INVESTIGACIÓN GEOTÉCNICA EN ÁREA DE CONSTRUCCIÓN DE LA PILONA 59, METRO CABLE, LÍNEA 2 SANTO DOMINGO OESTE, R.D.

Preparado para:
J. Fortuna

MAYO 05/2021

Rev	Fecha	Descripción	Prep.	Rev.	Aprob.
00	05/05/2021	Informe para revisión	MOF	HSJ	ACC

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METRO CABLE PILONA 59

Santo Domingo Oeste, R.D.

INFORME GEOTÉCNICO

INFORME FINAL

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INVESTIGACIÓN GEOTÉCNICA EN EL ÁREA DE CONSTRUCCIÓN DE LA PILONA 59, METRO CABLE LÍNEA 2, SANTO DOMINGO OESTE, R.D.

1 DESCRIPCIÓN DEL PROYECTO

1.1 Introducción

A solicitud de **J. Fortuna**, la empresa **Ingeniería Global Especializada, SRL (INGESA)** ha realizado una investigación geotécnica en el área donde se proyecta la construcción de la pilona 59 del teleférico Línea 2, ubicada en tramo comprendido entre la estación E-07 a la estación E-08 localizada en el municipio de Los Alcarrizos, Santo Domingo Oeste, R.D., aproximadamente en las coordenadas 390919.20 m E/ 2048395.35 m N UTM/WGS-84.

En este informe se presentan los resultados de los trabajos realizados, los cuales tienen como finalidad evaluar las características geotécnicas del área de estudio y proponer recomendaciones de fundación para la construcción de la pilona.

La investigación geotécnica incluye la realización de un (01) sondeo geotécnico realizado a una profundidad de 25.00 m por debajo del nivel actual del terreno. El sondeo es del tipo SPT con recuperación de testigo y se ejecutó según las especificaciones del ASTM D-1586 del tipo HQ (Diámetro 2" Nominal) con golpeos para los suelos y según el ASTM D-2113 para extraer testigos de rocas a rotación en los casos donde existiese rechazo.

1.2 Alcance de la investigación geotécnica

El alcance del estudio aquí presentado se limita a la investigación geotécnica para el área de construcción de la pilona 59, Metro Cable, ubicada en el municipio de Los Alcarrizos, Santo Domingo Oeste, R.D.

El estudio incluye lo siguiente:

- Realización de sondeos geotécnicos tipo SPT
- Realización de ensayos de laboratorio
- Perfiles estratigráficos y descripción estratigráfica
- Caracterización de la estratigrafía existente
- Ubicación del nivel freático
- Identificación de datos relevantes de la zona investigada
- Recomendaciones de fundación

1.3 Limitaciones

En general, en las investigaciones geotécnicas existen ciertas incertidumbres y limitaciones debido a que las propiedades geotécnicas de los materiales pueden variar entre los puntos explorados, además las condiciones de agua y la humedad de los materiales pueden cambiar de acuerdo a la variación de las condiciones climáticas. Debido a esto, no se puede tener una total certeza de los estratos subyacentes en el área de estudio. Toda la información incluida en el presente informe está basada en los puntos explorados y están sujetas a confirmación.

2 DESCRIPCIÓN DEL ÁREA DE ESTUDIO

El sitio de estudio se encuentra a unos 20 m al Sur de la calle Duarte y estará ubicada en tramo comprendido entre la estación E-07 a la estación E-08 del teleférico Línea 2, en el municipio de Los Alcarrizos, Santo Domingo Oeste, R.D., aproximadamente en las coordenadas 390278.01 m E/ 2048319.83 m N UTM/WGS-84. (Ver figura 1 y anexo A). Al momento de los trabajos de campo el área era de topografía relativamente plana (Ver figura 2).

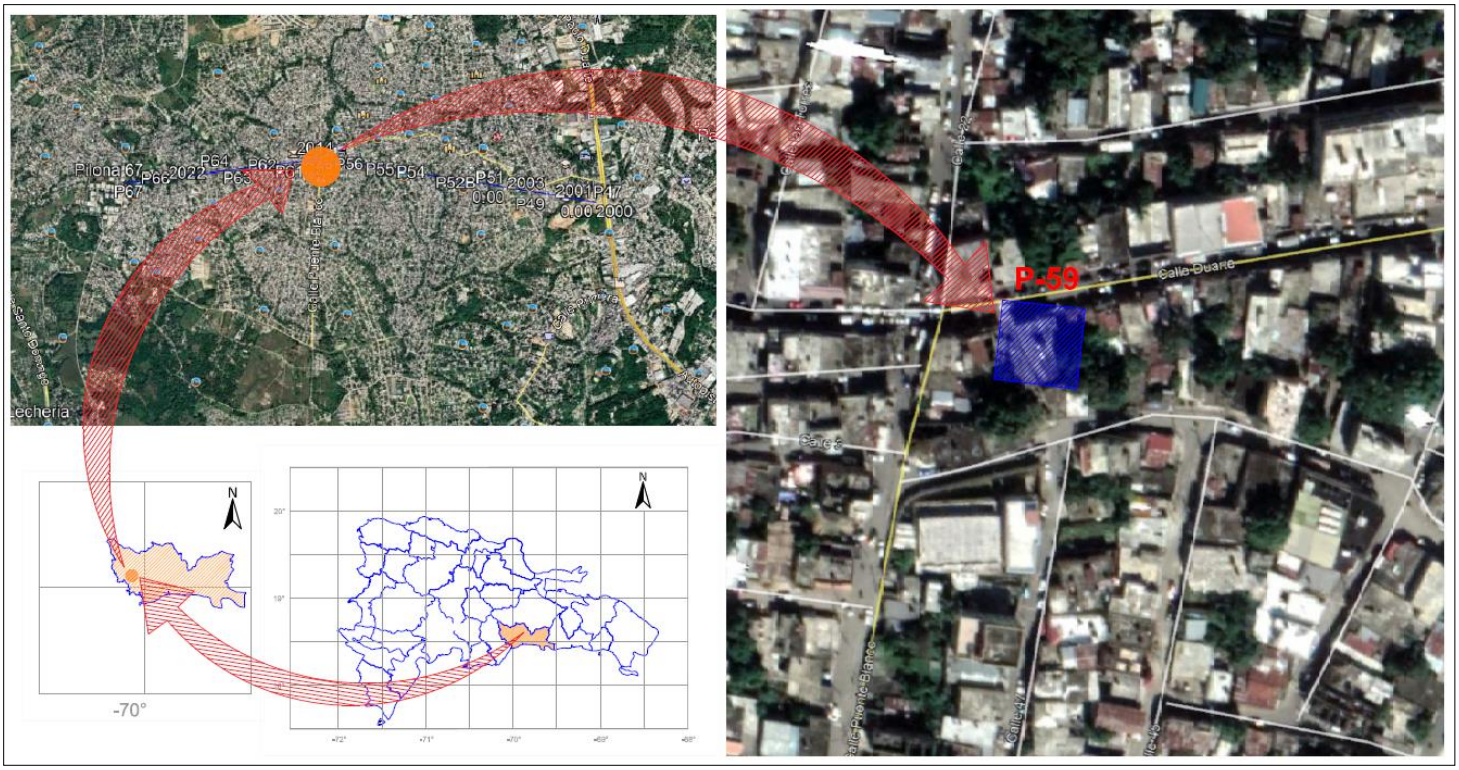

Figura 1 Localización del área de estudio

Figura 2 Foto del entorno del proyecto

3 ENSAYOS DE LABORATORIO REALIZADOS

3.1 Clasificación de materiales según resultados de laboratorio

Se han realizado los siguientes ensayos de laboratorio con los estándares mostrados a continuación:

- 05 unidades por el método de prueba estándar para la determinación en laboratorio del contenido de agua (humedad) de suelos y rocas por masa **(ASTM D 2216).**
- 05 unidades de ensayo limite líquido y límite e índice plástico **(ASTM D 4318).**
- 05 unidades de ensayo granulométrico por tamizado **(ASTM - D 6913).**

En la tabla mostrada a continuación se presenta un resumen de los resultados de laboratorio y la densidad y/o consistencia de los materiales muestreados.

SONDEO	Prof. (m)	Estratigrafía	Granulom (%)	Prop. Índices (%)	Clasif. SUCS	Valor Nprom/ RQD
P-59	0.00-0.90	Limo de baja plasticidad arenoso	G=4.04 S=36.84 F=59.13	LL=24.56 LP=23.11 IP=1.45 W=17.77	ML	11
	0.90-2.25					22
	2.25-4.05					15
	4.05-5.40	Arcilla de baja plasticidad arenosa	G=0.23 S=31.65 F=68.12	LL=44.25 LP=24.38 IP=19.87 W=27.63	CL	28
	5.40-9.00					48
	9.00-10.35	Arcilla de alta plasticidad	G=1.81 S=1.63 F=96.56	LL=88.75 LP=38.35 IP=50.40 W=37.89	CH	23
	10.35-11.70					32
	11.70-12.60					29
	12.60-14.85	Limo de baja plasticidad	G=1.95 S=14.34 F=83.70	LL=49.27 LP=29.38 IP=19.89 W=25.26	ML	63
	14.85-16.35	Limo de baja plasticidad, recuperado en rotación	--	--	ML	--
	16.35-17.25	Arcilla de alta plasticidad	G=5.00 S=8.23 F=86.77	LL=80.80 LP=30.75 IP=50.05 W=28.29	CH	81
	17.25-18.25	No recuperado	--	--	--	--
	18.25-25.00	Arcilla de alta plasticidad	G=5.00 S=8.23 F=86.77	LL=80.80 LP=30.75 IP=50.05 W=28.29	CH	45

Tabla 1 Resumen de clasificación de materiales G=Grava, S=Arena, F=Fino, LL=Limite líquido, LP=Limite plástico, IP=Índice de plasticidad.

4 CONDICIONES GEOTÉCNICAS DEL SITIO

4.1 Estratigrafía de sondeos realizados

El área de estudio está compuesta por materiales cohesivos intercalados entre sí, los cuales son del tipo limo y arcilla arenosa de baja plasticidad (ML/CL); y arcilla de alta plasticidad (CH). Los valores de N_{SPT} se encuentran generalmente por encima de 16 y alcanzan valores superiores a 50, lo que muestra el predominio de material cohesivo de muy consistente a duro. Sin embargo, superficialmente, se midieron valores de N_{SPT} más bajos, en un rango de 9 a 15, los cuales se extienden hasta una profundidad de 4.00 m aprox.

La descripción estratigráfica detallada se presenta en tabla 1 y en las columnas estratigráficas presentadas en el **Anexo E.**

4.2 Nivel freático

En esta investigación geotécnica no se encontró presencia de nivel freático hasta la profundidad estudiada.

4.1 Evaluación del potencial de licuefacción

Hasta la profundidad investigada la posibilidad de ocurrencia de licuefacción es inexistente debido a que no se detectó la presencia de nivel freático.

4.2 Clasificación sísmica

De acuerdo con el Reglamento Para el Análisis y Diseño Sísmico de Estructuras (R-001) del MOPC de la República Dominicana, para las consideraciones sísmicas se recomienda lo siguiente:

ZONA SISMICA	CLASE DE SITIO	CAMPO CERCANO
II	D	NO

Tabla 2 Clasificación sísmica

5 CARACTERIZACIÓN DE LOS MATERIALES

5.1.1 Consideraciones para el ángulo de fricción interna (ø) y cohesión (C)

En el área de estudio se encontraron materiales cohesivos. Para los análisis de estos materiales, se han caracterizado tomando un valor de la cohesión (C) como único parámetro de resistencia y el ángulo de fricción interna (ø) se ha considerado cero.

Los parámetros asignados para la cohesión son basados en los valores de N_{SPT} a partir del gráfico presentado por NAVFAC y que incluye una gráfica propuesta por Terzaghi, la cual se muestra a continuación.

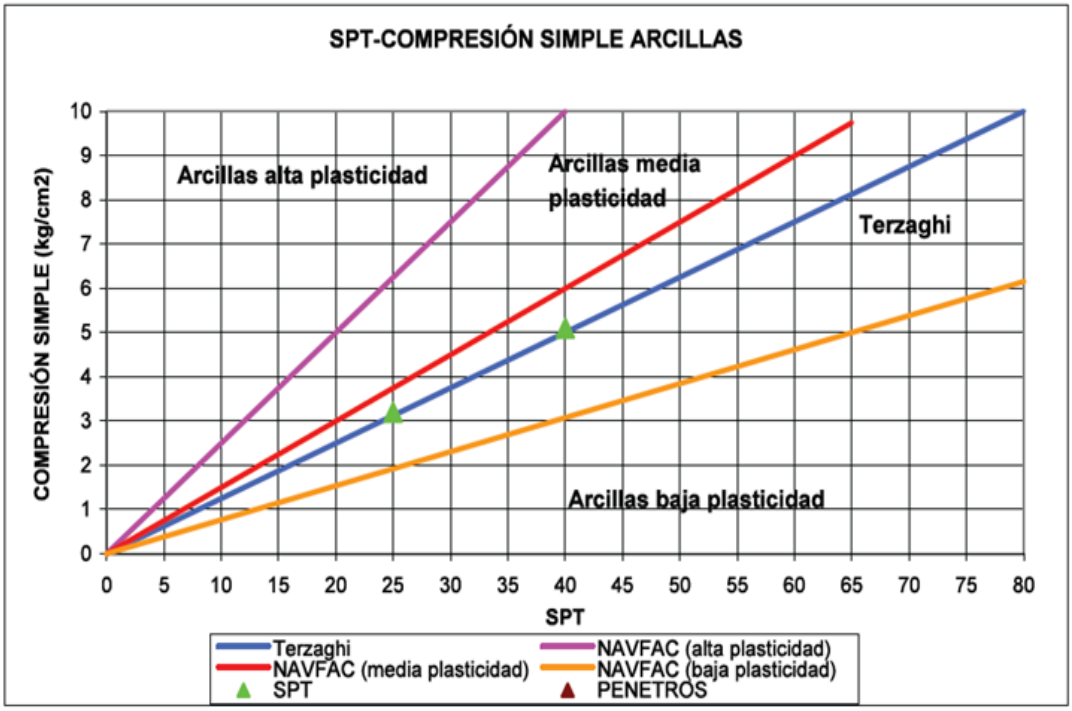

Figura 3 Correlación Nspt vs Qu

Este valor se ha comparado con la expresión propuesta por Stroud (1974), en la que C=K.Nf, Donde K = constante = 3.5 @ 6.5 KN/m².

5.1.2 Resumen de parámetros utilizados para los cálculos

Como caso más desfavorable, se consideró la estratigrafía del sondeo en la que se ha utilizado la correlación más apropiada de acuerdo a las formulaciones mostradas en el acápite 5.1.1. Los valores para se muestran a continuación en la tabla 3:

Estratigrafía considerada para la Pilona 59

No.	Prof (m)	Tipo de material considerado	Nprom/ RQD%	Cohesion Kpa	fricción	Peso especifico (KN/m3)
1	0.00-4.05	Limo ML	16	100	0	17.0
2	4.05-5.40	Arcilla CL	29	185	0	18.0
3	5.40-9.00	Arcilla CL	50	290	0	20.0
4	9.00-13.05	Arcilla CH	29	185	0	18.0
5	13.05-18.25	Arcilla CH/Limo ML	60	300	0	20.0
6	18.25-25.00	Arcilla CH	45	280	0	20.0

Tabla 3 Parámetros geotécnicos considerados para el sondeo P-59 desde la superficie

6 ANÁLISIS GEOTÉCNICO

6.1 Cimentaciones profundas

El diseño se realizó utilizando el programa SHAFT versión 2017.8.2 para el cálculo de la capacidad axial y el programa LPILE versión 2017.8.2 para el cálculo de la capacidad lateral, ambos programas de Ensoft, Inc. Estos análisis se realizaron siguiendo las especificaciones LRFD ("Load and Resístance Factor Design") para puentes de la AASHTO. Los cálculos y resultados se encuentran en el anexo D.

Los resultados de los análisis se muestran en la tabla 4 mostrada a continuación.

CAPACIDAD PILOTES PILONA 59. METROCABLE, LINEA 2						
Diámetro de pilote	**Longitud (m)**	**Capacidad axial Compresión última (ton)**	**Capacidad axial Tracción última (ton)**	**Capacidad lateral última (ton)**	**Loading condition**	**Observaciones**
0.60	12	420	290	45	Fixed-Head	14 ϕ 1″ MIN
	15	600	410			
0.80	12	620	390	100	Fixed-Head	24 ϕ 1″ MIN
	15	850	530			

Tabla 4 Capacidad de carga de pilotes

7 CONCLUSIONES Y RECOMENDACIONES

La investigación geotécnica presentada en este informe fue realizada con la finalidad de identificar las características del suelo de fundación, determinar la capacidad portante del terreno y asentamientos según las condiciones actuales del terreno en el área de construcción de la pilona 59, Metro Cable, ubicada en el municipio de Los Alcarrizos, Santo Domingo Oeste, R.D. Los resultados de este estudio solo aplican para este proyecto y no podrán ser extrapolados para otras áreas.

De acuerdo a los resultados de la investigación realizada, se concluye y recomienda lo siguiente:

- El área de estudio está compuesta por materiales cohesivos intercalados entre sí, los cuales son del tipo limo y arcilla arenosa de baja plasticidad (ML/CL); y arcilla de alta plasticidad (CH). Los valores de N_{SPT} se encuentran generalmente por encima de 16 y alcanzan valores superiores a 50, lo que muestra el predominio de material cohesivo de muy consistente a duro. Sin embargo, superficialmente, se midieron valores de N_{SPT} más bajos, en un rango de 9 a 15, los cuales se extienden hasta una profundidad de 4.00 m aprox.

- En esta investigación geotécnica no se encontró presencia de nivel freático hasta la profundidad estudiada.

- Hasta la profundidad investigada la posibilidad de ocurrencia de licuefacción es inexistente debido a que no se detectó la presencia de nivel freático.

- Debido al tipo de solicitaciones esperadas, presencia de suelos de baja resistencia hasta aprox. 3.00 m y a la existencia de arcillas CH potencialmente expansivas, se recomienda el uso de cimentaciones profundas mediante pilotes hormigonados in situ tipo "Drill Shaft" o "Continuous Flight Auger, CFA". La capacidad de carga última recomendada se muestra a continuación.

CAPACIDAD PILOTES PILONA 59. METROCABLE, LINEA 2

Diámetro de pilote	Longitud (m)	Capacidad axial Compresión última (ton)	Capacidad axial Tracción última (ton)	Capacidad lateral última (ton)	Loading condition	Observaciones
0.60	12	420	290	45	Fixed-Head	14 ϕ 1" MIN
	15	600	410			
0.80	12	620	390	100	Fixed-Head	24 ϕ 1" MIN
	15	850	530			

- La deformación lateral es menor de 1 pulg. (2.54 cm) para la carga lateral recomendada.

- Se sugiere realizar pruebas de carga estática o dinámica para comprobar las capacidades recomendadas siguiendo normativas del MOPC o según criterios del proyectista siempre cumpliendo con lo mínimo recomendado por normativas (3% del total de los pilotes).

- Se recomienda realizar pruebas de integridad estructural tales como "Pile Integrity Test (PIT)" o "Cross Sonic Logging (CSL)" como mínimo a un 25% de los pilotes y en caso de incertidumbre durante el proceso constructivo, se sugiere realizar al

100% o según criterio del proyectista siempre cumpliendo normativas. El armado recomendado para los pilotes deberá ser revisado estructuralmente.

- Según el método de diseño estructural utilizado, se recomiendan los siguientes factores de seguridad y reducción para las cargas recomendadas:

Método de cálculo	Tipo de factor	Factor recomendado	
		Carga axial	Carga lateral
ASD	Factor de seguridad	3	1.1
LRFD	Factor de reducción	0.45	1.0

- En caso de realizar las pruebas de cargas dinámica por lo menos a un 3% de los pilotes, los factores de seguridad para carga axial podrán ser disminuido de la manera siguiente.

Tipo de prueba de carga	Método de cálculo	Tipo de factor	Factor recomendado carga axial
Dinámica	**ASD**	Factor de seguridad	2.25
	LRFD	Factor de reducción	0.65

- De acuerdo a la separación de los pilotes según su diámetro, la capacidad axial recomendada se verá afectada por el efecto de "grupo de pilotes", para los que se recomiendan se utilicen los siguientes factores de reducción.

Separación	Eficiencia
3D	**0.67**
4D	**0.78**
5D	**0.89**
6D o más	**1.00**

- De igual manera las cargas laterales se verán afectadas por efecto de "grupo de pilotes" según la separación de estos y el arreglo usado de acuerdo a la dirección de la carga. Se recomiendan los siguientes factores de reducción para la carga lateral, los cuales podrán ser interpolados en caso de encontrarse en condición intermedia a las mostradas en la tabla.

separación	Factor de reducción de grupo para carga lateral		
	Fila 1	Fila 2	Fila 3
3D	0.80	0.40	0.30
5D	1.00	0.85	0.70

- De acuerdo con el Reglamento Para el Análisis y Diseño Sísmico de Estructuras (R-001) del MOPC de la República Dominicana, para las consideraciones sísmica se recomienda lo siguiente:

ZONA SISMICA	CLASE DE SITIO	CAMPO CERCANO
II	D	NO

En general, en las investigaciones geotécnicas existen ciertas incertidumbres y limitaciones debido a que las propiedades geotécnicas de los materiales pueden variar entre los puntos explorados, además las condiciones de agua y la humedad de los materiales pueden cambiar de acuerdo a la variación de las condiciones climáticas. Debido a esto, no se puede tener una total certeza de los estratos subyacentes en el área de estudio. Todas las informaciones incluidas en el presente informe están basadas en los puntos explorados y están sujetas a confirmación durante el proceso constructivo.

Por Ingeniería Global Especializada,

Arístides Carrasco C., MS.c
Director General/Consultor geotécnico

Ing. Elia Báez, MSc
Gerente de Proyecto

Hipólito Soler Jiménez, MSc
Consultor Geotécnico

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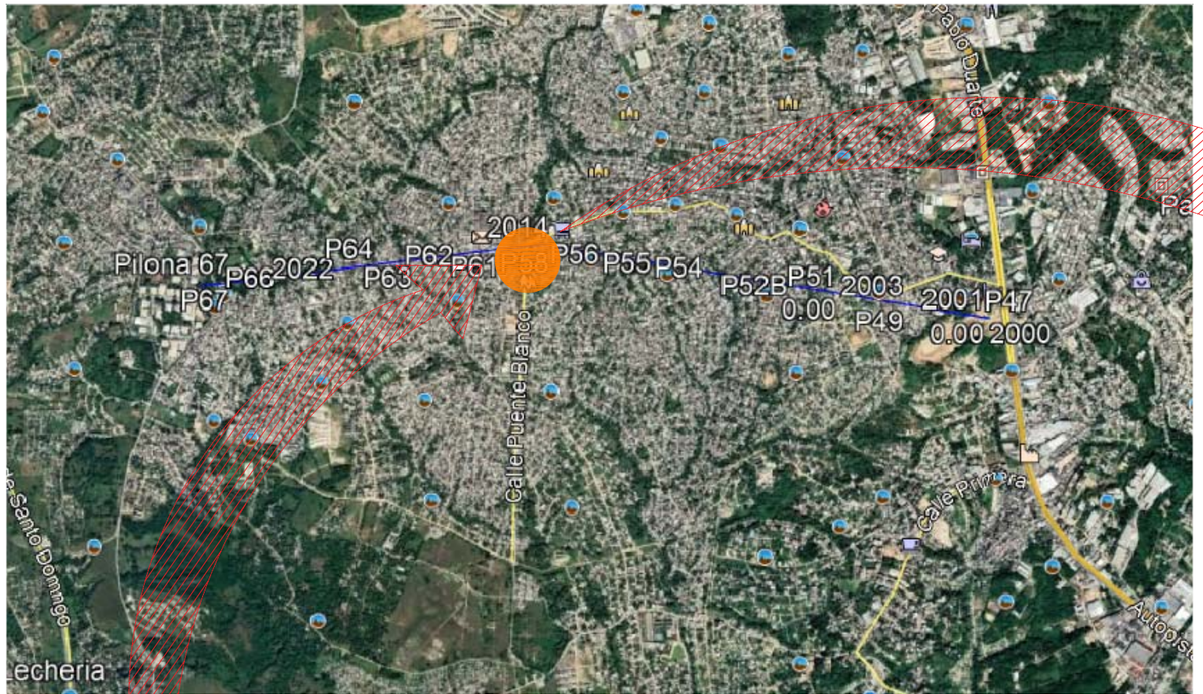
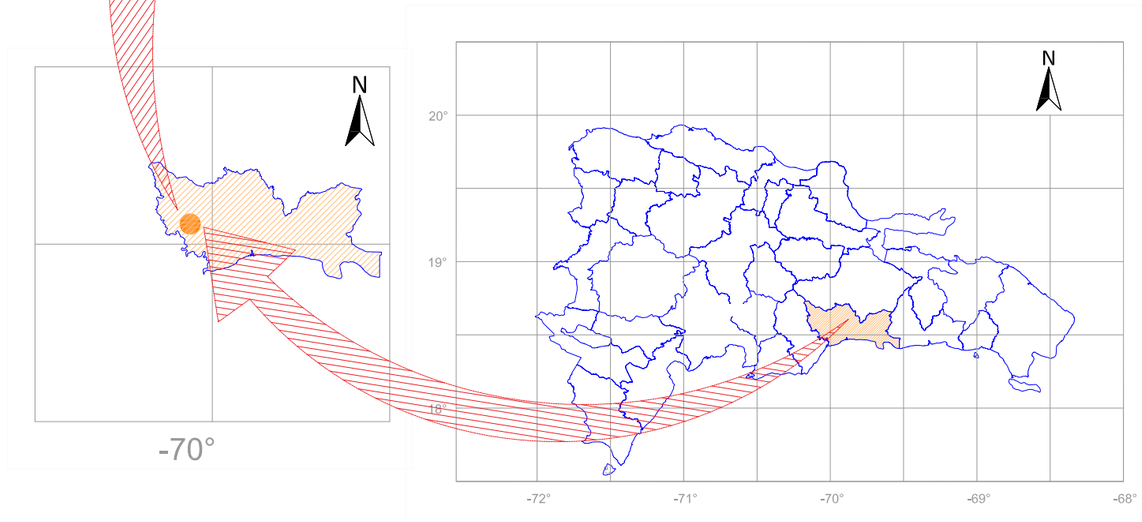
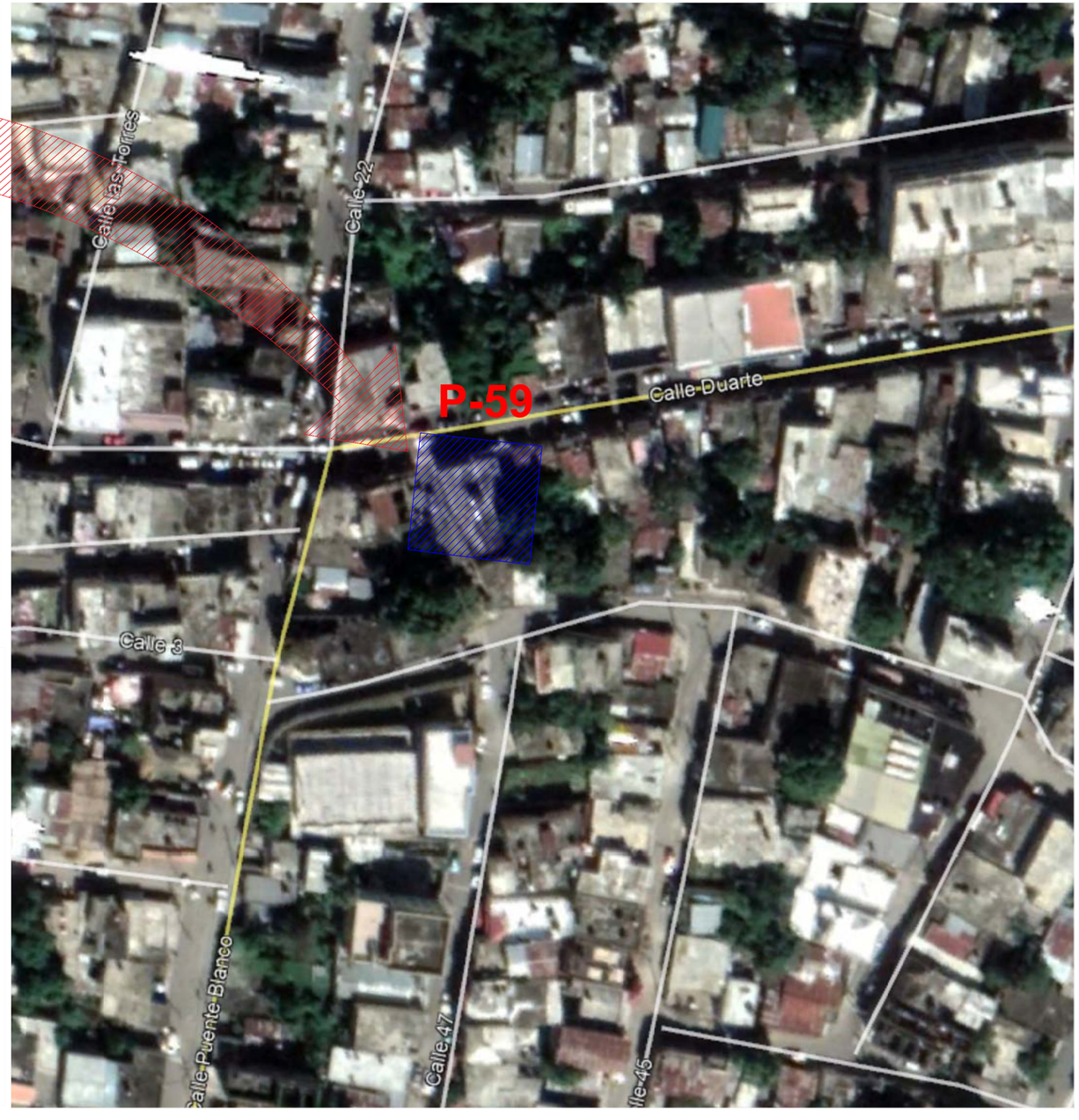
ANEXOS

ANEXO A

Planta de ubicación del sitio de estudio

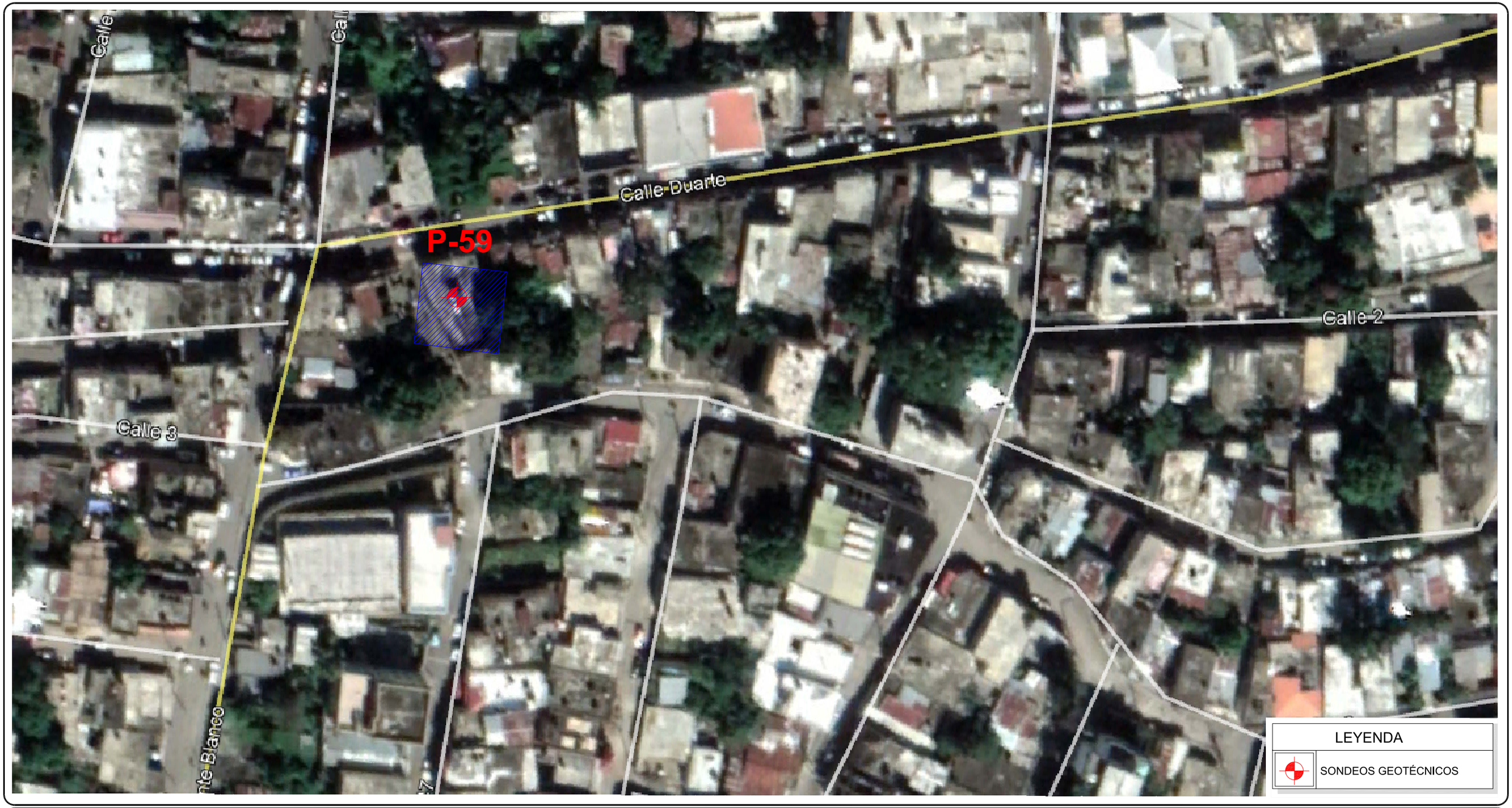






INGESA INGENIERÍA GLOBAL ESPECIALIZADA	PROYECTO: **METRO CABLE PILONA 59** Santo Domingo Oeste, Rep. Dom.	CLIENTE: **J FORTUNA**	CONTENIDO: PLANTA UBICACIÓN DE SITIO	REALIZADO POR: INGENIERÍA GLOBAL ESPECIALIZADA REVISADO POR: ING. ARISTIDES CARRASCO Codia 18370	**ING. ACC**	EMITIDO PARA INFORMACIÓN	HOJA **1**

ANEXO B
Planta de ubicación de sondeos



INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
METRO CABLE
PILONA 59
Santo Domingo Oeste, Rep. Dom.

CLIENTE:
J FORTUNA

CONTENIDO:
PLANTA UBICACIÓN DE SONDEOS

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA
REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

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HOJA
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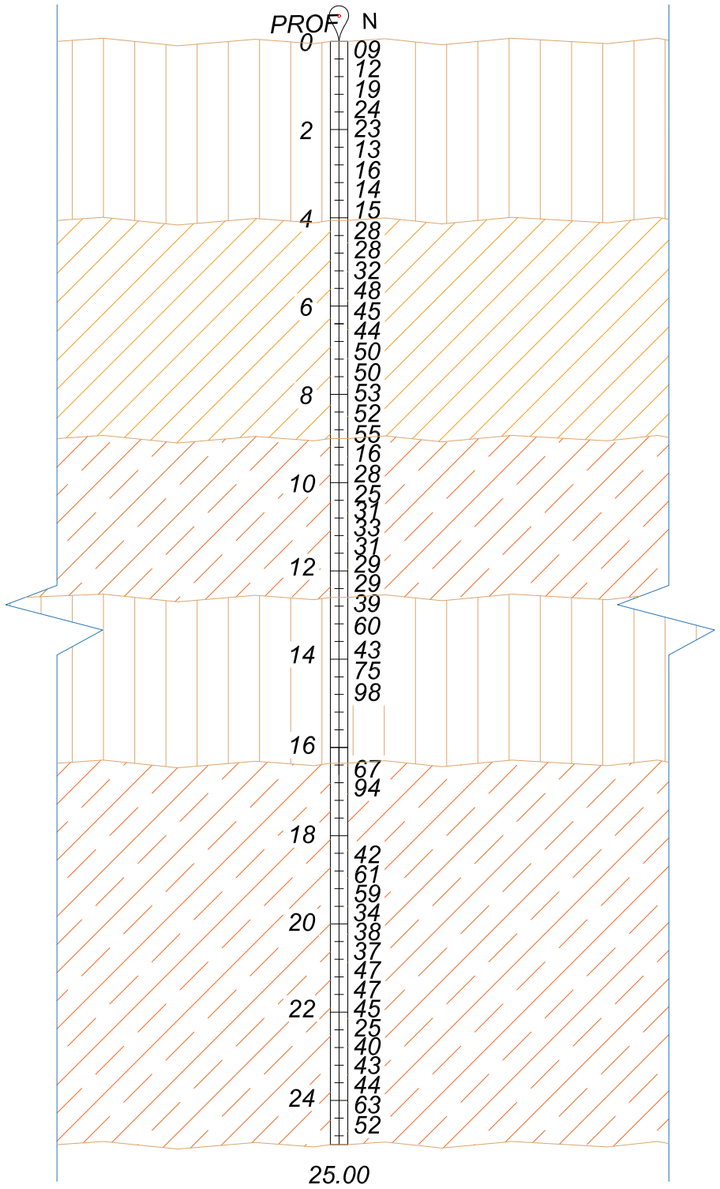
ANEXO C
Columna estratigráfica

PILONA 59



MONITOR

LEYENDA	
	LIMO DE BAJA PLASTICIDAD ARENOSO (ML)
	ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL)
	ARCILLA DE ALTA PLASTICIDAD (CH)

COLUMNA ESTRATIGRÁFICA

PILONA 59

No a escala

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
METRO CABLE
PILONA 59
Santo Domingo Oeste, Rep. Dom.

CLIENTE:
J FORTUNA

CONTENIDO:
COLUMNA ESTRATIGRAFÍCA

REALIZADO POR:
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REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

ING.
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HOJA

ANEXO D
Memoria de cálculos

Carga Axial

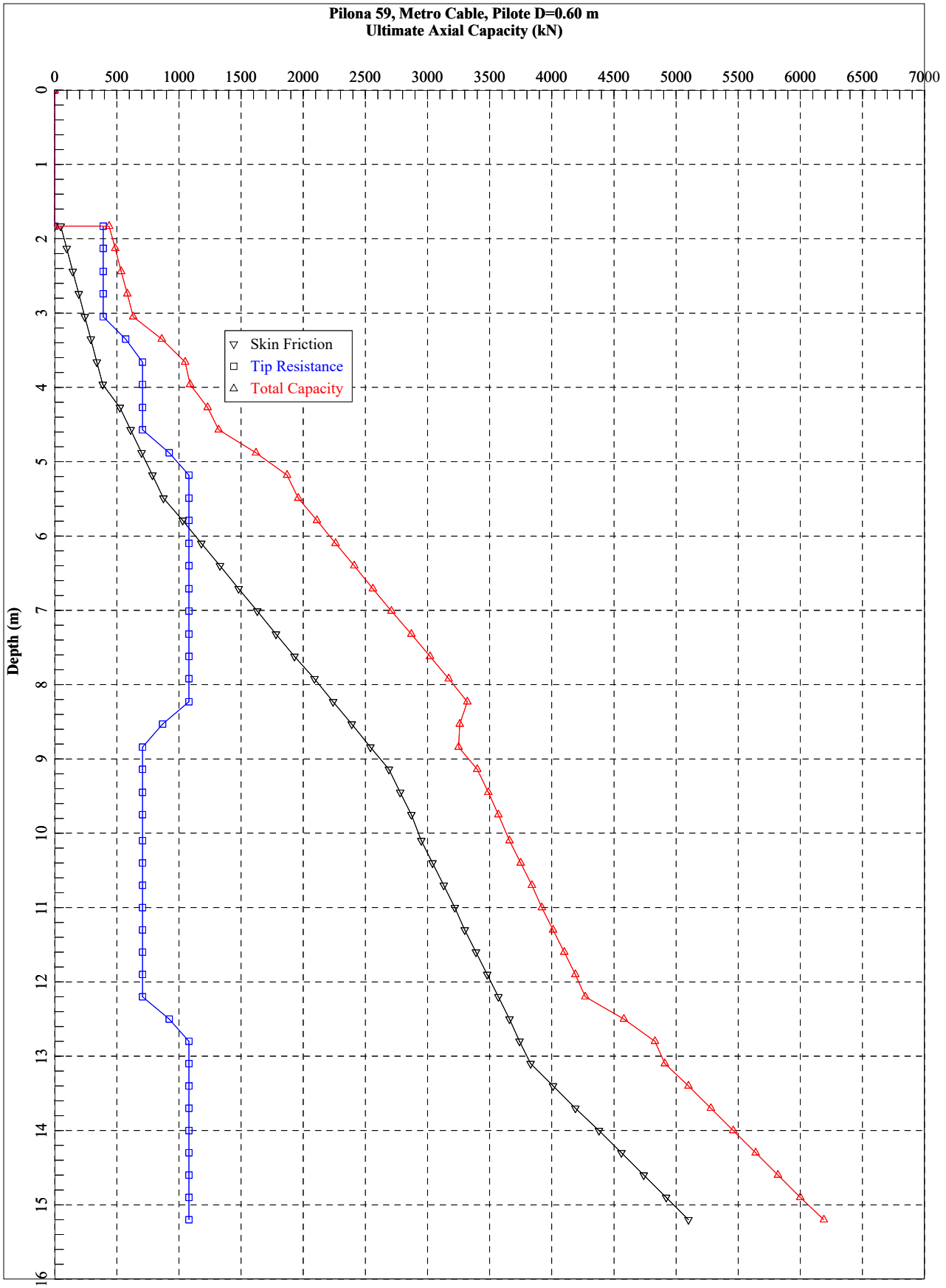
Carga Axial Compresión

Carga Axial Compresión
(Pilona 59)

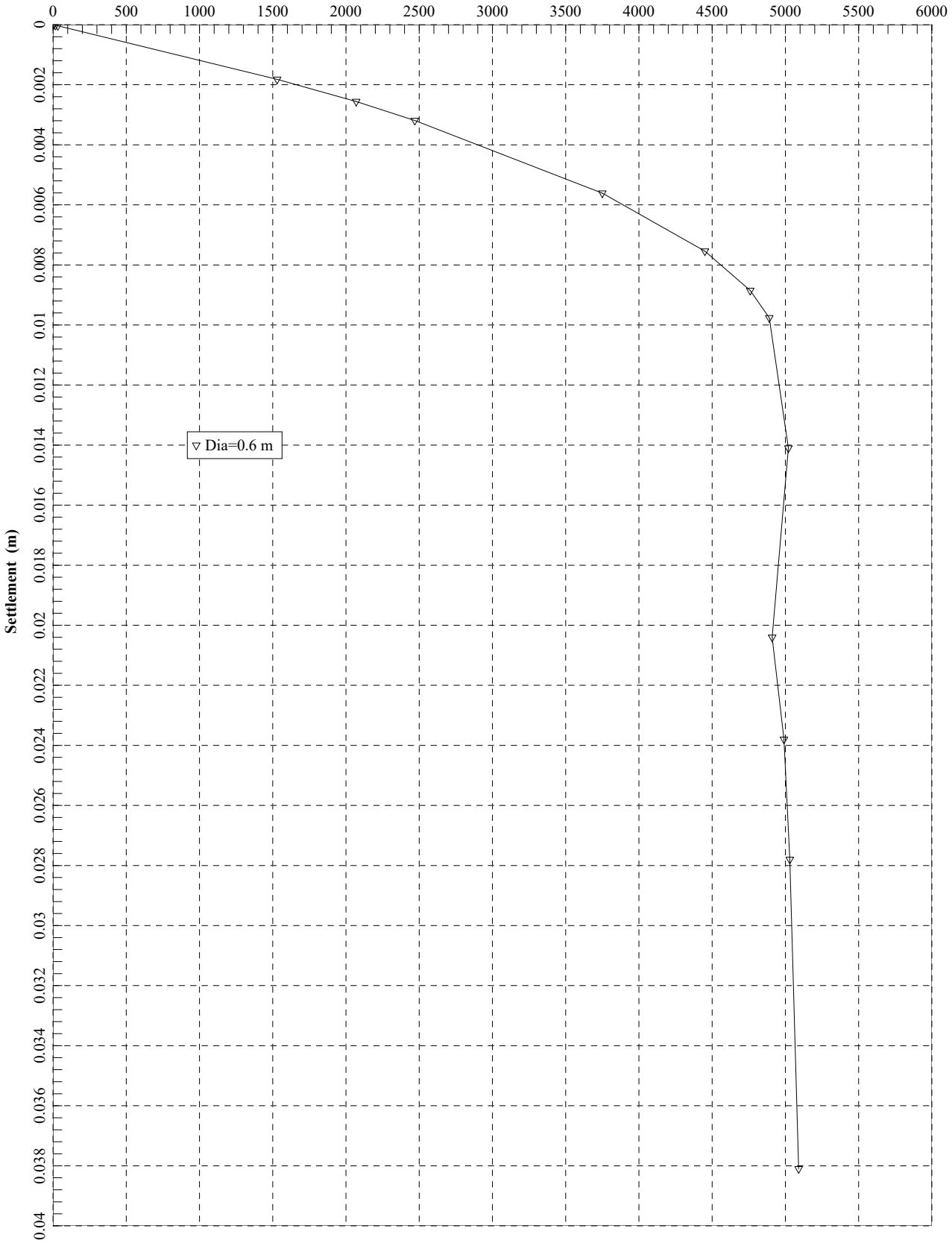
Carga Axial Compresión

(Pilona 59)

PILOTE D=0.60m


Pilona 59, Metro Cable, Pilote D=0.60 m
Ultimate Axial Capacity (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Skin Friction
Tip Resistance
Total Capacity

Pilona 59, Metro Cable, Pilote D=0.60 m
Axial Load (kN)



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                      SHAFT for Windows, Version 2017.8.9

                       Serial Number :  185077621

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2017
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Cable-- Pilonas\Pilona 59\Calculos\Axial\
     Name of input data file     : PILONA 59. Pilote D=0.60 m. Axial.sf8d
     Name of output file         : PILONA 59. Pilote D=0.60 m. Axial.sf8o
     Name of plot output file    : PILONA 59. Pilote D=0.60 m. Axial.sf8p
     Name of runtime file        : PILONA 59. Pilote D=0.60 m. Axial.sf8r


     ---------------------------------------------------------------------------
                          Time and Date of Analysis
     ---------------------------------------------------------------------------

               Date:  April 30, 2021     Time:  11:43:10

Pilona 59, Metro Cable, Pilote D=0.60 m.


PROPOSED DEPTH =      15.0 M
----------------


NUMBER OF LAYERS =    6
------------------


WATER TABLE DEPTH =      30.0 M
--------------------



FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 2.50
-----------------------------------------------------------
FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.50
-----------------------------------------------------------


SOIL INFORMATION
---------------

LAYER NO  1----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.600E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
  SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.000E+00


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
  SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.405E+01


LAYER NO  2----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
```

END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.405E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.131E+02

LAYER NO 5----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.600E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.131E+02

AT THE BOTTOM

```
  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.600E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.182E+02


LAYER NO  6----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.182E+02


  AT THE BOTTOM
  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.250E+02


(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS


INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER    =    0.600  M
 MAXIMUM SHAFT DIAMETER    =    0.600  M
 RATIO BASE/SHAFT DIAMETER =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 ELASTIC MODULUS, Ec       = 0.229E+08 KN/SQ M




COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM          =    0.600  M
 DIAMETER OF BASE          =    0.600  M
 END OF STEM TO BASE       =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 AREA OF ONE PERCENT STEEL =    0.003  SQ. M
 ELASTIC MODULUS, Ec       = 0.229E+08 KN/SQ M
 VOLUME OF UNDERREAM       =    0.000  CU. M
 SHAFT LENGTH              =   15.000  M
```

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (M)	VOLUME (CU.M)	QS (KN)	QB (KN)	QU (KN)	QBD (KN)	QDN (KN)	QU/VOLUME (KN /CU.M)
2.0	0.6	75.6	389.9	465.6	231.6	186.2	824.66
2.5	0.7	155.1	389.9	545.0	311.0	218.0	771.32
3.0	0.8	234.5	389.9	624.4	390.5	249.8	736.26
3.5	1.0	313.9	636.5	950.5	568.5	380.2	958.03
4.0	1.1	404.2	706.8	1110.9	686.9	444.4	981.73
4.5	1.3	590.6	706.8	1297.4	873.3	518.9	1019.46
5.0	1.4	734.6	987.0	1721.6	1129.4	688.6	1216.05
5.5	1.6	881.4	1083.2	1964.5	1314.6	785.8	1262.98
6.0	1.7	1129.6	1083.2	2212.8	1562.9	885.1	1303.82
6.5	1.8	1377.8	1083.2	2461.0	1811.1	984.4	1338.60
7.0	2.0	1626.1	1083.2	2709.2	2059.3	1083.7	1368.54
7.5	2.1	1874.3	1083.2	2957.5	2307.6	1183.0	1394.22
8.0	2.3	2122.5	1083.2	3205.7	2555.8	1282.3	1416.84
8.5	2.4	2370.7	892.4	3263.2	2727.7	1305.3	1357.78
9.0	2.5	2619.0	706.8	3325.7	2901.7	1330.3	1306.54
9.5	2.7	2793.0	706.8	3499.8	3075.7	1399.9	1302.71
10.0	2.8	2937.0	706.8	3643.7	3219.7	1457.5	1288.48
10.5	3.0	3080.9	706.8	3787.7	3363.6	1515.1	1275.63
11.0	3.1	3224.9	706.8	3931.7	3507.6	1572.7	1263.89
11.5	3.3	3368.9	706.8	4075.7	3651.6	1630.3	1253.22
12.0	3.4	3512.9	706.8	4219.6	3795.6	1687.9	1243.43
12.5	3.5	3656.8	923.5	4580.3	4026.2	1832.1	1295.68
13.0	3.7	3800.8	1083.2	4884.0	4234.1	1953.6	1328.50
13.5	3.8	4065.9	1083.2	5149.1	4499.2	2059.6	1348.61
14.0	4.0	4363.8	1083.2	5446.9	4797.0	2178.8	1375.73
14.5	4.1	4661.6	1083.2	5744.8	5094.9	2297.9	1400.88
15.0	4.2	4959.5	1083.2	6042.7	5392.8	2417.1	1424.43

WARNING MESSAGE

THE PREDICTED LOAD TRANSFER IN CLAY BASED ON THE N-VALUE
FROM STANDARD PENETRATION TESTS IS NOT RECOMMENDED FOR
THE FINAL DESIGN. PLEASE INPUT THE UNDRAINED SHEAR
STRENGTH FOR CLAY LAYERS IN THE FINAL DESIGN.

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.3197E+01	0.3633E-05	0.3622E-01	0.2540E-06
0.1620E+02	0.1829E-04	0.1811E+00	0.1270E-05
0.3294E+02	0.3705E-04	0.3622E+00	0.2540E-05
0.1531E+04	0.1818E-02	0.1811E+02	0.1270E-03
0.2067E+04	0.2562E-02	0.2717E+02	0.1905E-03
0.2474E+04	0.3191E-02	0.3622E+02	0.2540E-03
0.3752E+04	0.5607E-02	0.9056E+02	0.6350E-03
0.4446E+04	0.7542E-02	0.1811E+03	0.1270E-02
0.4764E+04	0.8847E-02	0.2717E+03	0.1905E-02
0.4887E+04	0.9761E-02	0.3622E+03	0.2540E-02
0.5021E+04	0.1408E-01	0.6242E+03	0.6350E-02
0.4906E+04	0.2042E-01	0.8684E+03	0.1270E-01
0.4986E+04	0.2378E-01	0.9479E+03	0.1588E-01
0.5029E+04	0.2785E-01	0.9914E+03	0.1984E-01
0.5089E+04	0.3814E-01	0.1051E+04	0.3000E-01

RESULT FROM UPPER-BOUND LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.6837E+01	0.6908E-05	0.5410E-01	0.2540E-06
0.3555E+02	0.3550E-04	0.2705E+00	0.1270E-05
0.7206E+02	0.7191E-04	0.5410E+00	0.2540E-05
0.2595E+04	0.3044E-02	0.2705E+02	0.1270E-03
0.3160E+04	0.3958E-02	0.4058E+02	0.1905E-03
0.3540E+04	0.4651E-02	0.5410E+02	0.2540E-03
0.4595E+04	0.7009E-02	0.1353E+03	0.6350E-03
0.5040E+04	0.8559E-02	0.2705E+03	0.1270E-02
0.5255E+04	0.9673E-02	0.4058E+03	0.1905E-02
0.5417E+04	0.1069E-01	0.5410E+03	0.2540E-02
0.5543E+04	0.1501E-01	0.8262E+03	0.6350E-02
0.5447E+04	0.2130E-01	0.9982E+03	0.1270E-01
0.5495E+04	0.2459E-01	0.1046E+04	0.1588E-01
0.5515E+04	0.2860E-01	0.1066E+04	0.1984E-01
0.5527E+04	0.3879E-01	0.1078E+04	0.3000E-01

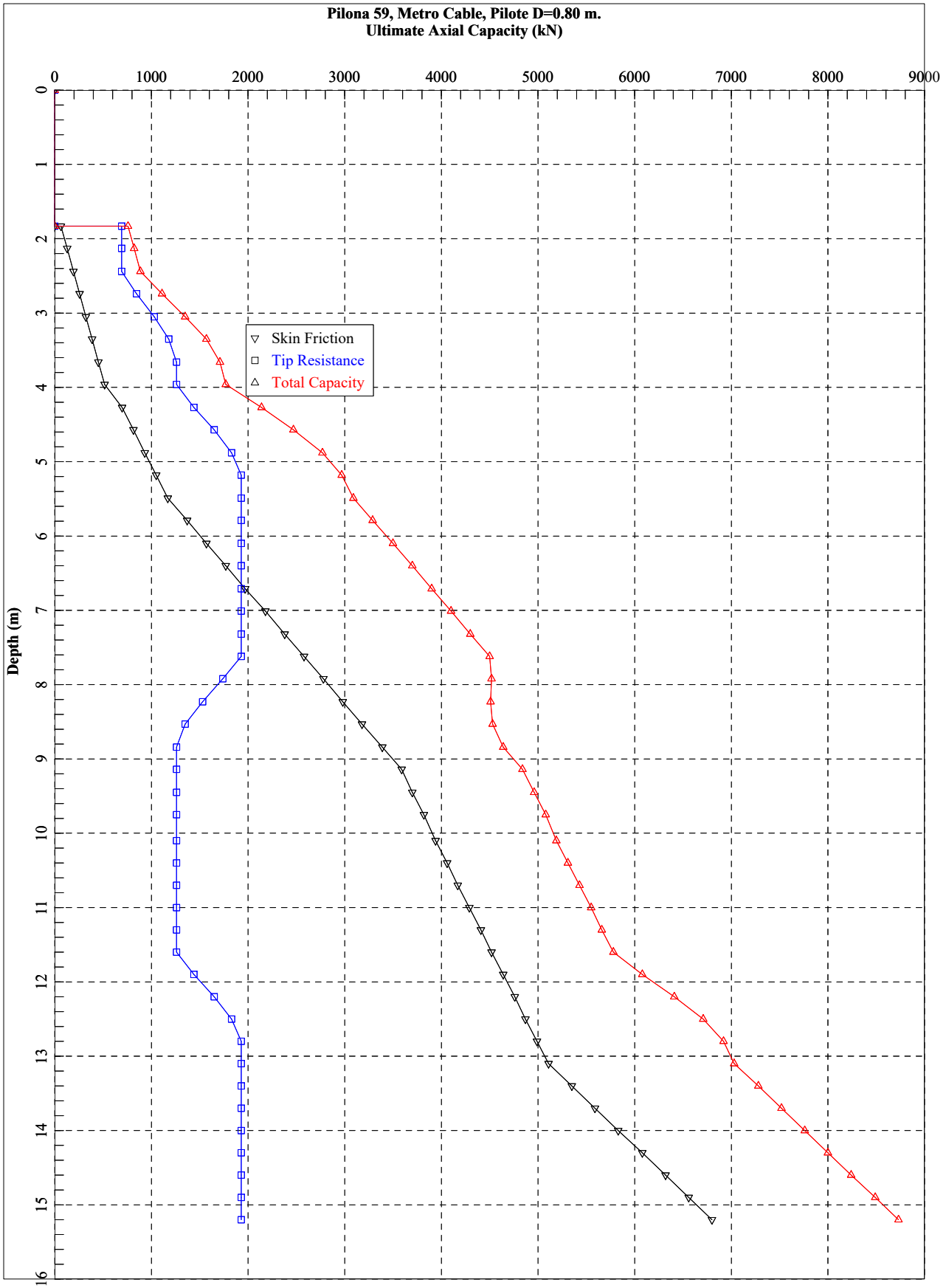
RESULT FROM LOWER-BOUND LINE

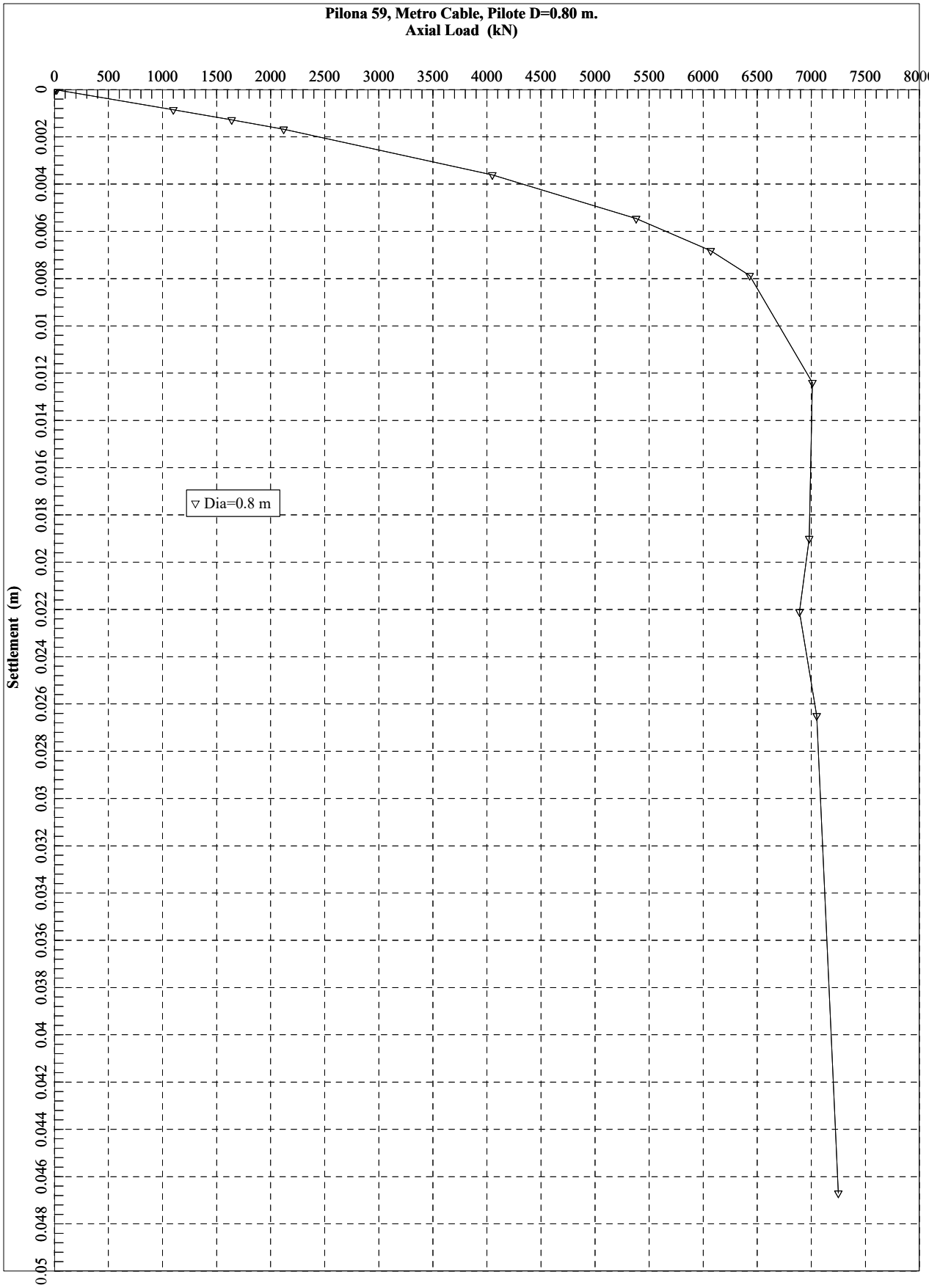
TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.1189E+01	0.1648E-05	0.1834E-01	0.2540E-06
0.5946E+01	0.8238E-05	0.9170E-01	0.1270E-05
0.1194E+02	0.1650E-04	0.1834E+00	0.2540E-05
0.6121E+03	0.8410E-03	0.9170E+01	0.1270E-03
0.9069E+03	0.1256E-02	0.1376E+02	0.1905E-03
0.1187E+04	0.1661E-02	0.1834E+02	0.2540E-03
0.2470E+04	0.3738E-02	0.4585E+02	0.6350E-03
0.3563E+04	0.6076E-02	0.9170E+02	0.1270E-02
0.4062E+04	0.7607E-02	0.1376E+03	0.1905E-02
0.4295E+04	0.8703E-02	0.1834E+03	0.2540E-02
0.4442E+04	0.1309E-01	0.4222E+03	0.6350E-02
0.4365E+04	0.1954E-01	0.7385E+03	0.1270E-01
0.4477E+04	0.2297E-01	0.8498E+03	0.1588E-01
0.4542E+04	0.2709E-01	0.9148E+03	0.1984E-01
0.4645E+04	0.3749E-01	0.1018E+04	0.3000E-01

Carga Axial Compresión

(Pilona 59)

PILOTE D=0.80m


Pilona 59, Metro Cable, Pilote D=0.80 m.
Ultimate Axial Capacity (kN)
0
1000
2000
3000
4000
5000
6000
7000
8000
9000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Skin Friction
Tip Resistance
Total Capacity


Pilona 59, Metro Cable, Pilote D=0.80 m.
Axial Load (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
6500
7000
7500
8000
Settlement (m)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
0.022
0.024
0.026
0.028
0.03
0.032
0.034
0.036
0.038
0.04
0.042
0.044
0.046
0.048
0.05
▽ Dia=0.8 m

```
     ==========================================================================

                       SHAFT for Windows, Version 2017.8.9

                        Serial Number :  185077621

                     VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                      (c) Copyright ENSOFT, Inc., 1987-2017
                            All Rights Reserved

     ==========================================================================


     Path to file locations      : \\192.168.1.2\Proyectos\INVESTIGACION GEOTECNICA\PROYECTOS 2021\J Fortuna\Metro
Cable-- Pilonas\Pilona 59\Calculos\Axial\
     Name of input data file     : PILONA 59. Pilote D=0.80 m. Axial.sf8d
     Name of output file         : PILONA 59. Pilote D=0.80 m. Axial.sf8o
     Name of plot output file    : PILONA 59. Pilote D=0.80 m. Axial.sf8p
     Name of runtime file        : PILONA 59. Pilote D=0.80 m. Axial.sf8r


     ---------------------------------------------------------------------------
                           Time and Date of Analysis
     ---------------------------------------------------------------------------

               Date:  April 30, 2021     Time:  12:05:03

Pilona 59, Metro Cable, Pilote D=0.80 m.


PROPOSED DEPTH =      15.0 M
----------------


NUMBER OF LAYERS =    6
------------------


WATER TABLE DEPTH =      30.0 M
--------------------



FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 2.50
-----------------------------------------------------------
FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.50
-----------------------------------------------------------


SOIL INFORMATION
---------------

LAYER NO  1----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.600E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
  SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.000E+00


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
  SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.405E+01


LAYER NO  2----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
```

```
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.290E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.180E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.405E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.290E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.180E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.540E+01


LAYER NO  3----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.500E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.540E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.500E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.900E+01


LAYER NO  4----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.290E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.180E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.900E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.290E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.180E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.131E+02


LAYER NO  5----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                     = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                          = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                   = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST       = 0.600E+02
  SOIL UNIT WEIGHT, KN/CU M                           = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M             = 0.100E+11
  DEPTH, M                                            = 0.131E+02


  AT THE BOTTOM
```

```
  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.600E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.182E+02


LAYER NO  6----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.182E+02


  AT THE BOTTOM
  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.250E+02


(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS


INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER    =    0.800  M
 MAXIMUM SHAFT DIAMETER    =    0.800  M
 RATIO BASE/SHAFT DIAMETER =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 ELASTIC MODULUS, Ec       = 0.229E+08 KN/SQ M




COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM          =    0.800  M
 DIAMETER OF BASE          =    0.800  M
 END OF STEM TO BASE       =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 AREA OF ONE PERCENT STEEL =    0.005  SQ. M
 ELASTIC MODULUS, Ec       = 0.229E+08 KN/SQ M
 VOLUME OF UNDERREAM       =    0.000  CU. M
 SHAFT LENGTH              =   15.000  M
```

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (M)	VOLUME (CU.M)	QS (KN)	QB (KN)	QU (KN)	QBD (KN)	QDN (KN)	QU/VOLUME (KN /CU.M)
2.0	1.0	100.8	693.2	794.1	378.1	317.6	791.86
2.5	1.3	206.7	724.3	931.0	496.4	372.4	739.18
3.0	1.5	312.6	997.8	1310.5	711.8	524.2	867.79
3.5	1.8	418.6	1216.8	1635.3	905.3	654.1	929.36
4.0	2.0	538.9	1279.0	1817.9	1050.5	727.1	903.07
4.5	2.3	787.5	1601.6	2389.0	1428.1	955.6	1055.02
5.0	2.5	979.4	1871.3	2850.7	1727.9	1140.3	1133.82
5.5	2.8	1175.2	1925.7	3100.8	1945.4	1240.3	1121.35
6.0	3.0	1506.1	1925.7	3431.8	2276.4	1372.7	1137.55
6.5	3.3	1837.1	1925.7	3762.8	2607.4	1505.1	1151.34
7.0	3.5	2168.1	1925.7	4093.7	2938.3	1637.5	1163.21
7.5	3.8	2499.0	1925.7	4424.7	3269.3	1769.9	1173.39
8.0	4.0	2830.0	1690.7	4520.7	3506.3	1808.3	1124.29
8.5	4.3	3161.0	1368.4	4529.4	3708.3	1811.8	1060.01
9.0	4.5	3492.0	1256.5	4748.5	3994.6	1899.4	1049.34
9.5	4.8	3724.0	1256.5	4980.5	4226.6	1992.2	1042.81
10.0	5.0	3916.0	1256.5	5172.4	4418.5	2069.0	1028.85
10.5	5.3	4107.9	1256.5	5364.4	4610.5	2145.8	1016.24
11.0	5.5	4299.9	1256.5	5556.4	4802.5	2222.5	1004.72
11.5	5.8	4491.8	1256.5	5748.3	4994.4	2299.3	994.26
12.0	6.0	4683.8	1517.7	6201.5	5290.9	2480.6	1027.74
12.5	6.3	4875.8	1835.3	6711.1	5609.9	2684.4	1067.88
13.0	6.5	5067.7	1925.7	6993.4	5838.0	2797.4	1070.04
13.5	6.8	5421.2	1925.7	7346.8	6191.4	2938.7	1082.39
14.0	7.0	5818.3	1925.7	7744.0	6588.6	3097.6	1100.20
14.5	7.3	6215.5	1925.7	8141.2	6985.8	3256.5	1116.71
15.0	7.5	6612.7	1925.7	8538.3	7382.9	3415.3	1132.17

WARNING MESSAGE

THE PREDICTED LOAD TRANSFER IN CLAY BASED ON THE N-VALUE
FROM STANDARD PENETRATION TESTS IS NOT RECOMMENDED FOR
THE FINAL DESIGN. PLEASE INPUT THE UNDRAINED SHEAR
STRENGTH FOR CLAY LAYERS IN THE FINAL DESIGN.

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.2138E+01	0.1671E-05	0.4830E-01	0.2540E-06
0.1069E+02	0.8357E-05	0.2415E+00	0.1270E-05
0.2147E+02	0.1674E-04	0.4830E+00	0.2540E-05
0.1102E+04	0.8534E-03	0.2415E+02	0.1270E-03
0.1636E+04	0.1277E-02	0.3622E+02	0.1905E-03
0.2117E+04	0.1685E-02	0.4830E+02	0.2540E-03
0.4049E+04	0.3615E-02	0.1207E+03	0.6350E-03
0.5383E+04	0.5459E-02	0.2415E+03	0.1270E-02
0.6075E+04	0.6824E-02	0.3622E+03	0.1905E-02
0.6435E+04	0.7871E-02	0.4830E+03	0.2540E-02
0.7013E+04	0.1243E-01	0.9472E+03	0.6350E-02
0.6980E+04	0.1900E-01	0.1376E+04	0.1270E-01
0.6887E+04	0.2211E-01	0.1502E+04	0.1588E-01
0.7050E+04	0.2645E-01	0.1666E+04	0.2000E-01
0.7252E+04	0.4671E-01	0.1868E+04	0.4000E-01

RESULT FROM UPPER-BOUND LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.4018E+01	0.2748E-05	0.7214E-01	0.2540E-06
0.2016E+02	0.1375E-04	0.3607E+00	0.1270E-05
0.4099E+02	0.2780E-04	0.7214E+00	0.2540E-05
0.2056E+04	0.1412E-02	0.3607E+02	0.1270E-03
0.2882E+04	0.2059E-02	0.5410E+02	0.1905E-03
0.3538E+04	0.2631E-02	0.7214E+02	0.2540E-03
0.5543E+04	0.4869E-02	0.1803E+03	0.6350E-03
0.6461E+04	0.6484E-02	0.3607E+03	0.1270E-02
0.6887E+04	0.7603E-02	0.5410E+03	0.1905E-02
0.7176E+04	0.8581E-02	0.7214E+03	0.2540E-02
0.7814E+04	0.1326E-01	0.1317E+04	0.6350E-02
0.7729E+04	0.1973E-01	0.1673E+04	0.1270E-01
0.7682E+04	0.2287E-01	0.1749E+04	0.1588E-01
0.7781E+04	0.2713E-01	0.1848E+04	0.2000E-01
0.7848E+04	0.4721E-01	0.1916E+04	0.4000E-01

RESULT FROM LOWER-BOUND LINE

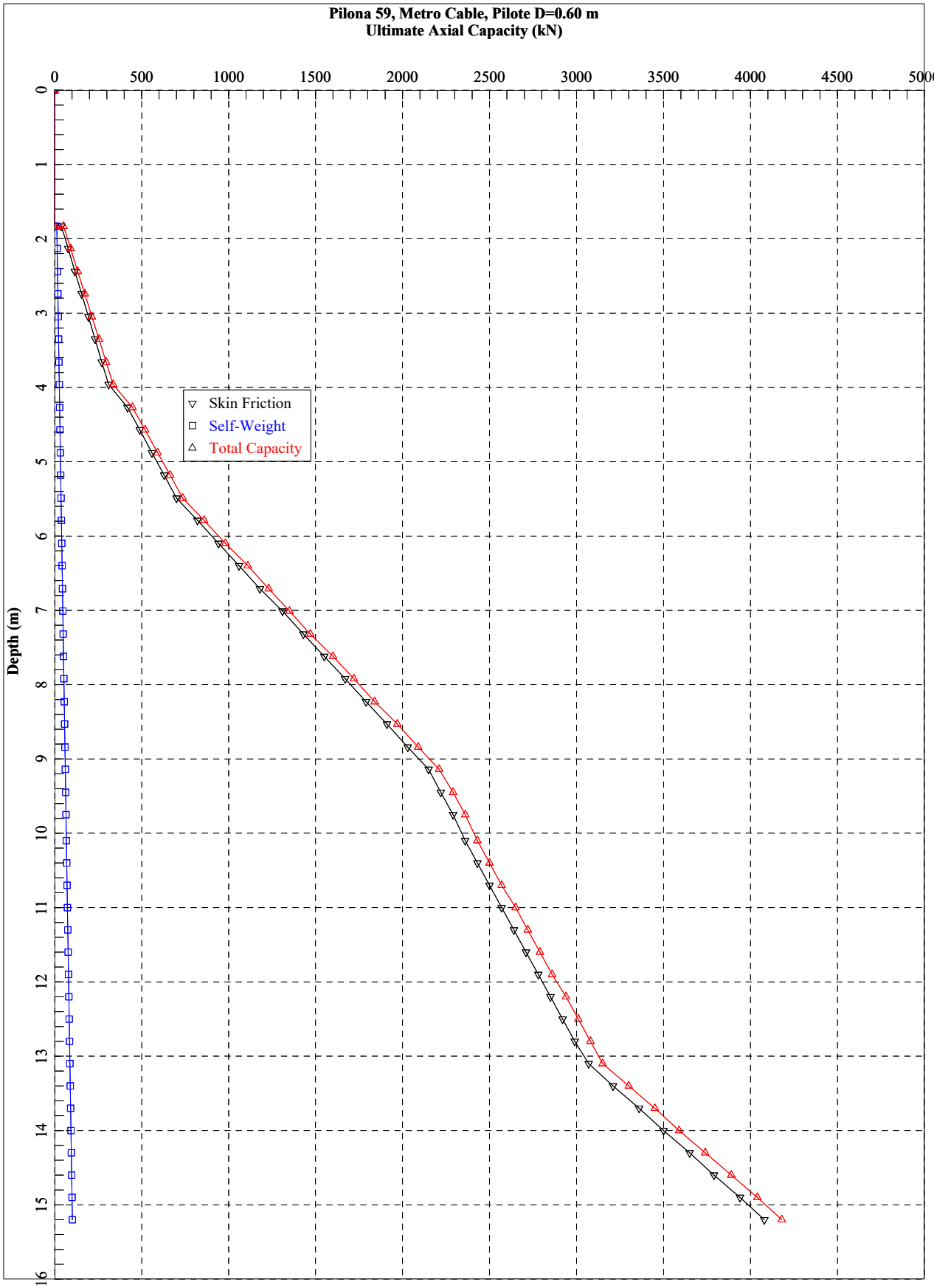
TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.9223E+00	0.9133E-06	0.2445E-01	0.2540E-06
0.4612E+01	0.4567E-05	0.1223E+00	0.1270E-05
0.9223E+01	0.9133E-05	0.2445E+00	0.2540E-05
0.4691E+03	0.4612E-03	0.1223E+02	0.1270E-03
0.7037E+03	0.6918E-03	0.1834E+02	0.1905E-03
0.9383E+03	0.9225E-03	0.2445E+02	0.2540E-03
0.2228E+04	0.2256E-02	0.6113E+02	0.6350E-03
0.3779E+04	0.4115E-02	0.1223E+03	0.1270E-02
0.4751E+04	0.5609E-02	0.1834E+03	0.1905E-02
0.5322E+04	0.6784E-02	0.2445E+03	0.2540E-02
0.6212E+04	0.1161E-01	0.5774E+03	0.6350E-02
0.6104E+04	0.1814E-01	0.1079E+04	0.1270E-01
0.6091E+04	0.2136E-01	0.1254E+04	0.1588E-01
0.6319E+04	0.2578E-01	0.1483E+04	0.2000E-01
0.6646E+04	0.4620E-01	0.1810E+04	0.4000E-01

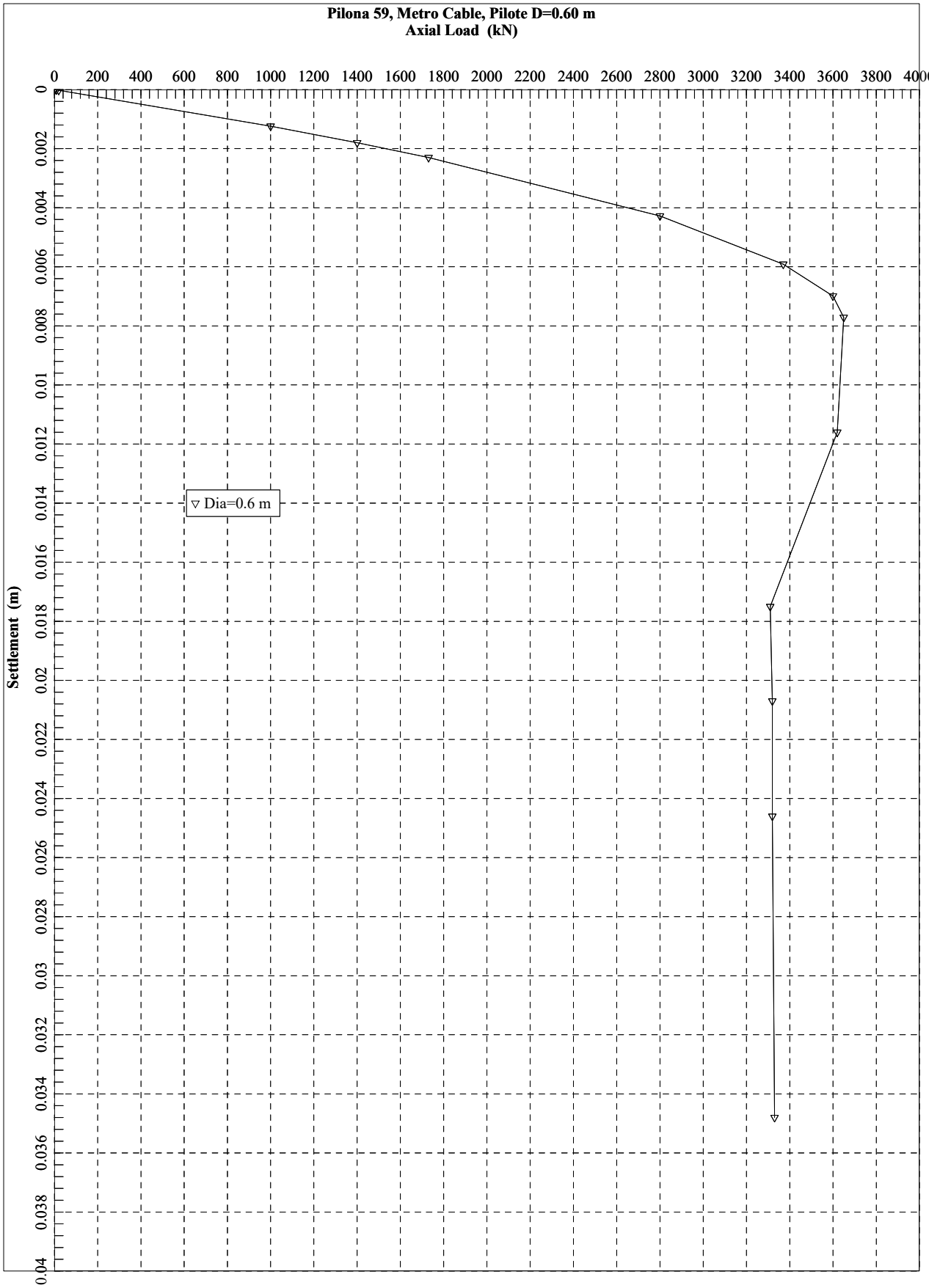
Carga Axial Tracción

Carga Axial Tracción
(Pilona 59)

Carga Axial Tracción
(Pilona 59)

PILOTE D=0.60m


Pilona 59, Metro Cable, Pilote D=0.60 m
Ultimate Axial Capacity (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Skin Friction
Self-Weight
Total Capacity


Pilona 59, Metro Cable, Pilote D=0.60 m
Axial Load (kN)
0 200 400 600 800 1000 1200 1400 1600 1800 2000 2200 2400 2600 2800 3000 3200 3400 3600 3800 4000
Settlement (m)
0 0.002 0.004 0.006 0.008 0.01 0.012 0.014 0.016 0.018 0.02 0.022 0.024 0.026 0.028 0.03 0.032 0.034 0.036 0.038 0.04
▽ Dia=0.6 m

```
     ========================================================================

                      SHAFT for Windows, Version 2017.8.9

                       Serial Number :  185077621

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2017
                           All Rights Reserved

     ========================================================================


     Path to file locations      : \\192.168.1.2\Proyectos\INVESTIGACION GEOTECNICA\PROYECTOS 2021\J Fortuna\Metro
Cable-- Pilonas\Pilona 59\Calculos\Axial\
     Name of input data file     : PILONA 59. Pilote D=0.60 m. Axial.sf8d
     Name of output file         : PILONA 59. Pilote D=0.60 m. Axial.sf8o
     Name of plot output file    : PILONA 59. Pilote D=0.60 m. Axial.sf8p
     Name of runtime file        : PILONA 59. Pilote D=0.60 m. Axial.sf8r


     ------------------------------------------------------------------------
                          Time and Date of Analysis
     ------------------------------------------------------------------------

               Date:  April 30, 2021     Time:  11:51:43

     Pilona 59, Metro Cable, Pilote D=0.60 m.


     PROPOSED DEPTH =      15.0 M
     ----------------


     REDUCTION FACTOR APPLIED FOR UPLIFT FRICTION = 0.800
     ------------------------------------------------


     NUMBER OF LAYERS =    6
     ------------------


     WATER TABLE DEPTH =      30.0 M
     -------------------



     FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 2.50
     ----------------------------------------------------------
     FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.50
     ----------------------------------------------------


     SOIL INFORMATION
     ---------------

     LAYER NO  1----CLAY

       AT THE TOP

       STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
       END BEARING COEFFICIENT-Nc                         = 0.600E+01  (*)
       UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
       BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
       SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
       MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
       DEPTH, M                                           = 0.000E+00


       AT THE BOTTOM

       STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
       END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
       UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
       BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
       SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
       MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
       DEPTH, M                                           = 0.405E+01


     LAYER NO  2----CLAY
```

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.405E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.131E+02

LAYER NO 5----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.600E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11

DEPTH, M = 0.131E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.600E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.182E+02

LAYER NO 6----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.450E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.182E+02

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.450E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.250E+02

(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS

INPUT DRILLED SHAFT INFORMATION

MINIMUM SHAFT DIAMETER = 0.600 M
MAXIMUM SHAFT DIAMETER = 0.600 M
RATIO BASE/SHAFT DIAMETER = 0.000 M
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 1.500 M
IGNORED BOTTOM PORTION = 0.000 M
ELASTIC MODULUS, Ec = 0.229E+08 KN/SQ M

COMPUTATION RESULTS

- CASE ANALYZED : 1
VARIATION LENGTH : 1
VARIATION DIAMETER : 1

DRILLED SHAFT INFORMATION

DIAMETER OF STEM = 0.600 M
DIAMETER OF BASE = 0.600 M
END OF STEM TO BASE = 0.000 M
ANGLE OF BELL = 0.000 DEG.
IGNORED TOP PORTION = 1.500 M
IGNORED BOTTOM PORTION = 0.000 M
AREA OF ONE PERCENT STEEL = 0.003 SQ. M

ELASTIC MODULUS, Ec = 0.229E+08 KN/SQ M
VOLUME OF UNDERREAM = 0.000 CU. M
SHAFT LENGTH = 15.000 M

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (M)	VOLUME (CU.M)	QS (KN)	WT (KN)	QU (KN)	QBD (KN)	QDN (KN)	QU/VOLUME (KN)
2.0	0.6	60.5	13.3	73.8	73.8	37.5	128.51
2.5	0.7	124.0	16.7	140.7	140.7	66.3	198.39
3.0	0.8	187.6	20.0	207.6	207.6	95.0	244.33
3.5	1.0	251.1	23.3	274.5	274.5	123.8	276.91
4.0	1.1	323.3	26.7	350.0	350.0	156.0	308.81
4.5	1.3	472.5	30.0	502.5	502.5	219.0	394.45
5.0	1.4	587.7	33.3	621.0	621.0	268.4	438.80
5.5	1.6	705.1	36.6	741.7	741.7	318.7	476.76
6.0	1.7	903.7	40.0	943.7	943.7	401.4	555.64
6.5	1.8	1102.3	43.3	1145.6	1145.6	484.2	622.81
7.0	2.0	1300.8	46.6	1347.5	1347.5	567.0	680.63
7.5	2.1	1499.4	50.0	1549.4	1549.4	649.7	730.22
8.0	2.3	1698.0	53.3	1751.3	1751.3	732.5	773.92
8.5	2.4	1896.6	56.6	1953.2	1953.2	815.3	812.47
9.0	2.5	2095.2	60.0	2155.1	2155.1	898.0	846.58
9.5	2.7	2234.4	63.3	2297.7	2297.7	957.1	855.24
10.0	2.8	2349.6	66.6	2416.2	2416.2	1006.5	854.38
10.5	3.0	2464.8	70.0	2534.7	2534.7	1055.9	853.61
11.0	3.1	2579.9	73.3	2653.2	2653.2	1105.3	852.90
11.5	3.3	2695.1	76.6	2771.7	2771.7	1154.7	852.26
12.0	3.4	2810.3	80.0	2890.2	2890.2	1204.1	851.67
12.5	3.5	2925.5	83.3	3008.8	3008.8	1253.5	851.13
13.0	3.7	3040.6	86.6	3127.3	3127.3	1302.9	850.63
13.5	3.8	3252.7	90.0	3342.7	3342.7	1391.0	875.45
14.0	4.0	3491.0	93.3	3584.3	3584.3	1489.7	905.27
14.5	4.1	3729.3	96.6	3825.9	3825.9	1588.3	932.92
15.0	4.2	3967.6	99.9	4067.6	4067.6	1687.0	958.82

WARNING MESSAGE

THE PREDICTED LOAD TRANSFER IN CLAY BASED ON THE N-VALUE
FROM STANDARD PENETRATION TESTS IS NOT RECOMMENDED FOR
THE FINAL DESIGN. PLEASE INPUT THE UNDRAINED SHEAR
STRENGTH FOR CLAY LAYERS IN THE FINAL DESIGN.

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.1984E+01	0.2433E-05	0.3396E-02	0.2540E-06
0.9922E+01	0.1217E-04	0.1698E-01	0.1270E-05
0.2020E+02	0.2457E-04	0.3396E-01	0.2540E-05
0.1000E+04	0.1241E-02	0.1698E+01	0.1270E-03
0.1401E+04	0.1802E-02	0.2547E+01	0.1905E-03
0.1730E+04	0.2297E-02	0.3396E+01	0.2540E-03
0.2800E+04	0.4283E-02	0.8490E+01	0.6350E-03
0.3374E+04	0.5907E-02	0.1698E+02	0.1270E-02
0.3604E+04	0.6988E-02	0.2547E+02	0.1905E-02
0.3653E+04	0.7712E-02	0.3396E+02	0.2540E-02
0.3623E+04	0.1156E-01	0.5852E+02	0.6350E-02
0.3312E+04	0.1746E-01	0.8141E+02	0.1270E-01
0.3319E+04	0.2065E-01	0.8887E+02	0.1588E-01

0.3323E+04	0.2463E-01	0.9295E+02	0.1984E-01
0.3329E+04	0.3480E-01	0.9849E+02	0.3000E-01

RESULT FROM UPPER-BOUND LINE

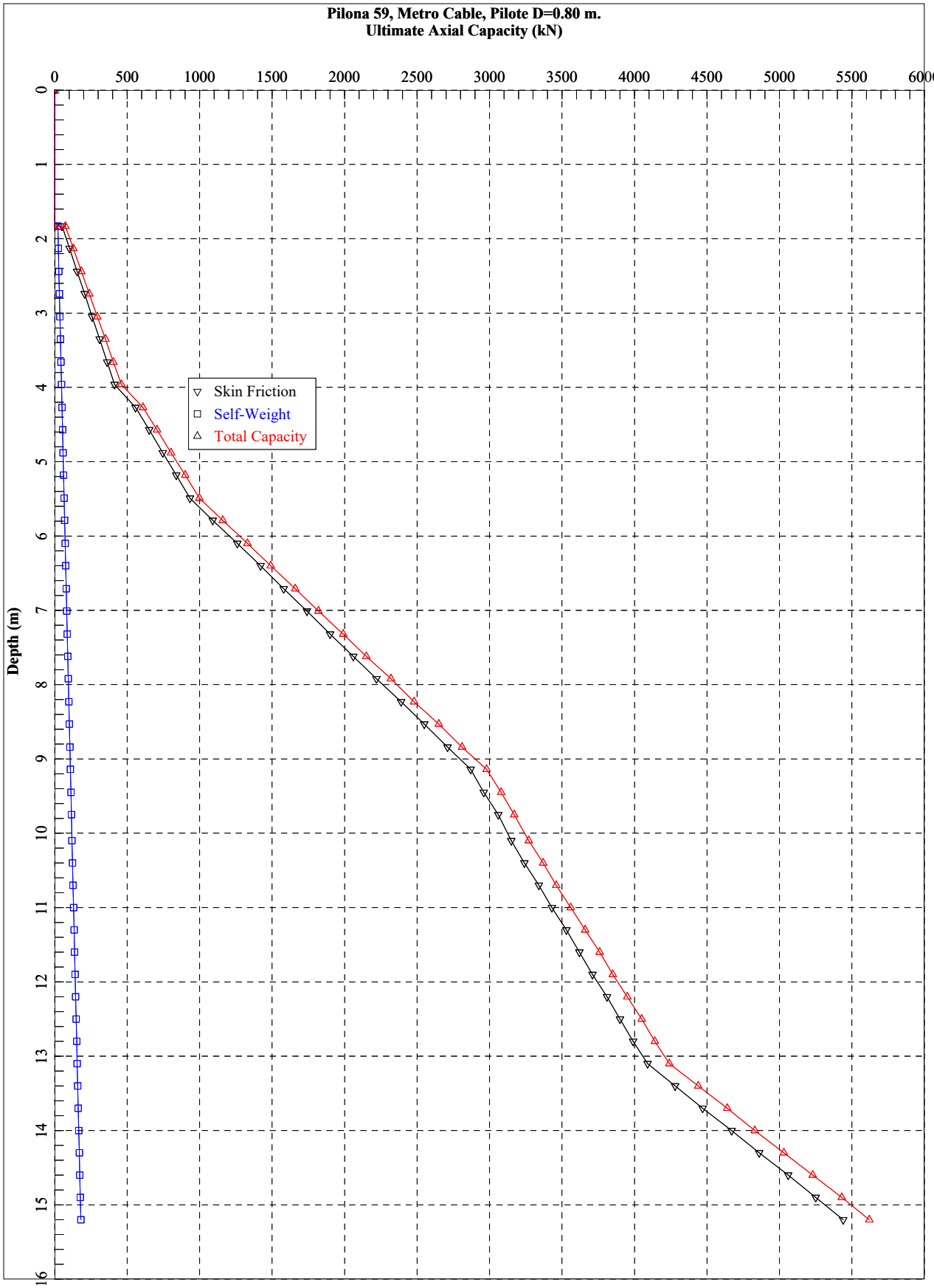
TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.3958E+01	0.4289E-05	0.5072E-02	0.2540E-06
0.2019E+02	0.2169E-04	0.2536E-01	0.1270E-05
0.4104E+02	0.4398E-04	0.5072E-01	0.2540E-05
0.1769E+04	0.2079E-02	0.2536E+01	0.1270E-03
0.2260E+04	0.2829E-02	0.3804E+01	0.1905E-03
0.2602E+04	0.3421E-02	0.5072E+01	0.2540E-03
0.3510E+04	0.5410E-02	0.1268E+02	0.6350E-03
0.3811E+04	0.6613E-02	0.2536E+02	0.1270E-02
0.3909E+04	0.7434E-02	0.3804E+02	0.1905E-02
0.3961E+04	0.8175E-02	0.5072E+02	0.2540E-02
0.3908E+04	0.1198E-01	0.7746E+02	0.6350E-02
0.3653E+04	0.1795E-01	0.9359E+02	0.1270E-01
0.3657E+04	0.2114E-01	0.9807E+02	0.1588E-01
0.3659E+04	0.2511E-01	0.9998E+02	0.1984E-01
0.3660E+04	0.3527E-01	0.1010E+03	0.3000E-01

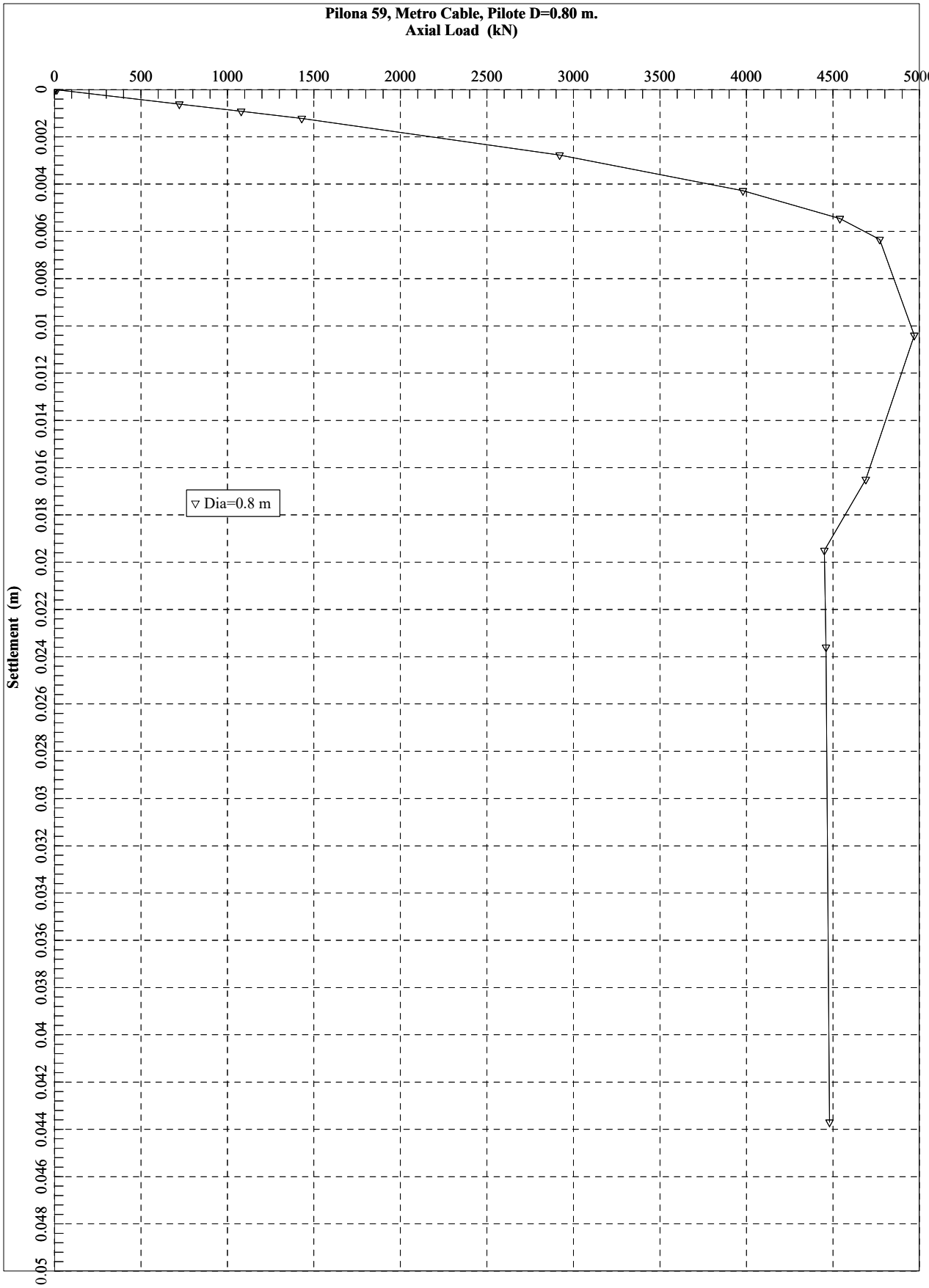
RESULT FROM LOWER-BOUND LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.8036E+00	0.1219E-05	0.1719E-02	0.2540E-06
0.4018E+01	0.6097E-05	0.8597E-02	0.1270E-05
0.8036E+01	0.1219E-04	0.1719E-01	0.2540E-05
0.4113E+03	0.6190E-03	0.8597E+00	0.1270E-03
0.6150E+03	0.9278E-03	0.1290E+01	0.1905E-03
0.8113E+03	0.1233E-02	0.1719E+01	0.2540E-03
0.1773E+04	0.2861E-02	0.4299E+01	0.6350E-03
0.2678E+04	0.4833E-02	0.8597E+01	0.1270E-02
0.3098E+04	0.6165E-02	0.1290E+02	0.1905E-02
0.3287E+04	0.7131E-02	0.1719E+02	0.2540E-02
0.3303E+04	0.1110E-01	0.3958E+02	0.6350E-02
0.2971E+04	0.1697E-01	0.6923E+02	0.1270E-01
0.2981E+04	0.2016E-01	0.7967E+02	0.1588E-01
0.2987E+04	0.2415E-01	0.8576E+02	0.1984E-01
0.2997E+04	0.3433E-01	0.9545E+02	0.3000E-01

Carga Axial Tracción
(Pilona 59)

PILOTE D=0.80m


Pilona 59, Metro Cable, Pilote D=0.80 m.
Ultimate Axial Capacity (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
Skin Friction
Self-Weight
Total Capacity


Pilona 59, Metro Cable, Pilote D=0.80 m.
Axial Load (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
Settlement (m)
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
0.022
0.024
0.026
0.028
0.03
0.032
0.034
0.036
0.038
0.04
0.042
0.044
0.046
0.048
0.05
Dia=0.8 m

```
     ========================================================================

                      SHAFT for Windows, Version 2017.8.9

                       Serial Number :  185077621

                    VERTICALLY LOADED DRILLED SHAFT ANALYSIS
                     (c) Copyright ENSOFT, Inc., 1987-2017
                           All Rights Reserved

     ========================================================================


     Path to file locations      : \\192.168.1.2\Proyectos\INVESTIGACION GEOTECNICA\PROYECTOS 2021\J Fortuna\Metro
Cable-- Pilonas\Pilona 59\Calculos\Axial\
     Name of input data file     : PILONA 59. Pilote D=0.80 m. Axial.sf8d
     Name of output file         : PILONA 59. Pilote D=0.80 m. Axial.sf8o
     Name of plot output file    : PILONA 59. Pilote D=0.80 m. Axial.sf8p
     Name of runtime file        : PILONA 59. Pilote D=0.80 m. Axial.sf8r


     ------------------------------------------------------------------------
                          Time and Date of Analysis
     ------------------------------------------------------------------------

               Date:  April 30, 2021     Time:  12:10:23

     Pilona 59, Metro Cable, Pilote D=0.80 m.


     PROPOSED DEPTH =      15.0 M
     ----------------


     REDUCTION FACTOR APPLIED FOR UPLIFT FRICTION = 0.800
     ------------------------------------------------


     NUMBER OF LAYERS =    6
     ------------------


     WATER TABLE DEPTH =      30.0 M
     -------------------



     FACTOR OF SAFETY APPLIED TO THE ULTIMATE SIDE FRICTION CAPACITY = 2.50
     -----------------------------------------------------
     FACTOR OF SAFETY APPLIED TO THE ULTIMATE BASE CAPACITY = 2.50
     -----------------------------------------------------


     SOIL INFORMATION
     ---------------

     LAYER NO  1----CLAY

       AT THE TOP

       STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
       END BEARING COEFFICIENT-Nc                         = 0.600E+01  (*)
       UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
       BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
       SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
       MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
       DEPTH, M                                           = 0.000E+00


       AT THE BOTTOM

       STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
       END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
       UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.000E+00
       BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.160E+02
       SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
       MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
       DEPTH, M                                           = 0.405E+01


     LAYER NO  2----CLAY
```

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.405E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

LAYER NO 3----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.540E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.500E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

LAYER NO 4----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.900E+01

AT THE BOTTOM

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.290E+02
SOIL UNIT WEIGHT, KN/CU M = 0.180E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11
DEPTH, M = 0.131E+02

LAYER NO 5----CLAY

AT THE TOP

STRENGTH REDUCTION FACTOR-ALPHA = 0.550E+00 (*)
END BEARING COEFFICIENT-Nc = 0.900E+01 (*)
UNDRAINED SHEAR STRENGTH, KN/SQ M = 0.000E+00
BLOWS PER FOOT FROM STANDARD PENETRATION TEST = 0.600E+02
SOIL UNIT WEIGHT, KN/CU M = 0.200E+02
MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M = 0.100E+11

```
  DEPTH, M                                          = 0.131E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.600E+02
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.182E+02


LAYER NO  6----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.182E+02

  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.000E+00
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.450E+02
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.250E+02


(*) ESTIMATED BY THE PROGRAM BASED ON OTHER PARAMETERS


INPUT DRILLED SHAFT INFORMATION
-------------------------------

 MINIMUM SHAFT DIAMETER    =    0.800  M
 MAXIMUM SHAFT DIAMETER    =    0.800  M
 RATIO BASE/SHAFT DIAMETER =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 ELASTIC MODULUS, Ec       = 0.229E+08 KN/SQ M


COMPUTATION RESULTS
-------------------


- CASE ANALYZED      :     1
  VARIATION LENGTH   :     1
  VARIATION DIAMETER :     1


DRILLED SHAFT INFORMATION

-------------------------

 DIAMETER OF STEM          =    0.800  M
 DIAMETER OF BASE          =    0.800  M
 END OF STEM TO BASE       =    0.000  M
 ANGLE OF BELL             =    0.000  DEG.
 IGNORED TOP PORTION       =    1.500  M
 IGNORED BOTTOM PORTION    =    0.000  M
 AREA OF ONE PERCENT STEEL =    0.005  SQ. M
```

ELASTIC MODULUS, Ec = 0.229E+08 KN/SQ M
VOLUME OF UNDERREAM = 0.000 CU. M
SHAFT LENGTH = 15.000 M

PREDICTED RESULTS

QS = ULTIMATE SIDE RESISTANCE;
QB = ULTIMATE BASE RESISTANCE;
WT = WEIGHT OF DRILLED SHAFT (FOR UPLIFT CAPACITY ONLY);
QU = TOTAL ULTIMATE RESISTANCE;
QBD = TOTAL ALLOWABLE LOAD USING A FACTOR OF SAFETY
APPLIED TO THE ULTIMATE BASE RESISTANCE;
QDN = TOTAL ALLOWABLE LOAD USING FACTORS OF SAFETY
APPLIED TO THE ULTIMATE SIDE RESISTANCE AND
THE ULTIMATE BASE RESISTANCE.

LENGTH (M)	VOLUME (CU.M)	QS (KN)	WT (KN)	QU (KN)	QBD (KN)	QDN (KN)	QU/VOLUME (KN)
2.0	1.0	80.7	23.7	104.4	104.4	56.0	102.27
2.5	1.3	165.4	29.6	195.0	195.0	95.8	154.69
3.0	1.5	250.1	35.5	285.7	285.7	135.6	189.14
3.5	1.8	334.8	41.5	376.3	376.3	175.4	213.57
4.0	2.0	431.1	47.4	478.5	478.5	219.8	237.50
4.5	2.3	630.0	53.3	683.3	683.3	305.3	301.72
5.0	2.5	783.5	59.2	842.8	842.8	372.6	334.99
5.5	2.8	940.1	65.2	1005.3	1005.3	441.2	363.46
6.0	3.0	1204.9	71.1	1276.0	1276.0	553.0	422.62
6.5	3.3	1469.7	77.0	1546.7	1546.7	664.9	473.00
7.0	3.5	1734.5	82.9	1817.4	1817.4	776.7	516.36
7.5	3.8	1999.2	88.8	2088.1	2088.1	888.5	553.56
8.0	4.0	2264.0	94.8	2358.8	2358.8	1000.4	586.33
8.5	4.3	2528.8	100.7	2629.5	2629.5	1112.2	615.24
9.0	4.5	2793.6	106.6	2900.2	2900.2	1224.0	640.82
9.5	4.8	2979.2	112.5	3091.7	3091.7	1304.2	647.32
10.0	5.0	3132.8	118.5	3251.2	3251.2	1371.6	646.68
10.5	5.3	3286.3	124.4	3410.7	3410.7	1438.9	646.10
11.0	5.5	3439.9	130.3	3570.2	3570.2	1506.3	645.57
11.5	5.8	3593.5	136.2	3729.7	3729.7	1573.6	645.08
12.0	6.0	3747.0	142.1	3889.2	3889.2	1641.0	644.64
12.5	6.3	3900.6	148.1	4048.7	4048.7	1708.3	644.23
13.0	6.5	4054.2	154.0	4208.2	4208.2	1775.7	643.86
13.5	6.8	4336.9	159.9	4496.9	4496.9	1894.7	662.48
14.0	7.0	4654.7	165.8	4820.5	4820.5	2027.7	684.85
14.5	7.3	4972.4	171.8	5144.2	5144.2	2160.7	705.58
15.0	7.5	5290.1	177.7	5467.8	5467.8	2293.7	725.00

WARNING MESSAGE

THE PREDICTED LOAD TRANSFER IN CLAY BASED ON THE N-VALUE
FROM STANDARD PENETRATION TESTS IS NOT RECOMMENDED FOR
THE FINAL DESIGN. PLEASE INPUT THE UNDRAINED SHEAR
STRENGTH FOR CLAY LAYERS IN THE FINAL DESIGN.

AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.1411E+01	0.1209E-05	0.4528E-02	0.2540E-06
0.7053E+01	0.6046E-05	0.2264E-01	0.1270E-05
0.1411E+02	0.1209E-04	0.4528E-01	0.2540E-05
0.7219E+03	0.6137E-03	0.2264E+01	0.1270E-03
0.1083E+04	0.9206E-03	0.3396E+01	0.1905E-03
0.1431E+04	0.1225E-02	0.4528E+01	0.2540E-03
0.2922E+04	0.2767E-02	0.1132E+02	0.6350E-03
0.3977E+04	0.4284E-02	0.2264E+02	0.1270E-02
0.4539E+04	0.5455E-02	0.3396E+02	0.1905E-02
0.4773E+04	0.6340E-02	0.4528E+02	0.2540E-02
0.4972E+04	0.1036E-01	0.8880E+02	0.6350E-02
0.4687E+04	0.1652E-01	0.1290E+03	0.1270E-01
0.4450E+04	0.1949E-01	0.1408E+03	0.1588E-01

0.4463E+04	0.2363E-01	0.1561E+03	0.2000E-01
0.4482E+04	0.4366E-01	0.1751E+03	0.4000E-01

RESULT FROM UPPER-BOUND LINE

TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.2512E+01	0.1863E-05	0.6763E-02	0.2540E-06
0.1256E+02	0.9314E-05	0.3382E-01	0.1270E-05
0.2533E+02	0.1869E-04	0.6763E-01	0.2540E-05
0.1299E+04	0.9539E-03	0.3382E+01	0.1270E-03
0.1903E+04	0.1421E-02	0.5072E+01	0.1905E-03
0.2421E+04	0.1860E-02	0.6763E+01	0.2540E-03
0.4134E+04	0.3724E-02	0.1691E+02	0.6350E-03
0.4833E+04	0.5049E-02	0.3382E+02	0.1270E-02
0.5077E+04	0.5931E-02	0.5072E+02	0.1905E-02
0.5197E+04	0.6684E-02	0.6763E+02	0.2540E-02
0.5354E+04	0.1068E-01	0.1235E+03	0.6350E-02
0.5053E+04	0.1682E-01	0.1568E+03	0.1270E-01
0.4911E+04	0.1987E-01	0.1640E+03	0.1588E-01
0.4919E+04	0.2400E-01	0.1733E+03	0.2000E-01
0.4925E+04	0.4401E-01	0.1796E+03	0.4000E-01

RESULT FROM LOWER-BOUND LINE

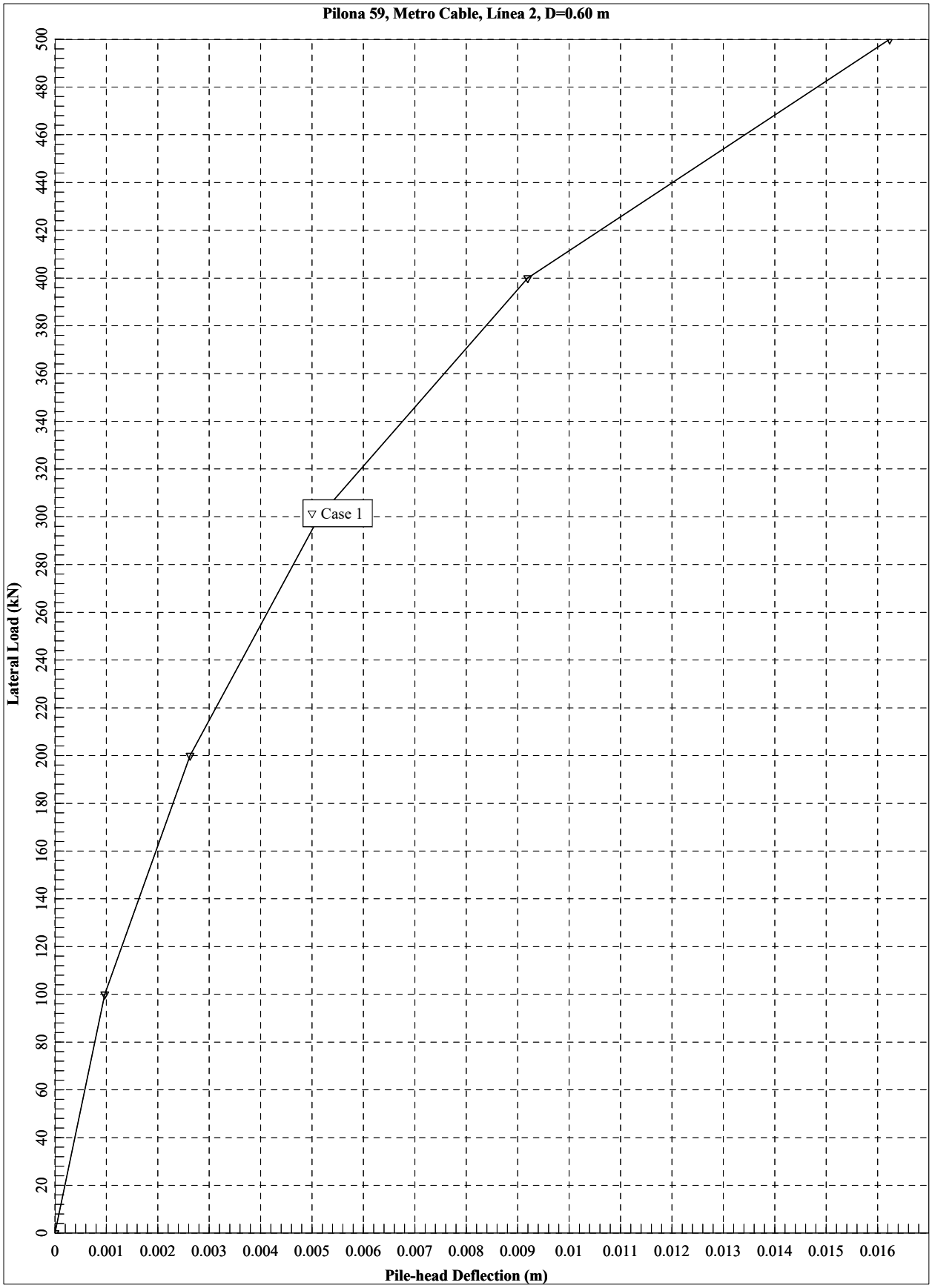
TOP LOAD KN.	TOP MOVEMENT M.	TIP LOAD KN.	TIP MOVEMENT M.
0.6490E+00	0.7219E-06	0.2293E-02	0.2540E-06
0.3245E+01	0.3609E-05	0.1146E-01	0.1270E-05
0.6490E+01	0.7219E-05	0.2293E-01	0.2540E-05
0.3288E+03	0.3634E-03	0.1146E+01	0.1270E-03
0.4932E+03	0.5451E-03	0.1719E+01	0.1905E-03
0.6577E+03	0.7268E-03	0.2293E+01	0.2540E-03
0.1592E+04	0.1796E-02	0.5731E+01	0.6350E-03
0.2766E+04	0.3330E-02	0.1146E+02	0.1270E-02
0.3549E+04	0.4622E-02	0.1719E+02	0.1905E-02
0.3994E+04	0.5652E-02	0.2293E+02	0.2540E-02
0.4592E+04	0.1005E-01	0.5413E+02	0.6350E-02
0.4172E+04	0.1609E-01	0.1011E+03	0.1270E-01
0.3988E+04	0.1911E-01	0.1176E+03	0.1588E-01
0.4008E+04	0.2326E-01	0.1390E+03	0.2000E-01
0.4038E+04	0.4330E-01	0.1697E+03	0.4000E-01

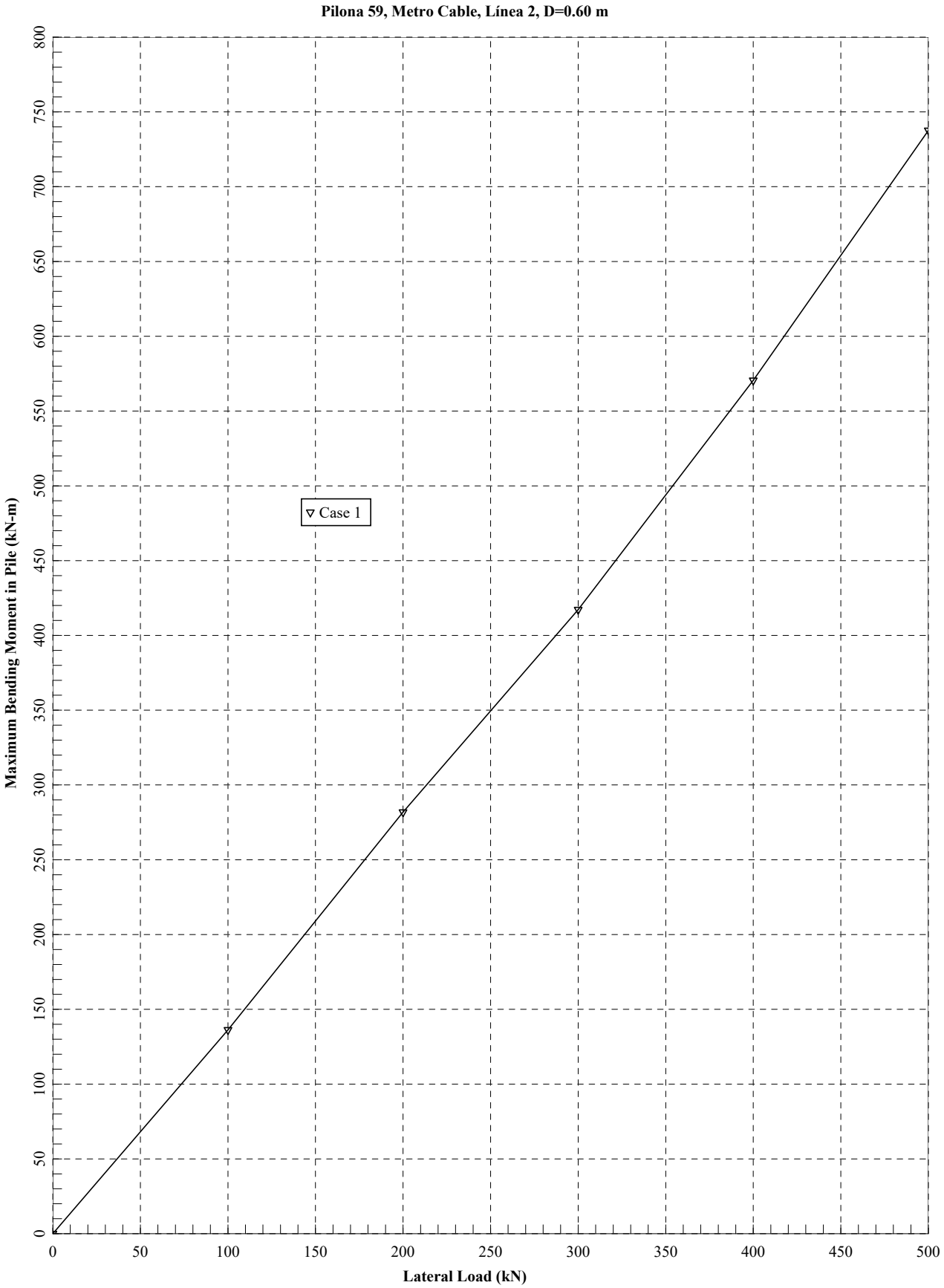
Carga Lateral

Carga Lateral
(Pilona 59)

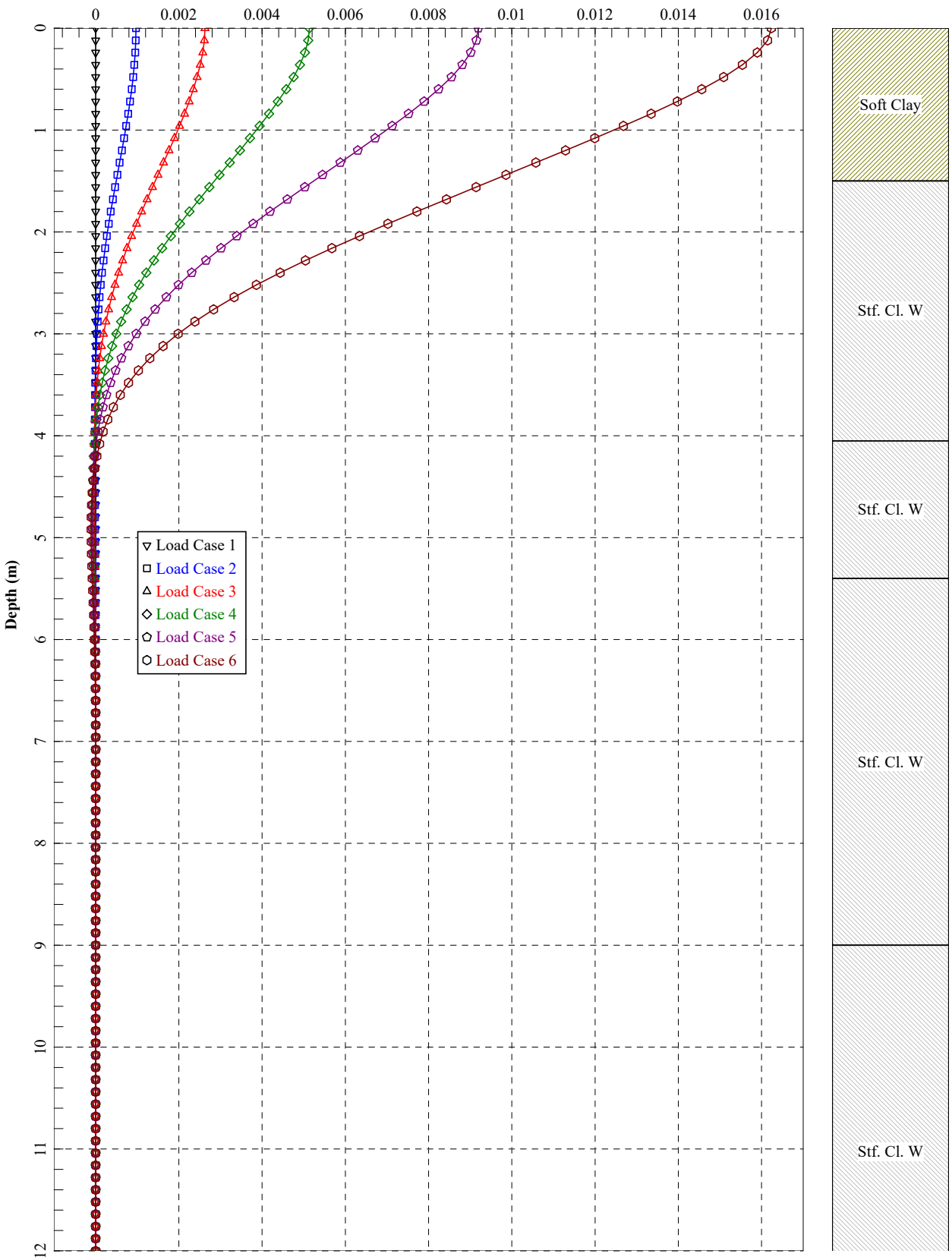
Carga Lateral
(Pilona 59)

PILOTE D=0.60m

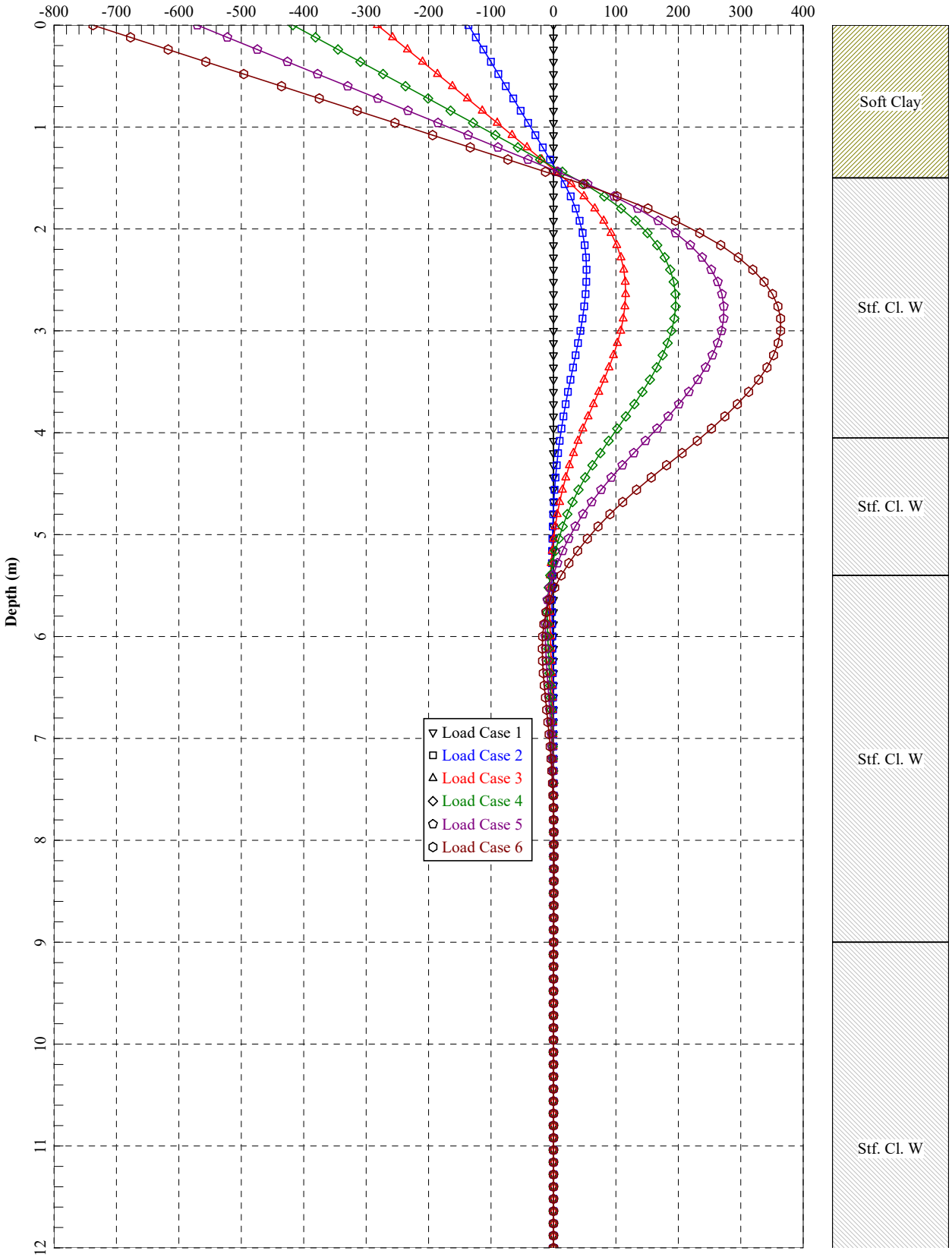

Pilona 59, Metro Cable, Línea 2, D=0.60 m
Lateral Load (kN)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
420
440
460
480
500
Case 1
0
0.001
0.002
0.003
0.004
0.005
0.006
0.007
0.008
0.009
0.01
0.011
0.012
0.013
0.014
0.015
0.016
Pile-head Deflection (m)

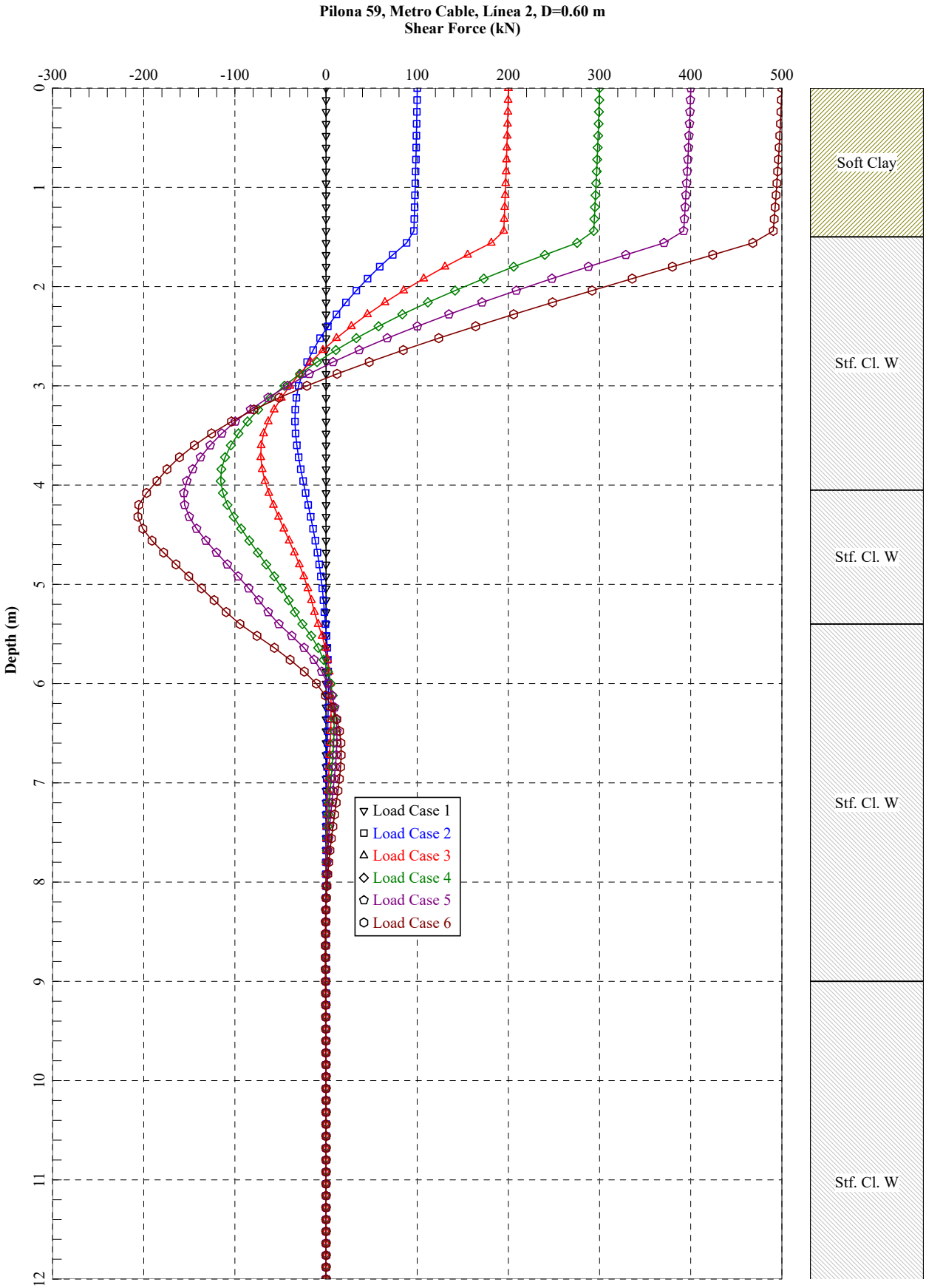

Pilona 59, Metro Cable, Línea 2, D=0.60 m
Maximum Bending Moment in Pile (kN-m)
Lateral Load (kN)
Case 1
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
750
800

Pilona 59, Metro Cable, Línea 2, D=0.60 m
Lateral Pile Deflection (meters)

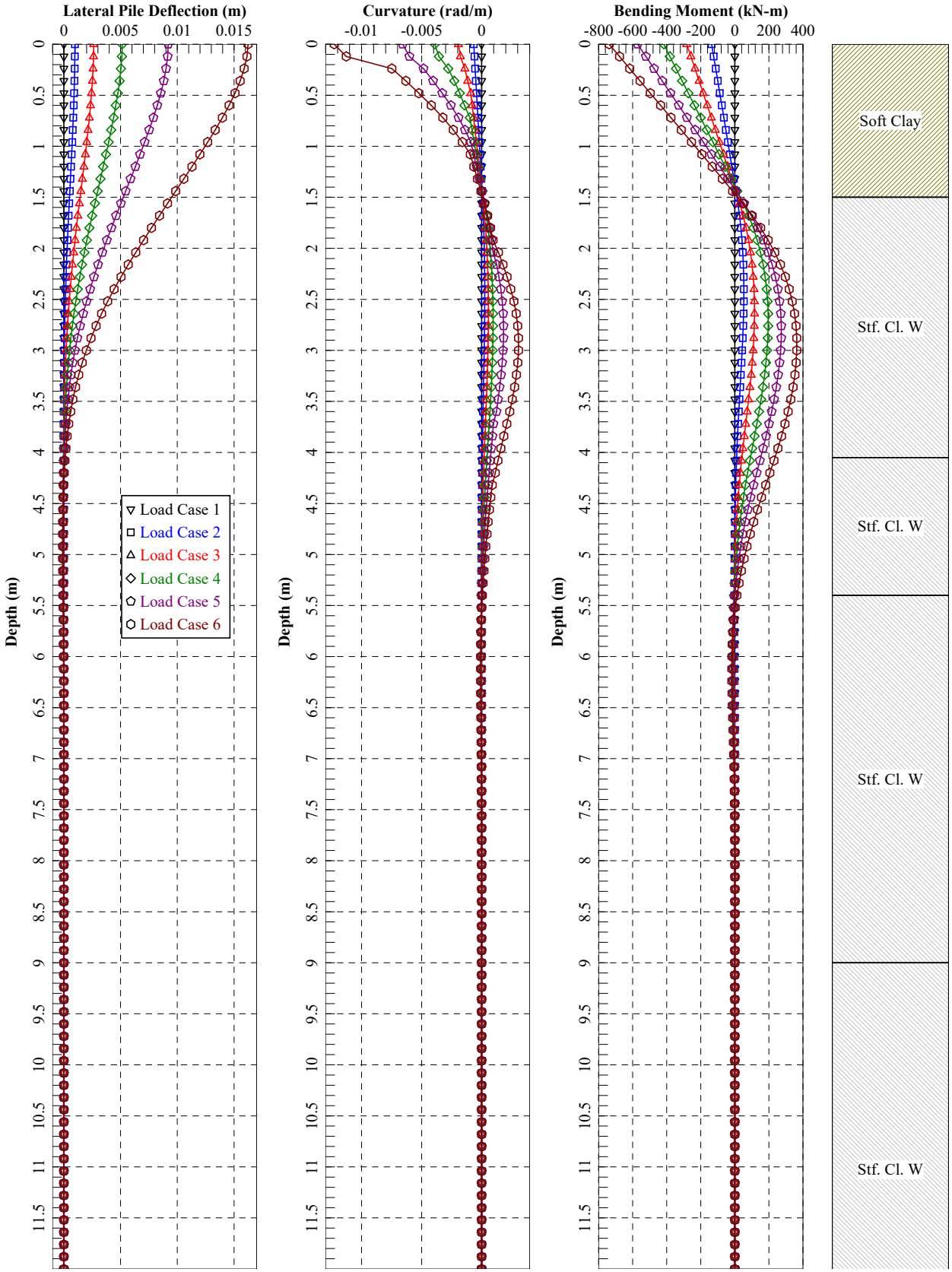


Pilona 59, Metro Cable, Línea 2, D=0.60 m
Bending Moment (kN-m)




Pilona 59, Metro Cable, Línea 2, D=0.60 m
Shear Force (kN)
-300
-200
-100
0
100
200
300
400
500
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
Load Case 1
Load Case 2
Load Case 3
Load Case 4
Load Case 5
Load Case 6
Soft Clay
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

Pilona 59, Metro Cable, Línea 2, D=0.60 m



```
================================================================================

                  LPile for Windows(Beta), Version 2018-10.009

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

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations on this computer:
\\192.168.1.2\Proyectos\INVESTIGACION GEOTECNICA\PROYECTOS 2021\J Fortuna\Metro
Cable-- Pilonas\Pilona 59\Calculos\Lateral\D=0.60 m\

Name of the input data file:
Pilona 59, D=0.60 m.lp10

Name of the output report file:
Pilona 59, D=0.60 m.lp10

Name of the plot output file:
Pilona 59, D=0.60 m.lp10

Name of the runtime message file:
Pilona 59, D=0.60 m.lp10

--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  May 5, 2021                Time:   9:56:43



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: PILONA 59, METRO CABLE, LINEA 2


Job Number: 1


Client: JFORTUNA


Engineer: HS


Description: PILOTE D=0.60 m




--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
```

Engineering Units Used for Data Input and Computations:
 - International System Units (kilonewtons, meters, millimeters)

Analysis Control Options:
 - Maximum number of iterations allowed = 100
 - Deflection tolerance for convergence = 2.5400E-07 m
 - Maximum allowable deflection = 0.0300 m
 - Number of pile increments = 100

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

 - Use of p-y modification factors for p-y curves not selected
 - 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
 - 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.
 - Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 12.000 m
Depth of ground surface below top of pile = 0.0000 m

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	Depth Below Pile Head meters	Pile Diameter millimeters
1	0.000	600.00
2	12.000	600.00

Input Structural Properties for Pile Sections:

Pile Section No. 1:

Section 1 is a round drilled shaft, bored pile, or CIDH pile
Length of section = 12.000000 m
Shaft Diameter = 0.600000 m
Shear capacity of section = 2760. kN

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 7 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer          =       0.0000 m
   Distance from top of pile to bottom of layer       =     1.500000 m
   Effective unit weight at top of layer              =    15.000000 kN/m3
   Effective unit weight at bottom of layer           =    15.000000 kN/m3
   Undrained cohesion at top of layer                 =     5.000000 kPa
   Undrained cohesion at bottom of layer              =     5.000000 kPa
   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 with water-induced erosion

   Distance from top of pile to top of layer          =     1.500000 m
   Distance from top of pile to bottom of layer       =     4.050000 m
   Effective unit weight at top of layer              =    17.000000 kN/m3
   Effective unit weight at bottom of layer           =    17.000000 kN/m3
   Undrained cohesion at top of layer                 =   100.000000 kPa
   Undrained cohesion at bottom of layer              =   100.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

Layer 3 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer          =     4.050000 m
   Distance from top of pile to bottom of layer       =     5.400000 m
   Effective unit weight at top of layer              =    18.000000 kN/m3
   Effective unit weight at bottom of layer           =    18.000000 kN/m3
   Undrained cohesion at top of layer                 =   185.000000 kPa
   Undrained cohesion at bottom of layer              =   185.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

   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          =     5.400000 m
   Distance from top of pile to bottom of layer       =     9.000000 m
   Effective unit weight at top of layer              =    20.000000 kN/m3
   Effective unit weight at bottom of layer           =    20.000000 kN/m3
   Undrained cohesion at top of layer                 =   290.000000 kPa
   Undrained cohesion at bottom of layer              =   290.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

Layer 5 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer          =     9.000000 m
   Distance from top of pile to bottom of layer       =    13.050000 m
   Effective unit weight at top of layer              =    18.000000 kN/m3
   Effective unit weight at bottom of layer           =    18.000000 kN/m3
   Undrained cohesion at top of layer                 =   185.000000 kPa
   Undrained cohesion at bottom of layer              =   185.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3
```

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

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

Layer 6 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	13.050000 m
Distance from top of pile to bottom of layer	=	18.250000 m
Effective unit weight at top of layer	=	20.000000 kN/m3
Effective unit weight at bottom of layer	=	20.000000 kN/m3
Undrained cohesion at top of layer	=	300.000000 kPa
Undrained cohesion at bottom of layer	=	300.000000 kPa
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 kN/m3
Subgrade k at bottom of layer	=	0.0000 kN/m3

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

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

Layer 7 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	18.250000 m
Distance from top of pile to bottom of layer	=	25.000000 m
Effective unit weight at top of layer	=	20.000000 kN/m3
Effective unit weight at bottom of layer	=	20.000000 kN/m3
Undrained cohesion at top of layer	=	280.000000 kPa
Undrained cohesion at bottom of layer	=	280.000000 kPa
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 kN/m3
Subgrade k at bottom of layer	=	0.0000 kN/m3

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 13.000 m below the pile tip)

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 = 6

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, kN
1	2	V = 0.0000 kN	S = 0.0000 m/m	1680.
2	2	V = 100.000000 kN	S = 0.0000 m/m	1680.
3	2	V = 200.000000 kN	S = 0.0000 m/m	1680.
4	2	V = 300.000000 kN	S = 0.0000 m/m	1680.
5	2	V = 400.000000 kN	S = 0.0000 m/m	1680.
6	2	V = 500.000000 kN	S = 0.0000 m/m	1680.

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

---

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	=	12.000000 m
Shaft Diameter	=	0.600000 m
Concrete Cover Thickness (to edge of long. rebar)	=	0.076200 m
Number of Reinforcing Bars	=	14 bars
Yield Stress of Reinforcing Bars	=	413685. kPa
Modulus of Elasticity of Reinforcing Bars	=	199947999. kPa
Gross Area of Shaft	=	0.282743 sq. m
Total Area of Reinforcing Steel	=	0.007135 sq. m
Area Ratio of Steel Reinforcement	=	2.52 percent
Edge-to-Edge Bar Spacing	=	0.068548 m
Maximum Concrete Aggregate Size	=	0.003000 m
Ratio of Bar Spacing to Aggregate Size	=	22.85
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 m

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	10105.173 kN
Tensile Load for Cracking of Concrete	=	-994.605 kN
Nominal Axial Tensile Capacity	=	-2951.840 kN

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. meters	Bar Area sq. m.	X meters	Y meters
1	0.025400	0.0005097	0.211100	0.00000
2	0.025400	0.0005097	0.190195	0.091593
3	0.025400	0.0005097	0.131619	0.165045
4	0.025400	0.0005097	0.046974	0.205807
5	0.025400	0.0005097	-0.046974	0.205807
6	0.025400	0.0005097	-0.131619	0.165045
7	0.025400	0.0005097	-0.190195	0.091593
8	0.025400	0.0005097	-0.211100	0.00000
9	0.025400	0.0005097	-0.190195	-0.091593
10	0.025400	0.0005097	-0.131619	-0.165045
11	0.025400	0.0005097	-0.046974	-0.205807
12	0.025400	0.0005097	0.046974	-0.205807
13	0.025400	0.0005097	0.131619	-0.165045
14	0.025400	0.0005097	0.190195	-0.091593

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

Minimum spacing between any two bars not equal to zero = 68.55 millimeters
between bars 5 and 6.

Ratio of bar spacing to maximum aggregate size = 22.85

Concrete Properties:

Compressive Strength of Concrete	=	30535. kPa
Modulus of Elasticity of Concrete	=	26153710. kPa
Modulus of Rupture of Concrete	=	-3441. kPa
Compression Strain at Peak Stress	=	0.001985
Tensile Strain at Fracture of Concrete	=	-0.0001152
Maximum Coarse Aggregate Size	=	0.003000 m

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kN
1	1680.000

Summary of Results for Nominal (Unfactored) 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 kN	Nominal Mom. Cap. kN-m	Max. Comp. Strain
1	1680.000	737.259	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 kN-m	Ult. (Fac) Ax. Thrust kN	Ult. (Fac) Moment Cap kN-m	Bend. Stiff. at Ult Mom kN-m^2
1	0.65	737.258872	1092.	479.218267	97165.
1	0.70	737.258872	1176.	516.081211	92528.
1	0.75	737.258872	1260.	552.944154	88509.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head meters	Equivalent Top Depth Below Grnd Surf meters	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer kN	F1 Integral for Layer kN
1	0.00	0.00	N.A.	No	0.00	27.0431
2	1.5000	4.9420	No	No	27.0431	147.5464
3	4.0500	4.2020	Yes	No	174.5895	144.5588
4	5.4000	4.7621	Yes	No	319.1483	603.4438
5	9.0000	9.5472	Yes	No	922.5922	321.4877
6	13.0500	13.0500	No	No	1244.	0.00
7	18.2500	18.2500	No	No	0.00	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.

```
i_Length           1   12.0000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           2   11.4000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
```

```
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          19   1.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          20  0.599999999999999
  12.0000000000000       0.600000000000000
exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 1
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =              0. kN
Slope      =         0.00000
Axial Load =           1680. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000      0.000000      0.000000      0.000000
   11.40000      0.000000      0.000000      0.000000
   10.80000      0.000000      0.000000      0.000000
   10.20000      0.000000      0.000000      0.000000
```

9.60000	0.000000	0.000000	0.000000
9.00000	0.000000	0.000000	0.000000
8.40000	0.000000	0.000000	0.000000
7.80000	0.000000	0.000000	0.000000
7.20000	0.000000	0.000000	0.000000
6.60000	0.000000	0.000000	0.000000
6.00000	0.000000	0.000000	0.000000
5.40000	0.000000	0.000000	0.000000
4.80000	0.000000	0.000000	0.000000
4.20000	0.000000	0.000000	0.000000
3.60000	0.000000	0.000000	0.000000
3.00000	0.000000	0.000000	0.000000
2.40000	0.000000	0.000000	0.000000
1.80000	0.000000	0.000000	0.000000
1.20000	0.000000	0.000000	0.000000

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

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 100.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 1680.0 kN

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.000970	-136.23964	100.00000	-1.43357	205525.

Output Summary for Load Case No. 2:

Pile-head deflection = 0.00096961 meters
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -136.23964401 kN-m
Maximum shear force = 100.00000000 kN
Depth of maximum bending moment = 0.000000 meters below pile head
Depth of maximum shear force = 0.000000 meters below pile head
Number of iterations = 9
Number of zero deflection points = 4

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 2 11.4000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 3 10.8000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 4 10.2000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 5 9.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 6 9.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 7 8.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 8 7.80000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 9 7.20000000000000
12.0000000000000 0.600000000000000

```
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          19   1.20000000000000
  12.0000000000000       0.600000000000000
before 180
exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 2
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            100. kN
Slope      =         0.00000
Axial Load =           1680. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00096961 -136.23964401  100.00000000
   11.40000    0.00100633 -138.14585049  100.00000000
   10.80000    0.00093023 -134.16200097  100.00000000
   10.20000    0.00094922 -135.18988313  100.00000000
    9.60000    0.00095731 -135.62778160  100.00000000
    9.00000    0.00095428 -135.47488670  100.00000000
    8.40000    0.00094026 -134.73327022  100.00000000
    7.80000    0.00098773 -137.23415372  100.00000000
    7.20000    0.00094541 -135.01993312  100.00000000
    6.60000    0.00095364 -135.46218312  100.00000000
    6.00000    0.00097130 -136.38828064  100.00000000
    5.40000    0.00095384 -135.50286245  100.00000000
    4.80000    0.00098219 -136.85497399  100.00000000
    4.20000    0.00100026 -137.19562815  100.00000000
    3.60000    0.00118283 -147.96732064  100.00000000
    3.00000    0.00141402 -168.97280310  100.00000000
    2.40000    0.00146056 -182.96579589  100.00000000
    1.80000    0.00391881 -161.32501819  100.00000000


-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
```

for Lateral Loading for Load Case Number 3

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 200.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 1680.0 kN

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.002627	-281.84797	200.00000	-1.99842	145649.

Output Summary for Load Case No. 3:

Pile-head deflection = 0.00262705 meters
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -281.84797024 kN-m
Maximum shear force = 200.00000000 kN
Depth of maximum bending moment = 0.000000 meters below pile head
Depth of maximum shear force = 0.000000 meters below pile head
Number of iterations = 12
Number of zero deflection points = 4

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 2 11.4000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 3 10.8000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 4 10.2000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 5 9.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 6 9.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 7 8.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 8 7.80000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 9 7.20000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 10 6.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 11 6.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 12 5.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 13 4.80000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 14 4.20000000000000

```
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 3
-------------------------------------------------------------------------------
 Boundary Condition Type 2, Shear and Slope

 Shear      =            200. kN
 Slope      =         0.00000
 Axial Load =           1680. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00262705 -281.84797024  200.00000000
   11.40000    0.00272358 -285.57081678  200.00000000
   10.80000    0.00251154 -278.47436500  200.00000000
   10.20000    0.00255856 -280.61291390  200.00000000
    9.60000    0.00258746 -281.03554507  200.00000000
    9.00000    0.00257538 -280.93965824  200.00000000
    8.40000    0.00253276 -279.83154986  200.00000000
    7.80000    0.00266650 -284.14879128  200.00000000
    7.20000    0.00254612 -280.35684523  200.00000000
    6.60000    0.00256498 -281.37972463  200.00000000
    6.00000    0.00261341 -283.03535628  200.00000000
    5.40000    0.00256812 -281.31988712  200.00000000
    4.80000    0.00267593 -284.31703888  200.00000000
    4.20000    0.00293504 -292.15461477  200.00000000
    3.60000    0.00370191 -323.31671411  200.00000000
    3.00000    0.00448937 -363.10205709  200.00000000
    2.40000    0.00465750 -378.24085620  200.00000000


-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 4
-------------------------------------------------------------------------------

 Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

 Shear force at pile head                              =        300.0 kN
 Rotation of pile head                                 =    0.000E+00 radians
 Axial load at pile head                               =       1680.0 kN

 (Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y          Moment        Force          p        Stiffness
   meters       meters        kN-m           kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000     0.005137   -417.25320    300.00000     -2.49895      107004.

 Output Summary for Load Case No. 4:

 Pile-head deflection             =     0.00513726 meters
 Computed slope at pile head      =       0.000000 radians
 Maximum bending moment           =  -417.25319772 kN-m
 Maximum shear force              =   300.00000000 kN
 Depth of maximum bending moment  =       0.000000 meters below pile head
```

```
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             15
Number of zero deflection points =              4

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           6   9.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
 i_Length          14   4.20000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          15   3.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          16   3.00000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          18   1.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 4
--------------------------------------------------------------------------------
```

Boundary Condition Type 2, Shear and Slope

```
Shear      =            300. kN
Slope      =         0.00000
Axial Load =           1680. kN
```

Pile Length meters	Pile Head Deflection meters	Maximum Moment kN-m	Maximum Shear kN
12.00000	0.00513726	-417.25319772	300.00000000
11.40000	0.00534150	-421.77153346	300.00000000
10.80000	0.00492241	-411.94553015	300.00000000
10.20000	0.00501832	-414.95087682	300.00000000
9.60000	0.00506469	-415.84626746	300.00000000
9.00000	0.00504124	-415.83141424	300.00000000
8.40000	0.00496666	-413.82403509	300.00000000
7.80000	0.00522272	-420.14736118	300.00000000
7.20000	0.00498692	-414.91114155	300.00000000
6.60000	0.00503090	-416.09238253	300.00000000
6.00000	0.00511662	-418.36231494	300.00000000
5.40000	0.00504476	-416.18906496	300.00000000
4.80000	0.00545381	-423.84656947	300.00000000
4.20000	0.00647712	-448.78329388	300.00000000
3.60000	0.00875269	-513.53745481	300.00000000
3.00000	0.01045982	-575.44317970	300.00000000
2.40000	0.01092398	-583.66689143	300.00000001

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 5

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =        400.0 kN
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =       1680.0 kN
```

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.009195	-570.51802	400.00000	-3.03405	86758.

Output Summary for Load Case No. 5:

```
Pile-head deflection            =     0.00919463 meters
Computed slope at pile head     =       0.000000 radians
Maximum bending moment          =  -570.51802099 kN-m
Maximum shear force             =   400.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations            =             19
Number of zero deflection points =              4

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
```

```
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          13   4.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          14   4.20000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          15   3.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 5
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            400. kN
Slope      =         0.00000
Axial Load =           1680. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00919463 -570.51802099  400.00000000
   11.40000    0.00960881 -578.47433737  400.00000000
   10.80000    0.00875721 -562.14641833  400.00000000
   10.20000    0.00896014 -566.85449504  400.00000000
    9.60000    0.00904850 -568.66321995  400.00000000
    9.00000    0.00900872 -568.02518210  400.00000000
    8.40000    0.00885003 -565.30091088  400.00000000
    7.80000    0.00936324 -575.63313845  400.00000000
    7.20000    0.00889750 -566.56348096  400.00000000
    6.60000    0.00898380 -568.47468792  400.00000000
    6.00000    0.00914838 -571.75609148  400.00000000
    5.40000    0.00907554 -569.18873399  400.00000000
    4.80000    0.01017380 -583.83942707  400.00000000
    4.20000    0.01328975 -639.28049993  400.00000000


-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 6
-------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =        500.0 kN
```

```
Rotation of pile head                                =    0.000E+00 radians
Axial load at pile head                              =       1680.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y          Moment        Force          p        Stiffness
   meters       meters        kN-m          kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000      0.01623   -737.61773    500.00000     -3.66712       60082.

Output Summary for Load Case No. 6:

Pile-head deflection             =     0.01623478 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -737.61773396 kN-m
Maximum shear force              =   500.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             36
Number of zero deflection points =              4

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           6   9.00000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           7   8.40000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           8   7.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           9   7.20000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          10   6.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          11   6.00000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          12   5.40000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          13   4.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 6
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope
```

Shear   =   500. kN
Slope   =   0.00000
Axial Load =   1680. kN

Pile Length meters	Pile Head Deflection meters	Maximum Moment kN-m	Maximum Shear kN
12.00000	0.01623478	-737.61773396	500.00000000
11.40000	0.01713623	-747.58547493	500.00000000
10.80000	0.01521429	-728.01103538	500.00000000
10.20000	0.01564351	-733.50442188	500.00000000
9.60000	0.01580463	-735.96551624	500.00000000
9.00000	0.01569480	-735.77721778	500.00000000
8.40000	0.01533473	-732.17159085	500.00000000
7.80000	0.01642269	-745.63950332	500.00000000
7.20000	0.01540102	-734.56828184	500.00000000
6.60000	0.01556357	-737.14895675	500.00000000
6.00000	0.01582840	-741.22528027	500.00000000
5.40000	0.01606232	-741.42561129	500.00000000

Summary of Pile-head Responses for Conventional Analyses

Definitions of Pile-head Loading Conditions:

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

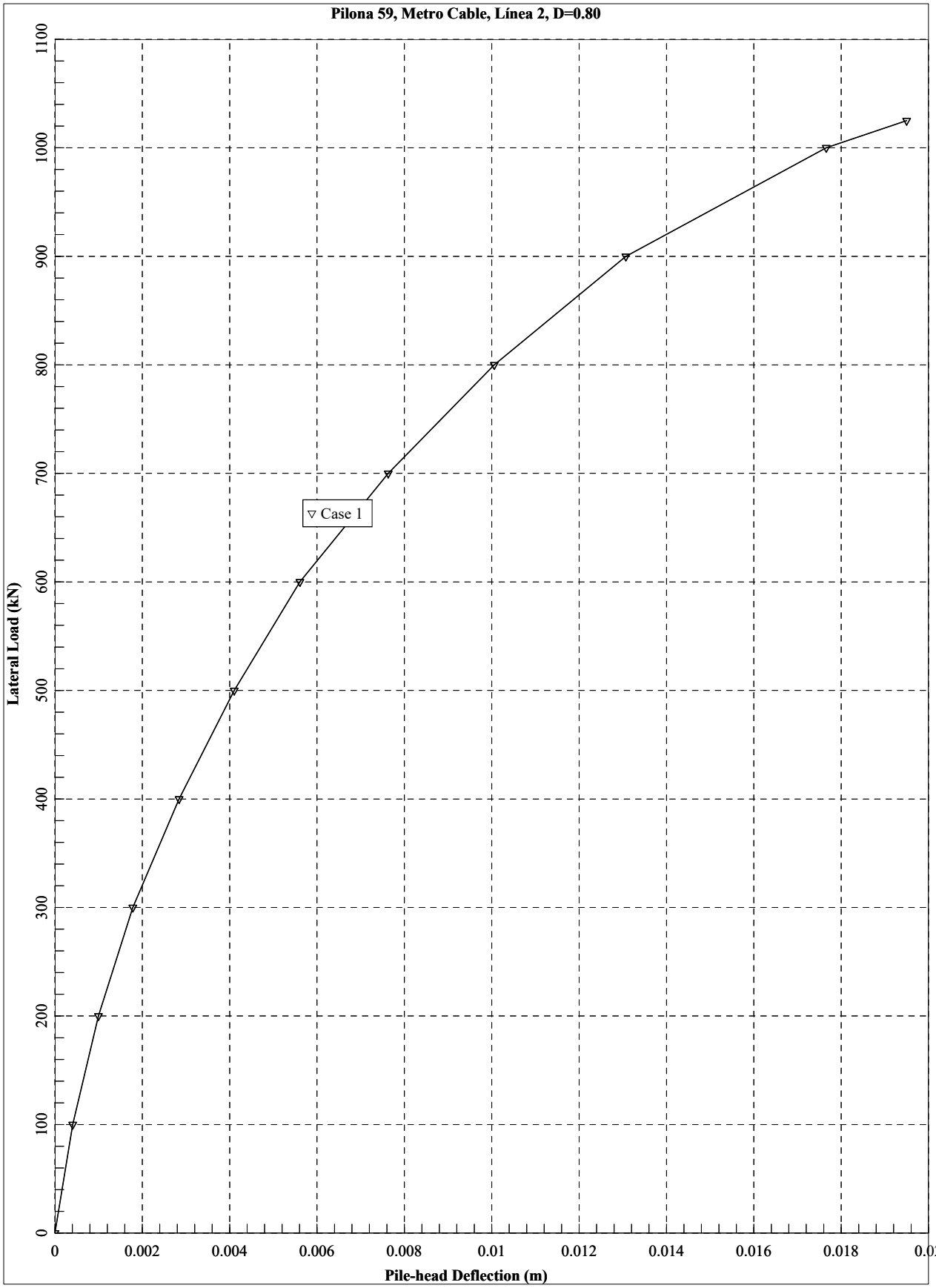
Load Case No.	Load Type	Pile-head Deflection meters	Pile-head Rotation radians	Max Shear in Pile kN	Max Moment in Pile kN-m
1	2	0.0000	0.0000	0.0000	0.0000
2	2	0.0009696	0.0000	100.000000	-136.239644
3	2	0.002627	0.0000	200.000000	-281.847970
4	2	0.005137	0.0000	300.000000	-417.253198
5	2	0.009195	0.0000	400.000000	-570.518021
6	2	0.016235	0.0000	500.000000	-737.617734

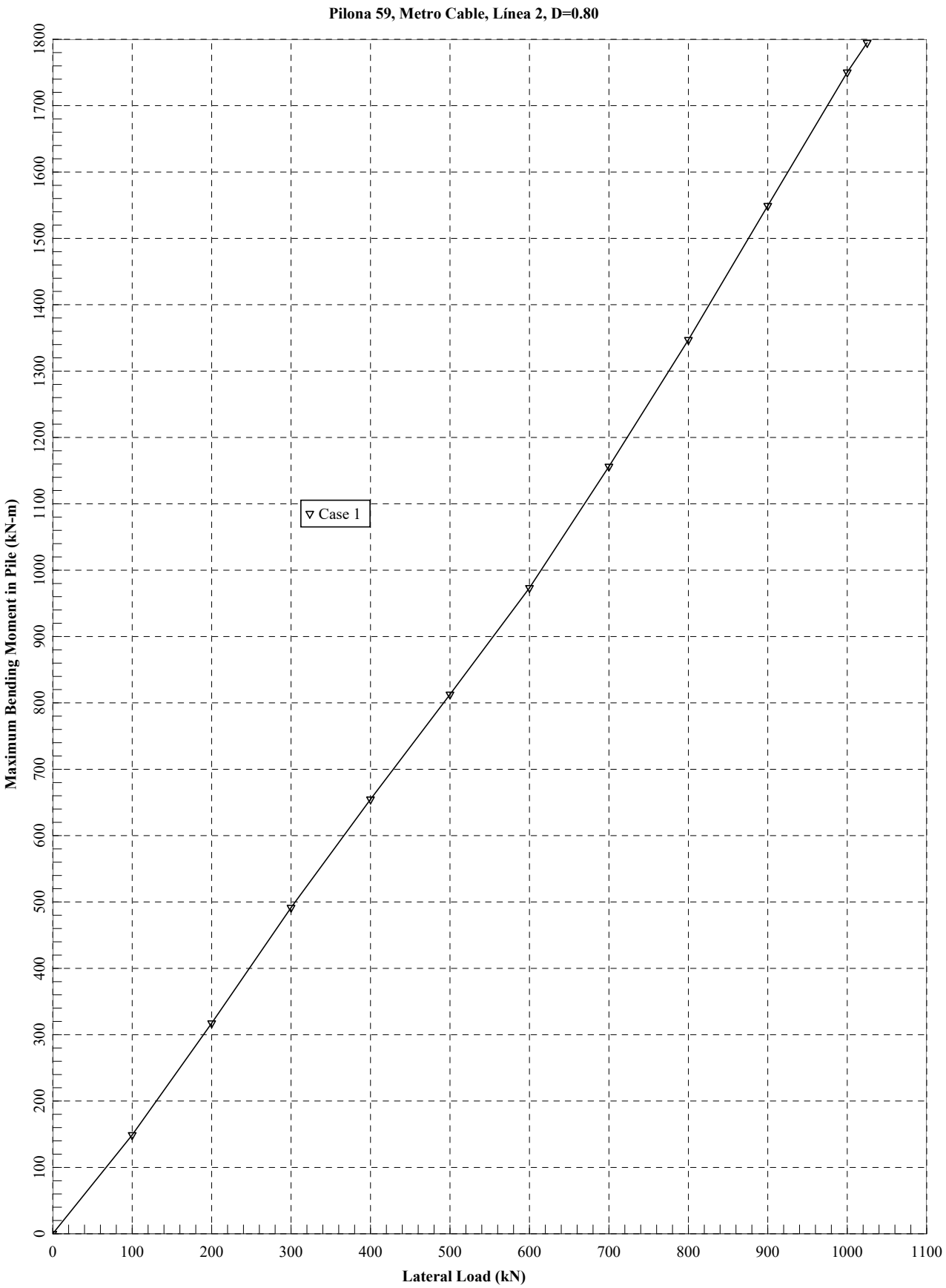
Maximum pile-head deflection = 0.0162347795 meters
Maximum pile-head rotation   = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.

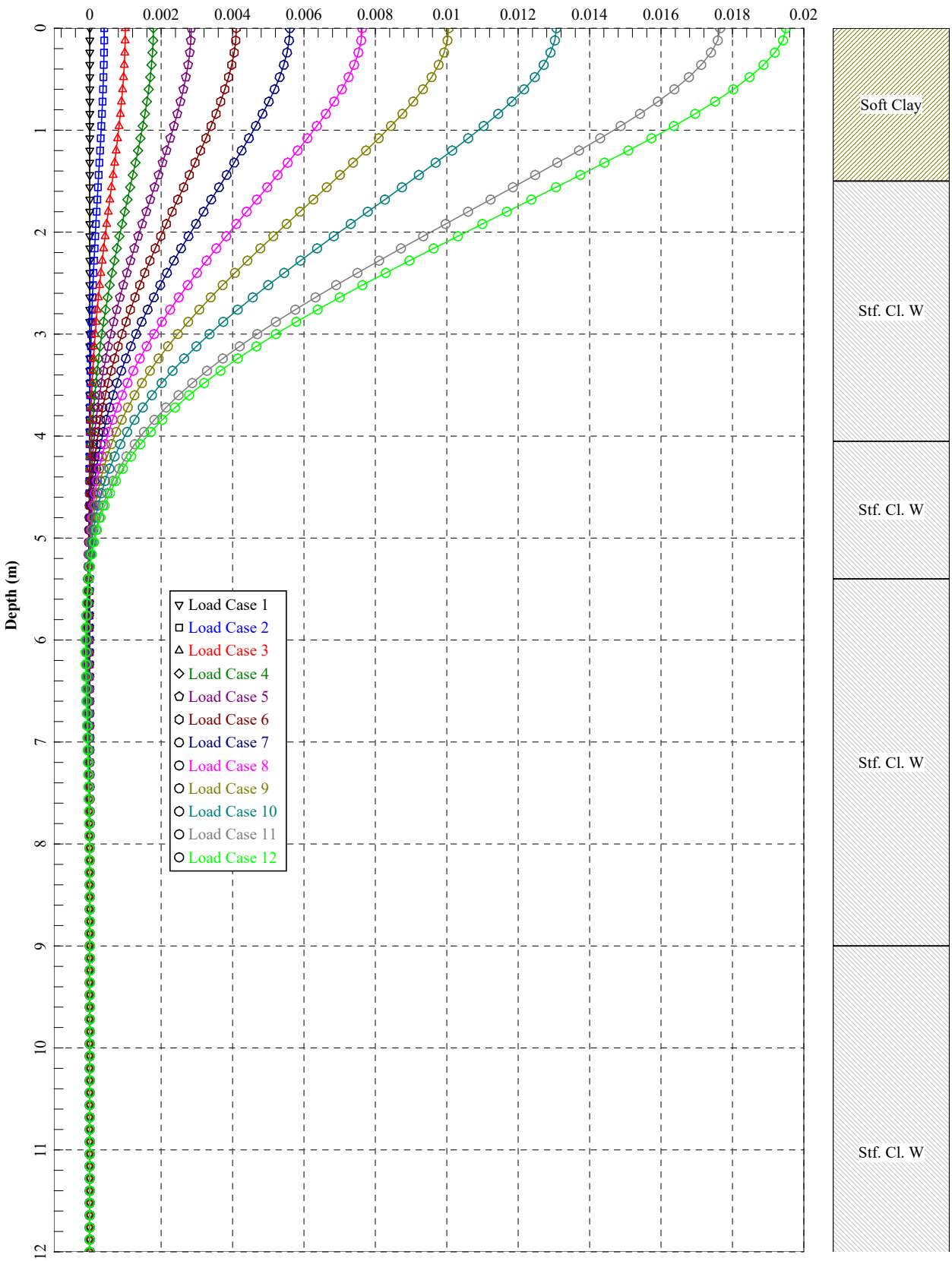
Carga Lateral
(Pilona 59)

PILOTE D=0.80m

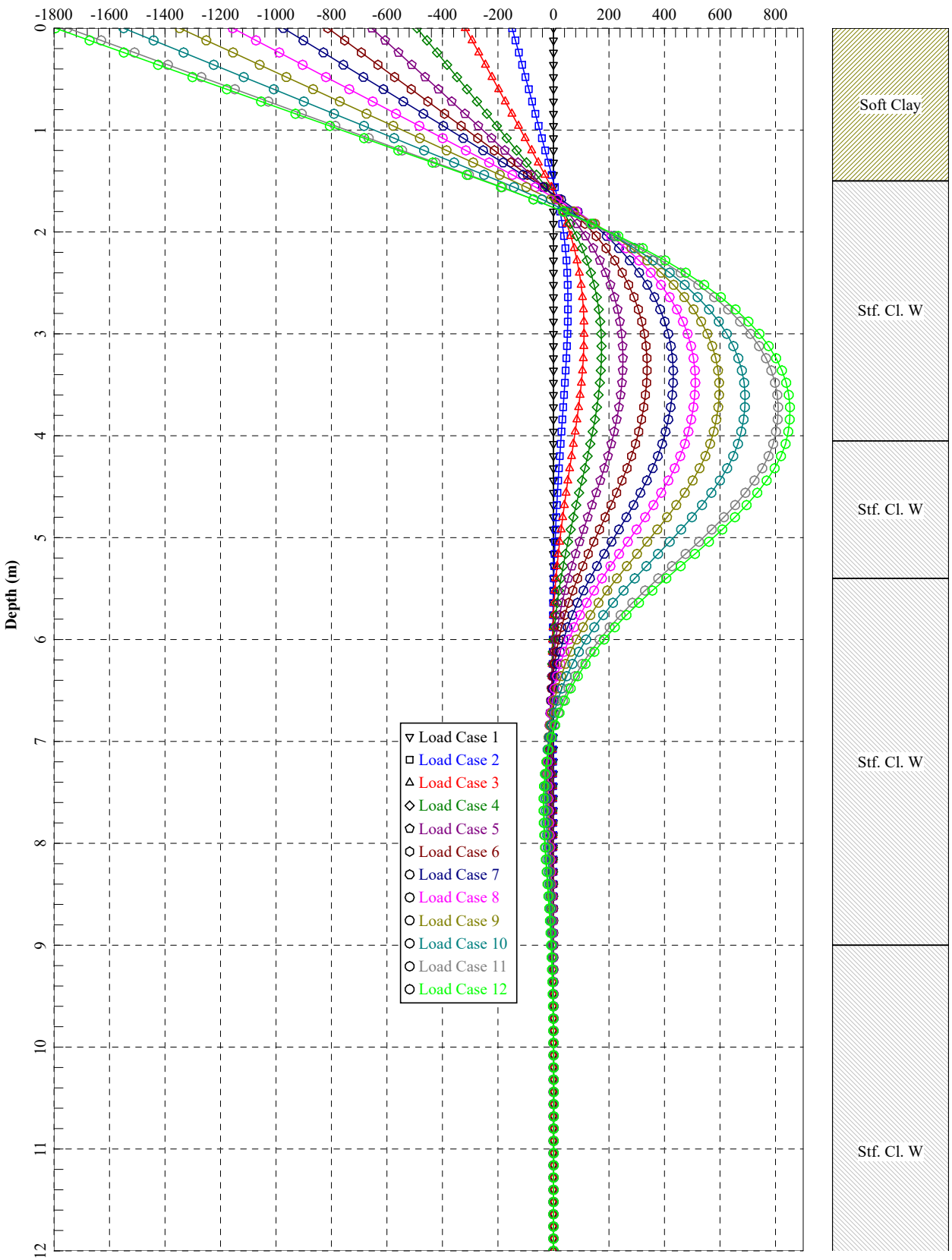

Pilona 59, Metro Cable, Línea 2, D=0.80
Lateral Load (kN)
Pile-head Deflection (m)
Case 1
0
100
200
300
400
500
600
700
800
900
1000
1100
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02

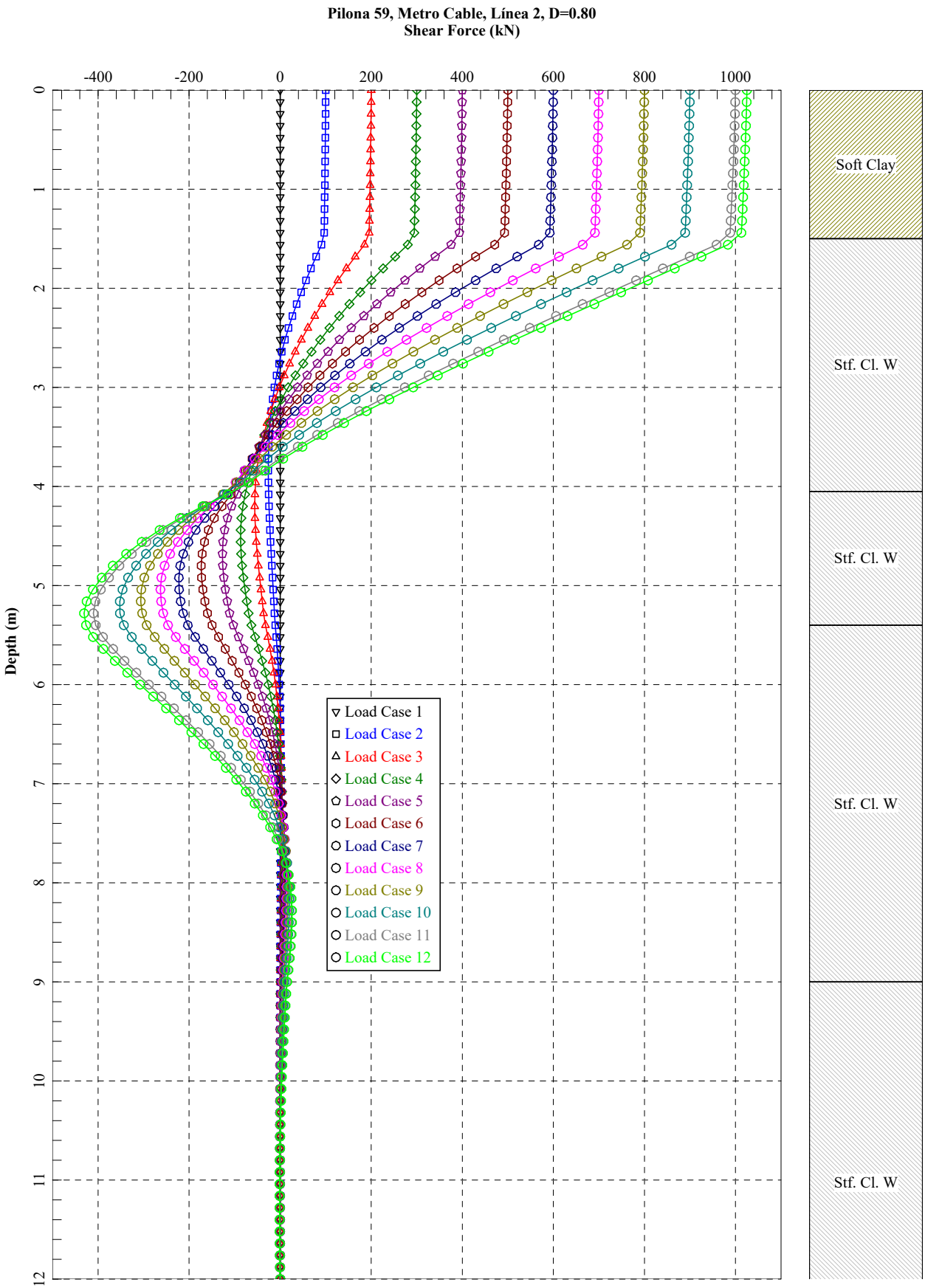

Pilona 59, Metro Cable, Línea 2, D=0.80
Maximum Bending Moment in Pile (kN-m)
Lateral Load (kN)
Case 1
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
1700
1800

Pilona 59, Metro Cable, Línea 2, D=0.80
Lateral Pile Deflection (meters)

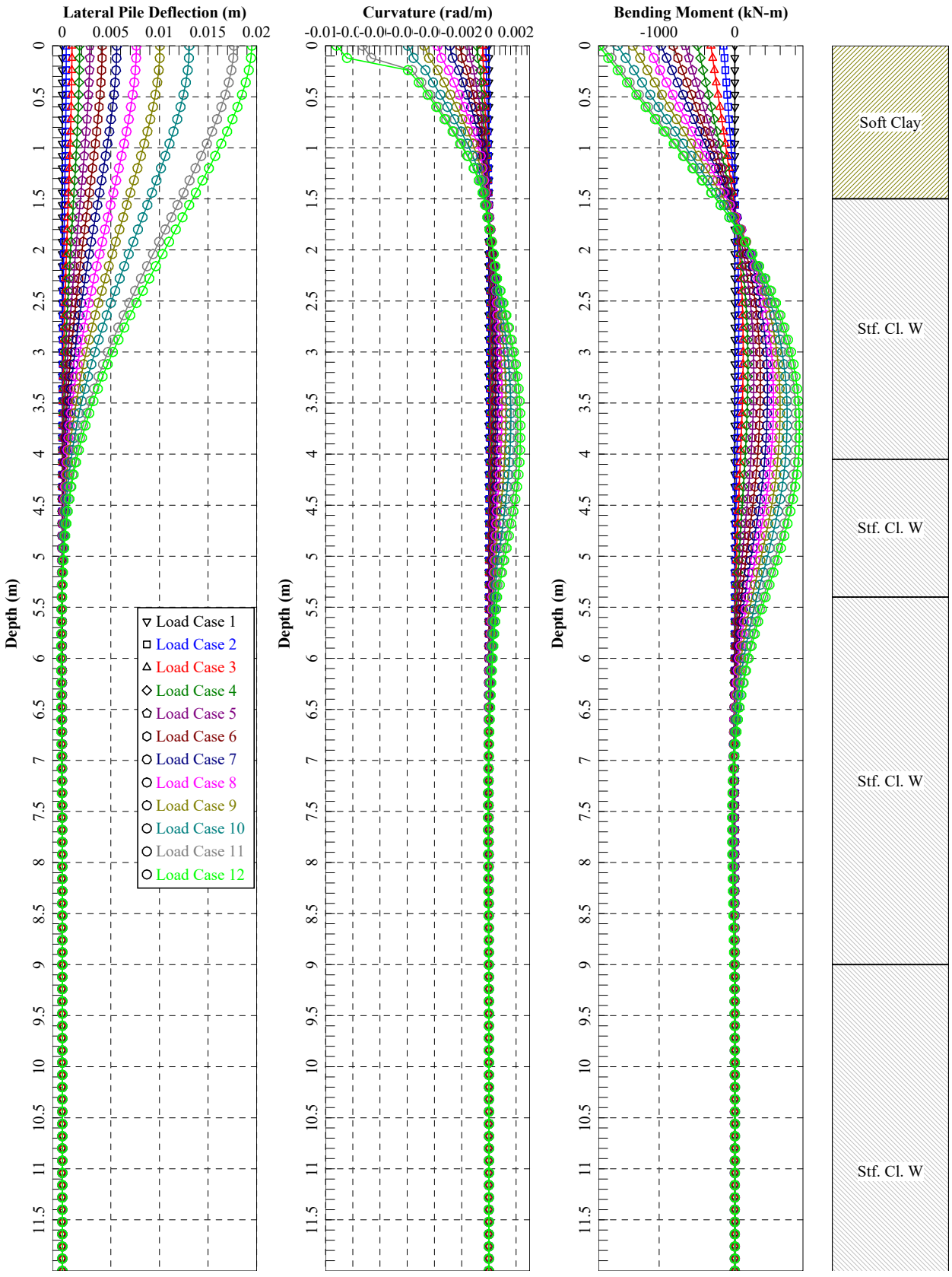


Pilona 59, Metro Cable, Línea 2, D=0.80
Bending Moment (kN-m)




Pilona 59, Metro Cable, Línea 2, D=0.80
Shear Force (kN)
-400
-200
0
200
400
600
800
1000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
Load Case 1
Load Case 2
Load Case 3
Load Case 4
Load Case 5
Load Case 6
Load Case 7
Load Case 8
Load Case 9
Load Case 10
Load Case 11
Load Case 12
Soft Clay
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W
Stf. Cl. W

Pilona 59, Metro Cable, Línea 2, D=0.80



```
================================================================================

                  LPile for Windows(Beta), Version 2018-10.009

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

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--------------------------------------------------------------------------------
                             Files Used for Analysis
--------------------------------------------------------------------------------

Path to file locations on this computer:
\\192.168.1.2\Proyectos\INVESTIGACION GEOTECNICA\PROYECTOS 2021\J Fortuna\Metro
Cable-- Pilonas\Pilona 59\Calculos\Lateral\D=0.80 m\

Name of the input data file:
Pilona 59, D=0.80 m.lp10

Name of the output report file:
Pilona 59, D=0.80 m.lp10

Name of the plot output file:
Pilona 59, D=0.80 m.lp10

Name of the runtime message file:
Pilona 59, D=0.80 m.lp10

--------------------------------------------------------------------------------
                           Date and Time of Analysis
--------------------------------------------------------------------------------

               Date:  May 5, 2021                Time:   9:32:21



--------------------------------------------------------------------------------
                                 Problem Title
--------------------------------------------------------------------------------

Project Name: PILONA 59, METRO CABLE, LINEA 2


Job Number: 1


Client: JFORTUNA


Engineer: HS


Description: PILOTE D=0.80 m




--------------------------------------------------------------------------------
                           Program Options and Settings
--------------------------------------------------------------------------------

Computational Options:
 - Use unfactored loads in computations (conventional analysis)
```

Engineering Units Used for Data Input and Computations:
 - International System Units (kilonewtons, meters, millimeters)

Analysis Control Options:
 - Maximum number of iterations allowed = 100
 - Deflection tolerance for convergence = 2.5400E-07 m
 - Maximum allowable deflection = 0.0300 m
 - Number of pile increments = 100

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

 - Use of p-y modification factors for p-y curves not selected
 - 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
 - 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.
 - Report only summary tables of pile-head deflection, maximum bending moment, and maximum shear force in output report file.
 - No p-y curves to be computed and reported for user-specified depths
 - Print using narrow report formats
   (Note: Some output information is omitted from the narrow report formats)

Pile Structural Properties and Geometry

Number of pile sections defined = 1
Total length of pile = 12.000 m
Depth of ground surface below top of pile = 0.0000 m

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	Depth Below Pile Head meters	Pile Diameter millimeters
1	0.000	800.00
2	12.000	800.00

Input Structural Properties for Pile Sections:

Pile Section No. 1:

   Section 1 is a round drilled shaft, bored pile, or CIDH pile
   Length of section = 12.000000 m
   Shaft Diameter = 0.800000 m
   Shear capacity of section = 2760. kN

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 7 layers

Layer 1 is soft clay, p-y criteria by Matlock, 1970

   Distance from top of pile to top of layer          =       0.0000 m
   Distance from top of pile to bottom of layer       =     1.500000 m
   Effective unit weight at top of layer              =    15.000000 kN/m3
   Effective unit weight at bottom of layer           =    15.000000 kN/m3
   Undrained cohesion at top of layer                 =     5.000000 kPa
   Undrained cohesion at bottom of layer              =     5.000000 kPa
   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 with water-induced erosion

   Distance from top of pile to top of layer          =     1.500000 m
   Distance from top of pile to bottom of layer       =     4.050000 m
   Effective unit weight at top of layer              =    17.000000 kN/m3
   Effective unit weight at bottom of layer           =    17.000000 kN/m3
   Undrained cohesion at top of layer                 =   100.000000 kPa
   Undrained cohesion at bottom of layer              =   100.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

Layer 3 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer          =     4.050000 m
   Distance from top of pile to bottom of layer       =     5.400000 m
   Effective unit weight at top of layer              =    18.000000 kN/m3
   Effective unit weight at bottom of layer           =    18.000000 kN/m3
   Undrained cohesion at top of layer                 =   185.000000 kPa
   Undrained cohesion at bottom of layer              =   185.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

   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          =     5.400000 m
   Distance from top of pile to bottom of layer       =     9.000000 m
   Effective unit weight at top of layer              =    20.000000 kN/m3
   Effective unit weight at bottom of layer           =    20.000000 kN/m3
   Undrained cohesion at top of layer                 =   290.000000 kPa
   Undrained cohesion at bottom of layer              =   290.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

Layer 5 is stiff clay with water-induced erosion

   Distance from top of pile to top of layer          =     9.000000 m
   Distance from top of pile to bottom of layer       =    13.050000 m
   Effective unit weight at top of layer              =    18.000000 kN/m3
   Effective unit weight at bottom of layer           =    18.000000 kN/m3
   Undrained cohesion at top of layer                 =   185.000000 kPa
   Undrained cohesion at bottom of layer              =   185.000000 kPa
   Epsilon-50 at top of layer                         =       0.0000
   Epsilon-50 at bottom of layer                      =       0.0000
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3
```

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

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

Layer 6 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	13.050000 m
Distance from top of pile to bottom of layer	=	18.250000 m
Effective unit weight at top of layer	=	20.000000 kN/m3
Effective unit weight at bottom of layer	=	20.000000 kN/m3
Undrained cohesion at top of layer	=	300.000000 kPa
Undrained cohesion at bottom of layer	=	300.000000 kPa
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 kN/m3
Subgrade k at bottom of layer	=	0.0000 kN/m3

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

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

Layer 7 is stiff clay with water-induced erosion

Distance from top of pile to top of layer	=	18.250000 m
Distance from top of pile to bottom of layer	=	25.000000 m
Effective unit weight at top of layer	=	20.000000 kN/m3
Effective unit weight at bottom of layer	=	20.000000 kN/m3
Undrained cohesion at top of layer	=	280.000000 kPa
Undrained cohesion at bottom of layer	=	280.000000 kPa
Epsilon-50 at top of layer	=	0.0000
Epsilon-50 at bottom of layer	=	0.0000
Subgrade k at top of layer	=	0.0000 kN/m3
Subgrade k at bottom of layer	=	0.0000 kN/m3

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 13.000 m below the pile tip)

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 = 12

Load No.	Load Type	Condition 1	Condition 2	Axial Thrust Force, kN
1	2	V = 0.0000 kN	S = 0.0000 m/m	2480.
2	2	V = 100.000000 kN	S = 0.0000 m/m	2480.
3	2	V = 200.000000 kN	S = 0.0000 m/m	2480.
4	2	V = 300.000000 kN	S = 0.0000 m/m	2480.
5	2	V = 400.000000 kN	S = 0.0000 m/m	2480.
6	2	V = 500.000000 kN	S = 0.0000 m/m	2480.
7	2	V = 600.000000 kN	S = 0.0000 m/m	2480.
8	2	V = 700.000000 kN	S = 0.0000 m/m	2480.
9	2	V = 800.000000 kN	S = 0.0000 m/m	2480.
10	2	V = 900.000000 kN	S = 0.0000 m/m	2480.
11	2	V = 1000.000000 kN	S = 0.0000 m/m	2480.
12	2	V = 1025. kN	S = 0.0000 m/m	2480.

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
---

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	=	12.000000 m
Shaft Diameter	=	0.800000 m
Concrete Cover Thickness (to edge of long. rebar)	=	0.076200 m
Number of Reinforcing Bars	=	24 bars
Yield Stress of Reinforcing Bars	=	413685. kPa
Modulus of Elasticity of Reinforcing Bars	=	199947999. kPa
Gross Area of Shaft	=	0.502655 sq. m
Total Area of Reinforcing Steel	=	0.012232 sq. m
Area Ratio of Steel Reinforcement	=	2.43 percent
Edge-to-Edge Bar Spacing	=	0.055813 m
Maximum Concrete Aggregate Size	=	0.003000 m
Ratio of Bar Spacing to Aggregate Size	=	18.60
Offset of Center of Rebar Cage from Center of Pile	=	0.0000 m

Axial Structural Capacities:

Nom. Axial Structural Capacity = 0.85 Fc Ac + Fy As	=	17789.093 kN
Tensile Load for Cracking of Concrete	=	-1759.117 kN
Nominal Axial Tensile Capacity	=	-5060.297 kN

Reinforcing Bar Dimensions and Positions Used in Computations:

Bar Number	Bar Diam. meters	Bar Area sq. m.	X meters	Y meters
1	0.025400	0.0005097	0.311100	0.00000
2	0.025400	0.0005097	0.300500	0.080519
3	0.025400	0.0005097	0.269421	0.155550
4	0.025400	0.0005097	0.219981	0.219981
5	0.025400	0.0005097	0.155550	0.269421
6	0.025400	0.0005097	0.080519	0.300500
7	0.025400	0.0005097	0.00000	0.311100
8	0.025400	0.0005097	-0.080519	0.300500
9	0.025400	0.0005097	-0.155550	0.269421
10	0.025400	0.0005097	-0.219981	0.219981
11	0.025400	0.0005097	-0.269421	0.155550
12	0.025400	0.0005097	-0.300500	0.080519
13	0.025400	0.0005097	-0.311100	0.00000
14	0.025400	0.0005097	-0.300500	-0.080519
15	0.025400	0.0005097	-0.269421	-0.155550
16	0.025400	0.0005097	-0.219981	-0.219981
17	0.025400	0.0005097	-0.155550	-0.269421
18	0.025400	0.0005097	-0.080519	-0.300500
19	0.025400	0.0005097	0.00000	-0.311100
20	0.025400	0.0005097	0.080519	-0.300500
21	0.025400	0.0005097	0.155550	-0.269421
22	0.025400	0.0005097	0.219981	-0.219981
23	0.025400	0.0005097	0.269421	-0.155550
24	0.025400	0.0005097	0.300500	-0.080519

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

Minimum spacing between any two bars not equal to zero = 55.81 millimeters
between bars 15 and 16.

Ratio of bar spacing to maximum aggregate size = 18.60

Concrete Properties:

Compressive Strength of Concrete	=	30535. kPa

Modulus of Elasticity of Concrete = 26153710. kPa
Modulus of Rupture of Concrete = -3441. kPa
Compression Strain at Peak Stress = 0.001985
Tensile Strain at Fracture of Concrete = -0.0001152
Maximum Coarse Aggregate Size = 0.003000 m

Number of Axial Thrust Force Values Determined from Pile-head Loadings = 1

Number	Axial Thrust Force kN
1	2480.000

Summary of Results for Nominal (Unfactored) 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 kN	Nominal Mom. Cap. kN-m	Max. Comp. Strain
1	2480.000	1768.551	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 kN-m	Ult. (Fac) Ax. Thrust kN	Ult. (Fac) Moment Cap kN-m	Bend. Stiff. at Ult Mom kN-m^2
1	0.65	1769.	1612.	1150.	308256.
1	0.70	1769.	1736.	1238.	296552.
1	0.75	1769.	1860.	1326.	286390.

Layering Correction Equivalent Depths of Soil & Rock Layers

Layer No.	Top of Layer Below Pile Head meters	Equivalent Top Depth Below Grnd Surf meters	Same Layer Type As Layer Above	Layer is Rock or is Below Rock Layer	F0 Integral for Layer kN	F1 Integral for Layer kN
1	0.00	0.00	N.A.	No	0.00	35.0606
2	1.5000	5.2841	No	No	35.0606	196.7285
3	4.0500	4.7583	Yes	No	231.7892	192.7451
4	5.4000	5.4121	Yes	No	424.5342	804.5918
5	9.0000	9.8425	Yes	No	1229.	428.6503
6	13.0500	13.0500	No	No	1658.	0.00
7	18.2500	18.2500	No	No	0.00	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.

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180

```
after 180
i_Length           2   11.4000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          19   1.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          20  0.599999999999999
  12.0000000000000       0.600000000000000
exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 1
-------------------------------------------------------------------------------
```

Boundary Condition Type 2, Shear and Slope

```
Shear      =              0. kN
Slope      =         0.00000
Axial Load =           2480. kN
```

Pile Length meters	Pile Head Deflection meters	Maximum Moment kN-m	Maximum Shear kN
12.00000	0.000000	0.000000	0.000000
11.40000	0.000000	0.000000	0.000000
10.80000	0.000000	0.000000	0.000000
10.20000	0.000000	0.000000	0.000000
9.60000	0.000000	0.000000	0.000000
9.00000	0.000000	0.000000	0.000000
8.40000	0.000000	0.000000	0.000000
7.80000	0.000000	0.000000	0.000000
7.20000	0.000000	0.000000	0.000000
6.60000	0.000000	0.000000	0.000000
6.00000	0.000000	0.000000	0.000000
5.40000	0.000000	0.000000	0.000000
4.80000	0.000000	0.000000	0.000000
4.20000	0.000000	0.000000	0.000000
3.60000	0.000000	0.000000	0.000000
3.00000	0.000000	0.000000	0.000000
2.40000	0.000000	0.000000	0.000000
1.80000	0.000000	0.000000	0.000000
1.20000	0.000000	0.000000	0.000000

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

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

```
Shear force at pile head                          =        100.0 kN
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =       2480.0 kN
```

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.000406	-148.85640	100.00000	-1.29939	674575.

Output Summary for Load Case No. 2:

```
Pile-head deflection             =     0.00040628 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -148.85640440 kN-m
Maximum shear force              =   100.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =              6
Number of zero deflection points =              4

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
```

```
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          19   1.20000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 2
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            100. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00040628 -148.85640440  100.00000000
   11.40000    0.00041557 -150.30034833  100.00000000
   10.80000    0.00039650 -147.32330639  100.00000000
   10.20000    0.00040122 -148.08447541  100.00000000
    9.60000    0.00040327 -148.41827141  100.00000000
    9.00000    0.00040247 -148.29787931  100.00000000
```

```
    8.40000    0.00039902 -147.75806834  100.00000000
    7.80000    0.00041083 -149.61869568  100.00000000
    7.20000    0.00040035 -147.98446121  100.00000000
    6.60000    0.00040251 -148.35296977  100.00000000
    6.00000    0.00040629 -148.94055811  100.00000000
    5.40000    0.00040475 -148.36635868  100.00000000
    4.80000    0.00042266 -150.49347076  100.00000000
    4.20000    0.00045280 -155.25828503  100.00000000
    3.60000    0.00052441 -171.25943013  100.00000000
    3.00000    0.00056969 -188.89199481  100.00000000
    2.40000    0.00058967 -188.12460635  100.00000000
    1.80000    0.00226134 -160.61923663  100.00000004


--------------------------------------------------------------------------------
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 3
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                          =        200.0 kN
Rotation of pile head                             =    0.000E+00 radians
Axial load at pile head                           =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y         Moment        Force          p        Stiffness
   meters       meters         kN-m          kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000     0.000995   -317.27207    200.00000     -1.75184      673968.

Output Summary for Load Case No. 3:

Pile-head deflection              =     0.00099516 meters
Computed slope at pile head       =       0.000000 radians
Maximum bending moment            =  -317.27207416 kN-m
Maximum shear force               =   200.00000000 kN
Depth of maximum bending moment   =       0.000000 meters below pile head
Depth of maximum shear force      =       0.000000 meters below pile head
Number of iterations              =              9
Number of zero deflection points  =              3

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
```

```
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          18   1.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 3
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            200. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00099516 -317.27207416  200.00000000
   11.40000    0.00102638 -321.18584436  200.00000000
   10.80000    0.00096199 -313.05652629  200.00000000
   10.20000    0.00097815 -315.15486773  200.00000000
    9.60000    0.00098522 -316.07388692  200.00000000
    9.00000    0.00098257 -315.74182879  200.00000000
    8.40000    0.00097087 -314.25902622  200.00000000
    7.80000    0.00101113 -319.36551647  200.00000000
    7.20000    0.00097550 -314.88543846  200.00000000
    6.60000    0.00098249 -315.84770852  200.00000000
    6.00000    0.00099842 -317.67769063  200.00000000
    5.40000    0.00100637 -317.03680379  200.00000000
    4.80000    0.00110037 -326.53001021  200.00000000
    4.20000    0.00122779 -347.22947003  200.00000000
    3.60000    0.00137418 -384.31736802  200.00000000
    3.00000    0.00140742 -408.54884414  200.00000000
    2.40000    0.00168368 -382.41620950  200.00000001


-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 4
-------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =        300.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2480.0 kN
```

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.001783	-491.51311	300.00000	-2.12758	545306.

Output Summary for Load Case No. 4:

```
Pile-head deflection             =     0.00178304 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -491.51311171 kN-m
Maximum shear force              =   300.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             11
Number of zero deflection points =              3

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
```

```
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 4
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            300. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00178304 -491.51311171  300.00000000
   11.40000    0.00183560 -497.47178296  300.00000000
   10.80000    0.00172058 -485.85939915  300.00000000
   10.20000    0.00174670 -489.17479943  300.00000000
    9.60000    0.00176628 -489.68487445  300.00000000
    9.00000    0.00176307 -489.02470496  300.00000000
    8.40000    0.00174016 -487.15361889  300.00000000
    7.80000    0.00180836 -494.87500259  300.00000000
    7.20000    0.00174314 -488.66035387  300.00000000
    6.60000    0.00175338 -490.22480020  300.00000000
    6.00000    0.00179112 -492.31083954  300.00000000
    5.40000    0.00184098 -494.28937465  300.00000000
    4.80000    0.00208364 -514.37203192  300.00000000
    4.20000    0.00237244 -551.71223955  300.00000000
    3.60000    0.00266985 -602.93025315  300.00000000
    3.00000    0.00275116 -629.63403434  300.00000000
    2.40000    0.00344799 -577.10507271  300.00000001


--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 5
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                              =        400.0 kN
Rotation of pile head                                 =    0.000E+00 radians
Axial load at pile head                               =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y          Moment        Force          p        Stiffness
   meters       meters         kN-m          kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000     0.002842   -654.73186    400.00000     -2.48531      443139.

Output Summary for Load Case No. 5:

Pile-head deflection             =     0.00284236 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -654.73186243 kN-m
Maximum shear force              =   400.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             12
Number of zero deflection points =              3

 i_Length           1   12.0000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
```

```
i_Length           2   11.4000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          18   1.80000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 5
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            400. kN
Slope      =         0.00000
Axial Load =           2480. kN
```

Pile Length meters	Pile Head Deflection meters	Maximum Moment kN-m	Maximum Shear kN
12.00000	0.00284236	-654.73186243	400.00000000
11.40000	0.00293506	-661.06020723	400.00000000
10.80000	0.00274794	-647.44354998	400.00000000
10.20000	0.00279285	-651.11350985	400.00000000
9.60000	0.00280979	-653.34204124	400.00000000
9.00000	0.00280514	-652.11642476	400.00000000
8.40000	0.00276892	-650.08847952	400.00000000
7.80000	0.00288251	-658.77689924	400.00000000
7.20000	0.00277907	-651.50714392	400.00000000
6.60000	0.00280006	-652.90795914	400.00000000
6.00000	0.00286298	-656.46199953	400.00000000
5.40000	0.00303089	-663.80574597	400.00000000
4.80000	0.00350208	-697.29063037	400.00000000
4.20000	0.00402416	-753.18659245	400.00000000
3.60000	0.00452206	-820.96166475	400.00000000
3.00000	0.00463766	-850.02933592	400.00000000
2.40000	0.00688240	-774.44829713	400.00000001

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 6

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 500.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.004104	-812.69900	500.00000	-2.80891	379549.

Output Summary for Load Case No. 6:

Pile-head deflection = 0.00410373 meters
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -812.69899991 kN-m
Maximum shear force = 500.00000000 kN
Depth of maximum bending moment = 0.000000 meters below pile head
Depth of maximum shear force = 0.000000 meters below pile head
Number of iterations = 13
Number of zero deflection points = 3

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 2 11.4000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 3 10.8000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 4 10.2000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 5 9.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 6 9.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 7 8.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180

```
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          15   3.60000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          16   3.00000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 6
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            500. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00410373 -812.69899991  500.00000000
   11.40000    0.00422621 -821.66139663  500.00000000
   10.80000    0.00396292 -805.20445963  500.00000000
   10.20000    0.00402964 -808.95515468  500.00000000
    9.60000    0.00405657 -811.66870084  500.00000000
    9.00000    0.00404574 -810.50170349  500.00000000
    8.40000    0.00399514 -808.20455005  500.00000000
    7.80000    0.00415267 -818.76108389  500.00000000
    7.20000    0.00401395 -809.22818536  500.00000000
    6.60000    0.00404231 -811.15803993  500.00000000
    6.00000    0.00416888 -816.93290449  500.00000000
    5.40000    0.00454552 -833.29248160  500.00000000
    4.80000    0.00539464 -885.88791694  500.00000000
    4.20000    0.00628143 -966.38963421  500.00000000
    3.60000    0.00701192        -1052.  500.00000000
    3.00000    0.00714249        -1079.  500.00000000


-------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 7
-------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)
```

```
Shear force at pile head                              =        600.0 kN
Rotation of pile head                                 =    0.000E+00 radians
Axial load at pile head                               =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y         Moment        Force          p        Stiffness
   meters       meters        kN-m          kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000     0.005607   -973.38770    600.00000     -3.11683      338452.

Output Summary for Load Case No. 7:

Pile-head deflection             =     0.00560670 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -973.38770143 kN-m
Maximum shear force              =   600.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             27
Number of zero deflection points =              3

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
```

```
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 7
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            600. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00560670 -973.38770143  600.00000000
   11.40000    0.00581682 -985.61543088  600.00000000
   10.80000    0.00541182 -961.95456801  600.00000000
   10.20000    0.00549159 -967.86161686  600.00000000
    9.60000    0.00553821 -969.89095084  600.00000000
    9.00000    0.00551382 -969.88128804  600.00000000
    8.40000    0.00545390 -966.02197407  600.00000000
    7.80000    0.00569471 -981.22183526  600.00000000
    7.20000    0.00547611 -967.66218662  600.00000000
    6.60000    0.00552141 -970.17230358  600.00000000
    6.00000    0.00577600 -979.20268086  600.00000000
    5.40000    0.00652634       -1012.  600.00000000
    4.80000    0.00798001       -1092.  600.00000000
    4.20000    0.00933053       -1200.  600.00000000
    3.60000    0.01024565       -1301.  600.00000000
    3.00000    0.01045020       -1317.  600.00000000


--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 8
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                              =        700.0 kN
Rotation of pile head                                 =    0.000E+00 radians
Axial load at pile head                               =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y          Moment        Force          p        Stiffness
   meters       meters        kN-m           kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000     0.007630       -1156.    700.00000     -3.45389      307282.

Output Summary for Load Case No. 8:

Pile-head deflection             =     0.00762983 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1156. kN-m
Maximum shear force              =   700.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             20
Number of zero deflection points =              3

 i_Length           1   12.0000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
```

```
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          16   3.00000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          17   2.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 8
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            700. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.00762983        -1156.  700.00000000
```

11.40000	0.00789044	-1169.	700.00000000
10.80000	0.00735066	-1142.	700.00000000
10.20000	0.00748427	-1149.	700.00000000
9.60000	0.00754277	-1153.	700.00000000
9.00000	0.00751707	-1152.	700.00000000
8.40000	0.00742255	-1147.	700.00000000
7.80000	0.00774394	-1164.	700.00000000
7.20000	0.00745390	-1149.	700.00000000
6.60000	0.00753227	-1152.	700.00000000
6.00000	0.00791473	-1163.	700.00000000
5.40000	0.00914395	-1207.	700.00000000
4.80000	0.01155513	-1325.	700.00000000
4.20000	0.01346987	-1463.	700.00000000
3.60000	0.01447646	-1574.	699.99999999
3.00000	0.01543171	-1569.	700.00000001

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 9

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 800.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.01006	-1347.	800.00000	-3.78688	284183.

Output Summary for Load Case No. 9:

Pile-head deflection = 0.01005612 meters
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -1347. kN-m
Maximum shear force = 800.00000000 kN
Depth of maximum bending moment = 0.000000 meters below pile head
Depth of maximum shear force = 0.000000 meters below pile head
Number of iterations = 19
Number of zero deflection points = 3

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 2 11.4000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 3 10.8000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 4 10.2000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 5 9.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 6 9.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 7 8.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 8 7.80000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 9 7.20000000000000
12.0000000000000 0.600000000000000

```
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          13   4.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          14   4.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          15   3.60000000000000
  12.0000000000000       0.600000000000000
before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 9
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            800. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.01005612        -1347.  800.00000000
   11.40000    0.01040308        -1363.  800.00000000
   10.80000    0.00969193        -1330.  800.00000000
   10.20000    0.00986196        -1339.  800.00000000
    9.60000    0.00994540        -1343.  800.00000000
    9.00000    0.00990896        -1342.  800.00000000
    8.40000    0.00978159        -1336.  800.00000000
    7.80000    0.01020237        -1356.  800.00000000
    7.20000    0.00982685        -1339.  800.00000000
    6.60000    0.00996182        -1342.  800.00000000
    6.00000    0.01059118        -1358.  800.00000000
    5.40000    0.01275043        -1429.  800.00000000
    4.80000    0.01701142        -1606.  800.00000000
    4.20000    0.02092634        -1780.  800.00000000


--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 10
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                                =        900.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y          Moment        Force          p        Stiffness
   meters       meters        kN-m           kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000      0.01307       -1549.    900.00000     -4.13269      260268.

Output Summary for Load Case No. 10:

Pile-head deflection             =     0.01307050 meters
```

```
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1549. kN-m
Maximum shear force              =   900.00000000 kN
Depth of maximum bending moment  =       0.000000 meters below pile head
Depth of maximum shear force     =       0.000000 meters below pile head
Number of iterations             =             23
Number of zero deflection points =              3

 i_Length           1   12.0000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
   12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           5   9.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
i_Length          12   5.40000000000000
   12.0000000000000       0.600000000000000
before 180
after 180
 i_Length          13   4.80000000000000
   12.0000000000000       0.600000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 10
-------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =            900. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.01307050        -1549.  900.00000000
   11.40000    0.01356028        -1568.  900.00000000
   10.80000    0.01257426        -1531.  900.00000000
   10.20000    0.01280289        -1540.  900.00000000
```

9.60000	0.01292823	-1545.	900.00000000
9.00000	0.01286974	-1544.	900.00000000
8.40000	0.01270517	-1538.	900.00000000
7.80000	0.01327144	-1560.	900.00000000
7.20000	0.01276632	-1540.	900.00000000
6.60000	0.01299631	-1546.	900.00000000
6.00000	0.01408952	-1571.	900.00000000
5.40000	0.01881762	-1701.	900.00000000

Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 11

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head = 1000.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

Depth X meters	Deflect. y meters	Bending Moment kN-m	Shear Force kN	Soil Res. p kN/m	Bending Stiffness kN-m^2
0.000	0.01766	-1750.	1000.00000	-4.56848	188581.

Output Summary for Load Case No. 11:

Pile-head deflection = 0.01765664 meters
Computed slope at pile head = 0.000000 radians
Maximum bending moment = -1750. kN-m
Maximum shear force = 1000.00000000 kN
Depth of maximum bending moment = 0.000000 meters below pile head
Depth of maximum shear force = 0.000000 meters below pile head
Number of iterations = 41
Number of zero deflection points = 3

i_Length 1 12.0000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 2 11.4000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 3 10.8000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 4 10.2000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 5 9.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 6 9.00000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 7 8.40000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 8 7.80000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 9 7.20000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 10 6.60000000000000
12.0000000000000 0.600000000000000
before 180
after 180
i_Length 11 6.00000000000000

```
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length          12   5.40000000000000
  12.0000000000000       0.600000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 11
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =           1000. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.01765664        -1750. 1000.00000000
   11.40000    0.01848340        -1769. 1000.00000000
   10.80000    0.01680573        -1733. 1000.00000000
   10.20000    0.01714775        -1743. 1000.00000000
    9.60000    0.01735016        -1749. 1000.00000000
    9.00000    0.01722498        -1748. 1000.00000000
    8.40000    0.01693581        -1742.         1000.
    7.80000    0.01782752        -1766.         1000.
    7.20000    0.01700288        -1746.         1000.
    6.60000    0.01748338        -1755. 1000.00000000
    6.00000    0.02018021        -1798.         1000.


--------------------------------------------------------------------------------
                Computed Values of Pile Loading and Deflection
                  for Lateral Loading for Load Case Number 12
--------------------------------------------------------------------------------

Pile-head conditions are Shear and Pile-head Rotation (Loading Type 2)

Shear force at pile head                              =       1025.0 kN
Rotation of pile head                                 =    0.000E+00 radians
Axial load at pile head                               =       2480.0 kN

(Zero slope for this load indicates fixed-head conditions)

    Depth      Deflect.      Bending       Shear      Soil Res.     Bending
      X            y         Moment        Force          p        Stiffness
   meters       meters         kN-m          kN          kN/m        kN-m^2
-----------  -----------  -----------  -----------  -----------  -----------
      0.000      0.01950       -1795.        1025.     -4.72211      160341.


Output Summary for Load Case No. 12:

Pile-head deflection              =     0.01949858 meters
Computed slope at pile head       =       0.000000 radians
Maximum bending moment            =          -1795. kN-m
Maximum shear force               =           1025. kN
Depth of maximum bending moment   =       0.000000 meters below pile head
Depth of maximum shear force      =       0.000000 meters below pile head
Number of iterations              =             56
Number of zero deflection points  =              3

 i_Length           1   12.0000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           2   11.4000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           3   10.8000000000000
  12.0000000000000       0.600000000000000
 before 180
 after 180
 i_Length           4   10.2000000000000
  12.0000000000000       0.600000000000000
```

```
before 180
after 180
i_Length           5   9.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           6   9.00000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           7   8.40000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           8   7.80000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length           9   7.20000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          10   6.60000000000000
  12.0000000000000       0.600000000000000
before 180
after 180
i_Length          11   6.00000000000000
  12.0000000000000       0.600000000000000
before 180
exit 180


--------------------------------------------------------------------------------
            Pile-head Deflection vs. Pile Length for Load Case 12
--------------------------------------------------------------------------------

Boundary Condition Type 2, Shear and Slope

Shear      =           1025. kN
Slope      =         0.00000
Axial Load =           2480. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   12.00000    0.01949858        -1795.         1025.
   11.40000    0.02073194        -1809.         1025.
   10.80000    0.01841783        -1780.         1025.
   10.20000    0.01882748        -1790.         1025.
    9.60000    0.01907973        -1795.         1025.
    9.00000    0.01891289        -1795.         1025.
    8.40000    0.01854360        -1790.         1025.
    7.80000    0.01978707        -1809.         1025.
    7.20000    0.01860993        -1794.         1025.
    6.60000    0.01930906        -1803.         1025.

--------------------------------------------------------------------------------
            Summary of Pile-head Responses for Conventional Analyses
--------------------------------------------------------------------------------

Definitions of Pile-head Loading Conditions:

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


Load            Pile-head      Pile-head      Max Shear     Max Moment
Case   Load    Deflection      Rotation        in Pile        in Pile
 No.   Type      meters         radians          kN            kN-m
----   ----   ------------   ------------   ------------   ------------
  1      2         0.0000         0.0000         0.0000         0.0000
  2      2      0.0004063         0.0000     100.000000    -148.856404
  3      2      0.0009952         0.0000     200.000000    -317.272074
  4      2       0.001783         0.0000     300.000000    -491.513112
  5      2       0.002842         0.0000     400.000000    -654.731862
  6      2       0.004104         0.0000     500.000000    -812.699000
```

7	2	0.005607	0.0000	600.000000	-973.387701
8	2	0.007630	0.0000	700.000000	-1156.
9	2	0.010056	0.0000	800.000000	-1347.
10	2	0.013071	0.0000	900.000000	-1549.
11	2	0.017657	0.0000	1000.000000	-1750.
12	2	0.019499	0.0000	1025.	-1795.

Maximum pile-head deflection = 0.0194985848 meters
Maximum pile-head rotation = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.

ANEXO E
Resultados de laboratorio

ESTRATIGRAFIA

PROYECTO: Metrocable Pilona 59

CLIENTE: J. Fortuna

ELEVACIÓN:

SONDEO No.: P-59

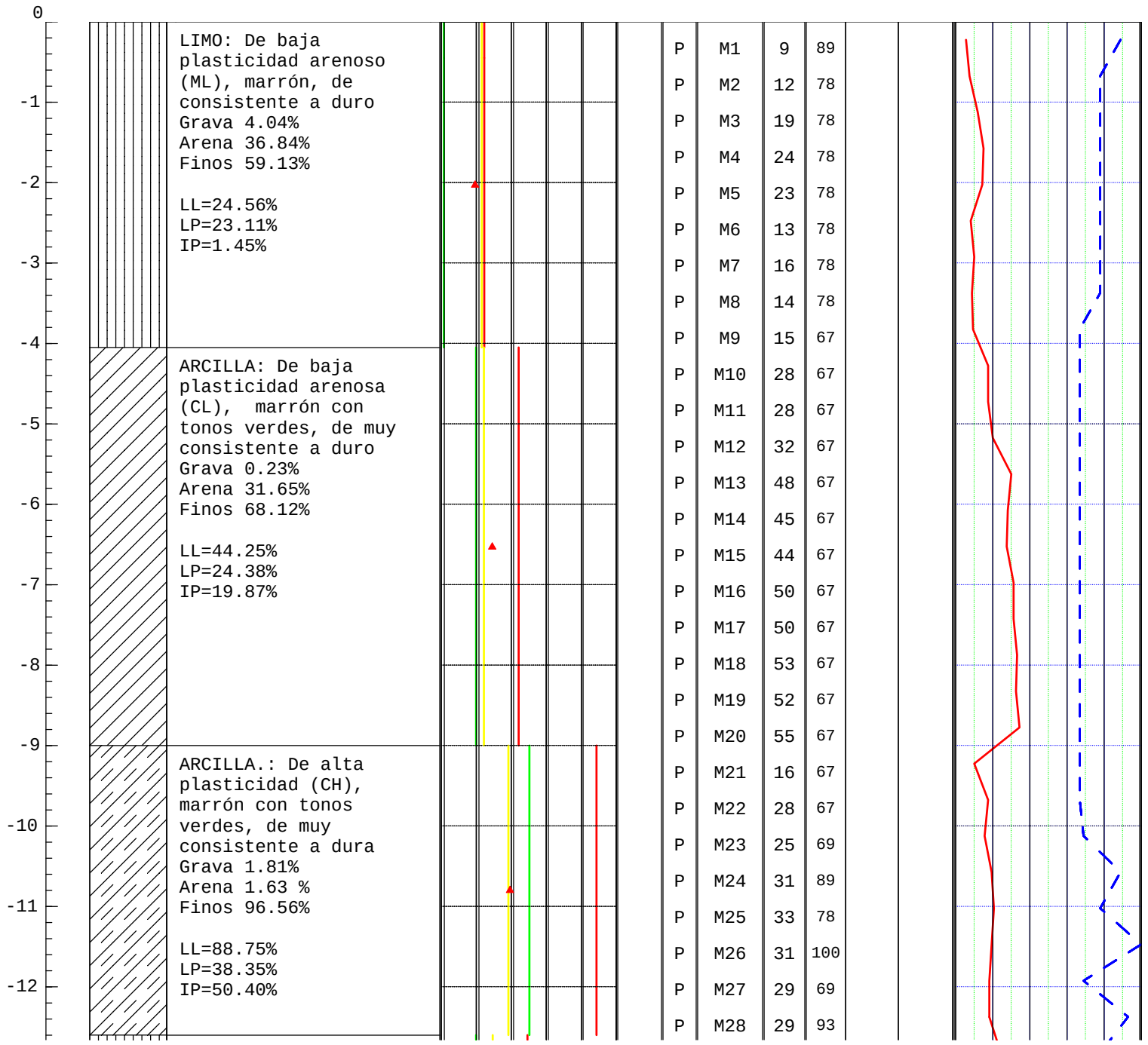
COORDENADAS: 390919.20 m E 2048395.35 m N **NIVEL FREÁTICO:** 7.20 m*

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

ING. DE CAMPO: JV
EDITADO POR: MO
SUPERVISADO POR: AC
FECHA INICIO: 19/03/2021
FECHA FIN: 19/03/2021
DESCRIPCIÓN
*P:percusión/ R:rotación/ M:muestra
V: veleta

DATOS DE LABORATORIO
Humedad △
L.liquido
L. plástico
Ind. plasticidad
20 40 60 80

SPT / REC / RQD
30 60 90 120
20 40 60 80
%



PROF. EN METROS	PERFIL	Nivel de degradación	Tipo de muestra	Número de muestra	N	Rec	qu kg/cm2	RQD
			P	M1	9	89		
			P	M2	12	78		
			P	M3	19	78		
			P	M4	24	78		
			P	M5	23	78		
			P	M6	13	78		
			P	M7	16	78		
			P	M8	14	78		
			P	M9	15	67		
			P	M10	28	67		
			P	M11	28	67		
			P	M12	32	67		
			P	M13	48	67		
			P	M14	45	67		
			P	M15	44	67		
			P	M16	50	67		
			P	M17	50	67		
			P	M18	53	67		
			P	M19	52	67		
			P	M20	55	67		
			P	M21	16	67		
			P	M22	28	67		
			P	M23	25	69		
			P	M24	31	89		
			P	M25	33	78		
			P	M26	31	100		
			P	M27	29	69		
			P	M28	29	93		

*Nivel de agua al finalizar el sondeo, posible nivel freático

ESTRATIGRAFIA

PROYECTO: Metrocable Pilona 59

CLIENTE: J. Fortuna

ELEVACIÓN:

SONDEO No.: P-59

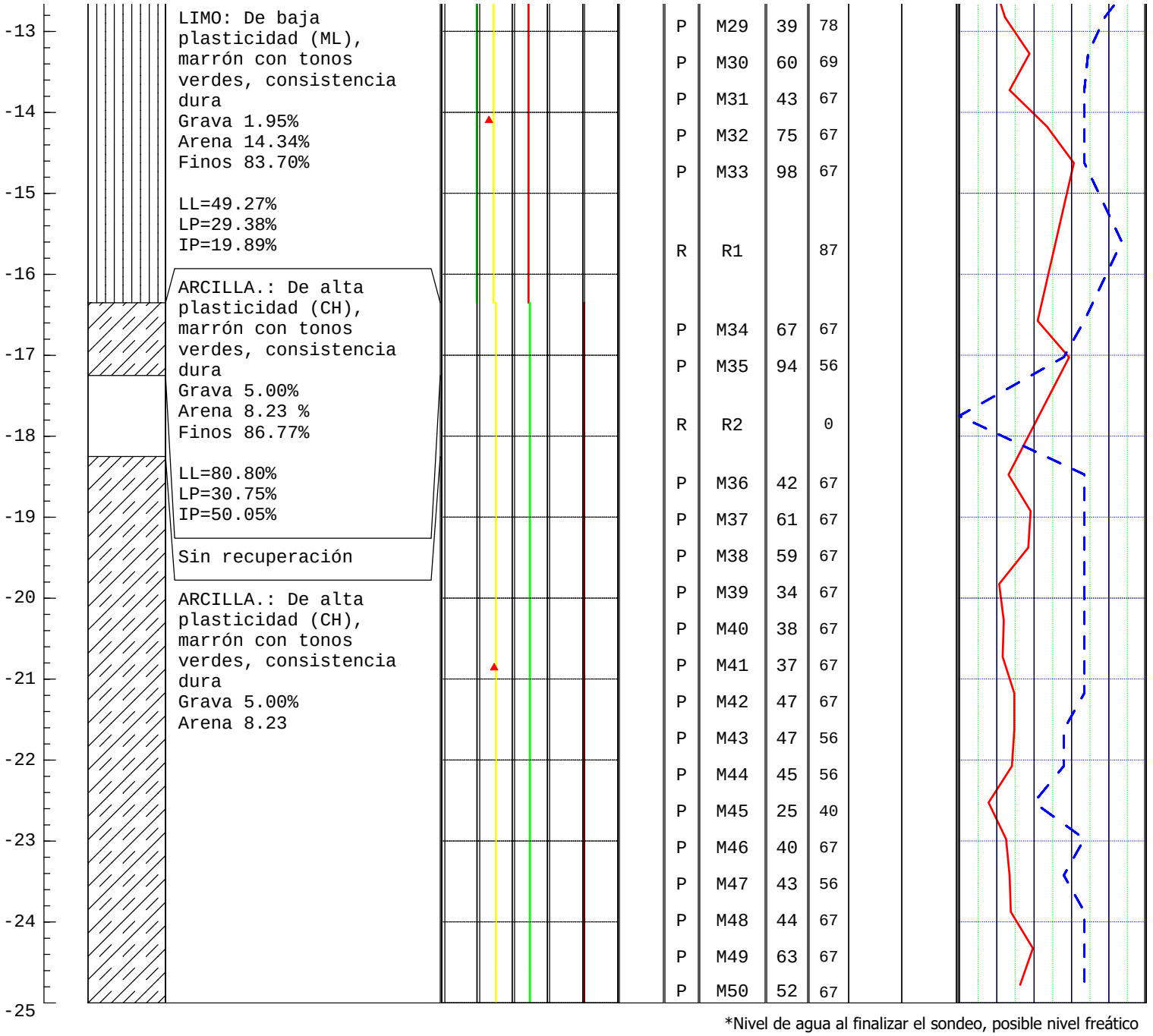
COORDENADAS: 390919.20 m E 2048395.35 m N **NIVEL FREÁTICO:** 7.20 m*

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

ING. DE CAMPO: JV
EDITADO POR: MO
SUPERVISADO POR: AC
FECHA INICIO: 19/03/2021
FECHA FIN: 19/03/2021
DESCRIPCIÓN
*P:percusión/ R:rotación/ M:muestra
V: veleta

DATOS DE LABORATORIO
Humedad △
L.liquido
L. plástico
Ind. plasticidad
20 40 60 80

SPT / REC / RQD
30 60 90 120
20 40 60 80
%



PROF. EN METROS	PERFIL		Nivel de degradación	Tipo de muestra	Número de muestra	N	Rec	qu kg/cm2	RQD
-13		LIMO: De baja plasticidad (ML), marrón con tonos verdes, consistencia dura Grava 1.95% Arena 14.34% Finos 83.70% LL=49.27% LP=29.38% IP=19.89%		P	M29	39	78		
				P	M30	60	69		
-14				P	M31	43	67		
				P	M32	75	67		
				P	M33	98	67		
-15									
				R	R1		87		
-16		ARCILLA.: De alta plasticidad (CH), marrón con tonos verdes, consistencia dura Grava 5.00% Arena 8.23 % Finos 86.77% LL=80.80% LP=30.75% IP=50.05%		P	M34	67	67		
				P	M35	94	56		
-17									
-18				R	R2		0		
		Sin recuperación		P	M36	42	67		
-19				P	M37	61	67		
				P	M38	59	67		
-20		ARCILLA.: De alta plasticidad (CH), marrón con tonos verdes, consistencia dura Grava 5.00% Arena 8.23		P	M39	34	67		
				P	M40	38	67		
-21				P	M41	37	67		
				P	M42	47	67		
				P	M43	47	56		
-22				P	M44	45	56		
				P	M45	25	40		
-23				P	M46	40	67		
				P	M47	43	56		
-24				P	M48	44	67		
				P	M49	63	67		
-25				P	M50	52	67		

*Nivel de agua al finalizar el sondeo, posible nivel freático

REPORTE DE LABORATORIO
ING-LAB-2021

Proyecto: SONDEOS GEOTECNICOS METRO CABLE PILONA 59, LOS ALCARRIZOS, SANTO DOMINGO OESTE, R.D.

Componente: ENSAYOS DE MUESTRA DE SUELO ASTM D2487 – ASTM D2216

Rev	Fecha	Descripción	Prep.	Rev.	Aprob.
00	26/04/2021	Reporte de Resultados para revisión	MC	MOF	ACC

RESULTADOS DE ENSAYOS DE LABORATORIO EN MUESTRAS DE SUELO METRO CABLE PILONA 59, LOS ALCARRIZOS, SANTO DOMINGO OESTE, R.D.

Para: J. Fortuna

De: Ingeniería Global Especializada, INGESA

Asunto: Resultados de Ensayos de Laboratorio en Muestras de Suelo. Metro Cable Pilona 59, Los Alcarrizos, Santo Domingo Oeste, R. D.

Fecha: 26 de Abril del 2021

Estimados Señores,

El presente reporte detalla los resultados de los ensayos de laboratorio realizados a las muestras de suelo extraídas el viernes 19 de marzo del 2021, mediante un (01) sondeo geotécnico realizado a 25.00 m de profundidad, ejecutado en Metro Cable Pilona 59, Los Alcarrizos, Santo Domingo Oeste, Rep. Dom.

A cada una de las muestras se le realizaron ensayos de clasificación, límites de Atterberg y contenido de humedad.

1.0 NORMAS APLICABLES

Para la ejecución de los ensayos se siguieron las siguientes normas ASTM:

1. ASTM D2487 – Sistema Unificado de Clasificación de Suelos.
2. ASTM D4318 – Límites de Atterberg.
3. ASTM D2216 – Contenido de Humedad.

2.0 RESUMEN DE ENSAYOS REALIZADOS.

Fecha Ensayo	Material	% Grava	% Arena	% de finos	Clasificación	IP	LL	Cont. Humedad
					SUCS			
15/04/2021	Pilona 59 Muestra M1-M9	4.04	36.84	59.13	(ML) Limo de baja plasticidad arenoso	1.45	24.56	17.77
15/04/2021	Pilona 59 Muestra M10-M20	0.23	31.65	68.12	(CL) Arcilla de baja plasticidad arenosa	19.87	44.25	27.63
15/04/2021	Pilona 59 Muestra M21-M28	1.81	1.63	96.56	(CH) Arcilla de alta plasticidad	50.40	88.75	37.89
15/04/2021	Pilona 59 Muestra M29-M33	1.95	14.34	83.70	(ML) Limo de baja plasticidad	19.89	49.27	25.26
15/04/2021	Pilona 59 Muestra M34-M50	5.00	8.23	86.77	(CH) Arcilla de alta plasticidad	50.05	80.80	28.29

Tabla 1. Ensayos de Clasificación.

Por Ingeniería Global Especializada

Muy atentamente

Marlenny Ortiz Ferreira

Manuel Castillo
Gerente de Laboratorio

Kilvio Arias
Técnico de Laboratorio

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

RESULTADOS ASTM D2487

SISTEMA UNIFICADO DE CLASIFICACION DE SUELO

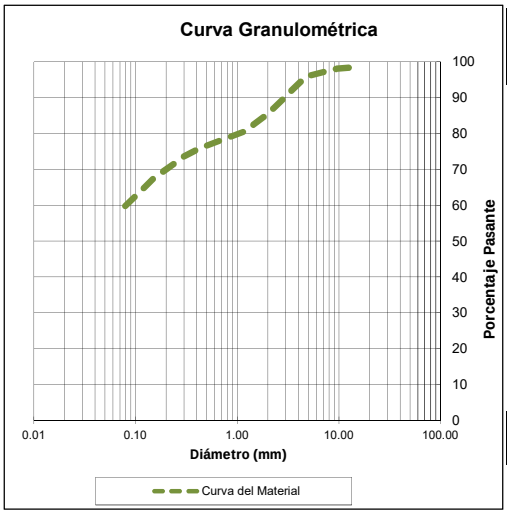
CLASIFICACIÓN DE SUELOS SEGÚN SISTEMA UNIFICADO DE CLASIFICACIÓN (ASTM D2487)

ID Muestra:	Metro Cable Pilona 59
Proyecto:	Metro Cable, Los Alcarrizos, Santo Domingo Oeste
Realizado por:	Kilvio Arias
Descripción:	B#35 (M1-M9)
Profundidad:	0.00-4.05 m
Fecha:	15/04/2021

Peso Sucio	**609.20**
Peso seco (gr):	**251.90**

Granulometría ASTM D-6913

Tamiz	Ø mm	W ret.	Ret. (%)	Acum. Ret (%)	Que pasa (%)
3 1/2"					
3"					
2 1/2"	63.00				
2"	50.00				
1 ½"	37.50				
1"	25.00				
3/4"	19.00				
1/2"	12.50	10.00	1.64	1.64	98.36
3/8"	9.50	1.60	0.26	1.90	98.10
No.4	4.75	13.00	2.13	4.04	95.96
No.10	2.00	64.00	10.51	14.54	85.46
No.16	1.18	29.80	4.89	19.44	80.56
No.40	0.43	28.20	4.63	24.06	75.94
No.50	0.3	14.10	2.31	26.38	73.62
No.100	0.15	37.40	6.14	32.52	67.48
No.200	0.075	50.90	8.36	40.87	59.13
Pan		2.20	0.36	41.23	
			0		



CONTENIDO DE HUMEDAD DE SUELOS ASTM D-2216

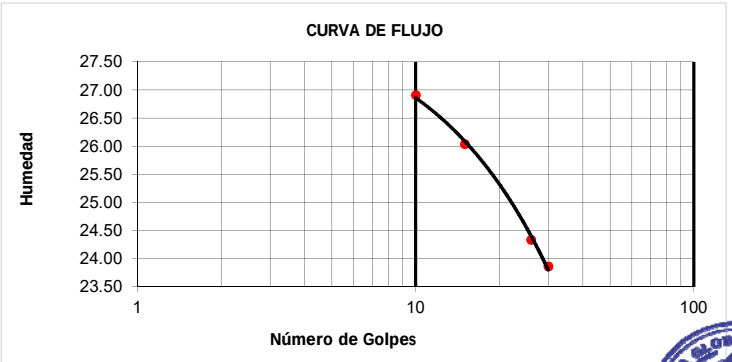
Recipiente No.	35
Recipiente + Wt. húmedo	1578.10
Recipiente + Wt. Seco	1360.60
Wt. Recipiente	136.40
Wt. del agua	217.50
Wt. material seco	1224.20
Contenido de agua	17.77
Promedio	17.77

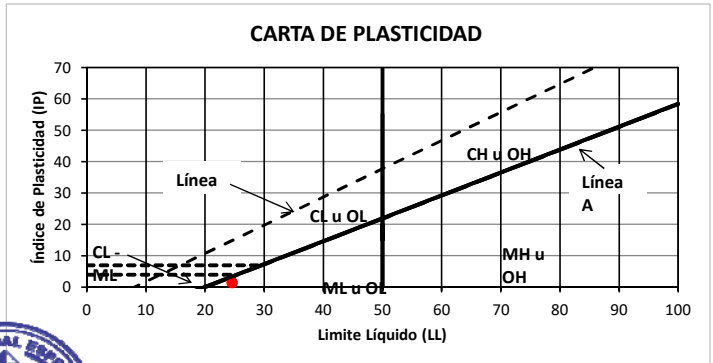
LIMITES ATTERBERG ASTM D-4318

	LIMITE LIQUIDO						LIMITE PLASTICO		
Ensayo	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
A) No. De Golpes	10	15	26	30					
B) Recipiente No.	A	B	C	D			E	F	G
C) Wt recipiente + suelo hum.	38.65	38.24	37.77	37.86			5.87	5.71	5.95
D) Wt recipiente + suelo seco	35.77	35.49	35.28	35.38			5.57	5.45	5.65
E) Wt del agua	2.88	2.75	2.49	2.48			0.30	0.26	0.30
G) Wt del recipiente	25.07	24.93	25.05	24.99			4.28	4.32	4.35
H) Wt del suelo seco (D-G)	10.70	10.56	10.23	10.39			1.29	1.13	1.30
I) Cont. de Humedad (E/H) %	26.92	26.04	24.34	23.87			23.26	23.01	23.08
Clasificación (SUCS):	**LIMO DE BAJA PLASTCIDAD ARENOSO (ML)**								

RESULTADOS

Porcentaje de grava	**4.04**
Porcentaje de arena	**36.84**
Porcentaje de finos	**59.13**
D10	**0.00**
D30	**0.00**
D60	**0.00**
Cu	
Cc	
Límite líquido	**24.56**
Límite plástico	**23.11**
Indice de plasticidad	**1.45**





Kilvio Arias
Realizado por:

Marlenny Ortiz Ferreira
Revisado por:

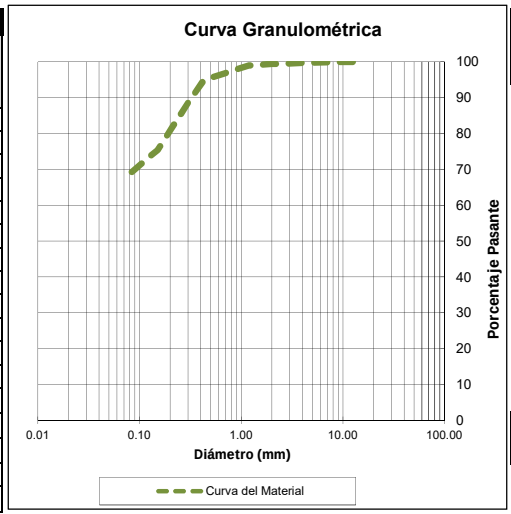
CLASIFICACIÓN DE SUELOS SEGÚN SISTEMA UNIFICADO DE CLASIFICACIÓN (ASTM D2487)

ID Muestra:	Metro Cable Pilona 59
Proyecto:	Metro Cable, Los Alcarrizos, Santo Domingo Oeste
Realizado por:	Kilvio Arias
Descripción:	B#51 (M10-M20)
Profundidad:	4.05-9.00 m
Fecha:	15/04/2021

Peso Sucio	**646.50**
Peso seco (gr):	**206.60**

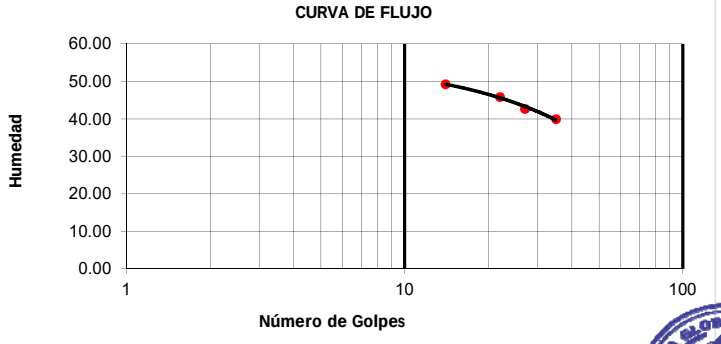
Granulometría ASTM D-6913

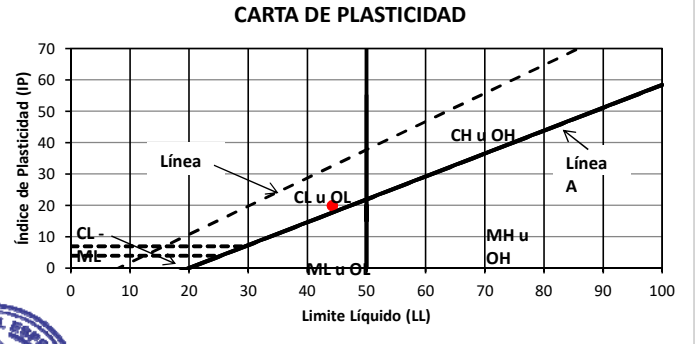
Tamiz	Ø mm	W ret.	Ret. (%)	Acum. Ret (%)	Que pasa (%)
3 1/2"					
3"					
2 1/2"	63.00				
2"	50.00				
1 ½"	37.50				
1"	25.00				
3/4"	19.00				
1/2"	12.50	0.00	0.00	0.00	100.00
3/8"	9.50	0.00	0.00	0.00	100.00
No.4	4.75	1.50	0.23	0.23	99.77
No.10	2.00	2.20	0.34	0.57	99.43
No.16	1.18	2.90	0.45	1.02	98.98
No.40	0.43	26.20	4.05	5.07	94.93
No.50	0.3	41.20	6.37	11.45	88.55
No.100	0.15	84.90	13.13	24.58	75.42
No.200	0.075	47.20	7.30	31.88	68.12
Pan		0.30	0.05	31.93	
			0		



CONTENIDO DE HUMEDAD DE SUELOS ASTM D-2216	
Recipiente No.	51
Recipiente + Wt. húmedo	1613.80
Recipiente + Wt. Seco	1292.60
Wt. Recipiente	130.10
Wt. del agua	321.20
Wt. material seco	1162.50
Contenido de agua	27.63
Promedio	27.63

LIMITES ATTERBERG ASTM D-4318										RESULTADOS	
	LIMITE LIQUIDO						LIMITE PLASTICO			Porcentaje de grava	**0.23**
Ensayo	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	Porcentaje de arena	**31.65**
A) No. De Golpes	14	22	27	35						Porcentaje de finos	**68.12**
B) Recipiente No.	A	B	C	D			E	F	G	D10	**0.00**
C) Wt recipiente + suelo hum.	37.57	38.30	35.09	33.17			17.62	16.94	17.16	D30	**0.00**
D) Wt recipiente + suelo seco	28.94	29.82	27.97	26.99			16.38	15.88	16.01	D60	**0.00**
E) Wt del agua	8.63	8.48	7.12	6.18			1.24	1.06	1.15	Cu	
G) Wt del recipiente	11.44	11.35	11.30	11.53			11.33	11.52	11.27	Cc	
H) Wt del suelo seco (D-G)	17.50	18.47	16.67	15.46			5.05	4.36	4.74	Límite líquido	**44.25**
I) Cont. de Humedad (E/H) %	49.31	45.91	42.71	39.97			24.55	24.31	24.26	Límite plástico	**24.38**
Clasificación (SUCS):	**ARCILLA DE BAJA PLASTCIDAD ARENOSA (CL)**									Indice de plasticidad	**19.87**





Kilvio Arias
Realizado por:

Marlenny Ortiz Ferreira
Revisado por:

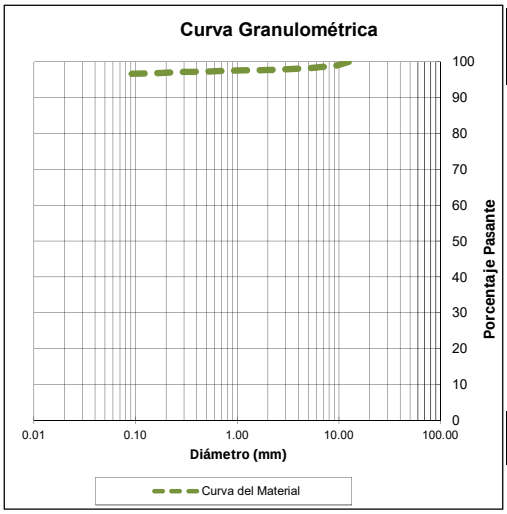
CLASIFICACIÓN DE SUELOS SEGÚN SISTEMA UNIFICADO DE CLASIFICACIÓN (ASTM D2487)

ID Muestra:	Metro Cable Pilona 59
Proyecto:	Metro Cable, Los Alcarrizos, Santo Domingo Oeste
Realizado por:	Kilvio Arias
Descripción:	B#31 (M21-M28)
Profundidad:	9.00-12.60 m
Fecha:	15/04/2021

Peso Sucio	**387.00**
Peso seco (gr):	**13.70**

Granulometría ASTM D-6913

Tamiz	Ø mm	W ret.	Ret. (%)	Acum. Ret (%)	Que pasa (%)
3 1/2"					
3"					
2 1/2"	63.00				
2"	50.00				
1 ½"	37.50				
1"	25.00				
3/4"	19.00				
1/2"	12.50	0.00	0.00	0.00	100.00
3/8"	9.50	4.10	1.06	1.06	98.94
No.4	4.75	2.90	0.75	1.81	98.19
No.10	2.00	1.80	0.47	2.27	97.73
No.16	1.18	0.50	0.13	2.40	97.60
No.40	0.43	1.20	0.31	2.71	97.29
No.50	0.3	0.50	0.13	2.84	97.16
No.100	0.15	1.30	0.34	3.18	96.82
No.200	0.075	1.00	0.26	3.44	96.56
Pan		0.00	0.00	3.44	
			0		



CONTENIDO DE HUMEDAD DE SUELOS ASTM D-2216

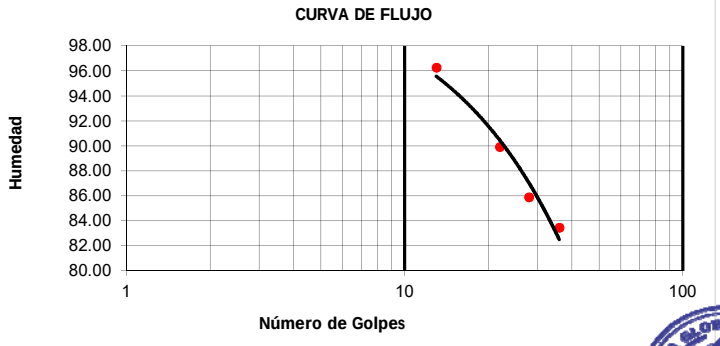
Recipiente No.	31
Recipiente + Wt. húmedo	1184.00
Recipiente + Wt. Seco	905.20
Wt. Recipiente	169.40
Wt. del agua	278.80
Wt. material seco	735.80
Contenido de agua	37.89
Promedio	37.89

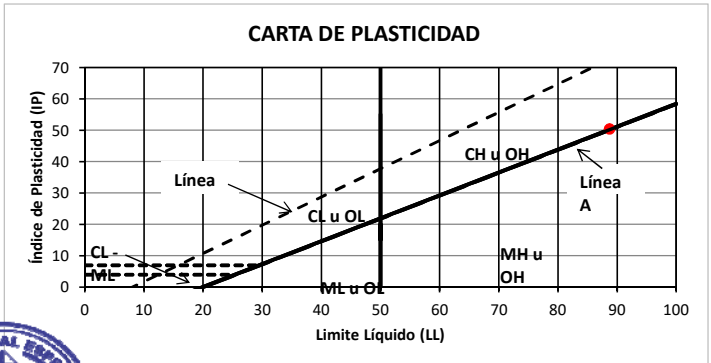
LIMITES ATTERBERG ASTM D-4318

	LIMITE LIQUIDO						LIMITE PLASTICO		
Ensayo	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
A) No. De Golpes	13	22	28	36					
B) Recipiente No.	A	B	C	D			E	F	G
C) Wt recipiente + suelo hum.	34.24	30.31	30.16	30.38			17.32	17.01	17.06
D) Wt recipiente + suelo seco	23.09	21.29	21.45	21.80			15.65	15.46	15.49
E) Wt del agua	11.15	9.02	8.71	8.58			1.67	1.55	1.57
G) Wt del recipiente	11.51	11.26	11.31	11.52			11.33	11.44	11.34
H) Wt del suelo seco (D-G)	11.58	10.03	10.14	10.28			4.32	4.02	4.15
I) Cont. de Humedad (E/H) %	96.29	89.93	85.90	83.46			38.66	38.56	37.83
Clasificación (SUCS):	**ARCILLA DE ALTA PLASTCIDAD (CH)**								

RESULTADOS

Porcentaje de grava	**1.81**
Porcentaje de arena	**1.63**
Porcentaje de finos	**96.56**
D10	**0.00**
D30	**0.00**
D60	**0.00**
Cu	
Cc	
Límite líquido	**88.75**
Límite plástico	**38.35**
Indice de plasticidad	**50.40**





Kilvio Arias
Realizado por:

Marlenny Ortiz Ferreira
Revisado por:

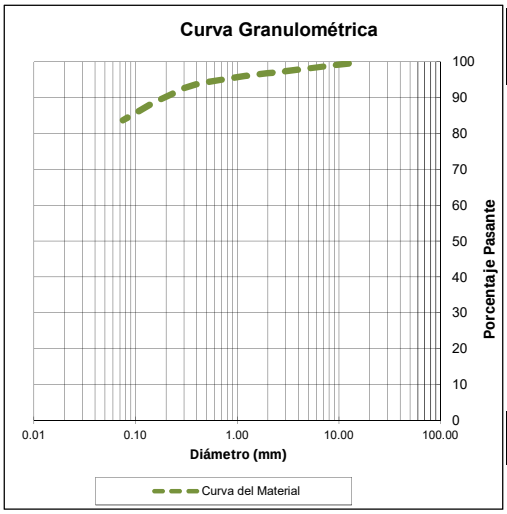
CLASIFICACIÓN DE SUELOS SEGÚN SISTEMA UNIFICADO DE CLASIFICACIÓN (ASTM D2487)

ID Muestra:	Metro Cable Pilona 59
Proyecto:	Metro Cable, Los Alcarrizos, Santo Domingo Oeste
Realizado por:	Kilvio Arias
Descripción:	B#42 (M29-M33)
Profundidad:	12.60-16.35 m
Fecha:	15/04/2021

Peso Sucio	**706.90**
Peso seco (gr):	**116.00**

Granulometría ASTM D-6913

Tamiz	Ø mm	W ret.	Ret. (%)	Acum. Ret (%)	Que pasa (%)
3 1/2"					
3"					
2 1/2"	63.00				
2"	50.00				
1 ½"	37.50				
1"	25.00				
3/4"	19.00				
1/2"	12.50	3.30	0.47	0.47	99.53
3/8"	9.50	2.90	0.41	0.88	99.12
No.4	4.75	7.60	1.08	1.95	98.05
No.10	2.00	8.40	1.19	3.14	96.86
No.16	1.18	5.80	0.82	3.96	96.04
No.40	0.43	14.00	1.98	5.94	94.06
No.50	0.3	10.10	1.43	7.37	92.63
No.100	0.15	28.30	4.00	11.37	88.63
No.200	0.075	34.80	4.92	16.30	83.70
Pan		0.40	0.06	16.35	
			0		

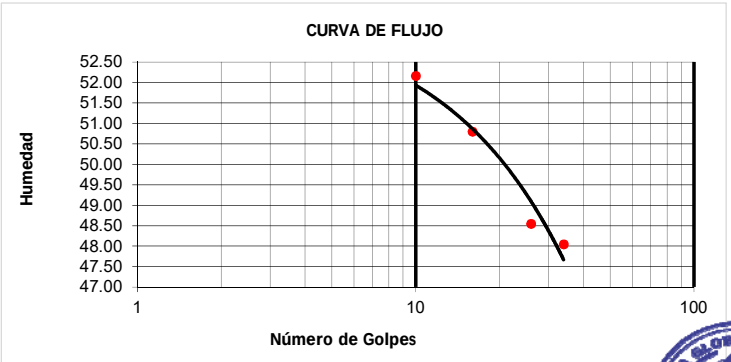


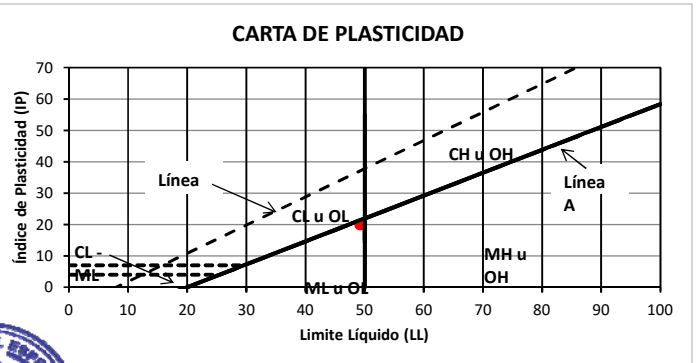
CONTENIDO DE HUMEDAD DE SUELOS ASTM D-2216	
Recipiente No.	42
Recipiente + Wt. húmedo	1792.60
Recipiente + Wt. Seco	1457.50
Wt. Recipiente	131.00
Wt. del agua	335.10
Wt. material seco	1326.50
Contenido de agua	25.26
Promedio	25.26

LIMITES ATTERBERG ASTM D-4318

	LIMITE LIQUIDO						LIMITE PLASTICO		
Ensayo	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
A) No. De Golpes	10	16	26	34					
B) Recipiente No.	A	B	C	D			E	F	G
C) Wt recipiente + suelo hum.	35.57	35.39	34.30	37.75			5.56	5.46	5.45
D) Wt recipiente + suelo seco	31.95	31.90	31.29	33.70			5.29	5.19	5.20
E) Wt del agua	3.62	3.49	3.01	4.05			0.27	0.27	0.25
G) Wt del recipiente	25.01	25.03	25.09	25.27			4.36	4.27	4.36
H) Wt del suelo seco (D-G)	6.94	6.87	6.20	8.43			0.93	0.92	0.84
I) Cont. de Humedad (E/H) %	52.16	50.80	48.55	48.04			29.03	29.35	29.76
Clasificación (SUCS):	**LIMO DE BAJA PLASTCIDAD (ML)**								

RESULTADOS	
Porcentaje de grava	**1.95**
Porcentaje de arena	**14.34**
Porcentaje de finos	**83.70**
D10	**0.00**
D30	**0.00**
D60	**0.00**
Cu	
Cc	
Límite líquido	**49.27**
Límite plástico	**29.38**
Indice de plasticidad	**19.89**





Kilvio Arias
Realizado por:

Marlenny Ortiz Ferreira
Revisado por:

CLASIFICACIÓN DE SUELOS SEGÚN SISTEMA UNIFICADO DE CLASIFICACIÓN (ASTM D2487)

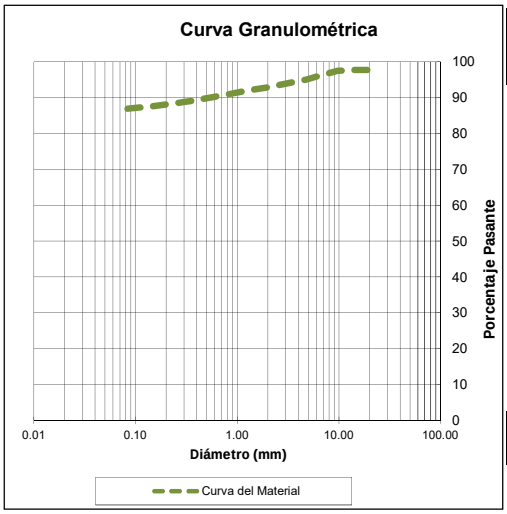
ID Muestra:	Metro Cable Pilona 59
Proyecto:	Metro Cable, Los Alcarrizos, Santo Domingo Oeste
Realizado por:	Kilvio Arias
Descripción:	B#41 (M34-M50)
Profundidad:	16.35-25.00 m
Fecha:	15/04/2021

Peso Sucio	**632.00**
Peso seco (gr):	**83.60**

Granulometría ASTM D-6913

Tamiz	Ø mm	W ret.	Ret. (%)	Acum. Ret (%)	Que pasa (%)
3 1/2"					
3"					
2 1/2"	63.00				
2"	50.00				
1 ½"	37.50				
1"	25.00				
3/4"	19.00	14.30	2.26	2.26	97.74
1/2"	12.50	0.00	0.00	2.26	97.74
3/8"	9.50	1.70	0.27	2.53	97.47
No.4	4.75	15.60	2.47	5.00	95.00
No.10	2.00	13.00	2.06	7.06	92.94
No.16	1.18	7.20	1.14	8.20	91.80
No.40	0.43	14.40	2.28	10.47	89.53
No.50	0.3	4.40	0.70	11.17	88.83
No.100	0.15	7.80	1.23	12.41	87.59
No.200	0.075	5.20	0.82	13.23	86.77
Pan		0.00	0.00	13.23	

0

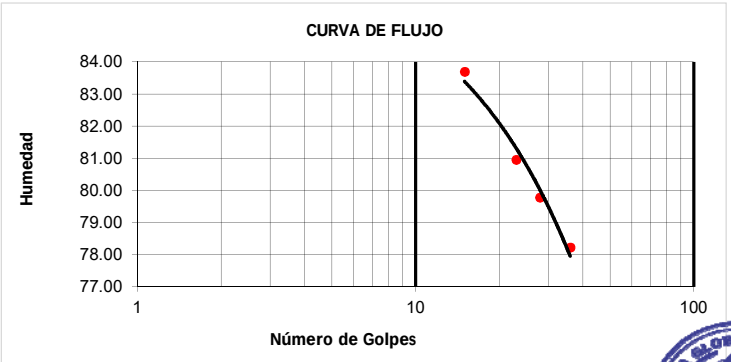


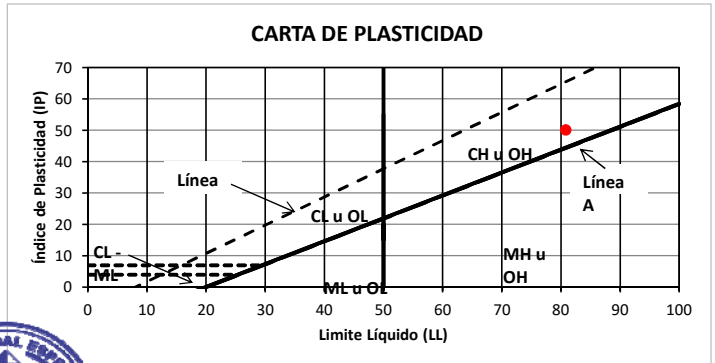
CONTENIDO DE HUMEDAD DE SUELOS ASTM D-2216	
Recipiente No.	41
Recipiente + Wt. húmedo	1656.80
Recipiente + Wt. Seco	1321.50
Wt. Recipiente	136.40
Wt. del agua	335.30
Wt. material seco	1185.10
Contenido de agua	28.29
Promedio	28.29

LIMITES ATTERBERG ASTM D-4318

	LIMITE LIQUIDO						LIMITE PLASTICO		
Ensayo	**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**
A) No. De Golpes	15	23	28	36					
B) Recipiente No.	A	B	C	D			E	F	G
C) Wt recipiente + suelo hum.	26.78	36.15	27.19	36.06			7.26	7.12	7.11
D) Wt recipiente + suelo seco	15.48	25.01	16.10	25.17			6.09	5.89	5.94
E) Wt del agua	11.30	11.14	11.09	10.89			1.17	1.23	1.17
G) Wt del recipiente	1.98	11.25	2.20	11.25			2.19	2.03	2.09
H) Wt del suelo seco (D-G)	13.50	13.76	13.90	13.92			3.90	3.86	3.85
I) Cont. de Humedad (E/H) %	83.70	80.96	79.78	78.23			30.00	31.87	30.39
Clasificación (SUCS):	**ARCILLA DE ALTA PLASTCIDAD (CH)**								

RESULTADOS	
Porcentaje de grava	**5.00**
Porcentaje de arena	**8.23**
Porcentaje de finos	**86.77**
D10	**0.00**
D30	**0.00**
D60	**0.00**
Cu	
Cc	
Límite líquido	**80.80**
Límite plástico	**30.75**
Indice de plasticidad	**50.05**



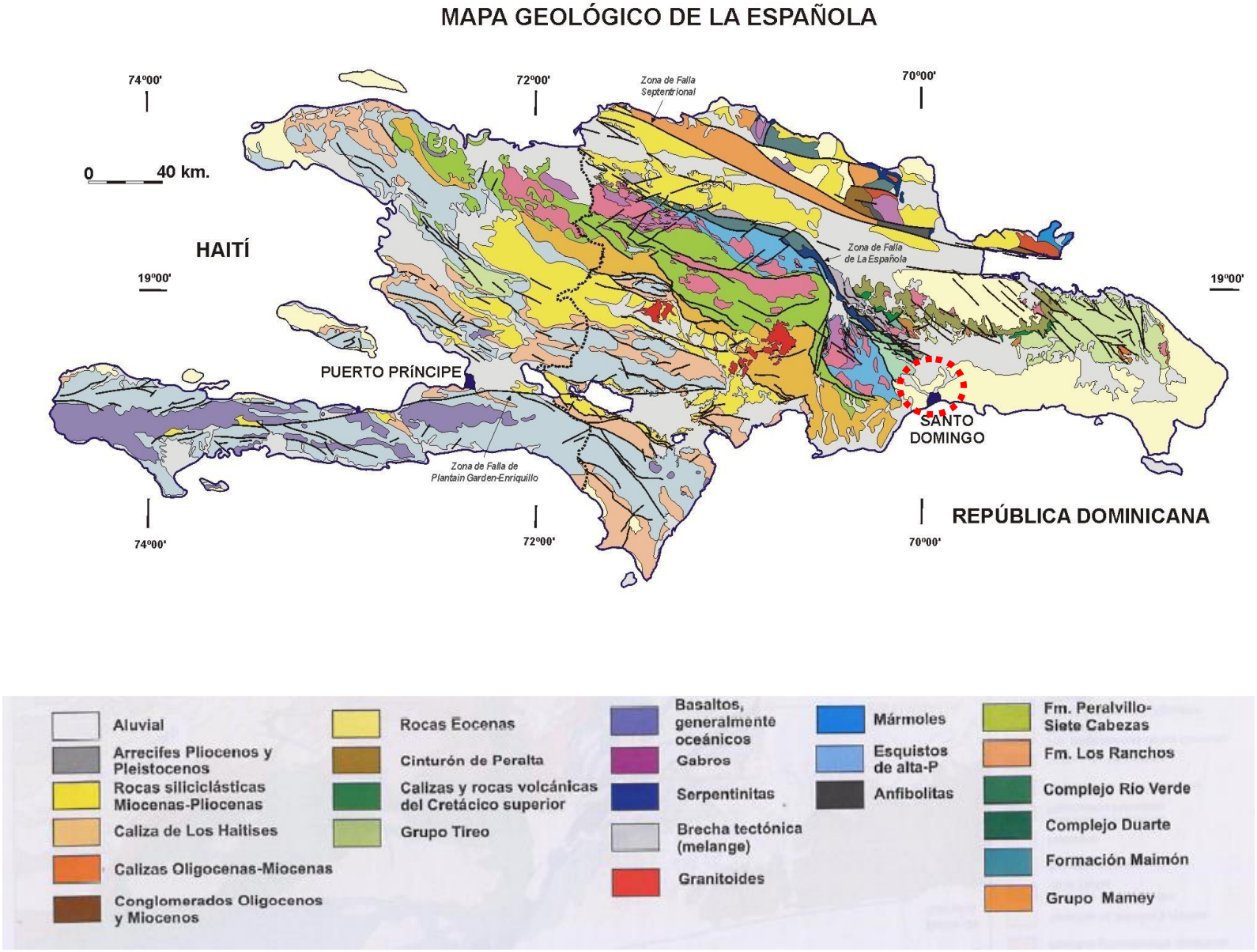


Kilvio Arias
Realizado por:

Marlenny Ortiz Ferreira
Revisado por:

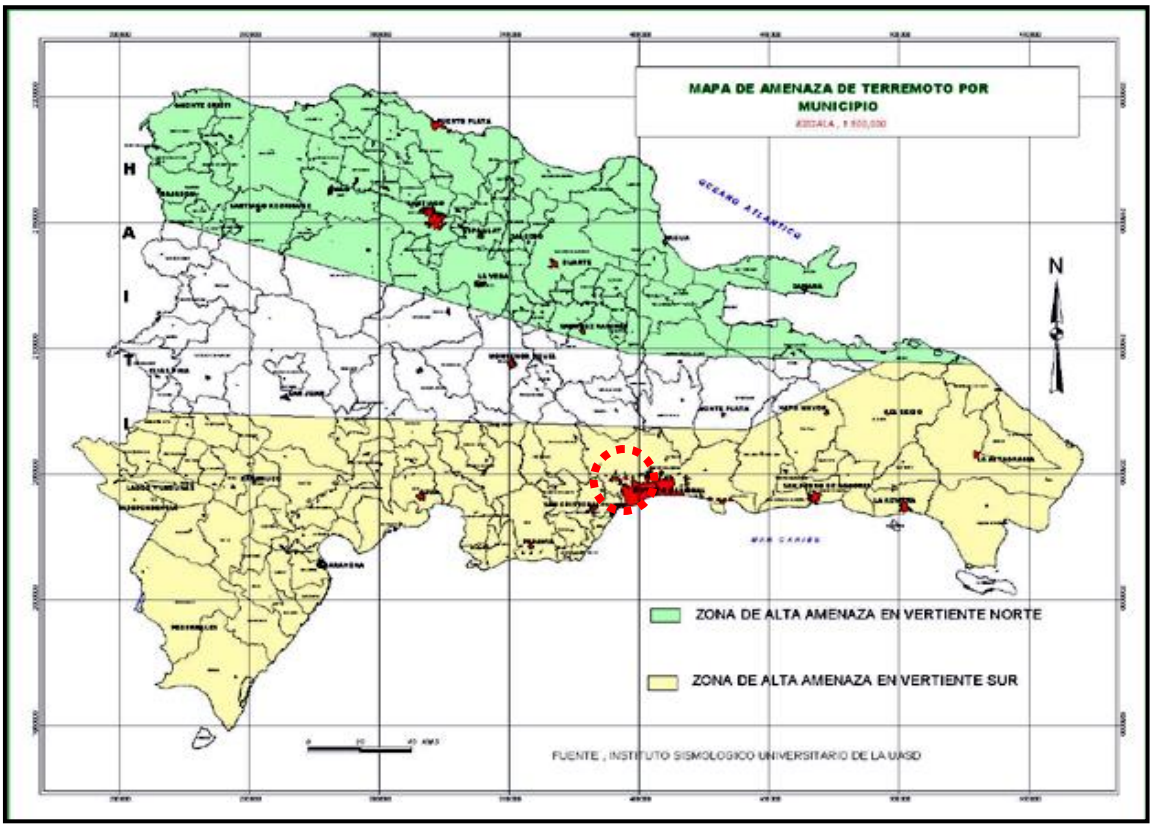
ANEXO F

Figuras geológicas



Mapa Geológico de la República Dominicana.

Mapa Zonas de Falla y Campo Cercano



Mapa Zonas de Falla y Vertientes de amenazas.

ANEXO G

Reporte fotográfico

Reporte Fotográfico

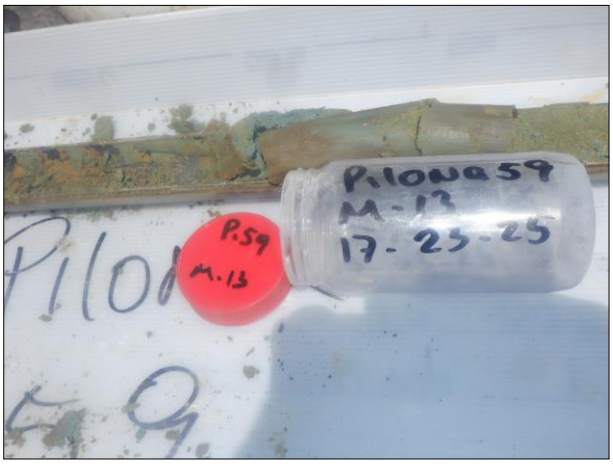
Metro Cable Pilona 59,
Los Alcarrizos, Santo Domingo Oeste, R.D.

FOTOS DEL SONDEO

FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

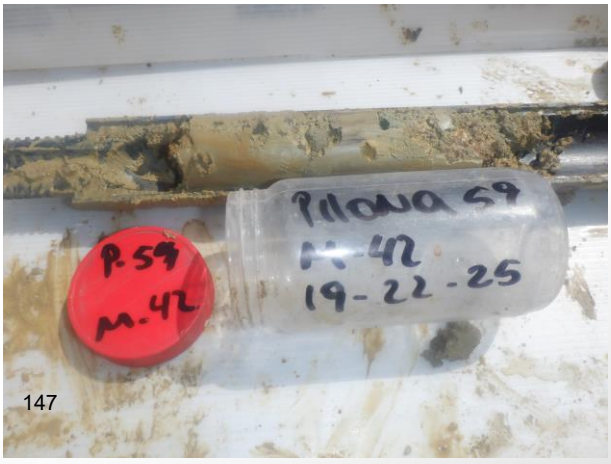


FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

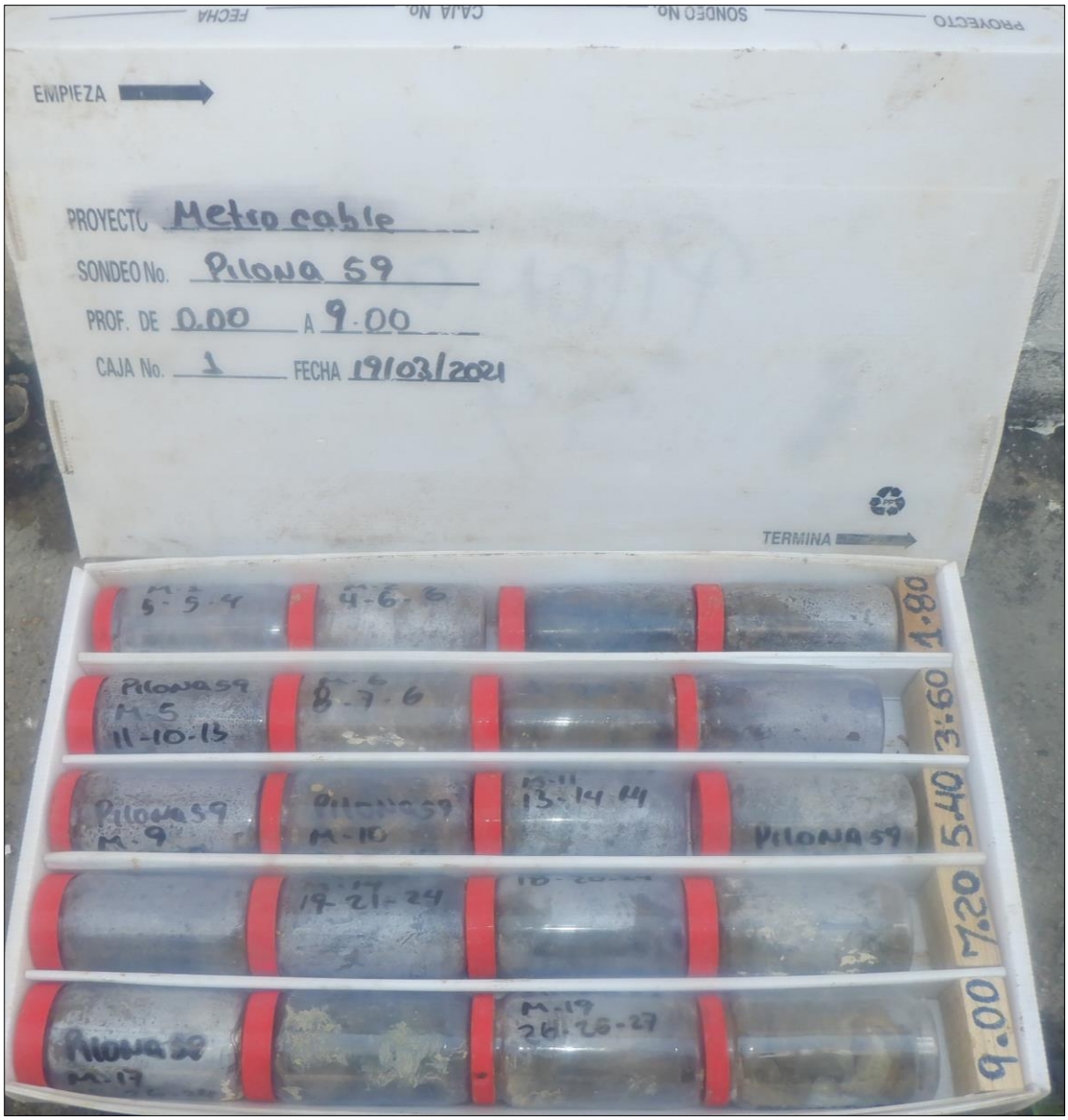
FOTOS DE MUESTRAS



FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

FOTOS DE MUESTRAS



FOTOS DE MUESTRAS

FOTOS DE MUESTRAS

ANEXO H
Listado de Abreviaturas

ABREVIATURAS	DEFINICION
ASCE	Sociedad Americana de Ingenieros Civiles
ASTM	Código de estándares internacionales
Bmax	Ancho máximo de la cimentación
Bmin	Ancho mínimo de la cimentación
CH	Arcilla de alta plasticidad
CL	Arcilla de baja plasticidad
DN	Distrito Nacional
Fa	Coeficiente de sitio para S_s
Fv	Coeficiente de sitio para S_1
GC	Grava arcillosa
GM	Grava limosa
GP	Grava pobremente graduada
GW	Grava bien graduada
H:V	Escala horizontal : vertical
IBC	Código internación de la edificación
IP	Índice de plasticidad
LL	Límite liquido
LP	Límite plástico
MASW	Análisis multicanal de ondas superficiales
M-014	Especificaciones generales para la construcción de carreteras
ML	Limo de baja plasticidad
MOPC	Ministerio de Obras Públicas y Comunicación
NF	Nivel freático
N_{SPT}	Número de golpes obtenidos del ensayo SPT
NWL	Tipo de tubería
Pe	Probabilidad de excedencia en un periodo de 50 años
R-024	Reglamento Para Estudios Geotécnico en Edificaciones
PGA	Aceleración máxima del suelo
RQD	Índice de calidad de la roca
S_1	Aceleración espectral a segundos a 1 segundo
SC	Arena arcillosa
SM	Arena limosa
SP	Arena pobremente graduada
SPT	Ensayo de penetración estándar
S_s	Aceleración espectral a 0.2 segundos
SW	Arena bien graduada
USGS	Agencia de los Estados Unidos de Reconocimiento Geológico
UTM	Coordenadas Universal Transversal de Mercador