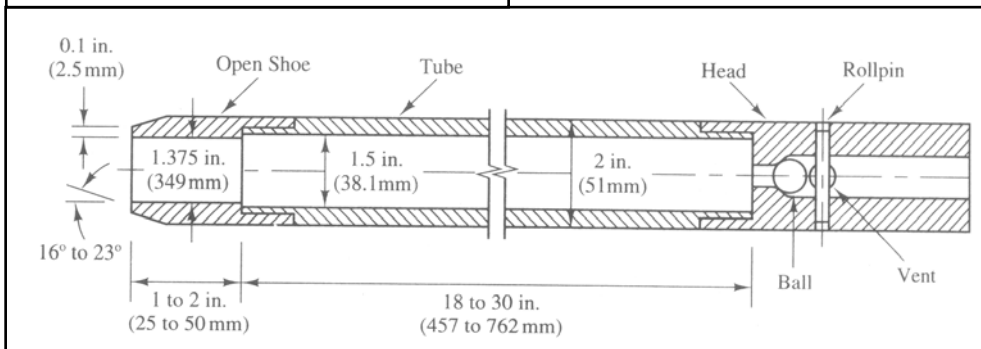


Deliverable 02
Sub-Surface Properties of Soil
Development in Rangamati,
Bandarban and Khagrachari
Municipality



January 2010

Submitted By



Asian Disaster Preparedness Center

House # 531/4, Lane # 11 (West), Baridhara DOHS, Dhaka-1219, Bangladesh

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1. Introduction

1.1 Scope of Work

The Asian Disaster Preparedness Centre (ADPC) is implementing the project “Seismic Hazard and Vulnerability Mapping for Rangamati, Bandarban and Khagrachari Municipality”. One of the major outcomes of the project is the development of seismic hazard maps of these three municipalities. Subsurface geotechnical investigation is essential to determine engineering properties of subsurface materials for the preparation of engineering geological and seismic hazard maps. The objectives of the subsurface geotechnical investigation of Rangamati, Bandarban and Khagrachari Towns include:

1. Construction of 10 (ten) SPT (Standard Penetration Test) boreholes using manual wash boring method.
2. Collection of disturbed samples using split spoon sampler and undisturbed samples using shelby tubing sampler.
3. Performance of geotechnical laboratory tests such as, moisture content, specific gravity, Atterberg limits, unit weight, grain size analysis, unconfined compression strength, direct shear, triaxial tests to determine physical and engineering properties, and shear strength parameters of the collected disturbed and undisturbed subsurface soil materials of Rangamati, Bandarban and Khagrachari Towns.

This report presents the initial findings from the boreholes conducted in the three municipalities.

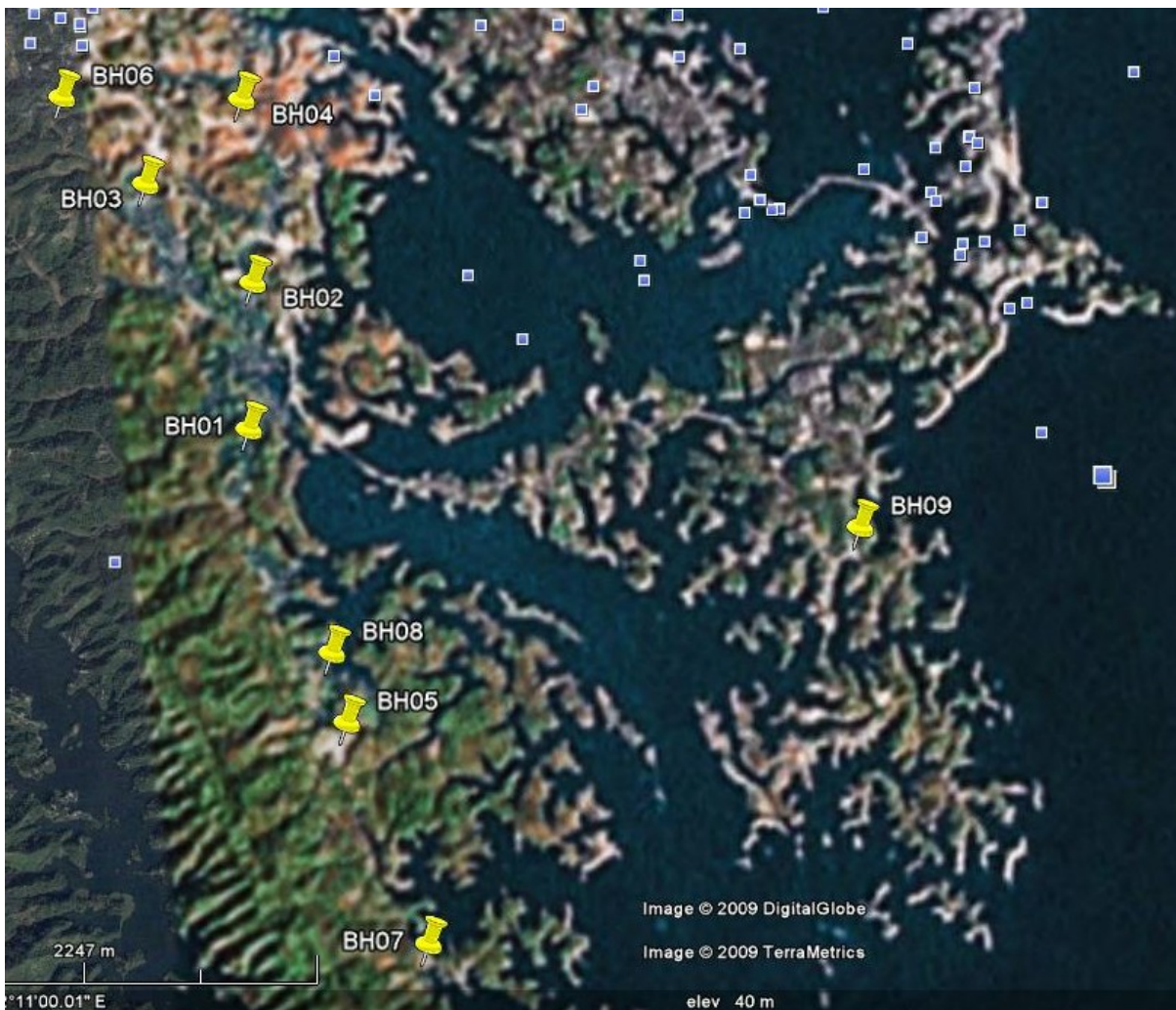
1.2 Borehole Locations and Selection Criteria

The geotechnical boreholes with Standard Penetration Test (SPT) have been conducted using wash boring method. In this investigation, 09 (nine) boreholes in Rangamati Town, 10 (ten) boreholes in Bandarban Town and 11 (eleven) boreholes in Khagrachari Town have been

prepared up to maximum 30 m depth. The borehole logs of three towns are enclosed in Appendix.

Rangamati

Response analysis will be conducted using SPT value to identify soft sedimentary soil which will amplify the seismic energy of the place. In Rangamati as the tertiary bed rocks are exposed in the hilly areas, there was no need for the SPT values in those areas.



Map 1 : Borehole locations in Rangamati Municipality

From the geomorphic assessment, Rangamati Municipality has been classified into 3 different classes viz. Valley Fill deposit, Erosional Slope Phase and Piedmond deposit other than the Hilly areas. The selection criteria for the SPT locations are described as follows:

Table 1: Geotechnical borehole locations in Rangamati Town

Borehole No.	Location	Latitude	Longitude	Geomorphic Unit
01	Shadhonapur, Rangapani	22°38'19"	92°09'34.6"	Erosional Slope Phase
02	Chompaknagar, Rangapani	22°38'41.8"	92°09'37.9"	Erosional Slope Phase
03	Monoghar, Vedvedi	22°38'59"	92°09'21.7"	Valley Fill Deposit
04	Montolla, Vedvedi	22°39'10.5"	92°09'39.5"	Valley Fill Deposit
05	Jhograbil, Thonchonkapara	22°37'31.6"	92°09'45.8"	Piedmond Deposit
06	Notunpara, Vedvedi	22°39'13.8"	92°09'09.3"	Valley Fill Deposit
07	Mitinga Chara Para, Thonchonkapara	22°36'55.7"	92°09'55.5"	Piedmond Deposit
08	Dakhin Thonchonkapara, Jograbil	22°37'42.9"	92°09'44.5"	Piedmond Deposit
09	BDR Sector Headquarters Gate	22°37'53.7"	92°11'15.9"	Piedmond Deposit

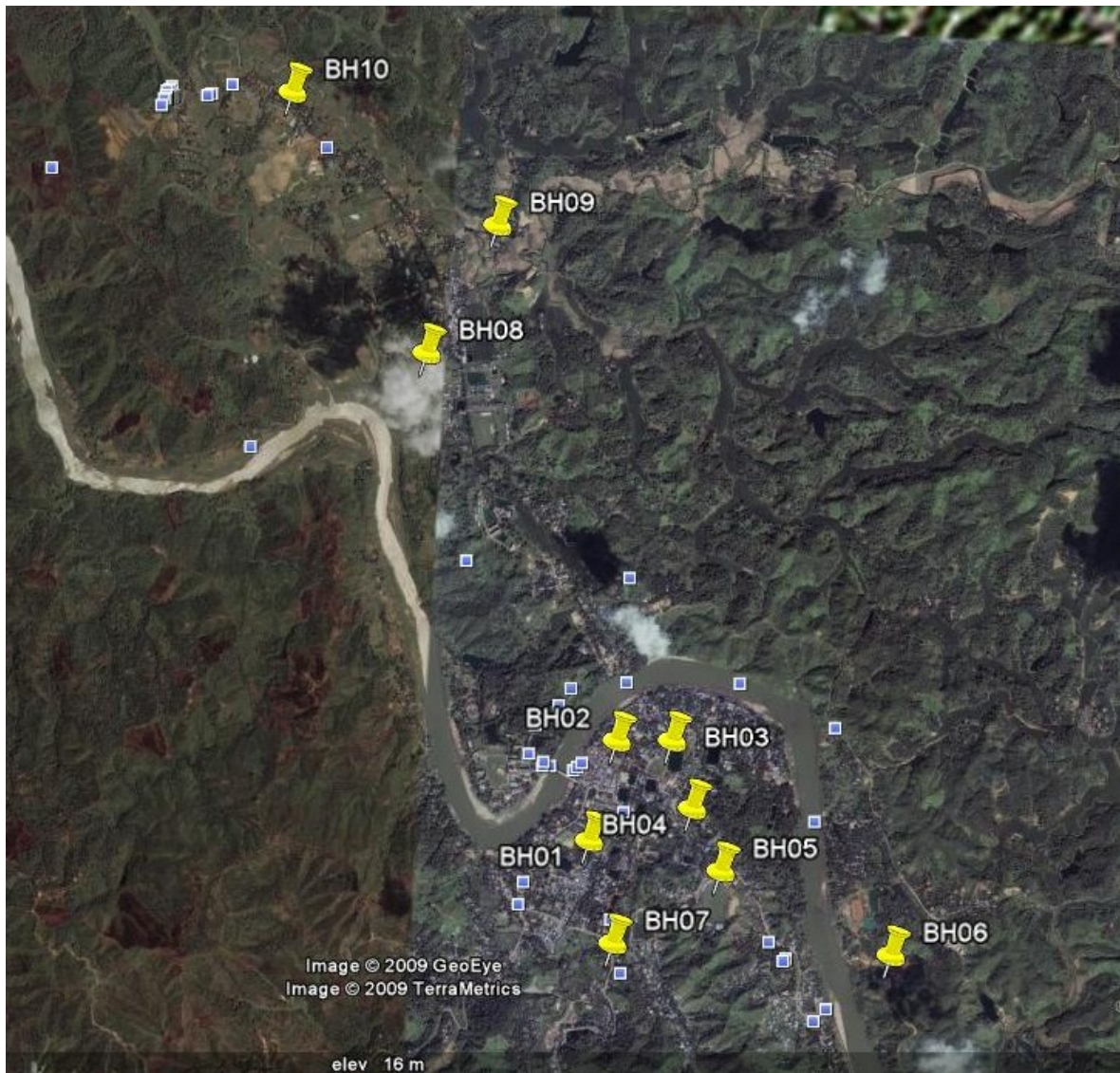
Some locations have been avoided as there is no urbanization in those particular areas, i.e. the seismic vulnerability is zero. To cross check and represent unique successive units, 2 or 3 boreholes have been selected from each class.

Bandarban

In Bandarban 7 different geomorphic classes have been identified other than the hilly areas. The locations of SPT are discussed as follows:

Table 2: Geotechnical borehole locations in Bandarban Town

Borehole No.	Location	Latitude	Longitude	Geomorphic Unit
01	Rassel Colony, Army Para	22°11'35"	92°13'3.6"	Erosional Slope Phase
02	Bandarban Govt. High School	22°11'49.69"	92°13'6.41"	Flood Plane
03	Rajar Math	22°11'50.5"	92°13'15"	Marshy Land
04	Girichaiya Police Quarter	22°11'40.6"	92°13'18.8"	Erosional Slope Phase/ Valley Fill
05	Bandarban Stadium	22°11'31.78"	92°13'23.83"	Level Hill
06	Kalaghata Notun Bridge	22°11'21.2 "	92°13'51.1"	Piedmond Deposit
07	Lushaibari	22°11'20.4"	92°13'07.7"	Valley Fill
08	Shoiloshova Housing Society	22°12'44"	92°12'33"	Flood Plane
09	Balaghata Muslim Para	22°13'03.1"	92°12'42.8"	Erosional Slope Phase
10	West Balaghata`	22°13'20.53"	92°12'09.56"	Valley Fill



Map 2: Geotechnical borehole locations are shown in Bandarban Town.

Khagrachari

In Khagrachari only different geomorphic classes have been identified other than the hilly areas. The locations of SPT are discussed as follows:

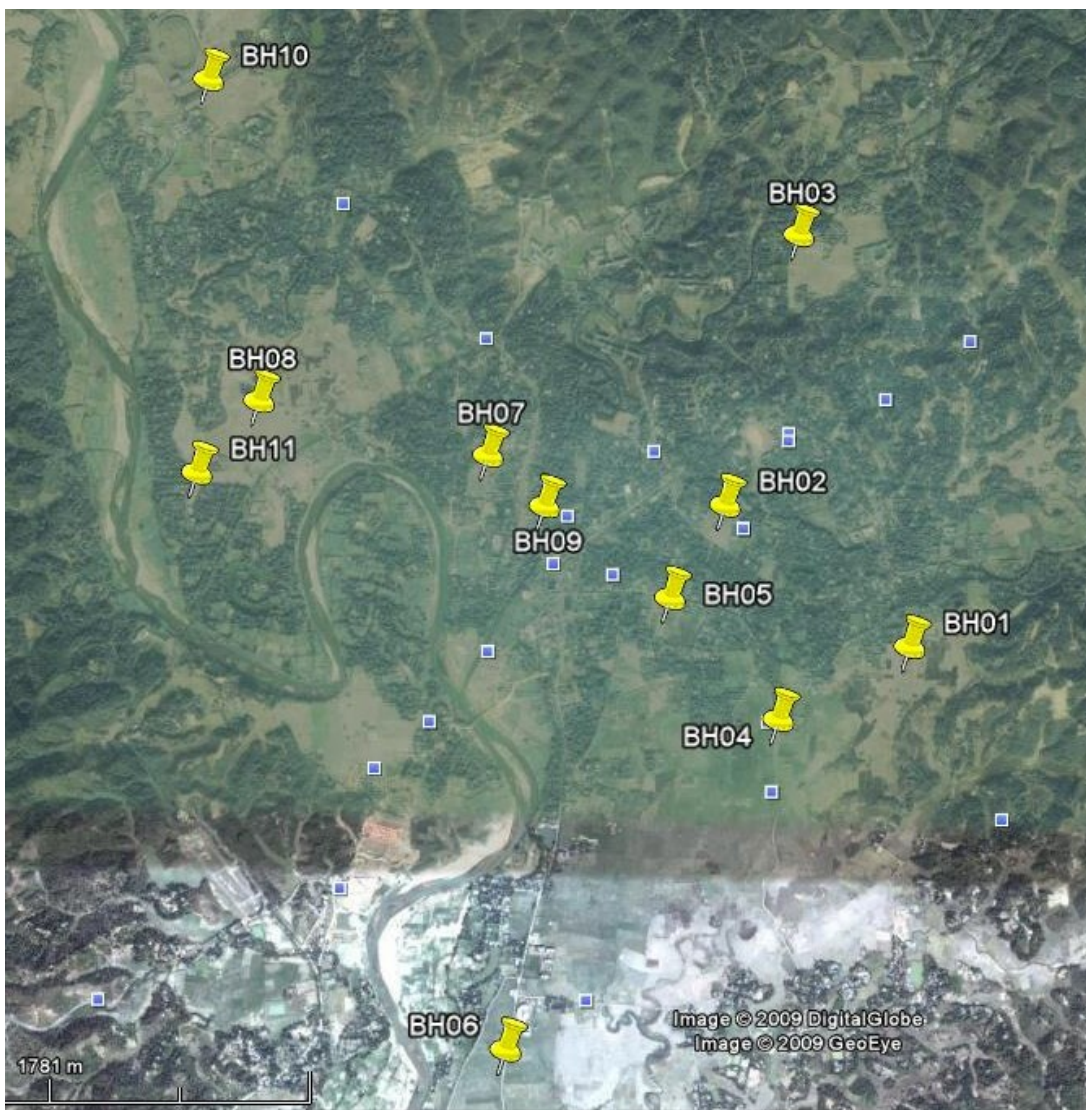
Table 3. Geotechnical borehole locations in Khagrachari Town.

Borehole No.	Location	Latitude	Longitude	Geomorphic units
01	Dakhin Modhupur	23°06'11.2"	91°59'41.3"	Valley fill deposit
02	Milonpur	23°06'27.4"	91°59'16.9"	Rounded Valley fill
03	Islampur	23°06'0.4"	91°59'25.3"	Rounded Valley fill
04	New Zealand Road	23°06'02.1"	91°59'24.7"	Rounded Valley fill

Geotechnical Investigation using Standard Penetration Test (SPT) in Rangamati, Bandarban and Khagrachari Towns

Borehole No.	Location	Latitude	Longitude	Geomorphic units
05	Anondonagar	23°06'16.1"	91°59'10.2"	Rounded Valley fill
06	Khagrachari Technical Training Institute	23°05'22.5"	91°58'51.4"	Point bar deposit
07	Arambag Math	23°06'32.5"	91°58'45.9"	Rounded Valley fill
08	Khobongpuria	23°06'38.2"	91°58'15.8"	Flood plane
09	Khagrachari Municipality	23°06'26.6"	91°58'53.5"	Rounded Valley fill
10	Dewanpara, Beside BDR Camp	23°07'17.3"	91°58'07"	Flood plane
11	Dakhin Khobongpuria	23°06'29.3"	91°58'08.24"	Point bar deposit

As the whole city is mostly fall within rounded valley fill areas, different locations have been selected with reference to different levels of the Engineering Bed Rock.



Map 3. Geotechnical borehole locations are shown in Khagrachari Town

2. Methods and Materials

The methods and materials used to carry out the geotechnical investigation have been described below:

2.1. Field Work

A detail field work has been carried out to select the locations of geotechnical borehole in different geomorphological and geological units of three towns. The locations of the boreholes have been recorded using Global Positioning System (GPS). The boreholes have been constructed in most of the geomorphological units of the towns. The geological materials encountered in boreholes have been interpreted and classified in the field.

2.1.1. Wash Boring

In this method, water is pumped through a string of hollow boring rods and is released under pressure through narrow holes in a chisel attached to the lower end of the rods (Figure 1). The soil is loosened and broken up by the water jets and the up and down movement of the chisel. There is also provision for the manual rotation of the chisel by means of a tiller attached to the boring rods above the surface. The soil particles are washed to the surface between the rods and the side of the borehole and are allowed to settle out in a sump. The rig consists of a derrick, a winch and a water pump. The winch carries a light steel cable which passes through the sheaf of the derrick and is attached to the top of the boring rods. The string of rods is raised and dropped by means of the winch unit, producing the chopping action of the chisel. The borehole is generally cased but the method can be used in uncased holes. Drilling fluid may be used as an alternative to water in the method, eliminating the need for casing.

Wash boring can be used in most types of soil but progress becomes slow if particles of coarse gravel size and larger are present. The accurate identification of soil types is difficult due to particles being broken up by the chisel and to mixing as the material is washed to the

surface: in addition, segregation of particles takes place as they settle out in the sump. However, a change in the feel of the boring tool can sometimes be detected, and there may be a change in the color of the water rising to the surface, when the boundaries between different strata are reached. The method is unacceptable as a means of obtaining soil samples. It is used only as a means of advancing a borehole to enable tube samples to be taken or in-situ tests such as Standard Penetration Test (SPT) to be carried out below the bottom of the hole. An advantage of the method is that the soil immediately below the hole remains relatively undisturbed.

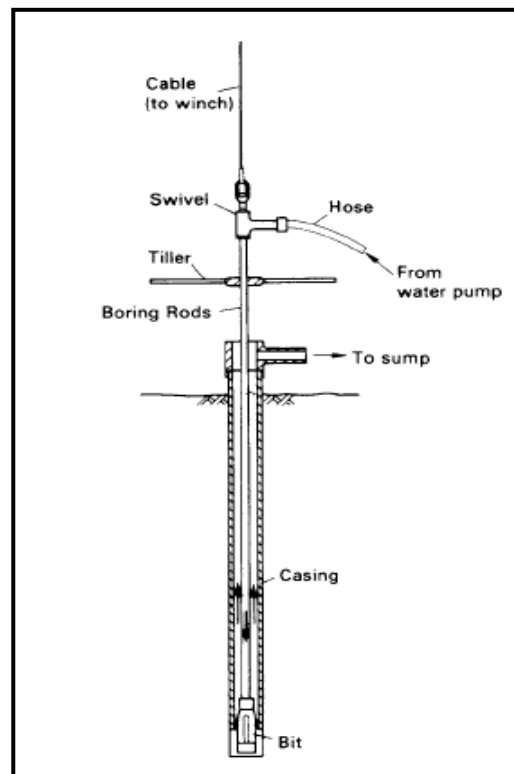


Figure 1: Wash Boring.

2.1.2. Soil Sampling

Soil samples are divided into two main categories, undisturbed and disturbed. Undisturbed samples, which are required mainly for shear strength and consolidation tests, are obtained

by techniques which aim at preserving the in-situ structure and water content of the soil. In boreholes, undisturbed samples can be obtained by withdrawing the boring tools (except when hollow-stem continuous-flight augers are used) and driving or pushing a sample tube into the soil at the bottom of the hole. The sampler is normally attached to a length of boring rod which can be lowered and raised by the cable of the percussion rig. When the tube is brought to the surface, some soil is removed from each end and molten wax is applied, in thin layers, to form a seal approximately 25mm thick: the ends of the tube are then covered by protective caps. Undisturbed block samples can be cut by hand from the bottom or sides of a trial pit. During cutting, the samples must be protected from water, wind and sun to avoid any change in water content: the samples should be covered with molten wax immediately they have been brought to the surface. It is impossible to obtain a sample that is completely undisturbed, no matter how elaborate or careful the ground investigation and sampling technique might be. In the case of clays, for example, swelling will take place adjacent to the bottom of a borehole due to the reduction in total stresses when soil is removed and structural disturbance may be caused by the action of the boring tools; subsequently, when a sample is removed from the ground the total stresses are reduced to zero.

Soft clays are extremely sensitive to sampling disturbance, the effects being more pronounced in clays of low plasticity than in those of high plasticity. The central core of a soft clay sample will be relatively less disturbed than the outer zone adjacent to the sampling tube. Immediately after sampling, the pore water pressure in the relatively undisturbed core will be negative due to the release of the in-situ total stresses. Swelling of the relatively undisturbed core will gradually take place due to water being drawn from the more disturbed outer zone and resulting in the dissipation of the negative excess pore water pressure: the outer zone of soil will consolidate due to the redistribution of water within the sample. The dissipation of the negative excess pore water pressure is accompanied by a corresponding reduction in effective stresses. The soil structure of the sample will thus offer less resistance to shear and will be less rigid than the in-situ soil.

A disturbed sample is one having the same particle size distribution as the in-situ soil but in which the soil structure has been significantly damaged or completely destroyed; in addition, the water content may be different from that of the in-situ soil. Disturbed samples, which are used mainly for soil classification tests, visual classification and compaction tests, can be excavated from trial pits or obtained from the tools used to advance boreholes (e.g. from augers and the clay cutter). The soil recovered from the shell in percussion boring will be deficient in fines and will be unsuitable for use as a disturbed sample. Samples in which the natural water content has been preserved should be placed in airtight, non-corrosive containers: all containers should be completely filled so that there is negligible air space above the sample.

All samples should be clearly labeled to show the project name, date, location, borehole number, depth and method of sampling; in addition, each sample should be given a serial number. Special care is required in the handling, transportation and storage of samples (particularly undisturbed samples) prior to testing.

The sampling method used should be related to the quality of sample required. Quality can be classified as follows, according to the uses to which the sample can be put:

Class 1: classification, water content, density, shear strength, deformation and consolidation tests.

Class 2: classification, water content and density tests.

Class 3: classification and water content tests.

Class 4: classification tests only.

Class 5: strata identification only.

For Classes 1 and 2 the sample must be undisturbed. Samples of Classes 3, 4 and 5 may be disturbed.

The types of tube samplers used in this study are described as follows.

2.1.2.1. Thin-walled Sampler

Thin-walled samplers (Figure 2) have been used to collect undisturbed samples from boreholes. These samplers are used in soils which are sensitive to disturbance such as soft to firm clays and plastic silts. The sampler does not employ a separate cutting shoe, the lower end of the tube itself being machined to form a cutting edge. The internal diameter may range from 35 to 100 mm. The area ratio is approximately 10% and samples of first-class quality can be obtained provided the soil has not been disturbed in advancing the borehole. In trial pits and shallow boreholes the tube can often be driven manually.

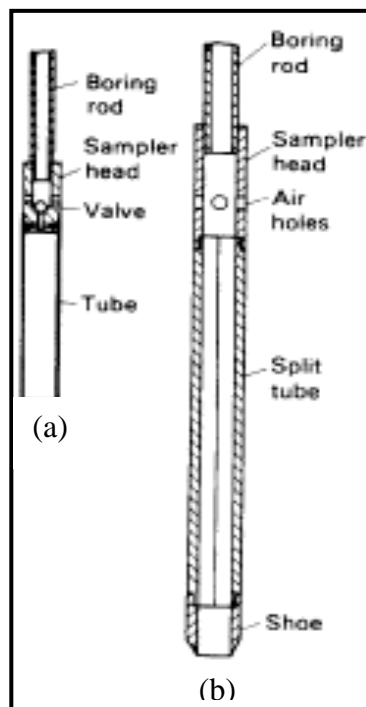


Figure 2. (a) Thin-walled (Shelby Tube) Sampler, and (b) Split-spoon Sampler.

2.1.2.2. Split-spoon Sampler

Split-spoon samplers (Figure 3) have been used to collect disturbed samples. It consists of a tube which is split longitudinally into two halves: a shoe and a sampler head incorporating air-

release holes are screwed onto the ends. The two halves of the tube can be separated when the shoe and head are detached to allow the sample to be removed. The internal and external diameters are 35 and 50 mm, respectively, the area ratio being approximately 100%, with the result that there is considerable disturbance of the sample (Class 3 or 4). This sampler is used mainly in sands, being the tool specified in the standard penetration test (SPT).

2.1.3. Standard Penetration Test (SPT)

One of the oldest and most common in-situ tests is the Standard Penetration Test or SPT (Figure 7). It was developed in the late 1920s and has been used extremely in North and South America, the United Kingdom, Japan, and elsewhere. Because of this long record of experience, the SPT is well-established in engineering practice. It is performed inside exploratory boring using inexpensive and readily available equipment, and thus adds little cost to a site characterization program.

Although the SPT also is plagued by many problems that affect its accuracy and reproducibility, it probably will continue to be used for the foreseeable future, primarily because of its low cost. However, it is partially being replaced by other test methods, especially on larger and more critical projects.

The ASTM standard D1586 has been followed to carry out SPT. The procedure is as follows.

1. Drill a 60-200 mm (2.5-8 in) diameter exploratory boring to the depth of the first test.
2. Insert the SPT sampler (also known as a Split-spoon Sampler) into the boring. The shape and dimensions of this sampler are shown in Figure 4. It is connected via steel rods to a 63.5 kg (140 lb) hammer, as shown in Figure 5.
3. Using either a rope and cathead arrangement (in case of wash boring used this technique in this investigation) or an automatic tripping mechanism (in case of rotary drilling used this technique in this investigation), raise the hammer a

distance of 760 mm (30 in) and allow it to fall. This energy drives the sampler into the bottom of the boring. Repeat this process until the sampler has penetrated a distance of 450 mm (18 in), recording the number of hammer blows required for each 150 mm (6 in) interval. Stop the test if more than 50 blows are required for any of intervals, or if more than 100 total blows are required. Either of these events is known as refusal and is so noted on the boring log.

4. Compute the N-value by summing the blow counts for the last 300 mm (12 in) of penetration. The blow count for the first 150 mm (6 in) is retained for reference purposes, but not used to compute N because the bottom of the boring is likely to be disturbed by the drilling process and may be covered with loose soil that fell from the sides of the boring. Note that the N-value is the same regardless of whether the engineer is using English or SI units.
5. Extract the SPT sampler, then remove and save the soil sample (disturbed sample).
6. Drill the boring to the depth of the next test and repeat steps 2 through 6 as required.

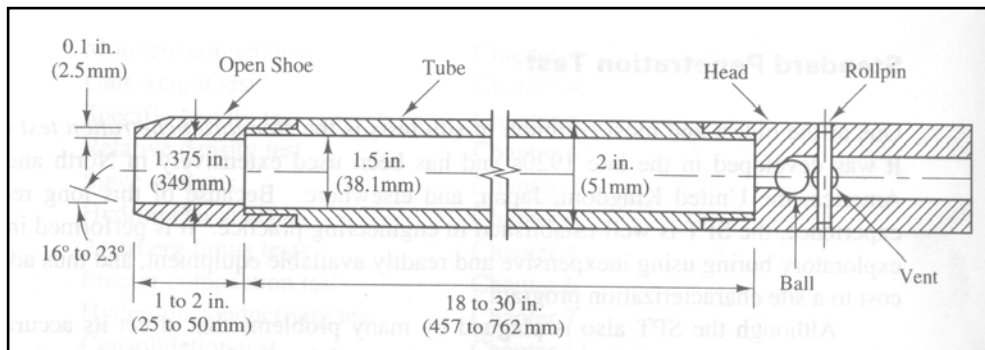


Figure 3: Split-spoon sampler

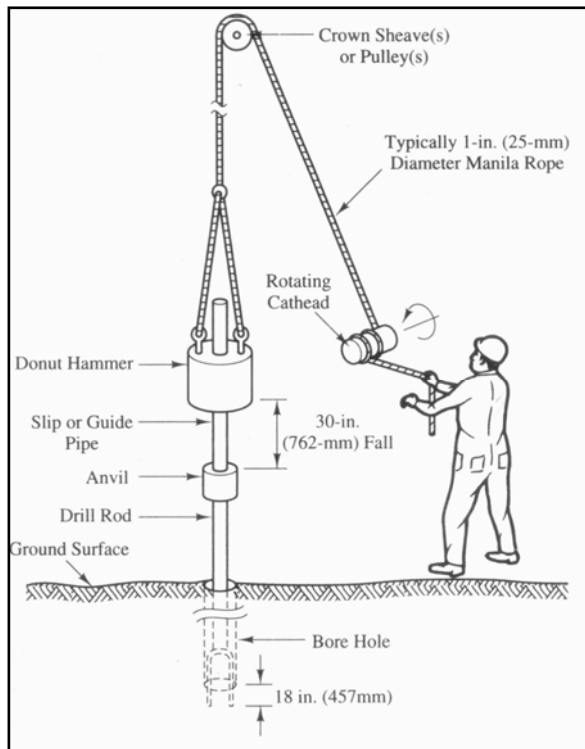


Figure 4: The SPT sampler in place in the boring.

Thus, N-values may be obtained at intervals no closer than 500 mm (20 in). Typically these tests are performed at 1.5 – 5 m (5 – 15 ft) intervals (1.5 m interval in this investigation).

The term consistency of the cohesive soil is generally used on the basis of the SPT values (N) in the following way.

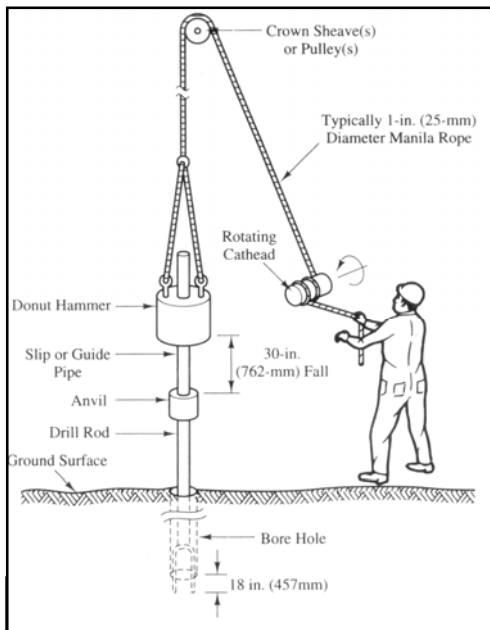
N	...	...	0-2	...	...	Very Soft
N	...	...	2-4	...	...	Soft
N	...	...	4-8	...	...	Medium
N	...	...	8-15	...	...	Stiff
N	...	...	15-30	...	...	Very Stiff
N	...	...	30-50	...	...	Hard
N	...	...	>50	...	...	Very Hard

The term relative density for the non-cohesive soil is used on the basis of the SPT values (N) in the following way.

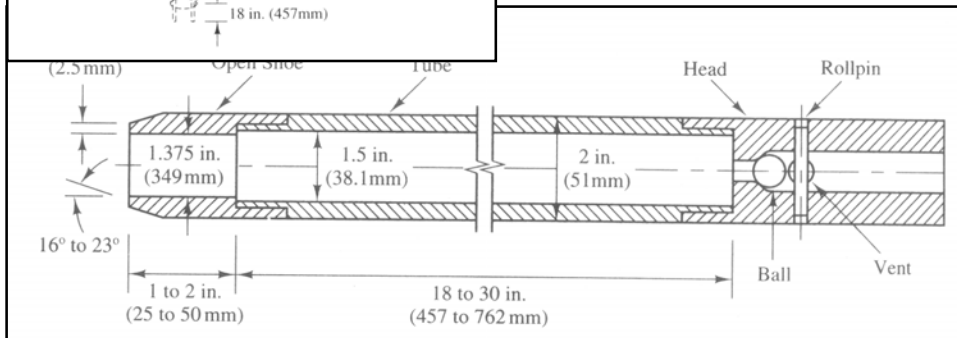
N	...	...	0-4	...	...	Very loose
N	...	...	4-10	...	...	Loose
N	...	...	10-30	...	...	Medium dense
N	...	...	30-50	...	...	Dense
N	...	...	>50	...	...	Very dense

3. Conclusion

Subsurface geotechnical investigation is essential to determine engineering properties of subsurface materials for the preparation of engineering geological and seismic hazard maps. Detail field work has been carried out to select the locations of geotechnical borehole in different geomorphological and geological units of three towns. The locations of the boreholes have been recorded using Global Positioning System (GPS). The boreholes have been constructed in most of the geomorphological units of the towns. The geological materials encountered in boreholes have been interpreted and classified in the field. The geotechnical boreholes with Standard Penetration Test (SPT) have been conducted using wash boring method. In this investigation, 09 (nine) boreholes in Rangamati Town, 10 (ten) boreholes in Bandarban Town and 11 (eleven) boreholes in Khagrachari Town have been prepared up to maximum 30 m depth. Split-spoon samplers have been used to collect disturb samples. Disturbed samples are used mainly for soil classification tests, visual classification. Thin-walled samplers have been used to collected undisturbed samples from boreholes. These samplers are used in soils which are sensitive to disturbance such as soft to firm clays and plastic silts. Undisturbed samples are required mainly for shear strength.



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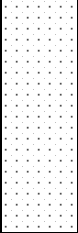
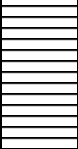
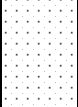
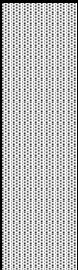
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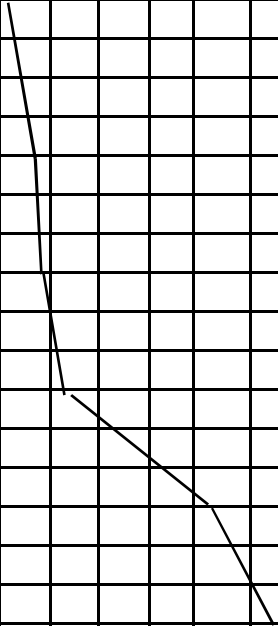

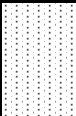

Client Name : UNDP-CHTDF					Borehole No: 01									
Project: Seismic Hazard and Vulnerability Assessment of Rangamati Town					Boring Depth: 16.5 m									
Location: Shadhonapur, Rangamati Town					G.W.L: 2.44 m									
Latitude: 22° 38' 19.0"			Longitude: 92° 09' 34.6"		Date: 23-12-2009									
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
			Extg. G.L											
2.5	1.5	S-1	Gray to brown very soft CLAY		1	0	1	1						
4.5	3	S-2	Gray loose SAND		3	4	5	9						
	4.5	S-3			1	2	7	9						
	6	S-4			3	4	5	9						
1.5	7.5	S-5	Gray medium silty CLAY with sand		1	2	2	4						
1.5	9	S-6	Gray loose SAND		3	4	5	9						
1.4	10.5	S-7	Yellowish brown dense SAND		10	15	25	40						
5.1	12	S-8	Yellowish brown very dense SAND		25	55	110	165						
	13.5	S-9			15	35	43	78						
	15	S-10			18	60	93	153						
	16.5	S-11			50	150								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 02		
Project: Seismic Hazard and Vulnerability Assessment of Rangamati Town			Boring Depth: 12 m		
Locatio:Chompoknagor,Rangapani, Rangamati Town			G.W.L: 1.83 m		
Latitude: 22° 38' 41.8"		Longitude: 92° 09' 37.9"		Date: 24-12-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2.3	1.5	S-1	Gray medium sandy CLAY		2	3	3	6					
3.2	3	S-2	Gray loose clayey SAND		1	2	1	3					
	4.5	S-3			2	3	4	7					
1.5	6	S-4	Gray soft CLAY with peat		1	1	2	3					
1.3	7.5	S-5	Gray loose SAND		1	2	4	6					
3.7	9	S-6	Gray very dense SAND		30	70	130	200					
	10.5	S-7			15	25	32	57					
	12	S-8			30	130	150						

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF					Borehole No: 03									
Project: Seismic Hazard and Vulnerability Assessment of Rangamati Town					Boring Depth: 12.0 m									
Location: Monoghor, Vedvedy, Rangamati Town					G.W.L: 0.66 m									
Latitude: 22° 38' 59.0"		Longitude: 92° 09' 21.7"			Date: 25-12-2009									
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
Extg. G.L.					15cm	15cm	15cm	N-value	10	20	30	40	50	
2	1.5	S-1	Gray very soft sandy CLAY		1	0	1	1						
3.5	3	S-2	Yellowish brown loose clayey SAND		2	3	4	7						
	4.5	S-3			2	3	5	8						
1.5	6	S-4	Yellowish brown medium SAND		3	5	7	12						
5	7.5	S-5	Yellowish brown dense to very dense SAND		10	16	25	41						
	9	S-6			12	22	32	54						
	10.5	S-7			20	42	90	132						
	12	S-8			88	218								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 04
Project: Seismic Hazard and Vulnerability Assessment of Rangamati Town		Boring Depth: 10.5 m
Location: Monotola, Vedvedy, Rangamati Town		G.W.L: 0.31 m
Latitude: 22°39'10.5"	Longitude: 92° 09' 39.5"	Date: 26-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2.5	1.5	S-1	Gray very soft sandy CLAY		1	2	2	4					
1.5	3	S-2	Yellowish brown medium dense clayey SAND		6	9	10	19					
6.4	4.5	S-3	Yellowish brown very dense SAND		9	22	34	56					
	6	S-4			25	40	50	90					
	7.5	S-5			15	36	57	93					
	9	S-6			31	175							
10.5	S-7			45	220								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF Borehole No: 05

Project: Seismic Hazard and Vulnerability Assessment of Rangamati Town Boring Depth: 15 m

Location: Jhograbil Thonchonkapara, Rangamati Town G.W.L: 1.37 m

Latitude: 22° 37' 31.6" Longitude: 92° 09' 45.8" Date: 27-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L.														
4	1.5	S-1	Yellowish brown medium CLAY	[Hatched]	1	2	3	5						
	3	S-2		[Hatched]	1	2	3	5						
3	4.5	S-3	Gray loose clayey SAND	[Dotted]	1	2	6	8						
	6	S-4		[Dotted]	3	4	6	10						
4.5	7.5	S-5	Gray medium dense clayey SAND	[Dotted]	4	7	10	17						
	9	S-6		[Dotted]	3	5	7	12						
	10.5	S-7		[Dotted]	2	3	7	10						
3.5	12	S-8	Yellowish brown dense to very dense SAND	[Dotted]	6	13	22	35						
	13.5	S-9		[Dotted]	40	175	100							
	15	S-10		[Dotted]	60	242	200							

Asian Disaster Preparedness Center (ADPC)

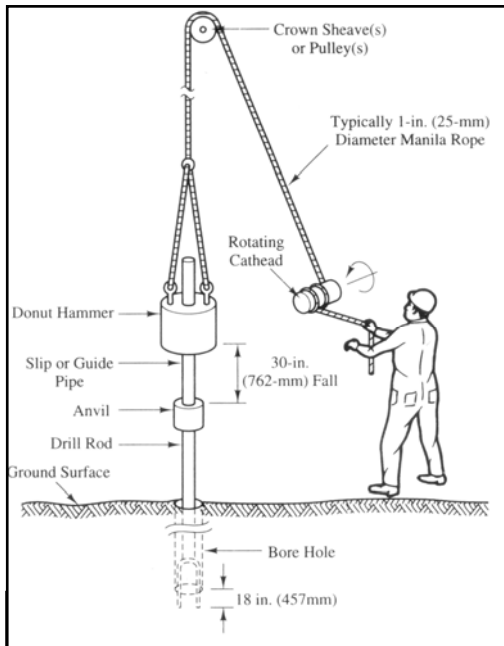
Client Name : UNDP-CHTDF				Borehole No: 06									
Project: Seismic Hazard and Vulnerability Assessment of Ragnamati Town				Boring Depth: 9 m									
Location: Notunpara, Vedvedy, Rangamati Town				G.W.L: 2.44 m									
Latitude: 22° 39' 13.8"		Longitude: 92° 09' 09.3"		Date: 31-12-2009									
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
4	1.5	S-1	Gray soft to medium sandy CLAY	1	1	2	3						
	3	S-2		1	2	2	4						
5	4.5	S-3	Yellowish brown very dense SAND	15	42	65	107						
	6	S-4		20	60	85	145						
	7.5	S-5		80	200								
	9	S-6		150	100								

Asian Disaster Preparedness Center (ADPC)

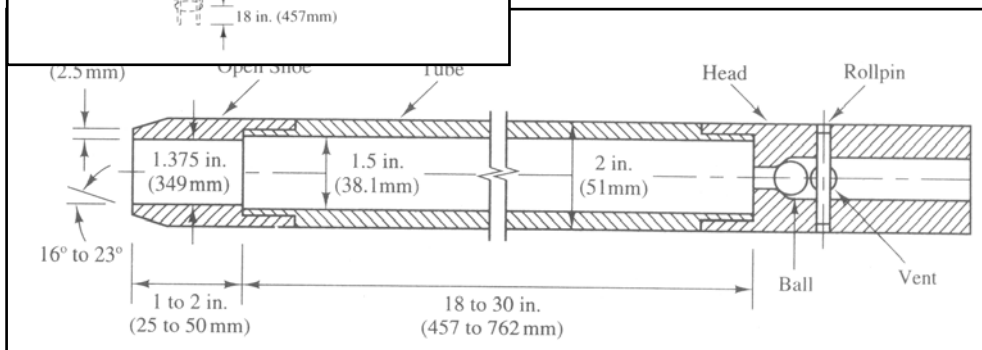
Client Name : UNDP-CHTDF				Borehole No: 08									
Project: Seismic Hazard and Vulnerability Assessment of Ragnamati Town				Boring Depth: 15 m									
Location: Jhograbil, Dakhin Tongchankapara, Ranganamati Town				G.W.L: 1.1 m									
Latitude: 22° 37' 49.9"		Longitude: 92° 09' 44.5"		Date: 29-12-2009									
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2.5	1.5	S-1	Yellowish brown soft sandy CLAY		1	1	1	2					
3	3	S-2	Yellowish brown loose clayey SAND.		2	3	4	7					
	4.5	S-3			2	3	4	7					
3	6	S-4	Yellowish brown medium dense SAND		4	8	12	20					
	7.5	S-5			4	5	6	11					
1.5	9	S-6	Yellowish brown loose SAND		1	3	4	7					
5	10.5	S-7	Yellowish brown dense to very dense SAND		6	13	25	38					
	12	S-8			16	32	43	75					
	13.5	S-9			62	230							
	15	S-10			100	190							

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF				Borehole No: 9									
Project: Seismic Hazard and Vulnerability Assessment of Ragnamati Town				Boring Depth: 13.5 m									
Location: BDR sector Head quartergate, Ragnamati Town				G.W.L: 1.37 m									
Latitude: 22° 37' 53.0"		Longitude: 92°11'15.9"		Date: 30-12-2009									
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
3	1.5	S-1	Reddish brown soft CLAY	1	1	1	2						
	3	S-2		1	1	2	3						
3	4.5	S-3	Yellowish brown loose clayey SAND	3	5	5	10						
	6	S-4		2	3	4	7						
7.5	7.5	S-5	Yellowish brown dense to very dense SAND	6	10	18	28						
	9	S-6		12	18	30	48						
	10.5	S-7		12	25	37	62						
	12	S-8		13	26	37	63						
13.5	S-9			35	105	232	337						



Deliverable 02
Sub-Surface Properties of Soil
Development in Bandarban
Municipality



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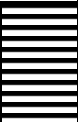
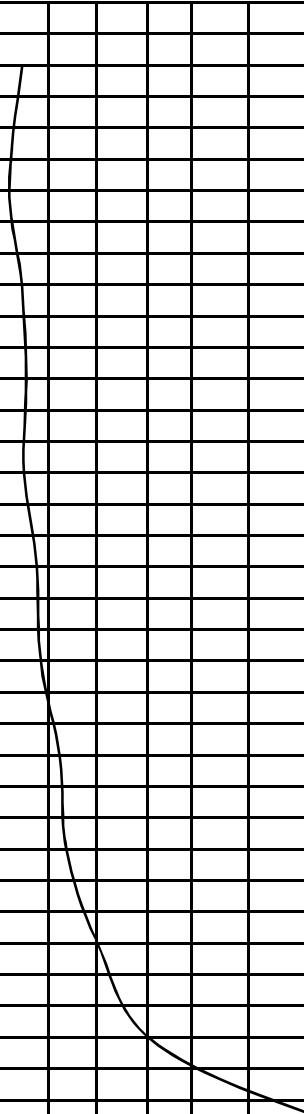


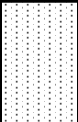
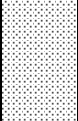


Asian Disaster Preparedness Center

House # 531/4, Lane # 11 (West), Baridhara DOHS, Dhaka-1219, Bangladesh

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 01		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 24 m		
Location: Rassel Colony, Armypara, Bandarban Town			G.W.L: 3.05 m		
Latitude: 22° 11' 35"		Longitude: 92° 13' 3.6"		Date: 23-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
4	1.5	S-1	Yellowish brown medium stiff CLAY		1	2	3	5						
	3	S-2			1	1	1	2						
4.3	4.5	S-3	Gray yellowish brown medium stiff silty CLAY		1	2	3	5						
	6	S-4			2	3	3	6						
	7.5	S-5			2	2	3	5						
5.7	9	S-6	Yellowish brown loose to medium SAND		3	3	5	8						
	10.5	S-7			3	3	6	9						
	12	S-8			4	5	7	12						
	13.5	S-9			3	5	8	13						
2	15	S-10	Grey medium silty SAND with clay		5	8	12	20						
8	16.5	S-11	Grey dense to very dense SAND		8	12	28	40						
	18	S-12			15	22	35	57						
	19.5	S-13			15	27	30	57						
	21	S-14			17	25	33	58						
	22.5	S-15			30	71	92	163						
	24	S-16			105	147								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 02
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town		Boring Depth: 25.5 m
Location: Bandarban Govt. High School, Bandarban Town		G.W.L: 3.05 m
Latitude: 22° 11' 49.69"	Longitude: 92° 13' 6.41"	Date: 20-11-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
4	1.5	S-1	Grey very soft to soft silty CLAY with sand		1	0	1	1						
	3	S-2			1	1	2	3						
6	4.5	S-3	Grey to yellowish brown medium to stiff CLAY		2	3	4	7						
	6	S-4			2	2	5	7						
	7.5	S-5			2	3	4	7						
	9	S-6			3	3	5	8						
1.5	10.5	S-7	Yellowish brown loose clayey SAND		2	3	3	6						
2.5	12	S-8	Yellowish brown medium SAND.		4	6	6	12						
	13.5	S-9			5	7	9	16						
2	15	S-10	Grey hard clayey SILT		8	15	22	37						
1.5	16.5	S-11	Grey medium SAND		6	8	14	22						
5.5	18	S-12	Grey medium to dense silty SAND		15	18	20	38						
	19.5	S-13			8	12	12	24						
	21	S-14			12	12	22	34						
	22.5	S-15			13	15	23	38						
2	24	S-16	Gray very dense SAND		17	28	40	68						
	25.5	S-17			40	60	85	145						


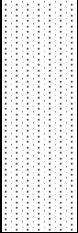

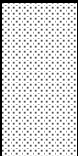
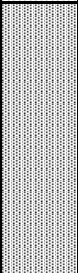
Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 04
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town		Boring Depth: 22.5 m
Location: Girichaiya Police Quarter, Bandarban Town		G.W.L: 2.13 m
Latitude: 22° 11' 40.6"	Longitude: 92° 13' 18.8"	Date: 25-11-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
2.5	1.5	S-1	Yellowish brown soft CLAY		1	1	1	2						
5.5	3	S-2	Gray to yellowish brown stiff CLAY		2	3	5	8						
	4.5	S-3			3	5	6	11						
	6	S-4			2	3	5	8						
	7.5	S-5			3	5	6	11						
3.5	9	S-6	Gray medium silty SAND		4	6	10	16						
	10.5	S-7			4	7	10	17						
9	12	S-8	Gray stiff to very stiff sandy CLAY		3	4	5	9						
	13.5	S-9			3	4	6	10						
	15	S-10			4	5	6	11						
	16.5	S-11			3	5	7	12						
	18	S-12			5	8	12	20						
2	19.5	S-13	Gray very dense SAND		5	8	12	20						
	21	S-14			18	20	28	48						
	22.5	S-15			140									

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 05		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 13.5 m		
Location: Bandarban Stadium, Bandarban Town			G.W.L: 2.0 m		
Latitude: 22° 11' 31.78"		Longitude: 92° 13' 23.83"		Date: 18-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
4	1.5	S-1	Grey to yellowish brown very soft to soft silty CLAY		1	0	1	1					
	3	S-2			1	1	1	2					
3.1	4.5	S-3	Gray loose to medium clayey SAND		1	2	4	6					
	6	S-4			4	6	8	14					
1.1	7.5	S-5	Gray loose SAND		2	3	4	7					
2	9	S-6	Grey dense SAND		7	12	20	32					
1.8	10.5	S-7	Grey very dense SAND		60	90							
	12	S-8			110	150							
	13.5	S-9			180								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 06
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town		Boring Depth: 15.0 m
Location: Kalaghata Notun Bridge, Bandarban Town		G.W.L: 0.46 m
Latitude: 22° 11' 21.2"	Longitude: 92° 13' 51.1"	Date: 19-11-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
2.0	1.5	S-1	Grey to yellowish brown medium stiff CLAY		1	1	2	3						
3.2	3	S-2	Grey to yellowish brown stiff CLAY		3	4	6	10						
	4.5	S-3			3	4	5	9						
6.3	6	S-4	Grey loose clayey SAND		2	3	4	7						
	7.5	S-5			3	4	5	9						
	9	S-6			3	3	5	8						
	10.5	S-7			2	3	4	7						
1.5	12	S-8	Grey dense silty SAND		6	12	20	32						
2.0	13.5	S-9	Grey very dense SAND		35	120								
	15	S-10			200									


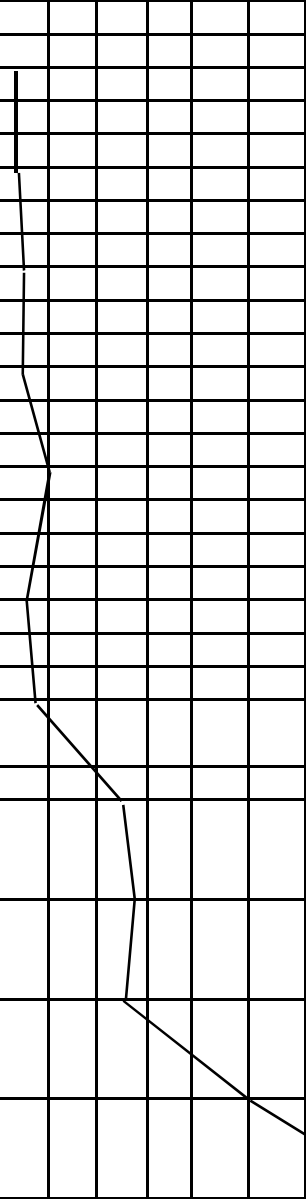
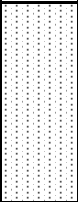

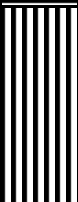
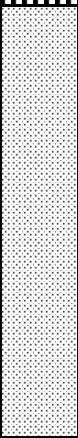
Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 07		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 18.0 m		
Location:Lushaibari, Bandarban Town			G.W.L: 2.44 m		
Latitude: 22° 11' 20.4"		Longitude: 92° 13' 07.7"		Date: 24-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
	1.5	S-1	Grey to yellowish gray medium stiff to stiff CLAY		2	3	4	7						
	3	S-2			2	3	4	7						
8.5	4.5	S-3			2	3	5	8						
	6	S-4			3	4	7	11						
	7.5	S-5			3	5	5	10						
1.5	9	S-6	Gray stiff silty CLAY		3	5	6	11						
1.5	10.5	S-7	Gray stiff CLAY		2	3	6	9						
1.5	12	S-8	Grey medium dense SAND		5	6	9	15						
4.5	13.5	S-9	Gray stiff silty CLAY		3	4	6	10						
	15	S-10			3	3	5	8						
2	16.5	S-11	Gray dense to very dense SAND		6	12	22	34						
	18	S-12			50	115								





Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 08		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 18 m		
Location: Shoiloshova Housing Society, Bandarban Town			G.W.L: 2.44 m		
Latitude: 22° 12' 44.0"		Longitude: 92° 12' 33.0"		Date: 22-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
4	1.5	S-1	Gray to yellowish brown soft CLAY		1	1	2	3						
	3	S-2			1	1	2	3						
3	4.5	S-3	Yellowish brown loose SAND		1	2	3	5						
	6	S-4			1	2	2	4						
1.5	7.5	S-5	Yellowish brown stiff CLAY.		2	4	6	10						
2.8	9	S-6	Gray medium stiff silty CLAY		1	2	3	5						
	10.5	S-7			2	3	3	6						
6.7	12	S-8	Grey medium dense to very dense SAND		6	9	15	24						
	13.5	S-9			6	10	16	26						
	15	S-10			6	10	15	25						
	16.5	S-11			13	18	22	40						
	18	S-12			13	22	148	170						

Asian Disaster Preparedness Center (ADPC)

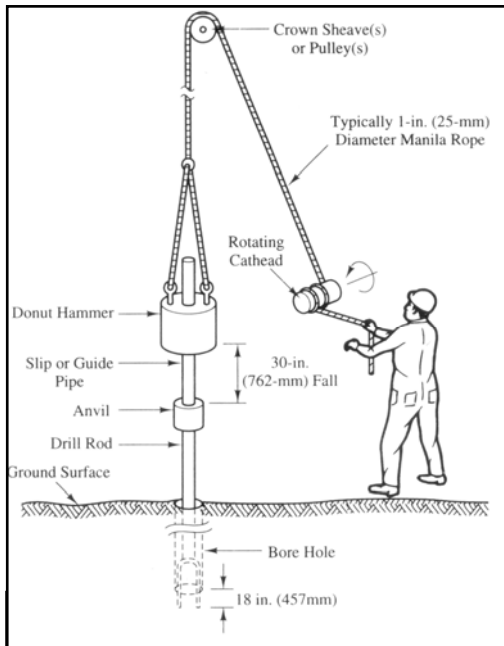
Client Name : UNDP-CHTDF			Borehole No: 09		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 18 m		
Location: Balaghata Muslimpara, Bandarban Town			G.W.L: 2.29		
Latitude: 22° 13' 03.1"		Longitude: 92° 12' 42.8"		Date: 21-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
4	1.5	S-1	Gray to yellowish brown medium stiff CLAY											
	3	S-2			2	3	4	7						
4.3	4.5	S-3	Yellowish brown loose SAND											
	6	S-4			1	2	4	6						
	7.5	S-5			2	3	5	8						
9.2	9	S-6	Gray medium stiff to stiff CLAY											
	10.5	S-7			3	4	5	9						
	12	S-8			2	2	3	5						
	13.5	S-9			1	2	3	5						
	15	S-10			2	3	5	8						
	16.5	S-11			2	3	6	9						
0.5	18	S-12	Grey very dense SAND		3	4	6	10						
					3	5	7	12						
					30	40	70	110						

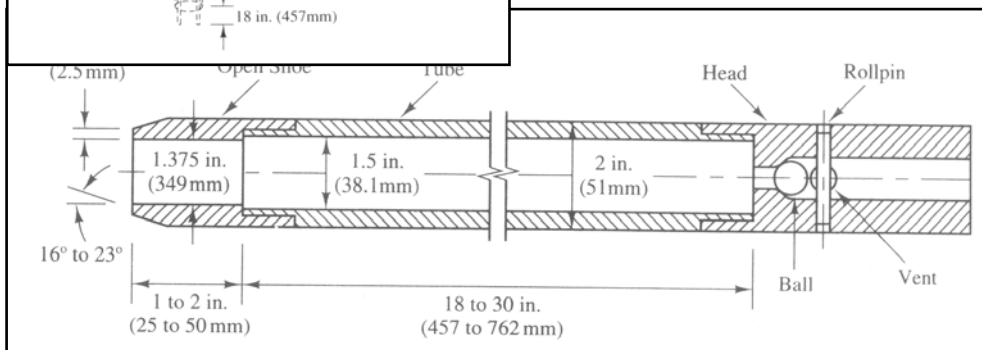
Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 10		
Project: Seismic Hazard and Vulnerability Assessment of Bandarban Town			Boring Depth: 16.5 m		
Location: West Balaghata (near Radio Station), Bandarban Town			G.W.L: 3.05 m		
Latitude: 22° 13' 20.53"		Longitude: 92° 12' 9.56"		Date: 21-11-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
10	1.5	S-1	Yellowish brown medium stiff to stiff CLAY	[Hatched]	1	2	3	5						
	3	S-2		[Hatched]	1	2	4	6						
	4.5	S-3		[Hatched]	1	2	3	5						
	6	S-4		[Hatched]	1	2	3	5						
	7.5	S-5		[Hatched]	2	3	4	7						
	9	S-6		[Hatched]	2	3	4	7						
6	10.5	S-7	Gray stiff CLAY	[Hatched]	3	3	6	9						
	12	S-8		[Hatched]	2	4	6	10						
	13.5	S-9		[Hatched]	3	5	5	10						
	15	S-10		[Hatched]	3	5	6	11						
0.5	16.5	S-11	Gray very dense SAND	[Dotted]	28	45	85	130						



Deliverable 02
Sub-Surface Properties of Soil
Development in Khagrachari
Municipality



January 2010

Submitted By



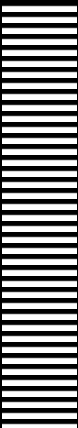
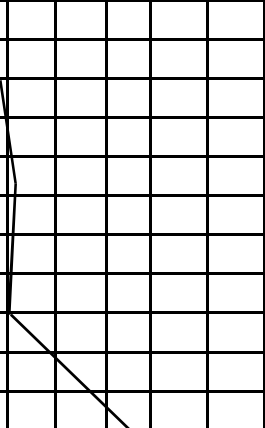
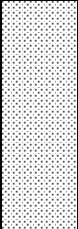
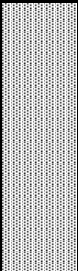
Asian Disaster Preparedness Center

House # 531/4, Lane # 11 (West), Baridhara DOHS, Dhaka-1219, Bangladesh

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF					Borehole No: 01								
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town					Boring Depth: 16.5 m								
Location: Dakhin Madhupur, Khagrachari Town					G.W.L: 0.76 m								
Latitude: 23° 6' 11.2"		Longitude: 91° 59' 41.3"			Date: 15-12-2009								
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2	1.5	S-1	Grey to yellowish brown soft CLAY	|	1	1	2	3					
5	3	S-2	Gray to yellowish brown medium stiff silty CLAY	|	1	2	2	4					
	4.5	S-3		|	2	3	4	7					
	6	S-4		|	2	2	2	4					
1.5	7.5	S-5	Gray to yellowish brown stiff sandy CLAY	|	2	3	5	8					
3	9	S-6	Grey medium dense SAND	|	4	7	8	15					
	10.5	S-7		|	7	11	14	25					
5	12	S-8	Yellowish brown very dense SAND	|	18	22	30	52					
	13.5	S-9		|	15	25	51	76					
	15	S-10		|	25	35	118	153					
	16.5	S-11		|	26	65	145	210					

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF				Borehole No: 02									
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town				Boring Depth: 12.0 m									
Location: Milonpur, Khagrachari Town				G.W.L: 2.95 m									
Latitude: 23° 06' 27.4"		Longitude: 91° 59' 16.9"		Date: 20-12-2009									
Thickness	Depth (m)	Sample No.	Lithology	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
5.3	1.5	S-1	Yellowish brown stiff CLAY										
	3	S-2			2	3	5	8					
	4.5	S-3			2	5	6	11					
3.1	6	S-4	Yellowish brown dense to very dense SAND		3	4	6	10					
	7.5	S-5			10	15	19	34					
3.6	9	S-6	Yellowish brown very dense SAND		20	24	36	60					
	10.5	S-7			33	55	88	143					
	12				30	56	90	146					
					22	80	241						

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF					Borehole No: 03								
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town					Boring Depth: 13.5 m								
Location: Islampur, Khagrachari Town					G.W.L: 0.95 m								
Latitude: 23° 07' 0.4"			Longitude: 91° 59' 25.3"		Date: 19-12-2009								
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
4	1.5	S-1	Yellowish brown medium stiff CLAY										
	3	S-2			2	2	3	5					
1.4	4.5	S-3	Grey to yellowish brown soft CLAY		1	2	2	4					
4.6	6	S-4	Gray medium dense SAND		3	5	7	12					
	7.5	S-5			6	10	15	25					
	9	S-6			6	11	15	26					
3.5	10.5	S-7	Yellowish brown very dense SAND		14	29	36	65					
	12	S-8			26	75	175	250					
	13.5	S-9			40	120	100	220					

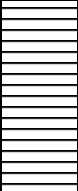

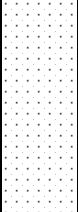

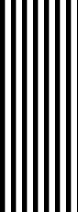

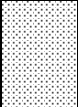
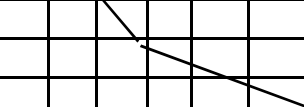
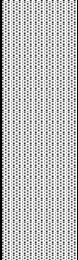
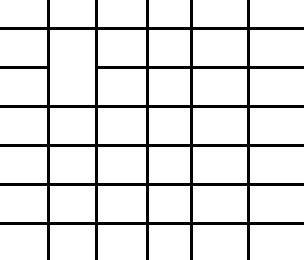
Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF Borehole No: 04

Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town Boring Depth: 15.0 m

Location: Newzeland Road, Khagrachari Town G.W.L: 0.0 m

Latitude: 23° 06' 02.1" Longitude: 91° 59' 24.7" Date: 16-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
4	1.5	S-1	Gray to yellowish brown medium stiff CLAY		2	2	2	4						
	3	S-2			2	2	2	4						
3	4.5	S-3	Gray to yellowish brown loose SAND		2	2	3	5						
	6	S-4			2	2	2	4						
3	7.5	S-5	Gray stiff silty CLAY		3	4	5	9						
	9	S-6			3	4	5	9						
1.5	10.5	S-7	Grey medium dense SAND		7	10	19	29						
3.5	12	S-8	Yellowish brown very dense SAND		30	40	45	85						
	13.5	S-9			30	50	102	152						
	15	S-10			65	106								

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 05		
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town			Boring Depth: 13.5 m		
Location: Anondonagar, Khagrachari Town			G.W.L: 0.70 m		
Latitude: 23° 16' 16.1"		Longitude: 91° 59' 10.2"		Date: 17-12-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve					
					15cm	15cm	15cm	N-value	10	20	30	40	50	
Extg. G.L														
5	1.5	S-1	Gray to yellowish brown soft to medium CLAY	[Hatched]	1	2	2	4						
	3	S-2		[Hatched]	3	4	5	9						
	4.5	S-3		[Hatched]	2	3	5	8						
3	6	S-4	Yellowish brown medium dense SAND	[Dotted]	3	5	8	13						
	7.5	S-5		[Dotted]	10	13	18	31						
5.5	9	S-6	Yellowish brown dense to very dense SAND	[Vertical Lines]	5	9	23	32						
	10.5	S-7		[Vertical Lines]	10	11	26	37						
	12	S-8		[Vertical Lines]	10	35	50	85						
	13.5	S-9		[Vertical Lines]	20	80	160	240						

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 06
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town		Boring Depth: 15.0 m
Location: Technical Training Institute, Khagrachari Town		G.W.L: 0.46 m
Latitude: 23° 05' 22.5"	Longitude: 91° 58' 51.4"	Date: 18-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2	1.5	S-1	Yellowish brown medium CLAY		1	2	2	4					
2	3	S-2	Yellowish brown medium dense clayey SAND		3	6	10	16					
3	4.5	S-3	Yellowish brown loose SAND		2	3	4	7					
	6	S-4			3	4	5	9					
3	7.5	S-5	Yellowish brown medium dense to dense SAND		8	11	14	25					
	9	S-6			6	16	18	34					
5	10.5	S-7	Yellowish brown dense to very dense SAND with pebbles		12	32	50	82					
	12	S-8			12	20	12	35					
	13.5	S-9			30	115	100	215					
	15	S-10			32	110							

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF					Borehole No: 07								
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town					Boring Depth: 10.5 m								
Location: Arambag Math, Khagrachari Town					G.W.L: 1.83 m								
Latitude: 23° 6' 32.5"		Longitude: 91° 58' 45.9"			Date: 12-12-2009								
Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
2	1.5	S-1	Yellowish brown medium CLAY		1	2	2	4					
2	3	S-2	Yellowish brown medium dense SAND		4	5	7	12					
3	4.5	S-3	Yellowish brown dense SAND		12	20	26	46					
	6	S-4			12	18	22	40					
3.5	7.5	S-5			25	28	52	80					
	9	S-6	Yellowish brown very dense SAND		20	72	121	193					
	10.5	S-7			60	150							

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 08
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town		Boring Depth: 15.0 m
Location: Khobongpuria, Khagrachari Town		G.W.L: 1.90 m
Latitude: 23° 06' 38.2"	Longitude: 91° 58' 15.8"	Date: 13-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
4	1.5	S-1	Yellowish brown medium CLAY	[Hatched]	2	3	4	7					
	3	S-2		[Hatched]	2	3	4	7					
3	4.5	S-3	Gray medium dense SAND	[Dotted]	5	7	10	17					
	6	S-4		[Dotted]	5	8	10	18					
4.5	7.5	S-5	Grey dense to very dense SILT and SAND	[Dotted]	20	26	30	56					
	9	S-6		[Dotted]	7	8	10	18					
	10.5	S-7		[Dotted]	5	7	18	25					
3.5	12	S-8	Yellowish brown very dense SAND	[Dotted]	17	30	90	120					
	13.5	S-9		[Dotted]	32	75	150	225					
	15	S-10		[Dotted]	45	150							

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF			Borehole No: 09		
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town			Boring Depth: 12.0 m		
Location: Khagrachari Municipality			G.W.L: 2.38 m		
Latitude: 23° 06' 26.6"		Longitude: 91° 58' 53.5"		Date: 21-12-2009	

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
	1.5	S-1	Grey soft CLAY		1	1	1	2					
5.5	3	S-2			1	1	1	2					
	4.5	S-3			1	1	2	3					
1.5	6	S-4	Gray medium dense silty CLAY with SAND		3	4	6	10					
	7.5	S-5	Yellowish brown dense SAND		12	17	22	39					
4.5	9	S-6			8	12	20	32					
	10.5	S-7			12	18	25	43					
0.5	12	S-8	Yellowsh brown very dense SAND		28	60	190	250					

Asian Disaster Preparedness Center (ADPC)

Client Name : UNDP-CHTDF		Borehole No: 11
Project: Seismic Hazard and Vulnerability Assessment of Khagrachari Town		Boring Depth: 10.5 m
Location: Dakkhin Khobonpuria, Khagrachari Town		G.W.L: 2.31 m
Latitude: 23° 06' 29.3"	Longitude: 91° 58' 24"	Date: 21-12-2009

Thickness (m)	Depth (m)	Sample No.	Lithologic Description	Bore Log	SPT Values				SPT Curve				
					15cm	15cm	15cm	N-value	10	20	30	40	50
Extg. G.L					15cm	15cm	15cm	N-value	10	20	30	40	50
7	1.5	S-1	Gray soft to medium CLAY		1	1	1	2					
	3	S-2			1	1	1	2					
	4.5	S-3			1	1	2	3					
	6	S-4			1	2	2	4					
1.5	7.5	S-5	Gray medium dense SAND		6	10	19	29					
2	9	S-6	Yellowish brown very dense SAND with pebbles		22	50	102	152					
	10.5	S-7			36	105	120						