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# INVESTIGACIÓN GEOTÉCNICA PARA LA CONSTRUCCIÓN DE LA ESTACIÓN E-08, CARRETERA HATO NUEVO LOS ALCARRIZOS TELEFÉRICO LÍNEA 2 SANTO DOMINGO OESTE. R.D.

## GARAJE Y ESTACIÓN MACIZOS Y PILONA

Ingeniería Global Especializada, S.A.

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# ESTACIÓN E-08, CARRETERA HATO NUEVO, LOS ALCARRIZOS.
## TELEFÉRICO LÍNEA 2
SANTO DOMINGO OESTE, R.D.

# INFORME GEOTÉCNICO

## INFORME FINAL


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# INVESTIGACIÓN GEOTÉCNICA PARA LA CONSTRUCCIÓN DE LA ESTACIÓN E-08, CARRETERA HATO NUEVO, LOS ALCARRIZOS. TELEFÉRICO 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 realizada para el Teleférico Línea 2, en el área de construcción de la estación E-08, la cual está ubicada en la carretera de Hato Nuevo, a unos 1.50 km al Este de la circunvalación Santo Domingo, en Santo Domingo Oeste, R.D., aproximadamente en las coordenadas 389195.00 m E/ 2048228.00 m N UTM/WGS-84.

En este informe se presentan los resultados de los trabajos de campo y de gabinete, los cuales tienen como finalidad evaluar las características geotécnicas del área de estudio, determinar la capacidad admisible del terreno, evaluar los asentamientos esperados y proponer recomendaciones de fundación para el proyecto.

La investigación geotécnica incluye la realización de doce (12) sondeos geotécnicos de los cuales cuatros (4) fueron ejecutados en el área de macizos y pilonas a profundidades que varían de 30.00 a 30.30 m por debajo del nivel actual del terreno y ocho (8) en el área de garaje y estación a profundidades variables de 8.10 a 10.35 m por debajo del nivel actual del terreno.

Los sondeos geotécnicos fueron ejecutados con una sonda equipada con martillo automático y al mismo tiempo con capacidad de realizar rotación. Los sondeos son del

tipo SPT con recuperación de testigo y se ejecutaron siguiendo norma ASTM D-1586 (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 mediante uso de muestreo con HQ3.

## 1.2 Alcance de la investigación geotécnica

El alcance del estudio aquí presentado fue propuesto por el cliente y se limita a la investigación geotécnica realizada para el Teleférico Línea 2, en el área de construcción de la estación E-08, la cual está ubicada en la carretera de Hato Nuevo, a unos 1.50 km al Este de la circunvalación Santo Domingo, en Santo Domingo Oeste, R.D.

El estudio incluye lo siguiente:

- Realización de sondeos geotécnicos tipo SPT
- Realización de ensayos de laboratorio
- Análisis de capacidad admisible y asentamiento de los suelos
- Descripción de la geología regional
- Ubicación de los ensayos realizados
- Perfiles estratigráficos y descripción estratigráfica
- Identificación de datos relevantes de la zona investigada
- Ubicación del nivel freático
- 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 localiza en la carretera de Hato Nuevo, a unos 1.50 km al Este de la circunvalación Santo Domingo, en Santo Domingo Oeste, R.D., aproximadamente en las coordenadas 389195.00 m E/ 2048228.00 m N UTM/WGS-84. Al momento de los trabajos de campo en el área estaba cubierta por una vegetación densa y presentaba topografía variable con elevaciones entre 63.72 a 66.32 msnm. (Ver figura 3 y 4).

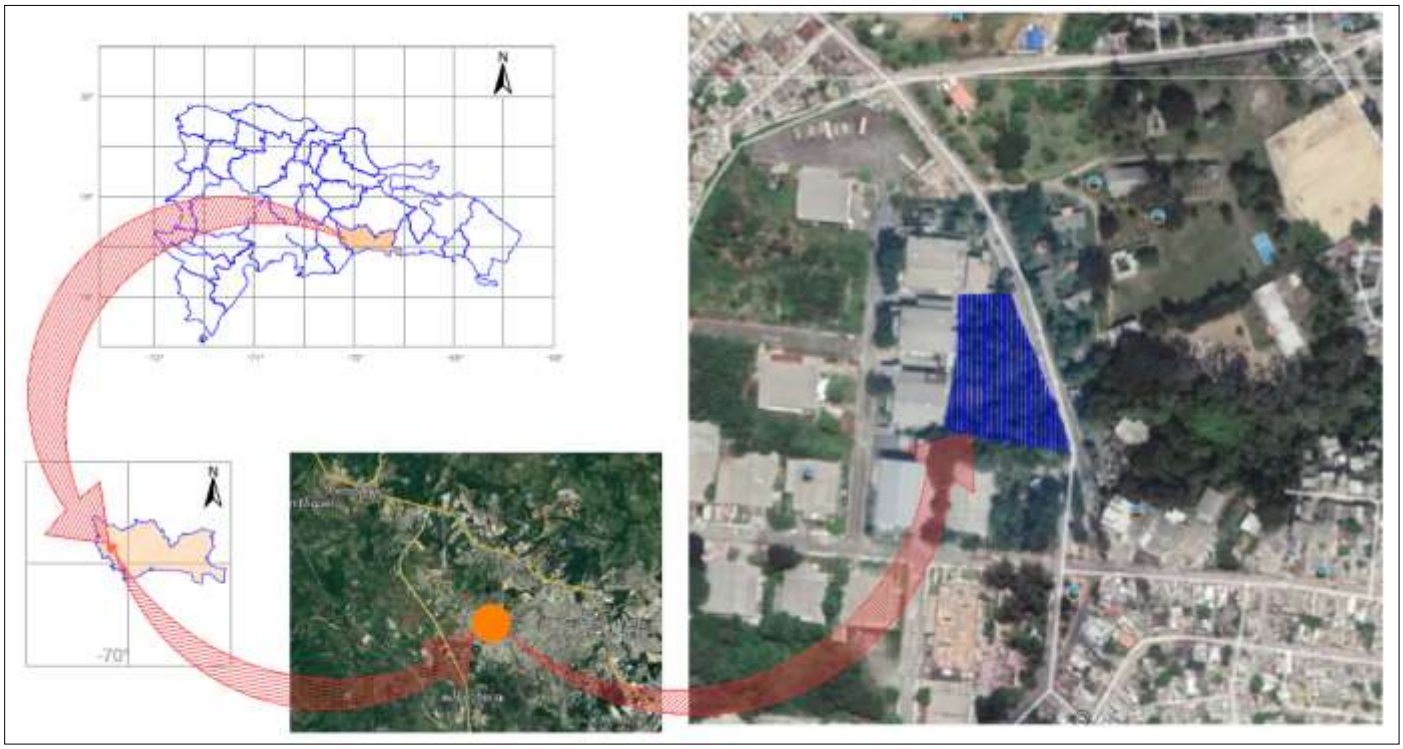

**Figura 1 Localización del área de estudio**

**Figura 2 Foto del entorno del proyecto (vista 1)**

**Figura 3 Foto del entorno del proyecto (vista 2)**

## 3 TIPO DE OBRA

El proyecto consiste en la construcción de la estación E-08 para el teleférico línea 2, la cual estará desarrollada principalmente sobre macizos y pilonas y consistirá en la construcción de área de estación y garaje para las cabinas de transporte.

# 4 CONDICIONES GEOLÓGICAS GENERALES DEL SITIO

**Geología Regional** (Fuente: Servicio Geológico Nacional, R.D)

## 4.1 Ubicación

El lugar donde se ubicará la estación E-08, teleférico línea 2, se localiza en el sector meridional de la República Dominicana, en el ámbito de Santo Domingo. Su fisiografía queda definida por la presencia de la Cordillera Central en el extremo noroccidental y, sobre todo, por la Llanura Costera del Caribe en las demás zonas; dos de los principales dominios fisiográficos de la República Dominicana.

En la zona de estudio, la fisonomía de la Llanura Costera del Caribe se caracteriza por pequeños contrastes altimétricos con altitud máxima cercana a +100 m en el borde de la Cordillera Central, y alcanza cotas mínimas ligeramente inferiores a +10 m. A grandes rasgos, estos pequeños desniveles confieren al paisaje una fisonomía de gran planicie.

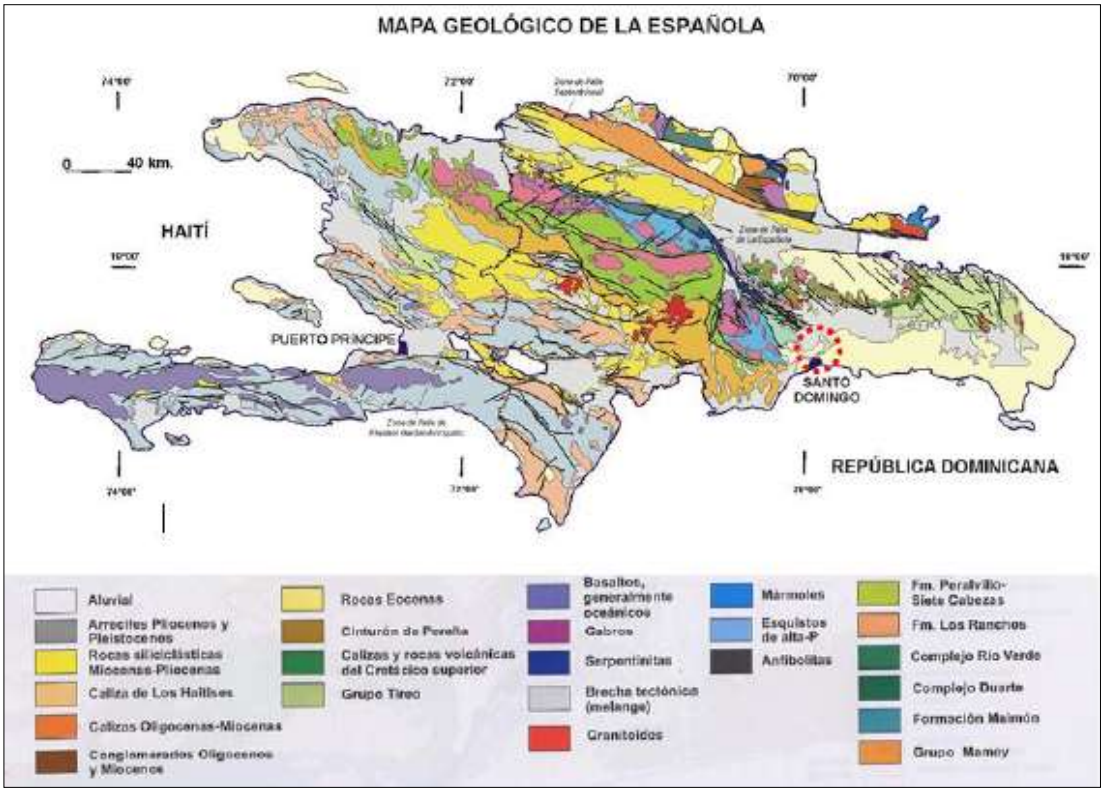


**Figura 4 Mapa Geológico.** En círculo rojo área de estudio. Fuente: Servicio geológico Nacional, R.D.

## 4.2 Marco geológico

En la zona de estudio se reconocen materiales mesozoicos de ambientes geodinámicos totalmente diferentes. Su flaco nororiental constituye un dominio con características específicas denominado Cinturón Intermedio. Uno de sus rasgos principales es la presencia de la Zona de Falla de La Española, accidente geodinámico de primer orden que favorece la extrusión de la Peridotita de Loma Caribe a favor de desgarres de dirección NO-SE, flanqueada en la región por materiales de arco insular, al noreste, y de meseta oceánica del Cretácico Inferior, al suroeste. Más recientemente, se han individualizado tres bloques tectónicos o corticales en la cordillera, en base a sus diferencias estratigráficas y geoquímicas.

## 4.3 Estratigrafía y petrografía

La banda nororiental está constituida por la Zona de Falla de La Española, caracterizada por la extrusión de la Peridotita de Loma Caribe. El límite nororiental de esta banda se encuentra oculto bajo sedimentos cuaternarios algunos kilómetros al noreste de los afloramientos peridotíticos de la zona, limitados a su vez por una falla de dirección NNO-SSE. Dentro de estas bandas, la tectónica de desgarre se ha resuelto en la zona mediante dos franjas que configuran sendas alineaciones morfológicas, mucho más pronunciada la nororiental, además trastocada por fallas de orientación NNO-SSE.

A tenor del carácter frágil de estas fábricas, de su asociación con los contactos por falla de la peridotita y de los sentidos de movimiento deducidos, la mayoría de ellas se correlacionan bien con la tectónica de desgarres. No obstante, tanto petrográficamente como a escala de afloramiento es posible identificar una fábrica previa de tipo dúctil y carácter no coaxial, relacionada con el metamorfismo retrógrado descrito en el apartado correspondiente.

# 5 ENSAYOS DE CAMPO REALIZADOS

## 5.1 Sondeos Geotécnicos tipo SPT

Se realizaron en el sitio sondeos geotécnicos con recuperación de testigos, utilizando el método de Prueba de Penetración Estándar "SPT" según las especificaciones del ASTM D-1586 del tipo HQ (Diámetro 2" Nominal) con golpeos para los suelos y el ASTM D-2113 para rotación en los casos donde exista rechazo. Una sonda con martillo automático fue utilizada en este estudio. Se extrajeron muestras de suelo para fines de identificación y para medir la resistencia a la penetración de la cuchara normal de muestreo.

En el anexo B se muestra la ubicación de los ensayos realizados. La investigación de campo consistió en lo siguiente:

- Realización de 12 sondeos geotécnicos de los cuales cuatro (04) fueron ejecutados en el área de macizos y pilonas a profundidades que varían de 30.00 a 30.30 m por debajo del nivel actual del terreno y ocho (08) en el área de garaje y estación a profundidades variables de 8.10 a 10.35 m por debajo del nivel actual del terreno.

En la tabla 1 se presenta la información de los sondeos realizados y en la figura 5 se presenta la planta de ubicación de los mismos.

| ÁREA | ID. | Prof. (m) | COORDENADAS UTM-WGS 84 | | Elevación (m.s.n.m.) | Nivel freático (m) |
|---|---|---|---|---|---|---|
| | | | Este (m) | Norte (m) | | |
| Macizos y Pilonas | T8-01 | 30.00 | 2048191.47 | 389180.65 | 66.29 | 5.75 |
| | T8-02 | 30.25 | 2048193.64 | 389199.65 | 66.32 | -- |
| | T8-03 | 30.15 | 2048195.86 | 389218.10 | 65.02 | 5.15 |
| | T8-04 | 30.30 | 2048198.65 | 389243.16 | 63.72 | -- |

| ÁREA | ID. | Prof. (m) | COORDENADAS UTM-WGS 84 | | Elevación (m.s.n.m.) | Nivel freático (m) |
|---|---|---|---|---|---|---|
| | | | Este (m) | Norte (m) | | |
| Garaje y Estación | **E8-01** | 8.10 | 2048257.28 | 389194.53 | 63.96 | -- |
| | **E8-02** | 9.00 | 2048249.36 | 389176.94 | 64.31 | -- |
| | **E8-03** | 9.00 | 2048252.26 | 389213.05 | 63.96 | -- |
| | **E8-04** | 9.00 | 2048230.49 | 389182.03 | 64.84 | -- |
| | **E8-05** | 10.35 | 2048237.39 | 389199.85 | 65.02 | -- |
| | **E8-06** | 9.00 | 2048210.99 | 389178.53 | 64.76 | -- |
| | **E8-07** | 9.00 | 2048215.94 | 389197.78 | 64.82 | -- |
| | **E8-08** | 9.00 | 2048224.63 | 389215.61 | 64.46 | -- |

**Tabla 1 Información de ensayos realizados**

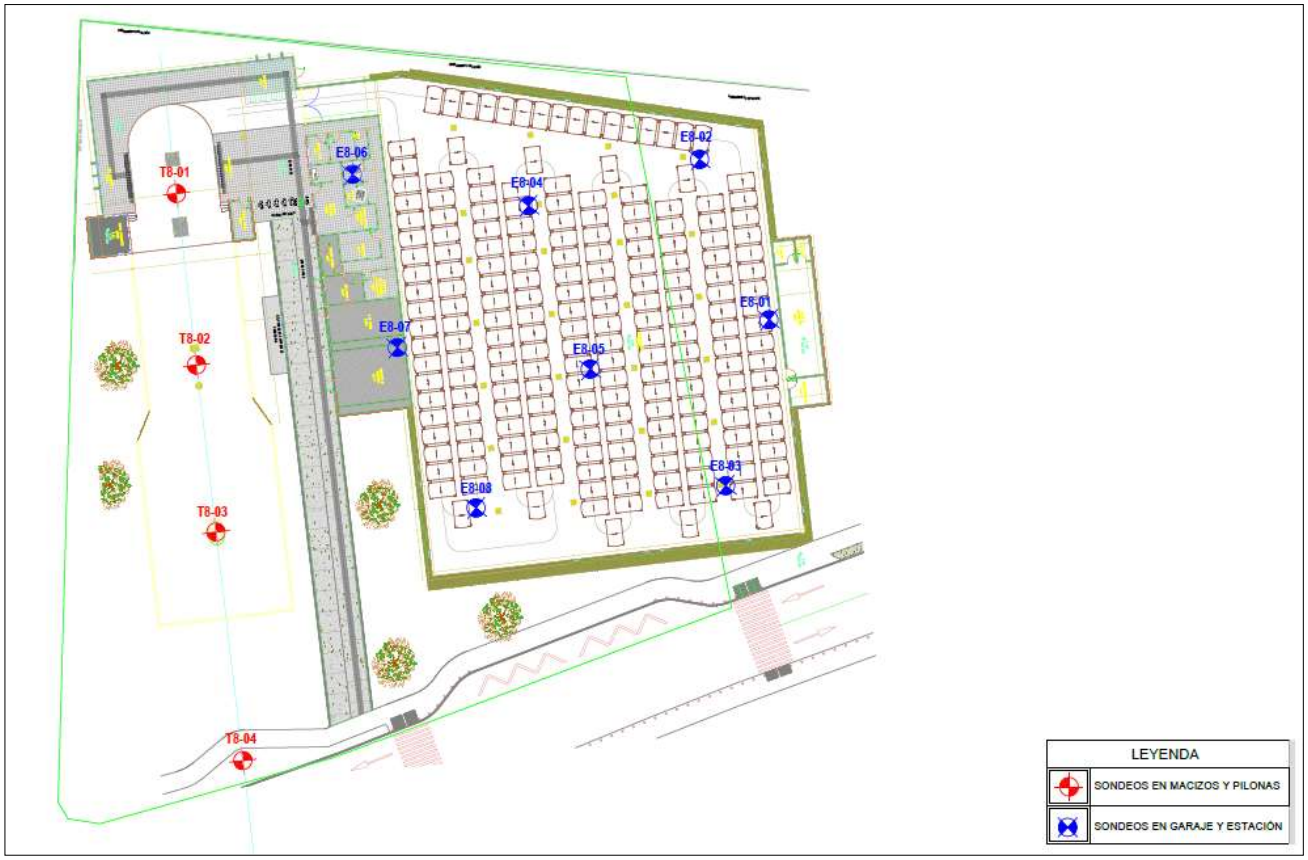


**Figura 5 Planta de ubicación de ensayos (ver anexo B)**

# 6 ENSAYOS DE LABORATORIO REALIZADOS

## 6.1 Clasificación de materiales según resultados de laboratorio

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

- 36 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).**
- 36 unidades de ensayo limite líquido y límite e índice plástico **(ASTM D 4318).**
- 36 unidades de ensayo granulométrico por tamizado **(ASTM - D 6913).**

En la tabla 2 mostrada a continuación se presenta un resumen de los resultados de laboratorio y la densidad y/o consistencia de los materiales muestreados.

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| T8-01 | 0.00-0.45 | Arcilla con capa vegetal | -- | -- | -- | 9 |
| | 0.45-2.25 | Arena arcillosa con grava | G= 8.20<br>A=49.02<br>F= 2.78 | LL= 24.77<br>LP=17.18<br>IP= 7.59<br>W= 6.55 | SC | 17 |
| | 2.25-2.70 | | | | | 44 |
| | 2.70-3.60 | | | | | 51 |
| | 3.60-4.05 | | | | | 45 |
| | 4.05-9.45 | | | | | 69 |
| | 9.45-9.45 | Bolos de grava | -- | -- | -- | -- |
| | 9.45-13.55 | Arcilla de alta plasticidad | G= 5.76<br>A= 9.84<br>F= 84.4 | LL= 70.12<br>LP=32.69<br>IP= 37.43<br>W= 38.53 | CH | 66 |
| | 13.55-15.70 | Arcilla recuperada en rotación | -- | -- | -- | -- |
| | 15.70-16.00 | Grava arena y arcilla | -- | -- | -- | >50 |
| | 16.00-17.00 | Arcilla con arena y grava | -- | -- | -- | -- |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | | recuperada en rotación | | | | |
| | 17.00-19.00 | Lutita | -- | -- | -- | -- |
| | 19.00-19.30 | Arcilla con arena y algo de grava | -- | -- | -- | >50 |
| | 19.30-20.30 | Arena, arcilla y grava, recuperada en rotación | -- | -- | -- | -- |
| | 20.30-22.30 | Lutita | -- | -- | -- | -- |
| | 22.30-22.45 | Arena, grava y arcilla | -- | -- | -- | >50 |
| | 22.45-23.45 | Lutita | -- | -- | -- | -- |
| | 23.45-23.75 | Arena con arcilla y grava | -- | -- | -- | >50 |
| | 23.75-25.75 | Lutita | -- | -- | -- | -- |
| | 25.75-30.00 | Bolos de grava | -- | -- | -- | -- |
| **T8-02** | 0.00-0.45 | Arcilla con capa vegetal | -- | -- | -- | 14 |
| | 0.45-0.90 | Arcilla de baja plasticidad | G= 0.94<br>A= 13.97<br>F= 85.09 | LL= 35.65<br>LP=23.40<br>IP= 12.25<br>W= 18.11 | CL | 17 |
| | 0.90-2.25 | | | | | 22 |
| | 2.25-4.05 | | | | | 61 |
| | 4.05-5.85 | | | | | 83 |
| | 5.85-6.30 | Arena limosa con grava | G= 0.91<br>A= 53.57<br>F= 25.51 | NP<br>W= 12.57 | SC | 104 |
| | 6.30-7.30 | | | | | -- |
| | 7.30-7.75 | | | | | 48 |
| | 7.75-8.20 | | | | | 50 |
| | 8.20-9.55 | | | | | 36 |
| | 9.55-10 | | | | | 52 |
| | 9.55-10.45 | | | | | 101 |
| | 10.45-11.05 | No recuperado | -- | -- | -- | -- |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | 11.05-13.30 | Arcilla de alta plasticidad con arena | G= 8.50<br>A= 17.24<br>F= 74.26 | LL= 73.45<br>LP=31.44<br>IP= 42.01<br>W= 29.53 | CL | 32 |
| | 13.30-14.65 | | | | | 66 |
| | 14.65-15.10 | | | | | 99 |
| | 15.10-17.10 | Arcilla, recuperada en rotación | -- | -- | -- | -- |
| | 17.10-17.40 | Arcilla con grava | -- | -- | -- | >50 |
| | 17.40-19.90 | Arcilla, recuperada en rotación | -- | -- | -- | -- |
| | 19.90-20.90 | Lutita | -- | -- | -- | -- |
| | 20.90-22.70 | Arcilla de baja plasticidad arenosa | -- | -- | CL | 74 |
| | 22.70-23.15 | | | | | 105 |
| | 23.15-24.15 | Lutita | -- | -- | -- | -- |
| | 24.15-25.95 | Arcilla de baja plasticidad arenosa | G= 0.58<br>A= 31.30<br>F= 68.12 | LL= 28.08<br>LP=18.61<br>IP= 9.47<br>W= 23.78 | CL | 77 |
| | 25.95-26.95 | Arenisca | -- | -- | -- | -- |
| | 26.95-27.25 | Arcilla de baja plasticidad arenosa | G= 0.58<br>A= 31.30<br>F= 68.12 | LL= 28.08<br>LP=18.61<br>IP= 9.47<br>W= 23.78 | CL | >50 |
| | 27.25-28.25 | Arena con grava, recuperada en rotación | -- | -- | -- | -- |
| | 28.25-29.25 | Arenisca con bolos de grava | -- | -- | -- | -- |
| | 29.25-30.25 | Bolos de grava, recuperado en rotación | -- | -- | -- | -- |
| **T8-03** | 0.00-0.45 | Capa vegetal | -- | -- | -- | -- |
| | 0.45-0.90 | Arcilla de alta plasticidad con arena | G=0.00<br>A=19.60<br>F=80.40 | LL=54.44<br>LP=23.13<br>IP=31.32<br>W=16.10 | CH | 14 |
| | 0.90-2.25 | | | | | 21 |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | 2.25-3.60 | Arena limosa con grava | G=37.83 A=43.71 F=18.46 | LL=25.40 LP=23.44 IP=1.95 W=7.59 | SM | 38 |
| | 3.60-4.95 | | | | | 54 |
| | 4.95-8.10 | | | | | 42 |
| | 8.10-8.55 | | | | | 56 |
| | 8.55-9.00 | | | | | 49 |
| | 9.00-9.90 | | | | | 53 |
| | 9.90-11.25 | | | | | 43 |
| | 11.25-12.15 | Arcilla | -- | -- | -- | 59 |
| | 12.15-12.45 | | | | | >50 |
| | 12.45-13.45 | Arcilla, recuperada en rotación | -- | -- | -- | -- |
| | 13.45-13.90 | Grava con arcilla y arena | -- | -- | -- | 115 |
| | 13.90-16.90 | Lutita | -- | -- | -- | -- |
| | 16.90-17.20 | Arena con arcilla y grava | -- | -- | -- | >50 |
| | 17.20-19.20 | Lutita | -- | -- | -- | -- |
| | 19.20-19.65 | Arena con arcilla y grava | -- | -- | -- | 95 |
| | 19.65-20.65 | Lutita | -- | -- | -- | -- |
| | 20.65-21.10 | Arena con arcilla y grava | -- | -- | -- | 103 |
| | 21.10-22.40 | Lutita | -- | -- | -- | -- |
| | 22.40-26.90 | Bolos de grava, recuperado en rotación | -- | -- | -- | -- |
| | 26.90-27.35 | Arcilla de alta plasticidad | G=4.44 A=14.96 F=80.60 | LL=53.84 LP=27.04 IP=26.80 W=31.61 | CH | 35 |
| | 27.35-29.15 | | | | | 75 |
| | 29.15-30.15 | Lutita | -- | -- | -- | -- |
| **T8-04** | 0.00-0.50 | Capa vegetal | -- | -- | -- | 19 |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | 0.50-2.70 | Arena arcillosa con grava | G=22.87 A=45.93 F=31.20 | LL=39.13 LP=24.42 IP=14.71 W=9.16 | SC | 34 |
| | 2.70-3.60 | | | | | 28 |
| | 3.60-4.05 | | | | | 31 |
| | 4.05-6.30 | | | | | 26 |
| | 6.30-7.65 | Arcilla de alta plasticidad con arena | G=0.73 A=27.27 F=72.00 | LL=68.34 LP=25.12 IP=43.23 W=32.35 | CH | 22 |
| | 7.65-8.55 | Arena gruesa con arcilla y algo de grava | -- | -- | -- | 20 |
| | 8.55-9.00 | Arcilla | -- | -- | -- | 22 |
| | 9.00-9.45 | | | | | 14 |
| | 9.45-11.70 | | | | | 22 |
| | 11.70-13.05 | | | | | 68 |
| | 13.05-14.55 | Lutita | -- | -- | -- | -- |
| | 14.55-19.50 | Arcilla de baja plasticidad | G=0.00 A=7.93 F=92.07 | LL=26.12 LP=18.40 IP=7.73 W=26.49 | CL | 47 |
| | 19.50-24.00 | Arcilla de baja plasticidad | G= 0.00 A=41.08 F=58.92 | LL=24.96 LP=17.53 IP=7.43 W=15.56 | CL | 58 |
| | 24.00-24.90 | Arena arcillosa | G= 14.00 A=57.04 F=28.96 | LL=25.14 LP=17.53 IP=7.67 W=5.75 | SC | 66 |
| | 24.90-30.30 | Arcilla de baja plasticidad | G=0.03 A= 5.42 F=94.55 | LL=37.37 LP=17.47 IP=13.80 W=23.88 | CL | 50 |
| **E8-01** | 0.00-0.90 | Arcilla con restos de capa vegetal | -- | -- | -- | 13 |
| | 0.90-1.80 | Arena arcillosa con grava | G=40.42 A=42.73 F=16.85 | LL=27.14 LP=20.55 IP=6.59 W=10.73 | SC | 36 |
| | 1.80-2.25 | | | | | 26 |
| | 2.25-2.70 | | | | | 77 |
| | 2.70-3.15 | | | | | 47 |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | 3.15-3.60 | Arcilla de alta plasticidad con arena | G=2.87<br>A=16.34<br>F=80.79 | LL=53.88<br>LP=27.22<br>IP=26.66<br>W=32.22 | CH | 38 |
| | 3.60-4.50 | | | | | 25 |
| | 4.50-7.65 | | | | | 37 |
| | 7.65-8.10 | | | | | 62 |
| E8-02 | 0.00-0.45 | Capa vegetal con arcilla | | | | 9 |
| | 0.45-0.90 | Arcilla de baja plasticidad con arena | G=0.19<br>A=19.46<br>F=80.35 | LL=42.84<br>LP=25.47<br>IP=17.37<br>W=21.57 | CL | 14 |
| | 0.90-1.35 | | | | | 26 |
| | 1.35-1.80 | Arena arcillosa con grava | G=24.85<br>A=52.78<br>F=22.37 | LL=25.24<br>LP=17.74<br>IP=7.49<br>W=37.10 | SC | 27 |
| | 1.80-2.70 | | | | | 39 |
| | 2.70-4.05 | | | | | 27 |
| | 4.05-4.50 | No recuperado | -- | -- | -- | -- |
| | 4.50-4.95 | Arcilla de alta plasticidad | G=5.32<br>A=11.51<br>F=83.18 | LL=73.74<br>LP=32.89<br>IP=40.85<br>W=8.51 | CH | 22 |
| | 4.95-5.85 | | | | | 38 |
| | 5.85-7.20 | | | | | 28 |
| | 7.20-7.65 | | | | | 53 |
| | 7.65-9.00 | | | | | 72 |
| E8-03 | 0.00-0.90 | Arcilla de baja plasticidad arenosa | G=2.61<br>A=37.73<br>F=59.65 | LL=32.69<br>LP=22.62<br>IP=10.07<br>W=25.17 | CL | 11 |
| | 0.90-1.35 | Arena arcillosa limosa con grava | G=32.62<br>A=45.05<br>F=22.33 | LL=25.01<br>LP=20.19<br>IP=4.81<br>W=8.20 | SC-SM | 16 |
| | 1.35-3.60 | | | | | 36 |
| | 3.60-4.05 | Arcilla de alta plasticidad | G=0.92<br>A=12.29<br>F=86.78 | LL=63.30<br>LP=29.45<br>IP=33.85<br>W=34.09 | CH | 12 |
| | 4.05-4.50 | | | | | 17 |
| | 4.50-4.95 | | | | | 26 |
| | 4.95-9.00 | | | | | 35 |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| E8-04 | 0.00-0.45 | Arcilla con restos de capa vegetal | -- | -- | -- | 7 |
| | 0.45-0.90 | Arcilla de alta plasticidad | G=0.00<br>A=9.85<br>F=90.15 | LL=50.60<br>LP=27.47<br>IP=23.14<br>W=28.50 | CH | 11 |
| | 0.90-1.80 | | | | | 24 |
| | 1.80-2.70 | Arena arcillosa con grava | G=36.39<br>A= 44.20<br>F=19.41 | LL=27.03<br>LP=20.38<br>IP=6.65<br>W=8.06 | SC | 31 |
| | 2.70-3.15 | | | | | 27 |
| | 3.15-4.05 | | | | | 34 |
| | 4.05-4.50 | | | | | 20 |
| | 4.50-5.40 | | | | | 32 |
| | 5.40-5.85 | | | | | 19 |
| | 5.85-6.30 | | | | | 32 |
| | 6.30-6.75 | Arcilla de alta plasticidad | G=5.13<br>A=1.40<br>F=93.47 | LL=79.39<br>LP=35.30<br>IP=44.09<br>W=37.72 | CH | 16 |
| | 6.75-9.00 | | | | | 25 |
| E8-05 | 0.00-0.45 | Arcilla con restos de capa vegetal | -- | -- | -- | 9 |
| | 0.45-2.25 | Arcilla de alta plasticidad | G=0.00<br>A= 3.56<br>F=96.44 | LL=50.55<br>LP=26.71<br>IP=23.85<br>W=28.77 | CH | 12 |
| | 2.25-2.70 | | | | | 26 |
| | 2.70-3.15 | | | | | 33 |
| | 3.15-5.40 | Grava arcillosa con arena | G=45.14<br>A=35.82<br>F=19.04 | LL=31.24<br>LP=17.75<br>IP=13.50<br>W=10.78 | GC | 39 |
| | 5.40-5.85 | Arcilla de alta plasticidad arenosa | G=0.00<br>A=49.95<br>F=50.05 | LL=75.42<br>LP=28.62<br>IP=46.80<br>W=33.34 | CH | 12 |
| | 5.85-7.65 | | | | | 22 |
| | 7.65-10.35 | | | | | 39 |
| E8-06 | 0.00-0.45 | Arcilla con restos de capa vegetal | -- | -- | -- | 14 |

| SOND | Prof. (m) | Estratigrafía | Granulom. (%) | Prop. Índices (%) | Clasif. SUCS | Valor Nprom/ %RQD |
|---|---|---|---|---|---|---|
| | 0.45-0.90 | Grava arcillosa con arena | G=43.17 A=39.79 F=17.05 | LL=27.23 LP=17.58 IP=9.65 W=6.63 | GC | 20 |
| | 0.90-2.25 | | | | | 35 |
| | 2.25-3.15 | | | | | 28 |
| | 3.15-6.30 | | | | | 40 |
| | 6.30-6.75 | | | | | 25 |
| | 6.75-7.65 | | | | | 32 |
| | 7.65-9.00 | Arcilla de alta plasticidad | G=0.00 A=12.71 F=87.29 | LL=64.37 LP=25.53 IP=38.83 W=45.03 | CH | 34 |
| **E8-07** | 0.00-0.45 | Arcilla con presencia de capa vegetal | -- | -- | -- | 10 |
| | 0.45-0.90 | Arena arcillosa con grava | G=38.80 A=42.31 F=18.89 | LL=28.45 LP=21.66 IP=6.79 W=6.86 | SC | 16 |
| | 0.90-1.80 | | | | | 32 |
| | 1.80-2.25 | | | | | 21 |
| | 2.25-5.85 | | | | | 35 |
| | 5.85-6.30 | | | | | 25 |
| | 6.30-6.75 | Arcilla de alta plasticidad con arena | G=0.00 A=15.49 F=84.51 | LL=52.42 LP=26.10 IP=26.32 W=31.47 | CH | 18 |
| | 6.75-9.00 | | | | | 26 |
| **E8-08** | 0.00-1.35 | Arcilla de alta plasticidad | G=0.00 A=1.69 F=98.31 | LL=54.93 LP=26.99 IP=27.94 W=25.37 | CH | 12 |
| | 1.35-1.80 | | | | | 19 |
| | 1.80-2.70 | Grava arcillosa con arena | G= 50.84 A=36.68 F=12.49 | LL=25.39 LP=17.62 IP=7.78 W=7.95 | GC | 35 |
| | 2.70-3.15 | | | | | 26 |
| | 3.15-3.60 | | | | | 33 |
| | 3.60-4.50 | Arcilla de alta plasticidad | G=0.00 A=6.89 F=93.11 | LL=62.38 LP=28.50 IP=33.88 W=36.26 | CH | 17 |
| | 4.50-4.95 | | | | | 10 |
| | 4.95-5.85 | | | | | 17 |
| | 5.85-8.10 | | | | | 25 |
| | 8.10-9.00 | | | | | 66 |

**Tabla 2 Resumen de clasificación de materiales. G=Grava, S=Arena, F=Fino, LL=Limite líquido, LP=Limite plástico, IP=Índice de plasticidad**

# 7 CONDICIONES GEOTÉCNICAS DEL SITIO

## 7.1 Estratigrafía de sondeos realizados

En el área de **macizos y pilonas** se encontró desde la superficie materiales granulares del tipo arena arcillosa y/o limosa (SC/SM), hasta profundidades variables de 6.00 a 11.00 m aproximadamente. Luego se encontraron materiales cohesivos principalmente del tipo arcilla de baja plasticidad (CL) y una menor proporción de arcilla de alta plasticidad (CH). Estos suelos se intercalan con material tipo lutita con textura plástica y en ocasiones con bolos de grava con arena. En general, los valores de $N_{SPT}$ se encuentran mayormente por encima de 25 y tienden a aumentar con la profundidad llegando a alcanzar valores por encima de 50 y eventualmente llegando a rechazos, lo que muestra el predominio de material cohesivo de muy consistente a duro y material granular muy denso.

En el área de **estación y garaje** se encontró desde la superficie materiales granulares del tipo arena arcillosa y/o limosa (SC/SM) y grava arcillosa con arena (GC), hasta profundidades variables de 3.00 a 7.50 m aproximadamente. Luego se encontraron materiales cohesivos del tipo arcilla de alta plasticidad (CH) hasta la profundidad de 10.00 m alcanzada en esta zona. En general, los valores de $N_{SPT}$ se encuentran mayormente por encima de 25 y tienden a aumentar con la profundidad llegando a alcanzar valores por encima de 50, lo que muestra material granular muy denso y cohesivo de muy consistente a duro.

La descripción estratigráfica detallada se presenta en tabla 2 y en las columnas estratigráficas presentadas en el Anexo C**.**

## 7.2 Nivel freático

El nivel freático se encontró a profundidades variables de 5.15 a 5.75 m. Este nivel fue medido a partir de la cota de los sondeos T8-03 (65.02 m.s.n.m.) y T8-01 (66.29

m.s.n.m.) respectivamente, lugares donde fueron instalados un piezómetro abierto tipo Casa grande.

### 7.3 Evaluación del potencial de licuefacción

Hasta la profundidad investigada la posibilidad de ocurrencia de licuefacción es inexistente debido a que las arcillas no son susceptibles a licuefacción y las arenas por debajo del nivel freático son densas con valores $N_{SPT}$ predominantemente por encima de 30.

### 7.4 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 3 Clasificación sísmica**

## 8 ANÁLISIS GEOTÉCNICO. Capacidad portante asentamientos y pilotes

### 8.1 Análisis de capacidad portante por cortante general en cimentaciones superficiales

En el análisis de las cimentaciones superficiales para la falla por resistencia al cortante se han considerado las cimentaciones sobre un suelo granular con un Angulo $\emptyset$ y sobre un suelo cohesivo con una cohesión $C$. Para los parámetros se ha tomado un valor representativo de acuerdo a los valores calculados como se detalla en el acápite 8.4.1. Se ha considerado falla por capacidad portante general mediante la ecuación de Terzaghi modificada por Meyerhof la cual incluye factores de forma (Sc. Sq y Sɣ), factores de profundidad (dc, dq y dɣ) y factores de inclinación (Ic, Iq e Iɣ).

El esquema de falla y su correspondiente modelo geo mecánico es el presentado a continuación en la fig. 6:

**Falla por Cortante General**

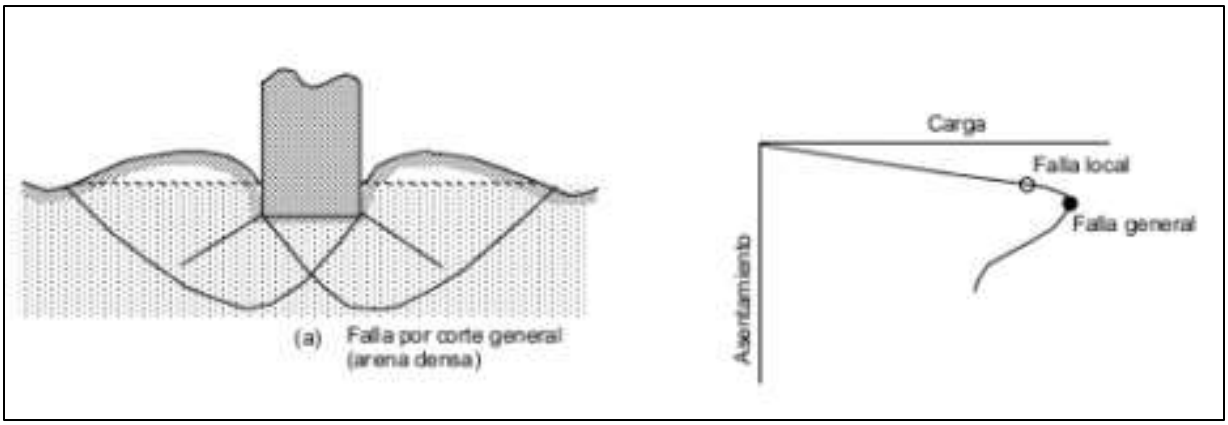


**Figura 6 Esquema de falla por cortante considerado**

## 8.2 Análisis de asentamientos en cimentaciones superficiales

Para el análisis del asentamiento se ha utilizado el software Settle 3D V2.016 de Rocscience, el cual considera las fórmulas de Schmertmann, Peck, Hanson, entre otros, tomando en cuenta la disminución de esfuerzo con la profundidad según Boussinesq, Westergaard, entre otros.

El mecanismo geotécnico considerado se muestra a continuación en la figura 7:

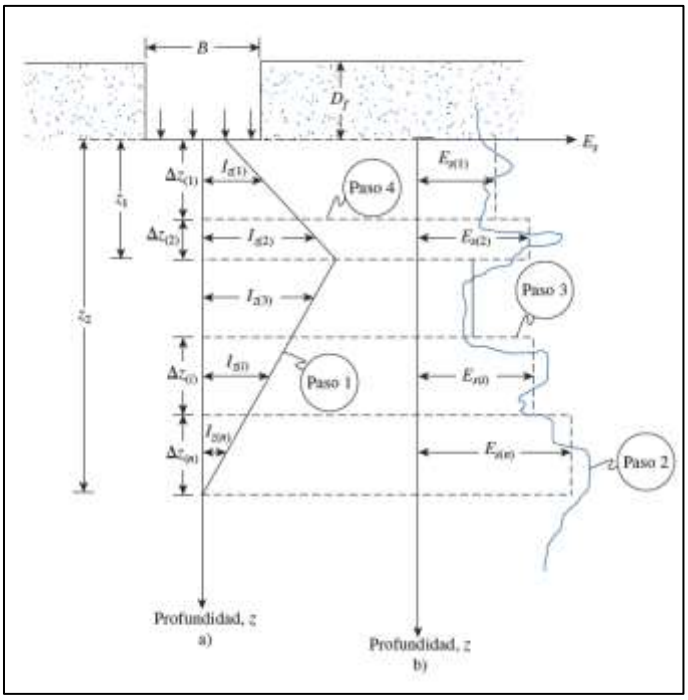


**Figura 7 Esquema de falla por asentamiento considerado**

## 8.3 Análisis de 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. Esto análisis se realizaron siguiendo las especificaciones LRFD ("Load and Resístance Factor Design") para puentes de la AASHTO. Los cálculos y resultados se pueden encontrar en los anexos. Los resultados de cálculos realizados se pueden encontrar en los anexos.

## 8.4 Caracterización de los materiales

### 8.4.1 Consideraciones para el ángulo de fricción interna (∅) y cohesión (C)

En el área de estudio se encontró tanto suelos cohesivos como suelos granulares. Para el análisis de los materiales granulares, se han caracterizado tomando al ángulo de

fricción interna (∅) como único parámetro de resistencia y se ha considerado la cohesión (C) igual a cero.

Los valores del ángulo de fricción han sido calculados de la manera Según Kulhawy y Mayne, 1990, de la manera siguiente:

$$\varphi = \mathrm{tg}^{-1}\left[\frac{\mathrm{Nf}}{12.2 + 20.3\left(\frac{\sigma'\mathrm{v}}{p\mathrm{a}}\right)}\right]^{0.34}$$ Según Kulhawy y Mayne, 1990.

$\varphi = 15 + \sqrt{18.Nf}$ Según Kishida. (Parámetros más conservadores que otros autores y tomando el valor del N de campo).

Nf= Numero de penetración estándar en campo
σ´v= Presión efectiva por sobre carga
Pa=Presión Atmosférica en las mismas unidades de σ´v
φ= Ángulo de fricción del suelo
C'= K.Nf, Según Stroud (1974)
Donde K = constante = 3.5 @ 6.5 KN/m²

Los valores fueron obtenidos de Terzaghi, peck y Mesri (1993)[1], peck, Hanson & thornburn (1974), Kishida, así como Kulhawy y Mayne, (1990) y Stroud (1974)[3], Muromachi (1974) y Schmertmann.

Para los suelos cohesivos se han caracterizado tomando la cohesión como único parámetro de resistencia y se ha considerado el ángulo de fricción interna (∅) igual a cero.

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

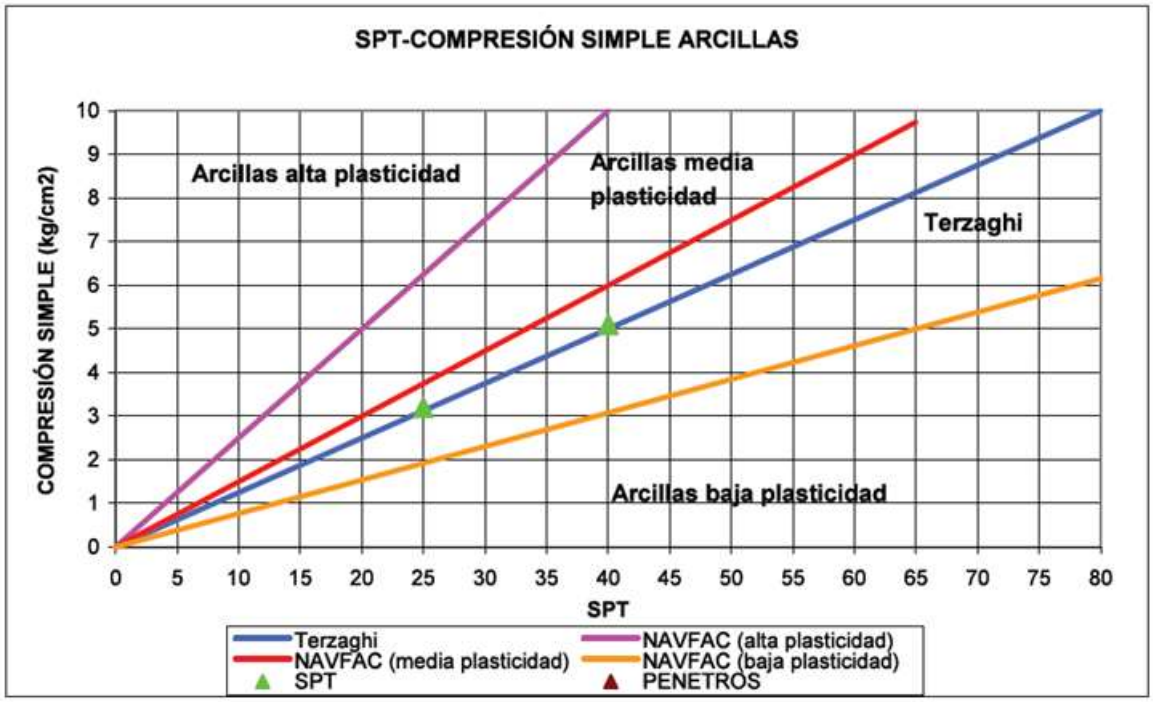


**Figura 8 Correlación Nspt vs Qu**

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.

### 8.4.2 Obtención del módulo de Young para análisis de asentamientos

El módulo de Young fue considerado tomando en cuenta diferentes formulaciones propuestas por Joseph Bowles según tipo de suelo las cuales se recopilan en el libro "Foundation Analysis and Design".

En la tabla 4 mostrada a continuación se presentan las correlaciones en base a $N_{SPT}$.

| Tipo de suelo | Fórmula |
|---|---|
| Arena (normalmente consolidada) | $E_s = 500(N15)+15)$ |
| | $E_s = 7000\sqrt{N}$ |
| | $E_s = 6000N$ |
| | $E_s = (15000 \text{ a } 22000) \times \ln N$ |
| Arena (saturada) | $E_s = 250(N+15)$ |
| Arena (normalmente consolidada) | $E_s = (2600 \text{ a } 2900)N$ |
| Arena (sobreconsolidada) | $E_s = 40000+1050N$ |
| Grava arenosa | $E_s = 1200(N+6)$ |
| | $E_{sv} = 600(N+6)$, Para $N \leq 15$ |
| | $E_s = 600(N+6)+2000$, Para $N>15$ |
| Arcilla arenosa | $E_s = 300(N+15)$ |
| Limo, arena limosa, o arcilla limosa | $E_{sv} = 300(N+6)$ |

**Tabla 4 Estimación de módulo de Young para suelo granular en función de NSPT. ES en KPa**

Para el análisis de capacidad de pilotes en el **área de macizos y pilonas**, como caso más desfavorable se consideró la estratigrafía del sondeo T8-04. Los valores se muestran a continuación en la **tabla 5**:

| Estratigrafía considerada T8-04 | | | | | | |
|---|---|---|---|---|---|---|
| **No.** | **Prof (m)** | **Tipo de material considerado** | **Nprom** | **Cohesion (Kpa)** | **Angulo Phi (Grados)** | **Peso especifico (KN/m3)** |
| 1 | 0.00-0.50 | Capa vegetal | -- | -- | -- | -- |
| 2 | 0.50-6.30 | Arena arcillosa (SC) | 30 | 0 | 36 | 18.5 |
| 3 | 6.30-7.65 | Arcilla Plasticidad alta (CH) | 22 | 140 | 0 | 17.5 |
| 4 | 7.65-8.55 | Arena con arcilla | 20 | 0 | 33 | 17.5 |
| 5 | 8.55-9.45 | Arcilla de baja plasticidad (CL) | 18 | 115 | 0 | 17.0 |
| 6 | 9.45-11.70 | Arcilla de baja plasticidad (CL) | 22 | 140 | 0 | 17.5 |
| 7 | 11.70-30.00 | Arcilla muy consistente y lutita | 50 | 250 | 0 | 20.0 |

**Tabla 5 Parámetros geotécnicos considerados para análisis de pilotes en T8-04**

Para el análisis de capacidad portante y asentamientos esperados en el **área de estación y garaje**, como caso más desfavorable se consideró la estratigrafía de los sondeos E8-04 y E8-08. Los valores se muestran a continuación en la **tabla 6, 7 y 8**:

**Estratigrafía considerada E8-04**

| No. | Prof (m) | Tipo de material considerado | Nprom | Modulo de Young kPa | Modulo de Poisson | Peso especifico (KN/m3) |
|---|---|---|---|---|---|---|
| 1 | 0.00-1.00 | Relleno estructural | N/A | 50000 | 0.30 | 20.0 |
| 2 | 1.00-1.80 | Arcilla de alta plasticidad (CH) | 24 | 30000 | 0.33 | 17.5 |
| 3 | 1.80-6.30 | Arena Arcillosa (SC) | 29 | 24000 | 0.33 | 18.0 |
| 4 | 6.30-9.00 | Arcilla de alta plasticidad (CH) | 24 | 30000 | 0.33 | 17.5 |

**Tabla 6 Parámetros geotécnicos considerados para análisis de asentamiento en E8-04**

**Estratigrafía considerada E8-08**

| No. | Prof (m) | Tipo de material considerado | Nprom | Modulo de Young kPa | Modulo de Poisson | Peso especifico (KN/m3) |
|---|---|---|---|---|---|---|
| 1 | 0.00-1.00 | Relleno estructural | N/A | 50000 | 0.30 | 20.0 |
| 2 | 1.00-1.80 | Arcilla de alta plasticidad (CH) | 17 | 22000 | 0.33 | 17.0 |
| 3 | 1.80-3.60 | Grava arcillosa con arena (GC) | 32 | 25000 | 0.33 | 18.5 |
| 4 | 3.60-5.85 | Arcilla de alta plasticidad (CH) | 15 | 19000 | 0.33 | 17.0 |
| 5 | 5.85-8.10 | | 25 | 32000 | 0.33 | 18.0 |
| 6 | 8.10-9.00 | | 50 | 50000 | 0.33 | 20.0 |

**Tabla 7 Parámetros geotécnicos considerados para análisis de asentamiento en E8-08**

| No. | Tipo de material considerado | Nspt considerado | Ángulo de fricción | Cohesión kPa | Peso especifico (KN/m3) |
|---|---|---|---|---|---|
| **1** | Material cohesivo | >25 | 0 | 160 | 18.0 |
| **2** | Material granular | >30 | 35 | 0 | 18.5 |

**Tabla 8 Parámetros geotécnicos general considerados para análisis de capacidad soporte por cortante**

Los valores anteriores han sido obtenidos utilizando la correlación más apropiada de acuerdo a los valores de $N_{SPT}$ medidos en campo y según la experiencia de INGESA para cada tipo de suelo. Para los casos de los edificios se ha tomado en cuenta la sustitución de material recomendada.

# 9 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 estación E-08 para el Teleférico Línea 2, la cual está ubicada en la carretera de Hato Nuevo, a unos 1.50 km al Este de la circunvalación Santo Domingo, en Santo Domingo Oeste, R.D. Los resultados de este estudio solo aplican para este informe y no podrán ser extrapolados para otro tipo de proyecto.

De acuerdo con los resultados de los análisis realizados según la estratigrafía del área, se concluye y recomienda lo siguiente:

**FUNDACIÓN EN ÁREA DE MACIZOS Y PILONAS**

- En el área de macizos y pilonas se encontró desde la superficie materiales granulares del tipo arena arcillosa y/o limosa (SC/SM), hasta profundidades variables de 6.00 a 11.00 m aproximadamente. Luego se encontraron materiales cohesivos principalmente del tipo arcilla de baja plasticidad (CL) y una menor proporción de arcilla de alta plasticidad (CH). Estos suelos se intercalan con material tipo lutita con textura plástica y en ocasiones con bolos de grava con arena. En general, los valores de $N_{SPT}$ se encuentran mayormente por encima de 25 y tienden a aumentar con la profundidad llegando a alcanzar valores por encima de 50 y eventualmente llegando a rechazos, lo que muestra el predominio de material cohesivo de muy consistente a duro y material granular muy denso.

- El nivel freático se encontró a profundidades variables de 5.15 a 5.75 m. Este nivel fue medido a partir de la cota de los sondeos T8-03 (65.02 m.s.n.m.) y T8-01 (66.29 m.s.n.m.) respectivamente, lugares donde fueron instalados un piezómetro abierto tipo Casa grande.

- Debido al tipo de solicitaciones a la que serán sometidas los macizos y pilonas, se recomienda el uso de cimentaciones profundas mediante pilotes hormigonados in situ tipo "Drill Shaft" o "Continuous Flight Auger, CFA". La capacidad de carga ultima recomendada se muestra a continuación.

**CAPACIDAD PILOTES PARA MACIZO Y PILONA. Est-08, LOS ALCARRIZOS**

| Diámetro de pilote | Longitud (m) | Capacidad axial Compresión última (ton) | Capacidad axial Tracción última (ton) | Capacidad lateral última (ton) | Loading condition | Observaciones |
|---|---|---|---|---|---|---|
| 0.60 | 15 | 280 | 180 | 20 | Fixed-Head | 14 ϕ 1" MIN |
| | 20 | 380 | 260 | | | |
| 0.80 | 15 | 390 | 240 | 40 | Fixed-Head | 24 ϕ 1" MIN |
| | 20 | 540 | 350 | | | |

- La profundidad mínima recomendada para el cabezal es de 1.00 m. La longitud recomendada de pilotes está medida a partir del cabezal.

- Se sugiere realizar pruebas de carga dinámica para comprobar las capacidades recomendadas. El armado recomendado para los pilotes deberá ser revisado estructuralmente.

- 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%.

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

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

| METODO DE CÁLCULO | TIPO DE FACTOR | Factor recomendado | |
|---|---|---|---|
| | | CARGA AXIAL | CARGA LATERAL |
| ASD | Factor de seguridad | 3 | 1.15 |
| 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 | METODO 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 |

## FUNDACIÓN EN ÁREA DE ESTACIÓN Y GARAJE

- En el área de estación y garaje se encontró desde la superficie materiales granulares del tipo arena arcillosa y/o limosa (SC/SM) y grava arcillosa con arena (GC), hasta profundidades variables de 3.00 a 7.50 m aproximadamente. Luego se encontraron materiales cohesivos del tipo arcilla de alta plasticidad (CH) hasta la profundidad de 10.00 m alcanzada en esta zona. En general, los valores de $N_{SPT}$ se encuentran mayormente por encima de 25 y tienden a aumentar con la profundidad llegando a alcanzar valores por encima de 50, lo que muestra material granular muy denso y cohesivo de muy consistente a duro.

- Debido a la existencia de material de consistencia baja encontrado superficialmente, los cuales se extienden hasta una profundidad de 1.00 m aproximadamente, se recomienda un saneamiento mediante reemplazo de este material de baja capacidad. Se deberá excavar hasta una profundidad de 1.00 m, compactar el fondo de la excavación y reemplazar por un material de relleno estructural que cumpla con las especificaciones de material de base o sub base según el reglamento R-024 de MOPC. Este material de relleno deberá ser colocado en capas no mayores de 15 cm y ser compactado al 98% del Proctor modificado.

- Luego de la mejora propuesta, se podrá fundar mediante el uso de cimentaciones convencionales consistentes en zapatas corridas y/o aisladas (Cuadradas o rectangulares). Para lo que se recomienda lo siguiente:
    - La capacidad portante admisible calculada es de **2.00 Kg/cm$^2$,** con dimensiones de B min =0.60 m y B máx.= 3.00 con cimentaciones sobre el material existente.
    - El módulo de winkler calculado es de **2.40 kg/cm$^3$.**
    - La profundidad mínima de desplante Df será de 0.70 m, para el caso de fundación sobre terreno natural existente (material tipo caliche) y en el caso de fundar sobre relleno, el Df deberá ser como mínimo 85 cm.

**RECOMENDACIONES GENERALES**

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

| ZONA SISMICA | CLASE DE SITIO | CAMPO CERCANO |
|---|---|---|
| II | D | NO |

- Se recomienda que los cortes se realicen con un talud de 0.75:1.00 (H:V) hasta profundidades de 2.50 m máx. Para los casos de profundidades mayores este talud deberá ser de por lo menos 1.00:1.00 (H:V).

- Para los casos de presión lateral de tierra se recomiendan los siguientes parámetros:
    - Coeficiente de presión lateral activa Ka= 0.29 (con Ø=33º).
    - Coeficiente de presión lateral pasiva Kp= 3.39 (con Ø =33º).
    - Coeficiente de empuje al reposo K0= 0.45 (con Ø =33º).

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 durante el proceso constructivo.

Por Ingeniería Global Especializada

Muy atentamente,

**Arístides Carrasco C, MS.c**
Especialista en Ingeniería Geotécnica

**Hipólito Soler Jiménez, MSc**
Consultor Geotécnico

**J. G. Paniagua, PhD, P.E.**
Consultor Geotécnico

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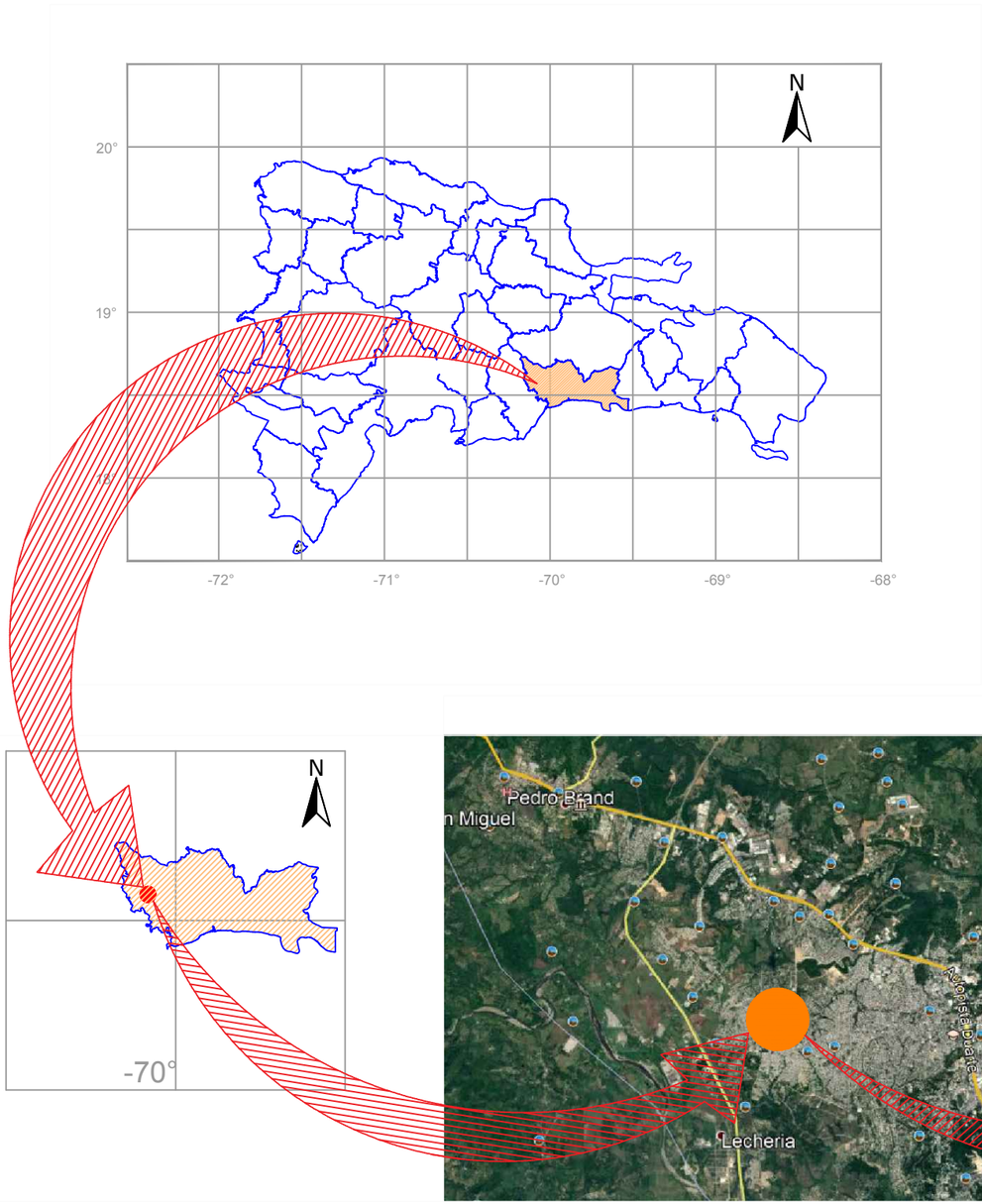
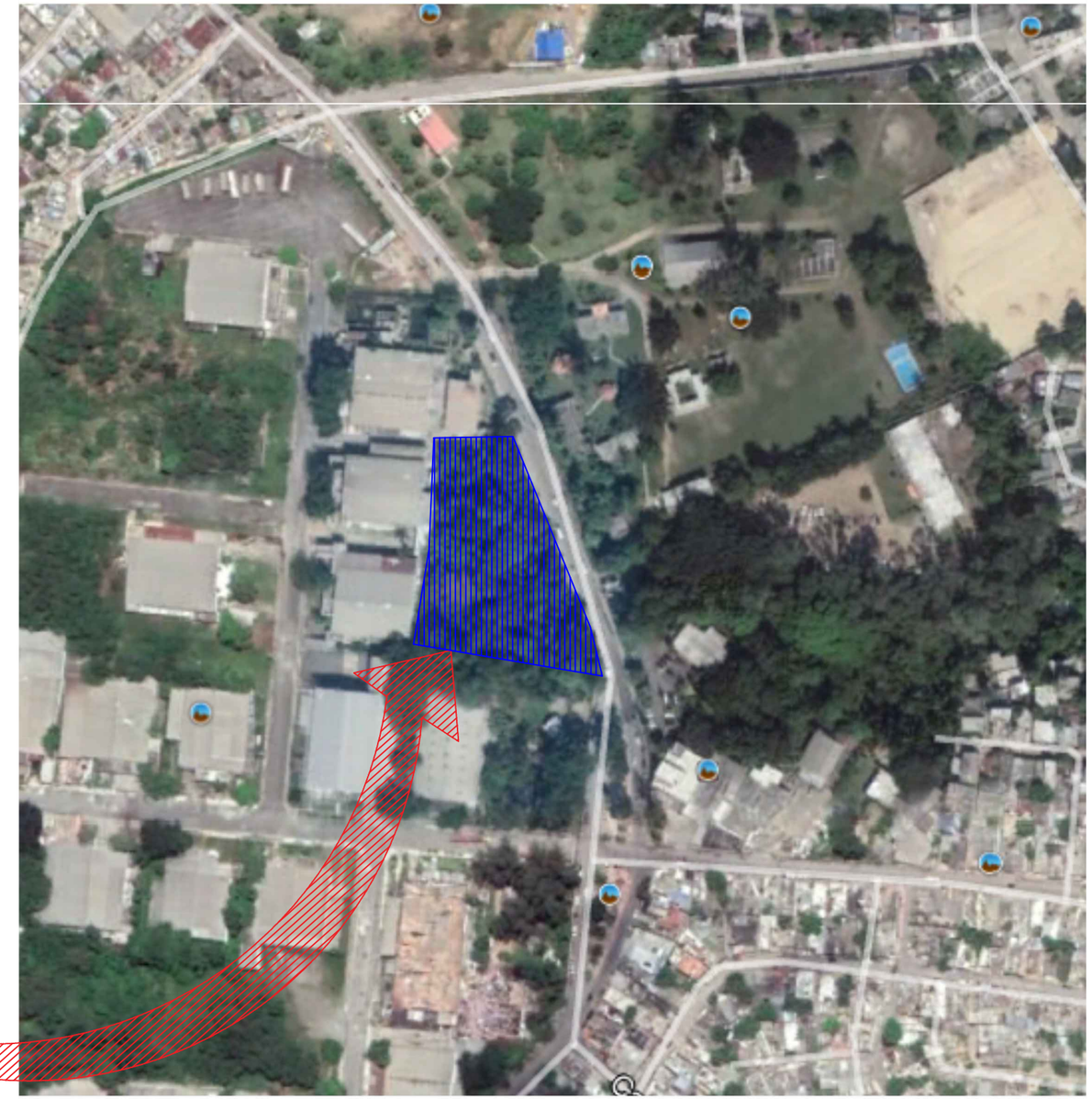
# ANEXOS

# ANEXO A

## Planta de ubicación del sitio de estudio



INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Dominog Oeste, República Dominicana

CLIENTE:
**J FORTUNA**

CONTENIDO:
PLANTA UBICACIÓN DE SITIO

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

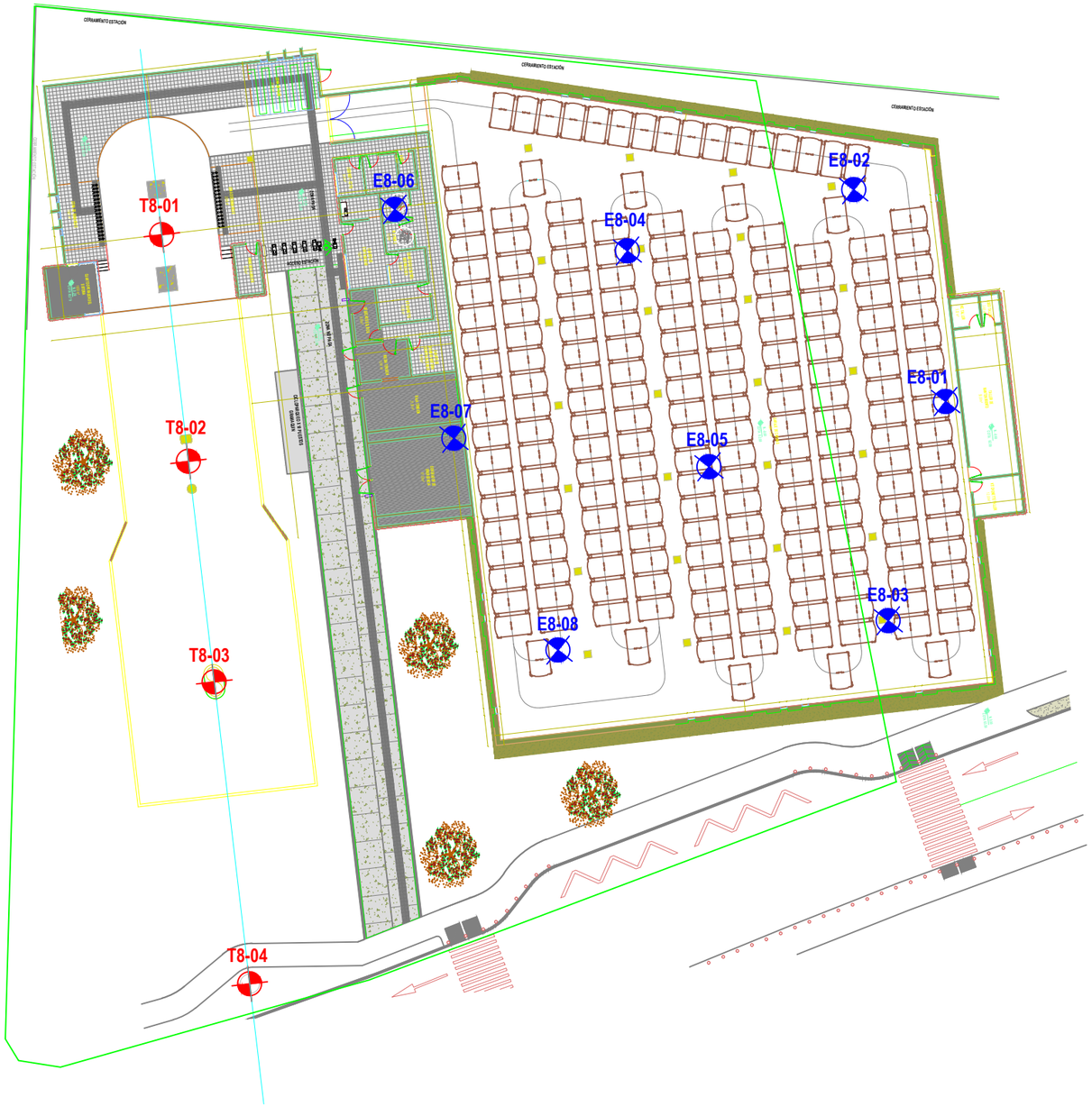
**ING.**
**ACC**

EMITIDO PARA INFORMACIÓN

HOJA
1

# ANEXO B

## Planta de ubicación de sondeos




| LEYENDA | |
|---|---|
| | SONDEOS EN MACIZOS Y PILONAS |
| | SONDEOS EN GARAJE Y ESTACIÓN |

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Domingo Oeste, R.D.

CLIENTE:
**J FORTUNA**

CONTENIDO:
PLANTA DE SONDEOS

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

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**ACC**

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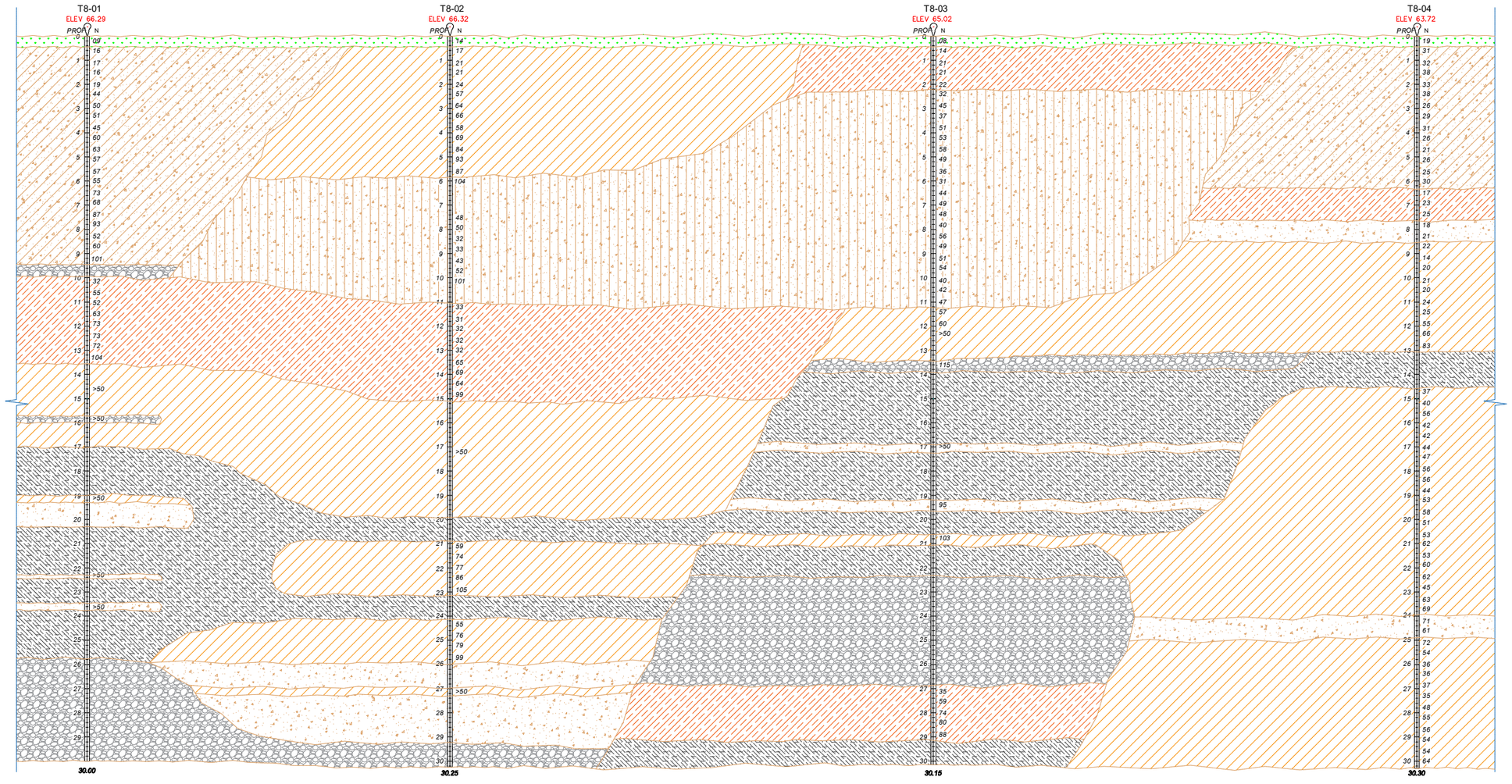
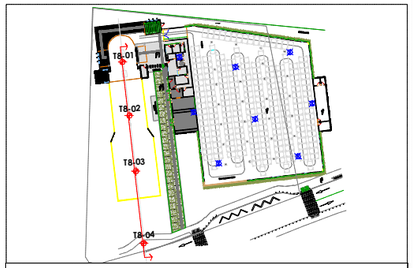
HOJA

# ANEXO C

## Perfiles estratigráficos




MONITOR

## LEYENDA

| | |
|---|---|
| | CAPA VEGETAL EN OCASIONES CON ARCILLA |
| | ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL) ARCILLA CON GRAVA Y ARENA |
| | ARENA ARCILLOSA CON GRAVA (SC) |
| | ARENA ARCILLOSA LIMOSA CON GRAVA (SC-SM |
| | ARENA CON ARCILLA Y GRAVA, EN OCASIONES RECUPERADA EN ROTACIÓN |
| | BOLOS DE GRAVA, EN OCASIONES CON ARENA Y ARCILLA |
| | ARCILLA DE ALTA PLASTICIDAD (CH), EN OCASIONES CON ARENA |
| | LUTITA |
| | GRAVA ARCILLOSA CON ARENA (GC) |

# PERFIL ESTRATIGRÁFICO I

**ENTRE SONDEOS T8-01, T8-02, T8-03 y T8-04**

No a escala

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Domingo Oeste, R.D.

CLIENTE:
**J FORTUNA**

CONTENIDO:
PERFIL ESTRATIGRAFÍCO I

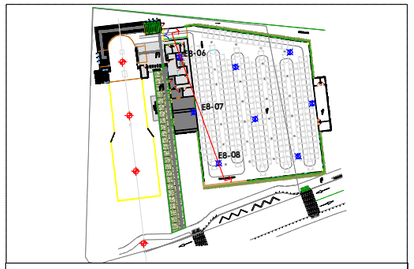
REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

**ING.**
**ACC**

EMITIDO PARA INFORMACIÓN

HOJA

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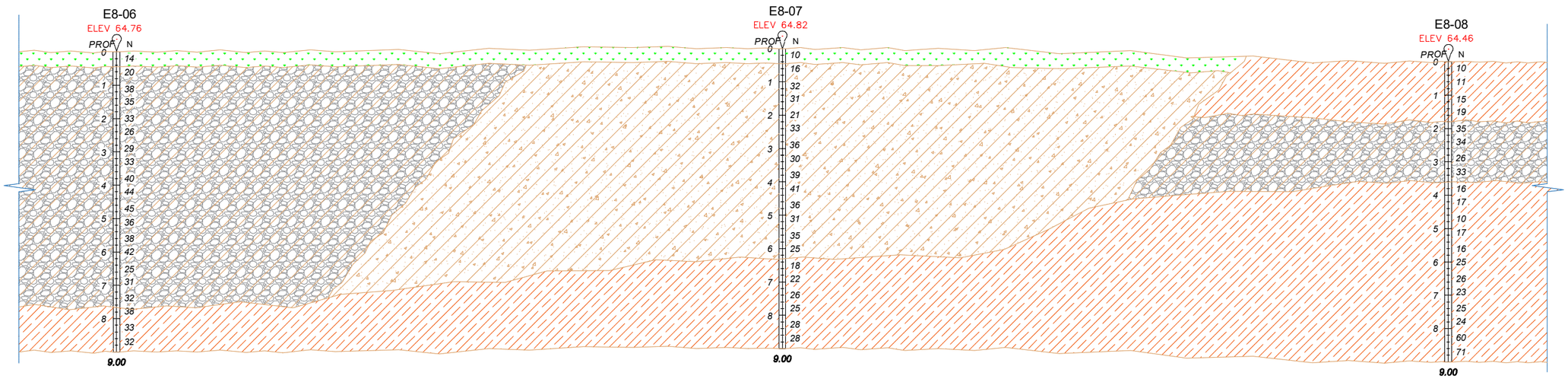


| LEYENDA | |
|---|---|
| | CAPA VEGETAL EN OCASIONES CON ARCILLA |
| | ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL) ARCILLA CON GRAVA Y ARENA |
| | ARENA ARCILLOSA CON GRAVA (SC) |
| | ARENA ARCILLOSA LIMOSA CON GRAVA (SC-Sm |
| | ARENA CON ARCILLA Y GRAVA, EN OCASIONES RECUPERADA EN ROTACIÓN |
| | BOLOS DE GRAVA, EN OCASIONES CON ARENA Y ARCILLA |
| | ARCILLA DE ALTA PLASTICIDAD (CH), EN OCASIONES CON ARENA |
| | LUTITA |
| | GRAVA ARCILLOSA CON ARENA (GC) |

## PERFIL ESTRATIGRÁFICO II

**ENTRE SONDEOS E8-06, E8-07 y E8-08**

No a escala

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Domingo Oeste, R.D.

CLIENTE:
**J FORTUNA**

CONTENIDO:
PERFIL ESTRATIGRAFÍCO II

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
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Codia 18370

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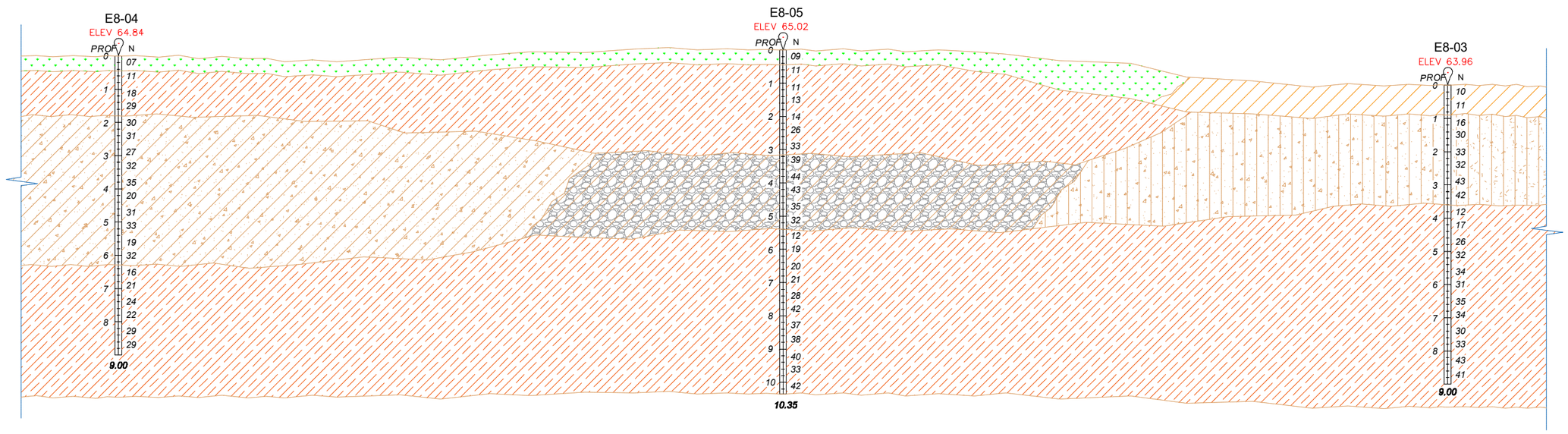
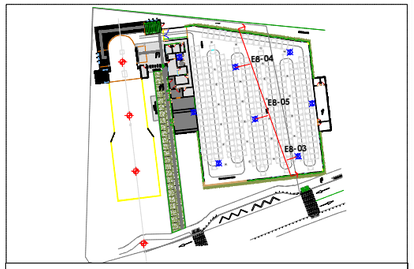
HOJA




MONITOR

| LEYENDA | |
|---|---|
| | CAPA VEGETAL EN OCASIONES CON ARCILLA |
| | ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL) ARCILLA CON GRAVA Y ARENA |
| | ARENA ARCILLOSA CON GRAVA (SC) |
| | ARENA ARCILLOSA LIMOSA CON GRAVA (SC-SM |
| | ARENA CON ARCILLA Y GRAVA, EN OCASIONES RECUPERADA EN ROTACIÓN |
| | BOLOS DE GRAVA, EN OCASIONES CON ARENA Y ARCILLA |
| | ARCILLA DE ALTA PLASTICIDAD (CH), EN OCASIONES CON ARENA |
| | LUTITA |
| | GRAVA ARCILLOSA CON ARENA (GC) |

## PERFIL ESTRATIGRÁFICO III

**ENTRE SONDEOS E8-04, E8-05 y E8-03**

No a escala

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Domingo Oeste, R.D.

CLIENTE:
**J FORTUNA**

CONTENIDO:
PERFIL ESTRATIGRAFÍCO III

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
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Codia 18370

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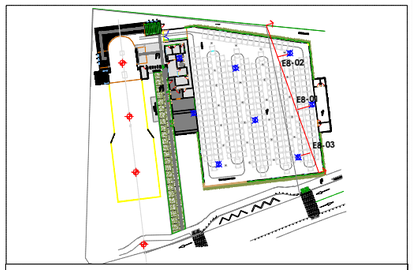


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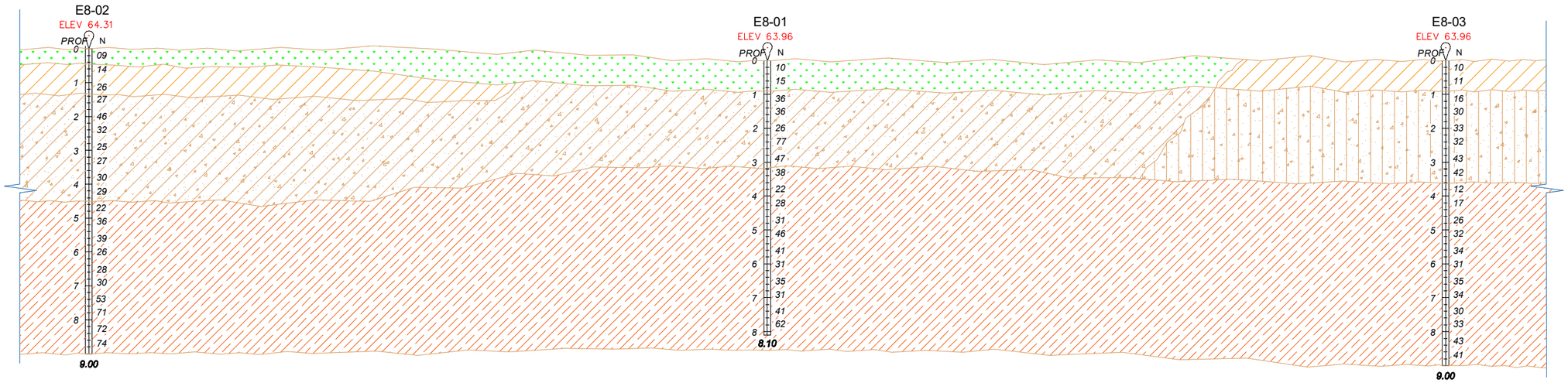


## LEYENDA

| | |
|---|---|
| | CAPA VEGETAL EN OCASIONES CON ARCILLA |
| | ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL) ARCILLA CON GRAVA Y ARENA |
| | ARENA ARCILLOSA CON GRAVA (SC) |
| | ARENA ARCILLOSA LIMOSA CON GRAVA (SC-SM |
| | ARENA CON ARCILLA Y GRAVA, EN OCASIONES RECUPERADA EN ROTACIÓN |
| | BOLOS DE GRAVA, EN OCASIONES CON ARENA Y ARCILLA |
| | ARCILLA DE ALTA PLASTICIDAD (CH), EN OCASIONES CON ARENA |
| | LUTITA |
| | GRAVA ARCILLOSA CON ARENA (GC) |

## PERFIL ESTRATIGRÁFICO IV

**ENTRE SONDEOS E8-02, E8-01 y E8-03**

No a escala

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

PROYECTO:
**METRO CABLE, ESTACIÓN 8**
Santo Domingo Oeste, R.D.

CLIENTE:
**J FORTUNA**

CONTENIDO:
PERFIL ESTRATIGRAFÍCO IV

REALIZADO POR:
INGENIERÍA GLOBAL ESPECIALIZADA

REVISADO POR:
ING. ARISTIDES CARRASCO
Codia 18370

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HOJA

# ANEXO D

## Memoria de cálculos

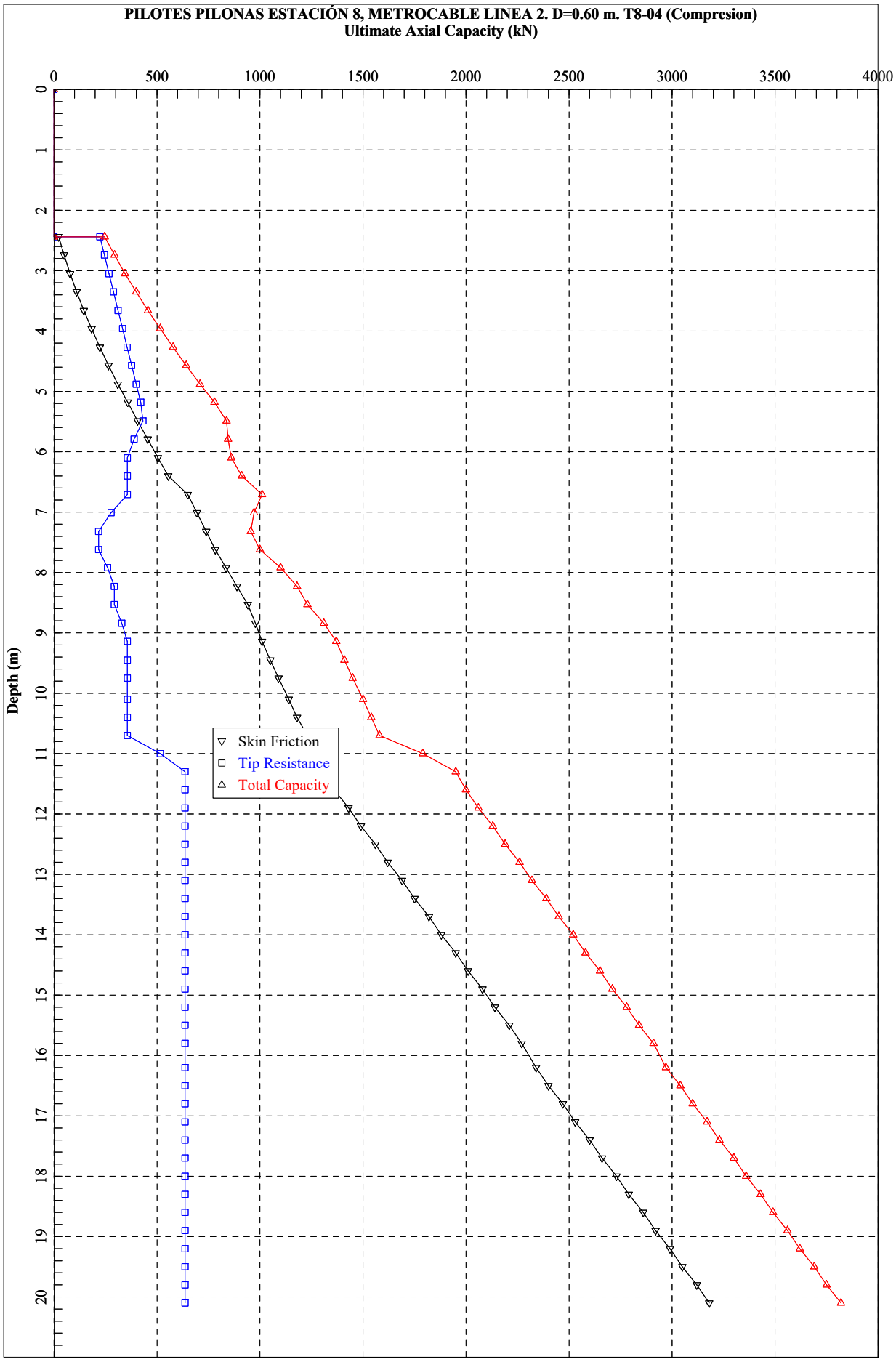
# Carga Axial

# Carga Axial Compresión

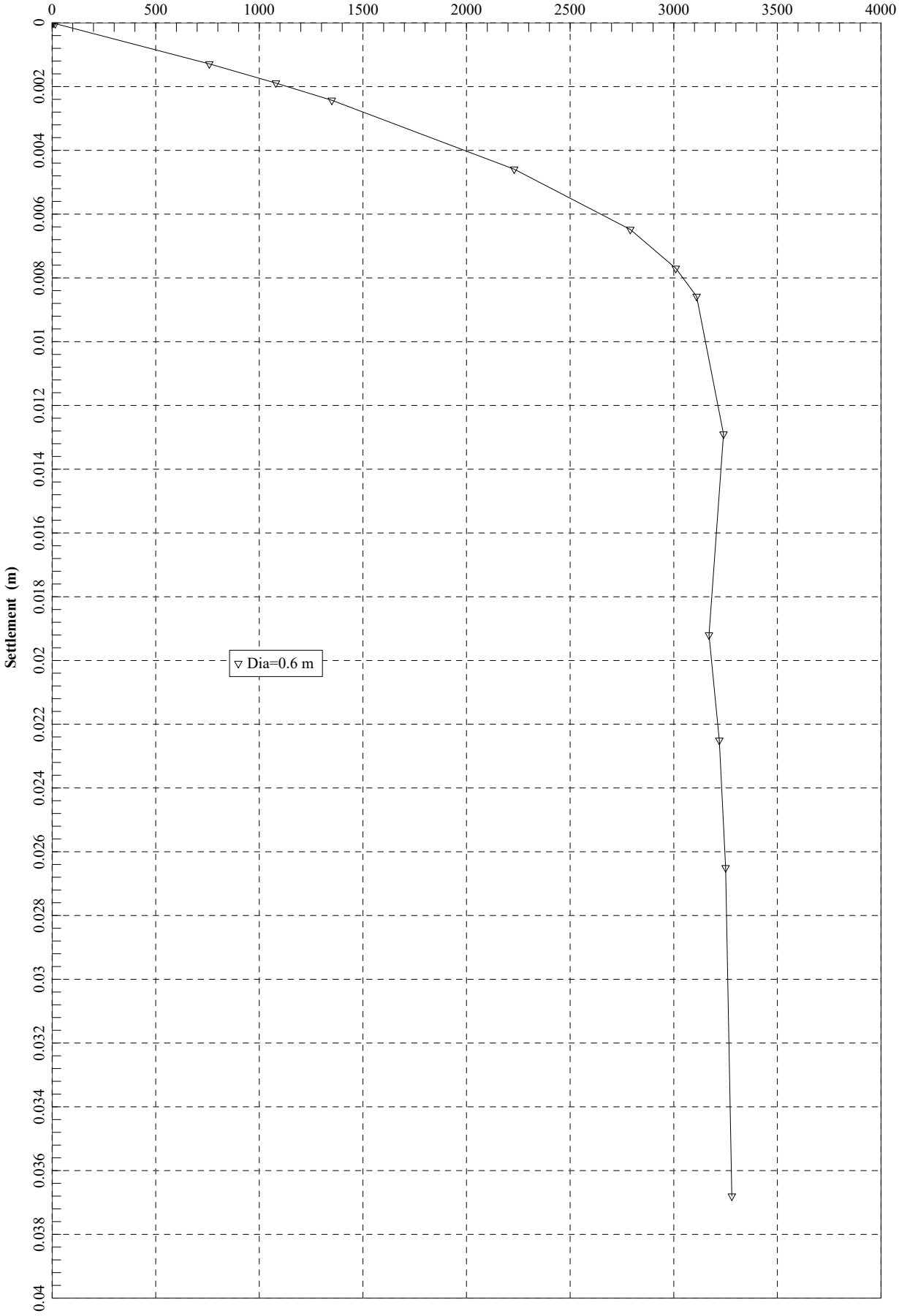
# Carga Axial Compresión Macizos y Pilonas (Estación 8, Carr. Hato Nuevo)

Carga Axial Compresión
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.60m


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04 (Compresion)
Ultimate Axial Capacity (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Skin Friction
Tip Resistance
Total Capacity

**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04 (Compresion)**



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

                 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      : C:\Users\Hipolito\Desktop\Cuarentena\Metro
Cable\Metro Cable, Estación E-8\Calculos\
     Name of input data file     : Axial T8-04, D=0.60.sf8d
     Name of output file         : Axial T8-04, D=0.60.sf8o
     Name of plot output file    : Axial T8-04, D=0.60.sf8p
     Name of runtime file        : Axial T8-04, D=0.60.sf8r


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

          Date:  May 21, 2020     Time:  19:31:28

     Pilotes Estacion E-01, KM 9, Metro Cable, Macizos y Pilonas(BH-02) D=0.8


     PROPOSED DEPTH =      20.0 M
     ----------------


     NUMBER OF LAYERS =    7
     ------------------


     WATER TABLE DEPTH =       5.0 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                  = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.150E+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                         = 0.720E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.150E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.600E+00


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.120E+01  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.600E+00

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.886E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.630E+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                  = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
```

```
  DEPTH, M                                          = 0.630E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01


LAYER NO  4----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.824E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.785E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01

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                 = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.115E+03
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.945E+01


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                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.945E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.117E+02


LAYER NO  7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.117E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.300E+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       =    2.000  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       =    2.000  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              =   20.000  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) |
|---|---|---|---|---|---|---|---|
| 2.5 | 0.7 | 28.3 | 227.5 | 255.9 | 119.3 | 102.3 | 361.44 |
| 3.0 | 0.8 | 73.8 | 263.6 | 337.4 | 179.2 | 134.9 | 397.37 |
| 3.5 | 1.0 | 127.1 | 299.7 | 426.9 | 247.0 | 170.7 | 430.82 |
| 4.0 | 1.1 | 187.4 | 335.8 | 523.3 | 321.8 | 209.3 | 462.44 |
| 4.5 | 1.3 | 254.9 | 372.0 | 626.9 | 403.7 | 250.7 | 492.37 |
| 5.0 | 1.4 | 329.2 | 408.1 | 737.2 | 492.4 | 294.9 | 521.12 |
| 5.5 | 1.6 | 408.5 | 430.3 | 838.8 | 580.6 | 335.5 | 539.31 |
| 6.0 | 1.7 | 489.5 | 366.7 | 856.2 | 636.1 | 342.5 | 504.75 |
| 6.5 | 1.8 | 586.2 | 356.3 | 942.5 | 728.7 | 377.0 | 512.43 |
| 7.0 | 2.0 | 692.9 | 279.3 | 972.1 | 804.6 | 388.9 | 491.14 |
| 7.5 | 2.1 | 765.5 | 216.7 | 982.1 | 852.1 | 392.9 | 463.03 |
| 8.0 | 2.3 | 848.5 | 268.1 | 1116.6 | 955.7 | 446.6 | 493.42 |
| 8.5 | 2.4 | 935.3 | 292.7 | 1228.0 | 1052.4 | 491.2 | 510.83 |
| 9.0 | 2.5 | 996.8 | 343.4 | 1340.2 | 1134.2 | 536.1 | 526.50 |
| 9.5 | 2.7 | 1057.7 | 356.3 | 1414.0 | 1200.3 | 565.6 | 526.33 |
| 10.0 | 2.8 | 1130.3 | 356.3 | 1486.6 | 1272.8 | 594.6 | 525.68 |
| 10.5 | 3.0 | 1202.9 | 356.3 | 1559.2 | 1345.4 | 623.7 | 525.09 |
| 11.0 | 3.1 | 1275.5 | 526.9 | 1802.4 | 1486.2 | 721.0 | 579.32 |
| 11.5 | 3.3 | 1348.1 | 636.3 | 1984.3 | 1602.6 | 793.7 | 610.15 |
| 12.0 | 3.4 | 1449.2 | 636.3 | 2085.5 | 1703.7 | 834.2 | 614.51 |
| 12.5 | 3.5 | 1556.1 | 636.3 | 2192.3 | 1810.6 | 876.9 | 620.17 |
| 13.0 | 3.7 | 1662.9 | 636.3 | 2299.1 | 1917.4 | 919.7 | 625.36 |
| 13.5 | 3.8 | 1769.7 | 636.3 | 2406.0 | 2024.2 | 962.4 | 630.18 |
| 14.0 | 4.0 | 1876.6 | 636.3 | 2512.8 | 2131.1 | 1005.1 | 634.67 |
| 14.5 | 4.1 | 1983.4 | 636.3 | 2619.6 | 2237.9 | 1047.9 | 638.82 |
| 15.0 | 4.2 | 2090.2 | 636.3 | 2726.5 | 2344.7 | 1090.6 | 642.72 |
| 15.5 | 4.4 | 2197.0 | 636.3 | 2833.3 | 2451.5 | 1133.3 | 646.36 |
| 16.0 | 4.5 | 2303.9 | 636.3 | 2940.1 | 2558.4 | 1176.0 | 649.76 |
| 16.5 | 4.7 | 2410.7 | 636.3 | 3047.0 | 2665.2 | 1218.8 | 652.97 |
| 17.0 | 4.8 | 2517.5 | 636.3 | 3153.8 | 2772.0 | 1261.5 | 655.99 |
| 17.5 | 4.9 | 2624.4 | 636.3 | 3260.6 | 2878.9 | 1304.2 | 658.83 |
| 18.0 | 5.1 | 2731.2 | 636.3 | 3367.4 | 2985.7 | 1347.0 | 661.52 |
| 18.5 | 5.2 | 2838.0 | 636.3 | 3474.3 | 3092.5 | 1389.7 | 664.06 |
| 19.0 | 5.4 | 2944.8 | 636.3 | 3581.1 | 3199.3 | 1432.4 | 666.46 |
| 19.5 | 5.5 | 3051.7 | 636.3 | 3687.9 | 3306.2 | 1475.2 | 668.75 |
| 20.0 | 5.7 | 3158.5 | 636.3 | 3794.8 | 3413.0 | 1517.9 | 670.92 |

## AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.1501E+01 | 0.2541E-05 | 0.2128E-01 | 0.2540E-06 |
| 0.7504E+01 | 0.1271E-04 | 0.1064E+00 | 0.1270E-05 |
| 0.1512E+02 | 0.2549E-04 | 0.2128E+00 | 0.2540E-05 |
| 0.7590E+03 | 0.1293E-02 | 0.1064E+02 | 0.1270E-03 |
| 0.1082E+04 | 0.1891E-02 | 0.1596E+02 | 0.1905E-03 |
| 0.1350E+04 | 0.2431E-02 | 0.2128E+02 | 0.2540E-03 |
| 0.2235E+04 | 0.4589E-02 | 0.5319E+02 | 0.6350E-03 |
| 0.2788E+04 | 0.6482E-02 | 0.1064E+03 | 0.1270E-02 |
| 0.3015E+04 | 0.7704E-02 | 0.1596E+03 | 0.1905E-02 |
| 0.3105E+04 | 0.8582E-02 | 0.2128E+03 | 0.2540E-02 |
| 0.3240E+04 | 0.1285E-01 | 0.3667E+03 | 0.6350E-02 |
| 0.3174E+04 | 0.1917E-01 | 0.5101E+03 | 0.1270E-01 |
| 0.3221E+04 | 0.2249E-01 | 0.5568E+03 | 0.1588E-01 |
| 0.3246E+04 | 0.2654E-01 | 0.5824E+03 | 0.1984E-01 |
| 0.3279E+04 | 0.3680E-01 | 0.6171E+03 | 0.3000E-01 |

RESULT FROM UPPER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.2911E+01 | 0.4415E-05 | 0.3178E-01 | 0.2540E-06 |
| 0.1467E+02 | 0.2215E-04 | 0.1589E+00 | 0.1270E-05 |
| 0.2974E+02 | 0.4476E-04 | 0.3178E+00 | 0.2540E-05 |
| 0.1366E+04 | 0.2173E-02 | 0.1589E+02 | 0.1270E-03 |
| 0.1789E+04 | 0.3011E-02 | 0.2384E+02 | 0.1905E-03 |
| 0.2089E+04 | 0.3689E-02 | 0.3178E+02 | 0.2540E-03 |
| 0.2864E+04 | 0.5904E-02 | 0.7945E+02 | 0.6350E-03 |
| 0.3170E+04 | 0.7344E-02 | 0.1589E+03 | 0.1270E-02 |
| 0.3313E+04 | 0.8381E-02 | 0.2384E+03 | 0.1905E-02 |
| 0.3424E+04 | 0.9343E-02 | 0.3178E+03 | 0.2540E-02 |
| 0.3549E+04 | 0.1360E-01 | 0.4853E+03 | 0.6350E-02 |
| 0.3480E+04 | 0.1987E-01 | 0.5864E+03 | 0.1270E-01 |
| 0.3508E+04 | 0.2313E-01 | 0.6145E+03 | 0.1588E-01 |
| 0.3520E+04 | 0.2714E-01 | 0.6264E+03 | 0.1984E-01 |
| 0.3527E+04 | 0.3731E-01 | 0.6330E+03 | 0.3000E-01 |

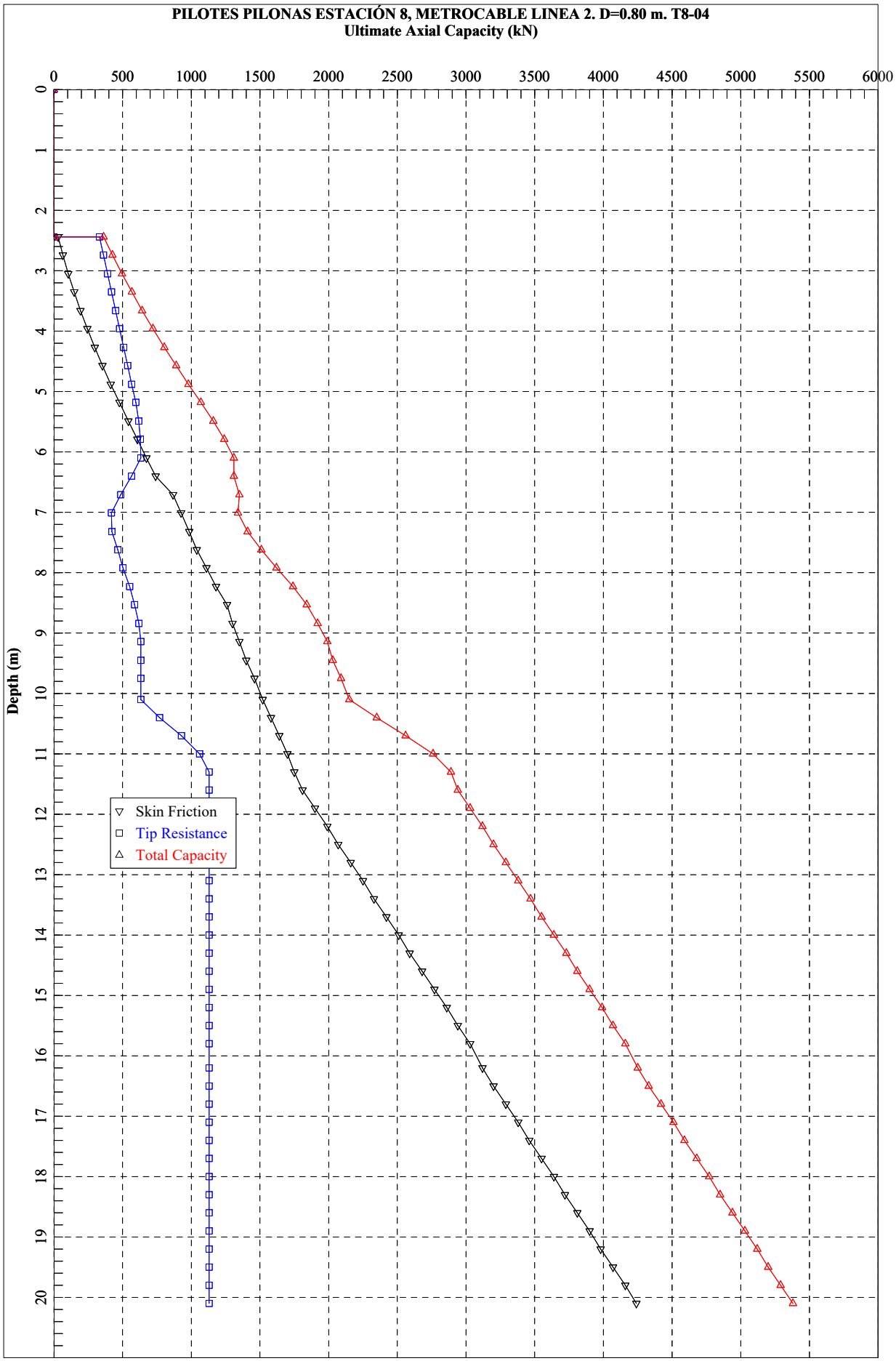
RESULT FROM LOWER-BOUND LINE

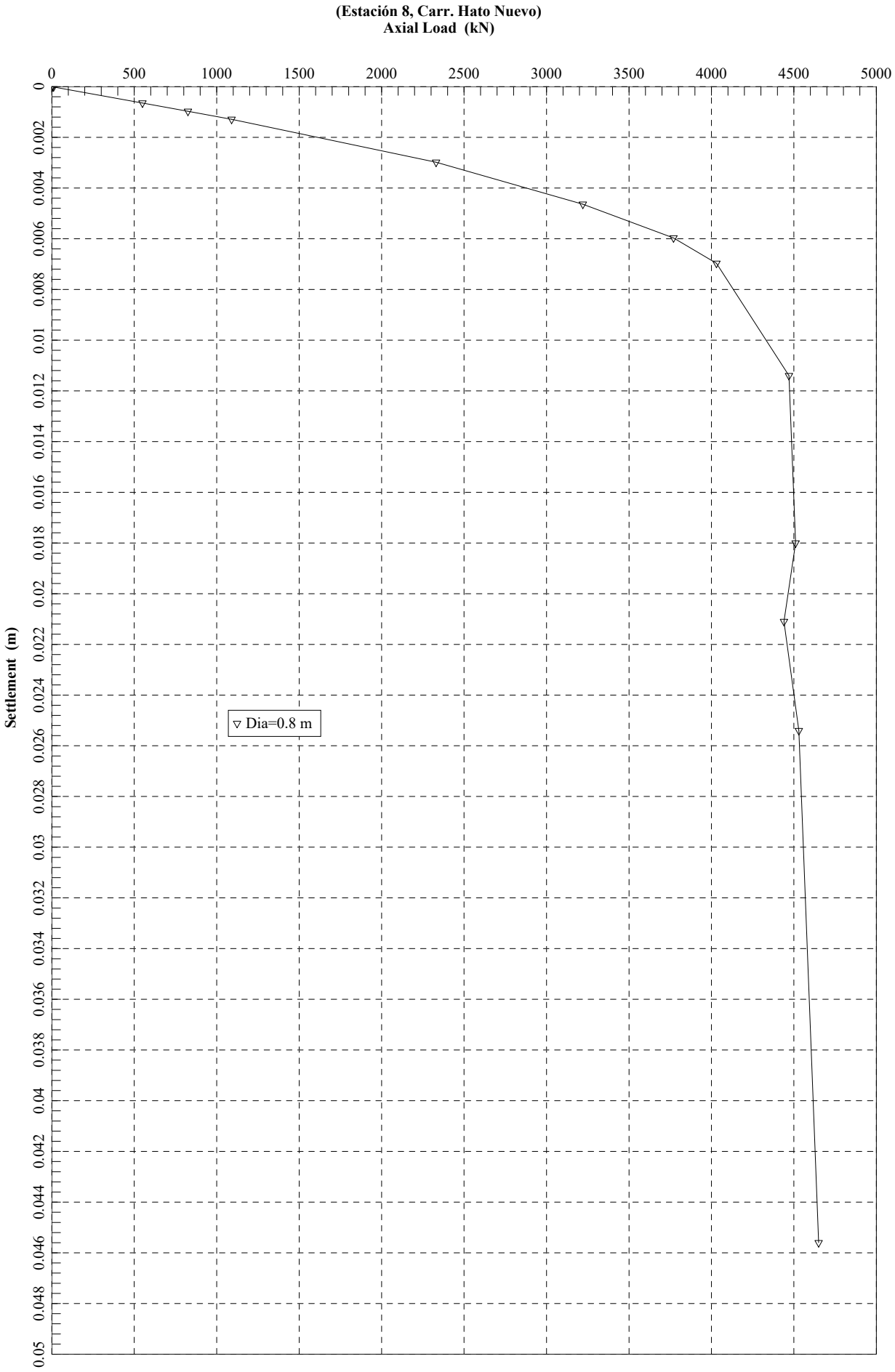
| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.6319E+00 | 0.1288E-05 | 0.1077E-01 | 0.2540E-06 |
| 0.3160E+01 | 0.6439E-05 | 0.5387E-01 | 0.1270E-05 |
| 0.6319E+01 | 0.1288E-04 | 0.1077E+00 | 0.2540E-05 |
| 0.3218E+03 | 0.6517E-03 | 0.5387E+01 | 0.1270E-03 |
| 0.4804E+03 | 0.9765E-03 | 0.8080E+01 | 0.1905E-03 |
| 0.6322E+03 | 0.1296E-02 | 0.1077E+02 | 0.2540E-03 |
| 0.1384E+04 | 0.3011E-02 | 0.2693E+02 | 0.6350E-03 |

| | | | |
|---|---|---|---|
| 0.2165E+04 | 0.5163E-02 | 0.5387E+02 | 0.1270E-02 |
| 0.2546E+04 | 0.6624E-02 | 0.8080E+02 | 0.1905E-02 |
| 0.2737E+04 | 0.7703E-02 | 0.1077E+03 | 0.2540E-02 |
| 0.2917E+04 | 0.1208E-01 | 0.2480E+03 | 0.6350E-02 |
| 0.2869E+04 | 0.1847E-01 | 0.4338E+03 | 0.1270E-01 |
| 0.2933E+04 | 0.2185E-01 | 0.4991E+03 | 0.1588E-01 |
| 0.2970E+04 | 0.2593E-01 | 0.5373E+03 | 0.1984E-01 |
| 0.3028E+04 | 0.3628E-01 | 0.5980E+03 | 0.3000E-01 |

Carga Axial Compresión
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.80m


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04
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
17
18
19
20
Skin Friction
Tip Resistance
Total Capacity


(Estación 8, Carr. Hato Nuevo)
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      : C:\Users\Hipolito\Desktop\Cuarentena\Metro
Cable\Metro Cable, Estación E-8\Calculos\
     Name of input data file     : Axial T8-04, D=0.80.sf8d
     Name of output file         : Axial T8-04, D=0.80.sf8o
     Name of plot output file    : Axial T8-04, D=0.80.sf8p
     Name of runtime file        : Axial T8-04, D=0.80.sf8r


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

          Date:  May 21, 2020     Time:  19:26:45

     Pilotes Estacion E-01, KM 9, Metro Cable, Macizos y Pilonas(BH-02) D=0.8


     PROPOSED DEPTH =      20.0 M
     ----------------


     NUMBER OF LAYERS =    7
     ------------------


     WATER TABLE DEPTH =       5.0 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                  = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.150E+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                         = 0.690E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.150E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.600E+00


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.120E+01  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.600E+00

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                    = 0.886E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                      = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.630E+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                  = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
```

```
  DEPTH, M                                          = 0.630E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01


LAYER NO  4----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.824E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.785E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01

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                 = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.115E+03
```

```
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.945E+01


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                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.945E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.117E+02


LAYER NO  7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.117E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.300E+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       =    2.000  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       =    2.000  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              =   20.000  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) |
|---|---|---|---|---|---|---|---|
| 2.5 | 1.3 | 37.8 | 337.3 | 375.1 | 172.7 | 150.0 | 298.13 |
| 3.0 | 1.5 | 98.3 | 385.4 | 483.8 | 252.5 | 193.5 | 320.55 |
| 3.5 | 1.8 | 169.5 | 433.6 | 603.1 | 342.9 | 241.2 | 342.43 |
| 4.0 | 2.0 | 249.9 | 481.7 | 731.6 | 442.6 | 292.7 | 363.71 |
| 4.5 | 2.3 | 339.9 | 529.9 | 869.8 | 551.8 | 347.9 | 384.28 |
| 5.0 | 2.5 | 438.9 | 578.1 | 1017.0 | 670.1 | 406.8 | 404.37 |
| 5.5 | 2.8 | 544.7 | 617.7 | 1162.4 | 791.7 | 465.0 | 420.35 |
| 6.0 | 3.0 | 652.6 | 632.1 | 1284.8 | 905.5 | 513.9 | 425.88 |
| 6.5 | 3.3 | 781.6 | 539.0 | 1320.5 | 997.2 | 528.2 | 404.14 |
| 7.0 | 3.5 | 923.9 | 420.4 | 1344.2 | 1092.0 | 537.7 | 381.98 |
| 7.5 | 3.8 | 1020.6 | 447.9 | 1468.5 | 1199.8 | 587.4 | 389.34 |
| 8.0 | 4.0 | 1131.3 | 514.0 | 1645.3 | 1336.9 | 658.1 | 408.98 |
| 8.5 | 4.3 | 1247.1 | 583.1 | 1830.1 | 1480.3 | 732.1 | 428.22 |
| 9.0 | 4.5 | 1329.1 | 626.1 | 1955.2 | 1579.5 | 782.1 | 432.11 |
| 9.5 | 4.8 | 1410.3 | 633.4 | 2043.7 | 1663.7 | 817.5 | 427.91 |
| 10.0 | 5.0 | 1507.1 | 633.4 | 2140.5 | 1760.5 | 856.2 | 425.76 |
| 10.5 | 5.3 | 1603.9 | 840.2 | 2444.0 | 1939.9 | 977.6 | 462.78 |
| 11.0 | 5.5 | 1700.6 | 1069.3 | 2769.9 | 2128.3 | 1108.0 | 500.84 |
| 11.5 | 5.8 | 1797.4 | 1131.1 | 2928.5 | 2249.9 | 1171.4 | 506.53 |
| 12.0 | 6.0 | 1932.3 | 1131.1 | 3063.4 | 2384.8 | 1225.4 | 507.76 |
| 12.5 | 6.3 | 2074.8 | 1131.1 | 3205.9 | 2527.2 | 1282.3 | 510.12 |
| 13.0 | 6.5 | 2217.2 | 1131.1 | 3348.3 | 2669.6 | 1339.3 | 512.29 |
| 13.5 | 6.8 | 2359.6 | 1131.1 | 3490.7 | 2812.1 | 1396.3 | 514.30 |
| 14.0 | 7.0 | 2502.1 | 1131.1 | 3633.2 | 2954.5 | 1453.3 | 516.18 |
| 14.5 | 7.3 | 2644.5 | 1131.1 | 3775.6 | 3097.0 | 1510.2 | 517.91 |
| 15.0 | 7.5 | 2786.9 | 1131.1 | 3918.1 | 3239.4 | 1567.2 | 519.54 |
| 15.5 | 7.8 | 2929.4 | 1131.1 | 4060.5 | 3381.8 | 1624.2 | 521.06 |
| 16.0 | 8.0 | 3071.8 | 1131.1 | 4202.9 | 3524.3 | 1681.2 | 522.48 |
| 16.5 | 8.3 | 3214.3 | 1131.1 | 4345.4 | 3666.7 | 1738.2 | 523.82 |
| 17.0 | 8.5 | 3356.7 | 1131.1 | 4487.8 | 3809.1 | 1795.1 | 525.08 |
| 17.5 | 8.8 | 3499.1 | 1131.1 | 4630.3 | 3951.6 | 1852.1 | 526.26 |
| 18.0 | 9.0 | 3641.6 | 1131.1 | 4772.7 | 4094.0 | 1909.1 | 527.39 |
| 18.5 | 9.3 | 3784.0 | 1131.1 | 4915.1 | 4236.5 | 1966.1 | 528.45 |
| 19.0 | 9.6 | 3926.5 | 1131.1 | 5057.6 | 4378.9 | 2023.0 | 529.45 |
| 19.5 | 9.8 | 4068.9 | 1131.1 | 5200.0 | 4521.3 | 2080.0 | 530.41 |
| 20.0 | 10.1 | 4211.3 | 1131.1 | 5342.5 | 4663.8 | 2137.0 | 531.31 |

## AXIAL LOAD VS SETTLEMENT CURVES

RESULT FROM TREND (AVERAGED) LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.1081E+01 | 0.1280E-05 | 0.2837E-01 | 0.2540E-06 |
| 0.5405E+01 | 0.6402E-05 | 0.1418E+00 | 0.1270E-05 |
| 0.1081E+02 | 0.1280E-04 | 0.2837E+00 | 0.2540E-05 |
| 0.5504E+03 | 0.6479E-03 | 0.1418E+02 | 0.1270E-03 |
| 0.8255E+03 | 0.9719E-03 | 0.2128E+02 | 0.1905E-03 |
| 0.1093E+04 | 0.1294E-02 | 0.2837E+02 | 0.2540E-03 |
| 0.2332E+04 | 0.2980E-02 | 0.7092E+02 | 0.6350E-03 |
| 0.3216E+04 | 0.4638E-02 | 0.1418E+03 | 0.1270E-02 |
| 0.3771E+04 | 0.5974E-02 | 0.2128E+03 | 0.1905E-02 |
| 0.4035E+04 | 0.6973E-02 | 0.2837E+03 | 0.2540E-02 |
| 0.4465E+04 | 0.1143E-01 | 0.5564E+03 | 0.6350E-02 |
| 0.4514E+04 | 0.1798E-01 | 0.8080E+03 | 0.1270E-01 |
| 0.4436E+04 | 0.2108E-01 | 0.8821E+03 | 0.1588E-01 |
| 0.4531E+04 | 0.2537E-01 | 0.9783E+03 | 0.2000E-01 |
| 0.4646E+04 | 0.4558E-01 | 0.1097E+04 | 0.4000E-01 |

RESULT FROM UPPER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.1886E+01 | 0.1963E-05 | 0.4237E-01 | 0.2540E-06 |
| 0.9428E+01 | 0.9815E-05 | 0.2119E+00 | 0.1270E-05 |
| 0.1889E+02 | 0.1964E-04 | 0.4237E+00 | 0.2540E-05 |
| 0.9675E+03 | 0.1000E-02 | 0.2119E+02 | 0.1270E-03 |
| 0.1431E+04 | 0.1494E-02 | 0.3178E+02 | 0.1905E-03 |
| 0.1853E+04 | 0.1966E-02 | 0.4237E+02 | 0.2540E-03 |
| 0.3373E+04 | 0.4076E-02 | 0.1059E+03 | 0.6350E-03 |
| 0.4032E+04 | 0.5592E-02 | 0.2119E+03 | 0.1270E-02 |
| 0.4320E+04 | 0.6641E-02 | 0.3178E+03 | 0.1905E-02 |
| 0.4502E+04 | 0.7557E-02 | 0.4237E+03 | 0.2540E-02 |
| 0.4926E+04 | 0.1208E-01 | 0.7736E+03 | 0.6350E-02 |
| 0.4930E+04 | 0.1855E-01 | 0.9826E+03 | 0.1270E-01 |
| 0.4886E+04 | 0.2168E-01 | 0.1027E+04 | 0.1588E-01 |
| 0.4944E+04 | 0.2591E-01 | 0.1086E+04 | 0.2000E-01 |
| 0.4984E+04 | 0.4597E-01 | 0.1125E+04 | 0.4000E-01 |

RESULT FROM LOWER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.5121E+00 | 0.7626E-06 | 0.1436E-01 | 0.2540E-06 |
| 0.2561E+01 | 0.3813E-05 | 0.7182E-01 | 0.1270E-05 |
| 0.5121E+01 | 0.7626E-05 | 0.1436E+00 | 0.2540E-05 |
| 0.2588E+03 | 0.3834E-03 | 0.7182E+01 | 0.1270E-03 |
| 0.3882E+03 | 0.5751E-03 | 0.1077E+02 | 0.1905E-03 |
| 0.5176E+03 | 0.7668E-03 | 0.1436E+02 | 0.2540E-03 |
| 0.1252E+04 | 0.1895E-02 | 0.3591E+02 | 0.6350E-03 |

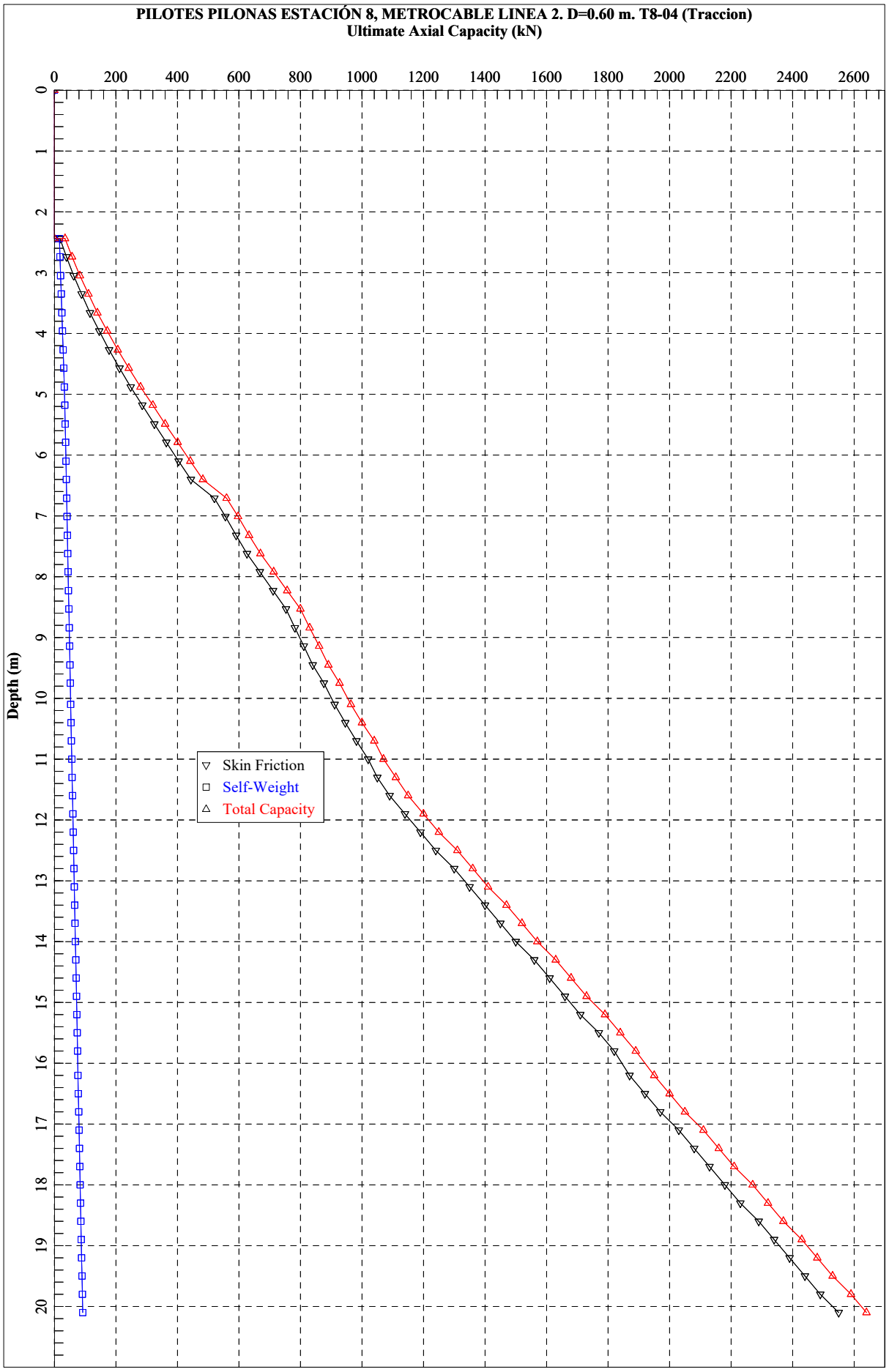
| | | | |
|---|---|---|---|
| 0.2182E+04 | 0.3517E-02 | 0.7182E+02 | 0.1270E-02 |
| 0.2854E+04 | 0.4907E-02 | 0.1077E+03 | 0.1905E-02 |
| 0.3274E+04 | 0.6026E-02 | 0.1436E+03 | 0.2540E-02 |
| 0.4005E+04 | 0.1079E-01 | 0.3392E+03 | 0.6350E-02 |
| 0.4006E+04 | 0.1729E-01 | 0.6335E+03 | 0.1270E-01 |
| 0.3985E+04 | 0.2048E-01 | 0.7368E+03 | 0.1588E-01 |
| 0.4117E+04 | 0.2484E-01 | 0.8709E+03 | 0.2000E-01 |
| 0.4304E+04 | 0.4517E-01 | 0.1063E+04 | 0.4000E-01 |

# Carga Axial Tracción

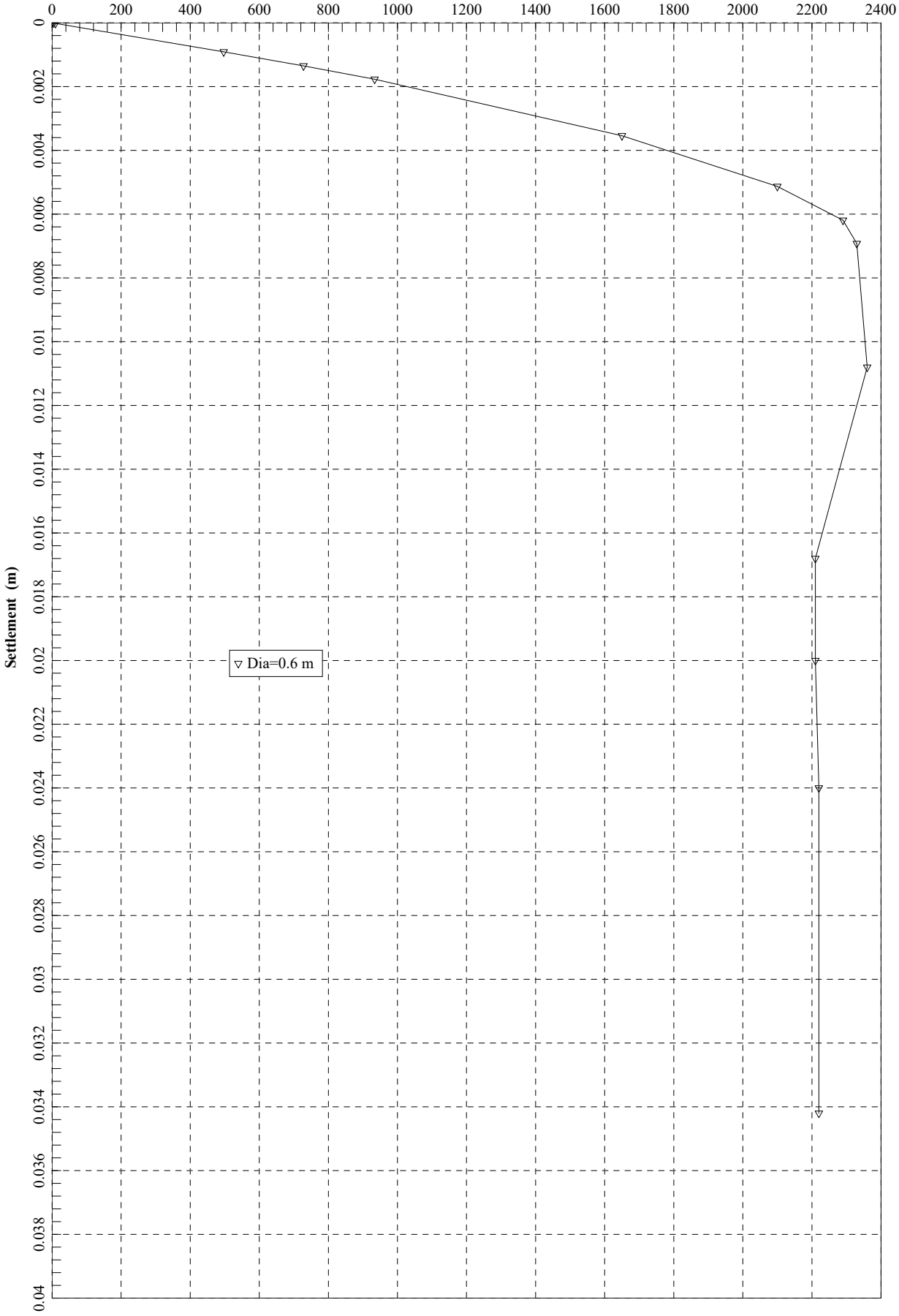
# Carga Axial Tracción
# Macizos y Pilonas
# (Estación 8, Carr. Hato Nuevo)

Carga Axial Tracción
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.60m


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04 (Traccion)
Ultimate Axial Capacity (kN)
0
200
400
600
800
1000
1200
1400
1600
1800
2000
2200
2400
2600
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Skin Friction
Self-Weight
Total Capacity

**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04 (Traccion)**



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

                 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      : C:\Users\Hipolito\Desktop\Cuarentena\Metro
Cable\Metro Cable, Estación E-8\Calculos\
     Name of input data file     : Axial T8-04, D=0.60.sf8d
     Name of output file         : Axial T8-04, D=0.60.sf8o
     Name of plot output file    : Axial T8-04, D=0.60.sf8p
     Name of runtime file        : Axial T8-04, D=0.60.sf8r


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

          Date:  May 21, 2020     Time:  19:35:39

     Pilotes Estacion E-01, KM 9, Metro Cable, Macizos y Pilonas(BH-02) D=0.8


     PROPOSED DEPTH =      20.0 M
     ----------------


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


     NUMBER OF LAYERS =    7
     ------------------


     WATER TABLE DEPTH =       5.0 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                = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.150E+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                       = 0.720E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.150E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.600E+00


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                  = 0.120E+01  (*)
  INTERNAL FRICTION ANGLE, DEG.                    = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.600E+00

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                  = 0.886E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                    = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.630E+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                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.630E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01


LAYER NO  4----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.824E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.785E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01

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                 = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01


  AT THE BOTTOM
```

```
  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.945E+01


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                  = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.945E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.117E+02


LAYER NO  7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M            = 0.100E+11
  DEPTH, M                                           = 0.117E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                    = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                         = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                  = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST      = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                          = 0.200E+02
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.300E+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       =    2.000  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       =    2.000  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              =   20.000  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 ) |
|---|---|---|---|---|---|---|---|
| 2.5 | 0.7 | 22.7 | 16.7 | 39.3 | 39.3 | 25.7 | 55.16 |
| 3.0 | 0.8 | 59.0 | 20.0 | 79.0 | 79.0 | 43.6 | 92.81 |
| 3.5 | 1.0 | 101.7 | 23.3 | 125.0 | 125.0 | 64.0 | 125.89 |
| 4.0 | 1.1 | 150.0 | 26.7 | 176.6 | 176.6 | 86.6 | 155.98 |
| 4.5 | 1.3 | 203.9 | 30.0 | 233.9 | 233.9 | 111.6 | 183.61 |
| 5.0 | 1.4 | 263.3 | 33.1 | 296.5 | 296.5 | 138.4 | 209.43 |
| 5.5 | 1.6 | 326.8 | 35.3 | 362.1 | 362.1 | 166.0 | 232.74 |
| 6.0 | 1.7 | 391.6 | 37.2 | 428.8 | 428.8 | 193.8 | 252.57 |
| 6.5 | 1.8 | 468.9 | 39.2 | 508.1 | 508.1 | 226.7 | 276.11 |
| 7.0 | 2.0 | 554.3 | 41.1 | 595.4 | 595.4 | 262.8 | 300.76 |
| 7.5 | 2.1 | 612.4 | 43.0 | 655.4 | 655.4 | 288.0 | 308.97 |
| 8.0 | 2.3 | 678.8 | 45.0 | 723.8 | 723.8 | 316.5 | 319.87 |
| 8.5 | 2.4 | 748.2 | 46.9 | 795.2 | 795.2 | 346.2 | 330.77 |
| 9.0 | 2.5 | 797.4 | 48.9 | 846.3 | 846.3 | 367.9 | 332.51 |
| 9.5 | 2.7 | 846.2 | 50.8 | 897.0 | 897.0 | 389.3 | 333.87 |
| 10.0 | 2.8 | 904.3 | 52.8 | 957.0 | 957.0 | 414.5 | 338.40 |
| 10.5 | 3.0 | 962.3 | 54.7 | 1017.0 | 1017.0 | 439.6 | 342.49 |
| 11.0 | 3.1 | 1020.4 | 56.7 | 1077.0 | 1077.0 | 464.8 | 346.22 |
| 11.5 | 3.3 | 1078.4 | 58.6 | 1137.1 | 1137.1 | 490.0 | 349.61 |
| 12.0 | 3.4 | 1159.4 | 60.6 | 1219.9 | 1219.9 | 524.3 | 359.44 |
| 12.5 | 3.5 | 1244.9 | 62.5 | 1307.4 | 1307.4 | 560.4 | 369.83 |
| 13.0 | 3.7 | 1330.3 | 64.4 | 1394.8 | 1394.8 | 596.6 | 379.35 |
| 13.5 | 3.8 | 1415.8 | 66.4 | 1482.2 | 1482.2 | 632.7 | 388.20 |
| 14.0 | 4.0 | 1501.2 | 68.3 | 1569.6 | 1569.6 | 668.8 | 396.43 |
| 14.5 | 4.1 | 1586.7 | 70.3 | 1657.0 | 1657.0 | 705.0 | 404.06 |
| 15.0 | 4.2 | 1672.2 | 72.2 | 1744.4 | 1744.4 | 741.1 | 411.20 |
| 15.5 | 4.4 | 1757.6 | 74.2 | 1831.8 | 1831.8 | 777.2 | 417.88 |
| 16.0 | 4.5 | 1843.1 | 76.1 | 1919.2 | 1919.2 | 813.4 | 424.13 |
| 16.5 | 4.7 | 1928.6 | 78.1 | 2006.6 | 2006.6 | 849.5 | 430.02 |
| 17.0 | 4.8 | 2014.0 | 80.0 | 2094.0 | 2094.0 | 885.6 | 435.55 |
| 17.5 | 4.9 | 2099.5 | 82.0 | 2181.4 | 2181.4 | 921.8 | 440.77 |
| 18.0 | 5.1 | 2185.0 | 83.9 | 2268.9 | 2268.9 | 957.9 | 445.71 |
| 18.5 | 5.2 | 2270.4 | 85.9 | 2356.3 | 2356.3 | 994.0 | 450.36 |
| 19.0 | 5.4 | 2355.9 | 87.8 | 2443.7 | 2443.7 | 1030.2 | 454.78 |
| 19.5 | 5.5 | 2441.3 | 89.7 | 2531.1 | 2531.1 | 1066.3 | 458.97 |
| 20.0 | 5.7 | 2526.8 | 91.7 | 2618.5 | 2618.5 | 1102.4 | 462.95 |

AXIAL LOAD VS SETTLEMENT CURVES
---

RESULT FROM TREND (AVERAGED) LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.9732E+00 | 0.1791E-05 | 0.3081E-02 | 0.2540E-06 |
| 0.4866E+01 | 0.8953E-05 | 0.1541E-01 | 0.1270E-05 |
| 0.9732E+01 | 0.1791E-04 | 0.3081E-01 | 0.2540E-05 |
| 0.4971E+03 | 0.9104E-03 | 0.1541E+01 | 0.1270E-03 |
| 0.7282E+03 | 0.1354E-02 | 0.2311E+01 | 0.1905E-03 |
| 0.9335E+03 | 0.1771E-02 | 0.3081E+01 | 0.2540E-03 |
| 0.1650E+04 | 0.3539E-02 | 0.7704E+01 | 0.6350E-03 |
| 0.2105E+04 | 0.5129E-02 | 0.1541E+02 | 0.1270E-02 |
| 0.2287E+04 | 0.6194E-02 | 0.2311E+02 | 0.1905E-02 |
| 0.2331E+04 | 0.6920E-02 | 0.3081E+02 | 0.2540E-02 |
| 0.2361E+04 | 0.1083E-01 | 0.5310E+02 | 0.6350E-02 |
| 0.2206E+04 | 0.1685E-01 | 0.7387E+02 | 0.1270E-01 |
| 0.2212E+04 | 0.2004E-01 | 0.8064E+02 | 0.1588E-01 |
| 0.2215E+04 | 0.2402E-01 | 0.8434E+02 | 0.1984E-01 |
| 0.2219E+04 | 0.3419E-01 | 0.8937E+02 | 0.3000E-01 |

RESULT FROM UPPER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.1780E+01 | 0.2913E-05 | 0.4603E-02 | 0.2540E-06 |
| 0.8902E+01 | 0.1457E-04 | 0.2301E-01 | 0.1270E-05 |
| 0.1800E+02 | 0.2929E-04 | 0.4603E-01 | 0.2540E-05 |
| 0.8907E+03 | 0.1477E-02 | 0.2301E+01 | 0.1270E-03 |
| 0.1235E+04 | 0.2127E-02 | 0.3452E+01 | 0.1905E-03 |
| 0.1498E+04 | 0.2685E-02 | 0.4603E+01 | 0.2540E-03 |
| 0.2185E+04 | 0.4592E-02 | 0.1151E+02 | 0.6350E-03 |
| 0.2411E+04 | 0.5768E-02 | 0.2301E+02 | 0.1270E-02 |
| 0.2483E+04 | 0.6581E-02 | 0.3452E+02 | 0.1905E-02 |
| 0.2526E+04 | 0.7327E-02 | 0.4603E+02 | 0.2540E-02 |
| 0.2535E+04 | 0.1120E-01 | 0.7029E+02 | 0.6350E-02 |
| 0.2400E+04 | 0.1725E-01 | 0.8492E+02 | 0.1270E-01 |
| 0.2404E+04 | 0.2044E-01 | 0.8899E+02 | 0.1588E-01 |
| 0.2406E+04 | 0.2441E-01 | 0.9072E+02 | 0.1984E-01 |
| 0.2407E+04 | 0.3457E-01 | 0.9168E+02 | 0.3000E-01 |

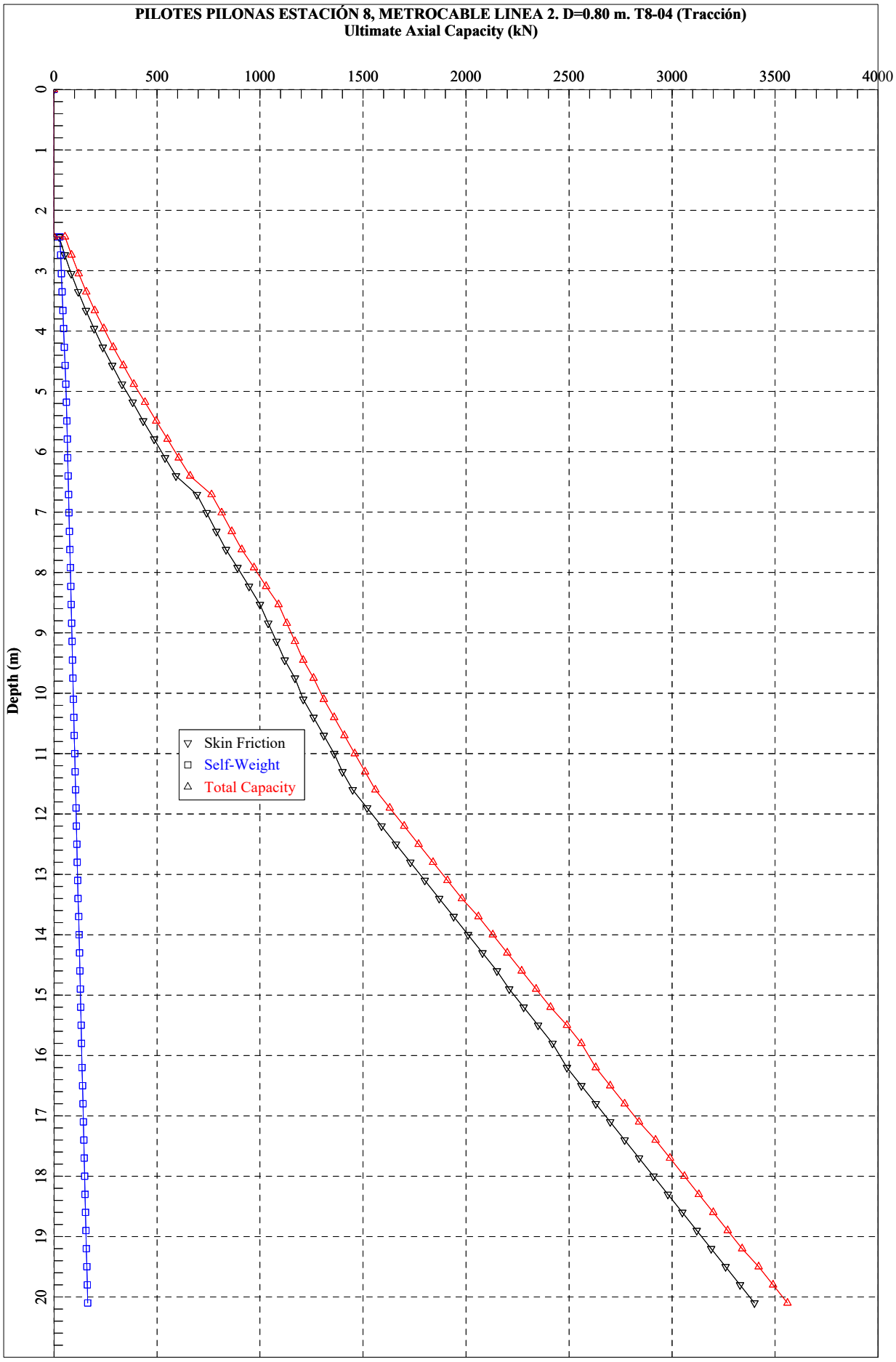
RESULT FROM LOWER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.4391E+00 | 0.9892E-06 | 0.1560E-02 | 0.2540E-06 |
| 0.2196E+01 | 0.4946E-05 | 0.7801E-02 | 0.1270E-05 |
| 0.4391E+01 | 0.9892E-05 | 0.1560E-01 | 0.2540E-05 |

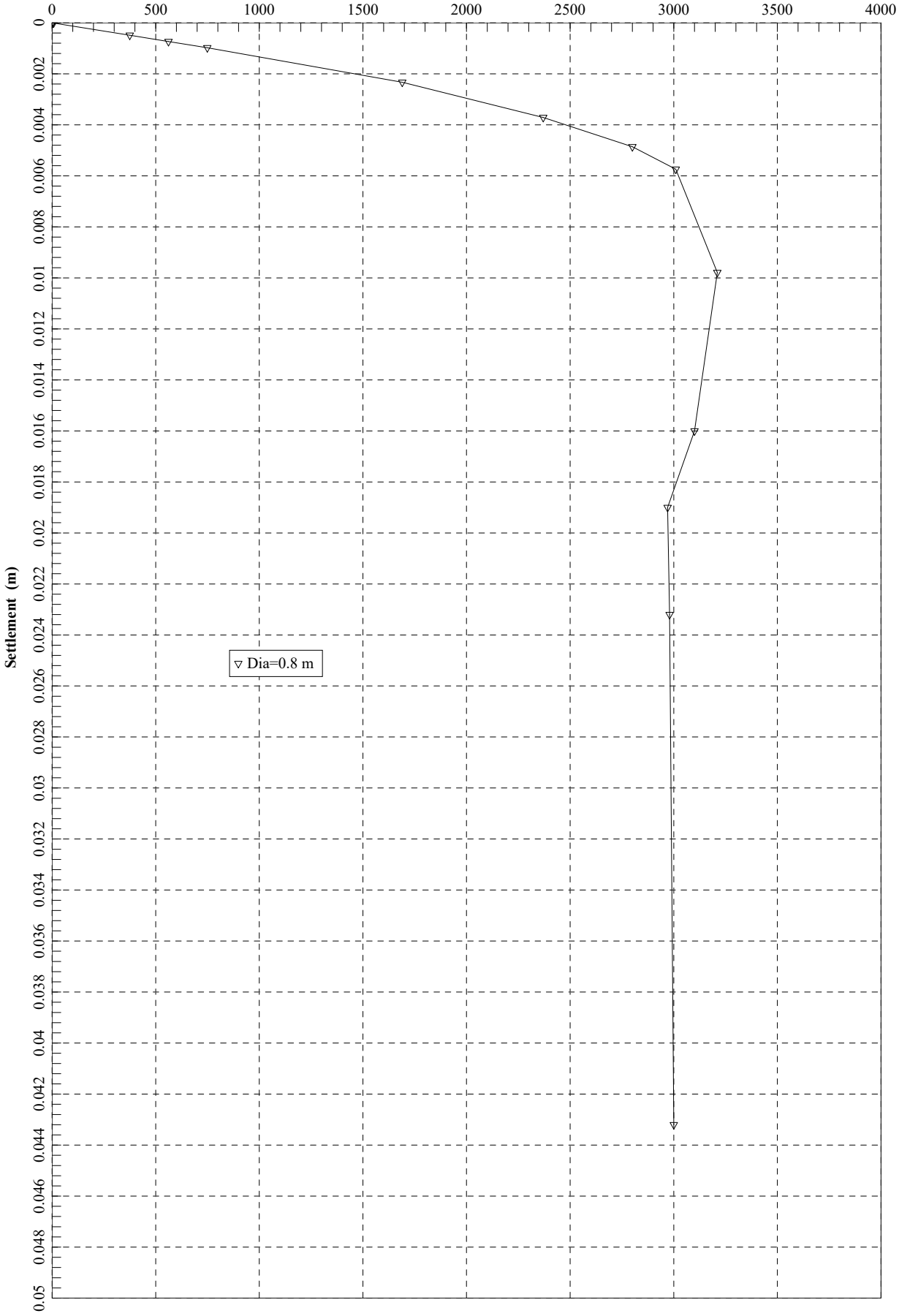
| | | | |
|---|---|---|---|
| 0.2227E+03 | 0.4989E-03 | 0.7801E+00 | 0.1270E-03 |
| 0.3341E+03 | 0.7483E-03 | 0.1170E+01 | 0.1905E-03 |
| 0.4426E+03 | 0.9962E-03 | 0.1560E+01 | 0.2540E-03 |
| 0.9984E+03 | 0.2362E-02 | 0.3901E+01 | 0.6350E-03 |
| 0.1609E+04 | 0.4155E-02 | 0.7801E+01 | 0.1270E-02 |
| 0.1931E+04 | 0.5442E-02 | 0.1170E+02 | 0.1905E-02 |
| 0.2090E+04 | 0.6404E-02 | 0.1560E+02 | 0.2540E-02 |
| 0.2184E+04 | 0.1045E-01 | 0.3592E+02 | 0.6350E-02 |
| 0.2011E+04 | 0.1644E-01 | 0.6282E+02 | 0.1270E-01 |
| 0.2020E+04 | 0.1965E-01 | 0.7229E+02 | 0.1588E-01 |
| 0.2025E+04 | 0.2363E-01 | 0.7782E+02 | 0.1984E-01 |
| 0.2031E+04 | 0.3381E-01 | 0.8661E+02 | 0.3000E-01 |

Carga Axial Tracción
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.80m


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04 (Tracción)
Ultimate Axial Capacity (kN)
0
500
1000
1500
2000
2500
3000
3500
4000
Depth (m)
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
Skin Friction
Self-Weight
Total Capacity

**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04 (Tracción)**



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

                 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      : C:\Users\Hipolito\Desktop\Cuarentena\Metro
Cable\Metro Cable, Estación E-8\Calculos\
     Name of input data file     : Axial T8-04, D=0.80.sf8d
     Name of output file         : Axial T8-04, D=0.80.sf8o
     Name of plot output file    : Axial T8-04, D=0.80.sf8p
     Name of runtime file        : Axial T8-04, D=0.80.sf8r


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

          Date:  May 21, 2020     Time:  19:28:12

     Pilotes Estacion E-01, KM 9, Metro Cable, Macizos y Pilonas(BH-02) D=0.8


     PROPOSED DEPTH =      20.0 M
     ----------------


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


     NUMBER OF LAYERS =    7
     ------------------


     WATER TABLE DEPTH =       5.0 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                = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.150E+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                       = 0.690E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.250E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.150E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.600E+00


LAYER NO  2----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                  = 0.120E+01  (*)
  INTERNAL FRICTION ANGLE, DEG.                    = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.600E+00

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                  = 0.886E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                    = 0.360E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.185E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.630E+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                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.630E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                   = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                        = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                 = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01


LAYER NO  4----SAND

  AT THE TOP

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.824E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.765E+01

  AT THE BOTTOM

  SIDE FRICTION PROCEDURE, BETA METHOD
  SKIN FRICTION COEFFICIENT- BETA                   = 0.785E+00  (*)
  INTERNAL FRICTION ANGLE, DEG.                     = 0.330E+02
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01

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                 = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST     = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                         = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M           = 0.100E+11
  DEPTH, M                                          = 0.855E+01


  AT THE BOTTOM
```

```
  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.115E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.170E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.945E+01


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                = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.945E+01


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.550E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.140E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.175E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.117E+02


LAYER NO  7----CLAY

  AT THE TOP

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.117E+02


  AT THE BOTTOM

  STRENGTH REDUCTION FACTOR-ALPHA                  = 0.453E+00  (*)
  END BEARING COEFFICIENT-Nc                       = 0.900E+01  (*)
  UNDRAINED SHEAR STRENGTH, KN/SQ M                = 0.250E+03
  BLOWS PER FOOT FROM STANDARD PENETRATION TEST    = 0.000E+00
  SOIL UNIT WEIGHT, KN/CU M                        = 0.200E+02
```

```
  MAXIMUM LOAD TRANSFER FOR SOIL, KN/SQ M          = 0.100E+11
  DEPTH, M                                         = 0.300E+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       =    2.000  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       =    2.000  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              =   20.000  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 ) |
|---|---|---|---|---|---|---|---|
| 2.5 | 1.3 | 30.2 | 29.6 | 59.8 | 59.8 | 41.7 | 47.26 |
| 3.0 | 1.5 | 78.7 | 35.5 | 114.2 | 114.2 | 67.0 | 75.50 |
| 3.5 | 1.8 | 135.6 | 41.5 | 177.1 | 177.1 | 95.7 | 100.31 |
| 4.0 | 2.0 | 199.9 | 47.4 | 247.3 | 247.3 | 127.4 | 122.88 |
| 4.5 | 2.3 | 271.9 | 53.3 | 325.2 | 325.2 | 162.1 | 143.60 |
| 5.0 | 2.5 | 351.1 | 58.9 | 410.0 | 410.0 | 199.3 | 162.93 |
| 5.5 | 2.8 | 435.7 | 62.7 | 498.4 | 498.4 | 237.0 | 180.23 |
| 6.0 | 3.0 | 522.1 | 66.1 | 588.2 | 588.2 | 275.0 | 194.91 |
| 6.5 | 3.3 | 625.2 | 69.6 | 694.8 | 694.8 | 319.7 | 212.41 |
| 7.0 | 3.5 | 739.1 | 73.1 | 812.1 | 812.1 | 368.7 | 230.76 |
| 7.5 | 3.8 | 816.5 | 76.5 | 893.0 | 893.0 | 403.1 | 236.80 |
| 8.0 | 4.0 | 905.1 | 80.0 | 985.0 | 985.0 | 442.0 | 244.87 |
| 8.5 | 4.3 | 997.6 | 83.4 | 1081.1 | 1081.1 | 482.5 | 252.96 |
| 9.0 | 4.5 | 1063.2 | 86.9 | 1150.2 | 1150.2 | 512.2 | 254.18 |
| 9.5 | 4.8 | 1128.3 | 90.4 | 1218.6 | 1218.6 | 541.7 | 255.13 |
| 10.0 | 5.0 | 1205.7 | 93.8 | 1299.5 | 1299.5 | 576.1 | 258.46 |
| 10.5 | 5.3 | 1283.1 | 97.3 | 1380.4 | 1380.4 | 610.5 | 261.47 |
| 11.0 | 5.5 | 1360.5 | 100.7 | 1461.2 | 1461.2 | 644.9 | 264.22 |
| 11.5 | 5.8 | 1437.9 | 104.2 | 1542.1 | 1542.1 | 679.4 | 266.72 |
| 12.0 | 6.0 | 1545.8 | 107.7 | 1653.5 | 1653.5 | 726.0 | 274.04 |
| 12.5 | 6.3 | 1659.8 | 111.1 | 1770.9 | 1770.9 | 775.0 | 281.79 |
| 13.0 | 6.5 | 1773.8 | 114.6 | 1888.3 | 1888.3 | 824.1 | 288.89 |
| 13.5 | 6.8 | 1887.7 | 118.0 | 2005.7 | 2005.7 | 873.1 | 295.50 |
| 14.0 | 7.0 | 2001.7 | 121.5 | 2123.1 | 2123.1 | 922.2 | 301.64 |
| 14.5 | 7.3 | 2115.6 | 125.0 | 2240.6 | 2240.6 | 971.2 | 307.33 |
| 15.0 | 7.5 | 2229.6 | 128.4 | 2358.0 | 2358.0 | 1020.2 | 312.66 |
| 15.5 | 7.8 | 2343.5 | 131.9 | 2475.4 | 2475.4 | 1069.3 | 317.64 |
| 16.0 | 8.0 | 2457.5 | 135.3 | 2592.8 | 2592.8 | 1118.3 | 322.31 |
| 16.5 | 8.3 | 2571.4 | 138.8 | 2710.2 | 2710.2 | 1167.4 | 326.70 |
| 17.0 | 8.5 | 2685.4 | 142.3 | 2827.6 | 2827.6 | 1216.4 | 330.83 |
| 17.5 | 8.8 | 2799.3 | 145.7 | 2945.0 | 2945.0 | 1265.4 | 334.72 |
| 18.0 | 9.0 | 2913.3 | 149.2 | 3062.4 | 3062.4 | 1314.5 | 338.40 |
| 18.5 | 9.3 | 3027.2 | 152.6 | 3179.8 | 3179.8 | 1363.5 | 341.87 |
| 19.0 | 9.6 | 3141.2 | 156.1 | 3297.3 | 3297.3 | 1412.6 | 345.17 |
| 19.5 | 9.8 | 3255.1 | 159.5 | 3414.7 | 3414.7 | 1461.6 | 348.30 |
| 20.0 | 10.1 | 3369.1 | 163.0 | 3532.1 | 3532.1 | 1510.6 | 351.26 |

AXIAL LOAD VS SETTLEMENT CURVES
---

RESULT FROM TREND (AVERAGED) LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.7388E+00 | 0.9682E-06 | 0.4109E-02 | 0.2540E-06 |
| 0.3694E+01 | 0.4841E-05 | 0.2054E-01 | 0.1270E-05 |
| 0.7388E+01 | 0.9682E-05 | 0.4109E-01 | 0.2540E-05 |
| 0.3746E+03 | 0.4881E-03 | 0.2054E+01 | 0.1270E-03 |
| 0.5619E+03 | 0.7323E-03 | 0.3081E+01 | 0.1905E-03 |
| 0.7491E+03 | 0.9763E-03 | 0.4109E+01 | 0.2540E-03 |
| 0.1691E+04 | 0.2331E-02 | 0.1027E+02 | 0.6350E-03 |
| 0.2370E+04 | 0.3711E-02 | 0.2054E+02 | 0.1270E-02 |
| 0.2803E+04 | 0.4855E-02 | 0.3081E+02 | 0.1905E-02 |
| 0.3006E+04 | 0.5742E-02 | 0.4109E+02 | 0.2540E-02 |
| 0.3212E+04 | 0.9791E-02 | 0.8058E+02 | 0.6350E-02 |
| 0.3104E+04 | 0.1603E-01 | 0.1170E+03 | 0.1270E-01 |
| 0.2971E+04 | 0.1904E-01 | 0.1278E+03 | 0.1588E-01 |
| 0.2984E+04 | 0.2319E-01 | 0.1417E+03 | 0.2000E-01 |
| 0.2999E+04 | 0.4321E-01 | 0.1589E+03 | 0.4000E-01 |

RESULT FROM UPPER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.1234E+01 | 0.1403E-05 | 0.6137E-02 | 0.2540E-06 |
| 0.6170E+01 | 0.7014E-05 | 0.3068E-01 | 0.1270E-05 |
| 0.1234E+02 | 0.1403E-04 | 0.6137E-01 | 0.2540E-05 |
| 0.6294E+03 | 0.7109E-03 | 0.3068E+01 | 0.1270E-03 |
| 0.9433E+03 | 0.1066E-02 | 0.4603E+01 | 0.1905E-03 |
| 0.1244E+04 | 0.1417E-02 | 0.6137E+01 | 0.2540E-03 |
| 0.2499E+04 | 0.3150E-02 | 0.1534E+02 | 0.6350E-03 |
| 0.3025E+04 | 0.4432E-02 | 0.3068E+02 | 0.1270E-02 |
| 0.3210E+04 | 0.5302E-02 | 0.4603E+02 | 0.1905E-02 |
| 0.3303E+04 | 0.6052E-02 | 0.6137E+02 | 0.2540E-02 |
| 0.3441E+04 | 0.1006E-01 | 0.1120E+03 | 0.6350E-02 |
| 0.3317E+04 | 0.1628E-01 | 0.1423E+03 | 0.1270E-01 |
| 0.3236E+04 | 0.1935E-01 | 0.1488E+03 | 0.1588E-01 |
| 0.3244E+04 | 0.2349E-01 | 0.1572E+03 | 0.2000E-01 |
| 0.3250E+04 | 0.4350E-01 | 0.1630E+03 | 0.4000E-01 |

RESULT FROM LOWER-BOUND LINE

| TOP LOAD KN. | TOP MOVEMENT M. | TIP LOAD KN. | TIP MOVEMENT M. |
|---|---|---|---|
| 0.3683E+00 | 0.6224E-06 | 0.2080E-02 | 0.2540E-06 |
| 0.1841E+01 | 0.3112E-05 | 0.1040E-01 | 0.1270E-05 |
| 0.3683E+01 | 0.6224E-05 | 0.2080E-01 | 0.2540E-05 |

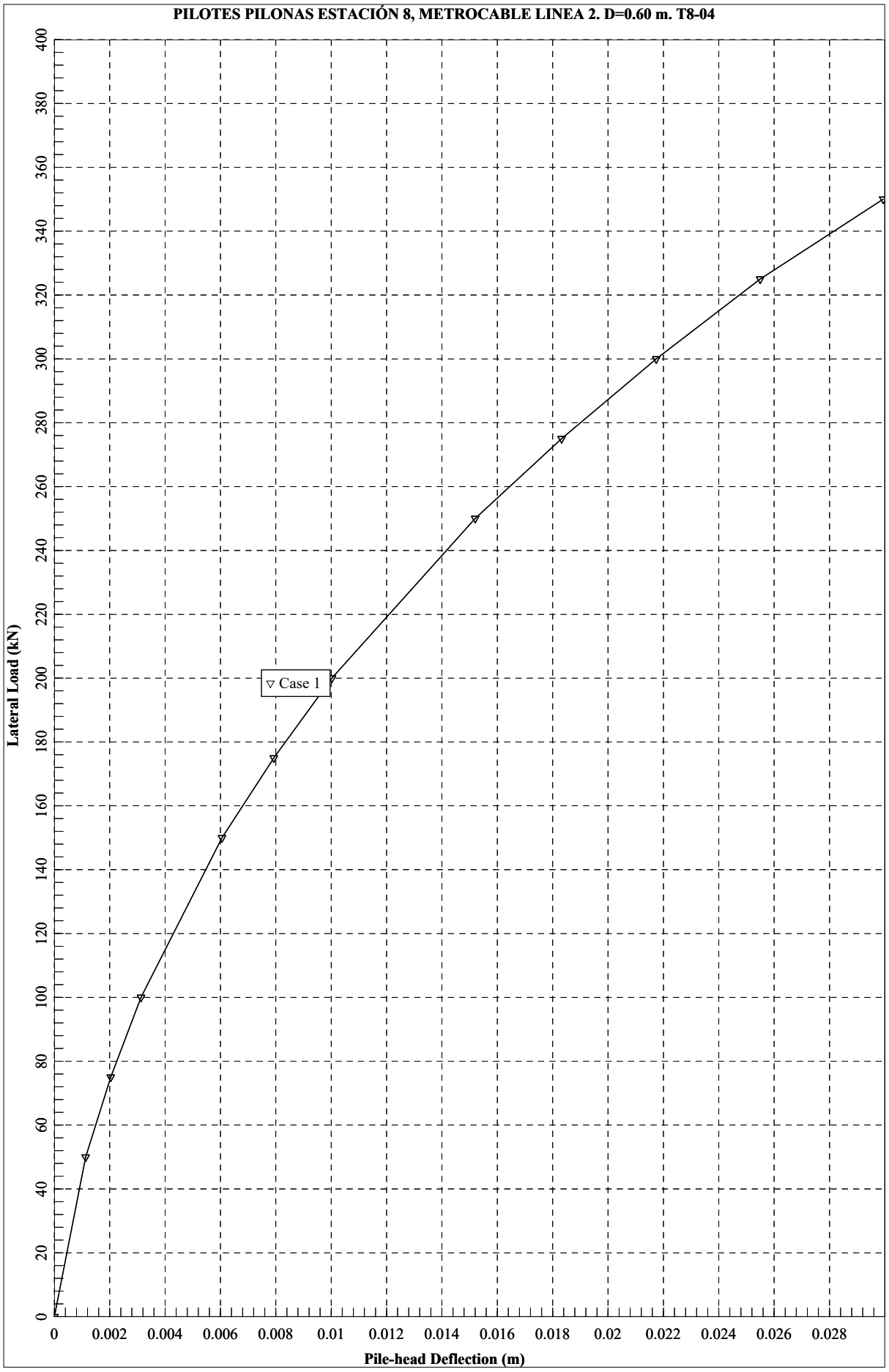
| | | | |
|---|---|---|---|
| 0.1856E+03 | 0.3124E-03 | 0.1040E+01 | 0.1270E-03 |
| 0.2785E+03 | 0.4686E-03 | 0.1560E+01 | 0.1905E-03 |
| 0.3713E+03 | 0.6248E-03 | 0.2080E+01 | 0.2540E-03 |
| 0.9089E+03 | 0.1552E-02 | 0.5201E+01 | 0.6350E-03 |
| 0.1606E+04 | 0.2916E-02 | 0.1040E+02 | 0.1270E-02 |
| 0.2124E+04 | 0.4118E-02 | 0.1560E+02 | 0.1905E-02 |
| 0.2453E+04 | 0.5116E-02 | 0.2080E+02 | 0.2540E-02 |
| 0.2983E+04 | 0.9518E-02 | 0.4912E+02 | 0.6350E-02 |
| 0.2804E+04 | 0.1567E-01 | 0.9175E+02 | 0.1270E-01 |
| 0.2706E+04 | 0.1872E-01 | 0.1067E+03 | 0.1588E-01 |
| 0.2724E+04 | 0.2288E-01 | 0.1261E+03 | 0.2000E-01 |
| 0.2747E+04 | 0.4293E-01 | 0.1540E+03 | 0.4000E-01 |

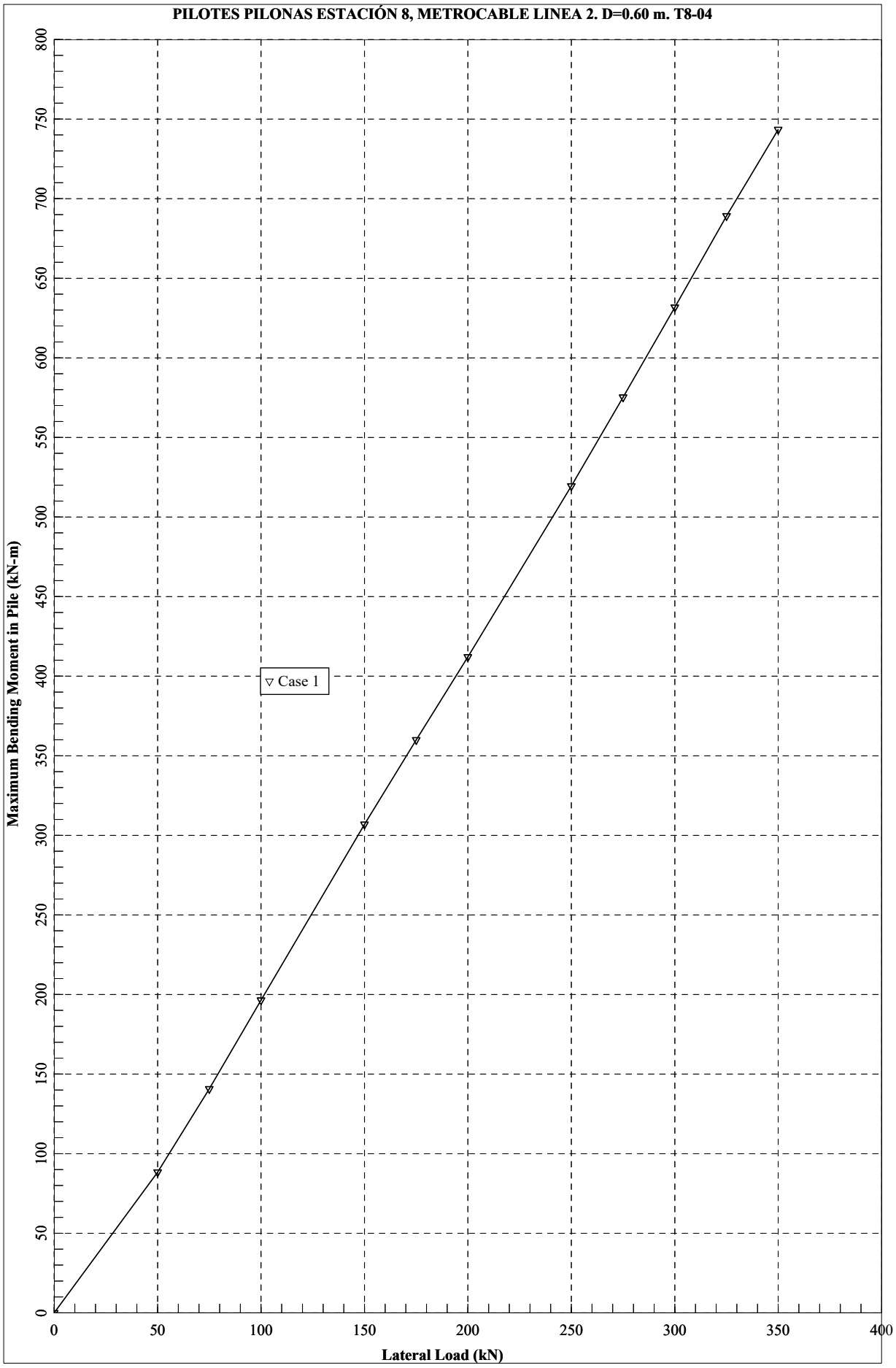
# Carga Lateral

# Carga Lateral
# Macizos y Pilonas
# (Estación 8, Carr. Hato Nuevo)

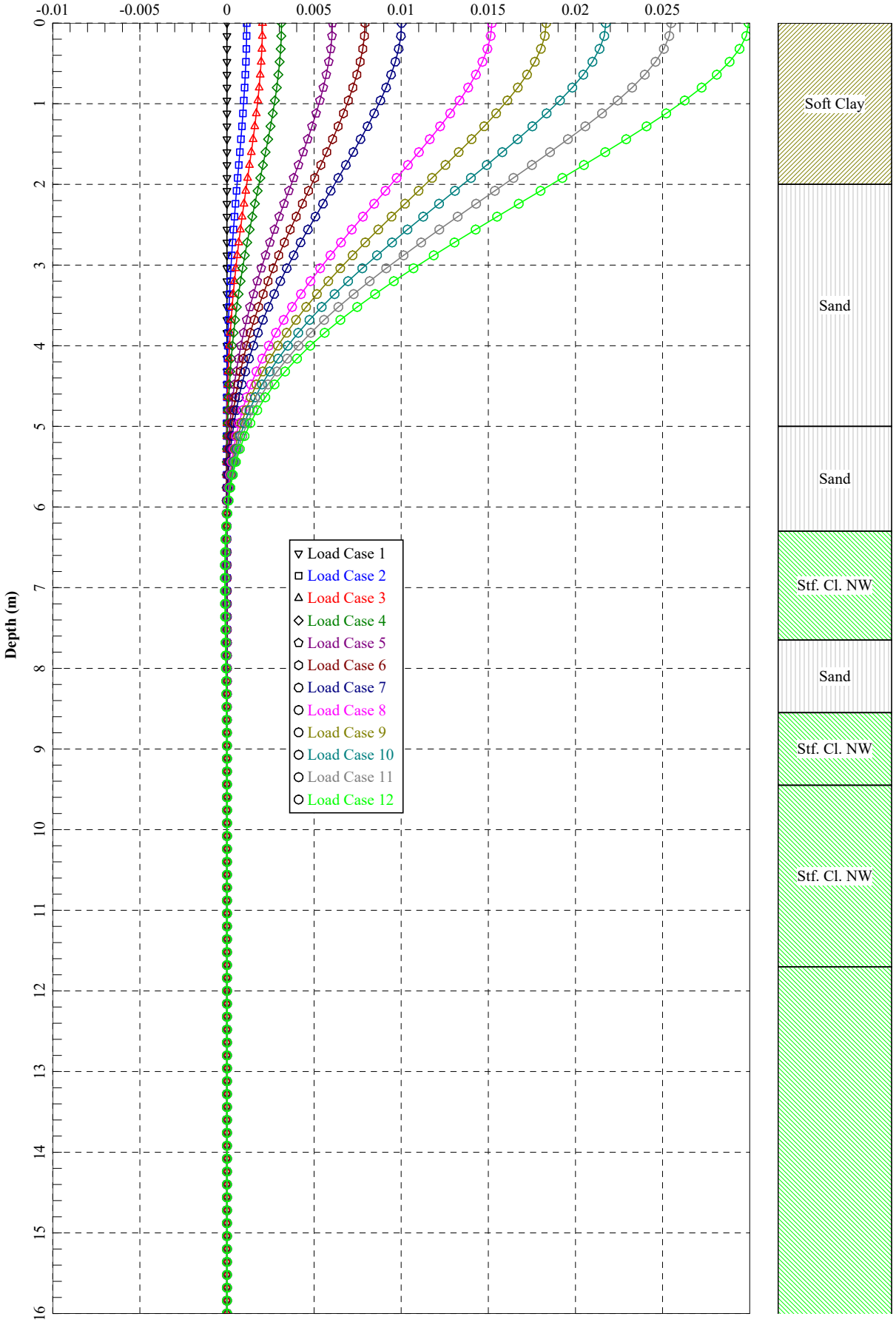
Carga Lateral
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.60m

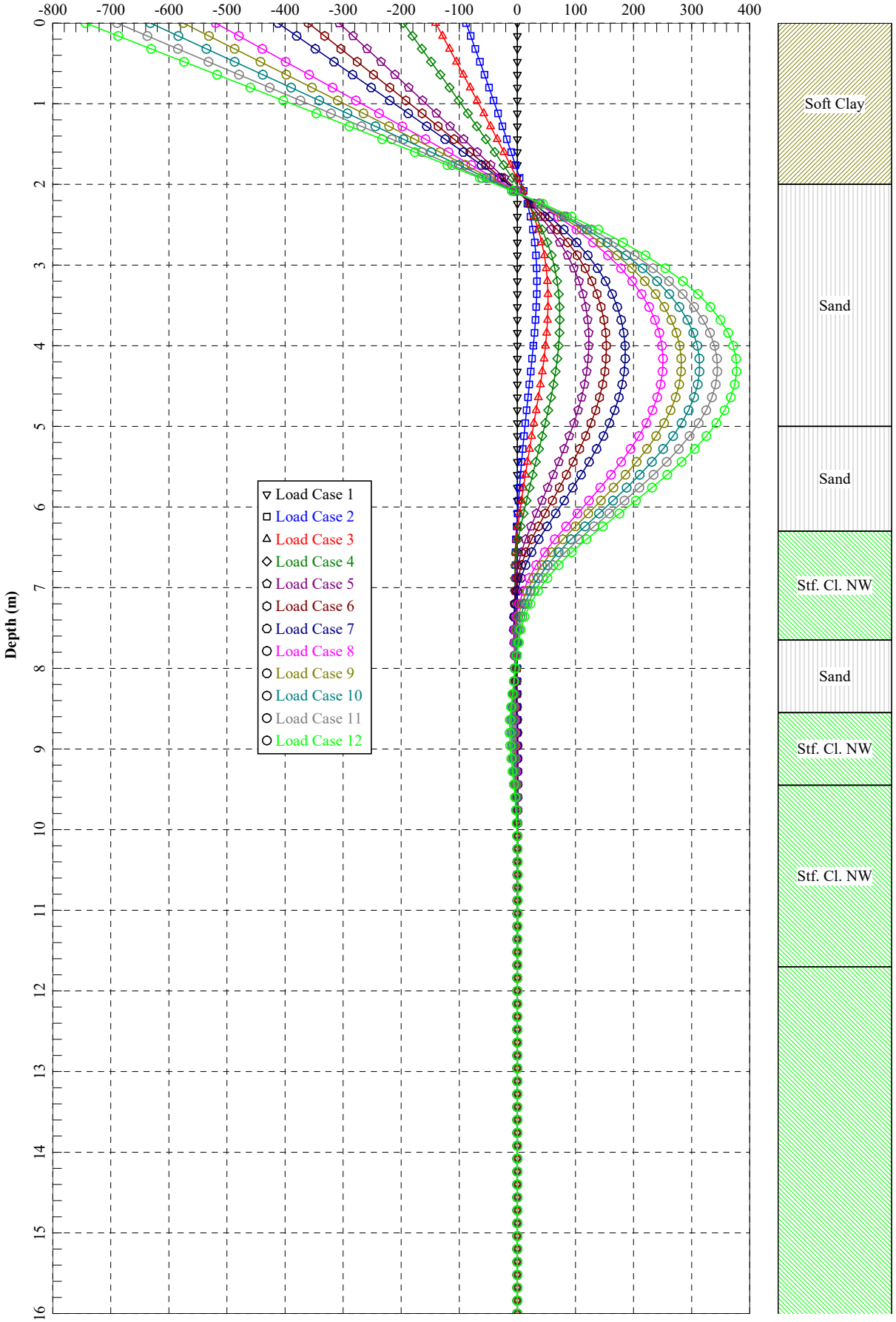

PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04
Lateral Load (kN)
0
20
40
60
80
100
120
140
160
180
200
220
240
260
280
300
320
340
360
380
400
Case 1
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
0.022
0.024
0.026
0.028
Pile-head Deflection (m)


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04
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

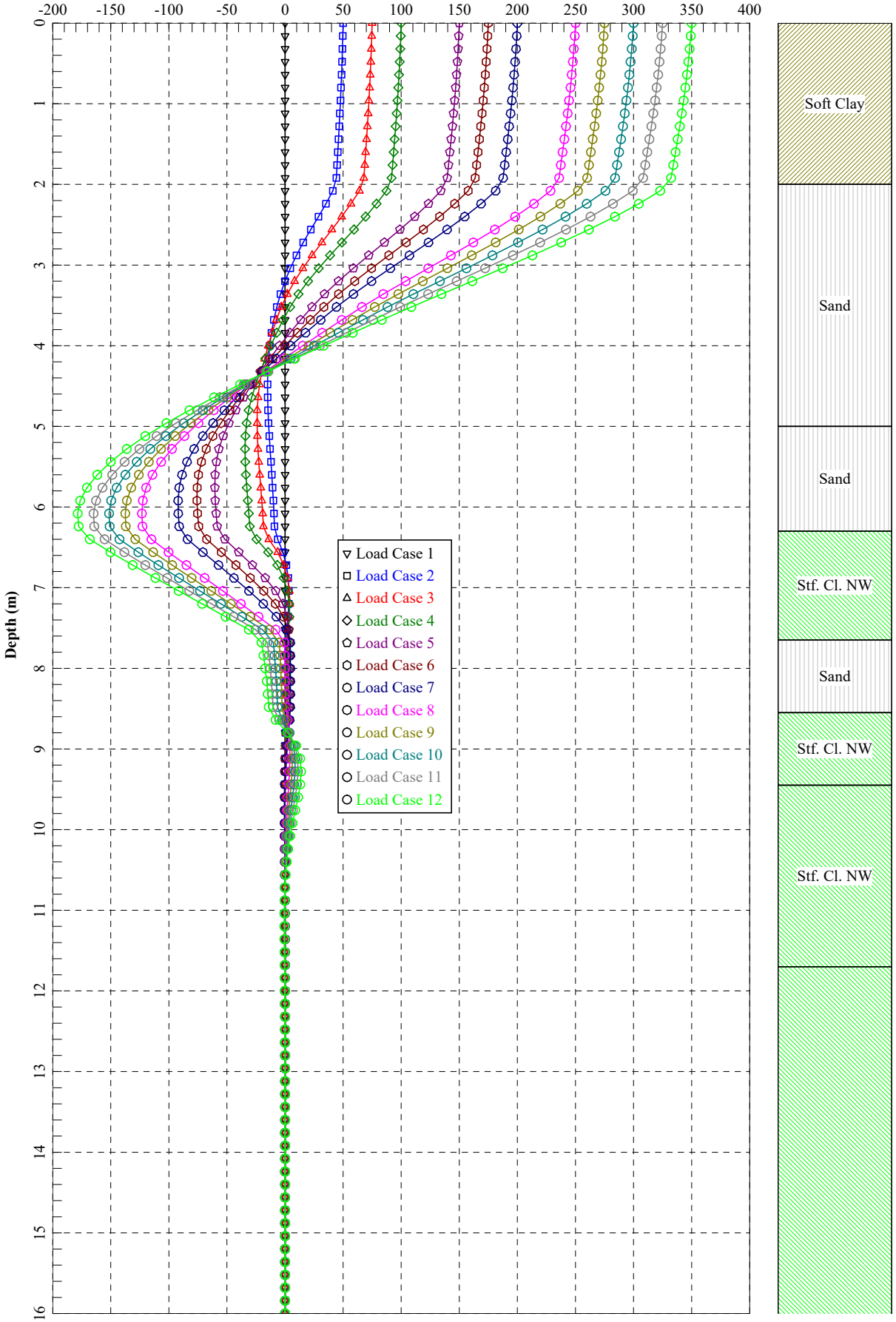
**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04**
**Lateral Pile Deflection (meters)**



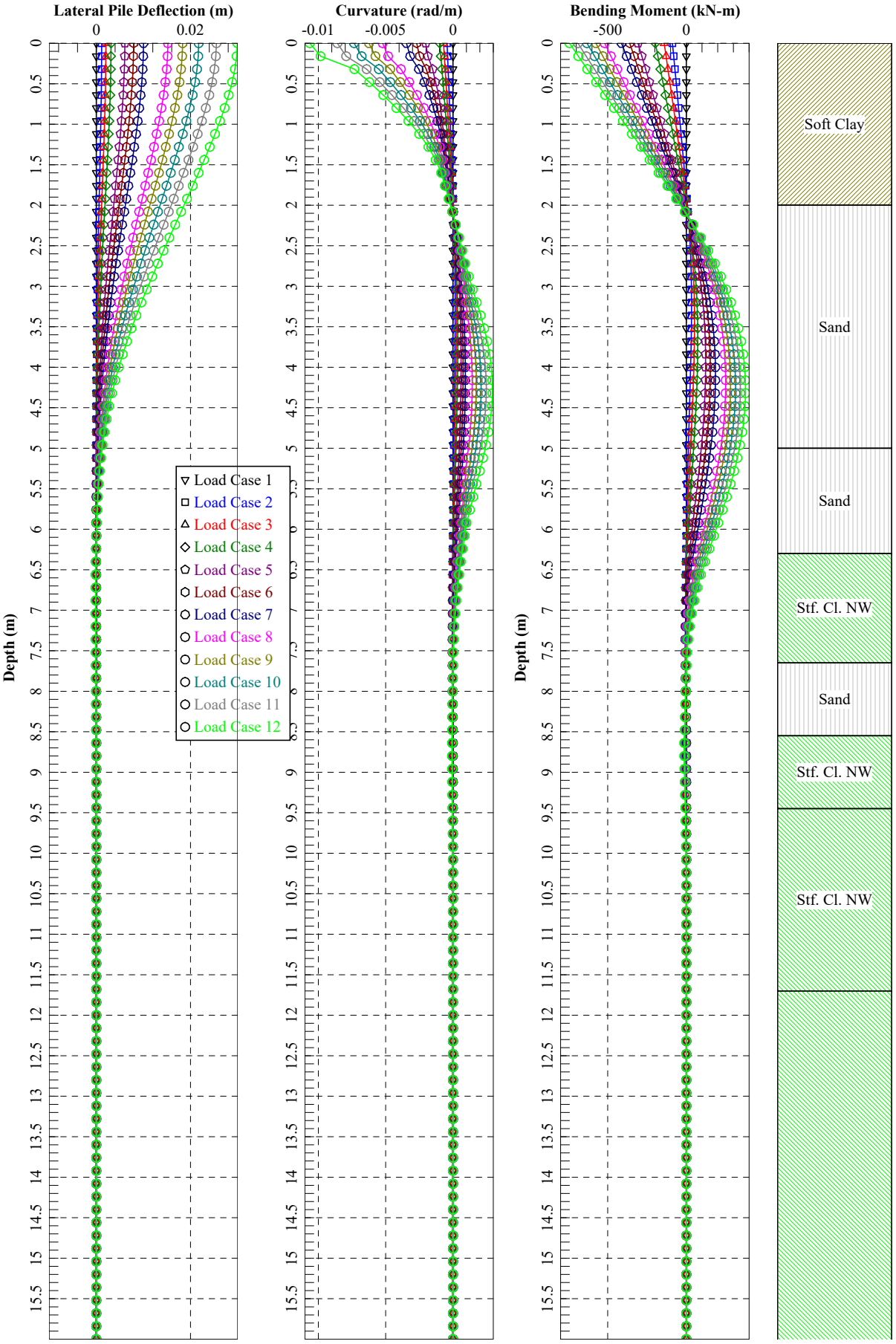
**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04**
**Bending Moment (kN-m)**



**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04**
**Shear Force (kN)**



**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.60 m. T8-04**



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

                  LPile for Windows(Beta), Version 2018-10.008

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

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1
1

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

Path to file locations:
\Users\Hipolito\Desktop\Cuarentena\Metro Cable\Metro Cable-Estacion
5\Calculos\Lateral\

Name of input data file:
Macizos y Pilonas Estacion 08, T8-04, D=0.6.lp10

Name of output report file:
Macizos y Pilonas Estacion 08, T8-04, D=0.6.lp10

Name of plot output file:
Macizos y Pilonas Estacion 08, T8-04, D=0.6.lp10

Name of runtime message file:
Macizos y Pilonas Estacion 08, T8-04, D=0.6.lp10



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

```
--------------------------------------------------------------------------------
-
               Date:  May 21, 2020                Time:  20:45:50


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

Project Name: PILOTES, E-06, LOS ALCARRIZOS. METRO CABLE


Job Number: 1


Client: JFORTUNA


Engineer: HS


Description: MACIZOS Y PILONAS (BH-01). 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 wide report formats




--------------------------------------------------------------------------------
-
                      Pile Structural Properties and Geometry
--------------------------------------------------------------------------------
-

Number of pile sections defined                        =            1
Total length of pile                                   =       16.000 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.

            Depth Below           Pile
Point        Pile Head          Diameter
               meters         millimeters
-----      -------------     -------------
  1             0.000            600.00
  2            16.000            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                                   =    16.000000 m
   Shaft Diameter                                      =     0.600000 m
```

```
   Shear capacity of section                          =   150.000000 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 8 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       =     2.000000 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 sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer          =     2.000000 m
   Distance from top of pile to bottom of layer       =     5.000000 m
   Effective unit weight at top of layer              =    15.000000 kN/m3
   Effective unit weight at bottom of layer           =    15.000000 kN/m3
   Friction angle at top of layer                     =    36.000000 deg.
   Friction angle at bottom of layer                  =    36.000000 deg.
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

```
   Distance from top of pile to top of layer           =     5.000000 m
   Distance from top of pile to bottom of layer        =     6.300000 m
   Effective unit weight at top of layer               =     5.000000 kN/m3
   Effective unit weight at bottom of layer            =     5.000000 kN/m3
   Friction angle at top of layer                      =    36.000000 deg.
   Friction angle at bottom of layer                   =    36.000000 deg.
   Subgrade k at top of layer                          =       0.0000 kN/m3
   Subgrade k at bottom of layer                       =       0.0000 kN/m3

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

Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer           =     6.300000 m
   Distance from top of pile to bottom of layer        =     7.650000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Undrained cohesion at top of layer                  =   140.000000 kPa
   Undrained cohesion at bottom of layer               =   140.000000 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 5 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer           =     7.650000 m
   Distance from top of pile to bottom of layer        =     8.550000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Friction angle at top of layer                      =    33.000000 deg.
   Friction angle at bottom of layer                   =    33.000000 deg.
   Subgrade k at top of layer                          =       0.0000 kN/m3
   Subgrade k at bottom of layer                       =       0.0000 kN/m3

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

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer           =     8.550000 m
   Distance from top of pile to bottom of layer        =     9.450000 m
   Effective unit weight at top of layer               =     7.000000 kN/m3
   Effective unit weight at bottom of layer            =     7.000000 kN/m3
   Undrained cohesion at top of layer                  =   115.000000 kPa
   Undrained cohesion at bottom of layer               =   115.000000 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 7 is stiff clay without free water

   Distance from top of pile to top of layer           =     9.450000 m
```

```
   Distance from top of pile to bottom of layer        =    11.700000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Undrained cohesion at top of layer                  =   140.000000 kPa
   Undrained cohesion at bottom of layer               =   140.000000 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 8 is stiff clay without free water

   Distance from top of pile to top of layer           =    11.700000 m
   Distance from top of pile to bottom of layer        =    30.000000 m
   Effective unit weight at top of layer               =    10.000000 kN/m3
   Effective unit weight at bottom of layer            =    10.000000 kN/m3
   Undrained cohesion at top of layer                  =   250.000000 kPa
   Undrained cohesion at bottom of layer               =   250.000000 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.

 (Depth of the lowest soil layer extends 14.000 m below the pile tip)



--------------------------------------------------------------------------------
-
                         Summary of Input Soil Properties
--------------------------------------------------------------------------------
-

Layer         Soil Type          Layer      Effective    Undrained    Angle of
      E50
Layer           Name             Depth       Unit Wt.    Cohesion     Friction
      or           kpy
 Num.     (p-y Curve Type)         m          kN/m3         kPa         deg.
      krm         kN/m3
-----   -------------------   ----------   ----------   ----------   ----------
  ----------   ----------
  1            Soft                 0.00      15.0000       5.0000       --
    default        --
               Clay               2.0000      15.0000       5.0000       --
    default        --
  2            Sand               2.0000      15.0000       --          36.0000
      --         default
          (Reese, et al.)         5.0000      15.0000       --          36.0000
      --         default
  3            Sand               5.0000       5.0000       --          36.0000
      --         default
          (Reese, et al.)         6.3000       5.0000       --          36.0000
      --         default
  4         Stiff Clay            6.3000       7.5000     140.0000       --
```

```
    default        --
          w/o Free Water          7.6500       7.5000     140.0000       --
    default        --
  5            Sand               7.6500       7.5000       --          33.0000
      --         default
          (Reese, et al.)         8.5500       7.5000       --          33.0000
      --         default
  6         Stiff Clay            8.5500       7.0000     115.0000       --
    default        --
          w/o Free Water          9.4500       7.0000     115.0000       --
    default        --
  7         Stiff Clay            9.4500       7.5000     140.0000       --
    default        --
          w/o Free Water         11.7000       7.5000     140.0000       --
    default        --
  8         Stiff Clay           11.7000      10.0000     250.0000       --
    default        --
          w/o Free Water         30.0000      10.0000     250.0000       --
    default        --


--------------------------------------------------------------------------------
-
                                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    Load         Condition                Condition            Axial Thrust
    Compute Top y
 No.    Type             1                        2                 Force, kN
   vs. Pile Length
-----   ----   --------------------   ------------------------
----------------   ---------------
   1     2     V =       0.0000 kN    S =       0.0000 m/m                2000.
         Yes
   2     2     V =    50.000000 kN    S =       0.0000 m/m                2000.
         Yes
   3     2     V =    75.000000 kN    S =       0.0000 m/m                2000.
         Yes
   4     2     V =   100.000000 kN    S =       0.0000 m/m                2000.
         Yes
   5     2     V =   150.000000 kN    S =       0.0000 m/m                2000.
```

```
        Yes
   6    2     V =   175.000000 kN    S =       0.0000 m/m                2000.
        Yes
   7    2     V =   200.000000 kN    S =       0.0000 m/m                2000.
        Yes
   8    2     V =   250.000000 kN    S =       0.0000 m/m                2000.
        Yes
   9    2     V =   275.000000 kN    S =       0.0000 m/m                2000.
        Yes
  10    2     V =   300.000000 kN    S =       0.0000 m/m                2000.
        Yes
  11    2     V =   325.000000 kN    S =       0.0000 m/m                2000.
        Yes
  12    2     V =   350.000000 kN    S =       0.0000 m/m                2000.
        Yes

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



-------------------------------------------------------------------------------
-
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
-------------------------------------------------------------------------------
-

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                                       =    16.000000 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          Bar Diam.      Bar Area          X              Y
    Number         meters         sq. m.         meters         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 | 2000.000 |

---
-
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 | 2000.000 | 756.435 | 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 | 756.435018 | 1300. | 491.682762 | 103784. |
| 1 | 0.70 | 756.435018 | 1400. | 529.504512 | 98101. |
| 1 | 0.75 | 756.435018 | 1500. | 567.326263 | 93199. |

---
-
Layering Correction Equivalent Depths of Soil & Rock Layers
---
-

| Layer | Top of Layer Below | Equivalent Top Depth Below | Same Layer Type As | Layer is Rock or | F0 Integral | F1 Integral |
|---|---|---|---|---|---|---|

| No. | Pile Head meters | Grnd Surf meters | Layer Above | is Below Rock Layer | for Layer kN | for Layer kN |
|---|---|---|---|---|---|---|
| 1 | 0.00 | 0.00 | N.A. | No | 0.00 | 39.9128 |
| 2 | 2.0000 | 0.8027 | No | No | 39.9128 | 1039. |
| 3 | 5.0000 | 3.8027 | Yes | No | 1079. | 1174. |
| 4 | 6.3000 | 5.0322 | No | No | 2253. | 936.8810 |
| 5 | 7.6500 | 6.7459 | No | No | 3190. | 1324. |
| 6 | 8.5500 | 9.4102 | No | No | 4513. | 559.1025 |
| 7 | 9.4500 | 8.9011 | Yes | No | 5072. | 1703. |
| 8 | 11.7000 | 7.3044 | Yes | No | 6775. | 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   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          19   1.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          20  0.799999999999999
   16.0000000000000       0.800000000000000
 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 =           2000. kN
```

| Pile Length meters | Pile Head Deflection meters | Maximum Moment kN-m | Maximum Shear kN |
|---|---|---|---|
| 16.00000 | 0.000000 | 0.000000 | 0.000000 |
| 15.20000 | 0.000000 | 0.000000 | 0.000000 |
| 14.40000 | 0.000000 | 0.000000 | 0.000000 |
| 13.60000 | 0.000000 | 0.000000 | 0.000000 |
| 12.80000 | 0.000000 | 0.000000 | 0.000000 |
| 12.00000 | 0.000000 | 0.000000 | 0.000000 |
| 11.20000 | 0.000000 | 0.000000 | 0.000000 |
| 10.40000 | 0.000000 | 0.000000 | 0.000000 |
| 9.60000 | 0.000000 | 0.000000 | 0.000000 |
| 8.80000 | 0.000000 | 0.000000 | 0.000000 |
| 8.00000 | 0.000000 | 0.000000 | 0.000000 |
| 7.20000 | 0.000000 | 0.000000 | 0.000000 |
| 6.40000 | 0.000000 | 0.000000 | 0.000000 |
| 5.60000 | 0.000000 | 0.000000 | 0.000000 |
| 4.80000 | 0.000000 | 0.000000 | 0.000000 |
| 4.00000 | 0.000000 | 0.000000 | 0.000000 |
| 3.20000 | 0.000000 | 0.000000 | 0.000000 |
| 2.40000 | 0.000000 | 0.000000 | 0.000000 |
| 1.60000 | 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                                =         50.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00113   -88.3484    50.0000       0.00       0.00    202255.
```

```
-1.5097   106.6382       0.00

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


Output Summary for Load Case No. 2:

Pile-head deflection             =     0.00113259 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =   -88.34839447 kN-m
Maximum shear force              =    50.00000000 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             =              8
Number of zero deflection points =              7

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
```

```
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          19   1.60000000000000
  16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =             50. kN
```

```
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00113259  -88.34839447   50.00000000
   15.20000    0.00115714  -89.07394662   50.00000000
   14.40000    0.00110702  -87.57336192   50.00000000
   13.60000    0.00111918  -87.96127887   50.00000000
   12.80000    0.00112417  -88.11980019   50.00000000
   12.00000    0.00112244  -88.06502128   50.00000000
   11.20000    0.00111336  -87.79823805   50.00000000
   10.40000    0.00114393  -88.71849344   50.00000000
    9.60000    0.00111647  -87.89854720   50.00000000
    8.80000    0.00112153  -88.05572816   50.00000000
    8.00000    0.00111266  -87.78777629   50.00000000
    7.20000    0.00112226  -88.10093490   50.00000000
    6.40000    0.00114098  -88.67258156   50.00000000
    5.60000    0.00117990  -89.34110468   50.00000000
    4.80000    0.00139230  -96.31071743   50.00000000
    4.00000    0.00167508 -111.04120655   50.00000000
    3.20000    0.00173620 -119.12901593   50.00000000
    2.40000    0.00933752  -98.39273625   49.99999998


--------------------------------------------------------------------------------
-
                 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                                =         75.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00204  -140.7397    75.0000       0.00       0.00    202112.
-1.8362    72.0818       0.00
```

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


Output Summary for Load Case No. 3:

Pile-head deflection             =     0.00203791 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -140.73968012 kN-m
Maximum shear force              =    75.00000000 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 =              7

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =             75. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
```

```
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00203791 -140.73968012   75.00000000
   15.20000    0.00208640 -141.95039423   75.00000000
   14.40000    0.00198761 -139.44135884   75.00000000
   13.60000    0.00201165 -140.08983432   75.00000000
   12.80000    0.00202223 -140.36661180   75.00000000
   12.00000    0.00201867 -140.26849969   75.00000000
   11.20000    0.00200039 -139.81945828   75.00000000
   10.40000    0.00206151 -141.36616276   75.00000000
    9.60000    0.00200661 -139.98387029   75.00000000
    8.80000    0.00201715 -140.25671923   75.00000000
    8.00000    0.00199954 -139.80822783   75.00000000
    7.20000    0.00201754 -140.31621546   75.00000000
    6.40000    0.00207897 -141.58496730   75.00000000
    5.60000    0.00226498 -145.10306472   75.00000000
    4.80000    0.00276736 -161.46968161   75.00000000
    4.00000    0.00309191 -182.65220044   75.00000000
    3.20000    0.00316692 -187.25983124   75.00000000


--------------------------------------------------------------------------------
-
                  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                                =        100.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00313  -196.4442   100.0000       0.00       0.00    201756.
-2.1183    54.1649       0.00

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

```
Output Summary for Load Case No. 4:

Pile-head deflection             =     0.00312861 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -196.44423948 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             =             13
Number of zero deflection points =              7

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            100. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00312861 -196.44423948  100.00000000
   15.20000    0.00319499 -198.01715773  100.00000000
   14.40000    0.00306011 -194.76967855  100.00000000
   13.60000    0.00309265 -195.60777032  100.00000000
   12.80000    0.00310711 -195.96813988  100.00000000
```

```
   12.00000    0.00310261 -195.84230395  100.00000000
   11.20000    0.00307727 -195.25965375  100.00000000
   10.40000    0.00316098 -197.26332851  100.00000000
    9.60000    0.00308583 -195.47245089  100.00000000
    8.80000    0.00310042 -195.82812634  100.00000000
    8.00000    0.00307635 -195.25214858  100.00000000
    7.20000    0.00310029 -195.90580328  100.00000000
    6.40000    0.00324137 -198.30692190  100.00000000
    5.60000    0.00366833 -206.87837088  100.00000000
    4.80000    0.00449703 -232.80440318  100.00000000
    4.00000    0.00492548 -257.93788568  100.00000000
    3.20000    0.00538075 -254.44797485  100.00000000


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-
                 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                                =        150.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00606  -306.9220   150.0000       0.00       0.00    152114.
-2.6399    34.8716       0.00

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


Output Summary for Load Case No. 5:

Pile-head deflection             =     0.00605620 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -306.92201211 kN-m
Maximum shear force              =   150.00000000 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 =              7

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
```

```
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            150. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00605620 -306.92201211  150.00000000
   15.20000    0.00616255 -309.12560997  150.00000000
   14.40000    0.00593398 -304.84110514  150.00000000
   13.60000    0.00598980 -305.89165208  150.00000000
   12.80000    0.00600743 -306.52062223  150.00000000
   12.00000    0.00599106 -306.54399562  150.00000000
   11.20000    0.00595443 -305.60786531  150.00000000
   10.40000    0.00609121 -308.36321443  150.00000000
    9.60000    0.00596278 -306.00859929  150.00000000
    8.80000    0.00598143 -306.60698123  150.00000000
    8.00000    0.00594170 -305.84243976  150.00000000
    7.20000    0.00598087 -306.66282476  150.00000000
```

```
    6.40000    0.00652875 -313.44936168  150.00000000
    5.60000    0.00791839 -335.33468807  150.00000000
    4.80000    0.01008465 -380.48334650  150.00000000
    4.00000    0.01096628 -413.76801778  150.00000000
    3.20000    0.01330362 -390.78068240  150.00000000


-----------------------------------------------------------------------------
-
                 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                                =        175.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00793  -359.9567   175.0000       0.00       0.00    133699.
-2.8875    29.1459       0.00

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


Output Summary for Load Case No. 6:

Pile-head deflection             =     0.00792566 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -359.95668135 kN-m
Maximum shear force              =   175.00000000 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 =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
```

```
before 180
after 180
i_Length           2   15.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           3   14.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           4   13.6000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           5   12.8000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
```

```
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            175. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00792566 -359.95668135  175.00000000
   15.20000    0.00806292 -362.24461678  175.00000000
   14.40000    0.00776348 -357.98750023  175.00000000
   13.60000    0.00782205 -359.36516099  175.00000000
   12.80000    0.00785816 -359.69084692  175.00000000
   12.00000    0.00783883 -359.74258033  175.00000000
   11.20000    0.00778592 -358.84361035  175.00000000
   10.40000    0.00795644 -361.84458505  175.00000000
    9.60000    0.00779503 -359.32087247  175.00000000
    8.80000    0.00782490 -359.82031829  175.00000000
    8.00000    0.00776845 -359.17593717  175.00000000
    7.20000    0.00782044 -360.02494738  175.00000000
    6.40000    0.00877057 -370.35431678  175.00000000
    5.60000    0.01090644 -400.25446675  175.00000000
    4.80000    0.01408291 -456.58272476  175.00000000
    4.00000    0.01525733 -494.57415307  175.00000000
    3.20000    0.01920594 -460.13996441  175.00000000
```

```
-----------------------------------------------------------------------------
-
                 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                                =        200.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.01003  -412.0945   200.0000       0.00       0.00    119494.
-3.1228    24.9192       0.00

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


Output Summary for Load Case No. 7:

Pile-head deflection             =     0.01002531 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -412.09454998 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             =             20
Number of zero deflection points =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
```

```
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           4   13.6000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           5   12.8000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
before 180
```

```
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180
```

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

Boundary Condition Type 2, Shear and Slope

Shear      =            200. kN
Slope      =         0.00000
Axial Load =           2000. kN
```

| Pile Length meters | Pile Head Deflection meters | Maximum Moment kN-m | Maximum Shear kN |
|---|---|---|---|
| 16.00000 | 0.01002531 | -412.09454998 | 200.00000000 |
| 15.20000 | 0.01018959 | -414.54011666 | 200.00000000 |
| 14.40000 | 0.00983016 | -410.03720420 | 200.00000000 |
| 13.60000 | 0.00991305 | -411.17606067 | 200.00000000 |
| 12.80000 | 0.00994095 | -411.91334106 | 200.00000000 |
| 12.00000 | 0.00992601 | -411.76211483 | 200.00000000 |
| 11.20000 | 0.00985172 | -411.07165431 | 200.00000000 |
| 10.40000 | 0.01006765 | -413.99658599 | 200.00000000 |
| 9.60000 | 0.00986704 | -411.47277771 | 200.00000000 |
| 8.80000 | 0.00989595 | -412.20710374 | 200.00000000 |
| 8.00000 | 0.00983467 | -411.34833356 | 200.00000000 |
| 7.20000 | 0.00992409 | -412.42621706 | 200.00000000 |
| 6.40000 | 0.01140550 | -427.09789892 | 200.00000000 |
| 5.60000 | 0.01448365 | -465.96438662 | 200.00000000 |
| 4.80000 | 0.01888680 | -534.53707341 | 200.00000000 |
| 4.00000 | 0.02036355 | -577.45356488 | 200.00000000 |
| 3.20000 | 0.02577996 | -530.11537912 | 200.00000001 |

```
-------------------------------------------------------------------------------
-
                 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                                =        250.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.01520  -519.4601   250.0000       0.00       0.00     99519.
-3.5877    18.8791       0.00

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


Output Summary for Load Case No. 8:

Pile-head deflection             =     0.01520285 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -519.46006571 kN-m
Maximum shear force              =   250.00000000 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 =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
```

```
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope
```

```
Shear      =            250. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.01520285 -519.46006571  250.00000000
   15.20000    0.01544734 -522.74701625  250.00000000
   14.40000    0.01491408 -516.58249021  250.00000000
   13.60000    0.01501777 -518.21756820  250.00000000
   12.80000    0.01508311 -519.06533260  250.00000000
   12.00000    0.01504570 -519.04359867  250.00000000
   11.20000    0.01494261 -517.95755055  250.00000000
   10.40000    0.01526992 -521.81767956  250.00000000
    9.60000    0.01496136 -518.42751001  250.00000000
    8.80000    0.01501233 -519.16419260  250.00000000
    8.00000    0.01490618 -518.26211738  250.00000000
    7.20000    0.01517611 -520.08620256  250.00000000
    6.40000    0.01781594 -541.25129967  250.00000000
    5.60000    0.02328519 -599.85659216  250.00000000


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

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

Shear force at pile head                                =        275.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.01832  -575.2109   275.0000       0.00       0.00     92226.
-3.8180    16.6700       0.00

* This analysis computed pile response using nonlinear moment-curvature rela-
  tionships. Values of total stress due to combined axial and bending stresses
  are computed only for elastic sections only and do not equal the actual
```

```
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 9:

Pile-head deflection             =     0.01832294 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -575.21092138 kN-m
Maximum shear force              =   275.00000000 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             =             21
Number of zero deflection points =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            275. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.01832294 -575.21092138  275.00000000
   15.20000    0.01861449 -578.67000199  275.00000000
   14.40000    0.01795586 -572.03929359  275.00000000
   13.60000    0.01810937 -573.83366176  275.00000000
   12.80000    0.01816878 -574.60768942  275.00000000
   12.00000    0.01813760 -574.65674304  275.00000000
   11.20000    0.01800894 -573.44442104  275.00000000
   10.40000    0.01839497 -577.70442104  275.00000000
    9.60000    0.01803404 -574.01596466  275.00000000
    8.80000    0.01809581 -574.89501791  275.00000000
    8.00000    0.01797030 -573.66394043  275.00000000
    7.20000    0.01836338 -576.16672913  275.00000000
    6.40000    0.02164264 -600.44832542  275.00000000
```

```
    5.60000    0.02834701 -666.97898952  275.00000000


-----------------------------------------------------------------------------
-
                  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                                =        300.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.02175  -631.7545   300.0000       0.00       0.00     86008.
-4.0423    14.8716       0.00

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


Output Summary for Load Case No. 10:

Pile-head deflection             =     0.02174506 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -631.75448114 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             =             19
Number of zero deflection points =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
```

```
before 180
after 180
i_Length           3   14.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           4   13.6000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           5   12.8000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
exit 180


--------------------------------------------------------------------------------
-
```

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

---

Boundary Condition Type 2, Shear and Slope

Shear = 300. kN
Slope = 0.00000
Axial Load = 2000. kN

| Pile Length meters | Pile Head Deflection meters | Maximum Moment kN-m | Maximum Shear kN |
|---|---|---|---|
| 16.00000 | 0.02174506 | -631.75448114 | 300.00000000 |
| 15.20000 | 0.02209354 | -635.33815976 | 300.00000000 |
| 14.40000 | 0.02134535 | -628.30172765 | 300.00000000 |
| 13.60000 | 0.02150725 | -630.32622193 | 300.00000000 |
| 12.80000 | 0.02158154 | -631.40022443 | 300.00000000 |
| 12.00000 | 0.02154509 | -631.10143829 | 300.00000000 |
| 11.20000 | 0.02139266 | -629.81148037 | 300.00000000 |
| 10.40000 | 0.02184180 | -634.45321938 | 300.00000000 |
| 9.60000 | 0.02142291 | -630.54697689 | 300.00000000 |
| 8.80000 | 0.02149470 | -631.50867654 | 300.00000000 |
| 8.00000 | 0.02135021 | -630.15509026 | 300.00000000 |
| 7.20000 | 0.02189268 | -632.98723255 | 300.00000000 |
| 6.40000 | 0.02579590 | -659.89939031 | 300.00000000 |

---

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 = 325.0 kN
Rotation of pile head = 0.000E+00 radians
Axial load at pile head = 2000.0 kN

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

| Depth X meters | Deflect. y meters | Bending Moment kN-m | Shear Force kN | Slope S radians | Total Stress kPa* | Bending Stiffness kN-m^2 | Soil Res. p kN/m | Soil Spr. Es*h kN/m | Distrib. Lat. Load kN/m |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.02550 | -689.1422 | 325.0000 | 0.00 | 0.00 | 80262. | | | |

```
-4.2626    13.3744       0.00

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


Output Summary for Load Case No. 11:

Pile-head deflection             =     0.02549675 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -689.14215979 kN-m
Maximum shear force              =   325.00000000 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 =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
```

```
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            325. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.02549675 -689.14215979  325.00000000
   15.20000    0.02590819 -692.87104176  325.00000000
   14.40000    0.02502774 -685.35181754  325.00000000
   13.60000    0.02521830 -687.39089580  325.00000000
   12.80000    0.02529999 -688.23807005  325.00000000
   12.00000    0.02525398 -688.32989369  325.00000000
   11.20000    0.02507577 -686.90601472  325.00000000
   10.40000    0.02559623 -691.88351878  325.00000000
    9.60000    0.02511431 -687.73502998  325.00000000
    8.80000    0.02520229 -688.60583133  325.00000000
    8.00000    0.02503655 -687.21010225  325.00000000
    7.20000    0.02573706 -690.48757087  325.00000000


-------------------------------------------------------------------------------
-
```

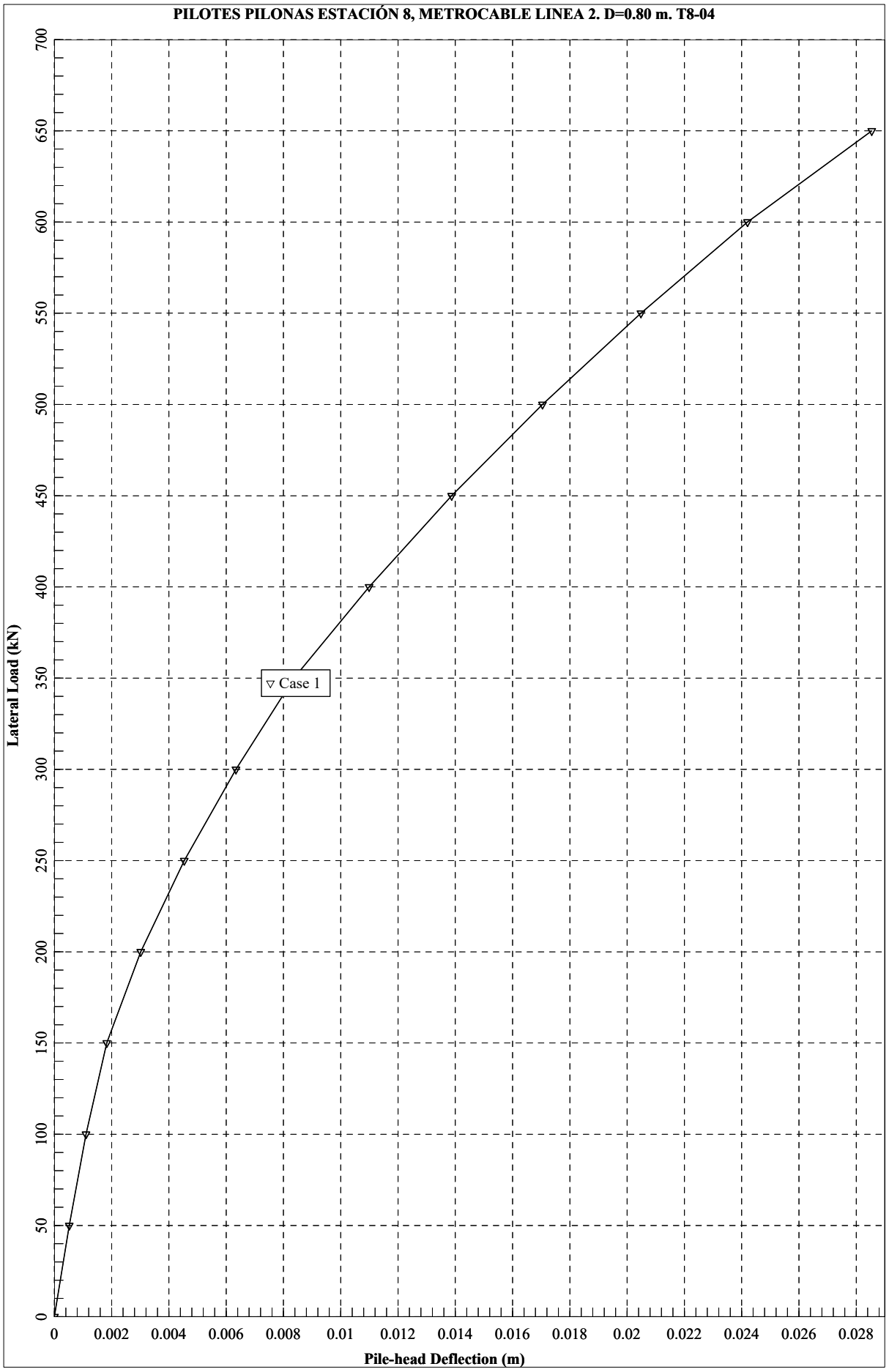
```
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 12
-------------------------------------------------------------------------------
-

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

Shear force at pile head                                =        350.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.02994  -743.4335   350.0000       0.00       0.00     69863.
-4.4971    12.0157       0.00

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


Output Summary for Load Case No. 12:

Pile-head deflection             =     0.02994154 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -743.43346079 kN-m
Maximum shear force              =   350.00000000 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             =             31
Number of zero deflection points =              6

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


-------------------------------------------------------------------------------
```

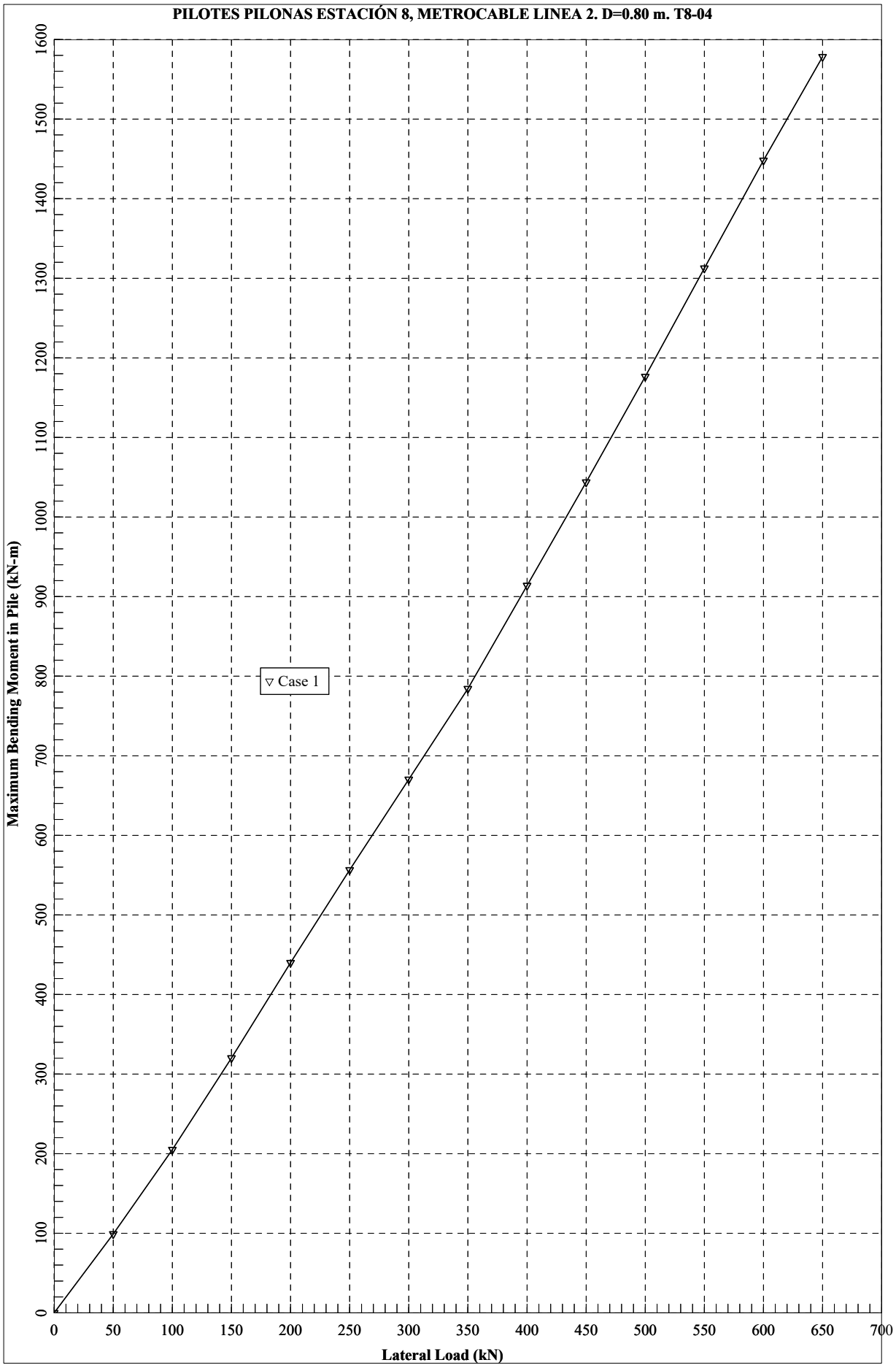
```
-
            Pile-head Deflection vs. Pile Length for Load Case 12
-------------------------------------------------------------------------------
-

Boundary Condition Type 2, Shear and Slope

Shear      =            350. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.02994154 -743.43346079  350.00000000

-------------------------------------------------------------------------------
-
            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 Load                Load                  Axial    Pile-head  Pile-head
Max Shear Max Moment
Case Type   Pile-head    Type     Pile-head   Loading  Deflection  Rotation
in Pile    in Pile
 No.  1      Load 1       2        Load 2       kN       meters     radians
 kN        kN-m
---- ----- ---------- ---------- ---------- ---------- ---------- ----------
---------- ----------
  1  V, kN       0.00   S, rad         0.00      2000.       0.00       0.00
   0.00       0.00
  2  V, kN    50.0000   S, rad         0.00      2000.    0.00113       0.00
50.0000   -88.3484
  3  V, kN    75.0000   S, rad         0.00      2000.    0.00204       0.00
75.0000  -140.7397
  4  V, kN   100.0000   S, rad         0.00      2000.    0.00313       0.00
100.0000  -196.4442
  5  V, kN   150.0000   S, rad         0.00      2000.    0.00606       0.00
150.0000  -306.9220
  6  V, kN   175.0000   S, rad         0.00      2000.    0.00793       0.00
175.0000  -359.9567
  7  V, kN   200.0000   S, rad         0.00      2000.    0.01003       0.00
```

```
200.0000  -412.0945
  8  V, kN   250.0000   S, rad         0.00      2000.    0.01520       0.00
250.0000  -519.4601
  9  V, kN   275.0000   S, rad         0.00      2000.    0.01832       0.00
275.0000  -575.2109
 10  V, kN   300.0000   S, rad         0.00      2000.    0.02175       0.00
300.0000  -631.7545
 11  V, kN   325.0000   S, rad         0.00      2000.    0.02550       0.00
325.0000  -689.1422
 12  V, kN   350.0000   S, rad         0.00      2000.    0.02994       0.00
350.0000  -743.4335


Maximum pile-head deflection = 0.0299415414 meters
Maximum pile-head rotation   = -0.0000000000 radians = -0.000000 deg.

The analysis ended normally.
```

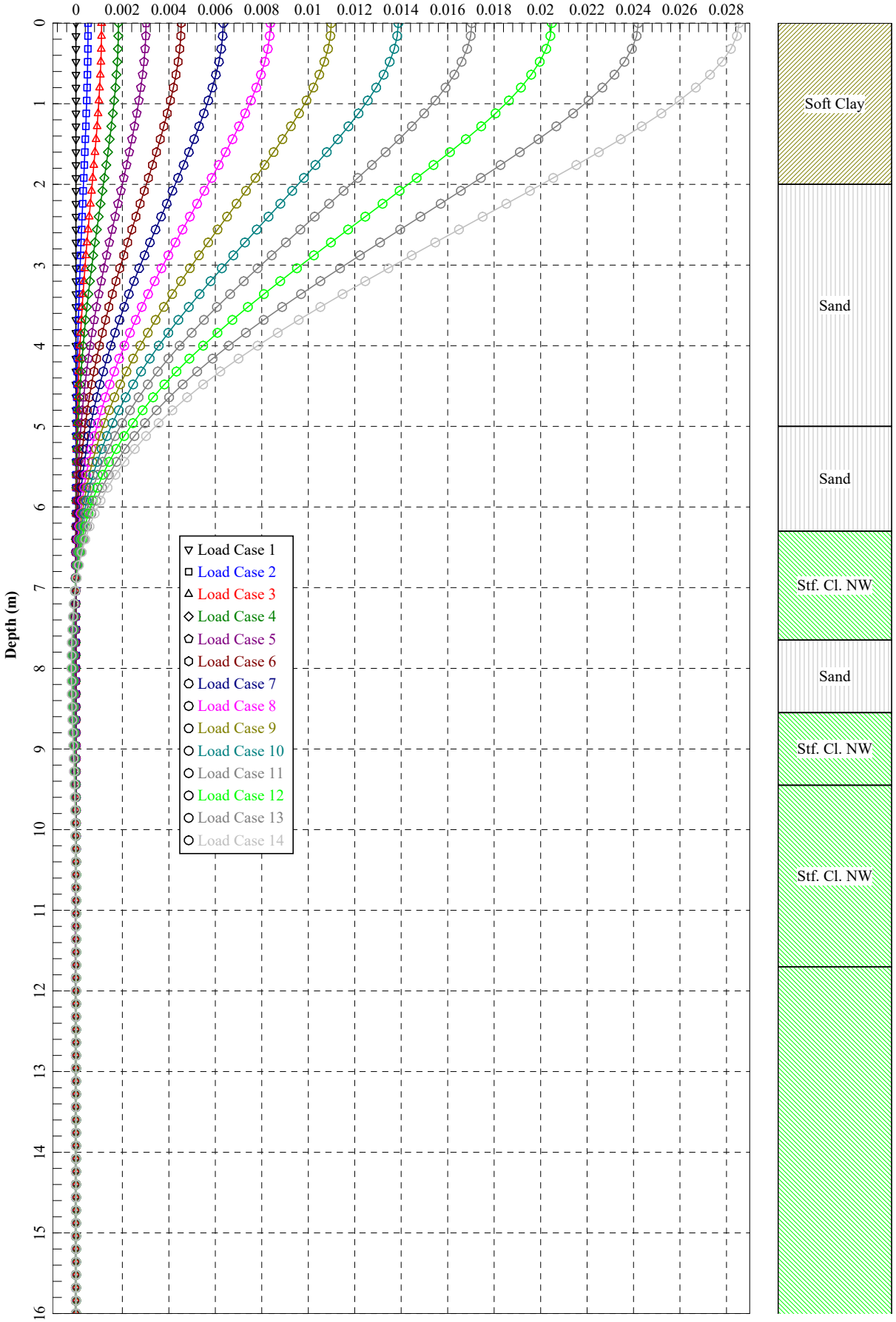
Carga Lateral
Macizos y Pilonas
(Estación 8, Carr. Hato Nuevo)

# PILOTE D=0.80m

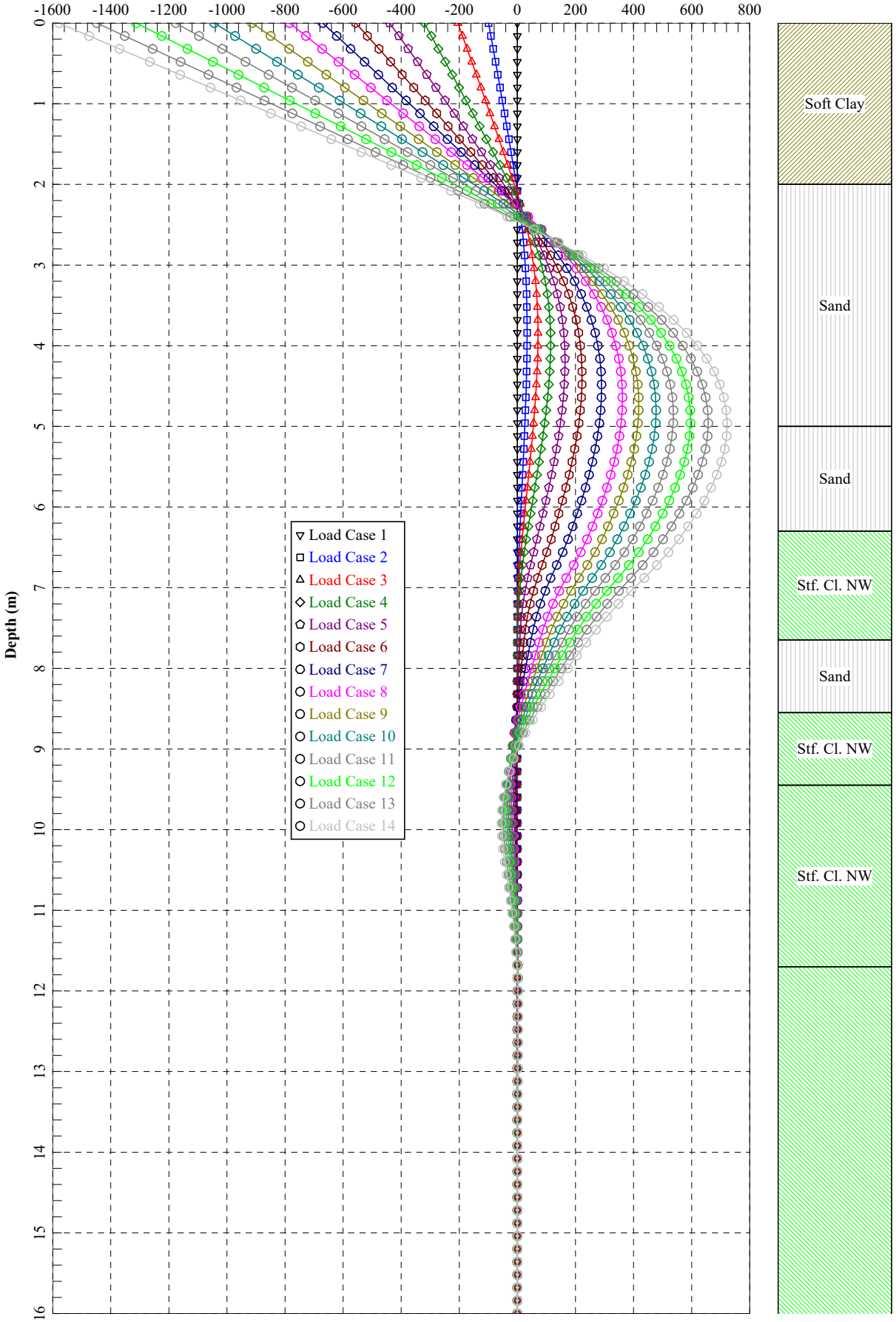

PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04
Lateral Load (kN)
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Case 1
0
0.002
0.004
0.006
0.008
0.01
0.012
0.014
0.016
0.018
0.02
0.022
0.024
0.026
0.028
Pile-head Deflection (m)


PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04
Maximum Bending Moment in Pile (kN-m)
0
100
200
300
400
500
600
700
800
900
1000
1100
1200
1300
1400
1500
1600
Case 1
0
50
100
150
200
250
300
350
400
450
500
550
600
650
700
Lateral Load (kN)

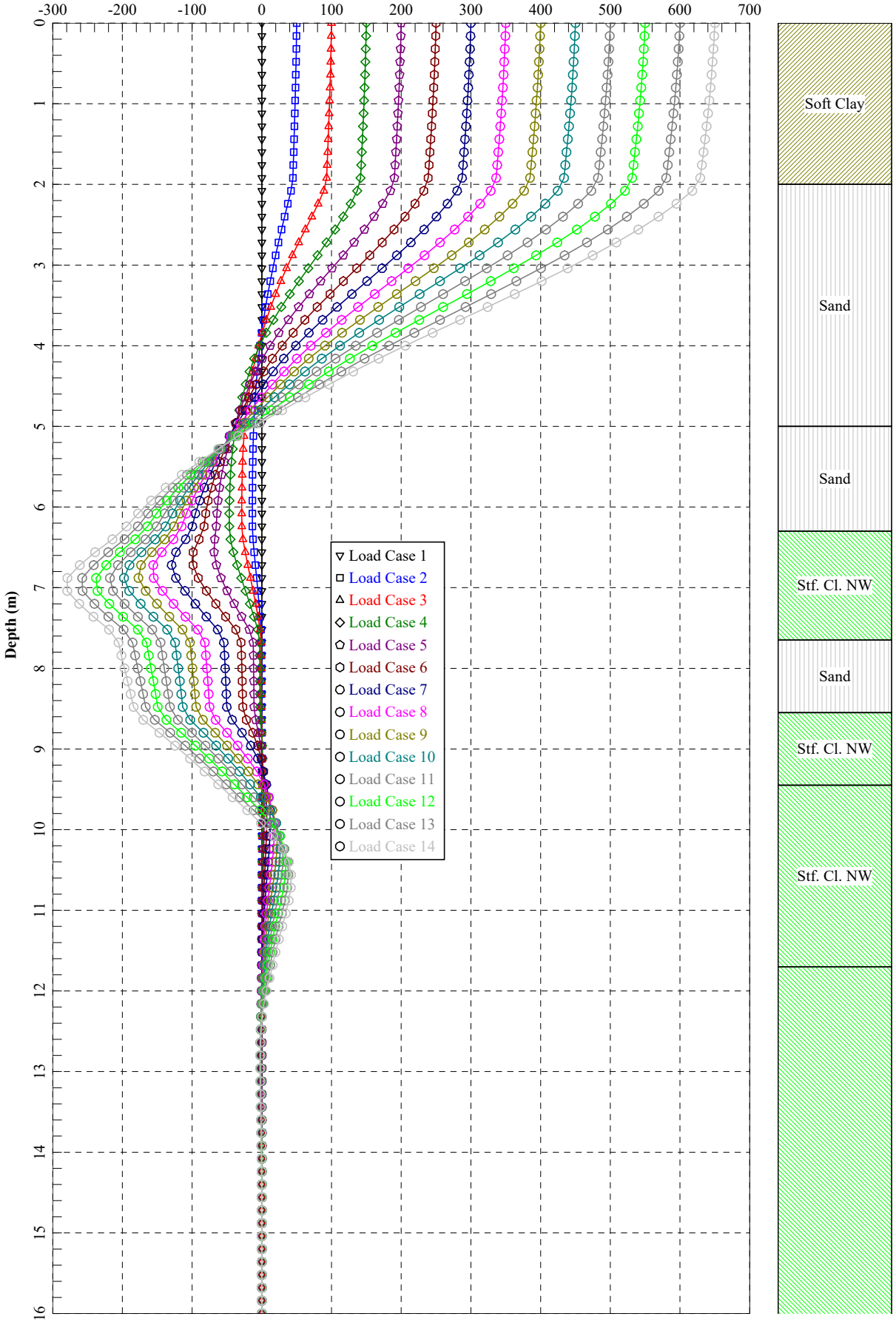
**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04**
**Lateral Pile Deflection (meters)**



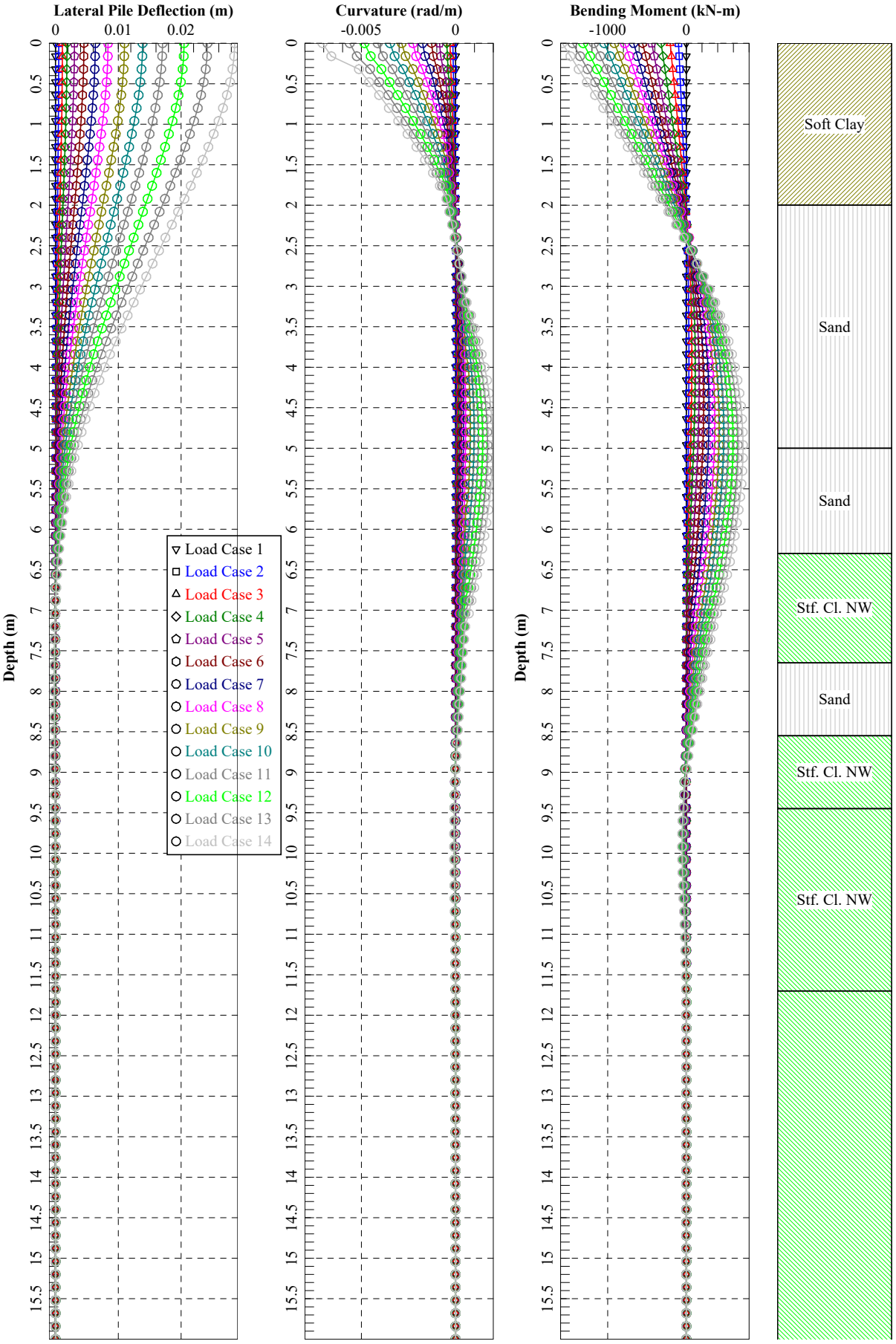
**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04**
**Bending Moment (kN-m)**



**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04**
**Shear Force (kN)**



**PILOTES PILONAS ESTACIÓN 8, METROCABLE LINEA 2. D=0.80 m. T8-04**



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

                  LPile for Windows(Beta), Version 2018-10.008

                 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:
\Users\Hipolito\Desktop\Cuarentena\Metro Cable\Metro Cable, Estación
E-8\Calculos\Lateral\

Name of input data file:
Macizos y Pilonas Estacion 08, T8-04, D=0.8.lp10

Name of output report file:
Macizos y Pilonas Estacion 08, T8-04, D=0.8.lp10

Name of plot output file:
Macizos y Pilonas Estacion 08, T8-04, D=0.8.lp10

Name of runtime message file:
Macizos y Pilonas Estacion 08, T8-04, D=0.8.lp10



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

```
--------------------------------------------------------------------------------
-
               Date:  May 21, 2020                Time:  20:35:15


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

Project Name: PILOTES, E-06, LOS ALCARRIZOS. METRO CABLE


Job Number: 1


Client: JFORTUNA


Engineer: HS


Description: MACIZOS Y PILONAS (BH-01). 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 wide report formats




--------------------------------------------------------------------------------
-
                      Pile Structural Properties and Geometry
--------------------------------------------------------------------------------
-

Number of pile sections defined                        =            1
Total length of pile                                   =       16.000 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.

            Depth Below           Pile
Point        Pile Head          Diameter
               meters         millimeters
-----      -------------     -------------
  1             0.000            800.00
  2            16.000            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                                   =    16.000000 m
   Shaft Diameter                                      =     0.800000 m
```

```
   Shear capacity of section                          =   150.000000 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 8 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       =     2.000000 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 sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer          =     2.000000 m
   Distance from top of pile to bottom of layer       =     5.000000 m
   Effective unit weight at top of layer              =    15.000000 kN/m3
   Effective unit weight at bottom of layer           =    15.000000 kN/m3
   Friction angle at top of layer                     =    36.000000 deg.
   Friction angle at bottom of layer                  =    36.000000 deg.
   Subgrade k at top of layer                         =       0.0000 kN/m3
   Subgrade k at bottom of layer                      =       0.0000 kN/m3

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

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

```
   Distance from top of pile to top of layer           =     5.000000 m
   Distance from top of pile to bottom of layer        =     6.300000 m
   Effective unit weight at top of layer               =     5.000000 kN/m3
   Effective unit weight at bottom of layer            =     5.000000 kN/m3
   Friction angle at top of layer                      =    36.000000 deg.
   Friction angle at bottom of layer                   =    36.000000 deg.
   Subgrade k at top of layer                          =       0.0000 kN/m3
   Subgrade k at bottom of layer                       =       0.0000 kN/m3

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

Layer 4 is stiff clay without free water

   Distance from top of pile to top of layer           =     6.300000 m
   Distance from top of pile to bottom of layer        =     7.650000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Undrained cohesion at top of layer                  =   140.000000 kPa
   Undrained cohesion at bottom of layer               =   140.000000 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 5 is sand, p-y criteria by Reese et al., 1974

   Distance from top of pile to top of layer           =     7.650000 m
   Distance from top of pile to bottom of layer        =     8.550000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Friction angle at top of layer                      =    33.000000 deg.
   Friction angle at bottom of layer                   =    33.000000 deg.
   Subgrade k at top of layer                          =       0.0000 kN/m3
   Subgrade k at bottom of layer                       =       0.0000 kN/m3

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

Layer 6 is stiff clay without free water

   Distance from top of pile to top of layer           =     8.550000 m
   Distance from top of pile to bottom of layer        =     9.450000 m
   Effective unit weight at top of layer               =     7.000000 kN/m3
   Effective unit weight at bottom of layer            =     7.000000 kN/m3
   Undrained cohesion at top of layer                  =   115.000000 kPa
   Undrained cohesion at bottom of layer               =   115.000000 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 7 is stiff clay without free water

   Distance from top of pile to top of layer           =     9.450000 m
```

```
   Distance from top of pile to bottom of layer        =    11.700000 m
   Effective unit weight at top of layer               =     7.500000 kN/m3
   Effective unit weight at bottom of layer            =     7.500000 kN/m3
   Undrained cohesion at top of layer                  =   140.000000 kPa
   Undrained cohesion at bottom of layer               =   140.000000 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 8 is stiff clay without free water

   Distance from top of pile to top of layer           =    11.700000 m
   Distance from top of pile to bottom of layer        =    30.000000 m
   Effective unit weight at top of layer               =    10.000000 kN/m3
   Effective unit weight at bottom of layer            =    10.000000 kN/m3
   Undrained cohesion at top of layer                  =   250.000000 kPa
   Undrained cohesion at bottom of layer               =   250.000000 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.

 (Depth of the lowest soil layer extends 14.000 m below the pile tip)



--------------------------------------------------------------------------------
-
                         Summary of Input Soil Properties
--------------------------------------------------------------------------------
-

Layer         Soil Type          Layer      Effective    Undrained    Angle of
      E50
Layer           Name             Depth       Unit Wt.    Cohesion     Friction
      or           kpy
 Num.     (p-y Curve Type)         m          kN/m3         kPa         deg.
      krm         kN/m3
-----   -------------------   ----------   ----------   ----------   ----------
  ----------   ----------
  1            Soft                 0.00      15.0000       5.0000       --
    default        --
               Clay               2.0000      15.0000       5.0000       --
    default        --
  2            Sand               2.0000      15.0000       --          36.0000
      --         default
          (Reese, et al.)         5.0000      15.0000       --          36.0000
      --         default
  3            Sand               5.0000       5.0000       --          36.0000
      --         default
          (Reese, et al.)         6.3000       5.0000       --          36.0000
      --         default
  4         Stiff Clay            6.3000       7.5000     140.0000       --
```

```
    default        --
          w/o Free Water          7.6500       7.5000     140.0000       --
    default        --
  5            Sand               7.6500       7.5000       --          33.0000
      --         default
          (Reese, et al.)         8.5500       7.5000       --          33.0000
      --         default
  6         Stiff Clay            8.5500       7.0000     115.0000       --
    default        --
          w/o Free Water          9.4500       7.0000     115.0000       --
    default        --
  7         Stiff Clay            9.4500       7.5000     140.0000       --
    default        --
          w/o Free Water         11.7000       7.5000     140.0000       --
    default        --
  8         Stiff Clay           11.7000      10.0000     250.0000       --
    default        --
          w/o Free Water         30.0000      10.0000     250.0000       --
    default        --


-------------------------------------------------------------------------------
-
                                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 = 14

Load    Load         Condition                Condition            Axial Thrust
    Compute Top y
 No.    Type             1                        2                 Force, kN
   vs. Pile Length
-----   ----   --------------------   ------------------------
----------------   ---------------
   1     2     V =       0.0000 kN    S =       0.0000 m/m                2000.
         Yes
   2     2     V =    50.000000 kN    S =       0.0000 m/m                2000.
         Yes
   3     2     V =   100.000000 kN    S =       0.0000 m/m                2000.
         Yes
   4     2     V =   150.000000 kN    S =       0.0000 m/m                2000.
         Yes
   5     2     V =   200.000000 kN    S =       0.0000 m/m                2000.
```

```
        Yes
   6    2     V =   250.000000 kN    S =       0.0000 m/m                2000.
        Yes
   7    2     V =   300.000000 kN    S =       0.0000 m/m                2000.
        Yes
   8    2     V =   350.000000 kN    S =       0.0000 m/m                2000.
        Yes
   9    2     V =   400.000000 kN    S =       0.0000 m/m                2000.
        Yes
  10    2     V =   450.000000 kN    S =       0.0000 m/m                2000.
        Yes
  11    2     V =   500.000000 kN    S =       0.0000 m/m                2000.
        Yes
  12    2     V =   550.000000 kN    S =       0.0000 m/m                2000.
        Yes
  13    2     V =   600.000000 kN    S =       0.0000 m/m                2000.
        Yes
  14    2     V =   650.000000 kN    S =       0.0000 m/m                2000.
        Yes

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



--------------------------------------------------------------------------------
-
     Computations of Nominal Moment Capacity and Nonlinear Bending Stiffness
--------------------------------------------------------------------------------
-

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                                    =    16.000000 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 | 2000.000 |

---
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 | 2000.000 | 1710.464 | 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 | 1710. | 1300. | 1112. | 291373. |
| 1 | 0.70 | 1710. | 1400. | 1197. | 282148. |

```
   1       0.75             1710.         1500.         1283.       274067.


-------------------------------------------------------------------------------
-
           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 | 52.1381 |
| 2 | 2.0000 | 0.8097 | No | No | 52.1381 | 1222. |
| 3 | 5.0000 | 3.8098 | Yes | No | 1274. | 1228. |
| 4 | 6.3000 | 4.7495 | No | No | 2502. | 1039. |
| 5 | 7.6500 | 6.8359 | No | No | 3541. | 1397. |
| 6 | 8.5500 | 8.7223 | No | No | 4938. | 745.4700 |
| 7 | 9.4500 | 8.4788 | Yes | No | 5684. | 2270. |
| 8 | 11.7000 | 7.3138 | Yes | No | 7954. | 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   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
```

```
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          19   1.60000000000000
  16.0000000000000       0.800000000000000
before 180
```

```
 after 180
 i_Length          20  0.799999999999999
   16.0000000000000       0.800000000000000
 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 =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000      0.000000      0.000000      0.000000
   15.20000      0.000000      0.000000      0.000000
   14.40000      0.000000      0.000000      0.000000
   13.60000      0.000000      0.000000      0.000000
   12.80000      0.000000      0.000000      0.000000
   12.00000      0.000000      0.000000      0.000000
   11.20000      0.000000      0.000000      0.000000
   10.40000      0.000000      0.000000      0.000000
    9.60000      0.000000      0.000000      0.000000
    8.80000      0.000000      0.000000      0.000000
    8.00000      0.000000      0.000000      0.000000
    7.20000      0.000000      0.000000      0.000000
    6.40000      0.000000      0.000000      0.000000
    5.60000      0.000000      0.000000      0.000000
    4.80000      0.000000      0.000000      0.000000
    4.00000      0.000000      0.000000      0.000000
    3.20000      0.000000      0.000000      0.000000
    2.40000      0.000000      0.000000      0.000000
    1.60000      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                                =         50.0 kN
```

```
Rotation of pile head                                  =    0.000E+00 radians
Axial load at pile head                                =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00   5.19E-04   -99.0699    50.0000       0.00       0.00    683428.
-1.4099   217.3347       0.00

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


Output Summary for Load Case No. 2:

Pile-head deflection             =     0.00051897 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =   -99.06988655 kN-m
Maximum shear force              =    50.00000000 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 =              5

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          19   1.60000000000000
```

```
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =             50. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00051897  -99.06988655   50.00000000
   15.20000    0.00052812  -99.80589593   50.00000000
   14.40000    0.00050906  -98.26614455   50.00000000
   13.60000    0.00051381  -98.66871414   50.00000000
   12.80000    0.00051583  -98.83791610   50.00000000
   12.00000    0.00051506  -98.77466856   50.00000000
   11.20000    0.00051154  -98.49554748   50.00000000
   10.40000    0.00052338  -99.45254754   50.00000000
    9.60000    0.00051281  -98.59876285   50.00000000
    8.80000    0.00051485  -98.77018964   50.00000000
    8.00000    0.00051134  -98.48815026   50.00000000
    7.20000    0.00051515  -98.70346258   50.00000000
    6.40000    0.00054039 -100.26222436   50.00000000
    5.60000    0.00059269 -105.40608767   50.00000000
    4.80000    0.00065639 -114.83236282   50.00000000
    4.00000    0.00068670 -123.61921983   50.00000000
    3.20000    0.00071200 -120.19176807   50.00000000
    2.40000    0.00476966  -97.90812693   50.00000000


-----------------------------------------------------------------------------
-
                 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                                =        100.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN
```

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00111  -205.0461   100.0000       0.00       0.00    683267.
-1.8142   131.3084       0.00

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


Output Summary for Load Case No. 3:

Pile-head deflection             =     0.00110528 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -205.04614550 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 =              5

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
```

```
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
before 180
exit 180
```

---

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

Boundary Condition Type 2, Shear and Slope

Shear      =            100. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00110528 -205.04614550  100.00000000
   15.20000    0.00112191 -206.38165937  100.00000000
   14.40000    0.00108740 -203.61714685  100.00000000
   13.60000    0.00109555 -204.30980345  100.00000000
   12.80000    0.00109930 -204.61969861  100.00000000
   12.00000    0.00109828 -204.53141599  100.00000000
   11.20000    0.00109194 -204.03826199  100.00000000
   10.40000    0.00111327 -205.74916768  100.00000000
    9.60000    0.00109428 -204.22674854  100.00000000
    8.80000    0.00109781 -204.52352099  100.00000000
    8.00000    0.00109170 -204.03303634  100.00000000
    7.20000    0.00109881 -204.39106550  100.00000000
    6.40000    0.00117987 -209.80101905  100.00000000
    5.60000    0.00133210 -224.51577075  100.00000000
    4.80000    0.00150260 -247.88536898  100.00000000
    4.00000    0.00155377 -264.08757364  100.00000000
    3.20000    0.00181974 -253.86862353  100.00000000


--------------------------------------------------------------------------------
-
                 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                                =        150.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
```

```
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00183  -320.1318   150.0000       0.00       0.00    682097.
-2.1466    93.7637       0.00

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


Output Summary for Load Case No. 4:

Pile-head deflection             =     0.00183150 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -320.13176423 kN-m
Maximum shear force              =   150.00000000 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             =             10
Number of zero deflection points =              5

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
```

```
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope
```

```
Shear      =            150. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00183150 -320.13176423  150.00000000
   15.20000    0.00186282 -322.26590020  150.00000000
   14.40000    0.00180243 -318.05230366  150.00000000
   13.60000    0.00181605 -319.07922907  150.00000000
   12.80000    0.00182218 -319.52993469  150.00000000
   12.00000    0.00182012 -319.38195745  150.00000000
   11.20000    0.00180969 -318.65032534  150.00000000
   10.40000    0.00184677 -321.26584125  150.00000000
    9.60000    0.00181368 -318.94027835  150.00000000
    8.80000    0.00181970 -319.38513084  150.00000000
    8.00000    0.00180959 -318.62530411  150.00000000
    7.20000    0.00182884 -319.32819504  150.00000000
    6.40000    0.00210966 -336.10261390  150.00000000
    5.60000    0.00245525 -368.21382104  150.00000000
    4.80000    0.00277974 -403.02668665  150.00000000
    4.00000    0.00283685 -419.73769655  150.00000000
    3.20000    0.00473333 -384.57483622  150.00000000


--------------------------------------------------------------------------------
-
                 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                                =        200.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00302  -439.9531   200.0000       0.00       0.00    516718.
-2.5354    67.2112       0.00
```

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


Output Summary for Load Case No. 5:

Pile-head deflection             =     0.00301782 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -439.95307909 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             =             17
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            200. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
```

```
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00301782 -439.95307909  200.00000000
   15.20000    0.00306168 -442.89263600  200.00000000
   14.40000    0.00295587 -437.86753650  200.00000000
   13.60000    0.00297490 -439.48930995  200.00000000
   12.80000    0.00298077 -440.42945487  200.00000000
   12.00000    0.00297081 -440.58819948  200.00000000
   11.20000    0.00297045 -438.57678170  200.00000000
   10.40000    0.00302565 -442.30729171  200.00000000
    9.60000    0.00296441 -439.73880266  200.00000000
    8.80000    0.00297931 -440.08676724  200.00000000
    8.00000    0.00296988 -439.19996673  200.00000000
    7.20000    0.00308041 -441.91030517  200.00000000
    6.40000    0.00376945 -473.37977019  200.00000000
    5.60000    0.00449966 -518.95736778  200.00000000
    4.80000    0.00501588 -563.91941840  200.00000000
    4.00000    0.00504034 -579.57704221  200.00000000
    3.20000    0.01044175 -515.42770318  200.00000000


-------------------------------------------------------------------------------
-
                  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                                =        250.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00453  -556.5366   250.0000       0.00       0.00    435055.
-2.9037    51.2429       0.00

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

```
Output Summary for Load Case No. 6:

Pile-head deflection             =     0.00453317 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -556.53659102 kN-m
Maximum shear force              =   250.00000000 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   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            250. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00453317 -556.53659102  250.00000000
   15.20000    0.00460645 -559.07812698  250.00000000
   14.40000    0.00446339 -552.99506310  250.00000000
   13.60000    0.00449106 -554.96932626  250.00000000
   12.80000    0.00449926 -556.27515958  250.00000000
```

```
   12.00000    0.00450296 -555.38925225  250.00000000
   11.20000    0.00446818 -554.87946607  250.00000000
   10.40000    0.00456109 -558.23846407  250.00000000
    9.60000    0.00447424 -555.66148263  250.00000000
    8.80000    0.00449767 -556.14983606  250.00000000
    8.00000    0.00455087 -556.06680040  250.00000000
    7.20000    0.00484298 -563.47594311  250.00000000
    6.40000    0.00610414 -613.10627862  250.00000000
    5.60000    0.00728799 -674.67571060  250.00000000
    4.80000    0.00802862 -729.51476087  250.00000000
    4.00000    0.00807351 -739.43025030  250.00000000
    3.20000    0.01951574 -646.72230155  249.99999999


-----------------------------------------------------------------------------
-
                 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                                =        300.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00634  -670.2394   300.0000       0.00       0.00    382459.
-3.2472    40.9729       0.00

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


Output Summary for Load Case No. 7:

Pile-head deflection             =     0.00634015 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -670.23937312 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             =             16
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
```

```
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          18   2.40000000000000
  16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            300. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00634015 -670.23937312  300.00000000
   15.20000    0.00641921 -674.08255808  300.00000000
   14.40000    0.00622163 -668.10945692  300.00000000
   13.60000    0.00627698 -668.98995449  300.00000000
   12.80000    0.00628978 -670.51251077  300.00000000
   12.00000    0.00628731 -669.84011406  300.00000000
   11.20000    0.00624314 -669.37929481  300.00000000
   10.40000    0.00635936 -673.30031323  300.00000000
    9.60000    0.00626346 -669.64939965  300.00000000
    8.80000    0.00632758 -671.02954486  300.00000000
    8.00000    0.00649953 -673.34867057  300.00000000
    7.20000    0.00711188 -688.34860366  300.00000000
```

```
    6.40000    0.00907379 -757.38482393  300.00000000
    5.60000    0.01078861 -835.71228923  300.00000000
    4.80000    0.01171998 -900.12349569  300.00000000
    4.00000    0.01189524 -900.30563264  300.00000001
    3.20000    0.02975462 -779.35183920  300.00000001


-----------------------------------------------------------------------------
-
                 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                                =        350.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.00837  -784.2720   350.0000       0.00       0.00    347278.
-3.5619    34.0516       0.00

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


Output Summary for Load Case No. 8:

Pile-head deflection             =     0.00836827 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -784.27202317 kN-m
Maximum shear force              =   350.00000000 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             =             16
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
```

```
before 180
after 180
i_Length           2   15.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           3   14.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           4   13.6000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           5   12.8000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
```

```
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            350. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.00836827 -784.27202317  350.00000000
   15.20000    0.00846568 -788.51076667  350.00000000
   14.40000    0.00824109 -780.61787818  350.00000000
   13.60000    0.00828858 -783.05576064  350.00000000
   12.80000    0.00832120 -783.58122409  350.00000000
   12.00000    0.00830004 -784.18474228  350.00000000
   11.20000    0.00826192 -782.57665002  350.00000000
   10.40000    0.00840241 -787.13441992  350.00000000
    9.60000    0.00828249 -783.38714410  350.00000000
    8.80000    0.00843896 -786.22008928  350.00000000
    8.00000    0.00880436 -791.38576426  350.00000000
    7.20000    0.00988341 -818.06591016  350.00000000
    6.40000    0.01263834 -906.86865774  350.00000000
    5.60000    0.01492669        -1002.  350.00000000
    4.80000    0.01600138        -1076.  350.00000000
    4.00000    0.01649779        -1063.  349.99999999


--------------------------------------------------------------------------------
-
                 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                                =        400.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.01099  -913.8174   400.0000       0.00       0.00    319703.
-3.9009    28.3903       0.00

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


Output Summary for Load Case No. 9:

Pile-head deflection             =     0.01099212 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =  -913.81742144 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             =             18
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
```

```
before 180
after 180
i_Length           5   12.8000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           6   12.0000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           7   11.2000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           8   10.4000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length           9   9.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          10   8.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          11   8.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          12   7.20000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          13   6.40000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          14   5.60000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          15   4.80000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          16   4.00000000000000
  16.0000000000000       0.800000000000000
before 180
after 180
i_Length          17   3.20000000000000
  16.0000000000000       0.800000000000000
before 180
exit 180
```

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

Boundary Condition Type 2, Shear and Slope

Shear      =            400. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.01099212 -913.81742144  400.00000000
   15.20000    0.01114712 -918.05104032  400.00000000
   14.40000    0.01083206 -909.93531099  400.00000000
   13.60000    0.01089123 -911.79899164  400.00000000
   12.80000    0.01092788 -913.08121136  400.00000000
   12.00000    0.01091695 -912.69989294  400.00000000
   11.20000    0.01086048 -911.07901170  400.00000000
   10.40000    0.01106016 -917.27973000  400.00000000
    9.60000    0.01088477 -912.25024790  400.00000000
    8.80000    0.01109557 -914.53587606  400.00000000
    8.00000    0.01155339 -918.26045505  400.00000000
    7.20000    0.01315539 -952.98505348  400.00000000
    6.40000    0.01675344        -1062.  400.00000000
    5.60000    0.01963879        -1175.  400.00000000
    4.80000    0.02081034        -1255.  400.00000000
    4.00000    0.02190512        -1226.  400.00000000


-------------------------------------------------------------------------------
-
                 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                                =        450.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
```

```
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.01387     -1044.   450.0000       0.00       0.00    299797.
-4.2157    24.3089       0.00

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


Output Summary for Load Case No. 10:

Pile-head deflection             =     0.01387364 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1044. kN-m
Maximum shear force              =   450.00000000 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             =             18
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          15   4.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          16   4.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          17   3.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            450. kN
Slope      =         0.00000
```

Axial Load = 2000. kN

| Pile Length meters | Pile Head Deflection meters | Maximum Moment kN-m | Maximum Shear kN |
|---|---|---|---|
| 16.00000 | 0.01387364 | -1044. | 450.00000000 |
| 15.20000 | 0.01405914 | -1050. | 450.00000000 |
| 14.40000 | 0.01367639 | -1039. | 450.00000000 |
| 13.60000 | 0.01375850 | -1041. | 450.00000000 |
| 12.80000 | 0.01379774 | -1043. | 450.00000000 |
| 12.00000 | 0.01378164 | -1043. | 450.00000000 |
| 11.20000 | 0.01371372 | -1041. | 450.00000000 |
| 10.40000 | 0.01394322 | -1048. | 450.00000000 |
| 9.60000 | 0.01373685 | -1042. | 450.00000000 |
| 8.80000 | 0.01404664 | -1045. | 450.00000000 |
| 8.00000 | 0.01468706 | -1051. | 450.00000000 |
| 7.20000 | 0.01690616 | -1094. | 450.00000000 |
| 6.40000 | 0.02138252 | -1222. | 450.00000000 |
| 5.60000 | 0.02485857 | -1351. | 450.00000000 |
| 4.80000 | 0.02610338 | -1438. | 450.00000000 |
| 4.00000 | 0.02803042 | -1389. | 450.00000000 |

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-

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

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-

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 = 2000.0 kN

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

| Depth X meters | Deflect. y meters | Bending Moment kN-m | Shear Force kN | Slope S radians | Total Stress kPa* | Bending Stiffness kN-m^2 | Soil Res. p kN/m | Soil Spr. Es*h kN/m | Distrib. Lat. Load kN/m |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.01704 | -1176. | 500.0000 | 0.00 | 0.00 | 284277. | -4.5148 | 21.1939 | 0.00 |

* This analysis computed pile response using nonlinear moment-curvature relationships. Values of total stress due to combined axial and bending stresses are computed only for elastic sections only and do not equal the actual

```
  stresses in concrete and steel. Stresses in concrete and steel may be inter-
  polated from the output for nonlinear bending properties relative to the
  magnitude of bending moment developed in the pile.


Output Summary for Load Case No. 11:

Pile-head deflection             =     0.01704190 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1176. 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             =             20
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          14   5.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            500. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.01704190        -1176.  500.00000000
   15.20000    0.01726037        -1183.  500.00000000
   14.40000    0.01681032        -1171.  500.00000000
   13.60000    0.01690187        -1174.  500.00000000
   12.80000    0.01695948        -1176.  500.00000000
   12.00000    0.01693302        -1175.  500.00000000
   11.20000    0.01685441        -1173.  500.00000000
   10.40000    0.01712530        -1180.  500.00000000
    9.60000    0.01687928        -1175.  500.00000000
    8.80000    0.01729193        -1178.  500.00000000
    8.00000    0.01813917        -1186.  500.00000000
    7.20000    0.02119836        -1245.  500.00000000
    6.40000    0.02645600        -1385.  500.00000000


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```

```
                 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                                =        550.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.02048     -1313.   550.0000       0.00       0.00    271481.
-4.8001    18.7497       0.00

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


Output Summary for Load Case No. 12:

Pile-head deflection             =     0.02048064 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1313. kN-m
Maximum shear force              =   550.00000000 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   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          13   6.40000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


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

Boundary Condition Type 2, Shear and Slope

Shear      =            550. kN
Slope      =         0.00000
Axial Load =           2000. kN
```

| Pile Length meters | Pile Head Deflection meters | Maximum Moment kN-m | Maximum Shear kN |
|---|---|---|---|
| 16.00000 | 0.02048064 | -1313. | 550.00000000 |
| 15.20000 | 0.02072841 | -1318. | 550.00000000 |
| 14.40000 | 0.02018664 | -1306. | 550.00000000 |
| 13.60000 | 0.02031674 | -1309. | 550.00000000 |
| 12.80000 | 0.02037006 | -1310. | 550.00000000 |
| 12.00000 | 0.02035575 | -1310. | 550.00000000 |
| 11.20000 | 0.02026273 | -1308. | 550.00000000 |
| 10.40000 | 0.02057832 | -1316. | 550.00000000 |
| 9.60000 | 0.02029336 | -1310. | 550.00000000 |
| 8.80000 | 0.02081322 | -1313. | 550.00000000 |
| 8.00000 | 0.02190147 | -1324. | 550.00000000 |
| 7.20000 | 0.02587301 | -1397. | 550.00000000 |

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Computed Values of Pile Loading and Deflection
for Lateral Loading for Load Case Number 13

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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 = 2000.0 kN

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

| Depth X meters | Deflect. y meters | Bending Moment kN-m | Shear Force kN | Slope S radians | Total Stress kPa* | Bending Stiffness kN-m^2 | Soil Res. p kN/m | Soil Spr. Es*h kN/m | Distrib. Lat. Load kN/m |
|---|---|---|---|---|---|---|---|---|---|
| 0.00 | 0.02420 | -1448. | 600.0000 | 0.00 | 0.00 | 257776. | -5.0750 | 16.7735 | 0.00 |

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

```
Output Summary for Load Case No. 13:

Pile-head deflection             =     0.02420474 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1448. 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             =             20
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
```

```
 after 180
 i_Length          12   7.20000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


-----------------------------------------------------------------------------
-
            Pile-head Deflection vs. Pile Length for Load Case 13
-----------------------------------------------------------------------------
-

Boundary Condition Type 2, Shear and Slope

Shear      =            600. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.02420474        -1448.  600.00000000
   15.20000    0.02447771        -1455.  600.00000000
   14.40000    0.02387942        -1442.  600.00000000
   13.60000    0.02401626        -1445.  600.00000000
   12.80000    0.02408139        -1447.  600.00000000
   12.00000    0.02403239        -1447.  600.00000000
   11.20000    0.02393970        -1444.  600.00000000
   10.40000    0.02430279        -1453.  600.00000000
    9.60000    0.02398016        -1446.  600.00000000
    8.80000    0.02461927        -1450.  600.00000000
    8.00000    0.02602453        -1464.  600.00000000


-----------------------------------------------------------------------------
-
                 Computed Values of Pile Loading and Deflection
                   for Lateral Loading for Load Case Number 14
-----------------------------------------------------------------------------
-

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

Shear force at pile head                                =        650.0 kN
Rotation of pile head                                   =    0.000E+00 radians
Axial load at pile head                                 =       2000.0 kN

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

   Depth    Deflect.    Bending     Shear      Slope      Total     Bending
Soil Res.  Soil Spr.  Distrib.
```

```
     X          y       Moment      Force        S       Stress    Stiffness
  p        Es*h     Lat. Load
  meters     meters      kN-m        kN       radians     kPa*      kN-m^2
kN/m       kN/m       kN/m
---------- ---------- ---------- ---------- ---------- ---------- ----------
---------- ---------- ----------
      0.00    0.02854     -1578.   650.0000       0.00       0.00    223477.
-5.3615    15.0287       0.00

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


Output Summary for Load Case No. 14:

Pile-head deflection             =     0.02854000 meters
Computed slope at pile head      =       0.000000 radians
Maximum bending moment           =         -1578. kN-m
Maximum shear force              =   650.00000000 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             =             25
Number of zero deflection points =              4

 i_Length           1   16.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           2   15.2000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           3   14.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           4   13.6000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           5   12.8000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           6   12.0000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           7   11.2000000000000
   16.0000000000000       0.800000000000000
```

```
 before 180
 after 180
 i_Length           8   10.4000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length           9   9.60000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          10   8.80000000000000
   16.0000000000000       0.800000000000000
 before 180
 after 180
 i_Length          11   8.00000000000000
   16.0000000000000       0.800000000000000
 before 180
 exit 180


--------------------------------------------------------------------------------
-
            Pile-head Deflection vs. Pile Length for Load Case 14
--------------------------------------------------------------------------------
-

Boundary Condition Type 2, Shear and Slope

Shear      =            650. kN
Slope      =         0.00000
Axial Load =           2000. kN


    Pile       Pile Head       Maximum       Maximum
   Length      Deflection      Moment         Shear
   meters        meters         kN-m           kN
------------  ------------  ------------  ------------
   16.00000    0.02854000        -1578.  650.00000000
   15.20000    0.02887074        -1585.  650.00000000
   14.40000    0.02810714        -1573.  650.00000000
   13.60000    0.02826221        -1577.  650.00000000
   12.80000    0.02831727        -1578.  650.00000000
   12.00000    0.02827251        -1578.  650.00000000
   11.20000    0.02812400        -1577.  650.00000000
   10.40000    0.02855818        -1585.  650.00000000
    9.60000    0.02815828        -1579.  650.00000000
    8.80000    0.02891680        -1583.  650.00000000

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

Definitions of Pile-head Loading Conditions:

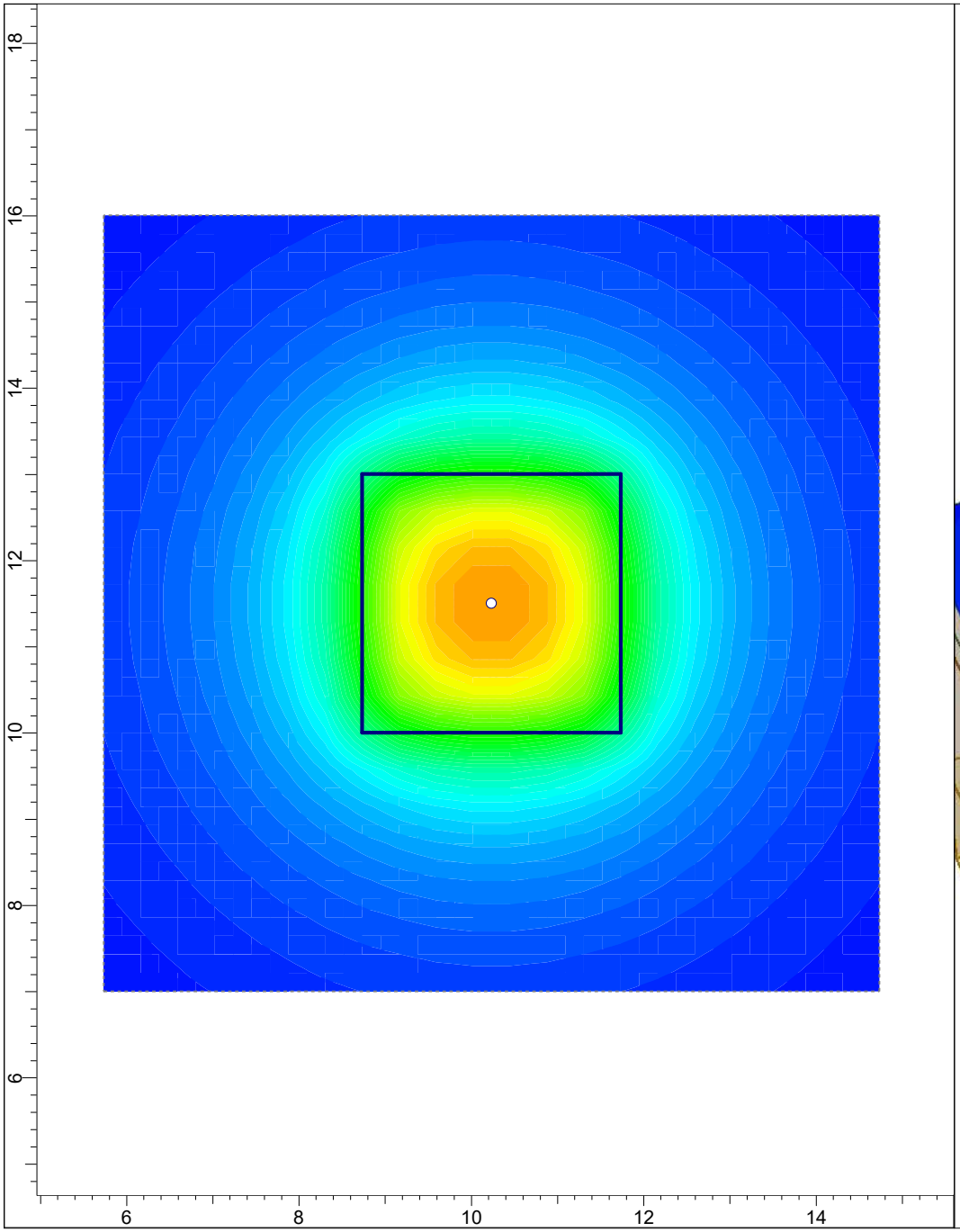
Load Type 1: Load 1 = Shear, V, kN, and Load 2 = Moment, M, kN-m
Load Type 2: Load 1 = Shear, V, kN, and Load 2 = Slope, S, radians
Load Type 3: Load 1 = Shear, V, kN, and Load 2 = Rot. Stiffness, R, kN-m/rad.
Load Type 4: Load 1 = Top Deflection, y, m, and Load 2 = Moment, M, kN-m
Load Type 5: Load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

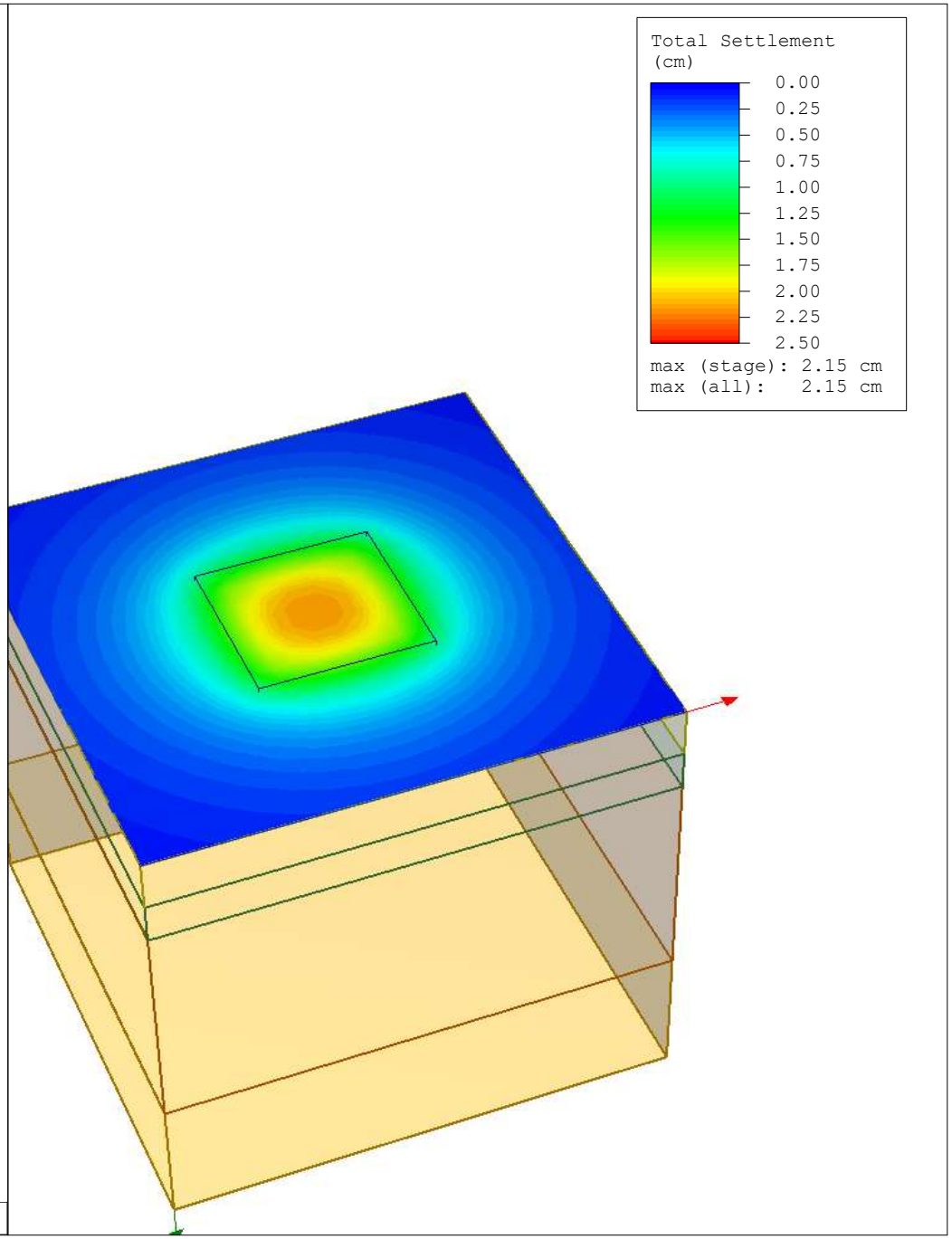
| Load Case No. | Load Type 1 | Max Shear in Pile Load 1 kN | Max Moment in Pile kN-m | Load Type 2 | Pile-head Load 2 | Axial Loading kN | Pile-head Deflection meters | Pile-head Rotation radians |
|---|---|---|---|---|---|---|---|---|
| 1 | V, kN | 0.00 | 0.00 | S, rad | 0.00 | 2000. | 0.00 | 0.00 |
| 2 | V, kN | 50.0000 | 50.0000 | S, rad | 0.00 | 2000. | 5.19E-04 | 0.00 |
| 3 | V, kN | 100.0000 | 100.0000 | S, rad | 0.00 | 2000. | 0.00111 | 0.00 |
| 4 | V, kN | 150.0000 | 150.0000 | S, rad | 0.00 | 2000. | 0.00183 | 0.00 |
| 5 | V, kN | 200.0000 | 200.0000 | S, rad | 0.00 | 2000. | 0.00302 | 0.00 |
| 6 | V, kN | 250.0000 | 250.0000 | S, rad | 0.00 | 2000. | 0.00453 | 0.00 |
| 7 | V, kN | 300.0000 | 300.0000 | S, rad | 0.00 | 2000. | 0.00634 | 0.00 |
| 8 | V, kN | 350.0000 | 350.0000 | S, rad | 0.00 | 2000. | 0.00837 | 0.00 |
| 9 | V, kN | 400.0000 | 400.0000 | S, rad | 0.00 | 2000. | 0.01099 | 0.00 |
| 10 | V, kN | 450.0000 | 450.0000 | S, rad | 0.00 | 2000. | 0.01387 | 0.00 |
| 11 | V, kN | 500.0000 | 500.0000 | S, rad | 0.00 | 2000. | 0.01704 | 0.00 |
| 12 | V, kN | 550.0000 | 550.0000 | S, rad | 0.00 | 2000. | 0.02048 | 0.00 |
| 13 | V, kN | 600.0000 | 600.0000 | S, rad | 0.00 | 2000. | 0.02420 | 0.00 |
| 14 | V, kN | 650.0000 | 650.0000 | S, rad | 0.00 | 2000. | 0.02854 | 0.00 |

Maximum pile-head deflection = 0.0285399952 meters
Maximum pile-head rotation = 0.0000000000 radians = 0.000000 deg.

The analysis ended normally.

# Análisis de asentamiento para cimentaciones convencionales


18
16
14
12
10
8
6
6
8
10
12
14


Total Settlement
(cm)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
max (stage): 2.15 cm
max (all): 2.15 cm

# Settle3D Analysis Information
# Metro Cable, Estación 8

## Project Settings

Document Name: Metro Cable, E8-04
Project Title: Metro Cable, Estación 8
Analysis: Estación E8-04
Date Created: 22/5/2020, 9:12:47 a. m.
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses

## Stage Settings

| Stage # | Name |
|---|---|
| 1 | Stage 1 |

## Results

Time taken to compute: 0 seconds

### Stage: Stage 1

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [cm] | 0 | 2.14806 |
| Consolidation Settlement [cm] | 0 | 0 |
| Immediate Settlement [cm] | 0 | 2.14806 |
| Loading Stress [kPa] | 0 | 200 |
| Total Stress [kPa] | 0 | 221.385 |
| Total Strain | -0 | 0.00721163 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [kPa] | 0.85 | 220.903 |
| Over-consolidation Ratio | 1 | 1 |
| Void Ratio | 0 | 0 |
| Hydroconsolidation Settlement [cm] | 0 | 0 |

## Loads

#### 1. Rectangular Load

Length: 3 m
Width: 3 m
Rotation angle: 0 degrees
Load Type: Flexible
Area of Load: 9 $m^2$
Load: 200 kPa
Depth: 0.85 m
Installation Stage: Stage 1

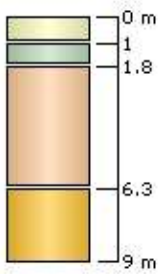
**Coordinates**

| X [m] | Y [m] |
|---|---|
| 8.732 | 10.004 |

| | |
|---|---|
| 11.732 | 10.004 |
| 11.732 | 13.004 |
| 8.732 | 13.004 |

## Soil Layers

| Layer # | Type | Thickness [m] | Depth [m] |
|---|---|---|---|
| 1 | Relleno estructural | 1 | 0 |
| 2 | Arcilla con arena | 0.8 | 1 |
| 3 | Grava con arena | 4.5 | 1.8 |
| 4 | Arcilla | 2.7 | 6.3 |




## Soil Properties

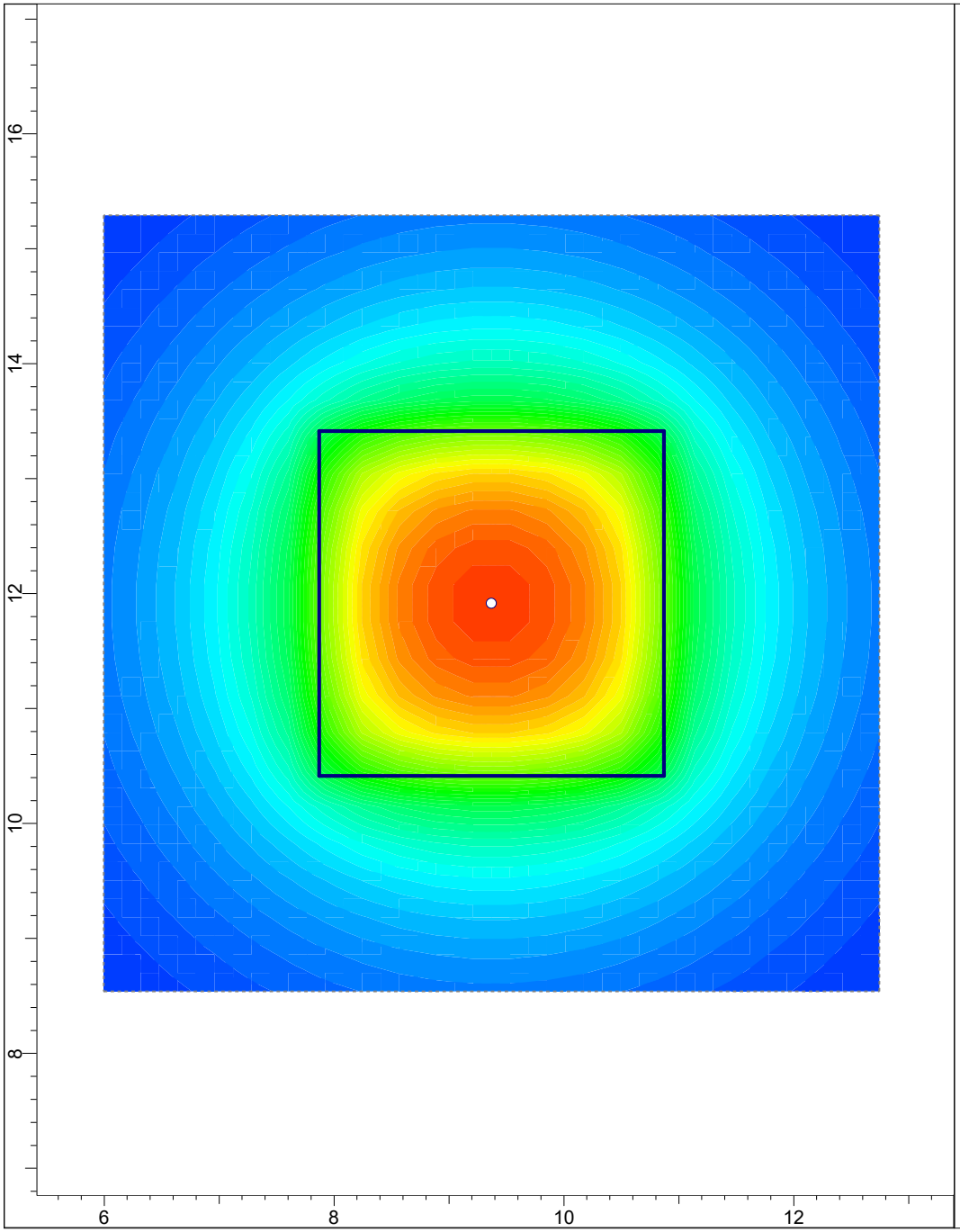
| Property | Relleno estructural | Arcilla con arena | Grava con arena | Arcilla |
|---|---|---|---|---|
| Color | | | | |
| Unit Weight [kN/m$^3$] | 20 | 17.5 | 18 | 17.5 |
| Immediate Settlement | Enabled | Enabled | Enabled | Enabled |
| Es [kPa] | 50000 | 30000 | 24000 | 30000 |
| Esur [kPa] | 50000 | 30000 | 24000 | 30000 |

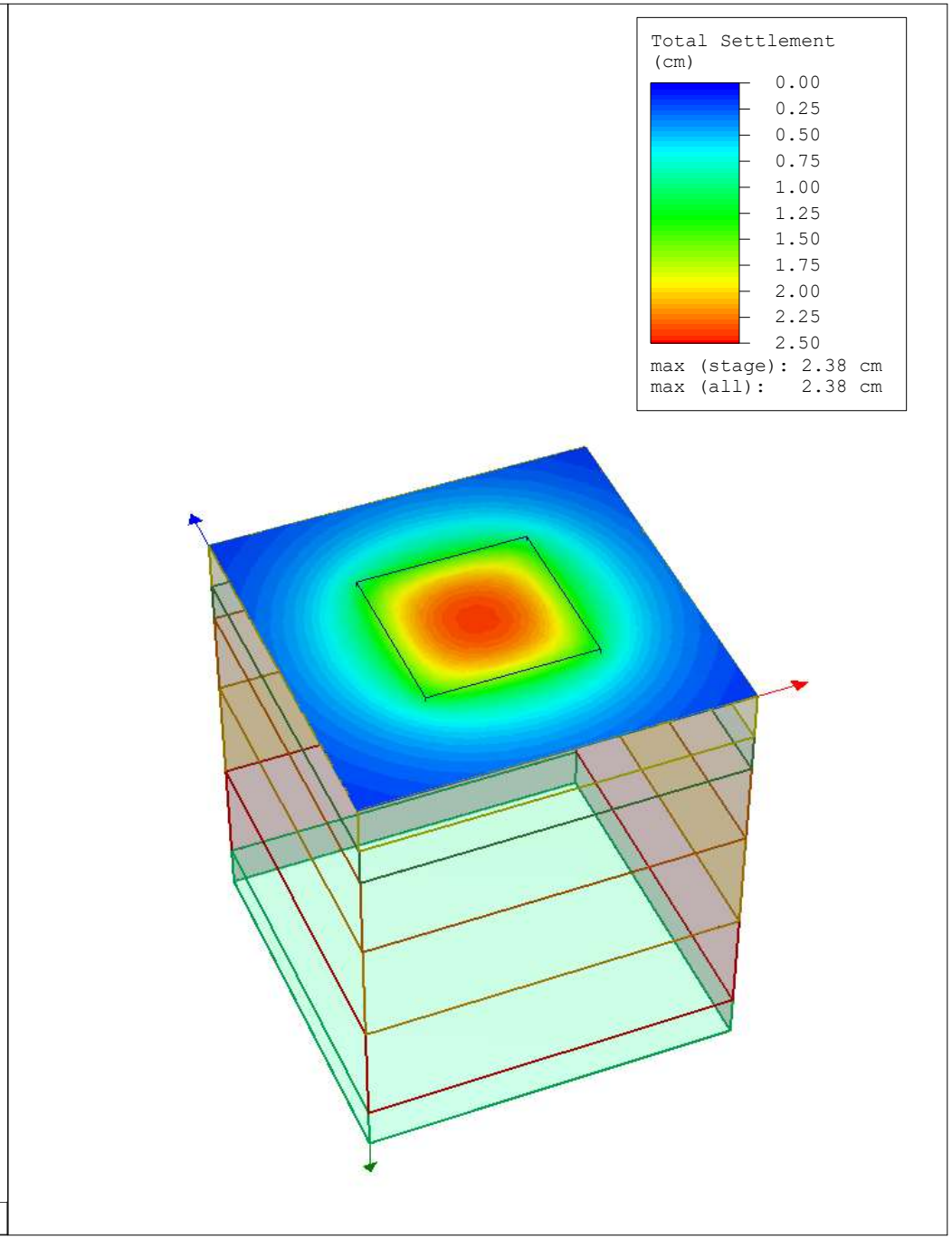
## Field Point Grid

Number of points: 484
Expansion Factor: 3

**Grid Coordinates**

| X [m] | Y [m] |
|---|---|
| 14.732 | 16.004 |
| 14.732 | 7.004 |
| 5.732 | 7.004 |
| 5.732 | 16.004 |


16
14
12
10
8
6
8
10
12


Total Settlement
(cm)
0.00
0.25
0.50
0.75
1.00
1.25
1.50
1.75
2.00
2.25
2.50
max (stage): 2.38 cm
max (all): 2.38 cm

# Settle3D Analysis Information
# Metro Cable Estación 8

## Project Settings

Document Name: Metro Cable, E8-08
Project Title: Metro Cable Estación 8
Analysis: Estación E8-08
Date Created: 22/5/2020, 9:26:08 a. m.
Stress Computation Method: Boussinesq
Use average properties to calculate layered stresses

## Stage Settings

| Stage # | Name |
|---|---|
| 1 | Stage 1 |

## Results

Time taken to compute: 0 seconds

### Stage: Stage 1

| Data Type | Minimum | Maximum |
|---|---|---|
| Total Settlement [cm] | 0 | 2.37832 |
| Consolidation Settlement [cm] | 0 | 0 |
| Immediate Settlement [cm] | 0 | 2.37832 |
| Loading Stress [kPa] | 0 | 200 |
| Total Stress [kPa] | 0 | 221.377 |
| Total Strain | -0 | 0.00906103 |
| Degree of Consolidation [%] | 0 | 0 |
| Pre-consolidation Stress [kPa] | 0.85 | 220.923 |
| Over-consolidation Ratio | 1 | 1 |
| Void Ratio | 0 | 0 |
| Hydroconsolidation Settlement [cm] | 0 | 0 |

## Loads

#### 1. Rectangular Load

Length: 3 m
Width: 3 m
Rotation angle: 0 degrees
Load Type: Flexible
Area of Load: 9 $m^2$
Load: 200 kPa
Depth: 0.85 m
Installation Stage: Stage 1

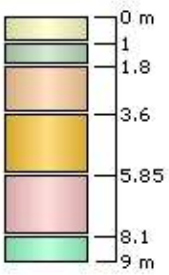
**Coordinates**

| X [m] | Y [m] |
|---|---|
| 7.87 | 10.414 |

| | |
|---|---|
| 10.87 | 10.414 |
| 10.87 | 13.414 |
| 7.87 | 13.414 |

## Soil Layers

| Layer # | Type | Thickness [m] | Depth [m] |
|---|---|---|---|
| 1 | Relleno estructural | 1 | 0 |
| 2 | Arcilla (N=17) | 0.8 | 1 |
| 3 | Grava con arena | 1.8 | 1.8 |
| 4 | Arcilla (N=15) | 2.25 | 3.6 |
| 5 | Arcilla (N=25) | 2.25 | 5.85 |
| 6 | Arcilla (N=50) | 0.9 | 8.1 |




## Soil Properties

| Property | Relleno estructural | Arcilla (N=17) | Grava con arena | Arcilla (N=15) | Arcilla (N=25) | Arcilla (N=50) |
|---|---|---|---|---|---|---|
| Color | | | | | | |
| Unit Weight [kN/m$^3$] | 20 | 17 | 18.5 | 17 | 18 | 20 |
| Immediate Settlement | Enabled | Enabled | Enabled | Enabled | Enabled | Enabled |
| Es [kPa] | 50000 | 22000 | 25000 | 19000 | 32000 | 50000 |
| Esur [kPa] | 50000 | 22000 | 25000 | 19000 | 32000 | 50000 |

## Field Point Grid

Number of points: 484
Expansion Factor: 3

**Grid Coordinates**

| X [m] | Y [m] |
|---|---|
| 12.745 | 15.289 |
| 12.745 | 8.539 |
| 5.995 | 8.539 |
| 5.995 | 15.289 |

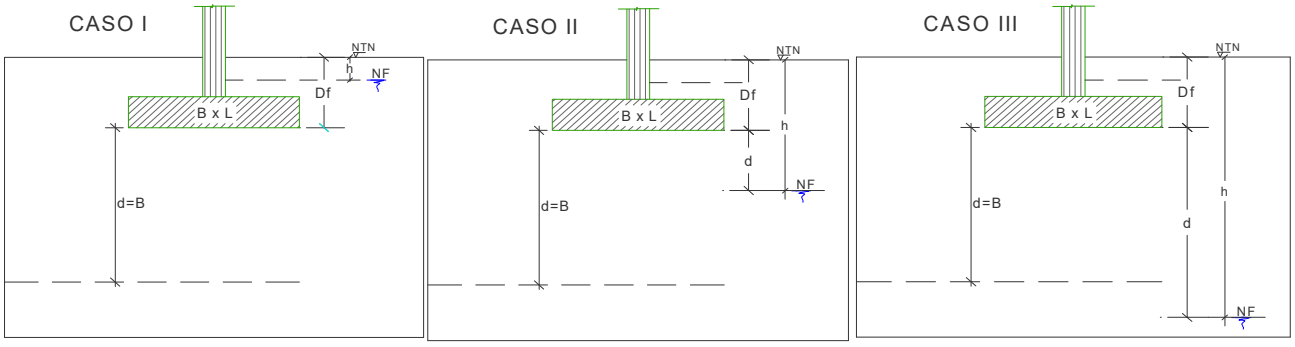
# Capacidad portante para cimentaciones convencionales

# Caso Suelo Cohesivo

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTACIÓN CORRIDA B=0.60 m

**Caso: Suelo Cohesivo




**CASO SUELO COHESIVO**
Ecuacion de terzaghi modificada por Meyerhof (1963)
$Qult = CN_cS_cd_cI_c + Pv\ N_qS_qd_qI_q + B\gamma N_\gamma S_\gamma d_\gamma I_\gamma$

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo ($\gamma$)= | 18.0 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >25 | |
| Angulo de Friccion Interna ($\Phi'$) = | 0 | grados |
| Cohesión del suelo (Cu) = | 160.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 0.60 | m |
| Longitud de la Cimentacion (L) = | 10.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva ($\dot{P}v$)= | 15.30 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 5.14 |
| $N_q$= | 1.00 |
| $N_\gamma$= | 0.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,085.98 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 361.99 | Kpa |
| Qadm= Qu/FS | 3.69 | $Kg/cm^2$ |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.01 |
| $S_q$= | 1.01 |
| $S_\gamma$= | 1.01 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.28 |
| $d_q$= | 1.14 |
| $d_\gamma$= | 1.14 |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

Realizado por: Aristides Carrasco C

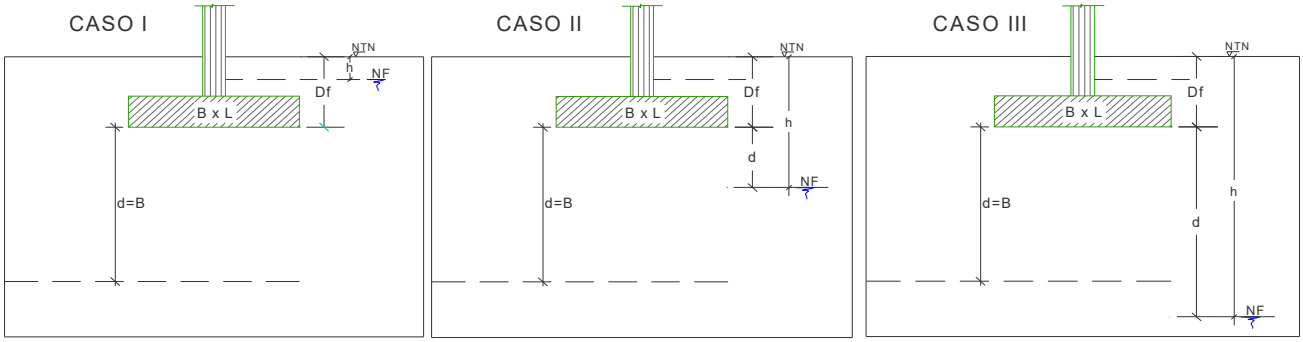
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=1.0 m L=1.00 m

**Caso: Suelo Cohesivo




**CASO SUELO COHESIVO**
Ecuacion de terzaghi modificada por Meyerhof (1963)
$Qult = CN_cS_cd_cI_c + Pv\ N_qS_qd_qI_q + B\gamma N_\gamma S_\gamma d_\gamma I_\gamma$

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo ($\gamma$)= | 18.0 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >25 | |
| Angulo de Friccion Interna ($\Phi'$) = | 0 | grados |
| Cohesión del suelo (Cu) = | 160.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 1.00 | m |
| Longitud de la Cimentacion (L) = | 1.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva ($\dot{P}v$)= | 15.30 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 5.14 |
| $N_q$= | 1.00 |
| $N_\gamma$= | 0.00 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.20 |
| $S_q$= | 1.10 |
| $S_\gamma$= | 1.10 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.17 |
| $d_q$= | 1.09 |
| $d_\gamma$= | 1.09 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,173.27 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 391.09 | Kpa |
| Qadm= Qu/FS | **3.99** | $Kg/cm^2$ |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

Realizado por: Aristides Carrasco C

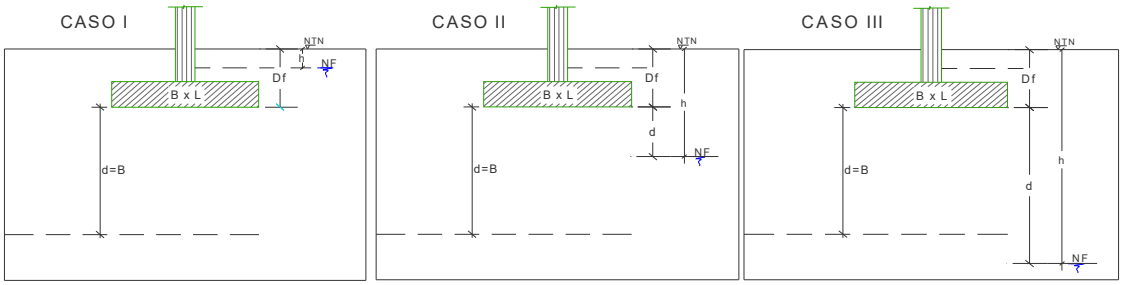
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=1.50 m L=1.50 m

**Caso: Suelo Cohesivo




**CASO SUELO COHESIVO**
Ecuacion de terzaghi modificada por Meyerhof (1963)
Qult = CNcScdcIc+ Pv NqSqdqIq+ BγNγSγdγIγ

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo (γ)= | 18.0 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >25 | |
| Angulo de Friccion Interna (Φ') = | 0 | grados |
| Cohesión del suelo (Cu) = | 160.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 1.50 | m |
| Longitud de la Cimentacion (L) = | 1.50 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva (Ṗv)= | 15.30 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 5.14 |
| $N_q$= | 1.00 |
| $N_\gamma$= | 0.00 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.20 |
| $S_q$= | 1.10 |
| $S_\gamma$= | 1.10 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.11 |
| $d_q$= | 1.06 |
| $d_\gamma$= | 1.06 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,116.85 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 372.28 | Kpa |
| Qadm= Qu/FS | **3.80** | $Kg/cm^2$ |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

Realizado por: Aristides Carrasco C

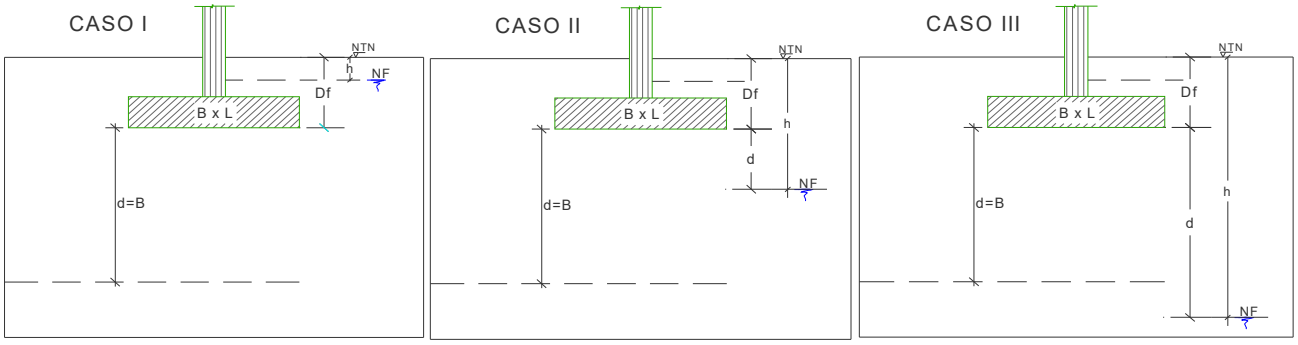
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=2.00 m L=2.00 m

**Caso: Suelo Cohesivo




**CASO SUELO COHESIVO**
Ecuacion de terzaghi modificada por Meyerhof (1963)
$Qult = CN_cS_cd_cI_c + P_v N_qS_qd_qI_q + B\gamma N_\gamma S_\gamma d_\gamma I_\gamma$

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo ($\gamma$)= | 18.0 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >25 | |
| Angulo de Friccion Interna ($\Phi'$) = | 0 | grados |
| Cohesión del suelo (Cu) = | 160.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 2.00 | m |
| Longitud de la Cimentacion (L) = | 2.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva ($\dot{P}v$)= | 15.30 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 5.14 |
| $N_q$= | 1.00 |
| $N_\gamma$= | 0.00 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.20 |
| $S_q$= | 1.10 |
| $S_\gamma$= | 1.10 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.09 |
| $d_q$= | 1.04 |
| $d_\gamma$= | 1.04 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,088.64 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 362.88 | Kpa |
| Qadm= Qu/FS | **3.70** | $Kg/cm^2$ |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

Realizado por: Aristides Carrasco C

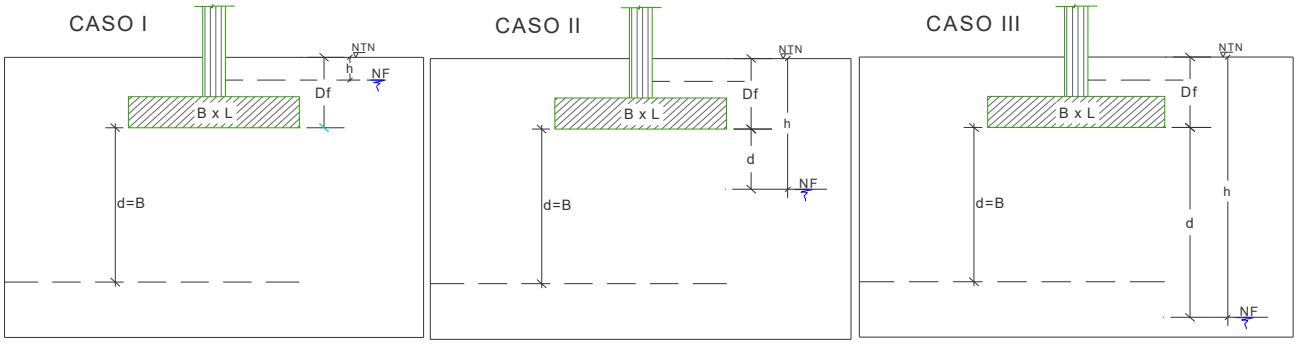
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=3.00 m L=3.00 m

**Caso: Suelo Cohesivo




**CASO SUELO COHESIVO**
Ecuacion de terzaghi modificada por Meyerhof (1963)
$Qult = CN_cS_cd_cI_c + P_v N_qS_qd_qI_q + B\gamma N_\gamma S_\gamma d_\gamma I_\gamma$

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo ($\gamma$)= | 18.0 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >25 | |
| Angulo de Friccion Interna ($\Phi'$) = | 0 | grados |
| Cohesión del suelo (Cu) = | 160.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 3.00 | m |
| Longitud de la Cimentacion (L) = | 3.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva ($\dot{P}v$)= | 15.30 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 5.14 |
| $N_q$= | 1.00 |
| $N_\gamma$= | 0.00 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.20 |
| $S_q$= | 1.10 |
| $S_\gamma$= | 1.10 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.06 |
| $d_q$= | 1.03 |
| $d_\gamma$= | 1.03 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,060.43 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 353.48 | Kpa |
| Qadm= Qu/FS | **3.60** | $Kg/cm^2$ |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

Realizado por: Aristides Carrasco C

NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

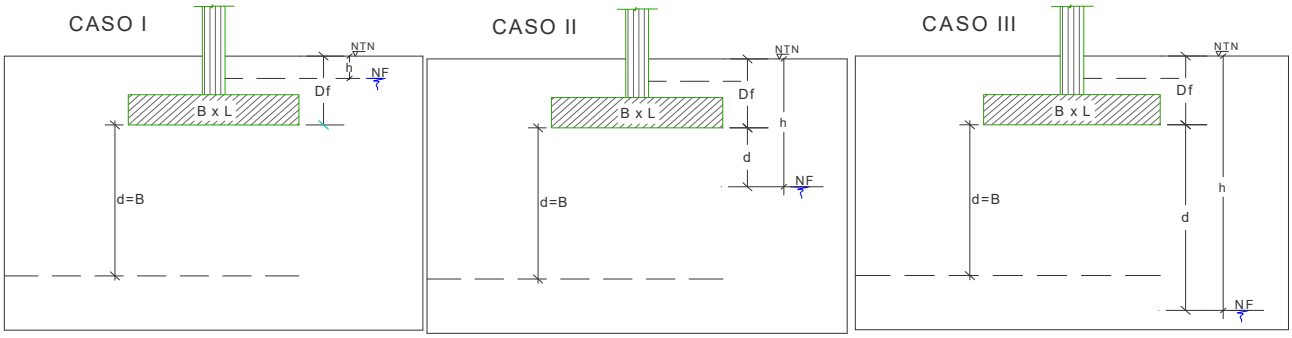
Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# Caso Suelo Granular

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable, Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTACIÓN CORRIDA B=0.60 m

**Caso: Suelo Granular




**CASO SUELO GRANULAR**
Ecuacion de terzaghi modificada por Meyerhof (1963)
Qult = CNcScdcIc+ Pv NqSqdqIq+ BγNγSγdγIγ

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo (γ)= | 18.5 | KN/m³ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | KN/m³ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | KN/m³ |
| Valor Promedio de N ($N_{PROM}$) = | >30 | |
| Angulo de Friccion Interna (Φ') = | 35 | grados |
| Cohesión del suelo (Cu) = | 0.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 0.60 | m |
| Longitud de la Cimentacion (L) = | 10.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| | | |
|---|---|---|
| Presión vertical efectiva (Ṗv)= | 15.73 m | KN/m² |

| CONDICION | Seco |
|---|---|

| Factores de Carga | |
|---|---|
| $N_c$= | 46.12 |
| $N_q$= | 33.30 |
| $N_\gamma$= | 48.03 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.04 |
| $S_q$= | 1.02 |
| $S_\gamma$= | 1.02 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.54 |
| $d_q$= | 1.27 |
| $d_\gamma$= | 1.27 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,027.43 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 342.48 | Kpa |
| Qadm= Qu/FS | 3.49 | Kg/cm² |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | Kg/cm² |
| Modulo de Balasto (Ks)= | 2.40 | Kg/cm³ |

Realizado por: Aristides Carrasco C

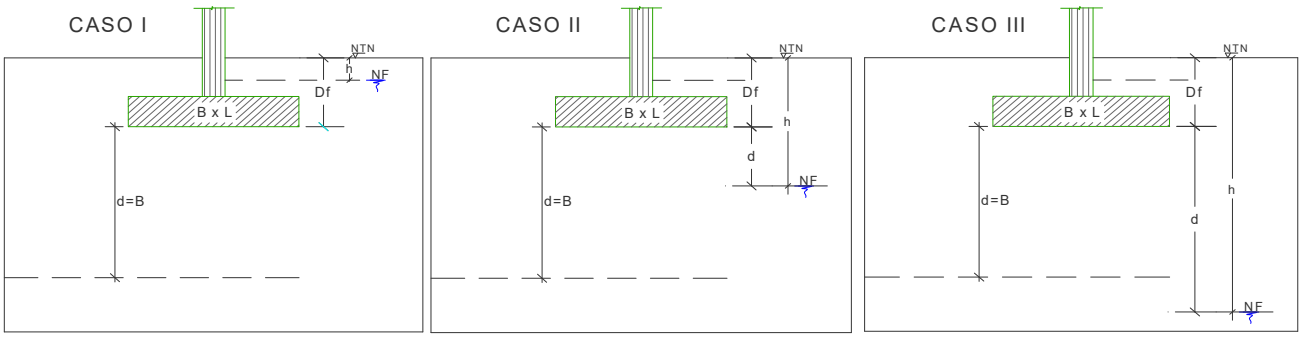
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable, Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=1.0 m L=1.00 m

**Caso: Suelo Granular




**CASO SUELO GRANULAR**
Ecuacion de terzaghi modificada por Meyerhof (1963)
Qult = CNcScdcIc+ Pv NqSqdqIq+ BγNγSγdγIγ

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo (γ)= | 18.5 | KN/m³ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | KN/m³ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | KN/m³ |
| Valor Promedio de N ($N_{PROM}$) = | >30 | |
| Angulo de Friccion Interna (Φ') = | 35 | grados |
| Cohesión del suelo (Cu) = | 0.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 1.00 | m |
| Longitud de la Cimentacion (L) = | 1.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva (Ṗv)= | 15.73 m | KN/m² |

| Factores de Carga | |
|---|---|
| $N_c$= | 46.12 |
| $N_q$= | 33.30 |
| $N_\gamma$= | 48.03 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.74 |
| $S_q$= | 1.37 |
| $S_\gamma$= | 1.37 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.33 |
| $d_q$= | 1.16 |
| $d_\gamma$= | 1.16 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,541.36 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 513.79 | Kpa |
| Qadm= Qu/FS | **5.24** | Kg/cm² |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | Kg/cm² |
| Modulo de Balasto (Ks)= | 2.40 | Kg/cm³ |

Realizado por: Aristides Carrasco C

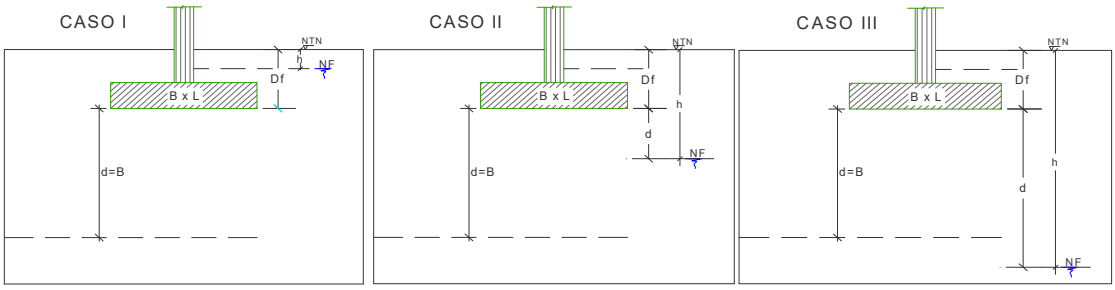
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable, Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=1.50 m L=1.50 m

**Caso: Suelo Granular




**CASO SUELO GRANULAR**
Ecuacion de terzaghi modificada por Meyerhof (1963)
$Qult = CN_cS_cd_cI_c + P_v N_qS_qd_qI_q + B\gamma N_\gamma S_\gamma d_\gamma I_\gamma$

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo ($\gamma$)= | 18.5 | $KN/m^3$ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | $KN/m^3$ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | $KN/m^3$ |
| Valor Promedio de N ($N_{PROM}$) = | >30 | |
| Angulo de Friccion Interna ($\Phi'$) = | 35 | grados |
| Cohesión del suelo (Cu) = | 0.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 1.50 | m |
| Longitud de la Cimentacion (L) = | 1.50 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva ($\dot{P}v$)= | 15.73 m | $KN/m^2$ |

| Factores de Carga | |
|---|---|
| $N_c$= | 46.12 |
| $N_q$= | 33.30 |
| $N_\gamma$= | 48.03 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.74 |
| $S_q$= | 1.37 |
| $S_\gamma$= | 1.37 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.22 |
| $d_q$= | 1.11 |
| $d_\gamma$= | 1.11 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,806.45 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 602.15 | Kpa |
| Qadm= Qu/FS | 6.14 | $Kg/cm^2$ |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | $Kg/cm^2$ |
| Modulo de Balasto (Ks)= | 2.40 | $Kg/cm^3$ |

Realizado por: Aristides Carrasco C

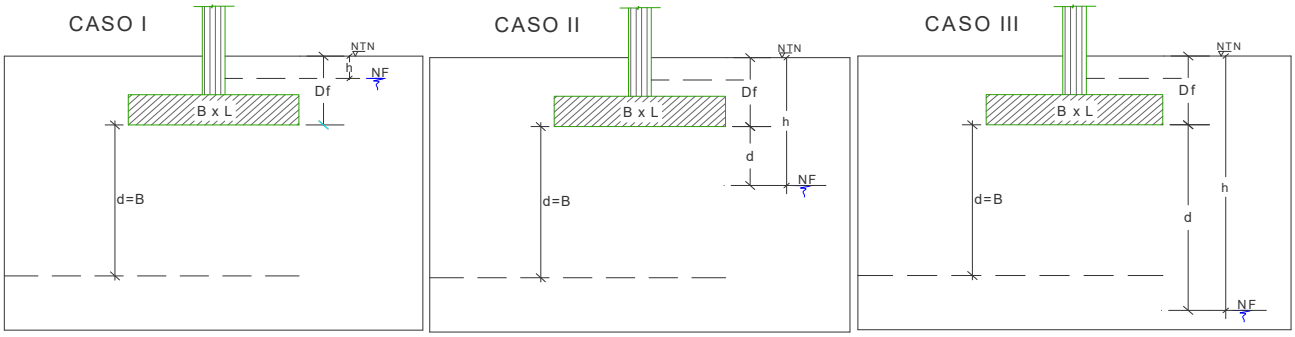
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable, Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=2.00 m L=2.00 m

**Caso: Suelo Granular




**CASO SUELO GRANULAR**
Ecuacion de terzaghi modificada por Meyerhof (1963)
Qult = CNcScdcIc+ Pv NqSqdqIq+ BγNγSγdγIγ

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo (γ)= | 18.5 | KN/m³ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | KN/m³ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | KN/m³ |
| Valor Promedio de N ($N_{PROM}$) = | >30 | |
| Angulo de Friccion Interna (Φ') = | 35 | grados |
| Cohesión del suelo (Cu) = | 0.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 2.00 | m |
| Longitud de la Cimentacion (L) = | 2.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva (Ṗv)= | 15.73 m | KN/m² |

| Factores de Carga | |
|---|---|
| $N_c$= | 46.12 |
| $N_q$= | 33.30 |
| $N_\gamma$= | 48.03 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.74 |
| $S_q$= | 1.37 |
| $S_\gamma$= | 1.37 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.16 |
| $d_q$= | 1.08 |
| $d_\gamma$= | 1.08 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 2,091.05 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 697.02 | Kpa |
| Qadm= Qu/FS | 7.11 | Kg/cm² |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | Kg/cm² |
| Modulo de Balasto (Ks)= | 2.40 | Kg/cm³ |

Realizado por: Aristides Carrasco C

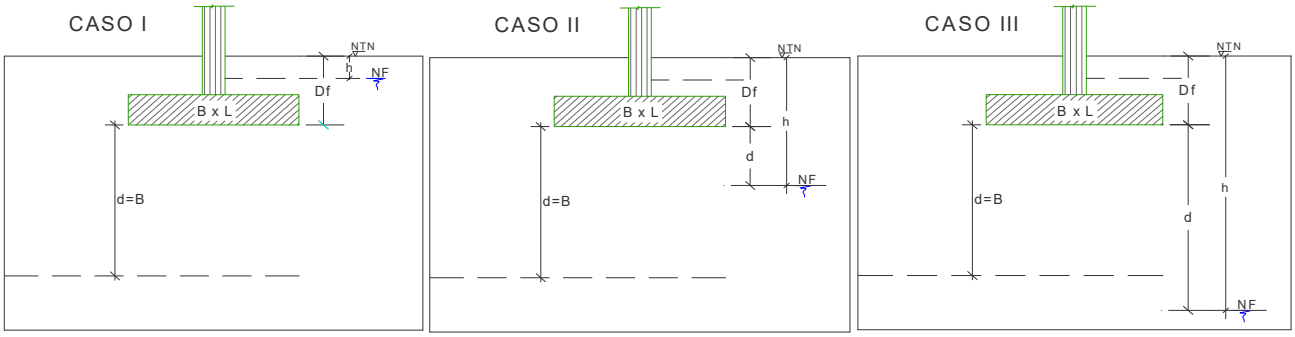
NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

## FALLA POR CORTANTE GENERAL (CIMENTACIONES FUNDADAS SOBRE EL TERRENO EXISTENTE)

**PROYECTO:** Metro Cable, Estación 8
**LOCALIZACIÓN:** Santo Domingo Oeste
**TIPO DE CIMIENTO:** CIMIENTO AISLADO B=3.00 m L=3.00 m

**Caso: Suelo Granular




**CASO SUELO GRANULAR**
Ecuacion de terzaghi modificada por Meyerhof (1963)
Qult = CNcScdcIc+ Pv NqSqdqIq+ BγNγSγdγIγ

| Datos del suelo: | | |
|---|---|---|
| Peso Esp. humedo del Suelo (γ)= | 17.5 | KN/m³ |
| Peso Esp. saturado del Suelo ($\gamma_{sat}$)= | 19 | KN/m³ |
| Peso Específico del Agua ($\gamma_w$) = | 9.81 | KN/m³ |
| Valor Promedio de N ($N_{PROM}$) = | 20 | |
| Angulo de Friccion Interna (Φ') = | 33 | grados |
| Cohesión del suelo (Cu) = | 0.0 | Kpa |

**Ponderado

| Geometría | | |
|---|---|---|
| Ancho de la Cimentacion (B) = | 3.00 | m |
| Longitud de la Cimentacion (L) = | 3.00 | m |
| Profundidad de Desplante ($D_f$) = | 0.85 | m |
| Profundidad del nivel freático (h)= | Seco | m |

**DATOS DE SALIDA:**

| CONDICION | Seco |
|---|---|

| | | |
|---|---|---|
| Presión vertical efectiva (Ṗv)= | 14.88 m | KN/m² |

| Factores de Carga | |
|---|---|
| $N_c$= | 38.64 |
| $N_q$= | 26.09 |
| $N_\gamma$= | 35.19 |

| Factores de Forma | |
|---|---|
| $S_c$= | 1.68 |
| $S_q$= | 1.34 |
| $S_\gamma$= | 1.34 |

| Factores de profundidad | |
|---|---|
| $d_c$= | 1.10 |
| $d_q$= | 1.05 |
| $d_\gamma$= | 1.05 |

| Factores de Inclinación | |
|---|---|
| $I_c$= | 1.00 |
| $I_q$= | 1.00 |
| $I_\gamma$= | 1.00 |

| RESULTADOS | | |
|---|---|---|
| Capacidad de Carga Ultima ($Q_{ult}$) = | 1,848.45 | Kpa |
| Factor de Seguridad (F.S.) = | 3.0 | |
| Capacidad de Carga Admisible ($q_{adm}$) = | 616.15 | Kpa |
| Qadm= Qu/FS | 6.28 | Kg/cm² |

**Modulo de Balasto=** Ks= 40 x FS x Q adm (Ecuación propuesta por Bowless)

| COMENTARIOS | | |
|---|---|---|
| Capacidad de Carga Recomendada ($q_{adm}$) = | 2.00 | Kg/cm² |
| Modulo de Balasto (Ks)= | 2.40 | Kg/cm³ |

Realizado por: Aristides Carrasco C

NOTA: LA CAPACIDAD ELEGIDA ESTA DOMINADA POR ASENTAMIENTO PERMISIBLE

Factores de forma y prof fueron tomados de Bowless (Ed. 5 pag 222)

# ANEXO E

## Reporte de laboratorio

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.28 msnm

**SONDEO No.:** T8-01 **COORDENADAS:** 389180 m E 2048191 m N **NIVEL FREÁTICO:** 5.75 m

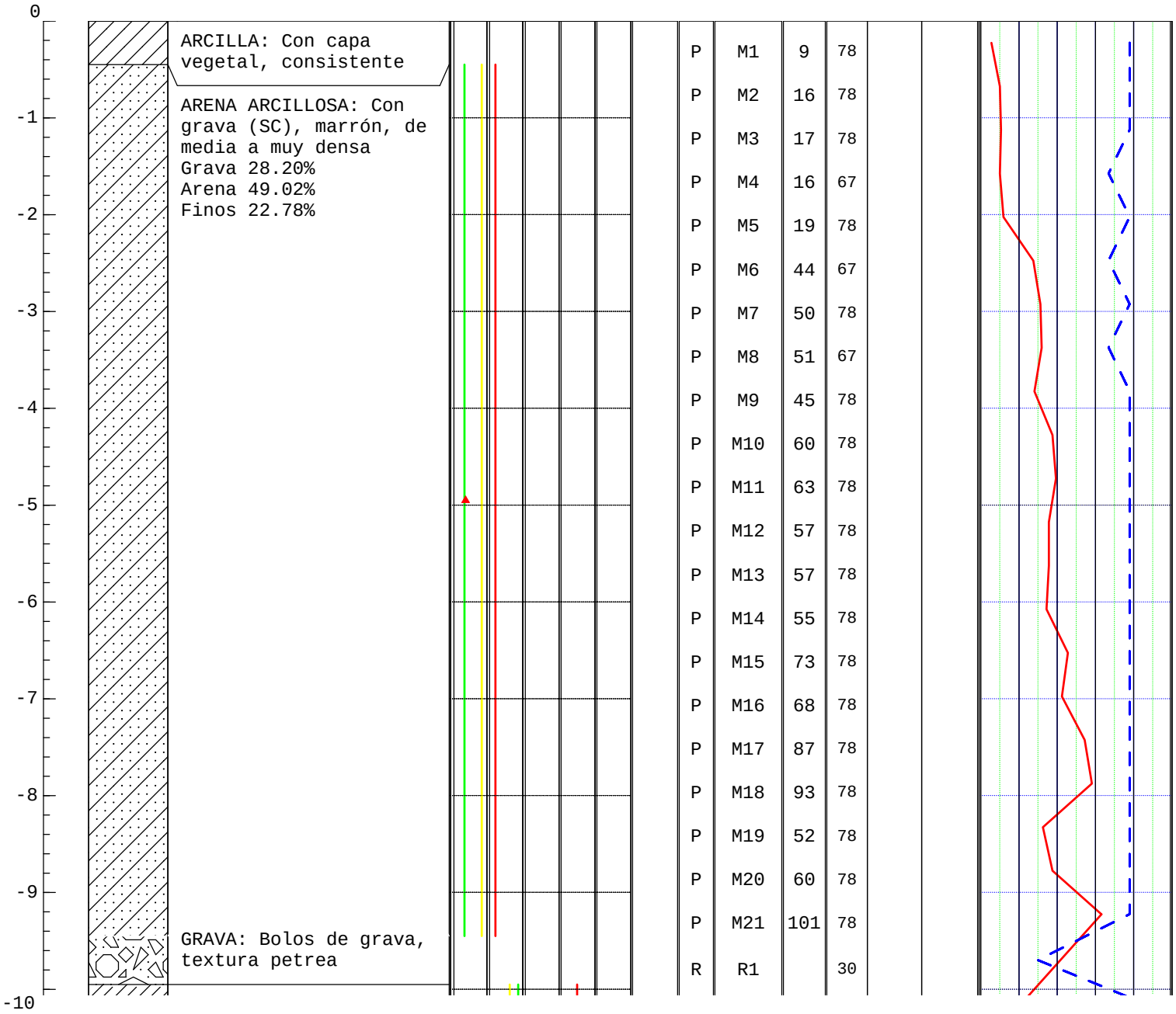
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 %



# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.28 msnm

**SONDEO No.:** T8-01 **COORDENADAS:** 389180 m E 2048191 m N **NIVEL FREÁTICO:** 5.75 m

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| -10 | | ARCILLA.: De alta plasticidad (CH), verde, consitencia dura<br>Grava 5.76%<br>Arena 9.84%<br>Finos 84.40% | | P | M22 | 32 | 89 | | |
| | | | | P | M23 | 55 | 78 | | |
| -11 | | | | P | M24 | 52 | 78 | | |
| | | | | P | M25 | 63 | 78 | | |
| -12 | | | | P | M26 | 73 | 78 | | |
| | | | | P | M27 | 73 | 78 | | |
| -13 | | | | P | M28 | 72 | 76 | | |
| | | | | P | M29 | 104 | 78 | | |
| -14 | | ARCILLA: Verde, recuperada en rotación | | R | R2 | | 55 | | |
| | | ARCILLA: Verde, dura | | P | M30 | >50 | 67 | | |
| -15 | | ARCILLA: Verde con grava, recuperada en rotación | | R | R3 | | 50 | | |
| -16 | | GRAVA: Con arena y arcilla, muy densa | | P | M31 | >50 | 100 | | |
| | | ARCILLA: Con arena y grava, verde, recuperada en rotación | | R | R4 | | 80 | | |
| -17 | | LUTITA: Marrón | | R | R5 | | 80 | | |
| -18 | | | | R | R6 | | 80 | | |
| -19 | | ARCILLA: Con arena y algo de grava, dura | | P | M32 | >50 | 83 | | |
| -20 | | ARENA: Arcilla y grava, recuperada en rotación | | R | R7 | | 40 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.28 msnm

**SONDEO No.:** T8-01 **COORDENADAS:** 389180 m E 2048191 m N **NIVEL FREÁTICO:** 5.75 m

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | LUTITA: Marrón | | | | | | | |
| -21 | | | | R | R8 | | 45 | | |
| -22 | | ARENA: con grava y arcilla, densa | | R | R9 | | 60 | | |
| | | LUTITA: Marrón | | P | M33 | >50 | 100 | | |
| -23 | | ARENA: Con arcilla y grava, dura | | R | R10 | | 50 | | |
| | | | | P | M34 | >50 | 83 | | |
| -24 | | LUTITA: Marrón | | R | R11 | | 35 | | |
| -25 | | | | R | R12 | | 30 | | |
| -26 | | GRAVA: Bolos de grava, textura petrea | | R | R13 | | 30 | | |
| -27 | | | | R | R14 | | 15 | | |
| -28 | | | | R | R15 | | 15 | | |
| -29 | | | | R | R16 | | 12 | | |
| -30 | | | | | | | | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.31 msnm

**SONDEO No.:** T8-02 **COORDENADAS:** 389199 m E 2048193 m N **NIVEL FREÁTICO:**

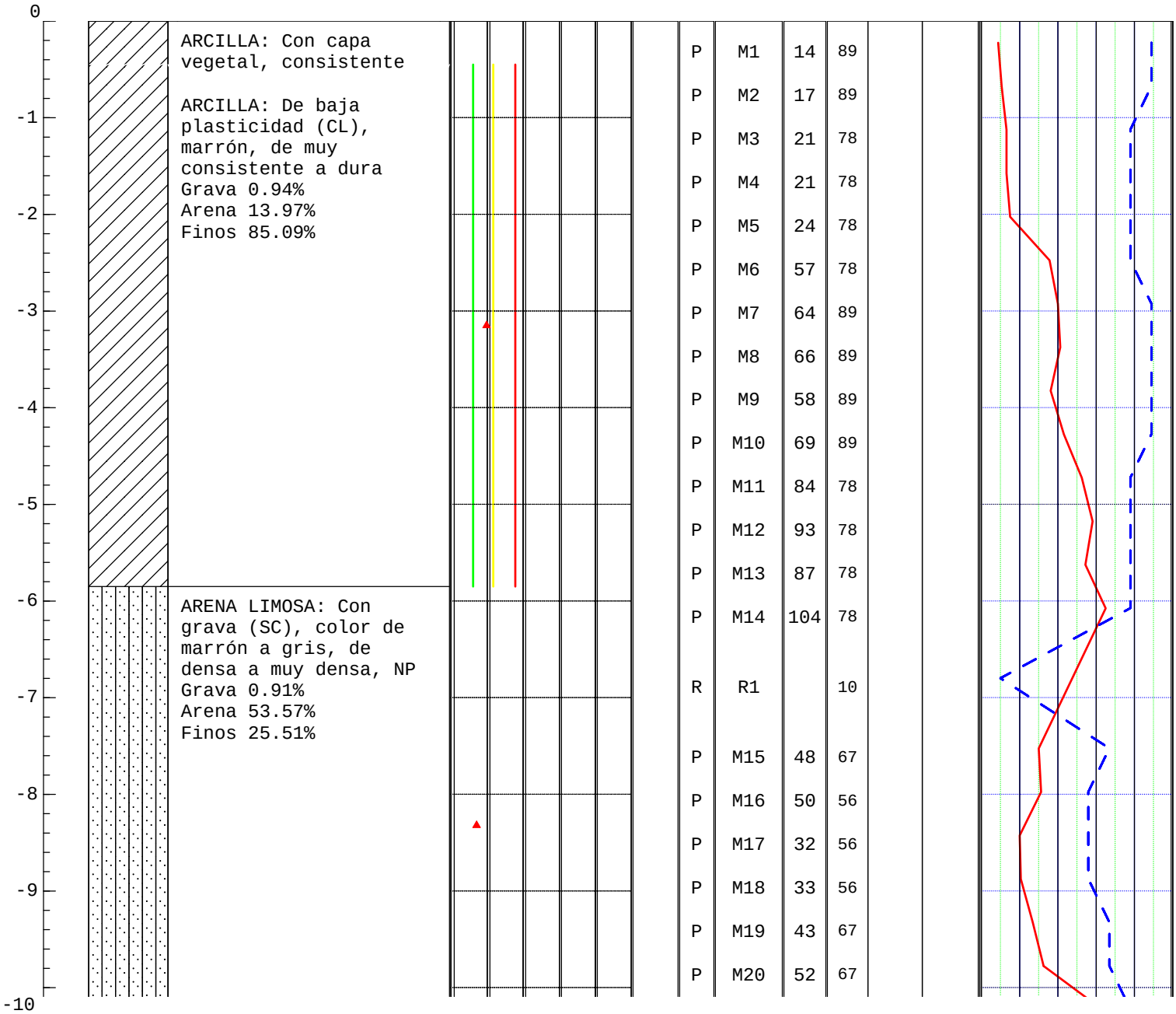
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 %




ARCILLA: Con capa vegetal, consistente

ARCILLA: De baja plasticidad (CL), marrón, de muy consistente a dura
Grava 0.94%
Arena 13.97%
Finos 85.09%

ARENA LIMOSA: Con grava (SC), color de marrón a gris, de densa a muy densa, NP
Grava 0.91%
Arena 53.57%
Finos 25.51%

| PROF. EN METROS | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|
| | | P | M1 | 14 | 89 | | |
| | | P | M2 | 17 | 89 | | |
| | | P | M3 | 21 | 78 | | |
| | | P | M4 | 21 | 78 | | |
| | | P | M5 | 24 | 78 | | |
| | | P | M6 | 57 | 78 | | |
| | | P | M7 | 64 | 89 | | |
| | | P | M8 | 66 | 89 | | |
| | | P | M9 | 58 | 89 | | |
| | | P | M10 | 69 | 89 | | |
| | | P | M11 | 84 | 78 | | |
| | | P | M12 | 93 | 78 | | |
| | | P | M13 | 87 | 78 | | |
| | | P | M14 | 104 | 78 | | |
| | | R | R1 | | 10 | | |
| | | P | M15 | 48 | 67 | | |
| | | P | M16 | 50 | 56 | | |
| | | P | M17 | 32 | 56 | | |
| | | P | M18 | 33 | 56 | | |
| | | P | M19 | 43 | 67 | | |
| | | P | M20 | 52 | 67 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.31 msnm

**SONDEO No.:** T8-02 **COORDENADAS:** 389199 m E 2048193 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|
| -10 | | | P | M21 | 101 | 78 | | |
| | No recuperado | | R | R2 | | 0 | | |
| -11 | ARCILLA.: De alta plasticidad con arena (CH), verde, consistencia dura Grava 8.50% Arena 17.24% Finos 74.26% | | P | M22 | 33 | 78 | | |
| | | | P | M23 | 31 | 78 | | |
| -12 | | | P | M24 | 32 | 78 | | |
| | | | R | M25 | 32 | 78 | | |
| -13 | | | P | M26 | 32 | 78 | | |
| | | | P | M27 | 65 | 78 | | |
| -14 | | | P | M28 | 69 | 78 | | |
| | | | P | M29 | 64 | 78 | | |
| -15 | | | P | M30 | 99 | 67 | | |
| | ARCILLA.: Arcilla de alta plasticidad (CH), verde, recuperada en rotación | | R | R3 | | 60 | | |
| -16 | | | | | | | | |
| | ARCILLA.: Arcilla de alta plasticidad con grava (CL), verde, consistencia dura | | R | R4 | | 50 | | |
| -17 | | | P | M31 | >50 | 100 | | |
| | ARCILLA.: Arcilla de alta plasticidad (CH), verde, recuperada en rotación | | R | R5 | | 55 | | |
| -18 | | | | | | | | |
| -19 | | | R | R6 | | 60 | | |
| -20 | LUTITA: Lutita, marrón | | | | | | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 66.31 msnm

**SONDEO No.:** T8-02 **COORDENADAS:** 389199 m E 2048193 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | | R | R7 | | 60 | | |
| -21 | | ARCILLA: De baja plasticidad arenosa (CL), marrón, consistencia dura | | P | M32 | 59 | 78 | | |
| | | | | P | M33 | 74 | 78 | | |
| -22 | | | | P | M34 | 77 | 76 | | |
| | | | | P | M35 | 86 | 89 | | |
| -23 | | | | P | M36 | 105 | 78 | | |
| | | LUTITA: Lutita, marrón | | R | R8 | | 40 | | |
| -24 | | | | | | | | | |
| | | ARCILLA: De baja plasticidad arenosa (CL), marrón oscuro, consistencia dura Grava 0.58% Arena 31.30% Finos 68.12% | | P | M37 | 55 | 78 | | |
| -25 | | | | P | M38 | 76 | 78 | | |
| | | | | P | M39 | 79 | 78 | | |
| | | | | P | M40 | 99 | 78 | | |
| -26 | | ARENA: Arenisca | | | | | | | |
| | | ARCILLA: De baja plasticidad arenosa (CL), marrón oscuro, consistencia dura Grava 0.58% Arena 31.30% Finos 68.12% | | R | R9 | | 35 | | |
| -27 | | | | P | M41 | >50 | 67 | | |
| -28 | | ARENA: Con grava recuperada en rotación | | R | R10 | | 25 | | |
| -29 | | ARENA: Arenisca con bolos de grava | | R | R11 | | 50 | | |
| | | GRAVA: Bolos de grava | | R | R12 | | 50 | | |
| -30 | | | | | | | | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8 Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 65.02 msnm

**SONDEO No.:** T8-03 **COORDENADAS:** 389218 m E 2048195 m N **NIVEL FREÁTICO:** 5.15 m

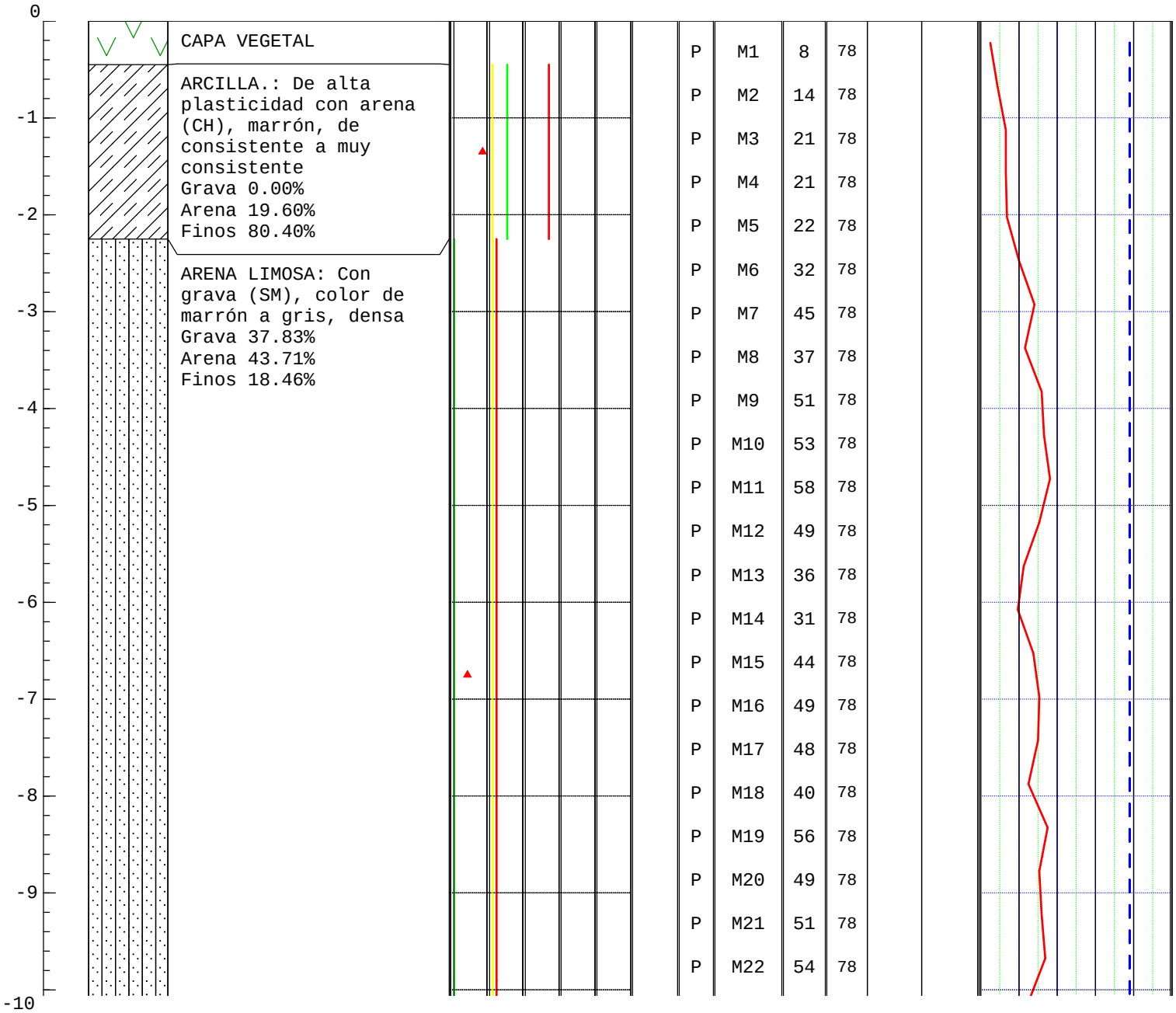
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 %



# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8 Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 65.02 msnm

**SONDEO No.:** T8-03 **COORDENADAS:** 389218 m E 2048195 m N **NIVEL FREÁTICO:** 5.15 m

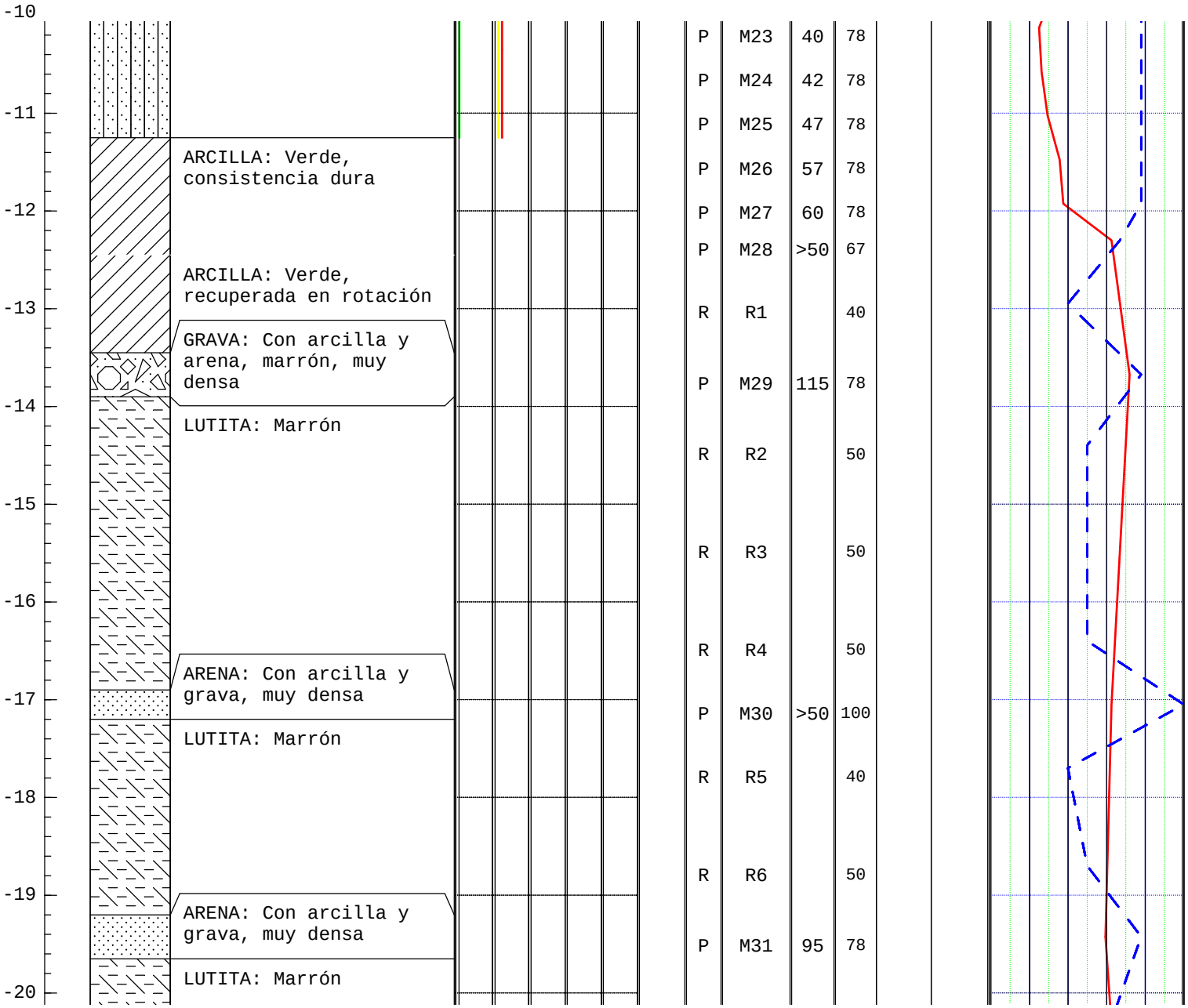
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 %



# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8 Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 65.02 msnm

**SONDEO No.:** T8-03 **COORDENADAS:** 389218 m E 2048195 m N **NIVEL FREÁTICO:** 5.15 m

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|
| | ARCILLA: Con grava y arena, dura | | R | R7 | | 65 | | |
| -21 | | | P | M32 | 103 | 78 | | |
| | LUTITA: Marrón | | | | | | | |
| -22 | | | R | R8 | | 88 | | |
| | GRAVA: Bolos de grava | | | | | | | |
| -23 | | | R | R9 | | 50 | | |
| | | | R | R10 | | 40 | | |
| -24 | | | | | | | | |
| | | | R | R11 | | 35 | | |
| -25 | | | | | | | | |
| | | | R | R12 | | 30 | | |
| -26 | | | | | | | | |
| | | | R | R13 | | 30 | | |
| -27 | ARCILLA.: De alta plasticidad (CH), verde, consistencia dura<br>Grava 4.44%<br>Arena 14.96%<br>Finos 80.60% | | P | M33 | 35 | 78 | | |
| | | | P | M34 | 59 | 78 | | |
| -28 | | | P | M35 | 74 | 78 | | |
| | | | P | M36 | 80 | 78 | | |
| -29 | | | P | M37 | 88 | 78 | | |
| | LUTITA: Marrón | | | | | | | |
| | | | R | R14 | | 100 | | |
| -30 | | | | | | | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 63.72 msnsm

**SONDEO No.:** T8-04 **COORDENADAS:** 389243 m E 2048198 m N **NIVEL FREÁTICO:**

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

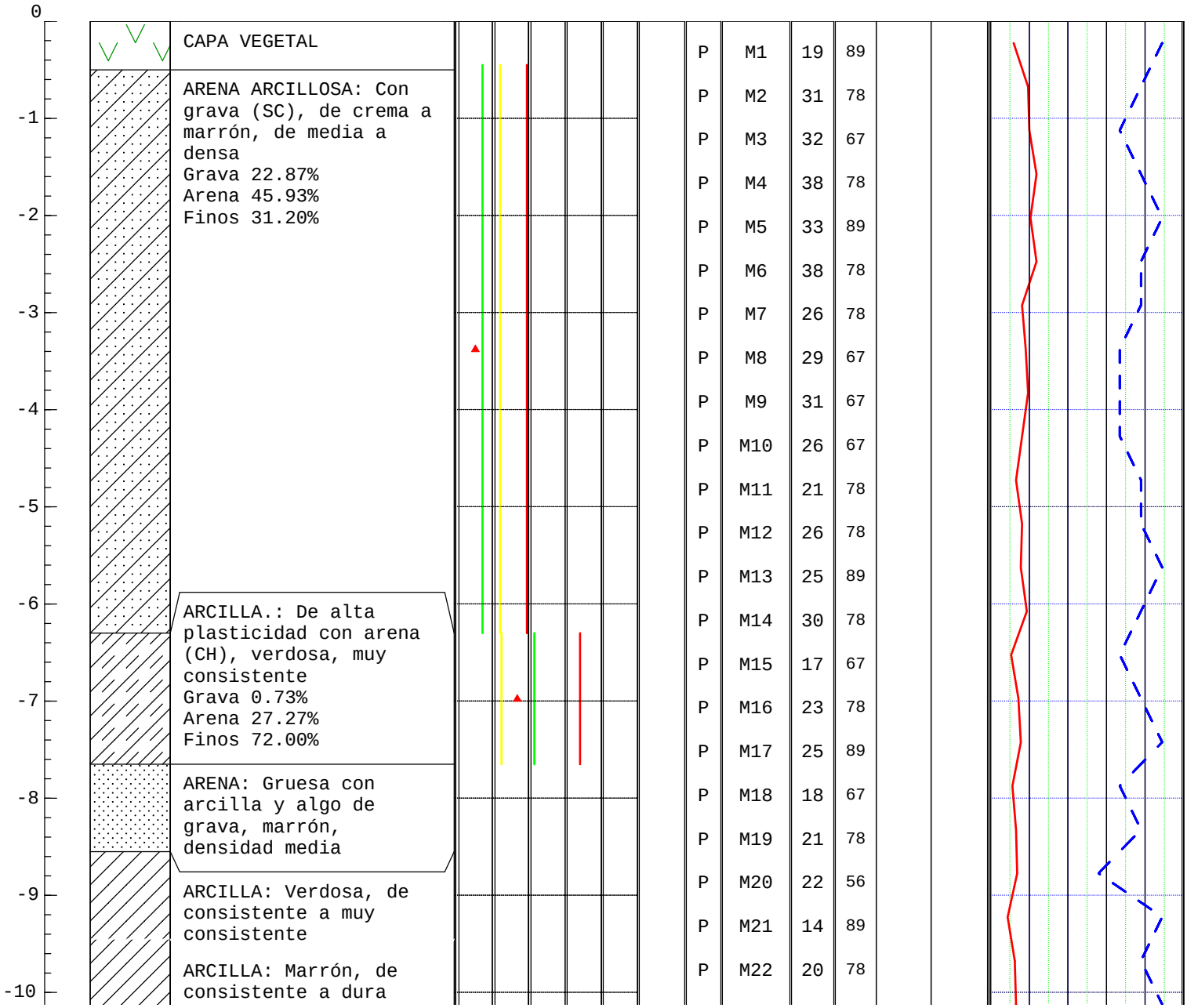
**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 17/3/2020
**FECHA FIN:** 17/3/2020

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 | su kPa | RQD




| Tipo de muestra | Número de muestra | N | Rec |
|---|---|---|---|
| P | M1 | 19 | 89 |
| P | M2 | 31 | 78 |
| P | M3 | 32 | 67 |
| P | M4 | 38 | 78 |
| P | M5 | 33 | 89 |
| P | M6 | 38 | 78 |
| P | M7 | 26 | 78 |
| P | M8 | 29 | 67 |
| P | M9 | 31 | 67 |
| P | M10 | 26 | 67 |
| P | M11 | 21 | 78 |
| P | M12 | 26 | 78 |
| P | M13 | 25 | 89 |
| P | M14 | 30 | 78 |
| P | M15 | 17 | 67 |
| P | M16 | 23 | 78 |
| P | M17 | 25 | 89 |
| P | M18 | 18 | 67 |
| P | M19 | 21 | 78 |
| P | M20 | 22 | 56 |
| P | M21 | 14 | 89 |
| P | M22 | 20 | 78 |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 63.72 msnsm

**SONDEO No.:** T8-04 **COORDENADAS:** 389243 m E 2048198 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 17/3/2020
**FECHA FIN:** 17/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | | | P | M23 | 21 | 89 | | |
| | | | | P | M24 | 20 | 89 | | |
| -11 | | | | P | M25 | 24 | 78 | | |
| | | | | P | M26 | 25 | 67 | | |
| -12 | | | | P | M27 | 55 | 89 | | |
| | | | | P | M28 | 66 | 78 | | |
| -13 | | | | P | M29 | 83 | 89 | | |
| | | LUTITA: De textura plastica, marrón | | | | | | | |
| -14 | | | | R | R1 | | 100 | | |
| -15 | | ARCILLA: De baja plasticidad (CL), marrón, consistencia dura<br>Grava 0.00%<br>Arena 7.93%<br>Finos 92.07% | | P | M30 | 37 | 78 | | |
| | | | | P | M31 | 40 | 89 | | |
| | | | | P | M32 | 56 | 89 | | |
| -16 | | | | P | M33 | 42 | 78 | | |
| | | | | P | M34 | 42 | 78 | | |
| -17 | | | | P | M35 | 44 | 78 | | |
| | | | | P | M36 | 47 | 89 | | |
| -18 | | | | P | M37 | 56 | 89 | | |
| | | | | P | M38 | 56 | 89 | | |
| -19 | | | | P | M39 | 44 | 78 | | |
| | | | | P | M40 | 53 | 89 | | |
| -20 | | ARCILLA: De baja plasticidad arenosa (CL), marrón, | | P | M41 | 58 | 89 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 63.72 msnsm

**SONDEO No.:** T8-04 **COORDENADAS:** 389243 m E 2048198 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 17/3/2020
**FECHA FIN:** 17/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| | | consistencia dura<br>Grava 0.00%<br>Arena 41.08%<br>Finos 58.92% | | P | M42 | 51 | 78 | | |
| | | | | P | M43 | 53 | 67 | | |
| -21 | | | | P | M44 | 62 | 67 | | |
| | | | | P | M45 | 53 | 78 | | |
| -22 | | | | P | M46 | 60 | 78 | | |
| | | | | P | M47 | 62 | 67 | | |
| -23 | | | | P | M48 | 45 | 89 | | |
| | | | | P | M49 | 63 | 89 | | |
| | | ARENA ARCILLOSA: (SC), marrón, muy densa | | P | M50 | 69 | 78 | | |
| -24 | | Grava 14.00%<br>Arena 57.04%<br>Finos 28.96% | | P | M51 | 71 | 78 | | |
| | | | | P | M52 | 61 | 67 | | |
| -25 | | ARCILLA: De baja plasticidad (CL), marrón, consistencia dura | | P | M53 | 72 | 67 | | |
| | | | | P | M54 | 54 | 78 | | |
| -26 | | Grava 0.03%<br>Arena 5.42%<br>Finos 94.55% | | P | M55 | 36 | 89 | | |
| | | | | P | M56 | 36 | 78 | | |
| -27 | | | | P | M57 | 37 | 67 | | |
| | | | | P | M58 | 35 | 67 | | |
| -28 | | | | P | M59 | 48 | 78 | | |
| | | | | P | M60 | 55 | 89 | | |
| | | | | P | M61 | 56 | 89 | | |
| -29 | | | | P | M62 | 54 | 78 | | |
| | | | | P | M63 | 54 | 67 | | |
| -30 | | | | P | M64 | 64 | 78 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 63.95 msnm

**SONDEO No.:** E8-01 **COORDENADAS:** 389194 m E 2048257 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | ARCILLA: Con restos de capa vegetal, marrón rojizo, consistente | | P | M1 | 10 | 67 | | |
| | | | | P | M2 | 15 | 67 | | |
| -1 | | ARENA ARCILLOSA: Con grava (SC), marrón grisaceo con tonos verdes, de media a densa<br>Grava 40.42%<br>Arena 42.73%<br>Finos 16.85% | | P | M3 | 36 | 67 | | |
| | | | | P | M4 | 36 | 67 | | |
| -2 | | | | P | M5 | 26 | 67 | | |
| | | | | P | M6 | 77 | 67 | | |
| -3 | | | | P | M7 | 47 | 67 | | |
| | | ARCILLA.: De alta plasticidad con arena (CH), verde, de muy consistente a dura<br>Grava 2.87%<br>Arena 16.34%<br>Finos 80.79% | | P | M8 | 38 | 67 | | |
| -4 | | | | P | M9 | 22 | 67 | | |
| | | | | P | M10 | 28 | 67 | | |
| | | | | P | M11 | 31 | 67 | | |
| -5 | | | | P | M12 | 46 | 67 | | |
| | | | | P | M13 | 41 | 67 | | |
| -6 | | | | P | M14 | 31 | 67 | | |
| | | | | P | M15 | 35 | 67 | | |
| -7 | | | | P | M16 | 31 | 67 | | |
| | | | | P | M17 | 41 | 67 | | |
| -8 | | | | P | M18 | 62 | 67 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 64.31 msnm

**SONDEO No.:** E8-02 **COORDENADAS:** 389176 m E 2048249 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | CAPA VEGETAL: Con arcilla, marrón | | P | M1 | 9 | 67 | | |
| | | ARCILLA: De baja plasticidad con arena (CL), marrón, mu consistente<br>Grava 0.19%<br>Arena 19.46%<br>Finos 80.35% | | P | M2 | 14 | 67 | | |
| -1 | | | | P | M3 | 26 | 67 | | |
| | | | | P | M4 | 27 | 67 | | |
| -2 | | ARENA ARCILLOSA: Con grava (SC), marrón con tonos grises, de media a densa<br>Grava 24.85%<br>Arena 52.78%<br>Finos 22.37% | | P | M5 | 46 | 67 | | |
| | | | | P | M6 | 32 | 67 | | |
| -3 | | | | P | M7 | 25 | 67 | | |
| | | | | P | M8 | 27 | 67 | | |
| -4 | | | | P | M9 | 30 | 67 | | |
| | | No recuperado | | P | M10 | 29 | 0 | | |
| | | ARCILLA.: De alta plasticidad (CH), verde, de muy consistente a dura<br>Grava 5.32%<br>Arena 11.51%<br>Finos 83.18% | | P | M11 | 22 | 67 | | |
| -5 | | | | P | M12 | 36 | 67 | | |
| | | | | P | M13 | 39 | 67 | | |
| -6 | | | | P | M14 | 26 | 67 | | |
| | | | | P | M15 | 28 | 67 | | |
| -7 | | | | P | M16 | 30 | 67 | | |
| | | | | P | M17 | 53 | 67 | | |
| -8 | | | | P | M18 | 71 | 67 | | |
| | | | | P | M19 | 72 | 67 | | |
| -9 | | | | P | M20 | 74 | 67 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 63.95 msnm

**SONDEO No.:** E8-03 **COORDENADAS:** 389213 m E 2048252 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 10/3/2020
**FECHA FIN:** 10/3/2020

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 | su kPa | RQD

0

ARCILLA: De baja plasticidad arenosa (CL), marrón oscuro, consistente
Grava 2.61%
Arena 37.73%
Finos 59.65%

ARENA ARCILLOSA: Limosa con grava (SC-SM), marrón grisaceo con tonos verdes, de media a densa
Grava 32.62%
Arena 45.05%
Finos 22.33%

ARCILLA.: De alta plasticidad (CH), verde, de consistente a dura
Grava 0.92%
Arena 12.29%
Finos 86.78%

| Tipo de muestra | Número de muestra | N | Rec |
|---|---|---|---|
| P | M1 | 10 | 67 |
| P | M2 | 11 | 67 |
| P | M3 | 16 | 67 |
| P | M4 | 30 | 67 |
| P | M5 | 33 | 67 |
| P | M6 | 32 | 67 |
| P | M7 | 43 | 67 |
| P | M8 | 42 | 67 |
| P | M9 | 12 | 67 |
| P | M10 | 17 | 67 |
| P | M11 | 26 | 67 |
| P | M12 | 32 | 67 |
| P | M13 | 34 | 67 |
| P | M14 | 31 | 67 |
| P | M15 | 35 | 67 |
| P | M16 | 34 | 67 |
| P | M17 | 30 | 67 |
| P | M18 | 33 | 67 |
| P | M19 | 43 | 67 |
| P | M20 | 41 | 67 |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 64.83 m

**SONDEO No.:** E8-04 **COORDENADAS:** 389182 m E 2048230 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | ARCILLA: Marrón, con restos de capa vegetal, consistencia media | | P | M1 | 7 | 67 | | |
| | | | | P | M2 | 11 | 67 | | |
| -1 | | ARCILLA.: De alta plasticidad (CH), marrón, de consistente a muy consistente<br>Grava 0.00%<br>Arena 9.85%<br>Finos 90.15% | | P | M3 | 18 | 67 | | |
| | | | | P | M4 | 29 | 67 | | |
| -2 | | | | P | M5 | 30 | 67 | | |
| | | | | P | M6 | 31 | 67 | | |
| -3 | | ARENA ARCILLOSA: Con grava (SC), marrón con tonos grises, de media a densa<br>Grava 36.39%<br>Arena 44.20%<br>Finos 19.41% | | P | M7 | 27 | 67 | | |
| | | | | P | M8 | 32 | 67 | | |
| -4 | | | | P | M9 | 35 | 67 | | |
| | | | | P | M10 | 20 | 67 | | |
| | | | | P | M11 | 31 | 67 | | |
| -5 | | | | P | M12 | 33 | 67 | | |
| | | | | P | M13 | 19 | 67 | | |
| -6 | | | | P | M14 | 32 | 67 | | |
| | | ARCILLA.: De alta plasticidad (CH), verde, muy consistente<br>Grava 5.13%<br>Arena 1.40%<br>Finos 93.47% | | P | M15 | 16 | 67 | | |
| -7 | | | | P | M16 | 21 | 67 | | |
| | | | | P | M17 | 24 | 67 | | |
| -8 | | | | P | M18 | 22 | 67 | | |
| | | | | P | M19 | 29 | 67 | | |
| -9 | | | | P | M20 | 29 | 67 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 65.02 msnm

**SONDEO No.:** E8-05 **COORDENADAS:** 389199 m E 2048237 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 | DESCRIPCIÓN | Nivel de degradación | Tipo de muestra | Número de muestra | N | Rec | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|---|
| 0 | | ARCILLA: Marrón, con restos de capa vegetal, consistente | | P | M1 | 9 | 67 | | |
| | | | | P | M2 | 11 | 67 | | |
| -1 | | ARCILLA.: De alta plasticidad (CH), marrón, de consistente a dura<br>Grava 0.00%<br>Arena 3.56%<br>Finos 96.44% | | P | M3 | 11 | 67 | | |
| | | | | P | M4 | 13 | 67 | | |
| -2 | | | | P | M5 | 14 | 67 | | |
| | | | | P | M6 | 26 | 67 | | |
| -3 | | | | P | M7 | 33 | 67 | | |
| | | GRAVA ARCILLOSA: Con arena (GC), marrón con tonos grises, densa<br>Grava 45.14%<br>Arena 35.82%<br>Finos 19.04% | | P | M8 | 39 | 67 | | |
| -4 | | | | P | M9 | 44 | 67 | | |
| | | | | P | M10 | 43 | 67 | | |
| -5 | | | | P | M11 | 35 | 67 | | |
| | | | | P | M12 | 32 | 67 | | |
| | | ARCILLA.: De alta plasticidad arenosa (CH), verde, de consistente a dura<br>Grava 0.00%<br>Arena 49.95%<br>Finos 50.05% | | P | M13 | 12 | 67 | | |
| -6 | | | | P | M14 | 19 | 67 | | |
| | | | | P | M15 | 20 | 67 | | |
| -7 | | | | P | M16 | 21 | 67 | | |
| | | | | P | M17 | 28 | 67 | | |
| -8 | | | | P | M18 | 42 | 67 | | |
| | | | | P | M19 | 37 | 67 | | |
| -9 | | | | P | M20 | 38 | 67 | | |
| | | | | P | M21 | 40 | 67 | | |
| | | | | P | M22 | 33 | 67 | | |
| -10 | | | | P | M23 | 42 | 67 | | |

# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 64.76 msnm

**SONDEO No.:** E8-06 **COORDENADAS:** 389178 m E 2048210 m N **NIVEL FREÁTICO:**

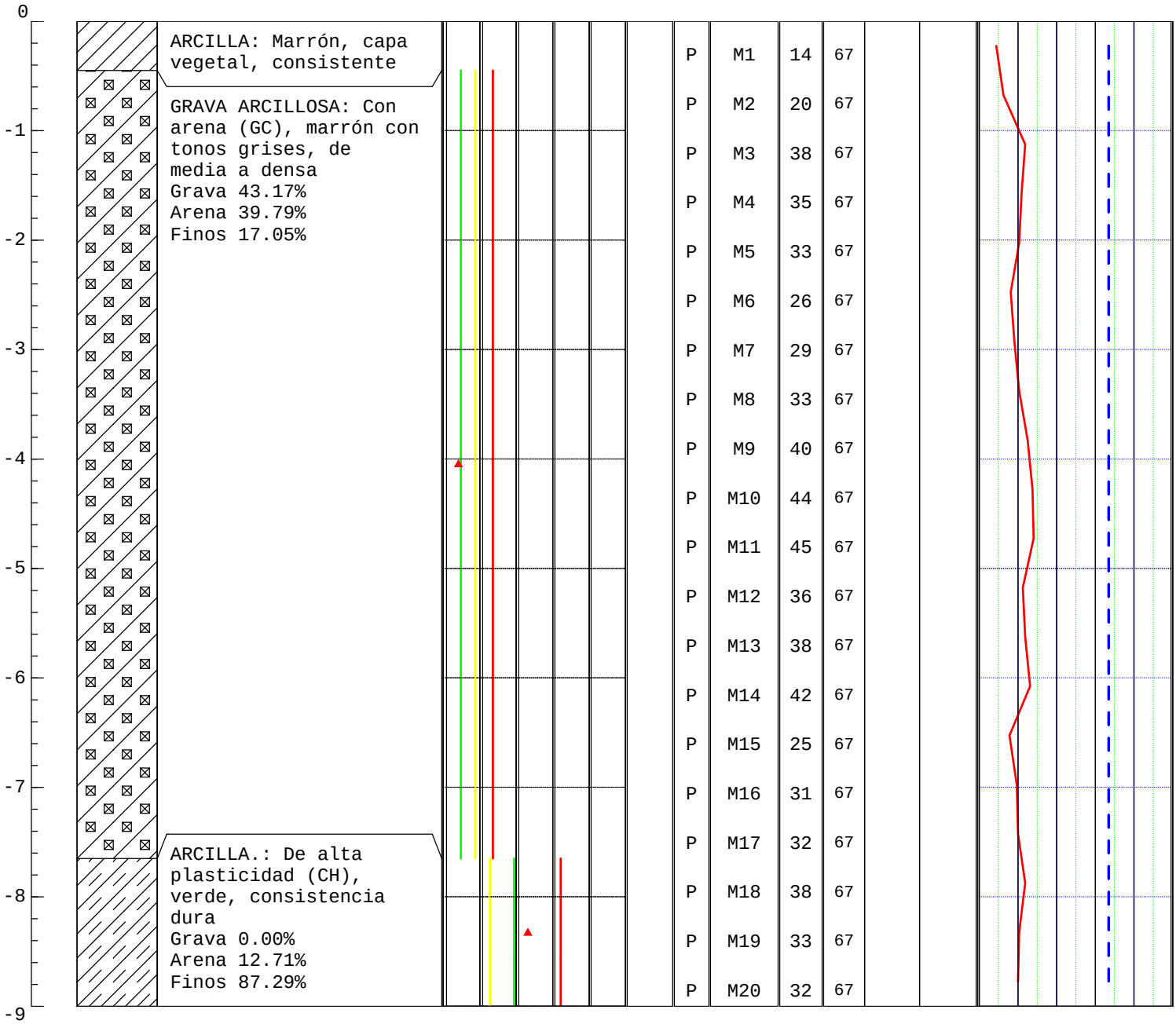
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 %



# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 64.82 msnm

**SONDEO No.:** E8-07 **COORDENADAS:** 389197 m E 2048215 m N **NIVEL FREÁTICO:**

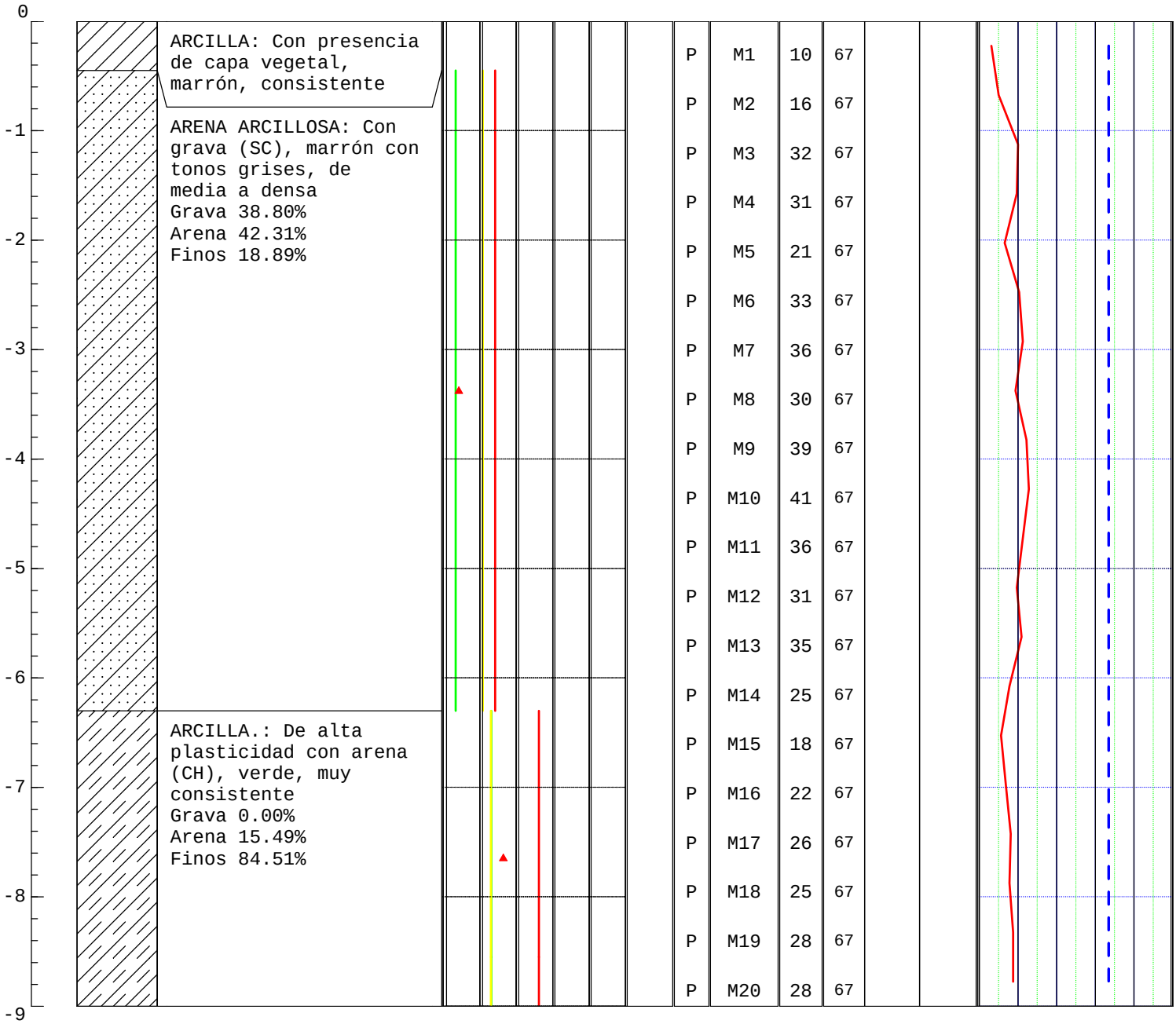
INGESA
INGENIERÍA GLOBAL ESPECIALIZADA
Calle B, No. 1, Arroyo Hondo Viejo
Tel. 809-562-1047/1075

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 11/3/2020
**FECHA FIN:** 11/3/2020

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 %



# ESTRATIGRAFIA

**PROYECTO:** Metro Cable Estación 8, Los Alcarrizos

**CLIENTE:** J Fortuna **ELEVACIÓN:** 64.46 msnm

**SONDEO No.:** E8-08 **COORDENADAS:** 389215 m E 2048224 m N **NIVEL FREÁTICO:**

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

**ING. DE CAMPO:** JV
**EDITADO POR:** AC
**SUPERVISADO POR:** AC
**FECHA INICIO:** 9/3/2020
**FECHA FIN:** 9/3/2020

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 | su kPa | RQD |
|---|---|---|---|---|---|---|---|---|
| 0 | ARCILLA.: De alta plasticidad (CH), marrón con tonos verdes, de consistente a muy consistente<br>Grava 0.00%<br>Arena 1.69%<br>Finos 98.31% | | P | M1 | 10 | 67 | | |
| | | | P | M2 | 11 | 67 | | |
| -1 | | | P | M3 | 15 | 67 | | |
| | | | P | M4 | 19 | 67 | | |
| -2 | GRAVA ARCILLOSA: Con arena (GC), marrón con tonos grises, de media a densa<br>Grava 50.84%<br>Arena 36.68%<br>Finos 12.49% | | P | M5 | 35 | 67 | | |
| | | | P | M6 | 34 | 67 | | |
| -3 | | | P | M7 | 26 | 67 | | |
| | | | P | M8 | 33 | 67 | | |
| -4 | ARCILLA.: De alta plasticidad (CH), verde, (M9 con presencia de cuarzo), de consistente a dura<br>Grava 0.00%<br>Arena 6.89%<br>Finos 93.11% | | P | M9 | 16 | 67 | | |
| | | | P | M10 | 17 | 67 | | |
| -5 | | | P | M11 | 10 | 67 | | |
| | | | P | M12 | 17 | 67 | | |
| | | | P | M13 | 16 | 67 | | |
| -6 | | | P | M14 | 25 | 67 | | |
| | | | P | M15 | 26 | 67 | | |
| -7 | | | P | M16 | 23 | 67 | | |
| | | | P | M17 | 25 | 67 | | |
| -8 | | | P | M18 | 24 | 67 | | |
| | | | P | M19 | 60 | 67 | | |
| -9 | | | P | M20 | 71 | 67 | | |

# REPORTE DE LABORATORIO
# ING-LAB-2020

## Proyecto: SONDEOS GEOTECNICOS METRO CABLE ESTACIÓN 08, LOS ALCARRIZOS, SANTO DOMINGO OESTE, R.D.

## Componente: ENSAYOS DE MUESTRA DE SUELO ASTM D2487 – ASTM D2216 - ASTM D4318

| Rev | Fecha | Descripción | Prep. | Rev. | Aprob. |
|---|---|---|---|---|---|
| 00 | 16/10/2020 | Reporte de Resultados para revisión | EBD | EGP | ACC |
| | | | | | |
| | | | | | |

# RESULTADOS DE ENSAYOS DE LABORATORIO EN MUESTRAS DE SUELO METRO CABLE ESTACIÓN 08, 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 Estación 08, Los Alcarrizos, Santo Domingo Oeste, R. D.

**Fecha:** 16 de Octubre del 2020

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Estimados Señores,

El presente reporte detalla los resultados de los ensayos de laboratorio realizados a las muestras de suelo extraídas el viernes 06 de marzo del 2020, mediante doce (12) sondeos geotécnicos realizados a profundidades variables de 7.20 a 30.95 m de profundidad, ejecutados en Metro Cable Estación 08, 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 | | | |
| 02/06/2020 | Sondeo E8-01 Muestra M3-M7 | 40.42 | 42.73 | 16.85 | (SC) Arena arcillosa con grava | 6.59 | 27.14 | 10.73 |
| 02/06/2020 | Sondeo E8-01 Muestra M8-M18 | 2.87 | 16.34 | 80.79 | (CH) Arcilla de alta plasticidad | 26.66 | 53.88 | 32.22 |
| 02/06/2020 | Sondeo E8-02 Muestra M2-M3 | 0.19 | 19.46 | 80.35 | (CL) Arcilla de baja plasticidad con arena | 17.37 | 42.84 | 21.57 |
| 02/06/2020 | Sondeo E8-02 Muestra M4-M9 | 24.85 | 52.78 | 22.37 | (SC) Arena arcillosa con grava | 7.49 | 25.24 | 37.10 |
| 02/06/2020 | Sondeo E8-02 Muestra M11-M20 | 5.32 | 11.51 | 83.18 | (CH) Arcilla de alta plasticidad | 40.85 | 73.74 | 8.51 |
| 02/06/2020 | Sondeo E8-03 Muestra M1-M2 | 2.61 | 37.73 | 59.65 | (CL) Arcilla de baja plasticidad arenosa | 10.07 | 32.69 | 25.17 |
| 02/06/2020 | Sondeo E8-03 Muestra M3-M8 | 32.62 | 45.05 | 22.33 | (SC) Arena arcillosa-limosa con grava | 4.81 | 25.01 | 8.20 |
| 02/06/2020 | Sondeo E8-03 Muestra M9-M20 | 0.92 | 12.29 | 86.78 | (CH) Arcilla de alta plasticidad | 33.85 | 63.30 | 34.09 |
| 02/06/2020 | Sondeo E8-04 Muestra M2-M4 | 0.00 | 9.85 | 90.15 | (CH) Arcilla de alta plasticidad | 23.14 | 50.60 | 28.50 |
| 02/06/2020 | Sondeo E8-04 Muestra M5-M12 | 36.39 | 44.20 | 19.41 | (SC) Arena arcillosa con grava | 6.65 | 27.03 | 8.06 |
| 02/06/2020 | Sondeo E8-04 Muestra M15-M20 | 5.13 | 1.40 | 93.47 | (CH) Arcilla de alta plasticidad | 44.09 | 79.39 | 37.72 |
| 02/06/2020 | Sondeo E8-05 Muestra M2-M7 | 0.00 | 3.56 | 96.44 | (CH) Arcilla de alta plasticidad | 23.85 | 50.55 | 28.77 |
| 02/06/2020 | Sondeo E8-05 Muestra M8-M12 | 45.14 | 35.82 | 19.04 | (GC) Grava arcillosa con arena | 13.50 | 31.24 | 10.78 |
| 02/06/2020 | Sondeo E8-05 Muestra M13-M23 | 0.00 | 49.95 | 50.05 | (CH) Arcilla de alta plasticidad arenosa | 46.80 | 75.42 | 33.34 |

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

| Fecha Ensayo | Material | % Grava | % Arena | % de finos | Clasificación SUCS | IP | LL | Cont. Humedad |
|---|---|---|---|---|---|---|---|---|
| 02/06/2020 | Sondeo E8-06 Muestra M2-M17 | 43.17 | 39.79 | 17.05 | (GC) Grava arcillosa con arena | 9.65 | 27.23 | 6.63 |
| 02/06/2020 | Sondeo E8-06 Muestra M18-M20 | 0.00 | 12.71 | 87.29 | (CH) Arcilla de alta plasticidad | 38.83 | 64.37 | 45.03 |
| 02/06/2020 | Sondeo E8-07 Muestra M2-M14 | 38.80 | 42.31 | 18.89 | (SC) Arena arcillosa con grava | 6.79 | 28.45 | 6.86 |
| 02/06/2020 | Sondeo E8-07 Muestra M15-M20 | 0.00 | 15.49 | 84.51 | (CH) Arcilla de alta plasticidad con arena | 26.32 | 52.42 | 31.47 |
| 02/06/2020 | Sondeo E8-08 Muestra M1-M4 | 0.00 | 1.69 | 98.31 | (CH) Arcilla de alta plasticidad | 27.94 | 54.93 | 25.37 |
| 02/06/2020 | Sondeo E8-08 Muestra M5-M8 | 50.84 | 36.68 | 12.49 | (GC) Grava arcillosa con arena | 7.78 | 25.39 | 7.95 |
| 02/06/2020 | Sondeo E8-08 Muestra M9-M20 | 0.00 | 6.89 | 93.11 | (CH) Arcilla de alta plasticidad | 33.88 | 62.38 | 36.26 |
| 02/06/2020 | Sondeo T8-01 Muestra M2-M21 | 28.20 | 49.02 | 22.78 | (SC) Arena arcillosa con grava | 7.59 | 24.77 | 6.55 |
| 02/06/2020 | Sondeo T8-01 Muestra M22-M29 | 5.76 | 9.84 | 84.40 | (CH) Arcilla de alta plasticidad | 37.43 | 70.12 | 38.53 |
| 02/06/2020 | Sondeo T8-02 Muestra M2-M13 | 0.94 | 13.97 | 85.09 | (CL) Arcilla de baja plasticidad | 12.25 | 35.65 | 18.11 |
| 02/06/2020 | Sondeo T8-02 Muestra M14-M21 | 20.91 | 53.57 | 25.51 | (SM) Arena limosa con grava | NO PLASTICO | | 12.57 |
| 02/06/2020 | Sondeo T8-02 Muestra M22-M30 | 8.50 | 17.24 | 74.26 | (CH) Arcilla de alta plasticidad con arena | 42.01 | 73.45 | 29.53 |
| 02/06/2020 | Sondeo T8-02 Muestra M37-M41 | 0.58 | 31.30 | 68.12 | (CL) Arcilla de baja plasticidad arenosa | 9.47 | 28.08 | 23.78 |
| 02/06/2020 | Sondeo T8-03 Muestra M2-M5 | 0.00 | 19.60 | 80.40 | (CH) Arcilla de alta plasticidad con arena | 31.32 | 54.44 | 16.10 |
| 02/06/2020 | Sondeo T8-03 Muestra M6-M25 | 37.83 | 43.71 | 18.46 | (SM) Arena limosa con grava | 1.95 | 25.40 | 7.59 |
| 02/06/2020 | Sondeo T8-03 Muestra M33-M37 | 4.44 | 14.96 | 80.60 | (CH) Arcilla de alta plasticidad | 26.80 | 53.84 | 31.61 |

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

| Fecha Ensayo | Material | % Grava | % Arena | % de finos | Clasificación SUCS | IP | LL | Cont. Humedad |
|---|---|---|---|---|---|---|---|---|
| 02/06/2020 | Sondeo T8-04 Muestra M3-M14 | 22.87 | 45.93 | 31.20 | (SC) Arena arcillosa con grava | 14.71 | 39.13 | 9.16 |
| 02/06/2020 | Sondeo T8-04 Muestra M15-M17 | 0.73 | 27.27 | 72.00 | (CH) Arcilla de alta plasticidad con arena | 43.23 | 68.34 | 32.35 |
| 02/06/2020 | Sondeo T8-04 Muestra M30-M40 | 0.00 | 7.93 | 92.07 | (CL) Arcilla de baja plasticidad | 7.73 | 26.12 | 26.49 |
| 02/06/2020 | Sondeo T8-04 Muestra M41-M50 | 0.00 | 41.08 | 58.92 | (CL) Arcilla de baja plasticidad arenosa | 7.43 | 24.96 | 15.56 |
| 02/06/2020 | Sondeo T8-04 Muestra M51-M52 | 14.00 | 57.04 | 28.96 | (SC) Arena arcillosa | 7.67 | 25.14 | 5.75 |
| 02/06/2020 | Sondeo T8-04 Muestra M53-M64 | 0.03 | 5.42 | 94.55 | (CL) Arcilla de baja plasticidad arenosa | 13.80 | 37.37 | 23.88 |

**Tabla 1. Ensayos de Clasificación.**

Por Ingeniería Global Especializada

Muy atentamente

Emil E. Güilamo Pichardo

Manuel Castillo
Gerente de Laboratorio

Kilvio Arias
Técnico de Laboratorio

INGENIERIA GLOBAL ESPECIALIZADA
INGESA

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# RESULTADOS ASTM D2487

## SISTEMA UNIFICADO DE CLASIFICACION DE SUELO

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

Fecha de Ensayo: 02/06/2020

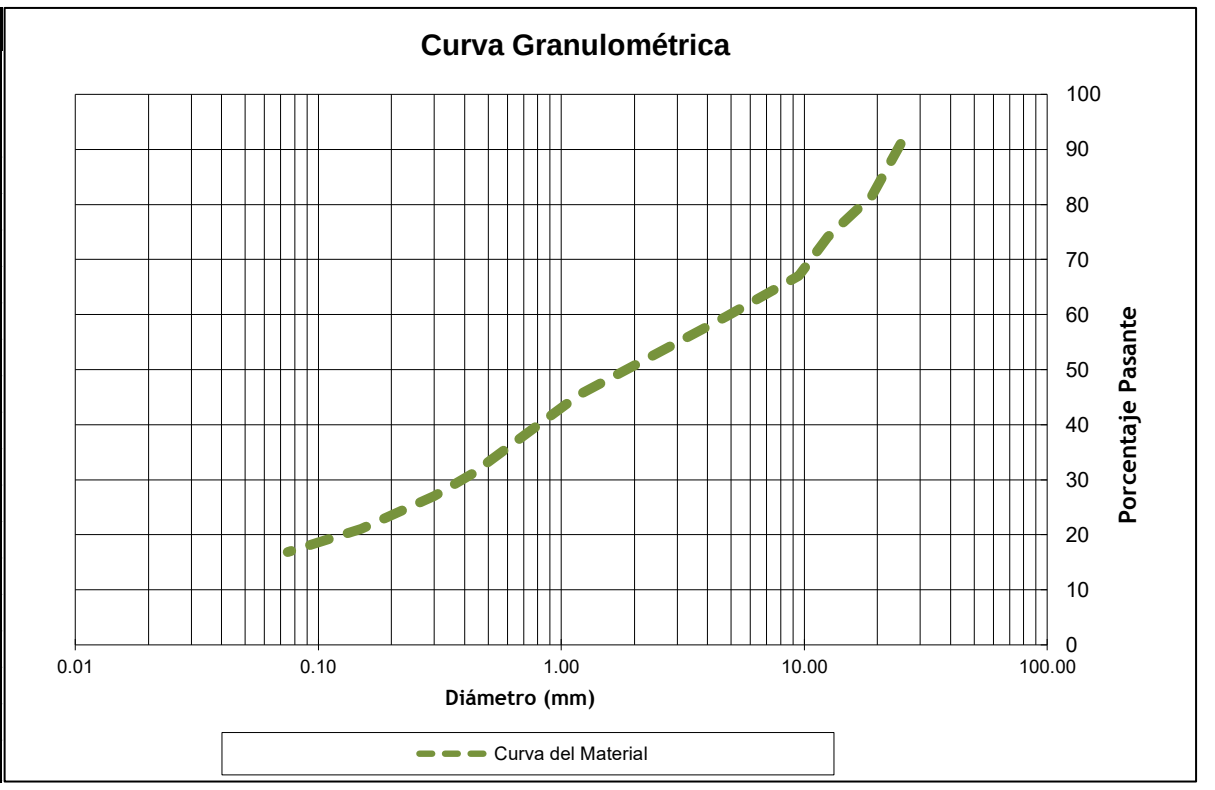
| | |
|---|---|
| ID Muestra: | Sondeo E8-01 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#39 (M3-M7) |
| Profundidad: | 0.90-3.15 m |

| | |
|---|---|
| Peso Sucio | **242.70** |
| Peso seco (gr): | **202.80** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | 21.80 | 8.98 | 8.98 | 91.02 |
| 3/4" | 19.00 | 22.80 | 9.39 | 18.38 | 81.62 |
| 1/2" | 12.50 | 18.30 | 7.54 | 25.92 | 74.08 |
| 3/8" | 9.50 | 17.00 | 7.00 | 32.92 | 67.08 |
| No.4 | 4.75 | 18.20 | 7.50 | 40.42 | 59.58 |
| No.10 | 2.00 | 21.40 | 8.82 | 49.24 | 50.76 |
| No.16 | 1.18 | 13.10 | 5.40 | 54.64 | 45.36 |
| No.40 | 0.43 | 34.60 | 14.26 | 68.89 | 31.11 |
| No.50 | 0.3 | 9.80 | 4.04 | 72.93 | 27.07 |
| No.100 | 0.15 | 14.60 | 6.02 | 78.95 | 21.05 |
| No.200 | 0.075 | 10.20 | 4.20 | 83.15 | 16.85 |
| Pan | | 1.00 | 0.41 | 83.56 | |

0

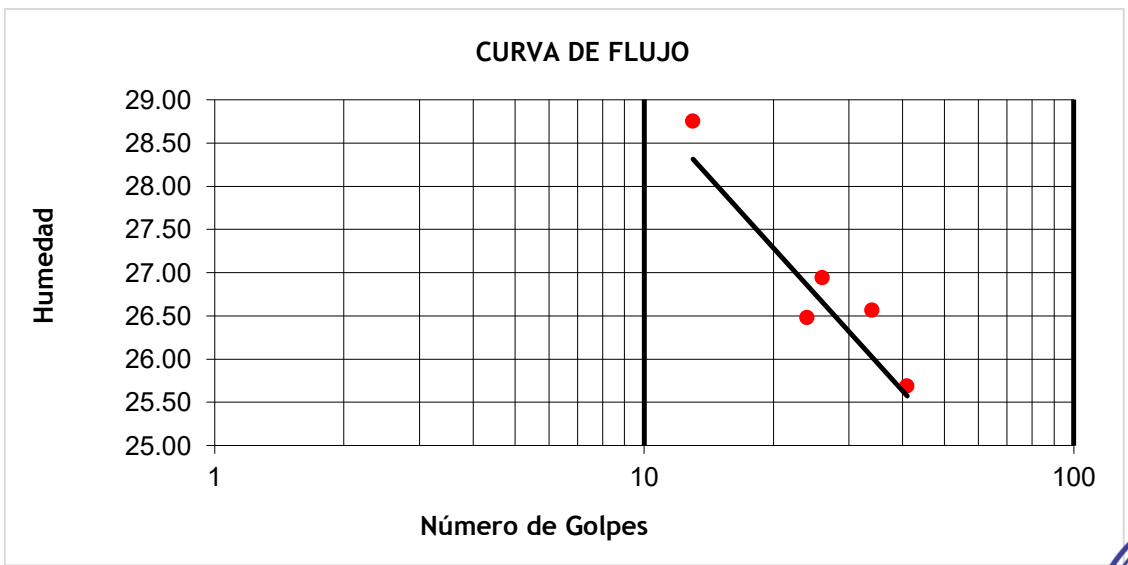


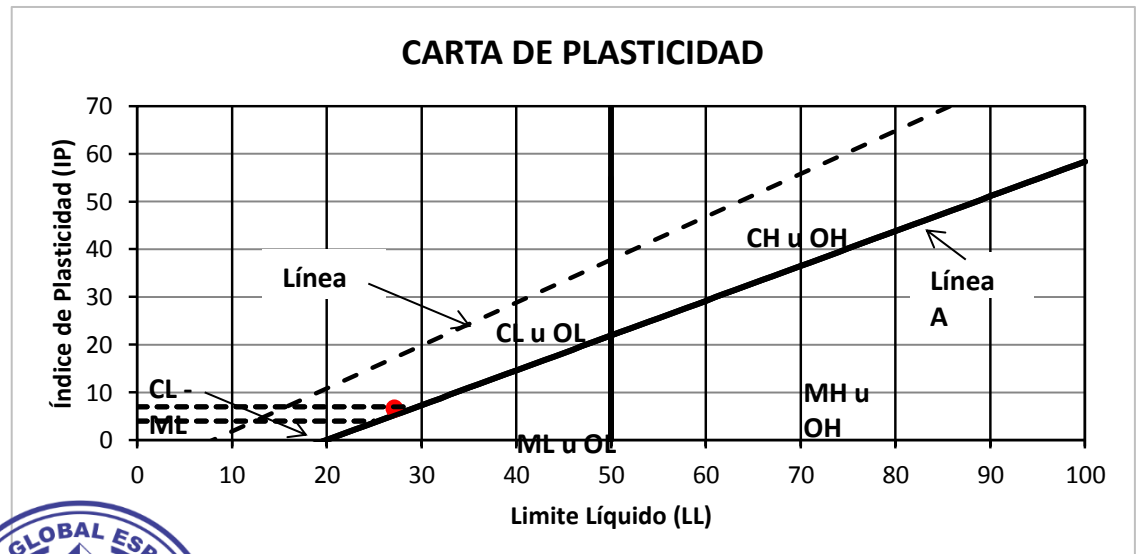

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 13 | 24 | 26 | 34 | 41 | | | |
| B) Número del recipiente | P10 | P7 | P12 | I4 | P6 | O4 | O10 | 2 |
| C) Peso del recip. + suelo húmedo | 18.35 | 19.47 | 17.31 | 18.08 | 16.41 | 5.28 | 5.45 | 5.44 |
| D) Peso del recip. + suelo seco | 16.76 | 17.77 | 16.06 | 16.68 | 15.38 | 5.12 | 5.26 | 5.25 |
| E) Peso agua (C-D) | 1.59 | 1.70 | 1.25 | 1.40 | 1.03 | 0.16 | 0.19 | 0.19 |
| G) Peso recipiente | 11.23 | 11.35 | 11.42 | 11.41 | 11.37 | 4.35 | 4.35 | 4.30 |
| H) Peso suelo seco (D-G) | 5.53 | 6.42 | 4.64 | 5.27 | 4.01 | 0.77 | 0.91 | 0.95 |
| I) Contenido de Humedad (E/H) % | 28.75 | 26.48 | 26.94 | 26.57 | 25.69 | 20.78 | 20.88 | 20.00 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **40.42** |
| Porcentaje de arena | **42.73** |
| Porcentaje de finos | **16.85** |
| D10 | **0.00** |
| D30 | **0.39** |
| D60 | **5.02** |
| Cu | |
| Cc | |
| Límite líquido | **27.14** |
| Límite plástico | **20.55** |
| Indice de plasticidad | **6.59** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

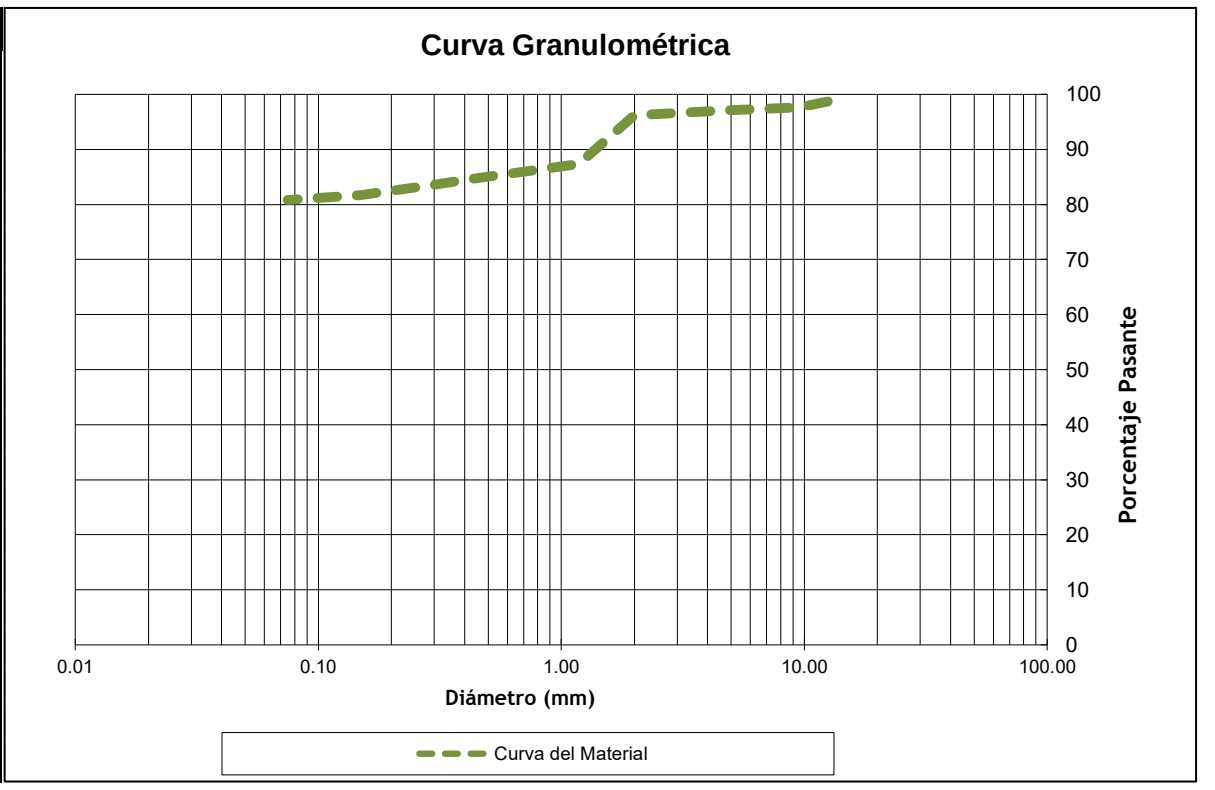
| | |
|---|---|
| ID Muestra: | Sondeo E8-01 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#42 (M8-M18) |
| Profundidad: | 3.15-8.10 m |

| | |
|---|---|
| Peso Sucio | **488.30** |
| Peso seco (gr): | **93.80** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 6.50 | 1.33 | 1.33 | 98.67 |
| 3/8" | 9.50 | 4.90 | 1.00 | 2.33 | 97.67 |
| No.4 | 4.75 | 2.60 | 0.53 | 2.87 | 97.13 |
| No.10 | 2.00 | 4.70 | 0.96 | 3.83 | 96.17 |
| No.16 | 1.18 | 43.00 | 8.81 | 12.64 | 87.36 |
| No.40 | 0.43 | 13.10 | 2.68 | 15.32 | 84.68 |
| No.50 | 0.3 | 5.50 | 1.13 | 16.44 | 83.56 |
| No.100 | 0.15 | 8.90 | 1.82 | 18.27 | 81.73 |
| No.200 | 0.075 | 4.60 | 0.94 | 19.21 | 80.79 |
| Pan | | 0.00 | 0.00 | 19.21 | |

0

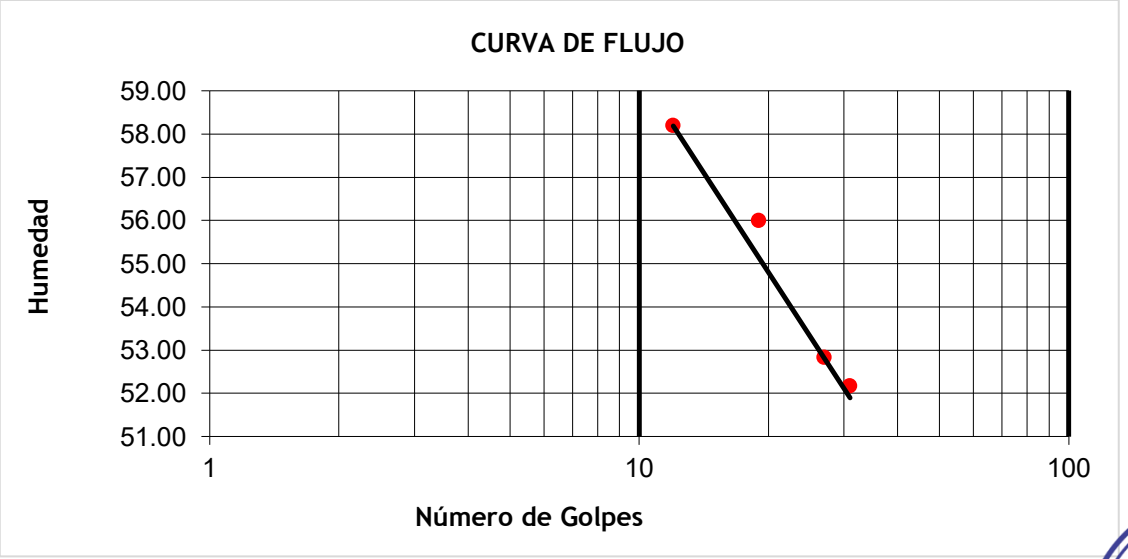


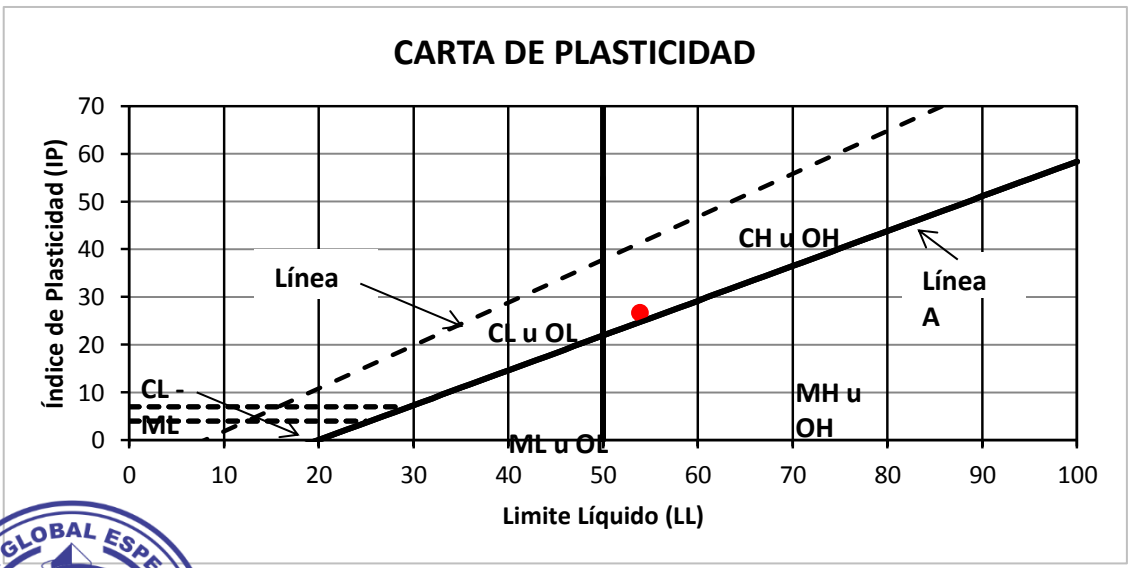

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 19 | 27 | 31 | | | | |
| B) Número del recipiente | C | P5 | P2 | B | | 5 | 13 | P7 |
| C) Peso del recip. + suelo húmedo | 18.94 | 18.78 | 21.59 | 20.40 | | 12.25 | 12.30 | 12.41 |
| D) Peso del recip. + suelo seco | 16.17 | 16.07 | 18.04 | 17.27 | | 12.08 | 12.12 | 12.24 |
| E) Peso agua (C-D) | 2.77 | 2.71 | 3.55 | 3.13 | | 0.17 | 0.18 | 0.17 |
| G) Peso recipiente | 11.41 | 11.23 | 11.32 | 11.27 | | 11.46 | 11.47 | 11.60 |
| H) Peso suelo seco (D-G) | 4.76 | 4.84 | 6.72 | 6.00 | | 0.62 | 0.65 | 0.64 |
| I) Contenido de Humedad (E/H) % | 58.19 | 55.99 | 52.83 | 52.17 | | 27.42 | 27.69 | 26.56 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD CON ARENA (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **2.87** |
| Porcentaje de arena | **16.34** |
| Porcentaje de finos | **80.79** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **53.88** |
| Límite plástico | **27.22** |
| Indice de plasticidad | **26.66** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

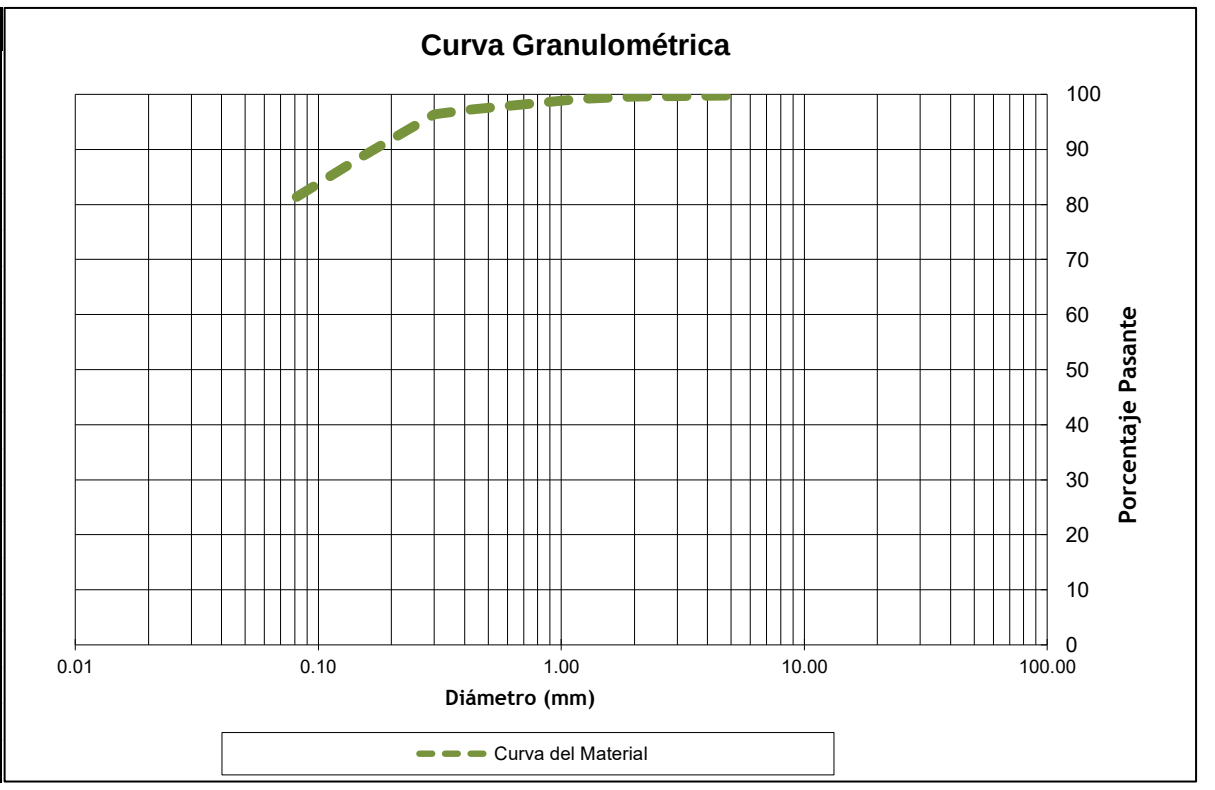
| | |
|---|---|
| ID Muestra: | Sondeo E8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#46 (M2-M3) |
| Profundidad: | 0.45-1.35 m |

| | |
|---|---|
| Peso Sucio | **257.50** |
| Peso seco (gr): | **51.10** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.50 | 0.19 | 0.19 | 99.81 |
| No.10 | 2.00 | 0.60 | 0.23 | 0.43 | 99.57 |
| No.16 | 1.18 | 1.00 | 0.39 | 0.82 | 99.18 |
| No.40 | 0.43 | 4.80 | 1.86 | 2.68 | 97.32 |
| No.50 | 0.3 | 2.40 | 0.93 | 3.61 | 96.39 |
| No.100 | 0.15 | 20.00 | 7.77 | 11.38 | 88.62 |
| No.200 | 0.075 | 21.30 | 8.27 | 19.65 | 80.35 |
| Pan | | 0.50 | 0.19 | 19.84 | |

0

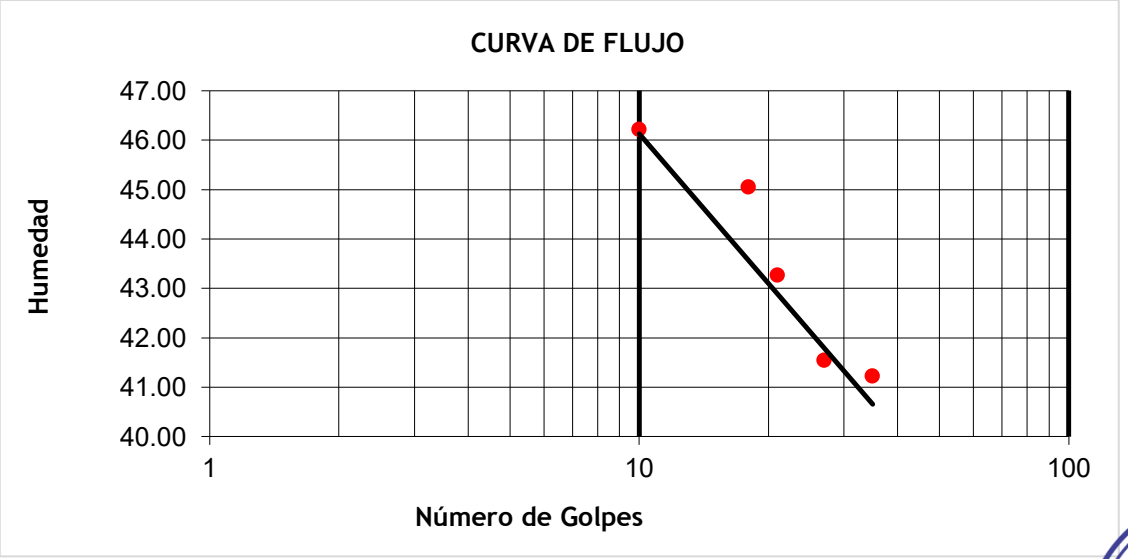


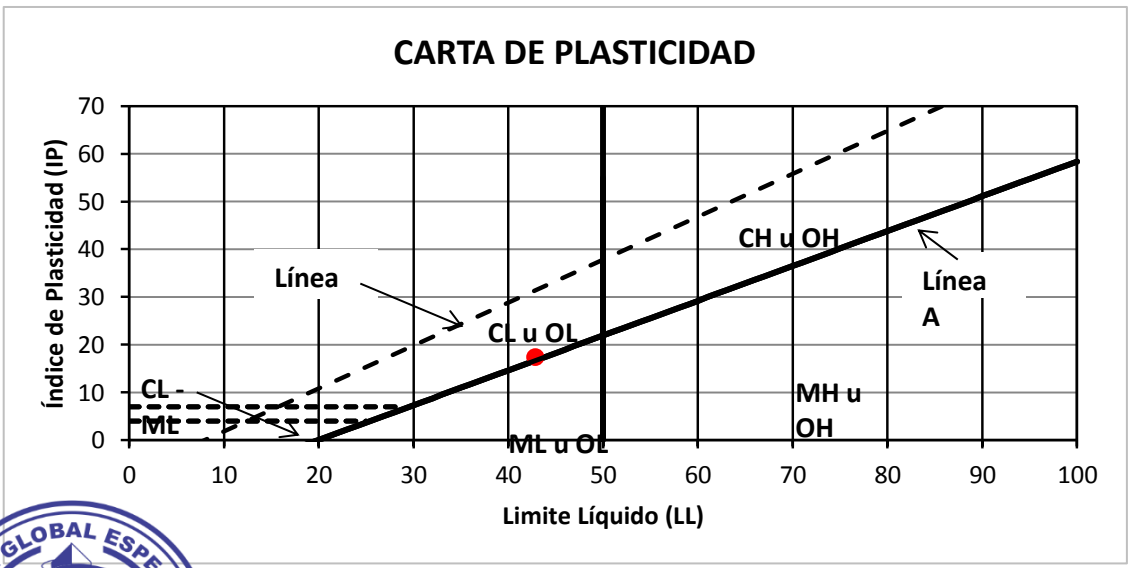

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 18 | 21 | 27 | 35 | | | |
| B) Número del recipiente | K1 | K5 | 12 | K11 | 16 | 11 | K15 | BK |
| C) Peso del recip. + suelo húmedo | 31.05 | 33.37 | 33.05 | 31.55 | 31.89 | 26.29 | 26.51 | 26.33 |
| D) Peso del recip. + suelo seco | 29.16 | 30.78 | 30.64 | 29.61 | 29.87 | 26.02 | 26.23 | 26.05 |
| E) Peso agua (C-D) | 1.89 | 2.59 | 2.41 | 1.94 | 2.02 | 0.27 | 0.28 | 0.28 |
| G) Peso recipiente | 25.07 | 25.03 | 25.07 | 24.94 | 24.97 | 24.98 | 25.12 | 24.94 |
| H) Peso suelo seco (D-G) | 4.09 | 5.75 | 5.57 | 4.67 | 4.90 | 1.04 | 1.11 | 1.11 |
| I) Contenido de Humedad (E/H) % | 46.21 | 45.04 | 43.27 | 41.54 | 41.22 | 25.96 | 25.23 | 25.23 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD CON ARENA (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.19** |
| Porcentaje de arena | **19.46** |
| Porcentaje de finos | **80.35** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **42.84** |
| Límite plástico | **25.47** |
| Indice de plasticidad | **17.37** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

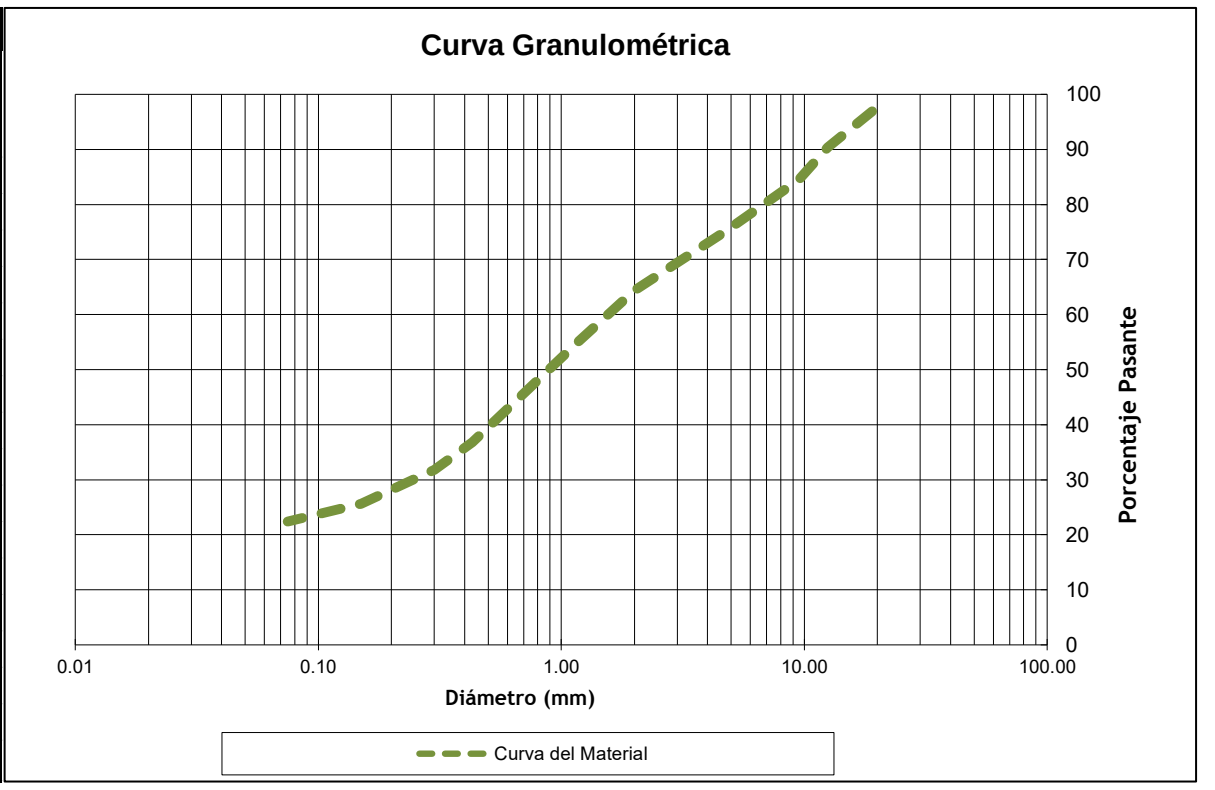
| | |
|---|---|
| ID Muestra: | Sondeo E8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#37 (M4-M9) |
| Profundidad: | 1.35-4.05 m |

| | |
|---|---|
| Peso Sucio | **719.50** |
| Peso seco (gr): | **558.64** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 22.10 | 3.07 | 3.07 | 96.93 |
| 1/2" | 12.50 | 47.20 | 6.56 | 9.63 | 90.37 |
| 3/8" | 9.50 | 42.20 | 5.87 | 15.50 | 84.50 |
| No.4 | 4.75 | 67.30 | 9.35 | 24.85 | 75.15 |
| No.10 | 2.00 | 77.60 | 10.79 | 35.64 | 64.36 |
| No.16 | 1.18 | 66.40 | 9.23 | 44.86 | 55.14 |
| No.40 | 0.43 | 131.90 | 18.33 | 63.20 | 36.80 |
| No.50 | 0.3 | 36.00 | 5.00 | 68.20 | 31.80 |
| No.100 | 0.15 | 44.44 | 6.18 | 74.38 | 25.62 |
| No.200 | 0.075 | 23.40 | 3.25 | 77.63 | 22.37 |
| Pan | | 0.10 | 0.01 | 77.64 | |

0

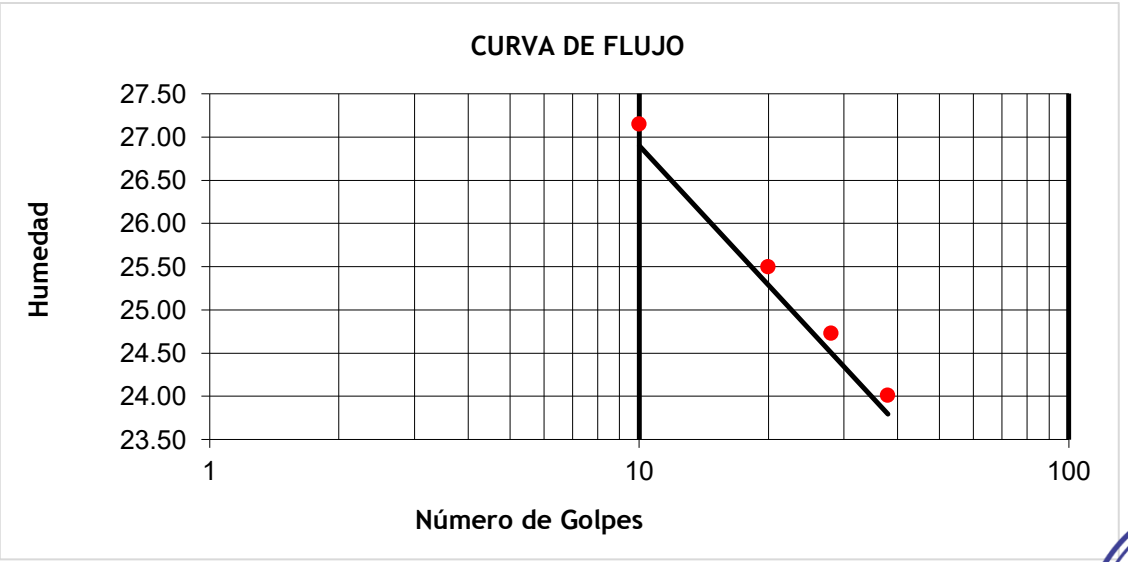


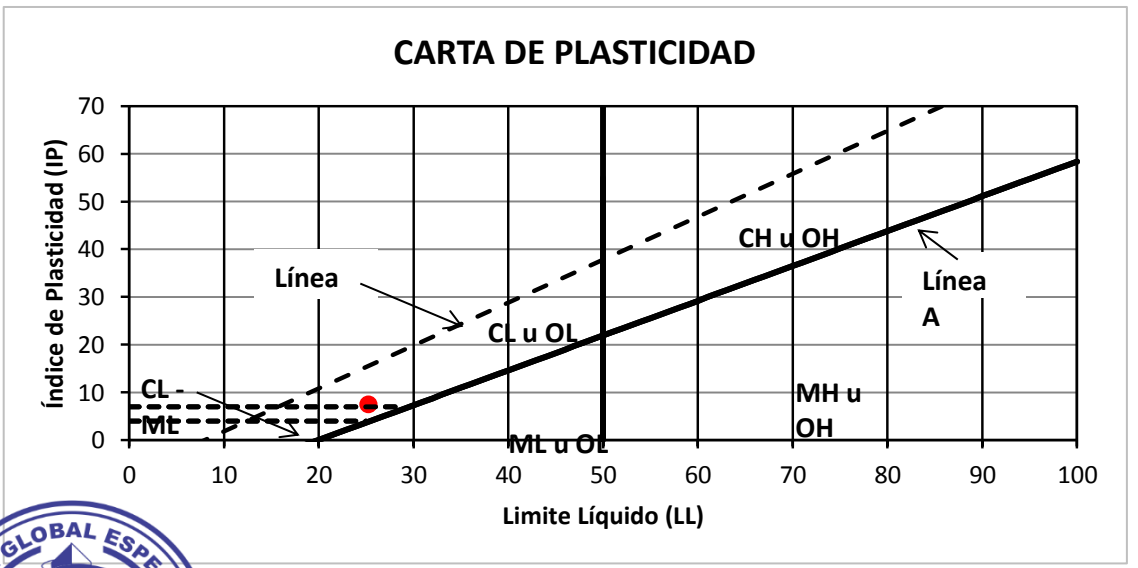

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 20 | 28 | 38 | | | | |
| B) Número del recipiente | 55 | E | P4 | P9 | | 3 | 8 | P4 |
| C) Peso del recip. + suelo húmedo | 19.75 | 21.09 | 19.27 | 19.04 | | 5.93 | 5.68 | 5.99 |
| D) Peso del recip. + suelo seco | 17.95 | 19.04 | 17.69 | 17.52 | | 5.68 | 5.48 | 5.74 |
| E) Peso agua (C-D) | 1.80 | 2.05 | 1.58 | 1.52 | | 0.25 | 0.20 | 0.25 |
| G) Peso recipiente | 11.32 | 11.00 | 11.30 | 11.19 | | 4.28 | 4.33 | 4.35 |
| H) Peso suelo seco (D-G) | 6.63 | 8.04 | 6.39 | 6.33 | | 1.40 | 1.15 | 1.39 |
| I) Contenido de Humedad (E/H) % | 27.15 | 25.50 | 24.73 | 24.01 | | 17.86 | 17.39 | 17.99 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **24.85** |
| Porcentaje de arena | **52.78** |
| Porcentaje de finos | **22.37** |
| D10 | **0.00** |
| D30 | **0.26** |
| D60 | **1.61** |
| Cu | |
| Cc | |
| Límite líquido | **25.24** |
| Límite plástico | **17.74** |
| Indice de plasticidad | **7.49** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

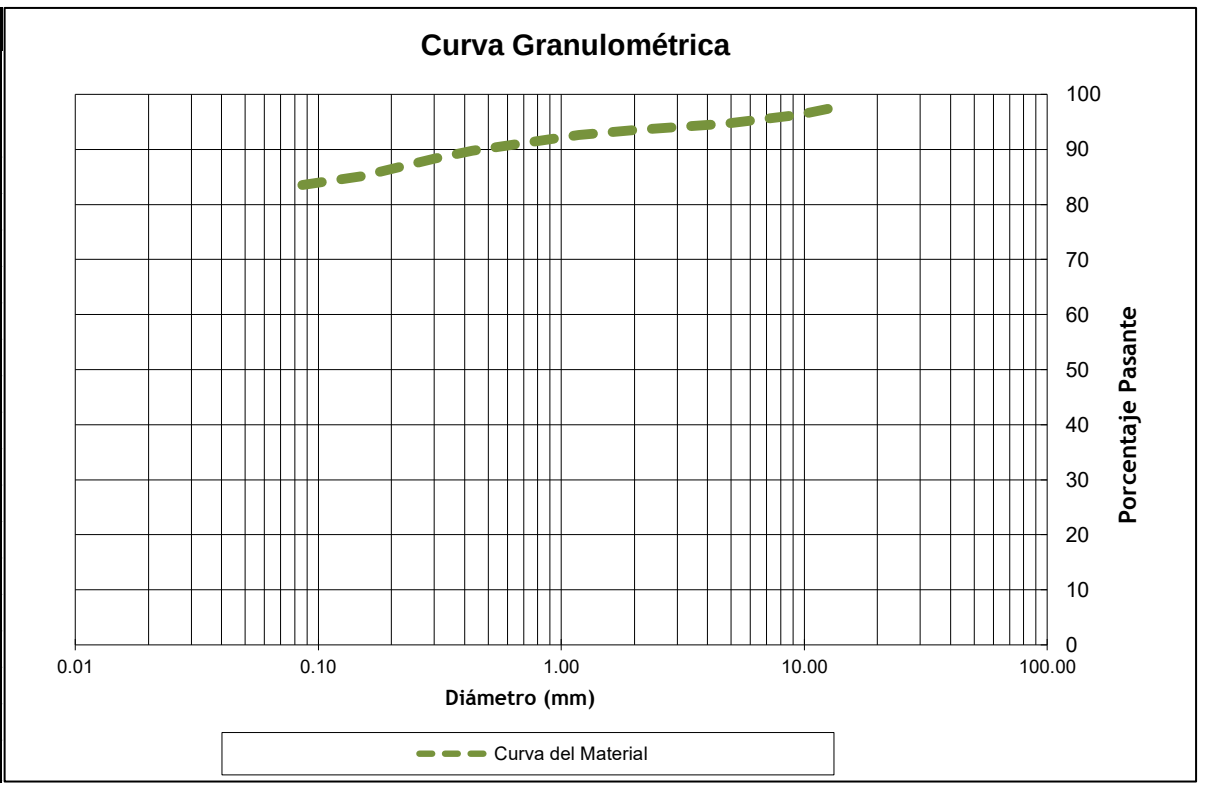
| | |
|---|---|
| ID Muestra: | Sondeo E8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#31 (M11-M20) |
| Profundidad: | 4.50-9.00 m |

| | |
|---|---|
| Peso Sucio | **423.20** |
| Peso seco (gr): | **71.50** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 11.30 | 2.67 | 2.67 | 97.33 |
| 3/8" | 9.50 | 4.50 | 1.06 | 3.73 | 96.27 |
| No.4 | 4.75 | 6.70 | 1.58 | 5.32 | 94.68 |
| No.10 | 2.00 | 4.90 | 1.16 | 6.47 | 93.53 |
| No.16 | 1.18 | 3.90 | 0.92 | 7.40 | 92.60 |
| No.40 | 0.43 | 12.20 | 2.88 | 10.28 | 89.72 |
| No.50 | 0.3 | 6.00 | 1.42 | 11.70 | 88.30 |
| No.100 | 0.15 | 13.50 | 3.19 | 14.89 | 85.11 |
| No.200 | 0.075 | 8.20 | 1.94 | 16.82 | 83.18 |
| Pan | | 0.30 | 0.07 | 16.90 | |

0

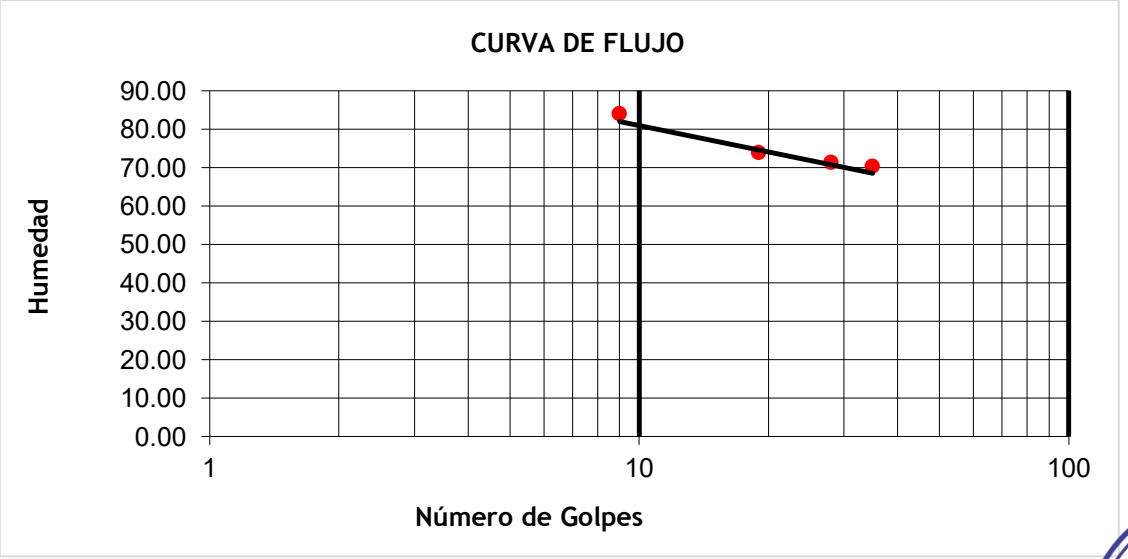


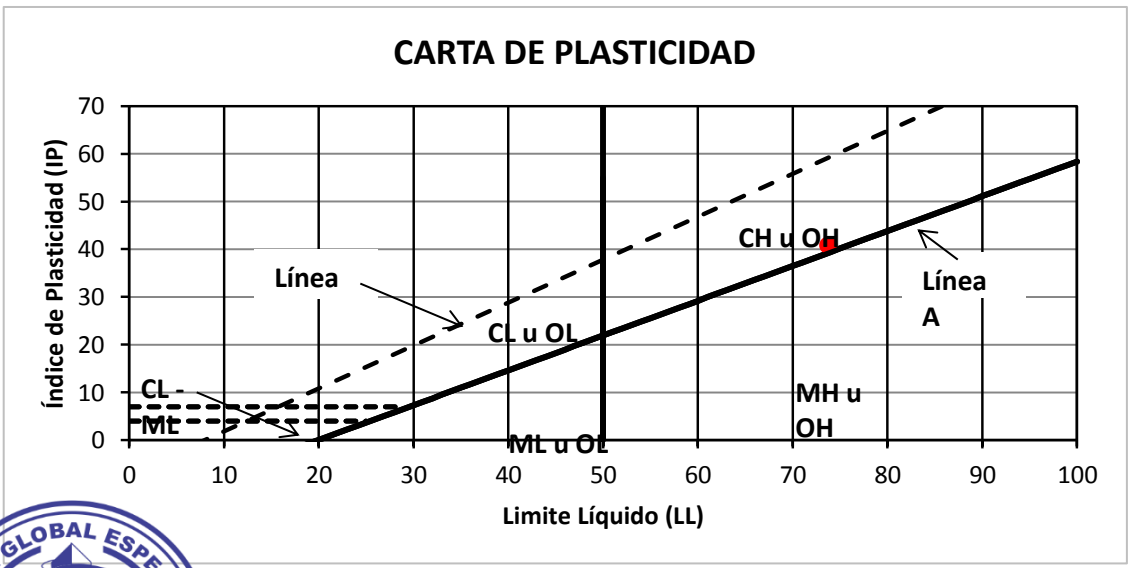

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 9 | 19 | 28 | 35 | | | | |
| B) Número del recipiente | XX | P10 | 4 | I4 | | I5 | I8 | X |
| C) Peso del recip. + suelo húmedo | 19.84 | 17.67 | 17.86 | 18.82 | | 12.01 | 11.94 | 12.04 |
| D) Peso del recip. + suelo seco | 16.05 | 14.93 | 15.07 | 15.76 | | 11.85 | 11.77 | 11.85 |
| E) Peso agua (C-D) | 3.79 | 2.74 | 2.79 | 3.06 | | 0.16 | 0.17 | 0.19 |
| G) Peso recipiente | 11.54 | 11.22 | 11.16 | 11.41 | | 11.36 | 11.25 | 11.28 |
| H) Peso suelo seco (D-G) | 4.51 | 3.71 | 3.91 | 4.35 | | 0.49 | 0.52 | 0.57 |
| I) Contenido de Humedad (E/H) % | 84.04 | 73.85 | 71.36 | 70.34 | | 32.65 | 32.69 | 33.33 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **5.32** |
| Porcentaje de arena | **11.51** |
| Porcentaje de finos | **83.18** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **73.74** |
| Límite plástico | **32.89** |
| Indice de plasticidad | **40.85** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

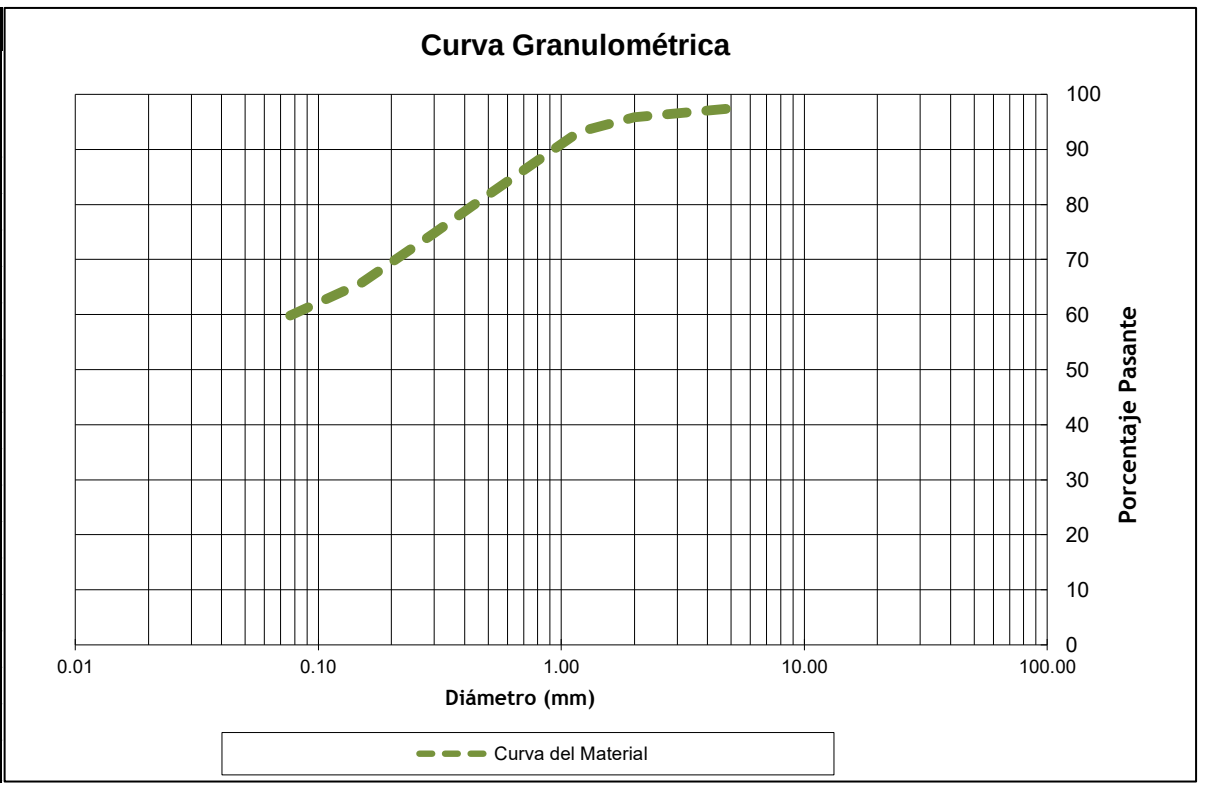
| | |
|---|---|
| ID Muestra: | Sondeo E8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#50 (M1-M2) |
| Profundidad: | 0.00-0.90 m |

| | |
|---|---|
| Peso Sucio | **149.20** |
| Peso seco (gr): | **60.20** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 3.90 | 2.61 | 2.61 | 97.39 |
| No.10 | 2.00 | 2.30 | 1.54 | 4.16 | 95.84 |
| No.16 | 1.18 | 4.00 | 2.68 | 6.84 | 93.16 |
| No.40 | 0.43 | 20.00 | 13.40 | 20.24 | 79.76 |
| No.50 | 0.3 | 7.40 | 4.96 | 25.20 | 74.80 |
| No.100 | 0.15 | 13.60 | 9.12 | 34.32 | 65.68 |
| No.200 | 0.075 | 9.00 | 6.03 | 40.35 | 59.65 |
| Pan | | 0.00 | 0.00 | 40.35 | |

0

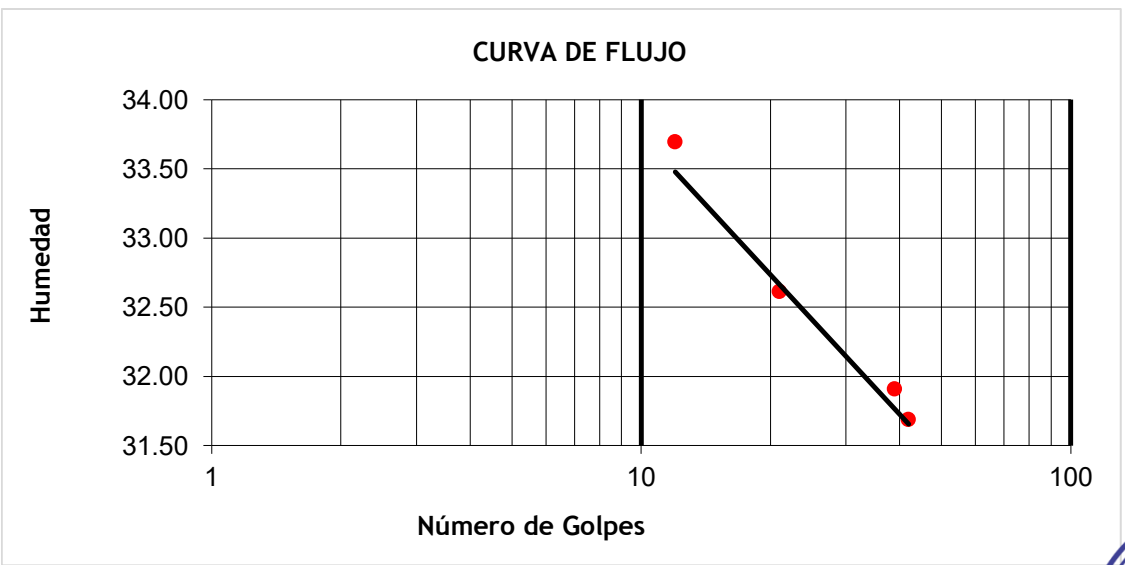


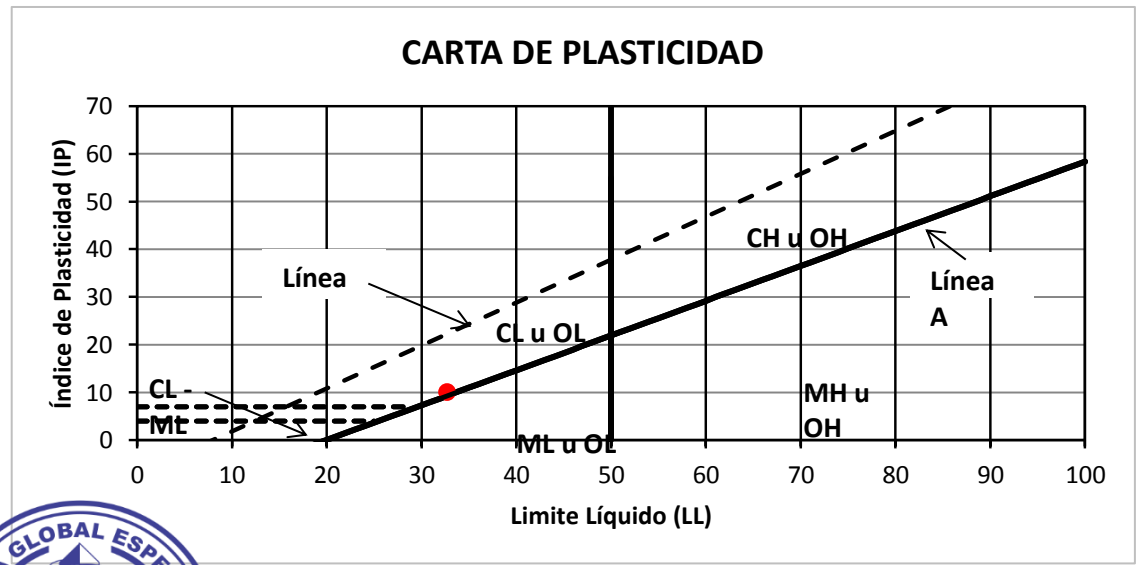

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 21 | 39 | 42 | | | | |
| B) Número del recipiente | I5 | P6 | P12 | K | | 13 | P9 | XX |
| C) Peso del recip. + suelo húmedo | 20.04 | 19.93 | 18.22 | 19.40 | | 12.82 | 12.56 | 12.95 |
| D) Peso del recip. + suelo seco | 17.86 | 17.82 | 16.58 | 17.41 | | 12.57 | 12.31 | 12.69 |
| E) Peso agua (C-D) | 2.18 | 2.11 | 1.64 | 1.99 | | 0.25 | 0.25 | 0.26 |
| G) Peso recipiente | 11.39 | 11.35 | 11.44 | 11.13 | | 11.46 | 11.20 | 11.55 |
| H) Peso suelo seco (D-G) | 6.47 | 6.47 | 5.14 | 6.28 | | 1.11 | 1.11 | 1.14 |
| I) Contenido de Humedad (E/H) % | 33.69 | 32.61 | 31.91 | 31.69 | | 22.52 | 22.52 | 22.81 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **2.61** |
| Porcentaje de arena | **37.73** |
| Porcentaje de finos | **59.65** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.08** |
| Cu | |
| Cc | |
| Límite líquido | **32.69** |
| Límite plástico | **22.62** |
| Indice de plasticidad | **10.07** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

Fecha de Ensayo: 02/06/2020

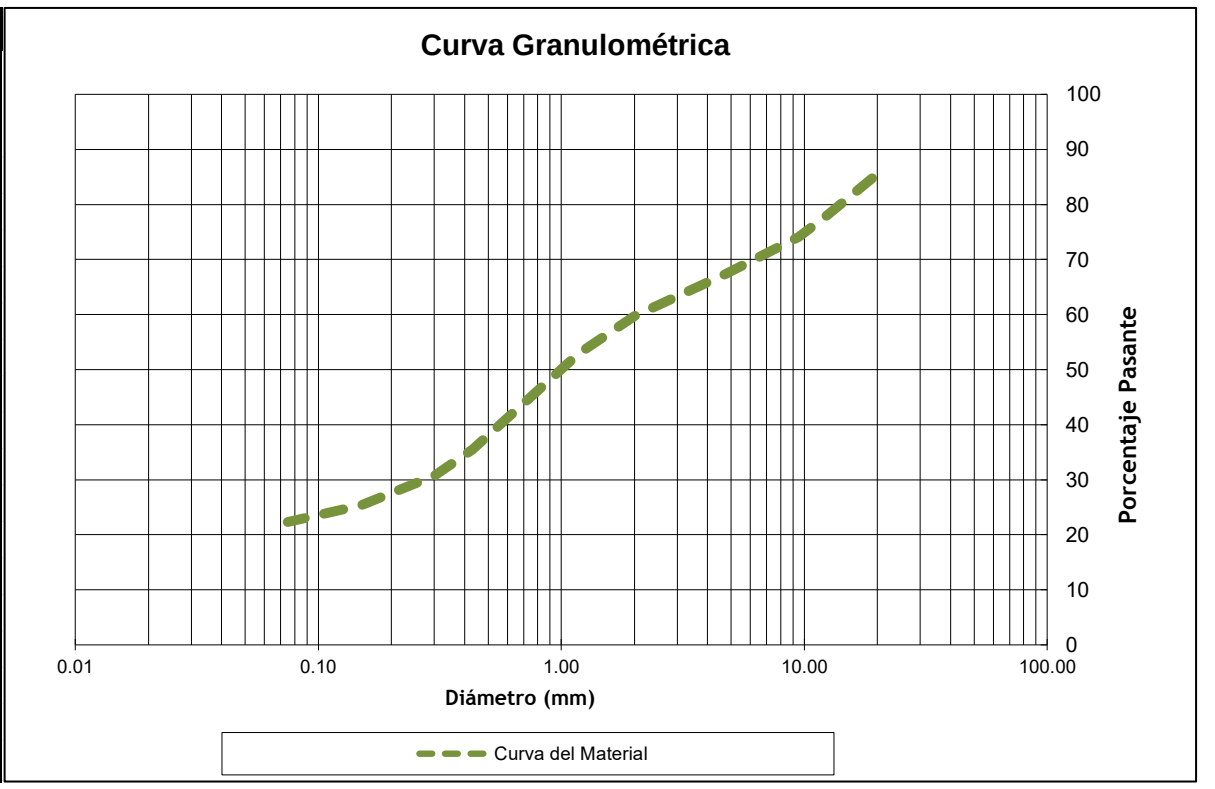
| | |
|---|---|
| ID Muestra: | Sondeo E8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#45 (M3-M8) |
| Profundidad: | 0.90-3.60 m |

| | |
|---|---|
| Peso Sucio | **572.00** |
| Peso seco (gr): | **444.40** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 87.00 | 15.21 | 15.21 | 84.79 |
| 1/2" | 12.50 | 38.10 | 6.66 | 21.87 | 78.13 |
| 3/8" | 9.50 | 22.90 | 4.00 | 25.87 | 74.13 |
| No.4 | 4.75 | 38.60 | 6.75 | 32.62 | 67.38 |
| No.10 | 2.00 | 44.00 | 7.69 | 40.31 | 59.69 |
| No.16 | 1.18 | 38.80 | 6.78 | 47.10 | 52.90 |
| No.40 | 0.43 | 99.70 | 17.43 | 64.53 | 35.47 |
| No.50 | 0.3 | 27.10 | 4.74 | 69.27 | 30.73 |
| No.100 | 0.15 | 30.60 | 5.35 | 74.62 | 25.38 |
| No.200 | 0.075 | 17.50 | 3.06 | 77.67 | 22.33 |
| Pan | | 0.10 | 0.02 | 77.69 | |

0

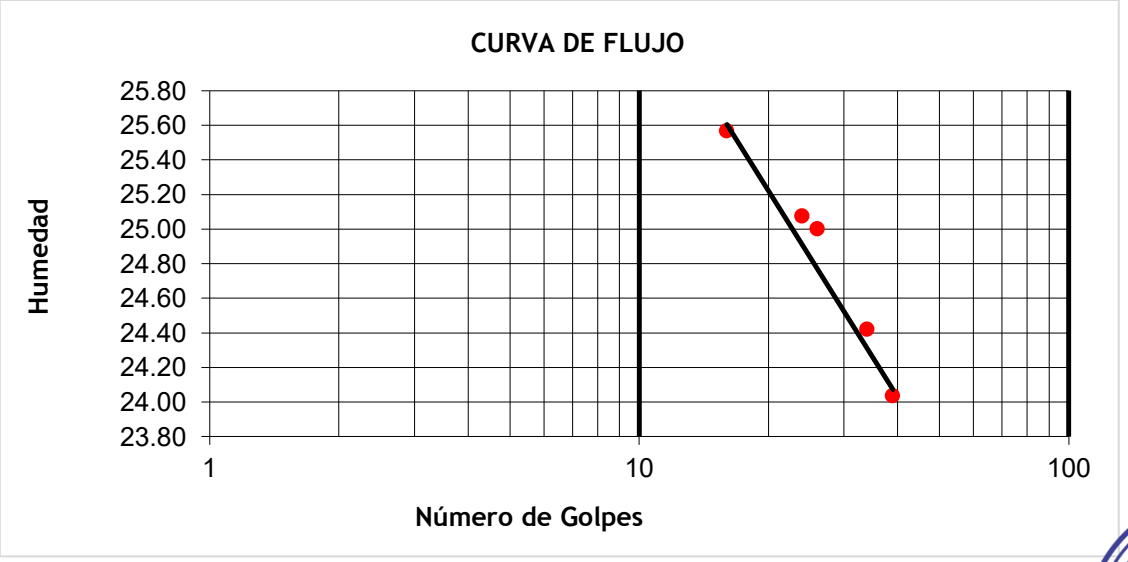


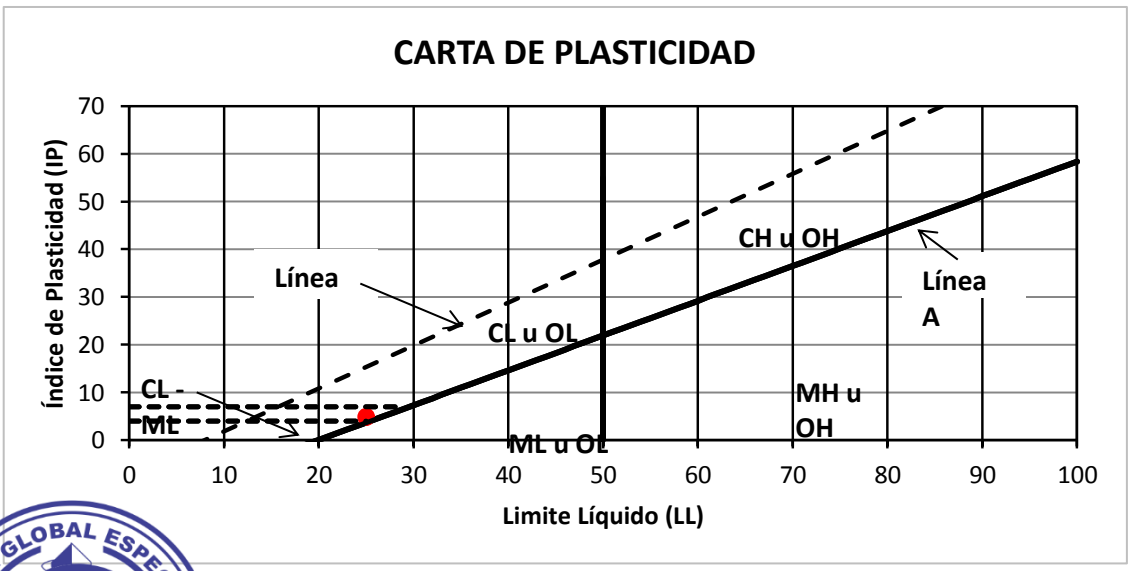

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 16 | 24 | 26 | 34 | 39 | | | |
| B) Número del recipiente | K12 | K16 | K26 | 22 | K18 | 2 | QQ | 7 |
| C) Peso del recip. + suelo húmedo | 35.07 | 33.52 | 33.12 | 34.63 | 35.54 | 6.04 | 6.09 | 5.88 |
| D) Peso del recip. + suelo seco | 33.04 | 31.80 | 31.52 | 32.74 | 33.55 | 5.75 | 5.80 | 5.61 |
| E) Peso agua (C-D) | 2.03 | 1.72 | 1.60 | 1.89 | 1.99 | 0.29 | 0.29 | 0.27 |
| G) Peso recipiente | 25.10 | 24.94 | 25.12 | 25.00 | 25.27 | 4.33 | 4.35 | 4.27 |
| H) Peso suelo seco (D-G) | 7.94 | 6.86 | 6.40 | 7.74 | 8.28 | 1.42 | 1.45 | 1.34 |
| I) Contenido de Humedad (E/H) % | 25.57 | 25.07 | 25.00 | 24.42 | 24.03 | 20.42 | 20.00 | 20.15 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA-LIMOSA CON GRAVA (SC-SM)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **32.62** |
| Porcentaje de arena | **45.05** |
| Porcentaje de finos | **22.33** |
| D10 | **0.00** |
| D30 | **0.28** |
| D60 | **2.11** |
| Cu | |
| Cc | |
| Límite líquido | **25.01** |
| Límite plástico | **20.19** |
| Indice de plasticidad | **4.81** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

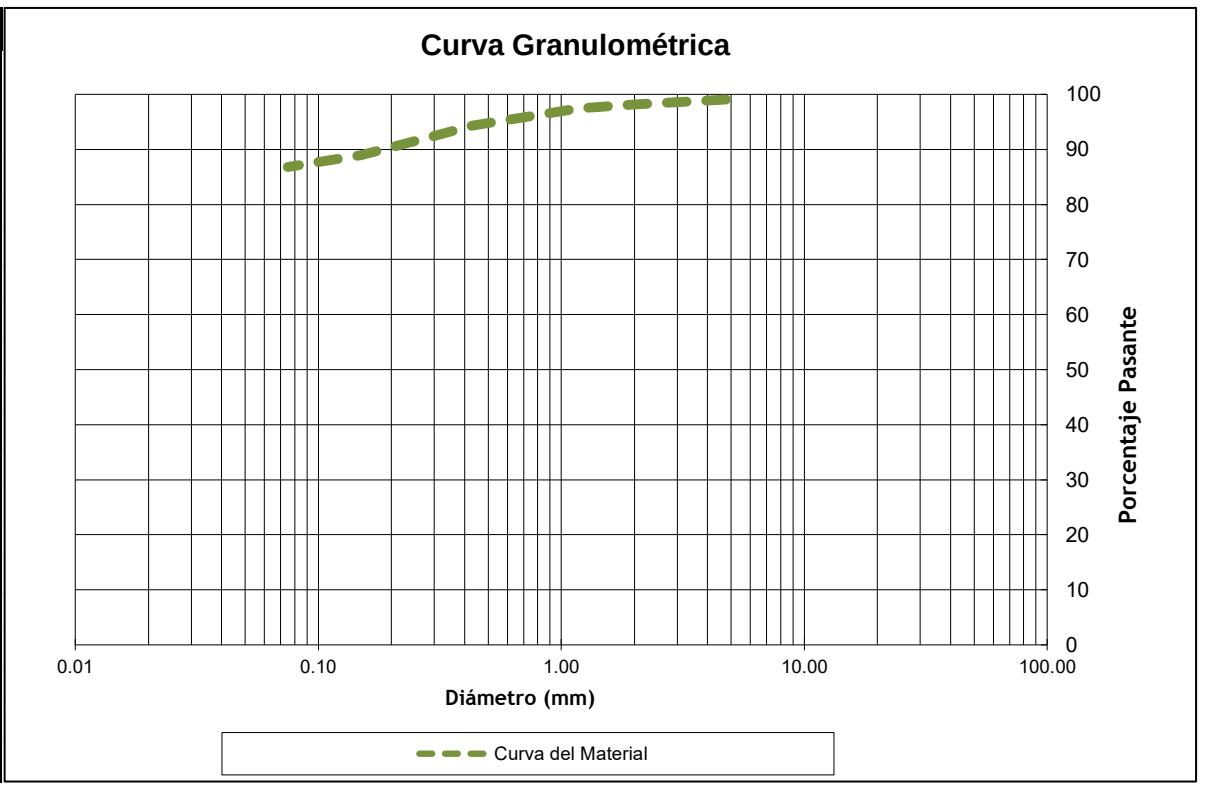
| | |
|---|---|
| ID Muestra: | Sondeo E8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#40 (M9-M20) |
| Profundidad: | 3.60-9.00 m |

| | |
|---|---|
| Peso Sucio | **584.80** |
| Peso seco (gr): | **78.70** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 5.40 | 0.92 | 0.92 | 99.08 |
| No.10 | 2.00 | 5.30 | 0.91 | 1.83 | 98.17 |
| No.16 | 1.18 | 4.30 | 0.74 | 2.56 | 97.44 |
| No.40 | 0.43 | 18.10 | 3.10 | 5.66 | 94.34 |
| No.50 | 0.3 | 10.90 | 1.86 | 7.52 | 92.48 |
| No.100 | 0.15 | 20.50 | 3.51 | 11.03 | 88.97 |
| No.200 | 0.075 | 12.80 | 2.19 | 13.22 | 86.78 |
| Pan | | 1.40 | 0.24 | 13.46 | |

0

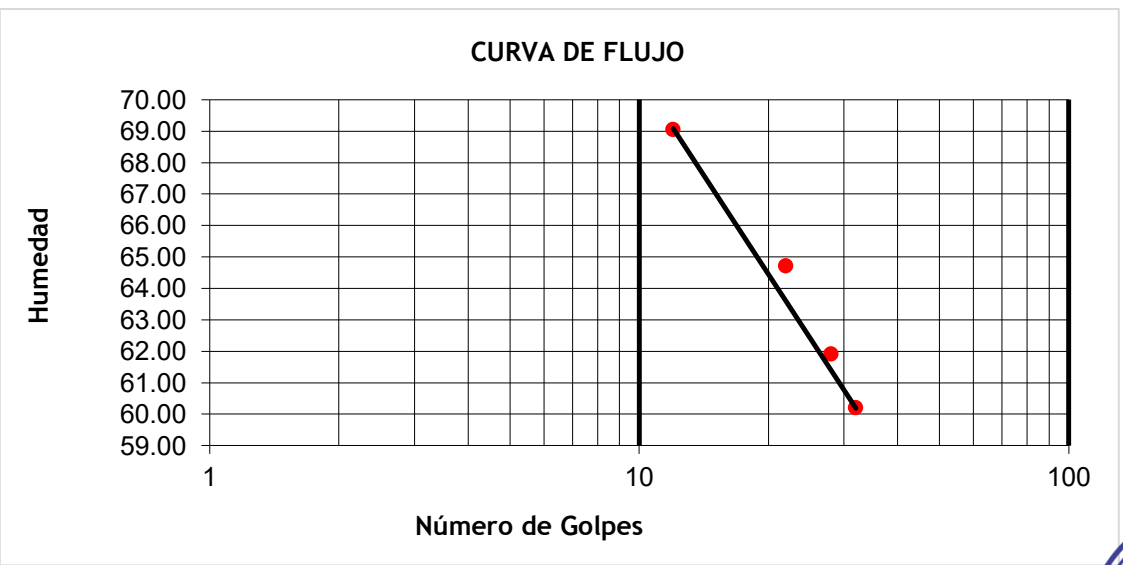


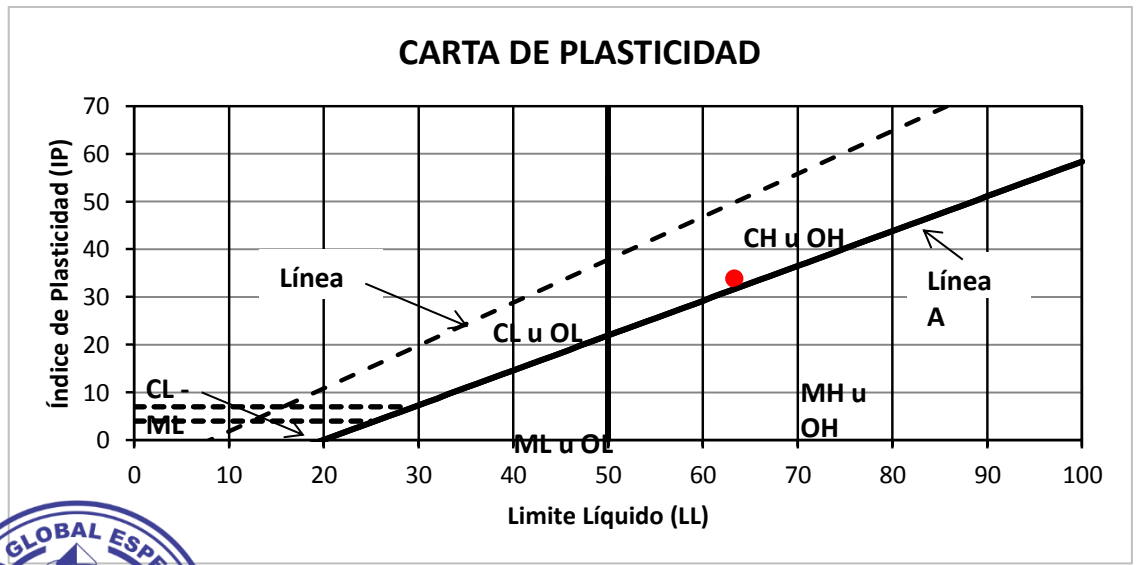

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 22 | 28 | 32 | | | | |
| B) Número del recipiente | K | P2 | P9 | P6 | | P8 | I8 | O13 |
| C) Peso del recip. + suelo húmedo | 19.13 | 20.59 | 20.84 | 24.34 | | 12.23 | 11.95 | 11.94 |
| D) Peso del recip. + suelo seco | 15.85 | 16.96 | 17.15 | 19.47 | | 12.05 | 11.79 | 11.75 |
| E) Peso agua (C-D) | 3.28 | 3.63 | 3.69 | 4.87 | | 0.18 | 0.16 | 0.19 |
| G) Peso recipiente | 11.10 | 11.35 | 11.19 | 11.38 | | 11.43 | 11.25 | 11.11 |
| H) Peso suelo seco (D-G) | 4.75 | 5.61 | 5.96 | 8.09 | | 0.62 | 0.54 | 0.64 |
| I) Contenido de Humedad (E/H) % | 69.05 | 64.71 | 61.91 | 60.20 | | 29.03 | 29.63 | 29.69 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA ALTA DE PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.92** |
| Porcentaje de arena | **12.29** |
| Porcentaje de finos | **86.78** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **63.30** |
| Límite plástico | **29.45** |
| Indice de plasticidad | **33.85** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

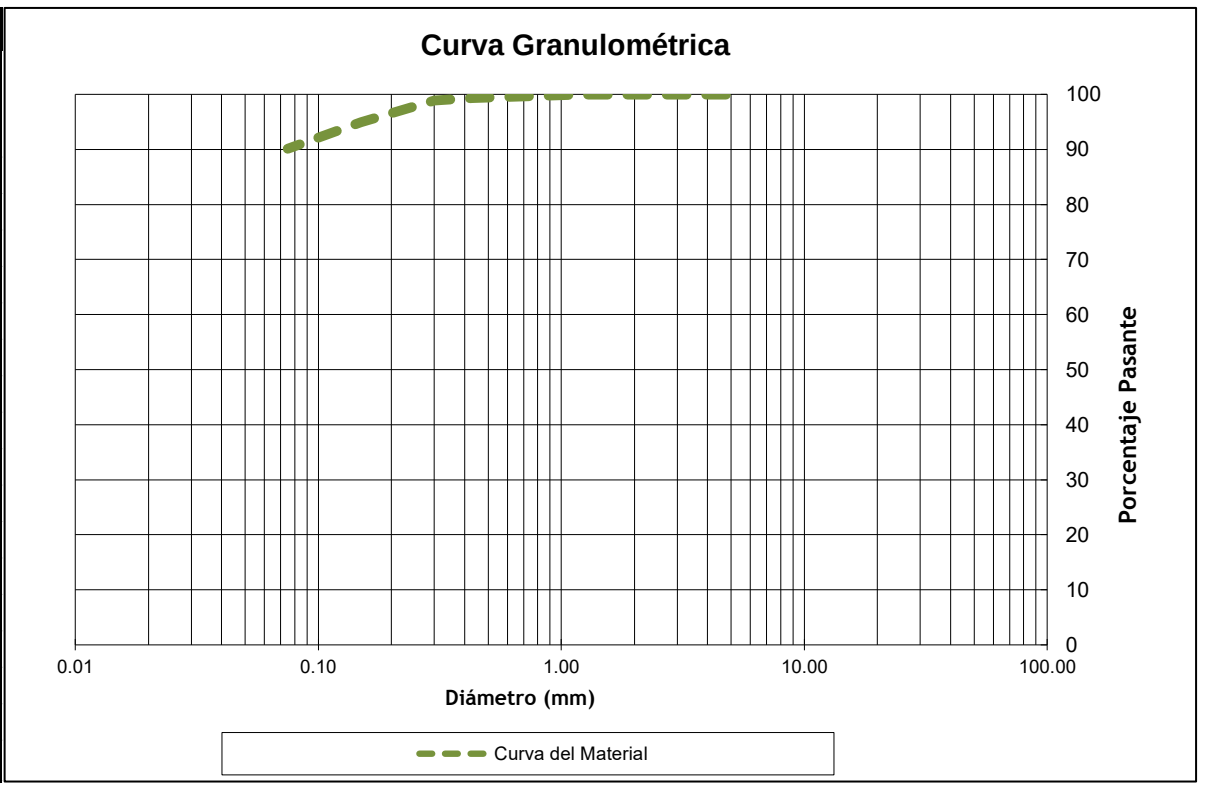
| | |
|---|---|
| ID Muestra: | Sondeo E8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#32 (M2-M4) |
| Profundidad: | 0.45-1.80 m |

| | |
|---|---|
| Peso Sucio | **318.80** |
| Peso seco (gr): | **31.40** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.10 | 0.03 | 0.03 | 99.97 |
| No.16 | 1.18 | 0.10 | 0.03 | 0.06 | 99.94 |
| No.40 | 0.43 | 2.00 | 0.63 | 0.69 | 99.31 |
| No.50 | 0.3 | 1.20 | 0.38 | 1.07 | 98.93 |
| No.100 | 0.15 | 12.70 | 3.98 | 5.05 | 94.95 |
| No.200 | 0.075 | 15.30 | 4.80 | 9.85 | 90.15 |
| Pan | | 0.00 | 0.00 | 9.85 | |

0

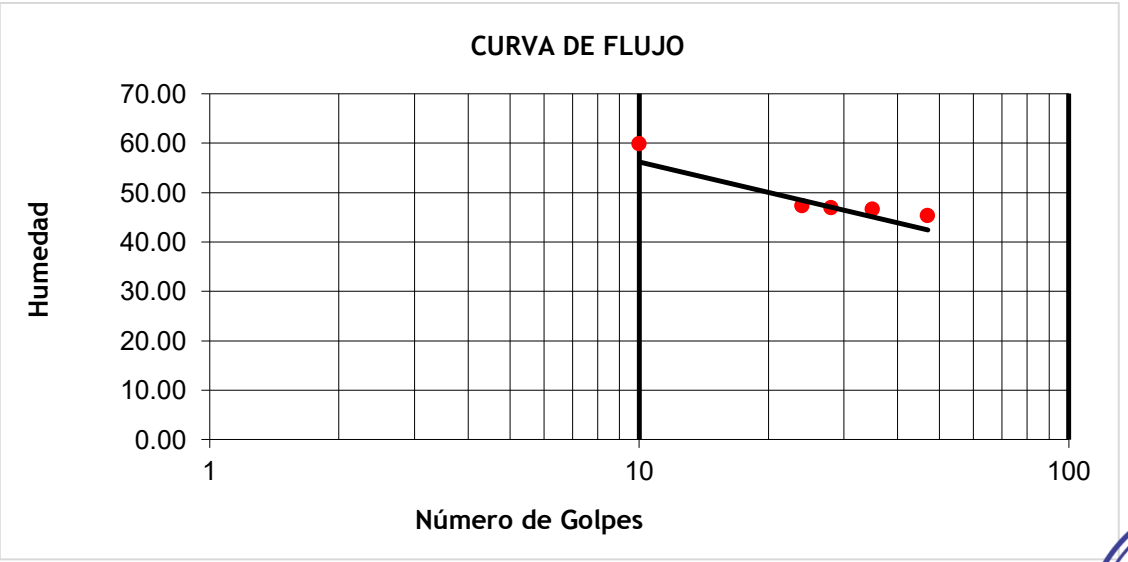


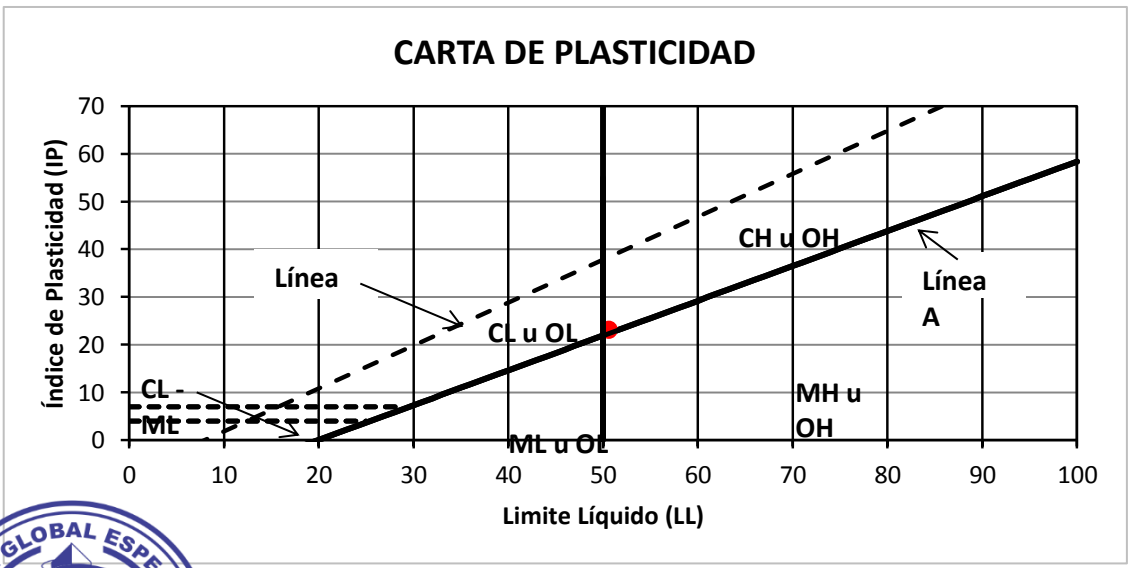

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 24 | 28 | 35 | 47 | | | |
| B) Número del recipiente | P1 | P5 | 55 | M | 4 | N1 | P9 | P8 |
| C) Peso del recip. + suelo húmedo | 19.92 | 18.56 | 19.18 | 19.55 | 18.51 | 5.92 | 5.98 | 5.90 |
| D) Peso del recip. + suelo seco | 16.68 | 16.20 | 16.67 | 16.96 | 16.22 | 5.58 | 5.63 | 5.56 |
| E) Peso agua (C-D) | 3.24 | 2.36 | 2.51 | 2.59 | 2.29 | 0.34 | 0.35 | 0.34 |
| G) Peso recipiente | 11.27 | 11.21 | 11.32 | 11.40 | 11.16 | 4.35 | 4.36 | 4.31 |
| H) Peso suelo seco (D-G) | 5.41 | 4.99 | 5.35 | 5.56 | 5.06 | 1.23 | 1.27 | 1.25 |
| I) Contenido de Humedad (E/H) % | 59.89 | 47.29 | 46.92 | 46.58 | 45.26 | 27.64 | 27.56 | 27.20 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA ALTA DE PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **9.85** |
| Porcentaje de finos | **90.15** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **50.60** |
| Límite plástico | **27.47** |
| Indice de plasticidad | **23.14** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

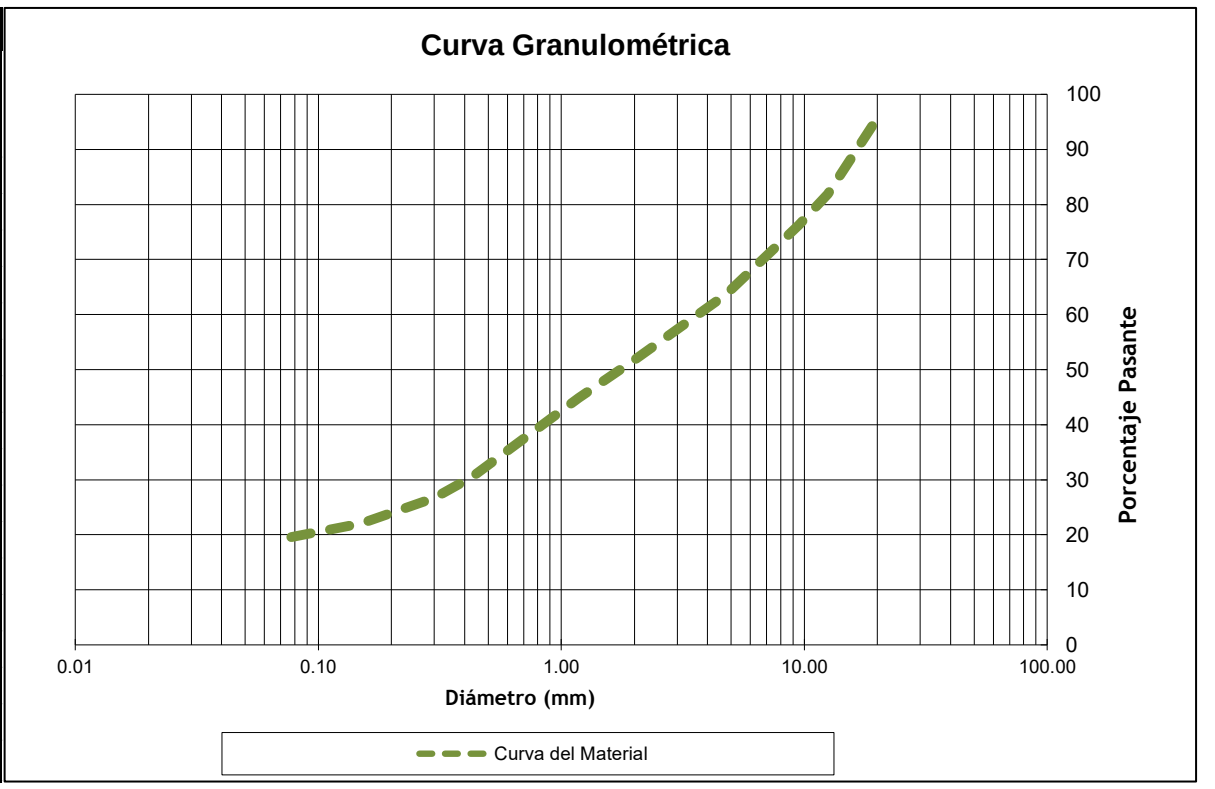
| | |
|---|---|
| ID Muestra: | Sondeo E8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#41 (M5-M14) |
| Profundidad: | 1.80-6.30 m |

| | |
|---|---|
| Peso Sucio | **860.60** |
| Peso seco (gr): | **694.90** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 49.70 | 5.78 | 5.78 | 94.22 |
| 1/2" | 12.50 | 106.40 | 12.36 | 18.14 | 81.86 |
| 3/8" | 9.50 | 47.90 | 5.57 | 23.70 | 76.30 |
| No.4 | 4.75 | 109.20 | 12.69 | 36.39 | 63.61 |
| No.10 | 2.00 | 102.20 | 11.88 | 48.27 | 51.73 |
| No.16 | 1.18 | 59.20 | 6.88 | 55.15 | 44.85 |
| No.40 | 0.43 | 123.20 | 14.32 | 69.46 | 30.54 |
| No.50 | 0.3 | 32.90 | 3.82 | 73.29 | 26.71 |
| No.100 | 0.15 | 40.40 | 4.69 | 77.98 | 22.02 |
| No.200 | 0.075 | 22.50 | 2.61 | 80.59 | 19.41 |
| Pan | | 1.30 | 0.15 | 80.75 | |

0

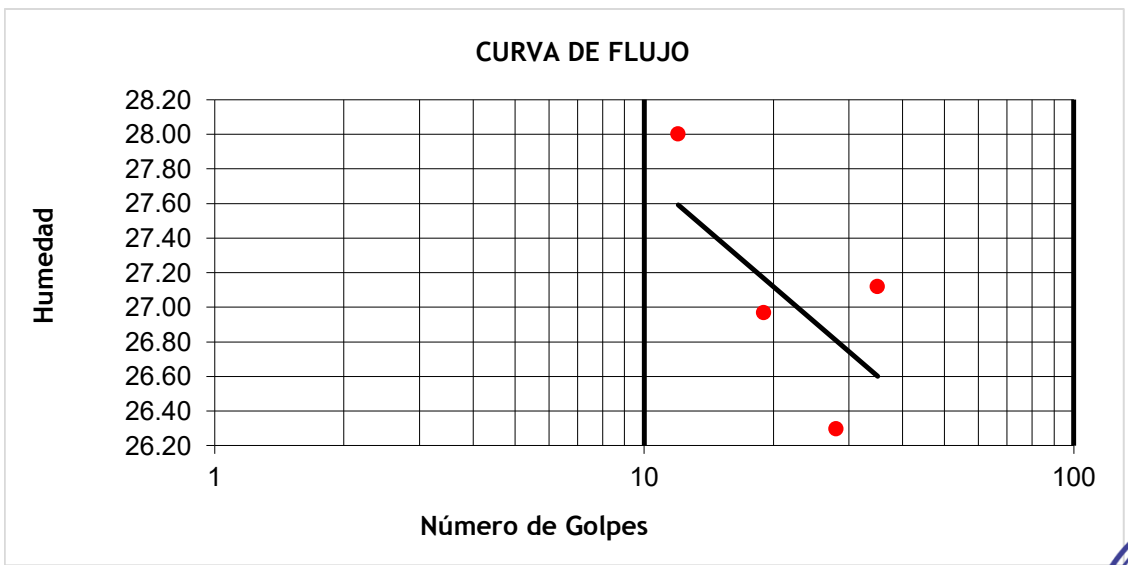


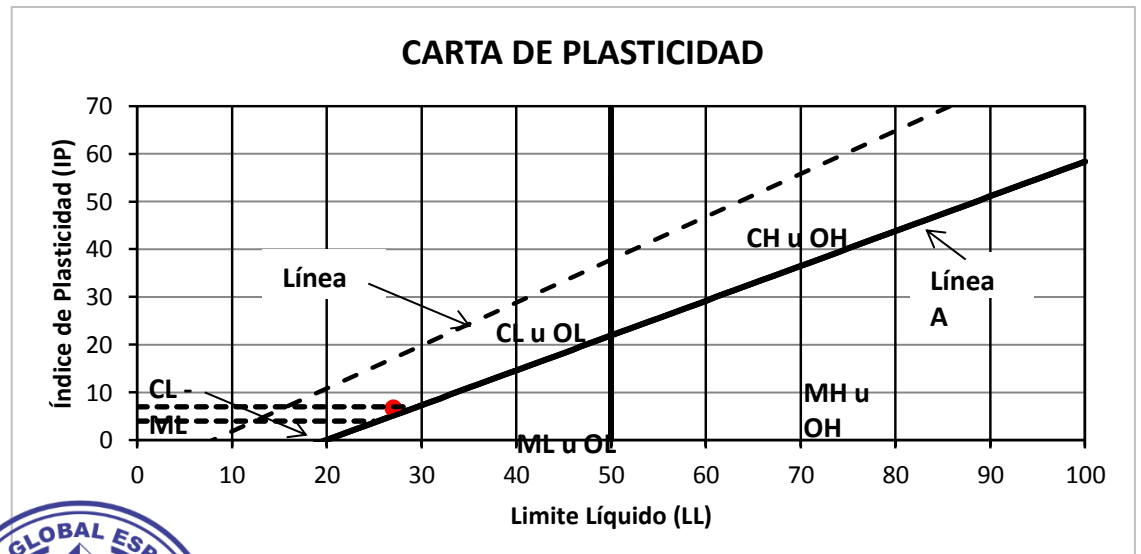

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 19 | 28 | 35 | | | | |
| B) Número del recipiente | 8 | X | I5 | 4 | | P9 | 10 | P12 |
| C) Peso del recip. + suelo húmedo | 18.92 | 18.02 | 18.19 | 18.86 | | 5.81 | 5.87 | 5.92 |
| D) Peso del recip. + suelo seco | 17.24 | 16.58 | 16.77 | 17.26 | | 5.56 | 5.61 | 5.66 |
| E) Peso agua (C-D) | 1.68 | 1.44 | 1.42 | 1.60 | | 0.25 | 0.26 | 0.26 |
| G) Peso recipiente | 11.24 | 11.24 | 11.37 | 11.36 | | 4.36 | 4.33 | 4.36 |
| H) Peso suelo seco (D-G) | 6.00 | 5.34 | 5.40 | 5.90 | | 1.20 | 1.28 | 1.30 |
| I) Contenido de Humedad (E/H) % | 28.00 | 26.97 | 26.30 | 27.12 | | 20.83 | 20.31 | 20.00 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **36.39** |
| Porcentaje de arena | **44.20** |
| Porcentaje de finos | **19.41** |
| D10 | **0.00** |
| D30 | **0.41** |
| D60 | **3.91** |
| Cu | |
| Cc | |
| Límite líquido | **27.03** |
| Límite plástico | **20.38** |
| Indice de plasticidad | **6.65** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

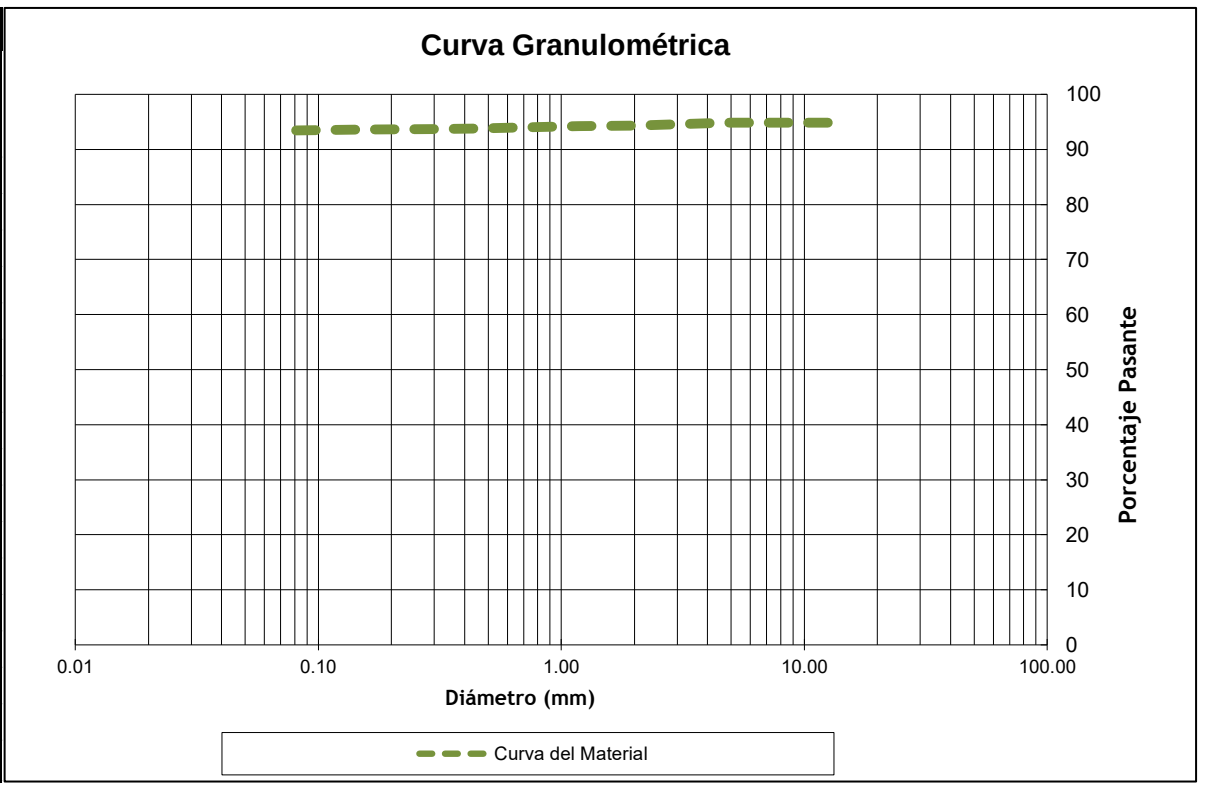
| | |
|---|---|
| ID Muestra: | Sondeo E8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#38 (M15-M20) |
| Profundidad: | 6.30-9.00 m |

| | |
|---|---|
| Peso Sucio | **206.80** |
| Peso seco (gr): | **13.50** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 10.60 | 5.13 | 5.13 | 94.87 |
| 3/8" | 9.50 | 0.00 | 0.00 | 5.13 | 94.87 |
| No.4 | 4.75 | 0.00 | 0.00 | 5.13 | 94.87 |
| No.10 | 2.00 | 1.10 | 0.53 | 5.66 | 94.34 |
| No.16 | 1.18 | 0.30 | 0.15 | 5.80 | 94.20 |
| No.40 | 0.43 | 0.90 | 0.44 | 6.24 | 93.76 |
| No.50 | 0.3 | 0.10 | 0.05 | 6.29 | 93.71 |
| No.100 | 0.15 | 0.30 | 0.15 | 6.43 | 93.57 |
| No.200 | 0.075 | 0.20 | 0.10 | 6.53 | 93.47 |
| Pan | | 0.00 | 0.00 | 6.53 | |

0

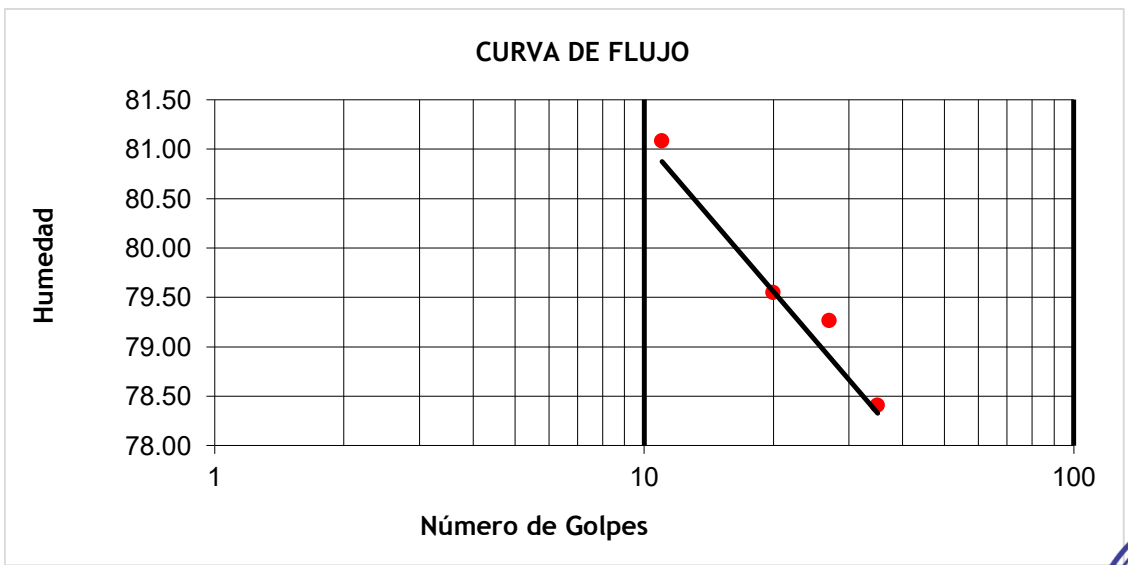


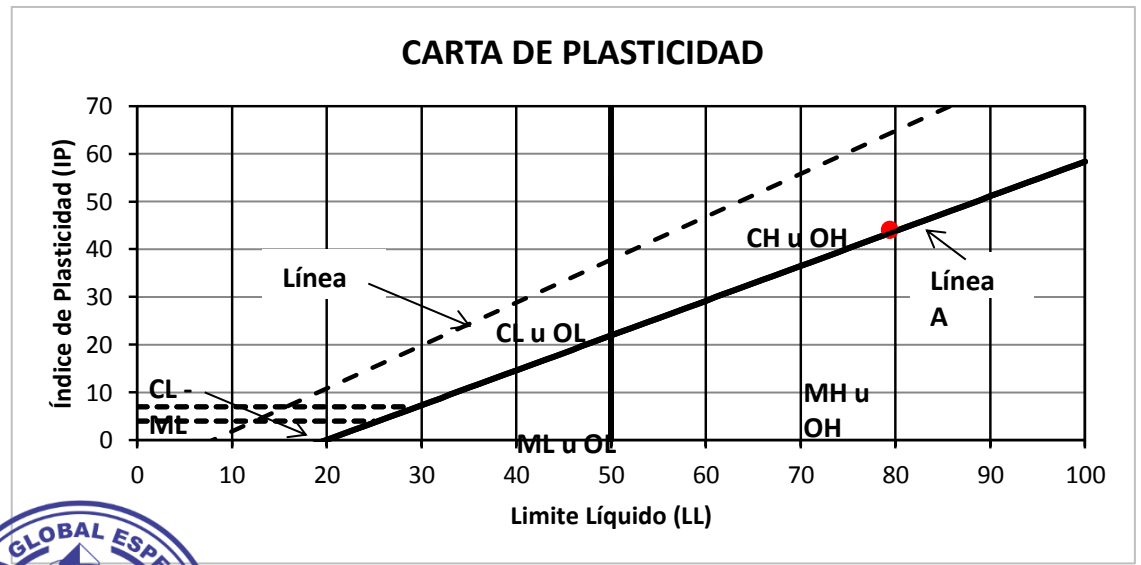

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 11 | 20 | 27 | 35 | | | | |
| B) Número del recipiente | B | P2 | P5 | P3 | | 5 | P8 | P12 |
| C) Peso del recip. + suelo húmedo | 19.30 | 16.06 | 18.08 | 18.30 | | 12.44 | 12.44 | 12.42 |
| D) Peso del recip. + suelo seco | 15.7 | 13.96 | 15.06 | 15.25 | | 12.18 | 12.18 | 12.16 |
| E) Peso agua (C-D) | 3.60 | 2.10 | 3.02 | 3.05 | | 0.26 | 0.26 | 0.26 |
| G) Peso recipiente | 11.26 | 11.32 | 11.25 | 11.36 | | 11.45 | 11.44 | 11.42 |
| H) Peso suelo seco (D-G) | 4.44 | 2.64 | 3.81 | 3.89 | | 0.73 | 0.74 | 0.74 |
| I) Contenido de Humedad (E/H) % | 81.08 | 79.55 | 79.27 | 78.41 | | 35.62 | 35.14 | 35.14 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **5.13** |
| Porcentaje de arena | **1.40** |
| Porcentaje de finos | **93.47** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **79.39** |
| Límite plástico | **35.30** |
| Indice de plasticidad | **44.09** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

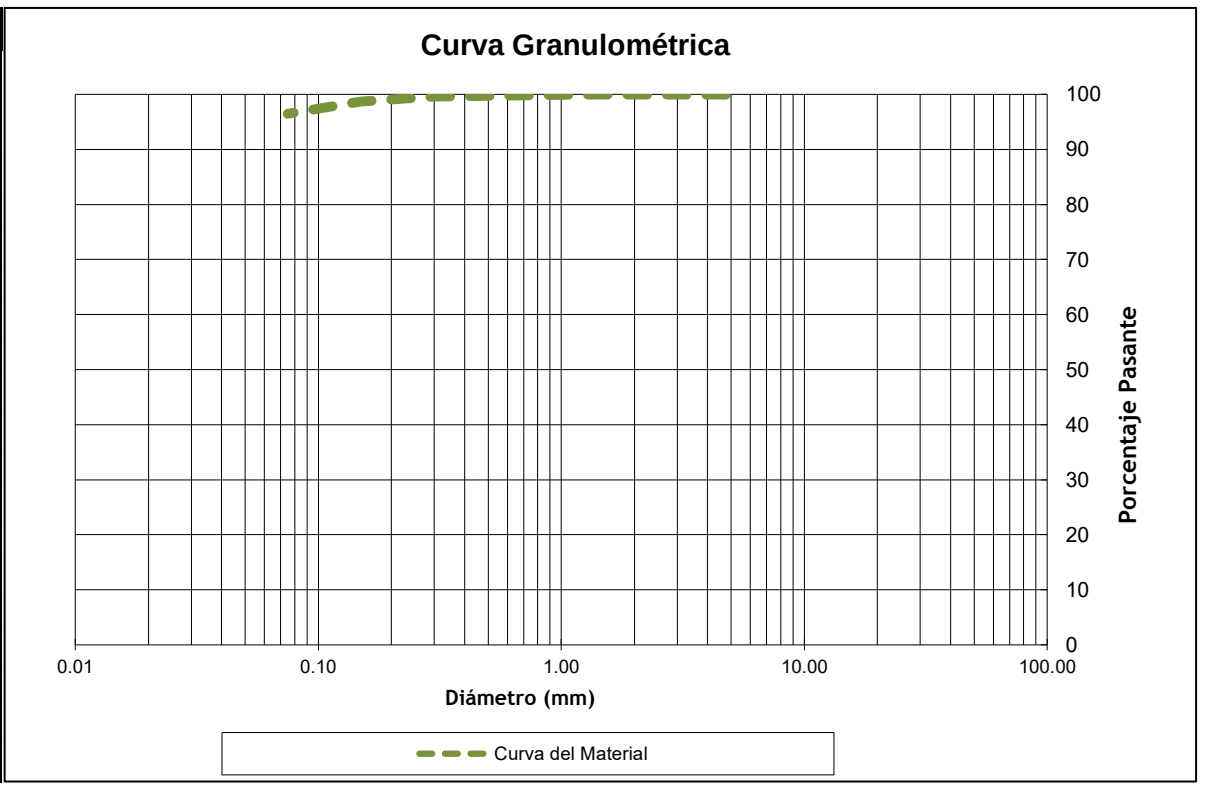
| | |
|---|---|
| ID Muestra: | Sondeo E8-05 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#53 (M2-M7) |
| Profundidad: | 0.45-3.15 m |

| | |
|---|---|
| Peso Sucio | **252.80** |
| Peso seco (gr): | **9.00** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.16 | 1.18 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.40 | 0.43 | 0.80 | 0.32 | 0.32 | 99.68 |
| No.50 | 0.3 | 0.30 | 0.12 | 0.44 | 99.56 |
| No.100 | 0.15 | 2.20 | 0.87 | 1.31 | 98.69 |
| No.200 | 0.075 | 5.70 | 2.25 | 3.56 | 96.44 |
| Pan | | 0.00 | 0.00 | 3.56 | |

0

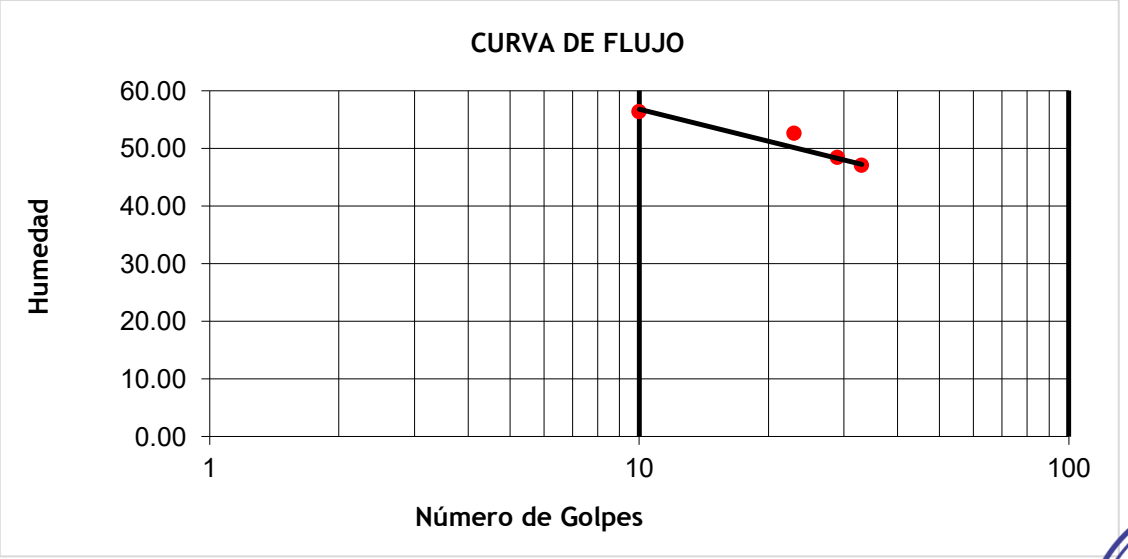


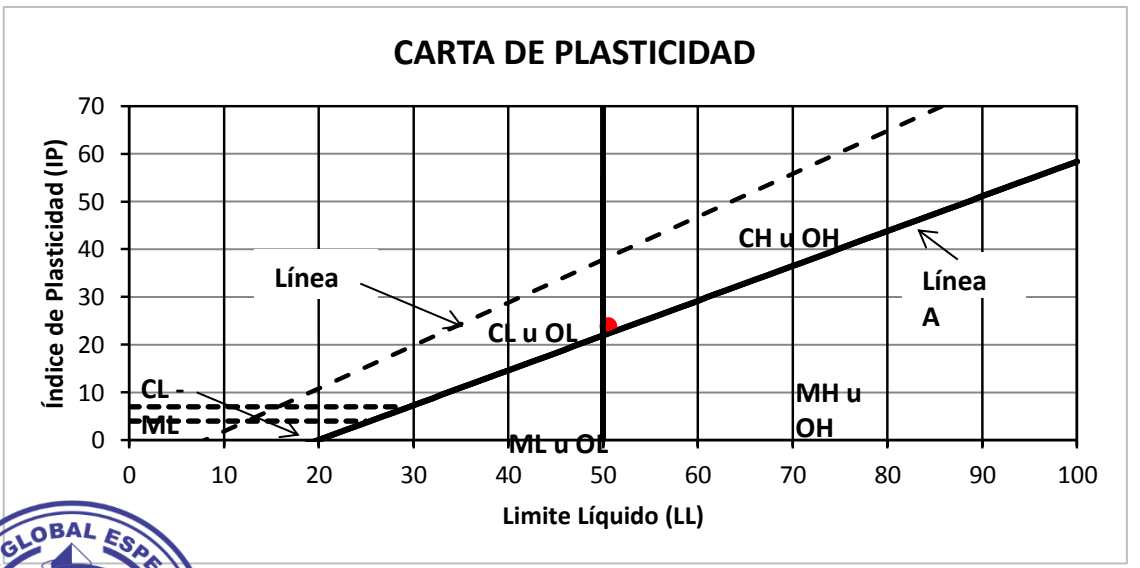

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 23 | 29 | 33 | | | | |
| B) Número del recipiente | P11 | 4 | U | XX | | O7 | 3 | O11 |
| C) Peso del recip. + suelo húmedo | 20.15 | 19.32 | 19.18 | 19.12 | | 5.55 | 5.70 | 5.35 |
| D) Peso del recip. + suelo seco | 17.04 | 16.66 | 16.63 | 16.70 | | 5.29 | 5.41 | 5.12 |
| E) Peso agua (C-D) | 3.11 | 2.66 | 2.55 | 2.42 | | 0.26 | 0.29 | 0.23 |
| G) Peso recipiente | 11.52 | 11.60 | 11.36 | 11.55 | | 4.31 | 4.33 | 4.26 |
| H) Peso suelo seco (D-G) | 5.52 | 5.06 | 5.27 | 5.15 | | 0.98 | 1.08 | 0.86 |
| I) Contenido de Humedad (E/H) % | 56.34 | 52.57 | 48.39 | 46.99 | | 26.53 | 26.85 | 26.74 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **3.56** |
| Porcentaje de finos | **96.44** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **50.55** |
| Límite plástico | **26.71** |
| Indice de plasticidad | **23.85** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

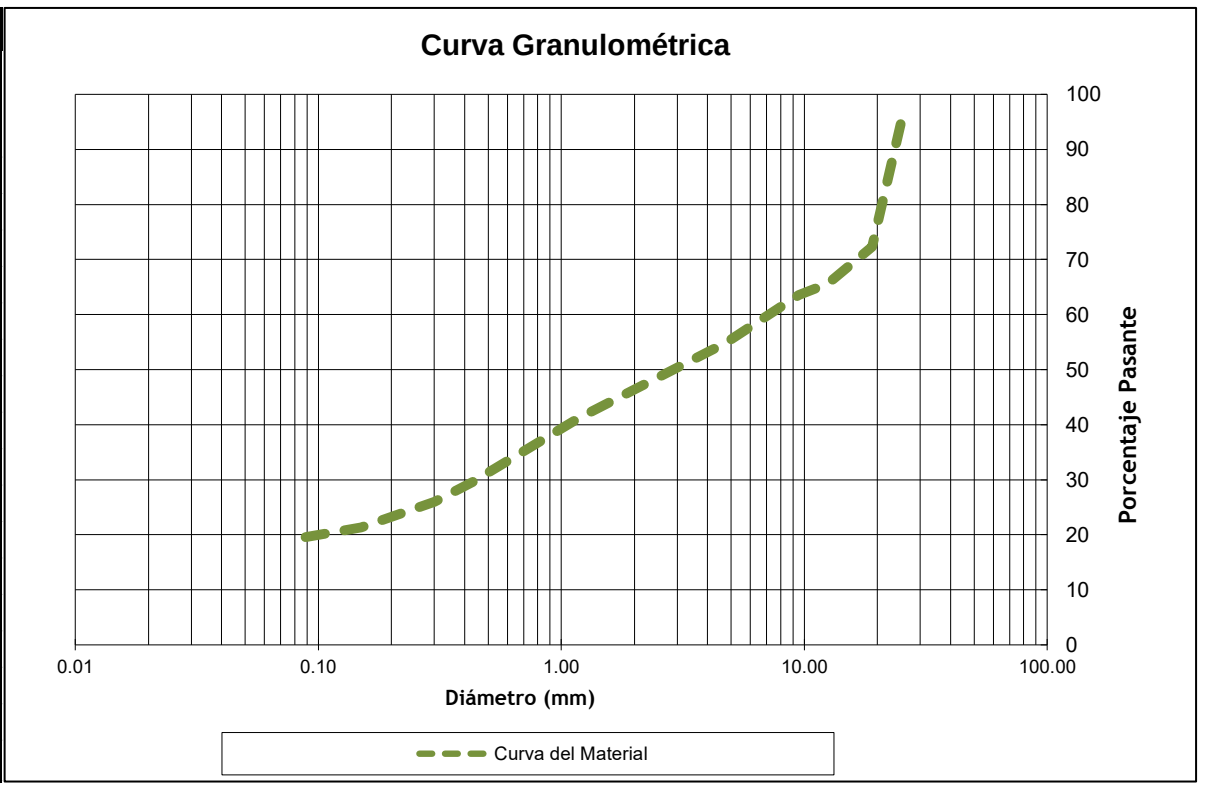
| | |
|---|---|
| ID Muestra: | Sondeo E8-05 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#33 (M8-M12) |
| Profundidad: | 3.15-5.40 m |

| | |
|---|---|
| Peso Sucio | **543.20** |
| Peso seco (gr): | **439.90** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | 29.20 | 5.38 | 5.38 | 94.62 |
| 3/4" | 19.00 | 121.20 | 22.31 | 27.69 | 72.31 |
| 1/2" | 12.50 | 36.30 | 6.68 | 34.37 | 65.63 |
| 3/8" | 9.50 | 11.30 | 2.08 | 36.45 | 63.55 |
| No.4 | 4.75 | 47.20 | 8.69 | 45.14 | 54.86 |
| No.10 | 2.00 | 46.00 | 8.47 | 53.61 | 46.39 |
| No.16 | 1.18 | 28.20 | 5.19 | 58.80 | 41.20 |
| No.40 | 0.43 | 63.20 | 11.63 | 70.43 | 29.57 |
| No.50 | 0.3 | 19.60 | 3.61 | 74.04 | 25.96 |
| No.100 | 0.15 | 25.10 | 4.62 | 78.66 | 21.34 |
| No.200 | 0.075 | 12.50 | 2.30 | 80.96 | 19.04 |
| Pan | | 0.10 | 0.02 | 80.98 | |

0

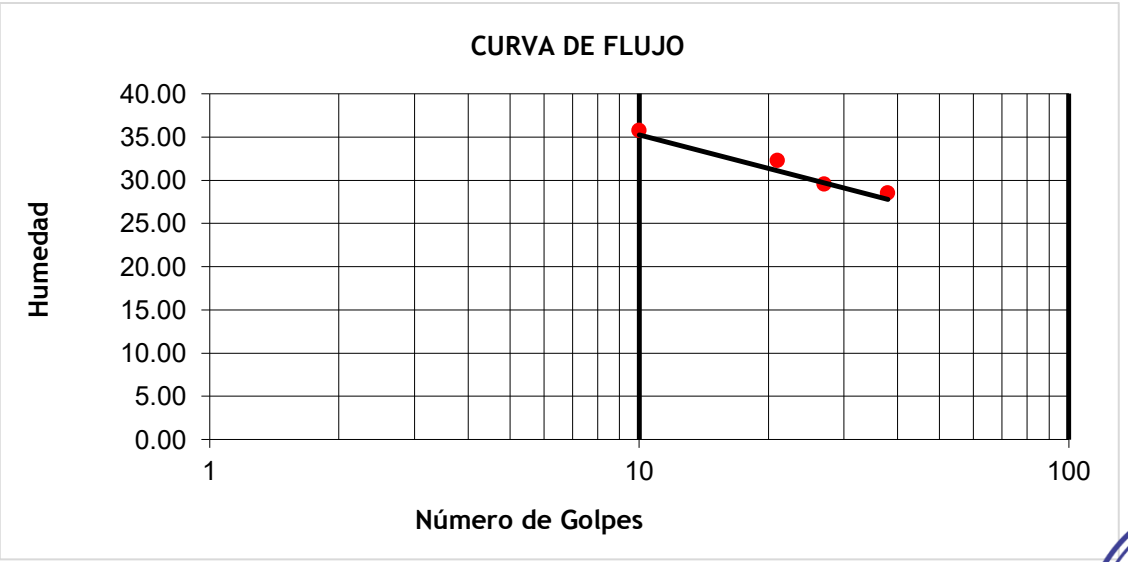


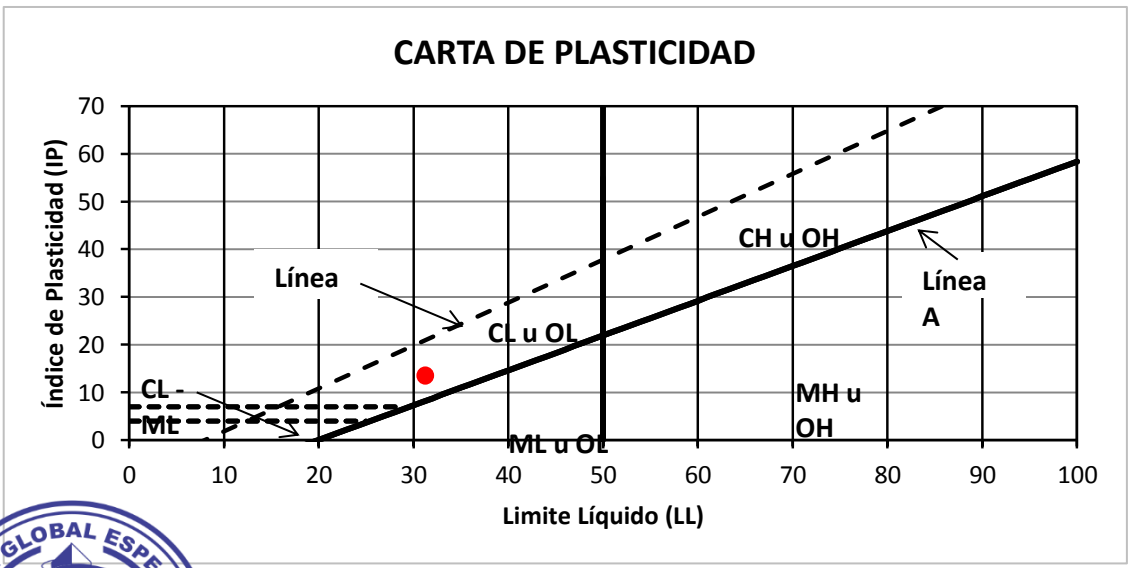

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 21 | 27 | 38 | | | | |
| B) Número del recipiente | K10 | 28 | 22 | K33 | | 2 | 7 | QQ |
| C) Peso del recip. + suelo húmedo | 33.55 | 33.28 | 34.76 | 33.64 | | 5.94 | 6.60 | 6.39 |
| D) Peso del recip. + suelo seco | 31.37 | 31.22 | 32.53 | 31.78 | | 5.70 | 6.25 | 6.08 |
| E) Peso agua (C-D) | 2.18 | 2.06 | 2.23 | 1.86 | | 0.24 | 0.35 | 0.31 |
| G) Peso recipiente | 25.27 | 24.84 | 24.98 | 25.25 | | 4.34 | 4.27 | 4.35 |
| H) Peso suelo seco (D-G) | 6.10 | 6.38 | 7.55 | 6.53 | | 1.36 | 1.98 | 1.73 |
| I) Contenido de Humedad (E/H) % | 35.74 | 32.29 | 29.54 | 28.48 | | 17.65 | 17.68 | 17.92 |
| Clasificación (Sistema Unificado de Suelos): | **GRAVA ARCILLOSA CON ARENA (GC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **45.14** |
| Porcentaje de arena | **35.82** |
| Porcentaje de finos | **19.04** |
| D10 | **0.00** |
| D30 | **0.46** |
| D60 | **7.56** |
| Cu | |
| Cc | |
| Límite líquido | **31.24** |
| Límite plástico | **17.75** |
| Indice de plasticidad | **13.50** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

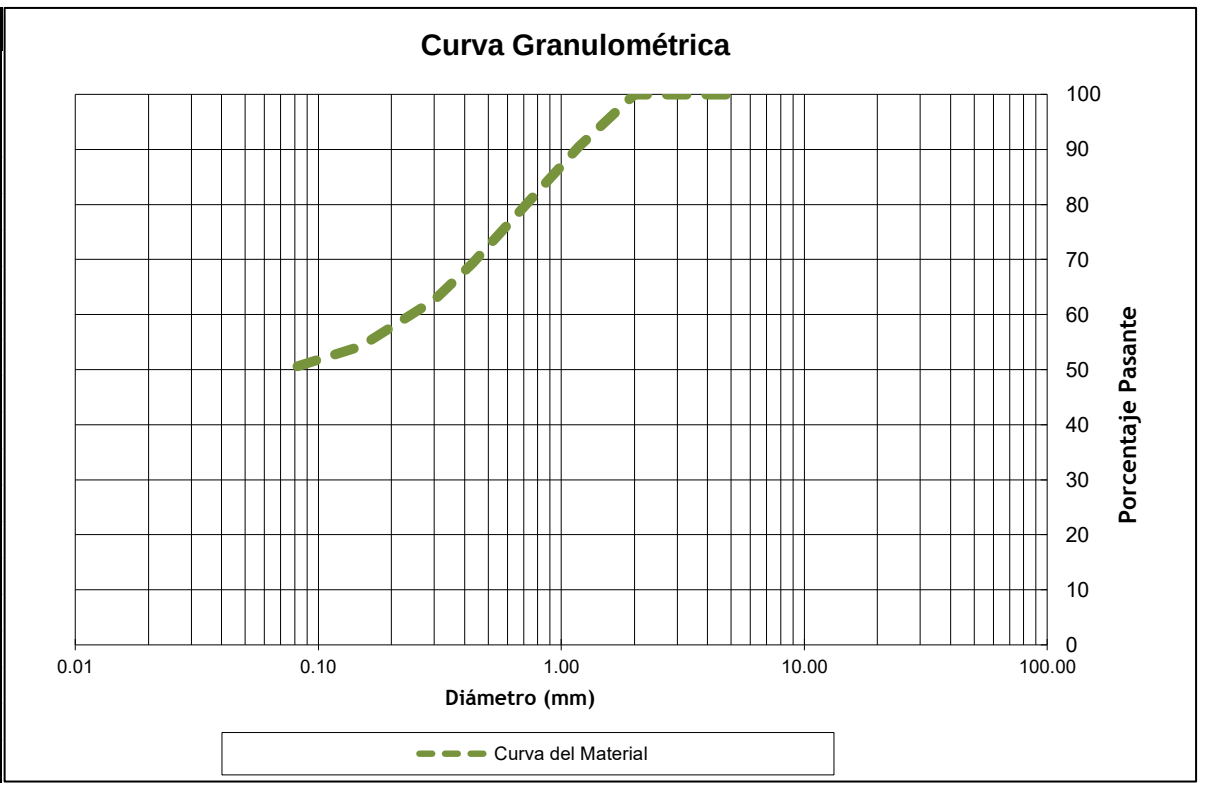
| | |
|---|---|
| ID Muestra: | Sondeo E8-05 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#36 (M13-M23) |
| Profundidad: | 5.40-10.35 m |

| | |
|---|---|
| Peso Sucio | **297.50** |
| Peso seco (gr): | **148.70** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.16 | 1.18 | 28.20 | 9.48 | 9.48 | 90.52 |
| No.40 | 0.43 | 63.20 | 21.24 | 30.72 | 69.28 |
| No.50 | 0.3 | 19.60 | 6.59 | 37.31 | 62.69 |
| No.100 | 0.15 | 25.10 | 8.44 | 45.75 | 54.25 |
| No.200 | 0.075 | 12.50 | 4.20 | 49.95 | 50.05 |
| Pan | | 0.10 | 0.03 | 49.98 | |

0

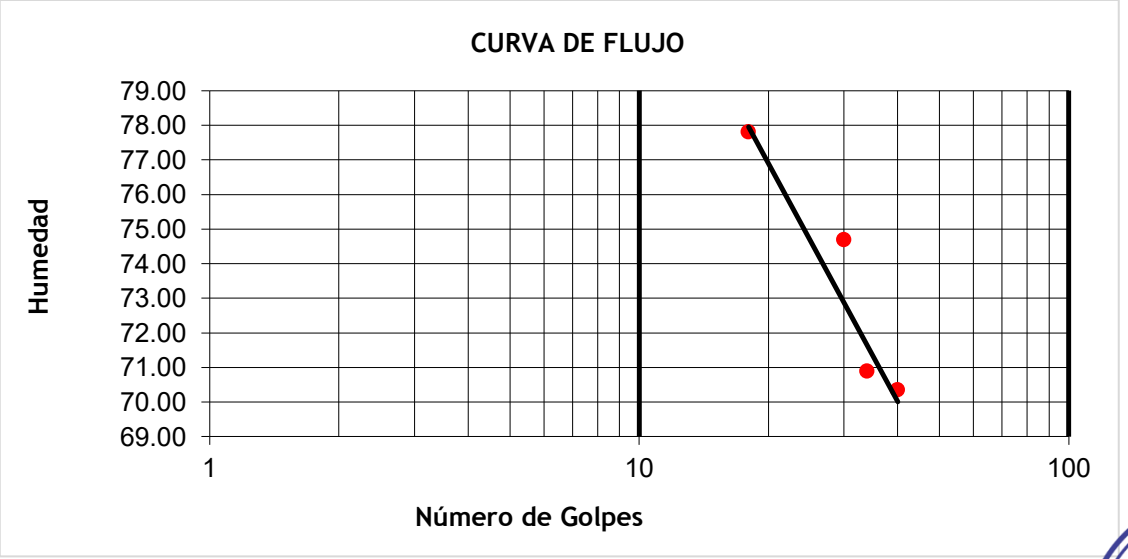


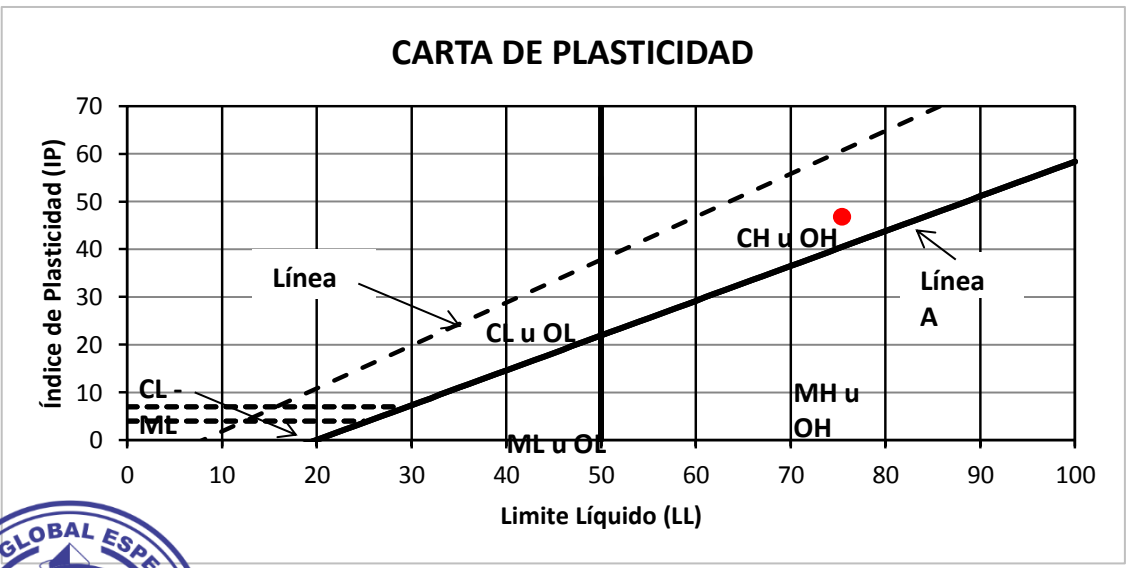

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 18 | 30 | 34 | 40 | | | | |
| B) Número del recipiente | 1 | 23 | P2 | B1 | | N1 | 5 | O8 |
| C) Peso del recip. + suelo húmedo | 17.47 | 16.89 | 17.22 | 17.76 | | 5.13 | 5.12 | 4.97 |
| D) Peso del recip. + suelo seco | 14.77 | 14.50 | 14.76 | 15.08 | | 4.96 | 4.95 | 4.83 |
| E) Peso agua (C-D) | 2.70 | 2.39 | 2.46 | 2.68 | | 0.17 | 0.17 | 0.14 |
| G) Peso recipiente | 11.30 | 11.30 | 11.29 | 11.27 | | 4.35 | 4.36 | 4.35 |
| H) Peso suelo seco (D-G) | 3.47 | 3.20 | 3.47 | 3.81 | | 0.61 | 0.59 | 0.48 |
| I) Contenido de Humedad (E/H) % | 77.81 | 74.69 | 70.89 | 70.34 | | 27.87 | 28.81 | 29.17 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD ARENOSA (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **49.95** |
| Porcentaje de finos | **50.05** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.25** |
| Cu | |
| Cc | |
| Límite líquido | **75.42** |
| Límite plástico | **28.62** |
| Indice de plasticidad | **46.80** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

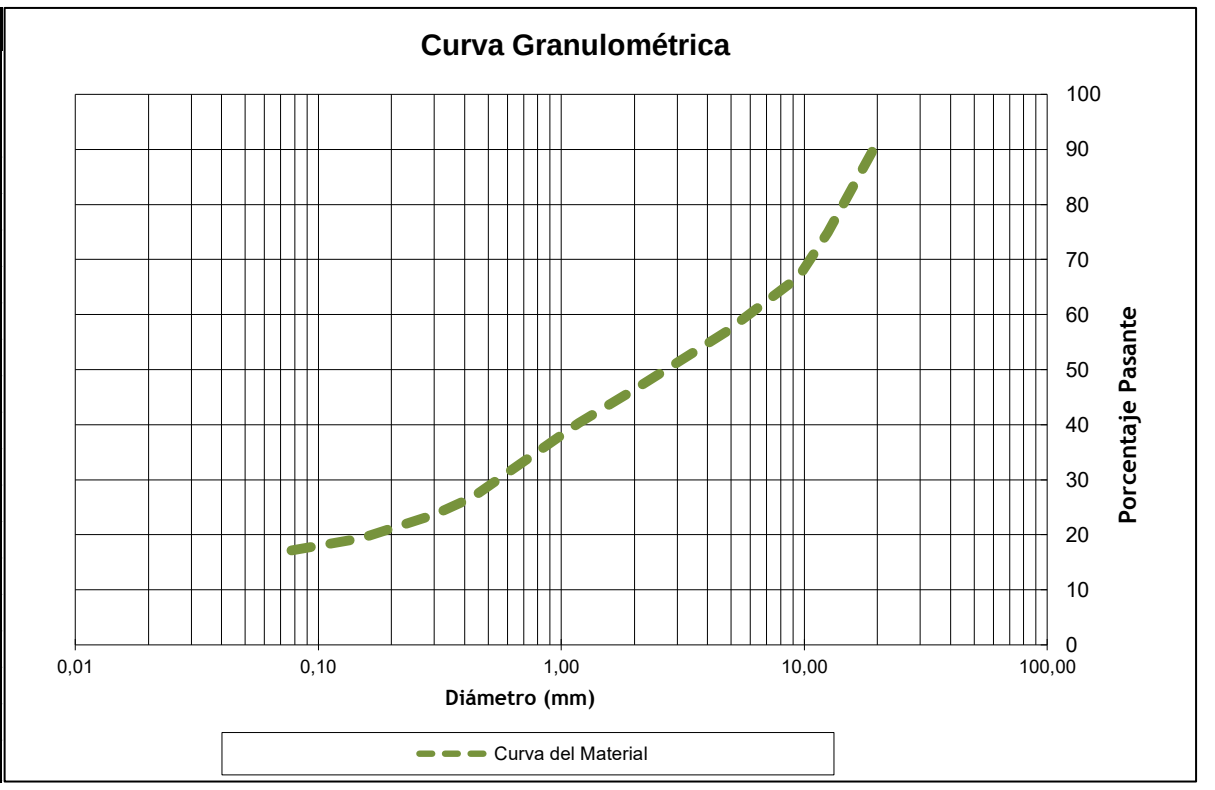
| | |
|---|---|
| ID Muestra: | Sondeo E8-06 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#44 (M2-M17) |
| Profundidad: | 0.45-7.65 m |

| | |
|---|---|
| Peso Sucio | **869.90** |
| Peso seco (gr): | **721.90** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 90.80 | 10.44 | 10.44 | 89.56 |
| 1/2" | 12.50 | 127.50 | 14.66 | 25.09 | 74.91 |
| 3/8" | 9.50 | 70.00 | 8.05 | 33.14 | 66.86 |
| No.4 | 4.75 | 87.20 | 10.02 | 43.17 | 56.83 |
| No.10 | 2.00 | 91.00 | 10.46 | 53.63 | 46.37 |
| No.16 | 1.18 | 53.10 | 6.10 | 59.73 | 40.27 |
| No.40 | 0.43 | 117.10 | 13.46 | 73.19 | 26.81 |
| No.50 | 0.3 | 27.40 | 3.15 | 76.34 | 23.66 |
| No.100 | 0.15 | 37.30 | 4.29 | 80.63 | 19.37 |
| No.200 | 0.075 | 20.20 | 2.32 | 82.95 | 17.05 |
| Pan | | 0.30 | 0.03 | 82.99 | |

0

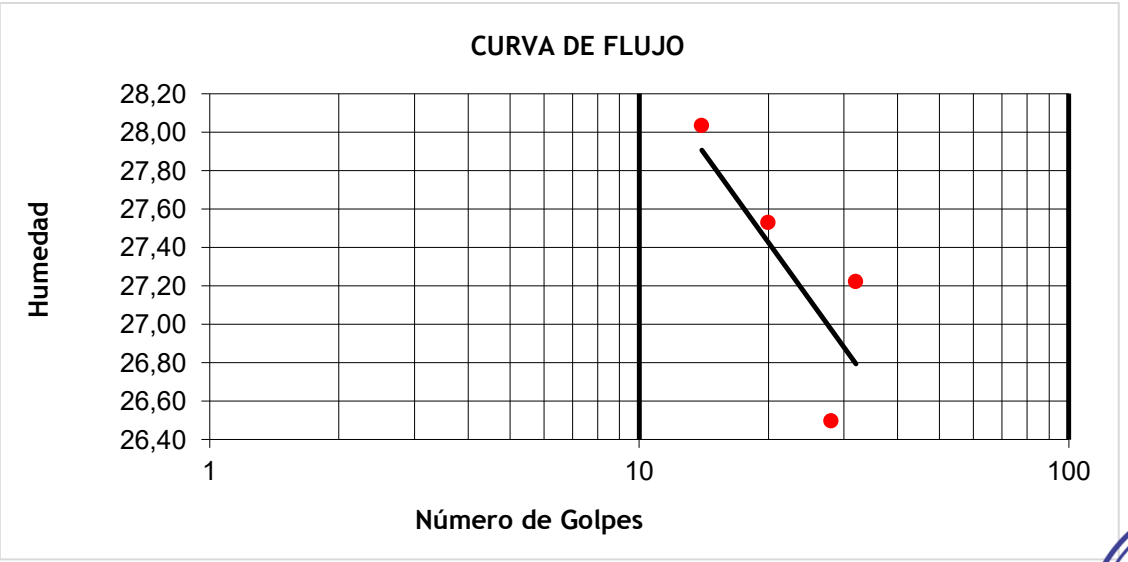


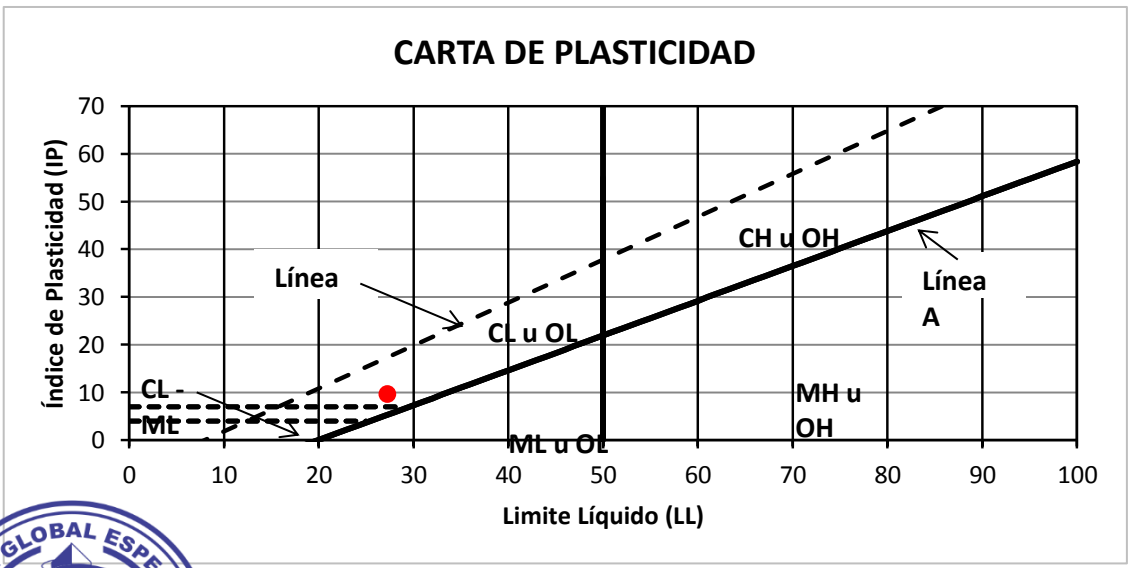

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 14 | 20 | 28 | 32 | | | | |
| B) Número del recipiente | U | P8 | C | B | | P7 | P3 | 23 |
| C) Peso del recip. + suelo húmedo | 20.22 | 20.51 | 18.84 | 20.42 | | 13.50 | 12.97 | 12.98 |
| D) Peso del recip. + suelo seco | 18.28 | 18.55 | 17.29 | 18.46 | | 13.22 | 12.73 | 12.72 |
| E) Peso agua (C-D) | 1.94 | 1.96 | 1.55 | 1.96 | | 0.28 | 0.24 | 0.26 |
| G) Peso recipiente | 11.36 | 11.43 | 11.44 | 11.26 | | 11.60 | 11.36 | 11.27 |
| H) Peso suelo seco (D-G) | 6.92 | 7.12 | 5.85 | 7.20 | | 1.62 | 1.37 | 1.45 |
| I) Contenido de Humedad (E/H) % | 28.03 | 27.53 | 26.50 | 27.22 | | 17.28 | 17.52 | 17.93 |
| Clasificación (Sistema Unificado de Suelos): | **GRAVA ARCILLOSA CON ARENA (GC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **43.17** |
| Porcentaje de arena | **39.79** |
| Porcentaje de finos | **17.05** |
| D10 | **0.00** |
| D30 | **0.61** |
| D60 | **6.25** |
| Cu | |
| Cc | |
| Límite líquido | **27.23** |
| Límite plástico | **17.58** |
| Indice de plasticidad | **9.65** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

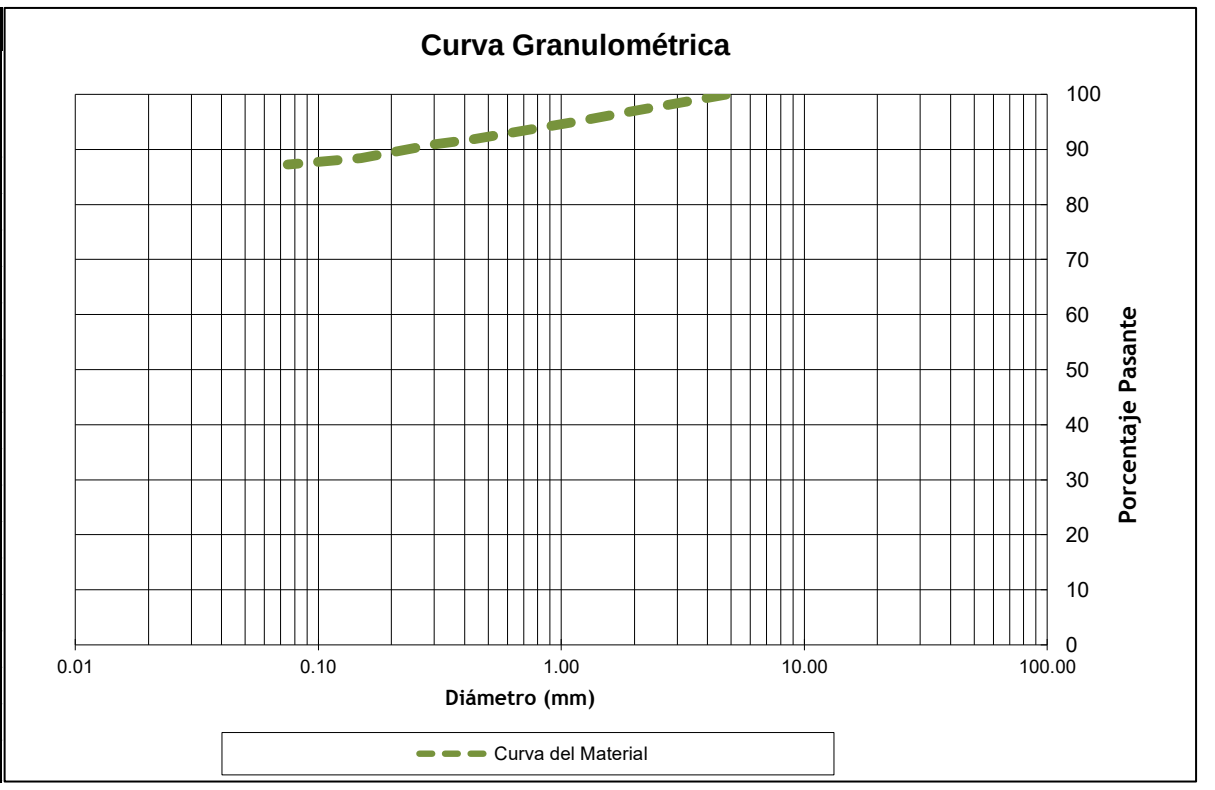
| | |
|---|---|
| ID Muestra: | Sondeo E8-06 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#08 (M18-M20) |
| Profundidad: | 7.65-9.00 m |

| | |
|---|---|
| Peso Sucio | **136.90** |
| Peso seco (gr): | **17.40** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 4.10 | 2.99 | 2.99 | 97.01 |
| No.16 | 1.18 | 2.60 | 1.90 | 4.89 | 95.11 |
| No.40 | 0.43 | 4.50 | 3.29 | 8.18 | 91.82 |
| No.50 | 0.3 | 1.20 | 0.88 | 9.06 | 90.94 |
| No.100 | 0.15 | 3.50 | 2.56 | 11.61 | 88.39 |
| No.200 | 0.075 | 1.50 | 1.10 | 12.71 | 87.29 |
| Pan | | 0.00 | 0.00 | 12.71 | |

0

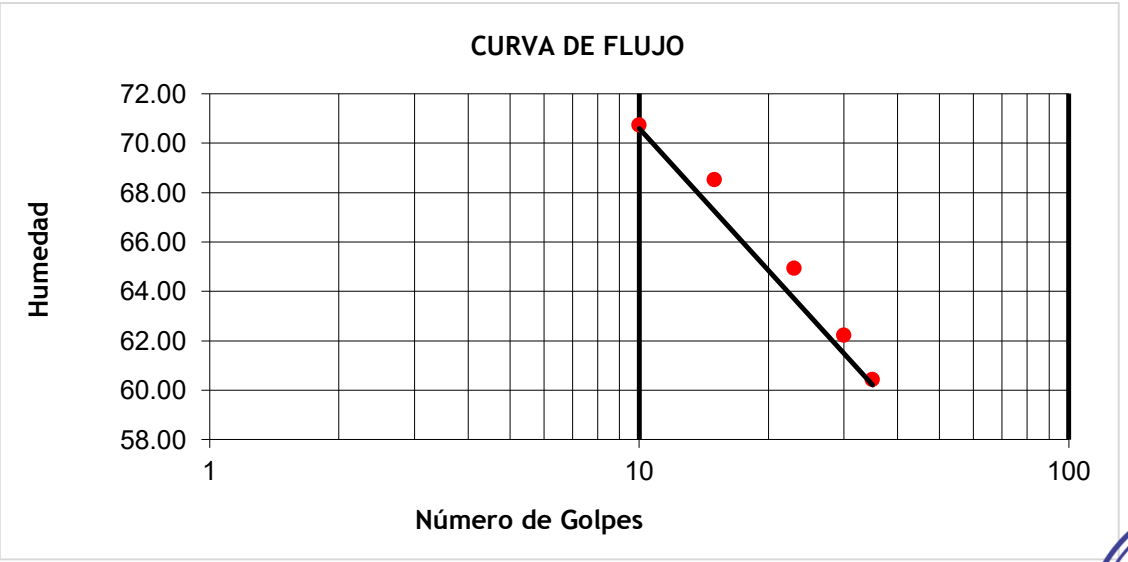


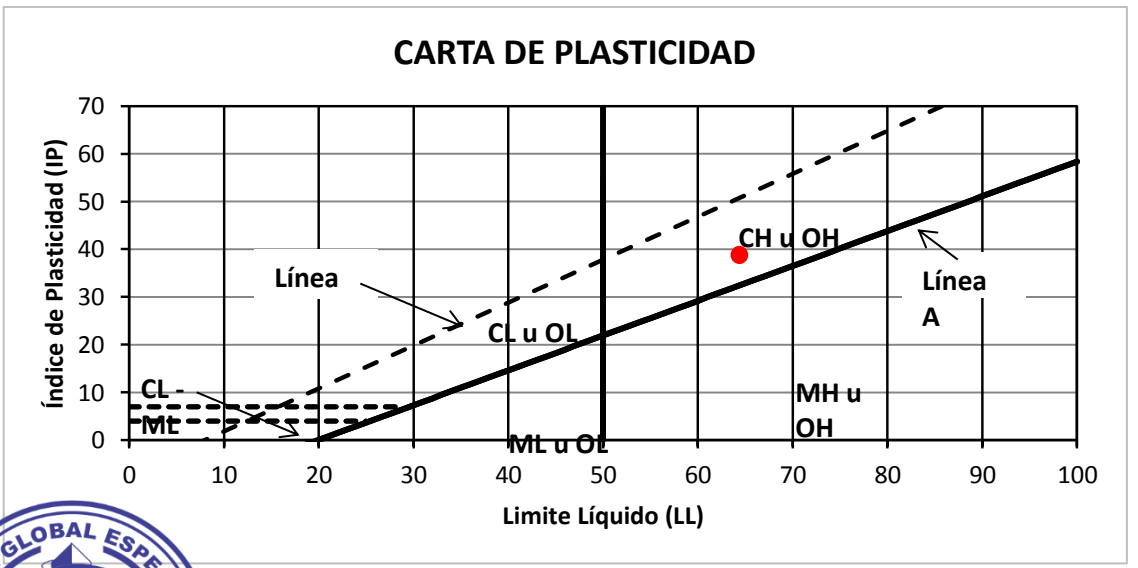

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 15 | 23 | 30 | 35 | | | |
| B) Número del recipiente | 17 | CK | AK | 14 | K33 | 23 | T | 6 |
| C) Peso del recip. + suelo húmedo | 32.66 | 30.34 | 31.75 | 29.69 | 31.35 | 5.08 | 5.16 | 5.06 |
| D) Peso del recip. + suelo seco | 29.47 | 28.12 | 29.14 | 27.83 | 29.06 | 4.92 | 5.00 | 4.90 |
| E) Peso agua (C-D) | 3.19 | 2.22 | 2.61 | 1.86 | 2.29 | 0.16 | 0.16 | 0.16 |
| G) Peso recipiente | 24.96 | 24.88 | 25.12 | 24.84 | 25.27 | 4.29 | 4.37 | 4.28 |
| H) Peso suelo seco (D-G) | 4.51 | 3.24 | 4.02 | 2.99 | 3.79 | 0.63 | 0.63 | 0.62 |
| I) Contenido de Humedad (E/H) % | 70.73 | 68.52 | 64.93 | 62.21 | 60.42 | 25.40 | 25.40 | 25.81 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **12.71** |
| Porcentaje de finos | **87.29** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **64.37** |
| Límite plástico | **25.53** |
| Indice de plasticidad | **38.83** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

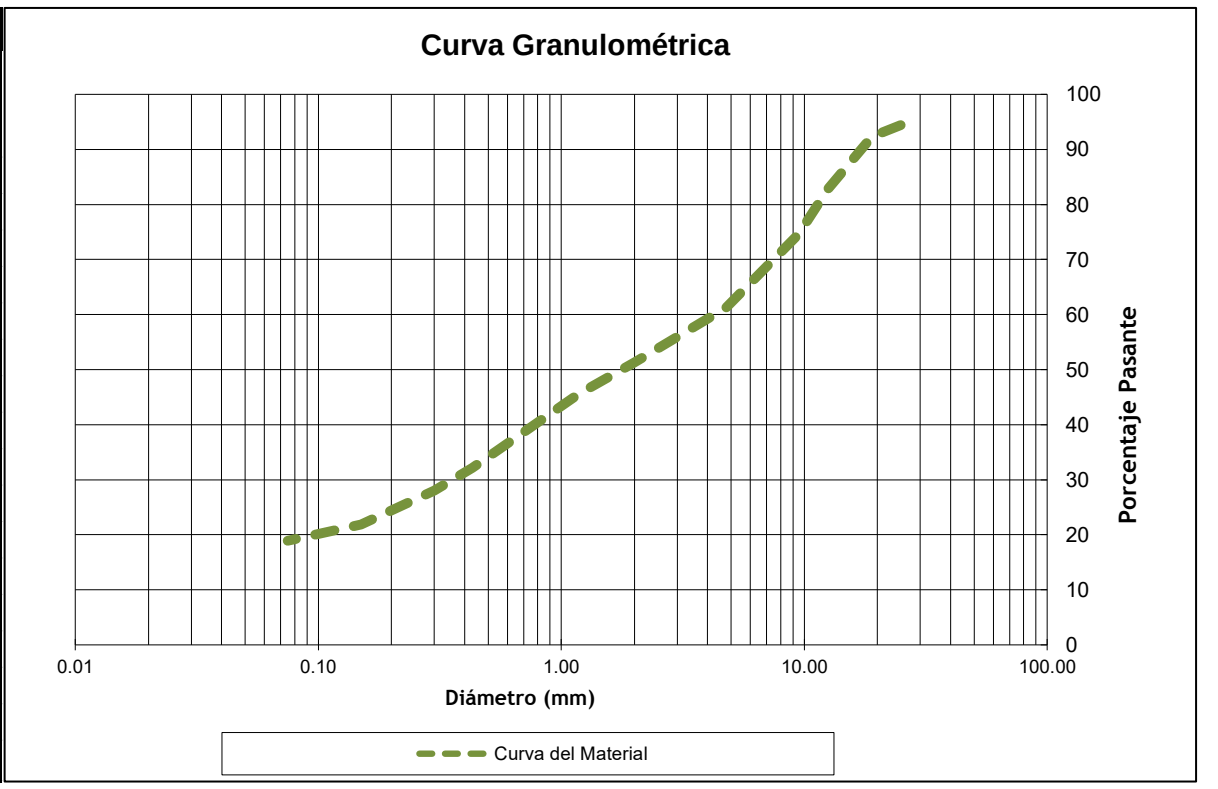
| | |
|---|---|
| ID Muestra: | Sondeo E8-07 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#07 (M2-M14) |
| Profundidad: | 0.45-6.30 m |

| | |
|---|---|
| Peso Sucio | **590.20** |
| Peso seco (gr): | **478.70** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | 32.80 | 5.56 | 5.56 | 94.44 |
| 3/4" | 19.00 | 12.40 | 2.10 | 7.66 | 92.34 |
| 1/2" | 12.50 | 56.20 | 9.52 | 17.18 | 82.82 |
| 3/8" | 9.50 | 48.20 | 8.17 | 25.35 | 74.65 |
| No.4 | 4.75 | 79.40 | 13.45 | 38.80 | 61.20 |
| No.10 | 2.00 | 58.50 | 9.91 | 48.71 | 51.29 |
| No.16 | 1.18 | 33.60 | 5.69 | 54.41 | 45.59 |
| No.40 | 0.43 | 79.20 | 13.42 | 67.82 | 32.18 |
| No.50 | 0.3 | 24.50 | 4.15 | 71.98 | 28.02 |
| No.100 | 0.15 | 36.30 | 6.15 | 78.13 | 21.87 |
| No.200 | 0.075 | 17.60 | 2.98 | 81.11 | 18.89 |
| Pan | | 0.00 | 0.00 | 81.11 | |

0

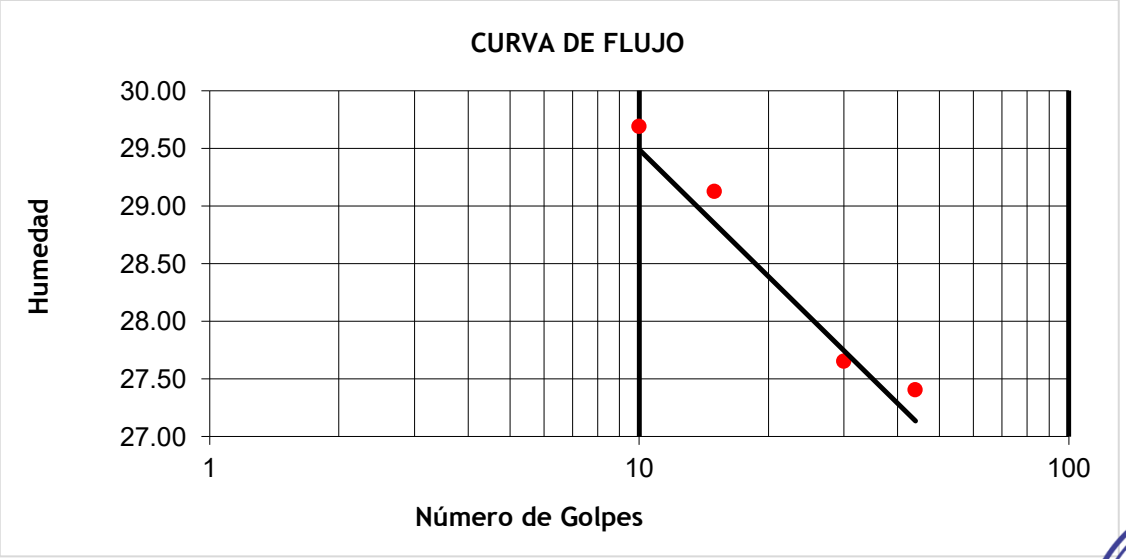


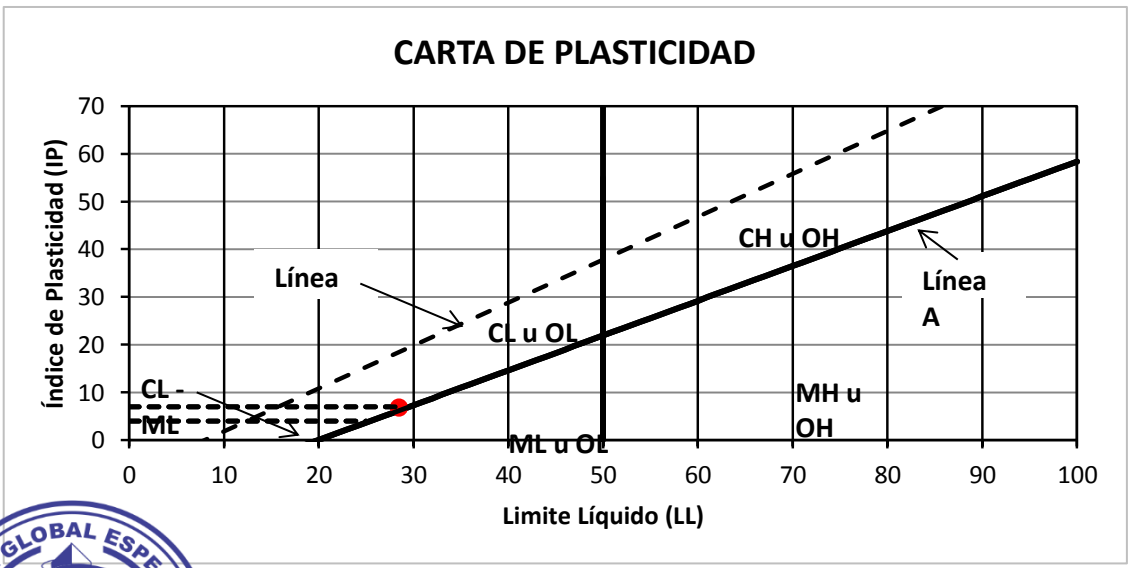

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 15 | 30 | 44 | | | | |
| B) Número del recipiente | P11 | O13 | 14 | X | | E | P10 | 2 |
| C) Peso del recip. + suelo húmedo | 19.46 | 20.10 | 21.53 | 19.21 | | 12.55 | 12.55 | 12.80 |
| D) Peso del recip. + suelo seco | 17.64 | 18.07 | 19.34 | 17.50 | | 12.27 | 12.32 | 12.53 |
| E) Peso agua (C-D) | 1.82 | 2.03 | 2.19 | 1.71 | | 0.28 | 0.23 | 0.27 |
| G) Peso recipiente | 11.51 | 11.10 | 11.42 | 11.26 | | 10.99 | 11.25 | 11.28 |
| H) Peso suelo seco (D-G) | 6.13 | 6.97 | 7.92 | 6.24 | | 1.28 | 1.07 | 1.25 |
| I) Contenido de Humedad (E/H) % | 29.69 | 29.12 | 27.65 | 27.40 | | 21.88 | 21.50 | 21.60 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **38.80** |
| Porcentaje de arena | **42.31** |
| Porcentaje de finos | **18.89** |
| D10 | **0.00** |
| D30 | **0.36** |
| D60 | **4.42** |
| Cu | |
| Cc | |
| Límite líquido | **28.45** |
| Límite plástico | **21.66** |
| Indice de plasticidad | **6.79** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

Fecha de Ensayo: 02/06/2020

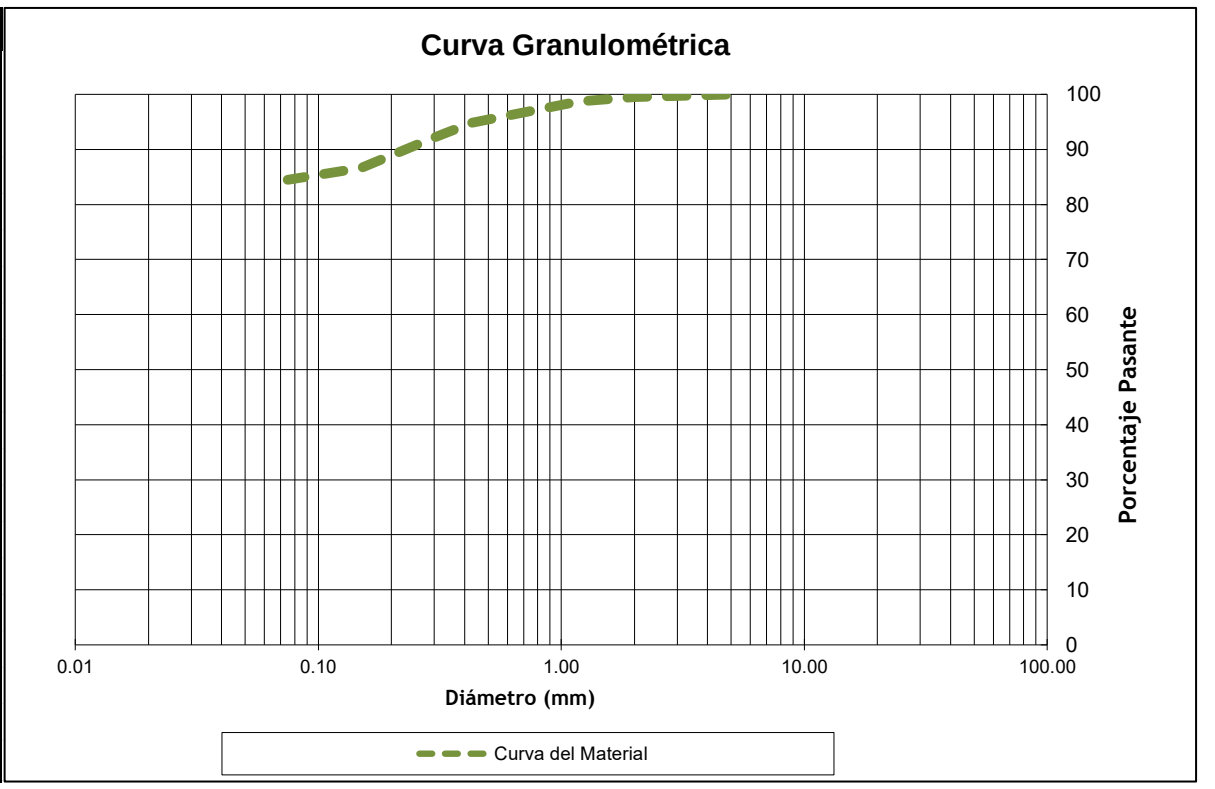
| | |
|---|---|
| ID Muestra: | Sondeo E8-07 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#05 (M15-M20) |
| Profundidad: | 6.30-9.00 m |

| | |
|---|---|
| Peso Sucio | **453.30** |
| Peso seco (gr): | **70.20** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 2.10 | 0.46 | 0.46 | 99.54 |
| No.16 | 1.18 | 3.90 | 0.86 | 1.32 | 98.68 |
| No.40 | 0.43 | 17.40 | 3.84 | 5.16 | 94.84 |
| No.50 | 0.3 | 12.10 | 2.67 | 7.83 | 92.17 |
| No.100 | 0.15 | 24.90 | 5.49 | 13.32 | 86.68 |
| No.200 | 0.075 | 9.80 | 2.16 | 15.49 | 84.51 |
| Pan | | 0.00 | 0.00 | 15.49 | |

0

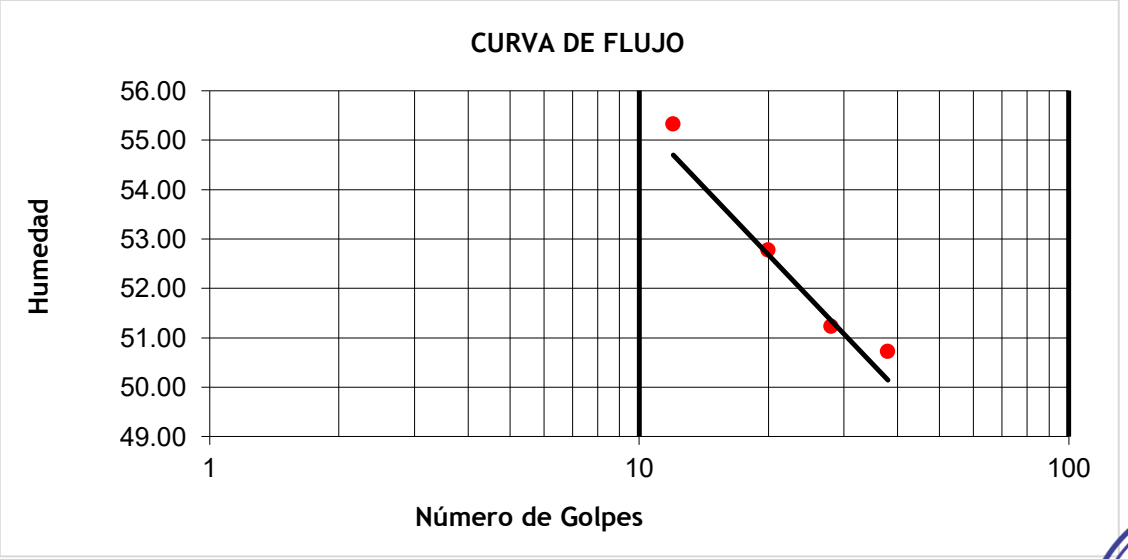


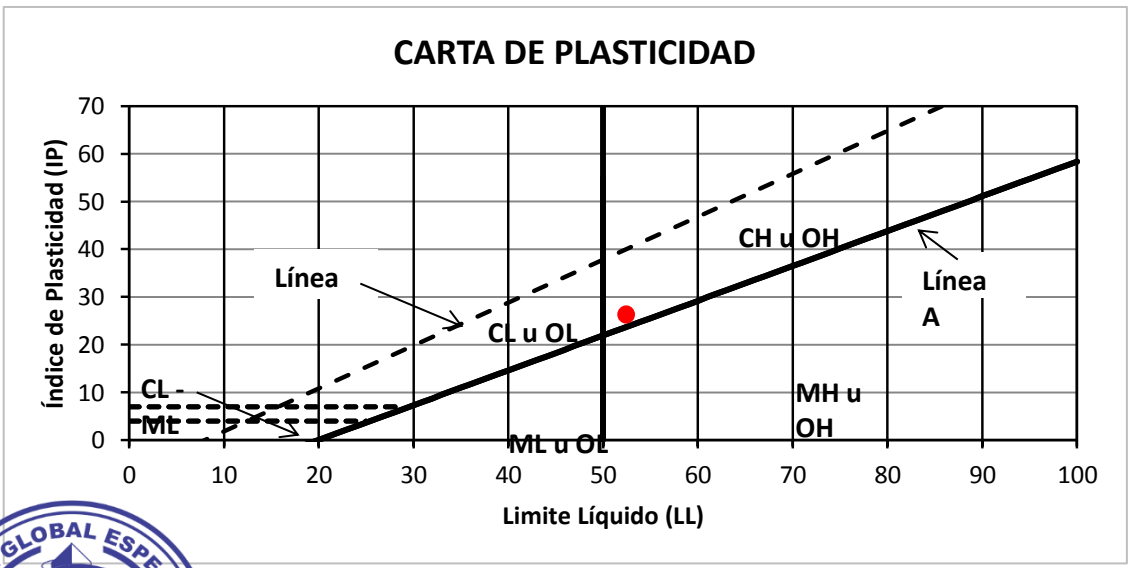

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 20 | 28 | 38 | | | | |
| B) Número del recipiente | P3 | 4 | V | P10 | | 7 | P11 | P1 |
| C) Peso del recip. + suelo húmedo | 20.11 | 21.09 | 20.55 | 20.71 | | 12.53 | 12.72 | 12.45 |
| D) Peso del recip. + suelo seco | 16.99 | 17.66 | 17.43 | 17.52 | | 12.33 | 12.48 | 12.21 |
| E) Peso agua (C-D) | 3.12 | 3.43 | 3.12 | 3.19 | | 0.20 | 0.24 | 0.24 |
| G) Peso recipiente | 11.35 | 11.16 | 11.34 | 11.23 | | 11.61 | 11.52 | 11.27 |
| H) Peso suelo seco (D-G) | 5.64 | 6.50 | 6.09 | 6.29 | | 0.72 | 0.96 | 0.94 |
| I) Contenido de Humedad (E/H) % | 55.32 | 52.77 | 51.23 | 50.72 | | 27.78 | 25.00 | 25.53 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD CON ARENA (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **15.49** |
| Porcentaje de finos | **84.51** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **52.42** |
| Límite plástico | **26.10** |
| Indice de plasticidad | **26.32** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

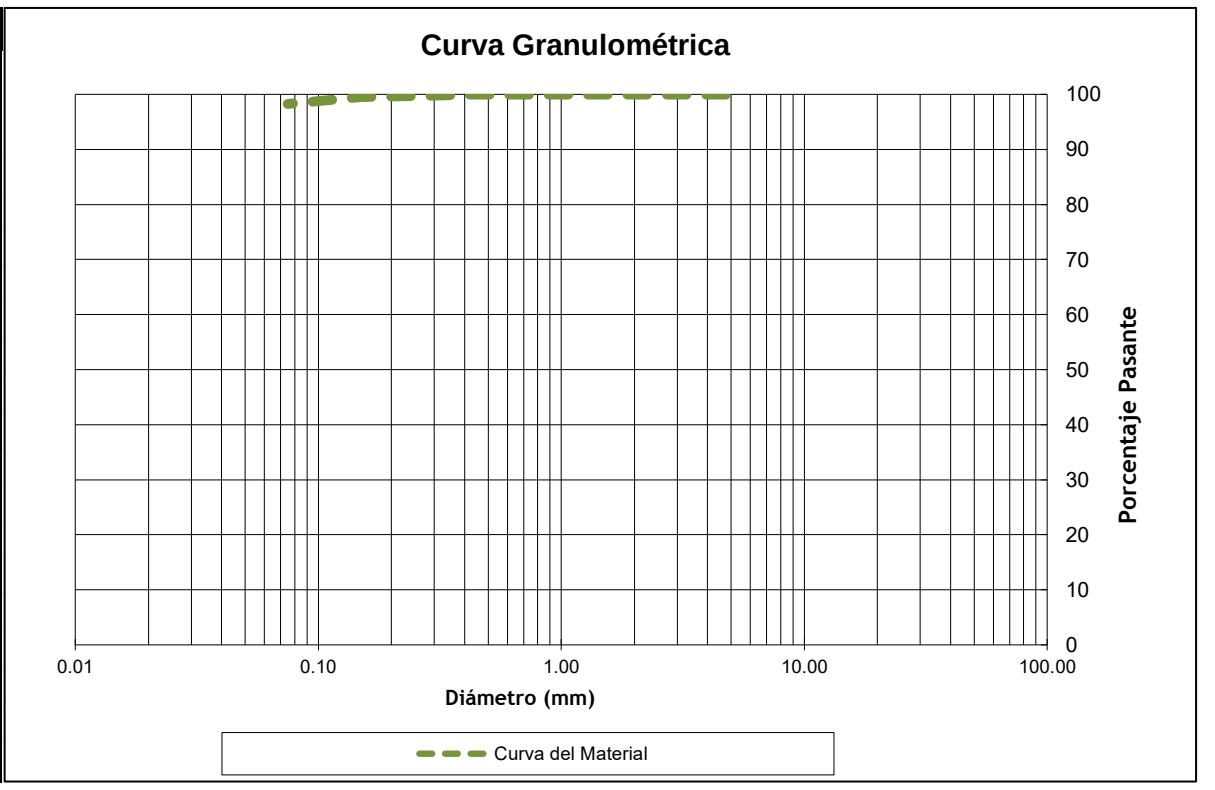
| | |
|---|---|
| ID Muestra: | Sondeo E8-08 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#47 (M1-M4) |
| Profundidad: | 0.00-1.80 m |

| | |
|---|---|
| Peso Sucio | **265.60** |
| Peso seco (gr): | **4.50** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.16 | 1.18 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.40 | 0.43 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.50 | 0.3 | 0.50 | 0.19 | 0.19 | 99.81 |
| No.100 | 0.15 | 0.90 | 0.34 | 0.53 | 99.47 |
| No.200 | 0.075 | 3.10 | 1.17 | 1.69 | 98.31 |
| Pan | | 0.00 | 0.00 | 1.69 | |

0

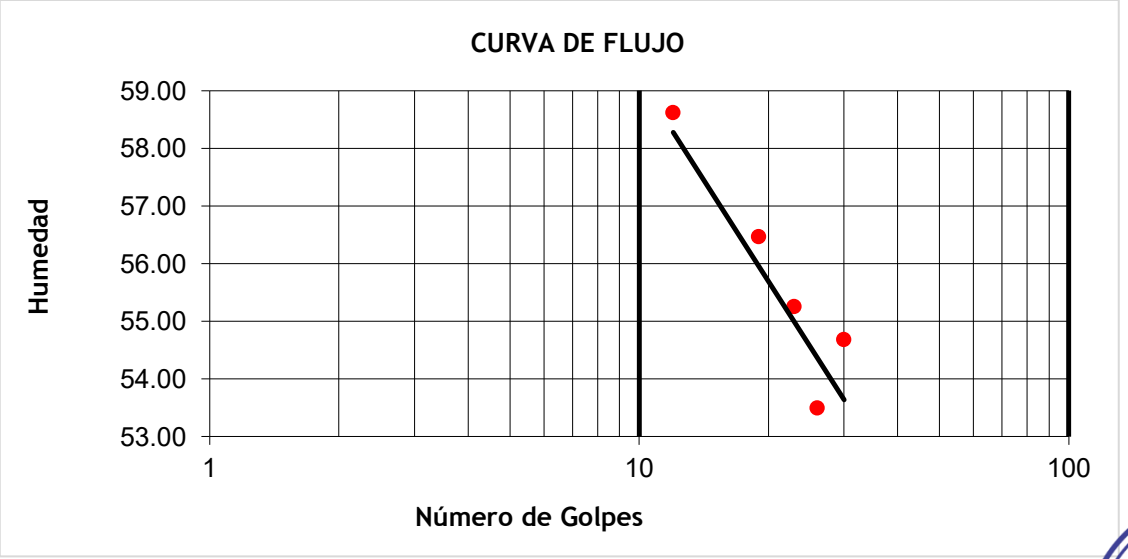


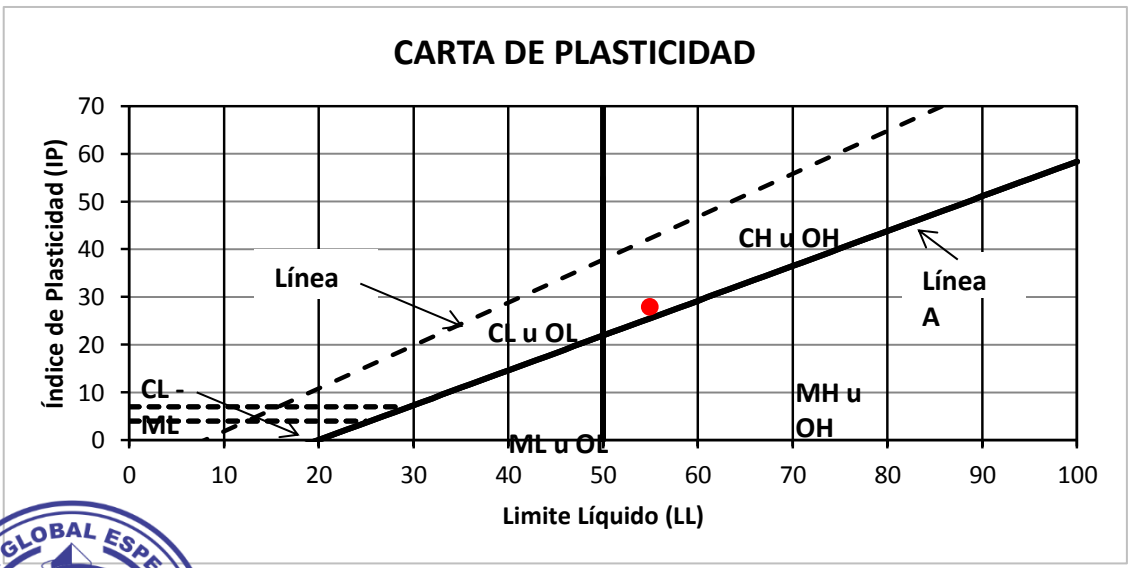

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 19 | 23 | 26 | 30 | | | |
| B) Número del recipiente | K34 | 18 | K17 | K2 | K36 | 9 | PD | O3 |
| C) Peso del recip. + suelo húmedo | 31.48 | 31.94 | 31.21 | 32.22 | 33.41 | 5.23 | 5.23 | 5.18 |
| D) Peso del recip. + suelo seco | 29.1 | 29.45 | 29.00 | 29.69 | 30.43 | 5.03 | 5.03 | 5.00 |
| E) Peso agua (C-D) | 2.38 | 2.49 | 2.21 | 2.53 | 2.98 | 0.20 | 0.20 | 0.18 |
| G) Peso recipiente | 25.04 | 25.04 | 25.00 | 24.96 | 24.98 | 4.27 | 4.31 | 4.33 |
| H) Peso suelo seco (D-G) | 4.06 | 4.41 | 4.00 | 4.73 | 5.45 | 0.76 | 0.72 | 0.67 |
| I) Contenido de Humedad (E/H) % | 58.62 | 56.46 | 55.25 | 53.49 | 54.68 | 26.32 | 27.78 | 26.87 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **1.69** |
| Porcentaje de finos | **98.31** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **54.93** |
| Límite plástico | **26.99** |
| Indice de plasticidad | **27.94** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

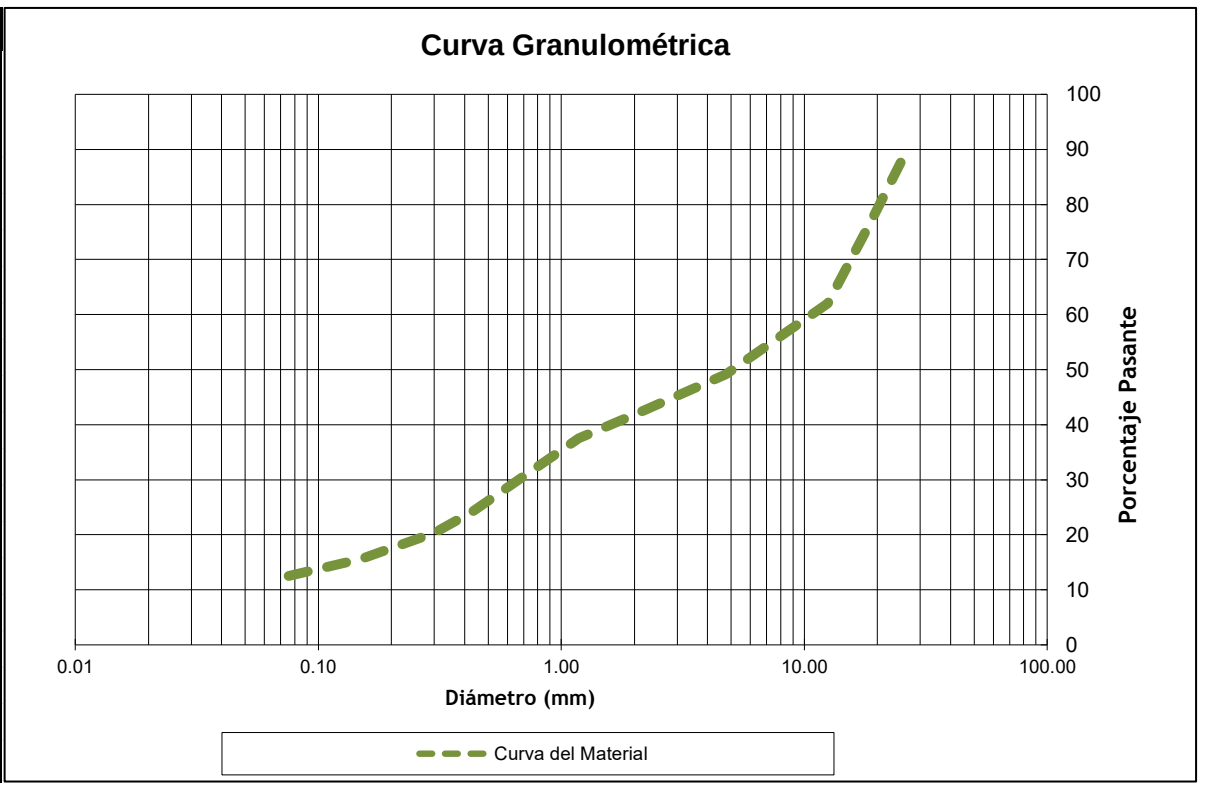
| | |
|---|---|
| ID Muestra: | Sondeo E8-08 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#AA (M5-M8) |
| Profundidad: | 1.80-3.60 m |

| | |
|---|---|
| Peso Sucio | **502.20** |
| Peso seco (gr): | **440.40** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | 62.30 | 12.41 | 12.41 | 87.59 |
| 3/4" | 19.00 | 51.60 | 10.27 | 22.68 | 77.32 |
| 1/2" | 12.50 | 77.00 | 15.33 | 38.01 | 61.99 |
| 3/8" | 9.50 | 18.20 | 3.62 | 41.64 | 58.36 |
| No.4 | 4.75 | 46.20 | 9.20 | 50.84 | 49.16 |
| No.10 | 2.00 | 36.80 | 7.33 | 58.16 | 41.84 |
| No.16 | 1.18 | 21.90 | 4.36 | 62.52 | 37.48 |
| No.40 | 0.43 | 66.80 | 13.30 | 75.83 | 24.17 |
| No.50 | 0.3 | 19.40 | 3.86 | 79.69 | 20.31 |
| No.100 | 0.15 | 23.80 | 4.74 | 84.43 | 15.57 |
| No.200 | 0.075 | 15.50 | 3.09 | 87.51 | 12.49 |
| Pan | | 0.90 | 0.18 | 87.69 | |

0

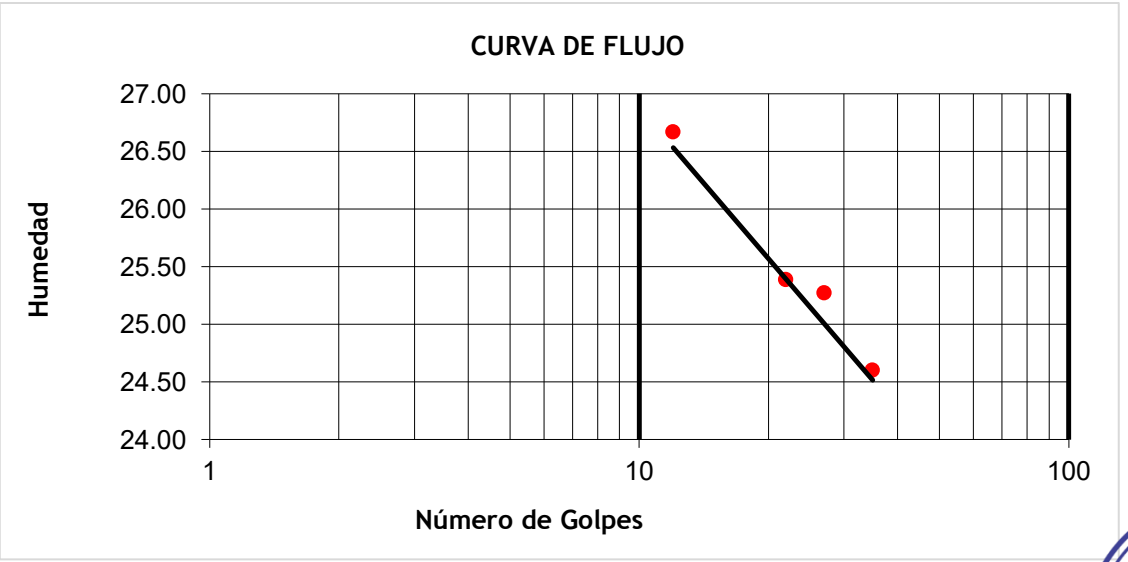


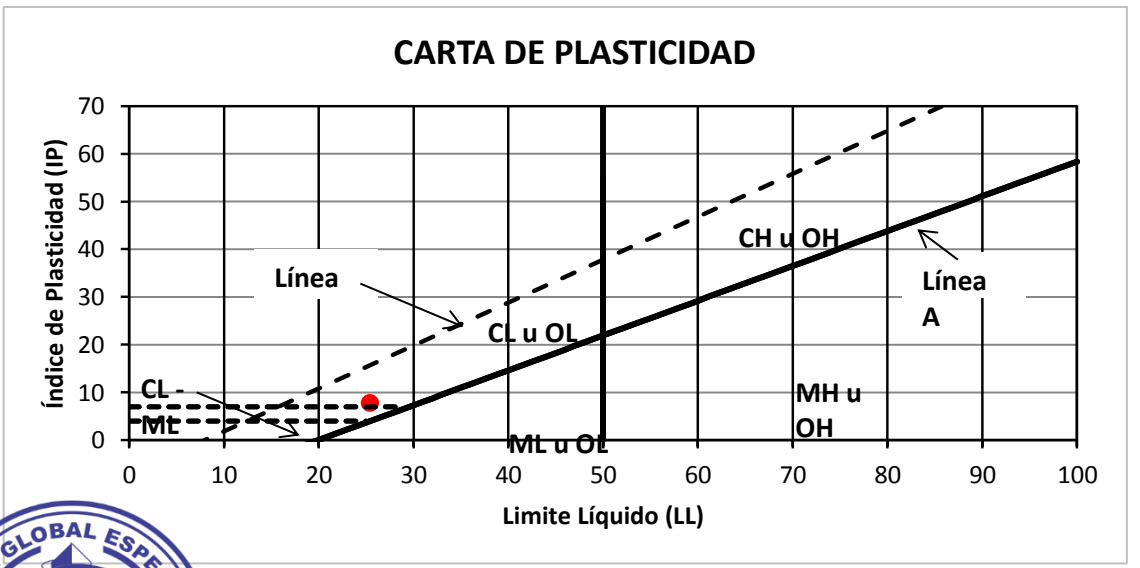

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 22 | 27 | 35 | | | | |
| B) Número del recipiente | K | P2 | 5 | 2H | | PE | PO | 1 |
| C) Peso del recip. + suelo húmedo | 17.55 | 18.63 | 18.40 | 18.20 | | 5.82 | 5.90 | 5.88 |
| D) Peso del recip. + suelo seco | 16.19 | 17.15 | 17.00 | 16.82 | | 5.59 | 5.66 | 5.64 |
| E) Peso agua (C-D) | 1.36 | 1.48 | 1.40 | 1.38 | | 0.23 | 0.24 | 0.24 |
| G) Peso recipiente | 11.09 | 11.32 | 11.46 | 11.21 | | 4.27 | 4.32 | 4.27 |
| H) Peso suelo seco (D-G) | 5.10 | 5.83 | 5.54 | 5.61 | | 1.32 | 1.34 | 1.37 |
| I) Contenido de Humedad (E/H) % | 26.67 | 25.39 | 25.27 | 24.60 | | 17.42 | 17.91 | 17.52 |
| Clasificación (Sistema Unificado de Suelos): | **GRAVA ARCILLOSA CON ARENA (GC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **50.84** |
| Porcentaje de arena | **36.68** |
| Porcentaje de finos | **12.49** |
| D10 | **0.00** |
| D30 | **0.76** |
| D60 | **10.85** |
| Cu | |
| Cc | |
| Límite líquido | **25.39** |
| Límite plástico | **17.62** |
| Indice de plasticidad | **7.78** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

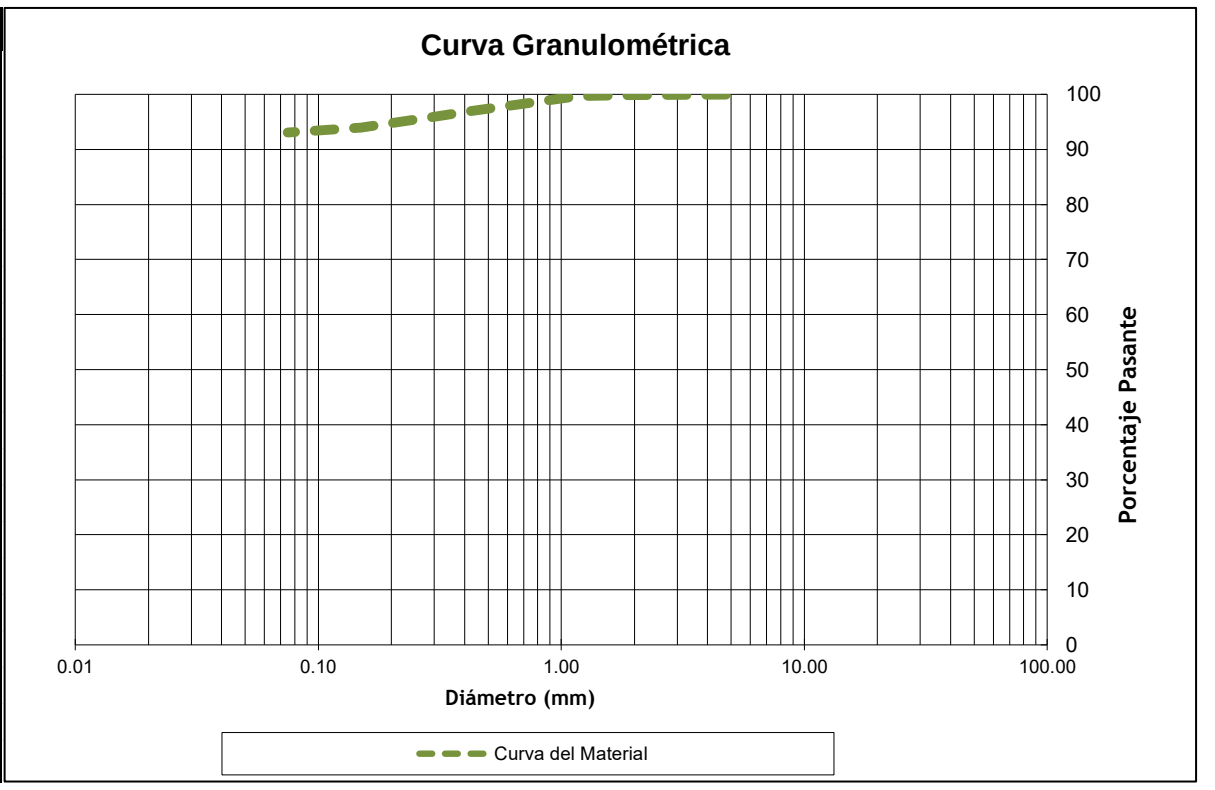
| | |
|---|---|
| ID Muestra: | Sondeo E8-08 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#19 (M9-M20) |
| Profundidad: | 3.60-9.00 m |

| | |
|---|---|
| Peso Sucio | **455.90** |
| Peso seco (gr): | **31.40** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.40 | 0.09 | 0.09 | 99.91 |
| No.16 | 1.18 | 1.00 | 0.22 | 0.31 | 99.69 |
| No.40 | 0.43 | 12.10 | 2.65 | 2.96 | 97.04 |
| No.50 | 0.3 | 5.00 | 1.10 | 4.06 | 95.94 |
| No.100 | 0.15 | 8.80 | 1.93 | 5.99 | 94.01 |
| No.200 | 0.075 | 4.10 | 0.90 | 6.89 | 93.11 |
| Pan | | 0.00 | 0.00 | 6.89 | |

0

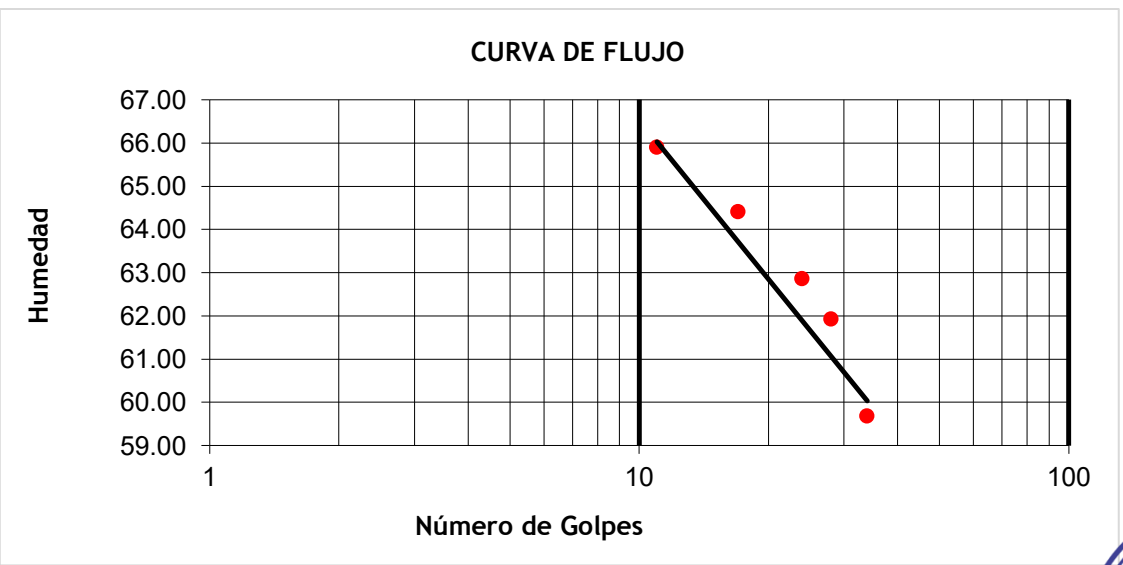


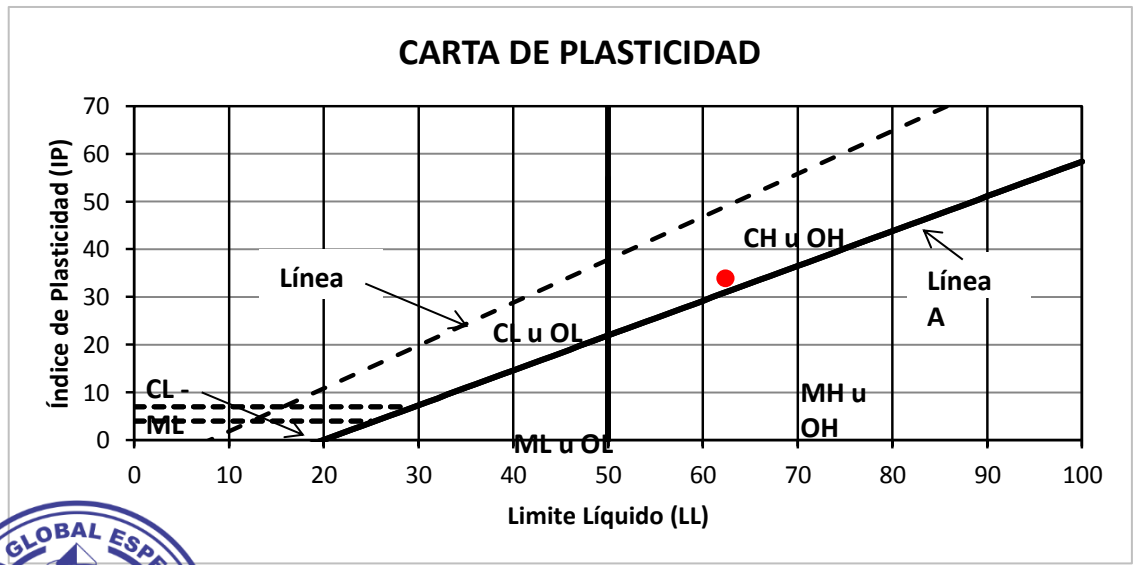

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 11 | 17 | 24 | 28 | 34 | | | |
| B) Número del recipiente | 55 | X | M | XX | 15 | P4 | P12 | 2 |
| C) Peso del recip. + suelo húmedo | 18.44 | 19.19 | 19.47 | 18.60 | 20.28 | 12.16 | 12.35 | 5.32 |
| D) Peso del recip. + suelo seco | 15.6 | 16.06 | 16.34 | 15.90 | 16.95 | 11.97 | 12.14 | 5.09 |
| E) Peso agua (C-D) | 2.84 | 3.13 | 3.13 | 2.70 | 3.33 | 0.19 | 0.21 | 0.23 |
| G) Peso recipiente | 11.29 | 11.20 | 11.36 | 11.54 | 11.37 | 11.30 | 11.40 | 4.29 |
| H) Peso suelo seco (D-G) | 4.31 | 4.86 | 4.98 | 4.36 | 5.58 | 0.67 | 0.74 | 0.80 |
| I) Contenido de Humedad (E/H) % | 65.89 | 64.40 | 62.85 | 61.93 | 59.68 | 28.36 | 28.38 | 28.75 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **6.89** |
| Porcentaje de finos | **93.11** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **62.38** |
| Límite plástico | **28.50** |
| Indice de plasticidad | **33.88** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

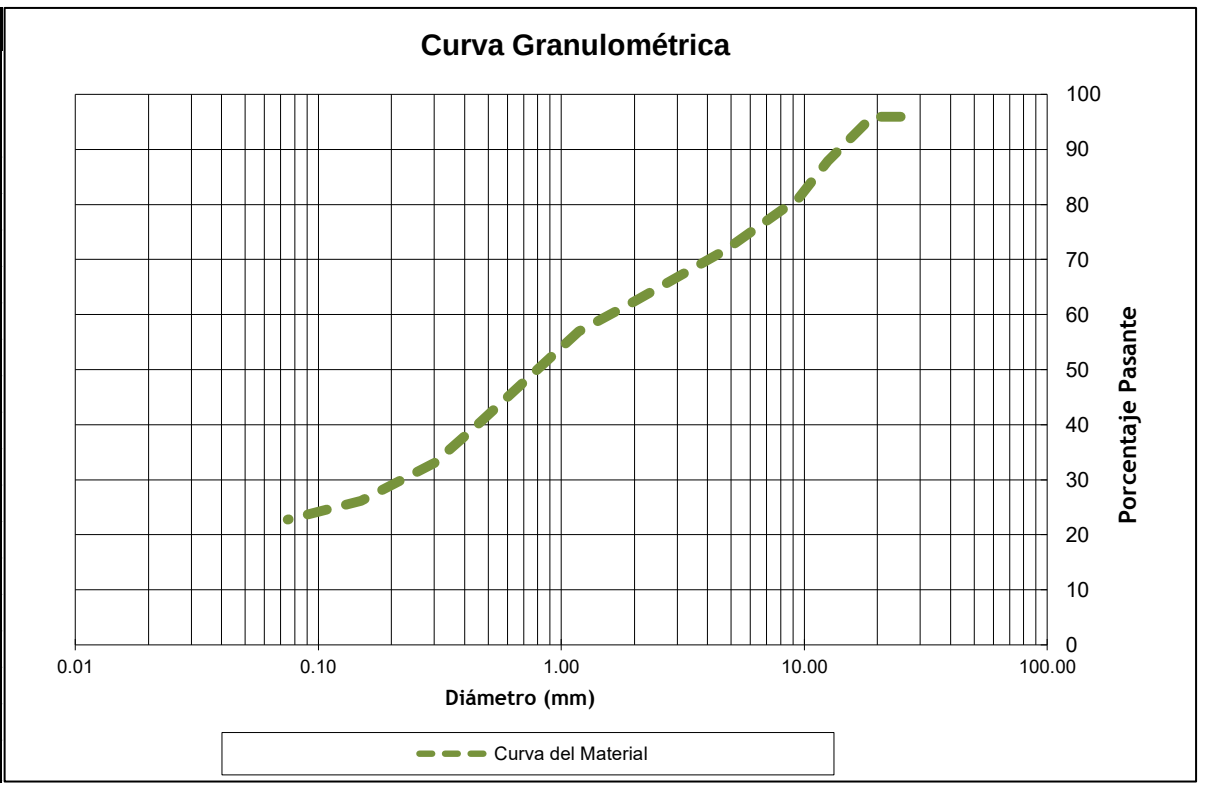
| | |
|---|---|
| ID Muestra: | Sondeo T8-01 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#30 (M2-M21) |
| Profundidad: | 0.45-9.45 m |

| | |
|---|---|
| Peso Sucio | **700.30** |
| Peso seco (gr): | **541.00** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | 28.30 | 4.04 | 4.04 | 95.96 |
| 3/4" | 19.00 | 0.00 | 0.00 | 4.04 | 95.96 |
| 1/2" | 12.50 | 56.30 | 8.04 | 12.08 | 87.92 |
| 3/8" | 9.50 | 47.30 | 6.75 | 18.83 | 81.17 |
| No.4 | 4.75 | 65.60 | 9.37 | 28.20 | 71.80 |
| No.10 | 2.00 | 65.70 | 9.38 | 37.58 | 62.42 |
| No.16 | 1.18 | 38.60 | 5.51 | 43.10 | 56.90 |
| No.40 | 0.43 | 124.60 | 17.79 | 60.89 | 39.11 |
| No.50 | 0.3 | 42.70 | 6.10 | 66.99 | 33.01 |
| No.100 | 0.15 | 48.00 | 6.85 | 73.84 | 26.16 |
| No.200 | 0.075 | 23.70 | 3.38 | 77.22 | 22.78 |
| Pan | | 0.20 | 0.03 | 77.25 | |

0

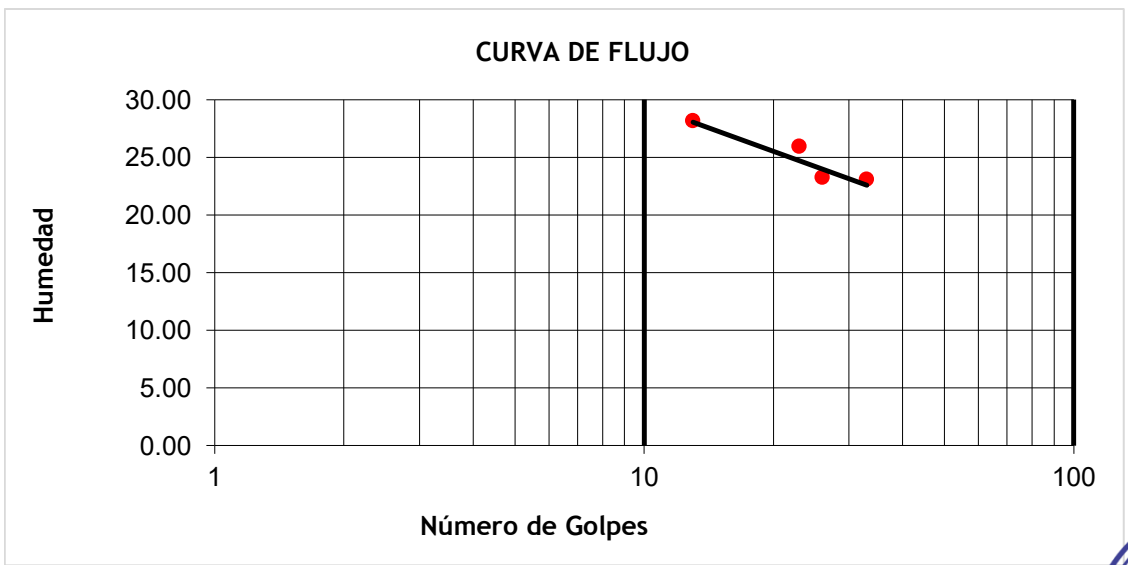


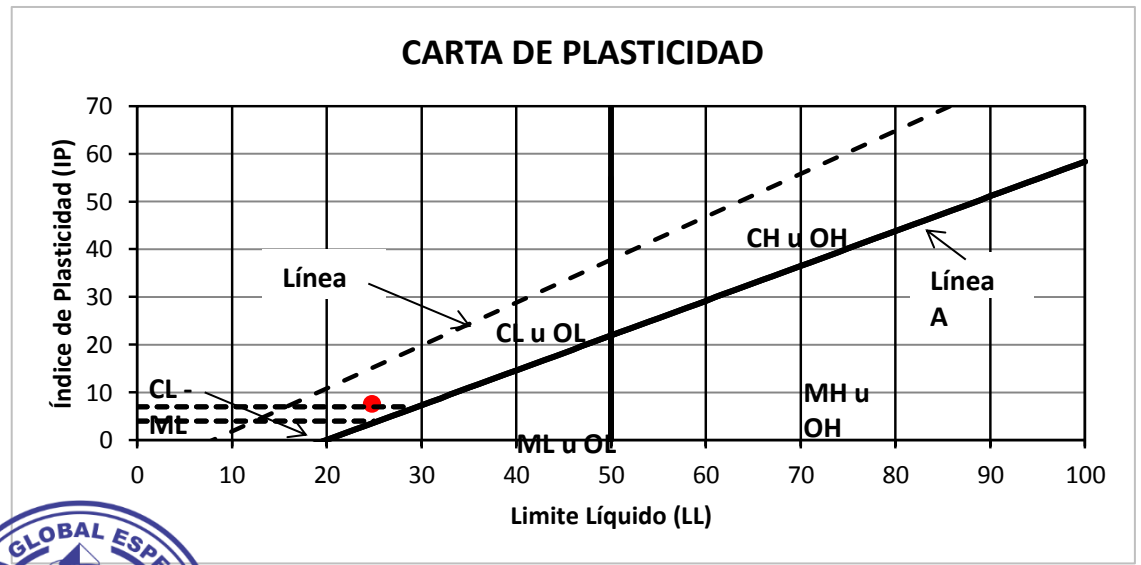

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 13 | 23 | 26 | 33 | | | | |
| B) Número del recipiente | K10 | K36 | K34 | 11 | | PD | QQ | 2 |
| C) Peso del recip. + suelo húmedo | 33.97 | 33.80 | 32.81 | 33.97 | | 6.05 | 6.01 | 6.12 |
| D) Peso del recip. + suelo seco | 31.99 | 31.98 | 31.35 | 32.29 | | 5.80 | 5.77 | 5.85 |
| E) Peso agua (C-D) | 1.98 | 1.82 | 1.46 | 1.68 | | 0.25 | 0.24 | 0.27 |
| G) Peso recipiente | 24.96 | 24.97 | 25.07 | 25.01 | | 4.33 | 4.34 | 4.33 |
| H) Peso suelo seco (D-G) | 7.03 | 7.01 | 6.28 | 7.28 | | 1.47 | 1.43 | 1.52 |
| I) Contenido de Humedad (E/H) % | 28.17 | 25.96 | 23.25 | 23.08 | | 17.01 | 16.78 | 17.76 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **28.20** |
| Porcentaje de arena | **49.02** |
| Porcentaje de finos | **22.78** |
| D10 | **0.00** |
| D30 | **0.23** |
| D60 | **1.64** |
| Cu | |
| Cc | |
| Límite líquido | **24.77** |
| Límite plástico | **17.18** |
| Indice de plasticidad | **7.59** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

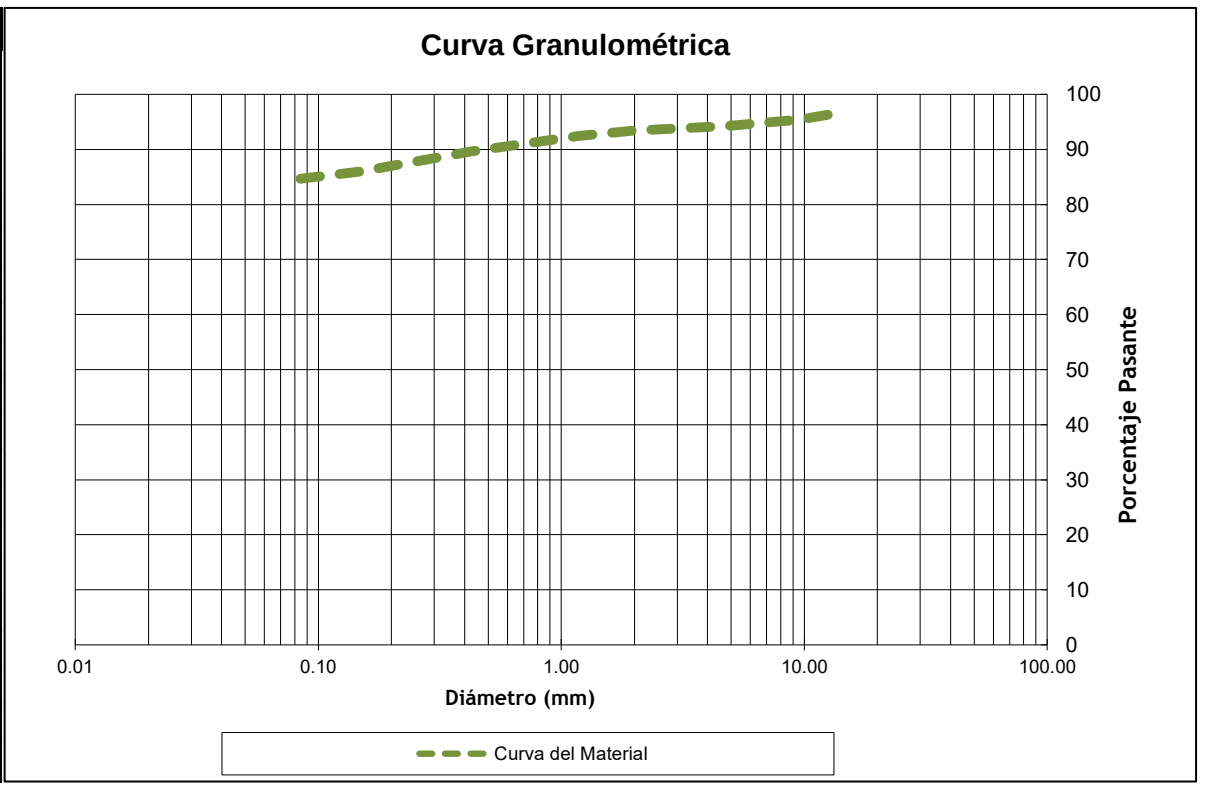
| | |
|---|---|
| ID Muestra: | Sondeo T8-01 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#09 (M22-M29) |
| Profundidad: | 9.95-13.55 m |

| | |
|---|---|
| Peso Sucio | **450.00** |
| Peso seco (gr): | **70.20** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 16.70 | 3.71 | 3.71 | 96.29 |
| 3/8" | 9.50 | 3.80 | 0.84 | 4.56 | 95.44 |
| No.4 | 4.75 | 5.40 | 1.20 | 5.76 | 94.24 |
| No.10 | 2.00 | 3.70 | 0.82 | 6.58 | 93.42 |
| No.16 | 1.18 | 4.40 | 0.98 | 7.56 | 92.44 |
| No.40 | 0.43 | 12.60 | 2.80 | 10.36 | 89.64 |
| No.50 | 0.3 | 5.50 | 1.22 | 11.58 | 88.42 |
| No.100 | 0.15 | 10.70 | 2.38 | 13.96 | 86.04 |
| No.200 | 0.075 | 7.40 | 1.64 | 15.60 | 84.40 |
| Pan | | 0.00 | 0.00 | 15.60 | |

0

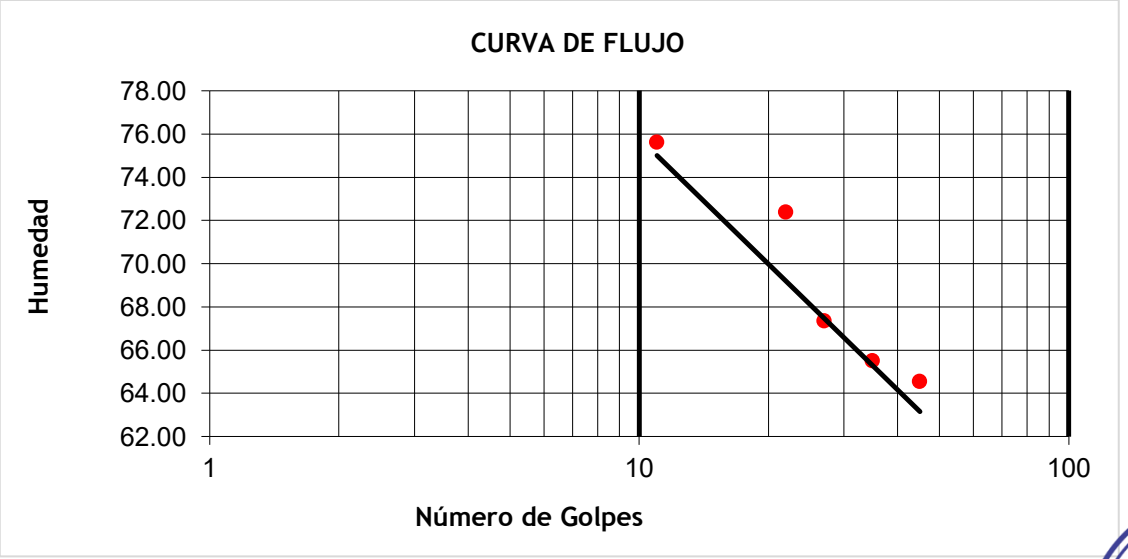


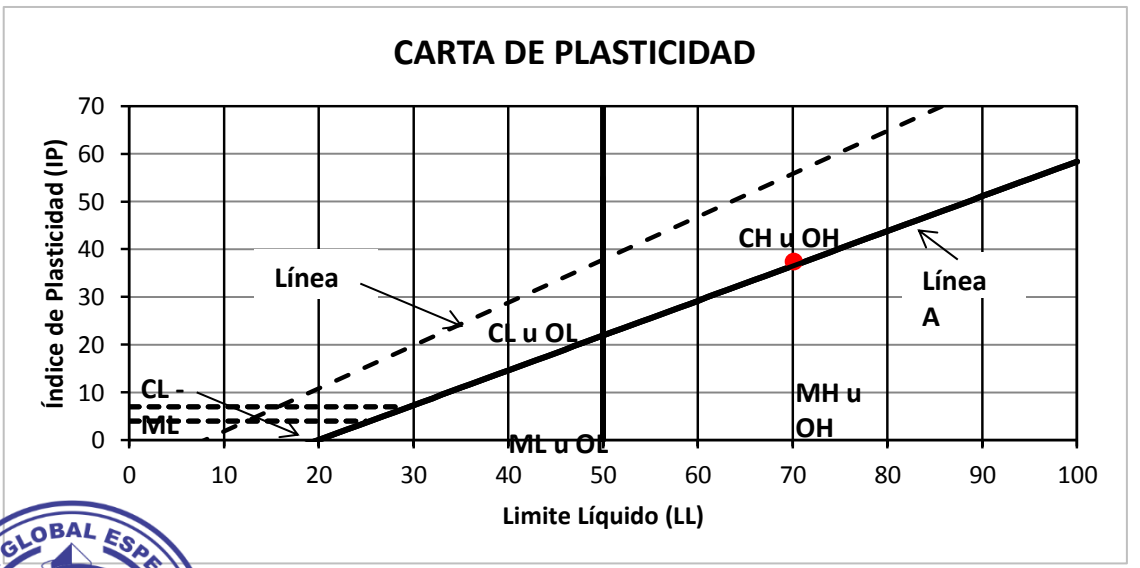

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 11 | 22 | 27 | 35 | 45 | | | |
| B) Número del recipiente | 16 | 17 | K24 | 8 | K15 | 4 | P8 | 10 |
| C) Peso del recip. + suelo húmedo | 33.62 | 32.25 | 31.98 | 31.20 | 31.26 | 5.88 | 5.74 | 5.54 |
| D) Peso del recip. + suelo seco | 29.9 | 29.21 | 29.28 | 28.77 | 28.84 | 5.48 | 5.39 | 5.24 |
| E) Peso agua (C-D) | 3.72 | 3.04 | 2.70 | 2.43 | 2.42 | 0.40 | 0.35 | 0.30 |
| G) Peso recipiente | 24.98 | 25.01 | 25.27 | 25.06 | 25.09 | 4.27 | 4.31 | 4.32 |
| H) Peso suelo seco (D-G) | 4.92 | 4.20 | 4.01 | 3.71 | 3.75 | 1.21 | 1.08 | 0.92 |
| I) Contenido de Humedad (E/H) % | 75.61 | 72.38 | 67.33 | 65.50 | 64.53 | 33.06 | 32.41 | 32.61 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **5.76** |
| Porcentaje de arena | **9.84** |
| Porcentaje de finos | **84.40** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **70.12** |
| Límite plástico | **32.69** |
| Indice de plasticidad | **37.43** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

Fecha de Ensayo: 02/06/2020

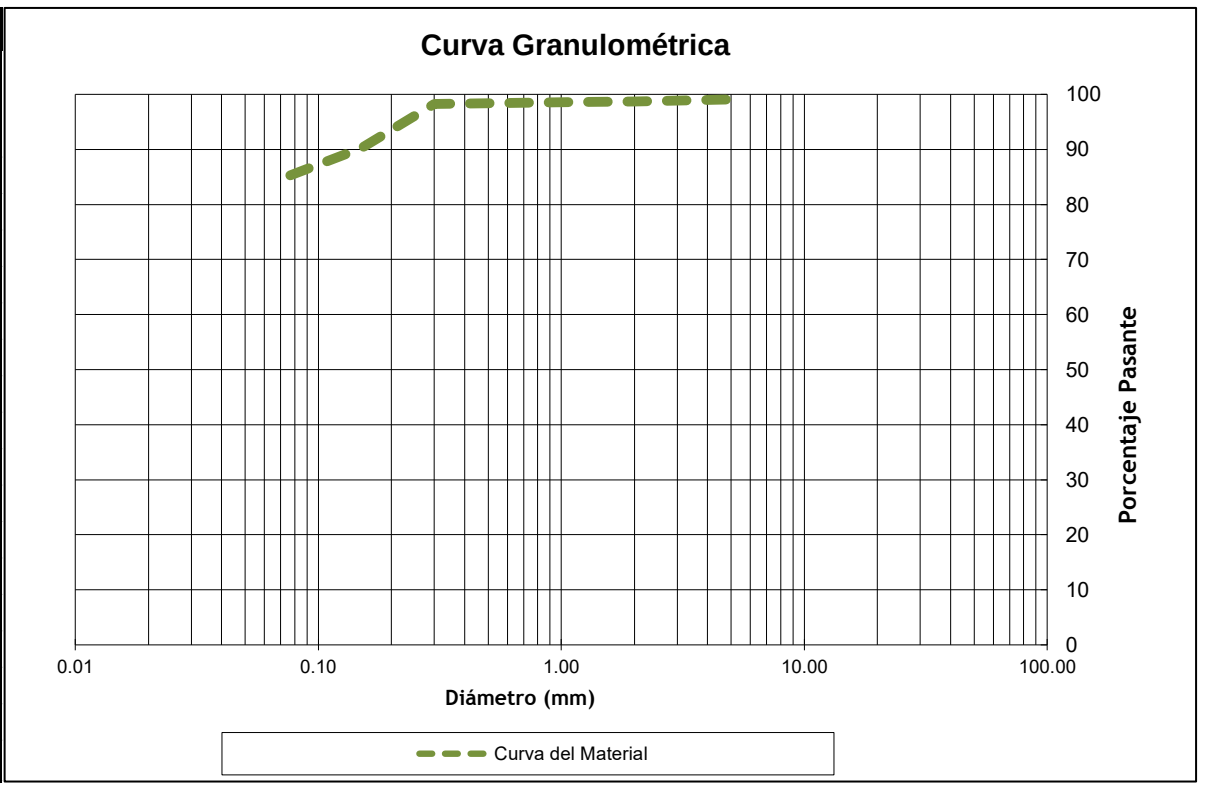
| | |
|---|---|
| ID Muestra: | Sondeo T8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#02 (M2-M13) |
| Profundidad: | 0.45-5.85 m |

| | |
|---|---|
| Peso Sucio | **350.00** |
| Peso seco (gr): | **52.30** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 3.30 | 0.94 | 0.94 | 99.06 |
| No.10 | 2.00 | 1.30 | 0.37 | 1.31 | 98.69 |
| No.16 | 1.18 | 0.30 | 0.09 | 1.40 | 98.60 |
| No.40 | 0.43 | 0.90 | 0.26 | 1.66 | 98.34 |
| No.50 | 0.3 | 0.30 | 0.09 | 1.74 | 98.26 |
| No.100 | 0.15 | 28.10 | 8.03 | 9.77 | 90.23 |
| No.200 | 0.075 | 18.00 | 5.14 | 14.91 | 85.09 |
| Pan | | 0.10 | 0.03 | 14.94 | |

0

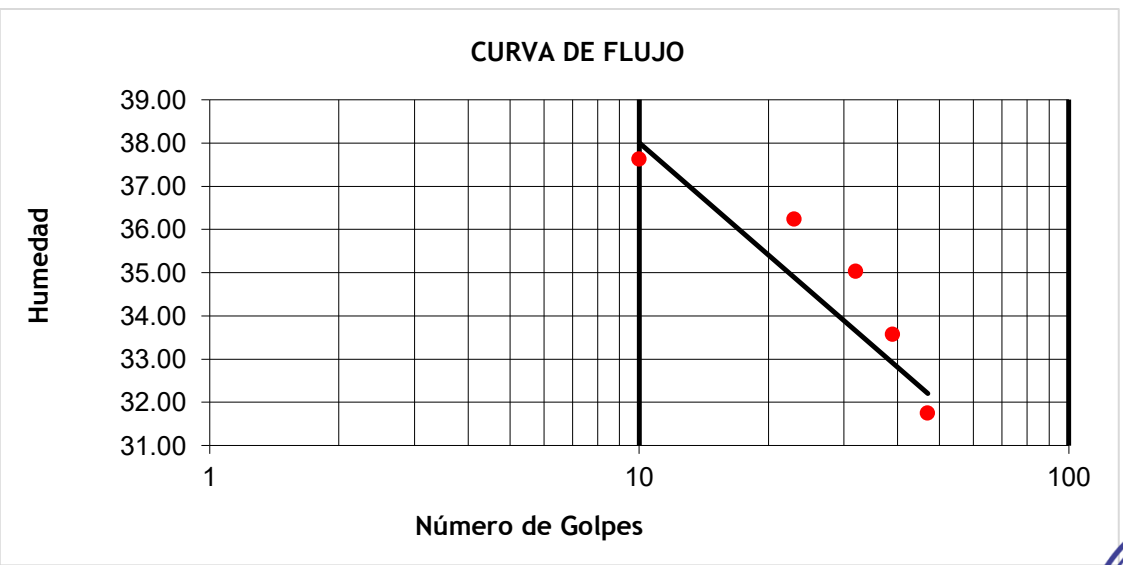


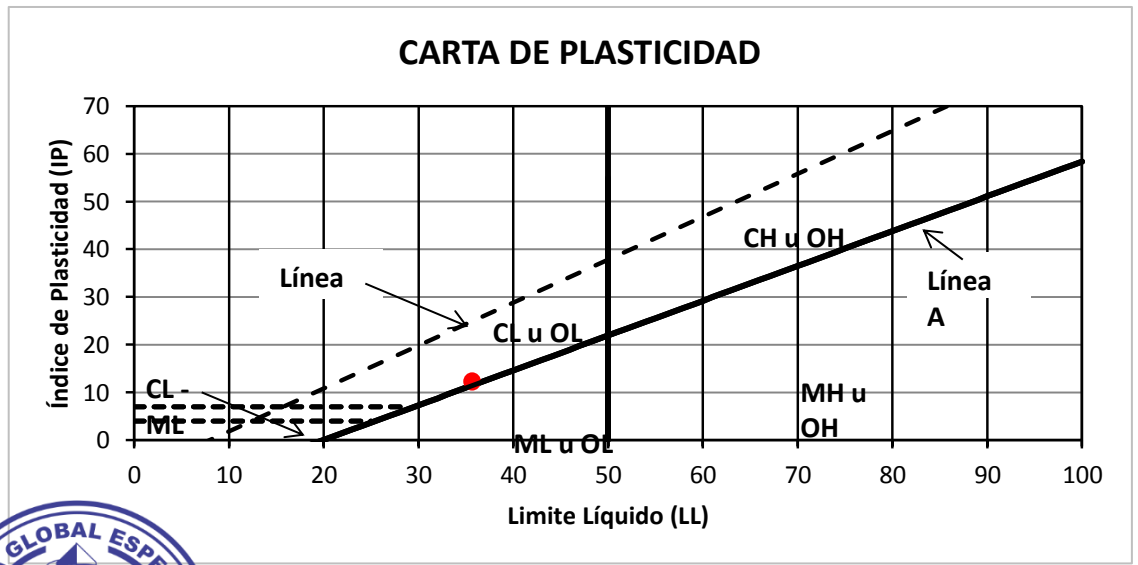

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 23 | 32 | 39 | 47 | | | |
| B) Número del recipiente | 3 | O11 | 2 | PE | PC | 4 | 10 | O8 |
| C) Peso del recip. + suelo húmedo | 13.02 | 14.90 | 13.63 | 13.81 | 14.04 | 5.76 | 5.45 | 5.65 |
| D) Peso del recip. + suelo seco | 10.65 | 12.07 | 11.21 | 11.41 | 11.70 | 5.48 | 5.24 | 5.41 |
| E) Peso agua (C-D) | 2.37 | 2.83 | 2.42 | 2.40 | 2.34 | 0.28 | 0.21 | 0.24 |
| G) Peso recipiente | 4.35 | 4.26 | 4.30 | 4.26 | 4.33 | 4.29 | 4.35 | 4.37 |
| H) Peso suelo seco (D-G) | 6.30 | 7.81 | 6.91 | 7.15 | 7.37 | 1.19 | 0.89 | 1.04 |
| I) Contenido de Humedad (E/H) % | 37.62 | 36.24 | 35.02 | 33.57 | 31.75 | 23.53 | 23.60 | 23.08 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.94** |
| Porcentaje de arena | **13.97** |
| Porcentaje de finos | **85.09** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **35.65** |
| Límite plástico | **23.40** |
| Indice de plasticidad | **12.25** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

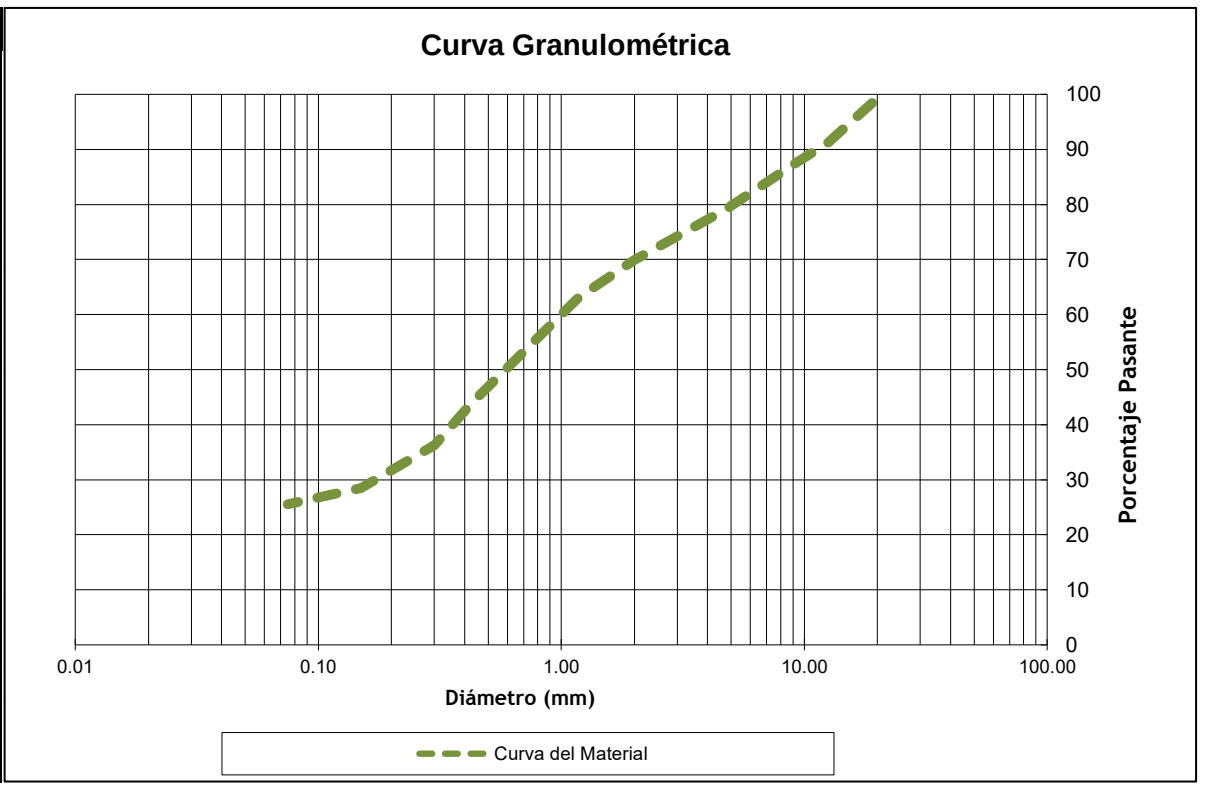
| | |
|---|---|
| ID Muestra: | Sondeo T8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#10 (M14-M21) |
| Profundidad: | 5.85-10.45 m |

| | |
|---|---|
| Peso Sucio | **700.00** |
| Peso seco (gr): | **521.50** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 11.00 | 1.57 | 1.57 | 98.43 |
| 1/2" | 12.50 | 50.40 | 7.20 | 8.77 | 91.23 |
| 3/8" | 9.50 | 23.70 | 3.39 | 12.16 | 87.84 |
| No.4 | 4.75 | 61.30 | 8.76 | 20.91 | 79.09 |
| No.10 | 2.00 | 64.40 | 9.20 | 30.11 | 69.89 |
| No.16 | 1.18 | 47.20 | 6.74 | 36.86 | 63.14 |
| No.40 | 0.43 | 133.90 | 19.13 | 55.99 | 44.01 |
| No.50 | 0.3 | 54.00 | 7.71 | 63.70 | 36.30 |
| No.100 | 0.15 | 54.80 | 7.83 | 71.53 | 28.47 |
| No.200 | 0.075 | 20.70 | 2.96 | 74.49 | 25.51 |
| Pan | | 0.10 | 0.01 | 74.50 | |

0

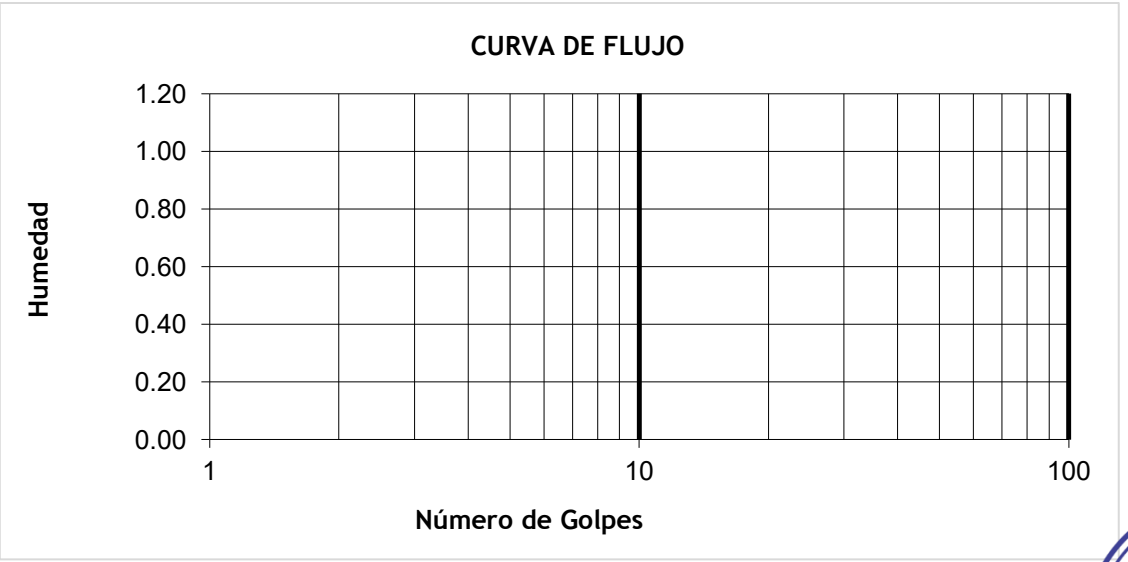


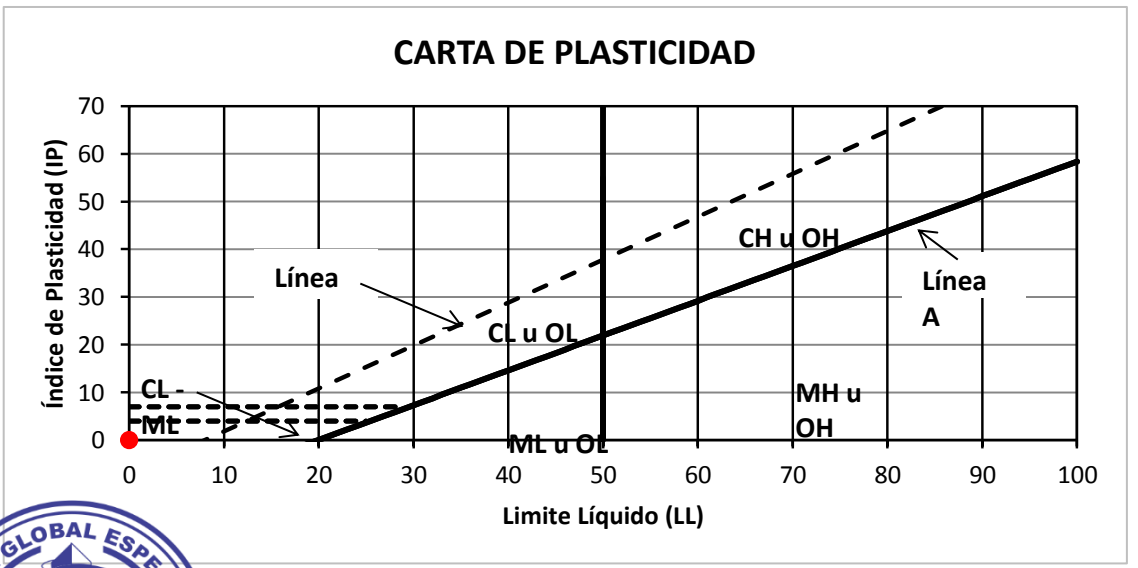

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | | | | | | | | |
| B) Número del recipiente | | | | | | | | |
| C) Peso del recip. + suelo húmedo | | | | | | | | |
| D) Peso del recip. + suelo seco | | NO PLASTICO | | | | NO PLASTICO | | |
| E) Peso agua (C-D) | | | | | | | | |
| G) Peso recipiente | | | | | | | | |
| H) Peso suelo seco (D-G) | | | | | | | | |
| I) Contenido de Humedad (E/H) % | | | | | | | | |
| Clasificación (Sistema Unificado de Suelos): | **ARENA LIMOSA CON GRAVA (SM)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **20.91** |
| Porcentaje de arena | **53.57** |
| Porcentaje de finos | **25.51** |
| D10 | **0.00** |
| D30 | **0.18** |
| D60 | **1.06** |
| Cu | |
| Cc | |
| Límite líquido | |
| Límite plástico | |
| Indice de plasticidad | |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

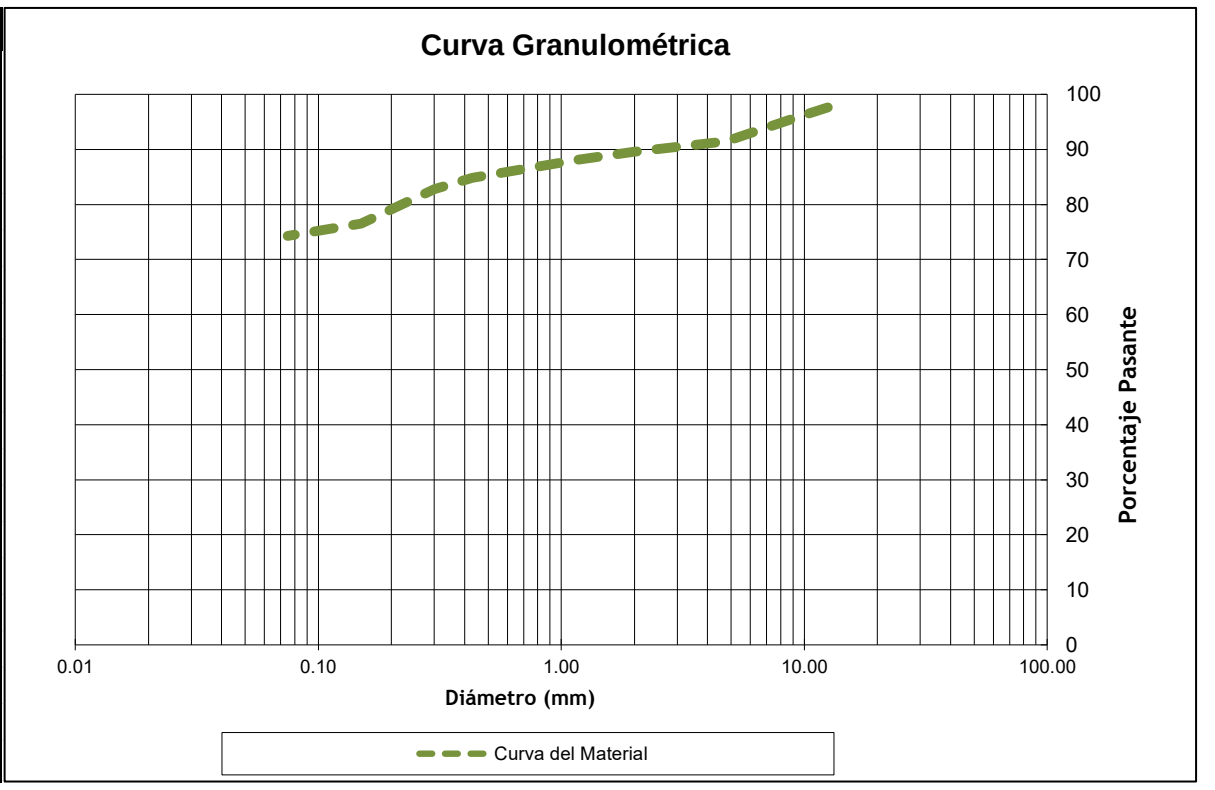
| | |
|---|---|
| ID Muestra: | Sondeo T8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#04 (M22-M30) |
| Profundidad: | 11.05-15.10 m |

| | |
|---|---|
| Peso Sucio | **500.00** |
| Peso seco (gr): | **128.70** |

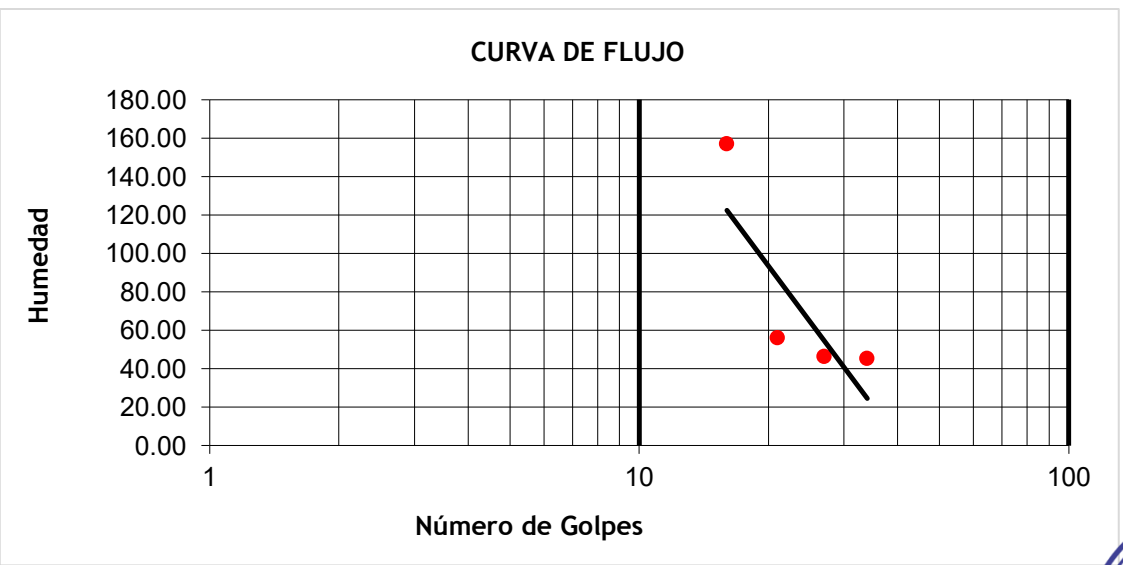
**Granulometría ASTM D-6913**

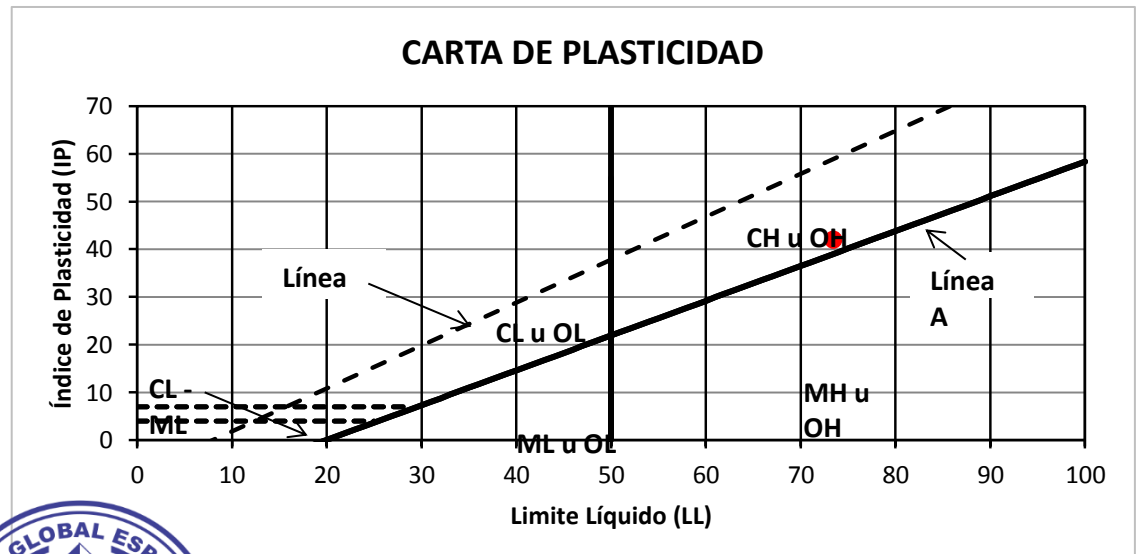
| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | | | | |
| 1/2" | 12.50 | 11.90 | 2.38 | 2.38 | 97.62 |
| 3/8" | 9.50 | 8.50 | 1.70 | 4.08 | 95.92 |
| No.4 | 4.75 | 22.10 | 4.42 | 8.50 | 91.50 |
| No.10 | 2.00 | 9.40 | 1.88 | 10.38 | 89.62 |
| No.16 | 1.18 | 7.30 | 1.46 | 11.84 | 88.16 |
| No.40 | 0.43 | 16.80 | 3.36 | 15.20 | 84.80 |
| No.50 | 0.3 | 10.00 | 2.00 | 17.20 | 82.80 |
| No.100 | 0.15 | 31.30 | 6.26 | 23.46 | 76.54 |
| No.200 | 0.075 | 11.40 | 2.28 | 25.74 | 74.26 |
| Pan | | 0.00 | 0.00 | 25.74 | |

0




| LIMITES ATTERBERG ASTM D-4318 | | | | | | | | | RESULTADOS | |
|---|---|---|---|---|---|---|---|---|---|---|
| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | | Porcentaje de grava | **8.50** |
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** | Porcentaje de arena | **17.24** |
| A) Número de Golpes | 16 | 21 | 27 | 34 | | | | | Porcentaje de finos | **74.26** |
| B) Número del recipiente | K33 | CK | K3 | K18 | | 8 | P9 | O10 | D10 | **0.00** |
| C) Peso del recip. + suelo húmedo | 32.21 | 32.50 | 33.81 | 32.26 | | 5.85 | 5.62 | 5.52 | D30 | **0.00** |
| D) Peso del recip. + suelo seco | 27.97 | 29.77 | 31.05 | 30.09 | | 5.49 | 5.32 | 5.24 | D60 | **0.00** |
| E) Peso agua (C-D) | 4.24 | 2.73 | 2.76 | 2.17 | | 0.36 | 0.30 | 0.28 | Cu | |
| G) Peso recipiente | 25.27 | 24.90 | 25.10 | 25.29 | | 4.35 | 4.35 | 4.36 | Cc | |
| H) Peso suelo seco (D-G) | 2.70 | 4.87 | 5.95 | 4.80 | | 1.14 | 0.97 | 0.88 | Límite líquido | **73.45** |
| I) Contenido de Humedad (E/H) % | 157.04 | 56.06 | 46.39 | 45.21 | | 31.58 | 30.93 | 31.82 | Límite plástico | **31.44** |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD CON ARENA (CH)** | | | | | | | | Indice de plasticidad | **42.01** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

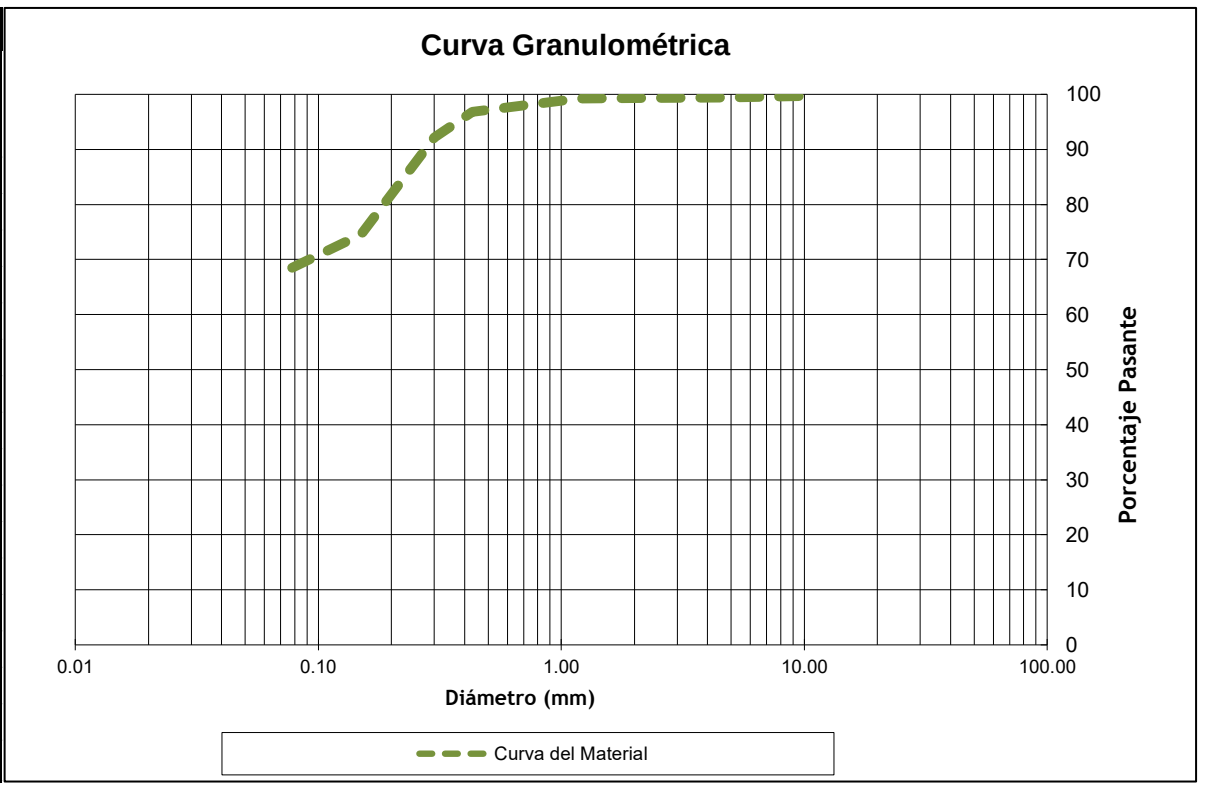
| | |
|---|---|
| ID Muestra: | Sondeo T8-02 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#01 (M37-M41) |
| Profundidad: | 24.15-27.25 m |

| | |
|---|---|
| Peso Sucio | **600.00** |
| Peso seco (gr): | **191.30** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | 2.10 | 0.35 | 0.35 | 99.65 |
| No.4 | 4.75 | 1.40 | 0.23 | 0.58 | 99.42 |
| No.10 | 2.00 | 0.70 | 0.12 | 0.70 | 99.30 |
| No.16 | 1.18 | 0.30 | 0.05 | 0.75 | 99.25 |
| No.40 | 0.43 | 14.30 | 2.38 | 3.13 | 96.87 |
| No.50 | 0.3 | 28.00 | 4.67 | 7.80 | 92.20 |
| No.100 | 0.15 | 105.70 | 17.62 | 25.42 | 74.58 |
| No.200 | 0.075 | 38.80 | 6.47 | 31.88 | 68.12 |
| Pan | | 0.00 | 0.00 | 31.88 | |

0

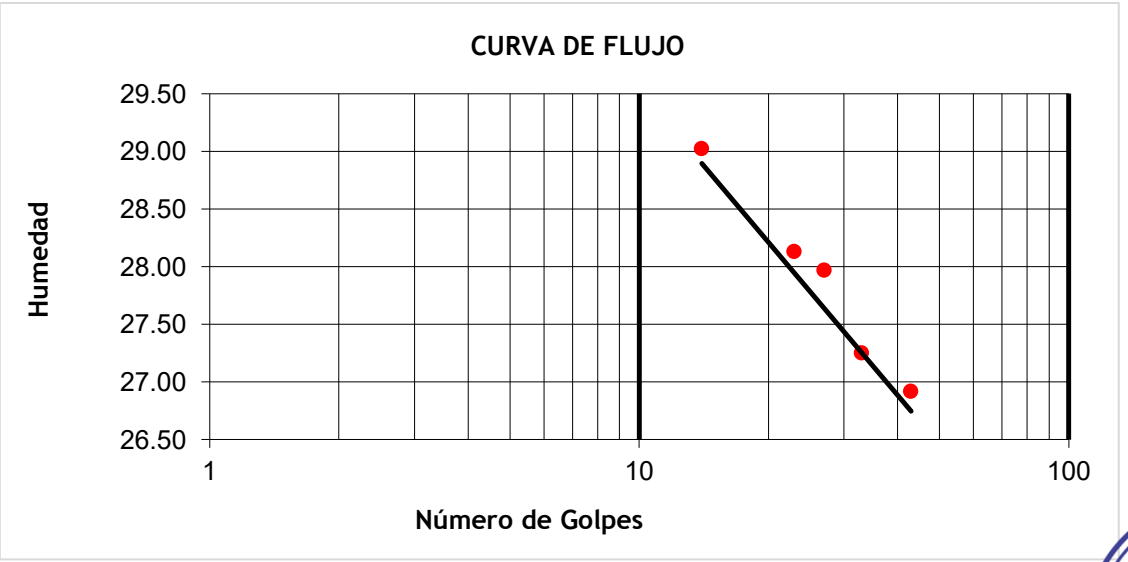


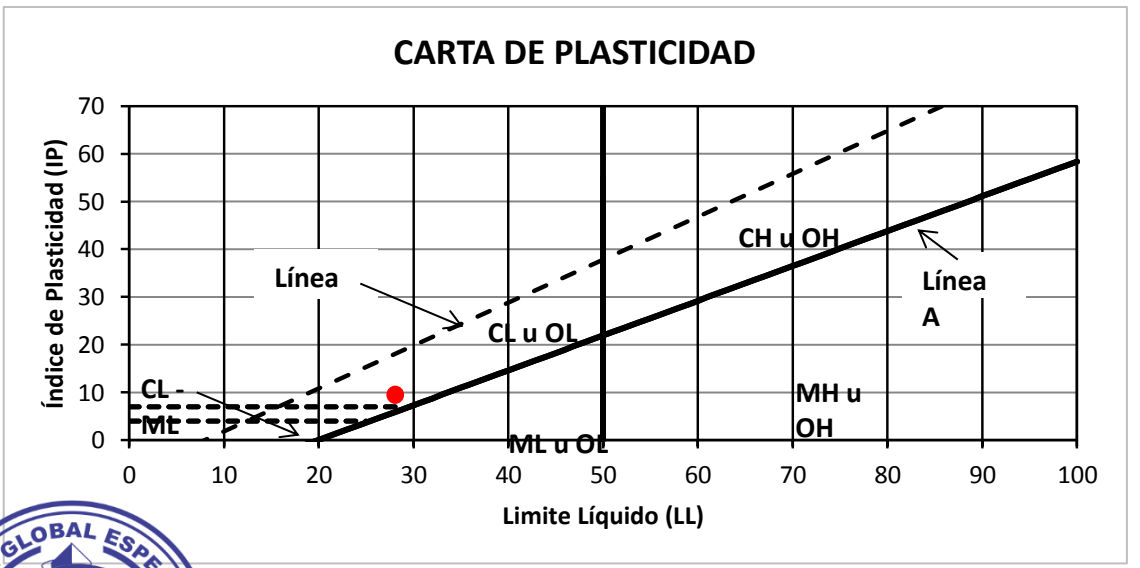

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 14 | 23 | 27 | 33 | 43 | | | |
| B) Número del recipiente | O10 | O4 | 3 | 8 | P0 | K10 | K12 | K26 |
| C) Peso del recip. + suelo húmedo | 13.37 | 13.48 | 13.98 | 19.18 | 12.79 | 27.30 | 27.14 | 27.22 |
| D) Peso del recip. + suelo seco | 11.35 | 11.48 | 11.86 | 16.00 | 11.00 | 26.93 | 26.82 | 26.89 |
| E) Peso agua (C-D) | 2.02 | 2.00 | 2.12 | 3.18 | 1.79 | 0.37 | 0.32 | 0.33 |
| G) Peso recipiente | 4.39 | 4.37 | 4.28 | 4.33 | 4.35 | 24.95 | 25.11 | 25.10 |
| H) Peso suelo seco (D-G) | 6.96 | 7.11 | 7.58 | 11.67 | 6.65 | 1.98 | 1.71 | 1.79 |
| I) Contenido de Humedad (E/H) % | 29.02 | 28.13 | 27.97 | 27.25 | 26.92 | 18.69 | 18.71 | 18.44 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.58** |
| Porcentaje de arena | **31.30** |
| Porcentaje de finos | **68.12** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **28.08** |
| Límite plástico | **18.61** |
| Indice de plasticidad | **9.47** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

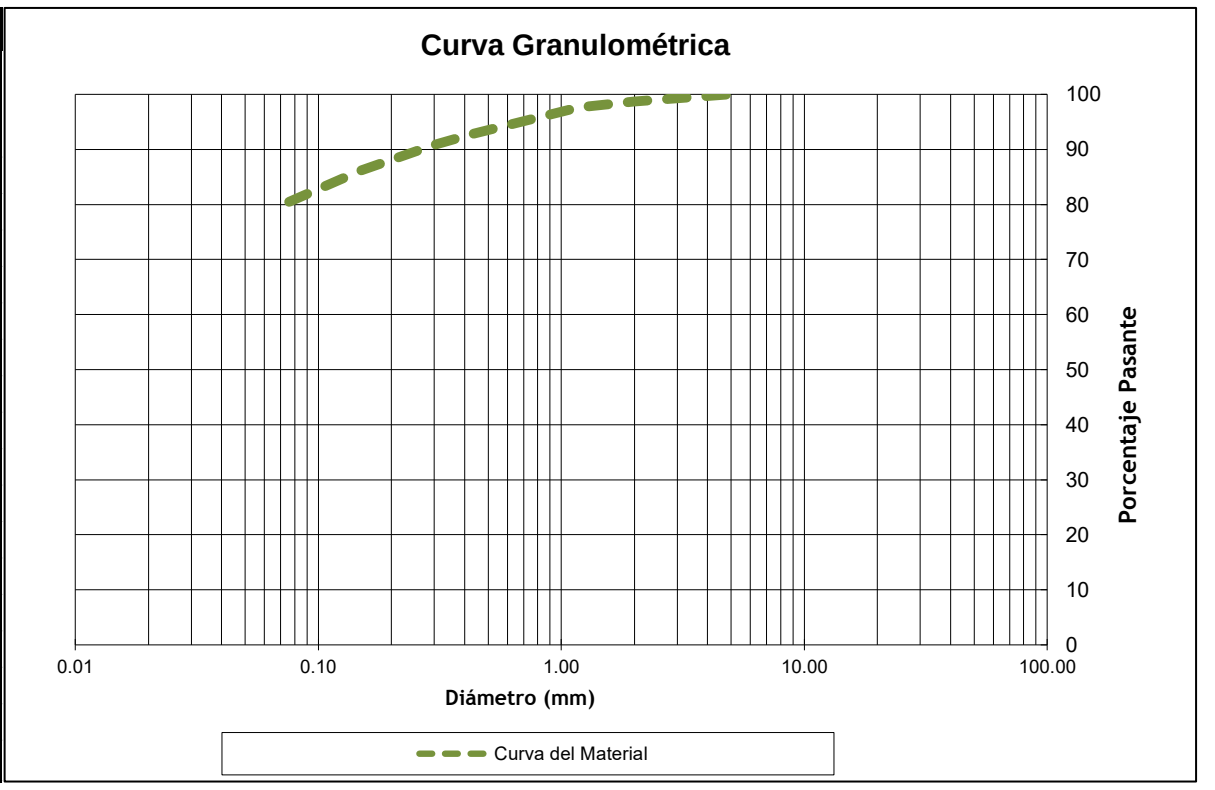
| | |
|---|---|
| ID Muestra: | Sondeo T8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#43 (M2-M5) |
| Profundidad: | 0.45-2.25 m |

| | |
|---|---|
| Peso Sucio | **200.00** |
| Peso seco (gr): | **39.20** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 2.50 | 1.25 | 1.25 | 98.75 |
| No.16 | 1.18 | 2.30 | 1.15 | 2.40 | 97.60 |
| No.40 | 0.43 | 9.50 | 4.75 | 7.15 | 92.85 |
| No.50 | 0.3 | 4.00 | 2.00 | 9.15 | 90.85 |
| No.100 | 0.15 | 9.40 | 4.70 | 13.85 | 86.15 |
| No.200 | 0.075 | 11.50 | 5.75 | 19.60 | 80.40 |
| Pan | | 0.00 | 0.00 | 19.60 | |

0

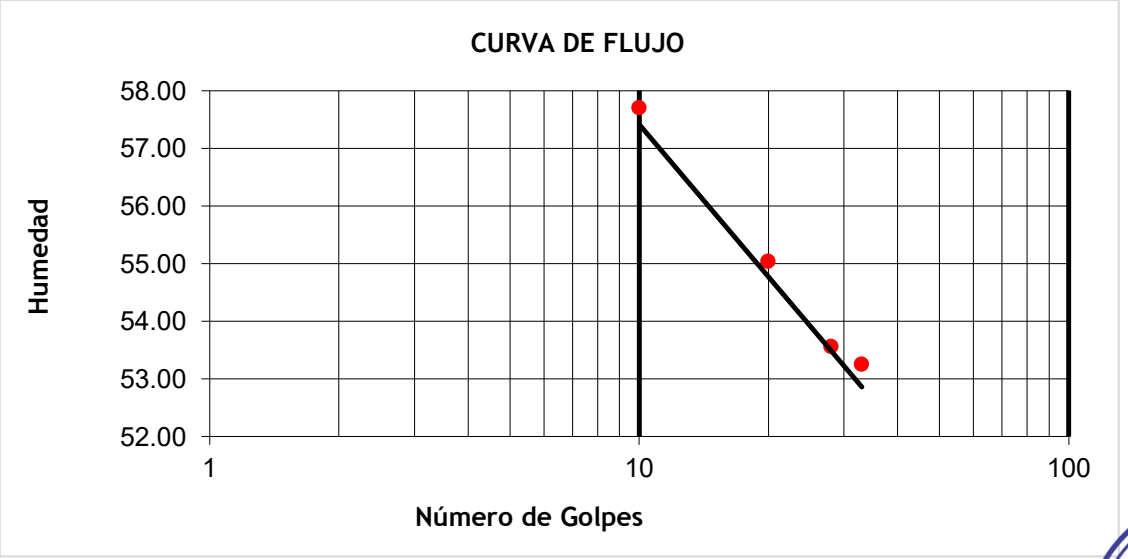


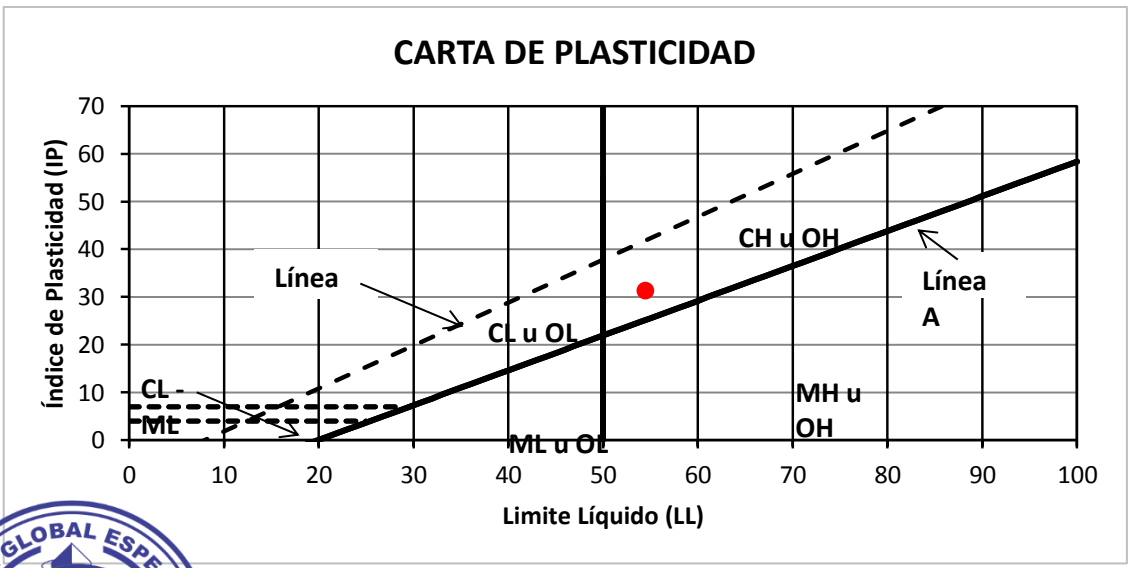

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 20 | 28 | 33 | | | | |
| B) Número del recipiente | K36 | K24 | K23 | K27 | | 15 | K25 | K7 |
| C) Peso del recip. + suelo húmedo | 34.20 | 31.54 | 31.15 | 32.48 | | 26.21 | 26.50 | 26.21 |
| D) Peso del recip. + suelo seco | 30.79 | 29.30 | 28.97 | 29.86 | | 25.94 | 26.20 | 25.96 |
| E) Peso agua (C-D) | 3.41 | 2.24 | 2.18 | 2.62 | | 0.27 | 0.30 | 0.25 |
| G) Peso recipiente | 24.88 | 25.23 | 24.90 | 24.94 | | 24.70 | 25.04 | 24.81 |
| H) Peso suelo seco (D-G) | 5.91 | 4.07 | 4.07 | 4.92 | | 1.24 | 1.16 | 1.15 |
| I) Contenido de Humedad (E/H) % | 57.70 | 55.04 | 53.56 | 53.25 | | 21.77 | 25.86 | 21.74 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD CON ARENA (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **19.60** |
| Porcentaje de finos | **80.40** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **54.44** |
| Límite plástico | **23.13** |
| Indice de plasticidad | **31.32** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

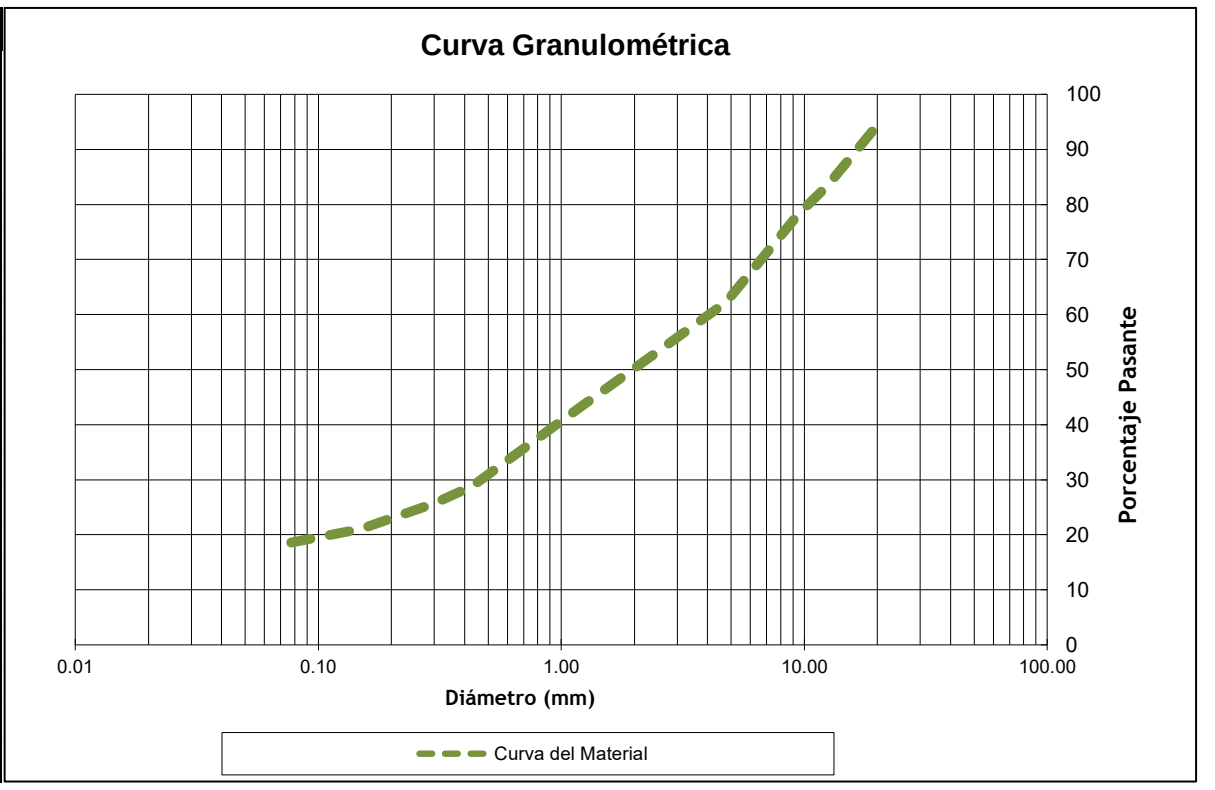
| | |
|---|---|
| ID Muestra: | Sondeo T8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#03 (M6-M25) |
| Profundidad: | 2.25-11.25 m |

| | |
|---|---|
| Peso Sucio | **700.00** |
| Peso seco (gr): | **570.90** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 47.50 | 6.79 | 6.79 | 93.21 |
| 1/2" | 12.50 | 68.10 | 9.73 | 16.51 | 83.49 |
| 3/8" | 9.50 | 36.30 | 5.19 | 21.70 | 78.30 |
| No.4 | 4.75 | 112.90 | 16.13 | 37.83 | 62.17 |
| No.10 | 2.00 | 83.90 | 11.99 | 49.81 | 50.19 |
| No.16 | 1.18 | 50.20 | 7.17 | 56.99 | 43.01 |
| No.40 | 0.43 | 99.20 | 14.17 | 71.16 | 28.84 |
| No.50 | 0.3 | 22.20 | 3.17 | 74.33 | 25.67 |
| No.100 | 0.15 | 32.10 | 4.59 | 78.91 | 21.09 |
| No.200 | 0.075 | 18.40 | 2.63 | 81.54 | 18.46 |
| Pan | | 0.10 | 0.01 | 81.56 | |

0

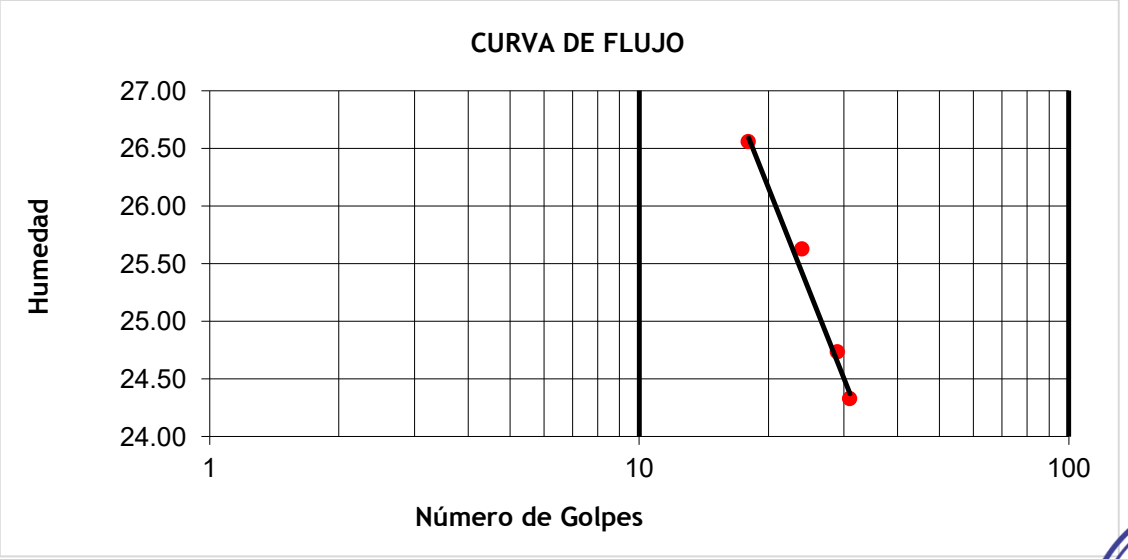


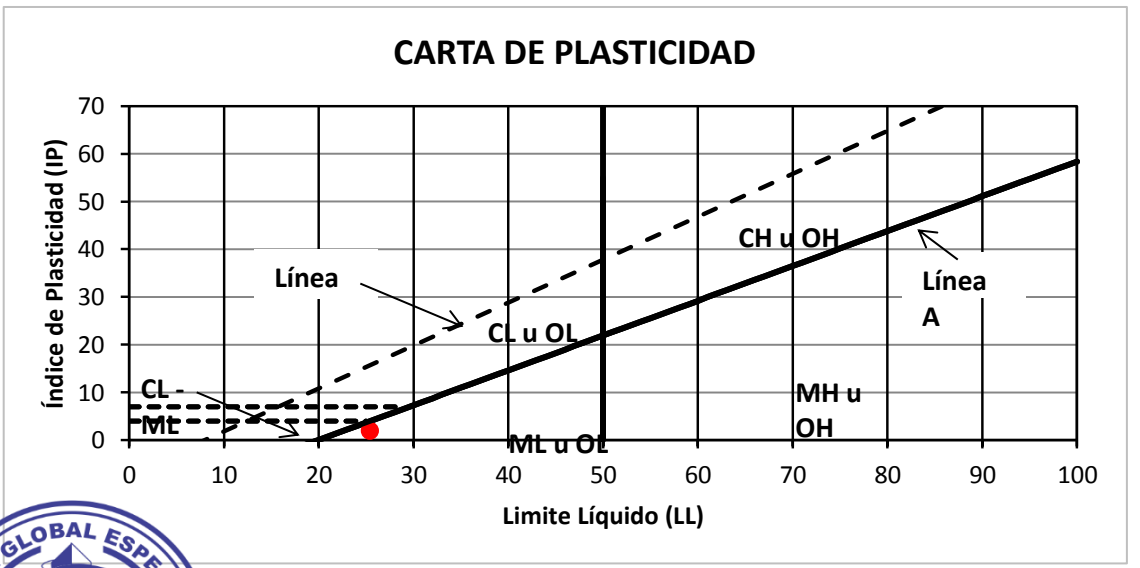

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 18 | 24 | 29 | 31 | | | | |
| B) Número del recipiente | K14 | K27 | K23 | K20 | | 7 | P12 | P4 |
| C) Peso del recip. + suelo húmedo | 31.89 | 31.46 | 31.90 | 33.34 | | 5.97 | 5.85 | 6.00 |
| D) Peso del recip. + suelo seco | 30.44 | 30.13 | 30.51 | 31.71 | | 5.66 | 5.57 | 5.68 |
| E) Peso agua (C-D) | 1.45 | 1.33 | 1.39 | 1.63 | | 0.31 | 0.28 | 0.32 |
| G) Peso recipiente | 24.98 | 24.94 | 24.89 | 25.01 | | 4.33 | 4.36 | 4.34 |
| H) Peso suelo seco (D-G) | 5.46 | 5.19 | 5.62 | 6.70 | | 1.33 | 1.21 | 1.34 |
| I) Contenido de Humedad (E/H) % | 26.56 | 25.63 | 24.73 | 24.33 | | 23.31 | 23.14 | 23.88 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA LIMOSA CON GRAVA (SM)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **37.83** |
| Porcentaje de arena | **43.71** |
| Porcentaje de finos | **18.46** |
| D10 | **0.00** |
| D30 | **0.49** |
| D60 | **4.25** |
| Cu | |
| Cc | |
| Límite líquido | **25.40** |
| Límite plástico | **23.44** |
| Indice de plasticidad | **1.95** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

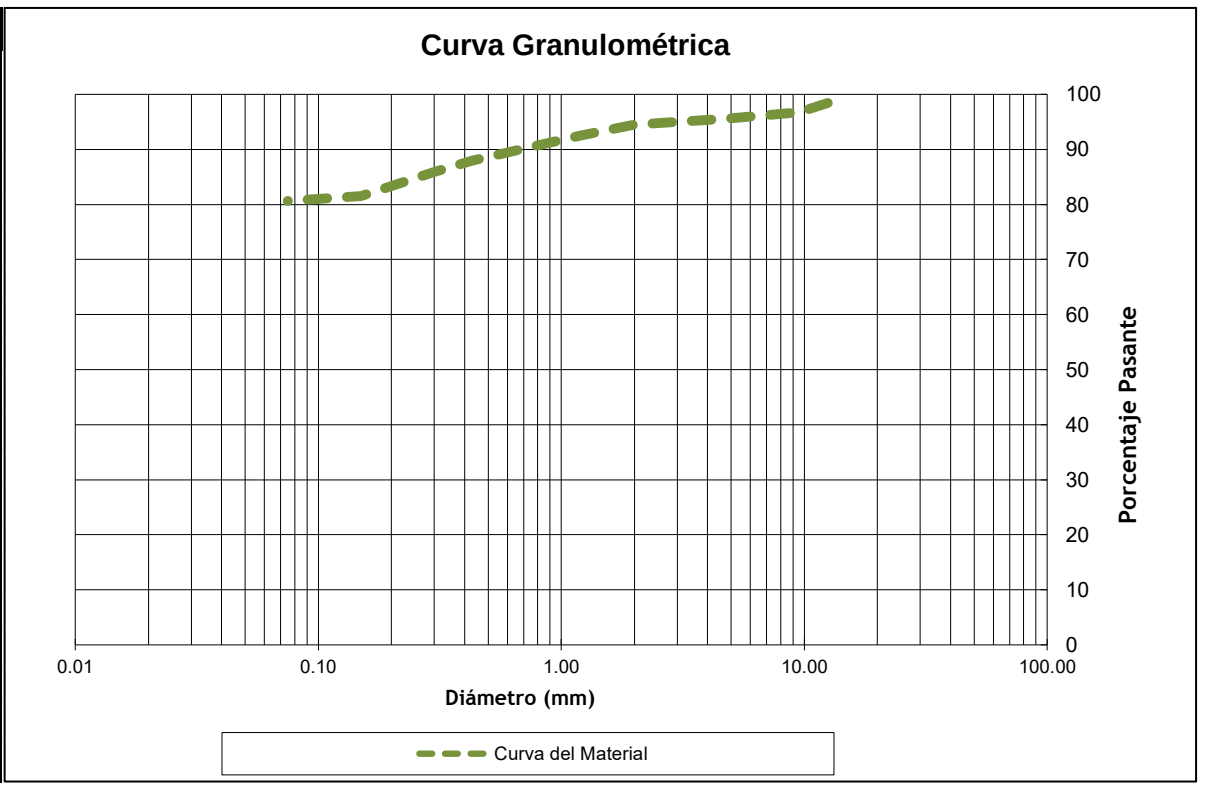
| | |
|---|---|
| ID Muestra: | Sondeo T8-03 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#06 (M33-M37) |
| Profundidad: | 26.90-29.15 m |

| | |
|---|---|
| Peso Sucio | **500.00** |
| Peso seco (gr): | **97.00** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 8.00 | 1.60 | 1.60 | 98.40 |
| 3/8" | 9.50 | 8.50 | 1.70 | 3.30 | 96.70 |
| No.4 | 4.75 | 5.70 | 1.14 | 4.44 | 95.56 |
| No.10 | 2.00 | 5.10 | 1.02 | 5.46 | 94.54 |
| No.16 | 1.18 | 10.30 | 2.06 | 7.52 | 92.48 |
| No.40 | 0.43 | 22.60 | 4.52 | 12.04 | 87.96 |
| No.50 | 0.3 | 10.10 | 2.02 | 14.06 | 85.94 |
| No.100 | 0.15 | 21.90 | 4.38 | 18.44 | 81.56 |
| No.200 | 0.075 | 4.80 | 0.96 | 19.40 | 80.60 |
| Pan | | 0.00 | 0.00 | 19.40 | |

0

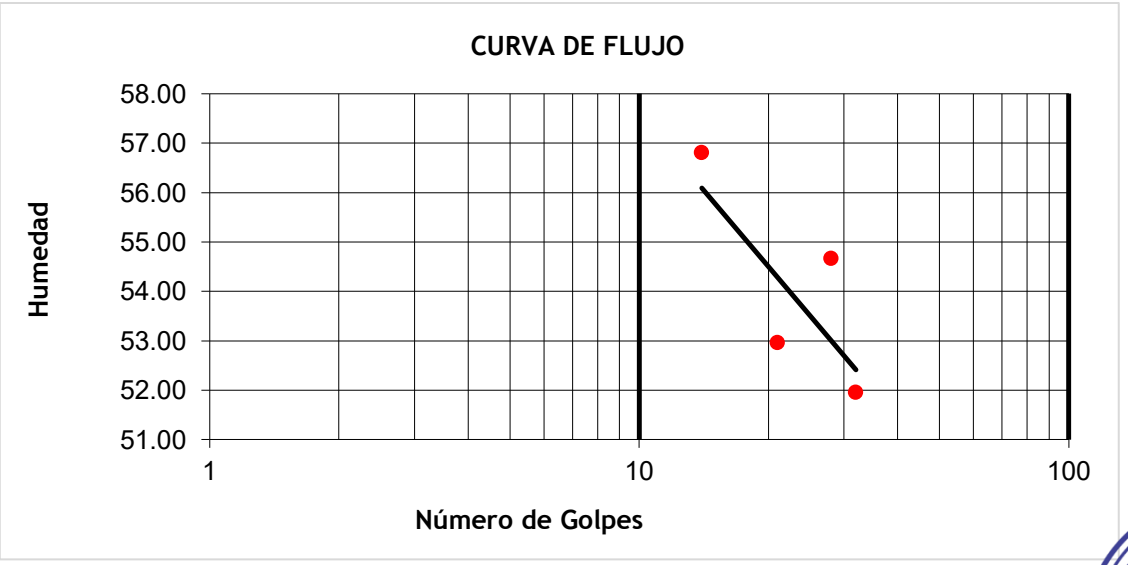


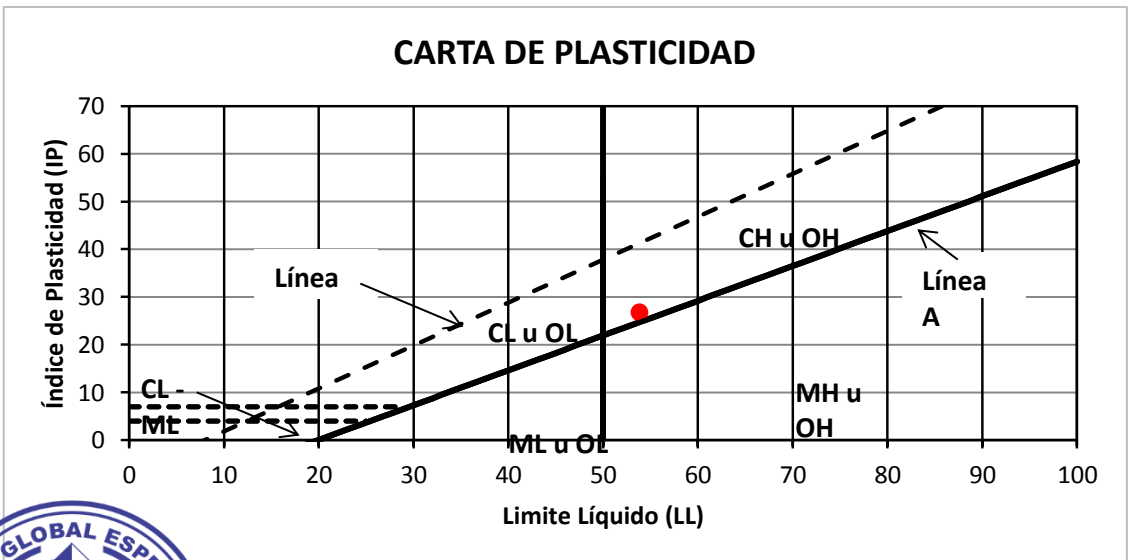

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 14 | 21 | 28 | 32 | | | | |
| B) Número del recipiente | P2 | 5 | P5 | 7 | | 5 | T | 6 |
| C) Peso del recip. + suelo húmedo | 21.26 | 20.75 | 19.81 | 19.00 | | 5.15 | 5.22 | 5.01 |
| D) Peso del recip. + suelo seco | 17.67 | 17.53 | 16.82 | 16.47 | | 4.98 | 5.04 | 4.86 |
| E) Peso agua (C-D) | 3.59 | 3.22 | 2.99 | 2.53 | | 0.17 | 0.18 | 0.15 |
| G) Peso recipiente | 11.35 | 11.45 | 11.35 | 11.60 | | 4.37 | 4.36 | 4.30 |
| H) Peso suelo seco (D-G) | 6.32 | 6.08 | 5.47 | 4.87 | | 0.61 | 0.68 | 0.56 |
| I) Contenido de Humedad (E/H) % | 56.80 | 52.96 | 54.66 | 51.95 | | 27.87 | 26.47 | 26.79 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **4.44** |
| Porcentaje de arena | **14.96** |
| Porcentaje de finos | **80.60** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **53.84** |
| Límite plástico | **27.04** |
| Indice de plasticidad | **26.80** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

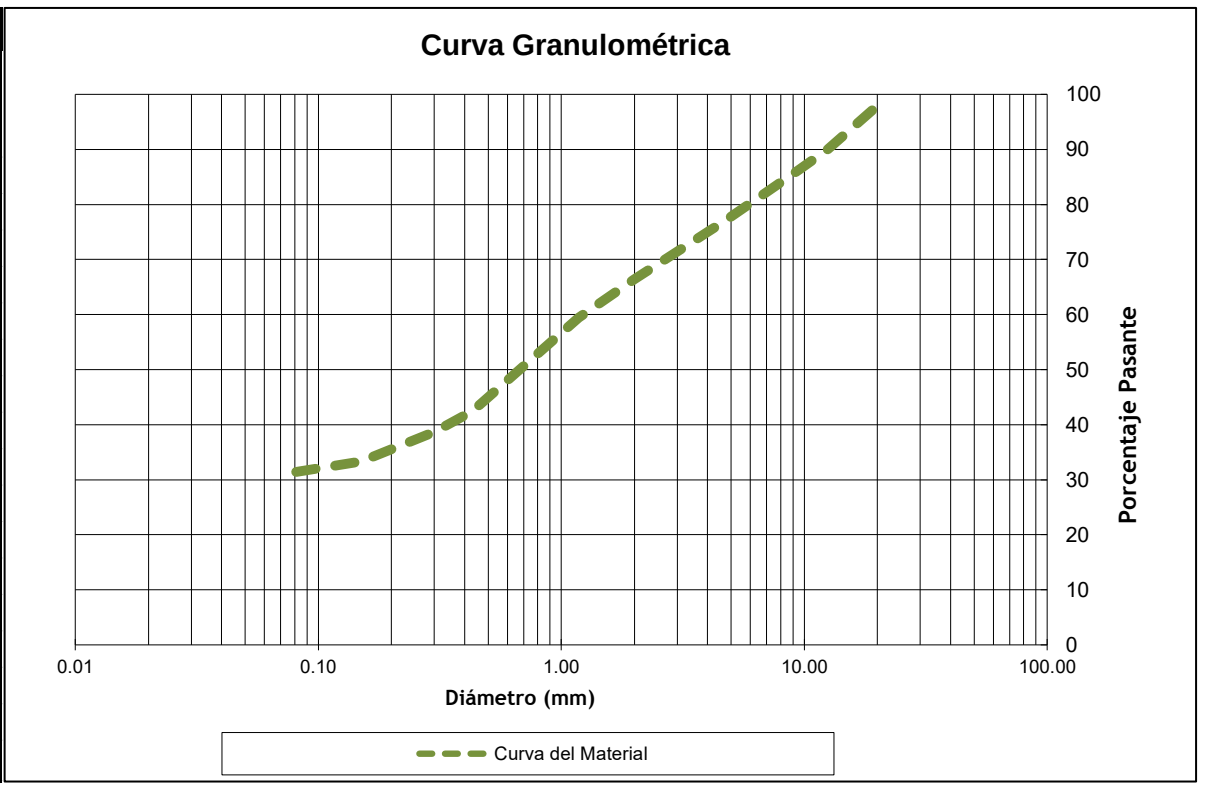
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#49 (M2-M14) |
| Profundidad: | 0.45-6.30 m |

| | |
|---|---|
| Peso Sucio | **1200.00** |
| Peso seco (gr): | **826.20** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 3 1/2" | | | | | |
| 3" | | | | | |
| 2 1/2" | 63.00 | | | | |
| 2" | 50.00 | | | | |
| 1 ½" | 37.50 | | | | |
| 1" | 25.00 | | | | |
| 3/4" | 19.00 | 35.10 | 2.93 | 2.93 | 97.08 |
| 1/2" | 12.50 | 84.10 | 7.01 | 9.93 | 90.07 |
| 3/8" | 9.50 | 46.00 | 3.83 | 13.77 | 86.23 |
| No.4 | 4.75 | 109.20 | 9.10 | 22.87 | 77.13 |
| No.10 | 2.00 | 128.30 | 10.69 | 33.56 | 66.44 |
| No.16 | 1.18 | 84.20 | 7.02 | 40.58 | 59.43 |
| No.40 | 0.43 | 203.90 | 16.99 | 57.57 | 42.43 |
| No.50 | 0.3 | 45.00 | 3.75 | 61.32 | 38.68 |
| No.100 | 0.15 | 64.00 | 5.33 | 66.65 | 33.35 |
| No.200 | 0.075 | 25.80 | 2.15 | 68.80 | 31.20 |
| Pan | | 0.60 | 0.05 | 68.85 | |

0

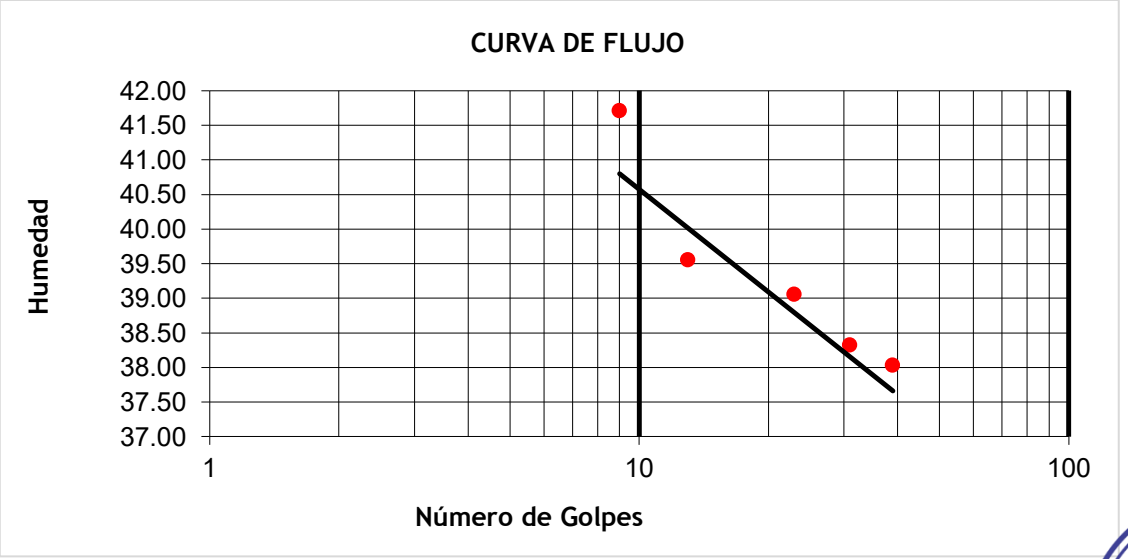


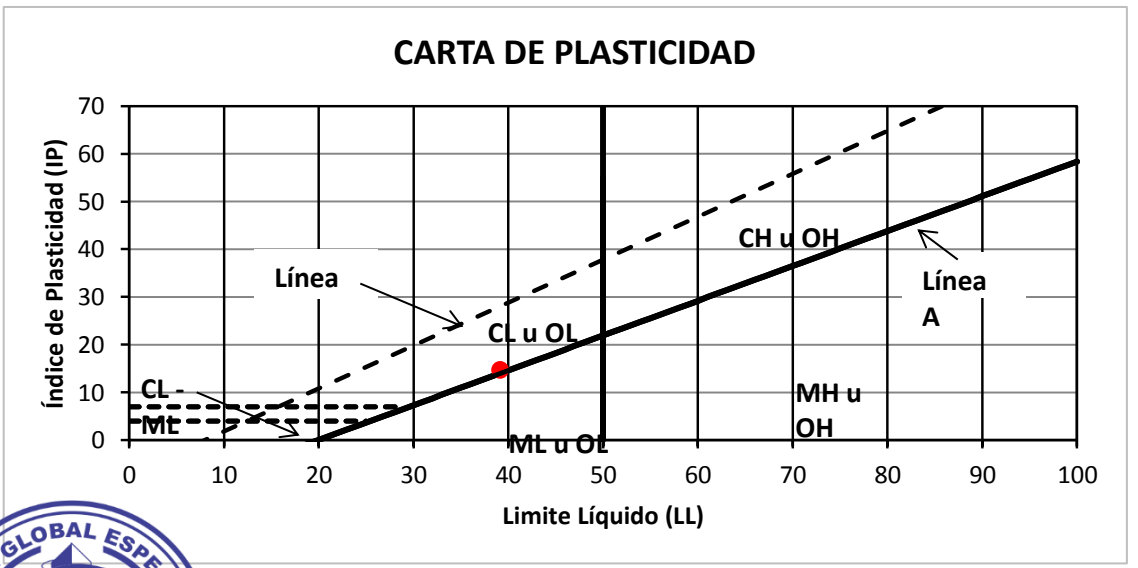

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 9 | 13 | 23 | 31 | 39 | | | |
| B) Número del recipiente | 13 | 23 | K | P | O13 | PE | O10 | O4 |
| C) Peso del recip. + suelo húmedo | 19.93 | 21.28 | 20.81 | 22.05 | 22.46 | 5.29 | 5.42 | 5.48 |
| D) Peso del recip. + suelo seco | 17.44 | 18.44 | 18.08 | 19.08 | 19.33 | 5.09 | 5.21 | 5.26 |
| E) Peso agua (C-D) | 2.49 | 2.84 | 2.73 | 2.97 | 3.13 | 0.20 | 0.21 | 0.22 |
| G) Peso recipiente | 11.47 | 11.26 | 11.09 | 11.33 | 11.10 | 4.27 | 4.35 | 4.36 |
| H) Peso suelo seco (D-G) | 5.97 | 7.18 | 6.99 | 7.75 | 8.23 | 0.82 | 0.86 | 0.90 |
| I) Contenido de Humedad (E/H) % | 41.71 | 39.55 | 39.06 | 38.32 | 38.03 | 24.39 | 24.42 | 24.44 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA CON GRAVA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **22.87** |
| Porcentaje de arena | **45.93** |
| Porcentaje de finos | **31.20** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **1.25** |
| Cu | |
| Cc | |
| Límite líquido | **39.13** |
| Límite plástico | **24.42** |
| Indice de plasticidad | **14.71** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

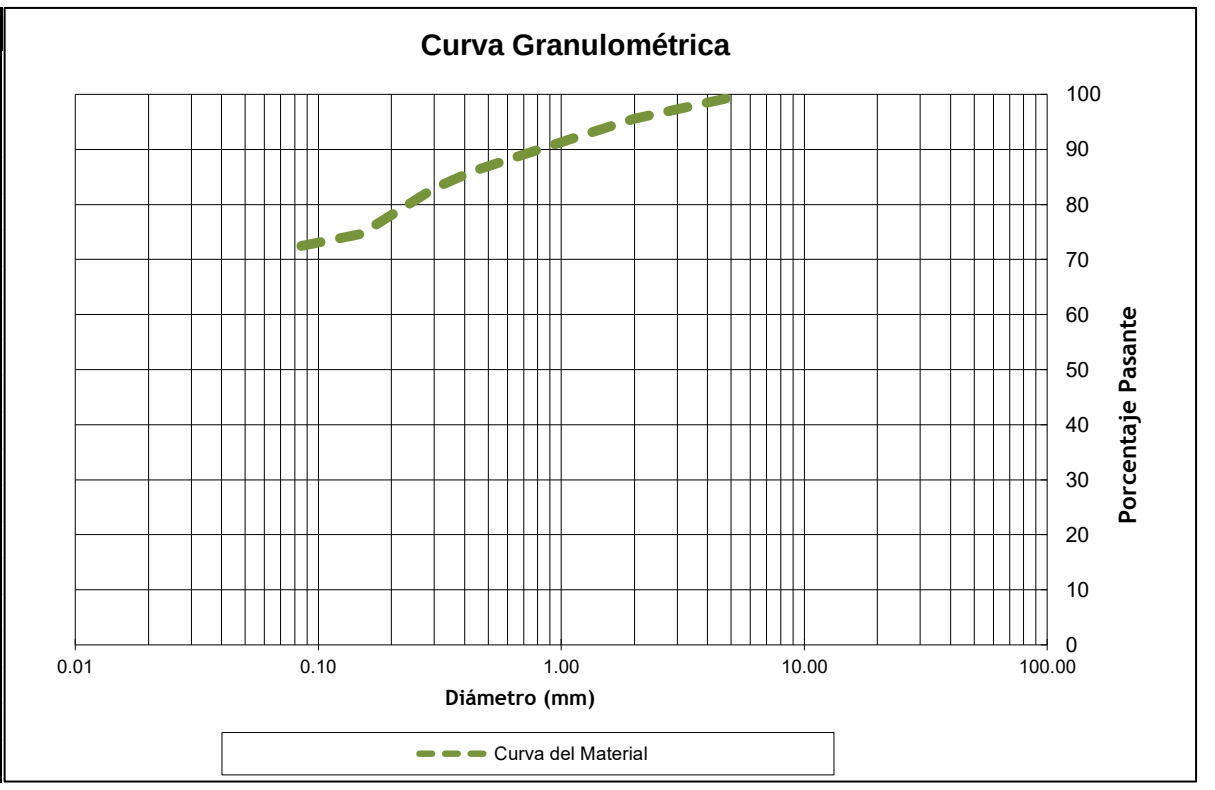
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#35 (M15-M17) |
| Profundidad: | 6.30-7.65 m |

| | |
|---|---|
| Peso Sucio | **300.00** |
| Peso seco (gr): | **85.80** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 2.20 | 0.73 | 0.73 | 99.27 |
| No.10 | 2.00 | 11.00 | 3.67 | 4.40 | 95.60 |
| No.16 | 1.18 | 9.70 | 3.23 | 7.63 | 92.37 |
| No.40 | 0.43 | 19.20 | 6.40 | 14.03 | 85.97 |
| No.50 | 0.3 | 8.90 | 2.97 | 17.00 | 83.00 |
| No.100 | 0.15 | 25.20 | 8.40 | 25.40 | 74.60 |
| No.200 | 0.075 | 7.80 | 2.60 | 28.00 | 72.00 |
| Pan | | 1.80 | 0.60 | 28.60 | |

0

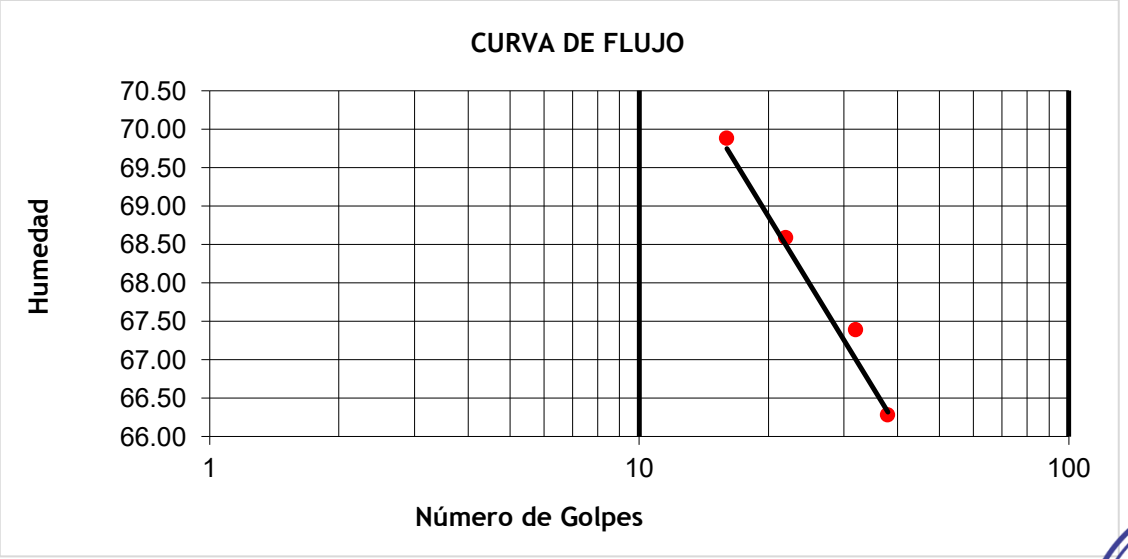


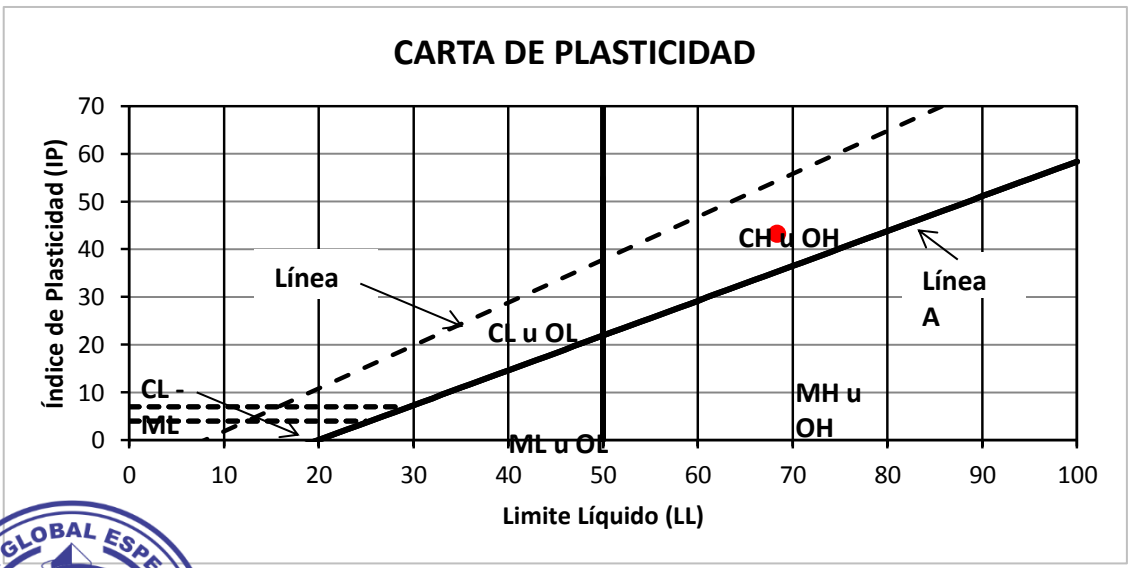

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 16 | 22 | 32 | 38 | | | | |
| B) Número del recipiente | 14 | K26 | K25 | K7 | | 2 | O3 | 9 |
| C) Peso del recip. + suelo húmedo | 31.71 | 32.16 | 30.51 | 32.03 | | 5.88 | 5.58 | 5.62 |
| D) Peso del recip. + suelo seco | 28.88 | 29.30 | 28.32 | 29.16 | | 5.56 | 5.33 | 5.35 |
| E) Peso agua (C-D) | 2.83 | 2.86 | 2.19 | 2.87 | | 0.32 | 0.25 | 0.27 |
| G) Peso recipiente | 24.83 | 25.13 | 25.07 | 24.83 | | 4.31 | 4.32 | 4.27 |
| H) Peso suelo seco (D-G) | 4.05 | 4.17 | 3.25 | 4.33 | | 1.25 | 1.01 | 1.08 |
| I) Contenido de Humedad (E/H) % | 69.88 | 68.59 | 67.38 | 66.28 | | 25.60 | 24.75 | 25.00 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE ALTA PLASTICIDAD CON ARENA (CH)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.73** |
| Porcentaje de arena | **27.27** |
| Porcentaje de finos | **72.00** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **68.34** |
| Límite plástico | **25.12** |
| Indice de plasticidad | **43.23** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

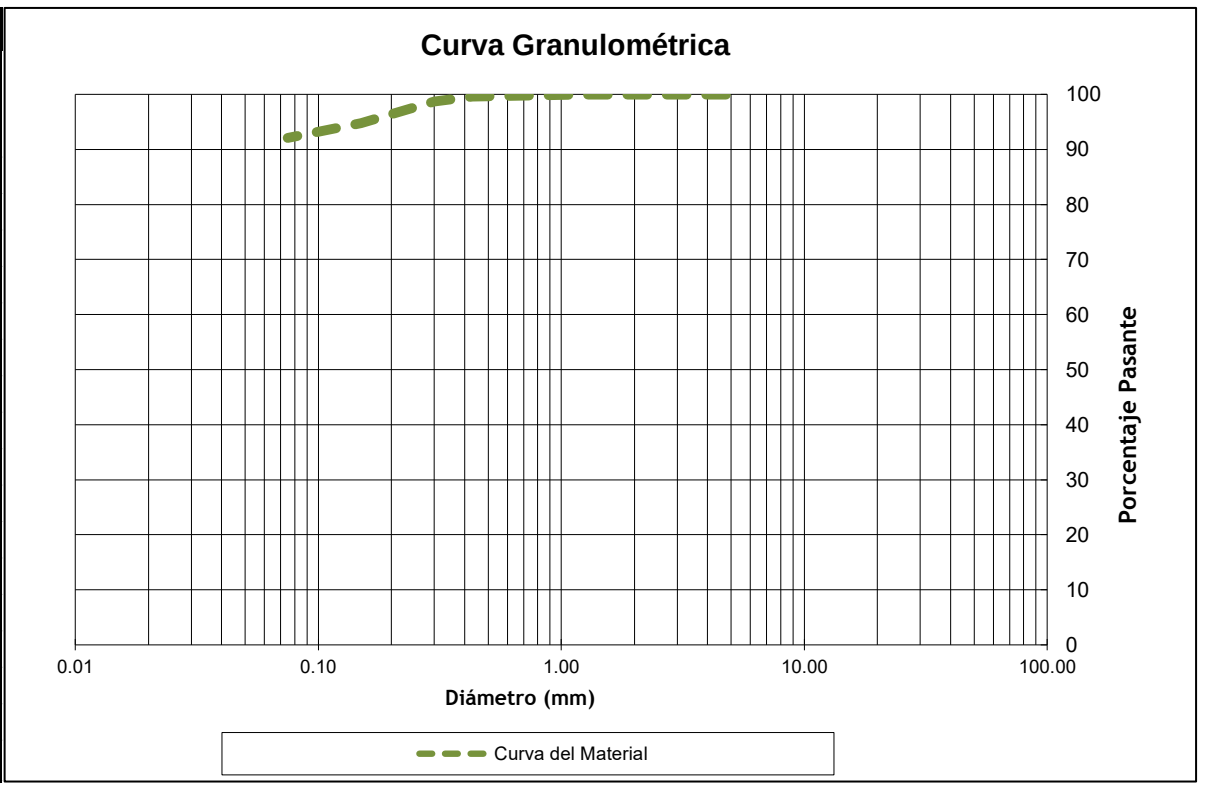
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#51 (M30-M40) |
| Profundidad: | 14.55-19.50 m |

| | |
|---|---|
| Peso Sucio | **750.00** |
| Peso seco (gr): | **59.50** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.16 | 1.18 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.40 | 0.43 | 3.00 | 0.40 | 0.40 | 99.60 |
| No.50 | 0.3 | 6.50 | 0.87 | 1.27 | 98.73 |
| No.100 | 0.15 | 29.40 | 3.92 | 5.19 | 94.81 |
| No.200 | 0.075 | 20.60 | 2.75 | 7.93 | 92.07 |
| Pan | | 0.00 | 0.00 | 7.93 | |

0

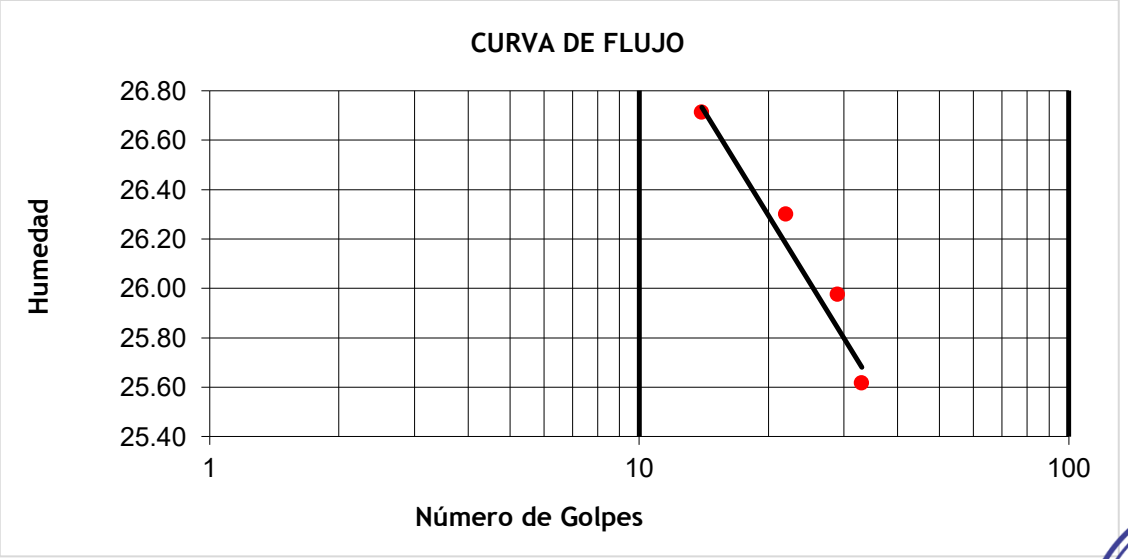


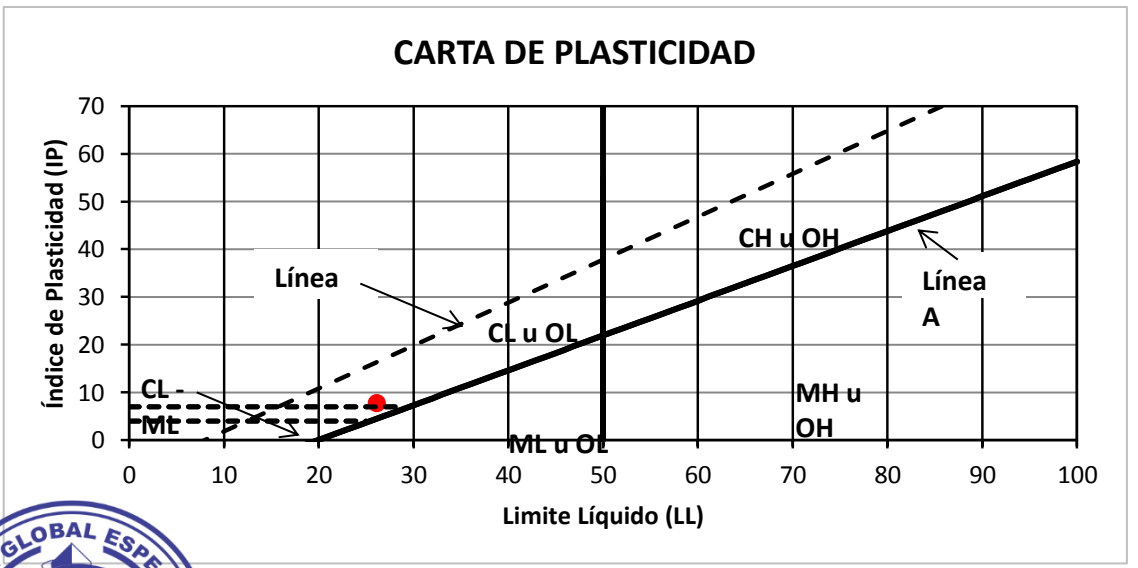

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 14 | 22 | 29 | 33 | | | | |
| B) Número del recipiente | K31 | K16 | K13 | K12 | | O7 | O8 | T |
| C) Peso del recip. + suelo húmedo | 34.28 | 33.67 | 34.30 | 33.26 | | 5.80 | 5.48 | 5.76 |
| D) Peso del recip. + suelo seco | 32.33 | 31.85 | 32.37 | 31.60 | | 5.57 | 5.30 | 5.54 |
| E) Peso agua (C-D) | 1.95 | 1.82 | 1.93 | 1.66 | | 0.23 | 0.18 | 0.22 |
| G) Peso recipiente | 25.03 | 24.93 | 24.94 | 25.12 | | 4.31 | 4.34 | 4.33 |
| H) Peso suelo seco (D-G) | 7.30 | 6.92 | 7.43 | 6.48 | | 1.26 | 0.96 | 1.21 |
| I) Contenido de Humedad (E/H) % | 26.71 | 26.30 | 25.98 | 25.62 | | 18.25 | 18.75 | 18.18 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **7.93** |
| Porcentaje de finos | **92.07** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **26.12** |
| Límite plástico | **18.40** |
| Indice de plasticidad | **7.73** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

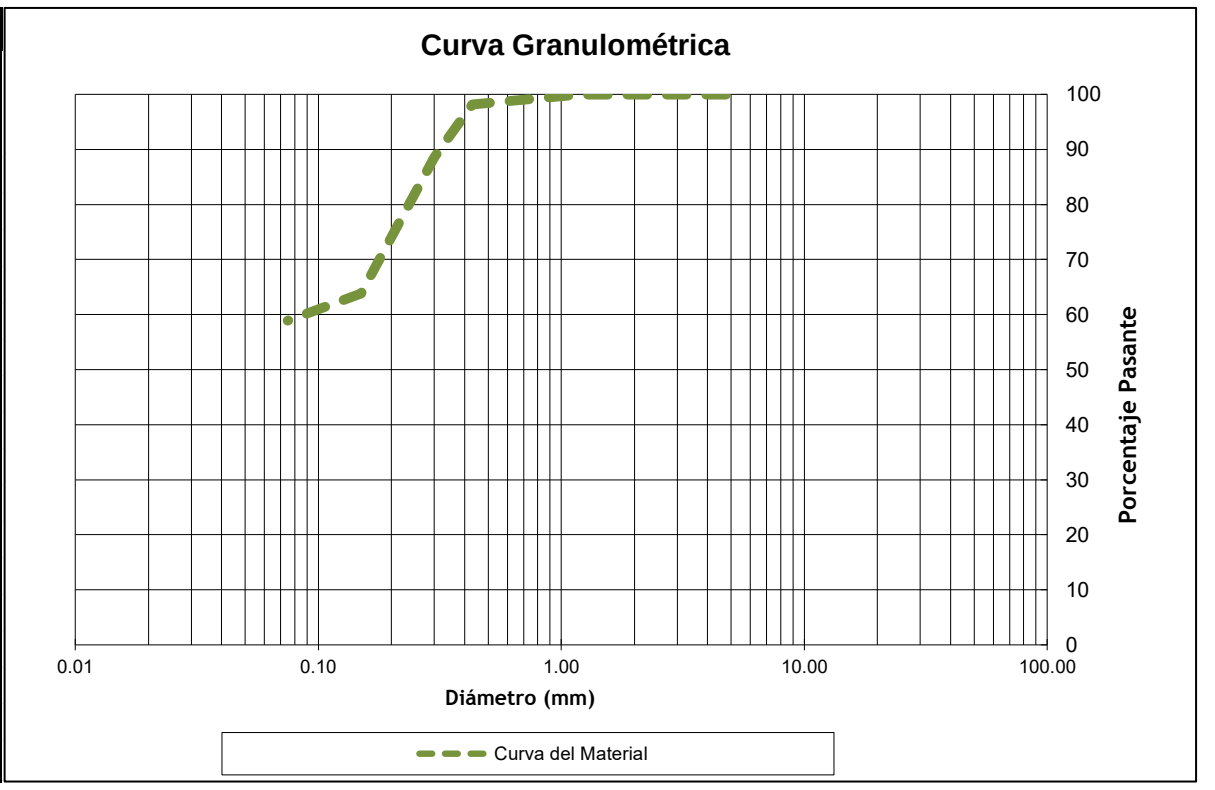
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#100 (M41-M50) |
| Profundidad: | 19.50-24.00 m |

| | |
|---|---|
| Peso Sucio | **1000.00** |
| Peso seco (gr): | **412.80** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.10 | 2.00 | 0.00 | 0.00 | 0.00 | 100.00 |
| No.16 | 1.18 | 0.50 | 0.05 | 0.05 | 99.95 |
| No.40 | 0.43 | 18.10 | 1.81 | 1.86 | 98.14 |
| No.50 | 0.3 | 95.00 | 9.50 | 11.36 | 88.64 |
| No.100 | 0.15 | 248.20 | 24.82 | 36.18 | 63.82 |
| No.200 | 0.075 | 49.00 | 4.90 | 41.08 | 58.92 |
| Pan | | 2.00 | 0.20 | 41.28 | |

0

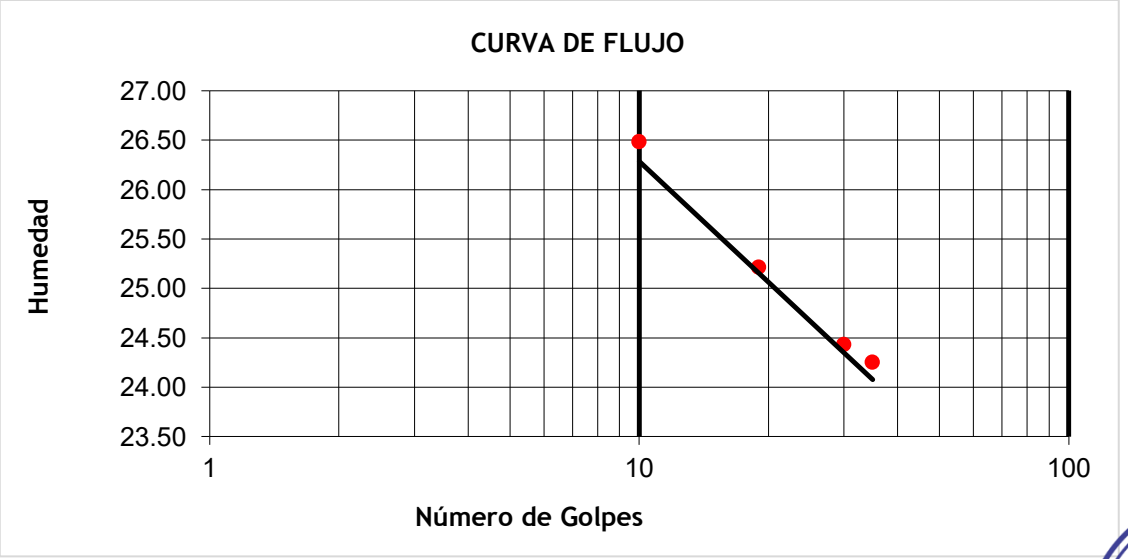


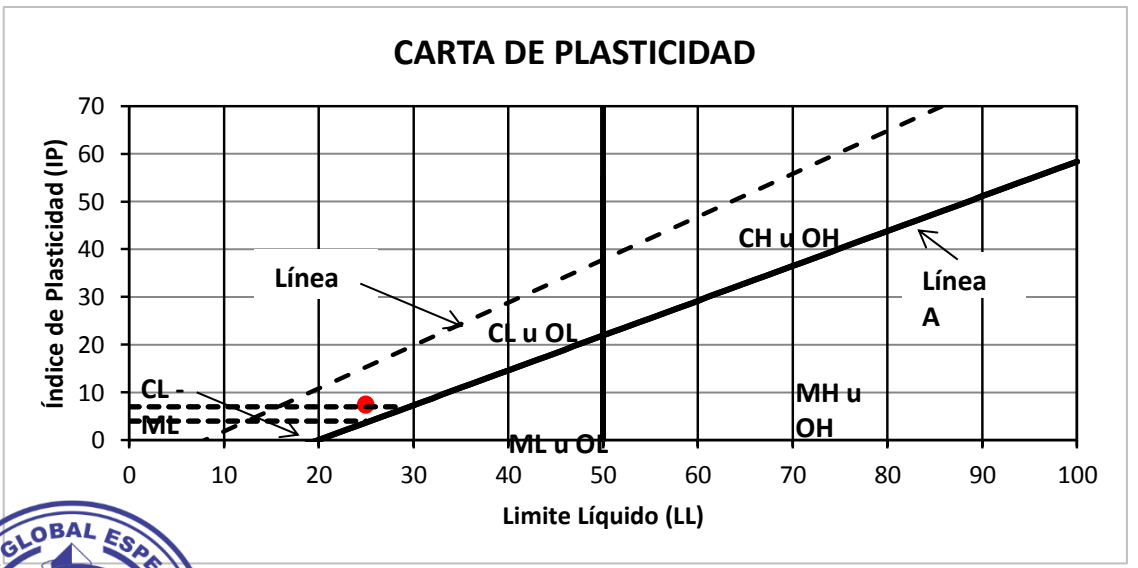

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 10 | 19 | 30 | 35 | | | | |
| B) Número del recipiente | 8 | 16 | K20 | K31 | | K6 | K9 | 13 |
| C) Peso del recip. + suelo húmedo | 35.51 | 32.31 | 34.81 | 32.92 | | 26.76 | 26.23 | 26.37 |
| D) Peso del recip. + suelo seco | 33.32 | 30.82 | 32.89 | 31.38 | | 26.52 | 26.05 | 26.16 |
| E) Peso agua (C-D) | 2.19 | 1.49 | 1.92 | 1.54 | | 0.24 | 0.18 | 0.21 |
| G) Peso recipiente | 25.05 | 24.91 | 25.03 | 25.03 | | 25.17 | 25.01 | 24.96 |
| H) Peso suelo seco (D-G) | 8.27 | 5.91 | 7.86 | 6.35 | | 1.35 | 1.04 | 1.20 |
| I) Contenido de Humedad (E/H) % | 26.48 | 25.21 | 24.43 | 24.25 | | 17.78 | 17.31 | 17.50 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD ARENOSA (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.00** |
| Porcentaje de arena | **41.08** |
| Porcentaje de finos | **58.92** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.09** |
| Cu | |
| Cc | |
| Límite líquido | **24.96** |
| Límite plástico | **17.53** |
| Indice de plasticidad | **7.43** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

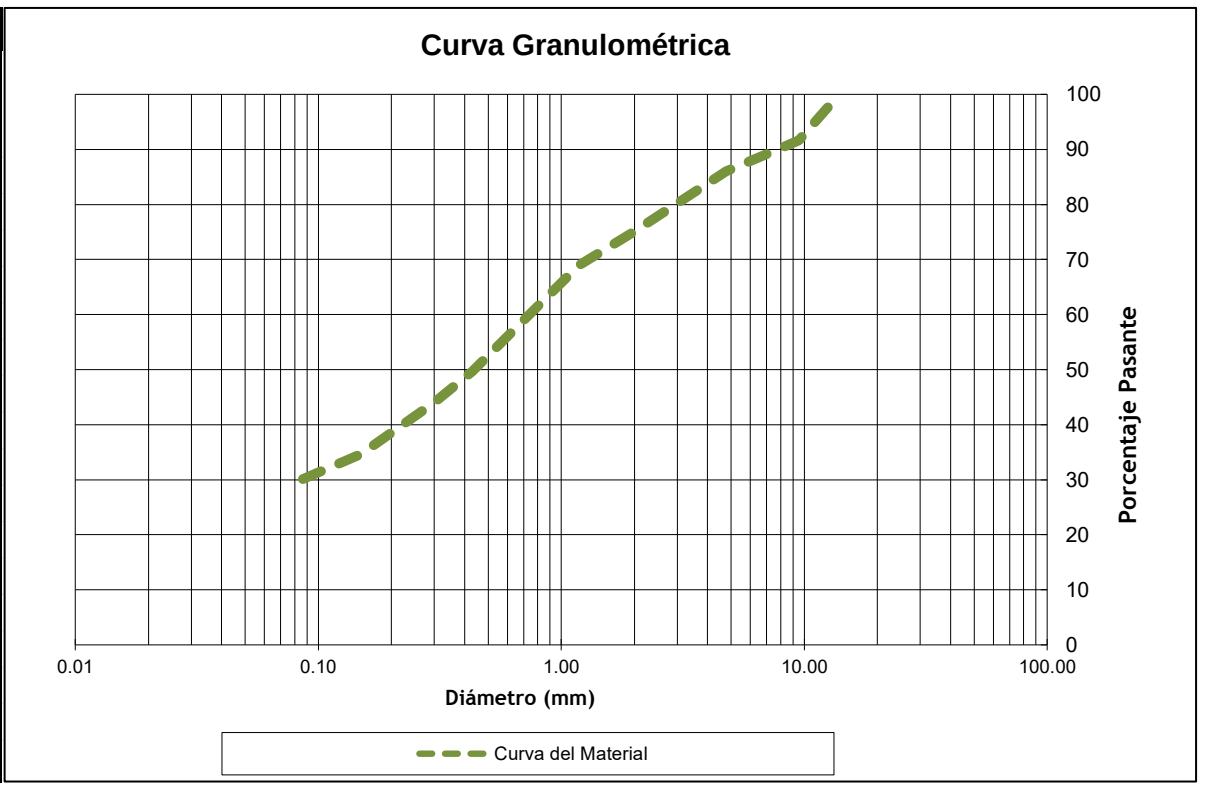
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#25 (M51-M52) |
| Profundidad: | 24.00-24.90 m |

| | |
|---|---|
| Peso Sucio | **250.00** |
| Peso seco (gr): | **177.60** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | 5.90 | 2.36 | 2.36 | 97.64 |
| 3/8" | 9.50 | 14.90 | 5.96 | 8.32 | 91.68 |
| No.4 | 4.75 | 14.20 | 5.68 | 14.00 | 86.00 |
| No.10 | 2.00 | 27.30 | 10.92 | 24.92 | 75.08 |
| No.16 | 1.18 | 15.50 | 6.20 | 31.12 | 68.88 |
| No.40 | 0.43 | 47.90 | 19.16 | 50.28 | 49.72 |
| No.50 | 0.3 | 14.10 | 5.64 | 55.92 | 44.08 |
| No.100 | 0.15 | 23.50 | 9.40 | 65.32 | 34.68 |
| No.200 | 0.075 | 14.30 | 5.72 | 71.04 | 28.96 |
| Pan | | 0.00 | 0.00 | 71.04 | |

0

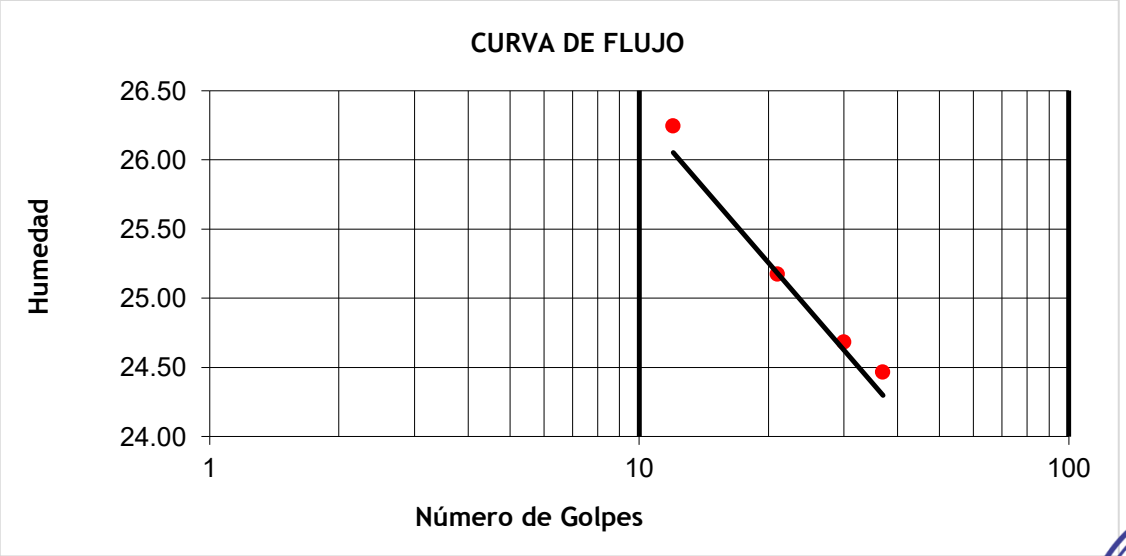


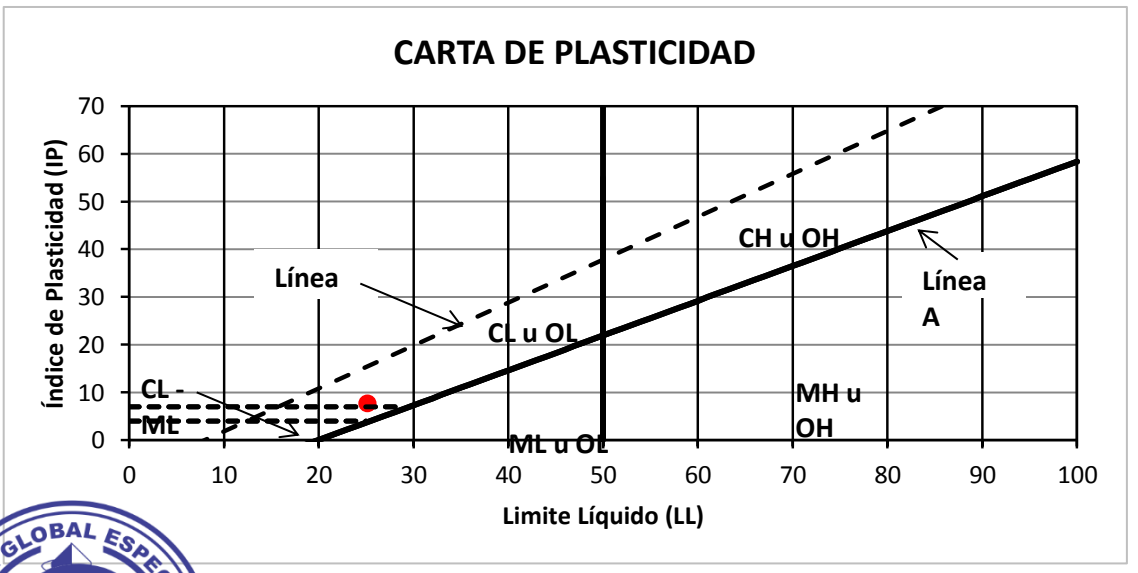

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 12 | 21 | 30 | 37 | | | | |
| B) Número del recipiente | M | P6 | P11 | C | | P7 | U | 2 |
| C) Peso del recip. + suelo húmedo | 19.75 | 18.63 | 19.35 | 20.09 | | 13.27 | 12.86 | 12.67 |
| D) Peso del recip. + suelo seco | 18.01 | 17.17 | 17.80 | 18.38 | | 13.02 | 12.63 | 12.45 |
| E) Peso agua (C-D) | 1.74 | 1.46 | 1.55 | 1.71 | | 0.25 | 0.23 | 0.22 |
| G) Peso recipiente | 11.38 | 11.37 | 11.52 | 11.39 | | 11.56 | 11.33 | 11.20 |
| H) Peso suelo seco (D-G) | 6.63 | 5.80 | 6.28 | 6.99 | | 1.46 | 1.30 | 1.25 |
| I) Contenido de Humedad (E/H) % | 26.24 | 25.17 | 24.68 | 24.46 | | 17.12 | 17.69 | 17.60 |
| Clasificación (Sistema Unificado de Suelos): | **ARENA ARCILLOSA (SC)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **14.00** |
| Porcentaje de arena | **57.04** |
| Porcentaje de finos | **28.96** |
| D10 | **0.00** |
| D30 | **0.09** |
| D60 | **0.83** |
| Cu | |
| Cc | |
| Límite líquido | **25.14** |
| Límite plástico | **17.47** |
| Indice de plasticidad | **7.67** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

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

Fecha de Ensayo: 02/06/2020

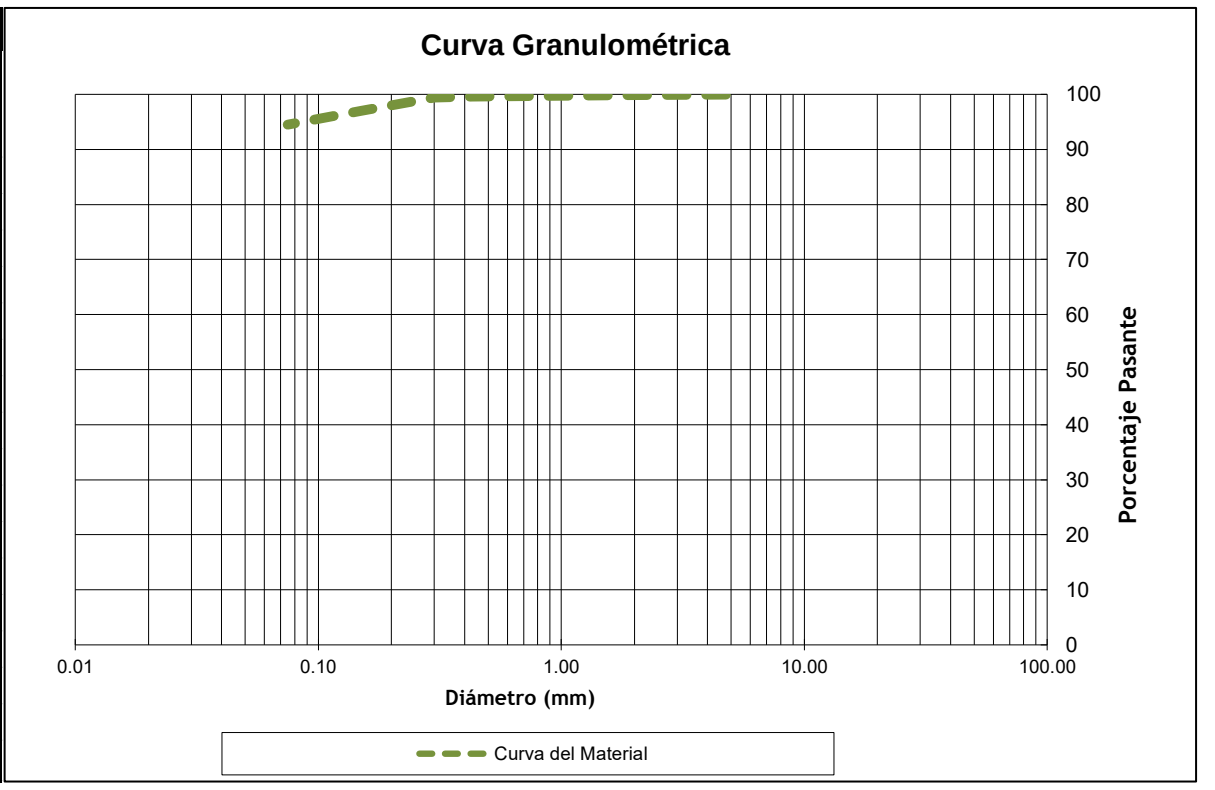
| | |
|---|---|
| ID Muestra: | Sondeo T8-04 |
| Proyecto: | Metro Cable Estación 8, Santo Domingo Oeste |
| Realizado por: | Manuel Castillo |
| Observaciones de la muestra: | B#17 (M53-M64) |
| Profundidad: | 24.90-30.30 m |

| | |
|---|---|
| Peso Sucio | **1150.00** |
| Peso seco (gr): | **62.80** |

**Granulometría ASTM D-6913**

| Tamiz | Tamaño en mm | Peso Retenido en gramos | Retenido (%) | Acumulado Retenido (%) | Pasante (%) |
|---|---|---|---|---|---|
| 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 | | | | |
| 3/8" | 9.50 | | | | |
| No.4 | 4.75 | 0.40 | 0.03 | 0.03 | 99.97 |
| No.10 | 2.00 | 1.50 | 0.13 | 0.17 | 99.83 |
| No.16 | 1.18 | 0.80 | 0.07 | 0.23 | 99.77 |
| No.40 | 0.43 | 2.20 | 0.19 | 0.43 | 99.57 |
| No.50 | 0.3 | 1.60 | 0.14 | 0.57 | 99.43 |
| No.100 | 0.15 | 28.20 | 2.45 | 3.02 | 96.98 |
| No.200 | 0.075 | 28.00 | 2.43 | 5.45 | 94.55 |
| Pan | | 0.10 | 0.01 | 5.46 | |

0

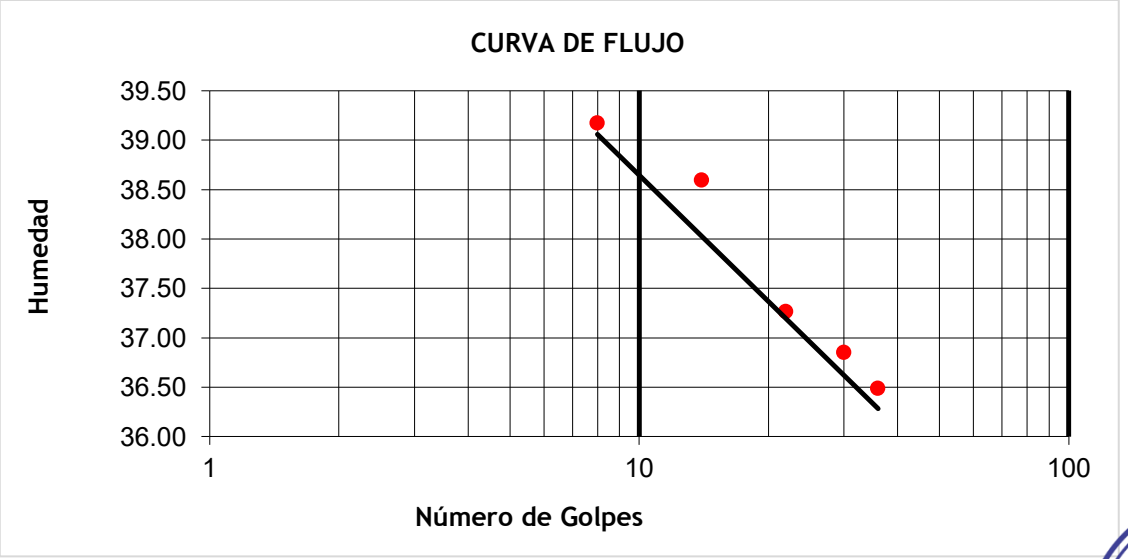


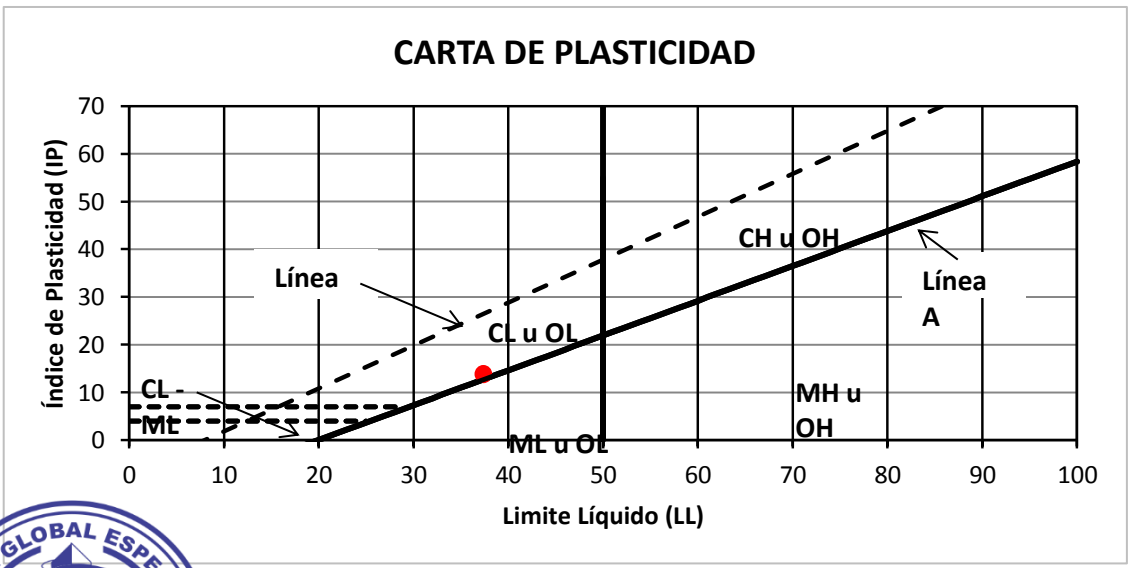

**LIMITES ATTERBERG ASTM D-4318**

| | LIMITE LIQUIDO | | | | | LIMITE PLASTICO | | |
|---|---|---|---|---|---|---|---|---|
| **Ensayo** | **1** | **2** | **3** | **4** | **5** | **1** | **2** | **3** |
| A) Número de Golpes | 8 | 14 | 22 | 30 | 36 | | | |
| B) Número del recipiente | P3 | 13 | C | P5 | M | PC | 4 | P8 |
| C) Peso del recip. + suelo húmedo | 19.00 | 17.97 | 18.61 | 19.17 | 17.60 | 5.43 | 5.48 | 5.48 |
| D) Peso del recip. + suelo seco | 16.83 | 16.16 | 16.65 | 17.04 | 15.94 | 5.22 | 5.25 | 5.26 |
| E) Peso agua (C-D) | 2.17 | 1.81 | 1.96 | 2.13 | 1.66 | 0.21 | 0.23 | 0.22 |
| G) Peso recipiente | 11.29 | 11.47 | 11.39 | 11.26 | 11.39 | 4.34 | 4.28 | 4.31 |
| H) Peso suelo seco (D-G) | 5.54 | 4.69 | 5.26 | 5.78 | 4.55 | 0.88 | 0.97 | 0.95 |
| I) Contenido de Humedad (E/H) % | 39.17 | 38.59 | 37.26 | 36.85 | 36.48 | 23.86 | 23.71 | 23.16 |
| Clasificación (Sistema Unificado de Suelos): | **ARCILLA DE BAJA PLASTICIDAD (CL)** | | | | | | | |

**RESULTADOS**

| | |
|---|---|
| Porcentaje de grava | **0.03** |
| Porcentaje de arena | **5.42** |
| Porcentaje de finos | **94.55** |
| D10 | **0.00** |
| D30 | **0.00** |
| D60 | **0.00** |
| Cu | |
| Cc | |
| Límite líquido | **37.37** |
| Límite plástico | **23.58** |
| Indice de plasticidad | **13.80** |




Manuel Castillo
Realizado por:

Emil E. Guilamo Pichardo
Revisado por:

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

# RESULTADOS
# ASTM D2216
## ENSAYO DE HUMEDAD

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-01, M3-M7
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#39
**Profundidad de la Muestra:** 0.90-3.15 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **84** | **73** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 176.70 | 154.00 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 164.00 | 143.00 |
| **PESO DEL CONTENEDOR** | | C | 43.00 | 42.60 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 10.50 | 10.96 |
| | **PROMEDIO** | 10.73 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-01, M8-M18
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#42
**Profundidad de la Muestra:** 3.15-8.10 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **74** | **80** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 244.00 | 241.70 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 194.80 | 193.10 |
| **PESO DEL CONTENEDOR** | | C | 42.30 | 42.10 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 32.26 | 32.19 |
| | **PROMEDIO** | 32.22 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-02, M2-M3
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#46
**Profundidad de la Muestra:** 0.45-1.35 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **88** | **85** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 205.70 | 200.70 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 176.80 | 172.50 |
| **PESO DEL CONTENEDOR** | | C | 42.30 | 42.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 21.49 | 21.66 |
| | **PROMEDIO** | 21.57 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-02, M11-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#31
**Profundidad de la Muestra:** 4.50-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **5** | **K** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 267.10 | 277.40 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 212.10 | 218.80 |
| **PESO DEL CONTENEDOR** | | C | 62.40 | 62.40 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 36.74 | 37.47 |
| | **PROMEDIO** | 37.10 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-02, M4-M9
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#37
**Profundidad de la Muestra:** 1.35-4.05 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **89** | **78** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 296.20 | 296.70 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 277.00 | 276.20 |
| **PESO DEL CONTENEDOR** | | C | 43.10 | 43.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 8.21 | 8.80 |
| | **PROMEDIO** | 8.51 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-03, M1-M2
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#50
**Profundidad de la Muestra:** 0.00-0.90 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **4** | **1** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 193.10 | 169.60 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 162.90 | 151.30 |
| **PESO DEL CONTENEDOR** | | C | 61.90 | 61.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 29.90 | 20.45 |
| | **PROMEDIO** | 25.17 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-03, M3-M8
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#45
**Profundidad de la Muestra:** 0.90-3.60 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **79** | **72** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 283.30 | 282.50 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 264.80 | 264.70 |
| **PESO DEL CONTENEDOR** | | C | 42.40 | 44.20 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 8.32 | 8.07 |
| | **PROMEDIO** | 8.20 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-03, M9-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#40
**Profundidad de la Muestra:** 3.60-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **83** | **86** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 196.40 | 199.60 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 157.80 | 159.80 |
| **PESO DEL CONTENEDOR** | | C | 44.30 | 43.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 34.01 | 34.16 |
| | **PROMEDIO** | 34.09 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-04, M2-M4
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#32
**Profundidad de la Muestra:** 0.45-1.80 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **81** | **87** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 169.50 | 196.10 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 141.30 | 163.50 |
| **PESO DEL CONTENEDOR** | | C | 43.30 | 48.00 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 28.78 | 28.23 |
| | **PROMEDIO** | 28.50 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-04, M5-M12
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#41
**Profundidad de la Muestra:** 1.80-6.30 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **9** | **G** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 294.50 | 296.40 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 277.50 | 278.70 |
| **PESO DEL CONTENEDOR** | | C | 62.80 | 62.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 7.92 | 8.20 |
| | **PROMEDIO** | 8.06 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-04, M15-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#38
**Profundidad de la Muestra:** 6.30-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **2** | **50** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 244.80 | 237.50 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 194.80 | 189.60 |
| **PESO DEL CONTENEDOR** | | C | 62.70 | 62.20 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 37.85 | 37.60 |
| | **PROMEDIO** | 37.72 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-05, M2-M7
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#53
**Profundidad de la Muestra:** 0.45-3.15 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **18** | **J** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 275.50 | 264.60 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 228.50 | 219.00 |
| **PESO DEL CONTENEDOR** | | C | 62.90 | 62.60 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 28.38 | 29.16 |
| | **PROMEDIO** | 28.77 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-05, M8-M12
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#33
**Profundidad de la Muestra:** 3.15-5.40 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **D** | **M** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 310.60 | 306.20 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 287.30 | 281.70 |
| **PESO DEL CONTENEDOR** | | C | 62.80 | 62.40 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 10.38 | 11.17 |
| | **PROMEDIO** | 10.78 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-05, M13-M23
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#36
**Profundidad de la Muestra:** 5.40-10.35 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **N** | **6** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 239.20 | 232.60 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 194.50 | 190.30 |
| **PESO DEL CONTENEDOR** | | C | 62.10 | 61.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 33.76 | 32.92 |
| | **PROMEDIO** | 33.34 | | |

Manuel Castillo
**Realizado por:**

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**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-06, M2-M17
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#44
**Profundidad de la Muestra:** 0.45-7.65 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **F** | **X** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 345.30 | 354.00 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 328.80 | 334.80 |
| **PESO DEL CONTENEDOR** | | C | 62.90 | 62.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 6.21 | 7.05 |
| | **PROMEDIO** | 6.63 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-06, M18-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#08
**Profundidad de la Muestra:** 7.65-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **EE** | **H** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 189.60 | 198.90 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 150.30 | 155.80 |
| **PESO DEL CONTENEDOR** | | C | 61.40 | 61.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 44.21 | 45.85 |
| | **PROMEDIO** | 45.03 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-07, M2-M14
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#07
**Profundidad de la Muestra:** 0.45-6.30 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **11** | **Y** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 195.20 | 199.80 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 186.50 | 191.20 |
| **PESO DEL CONTENEDOR** | | C | 61.70 | 63.60 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 6.97 | 6.74 |
| | **PROMEDIO** | 6.86 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-07, M15-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#05
**Profundidad de la Muestra:** 6.30-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **8** | **K20** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 148.40 | 140.10 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 118.80 | 112.60 |
| **PESO DEL CONTENEDOR** | | C | 25.00 | 25.00 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 31.56 | 31.39 |
| | **PROMEDIO** | 31.47 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-08, M1-M4
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#47
**Profundidad de la Muestra:** 0.00-1.80 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **K11** | **K5** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 153.10 | 154.40 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 126.70 | 128.70 |
| **PESO DEL CONTENEDOR** | | C | 25.00 | 25.00 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 25.96 | 24.78 |
| | **PROMEDIO** | 25.37 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-08, M5-M8
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#AA
**Profundidad de la Muestra:** 1.80-3.60 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **K36** | **K34** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 167.60 | 168.90 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 157.20 | 158.20 |
| **PESO DEL CONTENEDOR** | | C | 25.00 | 25.10 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 7.87 | 8.04 |
| | **PROMEDIO** | 7.95 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo E8-08, M9-M20
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#19
**Profundidad de la Muestra:** 3.60-9.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **K18** | **K24** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 135.80 | 135.40 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 106.80 | 105.60 |
| **PESO DEL CONTENEDOR** | | C | 25.20 | 25.00 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 35.54 | 36.97 |
| | **PROMEDIO** | 36.26 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-01, M2-M21
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#30
**Profundidad de la Muestra:** 0.45-9.45 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **86** | **82** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 224.20 | 224.80 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 213.20 | 213.40 |
| **PESO DEL CONTENEDOR** | | C | 43.20 | 41.50 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 6.47 | 6.63 |
| | **PROMEDIO** | 6.55 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-01, M22-M29
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#09
**Profundidad de la Muestra:** 9.95-13.55 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **87** | **81** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 202.80 | 205.70 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 160.00 | 160.30 |
| **PESO DEL CONTENEDOR** | | C | 48.10 | 43.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 38.25 | 38.80 |
| | **PROMEDIO** | 38.53 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-02, M2-M4
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#02
**Profundidad de la Muestra:** 0.45-1.80 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **77** | **75** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 193.90 | 194.20 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 171.70 | 170.80 |
| **PESO DEL CONTENEDOR** | | C | 47.90 | 42.90 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 17.93 | 18.30 |
| | **PROMEDIO** | 18.11 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-02, M14-M21
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#10
**Profundidad de la Muestra:** 5.85-10.45 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **85** | **89** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 284.10 | 284.10 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 258.20 | 256.20 |
| **PESO DEL CONTENEDOR** | | C | 43.30 | 43.10 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 12.05 | 13.09 |
| | **PROMEDIO** | 12.57 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-02, M22-M30
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#04
**Profundidad de la Muestra:** 11.05-15.10 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **80** | **88** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 239.40 | 237.70 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 194.70 | 193.10 |
| **PESO DEL CONTENEDOR** | | C | 42.10 | 43.30 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 29.29 | 29.77 |
| | **PROMEDIO** | 29.53 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-02, M37-M40
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#01
**Profundidad de la Muestra:** 24.15-27.25 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **76** | **70** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 263.70 | 263.90 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 220.60 | 221.80 |
| **PESO DEL CONTENEDOR** | | C | 40.50 | 43.60 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 23.93 | 23.63 |
| | **PROMEDIO** | 23.78 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-03, M2-M5
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#43
**Profundidad de la Muestra:** 0.45-2.25 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **84** | **73** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 211.80 | 211.30 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 187.80 | 188.50 |
| **PESO DEL CONTENEDOR** | | C | 43.10 | 42.40 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 16.59 | 15.61 |
| | **PROMEDIO** | 16.10 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-03, M6-M25
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#03
**Profundidad de la Muestra:** 2.25-11.25 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **2** | **3** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 339.10 | 338.90 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 320.40 | 318.60 |
| **PESO DEL CONTENEDOR** | | C | 62.60 | 62.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 7.25 | 7.94 |
| | **PROMEDIO** | 7.59 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-03, M33-M37
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#06
**Profundidad de la Muestra:** 26.90-29.15 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **G** | **O** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 276.00 | 277.10 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 226.40 | 224.10 |
| **PESO DEL CONTENEDOR** | | C | 62.80 | 63.00 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 30.32 | 32.90 |
| | **PROMEDIO** | 31.61 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M3-M14
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#49
**Profundidad de la Muestra:** 0.45-6.30 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **I** | **A** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 377.30 | 376.00 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 351.30 | 349.30 |
| **PESO DEL CONTENEDOR** | | C | 63.00 | 62.20 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 9.02 | 9.30 |
| | **PROMEDIO** | 9.16 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M15-M17
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#35
**Profundidad de la Muestra:** 6.30-7.65 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **Y** | **9** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 245.70 | 247.00 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 201.50 | 201.50 |
| **PESO DEL CONTENEDOR** | | C | 63.00 | 62.70 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 31.91 | 32.78 |
| | **PROMEDIO** | 32.35 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M30-M40
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#51
**Profundidad de la Muestra:** 14.55-19.50 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **20** | **6** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 241.10 | 242.80 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 203.80 | 205.00 |
| **PESO DEL CONTENEDOR** | | C | 62.50 | 62.80 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 26.40 | 26.58 |
| | **PROMEDIO** | 26.49 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M41-M50
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#100
**Profundidad de la Muestra:** 19.50-24.00 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **H** | **I** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 330.40 | 337.20 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 294.70 | 299.70 |
| **PESO DEL CONTENEDOR** | | C | 61.80 | 62.20 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 15.33 | 15.79 |
| | **PROMEDIO** | 15.56 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M51-M52
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#25
**Profundidad de la Muestra:** 24.00-24.90 m

| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **3** | **K** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 192.00 | 201.00 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 184.80 | 193.70 |
| **PESO DEL CONTENEDOR** | | C | 63.40 | 62.40 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 5.93 | 5.56 |
| | **PROMEDIO** | 5.75 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

# ENSAYO DE CONTENIDO DE HUMEDAD
## ASTM D 2216

**Fecha de Ensayo:** 09/06/2020

**ID.Muestra** Sondeo T8-04, M53-M64
**Proyecto:** Metro Cable Estación 8
**Realizado por:** Manuel Castillo
**Observaciones de la Muestra:** B#17
**Profundidad de la Muestra:** 24.90-30.30 m

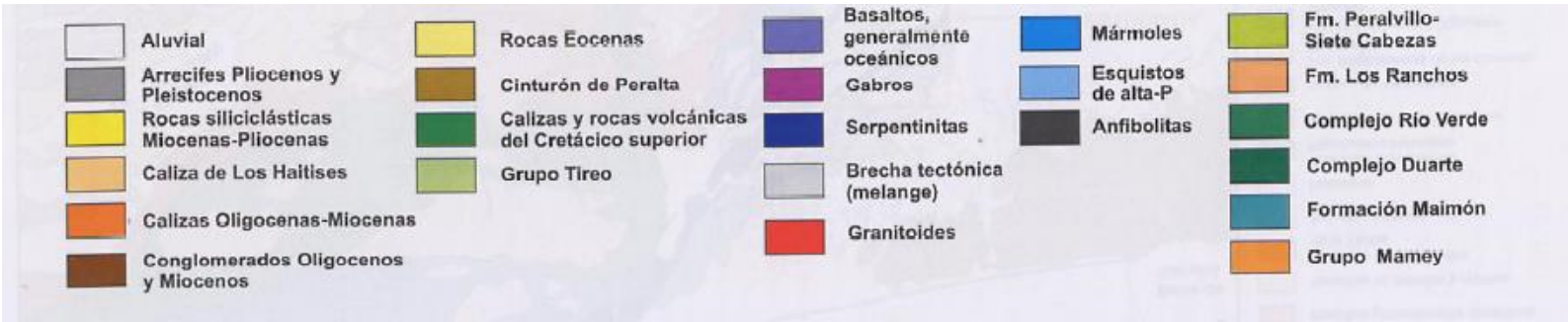
| CONTENIDO DE HUMEDAD | | | | |
|---|---|---|---|---|
| **CONTENEDOR** | | **No.** | **50** | **L** |
| **PESO DEL CONTENEDOR + MUESTRA HUMEDAD** | | A | 296.80 | 286.80 |
| **PESO DEL CONTENEDOR + MUESTRA SECA** | | B | 250.90 | 244.30 |
| **PESO DEL CONTENEDOR** | | C | 62.30 | 62.90 |
| **% DE HUMEDAD EN MUESTRA** | **(A-B)÷(B-C) x100** | %H | 24.34 | 23.43 |
| | **PROMEDIO** | 23.88 | | |

Manuel Castillo
**Realizado por:**

Emil E. Güílamo Pichardo
**Revisado por:**

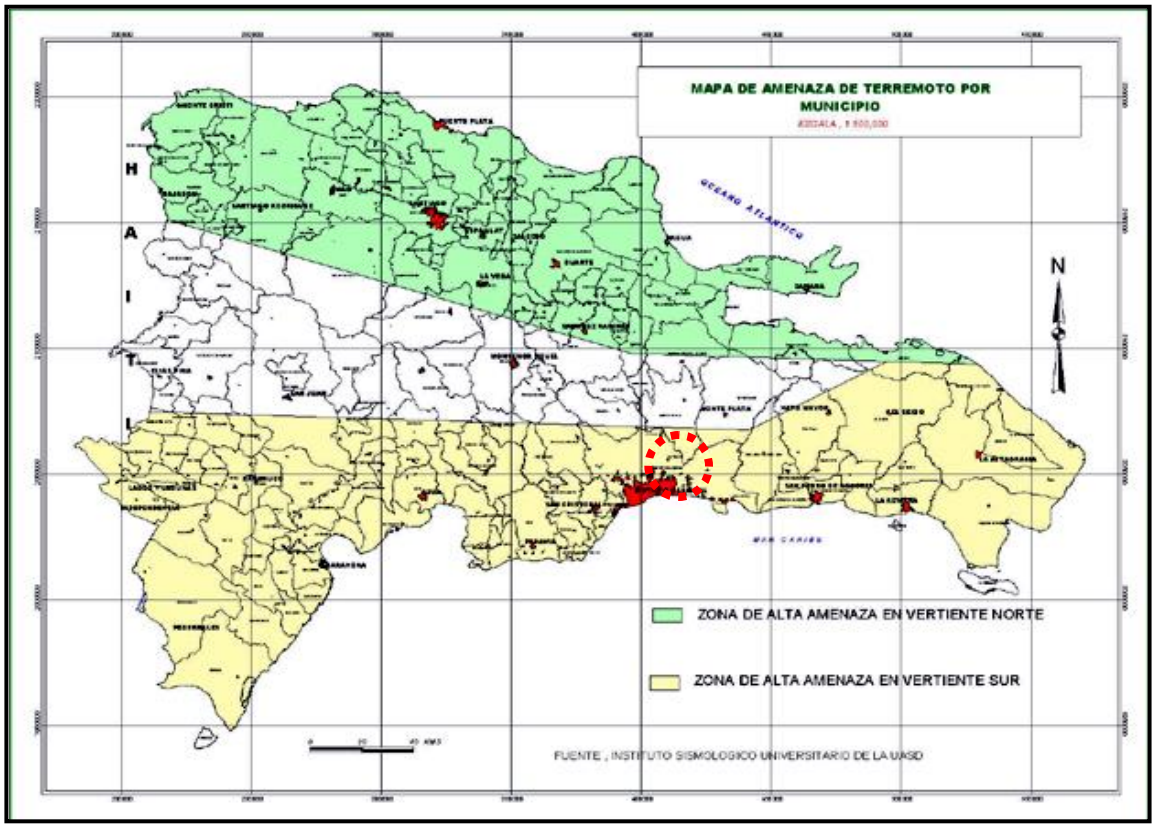
# ANEXO F

## 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

INGESA
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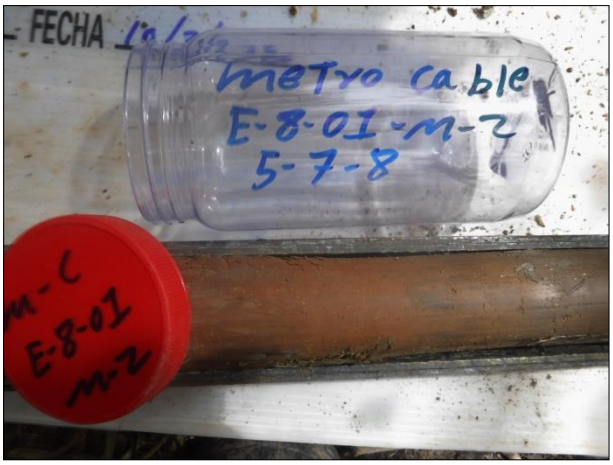
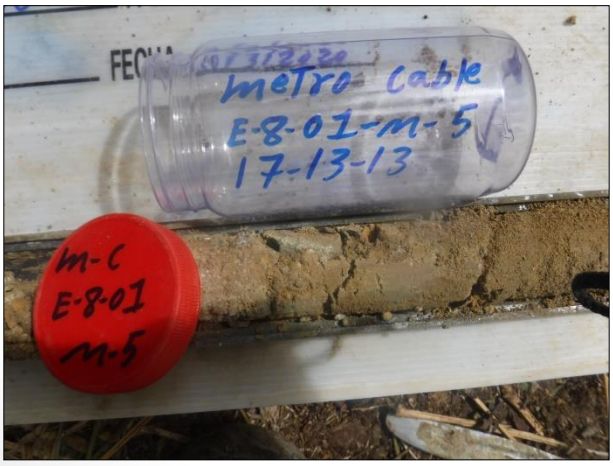
# Reporte Fotográfico

## Sondeo E**8-01,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

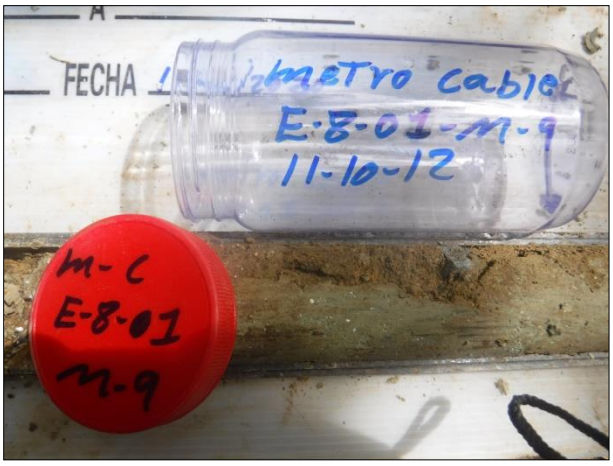
# FOTOS DEL SONDEO

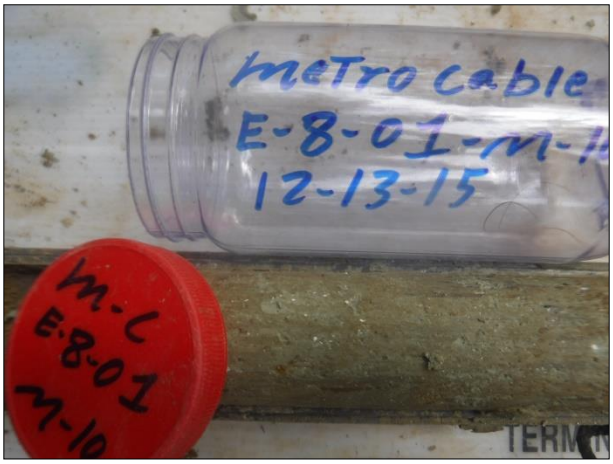
# FOTOS DE MUESTRAS

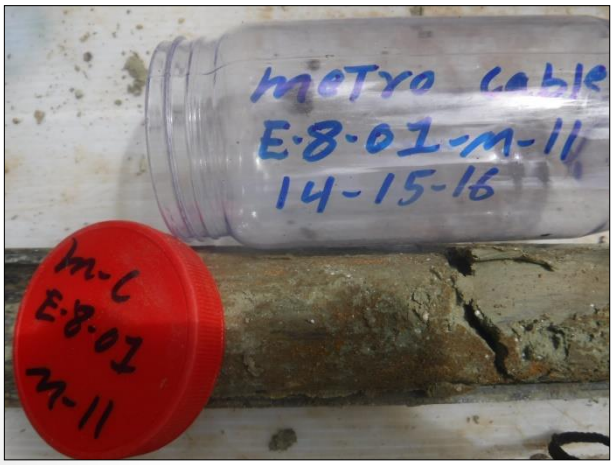


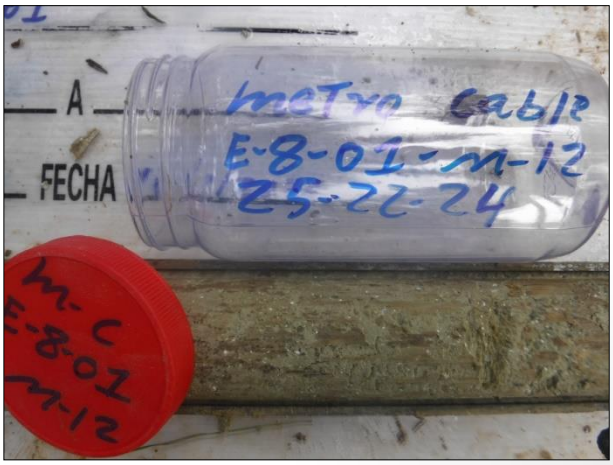


# FOTOS DE MUESTRAS

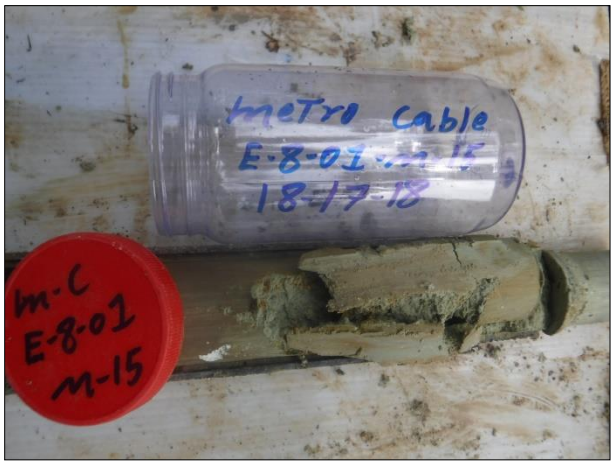


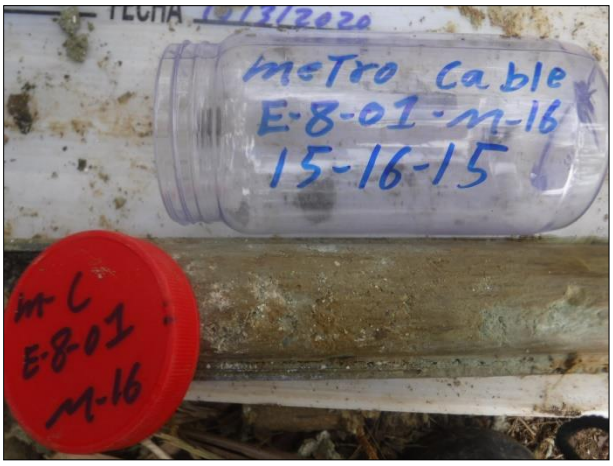



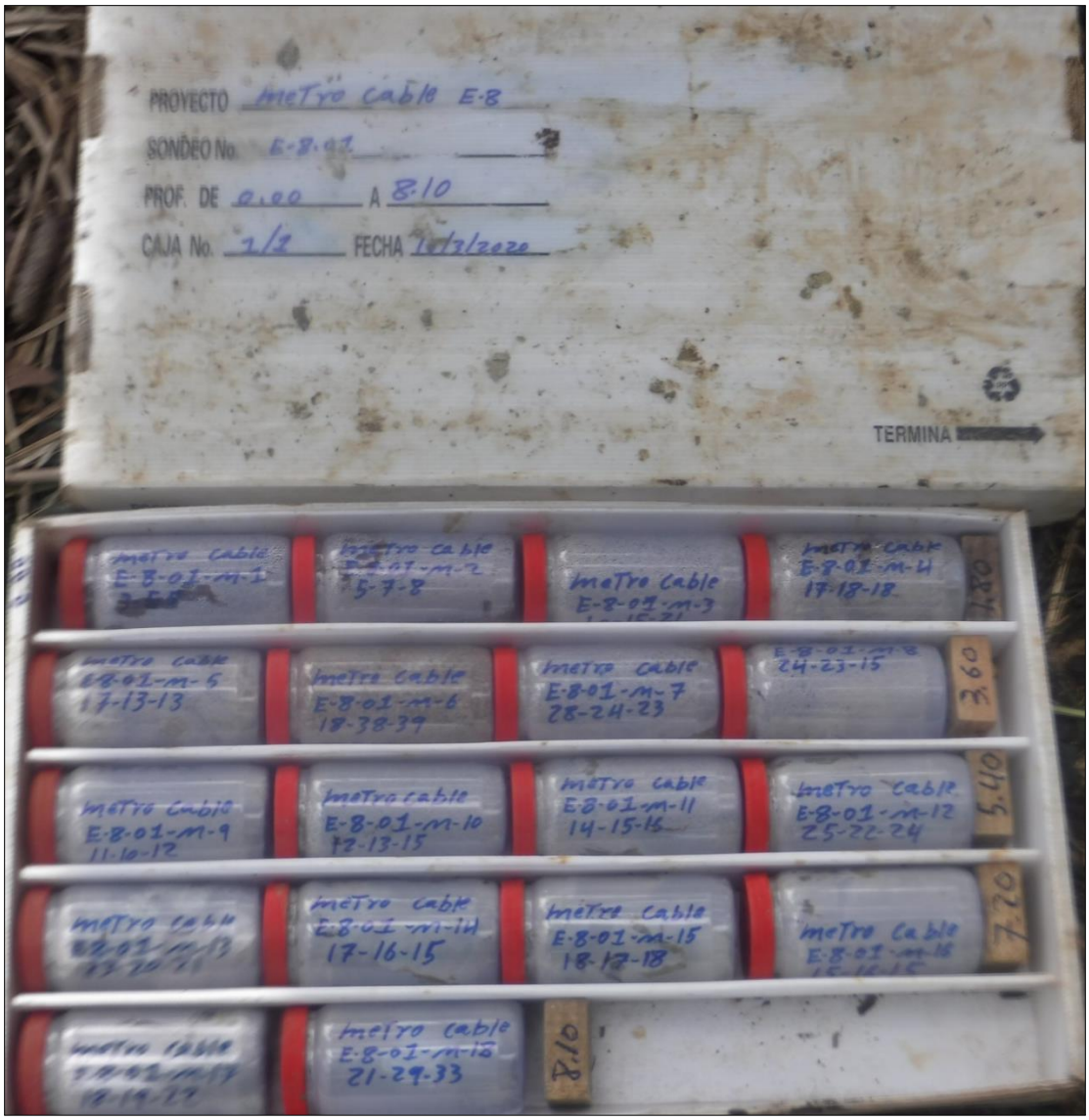



# FOTOS DE MUESTRAS



# FOTOS DE MUESTRAS



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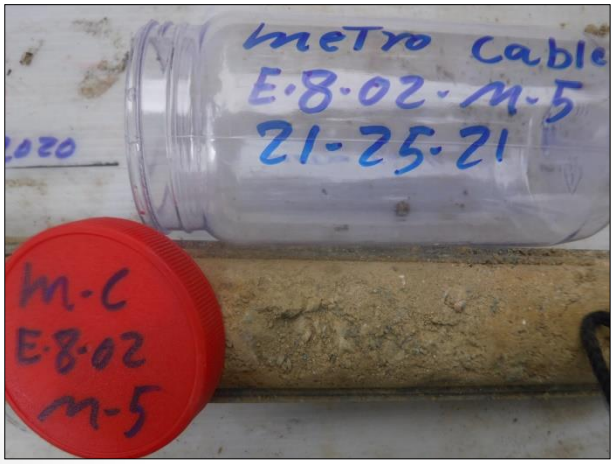
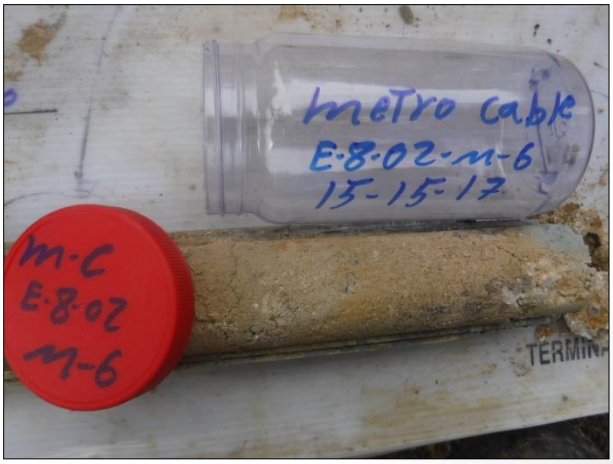
# Reporte Fotográfico

## Sondeo E**8-02,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

# FOTOS DE MUESTRAS



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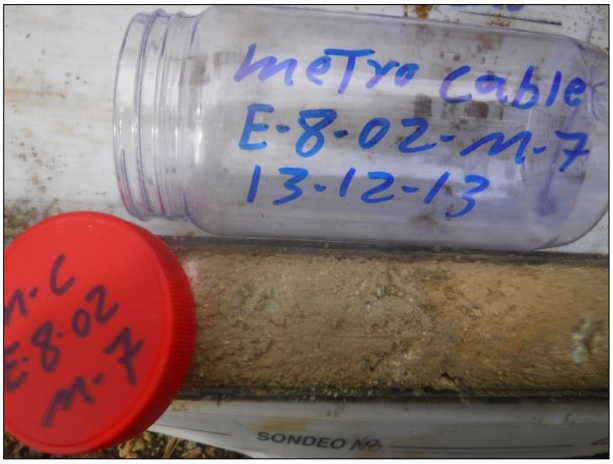

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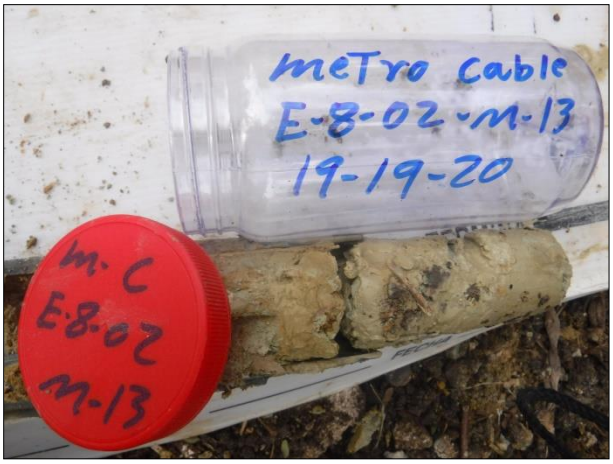

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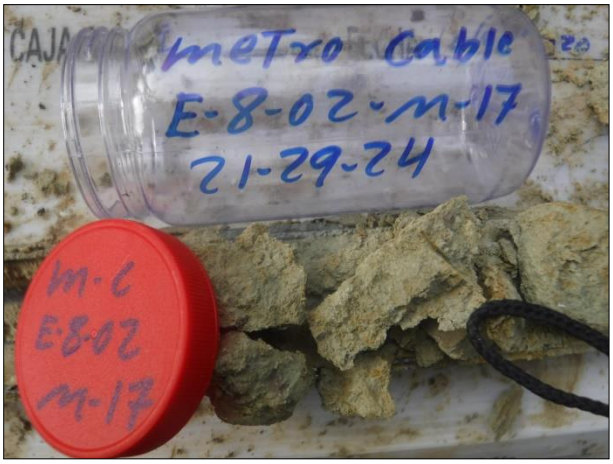
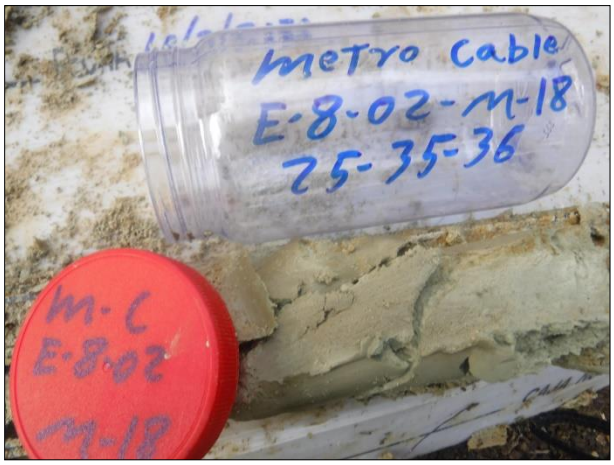
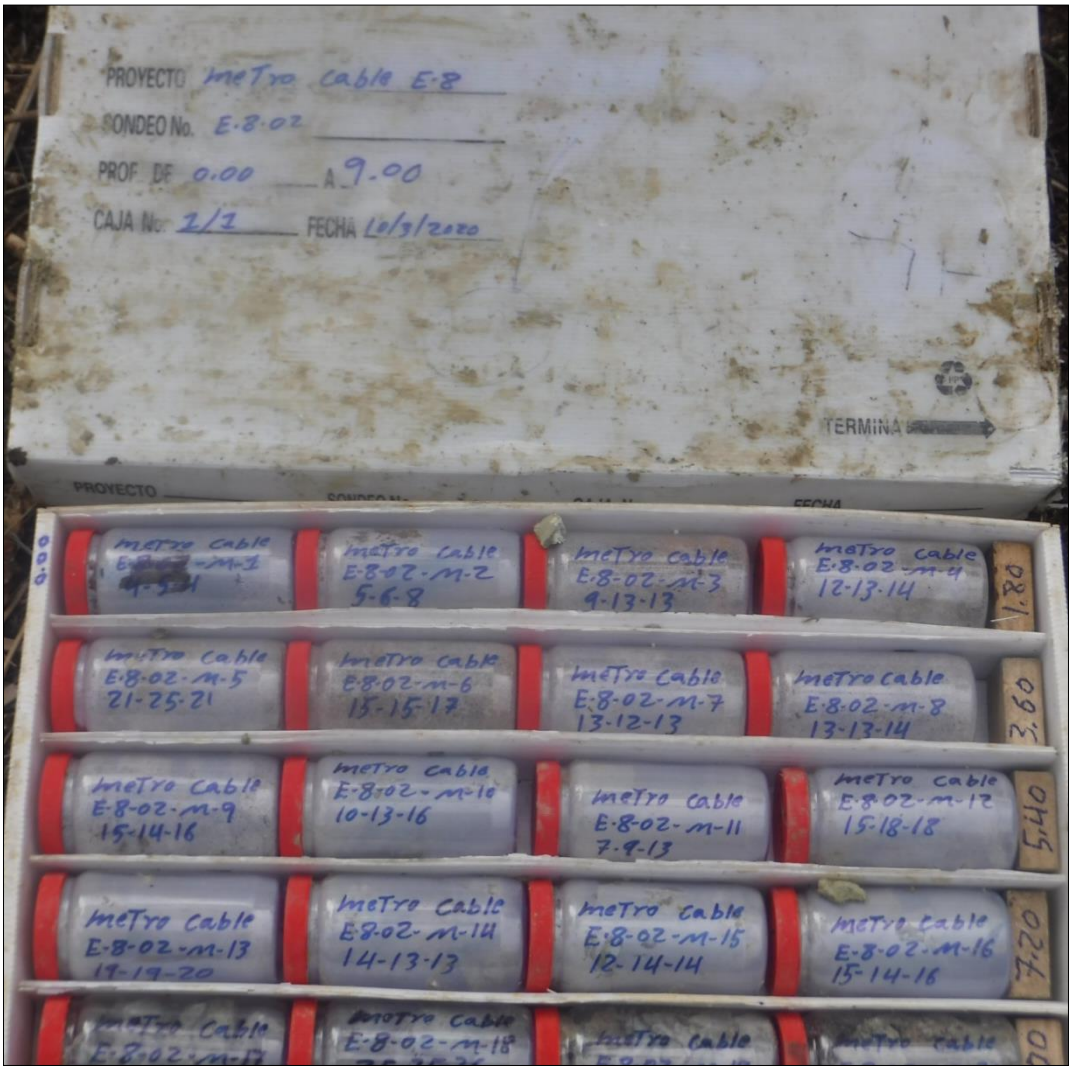


# FOTOS DE MUESTRAS



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# Reporte Fotográfico

## Sondeo E**8-03,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

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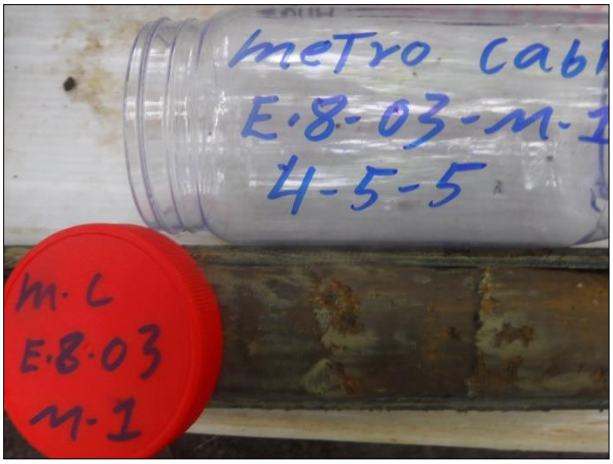
# FOTOS DE MUESTRAS



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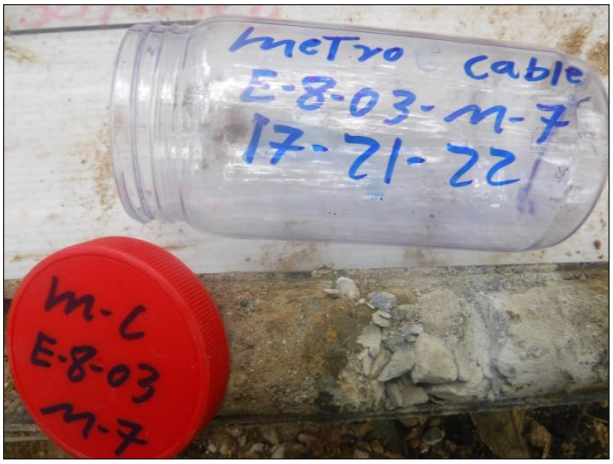
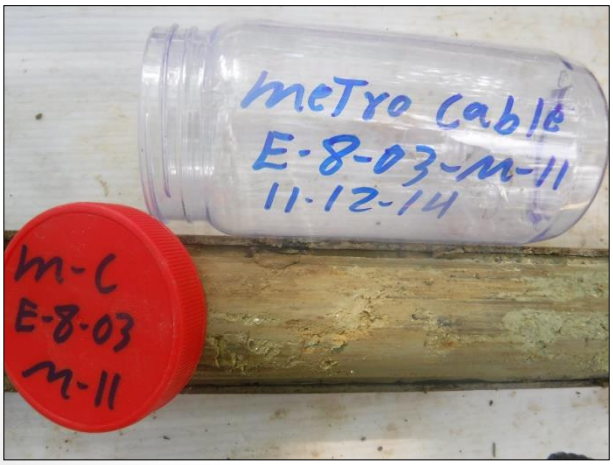
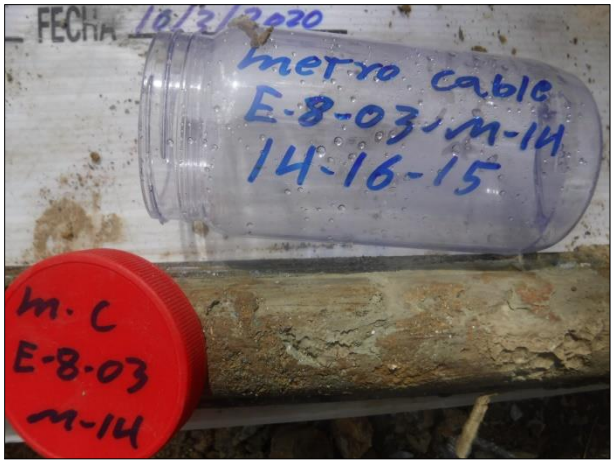
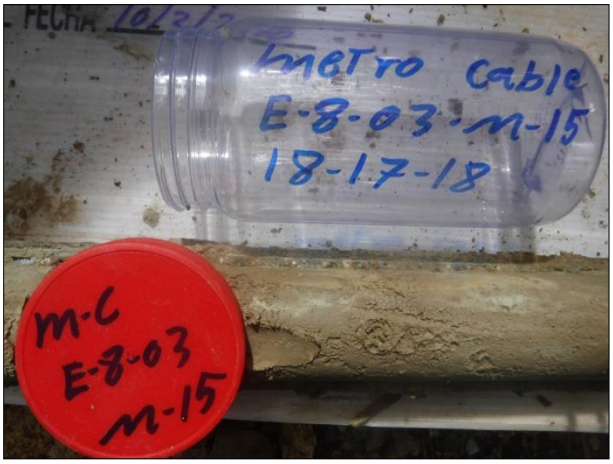


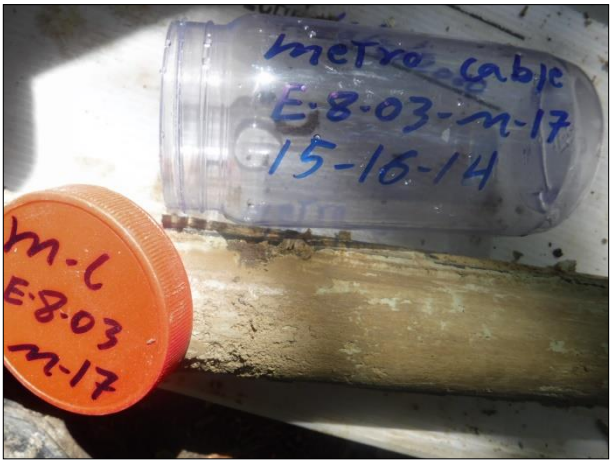


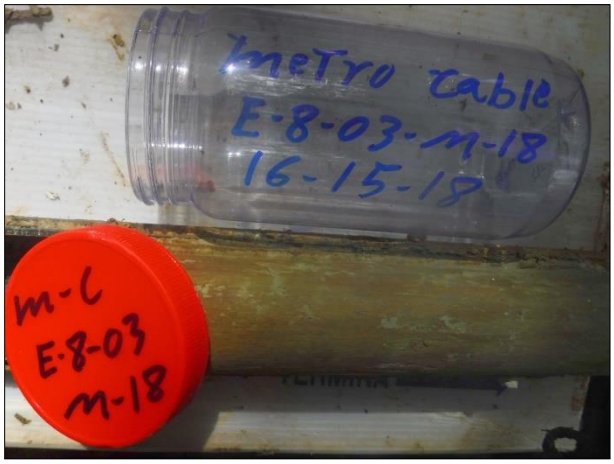
# FOTOS DE MUESTRAS

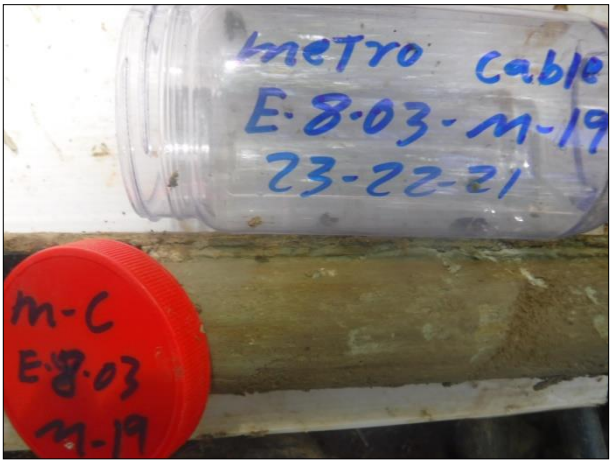


# FOTOS DE MUESTRAS



# FOTOS DE MUESTRAS

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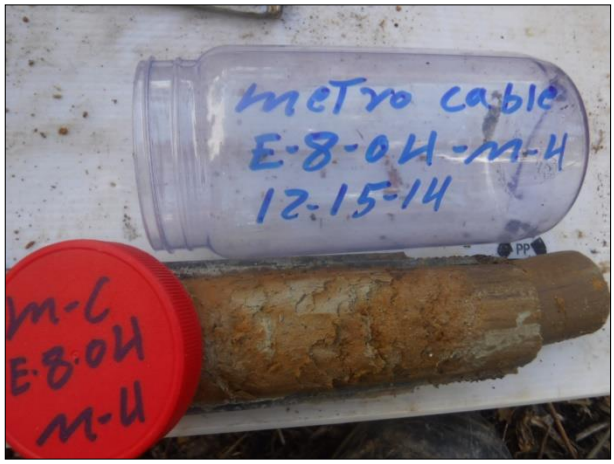
# Reporte Fotográfico

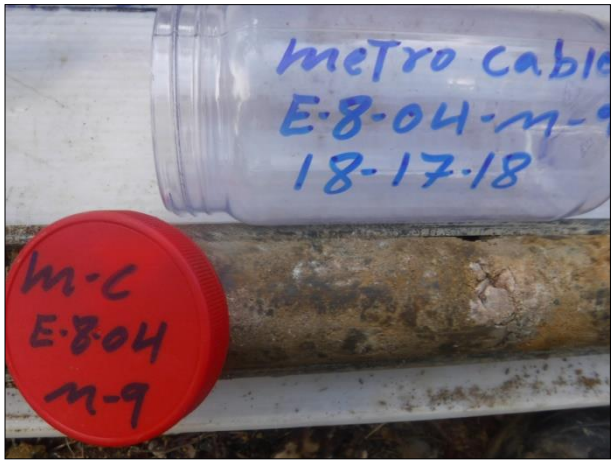
## Sondeo E**8-04,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

# FOTOS DE MUESTRAS



# FOTOS DE MUESTRAS



# FOTOS DE MUESTRAS

# FOTOS DE MUESTRAS

# FOTOS DE MUESTRAS

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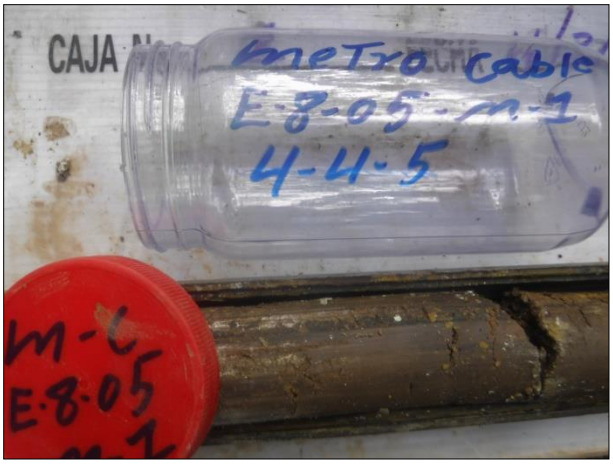
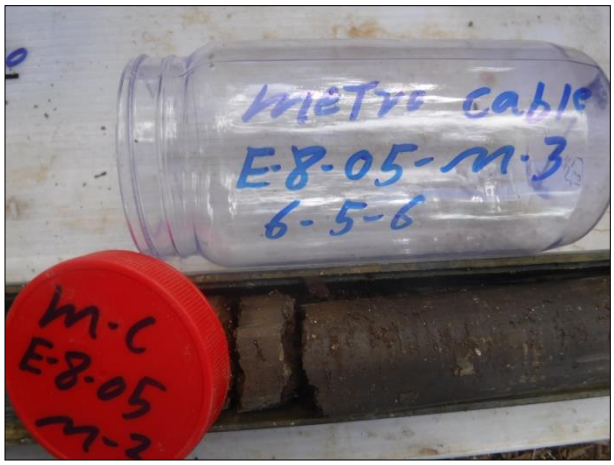
# Reporte Fotográfico

## Sondeo E**8-05,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

# FOTOS DE MUESTRAS





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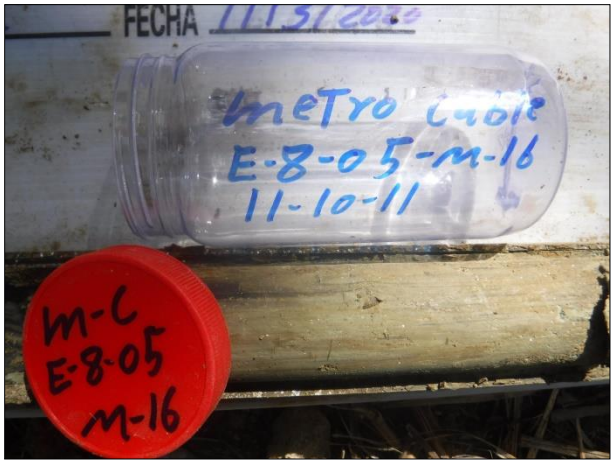


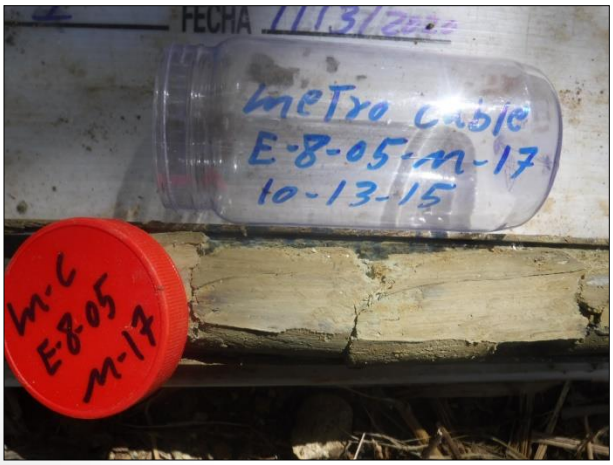


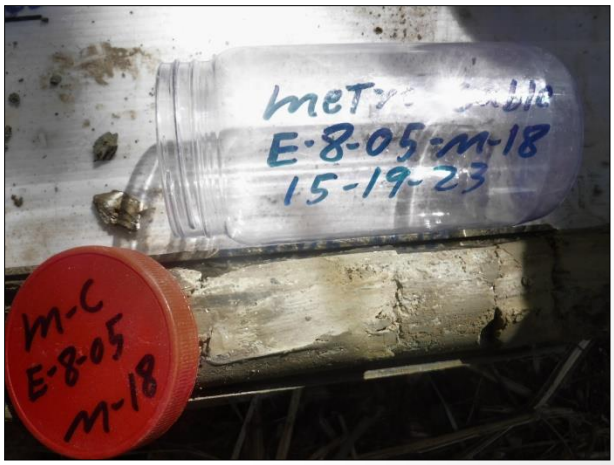

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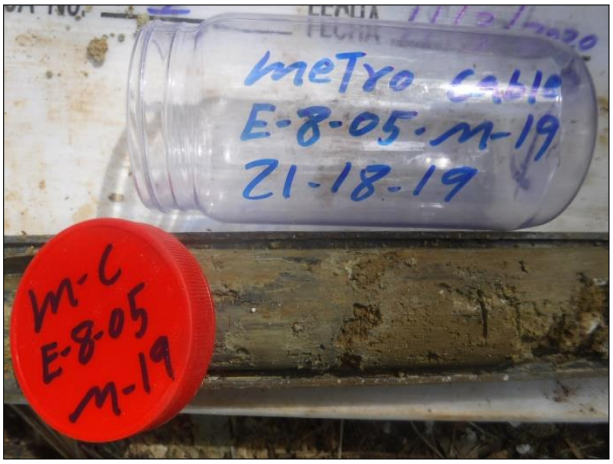

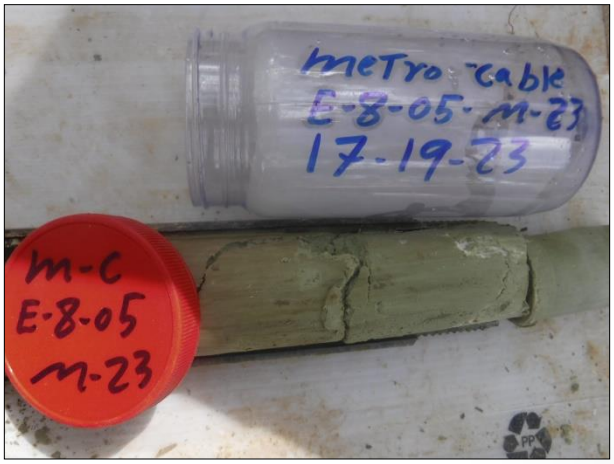

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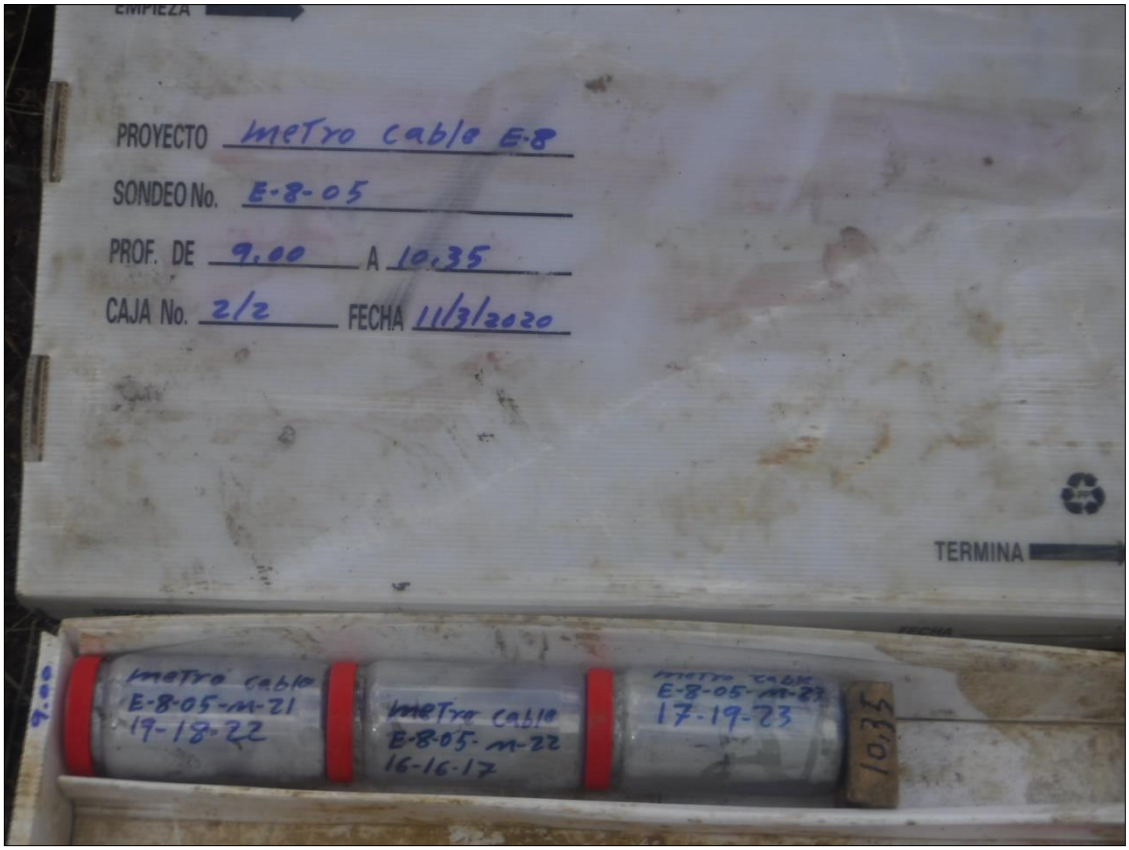

# Reporte Fotográfico

## Sondeo E**8-06,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

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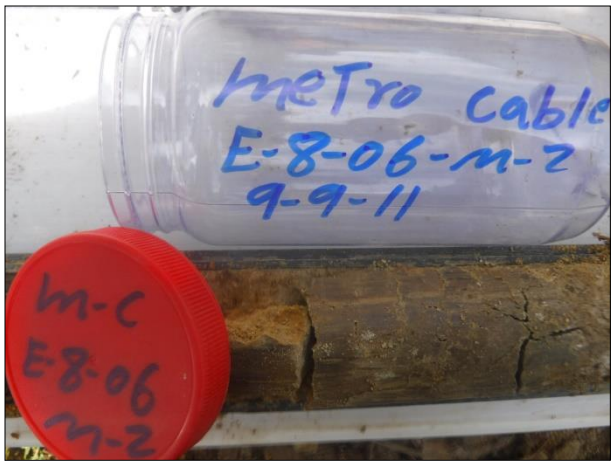

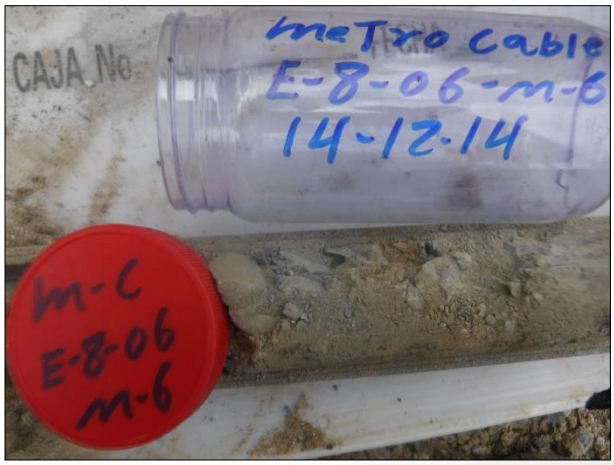

INGESA
INGENIERÍA GLOBAL ESPECIALIZADA

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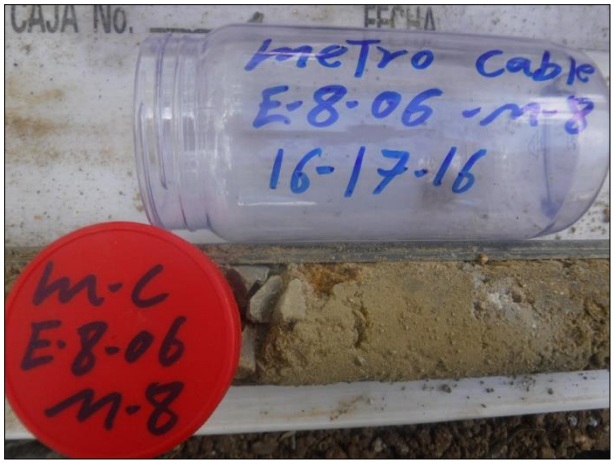


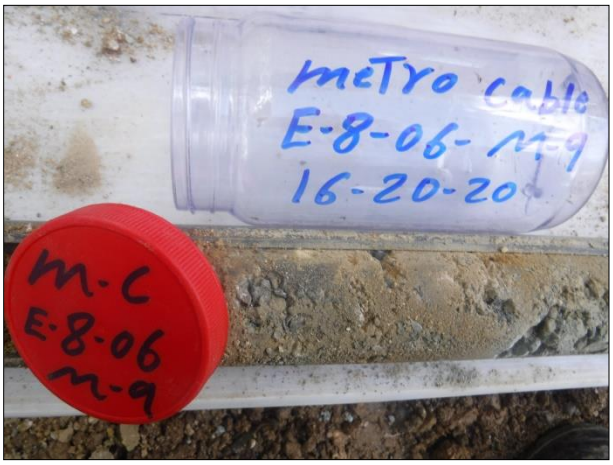


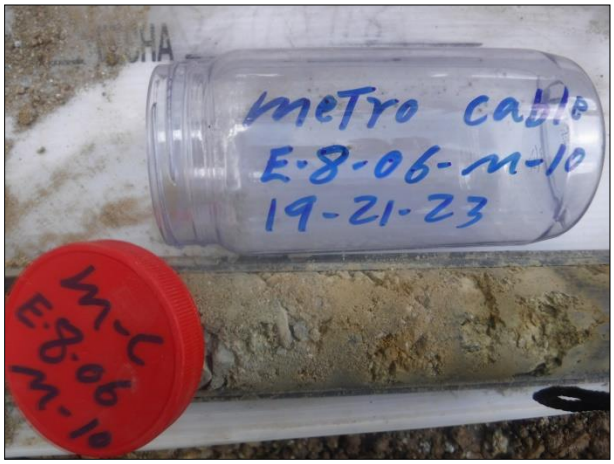

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# Reporte Fotográfico

## Sondeo E**8-07,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

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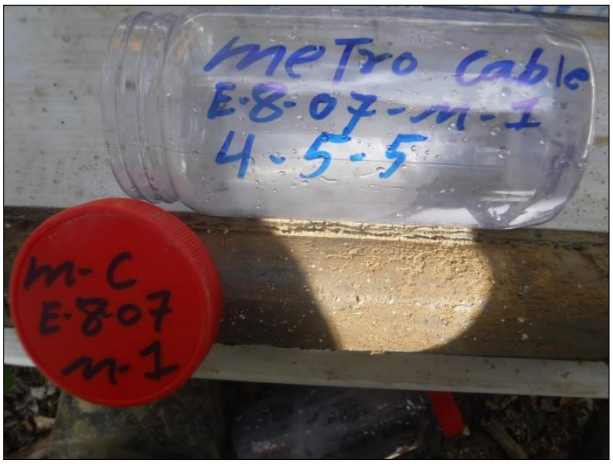

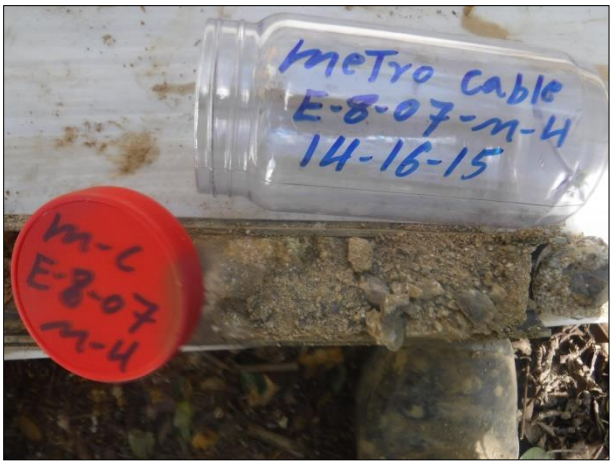

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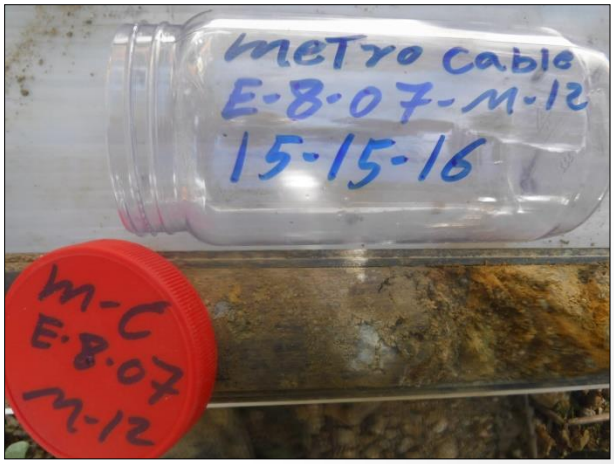

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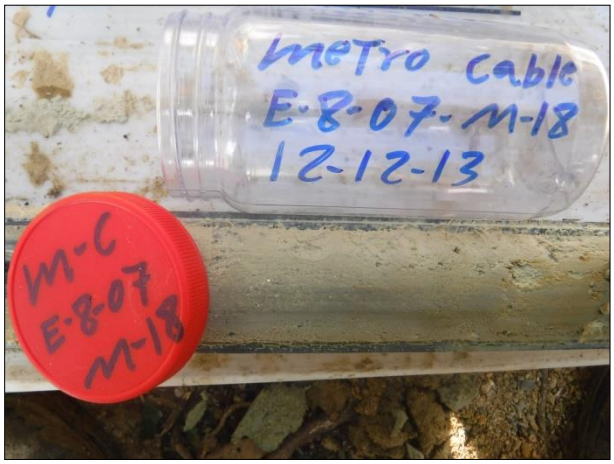


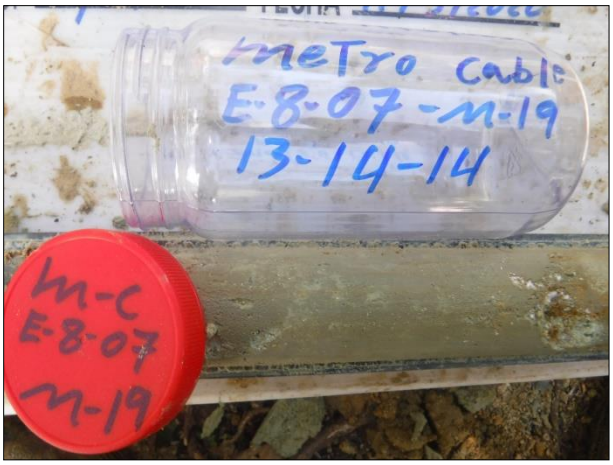

# FOTOS DE MUESTRAS

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# Reporte Fotográfico

## Sondeo E**8-08,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

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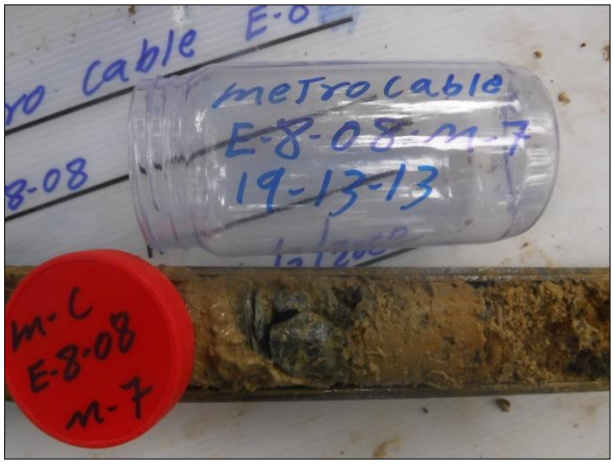

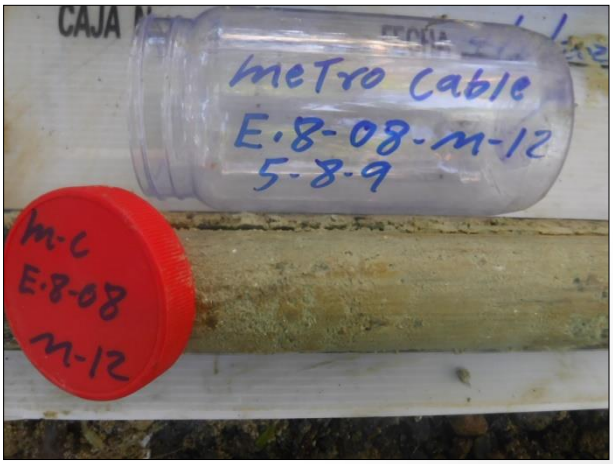

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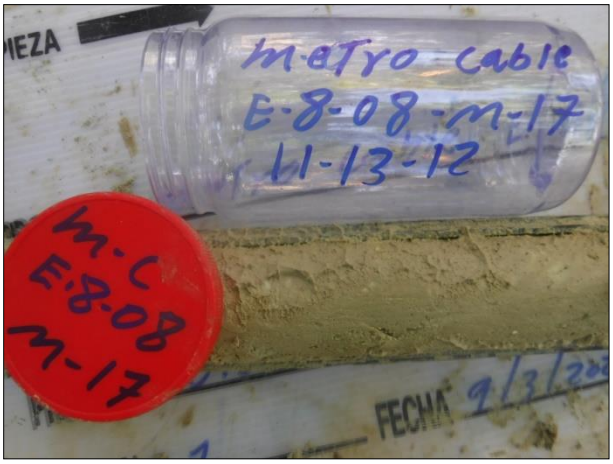


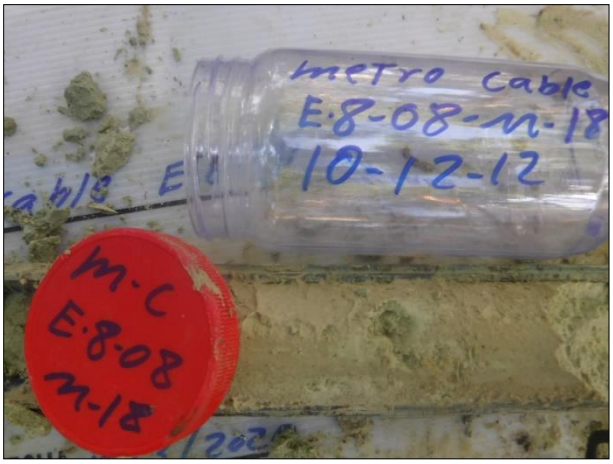

# FOTOS DE MUESTRAS

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# Reporte Fotográfico

## Sondeo **T8-01,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

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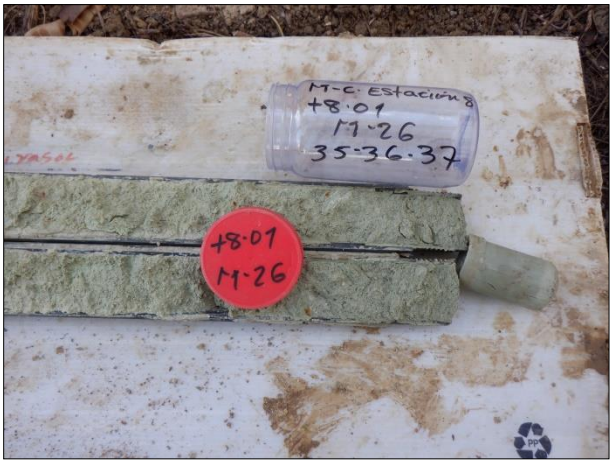

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# Reporte Fotográfico

## Sondeo **T8-02,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DEL SONDEO

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# FOTOS DE MUESTRAS

Sondeo T8-02, Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

# FOTOS DE MUESTRAS

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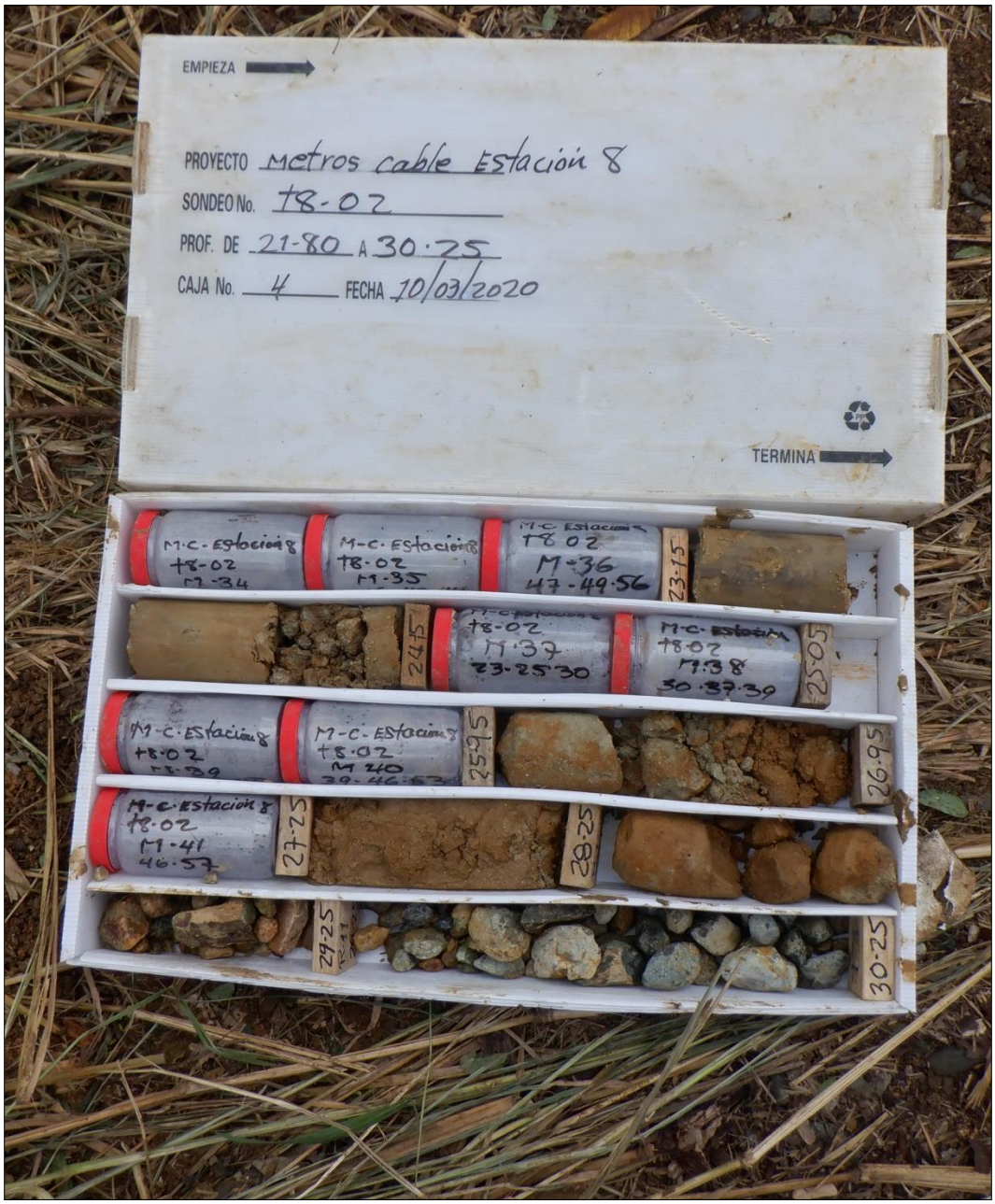

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# Reporte Fotográfico

## Sondeo **T8-03,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

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# Reporte Fotográfico

## Sondeo **T8-04,** Metro Cable, Estación 8, Los Alcarrizos, Santo Domingo Oeste, R.D.

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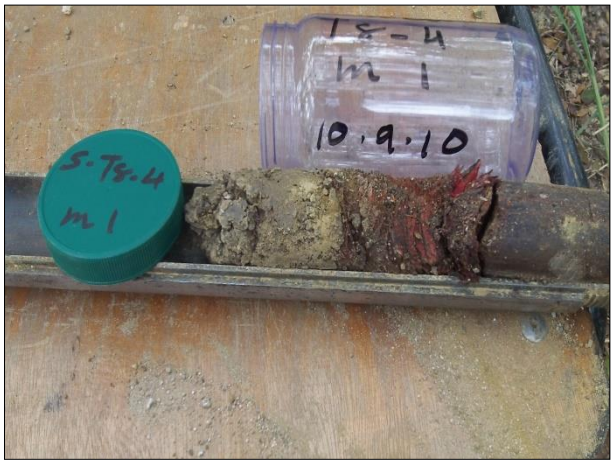

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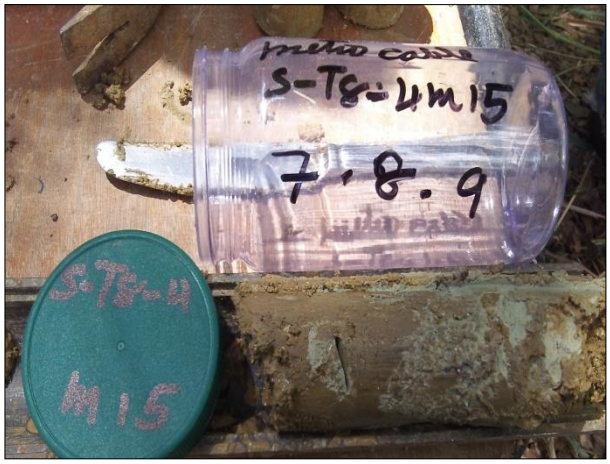

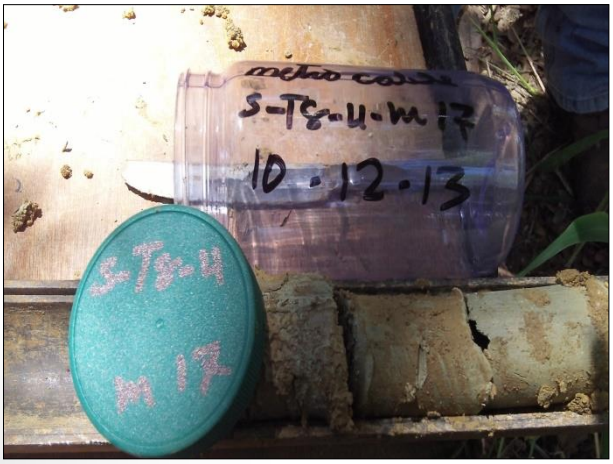

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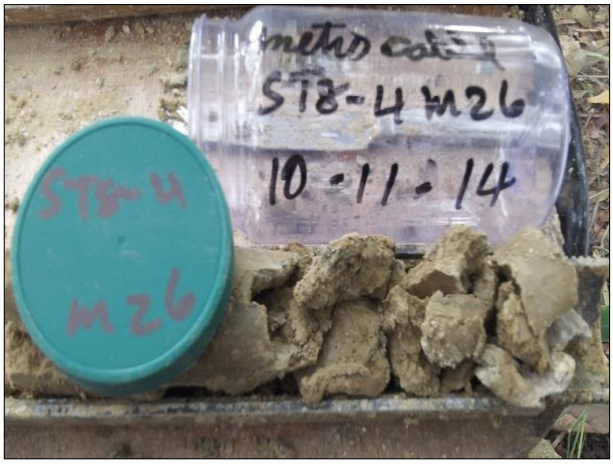

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# ANEXO H

## 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 |