Study on selection of suitable foundation for Khulna city corporation area

by

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A thesis submitted in partial fulfillment of the requirements for the degree of Master of Engineering in Civil Engineering

Khulna University of Engineering & Technology
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Declaration

This is to certify that the thesis work entitle as "Study on selection of suitable foundation for Khulna city corporation area" has been carried out by Md. Abdur Razzaque in the Department of Civil Engineering, Khulna University of Engineering & Technology, Khulna, Bangladesh. The above research work or any part of this work has not been submitted anywhere for the award of any degree of diploma.

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Md. Abdur Razzaque
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Abstract

The soil condition of Khulna City Corporation (KCC) area is different from other places due to its very soft nature up to a great depth and the existence of peat layer. As a result, the selection of suitable foundation type is a challenging job for the geotechnical engineer. In this region, even for a small project, a sub-soil condition is required to reveal completely for the safe design of structure. Since sub-soil exploration is expensive and time consuming, an evaluation of sub-soil condition in a comprehensive way may help designer in this context for the selection of suitable foundation for KCC area.

In this study, samples were collected by auger boring from 109 points within KCC. From test results of these samples and using correlation equations, the parameters are calculated. The samples from auger are disturbed sample from which moisture content, liquid limit, plastic limit and specific gravity are obtained. Unconfined compressive strength (q_u) and compression index (Cc) are the important parameters for design purpose for which undisturbed samples are required. For these tests sample collection, preparation and testing need considerable amount of refinement, precaution and time, with the result that the procedure is costly. This situation calls for an alternative method by which this issue can be addressed. Correlation equation is available in literature verified in the context of Khulna soil. For this purpose available existing soil reports (202 nos.) were studied for where 617 nos. value for q_u and 210 nos. value for Cc were collected. Using existing correlation equations q_u and Cc were calculated from corresponding values of moisture content, liquid limit, plastic limit and specific gravity. Comparing the actual and calculated values, it was observed that the actual value of q_u is approximately 1.98 times more than the correlation equations q_u value and Cc is approximately 1.09 times more than the correlation equation Cc value, which means the q_u and Cc from equation were much conservative and safe for structure. From the result of collected existing 112 nos. bore log and 109 nos. auger boring, the position and depth of peat layer are described. By combination auger boring and existing 202 nos. soil reports, the profile of q_u and Cc are prepared. From this profile, q_u and Cc may be measured from different places. The position of peat layer and instant observation water table are shown.

The results accomplished in the study can be used by the practicing engineers as a background information for the selection of suitable foundation in KCC areas for the construction of relevant structures.

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C = Cohesion of soil

Cc = Compression index

C_T = undrained cohesion of soil

e = void ratio

G_s = Specific gravity of soil

G_t = The specific gravity of water at temperature T

I_L , LI = Liquidity Index

I_p , PI = Plasticity Index

N_c , N_q and N_γ are bearing capacity factor (coefficients)

P_o', σ_o' = Effective pressure (Overburden pressure)

q_u = Unconfined compressive strength

q_{ult} = Ultimate bearing capacity

S_u= Undrained Shear Strength

w, W_N = Moisture content

W_L, LL =Liquid Limit

W_P , PL = Plastic Limit

W_w = Weight of water

W_d = Weight of dry soil

W_s = The weight of over dry soil

W_1 = Weight of flask + soil + water

W_2 = Weight of flask + water

Z = Height form ground level to water table

γ = Bulk unit weight of soil

γ_w = Unit weight or water

γ' = Submerge unit weight of soil

CHAPTER ONE

INTRODUCTION

1.1 General

Khulna City Corporation is situated on the south-western (Fig. 1.1) region of Bangladesh. Bangladesh is a part of Bengal Basin at the lower reaches of the three mighty river the Ganges, the Brahammaputra and the Meghna and their associated tributaries. In the upper horizons, the sub-soil of vast area of Bangladesh is composed of very soft fine grained soil deposits of recent origin. In the south-western costal districts, fine grained soil deposits where predominantly peat and muck are abundant are undergoing continuous subsidence. In these regions peat deposits are encountered due to the presence of World's biggest mangrove forest the Sundarbans (of 6,017 Sq. Km. as its area at 2004[1]). In the past, the Sundarbans was extended in these regions. For the last few centuries it was double spreading over the present area. By Pollen analytical studies and studying the peat soil it was claimed that the present metropolitan of Kolkata city was under the mangrove swamps of Sundarbans only 5,000 years back[2,3,4,5,6]. During the geological changes in the past, some part of the Sundarbans were submerged by the weathered and sedimented deposits resulting in the present peat deposits in these regions. The peat deposits extend south-western coastal districts through Satkhira to Patuakhali[7].

1.2 Background of this study

Settlement of structures and the related problems are common to many structure in this region. Presence of peat deposits, are not known properly without soil boring. Shallow boring by hand auger can be adopted to identify peat location, water table and to collect disturbed samples. Laboratory tests results like Moisture content (w), Liquid limit (LL), Plastic limit (PL), Specific gravity (G) etc. on disturbed soil may be used for established equations to obtain Unconfined Compressive Strength (q_u) and Compression Index Cc. Which will give rough guide for selection of foundation. Several structures have been and

are being constructed in a typical peat deposits of around 20 feet thickness from the existing ground level at Khulna city[8].

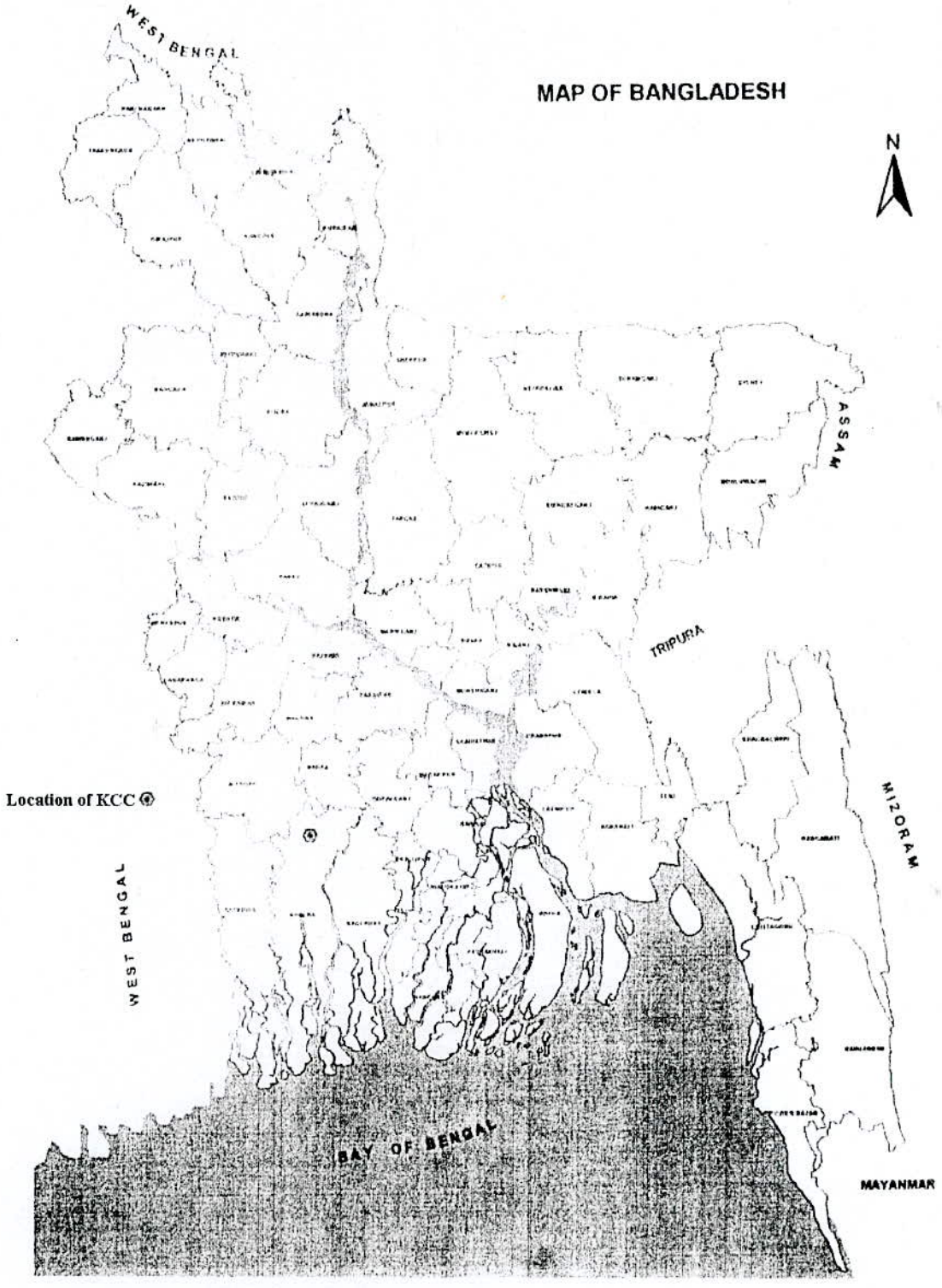


Figure 1.1 Map of Bangladesh showing the location of KCC

1.3 Objective of this study

Khulna city has got a new dimension after the declaration of Metropolitan city in 1984. Khulna city is also a divisional city of Bangladesh. Moreover, it is an industrial and port city. Due to above reasons Khulna is considered as a rapidly developing city in Bangladesh. For this rapid development infrastructures are constructed or going to be constructed in and around Khulna City Corporation area. It is well known that subsoil of Khulna is of critical nature. Excepting some heavily loaded structures which will use pile foundation there are lot of small scale projects. Location of low rise small scale projects may suitably be selected if authentic information are possible to gather within shallow depth.

1.4 Statement of the Problem

Study on general behaviour of bearing capacity and settlement within shallow depth for KCC area and to suggest suitable suggestion.

1.5 Scope of this study

Undisturbed samples collected from different bore location (Auger boring) to be tested in the laboratory to determine (i) Liquid limit (ii) Plastic limit (iii) Moisture content (iv) Unconfined compressive strength (by formula) and (v) Compression index (by formula).

1.6 The research outlines of this study are described as the followings:

(I) Selection of different location of Khulna city corporation area from Labonchora to KUET campus.

(II) Conduct auger boring at selected locations up to depth 20 feet at interval of 5 feet and collection disturbed sample from each layer.

(III) Determination the instant observation of water table from each bore hole.

(IV) Prepare bore logs for soil strata of all 109 points.

(V) Performing laboratory tests to determine following soil parameters:
(a) Moisture content, (b) Liquid limit, (c) Plastic limit and (d) Specific gravity.

(VI) Performing unconfined compression test on soil samples of four locations for comparison.

(VII) Calculate Liquidity index (IL), Plasticity index (PL), submerge unit weight (γ_{sat}), bulk unit weight (γ), and overburden pressure (p_o').

(VIII) Calculate unconfined compression strength (q_u) by three correlation equations from the data.

(IX) Calculation of compression index (Cc) by equation.

(X) Collection of bore logs from existing soil report obtained from different sources.

(XI) Collection of test result from existing soil report in KCC and out side of KCC from compare actual and calculated q_u and Cc.

(XII) Preparation of zoning maps for occurrence of peat of its location and depth.

(XIII) Preparation of profiles for q_u and Cc obtain from correlation equation.

(XIV) Preparation of profile for peat, instant observation of water table.

(XV) Proposed suitable foundation of Khulna City Corporation area.

CHAPTER TWO

LITERATURE REVIEW

2.1 General

The City Corporation area of Khulna contains fine grained soil deposits underlain by peat layer of varying thickness[9]. The soil below the peat layer is also very compressible in general. In this region peat deposits are present for the world's biggest mangrove forest called Sundarbans. Khulna was within the Sundarbans. In course of time some parts of Sundarbans were submerged by tidal sediment deposits resulting in the present peat layer in this region. This happened about 800 years ago[10]. The large settlement of structure and the related problems are inevitable due to the presence of this layer of peat. Some of the buildings constructed within last 10 years back are found to have settled as much as 2.5 feet[11].

2.2 Khulna Metropolitan Subsoil condition

In the year 2001, Rahman G.M.M.[12], carried out a research on "Study on pile capacity in Khulna subsoil". He constructed two tentative average soil profiles from North to South and East to West of Khulna city. He also developed a table which contain important soil properties and parameters of Khulna soil. He also determined the ultimate load carrying capacity of pile (Timber, Bored and Driven pile) in Khulna city area on the basis of both direct (pile load test) and indirect (soil investigation report) approach. He developed chart for ultimate load carrying capacity of pile in Khulna sub soil. For his study he collect 25 soil investigation report of Khulna. His result was further supplemented by 12 nos. of load tests have been executed in different locations of Khulna city. That load tests are done by organizations like Khulna Development Authority (KDA), Local Government Engineering Department (LGED), Divisional Office of Janata Bank Ltd., National Game Council (NGC) etc. It was to be mentioned that the author was presented there at the time of conducting the tests. By using these pipe load tests results actual pile capacity in Khulna sub-soil can be predicted.

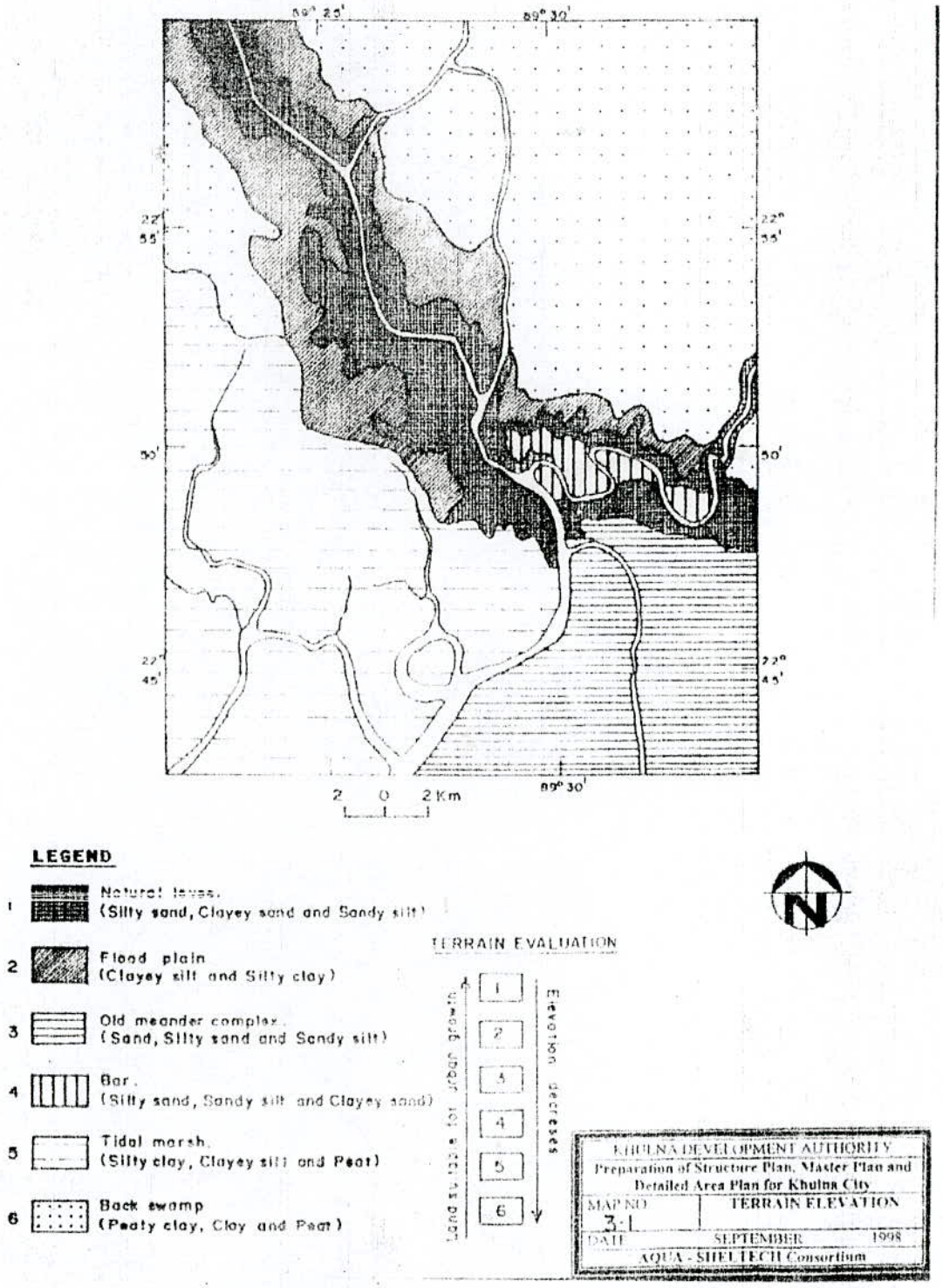
According to Master plan and detailed area plan for Khulna city of comprehensive report for KDA performed by AQUA-SHELTECH CONSORTIUM (1999)[13], the physiography of KCC region can be broadly characterized by the Ganges-tidal floodplain having lower relief and being criss-crossed by innumerable tidal rivers and channels. This physiographic unit is nearly flat and the surface is poorly drained. Some peat basins of up to 3 m thick have also been found in many parts of KCC. These peats are formed due to the decomposition of reeds and grasses having relationship with a tidal or mangrove eco-system.

The surface physiography of the KCC is not perfectly level and can be characterized by six major geomorphic units (Fig. 2.1). These are natural levees, floodplains old meander complex, bar, tidal march and back swamps. Natural levees are well developed along the Bhairab-Rupsha banks (mostly on the west bank) and is occupied mainly by the present built-up area of the city. This part of the city is 4 m above the mean sea level (MSL).

The flood plains occupied mainly by fringe areas of the city are relatively broad, more or less flat and extended from the edges of the levees up to swampy areas. The altitude of this unit is 2 m above MSL. Old meander complex with soil characteristics of sand, silty-sand and sandy silt form a vast area to the southeast of the city along the Khulna-Mongla Road. The tidal marsh region also forms a vast area characterized by silty-clay, clayey-silt and peat located in the southwestern part of the city periphery. The low-lying swampy areas, currently used as the agricultural lands, are poorly drained and has persistent water logging problems compared with other two units. The average altitude of swamp area is less than 2 m above MSL.

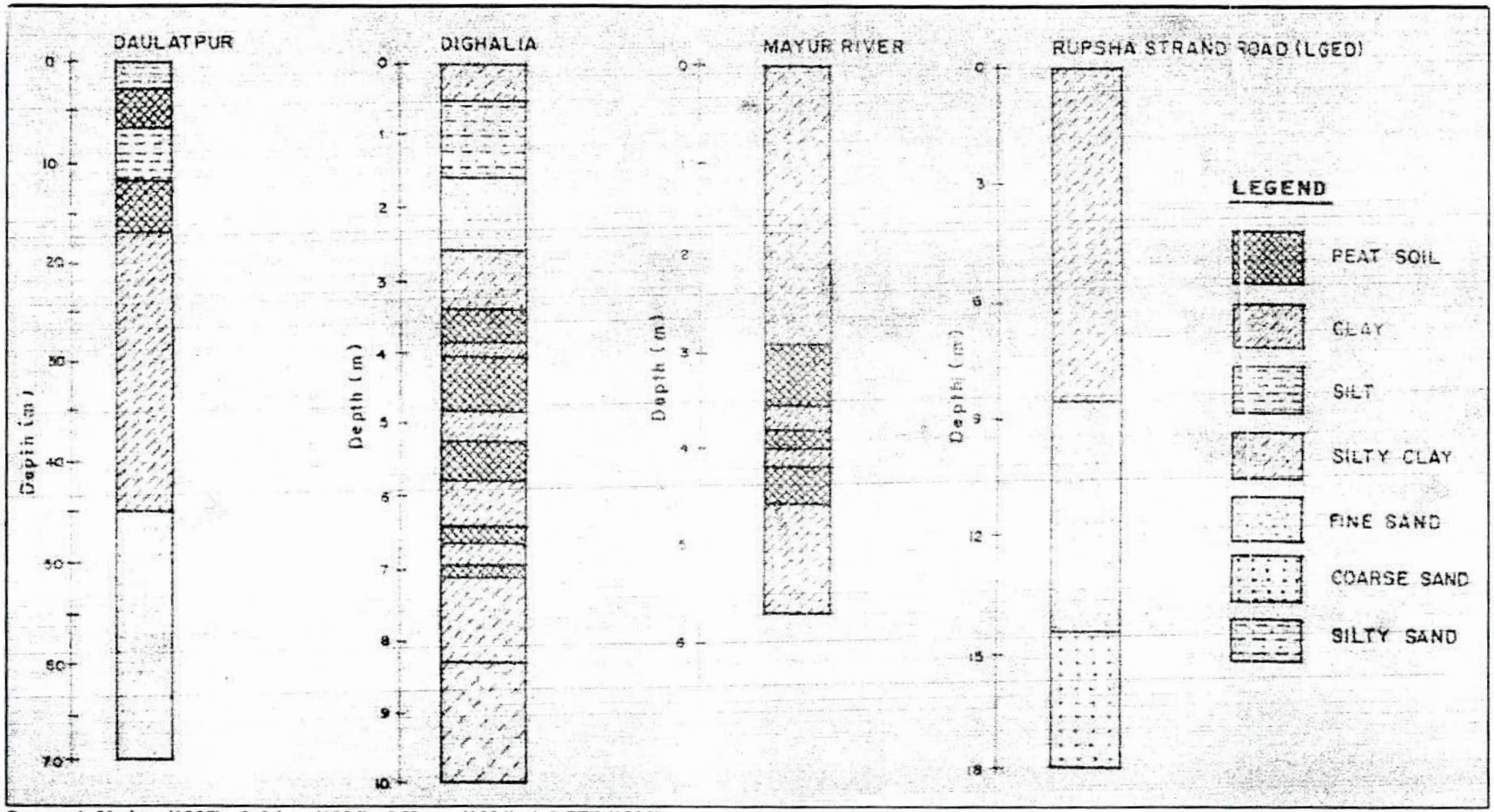
Fig. 2.1 also shows the terrain elevation of the KCC region. Elevation decreases sharply to the east and the west directions of the city. However, along the north-south direction lands are available with moderate elevation.

According to Master plan and detailed area plan for Khulna city of comprehensive report for KDA performed by AQUA-SHELTECH CONSORTIUM (1999)[13], the Lithostratigraphy of Khulna suffers from too many generalizations. The infilling of this part of the basin with sediments has greatly been controlled by the northward transgression



Source:- Geological Survey of Bangladesh, 1998.

Figure 2.1 Geological Characteristics and Terrain Elevation.



Sources1. Umitsu (1987); 2. Islam (1996); 3.Hasan (1984); 4. LGED(1998)

Figure 2.2 Lithology of Khulna city and surrounding areas

and subsequently southward regression of the sea. Regional glaciation/ deglaciation in the Himalayas is likely to have had marked effect on the Lithological sequences and sea level movements of the Bengal Basin. During the last glacial period maximum (about 18,000 years ago) the sea level at Khulna was about 100 meters lower than today. A gravel bed of 10 m thick was then deposited at that depth which is overlain by coarse sandy sediment. This was deposited in a markedly fluvial environment during the late pleistocene.

Geological Survey of Bangladesh (GSB) has compiled some reports on the Lithological sequence of Khulna and surrounding regions (Zaher, 1962; Hasan, 1984). Such reports show the presence of a number of intercalated sub-surface peat layers in regional lithology. In an in-depth study at Panigati or Dighalia thana by Islam (1966), at least five peat layers in and around Khulna city (Fig. 2.2). The existence of sub-surface peat layers have also been reported in a number of research works in Calcutta and surrounding regions.

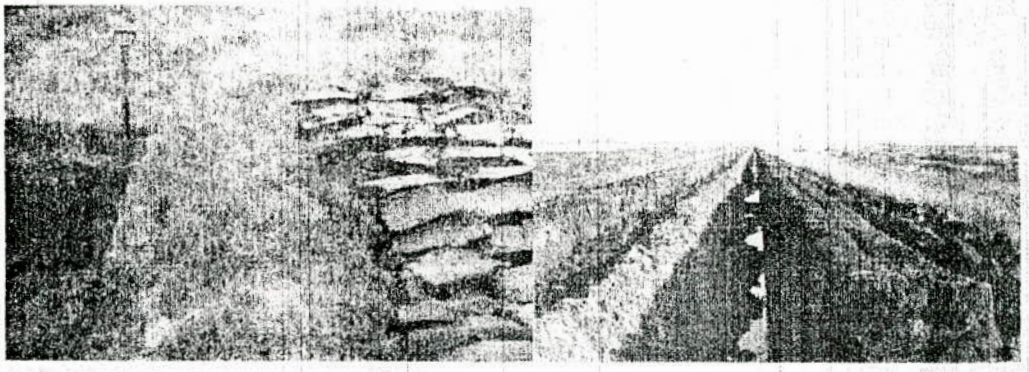
A 70 meter long bore hole records at Daulatpur, collected by a Japanese Geographer Umitsu (1987), is a remarkable work on the Quaternary lithology of Khulna city. He has identified at least five distinct sedimentary sequences at the site which were the result of the post-glacial regional sea-level movements (covering about 12,000 years). He has identified a number of peat layers in his bore hole.

For Physical planning of any city, the clear knowledge on the sub-surface geology and lithological sequences is a prerequisite. However, due to scarcity of micro-level information on the lithology of Khulna city, it becomes difficult at this stage to suggest how much load the city can bear geologically and expansion in which direction. Detailed study on lithostratigraphy of the Khulna city and its region can give a precise idea about direction. However, on the basis of some secondary information major lithological sequences of Khulna identified are shown (Fig. 2.2).

2.5 Peat soil

According to a project of Media Wiki of Wikimedia Foundation, Inc., Florida, USA (2006)[14], peat is an accumulation of partially decayed vegetation matter. Peat forms in

wetlands or peatlands, variously called bogs, moors, muskegs, mires, tropical swamp forests and fens.



(a) (b)

Figure 2.3 (a) Peat soil, (b) Exploitation of peat in East Frisia Germany, Geographic distribution

Peat deposits are found in many places around the world, notably in Russia, Ireland, Scotland, northern Germany and Scandinavia, and in North America, principally in Canada, Michigan and the Florida Everglades. The majority (around 80%) of peatlands are found in high latitudes; approximately 60% of the world's wetlands are peat. Peatlands cover a total of around 3% of global land mass or 3,850,000 to 4,100,000 km². About 7% of this total has been exploited for agriculture and forestry, with significant environmental repercussions. Under proper conditions, peat will turn into lignite coal over geologic periods of time.

2.3.1 Peat formation

Peat forms when plant material, usually in marshy areas, is inhibited from decaying fully by acidic conditions. It is composed mainly of peat moss or sphagnum, but may also include other marshland vegetation: trees, grasses, fungi, as well as other types of organic remains, such as insects, and animal corpses. Under certain conditions the decomposition of the latter ones in the absence of oxygen is inhibited, and archaeology often takes an advantage of this.

Peat layer growth and degree of decomposition (or humification) depends principally on its composition and on the degree of waterlogging. Peat formed in very wet conditions will grow considerably faster, and be less decomposed, than that in drier places. This allows climatologists to use peat as an indicator of climatic change. The composition of peat can also be used to reconstruct ancient ecologies by examining the types and quantities of its organic elements.

Under the right conditions, peat is the earliest stage in the formation of coal. Most modern peat bogs formed in high latitudes after the retreat of the glaciers at the end of the last ice age some 9,000 years ago. They usually grow slowly, at the rate of about a millimetre per year.

2.3.2 Classification of peat material

Peat material is either sapric, hemic, or fibric. Fibric peats are the least decomposed, they are composed of undecomposed fiber. Hemic peats are somewhat decomposed, and sapric are the most decomposed.

Phragmites peat is a peat composed of reed grass, Phragmites australis, and other grasses. It is denser than many other types of peat.

2.3.3 Types of peatland

Six principal types of peatlands are widely recognized. These are:

Blanket mires. Rain-fed peatlands generally 1 to 3 m deep. Many of the peatlands found in the United Kingdom are of this type, with the UK possessing around 13% of the total global blanket mire area. They generally develop in cool climates with small seasonal temperature fluctuations and over 1 m of rainfall and over 160 rain days each year.

Raised mires: Rain-fed, potentially deep peatlands occurring principally in lowland areas across much of Northern Europe, as well as in the former USSR, North America and parts of the southern hemisphere.

String mires: flat or concave peatlands with a string-like pattern of hummocks (hence the name), found principally in northern Scandinavia but occurring in the western parts of the former USSR and in North America. A few examples exist in northern Britain.

Tundra mires: peatlands with a shallow peat layer, only about 500 mm thick, dominated by sedges and grasses. They form in permafrost areas, covering around 110,000 to 160,000 km² in Alaska, Canada, and the former USSR.

Palsa mires: a type of peatland typified by characteristic high mounds, each with a permanently frozen core, with wet depressions between the mounds. These develop where the ground surface is frozen only for part of the year, and are common in the former USSR, Canada and parts of Scandinavia.

Peat swamps: forested peatlands including both rain- and groundwater-fed types, commonly recorded in tropical regions with high rainfall. This type of peatland covers around 350,000 km², primarily in south-east Asia but also occurring in the Everglades in Florida.

2.3.4 Characteristics and uses

Peat is soft and easily compressed. Under pressure, water in the peat is forced out. Upon drying, peat can be used as a fuel, and is traditionally used for cooking and domestic heating in many countries including Ireland and Scotland, where trees are often scarce. Stacks of drying peat dug from the bogs can still be seen in some rural areas.

Peat is also dug into soil to increase the soil's capacity to retain moisture and add nutrients. This makes it of considerable importance agriculturally, for farmers and gardeners alike. Its insulating properties make it of use to industry as well.

Peat fires are used to dry malted barley for use in Scotch whisky distillation. This gives Scotch whisky its distinctive smoky flavour, often referred to as "peatiness" by its aficionados.

Although peat has many uses for humans, it also presents severe problems at times. When dry, it can be a major fire hazard, as peat fires can burn almost indefinitely (or at least until the fuel source has been exhausted), even underground, provided there is a source of oxygen. Peat deposits also pose major difficulties to builders of structures, roads and railways, as it is highly compressible under even small loads. When the West Highland Line was built across Rannoch Moor in western Scotland, its builders had to float the tracks on a mattress of tree roots, brushwood and thousands of tons of earth and ashes.

During prehistoric times, peat bogs had considerable ritual significance to Bronze Age and Iron Age peoples, who considered them to be home to (or at least associated with) nature gods or spirits. The bodies of the victims of ritual sacrifices have been found in a number of locations in England, Germany and Denmark, almost perfectly preserved by the tanning properties of the acidic water. Peat wetlands formerly had a degree of metallurgical importance as well. During the Dark Ages, peat bogs were the primary source of bog iron, used to create the swords and armour of the Vikings.

Many peat swamps along the coast of Malaysia serve as a natural means of flood mitigation. The peat swamps serve like a natural form of water catchment whereby any overflow will be absorbed by the peat. However, this is effective only if the forests are still present, since they prevent peat fires. Peat is also an important raw material in horticulture, it is used in medicine and balneology, to produce filters, textiles etc.

Peat is sometimes used in freshwater aquaria, most commonly in soft water or blackwater river systems, such as those mimicking the Amazon River basin. In addition to being soft in texture and therefore suitable for demersal (bottom-dwelling) species such as Corydoras catfish, peat is reported to have a number of other beneficial functions in freshwater aquaria. It softens water by acting as an ion exchanger, it contains substances good for plants and for the reproductive health of fishes, and can even prevent algae growth and kill microorganisms. Peat often stains the water yellow or brown due to the leaching of tannins.

2.3.5 Wise use and peat swamp protection

In June 2002 the United Nations Development Programme launched the Wetlands Ecosystem and Tropical Peat Swamp Forest Rehabilitation Project. This project is targeted to last for 5 years till 2007 and brings together the efforts of various non-government organisations.

In November 2002, the International Peat Society and the International Mire Conservation Group published guidelines on the "Wise Use of Mires and Peatlands — Backgrounds and Principles including a framework for decision-making". The aim of this publication is to

develop mechanisms that can balance the conflicting demands on the global peatland heritage, to ensure its wise use to meet the needs of humankind.

2.4 Method of Exploration

Sub-soil exploration is mostly done by one or more of the following methods: (i) Boring, (ii) sounding, (iii) test pits, and (iv) geophysical. Commonly used boring methods may be classified in to six groups: (i) Auger boring, (ii) wash boring, (iii) displacement boring, (iv) percussion drilling, (v) rotary drilling and (vi) continuous sampling[15].

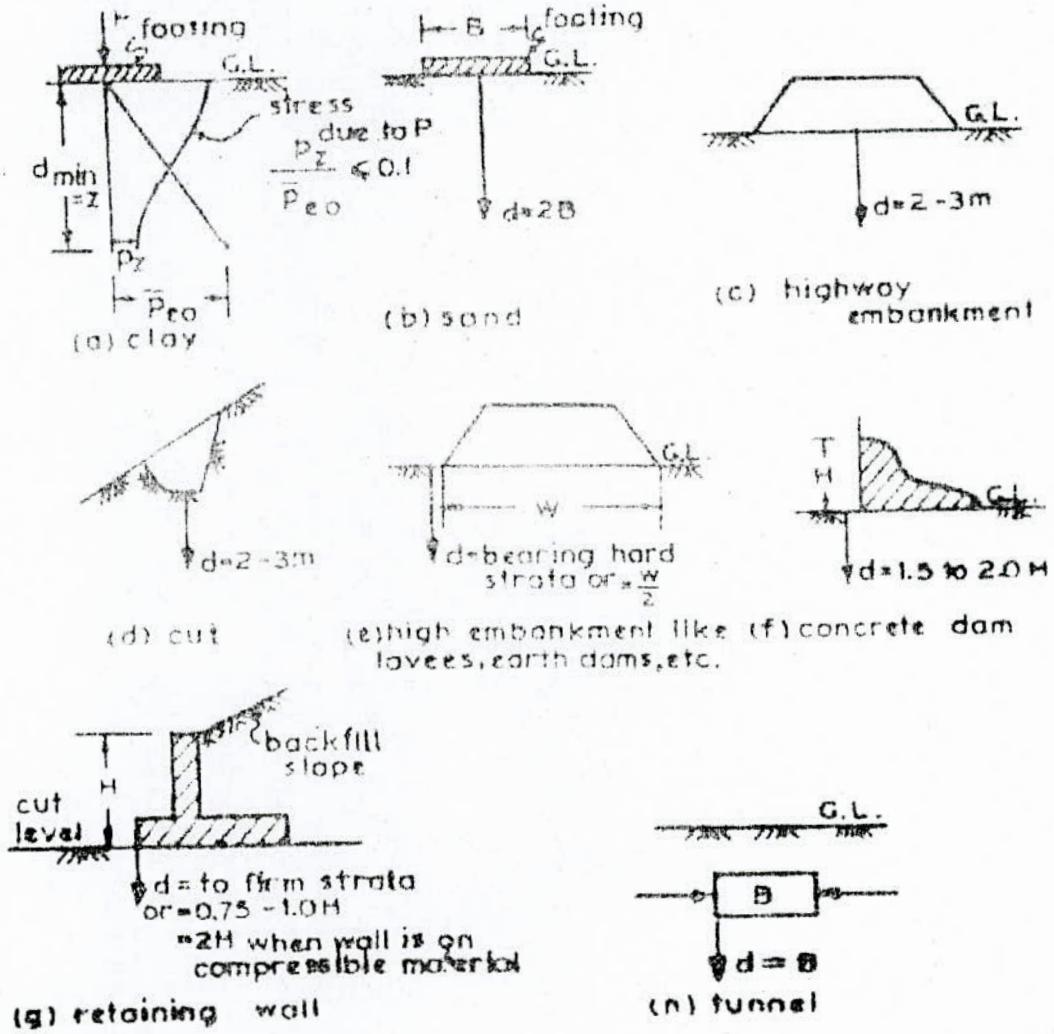


Figure 2.4 Depth of exploratory borings: (a) footing on clay (b) footing on sand (c) highway embankment (d) cut in natural deposit (e) high embankment like levees, earth dam etc. (f) concrete dams weirs, etc. (g) retaining wall (h) tunnel.

The depth of boring on the type of foundation and the structures some typical examples are shown in Figure 2.4.

2.4.1 Auger boring

Augers of various types as shown if Figure 2.5 are frequently used for penetrating the ground to desired depths and the brough up material is examined and tested for classification. Soundings can be made at the bottom of the hole or samples can be used to take samples below the bottom of the hole, made by the auger boring. Manually operated auger are used for exploring to moderate depths.

The hand auger used in boring are about 15 to 20 cm in diameter. These are suitable for advancing holes upto a depth of 3 to 6 m in soft soils. The hand auger is attached to the lower end of a pipe of about 18 mm diameter. The pipe is provided with a cross-arm at its top. The hole is advanced by turning the cross-arm manually and at the same time applying thrust in the downward direction. When the auger is filled with soil it is taken out.

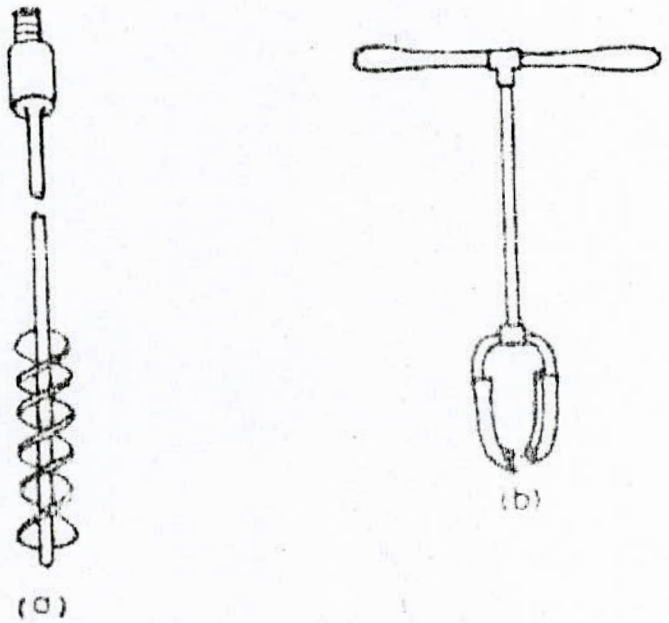


Figure 2.5 Hand operated augers (a) earth auger (b) post-hole auger

This method uses simple, light, inexpensive and flexible equipment and is suitable for holes of small to large diameters. It is very efficient in medium soft to stiff cohesive soils and is suitable for determining the true ground water level. Soil remove by the auger, through considerably disturbed, is more suitable for positive identification than that obtained by wash boring, percussion and rotary drilling. However, this method is not well-sited in very hard or cemented soils, very soft soils and fully strurated cohesionless soils. Soft soils have the tendency to flow into the hole[15].

2.4.2 Wash boring

Wash boring is used to form an open hole in the ground to that soil-sampling or rock-drilling operation may be conducted at the bottom of the hole. The hole is advanced partly by the chopping and twisting action of a light bit. The cutter process is augmented by jetting, which is accomplished by forcing water under pressure through the drill rods that are operated inside the hole. the jetting action not only loosens the soil but also brings the cuttings from the bottom to the surface. An experienced and conscientious driller, by the

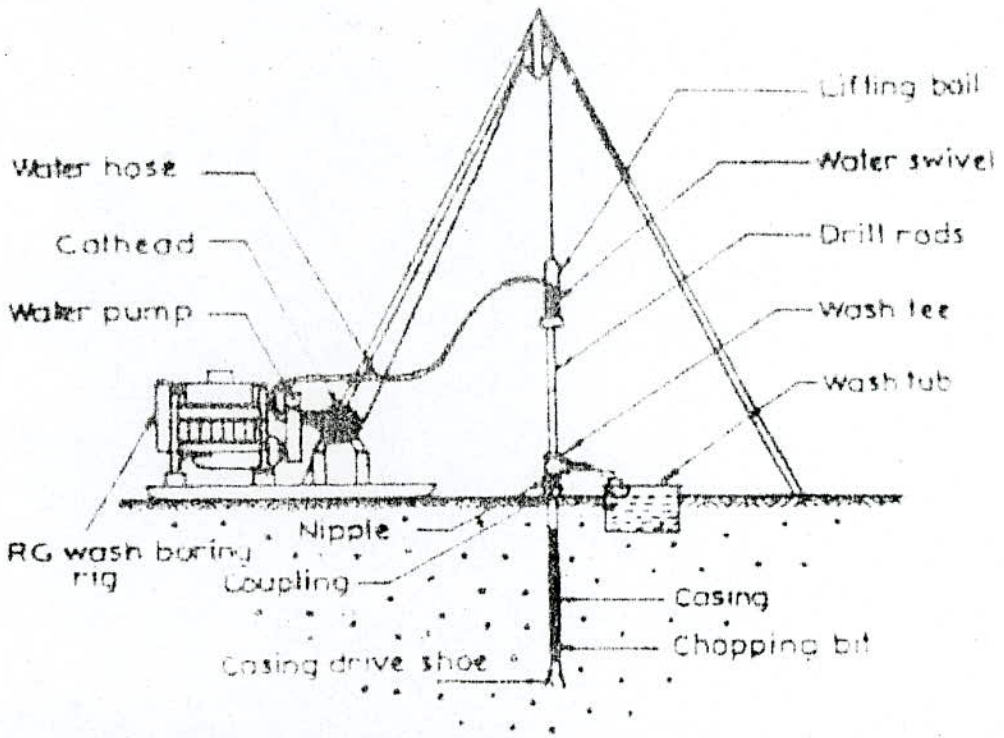


Figure 2.6 Apparatus for wash-boring operations (The Acker Drill company)

feel of the drill rods as it is churned and rotated and by the colour of the wash water carrying the cuttings, can usually detect conspicuous change in the character of the materials. He, with reasonable accuracy, thus notes the elevations of boundaries between strata and stops drilling to take samples and/or perform sounding[15].

2.4.3 Displacement boring

The method combines sampling and boring operations. A close bottom sampler–silt, cup or piston type- is forced into the ground to the desired depth. The sampler is detached from the soil below it by rotating and the piston is released or withdrawn. The sampler is then forced further down and it takes a sample. After withdrawal of the sampler and removal of the sampler from the sampler, the sampler is closed condition is again inserted into the hole and forced to a new depth. The method is simple and economical when excessive caving does not occur and the major changer in soil character can be detected by means of the penetration resistance. The displacement borings are generally limited from 2.5 to 7.5 cm diameter holes as larger diameter requires heavy construction equipment and becomes impractical. It requires fairly continuous sampling in stiff and dense soil either to protect the sampler from damage or to avoid objectionably heavy construction equipment[15].

2.4.4 Percussion Drilling

The Advancement of the hole is accomplished by alternatively lifting and dropping a heavy drilling bit which is attached to the lower end of a drill stem. The upper end of the drill rod is attached to a cable. The bore hole is generally kept dry except for a small amount of water which is added to form a slurry of the cuttings. The slurry of the cuttings is remover with the help of a bailer after the drilling bit is withdrawn.

The strokes of the drilling bit vary according to the ground formation. The usual range is 45 to 100 cm drop with 35 to 65 drops per minute[15].

2.4.5 Rotary Drilling

The main features of rotary drilling are similar to those of wash boring except that the loosening the soil is accomplished by rotating a heavy string of drill rods mechanically while the rods as well as the cutter bit at the bottom of the hole are subjected to a

continuous heavy pressure, instead of utilizing a chopping action. A number of different bits that are capable of cutting, chipping and grinding the most compact soil formation to small chips are used. It is worth mentioning that the chopping action used in wash boring requires relatively light equipment while rotary drilling requires fairly large, heavy and powerful machines. For fairly shallow holes or in rugged inaccessible country, wash boring is often more practical while for deep drilling or in hard formations rotary drilling is often found superior[15].

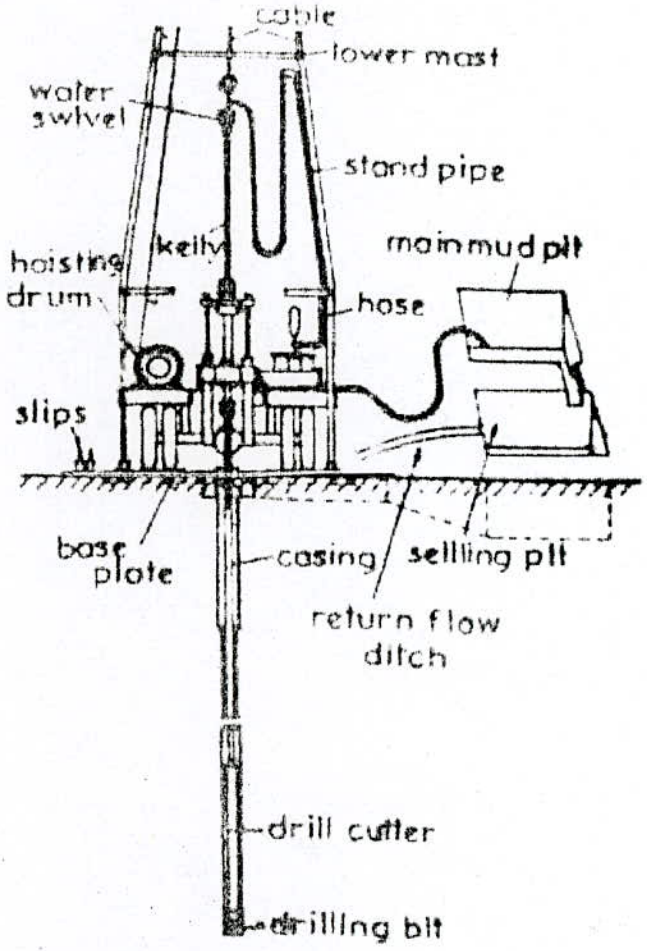


Figure 2.7 Schematic set-up of a rotary drill

2.4.6 Continuous Sampling

In this method, each sampling operation advances the bore hole and the boring is accomplished entirely by taking samples continuously. It is used extensively in detailed and special foundation explorations for important structure. It provides a more reliable and

detailed information on soil conditions than any other method. This is generally slower and more expensive than intermittent sampling[15].

2.5 Consolidation

According to Terzaghi (1943)[16] every process involving a decrease in the water content of a sturated soil without replacement of the water by air is called a process of consolidation. The opposite process in called a process of swelling, which involves an increase in the water content due to an increase in the volume of voids.

Skempton (1944)[17] conducted consolidation tests on a number of clays from different parts of the world, and gave the following equation for the compression index for a remoulded sample:

$$Cc = 0.007(LL-10) \tag{2.1}$$

For an ordinary clay of medium to low sensitivity the value of Cc corresponding to the field consolidation line is roughly equal to 1.3 times the value of Cc corresponding to remoulded sample.

Hence, $$Cc = 0.009(LL-10) \tag{2.2}$$

where,

Cc = Compression index
LL = Liquid Limit.

2.6 Bearing Capacity of Shallow foundation

According to Terzaghi (1943)[18] theoretical methods for predicting ultimate bearing capacity are generally based only on the general shear failure case. For the other failure modes, a reduction in the ultimate bearing capacity due to compressibility effects is applied to the value obtained for the general shear case.

The Terzaghi analysis makes the following assumptions to arrive at an approximate value of the bearing capacity.

(1) The footing is a strip at shallow depth and has a rough base; ($L>5B$, $D\leq B$).

(2) The soil is homogeneous, isotropic and relatively incompressible. There is two-dimensional general shear failure with well defined failure surfaces and zones as

indicated in figure 2.8. The wedge of soil directly beneath the footing, elastic zone 1, acts as part of the footing and pushes side ways the plastic zones-the radial shear zone 2 and the Rankine passive zone 3.

(3) The failure zones do not extend above the horizontal plane through the base of the footing. The shearing resistance of soil above the base level as well as friction between soil and sides of the footing are neglected. The overburden soil is replaced by a uniformly distributed equivalent surcharge $\sigma_o = \gamma D$

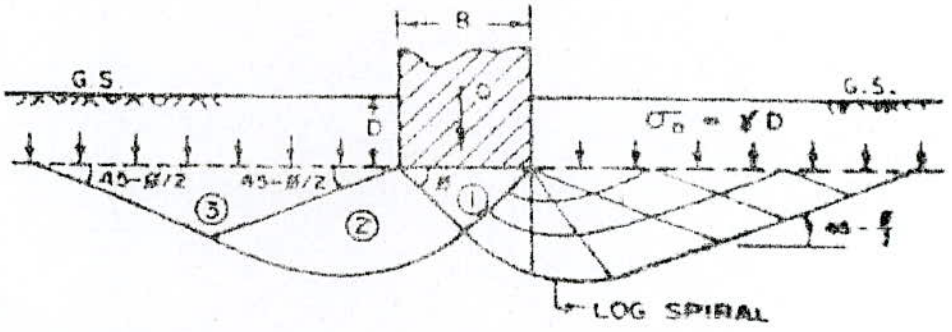


Figure 2.8 Failure surface and zones in the Tarzaghi analysis

The bearing capacity depends onthe shearing resistance on the boundary of the failure zones. This shearing resistance can be conveniently divided into three parts:

(1) Cohesive resistance.
(2) Frictional resistance from the surcharge σ_o at the footing level.
(3) Friction resistance resulting from the weight of soil within the failure zones.

Although these quantities are not entirely independent, they may be considered separately and on superposition the ultimate bearing capacity may be expressed by given below (Tomlinson 1980)[19]. This superposition is believed to lead to errors on the safe side, (not exceeding 17% to 20% for φ=30° to 40°, while being equal to zero for φ = 0, Vesic 1973)[20].

$$q_t = C_T N_c + \sigma_o' N_q + 0.5\,\gamma B N_\gamma \qquad (2.3)$$

Where, C_T = undrained cohesion of soil

σ_o' = effective overburden pressure at foundation level (=γ'D, if submerged)

γ = unit weight of soil below foundation lever (use γ', if submerged)

N_c, N_q and N_γ are bearing capacity factor(coefficients) depending only on the value of φ.

According to Skempton (1951)[21] the net ultimate bearing capacity of a footing on homogeneous clay deposit can be express as:

$$q_{nu}=CN_c \qquad (2.4)$$

Where, q_{nu} = ultimate bearing capacity

C = half of unconfined compression strength Shelby tube (thin walled sampler) sample

N_c = bearing capacity factor depending on depth and shape of footing.

According to Meyerhof (1957)[22] the following equation for determining the bearing capacity of continuous footing on slop:

$$q_{ult} = CN_{cq} + 0.5\,\gamma BN_\gamma \qquad (2.5)$$

q_{ult} = ultimate bearing capacity

C = Cohesion of soil

γ = unit weight of soil

N_{cq} and N_γ = bearing capacity factor

For Calculation of unconfined compression strength these following equations were used:

(i) Computation of Bulk Unit weight (γ):

$$\gamma = \frac{G\,(1+w)}{1+e}\,\gamma_w \qquad (2.6)^{23}$$

where, γ = Bulk unit weight of soil

γ_w = Unit weight or water

G = Specific gravity of soil of particular layer

e = void ratio = wG (at full saturation)

(ii) Computation of Submerge unit weight of soil (γ') :

$$\gamma' = \frac{G - 1}{1 + e}\gamma_w \qquad (2.7)^{23}$$

where,

γ' = Submerge unit weight of soil

γ_w = Unit weight or water

G = Specific gravity of soil of particular layer

e = void ratio = wG (at full saturation)

(iii) Computation of effective pressure [Overburden pressure] (P_o')

$$P_o' = Z_1\gamma + (Z-Z_1)\gamma' > Z\gamma' \qquad (2.8)^{23}$$

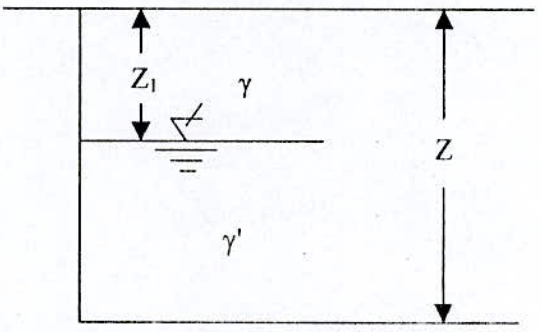
Where, P_o' = Effective pressure (Overburden pressure)

Z = Height form ground level to water table

$Z-Z_1$ = Depth below water table

γ = Bulk unit weight of soil above water table

γ' = Submerge unit weight of soil



(iv) Computation of plasticity Index (I_p):

$$I_p = W_L - W_P \qquad (2.9)^{24}$$

where, I_p = Plasticity Index

W_L=Liquid Limit

W_P = Plastic Limit

(v) Computation of Liquidity Index (I_L):

$$I_L = \frac{W_N - W_P}{W_L - W_P} \qquad (2.10)^{25}$$

Where, I_L = Liquidity Index

W_N=Moisture Content

W_L= Liquid Limit

W_P=Plastic Limit

(vi) Computation of Undrained Shear Strength (S_u) :

Many clay soil have been found to exhibit normalized behavior between undrained shear strength S_u and the in-situ overburden pressure P_o' and some index property.

The following are several correlations of this general form for normally consolidated clays:

Bjerrim and Simon (1960)[26]

$$\frac{S_u}{P_o'} = 0.45(I_p)^{1/2} \qquad (2.11)$$

Here, $I_p > 5\%$

With a scatter of ± 25%

Where S_u= Undrained Shear Strength

P_o' = Overburden Pressure (Effective Pressure)

I_p = Plasticity Index

$$\frac{S_u}{P_o'} = 0.18(I_L)^{-1/2} \qquad (2.12)$$

Here, $I_L > 0.5$

Where, I_L = Liquidity Index

Use I_P, I_L as decimal values

Karlsson and Veberg (1967)[27]

$$\frac{S_u}{P_o'} = 0.5 W_L \qquad (2.13)$$

$W_L > 20\%$

With a scatter of ± 30%

Where, S_U = Undrained Shear Strength
W_L = Liquid Limit
P_o' = Overburden pressure (Effective Pressure)

(vii) Computation of Unconfined Compression Strength (q_u):

In general, the strength for normally consolidated clays for cohesive soil is as follows:

Unconfined compression: $S_u = C = q_u/2$ (φ=0)

$$q_u = 2S_u \qquad (2.14)^{25}$$

Where, q_u = unconfined compressive strength
Su =Undrained Shear Strength

Unconfined compression Strength (q_u) is same as Ultimate bearing capacity (q_{ult})

These three formulae were used for calculation of qu:

(1) $q_u = 2*0.45\ P_o'(I_p)^{½}$ (2.15)

(2) $q_u = 2*0.18\ P_o'(I_L)^{-½}$ (2.16)

(3) $q_u = 2*0.5\ P_o' W_L$ (2.17)

2.7 Existing Soil Reports

Valuable information from existing soil reports of Khulna City Corporation area and other places have been collected from different sources (CRTS Civil, KUET, different organization, personal). Bore logs of soil reports of KCC area are shown in Annexure. All bore holes are located and marked on the KCC map (Fig. 3.1). Location of peat layer were also observed from these bore logs. Important soil parameters like w, LL, PL, G_s, q_u & Cc were studied from 202 soil reports (617 values for q_u and 210 values for Cc) obtained from CRTS Civil KUET and other organization. Summary of this collection is shown in Table 5.2.

CHAPTER THREE

FIELD WORK

3.1 General

Field work consist of 109 numbers of exploratory borings up to 20 feet depth below the existing ground level. The location of boring are shown in Figure 3.1. The land is approximately plane ground. Each of the boring includes the following field works:

a. Collection of disturbed samples
b. Collection of undisturbed samples (4 nos.)
c. Record of instant observation water table
d. Field classification of soils

3.1 Soil sampling

Two main types samples are of interest to civil engineers. In some cases it is only necessary to obtain samples which are complete, i.e. all the constituents of the soil are present, and the structural disturbance is not important. Such samples can be used for classification test, particle size determination and limit determination. The auger cuttings, contents of split spoon samplers in the standard penetration tests, sludge from the shell or wash water return or dug out material by hand from trial pits can be used in such cases and are called disturbed samples. These samples are placed in air-tight polythene bags properly labeled to identify the bore hole number, depth of sample, area of exploration and date of sampling. In other cases, the disturbance to the sample must be reduced to an absolute minimum so that in-situ structure, water content and void ratio are not altered. These samples are called undisturbed and are necessary in determining the in-place density, compressibility and shearing strength of a natural formation. Exploration involving collection of undisturbed samples are performed only when it is essential, as it is always costlier than the exploration with disturbed samples.

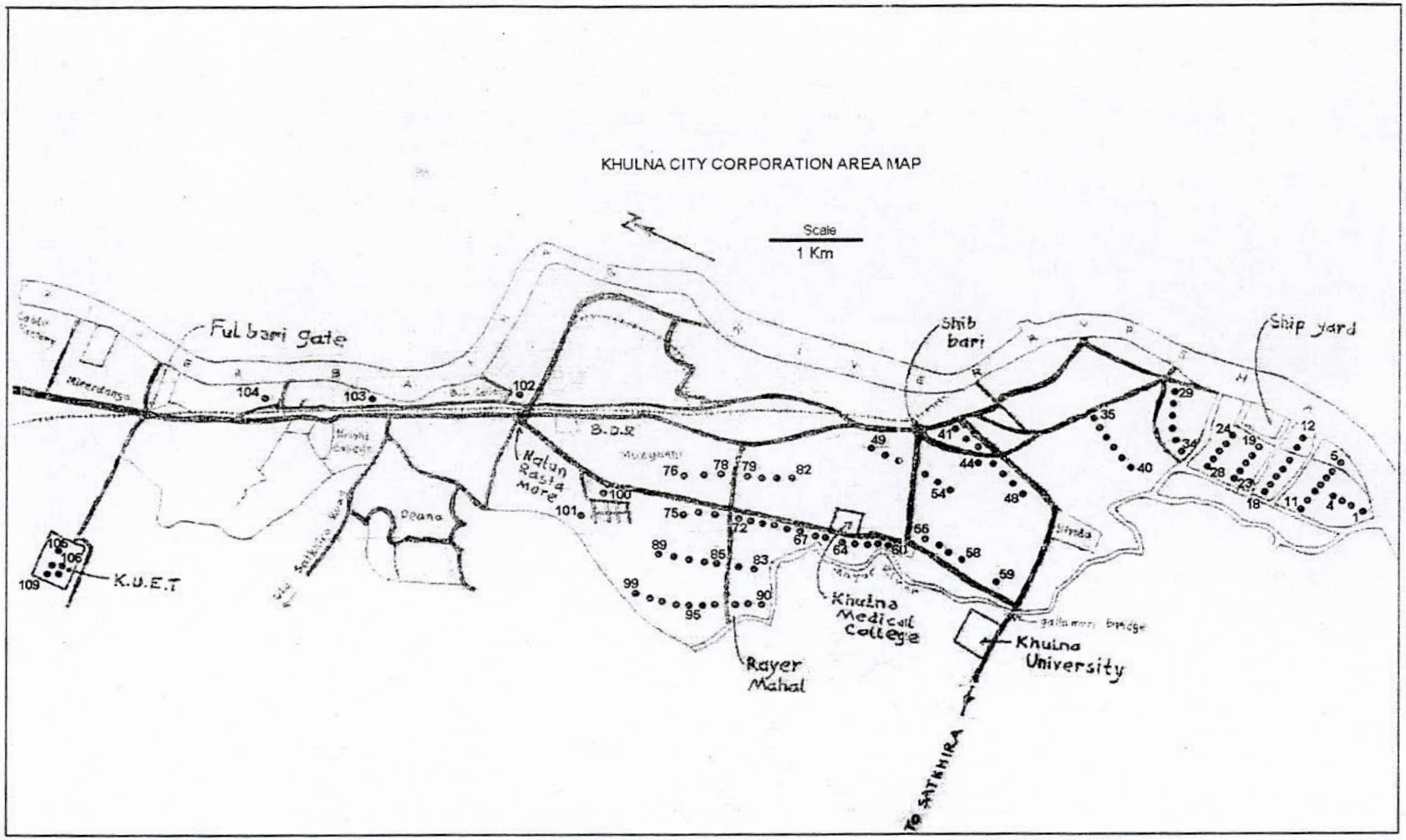
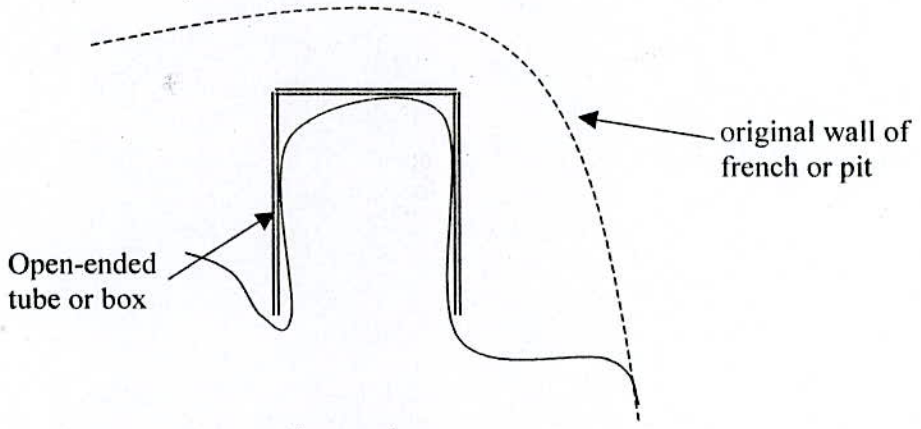


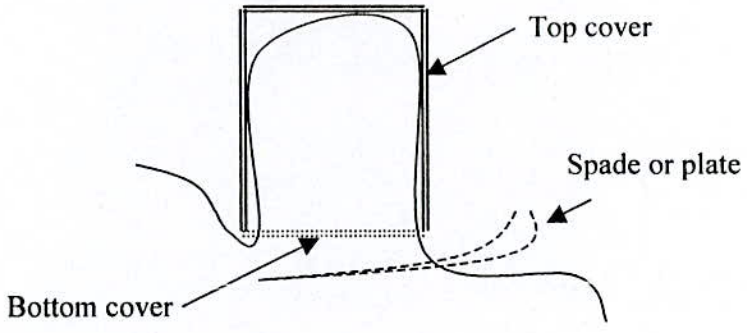
Figure 3.1 Location of bore-hole at KCC (Auger boring)

3.3 Collection of Undisturbed soil samples

Only 4 undisturbed soil samples were collected from depth of 5 feet from test pit. Test pit is one of the direct methods of exploration. A pit or trench is an alternate or preferable method of boring under certain conditions. Generally, the net dimensions at the bottom of



Stage – I
Soil Column isolator



Stage – II
Sample encased

Figure 3.2 Test pit sampling

the pit are 1.2 m in diameter or 1 m x 1.5 m. shown in Fig. 3.2. This is the only satisfactory means of obtaining samples with a minimum of disturbance. It permits visual examination of undisturbed soil in place and provides opportunities of conducting in-situ tests on undisturbed formations. If shallow depth determination of engineering properties of undisturbed soil formation is required then test pit or trenches become a necessity.

3.4 Collection of Disturbed soil samples:

Disturb soil samples were colleted at 5 feet intervals and at every change of soil strata by split spoon sampler. Split spoon sampler is made up of a driving shoe, to ensure a reasonable service life from driving into the soil, and a barrel. The barrel consists of a piece of tube split (split spoon) lengthwise with a coupling on the upper end to connect the drill rod to the surface. Length of barrel is 61 cm and diameter is 5 cm. These samples were collected and duly preserved in polythene bags and labeled with detailed job designation (bore hole number, depth). These soil samples were studied visually and the soil classification was prepared in strata chart shown in Fig. 3.3. Before collection of samples, the hole is cleaned. The sampler is then pressed down into the soil by rapid continuous movement for penetration depth of 50 cm.

3.4 Instant observation water table

The instant observation water table in each borehole was also recorded. It was measured when the boring is completed. Instant observation water tables are recorded and prepared a profile.

3.5 Field Classifications

The disturbed soil samples which have been collected in the field were thoroughly examined and types were classified roughly and noted in accordance with bore hole and depth.

Figure 3.3 Strata chart of bore log at KCC area

Bore hole no. 1
Site: Labonchora (South)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Silty clay	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 2
Site: Labonchora (South)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Silty clay	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 3
Site: Labonchora (South)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Clay with silt	
15'	Clay with little Silt	
20'	Sandy clay	

Bore hole no. 4
Site: Labonchora (South)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Silty Clay	
15'	Clay with little Silt	
20'	Clay with little Silt	

Bore hole no. 9
Site: Labonchora (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay with Silt	
20'	Clay with Silt	

Bore hole no. 10
Site: Labonchora (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with Silt	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 11
Site: Labonchora (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with sand	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 12
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Sandy Clay	
15'	Sandy clay	
20'	Sand with silt	

Bore hole no. 13
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Organic silt	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 14
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with little organic	
15'	Sandy clay	
20'	Sandy clay	

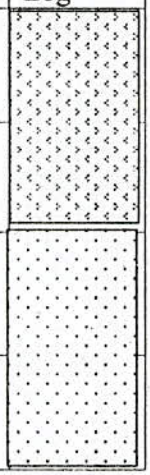
Bore hole no. 15
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Silt	
15'	Sandy clay	
20'	Sandy clay	

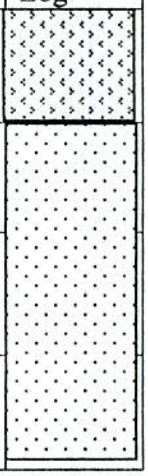
Bore hole no. 16
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0' 5'	Sandy Clay	
10'	Clay	
15'	Sandy clay	
20'	Sand with silt	

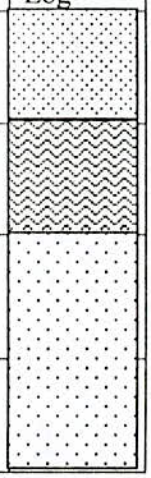
Bore hole no. 17
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0'	Silty Clay	
5'		
10'	Silty Clay	
15'	Sandy clay	
20'	Sandy clay	

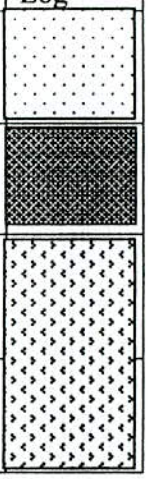
Bore hole no. 18
Site: Labonchora (North)

Depth	Strata Encountered	Bore Log
0'	Silty Clay	
5'		
10'	Sandy clay	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 19
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Silt	
5'		
10'	Silty Clay	
15'	Silty Sand	
20'	Silty Sand	

Bore hole no. 20
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Sand with Organic	
15'	Sand with Clay	
20'	Sandy clay	

Bore hole no. 21
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Organic silt	
15'	Clayey silt	
20'	Clayey silt	

Bore hole no. 22
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Clayey silt	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 23
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Clay	
5'		
10'	Clay	
15'	Sand with Clay	
20'	Sand with Clay	

Bore hole no. 24
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0'	Silt	
5'		
10'	Clay	
15'	Organic with silt	
20'	Organic with silt	

Bore hole no. 25
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Clay	
15'	Organic with clay	
20'	Organic with clay	

Bore hole no. 26
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Clay with organic	
20'	Clay with organic	

Bore hole no. 27
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Clayey silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 28
Site: Shipyard (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt with Clay	
15'	Organic Matter	
20'	Organic with clay	

Bore hole no. 29
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Sandy Clay	
10'	Sandy Clay little organic	
15'	Organic with silt	
20'	Organic with silt	

Bore hole no. 30
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Sandy Clay little organic	
15'	Organic with silt	
20'	Organic with silt	

Bore hole no. 31
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Organic with Clay	
20'	Organic with Clay	

Bore hole no. 32
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Clay	
15'	Organic with silt	
20'	Organic with silt	

Bore hole no. 33
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Silt with organic	
20'	Silt with organic	

Bore hole no. 34
Site: Rupsa (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Silt with organic	
20'	Silt with organic	

Bore hole no. 35
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Clayey Silt	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 36
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Clayey Silt	
10'	Clay	
15'	Clay with organic	
20'	Clay with organic	

Bore hole no. 37
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Silty Clay	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 38
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Organic with little Sand	
20'	Organic with little Sand d	

Bore hole no. 39
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clayey silt	
15'	Organic silt	
20'	Organic silt	

Bore hole no. 40
Site: Toot Para

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clayey silt	
15'	Organic silt	
20'	Organic silt	

Bore hole no. 41
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 42
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' – 5'	Silt	
10'	Silt	
15'	Sand with organic	
20'	Sand with organic	

Bore hole no. 43
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Sandy Clay	
15'	Silty with organic	
20'	Silt with organic	

Bore hole no. 44
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Silt	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 45
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey Silt	
10'	Clay with organic	
15'	Clay with organic	
20'	Clay with organic	

Bore hole no. 46
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with organic	
15'	Clay with organic	
20'	Clay with organic	

Bore hole no. 47
Site: Faraji Para (Moylapota)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clayey Silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 48
Site: Basu Para

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clayey silt	
15'	Clay	
20'	Organic silt	

Bore hole no. 49
Site: Shibbari

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 50
Site: Shibbari

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Sily	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 51
Site: Shibbari

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 52
Site: Shibbari

Depth	Strata Encountered	Bore Log
0' 5'	Clayey Silt	
10'	Silt	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 53
Site: Shibbari

Depth	Strata Encountered	Bore Log
0' 5'	Clay with clay	
10'	Silt	
15'	Organic with clay	
20'	Organic with clay	

Bore hole no. 54
Site: Gobarchaka

Depth	Strata Encountered	Bore Log
0' 5'	Clay with little silt	
10'	Clay	
15'	Clay with silt	
20'	Organic Matter	

Bore hole no. 55
Site: Sonadanga Bus stand (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic Matter	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 56
Site: Sonadanga Bus stand (South)

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Clay	
15'	Clay	
20'	Organic Matter	

Bore hole no. 57
Site: Sonadanga Bus stand (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic Matter	
15'	Organic Matter	
20'	Clay with Organic Matter	

Bore hole no.58
Site: Sonadanga Bus stand (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic Matter	
15'	Organic Matter	
20'	Clay with Organic Matter	

Bore hole no. 59
Site: Gallamari

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with silt	
15'	Clay with Organic Matter	
20'	Organic Matter	

Bore hole no. 60
Site: S. Bus Stand (North) Bypass

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 61
Site: S. Bus Stand (North) Bypass

Depth	Strata Encountered	Bore Log
0' – 5'	Clay with little silt	
10'	Clay	
15'	Organic clay	
20'	Organic clay	

Bore hole no. 62
Site: S. Bus Stand (North) Bypass

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Clay with silt	
15'	Organic clay	
20'	Organic clay	

Bore hole no. 63
Site: Medical College (West)

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 64
Site: Medical College (West)

Depth	Strata Encountered	Bore Log
0' – 5'	Clay	
10'	Clayey silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 65
Site: Medical College (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clayey silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 66
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 67
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 68
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clayey silt	
15'	Silt with organic	
20'	Silt with organic	

Bore hole no. 69
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty sand	
15'	Clayey sand	
20'	Sandy clay	

Bore hole no. 70
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	
15'	Silty Sand	
20'	Silty Sand	

Bore hole no. 71
Site: Boyra More (South)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Silt	
20'	Silty sand	

Bore hole no. 72
Site: Boyra
Private plot

Depth	Strata Encountered	Bore Log
0' 5'	Silt with Clay	
10'	Clay	
15'	Sandy soil	
20'	Sandy soil	

Bore hole no. 73
Site: Boyra
Private plot

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Sandy clay	
20'	Sand caly	

Bore hole no. 74
Site: Boyra
Private plot

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Silty Sand	
15'	Sandy clay	
20'	Sandy clay	

Bore hole no. 75
Site: Mojgunni Police line (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with little silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 76
Site: Mojgunni Residence Area

Depth	Strata Encountered	Bore Log
0' 5'	Silty Clay	
10'	Silty Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 77
Site: Boyra (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay with little silt	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no.78
Site: Boyra (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic with little Sand	
15'	Organic with little Sand	
20'	Organic with little Sand	

Bore hole no. 79
Site: Boyra (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Sandy silt	
20'	Organic clay	

Bore hole no. 80
Site: Boyra (East)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Clay	
15'	Organic matter	
20'	Organic matter	

Bore hole no. 81
Site: Boyra (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 82
Site: Boyra (Central)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Clay	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 83
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with little silt	
15'	Clay with little silt	
20'	Organic Matter	

Bore hole no. 84
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Silty Sand	
20'	Silty Sand	

Bore hole no. 85
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	
15'	Silty Clay	
20'	Silty sand	

Bore hole no. 86
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay silt	
20'	Clay sand	

Bore hole no. 87
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay sand	
10'	Clay sand	
15'	Sand with little Silt	
20'	Sand with little Silt	

Bore hole no. 88
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Sandy Clay	
15'	Sandy clay	
20'	Silty Sand	

Bore hole no. 89
Site: Rayel Mahal (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay with Organic matter	
20'	Organic Matter	

Bore hole no. 90
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay with silt	
20'	Clay with silt	

Bore hole no. 91
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay with sand	
20'	Clay with sand	

Bore hole no. 92
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with sand	
15'	Clay with sand	
20'	Silt with sand	

Bore hole no. 93
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Sandy silt	
15'	Sandy clay	
20'	Silty Sand	

Bore hole no. 94
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Clay	
15'	Sand clay	
20'	Sandy clay	

Bore hole no. 95
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with little silt	
15'	Sandy clay	
20'	Sand with silt	

Bore hole no. 96
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay with silt	
10'	Silt	
15'	Silt with sand	
20'	Sand with clay	

Bore hole no. 97
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silt	
10'	Silt	
15'	Silt with sand	
20'	Silt with sand	

Bore hole no. 98
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Clay with silt	
10'	Clay with silt	
15'	Sand with silt	
20'	Sand with silt	

Bore hole no. 99
Site: Rayer Mahal (West)

Depth	Strata Encountered	Bore Log
0' 5'	Silty clay	
10'	Clay	
15'	Clay with little sand	
20'	Clay with little sand	

Bore hole no. 100
Site: Bastohara (East)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic Matter	
15'	Organic Matter	
20'	Organic Matter	

Bore hole no. 101
Site: Bastohara (North)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Organic Matter	
15'	Organic Matter	
20'	Clay with Organic matter	

Bore hole no. 102
Site: Natun Rasta More
(Collegiate School)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay	
15'	Clay	
20'	Clayey Sand	

Bore hole no. 103
Site: Daulat Pur

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Clay with silt	
15'	Silty Clay	
20'	Silty Clay	

Bore hole no. 104
Site: Raily Gate

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	
15'	Sandy Clay	
20'	Sandy Clay	

Bore hole no. 105
Site: KUET (Inside Civil Dept)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey Silt	
10'	Sandy Clay	
15'	Clay with trace silt	

Bore hole no. 106
Site: KUET (Outside CE building, South-East Corner)

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Clay	

Bore hole no. 107
Site: KUET(Outside CE building, South-East Corner)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silty Clay	

Bore hole no. 108
Site: KUET Campus

Depth	Strata Encountered	Bore Log
0' 5'	Clayey silt	
10'	Clay	

Bore hole no. 109
Site: KUET(Near Pond South side)

Depth	Strata Encountered	Bore Log
0' 5'	Clay	
10'	Silt	

CHAPTER FOUR

LABRORATORY INVESTIGATION

4.1 General

This chapter describes the different methods of laboratory investigation used in this study to evaluate geotechnical engineering properties of collected soil samples. Both the undisturbed and disturbed soil samples were collected the relevant ASTM standard laboratory tests were conducted.

4.2 Natural Moisture content

The water content of a soil sample is the ratio of the water in the sample to its dry weight. It is usually expressed as a percentage. The soil sample is weighed both in natural state and in oven dry state (temp. 105°-110°C, 24 hours) and the moisture content is calculated by diving the loss of weight of the sample by its dry weight.

$$w = \frac{W_w}{W_d} \times 100 \qquad (4.1)$$

Where, w = Moisture Content

W_w = weight of water

W_d = weight of dry soil

4.3 Atterberg limits

Physical properties of clay are greatly influenced by water content. A given soil behave as a fluid or soil or as plastic materials, depending on how much water it contains. The water contents that correspond to the boundaries between the states of consisting are called as the Atterberg Limits. Liquid Limit is the minimum water content at which a clay soil just starts behaving like a fluid. It is determined with help of a standard limit device which consists of brass cup and an arrangement to impart blows to cup at an uniform rate. Water

content at which 25 blows are required is termed as the limit. The plastic limit is the minimum water content at which a soil is just plastic and is determined by rolling out a soil sample at a slowly decreasing water content until the desired water content is reached at which a thread of 1/8 inch diameter just begging to crumble. The thread is rolled on a glass plate with hand.

4.3.1 Liquid Limit

Liquid limit is the minimum moisture content at which the soil changes from liquid state to the plastic state. At the liquid limit, the clay is practically like a liquid, but possesses a small value that can be measured in the laboratory. The liquid limit of soil depends upon the clay minerals present. The stronger the surface charge and the thinner the particle, the greater will be the amount of adsorbed water and, therefore, the higher will be the liquid limit. The liquid limit is determined in the laboratory either by Casagrande's apparatus or by cone penetration method. The device is Casagrande's method consists of a brass cup which drops through a height of 1 cm on a hard base when operated by the handle. The device is operated by turning the crank which raises the cup and lets it drop on the rubber base. The height of drop is adjusted with the help of adjusting screws.

About 120 gm of an air-dried sample passing through 425 μ IS sieve is taken in a dish and mixed with distilled water to form liquid limit device, and the surface is smoothened and a leveled with a spatula to a maximum depth of 1 cm. A groove is cut through the sample along the symmetrical axis of the cup, preferably in one stroke, using a standard grooving tool. IS: 2720-Part V recommends two types of grooving tools: (1) Casagrande tools, (2) ASTM tools. The ASTM tools cuts a groove of width 2 mm at the bottom, 13.6 mm at the top and 10 mm deep. The Casagrande tool is recommended for normal fine-grained soils, whereas the ASTM tool is recommended for sandy, fine grained soils, in which the Casagrande tool tends to tear the soil in the groove. The liquid limit is the water content at which the soil is sufficiently fluid to flow when the device is given 25 blows. As it is difficult to get exactly 25 blows for the sample to flow, the test is conducted at different water contents so as to get blows in the range of 10 to 40. A plot is made between the water content as ordinate and the number of blows on log scale as abscissa. The plot is approximately a straight line. The plot is known as flow curve. The liquid limit is

obtained, from the plot, corresponding to 25 blows. The liquid limit is expressed as the nearest whole number.

4.3.2 Plastic limit

The plastic limit is the minimum moisture content below which the soil stops behaving as a plastic material. It begins to crumble when rolled in to a thread of soil of 3 mm diameter. At this water content, the soil loses its plasticity and passes to a semi-solid state.
For determination of the plastic limit of a soil, it is air-dried and sieved through a 425 μ IS sieve. About 30 gm of soil is taken in an evaporation dish. It is mixed thoroughly with distilled water till it becomes plastic, and can be easily moulded.

About 10 gm of the plastic soil mass is taken in one hand and a ball is formed. The ball is rolled with fingers on a glass plate to form a soil thread of uniform diameter. The rate of rolling is kept about 80 to 90 strokes per minute. If the diameter of the thread becomes smaller than 3 mm, without crack formation, it shows that the water content is more than the plastic limit. The soil is kneaded further. This results in the reduction of the water content, as some water is evaporated due to the heat of hand. The soil is re-rolled and the procedure repeat till the thread crumbles. The water content at which the soil can be rolled into a thread of approximately 3 mm in diameter without crumbling is known as the plastic limit. The test is repeated, taking a fresh sample each time. The plastic limit is taken as the average of three values. The plastic limit is reported to the nearest whole number.

4.4 Specific gravity

The specific gravity of a solid defined as the rate of the unit weight of the solid in air to the weight or water. To determine the specific gravity of soil sample, 25 grams of oven dried sample is thoroughly pulverized and is placed in a calibrated pycnometer. Water is poured inside the pycnometer until the its top is slightly below the calibrated mark. The mixture is then boiled thoroughly in order to eliminate all the air babbles. More water is then added to the mixture till it over night, the temperature is then recorded and the bottle is weighed.

The Specific gravity Gs is given by:

$$G_s = \frac{G_t \times W_s}{(W_s - W_1 + W_2)} \qquad (4.2)$$

where, G_s = Specific gravity of soil

G_t = The specific gravity of water at room temperature.

W_s = The weight of over dry soil (25grams)

W_1 = Weight of flask + soil + water

W_2 = Weight of flask + water

4.5 Unconfined Compression Test

Unconfined compression test is a simple method for determination of shearing strength of cohesive soil which is very important to determine the bearing capacity of soil. As the name implies, the lateral confining pressure in and unconfined compression test is kept zero, unsupported specimen and at failure is measured. The specimen is prepared from the undisturbed soil sample by carefully trimming it to a cylindrical shape of 7 cm height and 3.5 cm diameter. The specimen is then placed on the level pedestal of the unconfined compression apparatus in a vertical position. The load is applied axially on the top of the specimen and is distributed uniformly over the surface of the specimen with the help of double providing ring assembly fitted with a strain gauge, fitted with apparatus. The load is applied at such a rate that the vertical deformation of the sample is nearly 2% per minute in order to avoid and drainage during compression. The maximum load at failure known as the unconfined compressive strength of the sample. The shearing strength of the sample is half of the unconfined compressive strength.

CHAPTER FIVE

RESULTS AND DISCUSSION

5.1 General

In this chapter laboratory test results Liquid Limit, Plastic Limit, Moisture Content, Specific Gravity of samples obtained from auger boring corresponding to level 5' and 10' from EGL are summarized. From these values unconfined compressive strength and compression index were obtained from equations published in literature. Equation proposed by different authors to find unconfined compressive strength and compression index indirectly (without doing consolidation and unconfined tests on undisturbed soil) where composed with the actual test values obtained from existing soil reports. Finally soil profiles for KCC area were drawn showing the peat layer, q_u, Cc, water table etc.

5.2 Summary of laboratory test results

Moisture content (w), Liquid limit (LL), Plastic limit (PL) and Specific gravity (G_s) obtained from samples collected from auger boring are shown in Table 5.1. Method adopted for above tests is respectively Casagrande's apparatus and pycnometer.
One example for each of above test result calculation is shown below:

Calculation procedure of w, LL, PL & Gs

	Moisture Content	Liquid Limit			Plastic Limit
Can No.	1	2	3	4	5
Wt. of wet soil + can	59.30	60.30	59.40	65.20	39.70
Wt. of dry soil + can	44.00	44.70	43.30	46.10	35.00
Wt. Can	22.40	22.60	20.80	22.60	22.40
Wt. of dry soil	21.60	22.10	22.50	23.50	12.60
Wt. of moisture	15.30	15.60	16.10	19.10	4.70
Water content, w%	**70.83**	70.59	71.56	81.28	**37.30**
No. of blows, N		40	20	12	

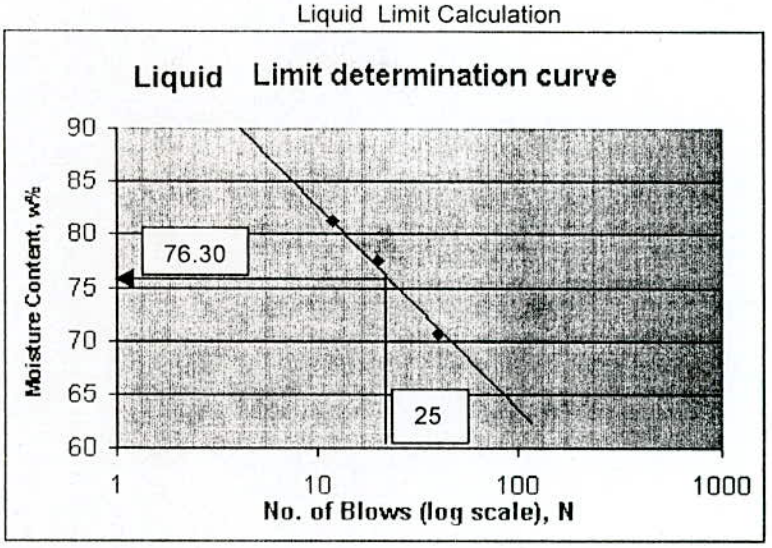
Moisture Content(w) Calculation
$w=(W_w/W_d)^* 100$
$= (15.3/21.6)^*100$
$w = \mathbf{70.83\ \%}$

Plastic Limit (PL) Calculation
PL = (4.7/12.6)*100
PL = **37.30 %**

Liquid Limit Calculation

N,	W%
40,	70.59
20,	77.56
12,	81.28

From Chart
Liquid Limit = **76.30**



Specific Gravity calculation

W_s= 50 gm
W_1= 673.6 gm
W_2= 642.8 gm
G_t (23° C)= 0.9976

$G_s=W_sG_t/(W_s-W_1+W_2)$
$=50*0.9976/(50-673.6+642.8)$
G_s = **2.60**

Calculation of laboratory test result

a. Moisture Content = 70.83 %
b. Liquid Limit = 76.30 %
c. Plastic Limit = 39.30 %
d. Specific Gravity = 2.60

Similar calculations are conducted for preparation of Table 5.1.

5.3 Comparison of q_u (Calculated and Laboratory results)

For this purpose correlations proposed by Bjerrim and Simon (1960)[26] & Karlsson and Veberg (1967)[27] Eq. 2.15, 2.16 and 2.17[25] are used. Values of q_u obtained by using these formulae on the test results of existing soil reports (202 Nos.) are shown in Table 5.2. With these values, graphs are plotted in Fig. 5.1 and Fig. 5.2 which shows the compliance of the calculated q_u values obtained from correlation Eq. 2.15, 2.16 and 2.17 with the laboratory test values. It can be concluded from Fig. 5.1 and Fig. 5.2 that correlation proposed by Karlsson and Veberg being in the conservative side best represents the laboratory results of the existing soil reports shown in Fig. 5.3, validating its use for indirect calculation of q_u. Sorted KCC area data from all collected data shown in Table 5.3 and location of bore-hole of q_u at KCC area shown in Table 5.4.

Table 5.1 Laboratory test results and calculated qu (samples from Auger boring)

Bore Hole No.	Location of Bore Hole	Dep-th (ft)	Moisture Content W %	Liquid Limit LL %	Plastic Limit PL %	Specific Gravity Gs	qu (Calculated by empirical formula*) kPa
1	2	3	4	5	6	7	8
1	Labonchora (South)	5	70.83	76.30	39.30	2.6	9.27
"	"	10	41.35	51.20	28.30	2.72	14.30
2	"	5	81.22	69.75	39.57	2.62	7.48
"	"	10	47.98	47.80	32.02	2.75	12.20
3	"	5	38.63	35.50	26.50	2.57	5.77
"	"	10	82.47	47.25	23.83	2.57	9.22
4	"	5	33.71	41.20	29.85	2.71	7.35
"	"	10	45.24	36.47	29.40	2.69	9.94
5	Labonchora (West)	5	37.01	45.10	28.22	2.73	7.15
"	"	10	56.40	46.50	35.10	2.69	10.72
6	"	5	38.63	35.50	26.50	2.57	5.77
"	"	10	39.20	42.10	23.50	2.57	11.72
7	"	5	34.50	41.20	29.00	2.65	7.77
"	"	10	58.20	46.50	38.20	2.69	11.93
8	"	5	35.11	39.50	23.85	2.61	6.73
"	"	10	38.90	34.50	28.90	2.67	9.99
9	Labonchora (East)	5	31.57	34.00	25.58	2.63	5.54
"	"	10	39.21	32.00	26.21	2.63	8.63
10	"	5	35.20	35.50	24.56	2.66	6.14
"	"	10	35.29	48.30	27.58	2.7	14.73
11	"	5	54.20	34.50	28.05	2.7	4.59
"	"	10	36.15	46.30	28.37	2.72	13.38
12	Labonchora (North)	5	61.20	48.50	25.60	2.79	6.96
"	"	10	44.32	45.20	23.93	2.79	12.83
13	"	5	140.50	98.70	64.20	2.59	8.00
"	"	10	48.83	59.00	24.80	2.66	14.49
14	"	5	54.38	49.50	39.40	2.62	6.42
"	"	10	219.00	168.90	100.80	2.54	16.89
15	"	5	38.82	48.00	26.50	2.62	7.91
"	"	10	36.15	41.50	24.76	2.62	12.18
16	"	5	35.11	39.50	23.85	2.61	6.73
"	"	10	42.90	49.20	32.35	2.63	13.46
17	"	5	31.57	34.00	25.58	2.63	5.54
"	"	10	38.20	32.00	26.21	2.63	8.73
18	"	5	35.20	35.50	24.56	2.66	6.14
"	"	10	35.29	48.30	27.58	2.7	14.73
19	Shipyard (West)	5	33.64	34.50	28.05	2.7	5.62
"	"	10	36.15	46.30	28.37	2.72	13.38
20	"	5	45.20	38.50	33.72	2.72	7.31
"	"	10	33.84	35.00	29.81	2.73	12.02
21	"	5	37.91	47.50	28.12	2.57	9.90
"	"	10	245.50	215.40	112.20	2.53	32.96
22	"	5	48.90	43.10	32.58	2.69	7.60
"	"	10	68.00	57.60	45.20	2.59	13.78
23	"	5	56.90	55.50	28.90	2.67	7.98

* According to Karlsson and Vebert (1967), here LL>20%

Table 5.1 (Continued)

1	2	3	4	5	6	7	8
23	Shipyard (West)	10	64.20	43.20	23.15	2.6	9.67
24	"	5	54.10	46.50	28.30	2.69	7.21
"	"	10	189.25	102.50	98.45	2.58	13.58
25	"	5	59.80	46.20	26.54	2.59	7.07
"	"	10	221.30	145.80	101.40	2.52	18.78
26	"	5	68.50	45.10	40.20	2.71	6.05
"	"	10	59.40	42.10	28.40	2.72	10.16
27	"	5	75.20	59.20	24.50	2.71	8.52
"	"	10	54.00	39.00	29.00	2.67	10.30
28	"	5	78.60	59.40	34.20	2.65	10.07
"	"	10	68.80	56.70	46.40	2.71	15.20
29	Rupsa (West)	5	46.50	38.90	31.10	2.69	5.53
"	"	10	38.50	42.50	28.20	2.69	11.81
30	"	5	33.50	34.00	28.50	2.7	5.55
"	"	10	38.63	35.50	26.50	2.54	9.31
31	"	5	54.20	42.10	19.60	2.6	6.69
"	"	10	69.20	48.20	21.30	2.7	11.42
32	"	5	58.30	32.10	12.40	2.69	4.83
"	"	10	198.70	106.50	99.84	2.53	13.65
33	"	5	36.50	34.20	25.40	2.57	5.67
"	"	10	54.80	41.20	29.00	2.65	10.13
34	"	5	65.30	42.10	24.60	2.59	4.97
"	"	10	49.90	32.10	15.40	2.64	7.75
35	Toot Para	5	40.06	36.50	24.41	2.6	7.00
"	"	10	124.00	102.00	98.00	2.54	18.93
36	"	5	30.44	34.00	23.86	2.59	7.56
"	"	10	44.34	32.50	24.65	2.66	10.31
37	"	5	31.16	46.00	23.93	2.67	11.07
"	"	10	78.77	52.60	28.60	2.66	13.93
38	"	5	40.06	35.26	14.58	2.64	7.36
"	"	10	75.21	65.29	34.50	2.64	16.57
39	"	5	30.98	39.20	27.15	2.7	8.35
"	"	10	198.60	121.30	86.24	2.59	18.44
40	"	5	58.60	45.20	19.90	2.6	6.98
"	"	10	65.20	35.40	29.40	2.72	8.67
41	Faraji para (Moyla Pota)	5	39.14	41.50	24.76	2.61	8.04
"	"	10	134.00	103.00	87.34	2.54	18.46
42	"	5	33.65	35.60	24.68	2.75	8.56
"	"	10	29.10	34.00	25.58	2.63	12.94
43	"	5	34.78	38.00	25.88	2.82	6.92
"	"	10	24.03	35.50	21.50	2.66	12.33
44	"	5	31.51	31.00	23.30	2.71	6.12
"	"	10	42.50	34.50	28.05	2.7	10.22
45	"	5	33.65	35.60	24.68	2.77	7.53
"	"	10	29.10	45.80	27.40	2.72	16.56
46	"	5	31.35	32.50	25.43	2.73	6.47
"	"	10	48.70	47.50	28.12	2.73	13.38
47	"	5	59.30	49.50	26.30	2.69	7.77
"	"	10	189.00	124.00	101.30	2.56	17.31
48	Basu Para	5	35.20	35.50	24.56	2.66	6.14
"	"	10	45.30	38.40	29.40	2.69	10.46

Table 5.1 (Continued)

1	2	3	4	5	6	7	8
49	Shibbari	5	38.50	42.50	28.20	2.68	6.52
"	"	10	163.00	124.00	112.90	2.53	14.77
50	"	5	38.69	35.50	26.50	2.67	5.95
"	"	10	36.36	35.00	25.86	2.71	10.58
51	"	5	31.35	41.20	24.60	2.65	6.16
"	"	10	29.18	39.50	26.90	2.7	11.81
52	"	5	53.20	47.10	24.30	2.71	6.34
"	"	10	50.26	26.40	19.20	2.59	6.24
53	"	5	48.50	56.20	26.30	2.65	8.58
"	"	10	34.80	42.50	26.50	2.65	12.80
54	Gobarchaka	5	33.84	35.00	29.81	2.73	8.88
"	"	10	37.91	47.50	28.12	2.73	17.74
55	Sonadanga Bus Stand (S)	5	37.29	39.20	27.15	2.7	7.30
"	"	10	145.00	88.00	78.00	2.59	14.05
56	"	5	30.98	39.20	27.15	2.72	8.39
"	"	10	50.95	55.00	33.72	2.72	15.96
57	Bus Stand (South) Bypass	5	41.87	52.10	28.28	2.69	9.30
"	"	10	256.30	124.00	124.50	2.61	15.17
58	"	5	38.86	48.60	35.20	2.69	8.90
"	"	10	198.60	123.40	101.20	2.57	16.86
59	Gallamari	5	35.29	57.50	27.58	2.7	10.91
"	"	10	33.64	34.50	28.05	2.7	11.24
60	Bus Stand (North) Bypass	5	27.45	45.80	25.50	2.72	10.16
"	"	10	51.18	48.60	29.80	2.7	13.99
61	"	5	33.33	56.00	31.00	2.71	11.70
"	"	10	38.50	45.20	28.60	2.69	14.59
62	"	5	43.33	34.60	27.60	2.57	6.94
"	"	10	68.20	45.20	41.20	2.69	12.10
63	Medical college (West)	5	38.82	34.26	23.86	2.59	7.13
"	"	10	87.90	76.50	54.20	2.54	16.60
64	"	5	44.32	45.86	23.93	2.67	8.67
"	"	10	86.90	78.20	65.40	2.58	18.40
65	"	5	48.83	60.25	14.58	2.66	11.90
"	"	10	98.60	78.00	54.20	2.57	12.68
66	Boyra More (South)	5	40.10	41.50	24.76	2.61	7.98
"	"	10	169.50	123.80	110.00	2.56	23.75
67	"	5	39.28	45.86	21.40	2.63	10.29
"	"	10	157.50	98.40	78.20	2.54	19.34
68	"	5	37.09	27.50	26.21	2.63	6.27
"	"	10	51.67	35.50	24.56	2.66	9.01
69	"	5	45.20	57.50	27.58	2.7	10.01
"	"	10	29.07	34.50	19.40	2.7	11.88
70	"	5	41.26	54.20	28.37	2.72	10.61
"	"	10	37.50	55.00	33.72	2.72	18.10
71	"	5	33.84	35.00	29.81	2.73	8.88
"	"	10	45.29	47.50	28.12	2.73	16.66
72	Private plot, Boyra	5	35.24	34.60	15.20	2.57	7.36
"	"	10	31.80	36.50	29.50	2.69	13.20
73	"	5	34.20	39.50	19.80	2.6	8.54
"	"	10	35.50	32.80	27.94	2.7	11.45

Table 5.1 (Continued)

1	2	3	4	5	6	7	8
74	Private plot, Boyra	5	36.79	34.00	23.86	2.59	7.18
"	"	10	39.40	34.80	28.90	2.68	11.62
75	Mogunni Police Line	5	40.22	52.00	30.23	2.66	10.89
"	"	10	48.83	59.00	14.58	2.7	18.21
76	Mujgunni R/A	5	34.00	29.40	24.65	2.66	6.02
"	"	10	44.32	46.00	23.93	2.67	13.95
77	Boyra More (East)	5	35.71	35.40	28.20	2.67	6.11
"	"	10	68.90	57.40	45.60	2.6	12.40
78	"	5	62.30	48.20	21.81	2.58	5.80
"	"	10	54.20	49.10	29.40	2.6	11.21
79	"	5	49.50	44.20	26.54	2.71	6.47
"	"	10	46.30	34.20	19.50	2.69	8.97
80	"	5	54.30	39.30	28.60	2.59	6.23
"	"	10	46.30	29.30	16.20	2.64	8.21
81	"	5	69.90	46.90	29.50	2.59	6.42
"	"	10	175.00	124.00	102.00	2.56	17.03
82	Boyra (Central)	5	70.20	54.10	29.30	2.72	6.39
"	"	10	78.30	59.80	43.20	2.69	11.51
83	Rayel Mahal (East)	5	80.20	54.20	27.36	2.69	6.76
"	"	10	71.50	55.41	24.19	2.6	11.75
84	"	5	68.50	46.20	31.20	2.59	5.34
"	"	10	53.20	27.40	19.50	2.71	6.55
85	"	5	69.30	43.80	31.20	2.73	6.53
"	"	10	50.20	32.10	19.40	2.56	8.47
86	"	5	30.69	38.50	29.50	2.57	6.20
"	"	10	56.41	66.50	32.59	2.69	15.33
87	"	5	33.84	34.10	29.81	2.73	8.66
"	"	10	45.20	47.50	28.12	2.67	16.42
88	"	5	33.84	34.12	29.81	2.73	8.15
"	"	10	37.91	54.20	32.10	2.59	18.66
89	"	5	33.84	34.50	29.21	2.73	8.76
"	"	10	54.20	49.30	19.40	2.7	16.06
90	Rayel Mahal (West)	5	37.91	47.50	28.12	2.73	10.29
"	"	10	56.20	43.10	24.50	2.7	12.56
91	"	5	80.10	74.50	41.20	2.59	11.32
"	"	10	65.00	45.00	34.50	2.67	11.57
92	"	5	39.40	31.50	16.20	2.58	5.57
"	"	10	69.90	54.10	42.10	2.6	12.41
93	"	5	46.50	42.10	19.70	2.56	7.62
"	"	10	74.50	46.20	31.20	2.7	11.24
94	"	5	46.30	39.40	26.50	2.6	5.45
"	"	10	69.50	49.70	21.10	2.71	10.29
95	"	5	68.20	54.12	27.10	2.7	7.26
"	"	10	52.48	28.70	19.40	2.67	7.25
96	"	5	71.25	37.51	31.57	2.69	5.49
"	"	10	43.21	29.41	24.16	2.71	8.68
97	"	5	59.25	49.58	28.16	2.68	6.29
"	"	10	75.21	69.28	48.36	2.57	13.15
98	"	5	63.25	55.14	47.29	2.72	7.68
"	"	10	49.35	47.26	41.46	2.69	12.37

Table 5.1 (Continued)

1	2	3	4	5	6	7	8
99	Rayel Mahal (West)	5	79.48	65.24	51.24	2.71	10.16
"	"	10	68.27	57.12	40.21	2.73	14.58
100	Bastohara (East)	5	46.25	42.18	23.16	2.69	7.27
"	"	10	102.00	98.50	76.00	2.57	18.65
101	Bastohara (North)	5	54.38	99.00	39.40	2.62	12.84
"	"	10	272.22	295.00	100.00	2.58	26.17
102	Natun Rasta More	5	38.82	48.00	26.50	2.62	9.34
"	"	10	39.14	41.50	24.76	2.58	12.85
103	Daulat Pur	5	35.11	42.50	23.85	2.61	9.78
"	"	10	54.60	51.00	32.35	2.54	15.16
104	Raily gate	5	31.57	34.00	25.58	2.69	8.71
"	"	10	30.20	27.50	26.21	2.63	10.75
105	KUET (Civil Dept.)	5	45.59	31.52	21.67	2.72	7.38
"	"	10	42.15	34.60	23.10	2.66	12.23
106	KUET Campus	5	34.31	54.40	28.57	2.70	9.61
107	"	5	34.69	47.40	24.51	2.70	8.34
108	"	5	22.65	45.50	34.67	2.70	9.21
109	"	5	27.39	40.00	26.47	2.67	9.95

Values of q_u from unconfined compression strength test on four undisturbed samples obtained from test pit at depth of 5' shown in Table 5.5 are compared with calculated q_u from Eq. 2.15, 2.16 and 2.17 shown in Fig. 5.4. The comparison shows that the calculated q_u is in conservative side. Thereby the use of q_u obtained indirectly from auger boring Eq. 2.15, 2.16 and 2.17 on samples (Table 5.1) can be a reasonable basis for q_u profile. Plot a curve of linear fit calculated q_u versus actual q_u shown in Fig. 5.5.

One example for each of above calculation is shown below:

Here, Depth (Z)=5'

Water table (Z1) = 5'

Moisture content (W_N) = 46.73 %

Liquid Limit (W_L) = 63.0 %

Plastic Limit (W_P) = 29.0 %

Specific Gravity (G_s) = 2.66, $e=W_N*G_s$

(a) Submerge unit wt. $(\gamma')= \gamma_w (G_s-1)/(1+e) = 62.4(2.66-1)/(1+0.4673*2.66) = 46.18$ lb/ft^3

(b) Bulk unit wt. $(\gamma)= \gamma_w(1+w)G_s/(1+e) = 62.4*2.66*(1+0.4673)/(1+0.4673*2.66) = 108.58$ lb/ft^3

(c) Effective pressure $(p'_o) = Z1\ \gamma + (Z-Z1)*\gamma' = 5*108.58 + (5-5)*46.18 = 542.903$ lb/ft^2

(d) Unconfined compressive strength (q_u), $q_u(1) = 2 * 0.45 * p'_o(I_p)^{½} = 2 * 0.45 * p'_o (W_L-W_P)^{½}$
$= 2*0.45*542.903\ (0.63-0.29)^{½} *6.895/144 = 13.64$ kPa

(e) Unconfined compressive strength, $q_u(2) = 2 * 0.18 * p'_o(I_L)^{-½} = 2* 0.18 * p'_o ((W_N-W_P)/ (W_L-W_P))^{-½}$ $=2*0.18*542.903*((0.4673-0.29)/(0.63-0.29))^{-½} * 6.895/144 = 12.96$ kPa

(f) Unconfined compressive strength (q_u), $q_u(3) = 2*0.5*p'_o*W_L$
$= 2*0.5*542.903*0.63 * 6.895/144 = 16.38$ kPa.

Similar calculations are conducted for preparation of Table 5.2.

5.3.1 Profile of qu

Unconfined compressive strength (q_u) obtained both from soil report and calculated (using Eq. 2.17) results which have been used for construction work in Khulna city (shown in Table 5.3) and from auger samples (using Eq. 2.17) shown in Table 5.1 are used to make profile for q_u. Profile of q_u of three section line X1-X2, Y1-Y2 and Z1-Z2 are plots in KCC map shown in Fig. 5.6. These profiles are (i) between Bhairab river and Khulna-Jessore highway shown in Fig. 5.7 and 5.8 (ii) approximately within 1 Km area parallel to Khulna- Jessore highway shown in Fig. 5.9 & 5.10 and (iii) the rest of the area away from Khulna- Jessore highway shown in Fig. 5.11 and 5.12.

Table 5.2 qu from correlation equation and laboratory test result (Collected data from Khulna and Barisal Divisional area)

Serial No. of value	Area and Location of Soil Report	Bore hole no.	Depth in feet	qu(From correlation equation) According to Bjerrim and Simon Here PI>5% kPa	Here LI>0.5 kPa	Karlsson & Veberg Here LL>20% kPa	qu (From Laboratory test result) (Existing soil report) kPa
1	2	3	4	5	6	7	8
1	Khulna University, 2nd Acdm Bldg.	1	5	13.64	12.96	16.38	16.27
2	"	4	5	14.62	16.79	19.78	15.31
3	"	6	5	11.53	13.24	13.11	20.13
4	KU, Professor's Quarter	1	10	13.83	13.87	25.13	41.60
5	KU, Class-III Employee's Quarter	1	10	10.91	11.00	14.20	22.76
6	"	2	15	16.12	22.98	21.49	25.17
7	KU, Class-IV Employee's Quarter	1	10	12.35	11.69	15.57	20.41
8	KU, Ladis Hall	1	5	2.90	2.36	3.30	16.27
9	"	2	5	2.74	2.39	3.06	18.20
10	"	4	5	3.08	3.65	3.45	22.00
11	"	5	5	2.64	2.35	3.02	17.24
12	"	6	10	9.45	8.33	10.94	17.24
13	KU, Assitant Professor's Quarter	1	15	16.35	36.40	22.94	20.40
14	"	2	10	11.52	10.03	14.73	16.55
15	KU, Adminstrative Building	1	15	15.38	14.61	18.72	20.41
16	Gopalgong Mohila Hostel	1	15	10.66	9.54	14.66	13.77
17	"	1	20	17.17	15.93	20.40	9.73
18	"	2	15	13.11	11.24	15.16	2.97
19	"	2	20	16.39	17.70	21.38	13.79
20	Khulna, Helatoa Market	1	10	8.03	14.54	10.93	54.32
21	"	1	15	21.17	*	39.30	31.55
22	"	1	20	19.11	24.63	37.22	57.62
23	"	2	10	10.02	12.14	12.88	19.63
24	"	2	20	12.22	10.37	16.92	62.40
25	"	3	10	5.67	7.09	8.92	31.65
26	"	3	15	13.39	11.36	16.14	4.39
27	Satkhira Shishu paribar	3	5	8.90	35.59	10.53	98.09
28	"	3	10	22.10	26.15	24.86	48.38
29	Bagerhat, Mongla Fire station	1	5	4.95	3.33	7.10	38.93
30	"	1	20	20.31	18.37	25.02	52.93
31	"	3	5	6.90	6.13	9.06	48.55
32	"	1	20	17.97	*	42.91	52.00
33	Chuadanga, Shilpa Academy	1	5	6.93	9.53	7.93	27.44
34	"	1	10	8.85	27.72	13.21	48.95
35	"	1	20	34.11	*	61.33	25.67
36	"	2	5	10.04	16.91	12.02	32.74
37	"	2	10	8.45	13.16	12.21	40.43
38	"	2	15	20.74	25.60	25.67	17.11
39	Khulna, Shiromony	1	10	3.34	4.29	11.05	17.20
40	"	2	5	3.65	2.91	5.15	9.67
41	"	2	10	3.68	3.24	9.29	9.67
42	"	2	15	3.48	2.75	10.90	10.10
43	"	2	20	16.22	10.55	30.98	34.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
44	Khulna, Shiromony	3	5	5.23	8.27	6.12	27.00
45	"	3	10	10.70	19.27	11.04	19.35
46	Tala,Sub-Registry	1	10	14.22	15.51	17.14	57.48
47	"	3	10	14.20	253.97	18.34	26.48
48	Barisal, TTC	1	5	6.24	8.54	9.55	38.60
49	"	2	5	5.99	12.46	9.76	36.15
50	"	2	10	10.97	5.91	13.81	46.60
51	"	4	10	9.37	9.62	14.28	24.55
52	Barguna, Police Line	1	10	8.34	18.09	13.11	39.25
53	"	2	15	7.92	7.15	13.51	20.00
54	"	3	5	5.13	5.39	7.02	21.53
55	"	3	10	8.79	12.04	12.70	20.81
56	Bhola, Shilpa. Academy	1	15	7.64	15.47	13.58	74.80
57	"	1	20	8.15	7.86	14.27	37.10
58	"	3	20	9.95	9.52	14.44	24.40
59	"	4	15	7.07	9.81	12.72	30.70
60	"	4	20	10.10	11.86	16.14	61.30
61	"	5	20	13.23	12.44	15.14	59.30
62	"	6	10	5.34	8.10	7.69	72.00
63	"	7	5	2.38	4.21	3.95	21.50
64	Jhinaidha, Dormitory	1	15	17.27	24.65	23.97	149.90
65	"	1	20	20.73	33.77	27.80	95.73
66	"	2	15	19.21	117.16	26.38	110.15
67	"	2	20	19.99	24.37	22.93	89.02
68	Pirojpur, Audtm. Compound	1	5	1.83	2.69	4.94	56.70
69	"	1	10	3.70	5.92	8.68	60.23
70	"	3	5	3.88	5.83	7.16	81.90
71	Khulna, ICMA	1	5	6.51	9.52	8.90	51.60
72	"	1	10	11.94	10.82	14.89	40.00
73	"	1	15	11.48	3.13	23.26	26.60
74	"	1	20	17.51	21.36	27.42	26.60
75	"	3	5	6.09	13.80	8.89	58.60
76	"	3	10	11.68	10.97	15.06	37.60
77	"	3	15	18.65	19.46	39.83	6.75
78	"	3	20	10.08	3.92	15.29	15.70
79	Barguna, Shilpa Academy	1	5	5.35	8.39	6.99	80.60
80	"	1	10	9.39	12.25	12.27	48.00
81	"	1	15	13.12	12.96	15.20	36.00
82	"	3	5	6.08	38.44	8.77	70.00
83	"	3	15	13.58	11.69	13.81	45.00
84	"	5	10	13.51	23.05	18.78	58.00
85	"	5	15	13.78	14.14	18.41	61.00
86	"	7	10	17.80	25.33	23.01	68.00
87	Magura, Shisu Paribar	1	5	5.65	8.00	7.51	58.80
88	"	1	10	15.46	21.16	18.64	163.70
89	"	2	5	7.83	8.48	9.03	82.36
90	"	2	10	18.60	24.14	20.97	95.52
91	"	3	10	9.10	9.17	11.42	31.21
92	"	4	5	6.81	15.41	8.38	55.03
93	"	4	10	11.57	16.46	15.20	144.83

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
94	Magura, Shisu Paribar	5	10	16.57	*	20.83	139.37
95	"	6	5	4.21	8.60	6.71	79.31
96	"	6	10	15.99	*	21.01	132.02
97	"	7	5	8.98	22.86	10.28	76.15
98	"	7	10	11.20	24.26	16.23	177.87
99	Bagerhat, Digraj	1	15	8.69	7.87	15.03	70.00
100	"	2	20	16.25	22.12	23.08	24.50
101	Khulna, Fultala Thana	2	5	8.54	24.16	11.73	82.00
102	"	3	10	15.01	16.05	17.79	39.00
103	Khulna, Mohila Techers TC	1	15	9.23	8.47	16.40	38.00
104	"	2	10	7.95	*	22.97	41.00
105	Patharghata Fire Service	1	5	2.81	11.25	4.75	49.00
106	"	1	10	6.22	8.29	8.62	42.00
107	"	4	10	5.15	7.29	8.71	55.00
108	"	6	10	4.54	4.41	7.67	26.00
109	Khulna, Khalishpur	1	10	5.27	9.43	10.48	59.00
110	KUET Road, Fulbarigate	1	5	3.92	5.55	5.29	54.50
111	"	1	15	19.64	*	30.89	32.70
112	"	2	20	27.17	*	50.54	48.00
113	"	3	5	4.55	8.14	6.42	34.00
114	Shiromony police barrak	1	5	4.15	16.60	7.61	91.80
115	"	1	10	8.37	21.65	12.15	100.00
116	"	2	15	12.53	12.82	19.60	48.00
117	"	3	5	4.35	8.20	5.82	65.00
118	"	3	10	5.26	12.16	9.85	49.00
119	"	3	15	9.05	10.24	12.93	23.00
120	"	3	20	6.76	7.18	15.45	25.80
121	"	4	20	8.55	11.80	17.58	23.00
122	"	5	10	5.74	7.92	11.06	32.60
123	Khulna, Goalkhali	1	5	6.71	*	13.13	32.60
124	"	1	15	12.83	18.38	78.24	41.28
125	"	2	20	14.03	15.33	25.74	45.93
126	"	3	15	17.59	6.14	40.73	49.54
127	"	3	20	17.63	22.41	30.98	46.33
128	"	4	15	19.82	16.43	43.81	26.54
129	"	4	20	17.60	22.49	30.14	53.51
130	Barguna, Police Fari	1	5	9.41	10.91	10.84	74.53
131	"	1	20	12.00	*	27.65	23.71
132	"	3	5	6.99	11.25	11.04	31.79
133	"	3	10	9.75	16.90	17.95	34.68
134	"	3	20	17.22	19.82	24.83	2.94
135	"	5	5	8.57	9.87	11.55	34.10
136	"	5	10	11.94	17.44	17.79	56.07
137	"	7	15	16.58	43.65	24.72	32.35
138	"	9	5	11.35	11.42	11.61	95.36
139	"	9	10	9.52	4.44	13.52	39.96
140	"	9	20	13.80	37.23	28.47	26.02
141	Khluna, Cable Shilpa	4	10	7.41	6.63	10.27	29.64
142	"	5	15	9.81	10.13	15.13	20.03
143	"	6	10	8.87	35.49	13.41	74.11

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
144	Khluna, Cable Shilpa	6	15	6.83	6.83	13.57	26.82
145	Pirojpur, Ansar & VDP	1	5	5.71	3.73	9.01	31.44
146	"	1	10	10.54	15.17	16.01	16.50
147	"	1	15	12.47	7.62	15.37	12.29
148	"	1	20	14.26	7.58	17.57	9.38
149	"	3	5	4.18	4.22	6.28	9.38
150	"	3	10	9.92	9.51	14.11	8.86
151	"	3	15	21.14	*	39.49	49.40
152	"	3	20	19.89	15.29	22.21	43.00
153	Bagerhat, Chitalmari	1	5	5.71	*	10.10	54.00
154	"	1	15	14.14	13.89	22.39	20.00
155	"	2	20	8.37	10.05	22.46	27.00
156	Satkhira, Police Line	1	10	7.33	16.94	12.75	110.00
157	"	2	5	9.43	*	12.44	122.00
158	"	3	10	7.58	30.31	12.80	89.00
159	Khulna, 100 Bed Diabetic Hospital	1	10	12.00	13.86	14.38	86.00
160	Shariatput, Sub-Register quarter	1	10	18.41	29.55	22.61	74.93
161	"	1	15	16.29	23.49	24.87	95.42
162	"	2	10	14.22	28.50	20.14	90.98
163	"	2	15	7.73	37.77	25.17	41.30
164	"	3	5	7.82	11.57	10.21	78.36
165	"	3	10	15.85	24.37	20.21	172.84
166	"	4	10	11.97	12.64	15.65	45.22
167	"	4	15	7.74	*	21.66	182.50
168	"	5	5	8.33	31.20	11.28	121.50
169	"	5	15	17.92	19.44	20.30	121.50
170	"	5	20	19.15	25.97	24.83	55.20
171	Khulna, Helatola	1	15	23.89	*	63.94	66.00
172	"	2	10	8.90	9.52	10.42	63.00
173	Satkhira, Ashashuni	1	5	7.08	12.67	10.85	53.00
174	"	4	5	10.10	12.77	14.02	44.40
175	Shiromony Police TC	1	10	7.25	28.99	11.53	76.92
176	"	1	20	10.44	13.21	17.41	45.00
177	"	2	5	7.86	12.83	8.89	79.50
178	"	2	15	11.91	12.30	14.99	96.52
179	"	4	10	4.52	*	10.15	43.80
180	"	6	15	7.87	7.87	11.42	36.12
181	"	8	20	13.16	13.59	17.13	49.37
182	"	9	15	9.30	9.61	13.92	56.19
183	"	11	20	10.19	12.29	16.99	38.86
184	"	12	10	11.57	16.36	12.72	45.76
185	"	15	5	6.09	17.23	8.56	53.40
186	Bhola, Police Line	1	5	4.24	5.36	8.98	92.68
187	"	2	10	7.41	10.48	16.64	128.50
188	"	3	10	11.35	14.35	17.16	55.00
189	Pirojpur, Police Super	2	10	5.31	4.92	9.30	17.56
190	"	3	15	7.20	8.44	13.54	10.67
191	Chuadanga	2	15	16.47	15.97	22.19	61.60
192	Bhola, Jail observation tower	1	10	12.97	12.58	14.58	39.30
193	"	3	5	5.37	5.55	8.81	29.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
194	Bhola, Jail observation tower	4	10	7.74	7.99	12.31	25.50
195	Jessore, Jhikarghacha	1	10	9.69	16.15	12.74	135.64
196	"	1	20	22.86	40.11	29.47	96.92
197	"	2	20	26.15	369.80	32.91	88.50
198	Jessore, Benapole Cs	2	15	21.81	61.70	32.56	125.90
199	"	2	20	18.68	21.57	29.06	128.30
200	Khulna, Ghat no-4	1	15	19.50	*	42.47	76.00
201	Khulna, Gallamary Bridge	3	15	13.49	12.82	18.17	51.00
202	Satkhira, Katia Dormitory	1	5	10.31	46.10	12.42	114.00
203	"	3	5	15.09	43.78	18.70	73.25
204	"	3	10	22.69	64.17	29.83	78.40
205	Khulna, Navel School	1	5	8.63	9.03	10.17	84.20
206	"	2	10	13.09	17.17	18.91	18.00
207	"	2	20	18.07	13.42	22.79	29.50
208	Barisal, Blind School	1	5	1.56	3.04	4.39	48.70
209	"	1	20	8.19	12.76	16.59	120.70
210	"	2	10	7.87	16.59	11.18	68.72
211	"	2	15	4.73	4.15	10.43	30.08
212	"	2	20	7.27	10.62	15.84	23.57
213	"	3	5	4.44	13.23	6.30	41.29
214	"	3	15	5.35	3.81	10.21	8.18
215	Barisal, Banaripar fire station	1	5	2.38	*	7.15	38.70
216	"	1	10	7.49	*	18.80	42.59
217	"	1	15	6.70	4.03	10.34	59.00
218	"	2	10	5.72	13.67	13.06	77.80
219	"	2	15	6.47	4.51	10.35	16.20
220	"	2	20	9.32	8.02	21.36	83.40
221	"	3	5	3.89	6.35	6.23	55.66
222	"	3	10	5.46	10.58	11.10	17.54
223	"	3	15	5.55	7.12	13.41	48.40
224	Bagerhat, DC court	1	15	9.58	14.48	16.18	55.70
225	"	3	5	5.95	11.90	8.60	47.90
226	"	3	15	14.09	*	20.79	54.70
227	Magura, Collegeate Building	1	5	3.43	6.20	6.64	66.70
228	"	2	15	12.31	*	19.19	64.50
229	"	4	20	8.96	8.72	18.60	51.66
230	Rajbari, Pangsha police station	1	5	2.37	2.94	5.64	37.50
231	"	2	5	6.35	24.22	8.87	45.00
232	"	2	10	15.01	47.48	18.28	79.96
233	Khulna, Farajipara	1	10	12.28	34.73	17.14	80.00
234	"	2	5	4.95	*	8.37	68.00
235	"	2	15	16.86	23.85	27.81	54.00
236	Magura, Sreepur	1	10	19.78	111.88	25.44	263.80
237	Madaripur, Dormitory	1	10	12.83	21.12	15.62	97.40
238	"	2	5	5.66	*	7.94	72.52
239	"	3	5	6.53	7.39	7.64	65.30
240	"	3	10	8.35	9.09	11.50	51.00
241	Barguna, Thana quarter	1	5	6.21	7.86	7.30	75.80
242	Gopalgong, Tungipara	1	5	2.97	2.78	4.89	24.70
243	"	1	10	4.89	5.77	10.03	14.10

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
244	Gopalgong, Tungipara	1	15	6.32	6.98	13.99	20.20
245	"	2	5	2.60	3.15	4.87	45.00
246	"	2	10	6.72	6.67	9.42	16.40
247	"	2	15	7.79	7.90	14.20	7.80
248	"	3	15	5.73	5.72	12.68	12.09
249	Jessore, Benapole Office bldg.	1	5	10.22	*	11.53	103.00
250	"	1	20	36.36	51.42	43.81	100.00
251	"	2	20	36.93	42.65	40.01	100.00
252	"	3	5	10.33	23.85	11.55	95.00
253	Bagerhat, Farkirhat Thana	2	20	19.82	17.30	22.58	80.50
254	Jhinaidha, Ansar, VDP	1	5	9.56	13.58	11.07	115.00
255	"	2	5	8.41	17.04	10.91	125.56
256	"	3	5	9.68	13.78	11.06	100.00
257	Khulna Mohila TTC	1	10	16.25	*	23.47	121.00
258	"	6	20	8.63	4.98	14.24	36.30
259	Barisal, Muladi Police station	4	5	3.00	4.00	4.77	57.60
260	Khulna Tibbet Market	1	10	8.30	15.01	11.26	54.30
261	"	1	15	21.03	*	39.19	31.50
262	"	1	20	17.98	21.69	35.32	57.70
263	"	2	10	9.96	11.81	12.63	19.68
264	"	2	20	13.20	10.75	16.80	62.48
265	"	3	10	6.11	7.61	9.48	31.65
266	"	3	15	13.85	11.76	16.69	4.39
267	Gopalgong, Shilpa	1	15	10.64	9.53	14.66	13.70
268	"	1	20	17.18	15.81	20.38	9.80
269	"	2	20	16.22	17.34	20.81	13.80
270	Khulna BPRTC office	3	20	27.84	*	57.70	77.00
271	Bagerhat, Mongla	1	5	5.60	3.68	7.37	38.90
272	"	3	5	7.00	6.26	9.34	48.50
273	Barisal Soil Research	2	5	4.25	5.38	6.25	46.00
274	Satkhira, Shisu paribar	3	5	9.07	36.28	10.73	98.10
275	"	3	10	26.55	30.79	29.67	48.10
276	"	5	5	9.44	*	11.20	128.10
277	Khulna Environment Research	1	20	17.90	*	42.89	52.00
278	"	2	20	24.90	46.96	41.17	53.00
279	"	3	20	24.58	*	71.82	35.00
280	Khulna, RPATC Building	2	15	4.61	4.28	13.75	37.00
281	"	3	5	2.46	4.93	4.44	14.56
282	"	3	10	7.01	8.00	8.35	32.40
283	Khulna, Mirerdanga	1	5	9.54	8.60	7.68	73.70
284	"	1	10	9.23	67.44	13.90	71.30
285	"	1	15	10.74	11.13	15.69	12.90
286	Madaripur, Shibchar	1	5	12.37	18.70	14.59	42.40
287	"	1	10	18.49	19.10	20.18	69.40
288	"	2	5	13.42	14.35	13.53	55.60
289	"	2	10	7.48	8.00	12.88	33.10
290	"	3	5	11.79	15.72	13.68	51.30
291	"	3	10	16.36	15.01	19.91	9.30
292	Jessore, Shisu Paribar	2	20	22.37	22.44	29.36	89.40
293	"	3	15	19.55	*	29.64	35.50

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
294	Jessore, Shisu Paribar	4	15	15.60	*	20.42	4.15
295	"	4	20	18.30	15.47	25.32	45.63
296	"	5	10	1.91	4.34	8.50	41.30
297	"	5	15	21.99	52.57	30.06	39.64
298	"	5	20	22.45	27.47	32.45	21.28
299	"	6	10	10.08	6.65	7.38	26.20
300	"	6	20	25.14	37.73	37.63	25.66
301	Kustia, Chaugacha	2	15	18.53	19.88	20.84	41.04
302	"	4	15	18.99	*	25.95	30.40
303	"	4	20	20.24	25.22	22.07	71.30
304	"	6	5	4.61	9.45	7.11	48.57
305	"	7	15	23.53	47.66	25.90	152.00
306	"	7	20	18.65	23.02	21.08	157.00
307	Khulna, Imam Traning Center	1	15	7.40	1.72	11.80	20.89
308	"	1	20	12.18	8.39	18.68	26.70
309	"	2	10	13.13	6.99	20.55	17.90
310	"	2	15	21.42	*	40.12	37.60
311	"	2	20	16.01	12.78	21.15	17.90
312	"	3	10	14.56	26.86	26.47	38.20
313	"	3	20	9.50	8.95	21.40	21.20
314	Kustia, TTC	3	20	26.78	*	39.28	107.00
315	"	4	15	12.65	12.69	15.41	23.50
316	"	6	15	21.29	*	27.21	56.90
317	"	7	10	10.27	*	15.33	16.29
318	Khulna, Rupsa Chanmari	1	15	18.39	10.73	23.19	23.60
319	"	2	15	11.71	12.99	15.79	51.00
320	"	2	20	15.77	21.76	21.86	74.60
321	"	3	10	10.97	13.23	18.70	24.10
322	"	3	15	10.41	11.33	15.17	39.60
323	"	3	20	12.16	10.75	18.38	21.40
324	Khulna Sonadanga Thana	1	5	7.63	*	13.80	90.00
325	"	1	10	23.85	*	69.33	35.80
326	"	1	15	5.92	1.34	10.13	18.60
327	"	4	5	3.22	2.75	4.44	49.30
328	"	4	15	9.30	4.97	12.56	31.60
329	Jhalokati Police Line	1	5	4.18	4.31	6.96	43.40
330	"	2	10	5.30	10.60	11.48	96.70
331	"	3	10	7.91	7.79	9.81	51.60
332	"	3	15	11.11	11.88	14.81	52.00
333	Jessore, Monirampur	1	10	12.13	26.31	16.27	117.70
334	"	2	10	10.68	22.52	16.62	196.00
335	Gopalgong Thana	1	15	23.15	15.43	42.18	33.50
336	"	2	10	8.97	17.94	17.26	54.00
337	Jessore Sadar Thana	1	10	9.46	*	17.60	113.00
338	"	2	10	15.15	30.31	17.26	206.00
339	Chuadanga RCC building	2	15	16.47	15.97	22.19	61.60
340	Shariatput, Thana building	1	5	7.53	10.65	10.04	52.00
341	"	2	10	10.05	11.15	15.62	19.70
342	Barguna, Taltoli	1	5	8.97	25.36	11.79	63.00
343	"	1	10	16.33	19.70	20.15	52.50

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
344	Barguna, Taltoli	5	10	18.44	22.24	22.02	31.00
345	Satkhira Shilpakola	1	10	10.66	11.56	13.21	33.00
346	"	2	10	13.94	20.64	15.65	115.00
347	"	4	10	8.78	11.46	13.03	79.00
348	Barisal, Jail kitchen	1	5	4.82	8.62	6.88	59.00
349	"	1	20	7.48	14.95	19.38	59.00
350	"	2	10	6.83	12.22	11.54	121.00
351	"	3	5	1.87	3.06	5.82	62.00
352	"	3	10	3.05	7.03	10.83	100.00
353	Bagerhat Rampal Sub-Register	1	15	9.01	14.72	13.90	41.00
354	"	1	20	16.70	17.86	21.57	15.00
355	"	3	20	15.93	20.78	22.09	19.00
356	Jhinaidha, jail Building	1	10	31.87	48.19	38.08	115.00
357	"	2	10	28.75	49.03	35.03	93.50
358	"	4	5	11.43	18.08	12.23	83.00
359	"	4	10	13.07	12.22	17.30	152.00
360	"	5	10	20.43	22.93	23.12	187.00
361	"	6	10	6.74	*	21.73	106.00
362	"	7	10	20.21	33.00	24.70	104.00
363	"	8	10	32.21	52.59	39.12	66.00
364	"	8	15	13.45	14.38	20.05	87.50
365	"	9	5	6.53	18.47	9.18	69.00
366	"	11	5	7.75	13.86	10.05	80.00
367	"	12	10	27.34	*	35.53	199.00
368	Sonadanga R/A	1	5	4.07	3.25	5.75	9.60
369	"	1	10	3.93	3.46	9.93	9.70
370	"	1	15	3.65	2.88	11.42	10.10
371	"	1	20	17.33	11.25	33.01	34.00
372	Mojgunni	1	5	5.77	9.15	6.76	27.80
373	"	1	10	11.43	20.59	11.79	19.20
374	Boyra	1	5	6.23	17.61	8.51	43.00
375	"	1	10	9.47	13.40	13.43	53.50
376	"	1	15	17.63	11.59	22.59	54.00
377	"	1	20	9.78	15.97	29.19	61.50
378	Khulna Shusu Sadan	1	5	5.09	10.18	7.15	81.00
379	"	1	15	21.85	20.05	34.25	46.00
380	"	2	10	7.86	11.11	12.22	27.00
381	"	2	20	17.12	7.96	52.05	66.00
382	"	3	10	7.14	11.65	10.53	38.00
383	Patharghata SP Quarter	1	5	9.63	14.56	12.71	64.40
384	"	1	15	15.51	16.59	20.90	63.00
385	"	3	15	16.21	22.92	22.80	60.00
386	"	4	10	7.20	7.99	10.17	48.50
387	"	5	15	8.87	13.41	14.53	80.20
388	"	6	5	4.69	5.41	5.52	28.60
389	Jhalokati Police Quarter	1	10	10.11	12.78	15.35	29.00
390	"	1	15	11.81	12.32	18.45	28.90
391	"	1	20	17.99	20.77	25.31	29.00
392	"	2	10	15.93	24.09	21.14	48.70
393	"	2	15	13.46	13.46	18.92	23.60

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
394	Jhalokati Police Quarter	3	5	6.86	10.37	10.67	35.00
395	"	3	10	9.72	14.70	15.27	51.60
396	Jessore, 6 storied Building	1	5	3.53	8.75	6.66	87.70
397	"	1	10	13.70	14.65	15.83	107.00
398	"	2	5	2.77	7.85	5.85	75.50
399	"	2	15	10.07	11.18	14.64	43.00
400	"	3	10	9.98	11.38	12.75	51.00
401	Barisal Uzirpur	1	10	9.20	13.17	13.06	100.00
402	"	2	5	5.42	*	8.28	120.00
403	"	2	10	15.28	12.22	13.59	122.00
404	"	4	5	6.06	4.80	4.77	63.00
405	"	4	10	8.25	9.53	11.31	53.00
406	Bhola, Borhanuddin	1	5	3.71	*	9.92	152.00
407	"	2	10	9.54	12.72	13.22	58.70
408	Khulna, Dumuria Fire station	2	10	6.01	4.18	8.50	14.70
409	"	2	20	12.18	11.18	15.34	24.00
410	Bhola Sadar police	1	20	17.10	19.74	22.80	38.60
411	Jessore Genreal Hospital	1	5	7.01	11.45	8.24	85.80
412	"	2	10	13.61	27.22	18.18	29.30
413	"	3	15	13.44	12.02	17.07	54.50
414	Barisal Circuit house	1	10	4.67	7.96	12.96	29.00
415	"	2	10	12.99	*	20.91	120.00
416	"	2	15	6.95	12.43	16.49	34.00
417	"	2	20	16.21	18.71	22.80	42.00
418	"	3	10	8.49	10.74	12.90	29.00
419	"	3	15	9.84	10.52	16.12	29.00
420	"	3	20	16.26	18.78	22.88	29.40
421	"	4	15	11.45	12.70	18.66	15.60
422	Barguna Shilpakola	1	5	7.33	11.49	9.57	80.60
423	"	1	10	11.03	15.60	14.96	48.00
424	"	1	15	15.10	15.10	17.49	36.00
425	"	2	5	5.09	28.79	7.35	70.00
426	"	2	15	12.51	10.67	12.72	45.00
427	"	5	10	12.64	17.88	18.21	58.00
428	"	8	15	12.30	10.04	11.64	23.00
429	Shariatput, Damuda	1	10	8.97	18.66	17.39	42.00
430	"	1	15	5.08	10.43	20.33	71.00
431	"	2	15	17.85	20.61	21.73	28.00
432	"	3	10	12.42	22.22	18.87	193.00
433	Khulna, Fulbarigate	1	5	6.12	9.99	8.11	49.00
434	"	1	15	16.17	32.35	21.56	51.00
435	"	2	10	12.05	13.91	14.51	37.00
436	"	2	20	24.31	21.22	31.96	27.00
437	Pirojpur, Nazirpur	1	5	7.46	9.00	9.68	53.00
438	"	1	10	5.01	5.01	12.20	20.50
439	"	2	10	5.36	7.15	7.72	30.00
440	Barisal, Gournadi	1	10	13.13	17.50	17.53	58.00
441	"	1	15	5.46	15.44	20.01	54.00
442	"	3	15	10.69	17.45	20.78	254.00
443	Jessore, Navaron	3	10	5.61	6.76	11.22	28.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
444	Shariatpur, Dormitor	2	5	13.71	17.35	15.58	58.00
445	"	2	10	12.28	14.18	16.86	71.00
446	"	3	10	11.46	17.32	17.40	78.00
447	Barisal, Gournadi quarter	1	5	3.18	40.20	5.83	116.00
448	"	2	10	6.99	8.43	9.10	47.00
449	"	3	10	4.61	6.52	9.17	61.00
450	"	4	10	4.42	4.91	8.23	41.00
451	Jessore, Town yard	3	10	9.78	14.79	10.66	45.40
452	Khulna, Dacope Thana	2	5	6.36	8.04	8.43	28.00
453	"	2	15	9.74	3.84	14.97	9.30
454	Rajbari, Pangsha Quarter	2	20	21.64	24.99	25.46	50.00
455	Rajbari, Fire station	2	5	5.38	21.50	7.90	84.00
456	Rajbari, Police Line	1	5	2.71	4.31	6.50	60.00
457	"	2	10	10.43	41.72	19.12	85.00
458	Khulna, Dumuria Thana	1	10	8.51	*	15.44	36.00
459	"	1	20	16.38	10.36	21.14	57.00
460	"	2	15	9.28	8.30	15.22	42.00
461	"	3	10	13.47	14.40	16.33	83.00
462	"	3	20	16.89	20.36	23.76	43.00
463	Khulna, Batiaghata Thana	1	5	6.47	4.89	11.64	12.00
464	Satkhira, Kalaroa Thana	1	20	21.55	121.90	36.34	50.00
465	Satkhira, Asashuni Thana	2	5	16.61	27.12	17.43	95.00
466	Gopalgong Sadar	1	10	25.86	*	35.94	56.00
467	"	2	10	25.38	*	36.10	43.00
468	Shariatpur, Palong	1	5	4.22	5.34	8.94	46.00
469	Shariatpur, Naria Thana	1	5	4.29	7.00	9.35	97.00
470		1	10	11.44	13.80	16.10	42.00
471		2	10	11.97	16.92	16.84	61.50
472	Shariatpur, Damuyada	2	15	7.94	31.75	21.83	107.00
473	Pirojpur, Police Building	2	15	19.33	44.64	27.92	160.00
474	"	3	5	8.96	20.68	12.00	161.00
475	"	3	10	6.01	3.58	11.01	25.00
476	"	3	20	22.09	51.00	41.10	23.00
477	Khulna, Terokhada Thana	1	5	9.98	*	12.74	28.00
478	"	1	10	17.73	11.82	21.69	16.00
479	Jessore, Shisu Paribar building	2	20	22.42	22.42	29.53	89.00
480	"	4	15	15.62	*	20.63	40.00
481	"	4	20	18.91	15.77	26.00	45.60
482	"	6	10	10.17	6.70	7.49	26.00
483	"	6	20	25.33	38.30	37.79	26.00
484	Rajbari, Private building	1	5	6.25	12.50	10.20	90.00
485	"	2	10	14.44	28.89	20.99	91.00
486	Madaripur, Shisu paribar	1	5	6.51	13.01	11.20	29.00
487	"	1	10	10.83	17.69	14.69	19.10
488	"	2	5	7.38	*	11.60	131.00
489	"	2	10	13.54	*	19.05	50.00
490	"	3	10	10.64	*	17.87	73.00
491	"	4	5	9.82	13.10	11.27	88.00
492	"	4	10	10.70	*	17.97	32.00
493	"	6	5	9.18	12.98	11.03	47.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
494	Madaripur, Sadar Thana	1	5	8.85	111.91	13.05	75.00
495	"	2	10	15.10	42.71	23.35	54.00
496	"	3	10	29.37	18.81	23.12	57.00
497	"	4	5	10.50	14.00	12.65	83.00
498	Rajbari, Police quarter	1	5	5.24	29.67	9.61	60.00
499	"	2	10	10.43	41.72	19.12	85.00
500	Khulna, Goalkhali Hostel	1	5	6.61	*	12.89	218.00
501	"	1	15	12.98	18.36	78.20	41.30
502	"	2	20	13.96	15.49	25.80	46.00
503	"	3	15	17.82	6.23	41.43	49.00
504	Rajbari police drill	2	5	5.24	12.09	9.02	118.00
505	Shariatpur, Sub-Register building	1	10	18.51	30.22	22.53	74.00
506	"	2	10	13.75	31.76	19.99	90.00
507	"	2	15	20.27	25.64	25.35	41.00
508	"	3	5	8.00	11.32	10.13	78.00
509	"	4	10	11.84	12.65	15.34	45.00
510	"	5	5	9.45	36.05	12.82	121.00
511	Patuakhali, Investigation center	1	10	7.67	6.16	7.56	74.00
512	"	2	20	12.49	10.90	16.68	17.00
513	"	4	10	5.31	7.51	9.63	50.00
514	"	8	10	7.12	7.36	9.59	56.00
515	Patuakhali, Mahipur	2	15	6.50	4.83	10.32	10.70
516	"	3	15	8.41	8.41	13.55	23.10
517	"	5	10	6.85	8.66	10.32	46.00
518	"	10	5	3.88	4.00	5.06	31.30
519	Faridpur Court building	1	5	6.58	9.31	9.95	120.00
520	"	2	15	15.55	18.76	21.15	22.30
521	"	7	15	14.64	15.12	17.49	44.00
522	Faridpur Medical Hostel	1	5	10.65	9.30	10.31	53.40
523	"	2	10	11.09	10.89	13.24	76.50
524	"	3	15	10.44	10.04	14.60	33.90
525	Barisal Textile institute	1	10	2.87	3.19	10.21	75.00
526	"	2	10	6.89	7.96	10.61	76.00
527	Narail SM Sultan institute	1	10	8.66	6.22	12.13	48.00
528	"	2	5	3.79	2.81	4.74	24.50
529	Barguna, Zakier	1	10	9.76	12.35	14.46	15.00
530	"	1	20	17.36	20.04	23.17	30.00
531	Khulna, Tarerpukur	1	5	3.67	32.84	6.16	95.00
532	"	2	15	16.17	20.46	20.90	54.00
533	Jessore, Benapole Exten. Bldg.	1	5	7.53	15.87	10.31	30.00
534	"	1	10	9.81	9.81	13.44	85.00
535	"	4	15	9.96	13.28	12.13	73.00
536	"	9	15	13.96	22.25	16.17	85.00
537	Jessore, Residence	1	5	3.48	8.62	6.56	87.70
538	"	1	10	13.82	14.82	15.96	107.00
539	"	2	5	3.03	7.17	5.89	75.00
540	"	2	15	10.67	11.49	14.63	42.90
541	Faridpur, Soil Institute	1	5	6.31	11.28	9.11	20.00
542	"	1	15	12.31	12.31	19.03	34.20
543	"	2	10	10.28	10.62	13.09	25.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
544	Jhalokati Academic	1	10	6.07	7.01	9.43	50.00
545	"	3	10	5.25	7.43	9.66	28.00
546	"	5	15	9.93	11.47	14.34	24.40
547	Barguna, Judge Court Bldg.	1	5	3.53	5.77	5.71	39.40
548	"	1	10	6.98	9.87	10.54	30.00
549	Bhola Shilpokola	1	5	2.46	13.94	5.06	41.00
550	"	1	15	7.68	16.42	13.65	74.80
551	"	5	20	13.66	12.88	15.17	59.00
552	Bagerhat, Police line	6	10	5.59	8.45	8.38	72.00
553	Pirojpur Auditoriam	1	5	4.95	19.78	7.65	102.00
554	"	2	1	2.35	2.28	2.44	35.00
555	Pirojpur Shisu Paribar	1	5	6.12	14.13	9.25	82.00
556	"	1	20	12.11	14.60	21.06	27.00
557	Patuakhali, Mirjagong	1	15	6.44	7.14	15.28	27.00
558	"	2	10	4.01	6.54	12.28	31.00
559	"	2	15	5.64	8.85	16.40	43.00
560	"	4	5	4.90	7.63	7.82	63.00
561	Patuakhali, Shilpakala Bldg.	1	5	106.79	161.45	129.50	84.00
562	"	2	5	4.21	5.95	6.48	21.00
563	"	3	15	12.30	11.94	16.40	40.00
564	"	4	10	8.01	18.51	12.39	50.00
565	"	5	15	11.03	9.40	15.63	12.00
566	Bagerhat, Morelgong	1	5	5.39	10.78	9.32	57.18
567	"	1	15	10.99	10.73	15.54	32.90
568	"	2	10	12.84	20.31	16.21	52.30
569	"	2	15	6.09	38.53	19.15	43.00
570	Jhalokati Girls Bhavan	3	5	4.30	8.59	6.05	18.75
571	Barisal Police Camp	1	5	2.66	3.84	5.63	54.00
572	Khulna, Medical college Hostel	1	5	9.41	13.31	12.13	75.00
573	"	1	15	11.48	4.89	18.01	46.00
574	"	2	10	9.62	10.68	13.89	54.00
575	"	2	20	31.74	*	66.92	29.00
576	"	3	20	24.74	19.41	37.38	26.00
577	Khulna, Medical Mosque	1	15	26.73	*	50.75	23.00
578	"	1	5	8.99	*	12.96	111.00
579	"	2	20	23.28	12.79	46.93	15.00
580	"	2	15	47.33	*	108.69	38.00
581	"	3	10	13.91	16.77	17.66	25.00
582	Shariatpur DC court	1	10	6.72	15.53	14.20	53.00
583	"	2	5	6.11	*	11.64	63.00
584	Shariatpur Non Gageted	1	10	12.94	36.60	17.73	73.00
585	"	1	5	9.03	16.15	12.24	90.00
586	"	2	5	13.89	16.75	15.52	57.00
587	"	2	10	12.01	13.87	16.50	71.00
588	"	3	10	10.67	17.43	17.19	78.00
589	Shariatpur	1	10	7.54	17.41	14.61	53.00
590	"	2	5	6.12	*	11.66	63.00
591	"	2	10	6.90	*	14.94	59.00
592	Khulna, Shishu Sadan	1	10	9.69	10.75	11.91	79.00
593	Khulna, Mujgunni	1	5	7.88	5.49	9.55	23.00

* Condition was not fulfilled

Table 5.2 (Continued)

1	2	3	4	5	6	7	8
594	Khulna, Mujgunni	2	10	12.96	*	28.79	6.80
595	"	3	5	11.77	21.06	14.58	54.00
596	Khulna, Baniakhamar	1	5	3.34	6.67	7.92	65.00
597	"	1	10	5.74	6.37	11.48	56.00
598	Khulna, Boyra	2	15	8.30	6.28	15.33	49.00
599	KUET, Dormitory	2	15	18.70	15.95	22.76	53.00
600	KUET, Engineering Section	2	10	14.84	20.99	17.45	52.00
601	Khulna, ICMA office	1	5	6.50	8.91	8.88	51.00
602	"	1	10	11.87	10.75	14.72	40.00
603	"	3	15	19.71	20.35	41.84	6.75
604	Shiromony private buliding	1	10	7.55	12.03	9.81	22.00
605	"	2	5	4.66	9.32	5.88	38.00
606	"	4	15	8.11	9.78	12.87	23.00
607	Khulna, BOC Rupsa	1	5	4.62	3.08	5.53	29.00
608	"	1	15	4.40	1.73	6.52	13.00
609	"	1	20	11.69	7.68	16.06	41.00
610	Khulna, Mongla	3	10	9.79	11.30	11.68	85.00
611	"	5	10	10.48	9.14	12.54	29.00
612	"	5	20	21.23	24.52	26.01	173.00
613	"	6	10	13.74	16.57	15.81	65.00
614	"	6	20	23.52	26.61	27.66	113.00
615	"	9	10	12.03	13.35	14.18	112.00
616	"	13	15	16.91	16.12	20.24	136.00
617	"	13	20	21.63	25.61	28.48	22.16

* Condition was not fulfilled

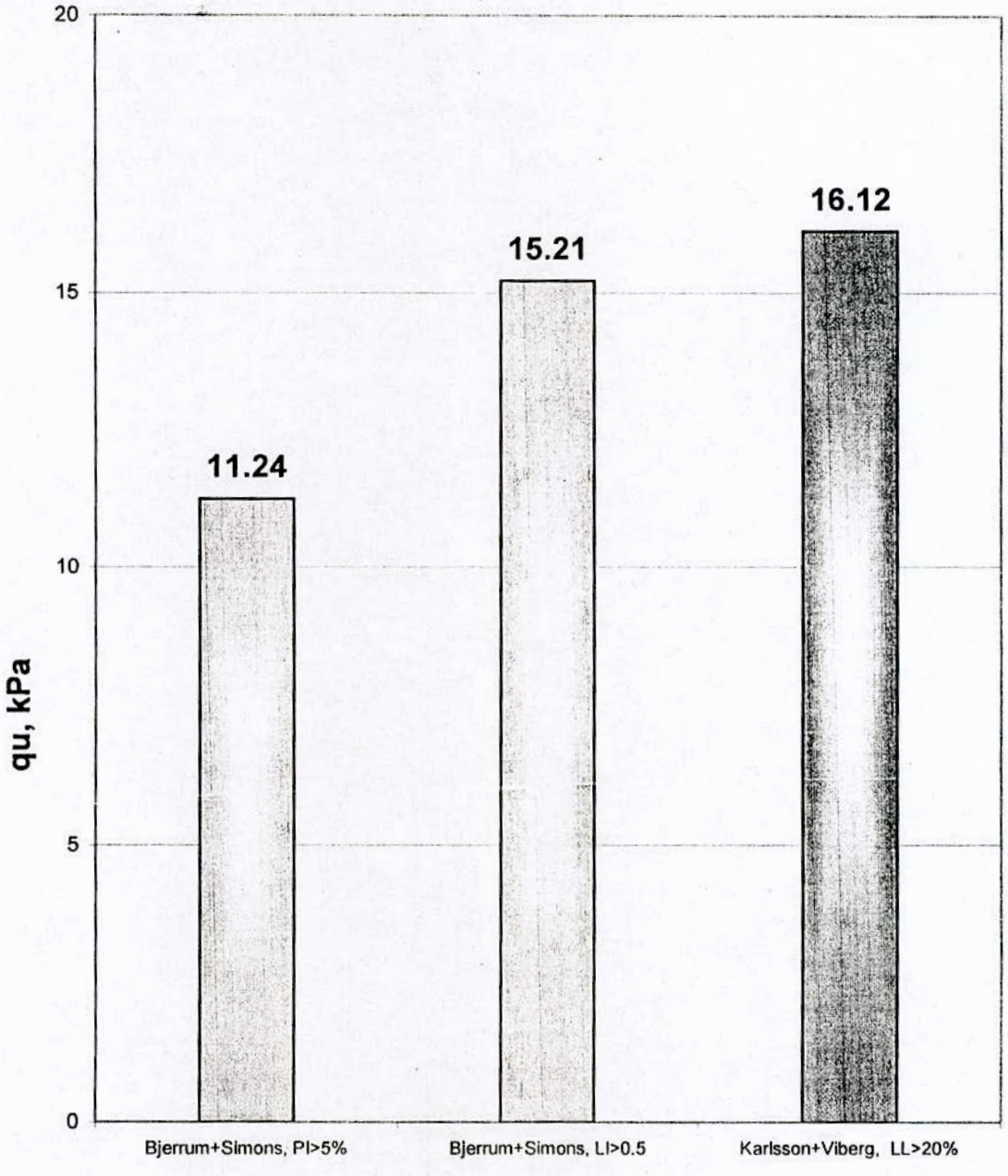


Figure 5.1 Average q_u from correlation equations (out side KCC)

Table 5.3 qu from calculated and existing result at KCC

Serial No. of Bore hole	Area & Location of Bore hole	Bore hole no.	Dep-th in feet	qu, according to Karlsson & Veberg Where LL>20% kPa	qu, according to Laboratory test result Existing soil report kPa
1	2	3	4	5	6
1	Khulna University, 2nd Acdm Bldg	1	5	16.38	16.27
2	"	4	5	19.78	15.31
3	"	6	5	13.11	20.13
4	KU, Professor's Quarter	1	10	25.13	41.60
5	KU, Class-III Employee's Quarter	1	10	14.20	22.76
6	"	2	15	21.49	25.17
7	KU, Class-IV Employee's Quarter	1	10	15.57	20.41
8	KU, Ladis Hall	1	5	3.30	16.27
9	"	2	5	3.06	18.20
10	"	4	5	3.45	22.00
11	"	5	5	3.02	17.24
12	"	6	10	10.94	17.24
13	KU, Assitant Professor's Quarter	1	15	22.94	20.40
14	"	2	10	14.73	16.55
15	KU, Adminstrative Building	1	15	18.72	20.41
16	Khulna, Helatoa Market	1	10	10.93	54.32
17	"	1	15	39.30	31.55
18	"	1	20	37.22	57.62
19	"	2	10	12.88	19.63
20	"	2	20	16.92	62.40
21	"	3	10	8.92	31.65
22	"	3	15	16.14	4.39
23	Khulna, Shiromony	1	10	11.05	17.20
24	"	2	5	5.15	9.67
25	"	2	10	9.29	9.67
26	"	2	15	10.90	10.10
27	"	2	20	30.98	34.00
28	"	3	5	6.12	27.00
29	"	3	10	11.04	19.35
30	Khulna, ICMA	1	5	8.90	51.60
31	"	1	10	14.89	40.00
32	"	1	15	23.26	26.60
33	"	1	20	27.42	26.60
34	"	3	5	8.89	58.60
35	"	3	10	15.06	37.60
36	"	3	15	39.83	6.75
37	"	3	20	15.29	15.70
38	Khulna, Mohila Techers TC	1	15	16.40	38.00
39	"	2	10	22.97	41.00
40	Khulna, Khalishpur	1	10	10.48	59.00
41	KUET Road, Fulbarigate	1	5	5.29	54.50
42	"	1	15	30.89	32.70
43	"	2	20	50.54	48.00

Table 5.3 (Continued)

1	2	3	4	5	6
44	KUET Road, Fulbarigate	3	5	6.42	34.00
45	Shiromony police barrak	1	5	7.61	91.80
46	"	1	10	12.15	100.00
47	"	2	15	19.60	48.00
48	"	3	5	5.82	65.00
49	"	3	10	9.85	49.00
50	"	3	15	12.93	23.00
51	"	3	20	15.45	25.80
52	"	4	20	17.58	23.00
53	"	5	10	11.06	32.60
54	Khulna, Goalkhali	1	5	13.13	32.60
55	"	1	15	78.24	41.28
56	"	2	20	25.74	45.93
57	"	3	15	40.73	49.54
58	"	3	20	30.98	46.33
59	"	4	15	43.81	26.54
60	"	4	20	30.14	53.51
61	Khluna, Cable Shilpa	4	10	10.27	29.64
62	"	5	15	15.13	20.03
63	"	6	10	13.41	74.11
64	"	6	15	13.57	26.82
65	Khulna, 100 Bed Diabetic Hospital	1	10	14.38	86.00
66	Khulna, Helatola	1	15	63.94	66.00
67	"	2	10	10.42	63.00
68	Shiromony Police TC	1	10	11.53	76.92
69	"	1	20	17.41	45.00
70	"	2	5	8.89	79.50
71	"	2	15	14.99	96.52
72	"	4	10	10.15	43.80
73	"	6	15	11.42	36.12
74	"	8	20	17.13	49.37
75	"	9	15	13.92	56.19
76	"	11	20	16.99	38.86
77	"	12	10	12.72	45.76
78	"	15	5	8.56	53.40
79	Khulna, Ghat no-4	1	15	42.47	76.00
80	Khulna, Gallamary Bridge	3	15	18.17	51.00
81	Khulna, Navel School	1	5	10.17	84.20
82	"	2	10	18.91	18.00
83	"	2	20	22.79	29.50
84	Khulna, Farajipara	1	10	17.14	80.00
85	"	2	5	8.37	68.00
86	"	2	15	27.81	54.00
88	Khulna Mohila TTC	6	20	14.24	36.30
89	Khulna Tibbet Market	1	10	11.26	54.30
90	"	1	15	39.19	31.50
91	"	1	20	35.32	57.70
92	"	2	10	12.63	19.68
93	"	2	20	16.80	62.48
94	"	3	10	9.48	31.65

Table 5.3 (Continued)

1	2	3	4	5	6
95	Khulna Tibbet Market	3	15	16.69	4.39
96	Khulna BPRTC office	3	20	57.70	77.00
97	Khulna Environ Research	1	20	42.89	52.00
98	"	2	20	41.17	53.00
99	"	3	20	71.82	35.00
100	Khulna, RPATC Building	2	15	13.75	37.00
101	"	3	5	4.44	14.56
102	"	3	10	8.35	32.40
103	Khulna, Mirerdanga	1	5	7.68	73.70
104	"	1	10	13.90	71.30
105	"	1	15	15.69	12.90
106	Khulna Imam TC	1	15	11.80	20.89
107	"	1	20	18.68	26.70
108	"	2	10	20.55	17.90
109	"	2	15	40.12	37.60
110	"	2	20	21.15	17.90
111	"	3	10	26.47	38.20
112	"	3	20	21.40	21.20
113	Khulna, Rupsa Chanmari	1	15	23.19	23.60
114	"	2	15	15.79	51.00
115	"	2	20	21.86	74.60
116	"	3	10	18.70	24.10
117	"	3	15	15.17	39.60
118	"	3	20	18.38	21.40
119	Khulna Sonadanga Thana	1	5	13.80	90.00
120	"	1	10	69.33	35.80
121	"	1	15	10.13	18.60
122	"	4	5	4.44	49.30
123	"	4	15	12.56	31.60
124	Sonadanga R/A	1	5	5.75	9.60
125	"	1	10	9.93	9.70
126	"	1	15	11.42	10.10
127	"	1	20	33.01	34.00
128	Gallamari	1	5	6.76	27.80
129	"	1	10	11.79	19.20
130	Khulna Shusu Sadan	1	5	7.15	81.00
131	"	1	15	34.25	46.00
132	"	2	10	12.22	27.00
133	"	2	20	52.05	66.00
134	"	3	10	10.53	38.00
135	Khulna, Fulbarigate	1	5	8.11	49.00
136	"	1	15	21.56	51.00
137	"	2	10	14.51	37.00
138	"	2	20	31.96	27.00
140	Khulna, Goalkhali Hostel	1	15	78.20	41.30
141	"	2	20	25.80	46.00
142	"	3	15	41.43	49.00
143	Khulna, Tarerpukur	1	5	6.16	95.00
144	"	2	15	20.90	54.00
145	Khulna, Medical college Hostel	1	5	12.13	75.00

Table 5.3 (Continued)

1	2	3	4	5	6
146	Khulna, Medical college Hostel	1	15	18.01	46.00
147	"	2	10	13.89	54.00
148	"	2	20	66.92	29.00
149	"	3	20	37.38	26.00
150	Khulna, Medical Mosque	1	15	50.75	23.00
152	"	2	20	46.93	15.00
154	"	3	10	17.66	25.00
155	Khulna, Shishu Sadan	1	10	11.91	79.00
156	Khulna, Mujgunni	1	5	9.55	23.00
157	"	2	10	28.79	6.80
158	"	3	5	14.58	54.00
159	Khulna, Baniakhamar	1	5	7.92	65.00
160	"	1	10	11.48	56.00
161	Khulna, Boyra	2	15	15.33	49.00
162	KUET, Dormitory	2	15	22.76	53.00
163	KUET, Engg. Sec	2	10	17.45	52.00
164	Khulna, ICMA off	1	5	8.88	51.00
165	"	1	10	14.72	40.00
166	"	2	10	32.17	6.75
167	"	3	15	41.84	8.76
168	Khulna, Shiromony private plot	1	10	9.81	22.00
169	"	2	5	5.88	38.00
170	"	4	15	12.87	23.00
171	Khulna, BOC Rupsa	1	5	5.53	29.00
172	"	1	15	6.52	13.00
173	"	1	20	16.06	41.00
174	Sonadanga R/A ph-I	1	5	*	2.18
175	Sonadanga Main Road	3	10	*	36.13
176	Tootpara	1	5	*	2.61
177	Nirala	1	5	*	2.61
178	Moylapota	1	5	*	13.09
179	Mujgunni	1	20	*	4.91
180	Sonadanga	1	5	*	16.37
181	Khalishpur	1	10	*	13.53
182	Baniakhamar	1	5	*	8.07
183	Boyra	1	20	*	4.91
184	Iqbal nagar	1	5	*	10.47
185	Daulatpur	1	10	*	2.61
186	Sher-e-Bangla Road	1	5	*	10.25
187	Shaikh para	1	20	*	4.91
188	Mojit sarany	1	5	*	15.06
189	Hazi Mohsin Road	1	5	*	22.91
190	Mirjapur Road	1	5	*	5.02
191	Banargathi	1	5	*	2.33
192	Poyltechnic	1	5	*	4.49
193	Shaikh para	1	5	*	2.18
194	Mujgunni	1	5	*	6.54
195	Municipal Tank Road	1	5	*	17.02
196	Prantic, Sonadanga	1	5	*	2.72

* Calculation was not done

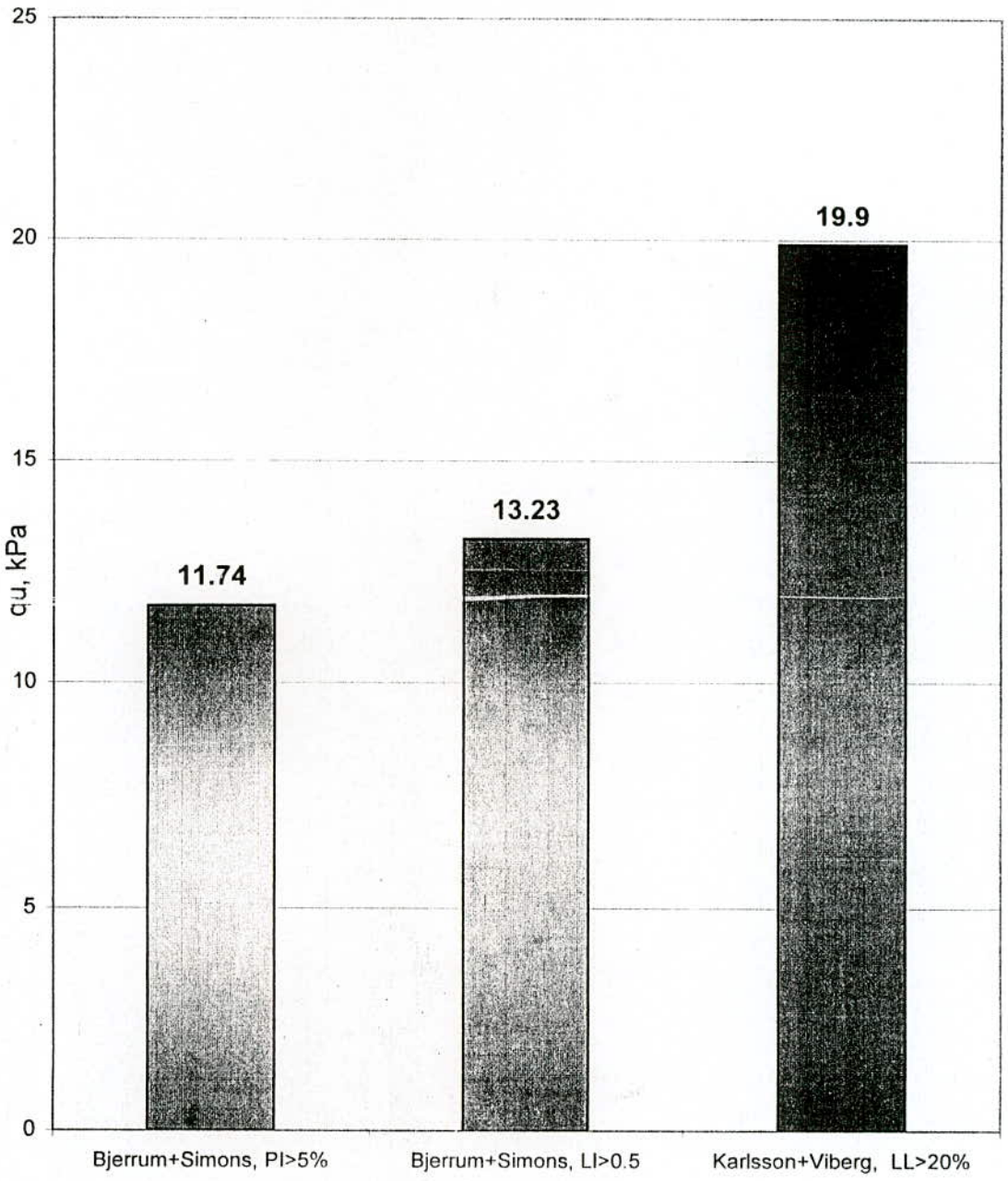


Figure 5.2 Average q_u from correlation equations (KCC)

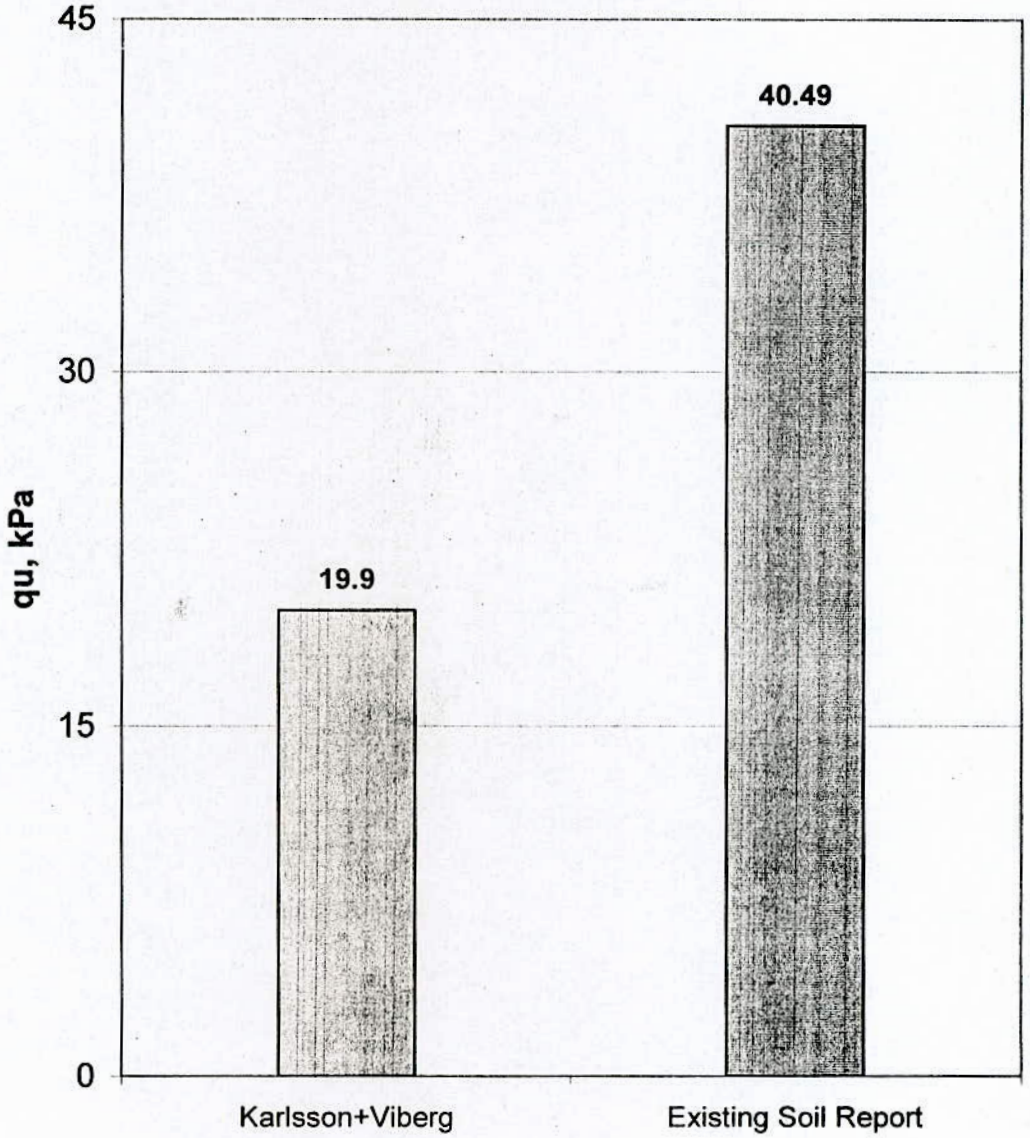


Figure 5.3 Average q_u from correlation equation and existing soil report (KCC)

Table 5.4 Comparison of q_u between calculated and laboratory test result

Bore Hole no.	Location of Bore Hole	Depth (ft)	Water table (ft)	Moisture Content W %	Liquid Limit LL %	Plastic Limit PL %	Specific Gravity G	Sub-merge unit wt	Bulk unit weight	Effectie pressure	q_u, According to Karlsson+Veberg kPa	q_u from Lab test kPa
106	KUET Campus	5	1.5	34.31	54.40	28.57	2.70	55.067	117.47	368.94	9.61	16.20
107	"	5	1.5	34.69	47.40	24.51	2.70	54.776	117.18	367.48	8.34	27.00
108	"	5	1.5	22.65	45.50	34.67	2.70	65.825	128.22	422.72	9.21	19.00
109	"	5	3.5	27.39	40.00	26.47	2.67	60.19	122.59	519.35	9.95	59.00

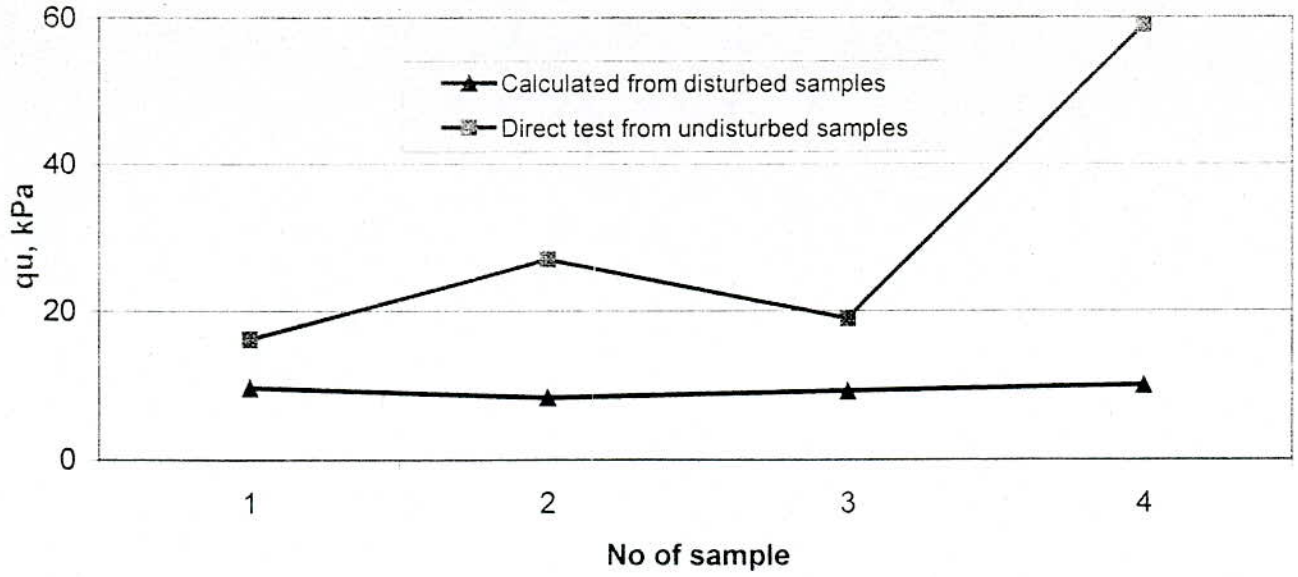


Figure 5.4 Comparison of q_u between calculated and laboratory test result

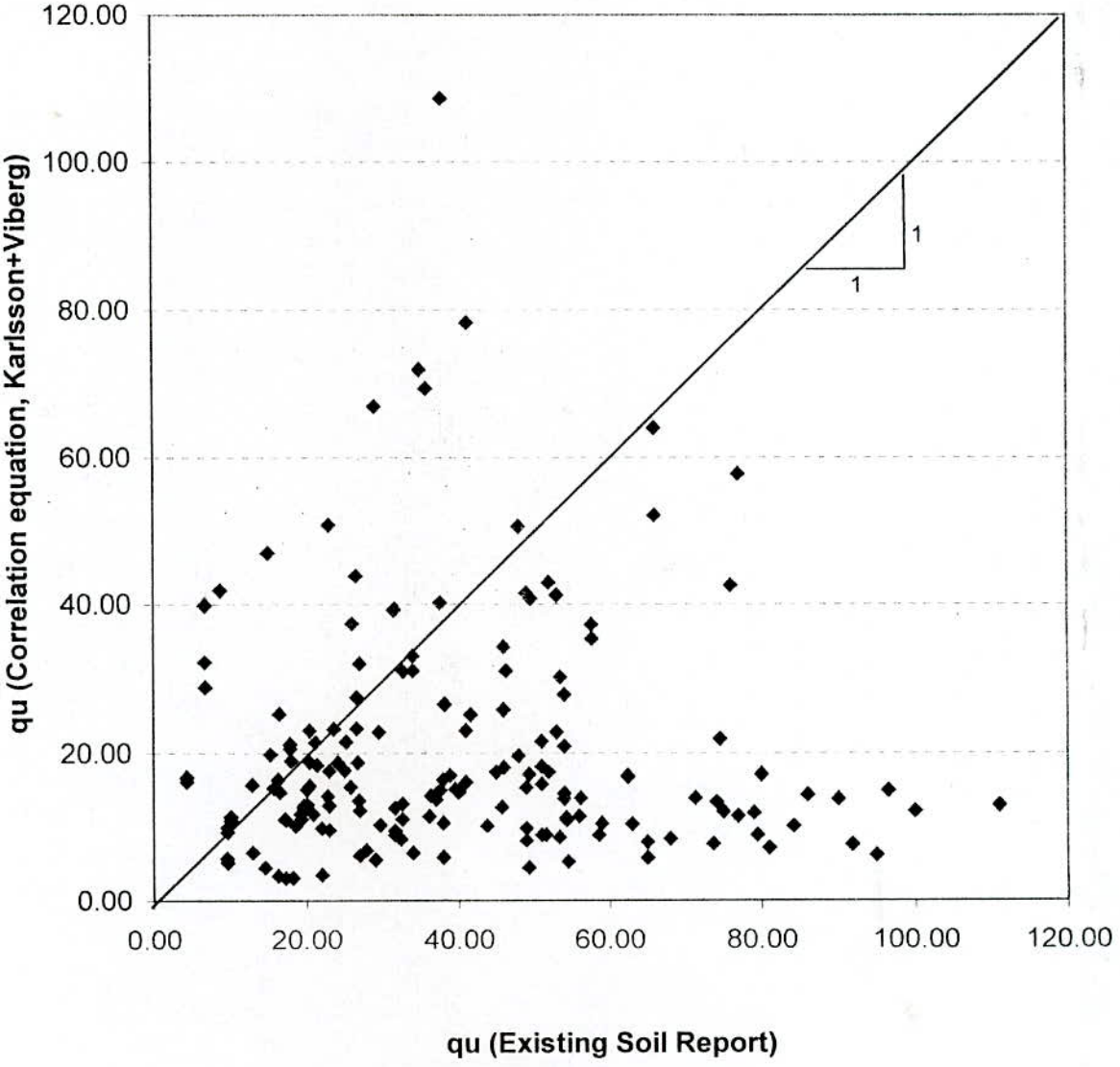


Figure 5.5 q_u (Existing Soil Report versus Correlation equation)

Table 5.5 Location of Bore hole (for qu result) at KCC

Serial No. of Bore hole	Area & Location	Bore Hole	Depth in feet	qu Laboratory test result / Existing soil report kPa
1	2	3	4	5
1	Banargathi	1	5	2.33
2	Baniakhamar	1	5	8.07
3	Boyra	1	20	4.91
4	Daulatpur	1	10	2.61
5	Gallamari	1	5	27.80
6	Hazi Mohsin Road	1	5	22.91
7	Iqbal nagar	1	5	10.47
8	Khalishpur	1	10	13.53
9	Khluna, Cable Shilpa	4	10	29.64
10	Khulna BPRTC office	3	20	77.00
11	Khulna Environ Research	1	20	52.00
12	Khulna Imam TC	1	15	20.89
13	Khulna Mohila TTC	6	20	36.30
14	Khulna Shusu Sadan	1	5	81.00
15	Khulna Sonadanga Thana	1	5	90.00
16	Khulna Tibbet Market	1	10	54.30
17	Khulna University, 2nd Acdm Bldg	1	5	16.27
18	Khulna, 100 Bed Diabetic Hospital	1	10	86.00
19	Khulna, Baniakhamar	1	5	65.00
20	Khulna, BOC Rupsa	1	5	29.00
21	Khulna, Boyra	2	15	49.00
22	Khulna, Farajipara	1	10	80.00
23	Khulna, Fulbarigate	1	5	49.00
24	Khulna, Gallamary Bridge	3	15	51.00
25	Khulna, Ghat no-4	1	15	76.00
26	Khulna, Goalkhali	1	5	32.60
27	Khulna, Goalkhali Hostel	1	15	41.30
28	Khulna, Helatoa Market	1	10	54.32
29	Khulna, Helatola	1	15	66.00
30	Khulna, ICMA	1	5	51.60
31	Khulna, ICMA off	1	5	51.00
32	Khulna, Khalishpur	1	10	59.00
33	Khulna, Medical college Hostel	1	5	75.00
34	Khulna, Medical Mosque	1	15	23.00
35	Khulna, Mirerdanga	1	5	73.70
36	Khulna, Mohila Techers TC	1	15	38.00
37	Khulna, Mujgunni	1	5	23.00
38	Khulna, Navel School	1	5	84.20
39	Khulna, RPATC Building	2	15	37.00
40	Khulna, Rupsa Chanmari	1	15	23.60
41	Khulna, Shiromony	1	10	17.20
42	Khulna, Shiromony private plot	1	10	22.00
43	Khulna, Shishu Sadan	1	10	79.00

Table 5.5 (Continued)

1	2	3	4	5
44	Khulna, Tarerpukur	1	5	95.00
45	KU, Adminstrative Building	1	15	20.41
46	KU, Assitant Professor's Quarter	1	15	20.40
47	KU, Class-III Employee's Quarter	1	10	22.76
48	KU, Class-IV Employee's Quarter	1	10	20.41
49	KU, Ladis Hall	1	5	16.27
50	KU, Professor's Quarter	1	10	41.60
51	KUET Road, Fulbarigate	1	5	54.50
52	KUET, Dormitory	2	15	53.00
53	KUET, Engg. Sec	2	10	52.00
54	Mirjapur Road	1	5	5.02
55	Mojit sarany	1	5	15.06
56	Moylapota	1	5	13.09
57	Mujgunni R/A	1	20	4.91
58	Mujgunni	1	5	6.54
59	Municipal Tank Road	1	5	17.02
60	Nirala	1	5	2.61
61	Poyltechnic	1	5	4.49
62	Prantic, Sonadanga	1	5	2.72
63	Shaikh para	1	20	4.91
64	Shaikh para Main Road	1	5	2.18
65	Sher-e-Bangla Road	1	5	10.25
66	Shiromony police barrak	1	5	91.80
67	Shiromony Police TC	1	10	76.92
68	Sonadanga	1	5	16.37
69	Sonadanga Main Road	3	10	36.13
70	Sonadanga R/A	1	5	9.60
71	Sonadanga R/A ph-I	1	5	2.18
72	Tutpara	1	5	2.61

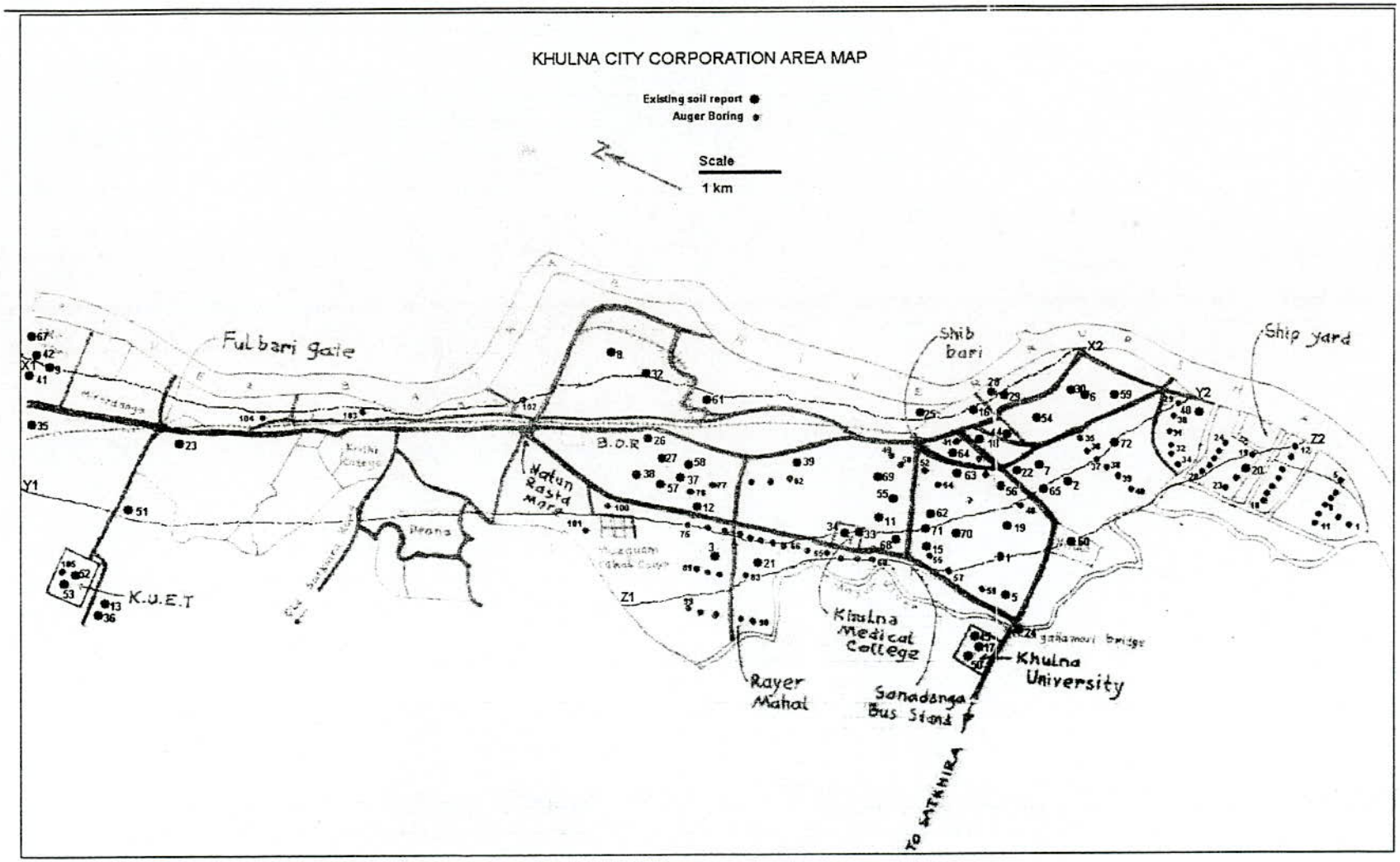


Figure 5.6 Location of Bore-hole (Auger boring and Existing report) at KCC area for q_u

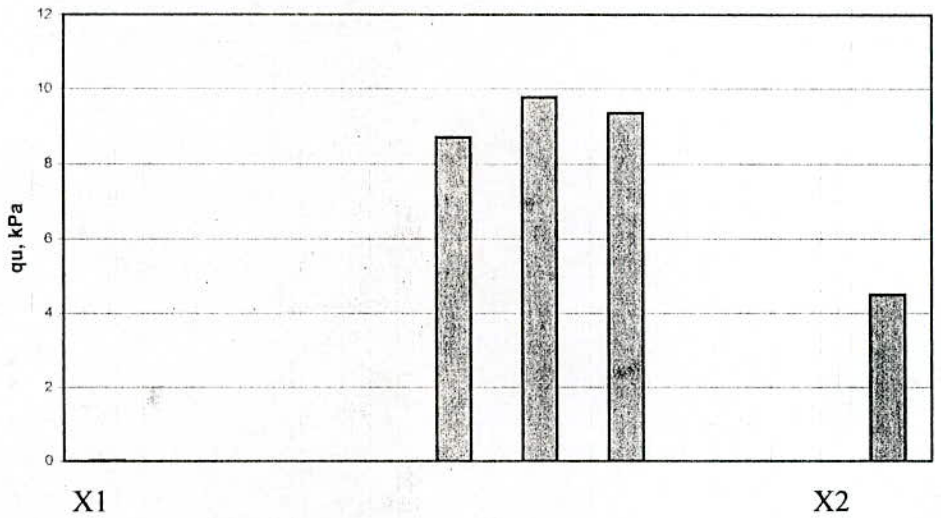


Figure 5.7 Profile of q_u at KCC area through section X1-X2 at depth 5 feet

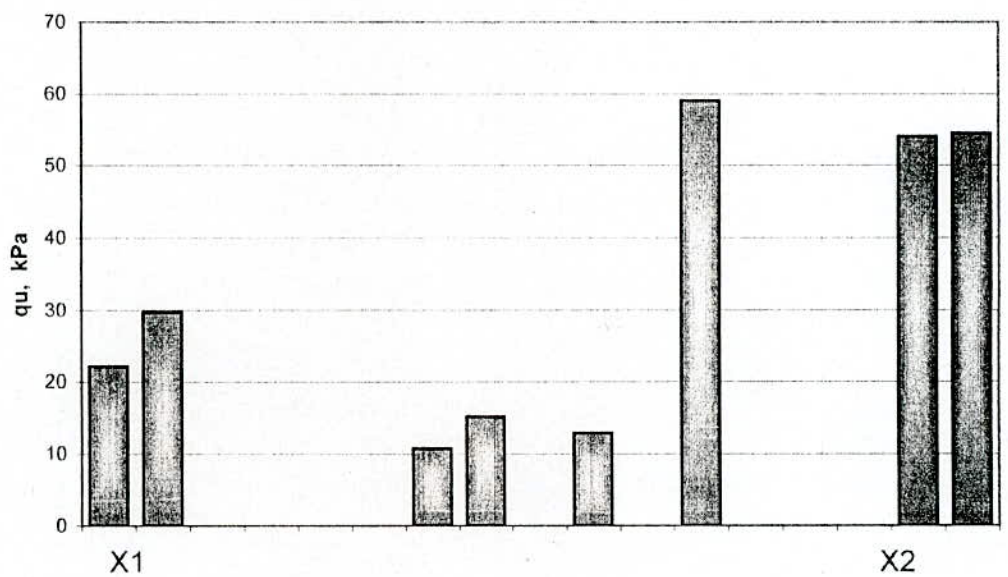


Figure 5.8 Profile of q_u at KCC area through section X1-X2 at depth 10 feet

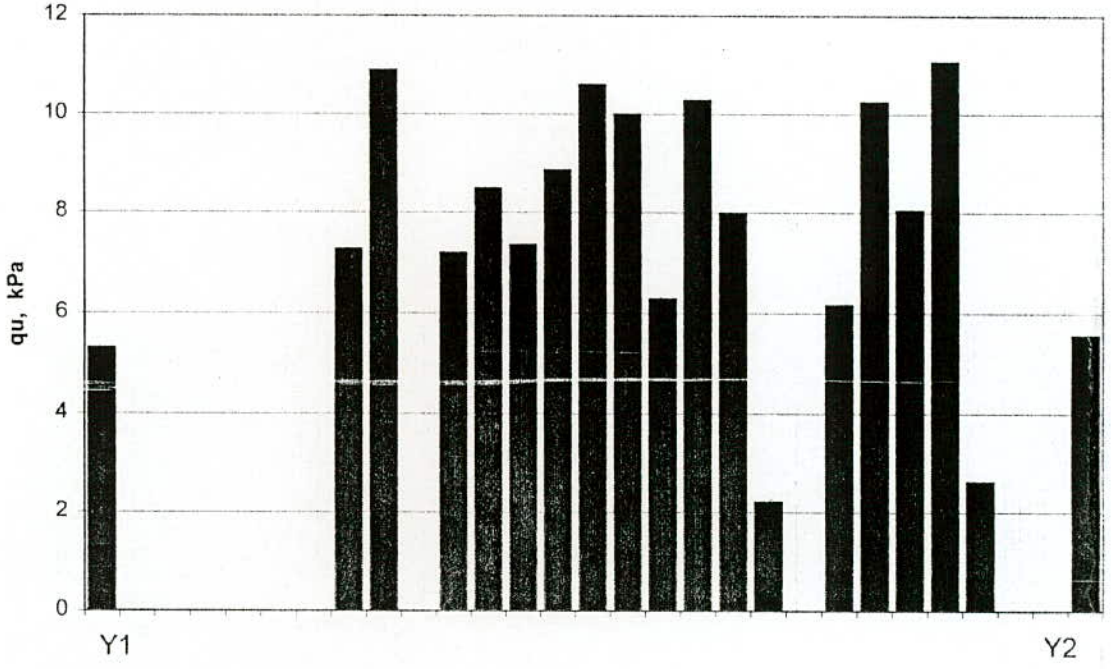


Figure 5.9 Profile of q_u at KCC area through section Y1-Y2 at depth 5 feet

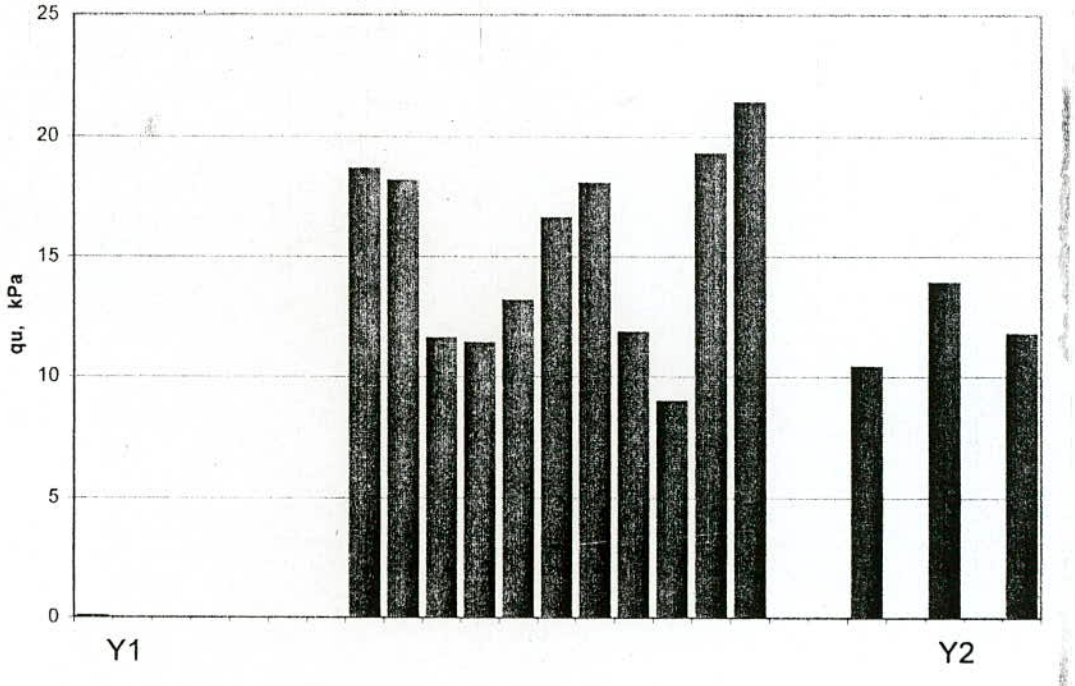


Figure 5.10 Profile of q_u at KCC area through section Y1-Y2 at depth 10 feet

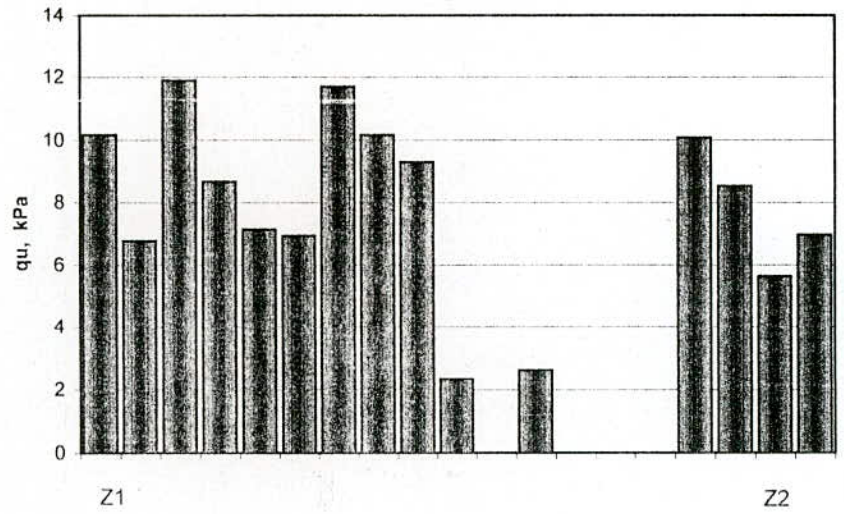


Figure 5.11 Profile of q_u at KCC area through section Z1-Z2 at depth 5 feet

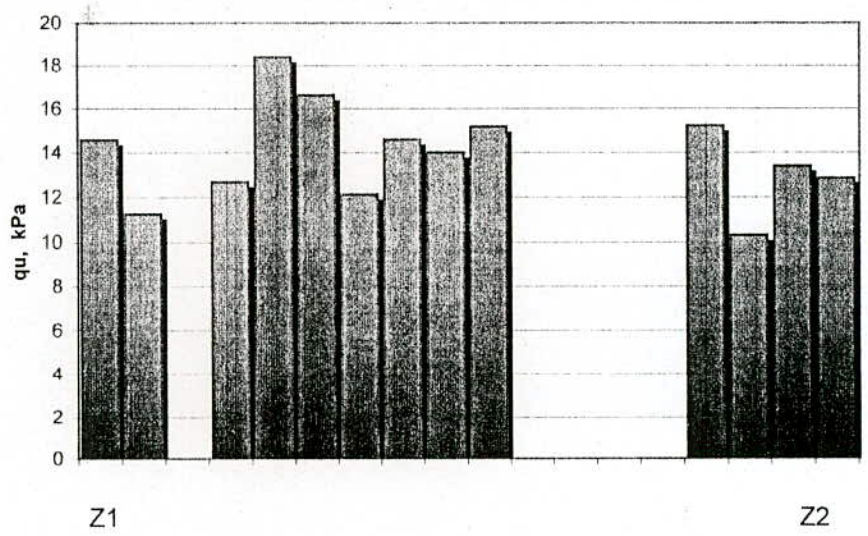


Figure 5.12 Profile of q_u at KCC area through section Z1-Z2 at depth 10 feet

5.4 Comparison of Cc (Calculated and Laboratory results)

For this purpose correlations proposed by Skempton (1944)[17] Eq. 2.2[25] is used. Values of Cc obtained by using this formula on the test results of existing soil reports (210 Nos. data) are shown in Table 5.7. With these values graphs are plotted in Fig.5.13 which

shows the compliance of the calculated Cc values obtained from correlation equations with the laboratory test values. Values of Cc from auger boring obtained in Table 5.6 are compared with the values of Cc obtained from correlation equation along with actual test result of Cc.

It can be concluded from Fig. 5.13 that proposed by Skempton (1944)[17] being the conservative side best represents the laboratory results of the existing soil reports valid testing its use for indirect equation Cc. Thereby the use of Cc obtained indirectly from auger boring samples can be a reasonable basis for Cc profile. Location of bore-hole of KCC area shown in Table 5.8.

5.4.1 Profile of Cc

Compression index (Cc) obtained both from soil report which has been used for construction work in Khulna city and from auger samples (using Eq. 2.2) is used to make profile for Cc. Although data of Cc was not enough in number to make conclusion on the basis of homogeneous distribution for the whole KCC area, these profile were made depending on the available data. Profiles are (i) between Bhairab river and Khulna-Jessore highway shown in Fig. 5.14 and 5.15 (ii) approximately within 1 Km area parallel to Khulna-Jessore highway shown in Fig. 5.16 & 5.17 and (iii) the rest of the area away from Khulna-Jessore highway shown in Fig. 5.18 and 5.19.

5.5 Profile of Peat layer

Bore logs of soil reports of KCC are collected from the different sources (KUET, Khulna University, different organization, persons). Location of bore-hole and existence of peat layer at KCC shown in Fig. 5.20. From these bore logs, the peat layers were identified within levels of 5-10 feet, 10-20 feet and the rest are in Table 5.9. Three maps are prepared showing the spatial distribution of peat layers as or where present in the above mentioned 3 levels shown in Fig. 5.21, 5.22 and 5.23. Profile of peat layer approximately North-South direction shown in Fig. 5.24.

5.6 Profile of water table of instant observation

While performing auger boring, when drilling was complete water table were recorded. From these results, instantly observed water table profile is prepared shown in Fig. 5.25

Table 5.6 Calculated Cc (Sample from Auger boring)

Bore Hole no.	Location of Bore Hole	Dep th (ft)	Liquid Limit LL %	Cc, According to Skempton (1944), Cc = 0.009(LL-10)
1	2	3	4	5
1	Labonchora (South)	5	76.30	0.597
"	"	10	51.20	0.371
2	"	5	69.75	0.538
"	"	10	47.80	0.340
3	"	5	35.50	0.230
"	"	10	47.25	0.335
4	"	5	41.20	0.281
"	"	10	98.57	0.797
5	Labonchora (West)	5	45.10	0.316
"	"	10	46.50	0.329
6	"	5	35.50	0.230
"	"	10	42.10	0.289
7	"	5	41.20	0.281
"	"	10	102.45	0.832
8	"	5	39.50	0.266
"	"	10	154.20	1.298
9	Labonchora (East)	5	34.00	0.216
"	"	10	32.00	0.198
10	"	5	35.50	0.230
"	"	10	48.30	0.345
11	"	5	34.50	0.221
"	"	10	46.30	0.327
12	Labonchora (North)	5	48.50	0.347
"	"	10	45.20	0.317
13	"	5	52.50	0.383
"	"	10	59.00	0.441
14	"	5	49.50	0.356
"	"	10	31.20	0.191
15	"	5	48.00	0.342
"	"	10	41.50	0.284
16	"	5	39.50	0.266
"	"	10	49.20	0.353
17	"	5	34.00	0.216
"	"	10	32.00	0.198
18	"	5	35.50	0.230
"	"	10	48.30	0.345
19	Shipyard (West)	5	34.50	0.221
"	"	10	46.30	0.327
20	"	5	38.50	0.257
"	"	10	35.00	0.225
21	"	5	47.50	0.338
"	"	10	215.40	1.849
22	"	5	43.10	0.298
"	"	10	57.60	0.428
23	"	5	55.50	0.410
"	"	10	43.20	0.299
24	"	5	46.50	0.329

Table 5.6 (Continued)

1	2	3	4	5
24	Shipyard (West)	10	102.50	0.833
25	"	5	46.20	0.326
"	"	10	145.80	1.222
26	"	5	45.10	0.316
"	"	10	42.10	0.289
27	"	5	59.20	0.443
"	"	10	39.00	0.261
28	Shipyard (West)	5	59.40	0.445
"	"	10	56.70	0.420
29	Rupsa (West)	5	38.90	0.260
"	"	10	42.50	0.293
30	"	5	34.00	0.216
"	"	10	35.50	0.230
31	"	5	42.10	0.289
"	"	10	48.20	0.344
32	"	5	32.10	0.199
"	"	10	159.50	1.346
33	"	5	34.20	0.218
"	"	10	41.20	0.281
34	"	5	42.10	0.289
"	"	10	32.10	0.199
35	Toot Para	5	36.50	0.239
"	"	10	200.50	1.715
36	"	5	34.00	0.216
"	"	10	32.50	0.203
37	"	5	46.00	0.324
"	"	10	52.60	0.383
38	"	5	35.26	0.227
"	"	10	65.29	0.498
39	"	5	39.20	0.263
"	"	10	121.30	1.002
40	"	5	45.20	0.317
"	"	10	35.40	0.229
41	Faraji para (Moyla Pota)	5	41.50	0.284
"	"	10	164.30	1.389
42	"	5	35.60	0.230
"	"	10	34.00	0.216
43	"	5	38.00	0.252
"	"	10	35.50	0.230
44	"	5	31.00	0.189
"	"	10	34.50	0.221
45	"	5	35.60	0.230
"	"	10	45.80	0.322
46	"	5	32.50	0.203
"	"	10	47.50	0.338
47	"	5	49.50	0.356
"	"	10	214.40	1.840
48	Basu Para	5	35.50	0.230
"	"	10	38.40	0.256
49	Shibbari	5	42.50	0.293

Table 5.6 (Continued)

1	2	3	4	5
49	Shibbari	10	210.10	1.801
50	"	5	35.50	0.230
"	"	10	35.00	0.225
51	"	5	41.20	0.281
"	"	10	39.50	0.266
52	"	5	47.10	0.334
"	"	10	26.40	0.148
53	"	5	56.20	0.416
"	"	10	42.50	0.293
54	Gobarchaka	5	35.00	0.225
"	"	10	47.50	0.338
55	S.Danga Bus Stand (S)	5	39.20	0.263
"	"	10	198.35	1.695
56	"	5	39.20	0.263
"	"	10	55.00	0.405
57	Bus Stand (S) Bypass	5	52.10	0.379
"	"	10	214.50	1.841
58	"	5	48.60	0.347
"	"	10	123.40	1.021
59	Gallamari	5	57.50	0.428
"	"	10	34.50	0.221
60	Bus Stand (N) Bypass	5	45.80	0.322
"	"	10	48.60	0.347
61	"	5	56.00	0.414
62	"	5	34.60	0.221
"	"	10	45.20	0.317
63	Medical college (West)	5	34.26	0.218
"	"	10	76.50	0.599
64	"	5	45.86	0.323
65	"	5	60.25	0.452
"	"	10	78.00	0.612
66	Boyra More (South)	5	41.50	0.284
"	"	10	211.30	1.812
67	"	5	45.86	0.323
68	"	5	27.50	0.158
"	"	10	35.50	0.230
69	"	5	57.50	0.428
"	"	10	34.50	0.221
70	"	5	54.20	0.398
"	"	10	55.00	0.405
71	"	5	35.00	0.225
"	"	10	47.50	0.338
72	Boyra Samad Sir Plot	5	34.60	0.221
"	"	10	36.50	0.239
73	"	5	39.50	0.266
"	"	10	32.80	0.205
74	"	5	34.00	0.216
"	"	10	34.80	0.223
75	Moj. Police Line (East)	5	72.00	0.558
"	"	10	59.00	0.441

Table 5.6 (Continued)

1	2	3	4	5
76	Mujgunni R/A	5	29.40	0.175
"		10	46.00	0.324
77	Boyra More (East)	5	35.40	0.229
"	"	10	57.40	0.427
78	"	5	48.20	0.344
"	"	10	49.10	0.352
79	"	5	44.20	0.308
"	"	10	34.20	0.218
80	"	5	39.30	0.264
"	"	10	29.30	0.174
81	"	5	46.90	0.332
"	"	10	124.00	1.026
82	Boyra (Central)	5	54.10	0.397
"	"	10	59.80	0.448
83	Rayel Mahal (East)	5	54.20	0.398
"	"	10	55.41	0.409
84	"	5	46.20	0.326
"	"	10	27.40	0.157
85	"	5	43.80	0.304
"	"	10	32.10	0.199
86	Rayel Mahal (East)	5	38.50	0.257
"	"	10	66.50	0.509
87	"	5	35.00	0.225
"	"	10	47.50	0.338
88	"	5	35.00	0.225
"	"	10	54.20	0.398
89	"	5	35.00	0.225
"	"	10	49.30	0.354
90	Rayel Mahal (West)	5	47.50	0.338
"	"	10	43.10	0.298
91	"	5	74.50	0.581
"	"	10	45.00	0.315
92	"	5	31.50	0.194
"	"	10	54.10	0.397
93	"	5	42.10	0.289
"	"	10	46.20	0.326
94	"	5	39.40	0.265
"	"	10	49.70	0.357
95	"	5	54.12	0.397
"	"	10	31.20	0.191
96	"	5	37.51	0.248
"	"	10	29.41	0.175
97	"	5	49.58	0.356
"	"	10	69.28	0.534
98	"	5	55.14	0.406
"	"	10	47.26	0.335
99	"	5	65.24	0.497
"	"	10	57.12	0.424
100	Bastohara (East)	5	42.18	0.290
"	"	10	98.50	0.797

Table 5.6 (Continued)

1	2	3	4	5
101	Bastohara (North)	5	99.00	0.801
"	"	10	295.00	2.565
102	Natun Rasta More	5	48.00	0.342
"	"	10	41.50	0.284
103	Daulat Pur	5	42.50	0.293
"	"	10	51.00	0.369
104	Raily gate	5	34.00	0.216
"	"	10	27.50	0.158
105	KUET (Civil Dept.)	5	31.52	0.194
"	"	10	34.60	0.221
106	KUET Campus	5	54.40	0.400
107	"	5	47.40	0.337
108	"	5	45.50	0.320
109	"	5	40.00	0.270

Table 5.7 Cc from Calculated and laboratory test result

Serial no.	Location of Bore Hole	Bore hole no	Depth feet	Liquid Limit LL %	Compression index (Cc)	
					According to Skepton	Existing Report
1	2	3	4	5	6	7
1	Tala, Sub Registry off	1	10	42.00	0.288	0.220
2	Barisal TTC	2	10	47.00	0.333	0.500
3	Borguna, Police Line	1	10	45.20	0.317	0.350
4	"	2	15	35.00	0.225	0.450
5	"	3	5	44.20	0.308	0.340
6	"	3	15	33.80	0.214	0.300
7	Bhola, Shilpakala Academ	1	15	29.50	0.176	0.300
8	"	5	20	30.20	0.182	0.200
9	Jhinaidha, Dormitory	1	15	40.00	0.270	0.349
10	"	1	20	37.00	0.243	0.217
11	"	2	15	41.00	0.279	0.381
12	Khulna, ICMA	1	10	48.00	0.342	0.420
13	"	1	15	143.00	1.197	2.650
14	"	1	20	51.50	0.374	0.420
15	Barguna, Shilpakala Acadm	1	10	44.00	0.306	0.290
16	Magura, Shishu paribar	1	10	60.00	0.450	0.469
17	"	2	10	64.50	0.491	0.395
18	"	5	10	61.00	0.459	0.269
19	"	6	10	62.00	0.468	0.432
20	"	7	10	53.00	0.387	0.290
21	Bagerhat, Digraj G/house	2	20	39.60	0.266	0.315
22	Khulna, Fultala Thana	3	10	32.00	0.198	0.210
23	Khulna, Mohila TTC	1	15	48.00	0.342	0.580
24	"	2	10	78.00	0.612	0.450
25	Barguna, Patharghata	4	10	34.00	0.216	0.240
26	Khulna, Khalishpur	1	10	31.00	0.189	0.240
27	KUET Road, Fulbarigate	1	15	96.00	0.774	0.530
28	Khulna, Shiromony Police	1	10	32.00	0.198	0.360
29	"	3	15	31.50	0.194	0.240
30	"	3	20	30.50	0.185	0.470
31	"	5	10	32.00	0.198	0.320
32	Barguna, Police Fari	1	5	38.50	0.257	0.180
33	"	1	20	38.00	0.252	0.980
34	"	3	20	36.00	0.234	0.180
35	"	5	10	40.00	0.270	0.160
36	Khulna, Cable Shilpa	6	10	36.00	0.234	0.180
37	Pirojpur, Ansar & VDP	1	10	55.00	0.405	0.456
38	"	1	15	48.00	0.342	0.365
39	"	1	20	46.00	0.324	0.465
40	"	3	10	52.50	0.383	0.510
41	"	3	15	102.00	0.828	0.400
42	Bagerhat, Chitolmari Thana	2	20	43.20	0.299	0.381
43	Satkhira, Police line	1	10	35.00	0.225	0.300
44	Kln, 100 bed diabetic hospital	1	10	47.00	0.333	0.370
45	"	1	10	41.30	0.282	0.170
46	"	1	15	38.00	0.252	0.230

Table 5.7 (Continued)

1	2	3	4	5	6	7
47	Kln, 100 bed diabetic hospital	2	15	39.00	0.261	0.260
48	"	4	10	35.50	0.230	0.300
49	"	5	5	38.80	0.259	0.190
50	Khulna, Helatola	1	15	185.00	1.575	1.050
51	"	2	20	69.00	0.531	1.480
52	Satkhira, Ashashuni	1	5	39.00	0.261	0.320
53	"	4	5	53.00	0.387	0.510
54	Shiromony Police TC	1	10	32.00	0.198	0.244
55	"	1	20	30.00	0.180	0.167
56	"	2	15	34.00	0.216	0.357
57	"	11	20	30.00	0.180	0.311
58	Bhola, Police Line	2	10	35.00	0.225	0.290
59	Bhola, Jail obser Tower	1	10	32.00	0.198	0.320
60	"	4	10	32.00	0.198	0.330
61	Jessore, Jhikarghacha	1	20	46.20	0.326	0.350
62	Jessore, Benapole	2	15	38.00	0.252	0.277
63	Khulna Gallamary	3	15	42.00	0.288	0.480
64	Barisal Blind school	1	20	32.60	0.203	0.136
65	"	2	10	43.00	0.297	0.212
66	"	2	15	32.00	0.198	0.122
67	"	2	20	31.00	0.189	0.164
68	"	3	15	36.00	0.234	0.202
69	Barisal Fire station, Banari	1	5	41.00	0.279	0.280
70	"	1	15	34.00	0.216	0.530
71	"	2	15	30.20	0.182	0.480
72	"	3	10	37.50	0.248	0.340
73	"	3	15	33.00	0.207	0.260
74	Barisal DC court	3	5	39.00	0.261	0.230
75	Magura, Collectary bldg	2	15	35.50	0.230	0.490
76	"	4	20	33.40	0.211	0.310
77	Rajbari, Police station	1	5	31.00	0.189	0.100
78	Khulna, Farajipara	1	1	47.00	0.333	0.240
79	"	2	15	68.00	0.522	0.270
80	"	3	5	44.80	0.313	0.163
81	"	3	1	41.50	0.284	0.194
82	Jessore, Benapole Office	2	20	39.00	0.261	0.240
83	Jhinaidha, Ansar VDP	1	5	39.00	0.261	0.470
84	"	2	5	38.00	0.252	0.290
85	"	3	5	39.00	0.261	0.210
86	KU, Academic-II	1	5	63.00	0.477	0.445
87	"	6	5	48.00	0.342	0.367
88	KU, Prof qtr	1	10	85.00	0.675	0.960
89	"	1	20	53.00	0.387	1.260
90	KU, Class-III	2	15	60.00	0.450	0.460
91	KU, Asstt. Prof	1	15	65.00	0.495	0.395
92	Khulna, Shishu Sadan	2	15	112.00	0.918	0.670
93		2	20	326.00	2.844	2.500
94	"	3	10	42.00	0.288	0.250
95	Patuakhali, SP	3	15	42.00	0.288	0.110
96	"	4	10	44.00	0.306	0.180

Table 5.7 (Continued)

1	2	3	4	5	6	7
97	Patuakhali, SP	5	15	39.00	0.261	0.120
98	"	6	5	45.00	0.315	0.230
99	Jhalokati, Police Qtr	1	10	41.00	0.279	0.240
100	"	1	15	39.00	0.261	0.380
101	"	2	10	56.00	0.414	0.280
102	"	2	15	40.00	0.270	0.350
103	"	3	10	40.00	0.270	0.320
104	Jessore 6 story bldg	1	10	55.00	0.405	0.390
105	"	2	5	35.50	0.230	0.360
106		2	15	37.00	0.243	0.360
107	"	3	10	46.00	0.324	0.410
108	Barisal, Uzirpur	2	10	46.00	0.324	0.320
109	"	4	10	39.00	0.261	0.260
110	Bhola, Borhanuddin	2	10	33.00	0.207	0.190
111	Bhola, Sadar	1	20	36.00	0.234	0.320
112	Jessore, General Hosp	3	15	28.00	0.162	0.400
113	Barisal, Circuit house	1	10	39.50	0.266	0.240
114	"	2	20	42.00	0.288	0.170
115	"	3	10	41.00	0.279	0.240
116	"	3	15	39.00	0.261	0.360
117	Shariatput, Damuda	3	10	41.00	0.279	0.220
118	Khulna, Fulbarigate	1	15	48.00	0.342	0.570
119	"	2	10	46.00	0.324	0.370
120	"	2	20	69.00	0.531	0.360
121	Pirojpur, Nazirpur	2	10	29.00	0.171	0.180
122	Barisal, Gournadi	1	10	38.00	0.252	0.340
123	Jessore, Navaron	3	10	36.00	0.234	0.280
124	Shariatput, Darmitory	3	10	41.00	0.279	0.350
125	Khulna, Dumuria	1	10	40.00	0.270	0.180
126	"	3	20	42.00	0.288	0.340
127	Shariatpur, Naria Thana	1	10	38.00	0.252	0.250
128	Shariatpur, Damuyada	2	15	35.00	0.225	0.170
129	Jessore, Shisu paribar	4	20	70.00	0.540	0.190
130	"	2	10	66.50	0.509	0.190
131	"	3	15	79.00	0.621	0.190
132	"	5	10	80.00	0.630	0.170
133	"	6	5	30.50	0.185	0.140
134	"	6	10	87.00	0.693	0.320
135	Rajbari, private bldg	1	5	36.00	0.234	0.250
136	Madaripur, Shisu paribar	4	10	40.00	0.270	0.330
137	"	6	5	39.00	0.261	0.310
138	Madaripur, Sadar	3	10	47.00	0.333	0.270
139	Khulna Goalkhali	2	20	44.00	0.306	0.470
140	"	4	15	117.00	0.963	0.240
141	Shariatpur Sub-Regist	1	15	38.00	0.252	0.230
142	Patuakhali, invest tower	1	10	32.00	0.198	0.180
143	"	4	10	40.00	0.270	0.340
144	"	8	10	42.00	0.288	0.410
145	Faridpur court bldg	7	15	34.00	0.216	0.390
146	Faridpur medical hostel	2	10	43.00	0.297	0.560

Table 5.7 (Continued)

1	2	3	4	5	6	7
147	Faridpur medical hostel	3	15	34.00	0.216	0.530
148	Barisal Textile inst.	2	10	31.00	0.189	0.300
149	Barguna, Zakiertabak	1	10	40.00	0.270	0.320
150	"	1	20	38.00	0.252	0.310
151	Bhola Shilpakola	5	20	30.00	0.180	0.200
152	Bagerhat, Morelgong	1	15	36.00	0.234	0.290
153	Shariatpur DC court	2	10	39.00	0.261	0.240
154	Khulna, Shisu sadan	1	10	35.00	0.225	0.200
155	KUET Officer Dormitory	2	15	61.00	0.459	0.500
156	Jessore, Monirumpur	1	1	27.00	0.153	0.207
157	"	2	10	24.00	0.126	0.540
158	Barguna, Taltola Thana	1	10	43.00	0.297	0.480
159	"	5	10	43.00	0.297	0.350
160	Satkhira, Shilpakola	1	5	48.00	0.342	0.150
161	"	1	10	37.00	0.243	0.270
162	"	2	10	35.00	0.225	0.280
163	Barisal, Jail kitchen	2	10	34.00	0.216	0.260
164	"	3	10	32.00	0.198	0.230
165	Jhinedha, Jail	2	10	63.00	0.477	0.530
166	"	4	10	32.40	0.202	0.490
167	"	5	10	42.00	0.288	0.440
168	"	7	10	44.00	0.306	0.440
169	"	8	10	70.00	0.540	0.350
170	Khulna Mohila TTC	6	20	42.00	0.288	1.340
171	Barisal, Muladi	4	5	35.00	0.225	0.360
172	Khulna Helatola	1	15	104.00	0.846	1.200
173	"	2	10	47.00	0.333	0.310
174	"	2	20	38.00	0.252	0.480
175	Gopalgong, Hostel	1	15	38.00	0.252	0.420
176	"	1	20	40.00	0.270	0.346
177	"	2	20	40.00	0.270	0.390
178	Khulna BPATC, Off	3	20	115.00	0.945	0.800
179	Bagerhat, Mongla fire	1	5	40.00	0.270	0.498
180	"	3	5	47.00	0.333	0.570
181	Barisal, soil research	2	5	35.00	0.225	0.300
182	Satkhira, Shisu paribar	3	10	62.00	0.468	0.250
183	Khulna, Environ research	1	15	36.80	0.241	1.420
184	"	2	15	160.00	1.350	2.520
185	"	2	20	102.00	0.828	0.730
186	"	3	20	195.00	1.665	0.490
187	Khulna BPATC, Bldg	2	15	63.00	0.477	1.800
188	"	3	10	32.50	0.203	0.240
189	Khulna, Mirerdanga	1	10	34.00	0.216	0.320
190	"	1	15	33.00	0.207	0.330
191	Madaripur, Shibchar	2	10	45.00	0.315	0.160
192	"	2	10	31.00	0.189	0.150
193	"	3	10	49.00	0.351	0.130
194	Kustia, Chuadanga	2	15	46.50	0.329	0.310
195	"	4	20	34.00	0.216	0.330
196	"	7	15	51.00	0.369	0.290

Table 5.7 (Continued)

1	2	3	4	5	6	7
197	Khulna, Imam TTC	1	15	101.00	0.819	3.900
198	"	1	20	44.50	0.311	0.590
199	"	2	10	100.00	0.810	0.220
200	"	2	15	107.00	0.873	0.410
201	"	3	10	118.00	0.972	0.740
202	Kustia, TTC	3	20	56.00	0.414	0.170
203	"	6	15	39.00	0.261	0.080
204	Khulna, Rupsa	1	15	52.00	0.378	0.600
205	"	2	15	47.00	0.333	0.550
206	"	3	10	97.00	0.783	0.670
207	Khulna Joragate	3	10	38.00	0.252	0.200
208	Khulna Hazimohsin rd	2	20	52.00	0.378	0.520
209	Khulna Sonadanga Thana	1	10	352.00	3.078	0.560
210	Jhalokati, Police Line	2	10	39.00	0.261	0.300

Table 5.8 Location of Bore hole for Cc at KCC

Bore Hole no.	Location of Bore Hole	Bore hole	Depth	Existing Report Cc
1	2	3	4	5
1	Khulna, ICMA	1	10	0.420
"	"	1	15	2.650
"	"	1	20	0.420
2	Khulna, Mohila TTC	1	15	0.580
"	"	2	10	0.450
3	Khulna, Khalishpur	1	10	0.240
4	KUET Road, Fulbarigate	1	15	0.530
5	Khulna, Shiromony Police	1	10	0.360
"	"	3	15	0.240
"	"	3	20	0.470
"	"	5	10	0.320
6	Khulna, Cable Shilpa	6	10	0.180
7	Khulna, 100 bed diabetic hospital	1	10	0.370
"	"	1	10	0.170
"	"	1	15	0.230
"	"	2	15	0.260
"	"	4	10	0.300
"	"	5	5	0.190
8	Khulna, Helatola	1	15	1.050
"	"	2	20	1.480
9	Shiromony Police TC	1	10	0.244
"	"	1	20	0.167
"	"	2	15	0.357
"	"	11	20	0.311
10	Khulna Gallamary	3	15	0.480
11	Khulna, Farajipara	1	10	0.240
"	"	2	15	0.270
"	"	3	5	0.163
"	"	3	10	0.194
12	KU, Academic Building-II	1	5	0.445
"	"	6	5	0.367
13	KU, Prof quarter	1	10	0.960
"	"	1	20	1.260
14	KU, Class-III Employee's quarter	2	15	0.460
15	KU, Asstt. Professor's quarter	1	15	0.395
16	Khulna, Shishu Sadan	2	15	0.670
"		2	20	2.500
"	"	3	10	0.250
17	Khulna, Fulbarigate	1	15	0.570
"	"	2	10	0.370
"	"	2	20	0.360
18	Khulna Goalkhali	2	20	0.470
"	"	4	15	0.240
19	Khulna, Shisu sadan	1	10	0.200
20	KUET Officer Dormitory	2	15	0.500
21	Khulna Mohila TTC	6	20	1.340
22	Khulna Helatola	1	15	1.200

Table 5.8 (Continued)

1	2	3	4	5
22	Khulna Helatola	2	10	0.310
"	"	2	20	0.480
23	Khulna BPATC, Office	3	20	0.800
24	Khulna, Environmet research	1	15	1.420
"	"	2	15	2.520
"	"	2	20	0.730
"	"	3	20	0.490
25	Khulna BPATC, Building	2	15	1.800
"	"	3	10	0.240
26	Khulna, Mirerdanga	1	10	0.320
"	"	1	15	0.330
27	Khulna, Imam TTC	1	15	3.900
"	"	1	20	0.590
"	"	2	10	0.220
"	"	2	15	0.410
"	"	3	10	0.740
"	"	3	20	0.300
28	Khulna, Rupsa	1	15	0.600
"	"	2	15	0.550
"	"	3	10	0.670
"	"	3	20	0.480
29	Khulna Joragate	3	10	0.200
30	Khulna Hazimohsin rd	2	20	0.520
31	Khulna Sonadanga Thana	1	10	0.560

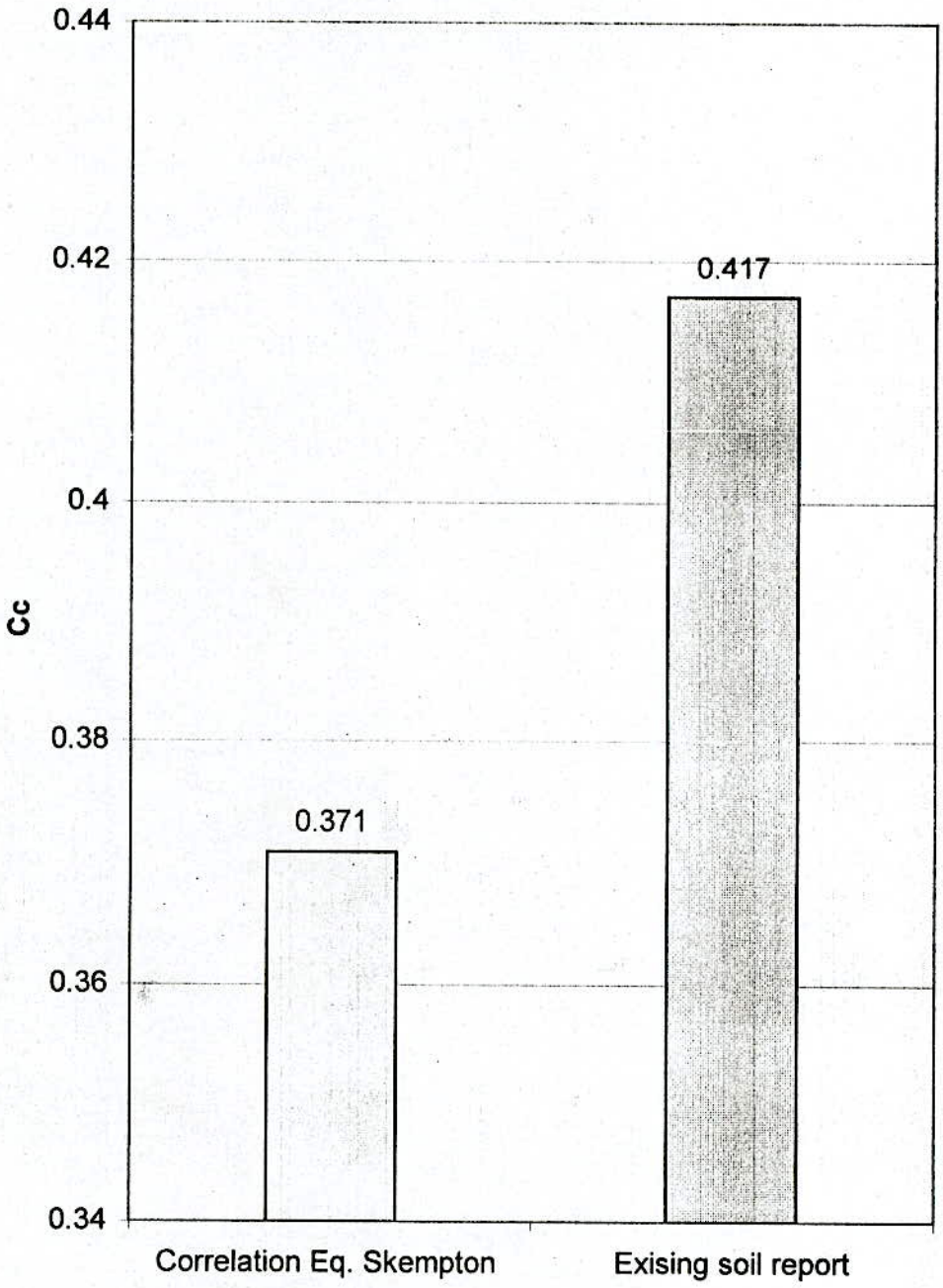


Figure 5.13 Average Cc from correlation equation and Existing soil report

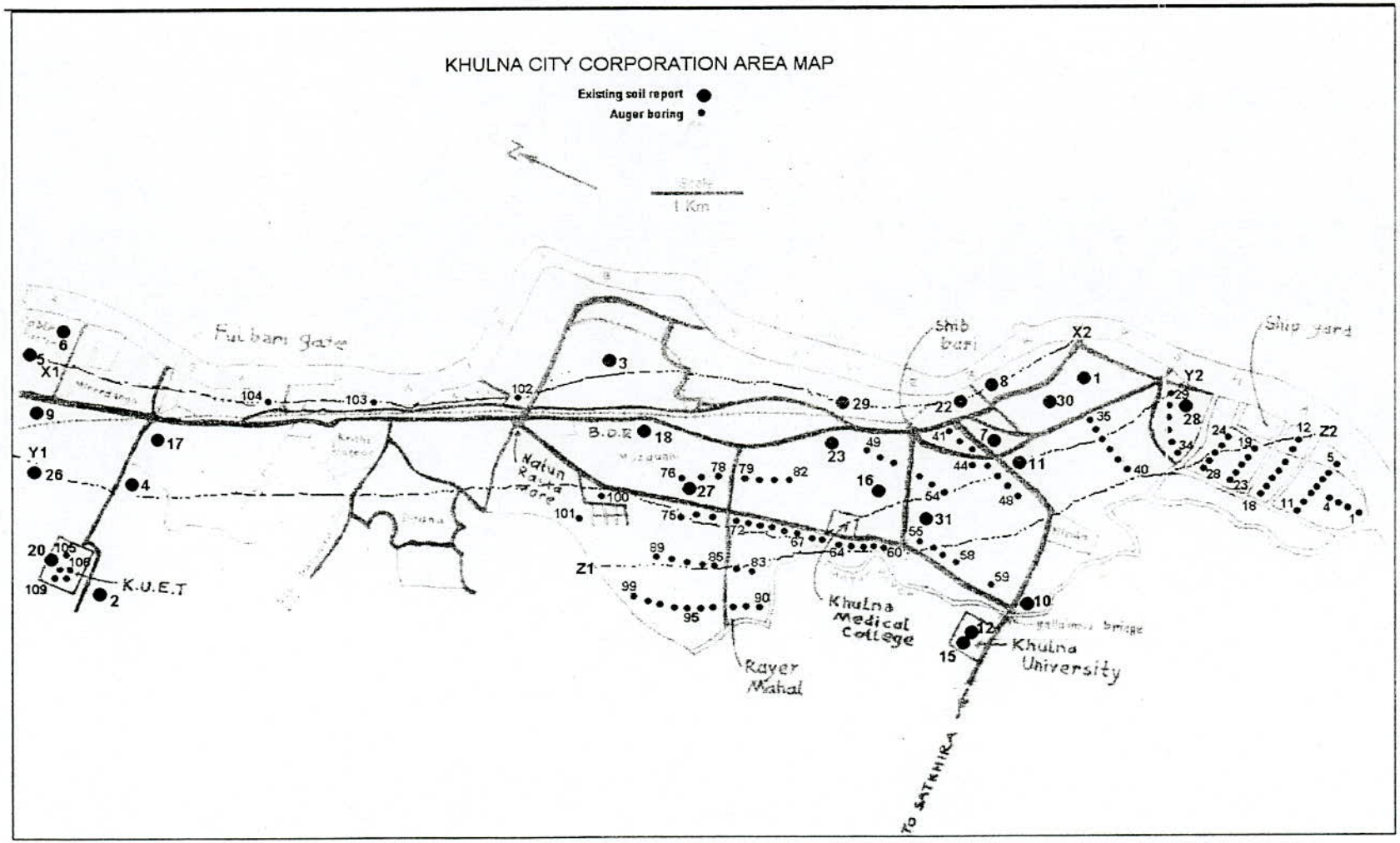


Figure 5.14 Location of Bore-hole (Auger boring and Existing report) at KCC area for Cc

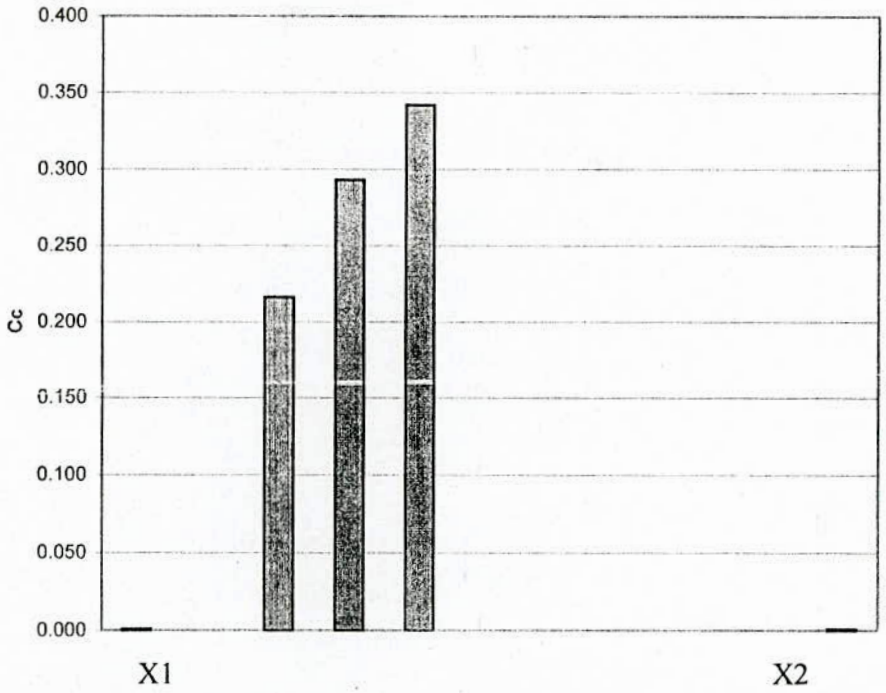


Figure 5.15 Profile of Cc at KCC area through section X1-X2 at depth 5 feet

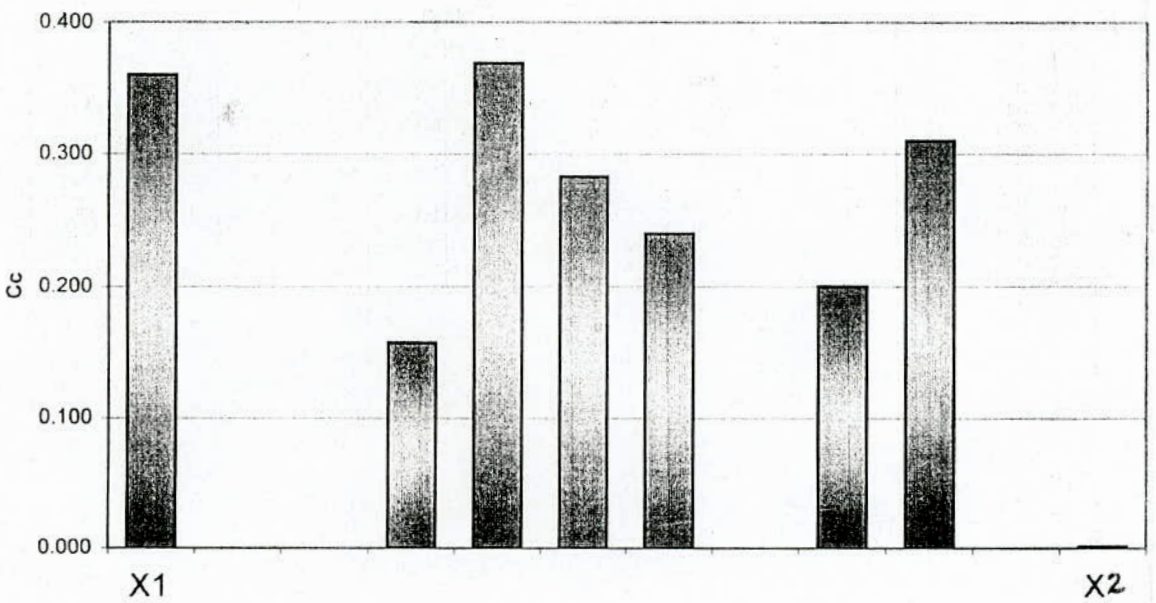


Figure 5.16 Profile of Cc at KCC area through section X1-X2 at depth 10 feet

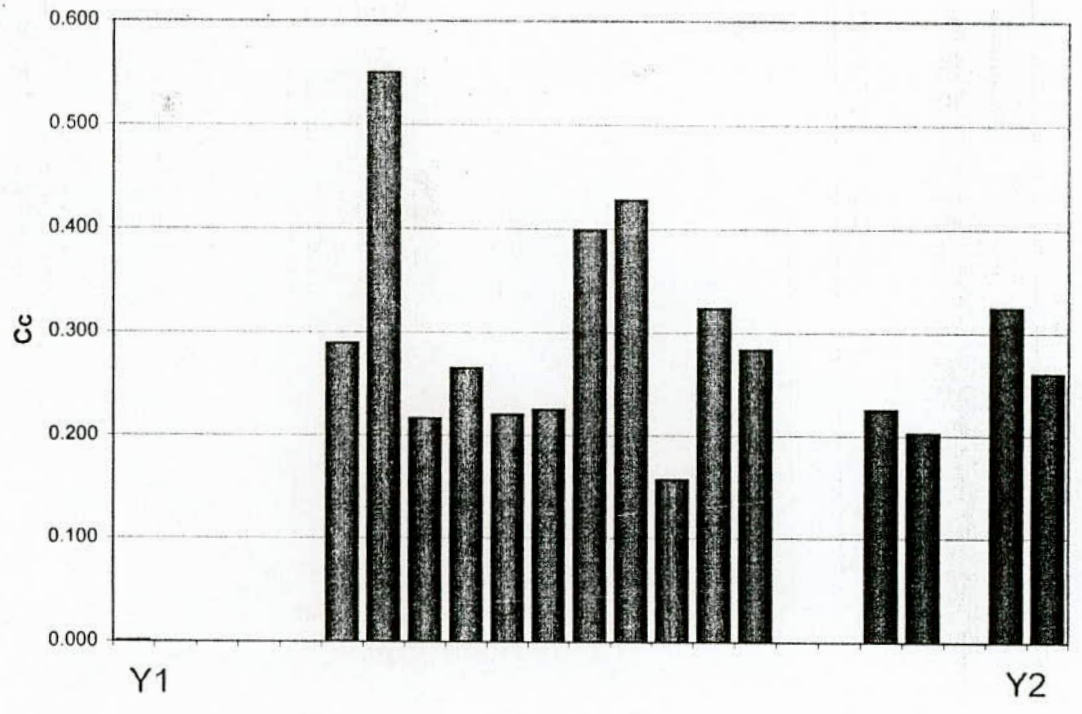


Figure 5.17 Profile of Cc at KCC area through section Y1-Y2 at depth 5 feet

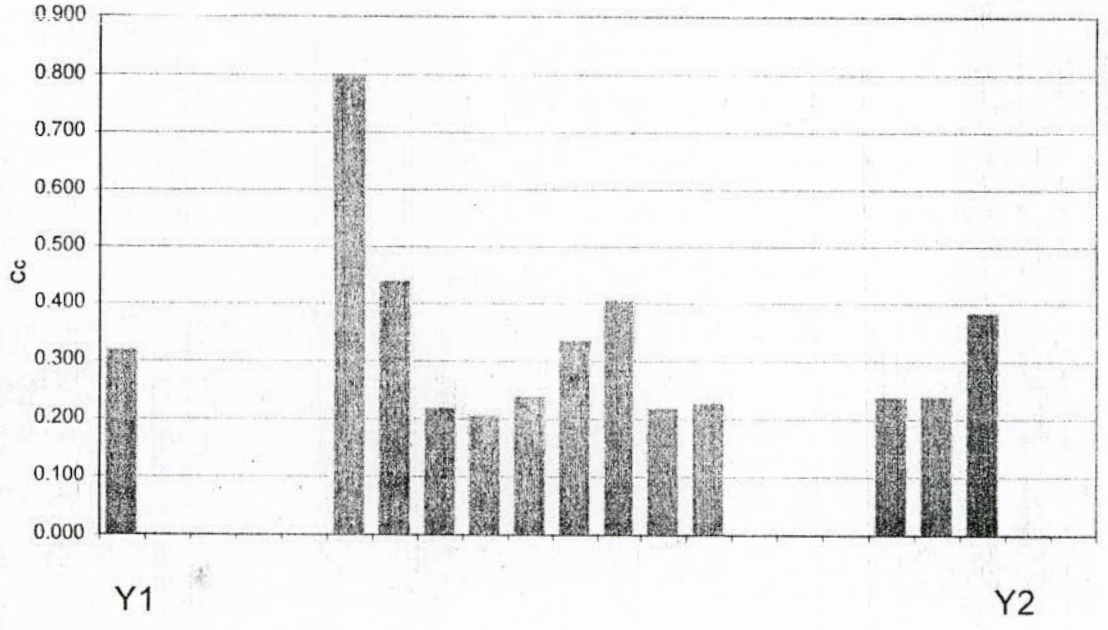


Figure 5.18 Profile of Cc at KCC area through section Y1-Y2 at depth 10 feet

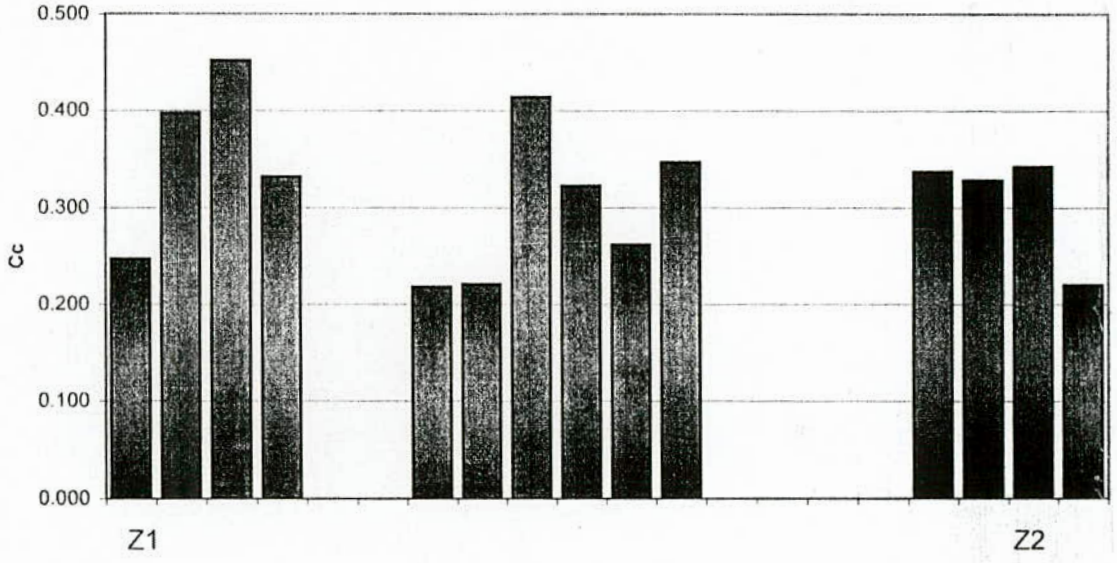


Figure 5.19 Profile of Cc at KCC area through section Z1-Z2 at depth 5 feet

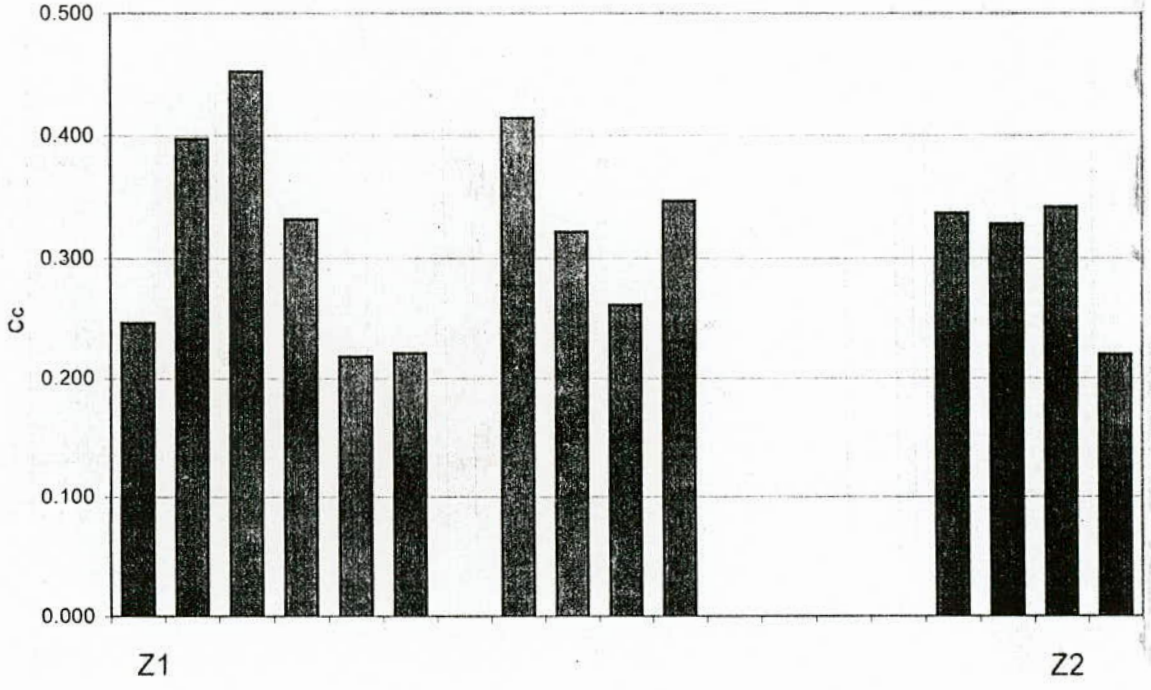


Figure 5.20 Profile of Cc at KCC area through section Z1-Z2 at depth 10 feet

Table 5.9 Existence of peat layer in different depth at KCC area

Serial no.	Bore hole no.	Location at KCC area	Existence of Peat layer (Organic matter),at depth		
			5' - 10'	10' - 20'	Above 20'
1	2	3	4	5	6
1	1	Road no. 19, Khalishpur			
2	2	110, Khanjahan Ali Road		●	
3	3	49, KDA Comm-cum-res building, Boyra			
4	4	21, Commertial plot, New Marker		●	●
5	5	Approach road, Chanmari bazar, Rupsa			
6	6	260, Sonadanga R/A, Phase-II		●	
7	7	10, Helatola Road, Khulna			
8	8	450, Nirala R/A, Khulna	●	●	
9	9	C.S. plot no. 1373, Tutpara			
10	10	South Central Road, khulna			
11	11	22, Farajipara, Khulna			
12	12	227, Sonadanga R/A, Phase-II			
13	14	Academic Building-II, Khulna University	●	●	●
14	17	Boy's Hall, Khulna University	●	●	
15	18	KDA Plot, Gallamary		●	
16	21	Sher-e-Bangla Road, Khulna			
17	22	Office Building, Hard board mills premises			
18	23	Khulna Collegiate School		●	●
19	24	50, Upper Jessore Road, Khulna			
20	25	Private Hospital, Fultala			
21	26	Officer's quarter, BNS Titumir, Khalishpur			
22	27	54, Jalil Sarani, Boyra		●	
23	28	2-A, KDA Avenue			
24	29	85, Shaikh para main Road		●	●
25	30	424, Sonadanga R/A, Phase-II	●	●	
26	31	Divisional Stadium, Boyra, Khulna			
27	32	Divisional Office Building, Janata Bank	●	●	●
28	34	KDA community center		●	●
29	35	Armed police Battalion Bhaban, Shiromony			
30	36	BOC, Rupsa, Khulna	●	●	
31	37	Police Traning center, Shiromony			
32	38	Ahsan Ahmed Road, Khulna		●	
33	39	Khulna Medical college Gymmasium	●	●	●
34	40	Chaina cement Factory Labonchora I/A	●	●	●
35	41	178, Sonadanga R/A, Phase-II			
36	42	Zonal Co-operative T. Institute, Boyra	●	●	●
37	43	389, Mujgunni R/A	●	●	●
38	44	10 storied building, Sir Iqbal Road		●	●
39	45	61, Housing Estate, Khalishpur			●
40	47	46, KDA Avenue		●	
41	48	Rest house & officer's quarter, Mujgunni	●	●	●
42	49	Staff colony, Hard Board Mills			
43	50	Rupsa, Chanmari, Khulna	●		
44	51	Shiromony, Khulna			
45	52	Fire Station, Daulatpur			●
46	53	Shishu Sadan, Mohessor pasa		●	●
47	54	OC Residence, Sonadanga Thana	●	●	

Table 5.9 (Continued)

1	2	3	4	5	6
48	55	Residence Area Hard Board Mills, Khalishpur			
49	56	Shipyard			
50	57	Molla Para Primary School		●	
51	58	Medical College Hospital, Khulna		●	●
52	59	Sonadanga R/A, Phase-I			
53	60	Divisional Museum, Khulna		●	●
54	61	VC Resident Building, Khulna University	●	●	
55	65	414, Sonadanga R/A, Phase-II	●	●	
56	66	635, Mujgunni R/A, Phase-II			
57	67	Plot no. 254, Road no. 19, Mujgunni R/A	●	●	
58	68	655, Tutpara, Khulna			
59	69	22, Mujgunni Main Road, Boyra		●	●
60	70	Gilatola, Attra			
61	71	BNS Titumir, Khalishpur			
62	72	52, Mujgunni Main Road			
63	73	West Tutpara cross Road, Tutpara			
64	76	1491, Jugipole, P.S. Khanjahan Ali			
65	77	18A, KDA Commertial Plot, New Market			
66	78	53, KDA Avenue, Khulna			
67	79	410, Sonadanga R/A, Phase-II			
68	80	Sir Iqbal Road, Helatola		●	
69	81	26, Sir Iqbal Road, Khulna		●	●
70	82	Shaikh para Mosque Road		●	●
71	83	404, Sonadanga R/A, Phase-II	●	●	
72	84	2/A, KDA Avenue			
73	85	429, Sonadanga R/A, Phase-II		●	●
74	86	Sailor's quarter, BNS Titumir, Khalishpur	●		
75	87	MES Banglow, BNS Titumit, Khalishpur			
76	88	Helatola Road, Khulna		●	
77	89	RPATC Boyra		●	●
78	90	Adminstrative Building, Khulna University	●	●	
79	92	Sahirley Islam Library, Khulna University	●	●	
80	93	TT College gate, Teleganti		●	●
81	94	81, Khalishpur Housing Estate,			
82	95	3, Sher-e-Bangla Road, Khulna	●	●	
83	96	129 Ka, Majid Sarani, Sonadanga		●	
84	97	31, BK Ray Road, Moylapota		●	
85	98	972, Tutpara, Khulna		●	
86	99	1026, Tutpara, Khulna		●	
87	100	4820, West Baniakhamar, Khulna		●	
88	102	1425, Sonadanga East lane, Baniakhamar		●	
89	104	477, Nirala R/A, Khulna	●		
90	105	3310, Shaikh para, Khulna		●	
91	106	3600, Shantidham moor, Khulna		●	
92	107	5041, Tutpara, Khulna		●	
93	108	7614, BK Main Road, Khulna			
94	109	4073, Polytechnic college Road, Goalpara		●	
95	110	20708, Baniakhamar, Khulna		●	
96	111	317, Helatola, Khulna		●	
97	112	5754, Prantik R/A, Baniakhamar, Khulna	●		

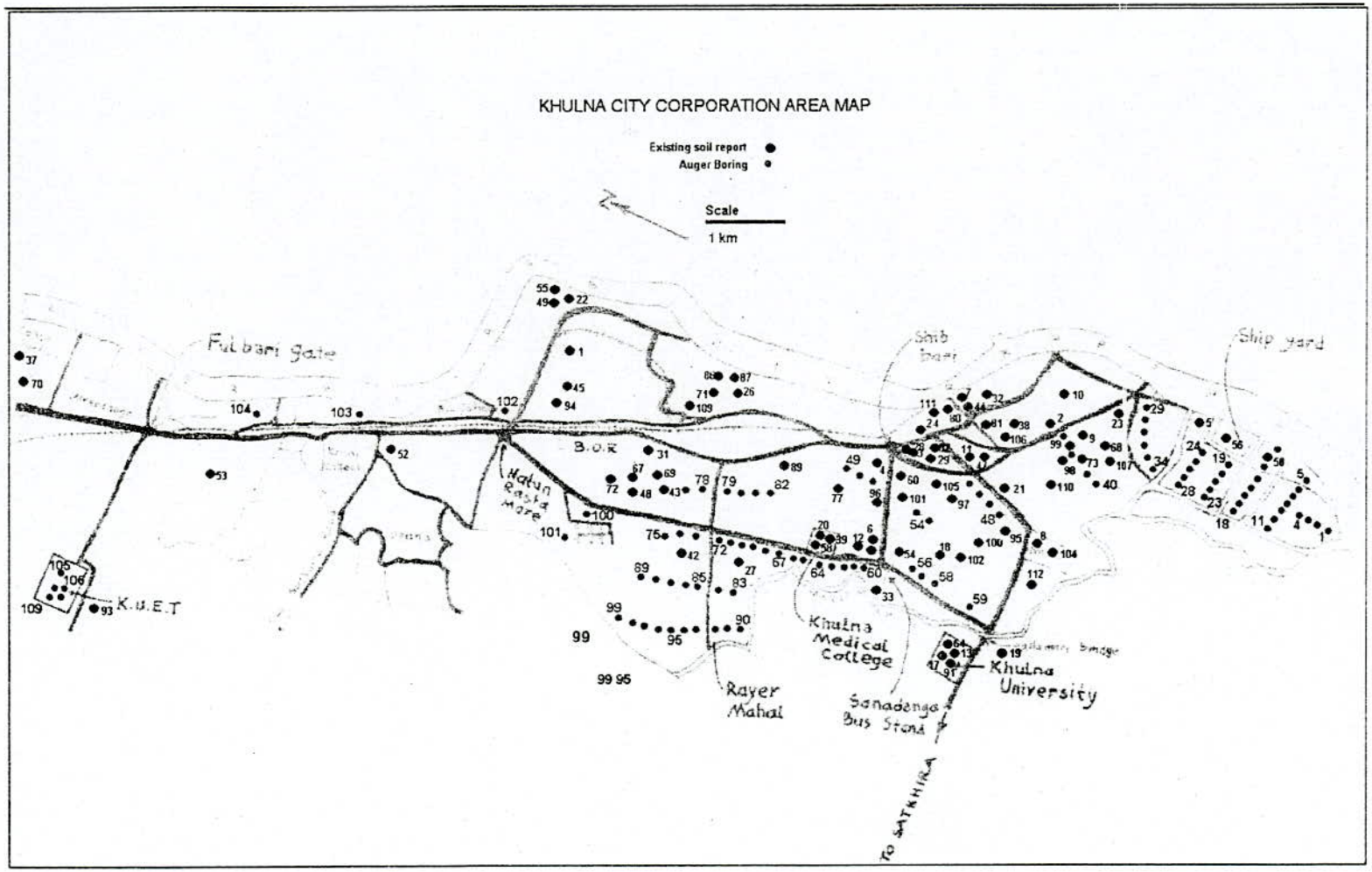


Figure 5.21 Location of Bore-hole (Auger boring and Existing report) at KCC area for Peat Layer

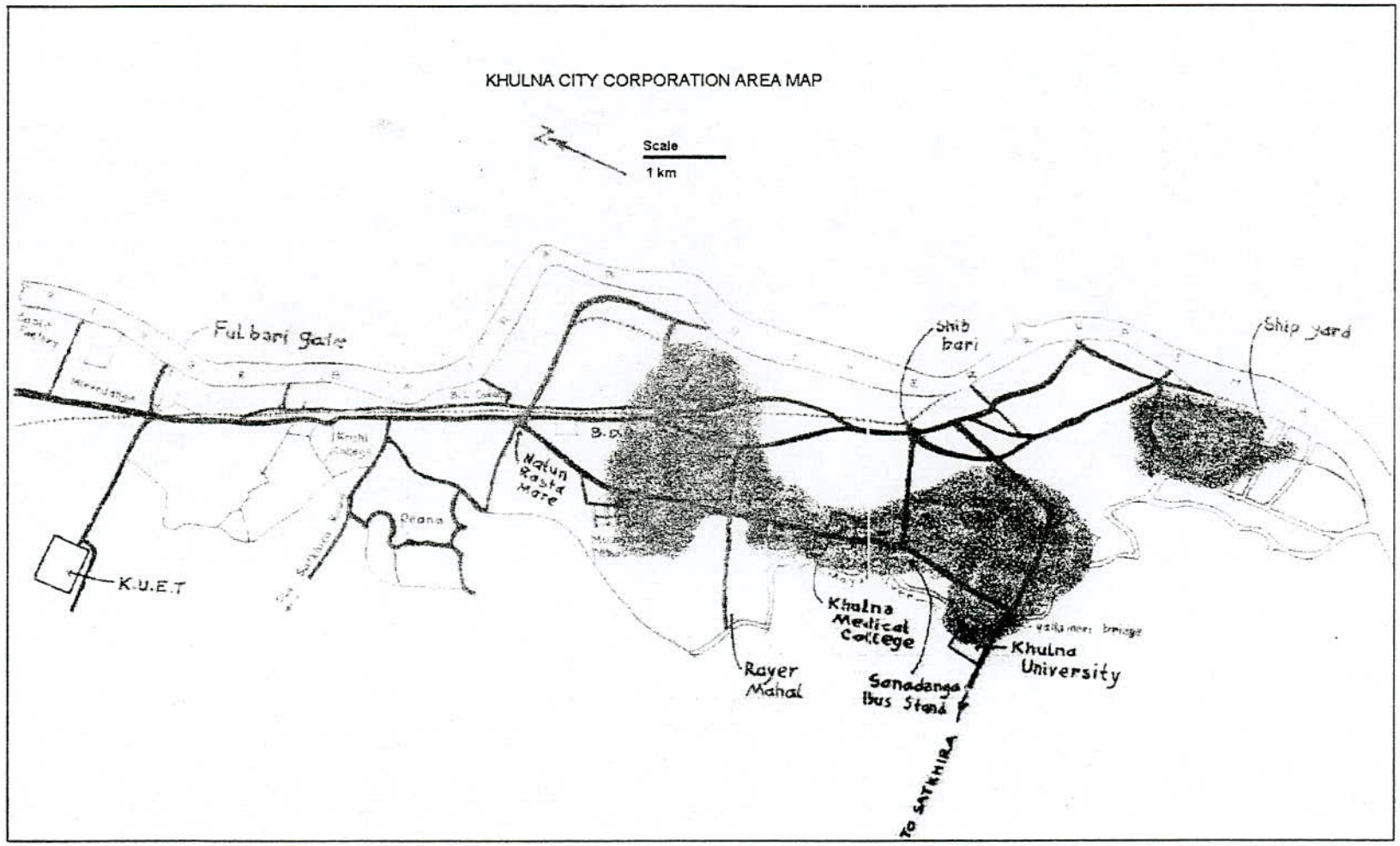


Figure 5.22 Existence of Peat layer in KCC at 5' to10' depth

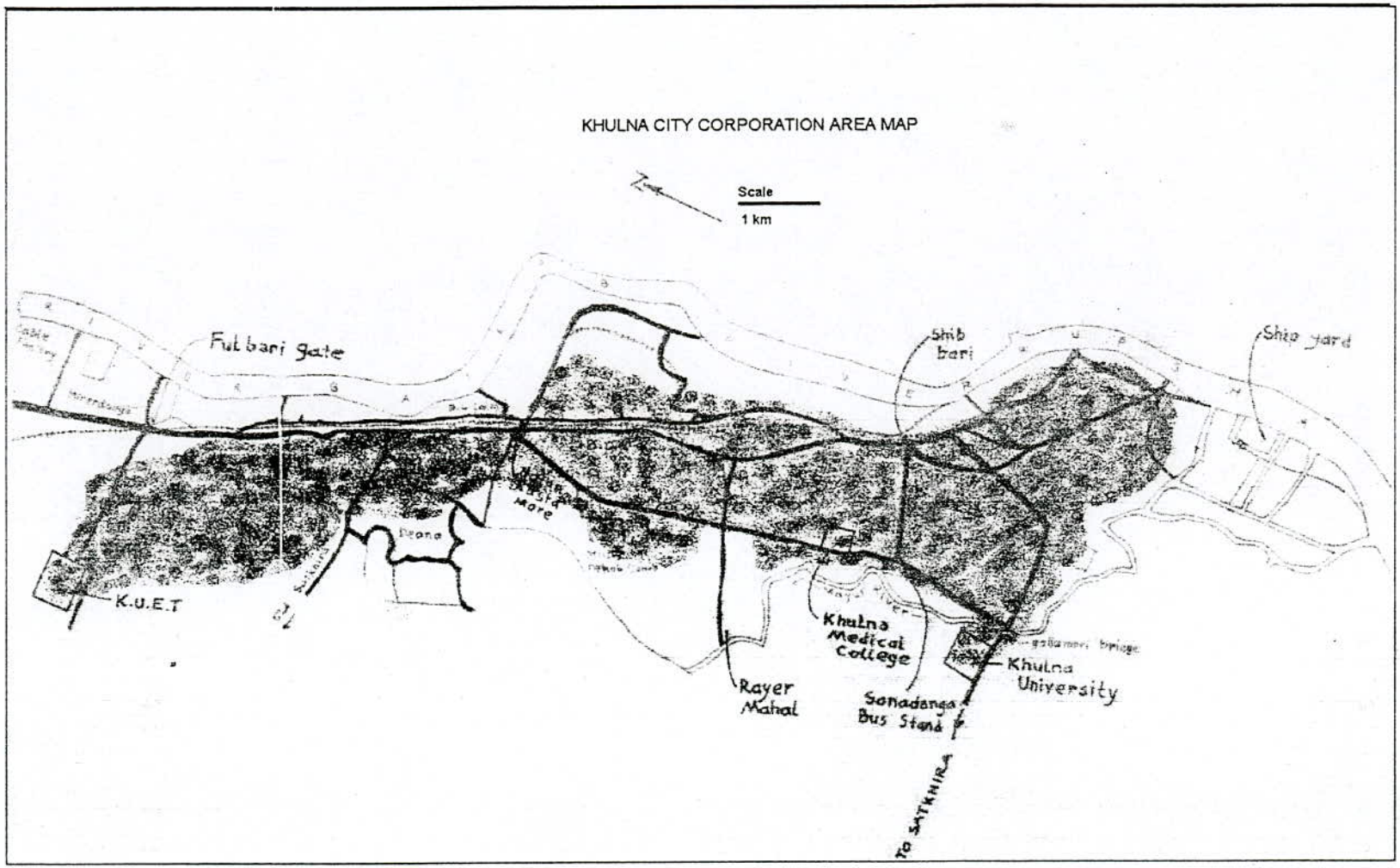


Figure 5.23 Existence of Peat layer in KCC at 10' to20' depth

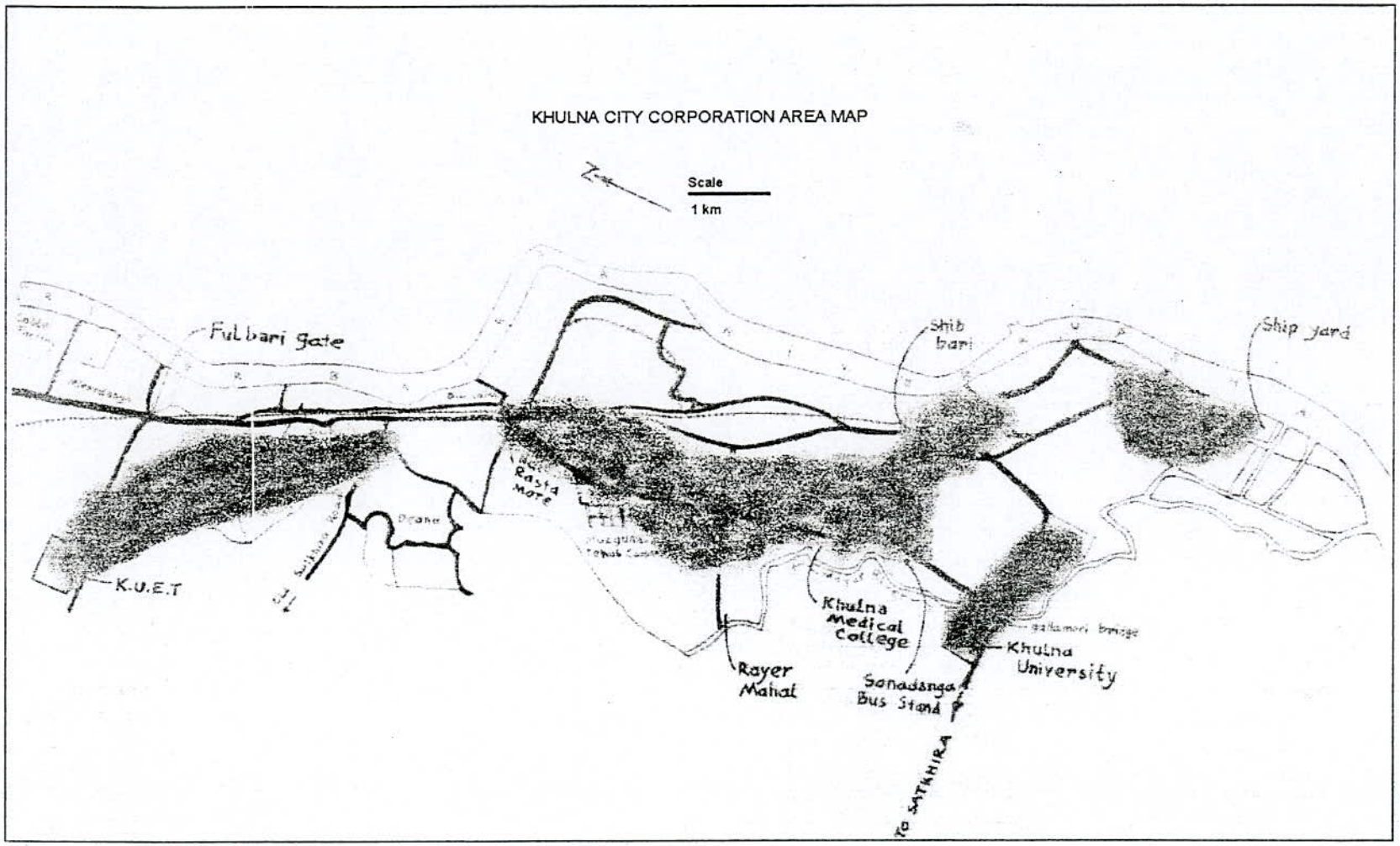


Figure 5.24 Existence of Peat layer in KCC above 20' depth

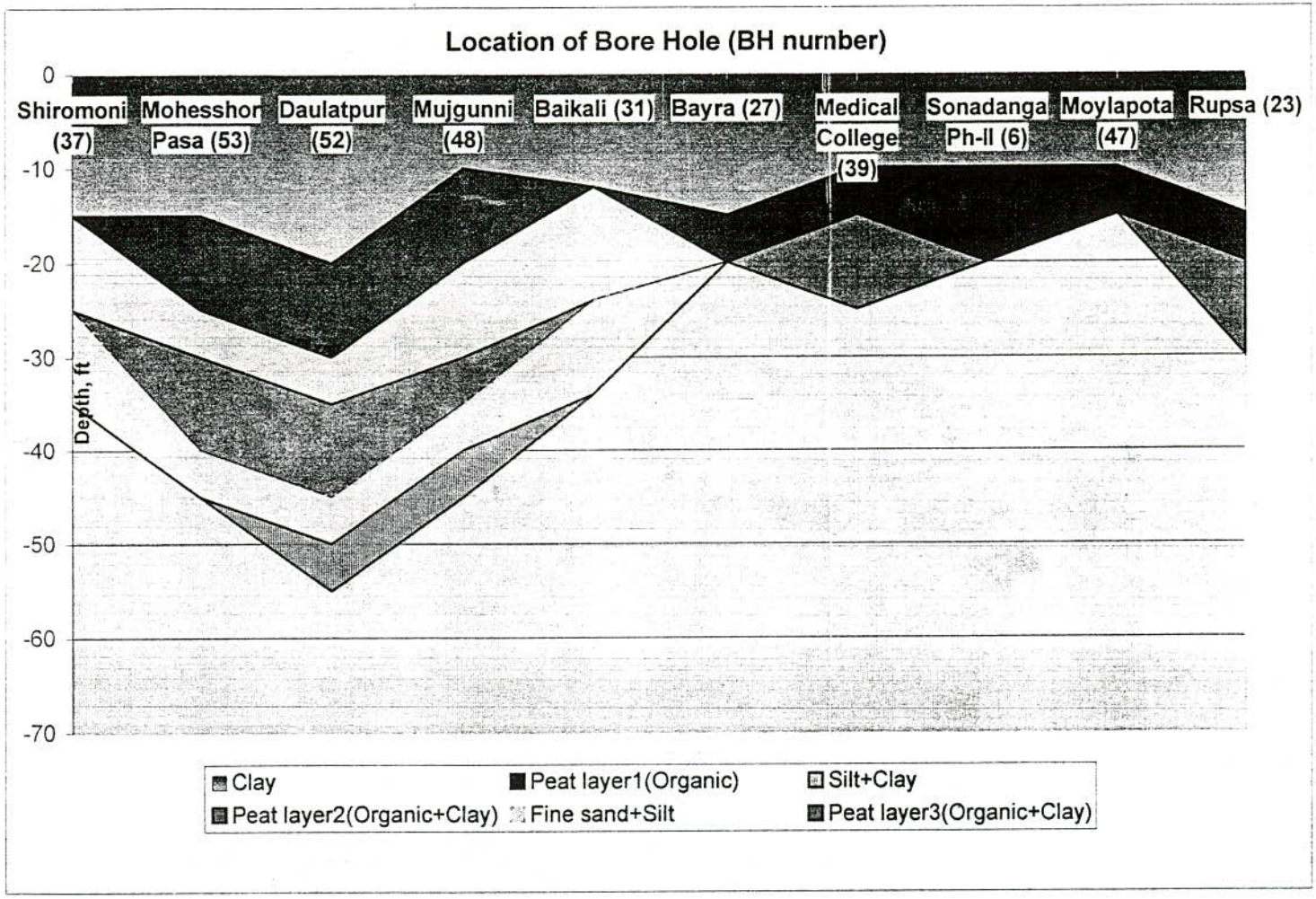


Figure 5.25 Peat layer, profile-I

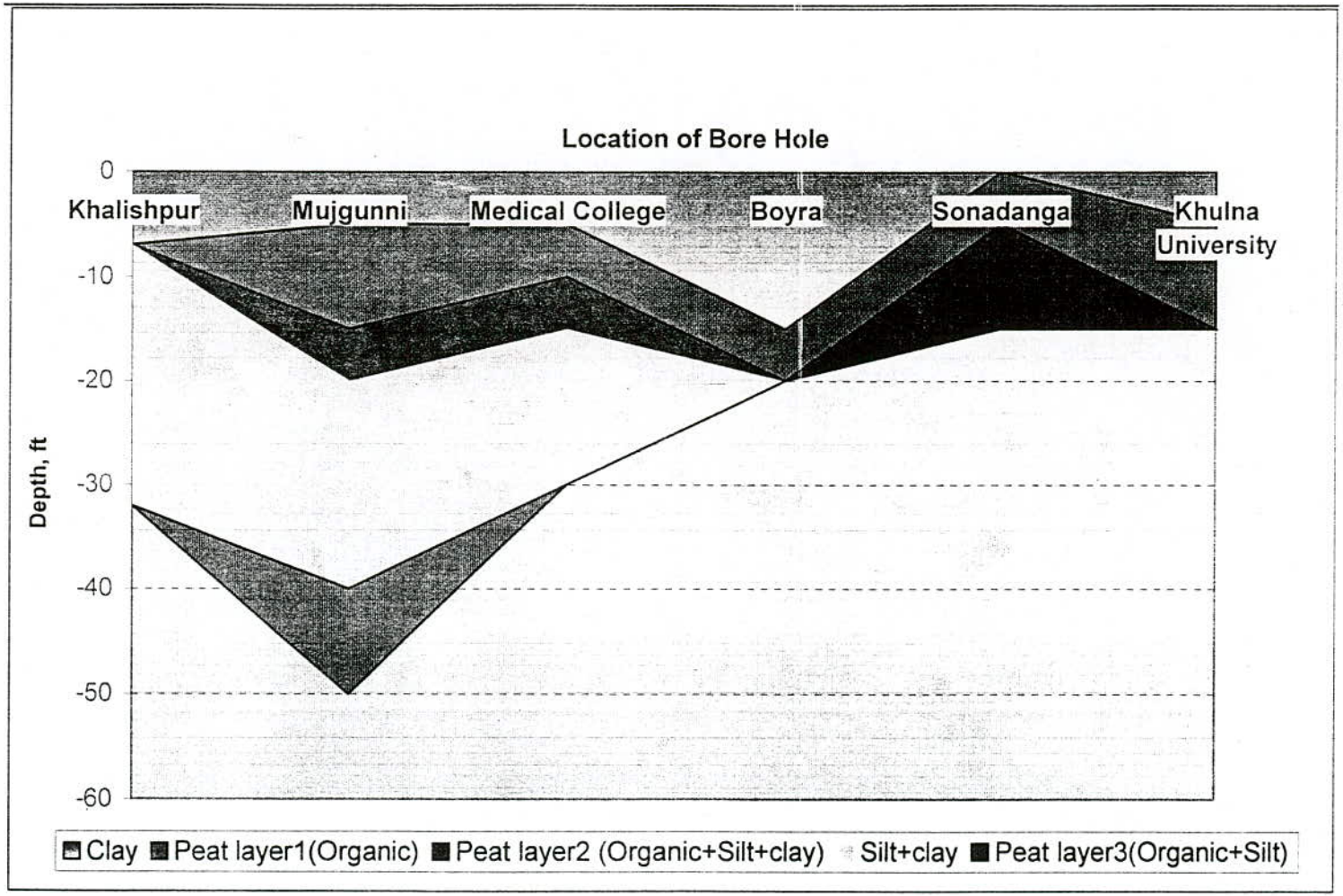


Figure 5.26 Peat layer, profile-II

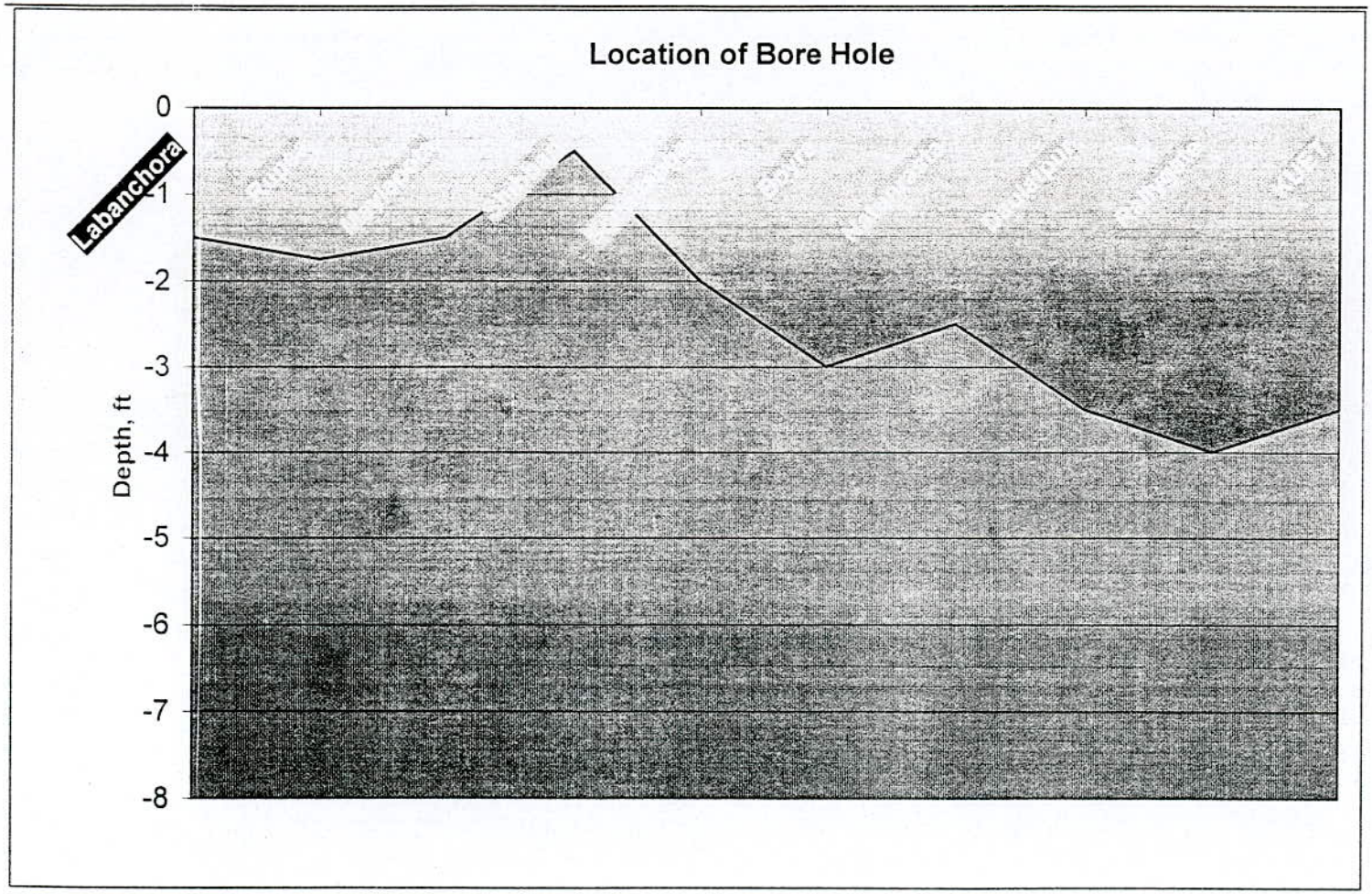


Figure 5.27 Profile of instant observation water table

CHAPTER SIX

CONCLUSIONS AND RECOMMENDATIONS

6.1 Sub-soil categories

The sub-soil exploration has been performed within Khulna City Corporation area by using total number of 109 exploratory shallow boring upto the depth of 20 feet below the existing ground level. The investigation reveals that from 0 to 10 feet from existing ground surface, the sub-soil mainly consists of cohesive soil (clay or clay with trace silt) with soft to medium consistency with occasional occurrence of peat layer and below this layer, the sub-soil predominantly consists of very fine sand and/or silty clay. In about 56% of bore holes, soil consists of decompose of organic clay layer mainly peat deposit encountered within 5 to 20 feet depth from the existing ground surface.

Depending on the bore logs (shallow and deep) KCC subsurface can be classified in to the following different categories:

A) Depending on shallow depth auger boring:

1. EGL to 5 feet having clay or silty clay underlain by peat.
2. EGL to 5 feet having clay or silty clay not underlain by peat.
3. EGL to 10 feet consisting of clay with silt and/or fine sand underlain by peat.
4. EGL to 10 feet consisting of clay with silt and/or fine sand not underlain by peat.

(B) Depending on deep boring:

1. Sub soil having presence of reasonable thickness of stiff clay or compacted sand/ sandwiched by soft layers for deeper depth.
2. Suitable layer available for the resting of deep foundation.

6.2 Proposal for foundation

The following different types of foundations can be proposed based on four different categories as mentioned above for auger boring:

A1. EGL to 5 feet having clay or silty clay underlain by peat:

In this sub-soil condition, normal residential building even up to 2-3 storied should not have foundation (load bearing wall / column-beam) laid above the peat layer. Soil up to bottom of peat layer to be removed within trench and extra void to be filled with sand and compacted up to the required compaction before the foundation is being laid. q_u and Cc obtained from correlations equations from the test results of sample collected by auger boring may used safely.

A2. EGL to 5 feet having clay or silty clay not underlain by peat:

When peat is not encounted within 20 feet (can be detected by auger boring) q_u and Cc obtained from correlation equations can be used to design the foundation that can be laid within normal depth of 3 to 5 feet for building of 2-3 storied having average room size.

A3. EGL to 10 feet consisting of clay with silt and/or fine sand underlain by peat:

Removal of peat from trench below 10 feet will cause practical inconvenience for Khulna due to ground water table and/or soft soil. Under such condition for commercial building floating foundation / micro piles may be used if dependable layer is available below the peat layer within close proximity. Soil improvement can also be a logical approach provided time and means are available within budget limit. The values of q_u and Cc can be taken from correlation equations.

A4. EGL to 10 feet consisting of clay with silt and/or fine sand not underlain by peat:

For such subsoil condition if bearing capacity and settlement calculation allows shallow foundation eg. column footing, wall footing and mat: correlation values may be used from samples of auger boring.

It is noted that for all 4 cases:

Parameters obtained from undisturbed soil sample collected through deep boring will be needed for the design of heavily loaded foundation.

The following different types of foundations can be proposed for the selection based on the two different categories as encountered by deep investigation:

For both situations:

B1. Sub soil having presence of reasonable thickness of stiff clay or compacted sand/ sandwiched by soft layers for deeper depth and

B2. Suitable layer available for the resting of deep foundation:-

Irrespective of the presence of peat foundation by using bored piles is a common example if suitable strata is available. In absence of such dependable layer friction piles can be a good alternatives. However for this purpose results from deep boring is necessary.

6.3 Recommendation for future investigation

Based on the present study the following recommendations for future research can be made.

1. Extension of this study for auger boring for the whole of KCC area with respect to well defined location.
2. Soil parameters for more nos. of samples can be evaluated to get a rational correlation.
3. Selection of boreholes should be checked with latitude and longitude from the KCC map where the borehole is shown. This information may be needed for some cases.
4. Details investigation about the engineering properties of peat soil are important.

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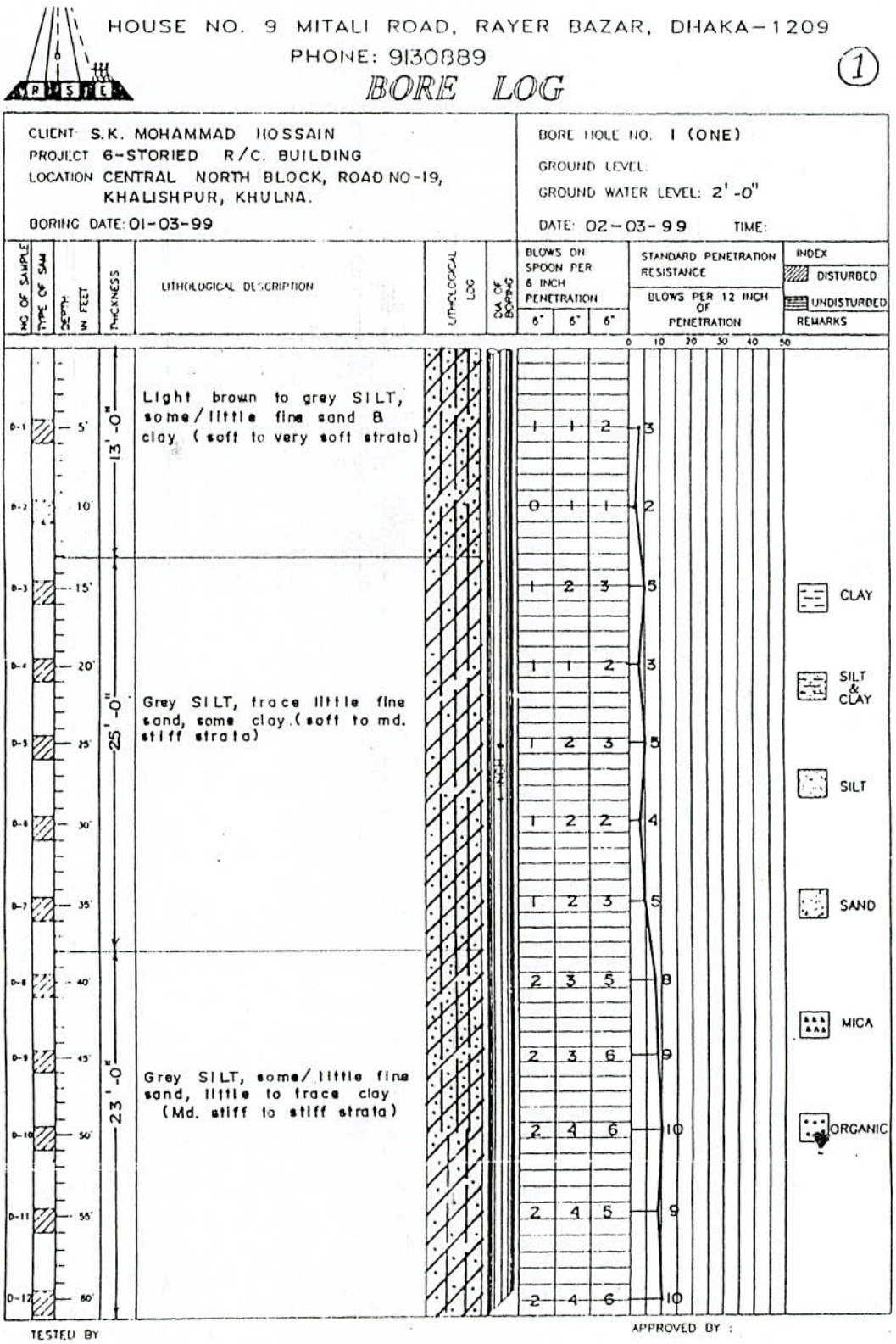
ANNEXURE

Existing Soil Reports



HOUSE NO. 9 MITALI ROAD, RAYER BAZAR, DHAKA–1209
PHONE: 9130889

(2)

BORE LOG

CLIENT: DR. M.A. QUADER
PROJECT: 6- STORIED COMMERCIAL BUILDING
LOCATION: 110, KHANJHAN ALI ROAD, KHULNA.

BORING DATE: 20-08-2000

BORE HOLE NO: 1 (ONE)
GROUND LEVEL:
GROUND WATER LEVEL: 1'-6"
DATE: 21-08-2000 TIME:

NO OF SAMPLE	TYPE OF SAM	DEPTH IN FEET	THICKNESS	LITHOLOGICAL DESCRIPTION	BLOWS ON SPOON PER 6 INCH PENETRATION 6"	6"	6"	BLOWS PER 12 INCH OF PENETRATION
D-1		5'	12'-0"	Light brown fine SAND, some silt (loose strata)	2	2	2	4
D-2		10'			2	2	3	5
D-3		15'	10'-0"	Grey / dark grey SILT, with organic soil (med. strata)	1	2	2	4
D-4		20'			1	2	4	6
D-5		25'	11'-0"	Grey SILT, trace fine sand, some clay (soft strata)	2	2	2	4
D-6		30'			1	1	1	2
D-7		35'	5'-0"	Grey sandy SILT, trace clay (loose strata)	1	3	3	6
D-8		40'	23'-0"	Grey fine SAND, some silt trace mica	1	4	6	10
D-9		45'			3	4	5	9
D-10		50'			3	3	6	9
D-11		55'			5	6	8	14
D-12		60'			6	8	11	19

LITHOLOGICAL LOG — DIA OF BORING 4 INCH

STANDARD PENETRATION RESISTANCE
BLOWS PER 12 INCH OF PENETRATION
0 10 20 30 40 50

INDEX
DISTURBED
UNDISTURBED
REMARKS

CLAY
SILT & CLAY
SILT
SAND
MICA
ORGANIC

TESTED BY :

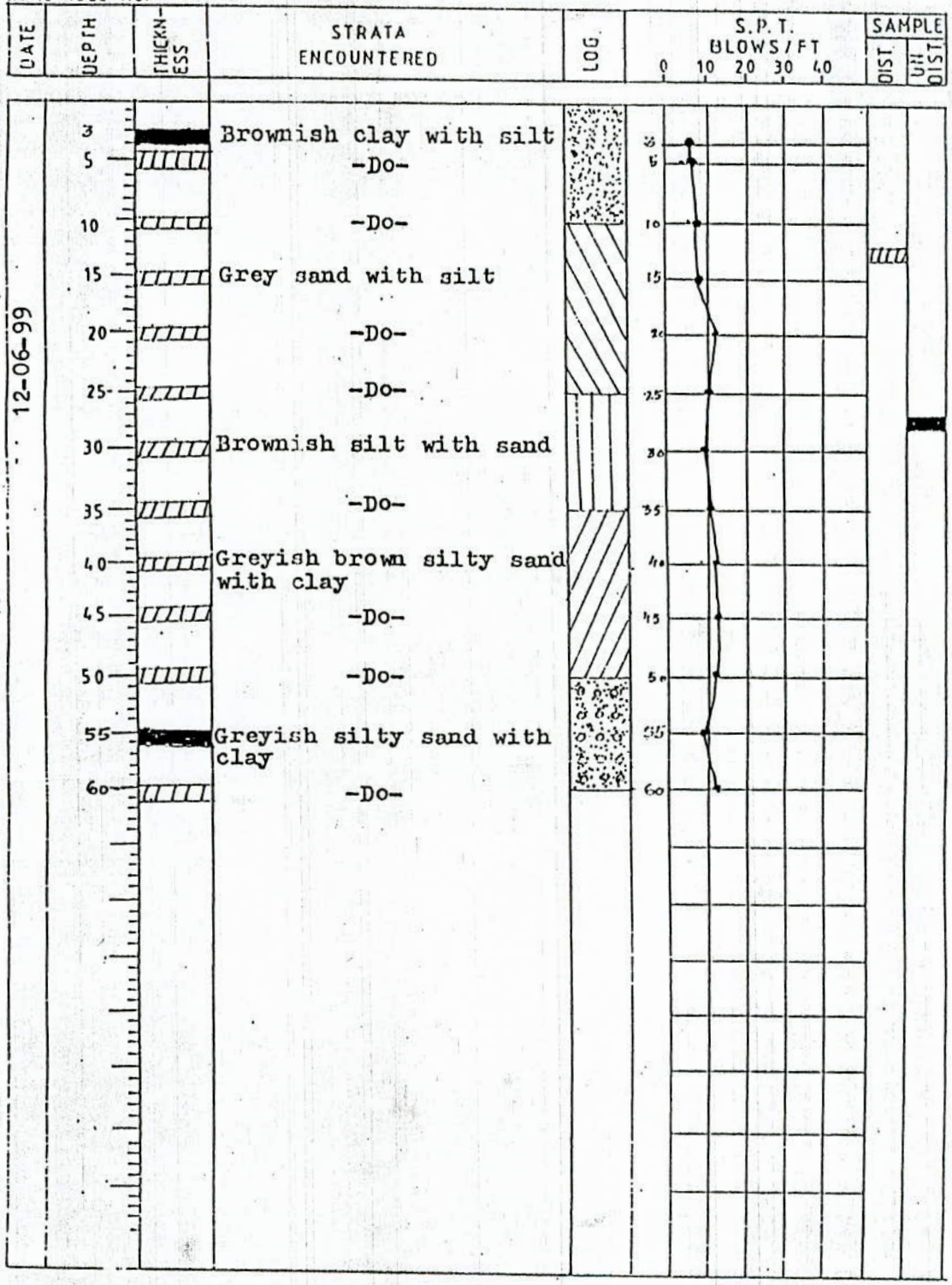
APPROVED BY :

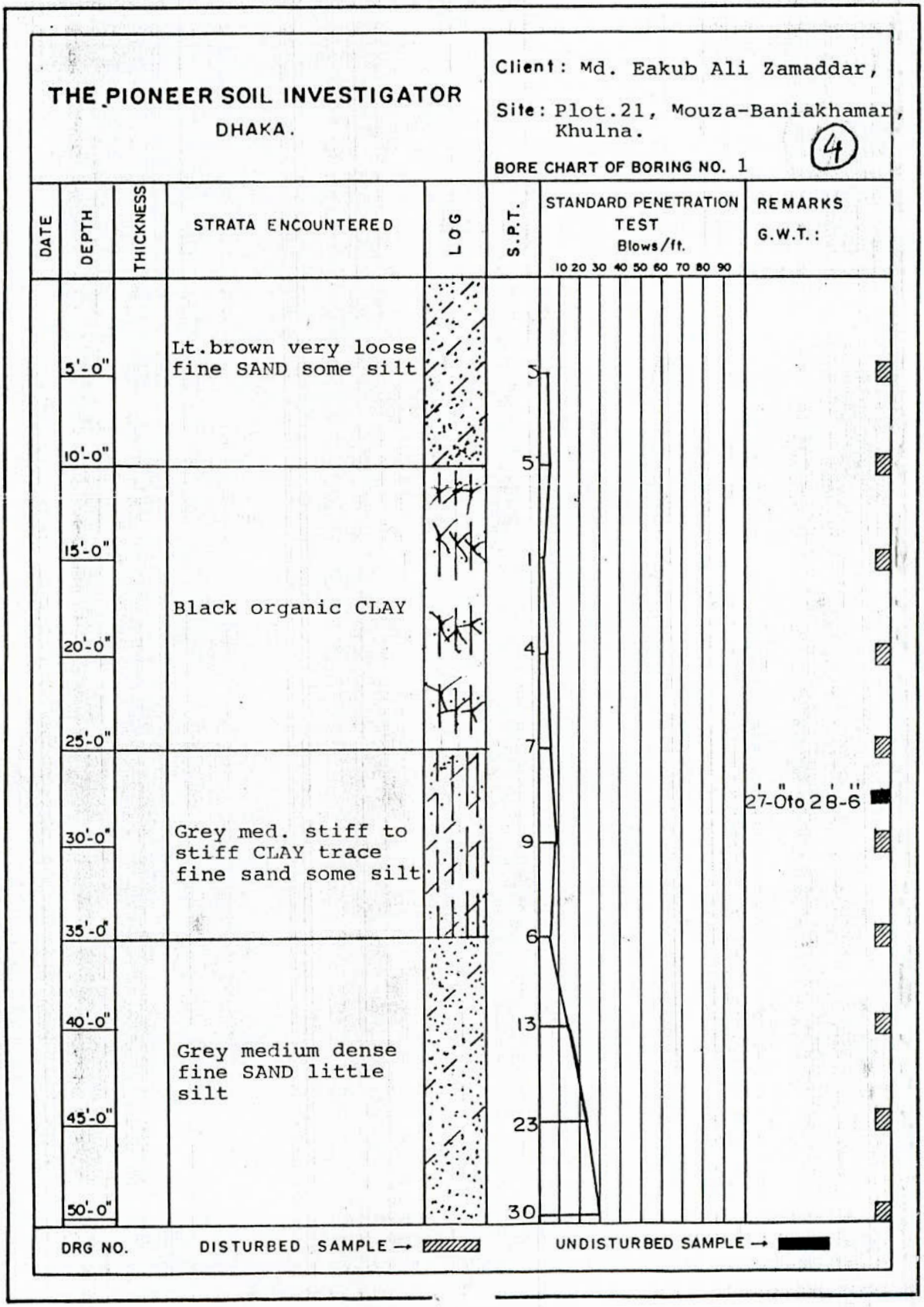
SOIL MECHANICS INTERNATIONAL LTD.

(3)

CLIENT – Md. Asmat Ali Bhuiyan
PROJECT – Commercial-cum-residential Building
LOCATION – Plot No-49, KDA, Khulna. (Boyra)

BORE HOLE NO. 1




THE PIONEER SOIL INVESTIGATOR
DHAKA.
Client: Md. Eakub Ali Zamaddar,
Site: Plot.21, Mouza-Baniakhamar, Khulna.
BORE CHART OF BORING NO. 1
(4)
DATE
DEPTH
THICKNESS
STRATA ENCOUNTERED
LOG
S.P.T.
STANDARD PENETRATION TEST
Blows/ft.
10 20 30 40 50 60 70 80 90
REMARKS
G.W.T.:
5'-0"
10'-0"
Lt.brown very loose fine SAND some silt
3
15'-0"
20'-0"
25'-0"
Black organic CLAY
5
1
4
30'-0"
35'-0"
Grey med. stiff to stiff CLAY trace fine sand some silt
7
9
6
27'-0" to 28'-6"
40'-0"
45'-0"
50'-0"
Grey medium dense fine SAND little silt
13
23
30
DRG NO.
DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:- MD. ANWARUL ISLAM.

SITE:- APPROACH ROAD, KHULNA.
CHANMARI BAZAR, LABAN CHORA

(5)

BORE CHART OF BORING NO. 1

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey CLAY trace fine sand some silt.		1		
	10'-0"				1		7'-to 8'- 6"
	15'-0"				1		
	20'-0"				1		
	25'-0"				1		
	30'-0"				1		
	35'-0"				2		
	40'-0"				4		
	45'-0"				5		
	50'-0"		Grey fine SAND some silt.		10		

DRG NO.

DISTURBED SAMPLE ⟶
UNDISTURBED SAMPLE ⟶

THE PIONEER SOIL INVESTIGATOR

DHAKA.

CLIENT:— MR. KAZI MONSUR ALAM.

SITE :— PLOT NO- 260, ROAD NO-6 SONADANGA, R/A, (2ND PHASE) KHULANA.

BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey SILT trace fine sand & some clay.		1		5'-10 6'-6"
	10'-0"				1		
	15'-0"		Black organic trace fine SAND & some silt.		1		
	20'-0"				1		
	25'-0"		Grey SILT trace fine sand & little clay.		2		
	30'-0"				3		
	35'-0"				5		
	40'-0"				5		
	45'-0"		Grey fine SAND & some silt.		13		
	50'-0"				13		
	55'-0"				18		
	60'-0"				18		
	65'-0"				20		
	70'-0"				22		
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →

UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR

DHAKA.

CLIENT:- Mrs. Selina Akter

SITE:- Plot.10, Helatola Road, Khulna.

(7)

BORE CHART OF BORING NO. 1

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"				2		
	10'-0"		Brownish CLAY trace fine sand little silt.		1		7' to 8'-6"
	15'-0"				1		
	20'-0"				1		
	25'-0"				2		
	30'-0"		Grey SILT trace fine sand little clay.		4		
	35'-0"				7		
	40'-0"				12		
	45'-0"				15		
	50'-0"				20		

DRG NO.

DISTURBED SAMPLE →

UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— MR. MUJIBUR RAHMAN.

SITE:— PLOT_450, NIRALA R/A, KHULNA.

BORE CHART OF BORING NO: 1 (8)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"		Grey CLAY trace fine sand little silt.		1		
	10'-0"		Black Organic CLAY.		1		7'-6" to 8'-6"
	15'-0"				1		
	20'-0"				1		
	25'-0"				1		
	30'-0"				1		
	35'-0"				1		
	40'-0"		Grey CLAY trace fine sand little silt.		1		
	45'-0"				8		
	50'-0"				7		
	55'-0"		Grey Silty SAND.		7		
	60'-0"				9		
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:– S.M. ABDUL BAKI
SITE:– C.S. Plot, 1373 Toot Para, Khulna

(9)

BORE CHART OF BORING NO: 1

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:–
	5'-0"		Grey very soft CLAY trace fine sand some silt.		1		
	10'-0"				1		7'-0" to 8'-6"
	15'-0"				2		
	20'-0"		Grey very loose silty-SAND		2		
	25'-0"				2		
	30'-0"		Grey loose to med. dense fine SAND little silt.		5		
	35'-0"				7		
	40'-0"				10		
	45'-0"				14		
	50'-0"				16		
	55'-0"		Grey medium dense silty-SAND with mica.		18		
	60'-0"				19		
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— Hafez..Abu Musa

SITE:— South Central Road, Khulna

BORE CHART OF BORING NO: 1 (10)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"				3		
	10'-0"				1		7'-to 8'-6"
	15'-0"		Grey CLAY trace fine sand little silt.		2		
	20'-0"				1		
	25'-0"				1		
	30'-0"				2		
	35'-0"				2		
	40'-0"				14		
	45'-0"		Grey fine SAND little silt.		15		
	50'-0"				18		
	55'-0"				22		
	60'-0"				26		
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— MD. YOUSUF ALI SEPAI

SITE:— 22 no, Forajipara Rd. Khulna.

BORE CHART OF BORING NO: 1 (11)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"		Grey CLAY trace fine sand little silt.		1		7/10 S: 6"
	10'-0"				2		
	15'-0"				1		
	20'-0"				3		
	25'-0"				2		
	30'-0"				2		
	35'-0"				2		
	40'-0"		Grey SILT little fine sand little clay.		20		
	45'-0"				21		
	50'-0"				25		
	55'-0"				29		
	60'-0"						
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

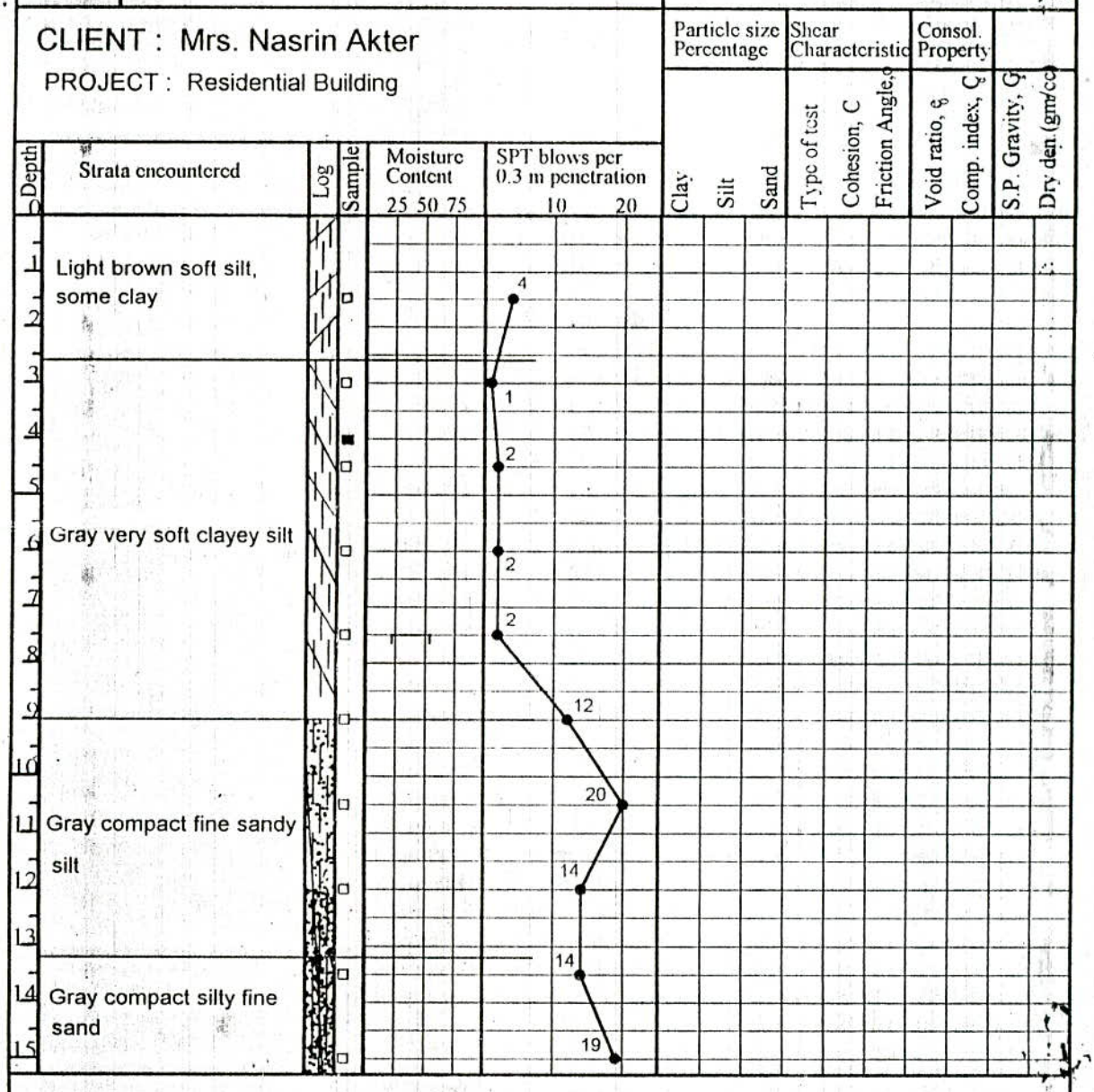
ORG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

UNIQUE BORING AND ENGINEERING LTD.
34, GREEN ROAD, NOWAB MANSION
3rd Floor, Dhaka

BORE HOLE NO: BH-1 (12)
LOCATION : Plot No. 277
Road No. 1, Sonadanga, Khulna

CLIENT : Mrs. Nasrin Akter
PROJECT : Residential Building



□ Disturbed sample (Split spoon)
■ Undisturbed sample (Shelby tube)
GWT : 0.91m below EGL

○ Moisture content
—●— SPT values
PL LL

THE NATIONAL SOIL ENGINEERS
DHAKA

BORE LOG

CLIENT:- CHIEF ENGINEER, KHULNA UNIVERSITY

LOCATION:- UNIVERSITY KHULNA.
ACADEMIC BUILDING - 2

(14)

BORE HOLE NO:- 2 DEPTH:-100 DIAM = 4"

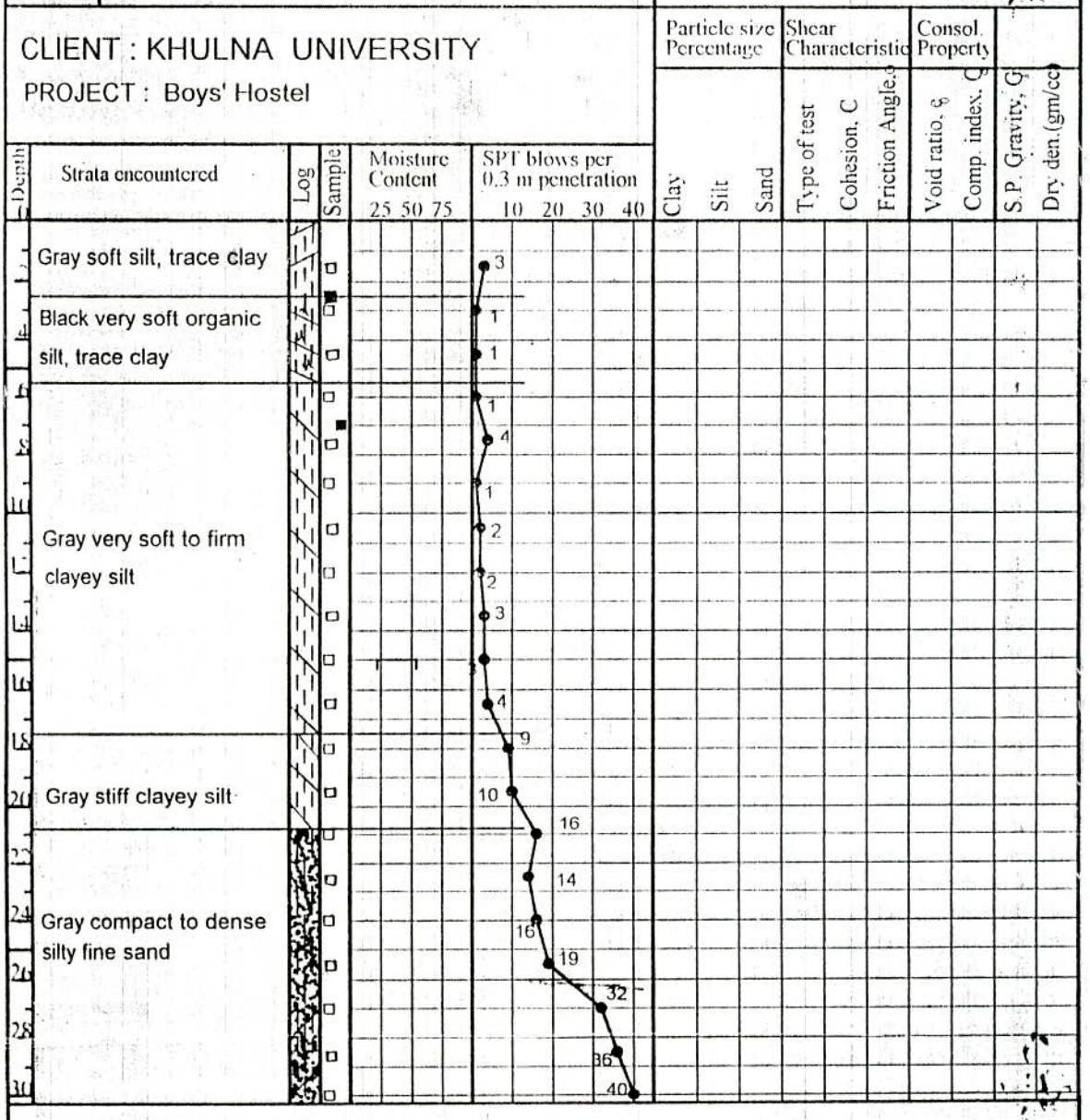
R.L.	DEPTH IN FEET	THICKNESS	CLASSIFICATION OF SOIL	LOG	STANDARD PENETRATION TEST/BLOWS (10 20 30 40 50)	REMARKS SAMPLES	DEPTH FEET	G.W.T.	DA
	5'-0"	5'-0"	Light brown & grey medium plastic CLAY. (soft.)		3	D-1=1'-6" to 3'-0"			
						U-1=3'-6" to 5'-0"			
	7'	2'	Dark grey organic CLAY, trace decomposed wood.(very soft)		1	D-2=5'-0" to 6'-6"			
						U-2=7'-0" to 8'-6"			
			Dark grey decomposed wood trace CLAY. (very soft)		1	D-3=8'-6" to 10'-0"			
					1	D-4=10'-6" to 12'-0"			
	15'	8'			1	D-5=12'-6" to 14'-0"			
					1	D-6=14'-6" to 16'-0"			
			Grey medium plastic CLAY, trace decomposed wood (very soft)		1	D-7=16'-6" to 18'-0"		17'-0"	
	21'	6'			1	D-8=18'-6" to 20'-0"			
						D-9=21'-6" to 22'-6"			
	23'	2'	Blueish grey medium plastic CLAY. (soft)		4	D-10=23'-6" to 25'-0"			
					3				
			Grey medium plastic CLAY. (soft)		3	D-11=28'-6" to 30'-0"			
					4	D-12=33'-6" to 35'-0"			
	37'	14'							
					5	D-13=38'-6" to 40'-0"			
			Grey medium plastic CLAY, trace decomposed wood. (medium stiff)		5	D-14=43'-6" to 45'-0"			
					5	D-15=48'-6" to 50'-0"			

Disturbed Sample ▨ Undisturbed Sample ■

UNIQUE BORING AND ENGINEERING LTD.
34, GREEN ROAD, NOWAB MANSION
3rd Floor, Dhaka

BORE HOLE NO: BH-4 (17)
LOCATION : Khulna University, Khulna

CLIENT : KHULNA UNIVERSITY
PROJECT : Boys' Hostel



□ Disturbed sample (Split spoon)
■ Undisturbed sample (Shelby tube)
GWT : 0.91m below EGL

○ Moisture content
—●— SPT values

PL LL

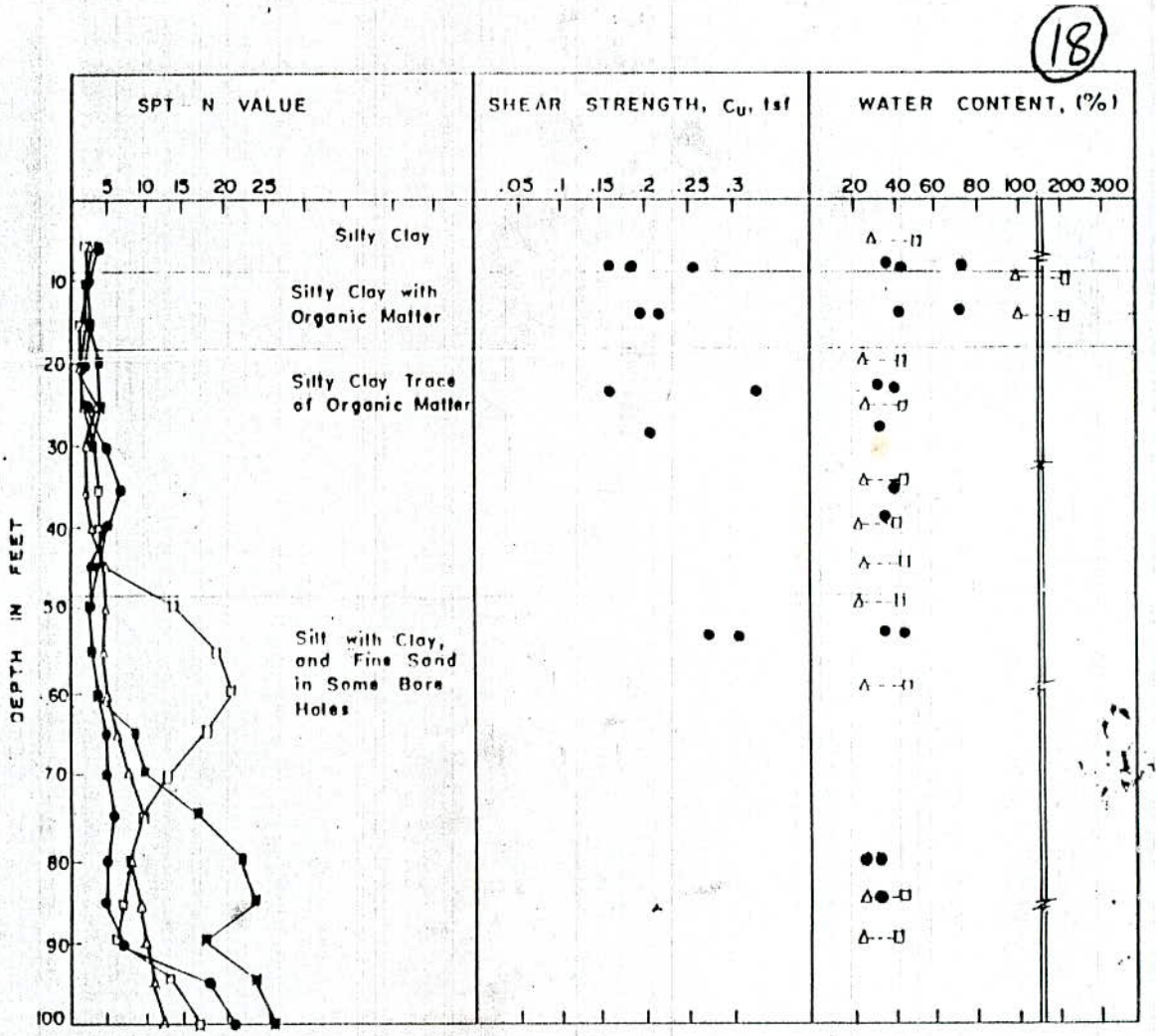


Figure 13. Subsoil conditions at Gallamari, Khulna. (Source: KDA, Khulna : Report on Subsoil Investigations at Gallamari by Explora Foundation, January, 1981).

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— KAZI FAZLUL HAQUE (21)

SITE :— Sher-e-Bangla road, Khulna.

BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey SILT trace fine sand & some clay.		4		5'-1o 6'-6"
	10'-0"				6		
	15'-0"				3		15'-1o 16'-6"
	20'-0"				4		
	25'-0"				4		
	30'-0"				3		
	35'-0"				5		
	40'-0"		Grey SILT little fine sand & little clay.		7		
	45'-0"				16		
	50'-0"				19		
	55'-0"				18		
	60'-0"		Grey fine SAND & little silt.		21		
	65'-0"				23		
	70'-0"				28		
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

EASTERN BORING & CONSTRUCTION CO. LTD.

ENGINEERS, DESIGNERS & BUILDERS

D H A K A

(22)

CLIENT: KHULNA HARD BOARD MILLS LTD. TIME OF EXECUTION: 22-01-90

PROJECT: 2-STORIED OFFICE BUILDING METHOD OF DRILLING: WASH BORING

LOCATION: KHULNA HARD BOARD MILLS PREMISES DIAM. OF BOREHOLE: 5"

BORE CHART FOR BOREHOLE NO. 1 G.W.T. 9'-6" BELOW GL ON 23-01-90

DEPTH	STRATA ENCOUNTERED	LOG	R L	S.P.T. RESULTS: BLOWS/FT PENETRATION (140 LBS HAMMER, 30" FREE FALL)	AT	SOIL SAMPLING AND G W L
	EXISTING GROUND SURFACE					
5'-6"	Brownish grey SILT with traces very fine sand & clay			6	4'	
				5	6.5'	
12'-6"	Brownish grey Silty very fine SAND			4	9'	
16'-0"	Lt. grey fine SAND with traces silt			4	14'	
				14	19'	
26'-0"	Lt. grey fine SAND with little silt			7	24'	
				13	29'	
				15	34'	
	Lt. grey fine to medium SAND with traces silt			23	39'	
				26	44'	
50'-0"				29	49'	

SPLIT-SPOON SAMPLES. .....

SHELBY TUBE SAMPLES. .....

SCALE 1"=10'-0"

SHEET NO. EBCL/90.122

DATE: 08-02-90 DRN BY A. R. K.

517: SUB-SOIL INVESTIGATION BORE LOG.

OJECT :- CONSTRUCTION OF KHULNA COLLAGIATE SCHOOL
BY THE SIDE OF KHANJAHAN ALI ROAD.

(23)

.INT :- KHULNA CITY CORPORATION

RING NO :- 1 W.I. - 1-6"

DEPTH R.L.	DEPTH F.L.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	SPT CURVE 5 15 25	SAMPLE D.S.	SAMPLE U.S.	REMARKS
	0′		BRown Filling earth stiff clay				●		
	5′		Yellowish brown Clayey very fine sand		3		●	▨	
	10′		Dark gray Clayey very fine sand		2		●	▨	
	15′		Black Decomposed organic matter with		7		●	▨	
	20′		Very dark gray Decomposed orginic matter with silty clay		2		●	▨	
	25′		Dark gray Stiff silty clay trace organic matter		5		●	▨	
	30′		Dark gray Stiff silty clay		5		●	▨	
	35′		Dark gray Silty clay		5		●	▨	
	40′		Gray Claye very fine sand		5		●	▨	
	45′		Light gray Clayey very fine fine sand		17		●	▨	
	50′		Fine sand		14		●		
	55′		Fine sand		15		●		
	60′		Light gray Fine to medium sand		24		●		
	65′								
	70′								

THE PIONEER : SOIL INVESTIGATOR
DHAKA.

CLIENT :— MD. ANISUR RAHMAN (24)

SITE :— 50 No, Upper Jessore road, Khulna.9100.

BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / 11. 10 20 30 40 50 60 70 80 90	REMARKS
	5'-0"		Grey SILT some fine sand and trace clay.		2		GWT :-
	10'-0"				6		10'- to 11'- 6"
	15'-0"				5		
	20'-0"		Grey SILT trace fine sand & some organic.		1		
	25'-0"				3		
	30'-0"				7		
	35'-0"		Bluish SILT some fine sand & trace clay.		6		
	40'-0"				7		
	45'-0"				9		
	50'-0"		Grey fine SAND & some silt.		11		
	55'-0"				12		
	60'-0"				16		
	65'-0"				30		
	70'-0"				34		
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE
UNDISTURBED SAMPLE

PROJECT:- Private Hospital, Fultala.

CLIENT:- Dr. A.T.M.M. Murshed

LOCATION:- Fultala

BORING NO:- 1

W.T -7'-3"

(25)
CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE (5 15 25)	SAMPLE DS	SAMPLE US	REMARKS
		0		Grayish brown Clay		5		●		
		5		Brown Silty clay		6		●	▨	
		10		Gray Very fine sand		7		●	▨	
		15		Gray Clayey silt		4		●	▨	
		20		Gray Very fine sand		4		●	▨	
		25		Light gray Fine to medium sand		10		●	▨	
		30		Light gray Fine to medium sand		18		●		
		35		Light gray Fine to medium sand		12		●		
		40		Gray Fine sand		19		●		
		45		Light gray Medium sand		18		●		
		50		Light gray Medium sand		24		●		
		55								

APPROVAL ENGINEER :

MD. REZAUL KARIM
Assistant Professor
Dept. of Civil Engineering
BIT, Khulna, Khulna-9203

PROJECT:- C-TYPE OFFICERS QTR. AT B.N.S, TITUMIR.

CLIENT:- EXECUTIVE ENGR. G.E.(NAVY), KHULNA.

LOCATION:- B.N.S. TITUMIR.

BORING NO:-

W.T - AT G.L.

26

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Grayish Brown. Very Soft Clay With Silt Traces.						
		5		GL		2				
		10		Gray Loose Silty Sand		0				Not Possible To Collect Sample.
		15		Dark Gray Loose Silty Sand		9				
		20		Gray Loose Silty Sand		6				
		25		Light Gray Medium Silty Sand		8				
		30				12				
		35		Gray Medium Silty Sand		12				
		40				12				
		45				13				
		50				18				

APPROVAL OF ENGINEER:-

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— Dr. Harun-Ur-Rashid

SITE:— Plot.54, Bayra Jalil Sarani Khulna.

BORE CHART OF BORING NO: 1 (27.)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"		Grey very soft CLAY trace fine sand little silt.		1		
	10'-0"		Grey very loose fine SAND some silt		1		
	15'-0"				2		
	20'-0"		Black organic CLAY		3		
	25'-0"		Grey medium stiff to stiff CLAY trace fine sand little silt.		4		
	30'-0"				5		
	35'-0"				5		
	40'-0"				5		
	45'-0"				5		
	50'-0"				5		
	55'-0"				7		
	60'-0"				9		
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE
UNDISTURBED SAMPLE

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:- MRS. FATEMA KHATUN

SITE:- PLOT NO. 2-A, K.D.A AVENUE KHULNA.

BORE CHART OF BORING NO. 1 (ONE) (28)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"				1		5' to 6'-6"
	10'-0"		Gray CLAY trace Fine sand & some silt		2		
	15'-0"				2		
	20'-0"				3		
	25'-0"				4		
	30'-0"				7		
	35'-0"				3		
	40'-0"				3		
	45'-0"		Gray fine SAND Same silt		14		
	50'-0"				18		

DRG NO.

DISTURBED SAMPLE ⟶
UNDISTURBED SAMPLE ⟶

OBJECT :- Construction of Residential Building

CLIENT :- Mr. Gazi Golam Mostofa

LOCATION :- 35, Shaikh Para Main Road, Khulna

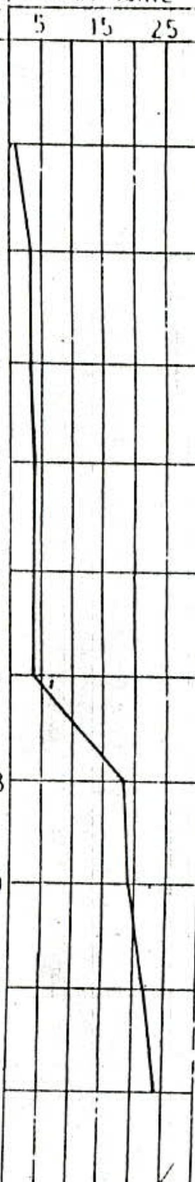
BORING NO :- 1

W.T. 1'-10"

(29)
CRIS
DEPT OF CIVIL ENGG.
B.I.T. KHULNA

Depth (FT)	Strata description	S.P.T. value	Sample DS	Sample US	Remarks
0	Black Filling earth, vegetation, brickchips		●		▽ (W.T.)
5	Dark olive gray Soft clay	1	●		
10	Gray Silty clay	3	●	▨	
15	Black Decomposed organic matter, trace soft clay	3	●	▨	
20		4	●	▨	
25	Dark gray Silty clay	4	●	▨	
30		4	●	▨	
35	Light gray Fine sand	18	●	▨	
40		19	●		
45		22	●		
50	Light gray Very fine sand	24	●		
55					

STANDARD PENETRATION TEST CURVE



APPROVAL ENGINEER 8.5.97

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:- Mrs. Shamima Begum.

SITE :- Plot no-424, Sonadanga, R
(2nd tarm) Khulna.

BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey SILT, trace fine & Some Clay.		1		5' to 6'-6"
	10'-0"		grey SILT, trace fine Sand & Some Organic.		1		
	15'-0"				1		
	20'-0"		Grey SILT, trace fine Sand & Little Clay.		1		
	25'-0"				2		
	30'-0"				3		
	35'-0"				2		
	40'-0"				7		
	45'-0"		Grey fine SAND, & Little Silt.		10		
	50'-0"				14		
	55'-0"				17		
	60'-0"		Gfey fine SAND, & Little Silt.		22		
	65'-0"				23		
	70'-0"				27		
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

FIG: 5.19: SUB-SOIL INVESTIGATION BORE LOG:
PROJECT:- CONSTRUCTION OF DIVISIONAL STADIUM AT BOYRA.

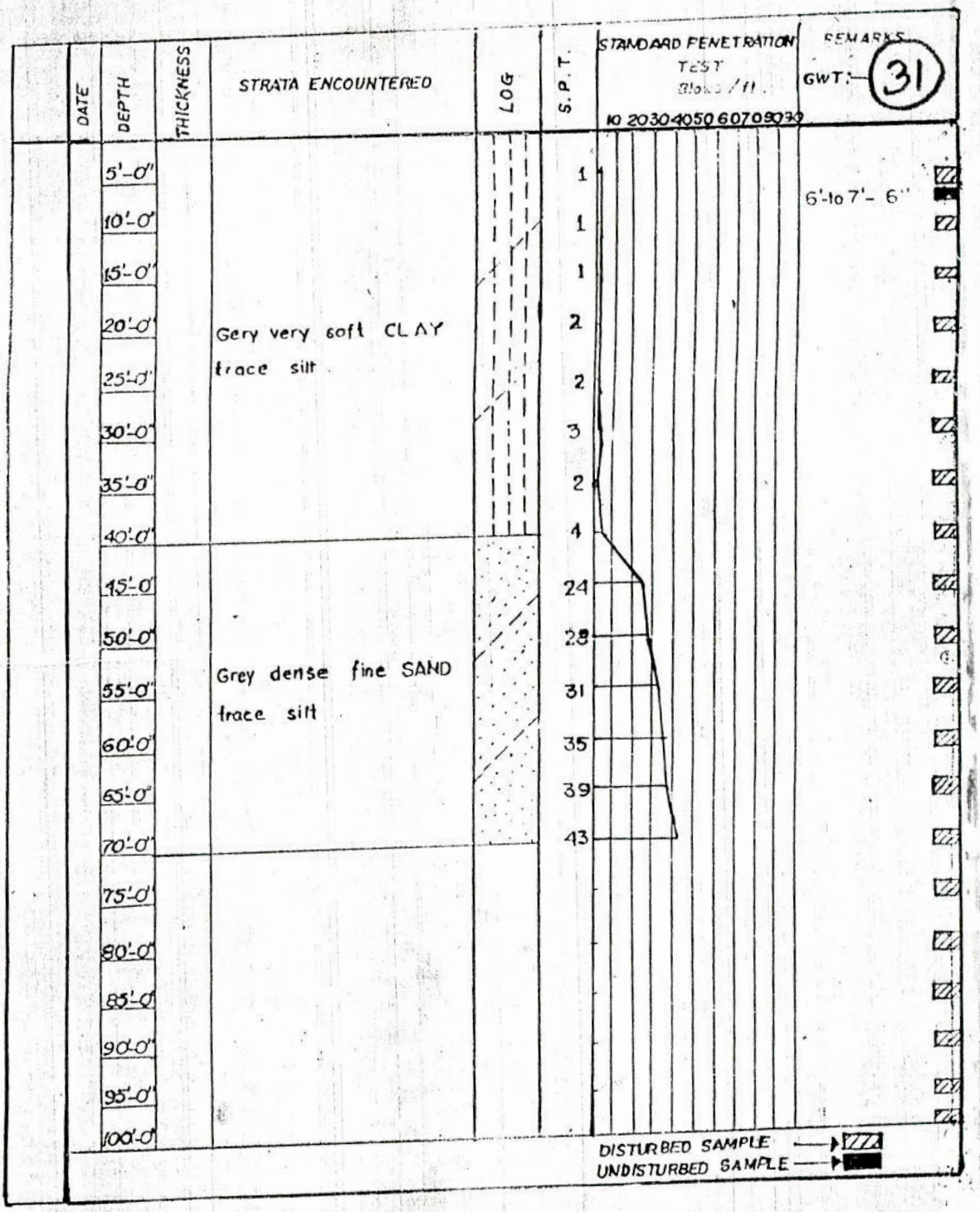


FIG: 5.12: SUB-SOIL INVESTIGATION BORE LOG.

PROJECT:- CONS. OF DIVISONAL OFFICE BLDG OF JANATA BANK

CLINT :- JANATA BANK KHULNA BRANCH

32

BORING NO :- 1

WT - 1'-10"

DATE	DEPTH RL	DEPTH FL	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	SPT CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Black Filling earth. Vegetation Brick chip						
		5		Dark olive gray Soft clay trace organic matter.		1				
		10		Olive gray Claye silt		4				
		15		Black Decomposed organic matter		8				
		20		Dark gray Silty clay trace organic matter		4				
		25				5				
		30		Very dark gray Silty clay		3				
		35				11				
		40		Light gray Fine sand		26				
		45				17				
		50		Light gray Very fine sand		22				
		55		Medium dence sand		27				
		60		Fine sand		31				
		65		Fine sand		26				
		70				25				

FIG: 5.15: SUB-SOIL INVESTIGATION BORE LOG.

PROJECT :- CONSTRUCTION OF COMMUNITY CENTRE

CLINT :- CHAIRMAN. K.D.A

LOCATION :- K D A OFFICE COMPOUND

(34)

BORING NO :- 1 W.T. - 1-6"

DATE	DEPTH R.L.	DEPTH F.L.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	SPT CURVE 5 15 25	SAMPLE D.S.	SAMPLE U.S.	REMARKS
		0		BRown Filling earth stiff clay						
		5		Yellowish brown Clayey very fine sand		3				
		10		Dark gray Clayey very fine sand		2				
		15		Black Decomposed organic matter with		7				
		20		Very dark gray Decomposed orginic matter with silty clay		2				
		25		Dark gray Stiff silty clay trace organic matter		5				
		30		Dark gray Stiff silty clay		5				
		35		Dark gray Silty clay		5				
		40		Gray Claye very fine sand		5				
		45		Light gray Clayey very fine fine sand.		17				
		50		Llght gray Fine sand, mjca,		14				
		55		Light gray Fine to medium sand		15				
		60		Light gray Fine to medium sand		24				
		65								
		70								

35

Project : Armed Police Battalion Bhabon		CRTS Civil, BIT Khulna.	
Client : Executive Engineer, PWD, Khulna		Engineer	Start:
Location : Shiromoni, Khulna			End:
Bore hole number : 1	G.W.T. : 3" below G.L		Sample

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 20 30 40	DS	US	Remark
0	Silty clay Brown						
5	Clay with trace silt Gray		9				
10	Clayey silt Gray		6				
15	Very fine sand Gray		7				
20	Very fine sand Gray		14				
25	Very fine sand Gray		54				
30	Very fine sand Gray		28				
35	Very fine sand Gray		17				
40			14				
45							

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC :

Project : Construction of A Liquid Tanker at Khulna Compound of BOC, Balgadesh Ltd

CRTS Civil, BIT Khulna

(36)

Client : Plant Manager BOC, Bangladesh.

Engineer

Start: 21-9-2000

Location : Khulna.

End: 21-9-2000

Bore hole number : 1 | G.W.T. : At G. L.

Sample

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Clay Dark gray						
5			3				
	Organic clay Very dark gray						
10			2				
	Clay with trace silt Dark gray						
15			5				
	Clay with trace organic Dark gray						
20			3				
	Clayey silt Dark gray						
25			2				
	Sandy clay Dark gray						
30			3				
	Very fine sand Gray						
35			11				
	Very fine sand Gray						
40			13				
	Very fine sand Gray						
45			10				
	Clayey silt Dark gray						
50			7				
	Sandy clay Dark gray						
55			6				
	Very fine sand Gray						
60			19				
	Fine sand Dark gray						
65			11				
	Sandy clay Dark gray						
70			9				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC:

37

Project : Construction of Police Training Center		**CRTS Civil, BIT Khulna.**
Client : Executive Engineer, PWD, Khulna	Engineer	**Start:**
Location : Shiromoni, Khulna		**End:**
Bore hole number : 1	**G.W.T. :**	**Sample**

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Silty clay Brown						
5	Silty clay Gray		5				
10	Silty clay Gray		5				
15	Silty clay Gray		4				
20	Silty clay Gray		5				
25	Silty clay Gray		5				
30	Clayey silt Gray		10				
35	Very fine sand Gray		12				
40	Very fine sand Gray		14				
45			30				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC :

38

Project : Construction of Building		CRTS Civil, BIT Khulna.
Client : Dr. Shamsun Nahar Lucky		Start:
Location : Ahashan Ahmmad Road , Khulna		End:
Bore hole number : 1	G.W.T. 1'- 6"	Sample

Engineer

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Clay Light olive brown						
5			6				
	Clayey silt Very dark grayish brown						
10			3				
	Clay with organic Black						
15			3				
	Organic mater Black						
20			6				
	Clay Dark gray						
25			3				
	Sandy clay Dark gray						
30			4				
	Sandy clay Dark gray						
35			4				
	Sandy clay Dark gray						
40			6				
	Sandy clay Dark gray						
45			6				
	Sandy clay Gray						
50			4				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC :

39

Project : Construction of Khulna Medical College Gymnasium, Khulna			**CRTS Civil, BIT Khulna.**
Client : Executive Engineer, PWD Division -III, Khulna		Engineer	**Start:**
Location : Khulna Medical College, Khulna			**End:**
Bore hole number : 1	G.W.T. 5' 0"		**Sample**

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Clay Gray		4				
5	Claycy silt Gray		2				
10	Organic Black		3				
15	Clay with trace organic Dark gray		2				
20	Clay with trace organic Dark gray		5				
25	Clay with trace silt Dark gray		4				
30	Silty clay Dark gray		4				
35	Very fine sand Dark gray		12				
40	Very fine sand Dark gray		19				
45	Very fine sand Dark gray		6				
50							

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC:

PROJECT :- China-Friendship Cement Co. Ltd

CLIENT :- Proposed Site for the Cement Factory

LOCATION :-Labanchora I/A, Rupsha, Khulna, Bangladesh.

BORING NO :- 1

W.T. 1'-11"

(40)

CRTS
DEPT. OF CIVIL E
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARI
		0		Dark gray Silty clay						
		5		Very dark grayish brown Organic clay		4				
		10		Dark gray Clay, organic traces		2				
		15		Very dark grayish brown Organic clay		3				
		20		Dark gray Clay, organic traces		2				
		25		Dark gray Silty clay		2				
		30		Gray Silty clay		2				
		35		Gray Clayey silt, sand traces		3				
		40				3				
		45		Gray Silty clay		4				
		50				4				
		55		Dark gray Silty clay		8				
		60		Dark gray Clayey silt		4				
		65		Gray Fine sand, mica traces		12				
		70		Gray Very fine sand, mica traces		15				
		75		Gray Very fine sand		32				
		80		Gray Very fine sand, mica traces		23				

APPROVAL ENGINEER :

PROJECT:- Private Residential Building

CLIENT:- Mr. Md. Lutfar Rahman Chowdhury

LOCATION:- Plot No.178, KDA Sonadanga R/A, 2nd Phase Khulna.

BORING NO:-1

W.T -

41

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Grayish brown Clay						
		5		Very dark grayish brown Clay with organic		3				
		10		Gray Clay		2				
		15		Dark gray Clay		2				
		20		Dark gray Silty clay		4				
		25		Dark gray Clayey silt		4				
		30				5				
		35		Gray Very fine sand		5				
		40		Light gray Very fine sand		16				
		45				24				

APPROVAL ENGINEER :

PROJECT :- KHULNA ZONAL CO-OPERATIVE TRAINING INSTITUTE

CLIENT :- EXECUTIVE ENGINEER, PWD-1, KHULNA.

LOCATION :- BOYRA, KHULNA.

BORING NO :- 1

W.T - 2'0"

CRTS (42)
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 2 6 10	SAMPLE DS	SAMPLE US	REMARKS
		5		Dark brown Organic with clay		2		●		
		10				2		●		
		15		Gray Silty clay, trace organic		3		●		
		20				6		●		
		25				6		●		
		30				6		●		
		35				6		●		
		40		Dark gray Silty clay, trace organic		4		●		
		45				6		●		
		50				7		●		
		55				7				

APPROVAL :-
ENGINEER :- 25/06/96

PROJECT:-Construction of a Residential Building

CLIENT:- Mrs. Sanjida Setara Bari, Goalpara Power Station, Khulna

LOCATION:- Plot No. 389 Mujgunni R/A, 2nd phase, KDA

BORING NO:- 1

WT - 1'-11"

(43)

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Gray Clay						▽ ▽
		5				1		●		
				Very dark gray						
		10		Organic clay		1		●		
		15				3		●		
				Gray Silty clay with trace organic						
		20				5		●		
				Gray						
		25		Silty clay		7		●		
		30				6		●		
				Gray						
		35		Clayey silt		4		●		
		40				5		●		
				Dark gray						
		45		Silty clay with trace organic		5		●		
		50				5		●		

APPROVAL ENGINEER :

(44)

Project : 10 Storied Commercial Building		CRTS Civil, BIT Khulna.
Client : G. M. Baksh & Co.		Start: 18/6/98
Location : Sir Iqbal Road, Khulna		End: 19/6/98
Bore hole number : 1	G.W.T. : 1.5 ft	

Engineer

SPT Curve

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	Sample DS	Sample US	Remark
0	Brown Silty Clay						
5	Grayish Brown Silty Clay		5				
10	Gray Very Fine sand with Clay		7				
15	Very Dark Gray Organic Clay		4				
20	Very Dark Brown Organic Clay		5				
25	Gray Soft Clay		5				
30	Gray Silty Clay		4				
35	Gray Silty Clay		5				
40	Gray Very Fine Sand with trace clay		7				
45	Gray Fine Sand with Trace Clay		11				
50	Light Gray Fine sand		17				
55	Gray Fine sand		33				
65	Gray Clayey Silt		12				
75	Gray Clayey Silt with trace of Fine Sand		19				
85			17				

DISTURBED: SAND: CLAY

UNDISTURBED: SILT : ORGANIC:

PROJECT:- Khalishpur

CLIENT:- Hazi Amjad Hossain

LOCATION:- 61 Commercial block, Housing State, Khalispur

BORING NO:- 1

W.T. At G.L.

(45)

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Olive gray Clay trace silt		3				
		5		Dark gray Silty clay		4				
		10		Gray Silty clay		2				
		15		Dark gray Silty clay		3				
		20		Reddish black Organic matter		4				
		25		Dark gray Clay, trace organic		9				
		30		Dark gray Clay, trace organic		6				
		35		Dark gray Clay, trace organic		5				
		40		Dark gray Clay, trace organic		4				
		45		Dark gray Clay, trace organic		6				
		50		Dark gray Clay, trace organic		5				
		55		Dark gray Clay, trace organic						

APPROVAL ENGINEER :

PROJECT :- COMMERCIAL BUILDING

CLIENT :- DR. MD. TORAB ALI

LOCATION :- 46, KDA AVENUE

BORING NO :- 01

W.T - 3'-0"

CRTS (47)
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

TE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		5		Light brown Clay		5		●	▨	
		10		Gray Clay trace silt		4		●	▨	
		15		Black Organic		7		●	▨	
		20		Gray Clay trace silt		4		●	▨	
		25				4		●	▨	
		30		Light gray Very fine sand trace silt		10		●	▨	
		35				6		●		
		40		Light gray Fine sand		15		●		
		45				16		●		
		50				16				

APPROVAL :-
ENGINEER :-

PROJECT: Construction of Rest House & Single Officers Qtr.

CLIENT: - Executive Engineer (Works) KDA, Khulna.

LOCATION: - Mujgunni, Khulna.

BORING NO: - 1

W.T. 3'- 3"

(48)

CRTS
DEPT. OF CIVIL ENGG.
B.I.T; KHULNA

DATE	DEPTH RL	DEPTH FT	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE (2 6 10)	SAMPLE DS	SAMPLE US	REMARKS
		0		Olive gray Clay						
		5		Gray Clay		3		●		
		10		Very dark brown Organic trace clay		3		●		
		15		Very dark gray Organic with clay		3		●		
		20		Gray Clay trace silt		4		●		
		25		Gray Clay with rotten woods		3		●		
		30		Very dark gray Organic clay with rotten woods.		3		●		
		35		Dark gray Clay with rotten woods		3		●		
		40		Very dark gray Organic clay		3		●		
		45		Gray Silty clay		4		●		
		50				6		●		

APPROVAL ENGINEER:

PROJECT :- STAFF COLONY OF KHULNA HARDBOARD MILLS LTD.

CLIENT :- M.D. KHULNA HARDBOARD MILLS LTD, KHALISHPUR KLN.

LOCATION :- RESIDENTIAL AREA OF THE MILL

BORING NO :- 1

W.T - 3'-6"

CRTS (49)
DEPT. OF CIVIL ENGG.
B.I.T, KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE (5 15 25)	SAMPLE DS	SAMPLE US	REMARKS
		0		Olive Clayey silt						
		5		Gray Fine sand		5				
		10		Dark gray Fine to medium sand		5				
		15		Light gray Fine sand		6				
		20		Gray Medium sand		11				
		25				17				
		30		Reddish gray Medium sand		18				
		35				23				

APPROVAL :-
ENGINEER :-

PROJECT:-4UNIT CONSTABLE RESIDENTIAL BUILDING.

CLIENT:- XEN, PWD-1, KHULNA.

LOCATION:- RUPSHA T.O.P., CHANMARI, KHULNA.

BORING NO :- 1

W.T 2'-0"

50

CRIS
DEPT OF CIVIL ENGG
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Very dark grayish brown Clay						
		5		Black Organic with trace clay		2				
		10		Dark gray Clay		2				
		15		Dark gray Very loose clay		4				
		20		Very dark gray Silty clay		0				
		25		Dark gray Fine sand with trace clay		3				
		30				3				
		35				4				
		40		Gray Fine sand		4				
		45				7				
		50				7				

APPROVAL
ENGINEER

PROJECT:- Private Hospital, Fultala.

CLIENT:- Dr. A.T.M.M. Murshed

LOCATION:- Fultala

BORING NO:- 1

WT -7'-3"

(51)

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Grayish brown Clay		5				
		5		Brown Silty clay		6				
		10		Gray Very fine sand		7				
		15		Gray Clayey silt		4				
		20		Gray Very fine sand		4				
		25		Light gray Fine to medium sand		10				
		30		Light gray Fine to medium sand		18				
		35		Light gray Fine to medium sand		12				
		40		Gray Fine sand		19				
		45		Light gray Medium sand		18				
		50		Light gray Medium sand		24				
		55								

APPROVAL ENGINEER : 12/11/98

MD REZAUL KARIM
Assistant Professor
Dept of Civil Engineering
BIT, Khulna, Khulna-9203

PROJECT:- Construction of Fire Station

CLIENT:- Executive Engineer, PWD, Division-1, Khulna

LOCATION:-Daulatpur, Khulna.

BORING NO:- 1 W.T. - 3'-0"

52

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH R.L	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Light yellowish brown Clayey silt						
		5		Light gray Clayey silt		8				
		10		Gray Silty clay		6				
		15		Gray Silty clay		7				
		20		Very dark brown Organic matter		4				
		25		Dark gray Organic clay		-7				
		30		Gray Clay (soft)		5				
		35		Gray Clay with trace of organic matter		5				
		40		Gray Soft clay with trace of organic matter		3				
		45		Gray Soft clay		4				
		50		Gray Soft clay with trace of organic matter		5				
		55				4				

APPROVAL
ENGINEER :

53

Project : Construction of Baby Home at Mohesshor Pasa Shishu Sadan				**CRTS Civil, BIT Khulna.**			
Client : Executive Engineer, PWD Division-II, Khulna				Engineer	**Start:**		
Location : Mohesshor Pasa Shishu Sadan, Khulna.					**End:**		
Bore hole number : 1	**G.W.T. : 2' - 6"**				**Sample**		
Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Clay with , silt traced Brown						
5	Clayey silt Gray		8				
10	Clay , silt traced Gray		3				
15	Organic Very dark gray		4				
20	Organic Black		4				
25	Silty clay Gray		7				
30	Clay with silt , organic traced Dark gray		9				
35	Silty clay , organic traced Dark gray		4				
40	Clay with , silt traced Dark gray		4				
45	Silty clay Dark gray		5				
50			5				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC :

(54)

Project : Construction of Residence of O.C. at Sonadanga Thana of Khulna Metropolition Police.				CRTS Civil, BIT Khulna.			
Client : Executive Engineer, PWD Division-I, Khulna				Engineer	Start:		
Location : Sonadanga Thana Premises, Khulna					End:		
Bore hole number : 1	G.W.T				Sample		
Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Clay with organic Very dark gray						
5	Clay with organic Very dark gray		2				
10	Clay, trace organic Dark gray		2				
15	Clay, trace silt Dark gray		2				
20	Silty clay Dark gray		5				
25	Silty clay Dark gray		4				
30	Silty clay Dark gray		6				
35	Sandy clay Dark gray		5				
40	Silty clay Dark gray		5				
45	Sandy clay Dark gray		5				
50			6				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC:

PROJECT :-STAFF COLONY OF KHULNA HARDBOARD MILLS LTD.

CLIENT : M.D. KHULNA HARDBOARD MILLS LTD, KHALISHPUR KLN.

LOCATION :-RESIDENTIAL AREA OF THE MILL

BORING NO :- 1

W.T - 3'-6"

(55)

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Olive Clayey silt						
		5		Gray Fine sand		5				
		10		Dark gray Fine to medium sand		5				
		15		Light gray Fine sand		6				
		20		Gray Medium sand		11				
		25				17				
		30		Reddish gray Medium sand		18				
		35				23				

APPROVAL :-
ENGINEER :-

PROJECT :- FOUR STORIED PRIMARY SCHOOL BUILDING

CLIENT :- ASST. ENGR. FACILITIES DEPT. KHULNA

LOCATION :- SHIPYARD, KHULNA.

CRIS 56

DEPT. OF CIVIL ENGG.
B.I.T, KHULNA

BORING NO :- 1

W.T - AT G.L

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE 10 20 30 40 50	SAMPLE DS	SAMPLE US	REMARKS
24-5-9		0		Black Fuuy organic deposits		0				▽
		5		Very dark gray Clay		1		●	▨	
		10		Dark gray Clay		3		●	▨	
		15		Light gray Silty clay		4		●	▨	
		20		Dark gray Silty clay		4		●		
		25		Gray Very fine sand		3		●	▨	
		30		Light gray Fine sand		6		●	▨	
		35		Dark gray Silty sand		11		●	▨	
		40		Gray Clayey silt		7		●	▨	
		50				5		●		

APPROVAL -

ENGINEER -

PROJECT :- MOLLAPARA 3 STORIED PRIMARY SCHOOL BUILDING

CLIENT :- ASST. ENGR. FACILITIES DEPT. KHULNA.

LOCATION :- MOLLAPARA (NEAR MOLLAPARA JAME MOSQUE)

BORING NO :- 1

W.T - AT G.L

57

CRTS
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	SPT VALUE	STANDARD PENETRATION TEST CURVE 10 20 30 40 50	SAMPLE DS	SAMPLE US	REMARKS
		0								▽
		5		Black Fully organice deposits		2				
		10				5				
		15		Very loose silty sand with organice deposit trace		5				
		20				3				
		25		Dark gray Soft stickly clay		1				
		30				2				
		35				5				
		40		Brownish gray Soft silty sand		5				
		45				5				
		50				6				
		55		Gray Medium silty sand						
		60				11				

APPROVAL :-
ENGINEER :-

PROJECT :- KHULNA MEDICAL COLLEGE HOSTELS

CLIENT :- PWD, DIVISION - I, KHULNA.

LOCATION :- 250 BED HOSPITAL KHULNA.

BORING NO :- 1

W.T - 4'-0"

CRTS (58)

DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Light brown Clay						
		5				3			5'	
		10		Gray Silty clay						
		15		Black Organic rotten leaves		7			15'	
		20				6			22'	
		25		Dark gray Clay, trace silt		6			26.5'	
		30				5			31.5'	
		35		Very dark gray Clay						
		40				7			42'	
		45		Gray Fine sand, trace mica						
		50				8			50'	

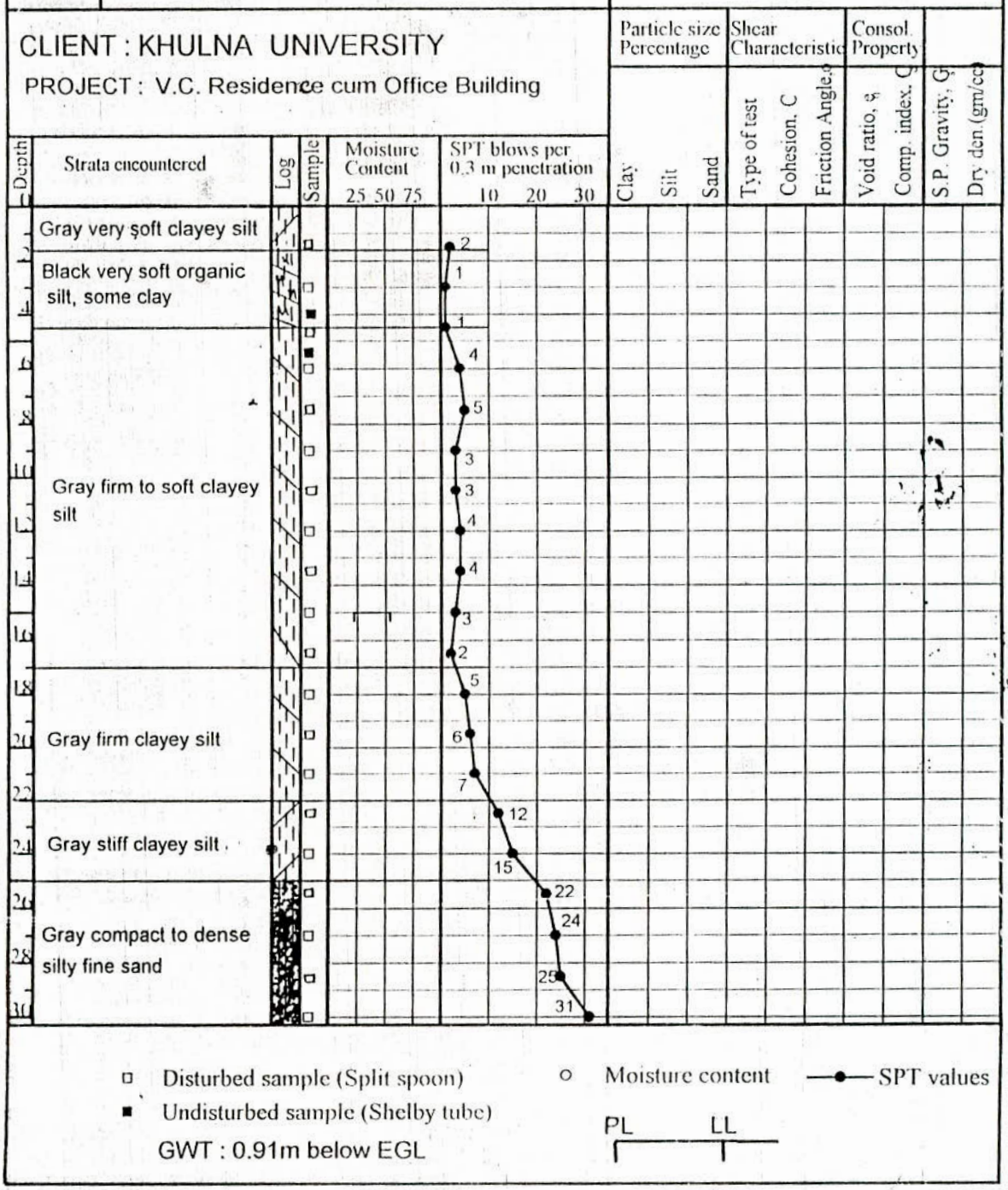
APPROVAL :-

ENGINEER -

UNIQUE BORING AND ENGINEERING LTD.
34, GREEN ROAD, NOWAB MANSION
3rd Floor, Dhaka

BORE HOLE NO: BH-2 (61)
LOCATION : Khulna University, Khulna

CLIENT : KHULNA UNIVERSITY
PROJECT : V.C. Residence cum Office Building



□ Disturbed sample (Split spoon)
■ Undisturbed sample (Shelby tube)
GWT : 0.91m below EGL

○ Moisture content
—●— SPT values
PL LL

S.S. BORING & ENGINEERS.

65

CLIENT : MR. MD. SYED MOSTAFA KAMAL , & OTHER'S.
PROJECT : 6-STORIED RESIDENTIAL BUILDING.
LOCATION : PLOT NO-414, SONADANGA R/A, 2 nd. PHASE. KHULNA.
BORING DATE : 02 – 02 – 2001

BORE HOLE NO : 1 (One)
GROUND LEVEL : (-) 0'- 0"
GROUND WATER LEVEL : (-) 0'- 0"
DATE : 03 – 02 – 2001 TIME :

NUMBER OF SAMPLE	TYPE OF SA	DEPTH IN FEET	THICKNESS	LITHOLOGICAL DESCRIPTION	LITHOLOGICA LOG	DIA OF BORING
D-1		5'	7'-0"	Light brown soft SILT, some clay, trace fine sand.		4 INCH Ø
D-2		10'	5'-0"	Deep black soft / very soft ash mix with organic SILT, some clay, trace to little fine sand.		
D-3		15'	21'-0"	Gray occasionally black spotted soft to medium SILT, some clay, trace fine sand.		
D-4		20'				
D-5		25'				
D-6		30'				
D-7		35'	18'-0"	Gray loose to medium dense medium to fine SAND, some to little silt, trace mica.		
D-8		40'				
D-9		45'				
D-10		50'				
D-11		55'				
D-12		60'				

STANDARD PENETRATION RESISTANCE
BLOWS PER 12 INCH OF PENETRATION

0 10 20 30 40 50

D-1: 2
D-2: 2
D-3: 5
D-4: 2
D-5: 7
D-6: 9
D-7: 18
D-8: 8
D-9: 15
D-10: 20

INDEX
DISTURBED
UNDISTURBED
REMARKS

CLAY
SILT & CLAY
SILT
SAND
MICA
ORGANIC

Technician
Soil Laboratory.

TESTED BY : M .. Technician

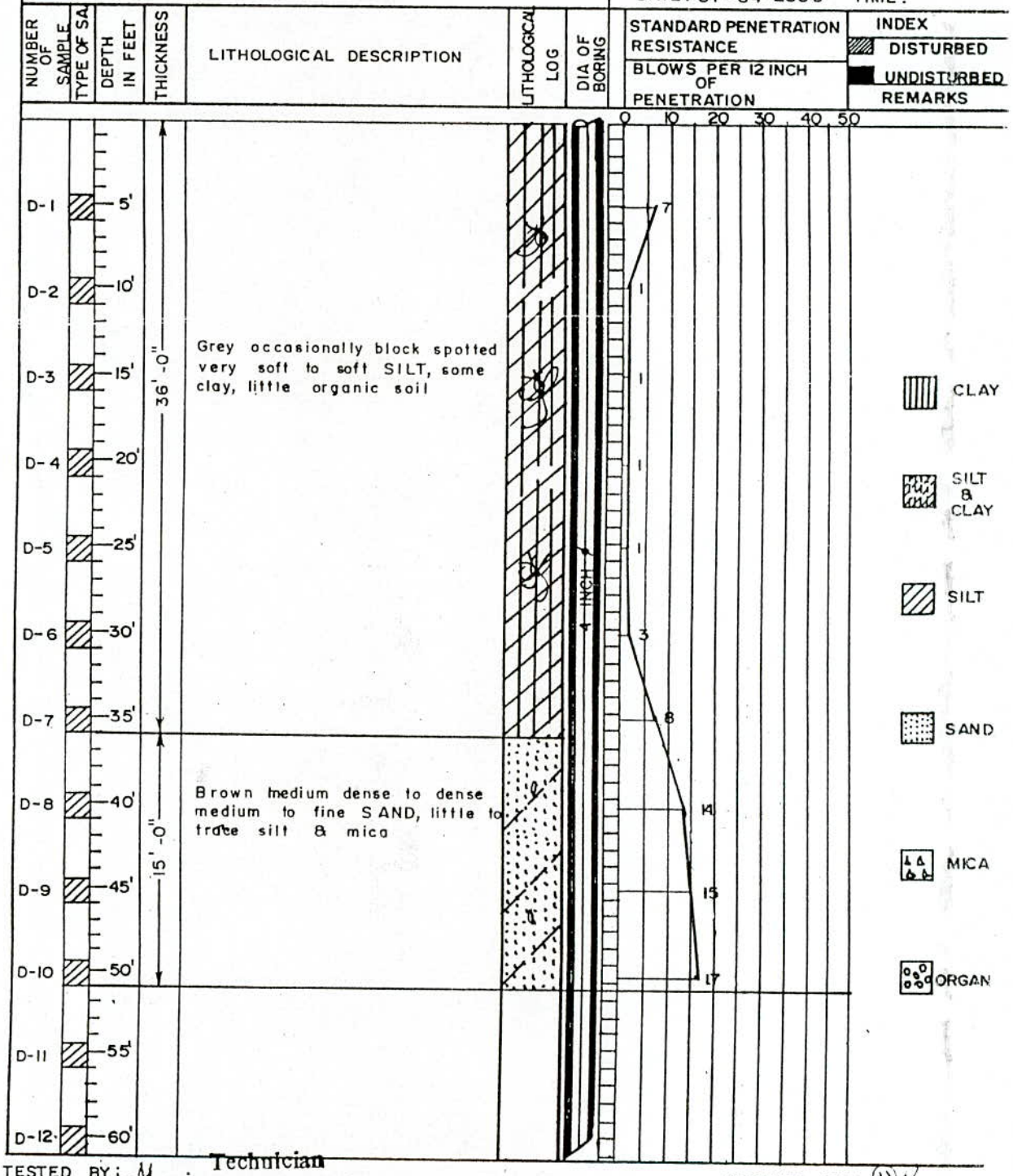
CHECKED BY :

THE PREMIER BORING & ENGINEER'S

CLIENT: MR. HASAN SHAHEEDKOYA
PROJECT: 6-STORIED RESIDENTIAL BUILDING
LOCATION: 18, BOSUPARA, KHULNA, PLOT NO-635, MUZGUNNI R/A, 2ND PHASE KHULNA
BORING DATE:

BORE HOLE NO: 1 (ONE)
GROUND LEVEL:
GROUND WATER LEVEL:
DATE: 07-04-2000 TIME:

66



TESTED BY: Technician Soil Laboratory

CHECKED BY:

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:— Sarder Ashraf Ali (67)

SITE:— Plot.254, Muzguni P/A, Khulna.

BORE CHART OF BORING NO: 1.

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"		Grey very soft CLAY trace fine sand some silt.		1		
	10'-0"		Black organic CLAY		1		
	15'-0"				1		
	20'-0"		Grey very soft to medium stiff CLAY trace fine sand little silt.		5		17'to18'-6"
	25'-0"				2		
	30'-0"				2		
	35'-0"				2		
	40'-0"				5		
	45'-0"				5		
	50'-0"		Grey med.stiff trace fine sand little Clay		6		
	55'-0"						
	60'-0"						
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE
UNDISTURBED SAMPLE

THE PREMIER BORING & ENGINEERS

CLINT : MR. SHAH MOHAMMAD ALI
PROJECT : 6 STORED RESIDENTIAL BUILDING
LOCATION : DAG NO 455(PART)
MOUJA TUTPARA
P.S. & DIST. – KHULNA

BORE HOLE NO. 1 (68)
GROUND LABEL :
GROUND WATER LABEL :
DATE :

NUMBER OF SAMPLE	TYPE	DEPTH IN FEET	THICKNESS	LITHOLOGICAL DISCRIPTION	LITHOLOGICAL LOG	DIA OF BORING	STANDARD PENETRATION RESISTANCE / BLOWS PER 12 INCH OF PENETRATION	INDEX: DISTURBED / UNDISTURBED / REMARKS
							5 10 20 30 40	
D-1		5		CLAY		1		
D-2		10		PIT SOIL		1		
D-3		15				1		
D-4		20		SILTY CLAY WITH LITTLE FINE SAND		2		
D-5		25				2		
D-6		30		SILT WITH LITTLE FINE SAND		2		
D-7		35				3		
D-8		40		BROWN MEDIUM DENSE TO DENSE MEDIUM TO FINE SAND, LITTLE TO TARACE SILT AND MICA		5		
D-9		45				6		
D-10		50				9		
D-11		55						
D-12		60						

S. S. BORING & ENGINEERS

CLIENT: SAYED BASIR AHMED
PROJECT : 6-STORIED RES. CUM COMM. BUILDING.
LOCATION : K.D.A. PLOT No-22, MUZGUNNI MAIN ROAD, SOTO BOYRA, KHULNA.
BORING DATE : 21 – 04 – 2001

BORE HOLE NO: 1 (ONE) (69)
GROUND LEVEL : (–) 0'-0"
GROUND WATER LEVEL: (–) 8'– 6"
DATE : 22 – 04 – 2001 TIME :

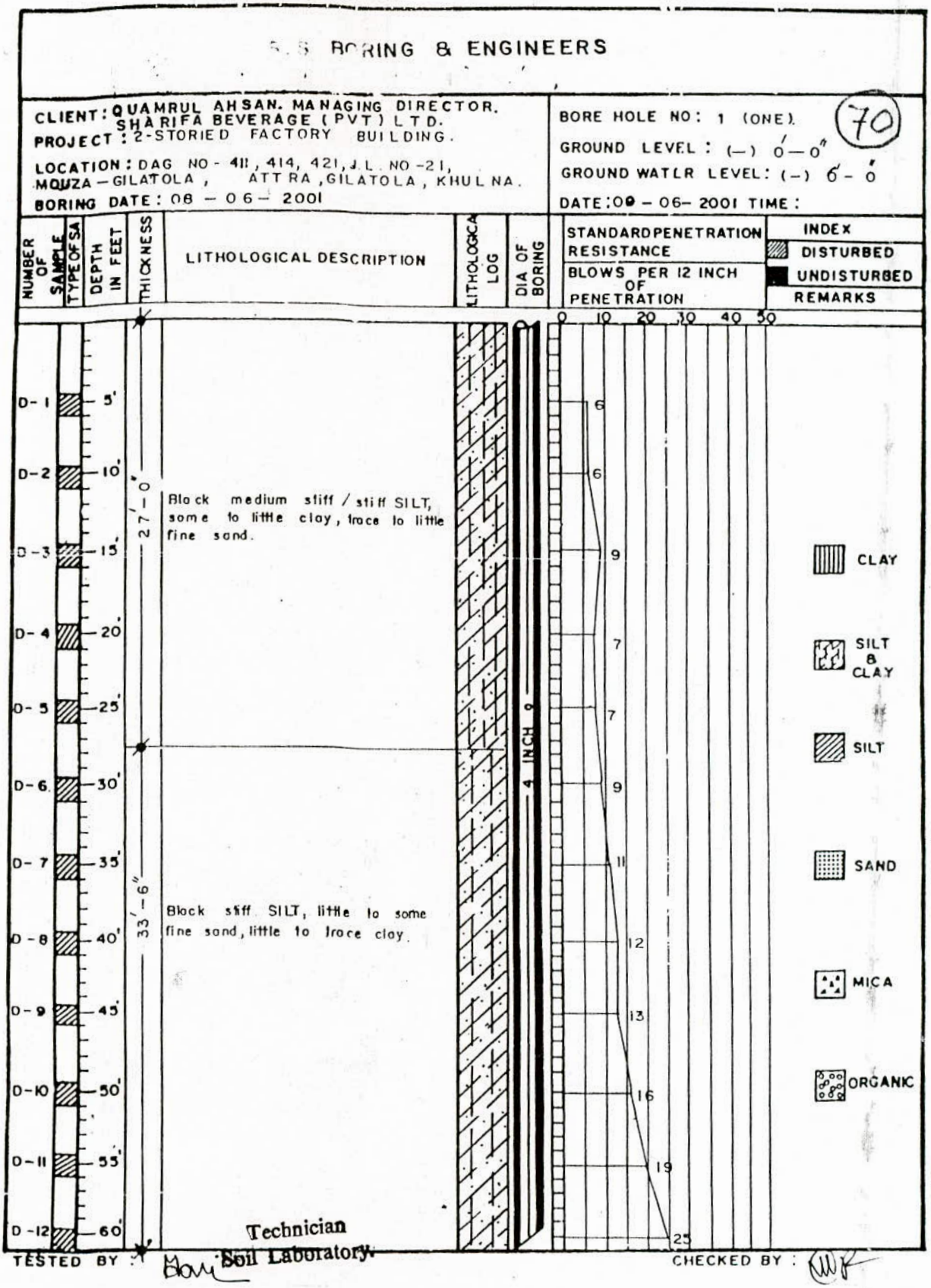
NUMBER OF SAMPLE	TYPE OF SA	DEPTH IN FEET	THICKNESS	LITHOLOGICAL DESCRIPTION	LITHOLOGICA LOG	DIA OF BORING	STANDARD PENETRATION RESISTANCE / BLOWS PER 12 INCH OF PENETRATION
D-1		5'	17'-6"	Light black layered soft SILT, some to little clay, trace fine sand.		4 INCH ø	5
D-2		10'					6
D-3		15'					7
D-4		20'	20'-6"	Black with gray / deep black patches organic SILT, little to trace clay, trace to little fine sand.			6
D-5		25'					7
D-6		30'					8
D-7		35'					12
D-8		40'	13'-0"	Light black loose to medium dense fine to medium SAND, some to little silt & mica.			13
D-9		45'					18
D-10		50'					20
D-11		55'					
D-12		60'					

0 10 20 30 40 50

INDEX
DISTURBED
UNDISTURBED
REMARKS

CLAY
SILT & CLAY
SILT
SAND
MICA
ORGANIC

TESTED BY : Technician
CHECKED BY :


S. S BORING & ENGINEERS
CLIENT : QUAMRUL AHSAN. MANAGING DIRECTOR. SHARIFA BEVERAGE (PVT) LTD.
PROJECT : 2-STORIED FACTORY BUILDING.
LOCATION : DAG NO - 411, 414, 421, J.L. NO -21, MOUZA - GILATOLA, ATTRA, GILATOLA, KHULNA.
BORING DATE : 08 - 06 - 2001
BORE HOLE NO : 1 (ONE).
GROUND LEVEL : (-) 0'-0"
GROUND WATER LEVEL : (-) 6'-0"
DATE : 09 - 06 - 2001 TIME :
70
NUMBER OF SAMPLE
TYPE OF SA
DEPTH IN FEET
THICKNESS
LITHOLOGICAL DESCRIPTION
LITHOLOGICA LOG
DIA OF BORING
STANDARD PENETRATION RESISTANCE
BLOWS PER 12 INCH OF PENETRATION
INDEX
DISTURBED
UNDISTURBED
REMARKS
0 10 20 30 40 50
D-1 5'
D-2 10'
D-3 15'
D-4 20'
D-5 25'
D-6 30'
D-7 35'
D-8 40'
D-9 45'
D-10 50'
D-11 55'
D-12 60'
27'-0"
33'-6"
Black medium stiff / stiff SILT, some to little clay, trace to little fine sand.
Black stiff SILT, little to some fine sand, little to trace clay.
4 INCH ø
6
6
9
7
7
9
11
12
13
16
19
25
CLAY
SILT & CLAY
SILT
SAND
MICA
ORGANIC
TESTED BY :
Technician
Soil Laboratory.
CHECKED BY :

S.S. BORING & ENGINEER'S

435/Kha, Elephant Road (2nd Floor)

Wirless Rail Gate, Moghbazar Dhaka

BORE LOG

(71)

CLIENT : GE (NAVY) KHULNA

PROJECT : 1 (ONE) STORIEDWITH (2 STORIED FD) BUILDING.

LOCATION : KHALISPUR BNS TITUMIR KHULNA .

BORE HOLE NO. 1 (ONE
GROUND LEVEL
GROUND WATER LEVEL 2' 2"
DATE : 15/08/2001

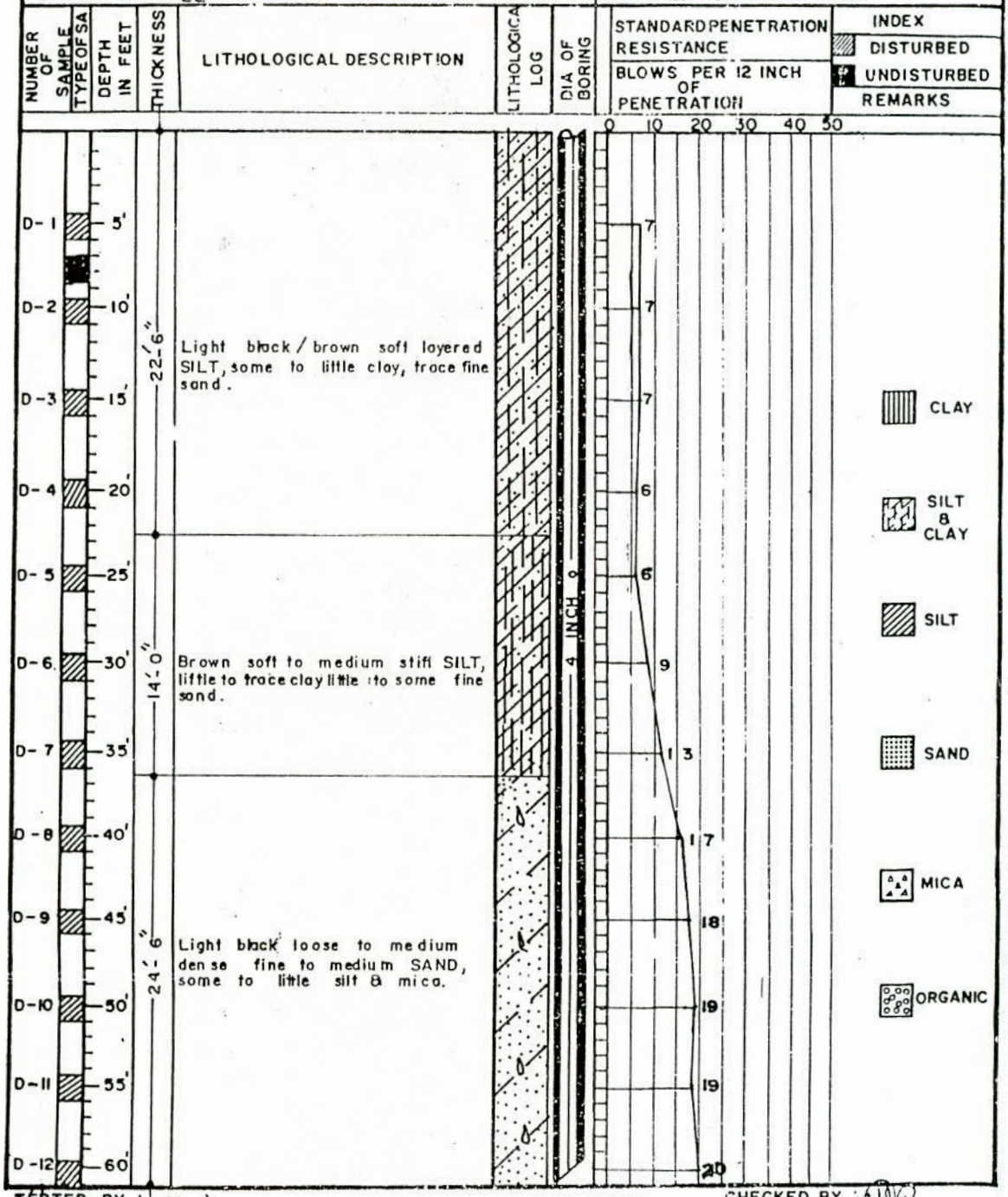
NO OF SAMPLE	TYPE OF SAM	DEPTH IN FEET	THICKNESS	LITHOLOGICL DESCRTIPTION	LITHOLOGICAL LOG	DIA OF BORING	BLOWS ON SPOON PER 6 INCH PENETRATION 6"	6"	6"	STANDARD PENETRATION REGISTANCE BLOWS PER 12 INCH OF PENETRATION	INDEX Disturbed / Undisturbed / Remarks
D1		0	5'-0"	Light browun silty Clay.			2	3	3	6	CLAY
U1		5'-0"	10'-0"	Gray Silt,Trace Fine Sand Some Clay.			0	3	2	5	SILT & CLAY
D2		10'-0"	15'	Gray Medium to Fine Sand, Some of Little Silt.			1	3	3	6	SILT
D3		15'	20'				2	8	9	17	SAND
D4		20'	25'	Gray Compacted Silty Fine Sand.			3	9	10	19	MICA
D5		25'	30'				10	12	15	27	ORGANIC
D6		30'	35'				11	13	16	29	
D7		35'	40'				10	15	18	33	
D8		40'	45'				13	17	20	37	
D9		45'	50'				13	18	22	40	
D10		50'									

S. S. BORING & ENGINEERS

72

CLIENT: MRS. NASIMA SULTANA.
PROJECT : 6-STORIED RES. CUM COMM. BUILDING.
LOCATION : K.D.A. COMMERCIAL PLOT No - 52, 53, MUZGUNNI MAIN ROAD KHULNA.
BORING DATE : 22 - 04 - 2001

BORE HOLE NO: 1 (One).
GROUND LEVEL : (-) 0' - 0"
GROUND WATER LEVEL: (-) 6' - 0"
DATE : 23 - 04 - 2001 TIME :



TESTED BY :

Technician
Soil Laboratory.

CHECKED BY :

S.S. BORING & ENGINEERS.

(73)

CLIENT: MD. ABUL HOSSAIN.
PROJECT : 5 - STORIED RESIDENTIAL BUILDING.
LOCATION : WEST TUTTPARA CROSS ROAD, WEST TUTTPARA KHULNA.
BORING DATE : 16 - 06 - 2001

BORE HOLE NO: 1 (ONE)
GROUND LEVEL : (-) 0'-0"
GROUND WATER LEVEL: (-) 0'-0"
DATE: 17 - 06 - 2001 TIME :

NUMBER OF SAMPLE	TYPE OF SA	DEPTH IN FEET	THICKNESS	LITHOLOGICAL DESCRIPTION	LITHOLOGICA LOG	DIA OF BORING
D-1		5'	22'-0"	Block soft layered occosionally SILT, some to little clay, trace to little fine sand.		4 INCH ø
D-2		10'				
D-3		15'				
D-4		20'				
D-5		25'	5'-6"	Block medium stiff sandy SILT, trace clay.		
D-6		30'	23'-6"	Block / white medium Dense to dense fine to medium SAND, some to little silt.		
D-7		35'				
D-8		40'				
D-9		45'				
D-10		50'				
D-11		55'				
D-12		60'				

STANDARD PENETRATION RESISTANCE
BLOWS PER 12 INCH OF PENETRATION

0 10 20 30 40 50

2 4 2 3 8 22 28 32 34 36

INDEX
DISTURBED
UNDISTURBED
REMARKS

CLAY
SILT & CLAY
SILT
SAND
MICA
ORGANIC

TESTED BY : Mali

CHECKED BY :

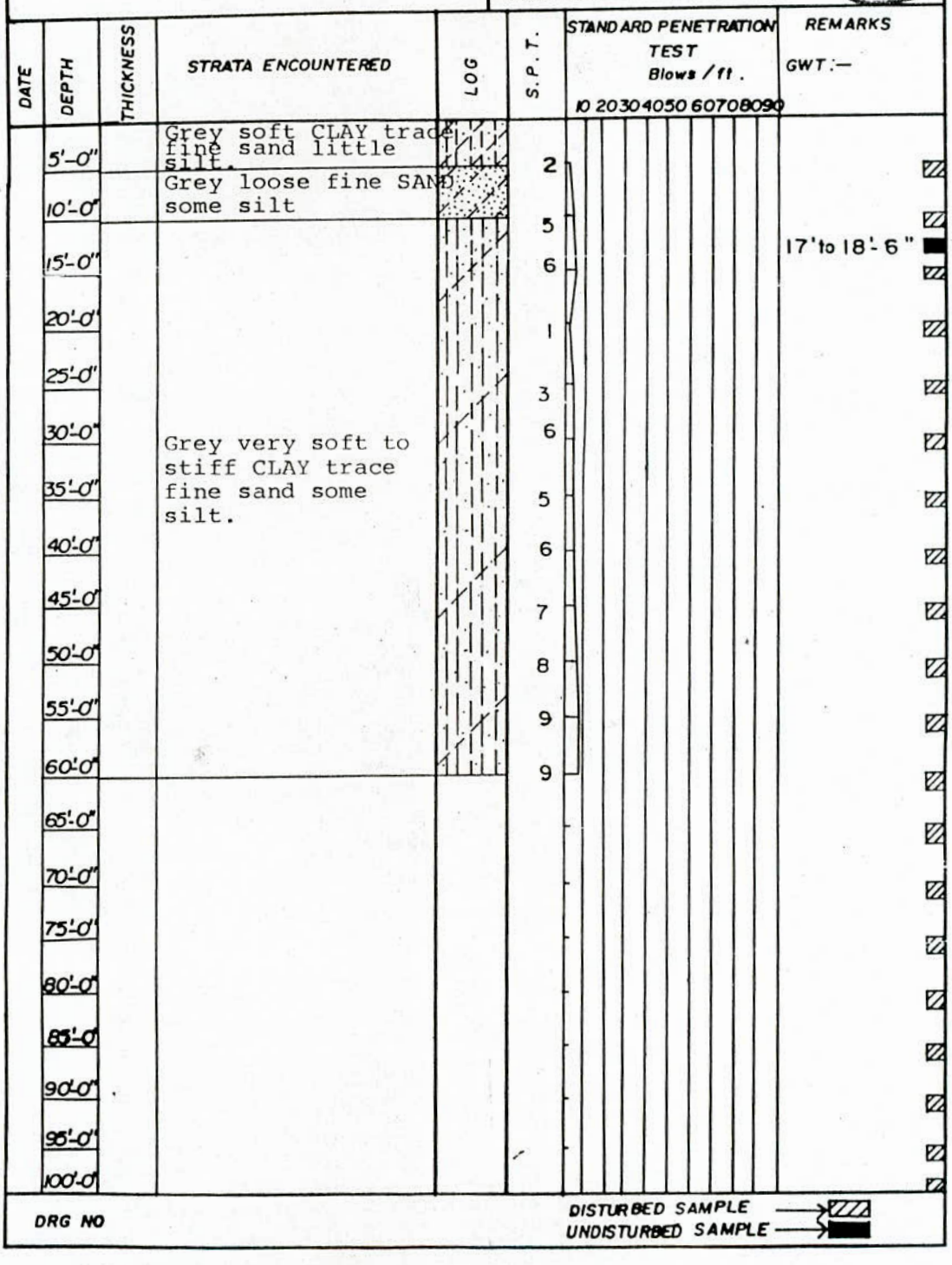
THE PIONEER SOIL INVESTIGATOR
DHAKA.

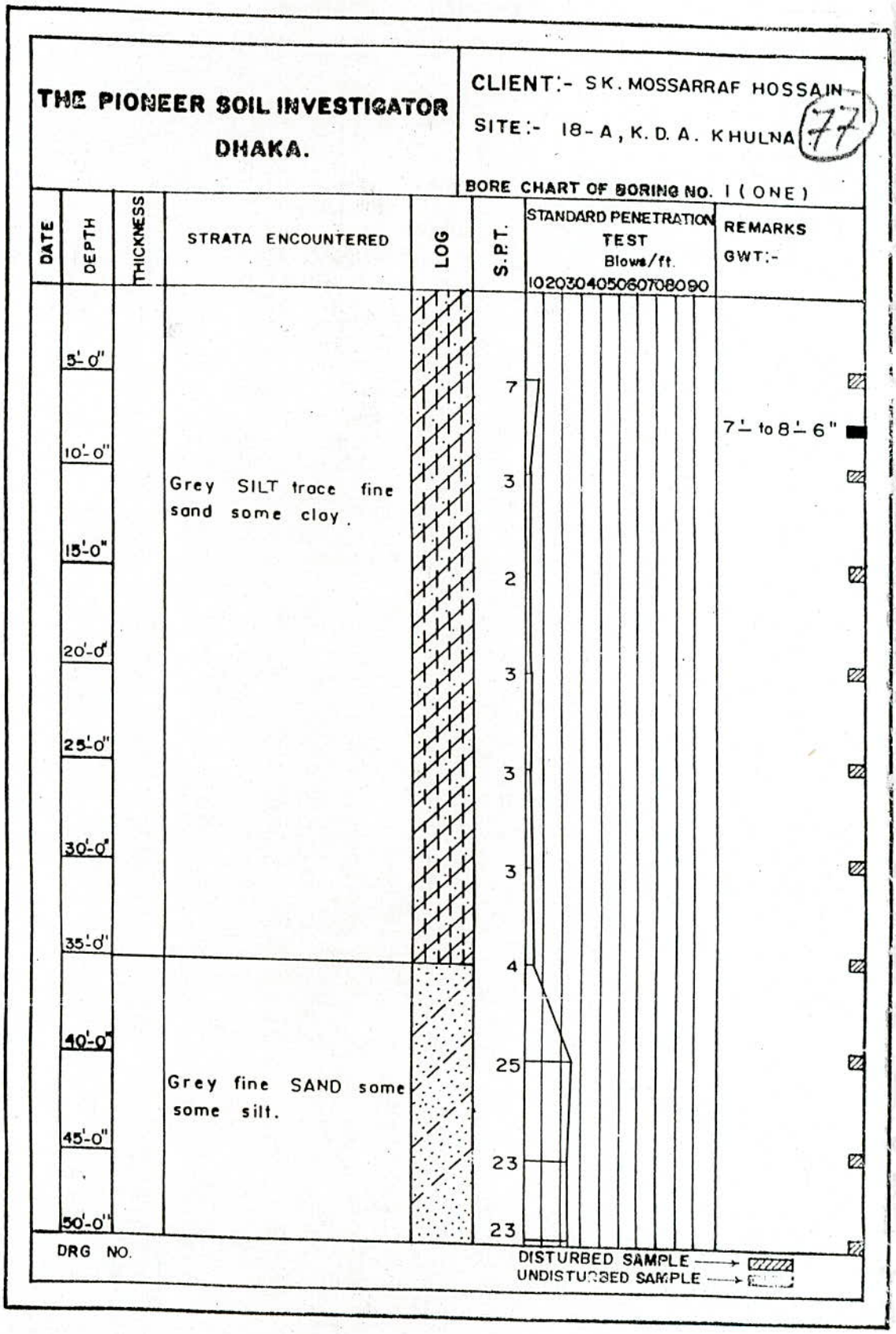
CLIENT:— Sayed Rafiqul Islam

SITE:— Plot.1491,1494,Mouza-Jugipole,Khulna.

BORE CHART OF BORING NO: 1.

76




THE PIONEER SOIL INVESTIGATOR
DHAKA.
CLIENT:- SK. MOSSARRAF HOSSAIN
SITE:- 18-A, K.D.A. KHULNA
77
BORE CHART OF BORING NO. 1 (ONE)
DATE
DEPTH
THICKNESS
STRATA ENCOUNTERED
LOG
S.P.T.
STANDARD PENETRATION TEST
Blows/ft.
10 20 30 40 50 60 70 80 90
REMARKS
GWT:-
3'-0"
10'-0"
15'-0"
20'-0"
25'-0"
30'-0"
35'-0"
40'-0"
45'-0"
50'-0"
Grey SILT trace fine sand some clay.
Grey fine SAND some some silt.
7
3
2
3
3
3
4
25
23
23
7'- to 8'- 6"
DRG NO.
DISTURBED SAMPLE
UNDISTURBED SAMPLE

THE PIONEER SOIL INVESTIGATOR

DHAKA.

CLIENT:- Miss Rexsona Zobbar

SITE:- 53, K.D.A. Avenue, Khulna.

BORE CHART OF BORING NO. 1 (78)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey SILT trace fine sand & some clay		5		
	10'-0"		Grey CLAY trace fine sand & some silt		2		7'- to 8'- 6"
	15'-0"				5		
	20'-0"		Grey SILT trace fine sand & some clay.		3		
	25'-0"				4		
	30'-0"				4		
	35'-0"				15		
	40'-0"		Grey SILT little fine sand &little clay.		20		
	45'-0"				23		
	50'-0"				25		

DRG NO.

DISTURBED SAMPLE ⟶

UNDISTURBED SAMPLE ⟶

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:- MRS ANJUMANARA (79)

SITE:- SONADANGA R/A 2ND PHASE

BORE CHART OF BORING NO: 1

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey CLAY trace fine sand & some silt.		7		7'-6 to 8'-6"
	10'-0"		Grey SILT trace fine sand &some clay.		6		
	15'-0"				5		
	20'-0"		Grey CLAY trace fine sand & some silt		7		
	25'-0"		Grey SILT trace fine sand & some clay.		5		
	30'-0"				7		
	35'-0"				6		
	40'-0"		Grey CLAY trace fine sand & some silt.		2		
	45'-0"				2		
	50'-0"		Grey SILT trace fine sand & some clay.		6		
	55'-0"				11		
	60'-0"				10		
	65'-0"				8		
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →
UNDISTURBED SAMPLE →

THE PIONEER SOIL INVESTIGATOR

DHAKA.

CLIENT:- Md. Wahiduzzaman Biplob

SITE:- Mouza-Helatola, Sir Iqbal Road, Khulna.

BORE CHART OF BORING NO. 1 (80)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey CLAY trace fine sand & some s ilt.		2		
	10'-0"		Grey SILT trace fine sand & some clay		3		7'-4o 8'- 6"
	15'-0"						
	20'-0"		Black organic & little clay		3		
	25'-0"		Grey SILT trace fine sand & some clay.		4		
	30'-0"				5		
	35'-0"				6		
	40'-0"				12		
	45'-0"		Grey fine SAND some silt.		17		
	50'-0"				20		
					25		

DRG NO.

DISTURBED SAMPLE →

UNDISTURBED SAMPLE →

RANA SOIL ENGINEERING

HOUSE NO. 9 MITALI ROAD, RAYER BAZAR, DHAKA–1209

PHONE: 9130889

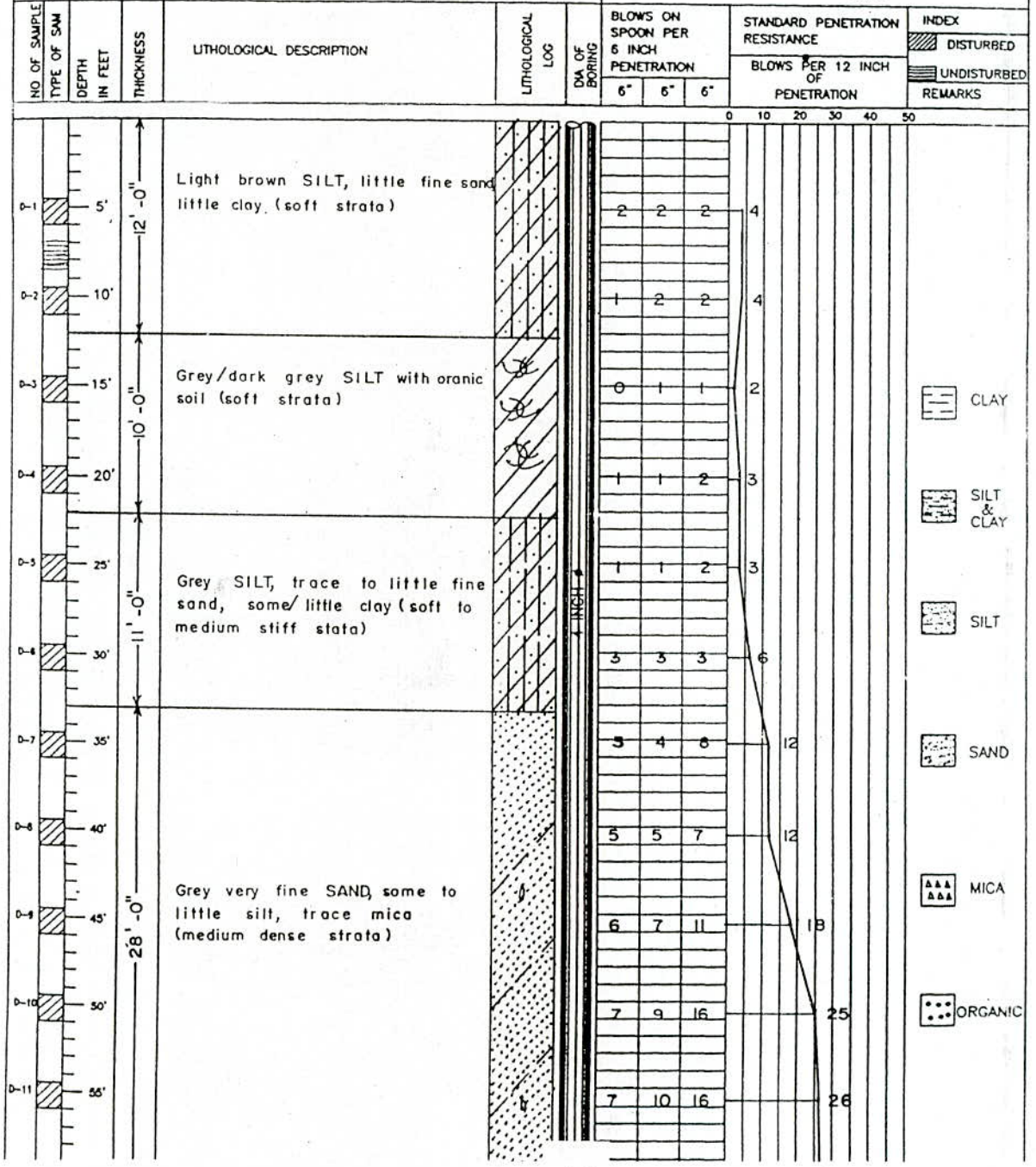
BORE LOG

81

CLIENT: ARUNESH NANDI
PROJECT: 5-STORIED COMMERCIAL BUILDING
LOCATION: 26, SIR IQBAL ROAD, KHULNA

BORING DATE: 6-11-98

BORE HOLE NO: 1
GROUND LEVEL:
GROUND WATER LEVEL: 2'-6"
DATE: 7-11-98 TIME:



THE PIONEER SOIL INVESTIGATOR

DHAKA.

CLIENT:— MD. JALAL UDDIN

SITE :— SK.PARA MASQUE ROAD, KHULNA.

82

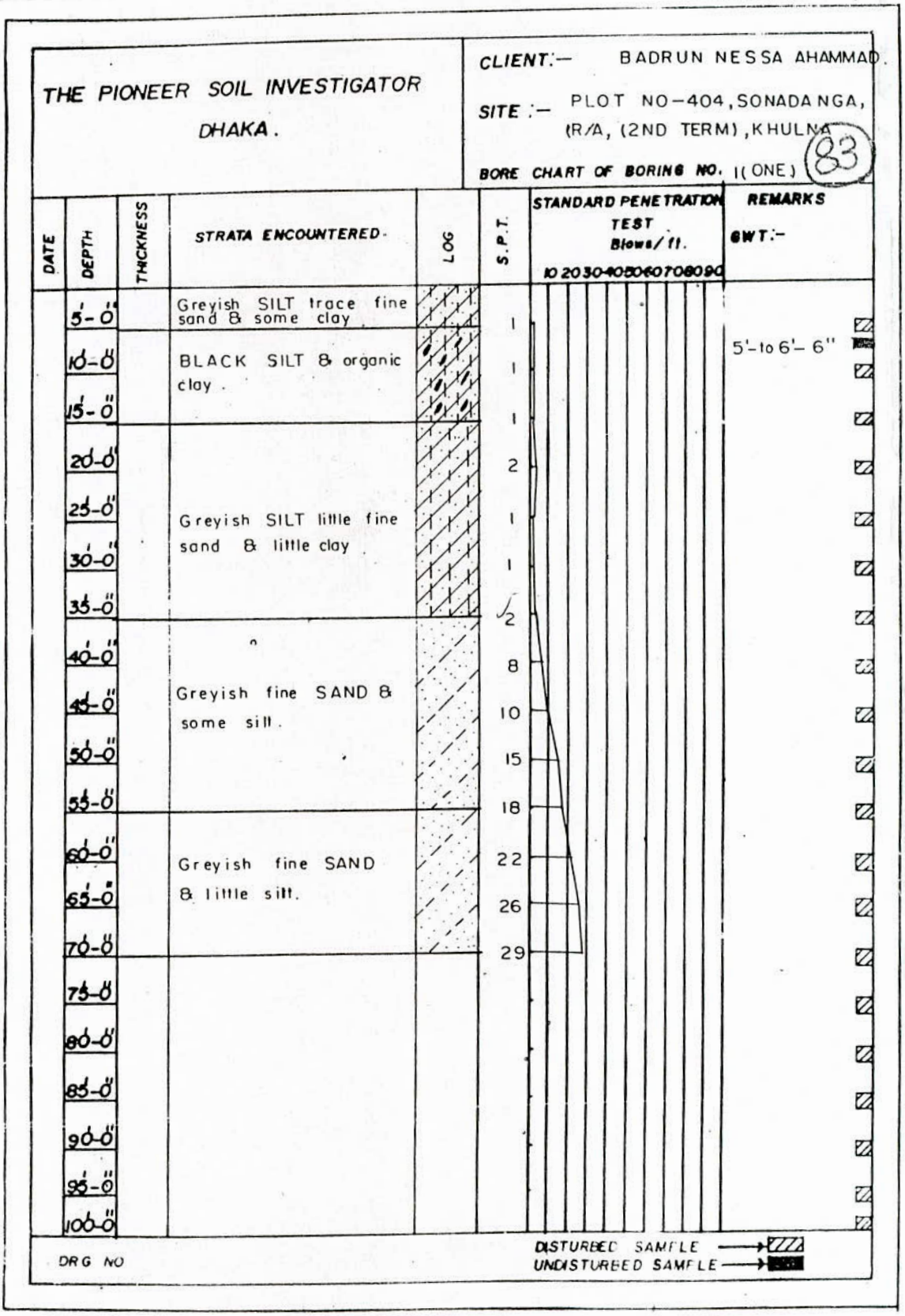
BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"		Grey, SILT, trace fine sand & some clay.		1		5'-1" to 6'-6"
	10'-0"				4		
	15'-0"				2		
	20'-0"		Black organic clay & trace silt.		2		
	25'-0"				3		
	30'-0"		Grey, SILT, little fine sand & little clay.		4		
	35'-0"				5		
	40'-0"		Grey, fine SAND, some silt.		21		
	45'-0"				25		
	50'-0"				28		
	55'-0"				33		
	60'-0"				37		
	65'-0"						
	70'-0"						
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE →

UNDISTURBED SAMPLE →


THE PIONEER SOIL INVESTIGATOR
DHAKA.
CLIENT:- BADRUN NESSA AHAMMAD.
SITE :- PLOT NO-404, SONADANGA, (R/A, (2ND TERM), KHULNA
BORE CHART OF BORING NO. 1(ONE)
83
DATE
DEPTH
THICKNESS
STRATA ENCOUNTERED.
LOG
S.P.T.
STANDARD PENETRATION TEST Blows/ft.
10 20 30 40 50 60 70 80 90
REMARKS
GWT:-
5'-0"
10'-0"
15'-0"
20'-0"
25'-0"
30'-0"
35'-0"
40'-0"
45'-0"
50'-0"
55'-0"
60'-0"
65'-0"
70'-0"
75'-0"
80'-0"
85'-0"
90'-0"
95'-0"
100'-0"
Greyish SILT trace fine sand & some clay
BLACK SILT & organic clay.
Greyish SILT little fine sand & little clay.
Greyish fine SAND & some silt.
Greyish fine SAND & little silt.
1
1
1
2
1
1
1/2
8
10
15
18
22
26
29
5'-to 6'- 6"
DISTURBED SAMPLE
UNDISTURBED SAMPLE
DRG NO

THE PIONEER SOIL INVESTIGATOR
DHAKA.

CLIENT:- MRS. FATEMA KHATUN

SITE:- PLOT NO. 2-A, K.D.A AVENUE KHULNA.

(84)

BORE CHART OF BORING NO. 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows/ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:-
	5'-0"				1		5' to 6'-6"
	10'-0"		Gray CLAY trace Fine sand & some silt		2		
	15'-0"				2		
	20'-0"				3		
	25'-0"				4		
	30'-0"				7		
	35'-0"				3		
	40'-0"				3		
	45'-0"		Gray fine SAND Same silt		14		
	50'-0"				18		

DRG NO.

DISTURBED SAMPLE ⟶
UNDISTURBED SAMPLE ⟶

THE PIONEER SOIL INVESTIGATOR
DHAKA

CLIENT:— A. SATTER SARDER (85)

SITE:— Plot No. 429 Road No.: Sonadanga R/A, 2nd Phase, Khulna.

BORE CHART OF BORING NO: 1 (ONE)

DATE	DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / ft. 10 20 30 40 50 60 70 80 90	REMARKS GWT:—
	5'-0"		Grey, SILT, trace, fine sand & some clay.		1		
	10'-0"				1		10'to11'-6"
	15'-0"				1		
	20'-0"		Black organic clay.		1		
	25'-0"				1		
	30'-0"		Grey, fine SAND, some silt.		10		
	35'-0"				11		
	40'-0"				11		
	45'-0"		Deep Grey, Medium to fine SAND & little silt.		21		
	50'-0"				29		
	55'-0"				33		
	60'-0"				34		
	65'-0"				37		
	70'-0"				40		
	75'-0"						
	80'-0"						
	85'-0"						
	90'-0"						
	95'-0"						
	100'-0"						

DRG NO

DISTURBED SAMPLE ——→ ▨
UNDISTURBED SAMPLE ——→ ■

PROJECT :- SAILORS QTR. AT SAILORS COLONY.

CLIENT :- EXECUTIVE ENGR. G.E.(NAVY) KHULNA.

LOCATION :- BOYRA, KHULNA.

BORING NO :-

W.T - 0'-0"

CRTS (86)
DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 5 15 25	SAMPLE DS	SAMPLE US	REMARKS
		0		Pale Yellow Soft Clay						▽
		5		Black Organic Soil		4		●		
		10		Gray Soft Clay		4		●		
		15				4		●		
		20		Dark Gray Medium To Stiff Clay		4		●		
		25		Gray Soft Clay		10		●		
		30		Gray Medium To Stiff Clay		4		●		
		35		Gray Clay With Silt Traces		6		●		
		40		Dark Gray Medium Stiff Clay		7		●		
		45		Dark Gray Medium Stiff Clay With Silt Traces		6		●		
		50				6		●		

APPROVAL :-

ENGINEER :-

PROJECT :- M.E.S. INSPECTION BUNGALOW. OF B.N.S. TITUMIR.

CLIENT :- EXECUTIVE ENGR. G.E. (NAVY), KHULNA.

LOCATION :- B.N.S. TITUMIR, KHULNA.

BORING NO :-

W.T - 0'-0"

CRTS 87

DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 10 30 50	SAMPLE DS	SAMPLE US	REMARKS
		0		Grayish Brown Soft Silty Clay						
		5		Yellow Medium Dense Silty Sand		3				
		10		Light Brownish Yellow Medium Dense Silty Sand		20				
		15		Light Brownish Yellow Loose To Medium Dense Silty Sand		21				
		20		Light Brownish Yellow Medium Dense Silty Sand		10				
		25		Yellow Loose To Medium Silty Sand		13				
		30		White Dense Silty Sand		9				
		35				42				
		40		Light Yellowish Brown Dense Silty Sand		42				
		45				43				
		50				44				

APPROVAL :-

ENGINEER :-

BORE LOG

88

Project : Construction of a Privet Building at Khulna		CRTS Civil, BIT Khulna.	
Client : M/s Gaffar Store, Helatola Road , Khulna			**Start** 26-6-2001
Location : Khulna.			**End** 26-6-2001
Bore hole number : 1	**W.T. : 1'- 1"**	Engineer	Sample

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	DS	US	Remark
0	Silty clay Gray						
5			6				
	Clay Gray						
10			3				
	Organic matter and clay Black						
15			5				
	Clay with organic matter Gray						
20			3				
	Clay with trace silt Gray						
25			6				
	Clay Dark gray						
30			3				
	Clay with trace silt Dark gray						
35			3				
	Very fine sand with trace clay Gray						
40			9				
	Very fine sand with trace clay Dark gray						
45			19				
	Sandy clay Gray						
50			8				

DISTURBED: SAND: CLAY : MATTER:

UNDISTURBED: SILT : ORGANIC :

BORE LOG

(89)

Project	: Construction of Office Building of RPATC, Boira, Khulna	**CRTS Civil, BIT Khulna.**
Client	: Executive Engineer, PWD, Khulna	**Start :**
Location	: Boira, Khulna	**End :**
Bore hole number : 1	**G.W.T.: 5′ – 3″**	**Engineer**

Depth (ft)	STRATA ENCOUNTERED	Bore Log	SPT Value	Blow number 10 20 30	Sample DS	Sample US	Remark
0	Clayey sand Brown						
5			6				
	Very fine sand Light brownish gray						
10			17				
	Very fine sand Gray						
15			14				
	Organic clay Black						
20							
	Organic clay Very dark gray		4				
25							
	Silty clay Gray		5				
30							
	Silty clay Gray		8				
35			5				
	Sandy clay Gray						
40			12				
	Sandy clay Gray						
45			6				
	Clay with trace organic Dark gray						
50			7				
	Very fine sand Gray						
55			6				
	Very fine sand Gray						
60			33				
	Very fine sand Gray						
70			16				
	Very fine sand Gray						
80			25				
	Very fine sand Gray						
90			16				

DISTURBED: SAND: CLAY :

UNDISTURBED: SILT : ORGANIC :

UNIQUE BORING AND ENGINEERING LTD.
34, GREEN ROAD, NOWAB MANSION
3rd Floor, Dhaka

BORE HOLE NO: BH-1 (90)
LOCATION : Khulna University, Khulna

CLIENT : KHULNA UNIVERSITY

PROJECT : Administrative Building

Strata encountered	Log	Sample	Moisture Content 25 50 75	SPT blows per 0.3 m penetration 10	Particle size Percentage: Clay	Silt	Sand	Shear Characteristic: Type of test	Cohesion, C	Friction Angle,	Consol. Property: Void ratio, e	Comp. Index, C	S.P. Gravity, G	Dry den.(gm/cc)
Black very soft organic silt, trace clay				1 1 1										
Gray soft to firm clayey silt				2 2 5 5 6 5 5 6 6 7										
Gray stiff to firm clayey silt				9 8 9 8 9										

□ Disturbed sample (Split spoon)
■ Undisturbed sample (Shelby tube)
GWT : 0.45m below EGL

○ Moisture content —●— SPT values

PL LL

PROJECT - Residential Building

CLIENT - Mr. K. Monsur Alam

LOCATION: Sonadanga R/A, Khulna

BORING NO - 1

W.T - 3'-0"

CRTS (59)

DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 2 4 6 8 10	SAMPLE DS	SAMPLE US	REMARKS
		5	Yellowish brown Stiff clay		3				
		10	Gray clay and Black rotten leaves		3				
		15	Gray Clay, trace silt		4				
		20	Dark gray Clay, trace silt		3				
		25	Dark gray Clay		3				
		30	Dark gray Stiff clay, trace silt		4				
		35	Dark gray Stiff clay, trace silt		5				
		40	Gray Clay with very fine sand, trace mica		5				
		45	Gray Fine sand, trace mica		4				
		50	Light gray Fine sand, trace mica		6				

APPROVAL ENGINEER - Rahul 25.01.96

PROPOSED DIVISIONAL MUSEUM AT KHULNA

CLIENT :- EXECUTIVE ENGR., PWD-1, KHULNA

LOCATION :-NEAR ZIA HALL, KHULNA

BORING NO :- 1

W.T - 1'-6"

CRTS (60)

DEPT. OF CIVIL ENGG.
B.I.T. KHULNA

DATE	DEPTH RL	DEPTH FT.	THICKNESS	STRATA ENCOUNTERED	BORE LOG	S.P.T VALUE	STANDARD PENETRATION TEST CURVE 10 20 30 40 50	SAMPLE DS	SAMPLE US	REMARKS
		0		Brown Silty clay		0				SZ
		5		Dark gray Soft silty clay		7				
		10				2				
		15		Black Organic deposits		6				
		20		Clay Stiff silty clay		7				
		25				8				
		30		Dark gray Stiff silty clay		5				
		35				7				
		40				7				
		45		Dark gray Fine sand						
		50				12				

APPROVAL :-

ENGINEER :-

THE PIONEER SOIL INVESTIGATOR
DHAKA

CLIENT : **KHULNA UNIVERSITY**
SITE : SHIRLEY ISLAM LIBRARY, KHULNA UNIVERSITY, KHULNA.
BORE CHART OF BORING NO : **1(ONE)**

92

DATE / DEPTH	THICKNESS	STRATA ENCOUNTERED	LOG	S.P.T.	STANDARD PENETRATION TEST Blows / 11 (10 20 30 40 50 60 70 80 90)	REMARKS GWT: 3'-0"
5'-0"		Grey very soft **CLAY** trace fine sand little silt		0+1=1		
10'-0"		Black Organic CLAY		1+2=3		
15'-0"				1+1=2		
20'-0"		Grey very soft to stiff **CLAY** trace fine sand little silt		1+1=2		16'to17'-6"
25'-0"				2+3=5		
30'-0				2+2=4		26'to27'
35'-0"				2+2=4		
40'-0"				2+3=6		36'to37'
45'-0"				2+3=5		
50'-0"				3+3=0		46'to47'-6"
55'-0"				6+7=13		
60'-0"				6+7=13		
65'-0"				6+8=14		
70'-0"				7+8=15		
75'-0"		Grey stiff to hard **CLAY** trace fine sand some silt		7+9=16		
80'-0"				6+8=14		
85'-0"				7+9=16		
90'-0"				8+10=18		
95'-0"				8+10=18		
100'-0"				19+23=42		

DISTURBED SAMPLE
UNDISTURBED SAMPLE

PREMIER BORING AND ENGINEERS

(93)

Client: Mr. Md. Joynal Abedin Sarder
Project :- Multi Storied Building
Location :- Dag no C. S.-3354, S.A.-3434, Mouja-Teleganti
T.T. College Gate, Teleganti road, Khulna,Bangladesh.
Boring Date:- 17-03-2006

Bore Hole No : 2(Two)
Ground Water : 5'-0"
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Grey medium stiff Sandy Clay.		4 inch DIA HOLE		7		
D-2	Disturbed	10	5	Grey medium stiff Sandy Clay.				8		
D-3	Disturbed	15	5	Black organic material.				5		
D-4	Disturbed	20	5	Black organic material.				5		
D-5	Disturbed	25	5	Grey very soft Clay.				2		
D-6	Disturbed	30	5	Grey soft Clay.				3		
D-7	Disturbed	35	5	Grey soft Clay, trace Clay.				3		
D-8	Disturbed	40	5	Grey soft Clay, trace organic.				4		
D-9	Disturbed	45	5	Grey medium stiff Clay.				5		
D-10	Disturbed	50	5	Grey medium stiff Clay.				5		
D-11	Disturbed	55	5	Grey medium stiff Clay.				6		
D-12	Disturbed	60	5	Grey medium stiff Clay.				8		
D-13	Disturbed	65	5	Grey medium stiff Silty Clay.				8		
D-14	Disturbed	70	5	Grey medium stiff Silty Clay.				8		

PREMIER BORING AND ENGINEERS

(94)

Client: Mr. Shah Alam Bepari
Project :- Multi Storied Building
Location :- Plot no - 81, Road no - 186,
Khalishpur Housing Estate, Khulna, Bangladesh.
Boring Date:- 08-03-2006

Bore Hole No : 1 (One)
Ground Water : 5'-0"
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Brown soft Sandy Clay.				4		
D-2	Disturbed	10	5	Grey loose Sandy Silt.				10		
D-3	Disturbed	15	5	Grey medium dense Sandy Silt.				12		
D-4	Disturbed	20	5	Grey medium dense Sandy Silt.				20		
D-5	Disturbed	25	5	Grey medium dense Silty Sand.				22		
D-6	Disturbed	30	5	Grey stiff Sandy Clay.				12		
D-7	Disturbed	35	5	Grey very stiff Sandy Clay.				29		
D-8	Disturbed	40	5	Grey very stiff Sandy Clay.				16		
D-9	Disturbed	45	5	Grey very stiff Silty Clay.				26		
D-10	Disturbed	50	5	Grey medium dense Silty Sand.				28		

PREMIER BORING AND ENGINEERS

95

Client: Mr. Kalidas Roy
Project :- Multi Storied Building
Location :- C.S.Dag No- 5676, Mouja- Baniakhamar, J.L. no- 3, Sher-e- Bangla road, Khulna, Bangladesh.
Boring Date:- 26-02-2006

Bore Hole No : 1(One)
Ground Water : 5'-6"
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H-1	Disturbed	5	5	Grey very soft Clay.			2		
H-2	Disturbed	10	5	Black organic material.			2		
H-3	Disturbed	15	5	Black organic material.			2		
H-4	Disturbed	20	5	Grey very soft Clay.			1		
H-5	Disturbed	25	5	Grey very soft Silty Clay.			1		
H-6	Disturbed	30	5	Grey very soft Silty Clay.			2		
H-7	Disturbed	35	5	Grey very soft Silty Clay.			2		
H-8	Disturbed	40	5	Grey very soft Silty Clay.			2		
H-9	Disturbed	45	5	Grey medium stiff Silty Clay.			8		
H-10	Disturbed	50	5	Grey medium stiff Silty Clay.			8		
H-11	Disturbed	55	5	Grey stiff Silty Clay.			9		
H-12	Disturbed	60	5	Grey medium stiff Silty Clay.			10		
H-13	Disturbed	65	5	Grey stiff Silty Clay.			12		
H-14	Disturbed	70	5	Grey very stiff Sandy Clay.			20		

PREMIER BORING AND ENGINEERS

96

Client: Mrs. Minu Momtaz & Mr. S.M. Zahangir
Project :- Multi Storied Building
Location :- Majid Sarani Plot no - 129 ka,
Majid Sarani, P.S.- Sonadanga, Khulna, Bangladesh.
Boring Date:- 24-02-2006

Bore Hole No : 2 (Two)
Ground Water : 6'-0'
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft.	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Grey soft Silty Clay.				4		
D-2	Disturbed	10	5	Grey soft Silty Clay.				4		
D-3	Disturbed	15	5	Black organic material.				2		
D-4	Disturbed	20	5	Grey soft Silty Clay.				3		
D-5	Disturbed	25	5	Grey soft Silty Clay.				3		
D-6	Disturbed	30	5	Grey stiff Sandy Clay.				14		
D-7	Disturbed	35	5	Grey medium dense Silty Sand.				16		
D-8	Disturbed	40	5	Grey dense Silty Sand.				39		
D-9	Disturbed	45	5	Grey dense Silty Sand.				40		
D-10	Disturbed	50	5	Grey dense Silty Sand.				44		
D-11	Disturbed	55	5	Grey dense Silty Sand.				45		
D-12	Disturbed	60	5	Grey dense Silty Sand.				46		

PREMIER BORING AND ENGINEERS

(97)

Client: Mr. Sk. Md. Azizul Haque
Project :- Multi Storied Building
Location :- 31, B.K. Roy Road,
Dalmill moor, Khulna, Bangladesh.
Boring Date:- 06-05-2006

Bore Hole No : 2 (Two)
Ground Water :
R.L. = 0'—0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Brown medium stiff Clay.				5		
D-2	Disturbed	10	5	Grey loose Clayey Silt.				4		
D-3	Disturbed	15	5	Grey Soft Clay.				4		
D-4	Disturbed	20	5	Blackish organic soft Clay.				6		
D-5	Disturbed	25	5	Grey medium stiff Clay.				6		
D-6	Disturbed	30	5	Grey medium stiff Clay.				8		
D-7	Disturbed	35	5	Grey stiff Sandy Clay.				9		
D-8	Disturbed	40	5	Grey medium dense Clayey Sand.				15		
D-9	Disturbed	45	5	Grey medium dense Sandy Silt.				25		
D-10	Disturbed	50	5	Grey very dense Silty Sand.				50		
D-11	Disturbed	55	5	Grey very dense Silty Sand.				50		

PREMIER BORING AND ENGINEERS

(98)

Client: Mrs. Fatema Zaman
Project :- Multi Storied Building
Location :- C.S. plot no - 972(part), J.L.no - 04, Mouja -Tootpara, P.S.& Dist.- Khulna, Bangladesh.
Boring Date:- 29-04-2006

Bore Hole No : 1 (One)
Ground Water :
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Grey medium stiff Clay.		DIA HOLE 4"		5		
D-2	Disturbed	10	5	Grey loose Sandy Silt.				6		
D-3	Disturbed	15	5	Black organic material.				3		
D-4	Disturbed	20	5	Blackish organic soft Clay.				2		
D-5	Disturbed	25	5	Grey soft Silty Clay.				3		
D-6	Disturbed	30	5	Grey soft Silty Clay.				3		
D-7	Disturbed	35	5	Grey medium dense Silty Sand.				10		
D-8	Disturbed	40	5	Grey medium dense Silty Sand, little Clay.				19		
D-9	Disturbed	45	5	Grey medium dense Silty Sand.				26		
D-10	Disturbed	50	5	Grey medium dense Silty Sand.				29		

PREMIER BORING AND ENGINEERS

(99)

Client: Mr. Reza Ahmed
Project :- Multi Storied Building
Location :- C.S.plot no- 1026(part), J.L.no - 03, Mouja -Tootpara, P.S.& Dist.- Khulna, Bangladesh.
Boring Date:- 11-03-2006

Bore Hole No : 1 (One)
Ground Water : 5'-8'
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
B-1	Disturbed	5	5	Brown medium stiff Silty Clay.				6		
B-2	Disturbed	10	5	Grey very soft Silty Clay.				2		
B-3	Disturbed	15	5	Black organic material.				4		
B-4	Disturbed	20	5	Grey soft Silty Clay.				3		
B-5	Disturbed	25	5	Grey medium dense Silty Sand.				25		
B-6	Disturbed	30	5	Grey medium dense Silty Sand.				27		
B-7	Disturbed	35	5	Grey medium dense Silty Sand.				29		
B-8	Disturbed	40	5	Grey dense Silty Sand.				31		
B-9	Disturbed	45	5	Grey dense Silty Sand.				33		
B-10	Disturbed	50	5	Grey dense Silty Sand.				34		

PREMIER BORING AND ENGINEERS

100

Client: Mrs. Farjana Alam Shilpi
Project :- Multi Storied Building
Location :-Dag no C.S.- 4820,4821,4822, S.A. Khatian-922,928
J.L.no-3, Mouja-Baniakhamar, West Baniakhamar, Khulna.
Boring Date:- 04-08-2006

Bore Hole No : 2 (Two)
Ground Water : Variable
R.L.=0'—0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
B-1	Disturbed	5	5	Color=Brown Condition=Medium stiff Soil Type=Sandy Clay.		Depth in Feet		6		
B-2	Disturbed	10	5	Color=Brown Condition=Medium stiff Soil Type=Sandy Clay.				6		
B-3	Disturbed	15	5	Black organic material.				7		
B-4	Disturbed	20	5	Color=Grey Condition=Medium stiff Soil Type= Silty Clay.				6		
B-5	Disturbed	25	5	Color=Grey Condition=Soft Soil Type=Silty Clay.				3		
B-6	Disturbed	30	5	Color=Grey Condition=Medium Stiff Soil Type=Silty Clay.				6		
B-7	Disturbed	35	5	Color=Grey Condition=Stiff Soil Type=Silty Clay.				10		
B-8	Disturbed	40	5	Color=Grey Condition=Medium stiff Soil Type=Silty Clay.				8		
B-9	Disturbed	45	5	Color=Grey Condition=very stiff Soil Type=Sandy Clay.				24		
B-10	Disturbed	50	5	Color=Grey Condition=medium Dense Soil Type=Silty Sand.				28		
B-11	Disturbed	55	5	Color=Grey Condition=medium stiff Soil Type=Clay.				8		
B-12	Disturbed	60	5	Color=Grey Condition=medium stiff Soil Type=Clay.				8		

PREMIER BORING AND ENGINEERS

(102)

Client: Mrs. Dipika Pal
Project :- Multi Storied Building
Location :- Dag no C.S. - 1425, S.A.- 1624, S.A. Khatian-2742
J.L.no-3, Mouja-Banlakhamar, Sonadanga East Lane, Khulna.
Boring Date:- 03-08-2006

Bore Hole No : 2 (Two)
Ground Water : Variable
R.L. = 0′ — 0″

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Brown medium stiff Silty Clay.				6		
D-2	Disturbed	10	5	Brown loose Silty Sand.				6		
D-3	Disturbed	15	5	Black organic material.				6		
D-4	Disturbed	20	5	Dark Grey soft Clay.				3		
D-5	Disturbed	25	5	Grey soft Clay.				3		
D-6	Disturbed	30	5	Grey medium stiff Silty Clay.				6		
D-7	Disturbed	35	5	Grey medium stiff Sandy Clay.				6		
D-8	Disturbed	40	5	Grey stiff Sandy Clay.				11		
D-9	Disturbed	45	5	Grey stiff Sandy Clay				13		
D-10	Disturbed	50	5	Grey dense Silty Sand.				36		
D-11	Disturbed	55	5	Grey very stiff Sandy Clay.				19		
D-12	Disturbed	60	5	Grey very stiff Sandy Clay.				18		

PREMIER BORING AND ENGINEERS

104

Client: Mr. Mahmood Hossain
Project :- Multi Storied Building
Location :- Plot no - 477, Road no -24, Nirala r/a,
P.S.- Sonadanga , Khulna, Bangladesh.
Boring Date:- 07-07-2006

Bore Hole No : 1 (One)
Ground Water : Variable
R.L. = 0'-0"

Number of Blows	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
B-1	Disturbed	5	5	Grey soft Clay.				3		
B-2	Disturbed	10	5	Black organic material.				4		
B-3	Disturbed	15	5	Grey very soft Clay.				2		
B-4	Disturbed	20	5	Grey medium stiff Silty Clay.				6		
B-5	Disturbed	25	5	Grey very soft Sandy Clay.				1		
B-6	Disturbed	30	5	Grey very soft Sandy Clay.				2		
B-7	Disturbed	35	5	Grey medium stiff Sandy Clay.				6		
B-8	Disturbed	40	5	Grey stiff Sandy Clay.				11		
B-9	Disturbed	45	5	Grey medium dense Silty Sand.				11		
B-10	Disturbed	50	5	Grey medium dense Silty Sand.				22		
B-11	Disturbed	55	5	Grey medium dense Silty Sand.				25		
B-12	Disturbed	60	5	Grey medium dense Silty Sand.				30		
B-13	Disturbed	65	5	Grey dense Silty Sand.				33		
B-14	Disturbed	70	5	Grey dense Silty Sand.				35		

PREMIER BORING AND ENGINEERS

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Client: Mrs. Tahmina Rahman Mina & Others
Project :- Multi Storied Building
Location :- on Dag no C.S.- 3310, S.A.- 4388,
Mouja- Baniakhamar, Shaikpara, Khulna, Bangladesh.
Boring Date:- 22-07-2006

Bore Hole No : 1 (One)
Ground Water : Variable
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Grey very soft Silty Clay.				1		
D-2	Disturbed	10	5	Grey very soft Silty Clay.				1		
D-3	Disturbed	15	5	Grey very soft Silty Clay.				1		
D-4	Disturbed	20	5	Black organic material.				5		
D-5	Disturbed	25	5	Grey soft Clay.				4		
D-6	Disturbed	30	5	Grey medium stiff Clayey Silt.				11		
D-7	Disturbed	35	5	Grey medium dense Silty Sand.				17		
D-8	Disturbed	40	5	Grey medium dense Silty Sand.				17		
D-9	Disturbed	45	5	Grey medium dense Silty Sand.				20		
D-10	Disturbed	50	5	Grey dense Silty Sand.				26		
D-11	Disturbed	55	5	Grey dense Silty Sand.				24		
D-12	Disturbed	60	5	Grey dense Silty Sand.				27		

PREMIER BORING AND ENGINEERS

(106)

Client: Mrs. Nasrina Parvin
Project :- Multi Storied Building
Location :- Dag no S.A.- 3600 & 3599, J.L. no - 3, Mouja - Baniakhamar, Shantidham moor, Khulna.
Boring Date:- 18-04-2006

Bore Hole No : 1 (One)
Ground Water :
R.L.=0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
D-1	Disturbed	5	5	Grey medium stiff Clayey Silt.		4" DIA HOLE		5		
D-2	Disturbed	10	5	Grey medium stiff Clayey Silt.				5		
D-3	Disturbed	15	5	Black organic material.				3		
D-4	Disturbed	20	5	Grey medium stiff Clay.				5		
D-5	Disturbed	25	5	Grey medium stiff Silty Clay.				6		
D-6	Disturbed	30	5	Grey loose Silty Sand.				10		
D-7	Disturbed	35	5	Grey medium dense Silty Sand.				16		
D-8	Disturbed	40	5	Grey medium dense Silty Sand.				21		
D-9	Disturbed	45	5	Grey medium dense Silty Sand.				23		
D-10	Disturbed	50	5	Grey medium dense Silty Sand, little Clay				16		
D-11	Disturbed	55	5	Grey medium dense Silty Sand, little Clay.				16		
D-12	Disturbed	60	5	Grey medium dense Silty Sand.				20		

PREMIER BORING AND ENGINEERS

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Client: Mr. Sultan Ahmed
Project :- Multi Storied Building
Location :- Dag No S.A-5041(part), C.S.Khatian-5041, J.L no-04,Mouja-Tootpara, Kabi Nazrul Road, Khulna
Boring Date:- 16-02-2006

Bore Hole No : 1 (One)
Ground Water : 6'-0"
R.L.=0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia. of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H-1	Disturbed	5	5	Grey very soft Clay.		4"		2		
H-2	Disturbed	10	5	Grey very soft Clay, trace organic.				2		
H-3	Disturbed	15	5	Black organic material.				2		
H-4	Disturbed	20	5	Grey very soft Clay.				2		
H-5	Disturbed	25	5	Grey soft Clayey Silt.				4		
H-6	Disturbed	30	5	Grey medium stiff Clayey Silt.				8		
H-7	Disturbed	35	5	Grey medium stiff Silty Clayey.				5		
H-8	Disturbed	40	5	Grey medium stiff Silty Clay.				9		
H-9	Disturbed	45	5	Grey medium dense Silty Sand.				25		
H-10	Disturbed	50	5	Grey medium dense Silty Sand.				30		
H-11	Disturbed	55	5	Grey medium dense Silty Sand.				28		
H-12	Disturbed	60	5	Grey medium dense Silty Sand.				30		

PREMIER BORING AND ENGINEERS

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Client: Mr. Sayed Ahmed Mamun
Project :- Multi Storied Building
Location :- S.A.Dag No- 7614,7615, S.A. Khatian-3074
Mouja-Banlakhamar, B.K. Main road,Khulna,Bangladesh.
Boring Date:- 13-02-2006

Bore Hole No : 1(One)
Ground Water : 5'-6"
R.L. = 0'-0"

Number of Bores	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H-1	Disturbed	5	5	Grey very soft Clay.			1		
H-2	Disturbed	10	5	Grey very soft Clay.			2		
H-3	Disturbed	15	5	Grey very soft Clay.			2		
H-4	Disturbed	20	5	Grey very soft Clay.			2		
H-5	Disturbed	25	5	Grey loose Silty Sand.			10		
H-6	Disturbed	30	5	Grey medium dense Silty Sand.			12		
H-7	Disturbed	35	5	Grey medium dense Silty Sand.			18		
H-8	Disturbed	40	5	Grey medium dense Silty Sand.			18		
H-9	Disturbed	45	5	Grey medium dense Silty Sand.			18		
H-10	Disturbed	50	5	Grey medium dense Sandy Silt.			18		
H-11	Disturbed	55	5	Grey medium stiff Silty Clay.			8		
H-12	Disturbed	60	5	Grey medium stiff Silty Clay.			8		
H-13	Disturbed	65	5	Grey medium dense Sandy Silt.			11		
H-14	Disturbed	70	5	Grey medium dense Sandy Silt.			18		

PREMIER BORING AND ENGINEERS (109)

Client: Mr. Md. Samsul Islam & Others
Project :- Multi Storied Building
Location :-S.A. dag no-4073,Khatian-1284/1,J.L. no-3, Mouja- Goalpara, Polytechnic College road, Khulna.
Boring Date:- 21-07-2006

Bore Hole No : 1(One)
Ground Water : Variable
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	No. of Blows	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H1	Disturbed	5	5	Grey loose Silty Sand.				8		
H2	Disturbed	10	5	Grey very soft Clayey Silt.				2		
H3	Disturbed	15	5	Grey very soft Silty Clay.				2		
H4	Disturbed	20	5	Black organic material.				4		
H5	Disturbed	25	5	Grey medium stiff Clay.				5		
H6	Disturbed	30	5	Grey medium stiff Clay.				7		
H7	Disturbed	35	5	Grey soft Silty Clay.				4		
H8	Disturbed	40	5	Grey stiff Silty Clay.				8		
H9	Disturbed	45	5	Grey stiff Silty Clay.				10		
H10	Disturbed	50	5	Grey medium stiff Silty Clay.				6		
H11	Disturbed	55	5	Grey stiff Silty Clay.				9		
H12	Disturbed	60	5	Grey very stiff Silty Clay.				16		
H13	Disturbed	65	5	Grey stiff Silty Clay.				12		
H14	Disturbed	70	5	Grey stiff Clay.				9		
H15	Disturbed	75	5	Grey stiff Clay.				11		
H16	Disturbed	80	5	Grey stiff Clay.				11		

PREMIER BORING AND ENGINEERS

(110)

Client: Mr. Alhaz Wadudur Rahman Panna
Project :- Multi Storied Building
Location :- Dag no - 20708, Khatian no - 17869,
J.L. no- 3, Mouja- Banlakhamar, Khulna, Bangladesh.
Boring Date:- 26-06-2006

Bore Hole No : 1 (One)
Ground Water : Variable
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H1	Disturbed	5	5	Grey stiff Sandy Clay.			7		
H2	Disturbed	10	5	Grey very soft Clay.			1		
H3	Disturbed	15	5	Black organic material.			4		
H4	Disturbed	20	5	Grey soft Clay.			4		
H5	Disturbed	25	5	Grey soft Clay.			3		
H6	Disturbed	30	5	Grey medium stiff Silty Clay.			6		
H7	Disturbed	35	5	Grey medium stiff Silty Clay.			5		
H8	Disturbed	40	5	Grey medium dense Clayey Sand.			11		
H9	Disturbed	45	5	Grey medium dense Sandy Silt with little Clay.			17		
H10	Disturbed	50	5	Grey medium dense Clayey Sand.			20		
H11	Disturbed	55	5	Grey medium dense Silty Sand.			28		
H12	Disturbed	60	5	Grey very dense Silty Sand.			50		
H13	Disturbed	65	5	Grey stiff Clay.			9		
H14	Disturbed	70	5	Grey stiff Clay.			9		
H15	Disturbed	75	5	Grey stiff Clay.			10		
H16	Disturbed	80	5	Grey stiff Clay.			12		

PREMIER BORING AND ENGINEERS

(111)

Client: Mr. Md. Nurul Haque & Mr. Md. Abu Taher
Project :- Multi Storied Building
Location :- C.S. dag no- 317 & 323(Part), J.L. no -3,
Mouja- Helatala, Khulna, Bangladesh.
Boring Date:- 16-04-2006

Bore Hole No : 1(One)
Ground Water : 5'-0"
R.L. = 0'-0"

Number of Sample	Disturbed / Undisturbed	Depth in Ft	Thickness	Strata Encounted	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H1	Disturbed	5	5	Grey medium stiff Silty Clay.		6		
H2	Disturbed	10	5	Grey medium stiff Silty Clay.		6		
H3	Disturbed	15	5	Grey soft Clay.		4		
H4	Disturbed	20	5	Black organic material.		5		
H5	Disturbed	25	5	Grey soft Silty Clay.		4		
H6	Disturbed	30	5	Grey soft Silty Clay.		3		
H7	Disturbed	35	5	Grey medium stiff Silty Clay.		5		
H8	Disturbed	40	5	Grey medium stiff Silty Clay.		6		
H9	Disturbed	45	5	Grey medium stiff Silty Clay.		7		
H10	Disturbed	50	5	Grey stiff Silty Clay.		9		
H11	Disturbed	55	5	Grey medium stiff Silty Clay.		8		
H12	Disturbed	60	5	Grey stiff Silty Clay.		10		
H13	Disturbed	65	5	Grey stiff Silty Clay.		11		
H14	Disturbed	70	5	Grey stiff Silty Clay.		14		
H15	Disturbed	75	5	Grey very stiff Silty Clay.		18		
H16	Disturbed	80	5	Grey medium dense Sandy Silt, little Clay.		27		
H17	Disturbed	90	5	Grey medium dense Silty Sand.		24		
H18	Disturbed	100	5	Grey dense Silty Sand.		45		

PREMIER BORING AND ENGINEERS (112)

Client:- Mr. Md. Abdul Jabber
Project :- Multi Storied Building
Location :- C. S.Dag No- 5754, J.L.no - 03,
Mouja-Banlakhamar, Prantik r/a, Khulna,Bangladesh.
Boring Date:- 23-02-2006

Bore Hole No : 1(One)
Ground Water : 4'-0"
R.L. = 0'-0"

Number of Sample	Type of Sample	Depth in Ft	Thickness	Strata Encounted	Lithological Log	Dia of Boring	Standard Penetration Test Curve (0 5 10 15 20 25 30 35 40 45 50)	S.P.T. Value	Type of Sample: Dist.	Type of Sample: Undist.
H-1	Disturbed	5	5	Grey very soft Clay.				2		
H-2	Disturbed	10	5	Black organic material.				2		
H-3	Disturbed	15	5	Grey very soft Clay.				2		
H-4	Disturbed	20	5	Grey very soft Clay.				3		
H-5	Disturbed	25	5	Grey soft Silty Clay.				4		
H-6	Disturbed	30	5	Grey medium stiff Silty Clay.				8		
H-7	Disturbed	35	5	Grey medium stiff Silty Clay.				7		
H-8	Disturbed	40	5	Grey medium stiff Silty Clay.				8		
H-9	Disturbed	45	5	Grey medium stiff Silty Clay.				9		
H-10	Disturbed	50	5	Grey medium stiff Sandy Clay.				10		
H-11	Disturbed	55	5	Grey stiff Silty Clay.				11		
H-12	Disturbed	60	5	Grey stiff Silty Clay.				15		
H-13	Disturbed	65	5	Grey stiff Silty Clay.				11		
H-14	Disturbed	70	5	Grey stiff Silty Clay.				12		