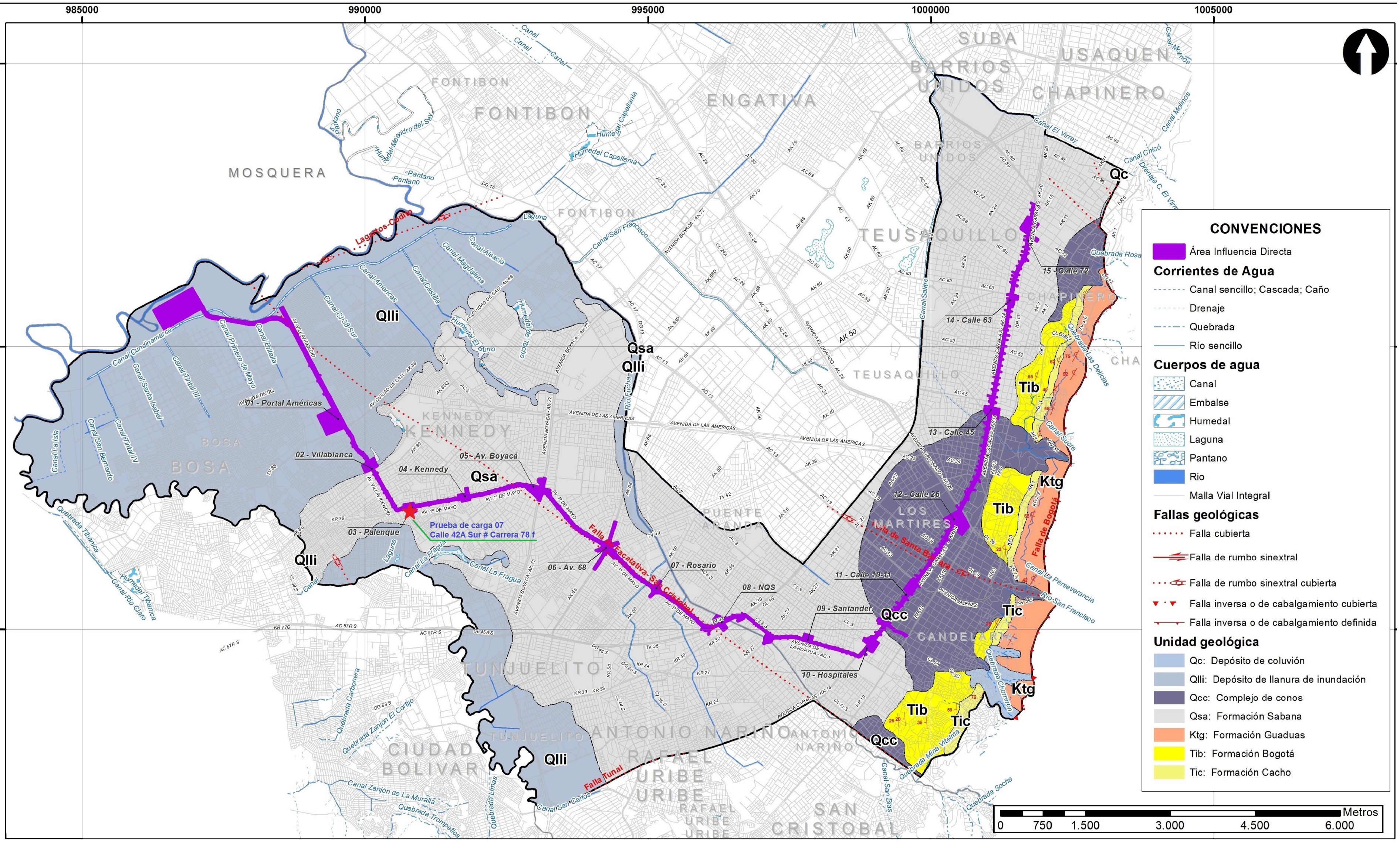
ANEXO 1


CONVENCIONES
Área Influencia Directa
Corrientes de Agua
Canal sencillo; Cascada; Caño
Drenaje
Quebrada
Río sencillo
Cuerpos de agua
Canal
Embalse
Humedal
Laguna
Pantano
Rio
Malla Vial Integral
Fallas geológicas
Falla cubierta
Falla de rumbo sinextral
Falla de rumbo sinextral cubierta
Falla inversa o de cabalgamiento cubierta
Falla inversa o de cabalgamiento definida
Unidad geológica
Qc: Depósito de coluvión
Qlli: Depósito de llanura de inundación
Qcc: Complejo de conos
Qsa: Formación Sabana
Ktg: Formación Guaduas
Tib: Formación Bogotá
Tic: Formación Cacho
0 750 1.500 3.000 4.500 6.000 Metros
985000
990000
995000
1000000
1005000
1010000
01 - Portal Américas
02 - Villablanca
03 - Palenque
04 - Kennedy
05 - Av. Boyacá
06 - Av. 68
07 - Rosario
08 - NQS
09 - Santander
10 - Hospitales
11 - Calle 10-11
12 - Calle 26
13 - Calle 45
14 - Calle 63
15 - Calle 72
Prueba de carga 07
Calle 42A Sur # Carrera 78 f
Falla Facatativá - San Cristóbal
Falla de Bogotá
Falla Tunal
Lagartos-Codito
MOSQUERA
FONTIBON
ENGATIVA
SUBA
USAQUEN
CHAPINERO
BARRIOS UNIDOS
TEUSAQUILLO
KENNEDY
BOSA
LOS MARTIRES
PUENTE ARANDA
CANDELARIA
TUNJUELITO
ANTONIO NARIÑO
RAFAEL URIBE URIBE
CIUDAD BOLIVAR
SAN CRISTOBAL

Este informe fue revisado, validado y aprobado por la interventoria en su R0.

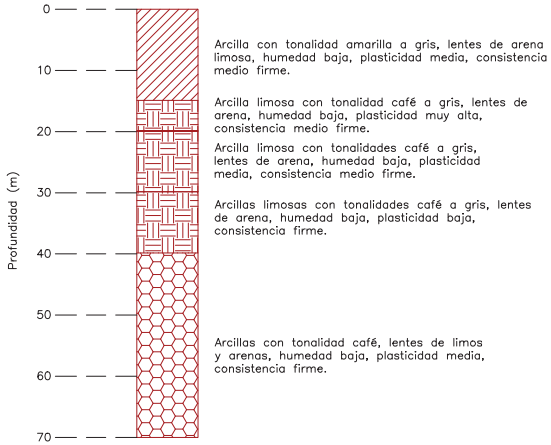
LORENZO NOGALES AVILA
Director interventoria

TRAMO 1.4—PLANTA
(AV. VILLAVICENCIO—TRANSVERSAL 78H — AV. PRIMERA DE MAYO—CALLE 4 SUR)

ESCALA

CONVENCIONES

- Perforaciones INGETEC
- Perforaciones existentes
- Piezoconos INGETEC
- Piezoconos existentes
- Trazado



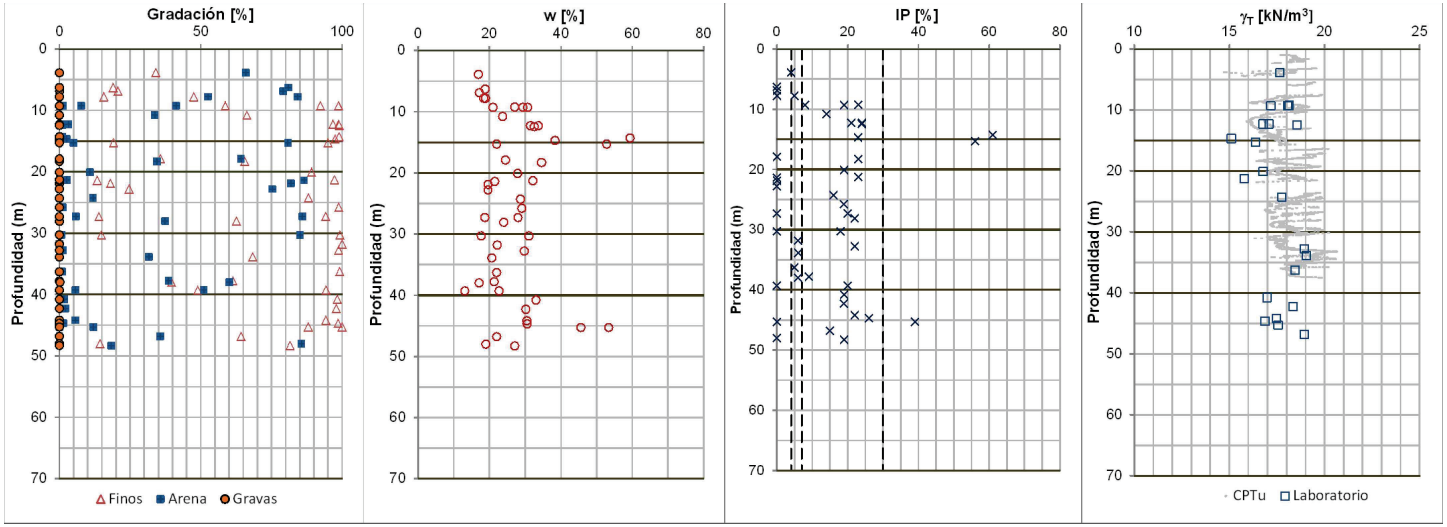
Arcilla con tonalidad amarilla a gris, lentes de arena limosa, humedad baja, plasticidad media, consistencia medio firme.

Arcilla limosa con tonalidad café a gris, lentes de arena, humedad baja, plasticidad muy alta, consistencia medio firme.

Arcilla limosa con tonalidades café a gris, lentes de arena, humedad baja, plasticidad media, consistencia medio firme.

Arcillas limosas con tonalidades café a gris, lentes de arena, humedad baja, plasticidad baja, consistencia firme.

Arcillas con tonalidad café, lentes de limos y arenas, humedad baja, plasticidad media, consistencia firme.



PARÁMETROS DE CARACTERIZACIÓN

0 7,5 15 22,5 30 37,5 m

ESCALA 1:750

FDN Financiera de Desarrollo Nacional

ESTRUCTURACIÓN TÉCNICA DE LA PRIMERA LINEA DEL METRO DE BOGOTÁ

CONSORCIO METRO BOG
SYSTRA INGETEC INGENIEROS CONSULTORES

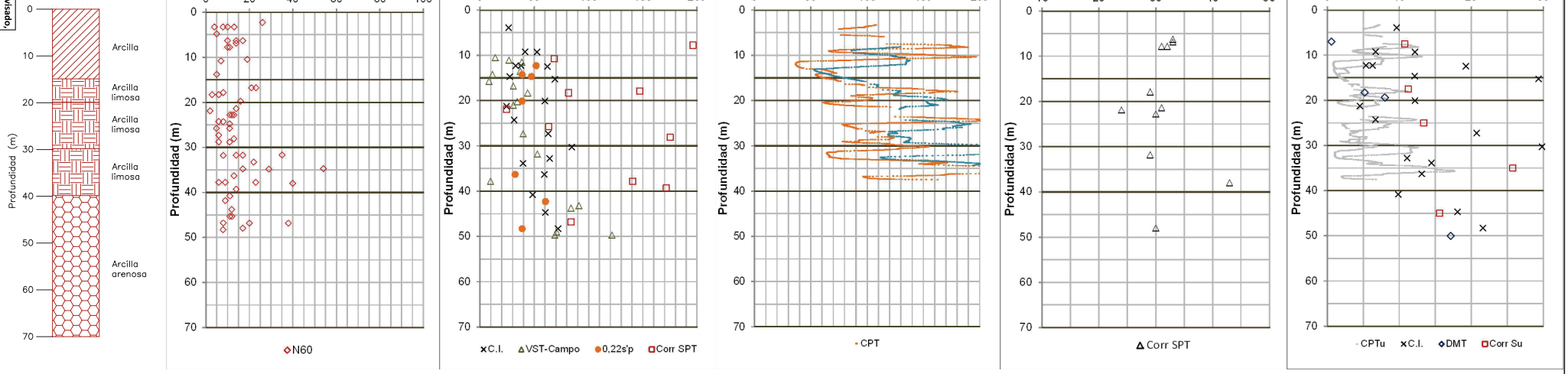
FIG No.6 DE 23
HOJA 1 DE 2

ZONA HOMOGENEA 1.4
AV. VILLAVICENCIO—TRANSVERSAL 78H — AV. PRIMERA DE MAYO—CALLE 4 SUR
AV. CARACAS CALLE 10

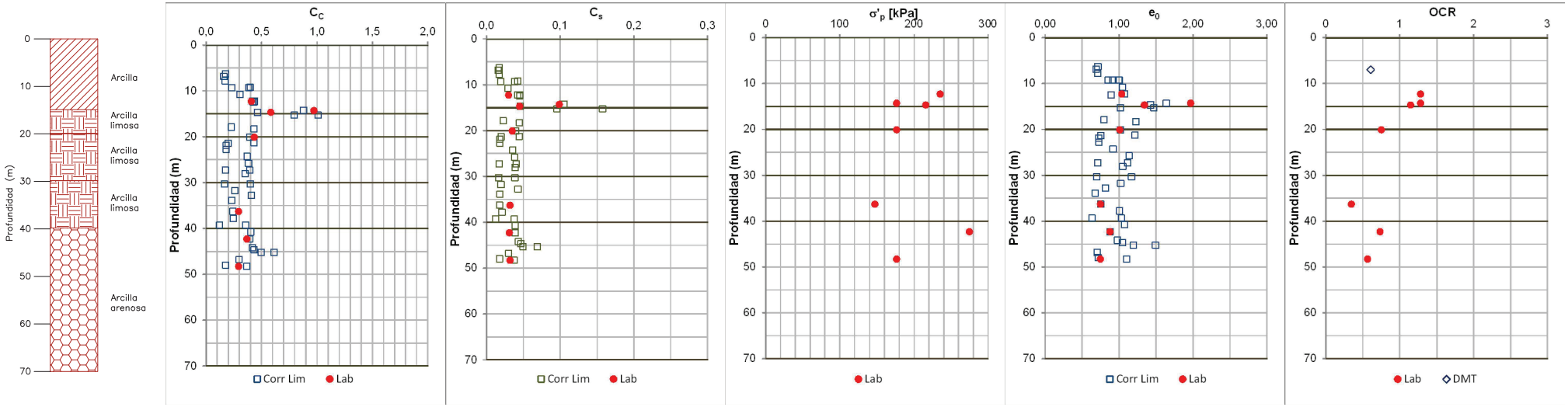
REV. 0
SEPTIEMBRE—2017

Este informe fue revisado, validado y aprobado por la interventoría en su R0.

LORENZO NOGALES AVILA
Director interventoría



PARÁMETROS DE RESISTENCIA Y DEFORMABILIDAD



PARÁMETROS DE DEFORMABILIDAD

FDN Financiera de Desarrollo Nacional

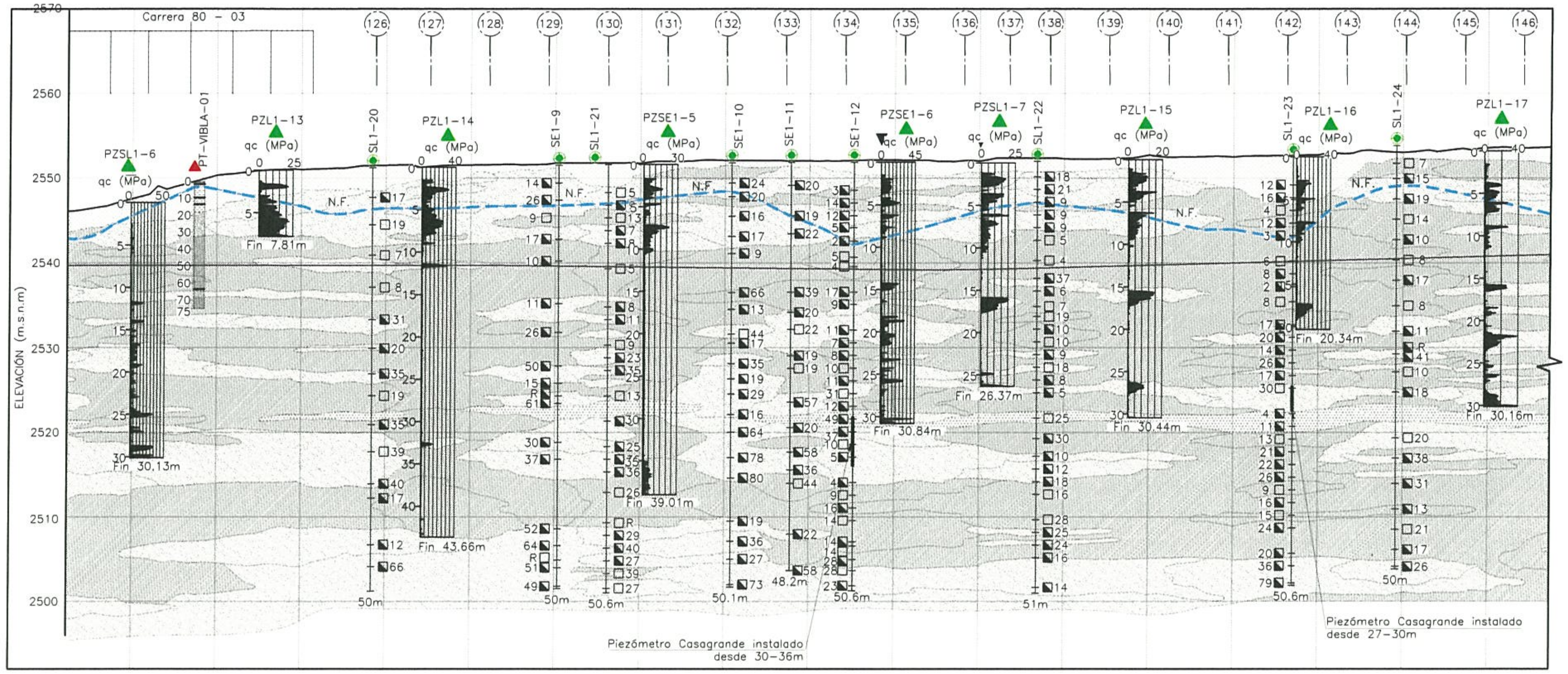
ESTRUCTURACIÓN TÉCNICA DE LA PRIMERA LINEA DEL METRO DE BOGOTÁ

CONSORCIO METRO BOG SYSTRA INGETEC INGENIEROS CONSULTORES

FIG No.6 DE 23
HOJA 2 DE 2

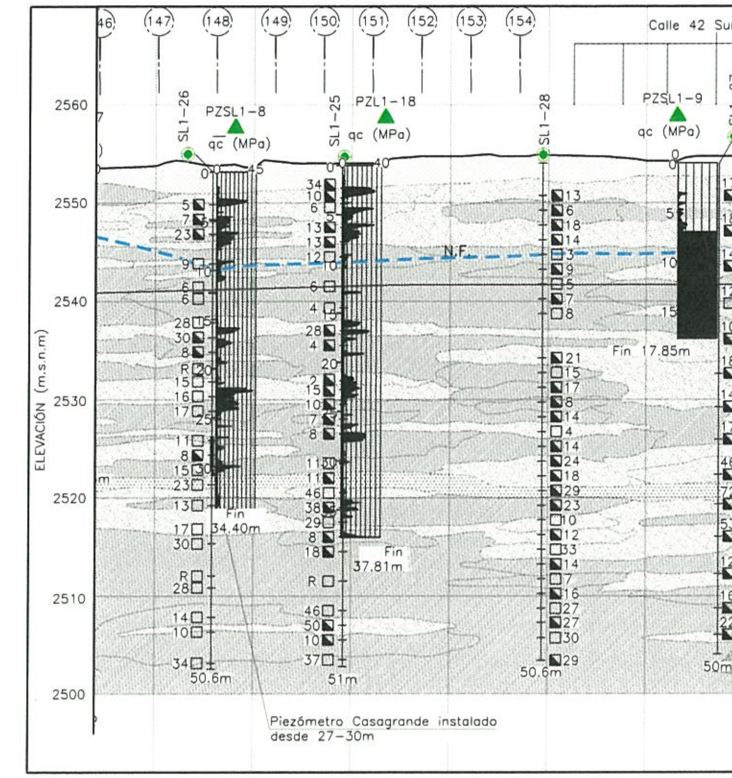
ZONA HOMOGENEA 1.3
AV. VILLAVICENCIO–TRANSVERSAL 78H – AV. PRIMERA DE MAYO–CALLE 4 SUR
GRÁFICAS

REV. 0
SEPTIEMBRE–2017



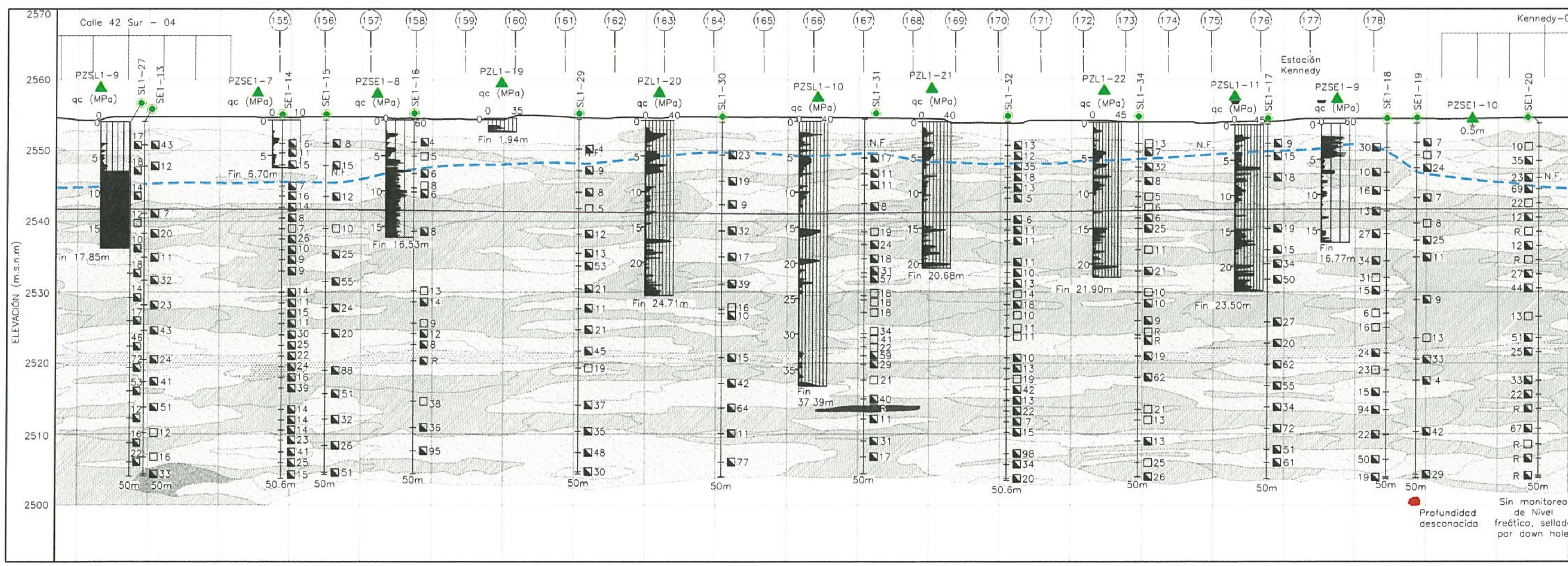
PERFIL TRAMO 1,3 ENTRE AV. VILLAVICENCIO CARRERA 80D – AV. VILLAVICENCIO TRANSVERSAL 78H

ESCALA A



PERFIL TRAMO 1,4 ENTRE AV. VILLAVICENCIO TRANSVERSAL 78H AV. PRIMERA DE MAYO/CALLE 4 SUR

ESCALA A



PERFIL TRAMO 1,5 ENTRE AV. PRIMERA DE MAYO /CALLE 4 SUR – AV. PRIMERA DE MAYO/CARRERA 73

ESCALA A

NOTAS

1. Las dimensiones mostradas están en metros, las elevaciones en msnm, excepto otra indicación.

CONVENCIONES

- Perforación CONSORCIO L1
- Perforación INGETEC S.A
- Piezocono CONSORCIO L1
- Piezocono INGETEC S.A
- SPT con indicación de N30
- Muestra inalterada no recuperada con indicación de N30
- Contacto roca
- Nivel Freático
- Relleno
- Coluvión
- Arcilla
- Gravas
- Limo Arenoso
- Arcillolita
- Arena Fina
- Turba
- Suelo orgánico
- Arena arcillosa
- Presencia de Gas Metano en el sondeo a la profundidad indicada
- N° de pila en el trazado
- Presencia Agua artesiana

0 30 60 90 120 150 m

ESCALA A 1:1500

FDN Financiera de Desarrollo Nacional		ESTRUCTURACIÓN TÉCNICA DE LA PRIMERA LINEA DEL METRO DE BOGOTÁ PERFIL TRAMO 1,3 ENTRE AV. VILLAVICENCIO CARRERA 80D – AV. VILLAVICENCIO TRANSVERSAL 78H PERFIL TRAMO 1,4 ENTRE AV. VILLAVICENCIO TRANSVERSAL 78H PERFIL TRAMO 1,5 ENTRE AV. PRIMERA DE MAYO /CALLE 4 SUR – AV. PRIMERA DE MAYO/CARRERA 73	CONSORCIO METRO BOG SYSTRA INGETEC
ESTRUCTURACIÓN TÉCNICA PLMB	0 — 15-03-2018 — Versión original	ESCALA: INDICADAS — HOJA N°: 1 DE 1	Plano No.: ETPLMB-ET03-L2.1-PLA-G-0002-R0

REV	FECHA	MODIFICACIÓN	DISEÑADOR	APROBACIÓN DEPARTAMENTO	APROBACIÓN DIVISIÓN	APROBACIÓN PROYECTO
0	15-03-2018	Versión original	A. Contreras	F. Angel	C. Fernández	

Este informe fue revisado, validado y aprobado por la interventoría en su R0.

LORENZO NOGALES AVILA
Director interventoría

ANEXO 2

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 1 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO	LITOLOGÍA	DESCRIPCIÓN
1.00	100		MA-1		HQ				0.30m (2549.70) Relleno antrópico, compuesto de zona asfáltica con clastos heterolitologicos de tamaño bloque, seca y no plástica. Relleno antrópico compuesto de clastos de arenisca amarilla oscura de tamaño bloque angulares, secos y no plásticos. Presencia de raíces y hacia la base existe una disminución en el tamaño de los clastos.
2.00	100		SPT-2	4-6-10 (16)	SPT			CL-ML	2.00m (2548.00) Depósito lacustre de arena de grano fino a medio con arcillas color gris azul, compuesta por fragmentos líticos, cuarzo y micas. Los fragmentos se presentan redondos y esfericos. Consistencia suelta a muy suelta, húmeda y no plástica.
3.00	88		MA-3		HQ		HW	CL	
4.00	100		SPT-4	2-2-3 (5)	SPT			CL	
5.00									5.00m (2545.00) Depósito fluvio-lacustre de arena de grano fino a medio, bien seleccionada, de color marrón amarillenta. Compuesta por fragmentos líticos y cuarzo principalmente, en fragmentos redondos y esféricos, húmeda a saturada, suelta. Localmente se evidencian lentes limo-arenosos y lentes con fragmentos más gruesos de arena, con composición similar.
6.00	100		MA-5		HQ			SM	

⊙ VALOR RP Kg/cm2 ⊙ (1 2 3 4)
SPT N VALOR (LP W LL) (20 40 60 80)
FINOS (%) (20 40 60 80)

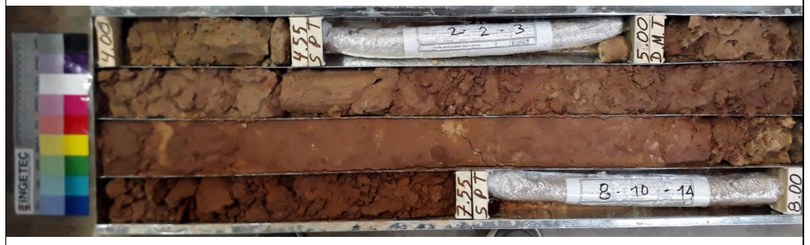
PROFUNDIDAD (m)	ENSAYOS
1.00	W = 14.8% LL = 20% LP = 16% Gravas: = 0% Arenas: = 40% Finos: = 60%
2.00	LL = 34% LP = 16% Gravas: = 0% Arenas: = 2% Finos: = 98%
3.00	
4.00	LL = 27% LP = 14% Gravas: = 0% Arenas: = 30% Finos: = 70% γm = 19.66kN/m³
5.00	
6.00	NL-NP Gravas: = 0% Arenas: = 78%

RETORNO AGUA

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 1

CAJA NÚMERO: 2



OBSERVACIONES

27/10/2018

Nota: Ensayo de SPT automático.

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
γm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
S,: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BDPROYECTOSINVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 2 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
7.00										Depósito fluvio-lacustre de arena de grano fino a medio, bien seleccionada, de color marrón amarillenta. Compuesta por fragmentos líticos y cuarzo principalmente, en fragmentos redondos y esféricos, húmeda a saturada, suelta. Localmente se evidencian lentes limo-arenosos y lentes con fragmentos más gruesos de arena, con composición similar.*(Continuatión)*
	100		SPT-6	8-10-14 (24)	SPT			ML		
8.00										
	100		MA-7		HQ					
9.00										9.00m 2541.00
										Depósito lacustre limo-arcilloso bien seleccionado de color gris pardusco compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo, consistencia compacta y plasticidad media. Presencia de raíces localmente.
										9.40m 2540.60
10.00	100		MI-8		TS			CL		Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color marrón amarillento, húmedo, compacto y plasticidad baja.
										10.20m 2539.80
	100		SPT-9	4-7-9 (16)	SPT			ML		Depósito lacustre limo-arcilloso bien seleccionado de color rojo purpura palido compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo, consistencia compacta y plasticidad media a alta.
11.00										
	100		MA-10		HQ					
12.00										
								CL		

PROFUNDIDAD (m) — ⊙ VALOR RP Kg/cm2 ⊙ (1 2 3 4) — ▲ SPT N VALOR ▲ (LP W LL) (20 40 60 80) — FINOS (%) (20 40 60 80)

ENSAYOS

- Finos: = 22%
- W = 17.2%, LL = 18%, LP = 16%, Gravas: = 0%, Arenas: = 42%, Finos: = 58%
- Suvl = 0.30kg/cm², RP = 1.00kg/cm², LL = 42%, LP = 19%, Gravas: = 0%, Arenas: = 1%, Finos: = 99%, qu = 79.08Kpa
- LL = 21%, LP = 17%, Gravas: = 0%, Arenas: = 41%, Finos: = 59%, γm = 20.28kN/m³

RETORNO AGUA: 80 % … 80 %

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 3

CAJA NÚMERO: 4

OBSERVACIONES

N.A. (0.00) m (+)
29/10/2018 N.A. (SECO (-))

(*Continua en la Página Siguiente*)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
- Suv:Veleta de Campo
- Suvl:Veleta de Laboratorio
- Resistencia al corte no drenado sin corrección por plasticidad
- RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
- W: Humedad
- LL: Limite Liquido
- LP: Limite Plástico
- qu: Compresión Inconfinada
- MO: Materia Orgánica
- PH: Prueba de acidez del suelo
- C: Equivalente de Arena
- EXP-C:Expansión Controlada
- EXP-L:Expansión Libre en Probeta
- γm: Peso Unitario Total
- Gs: Gravedad Específica
- CBR Nat.: Muestra inalterada Natural
- IL: Alargamiento
- IA: Aplanamiento
- Am: Azul de Metileno
- (E): Solidez

LABORATORIO EN ROCA
- Cs: Compresión Simple
- σc-cp: Carga Puntual
- σc: Compresion Uniaxial en Roca
- S_t: Tracción Indirecta (Método Brasilero)
- σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO; BD\PROYECTOS\INVESTIGACIONES 8/1/19

CONSORCIO METRO BOG
SYSTRA INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 3 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
	100		MI-11		TS			CL		Depósito lacustre limo-arcilloso bien seleccionado de color rojo purpura palido compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo, consistencia compacta y plasticidad media a alta.*(Continuatión)*
	0		MA-12		VLT					
14.00	100		MA-13		HQ					
15.00	100		MA-14		HQ					15.00m 2535.00 15.30m Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color marrón amarillento, húmedo, compacto y plasticidad baja. 2534.70 Depósito lacustre limo-arcilloso bien seleccionado de color gris verdoso compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo, consistencia compacta a densa y plasticidad media a alta. Presenta lente limo-arenoso con fragmentos líticos meteorizados a 15,60 m de profundidad.
16.00	100		MI-15		TS			CH		
17.00	100		SPT-16	11-12-18 (30)	SPT			SM		
	71		MA-17		HQ					18.00m 2532.00 Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color rojo púrpura pálido, húmedo, compacto y con plasticidad baja. Hacia la base zona más oscura, laminada, compacta.
18.00										
19.00	78		MA-18		HQ					19.10m 2530.90

(Continua en la Página Siguiente)

PROFUNDIDAD (m)	VALOR RP Kg/cm2 (1 2 3 4)	SPT N VALOR (LP W LL) (20 40 60 80)	FINOS (%) (20 40 60 80)	ENSAYOS
14.00				Suvl = 0.10kg/cm² RP = 0.25kg/cm² LL = 26% LP = 14% Gravas: = 0% Arenas: = 39% Finos: = 61% Suv = 1.25kg/cm²
15.00				
16.00				Suvl = 0.04kg/cm² RP = 0.40kg/cm² LL = 182% LP = 51% Gravas: = 0% Arenas: = 2% Finos: = 98% qu = 147.65Kpa
17.00				W = 23.3% NL-NP Gravas: = 0% Arenas: = 52% Finos: = 48%
18.00				
19.00				

RETORNO AGUA: 80 % | 80 %

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 5

OBSERVACIONES

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
- Suv:Veleta de Campo
- Suvl:Veleta de Laboratorio
- Resistencia al corte no drenado sin corrección por plasticidad
- RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
- W: Humedad
- LL: Limite Liquido
- LP: Limite Plástico
- qu: Compresión Inconfinada
- MO: Materia Orgánica
- PH: Prueba de acidez del suelo
- C: Equivalente de Arena
- EXP-C:Expansión Controlada
- EXP-L:Expansión Libre en Probeta
- γm: Peso Unitario Total
- Gs: Gravedad Específica
- CBR Nat.: Muestra inalterada Natural
- IL: Alargamiento
- IA: Aplanamiento
- Am: Azul de Metileno
- (E): Solidez

LABORATORIO EN ROCA
- Cs: Compresión Simple
- σc-cp: Carga Puntual
- σc: Compresion Uniaxial en Roca
- S_t: Tracción Indirecta (Método Brasilero)
- σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 4 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO	LITOLOGÍA	DESCRIPCIÓN	PROFUNDIDAD (m)	VALOR RP Kg/cm2 / SPT N VALOR / FINOS (%)	ENSAYOS	RETORNO AGUA	REGISTRO FOTOGRÁFICO	OBSERVACIONES
20.00								CL	Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color marrón amarillento, húmedo, compacto y con plasticidad baja. Menor contenido de fracción limosa en el tope.*(Continuación)*	20.00		LL = 37% LP = 22% Gravas: = 0% Arenas: = 18% Finos: = 82% MO = 5.7%	80 %		
	100		SPT-19	7-7-9 (16)	SPT			CL				LL = 35% LP = 20% Gravas: = 0% Arenas: = 15% Finos: = 85% γm = 19.14kN/m³			N.A. (5.00) m (+) 30/10/2018 N.A. (1.00) m (-)
21.00									21.00m 2529.00 Depósito lacustre limo-arcilloso bien seleccionado de color rojo purpura palido compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo, consistencia compacta y plasticidad media a alta.	21.00					
22.00	100		MA-20		HQ				22.00m 2528.00 Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color marrón amarillento, húmedo, compacto y con plasticidad baja.	22.00					
								CL				LL = 23% LP = 15% Gravas: = 0% Arenas: = 28% Finos: = 72%			
23.00									23.00m 2527.00 Deoósito fluvio-lacustre de arena de grano fino a medio, bien seleccionada, de color marrón amarillenta. Compuesta por fragmentos líticos y cuarzo principalmente, en fragmentos redondos y esféricos, húmeda, suelta. Localmente se evidencian lentes limo-arcillosos marrón oscuro.	23.00					
	100		SPT-21	5-8-14 (22)	SPT			SP-SM				NL-NP Gravas: = 0% Arenas: = 89% Finos: = 11% γm = 19.65kN/m³			
24.00										24.00					
25.00	31		MA-22		HQ					25.00					

CAJA NÚMERO: 6

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO	LABORATORIO EN SUELOS			LABORATORIO EN ROCA
Suv:Veleta de Campo	W: Humedad	C: Equivalente de Arena	IL: Alargamiento	Cs: Compresión Simple
Suvl:Veleta de Laboratorio	LL: Límite Líquido	EXP-C:Expansión Controlada	IA: Aplanamiento	σc-cp: Carga Puntual
Resistencia al corte no drenado sin corrección por plasticidad	LP: Límite Plástico	EXP-L:Expansión Libre en Probeta	Am: Azul de Metileno	σc: Compresion Uniaxial en Roca
RP: Penetrómetro de Bolsillo	qu: Compresión Inconfinada	γm: Peso Unitario Total	(E): Solidez	S_t: Tracción Indirecta (Método Brasilero)
	MO: Materia Orgánica	Gs: Gravedad Específica		σm: Compresión de nucleo de Concreto
	PH: Prueba de acidez del suelo	CBR Nat.: Muestra inalterada Natural		

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BD\PROYECTOS\INVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 5 de 12**
TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD % (20 40 60 80)	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
27.00	100		SPT-23	12-14-21 (35)	SPT			SM		Deoósito fluvio-lacustre de arena de grano fino a medio, bien seleccionada, de color marrón amarillenta. Compuesta por fragmentos líticos y cuarzo principalmente, en fragmentos redondos y esféricos, húmeda, suelta. Localmente se evidencian lentes limo-arcillosos marrón oscuro.*(Continuación)*
28.00	24		MA-24		HQ					
29.00	100		SPT-25	30-40-32 (72)	SPT			CL		
30.00	90		MA-26		HQ			SM		
31.00	100		MA-27		HQ					
32.00										

31.20m 2518.80

Depósito lacustre limo-arenoso compuesto por arcillas y cuarzo. Presenta color marrón amarillento, húmedo, compacto y plasticidad baja.

32.50m 2517.50

(Continua en la Página Siguiente)

PROFUNDIDAD (m)	VALOR RP Kg/cm2 (1 2 3 4) / SPT N VALOR (LP W LL) (20 40 60 80) / FINOS (%) (20 40 60 80)
27.00	
28.00	
29.00	
30.00	
31.00	
32.00	

ENSAYOS

- 27.00: W = 18.7%; NL-NP; Gravas: = 0%; Arenas: = 78%; Finos: = 22%
- 30.00: LL = 31%; LP = 17%; Gravas: = 0%; Arenas: = 21%; Finos: = 79%; γm = 19.80kN/m³
- 31.00: NL-NP; Gravas: = 0%; Arenas: = 70%; Finos: = 30%

RETORNO AGUA

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 7

OBSERVACIONES

N.A. (0.00) m (+)
31/10/2018 N.A. (15.00) m (-)

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BD\PROYECTOS\INVESTIGACIONES 8/1/19

LEYENDA: RELLENO; TURBA; SM; SP; CH; MLS
MUESTRA: Muestra Alterada; Standard Penetration Test; Muestra inalterada

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
γm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
S_t: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 6 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
33.00	100		MA-28		HQ			SM		Capa de turba liviana que se relaciona con zona rica en materia orgánica. Seca a humeda, compacta y no plástica. Localmente presenta contenido de raíces.
										33.55m 2516.45
34.00	100		SPT-29	5-24-24 (48)	SPT			CL		Depósito lacustre limo-arcilloso bien seleccionado de color gris azulada compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo a seco, consistencia compacta a densa y plasticidad media a alta.
35.00	100		MA-30		HQ					
36.00	100		SPT-31	5-10-22 (32)	SPT			CL		
37.00										37.00m 2513.00
38.00	100		MA-32		HQ			CL		Depósito fluvio-lacustre de arena de grano fino a medio, bien seleccionada, de color cafe oscuro. Compuesta por fragmentos líticos y cuarzo principalmente, en fragmentos redondos y esféricos, húmeda, suelta.

PROFUNDIDAD (m)	VALOR RP Kg/cm2 (1 2 3 4)	SPT N VALOR (LP W LL) (20 40 60 80)	FINOS (%) (20 40 60 80)	ENSAYOS	RETORNO AGUA
33.00				LL = 210% LP = 154% Gravas: = 0% Arenas: = 60% Finos: = 40% MO = 48.6%	
34.00				W = 25.90% LL = 42% LP = 21% Gravas: = 0% Arenas: = 29% Finos: = 71%	
35.00					
36.00				LL = 35% LP = 15% Gravas: = 0% Arenas: = 25% Finos: = 75% γm = 19.51kN/m³	
37.00				LL = 25% LP = 15% Gravas: = 0% Arenas: = 49% Finos: = 51%	
38.00					

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 8

CAJA NÚMERO: 9

OBSERVACIONES

N.A. (6.00) m (+)
1/11/2018 N.A. (10.00) m (-)

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
γm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
S_t: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BDPROYECTOSINVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 7 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

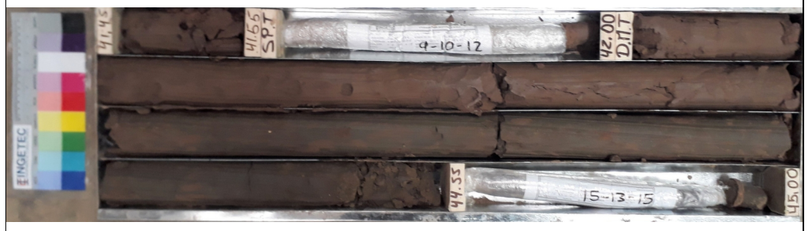
PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO	LITOLOGÍA	DESCRIPCIÓN	ENSAYOS
40.00	100		SPT-33	17-25-27 (52)	SPT			SC-SM	39.50m 2510.50 Depósito lacustre limo-arcilloso bien seleccionado de color rojo púrpura pálido compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo a seco, consistencia compacta a densa y plasticidad media a alta.	W = 19.4% LL = 21% LP = 15% Gravas: = 0% Arenas: = 66% Finos: = 34%
41.00	100		MA-34		HQ					
42.00	100		SPT-35	9-10-12 (22)	SPT			SM		NL-NP Gravas: = 0% Arenas: = 82% Finos: = 18% γm = 20.28kN/m³
43.00	100		MA-36		HQ				43.50m 2506.50 Depósito lacustre limo-arcilloso bien seleccionado de color marrón oscuro amarillento compuesto por fragmentos de cuarzo, micas y arcillas. Húmedo a seco, consistencia compacta a densa y plasticidad media a alta.	
44.00										
45.00	100		SPT-37	15-13-15 (28)	SPT			SM	45.00m 2505.00	W = 23.3% NL-NP Gravas: = 0% Arenas: = 81% Finos: = 19%

VALOR RP Kg/cm2 (1 2 3 4)
SPT N VALOR (LP W LL) (20 40 60 80)
FINOS (%) (20 40 60 80)

RETORNO AGUA

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 10



CAJA NÚMERO: 11

OBSERVACIONES

N.A. (7.00) m (+)
2/11/2018 N.A. (10.00) m (-)

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
γm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
St: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BDPROYECTOSINVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 8 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN	ENSAYOS	RETORNO AGUA
46.00	78		MA-38		HQ					45.70m 2504.30 Depósito lacustre limo-arenoso de tamaño fino compuesto por arcillas y cuarzo. Presenta color marrón oscuro, húmedo, de suelto a muy suelto y con plasticidad baja a nula.*(Continuatión)*		
47.00										Depósito lacustre limo-arcilloso bien seleccionado de color marrón oscuro compuesto por fragmentos de cuarzo de tamaño fino a forma de clasto arenoso alterado de color blanco, micas y arcillas. Húmedo, consistencia compacta a densa y plasticidad baja a media.		
48.00	100		SPT-39	4-8-10 (18)	SPT			SM		47.55m 2502.45 Depósito lacustre limo-arenoso de tamaño fino con lentes de arena de grano fino, compuesto por arcillas (se destaca arcilla azulosa con hábito granular en zonas <= 5 mm de diametro) y cuarzo. Presenta color amarillo moderado principalmente pero localmente puede variar el color, seco a húmedo, suelto y con plasticidad baja a nula.	NL-NP Gravas: = 0% Arenas: = 84% Finos: = 16% γm = 19.18kN/m³	
49.00	55		MA-40		HQ							
50.00												
51.00	100		SPT-41	5-8-8 (16)	SPT			CL			W = 23.4% LL = 37% LP = 15% Gravas: = 0% Arenas: = 5% Finos: = 95%	
										51.60m 2498.40		

⊙ VALOR RP Kg/cm2 ⊙ (1 2 3 4)
▲ SPT N VALOR ▲ (LP W LL) (20 40 60 80)
▯ FINOS (%) ▯ (20 40 60 80)

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 12

OBSERVACIONES

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
- Suv:Veleta de Campo
- Suvl:Veleta de Laboratorio
- Resistencia al corte no drenado sin corrección por plasticidad
- RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
- W: Humedad
- LL: Limite Liquido
- LP: Limite Plástico
- qu: Compresión Inconfinada
- MO: Materia Orgánica
- PH: Prueba de acidez del suelo
- C: Equivalente de Arena
- EXP-C:Expansión Controlada
- EXP-L:Expansión Libre en Probeta
- γm: Peso Unitario Total
- Gs: Gravedad Específica
- CBR Nat.: Muestra inalterada Natural
- IL: Alargamiento
- IA: Aplanamiento
- Am: Azul de Metileno
- (E): Solidez

LABORATORIO EN ROCA
- Cs: Compresión Simple
- σc-cp: Carga Puntual
- σc: Compresion Uniaxial en Roca
- S_t: Tracción Indirecta (Método Brasilero)
- σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BDPROYECTOSINVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 9 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

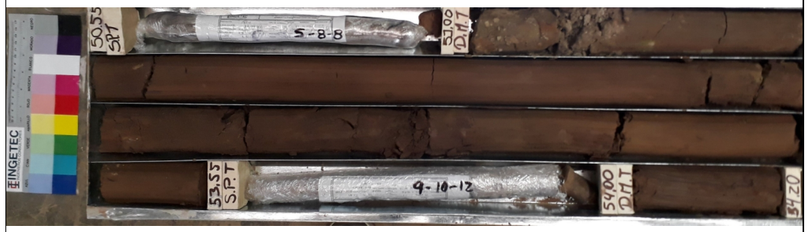
ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD % (20 40 60 80)	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
53.00	100		MA-42		HQ					Depósito lacustre limo-arcilloso bien seleccionado de color marrón claro compuesto por fragmentos de cuarzo de tamaño fino a forma de clasto arenoso alterado de color blanco, micas y arcillas (se destaca arcilla azulosa con hábito granular en zonas <= 5 mm de diametro). Húmedo, consistencia compacta a densa y plasticidad media a alta.*(Continuación)*
54.00	100		SPT-43	9-10-12 (22)	SPT			CL		
55.00	100		MA-44		HQ					55.20m 2494.80 Depósito lacustre limo-arenoso de tamaño fino con lentes de arena de grano fino, compuesto por arcillas (se destaca arcilla azulosa con hábito granular en zonas <= 5 mm de diametro) y cuarzo en cristales redondos y esféricos. Presenta color marrón medio, seco a húmedo, suelto y con plasticidad baja a nula. Presenta arenas más gruesas hacia el tope.
56.00										
57.00	100		SPT-45	9-11-11 (22)	SPT			SM		57.00m 2493.00
58.00	100		MA-46		HQ			CL-ML		Depósito lacustre limo-arcilloso bien seleccionado de color marrón claro compuesto por fragmentos de cuarzo de tamaño fino a forma de clasto arenoso alterado de color blanco, micas y arcillas. Húmedo, consistencia compacta a densa y plasticidad media a alta. Se puede evidenciar laminación localmente.

PROFUNDIDAD (m)	VALOR RP Kg/cm2 (1 2 3 4)	SPT N VALOR (LP W LL) (20 40 60 80)	FINOS (%) (20 40 60 80)	ENSAYOS
53.00				LL = 26% LP = 13% Gravas: = 0% Arenas: = 38% Finos: = 62% γm = 19.65kN/m³
54.00				
55.00				
56.00				W = 18.4% NL-NP Gravas: = 0% Arenas: = 62% Finos: = 38%
57.00				LL = 27% LP = 17% Gravas: = 0% Arenas: = 2% Finos: = 98%
58.00				

RETORNO AGUA

REGISTRO FOTOGRÁFICO



CAJA NÚMERO: 13

CAJA NÚMERO: 14

OBSERVACIONES

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada
SM, SP, CH, MLS

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
γm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
St: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BDPROYECTOSINVESTIGACIONES 8/1/19

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 10 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

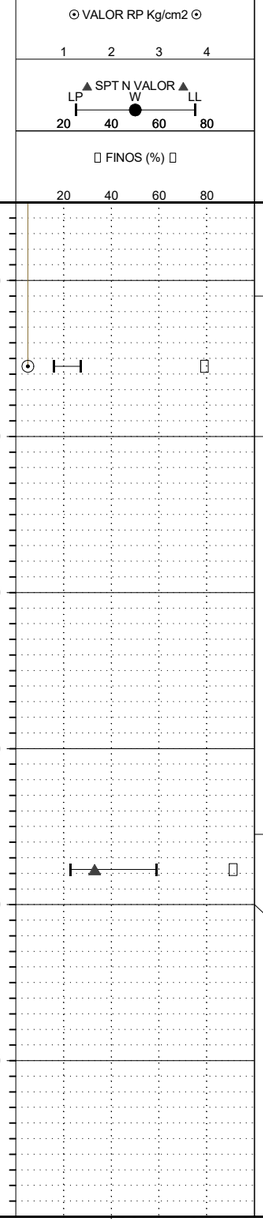
ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO	LITOLOGÍA
59.00								
	100		MI-47		TS			CL
60.00								
61.00	100		MA-48		HQ			
62.00								
	100		SPT-49	15-15-18 (33)	SPT			CH
63.00								
64.00	100		MA-50		HQ			

DESCRIPCIÓN

Depósito lacustre limo-arcilloso bien seleccionado de color marrón claro compuesto por fragmentos de cuarzo de tamaño fino a forma de clasto arenoso alterado de color blanco, micas y arcillas. Húmedo, consistencia compacta a densa y plasticidad media a alta. Se puede evidenciar laminación localmente.*(Continuación)*

(Continua en la Página Siguiente)



ENSAYOS

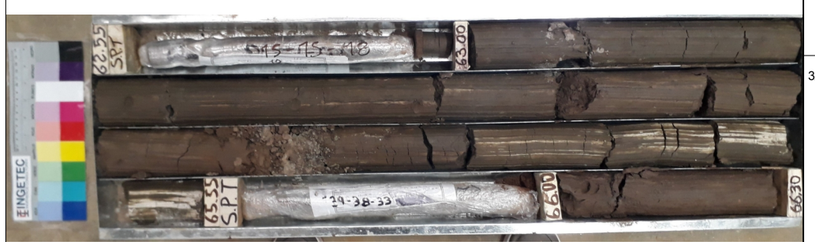
Suvl = 0.16kg/cm²
RP = 0.25kg/cm²
LL = 27%
LP = 16%
Gravas: = 0%
Arenas: = 21%
Finos: = 79%
qu = 89.87Kpa

LL = 59%
LP = 23%
Gravas: = 0%
Arenas: = 9%
Finos: = 91%
γm = 18.95kN/m³

RETORNO AGUA

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 15



OBSERVACIONES

N.A. (0.00) m (+)
3/11/2018 N.A. (0.00) m (-)

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO; BD\PROYECTOS\INVESTIGACIONES 8/1/19

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO	LABORATORIO EN SUELOS			LABORATORIO EN ROCA
Suv:Veleta de Campo	W: Humedad	C: Equivalente de Arena	IL: Alargamiento	Cs: Compresión Simple
Suvl:Veleta de Laboratorio	LL: Límite Líquido	EXP-C:Expansión Controlada	IA: Aplanamiento	σc-cp: Carga Puntual
Resistencia al corte no drenado sin corrección por plasticidad	LP: Límite Plástico	EXP-L:Expansión Libre en Probeta	Am: Azul de Metileno	σc: Compresion Uniaxial en Roca
RP: Penetrómetro de Bolsillo	qu: Compresión Inconfinada	γm: Peso Unitario Total	(E): Solidez	S_i: Tracción Indirecta (Método Brasilero)
	MO: Materia Orgánica	Gs: Gravedad Específica		σm: Compresión de nucleo de Concreto
	PH: Prueba de acidez del suelo	CBR Nat.: Muestra inalterada Natural		

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

CONSORCIO METRO BOG — SYSTRA — INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 11 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD % (20 40 60 80)	REVESTIMIENTO		LITOLOGÍA	DESCRIPCIÓN
66.00	100		SPT-51	39-38-33 (71)	SPT			CH		Depósito lacustre limo-arcilloso bien seleccionado de color marrón claro compuesto por fragmentos de cuarzo de tamaño fino a forma de clasto arenoso alterado de color blanco, micas y arcillas. Húmedo, consistencia compacta a densa y plasticidad media a alta. Se puede evidenciar laminación localmente.*(Continuatión)*
67.00	100		MA-52		HQ					
68.00										
	100		SPT-53	18-27-34 (61)	SPT			CL		Depósito lacustre limo-arenoso de tamaño fino, compuesto por arcillas y cuarzo en cristales redondos y sub-esféricos. Presenta color marrón oscuro amarillento, húmedo, suelto y con plasticidad baja a nula.
69.00										
70.00	100		MA-54		HQ					
71.00										

68.55m

PROFUNDIDAD (m)	⊙ VALOR RP Kg/cm2 ⊙ (1 2 3 4) / ▲ SPT N VALOR ▲ (LP W LL) (20 40 60 80) / ▯ FINOS (%) ▯ (20 40 60 80)	ENSAYOS
66.00		W = 79.6% LL = 115% LP = 31% Gravas: = 0% Arenas: = 4% Finos: = 96%
67.00		
68.00		
68.55m 2481.45		LL = 28% LP = 15% Gravas: = 0% Arenas: = 46% Finos: = 54% ɣm = 18.95kN/m³
69.00		
70.00		
71.00		

RETORNO AGUA

REGISTRO FOTOGRÁFICO

CAJA NÚMERO: 16

CAJA NÚMERO: 17

OBSERVACIONES

4/11/2018 N.A. (0.00) m (-)

(Continua en la Página Siguiente)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO
Suv:Veleta de Campo
Suvl:Veleta de Laboratorio
Resistencia al corte no drenado sin corrección por plasticidad
RP: Penetrómetro de Bolsillo

LABORATORIO EN SUELOS
W: Humedad
LL: Limite Liquido
LP: Limite Plástico
qu: Compresión Inconfinada
MO: Materia Orgánica
PH: Prueba de acidez del suelo
C: Equivalente de Arena
EXP-C:Expansión Controlada
EXP-L:Expansión Libre en Probeta
ɣm: Peso Unitario Total
Gs: Gravedad Específica
CBR Nat.: Muestra inalterada Natural
IL: Alargamiento
IA: Aplanamiento
Am: Azul de Metileno
(E): Solidez

LABORATORIO EN ROCA
Cs: Compresión Simple
σc-cp: Carga Puntual
σc: Compresion Uniaxial en Roca
S_t: Tracción Indirecta (Método Brasilero)
σm: Compresión de nucleo de Concreto

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

REGISTRO SUELO/ROCA - TABLOIDE METRO L1 (Pruebas de Carga) SQLSERVIDOR.INGETEC.COM.CO: BD\PROYECTOS\INVESTIGACIONES 8/1/19

CONSORCIO METRO BOG
SYSTRA INGETEC INGENIEROS CONSULTORES

INGETEC
Cra 6 No 30a-30
Bogotá/110311
Tel.: 571 3238050
Fax: 571 2884531

CLIENTE: ALCALDIA MAYOR DE BOGOTA - IDU
CÓDIGO: 4816
PROYECTO: METRO L1 (Pruebas de Carga)

LOCALIZACIÓN: CRA 78 CALLE 42
FECHA COMIENZO: 27-10-18
FECHA FINAL: 04-11-18
REGISTRADO POR: BARRANTES R ARLEY A
GEÓLOGO: SILVA S SERGIO E
REVISÓ: ARIAS V CARLOS A

COORDENADAS
ORIGEN: CARTESIANAS BOGOTÁ
ESTE: 90 816.00 m
NORTE: 102 102.00 m
COTA: 2,550.00 msnm
PROFUNDIDAD TOTAL: 73.00 m

PERFORACIÓN **PT-PLMB-PC-07** **HOJA 12 de 12**

TALADRO: DELTA BASE 520 III (T11)
ORIENTACIÓN: Vertical

ALCALDÍA MAYOR DE BOGOTÁ D.C.
BOGOTÁ MEJOR PARA TODOS
Rev. B

PROFUNDIDAD (m)	RECUPERACIÓN (%)	MUESTRA	MUESTRA - NÚMERO	GOLPES (N)	SISTEMA DIÁMETRO	RQD %	REVESTIMIENTO	LITOLOGÍA	DESCRIPCIÓN	PROFUNDIDAD (m)	VALOR RP Kg/cm2 / SPT N VALOR / FINOS (%)	ENSAYOS	RETORNO AGUA	REGISTRO FOTOGRÁFICO	OBSERVACIONES
72.00	100		SPT-55	28-33-41 (74)	SPT			SW-SM	72.00m 2478.00	72.00		W = 22.5% NL-NP Gravas: = 0% Arenas: = 91% Finos: = 9%			
	100		MA-56		HQ				Depósito lacustre limo-arcilloso bien seleccionado de color azul pálido compuesto por micas y arcillas (se destaca arcilla azulosa con hábito granular en zonas <= 5 mm de diametro). Húmedo, consistencia compacta a densa y plasticidad media a alta. 72.40m 2477.60					
73.00	89		SPT-57	38-44-50 (94)	SPT			SM	73.00m 2477.00 Depósito lacustre limo-arenoso de tamaño fino, compuesto por arcillas y cuarzo en cristales redondos y sub-esféricos. Presenta color marrón oscuro amarillento, húmedo, suelto y con plasticidad baja a nula. FIN DE PERFORACIÓN A 73.00m	73.00		NL-NP Gravas: = 0% Arenas: = 67% Finos: = 33% γm = 21.11kN/m³			N.A. (0.00) m (+)

LEYENDA: RELLENO, TURBA, SM, SP, CH, MLS
MUESTRA: Muestra Alterada, Standard Penetration Test, Muestra inalterada

CONVENCIONES

CAMPO	LABORATORIO EN SUELOS			LABORATORIO EN ROCA
Suv:Veleta de Campo	W: Humedad	C: Equivalente de Arena	IL: Alargamiento	Cs: Compresión Simple
Suvl:Veleta de Laboratorio Resistencia al corte no drenado sin corrección por plasticidad	LL: Limite Liquido	EXP-C:Expansión Controlada	IA: Aplanamiento	σc-cp: Carga Puntual
RP: Penetrómetro de Bolsillo	LP: Limite Plástico	EXP-L:Expansión Libre en Probeta	Am: Azul de Metileno	σc: Compresion Uniaxial en Roca
	qu: Compresión Inconfinada	γm: Peso Unitario Total	(E): Solidez	S_t: Tracción Indirecta (Método Brasilero)
	MO: Materia Orgánica	Gs: Gravedad Específica		σm: Compresión de nucleo de Concreto
	PH: Prueba de acidez del suelo	CBR Nat.: Muestra inalterada Natural		

(-) NIVEL DE AGUA (N.A.) A LAS 6 A. M.
(+) NIVEL DE AGUA (N.A.) A LAS 6 P. M.

ANEXO 3

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

RESUMEN DE RESULTADOS DE ENSAYOS DE LABORATORIO Y CAMPO DE LA PERFORACIÓN DEL SITIO PT-PLMB-PC-07

Perforación					SPT					Caracterización										Consolidación						Campo [kPa]					Laboratorio								Laboratorio [kPa]	
Perforación	Prof. [m]		Prom	Nivel freático [m]	ENSAYO DE PENETRACIÓN STANDARD			N_{campo} [golpes]	N_{60} [golpes]	wn	LL	LP	IP	Gravas	Arenas	Finos	γ_t	USCS	Cc	Cr	σ'_p (kPa)	e_o	Gs	OCR	*Rp1*	*Rp*	*VST 1*	VST_P	VST_R	*VST*	Compresión Inconfinada	Comport.	S_t	ϕ *Bjerrum (1972)*	ϕ *Morris et all. (1994)*	ϕ *Chandler (1988)*	VST_{Cor}	*Rp*	VST	*Su - qu/2*
PT-PLMB-PC-07	1.55	2.00	1.78	10.0	4	6	10	16	19	14.8	20.0	16.0	4.0	0.0	40.0	60.0	0.0	CL													0.0		Transición C							0.0	
PT-PLMB-PC-07	2.50	3.00	2.75	10.0				0	0		34.0	16.0	18.0	0.0	2.0	98.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	4.55	5.00	4.78	10.0	2	2	3	5	6	23.7	27.0	14.0	13.0	0.0	30.0	70.0	19.7	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	6.20	6.50	6.35	10.0				0	0		NL	NP	0.0	0.0	78.0	22.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	7.55	8.00	7.78	10.0	8	10	14	24	28	17.2	18.0	16.0	2.0	0.0	42.0	58.0	0.0	ML												0.0		Granular							0.0	
PT-PLMB-PC-07	9.65	10.55	10.10	10.0				0	0	30.1	42.0	19.0	23.0	0.0	1.0	99.0	19.3	CL								1.00	98.1				29.4	79.1	Cohesivo						49.1	29.4	39.5
PT-PLMB-PC-07	10.55	11.00	10.78	10.0	4	7	9	16	19	19.0	21.0	17.0	4.0	0.0	41.0	59.0	20.3	ML												0.0		Transición C							0.0	
PT-PLMB-PC-07	12.65	13.55	13.10	10.0				0	0		26.0	14.0	12.0	0.0	39.0	61.0	0.0	CL								0.25	24.5				9.8		Cohesivo						12.3	9.8	
PT-PLMB-PC-07	13.55	14.05	13.80	10.0													0.0		0.091	0.037		0.64	2.67					125.0	69.4			Cohesivo	1.8	1.3	1.3	0.9	146.6			
PT-PLMB-PC-07	16.00	16.85	16.43	10.0				0	0	90.7	182.0	51.0	131.0	0.0	2.0	98.0	14.1	CH								0.40	39.2				3.9	147.7	Cohesivo						19.6	3.9	73.8
PT-PLMB-PC-07	16.85	17.30	17.08	10.0	11	12	18	30	35		NL	NP	0.0	0.0	52.0	48.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	20.00	20.50	20.25	10.0				0	0		37.0	22.0	15.0	0.0	18.0	82.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	20.55	21.00	20.78	10.0	7	7	9	16	19	26.5	35.0	20.0	15.0	0.0	15.0	85.0	19.1	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	22.50	23.00	22.75	10.0				0	0		23.0	15.0	8.0	0.0	28.0	72.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	23.55	24.00	23.78	10.0	5	8	14	22	26	17.7	NL	NP	0.0	0.0	89.0	11.0	19.7	SP												0.0									0.0	
PT-PLMB-PC-07	26.55	27.00	26.78	10.0	12	14	21	35	41	18.7	NL	NP	0.0	0.0	78.0	22.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	29.55	30.00	29.78	10.0	30	40	32	72	84	23.2	31.0	17.0	14.0	0.0	21.0	79.0	19.8	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	30.50	31.00	30.75	10.0				0	0		NL	NP	0.0	0.0	70.0	30.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	32.50	33.55	33.03	10.0				0	0		210.0	154.0	56.0	0.0	60.0	40.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	33.55	34.00	33.78	10.0	5	24	24	48	56	25.9	42.0	21.0	21.0	0.0	29.0	71.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	36.55	37.00	36.78	10.0	5	10	22	32	37	21.0	35.0	15.0	20.0	0.0	25.0	75.0	19.5	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	37.50	38.00	37.75	10.0				0	0		25.0	15.0	10.0	0.0	49.0	51.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	39.05	39.50	39.28	10.0	17	25	27	52	61	19.4	21.0	15.0	6.0	0.0	66.0	34.0	0.0	SC												0.0		Transición C							0.0	
PT-PLMB-PC-07	41.55	42.00	41.78	10.0	9	10	12	22	26	20.2	NL	NP	0.0	0.0	82.0	18.0	20.3	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	44.55	45.00	44.78	10.0	15	13	15	28	33	23.2	NL	NP	0.0	0.0	81.0	19.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	47.55	48.00	47.78	10.0	4	8	10	18	21	21.0	NL	NP	0.0	0.0	84.0	16.0	19.2	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	50.55	51.00	50.78	10.0	5	8	8	16	19	23.4	37.0	15.0	22.0	0.0	5.0	95.0	0.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	53.55	54.00	53.78	10.0	9	10	12	22	26	22.3	26.0	13.0	13.0	0.0	38.0	62.0	19.7	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	56.55	57.00	56.78	10.0	9	11	11	22	26	16.4	NL	NP	0.0	0.0	62.0	38.0	0.0	SM												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	57.00	57.50	57.25	10.0				0	0		24.0	17.0	7.0	0.0	2.0	98.0	0.0	CL												0.0		Transición C							0.0	
PT-PLMB-PC-07	59.10	60.00	59.55	10.0				0	0	24.5	27.0	16.0	11.0	0.0	21.0	79.0	18.9	CL	0.118	0.036		0.82	2.64			0.25	24.5				15.7	89.9	Cohesivo						12.3	15.7	44.9
PT-PLMB-PC-07	62.55	63.00	62.78	10.0	15	15	18	33	39	34.3	59.0	23.0	36.0	0.0	9.0	91.0	19.0	CH												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	65.55	66.00	65.78	10.0	34	38	33	71	83	79.6	115.0	31.0	84.0	0.0	4.0	96.0	0.0	CH												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	68.55	69.00	68.78	10.0	18	27	34	61	71	26.3	28.0	15.0	13.0	0.0	46.0	54.0	19.0	CL												0.0		Cohesivo							0.0	
PT-PLMB-PC-07	71.55	72.00	71.78	10.0	28	33	41	74	86		NL	NP	0.0	0.0	91.0	9.0	0.0	SW												0.0									0.0	
PT-PLMB-PC-07	72.55	73.00	72.78	10.0	38	44	50	94	110	14.6	NL	NP	0.0	0.0	67.0	33.0	21.1	SM												0.0		Cohesivo							0.0	

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

RESUMEN DE RESULTADOS DE ENSAYOS DE LABORATORIO Y CAMPO DE LA PERFORACIONES CERCANAS

Perforación	Perforación				SPT					Caracterización										Consolidación					Campo [kPa]					Laboratorio [kPa]																		Laboratorio [kPa]		
					ENSAYO DE PENETRACIÓN STANDARD			N_{campo}	N_{60}																																									
Perforación	Prof. [m]		Prom	Nivel freático [m]				[golpes]	[golpes]	wn	LL	LP	IP	Gravas	Arenas	Finos	γ_t	USCS	Cc	Cr	σ'_p (kPa)	e_o	Gs	Rp	Rp	VST_P	VST_P	VST_R	VST	Compresión Inconfinada	Compresión Inconfinada	Corte Directo	Triaxial - CU	Compresión Simple [MPa]	Comport.	$\gamma_{t,\ saturado}$	IP	S_t	μ Bjerrum (1972)	μ Morris et all. (1994)	μ Chandler (1988)	VST_{Campo}	Rp	VST	qu/2
SL1-25	2.00	2.60	2.30	11.2	7	12	22	34	40																									-	16.0												
SL1-25	3.00	3.60	3.30	11.2	7	5	5	10	12																									-	16.0												
SL1-25	3.60	4.20	3.90	11.2						16.9	21.0	17.0	4.0	0.0	65.9	34.1	17.7	SM-SC											0.5	53.0				Transición C	17.7	4.0										26.5
SL1-25	6.00	6.60	6.30	11.2	7	7	6	13	15																									-	16.0												
SL1-25	7.50	8.10	7.80	11.2	4	7	6	13	15	18.9	22.0	17.0	5.0	0.0	52.5	47.5		SM-SC																Transición C	16.0	5.0										
SL1-25	9.00	9.60	9.30	11.2						30.7	42.0	23.0	19.0	0.0	7.7	92.3	18.1	CL																Cohesivo	18.1	19.0										
SL1-25	10.00	11.00	10.50	11.2																					0.2	15.7								-	16.0		NP	1.0	0.8	0.9	14.1				
SL1-25	11.00	12.00	11.50	11.2																					0.5	44.1								-	16.0		NP	1.0	0.8	0.8	38.5				
SL1-25	12.00	12.60	12.30	11.2						31.5	46.0	25.0	21.0	0.0	1.2	98.8	16.8	CL							0.2	15.7			0.7	65.7				Cohesivo	16.8	21.0	NP	1.0	0.8	0.8	13.7			32.9	
SL1-25	14.40	15.00	14.70	11.2						38.3	48.0	25.0	23.0	0.0	2.5	97.5	15.1	CL	0.584	0.045		1.34			0.3	24.5			0.6	54.9				Cohesivo	15.1	23.0	NP	1.0	0.8	0.8	20.9			27.5	
SL1-25	15.00	16.50	15.75	11.2																					0.1	9.8								-	16.0		NP	1.0	0.8	0.8	8.4				
SL1-25	16.50	17.10	16.80	11.2	3	11	17	28	33																0.4	34.3								-	16.0		NP	1.0	0.8	0.9	30.8				
SL1-25	18.00	18.60	18.30	11.2	1	2	2	4	5																0.5	49.1								-	16.0		NP	1.0	0.8	0.9	44.0				
SL1-25	20.00	20.50	20.25	11.2																					0.4	38.3								-	16.0		NP	1.0	0.8	0.9	34.3				
SL1-25	20.50	21.60	21.05	11.2																					0.4	34.3								-	16.0		NP	1.0	0.8	0.9	30.8				
SL1-25	21.60	22.20	21.90	11.2	3	1	1	2	2	19.6	-	NP		0.0	81.9	18.1		SM																-	18.0												
SL1-25	22.50	23.10	22.80	11.2	4	4	11	15	18																									-	16.0												
SL1-25	24.00	24.60	24.30	11.2	5	5	5	10	12																									-	16.0												
SL1-25	25.50	26.10	25.80	11.2	3	2	5	7	8	29.1	41.0	22.0	19.0	0.0	1.2	98.8		CL																Cohesivo	16.0	19.0											
SL1-25	27.00	27.60	27.30	11.2	4	3	5	8	9																0.5	44.1								-	16.0		NP	1.0	0.8	0.9	39.9				
SL1-25	30.00	30.60	30.30	11.2						31.1	43.0	25.0	18.0	0.0	0.7	99.3		CL							0.5	50.0			1.7	169.7				Cohesivo	16.0	18.0	NP	1.0	0.8	0.9	45.5			84.9	
SL1-25	31.50	32.10	31.80	11.2	3	4	7	11	13	22.2	26.0	20.0	6.0	0.0	0.0	100.0		CL-ML							0.5	45.1								Transición C	16.0	6.0	NP	1.3	1.3	0.9	52.9				
SL1-25	34.50	35.10	34.80	11.2	12	18	20	38	44																									-	16.0												
SL1-25	36.00	36.60	36.30	11.2						22.0	24.0	19.0	5.0	0.0	0.9	99.1	18.4	CL-ML	0.293	0.032		0.75							1.2	118.7				Transición C	18.4	5.0								59.4	
SL1-25	37.50	38.10	37.80	11.2	2	2	6	8	9																0.1	9.8								-	16.0		NP	1.1	1.0	0.9	9.8				
SL1-25	39.00	39.60	39.30	11.2	5	9	9	18	21	22.7	41.0	21.0	20.0	0.0	5.7	94.3		CL																Cohesivo	16.0	20.0											
SL1-25	43.00	43.50	43.25	11.2																					1.1	103.0								-	16.0		NP	1.0	0.8	0.8	91.1				
SL1-25	43.50	44.00	43.75	11.2																					1.2	112.8								-	16.0		NP	0.8	0.6	0.8	83.9				
SL1-25	45.00	45.60	45.30	11.2						45.6	68.0	29.0	39.0	0.0	0.0	100.0	17.6	CH																Cohesivo	17.6	39.0											
SL1-25	46.50	47.10	46.80	11.2	12	17	33	50	58																									-	16.0												
SL1-25	48.00	48.60	48.30	11.2	5	4	6	10	12																									-	16.0												
SL1-25	48.50	49.50	49.00	11.2																					0.9	83.4								-	16.0		NP	1.0	0.8	0.8	70.6				
SL1-25	49.50	50.00	49.75	11.2																					0.8	81.4								-	16.0		NP	1.0	0.8	0.8	69.0				
SL1-26	3.00	3.60	3.30	9.6	2	2	3	5	6																									-	16.0												
SL1-26	4.50	5.10	4.80	9.6	2	4	3	7	8																									-	16.0												
SL1-26	6.00	6.60	6.30	9.6	7	11	12	23	27																									-	16.0												
SL1-26	9.00	9.60	9.30	9.6						21.0	24.0	16.0	8.0	0.0	41.3	58.7		CL														0.0	31.0		Cohesivo	16.0	8.0											
SL1-26	10.80	11.40	11.10	9.6																					0.3	28.4								-	16.0		NP	1.0	0.9	0.9	26.7				
SL1-26	12.00	12.60	12.30	9.6						33.7	47.0	23.0	24.0	0.0	3.2	96.8	17.1	CL	0.409	0.030		1.04			0.4	39.2			0.8	75.5				Cohesivo	17.1	24.0	NP	1.0	0.7	0.8	33.1			37.8	
SL1-26	13.00	14.00	13.50	9.6																					0.5	44.1								-	16.0		NP	1.0	0.7	0.8	37.2				
SL1-26	14.00	14.50	14.25	9.6																					0.2	19.6								-	16.0		NP	0.6	0.6	0.6	11.5				
SL1-26	15.00	15.60	15.30	9.6						22.0	149.0	42.0	107.0	0.0	80.9	19.1		CH																Cohesivo	16.0	107.0											
SL1-26	16.50	17.10	16.80	9.6	7	11	19	30	35																									-	16.0												
SL1-26	18.00	18.60	18.30	9.6	3	3	5	8	9	34.6	48.0	25.0	23.0	0.0	34.5	65.5		CL																Cohesivo	16.0	23.0											
SL1-26	19.80	20.40	20.10	9.6						27.9	45.0	26.0	19.0	0.0	10.8	89.2	16.8	CL	0.436	0.035		1.01							1.2	119.7				Cohesivo	16.8	19.0								59.8	
SL1-26	22.50	23.10	22.80	9.6	6	7	9	16	19	19.6	-	NP		0.0	75.3	24.7		SM																-	18.0												
SL1-26	24.00	24.60	24.30	9.6						28.7	41.0	25.0	16.0	0.0	11.9	88.1	17.8	CL											0.6	63.1				Cohesivo	17.8	16.0								31.5	
SL1-26	27.00	27.60	27.30	9.6						28.0	44.0	24.0	20.0	0.0	5.8	94.2		CL											1.3	126.2				Cohesivo	16.0	20.0								63.1	
SL1-26	28.50	29.10	28.80	9.6	2	2	6	8	9																									-	16.0												
SL1-26	31.50	32.10	31.80	9.6	8	11	12	23	27																									-	16.0												
SL1-26	33.60	34.20	33.90	9.6						20.7	25.0	19.0	6.0	0.0	31.6	68.4	19.0	CL-ML											0.8	79.5				Transición C	19.0	6.0								39.7	
SL1-26	36.00	36.60	36.30	9.6	6	8	9	17	20																									-	16.0												
SL1-26	37.50	38.10	37.80	9.6	5	16	14	30	35	21.3	26.0	17.0	9.0	0.0	38.6	61.4		CL-ML																Cohesivo	16.0	9.0											
SL1-26	44.00	44.40	44.20	9.6						30.5	47.0	25.0	22.0	0.0	5.7	94.3	17.5	CL																Cohesivo	17.5	22.0											
SL1-26	45.00	45.60	45.30	9.6	6	6	8	14	16																									-	16.0												
SL1-26	46.50	47.10	46.80	9.6	4	4	6	10	12	22.0	35.0	20.0	15.0	0.0	35.7	64.3	18.9	CL																Cohesivo	18.9	15.0											
SL1-27	3.00	3.60	3.30	5.0	7	8	9	17	20																									-	16.0												
SL1-27	6.60	7.20	6.90	5.0	6	8	10	18	21	17.2	-	NP		0.1	79.2	20.7		SM																-	18.0												
SL1-27	9.00	9.50	9.25	5.0						27.1	45.0	22.0	23.0	0.0	1.3	98.7	18.1	CL											0.9	83.4				Cohesivo	18.1	23.0								41.7	
SL1-27	10.20	10.80	10.50	5.0	10	13	12	25	29																									-	16.0												
SL1-27	12.20	12.70	12.45	5.0						32.6	47.0	23.3	24.0	0.0	1.0	99.0	18.5	CL											1.3	124.6				Cohesivo	18.5	24.0								62.3	
SL1-27	14.00	14.60	14.30	5.0						59.4	102.0	40.9	61.0	0.0	1.1	98.9		CH	0.971	0.099		1.97												Cohesivo	16.0	61.0											
SL1-27	17.60	18.20	17.90	5.0	5	5	5	10	12	24.5	-	NP		0.0	64.2	35.8		SM																-	18.0												
SL1-27	21.10	21.70	21.40	5.0	10	9	9	18	21	21.5	-	NP		0.1	86.5	13.4		SM																-	18.0												
SL1-27	24.50	25.10	24.80	5.0	5	7	7	14	16																									-	16.0												
SL1-27	27.80	28.40	28.10	5.0	12	10	7	17	20	24.0	41.0	19.0	22.0	0.0	37.4	62.6		CL																Cohesivo	16.0	22.0											
SL1-27	31.40	32.00	31.70	5.0	16	23	23	46	54																									-	16.0												
SL1-27	32.60	33.00	32.80	5.0						29.8	46.0	24.0	22.0	0.0	1.3	98.7	18.9	CL											1.3	128.5				Cohesivo	18.9	22.0								64.3	
SL1-27	34.40	35.00	34.70	5.0	20	22	50	72	84																									-	16.0												
SL1-27	37.70	38.30	38.00	5.0	15	26	27	53	62	17.1	20.0	14.0	6.0	0.2	60.1	39.7		SM-SC																Transición C	16.0	6.0											
SL1-27	40.60	41.00	40.80	5.0						33.1	42.0	23.0	19.0	0.0	1.7	98.3	17.0	CL											1.0	97.1				Cohesivo	17.0	19.0								48.6	
SL1-27	41.50	42.10	41.80	5.0	6	5	7	12	14																									-	16.0												
SL1-27	44.50	44.90	44.70	5.0						30.6	48.0	22.0	26.0	0.0	1.4	98.6	16.9	CL											1.2	120.7				Cohesivo	16.9	26.0								60.3	
SL1-27	45.00	45.60	45.30	5.0	9	8	8	16	19																									-	16.0												
SL1-27	47.70	48.30	48.00	5.0	12	10	12	22	26	19.0	-	NP		0.0	85.6	14.4		SM																-	18.0												
SL1-28	3.00	3.60	3.30	1.3	2	3	10	13	15																									-	16.0												
SL1-28	4.50	5.10	4.80	1.3	3	3	3	6	7																									-	16.0												
SL1-28	6.00	6.60	6.30	1.3	6	9	9	18	21	18.8	-	NP		0.0	81.0	19.0		SM																-	18.0												
SL1-28	7.50	8.10	7.80	1.3	2	7	7	14	16	18.4	-	NP		0.0	84.3	15.7		SM																-	18.0												
SL1-28	9.00	9.60	9.30	1.3						29.4	42.0	23.0	19.0	0.0	1.3	98.7	17.2	CL											1.1	105.5				Cohesivo	17.2	19.0								52.7	
SL1-28	10.50	11.10	10.80	1.3	5	3	6	9	11	23.7	34.0	20.0	14.0	0.0	33.7	66.3		CL																Cohesivo	16.0	14.0											
SL1-28	13.50	14.10	13.80	1.3	3	3	4	7	8																									-	16.0												
SL1-28	15.00	15.60	15.30	1.3						52.8	93.0	37.0	56.0	0.0	5.0	95.0	16.4	CH											1.4	138.3				Cohesivo	16.4	56.0								69.2	
SL1-28	19.50	20.10	19.80	1.3	7	12	9	21	25																									-	16.0												
SL1-28	21.00	21.60	21.30	1.3						32.2	47.0	24.0	23.0	0.0	2.7	97.3	15.8	CL											0.5	49.1				Cohesivo	15.8	23.0								24.6	
SL1-28	22.50	23.10	22.80	1.3	7	10	7	17	20																									-	16.0												
SL1-28	24.00	24.60	24.30	1.3	4	3	5	8	9																									-	16.0												
SL1-28	25.50	26.10	25.80	1.3	4	8	6	14	16																									-	16.0												
SL1-28	27.00	27.60	27.30	1.3						18.7	-	NP		0.0	86.0	14.0		SM																-	18.0												
SL1-28	28.50	29.10	28.80	1.3	7	7	7	14	16																									-	16.0												
SL1-28	30.00	30.60	30.30	1.3						17.7	-	NP		0.0	85.1	14.9		SM																-	18.0												
SL1-28	31.50	32.10	31.80	1.3	4	9	9	18	21																									-	16.0												
SL1-28	33.00	33.60	33.30	1.3	13	11	18	29	34																									-	16.0												
SL1-28	34.50	35.10	34.80	1.3	10	11	12	23	27																									-	16.0												
SL1-28	37.50	38.10	37.80	1.3	5	5	7	12	14																									-	16.0												

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

RESUMEN DE RESULTADOS DE ENSAYOS DE LABORATORIO Y CAMPO DE LA PERFORACIONES CERCANAS

Perforación					SPT					Caracterización									Consolidación					Campo [kPa]					Laboratorio [kPa]																Laboratorio [kPa]		
Perforación	Prof. [m]		Prom	Nivel freático [m]	ENSAYO DE PENETRACIÓN STANDARD			N_{campo} [golpes]	N_{60} [golpes]	wn	LL	LP	IP	Grava s	Arenas	Finos	γ_t	USCS	Cc	Cr	σ'_p (kPa)	e_o	Gs	*Rp*	*Rp*	VST_P	VST_P	VST_R	*VST*	Compresión Inconfinada	Compresión Inconfinada	Corte Directo		Triaxial - CU		Compresión Simple [MPa]	Comport.	γ_t, saturada	IP	S_t	*β Bjerrum (1972)*	*β Morris et all. (1994)*	*β Chandler (1988)*	VST_{Campo}	*Rp*	VST	*qu/2*
SL1-28	39.00	39.60	39.30	1.3						13.1	-	NP		0.0	51.1	48.9		SP																		-	18.0										
SL1-28	40.50	41.10	40.80	1.3	6	6	8	14	16																											-	16.0										
SL1-28	42.00	42.60	42.30	1.3						30.2	43.0	24.0	19.0	0.0	2.1	97.9	18.3	CL	0.367	0.031		0.88														Cohesivo	18.3	19.0									
SL1-28	43.50	44.10	43.80	1.3	5	7	9	16	19																											-	16.0										
SL1-28	45.00	45.60	45.30	1.3						53.4	-	NP		0.0	12.0	88.0		ML															0.3	22.1		-	16.0										
SL1-28	46.50	47.10	46.80	1.3	13	13	14	27	32																											-	16.0										
SL1-28	48.00	48.60	48.30	1.3						27.1	41.0	22.0	19.0	0.0	18.4	81.6		CL	0.293	0.032		0.75										1.5	144.2					Cohesivo	16.0	19.0								72.1
SL1-28	49.40	50.00	49.70	1.3																						1.4	135.4								-	16.0		NP	1.0	0.8	0.9	121.5			

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
1.5	3.134	43.1	5	3.13481	1.37488	3.74E-06	9	39.88731	46	38	31.82498	39.88731	0	0	0	0.33	0	148.45297	-0.11172	0	0	20
1.52	3.134	43.1	5	3.13481	1.37488	3.67E-06	9	40.00875	46	38	31.92187	40.00875	0	0	0	0.33	0	148.67879	-0.1111	0	0	20
1.54	3.134	43.1	5	3.14078	1.5113	3.07E-06	9	41.40751	46	38	33.0379	41.40751	0	0	0	0.33	0	150.78174	-0.11633	0	0	20
1.56	3.152	56.2	5	3.02275	1.79969	2.06E-06	9	42.81634	46	38	34.16197	42.81634	0	0	0	0.33	0	152.71907	-0.12481	0	0	20
1.58	2.78	63.9	5	3.00195	2.41066	1.17E-06	10	41.63427	46	38	37.57336	47.09195	0	0	0	0.33	0	158.73422	-0.14572	0	0	20
1.6	3.072	97	5	2.97985	3.04713	7.24E-07	10	41.31966	47	38	40.67093	50.97423	0	0	0	0.33	0	163.99706	-0.16419	0	0	20
1.62	3.086	111.5	4	3.07498	3.60544	5.40E-07	11	42.64625	0	0	44.2623	55.47542	14	217.58293	5.661	0.33	26.15384	169.9832	0	2.00927	1.92331	20
1.64	3.066	124.1	4	3.06049	4.08758	4.08E-07	11	42.4381	0	0	46.33641	58.07497	14	216.52094	5.68469	0.33	26.26327	173.29057	0	2.01214	1.69617	20
1.66	3.029	139.7	4	3.00008	4.53876	3.12E-07	11	41.58705	0	0	47.66305	59.73769	14	212.17883	5.61497	0.33	25.94116	175.33899	0	2.00367	1.52706	20
1.68	2.905	144.7	9	2.92587	4.89313	2.51E-07	11	40.54271	0	0	48.33225	60.57642	14	206.85058	5.49763	0.33	25.39903	176.34343	0	1.98925	1.41593	20
1.7	2.843	145.1	9	2.84371	4.96418	2.28E-07	11	39.38708	0	0	47.79425	59.90213	14	200.95451	5.32145	0.33	24.58508	175.48372	0	1.96721	1.39506	20
1.72	2.782	133.7	4	2.76879	4.88421	2.21E-07	10	38.33288	0	0	46.78133	58.6326	14	195.5759	5.13819	0.33	23.73842	173.88611	0	1.94377	1.41729	20
1.74	2.68	126.9	4	2.6983	4.61154	2.33E-07	10	37.34081	0	0	45.12748	56.55978	14	190.51436	4.93937	0.33	22.81988	171.26094	0	1.91771	1.50043	20
1.76	2.632	112.7	4	2.63249	4.39761	2.41E-07	10	36.41411	0	0	43.73655	54.81647	14	185.78627	4.76051	0.33	21.99356	169.01472	0	1.89367	1.57274	20
1.78	2.585	107.7	4	2.55602	4.26184	2.39E-07	9	35.33823	0	0	42.50913	53.27811	14	180.29712	4.57895	0.33	21.15473	166.98718	0	1.86865	1.62201	20
1.8	2.451	106.4	4	2.47286	4.28787	2.18E-07	9	34.1689	0	0	41.78458	52.37001	14	174.33112	4.41121	0.33	20.37978	165.75137	0	1.84495	1.61123	20
1.82	2.383	104	4	2.37928	4.40189	1.89E-07	9	32.8535	0	0	41.22075	51.66334	14	167.61992	4.23906	0.33	19.58445	164.757	0	1.82	1.56844	20
1.84	2.305	103.8	4	2.32865	4.4389	1.76E-07	9	32.13949	0	0	40.87156	51.22569	14	163.97697	4.1275	0.33	19.06906	164.16039	0	1.80348	1.55463	20
1.86	2.3	102.3	4	2.31923	4.42963	1.72E-07	9	32.00234	0	0	40.85028	51.19902	14	163.27725	4.07757	0.33	18.83836	164.15561	0	1.79599	1.55754	20
1.88	2.355	102.1	4	2.35461	4.32909	1.82E-07	9	32.49249	0	0	41.0487	51.4477	14	165.77801	4.08882	0.33	18.89035	164.56787	0	1.79768	1.59381	20
1.9	2.411	101.4	4	2.38842	4.18546	1.97E-07	9	32.96064	0	0	41.06217	51.46459	14	168.16653	4.09233	0.33	18.90657	164.66975	0	1.79821	1.64858	20
1.92	2.401	96.4	4	2.40487	3.96834	2.18E-07	9	33.18565	0	0	40.58695	50.86898	14	169.31453	4.06024	0.33	18.75833	163.9377	0	1.79337	1.73868	20
1.94	2.404	88.5	4	2.44929	3.69358	2.56E-07	9	33.80239	0	0	40.16255	50.33706	14	172.46117	4.06285	0.33	18.77037	163.31801	0	1.79377	1.86822	20
1.96	2.544	86.5	4	2.59435	3.36372	3.38E-07	9	35.82805	0	0	40.48147	50.73677	14	182.79618	4.20332	0.33	19.41932	164.05098	0	1.81474	2.05279	20
1.98	2.836	86.8	4	2.81897	3.35702	3.92E-07	10	38.96747	0	0	42.86054	53.71855	14	198.81363	4.49658	0.33	20.77422	168.23489	0	1.85709	2.05887	20
2	3.078	110.6	4	2.9969	3.42576	4.17E-07	11	41.45325	0	0	45.08813	56.51045	14	211.49615	4.72872	0.33	21.84667	172.01085	0	1.88934	2.01883	20
2.02	3.078	110.6	4	3.07747	3.59386	3.92E-07	11	42.57605	0	0	46.81967	58.68065	14	217.22472	4.83431	0.33	22.33452	174.83627	0	1.90366	1.92478	20
2.04	3.078	110.6	4	2.93285	3.7813	3.18E-07	11	40.54607	0	0	46.30373	58.03401	14	206.86772	4.61979	0.33	21.34345	173.94113	0	1.87434	1.82805	20
2.06	2.644	111.5	4	2.7886	3.96256	2.59E-07	10	38.52126	0	0	45.65778	57.22442	14	196.53707	4.4029	0.33	20.3414	172.83154	0	1.84376	1.74304	20
2.08	2.645	109.4	4	2.58936	4.23657	1.94E-07	10	35.72661	0	0	44.63928	55.9479	14	182.2786	4.1147	0.33	19.0099	171.06047	0	1.80156	1.62838	20
2.1	2.48	108.2	4	2.55309	4.2132	1.88E-07	10	35.21361	0	0	44.2499	55.45987	14	179.66125	4.02977	0.33	18.61753	170.44002	0	1.78876	1.63683	20
2.12	2.535	105.1	4	2.5438	3.90098	2.14E-07	10	35.07842	0	0	43.04559	53.95047	14	178.97154	3.95511	0.33	18.27263	168.52882	0	1.77735	1.76747	20
2.14	2.617	84.4	4	2.50487	3.49453	2.54E-07	9	34.52816	0	0	41.07891	51.48557	14	176.16406	3.82879	0.33	17.68901	165.30157	0	1.75773	1.97229	20
2.16	2.363	73.1	4	2.41362	3.13637	2.86E-07	9	33.24548	0	0	38.70662	48.5123	14	169.61982	3.63647	0.33	16.8005	161.25032	0	1.72702	2.19587	20
2.18	2.261	69.6	4	2.28012	3.00277	2.73E-07	8	31.37144	0	0	36.84412	46.17796	14	160.05839	3.41474	0.33	15.77609	157.91655	0	1.69026	2.291	20
2.2	2.216	62.7	4	2.23262	2.80687	2.92E-07	8	30.70137	0	0	35.61676	44.63967	14	156.63962	3.3063	0.33	15.27512	155.73579	0	1.6717	2.44958	20
2.22	2.22	55.7	5	2.2101	2.57153	3.31E-07	8	30.38104	36	36	34.45366	43.18193	0	0	0	0.33	0	153.66747	-0.11779	0	0	20
2.24	2.193	52.1	5	2.21683	2.32615	3.94E-07	8	30.47029	36	36	33.48558	41.96859	0	0	0	0.33	0	151.96277	-0.10961	0	0	20
2.26	2.236	46.9	5	2.1182	2.33532	3.50E-07	8	29.08447	35	36	32.65699	40.9301	0	0	0	0.33	0	150.34637	-0.10715	0	0	20
2.28	1.924	49.4	5	1.96424	2.40127	2.79E-07	7	26.92408	34	35	31.49625	39.4753	0	0	0	0.33	0	147.99937	-0.10506	0	0	20
2.3	1.731	45.2	4	1.75494	2.64017	1.82E-07	7	23.98897	0	0	30.32075	38.00201	14	122.39273	2.553	0.33	11.79487	145.47366	0	1.53022	2.58874	20
2.32	1.608	44.4	4	1.59501	2.79204	1.32E-07	6	21.74504	0	0	29.13821	36.51989	14	110.94411	2.33391	0.33	10.78266	142.94258	0	1.48397	2.44143	20
2.34	1.444	44	4	1.49908	2.82395	1.11E-07	6	20.39721	0	0	0	35.33655	14	104.06739	2.19176	0.33	10.12594	140.93787	0	1.45242	2.40912	20
2.36	1.443	38.6	4	1.45482	2.66471	1.13E-07	6	19.77267	0	0	27.22981	34.12803	14	100.88095	2.108	0.33	9.73894	138.95638	0	1.43319	2.55022	20
2.38	1.475	33.7	4	1.5839	2.13188	1.98E-07	6	21.5749	0	0	26.84972	33.65164	14	110.07601	2.22618	0.33	10.28494	138.48825	0	1.46018	3.1947	20
2.4	1.831	29	5	1.79463	1.65308	3.96E-07	6	24.52042	31	34	26.91812	33.73738	0	0	0	0.33	0	139.07323	-0.0708	0	0	20
2.42	2.075	26.3	5	1.97036	1.38215	6.46E-07	7	26.97582	32	35	27.10194	33.96777	0	0	0	0.33	0	139.80334	-0.06287	0	0	20
2.44	2.002	26.4	5	1.97638	1.34252	6.72E-07	7	27.05533	32	35	26.98741	33.82422	0	0	0	0.33	0	139.62555	-0.06081	0	0	20
2.46	1.849	26.9	5	1.86274	1.42622	5.25E-07	6	25.45959	31	34	26.55636	33.28397	0	0	0	0.33	0	138.59259	-0.06158	0	0	20
2.48	1.734	26.4	5	1.77943	1.5061	4.27E-07	6	24.28859	31	34	26.30215	32.96536	0	0	0	0.33	0	137.95804	-0.06277	0	0	20
2.5	1.752	27.1	5	1.80685	1.46849	4.54E-07	6	24.66762	31	34	26.41334	33.10472	0	0	0	0.33	0	138.27228	-0.0615	0	0	20
2.52	1.931	26.1	5	1.93865	1.33942	6.12E-07	7	26.50815	32	35	26.89988	33.71452	0	0	0	0.33	0	139.5311	-0.05854	0	0	20
2.54	2.129	24.7	5	2.14748	1.16261	9.57E-07	7	29.4269	33	35	27.53683	34.51282	0	0	0	0.33	0	141.19807	-0.05454	0	0	20
2.56	2.378	24.1	5	2.31332	1.0562	1.31E-06	7	31.74393	34	35	28.08459	35.19936	0	0	0	0.33	0	142.58006	-0.05257	0	0	20
2.58	2.428	24.5	5	2.43377	1.02036	1.53E-06	8	33.42551	34	35	28.72871	36.00665	0	0	0	0.33	0	144.04419	-0.0532	0	0	20
2.6	2.49	25.9	5	2.51426	1.03543	1.60E-06	8	34.54756	35	36	29.46923	36.93477	0	0	0	0.33	0	145.60362	-0.05565	0	0	20
2.62	2.619	27.7	5	2.61379	1.07124	1.64E-06	8	35.93614	36	36	30.50954	38.23862	0	0	0	0.33	0	147.72557	-0.0596	0	0	20
2.64	2.726	30.4	5	2.77203	1.02692	1.98E-06	8	39.20865	36	36	31.28349	39.20865	0	0	0	0.33	0	149.40709	-0.06052	0	0	20

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2.66	2.964	27.3	5	2.0381	0.94369	1.07E-06	7	27.86706	31	35	25.55467	32.02853	0	0	0	0.33	0	137.32193	-0.03778	0	0	20
2.68	0.414	0	5	1.41388	1.03498	3.77E-07	5	19.1234	26	33	21.18329	26.54972	0	0	0	0.33	0	126.76781	-0.02567	0	0	20
2.7	0.85	16.6	5	1.19292	0.98917	2.58E-07	4	16.02551	24	32	19.00921	23.82487	0	0	0	0.33	0	121.26206	-0.01573	0	0	20
2.72	2.298	18.8	5	2.70796	1.03768	1.77E-06	8	37.23127	36	36	31.18298	39.08267	0	0	0	0.33	0	149.27034	-0.05847	0	0	20
2.74	4.958	48.9	6	5.93698	0.68609	2.08E-05	15	55.37804	50	39	44.18461	55.37804	0	0	0	0.33	0	174.0408	-0.10323	0	0	20
2.76	10.534	54.5	6	9.77564	0.60218	7.93E-05	21	71.82675	63	41	57.30858	71.82675	0	0	0	0.33	0	194.89763	-0.14914	0	0	20
2.78	13.808	73.2	6	15.15783	0.44817	3.44E-04	29	85.54641	76	43	68.25512	85.54641	0	0	0	0.33	0	210.81482	-0.20201	0	0	20
2.8	21.102	76.1	6	19.39598	0.38926	7.51E-04	34	95.11835	85	44	75.8923	95.11835	0	0	0	0.33	0	221.03568	-0.23278	0	0	20
2.82	23.251	77.2	7	23.20846	0.33278	1.45E-03	38	101.08742	92	45	80.65486	101.08742	0	0	0	0.33	0	227.30147	-0.25465	0	0	20
2.84	25.255	78.4	7	25.9703	0.30907	2.10E-03	42	105.8179	96	45	84.42917	105.8179	0	0	0	0.33	0	232.03122	-0.26848	0	0	20
2.86	29.395	85.2	7	28.56057	0.30462	2.65E-03	45	111.60772	100	46	89.04871	111.60772	0	0	0	0.33	0	237.5006	-0.28058	0	0	20
2.88	31.027	97.4	7	30.88287	0.30815	3.07E-03	48	117.50434	100	46	93.75347	117.50434	0	0	0	0.33	0	242.86206	-0.29071	0	0	20
2.9	32.223	102.9	7	32.33202	0.32424	3.08E-03	50	122.91774	100	46	98.07266	122.91774	0	0	0	0.33	0	247.57846	-0.29695	0	0	20
2.92	33.743	114.2	7	33.38162	0.35738	2.74E-03	52	129.6109	100	46	103.41295	129.6109	0	0	0	0.33	0	253.19608	-0.30181	0	0	20
2.94	34.176	140.8	7	34.22957	0.40365	2.27E-03	54	137.5075	100	46	109.71343	137.5075	0	0	0	0.33	0	259.62933	-0.30602	0	0	20
2.96	34.767	159.5	7	34.54087	0.46418	1.74E-03	56	145.67652	100	47	116.23126	145.67652	0	0	0	0.33	0	266.07166	-0.30831	0	0	20
2.98	34.677	180.7	7	34.62986	0.53884	1.27E-03	58	154.57134	100	47	123.32819	154.57134	0	0	0	0.33	0	272.89063	-0.30985	0	0	20
3	34.443	219.6	7	34.30322	0.61957	9.17E-04	59	162.40639	100	47	129.57957	162.40639	0	0	0	0.33	0	278.72351	-0.30968	0	0	20
3.02	33.787	237.3	6	33.86691	0.69753	6.85E-04	60	169.03306	100	47	134.8668	169.03306	0	0	0	0.33	0	283.54739	-0.30884	0	0	20
3.04	33.368	251.8	6	33.41124	0.75733	5.52E-04	60	173.37209	100	47	138.3288	173.37209	0	0	0	0.33	0	286.651	-0.30749	0	0	20
3.06	33.076	270	6	33.03423	0.80482	4.69E-04	61	176.57257	100	46	140.88237	176.57257	0	0	0	0.33	0	288.91815	-0.3062	0	0	20
3.08	32.656	275.8	6	32.71155	0.84262	4.13E-04	61	178.93321	100	46	142.76586	178.93321	0	0	0	0.33	0	290.57895	-0.30495	0	0	20
3.1	32.4	281.1	6	32.32091	0.86786	3.75E-04	61	179.8263	100	46	143.47843	179.8263	0	0	0	0.33	0	291.19449	-0.30321	0	0	20
3.12	31.904	284.6	6	31.52925	0.89747	3.31E-04	60	179.44063	100	46	143.17072	179.44063	0	0	0	0.33	0	290.87814	-0.29977	0	0	20
3.14	30.281	283.2	6	30.56762	0.92669	2.90E-04	59	178.18382	100	46	142.16794	178.18382	0	0	0	0.33	0	289.93195	-0.29547	0	0	20
3.16	29.515	282	6	29.54794	0.95652	2.53E-04	57	176.55537	100	46	140.86864	176.55537	0	0	0	0.33	0	288.71225	-0.29075	0	0	20
3.18	28.845	282.7	6	28.62827	0.98865	2.21E-04	56	175.32476	100	46	139.88678	175.32476	0	0	0	0.33	0	287.77701	-0.28634	0	0	20
3.2	27.522	284.4	6	27.72358	1.02127	1.92E-04	55	174.00746	100	46	138.83574	174.00746	0	0	0	0.33	0	286.77609	-0.28185	0	0	20
3.22	26.801	282.3	6	26.78989	1.05015	1.69E-04	54	172.12069	99	46	137.33034	172.12069	0	0	0	0.33	0	285.35785	-0.27701	0	0	20
3.24	26.044	277.3	6	25.58221	1.08096	1.45E-04	52	168.95498	97	45	134.80451	168.95498	0	0	0	0.33	0	282.97733	-0.27056	0	0	20
3.26	23.899	270	6	24.20549	1.09507	1.27E-04	50	163.73996	94	45	130.64358	163.73996	0	0	0	0.33	0	279.04764	-0.26268	0	0	20
3.28	22.671	247.9	6	22.66077	1.10529	1.10E-04	48	157.34367	91	45	125.54016	157.34367	0	0	0	0.33	0	274.14474	-0.25332	0	0	20
3.3	21.41	233.5	6	21.05938	1.11241	9.41E-05	45	150.32637	88	44	119.94125	150.32637	0	0	0	0.33	0	268.64954	-0.24293	0	0	20
3.32	19.095	221.4	6	19.55932	1.1045	8.28E-05	42	142.8457	85	44	113.97263	142.8457	0	0	0	0.33	0	262.6622	-0.2334	0	0	20
3.34	18.171	193.2	6	17.93758	1.09454	7.13E-05	39	134.58059	81	44	107.37813	134.58059	0	0	0	0.33	0	255.8535	-0.22317	0	0	20
3.36	16.545	174.4	6	16.78883	1.03342	7.04E-05	37	126.19655	78	43	100.68874	126.19655	0	0	0	0.33	0	248.79172	-0.21338	0	0	20
3.38	15.649	152.9	6	15.57544	0.95556	7.10E-05	34	116.8777	75	43	93.25349	116.8777	0	0	0	0.33	0	240.66727	-0.20199	0	0	20
3.4	14.531	119.2	6	13.97037	0.90549	6.29E-05	31	107.09954	71	42	85.45176	107.09954	0	0	0	0.33	0	231.7227	-0.18796	0	0	20
3.42	11.73	107.4	6	12.15296	0.89059	4.81E-05	28	97.73936	67	42	77.98353	97.73936	0	0	0	0.33	0	222.69423	-0.17195	0	0	20
3.44	10.197	98.1	6	10.14886	0.94592	2.88E-05	24	89.45318	61	41	71.37222	89.45318	0	0	0	0.33	0	214.1955	-0.15411	0	0	20
3.46	8.519	82.5	6	8.0261	1.07275	1.35E-05	20	81.03824	55	40	64.65817	81.03824	0	0	0	0.33	0	205.02849	-0.13387	0	0	20
3.48	5.362	77.7	5	5.96536	1.3232	4.66E-06	17	72.7599	48	39	58.05311	72.7599	0	0	0	0.33	0	195.38153	-0.11558	0	0	20
3.5	4.015	76.6	5	4.13598	1.89798	1.03E-06	13	57.00584	40	37	52.59678	65.92129	0	0	0	0.33	0	186.70738	-0.11046	0	0	20
3.52	3.031	81.2	4	3.03995	2.62175	2.78E-07	11	41.65626	0	0	48.75835	61.11047	14	212.53192	3.04918	0.33	14.08719	180.25496	0	1.62605	2.61332	20
3.54	2.074	81.3	4	2.26892	3.68605	7.37E-08	9	30.85662	0	0	0	57.54811	14	157.43172	2.32	0.33	10.71839	175.19188	0	1.48094	1.84476	20
3.56	1.702	88.4	3	1.72426	4.79433	2.34E-08	8	23.22631	0	0	0	53.31595	14	118.50156	1.78453	0.33	8.24451	169.17337	0	1.35382	1.40482	20
3.58	1.397	78.3	3	1.4603	5.2455	1.32E-08	7	19.52579	0	0	0	49.7003	14	99.62138	1.51201	0.33	6.98547	164.01712	0	1.27922	1.27453	20
3.6	1.282	63.1	3	1.34946	4.42645	1.50E-08	6	17.96912	0	0	0	44.69739	14	91.67916	1.38016	0.33	6.37633	156.91869	0	1.23992	1.50411	20
3.62	1.369	37.8	4	1.39469	3.16438	2.98E-08	6	18.59744	0	0	0	40.84809	14	94.88491	1.39949	0.33	6.46566	151.44327	0	1.24583	2.10696	20
3.64	1.532	31.5	4	1.48499	2.09877	7.07E-08	6	19.85686	0	0	0	37.31552	14	101.31049	1.45916	0.33	6.74133	146.33028	0	1.26375	3.18559	20
3.66	1.552	24.2	4	1.48696	1.70819	9.86E-08	6	19.8796	0	0	0	35.17425	14	101.42652	1.44383	0.33	6.6705	143.05583	0	1.25919	3.91331	20
3.68	1.374	20.5	4	1.40089	1.37532	1.18E-07	6	18.67002	0	0	25.53387	32.00245	14	95.25518	1.34513	0.33	6.2145	137.85373	0	1.22906	4.84516	20
3.7	1.273	13.1	4	1.28583	1.14841	1.21E-07	5	17.05474	0	0	23.20373	29.08201	14	87.01397	1.22296	0.33	5.65008	132.78204	0	1.18968	5.77474	20
3.72	1.206	10.7	5	1.24477	0.82211	1.74E-07	5	16.47537	22	31	20.99341	26.31174	0	0	0	0.33	0	128.02937	0.00392	0	0	20
3.74	1.25	6.9	5	1.22602	0.67155	2.13E-07	5	16.20854	21	31	19.90493	24.94751	0	0	0	0.33	0	125.69186	0.01507	0	0	20
3.76	1.216	7.1	5	1.18719	0.58963	2.25E-07	4	15.66063	21	31	19.04556	23.87044	0	0	0	0.33	0	123.7461	0.0227	0	0	20
3.78	1.089	7	5	1.09066	0.61125	1.67E-07	4	14.305	20	30	18.35582	23.00597	0	0	0	0.33	0	121.83833	0.02422	0	0	20
3.8	0.96	5.9	5	0.96234	0.60616	1.16E-07	4	11.00763	19	30	17.14184	21.48444	0	0	0	0.33	0	118.52892	0.02921	0	0	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
3.82	0.83	4.6	4	0.87173	0.56975	9.18E-08	4	8.8894	0	0	0	20.1316	14	57.30455	0.79146	0.33	3.65653	115.59859	0	1.02516	11.30707	20
3.84	0.816	4.4	4	0.8185	0.57829	7.39E-08	3	7.74698	0	0	0	19.53976	14	53.48129	0.73905	0.33	3.41442	114.19431	0	1.00142	11.07289	20
3.86	0.799	5.2	4	0.8219	0.56373	7.61E-08	3	7.77799	0	0	0	19.51742	14	53.70318	0.73894	0.33	3.41392	114.21831	0	1.00137	11.3588	20
3.88	0.839	4.3	4	0.86532	0.53544	9.29E-08	4	8.63084	0	0	0	19.90402	14	56.78397	0.77548	0.33	3.58272	115.26646	0	1.01804	12.01042	20
3.9	0.945	4.4	5	0.9254	0.48628	1.25E-07	4	9.88652	18	29	16.19286	20.29505	0	0	0	0.33	0	116.42432	0.04101	0	0	20
3.92	0.978	4.8	5	0.97447	0.5131	1.36E-07	4	10.98969	19	30	16.85236	21.12162	0	0	0	0.33	0	118.20546	0.03705	0	0	20
3.94	0.985	5.8	5	0.98986	0.55563	1.29E-07	4	11.33005	19	30	17.29563	21.67719	0	0	0	0.33	0	119.28576	0.03309	0	0	20
3.96	0.99	5.9	4	0.98759	0.61429	1.13E-07	4	11.25281	0	0	17.66386	22.13871	14	65.43192	0.87744	0.33	4.05375	120.10004	0	1.06197	10.56977	20
3.98	0.97	6.5	4	0.97089	0.76562	8.16E-08	4	10.86248	0	0	0	23.04824	14	64.21758	0.86302	0.33	3.98713	121.62818	0	1.05597	8.46635	20
4	0.934	9.9	4	1.03851	0.91156	7.83E-08	4	12.51084	0	0	0	24.95568	14	69.02519	0.92475	0.33	4.27233	125.32099	0	1.08122	7.14557	20
4.02	1.192	12	4	1.11709	1.36963	5.36E-08	5	14.62453	0	0	0	28.8908	14	74.61495	1.0023	0.33	4.63061	132.39854	0	1.11141	4.77926	20
4.04	1.192	24	5	1.80487	1.10811	2.67E-07	7	24.24883	25	32	28.57837	35.81822	0	0	0	0.33	0	145.22612	-0.02593	0	0	20
4.06	2.984	24	5	3.29283	0.72379	2.42E-06	10	44.69794	34	35	35.66325	44.69794	0	0	0	0.33	0	160.16751	-0.03452	0	0	20
4.08	5.641	23.5	6	5.38861	0.45652	1.67E-05	13	52.0224	43	37	41.50723	52.0224	0	0	0	0.33	0	171.66531	-0.05917	0	0	20
4.1	7.488	26.3	6	5.78605	0.42804	2.18E-05	14	53.2722	44	38	42.50441	53.2722	0	0	0	0.33	0	173.5396	-0.06445	0	0	20
4.12	4.195	24.5	6	4.91856	0.5076	1.12E-05	13	50.98123	41	37	40.67651	50.98123	0	0	0	0.33	0	170.02707	-0.05273	0	0	20
4.14	3.06	24.1	5	3.18164	0.80776	1.82E-06	10	43.49947	33	35	36.25367	45.43793	0	0	0	0.33	0	161.14146	-0.03662	0	0	20
4.16	2.289	28.5	5	2.32407	1.27363	3.92E-07	8	31.48867	29	34	34.62506	43.39674	0	0	0	0.33	0	157.2877	-0.04509	0	0	20
4.18	1.624	36.2	4	1.7152	2.25435	6.83E-08	7	22.9596	0	0	0	43.40918	14	117.14079	1.51559	0.33	7.00203	156.44496	0	1.28025	2.96891	20
4.2	1.234	51.3	3	1.27028	4.27727	9.85E-09	6	16.72577	0	0	0	44.89796	14	85.33554	1.12901	0.33	5.21605	157.85732	0	1.1576	1.53918	20
4.22	0.954	75.5	3	1.02035	6.56313	2.36E-09	6	11.74472	0	0	0	45.96895	14	67.45757	0.88829	0.33	4.10391	159.02663	0	1.06645	0.98718	20
4.24	0.874	74.1	3	0.90577	7.84967	1.19E-09	5	9.01761	0	0	0	45.72288	14	59.24801	0.77654	0.33	3.5876	158.49725	0	1.01851	0.81664	20
4.26	0.89	63.7	3	0.88553	7.36285	1.25E-09	5	8.5356	0	0	0	44.14486	14	57.77671	0.75375	0.33	3.48231	156.21271	0	1.00819	0.86842	20
4.28	0.893	57.8	3	0.89067	6.45206	1.63E-09	5	8.59756	0	0	0	42.33086	14	58.11906	0.75475	0.33	3.48693	153.5896	0	1.00865	0.99113	20
4.3	0.889	50.9	3	0.88559	5.40507	2.24E-09	5	8.44502	0	0	0	39.71537	14	57.73112	0.74634	0.33	3.44808	149.67497	0	1.00479	1.18196	20
4.32	0.874	34.9	3	0.87522	4.23895	3.38E-09	5	8.18644	0	0	0	36.36905	14	56.96587	0.7332	0.33	3.3874	144.47217	0	0.99871	1.50476	20
4.34	0.861	25.5	3	0.85696	3.104	5.52E-09	5	7.77579	0	0	0	32.50743	14	55.63796	0.71305	0.33	3.29427	138.17567	0	0.98923	2.04982	20
4.36	0.833	19.4	3	0.83034	2.27618	8.44E-09	4	7.21694	0	0	0	29.05944	14	53.71313	0.68551	0.33	3.16707	132.25648	0	0.976	2.78513	20
4.38	0.791	11.8	3	0.79943	1.71788	1.17E-08	4	6.60327	0	0	0	26.25712	14	51.48301	0.65439	0.33	3.0233	127.21716	0	0.96061	3.67379	20
4.4	0.764	10	4	0.78604	1.37823	1.52E-08	4	6.31222	0	0	0	24.55861	14	50.50353	0.63768	0.33	2.94609	124.12778	0	0.95215	4.56863	20
4.42	0.788	10.7	4	0.79406	1.38109	1.55E-08	4	6.42446	0	0	0	24.75506	14	51.0545	0.64202	0.33	2.96612	124.55172	0	0.95436	4.56232	20
4.44	0.811	12.2	4	0.81751	1.39041	1.65E-08	4	6.81494	0	0	0	25.25227	14	52.70659	0.65969	0.33	3.04778	125.58645	0	0.96326	4.5442	20
4.46	0.831	11.2	4	0.84759	1.36072	1.88E-08	4	7.33617	0	0	0	25.67099	14	54.83303	0.68261	0.33	3.15365	126.50018	0	0.97458	4.65922	20
4.48	0.875	11.2	4	0.93949	1.22052	2.94E-08	4	9.10679	0	0	0	26.48683	14	61.37455	0.75704	0.33	3.49754	128.3609	0	1.0097	5.24538	20
4.5	1.083	12	5	2.43446	0.48882	1.50E-06	8	32.95444	28	33	28.44006	35.64487	0	0	0	0.33	0	147.01881	0.00491	0	0	20
4.52	5.311	12.5	6	5.14328	0.26961	2.39E-05	12	46.4404	40	37	37.05351	46.4404	0	0	0	0.33	0	165.46205	-0.03808	0	0	20
4.54	8.994	17.1	6	9.19637	0.1642	1.97E-04	18	57.06791	54	40	45.53291	57.06791	0	0	0	0.33	0	181.67685	-0.10084	0	0	20
4.56	13.243	15.7	6	13.34181	0.12792	6.93E-04	24	66.1447	64	41	52.77503	66.1447	0	0	0	0.33	0	193.97757	-0.15229	0	0	20
4.58	17.756	18.4	7	16.2367	0.12277	1.25E-03	27	72.43125	71	42	57.79089	72.43125	0	0	0	0.33	0	201.50839	-0.17942	0	0	20
4.6	17.696	25.7	7	17.12664	0.14947	1.23E-03	29	76.62026	72	42	61.13319	76.62026	0	0	0	0.33	0	205.45177	-0.1869	0	0	20
4.62	15.924	32.7	6	16.17159	0.21375	7.14E-04	29	79.83581	70	42	63.69878	79.83581	0	0	0	0.33	0	207.83955	-0.17921	0	0	20
4.64	14.896	45.3	6	14.9569	0.34076	3.05E-04	29	86.08893	68	42	68.68797	86.08893	0	0	0	0.33	0	213.38733	-0.16894	0	0	20
4.66	14.052	74.9	6	13.92887	0.49777	1.37E-04	29	92.6074	66	42	73.88888	92.6074	0	0	0	0.33	0	219.39467	-0.15951	0	0	20
4.68	12.84	87.8	6	13.10185	0.65258	7.26E-05	29	97.68106	64	41	77.93702	97.68106	0	0	0	0.33	0	224.03659	-0.15417	0	0	20
4.7	12.415	93.8	6	12.48621	0.71626	5.42E-05	28	98.09928	62	41	78.2707	98.09928	0	0	0	0.33	0	224.32022	-0.15119	0	0	20
4.72	12.205	86.7	6	12.33225	0.71385	5.27E-05	28	97.37982	62	41	77.69667	97.37982	0	0	0	0.33	0	223.6301	-0.14946	0	0	20
4.74	12.378	83.6	6	12.45195	0.66255	6.15E-05	28	95.61388	62	41	76.28767	95.61388	0	0	0	0.33	0	222.00591	-0.14826	0	0	20
4.76	12.774	77.2	6	12.83498	0.5994	7.88E-05	28	94.24595	63	41	75.19623	94.24595	0	0	0	0.33	0	220.81125	-0.14857	0	0	20
4.78	13.354	70	6	13.43061	0.54006	1.05E-04	28	93.61913	64	41	74.69611	93.61913	0	0	0	0.33	0	220.3685	-0.15266	0	0	20
4.8	14.165	70.4	6	13.96881	0.50756	1.28E-04	29	93.95143	65	42	74.96125	93.95143	0	0	0	0.33	0	220.82428	-0.15777	0	0	20
4.82	14.39	72.3	6	14.34402	0.49916	1.40E-04	29	94.95509	66	42	75.76204	94.95509	0	0	0	0.33	0	221.87469	-0.16118	0	0	20
4.84	14.482	72.1	6	14.48775	0.49122	1.47E-04	30	95.09686	66	42	75.87516	95.09686	0	0	0	0.33	0	222.05881	-0.16226	0	0	20
4.86	14.599	69.1	6	14.60603	0.46716	1.63E-04	30	94.13656	67	42	75.10896	94.13656	0	0	0	0.33	0	221.19975	-0.16302	0	0	20
4.88	14.747	63.5	6	14.76641	0.43838	1.85E-04	30	92.97039	67	42	74.17851	92.97039	0	0	0	0.33	0	220.15446	-0.16416	0	0	20
4.9	14.962	61.6	6	14.86845	0.41565	2.05E-04	29	91.92615	67	42	73.34534	91.92615	0	0	0	0.33	0	219.21013	-0.16475	0	0	20
4.92	14.902	60.3	6	14.80139	0.42316	1.96E-04	29	92.27244	67	42	73.62163	92.27244	0	0	0	0.33	0	219.54265	-0.16385	0	0	20
4.94	14.542	66	6	14.5615	0.44707	1.70E-04	29	93.05706	66	42	74.24766	93.05706	0	0	0	0.33	0	220.2504	-0.16134	0	0	20
4.96	14.241	69	6	14.40446	0.46976	1.52E-04	29	93.99818	66	42	74.99855	93.99818	0	0	0	0.33	0	221.12454	-0.15958	0	0	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
4.98	14.431	68	6	14.44683	0.47692	1.48E-04	30	94.68027	66	42	75.54277	94.68027	0	0	0	0.33	0	221.79662	-0.15972	0	0	20
5	14.669	69.7	6	14.70467	0.47332	1.56E-04	30	95.48019	66	42	76.181	95.48019	0	0	0	0.33	0	222.62306	-0.16193	0	0	20
5.02	15.014	71.1	6	14.92393	0.47709	1.59E-04	30	96.59718	67	42	77.07221	96.59718	0	0	0	0.33	0	223.7332	-0.16376	0	0	20
5.04	15.088	72.8	6	15.05311	0.48074	1.59E-04	31	97.38325	67	42	77.6994	97.38325	0	0	0	0.33	0	224.51128	-0.1647	0	0	20
5.06	15.056	73.2	6	14.91384	0.48501	1.53E-04	30	97.23514	67	42	77.58123	97.23514	0	0	0	0.33	0	224.3647	-0.1631	0	0	20
5.08	14.596	71	6	14.67218	0.48277	1.47E-04	30	96.29949	66	42	76.8347	96.29949	0	0	0	0.33	0	223.46176	-0.16047	0	0	20
5.1	14.363	68.3	6	14.40154	0.48004	1.41E-04	30	95.22375	65	42	75.9764	95.22375	0	0	0	0.33	0	222.41646	-0.15752	0	0	20
5.12	14.244	68.1	6	14.24422	0.47575	1.39E-04	29	94.46662	65	41	75.37231	94.46662	0	0	0	0.33	0	221.69008	-0.15565	0	0	20
5.14	14.124	66.9	6	14.09722	0.47456	1.35E-04	29	93.9376	65	41	74.95022	93.9376	0	0	0	0.33	0	221.17867	-0.15388	0	0	20
5.16	13.922	65.7	6	13.8902	0.47396	1.30E-04	29	93.21993	64	41	74.3776	93.21993	0	0	0	0.33	0	220.47359	-0.15148	0	0	20
5.18	13.623	64.9	6	13.5075	0.48097	1.17E-04	28	92.29216	63	41	73.63736	92.29216	0	0	0	0.33	0	219.52521	-0.14721	0	0	20
5.2	12.976	64.3	6	13.07218	0.4929	1.03E-04	28	91.40803	62	41	72.93194	91.40803	0	0	0	0.33	0	218.59947	-0.14225	0	0	20
5.22	12.616	64.1	6	12.62287	0.50886	8.89E-05	27	90.62832	61	41	72.30983	90.62832	0	0	0	0.33	0	217.76373	-0.13702	0	0	20
5.24	12.275	64.3	6	12.11891	0.5303	7.44E-05	26	89.83252	60	41	71.67489	89.83252	0	0	0	0.33	0	216.89247	-0.13346	0	0	20
5.26	11.464	64.4	6	11.59756	0.55701	6.09E-05	26	89.10676	58	40	71.09582	89.10676	0	0	0	0.33	0	216.07747	-0.12961	0	0	20
5.28	11.052	65.1	6	11.06254	0.58606	4.92E-05	25	88.27929	57	40	70.4356	88.27929	0	0	0	0.33	0	215.1521	-0.12534	0	0	20
5.3	10.67	65	6	10.68318	0.60625	4.23E-05	25	87.59684	56	40	69.89109	87.59684	0	0	0	0.33	0	214.40231	-0.12201	0	0	20
5.32	10.326	64.2	6	10.45081	0.61112	3.93E-05	24	86.83768	55	40	69.28538	86.83768	0	0	0	0.33	0	213.61143	-0.11951	0	0	20
5.34	10.355	62.4	6	10.40603	0.60798	3.90E-05	24	86.57695	55	40	69.07735	86.57695	0	0	0	0.33	0	213.36197	-0.11867	0	0	20
5.36	10.536	63.2	6	10.50831	0.60016	4.06E-05	24	86.77983	55	40	69.23922	86.77983	0	0	0	0.33	0	213.61119	-0.11921	0	0	20
5.38	10.634	63.6	6	10.66152	0.58747	4.35E-05	24	86.97979	55	40	69.39877	86.97979	0	0	0	0.33	0	213.8708	-0.12009	0	0	20
5.4	10.817	61.1	6	10.95669	0.54913	5.20E-05	25	86.55702	56	40	69.06146	86.55702	0	0	0	0.33	0	213.55513	-0.12135	0	0	20
5.42	11.424	55.8	6	11.33474	0.49906	6.62E-05	25	85.73596	57	40	68.40635	85.73596	0	0	0	0.33	0	212.87146	-0.1227	0	0	20
5.44	11.769	52.8	6	11.76614	0.46319	8.19E-05	25	85.64973	58	40	68.33755	85.64973	0	0	0	0.33	0	212.92787	-0.1248	0	0	20
5.46	12.111	54.9	6	12.27727	0.44744	9.63E-05	26	86.82672	59	41	69.27664	86.82672	0	0	0	0.33	0	214.23904	-0.12941	0	0	20
5.48	12.957	57.1	6	12.85015	0.4428	1.10E-04	27	88.79292	61	41	70.84541	88.79292	0	0	0	0.33	0	216.31372	-0.1357	0	0	20
5.5	13.488	58.7	6	13.42585	0.43449	1.26E-04	28	90.48754	62	41	72.19751	90.48754	0	0	0	0.33	0	218.10223	-0.14174	0	0	20
5.52	13.838	59.2	6	13.79553	0.4284	1.38E-04	28	91.51888	63	41	73.02038	91.51888	0	0	0	0.33	0	219.19231	-0.14538	0	0	20
5.54	14.065	59.4	6	13.94089	0.43637	1.37E-04	29	92.62544	63	41	73.90328	92.62544	0	0	0	0.33	0	220.29387	-0.14662	0	0	20
5.56	13.923	63.9	6	13.86352	0.45179	1.26E-04	29	93.39855	63	41	74.52012	93.39855	0	0	0	0.33	0	221.02602	-0.14554	0	0	20
5.58	13.605	64.6	6	12.63423	0.48202	8.89E-05	27	90.65196	60	41	72.32869	90.65196	0	0	0	0.33	0	218.14703	-0.13188	0	0	20
5.6	10.375	54.2	6	11.45224	0.50354	6.38E-05	25	87.17542	57	40	69.55486	87.17542	0	0	0	0.33	0	214.50021	-0.12201	0	0	20
5.62	10.375	54.2	6	10.16225	0.53335	4.23E-05	23	83.22529	53	40	66.40316	83.22529	0	0	0	0.33	0	210.24768	-0.10977	0	0	20
5.64	9.733	54.2	6	9.73226	0.55143	3.56E-05	23	82.20046	52	39	65.58548	82.20046	0	0	0	0.33	0	209.10748	-0.10545	0	0	20
5.66	9.085	52.6	6	9.10397	0.57191	2.80E-05	22	80.242	50	39	64.02287	80.242	0	0	0	0.33	0	206.94063	-0.09865	0	0	20
5.68	8.49	49.4	6	8.31168	0.59956	2.03E-05	20	77.56146	48	39	61.88414	77.56146	0	0	0	0.33	0	203.92873	-0.08963	0	0	20
5.7	7.356	47.5	6	7.56438	0.63543	1.43E-05	19	75.08925	46	38	59.91163	75.08925	0	0	0	0.33	0	201.07948	-0.08099	0	0	20
5.72	6.843	47.3	6	6.88873	0.67744	1.00E-05	18	72.85078	44	38	58.12562	72.85078	0	0	0	0.33	0	198.44058	-0.07323	0	0	20
5.74	6.463	45.2	6	6.46739	0.71075	7.79E-06	17	71.50739	42	37	57.05377	71.50739	0	0	0	0.33	0	196.82805	-0.06853	0	0	20
5.76	6.092	45.4	6	6.1173	0.74052	6.24E-06	17	70.32678	41	37	56.1118	70.32678	0	0	0	0.33	0	195.40237	-0.06466	0	0	20
5.78	5.793	45.3	6	5.78153	0.77719	4.93E-06	16	69.28856	40	37	55.28343	69.28856	0	0	0	0.33	0	194.12123	-0.06134	0	0	20
5.8	5.457	44.1	5	5.39653	0.82213	3.72E-06	16	67.97113	38	36	54.23228	67.97113	0	0	0	0.33	0	192.4859	-0.05773	0	0	20
5.82	4.939	43.7	5	5.01573	0.82673	3.01E-06	15	65.52273	37	36	52.27877	65.52273	0	0	0	0.33	0	189.54539	-0.0521	0	0	20
5.84	4.654	36.6	5	4.65351	0.83235	2.42E-06	14	63.13331	35	36	50.37232	63.13331	0	0	0	0.33	0	186.61705	-0.04672	0	0	20
5.86	4.373	35.9	5	4.26779	0.83259	1.90E-06	13	60.35012	34	35	48.15169	60.35012	0	0	0	0.33	0	183.14009	-0.04057	0	0	20
5.88	3.784	34.1	5	3.87179	1.07272	9.57E-07	13	52.71915	32	35	49.33445	61.83252	0	0	0	0.33	0	184.6338	-0.0474	0	0	20
5.9	3.467	54.6	5	3.42754	1.41696	4.25E-07	12	46.49456	30	34	50.39514	63.1619	0	0	0	0.33	0	185.91336	-0.05707	0	0	20
5.92	3.041	57	4	2.96501	1.97639	1.58E-07	11	40.0141	0	0	51.86691	65.00652	14	204.15357	1.9264	0.33	8.89996	187.7702	0	1.3897	3.41417	20
5.94	2.397	64.2	4	2.52831	2.42587	7.06E-08	10	33.89522	0	0	0	63.70319	14	172.93477	1.62201	0.33	7.49371	185.92281	0	1.31032	2.7632	20
5.96	2.157	62.8	4	2.19132	3.04535	3.13E-08	10	29.17235	0	0	0	63.51639	14	148.83853	1.38717	0.33	6.40874	185.43364	0	1.24207	2.18574	20
5.98	2.03	73.2	4	2.38441	3.07694	3.80E-08	10	31.87043	0	0	0	67.01823	14	162.60422	1.51172	0.33	6.98413	189.73801	0	1.27913	2.172	20
6	2.976	84.1	4	2.65748	3.02794	5.14E-08	11	35.68825	0	0	0	71.05456	14	182.08292	1.68951	0.33	7.80555	194.5822	0	1.32872	2.21758	20
6.02	2.976	84.1	4	2.88853	2.91151	6.80E-08	12	38.91785	0	0	0	73.64597	14	198.56043	1.83884	0.33	8.49544	197.65488	0	1.36777	2.31378	20
6.04	2.723	84.1	4	2.68883	3.12404	4.90E-08	12	36.11685	0	0	0	72.52899	14	184.26965	1.69851	0.33	7.8471	196.30338	0	1.33113	2.14981	20
6.06	2.377	83.8	4	2.4138	3.28251	3.34E-08	11	32.26129	0	0	0	69.42291	14	164.59843	1.50955	0.33	6.97411	192.62119	0	1.27851	2.03584	20
6.08	2.151	69.8	5	4.04378	1.87284	3.66E-07	14	55.07576	32	35	61.3316	76.86894	0	0	0	0.33	0	201.88737	-0.08307	0	0	20
6.1	7.613	73.6	6	7.57782	0.99853	5.80E-06	21	88.51735	45	38	70.62555	88.51735	0	0	0	0.33	0	215.2541	-0.09168	0	0	20
6.12	12.979	83.6	6	12.86913	0.63382	5.05E-05	29	102.21332	59	40	81.55318	102.21332	0	0	0	0.33	0	229.54242	-0.13459	0	0	20

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Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
6.14	18.025	87.5	6	18.32078	0.46359	2.16E-04	36	112.14087	70	42	89.4741	112.14087	0	0	0	0.33	0	239.29015	-0.1787	0	0	20
6.16	23.968	83.7	6	22.40039	0.3613	5.59E-04	40	115.58747	78	43	92.22404	115.58747	0	0	0	0.33	0	242.80313	-0.20822	0	0	20
6.18	25.218	71.6	7	24.78276	0.31837	8.99E-04	43	117.40707	82	44	93.67585	117.40707	0	0	0	0.33	0	244.64648	-0.22297	0	0	20
6.2	25.172	81.4	7	25.04545	0.32767	8.76E-04	43	119.21121	82	44	95.11533	119.21121	0	0	0	0.33	0	246.20378	-0.22425	0	0	20
6.22	24.756	93.2	6	24.75051	0.39986	5.93E-04	44	126.41614	82	44	100.86394	126.41614	0	0	0	0.33	0	252.16051	-0.22198	0	0	20
6.24	24.333	122.3	6	24.24156	0.47384	4.07E-04	45	132.53897	81	44	105.74918	132.53897	0	0	0	0.33	0	257.11993	-0.21841	0	0	20
6.26	23.645	129.1	6	23.72628	0.5364	3.02E-04	45	136.93371	80	43	109.25562	136.93371	0	0	0	0.33	0	260.62222	-0.2148	0	0	20
6.28	23.21	130.4	6	23.18634	0.57361	2.49E-04	45	138.56263	79	43	110.55529	138.56263	0	0	0	0.33	0	261.89078	-0.21105	0	0	20
6.3	22.713	139.5	6	22.4144	0.61121	2.01E-04	45	139.17523	77	43	111.04406	139.17523	0	0	0	0.33	0	262.32944	-0.20571	0	0	20
6.32	21.329	141.1	6	21.4598	0.65363	1.58E-04	44	139.20748	75	43	111.0698	139.20748	0	0	0	0.33	0	262.29095	-0.19893	0	0	20
6.34	20.346	140.2	6	20.24418	0.69271	1.22E-04	42	137.59275	73	43	109.78145	137.59275	0	0	0	0.33	0	260.91409	-0.18999	0	0	20
6.36	19.066	139.4	6	18.47788	0.75766	8.13E-05	40	134.98675	70	42	107.70219	134.98675	0	0	0	0.33	0	258.67239	-0.17746	0	0	20
6.38	16.03	140.4	6	16.52493	0.84942	4.92E-05	37	132.07872	66	42	105.38196	132.07872	0	0	0	0.33	0	256.12875	-0.16727	0	0	20
6.4	14.487	141.3	6	14.58297	0.95888	2.85E-05	35	128.57062	61	41	102.58294	128.57062	0	0	0	0.33	0	253.03972	-0.15551	0	0	20
6.42	13.24	137.8	6	13.02736	1.05445	1.79E-05	32	124.83073	58	40	99.59899	124.83073	0	0	0	0.33	0	249.7366	-0.14506	0	0	20
6.44	11.363	133	6	11.7194	1.1417	1.18E-05	30	121.00056	55	40	96.543	121.00056	0	0	0	0.33	0	246.32013	-0.13581	0	0	20
6.46	10.563	130.6	6	10.51045	1.28253	7.12E-06	28	118.69871	52	39	94.70642	118.69871	0	0	0	0.33	0	244.1731	-0.12874	0	0	20
6.48	9.613	140.8	5	9.77751	1.43288	4.75E-06	27	118.72198	50	39	94.72498	118.72198	0	0	0	0.33	0	244.09305	-0.12646	0	0	20
6.5	9.164	148.9	5	9.76325	1.51452	4.19E-06	28	121.24392	50	39	96.73717	121.24392	0	0	0	0.33	0	246.28482	-0.12876	0	0	20
6.52	10.52	153.9	5	10.42143	1.48092	5.09E-06	29	125.04677	51	39	99.77136	125.04677	0	0	0	0.33	0	249.64519	-0.13348	0	0	20
6.54	11.587	160.2	6	12.38228	1.2849	1.02E-05	32	131.26119	56	40	104.72968	131.26119	0	0	0	0.33	0	255.11893	-0.14458	0	0	20
6.56	15.046	163.2	6	14.43503	1.05577	2.19E-05	35	133.42585	61	41	106.4568	133.42585	0	0	0	0.33	0	257.15335	-0.15501	0	0	20
6.58	16.678	133.8	6	16.54486	0.85283	4.68E-05	38	133.44182	65	41	106.46953	133.44182	0	0	0	0.33	0	257.40494	-0.16524	0	0	20
6.6	17.917	126.3	6	17.84033	0.7115	8.06E-05	39	130.45505	68	42	104.08647	130.45505	0	0	0	0.33	0	255.10782	-0.1693	0	0	20
6.62	18.933	120.7	6	18.57718	0.66551	1.01E-04	39	130.40381	69	42	104.04559	130.40381	0	0	0	0.33	0	255.15364	-0.17375	0	0	20
6.64	18.889	123.9	6	18.83415	0.67643	1.01E-04	40	132.3098	70	42	105.56633	132.3098	0	0	0	0.33	0	256.75171	-0.17547	0	0	20
6.66	18.688	137.6	6	18.5338	0.73955	8.06E-05	40	135.56721	69	42	108.16532	135.56721	0	0	0	0.33	0	259.38	-0.17402	0	0	20
6.68	18.032	149.7	6	18.12987	0.77	7.01E-05	40	135.97853	68	42	108.49351	135.97853	0	0	0	0.33	0	259.69034	-0.17231	0	0	20
6.7	17.677	131.5	6	17.53096	0.783	6.23E-05	39	134.30216	67	42	107.15598	134.30216	0	0	0	0.33	0	258.29541	-0.16862	0	0	20
6.72	16.891	130.6	6	16.99703	0.77739	5.84E-05	38	131.68535	66	42	105.0681	131.68535	0	0	0	0.33	0	256.12814	-0.16463	0	0	20
6.74	16.43	134.3	6	16.44604	0.81114	4.93E-05	37	131.36137	64	41	104.80961	131.36137	0	0	0	0.33	0	255.82367	-0.16157	0	0	20
6.76	16.024	135.3	6	16.07904	0.83691	4.36E-05	37	131.28099	64	41	104.74547	131.28099	0	0	0	0.33	0	255.73653	-0.15943	0	0	20
6.78	15.79	134.1	6	15.93406	0.84097	4.21E-05	37	130.93784	63	41	104.47168	130.93784	0	0	0	0.33	0	255.4561	-0.15826	0	0	20
6.8	15.995	132.6	6	16.02572	0.81473	4.53E-05	37	129.94555	63	41	103.67996	129.94555	0	0	0	0.33	0	254.66527	-0.15798	0	0	20
6.82	16.299	125	6	16.55639	0.76768	5.50E-05	37	129.63147	64	41	103.42937	129.63147	0	0	0	0.33	0	254.47688	-0.1602	0	0	20
6.84	17.382	123.7	6	17.19802	0.72702	6.70E-05	38	129.96467	66	42	103.69522	129.96467	0	0	0	0.33	0	254.83148	-0.16313	0	0	20
6.86	17.92	126.4	6	17.85331	0.7093	7.68E-05	39	131.66916	67	42	105.05518	131.66916	0	0	0	0.33	0	256.30811	-0.16663	0	0	20
6.88	18.265	129.8	6	18.08524	0.72472	7.55E-05	39	133.79057	67	42	106.7478	133.79057	0	0	0	0.33	0	258.07254	-0.16844	0	0	20
6.9	18.078	137	6	18.01467	0.77696	6.46E-05	40	137.07934	67	42	109.37181	137.07934	0	0	0	0.33	0	260.7356	-0.16948	0	0	20
6.92	17.709	153.1	6	17.67006	0.84889	5.11E-05	40	140.24922	66	42	111.90097	140.24922	0	0	0	0.33	0	263.25284	-0.1691	0	0	20
6.94	17.232	159.9	6	17.08379	0.91939	3.98E-05	39	141.867	65	41	113.19176	141.867	0	0	0	0.33	0	264.50037	-0.16678	0	0	20
6.96	16.32	158.2	6	16.49923	0.93459	3.52E-05	39	140.00082	64	41	111.70278	140.00082	0	0	0	0.33	0	262.98334	-0.16283	0	0	20
6.98	15.955	144.5	6	15.94315	0.9306	3.26E-05	37	137.12915	63	41	109.41156	137.12915	0	0	0	0.33	0	260.6499	-0.15848	0	0	20
7	15.563	142.4	6	15.34215	0.92751	2.99E-05	36	134.05937	61	41	106.96227	134.05937	0	0	0	0.33	0	258.12531	-0.15367	0	0	20
7.02	14.516	140	6	14.6893	0.94559	2.57E-05	35	131.8024	60	41	105.16149	131.8024	0	0	0	0.33	0	256.23218	-0.14886	0	0	20
7.04	13.996	134.3	6	14.0107	0.95165	2.26E-05	34	128.68914	58	40	102.67751	128.68914	0	0	0	0.33	0	253.608	-0.14334	0	0	20
7.06	13.527	125.7	6	13.42934	0.93303	2.11E-05	33	124.81072	57	40	99.58302	124.81072	0	0	0	0.33	0	250.3172	-0.13778	0	0	20
7.08	12.771	115.9	6	13.0213	0.91517	2.02E-05	32	121.88937	56	40	97.25216	121.88937	0	0	0	0.33	0	247.81184	-0.13356	0	0	20
7.1	12.771	115.9	6	12.95423	0.88826	2.11E-05	32	120.33035	56	40	96.00826	120.33035	0	0	0	0.33	0	246.48953	-0.132	0	0	20
7.12	13.325	113.4	6	13.21095	0.86898	2.30E-05	32	120.80556	56	40	96.38742	120.80556	0	0	0	0.33	0	246.94492	-0.13348	0	0	20
7.14	13.542	115.1	6	13.7331	0.83982	2.70E-05	33	122.05319	57	40	97.38287	122.05319	0	0	0	0.33	0	248.08794	-0.13691	0	0	20
7.16	14.339	117.5	6	14.2301	0.82735	3.02E-05	34	123.9429	59	40	98.89061	123.9429	0	0	0	0.33	0	249.76163	-0.14048	0	0	20
7.18	14.818	120.6	6	14.77671	0.81886	3.37E-05	35	126.22528	60	41	100.71166	126.22528	0	0	0	0.33	0	251.7543	-0.14444	0	0	20
7.2	15.184	124.9	6	15.42611	0.80729	3.84E-05	36	128.75444	61	41	102.72961	128.75444	0	0	0	0.33	0	253.94183	-0.14896	0	0	20
7.22	16.289	128.1	6	15.96827	0.81224	4.11E-05	37	131.68939	62	41	105.07132	131.68939	0	0	0	0.33	0	256.42734	-0.15295	0	0	20
7.24	16.445	136.1	6	16.3748	0.85742	3.89E-05	38	136.40107	63	41	108.83064	136.40107	0	0	0	0.33	0	260.30725	-0.15691	0	0	20
7.26	16.403	157	6	16.14778	0.93718	3.12E-05	38	140.03294	62	41	111.72841	140.03294	0	0	0	0.33	0	263.21133	-0.15708	0	0	20
7.28	15.607	160.9	6	15.64615	1.02304	2.39E-05	38	142.29059	61	41	113.52972	142.29059	0	0	0	0.33	0	264.97449	-0.15529	0	0	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
7.3	14.94	162.3	6	14.91551	1.06198	1.96E-05	37	140.50904	59	41	112.10828	140.50904	0	0	0	0.33	0	263.51187	-0.15052	0	0	20
7.32	14.211	152	6	13.86519	1.09387	1.54E-05	35	136.34466	57	40	108.78563	136.34466	0	0	0	0.33	0	260.08881	-0.14286	0	0	20
7.34	12.456	140.7	6	12.73286	1.13564	1.16E-05	33	131.79346	54	40	105.15436	131.79346	0	0	0	0.33	0	256.27911	-0.13444	0	0	20
7.36	11.543	141.1	6	11.55183	1.1975	8.14E-06	31	127.27267	52	39	101.54734	127.27267	0	0	0	0.33	0	252.41197	-0.12583	0	0	20
7.38	10.668	133.2	5	10.27146	1.26045	5.46E-06	29	121.44246	48	39	96.89558	121.44246	0	0	0	0.33	0	247.32915	-0.11605	0	0	20
7.4	8.615	114.1	5	8.93673	1.32711	3.46E-06	26	114.50755	45	38	91.36241	114.50755	0	0	0	0.33	0	241.12012	-0.10553	0	0	20
7.42	7.539	108.5	5	7.74331	1.39604	2.17E-06	23	107.7276	42	37	85.95287	107.7276	0	0	0	0.33	0	234.85707	-0.0961	0	0	20
7.44	7.088	101.7	5	7.20294	1.44571	1.67E-06	22	98.93061	40	37	83.67674	104.87484	0	0	0	0.33	0	232.15555	-0.09233	0	0	20
7.46	6.994	102.2	5	6.99224	1.46162	1.51E-06	22	95.97546	39	37	82.70838	103.66116	0	0	0	0.33	0	231.00772	-0.09062	0	0	20
7.48	6.907	102.7	5	6.88788	1.56216	1.26E-06	22	94.50909	39	37	84.08841	105.39081	0	0	0	0.33	0	232.60094	-0.09325	0	0	20
7.5	6.775	117.9	5	6.97677	1.62683	1.20E-06	22	95.74811	39	37	86.0373	107.83342	0	0	0	0.33	0	234.87372	-0.09643	0	0	20
7.52	7.261	119.9	5	7.18929	1.65988	1.23E-06	23	98.71802	40	37	88.23666	110.58995	0	0	0	0.33	0	237.42905	-0.09961	0	0	20
7.54	7.545	120.2	5	7.39177	1.65003	1.33E-06	23	101.54737	40	37	89.52129	112.20001	0	0	0	0.33	0	238.92928	-0.10109	0	0	20
7.56	7.383	125.8	5	6.5803	1.91987	7.25E-07	22	90.18134	38	36	88.74439	111.2263	0	0	0	0.33	0	237.91571	-0.10248	0	0	20
7.58	4.827	133	4	5.35687	2.45604	2.58E-07	20	73.04803	0	0	86.63449	108.5819	14	372.69403	2.80065	0.33	12.93901	235.26695	0	1.57945	2.77608	20
7.6	3.875	135.9	4	4.03282	3.04584	7.99E-08	17	54.50599	0	0	0	100.18946	14	278.0918	2.04085	0.33	9.42872	227.10335	0	1.41741	2.2187	20
7.62	3.411	99.6	4	3.25047	3.39233	3.63E-08	14	43.54784	0	0	0	92.33443	14	222.18285	1.6031	0.33	7.40634	219.21194	0	1.30507	1.97466	20
7.64	2.48	95.3	3	2.59612	3.66701	1.70E-08	12	34.38169	0	0	0	83.58217	14	175.41676	1.25043	0.33	5.77698	209.99025	0	1.19875	1.80576	20
7.66	1.912	90.7	3	1.97449	4.4214	5.73E-09	10	23.90954	0	0	0	76.0079	14	130.98823	0.93129	0.33	4.30254	201.3605	0	1.08383	1.47043	20
7.68	1.546	75.9	3	1.58318	4.70782	2.75E-09	9	14.749	0	0	0	68.25297	14	103.01174	0.7305	0.33	3.37491	192.21013	0	0.99744	1.35445	20
7.7	1.306	57	3	1.38755	4.4587	2.07E-09	8	10.98482	0	0	0	62.07408	14	89.01254	0.62963	0.33	2.90889	184.65762	0	0.94802	1.41	20
7.72	1.325	52.7	3	1.31526	4.18168	1.98E-09	8	9.71715	0	0	0	58.95626	14	83.8238	0.59145	0.33	2.73248	180.75087	0	0.92795	1.49359	20
7.74	1.329	55.3	3	1.37663	3.68532	2.82E-09	8	10.72727	0	0	0	58.17009	14	88.18243	0.62066	0.33	2.86743	179.92528	0	0.94338	1.70339	20
7.76	1.49	44.2	3	1.61702	2.84062	7.09E-09	8	15.26638	0	0	0	58.80301	14	105.32756	0.7395	0.33	3.41649	181.17207	0	1.00163	2.24719	20
7.78	2.046	38.3	4	2.15171	1.74125	3.77E-08	9	28.12507	0	0	0	59.23097	14	143.49525	1.01536	0.33	4.69096	182.47934	0	1.11634	3.75335	20
7.8	2.933	29.9	5	3.06141	1.1204	2.25E-07	11	40.85593	25	32	49.66534	62.24722	0	0	0	0.33	0	186.88792	-0.02442	0	0	20
7.82	4.219	34.7	5	4.25941	0.81936	9.86E-07	14	57.62299	30	34	53.63695	67.22498	0	0	0	0.33	0	193.40764	-0.02471	0	0	20
7.84	5.64	40.1	5	5.31969	0.77448	2.05E-06	16	74.0745	34	35	59.10199	74.0745	0	0	0	0.33	0	201.45032	-0.03633	0	0	20
7.86	6.114	48.8	5	5.39763	0.8547	1.80E-06	17	73.54798	34	35	61.39968	76.95427	0	0	0	0.33	0	204.55533	-0.04165	0	0	20
7.88	4.453	49.5	5	4.94821	1.01383	1.04E-06	16	67.25106	32	35	61.96275	77.65998	0	0	0	0.33	0	205.13284	-0.04426	0	0	20
7.9	4.292	52.2	5	4.1258	1.34439	3.77E-07	15	55.73226	29	34	61.73499	77.37452	0	0	0	0.33	0	204.49683	-0.04977	0	0	20
7.92	3.647	64.7	4	3.30808	1.9266	1.04E-07	13	44.27905	0	0	0	77.58507	14	225.91352	1.6037	0.33	7.4091	204.35248	0	1.30524	3.47377	20
7.94	2	74.3	3	2.39004	3.08363	1.72E-08	11	31.42138	0	0	0	76.29155	14	160.31314	1.10063	0.33	5.0849	202.40599	0	1.14756	2.13171	20
7.96	1.538	82.1	3	1.63504	4.6013	2.85E-09	9	15.18432	0	0	0	70.01938	14	106.359	0.72839	0.33	3.36517	194.55745	0	0.99646	1.38545	20
7.98	1.382	69.3	3	1.53506	4.89449	2.11E-09	9	13.174	0	0	0	68.95773	14	99.19133	0.67762	0.33	3.13062	193.21385	0	0.97214	1.2938	20
8	1.7	74	3	1.35537	4.74165	1.55E-09	8	9.95491	0	0	0	63.45269	14	86.33041	0.58833	0.33	2.71806	186.51535	0	0.92627	1.31645	20
8.02	0.998	49.5	3	1.22765	4.69732	1.17E-09	7	7.9378	0	0	0	59.72351	14	77.18258	0.52472	0.33	2.42419	181.77933	0	0.89072	1.31166	20
8.04	0.998	49.5	3	0.99392	4.98028	7.50E-10	6	4.85965	0	0	0	53.75715	14	60.46262	0.41007	0.33	1.89454	173.72247	0	0.8187	1.19704	20
8.06	0.998	49.5	3	1.00161	4.67249	7.96E-10	6	4.93262	0	0	0	52.95099	14	60.98679	0.41265	0.33	1.90646	172.71951	0	0.82046	1.27707	20
8.08	1.021	41.4	3	1.06632	4.11072	9.61E-10	7	5.69097	0	0	0	52.79139	14	65.58425	0.44272	0.33	2.04537	172.71376	0	0.84043	1.46629	20
8.1	1.192	40.6	3	1.15036	3.61625	1.48E-09	7	6.75999	0	0	0	53.0513	14	71.56271	0.48195	0.33	2.22661	173.2935	0	0.8652	1.68585	20
8.12	1.25	42.8	3	1.22841	3.39191	2.01E-09	7	7.83091	0	0	0	54.0731	14	77.11291	0.51812	0.33	2.39371	174.81822	0	0.88688	1.8137	20
8.14	1.255	41.6	3	1.22878	3.27696	2.12E-09	7	7.81305	0	0	0	53.55588	14	77.11448	0.51693	0.33	2.3882	174.17693	0	0.88618	1.87679	20
8.16	1.193	36.4	3	1.20484	3.09032	2.19E-09	7	7.44824	0	0	0	52.04856	14	75.37952	0.50413	0.33	2.32909	172.19444	0	0.87861	1.98403	20
8.18	1.178	33.7	3	1.18122	3.00255	2.15E-09	7	7.09759	0	0	0	51.05436	14	73.66811	0.49156	0.33	2.271	170.8573	0	0.87106	2.03557	20
8.2	1.184	36.3	3	1.18494	2.9678	2.20E-09	7	7.12785	0	0	0	51.01515	14	73.90944	0.49204	0.33	2.27324	170.83432	0	0.87135	2.05966	20
8.22	1.204	35.5	3	1.20365	2.93829	2.33E-09	7	7.36626	0	0	0	51.37092	14	75.22112	0.49963	0.33	2.30831	171.36638	0	0.87592	2.08436	20
8.24	1.234	34.3	3	1.22036	2.97726	2.36E-09	7	7.57971	0	0	0	52.03955	14	76.39024	0.50624	0.33	2.33884	172.29584	0	0.87987	2.06043	20
8.26	1.234	39.2	3	1.19708	3.10757	2.05E-09	7	7.23199	0	0	0	52.19452	14	74.70255	0.49393	0.33	2.28196	172.45328	0	0.87249	1.96797	20
8.28	1.134	38.1	3	1.1548	3.27328	1.67E-09	7	6.63947	0	0	0	51.99292	14	71.65843	0.47273	0.33	2.184	172.09683	0	0.8595	1.85781	20
8.3	1.107	36.1	3	1.11487	3.19619	1.54E-09	7	6.10324	0	0	0	50.61761	14	68.78144	0.45272	0.33	2.09158	170.20815	0	0.84688	1.89165	20
8.32	1.114	32.7	3	1.13359	2.90818	1.89E-09	7	6.32419	0	0	0	49.70835	14	70.09398	0.46033	0.33	2.12672	169.08281	0	0.85172	2.08368	20
8.34	1.19	30.1	3	1.16967	2.56768	2.55E-09	7	6.77822	0	0	0	48.80867	14	72.64725	0.47604	0.33	2.19929	168.01514	0	0.86155	2.37051	20
8.36	1.215	27.3	3	1.20741	2.36043	3.21E-09	7	7.26975	0	0	0	48.532	14	75.31856	0.49245	0.33	2.27512	167.77634	0	0.8716	2.5899	20
8.38	1.227	28.1	3	1.21449	2.25609	3.49E-09	7	7.34688	0	0	0	48.10249	14	75.80053	0.49451	0.33	2.28463	167.24519	0	0.87284	2.71111	20
8.4	1.211	26.8	3	1.19722	2.28864	3.24E-09	7	7.08947	0	0	0	47.95683	14	74.54263	0.48524	0.33	2.24179	167.01897	0	0.86721	2.66612	20
8.42	1.163	27.3	3	1.17596	2.25632	3.11E-09	7	6.78418	0	0	0	47.32023	14	72.99979	0.47415	0.33	2.19059	166.1228	0	0.86038	2.69622	20
8.44	1.163	25.5	3	1.13103	2.36364	2.53E-09	6	6.18301	0	0	0	46.95223	14	69.76648	0.45217	0.33	2.089	165.50658	0	0.84652	2.55752	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
8.46	1.076	27.4	3	1.06543	2.58737	1.78E-09	6	5.36479	0	0	0	46.62727	14	65.05733	0.42073	0.33	1.94376	164.87204	0	0.82591	2.3128	20
8.48	0.966	29.8	3	0.98384	2.9307	1.11E-09	6	4.43333	0	0	0	46.23643	14	59.20492	0.38205	0.33	1.76506	164.07663	0	0.79911	2.01228	20
8.5	0.918	29.3	3	0.9039	3.38534	8.15E-10	6	3.6083	0	0	0	45.98123	14	53.4708	0.34429	0.33	1.59064	163.4491	0	0.77118	1.71246	20
8.52	0.836	32.7	3	0.84963	3.62904	7.00E-10	6	3.09437	0	0	0	45.30877	14	49.57039	0.31849	0.33	1.47142	162.32162	0	0.7509	1.57553	20
8.54	0.803	30.5	3	0.80635	3.82797	6.17E-10	5	2.71173	0	0	0	44.6742	14	46.45465	0.29782	0.33	1.37595	161.27084	0	0.73387	1.47491	20
8.56	0.788	29.4	3	0.7904	3.63951	6.19E-10	5	2.57214	0	0	0	43.50996	14	45.29178	0.28975	0.33	1.33863	159.57614	0	0.727	1.54296	20
8.58	0.788	26.4	3	0.80856	3.42586	6.69E-10	5	2.71295	0	0	0	43.34733	14	46.56479	0.29725	0.33	1.37332	159.44304	0	0.73339	1.64742	20
8.6	0.85	27.3	3	0.85007	3.21149	7.58E-10	6	3.05999	0	0	0	43.84106	14	49.50625	0.31536	0.33	1.45695	160.33669	0	0.74837	1.77715	20
8.62	0.905	28.2	3	0.87827	3.12735	8.11E-10	6	3.30395	0	0	0	44.38175	14	51.49673	0.32734	0.33	1.51231	161.22835	0	0.75797	1.83738	20
8.64	0.865	26.9	3	0.87839	3.04725	8.24E-10	6	3.29494	0	0	0	44.08385	14	51.48105	0.32655	0.33	1.50864	160.82874	0	0.75734	1.88486	20
8.66	0.85	25.2	3	0.8599	2.8957	8.24E-10	6	3.11849	0	0	0	42.92468	14	50.13647	0.31735	0.33	1.46614	159.13535	0	0.74998	1.97324	20
8.68	0.849	22.6	3	0.85776	2.69694	8.61E-10	5	3.09016	0	0	0	42.02257	14	49.96045	0.31557	0.33	1.45794	157.86115	0	0.74854	2.11648	20
8.7	0.858	21.6	3	0.85729	2.47679	9.11E-10	5	3.0767	0	0	0	41.03317	14	49.90327	0.31456	0.33	1.45326	156.45959	0	0.74772	2.30323	20
8.72	0.848	19.5	3	0.84581	2.31729	9.31E-10	5	2.9675	0	0	0	39.98896	14	49.06016	0.30861	0.33	1.42577	154.91472	0	0.74285	2.45301	20
8.74	0.814	17.7	3	0.823	2.18713	9.24E-10	5	2.76523	0	0	0	38.76132	14	47.40696	0.2976	0.33	1.37491	153.02672	0	0.73368	2.58105	20
8.76	0.789	16.8	3	0.8025	2.09345	9.11E-10	5	2.58926	0	0	0	37.77029	14	45.9202	0.28768	0.33	1.3291	151.47365	0	0.72522	2.67868	20
8.78	0.786	15.9	3	0.80871	1.93723	9.69E-10	5	2.63161	0	0	0	37.18309	14	46.34081	0.28974	0.33	1.33858	150.65297	0	0.72699	2.89877	20
8.8	0.832	14.3	3	0.86027	1.70489	1.43E-09	5	3.05757	0	0	0	37.28087	14	50.00067	0.31199	0.33	1.44141	151.09639	0	0.74563	3.34095	20
8.82	0.943	13.8	3	0.91517	1.52976	2.08E-09	5	3.5459	0	0	0	37.57973	14	53.89937	0.33565	0.33	1.5507	151.84206	0	0.7645	3.77296	20
8.84	0.95	13.9	3	0.9587	1.53681	2.41E-09	5	3.95563	0	0	0	38.66363	14	56.98523	0.35416	0.33	1.63621	153.64894	0	0.77866	3.79042	20
8.86	0.962	16.5	3	0.92819	1.713	1.83E-09	5	3.64854	0	0	0	39.0894	14	54.78348	0.33979	0.33	1.56984	154.13202	0	0.76771	3.37659	20
8.88	0.851	17.3	3	0.88838	1.85356	1.38E-09	5	3.27009	0	0	0	38.96247	14	51.91646	0.32137	0.33	1.48471	153.76981	0	0.75321	3.08976	20
8.9	0.83	15.6	3	0.83694	1.99139	9.86E-10	5	2.81526	0	0	0	38.4081	14	48.21897	0.29788	0.33	1.37622	152.71439	0	0.73392	2.83528	20
8.92	0.807	17.1	3	0.85055	1.97912	1.06E-09	5	2.92132	0	0	0	38.73719	14	49.16789	0.30314	0.33	1.4005	153.28362	0	0.73832	2.86245	20
8.94	0.891	17.8	3	0.89821	1.9446	1.31E-09	5	3.33031	0	0	0	39.82211	14	52.54958	0.32334	0.33	1.49383	155.11163	0	0.75479	2.94839	20
8.96	0.972	17.5	3	0.97017	1.82443	1.88E-09	6	4.00233	0	0	0	40.94604	14	57.66572	0.35411	0.33	1.63599	157.06873	0	0.77863	3.19279	20
8.98	1.022	17.8	3	1.0351	1.69066	2.61E-09	6	4.65921	0	0	0	41.65962	14	62.28042	0.38168	0.33	1.76338	158.37424	0	0.79886	3.4877	20
9	1.085	17.2	3	1.07638	1.68156	2.99E-09	6	5.09701	0	0	0	42.56681	14	65.206	0.39881	0.33	1.84253	159.82582	0	0.81094	3.53049	20
9.02	1.095	19.3	3	1.12104	1.63836	3.54E-09	6	5.59279	0	0	0	43.28882	14	68.37212	0.41734	0.33	1.92813	161.01605	0	0.82363	3.64817	20
9.04	1.155	18.6	5	2.70544	0.71584	2.08E-07	10	35.57791	22	31	43.88003	54.9963	0	0	0	0.33	0	179.31824	0.01066	0	0	20
9.06	5.837	20.2	6	5.99667	0.35075	6.88E-06	16	67.02739	34	35	53.4793	67.02739	0	0	0	0.33	0	195.64369	-0.01214	0	0	20
9.08	10.968	24.3	6	11.41442	0.21844	9.22E-05	24	80.83328	49	39	64.49464	80.83328	0	0	0	0.33	0	212.13507	-0.07642	0	0	20
9.1	17.411	30.3	6	15.75236	0.18495	3.06E-04	30	90.17042	59	41	71.94448	90.17042	0	0	0	0.33	0	222.15305	-0.12816	0	0	20
9.12	18.855	32.8	6	18.54989	0.19209	4.87E-04	34	97.77166	64	41	78.0093	97.77166	0	0	0	0.33	0	229.45079	-0.15348	0	0	20
9.14	19.365	43.8	6	18.89046	0.23257	4.02E-04	35	103.09412	65	41	82.25595	103.09412	0	0	0	0.33	0	234.02692	-0.15519	0	0	20
9.16	18.434	55.2	6	18.3607	0.30445	2.48E-04	36	109.27913	63	41	87.1908	109.27913	0	0	0	0.33	0	239.22665	-0.149	0	0	20
9.18	17.266	68.7	6	17.17773	0.4271	1.17E-04	36	117.09331	61	41	93.42552	117.09331	0	0	0	0.33	0	245.75508	-0.13618	0	0	20
9.2	15.816	96.2	6	15.3451	0.58868	4.77E-05	35	122.89011	57	40	98.05062	122.89011	0	0	0	0.33	0	250.47711	-0.12458	0	0	20
9.22	12.936	106.1	6	13.4918	0.77603	1.98E-05	33	126.51579	52	39	100.94345	126.51579	0	0	0	0.33	0	253.35257	-0.11414	0	0	20
9.24	11.706	111.8	6	11.89616	0.97314	9.00E-06	32	128.39457	48	39	102.44247	128.39457	0	0	0	0.33	0	254.78366	-0.10578	0	0	20
9.26	11.029	129.4	6	11.04551	1.12293	5.52E-06	31	130.08746	46	38	103.79318	130.08746	0	0	0	0.33	0	256.12216	-0.103	0	0	20
9.28	10.384	130.9	5	10.33088	1.25352	3.68E-06	30	130.76072	44	38	104.33037	130.76072	0	0	0	0.33	0	256.62604	-0.1011	0	0	20
9.3	9.562	128.2	5	9.61955	1.32681	2.71E-06	28	128.56304	43	37	102.57689	128.56304	0	0	0	0.33	0	254.74863	-0.09736	0	0	20
9.32	8.895	123.8	5	8.79187	1.41039	1.88E-06	27	125.32819	40	37	99.9959	125.32819	0	0	0	0.33	0	251.96265	-0.093	0	0	20
9.34	7.901	120	5	7.9852	1.50403	1.27E-06	25	109.41557	38	36	97.26705	121.90803	0	0	0	0.33	0	248.97484	-0.08916	0	0	20
9.36	7.142	116.5	5	7.15349	1.59875	8.34E-07	24	97.76616	36	36	93.80442	117.56821	0	0	0	0.33	0	245.12923	-0.085	0	0	20
9.38	6.4	106.6	5	6.24787	1.69605	5.11E-07	22	85.08217	33	35	89.17986	111.77209	0	0	0	0.33	0	239.88469	-0.07987	0	0	20
9.4	5.185	94.8	5	5.43456	1.745	3.28E-07	20	73.69059	31	34	83.70212	104.90666	0	0	0	0.33	0	233.51341	-0.07324	0	0	20
9.42	4.704	83.1	5	4.75883	1.75043	2.24E-07	18	64.22519	28	34	78.16164	97.96259	0	0	0	0.33	0	226.85831	-0.06583	0	0	20
9.44	4.376	72	5	4.55896	1.69045	2.11E-07	17	61.42167	28	33	75.56408	94.70698	0	0	0	0.33	0	223.69218	-0.06113	0	0	20
9.46	4.588	76.1	5	4.67103	1.65559	2.34E-07	17	62.98555	28	33	76.0574	95.32527	0	0	0	0.33	0	224.34093	-0.06102	0	0	20
9.48	5.042	83.9	5	4.93543	1.54191	3.11E-07	18	66.68192	29	34	76.45776	95.82706	0	0	0	0.33	0	224.91476	-0.05948	0	0	20
9.5	5.172	68.3	5	4.95643	1.415	3.69E-07	18	66.97072	29	34	74.48152	93.35017	0	0	0	0.33	0	222.54231	-0.05433	0	0	20
9.52	4.655	58.2	5	4.73268	1.29736	3.77E-07	17	63.83309	28	34	70.71237	88.62617	0	0	0	0.33	0	217.84615	-0.04647	0	0	20
9.54	4.376	57.7	5	4.34996	1.3548	2.71E-07	16	58.46985	27	33	68.76382	86.18399	0	0	0	0.33	0	215.29132	-0.0444	0	0	20
9.56	4.028	60.9	4	4.05024	1.52172	1.76E-07	15	54.26871	0	0	68.95749	86.42672	14	276.88115	1.67979	0.33	7.76063	215.45168	0	1.3261	4.40254	20
9.58	3.759	66.3	4	3.81789	1.70164	1.20E-07	15	51.01066	0	0	69.50771	87.11633	14	260.25846	1.5576	0.33	7.1961	216.08524	0	1.29228	3.92591	20
9.6	3.681	67.7	4	3.68656	1.793	9.76E-08	15	49.16698	0	0	0	87.16118	14	250.85195	1.48894	0.33	6.87889	216.10265	0	1.27251	3.71914	20

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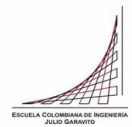
Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
9.62	3.635	64.3	4	3.51432	1.87424	7.75E-08	14	46.75043	0	0	0	86.39286	14	238.52261	1.40305	0.33	6.48208	215.27989	0	1.24691	3.54887	20
9.64	3.243	65.6	4	3.2447	1.96423	5.58E-08	14	42.97067	0	0	0	84.29077	14	219.23813	1.27409	0.33	5.88632	213.04398	0	1.20646	3.37113	20
9.66	2.873	61.3	4	2.88183	2.16414	3.24E-08	13	37.88539	0	0	0	81.97602	14	193.2928	1.10239	0.33	5.09303	210.50552	0	1.14819	3.03731	20
9.68	2.547	60.2	4	2.594	2.26805	2.20E-08	12	33.20094	0	0	0	78.54496	14	172.70798	0.9808	0.33	4.53131	206.66579	0	1.1032	2.87684	20
9.7	2.38	55	4	2.43065	2.36288	1.70E-08	12	28.79847	0	0	0	76.75379	14	161.01454	0.91253	0.33	4.2159	204.59447	0	1.07631	2.74743	20
9.72	2.383	57.1	4	2.44634	2.28368	1.82E-08	12	29.13226	0	0	0	76.28862	14	162.10972	0.91687	0.33	4.23595	204.14014	0	1.07806	2.84369	20
9.74	2.594	55.5	4	2.61203	2.1452	2.43E-08	12	33.46311	0	0	0	77.70783	14	173.91879	0.98167	0.33	4.5353	205.86662	0	1.10353	3.04177	20
9.76	2.877	55.5	4	2.72901	2.18883	2.64E-08	12	35.72074	0	0	0	80.21723	14	182.24868	1.02659	0.33	4.74284	208.64084	0	1.12055	2.99002	20
9.78	2.734	68.2	4	2.68164	2.48356	2.01E-08	13	35.05242	0	0	0	82.72237	14	178.83887	1.00532	0.33	4.64458	211.18289	0	1.11256	2.63156	20
9.8	2.452	76.1	3	2.46795	3.10245	1.07E-08	12	29.41038	0	0	0	84.82907	14	163.54901	0.91748	0.33	4.23876	213.10349	0	1.0783	2.09331	20
9.82	2.236	85.4	3	2.45163	3.19652	9.85E-09	12	28.92376	0	0	0	85.41042	14	162.3572	0.90892	0.33	4.19922	213.69148	0	1.07485	2.03033	20
9.84	2.685	73.6	3	2.73131	2.81672	1.66E-08	13	35.73241	0	0	0	87.27824	14	182.30822	1.01852	0.33	4.70556	215.8967	0	1.11753	2.3223	20
9.86	3.291	71.8	4	3.30464	2.18581	4.49E-08	14	43.75393	0	0	0	89.2535	14	223.23436	1.25925	0.33	5.81776	218.32281	0	1.20164	3.02865	20
9.88	3.956	71.3	4	3.72993	1.95536	7.88E-08	15	49.70274	0	0	0	91.58037	14	253.58541	1.45313	0.33	6.71347	220.80498	0	1.26196	3.40741	20
9.9	3.961	75.7	4	3.94754	1.86023	1.02E-07	16	52.74414	0	0	0	92.80754	14	269.10274	1.55141	0.33	7.16751	222.10114	0	1.29052	3.59129	20
9.92	3.944	73.3	4	3.93148	1.82629	1.03E-07	16	52.51414	0	0	0	92.11497	14	267.92927	1.54237	0.33	7.12575	221.43553	0	1.28795	3.65697	20
9.94	3.908	66.4	4	3.91211	1.72371	1.13E-07	16	52.23784	0	0	71.94366	90.16939	14	266.51959	1.53554	0.33	7.09418	219.52615	0	1.28599	3.8733	20
9.96	3.903	62.6	4	3.92743	1.75688	1.10E-07	16	52.44715	0	0	0	91.02803	14	267.5875	1.53711	0.33	7.10145	220.40135	0	1.28644	3.80052	20
9.98	3.99	78	4	4.00207	1.88402	1.01E-07	16	53.48703	0	0	0	94.24833	14	272.89299	1.56022	0.33	7.20823	223.60257	0	1.29303	3.54689	20
10	4.132	85.6	4	3.23396	1.96044	4.95E-08	14	42.72834	0	0	0	85.62909	14	218.00173	1.2156	0.33	5.61605	214.77165	0	1.18723	3.36974	20
10.02	1.598	26.6	4	2.44151	1.895	2.27E-08	11	27.99961	0	0	0	72.9758	14	161.3727	0.88525	0.33	4.08985	200.87955	0	1.06519	3.41812	20
10.04	1.612	26.6	3	1.60142	1.66103	7.78E-09	8	11.02206	0	0	0	55.6373	14	101.34183	0.5549	0.33	2.56366	179.4852	0	0.90793	3.73365	20
10.06	1.611	26.6	3	1.60476	1.65549	7.83E-09	8	11.04829	0	0	0	55.69647	14	101.55643	0.55505	0.33	2.56433	179.58401	0	0.90801	3.74625	20
10.08	1.608	26.5	3	1.60279	1.65337	7.77E-09	8	10.99209	0	0	0	55.68451	14	101.39152	0.55312	0.33	2.55543	179.58255	0	0.90693	3.74957	20
10.1	1.606	26.4	3	1.61647	1.66824	7.83E-09	8	11.17901	0	0	0	56.13257	14	102.34455	0.55729	0.33	2.57469	180.1795	0	0.90926	3.71932	20
10.12	1.652	28	4	2.61743	1.60462	3.58E-08	12	32.28055	0	0	0	72.42306	14	173.81683	0.94753	0.33	4.37759	200.5963	0	1.09025	4.05573	20
10.14	4.611	71.6	4	3.65122	1.58668	1.01E-07	15	48.53601	0	0	0	85.44413	14	247.63268	1.39473	0.33	6.44364	214.87726	0	1.24438	4.18895	20
10.16	4.708	74.2	4	4.59227	1.66947	1.81E-07	17	61.70555	0	0	78.08498	97.8665	14	314.82426	1.80384	0.33	8.33372	227.41243	0	1.35881	4.02428	20
10.18	4.476	84.2	4	4.31767	1.93237	1.13E-07	17	57.85582	0	0	79.65426	99.83334	14	295.18275	1.66202	0.33	7.67854	229.23196	0	1.32128	3.46719	20
10.2	3.788	91.9	4	3.93585	2.31462	6.05E-08	17	52.50515	0	0	0	101.48185	14	267.88341	1.4741	0.33	6.81034	230.71101	0	1.26816	2.88173	20
10.22	3.563	97.2	4	3.3912	2.81021	2.70E-08	15	44.87486	0	0	0	100.33833	14	228.95337	1.2319	0.33	5.69136	229.43976	0	1.19265	2.3544	20
10.24	2.842	96.8	3	3.07593	3.15135	1.68E-08	15	40.45587	0	0	0	98.62583	14	206.40751	1.10836	0.33	5.12062	227.58214	0	1.15031	2.08679	20
10.26	2.842	96.8	3	2.8357	3.41362	1.16E-08	14	37.08738	0	0	0	96.72311	14	189.22135	1.01404	0.33	4.68487	225.57407	0	1.11585	1.91567	20
10.28	2.842	96.8	3	2.88803	3.28482	1.30E-08	14	37.81483	0	0	0	96.58444	14	192.93283	1.03187	0.33	4.76725	225.51025	0	1.12252	1.99305	20
10.3	2.999	91	3	2.85833	3.21983	1.30E-08	14	37.39381	0	0	0	95.45139	14	190.78472	1.01836	0.33	4.70481	224.41766	0	1.11747	2.03154	20
10.32	2.753	88.3	3	2.72226	3.18608	1.15E-08	13	34.22156	0	0	0	92.55428	14	181.039	0.96443	0.33	4.45568	221.50414	0	1.09687	2.04556	20
10.34	2.434	80.9	3	2.38654	3.4555	6.87E-09	12	25.69702	0	0	0	88.17274	14	157.03224	0.83491	0.33	3.85727	216.83411	0	1.04408	1.86611	20
10.36	1.992	78.2	3	2.15582	3.67532	4.59E-09	12	20.53893	0	0	0	84.89615	14	140.52668	0.7457	0.33	3.44512	213.26027	0	1.00449	1.73811	20
10.38	2.061	78.6	3	2.12718	3.45528	4.91E-09	11	19.89918	0	0	0	82.62577	14	138.45446	0.73328	0.33	3.38777	210.91711	0	0.99874	1.84606	20
10.4	2.348	63.7	3	2.48985	2.73778	1.16E-08	12	27.97936	0	0	0	83.99498	14	164.33358	0.86867	0.33	4.01326	212.8111	0	1.05833	2.36255	20
10.42	3.08	62.2	4	2.97754	2.09345	3.03E-08	13	39.03191	0	0	0	85.50425	14	199.1424	1.05065	0.33	4.85402	214.91733	0	1.12947	3.1309	20
10.44	3.524	61.1	4	3.45717	2.0267	4.98E-08	15	45.74169	0	0	0	91.58946	14	233.37595	1.245	0.33	5.75191	221.26817	0	1.19697	3.26415	20
10.46	3.787	86.9	4	3.59948	2.15865	4.94E-08	15	47.72883	0	0	0	95.68153	14	243.51442	1.29617	0.33	5.9883	225.33337	0	1.21357	3.07135	20
10.48	3.507	85.1	4	3.45876	2.39681	3.56E-08	15	45.75353	0	0	0	97.32691	14	233.43638	1.2258	0.33	5.6632	226.8994	0	1.19062	2.75956	20
10.5	3.102	76.7	4	3.14039	2.44343	2.62E-08	14	41.29122	0	0	0	92.82658	14	210.66947	1.10288	0.33	5.09531	222.34776	0	1.14836	2.69057	20
10.52	2.832	68.4	4	3.20903	2.29976	3.08E-08	14	42.24698	0	0	0	92.2486	14	215.54583	1.12624	0.33	5.20324	221.87468	0	1.15663	2.86226	20
10.54	3.713	76.3	4	3.72635	1.89462	6.87E-08	16	49.48436	0	0	0	93.4622	14	252.47123	1.34861	0.33	6.23057	223.29102	0	1.23015	3.50456	20
10.56	4.654	67.1	5	4.60265	1.47161	2.06E-07	17	61.74745	26	33	76.27211	95.59437	0	0	0	0.33	0	225.61945	-0.04726	0	0	20
10.58	5.461	59.8	5	5.74957	1.10153	6.78E-07	19	77.7991	30	34	77.48136	97.10997	0	0	0	0.33	0	227.35129	-0.04286	0	0	20
10.6	7.154	63.1	5	6.91743	1.0023	1.38E-06	22	94.14393	34	35	82.42573	103.30692	0	0	0	0.33	0	233.38762	-0.0498	0	0	20
10.62	8.158	85.1	5	8.08595	0.99762	2.18E-06	24	111.65085	37	36	89.08312	111.65085	0	0	0	0.33	0	241.11823	-0.06099	0	0	20
10.64	8.967	93.8	5	8.80082	1.05824	2.47E-06	26	119.07	38	36	95.00266	119.07	0	0	0	0.33	0	247.70361	-0.07028	0	0	20
10.66	9.299	100.5	5	9.04769	1.07136	2.59E-06	27	121.39475	39	37	96.85751	121.39475	0	0	0	0.33	0	249.73898	-0.07296	0	0	20
10.68	8.899	96.5	5	8.85126	1.07593	2.41E-06	27	120.30989	38	36	95.99193	120.30989	0	0	0	0.33	0	248.80807	-0.07122	0	0	20
10.7	8.378	88.7	5	8.33385	1.06793	2.05E-06	25	116.44863	37	36	92.91114	116.44863	0	0	0	0.33	0	245.43361	-0.06596	0	0	20
10.72	7.747	81.8	5	7.90718	0.99951	1.99E-06	24	110.92232	36	36	88.50185	110.92232	0	0	0	0.33	0	240.53532	-0.05871	0	0	20
10.74	7.619	66.6	5	7.69552	0.86804	2.37E-06	23	104.47698	36	36	83.35929	104.47698	0	0	0	0.33	0	234.71785	-0.05027	0	0	20
10.76	7.743	52	5	7.99918	0.65465	4.35E-06	23	97.4166	37	36	77.72601	97.4166	0	0	0	0.33	0	228.28108	-0.04287	0	0	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

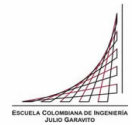
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
10.78	8.658	38.5	6	8.47216	0.54689	6.95E-06	23	94.91911	38	36	75.73333	94.91911	0	0	0	0.33	0	226.06915	-0.04291	0	0	20
10.8	9.038	48.5	6	8.92414	0.5431	8.21E-06	24	97.14345	39	37	77.50807	97.14345	0	0	0	0.33	0	228.25394	-0.0478	0	0	20
10.82	9.099	58.4	6	8.84614	0.68203	5.41E-06	25	103.80657	39	37	82.82439	103.80657	0	0	0	0.33	0	234.36511	-0.05299	0	0	20
10.84	8.424	74.1	5	8.49745	0.89674	2.92E-06	25	111.37546	38	36	88.8634	111.37546	0	0	0	0.33	0	241.11839	-0.05901	0	0	20
10.86	7.992	96.1	5	8.14676	1.09123	1.78E-06	25	111.28643	36	36	93.12301	116.71417	0	0	0	0.33	0	245.77809	-0.06425	0	0	20
10.88	8.047	96.5	5	7.9434	1.19512	1.38E-06	25	108.43401	36	36	94.98895	119.05282	0	0	0	0.33	0	247.79825	-0.06679	0	0	20
10.9	7.814	92.2	5	7.90706	1.03283	1.79E-06	24	107.92	36	36	90.14464	112.98128	0	0	0	0.33	0	242.51456	-0.05913	0	0	20
10.92	7.883	56.3	5	7.93338	0.78697	2.97E-06	23	103.46729	36	36	82.55369	103.46729	0	0	0	0.33	0	233.96695	-0.04762	0	0	20
10.94	8.126	38.8	6	8.24771	0.53631	6.37E-06	23	93.78873	37	36	74.83143	93.78873	0	0	0	0.33	0	225.11258	-0.03863	0	0	20
10.96	8.757	37.6	6	8.38004	0.45067	8.74E-06	22	90.02223	38	36	71.82625	90.02223	0	0	0	0.33	0	221.62105	-0.03595	0	0	20
10.98	8.28	36.9	6	8.48403	0.51862	7.27E-06	23	94.25535	38	36	75.20373	94.25535	0	0	0	0.33	0	225.64236	-0.04026	0	0	20
11	8.438	57.5	5	8.00169	0.64028	4.28E-06	23	97.69256	36	36	77.94619	97.69256	0	0	0	0.33	0	228.76047	-0.04056	0	0	20
11.02	7.31	59.3	5	7.32669	0.7889	2.28E-06	22	100.01632	34	35	79.80026	100.01632	0	0	0	0.33	0	230.80487	-0.04075	0	0	20
11.04	6.255	56.6	5	6.17439	0.87944	1.12E-06	20	83.6268	31	34	76.09741	95.37542	0	0	0	0.33	0	226.23225	-0.03336	0	0	20
11.06	4.981	47	5	4.7461	1.00293	3.94E-07	17	63.62564	27	33	69.90164	87.61005	0	0	0	0.33	0	218.33926	-0.02457	0	0	20
11.08	3.025	39.2	4	3.5438	1.25101	1.07E-07	14	46.78854	0	0	0	81.59633	14	238.71706	1.23023	0.33	5.68365	211.85417	0	1.19209	5.2769	20
11.1	2.648	46.8	4	2.70882	1.74369	2.61E-08	12	31.08805	0	0	0	78.97732	14	179.04984	0.88586	0.33	4.09266	208.6028	0	1.06544	3.71494	20
11.12	2.476	55.7	3	2.27451	2.33897	9.59E-09	11	21.20376	0	0	0	78.24517	14	148.00192	0.73095	0.33	3.377	207.22763	0	0.99766	2.72635	20
11.14	1.722	57.1	3	1.8352	2.92612	3.44E-09	10	13.13688	0	0	0	74.21779	14	116.59732	0.57484	0.33	2.65576	202.2291	0	0.91895	2.12785	20
11.16	1.33	48.3	3	1.38324	3.52794	9.99E-10	9	6.85349	0	0	0	66.79628	14	84.2897	0.41484	0.33	1.91656	193.03987	0	0.82194	1.6927	20
11.18	1.12	41	3	1.15795	3.54073	7.61E-10	8	4.47556	0	0	0	60.26903	14	68.17294	0.33495	0.33	1.54747	184.78183	0	0.76395	1.6295	20
11.2	1.046	33.7	3	1.04599	3.19315	6.98E-10	7	3.47843	0	0	0	55.04934	14	60.1511	0.29504	0.33	1.36309	178.01732	0	0.73151	1.76491	20
11.22	0.994	25.5	3	0.99269	2.76691	7.09E-10	7	3.04441	0	0	0	51.21877	14	56.31972	0.27579	0.33	1.27417	172.96008	0	0.71483	2.00947	20
11.24	0.96	23.2	3	0.96003	2.43396	7.32E-10	6	2.79045	0	0	0	48.45475	14	53.96339	0.26383	0.33	1.21888	169.23293	0	0.70407	2.26323	20
11.26	0.948	21.4	3	0.95005	2.16129	7.78E-10	6	2.71046	0	0	0	46.6334	14	53.22705	0.25981	0.33	1.20032	166.79086	0	0.70038	2.54038	20
11.28	0.964	17	3	0.9564	1.93783	8.45E-10	6	2.75006	0	0	0	45.48858	14	53.65717	0.26149	0.33	1.20809	165.31154	0	0.70193	2.83727	20
11.3	0.979	17.2	3	0.97676	1.70973	9.48E-10	6	2.89416	0	0	0	44.58739	14	55.08853	0.26804	0.33	1.23836	164.2287	0	0.70789	3.23274	20
11.32	1.009	15.9	3	0.99577	1.63357	1.04E-09	6	3.03137	0	0	0	44.59063	14	56.42361	0.27411	0.33	1.26638	164.35049	0	0.71333	3.39929	20
11.34	1.021	15.7	3	1.01313	1.5694	1.17E-09	6	3.15852	0	0	0	44.60738	14	57.64002	0.27958	0.33	1.29165	164.48093	0	0.71817	3.55266	20
11.36	1.031	16.1	3	1.00548	1.59459	1.10E-09	6	3.09158	0	0	0	44.6232	14	57.07071	0.27638	0.33	1.27689	164.47603	0	0.71535	3.48831	20
11.38	0.986	16.3	3	0.98484	1.66524	9.67E-10	6	2.9269	0	0	0	44.61329	14	55.57352	0.26871	0.33	1.24144	164.36607	0	0.7085	3.32086	20
11.4	0.959	16.8	3	0.95353	1.73391	8.89E-10	6	2.68946	0	0	0	44.26893	14	53.31336	0.25738	0.33	1.18909	163.74603	0	0.69813	3.16011	20
11.42	0.937	16.5	3	0.93721	1.74631	8.57E-10	6	2.56689	0	0	0	43.93228	14	52.12501	0.25125	0.33	1.16077	163.21432	0	0.6924	3.12113	20
11.44	0.937	15.8	3	0.92755	1.72856	8.45E-10	6	2.49325	0	0	0	43.57735	14	51.41182	0.24743	0.33	1.14311	162.69272	0	0.68878	3.14243	20
11.46	0.93	15.8	3	0.92391	1.70291	8.45E-10	6	2.46204	0	0	0	43.33608	14	51.12866	0.24568	0.33	1.13505	162.35857	0	0.68711	3.18471	20
11.48	0.926	15.6	3	0.91993	1.70303	8.36E-10	6	2.42877	0	0	0	43.25427	14	50.82135	0.24383	0.33	1.12649	162.23814	0	0.68534	3.17904	20
11.5	0.925	15.6	3	0.91596	1.69586	8.30E-10	6	2.39581	0	0	0	43.12433	14	50.5144	0.24198	0.33	1.11795	162.05203	0	0.68356	3.18696	20
11.52	0.918	15.4	3	0.91198	1.6923	8.23E-10	6	2.36311	0	0	0	43.01748	14	50.20712	0.24014	0.33	1.10944	161.89688	0	0.68177	3.1881	20
11.54	0.914	15.3	3	0.91	1.68864	8.18E-10	6	2.34408	0	0	0	42.96558	14	50.04305	0.23899	0.33	1.10412	161.8284	0	0.68065	3.19147	20
11.56	0.919	15.4	3	0.90635	1.71383	8.03E-10	6	2.31404	0	0	0	43.05474	14	49.75957	0.23727	0.33	1.09618	161.94154	0	0.67897	3.13934	20
11.58	0.907	15.9	3	0.90205	1.74049	7.86E-10	6	2.27987	0	0	0	43.13224	14	49.42881	0.23533	0.33	1.08722	162.03467	0	0.67707	3.08537	20
11.6	0.901	15.8	3	0.89606	1.75583	7.70E-10	6	2.23507	0	0	0	43.08706	14	48.97829	0.23283	0.33	1.07566	161.95035	0	0.6746	3.05077	20
11.62	0.901	15.5	3	0.89509	1.72051	7.77E-10	6	2.22323	0	0	0	42.86005	14	48.88566	0.23203	0.33	1.07198	161.64883	0	0.67381	3.11091	20
11.64	0.904	14.9	3	0.89742	1.69002	7.87E-10	6	2.23294	0	0	0	42.75569	14	49.02972	0.23236	0.33	1.0735	161.53508	0	0.67414	3.16807	20
11.66	0.908	15.1	3	0.89978	1.66337	7.97E-10	6	2.2428	0	0	0	42.67425	14	49.17523	0.2327	0.33	1.07505	161.4528	0	0.67447	3.21994	20
11.68	0.908	14.9	3	0.89979	1.65223	7.98E-10	6	2.23738	0	0	0	42.62759	14	49.15301	0.23224	0.33	1.07294	161.40326	0	0.67402	3.24013	20
11.7	0.904	14.6	3	0.89516	1.63844	7.93E-10	6	2.20195	0	0	0	42.43267	14	48.79927	0.23022	0.33	1.06361	161.12195	0	0.672	3.26068	20
11.72	0.894	14.5	3	0.88207	1.68165	7.57E-10	6	2.11314	0	0	0	42.37014	14	47.84123	0.22536	0.33	1.04115	160.96631	0	0.66712	3.16075	20
11.74	0.867	15.4	3	0.87031	1.73501	7.23E-10	6	2.03453	0	0	0	42.39742	14	46.97841	0.22096	0.33	1.02083	160.94115	0	0.66264	3.04893	20
11.76	0.867	15.4	3	0.86987	1.77038	7.11E-10	6	2.02676	0	0	0	42.63207	14	46.92401	0.22037	0.33	1.0181	161.27325	0	0.66203	2.98607	20
11.78	0.891	15.4	3	0.87856	1.7339	7.31E-10	6	2.07557	0	0	0	42.6816	14	47.52153	0.22284	0.33	1.02952	161.41063	0	0.66456	3.05718	20
11.8	0.893	14.9	3	0.88726	1.67557	7.59E-10	6	2.12499	0	0	0	42.58281	14	48.12016	0.22531	0.33	1.04092	161.34547	0	0.66707	3.17205	20
11.82	0.893	14.3	3	0.88698	1.60095	7.79E-10	6	2.11802	0	0	0	42.10876	14	48.07707	0.22477	0.33	1.03843	160.70999	0	0.66652	3.31799	20
11.84	0.89	13.4	3	0.88435	1.53786	7.92E-10	6	2.09639	0	0	0	41.63542	14	47.86667	0.22345	0.33	1.03235	160.05858	0	0.66518	3.44922	20
11.86	0.885	13.1	3	0.88171	1.48197	8.04E-10	6	2.07487	0	0	0	41.20346	14	47.65563	0.22214	0.33	1.02627	159.46216	0	0.66384	3.57417	20
11.88	0.885	12.7	3	0.88008	1.45821	8.07E-10	6	2.05968	0	0	0	41.01773	14	47.51605	0.22116	0.33	1.02175	159.20975	0	0.66284	3.6285	20
11.9	0.885	12.7	3	0.87943	1.4479	8.08E-10	6	2.05072	0	0	0	40.95253	14	47.44755	0.22051	0.33	1.01878	159.12968	0	0.66218	3.65172	20
11.92	0.883	12.8	3	0.87814	1.46141	7.99E-10	6	2.03781	0	0	0	41.03577	14	47.33285	0.21966	0.33	1.01482	159.24899	0	0.6613	3.61451	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
11.94	0.881	13	3	0.87952	1.47049	7.96E-10	6	2.04133	0	0	0	41.16184	14	47.40861	0.21968	0.33	1.01494	159.44554	0	0.66133	3.5923	20
11.96	0.889	13	3	0.88491	1.46155	8.06E-10	6	2.06956	0	0	0	41.27337	14	47.77044	0.22104	0.33	1.02119	159.64966	0	0.66272	3.61972	20
11.98	0.899	12.8	3	0.89296	1.43717	8.25E-10	6	2.11459	0	0	0	41.34775	14	48.32276	0.22326	0.33	1.03148	159.82091	0	0.66499	3.6901	20
12	0.905	12.7	3	0.90102	1.52049	8.08E-10	6	2.16012	0	0	0	42.18156	14	48.87627	0.22549	0.33	1.04176	161.0262	0	0.66725	3.49626	20
12.02	0.911	15.6	3	0.90575	1.6156	7.83E-10	6	2.18479	0	0	0	42.99166	14	49.19086	0.2266	0.33	1.04691	162.17018	0	0.66838	3.29433	20
12.04	0.911	15.6	3	0.91714	1.70095	7.73E-10	6	2.25221	0	0	0	43.91216	14	49.98117	0.2299	0.33	1.06216	163.49808	0	0.67169	3.13984	20
12.06	0.937	15.6	3	0.92551	1.68557	7.88E-10	6	2.30089	0	0	0	44.07294	14	50.55588	0.2322	0.33	1.07278	163.77943	0	0.67398	3.17595	20
12.08	0.936	15.6	3	0.9359	1.66684	8.07E-10	6	2.36337	0	0	0	44.2651	14	51.27559	0.23516	0.33	1.08644	164.11426	0	0.6769	3.22116	20
12.1	0.942	15.6	3	0.9363	1.67681	8.03E-10	6	2.36037	0	0	0	44.37087	14	51.281	0.23484	0.33	1.08495	164.27194	0	0.67659	3.20098	20
12.12	0.938	15.9	3	0.93504	1.69334	7.94E-10	6	2.34649	0	0	0	44.47414	14	51.1677	0.23397	0.33	1.08096	164.41608	0	0.67573	3.16701	20
12.14	0.932	16	3	0.93009	1.69517	7.84E-10	6	2.3087	0	0	0	44.37362	14	50.79144	0.23191	0.33	1.07143	164.26521	0	0.67369	3.15702	20
12.16	0.927	15.4	3	0.92583	1.68137	7.79E-10	6	2.27567	0	0	0	44.18646	14	50.4639	0.23008	0.33	1.06295	164.00204	0	0.67186	3.17696	20
12.18	0.925	15.3	3	0.92289	1.65784	7.80E-10	6	2.2514	0	0	0	43.97031	14	50.2309	0.22868	0.33	1.05649	163.70761	0	0.67046	3.2174	20
12.2	0.923	15.2	3	0.9203	1.6625	7.72E-10	6	2.22951	0	0	0	43.95469	14	50.02279	0.2274	0.33	1.05058	163.68401	0	0.66918	3.20407	20
12.22	0.919	15.4	3	0.92003	1.66662	7.69E-10	6	2.22247	0	0	0	44.00087	14	49.98027	0.22687	0.33	1.04815	163.75783	0	0.66865	3.19439	20
12.24	0.924	15.4	3	0.92376	1.66711	7.72E-10	6	2.24091	0	0	0	44.13626	14	50.22382	0.22765	0.33	1.05172	163.97623	0	0.66943	3.19606	20
12.26	0.934	15.4	3	0.93214	1.65569	7.86E-10	6	2.28924	0	0	0	44.32185	14	50.79961	0.22992	0.33	1.06223	164.29027	0	0.67171	3.22572	20
12.28	0.944	15.5	3	0.94021	1.64857	7.99E-10	6	2.33598	0	0	0	44.52621	14	51.35302	0.23209	0.33	1.07223	164.62639	0	0.67386	3.24684	20
12.3	0.948	15.6	3	0.94227	1.65911	7.96E-10	6	2.3439	0	0	0	44.6834	14	51.47748	0.23231	0.33	1.07327	164.86201	0	0.67409	3.22695	20
12.32	0.94	15.8	3	0.93835	1.67669	7.83E-10	6	2.31302	0	0	0	44.72027	14	51.17443	0.23061	0.33	1.0654	164.9007	0	0.67239	3.18756	20
12.34	0.932	15.8	3	0.93144	1.68914	7.67E-10	6	2.26323	0	0	0	44.63531	14	50.65746	0.22794	0.33	1.05311	164.75847	0	0.66973	3.15536	20
12.36	0.927	15.6	3	0.9262	1.6879	7.58E-10	6	2.22465	0	0	0	44.50366	14	50.26026	0.22583	0.33	1.04333	164.56377	0	0.6676	3.15064	20
12.38	0.924	15.5	3	0.92795	1.66676	7.65E-10	6	2.23044	0	0	0	44.43595	14	50.36201	0.22596	0.33	1.04394	164.49776	0	0.66773	3.19104	20
12.4	0.937	15.3	3	0.93201	1.64518	7.75E-10	6	2.25093	0	0	0	44.42942	14	50.62937	0.22683	0.33	1.04796	164.52798	0	0.66861	3.23588	20
12.42	0.939	15.2	3	0.93675	1.62976	7.85E-10	6	2.27574	0	0	0	44.48229	14	50.94434	0.22791	0.33	1.05296	164.64156	0	0.6697	3.27023	20
12.44	0.938	15.3	3	0.93848	1.62674	7.86E-10	6	2.2815	0	0	0	44.53626	14	51.04539	0.22804	0.33	1.05353	164.73776	0	0.66982	3.27671	20
12.46	0.942	15.3	3	0.93922	1.63256	7.84E-10	6	2.28086	0	0	0	44.62366	14	51.07501	0.22784	0.33	1.05263	164.87212	0	0.66962	3.26436	20
12.48	0.941	15.4	3	0.94062	1.63013	7.84E-10	6	2.28448	0	0	0	44.6723	14	51.15224	0.22786	0.33	1.05271	164.95901	0	0.66964	3.2693	20
12.5	0.942	15.3	3	0.94036	1.63766	7.80E-10	6	2.27751	0	0	0	44.74365	14	51.11077	0.22735	0.33	1.05035	165.06566	0	0.66913	3.2525	20
12.52	0.941	15.5	3	0.94044	1.64817	7.75E-10	6	2.27268	0	0	0	44.84491	14	51.0931	0.22694	0.33	1.04848	165.21402	0	0.66872	3.2304	20
12.54	0.941	15.7	3	0.94052	1.66574	7.68E-10	6	2.26792	0	0	0	44.99521	14	51.07613	0.22654	0.33	1.04664	165.42734	0	0.66832	3.19498	20
12.56	0.942	15.8	3	0.94293	1.67563	7.66E-10	6	2.27791	0	0	0	45.1582	14	51.2251	0.22688	0.33	1.04819	165.67159	0	0.66866	3.17725	20
12.58	0.948	15.9	3	0.94635	1.69422	7.64E-10	6	2.29436	0	0	0	45.41024	14	51.44654	0.22754	0.33	1.05121	166.03943	0	0.66932	3.14455	20
12.6	0.951	16.4	3	0.94976	1.71622	7.60E-10	6	2.31075	0	0	0	45.68518	14	51.66688	0.22818	0.33	1.05421	166.43652	0	0.66997	3.10635	20
12.62	0.952	16.6	3	0.95116	1.74874	7.51E-10	6	2.3143	0	0	0	45.974	14	51.74361	0.2282	0.33	1.05426	166.83887	0	0.66998	3.04862	20
12.64	0.952	16.9	3	0.95254	1.7672	7.46E-10	6	2.31776	0	0	0	46.1658	14	51.81926	0.2282	0.33	1.0543	167.11275	0	0.66999	3.0168	20
12.66	0.955	17	3	0.95525	1.77964	7.45E-10	6	2.32967	0	0	0	46.35488	14	51.9894	0.22863	0.33	1.05625	167.39053	0	0.67041	2.99704	20
12.68	0.96	17.1	3	0.96233	1.77001	7.55E-10	6	2.36974	0	0	0	46.52023	14	52.47193	0.23042	0.33	1.06453	167.66255	0	0.6722	3.01893	20
12.7	0.973	17	3	0.96841	1.75201	7.67E-10	6	2.40359	0	0	0	46.59794	14	52.88302	0.23189	0.33	1.07135	167.81337	0	0.67367	3.05454	20
12.72	0.973	16.8	3	0.97285	1.73031	7.78E-10	6	2.42692	0	0	0	46.60102	14	53.17687	0.23285	0.33	1.07577	167.85678	0	0.67462	3.09584	20
12.74	0.973	16.7	3	0.9766	1.7066	7.88E-10	6	2.44584	0	0	0	46.5683	14	53.42168	0.23359	0.33	1.07919	167.84941	0	0.67536	3.14119	20
12.76	0.984	16.5	3	0.98103	1.6955	7.96E-10	6	2.46926	0	0	0	46.64176	14	53.71483	0.23454	0.33	1.08357	167.9847	0	0.67629	3.16476	20
12.78	0.986	16.7	3	0.98646	1.69293	8.02E-10	6	2.49935	0	0	0	46.80309	14	54.07939	0.2358	0.33	1.08938	168.24011	0	0.67753	3.17352	20
12.8	0.989	16.9	3	0.98919	1.7051	8.00E-10	6	2.51171	0	0	0	46.99351	14	54.25132	0.23621	0.33	1.0913	168.51718	0	0.67794	3.15215	20
12.82	0.992	17	3	0.99359	1.72103	8.00E-10	6	2.53517	0	0	0	47.2577	14	54.54263	0.23715	0.33	1.09561	168.89915	0	0.67885	3.12583	20
12.84	0.999	17.4	3	0.99767	1.73404	8.00E-10	6	2.55651	0	0	0	47.49212	14	54.81046	0.23797	0.33	1.09944	169.23975	0	0.67966	3.10487	20
12.86	1.001	17.5	3	1.00677	1.73492	8.10E-10	6	2.61162	0	0	0	47.78162	14	55.4372	0.24035	0.33	1.11044	169.67912	0	0.68198	3.11041	20
12.88	1.019	17.5	3	1.01621	1.72865	8.24E-10	7	2.66954	0	0	0	48.0283	14	56.0881	0.24283	0.33	1.12189	170.06358	0	0.68438	3.12901	20
12.9	1.027	17.7	3	1.02664	1.72082	8.39E-10	7	2.73484	0	0	0	48.28961	14	56.81005	0.24561	0.33	1.13473	170.47095	0	0.68705	3.15135	20
12.92	1.032	17.8	3	1.03041	1.73071	8.39E-10	7	2.75467	0	0	0	48.49391	14	57.05579	0.24633	0.33	1.13803	170.76726	0	0.68773	3.1354	20
12.94	1.03	18	3	1.0315	1.74827	8.33E-10	7	2.75605	0	0	0	48.67969	14	57.11032	0.24622	0.33	1.13752	171.02469	0	0.68762	3.10359	20
12.96	1.03	18.3	3	1.0319	1.77019	8.25E-10	7	2.75273	0	0	0	48.8775	14	57.11614	0.24589	0.33	1.13603	171.29344	0	0.68732	3.06426	20
12.98	1.033	18.5	3	1.03565	1.78954	8.22E-10	7	2.77239	0	0	0	49.14953	14	57.36004	0.2466	0.33	1.13928	171.67464	0	0.68799	3.03307	20
13	1.041	18.8	3	1.04274	1.80933	8.24E-10	7	2.81534	0	0	0	49.51865	14	57.84342	0.24833	0.33	1.14726	172.19643	0	0.68963	3.00459	20
13.02	1.051	19.3	3	1.05584	1.81845	8.38E-10	7	2.90076	0	0	0	49.97901	14	58.75569	0.25189	0.33	1.16372	172.86351	0	0.693	2.99899	20
13.04	1.072	19.5	3	1.07027	1.81263	8.57E-10	7	2.99684	0	0	0	50.36637	14	59.76282	0.25584	0.33	1.182	173.44162	0	0.69671	3.01895	20
13.06	1.084	19.4	3	1.08336	1.79688	8.78E-10	7	3.08461	0	0	0	50.64047	14	60.67435	0.25938	0.33	1.19834	173.86737	0	0.69999	3.0545	20
13.08	1.09	19.5	3	1.09344	1.78946	8.92E-10	7	3.15141	0	0	0	50.89051	14	61.37086	0.26199	0.33	1.2104	174.24602	0	0.70239	3.07377	20

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In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
13.1	1.102	19.8	3	1.10186	1.79393	9.01E-10	7	3.20656	0	0	0	51.18305	14	61.94901	0.26409	0.33	1.22009	174.66837	0	0.7043	3.07133	20
13.12	1.109	20	3	1.10929	1.80597	9.05E-10	7	3.25466	0	0	0	51.50501	14	62.45571	0.26587	0.33	1.22834	175.12119	0	0.70593	3.05524	20
13.14	1.112	20.3	3	1.1144	1.82161	9.05E-10	7	3.28573	0	0	0	51.79139	14	62.79715	0.26695	0.33	1.23332	175.51698	0	0.70691	3.03159	20
13.16	1.117	20.6	3	1.11452	1.85133	8.93E-10	7	3.27955	0	0	0	52.04678	14	62.78214	0.26652	0.33	1.2313	175.84912	0	0.70651	2.9819	20
13.18	1.109	21	3	1.11461	1.75847	9.22E-10	7	3.27319	0	0	0	51.37884	14	62.76506	0.26607	0.33	1.22925	175.03049	0	0.70611	3.13825	20
13.2	1.112	17.2	3	1.11062	1.93286	8.59E-10	7	3.23654	0	0	0	52.59902	14	62.45641	0.26439	0.33	1.22149	176.54344	0	0.70458	2.85127	20
13.22	1.096	26.2	3	1.10926	2.09149	8.11E-10	7	3.21949	0	0	0	53.71936	14	62.33561	0.26351	0.33	1.21741	177.93683	0	0.70378	2.63314	20
13.24	1.096	26.2	3	1.11521	2.34934	7.54E-10	7	3.25643	0	0	0	55.66771	14	62.73663	0.26483	0.33	1.22351	180.36746	0	0.70498	2.34664	20
13.26	1.121	26.2	3	1.12603	2.28829	7.78E-10	7	3.3299	0	0	0	55.61187	14	63.48529	0.26761	0.33	1.23636	180.36018	0	0.7075	2.41458	20
13.28	1.128	24.9	3	1.1369	2.21948	8.06E-10	7	3.40455	0	0	0	55.4918	14	64.23827	0.2704	0.33	1.24926	180.2749	0	0.71002	2.49485	20
13.3	1.128	24.6	3	1.14118	2.15274	8.26E-10	7	3.42966	0	0	0	55.18326	14	64.52009	0.27121	0.33	1.25297	179.9308	0	0.71074	2.5738	20
13.32	1.133	24.2	3	1.14546	2.09232	8.46E-10	7	3.45484	0	0	0	54.90921	14	64.80196	0.27201	0.33	1.25668	179.62857	0	0.71146	2.64976	20
13.34	1.14	23.1	3	1.15742	2.01886	8.79E-10	7	3.53898	0	0	0	54.74419	14	65.63219	0.27511	0.33	1.27101	179.49388	0	0.71422	2.75262	20
13.36	1.163	22.8	3	1.17037	1.9538	9.14E-10	7	3.63178	0	0	0	54.64963	14	66.53353	0.2785	0.33	1.28666	179.4498	0	0.71722	2.85144	20
13.38	1.171	22.7	3	1.18437	1.90256	9.47E-10	7	3.73392	0	0	0	54.67161	14	67.50952	0.28219	0.33	1.30372	179.5524	0	0.72046	2.93607	20
13.4	1.181	22.1	3	1.19571	1.85106	9.77E-10	7	3.81614	0	0	0	54.60695	14	68.29614	0.28508	0.33	1.31708	179.53767	0	0.72297	3.02396	20
13.42	1.196	21.6	3	1.20376	1.80822	1.03E-09	7	3.87264	0	0	0	54.5125	14	68.84754	0.28699	0.33	1.32588	179.47221	0	0.72462	3.09972	20
13.44	1.194	21.6	3	1.20783	1.79661	1.05E-09	7	3.89731	0	0	0	54.55801	14	69.1143	0.2877	0.33	1.32918	179.55922	0	0.72524	3.12129	20
13.46	1.192	21.9	3	1.19959	1.82285	9.86E-10	7	3.82326	0	0	0	54.58192	14	68.50189	0.28476	0.33	1.31558	179.56516	0	0.72269	3.07005	20
13.48	1.17	22.1	3	1.18568	1.86392	9.50E-10	7	3.70541	0	0	0	54.5655	14	67.48435	0.28014	0.33	1.29425	179.49634	0	0.71866	2.99252	20
13.5	1.151	22.3	3	1.16744	1.92158	9.05E-10	7	3.55631	0	0	0	54.54624	14	66.15833	0.27426	0.33	1.26707	179.40378	0	0.71347	2.89013	20
13.52	1.136	22.9	3	1.15324	1.97415	8.69E-10	7	3.44079	0	0	0	54.58052	14	65.1198	0.26958	0.33	1.24546	179.39395	0	0.70928	2.80311	20
13.54	1.126	23.1	3	1.14971	2.01791	8.50E-10	7	3.40699	0	0	0	54.83573	14	64.84386	0.26807	0.33	1.23848	179.7021	0	0.70792	2.73909	20
13.56	1.139	23.6	3	1.16458	1.995	8.73E-10	7	3.51216	0	0	0	55.11266	14	65.88244	0.27199	0.33	1.25658	180.11972	0	0.71125	2.77897	20.01259
13.58	1.179	23	3	1.20317	1.91993	9.44E-10	7	3.80432	0	0	0	55.62962	14	68.61505	0.28288	0.33	1.3069	180.93062	0	0.71539	2.91094	20.38255
13.6	1.24	22.7	3	1.24752	1.77953	1.15E-09	8	4.15526	0	0	0	55.7076	14	71.75926	0.29544	0.33	1.36492	181.2305	0	0.72032	3.16775	20.79324
13.62	1.27	20.9	3	1.28194	1.66154	1.39E-09	8	4.43598	0	0	0	55.61091	14	74.19423	0.30504	0.33	1.40931	181.27574	0	0.7236	3.41363	21.13789
13.64	1.28	20.3	3	1.30307	1.57321	1.59E-09	8	4.60907	0	0	0	55.37666	14	75.67938	0.31073	0.33	1.43556	181.09967	0	0.72473	3.61784	21.39714
13.66	1.301	20.3	3	1.31655	1.53685	1.70E-09	8	4.71778	0	0	0	55.40142	14	76.61871	0.31416	0.33	1.45141	181.20096	0	0.72463	3.71102	21.60882
13.68	1.308	20.1	3	1.33179	1.52177	1.79E-09	8	4.84325	0	0	0	55.6583	14	77.6835	0.31809	0.33	1.46958	181.58597	0	0.72466	3.75641	21.84149
13.7	1.323	20.4	3	1.35337	1.5172	1.89E-09	8	5.02758	0	0	0	56.16084	14	79.20172	0.32387	0.33	1.49627	182.28723	0	0.72579	3.78008	22.10734
13.72	1.363	21.1	3	1.37228	1.56187	1.90E-09	8	5.1904	0	0	0	57.06601	14	80.52867	0.32885	0.33	1.51927	183.4482	0	0.72657	3.68203	22.3496
13.74	1.362	22.8	3	1.38656	1.67801	1.77E-09	8	5.31232	0	0	0	58.52456	14	81.52465	0.33246	0.33	1.53596	185.23085	0	0.72658	3.43385	22.56608
13.76	1.363	25.9	3	1.38217	1.82563	1.54E-09	8	5.26121	0	0	0	59.77755	14	81.18716	0.33063	0.33	1.52751	186.69	0	0.7235	3.15311	22.67567
13.78	1.347	27	3	1.37213	1.96289	1.34E-09	8	5.15843	0	0	0	60.73979	14	80.44552	0.32716	0.33	1.51148	187.78409	0	0.71949	2.9271	22.75228
13.8	1.329	27.9	3	1.35873	2.07547	1.18E-09	8	5.02642	0	0	0	61.36027	14	79.46429	0.32272	0.33	1.49098	188.46718	0	0.71497	2.76152	22.80382
13.82	1.32	29.7	3	1.34336	2.18358	1.04E-09	8	4.87875	0	0	0	61.85333	14	78.34228	0.31773	0.33	1.46791	188.99458	0	0.71006	2.61734	22.84543
13.84	1.298	30.4	3	1.33138	2.27584	9.64E-10	8	4.76314	0	0	0	62.28045	14	77.46189	0.31373	0.33	1.44941	189.45728	0	0.70564	2.50537	22.91035
13.86	1.29	30.8	3	1.31981	2.3261	9.34E-10	8	4.65265	0	0	0	62.37993	14	76.61101	0.30985	0.33	1.43151	189.54317	0	0.70114	2.44556	22.98618
13.88	1.282	30.9	3	1.30625	2.35534	9.08E-10	8	4.52667	0	0	0	62.25817	14	75.61871	0.30542	0.33	1.41103	189.36623	0	0.69628	2.40866	23.05038
13.9	1.254	30.6	3	1.30337	2.34008	9.07E-10	8	4.493	0	0	0	62.10019	14	75.38868	0.30407	0.33	1.4048	189.18614	0	0.69327	2.42232	23.17434
13.92	1.278	30	3	1.30754	2.29438	9.23E-10	8	4.51946	0	0	0	61.90935	14	75.66224	0.30476	0.33	1.40797	188.99402	0	0.69142	2.47163	23.34319
13.94	1.291	29.4	3	1.34174	2.19863	9.88E-10	8	4.80644	0	0	0	62.14227	14	78.08082	0.31407	0.33	1.45099	189.40175	0	0.69485	2.59387	23.68072
13.96	1.353	29.1	3	1.38003	2.10864	1.17E-09	8	5.13893	0	0	0	62.4748	14	80.79155	0.32453	0.33	1.49932	189.9353	0	0.69892	2.72082	24.0406
13.98	1.389	28.8	3	1.44318	2.17113	1.31E-09	9	5.71761	0	0	0	64.6703	14	85.2775	0.34208	0.33	1.58039	192.66513	0	0.67082	2.66719	27.08979
14	1.408	36.1	3	1.47501	2.28247	1.30E-09	9	6.01487	0	0	0	66.45339	14	87.52652	0.35062	0.33	1.61984	194.78534	0	0.64364	2.5478	29.50047
14.02	1.377	36.1	3	1.49446	2.41558	1.24E-09	9	6.20023	0	0	0	68.05856	14	88.8915	0.35587	0.33	1.64412	196.63632	0	0.61747	2.41312	31.61439
14.04	1.377	36.1	3	1.4881	2.42143	1.21E-09	9	6.12989	0	0	0	67.95188	14	88.41219	0.35374	0.33	1.63428	196.50357	0	0.6151	2.40455	31.64379
14.06	1.387	35.9	3	1.49248	2.41879	1.22E-09	9	6.16627	0	0	0	68.06097	14	88.70062	0.35468	0.33	1.63863	196.6427	0	0.61465	2.40794	31.73274
14.08	1.387	36.3	3	1.47222	2.44529	1.14E-09	9	5.95977	0	0	0	67.74848	14	87.2287	0.34859	0.33	1.61048	196.23868	0	0.6081	2.37456	31.7985
14.1	1.312	35.8	3	1.43599	2.50235	9.93E-10	9	5.60475	0	0	0	67.23017	14	84.61585	0.33795	0.33	1.56131	195.55281	0	0.59854	2.3077	31.77877
14.12	1.276	35.7	3	1.37378	2.59138	9.02E-10	9	5.02556	0	0	0	66.18752	14	80.14828	0.31991	0.33	1.47801	194.18651	0	0.58286	2.20633	31.6872
14.14	1.199	35.3	3	1.32647	2.65115	8.38E-10	8	4.60502	0	0	0	65.27901	14	76.74419	0.30615	0.33	1.4144	193.00349	0	0.57096	2.13865	31.59221
14.16	1.17	34.5	3	1.28519	2.69999	7.84E-10	8	4.25265	0	0	0	64.42351	14	73.77122	0.29411	0.33	1.35881	191.88811	0	0.56021	2.08345	31.51747
14.18	1.152	34.3	3	1.31651	2.60285	8.36E-10	8	4.50889	0	0	0	64.67453	14	75.98349	0.30276	0.33	1.39874	192.29086	0	0.56769	2.17307	31.58852
14.2	1.292	34	3	1.39514	2.40358	9.70E-10	9	5.19397	0	0	0	65.42339	14	81.57577	0.32485	0.33	1.5008	193.41579	0	0.58754	2.38402	31.68859
14.22	1.407	32.3	3	1.47384	2.15763	1.37E-09	9	5.92769	0	0	0	65.53537	14	87.17275	0.34694	0.33	1.60284	193.80737	0	0.61786	2.68646	31.03328
14.24	1.416	29.1	3	1.44883	2.12586	1.32E-09	9	5.68063	0	0	0	64.63693	14	85.36145	0.33953	0.33	1.56863	192.71834	0	0.62839	2.71605	29.85233

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
14.26	1.254	31	3	1.35267	2.16856	9.88E-10	8	4.79754	0	0	0	62.4693	14	78.46873	0.31194	0.33	1.44114	189.91852	0	0.61957	2.62157	28.69422
14.28	1.145	27.9	3	1.26857	2.23611	8.70E-10	8	4.0861	0	0	0	60.69377	14	72.43776	0.2878	0.33	1.32963	187.54901	0	0.59772	2.50255	28.58419
14.3	1.158	26.2	3	1.2517	2.11446	8.83E-10	8	3.94638	0	0	0	59.31079	14	71.20834	0.28276	0.33	1.30633	185.86655	0	0.58427	2.63668	29.14539
14.32	1.185	25.3	3	1.27509	2.00247	9.43E-10	8	4.12878	0	0	0	59.08699	14	72.85564	0.28914	0.33	1.33581	185.70416	0	0.58071	2.79629	29.81097
14.34	1.197	25.1	3	1.29742	1.96287	9.83E-10	8	4.30634	0	0	0	59.37762	14	74.42639	0.29521	0.33	1.36385	186.14011	0	0.57779	2.86405	30.41085
14.36	1.208	26	3	1.32825	2.00766	1.04E-09	8	4.55949	0	0	0	60.57503	14	76.60419	0.30367	0.33	1.40297	187.66205	0	0.57793	2.8152	30.96134
14.38	1.262	28.9	3	1.36079	1.89596	1.23E-09	8	4.83473	0	0	0	60.49886	14	78.90453	0.31262	0.33	1.4443	187.70386	0	0.57909	2.99715	31.46869
14.4	1.28	22.5	3	1.39829	1.76882	1.50E-09	8	5.1627	0	0	0	60.3357	14	81.55945	0.32296	0.33	1.49207	187.66318	0	0.58211	3.2316	31.93364
14.42	1.307	22.8	3	1.42433	1.62416	1.81E-09	8	5.39471	0	0	0	59.63167	14	83.39482	0.33004	0.33	1.52481	186.95404	0	0.58306	3.53286	32.32209
14.44	1.328	24.1	3	1.43887	1.70736	1.74E-09	8	5.52374	0	0	0	60.78521	14	84.40962	0.33388	0.33	1.54251	188.34306	0	0.58364	3.36722	32.52645
14.46	1.317	26.8	3	1.44021	1.82612	1.57E-09	9	5.53005	0	0	0	61.93045	14	84.48144	0.33397	0.33	1.54296	189.66512	0	0.58256	3.14798	32.60533
14.48	1.308	28	3	1.43215	1.94812	1.40E-09	9	5.44869	0	0	0	62.83181	14	83.88139	0.33141	0.33	1.53113	190.66937	0	0.5797	2.94637	32.63536
14.5	1.302	28.9	3	1.42976	2.03298	1.30E-09	9	5.42026	0	0	0	63.51934	14	83.68603	0.33045	0.33	1.5267	191.44748	0	0.5795	2.82152	32.5878
14.52	1.311	30.3	3	1.43728	2.09424	1.26E-09	9	5.48377	0	0	0	64.24807	14	84.19894	0.33229	0.33	1.53518	192.30405	0	0.5814	2.74136	32.5765
14.54	1.331	31.1	3	1.45892	2.13171	1.29E-09	9	5.68051	0	0	0	65.13833	14	85.72061	0.3381	0.33	1.56202	193.38615	0	0.58696	2.70116	32.56954
14.56	1.368	31.9	3	1.48303	2.14201	1.35E-09	9	5.90434	0	0	0	65.86018	14	87.4183	0.3446	0.33	1.59204	194.28036	0	0.59119	2.69685	32.69129
14.58	1.38	32.3	3	1.50638	2.142	1.43E-09	9	6.12489	0	0	0	66.47073	14	89.06179	0.35087	0.33	1.62104	195.04239	0	0.59451	2.70498	32.85806
14.6	1.396	32.6	3	1.52473	2.14465	1.48E-09	9	6.29936	0	0	0	66.97354	14	90.34751	0.35573	0.33	1.64349	195.66466	0	0.59625	2.70766	33.04103
14.62	1.417	33.2	3	1.54417	2.16513	1.52E-09	9	6.48728	0	0	0	67.65835	14	91.71188	0.3609	0.33	1.66734	196.48866	0	0.59893	2.68826	33.17734
14.64	1.434	34.5	3	1.56593	2.18827	1.57E-09	9	6.70153	0	0	0	68.42414	14	93.2412	0.3667	0.33	1.69415	197.40422	0	0.60294	2.66663	33.26052
14.66	1.459	35.1	3	1.58961	2.2018	1.63E-09	9	6.93922	0	0	0	69.15281	14	94.90809	0.37304	0.33	1.72343	198.2793	0	0.60706	2.65743	33.36659
14.68	1.485	35.4	3	1.61403	2.19739	1.72E-09	9	7.18881	0	0	0	69.73794	14	96.62818	0.37957	0.33	1.75363	198.99486	0	0.61046	2.66999	33.53049
14.7	1.502	35.9	3	1.60604	2.3557	1.51E-09	10	7.09618	0	0	0	70.94022	14	96.03208	0.37701	0.33	1.74178	200.28362	0	0.60812	2.48753	33.53457
14.72	1.434	42.2	3	1.58883	2.52387	1.30E-09	10	6.90797	0	0	0	71.92547	14	94.77828	0.37187	0.33	1.71802	201.30562	0	0.60428	2.31628	33.48342
14.74	1.434	42.2	3	1.56472	2.69696	1.11E-09	10	6.65168	0	0	0	72.69182	14	93.03143	0.36479	0.33	1.68534	202.06874	0	0.60027	2.16045	33.32474
14.76	1.434	42.2	3	1.57399	2.67049	1.14E-09	10	6.73905	0	0	0	72.74826	14	93.6685	0.36707	0.33	1.69586	202.16042	0	0.60118	2.18387	33.40204
14.78	1.459	41.7	3	1.58861	2.62074	1.21E-09	10	6.88235	0	0	0	72.75658	14	94.6875	0.37084	0.33	1.71329	202.21515	0	0.60252	2.22883	33.53958
14.8	1.473	41	3	1.60054	2.57413	1.28E-09	10	6.99896	0	0	0	72.70919	14	95.51484	0.37386	0.33	1.72722	202.20238	0	0.60251	2.27195	33.72216
14.82	1.463	40.9	3	1.59197	2.5482	1.27E-09	10	6.90183	0	0	0	72.28617	14	94.87804	0.37114	0.33	1.71469	201.72827	0	0.59797	2.29204	33.86378
14.84	1.427	39.8	3	1.57448	2.52571	1.24E-09	10	6.71363	0	0	0	71.6552	14	93.6033	0.36594	0.33	1.69064	201.00256	0	0.59278	2.30674	33.89761
14.86	1.418	38.6	3	1.56355	2.47727	1.24E-09	9	6.59472	0	0	0	70.98407	14	92.79802	0.36258	0.33	1.67511	200.24879	0	0.59155	2.3479	33.77581
14.88	1.434	37.8	3	1.57478	2.41092	1.33E-09	9	6.7017	0	0	0	70.74153	14	93.57526	0.3654	0.33	1.68815	200.02306	0	0.59768	2.41538	33.5358
14.9	1.47	37.5	3	1.61782	2.32412	1.54E-09	10	7.14142	0	0	0	71.1205	14	96.62477	0.37709	0.33	1.74214	200.56288	0	0.60967	2.51841	33.43479
14.92	1.553	37.5	3	1.66264	2.26347	1.76E-09	10	7.61427	0	0	0	71.72384	14	99.80176	0.38925	0.33	1.79836	201.34508	0	0.61862	2.59891	33.55652
14.94	1.566	37.9	3	1.70067	2.22462	1.94E-09	10	8.02573	0	0	0	72.32174	14	102.49302	0.39952	0.33	1.84576	202.0966	0	0.62242	2.65489	33.90457
14.96	1.572	38.1	3	1.72084	2.21985	2.02E-09	10	8.24415	0	0	0	72.78456	14	103.90901	0.4048	0.33	1.87016	202.65115	0	0.62289	2.66573	34.18034
14.98	1.603	38.6	3	1.73808	2.22276	2.08E-09	10	8.43173	0	0	0	73.24547	14	105.11558	0.40925	0.33	1.89076	203.19366	0	0.62412	2.66644	34.3561
15	1.611	39.2	3	1.75494	2.24319	2.12E-09	10	8.61695	0	0	0	73.86086	14	106.29532	0.4136	0.33	1.91084	203.89711	0	0.6278	2.64613	34.35946
15.02	1.623	40.3	3	1.77032	2.27077	2.13E-09	10	8.78665	0	0	0	74.50775	14	107.36884	0.41753	0.33	1.92899	204.62703	0	0.632	2.61745	34.30299
15.04	1.652	41.1	3	1.77934	2.31172	2.10E-09	10	8.883	0	0	0	75.12607	14	107.98815	0.41969	0.33	1.93896	205.30769	0	0.63589	2.57281	34.16548
15.06	1.644	42	3	1.78437	2.3519	2.06E-09	10	8.93275	0	0	0	75.63913	14	108.32254	0.42074	0.33	1.9438	205.8654	0	0.63854	2.52953	34.04698
15.08	1.643	42.8	3	1.78137	2.40077	1.98E-09	10	8.88796	0	0	0	76.03324	14	108.08297	0.41955	0.33	1.93834	206.27692	0	0.63846	2.47673	33.98475
15.1	1.645	43.5	3	1.7761	2.45294	1.89E-09	10	8.81675	0	0	0	76.39531	14	107.68148	0.41775	0.33	1.92998	206.64854	0	0.63641	2.42222	34.01883
15.12	1.626	44.4	3	1.77204	2.49619	1.82E-09	10	8.75992	0	0	0	76.70054	14	107.36614	0.41627	0.33	1.92317	206.96315	0	0.63404	2.37872	34.09345
15.14	1.627	44.8	3	1.77122	2.52181	1.78E-09	10	8.741	0	0	0	76.92595	14	107.28246	0.4157	0.33	1.92052	207.20195	0	0.63247	2.35381	34.16651
15.16	1.639	44.8	3	1.77912	2.51436	1.81E-09	10	8.82377	0	0	0	77.07448	14	107.82163	0.41753	0.33	1.92901	207.38171	0	0.63306	2.36211	34.23206
15.18	1.647	44.6	3	1.78507	2.48544	1.86E-09	10	8.88398	0	0	0	76.98028	14	108.22141	0.41883	0.33	1.935	207.30321	0	0.63354	2.39047	34.27428
15.2	1.643	43.7	3	1.78969	2.45853	1.90E-09	10	8.92881	0	0	0	76.86856	14	108.52667	0.41976	0.33	1.93929	207.20317	0	0.63372	2.41719	34.31516
15.22	1.651	43.7	3	1.78622	2.44091	1.91E-09	10	8.87862	0	0	0	76.63952	14	108.25362	0.41845	0.33	1.93325	206.96053	0	0.63262	2.43322	34.3142
15.24	1.636	43.4	3	1.78886	2.43916	1.92E-09	10	8.90021	0	0	0	76.70611	14	108.41759	0.41884	0.33	1.93502	207.0419	0	0.63306	2.43505	34.30671
15.26	1.651	43.8	3	1.78379	2.44984	1.88E-09	10	8.8314	0	0	0	76.69492	14	108.03001	0.41709	0.33	1.92695	207.02286	0	0.6319	2.42264	34.28445
15.28	1.636	43.9	3	1.78352	2.4689	1.85E-09	10	8.81887	0	0	0	76.87829	14	107.98564	0.41667	0.33	1.92501	207.21895	0	0.63093	2.40331	34.32583
15.3	1.633	44.4	3	1.77975	2.49099	1.81E-09	10	8.76558	0	0	0	77.00089	14	107.69113	0.41528	0.33	1.91861	207.3428	0	0.62902	2.38054	34.37404
15.32	1.637	44.7	3	1.78939	2.49433	1.83E-09	10	8.86864	0	0	0	77.28879	14	108.35483	0.41759	0.33	1.92928	207.67198	0	0.62957	2.37911	34.46948
15.34	1.661	44.8	3	1.80449	2.47531	1.90E-09	10	9.03643	0	0	0	77.50852	14	109.4078	0.4214	0.33	1.94686	207.94286	0	0.63187	2.40044	34.53298
15.36	1.676	44.5	3	1.81916	2.44801	1.98E-09	11	9.20078	0	0	0	77.63769	14	110.43125	0.42509	0.33	1.9639	208.11803	0	0.63414	2.43015	34.59
15.38	1.679	44.3	3	1.83383	2.41389	2.08E-09	11	9.36635	0	0	0	77.69738	14	111.45376	0.42877	0.33	1.98089	208.22067	0	0.63711	2.46743	34.59991
15.4	1.705	44	3	1.8439	2.38986	2.15E-09	11	9.47768	0	0	0	77.734	14	112.14769	0.43118	0.33	1.99204	208.28818	0	0.63867	2.49406	34.63124

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

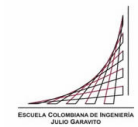
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
15.42	1.705	43.9	3	1.86476	2.35776	2.27E-09	11	9.72113	0	0	0	77.94979	14	113.61282	0.43655	0.33	2.01686	208.56699	0	0.64237	2.53239	34.68593
15.44	1.74	44	3	1.88769	2.33619	2.39E-09	11	9.99301	0	0	0	78.30749	14	115.22507	0.44248	0.33	2.04426	208.99643	0	0.6464	2.56056	34.74733
15.46	1.772	44.4	3	1.9087	2.3454	2.46E-09	11	10.2445	0	0	0	78.91402	14	116.70087	0.44788	0.33	2.0692	209.67612	0	0.65092	2.55473	34.74521
15.48	1.769	45.9	3	1.91197	2.39194	2.39E-09	11	10.27503	0	0	0	79.46194	14	116.90973	0.44841	0.33	2.07166	210.25218	0	0.65282	2.50521	34.64732
15.5	1.754	46.9	3	1.87884	2.49267	2.11E-09	11	9.85298	0	0	0	79.6382	14	114.51796	0.43897	0.33	2.02806	210.36218	0	0.6483	2.39632	34.42346
15.52	1.68	47.7	3	1.83774	2.60284	1.82E-09	11	9.34436	0	0	0	79.65083	14	111.55665	0.42736	0.33	1.97442	210.28465	0	0.64485	2.28555	34.00002
15.54	1.661	48.9	3	1.79566	2.71209	1.57E-09	11	8.8382	0	0	0	79.56695	14	108.52591	0.4155	0.33	1.91962	210.10391	0	0.64054	2.18389	33.61118
15.56	1.641	49.5	3	1.7785	2.78887	1.45E-09	11	8.63038	0	0	0	79.7997	14	107.27479	0.41047	0.33	1.89635	210.30763	0	0.63945	2.11954	33.39305
15.58	1.636	50.4	3	1.77564	2.81964	1.41E-09	11	8.58833	0	0	0	80.0034	14	107.04544	0.40934	0.33	1.89115	210.5155	0	0.63465	2.0953	33.65266
15.6	1.641	50.3	3	1.78697	2.80549	1.45E-09	11	8.7093	0	0	0	80.19771	14	107.82931	0.41209	0.33	1.90385	210.74739	0	0.63161	2.10783	34.01656
15.62	1.66	49.7	3	1.79726	2.76533	1.51E-09	11	8.81894	0	0	0	80.13952	14	108.53865	0.41455	0.33	1.91522	210.71721	0	0.62811	2.1402	34.3934
15.64	1.651	49.1	3	1.80835	2.69675	1.61E-09	11	8.93869	0	0	0	79.84803	14	109.30589	0.41723	0.33	1.9276	210.44926	0	0.62815	2.19658	34.54423
15.66	1.668	47.5	3	1.8131	2.63453	1.68E-09	11	8.98474	0	0	0	79.43833	14	109.61994	0.41818	0.33	1.93198	210.04427	0	0.62823	2.24901	34.59257
15.68	1.672	46.7	3	1.83233	2.54138	1.84E-09	11	9.20167	0	0	0	79.10197	14	110.96855	0.42307	0.33	1.95458	209.74889	0	0.63228	2.33534	34.6007
15.7	1.709	45.5	3	1.84358	2.46079	1.97E-09	11	9.32563	0	0	0	78.65572	14	111.74673	0.42578	0.33	1.96711	209.32076	0	0.63595	2.41393	34.50847
15.72	1.706	43.9	3	1.85122	2.40742	2.06E-09	11	9.40711	0	0	0	78.35976	14	112.26707	0.42751	0.33	1.9751	209.03867	0	0.63743	2.4687	34.50714
15.74	1.695	44.3	3	1.8351	2.4104	2.00E-09	11	9.20558	0	0	0	78.0113	14	111.09089	0.42278	0.33	1.95325	208.64447	0	0.63402	2.46125	34.46772
15.76	1.661	44.5	3	1.82152	2.42838	1.92E-09	11	9.03598	0	0	0	77.86259	14	110.0953	0.41875	0.33	1.93461	208.46239	0	0.62989	2.43919	34.51451
15.78	1.662	43.9	3	1.81705	2.41967	1.91E-09	11	8.97428	0	0	0	77.68855	14	109.75115	0.41719	0.33	1.92742	208.27609	0	0.62858	2.44631	34.51289
15.8	1.681	43.5	3	2.2829	1.90548	5.86E-09	12	15.22644	0	0	0	82.63884	14	143.00059	0.54326	0.33	2.50984	214.35078	0	0.71858	3.22162	35.29163
15.82	3.053	43.1	4	4.23	1.02364	1.05E-07	17	55.28258	0	0	0	96.67465	14	282.05398	1.09608	0.33	5.0639	230.33638	0	1.04397	6.38367	37.9575
15.84	7.494	43.3	6	10.35558	0.42039	9.13E-06	27	109.98658	38	36	87.75525	109.98658	0	0	0	0.33	0	243.31651	-0.03275	0	0	20
15.86	20.133	44.2	6	17.1678	0.25998	1.00E-04	36	119.50662	52	39	95.35103	119.50662	0	0	0	0.33	0	252.09387	-0.09121	0	0	20
15.88	23.638	46.4	6	23.16525	0.21196	3.63E-04	44	128.33554	62	41	102.39537	128.33554	0	0	0	0.33	0	259.66412	-0.1444	0	0	20
15.9	25.639	56.7	6	25.32484	0.2281	4.39E-04	47	135.66479	66	42	108.24319	135.66479	0	0	0	0.33	0	265.40869	-0.15871	0	0	20
15.92	26.681	70.2	6	26.27047	0.30402	3.13E-04	50	149.69828	66	42	119.44011	149.69828	0	0	0	0.33	0	275.9881	-0.16141	0	0	20
15.94	26.476	112.7	6	26.43048	0.40799	1.87E-04	53	165.32352	66	42	131.90706	165.32352	0	0	0	0.33	0	287.45392	-0.15833	0	0	20
15.96	26.119	140.6	6	26.06725	0.54206	1.02E-04	55	181.92179	64	41	145.15036	181.92179	0	0	0	0.33	0	299.21826	-0.15167	0	0	20
15.98	25.591	170.6	6	25.67341	0.75201	4.85E-05	58	204.92496	62	41	163.50396	204.92496	0	0	0	0.33	0	314.79572	-0.15205	0	0	20
16	25.292	268	6	24.84454	0.94803	2.63E-05	60	221.37453	60	41	176.62861	221.37453	0	0	0	0.33	0	325.45737	-0.15067	0	0	20
16.02	23.63	268	6	24.19163	1.10782	1.71E-05	60	232.96383	59	41	185.8754	232.96383	0	0	0	0.33	0	332.74713	-0.14974	0	0	20
16.04	23.63	268	6	23.45463	1.14263	1.47E-05	59	232.17729	58	40	185.24784	232.17729	0	0	0	0.33	0	332.28046	-0.14644	0	0	20
16.06	23.081	268	6	23.07133	1.18199	1.30E-05	59	233.49826	57	40	186.3018	233.49826	0	0	0	0.33	0	333.11392	-0.14507	0	0	20
16.08	22.48	282.1	6	22.38838	1.24425	1.06E-05	58	234.83686	56	40	187.36983	234.83686	0	0	0	0.33	0	333.96255	-0.1426	0	0	20
16.1	21.581	285.6	6	21.77444	1.30979	8.74E-06	58	236.47651	55	40	188.67806	236.47651	0	0	0	0.33	0	334.99338	-0.14064	0	0	20
16.12	21.239	287.9	6	21.34014	1.35051	7.70E-06	57	237.03291	54	40	189.12201	237.03291	0	0	0	0.33	0	335.35226	-0.13916	0	0	20
16.14	21.177	291.1	6	21.19519	1.37248	7.27E-06	57	237.85628	54	40	189.77895	237.85628	0	0	0	0.33	0	335.86832	-0.13881	0	0	20
16.16	21.146	293.7	6	21.18258	1.38321	7.12E-06	57	238.64504	54	40	190.40828	238.64504	0	0	0	0.33	0	336.35934	-0.1389	0	0	20
16.18	21.201	294.2	6	21.189	1.42291	6.65E-06	58	241.65694	53	40	192.81139	241.65694	0	0	0	0.33	0	338.20557	-0.13975	0	0	20
16.2	21.196	316.6	6	21.15882	1.41202	6.73E-06	58	240.7578	53	40	192.09399	240.7578	0	0	0	0.33	0	337.66562	-0.13927	0	0	20
16.22	21.054	285.5	6	21.08825	1.40046	6.79E-06	57	239.55831	53	40	191.13695	239.55831	0	0	0	0.33	0	336.94199	-0.13855	0	0	20
16.24	20.988	283.9	6	20.85931	1.36438	7.01E-06	57	235.59462	53	40	187.97443	235.59462	0	0	0	0.33	0	334.521	-0.13645	0	0	20
16.26	20.508	284.4	6	20.59023	1.37865	6.60E-06	56	235.05165	53	39	187.54121	235.05165	0	0	0	0.33	0	334.19958	-0.13527	0	0	20
16.28	20.247	283.3	5	20.17384	1.4033	5.99E-06	56	234.29147	52	39	186.93468	234.29147	0	0	0	0.33	0	333.74719	-0.13355	0	0	20
16.3	19.739	281.6	5	19.79749	1.42291	5.51E-06	55	233.35718	51	39	186.18924	233.35718	0	0	0	0.33	0	333.18546	-0.13194	0	0	20
16.32	19.379	280.2	5	19.0555	1.47499	4.57E-06	54	232.16113	50	39	185.23494	232.16113	0	0	0	0.33	0	332.46948	-0.12918	0	0	20
16.34	18.021	281.4	5	18.06685	1.55404	3.51E-06	52	230.67696	48	39	184.05076	230.67696	0	0	0	0.33	0	331.57935	-0.12587	0	0	20
16.36	16.773	280.7	5	16.71483	1.66299	2.44E-06	50	227.68416	46	38	181.66289	227.68416	0	0	0	0.33	0	329.75281	-0.1215	0	0	20
16.38	15.323	271.8	5	14.68981	1.85571	1.34E-06	46	201.56138	42	37	177.52417	222.49695	0	0	0	0.33	0	326.54724	-0.116	0	0	20
16.4	11.946	265.3	5	12.50344	2.12075	6.36E-07	42	170.94659	38	36	172.25339	215.89091	0	0	0	0.33	0	322.40097	-0.11154	0	0	20
16.42	10.214	258.4	4	10.17676	2.50702	2.46E-07	38	138.36737	0	0	165.5874	207.53621	14	705.95599	2.79696	0.33	12.92194	317.0621	0	1.57873	2.71167	20
16.44	8.343	241.7	4	7.79479	3.15211	6.96E-08	32	105.01409	0	0	0	197.89458	14	535.78619	1.98554	0.33	9.17321	310.72839	0	1.40415	2.13704	20
16.46	4.8	237	3	5.56252	4.27684	1.63E-08	26	73.75675	0	0	0	180.76431	14	376.30997	1.3935	0.33	6.43798	298.21246	0	1.244	1.55016	20
16.48	3.517	235	3	3.68426	6.24911	2.62E-09	21	42.51681	0	0	0	161.87525	14	242.12021	0.89593	0.33	4.13919	283.59647	0	1.06957	1.0306	20
16.5	2.707	218.7	3	2.74111	8.0758	8.41E-10	17	22.12551	0	0	0	148.39138	14	174.72473	0.64607	0.33	2.98487	272.62506	0	0.95642	0.77351	20
16.52	1.968	210.4	2	2.1332	9.76778	5.10E-10	15	12.48072	0	0	0	136.21999	14	131.27497	0.48507	0.33	2.24101	262.31763	0	0.8671	0.61742	20
16.54	1.689	196	2	1.73735	10.85181	3.49E-10	13	7.67382	0	0	0	124.49354	14	102.97191	0.38022	0.33	1.75662	252.03331	0	0.79781	0.53525	20
16.56	1.512	159.2	2	1.56265	10.27957	3.13E-10	12	5.91906	0	0	0	114.288	14	90.46631	0.33382	0.33	1.54224	242.90666	0	0.76307	0.55192	20



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Inicio cono (m	1.5	Fin cono (m	38.26

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Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
16.58	1.436	126.7	2	1.4621	8.78643	3.23E-10	11	5.01008	0	0	0	103.82019	14	83.2579	0.30702	0.33	1.41842	233.25616	0	0.74154	0.63513	20
16.6	1.379	99.5	2	1.41492	6.84376	3.78E-10	11	4.60669	0	0	0	93.5108	14	79.86105	0.29431	0.33	1.35969	223.39674	0	0.72188	0.80823	20.61918
16.62	1.361	64.3	3	1.38998	5.13436	4.63E-10	10	4.39795	0	0	0	84.25482	14	78.05434	0.28747	0.33	1.32813	214.14723	0	0.70985	1.07183	21.03138
16.64	1.351	50.3	3	1.38192	3.61334	6.00E-10	9	4.32796	0	0	0	75.30014	14	77.453	0.28509	0.33	1.31714	204.80824	0	0.70038	1.52011	21.52774
16.66	1.344	35.2	3	1.37846	2.52939	7.75E-10	9	4.29537	0	0	0	67.74116	14	77.18176	0.28394	0.33	1.31181	196.58165	0	0.69153	2.16935	22.05356
16.68	1.339	19.1	3	1.37787	1.81439	9.71E-10	9	4.28578	0	0	0	61.82424	14	77.11548	0.28355	0.33	1.31001	189.92616	0	0.68319	3.02293	22.58901
16.7	1.337	20.7	3	1.37545	1.48315	1.27E-09	8	4.26183	0	0	0	58.61603	14	76.91882	0.28269	0.33	1.30602	186.2364	0	0.67466	3.69512	23.10736
16.72	1.324	21.4	3	1.37111	1.56807	1.16E-09	8	4.22281	0	0	0	59.3569	14	76.58505	0.28132	0.33	1.2997	187.07596	0	0.66539	3.49085	23.64116
16.74	1.312	22.4	3	1.36294	1.63616	1.06E-09	8	4.15403	0	0	0	59.81285	14	75.97801	0.27895	0.33	1.28875	187.56924	0	0.65544	3.33894	24.15321
16.76	1.298	23.1	3	1.34991	1.67665	9.82E-10	8	4.04826	0	0	0	59.86545	14	75.02345	0.27531	0.33	1.27191	187.57646	0	0.64461	3.24844	24.63868
16.78	1.27	22.4	3	1.34297	1.67043	9.74E-10	8	3.99034	0	0	0	59.63584	14	74.50356	0.27326	0.33	1.26246	187.28477	0	0.63486	3.25469	25.15147
16.8	1.276	21.8	3	1.34204	1.6393	9.84E-10	8	3.97868	0	0	0	59.33032	14	74.41333	0.27279	0.33	1.2603	186.93169	0	0.62637	3.31478	25.68256
16.82	1.28	21.8	3	1.3549	1.60651	1.05E-09	8	4.07291	0	0	0	59.36241	14	75.30824	0.27593	0.33	1.27482	187.03058	0	0.62056	3.3906	26.27477
16.84	1.293	21.7	3	1.36014	1.60523	1.07E-09	8	4.10881	0	0	0	59.49443	14	75.65838	0.27708	0.33	1.2801	187.21034	0	0.61499	3.39596	26.72078
16.86	1.279	22	3	1.36431	1.58078	1.10E-09	8	4.13657	0	0	0	59.37544	14	75.93247	0.27794	0.33	1.2841	187.09586	0	0.60643	3.45041	27.34693
16.88	1.274	21	3	1.36484	1.55574	1.13E-09	8	4.13607	0	0	0	59.15522	14	75.94682	0.27786	0.33	1.2837	186.84837	0	0.59728	3.50524	27.94958
16.9	1.276	20.7	3	1.37728	1.50297	1.22E-09	8	4.22869	0	0	0	58.95712	14	76.81156	0.28088	0.33	1.29767	186.68008	0	0.59102	3.63649	28.56981
16.92	1.298	20.4	3	1.41378	1.42644	1.45E-09	8	4.51568	0	0	0	59.0847	14	79.3949	0.29018	0.33	1.34065	186.99464	0	0.5902	3.8582	29.24588
16.94	1.365	19.4	4	2.09481	0.94201	1.04E-08	10	11.73406	0	0	0	66.64996	14	128.01604	0.46766	0.33	2.16058	197.85641	0	0.7131	6.35755	31.57438
16.96	3.298	19.4	5	3.5544	0.54955	1.25E-07	14	39.70439	19	30	61.57315	77.17168	0	0	0	0.33	0	211.69461	0.03332	0	0	34.61042
16.98	5.659	19.8	5	5.63118	0.36996	1.15E-06	18	74.59091	25	32	67.49155	84.58941	0	0	0	0.33	0	220.0097	0.02534	0	0	35.27364
17	7.682	23.3	6	7.58707	0.31369	4.14E-06	22	91.73627	31	34	73.19383	91.73627	0	0	0	0.33	0	227.34889	0.00756	0	0	20
17.02	9.269	28.3	6	8.79465	0.33278	6.45E-06	24	98.71436	34	35	78.76146	98.71436	0	0	0	0.33	0	233.86784	-0.00758	0	0	20
17.04	9.39	36.2	5	9.30012	0.50107	4.26E-06	26	112.74964	34	35	89.95982	112.74964	0	0	0	0.33	0	246.10355	-0.0221	0	0	20
17.06	9.218	75.3	5	9.12353	0.77857	1.87E-06	28	128.22175	33	35	102.30459	128.22175	0	0	0	0.33	0	259.08102	-0.03514	0	0	20
17.08	8.75	101.6	5	8.89317	1.15369	8.18E-07	29	120.23319	32	35	115.76648	145.09399	0	0	0	0.33	0	272.61139	-0.05145	0	0	20
17.1	8.707	130.9	5	8.71447	1.47915	4.64E-07	30	117.72598	31	34	125.58188	157.39596	0	0	0	0.33	0	282.06369	-0.0638	0	0	20
17.12	8.686	154.2	5	8.75441	1.72104	3.41E-07	31	118.27956	31	34	133.40537	167.2014	0	0	0	0.33	0	289.36893	-0.073	0	0	20
17.14	8.874	166.9	5	9.05583	1.84706	3.23E-07	33	122.49394	31	35	139.48191	174.81732	0	0	0	0.33	0	294.88489	-0.07944	0	0	20
17.16	9.615	180.7	5	9.57575	1.88532	3.63E-07	34	129.76734	32	35	144.68658	181.34052	0	0	0	0.33	0	299.50812	-0.08423	0	0	20
17.18	10.249	194	5	10.30455	1.85937	4.63E-07	36	139.96498	34	35	149.34199	187.1753	0	0	0	0.33	0	303.55029	-0.08821	0	0	20
17.2	11.063	200.1	5	11.06418	1.76998	6.32E-07	38	150.59419	35	36	151.92493	190.41257	0	0	0	0.33	0	305.76224	-0.09	0	0	20
17.22	11.896	193.4	5	11.97826	1.52972	1.09E-06	39	163.38563	37	36	149.36882	187.20892	0	0	0	0.33	0	303.52921	-0.08732	0	0	20
17.24	12.992	156.2	5	13.03515	1.25328	2.13E-06	39	180.78786	40	37	144.24563	180.78786	0	0	0	0.33	0	299.02634	-0.08404	0	0	20
17.26	14.234	140.5	5	13.9111	1.02268	3.95E-06	40	172.80904	42	37	137.87956	172.80904	0	0	0	0.33	0	293.34702	-0.08161	0	0	20
17.28	14.524	130.1	6	14.55674	0.84795	6.63E-06	40	164.82692	43	38	131.51084	164.82692	0	0	0	0.33	0	287.55917	-0.08025	0	0	20
17.3	14.929	99.7	6	15.0117	0.69768	1.07E-05	39	155.98154	45	38	124.45336	155.98154	0	0	0	0.33	0	281.01291	-0.079	0	0	20
17.32	15.599	84.4	6	15.46066	0.57975	1.66E-05	39	148.38198	46	38	118.38988	148.38198	0	0	0	0.33	0	275.27628	-0.07926	0	0	20
17.34	15.871	84.8	6	15.91165	0.53881	2.08E-05	39	146.73373	47	38	117.07478	146.73373	0	0	0	0.33	0	274.0296	-0.08176	0	0	20
17.36	16.282	88	6	16.53533	0.5324	2.40E-05	40	148.76328	48	39	118.69411	148.76328	0	0	0	0.33	0	275.59354	-0.08639	0	0	20
17.38	17.47	91.3	6	17.18398	0.53926	2.63E-05	41	152.09228	49	39	121.35022	152.09228	0	0	0	0.33	0	278.12677	-0.09136	0	0	20
17.4	17.817	98.7	6	17.67295	0.60035	2.34E-05	43	159.92799	50	39	127.60212	159.92799	0	0	0	0.33	0	283.97836	-0.0961	0	0	20
17.42	17.749	128.3	6	17.53256	0.69813	1.69E-05	44	168.20135	49	39	134.2032	168.20135	0	0	0	0.33	0	290.03094	-0.09709	0	0	20
17.44	17.049	140.2	6	17.10519	0.8019	1.18E-05	44	174.97467	48	39	139.60745	174.97467	0	0	0	0.33	0	294.90063	-0.09647	0	0	20
17.46	16.535	143	6	16.45784	0.83121	9.78E-06	43	174.10042	47	38	138.90991	174.10042	0	0	0	0.33	0	294.29623	-0.09267	0	0	20
17.48	15.807	127.2	6	15.52984	0.83431	8.16E-06	42	169.57016	45	38	135.29534	169.57016	0	0	0	0.33	0	291.06818	-0.08616	0	0	20
17.5	14.265	118.5	6	14.54121	0.82387	6.86E-06	40	163.60229	43	38	130.53374	163.60229	0	0	0	0.33	0	286.74405	-0.07862	0	0	20
17.52	13.569	113.7	6	13.59189	0.84094	5.36E-06	38	159.66427	41	37	127.3917	159.66427	0	0	0	0.33	0	283.85385	-0.07209	0	0	20
17.54	12.959	110.7	5	12.72192	0.88351	3.96E-06	36	157.56291	40	37	125.71508	157.56291	0	0	0	0.33	0	282.30411	-0.06709	0	0	20
17.56	11.655	112.8	5	11.76093	0.97271	2.57E-06	35	157.20991	38	36	125.43344	157.20991	0	0	0	0.33	0	282.05917	-0.06347	0	0	20
17.58	10.686	119.7	5	10.63461	1.14563	1.36E-06	34	144.47637	35	36	126.93382	159.09039	0	0	0	0.33	0	283.49396	-0.06254	0	0	20
17.6	9.58	133	5	9.47626	1.35743	6.74E-07	32	128.25405	32	35	127.87478	160.26973	0	0	0	0.33	0	284.40912	-0.06317	0	0	20
17.62	8.18	133.2	5	8.47392	1.56244	3.57E-07	30	114.2158	30	34	127.75977	160.12558	0	0	0	0.33	0	284.35193	-0.064	0	0	20
17.64	7.679	131	5	7.68357	1.69236	2.24E-07	29	103.1455	28	33	125.51848	157.31649	0	0	0	0.33	0	282.27048	-0.06287	0	0	20
17.66	7.209	125.9	4	7.48991	1.75837	1.91E-07	28	100.42888	0	0	125.79205	157.65937	14	512.39227	1.91844	0.33	8.86321	282.54245	0	1.38774	3.81279	20
17.68	7.599	138.2	4	7.84391	1.77038	2.16E-07	29	105.37937	0	0	129.0571	161.75157	14	537.64984	2.02537	0.33	9.35722	285.6066	0	1.41372	3.79426	20
17.7	8.741	152.5	5	8.81243	1.69609	3.35E-07	32	118.93328	31	34	134.54472	168.62938	0	0	0	0.33	0	290.65143	-0.07118	0	0	20
17.72	10.114	157.7	5	8.34748	1.79136	2.53E-07	31	112.41839	30	34	133.7847	167.67683	0	0	0	0.33	0	289.97949	-0.07115	0	0	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

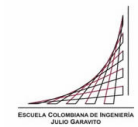
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
17.74	6.203	138.4	5	8.65618	1.68743	3.20E-07	31	116.73476	30	34	133.19847	166.94209	0	0	0	0.33	0	289.44009	-0.06967	0	0	20
17.76	9.666	142.1	5	8.55302	1.6006	3.44E-07	31	115.28502	30	34	129.84645	162.74088	0	0	0	0.33	0	286.35519	-0.06569	0	0	20
17.78	9.804	130.2	5	8.78534	1.50099	4.26E-07	31	118.53211	31	34	128.38879	160.91395	0	0	0	0.33	0	284.98361	-0.06359	0	0	20
17.8	6.9	123.3	4	7.35403	1.65125	2.02E-07	28	98.48839	0	0	122.12227	153.05992	14	502.4918	1.87725	0.33	8.67288	279.11459	0	1.37747	4.05525	20
17.82	5.372	110.8	4	5.4764	2.11209	5.18E-08	23	72.1962	0	0	0	143.51017	14	368.34796	1.30595	0.33	6.03348	271.45987	0	1.2167	3.12087	20
17.84	4.171	112.9	3	4.0661	2.8299	1.35E-08	20	49.72378	0	0	0	133.05685	14	267.58489	0.94808	0.33	4.38014	262.21225	0	1.09047	2.27897	20
17.86	2.669	121.5	3	3.02015	3.80224	3.35E-09	17	25.81006	0	0	0	123.31088	14	192.84722	0.68284	0.33	3.15473	253.20372	0	0.97469	1.64578	20
17.88	2.234	110.1	3	2.30656	4.9352	9.52E-10	14	13.95551	0	0	0	114.59815	14	141.84995	0.50195	0.33	2.31901	244.83156	0	0.87731	1.2212	20
17.9	2.03	109.9	3	1.92466	5.67027	6.54E-10	13	9.09424	0	0	0	107.62267	14	114.54476	0.40507	0.33	1.87145	238.0126	0	0.81527	1.02859	20
17.92	1.523	107.4	3	1.6724	6.16281	4.93E-10	12	6.45058	0	0	0	101.55296	14	96.4995	0.34105	0.33	1.57565	231.94931	0	0.76868	0.91756	20
17.94	1.477	91.9	2	1.4895	5.76257	4.33E-10	11	4.81633	0	0	0	92.50538	14	83.40912	0.29461	0.33	1.3611	222.91536	0	0.73115	0.95232	20
17.96	1.481	58.2	3	1.46824	4.42706	5.20E-10	10	4.63704	0	0	0	84.32222	14	81.8654	0.28899	0.33	1.33514	214.74873	0	0.72635	1.23428	20
17.98	1.459	44.9	3	1.44867	3.10169	6.64E-10	10	4.47481	0	0	0	75.08902	14	80.44242	0.28381	0.33	1.31122	205.12331	0	0.72187	1.75446	20
18	1.418	31.7	3	1.42086	2.71198	7.08E-10	9	4.25157	0	0	0	71.38446	14	78.431	0.27657	0.33	1.27775	201.0598	0	0.71552	1.9947	20
18.02	1.393	39	3	1.39404	2.62307	7.00E-10	9	4.0417	0	0	0	69.9108	14	76.49076	0.26959	0.33	1.24549	199.36282	0	0.70929	2.04998	20
18.04	1.374	39	3	1.38086	2.82433	6.53E-10	9	3.93814	0	0	0	71.01186	14	75.52446	0.26604	0.33	1.22911	200.51761	0	0.70608	1.89779	20
18.06	1.374	39	3	1.40686	2.77213	6.82E-10	9	4.12936	0	0	0	71.44497	14	77.35684	0.27235	0.33	1.25826	201.08667	0	0.71176	1.94384	20
18.08	1.471	39	3	1.47093	2.50635	7.90E-10	9	4.62718	0	0	0	71.31044	14	81.90857	0.28822	0.33	1.3316	201.17387	0	0.72569	2.17732	20
18.1	1.566	32.6	3	1.55736	2.1896	9.56E-10	10	5.34523	0	0	0	71.03493	14	88.05779	0.3097	0.33	1.43082	201.18007	0	0.74375	2.53069	20
18.12	1.633	30.7	3	1.57816	2.02346	1.10E-09	10	5.52122	0	0	0	70.06064	14	89.51877	0.31468	0.33	1.45381	200.20554	0	0.74781	2.74724	20
18.14	1.533	32.5	3	1.54361	1.93054	1.08E-09	9	5.21544	0	0	0	68.28559	14	87.02678	0.30576	0.33	1.41262	198.16234	0	0.7405	2.86195	20
18.16	1.462	26.2	3	1.48541	1.86704	9.80E-10	9	4.72395	0	0	0	66.16793	14	82.84552	0.29092	0.33	1.34407	195.6248	0	0.72801	2.92747	20
18.18	1.458	24.5	3	1.45157	1.71768	9.94E-10	9	4.44742	0	0	0	63.85348	14	80.40398	0.28221	0.33	1.30382	192.92097	0	0.72048	3.16026	20
18.2	1.431	24.1	3	1.43607	1.65034	1.00E-09	9	4.32109	0	0	0	62.79892	14	79.27312	0.27811	0.33	1.28485	191.67734	0	0.71687	3.27796	20
18.22	1.415	22.5	3	1.41791	1.66913	9.70E-10	9	4.1762	0	0	0	62.52218	14	77.95179	0.27334	0.33	1.26282	191.2916	0	0.71265	3.22786	20
18.24	1.403	24.4	3	1.39074	1.67777	9.33E-10	9	3.9664	0	0	0	61.90171	14	75.98693	0.26632	0.33	1.23039	190.47498	0	0.70633	3.19145	20
18.26	1.349	23.1	3	1.36986	1.68388	9.05E-10	9	3.80794	0	0	0	61.41468	14	74.47162	0.26088	0.33	1.20527	189.83209	0	0.70137	3.16397	20
18.28	1.352	21.7	3	1.35903	1.58937	9.25E-10	8	3.72509	0	0	0	60.22674	14	73.67463	0.25797	0.33	1.1918	188.43069	0	0.69868	3.34265	20
18.3	1.37	20	3	1.37486	1.51531	9.72E-10	9	3.83602	0	0	0	59.91528	14	74.78139	0.26172	0.33	1.20913	188.15288	0	0.70213	3.51772	20
18.32	1.396	20.8	3	1.38403	1.47636	9.99E-10	9	3.89925	0	0	0	59.76428	14	75.41306	0.2638	0.33	1.21877	188.02751	0	0.70404	3.61687	20
18.34	1.379	20.5	3	1.38554	1.47957	9.98E-10	9	3.90609	0	0	0	59.84471	14	75.4971	0.26397	0.33	1.21955	188.13037	0	0.7042	3.60913	20
18.36	1.374	20.2	3	1.40408	1.38644	1.18E-09	9	4.03993	0	0	0	59.34612	14	76.79765	0.26839	0.33	1.23997	187.65298	0	0.70821	3.86618	20
18.38	1.451	17.7	3	1.45128	1.24718	1.54E-09	9	4.3978	0	0	0	58.95475	14	80.14556	0.27996	0.33	1.29343	187.43643	0	0.71851	4.33937	20
18.4	1.52	16.4	3	1.52318	1.10952	2.17E-09	9	4.97442	0	0	0	58.9553	14	85.2576	0.29768	0.33	1.37529	187.78194	0	0.73375	4.94393	20
18.42	1.589	16.6	3	1.59909	1.04643	2.82E-09	9	5.62177	0	0	0	59.80135	14	90.65643	0.31639	0.33	1.46171	189.08278	0	0.7492	5.30936	20
18.44	1.678	17.2	3	1.65767	1.04967	3.21E-09	9	6.14682	0	0	0	61.09773	14	94.81742	0.33076	0.33	1.52809	190.78011	0	0.76067	5.34029	20
18.46	1.695	18.4	3	1.69891	1.12818	3.19E-09	9	6.52838	0	0	0	63.04861	14	97.73908	0.34079	0.33	1.57443	193.0959	0	0.76848	4.99744	20
18.48	1.712	21.9	3	1.70813	1.22941	2.89E-09	10	6.61037	0	0	0	64.59791	14	98.37452	0.34284	0.33	1.5839	194.8257	0	0.77006	4.59081	20
18.5	1.705	22.7	3	1.71136	1.3498	2.55E-09	10	6.6349	0	0	0	66.20787	14	98.58087	0.34339	0.33	1.58645	196.58989	0	0.77048	4.18222	20
18.52	1.704	24.7	3	1.70959	1.49354	2.20E-09	10	6.61132	0	0	0	67.91623	14	98.42991	0.34269	0.33	1.58324	198.43338	0	0.76995	3.77786	20
18.54	1.706	29.2	3	1.70978	1.65323	1.90E-09	10	6.60659	0	0	0	69.76417	14	98.4195	0.34248	0.33	1.58228	200.42296	0	0.76979	3.41219	20
18.56	1.705	30.9	3	1.71532	1.78975	1.70E-09	10	6.65317	0	0	0	71.40531	14	98.79098	0.3436	0.33	1.58744	202.19641	0	0.77065	3.15359	20
18.58	1.72	32	3	1.71754	1.86895	1.60E-09	10	6.66781	0	0	0	72.31462	14	98.925	0.34389	0.33	1.58878	203.17291	0	0.77087	3.02014	20
18.6	1.712	33.4	3	1.71077	1.93285	1.49E-09	10	6.59609	0	0	0	72.82645	14	98.41683	0.34195	0.33	1.5798	203.69746	0	0.76938	2.91679	20
18.62	1.684	33.8	3	1.68799	2.00436	1.34E-09	10	6.3732	0	0	0	72.99584	14	96.7647	0.33603	0.33	1.55248	203.80864	0	0.7648	2.80284	20
18.64	1.651	34.3	3	1.66552	2.06942	1.22E-09	10	6.15718	0	0	0	73.07974	14	95.13529	0.33021	0.33	1.52555	203.83	0	0.76024	2.70501	20
18.66	1.644	35.3	3	1.67074	2.11084	1.19E-09	10	6.19912	0	0	0	73.63091	14	95.48345	0.33124	0.33	1.53034	204.43381	0	0.76105	2.65332	20
18.68	1.699	36.2	3	1.70397	2.11271	1.27E-09	10	6.50447	0	0	0	74.51852	14	97.83229	0.33921	0.33	1.56717	205.47681	0	0.76727	2.66321	20
18.7	1.75	36.5	3	1.75323	2.04955	1.48E-09	10	6.97371	0	0	0	75.14822	14	101.32611	0.35115	0.33	1.62229	206.29076	0	0.77639	2.76344	20
18.72	1.791	35.1	3	1.79249	1.96189	1.71E-09	11	7.35769	0	0	0	75.2229	14	104.10532	0.36059	0.33	1.66592	206.49051	0	0.78347	2.90113	20
18.74	1.816	33.9	3	1.81842	1.89909	1.88E-09	11	7.61434	0	0	0	75.19121	14	105.93288	0.36673	0.33	1.69429	206.53889	0	0.78801	3.0062	20
18.76	1.827	34.6	3	1.82835	1.90882	1.90E-09	11	7.70909	0	0	0	75.54917	14	106.61756	0.36891	0.33	1.70435	206.94476	0	0.78961	2.99385	20
18.78	1.82	36.2	3	1.83528	1.95247	1.86E-09	11	7.7732	0	0	0	76.20231	14	107.08791	0.37034	0.33	1.71098	207.64664	0	0.79066	2.92873	20
18.8	1.836	36.7	3	1.87788	1.96321	1.99E-09	11	8.2132	0	0	0	77.35416	14	110.10582	0.38058	0.33	1.75828	208.96017	0	0.79806	2.92686	20
18.82	1.954	37.7	3	1.94247	1.98373	2.20E-09	11	8.90732	0	0	0	79.12511	14	114.69436	0.39623	0.33	1.83059	210.95157	0	0.80914	2.91697	20
18.84	2.013	41.2	3	2.2037	1.84387	3.79E-09	12	12.03038	0	0	0	83.3697	14	133.32892	0.46036	0.33	2.12687	215.85979	0	0.85174	3.21564	20
18.86	2.619	43	3	2.64726	1.66209	8.13E-09	13	18.41152	0	0	0	89.87231	14	164.98636	0.56936	0.33	2.63043	223.09357	0	0.91595	3.6747	20
18.88	3.284	47.8	4	3.24004	1.56068	1.69E-08	15	29.05077	0	0	0	98.87438	14	207.30226	0.71499	0.33	3.30324	232.44707	0	0.99015	4.01759	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

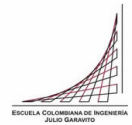
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
18.9	3.791	60.9	4	3.60709	1.69204	2.07E-08	17	36.83405	0	0	0	107.42073	14	233.49398	0.80486	0.33	3.71843	240.56526	0	1.03107	3.74917	20
18.92	3.721	74.4	4	3.71841	1.99637	1.73E-08	18	39.35332	0	0	0	114.74098	14	241.4187	0.83168	0.33	3.84235	247.02538	0	1.04269	3.18712	20
18.94	3.62	87.4	3	3.68415	2.3289	1.29E-08	18	38.52769	0	0	0	119.6433	14	238.94521	0.82266	0.33	3.80067	251.13994	0	1.03881	2.72921	20
18.96	3.69	95.6	3	3.60957	2.57095	1.03E-08	18	36.79794	0	0	0	121.97393	14	233.59113	0.80373	0.33	3.71324	253.01486	0	1.03058	2.4668	20
18.98	3.498	95.4	3	3.47436	2.74007	8.20E-09	18	33.7894	0	0	0	121.7745	14	223.90703	0.76994	0.33	3.55712	252.70836	0	1.01555	2.30493	20
19	3.214	94.6	3	3.21254	2.83784	6.10E-09	17	28.35607	0	0	0	117.72657	14	205.17863	0.70511	0.33	3.25762	249.00465	0	0.98545	2.20558	20
19.02	2.904	83.5	3	3.18583	2.85849	5.86E-09	17	27.80715	0	0	0	117.4571	14	203.24453	0.69804	0.33	3.22495	248.74931	0	0.98206	2.18718	20
19.04	3.417	95.1	3	3.40882	2.76146	7.60E-09	17	32.30867	0	0	0	120.83321	14	219.14545	0.7522	0.33	3.47514	251.86623	0	1.00748	2.28147	20
19.06	3.882	103.8	3	3.85901	2.73041	1.11E-08	19	42.45048	0	0	0	129.32726	14	251.27494	0.86194	0.33	3.98217	259.34137	0	1.05552	2.33707	20
19.08	4.254	117.2	3	4.4104	2.62335	1.74E-08	21	56.75429	0	0	0	137.88466	14	290.63264	0.99632	0.33	4.60299	266.66379	0	1.10914	2.46171	20
19.1	5.071	126.1	4	4.83923	2.52726	2.41E-08	22	62.96226	0	0	0	143.71112	14	321.23604	1.10053	0.33	5.08444	271.53107	0	1.14752	2.57409	20
19.12	5.169	123.6	4	5.17141	2.38168	3.22E-08	23	67.60749	0	0	0	146.47884	14	344.93618	1.18097	0.33	5.45606	273.89291	0	1.17555	2.74455	20
19.14	5.253	119.8	4	5.40843	2.20643	4.16E-08	24	70.92041	0	0	0	146.664	14	361.83884	1.23805	0.33	5.71977	274.20334	0	1.19468	2.97153	20
19.16	5.785	114.6	4	5.63601	2.14809	4.88E-08	24	74.10112	0	0	0	148.89666	14	378.06693	1.29274	0.33	5.97247	276.04901	0	1.21248	3.06034	20
19.18	5.855	128.8	4	5.78737	2.09594	5.47E-08	25	76.21476	0	0	0	150.0102	14	388.85084	1.32877	0.33	6.1389	276.9899	0	1.22393	3.14158	20
19.2	5.71	120.5	4	5.50995	2.1803	4.45E-08	24	72.32555	0	0	0	147.7772	14	369.00789	1.26015	0.33	5.82191	275.1355	0	1.20193	3.01022	20
19.22	4.956	111.1	4	5.11525	2.54729	2.74E-08	23	66.7943	0	0	0	148.96694	14	340.78722	1.16303	0.33	5.37322	275.77359	0	1.16941	2.5631	20
19.24	4.673	159.3	3	4.76937	3.00319	1.67E-08	23	61.94669	0	0	0	151.06755	14	316.05454	1.07793	0.33	4.98003	277.12036	0	1.13941	2.16244	20
19.26	4.673	159.3	3	5.12781	3.10659	1.91E-08	24	66.95938	0	0	0	159.3848	14	341.62949	1.16439	0.33	5.37948	283.54636	0	1.16988	2.10168	20
19.28	6.031	159.3	4	6.22002	2.49624	4.81E-08	27	82.24477	0	0	0	165.6922	14	419.61617	1.42925	0.33	6.60314	288.77188	0	1.25483	2.6485	20
19.3	7.95	147.2	4	7.94548	1.92772	1.60E-07	31	106.3958	0	0	137.60233	172.46159	14	542.83571	1.91156	0.33	8.83141	294.02246	0	1.38603	3.4732	20
19.32	9.851	153	5	9.46422	1.55075	4.32E-07	33	127.6527	31	34	137.93788	172.88215	0	0	0	0.33	0	294.24567	-0.06733	0	0	20
19.34	10.59	140.1	5	10.61388	1.32939	8.44E-07	35	143.74245	34	35	137.6064	172.46669	0	0	0	0.33	0	293.90192	-0.06626	0	0	20
19.36	11.403	130.2	5	11.4817	1.17462	1.38E-06	36	155.88646	36	36	136.46763	171.03944	0	0	0	0.33	0	292.84659	-0.06567	0	0	20
19.38	12.458	134.3	5	12.06479	1.10597	1.82E-06	37	164.04417	37	36	136.68523	171.31215	0	0	0	0.33	0	293.02975	-0.06673	0	0	20
19.4	12.342	135.8	5	12.09811	1.13076	1.75E-06	37	164.50516	37	36	138.05221	173.02544	0	0	0	0.33	0	294.26807	-0.0679	0	0	20
19.42	11.505	140.3	5	11.30993	1.17832	1.30E-06	36	153.46521	35	36	135.78554	170.18454	0	0	0	0.33	0	292.25955	-0.06451	0	0	20
19.44	10.095	123.7	5	10.24217	1.24616	8.56E-07	34	138.51108	33	35	132.26995	165.77834	0	0	0	0.33	0	289.10071	-0.0601	0	0	20
19.46	9.14	118.9	5	9.05403	1.33274	5.08E-07	31	121.8717	31	34	127.90873	160.31228	0	0	0	0.33	0	285.11523	-0.05552	0	0	20
19.48	7.941	119.4	4	7.40731	1.62362	1.80E-07	28	98.8122	0	0	125.11918	156.81604	14	504.14388	1.77544	0.33	8.20255	282.57974	0	1.35145	4.10805	20
19.5	5.155	122.5	4	5.69198	2.13341	4.91E-08	24	74.79231	0	0	0	150.1077	14	381.59339	1.29039	0.33	5.96161	277.11682	0	1.21172	3.07956	20
19.52	3.994	122.4	3	4.09641	2.86348	1.16E-08	20	47.43167	0	0	0	136.73464	14	267.59683	0.90434	0.33	4.17805	265.63684	0	1.073	2.23568	20
19.54	3.154	107	3	3.0422	3.73195	3.01E-09	17	24.47143	0	0	0	125.36123	14	192.26894	0.64937	0.33	3.0001	255.36987	0	0.95808	1.65963	20
19.56	1.992	111.2	3	2.29665	4.93763	8.72E-10	15	12.78023	0	0	0	116.30912	14	138.98882	0.46914	0.33	2.16743	246.69218	0	0.85726	1.20114	20
19.58	1.757	122	3	1.81941	6.41968	4.96E-10	13	7.27191	0	0	0	110.13027	14	104.87331	0.35378	0.33	1.63444	240.40512	0	0.77838	0.87993	20
19.6	1.722	117.2	2	1.72881	6.61727	4.46E-10	13	6.39489	0	0	0	107.80695	14	98.37548	0.33166	0.33	1.53226	238.13283	0	0.76138	0.84273	20
19.62	1.72	104	3	1.71988	6.03532	4.76E-10	12	6.30506	0	0	0	104.25074	14	97.71078	0.32922	0.33	1.52101	234.89024	0	0.75946	0.92251	20
19.64	1.73	90.2	3	1.89905	4.90946	6.57E-10	13	8.0564	0	0	0	103.5836	14	110.48288	0.37204	0.33	1.71883	234.67932	0	0.79189	1.16131	20
19.66	2.257	85.5	3	2.07888	4.18815	8.56E-10	13	10.02853	0	0	0	103.97884	14	123.30158	0.41497	0.33	1.91714	235.40765	0	0.82203	1.38785	20
19.68	2.257	85.5	3	2.21436	3.86115	1.03E-09	14	11.65311	0	0	0	105.24242	14	132.95254	0.44719	0.33	2.066	236.81233	0	0.84332	1.5239	20
19.7	2.134	85.5	3	2.12244	3.6059	9.91E-10	13	10.52025	0	0	0	100.46282	14	126.36073	0.42477	0.33	1.96245	232.28075	0	0.82862	1.61803	20
19.72	1.981	58.6	3	2.03055	3.17484	1.07E-09	12	9.44636	0	0	0	94.11611	14	119.77102	0.4024	0.33	1.85908	226.15471	0	0.81343	1.82072	20
19.74	1.981	49.3	3	1.89569	2.68153	1.11E-09	12	7.97999	0	0	0	85.93996	14	110.11244	0.36975	0.33	1.70825	217.92455	0	0.79022	2.12282	20
19.76	1.729	44.6	3	1.81247	2.48831	1.07E-09	11	7.13455	0	0	0	81.90712	14	104.14349	0.34953	0.33	1.61481	213.68405	0	0.77516	2.26298	20
19.78	1.731	41.4	3	1.73526	2.38196	9.77E-10	11	6.39241	0	0	0	78.84692	14	98.60364	0.33076	0.33	1.52812	210.35478	0	0.76067	2.33786	20
19.8	1.749	38	3	1.74673	2.21748	1.11E-09	11	6.49246	0	0	0	77.58256	14	99.39758	0.33326	0.33	1.53964	209.09372	0	0.76263	2.51488	20
19.82	1.763	36.8	3	1.75886	2.08279	1.25E-09	11	6.59958	0	0	0	76.56137	14	100.23959	0.33591	0.33	1.5519	208.08072	0	0.7647	2.68157	20
19.84	1.767	35.1	3	1.75833	2.00759	1.32E-09	11	6.58797	0	0	0	75.78619	14	100.17653	0.33553	0.33	1.55014	207.28032	0	0.76441	2.7811	20
19.86	1.747	34	3	1.74645	1.91818	1.38E-09	10	6.47045	0	0	0	74.56095	14	99.30369	0.33244	0.33	1.53587	205.97205	0	0.76199	2.905	20
19.88	1.727	31.4	3	1.72524	1.83163	1.41E-09	10	6.26831	0	0	0	73.11917	14	97.76428	0.32713	0.33	1.51132	204.39723	0	0.7578	3.03193	20
19.9	1.703	29.4	3	1.69803	1.77657	1.39E-09	10	6.01551	0	0	0	71.86056	14	95.79603	0.32038	0.33	1.48017	202.98242	0	0.75242	3.11205	20
19.92	1.665	29.7	3	1.67548	1.7766	1.32E-09	10	5.80911	0	0	0	71.31114	14	94.16114	0.31476	0.33	1.4542	202.3261	0	0.74788	3.10004	20
19.94	1.659	30.2	3	1.66392	1.819	1.23E-09	10	5.70185	0	0	0	71.48376	14	93.31051	0.31177	0.33	1.44036	202.47307	0	0.74544	3.02129	20
19.96	1.668	30.9	3	1.66836	1.83813	1.22E-09	10	5.73495	0	0	0	71.81014	14	93.60379	0.31259	0.33	1.44418	202.83917	0	0.74612	2.99125	20
19.98	1.678	30.9	3	1.63413	1.89091	1.08E-09	10	5.43366	0	0	0	71.49286	14	91.13409	0.3042	0.33	1.40539	202.38603	0	0.7392	2.89034	20
20	1.556	30.9	3	1.62806	1.96348	9.91E-10	10	5.37656	0	0	0	72.08052	14	90.67624	0.30252	0.33	1.39764	202.9933	0	0.7378	2.77986	20
20.02	1.645	34.1	3	1.61863	2.04082	9.55E-10	10	5.29144	0	0	0	72.60726	14	89.97775	0.30004	0.33	1.3862	203.52307	0	0.73573	2.66937	20
20.04	1.645	34.1	3	1.65923	2.01298	1.04E-09	10	5.6323	0	0	0	73.41744	14	92.85351	0.30948	0.33	1.42979	204.52344	0	0.74357	2.72444	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

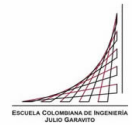
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
20.06	1.673	32	3	1.68801	1.89572	1.21E-09	10	5.87849	0	0	0	72.97489	14	94.88445	0.31609	0.33	1.46035	204.15918	0	0.74896	2.90584	20
20.08	1.731	29.9	3	1.73483	1.72159	1.54E-09	10	6.29395	0	0	0	72.27159	14	98.20406	0.32699	0.33	1.51071	203.58159	0	0.7577	3.22232	20
20.1	1.785	27.7	3	1.77406	1.62527	1.82E-09	10	6.65187	0	0	0	72.1236	14	100.98217	0.33608	0.33	1.55269	203.56311	0	0.76483	3.43223	20
20.12	1.79	28.9	3	1.73896	1.69258	1.59E-09	10	6.31949	0	0	0	72.07022	14	98.45073	0.3275	0.33	1.51303	203.39232	0	0.7581	3.27797	20
20.14	1.625	31.7	3	1.6999	1.72363	1.42E-09	10	5.96043	0	0	0	71.47432	14	95.6361	0.31798	0.33	1.46907	202.63234	0	0.75049	3.19875	20
20.16	1.667	27.3	3	1.68948	1.5784	1.57E-09	10	5.86222	0	0	0	69.59557	14	94.86745	0.31527	0.33	1.45657	200.60263	0	0.7483	3.48638	20
20.18	1.758	21	3	1.7034	1.50679	1.73E-09	10	5.97991	0	0	0	69.10337	14	95.83768	0.31835	0.33	1.47077	200.13292	0	0.75079	3.65926	20
20.2	1.666	28.7	3	1.67768	1.70673	1.36E-09	10	5.74706	0	0	0	70.77353	14	93.97583	0.31201	0.33	1.4415	201.82288	0	0.74564	3.2164	20
20.22	1.589	36.2	3	1.62199	1.86397	1.04E-09	10	5.26542	0	0	0	71.04288	14	89.97355	0.29858	0.33	1.37944	201.91298	0	0.7345	2.91645	20
20.24	1.59	25.8	3	1.60029	1.86633	9.83E-10	10	5.08035	0	0	0	70.51297	14	88.39952	0.29322	0.33	1.35466	201.27159	0	0.72996	2.90061	20
20.26	1.6	27.6	3	1.58525	1.72423	1.07E-09	10	4.95253	0	0	0	68.66401	14	87.30111	0.28944	0.33	1.33719	199.23212	0	0.72673	3.13006	20
20.28	1.543	28.6	3	1.56787	1.75609	9.85E-10	10	4.80771	0	0	0	68.55859	14	86.03567	0.2851	0.33	1.31718	199.05473	0	0.72299	3.06229	20
20.3	1.537	26.4	3	1.5472	1.78602	9.51E-10	10	4.63922	0	0	0	68.33556	14	84.53463	0.28	0.33	1.29359	198.73607	0	0.71854	2.99797	20
20.32	1.537	27.9	3	1.54984	1.74426	9.68E-10	10	4.6551	0	0	0	67.98782	14	84.69923	0.28041	0.33	1.29549	198.37357	0	0.7189	3.07048	20
20.34	1.55	26.8	3	1.55218	1.73734	9.72E-10	10	4.66858	0	0	0	67.98788	14	84.84181	0.28075	0.33	1.29706	198.3869	0	0.7192	3.08325	20
20.36	1.543	26.2	3	1.54983	1.71632	9.76E-10	10	4.64527	0	0	0	67.71907	14	84.64965	0.27998	0.33	1.29352	198.08978	0	0.71852	3.11867	20
20.38	1.529	26.8	3	1.54182	1.74036	9.57E-10	10	4.57794	0	0	0	67.76933	14	84.05378	0.27788	0.33	1.2838	198.11612	0	0.71667	3.06979	20
20.4	1.525	27.5	3	1.53582	1.79491	9.30E-10	10	4.52662	0	0	0	68.1778	14	83.60109	0.27625	0.33	1.27629	198.53934	0	0.71524	2.97203	20
20.42	1.524	28.4	3	1.53349	1.83024	9.15E-10	10	4.50384	0	0	0	68.48122	14	83.41027	0.27549	0.33	1.27277	198.86292	0	0.71456	2.91243	20
20.44	1.521	28.3	3	1.53216	1.86012	9.03E-10	10	4.48882	0	0	0	68.75321	14	83.29086	0.27497	0.33	1.27034	199.15611	0	0.71409	2.86404	20
20.46	1.52	28.8	3	1.54517	1.87035	9.12E-10	10	4.58469	0	0	0	69.21429	14	84.19559	0.27782	0.33	1.28353	199.70966	0	0.71662	2.85508	20
20.48	1.562	29.6	3	1.55554	1.87931	9.19E-10	10	4.66081	0	0	0	69.59177	14	84.91196	0.28005	0.33	1.29383	200.16089	0	0.71858	2.84654	20
20.5	1.551	29.3	3	1.59058	1.84629	9.66E-10	10	4.93453	0	0	0	70.19897	14	87.39058	0.28809	0.33	1.33097	200.951	0	0.72557	2.91633	20
20.52	1.624	29.2	3	1.61	1.80745	1.00E-09	10	5.0872	0	0	0	70.31719	14	88.75336	0.29244	0.33	1.35108	201.15459	0	0.7293	2.98895	20
20.54	1.619	28.8	3	1.64577	1.74791	1.17E-09	10	5.37891	0	0	0	70.61675	14	91.28426	0.30064	0.33	1.38894	201.61113	0	0.73623	3.1098	20
20.56	1.657	28.3	3	1.67524	1.70722	1.29E-09	10	5.62418	0	0	0	70.92696	14	93.36455	0.30734	0.33	1.41992	202.05276	0	0.7418	3.1992	20
20.58	1.711	28.7	3	1.71072	1.69519	1.41E-09	10	5.92785	0	0	0	71.68457	14	95.87481	0.31545	0.33	1.4574	202.98607	0	0.74844	3.23991	20
20.6	1.724	30	3	1.7542	1.70258	1.54E-09	10	6.31192	0	0	0	72.84422	14	98.95573	0.32543	0.33	1.50351	204.3611	0	0.75646	3.24698	20
20.62	1.786	30.9	3	1.81598	1.72726	1.71E-09	11	6.88084	0	0	0	74.63262	14	103.34428	0.3397	0.33	1.56943	206.43484	0	0.76764	3.22882	20
20.64	1.895	33.2	3	1.89482	1.79437	1.89E-09	11	7.64393	0	0	0	77.30761	14	108.95089	0.35796	0.33	1.65376	209.43831	0	0.78151	3.14035	20
20.66	1.959	37.9	3	1.95171	1.86674	1.97E-09	11	8.21705	0	0	0	79.5157	14	112.98951	0.37104	0.33	1.71421	211.85236	0	0.79116	3.03924	20
20.68	1.955	38.2	3	2.00631	1.91895	2.08E-09	12	8.78592	0	0	0	81.43107	14	116.86458	0.38357	0.33	1.77211	213.93349	0	0.8002	2.97473	20
20.7	2.057	39.4	3	2.06027	1.93664	2.25E-09	12	9.36643	0	0	0	82.92027	14	120.69409	0.39594	0.33	1.82925	215.56448	0	0.80894	2.96442	20
20.72	2.119	42.1	3	2.22422	2.28244	2.27E-09	13	11.26202	0	0	0	90.83153	14	132.3796	0.43405	0.33	2.00531	223.66444	0	0.76164	2.55546	26.02258
20.74	2.328	70.8	3	2.35404	2.6012	2.22E-09	13	12.88335	0	0	0	97.56577	14	141.62655	0.46412	0.33	2.14422	230.27806	0	0.73782	2.26664	29.58495
20.76	2.328	70.8	3	2.4782	2.85691	2.25E-09	14	14.53424	0	0	0	103.43225	14	150.46871	0.49282	0.33	2.27684	235.88333	0	0.72179	2.08276	32.3689
20.78	2.374	70.8	3	2.51011	2.88035	2.31E-09	14	14.96452	0	0	0	104.48937	14	152.72203	0.49993	0.33	2.30965	236.89725	0	0.72474	2.07009	32.553
20.8	2.417	75.3	3	2.55754	2.9299	2.38E-09	15	15.62189	0	0	0	106.21219	14	156.08384	0.51065	0.33	2.35918	238.52687	0	0.72887	2.04131	32.84992
20.82	2.459	78.7	3	2.59261	3.03169	2.34E-09	15	16.11303	0	0	0	108.2143	14	158.56283	0.51847	0.33	2.39531	240.3699	0	0.72872	1.97699	33.28519
20.84	2.459	81.8	3	2.59787	3.12949	2.22E-09	15	16.17495	0	0	0	109.43613	14	158.91188	0.51931	0.33	2.39923	241.46284	0	0.72518	1.91554	33.57763
20.86	2.417	83.4	3	2.58902	3.22129	2.09E-09	15	16.03215	0	0	0	110.22809	14	158.25352	0.51687	0.33	2.38795	242.15074	0	0.72007	1.85957	33.80129
20.88	2.419	85	3	2.56426	3.31999	1.92E-09	15	15.66173	0	0	0	110.66991	14	156.45881	0.51072	0.33	2.35953	242.50423	0	0.71447	1.80105	33.85795
20.9	2.379	87	3	2.53394	3.44654	1.73E-09	15	15.21725	0	0	0	111.21891	14	154.26633	0.50328	0.33	2.32515	242.94194	0	0.71054	1.73108	33.72784
20.92	2.33	90	3	2.4845	3.60099	1.50E-09	15	14.51524	0	0	0	111.4862	14	150.7087	0.49139	0.33	2.27024	243.10088	0	0.70635	1.65083	33.37066
20.94	2.285	91.4	3	2.40584	3.79078	1.23E-09	15	13.44053	0	0	0	111.19807	14	145.06332	0.47272	0.33	2.18396	242.72269	0	0.69826	1.55879	32.89996
20.96	2.16	92.2	3	2.35333	3.91078	1.08E-09	14	12.74243	0	0	0	110.86388	14	141.28591	0.46015	0.33	2.12588	242.34457	0	0.69147	1.50446	32.66796
20.98	2.179	92.5	3	2.42366	3.81654	1.24E-09	15	13.65207	0	0	0	111.97481	14	146.28348	0.47615	0.33	2.19983	243.44333	0	0.70209	1.54981	32.82538
21	2.494	92.8	3	3.00122	3.10985	3.49E-09	16	22.41877	0	0	0	119.03342	14	187.51092	0.61	0.33	2.8182	250.37666	0	0.7912	1.96886	33.68517
21.02	3.899	94.7	3	3.38436	2.64058	6.68E-09	17	29.41621	0	0	0	121.27638	14	214.85158	0.69854	0.33	3.22726	252.75098	0	0.87609	2.35607	31.87948
21.04	3.459	80.6	3	3.38214	2.54868	7.06E-09	17	29.34881	0	0	0	119.93806	14	214.66646	0.69754	0.33	3.22264	251.63475	0	0.98182	2.44052	20
21.06	2.623	83.3	3	2.65323	3.34561	2.07E-09	15	16.82379	0	0	0	113.40505	14	162.575	0.52798	0.33	2.43925	245.07706	0	0.89261	1.79486	20
21.08	1.838	102.4	3	2.08811	4.45379	7.66E-10	14	9.49713	0	0	0	107.69961	14	122.18288	0.39658	0.33	1.83218	239.07953	0	0.80938	1.28752	20
21.1	1.767	93.3	3	1.81351	5.1631	5.45E-10	13	6.6855	0	0	0	103.65817	14	102.54225	0.33264	0.33	1.5368	234.84492	0	0.76215	1.07324	20
21.12	1.786	85.2	3	1.85327	4.64044	6.14E-10	13	7.05357	0	0	0	101.52826	14	105.35628	0.34158	0.33	1.5781	232.98587	0	0.76909	1.20057	20
21.14	1.935	79.5	3	1.9674	4.05442	7.50E-10	13	8.17905	0	0	0	100.89921	14	113.48195	0.36772	0.33	1.69888	232.66681	0	0.78874	1.39422	20
21.16	2.082	74.6	3	2.1075	3.64571	9.06E-10	13	9.67576	0	0	0	101.7427	14	123.46299	0.39985	0.33	1.84729	233.7442	0	0.76931	1.57476	23.39501
21.18	2.191	76.4	3	2.19052	3.34928	1.09E-09	13	10.61753	0	0	0	101.43439	14	129.36731	0.41874	0.33	1.93457	233.63478	0	0.77678	1.72803	23.93148
21.2	2.178	69.1	3	2.24663	2.80272	1.59E-09	13	11.27516	0	0	0	97.55277	14	133.34912	0.4314	0.33	1.99305	230.1722	0	0.78181	2.07542	24.28435



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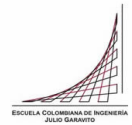
Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
21.22	2.246	43.4	3	2.30156	2.27382	2.43E-09	13	11.93781	0	0	0	93.04605	14	137.24742	0.44378	0.33	2.05025	226.06972	0	0.78654	2.57011	24.64081
21.24	2.351	44.5	3	2.38366	1.92841	3.54E-09	13	12.96851	0	0	0	90.60675	14	143.08626	0.46242	0.33	2.13638	223.93956	0	0.79473	3.05057	25.08558
21.26	2.419	50	3	2.40915	2.12246	3.15E-09	13	13.28908	0	0	0	93.69766	14	144.88159	0.46798	0.33	2.16206	226.91817	0	0.79683	2.77674	25.24433
21.28	2.32	58.9	3	2.34103	2.40208	2.34E-09	13	12.4003	0	0	0	95.53858	14	139.98964	0.45194	0.33	2.08796	228.50778	0	0.78604	2.43965	25.16554
21.3	2.143	59.8	3	2.16656	2.71552	1.47E-09	13	10.28127	0	0	0	94.68888	14	127.50218	0.41141	0.33	1.90071	227.34821	0	0.76047	2.12383	24.76573
21.32	1.891	57.8	3	2.00285	2.73777	1.10E-09	12	8.47373	0	0	0	90.6325	14	115.78286	0.3734	0.33	1.72511	223.11607	0	0.7344	2.06931	24.45757
21.34	1.821	46.9	3	1.89371	2.6192	9.71E-10	12	7.36385	0	0	0	86.55318	14	107.96183	0.348	0.33	1.60776	218.87737	0	0.71508	2.13312	24.32864
21.36	1.807	44.1	3	1.88384	2.34628	1.12E-09	11	7.26094	0	0	0	83.60689	14	107.2317	0.34547	0.33	1.59608	215.94131	0	0.70914	2.37754	24.59975
21.38	1.852	41.6	3	1.96327	2.11042	1.53E-09	12	8.04211	0	0	0	83.15268	14	112.8807	0.36349	0.33	1.67933	215.71309	0	0.71517	2.66991	25.26282
21.4	2.048	38.6	3	2.4383	1.64595	4.79E-09	13	13.59201	0	0	0	87.99211	14	146.78619	0.47244	0.33	2.18265	221.60831	0	0.77576	3.58431	27.19185
21.42	3.218	40.2	4	4.36549	0.89108	7.64E-08	18	51.00371	0	0	0	103.29616	14	284.41688	0.91494	0.33	4.227	238.83781	0	1.01695	7.16526	31.20602
21.44	7.618	37.9	5	6.72463	0.55765	7.40E-07	22	88.76878	26	33	87.03347	109.08195	0	0	0	0.33	0	244.58679	0.00785	0	0	20
21.46	9.177	34.4	5	8.53608	0.43306	2.56E-06	25	112.05724	30	34	89.40737	112.05724	0	0	0	0.33	0	247.38205	0.00015	0	0	20
21.48	8.718	38.6	5	8.47888	0.47097	2.19E-06	26	114.3909	30	34	91.26934	114.3909	0	0	0	0.33	0	249.34702	-0.00177	0	0	20
21.5	7.519	46.8	5	7.63549	0.67186	8.53E-07	25	101.50561	28	33	96.99478	121.5668	0	0	0	0.33	0	255.30132	-0.00751	0	0	20
21.52	6.662	68.5	5	6.89943	1.0025	2.95E-07	25	91.19542	25	32	105.60735	132.36121	0	0	0	0.33	0	264.20282	-0.02049	0	0	20
21.54	6.516	92.2	4	6.65247	1.46312	1.26E-07	26	87.73274	0	0	118.41441	148.41273	14	447.61601	1.44967	0.33	6.69749	276.95737	0	1.26093	4.50682	20
21.56	6.781	131.3	4	6.51383	2.10271	6.22E-08	27	85.78633	0	0	0	164.98776	14	437.68537	1.40252	0.33	6.47966	289.09744	0	1.24675	3.13165	20
21.58	6.246	187.4	4	5.81994	2.76177	2.79E-08	26	76.06641	0	0	0	169.14131	14	388.09393	1.24284	0.33	5.74193	291.65494	0	1.19626	2.36623	20
21.6	4.434	163.5	3	4.77803	3.43377	1.08E-08	24	61.47422	0	0	0	162.24325	14	313.64399	1.0038	0.33	4.63756	286.02747	0	1.11198	1.87345	20
21.62	3.655	141.3	3	3.70523	4.16168	3.67E-09	20	35.20925	0	0	0	149.07755	14	236.98823	0.75801	0.33	3.502	275.3743	0	1.01014	1.50615	20
21.64	3.027	157.8	3	3.08015	4.69565	1.69E-09	18	23.17175	0	0	0	139.13795	14	192.31243	0.61475	0.33	2.84012	267.03824	0	0.94029	1.30306	20
21.66	2.558	134.8	3	2.57309	5.00436	9.24E-10	16	15.25143	0	0	0	127.62493	14	156.06657	0.49859	0.33	2.30349	257.11621	0	0.8753	1.18777	20
21.68	2.133	93.7	3	2.21696	4.34078	8.32E-10	14	10.67451	0	0	0	111.39987	14	130.60198	0.41701	0.33	1.92657	242.74335	0	0.82341	1.33	20
21.7	1.958	60.2	3	1.97378	3.45361	8.29E-10	13	8.01602	0	0	0	96.71087	14	113.20623	0.36127	0.33	1.66907	228.91318	0	0.78398	1.62751	20
21.72	1.828	50.6	3	1.82428	2.80293	8.50E-10	12	6.56852	0	0	0	86.66138	14	102.50255	0.32695	0.33	1.51049	218.88635	0	0.75766	1.96452	20
21.74	1.684	42.6	3	1.72379	2.40555	8.61E-10	11	5.67503	0	0	0	80.16034	14	95.2996	0.30382	0.33	1.40366	212.09254	0	0.73889	2.25226	20
21.76	1.656	31.2	3	1.64832	2.05057	8.89E-10	10	5.046	0	0	0	74.64537	14	89.88415	0.28642	0.33	1.32327	206.15988	0	0.72413	2.60611	20
21.78	1.601	27.6	3	1.59583	1.67729	9.59E-10	10	4.62909	0	0	0	69.37812	14	86.11054	0.27427	0.33	1.26714	200.39273	0	0.71348	3.15274	20
21.8	1.526	21.5	3	1.54636	1.43563	9.99E-10	10	4.25266	0	0	0	65.41632	14	82.55331	0.26283	0.33	1.21426	195.90483	0	0.70315	3.64425	20
21.82	1.507	17.5	3	1.52554	1.22798	1.20E-09	9	4.09669	0	0	0	62.42854	14	81.04257	0.25791	0.33	1.19153	192.53661	0	0.69862	4.23959	20
21.84	1.538	17.2	3	1.55007	1.10963	1.46E-09	9	4.27151	0	0	0	61.51456	14	82.77113	0.2633	0.33	1.21643	191.65706	0	0.70358	4.71603	20
21.86	1.599	16.9	3	1.60158	1.03231	1.83E-09	9	4.65525	0	0	0	61.66484	14	86.42723	0.27481	0.33	1.26963	192.08368	0	0.71396	5.1229	20
21.88	1.661	15.5	3	1.67311	0.96427	2.37E-09	10	5.21706	0	0	0	62.27928	14	91.51299	0.29086	0.33	1.34378	193.10555	0	0.72795	5.55885	20
21.9	1.752	16	3	1.89132	0.85831	4.43E-09	10	7.13934	0	0	0	65.09764	14	107.07558	0.34018	0.33	1.57164	197.10133	0	0.76801	6.46411	20
21.92	2.253	17.2	4	2.83221	0.64496	2.69E-08	13	18.90056	0	0	0	76.43303	14	174.25858	0.55338	0.33	2.55662	211.71056	0	0.90707	9.34891	20
21.94	4.483	21.6	6	8.77108	0.24588	5.70E-06	24	99.60656	31	34	79.47332	99.60656	0	0	0	0.33	0	237.29448	0.01114	0	0	20
21.96	19.568	25.9	6	17.2108	0.16114	1.10E-04	36	117.05049	48	39	93.39135	117.05049	0	0	0	0.33	0	253.26898	-0.07193	0	0	20
21.98	27.573	35.7	6	27.27019	0.14534	6.58E-04	49	135.34935	65	41	107.9915	135.34935	0	0	0	0.33	0	267.98779	-0.15507	0	0	20
22	34.664	57.3	6	26.38909	0.12733	6.64E-04	47	130.70083	64	41	104.28258	130.70083	0	0	0	0.33	0	264.80023	-0.15031	0	0	20
22.02	16.926	7.8	6	22.84007	0.10639	4.46E-04	42	121.25967	58	40	96.74974	121.25967	0	0	0	0.33	0	258.0965	-0.12566	0	0	20
22.04	16.926	7.8	0	16.93661	0.04645	0.00E+00	34	106.64161	0	0	85.08639	106.64161	0	0	0	0.33	0	252.2171	0	0	0	20
22.06	16.952	8	0	16.9463	0.04721	0.00E+00	34	106.6099	0	0	85.06109	106.6099	0	0	0	0.33	0	252.02982	0	0	0	20
22.08	16.955	8.2	0	16.95633	0.04816	0.00E+00	34	106.56873	0	0	85.02824	106.56873	0	0	0	0.33	0	251.79811	0	0	0	20
22.1	16.956	8.3	0	16.95903	0.04953	0.00E+00	34	106.49202	0	0	84.96704	106.49202	0	0	0	0.33	0	251.46004	0	0	0	20
22.12	16.96	8.7	0	16.96141	0.0509	0.00E+00	34	106.43287	0	0	84.91984	106.43287	0	0	0	0.33	0	251.15034	0	0	0	20
22.14	16.962	8.9	0	16.96414	0.05423	0.00E+00	34	106.3168	0	0	84.82723	106.3168	0	0	0	0.33	0	250.46025	0	0	0	20
22.16	16.964	10	6	23.08317	0.18051	2.78E-04	45	133.46666	58	40	106.48936	133.46666	0	0	0	0.33	0	266.16324	-0.12264	0	0	20
22.18	35.317	106.1	6	29.93422	0.2971	3.25E-04	57	169.01281	66	42	134.85064	169.01281	0	0	0	0.33	0	291.93997	-0.16178	0	0	20
22.2	37.516	150.7	6	37.7692	0.39291	3.94E-04	71	206.50576	75	43	164.76524	206.50576	0	0	0	0.33	0	317.21906	-0.19697	0	0	20
22.22	40.47	188.4	6	39.76385	0.47564	3.05E-04	76	227.8455	76	43	181.79162	227.8455	0	0	0	0.33	0	330.76141	-0.20207	0	0	20
22.24	41.302	228.3	6	41.19781	0.59639	2.02E-04	82	254.46871	77	43	203.03354	254.46871	0	0	0	0.33	0	346.89163	-0.20344	0	0	20
22.26	41.818	320.4	6	41.52454	0.74157	1.23E-04	86	280.61415	76	43	223.89427	280.61415	0	0	0	0.33	0	361.99161	-0.20005	0	0	20
22.28	41.45	375.1	6	41.43598	0.8894	7.81E-05	90	303.86033	75	43	242.44175	303.86033	0	0	0	0.33	0	374.85516	-0.19751	0	0	20
22.3	41.036	410.1	6	41.07374	1.03635	5.20E-05	93	324.12761	73	43	258.61245	324.12761	0	0	0	0.33	0	385.681	-0.19797	0	0	20
22.32	40.731	491.8	6	40.51248	1.17906	3.62E-05	94	341.34154	72	42	272.34697	341.34154	0	0	0	0.33	0	394.61664	-0.19736	0	0	20
22.34	39.766	531.1	6	39.70357	1.33347	2.51E-05	96	357.3625	70	42	285.12966	357.3625	0	0	0	0.33	0	403.03537	-0.19599	0	0	20
22.36	38.609	565.4	6	38.29434	1.52042	1.64E-05	96	372.24835	68	42	297.00667	372.24835	0	0	0	0.33	0	411.3439	-0.19313	0	0	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

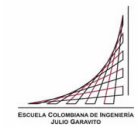
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
22.38	36.503	650.2	6	34.97096	1.79949	8.50E-06	93	382.34558	64	41	305.06296	382.34558	0	0	0	0.33	0	416.88541	-0.18551	0	0	20
22.4	29.794	672.3	5	31.50454	2.1106	4.37E-06	89	387.96993	59	41	309.55048	387.96993	0	0	0	0.33	0	419.94043	-0.17886	0	0	20
22.42	28.208	672.3	5	28.14244	2.38371	2.43E-06	84	384.86506	55	40	307.07319	384.86506	0	0	0	0.33	0	418.25668	-0.17254	0	0	20
22.44	26.415	667.9	5	25.73186	2.57346	1.60E-06	80	354.60899	52	39	302.33887	378.93138	0	0	0	0.33	0	415.01993	-0.16798	0	0	20
22.46	22.562	646.4	5	22.67033	2.86777	8.87E-07	74	311.74151	48	38	295.78832	370.72136	0	0	0	0.33	0	410.49933	-0.16322	0	0	20
22.48	19.023	636.1	5	19.63115	3.16996	4.77E-07	68	269.18698	43	38	285.73016	358.11513	0	0	0	0.33	0	403.9476	-0.15798	0	0	20
22.5	17.297	584.4	4	17.49064	3.35322	3.08E-07	63	239.21375	0	0	274.82154	344.443	14	1220.47832	4.05209	0.33	18.72066	397.20001	0	1.79214	2.03933	20
22.52	16.14	539	4	16.94905	3.14374	3.33E-07	61	231.62553	0	0	262.40348	328.87903	14	1181.7629	3.93927	0.33	18.19943	389.23663	0	1.77492	2.17353	20
22.54	17.397	475.1	5	18.01851	2.78917	5.24E-07	62	246.59202	42	37	257.33286	322.52385	0	0	0	0.33	0	385.85464	-0.14253	0	0	20
22.56	20.504	493.6	5	19.69887	2.38711	9.74E-07	64	270.11117	44	38	251.96929	315.80151	0	0	0	0.33	0	382.19293	-0.13981	0	0	20
22.58	21.181	442	5	21.0885	2.14967	1.50E-06	66	289.56003	47	38	249.66572	312.91437	0	0	0	0.33	0	380.58511	-0.13954	0	0	20
22.6	21.568	424.4	5	21.33706	1.95278	1.96E-06	65	301.84534	47	38	240.83405	301.84534	0	0	0	0.33	0	374.61176	-0.13547	0	0	20
22.62	21.254	383.6	5	21.05282	1.79944	2.31E-06	63	289.16693	47	38	230.7183	289.16693	0	0	0	0.33	0	367.6601	-0.13016	0	0	20
22.64	20.334	328.5	5	20.32272	1.67169	2.50E-06	61	274.93783	46	38	219.36529	274.93783	0	0	0	0.33	0	359.69208	-0.12335	0	0	20
22.66	19.383	307.1	5	19.22471	1.60037	2.37E-06	58	262.19045	45	38	209.19451	262.19045	0	0	0	0.33	0	352.40042	-0.11611	0	0	20
22.68	17.964	287.4	5	18.32009	1.46087	2.56E-06	55	246.18455	44	38	196.42384	246.18455	0	0	0	0.33	0	342.95844	-0.10749	0	0	20
22.7	17.622	208.4	5	17.71242	1.26484	3.22E-06	52	228.14599	44	38	182.03137	228.14599	0	0	0	0.33	0	331.91727	-0.09828	0	0	20
22.72	17.561	176.3	6	17.63761	0.95516	5.88E-06	49	203.70501	44	38	162.53059	203.70501	0	0	0	0.33	0	316.2099	-0.08838	0	0	20
22.74	17.74	120.7	6	16.06564	0.82951	5.92E-06	44	184.86675	42	37	147.50007	184.86675	0	0	0	0.33	0	303.56238	-0.07447	0	0	20
22.76	12.906	102.8	6	14.5497	0.79131	4.76E-06	41	173.70493	40	37	138.59436	173.70493	0	0	0	0.33	0	295.80966	-0.06281	0	0	20
22.78	13.013	121.9	5	14.54977	0.84996	4.12E-06	41	178.32071	40	37	142.27716	178.32071	0	0	0	0.33	0	299.08316	-0.06491	0	0	20
22.8	17.74	146.3	5	15.39149	0.93666	4.01E-06	44	189.80271	41	37	151.43833	189.80271	0	0	0	0.33	0	307.01163	-0.07351	0	0	20
22.82	15.431	164.3	6	17.02121	0.93217	5.51E-06	47	198.72153	43	38	158.55441	198.72153	0	0	0	0.33	0	312.9653	-0.08358	0	0	20
22.84	17.902	165.4	6	16.53256	0.89863	5.43E-06	46	193.35571	43	37	154.27317	193.35571	0	0	0	0.33	0	309.38666	-0.07939	0	0	20
22.86	16.274	116	6	15.48029	0.69551	7.40E-06	42	170.88111	42	37	136.34131	170.88111	0	0	0	0.33	0	293.79816	-0.06573	0	0	20
22.88	12.274	41.6	6	15.43484	0.65998	8.10E-06	41	167.60275	42	37	133.7256	167.60275	0	0	0	0.33	0	291.45309	-0.06421	0	0	20
22.9	17.764	148	6	16.29112	0.69015	8.82E-06	43	174.47092	43	37	139.20552	174.47092	0	0	0	0.33	0	296.33905	-0.07118	0	0	20
22.92	18.841	147.7	6	18.65159	0.83299	9.14E-06	49	199.08292	46	38	158.84275	199.08292	0	0	0	0.33	0	313.16403	-0.0906	0	0	20
22.94	19.354	170.4	6	18.99093	0.87568	8.67E-06	51	204.74282	46	38	163.35864	204.74282	0	0	0	0.33	0	316.90768	-0.09369	0	0	20
22.96	18.782	180.8	6	19.40617	0.88116	9.11E-06	51	207.43327	47	38	165.50527	207.43327	0	0	0	0.33	0	318.66174	-0.09626	0	0	20
22.98	20.087	161.8	6	19.77262	0.90681	9.04E-06	52	211.72529	47	38	168.92975	211.72529	0	0	0	0.33	0	321.44717	-0.09899	0	0	20
23	20.454	195.3	6	20.32454	0.94664	8.92E-06	54	218.30194	48	39	174.17708	218.30194	0	0	0	0.33	0	325.65967	-0.10307	0	0	20
23.02	20.439	220.1	6	20.36562	1.06257	6.93E-06	55	228.95166	48	38	182.6742	228.95166	0	0	0	0.33	0	332.3912	-0.10606	0	0	20
23.04	20.212	233.8	5	15.91186	0.96113	4.11E-06	45	195.44712	41	37	155.94185	195.44712	0	0	0	0.33	0	310.90912	-0.07691	0	0	20
23.06	7.092	4.9	5	11.48528	0.70815	2.64E-06	34	151.2959	34	35	120.71482	151.2959	0	0	0	0.33	0	279.61395	-0.03619	0	0	20
23.08	7.158	5.3	0	7.13528	0.07334	0.00E+00	20	81.669	0	0	65.16144	81.669	0	0	0	0.33	0	226.29391	0	0	0	20
23.1	7.16	5.5	0	7.178	0.07987	0.00E+00	20	82.15334	0	0	65.54788	82.15334	0	0	0	0.33	0	226.18997	0	0	0	20
23.12	7.22	6.4	0	7.03907	0.06109	0.00E+00	20	80.98019	0	0	64.61185	80.98019	0	0	0	0.33	0	227.02101	0	0	0	20
23.14	6.74	1	0	7.09215	0.06768	0.00E+00	20	81.35377	0	0	64.90992	81.35377	0	0	0	0.33	0	226.59482	0	0	0	20
23.16	7.318	7	5	7.18121	0.13183	3.99E-06	21	85.78001	27	33	68.4415	85.78001	0	0	0	0.33	0	227.00824	0.04185	0	0	20
23.18	7.486	20.4	5	8.1349	0.39787	2.00E-06	25	110.88225	28	34	88.46988	110.88225	0	0	0	0.33	0	247.26363	0.01049	0	0	20
23.2	9.601	69.7	5	9.7999	0.96838	8.52E-07	32	131.35287	30	34	125.52315	157.32235	0	0	0	0.33	0	284.25668	-0.03684	0	0	20
23.22	12.313	194.6	5	12.53527	1.03096	1.67E-06	39	169.64248	35	36	143.57458	179.94681	0	0	0	0.33	0	300.49365	-0.05785	0	0	20
23.24	15.692	123.4	5	16.00994	1.07079	3.28E-06	47	204.83838	41	37	163.43488	204.83838	0	0	0	0.33	0	317.22363	-0.0808	0	0	20
23.26	20.025	196.3	6	18.58383	0.88554	7.73E-06	50	204.38937	45	38	163.07663	204.38937	0	0	0	0.33	0	316.79535	-0.09054	0	0	20
23.28	20.036	174	6	20.06677	0.89867	9.42E-06	53	213.3065	48	38	170.19136	213.3065	0	0	0	0.33	0	322.54681	-0.09964	0	0	20
23.3	20.143	170.7	6	20.23349	0.85716	1.07E-05	53	210.30031	48	39	167.7928	210.30031	0	0	0	0.33	0	320.59842	-0.09959	0	0	20
23.32	20.528	175.6	6	20.59995	0.86796	1.09E-05	54	213.22124	48	39	170.12333	213.22124	0	0	0	0.33	0	322.48047	-0.10191	0	0	20
23.34	21.138	190.1	6	21.23121	0.86806	1.20E-05	55	216.41571	49	39	172.67211	216.41571	0	0	0	0.33	0	324.51291	-0.10549	0	0	20
23.36	22.039	187.2	6	21.80663	0.85769	1.33E-05	56	218.25704	50	39	174.14126	218.25704	0	0	0	0.33	0	325.67099	-0.10848	0	0	20
23.38	22.256	183.8	6	22.16656	0.86707	1.36E-05	57	221.01012	51	39	176.33786	221.01012	0	0	0	0.33	0	327.41357	-0.11062	0	0	20
23.4	22.219	205.6	6	22.26858	0.90681	1.24E-05	57	225.56577	51	39	179.97269	225.56577	0	0	0	0.33	0	330.29279	-0.11187	0	0	20
23.42	22.346	216.4	6	22.58059	0.95569	1.15E-05	58	232.03731	51	39	185.13615	232.03731	0	0	0	0.33	0	334.32446	-0.11446	0	0	20
23.44	23.193	225.4	6	23.1187	1.03653	1.02E-05	61	242.77088	51	39	193.70017	242.77088	0	0	0	0.33	0	340.88724	-0.11885	0	0	20
23.46	23.834	277.1	6	23.37089	0.95946	1.25E-05	60	236.54477	52	39	188.73253	236.54477	0	0	0	0.33	0	337.08231	-0.11859	0	0	20
23.48	23.102	170.2	6	23.34082	0.88186	1.51E-05	59	228.5274	52	39	182.33569	228.5274	0	0	0	0.33	0	332.12643	-0.11695	0	0	20
23.5	23.102	170.2	6	22.95943	0.73884	2.11E-05	56	211.49201	52	39	168.74362	211.49201	0	0	0	0.33	0	321.32162	-0.11241	0	0	20
23.52	22.689	168.5	6	22.76863	0.73039	2.10E-05	56	209.78661	52	39	167.38294	209.78661	0	0	0	0.33	0	320.23096	-0.11112	0	0	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

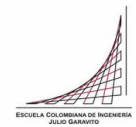
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
23.54	22.53	160.2	6	22.57314	0.70792	2.19E-05	55	206.50629	52	39	164.76566	206.50629	0	0	0	0.33	0	318.10739	-0.10957	0	0	20
23.56	22.516	150.7	6	22.63339	0.65655	2.58E-05	54	201.00119	52	39	160.37329	201.00119	0	0	0	0.33	0	314.48782	-0.10907	0	0	20
23.58	22.87	134.9	6	23.40364	0.60446	3.38E-05	55	197.98038	53	40	157.96307	197.98038	0	0	0	0.33	0	312.45877	-0.11272	0	0	20
23.6	24.841	138.8	6	24.33256	0.58139	4.12E-05	56	198.71963	55	40	158.5529	198.71963	0	0	0	0.33	0	312.92422	-0.11757	0	0	20
23.62	25.303	150.7	6	25.09015	0.62628	3.87E-05	58	207.3347	56	40	165.42662	207.3347	0	0	0	0.33	0	318.57635	-0.1222	0	0	20
23.64	25.143	181.9	6	24.65043	0.72534	2.68E-05	59	217.65762	54	40	173.663	217.65762	0	0	0	0.33	0	325.26199	-0.12103	0	0	20
23.66	23.522	203.8	6	23.75273	0.85295	1.68E-05	59	228.0334	53	39	181.94155	228.0334	0	0	0	0.33	0	331.86121	-0.11801	0	0	20
23.68	22.61	222.1	6	22.65835	0.95285	1.14E-05	59	233.06458	51	39	185.95579	233.06458	0	0	0	0.33	0	335.04849	-0.11387	0	0	20
23.7	21.86	221.8	6	21.59833	0.9973	8.96E-06	57	231.94836	49	39	185.06518	231.94836	0	0	0	0.33	0	334.41794	-0.10902	0	0	20
23.72	20.342	202.3	6	20.53368	0.9917	7.80E-06	55	225.83614	48	38	180.18841	225.83614	0	0	0	0.33	0	330.66562	-0.10297	0	0	20
23.74	19.416	186.8	6	19.42708	0.94164	7.40E-06	52	215.46039	46	38	171.90989	215.46039	0	0	0	0.33	0	324.13861	-0.09535	0	0	20
23.76	18.54	159.7	6	18.52879	0.88907	7.24E-06	50	206.06742	45	38	164.41549	206.06742	0	0	0	0.33	0	318.09293	-0.08856	0	0	20
23.78	17.647	147.7	6	17.4345	0.8638	6.37E-06	48	198.13565	43	38	158.08695	198.13565	0	0	0	0.33	0	312.90335	-0.08104	0	0	20
23.8	16.133	144.4	6	16.46987	0.89578	4.94E-06	46	195.68756	42	37	156.13369	195.68756	0	0	0	0.33	0	311.32117	-0.07594	0	0	20
23.82	15.646	150.5	5	15.71724	0.94503	3.82E-06	45	195.45014	40	37	155.94426	195.45014	0	0	0	0.33	0	311.21213	-0.07285	0	0	20
23.84	15.389	150.7	5	15.63359	0.96374	3.59E-06	45	196.48108	40	37	156.76682	196.48108	0	0	0	0.33	0	311.91873	-0.07293	0	0	20
23.86	15.882	150.8	5	15.9889	0.92877	4.16E-06	46	195.85326	41	37	156.2659	195.85326	0	0	0	0.33	0	311.48325	-0.07385	0	0	20
23.88	16.712	144	6	16.8432	0.86702	5.63E-06	47	195.5673	42	37	156.03774	195.5673	0	0	0	0.33	0	311.25034	-0.0771	0	0	20
23.9	17.952	143.3	6	18.46946	0.78436	9.22E-06	49	196.61122	45	38	156.87065	196.61122	0	0	0	0.33	0	311.87436	-0.08493	0	0	20
23.92	20.761	147.3	6	20.29335	0.77168	1.27E-05	52	204.20833	48	39	162.93218	204.20833	0	0	0	0.33	0	316.84012	-0.09583	0	0	20
23.94	22.184	179.2	6	22.26087	0.78673	1.61E-05	56	214.96773	51	39	171.51681	214.96773	0	0	0	0.33	0	323.75104	-0.1076	0	0	20
23.96	23.855	198.9	6	23.53737	0.83952	1.65E-05	59	226.58845	52	39	180.78866	226.58845	0	0	0	0.33	0	331.07092	-0.11552	0	0	20
23.98	24.591	214.7	6	20.44286	0.80794	1.17E-05	53	208.74455	48	39	166.5515	208.74455	0	0	0	0.33	0	319.82678	-0.09729	0	0	20
24	12.9	81.9	6	16.7914	0.75138	7.39E-06	45	185.55981	43	37	148.05304	185.55981	0	0	0	0.33	0	304.48721	-0.07279	0	0	20
24.02	12.9	81.9	5	12.89465	0.63515	4.30E-06	37	155.88412	37	36	124.37563	155.88412	0	0	0	0.33	0	283.4314	-0.04079	0	0	20
24.04	12.9	81.9	5	12.89468	0.646	4.16E-06	37	156.81554	36	36	125.11878	156.81554	0	0	0	0.33	0	284.13144	-0.04121	0	0	20
24.06	12.9	86.1	6	16.86096	0.60297	1.15E-05	44	172.06956	43	38	137.28954	172.06956	0	0	0	0.33	0	295.07037	-0.06886	0	0	20
24.08	24.799	137	6	21.14659	0.56889	2.66E-05	51	186.35301	50	39	148.68591	186.35301	0	0	0	0.33	0	304.87613	-0.09685	0	0	20
24.1	25.757	137.8	6	25.20085	0.55686	4.81E-05	57	200.18065	56	40	159.7186	200.18065	0	0	0	0.33	0	314.0394	-0.12014	0	0	20
24.12	25.063	146.2	6	24.86422	0.58156	4.21E-05	57	202.24364	55	40	161.36461	202.24364	0	0	0	0.33	0	315.42148	-0.11857	0	0	20
24.14	23.789	149.8	6	23.12162	0.63995	2.76E-05	55	202.78621	52	39	161.79751	202.78621	0	0	0	0.33	0	315.85529	-0.10952	0	0	20
24.16	20.529	147.9	6	20.96737	0.71619	1.61E-05	53	202.27849	49	39	161.39241	202.27849	0	0	0	0.33	0	315.62207	-0.09795	0	0	20
24.18	18.6	152.8	6	18.58481	0.82666	8.21E-06	50	202.00435	45	38	161.17369	202.00435	0	0	0	0.33	0	315.56659	-0.08581	0	0	20
24.2	16.641	160.2	5	16.6052	0.975	4.08E-06	47	204.18317	41	37	162.91211	204.18317	0	0	0	0.33	0	317.12762	-0.07816	0	0	20
24.22	14.59	172.7	5	14.30793	1.19025	1.68E-06	44	194.1798	37	36	164.08155	205.64888	0	0	0	0.33	0	318.2551	-0.07237	0	0	20
24.24	11.708	178	5	12.43594	1.36995	8.04E-07	41	167.96645	34	35	162.20345	203.295	0	0	0	0.33	0	316.85284	-0.06852	0	0	20
24.26	11.025	160.4	5	11.06997	1.48149	4.70E-07	39	148.83726	31	34	158.42495	198.55927	0	0	0	0.33	0	313.83987	-0.06472	0	0	20
24.28	10.492	153.6	5	10.28198	1.53051	3.47E-07	37	137.79989	30	34	154.96083	194.21758	0	0	0	0.33	0	310.98633	-0.06182	0	0	20
24.3	9.344	158.1	5	9.43797	1.68645	2.15E-07	35	125.97824	28	33	154.49592	193.63489	0	0	0	0.33	0	310.67529	-0.06221	0	0	20
24.32	8.493	165.8	4	8.41699	2.02527	1.05E-07	34	111.67914	0	0	0	195.23835	14	569.79151	1.68242	0.33	7.77276	311.68198	0	1.32681	3.27569	20
24.34	7.429	187.5	4	7.19169	2.60718	4.35E-08	31	94.51936	0	0	0	193.95766	14	482.24161	1.42307	0.33	6.57459	310.2709	0	1.25297	2.52052	20
24.36	5.668	209.2	3	5.6949	3.39251	1.41E-08	27	73.55878	0	0	0	185.06869	14	375.29988	1.10685	0.33	5.11362	303.50052	0	1.14977	1.9037	20
24.38	4.002	182.9	3	4.55274	4.20992	5.01E-09	24	49.82968	0	0	0	174.59156	14	293.68877	0.86565	0.33	3.99932	295.49744	0	1.05707	1.50164	20
24.4	4.002	182.9	3	3.99191	4.58177	2.92E-09	22	37.13378	0	0	0	166.22631	14	253.60161	0.74707	0.33	3.45146	289.1008	0	1.00513	1.35883	20
24.42	3.985	182.9	3	3.98459	4.59939	2.88E-09	22	36.95148	0	0	0	166.29845	14	253.05064	0.74502	0.33	3.442	289.15167	0	1.00418	1.35316	20
24.44	3.98	184	3	4.01427	4.5878	2.95E-09	22	37.54357	0	0	0	166.9298	14	255.14287	0.75075	0.33	3.46847	289.63712	0	1.00682	1.35768	20
24.46	4.091	185.6	3	4.05695	4.63238	2.98E-09	23	38.41581	0	0	0	168.57897	14	258.16364	0.7592	0.33	3.50753	290.86066	0	1.01068	1.34622	20
24.48	4.113	194.2	3	4.09994	4.66917	3.03E-09	23	39.30424	0	0	0	170.14044	14	261.20675	0.76771	0.33	3.54683	292.01593	0	1.01454	1.33719	20
24.5	4.109	194.5	3	4.61398	4.38161	4.78E-09	25	51.09135	0	0	0	178.64951	14	297.89577	0.87504	0.33	4.04268	298.40656	0	1.06098	1.44405	20
24.52	5.633	217.8	3	5.12069	4.10166	7.24E-09	26	64.21196	0	0	0	185.82416	14	334.06087	0.9807	0.33	4.53081	303.69327	0	1.10316	1.5587	20
24.54	5.633	217.8	3	5.81407	3.57122	1.33E-08	28	75.17775	0	0	0	191.03772	14	383.55996	1.12535	0.33	5.19911	307.64813	0	1.15631	1.81035	20
24.56	6.189	187.3	3	5.84443	3.32453	1.54E-08	28	75.59718	0	0	0	187.05099	14	385.69988	1.13097	0.33	5.22508	304.99423	0	1.15828	1.94537	20
24.58	5.724	177.8	3	5.69513	3.24312	1.50E-08	27	73.5015	0	0	0	182.74734	14	375.00763	1.09898	0.33	5.0773	301.98773	0	1.14697	1.98975	20
24.6	5.185	189	3	5.30716	3.4287	1.11E-08	26	68.06449	0	0	0	178.71301	14	347.26782	1.0171	0.33	4.69902	298.97211	0	1.117	1.87025	20
24.62	5.025	179.1	3	5.00519	3.69217	8.21E-09	25	60.85047	0	0	0	177.07755	14	325.67017	0.9533	0.33	4.40425	297.63657	0	1.09252	1.72704	20
24.64	4.818	186.3	3	4.78687	3.79789	6.85E-09	25	55.12109	0	0	0	174.18013	14	310.04804	0.90705	0.33	4.19059	295.46228	0	1.0741	1.67133	20
24.66	4.53	180	3	4.47555	3.99429	5.14E-09	24	47.46173	0	0	0	170.31514	14	287.78312	0.84144	0.33	3.88744	292.5033	0	1.04686	1.57763	20
24.68	4.091	170	3	4.09424	4.19044	3.62E-09	22	38.87281	0	0	0	164.23654	14	260.51867	0.76129	0.33	3.51717	287.83688	0	1.01163	1.4881	20



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ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

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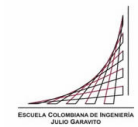
24.7	3.674	164.7	3	3.65928	4.336	2.43E-09	21	30.1301	0	0	0	155.4383	14	229.42287	0.67005	0.33	3.09563	280.98334	0	0.96841	1.41702	20
24.72	3.225	141.3	3	3.14901	4.63426	1.36E-09	19	21.29942	0	0	0	145.31631	14	192.9474	0.56321	0.33	2.60205	272.76898	0	0.91255	1.29572	20
24.74	2.56	131.8	3	2.79608	4.73401	9.39E-10	17	16.08348	0	0	0	136.27122	14	167.71097	0.48929	0.33	2.2605	265.23813	0	0.86968	1.24168	20
24.76	2.615	124	3	2.64383	4.89946	8.40E-10	17	14.05288	0	0	0	133.25772	14	156.80865	0.45723	0.33	2.11242	262.60953	0	0.84976	1.18635	20
24.78	2.768	132.8	3	2.66856	4.7841	8.67E-10	17	14.35881	0	0	0	132.99177	14	158.54849	0.46206	0.33	2.13473	262.43823	0	0.85281	1.21706	20
24.8	2.634	126.2	3	2.61096	4.75176	8.43E-10	17	13.61126	0	0	0	130.97933	14	154.40709	0.44975	0.33	2.07786	260.72922	0	0.84498	1.21966	20
24.82	2.442	113.2	3	2.44203	4.42392	8.06E-10	16	11.55663	0	0	0	122.91191	14	142.31356	0.41431	0.33	1.91413	253.8161	0	0.82158	1.29097	20
24.84	2.261	84.7	3	2.22477	4.02589	7.50E-10	15	9.16525	0	0	0	112.73676	14	126.76873	0.36887	0.33	1.70419	244.73213	0	0.78958	1.38705	20
24.86	1.982	70.8	3	1.97517	3.77858	6.46E-10	13	6.762	0	0	0	102.79812	14	108.91403	0.31676	0.33	1.46345	235.32915	0	0.74951	1.43014	20
24.88	1.693	68.4	3	1.78587	3.68448	5.53E-10	12	5.18198	0	0	0	95.86556	14	95.36697	0.27723	0.33	1.28081	228.40948	0	0.7161	1.42036	20
24.9	1.693	58.2	3	1.62091	3.679	4.63E-10	12	3.97633	0	0	0	90.18762	14	83.55893	0.24279	0.33	1.1217	222.47189	0	0.68434	1.37319	20
24.92	1.487	52.3	3	1.85792	4.22336	5.32E-10	13	5.74496	0	0	0	102.5042	14	100.46191	0.29176	0.33	1.34794	234.77245	0	0.72872	1.25471	20
24.94	2.403	124.9	3	2.00029	4.85095	5.41E-10	14	6.96008	0	0	0	112.13769	14	110.60511	0.32106	0.33	1.48329	243.74251	0	0.75297	1.11707	20
24.96	2.119	113.9	3	2.16269	5.30513	5.71E-10	15	8.48833	0	0	0	121.17024	14	122.17762	0.35447	0.33	1.63763	251.85913	0	0.7789	1.04359	20
24.98	1.973	105.4	3	2.0115	5.05427	5.27E-10	14	7.0472	0	0	0	114.06075	14	111.35228	0.3229	0.33	1.49178	245.45404	0	0.75444	1.07336	20
25	1.949	85.7	3	1.96465	4.40622	5.64E-10	14	6.62343	0	0	0	107.61327	14	107.97924	0.31296	0.33	1.44587	239.67078	0	0.74641	1.22241	20
25.02	1.978	68.6	3	2.03646	3.43407	7.26E-10	13	7.26081	0	0	0	101.85509	14	113.08272	0.32759	0.33	1.51347	234.65419	0	0.75817	1.58467	20
25.04	2.188	55.5	3	2.31426	2.44427	1.41E-09	14	10.02388	0	0	0	99.42587	14	132.89969	0.38482	0.33	1.77786	233.09471	0	0.80109	2.30245	20
25.06	2.782	45.6	3	3.30503	1.47452	1.05E-08	16	23.52476	0	0	0	105.91836	14	203.6435	0.58938	0.33	2.72296	240.81856	0	0.92684	4.09516	20
25.08	4.95	45.1	4	4.48376	1.06607	4.50E-08	19	46.96761	0	0	0	115.01382	14	287.81289	0.83259	0.33	3.84657	250.28481	0	1.04309	5.90077	20
25.1	5.724	52.7	4	5.25103	1.00425	8.00E-08	22	66.51543	0	0	0	123.38825	14	342.59215	0.99058	0.33	4.57647	257.99661	0	1.10695	6.36676	20
25.12	5.084	60.4	4	4.74594	1.20735	4.46E-08	21	53.20868	0	0	0	122.6829	14	306.48788	0.88575	0.33	4.09218	256.8576	0	1.0654	5.24185	20
25.14	3.435	58.8	4	3.70187	1.65322	1.26E-08	18	30.44339	0	0	0	116.6193	14	231.88577	0.66983	0.33	3.0946	250.56369	0	0.9683	3.7132	20
25.16	2.592	64.4	3	2.66961	2.67954	1.98E-09	15	14.1496	0	0	0	111.25727	14	158.12693	0.45654	0.33	2.10923	244.37296	0	0.84932	2.16632	20
25.18	1.987	91.4	3	2.14874	3.78827	7.31E-10	14	8.26681	0	0	0	108.612	14	120.89537	0.34888	0.33	1.61181	241.01945	0	0.77467	1.4555	20
25.2	1.872	88.4	3	1.91551	4.79246	5.01E-10	14	6.13932	0	0	0	108.96289	14	104.20986	0.30058	0.33	1.38866	240.79059	0	0.73618	1.11248	20
25.22	1.892	95.6	3	1.87794	4.81379	4.82E-10	13	5.82127	0	0	0	107.79127	14	101.49987	0.29261	0.33	1.35188	239.65686	0	0.72945	1.10033	20
25.24	1.874	87.2	3	1.85902	4.66733	4.85E-10	13	5.66157	0	0	0	106.08317	14	100.12257	0.2885	0.33	1.33288	238.08087	0	0.72593	1.13085	20
25.26	1.815	77.5	3	1.82314	4.24725	5.04E-10	13	5.36993	0	0	0	101.7578	14	97.53333	0.2809	0.33	1.29778	234.06047	0	0.71933	1.23439	20
25.28	1.784	67.6	3	1.77623	3.33103	5.78E-10	12	5.00225	0	0	0	92.97631	14	94.15704	0.27105	0.33	1.25227	225.72084	0	0.7106	1.55956	20
25.3	1.733	32.4	3	1.74766	2.40513	7.09E-10	12	4.78304	0	0	0	83.74769	14	92.0912	0.26499	0.33	1.22425	216.65703	0	0.70513	2.14709	20
25.32	1.729	26.1	3	1.7274	1.62479	9.04E-10	11	4.6295	0	0	0	74.76286	14	90.61984	0.26065	0.33	1.20419	207.50484	0	0.70115	3.16416	20
25.34	1.723	25.7	3	1.72548	1.5358	9.34E-10	11	4.61116	0	0	0	73.63993	14	90.45882	0.26008	0.33	1.20156	206.34377	0	0.70063	3.34527	20
25.36	1.727	27.7	3	1.72724	1.57091	9.22E-10	11	4.61954	0	0	0	74.12619	14	90.55966	0.26026	0.33	1.2024	206.85599	0	0.7008	3.27083	20
25.38	1.734	28	3	1.72633	1.62194	9.01E-10	11	4.60852	0	0	0	74.72994	14	90.47033	0.2599	0.33	1.20072	207.47725	0	0.70046	3.16646	20
25.4	1.72	28.3	3	1.72242	1.63336	8.92E-10	11	4.57577	0	0	0	74.77353	14	90.16707	0.25892	0.33	1.1962	207.50975	0	0.69956	3.14089	20
25.42	1.715	28.1	3	1.71518	1.58584	9.01E-10	11	4.5191	0	0	0	74.02139	14	89.62541	0.25726	0.33	1.18852	206.70888	0	0.69802	3.22915	20
25.44	1.712	25.2	3	1.71117	1.64994	8.74E-10	11	4.486	0	0	0	74.69187	14	89.31512	0.25626	0.33	1.18391	207.38686	0	0.69709	3.10019	20
25.46	1.704	31.4	3	1.70879	1.71661	8.48E-10	11	4.46462	0	0	0	75.41801	14	89.1206	0.25559	0.33	1.18084	208.12738	0	0.69647	2.97744	20
25.48	1.704	31.4	3	1.70775	1.82502	8.13E-10	11	4.45283	0	0	0	76.63395	14	89.02158	0.2552	0.33	1.17903	209.37289	0	0.69611	2.79918	20
25.5	1.705	30.7	3	1.71315	1.79981	8.25E-10	11	4.48714	0	0	0	76.5083	14	89.38269	0.25613	0.33	1.18332	209.26926	0	0.69697	2.84092	20
25.52	1.72	30.4	3	1.72158	1.76969	8.41E-10	11	4.54349	0	0	0	76.40535	14	89.96096	0.25768	0.33	1.19048	209.20093	0	0.69841	2.89371	20
25.54	1.729	30.3	3	1.73307	1.70987	8.70E-10	11	4.62233	0	0	0	76.03198	14	90.75713	0.25985	0.33	1.20051	208.86821	0	0.70042	3.00142	20
25.56	1.739	28.2	3	1.74489	1.64862	9.01E-10	11	4.70425	0	0	0	75.62954	14	91.5768	0.26209	0.33	1.21085	208.50711	0	0.70248	3.11977	20
25.58	1.755	27.8	3	1.75703	1.58411	9.36E-10	11	4.78926	0	0	0	75.17287	14	92.41962	0.26439	0.33	1.22149	208.09187	0	0.70458	3.25406	20
25.6	1.765	27.5	3	1.76984	1.56134	9.57E-10	11	4.88001	0	0	0	75.23186	14	93.31041	0.26683	0.33	1.23275	208.20718	0	0.7068	3.3092	20
25.62	1.777	27.6	3	1.78199	1.54883	9.73E-10	11	4.96659	0	0	0	75.39692	14	94.15395	0.26913	0.33	1.24339	208.4279	0	0.70888	3.34315	20
25.64	1.791	27.7	3	1.78613	1.5583	9.73E-10	11	4.9932	0	0	0	75.63214	14	94.42532	0.2698	0.33	1.24645	208.68797	0	0.70947	3.32468	20
25.66	1.777	28.2	3	1.78128	1.585	9.56E-10	11	4.95201	0	0	0	75.85144	14	94.05454	0.26862	0.33	1.24105	208.89609	0	0.70842	3.2647	20
25.68	1.762	28.8	3	1.76942	1.60316	9.37E-10	11	4.85862	0	0	0	75.77925	14	93.18267	0.26602	0.33	1.22903	208.77917	0	0.70607	3.21924	20
25.7	1.755	28.1	3	1.77724	1.58298	9.51E-10	11	4.91247	0	0	0	75.74236	14	93.71701	0.26744	0.33	1.23557	208.77615	0	0.70735	3.26455	20
25.72	1.8	27.5	3	1.80506	1.51611	1.04E-09	11	5.11831	0	0	0	75.61835	14	95.67996	0.27293	0.33	1.26093	208.76338	0	0.71228	3.4263	20
25.74	1.845	26.5	3	1.85258	1.43584	1.25E-09	11	5.48295	0	0	0	75.75595	14	99.04984	0.28243	0.33	1.30481	209.09285	0	0.72066	3.6492	20
25.76	1.897	25.8	3	2.12276	1.21854	2.68E-09	12	7.82126	0	0	0	78.79076	14	118.32446	0.33725	0.33	1.55808	213.11429	0	0.76574	4.48291	20
25.78	2.61	25.3	4	3.22861	0.79291	2.16E-08	15	21.73459	0	0	0	90.03487	14	197.28898	0.56207	0.33	2.59678	226.82402	0	0.91192	7.55247	20
25.8	5.162	25.7	5	6.32775	0.41563	5.36E-07	22	82.05171	23	31	85.25919	106.85818	0	0	0	0.33	0	245.05406	0.03014	0	0	20
25.82	11.194	27.9	5	7.17843	0.44717	7.84E-07	24	93.95622	25	32	91.15136	114.24303	0	0	0	0.33	0	251.38928	0.02039	0	0	20
25.84	5.162	42.7	6	11.42015	0.40747	5.04E-06	32	133.16817	34	35	106.2512	133.16817	0	0	0	0.33	0	266.89825	-0.01328	0	0	20



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

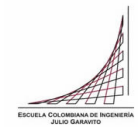
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
25.86	17.888	69	5	11.55581	0.52037	3.53E-06	33	143.76099	33	35	114.70292	143.76099	0	0	0	0.33	0	275.07358	-0.02024	0	0	20
25.88	11.602	68.7	6	12.78122	0.53333	4.81E-06	36	150.94746	36	36	120.4368	150.94746	0	0	0	0.33	0	280.49228	-0.03055	0	0	20
25.9	8.84	66.8	5	8.96824	0.89761	5.48E-07	31	118.9927	27	33	123.18033	154.38601	0	0	0	0.33	0	283.25211	-0.0222	0	0	20
25.92	6.45	106	4	6.69072	1.6351	7.22E-08	28	87.10202	0	0	0	163.05127	14	444.39805	1.26175	0.33	5.82927	289.25568	0	1.20245	3.9809	20
25.94	4.77	155.4	3	4.76959	3.19524	8.46E-09	24	52.4703	0	0	0	166.09532	14	307.14728	0.87159	0.33	4.02673	290.04132	0	1.05954	1.97509	20
25.96	3.076	195.8	3	3.47951	5.69046	1.13E-09	21	25.68838	0	0	0	167.21965	14	214.97019	0.60968	0.33	2.81672	289.67709	0	0.93764	1.06399	20
25.98	2.579	242.8	2	2.69776	8.30195	5.26E-10	19	14.06363	0	0	0	163.10878	14	159.10327	0.45099	0.33	2.08355	285.77155	0	0.84577	0.69618	20
26	2.424	233.3	2	2.43938	9.26193	4.11E-10	18	10.97968	0	0	0	159.1594	14	140.61937	0.39837	0.33	1.84048	282.49652	0	0.81063	0.60995	20
26.02	2.199	201.7	2	2.37421	8.93911	4.07E-10	18	10.25501	0	0	0	154.54602	14	135.93689	0.3849	0.33	1.77822	278.95981	0	0.73072	0.6277	25.42021
26.04	2.282	201.7	2	2.32397	8.28467	4.20E-10	17	9.71138	0	0	0	148.50853	14	132.32054	0.37445	0.33	1.72997	274.30453	0	0.6834	0.67352	28.19887
26.06	2.155	174.2	2	2.26148	7.54374	4.36E-10	16	9.0585	0	0	0	141.36627	14	127.82929	0.36155	0.33	1.67037	268.66696	0	0.66519	0.73431	28.68603
26.08	1.982	135.9	2	2.14369	6.10474	4.77E-10	15	7.8977	0	0	0	127.30869	14	119.38897	0.33751	0.33	1.55927	257.14667	0	0.6316	0.89405	29.50552
26.1	1.878	82.5	3	1.93909	4.86998	4.83E-10	14	6.0765	0	0	0	111.10207	14	104.7483	0.29597	0.33	1.36739	242.89761	0	0.58926	1.08705	29.69263
26.12	1.513	64.9	3	1.788	3.95787	4.91E-10	13	4.88388	0	0	0	98.96764	14	93.93004	0.26528	0.33	1.22559	231.53571	0	0.55675	1.30077	29.78598
26.14	1.513	64.9	3	1.66415	3.90389	4.34E-10	12	4.00303	0	0	0	94.19231	14	85.05828	0.24011	0.33	1.10932	226.66989	0	0.53498	1.28308	29.44723
26.16	1.512	65.1	3	1.65839	3.92347	4.29E-10	12	3.96019	0	0	0	94.14118	14	84.6214	0.23877	0.33	1.10312	226.60558	0	0.53387	1.27452	29.4235
26.18	1.496	65.2	3	1.72393	3.6583	4.86E-10	12	4.40589	0	0	0	94.46879	14	89.27692	0.25179	0.33	1.16327	227.13249	0	0.5468	1.38728	29.50128
26.2	1.71	58.9	3	1.78985	3.40811	5.49E-10	12	4.87795	0	0	0	94.69392	14	93.95951	0.26487	0.33	1.22372	227.55466	0	0.55921	1.50951	29.59475
26.22	1.71	58.9	3	1.83955	3.20549	6.03E-10	13	5.24842	0	0	0	94.59032	14	97.4844	0.27469	0.33	1.26905	227.61098	0	0.56811	1.62015	29.67658
26.24	1.645	59.1	3	1.76082	3.34315	5.39E-10	12	4.65559	0	0	0	93.21864	14	91.83479	0.25865	0.33	1.19496	226.07283	0	0.5537	1.52885	29.5267
26.26	1.474	58.6	3	1.67906	3.49997	4.76E-10	12	4.07804	0	0	0	91.73005	14	85.9695	0.24202	0.33	1.11813	224.38712	0	0.53803	1.43364	29.38333
26.28	1.465	58.6	3	1.61851	3.62474	4.32E-10	12	3.67406	0	0	0	90.57086	14	81.61875	0.22967	0.33	1.06107	223.06496	0	0.52603	1.3634	29.27457
26.3	1.464	58.8	3	1.72417	2.72982	5.99E-10	12	4.38055	0	0	0	86.7295	14	89.14083	0.25072	0.33	1.15834	219.69769	0	0.53991	1.85605	29.882
26.32	1.773	23.8	3	1.83285	1.93506	8.53E-10	12	5.17192	0	0	0	81.80999	14	96.87905	0.27237	0.33	1.25837	215.22792	0	0.55385	2.67692	30.46913
26.34	1.773	23.8	3	1.94191	1.22559	1.75E-09	11	6.03196	0	0	0	75.26359	14	104.64528	0.29409	0.33	1.3587	209.08919	0	0.56738	4.30892	31.03495
26.36	1.773	23.8	3	1.94389	1.21578	1.77E-09	11	6.04303	0	0	0	75.17017	14	104.76212	0.2943	0.33	1.35968	209.007	0	0.56802	4.34416	31.00584
26.38	1.78	23.3	3	1.94453	1.20166	1.80E-09	11	6.04313	0	0	0	74.97968	14	104.78374	0.29425	0.33	1.35942	208.82198	0	0.56843	4.39464	30.97493
26.4	1.776	23	3	1.95069	1.16882	1.89E-09	11	6.08882	0	0	0	74.62333	14	105.19992	0.2953	0.33	1.36428	208.49225	0	0.57064	4.52175	30.89683
26.42	1.795	22.1	3	1.95856	1.12838	2.01E-09	11	6.14885	0	0	0	74.17508	14	105.73793	0.29669	0.33	1.37072	208.07729	0	0.57344	4.68883	30.80167
26.44	1.808	21.2	3	1.95108	1.20275	1.81E-09	11	6.08165	0	0	0	75.17634	14	105.17942	0.29501	0.33	1.36294	209.05722	0	0.57694	4.39244	30.45473
26.46	1.768	27.1	3	1.92707	1.30422	1.54E-09	11	5.87987	0	0	0	76.14714	14	103.44057	0.29002	0.33	1.33987	209.94177	0	0.57681	4.03336	30.13064
26.48	1.735	27.1	3	1.8845	1.4575	1.20E-09	11	5.53434	0	0	0	77.2879	14	100.37551	0.28131	0.33	1.29964	210.92712	0	0.57199	3.58136	29.86784
26.5	1.688	28.2	3	1.84184	1.50936	1.04E-09	11	5.19871	0	0	0	76.92623	14	97.30401	0.27259	0.33	1.25936	210.40157	0	0.56285	3.43014	29.88354
26.52	1.636	28.1	3	1.81435	1.53958	9.64E-10	11	4.98639	0	0	0	76.62971	14	95.31561	0.26691	0.33	1.23313	209.99728	0	0.55648	3.34401	29.91711
26.54	1.649	27.5	3	1.80881	1.52587	9.63E-10	11	4.94054	0	0	0	76.32135	14	94.89557	0.26563	0.33	1.2272	209.6665	0	0.55377	3.36948	30.00844
26.56	1.667	27.2	3	1.83631	1.47579	1.05E-09	11	5.14253	0	0	0	76.37458	14	96.83554	0.27095	0.33	1.25178	209.83353	0	0.55714	3.5018	30.15153
26.58	1.714	26.6	3	1.87241	1.43665	1.18E-09	11	5.41522	0	0	0	76.75793	14	99.38981	0.27798	0.33	1.28428	210.36601	0	0.56141	3.62089	30.34847
26.6	1.751	26.9	3	1.9054	1.44326	1.26E-09	11	5.67008	0	0	0	77.66923	14	101.72236	0.28439	0.33	1.31389	211.41194	0	0.56902	3.62502	30.27414
26.62	1.771	29	3	1.90031	1.46642	1.21E-09	12	5.62463	0	0	0	77.87181	14	101.33442	0.28319	0.33	1.30835	211.59929	0	0.56814	3.56367	30.25214
26.64	1.699	27.7	3	1.91904	1.44343	1.29E-09	12	5.76906	0	0	0	78.02567	14	102.64802	0.28675	0.33	1.32477	211.82771	0	0.56924	3.63159	30.41831
26.66	1.801	26.4	3	1.98874	1.29563	1.73E-09	12	6.33679	0	0	0	77.56596	14	107.60185	0.30046	0.33	1.38815	211.63463	0	0.57596	4.09249	30.88194
26.68	1.964	23.2	3	2.115	1.13317	2.64E-09	12	7.43754	0	0	0	77.82541	14	116.59659	0.32545	0.33	1.50359	212.36174	0	0.59608	4.76765	31.15124
26.7	2.074	22.3	3	2.15317	1.06355	3.08E-09	12	7.78317	0	0	0	77.45692	14	119.29854	0.33286	0.33	1.53783	212.14375	0	0.60953	5.10535	30.71362
26.72	1.939	23.2	3	2.09498	1.22356	2.29E-09	12	7.24437	0	0	0	78.88732	14	115.1183	0.32107	0.33	1.48334	213.34184	0	0.60662	4.40114	30.15854
26.74	1.81	31.4	3	1.97588	1.44577	1.43E-09	12	6.20781	0	0	0	79.48618	14	106.58637	0.29715	0.33	1.37285	213.50945	0	0.58811	3.65652	29.84773
26.76	1.72	31.1	3	1.90478	1.64673	9.99E-10	12	5.62531	0	0	0	80.44175	14	101.48346	0.28281	0.33	1.30658	214.2043	0	0.57004	3.17068	30.09926
26.78	1.709	31.6	3	1.8762	1.72334	9.42E-10	12	5.39634	0	0	0	80.68362	14	99.41718	0.27694	0.33	1.27945	214.34471	0	0.55984	3.01326	30.38223
26.8	1.71	34.3	3	1.87371	1.79679	9.13E-10	12	5.37217	0	0	0	81.53112	14	99.21489	0.27626	0.33	1.27632	215.18057	0	0.55806	2.88804	30.45462
26.82	1.709	35.1	3	1.87204	1.87496	8.85E-10	12	5.35428	0	0	0	82.4358	14	99.07026	0.27574	0.33	1.27392	216.07352	0	0.55698	2.76606	30.49101
26.84	1.702	35.9	3	1.86493	1.85887	8.83E-10	12	5.29472	0	0	0	82.06568	14	98.53828	0.27415	0.33	1.26656	215.68597	0	0.55607	2.7856	30.44261
26.86	1.69	33	3	1.85135	1.76988	8.99E-10	12	5.18618	0	0	0	80.64581	14	97.54318	0.27127	0.33	1.25325	214.23106	0	0.55341	2.91736	30.42211
26.88	1.668	29.4	3	1.83636	1.64274	9.29E-10	11	5.06836	0	0	0	78.69343	14	96.44845	0.26811	0.33	1.23868	212.22746	0	0.54909	3.13324	30.492
26.9	1.653	28.1	3	1.8392	1.49521	9.89E-10	11	5.0851	0	0	0	76.87794	14	96.62698	0.2685	0.33	1.24047	210.41595	0	0.54434	3.44343	30.83609
26.92	1.684	25	3	1.88189	1.37096	1.24E-09	11	5.40628	0	0	0	76.25812	14	99.65166	0.27679	0.33	1.27879	209.96457	0	0.54529	3.78522	31.34512
26.94	1.776	24.3	4	3.38391	0.7319	2.54E-08	15	23.29875	0	0	0	91.69745	14	206.91407	0.5745	0.33	2.65417	229.04253	0	0.76221	8.18745	33.90535
26.96	6.134	25	5	7.6539	0.5078	7.37E-07	26	100.32998	25	32	98.42465	123.3589	0	0	0	0.33	0	259.44318	0.01361	0	0	35.61348
26.98	14.662	67.3	6	11.8906	0.44741	4.56E-06	34	141.18714	34	35	112.64932	141.18714	0	0	0	0.33	0	273.55548	-0.01666	0	0	20
27	14.662	67.3	6	13.23531	0.53594	4.91E-06	37	155.70575	36	36	124.23331	155.70575	0	0	0	0.33	0	284.43234	-0.03154	0	0	20



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MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

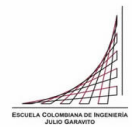
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
27.02	10.352	78.2	5	11.09407	0.69767	1.65E-06	34	148.47667	31	35	125.86973	157.75673	0	0	0	0.33	0	286.05194	-0.02391	0	0	20
27.04	8.238	86.7	5	8.32373	1.16334	2.31E-07	31	109.68662	25	32	132.73917	166.36643	0	0	0	0.33	0	292.61511	-0.02926	0	0	20
27.06	6.35	125.6	4	6.13525	1.95863	3.84E-08	27	79.04253	0	0	0	165.89471	14	403.27819	1.11637	0.33	5.15764	291.19821	0	1.15315	3.28887	20
27.08	3.785	148.2	3	4.41889	3.40055	5.56E-09	23	42.71408	0	0	0	163.74645	14	280.65308	0.77651	0.33	3.58746	288.32205	0	1.0185	1.83035	20
27.1	3.087	177	3	3.02031	5.73892	8.17E-10	19	17.70309	0	0	0	155.2902	14	180.72712	0.49977	0.33	2.30893	280.64523	0	0.87601	1.0218	20
27.12	2.151	194.8	2	2.42064	7.82026	4.50E-10	18	10.29638	0	0	0	150.53079	14	137.86554	0.38104	0.33	1.76041	276.19336	0	0.79839	0.71373	20
27.14	1.979	196.1	2	2.06298	8.98213	3.08E-10	16	6.82715	0	0	0	142.66904	14	112.29146	0.3102	0.33	1.43311	269.48264	0	0.74415	0.59388	20
27.16	1.996	165	2	2.05343	8.22362	3.30E-10	16	6.73767	0	0	0	138.01413	14	111.58194	0.30808	0.33	1.42332	265.7999	0	0.74241	0.64755	20
27.18	2.097	145.5	2	2.13716	6.79407	4.14E-10	16	7.47197	0	0	0	132.72063	14	117.53491	0.32435	0.33	1.49849	261.73648	0	0.7556	0.79328	20
27.2	2.197	125.1	3	2.25229	5.30274	5.53E-10	16	8.5463	0	0	0	126.38087	14	125.7321	0.3468	0.33	1.6022	256.79468	0	0.73451	1.03168	22.85262
27.22	2.298	87.7	3	2.36582	3.99157	7.50E-10	15	9.67569	0	0	0	118.9526	14	133.81441	0.36891	0.33	1.70438	250.81558	0	0.72997	1.38868	24.5133
27.24	2.398	70.5	3	2.42108	2.85548	1.04E-09	15	10.24633	0	0	0	108.86671	14	137.73567	0.37955	0.33	1.75351	242.24232	0	0.72424	1.95247	25.57419
27.26	2.331	49.2	3	2.42437	2.21776	1.57E-09	14	10.27296	0	0	0	101.21996	14	137.94532	0.37996	0.33	1.75539	235.45457	0	0.71603	2.51432	26.19736
27.28	2.284	41.6	3	2.50354	1.7402	2.56E-09	14	11.12376	0	0	0	96.41838	14	143.57506	0.39529	0.33	1.82624	231.2897	0	0.71753	3.22961	27.01278
27.3	2.611	39.9	3	2.59917	1.67489	3.10E-09	14	12.19794	0	0	0	97.54098	14	150.38026	0.41385	0.33	1.91197	232.54355	0	0.72279	3.38528	27.7385
27.32	2.597	49.1	3	2.60455	1.921	2.53E-09	15	12.25079	0	0	0	101.43222	14	150.73903	0.41465	0.33	1.91569	236.06598	0	0.72765	2.95252	27.42895
27.34	2.314	61.1	3	2.3783	2.57327	1.14E-09	14	9.75662	0	0	0	104.53153	14	134.55253	0.36996	0.33	1.7092	238.33495	0	0.70347	2.1546	26.49808
27.36	1.945	73.4	3	2.08963	3.23183	7.12E-10	14	6.98911	0	0	0	103.43188	14	113.90748	0.31305	0.33	1.44629	236.6611	0	0.66669	1.65295	25.55853
27.38	1.732	68.1	3	1.90563	3.60861	5.56E-10	13	5.46403	0	0	0	101.02004	14	100.73877	0.27673	0.33	1.2785	233.9794	0	0.62873	1.43564	25.78509
27.4	1.729	64.8	3	1.84378	3.54163	5.30E-10	13	4.99038	0	0	0	98.40837	14	96.29527	0.26441	0.33	1.22156	231.3967	0	0.60708	1.44517	26.39764
27.42	1.728	63	3	1.84904	3.45584	5.42E-10	13	5.02446	0	0	0	97.87275	14	96.64526	0.26525	0.33	1.22545	230.91881	0	0.5981	1.4822	27.04651
27.44	1.723	63.9	3	1.85602	3.18424	5.80E-10	13	5.07147	0	0	0	95.74694	14	97.118	0.26643	0.33	1.23089	228.95987	0	0.59071	1.61042	27.61406
27.46	1.728	50.4	3	1.86406	2.7306	6.53E-10	13	5.12672	0	0	0	91.7893	14	97.66681	0.26782	0.33	1.23731	225.25014	0	0.58437	1.88042	28.12831
27.48	1.732	38.4	3	1.87424	2.12709	7.86E-10	12	5.19852	0	0	0	85.82731	14	98.369	0.26963	0.33	1.24568	219.5443	0	0.57912	2.4181	28.59978
27.5	1.735	30.8	3	1.88174	1.75724	9.00E-10	12	5.25054	0	0	0	81.70356	14	98.88007	0.27092	0.33	1.25164	215.52689	0	0.57538	2.93052	28.93592
27.52	1.737	30	3	1.88765	1.6193	9.55E-10	12	5.29075	0	0	0	80.12344	14	99.27805	0.2719	0.33	1.25618	213.9866	0	0.57207	3.18296	29.22276
27.54	1.738	30.9	3	1.891	1.63406	9.51E-10	12	5.31149	0	0	0	80.41114	14	99.49243	0.27238	0.33	1.25838	214.28835	0	0.56898	3.15542	29.46125
27.56	1.735	31.8	3	1.89446	1.67682	9.38E-10	12	5.33314	0	0	0	81.05986	14	99.71523	0.27288	0.33	1.26069	214.94763	0	0.56616	3.07621	29.68291
27.58	1.738	32.6	3	1.89837	1.6997	9.32E-10	12	5.35825	0	0	0	81.46339	14	99.97002	0.27346	0.33	1.2634	215.36469	0	0.56333	3.03628	29.9119
27.6	1.74	32.4	3	1.72091	1.99507	6.94E-10	11	4.08161	0	0	0	80.05859	14	87.26952	0.23862	0.33	1.10244	213.29066	0	0.53356	2.49099	29.43296
27.62	1.211	38	3	1.54078	2.34514	4.97E-10	11	2.96361	0	0	0	78.03524	14	74.37829	0.20329	0.33	0.93921	210.47829	0	0.50187	2.01727	28.86187
27.64	1.211	38	3	1.57378	2.40398	5.10E-10	11	3.15111	0	0	0	79.66102	14	76.71078	0.20958	0.33	0.96826	212.2851	0	0.51653	1.98705	28.39142
27.66	1.856	37.5	3	1.79887	2.11058	7.25E-10	12	4.60605	0	0	0	83.60033	14	92.7639	0.25333	0.33	1.1704	217.12465	0	0.55918	2.39443	28.792
27.68	1.885	38.4	3	1.80001	2.1185	7.24E-10	12	4.60976	0	0	0	83.73035	14	92.82047	0.25338	0.33	1.17063	217.26045	0	0.55802	2.38542	28.8723
27.7	1.211	38.5	3	1.7718	2.15788	6.93E-10	12	4.40756	0	0	0	83.34588	14	90.78073	0.24771	0.33	1.14443	216.78003	0	0.54809	2.3269	29.12714
27.72	1.759	37.8	3	1.73036	2.17873	6.56E-10	12	4.1208	0	0	0	82.35332	14	87.79603	0.23947	0.33	1.10635	215.64178	0	0.53448	2.28223	29.43377
27.74	1.746	36.8	3	1.91672	1.91821	8.69E-10	12	5.46013	0	0	0	84.73179	14	101.08239	0.27559	0.33	1.27325	218.66829	0	0.56247	2.69431	30.11505
27.76	1.753	35.7	3	1.92486	1.83217	9.02E-10	12	5.51814	0	0	0	83.91606	14	101.63881	0.277	0.33	1.27973	217.90349	0	0.55814	2.82437	30.49961
27.78	1.767	33.3	3	1.94218	1.7283	9.53E-10	12	5.6483	0	0	0	83.07939	14	102.8515	0.28019	0.33	1.29447	217.14912	0	0.55604	3.00281	30.85755
27.8	1.783	31.7	3	2.02686	1.55906	1.27E-09	12	6.32677	0	0	0	82.97494	14	108.87558	0.29648	0.33	1.36974	217.34662	0	0.56596	3.37652	31.289
27.82	1.992	29.8	3	2.8405	1.00334	8.43E-09	14	14.87345	0	0	0	90.34373	14	166.96797	0.45449	0.33	2.09974	226.72241	0	0.68326	5.74135	32.91674
27.84	4.183	24	4	3.6834	0.70406	3.30E-08	16	27.51671	0	0	0	96.01343	14	227.15026	0.61806	0.33	2.85541	233.78888	0	0.78719	8.58383	34.38445
27.86	4.29	24	4	4.4128	0.51819	8.73E-08	18	41.563	0	0	0	98.99734	14	279.22563	0.75944	0.33	3.50863	237.9156	0	0.86962	11.96681	35.46475
27.88	4.162	20.6	5	5.34372	0.44413	1.98E-07	20	64.14614	19	30	84.30187	105.65834	0	0	0	0.33	0	244.96132	0.03896	0	0	36.36767
27.9	6.976	26.6	5	6.77621	0.34582	7.19E-07	23	87.80627	23	32	86.52345	108.44272	0	0	0	0.33	0	247.62079	0.0356	0	0	37.24118
27.92	8.61	23.1	5	8.0613	0.29358	1.75E-06	25	105.79272	26	33	88.7256	111.20275	0	0	0	0.33	0	250.19051	0.02908	0	0	37.8256
27.94	8.038	21.3	5	8.31905	0.25644	2.33E-06	25	109.23109	27	33	87.15247	109.23109	0	0	0	0.33	0	248.72971	0.02986	0	0	37.76296
27.96	7.767	19.6	5	6.72089	0.8729	1.68E-07	26	87.01693	22	31	111.50762	139.75622	0	0	0	0.33	0	272.95026	-0.00174	0	0	34.73169
27.98	3.963	135.1	4	5.31241	1.81838	2.67E-08	24	62.67517	0	0	0	150.81004	14	343.33135	0.93138	0.33	4.30297	279.8862	0	1.08386	3.48307	20
28	3.963	135.1	3	3.99372	3.38281	3.86E-09	22	32.97896	0	0	0	155.26496	14	249.11183	0.67544	0.33	3.12053	281.93402	0	0.97107	1.80703	20
28.02	3.963	135.1	3	3.99372	3.38281	3.85E-09	22	32.955	0	0	0	155.29606	14	249.08446	0.67502	0.33	3.11861	281.96225	0	0.97086	1.80683	20
28.04	3.963	135.1	3	3.77272	3.58097	2.91E-09	21	28.88893	0	0	0	152.98755	14	233.2714	0.63185	0.33	2.91915	280.01822	0	0.94916	1.69212	20
28.06	3.3	135.1	3	3.4115	4.08325	1.67E-09	20	22.83414	0	0	0	150.4154	14	207.44252	0.5616	0.33	2.59461	277.67877	0	0.91166	1.45939	20
28.08	2.872	147.7	3	3.12076	4.35364	1.12E-09	19	18.47652	0	0	0	145.63249	14	186.64848	0.50506	0.33	2.33336	273.67816	0	0.87916	1.34629	20
28.1	3.069	124.8	3	4.10529	3.15041	4.73E-09	22	34.99696	0	0	0	154.38176	14	256.94426	0.69492	0.33	3.21053	281.42206	0	0.98056	1.94695	20
28.12	6.226	115.5	4	5.84742	1.89941	3.26E-08	26	74.74564	0	0	0	161.547	14	381.35533	1.03088	0.33	4.76267	288.17664	0	1.12215	3.3649	20
28.14	8.073	92.9	4	7.70943	1.22318	1.50E-07	30	100.80844	0	0	131.97453	165.40808	14	514.32878	1.38964	0.33	6.42016	292.23056	0	1.24282	5.34509	20
28.16	8.647	74.5	5	7.85625	0.95253	2.46E-07	29	102.85863	24	32	123.07369	154.25236	0	0	0	0.33	0	284.14529	-0.01393	0	0	20



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Inicio cono (m	1.5	Fin cono (m	38.26

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28.18	6.663	57.1	5	7.00997	0.86686	1.92E-07	27	91.00561	22	31	113.91003	142.76724	0	0	0	0.33	0	275.4516	-0.00306	0	0	20
28.2	5.532	50.7	4	5.61883	0.89995	9.15E-08	23	70.42216	0	0	0	128.28957	14	364.92136	0.98459	0.33	4.54879	263.23236	0	1.10465	7.07231	20
28.22	4.458	43.9	4	4.45908	1.05478	3.51E-08	20	42.05242	0	0	0	117.88552	14	282.05637	0.76067	0.33	3.51432	253.53598	0	1.01135	5.87701	20
28.24	3.159	46.5	4	3.53305	1.32086	1.18E-08	17	24.62499	0	0	0	109.9256	14	215.88533	0.58197	0.33	2.68868	245.49805	0	0.83943	4.53359	28.39326
28.26	2.722	49.6	3	2.86639	1.78738	3.65E-09	16	14.94876	0	0	0	105.94864	14	168.24128	0.45333	0.33	2.09439	240.83316	0	0.74902	3.21815	28.12255
28.28	2.408	57.6	3	2.47885	2.17708	1.59E-09	15	10.42596	0	0	0	102.86802	14	140.53448	0.37851	0.33	1.74871	237.27895	0	0.68662	2.55202	28.21796
28.3	1.948	54.7	3	2.18423	2.36392	9.25E-10	14	7.53074	0	0	0	97.64301	14	119.46414	0.32162	0.33	1.48589	231.81776	0	0.63266	2.26743	28.42724
28.32	1.794	42.6	3	2.02714	2.53559	7.70E-10	13	6.17701	0	0	0	95.21047	14	108.21837	0.29122	0.33	1.34544	229.1295	0	0.60227	2.06331	28.50623
28.34	1.916	56.9	3	1.98907	2.51876	7.47E-10	13	5.86519	0	0	0	93.94221	14	105.47408	0.28371	0.33	1.31076	227.83365	0	0.58798	2.06317	28.96193
28.36	1.81	50.8	3	1.96217	2.56348	7.19E-10	13	5.64825	0	0	0	93.64179	14	103.52717	0.27836	0.33	1.28601	227.47316	0	0.57232	2.01703	29.64592
28.38	1.681	43.2	3	1.89197	2.28686	7.27E-10	12	5.10956	0	0	0	88.65344	14	98.48719	0.2647	0.33	1.2229	222.50789	0	0.54937	2.23076	30.23647
28.4	1.675	35.8	3	1.85162	2.03785	7.55E-10	12	4.81046	0	0	0	84.74322	14	95.58067	0.25678	0.33	1.18632	218.57869	0	0.53543	2.4824	30.60923
28.42	1.671	34.2	3	1.85186	1.872	7.99E-10	12	4.80772	0	0	0	82.83157	14	95.57262	0.25665	0.33	1.18574	216.70699	0	0.53336	2.70176	30.7383
28.44	1.676	34	3	1.84937	1.84207	8.05E-10	12	4.78549	0	0	0	82.41626	14	95.37055	0.25601	0.33	1.18276	216.29181	0	0.53298	2.74354	30.71789
28.46	1.668	34	3	1.83765	1.87558	7.85E-10	12	4.69751	0	0	0	82.50226	14	94.50882	0.25359	0.33	1.17161	216.33586	0	0.53109	2.68719	30.6723
28.48	1.637	35.4	3	1.80397	1.94571	7.38E-10	12	4.45717	0	0	0	82.38368	14	92.0779	0.24697	0.33	1.14101	216.0938	0	0.52452	2.57084	30.63567
28.5	1.575	35.9	3	1.77278	1.97617	7.06E-10	12	4.24011	0	0	0	81.84777	14	89.82593	0.24084	0.33	1.11266	215.44504	0	0.51773	2.51273	30.64267
28.52	1.573	33.8	3	1.75159	1.96393	6.91E-10	12	4.09445	0	0	0	81.10841	14	88.2872	0.23661	0.33	1.09316	214.6286	0	0.51285	2.51516	30.65878
28.54	1.572	33.5	3	1.75221	1.92519	7.01E-10	12	4.09463	0	0	0	80.70125	14	88.30673	0.23657	0.33	1.09297	214.22801	0	0.51373	2.56543	30.59731
28.56	1.579	33.9	3	1.7615	1.89043	7.16E-10	12	4.1525	0	0	0	80.58268	14	88.94627	0.23819	0.33	1.10044	214.15031	0	0.51558	2.61764	30.59249
28.58	1.601	32.5	3	1.77927	1.83596	7.44E-10	12	4.26783	0	0	0	80.46598	14	90.19084	0.24143	0.33	1.1154	214.10851	0	0.51859	2.70573	30.62873
28.6	1.624	31.6	3	1.81141	1.75554	7.93E-10	12	4.48368	0	0	0	80.41147	14	92.46175	0.24741	0.33	1.14303	214.1857	0	0.52656	2.84945	30.53163
28.62	1.68	31.3	3	1.84308	1.70729	8.34E-10	12	4.70146	0	0	0	80.69052	14	94.69934	0.2533	0.33	1.17023	214.59119	0	0.53511	2.94932	30.38387
28.64	1.703	31.5	3	1.86656	1.69116	8.59E-10	12	4.86509	0	0	0	81.12881	14	96.35227	0.25762	0.33	1.19019	215.12	0	0.54214	2.9913	30.22158
28.66	1.702	31.9	3	1.86178	1.70267	8.50E-10	12	4.82625	0	0	0	81.15599	14	95.98579	0.25653	0.33	1.18519	215.13187	0	0.54241	2.96738	30.12801
28.68	1.669	31.7	3	1.83918	1.73085	8.21E-10	12	4.66099	0	0	0	80.9075	14	94.34681	0.25205	0.33	1.16449	214.80135	0	0.53918	2.9045	30.02544
28.7	1.638	31.9	3	1.8126	1.75623	7.90E-10	12	4.47115	0	0	0	80.502	14	92.42367	0.24682	0.33	1.14031	214.29716	0	0.53477	2.84529	29.94406
28.72	1.624	31.9	3	1.78769	1.77138	7.63E-10	12	4.29664	0	0	0	80.00534	14	90.61995	0.24191	0.33	1.11761	213.70558	0	0.52948	2.80445	29.94071
28.74	1.593	31.2	3	1.76696	1.74877	7.52E-10	12	4.15347	0	0	0	79.16673	14	89.11485	0.2378	0.33	1.09862	212.78493	0	0.52471	2.8263	29.95803
28.76	1.574	29.6	3	1.7438	1.72803	7.37E-10	11	3.99689	0	0	0	78.28027	14	87.43599	0.23323	0.33	1.0775	211.80003	0	0.52066	2.8436	29.89128
28.78	1.556	29.6	3	1.72113	1.72561	7.18E-10	11	3.84657	0	0	0	77.62231	14	85.79264	0.22875	0.33	1.05684	211.04172	0	0.51803	2.83087	29.73441
28.8	1.53	29.9	3	1.7028	1.75789	6.94E-10	11	3.72644	0	0	0	77.48821	14	84.45881	0.22511	0.33	1.04	210.82916	0	0.51507	2.76513	29.65882
28.82	1.521	30.3	3	1.69346	1.76561	6.83E-10	11	3.66425	0	0	0	77.3186	14	83.76736	0.22318	0.33	1.03109	210.61917	0	0.5119	2.74555	29.72305
28.84	1.525	29.5	3	1.7038	1.7549	6.94E-10	11	3.72553	0	0	0	77.49973	14	84.48126	0.22499	0.33	1.03947	210.85135	0	0.51315	2.76895	29.77653
28.86	1.559	29.9	3	1.71734	1.74688	7.06E-10	11	3.80768	0	0	0	77.8013	14	85.4242	0.22742	0.33	1.05067	211.21872	0	0.51678	2.79052	29.71774
28.88	1.564	30.6	3	1.72899	1.77174	7.09E-10	11	3.87851	0	0	0	78.43311	14	86.23187	0.22948	0.33	1.06019	211.90979	0	0.52183	2.75867	29.5372
28.9	1.567	31.4	3	1.73007	1.82459	6.95E-10	11	3.88168	0	0	0	79.08688	14	86.28401	0.22953	0.33	1.06041	212.57559	0	0.52466	2.67872	29.35421
28.92	1.569	32.7	3	1.7293	1.86588	6.84E-10	11	3.87304	0	0	0	79.54728	14	86.20492	0.22923	0.33	1.05902	213.03802	0	0.52616	2.61821	29.23381
28.94	1.566	32.7	3	1.73348	1.87291	6.85E-10	12	3.89618	0	0	0	79.75762	14	86.47903	0.22986	0.33	1.06197	213.26968	0	0.5263	2.61035	29.27151
28.96	1.578	32	3	1.75157	1.83264	7.09E-10	12	4.00966	0	0	0	79.82356	14	87.74662	0.23314	0.33	1.07712	213.41418	0	0.52729	2.67887	29.44745
28.98	1.617	31.6	3	1.77751	1.78339	7.42E-10	12	4.17683	0	0	0	79.98852	14	89.57457	0.23791	0.33	1.09913	213.68921	0	0.52997	2.76918	29.61798
29	1.638	31.5	3	1.80442	1.74017	7.76E-10	12	4.35398	0	0	0	80.22716	14	91.47229	0.24285	0.33	1.12197	214.03996	0	0.53361	2.85487	29.73574
29.02	1.655	31.1	3	1.83128	1.70008	8.10E-10	12	4.53439	0	0	0	80.4793	14	93.36644	0.24778	0.33	1.14476	214.40192	0	0.53724	2.93894	29.84906
29.04	1.694	30.8	3	1.92484	1.58628	9.32E-10	12	5.20215	0	0	0	81.50189	14	100.02477	0.26535	0.33	1.22592	215.78035	0	0.55247	3.2104	30.07529
29.06	1.914	29.7	3	2.05594	1.43973	1.32E-09	12	6.21651	0	0	0	82.73644	14	109.36394	0.29001	0.33	1.33986	217.47464	0	0.57539	3.62083	30.22539
29.08	2.05	28.3	3	2.1954	1.31639	1.95E-09	13	7.39465	0	0	0	84.11672	14	119.3011	0.31624	0.33	1.46103	219.29628	0	0.60035	4.0455	30.27093
29.1	2.121	28.7	3	2.31199	1.25577	2.55E-09	13	8.45653	0	0	0	85.71315	14	127.60464	0.33812	0.33	1.56211	221.20552	0	0.62038	4.30721	30.30887
29.12	2.272	30.1	3	2.41602	1.1948	3.24E-09	13	9.46293	0	0	0	86.87282	14	135.01068	0.3576	0.33	1.65213	222.63051	0	0.63655	4.5835	30.42002
29.14	2.366	27.8	3	2.52373	1.16362	3.96E-09	14	10.56434	0	0	0	88.52796	14	142.67963	0.37777	0.33	1.74529	224.50331	0	0.65353	4.76139	30.48595
29.16	2.451	30.2	3	2.562	1.14754	4.26E-09	14	10.96494	0	0	0	89.00612	14	145.38822	0.38479	0.33	1.77772	225.06259	0	0.66012	4.84627	30.45413
29.18	2.392	30.2	3	2.60867	1.12829	4.66E-09	14	11.46531	0	0	0	89.57397	14	148.69775	0.39339	0.33	1.81747	225.72552	0	0.6669	4.95098	30.50012
29.2	2.508	27.9	3	2.69347	1.09277	5.48E-09	14	12.4095	0	0	0	90.52957	14	154.72988	0.40919	0.33	1.89045	226.84573	0	0.6791	5.15182	30.58855
29.22	2.709	30.2	3	2.92719	1.2606	6.07E-09	15	15.22104	0	0	0	98.41548	14	171.39898	0.45309	0.33	2.09325	234.5439	0	0.73486	4.55206	29.16249
29.24	3.194	52.6	3	3.02829	1.26364	6.82E-09	16	16.51928	0	0	0	100.41446	14	178.59573	0.47192	0.33	2.18025	236.54454	0	0.77379	4.57379	27.31565
29.26	2.909	32	3	3.06659	1.27612	7.02E-09	16	17.01747	0	0	0	101.40743	14	181.30625	0.47888	0.33	2.21242	237.50502	0	0.80778	4.54038	24.98723
29.28	2.913	32.8	3	2.98712	1.09916	7.87E-09	15	15.95756	0	0	0	96.21509	14	175.60457	0.46363	0.33	2.14199	232.74774	0	0.79742	5.2414	24.9378
29.3	2.951	33.7	3	3.10005	1.41933	6.23E-09	16	17.44505	0	0	0	104.95295	14	183.64537	0.48466	0.33	2.23912	240.67474	0	0.81024	4.09028	25.1256
29.32	3.25	65.5	3	3.22647	1.69432	5.48E-09	17	19.1894	0	0	0	112.68333	14	192.64996	0.5082	0.33	2.34789	247.54222	0	0.88103	3.4536	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
29.34	3.294	64.8	3	4.08146	1.89556	1.00E-08	20	33.26177	0	0	0	133.07059	14	253.69432	0.66893	0.33	3.09044	265.42706	0	0.96785	3.21353	20
29.36	5.53	101.8	4	4.83718	1.84956	1.77E-08	23	48.89053	0	0	0	145.51287	14	307.64716	0.8108	0.33	3.74591	275.83511	0	1.03367	3.36991	20
29.38	5.53	101.8	4	5.67897	1.79258	3.03E-08	26	69.82479	0	0	0	157.85955	14	367.74792	0.96873	0.33	4.47554	285.70404	0	1.09854	3.54021	20
29.4	5.832	101.8	4	5.81661	1.92953	2.88E-08	26	73.56169	0	0	0	163.63855	14	377.55254	0.99407	0.33	4.59262	289.96024	0	1.10828	3.29672	20
29.42	5.937	133.1	4	6.02095	2.08107	2.79E-08	27	76.85567	0	0	0	170.83478	14	392.12078	1.03192	0.33	4.76746	295.18768	0	1.12254	3.06687	20
29.44	6.133	141	4	6.58497	2.19388	3.30E-08	29	84.74649	0	0	0	182.81568	14	432.38005	1.13729	0.33	5.25428	303.80295	0	1.16049	2.93308	20
29.46	7.51	159.3	4	7.12043	2.23956	3.96E-08	31	92.23747	0	0	0	192.47085	14	470.59935	1.23718	0.33	5.71578	310.5766	0	1.19439	2.89206	20
29.48	7.547	178.1	4	7.36008	2.31429	4.09E-08	32	95.58702	0	0	0	198.28699	14	487.68887	1.28145	0.33	5.92028	314.52383	0	1.20884	2.80588	20
29.5	6.867	173.6	4	6.87493	2.44802	3.05E-08	31	88.78945	0	0	0	194.21666	14	453.00739	1.1897	0.33	5.49643	311.5957	0	1.17852	2.63783	20
29.52	6.075	153.2	4	6.1441	2.51407	2.11E-08	29	78.55228	0	0	0	183.66046	14	400.77694	1.052	0.33	4.86024	304.10977	0	1.12996	2.54269	20
29.54	5.361	136.6	3	5.41618	2.51284	1.46E-08	26	62.54545	0	0	0	170.80407	14	348.7557	0.91499	0.33	4.22727	294.74368	0	1.0773	2.51125	20
29.56	4.66	118.5	3	4.95272	2.51444	1.12E-08	24	51.2012	0	0	0	162.2884	14	315.62393	0.82766	0.33	3.82381	288.32416	0	1.04097	2.48376	20
29.58	4.66	118.5	3	4.72653	2.50713	9.74E-09	24	46.06258	0	0	0	157.85944	14	299.43978	0.78484	0.33	3.62597	284.92148	0	1.02223	2.47638	20
29.6	4.66	118.5	3	4.72653	2.50713	9.72E-09	24	46.03183	0	0	0	157.89081	14	299.41252	0.78439	0.33	3.62388	284.9498	0	1.02202	2.47615	20
29.62	4.66	118.5	3	4.77041	2.89702	7.76E-09	24	46.96897	0	0	0	166.18655	14	302.51978	0.79214	0.33	3.65968	290.96677	0	1.02547	2.14522	20
29.64	4.797	177.6	3	5.58285	2.61515	1.48E-08	27	66.67347	0	0	0	176.21733	14	360.52352	0.94355	0.33	4.35919	298.66342	0	1.08868	2.41995	20
29.66	7.123	141.9	4	6.13612	2.59447	1.97E-08	29	78.40288	0	0	0	185.66106	14	400.01469	1.04637	0.33	4.83423	305.49341	0	1.12789	2.4624	20
29.68	6.36	158.1	4	6.64708	2.48079	2.68E-08	30	85.55088	0	0	0	191.66454	14	436.48409	1.14118	0.33	5.27227	309.82913	0	1.16185	2.59402	20
29.7	6.364	194.7	3	6.68102	2.86334	2.09E-08	31	86.02046	0	0	0	201.52814	14	438.87991	1.14685	0.33	5.29845	316.30942	0	1.16382	2.24831	20
29.72	7.236	221.1	4	7.18771	2.93232	2.45E-08	33	93.1085	0	0	0	212.01474	14	475.04338	1.2407	0.33	5.73202	323.29547	0	1.19555	2.20881	20
29.74	7.88	216.5	4	7.81662	2.63541	3.74E-08	34	101.90779	0	0	0	214.83954	14	519.93769	1.35723	0.33	6.27042	325.39426	0	1.23283	2.47349	20
29.76	8.252	180.4	4	8.21811	2.23247	5.80E-08	35	107.52303	0	0	0	209.39613	14	548.58691	1.43127	0.33	6.61248	322.16983	0	1.25543	2.93032	20
29.78	8.445	153.5	4	8.47049	1.8287	8.98E-08	34	111.05093	0	0	0	199.85838	14	566.5864	1.47748	0.33	6.82595	316.21323	0	1.26915	3.5846	20
29.8	8.642	130.8	4	8.99696	1.45679	1.57E-07	35	118.41603	0	0	153.75874	192.71096	14	604.16339	1.57468	0.33	7.27501	311.85483	0	1.29711	4.5174	20
29.82	9.835	108.9	5	9.99248	1.13152	3.52E-07	36	132.34788	27	33	148.42721	186.02877	0	0	0	0.33	0	307.42767	-0.0341	0	0	20
29.84	11.434	99.5	5	11.68769	0.8904	9.71E-07	38	156.07549	30	34	145.68143	182.5874	0	0	0	0.33	0	304.84985	-0.03257	0	0	20
29.86	13.727	103.8	5	14.72927	0.71173	3.31E-06	43	186.15942	36	36	148.53145	186.15942	0	0	0	0.33	0	307.04462	-0.04294	0	0	20
29.88	18.964	111.2	6	18.22095	0.652	8.04E-06	49	197.54512	41	37	157.61579	197.54512	0	0	0	0.33	0	314.47025	-0.0631	0	0	20
29.9	21.923	141.4	6	21.9407	0.6273	1.60E-05	55	211.06743	47	38	168.40487	211.06743	0	0	0	0.33	0	323.07864	-0.08528	0	0	20
29.92	24.902	160.3	6	24.96858	0.62011	2.49E-05	60	222.48528	51	39	177.51485	222.48528	0	0	0	0.33	0	330.16592	-0.10223	0	0	20
29.94	28.06	162.8	6	26.68702	0.63864	2.88E-05	63	231.83961	53	39	184.97842	231.83961	0	0	0	0.33	0	335.89691	-0.11141	0	0	20
29.96	27.063	188.2	6	27.37044	0.66958	2.82E-05	65	238.91882	53	40	190.62672	238.91882	0	0	0	0.33	0	340.20102	-0.11511	0	0	20
29.98	26.941	198.8	6	26.0531	0.79952	1.64E-05	65	250.6133	51	39	199.95742	250.6133	0	0	0	0.33	0	347.32846	-0.11006	0	0	20
30	24.1	237.9	6	24.24803	0.97561	8.40E-06	65	262.73285	48	39	209.62728	262.73285	0	0	0	0.33	0	354.59518	-0.10426	0	0	20
30.02	21.658	273	5	21.05626	1.34259	2.64E-06	63	280.3718	43	37	223.7009	280.3718	0	0	0	0.33	0	364.96481	-0.09886	0	0	20
30.04	17.366	337.2	5	19.3284	1.58903	1.38E-06	61	262.9889	40	37	230.42077	288.79404	0	0	0	0.33	0	369.84641	-0.09873	0	0	20
30.06	18.912	311.2	5	17.98573	1.83386	7.92E-07	60	244.18573	38	36	236.45043	296.35121	0	0	0	0.33	0	374.16302	-0.10049	0	0	20
30.08	17.625	341.1	5	17.66438	1.89855	6.87E-07	59	239.68101	37	36	238.14291	298.47244	0	0	0	0.33	0	375.38925	-0.10089	0	0	20
30.1	16.4	353.8	5	15.45605	2.33328	2.84E-07	56	208.75863	34	35	243.37155	305.02567	0	0	0	0.33	0	379.19284	-0.10382	0	0	20
30.12	12.282	387	4	14.45372	2.43098	2.11E-07	54	194.72023	0	0	239.6011	300.30004	14	993.47054	2.56847	0.33	11.86635	376.74814	0	1.53338	2.7709	20
30.14	14.618	313.3	4	13.31142	2.52791	1.58E-07	51	178.72212	0	0	231.55355	290.21378	14	911.84755	2.35488	0.33	10.87955	371.09464	0	1.48852	2.6556	20
30.16	12.985	309.2	4	12.94327	2.3227	1.74E-07	49	173.56239	0	0	221.15982	277.18698	14	885.52238	2.28563	0.33	10.55961	363.9082	0	1.4734	2.88661	20
30.18	11.197	279.4	4	11.14052	2.46039	1.06E-07	45	148.31818	0	0	0	259.13568	14	756.72543	1.95213	0.33	9.01883	353.27118	0	1.39602	2.70555	20
30.2	9.227	233.7	4	9.33091	2.5671	6.12E-08	39	122.97796	0	0	0	237.20656	14	627.43855	1.61774	0.33	7.47397	339.85892	0	1.30914	2.56703	20
30.22	7.563	205.5	4	7.54708	2.62397	3.30E-08	34	97.99883	0	0	0	211.33481	14	499.99401	1.28848	0.33	5.95279	323.20715	0	1.21111	2.4743	20
30.24	5.849	154.9	3	6.15524	2.75916	1.70E-08	29	78.5076	0	0	0	190.96463	14	400.549	1.03169	0.33	4.76642	309.22794	0	1.12245	2.31131	20
30.26	5.053	149.1	3	4.83312	3.19462	6.42E-09	25	47.27353	0	0	0	174.01128	14	306.08416	0.78799	0.33	3.64052	296.71875	0	1.02363	1.94276	20
30.28	3.597	159.2	3	3.88624	4.05534	2.14E-09	22	28.66913	0	0	0	165.40481	14	238.42154	0.6135	0.33	2.83436	289.73669	0	0.93964	1.48257	20
30.3	3.008	164.5	3	3.32065	4.70591	9.81E-10	20	19.76156	0	0	0	158.07554	14	197.9951	0.50923	0.33	2.35263	283.75955	0	0.88164	1.24169	20
30.32	3.355	145.1	3	4.17946	3.5164	3.45E-09	23	33.88006	0	0	0	164.90667	14	259.31137	0.6666	0.33	3.0797	289.69348	0	0.9667	1.72913	20
30.34	6.172	131.3	4	6.0229	2.24311	2.28E-08	28	76.62771	0	0	0	176.67863	14	390.9577	1.00453	0.33	4.64092	299.51935	0	1.11226	2.83596	20
30.36	8.537	128.9	4	8.14504	1.5666	1.00E-07	33	106.33232	0	0	0	187.58578	14	542.51182	1.39325	0.33	6.43681	308.22733	0	1.24392	4.16663	20
30.38	9.721	122.6	4	8.99329	1.36657	1.66E-07	34	118.20237	0	0	151.80202	190.25853	14	603.07332	1.54802	0.33	7.15185	310.45694	0	1.28956	4.80888	20
30.4	8.717	117.2	5	8.84701	1.2995	1.72E-07	34	116.14905	25	32	148.2308	185.7826	0	0	0	0.33	0	307.44333	-0.03421	0	0	20
30.42	8.099	105.1	4	8.0441	1.34343	1.24E-07	32	104.90292	0	0	142.05725	178.04509	14	535.21898	1.37252	0.33	6.34103	301.81696	0	1.23756	4.85362	20
30.44	7.313	101.9	4	7.14299	1.44944	7.76E-08	29	92.28211	0	0	0	170.50112	14	470.82708	1.20682	0.33	5.5755	296.08685	0	1.18429	4.45664	20
30.46	6.014	103.6	4	6.22608	1.70198	3.98E-08	27	79.43989	0	0	0	165.64015	14	405.30558	1.03838	0.33	4.79732	292.03433	0	1.12494	3.74834	20
30.48	5.348	112.4	4	5.28027	1.99926	1.86E-08	25	57.24575	0	0	0	158.43059	14	337.72131	0.86483	0.33	3.9955	286.11566	0	1.05672	3.13515	20

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

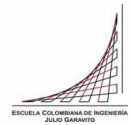
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
30.5	4.475	100.7	3	4.27691	2.41062	7.06E-09	22	35.50345	0	0	0	148.65306	14	266.02529	0.68091	0.33	3.14582	277.93796	0	0.97375	2.52866	20
30.52	3.003	96.2	3	3.38463	3.00181	2.27E-09	19	20.5146	0	0	0	138.72607	14	202.26407	0.51747	0.33	2.39073	269.25851	0	0.8865	1.95097	20
30.54	2.67	107.9	3	2.77744	3.67125	9.01E-10	17	12.65007	0	0	0	131.23719	14	158.86653	0.40626	0.33	1.87692	262.39136	0	0.81609	1.52686	20
30.56	2.652	101.8	3	2.72218	3.71884	8.63E-10	17	12.01971	0	0	0	130.19146	14	154.89293	0.39592	0.33	1.82915	261.45578	0	0.80892	1.49946	20
30.58	2.836	94	3	2.67353	3.53964	8.70E-10	17	11.47731	0	0	0	126.82574	14	151.39172	0.3868	0.33	1.787	258.63937	0	0.8025	1.56778	20
30.6	2.523	88.1	3	2.50569	3.41889	8.02E-10	16	9.72352	0	0	0	120.63584	14	139.37654	0.35594	0.33	1.64445	253.19926	0	0.78	1.59442	20
30.62	2.147	74.9	3	2.23871	3.39035	6.64E-10	15	7.23844	0	0	0	112.29071	14	120.28031	0.30704	0.33	1.41852	245.50085	0	0.74156	1.55303	20
30.64	2.033	64.7	3	2.08513	3.07575	6.28E-10	14	5.97295	0	0	0	104.36107	14	109.28428	0.27885	0.33	1.2883	238.11806	0	0.71753	1.66994	20
30.66	2.06	52.8	3	2.06202	2.49593	7.15E-10	14	5.78884	0	0	0	97.53897	14	107.60873	0.27447	0.33	1.26803	231.86206	0	0.71365	2.04903	20
30.68	2.076	36.9	3	2.08776	2.03567	8.43E-10	13	5.98321	0	0	0	92.8395	14	109.42207	0.27898	0.33	1.28889	227.58916	0	0.71764	2.52314	20
30.7	2.109	37.8	3	2.0595	1.87262	8.69E-10	13	5.75955	0	0	0	90.00484	14	107.37842	0.27366	0.33	1.26432	224.83664	0	0.71294	2.72854	20
30.72	1.974	41	3	2.01597	1.82047	8.50E-10	13	5.4261	0	0	0	88.16831	14	104.24392	0.26557	0.33	1.22694	222.94785	0	0.70565	2.78363	20
30.74	1.944	31.3	3	1.96014	1.70396	8.40E-10	12	5.01452	0	0	0	85.15201	14	100.23149	0.25525	0.33	1.17927	219.85507	0	0.69615	2.94092	20
30.76	1.94	27.9	3	1.95898	1.44463	9.33E-10	12	5.00197	0	0	0	81.5612	14	100.12446	0.25489	0.33	1.17757	216.36745	0	0.69581	3.46721	20
30.78	1.969	25.7	3	1.96637	1.3324	9.88E-10	12	5.05059	0	0	0	80.10697	14	100.62838	0.25607	0.33	1.18306	214.97928	0	0.69692	3.76396	20
30.8	1.965	25	3	1.97489	1.26758	1.09E-09	12	5.10749	0	0	0	79.33784	14	101.21202	0.25747	0.33	1.18949	214.26469	0	0.69821	3.96223	20
30.82	1.964	24.4	3	1.99074	1.23405	1.16E-09	12	5.21806	0	0	0	79.20993	14	102.32021	0.26019	0.33	1.20208	214.20932	0	0.70073	4.0817	20
30.84	2.015	24.3	3	2.0156	1.2056	1.27E-09	12	5.39627	0	0	0	79.3648	14	104.07162	0.26455	0.33	1.22221	214.468	0	0.70472	4.19713	20
30.86	2.038	24.2	3	2.05081	1.1849	1.39E-09	12	5.65567	0	0	0	79.87409	14	106.56291	0.27078	0.33	1.25102	215.11284	0	0.71036	4.2976	20
30.88	2.068	24.4	3	2.05668	1.21393	1.36E-09	12	5.69559	0	0	0	80.49771	14	106.95784	0.27169	0.33	1.2552	215.74574	0	0.71117	4.19835	20
30.9	2.031	26.3	3	2.04088	1.34092	1.15E-09	12	5.57142	0	0	0	82.13665	14	105.80501	0.26866	0.33	1.24121	217.27481	0	0.70845	3.78888	20
30.92	1.989	31.4	3	2.01808	1.45849	9.75E-10	12	5.39662	0	0	0	83.34237	14	104.15134	0.26436	0.33	1.22136	218.35622	0	0.70455	3.46778	20
30.94	1.998	30.6	3	2.02863	1.51991	9.59E-10	13	5.47041	0	0	0	84.51068	14	104.88069	0.26611	0.33	1.22945	219.52669	0	0.70615	3.33351	20
30.96	2.061	30.5	3	2.05887	1.48302	1.03E-09	13	5.69328	0	0	0	84.75007	14	107.01589	0.27143	0.33	1.25401	219.87303	0	0.71094	3.43479	20
30.98	2.078	30.5	3	2.08143	1.52619	1.03E-09	13	5.8612	0	0	0	85.96014	14	108.60304	0.27535	0.33	1.27213	221.11768	0	0.71444	3.3504	20
31	2.064	34.3	3	2.07563	1.6236	9.57E-10	13	5.81171	0	0	0	87.22081	14	108.16413	0.27413	0.33	1.2665	222.30252	0	0.71336	3.14543	20
31.02	2.042	36.3	3	2.06447	1.71634	9.12E-10	13	5.72151	0	0	0	88.22889	14	107.34206	0.27195	0.33	1.2564	223.2252	0	0.7114	2.96882	20
31.04	2.043	35.7	3	1.80567	1.56913	7.42E-10	12	3.91695	0	0	0	79.31406	14	88.83185	0.22497	0.33	1.03936	213.55284	0	0.66673	3.07254	20
31.06	1.171	13	3	1.55453	1.32945	5.96E-10	11	2.49217	0	0	0	69.0965	14	70.86939	0.17942	0.33	0.82891	201.82529	0	0.58749	3.36058	21.73034
31.08	1.17	13.3	3	1.46544	1.07817	5.89E-10	10	2.06255	0	0	0	63.18879	14	64.48276	0.16319	0.33	0.75396	194.95619	0	0.50747	3.99956	25.30412
31.1	1.657	21.1	3	1.77171	1.45998	7.45E-10	12	3.69603	0	0	0	76.96044	14	86.33509	0.21842	0.33	1.0091	211.05464	0	0.5622	3.27094	26.10619
31.12	2.088	43.2	3	2.06408	1.75866	8.94E-10	13	5.69547	0	0	0	88.84346	14	107.19333	0.27109	0.33	1.25241	223.82275	0	0.60398	2.89392	27.0512
31.14	2.041	44.6	3	2.17524	2.03196	8.93E-10	14	6.56503	0	0	0	95.42339	14	115.10848	0.29099	0.33	1.34436	230.33627	0	0.61431	2.55218	27.68455
31.16	1.975	44.8	3	2.13248	2.05864	8.52E-10	14	6.216	0	0	0	94.6229	14	112.0289	0.28309	0.33	1.30788	229.46858	0	0.60128	2.50087	28.03289
31.18	1.939	42.3	3	2.08834	2.05586	8.20E-10	13	5.866	0	0	0	93.39129	14	108.85067	0.27495	0.33	1.27027	228.1881	0	0.58848	2.48463	28.33935
31.2	1.89	41.7	3	2.06137	1.97442	8.22E-10	13	5.65535	0	0	0	91.63617	14	106.8992	0.26992	0.33	1.24701	226.46167	0	0.57819	2.57399	28.68086
31.22	1.876	38.1	3	2.04356	1.89539	8.30E-10	13	5.51681	0	0	0	90.1517	14	105.6021	0.26654	0.33	1.23141	225.00723	0	0.56905	2.67186	29.0563
31.24	1.867	36.4	3	2.02776	1.76714	8.56E-10	13	5.39493	0	0	0	88.05918	14	104.44906	0.26353	0.33	1.2175	222.97168	0	0.56013	2.85656	29.43994
31.26	1.824	33	3	2.03155	1.65391	8.97E-10	13	5.4183	0	0	0	86.63839	14	104.69482	0.26405	0.33	1.2199	221.63364	0	0.55653	3.0536	29.71512
31.28	1.875	31.4	3	2.04649	1.5099	9.64E-10	13	5.52471	0	0	0	84.99793	14	105.73762	0.26658	0.33	1.23159	220.12123	0	0.55335	3.35349	30.1019
31.3	1.895	28.3	3	2.1014	1.36893	1.21E-09	13	5.93729	0	0	0	84.25496	14	109.63492	0.2763	0.33	1.27651	219.61789	0	0.55669	3.73496	30.54894
31.32	1.971	26.6	3	2.16013	1.25455	1.53E-09	13	6.39531	0	0	0	83.82799	14	113.806	0.28671	0.33	1.32459	219.43291	0	0.56059	4.11549	30.99474
31.34	2.033	26.4	3	2.23995	1.18902	1.91E-09	13	7.04664	0	0	0	84.5535	14	119.48268	0.3009	0.33	1.39015	220.41959	0	0.56908	4.39648	31.37283
31.36	2.12	26.9	3	2.33631	1.15282	2.36E-09	13	7.87595	0	0	0	86.05267	14	126.34123	0.31805	0.33	1.46941	222.17622	0	0.58183	4.59707	31.63676
31.38	2.252	27.5	3	2.41314	1.14236	2.72E-09	14	8.56866	0	0	0	87.52736	14	131.80448	0.33169	0.33	1.53239	223.81587	0	0.59389	4.68567	31.69659
31.4	2.265	28.3	3	2.44126	1.2316	2.56E-09	14	8.82526	0	0	0	89.79364	14	133.78853	0.33655	0.33	1.55487	226.00832	0	0.60256	4.36073	31.41882
31.42	2.221	34.4	3	2.40339	1.38832	2.03E-09	14	8.46554	0	0	0	91.71943	14	131.05838	0.32956	0.33	1.52256	227.6691	0	0.60264	3.84927	30.97057
31.44	2.159	37.4	3	2.34832	1.60398	1.50E-09	14	7.95887	0	0	0	93.94181	14	127.10042	0.31948	0.33	1.47601	229.54926	0	0.59906	3.30686	30.56754
31.46	2.116	41.2	3	2.30648	1.78482	1.19E-09	14	7.58295	0	0	0	95.63679	14	124.08672	0.31179	0.33	1.44045	230.9823	0	0.5935	2.95397	30.44445
31.48	2.098	44.9	3	2.28188	1.93115	9.95E-10	14	7.36377	0	0	0	97.09117	14	122.30435	0.30719	0.33	1.4192	232.24254	0	0.58938	2.71993	30.42232
31.5	2.084	46.1	3	2.26155	2.04284	9.41E-10	14	7.18408	0	0	0	98.08609	14	120.82691	0.30336	0.33	1.4015	233.09341	0	0.58562	2.56299	30.42383
31.52	2.053	47.6	3	2.23608	2.11531	8.99E-10	14	6.96361	0	0	0	98.37251	14	118.98205	0.2986	0.33	1.37955	233.28387	0	0.58177	2.46517	30.36917
31.54	2.022	48.2	3	2.19903	2.16307	8.58E-10	14	6.65178	0	0	0	97.9942	14	116.31065	0.29178	0.33	1.34804	232.83446	0	0.57508	2.39631	30.36511
31.56	1.97	46.9	3	2.14628	2.18052	8.15E-10	14	6.22246	0	0	0	96.77323	14	112.51691	0.28216	0.33	1.30356	231.56232	0	0.56516	2.35612	30.38135
31.58	1.89	45.3	3	2.10492	2.09509	8.07E-10	14	5.89501	0	0	0	94.57586	14	109.53779	0.27458	0.33	1.26855	229.40997	0	0.55487	2.43417	30.5525
31.6	1.887	40.1	3	2.09146	1.97469	8.30E-10	13	5.78708	0	0	0	92.69388	14	108.55153	0.272	0.33	1.25664	227.61954	0	0.54947	2.5758	30.73577
31.62	1.92	38.5	3	2.11677	1.8314	8.92E-10	13	5.97643	0	0	0	91.50427	14	110.33429	0.27636	0.33	1.27678	226.59494	0	0.55177	2.78919	30.88194
31.64	1.96	37.7	3	2.13579	1.76359	9.30E-10	13	6.11941	0	0	0	91.0913	14	111.66769	0.27959	0.33	1.29172	226.27521	0	0.55924	2.90534	30.60304



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

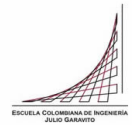
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
31.66	1.958	36.8	3	2.1379	1.74002	9.39E-10	13	6.13088	0	0	0	90.83088	14	111.79361	0.2798	0.33	1.29268	226.04195	0	0.56382	2.9451	30.31095
31.68	1.94	37.1	3	2.08662	1.74285	8.95E-10	13	5.73092	0	0	0	89.53939	14	108.10613	0.27047	0.33	1.24957	224.65714	0	0.55792	2.91322	30.06633
31.7	1.814	35.2	3	2.06365	1.76225	8.69E-10	13	5.55357	0	0	0	89.2055	14	106.44044	0.2662	0.33	1.22985	224.26523	0	0.55043	2.86833	30.27047
31.72	1.878	36.8	3	2.05767	1.76251	8.63E-10	13	5.50439	0	0	0	89.06056	14	105.98821	0.26497	0.33	1.22416	224.11053	0	0.54606	2.86402	30.47576
31.74	1.912	36.8	3	2.10408	1.74581	9.06E-10	13	5.84922	0	0	0	90.07317	14	109.27845	0.27309	0.33	1.26168	225.23045	0	0.55116	2.91541	30.69763
31.76	1.945	36.6	3	2.13607	1.69158	9.51E-10	13	6.09132	0	0	0	90.16102	14	111.53822	0.27863	0.33	1.28728	225.42543	0	0.55642	3.02511	30.72619
31.78	1.974	35	3	2.12477	1.66135	9.52E-10	13	5.99857	0	0	0	89.45273	14	110.70673	0.27645	0.33	1.2772	224.7247	0	0.55445	3.07344	30.70874
31.8	1.878	34.3	3	2.13862	1.61786	9.80E-10	13	6.10126	0	0	0	89.19443	14	111.67134	0.27875	0.33	1.28785	224.53282	0	0.55838	3.16295	30.60365
31.82	1.992	34.5	3	2.14505	1.59748	9.93E-10	13	6.14648	0	0	0	89.07218	14	112.10549	0.27973	0.33	1.29237	224.44347	0	0.56084	3.20613	30.5056
31.84	1.998	34	3	2.18361	1.56011	1.12E-09	13	6.44697	0	0	0	89.49852	14	114.83464	0.28644	0.33	1.32333	224.97934	0	0.56831	3.30346	30.45951
31.86	1.998	33.7	3	2.1875	1.54819	1.14E-09	13	6.47305	0	0	0	89.4277	14	115.08832	0.28696	0.33	1.32576	224.92979	0	0.56926	3.33031	30.43104
31.88	2.005	33.9	3	2.19907	1.54914	1.16E-09	13	6.56106	0	0	0	89.74008	14	115.88985	0.28885	0.33	1.33449	225.26518	0	0.57081	3.33382	30.45475
31.9	2.032	34.6	3	2.22743	1.54588	1.23E-09	13	6.78702	0	0	0	90.40112	14	117.89075	0.29373	0.33	1.35702	225.98116	0	0.57485	3.35526	30.50977
31.92	2.082	34.8	3	2.25813	1.54701	1.29E-09	14	7.03624	0	0	0	91.18101	14	120.05841	0.29901	0.33	1.38145	226.81131	0	0.57891	3.36805	30.58863
31.94	2.095	35.4	3	2.27712	1.56045	1.32E-09	14	7.19052	0	0	0	91.86263	14	121.39045	0.30222	0.33	1.39625	227.50836	0	0.58323	3.34792	30.50936
31.96	2.094	36.4	3	2.28472	1.59611	1.29E-09	14	7.24921	0	0	0	92.60737	14	121.90803	0.30339	0.33	1.40167	228.22496	0	0.58645	3.27614	30.37022
31.98	2.112	37.6	3	2.27186	1.64917	1.20E-09	14	7.1347	0	0	0	93.10522	14	120.96438	0.30093	0.33	1.39029	228.64789	0	0.5864	3.16402	30.21139
32	2.063	38.4	3	2.25746	1.77781	1.05E-09	14	7.0083	0	0	0	94.63934	14	119.9111	0.29819	0.33	1.37765	230.01988	0	0.58362	2.92806	30.21823
32.02	2.049	44.4	3	2.23749	1.89498	9.50E-10	14	6.83699	0	0	0	95.78287	14	118.45952	0.29447	0.33	1.36045	231.01212	0	0.57957	2.73798	30.2429
32.04	2.049	44.4	3	2.23512	1.97902	9.20E-10	14	6.81188	0	0	0	96.87686	14	118.26477	0.29387	0.33	1.35768	232.0097	0	0.57826	2.62018	30.29076
32.06	2.053	43.9	3	2.23085	1.96935	9.19E-10	14	6.77131	0	0	0	96.64676	14	117.93504	0.29294	0.33	1.35337	231.79022	0	0.57747	2.63072	30.28159
32.08	2.036	43.5	3	2.23251	1.96341	9.21E-10	14	6.77934	0	0	0	96.62321	14	118.02793	0.29305	0.33	1.35391	231.77733	0	0.57736	2.6388	30.29655
32.1	2.053	44.1	3	2.23726	1.92646	9.36E-10	14	6.81287	0	0	0	96.25954	14	118.34239	0.29372	0.33	1.35699	231.46271	0	0.57643	2.69085	30.40339
32.12	2.062	41.7	3	2.23494	1.8882	9.47E-10	14	6.78824	0	0	0	95.68618	14	118.15118	0.29313	0.33	1.35427	230.93402	0	0.5763	2.7438	30.37323
32.14	2.03	40.8	3	2.22156	1.85155	9.48E-10	14	6.67347	0	0	0	94.84284	14	117.1706	0.29059	0.33	1.34251	230.12175	0	0.5748	2.79158	30.30333
32.16	2.015	40.9	3	2.19313	1.88467	9.13E-10	14	6.43886	0	0	0	94.56532	14	115.11479	0.28538	0.33	1.31845	229.78064	0	0.57256	2.72933	30.10426
32.18	1.984	42.3	3	2.16449	1.92039	8.79E-10	14	6.20693	0	0	0	94.2988	14	113.04421	0.28014	0.33	1.29424	229.44724	0	0.56703	2.6652	30.11948
32.2	1.941	41.5	3	2.13916	1.93378	8.55E-10	14	6.00481	0	0	0	93.80812	14	111.20983	0.27549	0.33	1.27275	228.91504	0	0.56135	2.63462	30.18235
32.22	1.934	40.3	3	2.12442	1.92837	8.45E-10	14	5.88668	0	0	0	93.34988	14	110.13155	0.27271	0.33	1.25992	228.44522	0	0.55579	2.63455	30.36292
32.24	1.93	41.1	3	2.13773	1.90544	8.61E-10	14	5.98379	0	0	0	93.41746	14	111.05756	0.2749	0.33	1.27003	228.55508	0	0.5557	2.67192	30.51903
32.26	1.974	40.8	3	2.16881	1.87353	8.94E-10	14	6.22022	0	0	0	93.83064	14	113.25202	0.28022	0.33	1.29463	229.04231	0	0.55812	2.73143	30.72069
32.28	2.019	40	3	2.20969	1.78155	9.57E-10	14	6.5398	0	0	0	93.64044	14	116.14699	0.28728	0.33	1.32722	229.00113	0	0.56382	2.89138	30.81689
32.3	2.05	37.3	3	2.23707	1.68971	1.06E-09	14	6.75647	0	0	0	93.03209	14	118.07774	0.29194	0.33	1.34877	228.53012	0	0.56865	3.06127	30.80641
32.32	2.058	36.1	3	2.24465	1.63054	1.13E-09	14	6.81317	0	0	0	92.35894	14	118.5945	0.29311	0.33	1.35416	227.93553	0	0.57134	3.17548	30.70386
32.34	2.047	36.4	3	2.23636	1.63212	1.11E-09	14	6.73989	0	0	0	92.18699	14	117.97721	0.29147	0.33	1.34661	227.75308	0	0.57084	3.16761	30.62802
32.36	2.028	37	3	2.21805	1.65611	1.04E-09	14	6.58597	0	0	0	92.09368	14	116.64432	0.28807	0.33	1.33089	227.6105	0	0.56758	3.11193	30.61856
32.38	2.002	36.8	3	2.20114	1.67035	9.88E-10	14	6.4451	0	0	0	91.8851	14	115.41179	0.28492	0.33	1.31633	227.36493	0	0.56414	3.07625	30.63649
32.4	1.994	36.5	3	2.19	1.6621	9.81E-10	14	6.3514	0	0	0	91.49281	14	114.59131	0.28279	0.33	1.30648	226.96678	0	0.56212	3.08515	30.62766
32.42	1.994	35.9	3	2.19046	1.65567	9.83E-10	14	6.34986	0	0	0	91.42216	14	114.59892	0.2827	0.33	1.30608	226.9061	0	0.56263	3.0967	30.58776
32.44	2.005	36.4	3	2.20322	1.65212	9.94E-10	14	6.44613	0	0	0	91.70646	14	115.48605	0.28478	0.33	1.31569	227.21658	0	0.56511	3.10924	30.56243
32.46	2.034	36.9	3	2.21873	1.64959	1.04E-09	14	6.56505	0	0	0	92.07339	14	116.56841	0.28734	0.33	1.32753	227.61197	0	0.56764	3.12123	30.56571
32.48	2.041	36.5	3	2.23	1.64873	1.06E-09	14	6.65072	0	0	0	92.35673	14	117.34861	0.28916	0.33	1.33591	227.91505	0	0.5697	3.12788	30.54979
32.5	2.04	36.9	3	2.22476	1.66909	1.03E-09	14	6.6031	0	0	0	92.53672	14	116.94975	0.28807	0.33	1.33087	228.06831	0	0.56993	3.08647	30.46065
32.52	2.022	38	3	2.21216	1.7223	9.71E-10	14	6.49656	0	0	0	93.00131	14	116.0243	0.28568	0.33	1.31984	228.46095	0	0.56875	2.98435	30.37894
32.54	2.006	39.4	3	2.17744	1.7911	9.18E-10	14	6.21669	0	0	0	93.08804	14	113.51918	0.2794	0.33	1.29085	228.43166	0	0.56326	2.85253	30.32149
32.56	1.936	39.6	3	2.17739	1.8784	8.88E-10	14	6.21119	0	0	0	94.30183	14	113.49053	0.27923	0.33	1.29003	229.55757	0	0.5623	2.71933	30.37363
32.58	2.019	43.7	3	2.18217	1.93996	8.72E-10	14	6.24353	0	0	0	95.27342	14	113.80742	0.2799	0.33	1.29314	230.47162	0	0.56257	2.6346	30.40121
32.6	2.019	43.7	3	2.21432	1.97352	8.85E-10	14	6.49268	0	0	0	96.5974	14	116.07829	0.28538	0.33	1.31844	231.78999	0	0.56653	2.60313	30.50702
32.62	2.029	43.7	3	2.24106	1.94997	9.11E-10	14	6.70264	0	0	0	97.00356	14	117.96297	0.2899	0.33	1.33933	232.24648	0	0.56938	2.64539	30.62074
32.64	2.095	43.7	3	2.28091	1.8969	9.58E-10	14	7.02441	0	0	0	97.32967	14	120.78444	0.29672	0.33	1.37083	232.66756	0	0.57235	2.7358	30.87613
32.66	2.128	42.4	3	2.34402	1.81313	1.11E-09	14	7.55255	0	0	0	97.76249	14	125.26688	0.30761	0.33	1.42116	233.25113	0	0.57896	2.88851	31.15043
32.68	2.208	41.4	3	2.39837	1.7359	1.30E-09	14	8.02175	0	0	0	97.98095	14	129.1241	0.31696	0.33	1.46436	233.61041	0	0.58453	3.03943	31.38393
32.7	2.249	41.1	3	2.4578	1.66952	1.52E-09	15	8.55134	0	0	0	98.41149	14	133.34383	0.32719	0.33	1.51164	234.17172	0	0.59318	3.18465	31.45815
32.72	2.306	40.6	3	2.50881	1.61298	1.73E-09	15	9.0183	0	0	0	98.73027	14	136.96238	0.33594	0.33	1.55206	234.6048	0	0.60024	3.31688	31.53705
32.74	2.36	39.7	3	2.5455	1.56354	1.91E-09	15	9.35979	0	0	0	98.78264	14	139.55797	0.34218	0.33	1.58087	234.75735	0	0.60646	3.43635	31.50914
32.76	2.363	39.1	3	2.55303	1.55632	1.94E-09	15	9.42513	0	0	0	98.8489	14	140.07095	0.34331	0.33	1.58608	234.84138	0	0.60887	3.45477	31.41649
32.78	2.334	40.4	3	2.52668	1.59498	1.80E-09	15	9.16663	0	0	0	98.89445	14	138.16308	0.3385	0.33	1.56388	234.81329	0	0.60908	3.3598	31.10075
32.8	2.296	41.4	3	2.51261	1.65963	1.65E-09	15	9.02701	0	0	0	99.62821	14	137.13313	0.33585	0.33	1.55163	235.43445	0	0.60895	3.22279	30.94198



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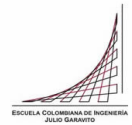
Inicio cono (m	1.5	Fin cono (m	38.26

In situ data				Basic Output Data		Estimations																
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
32.82	2.328	43.3	3	2.52653	1.70062	1.63E-09	15	9.15153	0	0	0	100.6277	14	138.10229	0.33809	0.33	1.56199	236.36768	0	0.60741	3.14989	31.18784
32.84	2.363	44.2	3	2.5708	1.71153	1.72E-09	15	9.5683	0	0	0	101.86559	14	141.23926	0.34564	0.33	1.59685	237.58862	0	0.60835	3.14578	31.59735
32.86	2.409	44.5	3	2.63359	1.72009	1.87E-09	15	10.17812	0	0	0	103.49279	14	145.69879	0.35641	0.33	1.64663	239.19011	0	0.61518	3.15198	31.80387
32.88	2.509	47.2	3	2.69027	1.78297	1.92E-09	16	10.7437	0	0	0	105.85289	14	149.72155	0.36611	0.33	1.69144	241.39951	0	0.62316	3.05894	31.85698
32.9	2.534	52.2	3	2.75806	1.85396	1.99E-09	16	11.44162	0	0	0	108.60027	14	154.53859	0.37774	0.33	1.74516	243.94414	0	0.63364	2.96182	31.84945
32.92	2.618	54	3	2.91839	1.8629	2.43E-09	17	13.19082	0	0	0	112.45172	14	165.96479	0.40551	0.33	1.87345	247.5954	0	0.65344	2.99164	32.14918
32.94	2.985	56.9	3	3.12316	1.84428	3.16E-09	17	15.60753	0	0	0	116.70492	14	180.56562	0.441	0.33	2.03744	251.58878	0	0.67962	3.07212	32.40295
32.96	3.15	61.9	3	3.31618	1.87967	3.79E-09	18	18.06965	0	0	0	121.5213	14	194.3264	0.47442	0.33	2.19181	255.92369	0	0.70048	3.05519	32.84066
32.98	3.185	68.2	3	3.53152	1.92552	4.54E-09	19	21.02938	0	0	0	126.92525	14	209.68165	0.51169	0.33	2.36402	260.66422	0	0.72204	3.02188	33.38549
33	3.612	73.9	3	3.83665	1.93311	5.97E-09	20	25.61174	0	0	0	133.32194	14	231.45064	0.56458	0.33	2.60835	266.19751	0	0.74956	3.05827	34.27409
33.02	4.026	80.4	3	4.22983	1.88423	8.58E-09	21	32.18399	0	0	0	139.9887	14	259.50851	0.63275	0.33	2.9233	271.88818	0	0.78716	3.19095	35.12494
33.04	4.33	84.8	3	4.75524	2.12958	1.02E-08	24	42.13933	0	0	0	155.22935	14	297.01044	0.72387	0.33	3.34427	283.8689	0	0.85042	2.87429	35.13215
33.06	5.232	138.6	3	5.13549	2.34966	1.10E-08	25	50.16761	0	0	0	167.20877	14	324.14418	0.78964	0.33	3.64814	292.83353	0	0.89947	2.63255	34.7289
33.08	5.232	138.6	3	5.38665	2.69803	9.98E-09	27	55.83939	0	0	0	179.52993	14	342.05653	0.83289	0.33	3.84794	301.60529	0	0.93546	2.30653	34.08281
33.1	5.155	158.8	3	5.38062	2.92903	8.59E-09	27	55.6635	0	0	0	184.228	14	341.59754	0.83138	0.33	3.84098	304.79666	0	0.93484	2.12415	34.05603
33.12	5.215	175.4	3	5.56019	3.15277	8.29E-09	28	59.88432	0	0	0	192.3778	14	354.39646	0.86212	0.33	3.98299	310.39011	0	0.95439	1.98122	34.02829
33.14	5.786	191.7	3	5.77643	3.55468	7.43E-09	30	65.17624	0	0	0	204.75357	14	369.81356	0.89919	0.33	4.15425	318.6239	0	0.97652	1.76502	34.07987
33.16	5.815	248.9	3	5.93215	4.05699	6.25E-09	31	69.11131	0	0	0	217.56942	14	380.90799	0.92571	0.33	4.27676	326.8551	0	0.99796	1.55107	33.61357
33.18	5.727	281.4	3	5.78723	4.99663	3.90E-09	31	65.36302	0	0	0	230.47658	14	370.52797	0.90003	0.33	4.15812	334.72519	0	0.99268	1.25574	32.71585
33.2	5.403	337.2	3	5.52519	6.25438	2.20E-09	32	58.88622	0	0	0	242.7459	14	351.78162	0.85405	0.33	3.94572	341.93683	0	0.96358	0.99763	32.83535
33.22	5.003	418.1	3	5.21814	7.56528	1.28E-09	31	51.7364	0	0	0	251.1496	14	329.82007	0.80032	0.33	3.69747	346.69046	0	0.91813	0.81877	33.81885
33.24	4.711	429	3	4.96546	8.59203	9.21E-10	31	46.19614	0	0	0	255.23176	14	311.74188	0.75606	0.33	3.49298	348.89917	0	0.87398	0.71609	34.98618
33.26	4.529	432.8	3	4.81916	8.89781	8.58E-10	31	43.1202	0	0	0	253.81954	14	301.2631	0.73026	0.33	3.37381	347.98029	0	0.85186	0.68852	35.33804
33.28	4.521	424.6	3	4.77832	8.83853	8.53E-10	30	42.25874	0	0	0	251.90136	14	298.31613	0.72274	0.33	3.33907	346.83789	0	0.84655	0.69223	35.35401
33.3	4.583	409.6	3	4.87352	8.31364	9.25E-10	30	44.17583	0	0	0	249.38673	14	305.08672	0.73876	0.33	3.41309	345.44028	0	0.85334	0.73793	35.63917
33.32	4.797	381.3	3	5.00337	7.35172	1.19E-09	30	46.86992	0	0	0	242.41128	14	314.33258	0.76076	0.33	3.51472	341.41797	0	0.86416	0.83746	35.91527
33.34	4.896	312.6	3	5.03592	6.54432	1.53E-09	30	47.53309	0	0	0	233.43359	14	316.62873	0.76593	0.33	3.5386	336.05795	0	0.86312	0.94153	36.22956
33.36	4.654	294.8	3	4.87406	6.10921	1.59E-09	29	44.09489	0	0	0	223.3222	14	305.03876	0.73753	0.33	3.40737	329.75168	0	0.84872	1.00393	35.90592
33.38	4.327	285.9	3	4.58779	6.34075	1.23E-09	28	38.35443	0	0	0	218.09538	14	284.56183	0.68767	0.33	3.17706	326.27542	0	0.82316	0.95865	35.30963
33.4	4.065	292	3	4.3371	6.68726	9.60E-10	27	33.65545	0	0	0	214.7402	14	266.62709	0.64401	0.33	2.97534	323.95737	0	0.80646	0.90091	34.33024
33.42	3.961	292.2	3	4.16234	7.03932	8.66E-10	26	30.55575	0	0	0	213.24058	14	254.1152	0.61349	0.33	2.83432	322.8569	0	0.79117	0.84994	33.86776
33.44	3.823	294.8	3	4.06675	7.22117	8.20E-10	26	28.91478	0	0	0	212.14717	14	247.25869	0.59664	0.33	2.75648	322.07861	0	0.7799	0.82513	33.80276
33.46	3.774	294	3	4.0002	7.26213	7.97E-10	26	27.7935	0	0	0	210.4508	14	242.47696	0.58481	0.33	2.70183	320.93869	0	0.76438	0.81799	34.28801
33.48	3.717	282.7	3	3.99798	6.98103	8.23E-10	26	27.73685	0	0	0	207.50151	14	242.28922	0.58407	0.33	2.69842	319.05035	0	0.75471	0.85075	34.92067
33.5	3.765	260.6	3	3.99846	6.31994	8.98E-10	25	27.72473	0	0	0	200.44379	14	242.2951	0.5838	0.33	2.69717	314.4772	0	0.74311	0.93965	35.69643
33.52	3.711	214.8	3	4.00608	5.56654	1.03E-09	25	27.8297	0	0	0	192.10169	14	242.81143	0.58477	0.33	2.70163	308.97751	0	0.7352	1.06706	36.27389
33.54	3.691	193.6	3	4.10297	4.77622	1.48E-09	24	29.41824	0	0	0	185.06639	14	249.70402	0.60108	0.33	2.77701	304.34415	0	0.74016	1.24873	36.74463
33.56	4.021	179.5	3	4.27151	4.13046	2.19E-09	24	32.30138	0	0	0	180.66293	14	261.71522	0.6297	0.33	2.90923	301.51294	0	0.76377	1.4537	36.56442
33.58	4.244	156.2	3	4.44635	3.69292	3.05E-09	25	35.43396	0	0	0	178.37853	14	274.17556	0.65938	0.33	3.04633	300.11893	0	0.79112	1.63637	36.15337
33.6	4.265	156.9	3	4.44095	3.55705	3.24E-09	25	35.31089	0	0	0	176.11704	14	273.76204	0.65808	0.33	3.04033	298.55627	0	0.8078	1.69838	34.93821
33.62	4.109	160.8	3	4.31438	4.03457	2.35E-09	25	32.99493	0	0	0	180.43663	14	264.69361	0.63599	0.33	2.93826	301.41455	0	0.81101	1.49023	33.59142
33.64	3.961	204.5	3	4.15273	4.62828	1.62E-09	24	30.15842	0	0	0	184.62226	14	253.1198	0.60789	0.33	2.80846	304.11609	0	0.80255	1.29062	32.74622
33.66	3.828	211.3	3	4.01567	5.23699	1.15E-09	24	27.85088	0	0	0	188.64732	14	243.3011	0.58403	0.33	2.69824	306.70422	0	0.78605	1.13379	32.69606
33.68	3.688	215.1	3	3.92071	5.53811	9.72E-10	24	26.30102	0	0	0	189.5251	14	236.49069	0.56742	0.33	2.62147	307.20148	0	0.77244	1.06737	32.80079
33.7	3.659	225	3	3.88549	5.71357	9.33E-10	24	25.72592	0	0	0	190.53816	14	233.94645	0.56105	0.33	2.59203	307.84927	0	0.77148	1.03274	32.52929
33.72	3.738	225.9	3	3.9229	5.67353	9.51E-10	24	26.2981	0	0	0	191.23113	14	236.59005	0.56712	0.33	2.62008	308.35693	0	0.7757	1.04175	32.54752
33.74	3.802	216.8	3	3.99016	5.12177	1.17E-09	24	27.35773	0	0	0	186.63811	14	241.36628	0.57829	0.33	2.67171	305.34113	0	0.77979	1.15742	32.84718
33.76	3.845	170.4	3	4.02158	4.48663	1.53E-09	24	27.84955	0	0	0	179.40582	14	243.58271	0.58333	0.33	2.69499	300.44153	0	0.77886	1.32299	33.18139
33.78	3.81	154.1	3	4.05669	3.88248	2.05E-09	23	28.40666	0	0	0	171.98406	14	246.06317	0.589	0.33	2.72119	295.32275	0	0.77765	1.53106	33.56601
33.8	3.881	148	3	4.14103	3.63034	2.47E-09	23	29.79452	0	0	0	170.38308	14	252.05965	0.60308	0.33	2.78624	294.29263	0	0.7819	1.64314	33.99349
33.82	4.072	148.9	3	4.23271	3.52493	2.78E-09	24	31.34194	0	0	0	171.01098	14	258.58101	0.61841	0.33	2.85703	294.83676	0	0.78334	1.69845	34.67334
33.84	4.038	150.7	3	4.31687	3.47088	3.04E-09	24	32.79439	0	0	0	172.19075	14	264.56485	0.63243	0.33	2.92182	295.75687	0	0.79214	1.73041	34.76143
33.86	4.133	149.9	3	4.24662	3.62955	2.66E-09	24	31.54111	0	0	0	173.03513	14	259.51937	0.62008	0.33	2.86479	296.27979	0	0.78666	1.65006	34.52496
33.88	3.874	161.8	3	4.08811	4.01734	1.96E-09	24	28.82936	0	0	0	174.87377	14	248.1694	0.59269	0.33	2.73825	297.40079	0	0.77897	1.48086	33.66428
33.9	3.616	181	3	3.74795	4.6034	1.15E-09	23	23.4441	0	0	0	173.60605	14	223.84487	0.53436	0.33	2.46872	296.14224	0	0.75266	1.27145	32.44706
33.92	3.17	174.8	3	3.42679	5.14281	8.41E-10	22	18.87128	0	0	0	170.58178	14	200.87714	0.47931	0.33	2.2144	293.62665	0	0.73261	1.11704	30.8358
33.94	2.986	172.9	3	3.11074	5.74997	6.60E-10	21	14.8566	0	0	0	166.84326	14	178.27432	0.42518	0.33	1.96434	290.54126	0	0.71938	0.97675	28.65975
33.96	2.762	188.9	2	2.81008	6.6214	4.99E-10	20	11.48346	0	0	0	164.21958	14	156.77066	0.37372	0.33	1.72661	288.20007	0	0.70256	0.8257	26.7923



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ENSAYO CON PIEZOCONO CPTu-PZSL18

Inicio cono (m	1.5	Fin cono (m	38.26

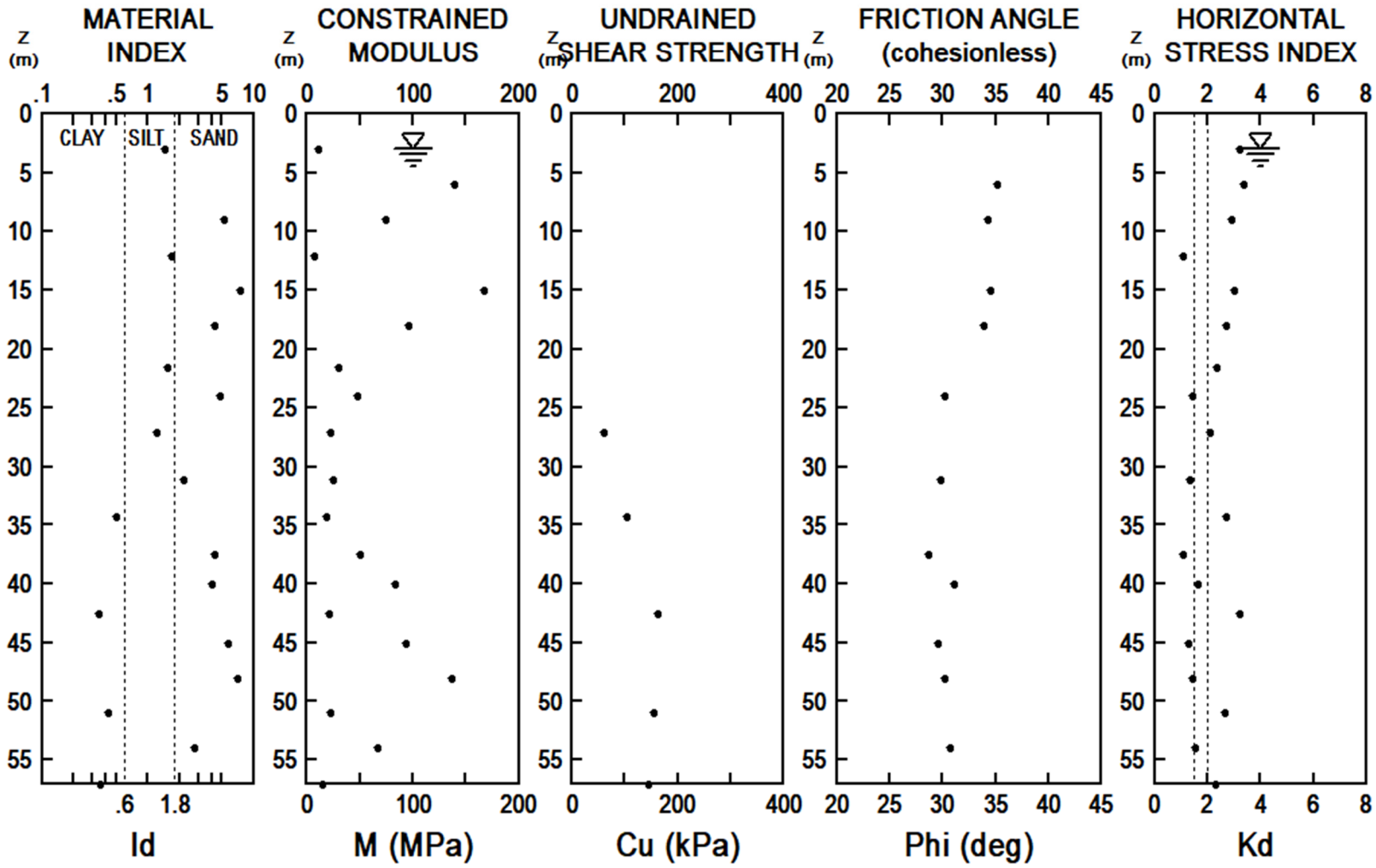
In situ data				Basic Output Data		Estimations															
Depth (m	qc (MPa	fs (kPa	SBTn	qt (MPa	Rf (%	Ksbt (m/s	SPT N60 (blows/30cm	Constrained Mod. (MPa	Dr (%	Friction angle (°	Es (MPa	Go (MPa	Nkt	Su (kPa	Su ratio	Kocr	OCR	Vs (m/s	State parameter	Ko	Sensitivity	Peak phi (°
33.98	2.329	196.4	2	2.43189	8.42828	3.19E-10	19	7.85999	0	0	0	162.61234	14	129.72966	0.30912	0.33	1.42813	286.37418	0	0.6533	0.62027	26.2244
34	1.831	229.6	2	2.26852	9.34972	2.58E-10	18	6.50347	0	0	0	161.08901	14	118.03221	0.28112	0.33	1.29876	284.93674	0	0.61501	0.54536	26.98698
34.02	2.216	210.3	2	2.23451	9.34285	2.51E-10	18	6.23266	0	0	0	159.47852	14	115.57515	0.27514	0.33	1.27115	283.6839	0	0.59103	0.54254	28.18243
34.04	2.167	186.4	2	2.32888	7.99956	3.08E-10	18	6.97457	0	0	0	155.37547	14	122.28826	0.29099	0.33	1.34437	280.84354	0	0.60093	0.64328	28.58096
34.06	2.104	162.2	2	2.29344	6.96189	3.37E-10	18	6.68278	0	0	0	146.80793	14	119.72949	0.28477	0.33	1.31566	274.29501	0	0.58992	0.73487	28.90377
34.08	2.09	130.4	2	2.25837	5.9084	3.75E-10	17	6.40033	0	0	0	137.69176	14	117.19732	0.27863	0.33	1.28727	267.12823	0	0.58058	0.86075	29.11375
34.1	2.048	107.7	3	2.23857	4.84535	4.32E-10	16	6.24132	0	0	0	128.44347	14	115.75682	0.27509	0.33	1.27091	259.66415	0	0.57246	1.04587	29.41428
34.12	2.028	87.3	3	1.93778	4.00114	3.79E-10	15	4.13554	0	0	0	110.23343	14	94.24563	0.22388	0.33	1.03432	243.44714	0	0.51761	1.19124	29.39912
34.14	1.17	37.6	2	1.63612	3.28216	3.04E-10	13	2.45806	0	0	0	92.8175	14	72.673	0.17257	0.33	0.79727	226.43431	0	0.60892	1.32625	20
34.16	1.131	36.2	2	1.34027	2.73577	2.09E-10	11	1.68509	0	0	0	76.50728	14	51.51623	0.12229	0.33	0.56497	208.62856	0	0.54125	1.37689	20
34.18	1.131	36.2	2	1.32136	2.68158	2.03E-10	11	1.68568	0	0	0	75.285	14	50.14082	0.11898	0.33	0.54969	207.22473	0	0.5362	1.38677	20
34.2	1.117	33.9	2	1.31589	2.63447	2.03E-10	11	1.68627	0	0	0	74.68471	14	49.72558	0.11795	0.33	0.54495	206.55763	0	0.53461	1.4057	20
34.22	1.116	33.9	2	1.40886	2.69248	2.41E-10	12	1.68687	0	0	0	79.0019	14	56.34169	0.1336	0.33	0.61723	211.64568	0	0.55788	1.45558	20
34.24	1.412	46	2	1.60444	2.9834	3.10E-10	13	2.29516	0	0	0	89.11826	14	70.28617	0.1666	0.33	0.76971	222.75453	0	0.60164	1.43901	20
34.26	1.714	63.7	3	1.80034	3.2105	3.80E-10	14	3.29677	0	0	0	98.38819	14	84.25408	0.19964	0.33	0.92232	232.33813	0	0.49375	1.42853	29.10673
34.28	1.714	63.7	3	1.87607	3.39006	3.98E-10	14	3.73009	0	0	0	102.74615	14	89.63764	0.21231	0.33	0.98088	236.59708	0	0.50967	1.38121	29.04733
34.3	1.643	63.4	3	1.8371	3.43296	3.77E-10	14	3.49854	0	0	0	101.72713	14	86.82778	0.20558	0.33	0.94976	235.53693	0	0.49956	1.34923	29.1912
34.32	1.59	62.1	3	1.81906	3.47799	3.66E-10	14	3.39214	0	0	0	101.46938	14	85.51374	0.20239	0.33	0.93503	235.23927	0	0.49293	1.32461	29.37724
34.34	1.652	64.3	3	1.80796	3.4809	3.60E-10	14	3.32624	0	0	0	101.09465	14	84.69544	0.20037	0.33	0.92572	234.85948	0	0.49	1.31888	29.41127
34.36	1.608	62.4	3	1.80834	3.48017	3.60E-10	14	3.32508	0	0	0	101.11317	14	84.69702	0.2003	0.33	0.92538	234.88046	0	0.48918	1.3189	29.45925
34.38	1.589	62.1	3	1.78778	3.47917	3.51E-10	14	3.20756	0	0	0	100.34974	14	83.20279	0.19669	0.33	0.9087	234.10844	0	0.48444	1.31091	29.48472
34.4	1.589	62.1	3	1.78238	3.48411	3.48E-10	14	3.17468	0	0	0	100.20031	14	82.79118	0.19564	0.33	0.90386	233.95367	0	0.48216	1.30653	29.55063

DILATOMETER TEST (D M T)

PRIMERA LÍNEA DEL METRO BOGOTA — FDN

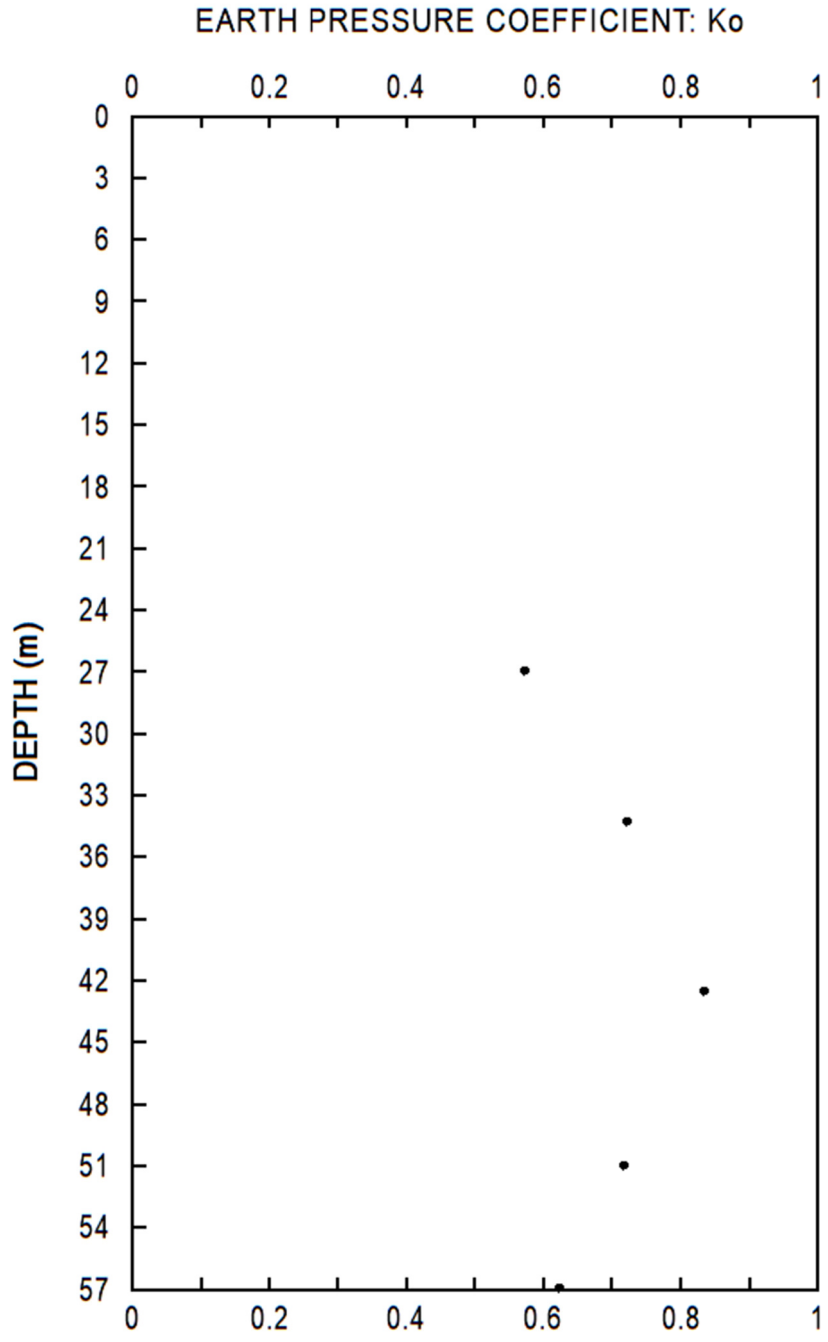
GEOTECHNICAL PARAMETERS — CLL 42 A Sur CRA 78F bis

TEST
PT-PLMB-PC07
17 OCTUBRE 2018



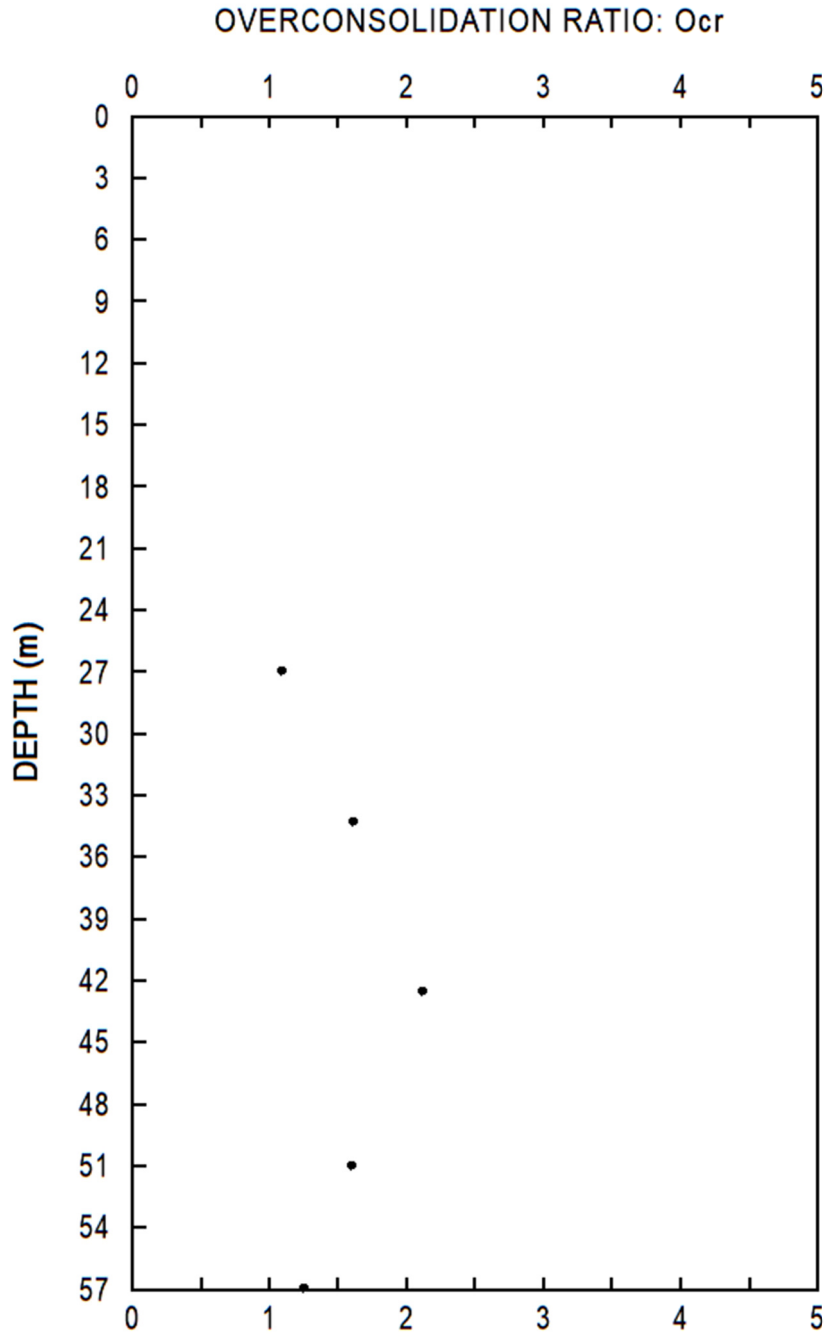
DILATOMETER TEST (D M T)

PRIMERA LÍNEA DEL METRO BOGOTA	FDN	TEST
GEOTECHNICAL PARAMETERS	CLL 42 A Sur CRA 78F bis	PT-PLMB-PC07
INTERPRETED GEOTECHNICAL PARAMETERS		17 OCTUBRE 2018



DILATOMETER TEST (D M T)

PRIMERA LÍNEA DEL METRO BOGOTA	FDN	TEST
GEOTECHNICAL PARAMETERS	CLL 42 A Sur CRA 78F bis	PT-PLMB-PC07
INTERPRETED GEOTECHNICAL PARAMETERS		17 OCTUBRE 2018



PT-PLMB-PC07

17 OCTUBRE 2018

PRIMERA LÍNEA DEL METRO BOGOTA
FDN
GEOTECHNICAL PARAMETERS
CLL 42 A Sur CRA 78F bis

LEGEND
Z = Depth Below Ground Level
Po,P1,P2 = Corrected A,B,C readings
Id = Material Index
Ed = Dilatometer Modulus
Ud = Pore Press. Index = (P2-Uo)/(Po-Uo)
Gamma = Bulk unit weight
Sigma' = Effective overb. stress
Uo = Pore pressure

INTERPRETED PARAMETERS
Phi = Safe floor value of Friction Angle
Ko = In situ earth press. coeff.
M = Constrained modulus (at Sigma')
Cu = Undrained shear strength
Ocr = Overconsolidation ratio
(OCR = 'relative OCR'- generally realistic. If accurate independent OCR available, apply suitable factor)

GENERAL PARAMETERS
DeltaA = 15 kPa
DeltaB = 60 kPa
GammaTop = 17.0 kN/m^3
FactorEd = 34.7
ZMCal = 0.0 kPa
ZMAB = 0.0 kPa
ZMC = 0.0 kPa
Zabs = 0.0 m
Zw = 3.0 m

WaterTable at 3.00 m
Reduction formulae according to Marchetti, ASCE Geot.Jnl.Mar. 1980, Vol.109, 299-321; Phi according to TC16 ISSMGE, 2001

Z (m)	A (kPa)	B (kPa)	C (kPa)	Po (kPa)	P1 (kPa)	P2 (kPa)	Gamma (kN/m^3)	Sigma' (kPa)	Uo (kPa)	Id	Kd	Ed (MPa)	Ud	Ko	Ocr	Phi (Deg)	M (MPa)	Cu (kPa)	PT-PLMB-PC07 DESCRIPTION
3.0	160	460	10	164	400	25	16.7	51	0	1.44	3.2	8.2	0.15			35	11.5		SANDY SILT
6.0	380	2900	10	273	2840	25	18.6	72	29	10.55	3.4	89.1	-0.02			35	139.2		SAND
9.0	400	1900	10	344	1840	25	18.6	98	59	5.25	2.9	51.9	-0.12			34	74.0		SAND
12.0	220	510	10	224	450	25	16.7	125	88	1.66	1.1	7.8	-0.47			29	6.7		SANDY SILT
15.0	700	3900	60	559	3840	75	19.6	145	118	7.44	3.0	113.9	-0.10			35	166.8		SAND
18.0	700	2700	70	619	2640	85	19.6	175	147	4.29	2.7	70.1	-0.13			34	95.6		SAND
21.5	700	1500	110	679	1440	125	19.1	209	181	1.53	2.4	26.4	-0.11			33	29.5		SANDY SILT
24.0	600	2200	110	539	2140	125	19.6	232	206	4.81	1.4	55.6	-0.24			30	47.2		SAND
27.0	800	1500	370	784	1440	385	19.1	262	235	1.20	2.1	22.8	0.27	0.57	1.1		21.8	61	SILT
31.0	700	1600	140	674	1540	155	18.6	299	275	2.17	1.3	30.1	-0.30			30	25.6		SILTY SAND
34.25	1200	1700	900	1194	1640	915	18.6	328	307	0.50	2.7	15.5	0.69	0.72	1.6		18.0	105	SILTY CLAY
37.5	800	2500	200	734	2440	215	19.6	356	338	4.32	1.1	59.2	-0.31			29	50.3		SAND
40.0	1100	3600	230	994	3540	245	19.6	381	363	4.04	1.7	88.4	-0.19			31	82.9		SAND
42.5	1700	2200	1200	1694	2140	1215	18.6	405	387	0.34	3.2	15.5	0.63	0.83	2.1		20.7	162	SILTY CLAY
45.0	1100	4200	1400	964	4140	1415	19.6	427	412	5.76	1.3	110.2	1.82			30	93.7		SAND
48.0	1300	5800	370	1094	5740	385	21.1	457	441	7.12	1.4	161.2	-0.09			30	137.0		SAND
51.0	1800	2400	1300	1789	2340	1315	18.6	491	471	0.42	2.7	19.1	0.64	0.71	1.6		22.0	156	SILTY CLAY
54.0	1400	3600	350	1309	3540	365	21.1	517	500	2.76	1.6	77.4	-0.17			31	66.5		SILTY SAND
57.0	1800	2300	1300	1794	2240	1315	18.6	551	530	0.35	2.3	15.5	0.62	0.62	1.2		15.3	144	SILTY CLAY

ANEXO 4

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

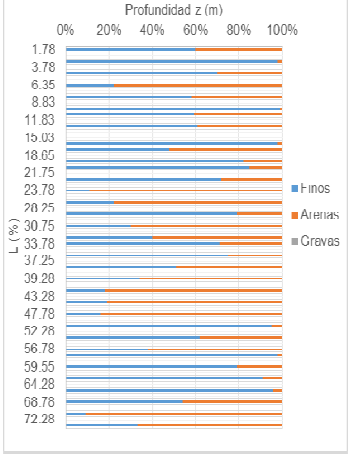
MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

GRÁFICOS DE LA CARACTERIZACIÓN GEOTÉCNICA DEL SITIO

DISTRIBUCIÓN GRANULOMÉTRICA



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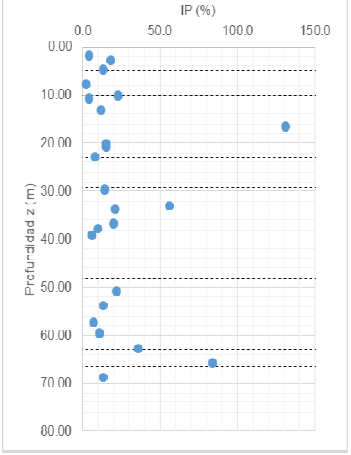
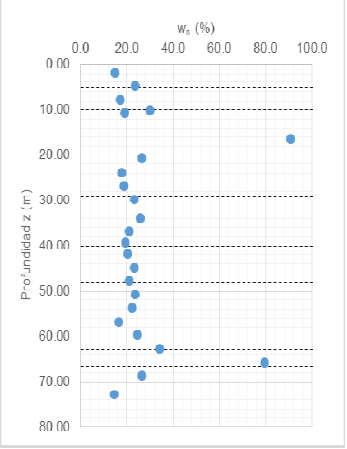
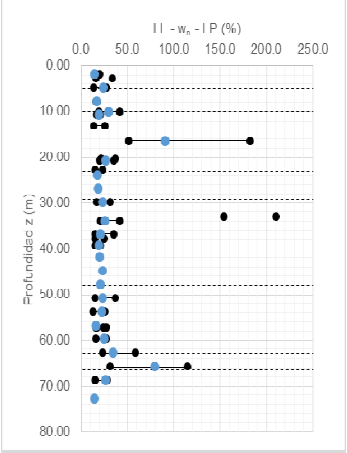


CONTENIDO DE HUMEDAD NATURAL



HUMEDAD Y LÍMITES DE CONSISTENCIA



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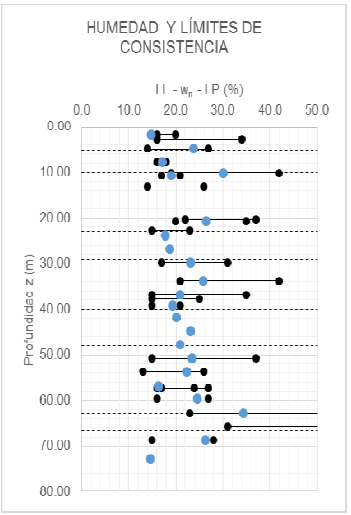

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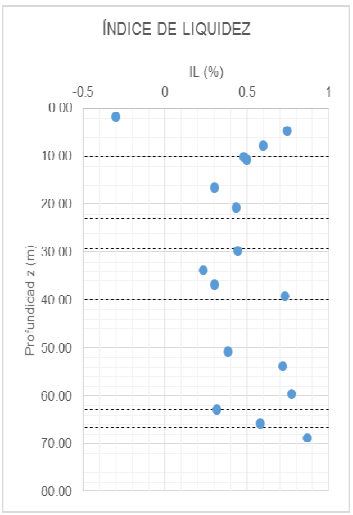
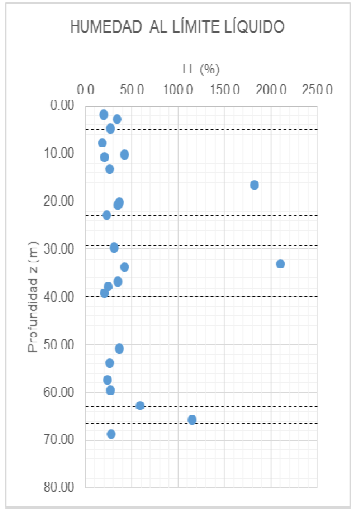
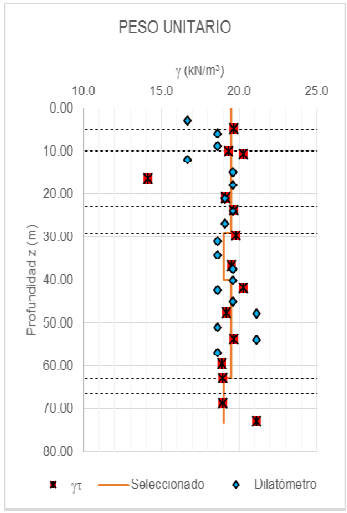


HUMEDAD AL LÍMITE LÍQUIDO



PESO UNITARIO



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

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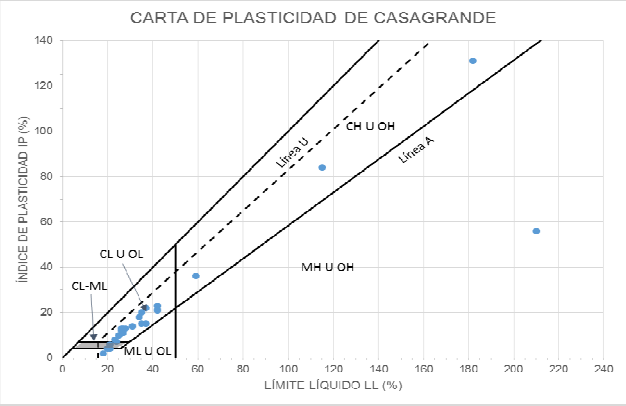
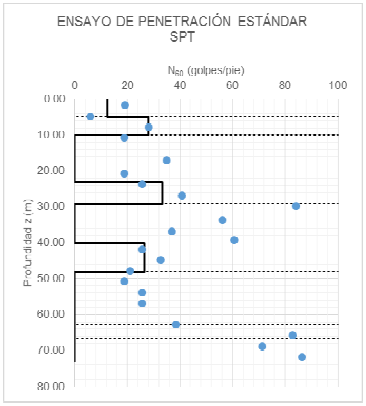
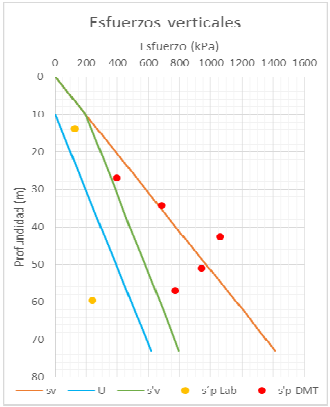
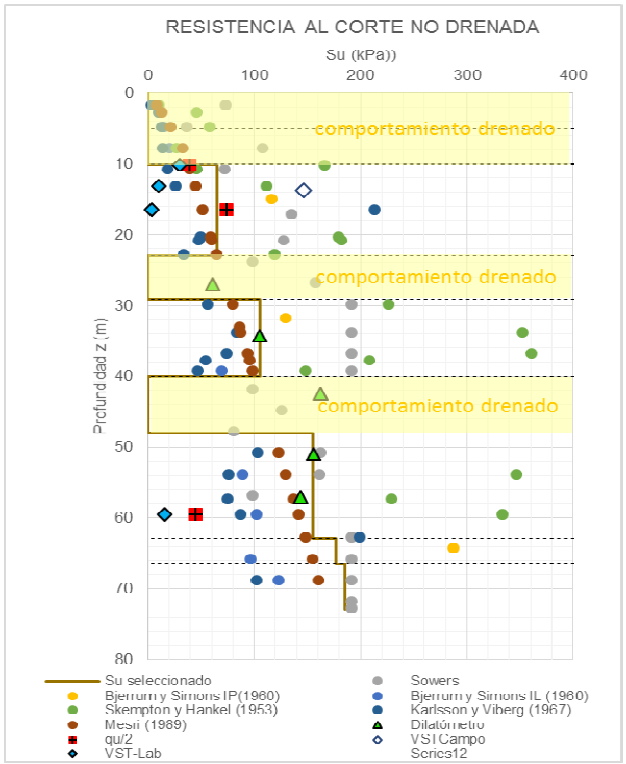
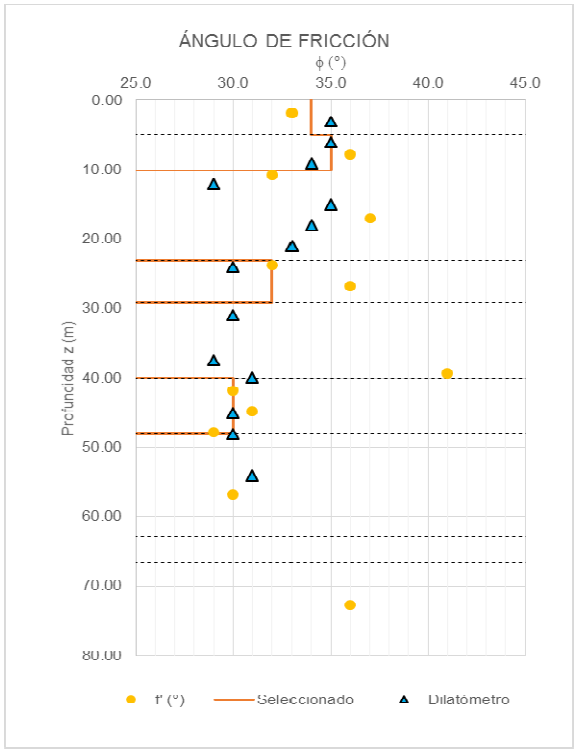
GRÁFICOS DE LA CARACTERIZACIÓN GEOTÉCNICA DEL SITIO

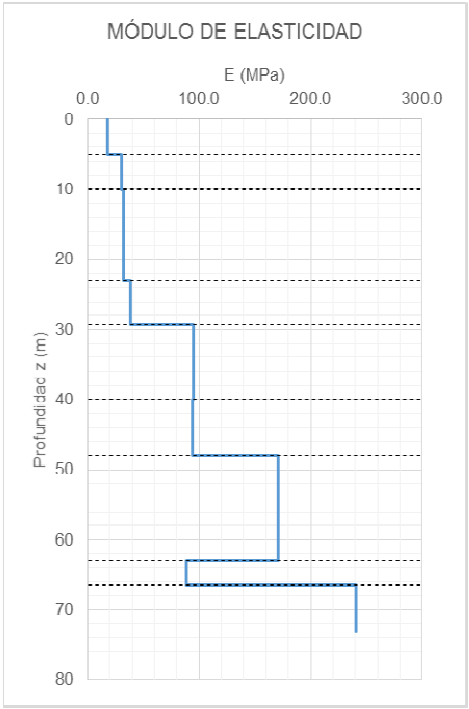












ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

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CARACTERIZACIÓN MEDIANTE CORRELACIONES EMPÍRICAS Y SEMIEMPÍRICAS

Perforación				SPT					Clasificación										Correlaciones (N - Límites)																φ' (°)						
Perforación	**Prof**		**Prom**	**ENSAYO DE PENETRACIÓN STANDARD**			$N_{campo (70)}$	N_{60}	**wn**	**LL**	**LP**	**IP**	**Gravas**	**Arenas**	**Finos**	γ_t	**USCS**	**Comport.**	*Sowers (mín - med - máx)*			*Sowers Su*	*Bjerrum y Simons IP(1960)*	*Bjerrum y Simons IL (1960)*	*Skempton y Hankel*	*Karlsson y Viberg (1967)*	*Mesri (1989)*	**Espesor**	γ	σ_v	**U**	σ'_v	R_s	C_N (Peck)	$(18N_{70})^{0.5}+15$	$0,36N_{70}+27$	$23.7+0,57N_{60}-0,0006(N_{60})^2$	$27,1+0,30N_{60}-0,00054(N_{60})^2$	$\tan^{-1}(N/(12,2+23,3*\sigma_o'/P_a))^{0,34}$	$(20N_{60})^{0.5}+20$	**Diseño**
	(m)	(m)	(m)	-	-	-		golpes/pie	%	%	%	%	%	%	%	kN/m3	-	-	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	kPa	m	kN/m3	kPa	kPa	kPa	-	-	°	°	°	°	°	°	°
	0.00	1.55	0.78																									1.55	19.50	30.23	0.00	30.23									
PT-PLMB-PC-07	1.55	2.00	1.78	4	6	10	16	19	14.8	20.0	16.0	4.0	0.0	40.0	60.0		CL	Transición C	146	146	383	73			10	4	9	0.45	19.50	39.00	0.00	39.00	0.3	1.4	32.0	33.0	40.0	36.0	32.0	45.0	33.0
	2.00	2.50	2.25																									0.50	19.50	48.75	0.00	48.75									
PT-PLMB-PC-07	2.50	3.00	2.75				0			34.0	16.0	18.0	0.0	2.0	98.0		CL	Cohesivo							45	10	13	0.50	19.50	58.50	0.00	58.50	0.4	1.3							
	3.00	4.55	3.78																									1.55	19.50	88.73	0.00	88.73									
PT-PLMB-PC-07	4.55	5.00	4.78	2	2	3	5	6	23.7	27.0	14.0	13.0	0.0	30.0	70.0	19.7	CL	Cohesivo	45	73	143	37		15	58	13	21	0.45	19.50	97.50	0.00	97.50	0.9	1.0							
	5.00	6.20	5.60																									1.20	19.50	120.90	0.00	120.90									
PT-PLMB-PC-07	6.20	6.50	6.35				0					-1.0	0.0	78.0	22.0		SM	Cohesivo										0.30	19.50	126.75	0.00	126.75	1.1	1.0							
	6.50	7.55	7.03																									1.05	19.50	147.23	3.43	143.79									
PT-PLMB-PC-07	7.55	8.00	7.78	8	10	14	24	28	17.2	18.0	16.0	2.0	0.0	42.0	58.0		ML	Granular	216	216	383	108		21	27	13	33	0.45	19.50	156.00	7.85	148.15	1.2	0.9	36.0	36.0	38.0	35.0	24.0	43.0	36.0
	8.00	9.65	8.83																									1.65	19.50	188.18	24.03	164.14									
PT-PLMB-PC-07	9.65	10.55	10.10				0		30.1	42.0	19.0	23.0	0.0	1.0	99.0	19.3	CL	Cohesivo							166	36	38	0.90	19.50	205.73	32.86	172.86	1.6	0.8							
PT-PLMB-PC-07	10.55	11.00	10.78	4	7	9	16	19	19.0	21.0	17.0	4.0	0.0	41.0	59.0	20.3	ML	Transición C	144	144	383	72			46	19	39	0.45	19.50	214.50	37.28	177.22	1.8	0.8	32.0	33.0	32.0	31.0	19.0	37.0	32.0
	11.00	12.65	11.83																									1.65	19.50	246.68	53.46	193.21									
PT-PLMB-PC-07	12.65	13.55	13.10				0			26.0	14.0	12.0	0.0	39.0	61.0		CL	Cohesivo							112	26	44	0.90	19.50	264.23	62.29	201.93	1.5	0.9							
PT-PLMB-PC-07	13.55	14.05	13.80															Cohesivo										0.50	19.50	273.98	67.20	206.78									
	14.05	16.00	15.03																				116					1.95	19.50	312.00	86.33	225.67									
PT-PLMB-PC-07	16.00	16.85	16.43				0		90.7	182.0	51.0	131.0	0.0	2.0	98.0	14.1	CH	Cohesivo							1159	213	51	0.85	19.50	328.58	94.67	233.91	1.4	0.9							
PT-PLMB-PC-07	16.85	17.30	17.08	11	12	18	30	35					0.0	52.0	48.0		SM	Cohesivo	270	270	383	135						0.45	19.50	337.35	99.08	238.27	2.1	0.8	38.0	38.0	37.0	34.0	22.0	42.0	37.0
	17.30	20.00	18.65																									2.70	19.50	390.00	125.57	264.43									
PT-PLMB-PC-07	20.00	20.55	20.28				0			37.0	22.0	15.0	0.0	18.0	82.0		CL	Cohesivo							179	50	59	0.55	19.50	400.73	130.96	269.76	1.9	0.8							
PT-PLMB-PC-07	20.55	21.00	20.78	7	7	9	16	19	26.5	35.0	20.0	15.0	0.0	15.0	85.0	19.1	CL	Cohesivo	144	255	383	127			182	48	60	0.45	19.50	409.50	135.38	274.12	2.6	0.7							
	21.00	22.50	21.75																									1.50	19.50	438.75	150.09	288.66									
PT-PLMB-PC-07	22.50	23.00	22.75				0			23.0	15.0	8.0	0.0	28.0	72.0		CL	Cohesivo							119	34	65	0.50	19.50	448.50	155.00	293.50	2.1	0.8							
	23.00	23.55	23.28																									0.55	19.50	459.23	160.39	298.83									
PT-PLMB-PC-07	23.55	24.00	23.78	5	8	14	22	26	17.7				0.0	89.0	11.0	19.7	SP		198	198	383	99						0.45	19.50	468.00	164.81	303.19	3.0	0.6							32.0
	24.00	26.55	25.28																									2.55	19.50	517.73	189.82	327.90									
PT-PLMB-PC-07	26.55	27.00	26.78	12	14	21	35	41	18.7				0.0	78.0	22.0		SM	Cohesivo	314	314	383	157						0.45	19.50	526.50	194.24	332.26	2.9	0.6	40.0	40.0	36.0	34.0	21.0	41.0	36.0
	27.00	29.50	28.25																									2.50	19.50	575.25	218.76	356.49									
PT-PLMB-PC-07	29.55	30.00	29.78	30	40	32	72	84	23.2	31.0	17.0	14.0	0.0	21.0	79.0	19.8	CL	Cohesivo	383	383	383	192			226	56	79	0.45	19.00	583.80	223.18	360.62	3.6	0.6							
	30.00	30.50	30.25																									0.50	19.00	593.30	228.08	365.22									
PT-PLMB-PC-07	30.50	31.00	30.75				0						0.0	70.0	30.0		SM	Cohesivo										0.50	19.00	602.80	232.99	369.81	3.2	0.6							
	31.00	32.50	31.75																				129					1.50	19.00	631.30	247.70	383.60									
PT-PLMB-PC-07	32.50	33.55	33.03				0			210.0	154.0	56.0	0.0	60.0	40.0		SM	Cohesivo							858	413	87	1.05	19.00	651.25	258.00	393.25	3.4	0.6							
PT-PLMB-PC-07	33.55	34.00	33.78	5	24	24	48	56	25.9	42.0	21.0	21.0	0.0	29.0	71.0		CL	Cohesivo	383	383	383	192			352	83	87	0.45	19.00	659.80	262.42	397.38	2.8	0.7							
	34.00	36.50	35.25																									2.50	19.00	707.30	286.94	420.36									
PT-PLMB-PC-07	36.55	37.00	36.78	5	10	22	32	37	21.0	35.0	15.0	20.0	0.0	25.0	75.0	19.5	CL	Cohesivo	285	383	383	192			361	74	93	0.45	19.00	715.85	291.36	424.49	4.2	0.5							
	37.00	37.50	37.25																									0.50	19.00	725.35	296.26	429.09									
PT-PLMB-PC-07	37.50	38.00	37.75				0			25.0	15.0	10.0	0.0	49.0	51.0		CL	Cohesivo							208	54	95	0.50	19.00	734.85	301.17	433.68	3.0	0.6							
	38.00	39.05	38.53																									1.05	19.00	754.80	311.47	443.33									
PT-PLMB-PC-07	39.05	39.50	39.28	17	25	27	52	61	19.4	21.0	15.0	6.0	0.0	66.0	34.0		SC	Transición C	383	383	383	192		69	149	47	98	0.45	19.00	763.35	315.88	447.47	3.1	0.6	46.0	46.0	41.0	36.0	23.0	45.0	41.0
	39.50	41.55	40.53																									2.05	19.00	802.30	335.99	466.31									
PT-PLMB-PC-07	41.55	42.00	41.78	9	10	12	22	26	20.2				0.0	82.0	18.0	20.3	SM	Cohesivo	198	198	383	99						0.45	19.50	811.08	340.41	470.67	5.0	0.5	35.0	35.0	29.0	30.0	15.0	34.0	30.0
	42.00	44.55	43.28																									2.55	19.50	860.80	365.42	495.38									
PT-PLMB-PC-07	44.55	45.00	44.78	15	13	15	28	33	23.2				0.0	81.0	19.0		SM	Cohesivo	252	252	383	126						0.45	19.50	869.58	369.84	499.74	4.3	0.5	37.0	37.0	31.0	31.0	17.0	36.0	31.0
	45.00	47.55	46.28																									2.55	19.50	919.30	394.85	524.45									
PT-PLMB-PC-07	47.55	48.00	47.78	4	8	10	18	21	21.0				0.0	84.0	16.0	19.2	SM	Cohesivo	162	162	383	81						0.45	19.50	928.08	399.27	528.81	5.1	0.5	33.0	33.0	28.0	29.0	14.0	32.0	29.0
	48.00	50.55	49.28																									2.55	19.50	977.80	424.28	553.52									
PT-PLMB-PC-07	50.55	51.00	50.78	5	8	8	16	19	23.4	37.0	15.0	22.0	0.0	5.0	95.0		CL	Cohesivo	144	325	383	163			515	103	123	0.45	19.50	986.58	428.70	557.88	3.8	0.6							
	51.00	53.55	52.28																									2.55	19.50	1036.30	453.71	582.59									
PT-PLMB-PC-07	53.55	54.00	53.78	9	10	12	22	26	22.3	26.0	13.0	13.0	0.0	38.0	62.0	19.7	CL	Cohesivo	198	322	383	161		89	347	76	129	0.45	19.50	1045.08	458.13	586.95	5.9	0.4							
	54.00	56.55	55.28																									2.55	19.50	1094.80	483.14	611.66									
PT-PLMB-PC-07	56.55	57.00	56.78	9	11	11	22	26	16.4				0.0	62.0	38.0		SM	Cohesivo	198	198	383	99						0.45	19.50	1103.58	487.56	616.02	5.3	0.4	35.0	35.0	29.0	30.0	15.0	33.0	30.0
PT-PLMB-PC-07	57.00	57.50	57.25				0			24.0	17.0	7.0	0.0	2.0	98.0		CL	Transición C							229	75	137	0.50	19.50	1113.33	492.46	620.86	4.2	0.5							
	57.50	59.10	58.30																									1.60	19.50	1144.53	508.16	636.37									
PT-PLMB-PC-07	59.10	60.00	59.55				0		24.5	27.0	16.0	11.0	0.0	21.0	79.0	18.9	CL	Cohesivo						102	334	87	142	0.90	19.50	1162.08	516.99	645.09	6.0	0.4							
	60.00	62.55	61.28																									2.55	19.50	1211.80	542.00	669.80									
PT-PLMB-PC-07	62.55	63.00	62.78	15	15	18	33	39	34.3	59.0	23.0	36.0	0.0	9.0	91.0	19.0	CH	Cohesivo	296	383	383	192			972	199	148	0.45	19.50	1220.58	546.42	674.16	6.4	0.4							
	63.00	65.55	64.28																				288					2.55	19.00	1269.03	571.43	697.59									
PT-PLMB-PC-07	65.55	66.00	65.78	34	38	33	71	83	79.6	115.0	31.0	84.0	0.0	4.0	96.0		CH	Cohesivo	383	383	383	192		96		403	154	0.45	19.00	1277.58	575.85	701.73	4.7	0.5							
	66.00	68.55	67.28																									2.55	19.00	1326.03	600.86	725.16									
PT-PLMB-PC-07	68.55	69.00	68.78	18	27	34	61	71	26.3	28.0	15.0	13.0	0.0	46.0	54.0	19.0	CL	Cohesivo	383	383	383	192		122	431	102	160	0.45	19.00	1334.58	605.28	729.30	6.9	0.4							
	69.00	71.55	70.28																									2.55	19.00	1383.03	630.29	752.73									
PT-PLMB-PC-07	71.55	72.00	71.78	28	33	41	74	86					0.0	91.0	9.0		SW		383	383	383	192						0.45	19.00	1391.58	634.71	756.87	5.1	0.5							
	72.00	72.55	72.28																									0.55	19.00	1402.03	640.10	761.92									
PT-PLMB-PC-07	72.55	73.00	72.78	38	44	50	94	110	14.6				0.0	67.0	33.0	21.1	SM	Cohesivo	383	383	383	192						0.45	19.00	1410.58	644.52	766.06	8.8	0.3	56.0	61.0	36.0	33.0	20.0	41.0	36.0

ANEXO 5

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upward Top of Pile Movement and Upper Pile Compression
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Top of Pile			Upper O-cell Compression Telltales		
Test Increment	Time (minutes)	Time (hh:mm:ss)	Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	A-92244 (mm)	B-91322 (mm)	Average (mm)	2A-1314998 (mm)	2B-1424659 (mm)	Average (mm)
1 L - 0	-	5/3/19 10:25:00	0	0	0	0	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	1	5/3/19 10:41:00	4.48	1	0	0	-0.12	-0.12	-0.12	0.05	0.04	0.04
1 L - 1	2	5/3/19 10:42:00	4	1	0	0	-0.14	-0.14	-0.14	0.05	0.04	0.04
1 L - 1	4	5/3/19 10:44:00	4	1	0	0	-0.07	-0.07	-0.07	0.06	0.05	0.05
1 L - 1	8	5/3/19 10:48:00	4	1	0	0	-0.09	-0.09	-0.09	0.07	0.06	0.07
1 L - 2	1	5/3/19 10:52:00	7	1	0	0	-0.03	-0.03	-0.03	0.08	0.06	0.07
1 L - 2	2	5/3/19 10:53:00	7	1	0	0	-0.09	-0.09	-0.09	0.08	0.06	0.07
1 L - 2	4	5/3/19 10:55:00	7	1	0	0	-0.06	-0.06	-0.06	0.09	0.07	0.08
1 L - 2	8	5/3/19 10:59:00	7	1	0	0	-0.05	-0.05	-0.05	0.10	0.08	0.09
1 L - 3	1	5/3/19 11:02:00	10	1	0	0	-0.04	-0.04	-0.04	0.10	0.08	0.09
1 L - 3	2	5/3/19 11:03:00	10	1	0	0	-0.02	-0.02	-0.02	0.10	0.08	0.09
1 L - 3	4	5/3/19 11:05:00	10	1	0	0	-0.02	-0.02	-0.02	0.11	0.09	0.10
1 L - 3	8	5/3/19 11:09:00	10	1	0	0	-0.04	-0.04	-0.04	0.12	0.10	0.11
1 L - 4	1	5/3/19 11:12:30	14	2	0	0	0.00	0.00	0.00	0.12	0.10	0.11
1 L - 4	2	5/3/19 11:13:30	14	2	0	0	-0.06	-0.06	-0.06	0.12	0.10	0.11
1 L - 4	4	5/3/19 11:15:30	14	2	0	0	-0.13	-0.13	-0.13	0.12	0.10	0.11
1 L - 4	8	5/3/19 11:19:30	14	2	0	0	-0.05	-0.05	-0.05	0.12	0.10	0.11
1 L - 5	1	5/3/19 11:21:30	17	2	0	0	0.16	0.16	0.16	0.12	0.10	0.11
1 L - 5	2	5/3/19 11:22:30	17	2	0	0	-0.02	-0.02	-0.02	0.12	0.10	0.11
1 L - 5	4	5/3/19 11:24:30	17	2	0	0	-0.08	-0.08	-0.08	0.12	0.10	0.11
1 L - 5	8	5/3/19 11:28:30	17	2	0	0	0.09	0.09	0.09	0.11	0.10	0.10
1 L - 6	1	5/3/19 11:30:30	21	3	0	0	-0.02	-0.02	-0.02	0.11	0.10	0.11
1 L - 6	2	5/3/19 11:31:30	21	3	0	0	-0.01	-0.01	-0.01	0.12	0.10	0.11
1 L - 6	4	5/3/19 11:33:30	21	3	0	0	-0.08	-0.08	-0.08	0.12	0.11	0.11
1 L - 6	8	5/3/19 11:37:30	21	3	0	0	0.00	0.00	0.00	0.13	0.11	0.12
1 L - 7	1	5/3/19 11:41:30	24	3	0	0	-0.03	-0.03	-0.03	0.13	0.12	0.12
1 L - 7	2	5/3/19 11:42:30	24	3	0	0	0.02	0.02	0.02	0.13	0.12	0.12
1 L - 7	4	5/3/19 11:44:30	24	3	0	0	-0.09	-0.09	-0.09	0.14	0.12	0.13
1 L - 7	8	5/3/19 11:48:30	24	3	0	0	-0.08	-0.08	-0.08	0.12	0.11	0.11
1 L - 8	1	5/3/19 11:51:00	28	4	0	0	0.04	0.04	0.04	0.12	0.11	0.12
1 L - 8	2	5/3/19 11:52:00	28	4	0	0	-0.01	-0.01	-0.01	0.12	0.11	0.11
1 L - 8	4	5/3/19 11:54:00	28	4	0	0	-0.11	-0.11	-0.11	0.12	0.11	0.11
1 L - 8	8	5/3/19 11:58:00	28	4	0	0	0.01	0.01	0.01	0.11	0.11	0.11
1 L - 9	1	5/3/19 12:00:30	31	4	0	0	0.01	0.01	0.01	0.12	0.10	0.11
1 L - 9	2	5/3/19 12:01:30	31	4	0	0	0.01	0.01	0.01	0.11	0.10	0.11
1 L - 9	4	5/3/19 12:03:30	31	4	0	0	-0.01	-0.01	-0.01	0.12	0.10	0.11
1 L - 9	8	5/3/19 12:07:30	31	4	0	0	-0.05	-0.05	-0.05	0.11	0.10	0.11
1 L - 10	1	5/3/19 12:10:00	35	5	0	0	-0.03	-0.03	-0.03	0.11	0.10	0.11
1 L - 10	2	5/3/19 12:11:00	35	5	0	0	0.03	0.03	0.03	0.11	0.10	0.11
1 L - 10	4	5/3/19 12:13:00	35	5	0	0	-0.01	-0.01	-0.01	0.11	0.10	0.10
1 L - 10	8	5/3/19 12:17:00	35	5	0	0	0.00	0.00	0.00	0.11	0.09	0.10
1 L - 11	1	5/3/19 12:20:00	38	5	0	0	0.00	0.00	0.00	0.11	0.09	0.10
1 L - 11	2	5/3/19 12:21:00	38	5	0	0	-0.01	-0.01	-0.01	0.11	0.09	0.10
1 L - 11	4	5/3/19 12:23:00	38	5	0	0	-0.05	-0.05	-0.05	0.11	0.09	0.10
1 L - 11	8	5/3/19 12:27:00	38	5	0	0	-0.13	-0.13	-0.13	0.11	0.09	0.10
1 L - 12	1	5/3/19 12:30:00	42	6	0	0	-0.04	-0.04	-0.04	0.13	0.10	0.11
1 L - 12	2	5/3/19 12:31:00	42	6	0	0	-0.06	-0.06	-0.06	0.13	0.10	0.12
1 L - 12	4	5/3/19 12:33:00	42	6	0	0	-0.07	-0.07	-0.07	0.14	0.10	0.12
1 L - 12	8	5/3/19 12:37:00	42	6	0	0	-0.06	-0.06	-0.06	0.12	0.09	0.11
1 L - 13	1	5/3/19 12:40:00	45	6	0	0	0.02	0.02	0.02	0.12	0.09	0.11
1 L - 13	2	5/3/19 12:41:00	45	6	0	0	0.02	0.02	0.02	0.12	0.09	0.11
1 L - 13	4	5/3/19 12:43:00	45	6	0	0	-0.04	-0.04	-0.04	0.11	0.09	0.10
1 L - 13	8	5/3/19 12:47:00	45	6	0	0	-0.04	-0.04	-0.04	0.12	0.09	0.10
1 L - 14	1	5/3/19 12:50:00	49	7	0	0	-0.04	-0.04	-0.04	0.12	0.08	0.10
1 L - 14	2	5/3/19 12:51:00	49	7	0	0	-0.12	-0.12	-0.12	0.12	0.09	0.10
1 L - 14	4	5/3/19 12:53:00	49	7	0	0	-0.14	-0.14	-0.14	0.12	0.09	0.11
1 L - 14	8	5/3/19 12:57:00	49	7	0	0	-0.01	-0.01	-0.01	0.12	0.10	0.11
1 L - 15	1	5/3/19 13:00:30	52	7	0	0	-0.05	-0.05	-0.05	0.13	0.10	0.11
1 L - 15	2	5/3/19 13:01:30	52	7	0	0	0.06	0.06	0.06	0.13	0.10	0.11
1 L - 15	4	5/3/19 13:03:30	52	7	0	0	-0.03	-0.03	-0.03	0.13	0.10	0.12
1 L - 15	8	5/3/19 13:07:30	52	7	0	0	-0.08	-0.08	-0.08	0.13	0.10	0.11
1 L - 16	1	5/3/19 13:10:00	55	8	0	0	-0.01	-0.01	-0.01	0.12	0.09	0.11
1 L - 16	2	5/3/19 13:11:00	55	8	0	0	-0.04	-0.04	-0.04	0.12	0.10	0.11
1 L - 16	4	5/3/19 13:13:00	55	8	0	0	0.00	0.00	0.00	0.13	0.09	0.11
1 L - 16	8	5/3/19 13:17:00	55	8	0	0	0.01	0.01	0.01	0.12	0.10	0.11
1 L - 17	1	5/3/19 13:20:00	59	8	0	0	0.04	0.04	0.04	0.12	0.10	0.11
1 L - 17	2	5/3/19 13:21:00	59	8	0	0	0.04	0.04	0.04	0.15	0.10	0.12
1 L - 17	4	5/3/19 13:23:00	59	8	0	0	-0.03	-0.03	-0.03	0.14	0.09	0.12
1 L - 17	8	5/3/19 13:27:00	59	8	0	0	-0.04	-0.04	-0.04	0.16	0.11	0.13

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

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DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upward Top of Pile Movement and Upper Pile Compression
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Top of Pile			Upper O-cell Compression Telltales		
Test Increment	Time (minutes)	Time (hh:mm:ss)	Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	A-92244 (mm)	B-91322 (mm)	Average (mm)	2A-1314998 (mm)	2B-1424659 (mm)	Average (mm)
1 L - 18	1	5/3/19 13:29:30	62	9	0	0	-0.02	-0.02	-0.02	0.16	0.11	0.14
1 L - 18	2	5/3/19 13:30:30	62	9	0	0	0.00	0.00	0.00	0.17	0.11	0.14
1 L - 18	4	5/3/19 13:32:30	62	9	0	0	0.06	0.06	0.06	0.18	0.12	0.15
1 L - 18	8	5/3/19 13:36:30	62	9	0	0	0.10	0.10	0.10	0.15	0.12	0.14
1 L - 19	1	5/3/19 13:38:30	66	9	0	0	0.17	0.17	0.17	0.15	0.12	0.14
1 L - 19	2	5/3/19 13:39:30	66	9	0	0	0.04	0.04	0.04	0.16	0.12	0.14
1 L - 19	4	5/3/19 13:41:30	66	9	0	0	0.15	0.15	0.15	0.17	0.13	0.15
1 L - 19	8	5/3/19 13:45:30	66	9	0	0	0.11	0.11	0.11	0.20	0.14	0.17
1 L - 20	1	5/3/19 13:48:30	69	10	0	0	0.02	0.02	0.02	0.22	0.15	0.19
1 L - 20	2	5/3/19 13:49:30	69	10	0	0	0.09	0.09	0.09	0.22	0.16	0.19
1 L - 20	4	5/3/19 13:51:30	69	10	0	0	0.03	0.03	0.03	0.23	0.16	0.19
1 L - 20	8	5/3/19 13:55:30	69	10	0	0	0.16	0.16	0.16	0.24	0.18	0.21
1 U - 1	1	5/3/19 13:59:00	55	8	0	0	0.10	0.10	0.10	0.25	0.18	0.21
1 U - 1	2	5/3/19 14:00:00	55	8	0	0	0.07	0.07	0.07	0.25	0.18	0.22
1 U - 1	4	5/3/19 14:02:00	55	8	0	0	0.13	0.13	0.13	0.25	0.18	0.22
1 U - 2	1	5/3/19 14:04:00	41	6	0	0	0.10	0.10	0.10	0.25	0.18	0.21
1 U - 2	2	5/3/19 14:05:00	41	6	0	0	0.11	0.11	0.11	0.24	0.17	0.21
1 U - 2	4	5/3/19 14:07:00	41	6	0	0	0.10	0.10	0.10	0.23	0.16	0.20
1 U - 3	1	5/3/19 14:09:30	28	4	0	0	0.01	0.01	0.01	0.23	0.16	0.20
1 U - 3	2	5/3/19 14:10:30	28	4	0	0	0.04	0.04	0.04	0.23	0.15	0.19
1 U - 3	4	5/3/19 14:12:30	28	4	0	0	0.02	0.02	0.02	0.23	0.16	0.19
1 U - 4	1	5/3/19 14:14:30	14	2	0	0	-0.05	-0.05	-0.05	0.22	0.15	0.18
1 U - 4	2	5/3/19 14:15:30	14	2	0	0	0.02	0.02	0.02	0.22	0.14	0.18
1 U - 4	4	5/3/19 14:17:30	14	2	0	0	0.05	0.05	0.05	0.22	0.14	0.18
1 U - 5	1	5/3/19 14:19:30	0	0	0	0	0.00	0.00	0.00	0.21	0.14	0.17
1 U - 5	2	5/3/19 14:20:30	0	0	0	0	0.00	0.00	0.00	0.21	0.14	0.18
1 U - 5	4	5/3/19 14:22:30	0	0	0	0	0.01	0.01	0.01	0.23	0.14	0.18
1 U - 5	8	5/3/19 14:26:30	0	0	0	0	0.06	0.06	0.06	0.23	0.16	0.20
2 L - 1	1	5/3/19 14:49:30	0	0	4	0	0.07	0.07	0.07	0.25	0.17	0.21
2 L - 1	2	5/3/19 14:50:30	0	0	4	0	0.10	0.10	0.10	0.24	0.17	0.21
2 L - 1	4	5/3/19 14:52:30	0	0	4	0	0.07	0.07	0.07	0.25	0.17	0.21
2 L - 1	8	5/3/19 14:56:30	0	0	4	0	0.00	0.00	0.00	0.24	0.17	0.20
2 L - 2	1	5/3/19 14:59:00	0	0	7	1	0.02	0.02	0.02	0.26	0.18	0.22
2 L - 2	2	5/3/19 15:00:00	0	0	7	1	0.04	0.04	0.04	0.26	0.18	0.22
2 L - 2	4	5/3/19 15:02:00	0	0	7	1	0.04	0.04	0.04	0.26	0.18	0.22
2 L - 2	8	5/3/19 15:06:00	0	0	7	1	0.19	0.19	0.19	0.25	0.17	0.21
2 L - 3	1	5/3/19 15:09:00	0	0	10	1	0.07	0.07	0.07	0.30	0.20	0.25
2 L - 3	2	5/3/19 15:10:00	0	0	10	1	0.12	0.12	0.12	0.30	0.20	0.25
2 L - 3	4	5/3/19 15:12:00	0	0	10	1	0.09	0.09	0.09	0.31	0.21	0.26
2 L - 3	8	5/3/19 15:16:00	0	0	10	1	0.06	0.06	0.06	0.32	0.21	0.27
2 L - 4	1	5/3/19 15:18:30	0	0	14	2	0.11	0.11	0.11	0.39	0.25	0.32
2 L - 4	2	5/3/19 15:19:30	0	0	14	2	0.16	0.16	0.16	0.39	0.25	0.32
2 L - 4	4	5/3/19 15:21:30	0	0	14	2	0.12	0.12	0.12	0.39	0.25	0.32
2 L - 4	8	5/3/19 15:25:30	0	0	14	2	0.15	0.15	0.15	0.39	0.25	0.32
2 L - 5	1	5/3/19 15:28:00	0	0	17	2	0.26	0.26	0.26	0.46	0.29	0.37
2 L - 5	2	5/3/19 15:29:00	0	0	17	2	0.28	0.28	0.28	0.47	0.30	0.38
2 L - 5	4	5/3/19 15:31:00	0	0	17	2	0.12	0.12	0.12	0.48	0.31	0.40
2 L - 5	8	5/3/19 15:35:00	0	0	17	2	0.31	0.31	0.31	0.49	0.32	0.41
2 L - 6	1	5/3/19 15:37:30	0	0	21	3	0.31	0.31	0.31	0.59	0.38	0.49
2 L - 6	2	5/3/19 15:38:30	0	0	21	3	0.39	0.39	0.39	0.60	0.39	0.50
2 L - 6	4	5/3/19 15:40:30	0	0	21	3	0.31	0.31	0.31	0.62	0.40	0.51
2 L - 6	8	5/3/19 15:44:30	0	0	21	3	0.41	0.41	0.41	0.63	0.41	0.52
2 L - 7	1	5/3/19 15:47:30	0	0	24	3	0.31	0.31	0.31	0.70	0.47	0.59
2 L - 7	2	5/3/19 15:48:30	0	0	24	3	0.28	0.28	0.28	0.71	0.47	0.59
2 L - 7	4	5/3/19 15:50:30	0	0	24	3	0.53	0.53	0.53	0.71	0.47	0.59
2 L - 7	8	5/3/19 15:54:30	0	0	24	3	0.36	0.36	0.36	0.73	0.49	0.61
2 L - 8	1	5/3/19 15:57:30	0	0	28	4	0.40	0.40	0.40	0.80	0.55	0.67
2 L - 8	2	5/3/19 15:58:30	0	0	28	4	0.39	0.39	0.39	0.80	0.55	0.67
2 L - 8	4	5/3/19 16:00:30	0	0	28	4	0.41	0.41	0.41	0.81	0.55	0.68
2 L - 8	8	5/3/19 16:04:30	0	0	28	4	0.38	0.38	0.38	0.80	0.54	0.67
2 L - 9	1	5/3/19 16:07:30	0	0	31	4	0.44	0.44	0.44	0.88	0.60	0.74
2 L - 9	2	5/3/19 16:08:30	0	0	31	4	0.42	0.42	0.42	0.88	0.61	0.74
2 L - 9	4	5/3/19 16:10:30	0	0	31	4	0.42	0.42	0.42	0.89	0.62	0.75
2 L - 9	8	5/3/19 16:14:30	0	0	31	4	0.51	0.51	0.51	0.89	0.62	0.76
2 L - 10	1	5/3/19 16:17:00	0	0	34	5	0.66	0.66	0.66	0.97	0.70	0.83
2 L - 10	2	5/3/19 16:18:00	0	0	34	5	0.47	0.47	0.47	0.98	0.71	0.84
2 L - 10	4	5/3/19 16:20:00	0	0	34	5	0.57	0.57	0.57	0.99	0.72	0.85
2 L - 10	8	5/3/19 16:24:00	0	0	34	5	0.52	0.52	0.52	1.01	0.73	0.87
2 L - 11	1	5/3/19 16:27:00	0	0	38	5	0.66	0.66	0.66	1.10	0.81	0.96

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upward Top of Pile Movement and Upper Pile Compression
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Top of Pile			Upper O-cell Compression Telltales		
Test Increment	Time (minutes)	Time (hh:mm:ss)	Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	A-92244 (mm)	B-91322 (mm)	Average (mm)	2A-1314998 (mm)	2B-1424659 (mm)	Average (mm)
2 L - 11	2	5/3/19 16:28:00	0	0	38	5	0.67	0.67	0.67	1.11	0.82	0.97
2 L - 11	4	5/3/19 16:30:00	0	0	38	5	0.65	0.65	0.65	1.12	0.83	0.98
2 L - 11	8	5/3/19 16:34:00	0	0	38	5	0.70	0.70	0.70	1.14	0.84	0.99
2 L - 12	1	5/3/19 16:37:00	0	0	41	6	0.71	0.71	0.71	1.22	0.90	1.06
2 L - 12	2	5/3/19 16:38:00	0	0	41	6	0.65	0.65	0.65	1.23	0.91	1.07
2 L - 12	4	5/3/19 16:40:00	0	0	41	6	0.63	0.63	0.63	1.24	0.92	1.08
2 L - 12	8	5/3/19 16:44:00	0	0	41	6	0.62	0.62	0.62	1.25	0.92	1.09
2 L - 13	1	5/3/19 16:46:00	0	0	44	6	0.68	0.68	0.68	1.33	0.99	1.16
2 L - 13	2	5/3/19 16:47:00	0	0	44	6	0.70	0.70	0.70	1.35	1.01	1.18
2 L - 13	4	5/3/19 16:49:00	0	0	44	6	0.72	0.72	0.72	1.35	1.01	1.18
2 L - 13	8	5/3/19 16:53:00	0	0	44	6	0.73	0.73	0.73	1.36	1.02	1.19
2 L - 14	1	5/3/19 16:55:00	0	0	48	7	0.78	0.78	0.78	1.43	1.10	1.26
2 L - 14	2	5/3/19 16:56:00	0	0	48	7	0.79	0.79	0.79	1.44	1.11	1.27
2 L - 14	4	5/3/19 16:58:00	0	0	48	7	0.83	0.83	0.83	1.48	1.14	1.31
2 L - 14	8	5/3/19 17:02:00	0	0	48	7	0.85	0.85	0.85	1.50	1.17	1.33
2 L - 15	1	5/3/19 17:05:30	0	0	52	7	0.90	0.90	0.90	1.61	1.26	1.43
2 L - 15	2	5/3/19 17:06:30	0	0	52	7	0.92	0.92	0.92	1.61	1.27	1.44
2 L - 15	4	5/3/19 17:08:30	0	0	52	7	0.92	0.92	0.92	1.62	1.27	1.44
2 L - 15	8	5/3/19 17:12:30	0	0	52	7	0.87	0.87	0.87	1.62	1.27	1.44
2 L - 16	1	5/3/19 17:14:30	0	0	55	8	0.94	0.94	0.94	1.70	1.34	1.52
2 L - 16	2	5/3/19 17:15:30	0	0	55	8	0.93	0.93	0.93	1.70	1.34	1.52
2 L - 16	4	5/3/19 17:17:30	0	0	55	8	0.94	0.94	0.94	1.71	1.35	1.53
2 L - 16	8	5/3/19 17:21:30	0	0	55	8	0.92	0.92	0.92	1.72	1.36	1.54
2 L - 17	1	5/3/19 17:25:00	0	0	59	8	1.00	1.00	1.00	1.82	1.44	1.63
2 L - 17	2	5/3/19 17:26:00	0	0	59	8	1.00	1.00	1.00	1.83	1.45	1.64
2 L - 17	4	5/3/19 17:28:00	0	0	59	8	1.03	1.03	1.03	1.84	1.46	1.65
2 L - 17	8	5/3/19 17:32:00	0	0	59	8	1.05	1.05	1.05	1.85	1.47	1.66
2 L - 18	1	5/3/19 17:34:30	0	0	62	9	1.10	1.10	1.10	1.94	1.56	1.75
2 L - 18	2	5/3/19 17:35:30	0	0	62	9	1.14	1.14	1.14	1.94	1.57	1.76
2 L - 18	4	5/3/19 17:37:30	0	0	62	9	1.16	1.16	1.16	1.95	1.58	1.77
2 L - 18	8	5/3/19 17:41:30	0	0	62	9	1.15	1.15	1.15	1.97	1.59	1.78
2 L - 19	1	5/3/19 17:43:30	0	0	65	9	1.21	1.21	1.21	2.04	1.66	1.85
2 L - 19	2	5/3/19 17:44:30	0	0	65	9	1.23	1.23	1.23	2.05	1.67	1.86
2 L - 19	4	5/3/19 17:46:30	0	0	65	9	1.27	1.27	1.27	2.06	1.68	1.87
2 L - 19	8	5/3/19 17:50:30	0	0	65	9	1.29	1.29	1.29	2.07	1.69	1.88
2 L - 20	1	5/3/19 17:52:30	0	0	69	10	1.37	1.37	1.37	2.15	1.77	1.96
2 L - 20	2	5/3/19 17:53:30	0	0	69	10	1.39	1.39	1.39	2.16	1.78	1.97
2 L - 20	4	5/3/19 17:55:30	0	0	69	10	1.41	1.41	1.41	2.17	1.79	1.98
2 L - 20	8	5/3/19 17:59:30	0	0	69	10	1.46	1.46	1.46	2.19	1.80	1.99
2 L - 21	1	5/3/19 18:04:00	0	0	73	10	1.52	1.52	1.52	2.29	1.90	2.09
2 L - 21	2	5/3/19 18:05:00	0	0	73	10	1.54	1.54	1.54	2.30	1.90	2.10
2 L - 21	4	5/3/19 18:07:00	0	0	73	10	1.49	1.49	1.49	2.31	1.92	2.11
2 L - 21	8	5/3/19 18:11:00	0	0	73	10	1.49	1.49	1.49	2.32	1.93	2.13
2 L - 22	1	5/3/19 18:13:00	0	0	76	11	1.54	1.54	1.54	2.42	2.03	2.22
2 L - 22	2	5/3/19 18:14:00	0	0	76	11	1.58	1.58	1.58	2.43	2.04	2.24
2 L - 22	4	5/3/19 18:16:00	0	0	76	11	1.64	1.64	1.64	2.45	2.05	2.25
2 L - 22	8	5/3/19 18:20:00	0	0	76	11	1.68	1.68	1.68	2.46	2.06	2.26
2 L - 23	1	5/3/19 18:23:00	0	0	79	11	1.69	1.69	1.69	2.54	2.14	2.34
2 L - 23	2	5/3/19 18:24:00	0	0	79	11	1.73	1.73	1.73	2.55	2.14	2.35
2 L - 23	4	5/3/19 18:26:00	0	0	79	11	1.69	1.69	1.69	2.57	2.16	2.36
2 L - 23	8	5/3/19 18:30:00	0	0	79	11	1.78	1.78	1.78	2.58	2.18	2.38
2 L - 24	1	5/3/19 18:32:30	0	0	83	12	1.90	1.90	1.90	2.67	2.25	2.46
2 L - 24	2	5/3/19 18:33:30	0	0	83	12	1.93	1.93	1.93	2.68	2.27	2.47
2 L - 24	4	5/3/19 18:35:30	0	0	83	12	1.95	1.95	1.95	2.69	2.27	2.48
2 L - 24	8	5/3/19 18:39:30	0	0	83	12	1.98	1.98	1.98	2.70	2.28	2.49
2 L - 25	1	5/3/19 18:43:00	0	0	86	12	2.20	2.20	2.20	2.80	2.37	2.59
2 L - 25	2	5/3/19 18:44:00	0	0	86	12	2.20	2.20	2.20	2.81	2.37	2.59
2 L - 25	4	5/3/19 18:46:00	0	0	86	12	2.19	2.19	2.19	2.82	2.39	2.61
2 L - 25	8	5/3/19 18:50:00	0	0	86	12	2.29	2.29	2.29	2.84	2.40	2.62
2 L - 26	1	5/3/19 18:53:00	0	0	90	13	2.35	2.35	2.35	2.93	2.49	2.71
2 L - 26	2	5/3/19 18:54:00	0	0	90	13	2.36	2.36	2.36	2.94	2.50	2.72
2 L - 26	4	5/3/19 18:56:00	0	0	90	13	2.44	2.44	2.44	2.96	2.51	2.74
2 L - 26	8	5/3/19 19:00:00	0	0	90	13	2.37	2.37	2.37	2.98	2.53	2.75
2 U - 1	1	5/3/19 19:02:30	0	0	71	10	2.43	2.43	2.43	2.92	2.50	2.71
2 U - 1	2	5/3/19 19:03:30	0	0	71	10	2.39	2.39	2.39	2.92	2.50	2.71
2 U - 1	4	5/3/19 19:05:30	0	0	71	10	2.43	2.43	2.43	2.91	2.50	2.70
2 U - 2	1	5/3/19 19:08:00	0	0	54	8	2.22	2.22	2.22	2.69	2.36	2.53
2 U - 2	2	5/3/19 19:09:00	0	0	54	8	2.23	2.23	2.23	2.68	2.35	2.52
2 U - 2	4	5/3/19 19:11:00	0	0	54	8	2.16	2.16	2.16	2.68	2.35	2.51

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

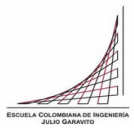
MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upward Top of Pile Movement and Upper Pile Compression
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Top of Pile			Upper O-cell Compression Telltales		
Test Increment	Time (minutes)	Time (hh:mm:ss)	Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	A-92244 (mm)	B-91322 (mm)	Average (mm)	2A-1314998 (mm)	2B-1424659 (mm)	Average (mm)
2 U - 3	1	5/3/19 19:13:30	0	0	35	5	1.80	1.80	1.80	2.33	2.08	2.21
2 U - 3	2	5/3/19 19:14:30	0	0	35	5	1.97	1.97	1.97	2.33	2.08	2.20
2 U - 3	4	5/3/19 19:16:30	0	0	35	5	1.78	1.78	1.78	2.33	2.07	2.20
2 U - 4	1	5/3/19 19:19:00	0	0	17	2	1.58	1.58	1.58	1.88	1.74	1.81
2 U - 4	2	5/3/19 19:20:00	0	0	17	2	1.51	1.51	1.51	1.88	1.74	1.81
2 U - 4	4	5/3/19 19:22:00	0	0	17	2	1.43	1.43	1.43	1.88	1.73	1.81
2 U - 5	1	5/3/19 19:24:30	0	0	0	0	1.03	1.03	1.03	1.37	1.27	1.32
2 U - 5	2	5/3/19 19:25:30	0	0	0	0	1.16	1.16	1.16	1.36	1.26	1.31
2 U - 5	4	5/3/19 19:27:30	0	0	0	0	1.08	1.08	1.08	1.35	1.26	1.30
2 U - 5	8	5/3/19 19:31:30	0	0	0	0	1.02	1.02	1.02	1.34	1.25	1.29



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

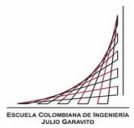
MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Embedded Pile Compression and Lower O-cell CompressionTelltales
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		ECT Level 1			Lower Compression Telltales		
Test	Time	Time	Pressure	Load	Pressure	Load	A-1747397	B-1747398	Average	1A-1433327	1B-08-23842	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	0.02	0.02	0.02	0.02	0.04	0.03
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	0.02	0.02	0.02	0.02	0.05	0.03
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	0.02	0.01	0.02	0.03	0.05	0.04
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	0.02	0.02	0.02	0.03	0.06	0.05
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	0.03	0.02	0.02	0.03	0.06	0.05
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	0.03	0.02	0.02	0.03	0.07	0.05
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	0.03	0.02	0.02	0.04	0.08	0.06
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	0.03	0.02	0.03	0.04	0.08	0.06
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	0.04	0.03	0.03	0.04	0.08	0.06
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	0.04	0.03	0.04	0.04	0.07	0.06
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	0.04	0.04	0.04	0.04	0.09	0.07
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	0.04	0.04	0.04	0.05	0.09	0.07
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	0.08	0.07	0.07	0.08	0.13	0.10
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	0.08	0.07	0.07	0.08	0.13	0.10
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	0.08	0.07	0.07	0.08	0.14	0.11
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	0.08	0.07	0.08	0.08	0.13	0.10
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	0.12	0.09	0.11	0.10	0.17	0.13
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	0.12	0.10	0.11	0.11	0.17	0.14
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	0.12	0.10	0.11	0.11	0.17	0.14
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	0.12	0.10	0.11	0.11	0.17	0.14
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	0.17	0.12	0.15	0.13	0.21	0.17
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	0.17	0.12	0.15	0.13	0.22	0.17
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	0.18	0.13	0.15	0.14	0.23	0.18
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	0.18	0.13	0.16	0.14	0.24	0.19
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	0.25	0.20	0.23	0.17	0.30	0.24
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	0.27	0.22	0.24	0.18	0.30	0.24
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	0.29	0.22	0.26	0.18	0.32	0.25
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	0.31	0.22	0.26	0.17	0.30	0.24
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	0.41	0.28	0.35	0.19	0.34	0.27
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	0.42	0.29	0.36	0.20	0.35	0.27
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	0.44	0.29	0.37	0.20	0.34	0.27
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	0.46	0.30	0.38	0.20	0.34	0.27
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	0.58	0.45	0.52	0.22	0.38	0.30
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	0.59	0.49	0.54	0.22	0.38	0.30
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	0.61	0.51	0.56	0.22	0.38	0.30
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	0.68	0.51	0.60	0.22	0.38	0.30
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	0.98	0.78	0.88	0.26	0.44	0.35
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	1.04	0.81	0.93	0.26	0.43	0.35
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	1.09	0.86	0.98	0.25	0.43	0.34
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	1.15	0.87	1.01	0.25	0.43	0.34
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	1.45	1.16	1.30	0.28	0.46	0.37
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	1.53	1.23	1.38	0.28	0.48	0.38
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	1.61	1.26	1.44	0.29	0.48	0.38
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	1.68	1.27	1.48	0.29	0.48	0.39
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	2.64	1.38	2.01	0.32	0.56	0.44
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	2.80	1.41	2.11	0.33	0.57	0.45
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	2.95	1.43	2.19	0.33	0.57	0.45
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	3.04	1.44	2.24	0.32	0.55	0.44
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	4.18	1.54	2.86	0.35	0.61	0.48
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	4.36	1.57	2.97	0.35	0.62	0.49
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	4.40	1.59	3.00	0.35	0.62	0.48
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	4.51	1.62	3.07	0.36	0.62	0.49
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	6.15	1.83	3.99	0.39	0.67	0.53
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	6.51	2.35	4.43	0.42	0.68	0.55
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	6.55	2.38	4.47	0.42	0.69	0.55
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	6.64	2.47	4.56	0.42	0.70	0.56
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	7.90	3.56	5.73	0.47	0.77	0.62
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	8.06	3.79	5.92	0.48	0.78	0.63
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	8.12	3.87	6.00	0.48	0.79	0.63
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	8.33	3.96	6.15	0.47	0.78	0.63
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	9.46	5.24	7.35	0.51	0.83	0.67
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	9.91	5.62	7.77	0.51	0.84	0.68
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	10.26	5.84	8.05	0.52	0.85	0.68
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	10.53	6.29	8.41	0.52	0.85	0.69
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	11.75	7.73	9.74	0.56	0.91	0.73
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	12.02	8.21	10.11	0.56	0.92	0.74
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	12.08	8.33	10.21	0.56	0.92	0.74
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	12.29	8.63	10.46	0.58	0.94	0.76



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

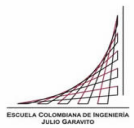
MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Embedded Pile Compression and Lower O-cell CompressionTelltales
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		ECT Level 1			Lower Compression Telltales		
Test	Time	Time	Pressure	Load	Pressure	Load	A-1747397	B-1747398	Average	1A-1433327	1B-08-23842	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	13.45	10.34	11.90	0.61	1.01	0.81
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	13.70	10.99	12.34	0.63	1.03	0.83
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	13.98	11.33	12.65	0.64	1.04	0.84
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	14.14	11.49	12.81	0.64	1.04	0.84
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	15.16	12.29	13.73	0.67	1.10	0.89
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	15.21	12.51	13.86	0.68	1.11	0.90
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	15.74	12.79	14.26	0.70	1.14	0.92
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	15.90	13.30	14.60	0.71	1.16	0.94
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	16.25	13.80	15.02	0.75	1.23	0.99
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	16.41	14.16	15.29	0.76	1.24	1.00
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	16.57	14.38	15.48	0.78	1.27	1.02
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	16.69	14.86	15.77	0.79	1.30	1.04
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	16.35	14.82	15.59	0.79	1.29	1.04
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	16.32	14.83	15.57	0.79	1.28	1.03
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	16.27	14.82	15.55	0.78	1.28	1.03
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	15.74	14.71	15.23	0.72	1.18	0.95
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	15.74	14.71	15.23	0.71	1.17	0.94
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	15.73	14.71	15.22	0.71	1.15	0.93
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	15.39	14.57	14.98	0.63	1.04	0.83
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	15.40	14.57	14.98	0.62	1.03	0.83
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	15.40	14.57	14.99	0.62	1.03	0.82
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	15.00	14.39	14.70	0.55	0.86	0.70
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	15.02	14.39	14.70	0.55	0.86	0.70
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	14.94	14.37	14.65	0.53	0.84	0.68
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	14.28	13.66	13.97	0.41	0.63	0.52
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	14.28	13.53	13.91	0.41	0.63	0.52
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	14.29	13.53	13.91	0.41	0.63	0.52
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	14.30	13.52	13.91	0.42	0.65	0.53
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	14.29	13.52	13.90	0.36	0.55	0.46
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	14.29	13.52	13.90	0.36	0.55	0.46
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	14.29	13.52	13.90	0.36	0.56	0.46
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	14.29	13.51	13.90	0.36	0.55	0.45
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	14.29	13.52	13.91	0.34	0.51	0.43
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	14.30	13.52	13.91	0.34	0.51	0.42
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	14.29	13.52	13.91	0.33	0.50	0.41
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	14.29	13.51	13.90	0.33	0.49	0.41
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	14.30	13.52	13.91	0.30	0.45	0.38
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	14.30	13.52	13.91	0.30	0.45	0.38
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	14.30	13.52	13.91	0.30	0.45	0.38
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	14.29	13.52	13.91	0.30	0.44	0.37
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	14.30	13.51	13.91	0.27	0.39	0.33
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	14.30	13.51	13.91	0.26	0.38	0.32
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	14.30	13.51	13.90	0.26	0.38	0.32
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	14.30	13.51	13.91	0.26	0.38	0.32
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	14.30	13.51	13.91	0.24	0.33	0.28
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	14.30	13.52	13.91	0.23	0.33	0.28
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	14.30	13.52	13.91	0.23	0.33	0.28
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	14.30	13.52	13.91	0.23	0.32	0.28
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	14.30	13.52	13.91	0.22	0.30	0.26
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	14.30	13.51	13.91	0.22	0.29	0.25
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	14.30	13.52	13.91	0.21	0.29	0.25
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	14.30	13.52	13.91	0.21	0.28	0.25
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	14.31	13.52	13.91	0.18	0.24	0.21
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	14.31	13.51	13.91	0.17	0.23	0.20
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	14.31	13.51	13.91	0.17	0.23	0.20
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	14.30	13.51	13.91	0.17	0.22	0.20
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	14.31	13.51	13.91	0.13	0.17	0.15
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	14.31	13.51	13.91	0.12	0.15	0.14
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	14.31	13.51	13.91	0.11	0.13	0.12
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	14.31	13.52	13.91	0.10	0.11	0.10
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	14.31	13.52	13.91	0.06	0.05	0.05
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	14.31	13.52	13.91	0.06	0.04	0.05
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	14.31	13.52	13.92	0.05	0.03	0.04
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	14.31	13.52	13.92	0.04	0.02	0.03
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	14.31	13.52	13.91	0.01	-0.03	-0.01
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	14.31	13.52	13.92	0.01	-0.03	-0.01
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	14.31	13.52	13.91	0.00	-0.05	-0.02
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	14.31	13.52	13.92	0.00	-0.06	-0.03
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	14.32	13.52	13.92	-0.04	-0.12	-0.08



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Embedded Pile Compression and Lower O-cell CompressionTelltales
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		ECT Level 1			Lower Compression Telltales		
Test	Time	Time	Pressure	Load	Pressure	Load	A-1747397	B-1747398	Average	1A-1433327	1B-08-23842	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	14.32	13.52	13.92	-0.04	-0.13	-0.09
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	14.32	13.52	13.92	-0.05	-0.14	-0.09
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	14.31	13.52	13.92	-0.06	-0.15	-0.11
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	14.32	13.52	13.92	-0.09	-0.20	-0.14
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	14.32	13.52	13.92	-0.09	-0.21	-0.15
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	14.32	13.52	13.92	-0.10	-0.22	-0.16
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	14.32	13.52	13.92	-0.10	-0.23	-0.17
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	14.32	13.52	13.92	-0.13	-0.27	-0.20
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	14.32	13.52	13.92	-0.14	-0.28	-0.21
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	14.32	13.52	13.92	-0.15	-0.29	-0.22
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	14.32	13.52	13.92	-0.17	-0.32	-0.24
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	14.33	13.51	13.92	-0.20	-0.37	-0.29
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	14.33	13.51	13.92	-0.21	-0.38	-0.29
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	14.33	13.51	13.92	-0.23	-0.42	-0.32
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	14.32	13.51	13.92	-0.25	-0.46	-0.35
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	14.33	13.51	13.92	-0.30	-0.54	-0.42
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	14.33	13.51	13.92	-0.31	-0.55	-0.43
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	14.33	13.51	13.92	-0.32	-0.57	-0.44
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	14.33	13.51	13.92	-0.33	-0.59	-0.46
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	14.33	13.51	13.92	-0.37	-0.65	-0.51
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	14.33	13.51	13.92	-0.37	-0.66	-0.52
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	14.33	13.51	13.92	-0.39	-0.68	-0.53
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	14.33	13.51	13.92	-0.40	-0.71	-0.56
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	14.34	13.52	13.93	-0.45	-0.78	-0.62
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	14.34	13.51	13.92	-0.46	-0.80	-0.63
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	14.33	13.51	13.92	-0.47	-0.83	-0.65
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	14.33	13.51	13.92	-0.49	-0.86	-0.67
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	14.34	13.52	13.93	-0.54	-0.93	-0.73
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	14.34	13.52	13.93	-0.55	-0.95	-0.75
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	14.34	13.52	13.93	-0.56	-0.97	-0.76
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	14.34	13.52	13.93	-0.59	-1.01	-0.80
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	14.34	13.52	13.93	-0.62	-1.07	-0.85
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	14.34	13.52	13.93	-0.63	-1.09	-0.86
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	14.34	13.52	13.93	-0.65	-1.12	-0.89
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	14.34	13.52	13.93	-0.67	-1.15	-0.91
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	14.35	13.52	13.93	-0.72	-1.22	-0.97
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	14.35	13.51	13.93	-0.73	-1.24	-0.98
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	14.34	13.51	13.93	-0.75	-1.27	-1.01
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	14.34	13.51	13.93	-0.77	-1.30	-1.03
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	14.35	13.51	13.93	-0.83	-1.40	-1.11
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	14.35	13.51	13.93	-0.84	-1.42	-1.13
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	14.35	13.51	13.93	-0.86	-1.45	-1.15
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	14.35	13.51	13.93	-0.88	-1.48	-1.18
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	14.35	13.51	13.93	-0.94	-1.58	-1.26
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	14.35	13.51	13.93	-0.96	-1.61	-1.28
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	14.35	13.51	13.93	-0.98	-1.63	-1.31
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	14.35	13.51	13.93	-1.01	-1.68	-1.35
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	14.35	13.51	13.93	-1.07	-1.77	-1.42
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	14.35	13.51	13.93	-1.08	-1.79	-1.44
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	14.35	13.51	13.93	-1.10	-1.83	-1.47
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	14.35	13.51	13.93	-1.14	-1.88	-1.51
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	14.36	13.51	13.93	-1.20	-1.98	-1.59
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	14.36	13.51	13.93	-1.22	-2.01	-1.62
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	14.36	13.51	13.93	-1.25	-2.06	-1.65
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	14.36	13.51	13.93	-1.28	-2.11	-1.70
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	14.36	13.51	13.94	-1.36	-2.24	-1.80
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	14.36	13.51	13.93	-1.38	-2.27	-1.82
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	14.36	13.52	13.94	-1.40	-2.31	-1.86
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	14.36	13.51	13.93	-1.44	-2.36	-1.90
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	14.36	13.51	13.94	-1.52	-2.50	-2.01
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	14.36	13.52	13.94	-1.55	-2.54	-2.04
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	14.36	13.52	13.94	-1.58	-2.60	-2.09
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	14.36	13.52	13.94	-1.63	-2.67	-2.15
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	14.31	13.51	13.91	-1.61	-2.66	-2.13
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	14.31	13.51	13.91	-1.61	-2.65	-2.13
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	14.31	13.51	13.91	-1.60	-2.65	-2.13
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	14.24	13.50	13.87	-1.52	-2.55	-2.03
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	14.24	13.50	13.87	-1.52	-2.54	-2.03
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	14.24	13.50	13.87	-1.52	-2.54	-2.03

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

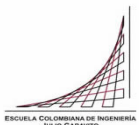
MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Embedded Pile Compression and Lower O-cell CompressionTelltales
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		ECT Level 1			Lower Compression Telltales		
Test	Time	Time	Pressure	Load	Pressure	Load	A-1747397	B-1747398	Average	1A-1433327	1B-08-23842	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)	(mm)
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	14.18	13.49	13.83	-1.38	-2.35	-1.86
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	14.18	13.49	13.83	-1.38	-2.34	-1.86
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	14.18	13.49	13.83	-1.37	-2.34	-1.85
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	14.12	13.48	13.80	-1.21	-2.05	-1.63
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	14.12	13.48	13.80	-1.20	-2.05	-1.63
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	14.12	13.48	13.80	-1.20	-2.04	-1.62
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	14.07	13.48	13.77	-0.97	-1.70	-1.34
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	14.07	13.47	13.77	-0.97	-1.69	-1.33
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	14.07	13.47	13.77	-0.96	-1.68	-1.32
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	14.08	13.47	13.78	-0.95	-1.67	-1.31



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

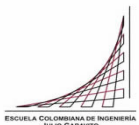
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Lower O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Lower O-cell Expansion 1A-1844379 (mm)	1B-1844380 (mm)	1C-1844381 (mm)	1D-1844382 (mm)	Average (mm)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	0.53	0.66	0.64	0.66	0.62
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	0.53	0.66	0.64	0.66	0.62
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	0.53	0.66	0.64	0.66	0.62
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	0.53	0.66	0.64	0.66	0.62
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	0.56	0.66	0.64	0.66	0.63
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	0.56	0.66	0.64	0.66	0.63
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	0.56	0.66	0.64	0.66	0.63
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	0.56	0.66	0.64	0.66	0.63
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	0.67	0.69	0.75	0.71	0.70
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	0.69	0.72	0.77	0.72	0.73
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	0.73	0.78	0.81	0.78	0.77
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	0.78	0.84	0.84	0.86	0.83
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	1.14	1.19	1.22	1.22	1.19
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	1.15	1.19	1.22	1.22	1.20
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	1.18	1.19	1.25	1.23	1.21
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	1.20	1.25	1.26	1.33	1.26
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	1.63	1.70	1.69	1.68	1.68
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	1.67	1.75	1.72	1.75	1.72
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	1.72	1.78	1.79	1.83	1.78
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	1.79	1.81	1.87	1.86	1.83
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	2.31	2.40	2.38	2.44	2.38
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	2.41	2.49	2.50	2.48	2.47
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	2.57	2.65	2.64	2.67	2.63
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	2.85	2.92	2.91	2.93	2.90
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	7.80	7.91	7.92	7.93	7.89
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	8.95	9.05	9.05	9.07	9.03
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	10.01	10.17	10.13	10.15	10.11
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	10.56	10.66	10.68	10.66	10.64
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	14.03	14.16	14.13	14.15	14.12
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	15.06	15.18	15.14	15.17	15.14
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	16.08	16.21	16.19	16.16	16.16
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	16.96	17.00	17.04	17.05	17.01
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	22.12	22.32	22.27	22.18	22.22
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	23.77	23.81	23.86	23.83	23.82
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	25.21	25.34	25.32	25.31	25.30
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	26.27	26.41	26.37	26.34	26.35
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	32.55	32.71	32.70	32.64	32.65
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	33.29	33.48	33.47	33.37	33.40
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	34.37	34.53	34.48	34.43	34.45
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	35.13	35.32	35.24	35.20	35.22
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	40.05	40.24	40.22	40.12	40.16
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	41.62	41.80	41.83	41.72	41.74
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	42.48	42.66	42.72	42.50	42.59
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	43.03	43.15	43.22	43.09	43.12
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	48.08	48.18	48.33	48.17	48.19
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	49.41	49.51	49.66	49.49	49.52
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	50.28	50.38	50.53	50.19	50.35
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	50.80	50.96	51.01	50.85	50.90
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	54.80	54.94	55.12	54.84	54.93
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	56.31	56.51	56.63	56.29	56.43
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	56.77	56.96	57.07	56.73	56.88
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	57.51	57.64	57.86	57.59	57.65
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	61.52	61.66	61.80	61.58	61.64
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	63.29	63.49	63.69	63.35	63.46
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	63.94	64.21	64.26	63.91	64.08
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	64.44	64.65	64.77	64.58	64.61
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	69.23	69.41	69.62	69.36	69.40
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	70.18	70.36	70.48	70.20	70.31
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	70.60	70.75	71.07	70.63	70.76
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	71.01	71.16	71.40	71.09	71.16
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	74.68	75.12	75.17	74.81	74.94
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	76.25	76.30	76.63	76.33	76.38
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	77.52	77.58	77.96	77.50	77.64
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	78.28	78.34	78.69	78.41	78.43



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

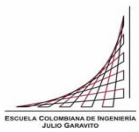
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Lower O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Lower O-cell Expansion				
Test	Time	Time	Pressure	Load	Pressure	Load	1A-1844379	1B-1844380	1C-1844381	1D-1844382	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	81.89	82.17	82.42	81.92	82.10
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	83.74	83.86	84.25	83.73	83.90
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	84.65	84.66	85.10	84.65	84.76
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	85.72	85.75	86.14	85.67	85.82
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	90.72	90.93	91.28	90.82	90.94
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	92.89	93.26	93.51	92.84	93.12
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	94.34	94.76	94.92	94.12	94.53
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	95.17	95.42	95.76	95.08	95.35
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	98.41	98.65	98.97	98.46	98.62
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	99.91	100.26	100.57	100.10	100.21
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	101.84	102.23	102.52	101.88	102.12
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	102.80	103.09	103.51	102.80	103.05
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	106.72	107.03	107.48	106.80	107.01
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	108.26	108.51	109.02	108.32	108.53
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	110.48	110.56	111.14	110.56	110.68
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	111.56	111.91	112.30	111.57	111.84
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	111.21	112.15	112.27	111.84	111.86
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	111.20	112.14	112.27	111.84	111.86
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	111.20	112.15	112.27	111.84	111.86
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	110.15	111.59	111.24	111.05	111.01
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	110.13	111.58	111.25	111.02	111.00
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	110.12	111.57	111.25	111.02	110.99
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	108.76	110.07	109.79	109.63	109.56
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	108.74	110.08	109.74	109.61	109.54
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	108.72	110.07	109.73	109.61	109.53
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	106.70	107.82	107.75	107.53	107.45
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	106.68	107.83	107.72	107.52	107.44
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	106.50	107.83	107.50	107.32	107.29
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	102.94	104.25	103.81	103.62	103.66
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	102.83	104.17	103.74	103.52	103.57
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	102.72	104.11	103.67	103.36	103.47
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	102.63	104.04	103.56	103.27	103.38
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	102.40	103.84	103.34	103.09	103.17
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	102.40	103.84	103.34	103.09	103.17
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	102.40	103.84	103.34	103.09	103.17
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	102.37	103.84	103.33	103.07	103.15
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	102.36	103.82	103.34	103.06	103.15
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	102.35	103.82	103.33	103.07	103.14
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	102.35	103.82	103.33	103.06	103.14
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	102.33	103.81	103.24	103.06	103.11
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	102.31	103.80	103.24	103.06	103.10
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	102.31	103.80	103.24	103.06	103.10
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	102.30	103.80	103.24	103.05	103.10
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	102.29	103.79	103.23	103.05	103.09
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	102.27	103.79	103.23	102.93	103.05
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	102.26	103.79	103.23	102.93	103.05
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	102.25	103.79	103.12	102.86	103.00
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	102.25	103.79	103.12	102.85	103.00
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	102.22	103.72	103.12	102.85	102.98
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	102.22	103.71	103.11	102.84	102.97
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	102.20	103.71	103.12	102.84	102.97
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	102.19	103.71	103.11	102.85	102.96
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	102.15	103.71	103.11	102.84	102.95
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	102.15	103.70	103.11	102.85	102.95
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	102.13	103.59	103.08	102.77	102.89
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	102.11	103.60	103.08	102.78	102.89
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	102.07	103.55	103.07	102.76	102.86
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	102.07	103.55	103.08	102.76	102.86
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	102.06	103.54	102.99	102.76	102.84
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	102.04	103.53	102.99	102.69	102.81
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	102.01	103.53	102.99	102.69	102.80
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	102.00	103.52	102.99	102.69	102.80
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	101.99	103.51	102.99	102.65	102.78
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	101.98	103.51	102.98	102.63	102.77
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	101.94	103.47	102.81	102.61	102.71



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

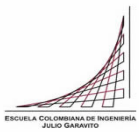
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Lower O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Lower O-cell Expansion 1A-1844379 (mm)	1B-1844380 (mm)	1C-1844381 (mm)	1D-1844382 (mm)	Average (mm)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	101.94	103.47	102.82	102.61	102.71
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	101.93	103.47	102.82	102.61	102.71
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	101.91	103.40	102.81	102.55	102.67
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	101.87	103.39	102.78	102.52	102.64
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	101.87	103.39	102.77	102.53	102.64
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	101.85	103.37	102.76	102.53	102.63
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	101.84	103.37	102.75	102.50	102.62
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	101.80	103.35	102.73	102.49	102.59
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	101.79	103.32	102.72	102.49	102.58
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	101.77	103.32	102.70	102.50	102.57
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	101.75	103.31	102.66	102.43	102.54
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	101.72	103.30	102.65	102.43	102.53
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	101.70	103.31	102.66	102.42	102.52
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	101.70	103.30	102.58	102.42	102.50
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	101.68	103.29	102.58	102.40	102.49
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	101.65	103.28	102.56	102.32	102.45
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	101.63	103.27	102.54	102.31	102.44
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	101.62	103.26	102.53	102.32	102.43
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	101.59	102.97	102.52	102.31	102.35
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	101.55	102.97	102.49	102.19	102.30
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	101.54	102.96	102.45	102.19	102.29
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	101.51	102.97	102.40	102.17	102.26
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	101.47	102.97	102.36	102.17	102.24
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	101.43	102.86	102.33	102.04	102.16
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	101.40	102.86	102.31	102.03	102.15
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	101.38	102.85	102.28	102.00	102.13
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	101.36	102.84	102.26	101.96	102.10
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	101.32	102.84	102.25	101.96	102.09
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	101.31	102.67	102.17	101.95	102.02
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	101.29	102.67	102.16	101.94	102.01
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	101.26	102.67	102.14	101.91	102.00
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	101.21	102.68	102.03	101.87	101.95
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	101.19	102.57	102.03	101.87	101.91
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	101.16	102.57	102.02	101.83	101.90
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	101.13	102.57	102.02	101.82	101.89
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	101.06	102.55	101.89	101.77	101.82
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	101.05	102.55	101.90	101.77	101.82
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	101.03	102.39	101.89	101.69	101.75
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	100.98	102.40	101.84	101.67	101.72
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	100.93	102.39	101.78	101.60	101.68
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	100.92	102.32	101.78	101.61	101.66
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	100.89	102.31	101.74	101.57	101.63
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	100.85	102.30	101.71	101.49	101.59
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	100.77	102.21	101.63	101.43	101.51
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	100.76	102.20	101.62	101.43	101.51
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	100.72	102.18	101.55	101.39	101.46
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	100.67	102.13	101.52	101.32	101.41
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	100.58	102.06	101.41	101.27	101.33
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	100.55	102.05	101.39	101.26	101.32
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	100.52	101.98	101.34	101.26	101.27
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	100.45	101.98	101.30	101.15	101.22
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	100.37	101.83	101.20	101.07	101.12
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	100.34	101.83	101.19	101.03	101.10
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	100.29	101.69	101.14	100.97	101.02
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	100.25	101.69	101.07	100.95	100.99
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	100.16	101.58	100.99	100.91	100.91
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	100.14	101.58	100.98	100.91	100.90
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	100.09	101.48	100.91	100.80	100.82
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	100.02	101.48	100.89	100.80	100.80
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	99.93	101.28	100.76	100.61	100.65
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	99.89	101.28	100.74	100.58	100.62
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	99.85	101.23	100.69	100.54	100.58
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	99.79	101.16	100.64	100.50	100.52
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	99.66	101.07	100.53	100.37	100.41
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	99.62	101.06	100.47	100.34	100.37



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

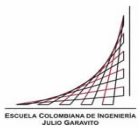
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Lower O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Lower O-cell Expansion				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	1A-1844379 (mm)	1B-1844380 (mm)	1C-1844381 (mm)	1D-1844382 (mm)	Average (mm)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	99.57	101.06	100.45	100.22	100.33
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	99.50	100.84	100.43	100.20	100.24
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	99.36	100.84	100.32	100.01	100.13
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	99.32	100.78	100.28	100.00	100.09
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	99.24	100.62	100.27	99.88	100.00
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	99.14	100.57	100.05	99.77	99.88
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	99.16	100.57	100.05	99.75	99.88
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	99.16	100.56	100.05	99.75	99.88
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	99.15	100.57	100.05	99.75	99.88
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	99.22	100.57	100.05	99.75	99.90
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	99.23	100.57	100.05	99.75	99.90
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	99.21	100.57	100.06	99.75	99.90
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	99.31	100.58	100.06	99.75	99.92
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	99.31	100.58	100.05	99.75	99.92
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	99.31	100.58	100.06	99.76	99.93
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	99.41	100.57	100.06	99.76	99.95
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	99.41	100.57	100.06	99.76	99.95
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	99.41	100.57	100.06	99.75	99.95
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	99.55	100.58	100.06	99.76	99.99
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	99.56	100.57	100.06	99.76	99.99
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	99.55	100.58	100.06	99.76	99.99
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	99.55	100.58	100.06	99.76	99.99



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

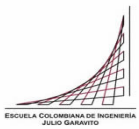
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upper O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Upper O-cell Expansion 2A-1844383 (mm)	2B-1844384 (mm)	2C-1844385 (mm)	2D-1844386 (mm)	Average (mm)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	-0.01	0.00	0.00	0.00	0.00
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	0.00	0.00	0.00	0.00	0.00
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	-0.01	-0.01	-0.01	-0.01	-0.01
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	-0.02	-0.02	-0.02	-0.02	-0.02
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	-0.04	-0.03	-0.03	-0.03	-0.03
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	-0.03	-0.03	-0.03	-0.03	-0.03
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	-0.04	-0.03	-0.03	-0.04	-0.03
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	-0.04	-0.03	-0.03	-0.04	-0.03
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	-0.05	-0.04	-0.05	-0.05	-0.05
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	-0.05	-0.04	-0.05	-0.05	-0.05
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	-0.06	-0.04	-0.05	-0.05	-0.05
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	-0.06	-0.04	-0.05	-0.05	-0.05
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	-0.07	-0.05	-0.06	-0.07	-0.06
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	-0.07	-0.05	-0.06	-0.06	-0.06
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	-0.07	-0.05	-0.06	-0.07	-0.06
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	-0.07	-0.05	-0.06	-0.07	-0.06
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	-0.08	-0.06	-0.08	-0.08	-0.08
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	-0.08	-0.06	-0.08	-0.08	-0.08
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	-0.08	-0.06	-0.08	-0.08	-0.08
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	-0.09	-0.06	-0.08	-0.08	-0.08
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	-0.10	-0.07	-0.10	-0.10	-0.09
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	-0.10	-0.08	-0.09	-0.10	-0.09
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	-0.10	-0.08	-0.10	-0.10	-0.09
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	-0.10	-0.08	-0.10	-0.10	-0.09
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	-0.11	-0.09	-0.12	-0.12	-0.11
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	-0.12	-0.09	-0.12	-0.12	-0.11
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	-0.12	-0.09	-0.11	-0.12	-0.11
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	-0.12	-0.09	-0.12	-0.12	-0.11
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	-0.13	-0.10	-0.13	-0.14	-0.13
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	-0.14	-0.10	-0.13	-0.14	-0.13
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	-0.14	-0.10	-0.13	-0.14	-0.13
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	-0.14	-0.10	-0.14	-0.14	-0.13
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	-0.15	-0.11	-0.15	-0.16	-0.14
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	-0.15	-0.12	-0.16	-0.17	-0.15
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	-0.15	-0.12	-0.16	-0.16	-0.15
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	-0.15	-0.12	-0.16	-0.17	-0.15
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	-0.17	-0.14	-0.18	-0.19	-0.17
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	-0.17	-0.14	-0.18	-0.19	-0.17
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	-0.17	-0.14	-0.19	-0.19	-0.17
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	-0.18	-0.14	-0.19	-0.19	-0.18
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	-0.20	-0.16	-0.21	-0.22	-0.20
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	-0.20	-0.17	-0.22	-0.22	-0.20
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	-0.20	-0.17	-0.22	-0.22	-0.20
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	-0.20	-0.17	-0.22	-0.23	-0.20
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	-0.23	-0.19	-0.24	-0.25	-0.22
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	-0.23	-0.19	-0.24	-0.25	-0.23
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	-0.23	-0.19	-0.25	-0.25	-0.23
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	-0.24	-0.20	-0.25	-0.26	-0.24



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

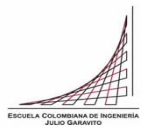
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upper O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Upper O-cell Expansion				
Test	Time	Time	Pressure	Load	Pressure	Load	2A-1844383	2B-1844384	2C-1844385	2D-1844386	Average
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(mm)	(mm)	(mm)	(mm)	(mm)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	-0.26	-0.22	-0.27	-0.28	-0.26
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	-0.27	-0.22	-0.28	-0.28	-0.26
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	-0.27	-0.22	-0.28	-0.29	-0.26
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	-0.28	-0.23	-0.29	-0.29	-0.27
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	-0.30	-0.25	-0.31	-0.32	-0.29
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	-0.30	-0.25	-0.31	-0.32	-0.30
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	-0.31	-0.26	-0.32	-0.33	-0.30
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	-0.31	-0.26	-0.33	-0.33	-0.31
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	-0.33	-0.28	-0.35	-0.35	-0.33
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	-0.33	-0.29	-0.35	-0.36	-0.33
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	-0.34	-0.29	-0.36	-0.37	-0.34
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	-0.35	-0.30	-0.37	-0.37	-0.35
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	-0.37	-0.32	-0.40	-0.40	-0.37
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	-0.38	-0.33	-0.40	-0.40	-0.38
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	-0.39	-0.34	-0.41	-0.41	-0.39
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	-0.40	-0.35	-0.42	-0.42	-0.40
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	-0.38	-0.33	-0.41	-0.40	-0.38
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	-0.38	-0.33	-0.40	-0.40	-0.38
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	-0.38	-0.33	-0.40	-0.40	-0.38
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	-0.35	-0.31	-0.37	-0.36	-0.35
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	-0.34	-0.31	-0.37	-0.36	-0.35
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	-0.35	-0.31	-0.37	-0.36	-0.35
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	-0.30	-0.27	-0.32	-0.31	-0.30
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	-0.30	-0.27	-0.32	-0.31	-0.30
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	-0.29	-0.27	-0.32	-0.31	-0.30
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	-0.24	-0.22	-0.26	-0.25	-0.24
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	-0.24	-0.22	-0.26	-0.25	-0.24
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	-0.23	-0.22	-0.25	-0.25	-0.24
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	-0.17	-0.16	-0.18	-0.17	-0.17
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	-0.17	-0.16	-0.18	-0.17	-0.17
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	-0.17	-0.16	-0.17	-0.17	-0.17
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	-0.17	-0.15	-0.17	-0.17	-0.16
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	0.55	0.64	0.52	0.55	0.56
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	0.55	0.64	0.52	0.55	0.56
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	0.55	0.65	0.52	0.55	0.57
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	0.56	0.65	0.52	0.56	0.57
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	0.79	0.87	0.73	0.76	0.79
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	0.79	0.87	0.73	0.77	0.79
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	0.80	0.88	0.74	0.77	0.80
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	0.81	0.89	0.74	0.78	0.81
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	1.03	1.10	0.95	0.99	1.02
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	1.03	1.11	0.96	1.00	1.03
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	1.05	1.12	0.97	1.01	1.04
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	1.10	1.17	1.02	1.06	1.09
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	1.35	1.42	1.26	1.31	1.33
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	1.36	1.43	1.27	1.32	1.35
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	1.38	1.44	1.29	1.33	1.36
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	1.40	1.46	1.31	1.35	1.38
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	1.64	1.69	1.53	1.58	1.61
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	1.67	1.72	1.56	1.61	1.64
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	1.70	1.76	1.60	1.65	1.68
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	1.74	1.79	1.62	1.68	1.71
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	2.01	2.05	1.89	1.94	1.97
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	2.02	2.07	1.90	1.96	1.99
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	2.06	2.10	1.94	1.99	2.02
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	2.10	2.14	1.97	2.03	2.06
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	2.36	2.40	2.23	2.28	2.32
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	2.38	2.41	2.24	2.30	2.33
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	2.40	2.44	2.27	2.33	2.36
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	2.44	2.48	2.30	2.36	2.39
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	2.72	2.75	2.58	2.64	2.67
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	2.74	2.77	2.60	2.66	2.69
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	2.78	2.81	2.64	2.70	2.73
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	2.82	2.85	2.68	2.74	2.77
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	3.11	3.14	2.95	3.02	3.06



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upper O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Upper O-cell Expansion 2A-1844383 (mm)	2B-1844384 (mm)	2C-1844385 (mm)	2D-1844386 (mm)	Average (mm)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	3.13	3.15	2.97	3.04	3.07
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	3.16	3.19	3.00	3.07	3.11
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	3.20	3.22	3.04	3.11	3.14
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	3.48	3.50	3.31	3.39	3.42
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	3.50	3.53	3.33	3.41	3.44
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	3.56	3.58	3.38	3.46	3.49
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	3.60	3.63	3.43	3.51	3.54
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	3.94	3.96	3.75	3.83	3.87
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	3.97	3.99	3.78	3.87	3.90
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	4.00	4.02	3.81	3.90	3.93
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	4.05	4.07	3.87	3.95	3.98
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	4.33	4.34	4.14	4.23	4.26
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	4.35	4.36	4.16	4.25	4.28
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	4.39	4.40	4.19	4.29	4.32
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	4.43	4.44	4.24	4.33	4.36
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	4.68	4.68	4.48	4.57	4.60
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	4.73	4.74	4.53	4.62	4.65
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	4.78	4.78	4.57	4.67	4.70
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	4.85	4.85	4.64	4.73	4.77
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	5.15	5.14	4.92	5.03	5.06
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	5.20	5.20	4.97	5.08	5.11
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	5.33	5.33	5.12	5.21	5.25
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	5.45	5.45	5.25	5.32	5.37
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	5.83	5.83	5.61	5.71	5.74
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	5.88	5.87	5.64	5.74	5.78
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	5.91	5.91	5.68	5.78	5.82
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	5.97	5.97	5.74	5.84	5.88
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	6.25	6.24	6.00	6.11	6.15
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	6.29	6.28	6.04	6.15	6.19
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	6.34	6.33	6.09	6.20	6.24
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	6.42	6.40	6.16	6.27	6.31
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	6.81	6.79	6.54	6.66	6.70
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	6.85	6.83	6.59	6.70	6.74
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	6.91	6.89	6.64	6.76	6.80
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	7.00	6.98	6.73	6.85	6.89
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	7.33	7.31	7.07	7.19	7.23
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	7.38	7.35	7.11	7.23	7.27
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	7.46	7.44	7.20	7.31	7.35
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	7.58	7.56	7.31	7.43	7.47
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	7.87	7.84	7.58	7.71	7.75
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	7.92	7.89	7.63	7.76	7.80
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	8.01	7.97	7.71	7.84	7.88
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	8.10	8.07	7.81	7.94	7.98
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	8.45	8.41	8.14	8.28	8.32
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	8.51	8.48	8.21	8.35	8.39
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	8.60	8.56	8.29	8.43	8.47
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	8.70	8.66	8.39	8.54	8.57
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	9.14	9.10	8.83	8.97	9.01
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	9.19	9.15	8.88	9.01	9.06
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	9.29	9.24	8.97	9.11	9.15
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	9.41	9.35	9.08	9.22	9.26
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	9.81	9.75	9.47	9.62	9.66
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	9.90	9.83	9.55	9.70	9.75
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	10.00	9.93	9.66	9.80	9.85
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	10.13	10.07	9.79	9.94	9.98
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	10.51	10.45	10.16	10.31	10.36
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	10.56	10.49	10.21	10.36	10.41
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	10.69	10.62	10.34	10.49	10.53
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	10.83	10.76	10.48	10.63	10.68
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	11.26	11.18	10.89	11.05	11.10
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	11.34	11.26	10.97	11.14	11.18
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	11.45	11.37	11.08	11.25	11.29
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	11.60	11.52	11.23	11.39	11.44
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	12.07	11.99	11.70	11.87	11.91
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	12.16	12.08	11.79	11.95	12.00

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

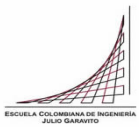
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Upper O-cell Expansion
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Upper O-cell Expansion				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	2A-1844383 (mm)	2B-1844384 (mm)	2C-1844385 (mm)	2D-1844386 (mm)	Average (mm)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	12.28	12.20	11.91	12.07	12.11
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	12.44	12.36	12.06	12.22	12.27
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	12.93	12.85	12.55	12.72	12.76
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	13.05	12.97	12.66	12.83	12.87
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	13.20	13.12	12.81	12.98	13.03
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	13.41	13.32	13.02	13.19	13.23
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	12.60	12.53	12.24	12.39	12.44
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	12.59	12.52	12.23	12.38	12.43
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	12.59	12.52	12.23	12.37	12.43
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	11.45	11.41	11.12	11.27	11.31
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	11.44	11.40	11.12	11.27	11.31
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	11.44	11.39	11.11	11.25	11.30
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	10.01	9.99	9.73	9.85	9.89
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	10.00	9.98	9.72	9.84	9.88
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	9.99	9.96	9.71	9.83	9.87
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	8.35	8.36	8.13	8.22	8.27
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	8.34	8.35	8.12	8.21	8.26
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	8.33	8.34	8.11	8.20	8.24
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	6.33	6.38	6.19	6.25	6.29
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	6.28	6.34	6.15	6.21	6.25
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	6.24	6.29	6.10	6.17	6.20
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	6.19	6.24	6.05	6.12	6.15



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

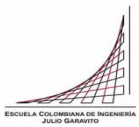
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 1
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 1 1A-1900597 (me)	1B-1900598 (me)	1C-1900599 (me)	1D-1900600 (me)	Av. Strain (me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	2.8	2.0	4.2	2.4	2.9
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	2.8	2.1	4.3	2.3	2.9
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	2.8	2.1	4.3	2.4	2.9
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	2.8	2.1	4.4	2.2	2.9
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	3.0	2.4	4.7	2.5	3.2
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	2.9	2.4	4.6	2.7	3.1
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	3.0	2.3	4.6	2.4	3.1
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	3.0	2.6	4.7	2.5	3.2
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	4.2	3.5	6.2	3.7	4.4
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	4.4	3.8	6.6	3.8	4.6
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	4.7	4.0	7.0	4.2	5.0
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	5.1	4.3	7.8	4.8	5.5
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	8.4	6.9	11.9	7.5	8.7
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	8.4	7.3	12.1	7.7	8.9
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	8.6	7.4	12.1	7.7	9.0
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	8.7	7.5	12.1	7.7	9.0
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	12.5	11.0	16.3	11.1	12.7
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	12.7	11.1	16.6	11.1	12.9
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	12.9	11.9	16.8	11.5	13.3
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	13.5	12.3	17.0	11.9	13.7
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	18.3	16.2	22.0	15.1	17.9
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	18.7	16.4	22.0	15.3	18.1
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	18.7	16.9	21.6	15.7	18.2
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	18.7	17.5	21.4	16.2	18.4
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	22.6	18.1	30.0	20.3	22.7
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	22.8	18.1	31.0	21.2	23.3
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	21.4	19.1	29.0	22.2	22.9
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	20.4	20.6	26.2	23.3	22.7
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	25.7	20.1	35.8	25.0	26.7
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	25.3	20.1	35.2	25.3	26.5
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	24.9	21.1	34.4	26.9	26.8
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	23.4	22.9	31.5	27.7	26.4
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	32.0	21.4	47.8	31.2	33.1
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	31.8	21.6	48.0	31.8	33.3
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	31.1	23.2	46.2	33.2	33.4
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	29.5	25.4	42.1	34.1	32.8
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	39.7	24.4	61.7	39.3	41.3
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	39.2	25.9	60.4	40.5	41.5
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	38.4	27.8	58.2	41.9	41.6
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	36.7	29.6	56.0	42.8	41.3
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	48.2	31.2	75.2	50.1	51.2
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	49.7	31.8	77.8	51.1	52.6
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	47.4	32.8	73.7	51.4	51.3
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	45.9	34.0	70.3	52.0	50.6
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	59.1	35.5	94.2	60.4	62.3
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	60.0	35.5	96.3	61.3	63.3
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	58.6	36.2	93.5	61.6	62.5
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	56.9	37.4	90.5	62.3	61.8
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	70.3	38.7	113.6	70.2	73.2
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	71.2	38.8	115.0	70.4	73.9
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	69.3	39.5	111.2	70.7	72.7
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	69.3	41.0	110.8	72.6	73.4
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	82.9	42.9	132.1	80.8	84.7
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	86.1	43.2	136.1	82.2	86.9
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	83.7	43.6	132.5	81.9	85.4
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	82.8	45.0	131.2	84.1	85.8
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	97.6	47.4	155.1	93.7	98.5
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	98.2	47.5	155.6	94.2	98.8
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	96.2	47.8	152.6	94.2	97.7
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	94.2	48.3	151.5	95.8	97.5
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	107.4	50.4	174.6	103.6	109.0
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	108.0	49.1	178.1	104.5	109.9
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	108.2	49.6	178.7	105.3	110.5
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	107.6	51.3	178.6	107.5	111.2



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

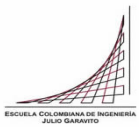
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 1
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 1 1A-1900597 (me)	1B-1900598 (me)	1C-1900599 (me)	1D-1900600 (me)	Av. Strain (me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	120.0	52.6	199.2	114.4	121.6
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	121.9	51.6	202.8	114.3	122.7
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	120.8	51.7	201.4	114.5	122.1
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	121.3	52.0	203.8	116.5	123.4
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	136.0	50.4	228.7	122.2	134.3
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	138.2	49.9	232.3	123.2	135.9
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	136.9	49.3	232.4	123.8	135.6
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	135.6	50.4	231.2	125.6	135.7
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	146.7	51.7	251.5	134.6	146.1
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	148.6	51.7	254.9	135.8	147.7
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	148.9	51.5	255.9	136.2	148.1
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	148.2	52.8	255.0	138.3	148.6
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	159.5	54.5	273.7	146.1	158.5
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	161.1	54.7	276.0	147.0	159.7
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	163.4	54.7	279.8	148.5	161.6
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	161.2	55.1	277.6	148.6	160.6
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	150.4	46.6	260.9	135.9	148.4
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	149.9	46.3	260.3	135.7	148.1
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	149.3	46.3	259.2	135.4	147.5
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	133.3	34.6	234.4	117.6	130.0
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	133.1	34.5	233.9	117.3	129.7
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	132.7	34.5	233.4	117.2	129.4
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	112.6	21.6	203.0	97.0	108.6
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	112.5	21.5	202.8	97.0	108.4
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	112.3	21.9	202.3	96.8	108.3
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	87.0	6.4	161.6	71.0	81.5
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	86.9	6.7	161.2	71.0	81.5
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	84.5	5.6	157.3	68.8	79.0
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	51.4	-8.8	102.4	36.3	45.3
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	50.8	-8.9	101.0	35.7	44.7
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	50.1	-8.9	99.6	35.0	43.9
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	49.4	-8.9	98.0	34.5	43.2
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	47.6	-9.0	94.9	33.2	41.7
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	47.5	-9.0	94.8	33.2	41.6
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	47.5	-9.0	94.7	33.1	41.6
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	47.3	-9.1	94.6	33.0	41.5
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	47.3	-9.0	94.6	33.1	41.5
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	47.4	-8.8	94.5	33.2	41.6
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	47.3	-8.9	94.4	33.1	41.5
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	47.1	-8.9	94.2	33.0	41.3
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	47.2	-8.9	94.2	33.1	41.4
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	47.2	-8.8	94.2	33.1	41.4
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	47.2	-8.8	94.3	33.1	41.4
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	47.0	-8.8	93.9	32.9	41.2
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	47.1	-8.7	94.1	33.1	41.4
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	47.2	-8.6	94.1	33.1	41.4
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	47.0	-8.7	93.9	33.0	41.3
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	46.8	-8.8	93.8	33.0	41.2
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	47.1	-8.6	93.9	33.0	41.3
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	46.9	-8.7	93.9	33.1	41.3
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	47.0	-8.6	93.9	33.1	41.4
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	46.8	-8.7	93.6	33.0	41.2
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	46.9	-8.6	93.9	33.2	41.4
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	47.0	-8.7	93.9	33.1	41.3
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	46.8	-8.6	93.6	33.1	41.2
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	46.8	-8.7	93.5	32.9	41.1
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	46.9	-8.4	93.7	32.9	41.3
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	46.9	-8.5	93.8	33.0	41.3
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	46.7	-8.6	93.4	32.8	41.1
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	46.6	-8.7	93.4	32.9	41.0
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	46.8	-8.6	93.5	32.8	41.1
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	46.9	-8.6	93.7	32.9	41.2
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	46.8	-8.5	93.4	33.0	41.1
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	46.7	-8.5	93.3	32.8	41.1
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	46.8	-8.5	93.4	33.0	41.2



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

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TESIS DE MAESTRÍA

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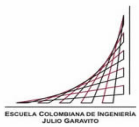
LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 1
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 1 1A-1900597 (me)	1B-1900598 (me)	1C-1900599 (me)	1D-1900600 (me)	Av. Strain (me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	46.7	-8.5	93.4	33.0	41.2
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	46.8	-8.3	93.4	33.1	41.2
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	46.6	-8.4	93.3	32.9	41.1
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	46.7	-8.4	93.3	32.9	41.1
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	46.8	-8.3	93.4	33.0	41.2
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	46.7	-8.4	93.3	33.1	41.2
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	46.6	-8.3	93.3	32.9	41.1
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	46.8	-8.2	93.4	33.1	41.3
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	46.8	-8.3	93.3	33.0	41.2
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	46.8	-8.2	93.4	33.0	41.2
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	46.5	-8.3	93.1	32.7	41.0
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	46.7	-8.3	93.3	33.0	41.2
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	46.8	-8.2	93.2	32.9	41.2
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	46.6	-8.2	93.2	32.9	41.1
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	46.6	-8.3	93.1	32.8	41.0
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	46.8	-8.2	93.3	33.1	41.2
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	46.8	-8.2	93.2	33.0	41.2
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	46.8	-8.2	93.3	33.0	41.2
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	46.8	-8.1	93.1	32.8	41.2
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	46.8	-8.0	93.3	32.9	41.3
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	46.8	-8.1	93.2	33.0	41.3
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	46.7	-8.1	93.3	32.9	41.2
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	46.7	-8.2	93.1	32.8	41.1
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	46.9	-8.0	93.2	32.9	41.2
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	46.9	-7.9	93.2	33.0	41.3
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	46.8	-7.9	93.3	32.9	41.3
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	46.8	-8.0	93.1	32.8	41.2
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	47.1	-7.9	93.3	33.2	41.4
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	47.0	-7.9	93.2	32.9	41.3
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	46.9	-8.0	93.1	32.9	41.2
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	46.8	-7.9	93.0	32.9	41.2
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	47.1	-7.7	93.3	33.0	41.4
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	47.1	-7.8	93.2	32.9	41.3
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	47.0	-8.0	93.2	33.0	41.3
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	46.8	-7.8	93.1	32.7	41.2
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	47.1	-7.7	93.1	32.8	41.3
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	47.1	-7.8	93.3	33.1	41.4
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	47.0	-7.7	93.2	32.9	41.3
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	47.0	-7.9	93.1	32.8	41.3
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	47.1	-7.5	93.3	33.1	41.5
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	47.1	-7.7	93.3	32.8	41.4
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	47.0	-7.8	93.0	32.9	41.3
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	47.0	-7.7	93.0	32.8	41.3
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	47.3	-7.5	93.3	33.0	41.5
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	47.2	-7.7	93.2	32.8	41.4
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	47.1	-7.7	93.1	32.9	41.3
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	47.2	-7.6	93.0	32.7	41.3
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	47.3	-7.5	93.1	32.7	41.4
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	47.2	-7.6	93.1	33.0	41.4
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	47.1	-7.6	93.1	32.8	41.4
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	47.1	-7.6	93.0	32.9	41.3
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	47.4	-7.5	93.2	32.9	41.5
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	47.4	-7.5	93.2	32.7	41.5
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	47.4	-7.4	93.2	32.8	41.5
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	47.3	-7.6	93.0	32.7	41.3
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	47.4	-7.5	93.2	32.6	41.4
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	47.3	-7.4	93.1	32.8	41.4
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	47.3	-7.4	93.1	32.6	41.4
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	47.3	-7.5	93.1	32.6	41.4
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	47.5	-7.4	93.2	32.5	41.4
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	47.5	-7.5	93.2	32.5	41.4
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	47.5	-7.5	93.1	32.6	41.4
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	47.4	-7.4	93.0	32.4	41.3
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	47.4	-7.5	93.2	32.5	41.4
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	47.6	-7.3	93.1	32.5	41.5



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

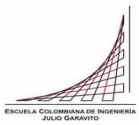
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 1
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 1				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	1A-1900597 (me)	1B-1900598 (me)	1C-1900599 (me)	1D-1900600 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	47.5	-7.5	93.1	32.4	41.4
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	47.6	-7.5	93.1	32.4	41.4
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	47.7	-7.3	93.5	32.3	41.5
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	47.7	-7.4	93.2	32.5	41.5
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	47.7	-7.4	93.3	32.2	41.5
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	47.7	-7.4	93.1	32.2	41.4
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	46.6	-8.1	91.4	31.2	40.3
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	46.6	-8.2	91.4	31.0	40.2
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	46.5	-8.1	91.3	31.1	40.2
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	45.4	-8.6	89.5	29.9	39.0
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	45.4	-8.6	89.5	30.1	39.1
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	45.4	-8.5	89.6	30.3	39.2
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	44.3	-8.9	87.7	29.2	38.1
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	44.4	-8.9	87.7	29.1	38.1
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	44.5	-8.8	87.8	29.2	38.2
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	43.5	-9.2	86.4	28.4	37.3
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	43.4	-9.0	86.5	28.9	37.5
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	43.6	-9.0	86.5	28.5	37.4
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	42.6	-9.3	85.2	28.0	36.6
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	42.7	-9.4	85.3	28.0	36.6
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	42.5	-9.2	85.4	28.2	36.7
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	42.7	-9.0	85.4	28.4	36.9



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

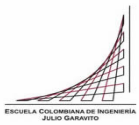
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 2
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 2 2A-1900601 (me)	2B-1900602 (me)	2C-1900603 (me)	2D-1900604 (me)	Av. Strain (me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	2.5	1.9	2.3	1.9	2.1
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	2.4	1.8	2.0	2.0	2.1
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	2.4	1.2	2.1	2.1	2.0
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	2.4	1.5	2.0	2.3	2.1
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	2.7	2.4	2.3	2.2	2.4
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	2.6	2.7	2.3	2.4	2.5
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	2.6	1.4	2.4	2.1	2.1
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	2.6	1.7	2.3	2.1	2.2
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	3.6	2.7	3.2	3.2	3.2
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	3.9	2.8	3.4	3.5	3.4
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	4.2	3.7	3.7	3.6	3.8
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	4.8	4.6	4.0	4.1	4.4
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	8.4	6.9	7.0	7.4	7.4
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	8.5	6.4	7.1	7.6	7.4
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	8.7	6.5	7.2	7.7	7.5
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	9.0	6.9	7.4	8.0	7.8
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	12.7	11.0	10.5	11.8	11.5
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	12.9	12.2	10.8	12.1	12.0
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	13.4	12.2	11.0	12.2	12.2
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	13.8	13.2	11.3	12.7	12.7
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	17.2	15.9	14.1	15.8	15.8
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	17.4	15.9	14.5	16.4	16.0
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	17.8	16.3	14.7	16.7	16.4
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	18.3	16.2	15.1	17.0	16.6
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	22.6	21.2	19.0	21.8	21.1
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	23.2	22.2	19.4	22.3	21.8
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	23.1	21.7	19.3	22.2	21.6
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	23.5	21.3	19.6	22.6	21.7
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	26.9	25.4	22.6	26.1	25.2
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	26.9	25.0	22.6	26.0	25.1
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	27.4	25.4	22.9	26.6	25.6
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	27.3	25.4	22.8	26.5	25.5
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	31.0	29.4	26.3	30.4	29.3
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	31.0	28.7	26.4	30.3	29.1
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	31.3	29.6	26.6	30.8	29.6
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	31.6	29.6	26.5	30.9	29.6
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	35.0	33.4	29.4	34.3	33.0
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	35.3	33.8	29.8	34.5	33.4
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	35.8	33.3	29.9	34.9	33.5
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	35.7	33.6	29.8	35.0	33.5
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	39.9	37.9	33.5	39.1	37.6
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	40.3	37.8	33.9	39.6	37.9
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	40.1	38.0	33.5	39.2	37.7
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	40.1	37.9	33.4	39.3	37.7
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	44.8	42.2	37.3	43.8	42.0
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	45.1	42.9	37.4	44.1	42.4
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	44.9	42.5	37.4	44.0	42.2
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	45.0	42.6	37.4	43.9	42.2
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	49.3	47.1	41.1	48.5	46.5
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	49.3	46.9	41.0	48.4	46.4
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	49.4	45.8	40.9	48.2	46.1
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	49.7	46.9	41.4	48.9	46.7
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	54.2	51.7	45.3	53.2	51.1
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	54.8	53.0	45.7	53.8	51.8
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	54.4	51.7	45.3	53.5	51.2
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	54.7	52.7	45.7	53.9	51.8
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	59.8	56.6	49.5	58.9	56.2
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	59.7	57.1	49.5	59.0	56.3
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	59.6	56.5	49.4	58.8	56.1
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	59.7	57.0	49.6	59.0	56.3
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	64.5	62.3	53.5	63.5	60.9
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	64.8	61.3	53.6	63.9	60.9
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	64.8	62.1	53.6	64.1	61.2
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	65.5	62.6	54.1	64.7	61.7



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

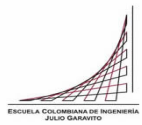
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 2
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 2 2A-1900601 (me)	2B-1900602 (me)	2C-1900603 (me)	2D-1900604 (me)	Av. Strain (me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	70.0	66.9	57.9	69.1	66.0
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	70.3	67.1	58.1	69.6	66.3
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	70.2	68.1	57.7	69.2	66.3
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	71.1	67.3	58.5	70.1	66.7
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	75.7	72.0	62.1	74.5	71.1
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	76.3	72.8	62.4	75.1	71.7
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	76.3	72.4	62.4	75.5	71.6
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	76.6	73.0	62.7	75.6	72.0
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	81.5	78.5	66.2	80.2	76.6
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	82.1	78.7	66.8	80.9	77.1
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	82.6	79.0	67.0	81.2	77.4
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	83.1	79.5	67.5	82.0	78.0
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	87.7	82.6	71.2	86.5	82.0
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	88.2	83.5	71.6	87.0	82.5
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	89.1	84.7	72.2	87.8	83.5
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	89.0	84.6	72.3	87.2	83.3
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	81.5	78.7	66.0	80.4	76.7
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	81.5	78.2	66.0	80.3	76.5
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	81.2	78.1	65.7	80.3	76.3
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	70.7	68.2	57.0	69.6	66.4
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	70.6	68.4	57.0	69.7	66.4
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	70.5	66.9	56.9	69.7	66.0
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	58.5	55.6	47.3	58.2	54.9
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	58.6	55.5	47.3	58.1	54.9
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	58.5	55.2	47.3	57.9	54.7
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	45.6	42.9	36.7	45.2	42.6
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	45.4	43.3	36.6	45.2	42.7
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	44.2	42.7	35.9	43.9	41.7
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	30.0	28.7	23.6	29.6	28.0
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	29.5	28.7	23.5	29.2	27.7
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	29.4	28.0	23.1	29.1	27.4
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	28.9	28.3	22.9	28.8	27.2
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	29.5	28.3	23.3	29.3	27.6
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	29.4	28.7	23.3	29.3	27.7
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	29.3	28.6	23.5	29.4	27.7
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	29.1	28.4	23.3	29.2	27.5
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	30.4	29.9	24.4	30.4	28.8
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	30.3	29.1	24.2	30.4	28.5
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	30.4	29.0	24.2	30.2	28.5
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	30.3	29.1	24.1	30.2	28.5
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	31.2	30.0	25.2	31.3	29.5
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	31.3	30.4	25.2	31.1	29.5
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	31.4	30.5	25.4	31.2	29.6
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	31.4	30.5	25.5	31.4	29.7
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	32.7	32.0	26.5	32.6	31.0
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	32.6	31.4	26.5	32.7	30.8
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	32.7	31.4	26.5	32.6	30.8
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	32.6	31.7	26.3	32.6	30.8
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	33.7	33.0	27.4	33.9	32.0
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	33.8	33.0	27.4	33.9	32.0
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	34.2	33.0	27.5	34.1	32.2
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	34.1	32.5	27.4	34.0	32.0
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	35.3	33.9	28.5	35.4	33.3
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	35.5	34.0	28.7	35.6	33.4
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	35.5	34.1	28.7	35.5	33.5
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	35.4	33.7	28.7	35.7	33.4
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	36.7	34.4	29.6	36.9	34.4
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	36.9	34.9	29.8	36.9	34.7
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	36.9	35.2	29.7	36.8	34.7
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	36.9	35.2	29.6	36.7	34.6
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	38.2	35.7	31.0	38.2	35.8
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	38.2	35.6	31.0	38.1	35.7
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	38.2	35.8	31.0	38.3	35.8
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	38.5	37.5	30.9	38.4	36.3
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	39.7	38.6	32.3	39.8	37.6



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

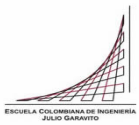
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 2
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 2 2A-1900601 (me)	2B-1900602 (me)	2C-1900603 (me)	2D-1900604 (me)	Av. Strain (me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	39.7	37.8	32.2	39.7	37.4
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	39.7	38.2	32.3	39.8	37.5
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	39.7	38.2	32.4	39.9	37.5
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	41.1	39.1	33.5	41.1	38.7
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	41.1	39.9	33.5	41.2	38.9
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	41.1	39.8	33.8	41.3	39.0
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	41.3	38.4	33.9	41.4	38.7
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	42.9	41.5	35.2	42.8	40.6
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	42.9	41.3	35.4	43.0	40.6
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	42.9	41.7	35.4	43.1	40.8
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	42.9	41.8	35.7	43.0	40.9
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	44.3	42.1	36.5	44.6	41.9
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	44.4	42.7	36.5	44.6	42.1
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	44.3	42.6	36.5	44.7	42.0
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	44.4	42.4	36.4	44.6	42.0
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	45.7	43.6	37.5	45.8	43.2
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	45.9	43.5	37.7	46.0	43.3
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	46.0	44.0	38.0	46.3	43.6
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	46.2	44.0	38.0	46.2	43.6
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	47.6	45.0	39.2	47.9	44.9
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	47.9	44.7	39.4	48.1	45.0
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	48.3	45.3	39.8	48.6	45.5
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	48.5	46.8	40.1	48.7	46.0
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	50.3	47.9	41.9	50.7	47.7
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	50.3	48.0	41.9	50.6	47.7
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	50.3	48.0	41.8	50.6	47.7
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	50.6	48.1	41.9	50.7	47.8
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	52.0	49.6	43.2	52.1	49.2
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	52.0	50.0	43.4	52.2	49.4
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	52.1	50.0	43.6	52.3	49.5
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	52.2	49.8	43.7	52.6	49.6
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	54.5	52.4	45.5	54.8	51.8
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	54.5	52.8	45.7	54.9	52.0
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	54.6	52.5	45.9	55.1	52.0
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	54.9	52.4	46.1	55.3	52.2
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	56.7	53.8	47.5	57.0	53.8
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	56.8	53.8	47.6	57.2	53.8
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	57.0	54.3	48.0	57.5	54.2
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	57.5	54.2	48.4	58.0	54.5
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	59.1	55.9	49.8	59.5	56.1
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	59.3	56.6	49.9	59.7	56.4
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	59.3	56.7	50.2	59.8	56.5
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	59.6	57.1	50.5	60.2	56.9
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	61.6	58.9	52.3	62.1	58.7
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	61.8	58.5	52.5	62.2	58.7
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	62.0	59.8	52.7	62.6	59.3
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	62.5	59.9	53.1	63.1	59.6
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	64.8	62.3	55.2	65.5	62.0
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	64.9	62.0	55.3	65.5	61.9
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	65.1	62.4	55.5	65.9	62.2
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	65.6	62.7	55.9	66.3	62.6
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	68.0	64.8	58.0	68.5	64.8
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	68.0	64.8	58.2	68.7	64.9
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	68.5	65.9	58.5	69.4	65.6
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	69.0	66.3	59.0	69.5	66.0
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	71.1	68.4	60.9	71.5	68.0
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	71.2	69.3	61.1	71.9	68.4
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	71.8	68.8	61.6	72.3	68.6
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	72.2	70.3	62.0	72.9	69.4
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	74.3	72.1	64.1	75.7	71.6
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	75.0	72.2	64.4	76.1	71.9
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	75.3	72.4	64.7	76.1	72.1
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	76.0	72.3	65.2	76.8	72.6
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	78.2	76.3	67.4	79.1	75.3
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	78.6	75.9	67.6	79.3	75.4



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

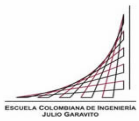
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 2
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 2				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	2A-1900601 (me)	2B-1900602 (me)	2C-1900603 (me)	2D-1900604 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	78.9	75.5	68.1	79.6	75.6
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	79.4	75.8	68.5	80.4	76.0
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	82.0	79.9	71.1	83.3	79.1
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	82.4	79.7	71.4	83.6	79.3
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	82.8	80.1	71.7	84.2	79.7
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	83.3	81.1	72.3	84.7	80.4
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	77.4	75.1	67.2	78.3	74.5
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	77.2	75.6	67.1	78.5	74.6
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	77.3	75.2	67.0	78.5	74.5
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	69.3	67.6	60.4	70.4	66.9
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	69.4	67.1	60.5	70.3	66.8
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	69.3	67.0	60.3	70.4	66.7
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	60.2	58.1	52.1	61.4	58.0
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	60.2	58.4	52.0	61.1	57.9
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	60.1	57.9	52.1	61.3	57.8
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	50.8	48.2	43.2	51.3	48.4
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	50.6	48.6	43.3	51.3	48.4
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	50.6	49.7	43.2	51.2	48.7
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	39.8	38.1	33.7	40.2	38.0
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	39.7	38.4	33.5	40.0	37.9
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	39.5	37.8	33.1	39.8	37.5
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	39.3	37.9	33.0	39.6	37.4



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

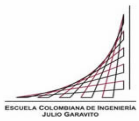
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 3
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Strain Gage Level 3				
Test	Time	Time	Pressure	Load	Pressure	Load	3A-1900605	3B-1900606	3C-1900607	3D-1900608	Av. Strain
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(me)	(me)	(me)	(me)	(me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	0.5	52.2	-42.3	1.1	0.8
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	1.6	23.0	-37.9	1.0	1.3
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	2.1	20.7	-728.1	0.9	1.5
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	0.0	68.2	-868.9	1.1	0.5
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	0.2	28.9	-1127.4	0.9	0.6
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	1.0	12.4	-1301.0	1.1	1.0
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	1.0	7.9	-1220.4	0.8	0.9
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	0.5	-28.3	606.1	1.0	0.7
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	0.3	2.2	-886.7	1.1	0.7
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	0.6	13.8	-1587.8	1.2	0.9
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	0.6	14.2	-1224.5	1.7	1.1
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	0.7	3.8	-1211.1	1.9	1.3
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	0.8	3.9	-390.7	3.1	1.9
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	1.0	14.0	-359.4	3.1	2.1
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	1.6	14.3	-490.8	3.1	2.4
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	3.0	2.9	-1074.2	3.2	3.1
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	4.8	4.5	613.2	4.8	4.8
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	3.5	4.6	-263.3	4.8	4.1
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	4.8	31.7	-1423.3	5.0	4.9
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	5.8	15.0	-2038.9	5.2	5.5
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	5.0	33.6	-982.9	6.2	5.6
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	5.6	33.2	-1761.4	6.4	6.0
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	5.7	35.5	-154.1	6.4	6.0
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	6.3	24.9	-1278.4	6.6	6.5
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	7.1	18.1	-555.4	8.3	7.7
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	8.2	7.6	-1217.0	8.6	8.4
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	6.8	8.5	356.2	8.6	7.7
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	8.5	10.9	-949.2	8.5	8.5
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	9.5	9.8	276.1	10.3	9.9
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	9.7	39.4	-629.1	10.0	9.8
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	9.9	27.2	4160.9	10.3	10.1
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	9.6	13.5	-1296.7	10.2	9.9
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	10.3	57.1	-1824.7	11.8	11.0
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	11.6	5.0	-1312.5	11.7	11.6
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	12.4	13.2	-1072.6	11.9	12.2
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	10.8	18.3	-1231.6	11.9	11.4
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	13.6	13.8	-1327.6	13.4	13.5
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	12.7	30.7	-1385.6	13.3	13.0
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	13.0	26.1	-1590.5	13.7	13.3
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	12.8	14.7	-753.0	13.8	13.3
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	15.5	33.6	-844.9	15.3	15.4
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	13.5	56.1	-1279.1	15.3	14.4
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	15.1	31.0	-630.2	15.4	15.2
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	16.6	41.6	381.9	15.6	16.1
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	16.4	52.2	-388.4	17.3	16.9
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	17.1	39.3	488.9	17.3	17.2
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	17.5	19.8	-878.2	17.4	17.5
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	16.8	30.5	-313.3	17.4	17.1
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	17.3	22.9	-917.8	19.3	18.3
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	17.8	37.1	878.9	19.2	18.5
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	18.6	71.1	-1278.0	19.3	19.0
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	19.5	48.9	-900.7	19.6	19.5
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	20.3	44.6	-1075.7	21.5	20.9
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	20.5	30.6	-446.4	21.4	20.9
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	19.6	33.3	-802.6	21.5	20.5
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	20.1	-1911.8	-507.4	21.8	21.0
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	22.3	58.5	-987.9	23.7	23.0
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	32.1	37.2	187.8	23.9	28.0
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	22.4	48.6	476.3	24.1	23.2
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	22.5	29.0	578.8	24.0	23.3
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	26.4	32.7	-944.2	25.8	26.1
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	25.3	43.2	-1018.6	26.0	25.6
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	26.0	23.4	-829.6	26.0	26.0
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	24.2	31.5	-581.9	26.4	25.3



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

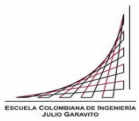
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 3
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 3 3A-1900605 (me)	3B-1900606 (me)	3C-1900607 (me)	3D-1900608 (me)	Av. Strain (me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	25.7	55.9	-478.1	28.5	27.1
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	27.7	53.8	-792.5	28.5	28.1
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	26.5	51.7	-585.8	28.6	27.5
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	28.4	57.8	-610.8	29.1	28.7
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	29.3	32.4	-660.9	30.9	30.1
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	28.3	56.5	-59.4	31.0	29.7
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	29.5	48.1	-952.9	31.5	30.5
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	30.5	51.4	-414.6	31.6	31.0
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	32.4	68.3	-1557.2	33.6	33.0
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	32.2	45.4	317.9	33.9	33.0
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	33.2	39.5	-1191.2	34.1	33.6
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	32.6	80.1	-434.6	34.2	33.4
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	36.8	84.9	-730.4	36.1	36.5
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	34.2	64.1	1265.5	36.6	35.4
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	34.4	45.0	-1411.7	37.5	36.0
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	36.5	28.0	-830.3	36.8	36.7
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	34.9	51.5	-1075.5	34.3	34.6
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	33.4	70.8	-9.9	34.4	33.9
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	32.5	60.7	-755.4	33.9	33.2
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	26.8	70.2	-491.7	30.1	28.4
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	28.5	47.1	-25.0	30.6	29.5
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	28.3	46.3	394.1	30.1	29.2
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	23.6	32.7	-2083.7	25.6	24.6
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	22.5	40.2	-1383.6	26.0	24.2
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	26.4	42.4	-964.4	25.7	26.0
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	20.0	38.0	-867.6	21.3	20.7
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	19.9	45.0	-447.3	21.3	20.6
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	19.2	36.7	174.2	20.9	20.1
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	14.1	58.4	934.0	15.5	14.8
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	15.5	42.8	-217.0	15.4	15.5
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	14.0	75.5	-171.2	15.5	14.7
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	15.7	68.5	1934.7	15.1	15.4
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	17.1	65.0	-1491.1	17.1	17.1
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	17.7	13.7	245.3	17.0	17.4
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	17.5	13.5	-1380.2	17.2	17.3
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	17.4	49.1	-675.4	17.2	17.3
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	19.4	26.4	-635.8	19.4	19.4
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	18.3	32.6	1515.9	19.3	18.8
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	18.6	16.4	-1322.3	19.3	19.0
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	18.1	71.5	-1963.1	19.6	18.8
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	19.6	53.6	-726.2	20.9	20.2
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	18.9	31.1	1209.4	21.3	20.1
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	19.7	27.8	-1793.0	21.4	20.5
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	20.2	329.2	-399.0	21.6	20.9
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	22.9	28.2	-1789.6	24.1	23.5
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	23.0	31.9	-241.2	24.2	23.6
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	23.1	50.2	-312.6	24.2	23.6
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	23.4	32.0	-1245.2	24.2	23.8
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	26.2	53.8	-1911.4	26.0	26.1
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	26.2	30.9	-1031.5	26.8	26.5
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	25.6	60.5	-1028.9	26.5	26.0
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	27.7	34.1	-1125.8	26.7	27.2
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	28.3	35.0	1431.2	29.4	28.9
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	28.9	48.5	-1475.8	29.5	29.2
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	27.7	40.4	-1788.0	29.6	28.7
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	29.1	51.3	-1486.4	29.9	29.5
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	29.4	56.9	-794.1	32.6	31.0
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	30.8	50.8	-844.5	31.9	31.4
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	31.6	42.8	-808.3	32.7	32.2
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	32.5	40.8	625.1	33.0	32.8
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	33.5	45.5	-536.4	34.8	34.1
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	34.2	56.7	29.8	35.3	34.8
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	32.1	54.9	-1126.3	35.5	33.8
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	32.0	74.2	-1777.7	35.5	33.7
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	35.4	39.4	-1081.5	38.7	37.1



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 3
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 3 3A-1900605 (me)	3B-1900606 (me)	3C-1900607 (me)	3D-1900608 (me)	Av. Strain (me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	34.7	48.2	-201.7	38.2	36.5
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	37.3	70.4	-1400.4	38.3	37.8
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	36.2	49.5	-1114.3	38.7	37.4
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	38.9	90.1	-1348.1	41.7	40.3
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	42.2	53.1	-570.1	41.8	42.0
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	41.2	72.0	-1567.8	42.1	41.7
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	42.6	71.9	-2054.7	42.3	42.5
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	43.1	69.0	1435.2	45.7	44.4
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	45.8	45.4	-527.4	45.6	45.7
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	44.2	70.1	2008.2	45.8	45.0
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	42.4	58.7	-594.5	46.0	44.2
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	46.9	70.9	-241.5	49.2	48.0
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	46.7	59.6	-1584.7	49.1	47.9
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	47.1	70.4	-1987.6	49.3	48.2
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	47.7	70.6	-1646.6	49.6	48.6
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	51.4	67.6	-1788.0	52.1	51.7
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	50.7	68.0	-1023.0	52.5	51.6
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	52.5	68.3	-1239.9	52.9	52.7
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	50.8	103.4	-582.9	53.2	52.0
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	54.9	68.3	-1656.5	55.7	55.3
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	56.4	74.4	-1461.7	56.9	56.6
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	56.6	63.9	-599.8	57.7	57.1
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	57.5	73.5	-918.0	58.6	58.0
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	61.2	69.0	-1113.6	62.5	61.8
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	62.4	89.5	-1041.5	62.4	62.4
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	63.3	78.2	-1392.5	62.4	62.9
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	60.6	74.2	-786.2	62.9	61.8
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	65.2	83.2	-780.4	65.7	65.4
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	65.7	69.2	-220.1	66.1	65.9
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	65.5	84.7	-154.6	66.5	66.0
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	66.4	112.4	-944.9	67.2	66.8
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	71.0	70.7	2060.5	71.3	71.2
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	71.8	94.5	-616.0	71.5	71.7
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	70.4	92.5	-561.9	72.0	71.2
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	71.2	81.9	451.7	72.6	71.9
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	75.3	106.2	-333.9	76.2	75.8
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	75.6	87.7	-1268.6	76.5	76.0
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	76.4	87.6	-1703.8	77.4	76.9
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	77.5	116.7	637.8	78.2	77.8
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	81.3	99.7	-1107.8	81.5	81.4
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	77.7	124.0	-324.5	82.0	79.9
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	81.1	144.9	-483.8	82.3	81.7
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	81.5	98.9	-604.9	83.1	82.3
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	85.0	107.3	-521.2	87.3	86.2
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	86.5	135.7	-1405.6	87.6	87.0
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	85.2	117.1	-247.4	88.4	86.8
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	85.9	109.5	-1255.6	89.1	87.5
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	92.1	115.7	-3.0	93.7	92.9
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	92.8	97.9	-1493.5	94.3	93.5
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	92.3	124.1	-557.7	94.7	93.5
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	92.6	127.7	-339.9	95.6	94.1
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	98.2	121.8	3223.6	99.9	99.1
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	99.0	130.5	-3.6	100.5	99.7
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	99.1	141.5	-700.4	100.9	100.0
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	98.5	135.3	-1454.5	101.8	100.2
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	103.6	127.1	-553.8	106.1	104.9
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	103.5	119.1	-23.0	106.1	104.8
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	104.1	137.0	-770.2	107.1	105.6
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	104.7	130.6	787.2	108.1	106.4
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	110.0	144.3	-741.1	112.0	111.0
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	109.3	133.4	-1314.6	112.7	111.0
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	109.2	127.0	-523.7	113.1	111.1
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	112.1	130.5	-746.6	113.8	113.0
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	115.4	176.3	340.1	118.5	117.0
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	116.8	132.9	-347.0	118.8	117.8

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

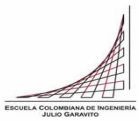
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 3
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 3				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	3A-1900605 (me)	3B-1900606 (me)	3C-1900607 (me)	3D-1900608 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	118.0	158.3	-144.8	119.1	118.5
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	116.8	124.6	1759.0	119.6	118.2
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	122.7	182.7	-606.7	124.4	123.6
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	122.5	167.2	-752.5	125.0	123.7
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	122.2	159.0	1332.5	125.3	123.8
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	123.4	182.5	1008.6	126.3	124.9
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	110.5	131.9	-302.2	115.0	112.8
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	111.8	141.0	-744.7	114.7	113.2
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	111.8	438.1	1027.4	114.6	113.2
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	105.3	133.9	-901.1	99.4	102.4
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	95.7	154.2	-1193.9	99.3	97.5
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	97.9	116.6	-934.3	99.6	98.7
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	77.0	112.9	-529.5	80.8	78.9
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	80.7	388.6	-630.5	80.8	80.8
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	77.6	76.9	-138.9	80.6	79.1
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	60.6	96.7	-513.4	62.1	61.3
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	60.9	390.3	-758.4	62.4	61.7
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	60.8	96.8	-1354.8	62.2	61.5
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	42.4	50.9	-744.9	43.1	42.7
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	40.9	79.1	893.9	42.7	41.8
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	40.8	103.2	-408.3	42.5	41.7
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	41.0	61.7	-1302.9	41.7	41.3



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

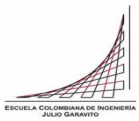
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 4
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 4				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	4A-1900609 (me)	4B-1900610 (me)	4C-1900611 (me)	4D-1900612 (me)	Av. Strain (me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	0.0	0.1	0.1	0.3	0.1
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	0.1	0.2	0.1	0.3	0.2
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	-0.1	0.3	0.0	0.4	0.2
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	0.0	0.2	0.0	0.3	0.1
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	-0.1	0.2	0.0	0.2	0.1
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	0.3	0.3	0.1	0.1	0.2
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	0.0	0.2	0.0	0.4	0.2
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	0.1	0.3	-0.1	0.3	0.1
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	0.2	0.2	-0.2	0.4	0.1
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	0.0	0.1	-0.2	0.4	0.1
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	0.1	0.0	-0.1	0.6	0.2
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	0.2	0.3	0.1	0.6	0.3
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	0.7	0.8	0.4	1.0	0.7
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	0.6	0.6	0.4	1.1	0.7
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	0.5	0.8	0.4	1.2	0.7
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	0.5	0.6	0.3	1.2	0.7
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	0.8	1.3	0.8	1.6	1.1
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	0.8	1.0	0.7	1.7	1.1
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	0.9	1.1	0.7	1.6	1.1
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	1.1	1.3	0.7	1.8	1.2
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	1.3	1.5	1.3	2.4	1.6
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	1.3	1.7	1.3	2.3	1.6
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	1.1	1.6	1.3	2.4	1.6
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	1.2	1.7	1.1	2.2	1.6
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	1.9	2.3	1.8	3.0	2.3
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	2.0	2.3	2.0	3.0	2.3
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	1.7	2.4	2.0	3.0	2.3
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	1.8	2.2	1.9	3.1	2.2
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	2.2	2.7	2.2	3.5	2.7
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	2.0	2.7	2.3	3.6	2.7
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	2.1	2.5	2.5	3.8	2.7
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	2.2	2.8	2.4	3.8	2.8
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	2.6	3.3	3.0	4.1	3.2
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	2.7	3.2	2.8	4.3	3.2
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	2.7	3.3	2.8	4.2	3.2
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	2.8	3.1	2.8	4.3	3.3
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	3.2	3.9	3.3	4.8	3.8
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	3.2	3.9	3.4	4.9	3.8
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	3.2	3.9	3.5	4.8	3.9
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	3.3	3.8	3.5	5.0	3.9
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	3.7	4.5	4.3	5.5	4.5
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	3.8	4.5	4.2	5.6	4.5
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	3.6	4.4	4.1	5.6	4.4
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	3.9	4.5	4.1	5.5	4.5
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	4.5	5.2	4.7	6.4	5.2
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	4.4	5.1	4.8	6.3	5.2
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	4.7	5.2	4.6	6.3	5.2
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	4.5	5.2	4.8	6.3	5.2
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	4.9	5.9	5.2	7.0	5.8
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	5.1	5.4	5.3	6.9	5.7
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	4.8	5.6	5.4	7.0	5.7
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	5.0	5.6	5.3	7.0	5.7
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	5.5	6.4	5.8	7.8	6.4
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	5.6	6.4	5.9	7.9	6.4
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	5.3	6.4	5.9	7.9	6.4
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	5.6	6.4	5.9	7.9	6.5
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	6.1	6.9	6.8	8.6	7.1
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	6.1	7.0	6.8	8.5	7.1
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	6.3	6.9	6.7	8.5	7.1
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	6.0	6.8	6.7	8.5	7.0
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	6.8	7.3	7.3	9.2	7.6
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	6.8	7.4	7.3	9.3	7.7
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	6.7	7.5	7.3	9.2	7.7
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	6.8	7.6	7.4	9.4	7.8



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

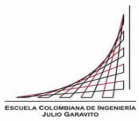
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 4
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Strain Gage Level 4				
Test	Time	Time	Pressure	Load	Pressure	Load	4A-1900609	4B-1900610	4C-1900611	4D-1900612	Av. Strain
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(me)	(me)	(me)	(me)	(me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	7.5	8.4	7.9	10.1	8.5
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	7.4	8.5	8.0	10.1	8.5
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	7.5	8.3	7.9	10.0	8.4
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	7.6	8.3	8.0	10.1	8.5
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	8.2	9.1	8.5	11.0	9.2
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	8.1	9.1	8.6	10.9	9.2
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	8.3	8.9	8.6	10.9	9.2
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	8.1	9.1	8.6	11.0	9.2
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	8.8	9.5	9.2	11.8	9.8
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	8.8	9.6	9.3	11.9	9.9
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	8.8	9.8	9.3	11.9	9.9
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	8.8	9.8	9.1	12.0	9.9
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	9.1	10.2	10.0	13.0	10.6
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	9.4	10.5	10.0	12.9	10.7
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	9.5	10.4	9.9	13.1	10.7
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	9.4	10.2	10.0	13.0	10.7
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	8.3	9.3	8.8	11.8	9.6
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	8.3	9.4	8.8	11.8	9.6
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	8.4	9.5	8.8	11.8	9.6
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	7.2	8.5	7.6	10.3	8.4
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	7.1	8.1	7.6	10.4	8.3
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	7.3	8.3	7.6	10.2	8.3
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	5.8	6.7	6.1	8.8	6.9
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	5.9	6.6	6.1	8.9	6.9
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	5.8	6.6	6.2	8.8	6.9
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	4.4	5.3	4.6	7.1	5.4
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	4.3	5.4	4.5	6.9	5.3
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	4.4	5.3	4.4	6.8	5.2
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	2.7	3.2	2.6	4.6	3.3
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	2.8	3.5	2.6	4.7	3.4
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	2.8	3.4	2.5	4.7	3.3
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	2.7	3.2	2.3	4.5	3.2
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	7.3	8.4	7.7	10.4	8.4
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	7.2	8.5	7.8	10.4	8.5
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	7.3	8.6	7.7	10.5	8.5
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	7.2	8.4	7.8	10.4	8.5
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	11.4	12.2	12.3	15.7	12.9
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	11.6	12.4	12.5	15.8	13.1
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	11.6	12.6	12.7	16.0	13.2
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	11.8	13.0	12.9	16.2	13.5
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	17.0	18.4	18.3	22.6	19.1
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	17.2	18.7	18.5	22.9	19.3
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	17.5	18.7	18.9	23.2	19.6
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	18.6	19.9	20.1	24.5	20.8
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	25.1	26.0	27.2	32.6	27.7
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	25.3	26.5	27.5	33.1	28.1
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	25.8	27.0	27.9	33.4	28.5
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	26.1	27.9	28.2	34.0	29.1
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	32.5	33.7	34.9	41.7	35.7
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	33.1	34.1	35.7	42.6	36.4
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	34.0	34.7	36.7	43.7	37.3
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	34.8	35.9	37.3	44.6	38.1
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	42.1	42.7	44.7	53.8	45.8
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	42.7	43.5	45.5	54.4	46.5
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	43.4	44.1	46.3	55.4	47.3
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	44.3	45.0	47.2	56.5	48.2
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	51.6	51.6	54.5	65.1	55.7
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	52.0	52.3	55.0	65.8	56.3
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	52.5	52.9	55.8	66.6	57.0
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	53.2	53.6	56.5	67.5	57.7
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	60.9	61.0	64.7	76.5	65.8
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	61.3	61.6	65.2	77.3	66.4
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	62.3	62.3	66.1	78.1	67.2
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	63.1	63.4	67.0	79.4	68.2
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	70.8	71.3	75.8	88.8	76.7



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

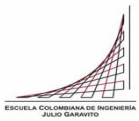
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 4
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 4 4A-1900609 (me)	4B-1900610 (me)	4C-1900611 (me)	4D-1900612 (me)	Av. Strain (me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	71.5	71.3	76.1	89.2	77.0
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	72.1	72.2	77.0	90.5	77.9
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	73.1	73.1	77.8	91.4	78.8
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	80.2	80.1	85.6	99.9	86.5
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	80.7	80.9	86.4	100.6	87.1
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	82.1	82.3	87.6	102.3	88.6
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	83.2	83.1	88.9	103.6	89.7
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	91.3	91.3	97.6	113.6	98.4
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	91.9	92.1	98.5	114.4	99.2
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	92.9	92.8	99.3	115.5	100.1
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	93.8	94.0	100.2	116.5	101.1
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	100.3	100.6	107.4	124.3	108.1
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	100.7	101.1	107.7	124.8	108.6
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	101.4	101.7	108.7	125.4	109.3
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	102.5	102.5	109.7	126.6	110.3
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	108.1	108.0	115.8	132.7	116.2
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	108.9	109.1	116.8	134.1	117.2
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	109.9	110.0	118.4	135.2	118.4
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	111.1	111.4	119.4	136.4	119.6
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	117.6	117.8	126.9	143.8	126.5
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	118.9	119.2	128.1	145.0	127.8
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	121.3	121.5	130.7	147.9	130.3
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	123.1	123.5	132.9	150.3	132.4
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	131.0	131.1	141.8	159.3	140.8
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	131.3	131.4	142.3	159.8	141.2
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	131.8	132.2	142.7	160.4	141.8
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	132.6	133.2	143.6	161.6	142.7
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	137.9	138.3	149.4	167.3	148.2
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	138.3	139.1	150.1	168.0	148.9
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	139.2	139.7	150.9	168.9	149.7
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	140.1	140.5	151.9	169.9	150.6
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	146.9	147.3	159.4	177.5	157.8
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	147.7	147.9	160.0	178.1	158.4
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	148.5	148.7	160.9	179.2	159.3
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	149.3	149.4	161.9	180.4	160.3
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	154.8	155.2	168.0	186.3	166.1
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	155.3	155.3	168.5	186.8	166.5
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	156.3	157.0	169.9	188.3	167.9
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	157.6	158.2	171.1	189.8	169.2
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	162.3	162.4	176.1	194.5	173.8
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	163.1	163.2	177.1	195.3	174.6
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	163.6	163.9	177.6	196.1	175.3
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	164.4	164.7	178.9	197.5	176.4
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	170.0	170.6	184.7	203.2	182.1
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	170.2	170.9	185.4	203.6	182.5
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	171.1	171.5	186.1	204.7	183.3
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	172.2	172.5	187.3	206.0	184.5
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	177.9	178.4	193.9	212.0	190.5
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	178.4	179.1	194.4	212.7	191.2
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	179.1	180.1	195.3	213.5	192.0
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	180.0	180.7	196.2	214.9	192.9
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	185.4	186.0	201.8	220.9	198.5
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	186.3	186.9	202.4	221.7	199.3
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	186.9	187.2	203.4	222.5	200.0
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	188.0	188.1	204.6	223.6	201.1
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	192.3	192.6	209.4	228.6	205.7
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	192.7	192.9	209.7	229.0	206.1
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	193.6	194.6	210.6	229.9	207.2
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	194.6	195.4	211.6	231.0	208.2
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	199.8	200.4	216.9	236.2	213.3
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	200.1	200.6	217.3	236.7	213.7
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	200.6	201.1	218.0	237.3	214.2
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	201.2	202.0	218.8	238.3	215.1
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	206.5	207.6	224.0	243.4	220.4
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	206.8	207.9	224.6	243.8	220.8



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 4
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 4				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	4A-1900609 (me)	4B-1900610 (me)	4C-1900611 (me)	4D-1900612 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	207.4	208.2	225.1	244.3	221.3
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	208.1	208.9	226.1	245.1	222.0
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	213.2	213.9	231.4	250.5	227.2
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	213.6	214.7	232.0	250.9	227.8
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	214.4	214.9	232.4	251.5	228.3
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	215.0	215.7	233.7	252.6	229.2
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	204.7	205.6	222.5	241.9	218.7
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	204.8	205.3	222.2	241.5	218.5
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	204.5	205.1	222.1	241.7	218.4
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	190.6	190.5	206.8	226.6	203.6
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	190.5	190.5	206.4	226.7	203.5
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	190.6	190.4	206.7	226.7	203.6
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	171.7	170.0	184.2	205.4	182.8
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	171.6	170.2	184.2	205.3	182.8
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	171.6	170.0	184.0	205.2	182.7
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	146.6	142.7	153.0	176.1	154.6
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	146.5	142.5	152.9	176.1	154.5
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	146.3	142.6	152.7	175.8	154.4
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	106.9	99.2	106.5	127.6	110.0
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	106.2	98.2	105.8	126.6	109.2
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	105.3	97.7	105.0	125.5	108.4
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	104.2	96.5	104.1	124.4	107.3

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

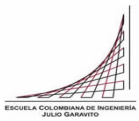
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 5
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 5 5A-1600613 (me)	5B-1600614 (me)	5C-1600615 (me)	5D-1600616 (me)	Av. Strain (me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	-0.2	0.4	0.3	0.0	0.1
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	-0.3	0.3	0.2	-0.1	0.0
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	-0.4	0.5	0.2	-0.2	0.0
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	-0.5	0.1	0.3	-0.1	-0.1
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	-0.5	0.3	0.1	-0.2	-0.1
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	-0.5	0.4	0.0	-0.2	-0.1
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	-0.3	0.2	0.0	-0.2	-0.1
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	-0.4	0.3	0.1	-0.2	-0.1
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	-0.5	0.4	0.0	-0.1	-0.1
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	-0.4	0.2	-0.1	-0.1	-0.1
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	-0.3	0.2	0.1	-0.1	0.0
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	-0.4	0.5	-0.1	0.0	0.0
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	-0.2	0.6	0.3	0.1	0.2
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	-0.2	0.8	0.4	0.0	0.3
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	-0.4	0.9	0.7	0.0	0.3
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	-0.2	0.5	0.5	0.1	0.2
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	-0.2	0.9	0.5	0.3	0.4
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	0.0	0.6	0.5	0.4	0.4
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	-0.1	1.1	0.7	0.3	0.5
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	0.1	1.3	0.5	0.4	0.6
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	0.2	1.4	0.6	0.4	0.7
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	0.2	1.5	0.6	0.4	0.7
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	0.1	1.7	0.6	0.4	0.7
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	0.2	1.2	0.5	0.6	0.6
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	0.6	1.8	1.0	0.7	1.0
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	0.4	1.8	0.9	0.7	0.9
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	0.3	1.7	1.0	0.7	0.9
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	0.3	1.8	0.8	0.7	0.9
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	0.5	2.2	1.1	0.8	1.1
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	0.5	2.0	1.0	1.0	1.1
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	0.6	2.2	1.0	0.9	1.2
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	0.5	2.1	1.0	0.9	1.1
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	0.8	2.5	1.4	1.2	1.5
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	1.1	2.3	1.2	1.0	1.4
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	0.9	2.4	1.4	1.1	1.5
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	0.7	2.1	1.2	1.2	1.3
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	1.0	2.5	1.4	1.3	1.6
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	1.0	2.5	1.5	1.4	1.6
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	1.1	2.7	1.5	1.4	1.7
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	0.8	2.6	1.6	1.3	1.6
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	1.5	2.8	1.7	1.7	1.9
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	1.3	2.3	1.7	1.7	1.8
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	1.4	2.7	1.7	1.6	1.9
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	1.2	2.9	1.6	1.5	1.8
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	1.7	3.0	1.9	1.8	2.1
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	1.7	3.1	2.0	1.9	2.2
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	1.5	2.7	2.0	1.7	2.0
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	2.1	2.8	2.0	1.7	2.2
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	2.0	2.9	2.3	2.0	2.3
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	2.1	3.1	2.1	2.0	2.3
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	2.0	2.9	2.2	2.0	2.3
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	2.1	3.0	2.2	2.0	2.3
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	2.2	3.1	2.4	2.2	2.5
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	2.1	3.1	2.4	2.2	2.4
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	2.2	3.4	2.5	2.2	2.6
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	2.4	2.9	2.5	2.2	2.5
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	2.8	3.4	2.7	2.5	2.8
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	2.4	3.3	2.8	2.4	2.7
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	2.4	3.3	2.7	2.4	2.7
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	2.4	3.3	2.8	2.4	2.7
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	2.7	3.5	2.9	2.8	3.0
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	3.0	3.5	3.1	2.6	3.1
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	2.5	3.4	3.0	2.6	2.9
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	3.0	3.5	3.0	2.7	3.0



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

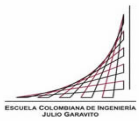
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 5
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 5 5A-1600613 (me)	5B-1600614 (me)	5C-1600615 (me)	5D-1600616 (me)	Av. Strain (me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	2.9	3.5	3.4	2.9	3.2
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	2.9	3.9	3.3	3.0	3.3
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	2.9	4.1	3.4	2.9	3.3
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	3.2	3.7	3.3	2.9	3.3
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	3.3	4.0	3.6	3.3	3.5
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	3.4	4.2	3.6	3.2	3.6
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	3.3	4.1	3.4	3.2	3.5
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	3.2	3.7	3.6	3.2	3.4
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	3.4	4.1	3.9	3.5	3.7
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	3.2	4.3	3.9	3.5	3.7
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	3.3	4.3	4.0	3.5	3.8
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	3.1	4.3	4.1	3.5	3.7
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	4.0	4.3	4.2	3.9	4.1
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	3.7	4.7	4.2	3.9	4.1
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	3.5	4.6	4.3	3.9	4.1
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	3.4	4.5	4.1	3.8	4.0
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	2.8	4.5	3.7	3.3	3.6
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	3.1	3.9	3.8	3.3	3.5
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	3.2	3.8	3.8	3.3	3.5
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	2.4	3.7	3.2	2.7	3.0
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	2.7	3.5	3.1	2.7	3.0
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	2.2	3.7	3.0	2.7	2.9
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	1.9	2.9	2.6	2.1	2.4
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	1.5	3.0	2.6	2.0	2.3
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	2.0	2.7	2.4	2.1	2.3
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	1.0	2.1	2.1	1.4	1.6
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	1.1	2.2	2.0	1.4	1.7
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	1.1	2.2	1.8	1.3	1.6
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	0.3	1.8	1.2	0.6	1.0
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	0.3	1.3	1.4	0.5	0.9
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	0.4	1.2	1.2	0.6	0.9
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	0.3	1.4	1.1	0.5	0.8
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	2.1	3.1	2.8	2.4	2.6
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	2.5	3.2	2.9	2.3	2.7
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	2.1	3.3	2.8	2.3	2.6
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	2.3	3.2	2.9	2.3	2.7
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	3.5	4.8	4.5	3.8	4.2
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	3.7	4.7	4.6	3.8	4.2
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	3.8	4.8	4.7	3.8	4.2
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	4.0	4.5	4.4	4.1	4.2
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	5.2	6.4	6.2	5.4	5.8
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	5.4	6.2	6.3	5.6	5.9
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	5.3	6.6	6.3	5.7	6.0
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	6.1	6.8	6.7	6.0	6.4
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	7.5	8.9	8.8	7.9	8.3
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	7.8	8.7	8.9	8.0	8.3
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	8.1	9.1	9.3	8.0	8.6
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	8.0	9.3	9.3	8.1	8.7
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	9.9	11.2	10.9	9.9	10.5
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	10.0	11.4	11.2	10.2	10.7
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	10.0	11.5	11.5	10.5	10.9
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	10.1	11.7	11.6	10.6	11.0
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	12.5	13.5	13.8	12.7	13.1
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	12.5	13.6	13.9	12.8	13.2
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	13.0	13.6	14.2	13.2	13.5
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	13.1	14.1	14.6	13.4	13.8
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	15.4	16.5	16.6	15.4	16.0
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	15.6	16.5	16.9	15.5	16.2
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	15.7	16.6	17.1	15.8	16.3
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	16.0	16.7	17.3	16.1	16.5
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	18.0	18.8	19.8	18.1	18.7
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	18.1	19.2	19.8	18.3	18.9
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	18.2	19.5	20.1	18.6	19.1
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	18.7	19.9	20.5	18.9	19.5
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	20.9	21.9	22.7	21.4	21.7



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

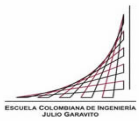
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 5
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 5 5A-1600613 (me)	5B-1600614 (me)	5C-1600615 (me)	5D-1600616 (me)	Av. Strain (me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	21.0	22.0	23.0	21.4	21.8
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	21.3	22.3	23.2	21.9	22.2
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	21.8	22.6	23.7	22.1	22.6
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	23.8	24.9	26.0	24.3	24.8
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	24.1	25.1	26.3	24.7	25.1
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	24.6	25.6	26.8	25.1	25.5
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	24.7	26.0	27.1	25.6	25.9
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	27.3	28.7	29.9	28.0	28.5
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	27.6	28.9	30.2	28.3	28.8
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	27.8	29.3	30.5	28.7	29.1
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	28.3	29.9	30.9	29.3	29.6
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	30.6	31.8	33.1	31.5	31.8
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	30.6	32.1	33.6	31.9	32.1
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	31.1	32.3	33.9	32.0	32.3
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	31.4	32.7	34.2	32.4	32.7
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	33.3	34.9	36.2	34.8	34.8
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	33.7	35.3	36.8	35.1	35.2
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	34.1	36.1	37.3	35.7	35.8
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	34.5	36.6	37.6	36.0	36.2
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	36.9	39.0	40.3	38.7	38.7
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	37.4	39.4	40.9	39.2	39.2
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	38.3	40.6	41.9	40.4	40.3
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	39.2	41.4	43.0	41.4	41.3
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	42.4	44.9	46.5	44.6	44.6
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	42.6	45.2	46.4	44.8	44.7
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	42.8	45.5	47.1	45.1	45.1
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	43.3	46.0	47.5	45.5	45.6
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	45.2	48.3	49.6	47.8	47.7
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	45.4	48.8	49.9	48.1	48.1
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	45.9	49.2	50.2	48.6	48.5
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	46.5	49.4	50.7	49.0	48.9
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	49.3	52.9	54.1	52.0	52.1
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	49.7	53.7	54.8	52.6	52.7
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	50.2	53.6	54.9	53.2	53.0
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	50.9	54.5	55.4	53.8	53.6
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	53.2	57.2	58.4	56.3	56.3
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	53.7	57.7	58.8	56.3	56.6
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	54.3	58.5	59.6	57.3	57.4
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	54.9	59.1	60.4	58.0	58.1
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	56.8	61.3	62.5	60.0	60.1
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	57.7	61.6	62.7	60.6	60.6
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	57.8	62.3	63.5	61.2	61.2
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	58.4	62.5	64.3	61.9	61.8
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	61.4	65.7	67.1	64.3	64.6
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	62.0	66.0	67.4	64.7	65.0
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	62.5	66.5	67.9	64.9	65.5
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	62.7	67.1	68.6	65.5	66.0
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	65.5	70.3	71.8	68.9	69.1
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	66.1	70.4	72.5	69.1	69.5
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	67.2	70.9	72.7	69.8	70.2
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	67.6	71.8	73.4	70.3	70.8
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	70.1	74.6	76.4	73.2	73.6
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	71.2	74.6	76.9	73.6	74.1
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	71.8	75.4	77.4	74.1	74.7
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	72.3	76.3	78.2	74.7	75.4
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	74.3	78.7	80.8	77.7	77.9
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	75.0	78.9	81.1	77.7	78.2
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	75.6	79.1	81.7	78.3	78.7
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	76.5	80.0	82.5	79.1	79.5
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	79.2	83.1	85.5	81.8	82.4
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	79.3	83.4	85.8	82.2	82.6
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	80.2	83.6	86.2	82.7	83.2
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	80.1	84.7	86.8	83.1	83.7
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	82.8	87.1	89.9	86.3	86.5
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	83.4	87.3	90.2	86.5	86.9



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 5
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 5				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	5A-1600613 (me)	5B-1600614 (me)	5C-1600615 (me)	5D-1600616 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	84.0	87.7	90.6	87.0	87.3
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	84.2	88.5	91.2	87.6	87.9
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	87.0	91.5	94.2	91.0	90.9
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	87.8	92.0	94.7	91.2	91.4
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	87.8	93.2	95.2	91.6	91.9
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	88.6	93.2	96.0	92.2	92.5
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	83.9	87.7	90.1	86.3	87.0
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	83.7	87.3	90.1	86.2	86.8
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	83.3	87.3	89.9	86.1	86.7
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	75.9	79.9	82.1	78.3	79.1
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	76.1	79.6	82.0	78.2	79.0
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	75.9	79.8	81.9	77.9	78.9
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	65.6	69.7	71.5	68.6	68.8
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	65.7	69.8	71.4	68.1	68.8
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	65.6	69.5	71.4	68.1	68.7
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	53.9	57.6	58.8	56.5	56.7
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	53.9	57.6	58.7	56.3	56.6
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	53.8	57.6	58.5	56.2	56.6
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	39.9	41.6	43.4	41.1	41.5
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	39.6	41.3	43.2	41.1	41.3
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	39.4	41.1	42.8	40.7	41.0
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	38.8	40.8	42.4	40.4	40.6

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

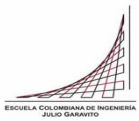
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 6
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Strain Gage Level 6				
Test	Time	Time	Pressure	Load	Pressure	Load	6A-1600617	6B-1600618	6C-1600619	6D-1600620	Av. Strain
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(me)	(me)	(me)	(me)	(me)
1 L - 0	-	5/3/19 10:25:00	0.00	0.00	0.00	0.00	0.0	0.0	0.0	0.0	0.0
1 L - 1	1	5/3/19 10:41:00	4.48	0.59	0.00	0.00	-0.3	-0.2	-0.3	0.1	-0.2
1 L - 1	2	5/3/19 10:42:00	4.48	0.59	0.00	0.00	-0.1	-0.1	-0.4	0.0	-0.2
1 L - 1	4	5/3/19 10:44:00	4.48	0.59	0.00	0.00	-0.2	-0.3	-0.5	-0.2	-0.3
1 L - 1	8	5/3/19 10:48:00	4.48	0.59	0.00	0.00	-0.1	-0.2	-0.5	-0.2	-0.3
1 L - 2	1	5/3/19 10:52:00	6.83	0.92	0.00	0.00	-0.2	-0.2	-0.5	-0.1	-0.3
1 L - 2	2	5/3/19 10:53:00	6.83	0.92	0.00	0.00	-0.2	-0.3	-0.6	-0.2	-0.3
1 L - 2	4	5/3/19 10:55:00	6.83	0.92	0.00	0.00	-0.2	-0.2	-0.5	-0.1	-0.2
1 L - 2	8	5/3/19 10:59:00	6.83	0.92	0.00	0.00	-0.2	-0.3	-0.4	-0.3	-0.3
1 L - 3	1	5/3/19 11:02:00	10.34	1.42	0.00	0.00	-0.2	-0.2	-0.7	-0.1	-0.3
1 L - 3	2	5/3/19 11:03:00	10.34	1.42	0.00	0.00	-0.2	-0.2	-0.7	-0.3	-0.3
1 L - 3	4	5/3/19 11:05:00	10.34	1.42	0.00	0.00	-0.3	-0.2	-0.7	-0.3	-0.4
1 L - 3	8	5/3/19 11:09:00	10.34	1.42	0.00	0.00	-0.2	-0.1	-0.5	-0.2	-0.3
1 L - 4	1	5/3/19 11:12:30	13.58	1.87	0.00	0.00	-0.1	-0.1	-0.6	-0.2	-0.3
1 L - 4	2	5/3/19 11:13:30	13.58	1.87	0.00	0.00	-0.2	-0.3	-0.7	0.2	-0.2
1 L - 4	4	5/3/19 11:15:30	13.58	1.87	0.00	0.00	-0.2	-0.2	-0.6	-0.1	-0.3
1 L - 4	8	5/3/19 11:19:30	13.58	1.87	0.00	0.00	-0.2	-0.2	-0.8	-0.2	-0.3
1 L - 5	1	5/3/19 11:21:30	17.17	2.38	0.00	0.00	-0.1	0.0	-0.5	-0.2	-0.2
1 L - 5	2	5/3/19 11:22:30	17.17	2.38	0.00	0.00	-0.1	0.0	-0.5	-0.1	-0.2
1 L - 5	4	5/3/19 11:24:30	17.17	2.38	0.00	0.00	-0.2	0.0	-0.6	0.1	-0.2
1 L - 5	8	5/3/19 11:28:30	17.17	2.38	0.00	0.00	-0.1	0.0	-0.8	-0.1	-0.3
1 L - 6	1	5/3/19 11:30:30	20.68	2.87	0.00	0.00	-0.2	0.0	-0.6	0.0	-0.2
1 L - 6	2	5/3/19 11:31:30	20.68	2.87	0.00	0.00	0.0	0.0	-0.6	0.0	-0.1
1 L - 6	4	5/3/19 11:33:30	20.68	2.87	0.00	0.00	-0.1	0.0	-0.8	-0.1	-0.2
1 L - 6	8	5/3/19 11:37:30	20.68	2.87	0.00	0.00	0.0	0.0	-0.7	-0.1	-0.2
1 L - 7	1	5/3/19 11:41:30	24.27	3.38	0.00	0.00	0.1	0.1	-0.2	0.0	0.0
1 L - 7	2	5/3/19 11:42:30	24.27	3.38	0.00	0.00	0.1	0.2	-0.3	-0.1	0.0
1 L - 7	4	5/3/19 11:44:30	24.27	3.38	0.00	0.00	0.0	0.2	-0.8	0.2	-0.1
1 L - 7	8	5/3/19 11:48:30	24.27	3.38	0.00	0.00	0.1	0.2	-0.2	0.0	0.0
1 L - 8	1	5/3/19 11:51:00	27.65	3.85	0.00	0.00	0.0	0.2	-0.6	0.0	-0.1
1 L - 8	2	5/3/19 11:52:00	27.65	3.85	0.00	0.00	0.2	0.3	-0.7	0.0	0.0
1 L - 8	4	5/3/19 11:54:00	27.65	3.85	0.00	0.00	0.1	0.3	-0.2	0.0	0.0
1 L - 8	8	5/3/19 11:58:00	27.65	3.85	0.00	0.00	0.1	0.3	-0.6	0.1	0.0
1 L - 9	1	5/3/19 12:00:30	31.44	4.39	0.00	0.00	0.2	0.2	-0.5	0.1	0.0
1 L - 9	2	5/3/19 12:01:30	31.44	4.39	0.00	0.00	0.1	0.3	-0.5	0.2	0.0
1 L - 9	4	5/3/19 12:03:30	31.44	4.39	0.00	0.00	0.1	0.4	-0.4	0.3	0.1
1 L - 9	8	5/3/19 12:07:30	31.44	4.39	0.00	0.00	0.1	0.2	-0.6	0.1	0.0
1 L - 10	1	5/3/19 12:10:00	34.82	4.86	0.00	0.00	0.2	0.3	-0.5	0.2	0.0
1 L - 10	2	5/3/19 12:11:00	34.82	4.86	0.00	0.00	0.2	0.2	-0.6	0.2	0.0
1 L - 10	4	5/3/19 12:13:00	34.82	4.86	0.00	0.00	0.2	0.3	-0.5	0.4	0.1
1 L - 10	8	5/3/19 12:17:00	34.82	4.86	0.00	0.00	0.3	0.3	-0.2	0.4	0.2
1 L - 11	1	5/3/19 12:20:00	38.20	5.34	0.00	0.00	0.4	0.4	0.2	0.3	0.3
1 L - 11	2	5/3/19 12:21:00	38.20	5.34	0.00	0.00	0.3	0.3	-0.1	0.4	0.3
1 L - 11	4	5/3/19 12:23:00	38.20	5.34	0.00	0.00	0.5	0.3	-0.1	0.4	0.3
1 L - 11	8	5/3/19 12:27:00	38.20	5.34	0.00	0.00	0.2	0.2	-0.1	0.4	0.2
1 L - 12	1	5/3/19 12:30:00	41.71	5.83	0.00	0.00	0.5	0.3	0.0	0.5	0.3
1 L - 12	2	5/3/19 12:31:00	41.71	5.83	0.00	0.00	0.4	0.3	0.1	0.4	0.3
1 L - 12	4	5/3/19 12:33:00	41.71	5.83	0.00	0.00	0.2	0.3	0.3	0.3	0.3
1 L - 12	8	5/3/19 12:37:00	41.71	5.83	0.00	0.00	0.3	0.3	0.1	0.3	0.2
1 L - 13	1	5/3/19 12:40:00	45.09	6.31	0.00	0.00	0.4	0.3	0.2	0.3	0.3
1 L - 13	2	5/3/19 12:41:00	45.09	6.31	0.00	0.00	0.4	0.3	0.3	0.5	0.4
1 L - 13	4	5/3/19 12:43:00	45.09	6.31	0.00	0.00	0.3	0.3	0.2	0.5	0.3
1 L - 13	8	5/3/19 12:47:00	45.09	6.31	0.00	0.00	0.4	0.2	0.1	0.4	0.3
1 L - 14	1	5/3/19 12:50:00	48.68	6.81	0.00	0.00	0.6	0.3	0.6	0.4	0.5
1 L - 14	2	5/3/19 12:51:00	48.68	6.81	0.00	0.00	0.5	0.3	0.5	0.4	0.4
1 L - 14	4	5/3/19 12:53:00	48.68	6.81	0.00	0.00	0.5	0.3	0.4	0.5	0.4
1 L - 14	8	5/3/19 12:57:00	48.68	6.81	0.00	0.00	0.5	0.2	0.4	0.4	0.4
1 L - 15	1	5/3/19 13:00:30	51.71	7.24	0.00	0.00	0.6	0.3	0.5	0.5	0.5
1 L - 15	2	5/3/19 13:01:30	51.71	7.24	0.00	0.00	0.7	0.2	0.5	0.6	0.5
1 L - 15	4	5/3/19 13:03:30	51.71	7.24	0.00	0.00	0.8	0.3	0.3	0.6	0.5
1 L - 15	8	5/3/19 13:07:30	51.71	7.24	0.00	0.00	0.7	0.3	0.5	0.6	0.5
1 L - 16	1	5/3/19 13:10:00	55.43	7.76	0.00	0.00	0.6	0.3	0.5	0.6	0.5
1 L - 16	2	5/3/19 13:11:00	55.43	7.76	0.00	0.00	0.6	0.3	0.4	0.6	0.5
1 L - 16	4	5/3/19 13:13:00	55.43	7.76	0.00	0.00	0.7	0.3	0.5	0.6	0.5
1 L - 16	8	5/3/19 13:17:00	55.43	7.76	0.00	0.00	0.7	0.4	0.6	0.5	0.5



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

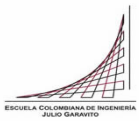
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 6
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell Pressure (MPa)	Lower O-cell Load (MN)	Upper O-cell Pressure (MPa)	Upper O-cell Load (MN)	Strain Gage Level 6 6A-1600617 (me)	6B-1600618 (me)	6C-1600619 (me)	6D-1600620 (me)	Av. Strain (me)
1 L - 17	1	5/3/19 13:20:00	58.88	8.25	0.00	0.00	0.8	0.4	0.7	0.7	0.6
1 L - 17	2	5/3/19 13:21:00	58.88	8.25	0.00	0.00	0.7	0.4	0.5	0.7	0.6
1 L - 17	4	5/3/19 13:23:00	58.88	8.25	0.00	0.00	0.6	0.4	0.6	0.7	0.6
1 L - 17	8	5/3/19 13:27:00	58.88	8.25	0.00	0.00	0.8	0.3	0.6	0.6	0.6
1 L - 18	1	5/3/19 13:29:30	62.12	8.70	0.00	0.00	0.8	0.4	0.8	0.7	0.7
1 L - 18	2	5/3/19 13:30:30	62.12	8.70	0.00	0.00	0.9	0.5	0.6	0.7	0.7
1 L - 18	4	5/3/19 13:32:30	62.12	8.70	0.00	0.00	0.8	0.4	0.6	0.7	0.6
1 L - 18	8	5/3/19 13:36:30	62.12	8.70	0.00	0.00	0.8	0.4	0.7	0.7	0.7
1 L - 19	1	5/3/19 13:38:30	65.71	9.21	0.00	0.00	1.0	0.4	0.7	1.0	0.8
1 L - 19	2	5/3/19 13:39:30	65.71	9.21	0.00	0.00	1.1	0.4	0.7	0.9	0.8
1 L - 19	4	5/3/19 13:41:30	65.71	9.21	0.00	0.00	0.8	0.5	0.7	0.9	0.7
1 L - 19	8	5/3/19 13:45:30	65.71	9.21	0.00	0.00	0.9	0.4	0.6	0.9	0.7
1 L - 20	1	5/3/19 13:48:30	69.36	9.72	0.00	0.00	0.8	0.5	0.5	0.9	0.7
1 L - 20	2	5/3/19 13:49:30	69.36	9.72	0.00	0.00	1.0	0.4	0.6	1.1	0.8
1 L - 20	4	5/3/19 13:51:30	69.36	9.72	0.00	0.00	1.0	0.4	0.7	0.8	0.7
1 L - 20	8	5/3/19 13:55:30	69.36	9.72	0.00	0.00	1.1	0.5	0.5	0.9	0.7
1 U - 1	1	5/3/19 13:59:00	55.43	7.76	0.00	0.00	0.8	0.1	0.3	0.7	0.5
1 U - 1	2	5/3/19 14:00:00	55.43	7.76	0.00	0.00	0.8	0.3	0.2	0.8	0.5
1 U - 1	4	5/3/19 14:02:00	55.43	7.76	0.00	0.00	0.8	0.2	0.2	0.6	0.4
1 U - 2	1	5/3/19 14:04:00	41.09	5.74	0.00	0.00	0.6	-0.1	0.0	0.6	0.2
1 U - 2	2	5/3/19 14:05:00	41.09	5.74	0.00	0.00	0.5	-0.1	-0.1	0.5	0.2
1 U - 2	4	5/3/19 14:07:00	41.09	5.74	0.00	0.00	0.5	-0.2	-0.1	0.7	0.2
1 U - 3	1	5/3/19 14:09:30	27.99	3.90	0.00	0.00	0.2	-0.3	-0.2	0.4	0.0
1 U - 3	2	5/3/19 14:10:30	27.99	3.90	0.00	0.00	0.4	-0.4	-0.6	0.2	-0.1
1 U - 3	4	5/3/19 14:12:30	27.99	3.90	0.00	0.00	0.3	-0.4	-0.5	0.3	0.0
1 U - 4	1	5/3/19 14:14:30	14.20	1.96	0.00	0.00	0.2	-0.6	-0.6	-0.1	-0.3
1 U - 4	2	5/3/19 14:15:30	14.20	1.96	0.00	0.00	0.0	-0.7	-0.7	0.0	-0.4
1 U - 4	4	5/3/19 14:17:30	14.20	1.96	0.00	0.00	0.0	-0.5	-0.6	-0.1	-0.3
1 U - 5	1	5/3/19 14:19:30	0.00	0.00	0.00	0.00	-0.2	-0.8	-1.0	-0.2	-0.6
1 U - 5	2	5/3/19 14:20:30	0.00	0.00	0.00	0.00	-0.3	-0.8	-1.1	-0.2	-0.6
1 U - 5	4	5/3/19 14:22:30	0.00	0.00	0.00	0.00	-0.2	-0.8	-1.2	-0.4	-0.6
1 U - 5	8	5/3/19 14:26:30	0.00	0.00	0.00	0.00	-0.2	-1.0	-0.9	-0.3	-0.6
2 L - 1	1	5/3/19 14:49:30	0.00	0.00	3.52	0.47	0.3	-0.6	-0.8	0.4	-0.2
2 L - 1	2	5/3/19 14:50:30	0.00	0.00	3.52	0.47	0.3	-0.5	-0.7	0.2	-0.2
2 L - 1	4	5/3/19 14:52:30	0.00	0.00	3.52	0.47	0.3	-0.6	-1.0	0.3	-0.2
2 L - 1	8	5/3/19 14:56:30	0.00	0.00	3.52	0.47	0.4	-0.5	-0.8	0.3	-0.2
2 L - 2	1	5/3/19 14:59:00	0.00	0.00	7.24	1.00	0.7	0.1	-0.3	0.7	0.3
2 L - 2	2	5/3/19 15:00:00	0.00	0.00	7.24	1.00	0.8	0.2	-0.2	0.7	0.4
2 L - 2	4	5/3/19 15:02:00	0.00	0.00	7.24	1.00	0.8	0.0	-0.2	0.6	0.3
2 L - 2	8	5/3/19 15:06:00	0.00	0.00	7.24	1.00	0.9	0.4	-0.2	1.1	0.5
2 L - 3	1	5/3/19 15:09:00	0.00	0.00	10.41	1.45	1.3	0.9	0.3	1.4	1.0
2 L - 3	2	5/3/19 15:10:00	0.00	0.00	10.41	1.45	1.2	0.9	0.3	1.5	1.0
2 L - 3	4	5/3/19 15:12:00	0.00	0.00	10.41	1.45	1.4	0.8	0.5	1.2	1.0
2 L - 3	8	5/3/19 15:16:00	0.00	0.00	10.41	1.45	1.5	1.0	0.7	1.7	1.2
2 L - 4	1	5/3/19 15:18:30	0.00	0.00	13.93	1.95	2.1	1.5	1.0	1.9	1.6
2 L - 4	2	5/3/19 15:19:30	0.00	0.00	13.93	1.95	2.0	1.6	1.3	2.0	1.7
2 L - 4	4	5/3/19 15:21:30	0.00	0.00	13.93	1.95	2.2	1.8	1.0	2.0	1.7
2 L - 4	8	5/3/19 15:25:30	0.00	0.00	13.93	1.95	2.1	1.8	1.3	2.0	1.8
2 L - 5	1	5/3/19 15:28:00	0.00	0.00	17.17	2.41	2.9	2.3	1.5	2.6	2.3
2 L - 5	2	5/3/19 15:29:00	0.00	0.00	17.17	2.41	3.0	2.5	1.8	2.8	2.5
2 L - 5	4	5/3/19 15:31:00	0.00	0.00	17.17	2.41	3.0	2.5	1.9	2.7	2.5
2 L - 5	8	5/3/19 15:35:00	0.00	0.00	17.17	2.41	3.0	2.6	1.9	2.6	2.5
2 L - 6	1	5/3/19 15:37:30	0.00	0.00	20.82	2.93	3.6	3.3	2.6	3.2	3.2
2 L - 6	2	5/3/19 15:38:30	0.00	0.00	20.82	2.93	3.6	3.2	2.6	3.6	3.2
2 L - 6	4	5/3/19 15:40:30	0.00	0.00	20.82	2.93	3.9	3.3	2.4	3.3	3.2
2 L - 6	8	5/3/19 15:44:30	0.00	0.00	20.82	2.93	3.9	3.4	2.7	3.6	3.4
2 L - 7	1	5/3/19 15:47:30	0.00	0.00	24.13	3.40	4.5	3.8	2.9	4.0	3.8
2 L - 7	2	5/3/19 15:48:30	0.00	0.00	24.13	3.40	4.6	3.9	3.0	4.3	3.9
2 L - 7	4	5/3/19 15:50:30	0.00	0.00	24.13	3.40	4.5	4.1	3.1	4.2	4.0
2 L - 7	8	5/3/19 15:54:30	0.00	0.00	24.13	3.40	4.7	4.1	3.0	4.5	4.1
2 L - 8	1	5/3/19 15:57:30	0.00	0.00	27.65	3.90	5.3	4.7	3.8	4.8	4.7
2 L - 8	2	5/3/19 15:58:30	0.00	0.00	27.65	3.90	5.3	4.7	3.8	5.0	4.7
2 L - 8	4	5/3/19 16:00:30	0.00	0.00	27.65	3.90	5.4	4.9	4.2	5.1	4.9
2 L - 8	8	5/3/19 16:04:30	0.00	0.00	27.65	3.90	5.5	4.9	4.0	5.2	4.9
2 L - 9	1	5/3/19 16:07:30	0.00	0.00	31.03	4.38	6.1	5.5	4.6	5.7	5.5



ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA

TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 6
TP-7 - Bogota Metro - Bogota, Colombia

Load	Hold		Lower O-cell		Upper O-cell		Strain Gage Level 6				
Test	Time	Time	Pressure	Load	Pressure	Load	6A-1600617	6B-1600618	6C-1600619	6D-1600620	Av. Strain
Increment	(minutes)	(hh:mm:ss)	(MPa)	(MN)	(MPa)	(MN)	(me)	(me)	(me)	(me)	(me)
2 L - 9	2	5/3/19 16:08:30	0.00	0.00	31.03	4.38	6.3	5.6	4.7	5.6	5.6
2 L - 9	4	5/3/19 16:10:30	0.00	0.00	31.03	4.38	6.6	5.9	5.0	6.2	5.9
2 L - 9	8	5/3/19 16:14:30	0.00	0.00	31.03	4.38	6.5	5.9	5.0	6.0	5.9
2 L - 10	1	5/3/19 16:17:00	0.00	0.00	34.47	4.87	7.2	7.0	5.5	6.6	6.6
2 L - 10	2	5/3/19 16:18:00	0.00	0.00	34.47	4.87	7.3	6.9	5.5	6.6	6.6
2 L - 10	4	5/3/19 16:20:00	0.00	0.00	34.47	4.87	7.3	7.0	5.9	7.1	6.8
2 L - 10	8	5/3/19 16:24:00	0.00	0.00	34.47	4.87	7.5	7.4	5.9	6.9	6.9
2 L - 11	1	5/3/19 16:27:00	0.00	0.00	38.34	5.42	8.3	8.1	6.7	7.4	7.6
2 L - 11	2	5/3/19 16:28:00	0.00	0.00	38.34	5.42	8.2	8.1	6.6	7.6	7.6
2 L - 11	4	5/3/19 16:30:00	0.00	0.00	38.34	5.42	8.3	7.9	6.6	7.7	7.6
2 L - 11	8	5/3/19 16:34:00	0.00	0.00	38.34	5.42	8.5	8.3	6.8	7.6	7.8
2 L - 12	1	5/3/19 16:37:00	0.00	0.00	41.30	5.84	9.1	9.3	7.4	8.1	8.5
2 L - 12	2	5/3/19 16:38:00	0.00	0.00	41.30	5.84	9.1	9.1	7.4	8.3	8.5
2 L - 12	4	5/3/19 16:40:00	0.00	0.00	41.30	5.84	9.2	9.1	7.2	8.4	8.5
2 L - 12	8	5/3/19 16:44:00	0.00	0.00	41.30	5.84	9.3	9.2	7.7	8.6	8.7
2 L - 13	1	5/3/19 16:46:00	0.00	0.00	44.47	6.29	10.0	9.9	7.9	9.0	9.2
2 L - 13	2	5/3/19 16:47:00	0.00	0.00	44.47	6.29	10.1	10.0	7.9	9.1	9.2
2 L - 13	4	5/3/19 16:49:00	0.00	0.00	44.47	6.29	10.2	10.2	8.4	9.3	9.5
2 L - 13	8	5/3/19 16:53:00	0.00	0.00	44.47	6.29	10.4	10.2	8.2	9.3	9.5
2 L - 14	1	5/3/19 16:55:00	0.00	0.00	48.26	6.83	11.0	10.8	9.0	10.0	10.2
2 L - 14	2	5/3/19 16:56:00	0.00	0.00	48.26	6.83	11.2	10.9	9.1	10.2	10.3
2 L - 14	4	5/3/19 16:58:00	0.00	0.00	48.26	6.83	11.5	11.4	9.4	10.7	10.8
2 L - 14	8	5/3/19 17:02:00	0.00	0.00	48.26	6.83	12.0	11.7	9.8	11.0	11.1
2 L - 15	1	5/3/19 17:05:30	0.00	0.00	51.85	7.34	13.0	12.7	10.6	11.7	12.0
2 L - 15	2	5/3/19 17:06:30	0.00	0.00	51.85	7.34	12.9	12.6	10.8	11.9	12.0
2 L - 15	4	5/3/19 17:08:30	0.00	0.00	51.85	7.34	13.1	12.7	10.8	11.5	12.0
2 L - 15	8	5/3/19 17:12:30	0.00	0.00	51.85	7.34	13.1	12.9	10.8	11.9	12.2
2 L - 16	1	5/3/19 17:14:30	0.00	0.00	54.81	7.76	13.7	13.5	11.5	12.4	12.8
2 L - 16	2	5/3/19 17:15:30	0.00	0.00	54.81	7.76	14.1	13.8	11.7	12.5	13.0
2 L - 16	4	5/3/19 17:17:30	0.00	0.00	54.81	7.76	14.0	13.7	11.8	12.5	13.0
2 L - 16	8	5/3/19 17:21:30	0.00	0.00	54.81	7.76	14.4	14.0	11.9	12.8	13.3
2 L - 17	1	5/3/19 17:25:00	0.00	0.00	58.88	8.33	15.1	14.9	12.8	13.6	14.1
2 L - 17	2	5/3/19 17:26:00	0.00	0.00	58.88	8.33	15.2	14.8	12.5	13.5	14.0
2 L - 17	4	5/3/19 17:28:00	0.00	0.00	58.88	8.33	15.2	15.2	12.9	13.6	14.2
2 L - 17	8	5/3/19 17:32:00	0.00	0.00	58.88	8.33	15.6	15.4	13.1	14.0	14.5
2 L - 18	1	5/3/19 17:34:30	0.00	0.00	62.05	8.78	16.4	15.9	13.5	14.5	15.1
2 L - 18	2	5/3/19 17:35:30	0.00	0.00	62.05	8.78	16.6	15.9	13.7	14.5	15.2
2 L - 18	4	5/3/19 17:37:30	0.00	0.00	62.05	8.78	16.7	16.4	13.9	14.8	15.4
2 L - 18	8	5/3/19 17:41:30	0.00	0.00	62.05	8.78	17.0	16.7	14.2	15.1	15.7
2 L - 19	1	5/3/19 17:43:30	0.00	0.00	65.43	9.26	17.5	17.4	14.8	15.7	16.3
2 L - 19	2	5/3/19 17:44:30	0.00	0.00	65.43	9.26	17.6	17.4	14.8	15.8	16.4
2 L - 19	4	5/3/19 17:46:30	0.00	0.00	65.43	9.26	17.7	17.5	14.8	15.8	16.5
2 L - 19	8	5/3/19 17:50:30	0.00	0.00	65.43	9.26	17.8	17.9	15.0	15.9	16.7
2 L - 20	1	5/3/19 17:52:30	0.00	0.00	68.88	9.75	18.7	18.5	15.8	16.6	17.4
2 L - 20	2	5/3/19 17:53:30	0.00	0.00	68.88	9.75	18.8	18.7	16.0	16.7	17.5
2 L - 20	4	5/3/19 17:55:30	0.00	0.00	68.88	9.75	18.9	18.7	16.1	17.0	17.7
2 L - 20	8	5/3/19 17:59:30	0.00	0.00	68.88	9.75	19.2	19.0	16.2	17.0	17.9
2 L - 21	1	5/3/19 18:04:00	0.00	0.00	72.67	10.29	20.1	19.9	16.9	17.8	18.7
2 L - 21	2	5/3/19 18:05:00	0.00	0.00	72.67	10.29	20.2	20.2	17.1	17.9	18.8
2 L - 21	4	5/3/19 18:07:00	0.00	0.00	72.67	10.29	20.4	20.3	17.1	18.1	19.0
2 L - 21	8	5/3/19 18:11:00	0.00	0.00	72.67	10.29	20.8	20.4	17.2	18.2	19.2
2 L - 22	1	5/3/19 18:13:00	0.00	0.00	76.26	10.80	21.7	21.2	18.2	19.0	20.0
2 L - 22	2	5/3/19 18:14:00	0.00	0.00	76.26	10.80	21.8	21.3	18.4	19.2	20.2
2 L - 22	4	5/3/19 18:16:00	0.00	0.00	76.26	10.80	22.0	21.7	18.3	19.3	20.3
2 L - 22	8	5/3/19 18:20:00	0.00	0.00	76.26	10.80	22.3	21.9	18.8	19.4	20.6
2 L - 23	1	5/3/19 18:23:00	0.00	0.00	79.29	11.23	22.9	22.7	19.6	20.2	21.4
2 L - 23	2	5/3/19 18:24:00	0.00	0.00	79.29	11.23	23.1	22.7	19.7	20.2	21.4
2 L - 23	4	5/3/19 18:26:00	0.00	0.00	79.29	11.23	23.4	23.0	19.9	20.5	21.7
2 L - 23	8	5/3/19 18:30:00	0.00	0.00	79.29	11.23	23.6	23.0	20.1	20.6	21.8
2 L - 24	1	5/3/19 18:32:30	0.00	0.00	82.88	11.74	24.4	24.0	21.0	21.6	22.8
2 L - 24	2	5/3/19 18:33:30	0.00	0.00	82.88	11.74	24.8	24.4	21.2	21.6	23.0
2 L - 24	4	5/3/19 18:35:30	0.00	0.00	82.88	11.74	25.3	24.3	21.3	21.9	23.2
2 L - 24	8	5/3/19 18:39:30	0.00	0.00	82.88	11.74	25.2	24.7	21.6	22.0	23.4
2 L - 25	1	5/3/19 18:43:00	0.00	0.00	86.05	12.19	26.1	25.7	22.6	23.0	24.3
2 L - 25	2	5/3/19 18:44:00	0.00	0.00	86.05	12.19	26.4	25.9	22.8	23.0	24.5

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DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

LECTURAS DE INSTRUMENTACIÓN DE LA PRUEBA DE CARGA

Strain Gage Readings and Loads at Level 6
TP-7 - Bogota Metro - Bogota, Colombia

Load Test Increment	Hold Time (minutes)	Time (hh:mm:ss)	Lower O-cell		Upper O-cell		Strain Gage Level 6				
			Pressure (MPa)	Load (MN)	Pressure (MPa)	Load (MN)	6A-1600617 (me)	6B-1600618 (me)	6C-1600619 (me)	6D-1600620 (me)	Av. Strain (me)
2 L - 25	4	5/3/19 18:46:00	0.00	0.00	86.05	12.19	26.5	26.2	22.8	23.3	24.7
2 L - 25	8	5/3/19 18:50:00	0.00	0.00	86.05	12.19	26.7	26.3	23.3	23.4	24.9
2 L - 26	1	5/3/19 18:53:00	0.00	0.00	89.77	12.72	27.7	27.6	24.3	24.2	26.0
2 L - 26	2	5/3/19 18:54:00	0.00	0.00	89.77	12.72	27.7	27.6	24.6	24.6	26.1
2 L - 26	4	5/3/19 18:56:00	0.00	0.00	89.77	12.72	28.2	27.6	24.8	24.7	26.3
2 L - 26	8	5/3/19 19:00:00	0.00	0.00	89.77	12.72	28.5	27.9	24.9	24.9	26.6
2 U - 1	1	5/3/19 19:02:30	0.00	0.00	70.88	10.04	26.5	26.3	23.3	23.2	24.8
2 U - 1	2	5/3/19 19:03:30	0.00	0.00	70.88	10.04	26.6	26.5	23.4	23.2	24.9
2 U - 1	4	5/3/19 19:05:30	0.00	0.00	70.88	10.04	26.5	26.3	23.2	23.3	24.8
2 U - 2	1	5/3/19 19:08:00	0.00	0.00	53.71	7.60	24.0	23.8	20.8	20.8	22.4
2 U - 2	2	5/3/19 19:09:00	0.00	0.00	53.71	7.60	24.0	23.8	20.7	20.8	22.3
2 U - 2	4	5/3/19 19:11:00	0.00	0.00	53.71	7.60	23.9	23.8	20.9	20.8	22.3
2 U - 3	1	5/3/19 19:13:30	0.00	0.00	35.23	4.98	20.8	20.8	18.2	18.0	19.4
2 U - 3	2	5/3/19 19:14:30	0.00	0.00	35.23	4.98	20.8	20.8	18.0	17.9	19.4
2 U - 3	4	5/3/19 19:16:30	0.00	0.00	35.23	4.98	20.9	20.8	17.8	17.9	19.4
2 U - 4	1	5/3/19 19:19:00	0.00	0.00	17.44	2.45	17.5	17.4	15.1	14.6	16.2
2 U - 4	2	5/3/19 19:20:00	0.00	0.00	17.44	2.45	17.5	17.4	15.0	14.6	16.1
2 U - 4	4	5/3/19 19:22:00	0.00	0.00	17.44	2.45	17.6	17.4	15.1	15.0	16.3
2 U - 5	1	5/3/19 19:24:30	0.00	0.00	0.00	0.00	13.6	13.4	11.3	10.8	12.3
2 U - 5	2	5/3/19 19:25:30	0.00	0.00	0.00	0.00	13.4	13.4	11.3	10.8	12.2
2 U - 5	4	5/3/19 19:27:30	0.00	0.00	0.00	0.00	13.5	13.4	11.1	10.8	12.2
2 U - 5	8	5/3/19 19:31:30	0.00	0.00	0.00	0.00	13.2	13.2	11.1	10.8	12.1

ANEXO 6

ESCUELA COLOMBIANA DE INGENIERÍA JULIO GARAVITO

MAESTRÍA EN INGENIERÍA CIVIL CON ÉNFASIS EN GEOTECNIA
TESIS DE MAESTRÍA

DETERMINACIÓN DE CURVAS DE TRANSFERENCIA DE CARGA CON BASE EN UN ENSAYO DE CARGA AXIAL BIDIRECCIONAL CON CELDAS OSTERBERG EN UN PILOTE DE CONCRETO PRE EXCAVADO EN LA SABANA DE BOGOTÁ

ANÁLISIS CON METODOOGÍA DE RIGIDEZ TANGENCIAL

Incremento de carga	CELDA DE CARGA P (MN)	ΔP (MN)	Strain (me)	SG1 Δ Strain (me)	AE (MN)
1 L - 0	0		0		
1 L - 1	0.59	0.59	2.85	2.85	206698
1 L - 2	0.92	0.33	3.19	0.34	984423
1 L - 3	1.42	0.5	5.49	2.30	217674
1 L - 4	1.87	0.45	9.02	3.54	127258
1 L - 5	2.38	0.51	13.69	4.67	109222
1 L - 6	2.87	0.49	18.45	4.75	103081
1 L - 7	3.38	0.51	22.65	4.20	121300
1 L - 8	3.85	0.47	26.37	3.72	126380
1 L - 9	4.39	0.54	32.78	6.41	84223
1 L - 10	4.86	0.47	41.27	8.49	55382
1 L - 11	5.34	0.48	50.56	9.29	51677
1 L - 12	5.83	0.49	61.77	11.22	43681
1 L - 13	6.31	0.48	73.44	11.66	41159
1 L - 14	6.81	0.5	85.77	12.33	40544
1 L - 15	7.24	0.43	97.46	11.69	36789
1 L - 16	7.76	0.52	111.24	13.79	37722
1 L - 17	8.25	0.49	123.41	12.17	40260
1 L - 18	8.7	0.45	135.70	12.29	36614
1 L - 19	9.21	0.51	148.58	12.88	39605
1 L - 20	9.72	0.51	160.61	12.03	42385

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ANÁLISIS CON METODOOGÍA DE RIGIDEZ TANGENCIAL

Incremento de carga	CELDA DE CARGA P (MN)	ΔP (MN)	SG2 Strain (me)	SG2 Δ Strain (me)	AE (MN)
2 L - 1	0.47		27.6260868		
2 L - 1	0.47	0	27.51	-0.12	0
2 L - 2	1	0.53	28.46	0.95	558328
2 L - 3	1.45	0.45	29.71	1.25	360015
2 L - 4	1.95	0.5	30.81	1.11	452292
2 L - 5	2.41	0.46	32.00	1.19	386957
2 L - 6	2.93	0.52	33.38	1.38	377826
2 L - 7	3.4	0.47	34.63	1.25	375617
2 L - 8	3.9	0.5	36.29	1.66	300374
2 L - 9	4.38	0.48	37.55	1.25	383591
2 L - 10	4.87	0.49	38.74	1.20	409607
2 L - 11	5.42	0.55	40.86	2.12	259281
2 L - 12	5.84	0.42	41.97	1.11	378218
2 L - 13	6.29	0.45	43.61	1.63	275816
2 L - 14	6.83	0.54	46.03	2.42	222702
2 L - 15	7.34	0.51	47.83	1.80	282648
2 L - 16	7.76	0.42	49.58	1.75	240315
2 L - 17	8.33	0.57	52.18	2.60	219407
2 L - 18	8.78	0.45	54.51	2.33	193406
2 L - 19	9.26	0.48	56.86	2.35	204366
2 L - 20	9.75	0.49	59.65	2.79	175373
2 L - 21	10.29	0.54	62.64	2.99	180345
2 L - 22	10.8	0.51	65.96	3.31	153848
2 L - 23	11.23	0.43	69.35	3.40	126650
2 L - 24	11.74	0.51	72.59	3.24	157632
2 L - 25	12.19	0.45	76.03	3.44	130880
2 L - 26	12.72	0.53	80.38	4.35	121806

Incremento de carga	CELDA DE CARGA P (MN)	ΔP (MN)	SG3 Strain (me)	SG3 Δ Strain (me)	AE (MN)
2 L - 1	0.47		17.301252		
2 L - 2	1	0.53	18.8314808	1.53	346353
2 L - 3	1.45	0.45	20.8969132	2.07	217872
2 L - 4	1.95	0.5	23.8161156	2.92	171280
2 L - 5	2.41	0.46	27.1885764	3.37	136399
2 L - 6	2.93	0.52	29.527982	2.34	222279
2 L - 7	3.4	0.47	32.7638936	3.24	145245
2 L - 8	3.9	0.5	33.7215944	0.96	522084
2 L - 9	4.38	0.48	37.440954	3.72	129054
2 L - 10	4.87	0.49	42.4886672	5.05	97074
2 L - 11	5.42	0.55	44.1855332	1.70	324127
2 L - 12	5.84	0.42	48.6247604	4.44	94611
2 L - 13	6.29	0.45	52.0295712	3.40	132166
2 L - 14	6.83	0.54	58.02018	5.99	90141
2 L - 15	7.34	0.51	61.7616304	3.74	136311
2 L - 16	7.76	0.42	66.7986548	5.04	83383
2 L - 17	8.33	0.57	71.891464	5.09	111923
2 L - 18	8.78	0.45	77.8099216	5.92	76033
2 L - 19	9.26	0.48	82.3186464	4.51	106460

2 L - 20	9.75	0.49	87.507904	5.19	94426
2 L - 21	10.29	0.54	94.0585088	6.55	82435
2 L - 22	10.8	0.51	100.1574324	6.10	83621
2 L - 23	11.23	0.43	106.41921	6.26	68671
2 L - 24	11.74	0.51	112.9517856	6.53	78070
2 L - 25	12.19	0.45	118.1753412	5.22	86148
2 L - 26	12.72	0.53	124.8547088	6.68	79349

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ANÁLISIS CON METODOOGÍA DE RIGIDEZ TANGENCIAL

Incremento de carga	CELDA DE CARGA P (MN)	ΔP (MN)	Strain (me)	SG4 Δ Strain (me)	AE (MN)
2 L - 1					
2 L - 1	0.47	0.47	8.46	8.46	55530
2 L - 2	1	0.53	13.46	4.99	106184
2 L - 3	1.45	0.45	20.78	7.33	61415
2 L - 4	1.95	0.5	29.07	8.28	60352
2 L - 5	2.41	0.46	38.15	9.08	50652
2 L - 6	2.93	0.52	48.23	10.08	51600
2 L - 7	3.4	0.47	57.69	9.47	49647
2 L - 8	3.9	0.5	68.24	10.55	47411
2 L - 9	4.38	0.48	78.84	10.60	45280
2 L - 10	4.87	0.49	89.69	10.85	45172
2 L - 11	5.42	0.55	101.13	11.44	48075
2 L - 12	5.84	0.42	110.30	9.18	45771
2 L - 13	6.29	0.45	119.59	9.28	48473
2 L - 14	6.83	0.54	132.45	12.86	41988
2 L - 15	7.34	0.51	142.73	10.29	49582
2 L - 16	7.76	0.42	150.61	7.88	53329
2 L - 17	8.33	0.57	160.25	9.64	59110
2 L - 18	8.78	0.45	169.18	8.93	50385
2 L - 19	9.26	0.48	176.38	7.19	66727
2 L - 20	9.75	0.49	184.52	8.14	60207
2 L - 21	10.29	0.54	192.93	8.42	64143
2 L - 22	10.8	0.51	201.06	8.13	62730
2 L - 23	11.23	0.43	208.16	7.09	60646
2 L - 24	11.74	0.51	215.10	6.94	73462
2 L - 25	12.19	0.45	222.02	6.92	65006
2 L - 26	12.72	0.53	229.23	7.21	73552

Incremento de carga	CELDA DE CARGA P (MN)	ΔP (MN)	Strain (me)	SG5 Δ Strain (me)	AE (MN)
2 L - 1	0.47		2.6779708		
2 L - 2	1	0.53	4.2251216	1.55	342565
2 L - 3	1.45	0.45	6.4016766	2.18	206749
2 L - 4	1.95	0.5	8.6780154	2.28	219651
2 L - 5	2.41	0.46	10.9907812	2.31	198896
2 L - 6	2.93	0.52	13.8225536	2.83	183631
2 L - 7	3.4	0.47	16.5008054	2.68	175488
2 L - 8	3.9	0.5	19.5120652	3.01	166043
2 L - 9	4.38	0.48	22.5628088	3.05	157339
2 L - 10	4.87	0.49	25.8598168	3.30	148620
2 L - 11	5.42	0.55	29.6044098	3.74	146878
2 L - 12	5.84	0.42	32.6566814	3.05	137602
2 L - 13	6.29	0.45	36.1923186	3.54	127276
2 L - 14	6.83	0.54	41.2510862	5.06	106745
2 L - 15	7.34	0.51	45.5824912	4.33	117745
2 L - 16	7.76	0.42	48.8958398	3.31	126760
2 L - 17	8.33	0.57	53.6394662	4.74	120161
2 L - 18	8.78	0.45	58.1131072	4.47	100589
2 L - 19	9.26	0.48	61.7769396	3.66	131010
2 L - 20	9.75	0.49	65.985057	4.21	116442

2 L - 21	10.29	0.54	70.7767114	4.79	112696
2 L - 22	10.8	0.51	75.3948374	4.62	110434
2 L - 23	11.23	0.43	79.5188094	4.12	104268
2 L - 24	11.74	0.51	83.6868606	4.17	122359
2 L - 25	12.19	0.45	87.8719572	4.19	107524
2 L - 26	12.72	0.53	92.472054	4.60	115215

	CELDA DE CARGA			SG6	
Incremento de carga	P	ΔP	Strain	Δ Strain	AE
	(MN)	(MN)	(me)	(me)	(MN)
2 L - 1	0.47		-0.1570016		
2 L - 2	1	0.53	0.5281306	0.69	773573
2 L - 3	1.45	0.45	1.2131408	0.69	656925
2 L - 4	1.95	0.5	1.7992494	0.59	853084
2 L - 5	2.41	0.46	2.5164028	0.72	641425
2 L - 6	2.93	0.52	3.3988068	0.88	589299
2 L - 7	3.4	0.47	4.0554678	0.66	715742
2 L - 8	3.9	0.5	4.9253298	0.87	574804
2 L - 9	4.38	0.48	5.8579076	0.93	514702
2 L - 10	4.87	0.49	6.9171664	1.06	462588
2 L - 11	5.42	0.55	7.7935782	0.88	627559
2 L - 12	5.84	0.42	8.6999458	0.91	463388
2 L - 13	6.29	0.45	9.5156662	0.82	551660
2 L - 14	6.83	0.54	11.1228956	1.61	335982
2 L - 15	7.34	0.51	12.1952744	1.07	475578
2 L - 16	7.76	0.42	13.290554	1.10	383464
2 L - 17	8.33	0.57	14.5312886	1.24	459405
2 L - 18	8.78	0.45	15.739986	1.21	372302
2 L - 19	9.26	0.48	16.676179	0.94	512715
2 L - 20	9.75	0.49	17.8725188	1.20	409583
2 L - 21	10.29	0.54	19.1588694	1.29	419792
2 L - 22	10.8	0.51	20.6233242	1.46	348252
2 L - 23	11.23	0.43	21.8193158	1.20	359534
2 L - 24	11.74	0.51	23.3724084	1.55	328377
2 L - 25	12.19	0.45	24.9371436	1.56	287589
2 L - 26	12.72	0.53	26.5659756	1.63	325387