diameter

$A_{bar.M.pos.x} = 0.790 \cdot in^2$ flexure bar area

$spa_{bar.x} := 12in$ flexure bar spacing

$$n_{bar.x} := Ceil\left[\frac{\left[w_{cap} - (4in)\right]}{spa_{bar.x}}, 1\right] + 1 = 4$$

$A_{s.beam.pos.x} := n_{bar.x} \cdot A_{bar.M.pos.x} = 3.16 \cdot in^2$

$d_x := h_{cap} - (2in) - \frac{dia_{M.pos.x}}{2} = 45.5 \cdot in$

$a_x := \frac{A_{s.beam.pos.x} \cdot f_y}{0.85 \cdot f'c \cdot w_{cap}} = 1.549 \cdot in$

$\phi M_{n.x} := \phi_f \cdot A_{s.beam.pos.x} \cdot f_y \cdot \left(d_x - \frac{a_x}{2}\right) = 636 \cdot kip \cdot ft$

$check_{M.cr.x} := \begin{cases} \text{"OK"} & \text{if } \phi M_{n.x} \geq M_{cr.x} \\ \text{"NG"} & \text{otherwise} \end{cases}$

$\phi M_{n.x} = 635.996 \cdot kip \cdot ft > M_{cr.x} = 592.773 \cdot kip \cdot ft$ $check_{M.cr.x} = \text{"OK"}$

Check Bending Between Drilled Shafts Due to Passive Pressure

The cap is expected to experience flexure during a seismic event due to passive pressure engaged by movement into the soil behind the cap. This pressure is approximated below. Note that the factor of 2 applied is per UDOT recommendations.

$$P_p := (2)\left(\frac{2}{3}\right)\cdot\left(h_{cap} + d_{cap.app}\right)\cdot\left(\frac{kip}{ft^3}\right) = 8\cdot ksf$$

$\gamma_{EQ} := 1.00$ load factor for earthquake load

$$M_{Pp} := \gamma_{EQ}\cdot\frac{\left[\left[P_p\cdot\left(h_{cap} + d_{cap.app}\right)\right]\cdot spa_{DS}^{2}\right]}{8} = 459.375\cdot kip\cdot ft$$

$$check_{M.Pp.y} := \begin{cases} \text{"OK"} & \text{if } \phi M_{n.y} \geq M_{Pp} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$\phi M_{n.y} = 582.556\cdot kip\cdot ft$ > $M_{Pp} = 459.375\cdot kip\cdot ft$ $check_{M.Pp.y} = \text{"OK"}$

Check Vertical Reinforcement for Bending Due to Seismic

Passive pressure forces and drilled shaft reactions due to seismic loading on the abutment will cause bending in the vertical abutment bars. This check is to ensure the bending can be resisted elasically. Passive pressure force was conservatively assumed as fulled mobilized. Drilled shaft reaction corresponds to 1/2" of longitudinal seismic movement per the Equivalent Static Analysis. Flexural tension at the backface controls by inspection. Conservatively used the same bars on the frontface and backface.

$P_p = 8\ ksf$ Uniform Passive Pressure force (Conservative)

$V_u := 38kip$ Drilled Shaft Reaction Due to Longitudinal Seismic Movement (From L-Pile analysis , See Appendix A of Calcs)

$X_{arm} := h_{cap} = 4\ ft$ Moment arm from bottom of abutment to Girder "Support"

$w_{distributed} := 2\cdot h_{cap} = 8\ ft$ Width of distribution of point load assuming a 45 deg angle to the Abutment height

$$M_{bending} := V_u\cdot X_{arm} + P_p\cdot X_{arm}\cdot w_{distributed}\cdot\frac{X_{arm}}{2} = 664\ kip\cdot ft$$ Bending Moment

$bar_{bf.vert} := 6$ flexure bar designation

$dia_{bf.vert} = 0.75\ in$ flexure bar diameter

$A_{bar.bf.vert} = 0.440\ in^2$ flexure bar area

$spa_{bf.vert} := 8in$ flexure bar spacing

$n_{bar.bf.vert} := 11$

$A_{s.beam.bf.vert} := n_{bar.bf.vert}\cdot A_{bar.bf.vert} = 4.84\cdot in^2$

$$d_{bf.vert} := w_{cap} - (2in) - \frac{dia_{bf.vert}}{2} = 33.625\cdot in$$

$$a_{bf.vert} := \frac{A_{s.beam.bf.vert} \cdot f_y}{0.85 \cdot f'c \cdot w_{distributed}} = 0.89\,in$$

$$\phi M_{n.bf.vert} := \phi_f \cdot A_{s.beam.bf.vert} \cdot f_y \cdot \left(d_{bf.vert} - \frac{a_{bf.vert}}{2} \right) = 722.66 \cdot kip \cdot ft$$

$$check_{M.bf.vert} := \begin{cases} \text{"OK"} & \text{if } \phi M_{n.bf.vert} \geq M_{bending} \\ \text{"NG"} & \text{otherwise} \end{cases}$$

$\phi M_{n.bf.vert} = 722.664 \cdot kip \cdot ft$ > $M_{bending} = 664 \cdot kip \cdot ft$ $check_{M.bf.vert} = \text{"OK"}$

Proportion Crack Control Reinforcement

To satisfy the crack control reinforcement requirement per AASHTO 5.8.2.6, the reinforcement in the vertical and horizontal direction shall satisfy the following:

$$\frac{A_v}{b_w \cdot s_v} > 0.003$$ AASHTO Eq. 5.8.2.6-1

$$\frac{A_h}{b_w \cdot s_h} > 0.003$$ AASHTO Eq. 5.8.2.6-2

A_h = total area of horizontal crack control reinforcement within spacing s_h

A_v = total area of vertical crack control reinforcement within spacing s_v

b_w = width of member's web

s_v , s_h = spacing of vertical and horizontal crack control reinforcement, respectively

$bar_V := 6$

$n_{V.leg} := 2$

$n_{V.set} := 1$

$bar_{V.temp} := bar_V = 6$ stirrup bar designation

$dia_{V.temp} = 0.75 \cdot in$ stirrup bar diameter

$A_{bar.V.temp} = 0.440 \cdot in^2$ strirrup bar area

$n_{V.leg.temp} := n_{V.leg} = 2$ single or double leg stirrup designation

$n_{V.set.temp} := n_{V.set} = 1$ number of stirrups per placement

$$s_{V.temp} := \frac{n_{V.leg.temp} \cdot n_{V.set.temp} \cdot A_{bar.V.temp}}{0.003 \cdot w_{cap}}$$

$s_{V.temp} = 8.148 \cdot in$ minimum stirrup spacing required

$bar_{h.temp} := 8$ stirrup bar designation

$dia_{h.temp} = 1 \cdot in$ stirrup bar diameter

$A_{bar.h.temp} = 0.790 \cdot in^2$ strirrup bar area

$n_{h.set.temp} := 3$ number of bars per row

$$s_{h.temp} := \frac{n_{h.set.temp} \cdot A_{bar.h.temp}}{0.003 \cdot w_{cap}} = 21.944 \cdot in$$

DRILLED SHAFT DESIGN

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Section Properties
Structure: Canal Bridge

Comp By: DML
Date: 08/28/2020
Chk By: ZAT
Date: 08/29/2020

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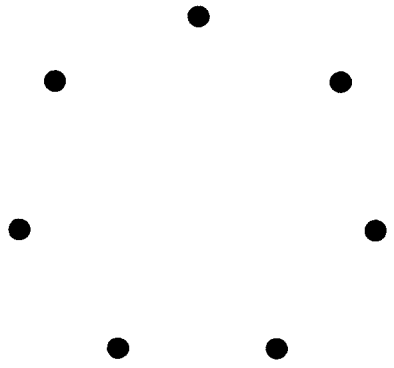
Property

1. Material

Concrete	Grade C4000	
fc'	4.00	kip/in²
Ec	0.00	kip/in²
Poisson's Ratio	0.20	
Weight Density	0.00	kip/in³
Nonlinear Property	Whitney Rectangular	
Rebar	Grade 60	
fy	60.00	kip/in²
Es	29000.00	kip/in²
Nonlinear Property	Elastic-Only	

2. Section



As	5.53	in²

I. General

Area	450.0960765	in²
Shear Area (y)	386.228987	in²
Shear Area (z)	386.2287969	in²
Ixx	32242.8707	in⁴
Iyy	16121.40311	in⁴
Izz	16121.40311	in⁴
Centroid (y)	11.999999	in
Centroid (z)	11.999999	in

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Section Properties
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II. Section Modulus

Section Modulus (Top)	1343.450259 in³
Section Modulus (Bottom)	1343.450259 in³
Section Modulus (Right)	1343.450259 in³
Section Modulus (Left)	1343.450259 in³

III. Principal Properties

Principal Angle	0 °
Iyy'	16121.40311 in⁴
Izz'	16121.40311 in⁴

IV. Plastic Properties

Plastic Modulus (Major axis)	2286.498531 in³
Plastic Modulus (Minor axis)	2286.498531 in³

3. Design Load Combination

No	Name	Pu(kip)	My(kip×in)	Mz(kip×in)	Vy(kip)	Vz(kip)	T(kip×in)
1	Seismic 1	110.00	3000.00	540.00	0.00	0.00	0.00
2	Seismic 2	110.00	900.00	1800.00	0.00	0.00	0.00
3	Strength 1	155.00	0.00	1800.00	0.00	0.00	0.00

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft P-M Curve
Structure: Canal Bridge

Comp By: DML
Date: 08/28/2020
Chk By: ZAT
Date: 08/29/2020

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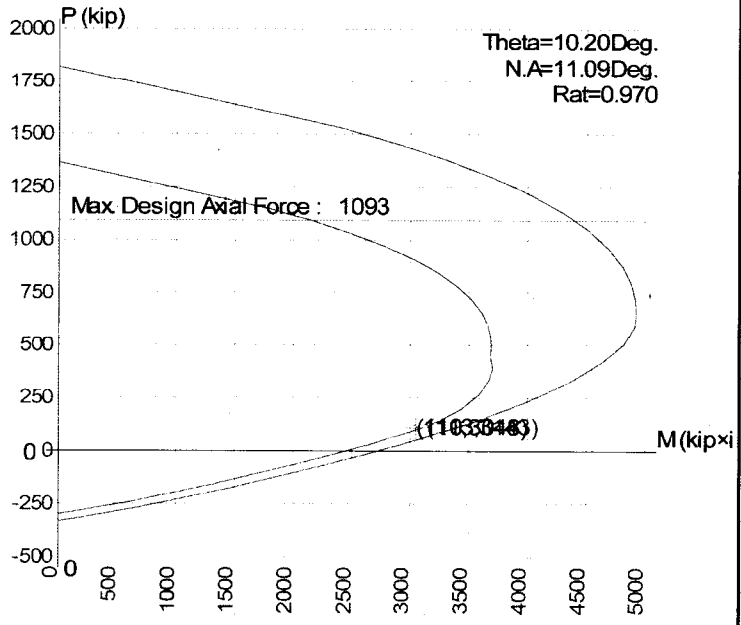
P-M Curve

Mode : Load Combination = Seismic 1
Checking Ratio = 0.970 (Keep M/P Constant)



Pu(kip)	Mn(kip×in)
1365.903	0.000
1145.170	1815.420
1089.889	2166.631
1032.383	2485.345
971.338	2777.294
908.970	3029.107
846.717	3232.288
782.490	3396.205
719.564	3518.640
656.579	3608.404
596.914	3661.584
539.387	3687.315
493.477	3692.347
442.614	3685.279
387.912	3702.877
331.037	3672.237
265.694	3584.358
195.860	3436.209
114.030	3146.948
26.825	2625.157
-64.784	2018.559
-157.999	1317.312
-240.505	618.501
-277.497	237.528
-298.620	0.000

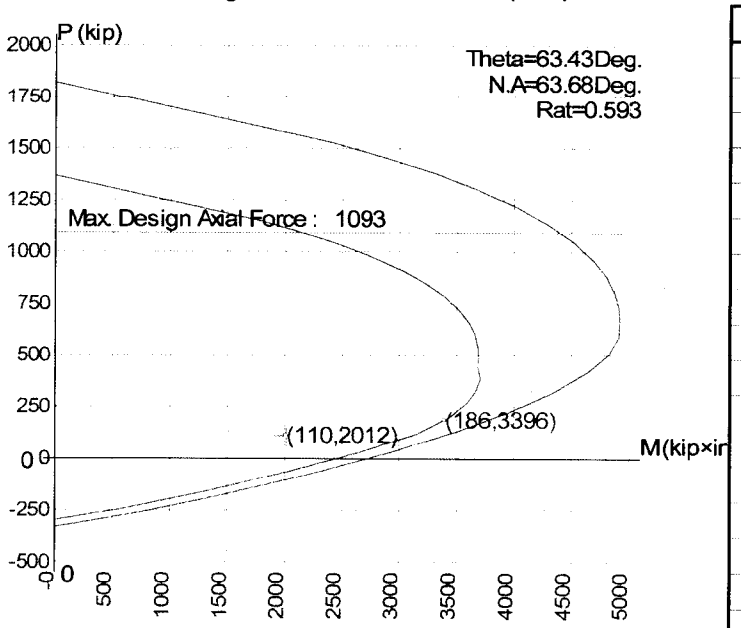
Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft P-M Curve
Structure: Canal Bridge

Comp By: DML
Date: 08/28/2020
Chk By: ZAT
Date: 08/29/2020

Kimley»Horn

P-M Curve

Mode : Load Combination = Seismic 2
Checking Ratio = 0.593 (Keep M/P Constant)



Pu(kip)	Mn(kip×in)
1365.903	0.000
1146.300	1805.235
1091.771	2155.909
1032.956	2486.447
972.863	2773.616
909.999	3023.735
847.858	3227.315
783.818	3393.054
719.897	3518.184
658.273	3606.583
597.117	3660.518
539.626	3686.276
494.278	3691.221
443.349	3684.248
388.488	3707.042
329.955	3671.094
266.670	3586.315
195.611	3430.658
115.943	3149.286
25.482	2620.114
-67.681	2008.064
-160.796	1297.454
-241.178	611.982
-278.070	231.296
-298.620	0.000

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft P-M Curve
Structure: Canal Bridge

Comp By: DML
Date: 08/28/2020
Chk By: ZAT
Date: 08/29/2020

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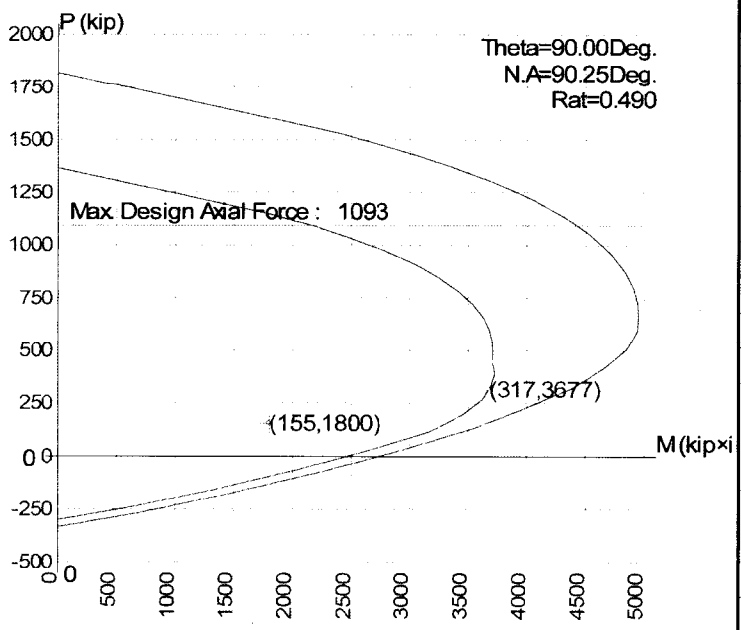
P-M Curve

Mode : Load Combination = Strength 1
Checking Ratio = 0.490 (Keep M/P Constant)



Pu(kip)	Mn(kip×in)
1365.903	0.000
1146.453	1811.668
1090.577	2172.856
1033.794	2492.956
973.152	2788.294
910.736	3042.356
848.984	3244.429
784.848	3409.828
721.012	3535.620
658.215	3626.776
599.201	3681.566
541.695	3706.662
495.980	3712.103
444.943	3705.784
389.805	3727.052
331.024	3693.116
266.083	3617.062
197.463	3453.525
112.574	3159.624
26.658	2639.218
-66.491	2025.455
-159.887	1309.530
-241.368	613.663
-278.290	230.263
-298.620	0.000

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Design
Structure: Canal Bridge

Comp By: JBG
Date: 08/27/2020
Chk By: ZAT
Date: 08/29/2020

Kimley»Horn

Assumptions

1. *Drilled Shafts will be built using the Continuous Flight Auger Method.*
2. *Reinforcement cage will extend to the depth where it is no longer required to resist shear and bending forces.*
3. *Reinforcement cage will be wet set with a center bar used for guiding the cage into the concrete.*
4. *Drilled Shafts are designed to remain elastic during the design seismic event.*

Loading Data

By Inspection STR I controls for axial loads and EE I controls for bending and shear.

STR I Axial Demand (Fx), P	155 kips		Preliminary Foundation Loading
EE I Moment Demand (My), M_{uy}	250 kip-ft		L-Pile
EE I Moment Demand (Mz), M_{uz}	150 kip-ft		L-Pile
EE I Shear Demand (Fy), V_{uy}	40 k		L-Pile
EE I Shear Demand (Fz), V_{uz}	52 k		L-Pile
EE I Moment Demand, M_u	$\sqrt{M_{uy}^2 + M_{uz}^2}$	=	291.55 k-ft
EE I Shear Demand, V_u	$\sqrt{V_{uy}^2 + V_{uz}^2}$	=	65.60 k

Resistance Factors

STR I Shear Resistance Factor (Normal Wt. Concrete), Φ_v	0.9	AASHTO 5.5.4.2.1
STR I Compression Resistance Factor, Φ_c	0.75	AASHTO 5.5.4.2.1
EE I Shear Resistance Factor (Normal Wt. Concrete), Φ_v	1.00	AASHTO 5.5.4.2.1
EE I Compression Resistance Factor, Φ_c	1.00	AASHTO 5.5.4.2.1

General Data

Concrete Strength, f'_c	4 ksi	
Concrete Nominal Aggregate Size	0.75 in	AASHTO C5.4.2.1
Area of Drilled Shaft	452.39 in^2	
Diameter of Drilled Shaft	2 ft	
Diameter of Rebar Circle	1.50 ft	
Area of Concrete Core (To Outside Diameter of Hoop)	254.47 in^2	
Concrete Cover (Formed Edges)	3 in	

Reinforcement

Rebar Yield Strength, f_y	60 ksi
Steel Modulus of Elasticity, E_s	29000 ksi
<u>Drilled Shaft Longitudinal Bars</u>	
Bar Size	7
Number of Bars	7 bars

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Design
Structure: Canal Bridge

Comp By: JBG
Date: 08/27/2020
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Bar Area	4.2 in^2
Bar Diameter	0.875 in

Column Transverse Bars in Top Section of DS

Bar Size	5
Vertical Spacing of Transverse Bars	4 in
Bar Area	0.31 in^2
Bar Area Per Foot	0.93 in^2/ft
Bar Diameter	0.625 in

Limits For Reinforcement of Compression Members in Seismic Zones 2, 3, and 4 — *AASHTO 5.6.4.2*

Area of Nonprestressed Longitudinal Steel, A_s		=	4.20 in^2
Gross Area of Section, A_g		=	452.39 in^2
Concrete Strength, f'_c		=	4 ksi
Rebar Yield Strength, f_y		=	60 ksi
Check Max. Area of Longitudinal Reinforcement	$\frac{A_s}{A_g} \le 0.08$	0.009 <=	0.080
Check Min. Area of Longitudinal Reinforcement	$min\begin{cases}\frac{A_s}{A_g} \ge 0.135\frac{f'_c}{f_y}\\ 0.015\end{cases}$	0.009 >=	0.009

Factored Axial Resistance — *AASHTO 5.6.4.4*

k_c 0.85

Concrete Strength, f'_c		=	4 ksi
Gross Area of Section, A_g		=	452.39 in^2
Area of Nonprestressed Longitudinal Steel, A_{st}		=	4.20 in^2
Rebar Yield Strength, f_y		=	60 ksi
STR I Axial Demand (Fx), P		=	155 kips
STR I Compression Resistance Factor, Φ_c		=	0.75
Nominal Axial Resistance, P_n	$0.80[k_c f'_c(A_g - A_{st}) + f_y A_{st}]$	=	1420.67 kips
Check Axial Resistance	$P \le \phi_c P_n$	155 <=	1065.51 kips

Nominal Shear Resistance — *AASHTO 5.7.3.3*

Diameter of Drilled Shaft, D	=	24 in
Diameter of Rebar Circle, D_r	=	18.00 in
EE I Moment Demand, M_u	=	291.55 k-ft
Area of Drilled Shaft Bars, $A_{s.DS}$	=	4.20 in^2
Area of Hoop Bars in Top Section of DS, A_{v1}	=	0.31 in^2

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Design
Structure: Canal Bridge

Comp By: JBG
Date: 08/27/2020
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Max Vertical Spacing of Hoop Bars in Top Section of DS, s_1		=	4 in	
Concrete Strength, f'_c		=	4 ksi	
Steel Modulus of Elasticity, E_s		=	29000 ksi	
Rebar Yield Strength, f_y		=	60 ksi	
Effective Web Width (Drilled Shaft Diameter), b_v		=	24 in	
EE I Shear Resistance Factor (Normal Wt. Concrete), Φ_v		=	1.00	
EE I Shear Demand, V_u		=	66 kips	
d_e (For Circular Member)	$\frac{D}{2}+\frac{D_r}{\pi}$	=	17.73 in	*C5.7.2.8-2*
Effective Shear Depth, d_v	$0.9d_e$	=	15.96 in	*C5.7.2.9*
Area of Flexural Bars (Half the Bars), $A_{s.bot}$	$\frac{A_{s.DS}}{2}$	=	2.10 in^2	
Absolute Value of Factored STR I Moment, $\lvert M_u \rvert$	$max\begin{Bmatrix} M_u * 12 \\ V_u d_v \end{Bmatrix}$	=	3499 k-in	
Net Longitudinal Strain, ϵ_s	$\frac{\left(\frac{\lvert M_u \rvert}{d_v}+\lvert V_u \rvert\right)}{E_s A_{s.bot}}$	=	0.005	
Diagonal Cracking Factor, β	$\frac{4.8}{(1+750\varepsilon_s)}$	=	1.06	
Angle of Inclination of Compressive Stresses, θ	$29+3500\varepsilon$	=	45.37 °	

Shear Resistance

Concrete Shear Resistance, V_c	$0.0316\beta\sqrt{f'c}b_v d_v$	=	25.77 kips	
Rebar Shear Resistance in Top Section of DS, V_{s1}	$\frac{A_{v1} f_y d_v \cot\theta}{s_1}$	=	73.24 kips	

Nominal Shear Resistance, V_n, Lesser of:

$V_n = 0.25 f'c b_v d_v$ And	=	382.96 kips	
$V_{n1} = V_c + V_{s1}$ *or*	=	99.01 kips	
$V_{n2} = V_c$	=	25.77 kips	
Nominal Shear Resistance in Top Section of DS, V_{n1}	=	99.01 kips	
EE I Shear Capacity Check	$V_u \le \Phi_v V_{n1}$	66 <=	99.01 k-ft

Minimum Transverse Reinforcement — *AASHTO 5.7.2.5*

Concrete Strength, f'_c	=	4 ksi	
Effective Web Width (Column Diameter), b_v	=	24 in	

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Design
Structure: Canal Bridge

Comp By: JBG
Date: 08/27/2020
Chk By: ZAT
Date: 08/29/2020

Kimley»Horn

Max Vertical Spacing of Hoop Bars, s			=	4 in
Rebar Yield Strength, f_y			=	60 ksi
Area of Hoop Bars (Per Foot), A_v			=	0.93 in^2/ft
Minimum Area of Transverse Reinforcement, $A_{v.min}$	$0.0316 * \sqrt{f'c}\frac{b_v s}{f_y}$		=	0.10 in^2/ft
Min. Tranverse Rebar Check	$A_v \geq A_{v.min}$	0.93	>=	0.10 in^2/ft

Maximum Spacing of Transverse Reinforcement — *AASHTO 5.7.2.6*

EE I Shear Demand, $V_{u.EEI}$			=	66 kips
EE I Shear Resistance Factor (Normal Wt. Concrete), Φ_v			=	1.00
Effective Web Width (Column Diameter), b_v			=	24 in
Effective Shear Depth, d_v			=	15.96 in
Concrete Strength, f'_c			=	4 ksi
Max Vertical Spacing of Hoop Bars in Top Section of DS, s_1			=	4 in
EE I Shear Stress, $v_{u.EEI}$	$\frac{V_{u.EEI}}{\Phi_v b_v d_v}$		=	0.17 ksi
Maximum Spacing, $s_{max.EEI}$	$if \begin{cases} v_u < 0.125f'c, & s_{max} = 0.8d_v \leq 24in \\ v_u \geq 0.125f'c, & s_{max} = 0.4d_v \leq 12in \end{cases}$		=	12.77 in
Maximum Spacing Check at Top of DS	$s \leq s_{max.EEI}$	4	<=	12.77 in

Transverse Rebar for Compression & Flexural Members — *AASHTO 5.10.4.2 & 5.10.5*

Concrete Nominal Aggregate Size, AG			=	0.75 in
Diameter of Longitudinal Bars, d_b			=	0.875 in
Diameter of Hoop Bar, $d_{b.s}$			=	0.625 in
Vertical Spacing of Spiral Bar, s			=	4.00 in
Minimum Hoop Diameter, $d_{s.min}$			=	0.375 in
Minimum Clear Spacing Between Hoops, $s_{clr.min}$	$max\begin{cases} 1.0\ in \\ 1.33AG \end{cases}$		=	1.00 in
Max Vertical Hoop Spacing, $s_{s.max}$	$min\begin{cases} 6d_b \\ 6\ in \end{cases}$		=	5.25 in
Check Hoop Bar Diameter	$d_b \geq d_{s.min}$	0.625	>=	0.375 in
Check Minimum Clear Spacing Between Hoops	$s - d_{b.s} \geq d_{clr.min}$	3.375	>=	1.000 in
Check Max Vertical Spacing of Hoop Bars	$s \leq s_{s.max}$	4.000	<=	5.250 in

Seismic Requirements for Cast-in-Place Piles — *AASHTO 5.11.4.5.2*

Project Name: Wasatch Peaks Ranch
Subject: Drilled Shaft Design
Structure: Canal Bridge

Comp By: JBG
Date: 08/27/2020
Chk By: ZAT
Date: 08/29/2020

Kimley»Horn

Area of Nonprestressed Longitudinal Steel, A_s		=	4.20	in^2
Gross Area of Section, A_g		=	452.39	in^2
Number of Longitudinal Bars, N		=	7.00	bars
Vertical Spacing of Hoop Bars, s		=	4.00	in
Check Longitudinal Steel Ratio	$\frac{A_s}{A_g} \geq 0.005$	0.009 >=	0.0075	
Check Minimum Number of Long. Bars	$N \geq 4$	7 >=	4	bars
Check Minimum Vertical Spacing of Hoop Bars at Top of Drilled Shaft		4 <=	4	in

APPENDIX A

ABUTMENT #1 FREE HEAD

LB16 2 ft_freehead.lp11o

LPile for Windows, Version 2019-11.004

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is being used by:

Kimley-Horn
Salt Lake City

Serial Number of Security Device: 563876719

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Kimley-Horn & Associates, Inc.,

Use of this program by any entity other than Kimley-Horn & Associates, Inc.,
is a violation of the software license agreement.

Files Used for Analysis

Path to file locations:
\SLC_Civil\096360005 - WPR_Project Files\Eng\Structural\Phase 0A\WBWCD Gateway Canal Crossing\Foundation Design\

Name of input data file:
LB16 2 ft_freehead.lp11d

Name of output report file:
LB16 2 ft_freehead.lp11o

Name of plot output file:
LB16 2 ft_freehead.lp11p

Name of runtime message file:
LB16 2 ft_freehead.lp11r

LB16 2 ft_freehead.lp11o
Date and Time of Analysis

Date: August 28, 2020 Time: 14:02:15

Problem Title

Project Name:

Job Number:

Client:

Engineer:

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

LB16 2 ft_freehead.lp11o

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	50.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	50.000	24.0000

Input Structural Properties for Pile Sections:

LB16 2 ft_freehead.lp11o

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	50.000000 ft
Shaft Diameter	=	24.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	20.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf
Undrained cohesion at top of layer	=	1500. psf
Undrained cohesion at bottom of layer	=	1500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	20.000000 ft
Distance from top of pile to bottom of layer	=	30.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf

Undrained cohesion at top of layer	=	2250. psf
Undrained cohesion at bottom of layer	=	2250. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	30.000000 ft
Distance from top of pile to bottom of layer	=	35.000000 ft
Effective unit weight at top of layer	=	120.000000 pcf
Effective unit weight at bottom of layer	=	120.000000 pcf
Friction angle at top of layer	=	32.000000 deg.
Friction angle at bottom of layer	=	32.000000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	35.000000 ft
Distance from top of pile to bottom of layer	=	90.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf
Undrained cohesion at top of layer	=	1300. psf
Undrained cohesion at bottom of layer	=	1300. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Default values for Epsilon-50 will be computed for this layer.

NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 40.000 ft below the pile tip)

Summary of Input Soil Properties

Layer	Soil Type	Layer	Effective	Undrained	Angle of	E50
Layer	Name	Depth	Unit Wt.	Cohesion	Friction	

LB16 2 ft_freehead.lp11o

or Num. krm	kpy (p-y Curve Type) pci	ft	pcf	psf	deg.
1 default	Stiff Clay --	0.00	115.0000	1500.	--
default	w/o Free Water --	20.0000	115.0000	1500.	--
2 default	Stiff Clay --	20.0000	115.0000	2250.	--
default	w/o Free Water --	30.0000	115.0000	2250.	--
3 --	Sand default	30.0000	120.0000	--	32.0000
--	(Reese, et al.) default	35.0000	120.0000	--	32.0000
4 default	Stiff Clay default	35.0000	115.0000	1300.	--
default	with Free Water default	90.0000	115.0000	1300.	--

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p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.9500	1.0000
2	50.000	0.9500	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

LB16 2 ft_freehead.lp11o

Number of loads specified = 2

Load No.	Load Type	Top y vs. Pile Length	Condition 1	Condition 2	Axial Thrust Force, lbs	Compute Run Analysis
1	4	y =	0.500000 in	M = 0.0000 in-lbs	155000.	N.A. Yes
2	4	y =	0.500000 in	M = 0.0000 in-lbs	110000.	N.A. Yes

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	50.000000 ft
Shaft Diameter	=	24.000000 in
Concrete Cover Thickness (to edge of long. rebar)	=	3.000000 in
Number of Reinforcing Bars	=	11 bars
Yield Stress of Reinforcing Bars	=	60000. psi
Modulus of Elasticity of Reinforcing Bars	=	29000000. psi
Gross Area of Shaft	=	452.389342 sq. in.
Total Area of Reinforcing Steel	=	8.690000 sq. in.

Area Ratio of Steel Reinforcement	=	1.92 percent
Edge-to-Edge Bar Spacing	=	3.789453 in
Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.05
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2029.978 kips
Tensile Load for Cracking of Concrete	=	-213.613 kips
Nominal Axial Tensile Capacity	=	-521.400 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	8.500000	0.00000
2	1.000000	0.790000	7.150655	4.595447
3	1.000000	0.790000	3.531028	7.731872
4	1.000000	0.790000	-1.209676	8.413482
5	1.000000	0.790000	-5.566316	6.423871
6	1.000000	0.790000	-8.155690	2.394727
7	1.000000	0.790000	-8.155690	-2.394727
8	1.000000	0.790000	-5.566316	-6.423871
9	1.000000	0.790000	-1.209676	-8.413482
10	1.000000	0.790000	3.531028	-7.731872
11	1.000000	0.790000	7.150655	-4.595447

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 3.789 inches
between bars 8 and 9.

Ratio of bar spacing to maximum aggregate size = 5.05

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154

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Maximum Coarse Aggregate Size = 0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	110.000
2	155.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 110.000 kips

Bending Max Conc Stress ksi	Bending Max Steel Stress ksi	Run Msg	Bending Curvature rad/in.	Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	93.7233430		74978674.	53.7609547	0.00006720	0.00003720	
0.2793213	1.8400846						
0.00000250	187.4594638		74983786.	32.8967277	0.00008224	0.00002224	
0.3399808	2.1675128						
0.00000375	281.1882926		74983545.	25.9491745	0.00009731	0.00000731	
0.4002503	2.4957227						
0.00000500	374.9020733		74980415.	22.4807555	0.0001124	-0.00000760	
0.4601262	2.8247096						
0.00000625	468.4886584		74958185.	20.4032063	0.0001275	-0.00002248	

LB16 2 ft_freehead.lp11o

0.5195866	3.1543312				
0.00000750	561.7827016	74904360.	19.0199912	0.0001426	-0.00003735
0.5785969	3.4843480				
0.00000875	654.7037731	74823288.	18.0329829	0.0001578	-0.00005221
0.6371367	3.8146193				
0.00001000	747.2139602	74721396.	17.2933311	0.0001729	-0.00006707
0.6951947	4.1450661				
0.00001125	839.2937919	74603893.	16.7184395	0.0001881	-0.00008192
0.7527640	4.4756409				
0.00001250	930.9327494	74474620.	16.2588007	0.0002032	-0.00009676
0.8098405	4.8063153				
0.00001375	930.9327494	67704200.	14.6096808	0.0002009	-0.0001291
0.8003573	4.6293602 C				
0.00001500	930.9327494	62062183.	14.1395444	0.0002121	-0.0001479
0.8421729	4.8457019 C				
0.00001625	930.9327494	57288169.	13.7297387	0.0002231	-0.0001669
0.8829835	5.0563894 C				
0.00001750	930.9327494	53196157.	13.3685834	0.0002340	-0.0001860
0.9228847	5.2620561 C				
0.00001875	930.9327494	49649747.	13.0475166	0.0002446	-0.0002054
0.9619700	5.4633372 C				
0.00002000	930.9327494	46546637.	12.7596199	0.0002552	-0.0002248
1.0002939	5.6605796 C				
0.00002125	930.9327494	43808600.	12.5002913	0.0002656	-0.0002444
1.0379634	5.8545543 C				
0.00002250	956.3429238	42504130.	12.2653226	0.0002760	-0.0002640
1.0750314	6.0456230 C				
0.00002375	985.0653077	41476434.	12.0514698	0.0002862	-0.0002838
1.1115563	6.2341999 C				
0.00002500	1013.	40535765.	11.8561237	0.0002964	-0.0003036
1.1475941	-6.6293103 C				
0.00002625	1041.	39669473.	11.6764021	0.0003065	-0.0003235
1.1831272	-7.0975889 C				
0.00002750	1069.	38869695.	11.5105223	0.0003165	-0.0003435
1.2181947	-7.5678588 C				
0.00002875	1096.	38131880.	11.3576496	0.0003265	-0.0003635
1.2528995	-8.0393095 C				
0.00003000	1123.	37445849.	11.2154327	0.0003365	-0.0003835
1.2871681	-8.5125734 C				
0.00003125	1150.	36807580.	11.0830555	0.0003463	-0.0004037
1.3210548	-8.9872309 C				
0.00003250	1177.	36213276.	10.9598789	0.0003562	-0.0004238
1.3546184	-9.4628140 C				
0.00003375	1203.	35656405.	10.8442530	0.0003660	-0.0004440
1.3877884	-9.9399373 C				
0.00003500	1230.	35135572.	10.7361965	0.0003758	-0.0004642
1.4206670	-10.4177604 C				
0.00003625	1256.	34646610.	10.6346947	0.0003855	-0.0004845

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1.4532272	-10.8965272 C				
0.00003750	1282.	34185663.	10.5388499	0.0003952	-0.0005048
1.4854407	-11.3765006 C				
0.00003875	1308.	33753624.	10.4493720	0.0004049	-0.0005251
1.5174729	-11.8562681 C				
0.00004000	1334.	33342853.	10.3637726	0.0004146	-0.0005454
1.5490722	-12.3380237 C				
0.00004125	1359.	32955632.	10.2833074	0.0004242	-0.0005658
1.5804617	-12.8198434 C				
0.00004250	1385.	32590447.	10.2077410	0.0004338	-0.0005862
1.6116721	-13.3014591 C				
0.00004375	1411.	32241518.	10.1350016	0.0004434	-0.0006066
1.6424674	-13.7849666 C				
0.00004500	1436.	31910841.	10.0662678	0.0004530	-0.0006270
1.6730577	-14.2685206 C				
0.00004625	1461.	31597370.	10.0014003	0.0004626	-0.0006474
1.7034707	-14.7518717 C				
0.00004750	1487.	31298654.	9.9395769	0.0004721	-0.0006679
1.7336276	-15.2357327 C				
0.00004875	1512.	31012479.	9.8800472	0.0004817	-0.0006883
1.7634495	-15.7208332 C				
0.00005125	1562.	30480231.	9.7701075	0.0005007	-0.0007293
1.8225664	-16.6904276 C				
0.00005375	1612.	29992815.	9.6696206	0.0005197	-0.0007703
1.8807631	-17.6612287 C				
0.00005625	1662.	29544349.	9.5773626	0.0005387	-0.0008113
1.9380509	-18.6331774 C				
0.00005875	1712.	29132002.	9.4934355	0.0005577	-0.0008523
1.9946384	-19.6043091 C				
0.00006125	1761.	28748570.	9.4151047	0.0005767	-0.0008933
2.0502110	-20.5776701 C				
0.00006375	1810.	28392802.	9.3430278	0.0005956	-0.0009344
2.1050232	-21.5508275 C				
0.00006625	1859.	28062076.	9.2768223	0.0006146	-0.0009754
2.1591362	-22.5231554 C				
0.00006875	1908.	27752713.	9.2151653	0.0006335	-0.0010165
2.2124135	-23.4960141 C				
0.00007125	1957.	27462059.	9.1572736	0.0006525	-0.0010575
2.2647966	-24.4700332 C				
0.00007375	2005.	27189493.	9.1037031	0.0006714	-0.0010986
2.3164812	-25.4432051 C				
0.00007625	2054.	26933225.	9.0540314	0.0006904	-0.0011396
2.3674642	-26.4155234 C				
0.00007875	2102.	26691692.	9.0078900	0.0007094	-0.0011806
2.4177423	-27.3869819 C				
0.00008125	2150.	26462343.	8.9638941	0.0007283	-0.0012217
2.4670859	-28.3600764 C				
0.00008375	2198.	26245008.	8.9226623	0.0007473	-0.0012627

LB16 2 ft_freehead.lp11o

2.5156779	-29.3328337 C				
0.00008625	2246.	26038870.	8.8841744	0.0007663	-0.0013037
2.5635647	-30.3047086 C				
0.00008875	2294.	25842975.	8.8482013	0.0007853	-0.0013447
2.6107431	-31.2756920 C				
0.00009125	2341.	25656471.	8.8145389	0.0008043	-0.0013857
2.6572099	-32.2457770 C				
0.00009375	2389.	25478598.	8.7830049	0.0008234	-0.0014266
2.7029617	-33.2149563 C				
0.00009625	2436.	25308498.	8.7532290	0.0008425	-0.0014675
2.7479479	-34.1838012 C				
0.00009875	2483.	25145175.	8.7245990	0.0008616	-0.0015084
2.7920571	-35.1536794 C				
0.0001013	2530.	24988694.	8.6977027	0.0008806	-0.0015494
2.8354493	-36.1226202 C				
0.0001038	2577.	24838552.	8.6724175	0.0008998	-0.0015902
2.8781212	-37.0906137 C				
0.0001063	2624.	24694294.	8.6486322	0.0009189	-0.0016311
2.9200692	-38.0576519 C				
0.0001088	2670.	24555504.	8.6262460	0.0009381	-0.0016719
2.9612897	-39.0237267 C				
0.0001113	2717.	24421805.	8.6051672	0.0009573	-0.0017127
3.0017792	-39.9888296 C				
0.0001138	2763.	24292853.	8.5853121	0.0009766	-0.0017534
3.0415340	-40.9529521 C				
0.0001163	2810.	24168333.	8.5666044	0.0009959	-0.0017941
3.0805503	-41.9160856 C				
0.0001188	2856.	24047956.	8.5489742	0.0010152	-0.0018348
3.1188244	-42.8782212 C				
0.0001213	2902.	23931457.	8.5323574	0.0010345	-0.0018755
3.1563525	-43.8393501 C				
0.0001238	2948.	23818534.	8.5165843	0.0010539	-0.0019161
3.1931047	-44.7998576 C				
0.0001263	2993.	23708817.	8.5013259	0.0010733	-0.0019567
3.2290126	-45.7607702 C				
0.0001288	3039.	23602328.	8.4869429	0.0010927	-0.0019973
3.2641693	-46.7206267 C				
0.0001313	3084.	23498873.	8.4733879	0.0011121	-0.0020379
3.2985711	-47.6794170 C				
0.0001338	3130.	23398275.	8.4606171	0.0011316	-0.0020784
3.3322135	-48.6371309 C				
0.0001363	3175.	23300368.	8.4485902	0.0011511	-0.0021189
3.3650926	-49.5937577 C				
0.0001388	3220.	23204997.	8.4372694	0.0011707	-0.0021593
3.3972041	-50.5492867 C				
0.0001413	3265.	23112020.	8.4266201	0.0011903	-0.0021997
3.4285435	-51.5037071 C				
0.0001438	3309.	23021304.	8.4166097	0.0012099	-0.0022401

LB16 2 ft_freehead.lp11o

3.4591067	-52.4570078 C				
0.0001463	3354.	22932723.	8.4072083	0.0012296	-0.0022804
3.4888890	-53.4091775 C				
0.0001488	3398.	22846162.	8.3983878	0.0012493	-0.0023207
3.5178860	-54.3602046 C				
0.0001588	3575.	22518046.	8.3684174	0.0013285	-0.0024815
3.6259285	-58.1526495 C				
0.0001688	3747.	22203717.	8.3446277	0.0014082	-0.0026418
3.7207798	-60.0000000 CY				
0.0001788	3891.	21766156.	8.3092906	0.0014853	-0.0028047
3.7993810	-60.0000000 CY				
0.0001888	3999.	21189081.	8.2571474	0.0015585	-0.0029715
3.8619803	-60.0000000 CY				
0.0001988	4095.	20601531.	8.2034351	0.0016304	-0.0031396
3.9120573	-60.0000000 CY				
0.0002088	4171.	19982466.	8.1447586	0.0017002	-0.0033098
3.9498999	-60.0000000 CY				
0.0002188	4236.	19364929.	8.0857118	0.0017687	-0.0034813
3.9767621	-60.0000000 CY				
0.0002288	4299.	18793918.	8.0334635	0.0018377	-0.0036523
3.9934952	-60.0000000 CY				
0.0002388	4356.	18246213.	7.9822696	0.0019058	-0.0038242
3.9999058	-60.0000000 CY				
0.0002488	4401.	17692640.	7.9279771	0.0019721	-0.0039979
3.9999843	-60.0000000 CY				
0.0002588	4438.	17152987.	7.8745719	0.0020375	-0.0041725
3.9999822	-60.0000000 CY				
0.0002688	4474.	16648023.	7.8267460	0.0021034	-0.0043466
3.9999172	-60.0000000 CY				
0.0002788	4509.	16175257.	7.7833743	0.0021696	-0.0045204
3.9996476	-60.0000000 CY				
0.0002888	4542.	15731325.	7.7434631	0.0022359	-0.0046941
3.9988848	-60.0000000 CY				
0.0002988	4574.	15309426.	7.7064084	0.0023023	-0.0048677
3.9971859	-60.0000000 CY				
0.0003088	4600.	14899449.	7.6691943	0.0023679	-0.0050421
4.0000000	-60.0000000 CY				
0.0003188	4622.	14499160.	7.6313233	0.0024325	-0.0052175
3.9991475	-60.0000000 CY				
0.0003288	4639.	14111797.	7.5935280	0.0024964	-0.0053936
3.9958785	-60.0000000 CY				
0.0003388	4655.	13742944.	7.5578821	0.0025602	-0.0055698
3.9996717	-60.0000000 CY				
0.0003488	4671.	13393086.	7.5233391	0.0026238	-0.0057462
3.9962628	-60.0000000 CY				
0.0003588	4686.	13061755.	7.4915861	0.0026876	-0.0059224
3.9996897	-60.0000000 CY				
0.0003688	4701.	12747375.	7.4624629	0.0027518	-0.0060982

LB16 2 ft_freehead.lp11o

3.9954329	-60.0000000 CY				
0.0003788	4715.	12448773.	7.4356448	0.0028163	-0.0062737
3.9993268	-60.0000000 CY				
0.0003888	4729.	12164755.	7.4109509	0.0028810	-0.0064490
3.9952701	-60.0000000 CY				
0.0003988	4743.	11894173.	7.3882420	0.0029461	-0.0066239
3.9981323	-60.0000000 CY				
0.0004088	4756.	11636229.	7.3671295	0.0030113	-0.0067987
3.9999891	-60.0000000 CYT				
0.0004188	4769.	11387838.	7.3467851	0.0030765	-0.0069735
3.9950948	-60.0000000 CYT				
0.0004288	4780.	11148842.	7.3269069	0.0031414	-0.0071486
3.9989120	-60.0000000 CYT				
0.0004388	4790.	10916382.	7.3052962	0.0032052	-0.0073248
3.9991604	-60.0000000 CYT				
0.0004488	4798.	10692409.	7.2840921	0.0032687	-0.0075013
3.9942552	-60.0000000 CYT				
0.0004588	4805.	10473982.	7.2615912	0.0033313	-0.0076787
3.9980763	-60.0000000 CYT				
0.0004688	4811.	10264161.	7.2400191	0.0033938	-0.0078562
3.9998574	-60.0000000 CYT				
0.0004788	4816.	10060314.	7.2181215	0.0034557	-0.0080343
3.9942767	-60.0000000 CYT				
0.0004888	4821.	9864271.	7.1972311	0.0035176	-0.0082124
3.9945738	-60.0000000 CYT				
0.0004988	4826.	9675905.	7.1774047	0.0035797	-0.0083903
3.9979989	60.0000000 CYT				
0.0005088	4830.	9494781.	7.1586066	0.0036419	-0.0085681
3.9997544	60.0000000 CYT				
0.0005188	4835.	9320443.	7.1408700	0.0037043	-0.0087457
3.9959852	60.0000000 CYT				
0.0005288	4839.	9152514.	7.1241228	0.0037669	-0.0089231
3.9916192	60.0000000 CYT				
0.0005388	4844.	8990317.	7.1087090	0.0038298	-0.0091002
3.9958709	60.0000000 CYT				

Axial Thrust Force = 155.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Run Msg	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	92.7409363		74192749.	71.1447125	0.00008893	0.00005893

LB16 2 ft_freehead.lp11o

0.3676739	2.4702458				
0.00000250	185.5014796	74200592.	41.5887777	0.0001040	0.00004397
0.4276076	2.7976864				
0.00000375	278.2546542	74201241.	31.7440643	0.0001190	0.00002904
0.4871510	3.1259170				
0.00000500	370.9967903	74199358.	26.8271567	0.0001341	0.00001414
0.5463014	3.4549377				
0.00000625	463.7242176	74195875.	23.8813720	0.0001493	-7.41425E-07
0.6050560	3.7847487				
0.00000750	556.4062054	74187494.	21.9209929	0.0001644	-0.00001559
0.6634076	4.1153160				
0.00000875	648.9096919	74161108.	20.5230141	0.0001796	-0.00003042
0.7213303	4.4464648				
0.00001000	741.1210439	74112104.	19.4759493	0.0001948	-0.00004524
0.7787999	4.7780253				
0.00001125	832.9771839	74042416.	18.6624935	0.0002100	-0.00006005
0.8358007	5.1098885				
0.00001250	924.4412013	73955296.	18.0123643	0.0002252	-0.00007485
0.8923224	5.4419821				
0.00001375	1015.	73853899.	17.4808975	0.0002404	-0.00008964
0.9483580	5.7742579				
0.00001500	1106.	73740866.	17.0383501	0.0002556	-0.0001044
1.0039026	6.1066823				
0.00001625	1106.	68068491.	15.7128386	0.0002553	-0.0001347
1.0024650	5.9909252 C				
0.00001750	1106.	63206456.	15.2643503	0.0002671	-0.0001529
1.0450575	6.2241578 C				
0.00001875	1106.	58992692.	14.8647454	0.0002787	-0.0001713
1.0866045	6.4514554 C				
0.00002000	1106.	55305649.	14.5070222	0.0002901	-0.0001899
1.1272774	6.6740729 C				
0.00002125	1106.	52052376.	14.1835470	0.0003014	-0.0002086
1.1670700	6.8918609 C				
0.00002250	1112.	49412510.	13.8903685	0.0003125	-0.0002275
1.2061349	7.1059655 C				
0.00002375	1144.	48176715.	13.6229126	0.0003235	-0.0002465
1.2444990	7.3165311 C				
0.00002500	1176.	47031716.	13.3776201	0.0003344	-0.0002656
1.2821974	7.5237746 C				
0.00002625	1207.	45968469.	13.1517059	0.0003452	-0.0002848
1.3192732	7.7279862 C				
0.00002750	1237.	44979414.	12.9429294	0.0003559	-0.0003041
1.3557720	7.9294863 C				
0.00002875	1267.	44058127.	12.7494777	0.0003665	-0.0003235
1.3917419	8.1286271 C				
0.00003000	1296.	43199073.	12.5698797	0.0003771	-0.0003429
1.4272341	8.3257946 C				
0.00003125	1325.	42393255.	12.4020332	0.0003876	-0.0003624

LB16 2 ft_freehead.lp11o

1.4622071	8.5205925 C				
0.00003250	1353.	41637295.	12.2449997	0.0003980	-0.0003820
1.4967120	8.7134123 C				
0.00003375	1381.	40930476.	12.0985905	0.0004083	-0.0004017
1.5308673	8.9052456 C				
0.00003500	1409.	40262426.	11.9604207	0.0004186	-0.0004214
1.5645310	-9.1751729 C				
0.00003625	1437.	39635179.	11.8309688	0.0004289	-0.0004411
1.5978670	-9.6389440 C				
0.00003750	1464.	39042176.	11.7087386	0.0004391	-0.0004609
1.6308010	-10.1042467 C				
0.00003875	1491.	38482618.	11.5935836	0.0004493	-0.0004807
1.6634057	-10.5704606 C				
0.00004000	1518.	37951667.	11.4843780	0.0004594	-0.0005006
1.6956239	-11.0381223 C				
0.00004125	1545.	37450509.	11.3815586	0.0004695	-0.0005205
1.7275879	-11.5060604 C				
0.00004250	1571.	36971437.	11.2830939	0.0004795	-0.0005405
1.7591001	-11.9760866 C				
0.00004375	1598.	36518903.	11.1904359	0.0004896	-0.0005604
1.7904171	-12.4458844 C				
0.00004500	1624.	36086270.	11.1017162	0.0004996	-0.0005804
1.8213434	-12.9172602 C				
0.00004625	1650.	35674009.	11.0172604	0.0005095	-0.0006005
1.8519754	-13.3893493 C				
0.00004750	1676.	35282689.	10.9374131	0.0005195	-0.0006205
1.8824144	-13.8612133 C				
0.00004875	1702.	34906445.	10.8603674	0.0005294	-0.0006406
1.9124430	-14.3349055 C				
0.00005125	1753.	34204599.	10.7171946	0.0005493	-0.0006807
1.9718019	-15.2828193 C				
0.00005375	1804.	33559124.	10.5855488	0.0005690	-0.0007210
2.0300180	-16.2335256 C				
0.00005625	1854.	32966252.	10.4652788	0.0005887	-0.0007613
2.0873326	-17.1847638 C				
0.00005875	1904.	32416137.	10.3535423	0.0006083	-0.0008017
2.1435122	-18.1389022 C				
0.00006125	1954.	31907238.	10.2508118	0.0006279	-0.0008421
2.1988342	-19.0932454 C				
0.00006375	2004.	31433582.	10.1554417	0.0006474	-0.0008826
2.2531950	-20.0488771 C				
0.00006625	2053.	30990914.	10.0664591	0.0006669	-0.0009231
2.3065747	-21.0060652 C				
0.00006875	2102.	30578481.	9.9843922	0.0006864	-0.0009636
2.3592090	-21.9623679 C				
0.00007125	2151.	30190447.	9.9071178	0.0007059	-0.0010041
2.4108283	-22.9206678 C				
0.00007375	2200.	29825749.	9.8348834	0.0007253	-0.0010447

LB16 2 ft_freehead.lp11o

2.4615840	-23.8793933 C				
0.00007625	2248.	29483212.	9.7677910	0.0007448	-0.0010852
2.5115959	-24.8372219 C				
0.00007875	2296.	29160048.	9.7049491	0.0007643	-0.0011257
2.5607796	-25.7950722 C				
0.00008125	2344.	28853106.	9.6451245	0.0007837	-0.0011663
2.6089642	-26.7549252 C				
0.00008375	2392.	28562900.	9.5892471	0.0008031	-0.0012069
2.6564057	-27.7138663 C				
0.00008625	2440.	28287961.	9.5369763	0.0008226	-0.0012474
2.7031006	-28.6718887 C				
0.00008875	2487.	28026991.	9.4880100	0.0008421	-0.0012879
2.7490455	-29.6289841 C				
0.00009125	2535.	27777341.	9.4409921	0.0008615	-0.0013285
2.7940057	-30.5880244 C				
0.00009375	2582.	27539279.	9.3966113	0.0008809	-0.0013691
2.8381707	-31.5467129 C				
0.00009625	2629.	27312184.	9.3548757	0.0009004	-0.0014096
2.8815853	-32.5044534 C				
0.00009875	2676.	27095211.	9.3155870	0.0009199	-0.0014501
2.9242456	-33.4612384 C				
0.0001013	2722.	26887601.	9.2785666	0.0009395	-0.0014905
2.9661481	-34.4170601 C				
0.0001038	2769.	26688670.	9.2436530	0.0009590	-0.0015310
3.0072891	-35.3719087 C				
0.0001063	2815.	26496819.	9.2098131	0.0009785	-0.0015715
3.0474694	-36.3285132 C				
0.0001088	2861.	26312413.	9.1777389	0.0009981	-0.0016119
3.0868661	-37.2844556 C				
0.0001113	2908.	26135055.	9.1474170	0.0010177	-0.0016523
3.1254992	-38.2393956 C				
0.0001138	2953.	25964269.	9.1187345	0.0010373	-0.0016927
3.1633649	-39.1933248 C				
0.0001163	2999.	25799622.	9.0915881	0.0010569	-0.0017331
3.2004593	-40.1462342 C				
0.0001188	3045.	25640717.	9.0658834	0.0010766	-0.0017734
3.2367783	-41.0981149 C				
0.0001213	3090.	25487189.	9.0415340	0.0010963	-0.0018137
3.2723179	-42.0489579 C				
0.0001238	3136.	25338704.	9.0184601	0.0011160	-0.0018540
3.3070739	-42.9987539 C				
0.0001263	3181.	25194864.	8.9964770	0.0011358	-0.0018942
3.3410181	-43.9478984 C				
0.0001288	3226.	25055022.	8.9750589	0.0011555	-0.0019345
3.3740474	-44.8981234 C				
0.0001313	3271.	24919406.	8.9547435	0.0011753	-0.0019747
3.4062890	-45.8472571 C				
0.0001338	3315.	24787770.	8.9354717	0.0011951	-0.0020149

LB16 2 ft_freehead.lp11o

3.4377386	-46.7952888 C				
0.0001363	3360.	24659886.	8.9171887	0.0012150	-0.0020550
3.4683917	-47.7422080 C				
0.0001388	3404.	24535541.	8.8998437	0.0012349	-0.0020951
3.4982439	-48.6880038 C				
0.0001413	3449.	24414539.	8.8833897	0.0012548	-0.0021352
3.5272906	-49.6326652 C				
0.0001438	3493.	24296697.	8.8677828	0.0012747	-0.0021753
3.5555270	-50.5761810 C				
0.0001463	3537.	24181842.	8.8529824	0.0012947	-0.0022153
3.5829487	-51.5185396 C				
0.0001488	3580.	24069815.	8.8389504	0.0013148	-0.0022552
3.6095507	-52.4597295 C				
0.0001588	3754.	23647142.	8.7898335	0.0013954	-0.0024146
3.7076647	-56.2125539 C				
0.0001688	3925.	23259180.	8.7502260	0.0014766	-0.0025734
3.7922086	-59.9473314 C				
0.0001788	4084.	22848664.	8.7119113	0.0015573	-0.0027327
3.8619153	-60.0000000 CY				
0.0001888	4208.	22294040.	8.6588402	0.0016344	-0.0028956
3.9152496	-60.0000000 CY				
0.0001988	4306.	21665916.	8.5979528	0.0017088	-0.0030612
3.9544547	-60.0000000 CY				
0.0002088	4394.	21048338.	8.5396721	0.0017827	-0.0032273
3.9813891	-60.0000000 CY				
0.0002188	4463.	20402401.	8.4755111	0.0018540	-0.0033960
3.9961523	-60.0000000 CY				
0.0002288	4524.	19777941.	8.4138988	0.0019247	-0.0035653
3.9978293	-60.0000000 CY				
0.0002388	4584.	19198128.	8.3598222	0.0019959	-0.0037341
3.9987298	-60.0000000 CY				
0.0002488	4636.	18638846.	8.3086218	0.0020668	-0.0039032
3.9990900	-60.0000000 CY				
0.0002588	4678.	18078993.	8.2545089	0.0021359	-0.0040741
3.9989972	-60.0000000 CY				
0.0002688	4712.	17534123.	8.2001516	0.0022038	-0.0042462
3.9984417	-60.0000000 CY				
0.0002788	4745.	17023151.	8.1511546	0.0022721	-0.0044179
3.9973022	-60.0000000 CY				
0.0002888	4777.	16544454.	8.1072648	0.0023410	-0.0045890
3.9986669	-60.0000000 CY				
0.0002988	4808.	16094811.	8.0679844	0.0024103	-0.0047597
3.9997887	-60.0000000 CY				
0.0003088	4838.	15670370.	8.0319909	0.0024799	-0.0049301
3.9985232	-60.0000000 CY				
0.0003188	4864.	15260181.	7.9950126	0.0025484	-0.0051016
3.9962724	-60.0000000 CY				
0.0003288	4886.	14861289.	7.9576012	0.0026161	-0.0052739

LB16 2 ft_freehead.lp11o

3.9995611	-60.0000000 CY				
0.0003388	4903.	14474212.	7.9198752	0.0026829	-0.0054471
3.9963393	-60.0000000 CY				
0.0003488	4918.	14101302.	7.8826972	0.0027491	-0.0056209
3.9997111	-60.0000000 CY				
0.0003588	4932.	13747893.	7.8484425	0.0028156	-0.0057944
3.9958452	-60.0000000 CY				
0.0003688	4946.	13412785.	7.8168133	0.0028824	-0.0059676
3.9994769	-60.0000000 CY				
0.0003788	4959.	13094212.	7.7867944	0.0029492	-0.0061408
3.9944734	-60.0000000 CY				
0.0003888	4972.	12790869.	7.7579989	0.0030159	-0.0063141
3.9984941	-60.0000000 CY				
0.0003988	4985.	12502259.	7.7311871	0.0030828	-0.0064872
3.9999091	-60.0000000 CYT				
0.0004088	4998.	12226947.	7.7065113	0.0031500	-0.0066600
3.9958736	-60.0000000 CYT				
0.0004188	5010.	11964406.	7.6834676	0.0032175	-0.0068325
3.9992650	-60.0000000 CYT				
0.0004288	5022.	11713558.	7.6619853	0.0032851	-0.0070049
3.9969728	-60.0000000 CYT				
0.0004388	5034.	11473506.	7.6420552	0.0033530	-0.0071770
3.9959300	-60.0000000 CYT				
0.0004488	5044.	11240664.	7.6215616	0.0034202	-0.0073498
3.9991346	60.0000000 CYT				
0.0004588	5054.	11017327.	7.6022463	0.0034875	-0.0075225
3.9984921	60.0000000 CYT				
0.0004688	5062.	10799147.	7.5818857	0.0035540	-0.0076960
3.9935045	60.0000000 CYT				
0.0004788	5070.	10589891.	7.5626698	0.0036206	-0.0078694
3.9975595	60.0000000 CYT				
0.0004888	5075.	10383916.	7.5418579	0.0036861	-0.0080439
3.9996220	60.0000000 CYT				
0.0004988	5080.	10185787.	7.5219186	0.0037516	-0.0082184
3.9968848	60.0000000 CYT				
0.0005088	5084.	9993544.	7.5018726	0.0038166	-0.0083934
3.9920025	60.0000000 CYT				

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain

1	110.000	4753.967	0.00300000
2	155.000	4969.342	0.00300000

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	4754.	71.500000	3090.	23485877.
2	0.65	4969.	100.750000	3230.	25042204.
1	0.75	4754.	77.000000	3565.	22535282.
2	0.75	4969.	108.500000	3727.	23712826.
1	0.90	4754.	82.500000	4279.	18979984.
2	0.90	4969.	116.250000	4472.	20306635.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	375142.
2	20.0000	15.5903	Yes	No	375142.	392091.
3	30.0000	20.1281	No	No	767233.	663263.
4	35.0000	572.7969	No	No	1430496.	N.A.

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Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 155000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Spr. Distrib. p
Es*h	Lat. Load						
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.5000	0.00	38160.	-0.00546	0.00	7.42E+10	
-372.1217	2233.	0.00					
0.5000	0.4672	227342.	35886.	-0.00545	0.00	7.42E+10	
-385.7884	4954.	0.00					
1.0000	0.4346	440779.	33534.	-0.00543	0.00	7.42E+10	
-398.4245	5501.	0.00					
1.5000	0.4021	639839.	31109.	-0.00538	0.00	7.42E+10	
-409.9563	6117.	0.00					
2.0000	0.3700	824093.	28618.	-0.00532	0.00	7.40E+10	
-420.2995	6816.	0.00					
2.5000	0.3383	993154.	26069.	-0.00525	0.00	7.39E+10	
-429.3563	7616.	0.00					
3.0000	0.3070	1146683.	23470.	-0.00514	0.00	4.81E+10	
-437.0108	8541.	0.00					
3.5000	0.2766	1284346.	20829.	-0.00498	0.00	4.35E+10	
-443.2423	9615.	0.00					
4.0000	0.2473	1405888.	18155.	-0.00478	0.00	4.03E+10	
-447.9850	10870.	0.00					
4.5000	0.2192	1511109.	15458.	-0.00456	0.00	3.81E+10	
-451.1756	12350.	0.00					
5.0000	0.1926	1599865.	12746.	-0.00431	0.00	3.65E+10	

LB16 2 ft_freehead.lp11o

-452.7518	14108.	0.00				
5.5000	0.1675	1672078.	10030.	-0.00404	0.00	3.53E+10
-452.6512	16216.	0.00				
6.0000	0.1441	1727731.	7320.	-0.00374	0.00	3.45E+10
-450.8108	18768.	0.00				
6.5000	0.1226	1766876.	4626.	-0.00344	0.00	3.40E+10
-447.1665	21893.	0.00				
7.0000	0.1029	1789633.	1959.	-0.00312	0.00	3.37E+10
-441.6517	25763.	0.00				
7.5000	0.08507	1796195.	-668.4279	-0.00280	0.00	3.37E+10
-434.1964	30623.	0.00				
8.0000	0.06921	1786828.	-3245.	-0.00249	0.00	3.38E+10
-424.7254	36821.	0.00				
8.5000	0.05525	1761875.	-5759.	-0.00217	0.00	3.41E+10
-413.1554	44867.	0.00				
9.0000	0.04315	1721760.	-8196.	-0.00187	0.00	3.46E+10
-399.3902	55531.	0.00				
9.5000	0.03285	1666990.	-10545.	-0.00158	0.00	3.54E+10
-383.3124	70020.	0.00				
10.0000	0.02423	1598158.	-12789.	-0.00130	0.00	3.65E+10
-364.7664	90315.	0.00				
10.5000	0.01720	1515950.	-14914.	-0.00105	0.00	3.80E+10
-343.5254	119864.	0.00				
11.0000	0.01160	1421153.	-16902.	-8.27E-04	0.00	4.00E+10
-319.2194	165183.	0.00				
11.5000	0.00727	1314665.	-18733.	-6.28E-04	0.00	4.27E+10
-291.1581	240164.	0.00				
12.0000	0.00406	1197523.	-20380.	-4.58E-04	0.00	4.63E+10
-257.8217	380826.	0.00				
12.5000	0.00178	1070956.	-21798.	-3.37E-04	0.00	7.38E+10
-214.8808	723673.	0.00				
13.0000	2.37E-05	936572.	-22466.	-2.55E-04	0.00	7.39E+10
-7.8033	1977789.	0.00				
13.5000	-0.00128	801837.	-21870.	-1.85E-04	0.00	7.41E+10
206.4266	968953.	0.00				
14.0000	-0.00219	674472.	-20526.	-1.25E-04	0.00	7.41E+10
241.5197	661571.	0.00				
14.5000	-0.00278	555751.	-19016.	-7.50E-05	0.00	7.42E+10
261.8085	566048.	0.00				
15.0000	-0.00309	446414.	-17407.	-3.45E-05	0.00	7.42E+10
274.6413	533261.	0.00				
15.5000	-0.00319	346930.	-15736.	-2.38E-06	0.00	7.42E+10
282.5372	531659.	0.00				
16.0000	-0.00312	257591.	-14028.	2.21E-05	0.00	7.42E+10
286.6737	551534.	0.00				
16.5000	-0.00292	178553.	-12305.	3.97E-05	0.00	7.42E+10
287.6897	590381.	0.00				
17.0000	-0.00264	109859.	-10584.	5.14E-05	0.00	7.42E+10

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285.9609	649355.	0.00				
17.5000	-0.00231	51451.	-8881.	5.79E-05	0.00	7.42E+10
281.7140	732535.	0.00				
18.0000	-0.00195	3181.	-7210.	6.01E-05	0.00	7.42E+10
275.0821	847420.	0.00				
18.5000	-0.00159	-35187.	-5591.	5.88E-05	0.00	7.42E+10
264.8535	1001749.	0.00				
19.0000	-0.00124	-64017.	-4049.	5.48E-05	0.00	7.42E+10
249.1357	1203460.	0.00				
19.5000	-9.29E-04	-83873.	-2606.	4.88E-05	0.00	7.42E+10
231.6749	1496429.	0.00				
20.0000	-6.56E-04	-95383.	-1216.	4.16E-05	0.00	7.42E+10
231.6932	2117784.	0.00				
20.5000	-4.30E-04	-98545.	230.3696	3.37E-05	0.00	7.42E+10
250.4900	3493469.	0.00				
21.0000	-2.52E-04	-92681.	1430.	2.60E-05	0.00	7.42E+10
149.4359	3560513.	0.00				
21.5000	-1.18E-04	-81431.	2093.	1.89E-05	0.00	7.42E+10
71.5843	3627557.	0.00				
22.0000	-2.45E-05	-67598.	2353.	1.29E-05	0.00	7.42E+10
15.0813	3694602.	0.00				
22.5000	3.66E-05	-53217.	2330.	8.03E-06	0.00	7.42E+10
-22.9568	3761646.	0.00				
23.0000	7.19E-05	-39658.	2123.	4.28E-06	0.00	7.42E+10
-45.8831	3828690.	0.00				
23.5000	8.79E-05	-27748.	1814.	1.55E-06	0.00	7.42E+10
-57.1039	3895734.	0.00				
24.0000	9.05E-05	-17892.	1463.	-2.93E-07	0.00	7.42E+10
-59.7908	3962779.	0.00				
24.5000	8.44E-05	-10186.	1115.	-1.43E-06	0.00	7.42E+10
-56.3948	4007812.	0.00				
25.0000	7.34E-05	-4511.	798.6179	-2.02E-06	0.00	7.42E+10
-49.0179	4007812.	0.00				
25.5000	6.02E-05	-599.2324	531.0273	-2.23E-06	0.00	7.42E+10
-40.1790	4007812.	0.00				
26.0000	4.66E-05	1866.	317.0528	-2.18E-06	0.00	7.42E+10
-31.1458	4007812.	0.00				
26.5000	3.40E-05	3209.	155.4630	-1.97E-06	0.00	7.42E+10
-22.7174	4007812.	0.00				
27.0000	2.29E-05	3735.	41.3230	-1.69E-06	0.00	7.42E+10
-15.3293	4007812.	0.00				
27.5000	1.37E-05	3708.	-32.1197	-1.39E-06	0.00	7.42E+10
-9.1516	4007812.	0.00				
28.0000	6.25E-06	3352.	-72.1027	-1.11E-06	0.00	7.42E+10
-4.1760	4007812.	0.00				
28.5000	4.29E-07	2845.	-85.4913	-8.55E-07	0.00	7.42E+10
-0.2869	4007812.	0.00				
29.0000	-4.01E-06	2328.	-78.3117	-6.46E-07	0.00	7.42E+10

2.6801	4007812.	0.00				
29.5000	-7.32E-06	1907.	-55.5938	-4.75E-07	0.00	7.42E+10
4.8925	4007812.	0.00				
30.0000	-9.71E-06	1662.	-40.0879	-3.31E-07	0.00	7.42E+10
0.2761	170575.	0.00				
30.5000	-1.13E-05	1426.	-38.2805	-2.06E-07	0.00	7.42E+10
0.3264	173418.	0.00				
31.0000	-1.22E-05	1203.	-36.2278	-9.95E-08	0.00	7.42E+10
0.3578	176261.	0.00				
31.5000	-1.25E-05	991.7741	-34.0362	-1.07E-08	0.00	7.42E+10
0.3727	179104.	0.00				
32.0000	-1.23E-05	794.2386	-31.7982	6.15E-08	0.00	7.42E+10
0.3733	181947.	0.00				
32.5000	-1.17E-05	610.0818	-29.5928	1.18E-07	0.00	7.42E+10
0.3618	184790.	0.00				
33.0000	-1.09E-05	438.9050	-27.4856	1.61E-07	0.00	7.42E+10
0.3406	187633.	0.00				
33.5000	-9.82E-06	279.9561	-25.5286	1.90E-07	0.00	7.42E+10
0.3118	190476.	0.00				
34.0000	-8.61E-06	132.2093	-23.7607	2.06E-07	0.00	7.42E+10
0.2775	193319.	0.00				
34.5000	-7.34E-06	-5.5560	-22.2078	2.12E-07	0.00	7.42E+10
0.2401	196162.	0.00				
35.0000	-6.08E-06	-134.6778	-17.8513	2.06E-07	0.00	7.42E+10
1.2121	1197000.	0.00				
35.5000	-4.87E-06	-220.1539	-11.2567	1.92E-07	0.00	7.42E+10
0.9861	1214100.	0.00				
36.0000	-3.78E-06	-270.1140	-5.9729	1.72E-07	0.00	7.42E+10
0.7752	1231200.	0.00				
36.5000	-2.81E-06	-292.1479	-1.8916	1.49E-07	0.00	7.42E+10
0.5853	1248300.	0.00				
37.0000	-1.99E-06	-293.0908	1.1233	1.25E-07	0.00	7.42E+10
0.4197	1265400.	0.00				
37.5000	-1.31E-06	-278.9010	3.2224	1.02E-07	0.00	7.42E+10
0.2799	1282500.	0.00				
38.0000	-7.64E-07	-254.6125	4.5589	8.06E-08	0.00	7.42E+10
0.1656	1299600.	0.00				
38.5000	-3.43E-07	-224.3446	5.2811	6.12E-08	0.00	7.42E+10
0.07520	1316700.	0.00				
39.0000	-2.98E-08	-191.3528	5.5266	4.44E-08	0.00	7.42E+10
0.00662	1333800.	0.00				
39.5000	1.90E-07	-158.1081	5.4180	3.03E-08	0.00	7.42E+10
-0.04283	1350900.	0.00				
40.0000	3.34E-07	-126.3933	5.0614	1.88E-08	0.00	7.42E+10
-0.07604	1368000.	0.00				
40.5000	4.15E-07	-97.4065	4.5455	9.72E-09	0.00	7.42E+10
-0.09591	1385100.	0.00				
41.0000	4.50E-07	-71.8652	3.9422	2.88E-09	0.00	7.42E+10

LB16 2 ft_freehead.lp11o

-0.1052	1402200.	0.00				
41.5000	4.50E-07	-50.1059	3.3072	-2.05E-09	0.00	7.42E+10
-0.1065	1419300.	0.00				
42.0000	4.26E-07	-32.1751	2.6822	-5.38E-09	0.00	7.42E+10
-0.1019	1436400.	0.00				
42.5000	3.85E-07	-17.9093	2.0965	-7.41E-09	0.00	7.42E+10
-0.09337	1453500.	0.00				
43.0000	3.37E-07	-7.0035	1.5688	-8.41E-09	0.00	7.42E+10
-0.08251	1470600.	0.00				
43.5000	2.84E-07	0.9322	1.1097	-8.66E-09	0.00	7.42E+10
-0.07054	1487700.	0.00				
44.0000	2.33E-07	6.3287	0.7230	-8.37E-09	0.00	7.42E+10
-0.05837	1504800.	0.00				
44.5000	1.84E-07	9.6232	0.4078	-7.72E-09	0.00	7.42E+10
-0.04669	1521900.	0.00				
45.0000	1.40E-07	11.2360	0.1599	-6.88E-09	0.00	7.42E+10
-0.03594	1539000.	0.00				
45.5000	1.02E-07	11.5544	-0.02696	-5.96E-09	0.00	7.42E+10
-0.02634	1556100.	0.00				
46.0000	6.86E-08	10.9236	-0.1600	-5.05E-09	0.00	7.42E+10
-0.01800	1573200.	0.00				
46.5000	4.10E-08	9.6441	-0.2466	-4.22E-09	0.00	7.42E+10
-0.01087	1590300.	0.00				
47.0000	1.81E-08	7.9727	-0.2937	-3.50E-09	0.00	7.42E+10
-0.00484	1607400.	0.00				
47.5000	-1.03E-09	6.1265	-0.3073	-2.93E-09	0.00	7.42E+10
2.79E-04	1624500.	0.00				
48.0000	-1.71E-08	4.2900	-0.2924	-2.51E-09	0.00	7.42E+10
0.00469	1641600.	0.00				
48.5000	-3.12E-08	2.6219	-0.2525	-2.23E-09	0.00	7.42E+10
0.00862	1658700.	0.00				
49.0000	-4.39E-08	1.2638	-0.1899	-2.07E-09	0.00	7.42E+10
0.01227	1675800.	0.00				
49.5000	-5.61E-08	0.3472	-0.1056	-2.01E-09	0.00	7.42E+10
0.01582	1692900.	0.00				
50.0000	-6.80E-08	0.00	0.00	-2.00E-09	0.00	7.42E+10
0.01939	855000.	0.00				

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

LB16 2 ft_freehead.lp11o

Pile-head deflection	=	0.50000000	inches
Computed slope at pile head	=	-0.00546181	radians
Maximum bending moment	=	1796195.	inch-lbs
Maximum shear force	=	38160.	lbs
Depth of maximum bending moment	=	7.50000000	feet below pile head
Depth of maximum shear force	=	0.000000	feet below pile head
Number of iterations	=	18	
Number of zero deflection points	=	5	

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)

Displacement of pile head	=	0.500000	inches
Moment at pile head	=	0.0	in-lbs
Axial load at pile head	=	110000.0	lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Spr. Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
0.00	0.5000	0.00	36649.	-0.00565	0.00	7.50E+10	
-372.1217	2233.	0.00					
0.5000	0.4661	216929.	34376.	-0.00564	0.00	7.50E+10	
-385.5523	4963.	0.00					
1.0000	0.4323	419966.	32026.	-0.00562	0.00	7.50E+10	
-397.8983	5523.	0.00					
1.5000	0.3987	608657.	29605.	-0.00558	0.00	7.49E+10	
-409.0736	6157.	0.00					
2.0000	0.3654	782590.	27121.	-0.00552	0.00	7.47E+10	
-418.9781	6881.	0.00					
2.5000	0.3324	941397.	24582.	-0.00542	0.00	4.32E+10	
-427.4931	7716.	0.00					
3.0000	0.3003	1084728.	21995.	-0.00527	0.00	3.84E+10	
-434.5937	8684.	0.00					
3.5000	0.2691	1212303.	19371.	-0.00509	0.00	3.55E+10	
-440.2144	9814.	0.00					
4.0000	0.2392	1323894.	16717.	-0.00487	0.00	3.35E+10	
-444.2897	11144.	0.00					
4.5000	0.2107	1419334.	14044.	-0.00461	0.00	3.21E+10	

LB16 2 ft_freehead.lp11o

-446.7540	12720.	0.00				
5.0000	0.1838	1498517.	11361.	-0.00434	0.00	3.12E+10
-447.5400	14607.	0.00				
5.5000	0.1587	1561397.	8679.	-0.00404	0.00	3.05E+10
-446.5784	16887.	0.00				
6.0000	0.1354	1607998.	6008.	-0.00373	0.00	3.00E+10
-443.7963	19673.	0.00				
6.5000	0.1140	1638410.	3359.	-0.00340	0.00	2.98E+10
-439.1164	23119.	0.00				
7.0000	0.09455	1652796.	744.4249	-0.00307	0.00	2.96E+10
-432.4548	27442.	0.00				
7.5000	0.07715	1651392.	-1824.	-0.00273	0.00	2.96E+10
-423.7187	32952.	0.00				
8.0000	0.06176	1634514.	-4334.	-0.00240	0.00	2.98E+10
-412.8026	40106.	0.00				
8.5000	0.04834	1602558.	-6771.	-0.00208	0.00	3.01E+10
-399.5821	49598.	0.00				
9.0000	0.03684	1556005.	-9121.	-0.00176	0.00	3.05E+10
-383.9035	62530.	0.00				
9.5000	0.02717	1495431.	-11370.	-0.00147	0.00	3.12E+10
-365.5654	80728.	0.00				
10.0000	0.01923	1421506.	-13499.	-0.00119	0.00	3.21E+10
-344.2822	107427.	0.00				
10.5000	0.01288	1335012.	-15491.	-9.38E-04	0.00	3.33E+10
-319.6077	148865.	0.00				
11.0000	0.00798	1236853.	-17322.	-7.11E-04	0.00	3.50E+10
-290.7461	218687.	0.00				
11.5000	0.00434	1128088.	-18962.	-5.15E-04	0.00	3.73E+10
-255.9968	353544.	0.00				
12.0000	0.00180	1009986.	-20361.	-3.50E-04	0.00	4.07E+10
-210.4356	701483.	0.00				
12.5000	1.50E-04	884211.	-21137.	-2.39E-04	0.00	7.45E+10
-48.1999	1933211.	0.00				
13.0000	-0.00107	756654.	-20702.	-1.73E-04	0.00	7.47E+10
193.2502	1079940.	0.00				
13.5000	-0.00193	636014.	-19435.	-1.18E-04	0.00	7.48E+10
229.0173	711114.	0.00				
14.0000	-0.00249	523584.	-18000.	-7.12E-05	0.00	7.49E+10
249.3037	601933.	0.00				
14.5000	-0.00279	420102.	-16466.	-3.34E-05	0.00	7.50E+10
262.0893	564410.	0.00				
15.0000	-0.00289	326033.	-14870.	-3.52E-06	0.00	7.50E+10
269.9893	561394.	0.00				
15.5000	-0.00283	241666.	-13237.	1.92E-05	0.00	7.50E+10
274.2027	581673.	0.00				
16.0000	-0.00266	167158.	-11589.	3.55E-05	0.00	7.50E+10
275.3756	622258.	0.00				
16.5000	-0.00240	102554.	-9941.	4.63E-05	0.00	7.50E+10

LB16 2 ft_freehead.lp11o

273.8880	684195.	0.00				
17.0000	-0.00210	47805.	-8309.	5.24E-05	0.00	7.50E+10
269.9729	771650.	0.00				
17.5000	-0.00177	2773.	-6708.	5.44E-05	0.00	7.50E+10
263.7725	892341.	0.00				
18.0000	-0.00145	-32764.	-5151.	5.32E-05	0.00	7.50E+10
255.3651	1059139.	0.00				
18.5000	-0.00114	-59106.	-3654.	4.95E-05	0.00	7.50E+10
243.6020	1287277.	0.00				
19.0000	-8.53E-04	-76675.	-2243.	4.41E-05	0.00	7.50E+10
226.7587	1595769.	0.00				
19.5000	-6.07E-04	-86077.	-937.7100	3.76E-05	0.00	7.50E+10
208.2495	2059887.	0.00				
20.0000	-4.02E-04	-87978.	225.4557	3.06E-05	0.00	7.50E+10
179.4724	2679361.	0.00				
20.5000	-2.39E-04	-83412.	1182.	2.37E-05	0.00	7.50E+10
139.4215	3493469.	0.00				
21.0000	-1.17E-04	-73823.	1809.	1.74E-05	0.00	7.50E+10
69.4656	3560513.	0.00				
21.5000	-3.01E-05	-61730.	2072.	1.20E-05	0.00	7.50E+10
18.2042	3627557.	0.00				
22.0000	2.72E-05	-48977.	2076.	7.59E-06	0.00	7.50E+10
-16.7498	3694602.	0.00				
22.5000	6.10E-05	-36826.	1911.	4.16E-06	0.00	7.50E+10
-38.2415	3761646.	0.00				
23.0000	7.71E-05	-26049.	1649.	1.64E-06	0.00	7.50E+10
-49.2059	3828690.	0.00				
23.5000	8.07E-05	-17041.	1344.	-8.06E-08	0.00	7.50E+10
-52.4098	3895734.	0.00				
24.0000	7.61E-05	-9920.	1036.	-1.16E-06	0.00	7.50E+10
-50.2903	3962779.	0.00				
24.5000	6.68E-05	-4609.	751.1643	-1.74E-06	0.00	7.50E+10
-44.6243	4007812.	0.00				
25.0000	5.53E-05	-904.0263	506.5651	-1.96E-06	0.00	7.50E+10
-36.9087	4007812.	0.00				
25.5000	4.33E-05	1472.	309.1295	-1.94E-06	0.00	7.50E+10
-28.9032	4007812.	0.00				
26.0000	3.20E-05	2808.	158.3106	-1.77E-06	0.00	7.50E+10
-21.3698	4007812.	0.00				
26.5000	2.21E-05	3374.	49.9901	-1.52E-06	0.00	7.50E+10
-14.7370	4007812.	0.00				
27.0000	1.38E-05	3410.	-21.7805	-1.25E-06	0.00	7.50E+10
-9.1865	4007812.	0.00				
27.5000	7.08E-06	3115.	-63.5288	-9.87E-07	0.00	7.50E+10
-4.7296	4007812.	0.00				
28.0000	1.90E-06	2649.	-81.5324	-7.57E-07	0.00	7.50E+10
-1.2716	4007812.	0.00				
28.5000	-2.00E-06	2137.	-81.3368	-5.65E-07	0.00	7.50E+10

LB16 2 ft_freehead.lp11o

1.3368	4007812.	0.00				
29.0000	-4.88E-06	1674.	-67.5470	-4.13E-07	0.00	7.50E+10
3.2598	4007812.	0.00				
29.5000	-6.96E-06	1327.	-43.8297	-2.93E-07	0.00	7.50E+10
4.6460	4007812.	0.00				
30.0000	-8.39E-06	1148.	-29.1759	-1.94E-07	0.00	7.50E+10
0.2386	170575.	0.00				
30.5000	-9.28E-06	977.4025	-27.6554	-1.09E-07	0.00	7.50E+10
0.2682	173418.	0.00				
31.0000	-9.70E-06	816.3442	-25.9960	-3.69E-08	0.00	7.50E+10
0.2849	176261.	0.00				
31.5000	-9.72E-06	665.4988	-24.2706	2.24E-08	0.00	7.50E+10
0.2902	179104.	0.00				
32.0000	-9.43E-06	525.0669	-22.5421	7.00E-08	0.00	7.50E+10
0.2859	181947.	0.00				
32.5000	-8.88E-06	394.9009	-20.8636	1.07E-07	0.00	7.50E+10
0.2736	184790.	0.00				
33.0000	-8.15E-06	274.5631	-19.2785	1.34E-07	0.00	7.50E+10
0.2548	187633.	0.00				
33.5000	-7.28E-06	163.3829	-17.8208	1.51E-07	0.00	7.50E+10
0.2311	190476.	0.00				
34.0000	-6.33E-06	60.5138	-16.5153	1.60E-07	0.00	7.50E+10
0.2041	193319.	0.00				
34.5000	-5.36E-06	-35.0118	-15.3775	1.61E-07	0.00	7.50E+10
0.1752	196162.	0.00				
35.0000	-4.40E-06	-124.2286	-12.2182	1.55E-07	0.00	7.50E+10
0.8779	1197000.	0.00				
35.5000	-3.50E-06	-181.8346	-7.4587	1.42E-07	0.00	7.50E+10
0.7086	1214100.	0.00				
36.0000	-2.69E-06	-213.9213	-3.6766	1.27E-07	0.00	7.50E+10
0.5521	1231200.	0.00				
36.5000	-1.98E-06	-226.1207	-0.7832	1.09E-07	0.00	7.50E+10
0.4124	1248300.	0.00				
37.0000	-1.38E-06	-223.4634	1.3283	9.11E-08	0.00	7.50E+10
0.2915	1265400.	0.00				
37.5000	-8.89E-07	-210.3014	2.7730	7.37E-08	0.00	7.50E+10
0.1901	1282500.	0.00				
38.0000	-4.98E-07	-190.2852	3.6665	5.77E-08	0.00	7.50E+10
0.1078	1299600.	0.00				
38.5000	-1.97E-07	-166.3793	4.1196	4.34E-08	0.00	7.50E+10
0.04327	1316700.	0.00				
39.0000	2.33E-08	-140.9068	4.2339	3.11E-08	0.00	7.50E+10
-0.00518	1333800.	0.00				
39.5000	1.76E-07	-115.6135	4.0994	2.08E-08	0.00	7.50E+10
-0.03966	1350900.	0.00				
40.0000	2.73E-07	-91.7420	3.7933	1.26E-08	0.00	7.50E+10
-0.06235	1368000.	0.00				
40.5000	3.27E-07	-70.1103	3.3800	6.07E-09	0.00	7.50E+10

LB16 2 ft_freehead.lp11o

-0.07543	1385100.	0.00				
41.0000	3.46E-07	-51.1905	2.9108	1.22E-09	0.00	7.50E+10
-0.08095	1402200.	0.00				
41.5000	3.41E-07	-35.1822	2.4257	-2.23E-09	0.00	7.50E+10
-0.08076	1419300.	0.00				
42.0000	3.20E-07	-22.0795	1.9539	-4.53E-09	0.00	7.50E+10
-0.07650	1436400.	0.00				
42.5000	2.87E-07	-11.7297	1.5157	-5.88E-09	0.00	7.50E+10
-0.06955	1453500.	0.00				
43.0000	2.49E-07	-3.8833	1.1239	-6.50E-09	0.00	7.50E+10
-0.06104	1470600.	0.00				
43.5000	2.09E-07	1.7661	0.7853	-6.59E-09	0.00	7.50E+10
-0.05184	1487700.	0.00				
44.0000	1.70E-07	5.5492	0.5019	-6.30E-09	0.00	7.50E+10
-0.04263	1504800.	0.00				
44.5000	1.34E-07	7.7974	0.2724	-5.76E-09	0.00	7.50E+10
-0.03387	1521900.	0.00				
45.0000	1.01E-07	8.8258	0.09322	-5.10E-09	0.00	7.50E+10
-0.02586	1539000.	0.00				
45.5000	7.24E-08	8.9227	-0.04069	-4.39E-09	0.00	7.50E+10
-0.01877	1556100.	0.00				
46.0000	4.82E-08	8.3433	-0.1349	-3.70E-09	0.00	7.50E+10
-0.01264	1573200.	0.00				
46.5000	2.80E-08	7.3085	-0.1951	-3.07E-09	0.00	7.50E+10
-0.00743	1590300.	0.00				
47.0000	1.14E-08	6.0058	-0.2266	-2.54E-09	0.00	7.50E+10
-0.00305	1607400.	0.00				
47.5000	-2.40E-09	4.5931	-0.2338	-2.11E-09	0.00	7.50E+10
6.49E-04	1624500.	0.00				
48.0000	-1.40E-08	3.2034	-0.2204	-1.80E-09	0.00	7.50E+10
0.00382	1641600.	0.00				
48.5000	-2.40E-08	1.9512	-0.1890	-1.59E-09	0.00	7.50E+10
0.00663	1658700.	0.00				
49.0000	-3.31E-08	0.9377	-0.1414	-1.48E-09	0.00	7.50E+10
0.00924	1675800.	0.00				
49.5000	-4.17E-08	0.2569	-0.07830	-1.43E-09	0.00	7.50E+10
0.01178	1692900.	0.00				
50.0000	-5.03E-08	0.00	0.00	-1.42E-09	0.00	7.50E+10
0.01432	855000.	0.00				

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

LB16 2 ft_freehead.lp11o
Output Summary for Load Case No. 2:

Pile-head deflection	=	0.50000000 inches
Computed slope at pile head	=	-0.00565227 radians
Maximum bending moment	=	1652796. inch-lbs
Maximum shear force	=	36649. lbs
Depth of maximum bending moment	=	7.00000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	18
Number of zero deflection points	=	5

Summary of Pile-head Responses for Conventional Analyses

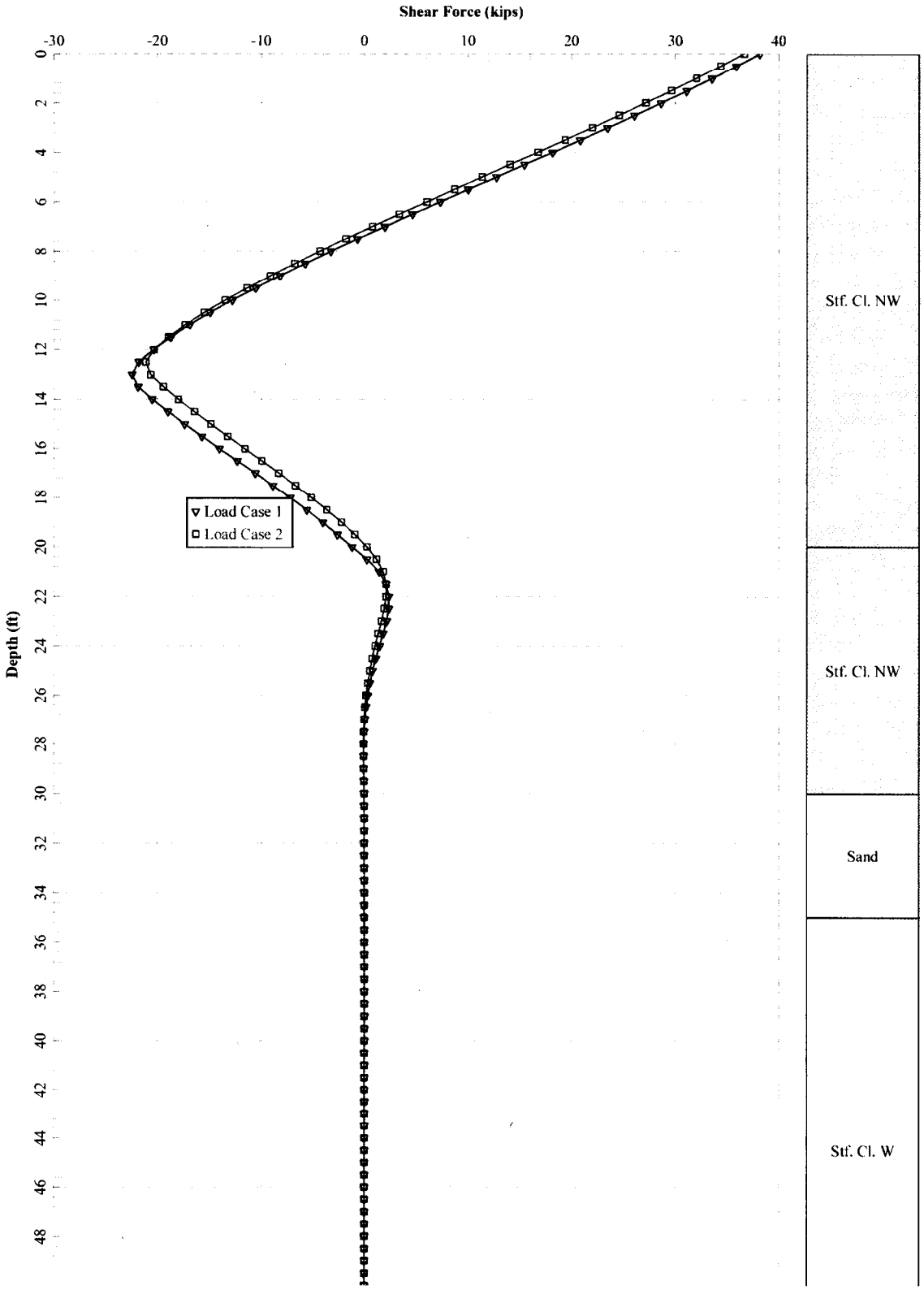
Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

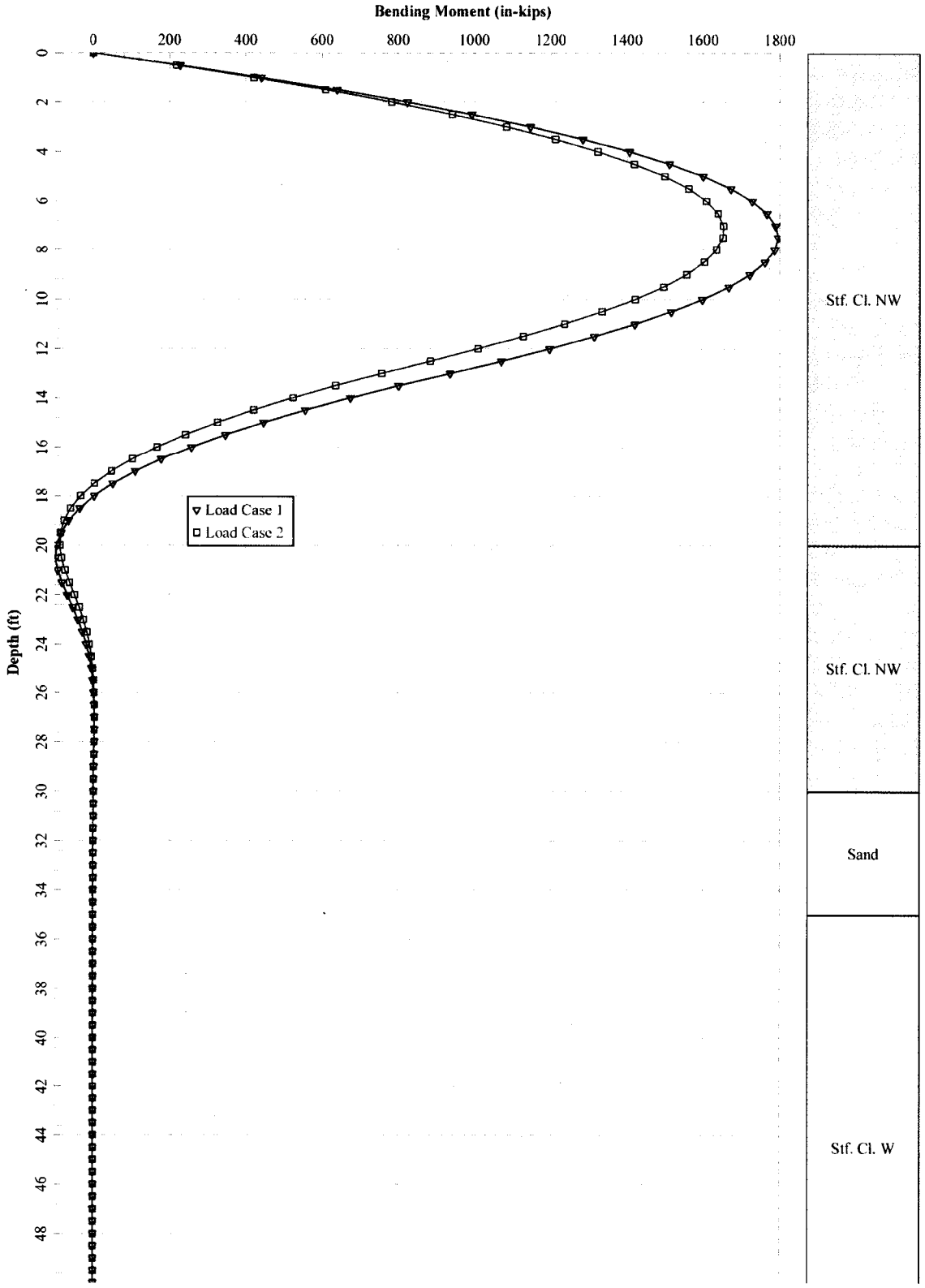
Load Case No.	Load Type	Pile-head Load 1	Load Type	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	0.5000	M, in-lb	0.00	155000.	0.5000	-0.00546	38160.	1796195.
2	y, in	0.5000	M, in-lb	0.00	110000.	0.5000	-0.00565	36649.	1652796.

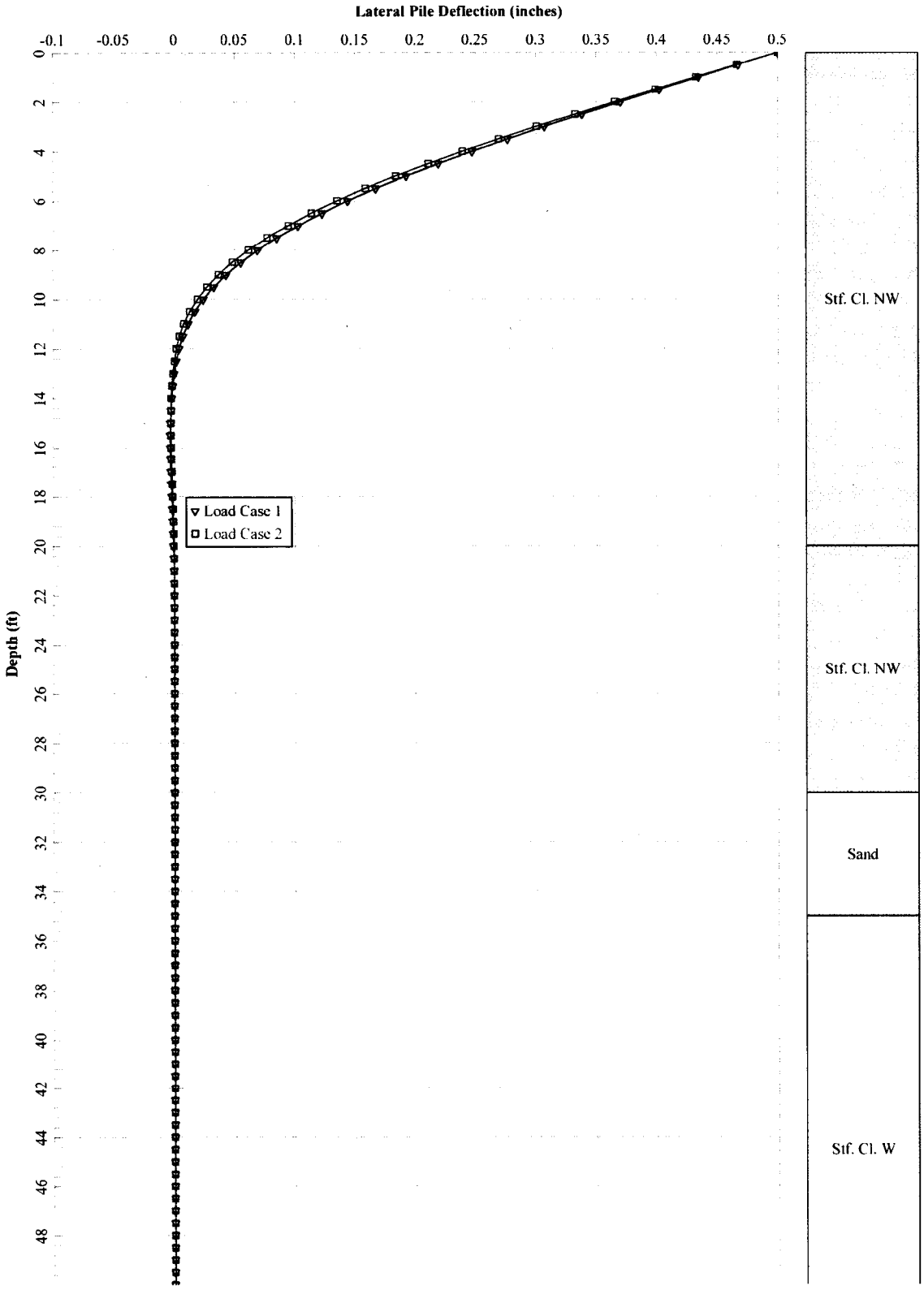
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0056522720 radians = -0.323851 deg.

The analysis ended normally.



PILE STIFFNESS = 38 KIPS / 0.5IN = 76 KIPS/IN


Bending Moment (in-kips)
0
200
400
600
800
1000
1200
1400
1600
1800
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Load Case 2
Stf. Cl. NW
Stf. Cl. NW
Sand
Stf. Cl. W


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Load Case 2
Stf. Cl. NW
Stf. Cl. NW
Sand
Stf. Cl. W

ABUTMENT #1 FIXED HEAD

LB16 2 ft_fixedhead.lp11o

LPile for Windows, Version 2019-11.004

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

This copy of LPile is being used by:

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is a violation of the software license agreement.

Files Used for Analysis

Path to file locations:
\SLC_Civil\096360005 - WPR_Project Files\Eng\Structural\Phase 0A\WBWCD Gateway Canal Crossing\Foundation Design\

Name of input data file:
LB16 2 ft_fixedhead.lp11d

Name of output report file:
LB16 2 ft_fixedhead.lp11o

Name of plot output file:
LB16 2 ft_fixedhead.lp11p

Name of runtime message file:
LB16 2 ft_fixedhead.lp11r

LB16 2 ft_fixedhead.lp11o
Date and Time of Analysis

Date: August 28, 2020 Time: 14:55:10

Problem Title

Project Name:

Job Number:

Client:

Engineer:

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

LB16 2 ft_fixedhead.lp11o

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	50.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	50.000	24.0000

Input Structural Properties for Pile Sections:

LB16 2 ft_fixedhead.lp11o

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	50.000000 ft
Shaft Diameter	=	24.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 4 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	20.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf
Undrained cohesion at top of layer	=	1500. psf
Undrained cohesion at bottom of layer	=	1500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is stiff clay without free water

Distance from top of pile to top of layer	=	20.000000 ft
Distance from top of pile to bottom of layer	=	30.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf

LB16 2 ft_fixedhead.lp11o

Undrained cohesion at top of layer	=	2250.	psf
Undrained cohesion at bottom of layer	=	2250.	psf
Epsilon-50 at top of layer	=	0.0000	
Epsilon-50 at bottom of layer	=	0.0000	

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 3 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	30.000000	ft
Distance from top of pile to bottom of layer	=	35.000000	ft
Effective unit weight at top of layer	=	120.000000	pcf
Effective unit weight at bottom of layer	=	120.000000	pcf
Friction angle at top of layer	=	32.000000	deg.
Friction angle at bottom of layer	=	32.000000	deg.
Subgrade k at top of layer	=	0.0000	pci
Subgrade k at bottom of layer	=	0.0000	pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 4 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	35.000000	ft
Distance from top of pile to bottom of layer	=	90.000000	ft
Effective unit weight at top of layer	=	115.000000	pcf
Effective unit weight at bottom of layer	=	115.000000	pcf
Undrained cohesion at top of layer	=	1300.	psf
Undrained cohesion at bottom of layer	=	1300.	psf
Epsilon-50 at top of layer	=	0.0000	
Epsilon-50 at bottom of layer	=	0.0000	
Subgrade k at top of layer	=	0.0000	pci
Subgrade k at bottom of layer	=	0.0000	pci

NOTE: Default values for Epsilon-50 will be computed for this layer.

NOTE: Default values for subgrade k will be computed for this layer.

(Depth of the lowest soil layer extends 40.000 ft below the pile tip)

Summary of Input Soil Properties

Layer	Soil Type	Layer	Effective	Undrained	Angle of	E50
Layer	Name	Depth	Unit Wt.	Cohesion	Friction	

LB16 2 ft_fixedhead.lp11o

or Num. krm	kpy (p-y Curve Type) pci	ft	pcf	psf	deg.
1 default	Stiff Clay --	0.00	115.0000	1500.	--
	w/o Free Water --	20.0000	115.0000	1500.	--
2 default	Stiff Clay --	20.0000	115.0000	2250.	--
	w/o Free Water --	30.0000	115.0000	2250.	--
3 --	Sand default	30.0000	120.0000	--	32.0000
	(Reese, et al.) default	35.0000	120.0000	--	32.0000
4 default	Stiff Clay default	35.0000	115.0000	1300.	--
	with Free Water default	90.0000	115.0000	1300.	--

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.6000	1.0000
2	50.000	0.6000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

LB16 2 ft_fixedhead.lp11o

Number of loads specified = 1

Load Compute Top y vs. Pile Length No.	Load Type	Condition Run Analysis 1	Condition 2	Axial Thrust Force, lbs
1	5	y = 0.500000 in	S = 0.0000 in/in	110000.
	N.A.	Yes		

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	50.000000	ft
Shaft Diameter	=	24.000000	in
Concrete Cover Thickness (to edge of long. rebar)	=	3.000000	in
Number of Reinforcing Bars	=	11	bars
Yield Stress of Reinforcing Bars	=	60000.	psi
Modulus of Elasticity of Reinforcing Bars	=	29000000.	psi
Gross Area of Shaft	=	452.389342	sq. in.
Total Area of Reinforcing Steel	=	8.690000	sq. in.
Area Ratio of Steel Reinforcement	=	1.92	percent
Edge-to-Edge Bar Spacing	=	3.789453	in

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Maximum Concrete Aggregate Size	=	0.750000 in
Ratio of Bar Spacing to Aggregate Size	=	5.05
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2029.978 kips
Tensile Load for Cracking of Concrete	=	-213.613 kips
Nominal Axial Tensile Capacity	=	-521.400 kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	8.500000	0.00000
2	1.000000	0.790000	7.150655	4.595447
3	1.000000	0.790000	3.531028	7.731872
4	1.000000	0.790000	-1.209676	8.413482
5	1.000000	0.790000	-5.566316	6.423871
6	1.000000	0.790000	-8.155690	2.394727
7	1.000000	0.790000	-8.155690	-2.394727
8	1.000000	0.790000	-5.566316	-6.423871
9	1.000000	0.790000	-1.209676	-8.413482
10	1.000000	0.790000	3.531028	-7.731872
11	1.000000	0.790000	7.150655	-4.595447

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 3.789 inches
between bars 8 and 9.

Ratio of bar spacing to maximum aggregate size = 5.05

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

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Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	110.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 110.000 kips

Bending Max Conc Stress ksi	Bending Max Steel Stress ksi	Run Msg	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
Curvature rad/in.	Moment in-kip					
0.00000125	93.7233430		74978674.	53.7609547	0.00006720	0.00003720
0.2793213	1.8400846					
0.00000250	187.4594638		74983786.	32.8967277	0.00008224	0.00002224
0.3399808	2.1675128					
0.00000375	281.1882926		74983545.	25.9491745	0.00009731	0.00000731
0.4002503	2.4957227					
0.00000500	374.9020733		74980415.	22.4807555	0.0001124	-0.00000760
0.4601262	2.8247096					
0.00000625	468.4886584		74958185.	20.4032063	0.0001275	-0.00002248
0.5195866	3.1543312					
0.00000750	561.7827016		74904360.	19.0199912	0.0001426	-0.00003735
0.5785969	3.4843480					

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0.00000875	654.7037731	74823288.	18.0329829	0.0001578	-0.00005221
0.6371367	3.8146193				
0.00001000	747.2139602	74721396.	17.2933311	0.0001729	-0.00006707
0.6951947	4.1450661				
0.00001125	839.2937919	74603893.	16.7184395	0.0001881	-0.00008192
0.7527640	4.4756409				
0.00001250	930.9327494	74474620.	16.2588007	0.0002032	-0.00009676
0.8098405	4.8063153				
0.00001375	930.9327494	67704200.	14.6096808	0.0002009	-0.0001291
0.8003573	4.6293602 C				
0.00001500	930.9327494	62062183.	14.1395444	0.0002121	-0.0001479
0.8421729	4.8457019 C				
0.00001625	930.9327494	57288169.	13.7297387	0.0002231	-0.0001669
0.8829835	5.0563894 C				
0.00001750	930.9327494	53196157.	13.3685834	0.0002340	-0.0001860
0.9228847	5.2620561 C				
0.00001875	930.9327494	49649747.	13.0475166	0.0002446	-0.0002054
0.9619700	5.4633372 C				
0.00002000	930.9327494	46546637.	12.7596199	0.0002552	-0.0002248
1.0002939	5.6605796 C				
0.00002125	930.9327494	43808600.	12.5002913	0.0002656	-0.0002444
1.0379634	5.8545543 C				
0.00002250	956.3429238	42504130.	12.2653226	0.0002760	-0.0002640
1.0750314	6.0456230 C				
0.00002375	985.0653077	41476434.	12.0514698	0.0002862	-0.0002838
1.1115563	6.2341999 C				
0.00002500	1013.	40535765.	11.8561237	0.0002964	-0.0003036
1.1475941	-6.6293103 C				
0.00002625	1041.	39669473.	11.6764021	0.0003065	-0.0003235
1.1831272	-7.0975889 C				
0.00002750	1069.	38869695.	11.5105223	0.0003165	-0.0003435
1.2181947	-7.5678588 C				
0.00002875	1096.	38131880.	11.3576496	0.0003265	-0.0003635
1.2528995	-8.0393095 C				
0.00003000	1123.	37445849.	11.2154327	0.0003365	-0.0003835
1.2871681	-8.5125734 C				
0.00003125	1150.	36807580.	11.0830555	0.0003463	-0.0004037
1.3210548	-8.9872309 C				
0.00003250	1177.	36213276.	10.9598789	0.0003562	-0.0004238
1.3546184	-9.4628140 C				
0.00003375	1203.	35656405.	10.8442530	0.0003660	-0.0004440
1.3877884	-9.9399373 C				
0.00003500	1230.	35135572.	10.7361965	0.0003758	-0.0004642
1.4206670	-10.4177604 C				
0.00003625	1256.	34646610.	10.6346947	0.0003855	-0.0004845
1.4532272	-10.8965272 C				
0.00003750	1282.	34185663.	10.5388499	0.0003952	-0.0005048
1.4854407	-11.3765006 C				

0.00003875	1308.	33753624.	10.4493720	0.0004049	-0.0005251
1.5174729	-11.8562681 C				
0.00004000	1334.	33342853.	10.3637726	0.0004146	-0.0005454
1.5490722	-12.3380237 C				
0.00004125	1359.	32955632.	10.2833074	0.0004242	-0.0005658
1.5804617	-12.8198434 C				
0.00004250	1385.	32590447.	10.2077410	0.0004338	-0.0005862
1.6116721	-13.3014591 C				
0.00004375	1411.	32241518.	10.1350016	0.0004434	-0.0006066
1.6424674	-13.7849666 C				
0.00004500	1436.	31910841.	10.0662678	0.0004530	-0.0006270
1.6730577	-14.2685206 C				
0.00004625	1461.	31597370.	10.0014003	0.0004626	-0.0006474
1.7034707	-14.7518717 C				
0.00004750	1487.	31298654.	9.9395769	0.0004721	-0.0006679
1.7336276	-15.2357327 C				
0.00004875	1512.	31012479.	9.8800472	0.0004817	-0.0006883
1.7634495	-15.7208332 C				
0.00005125	1562.	30480231.	9.7701075	0.0005007	-0.0007293
1.8225664	-16.6904276 C				
0.00005375	1612.	29992815.	9.6696206	0.0005197	-0.0007703
1.8807631	-17.6612287 C				
0.00005625	1662.	29544349.	9.5773626	0.0005387	-0.0008113
1.9380509	-18.6331774 C				
0.00005875	1712.	29132002.	9.4934355	0.0005577	-0.0008523
1.9946384	-19.6043091 C				
0.00006125	1761.	28748570.	9.4151047	0.0005767	-0.0008933
2.0502110	-20.5776701 C				
0.00006375	1810.	28392802.	9.3430278	0.0005956	-0.0009344
2.1050232	-21.5508275 C				
0.00006625	1859.	28062076.	9.2768223	0.0006146	-0.0009754
2.1591362	-22.5231554 C				
0.00006875	1908.	27752713.	9.2151653	0.0006335	-0.0010165
2.2124135	-23.4960141 C				
0.00007125	1957.	27462059.	9.1572736	0.0006525	-0.0010575
2.2647966	-24.4700332 C				
0.00007375	2005.	27189493.	9.1037031	0.0006714	-0.0010986
2.3164812	-25.4432051 C				
0.00007625	2054.	26933225.	9.0540314	0.0006904	-0.0011396
2.3674642	-26.4155234 C				
0.00007875	2102.	26691692.	9.0078900	0.0007094	-0.0011806
2.4177423	-27.3869819 C				
0.00008125	2150.	26462343.	8.9638941	0.0007283	-0.0012217
2.4670859	-28.3600764 C				
0.00008375	2198.	26245008.	8.9226623	0.0007473	-0.0012627
2.5156779	-29.3328337 C				
0.00008625	2246.	26038870.	8.8841744	0.0007663	-0.0013037
2.5635647	-30.3047086 C				

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0.00008875	2294.	25842975.	8.8482013	0.0007853	-0.0013447
2.6107431	-31.2756920 C				
0.00009125	2341.	25656471.	8.8145389	0.0008043	-0.0013857
2.6572099	-32.2457770 C				
0.00009375	2389.	25478598.	8.7830049	0.0008234	-0.0014266
2.7029617	-33.2149563 C				
0.00009625	2436.	25308498.	8.7532290	0.0008425	-0.0014675
2.7479479	-34.1838012 C				
0.00009875	2483.	25145175.	8.7245990	0.0008616	-0.0015084
2.7920571	-35.1536794 C				
0.0001013	2530.	24988694.	8.6977027	0.0008806	-0.0015494
2.8354493	-36.1226202 C				
0.0001038	2577.	24838552.	8.6724175	0.0008998	-0.0015902
2.8781212	-37.0906137 C				
0.0001063	2624.	24694294.	8.6486322	0.0009189	-0.0016311
2.9200692	-38.0576519 C				
0.0001088	2670.	24555504.	8.6262460	0.0009381	-0.0016719
2.9612897	-39.0237267 C				
0.0001113	2717.	24421805.	8.6051672	0.0009573	-0.0017127
3.0017792	-39.9888296 C				
0.0001138	2763.	24292853.	8.5853121	0.0009766	-0.0017534
3.0415340	-40.9529521 C				
0.0001163	2810.	24168333.	8.5666044	0.0009959	-0.0017941
3.0805503	-41.9160856 C				
0.0001188	2856.	24047956.	8.5489742	0.0010152	-0.0018348
3.1188244	-42.8782212 C				
0.0001213	2902.	23931457.	8.5323574	0.0010345	-0.0018755
3.1563525	-43.8393501 C				
0.0001238	2948.	23818534.	8.5165843	0.0010539	-0.0019161
3.1931047	-44.7998576 C				
0.0001263	2993.	23708817.	8.5013259	0.0010733	-0.0019567
3.2290126	-45.7607702 C				
0.0001288	3039.	23602328.	8.4869429	0.0010927	-0.0019973
3.2641693	-46.7206267 C				
0.0001313	3084.	23498873.	8.4733879	0.0011121	-0.0020379
3.2985711	-47.6794170 C				
0.0001338	3130.	23398275.	8.4606171	0.0011316	-0.0020784
3.3322135	-48.6371309 C				
0.0001363	3175.	23300368.	8.4485902	0.0011511	-0.0021189
3.3650926	-49.5937577 C				
0.0001388	3220.	23204997.	8.4372694	0.0011707	-0.0021593
3.3972041	-50.5492867 C				
0.0001413	3265.	23112020.	8.4266201	0.0011903	-0.0021997
3.4285435	-51.5037071 C				
0.0001438	3309.	23021304.	8.4166097	0.0012099	-0.0022401
3.4591067	-52.4570078 C				
0.0001463	3354.	22932723.	8.4072083	0.0012296	-0.0022804
3.4888890	-53.4091775 C				

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0.0001488	3398.	22846162.	8.3983878	0.0012493	-0.0023207
3.5178860	-54.3602046 C				
0.0001588	3575.	22518046.	8.3684174	0.0013285	-0.0024815
3.6259285	-58.1526495 C				
0.0001688	3747.	22203717.	8.3446277	0.0014082	-0.0026418
3.7207798	-60.0000000 CY				
0.0001788	3891.	21766156.	8.3092906	0.0014853	-0.0028047
3.7993810	-60.0000000 CY				
0.0001888	3999.	21189081.	8.2571474	0.0015585	-0.0029715
3.8619803	-60.0000000 CY				
0.0001988	4095.	20601531.	8.2034351	0.0016304	-0.0031396
3.9120573	-60.0000000 CY				
0.0002088	4171.	19982466.	8.1447586	0.0017002	-0.0033098
3.9498999	-60.0000000 CY				
0.0002188	4236.	19364929.	8.0857118	0.0017687	-0.0034813
3.9767621	-60.0000000 CY				
0.0002288	4299.	18793918.	8.0334635	0.0018377	-0.0036523
3.9934952	-60.0000000 CY				
0.0002388	4356.	18246213.	7.9822696	0.0019058	-0.0038242
3.9999058	-60.0000000 CY				
0.0002488	4401.	17692640.	7.9279771	0.0019721	-0.0039979
3.9999843	-60.0000000 CY				
0.0002588	4438.	17152987.	7.8745719	0.0020375	-0.0041725
3.9999822	-60.0000000 CY				
0.0002688	4474.	16648023.	7.8267460	0.0021034	-0.0043466
3.9999172	-60.0000000 CY				
0.0002788	4509.	16175257.	7.7833743	0.0021696	-0.0045204
3.9996476	-60.0000000 CY				
0.0002888	4542.	15731325.	7.7434631	0.0022359	-0.0046941
3.9988848	-60.0000000 CY				
0.0002988	4574.	15309426.	7.7064084	0.0023023	-0.0048677
3.9971859	-60.0000000 CY				
0.0003088	4600.	14899449.	7.6691943	0.0023679	-0.0050421
4.0000000	-60.0000000 CY				
0.0003188	4622.	14499160.	7.6313233	0.0024325	-0.0052175
3.9991475	-60.0000000 CY				
0.0003288	4639.	14111797.	7.5935280	0.0024964	-0.0053936
3.9958785	-60.0000000 CY				
0.0003388	4655.	13742944.	7.5578821	0.0025602	-0.0055698
3.9996717	-60.0000000 CY				
0.0003488	4671.	13393086.	7.5233391	0.0026238	-0.0057462
3.9962628	-60.0000000 CY				
0.0003588	4686.	13061755.	7.4915861	0.0026876	-0.0059224
3.9996897	-60.0000000 CY				
0.0003688	4701.	12747375.	7.4624629	0.0027518	-0.0060982
3.9954329	-60.0000000 CY				
0.0003788	4715.	12448773.	7.4356448	0.0028163	-0.0062737
3.9993268	-60.0000000 CY				

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0.0003888	4729.	12164755.	7.4109509	0.0028810	-0.0064490
3.9952701	-60.0000000 CY				
0.0003988	4743.	11894173.	7.3882420	0.0029461	-0.0066239
3.9981323	-60.0000000 CY				
0.0004088	4756.	11636229.	7.3671295	0.0030113	-0.0067987
3.9999891	-60.0000000 CYT				
0.0004188	4769.	11387838.	7.3467851	0.0030765	-0.0069735
3.9950948	-60.0000000 CYT				
0.0004288	4780.	11148842.	7.3269069	0.0031414	-0.0071486
3.9989120	-60.0000000 CYT				
0.0004388	4790.	10916382.	7.3052962	0.0032052	-0.0073248
3.9991604	-60.0000000 CYT				
0.0004488	4798.	10692409.	7.2840921	0.0032687	-0.0075013
3.9942552	-60.0000000 CYT				
0.0004588	4805.	10473982.	7.2615912	0.0033313	-0.0076787
3.9980763	-60.0000000 CYT				
0.0004688	4811.	10264161.	7.2400191	0.0033938	-0.0078562
3.9998574	-60.0000000 CYT				
0.0004788	4816.	10060314.	7.2181215	0.0034557	-0.0080343
3.9942767	-60.0000000 CYT				
0.0004888	4821.	9864271.	7.1972311	0.0035176	-0.0082124
3.9945738	-60.0000000 CYT				
0.0004988	4826.	9675905.	7.1774047	0.0035797	-0.0083903
3.9979989	60.0000000 CYT				
0.0005088	4830.	9494781.	7.1586066	0.0036419	-0.0085681
3.9997544	60.0000000 CYT				
0.0005188	4835.	9320443.	7.1408700	0.0037043	-0.0087457
3.9959852	60.0000000 CYT				
0.0005288	4839.	9152514.	7.1241228	0.0037669	-0.0089231
3.9916192	60.0000000 CYT				
0.0005388	4844.	8990317.	7.1087090	0.0038298	-0.0091002
3.9958709	60.0000000 CYT				

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	110.000	4753.967	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	4754.	71.500000	3090.	23485877.
1	0.75	4754.	77.000000	3565.	22535282.
1	0.90	4754.	82.500000	4279.	18979984.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	375142.
2	20.0000	15.5903	Yes	No	375142.	392091.
3	30.0000	20.1281	No	No	767233.	663263.
4	35.0000	572.7969	No	No	1430496.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

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Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 110000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Spr. Distrib. p
Es*h	Lat. Load						
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	
lb/inch	lb/inch	lb/inch					
0.00	0.5000	-3067151.	51746.	0.00	0.00	2.35E+10	
-235.0243	1410.	0.00					
0.5000	0.4977	-2760901.	50256.	-7.43E-04	0.00	2.35E+10	
-247.5289	2984.	0.00					
1.0000	0.4911	-2463098.	48735.	-0.00139	0.00	2.52E+10	
-259.4464	3170.	0.00					
1.5000	0.4810	-2174248.	47144.	-0.00193	0.00	2.64E+10	
-270.7765	3378.	0.00					
2.0000	0.4679	-1894819.	45488.	-0.00238	0.00	2.78E+10	
-281.5058	3609.	0.00					
2.5000	0.4524	-1625255.	43768.	-0.00275	0.00	2.99E+10	
-291.6243	3867.	0.00					
3.0000	0.4350	-1365974.	41990.	-0.00304	0.00	3.29E+10	
-301.1263	4154.	0.00					
3.5000	0.4160	-1117368.	40157.	-0.00325	0.00	3.76E+10	
-310.0107	4471.	0.00					
4.0000	0.3960	-879806.	38272.	-0.00337	0.00	7.45E+10	
-318.2808	4823.	0.00					
4.5000	0.3755	-653655.	36339.	-0.00344	0.00	7.48E+10	
-326.0004	5209.	0.00					
5.0000	0.3548	-439205.	34361.	-0.00348	0.00	7.50E+10	
-333.1401	5634.	0.00					
5.5000	0.3338	-236725.	32343.	-0.00351	0.00	7.50E+10	
-339.6677	6106.	0.00					
6.0000	0.3127	-46461.	30287.	-0.00352	0.00	7.50E+10	
-345.5481	6631.	0.00					
6.5000	0.2916	131367.	28198.	-0.00351	0.00	7.50E+10	
-350.7422	7218.	0.00					
7.0000	0.2705	296560.	26081.	-0.00350	0.00	7.50E+10	
-355.2061	7879.	0.00					

7.5000	0.2496	448950.	23938.	-0.00347	0.00	7.50E+10
-358.8892	8628.	0.00				
8.0000	0.2289	588397.	21776.	-0.00343	0.00	7.49E+10
-361.7327	9482.	0.00				
8.5000	0.2085	714790.	19600.	-0.00337	0.00	7.48E+10
-363.6669	10466.	0.00				
9.0000	0.1884	828053.	17415.	-0.00331	0.00	7.46E+10
-364.6073	11611.	0.00				
9.5000	0.1687	928147.	15228.	-0.00322	0.00	5.04E+10
-364.4496	12959.	0.00				
10.0000	0.1497	1015047.	13045.	-0.00309	0.00	4.05E+10
-363.1876	14554.	0.00				
10.5000	0.1316	1088774.	10873.	-0.00293	0.00	3.83E+10
-360.8383	16449.	0.00				
11.0000	0.1145	1149397.	8719.	-0.00275	0.00	3.68E+10
-357.3663	18720.	0.00				
11.5000	0.09858	1197032.	6588.	-0.00256	0.00	3.58E+10
-352.7365	21468.	0.00				
12.0000	0.08383	1231836.	4489.	-0.00235	0.00	3.51E+10
-346.9134	24830.	0.00				
12.5000	0.07034	1254012.	2429.	-0.00214	0.00	3.47E+10
-339.8608	28991.	0.00				
13.0000	0.05815	1263810.	414.8795	-0.00192	0.00	3.45E+10
-331.5419	34210.	0.00				
13.5000	0.04728	1261527.	-1546.	-0.00170	0.00	3.45E+10
-321.9192	40856.	0.00				
14.0000	0.03772	1247511.	-3444.	-0.00149	0.00	3.48E+10
-310.9551	49462.	0.00				
14.5000	0.02945	1222158.	-5273.	-0.00127	0.00	3.53E+10
-298.6125	60829.	0.00				
15.0000	0.02244	1185918.	-7023.	-0.00107	0.00	3.60E+10
-284.8573	76180.	0.00				
15.5000	0.01660	1139293.	-8687.	-8.80E-04	0.00	3.71E+10
-269.6619	97458.	0.00				
16.0000	0.01187	1082838.	-10255.	-7.03E-04	0.00	3.85E+10
-253.0147	127842.	0.00				
16.5000	0.00816	1017164.	-11719.	-5.44E-04	0.00	4.04E+10
-234.9400	172739.	0.00				
17.0000	0.00535	942932.	-13070.	-4.03E-04	0.00	4.32E+10
-215.5442	241627.	0.00				
17.5000	0.00333	860853.	-14302.	-3.02E-04	0.00	7.46E+10
-195.0916	351484.	0.00				
18.0000	0.00172	771706.	-15393.	-2.37E-04	0.00	7.47E+10
-168.5816	586750.	0.00				
18.5000	4.89E-04	676449.	-16273.	-1.79E-04	0.00	7.48E+10
-124.7239	1529003.	0.00				
19.0000	-4.19E-04	576666.	-16322.	-1.28E-04	0.00	7.49E+10
108.4506	1551357.	0.00				

19.5000	-0.00105	480757.	-15544.	-8.60E-05	0.00	7.49E+10
150.9777	861820.	0.00				
20.0000	-0.00145	390257.	-14555.	-5.12E-05	0.00	7.50E+10
178.5387	737836.	0.00				
20.5000	-0.00167	306165.	-13297.	-2.33E-05	0.00	7.50E+10
240.9057	868013.	0.00				
21.0000	-0.00173	230728.	-11830.	-1.83E-06	0.00	7.50E+10
247.9407	859118.	0.00				
21.5000	-0.00169	164206.	-10333.	1.40E-05	0.00	7.50E+10
250.9750	892518.	0.00				
22.0000	-0.00156	106710.	-8828.	2.48E-05	0.00	7.50E+10
250.8130	962226.	0.00				
22.5000	-0.00139	58237.	-7332.	3.14E-05	0.00	7.50E+10
247.9242	1070576.	0.00				
23.0000	-0.00119	18687.	-5860.	3.45E-05	0.00	7.50E+10
242.6033	1226252.	0.00				
23.5000	-9.76E-04	-12131.	-4427.	3.47E-05	0.00	7.50E+10
235.0406	1445454.	0.00				
24.0000	-7.70E-04	-34486.	-3046.	3.29E-05	0.00	7.50E+10
225.3532	1755867.	0.00				
24.5000	-5.81E-04	-48727.	-1733.	2.96E-05	0.00	7.50E+10
212.4188	2193528.	0.00				
25.0000	-4.15E-04	-55318.	-569.7623	2.54E-05	0.00	7.50E+10
175.2487	2531250.	0.00				
25.5000	-2.76E-04	-55598.	305.7207	2.10E-05	0.00	7.50E+10
116.5790	2531250.	0.00				
26.0000	-1.64E-04	-51677.	862.9710	1.67E-05	0.00	7.50E+10
69.1711	2531250.	0.00				
26.5000	-7.64E-05	-45264.	1167.	1.28E-05	0.00	7.50E+10
32.2307	2531250.	0.00				
27.0000	-1.06E-05	-37688.	1277.	9.46E-06	0.00	7.50E+10
4.4589	2531250.	0.00				
27.5000	3.72E-05	-29949.	1244.	6.76E-06	0.00	7.50E+10
-15.6789	2531250.	0.00				
28.0000	7.05E-05	-22774.	1107.	4.65E-06	0.00	7.50E+10
-29.7502	2531250.	0.00				
28.5000	9.29E-05	-16668.	900.4223	3.07E-06	0.00	7.50E+10
-39.2085	2531250.	0.00				
29.0000	1.07E-04	-11973.	646.9249	1.92E-06	0.00	7.50E+10
-45.2906	2531250.	0.00				
29.5000	1.16E-04	-8907.	364.2106	1.09E-06	0.00	7.50E+10
-48.9475	2531250.	0.00				
30.0000	1.20E-04	-7604.	210.8817	4.28E-07	0.00	7.50E+10
-2.1621	107732.	0.00				
30.5000	1.21E-04	-6377.	197.7605	-1.32E-07	0.00	7.50E+10
-2.2116	109527.	0.00				
31.0000	1.19E-04	-5230.	184.5111	-5.96E-07	0.00	7.50E+10
-2.2048	111323.	0.00				

31.5000	1.14E-04	-4162.	171.4487	-9.72E-07	0.00	7.50E+10
-2.1493	113118.	0.00				
32.0000	1.07E-04	-3172.	158.8432	-1.27E-06	0.00	7.50E+10
-2.0526	114914.	0.00				
32.5000	9.88E-05	-2255.	146.9191	-1.48E-06	0.00	7.50E+10
-1.9221	116709.	0.00				
33.0000	8.94E-05	-1407.	135.8568	-1.63E-06	0.00	7.50E+10
-1.7653	118505.	0.00				
33.5000	7.93E-05	-622.2784	125.7928	-1.71E-06	0.00	7.50E+10
-1.5893	120301.	0.00				
34.0000	6.89E-05	105.0161	116.8213	-1.73E-06	0.00	7.50E+10
-1.4012	122096.	0.00				
34.5000	5.85E-05	781.8624	108.9942	-1.70E-06	0.00	7.50E+10
-1.2079	123892.	0.00				
35.0000	4.85E-05	1415.	87.0335	-1.61E-06	0.00	7.50E+10
-6.1124	756000.	0.00				
35.5000	3.92E-05	1828.	53.6651	-1.48E-06	0.00	7.50E+10
-5.0104	766800.	0.00				
36.0000	3.08E-05	2061.	26.6676	-1.32E-06	0.00	7.50E+10
-3.9888	777600.	0.00				
36.5000	2.33E-05	2150.	5.5009	-1.15E-06	0.00	7.50E+10
-3.0668	788400.	0.00				
37.0000	1.69E-05	2129.	-10.4661	-9.82E-07	0.00	7.50E+10
-2.2555	799200.	0.00				
37.5000	1.15E-05	2026.	-21.9104	-8.16E-07	0.00	7.50E+10
-1.5592	810000.	0.00				
38.0000	7.14E-06	1867.	-29.5179	-6.60E-07	0.00	7.50E+10
-0.9766	820800.	0.00				
38.5000	3.62E-06	1673.	-33.9545	-5.19E-07	0.00	7.50E+10
-0.5023	831600.	0.00				
39.0000	9.12E-07	1460.	-35.8457	-3.94E-07	0.00	7.50E+10
-0.1281	842400.	0.00				
39.5000	-1.10E-06	1243.	-35.7614	-2.85E-07	0.00	7.50E+10
0.1562	853200.	0.00				
40.0000	-2.51E-06	1031.	-34.2076	-1.94E-07	0.00	7.50E+10
0.3618	864000.	0.00				
40.5000	-3.43E-06	832.6417	-31.6215	-1.20E-07	0.00	7.50E+10
0.5002	874800.	0.00				
41.0000	-3.95E-06	651.9741	-28.3717	-6.04E-08	0.00	7.50E+10
0.5830	885600.	0.00				
41.5000	-4.16E-06	492.2610	-24.7599	-1.46E-08	0.00	7.50E+10
0.6209	896400.	0.00				
42.0000	-4.13E-06	354.8744	-21.0258	1.93E-08	0.00	7.50E+10
0.6238	907200.	0.00				
42.5000	-3.92E-06	239.9255	-17.3530	4.31E-08	0.00	7.50E+10
0.6005	918000.	0.00				
43.0000	-3.61E-06	146.5820	-13.8755	5.85E-08	0.00	7.50E+10
0.5586	928800.	0.00				

43.5000	-3.22E-06	73.3420	-10.6857	6.73E-08	0.00	7.50E+10	
0.5046	939600.	0.00					
44.0000	-2.80E-06	18.2652	-7.8407	7.10E-08	0.00	7.50E+10	
0.4437	950400.	0.00					
44.5000	-2.37E-06	-20.8405	-5.3704	7.09E-08	0.00	7.50E+10	
0.3798	961200.	0.00					
45.0000	-1.95E-06	-46.2736	-3.2833	6.82E-08	0.00	7.50E+10	
0.3159	972000.	0.00					
45.5000	-1.55E-06	-60.3304	-1.5728	6.39E-08	0.00	7.50E+10	
0.2542	982800.	0.00					
46.0000	-1.18E-06	-65.2314	-0.2224	5.89E-08	0.00	7.50E+10	
0.1959	993600.	0.00					
46.5000	-8.45E-07	-63.0766	0.7898	5.38E-08	0.00	7.50E+10	
0.1415	1004400.	0.00					
47.0000	-5.38E-07	-55.8252	1.4871	4.90E-08	0.00	7.50E+10	
0.09096	1015200.	0.00					
47.5000	-2.57E-07	-45.2963	1.8917	4.50E-08	0.00	7.50E+10	
0.04392	1026000.	0.00					
48.0000	2.13E-09	-33.1837	2.0224	4.18E-08	0.00	7.50E+10	
-3.68E-04	1036800.	0.00					
48.5000	2.45E-07	-21.0826	1.8929	3.97E-08	0.00	7.50E+10	
-0.04281	1047600.	0.00					
49.0000	4.78E-07	-10.5216	1.5114	3.84E-08	0.00	7.50E+10	
-0.08434	1058400.	0.00					
49.5000	7.06E-07	-2.9963	0.8810	3.79E-08	0.00	7.50E+10	
-0.1258	1069200.	0.00					
50.0000	9.32E-07	0.00	0.00	3.77E-08	0.00	7.50E+10	
-0.1678	540000.	0.00					

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.50000000 inches
Computed slope at pile head	=	0.000000 radians
Maximum bending moment	=	-3067151. inch-lbs
Maximum shear force	=	51746. lbs
Depth of maximum bending moment	=	0.000000 feet below pile head
Depth of maximum shear force	=	0.000000 feet below pile head
Number of iterations	=	55
Number of zero deflection points	=	4

LB16 2 ft_fixedhead.lp11o

Summary of Pile-head Responses for Conventional Analyses

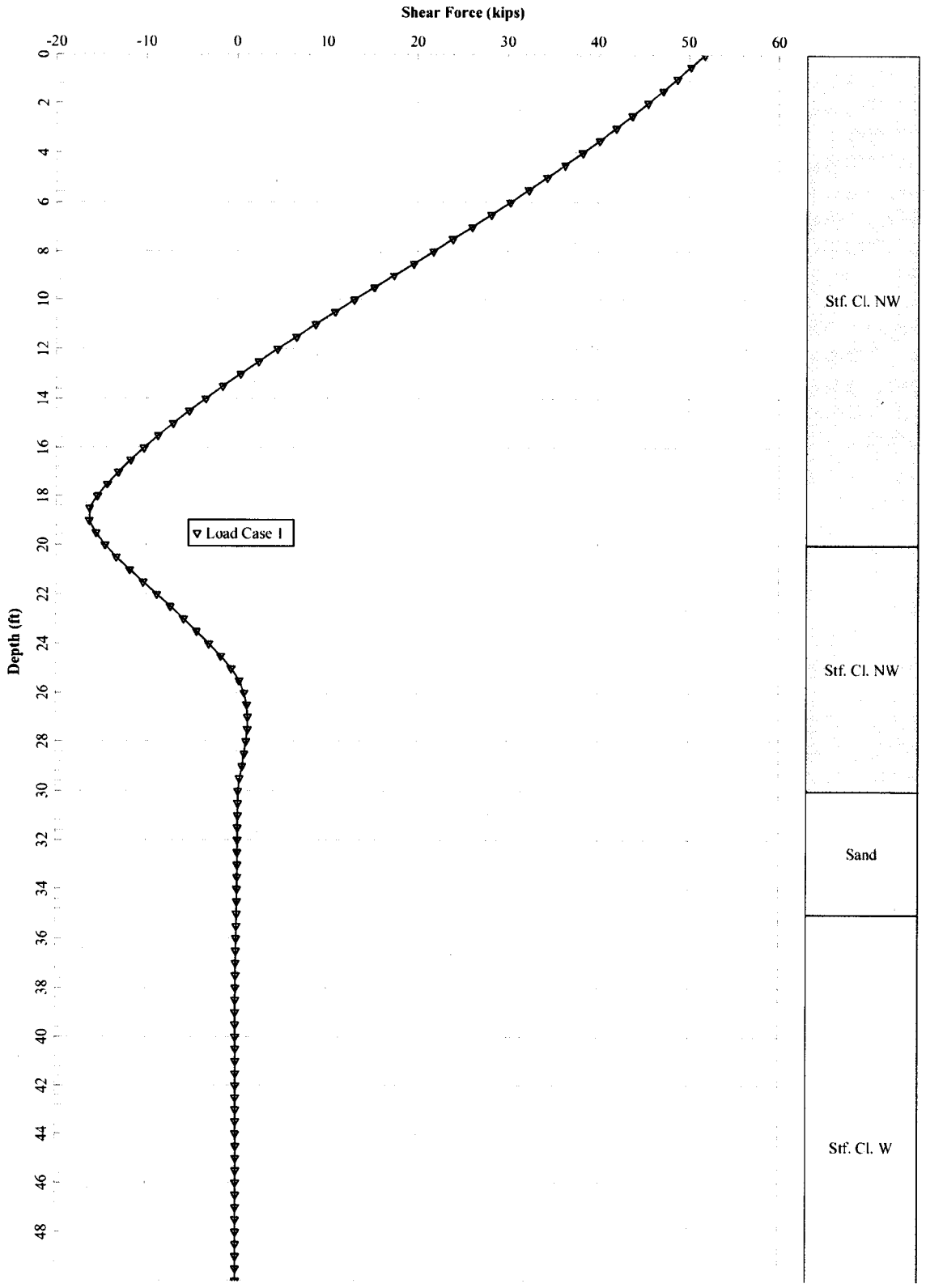
Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

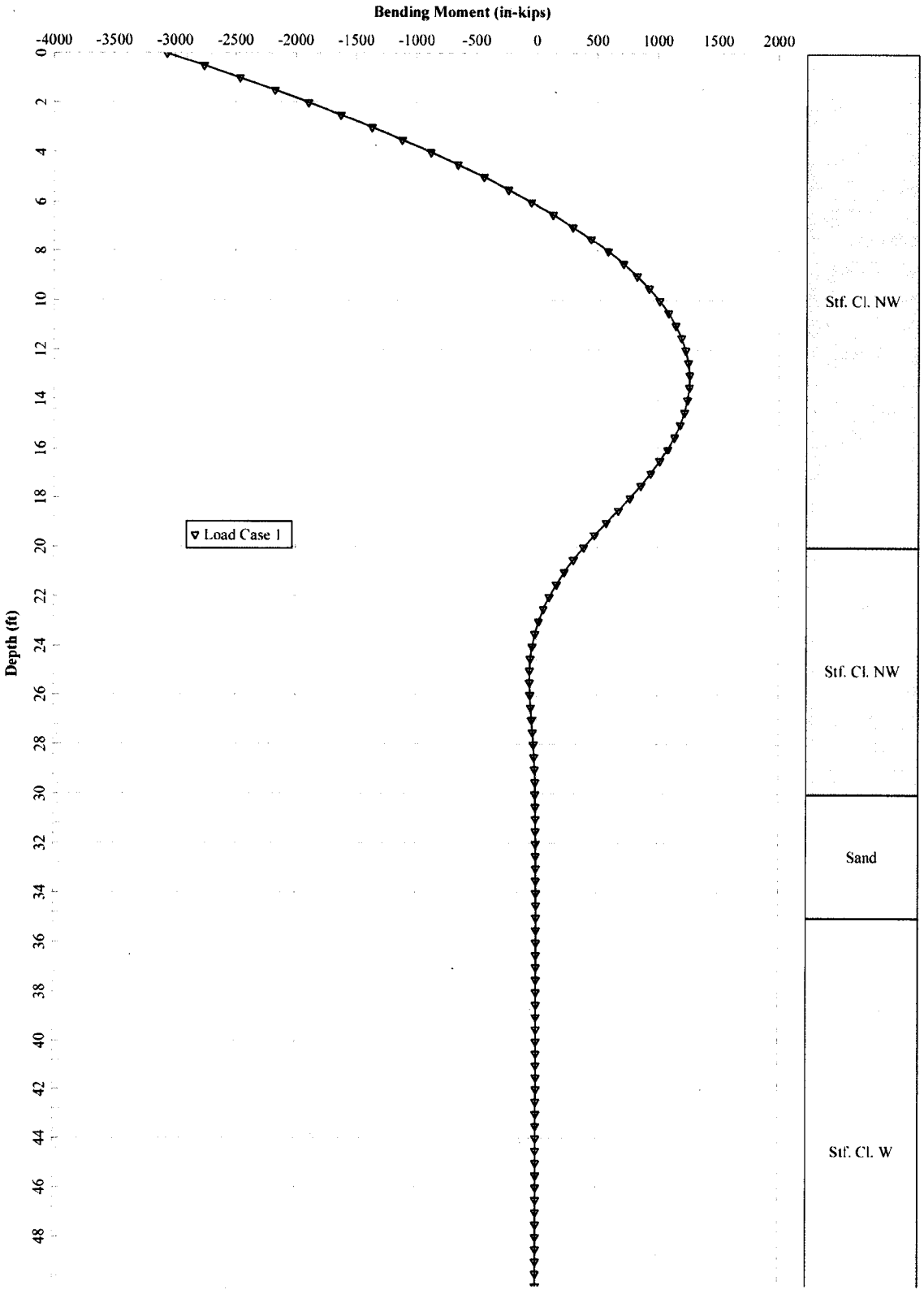
Load Case No.	Load Type	Load 1	Load Type	Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	0.5000	S, rad	0.00	110000.	0.5000	0.00	51746.	-3067151.

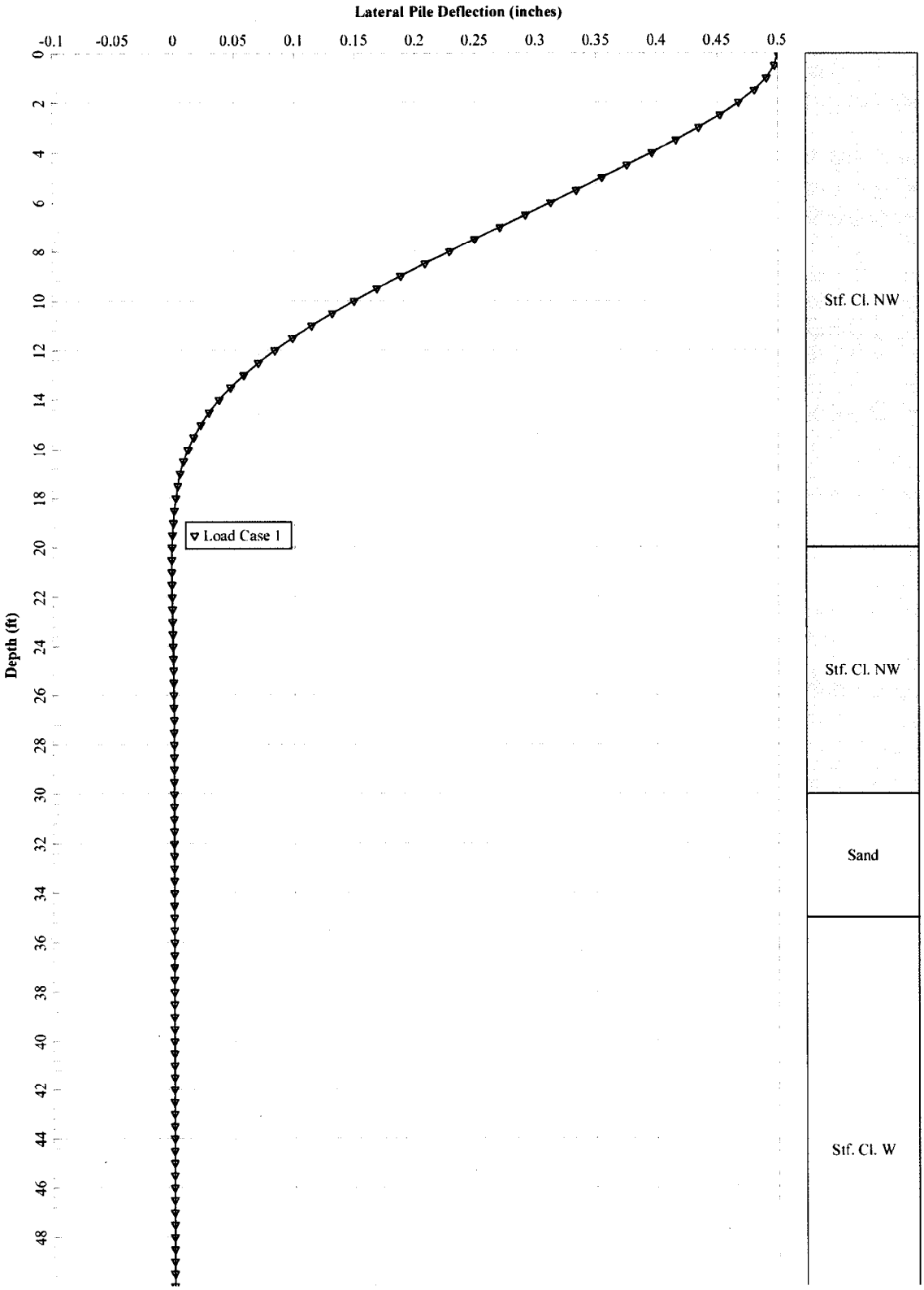
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.



DRILLED SHAFT STIFFNESS = 52 KIPS / 0.5 IN = 104 KIPS/IN


Bending Moment (in-kips)
-4000
-3500
-3000
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Stf. Cl. NW
Stf. Cl. NW
Sand
Stf. Cl. W


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Stf. Cl. NW
Stf. Cl. NW
Sand
Stf. Cl. W

ABUTMENT #2 FREE HEAD

LB10 2 ft_freehead.lp11o

LPile for Windows, Version 2019-11.004

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\SLC_Civil\096360005 - WPR_Project Files\Eng\Structural\Phase 0A\WBWCD Gateway Canal Crossing\Foundation Design\

Name of input data file:
LB10 2 ft_freehead.lp11d

Name of output report file:
LB10 2 ft_freehead.lp11o

Name of plot output file:
LB10 2 ft_freehead.lp11p

Name of runtime message file:
LB10 2 ft_freehead.lp11r

LB10 2 ft_freehead.lp11o
Date and Time of Analysis

Date: August 28, 2020 Time: 14:57:49

Problem Title

Project Name:

Job Number:

Client:

Engineer:

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

LB10 2 ft_freehead.lp11o

Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	45.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	45.000	24.0000

Input Structural Properties for Pile Sections:

LB10 2 ft_freehead.lp11o

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	45.000000	ft
Shaft Diameter	=	24.000000	in
Shear capacity of section	=	0.0000	lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000	degrees
	=	0.000	radians
Pile Batter Angle	=	0.000	degrees
	=	0.000	radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000	ft
Distance from top of pile to bottom of layer	=	20.000000	ft
Effective unit weight at top of layer	=	115.000000	pcf
Effective unit weight at bottom of layer	=	115.000000	pcf
Undrained cohesion at top of layer	=	1500.	psf
Undrained cohesion at bottom of layer	=	1500.	psf
Epsilon-50 at top of layer	=	0.0000	
Epsilon-50 at bottom of layer	=	0.0000	

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	20.000000	ft
Distance from top of pile to bottom of layer	=	25.000000	ft
Effective unit weight at top of layer	=	125.000000	pcf
Effective unit weight at bottom of layer	=	125.000000	pcf

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Friction angle at top of layer	=	37.000000 deg.
Friction angle at bottom of layer	=	37.000000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	25.000000 ft
Distance from top of pile to bottom of layer	=	60.000000 ft
Effective unit weight at top of layer	=	140.000000 pcf
Effective unit weight at bottom of layer	=	140.000000 pcf
Uniaxial compressive strength at top of layer	=	500.000000 psi
Uniaxial compressive strength at bottom of layer	=	500.000000 psi
Initial modulus of rock at top of layer	=	104000. psi
Initial modulus of rock at bottom of layer	=	104000. psi
RQD of rock at top of layer	=	80.000000 %
RQD of rock at bottom of layer	=	80.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 15.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth or ft	Effective Unit Wt. kpy pcf	Undrained Cohesion Rock Mass Modulus psf	Angle of Friction deg.
			E50 krm	qu RQD % psi psi	
1	Stiff Clay	0.00	115.0000	1500.	--
--	--	default	--	--	
	w/o Free Water	20.0000	115.0000	1500.	--
--	--	default	--	--	
2	Sand	20.0000	125.0000	--	37.0000
--	--	--	default	--	
	(Reese, et al.)	25.0000	125.0000	--	37.0000
--	--	--	default	--	
3	Weak	25.0000	140.0000	--	--

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500.0000	80.0000	5.00E-04	--	104000.			
	Rock		60.0000	140.0000	--	--	
500.0000	80.0000	5.00E-04	--	104000.			

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p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.9500	1.0000
2	25.000	0.9500	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 2

Load Compute vs. Pile Length No.	Load Top y Type	Condition Run Analysis 1		Condition 2		Axial Thrust Force, lbs
1	4	y =	0.500000 in	M =	0.0000 in-lbs	155000.
N.A.			Yes			
2	4	y =	0.500000 in	M =	0.0000 in-lbs	110000.
N.A.			Yes			

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis

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S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head
Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

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Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	45.000000	ft
Shaft Diameter	=	24.000000	in
Concrete Cover Thickness (to edge of long. rebar)	=	3.000000	in
Number of Reinforcing Bars	=	11	bars
Yield Stress of Reinforcing Bars	=	60000.	psi
Modulus of Elasticity of Reinforcing Bars	=	29000000.	psi
Gross Area of Shaft	=	452.389342	sq. in.
Total Area of Reinforcing Steel	=	8.690000	sq. in.
Area Ratio of Steel Reinforcement	=	1.92	percent
Edge-to-Edge Bar Spacing	=	3.789453	in
Maximum Concrete Aggregate Size	=	0.750000	in
Ratio of Bar Spacing to Aggregate Size	=	5.05	
Offset of Center of Rebar Cage from Center of Pile	=	0.0000	in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2029.978	kips
Tensile Load for Cracking of Concrete	=	-213.613	kips
Nominal Axial Tensile Capacity	=	-521.400	kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches

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1	1.000000	0.790000	8.500000	0.00000
2	1.000000	0.790000	7.150655	4.595447
3	1.000000	0.790000	3.531028	7.731872
4	1.000000	0.790000	-1.209676	8.413482
5	1.000000	0.790000	-5.566316	6.423871
6	1.000000	0.790000	-8.155690	2.394727
7	1.000000	0.790000	-8.155690	-2.394727
8	1.000000	0.790000	-5.566316	-6.423871
9	1.000000	0.790000	-1.209676	-8.413482
10	1.000000	0.790000	3.531028	-7.731872
11	1.000000	0.790000	7.150655	-4.595447

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 3.789 inches
between bars 8 and 9.

Ratio of bar spacing to maximum aggregate size = 5.05

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 2

Number	Axial Thrust Force kips
1	110.000
2	155.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in

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reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.

Z = depth of tensile zone in concrete section is less than 10 percent of section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 110.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Run Msg	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	93.7233430		74978674.	53.7609547	0.00006720	0.00003720
0.2793213	1.8400846					
0.00000250	187.4594638		74983786.	32.8967277	0.00008224	0.00002224
0.3399808	2.1675128					
0.00000375	281.1882926		74983545.	25.9491745	0.00009731	0.00000731
0.4002503	2.4957227					
0.00000500	374.9020733		74980415.	22.4807555	0.0001124	-0.00000760
0.4601262	2.8247096					
0.00000625	468.4886584		74958185.	20.4032063	0.0001275	-0.00002248
0.5195866	3.1543312					
0.00000750	561.7827016		74904360.	19.0199912	0.0001426	-0.00003735
0.5785969	3.4843480					
0.00000875	654.7037731		74823288.	18.0329829	0.0001578	-0.00005221
0.6371367	3.8146193					
0.00001000	747.2139602		74721396.	17.2933311	0.0001729	-0.00006707
0.6951947	4.1450661					
0.00001125	839.2937919		74603893.	16.7184395	0.0001881	-0.00008192
0.7527640	4.4756409					
0.00001250	930.9327494		74474620.	16.2588007	0.0002032	-0.00009676
0.8098405	4.8063153					
0.00001375	930.9327494		67704200.	14.6096808	0.0002009	-0.0001291
0.8003573	4.6293602	C				
0.00001500	930.9327494		62062183.	14.1395444	0.0002121	-0.0001479
0.8421729	4.8457019	C				
0.00001625	930.9327494		57288169.	13.7297387	0.0002231	-0.0001669
0.8829835	5.0563894	C				
0.00001750	930.9327494		53196157.	13.3685834	0.0002340	-0.0001860

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0.9228847	5.2620561 C				
0.00001875	930.9327494	49649747.	13.0475166	0.0002446	-0.0002054
0.9619700	5.4633372 C				
0.00002000	930.9327494	46546637.	12.7596199	0.0002552	-0.0002248
1.0002939	5.6605796 C				
0.00002125	930.9327494	43808600.	12.5002913	0.0002656	-0.0002444
1.0379634	5.8545543 C				
0.00002250	956.3429238	42504130.	12.2653226	0.0002760	-0.0002640
1.0750314	6.0456230 C				
0.00002375	985.0653077	41476434.	12.0514698	0.0002862	-0.0002838
1.1115563	6.2341999 C				
0.00002500	1013.	40535765.	11.8561237	0.0002964	-0.0003036
1.1475941	-6.6293103 C				
0.00002625	1041.	39669473.	11.6764021	0.0003065	-0.0003235
1.1831272	-7.0975889 C				
0.00002750	1069.	38869695.	11.5105223	0.0003165	-0.0003435
1.2181947	-7.5678588 C				
0.00002875	1096.	38131880.	11.3576496	0.0003265	-0.0003635
1.2528995	-8.0393095 C				
0.00003000	1123.	37445849.	11.2154327	0.0003365	-0.0003835
1.2871681	-8.5125734 C				
0.00003125	1150.	36807580.	11.0830555	0.0003463	-0.0004037
1.3210548	-8.9872309 C				
0.00003250	1177.	36213276.	10.9598789	0.0003562	-0.0004238
1.3546184	-9.4628140 C				
0.00003375	1203.	35656405.	10.8442530	0.0003660	-0.0004440
1.3877884	-9.9399373 C				
0.00003500	1230.	35135572.	10.7361965	0.0003758	-0.0004642
1.4206670	-10.4177604 C				
0.00003625	1256.	34646610.	10.6346947	0.0003855	-0.0004845
1.4532272	-10.8965272 C				
0.00003750	1282.	34185663.	10.5388499	0.0003952	-0.0005048
1.4854407	-11.3765006 C				
0.00003875	1308.	33753624.	10.4493720	0.0004049	-0.0005251
1.5174729	-11.8562681 C				
0.00004000	1334.	33342853.	10.3637726	0.0004146	-0.0005454
1.5490722	-12.3380237 C				
0.00004125	1359.	32955632.	10.2833074	0.0004242	-0.0005658
1.5804617	-12.8198434 C				
0.00004250	1385.	32590447.	10.2077410	0.0004338	-0.0005862
1.6116721	-13.3014591 C				
0.00004375	1411.	32241518.	10.1350016	0.0004434	-0.0006066
1.6424674	-13.7849666 C				
0.00004500	1436.	31910841.	10.0662678	0.0004530	-0.0006270
1.6730577	-14.2685206 C				
0.00004625	1461.	31597370.	10.0014003	0.0004626	-0.0006474
1.7034707	-14.7518717 C				
0.00004750	1487.	31298654.	9.9395769	0.0004721	-0.0006679

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1.7336276	-15.2357327 C				
0.00004875	1512.	31012479.	9.8800472	0.0004817	-0.0006883
1.7634495	-15.7208332 C				
0.00005125	1562.	30480231.	9.7701075	0.0005007	-0.0007293
1.8225664	-16.6904276 C				
0.00005375	1612.	29992815.	9.6696206	0.0005197	-0.0007703
1.8807631	-17.6612287 C				
0.00005625	1662.	29544349.	9.5773626	0.0005387	-0.0008113
1.9380509	-18.6331774 C				
0.00005875	1712.	29132002.	9.4934355	0.0005577	-0.0008523
1.9946384	-19.6043091 C				
0.00006125	1761.	28748570.	9.4151047	0.0005767	-0.0008933
2.0502110	-20.5776701 C				
0.00006375	1810.	28392802.	9.3430278	0.0005956	-0.0009344
2.1050232	-21.5508275 C				
0.00006625	1859.	28062076.	9.2768223	0.0006146	-0.0009754
2.1591362	-22.5231554 C				
0.00006875	1908.	27752713.	9.2151653	0.0006335	-0.0010165
2.2124135	-23.4960141 C				
0.00007125	1957.	27462059.	9.1572736	0.0006525	-0.0010575
2.2647966	-24.4700332 C				
0.00007375	2005.	27189493.	9.1037031	0.0006714	-0.0010986
2.3164812	-25.4432051 C				
0.00007625	2054.	26933225.	9.0540314	0.0006904	-0.0011396
2.3674642	-26.4155234 C				
0.00007875	2102.	26691692.	9.0078900	0.0007094	-0.0011806
2.4177423	-27.3869819 C				
0.00008125	2150.	26462343.	8.9638941	0.0007283	-0.0012217
2.4670859	-28.3600764 C				
0.00008375	2198.	26245008.	8.9226623	0.0007473	-0.0012627
2.5156779	-29.3328337 C				
0.00008625	2246.	26038870.	8.8841744	0.0007663	-0.0013037
2.5635647	-30.3047086 C				
0.00008875	2294.	25842975.	8.8482013	0.0007853	-0.0013447
2.6107431	-31.2756920 C				
0.00009125	2341.	25656471.	8.8145389	0.0008043	-0.0013857
2.6572099	-32.2457770 C				
0.00009375	2389.	25478598.	8.7830049	0.0008234	-0.0014266
2.7029617	-33.2149563 C				
0.00009625	2436.	25308498.	8.7532290	0.0008425	-0.0014675
2.7479479	-34.1838012 C				
0.00009875	2483.	25145175.	8.7245990	0.0008616	-0.0015084
2.7920571	-35.1536794 C				
0.0001013	2530.	24988694.	8.6977027	0.0008806	-0.0015494
2.8354493	-36.1226202 C				
0.0001038	2577.	24838552.	8.6724175	0.0008998	-0.0015902
2.8781212	-37.0906137 C				
0.0001063	2624.	24694294.	8.6486322	0.0009189	-0.0016311

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2.9200692	-38.0576519 C				
0.0001088	2670.	24555504.	8.6262460	0.0009381	-0.0016719
2.9612897	-39.0237267 C				
0.0001113	2717.	24421805.	8.6051672	0.0009573	-0.0017127
3.0017792	-39.9888296 C				
0.0001138	2763.	24292853.	8.5853121	0.0009766	-0.0017534
3.0415340	-40.9529521 C				
0.0001163	2810.	24168333.	8.5666044	0.0009959	-0.0017941
3.0805503	-41.9160856 C				
0.0001188	2856.	24047956.	8.5489742	0.0010152	-0.0018348
3.1188244	-42.8782212 C				
0.0001213	2902.	23931457.	8.5323574	0.0010345	-0.0018755
3.1563525	-43.8393501 C				
0.0001238	2948.	23818534.	8.5165843	0.0010539	-0.0019161
3.1931047	-44.7998576 C				
0.0001263	2993.	23708817.	8.5013259	0.0010733	-0.0019567
3.2290126	-45.7607702 C				
0.0001288	3039.	23602328.	8.4869429	0.0010927	-0.0019973
3.2641693	-46.7206267 C				
0.0001313	3084.	23498873.	8.4733879	0.0011121	-0.0020379
3.2985711	-47.6794170 C				
0.0001338	3130.	23398275.	8.4606171	0.0011316	-0.0020784
3.3322135	-48.6371309 C				
0.0001363	3175.	23300368.	8.4485902	0.0011511	-0.0021189
3.3650926	-49.5937577 C				
0.0001388	3220.	23204997.	8.4372694	0.0011707	-0.0021593
3.3972041	-50.5492867 C				
0.0001413	3265.	23112020.	8.4266201	0.0011903	-0.0021997
3.4285435	-51.5037071 C				
0.0001438	3309.	23021304.	8.4166097	0.0012099	-0.0022401
3.4591067	-52.4570078 C				
0.0001463	3354.	22932723.	8.4072083	0.0012296	-0.0022804
3.4888890	-53.4091775 C				
0.0001488	3398.	22846162.	8.3983878	0.0012493	-0.0023207
3.5178860	-54.3602046 C				
0.0001588	3575.	22518046.	8.3684174	0.0013285	-0.0024815
3.6259285	-58.1526495 C				
0.0001688	3747.	22203717.	8.3446277	0.0014082	-0.0026418
3.7207798	-60.0000000 CY				
0.0001788	3891.	21766156.	8.3092906	0.0014853	-0.0028047
3.7993810	-60.0000000 CY				
0.0001888	3999.	21189081.	8.2571474	0.0015585	-0.0029715
3.8619803	-60.0000000 CY				
0.0001988	4095.	20601531.	8.2034351	0.0016304	-0.0031396
3.9120573	-60.0000000 CY				
0.0002088	4171.	19982466.	8.1447586	0.0017002	-0.0033098
3.9498999	-60.0000000 CY				
0.0002188	4236.	19364929.	8.0857118	0.0017687	-0.0034813

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3.9767621	-60.0000000 CY				
0.0002288	4299.	18793918.	8.0334635	0.0018377	-0.0036523
3.9934952	-60.0000000 CY				
0.0002388	4356.	18246213.	7.9822696	0.0019058	-0.0038242
3.9999058	-60.0000000 CY				
0.0002488	4401.	17692640.	7.9279771	0.0019721	-0.0039979
3.9999843	-60.0000000 CY				
0.0002588	4438.	17152987.	7.8745719	0.0020375	-0.0041725
3.9999822	-60.0000000 CY				
0.0002688	4474.	16648023.	7.8267460	0.0021034	-0.0043466
3.9999172	-60.0000000 CY				
0.0002788	4509.	16175257.	7.7833743	0.0021696	-0.0045204
3.9996476	-60.0000000 CY				
0.0002888	4542.	15731325.	7.7434631	0.0022359	-0.0046941
3.9988848	-60.0000000 CY				
0.0002988	4574.	15309426.	7.7064084	0.0023023	-0.0048677
3.9971859	-60.0000000 CY				
0.0003088	4600.	14899449.	7.6691943	0.0023679	-0.0050421
4.0000000	-60.0000000 CY				
0.0003188	4622.	14499160.	7.6313233	0.0024325	-0.0052175
3.9991475	-60.0000000 CY				
0.0003288	4639.	14111797.	7.5935280	0.0024964	-0.0053936
3.9958785	-60.0000000 CY				
0.0003388	4655.	13742944.	7.5578821	0.0025602	-0.0055698
3.9996717	-60.0000000 CY				
0.0003488	4671.	13393086.	7.5233391	0.0026238	-0.0057462
3.9962628	-60.0000000 CY				
0.0003588	4686.	13061755.	7.4915861	0.0026876	-0.0059224
3.9996897	-60.0000000 CY				
0.0003688	4701.	12747375.	7.4624629	0.0027518	-0.0060982
3.9954329	-60.0000000 CY				
0.0003788	4715.	12448773.	7.4356448	0.0028163	-0.0062737
3.9993268	-60.0000000 CY				
0.0003888	4729.	12164755.	7.4109509	0.0028810	-0.0064490
3.9952701	-60.0000000 CY				
0.0003988	4743.	11894173.	7.3882420	0.0029461	-0.0066239
3.9981323	-60.0000000 CY				
0.0004088	4756.	11636229.	7.3671295	0.0030113	-0.0067987
3.9999891	-60.0000000 CYT				
0.0004188	4769.	11387838.	7.3467851	0.0030765	-0.0069735
3.9950948	-60.0000000 CYT				
0.0004288	4780.	11148842.	7.3269069	0.0031414	-0.0071486
3.9989120	-60.0000000 CYT				
0.0004388	4790.	10916382.	7.3052962	0.0032052	-0.0073248
3.9991604	-60.0000000 CYT				
0.0004488	4798.	10692409.	7.2840921	0.0032687	-0.0075013
3.9942552	-60.0000000 CYT				
0.0004588	4805.	10473982.	7.2615912	0.0033313	-0.0076787

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3.9980763	-60.0000000 CYT				
0.0004688	4811.	10264161.	7.2400191	0.0033938	-0.0078562
3.9998574	-60.0000000 CYT				
0.0004788	4816.	10060314.	7.2181215	0.0034557	-0.0080343
3.9942767	-60.0000000 CYT				
0.0004888	4821.	9864271.	7.1972311	0.0035176	-0.0082124
3.9945738	-60.0000000 CYT				
0.0004988	4826.	9675905.	7.1774047	0.0035797	-0.0083903
3.9979989	60.0000000 CYT				
0.0005088	4830.	9494781.	7.1586066	0.0036419	-0.0085681
3.9997544	60.0000000 CYT				
0.0005188	4835.	9320443.	7.1408700	0.0037043	-0.0087457
3.9959852	60.0000000 CYT				
0.0005288	4839.	9152514.	7.1241228	0.0037669	-0.0089231
3.9916192	60.0000000 CYT				
0.0005388	4844.	8990317.	7.1087090	0.0038298	-0.0091002
3.9958709	60.0000000 CYT				

Axial Thrust Force = 155.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Run Msg	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	92.7409363		74192749.	71.1447125	0.00008893	0.00005893
0.3676739	2.4702458					
0.00000250	185.5014796		74200592.	41.5887777	0.0001040	0.00004397
0.4276076	2.7976864					
0.00000375	278.2546542		74201241.	31.7440643	0.0001190	0.00002904
0.4871510	3.1259170					
0.00000500	370.9967903		74199358.	26.8271567	0.0001341	0.00001414
0.5463014	3.4549377					
0.00000625	463.7242176		74195875.	23.8813720	0.0001493	-7.41425E-07
0.6050560	3.7847487					
0.00000750	556.4062054		74187494.	21.9209929	0.0001644	-0.00001559
0.6634076	4.1153160					
0.00000875	648.9096919		74161108.	20.5230141	0.0001796	-0.00003042
0.7213303	4.4464648					
0.00001000	741.1210439		74112104.	19.4759493	0.0001948	-0.00004524
0.7787999	4.7780253					
0.00001125	832.9771839		74042416.	18.6624935	0.0002100	-0.00006005
0.8358007	5.1098885					
0.00001250	924.4412013		73955296.	18.0123643	0.0002252	-0.00007485

LB10 2 ft_freehead.lp11o

0.8923224	5.4419821				
0.00001375	1015.	73853899.	17.4808975	0.0002404	-0.00008964
0.9483580	5.7742579				
0.00001500	1106.	73740866.	17.0383501	0.0002556	-0.0001044
1.0039026	6.1066823				
0.00001625	1106.	68068491.	15.7128386	0.0002553	-0.0001347
1.0024650	5.9909252 C				
0.00001750	1106.	63206456.	15.2643503	0.0002671	-0.0001529
1.0450575	6.2241578 C				
0.00001875	1106.	58992692.	14.8647454	0.0002787	-0.0001713
1.0866045	6.4514554 C				
0.00002000	1106.	55305649.	14.5070222	0.0002901	-0.0001899
1.1272774	6.6740729 C				
0.00002125	1106.	52052376.	14.1835470	0.0003014	-0.0002086
1.1670700	6.8918609 C				
0.00002250	1112.	49412510.	13.8903685	0.0003125	-0.0002275
1.2061349	7.1059655 C				
0.00002375	1144.	48176715.	13.6229126	0.0003235	-0.0002465
1.2444990	7.3165311 C				
0.00002500	1176.	47031716.	13.3776201	0.0003344	-0.0002656
1.2821974	7.5237746 C				
0.00002625	1207.	45968469.	13.1517059	0.0003452	-0.0002848
1.3192732	7.7279862 C				
0.00002750	1237.	44979414.	12.9429294	0.0003559	-0.0003041
1.3557720	7.9294863 C				
0.00002875	1267.	44058127.	12.7494777	0.0003665	-0.0003235
1.3917419	8.1286271 C				
0.00003000	1296.	43199073.	12.5698797	0.0003771	-0.0003429
1.4272341	8.3257946 C				
0.00003125	1325.	42393255.	12.4020332	0.0003876	-0.0003624
1.4622071	8.5205925 C				
0.00003250	1353.	41637295.	12.2449997	0.0003980	-0.0003820
1.4967120	8.7134123 C				
0.00003375	1381.	40930476.	12.0985905	0.0004083	-0.0004017
1.5308673	8.9052456 C				
0.00003500	1409.	40262426.	11.9604207	0.0004186	-0.0004214
1.5645310	-9.1751729 C				
0.00003625	1437.	39635179.	11.8309688	0.0004289	-0.0004411
1.5978670	-9.6389440 C				
0.00003750	1464.	39042176.	11.7087386	0.0004391	-0.0004609
1.6308010	-10.1042467 C				
0.00003875	1491.	38482618.	11.5935836	0.0004493	-0.0004807
1.6634057	-10.5704606 C				
0.00004000	1518.	37951667.	11.4843780	0.0004594	-0.0005006
1.6956239	-11.0381223 C				
0.00004125	1545.	37450509.	11.3815586	0.0004695	-0.0005205
1.7275879	-11.5060604 C				
0.00004250	1571.	36971437.	11.2830939	0.0004795	-0.0005405

LB10 2 ft_freehead.lp11o

1.7591001	-11.9760866 C				
0.00004375	1598.	36518903.	11.1904359	0.0004896	-0.0005604
1.7904171	-12.4458844 C				
0.00004500	1624.	36086270.	11.1017162	0.0004996	-0.0005804
1.8213434	-12.9172602 C				
0.00004625	1650.	35674009.	11.0172604	0.0005095	-0.0006005
1.8519754	-13.3893493 C				
0.00004750	1676.	35282689.	10.9374131	0.0005195	-0.0006205
1.8824144	-13.8612133 C				
0.00004875	1702.	34906445.	10.8603674	0.0005294	-0.0006406
1.9124430	-14.3349055 C				
0.00005125	1753.	34204599.	10.7171946	0.0005493	-0.0006807
1.9718019	-15.2828193 C				
0.00005375	1804.	33559124.	10.5855488	0.0005690	-0.0007210
2.0300180	-16.2335256 C				
0.00005625	1854.	32966252.	10.4652788	0.0005887	-0.0007613
2.0873326	-17.1847638 C				
0.00005875	1904.	32416137.	10.3535423	0.0006083	-0.0008017
2.1435122	-18.1389022 C				
0.00006125	1954.	31907238.	10.2508118	0.0006279	-0.0008421
2.1988342	-19.0932454 C				
0.00006375	2004.	31433582.	10.1554417	0.0006474	-0.0008826
2.2531950	-20.0488771 C				
0.00006625	2053.	30990914.	10.0664591	0.0006669	-0.0009231
2.3065747	-21.0060652 C				
0.00006875	2102.	30578481.	9.9843922	0.0006864	-0.0009636
2.3592090	-21.9623679 C				
0.00007125	2151.	30190447.	9.9071178	0.0007059	-0.0010041
2.4108283	-22.9206678 C				
0.00007375	2200.	29825749.	9.8348834	0.0007253	-0.0010447
2.4615840	-23.8793933 C				
0.00007625	2248.	29483212.	9.7677910	0.0007448	-0.0010852
2.5115959	-24.8372219 C				
0.00007875	2296.	29160048.	9.7049491	0.0007643	-0.0011257
2.5607796	-25.7950722 C				
0.00008125	2344.	28853106.	9.6451245	0.0007837	-0.0011663
2.6089642	-26.7549252 C				
0.00008375	2392.	28562900.	9.5892471	0.0008031	-0.0012069
2.6564057	-27.7138663 C				
0.00008625	2440.	28287961.	9.5369763	0.0008226	-0.0012474
2.7031006	-28.6718887 C				
0.00008875	2487.	28026991.	9.4880100	0.0008421	-0.0012879
2.7490455	-29.6289841 C				
0.00009125	2535.	27777341.	9.4409921	0.0008615	-0.0013285
2.7940057	-30.5880244 C				
0.00009375	2582.	27539279.	9.3966113	0.0008809	-0.0013691
2.8381707	-31.5467129 C				
0.00009625	2629.	27312184.	9.3548757	0.0009004	-0.0014096

LB10 2 ft_freehead.lp11o

2.8815853	-32.5044534 C				
0.00009875	2676.	27095211.	9.3155870	0.0009199	-0.0014501
2.9242456	-33.4612384 C				
0.0001013	2722.	26887601.	9.2785666	0.0009395	-0.0014905
2.9661481	-34.4170601 C				
0.0001038	2769.	26688670.	9.2436530	0.0009590	-0.0015310
3.0072891	-35.3719087 C				
0.0001063	2815.	26496819.	9.2098131	0.0009785	-0.0015715
3.0474694	-36.3285132 C				
0.0001088	2861.	26312413.	9.1777389	0.0009981	-0.0016119
3.0868661	-37.2844556 C				
0.0001113	2908.	26135055.	9.1474170	0.0010177	-0.0016523
3.1254992	-38.2393956 C				
0.0001138	2953.	25964269.	9.1187345	0.0010373	-0.0016927
3.1633649	-39.1933248 C				
0.0001163	2999.	25799622.	9.0915881	0.0010569	-0.0017331
3.2004593	-40.1462342 C				
0.0001188	3045.	25640717.	9.0658834	0.0010766	-0.0017734
3.2367783	-41.0981149 C				
0.0001213	3090.	25487189.	9.0415340	0.0010963	-0.0018137
3.2723179	-42.0489579 C				
0.0001238	3136.	25338704.	9.0184601	0.0011160	-0.0018540
3.3070739	-42.9987539 C				
0.0001263	3181.	25194864.	8.9964770	0.0011358	-0.0018942
3.3410181	-43.9478984 C				
0.0001288	3226.	25055022.	8.9750589	0.0011555	-0.0019345
3.3740474	-44.8981234 C				
0.0001313	3271.	24919406.	8.9547435	0.0011753	-0.0019747
3.4062890	-45.8472571 C				
0.0001338	3315.	24787770.	8.9354717	0.0011951	-0.0020149
3.4377386	-46.7952888 C				
0.0001363	3360.	24659886.	8.9171887	0.0012150	-0.0020550
3.4683917	-47.7422080 C				
0.0001388	3404.	24535541.	8.8998437	0.0012349	-0.0020951
3.4982439	-48.6880038 C				
0.0001413	3449.	24414539.	8.8833897	0.0012548	-0.0021352
3.5272906	-49.6326652 C				
0.0001438	3493.	24296697.	8.8677828	0.0012747	-0.0021753
3.5555270	-50.5761810 C				
0.0001463	3537.	24181842.	8.8529824	0.0012947	-0.0022153
3.5829487	-51.5185396 C				
0.0001488	3580.	24069815.	8.8389504	0.0013148	-0.0022552
3.6095507	-52.4597295 C				
0.0001588	3754.	23647142.	8.7898335	0.0013954	-0.0024146
3.7076647	-56.2125539 C				
0.0001688	3925.	23259180.	8.7502260	0.0014766	-0.0025734
3.7922086	-59.9473314 C				
0.0001788	4084.	22848664.	8.7119113	0.0015573	-0.0027327

LB10 2 ft_freehead.lp11o

3.8619153	-60.0000000 CY				
0.0001888	4208.	22294040.	8.6588402	0.0016344	-0.0028956
3.9152496	-60.0000000 CY				
0.0001988	4306.	21665916.	8.5979528	0.0017088	-0.0030612
3.9544547	-60.0000000 CY				
0.0002088	4394.	21048338.	8.5396721	0.0017827	-0.0032273
3.9813891	-60.0000000 CY				
0.0002188	4463.	20402401.	8.4755111	0.0018540	-0.0033960
3.9961523	-60.0000000 CY				
0.0002288	4524.	19777941.	8.4138988	0.0019247	-0.0035653
3.9978293	-60.0000000 CY				
0.0002388	4584.	19198128.	8.3598222	0.0019959	-0.0037341
3.9987298	-60.0000000 CY				
0.0002488	4636.	18638846.	8.3086218	0.0020668	-0.0039032
3.9990900	-60.0000000 CY				
0.0002588	4678.	18078993.	8.2545089	0.0021359	-0.0040741
3.9989972	-60.0000000 CY				
0.0002688	4712.	17534123.	8.2001516	0.0022038	-0.0042462
3.9984417	-60.0000000 CY				
0.0002788	4745.	17023151.	8.1511546	0.0022721	-0.0044179
3.9973022	-60.0000000 CY				
0.0002888	4777.	16544454.	8.1072648	0.0023410	-0.0045890
3.9986669	-60.0000000 CY				
0.0002988	4808.	16094811.	8.0679844	0.0024103	-0.0047597
3.9997887	-60.0000000 CY				
0.0003088	4838.	15670370.	8.0319909	0.0024799	-0.0049301
3.9985232	-60.0000000 CY				
0.0003188	4864.	15260181.	7.9950126	0.0025484	-0.0051016
3.9962724	-60.0000000 CY				
0.0003288	4886.	14861289.	7.9576012	0.0026161	-0.0052739
3.9995611	-60.0000000 CY				
0.0003388	4903.	14474212.	7.9198752	0.0026829	-0.0054471
3.9963393	-60.0000000 CY				
0.0003488	4918.	14101302.	7.8826972	0.0027491	-0.0056209
3.9997111	-60.0000000 CY				
0.0003588	4932.	13747893.	7.8484425	0.0028156	-0.0057944
3.9958452	-60.0000000 CY				
0.0003688	4946.	13412785.	7.8168133	0.0028824	-0.0059676
3.9994769	-60.0000000 CY				
0.0003788	4959.	13094212.	7.7867944	0.0029492	-0.0061408
3.9944734	-60.0000000 CY				
0.0003888	4972.	12790869.	7.7579989	0.0030159	-0.0063141
3.9984941	-60.0000000 CY				
0.0003988	4985.	12502259.	7.7311871	0.0030828	-0.0064872
3.9999091	-60.0000000 CYT				
0.0004088	4998.	12226947.	7.7065113	0.0031500	-0.0066600
3.9958736	-60.0000000 CYT				
0.0004188	5010.	11964406.	7.6834676	0.0032175	-0.0068325

```
   3.9992650   -60.0000000 CYT
    0.0004288         5022.     11713558.     7.6619853     0.0032851    -0.0070049
   3.9969728   -60.0000000 CYT
    0.0004388         5034.     11473506.     7.6420552     0.0033530    -0.0071770
   3.9959300   -60.0000000 CYT
    0.0004488         5044.     11240664.     7.6215616     0.0034202    -0.0073498
   3.9991346    60.0000000 CYT
    0.0004588         5054.     11017327.     7.6022463     0.0034875    -0.0075225
   3.9984921    60.0000000 CYT
    0.0004688         5062.     10799147.     7.5818857     0.0035540    -0.0076960
   3.9935045    60.0000000 CYT
    0.0004788         5070.     10589891.     7.5626698     0.0036206    -0.0078694
   3.9975595    60.0000000 CYT
    0.0004888         5075.     10383916.     7.5418579     0.0036861    -0.0080439
   3.9996220    60.0000000 CYT
    0.0004988         5080.     10185787.     7.5219186     0.0037516    -0.0082184
   3.9968848    60.0000000 CYT
    0.0005088         5084.      9993544.     7.5018726     0.0038166    -0.0083934
   3.9920025    60.0000000 CYT
```

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	110.000	4753.967	0.00300000
2	155.000	4969.342	0.00300000

Note that the values of moment capacity in the table above are not factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction factor to compute ultimate moment capacity according to ACI 318, Section 9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding bending stiffnesses computed for common resistance factor values used for reinforced concrete sections.

LB10 2 ft_freehead.lp11o

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	4754.	71.500000	3090.	23485877.
2	0.65	4969.	100.750000	3230.	25042204.
1	0.75	4754.	77.000000	3565.	22535282.
2	0.75	4969.	108.500000	3727.	23712826.
1	0.90	4754.	82.500000	4279.	18979984.
2	0.90	4969.	116.250000	4472.	20306635.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	374692.
2	20.0000	13.2858	No	No	374692.	515951.
3	25.0000	25.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs
Axial load at pile head = 155000.0 lbs

LB10 2 ft_freehead.lp11o

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Es*h	Soil Spr. Distrib. p Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch
0.00	0.5000	0.00	38141.	-0.00545	0.00	7.42E+10	-372.1217	2009. 0.00
0.4500	0.4706	205093.	36098.	-0.00544	0.00	7.42E+10	-384.4847	4412. 0.00
0.9000	0.4413	398962.	33990.	-0.00542	0.00	7.42E+10	-396.0220	4846. 0.00
1.3500	0.4121	581258.	31823.	-0.00538	0.00	7.42E+10	-406.6815	5329. 0.00
1.8000	0.3831	751660.	29601.	-0.00533	0.00	7.41E+10	-416.4047	5869. 0.00
2.2500	0.3545	909874.	27329.	-0.00527	0.00	7.40E+10	-425.1249	6476. 0.00
2.7000	0.3262	1055636.	25012.	-0.00520	0.00	7.38E+10	-432.7652	7164. 0.00
3.1500	0.2983	1188714.	22658.	-0.00509	0.00	4.66E+10	-439.2353	7951. 0.00
3.6000	0.2712	1308868.	20272.	-0.00494	0.00	4.28E+10	-444.5394	8851. 0.00
4.0500	0.2450	1415922.	17860.	-0.00476	0.00	4.01E+10	-448.6304	9890. 0.00
4.5000	0.2198	1509733.	15430.	-0.00456	0.00	3.81E+10	-451.4627	11094. 0.00
4.9500	0.1957	1590201.	12988.	-0.00434	0.00	3.66E+10	-452.9914	12499. 0.00
5.4000	0.1729	1657264.	10541.	-0.00409	0.00	3.56E+10	-453.1716	14152. 0.00
5.8500	0.1515	1710901.	8098.	-0.00384	0.00	3.48E+10	-451.9582	16111. 0.00
6.3000	0.1315	1751137.	5664.	-0.00356	0.00	3.42E+10	-449.3051	18452. 0.00
6.7500	0.1130	1778041.	3249.	-0.00328	0.00	3.39E+10	-445.1652	21276. 0.00
7.2000	0.09602	1791725.	860.4543	-0.00300	0.00	3.37E+10	-439.4895	24717. 0.00
7.6500	0.08059	1792354.	-1493.	-0.00271	0.00	3.37E+10	-432.2260	28960. 0.00
8.1000	0.06672	1780139.	-3803.	-0.00243	0.00	3.39E+10	-423.3186	34259. 0.00
8.5500	0.05439	1755343.	-6060.	-0.00215	0.00	3.42E+10	-412.7045	40977. 0.00

LB10 2 ft_freehead.lp11o

9.0000	0.04355	1718279.	-8256.	-0.00187	0.00	3.47E+10
-400.3108	49639.	0.00				
9.4500	0.03415	1669319.	-10379.	-0.00161	0.00	3.54E+10
-386.0480	61037.	0.00				
9.9000	0.02614	1608888.	-12420.	-0.00137	0.00	3.63E+10
-369.7980	76405.	0.00				
10.3500	0.01941	1537474.	-14367.	-0.00114	0.00	3.76E+10
-351.3922	97764.	0.00				
10.8000	0.01388	1455628.	-16208.	-9.25E-04	0.00	3.92E+10
-330.5669	128651.	0.00				
11.2500	0.00942	1363975.	-17929.	-7.35E-04	0.00	4.14E+10
-306.8648	175843.	0.00				
11.7000	0.00593	1263225.	-19512.	-5.69E-04	0.00	4.42E+10
-279.3922	254267.	0.00				
12.1500	0.00328	1154198.	-20931.	-4.27E-04	0.00	4.78E+10
-246.0863	405421.	0.00				
12.6000	0.00133	1037887.	-22137.	-3.24E-04	0.00	7.38E+10
-200.5008	816866.	0.00				
13.0500	-2.17E-04	915665.	-22484.	-2.52E-04	0.00	7.40E+10
71.6624	1784022.	0.00				
13.5000	-0.00140	795477.	-21721.	-1.90E-04	0.00	7.41E+10
211.1748	815546.	0.00				
13.9500	-0.00227	681399.	-20494.	-1.36E-04	0.00	7.41E+10
243.0951	579197.	0.00				
14.4000	-0.00287	574367.	-19128.	-9.02E-05	0.00	7.42E+10
262.8497	495143.	0.00				
14.8500	-0.00324	474966.	-17673.	-5.21E-05	0.00	7.42E+10
276.2307	460238.	0.00				
15.3000	-0.00343	383590.	-16156.	-2.08E-05	0.00	7.42E+10
285.4020	449483.	0.00				
15.7500	-0.00347	300513.	-14599.	4.09E-06	0.00	7.42E+10
291.4336	454084.	0.00				
16.2000	-0.00338	225916.	-13016.	2.32E-05	0.00	7.42E+10
294.9445	470567.	0.00				
16.6500	-0.00321	159906.	-11419.	3.73E-05	0.00	7.42E+10
296.3340	497770.	0.00				
17.1000	-0.00298	102527.	-9820.	4.68E-05	0.00	7.42E+10
295.8833	535803.	0.00				
17.5500	-0.00271	53770.	-8228.	5.25E-05	0.00	7.42E+10
293.8082	585669.	0.00				
18.0000	-0.00241	13577.	-6651.	5.50E-05	0.00	7.42E+10
290.2873	649140.	0.00				
18.4500	-0.00212	-18151.	-5099.	5.48E-05	0.00	7.42E+10
284.6256	726597.	0.00				
18.9000	-0.00182	-41580.	-3590.	5.26E-05	0.00	7.42E+10
274.2308	812338.	0.00				
19.3500	-0.00155	-57009.	-2139.	4.90E-05	0.00	7.42E+10
263.1972	918772.	0.00				

LB10 2 ft_freehead.lp11o

19.8000	-0.00129	-64759.	-748.5306	4.46E-05	0.00	7.42E+10
251.6690	1050811.	0.00				
20.2500	-0.00107	-65167.	54.6556	3.99E-05	0.00	7.42E+10
45.8074	232234.	0.00				
20.7000	-8.63E-04	-64236.	280.7212	3.52E-05	0.00	7.42E+10
37.9206	237395.	0.00				
21.1500	-6.85E-04	-62195.	466.2150	3.06E-05	0.00	7.42E+10
30.7808	242555.	0.00				
21.6000	-5.32E-04	-59252.	615.2660	2.62E-05	0.00	7.42E+10
24.4233	247716.	0.00				
22.0500	-4.03E-04	-55593.	732.1424	2.20E-05	0.00	7.42E+10
18.8642	252877.	0.00				
22.5000	-2.95E-04	-51382.	821.1501	1.81E-05	0.00	7.42E+10
14.1016	258038.	0.00				
22.9500	-2.08E-04	-46755.	886.5412	1.45E-05	0.00	7.42E+10
10.1173	263199.	0.00				
23.4000	-1.38E-04	-41831.	932.4311	1.13E-05	0.00	7.42E+10
6.8790	268359.	0.00				
23.8500	-8.57E-05	-36704.	962.7256	8.43E-06	0.00	7.42E+10
4.3412	273520.	0.00				
24.3000	-4.74E-05	-31448.	981.0542	5.95E-06	0.00	7.42E+10
2.4472	278681.	0.00				
24.7500	-2.15E-05	-26118.	990.7114	3.85E-06	0.00	7.42E+10
1.1296	283842.	0.00				
25.2000	-5.83E-06	-20755.	1179.	2.15E-06	0.00	7.42E+10
68.6884	6.36E+07	0.00				
25.6500	1.68E-06	-13386.	1297.	9.03E-07	0.00	7.42E+10
-25.0133	8.05E+07	0.00				
26.1000	3.92E-06	-6747.	1039.	1.70E-07	0.00	7.42E+10
-70.7065	9.73E+07	0.00				
26.5500	3.51E-06	-2169.	647.1042	-1.54E-07	0.00	7.42E+10
-74.3287	1.14E+08	0.00				
27.0000	2.26E-06	242.0339	298.6638	-2.24E-07	0.00	7.42E+10
-54.7233	1.31E+08	0.00				
27.4500	1.09E-06	1057.	70.2836	-1.77E-07	0.00	7.42E+10
-29.8619	1.48E+08	0.00				
27.9000	3.41E-07	1001.	-38.4447	-1.02E-07	0.00	7.42E+10
-10.4078	1.65E+08	0.00				
28.3500	-1.45E-08	642.1009	-65.2317	-4.25E-08	0.00	7.42E+10
0.4867	1.82E+08	0.00				
28.8000	-1.18E-07	296.9619	-52.2352	-8.32E-09	0.00	7.42E+10
4.3268	1.98E+08	0.00				
29.2500	-1.04E-07	77.9747	-29.3253	5.33E-09	0.00	7.42E+10
4.1583	2.15E+08	0.00				
29.7000	-6.02E-08	-19.7606	-11.1088	7.45E-09	0.00	7.42E+10
2.5886	2.32E+08	0.00				
30.1500	-2.39E-08	-42.0125	-1.1449	5.20E-09	0.00	7.42E+10
1.1018	2.49E+08	0.00				

LB10 2 ft_freehead.lp11o

30.6000	-4.09E-09	-32.1340	2.3731	2.50E-09	0.00	7.42E+10	
0.2012	2.66E+08	0.00					
31.0500	3.09E-09	-16.3868	2.4821	7.33E-10	0.00	7.42E+10	
-0.1608	2.81E+08	0.00					
31.5000	3.83E-09	-5.3281	1.5100	-5.70E-11	0.00	7.42E+10	
-0.1992	2.81E+08	0.00					
31.9500	2.48E-09	-0.07905	0.6243	-2.54E-10	0.00	7.42E+10	
-0.1288	2.81E+08	0.00					
32.4000	1.09E-09	1.4145	0.1234	-2.05E-10	0.00	7.42E+10	
-0.05671	2.81E+08	0.00					
32.8500	2.61E-10	1.2541	-0.06630	-1.08E-10	0.00	7.42E+10	
-0.01355	2.81E+08	0.00					
33.3000	-7.67E-11	0.6986	-0.09211	-3.70E-11	0.00	7.42E+10	
0.00399	2.81E+08	0.00					
33.7500	-1.39E-10	0.2594	-0.06177	-2.16E-12	0.00	7.42E+10	
0.00725	2.81E+08	0.00					
34.2000	-1.00E-10	0.03147	-0.02817	8.43E-12	0.00	7.42E+10	
0.00520	2.81E+08	0.00					
34.6500	-4.83E-11	-0.04481	-0.00734	7.94E-12	0.00	7.42E+10	
0.00251	2.81E+08	0.00					
35.1000	-1.43E-11	-0.04779	0.00145	4.57E-12	0.00	7.42E+10	
7.41E-04	2.81E+08	0.00					
35.5500	1.04E-12	-0.02916	0.00331	1.77E-12	0.00	7.42E+10	
-5.40E-05	2.81E+08	0.00					
36.0000	4.87E-12	-0.01209	0.00248	0.00	0.00	7.42E+10	
-2.53E-04	2.81E+08	0.00					
36.4500	3.96E-12	-0.00242	0.00124	0.00	0.00	7.42E+10	
-2.06E-04	2.81E+08	0.00					
36.9000	2.09E-12	0.00126	3.88E-04	0.00	0.00	7.42E+10	
-1.09E-04	2.81E+08	0.00					
37.3500	0.00	0.00177	-6.50E-06	0.00	0.00	7.42E+10	
-3.74E-05	2.81E+08	0.00					
37.8000	0.00	0.00119	-1.14E-04	0.00	0.00	7.42E+10	
-2.30E-06	2.81E+08	0.00					
38.2500	0.00	5.45E-04	-9.71E-05	0.00	0.00	7.42E+10	
8.40E-06	2.81E+08	0.00					
38.7000	0.00	1.43E-04	-5.30E-05	0.00	0.00	7.42E+10	
7.96E-06	2.81E+08	0.00					
39.1500	0.00	-2.72E-05	-1.91E-05	0.00	0.00	7.42E+10	
4.59E-06	2.81E+08	0.00					
39.6000	0.00	-6.35E-05	-1.90E-06	0.00	0.00	7.42E+10	
1.79E-06	2.81E+08	0.00					
40.0500	0.00	-4.77E-05	3.67E-06	0.00	0.00	7.42E+10	
2.77E-07	2.81E+08	0.00					
40.5000	0.00	-2.39E-05	3.72E-06	0.00	0.00	7.42E+10	
-2.56E-07	2.81E+08	0.00					
40.9500	0.00	-7.53E-06	2.22E-06	0.00	0.00	7.42E+10	
-3.00E-07	2.81E+08	0.00					

LB10 2 ft_freehead.lp11o

41.4000	0.00	9.38E-08	8.99E-07	0.00	0.00	7.42E+10
-1.90E-07	2.81E+08	0.00				
41.8500	0.00	2.18E-06	1.64E-07	0.00	0.00	7.42E+10
-8.20E-08	2.81E+08	0.00				
42.3000	0.00	1.87E-06	-1.07E-07	0.00	0.00	7.42E+10
-1.85E-08	2.81E+08	0.00				
42.7500	0.00	1.02E-06	-1.39E-07	0.00	0.00	7.42E+10
6.77E-09	2.81E+08	0.00				
43.2000	0.00	3.72E-07	-9.03E-08	0.00	0.00	7.42E+10
1.12E-08	2.81E+08	0.00				
43.6500	0.00	4.72E-08	-3.88E-08	0.00	0.00	7.42E+10
7.94E-09	2.81E+08	0.00				
44.1000	0.00	-4.64E-08	-7.21E-09	0.00	0.00	7.42E+10
3.75E-09	2.81E+08	0.00				
44.5500	0.00	-3.06E-08	4.30E-09	0.00	0.00	7.42E+10
5.11E-10	2.81E+08	0.00				
45.0000	0.00	0.00	0.00	0.00	0.00	7.42E+10
-2.10E-09	1.40E+08	0.00				

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.50000000	inches
Computed slope at pile head	=	-0.00544643	radians
Maximum bending moment	=	1792354.	inch-lbs
Maximum shear force	=	38141.	lbs
Depth of maximum bending moment	=	7.65000000	feet below pile head
Depth of maximum shear force	=	0.000000	feet below pile head
Number of iterations	=	20	
Number of zero deflection points	=	10	

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 2

Pile-head conditions are Displacement and Moment (Loading Type 4)
Displacement of pile head = 0.500000 inches
Moment at pile head = 0.0 in-lbs

LB10 2 ft_freehead.lp11o

Axial load at pile head = 110000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Spr. Es*h	Distrib. p
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch	lb/inch
0.00	0.5000	0.00	36639.	-0.00563	0.00	7.50E+10	-372.1217	2009.
0.4500	0.4696	195771.	34597.	-0.00563	0.00	7.50E+10	-384.2795	4419.
0.9000	0.4392	380327.	32491.	-0.00560	0.00	7.50E+10	-395.5699	4863.
1.3500	0.4091	553333.	30327.	-0.00557	0.00	7.49E+10	-405.9323	5359.
1.8000	0.3791	714478.	28110.	-0.00553	0.00	7.48E+10	-415.2976	5916.
2.2500	0.3494	863482.	25845.	-0.00547	0.00	7.46E+10	-423.5859	6547.
2.7000	0.3200	1000097.	23538.	-0.00537	0.00	4.10E+10	-430.7029	7268.
3.1500	0.2914	1124075.	21196.	-0.00522	0.00	3.74E+10	-436.6557	8092.
3.6000	0.2636	1235223.	18826.	-0.00505	0.00	3.50E+10	-441.3964	9042.
4.0500	0.2369	1333387.	16433.	-0.00484	0.00	3.33E+10	-444.8779	10142.
4.5000	0.2113	1418450.	14024.	-0.00462	0.00	3.21E+10	-447.0526	11426.
4.9500	0.1870	1490336.	11608.	-0.00437	0.00	3.13E+10	-447.8719	12933.
5.4000	0.1641	1549009.	9191.	-0.00410	0.00	3.06E+10	-447.2860	14719.
5.8500	0.1427	1594476.	6781.	-0.00382	0.00	3.02E+10	-445.2429	16852.
6.3000	0.1228	1626791.	4387.	-0.00353	0.00	2.99E+10	-441.6881	19424.
6.7500	0.1045	1646051.	2015.	-0.00324	0.00	2.97E+10	-436.5631	22559.
7.2000	0.08782	1652403.	-323.8326	-0.00294	0.00	2.96E+10	-429.8048	26427.
7.6500	0.07277	1646044.	-2622.	-0.00264	0.00	2.97E+10	-421.3430	31265.
8.1000	0.05934	1627220.	-4870.	-0.00234	0.00	2.99E+10	-411.0979	37409.

LB10 2 ft_freehead.lp11o

8.5500	0.04750	1596233.	-7057.	-0.00205	0.00	3.01E+10
-398.9758	45359.	0.00				
9.0000	0.03720	1553443.	-9173.	-0.00177	0.00	3.06E+10
-384.8617	55868.	0.00				
9.4500	0.02838	1499267.	-11207.	-0.00150	0.00	3.12E+10
-368.6068	70130.	0.00				
9.9000	0.02097	1434188.	-13148.	-0.00125	0.00	3.19E+10
-350.0055	90133.	0.00				
10.3500	0.01487	1358758.	-14980.	-0.00102	0.00	3.30E+10
-328.7499	119421.	0.00				
10.8000	0.00996	1273610.	-16690.	-8.08E-04	0.00	3.43E+10
-304.3280	164937.	0.00				
11.2500	0.00614	1179469.	-18256.	-6.19E-04	0.00	3.62E+10
-275.7696	242387.	0.00				
11.7000	0.00328	1077182.	-19651.	-4.56E-04	0.00	3.86E+10
-240.8443	397110.	0.00				
12.1500	0.00122	967783.	-20820.	-3.19E-04	0.00	4.21E+10
-192.1889	851101.	0.00				
12.6000	-1.67E-04	852705.	-21193.	-2.26E-04	0.00	7.46E+10
53.9658	1747914.	0.00				
13.0500	-0.00122	739165.	-20507.	-1.68E-04	0.00	7.47E+10
200.1089	886132.	0.00				
13.5000	-0.00198	631428.	-19344.	-1.19E-04	0.00	7.48E+10
230.6090	627749.	0.00				
13.9500	-0.00250	530388.	-18049.	-7.69E-05	0.00	7.49E+10
249.2485	537944.	0.00				
14.4000	-0.00281	436594.	-16669.	-4.20E-05	0.00	7.50E+10
261.6743	502174.	0.00				
14.8500	-0.00296	350412.	-15234.	-1.37E-05	0.00	7.50E+10
269.9709	493204.	0.00				
15.3000	-0.00296	272087.	-13762.	8.73E-06	0.00	7.50E+10
275.1571	501705.	0.00				
15.7500	-0.00286	201774.	-12269.	2.58E-05	0.00	7.50E+10
277.8124	524261.	0.00				
16.2000	-0.00268	139553.	-10767.	3.81E-05	0.00	7.50E+10
278.3012	560132.	0.00				
16.6500	-0.00245	85442.	-9268.	4.62E-05	0.00	7.50E+10
276.8715	610204.	0.00				
17.1000	-0.00218	39400.	-7782.	5.07E-05	0.00	7.50E+10
273.7044	676700.	0.00				
17.5500	-0.00190	1338.	-6317.	5.22E-05	0.00	7.50E+10
268.9428	763251.	0.00				
18.0000	-0.00162	-28882.	-4881.	5.12E-05	0.00	7.50E+10
262.7088	875216.	0.00				
18.4500	-0.00135	-51439.	-3485.	4.83E-05	0.00	7.50E+10
254.3522	1017231.	0.00				
18.9000	-0.00110	-66578.	-2146.	4.40E-05	0.00	7.50E+10
241.6019	1186488.	0.00				

LB10 2 ft_freehead.lp11o

19.3500	-8.75E-04	-74669.	-877.7009	3.89E-05	0.00	7.50E+10	
228.1521	1408286.	0.00					
19.8000	-6.79E-04	-76104.	316.4476	3.35E-05	0.00	7.50E+10	
214.1251	1702600.	0.00					
20.2500	-5.13E-04	-71291.	954.1543	2.82E-05	0.00	7.50E+10	
22.0626	232234.	0.00					
20.7000	-3.75E-04	-65832.	1058.	2.33E-05	0.00	7.50E+10	
16.4689	237395.	0.00					
21.1500	-2.62E-04	-59890.	1134.	1.87E-05	0.00	7.50E+10	
11.7608	242555.	0.00					
21.6000	-1.72E-04	-53603.	1188.	1.46E-05	0.00	7.50E+10	
7.9056	247716.	0.00					
22.0500	-1.04E-04	-47083.	1222.	1.10E-05	0.00	7.50E+10	
4.8555	252877.	0.00					
22.5000	-5.33E-05	-40419.	1242.	7.87E-06	0.00	7.50E+10	
2.5493	258038.	0.00					
22.9500	-1.87E-05	-33679.	1251.	5.20E-06	0.00	7.50E+10	
0.9129	263199.	0.00					
23.4000	2.79E-06	-26911.	1253.	3.02E-06	0.00	7.50E+10	
-0.1386	268359.	0.00					
23.8500	1.38E-05	-20146.	1251.	1.32E-06	0.00	7.50E+10	
-0.7012	273520.	0.00					
24.3000	1.71E-05	-13400.	1247.	1.14E-07	0.00	7.50E+10	
-0.8806	278681.	0.00					
24.7500	1.51E-05	-6680.	1242.	-6.09E-07	0.00	7.50E+10	
-0.7922	283842.	0.00					
25.2000	1.05E-05	17.7822	906.6228	-8.49E-07	0.00	7.50E+10	
-123.5475	6.36E+07	0.00					
25.6500	5.90E-06	3113.	335.6185	-7.37E-07	0.00	7.50E+10	
-87.9355	8.05E+07	0.00					
26.1000	2.53E-06	3643.	-24.7893	-4.93E-07	0.00	7.50E+10	
-45.5488	9.73E+07	0.00					
26.5500	5.71E-07	2846.	-180.3932	-2.60E-07	0.00	7.50E+10	
-12.0822	1.14E+08	0.00					
27.0000	-2.77E-07	1695.	-194.8427	-9.61E-08	0.00	7.50E+10	
6.7306	1.31E+08	0.00					
27.4500	-4.67E-07	741.4013	-142.1593	-8.37E-09	0.00	7.50E+10	
12.7818	1.48E+08	0.00					
27.9000	-3.68E-07	160.0888	-77.3591	2.41E-08	0.00	7.50E+10	
11.2183	1.65E+08	0.00					
28.3500	-2.06E-07	-94.1053	-28.3221	2.65E-08	0.00	7.50E+10	
6.9435	1.82E+08	0.00					
28.8000	-8.18E-08	-145.8218	-1.4543	1.78E-08	0.00	7.50E+10	
3.0075	1.98E+08	0.00					
29.2500	-1.39E-08	-109.8332	8.1633	8.63E-09	0.00	7.50E+10	
0.5546	2.15E+08	0.00					
29.7000	1.13E-08	-57.6683	8.3484	2.59E-09	0.00	7.50E+10	
-0.4860	2.32E+08	0.00					

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30.1500	1.41E-08	-19.6739	5.2812	-1.92E-10	0.00	7.50E+10	
-0.6500	2.49E+08	0.00					
30.6000	9.24E-09	-0.6315	2.2987	-9.23E-10	0.00	7.50E+10	
-0.4546	2.66E+08	0.00					
31.0500	4.13E-09	5.1536	0.4915	-7.60E-10	0.00	7.50E+10	
-0.2147	2.81E+08	0.00					
31.5000	1.03E-09	4.6780	-0.2322	-4.06E-10	0.00	7.50E+10	
-0.05336	2.81E+08	0.00					
31.9500	-2.57E-10	2.6463	-0.3401	-1.42E-10	0.00	7.50E+10	
0.01338	2.81E+08	0.00					
32.4000	-5.11E-10	1.0046	-0.2322	-1.09E-11	0.00	7.50E+10	
0.02659	2.81E+08	0.00					
32.8500	-3.75E-10	0.1381	-0.1078	3.03E-11	0.00	7.50E+10	
0.01949	2.81E+08	0.00					
33.3000	-1.85E-10	-0.1600	-0.02930	2.95E-11	0.00	7.50E+10	
0.00959	2.81E+08	0.00					
33.7500	-5.65E-11	-0.1783	0.00453	1.73E-11	0.00	7.50E+10	
0.00294	2.81E+08	0.00					
34.2000	2.23E-12	-0.1111	0.01214	6.87E-12	0.00	7.50E+10	
-1.16E-04	2.81E+08	0.00					
34.6500	1.77E-11	-0.04720	0.00934	1.17E-12	0.00	7.50E+10	
-9.22E-04	2.81E+08	0.00					
35.1000	1.49E-11	-0.01020	0.00477	0.00	0.00	7.50E+10	
-7.73E-04	2.81E+08	0.00					
35.5500	8.03E-12	0.00428	0.00155	-1.11E-12	0.00	7.50E+10	
-4.17E-04	2.81E+08	0.00					
36.0000	2.86E-12	0.00659	2.55E-05	0.00	0.00	7.50E+10	
-1.49E-04	2.81E+08	0.00					
36.4500	0.00	0.00456	-4.12E-04	0.00	0.00	7.50E+10	
-1.33E-05	2.81E+08	0.00					
36.9000	0.00	0.00214	-3.67E-04	0.00	0.00	7.50E+10	
2.99E-05	2.81E+08	0.00					
37.3500	0.00	5.97E-04	-2.05E-04	0.00	0.00	7.50E+10	
2.99E-05	2.81E+08	0.00					
37.8000	0.00	-7.70E-05	-7.69E-05	0.00	0.00	7.50E+10	
1.77E-05	2.81E+08	0.00					
38.2500	0.00	-2.34E-04	-9.80E-06	0.00	0.00	7.50E+10	
7.14E-06	2.81E+08	0.00					
38.7000	0.00	-1.83E-04	1.29E-05	0.00	0.00	7.50E+10	
1.28E-06	2.81E+08	0.00					
39.1500	0.00	-9.44E-05	1.40E-05	0.00	0.00	7.50E+10	
-8.74E-07	2.81E+08	0.00					
39.6000	0.00	-3.13E-05	8.64E-06	0.00	0.00	7.50E+10	
-1.12E-06	2.81E+08	0.00					
40.0500	0.00	-1.00E-06	3.63E-06	0.00	0.00	7.50E+10	
-7.35E-07	2.81E+08	0.00					
40.5000	0.00	7.88E-06	7.56E-07	0.00	0.00	7.50E+10	
-3.29E-07	2.81E+08	0.00					

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40.9500	0.00	7.16E-06	-3.54E-07	0.00	0.00	7.50E+10
-8.20E-08	2.81E+08	0.00				
41.4000	0.00	4.05E-06	-5.20E-07	0.00	0.00	7.50E+10
2.03E-08	2.81E+08	0.00				
41.8500	0.00	1.54E-06	-3.56E-07	0.00	0.00	7.50E+10
4.07E-08	2.81E+08	0.00				
42.3000	0.00	2.13E-07	-1.65E-07	0.00	0.00	7.50E+10
2.98E-08	2.81E+08	0.00				
42.7500	0.00	-2.44E-07	-4.49E-08	0.00	0.00	7.50E+10
1.47E-08	2.81E+08	0.00				
43.2000	0.00	-2.72E-07	7.04E-09	0.00	0.00	7.50E+10
4.52E-09	2.81E+08	0.00				
43.6500	0.00	-1.68E-07	1.87E-08	0.00	0.00	7.50E+10
-1.85E-10	2.81E+08	0.00				
44.1000	0.00	-6.95E-08	1.42E-08	0.00	0.00	7.50E+10
-1.49E-09	2.81E+08	0.00				
44.5500	0.00	-1.45E-08	6.44E-09	0.00	0.00	7.50E+10
-1.39E-09	2.81E+08	0.00				
45.0000	0.00	0.00	0.00	0.00	0.00	7.50E+10
-9.95E-10	1.40E+08	0.00				

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 2:

Pile-head deflection	=	0.50000000	inches
Computed slope at pile head	=	-0.00563234	radians
Maximum bending moment	=	1652403.	inch-lbs
Maximum shear force	=	36639.	lbs
Depth of maximum bending moment	=	7.20000000	feet below pile head
Depth of maximum shear force	=	0.000000	feet below pile head
Number of iterations	=	22	
Number of zero deflection points	=	10	

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

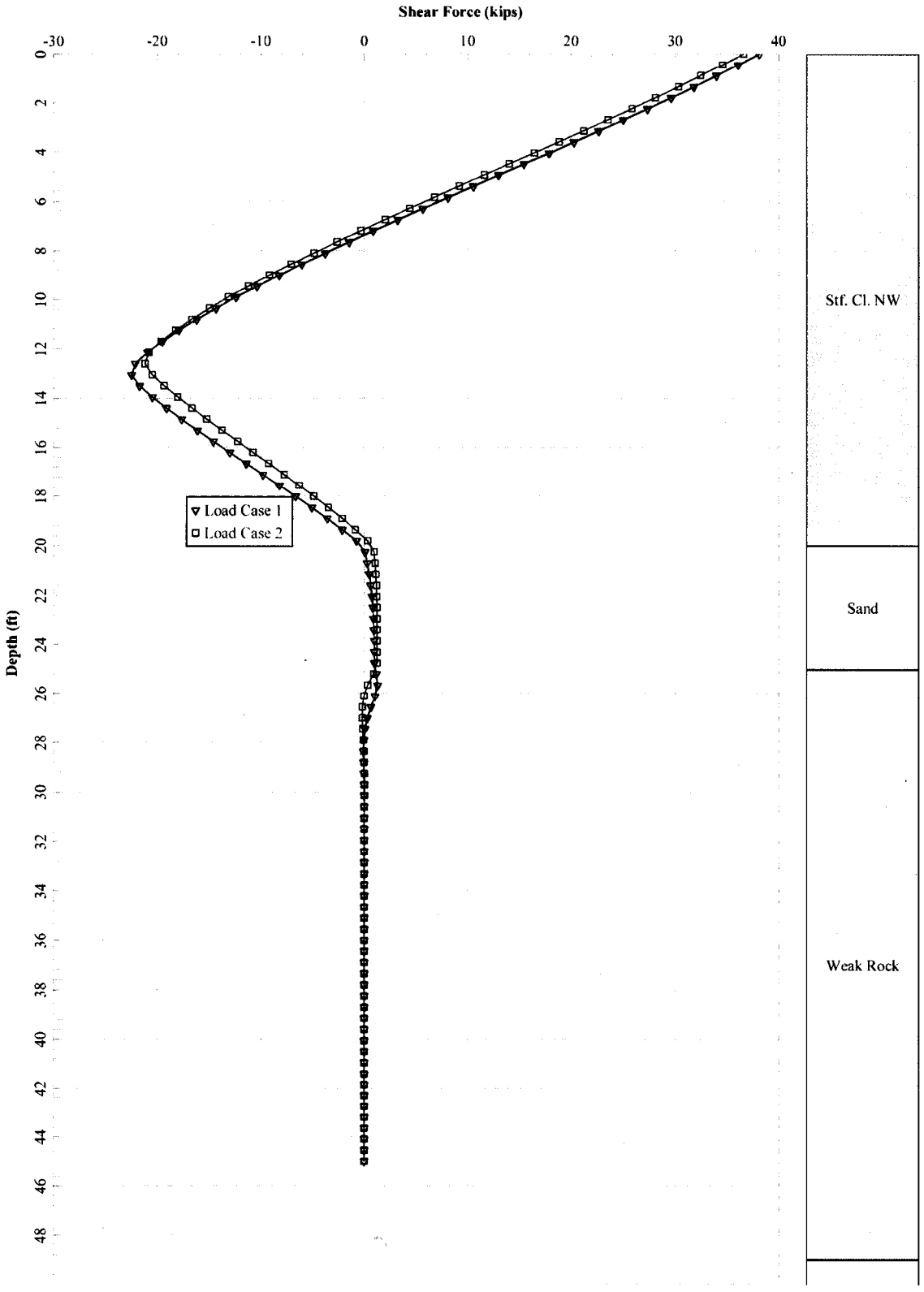
Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs

LB10 2 ft_freehead.lp11o
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

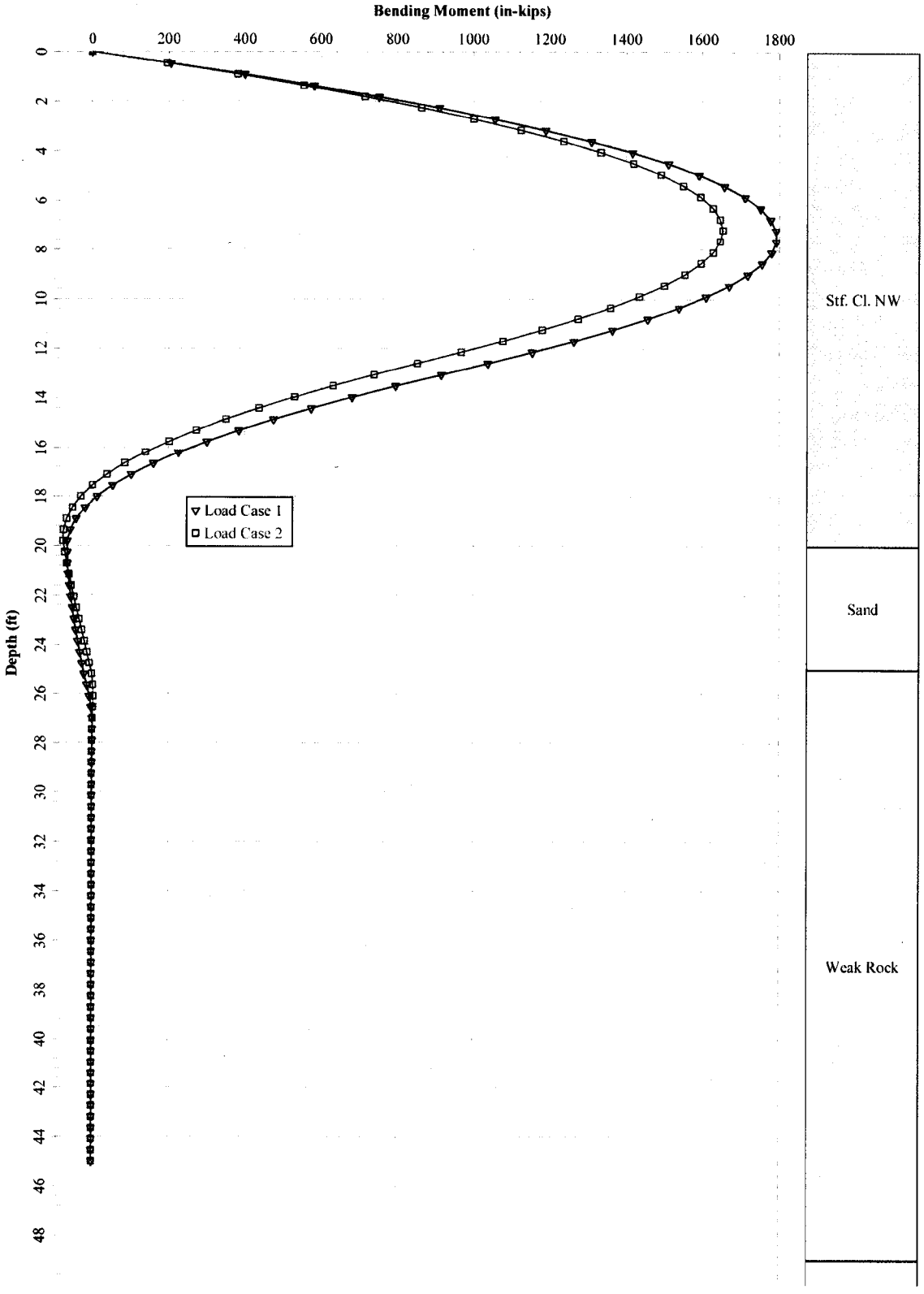
Load Case No.	Load Type 1	Pile-head Load 1	Load Type 2	Pile-head Load 2	Axial Loading lbs	Pile-head Deflection inches	Pile-head Rotation radians	Max Shear in Pile lbs	Max Moment in Pile in-lbs
1	y, in	0.5000	M, in-lb	0.00	155000.	0.5000	-0.00545	38141.	1792354.
2	y, in	0.5000	M, in-lb	0.00	110000.	0.5000	-0.00563	36639.	1652403.

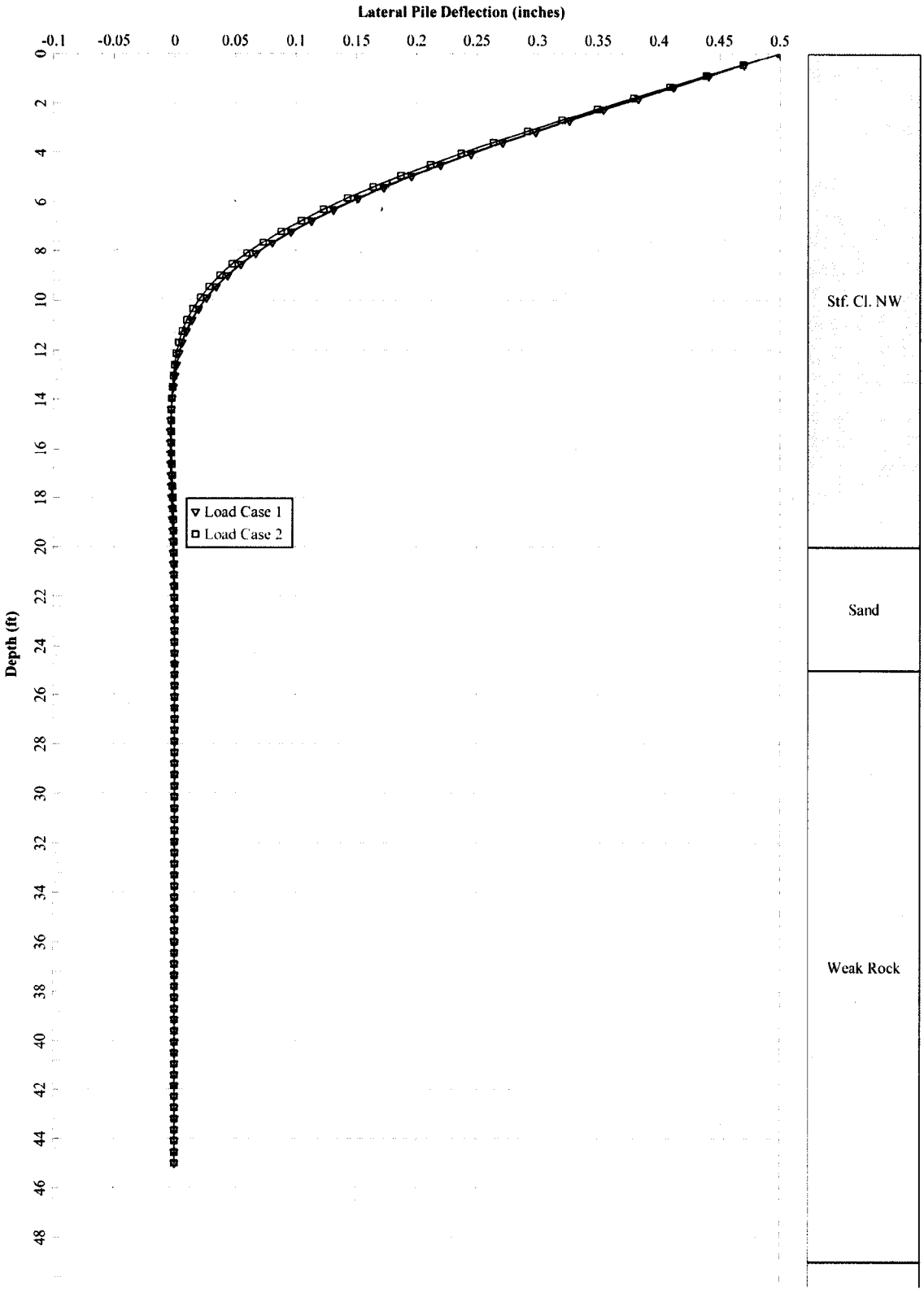
Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation = -0.0056323438 radians = -0.322710 deg.

The analysis ended normally.



DRILLED SHAFT STIFFNESS 38 KIPS / 0.5 IN = 76 KIPS/IN


Bending Moment (in-kips)
0
200
400
600
800
1000
1200
1400
1600
1800
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Load Case 2
Stf. Cl. NW
Sand
Weak Rock


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Load Case 2
Stf. Cl. NW
Sand
Weak Rock

ABUTMENT #2 FIXED HEAD

LB10 2 ft_fixedhead.lp11o

LPile for Windows, Version 2019-11.004

Analysis of Individual Piles and Drilled Shafts
Subjected to Lateral Loading Using the p-y Method

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Files Used for Analysis

Path to file locations:
\SLC_Civil\096360005 - WPR_Project Files\Eng\Structural\Phase 0A\WBWCD Gateway Canal Crossing\Foundation Design\

Name of input data file:
LB10 2 ft_fixedhead.lp11d

Name of output report file:
LB10 2 ft_fixedhead.lp11o

Name of plot output file:
LB10 2 ft_fixedhead.lp11p

Name of runtime message file:
LB10 2 ft_fixedhead.lp11r

LB10 2 ft_fixedhead.lp11o
Date and Time of Analysis

Date: August 28, 2020 Time: 15:00:12

Problem Title

Project Name:

Job Number:

Client:

Engineer:

Description:

Program Options and Settings

Computational Options:
- Conventional Analysis

Engineering Units Used for Data Input and Computations:
- US Customary System Units (pounds, feet, inches)

Analysis Control Options:

- Maximum number of iterations allowed	=	500
- Deflection tolerance for convergence	=	1.0000E-05 in
- Maximum allowable deflection	=	100.0000 in
- Number of pile increments	=	100

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Loading Type and Number of Cycles of Loading:
- Static loading specified

- Analysis uses p-y modification factors for p-y curves
- Analysis uses layering correction (Method of Georgiadis)
- No distributed lateral loads are entered
- Loading by lateral soil movements acting on pile not selected
- Input of shear resistance at the pile tip not selected
- Input of moment resistance at the pile tip not selected
- Input of side resistance moment along pile not selected
- Computation of pile-head foundation stiffness matrix not selected
- Push-over analysis of pile not selected
- Buckling analysis of pile not selected

Output Options:
- Output files use decimal points to denote decimal symbols.
- Values of pile-head deflection, bending moment, shear force, and soil reaction are printed for full length of pile.
- Printing Increment (nodal spacing of output points) = 1
- No p-y curves to be computed and reported for user-specified depths
- Print using wide report formats

Pile Structural Properties and Geometry

Number of pile sections defined	=	1
Total length of pile	=	45.000 ft
Depth of ground surface below top of pile	=	0.0000 ft

Pile diameters used for p-y curve computations are defined using 2 points.

p-y curves are computed using pile diameter values interpolated with depth over the length of the pile. A summary of values of pile diameter vs. depth follows.

Point No.	Depth Below Pile Head feet	Pile Diameter inches
1	0.000	24.0000
2	45.000	24.0000

Input Structural Properties for Pile Sections:

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Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile

Length of section	=	45.000000 ft
Shaft Diameter	=	24.000000 in
Shear capacity of section	=	0.0000 lbs

Ground Slope and Pile Batter Angles

Ground Slope Angle	=	0.000 degrees
	=	0.000 radians
Pile Batter Angle	=	0.000 degrees
	=	0.000 radians

Soil and Rock Layering Information

The soil profile is modelled using 3 layers

Layer 1 is stiff clay without free water

Distance from top of pile to top of layer	=	0.0000 ft
Distance from top of pile to bottom of layer	=	20.000000 ft
Effective unit weight at top of layer	=	115.000000 pcf
Effective unit weight at bottom of layer	=	115.000000 pcf
Undrained cohesion at top of layer	=	1500. psf
Undrained cohesion at bottom of layer	=	1500. psf
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000

NOTE: Default values for Epsilon-50 will be computed for this layer.

Layer 2 is sand, p-y criteria by Reese et al., 1974

Distance from top of pile to top of layer	=	20.000000 ft
Distance from top of pile to bottom of layer	=	25.000000 ft
Effective unit weight at top of layer	=	125.000000 pcf
Effective unit weight at bottom of layer	=	125.000000 pcf

Friction angle at top of layer	=	37.000000 deg.
Friction angle at bottom of layer	=	37.000000 deg.
Subgrade k at top of layer	=	0.0000 pci
Subgrade k at bottom of layer	=	0.0000 pci

NOTE: Default values for subgrade k will be computed for this layer.

Layer 3 is weak rock, p-y criteria by Reese, 1997

Distance from top of pile to top of layer	=	25.000000 ft
Distance from top of pile to bottom of layer	=	60.000000 ft
Effective unit weight at top of layer	=	140.000000 pcf
Effective unit weight at bottom of layer	=	140.000000 pcf
Uniaxial compressive strength at top of layer	=	500.000000 psi
Uniaxial compressive strength at bottom of layer	=	500.000000 psi
Initial modulus of rock at top of layer	=	104000. psi
Initial modulus of rock at bottom of layer	=	104000. psi
RQD of rock at top of layer	=	80.000000 %
RQD of rock at bottom of layer	=	80.000000 %
k rm of rock at top of layer	=	0.0005000
k rm of rock at bottom of layer	=	0.0005000

(Depth of the lowest soil layer extends 15.000 ft below the pile tip)

Summary of Input Soil Properties

Layer Num.	Soil Type Name (p-y Curve Type)	Layer Depth or ft	Effective Unit Wt. kpy pcf	Undrained Cohesion Rock Mass Modulus psf	Angle of Friction deg.
		E50 krm			
		qu psi	RQD %		
1	Stiff Clay	0.00	115.0000	1500.	--
--	--	default	--	--	
	w/o Free Water	20.0000	115.0000	1500.	--
--	--	default	--	--	
2	Sand	20.0000	125.0000	--	37.0000
--	--	--	default	--	
	(Reese, et al.)	25.0000	125.0000	--	37.0000
--	--	--	default	--	
3	Weak	25.0000	140.0000	--	--

LB10 2 ft_fixedhead.lp11o

500.0000	80.0000	5.00E-04	--	104000.			
	Rock		60.0000	140.0000	--	--	
500.0000	80.0000	5.00E-04	--	104000.			

---

p-y Modification Factors for Group Action

Distribution of p-y modifiers with depth defined using 2 points

Point No.	Depth X ft	p-mult	y-mult
1	0.000	0.6000	1.0000
2	25.000	0.6000	1.0000

Static Loading Type

Static loading criteria were used when computing p-y curves for all analyses.

Pile-head Loading and Pile-head Fixity Conditions

Number of loads specified = 1

Load Compute No.	Load Top y Type	Condition Run Analysis 1	Condition 2	Axial Thrust Force, lbs vs. Pile Length
1	5	y = 0.500000 in	S = 0.0000 in/in	110000.
N.A.		Yes		

V = shear force applied normal to pile axis
M = bending moment applied to pile head
y = lateral deflection normal to pile axis
S = pile slope relative to original pile batter angle
R = rotational stiffness applied to pile head

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Values of top y vs. pile lengths can be computed only for load types with specified shear loading (Load Types 1, 2, and 3).
Thrust force is assumed to be acting axially for all pile batter angles.

Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness

---

Axial thrust force values were determined from pile-head loading conditions

Number of Pile Sections Analyzed = 1

Pile Section No. 1:

Dimensions and Properties of Drilled Shaft (Bored Pile):

Length of Section	=	45.000000	ft
Shaft Diameter	=	24.000000	in
Concrete Cover Thickness (to edge of long. rebar)	=	3.000000	in
Number of Reinforcing Bars	=	11	bars
Yield Stress of Reinforcing Bars	=	60000.	psi
Modulus of Elasticity of Reinforcing Bars	=	29000000.	psi
Gross Area of Shaft	=	452.389342	sq. in.
Total Area of Reinforcing Steel	=	8.690000	sq. in.
Area Ratio of Steel Reinforcement	=	1.92	percent
Edge-to-Edge Bar Spacing	=	3.789453	in
Maximum Concrete Aggregate Size	=	0.750000	in
Ratio of Bar Spacing to Aggregate Size	=	5.05	
Offset of Center of Rebar Cage from Center of Pile	=	0.0000	in

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	2029.978	kips
Tensile Load for Cracking of Concrete	=	-213.613	kips
Nominal Axial Tensile Capacity	=	-521.400	kips

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. inches	Bar Area sq. in.	X inches	Y inches
1	1.000000	0.790000	8.500000	0.00000

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2	1.000000	0.790000	7.150655	4.595447
3	1.000000	0.790000	3.531028	7.731872
4	1.000000	0.790000	-1.209676	8.413482
5	1.000000	0.790000	-5.566316	6.423871
6	1.000000	0.790000	-8.155690	2.394727
7	1.000000	0.790000	-8.155690	-2.394727
8	1.000000	0.790000	-5.566316	-6.423871
9	1.000000	0.790000	-1.209676	-8.413482
10	1.000000	0.790000	3.531028	-7.731872
11	1.000000	0.790000	7.150655	-4.595447

NOTE: The positions of the above rebars were computed by LPile

Minimum spacing between any two bars not equal to zero = 3.789 inches
between bars 8 and 9.

Ratio of bar spacing to maximum aggregate size = 5.05

Concrete Properties:

Compressive Strength of Concrete	=	4000. psi
Modulus of Elasticity of Concrete	=	3604997. psi
Modulus of Rupture of Concrete	=	-474.341649 psi
Compression Strain at Peak Stress	=	0.001886
Tensile Strain at Fracture of Concrete	=	-0.0001154
Maximum Coarse Aggregate Size	=	0.750000 in

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kips
1	110.000

Definitions of Run Messages and Notes:

C = concrete in section has cracked in tension.
Y = stress in reinforcing steel has reached yield stress.
T = ACI 318 criteria for tension-controlled section met, tensile strain in reinforcement exceeds 0.005 while simultaneously compressive strain in concrete more than 0.003. See ACI 318, Section 10.3.4.
Z = depth of tensile zone in concrete section is less than 10 percent of

section depth.

Bending Stiffness (EI) = Computed Bending Moment / Curvature.
Position of neutral axis is measured from edge of compression side of pile.
Compressive stresses and strains are positive in sign.
Tensile stresses and strains are negative in sign.

Axial Thrust Force = 110.000 kips

Bending Max Conc Curvature Stress rad/in. ksi	Bending Max Steel Moment Stress in-kip ksi	Run Msg	Bending Stiffness kip-in2	Depth to N Axis in	Max Comp Strain in/in	Max Tens Strain in/in
0.00000125	93.7233430		74978674.	53.7609547	0.00006720	0.00003720
0.2793213	1.8400846					
0.00000250	187.4594638		74983786.	32.8967277	0.00008224	0.00002224
0.3399808	2.1675128					
0.00000375	281.1882926		74983545.	25.9491745	0.00009731	0.00000731
0.4002503	2.4957227					
0.00000500	374.9020733		74980415.	22.4807555	0.0001124	-0.00000760
0.4601262	2.8247096					
0.00000625	468.4886584		74958185.	20.4032063	0.0001275	-0.00002248
0.5195866	3.1543312					
0.00000750	561.7827016		74904360.	19.0199912	0.0001426	-0.00003735
0.5785969	3.4843480					
0.00000875	654.7037731		74823288.	18.0329829	0.0001578	-0.00005221
0.6371367	3.8146193					
0.00001000	747.2139602		74721396.	17.2933311	0.0001729	-0.00006707
0.6951947	4.1450661					
0.00001125	839.2937919		74603893.	16.7184395	0.0001881	-0.00008192
0.7527640	4.4756409					
0.00001250	930.9327494		74474620.	16.2588007	0.0002032	-0.00009676
0.8098405	4.8063153					
0.00001375	930.9327494		67704200.	14.6096808	0.0002009	-0.0001291
0.8003573	4.6293602	C				
0.00001500	930.9327494		62062183.	14.1395444	0.0002121	-0.0001479
0.8421729	4.8457019	C				
0.00001625	930.9327494		57288169.	13.7297387	0.0002231	-0.0001669
0.8829835	5.0563894	C				
0.00001750	930.9327494		53196157.	13.3685834	0.0002340	-0.0001860
0.9228847	5.2620561	C				
0.00001875	930.9327494		49649747.	13.0475166	0.0002446	-0.0002054
0.9619700	5.4633372	C				

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0.00002000	930.9327494	46546637.	12.7596199	0.0002552	-0.0002248
1.0002939	5.6605796 C				
0.00002125	930.9327494	43808600.	12.5002913	0.0002656	-0.0002444
1.0379634	5.8545543 C				
0.00002250	956.3429238	42504130.	12.2653226	0.0002760	-0.0002640
1.0750314	6.0456230 C				
0.00002375	985.0653077	41476434.	12.0514698	0.0002862	-0.0002838
1.1115563	6.2341999 C				
0.00002500	1013.	40535765.	11.8561237	0.0002964	-0.0003036
1.1475941	-6.6293103 C				
0.00002625	1041.	39669473.	11.6764021	0.0003065	-0.0003235
1.1831272	-7.0975889 C				
0.00002750	1069.	38869695.	11.5105223	0.0003165	-0.0003435
1.2181947	-7.5678588 C				
0.00002875	1096.	38131880.	11.3576496	0.0003265	-0.0003635
1.2528995	-8.0393095 C				
0.00003000	1123.	37445849.	11.2154327	0.0003365	-0.0003835
1.2871681	-8.5125734 C				
0.00003125	1150.	36807580.	11.0830555	0.0003463	-0.0004037
1.3210548	-8.9872309 C				
0.00003250	1177.	36213276.	10.9598789	0.0003562	-0.0004238
1.3546184	-9.4628140 C				
0.00003375	1203.	35656405.	10.8442530	0.0003660	-0.0004440
1.3877884	-9.9399373 C				
0.00003500	1230.	35135572.	10.7361965	0.0003758	-0.0004642
1.4206670	-10.4177604 C				
0.00003625	1256.	34646610.	10.6346947	0.0003855	-0.0004845
1.4532272	-10.8965272 C				
0.00003750	1282.	34185663.	10.5388499	0.0003952	-0.0005048
1.4854407	-11.3765006 C				
0.00003875	1308.	33753624.	10.4493720	0.0004049	-0.0005251
1.5174729	-11.8562681 C				
0.00004000	1334.	33342853.	10.3637726	0.0004146	-0.0005454
1.5490722	-12.3380237 C				
0.00004125	1359.	32955632.	10.2833074	0.0004242	-0.0005658
1.5804617	-12.8198434 C				
0.00004250	1385.	32590447.	10.2077410	0.0004338	-0.0005862
1.6116721	-13.3014591 C				
0.00004375	1411.	32241518.	10.1350016	0.0004434	-0.0006066
1.6424674	-13.7849666 C				
0.00004500	1436.	31910841.	10.0662678	0.0004530	-0.0006270
1.6730577	-14.2685206 C				
0.00004625	1461.	31597370.	10.0014003	0.0004626	-0.0006474
1.7034707	-14.7518717 C				
0.00004750	1487.	31298654.	9.9395769	0.0004721	-0.0006679
1.7336276	-15.2357327 C				
0.00004875	1512.	31012479.	9.8800472	0.0004817	-0.0006883
1.7634495	-15.7208332 C				

0.00005125	1562.	30480231.	9.7701075	0.0005007	-0.0007293
1.8225664	-16.6904276 C				
0.00005375	1612.	29992815.	9.6696206	0.0005197	-0.0007703
1.8807631	-17.6612287 C				
0.00005625	1662.	29544349.	9.5773626	0.0005387	-0.0008113
1.9380509	-18.6331774 C				
0.00005875	1712.	29132002.	9.4934355	0.0005577	-0.0008523
1.9946384	-19.6043091 C				
0.00006125	1761.	28748570.	9.4151047	0.0005767	-0.0008933
2.0502110	-20.5776701 C				
0.00006375	1810.	28392802.	9.3430278	0.0005956	-0.0009344
2.1050232	-21.5508275 C				
0.00006625	1859.	28062076.	9.2768223	0.0006146	-0.0009754
2.1591362	-22.5231554 C				
0.00006875	1908.	27752713.	9.2151653	0.0006335	-0.0010165
2.2124135	-23.4960141 C				
0.00007125	1957.	27462059.	9.1572736	0.0006525	-0.0010575
2.2647966	-24.4700332 C				
0.00007375	2005.	27189493.	9.1037031	0.0006714	-0.0010986
2.3164812	-25.4432051 C				
0.00007625	2054.	26933225.	9.0540314	0.0006904	-0.0011396
2.3674642	-26.4155234 C				
0.00007875	2102.	26691692.	9.0078900	0.0007094	-0.0011806
2.4177423	-27.3869819 C				
0.00008125	2150.	26462343.	8.9638941	0.0007283	-0.0012217
2.4670859	-28.3600764 C				
0.00008375	2198.	26245008.	8.9226623	0.0007473	-0.0012627
2.5156779	-29.3328337 C				
0.00008625	2246.	26038870.	8.8841744	0.0007663	-0.0013037
2.5635647	-30.3047086 C				
0.00008875	2294.	25842975.	8.8482013	0.0007853	-0.0013447
2.6107431	-31.2756920 C				
0.00009125	2341.	25656471.	8.8145389	0.0008043	-0.0013857
2.6572099	-32.2457770 C				
0.00009375	2389.	25478598.	8.7830049	0.0008234	-0.0014266
2.7029617	-33.2149563 C				
0.00009625	2436.	25308498.	8.7532290	0.0008425	-0.0014675
2.7479479	-34.1838012 C				
0.00009875	2483.	25145175.	8.7245990	0.0008616	-0.0015084
2.7920571	-35.1536794 C				
0.0001013	2530.	24988694.	8.6977027	0.0008806	-0.0015494
2.8354493	-36.1226202 C				
0.0001038	2577.	24838552.	8.6724175	0.0008998	-0.0015902
2.8781212	-37.0906137 C				
0.0001063	2624.	24694294.	8.6486322	0.0009189	-0.0016311
2.9200692	-38.0576519 C				
0.0001088	2670.	24555504.	8.6262460	0.0009381	-0.0016719
2.9612897	-39.0237267 C				

LB10 2 ft_fixedhead.lp11o

0.0001113	2717.	24421805.	8.6051672	0.0009573	-0.0017127
3.0017792	-39.9888296 C				
0.0001138	2763.	24292853.	8.5853121	0.0009766	-0.0017534
3.0415340	-40.9529521 C				
0.0001163	2810.	24168333.	8.5666044	0.0009959	-0.0017941
3.0805503	-41.9160856 C				
0.0001188	2856.	24047956.	8.5489742	0.0010152	-0.0018348
3.1188244	-42.8782212 C				
0.0001213	2902.	23931457.	8.5323574	0.0010345	-0.0018755
3.1563525	-43.8393501 C				
0.0001238	2948.	23818534.	8.5165843	0.0010539	-0.0019161
3.1931047	-44.7998576 C				
0.0001263	2993.	23708817.	8.5013259	0.0010733	-0.0019567
3.2290126	-45.7607702 C				
0.0001288	3039.	23602328.	8.4869429	0.0010927	-0.0019973
3.2641693	-46.7206267 C				
0.0001313	3084.	23498873.	8.4733879	0.0011121	-0.0020379
3.2985711	-47.6794170 C				
0.0001338	3130.	23398275.	8.4606171	0.0011316	-0.0020784
3.3322135	-48.6371309 C				
0.0001363	3175.	23300368.	8.4485902	0.0011511	-0.0021189
3.3650926	-49.5937577 C				
0.0001388	3220.	23204997.	8.4372694	0.0011707	-0.0021593
3.3972041	-50.5492867 C				
0.0001413	3265.	23112020.	8.4266201	0.0011903	-0.0021997
3.4285435	-51.5037071 C				
0.0001438	3309.	23021304.	8.4166097	0.0012099	-0.0022401
3.4591067	-52.4570078 C				
0.0001463	3354.	22932723.	8.4072083	0.0012296	-0.0022804
3.4888890	-53.4091775 C				
0.0001488	3398.	22846162.	8.3983878	0.0012493	-0.0023207
3.5178860	-54.3602046 C				
0.0001588	3575.	22518046.	8.3684174	0.0013285	-0.0024815
3.6259285	-58.1526495 C				
0.0001688	3747.	22203717.	8.3446277	0.0014082	-0.0026418
3.7207798	-60.0000000 CY				
0.0001788	3891.	21766156.	8.3092906	0.0014853	-0.0028047
3.7993810	-60.0000000 CY				
0.0001888	3999.	21189081.	8.2571474	0.0015585	-0.0029715
3.8619803	-60.0000000 CY				
0.0001988	4095.	20601531.	8.2034351	0.0016304	-0.0031396
3.9120573	-60.0000000 CY				
0.0002088	4171.	19982466.	8.1447586	0.0017002	-0.0033098
3.9498999	-60.0000000 CY				
0.0002188	4236.	19364929.	8.0857118	0.0017687	-0.0034813
3.9767621	-60.0000000 CY				
0.0002288	4299.	18793918.	8.0334635	0.0018377	-0.0036523
3.9934952	-60.0000000 CY				

LB10 2 ft_fixedhead.lp11o

0.0002388	4356.	18246213.	7.9822696	0.0019058	-0.0038242
3.9999058	-60.0000000 CY				
0.0002488	4401.	17692640.	7.9279771	0.0019721	-0.0039979
3.9999843	-60.0000000 CY				
0.0002588	4438.	17152987.	7.8745719	0.0020375	-0.0041725
3.9999822	-60.0000000 CY				
0.0002688	4474.	16648023.	7.8267460	0.0021034	-0.0043466
3.9999172	-60.0000000 CY				
0.0002788	4509.	16175257.	7.7833743	0.0021696	-0.0045204
3.9996476	-60.0000000 CY				
0.0002888	4542.	15731325.	7.7434631	0.0022359	-0.0046941
3.9988848	-60.0000000 CY				
0.0002988	4574.	15309426.	7.7064084	0.0023023	-0.0048677
3.9971859	-60.0000000 CY				
0.0003088	4600.	14899449.	7.6691943	0.0023679	-0.0050421
4.0000000	-60.0000000 CY				
0.0003188	4622.	14499160.	7.6313233	0.0024325	-0.0052175
3.9991475	-60.0000000 CY				
0.0003288	4639.	14111797.	7.5935280	0.0024964	-0.0053936
3.9958785	-60.0000000 CY				
0.0003388	4655.	13742944.	7.5578821	0.0025602	-0.0055698
3.9996717	-60.0000000 CY				
0.0003488	4671.	13393086.	7.5233391	0.0026238	-0.0057462
3.9962628	-60.0000000 CY				
0.0003588	4686.	13061755.	7.4915861	0.0026876	-0.0059224
3.9996897	-60.0000000 CY				
0.0003688	4701.	12747375.	7.4624629	0.0027518	-0.0060982
3.9954329	-60.0000000 CY				
0.0003788	4715.	12448773.	7.4356448	0.0028163	-0.0062737
3.9993268	-60.0000000 CY				
0.0003888	4729.	12164755.	7.4109509	0.0028810	-0.0064490
3.9952701	-60.0000000 CY				
0.0003988	4743.	11894173.	7.3882420	0.0029461	-0.0066239
3.9981323	-60.0000000 CY				
0.0004088	4756.	11636229.	7.3671295	0.0030113	-0.0067987
3.9999891	-60.0000000 CYT				
0.0004188	4769.	11387838.	7.3467851	0.0030765	-0.0069735
3.9950948	-60.0000000 CYT				
0.0004288	4780.	11148842.	7.3269069	0.0031414	-0.0071486
3.9989120	-60.0000000 CYT				
0.0004388	4790.	10916382.	7.3052962	0.0032052	-0.0073248
3.9991604	-60.0000000 CYT				
0.0004488	4798.	10692409.	7.2840921	0.0032687	-0.0075013
3.9942552	-60.0000000 CYT				
0.0004588	4805.	10473982.	7.2615912	0.0033313	-0.0076787
3.9980763	-60.0000000 CYT				
0.0004688	4811.	10264161.	7.2400191	0.0033938	-0.0078562
3.9998574	-60.0000000 CYT				

0.0004788	4816.	10060314.	7.2181215	0.0034557	-0.0080343
3.9942767	-60.0000000 CYT				
0.0004888	4821.	9864271.	7.1972311	0.0035176	-0.0082124
3.9945738	-60.0000000 CYT				
0.0004988	4826.	9675905.	7.1774047	0.0035797	-0.0083903
3.9979989	60.0000000 CYT				
0.0005088	4830.	9494781.	7.1586066	0.0036419	-0.0085681
3.9997544	60.0000000 CYT				
0.0005188	4835.	9320443.	7.1408700	0.0037043	-0.0087457
3.9959852	60.0000000 CYT				
0.0005288	4839.	9152514.	7.1241228	0.0037669	-0.0089231
3.9916192	60.0000000 CYT				
0.0005388	4844.	8990317.	7.1087090	0.0038298	-0.0091002
3.9958709	60.0000000 CYT				

Summary of Results for Nominal Moment Capacity for Section 1

Moment values interpolated at maximum compressive strain = 0.003
or maximum developed moment if pile fails at smaller strains.

Load No.	Axial Thrust kips	Nominal Mom. Cap. in-kip	Max. Comp. Strain
1	110.000	4753.967	0.00300000

Note that the values of moment capacity in the table above are not
factored by a strength reduction factor (phi-factor).

In ACI 318, the value of the strength reduction factor depends on whether
the transverse reinforcing steel bars are tied hoops (0.65) or spirals (0.70).

The above values should be multiplied by the appropriate strength reduction
factor to compute ultimate moment capacity according to ACI 318, Section
9.3.2.2 or the value required by the design standard being followed.

The following table presents factored moment capacities and corresponding
bending stiffnesses computed for common resistance factor values used for
reinforced concrete sections.

Axial Load No.	Resist. Factor for Moment	Nominal Moment Cap in-kips	Ult. (Fac) Ax. Thrust kips	Ult. (Fac) Moment Cap in-kips	Bend. Stiff. at Ult Mom kip-in^2
1	0.65	4754.	71.500000	3090.	23485877.

1	0.75	4754.	77.000000	3565.	22535282.
1	0.90	4754.	82.500000	4279.	18979984.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head ft	Equivalent Top Depth Below Grnd Surf ft	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer lbs	F1 Integral for Layer lbs
1	0.00	0.00	N.A.	No	0.00	374692.
2	20.0000	13.2858	No	No	374692.	515951.
3	25.0000	25.0000	No	Yes	N.A.	N.A.

Notes: The F0 integral of Layer n+1 equals the sum of the F0 and F1 integrals for Layer n. Layering correction equivalent depths are computed only for soil types with both shallow-depth and deep-depth expressions for peak lateral load transfer. These soil types are soft and stiff clays, non-liquefied sands, and cemented c-phi soil.

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 1

Pile-head conditions are Displacement and Pile-head Rotation (Loading Type 5)
Displacement of pile head = 0.500000 inches
Rotation of pile head = 0.000E+00 radians
Axial load on pile head = 110000.0 lbs

Depth X	Deflect. y	Bending Moment	Shear Force	Slope S	Total Stress	Bending Stiffness	Soil Res. Spr. Distrib. p
							Es*h Lat. Load
feet	inches	in-lbs	lbs	radians	psi*	lb-in^2	lb/inch lb/inch lb/inch
0.00	0.5000	-3066037.	51767.	0.00	0.00	2.35E+10	

LB10 2 ft_fixedhead.lp11o

-235.0243	1269.	0.00				
0.4500	0.4981	-2789898.	50433.	-6.72E-04	0.00	2.35E+10
-246.3060	2670.	0.00				
0.9000	0.4927	-2520561.	49074.	-0.00126	0.00	2.50E+10
-257.1156	2818.	0.00				
1.3500	0.4845	-2258399.	47658.	-0.00177	0.00	2.60E+10
-267.4526	2981.	0.00				
1.8000	0.4736	-2003756.	46187.	-0.00220	0.00	2.72E+10
-277.3069	3162.	0.00				
2.2500	0.4607	-1756964.	44664.	-0.00257	0.00	2.88E+10
-286.6706	3361.	0.00				
2.7000	0.4459	-1518335.	43092.	-0.00287	0.00	3.09E+10
-295.5381	3579.	0.00				
3.1500	0.4297	-1288167.	41473.	-0.00310	0.00	3.41E+10
-303.9071	3819.	0.00				
3.6000	0.4124	-1066739.	39811.	-0.00328	0.00	3.89E+10
-311.7782	4082.	0.00				
4.0500	0.3943	-854315.	38108.	-0.00338	0.00	7.46E+10
-319.1549	4371.	0.00				
4.5000	0.3759	-651161.	36365.	-0.00343	0.00	7.48E+10
-326.0841	4684.	0.00				
4.9500	0.3572	-457487.	34587.	-0.00347	0.00	7.50E+10
-332.5446	5027.	0.00				
5.4000	0.3384	-273491.	32775.	-0.00350	0.00	7.50E+10
-338.5130	5402.	0.00				
5.8500	0.3194	-99354.	30933.	-0.00351	0.00	7.50E+10
-343.9644	5815.	0.00				
6.3000	0.3004	64757.	29062.	-0.00352	0.00	7.50E+10
-348.8713	6271.	0.00				
6.7500	0.2814	218692.	27166.	-0.00351	0.00	7.50E+10
-353.2032	6777.	0.00				
7.2000	0.2626	362319.	25249.	-0.00348	0.00	7.50E+10
-356.9261	7341.	0.00				
7.6500	0.2438	495522.	23313.	-0.00345	0.00	7.49E+10
-360.0010	7973.	0.00				
8.1000	0.2253	618206.	21363.	-0.00341	0.00	7.49E+10
-362.3830	8687.	0.00				
8.5500	0.2069	730296.	19402.	-0.00337	0.00	7.47E+10
-364.0197	9499.	0.00				
9.0000	0.1889	831741.	17434.	-0.00331	0.00	7.46E+10
-364.8486	10429.	0.00				
9.4500	0.1712	922511.	15464.	-0.00325	0.00	7.45E+10
-364.7939	11506.	0.00				
9.9000	0.1539	1002603.	13497.	-0.00315	0.00	4.09E+10
-363.7620	12766.	0.00				
10.3500	0.1372	1072010.	11537.	-0.00300	0.00	3.88E+10
-361.8469	14238.	0.00				
10.8000	0.1214	1130776.	9591.	-0.00285	0.00	3.73E+10

-359.0210	15967.	0.00				
11.2500	0.1065	1178976.	7662.	-0.00268	0.00	3.62E+10
-355.2561	18016.	0.00				
11.7000	0.09250	1216713.	5757.	-0.00250	0.00	3.54E+10
-350.5233	20464.	0.00				
12.1500	0.07951	1244117.	3880.	-0.00231	0.00	3.49E+10
-344.7922	23416.	0.00				
12.6000	0.06757	1261353.	2036.	-0.00211	0.00	3.45E+10
-338.0308	27014.	0.00				
13.0500	0.05669	1268615.	231.6754	-0.00191	0.00	3.44E+10
-330.2043	31452.	0.00				
13.5000	0.04689	1266130.	-1527.	-0.00172	0.00	3.45E+10
-321.2747	36999.	0.00				
13.9500	0.03816	1254159.	-3235.	-0.00152	0.00	3.47E+10
-311.1996	44040.	0.00				
14.4000	0.03048	1232997.	-4885.	-0.00133	0.00	3.51E+10
-299.9303	53135.	0.00				
14.8500	0.02383	1202977.	-6471.	-0.00114	0.00	3.57E+10
-287.4095	65131.	0.00				
15.3000	0.01816	1164467.	-7986.	-9.63E-04	0.00	3.65E+10
-273.5670	81343.	0.00				
15.7500	0.01342	1117878.	-9422.	-7.97E-04	0.00	3.76E+10
-258.3132	103914.	0.00				
16.2000	0.00955	1063661.	-10771.	-6.43E-04	0.00	3.90E+10
-241.5264	136519.	0.00				
16.6500	0.00648	1002314.	-12025.	-5.03E-04	0.00	4.09E+10
-223.0314	185897.	0.00				
17.1000	0.00412	934384.	-13175.	-3.88E-04	0.00	5.14E+10
-202.5532	265569.	0.00				
17.5500	0.00229	860490.	-14202.	-3.08E-04	0.00	7.46E+10
-177.8371	419638.	0.00				
18.0000	7.95E-04	781372.	-15056.	-2.48E-04	0.00	7.47E+10
-138.7048	942478.	0.00				
18.4500	-3.94E-04	698177.	-15156.	-1.95E-04	0.00	7.48E+10
101.8436	1396221.	0.00				
18.9000	-0.00131	617922.	-14450.	-1.47E-04	0.00	7.49E+10
159.6027	657795.	0.00				
19.3500	-0.00199	542294.	-13541.	-1.06E-04	0.00	7.49E+10
177.0413	481424.	0.00				
19.8000	-0.00245	471805.	-12559.	-6.90E-05	0.00	7.50E+10
186.5732	411165.	0.00				
20.2500	-0.00273	406737.	-11855.	-3.74E-05	0.00	7.50E+10
74.1878	146674.	0.00				
20.7000	-0.00285	343814.	-11441.	-1.04E-05	0.00	7.50E+10
79.2453	149934.	0.00				
21.1500	-0.00284	283188.	-11009.	1.22E-05	0.00	7.50E+10
80.6579	153193.	0.00				
21.6000	-0.00272	224901.	-10578.	3.05E-05	0.00	7.50E+10

LB10 2 ft_fixedhead.lp11o

78.8666	156452.	0.00					
22.0500	-0.00251	168905.	-10165.	4.47E-05	0.00	7.50E+10	
74.3424	159712.	0.00					
22.5000	-0.00224	115069.	-9782.	5.49E-05	0.00	7.50E+10	
67.5841	162971.	0.00					
22.9500	-0.00192	63199.	-9439.	6.13E-05	0.00	7.50E+10	
59.1172	166231.	0.00					
23.4000	-0.00158	13050.	-9146.	6.41E-05	0.00	7.50E+10	
49.4938	169490.	0.00					
23.8500	-0.00123	-35656.	-8906.	6.33E-05	0.00	7.50E+10	
39.2933	172749.	0.00					
24.3000	-8.94E-04	-83214.	-8722.	5.90E-05	0.00	7.50E+10	
29.1240	176009.	0.00					
24.7500	-5.91E-04	-129920.	-8590.	5.13E-05	0.00	7.50E+10	
19.6250	179268.	0.00					
25.2000	-3.39E-04	-176049.	-5003.	4.03E-05	0.00	7.50E+10	
1309.	2.08E+07	0.00					
25.6500	-1.56E-04	-184006.	2243.	2.73E-05	0.00	7.50E+10	
1375.	4.76E+07	0.00					
26.1000	-4.41E-05	-151854.	8101.	1.52E-05	0.00	7.50E+10	
794.4182	9.73E+07	0.00					
26.5500	8.71E-06	-96531.	9749.	6.30E-06	0.00	7.50E+10	
-184.2185	1.14E+08	0.00					
27.0000	2.40E-05	-46575.	7682.	1.14E-06	0.00	7.50E+10	
-581.1919	1.31E+08	0.00					
27.4500	2.11E-05	-13565.	4555.	-1.02E-06	0.00	7.50E+10	
-577.1835	1.48E+08	0.00					
27.9000	1.29E-05	2615.	1932.	-1.42E-06	0.00	7.50E+10	
-394.2943	1.65E+08	0.00					
28.3500	5.79E-06	7297.	341.1450	-1.06E-06	0.00	7.50E+10	
-194.7436	1.82E+08	0.00					
28.8000	1.50E-06	6301.	-333.0720	-5.69E-07	0.00	7.50E+10	
-54.9664	1.98E+08	0.00					
29.2500	-3.49E-07	3701.	-443.8770	-2.08E-07	0.00	7.50E+10	
13.9275	2.15E+08	0.00					
29.7000	-7.55E-07	1507.	-318.6150	-2.09E-08	0.00	7.50E+10	
32.4659	2.32E+08	0.00					
30.1500	-5.75E-07	259.7504	-159.3652	4.27E-08	0.00	7.50E+10	
26.5156	2.49E+08	0.00					
30.6000	-2.94E-07	-214.2552	-48.7089	4.44E-08	0.00	7.50E+10	
14.4682	2.66E+08	0.00					
31.0500	-9.61E-08	-266.3582	3.8414	2.70E-08	0.00	7.50E+10	
4.9949	2.81E+08	0.00					
31.5000	-1.79E-09	-172.7999	17.5787	1.12E-08	0.00	7.50E+10	
0.09302	2.81E+08	0.00					
31.9500	2.53E-08	-76.5218	14.2814	2.26E-09	0.00	7.50E+10	
-1.3142	2.81E+08	0.00					
32.4000	2.26E-08	-18.5632	7.5634	-1.17E-09	0.00	7.50E+10	

-1.1739	2.81E+08	0.00				
32.8500	1.27E-08	5.1642	2.6165	-1.65E-09	0.00	7.50E+10
-0.6582	2.81E+08	0.00				
33.3000	4.75E-09	9.6971	0.1724	-1.12E-09	0.00	7.50E+10
-0.2470	2.81E+08	0.00				
33.7500	6.12E-10	7.0274	-0.5804	-5.13E-10	0.00	7.50E+10
-0.03184	2.81E+08	0.00				
34.2000	-7.92E-10	3.4291	-0.5552	-1.37E-10	0.00	7.50E+10
0.04120	2.81E+08	0.00				
34.6500	-8.63E-10	1.0319	-0.3228	2.40E-11	0.00	7.50E+10
0.04488	2.81E+08	0.00				
35.1000	-5.33E-10	-0.05665	-0.1268	5.92E-11	0.00	7.50E+10
0.02769	2.81E+08	0.00				
35.5500	-2.24E-10	-0.3378	-0.02060	4.50E-11	0.00	7.50E+10
0.01165	2.81E+08	0.00				
36.0000	-4.69E-11	-0.2792	0.01743	2.27E-11	0.00	7.50E+10
0.00244	2.81E+08	0.00				
36.4500	2.16E-11	-0.1495	0.02099	7.30E-12	0.00	7.50E+10
-0.00112	2.81E+08	0.00				
36.9000	3.20E-11	-0.05260	0.01346	0.00	0.00	7.50E+10
-0.00166	2.81E+08	0.00				
37.3500	2.19E-11	-0.00417	0.00589	-2.02E-12	0.00	7.50E+10
-0.00114	2.81E+08	0.00				
37.8000	1.02E-11	0.01105	0.00139	-1.77E-12	0.00	7.50E+10
-5.30E-04	2.81E+08	0.00				
38.2500	2.78E-12	0.01082	-4.34E-04	0.00	0.00	7.50E+10
-1.45E-04	2.81E+08	0.00				
38.7000	0.00	0.00636	-7.67E-04	0.00	0.00	7.50E+10
2.16E-05	2.81E+08	0.00				
39.1500	-1.14E-12	0.00253	-5.49E-04	0.00	0.00	7.50E+10
5.93E-05	2.81E+08	0.00				
39.6000	0.00	4.37E-04	-2.65E-04	0.00	0.00	7.50E+10
4.58E-05	2.81E+08	0.00				
40.0500	0.00	-3.27E-04	-7.81E-05	0.00	0.00	7.50E+10
2.34E-05	2.81E+08	0.00				
40.5000	0.00	-4.08E-04	5.77E-06	0.00	0.00	7.50E+10
7.66E-06	2.81E+08	0.00				
40.9500	0.00	-2.65E-04	2.69E-05	0.00	0.00	7.50E+10
1.52E-07	2.81E+08	0.00				
41.4000	0.00	-1.17E-04	2.19E-05	0.00	0.00	7.50E+10
-2.01E-06	2.81E+08	0.00				
41.8500	0.00	-2.85E-05	1.16E-05	0.00	0.00	7.50E+10
-1.80E-06	2.81E+08	0.00				
42.3000	0.00	7.85E-06	4.01E-06	0.00	0.00	7.50E+10
-1.01E-06	2.81E+08	0.00				
42.7500	0.00	1.48E-05	2.68E-07	0.00	0.00	7.50E+10
-3.78E-07	2.81E+08	0.00				
43.2000	0.00	1.07E-05	-8.84E-07	0.00	0.00	7.50E+10

LB10 2 ft_fixedhead.lp11o

-4.81E-08	2.81E+08	0.00				
43.6500	0.00	5.26E-06	-8.39E-07	0.00	0.00	7.50E+10
6.50E-08	2.81E+08	0.00				
44.1000	0.00	1.68E-06	-4.69E-07	0.00	0.00	7.50E+10
7.17E-08	2.81E+08	0.00				
44.5500	0.00	1.93E-07	-1.56E-07	0.00	0.00	7.50E+10
4.44E-08	2.81E+08	0.00				
45.0000	0.00	0.00	0.00	0.00	0.00	7.50E+10
1.32E-08	1.40E+08	0.00				

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual stresses in concrete and steel. Stresses in concrete and steel may be interpolated from the output for nonlinear bending properties relative to the magnitude of bending moment developed in the pile.

Output Summary for Load Case No. 1:

Pile-head deflection	=	0.50000000	inches
Computed slope at pile head	=	0.000000	radians
Maximum bending moment	=	-3066037.	inch-lbs
Maximum shear force	=	51767.	lbs
Depth of maximum bending moment	=	0.000000	feet below pile head
Depth of maximum shear force	=	0.000000	feet below pile head
Number of iterations	=	62	
Number of zero deflection points	=	10	

Summary of Pile-head Responses for Conventional Analyses

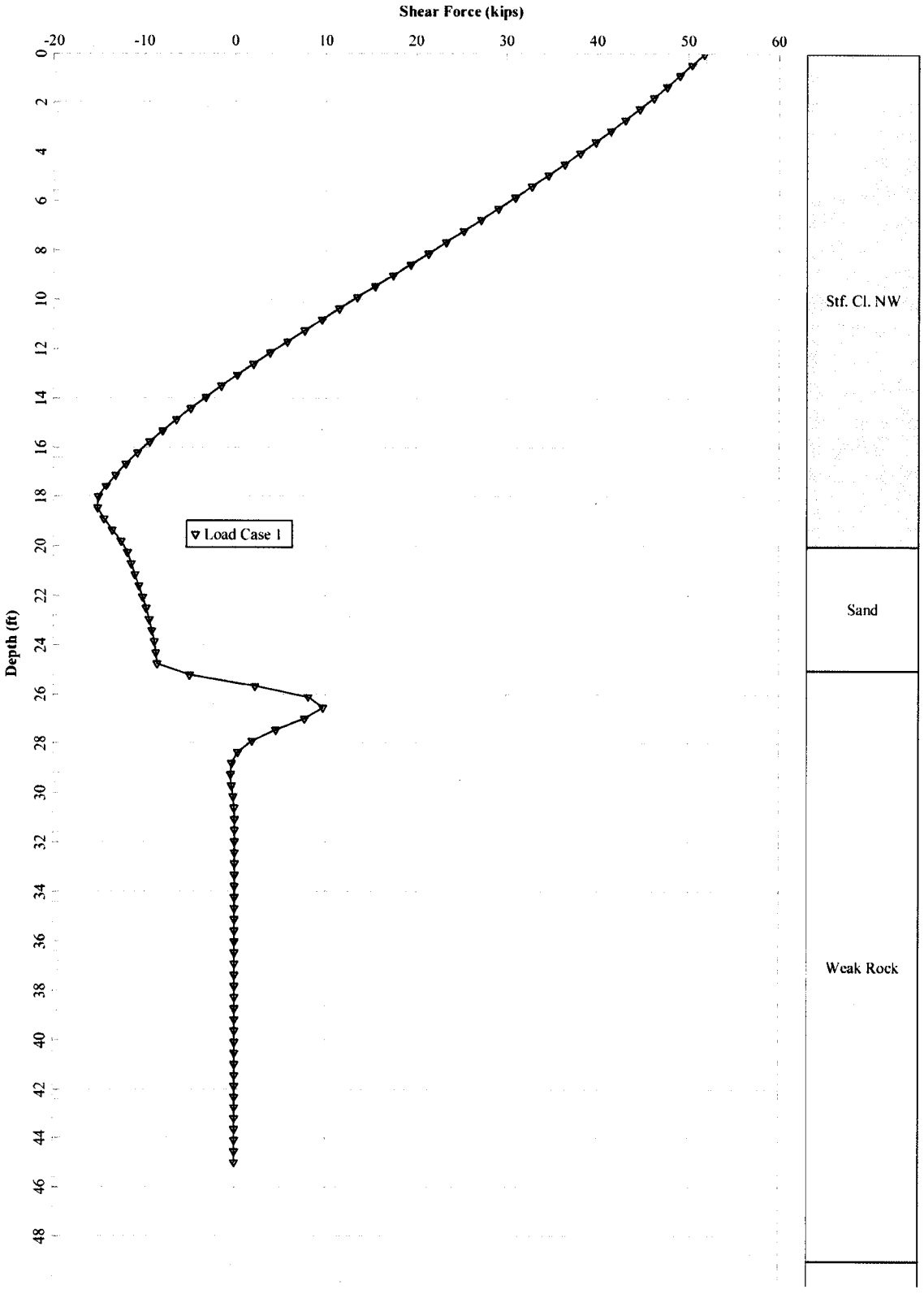
Definitions of Pile-head Loading Conditions:

Load Type 1: Load 1 = Shear, V, lbs, and Load 2 = Moment, M, in-lbs
Load Type 2: Load 1 = Shear, V, lbs, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, lbs, and Load 2 = Rot. Stiffness, R, in-lbs/rad.
Load Type 4: Load 1 = Top Deflection, y, inches, and Load 2 = Moment, M, in-lbs
Load Type 5: Load 1 = Top Deflection, y, inches, and Load 2 = Slope, S, radians

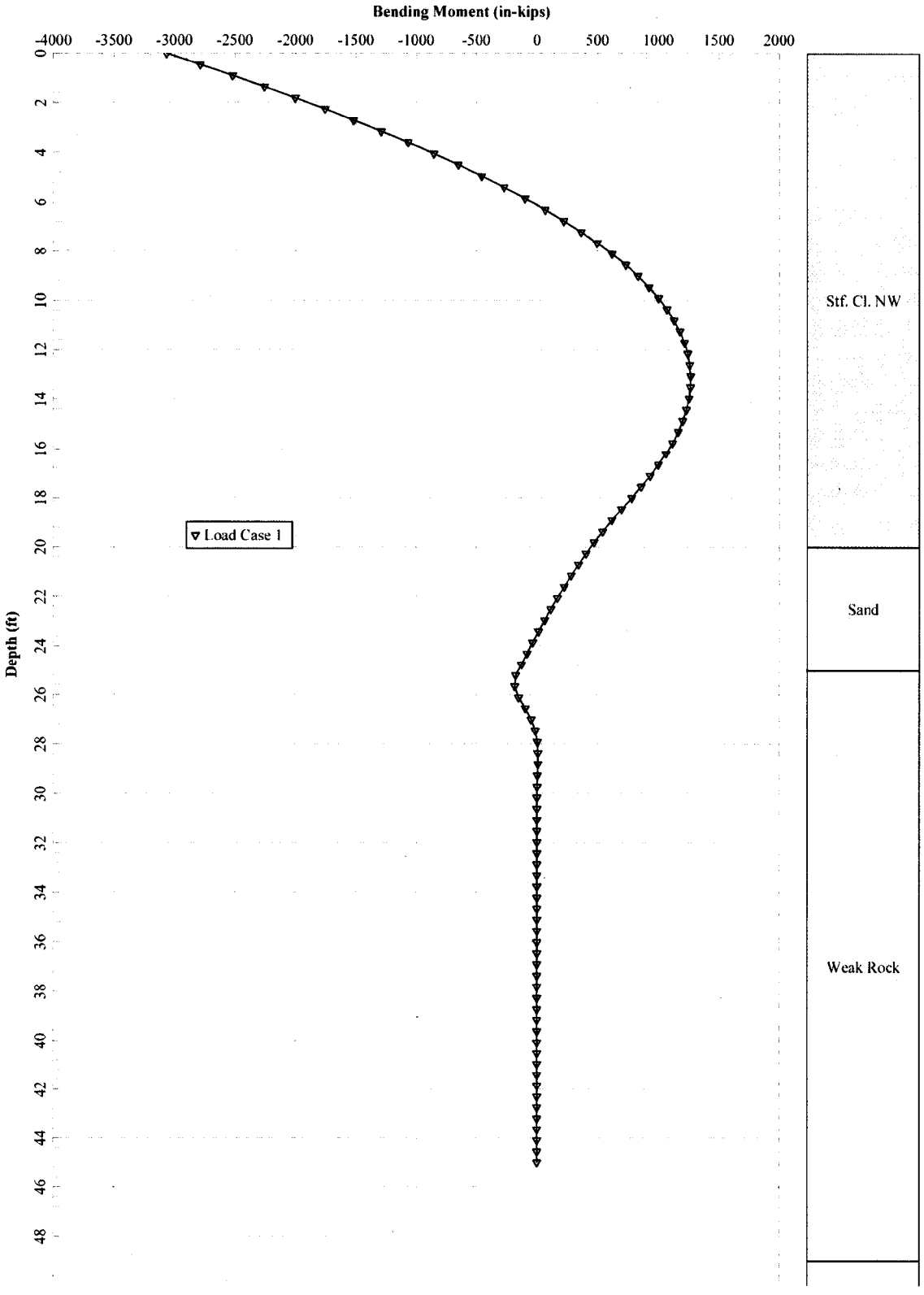
Load Case No.	Load Type	Load 1	Load Type	Load 2	Axial Loading	Pile-head Deflection	Pile-head Rotation	Max Shear in Pile	Max Moment in Pile
		Pile-head		Pile-head	lbs	inches	radians	lbs	
No. 1		Load 1	2	Load 2					

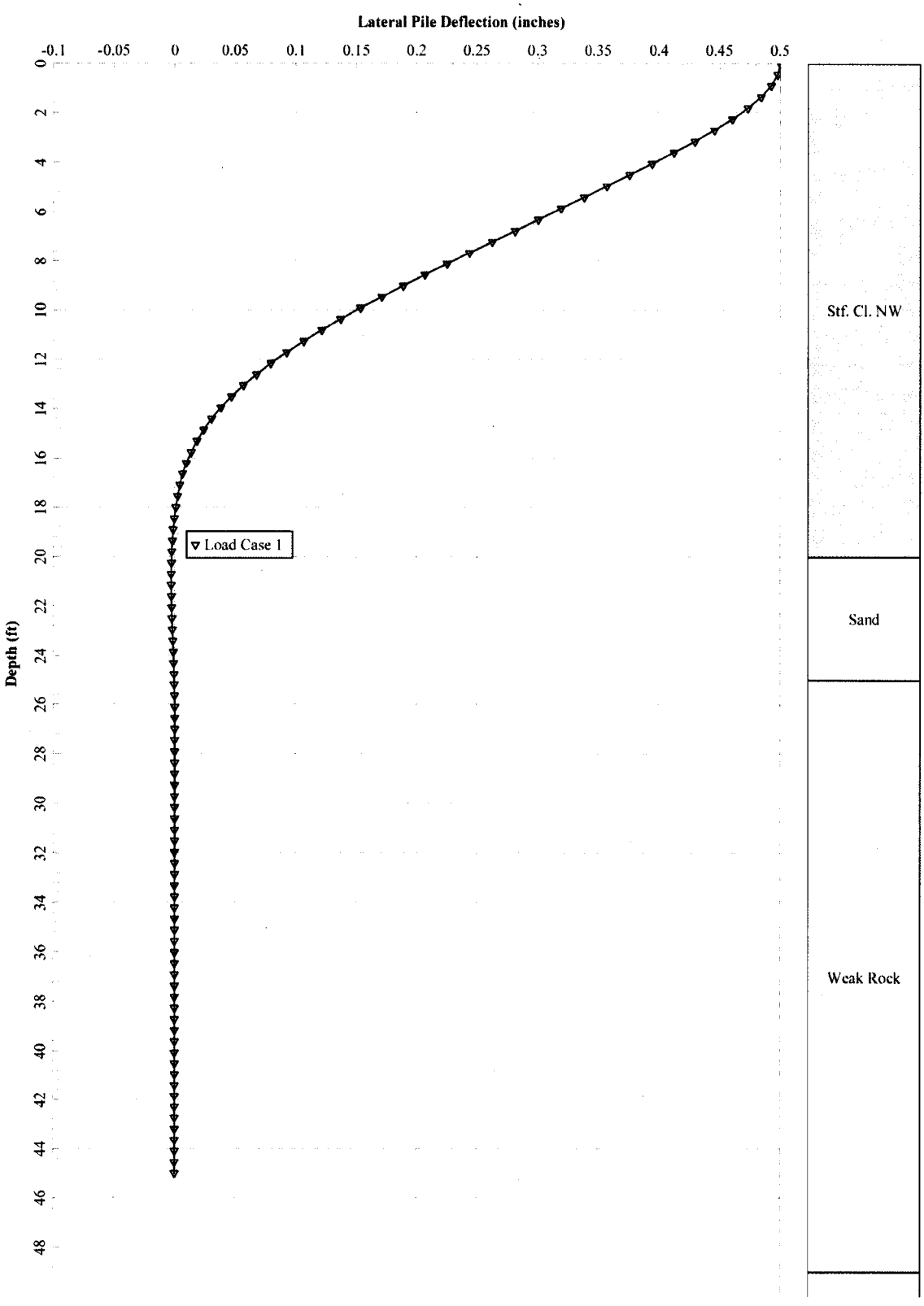
LB10 2 ft_fixedhead.lp11o

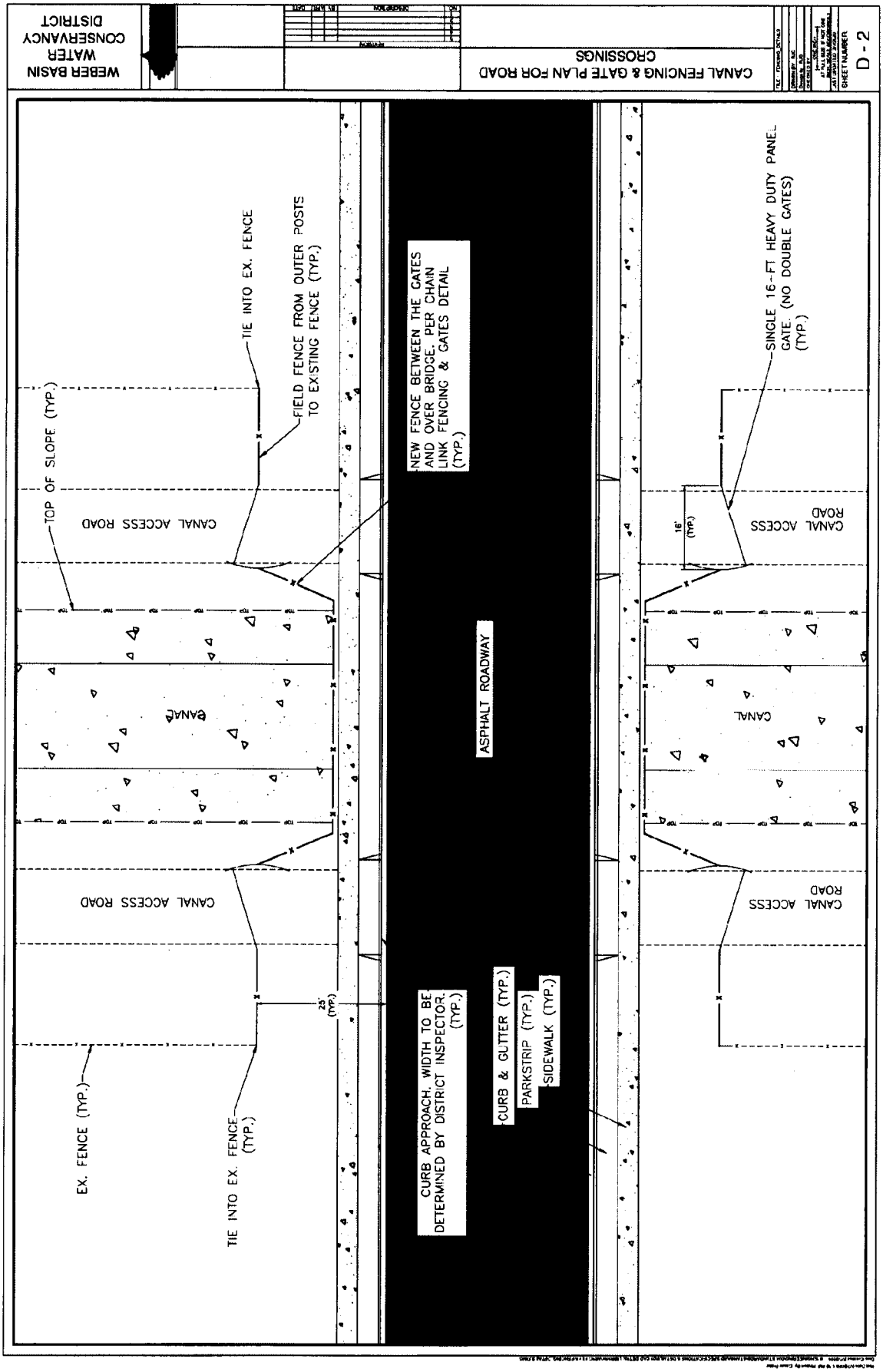
```
     in-lbs
---- ----- ---------- ---------- ---------- ---------- ---------- ----------
---------- ----------
  1  y, in      0.5000   S, rad         0.00    110000.     0.5000       0.00
51767.  -3066037.


Maximum pile-head deflection = 0.5000000000 inches
Maximum pile-head rotation   = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.
```

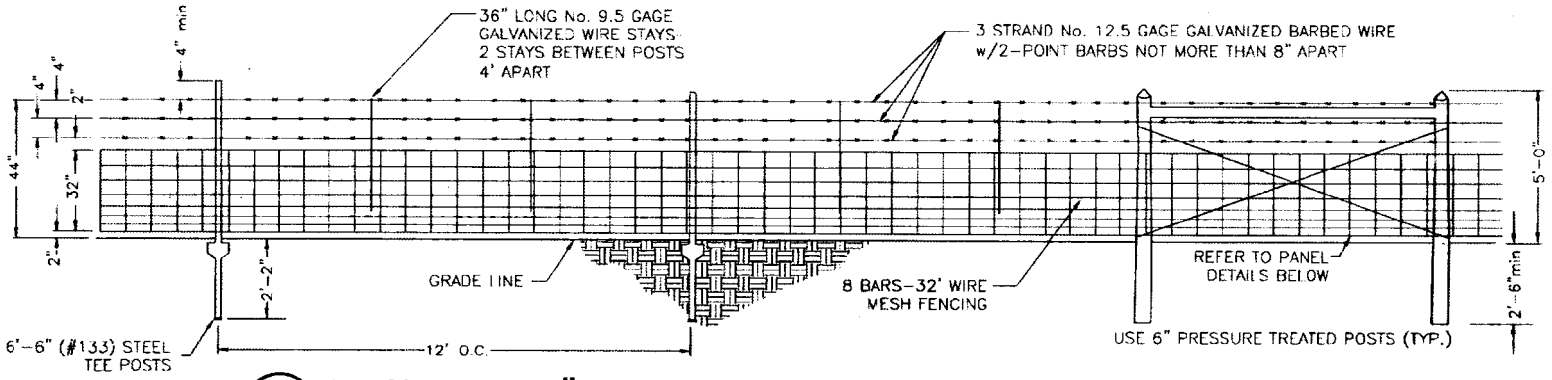


DRILLED SHAFT STIFFNESS 52 KIPS / 0.5 IN = 104 KIPS/IN


Bending Moment (in-kips)
-4000
-3500
-3000
-2500
-2000
-1500
-1000
-500
0
500
1000
1500
2000
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Stf. Cl. NW
Sand
Weak Rock


Lateral Pile Deflection (inches)
-0.1
-0.05
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
0.5
Depth (ft)
0
2
4
6
8
10
12
14
16
18
20
22
24
26
28
30
32
34
36
38
40
42
44
46
48
Load Case 1
Stf. Cl. NW
Sand
Weak Rock


WEBER BASIN WATER CONSERVANCY DISTRICT
CANAL FENCING & GATE PLAN FOR ROAD CROSSINGS
SHEET NUMBER
D - 2
TIE INTO EX. FENCE
FIELD FENCE FROM OUTER POSTS TO EXISTING FENCE (TYP.)
TOP OF SLOPE (TYP.)
CANAL ACCESS ROAD
NEW FENCE BETWEEN THE GATES AND OVER BRIDGE, PER CHAIN LINK FENCING & GATES DETAIL (TYP.)
ASPHALT ROADWAY
CANAL
SINGLE 16'-FT HEAVY DUTY PANEL GATE. (NO DOUBLE GATES) (TYP.)
16' (TYP.)
CURB APPROACH. WIDTH TO BE DETERMINED BY DISTRICT INSPECTOR. (TYP.)
CURB & GUTTER (TYP.)
PARKSTRIP (TYP.)
SIDEWALK (TYP.)
25' (TYP.)
EX. FENCE (TYP.)
TIE INTO EX. FENCE (TYP.)

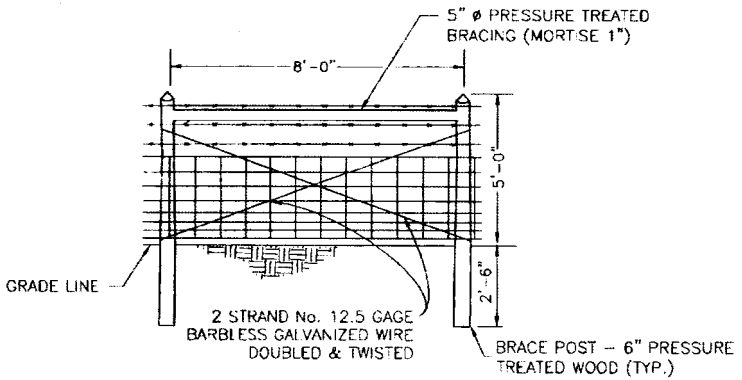


1 STANDARD 44" TALL FIELD FENCE DETAIL

SCALE NTS

* SEE GENERAL NOTES

INSTALL BRACE PANEL IN STRAIGHT LINE FENCE AT 500' MAXIMUM SPACING



2 IN-LINE BRACE PANEL

SCALE NTS

GENERAL NOTES:

1. BARBED WIRE AND WIRE MESH TO BE ATTACHED TO EACH POST WITH NO. 9 GAGE, 1-3/4" LONG STAPLES OR 12.5 GAGE WIRE TIES AS APPLICABLE. A MINIMUM OF 4 STAPLES OR WIRE TIES REQUIRED AT EACH POST FOR WIRE MESH.
2. IN-LINE BRACE PANEL POSTS TO BE INSTALLED AT 500 FOOT MAXIMUM INTERVALS OR AS DIRECTED BY THE DISTRICT.
3. CONTRACTOR SHALL TAKE ALL PRECAUTIONARY MEASURES NECESSARY TO PROTECT EXISTING IMPROVEMENTS FROM DAMAGE & SHALL BE RESPONSIBLE FOR BLUE STAKING & PROTECTING ALL BURIED UTILITIES WITHIN THE DESIGNATED WORK AREA.

WEBER BASIN WATER CONSERVANCY DISTRICT

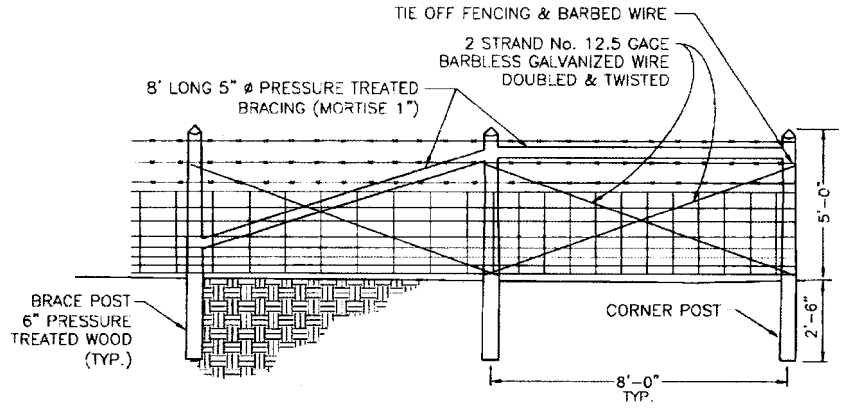
BID SET

NOT FOR CONSTRUCTION

FIELD FENCE DETAILS

SHEET NUMBER D-2

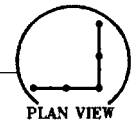
Ent 161569 Bk 393 Pg 1550

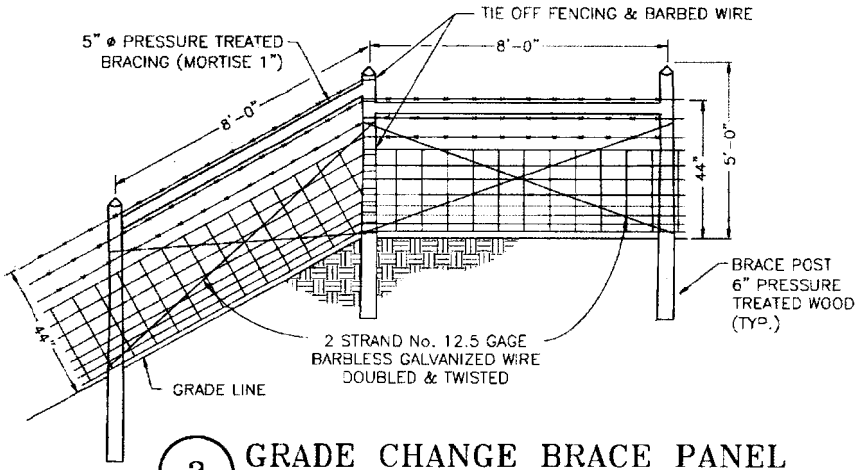


1 CORNER/END BRACE PANEL

3 POSTS USED FOR END BRACE PANEL
5 POSTS USED FOR CORNER PANEL
(REFER TO PLAN VIEW)

SCALE
NTS





3 GRADE CHANGE BRACE PANEL

SCALE
NTS

WEBER BASIN WATER CONSERVANCY DISTRICT

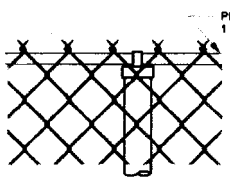
BID SET

NOT FOR CONSTRUCTION

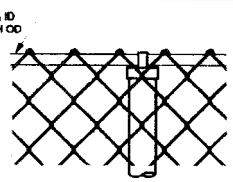
FIELD FENCE DETAILS

SHEET NUMBER
D - 3

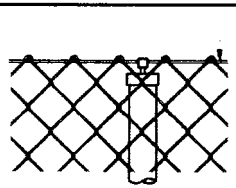
Ent 161569 Bk 393 Pg 1551



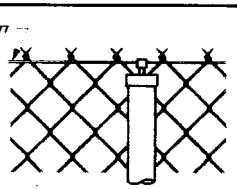
TWISTED & BARBED SELVAGE TYPE I



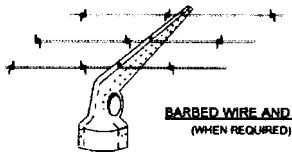
KNUCKLED SELVAGE TYPE II



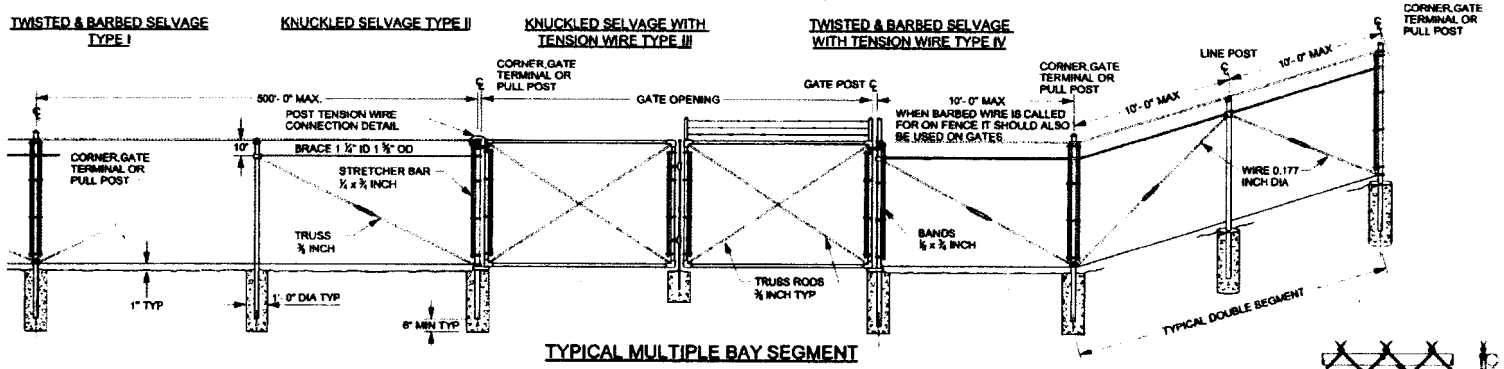
KNUCKLED SELVAGE WITH TENSION WIRE TYPE III



TWISTED & BARBED SELVAGE WITH TENSION WIRE TYPE IV



BARBED WIRE AND ARM
(WHEN REQUIRED)

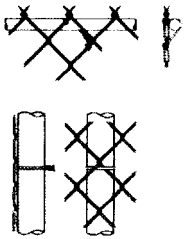


TYPICAL MULTIPLE BAY SEGMENT

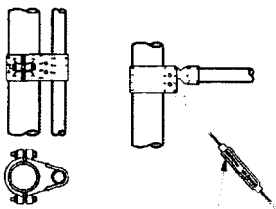
HEIGHT	GATE OPENING	GATE POST	GATE FRAME
UNDER 6 FT	SINGLE TO 6 FT OR DOUBLE TO 12 FT	2"	1"
	SINGLE OVER 6 TO 8 FT OR DOUBLE OVER 12 TO 16 FT	2 ½"	1 ½"
	SINGLE OVER 8 TO 12 FT OR DOUBLE 16 TO 24 FT	3 ½"	
6 FT AND OVER *	SINGLE TO 6 FT OR DOUBLE TO 12 FT	2 ½"	1 ½"
	SINGLE 6 TO 13 FT OR DOUBLE OVER 12 TO 24 FT	3 ½"	
	SINGLE OVER 13 TO 18 FT OR DOUBLE OVER 24 TO 36 FT	6"	
	SINGLE OVER 18 FT OR DOUBLE OVER 36 FT	8"	

* GATES OVER 6 FT IN HEIGHT AND WIDER THAN 12 FT WILL REQUIRE (3) INDUSTRIAL PRESSED STEEL HINGES.

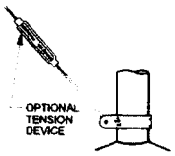
HEIGHT OF FABRIC	DEPTH OF POSTS	LENGTH OF END CORNER OR PULL POSTS	LENGTH OF LINE POSTS	SIZE OF POSTS								
				END, CORNER & PULL POSTS				LINE POST MIN.SIZE				
				NOM SIZE	OUTSIDE DIA	PIPE WEIGHT ASTM F 1083	PIPE WEIGHT TRIPLE COAT	NOM SIZE	OUTSIDE DIA	PIPE WEIGHT ASTM F 1083	PIPE WEIGHT TRIPLE COAT	OUTSIDE DIMENSIONS C-SECTION	WT/FT
7 FT	3 FT	10 FT	9'- 0"	2 ½"	2.875"	5.80	4.64	2"	2.375"	3.65	3.11	1.875 x 1.625	2.40
6 FT	3 FT	9 FT	8'- 0"	2"	2.375"	5.80	5.11	1 ½"	1.900"	2.72	2.23	1.875 x 1.625	1.85
5 FT	3 FT	8 FT	7'- 0"	2"	2.375"	3.65	3.11	1 ½"	1.900"	2.72	2.23	1.875 x 1.625	1.85
4 FT	2 FT	8 FT	6'- 0"	2"	2.375	3.65	3.11	1 ½"	1.900"	2.72	2.23	1.875 x 1.625	1.85
3 FT	2 FT	5 FT	4'- 0"	2"	2.375	3.65	3.11	1 ½"	1.900"	2.72	2.23	1.875 x 1.625	1.85



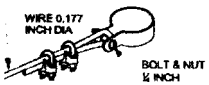
PIPE POST TIE



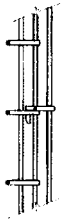
TOP GATE HINGE



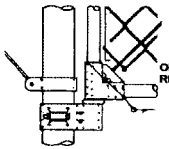
BRACE & TRUSS CONNECTIONS



POST TENSION WIRE CONNECTION DETAIL

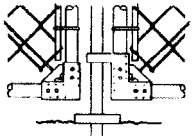


DROP ROD ASSY



GATE HINGE DETAIL BOTTOM

GATE HOLD BACK DETAIL



GATE STOP DETAIL

NOTES:

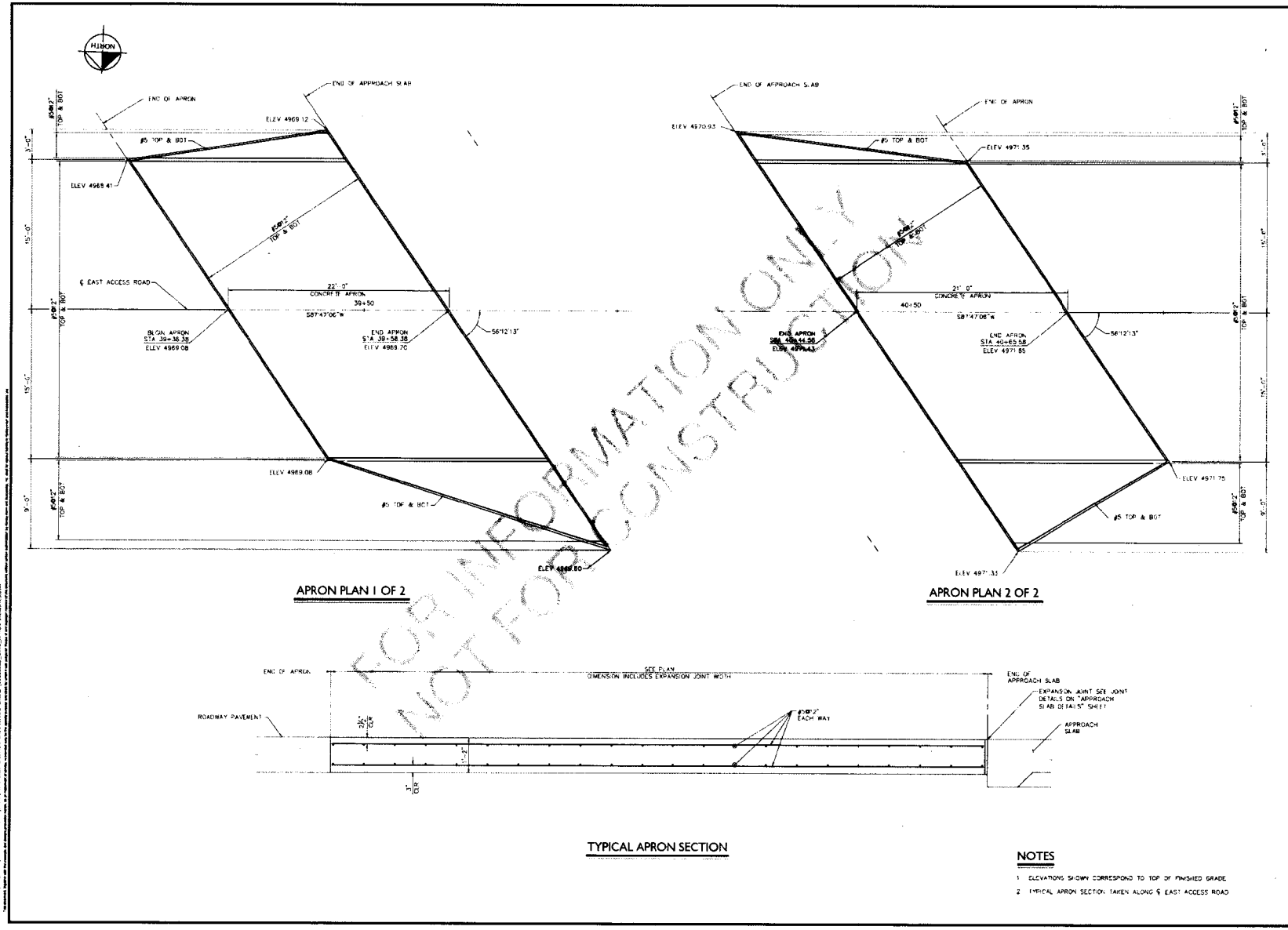
1. POSTS: SCHEDULE 40 PIPE. TRIPLE COATED HIGH TENSILE STEEL PIPE OR ROLL-FORMED C-SECTION OF THE SIZE SHOWN IN THE CHART AND AS DEFINED IN THE ASTM F 1043 GROUP II. WEIGHT IN lb/ft WITH TOLERANCE OF 10 PERCENT. OTHER TYPES OF POSTS WITH EQUAL OR GREATER SECTION MODULUS MAY BE USED IF APPROVED, IN ADVANCE, BY THE ENGINEER.
2. FABRIC HEIGHTS LESS THAN 5 FT. TRUSS RODS AND BRACES NOT REQUIRED
3. USE TRIPLE COATED HIGH TENSILE STEEL PIPE CONFORMING TO ASTM F 1043 GROUP IC.

WEBER BASIN WATER CONSERVANCY DISTRICT

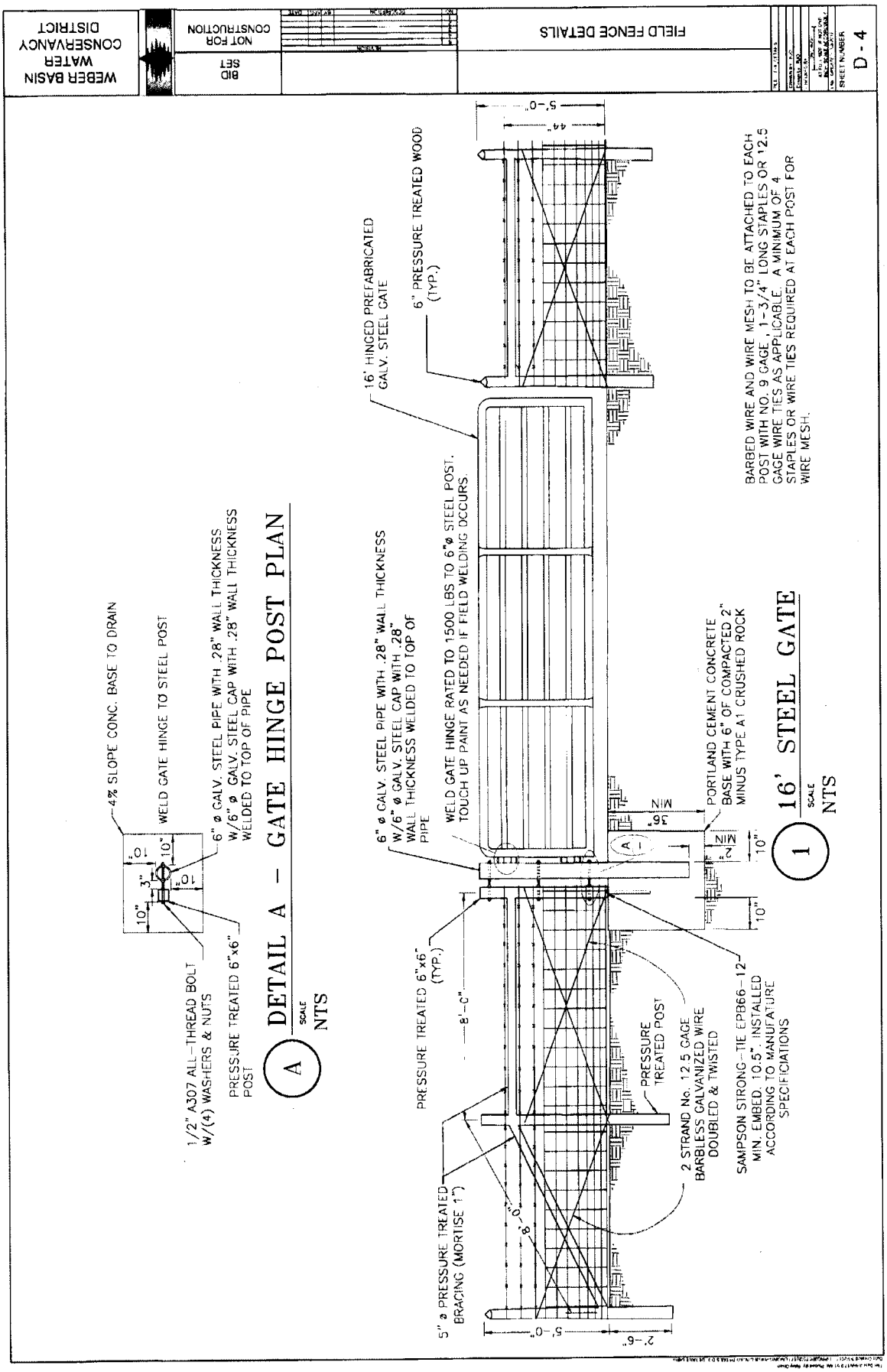
CHAIN LINK FENCING & GATE DETAILS

FILE: FENCING_DETAILS

SHEET NUMBER: D - 1



Ent 161569 393 1343


WEBER BASIN WATER CONSERVANCY DISTRICT
BID SET
NOT FOR CONSTRUCTION
FIELD FENCE DETAILS
SHEET NUMBER
D - 4
4% SLOPE CONC. BASE TO DRAIN
WELD GATE HINGE TO STEEL POST
6" ø GALV. STEEL PIPE WITH .28" WALL THICKNESS W/6" ø GALV. STEEL CAP WITH .28" WALL THICKNESS WELDED TO TOP OF PIPE
1/2" A307 ALL-THREAD BOLT W/(4) WASHERS & NUTS
PRESSURE TREATED 6"x6" POST
A
DETAIL A - GATE HINGE POST PLAN
SCALE
NTS
16' HINGED PREFABRICATED GALV. STEEL GATE
6" PRESSURE TREATED WOOD (TYP.)
6" ø GALV. STEEL PIPE WITH .28" WALL THICKNESS W/6" ø GALV. STEEL CAP WITH .28" WALL THICKNESS WELDED TO TOP OF PIPE
WELD GATE HINGE RATED TO 1500 LBS TO 6"ø STEEL POST. TOUCH UP PAINT AS NEEDED IF FIELD WELDING OCCURS.
BARBED WIRE AND WIRE MESH TO BE ATTACHED TO EACH POST WITH NO. 9 GAGE, 1-3/4" LONG STAPLES OR 12.5 GAGE WIRE TIES AS APPLICABLE. A MINIMUM OF 4 STAPLES OR WIRE TIES REQUIRED AT EACH POST FOR WIRE MESH.
PORTLAND CEMENT CONCRETE BASE WITH 6" OF COMPACTED 2" MINUS TYPE A1 CRUSHED ROCK
PRESSURE TREATED 6"x6" (TYP.)
8'-0"
PRESSURE TREATED POST
2 STRAND No. 12.5 GAGE BARBLESS GALVANIZED WIRE DOUBLED & TWISTED
SAMPSON STRONG-TIE EPB66-12 MIN. EMBED. 10.5". INSTALLED ACCORDING TO MANUFATURE SPECIFICATIONS
5" ø PRESSURE TREATED BRACING (MORTISE 1")
1
16' STEEL GATE
SCALE
NTS