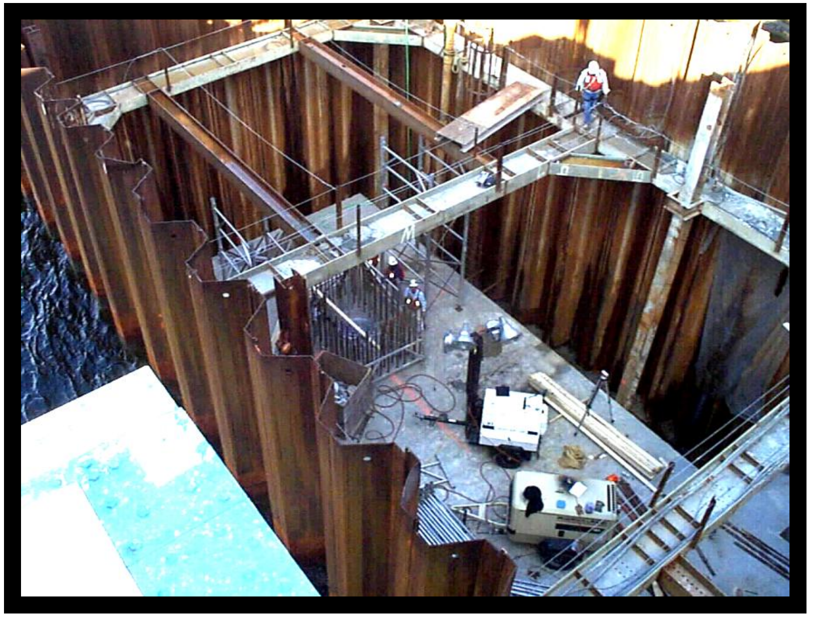
Foundation Engineering   CEG 4111-5115

Deep Foundation

By: Kamal Tawfiq, Ph.D., P.E.

Sheet Pile Walls



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Drilled Shaft

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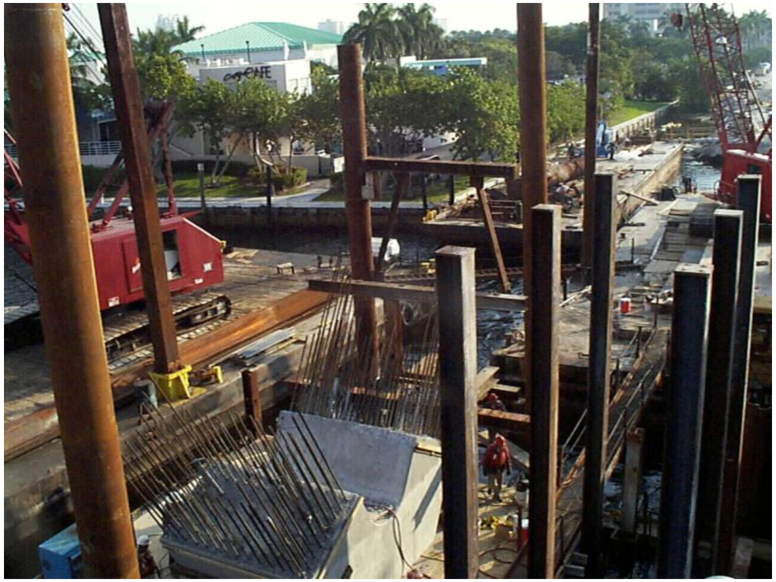


(a)

(b)

(c)

(d)

Figure 3-1: Solid Stem Continuous Flight Auger Drilling System: (a) In use on drill rig, (b) Finger and fishtail bits, (c) Sizes of solid stem auger flights, (d) Different assemblies of bits and auger flights. (All pictures in the above format are courtesy of DeJong and Boulanger, 2000)

Figure 3-3: **Hollow Stem Continuous Flight Auger Drilling Systems: (a) Comparison with solid stem auger; (b) Typical drilling configuration; (c) Sizes of hollow stem auger flights; (d) Stepwise center bit; (e) Outer bits; (f) Outer and inner assembly.**

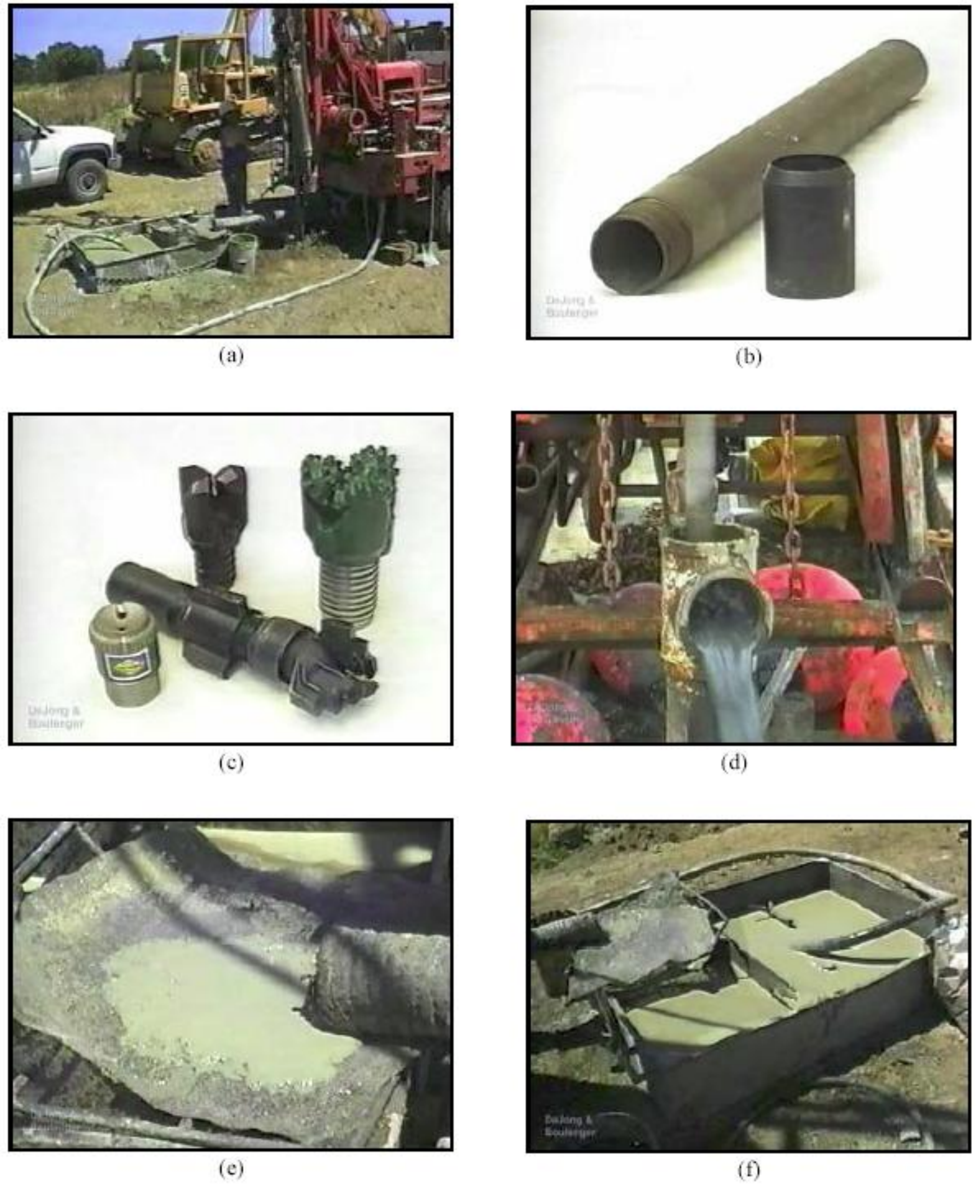


Figure 3-5: **Rotary Wash Drilling System: (a) Typical drilling configuration; (b) Casing and driving shoe; (c) Diamond, drag, and roller bits; (d) Drill fluid discharge; (e) Fluid cuttings catch screen; (f) Settling basin (mud tank).**

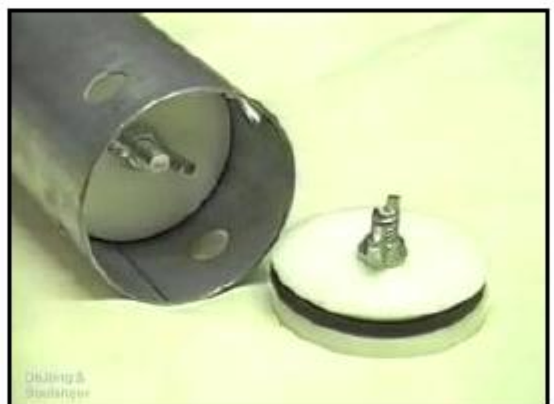
(a)

(b)

Figure 3-7: Split-Barrel Samplers: (a) Lengths of 457 mm (18 in) and 610 mm (24 in); (b) Inside diameters from 38.1 mm (1.5 in) to 89 mm (3.5 in).

Figure 3-11: Selected Sizes and Types of Thin-Walled Shelby Tubes.

(a)



(b)

Figure 3-12: Shelby Tube Sealing Methods. (a) Microcrystalline wax (b) O-ring packer.

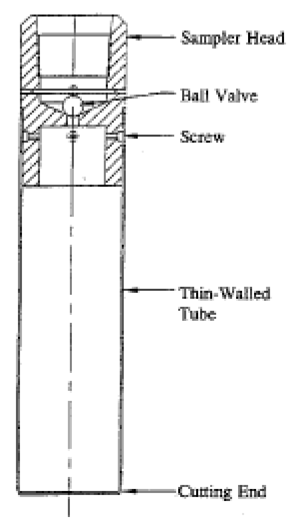


Figure 3-10: Schematic of Thin-Walled Shelby Tube (After ASTM D 4700).

(a) (b)

Figure 3-8: **Split Barrel Sampler: (a) Open sampler with soil sample and cutting shoe; (b) Sample jar, split-spoon, shelby tube, and storage box for transport of jar samples.**

(a) (b)

Figure 3-9: **Split Barrel Sampler. (a) Stainless steel and brass retainer rings (b) Sample catchers.**

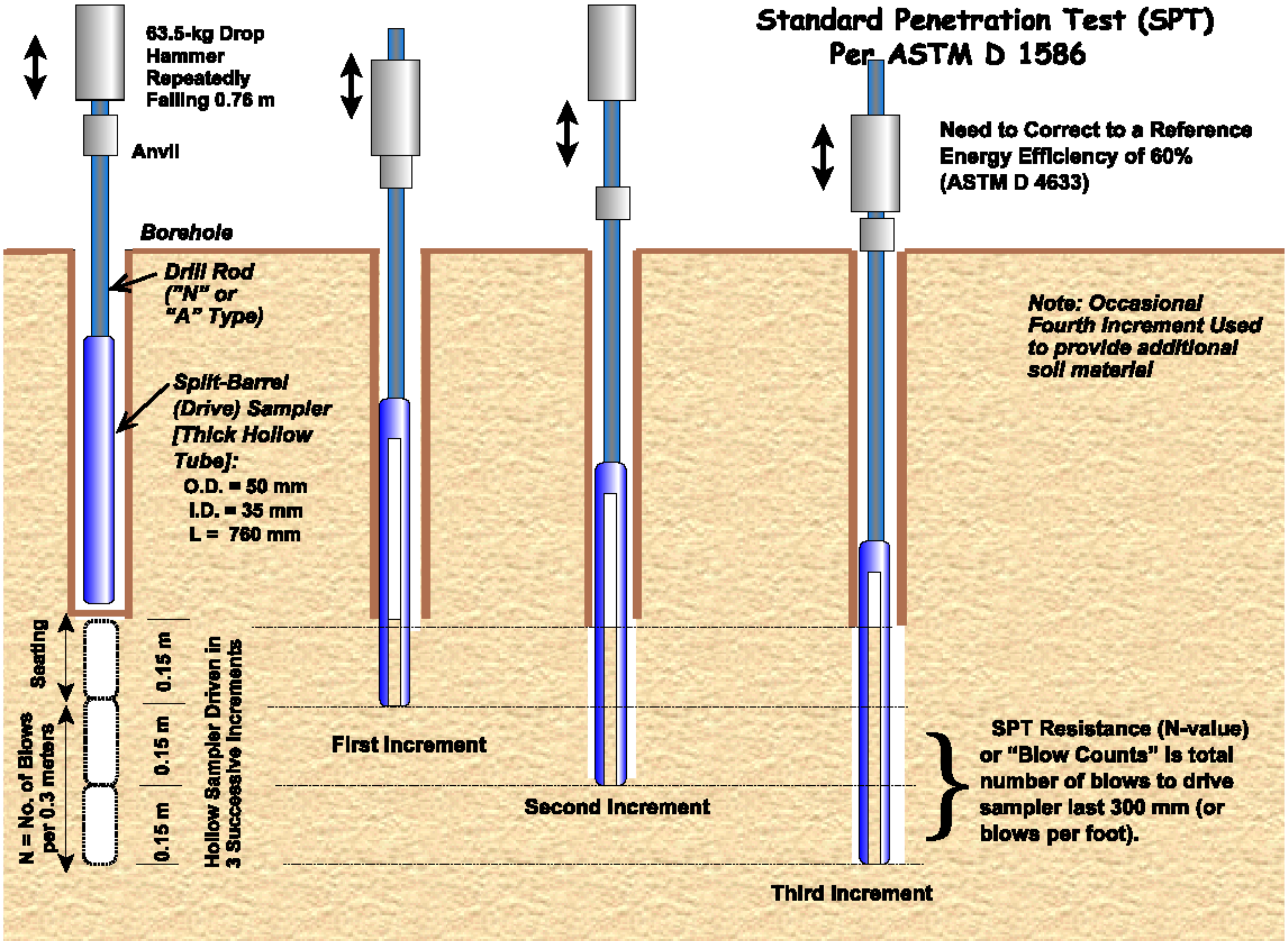


Figure 5-3. Sequence of Driving Split-Barrel Sampler During the Standard Penetration Test.

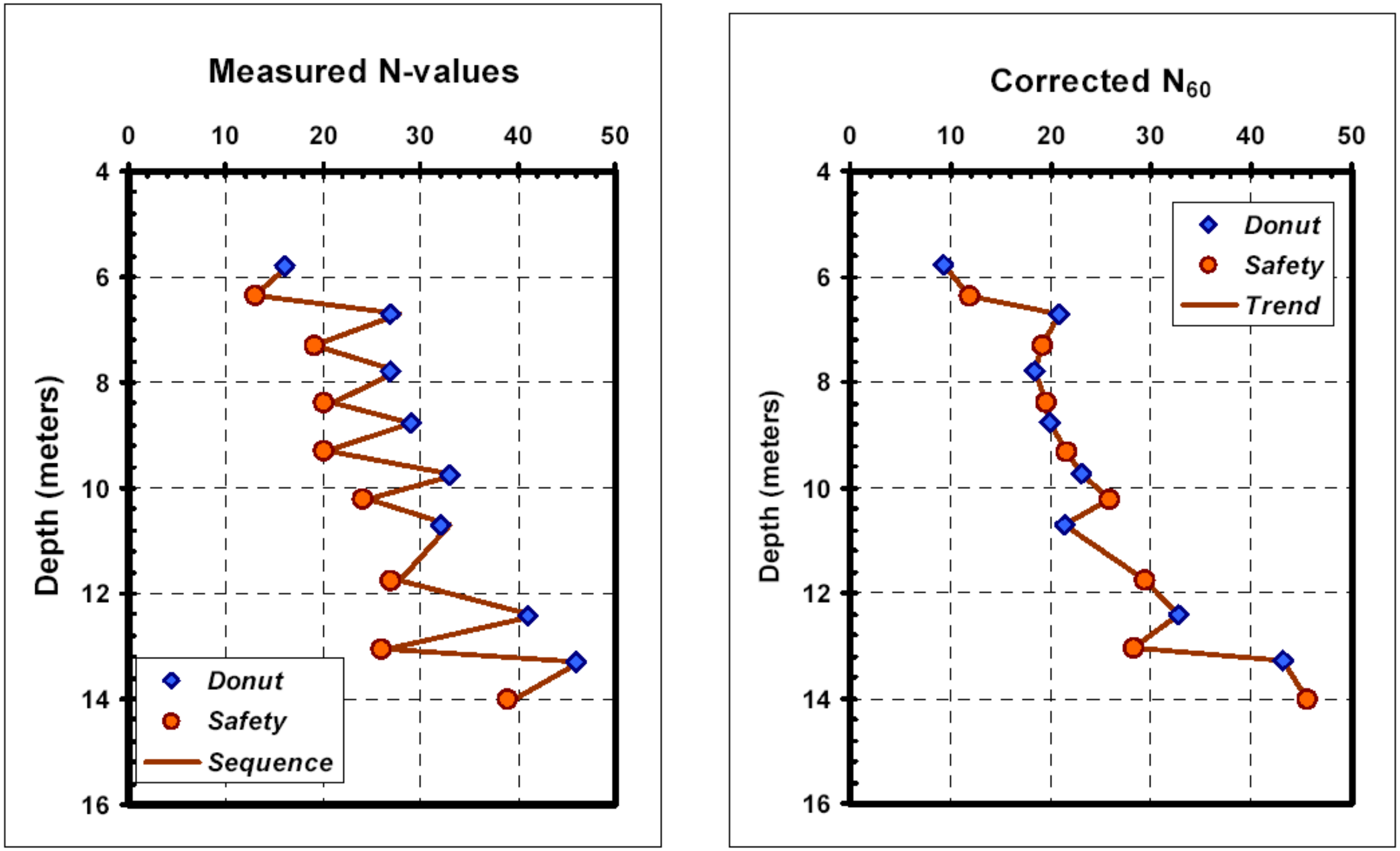


Figure 5-4. SPT-N values from (a) Uncorrected Data and (b) Corrected to 60% Efficiency.
(Data modified after Robertson, et al. 1983)

Figure 5-5. Various Cone Penetrometers Including Electric Friction and Piezocone Types.

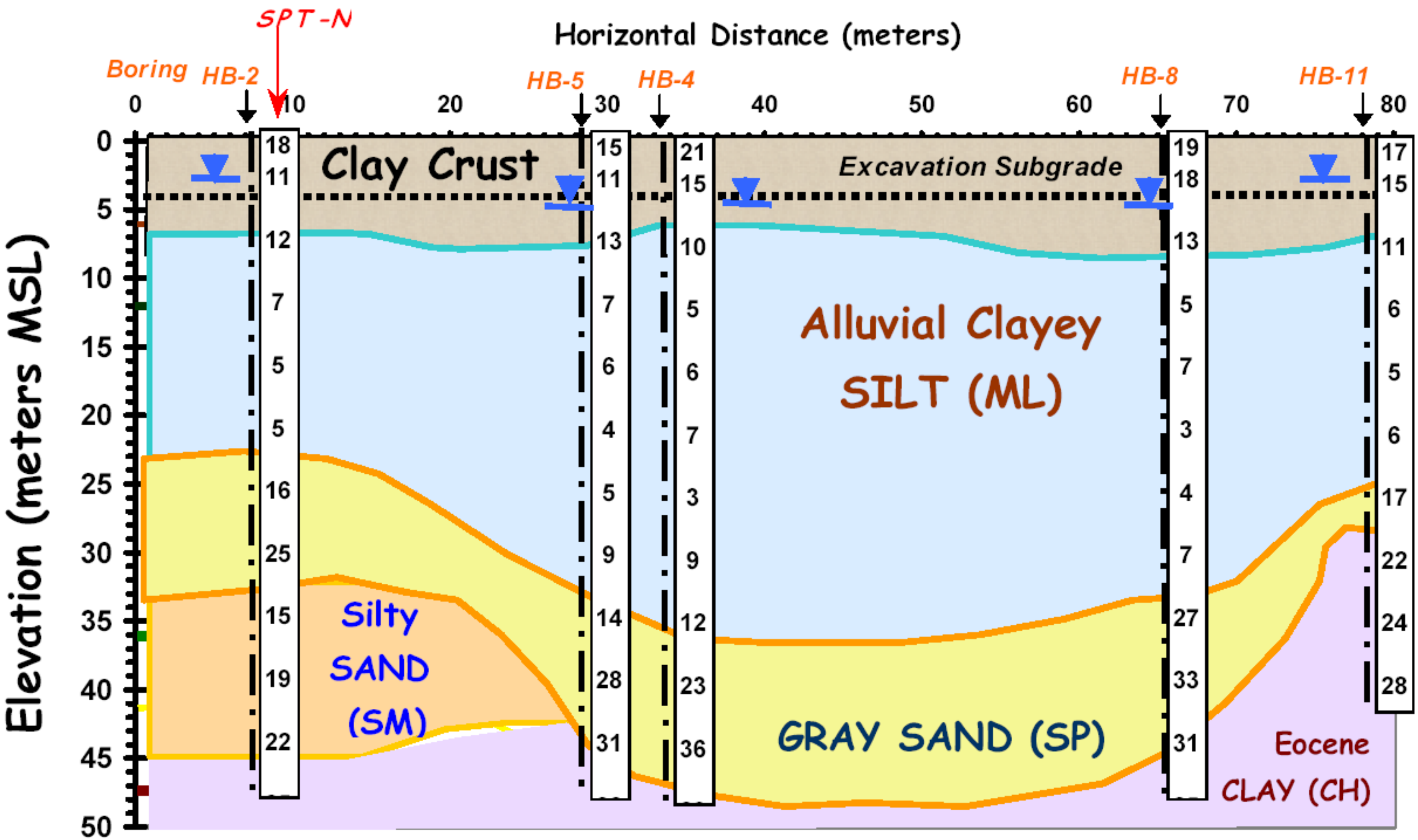


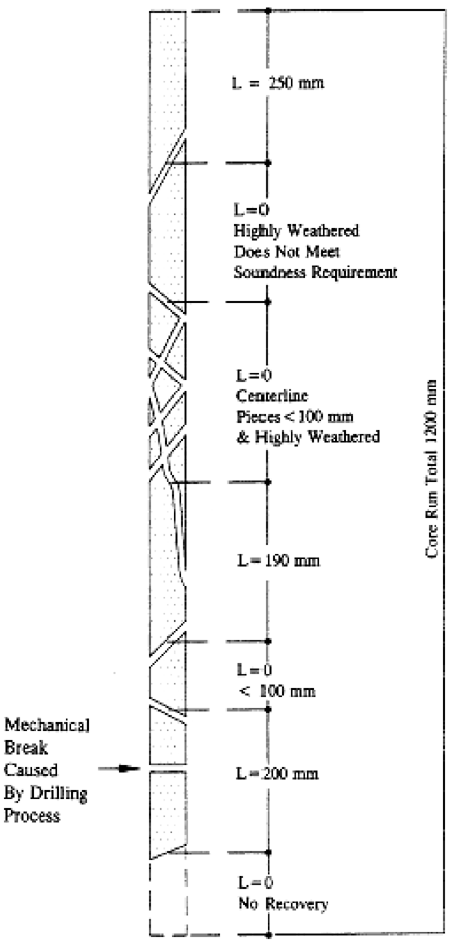
Figure 11-5. Subsurface Profile Based on Boring Data Showing Cross-Sectional View.

Rock Coring

(a) (b)

Figure 3-18: Double Tube Core Barrel. (a) Outer barrel assembly (b) Inner barrel assembly.

Figure 3-19: Coring Bits. From left to right: Diamond, Carbide, & Sawtooth.



$$RQD = \frac{\sum \text{Length of Sound Core Pieces} > 100 \ldots}{\text{Total Core Run Length}}$$

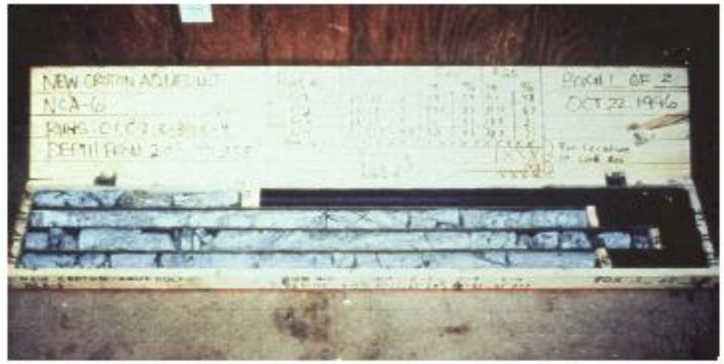
$$RQD = \frac{250 + 190 + 200}{1200} \times 100\%$$

$$RQD = 53\% \text{ (Fair)}$$

Rock Quality Description

RQD (Rock Quality Designation)	Description of Rock Quality
0 - 25%	Very Poor
25 - 50%	Poor
50 - 75%	Fair
75 - 90%	Good
90 - 100%	Excellent

Figure 3-20: Modified Core Recovery as an Index of Rock Mass Quality.



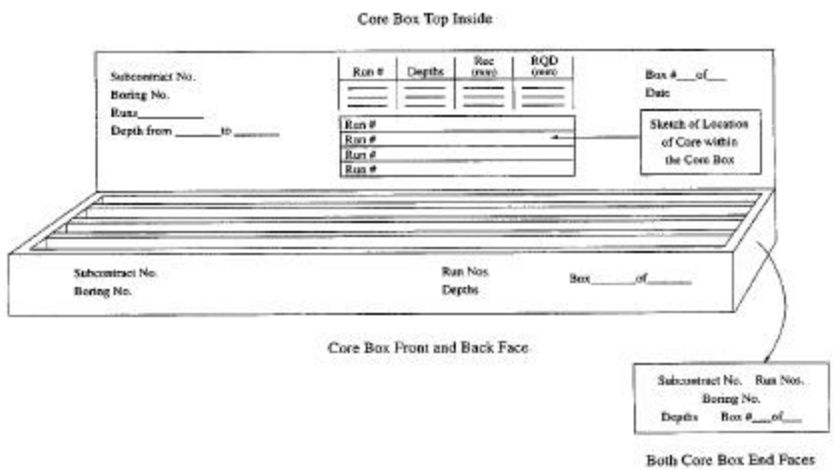


Figure 3-22: Core Box for Storage of Recovered Rock and Labeling .

EVALUATION OF THE CONSISTENCY OF FINE-GRAINED SOILS

Uncorrected N-value	Consistency	Unconfined Compressive Strength, q_u, kPa	Results Of Manual Manipulation
<2	Very soft	<25	Specimen (height = twice the diameter) sags under its own weight; extrudes between fingers when squeezed.
2 - 4	Soft	25 - 50	Specimen can be pinched in two between the thumb and forefinger; remolded by light finger pressure.
4 - 8	Firm	50 - 100	Can be imprinted easily with fingers; remolded by strong finger pressure.
8 - 15	Stiff	100 - 200	Can be imprinted with considerable pressure from fingers or indented by thumbnail.
15 - 30	Very stiff	200 - 400	Can barely be imprinted by pressure from fingers or indented by thumbnail.
>30	Hard	>400	Cannot be imprinted by fingers or difficult to indent by thumbnail.

PARTICLE SIZE DEFINITION FOR GRAVELS AND SANDS

Soil Component	Grain Size	Determination
Boulders*	300 mm +	Measurable
Cobbles*	300 mm to 75 mm	Measurable
Gravel		
Coarse	75 mm to 19 mm	Measurable
Fine	19 mm to #4 sieve (4.75 mm)	Measurable
Sand		
Coarse	#4 to #10 sieve	Measurable and visible to eye
Medium	#10 to #40 sieve	Measurable and visible to eye
Fine	#40 to #200 sieve	Measurable and barely discernible to the eye

*Boulders and cobbles are not considered soil or part of the soil's classification or description, except under miscellaneous description; i.e., with cobbles at about 5 percent (volume).

ENGINEERING SOIL TEST BORING RECORD

November 3, 2001

Elevation (ft-msl) +182.2	Stratum Depth (ft)	Visual Soil Description	Sample Depth (ft)	Sample Recovery (in)	Soil Sym. K	Penetration N 60 (blows/ft)	Remarks and raw SPT data
+180	0.3	Top soil, grass, and roots					
		Loose gray-brown clayey fine **SAND** (SC)	6.0	16		**7**	*(2+3+4)*
	7.0						
+170		Soft blue-tan clayey **SILT** (MH)	12.0	16		**3**	*(0+2+1)* ***Groundwater*** z_w ***= 15.5 feet*** *(Nov. 8, 2001)*
	14.5						
		Firm yellow-tan clean to slightly silty fine **SAND** (SP to SP-SM)	20.5	18		**32**	*(11+14+18)*
+160	21.5						
		Firm yellow-tan clean fine to medium **SAND** (SP)	28.0	11		**28**	*(+13+15+13)*
+150	30.0						
		Loose white to yellow slightly silty medium to coarse **SAND** (SP)	36.0	11		**5**	*(+2+3+2)*
	39.0						
+140		Very stiff green fine-medium sandy **CLAY** (CL)	43.5	16		**20**	*(+10+10+10)*
	45.5						
+130		Stiff green-gray silty to sandy **CLAY** (CL)	52.5	18		**15**	*(+6+7+8)*
	60.2						
+120		Dense white medium **SAND** (SP) with shells	63.5	10		**42**	*(+20+22+20)*
	64.0						
		REFUSAL at 64 feet					

Soil Symbols K (Unified Soil Classification System)

Top Soil
CL
MH
CH
SP

Other Symbols

Water Level

Driller:	E. Van Halen
Boring Number:	**AGB-1**
Date Drilled:	Oct/29/2001
Job Number	32335
Site Location:	Tampa Florida
Test Method:	ASTM D 1586
Hammer Type:	Diedrich Automatic (ER =82%)
Sampler:	Drive (split-barrel)
Drilling Method:	Hollow Stem Augers
Make of Drilling Rig:	CME-850 (truck mounted)

Notes:

N = Penetration in blows per foot (ASTM D-1586)

$N_{60} = (E_f/60) * N_{measured}$ = Energy-Corrected N-value

E_f = Energy Efficiency of Hammer Used

ER = energy ratio per ASTM D-4633