DATABASE OF SOIL PROPERTIES ALONG IPOH-LUMUT HIGHWAY

By

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FINAL PROJECT REPORT

Submitted to the Civil Engineering Programme
in Partial Fulfillment of the Requirements
for the Degree
Bachelor of Engineering (Hons)
(Civil Engineering)

Universiti Teknologi Petronas
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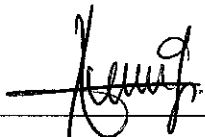Perak Darul Ridzuan

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CERTIFICATION OF APPROVAL

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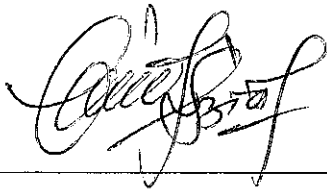(Civil Engineering)

Approved:

_____
Miss Niraku Rosmawati Binti Ahmad
Project Supervisor

UNIVERSITI TEKNOLOGI PETRONAS

TRONOH, PERAK

June 2007

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CERTIFICATION OF ORIGINALITY

This is to certify that I am responsible for the work submitted in this project, that the original work is my own except as specified in the references and acknowledgements, and that the original work contained herein have not been undertaken or done by unspecified sources or persons.

Lily Suziana Binti Yacob

ABSTRACT

The project aims is to create database system namely "Database of Soil Properties along Ipoh-Lumut Highway". Based on the interviews conducted with JKR Perak and MRCB, database in Malaysia is still new and not applicable in their storing data system. The database is designed to manage large bodies of information. The database of soil properties are needed to help many researchers, engineers and contractors to evaluate the soil condition for road maintenance, ground improvement and neighborhoods development. They could generate this data manually, but it is a long job due to many procedures needs to be followed before they can access the data. The main objective of this project is to organize, store, and retrieve information from Soil Investigation data as efficiently and effectively. The scope of study is along Ipoh Lumut Highway. This project involves the soil profiling about 34 600 m long. The highway consists of 5 major chainages which are Sitiawan, Ayer Tawar, Bota Kanan, Sri Iskandar, Tronoh and Pusing. The most predominant soil between the chainage 300 m until chainage 34 944 m is silty clay with average thickness of 6 m. The engineer needs to be aware with the problem that may occur in the soft clay. The softwares used in this project are Map Info Professional, Microsoft Excel and Microsoft Visual Basic. The methods used to gather the information are by conducting an interview, information gathering from the journals, developing the database and generate the soil profile. In conclusions, the database applications will give benefits to all individual and related organization to do their findings or research regarding soil properties and engineering characteristics in Malaysia and the applications of database will be more effective in presenting better information.

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All praise be to Allah, Lord of the worlds, who, through His mercy and grace, has revealed some of His knowledge to me in finishing this project. Verily all good are from Allah and all shortcomings are due to my own weaknesses.

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CHAPTER 1

INTRODUCTION

1.1 BACKGROUND

Malaysia is lack of proper system of storing data. Based on the interviews conducted with JKR Perak and MRCB, database in Malaysia is still new and not applicable in their storing data system. As example, the students having difficulties to gather the data because many procedures need to be followed such as conducting an interview and information gathering from one department to another department. It is a long job for user to retrieve the information. The applications of database with systematic way of storing data will be applied to soil properties and the engineering characteristics. The importance of a comprehensive database has often been emphasized in the development planning in Malaysia such as for road development.

The database is needed and usually designed to manage large bodies of information. Before this, database system is used extensively in bank application to facilitate customer. Multiple users can use the system with faster response time and every user of the system should be able to access the data. These concerns had lead to the creation of database of soil properties along Ipoh-Lumut Highway. Database of soil properties is required for user to easily review the existing soil properties in data gathering and to search for ways and means to improve the soil condition for current development. Improper systems of storing data in Malaysia give difficulties to user to manage and maintain the data and records. The database system is necessary to assist people in handling data redundancy and inconsistency where same information may be duplicated in several places or all copies may not be updated properly.

Database is a data structure used to store organized information. It is a set of application programs used to access, update and manage data which form the data management system. A database is typically made up of many linked tables of rows and columns. Database software, such as Map Info Professional and Microsoft Visual Basic used to help individuals organize large amounts of information in a way where the data can be easily searched, sorted, and updated. Extensive data and records about soil properties collected during the soil survey will be summarized in the database. The sources of the data are from soil borings made during the course of the survey and the laboratory analyses of samples selected from representative soil profiles in the field. When the engineers carry out soil borings during field mapping, several important soil properties and engineering characteristics will be identified. Database will be created by recording all the data and convert it into the soil profile.

1.2 PROBLEM STATEMENT

This project details the problem caused by improper filing system in Malaysia. It then considers the concern of establishing such a program or software to create an interactive and user friendly database. A proper way of storing and collecting data for soil is required to easy access. The main goal of the project is to provide an environment that is both convenient and efficient to use in retrieving information from the database and storing information into the database. This concern includes a detailed description of the soil properties and engineering characteristics. The database of soil properties are needed to help many researchers, engineers and contractors evaluate the soil condition for road maintenance, ground improvement and neighborhoods development. Although they could generate this data manually, but it is a long job due to many procedures need to be followed before they can access the data. The database functionality will manage the soil characteristic in a simple manner and quick access. Soil properties and engineering characteristics at different location are to be collected and gather based on soil investigation done at site. All the information is to be installed in systematize way called database.

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1.3 OBJECTIVES AND SCOPE OF STUDY

1.3.1 Objective

There are several objectives needed to be achieved in this project which are:

- To organize, store, and retrieve information from Soil Investigation data as efficiently and effectively.
- To generate more efficient way of creating the soil profile and storing the data using GUI (Graphical User Interface).

1.3.2 Scope of Study

These studies focus on the implementation of database for the soil properties. Scope of study will be within Perak area which is along Ipoh Lumut Highway. To accomplish the project, research, allocating the resource, work planning, and interview are performed. This project involves the soil profiling about 34 600 m long.

CHAPTER 2

LITERATURE REVIEW AND/OR THEORY

2.1 BACKGROUND OF IPOH-LUMUT HIGHWAY

Soil boring data had been provided by JKR Perak to be included in Map Info Software. The boring method depends on soil type. For Ipoh-Lumut Highway, they are using rock coring method. Rotary open hole drilling and rotary core drilling are the traditional methods of drilling for rock exploration in which the drill bit is rotated on the bottom of the borehole. There are two basic types of rotary drilling; in which the drill bits cuts all the material within the diameter of the borehole and core drilling in which an annual bit fixed to the bottom of the outer rotating tube of a rotary core barrel cuts a core, which is returned within the inner stationary tube of the core barrel and brought to the surface for examination and testing.

This project involves the soil profiling about 34 600 m long. There are about 5 main chainages available along this highway which is Sitiawan, Ayer Tawar, Bota Kanan, Sri Iskandar, Tronoh and Pusing. The database consists of depth of borehole, Atternberg limit (liquid limit, plastic limit, and plasticity index), wet sieve grading, M.Proctor, CBR Ratio, colour and type of soil. The main function of this database is for road maintenance. Several aspects of the soil properties are important during the road construction and the road maintenance. Soil properties important in the evaluation of a site for its resistance to erosion include particle size, permeability, water retention characteristics, compressibility, shear strength, void ratio or porosity, shrink-swell potential, liquid limit and plasticity index. Soil developmental characteristics such as horizonation, depth to bedrock or parent material, and depth to seasonal water table are helpful for the road maintenance.

The other function of this database is for ground improvement. The database shows the soil profile below the ground which will present the type of soil and the properties. It will help many researchers in the future to determine which type of ground improvement is suitable with the ground condition. There are about four types of ground improvement applied along Ipoh-Lumut highway which are sand replacement, vertical drain with surcharge preloading, pile embankment and surcharge. Refer to appendix 8-2. The ground improvements were implemented along Sitiawan until Bota Kanan highway since the major division of soils is silty clay.

The database is also important to determine the design of pile foundation for building construction. The type of soil-boring will be determined by the type of soil profile that exists. In a clay layer or profile, sufficient undisturbed samples should be obtained to determine the shear strength and consolidation characteristics of the clay. The sensitivity of the clay soils will have to be determined, as strength loss from remolding during installation may reduce ultimate pile capacity. The database consists of soil profiles give some idea to the contractors and engineers about the soil condition below the ground for future use such as to construct any structure or building along Ipoh-Lumut highway.

2.2   SOIL PROPERTIES

The research article on the 'Soil Properties' written by P.J Atkinson (2000) stated that the soils properties can be classified in different type of estimation include the range of grain-size distribution, the engineering classification, and the physical and chemical properties of the major layers of each soil. Engineering characteristics of soil includes particles size distribution, liquid limit, plasticity index (Atterberg limits), specific gravity, shrinkage limit, and hydraulic conductivity and shear strength.

The necessary of soil description and classification is to describe the various materials found in ground investigation. When the soil scientists make soil borings during field mapping, they can identify several important soil properties. They note the soil

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moisture condition, or the presence of free water and its depth in the profile. They also note the thickness of the soil and its color, the texture, or the amount of clay, silt, sand and gravel or other coarse fragments, the structure, or natural pattern of cracks and pores in the undisturbed soil; and the consistence of soil in place under the existing soil moisture conditions (P.J Atkinson, 2000).

Soil properties are determined by field examination of the soils and by laboratory index testing of some benchmark soils. During the survey, many shallow borings are made and examined to identify and classify the soils and to delineate them on the soil maps. Samples are taken from some typical profiles and tested in the laboratory to determine grain-size distribution, plasticity, and compaction characteristics. Estimates of soil properties are based on field examinations, on laboratory tests of samples from the survey area, and on laboratory tests of samples of similar soils in nearby areas.

2.3 SOIL FORMATION AND SOIL PROFILE

A soil profile is the sequence of natural layers, or horizons, in a soil. Each soil series consists of soils having major horizons that are similar in color, texture, structure, reaction, consistency, mineral and chemical composition, and arrangement in the soil profile. The soil profile extends from the surface downward to unconsolidated material. Most soils have three major horizons called the surface horizon, the subsoil, and the substratum. The factors in soil formation are as parent material, time, climate, atmospheric composition, topography and organisms (M.E Ritter, 2001). The Figure 2.1 below represents the major soil profile layer.
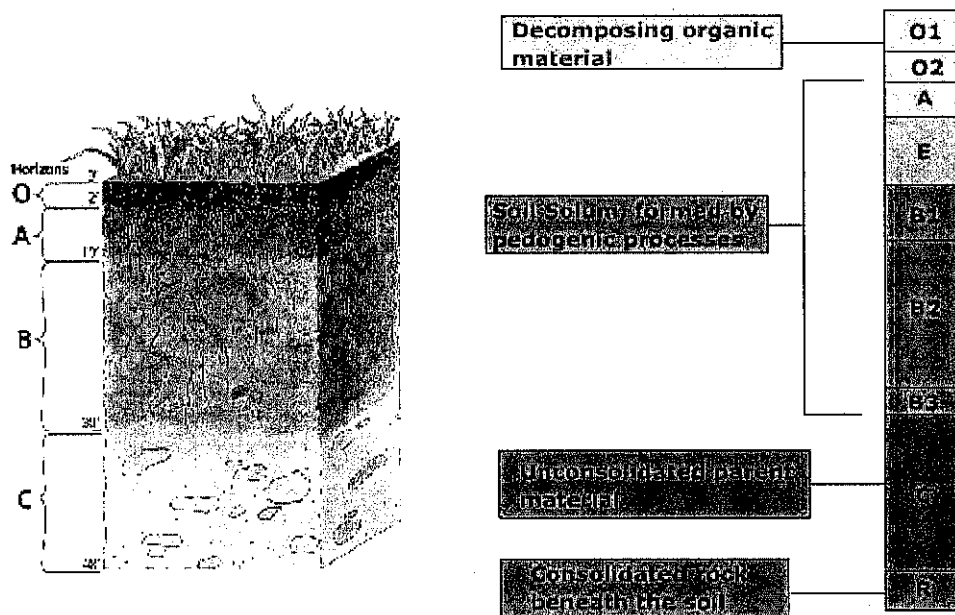
Figure 2.1: Major Soil Profile Layer.

2.3.1   O Horizon

The O horizon is primarily composed of organic matter. Fresh litter is found at the surface, while at depth all signs of vegetation structure have been destroyed by decomposition.

2.3.2   A Horizon

The A horizon marks the beginning of the true mineral soil. In this horizon organic material mixes with inorganic products of weathering. The A horizon typically is dark colored horizon due to the presence organic matter.

2.3.3 E Horizon

The E horizon generally is a light-colored horizon with eluviation being the dominant process. Leaching or the removal of clay particles, organic matter, and/or oxides of iron and aluminum is active in this horizon.

2.3.4 B Horizon

The B horizon is a zone of illuviation where downward moving, especially fine material, is accumulated. The accumulation of fine material leads to the creation of a dense layer in the soil. In some soils the B horizon is enriched with calcium carbonate in the form of nodules or as a layer.

2.3.5 C Horizon

The C horizon represents the soil parent material, either created in situ or transported into its present location. Beneath the C horizon lies bedrock.

2.4 STANDARD PENETRATION TEST (SPT)

The Standard Penetration Test is mainly used to estimate the relative stiffness and strength (bearing capacity) of soils. The Standard Penetration Test (SPT) provides a measure of the resistance of the soil to penetration through the blow count "N," and a disturbed but representative soil sample that can be used for classification and index tests. The main purpose of the test is to obtain an indication of the relative density of sands and gravels, but it has also been used to obtain an indication of the consistency of others soils (silts and clays) and of weak rocks (chalk). The SPT has been used widely for preliminary exploration, and many useful correlations have been established between the blow count, N and soil properties, foundation performance, and susceptibility to liquefaction (C.R Daniel, 2001).

The Standard Penetration test is conducted inside a borehole. A 'split spoon' sampler is attached to the bottom of a core barrel and lowered into position at the bottom of the borehole. The sampler is driven into the ground by a drop hammer weighing 68 kg falling through a height of 76 cm. The number of hammer blows is counted. The number required to drive the sampler three successive 150mm increments is recorded. The first increment (0-150mm) is not included in the N value as it is assumed that the top of the test area has been disturbed by the drilling process. The SPT N is the number of blows required to achieve penetration from 150-450mm.The hammer weight, drop height, spoon diameter, rope diameter etc. are standard dimensions (BS 5930: 1981).

The penetration resistance depends on the grain size of soils, and that fines-containing sands have smaller SPT N-values than clean sands. The investigations on the link between the penetration resistance and relative density have indicated that the ratio between the normalized N-value and the square of the relative density, N_1/D^2_r, is dependent on the grain size of sands. While this dependence has not been properly quantified, it has been customary to utilize the well-known expression of Meyerhof with N_1/D^2_r being fixed at 41. An attempt was made to correlate the penetration resistance and relative density by accounting for the grain size properties of soils. The void ratio range ($e_{max}-e_{min}$) was used as a measure indicative of the grain size and grain size composition. It was found that N_1/D^2_r is highly dependent on the value of ($e_{max}-e_{min}$) and that this ratio gradually decreases with increasing void ratio range from a value of about 100 for gravels to a value of about 10 for silty sands. This dependence is mathematically formulated and used to establish an empirical correlation between the SPT N-value and D_r that is applicable to various kinds of soils ranging from silty sands to gravels. The correlation is developed by using data of high-quality undisturbed samples and results of SPT measurements on natural deposits of sandy soils and gravels (I. Kenji 2004).

The SPT sampler (Adapted from ASTM D1586; Copyright ASTM, used with permission)
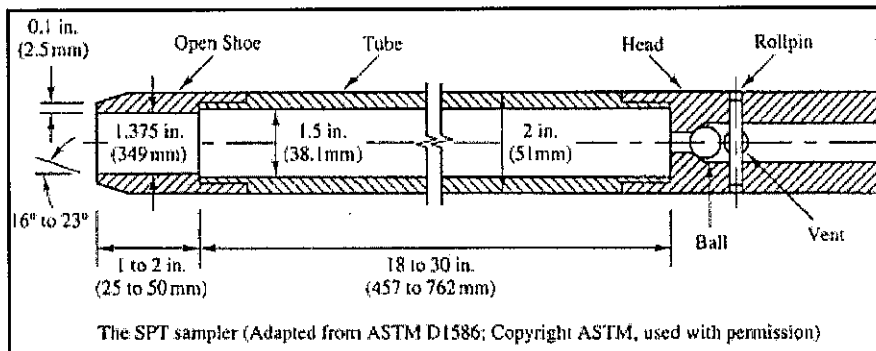
Figure 2.2: The Standard Penetration Test, SPT sampler

Table 2.1: Recommended SPT Procedure

Borehole size	66 mm < Diameter < 1 15 mm
Borehole support	Casing for full length and/or drilling mud
Drilling	Wash boring; side discharge bit Rotary boring; side or upward discharge bit Clean bottom of borehole*
Drill rods	A or AW for depths of less than 15 m N or NW for greater depths
Sampler	Standard 51 mm O.D. +/- 1 mm 35 mm I.D. +/- 1 mm >457 mm length
Penetration Resistance	Record number of blows for each 150 mm; N = number of blows from 150 to 450 mm penetration
Blow count Rate	30 to 40 blows per minute*

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2.5 TERM DESCRIBING CONSISTENCY OR CONDITION

Coarsed-grained soils (major portions retained on No.200 sieve) includes clean gravel and sand and silty or clayey gravels and sands. Condition is rated according to relative density as determined by laboratory tests or standard penetration resistance tests (B.M Das 2002).

Table 2.2: Soil consistency for coarsed-grained soils

Descriptive terms	Relative Density	SPT Blow Count
Very loose	0 to 15%	< 4
Loose	15 to 35%	4 to 10
Medium Dense	35 to 65%	10 to 30
Dense	65 to 85%	30 to 50
Very Dense	85 to 100%	> 50

Fine-grained soils (major portions passing on No.200 sieve) includes inorganic and organic silts and clays, gravelly, sandy orsilty clays and clayey silts. Consistency is rated according to shearing strength, as indicated by penetrometer readings, SPT blow count or unconfined compression tests (B.M Das 2002).

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Table 2.3: Soil consistency for fine-grained soils

Descriptive terms	Strength kPa	SPT Blow Count
Very soft	< 25	< 2
Soft	25 to 50	2 to 4
Medium Stiff	50 to 100	4 to 8
Stiff	100 to 200	8 to 15
Very Stiff	200 to 400	15 to 30
Hard	> 400	> 30

2.6 PHYSICAL PROPERTIES OF THE SOIL

2.6.1 Clay Soil

Clay as a soil separate consists of mineral soil particles that are less than 0.002 millimeter in diameter. In this table, the estimated clay content of each major soil layer is given as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The amount and kind of clay greatly affect the fertility and physical condition of the soil. They determine the ability of the soil to adsorb cations and to retain moisture. They influence shrink-swell potential, permeability, and plasticity, the ease of soil dispersion, and other soil properties. The amount and kind of clay in a soil also affect tillage and earthmoving operations. The particle size for clay is less than 0.002 mm.

When clay soils are wet they are very sticky, lumpy and pliable but when they dry they form rock-hard clots. Clay soils are composed of very fine particles with few air

spaces, thus they are hard to work and often drain poorly - they are also prone to water logging in spring. Blue or grey clays have poor aeration and must be loosened in order to support healthy growth. Red colour in clay soil indicates good aeration and a "loose" soil that drains well. As clay contains high nutrient levels plants grow well if drainage is adequate.

2.6.2   Sandy Soil

Sandy soils have a gritty texture and are formed from weathered rocks such as limestone, quartz, granite, and shale. If sandy soil contains enough organic matter it is easy to cultivate, however it is prone to over-draining and summer dehydration, and in wet weather it can have problems retaining moisture and nutrients. The range of particle size is between 2.0 to 0.05 mm

2.6.3   Silty Soil

Silty soil is considered to be among the most fertile of soils. Usually composed of minerals (predominantly quartz) and fine organic particles, it has more nutrients than sandy soil yet still offers good drainage. When dry it has rather a smooth texture and looks like dark sand. Its weak soil structure means that it is easy to work with when moist and it holds moisture well. The range of particle size is between 0.05 to 0.002 mm.

2.6.4   Organic Matter

Organic matter is the plant and animal residue in the soil at various stages of decomposition. The estimated content of organic matter is expressed as a percentage, by weight, of the soil material that is less than 2 millimeters in diameter. The content of organic matter in a soil can be maintained or increased by returning crop residue to the soil. Organic matter affects the available water capacity, infiltration rate, and tilth. It is a source of nitrogen and other nutrients for crops.

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2.7 ROTARY CORE DRILLING

Geotechnical soil boring or boring means an uncased well drilled for the purpose of obtaining soil samples to ascertain structural properties of the subsurface. Geotechnical soil boring includes auger borings, rotary borings, cone penetrometer probes and vane shear probes, or any other uncased ground penetration for geotechnical information. The determination of the groundwater conditions is a most important part of ground investigation. It involves borehole or field testing. Types of soil consider the factors involved in the choice of the most suitable procedures for boring including drilling (BS 5930: 1981).

Rotary open hole drilling and rotary core drilling are the traditional methods of drilling for rock exploration in which the drill bit is rotated on the bottom of the borehole. The drilling fluid, which is pumped down to the bit through hollow drill rods, lubricates the bit, and flushes the drill debris up the borehole. There are two basic types of rotary drilling; in which the drill bits cuts all the material within the diameter of the borehole and core drilling in which an annual bit fixed to the bottom of the outer rotating tube of a rotary core barrel cuts a core, which is returned within the inner stationary tube of the core barrel and brought to the surface for examination and testing.

For rotary core drilling, the choice of a drill and suite of compatible equipment and their condition for the work required are most important. The drill should be well maintained, be smooth running and mounted such that minimum vibration or movement is transmitted by the drill string to the core barrel.

CHAPTER 3

METHODOLOGY

3.1 PROJECT IDENTIFICATION

The information and data regarding the soil are gathered from many parties such as JKR, developer, and Construction Company (MRCB). The Figure 3.1 shows the project field work. An interview had been conducted while collecting the data. In this project, the methodologies are as below:

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┌─────────────────────────────────────┐
│        Selection of project topic    │
└─────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────┐
│       Preliminary research work       │
│          - Literature review          │
└─────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────┐
│              Field work                │
│  - Observation and data gathering,     │
│             interviewing               │
└─────────────────────────────────────┘
                    │
                    ▼
┌─────────────────────────────────────┐
│    Software application (Map Info      │
│           Professional)                │
│             - Results                  │
└─────────────────────────────────────┘
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│         Final Report Draught           │
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│        Submission of final report      │
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│            Oral Presentation           │
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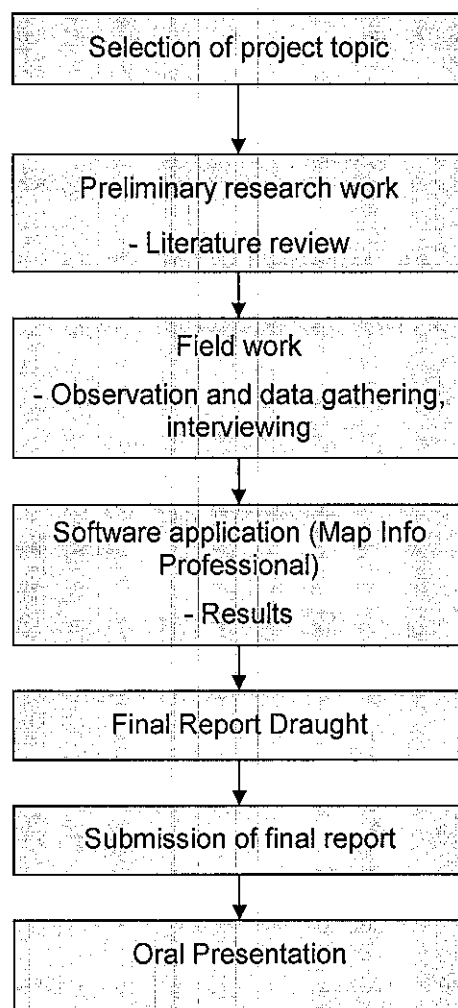
Discussion with the supervisor needed as the method will varies time to time.

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Interviewed session has been conducted with JKR Perak Darul Ridzuan in collaboration with MRCB Engineering Sdn. Bhd for Ipoh Lumut Highway road upgrading. Three interview sessions with three different people have been conducted:

- Mr. Muhammad Harridzan Abdullah (Penolong Pengarah Jalan 4, Bhagina Jalan, JKR Perak Darul Ridzuan).
- Mr. Mohammad Jamal (Bridge Specialist, MRCB Engineering Sdn. Bhd, project *"Merekabentuk, Membina & Menyiapkn Kerja-kerja Naik Taraf Laluan Persekutuan 5 dari Ipoh ke Lumut"*)
- Mr Mohd Sobri bin Su @ Hassan (Laboratory Technician, MRCB Engineering Sdn. Bhd, project "Merekabentuk, Membina & Menyiapkn Kerja-kerja Naik Taraf Laluan Persekutuan 5 dari Ipoh ke Lumut")

The data were gathered based on the soil boring and prepared in the current format as input to produce map in Map Info Professional software. Map Info Professional was used to create the map of Ipoh-Lumut Highway. The data provided in the Microsoft Excel were manually entered into the information box in Microsoft Visual Basic software. This database contain soil maps and descriptions of all soils found within Ipoh-Lumut highway. Like most soil mapping projects, the data will relies on collected soil boring data. The database in Map Info Software was linked to the Microsoft Excel to generate soil profile. The soil profile properly estimates the soil layers by depth from the surface or by elevations.

3.2   PROJECT FIELD WORK

Figure 3.1: Project Area (along Ipoh-Lumut Highway)

3.3   SOFTWARES

This project requires the use of Microsoft Visual Basic and Map Info Professional softwares.

3.3.1   Microsoft Visual Basic

Microsoft Visual Basic (VB) is an event driven programming language and associated development environment. This project is using VB as the interface for the generated soil profile. VB is used as the medium for user to display the soil properties data and the soil profile. Visual Basic is seen as a controversial language. It was designed to be a simple language. This leads to some programmers praising Visual Basic for how simple it is to use, but can also lead to frustration when programmers encounter problems that the features would have detected. For instance, in Visual Basic a common mistake is to incorrectly type the name of a variable, creating a new variable with a slightly different name.

There are quite a number of reasons for the enormous success of Visual Basic (VB):

a)   The structure of the Basic programming language is very simple, particularly as to the executable code.

b)   VB is not only a language but primarily an integrated, interactive development environment

c)   The VB has been highly optimized to support rapid application development. t is particularly easy to develop graphical user interfaces and to connect them to handler functions provided by the application.

d)   VB provides a comprehensive interactive and context-sensitive online help system.

Nevertheless, there are still remain many problems that have not been addressed at all by Java, VB, and other languages or that has not found a really satisfactory solution so far.

3.3.2 Map Info Professional Software

Map Info Professional is one of intuitive user interface for discovery that offers a hierarchical view of available data stores, themes, layers and layer styles. The software is used to layout the map using the existing map provided by MRCB. The new generated map is then used to locate the major chainages exist along Ipoh-Lumut highway. There are about 5 main chainages available along this highway which is Sitiawan, Ayer Tawar, Bota Kanan, Sri Iskandar, Tronoh and Pusing. MapInfo Professional includes a very good digitiser – thus a potential data creator. The map composed by simply dragging and dropping layers and layer styles from tree structure onto a map composition window. User can define the order in which layers are 'stacked'. Panning or zooming automatically triggers map request to refresh map view on screen. The 'Server Information' and 'Layer Information' tabs allow user to peruse metadata associated with data, contained in capabilities document. Soil data will be inserted properly in the map layer. The figure below shows the example use of Map Info Professional.

By using mapping wizard tool in the Tool menu, the map will be converted to Map Info Tab format. Below is the example of map boundary which has been converted.
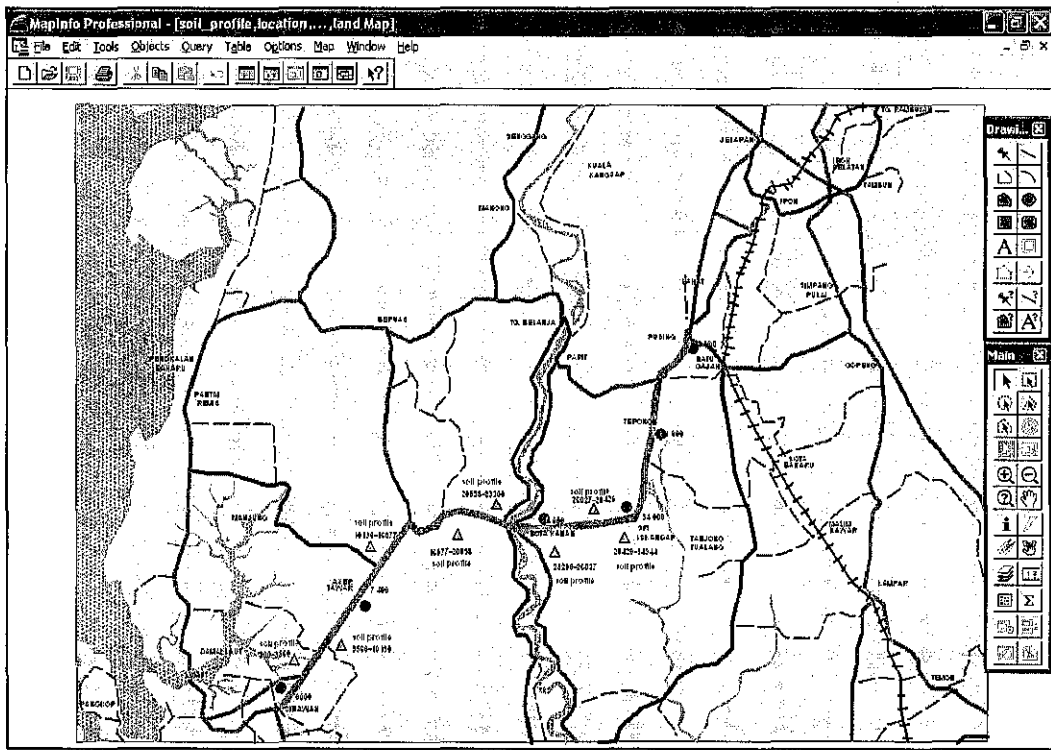
Figure 3.2: The converted Map Boundary

The close line or boundaries can be converted to a region. This region can be fill or mark with color to differentiate it identity. This can be done by using function "Region Style" at drawing menu. The line or point will show the borehole area. The author will label all the important point on the map. The label is on their respective layer.

CHAPTER 4

RESULTS AND DISCUSSION

4.1 DISCUSSION

This project involves the soil profiling about 34 600 m long. There are about 5 main chainages available along this highway which is Sitiawan, Ayer Tawar, Bota Kanan, Sri Iskandar, Tronoh and Pusing. There are about 40 boreholes used to create this soil profile. Figure 4.1 until Figure 4.8 show the soil profile that had been created from chainage 300 m until chainage 34 944 m.
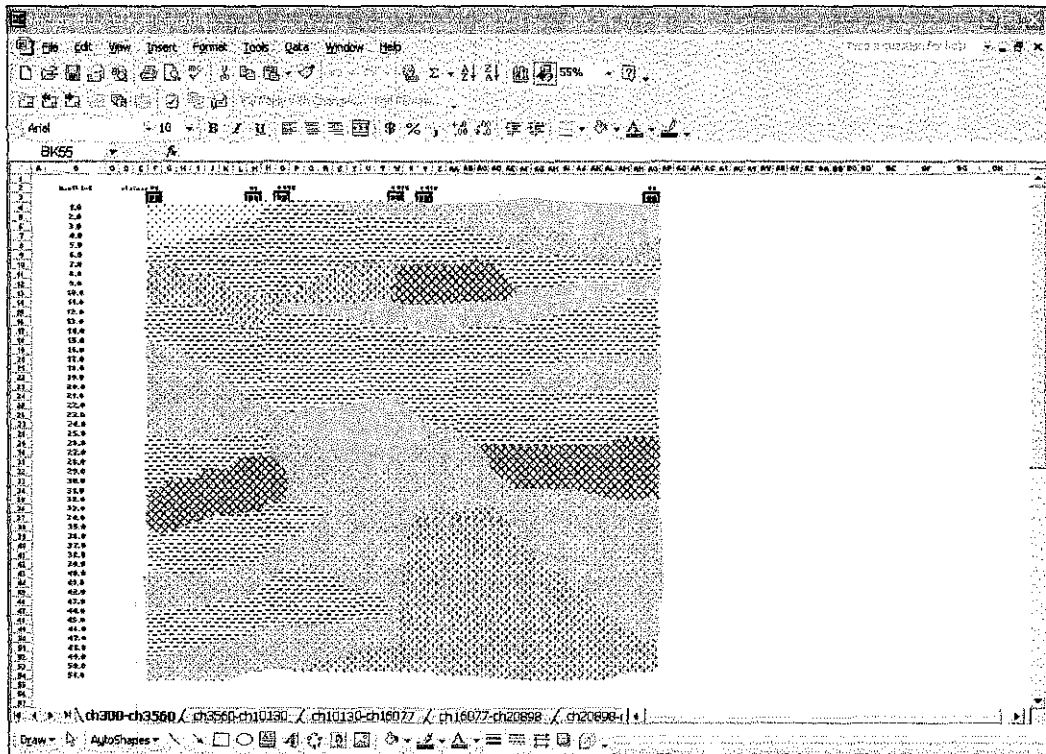

Figure 4.1: Soil profile between chainage 300 m until 3 560 m

The Figure 4.1 shows the soil profiling of Ipoh-Lumut Highway between chainage 300 m until chainage 3 560 m. The silty clay is the predominant soil for the chainage along this 3 260 m highway with average thickness of 7 m. There are about six boreholes between the chainage 300 m until chainage 3 560 m. The second type of soil is silty sand with average thickness of 5 m. The other types of soil occupied the first part of soil profile are clayey sand, sand, silt, and sandy clay. This area required ground improvement since the predominant soil is silty clay. Clay particles may adsorb large amounts of water, and the soil becomes very cohesive and plastic.

Figure 4.2: Soil profile between chainage 3560 m until 10 130 m

The next figure is Figure 4.2 that shows the soil profiling of Ipoh-Lumut Highway between chainage 3 560 m until chainage 10 130 m. The silty clay is still the predominant soil for the chainage along this 6 570 m highway with average thickness of 7 m. There are about six boreholes between the chainage 3 560 m until chainage 10130 m. The sand soil occupied some major area between this chainage with

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average thickness of 11 m. The other types of soil exist between this chainages are
profile is gravel, silty sand, silty gravel, clayey sand, sandy silt and silt.
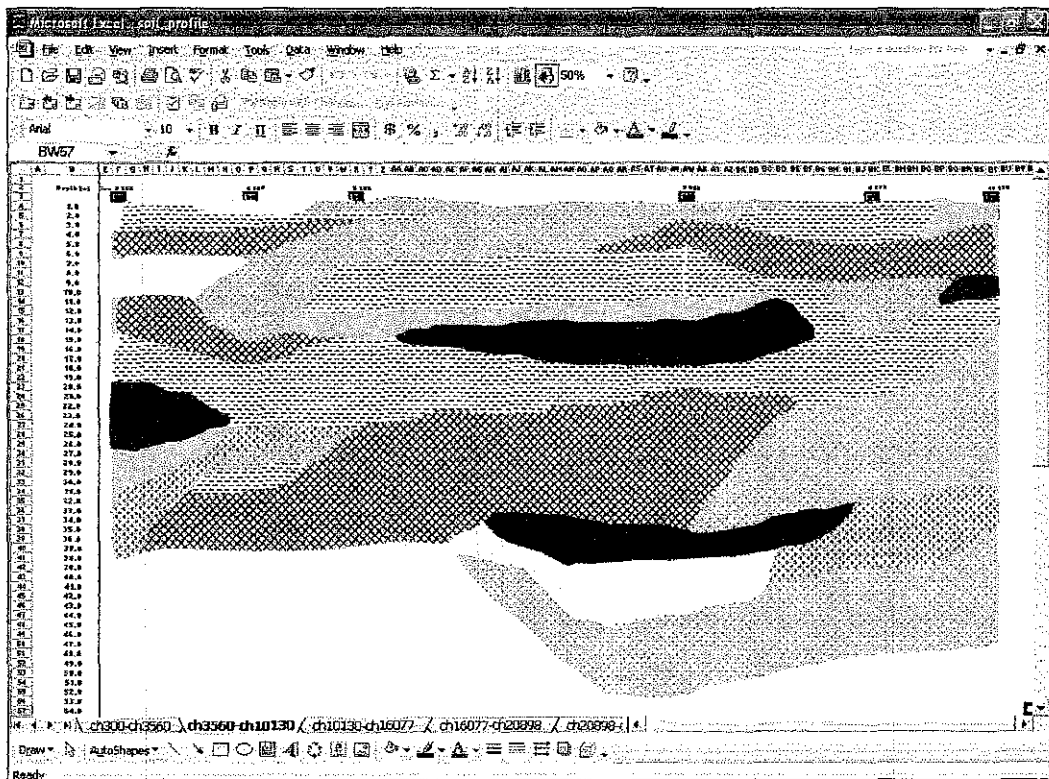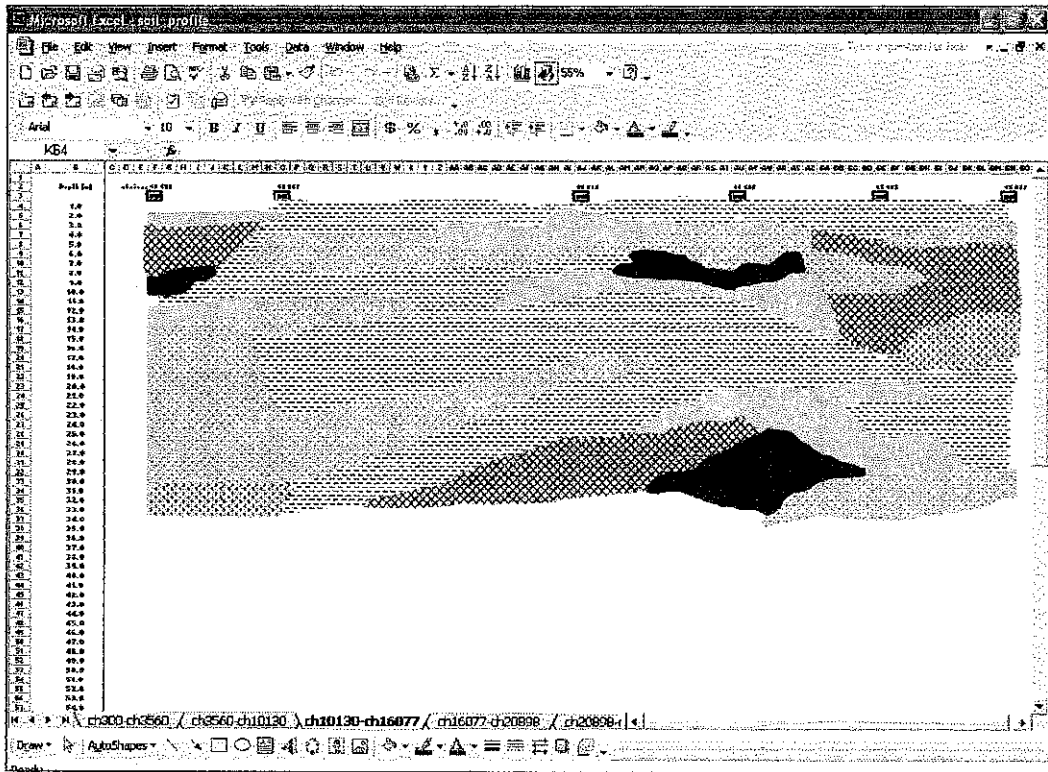

Figure 4.3: Soil profile between chainage 10 130 m until 16 077 m

The Figure 4.3 shows the soil profiling of Ipoh-Lumut Highway between chainage
10130 m until chainage 16 077 m. The silty clay is the predominant soil for the
chainage along this 5 947 m highway with average thickness of 6 m. There are about
four boreholes between the chainage 10 130 m until chainage 16 077 m. In a clay
layer or profile, sufficient undisturbed samples should be obtained to determine the
shear strength and consolidation characteristics of the clay. The sandy soil and silty
soil are the second major soil covers this area with average thickness of 4 m. The
other types of soil are same as the previous part.
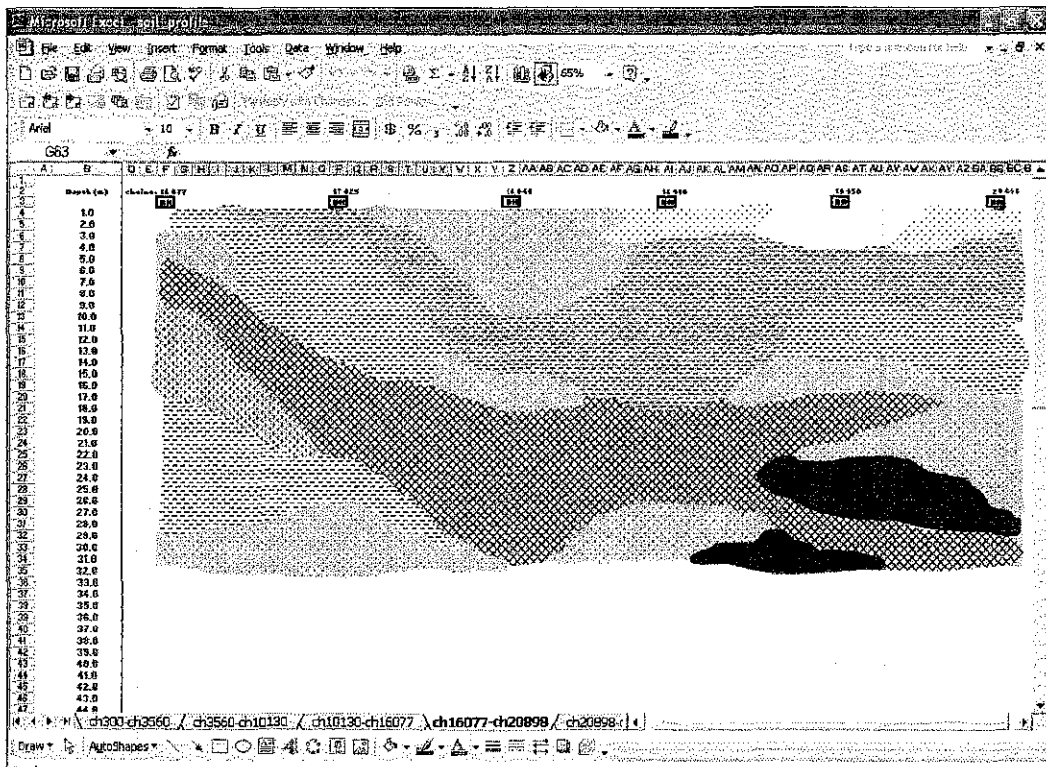
Figure 4.4: Soil profile between chainage 16 077 m until 20 898 m

The length of the highway for the chainage 16 077 m until 20 898 m is 4 821 m with sandy soil and clayey silt as the predominant soil. The average thickness for the both soil is about 6 m. There are about six boreholes exist along this chainage. The sandy soil is good as the natural drainage for this area. The gravel sandy soil has minor existing along this area with average thickness of 4 m. The other remaining types of soils are silty sand, silty clay, clay, sandy clay, sandy silt and gravel.
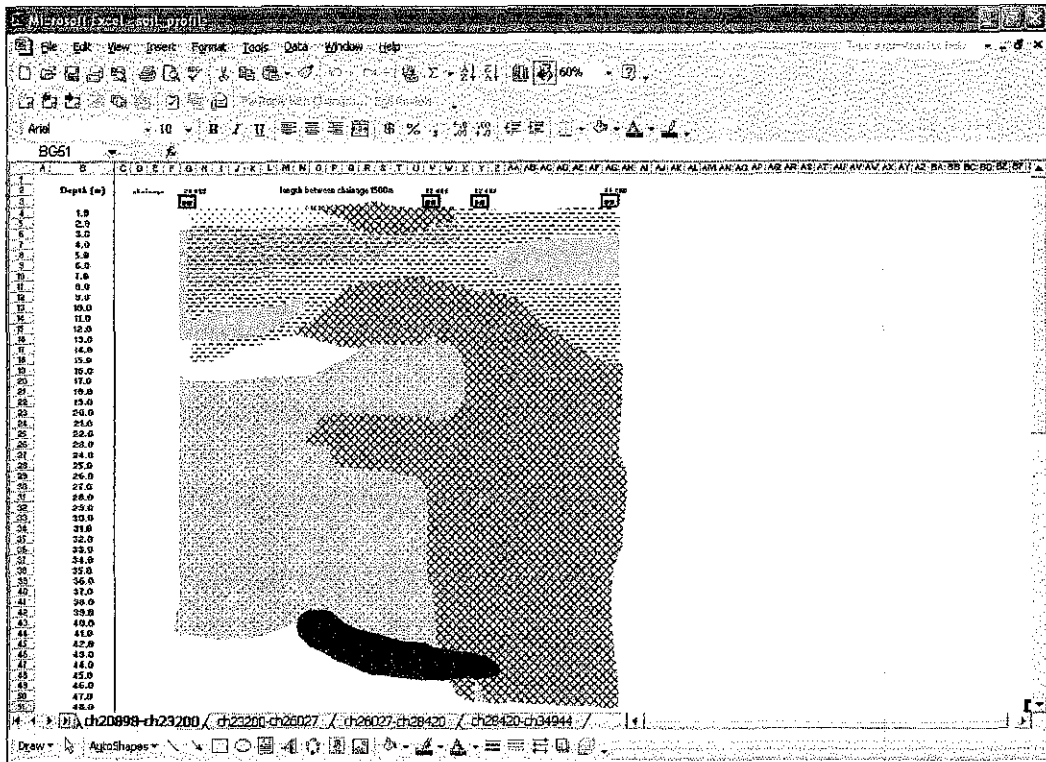
Figure 4.5: Soil profile between chainage 20 898 m until 23 200 m

The Figure 4.5 shows the soil profiling between chainage 20 898 m until 23 200 m. The length of the highway between this chainages is 2 302 m. 4 boreholes are used to predict the soil layer along this area. The major type of soil is sandy soil. The thickness of the sandy soil quit large with average thickness of 38 m. The sandy soils have a gritty texture and are formed from weathered rocks such as limestone, quartz, granite, and shale. The other remaining types of soils are silty sand, silty clay, clay, sandy clay, sandy silt and gravel.
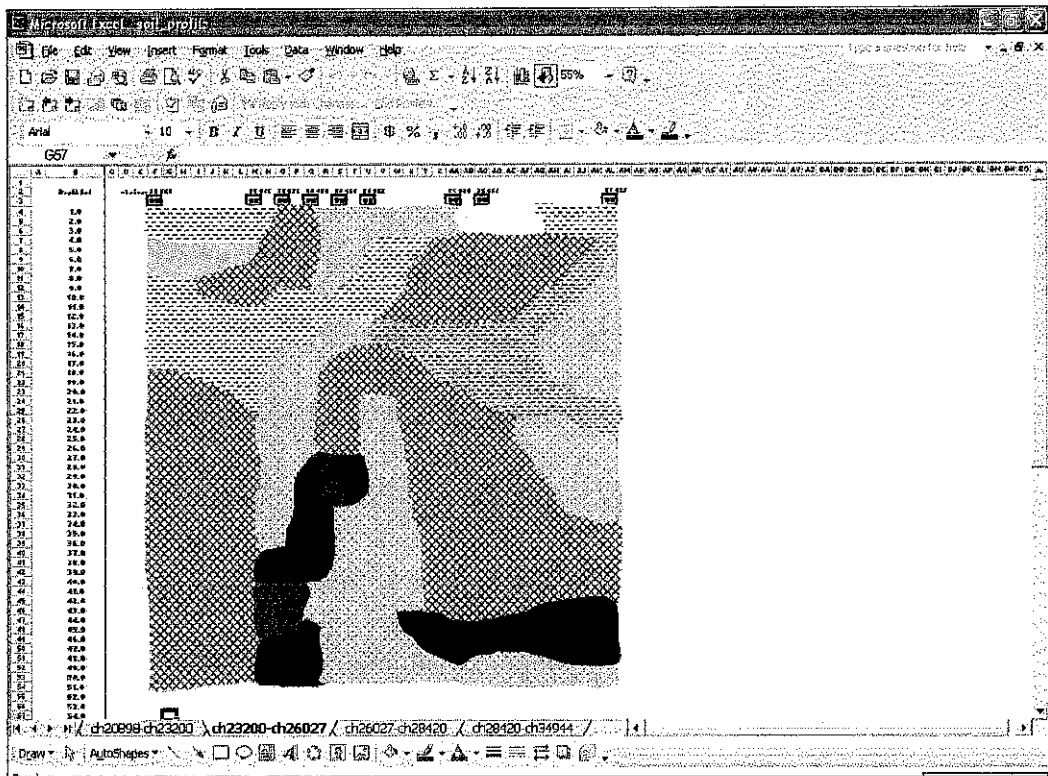
Figure 4.6: Soil profile between chainage 23 200 m until 26 027 m

The sandy soil occupied the major distribution of soil in this area with average thickness of 25 m. The length of the highway between chainage 23 200 m and chainage 26 027 m is 2 827 m. There are about 9 boreholes used as the reference to generate the soil profile as shown in Figure 4.6. The silty sand soil is the second major predominant soil in this area with average thickness of 11 m. The silty soil usually composed of minerals (predominantly quartz) and fine organic particles; it has more nutrients than sandy soil yet still offers good drainage.

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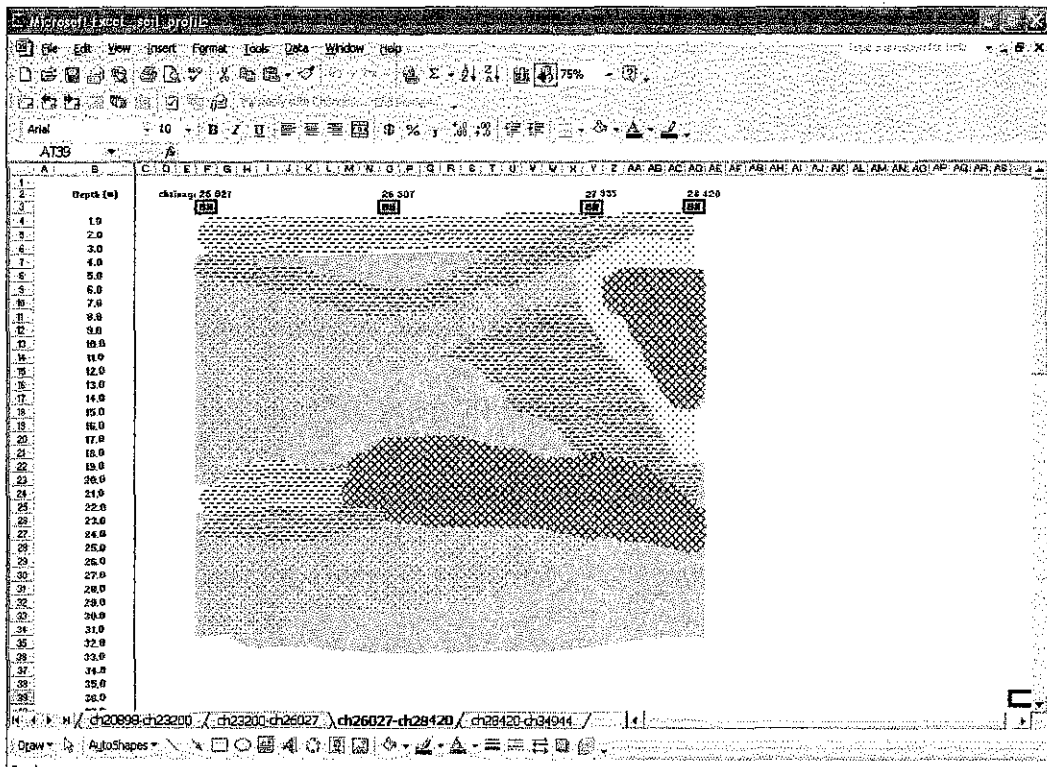
Figure 4.7: Soil profile between chainage 26 027 m until 28 420 m

The Figure 4.7 shows the soil profiling along 2 393 m highway. There are 4 recognized boreholes exist between chainage 26 027 m until chainage 28 420 m. The major soil distribution occupied this area is silty sand with average thickness of 6 m. The clayey silt is not uniformly distributed along this area. The thickness of the clayey silt is 2 m. The other remaining types of soils are silt, sand, fine sand, and silty clay.
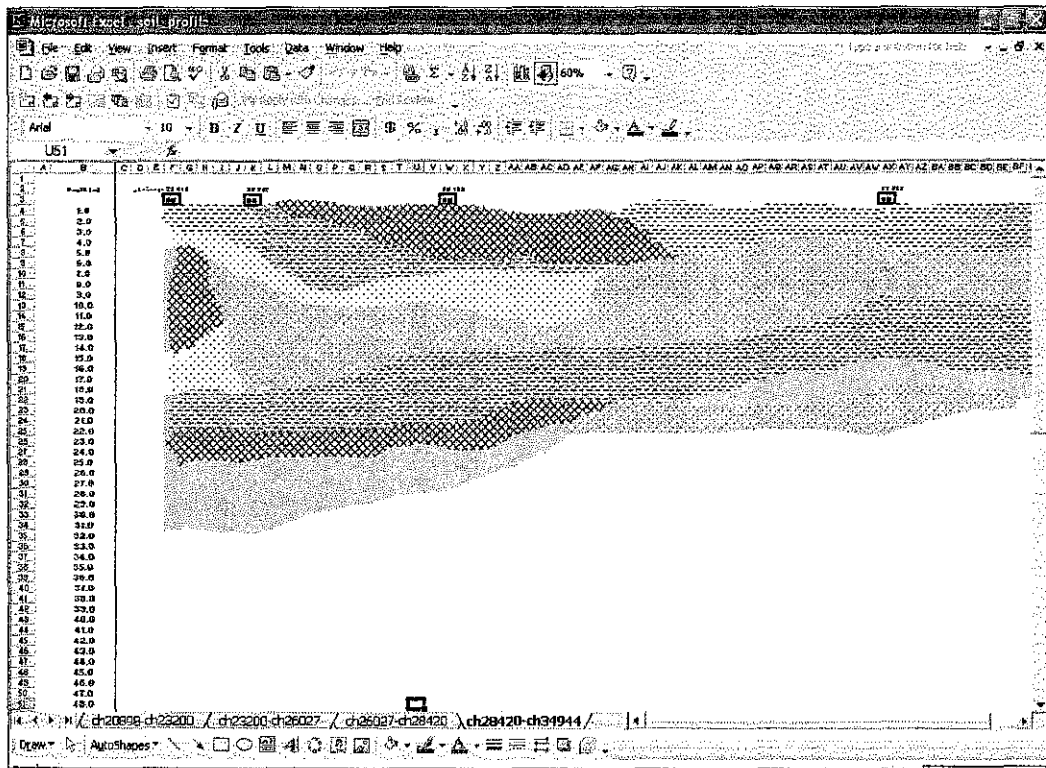
Figure 4.8: Soil profile between chainage 28 420 m until 34 944 m

There are about 7 types of soils occupied the area between chainage 28 420 m until chainage 34 944 m in Figure 4.8. There are about 5 boreholes exist to create the soil profile. Each soil has the approximately same thickness with average thickness of 2 m up to 4 m. The soils display in the layer of soil profiling are sand, clayey silt, fine sand, sandy silt, silty sand, sandy clay, and silty clay.

Generally, the major type of soil along chainage 300 m -17 025 m, 19 950 m -25 004 m, and 26 027 m - 28 917 m is silty clay with average thickness of 6 m. The engineer needs to be aware with the problem that may occur in the soft clay. Clayey soil has small sized non-living particles creating highly dense soil. The ground improvement had been implemented along this area. The average thickness of silty sand is 4 m and exists along the chainage 300 m – 3 560 m, 5 380 m – 13 038 m, 19 950 m – 22 401 m, 24 075 m – 27 935 m and 28 917 m – 34 944 m. Silty soil has medium sized non-living particles creating to medium density soil. For the clayey sand, the average thickness is 15 m and the area covered is along chainage 300 m until 3 560 m. The other types of soil is clayey silt with average thickness of 5 m from chainage 300 m

until chainage 3 560 m. The sand soil occupied the area from Sitiawan (chainage 4600 m) until Bota Kanan (chainage 26 027 m). The average thickness is 10 m and the sand soil is good as the natural drainage. The sand grains are generally broken rock particles that have been formed by physical weathering, or they are the resistant components of rocks broken down by chemical weathering.

The sandy clay soil only has average thickness of 3 m and the area occupied is from chainage 300 m – 950 m, 18 910 m – 19 000 m, 20 898 m – 21 000 m and 27 935 m – 30 300 m. The sandy soil has large sized non-living particles creating low density soil. The next type of soil is silt soil which has major existence along chainage 10 000 m up to 15 130 m with average thickness of 3 m. The silt particles themselves, because of their smaller diameter impart to the soil greater water holding capacity and slower drainage. The clay soil is not uniformly distributed along the Ipoh-Lumut highway. The thickness of the soil from chainage 300 m until chainage 3560 m is quit large. The thickness is 17 m compared to other locations which are only 2 m. Clay particles may adsorb large amounts of water, and the soil becomes very cohesive and plastic. Soils high in clay content are also sticky when wet. The quartz/ gravel only cover some of the portion along the highway with the range thickness of 2 m – 3 m from chainage 24 075 m until chainage 26 027 m. The fine sand also manages to cover minor portion of the area involved which is from chainage 26 027 m until chainage 30 100 m with average thickness of 5 m.

The soil textures depend on size of individual particles. For sand, the range of particle size is between 2.0 to 0.05 mm. While for silt, the range of particle is between 0.05 to 0.002 mm and for clay is less than 0.002 mm. The texture of the soil is very important for determining the suitability of the site for road construction. The soil texture is the relative proportion of sand, silt and clay content of the soil.
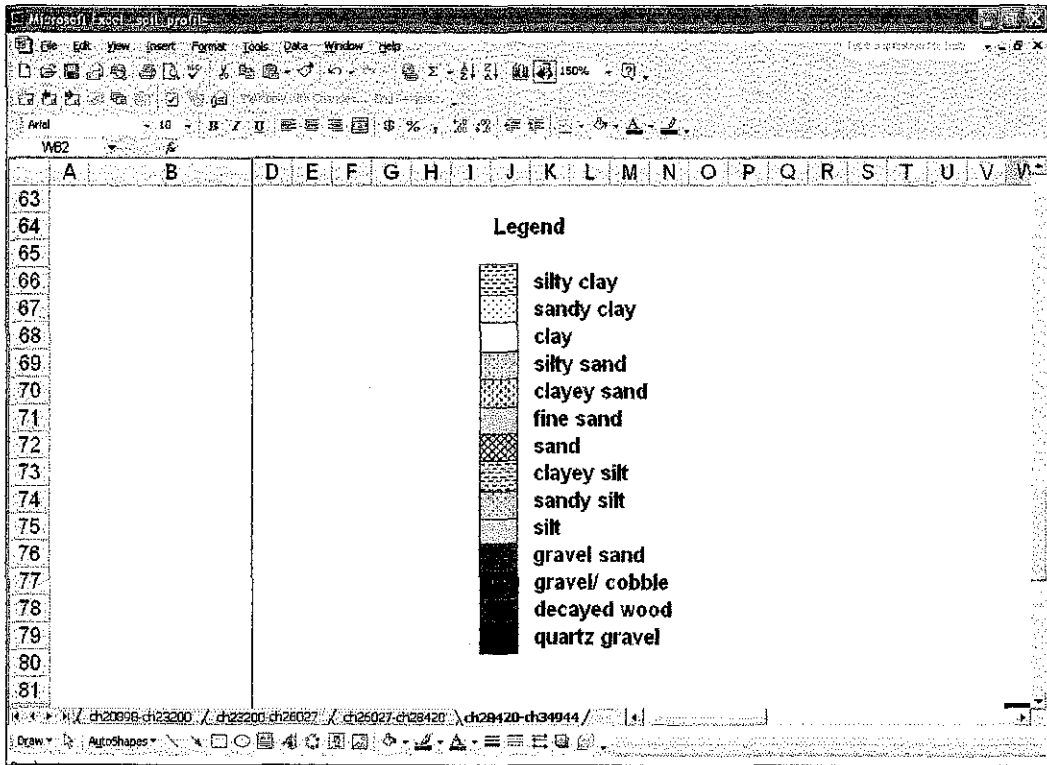
Figure 4.9: Soil legend

CHAPTER 5

CONCLUSIONS

In a nutshell, the database will give benefits to all individual and related organisation to do their findings or research regarding soil properties and engineering characteristics in Malaysia. The applications of database will be more effective in presenting better information. The Map Info Professional software is a very effective tool that easily help user search or discover for information about the soil characteristic and the Microsoft Visual Basic helps user in presenting much better and easy to interpret visual data. The generated soil profile is drawn using simpler and user friendly software which is called Microsoft Excel. The application of the database with attractive and proper data presentation helps many users in the future in evaluating the soil properties and soil profile. To an engineer, soil is an important and precious material that can be built on the foundations to buildings, bridges, to build in the tunnels, culverts, basements, to build with the roads, runways, embankments, and dams and supported by retaining walls and quays. As overall conclusion; this project had achieved the objectives.

CHAPTER 6

RECOMMENDATIONS

These are some of the recommendations that can be implemented in the future for a better result regarding this project. Gathering the data is the most crucial aspect in this project. Some of the data such as the strength of the soil were excluded from the database because of the inadequate data sources. For future analysis, the data can be gathered from the MRCB Head Quarters in Shah Alam as suggested by the project consultant. The project map including the road, highway, river and others were not to scale due to the time constraint. The map can be converted into the real scale for the future filing. Additional data or information regarding the background of Ipoh-Lumut highway, location of ground improvement, other experiment data and some pictures during the road construction can be included in a way to make the database more functional. This project can be very valuable and helpful if the project is expands to the entire road and highway in Malaysia including Sabah and Sarawak.

CHAPTER 7

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CHAPTER 8

APPENDICES

APPENDIX 8-1   The application of the software

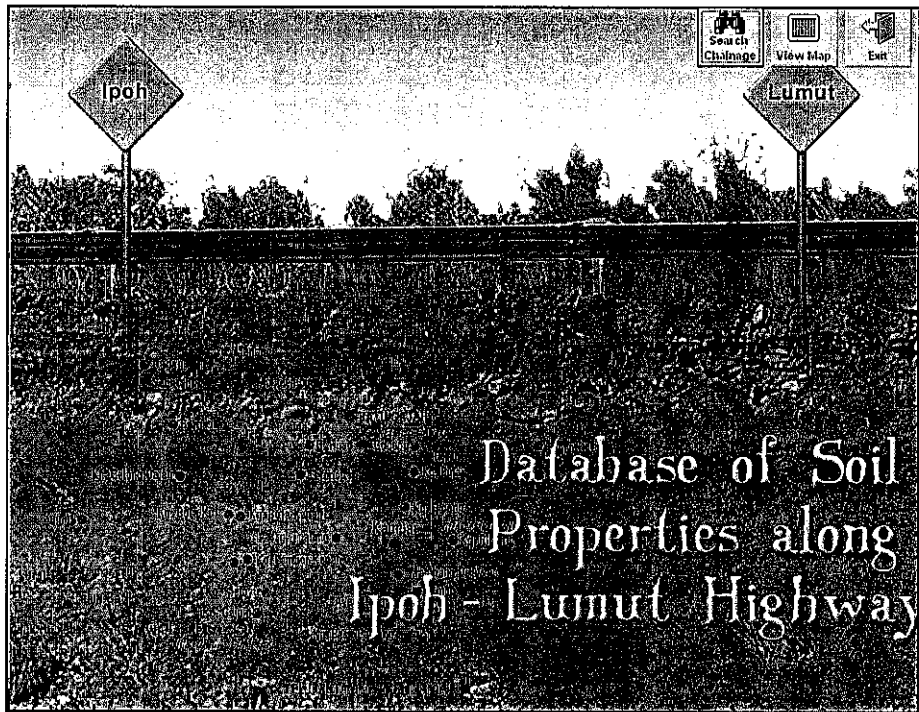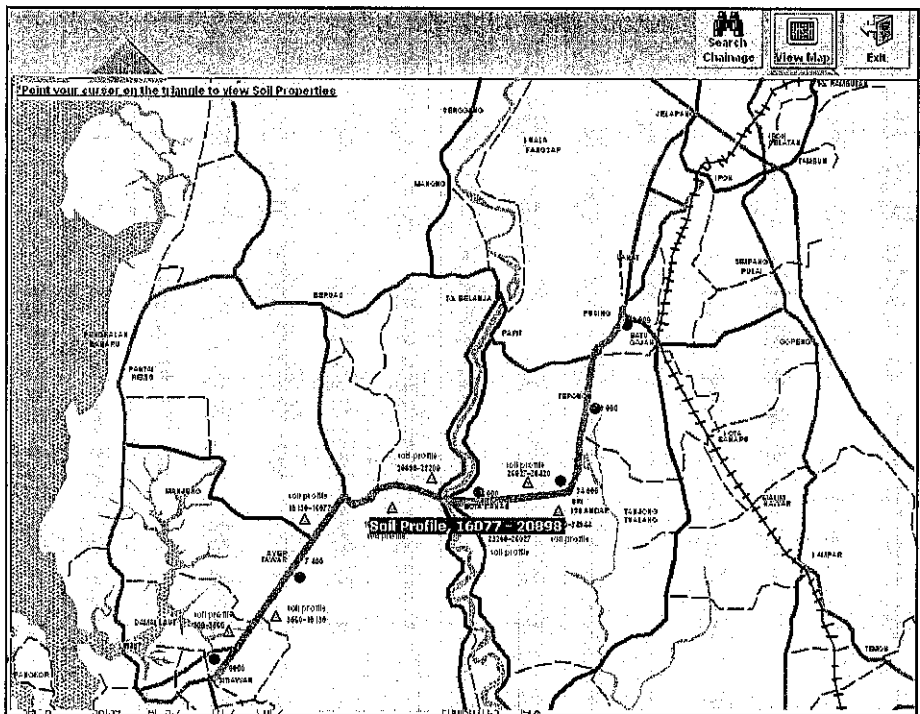Figure 8.1a: The interface of the database.

Figure 8.2a: Viewing the map to display the soil profile
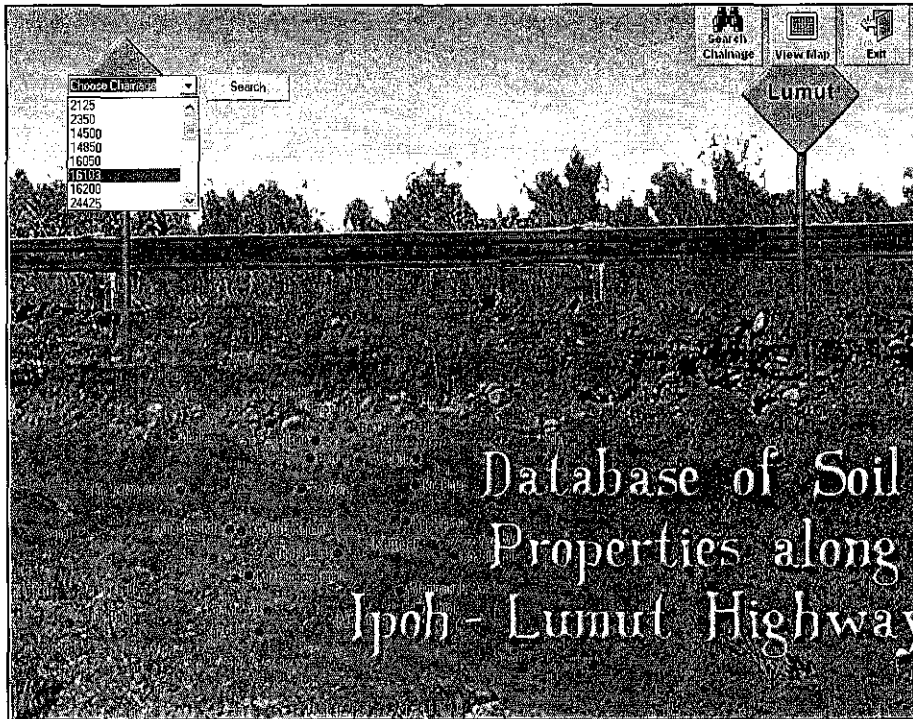
Figure 8.1c: Search the chainage to display the soil properties.
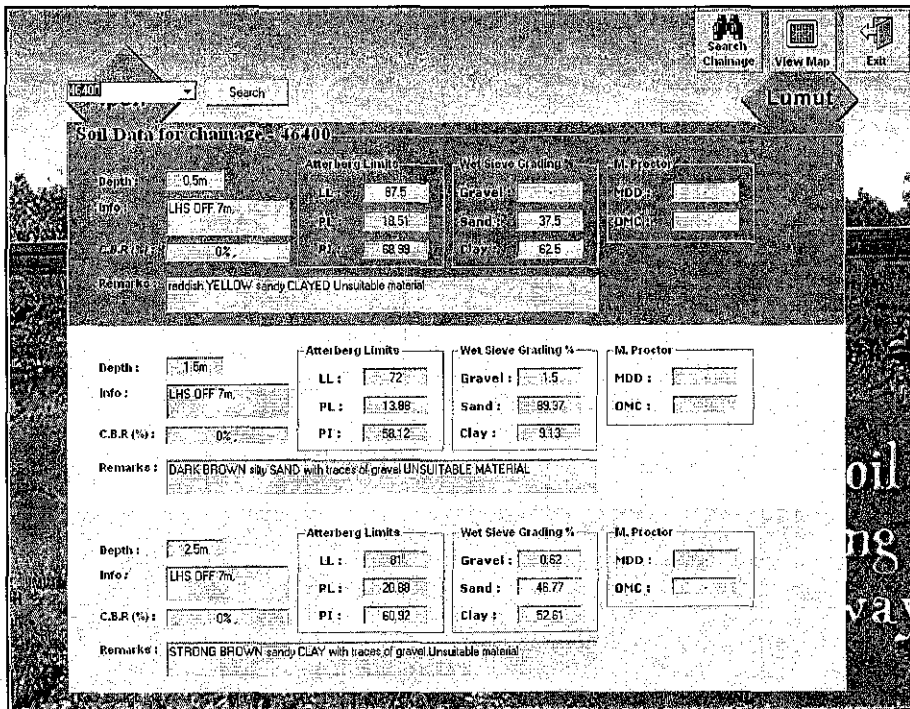

Figure 8.1d: The soil properties.
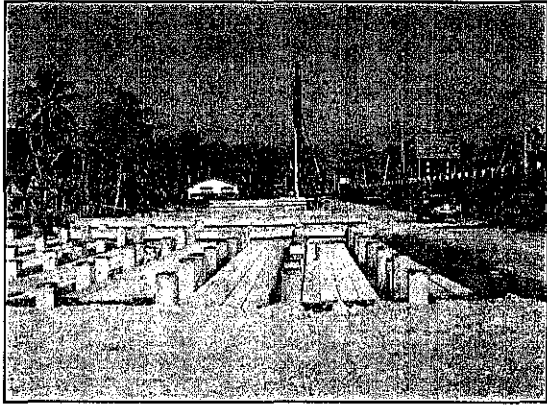
APPENDIX 8-2   The ground improvement applied

Figure 8.2a: Pile embankment

Figure 8.2b: Pile embankment

Figure 8.2c: Pile embankment
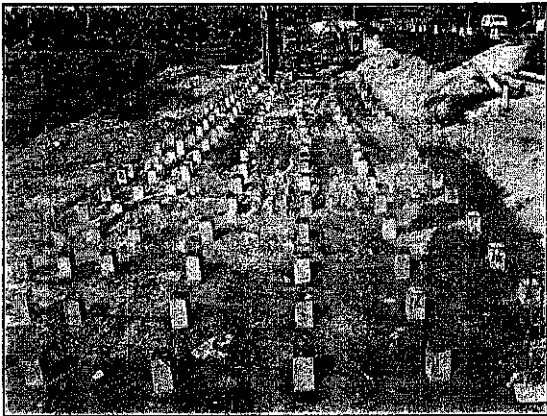
Figure 8.2d: Surcharge fills

Figure 8.2e: Pile Embankment

APPENDIX 8-3   The soil properties.

Table 8.3a: The soil properties

chainage		Depth	Attenberg limits		wet. Sieve grading %		M.Proctor		C.B.R(%)	Remarks
2125	RHS	1.0m	LL: 60.90		Gravel: 0.59		MDD: 1.89		7% Subgrade	YELLOWISH BROWN CLAYEY SAND
			PL: 31.91		Sand: 59.00		OMC: 14.10			
			PI: 28.99		Clay: 40.41					
2350	OFFSET 12m	1.0m	LL: 68.70		Gravel: NIL		MDD: 1.54		6% Subgrade	YELLOWISH GREY + RED SILTY CLAY
			PL: 38.68		Sand: 14.77		OMC: 22.20			
			PI: 30.02		Clay: 85.23					
14500	LHS	1.0m	LL: N.P		Gravel: -		MDD: 1.85			brownish GREY SILTY CLAY with sand, REMOVED from site
			PL: N.P		Sand: 27.66		OMC: 15.00			
			PI: N.P		Clay: 72.34					
14500	LHS	2.0m	LL: N.P		Gravel: 22.97		MDD: 2.14		11% Subgrade	GREY silty sand with some gravel. Suitable for filing and subgrade
			PL: N.P		Sand: 53.94		OMC: 7.30			
			PI: N.P		Clay: 23.09					
14850	LHS	1.2m	LL: N.P		Gravel: 3.84		MDD: 2.05		9% Subgrade	yellowish GREY silty SAND with traces of gravel. Suitable for filing and subgrade
			PL: N.P		Sand: 86.88		OMC: 9.65			
			PI: N.P		Clay: 9.28					
14850	LHS	1.8m	LL: 26.10		Gravel: 4.82		MDD: 2.07		21% Subgrade	yellowish DARK GREY silty clay SAND with some gravel. Suitable for filing and subgrade.
			PL: 23.41		Sand: 75.07		OMC: 8.00			
			PI: 2.69		Clay: 20.11					
16050	LHS	0.3m	LL: 58.00		Gravel: NIL		MDD:			DARK BROWN sandy CLAYEY SILTY CLAY
			PL: 30.35		Sand: 16.55		OMC:			
			PI: 27.65		Clay: 83.45					
16050	LHS	1.0m	LL: 64.50		Gravel: NIL		MDD:			YELLOW SANDY CLAYEY SILTY CLAY
			PL: 39.85		Sand: 16.87		OMC:			
			PI: 24.65		Clay: 83.13					
16103	LHS	0.3m	LL: 57.00		Gravel: NIL		MDD:			GREYISH BROWN CLAYEY SAND
			PL: 22.92		Sand: 20.65		OMC:			
			PI: 34.08		Clay: 79.35					
16103	LHS	1.0m	LL: 70.50		Gravel: NIL		MDD:			BROWNISH YELLOW CLAYEY SAND
			PL: 37.50		Sand: 14.05		OMC:			
			PI: 33.00		Clay: 85.95					
16200	LHS	0.3m	LL: 76.00		Gravel: NIL		MDD:			DARK GREY CLAYEY SAND
			PL: 35.42		Sand: 14.05		OMC:			
			PI: 40.58		Clay: 85.95					
16200	LHS	1.0m	LL: 52.00		Gravel: 0.76		MDD:			REDDISH BROWN CLAYEY SAND WITH TRACES OF GRAVEL
			PL: 29.19		Sand: 19.84		OMC:			
			PI: 22.81		Clay: 79.40					
24425	Abutment B (slope) OFFSET: 10 m	1.0m	LL: 53.50		Gravel: 16.37		MDD: 1.70			DARK REDDISH BROWN . Silty clay with some gravel
			PL: 33.24		Sand: -		OMC: 22.40			
			PI: 20.26		Clay: 59.27					
28500	RHS BOTA AREA	3.0m	LL: 51.00		Gravel: 0.19		MDD: 1.91		7% Subgrade	RED sandy CLAY
			PL: 27.40		Sand: 42.99		OMC: 14.00			
			PI: 23.56		Clay: 56.82					
38000	RHS	1.0m	LL: N.P		Gravel: 4.37		MDD: 2.11		8% Subgrade	REDDISH GREY SANDY SILTY WITH SOME GRAVEL
			PL: N.P		Sand: 84.44		OMC: 7.70			
			PI: N.P		Clay: 11.19					
39000	RHS	1.0m	LL: 31.80		Gravel: 3.33		MDD: 2.07			LIGHT GREY SANDY SILTY WITH SOME GRAVEL
			PL: 22.04		Sand: 66.25		OMC: 9.00			
			PI: 9.76		Clay: 30.42					
39400	RHS OFFSET 8.0 m	1.0m	LL: 81.60		Gravel: 0.80		MDD: 2.08			YELLOWISH BROWN SILTY CLAY

Chainage	Location	Depth									Description
			PL:	28.35	Sand:	23.17	OMC:	9.50			UNSUITABLE MATERIAL
			PI:	53.25	Clay:	76.03					
39400	RHS OFFSET 8.0 m	1.0m	LL:	81.60	Gravel:	0.80	MDD:	2.08			YELLOWISH BROWN SILTY CLAY UNSUITABLE MATERIAL
			PL:	28.35	Sand:	23.17	OMC:	9.50			
			PI:	53.25	Clay:	76.03					
41050	RHS OFFSET 5.0 m	1.0m	LL:	18.75	Gravel:	7.87	MDD:	2.21			DARK GREY SANDY SILTY CLAY
			PL:	9.67	Sand:	71.63	OMC:	11.40			
			PI:	9.08	Clay:	20.50					
44075	LHS cutting area	0.5m	LL:	N.P	Gravel:	3.76	MDD:	1.97	15% Subgrade		DARK GREY SANDY CLAY with some gravel Suitable for filing and subgrade
			PL:	N.P	Sand:	54.41	OMC:	11.20			
			PI:	N.P	Clay:	41.83					
44175	OFF 200m	1.5m	LL:	84.30	Gravel:	0.04	MDD:	1.61			YELLOW BROWN VERY CLAYEY SAND Unsuitable material
			PL:	42.58	Sand:	43.79	OMC:	21.40			
			PI:	41.72	Clay:	56.17					
44175	OFF 200m	3.0m	LL:	64.00	Gravel:	1.06	MDD:	1.79			WHITE+YELLOW+RED SANDY SILTY CLAY WITH SOME GRAVEL
			PL:	47.92	Sand:	49.60	OMC:	15.00			
			PI:	16.08	Clay:	49.34					
44500	LHS	1.0m	LL:	23.00	Gravel:	-	MDD:	2.13	34% Subgrade		RED+BROWN+GREY SILTY CLAY with a little sand Suitable for filling and subgrade
			PL:	18.18	Sand:	16.46	OMC:	7.00			
			PI:	4.82	Clay:	83.54					
44500	LHS	2.0m	LL:	N.P	Gravel:	21.98	MDD:	2.19	18% Subgrade		YELLOW silty SAND with some gravel
			PL:	N.P	Sand:	61.15	OMC:	7.60			
			PI:	N.P	Clay:	16.57					
45500	LHS	1.0m	LL:	24.50	Gravel:	0.12	MDD:	2.11	6% Subgrade		yellowish RED silty clay SAND with traces of gravel
			PL:	19.11	Sand:	74.86	OMC:	9.10			
			PI:	5.39	Clay:	26.27					
45500	LHS	1.7m	LL:	N.P	Gravel:	12.55	MDD:	2.18			yellowish GREY silty SAND with some gravel
			PL:	N.P	Sand:	77.51	OMC:	6.40			
			PI:	N.P	Clay:	9.94					
46250	LHS 1.0m below subgrade	1.0m	LL:	77.00	Gravel:	0.48					YELLOWISH CLAY VERY CLAYEY SILTY CLAY WITH SAND unsuitable material
			PL:	12.63	Sand:	31.03					
			PI:	64.37	Clay:	68.49					
46400	LHS OFF 7m	0.5m	LL:	87.50	Gravel:	-					reddish YELLOW sandy CLAYED Unsuitable material
			PL:	18.51	Sand:	37.50					
			PI:	68.99	Clay:	62.50					
46400	LHS OFF 7m	1.5m	LL:	72.00	Gravel:	1.50					DARK BROWN silty SAND with traces of gravel UNSUITABLE MATERIAL
			PL:	13.88	Sand:	89.37					
			PI:	58.12	Clay:	9.13					
46400	LHS OFF 7m	2.5m	LL:	81.00	Gravel:	0.62					STRONG BROWN sandy CLAY with traces of gravel Unsuitable material
			PL:	20.88	Sand:	46.77					
			PI:	60.92	Clay:	52.61					
46475	LHS	1.0m	LL:	N.P	Gravel:	0.44	MDD:	1.87	32% Subgrade		GREY silty SAND with traces of gravel
			PL:	N.P	Sand:	93.83	OMC:	6.80			
			PI:	N.P	Clay:	5.73					
46475	LHS	1.8m	LL:	N.P	Gravel:	0.96	MDD:	1.86	47% Subgrade		GREYISH BROWN silty SAND with traces of gravel
			PL:	N.P	Sand:	95.01	OMC:	14.50			
			PI:	N.P	Clay:	4.03					
46800	LHS OFF 7m	2.0m	LL:	86.00	Gravel:	0.33					DARK GREY Sandy clay with traves of gravel Unsuitable Material
			PL:	34.16	Sand:	13.66					
			PI:	57.84	Clay:	86.11					
46850	OFFSET 11.0 m	0.5m	LL:	52.50	Gravel:	2.72	MDD:	2.02			LIGHT GREY silty SAND with traces of gravel
			PL:	20.86	Sand:	90.60	OMC:	9.64			
			PI:	31.64	Clay:	6.68					
46850	OFFSET 11.0 m	1.5m	LL:	25.90	Gravel:	0.10	MDD:	1.76			DARK GREY silty clay SAND with traces of gravel
			PL:	14.33	Sand:	60.44	OMC:	14.30			
			PI:	11.57	Clay:	39.46					
47350	OFFSET 10.0 m	0.5m	LL:	33.50	Gravel:	0.12	MDD:	1.68			light yellowish BROWN

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			PL:	18.21	Sand:	39.60	OMC:	18.30		silty SAND with traces of gravel
			PI:	15.29	Clay:	60.28				
47350	OFFSET 10.0 m	1.5m	LL:	28.00	Gravel:	0.69	MDD:	1.89		light yellowish BROWN silty SAND with traces of gravel
			PL:	16.85	Sand:	60.03	OMC:	13.00		
			PI:	11.15	Clay:	39.28				
47450	LHS	1.0m	LL:	N.P	Gravel:	2.01	MDD:	1.86		GREY silty SAND with traces of gravel
			PL:	N.P	Sand:	94.42	OMC:	11.50		
			PI:	N.P	Clay:	3.57				
47450	LHS	2.0m	LL:	22.75	Gravel:	0.87	MDD:	2.04		DARK GREY silty SAND with some gravel
			PL:	18.93	Sand:	77.16	OMC:	10.10		
			PI:	3.82	Clay:	21.97				
47550	OFFSET 10.0 m	0.5m	LL:	26.50	Gravel:	0.85	MDD:	2.03		VERY DARK GREY silty clay sand with traces of gravel
			PL:	14.69	Sand:	64.97	OMC:	8.12		
			PI:	4.81	Clay:	34.18				
47550	OFFSET 10.0 m	1.5m	LL:	23.40	Gravel:	1.65	MDD:	2.08		GREYISH BROWN silty sand with traces of gravel
			PL:	18.54	Sand:	77.51	OMC:	9.50		
			PI:	11.81	Clay:	20.84				

APPENDIX 8-4   The coding for Microsoft Visual basic application.

'Declaration of Excel Object

```
Option Explicit


Dim objExcel As excel.Application
Dim objWorkbook As excel.Workbook
Dim objWorksheet As excel.Worksheet
```

'Function for view Soil Profile for each triangle on the map

```
Public Sub OpenExcel(fileName As String)


Dim i As Long
Dim n As Long
On Error Resume Next
Set objExcel = GetObject(, "Excel.Application")
If Err.Number Then
   Err.Clear
   Set objExcel = CreateObject("Excel.Application")
   If Err.Number Then
      MsgBox "Can't open Excel."
   End If
End If
objExcel.Visible = True
Set objWorkbook = objExcel.Workbooks.Open(App.Path & "\soil_profile.xls")
Set objWorksheet = objWorkbook.ActiveSheet


Set objWorksheet = objWorkbook.Sheets(fileName).Select


objExcel.ActiveWindow.Activate


End Sub
```

'Function for all chainage that has only one soil profile data

```
Public Sub OpenExcel2(FirstRow, SecRow, ThirdRow As Integer)


Dim i As Long
Dim n As Long
clearData
```

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```vb
On Error Resume Next
Set objExcel = GetObject(, "Excel.Application")
If Err.Number Then
  Err.Clear
  Set objExcel = CreateObject("Excel.Application")
  If Err.Number Then
    MsgBox "Can't open Excel."
  End If
End If
objExcel.Visible = False
Set objWorkbook = objExcel.Workbooks.Open(App.Path & "\data.xls")
Set objWorksheet = objWorkbook.ActiveSheet


With objWorksheet

  frmMap.txtInfo.Text = .Cells(FirstRow, 3) & ", " & .Cells(SecRow, 3)
  frmMap.txtDepth.Text = .Cells(FirstRow, 4)
  frmMap.txtLL.Text = .Cells(FirstRow, 6)
  frmMap.txtPL.Text = .Cells(SecRow, 6)
  frmMap.txtPI.Text = .Cells(ThirdRow, 6)
  frmMap.txtGravel.Text = .Cells(FirstRow, 8)
  frmMap.txtSand.Text = .Cells(SecRow, 8)
  frmMap.txtClay.Text = .Cells(ThirdRow, 8)
  frmMap.txtMDD.Text = .Cells(FirstRow, 10)
  frmMap.txtOMC.Text = .Cells(SecRow, 10)
  frmMap.txtCBR.Text = (.Cells(FirstRow, 11) * 100) & "% , " & .Cells(SecRow, 11)
  frmMap.txtRemarks.Text = .Cells(FirstRow, 12)

End With


frmMap.Frame13.Visible = True
frmMap.Frame14.Visible = True
frmMap.Frame5.Visible = False
frmMap.Frame9.Visible = False


objWorkbook.Close


End Sub
```

```vb
'Function for all chainage that has only two soil profile data
Public Sub OpenExcel3(FirstRow, SecRow, ThirdRow, FirstRow2, SecRow2, ThirdRow2 As Integer)
```

```
Dim i As Long
Dim n As Long
clearData


On Error Resume Next
Set objExcel = GetObject(, "Excel.Application")
If Err.Number Then
  Err.Clear
  Set objExcel = CreateObject("Excel.Application")
  If Err.Number Then
    MsgBox "Can't open Excel."
  End If
End If
objExcel.Visible = False
Set objWorkbook = objExcel.Workbooks.Open(App.Path & "\data.xls")
Set objWorksheet = objWorkbook.ActiveSheet


With objWorksheet

    frmMap.txtInfo.Text = .Cells(FirstRow, 3) & ", " & .Cells(SecRow, 3)
    frmMap.txtDepth.Text = .Cells(FirstRow, 4)
    frmMap.txtLL.Text = .Cells(FirstRow, 6)
    frmMap.txtPL.Text = .Cells(SecRow, 6)
    frmMap.txtPI.Text = .Cells(ThirdRow, 6)
    frmMap.txtGravel.Text = .Cells(FirstRow, 8)
    frmMap.txtSand.Text = .Cells(SecRow, 8)
    frmMap.txtClay.Text = .Cells(ThirdRow, 8)
    frmMap.txtMDD.Text = .Cells(FirstRow, 10)
    frmMap.txtOMC.Text = .Cells(SecRow, 10)
    frmMap.txtCBR.Text = (.Cells(FirstRow, 11) * 100) & "% , " & .Cells(SecRow, 11)
    frmMap.txtRemarks.Text = .Cells(FirstRow, 12)

    frmMap.txtInfo2.Text = .Cells(FirstRow2, 3) & ", " & .Cells(SecRow2, 3)
    frmMap.txtDepth2.Text = .Cells(FirstRow2, 4)
    frmMap.txtLL2.Text = .Cells(FirstRow2, 6)
    frmMap.txtPL2.Text = .Cells(SecRow2, 6)
    frmMap.txtPI2.Text = .Cells(ThirdRow2, 6)
    frmMap.txtGravel2.Text = .Cells(FirstRow2, 8)
    frmMap.txtSand2.Text = .Cells(SecRow2, 8)
    frmMap.txtClay2.Text = .Cells(ThirdRow2, 8)
    frmMap.txtMDD2.Text = .Cells(FirstRow2, 10)
    frmMap.txtOMC2.Text = .Cells(SecRow2, 10)
    frmMap.txtCBR2.Text = (.Cells(FirstRow2, 11) * 100) & "% , " & .Cells(SecRow2, 11)
```

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```
        frmMap.txtRemarks2.Text = .Cells(FirstRow2, 12)


End With


frmMap.Frame13.Visible = False

frmMap.Frame14.Visible = True

frmMap.Frame5.Visible = True

frmMap.Frame9.Visible = False


objWorkbook.Close


End Sub
```

'Function for all chainage that has three soil profile data
```
Public Sub OpenExcel4(FirstRow, SecRow, ThirdRow, FirstRow2, SecRow2, ThirdRow2, FirstRow3,
SecRow3, ThirdRow3 As Integer)


Dim i As Long

Dim n As Long

clearData


On Error Resume Next

Set objExcel = GetObject(, "Excel.Application")

If Err.Number Then

   Err.Clear

   Set objExcel = CreateObject("Excel.Application")

   If Err.Number Then

      MsgBox "Can't open Excel."

   End If

End If

objExcel.Visible = False

Set objWorkbook = objExcel.Workbooks.Open(App.Path & "\data.xls")

Set objWorksheet = objWorkbook.ActiveSheet


With objWorksheet


   frmMap.txtInfo.Text = .Cells(FirstRow, 3) & ", " & .Cells(SecRow, 3)

   frmMap.txtDepth.Text = .Cells(FirstRow, 4)

   frmMap.txtLL.Text = .Cells(FirstRow, 6)

   frmMap.txtPL.Text = .Cells(SecRow, 6)

   frmMap.txtPI.Text = .Cells(ThirdRow, 6)

   frmMap.txtGravel.Text = .Cells(FirstRow, 8)

   frmMap.txtSand.Text = .Cells(SecRow, 8)
```

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```
            frmMap.txtClay.Text = .Cells(ThirdRow, 8)
            frmMap.txtMDD.Text = .Cells(FirstRow, 10)
            frmMap.txtOMC.Text = .Cells(SecRow, 10)
            frmMap.txtCBR.Text = (.Cells(FirstRow, 11) * 100) & "% , " & .Cells(SecRow, 11)
            frmMap.txtRemarks.Text = .Cells(FirstRow, 12)


            frmMap.txtInfo2.Text = .Cells(FirstRow2, 3) & ", " & .Cells(SecRow2, 3)
            frmMap.txtDepth2.Text = .Cells(FirstRow2, 4)
            frmMap.txtLL2.Text = .Cells(FirstRow2, 6)
            frmMap.txtPL2.Text = .Cells(SecRow2, 6)
            frmMap.txtPI2.Text = .Cells(ThirdRow2, 6)
            frmMap.txtGravel2.Text = .Cells(FirstRow2, 8)
            frmMap.txtSand2.Text = .Cells(SecRow2, 8)
            frmMap.txtClay2.Text = .Cells(ThirdRow2, 8)
            frmMap.txtMDD2.Text = .Cells(FirstRow2, 10)
            frmMap.txtOMC2.Text = .Cells(SecRow2, 10)
            frmMap.txtCBR2.Text = (.Cells(FirstRow2, 11) * 100) & "% , " & .Cells(SecRow2, 11)
            frmMap.txtRemarks2.Text = .Cells(FirstRow2, 12)


            frmMap.txtInfo3.Text = .Cells(FirstRow3, 3) & ", " & .Cells(SecRow3, 3)
            frmMap.txtDepth3.Text = .Cells(FirstRow3, 4)
            frmMap.txtLL3.Text = .Cells(FirstRow3, 6)
            frmMap.txtPL3.Text = .Cells(SecRow3, 6)
            frmMap.txtPI3.Text = .Cells(ThirdRow3, 6)
            frmMap.txtGravel3.Text = .Cells(FirstRow3, 8)
            frmMap.txtSand3.Text = .Cells(SecRow3, 8)
            frmMap.txtClay3.Text = .Cells(ThirdRow3, 8)
            frmMap.txtMDD3.Text = .Cells(FirstRow3, 10)
            frmMap.txtOMC3.Text = .Cells(SecRow3, 10)
            frmMap.txtCBR3.Text = (.Cells(FirstRow3, 11) * 100) & "% , " & .Cells(SecRow3, 11)
            frmMap.txtRemarks3.Text = .Cells(FirstRow3, 12)


End With

frmMap.Frame13.Visible = False
frmMap.Frame14.Visible = False
frmMap.Frame5.Visible = True
frmMap.Frame9.Visible = True


objWorkbook.Close


End Sub
```

'Hide the map when user start the program OR when user click the 'Search Chainage' button

```
Public Sub HideMap()


frmMap.Image1.Visible = False
frmMap.Image2.Visible = False
frmMap.Image3.Visible = False
frmMap.Image4.Visible = False
frmMap.Image5.Visible = False
frmMap.Image6.Visible = False
frmMap.Image7.Visible = False
frmMap.Image8.Visible = False
frmMap.Image9.Visible = False
frmMap.Label9.Visible = False


End Sub
```

'Show the map when user click on 'View Map' button

```
Public Sub ShowMap()


frmMap.Image1.Visible = True
frmMap.Image2.Visible = True
frmMap.Image3.Visible = True
frmMap.Image4.Visible = True
frmMap.Image5.Visible = True
frmMap.Image6.Visible = True
frmMap.Image7.Visible = True
frmMap.Image8.Visible = True
frmMap.Image9.Visible = True
frmMap.Label9.Visible = True


End Sub
```

'Function for clear the label that pop-up each time user point cursor at the triangle

```
Public Sub ClearLabel()


frmMap.Label1.Caption = ""
frmMap.Label1.BackStyle = 0
```

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```vb
frmMap.Label2.Caption = ""
frmMap.Label2.BackStyle = 0

frmMap.Label3.Caption = ""
frmMap.Label3.BackStyle = 0

frmMap.Label4.Caption = ""
frmMap.Label4.BackStyle = 0

frmMap.Label5.Caption = ""
frmMap.Label5.BackStyle = 0

frmMap.Label6.Caption = ""
frmMap.Label6.BackStyle = 0

frmMap.Label7.Caption = ""
frmMap.Label7.BackStyle = 0

frmMap.Label8.Caption = ""
frmMap.Label8.BackStyle = 0


End Sub
```

```vb
'Function for change the label's backstyle to 'none'
Public Sub BackStyle()

frmMap.Label1.BackStyle = 0
frmMap.Label2.BackStyle = 0
frmMap.Label3.BackStyle = 0
frmMap.Label4.BackStyle = 0
frmMap.Label5.BackStyle = 0
frmMap.Label6.BackStyle = 0
frmMap.Label7.BackStyle = 0
frmMap.Label8.BackStyle = 0


End Sub
```

```
'Function to clear all data
Public Sub clearData()

frmMap.txtInfo.Text = ""
frmMap.txtDepth.Text = ""
frmMap.txtLL.Text = ""
frmMap.txtPL.Text = ""
frmMap.txtPI.Text = ""
frmMap.txtGravel.Text = ""
frmMap.txtSand.Text = ""
frmMap.txtClay.Text = ""
frmMap.txtMDD.Text = ""
frmMap.txtOMC.Text = ""
frmMap.txtCBR.Text = ""
frmMap.txtRemarks.Text = ""

frmMap.txtInfo2.Text = ""
frmMap.txtDepth2.Text = ""
frmMap.txtLL2.Text = ""
frmMap.txtPL2.Text = ""
frmMap.txtPI2.Text = ""
frmMap.txtGravel2.Text = ""
frmMap.txtSand2.Text = ""
frmMap.txtClay2.Text = ""
frmMap.txtMDD2.Text = ""
frmMap.txtOMC2.Text = ""
frmMap.txtCBR2.Text = ""
frmMap.txtRemarks2.Text = ""

frmMap.txtInfo3.Text = ""
frmMap.txtDepth3.Text = ""
frmMap.txtLL3.Text = ""
frmMap.txtPL3.Text = ""
frmMap.txtPI3.Text = ""
frmMap.txtGravel3.Text = ""
frmMap.txtSand3.Text = ""
frmMap.txtClay3.Text = ""
frmMap.txtMDD3.Text = ""
frmMap.txtOMC3.Text = ""
frmMap.txtCBR3.Text = ""
frmMap.txtRemarks3.Text = ""
```

End Sub

```vb
'Function for command 'EXIT' button
Private Sub cmdExit_Click()

Dim Cancel As Integer
    Cancel = MsgBox("Are you sure want to exit?", vbYesNo + vbQuestion + _
    vbDefaultButton2, "Exit Application")
If Cancel = vbNo Then
    Exit Sub
Else
    End
End If
End

End Sub
```

```vb
'Function for 'Search Chainage' button
Private Sub cmdSearch_Click()

Dim first, second, third As Integer
Dim first2, second2, third2 As Integer
Dim first3, second3, third3 As Integer

    If cmbChain.Text = "2125" Then
        first = 4
        second = 5
        third = 6
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "2350" Then
        first = 7
        second = 8
        third = 9
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "24425" Then
        first = 40
        second = 41
        third = 42
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "28500" Then
```

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```vb
        first = 43
        second = 44
        third = 45
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "38000" Then
        first = 46
        second = 47
        third = 48
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "39000" Then
        first = 49
        second = 50
        third = 51
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "41050" Then
        first = 58
        second = 59
        third = 60
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "44075" Then
        first = 61
        second = 62
        third = 63
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "46250" Then
        first = 82
        second = 83
        third = 84
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "46800" Then
        first = 100
        second = 101
        third = 102
        OpenExcel2 first, second, third
    ElseIf cmbChain.Text = "14500" Then
        first = 10
        second = 11
        third = 12
        first2 = 13
        second2 = 14
        third2 = 15
        OpenExcel3 first, second, third, first2, second2, third2
    ElseIf cmbChain.Text = "14850" Then
```

```vb
        first = 16
        second = 17
        third = 18
        first2 = 19
        second2 = 20
        third2 = 21
        OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "16050" Then
        first = 22
        second = 23
        third = 24
        first2 = 25
        second2 = 26
        third2 = 27
        OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "16103" Then
        first = 28
        second = 29
        third = 30
        first2 = 31
        second2 = 32
        third2 = 33
        OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "16200" Then
        first = 34
        second = 35
        third = 36
        first2 = 37
        second2 = 38
        third2 = 39
        OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "39400" Then
        first = 52
        second = 53
        third = 54
        first2 = 55
        second2 = 56
        third2 = 57
        OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "44175" Then
        first = 64
        second = 65
        third = 66
```

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```
    first2 = 67
    second2 = 68
    third2 = 69
    OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "44500" Then
    first = 70
    second = 71
    third = 72
    first2 = 73
    second2 = 74
    third2 = 75
    OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "45500" Then
    first = 76
    second = 77
    third = 78
    first2 = 79
    second2 = 80
    third2 = 81
    OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "46475" Then
    first = 94
    second = 95
    third = 96
    first2 = 97
    second2 = 98
    third2 = 99
    OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "46850" Then
    first = 103
    second = 104
    third = 105
    first2 = 106
    second2 = 107
    third = 108
    OpenExcel3 first, second, third, first2, second2, third2
ElseIf cmbChain.Text = "47350" Then
    first = 109
    second = 110
    third = 111
    first2 = 112
    second2 = 113
    third2 = 114
```

```
        OpenExcel3 first, second, third, first2, second2, third2
    ElseIf cmbChain.Text = "47450" Then
        first = 115
        second = 116
        third = 117
        first2 = 118
        second2 = 119
        third2 = 120
        OpenExcel3 first, second, third, first2, second2, third2
    ElseIf cmbChain.Text = "47550" Then
        first = 121
        second = 122
        third = 123
        first2 = 124
        second2 = 125
        third2 = 126
        OpenExcel3 first, second, third, first2, second2, third2
    ElseIf cmbChain.Text = "46400" Then
        first = 85
        second = 86
        third = 87
        first2 = 88
        second2 = 89
        third2 = 90
        first3 = 91
        second3 = 92
        third3 = 93
        OpenExcel4 first, second, third, first2, second2, third2, first3, second3, third3
    Else
        MsgBox "Please choose the chainage", vbInformation, "Error"
        clearData
        Exit Sub
    End If


Me.Frame1.Caption = "Soil Data for chainage - " & Me.cmbChain.Text
Me.Frame1.Visible = True
Me.cmbChain.Refresh


End Sub
```

```
Private Sub cmdSrcChain_Click()
```

```vb
Image9.Visible = False
Label9.Visible = False
'Unload Me
'Picture1.Visible = True
'Frame1.Visible = True
cmbChain.Visible = True
cmdSearch.Visible = True
'frmData.Show


End Sub
```

```vb
Private Sub cmdViewMap_Click()

cmbChain.Text = "Choose Chainage"
ShowMap
Frame1.Visible = False
cmbChain.Visible = False
cmdSearch.Visible = False
'Picture1.Visible = False
Image9.Visible = True


End Sub
```

```vb
Private Sub Form_Load()

BackStyle
HideMap
Frame1.Visible = False
cmbChain.Visible = False
cmdSearch.Visible = False

Me.Frame13.Visible = False
Me.Frame14.Visible = False


End Sub
```

```vb
Private Sub Image1_Click()
    Dim flName As String
```

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```vb
flName = "ch300-ch3560"


OpenExcel (flName)


End Sub
```

```vb
Private Sub Image1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

Me.Label1.Caption = "Soil Profile, 300 - 3560"
Me.Label1.BackStyle = 1
Me.Label1.ForeColor = vbWhite
Me.Label1.BackColor = &H8000000D

End Sub
```

```vb
Private Sub Image2_Click()
Dim flName As String


flName = "ch3560-ch10130"


OpenExcel (flName)


End Sub
```

```vb
Private Sub Image2_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

Me.Label2.Caption = "Soil Profile, 3560 - 10130"
Me.Label2.BackStyle = 1
Me.Label2.ForeColor = vbWhite
Me.Label2.BackColor = &H8000000D

End Sub
```

```vb
Private Sub Image3_Click()
Dim flName As String


flName = "ch10130-ch16077"


OpenExcel (flName)
```

End Sub

Private Sub Image3_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

Me.Label3.Caption = "Soil Profile, 10130 - 16077"
Me.Label3.BackStyle = 1
Me.Label3.ForeColor = vbWhite
Me.Label3.BackColor = &H8000000D

End Sub

Private Sub Image4_Click()
Dim flName As String

flName = "ch16077-ch20898"

OpenExcel (flName)
End Sub

Private Sub Image4_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

Me.Label4.Caption = "Soil Profile, 16077 - 20898"
Me.Label4.BackStyle = 1
Me.Label4.ForeColor = vbWhite
Me.Label4.BackColor = &H8000000D

End Sub

Private Sub Image5_Click()
Dim flName As String

flName = "ch20898-ch23200"

OpenExcel (flName)
End Sub

Private Sub Image5_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

```vb
Me.Label5.Caption = "Soil Profile, 20898 - 23200"
Me.Label5.BackStyle = 1
Me.Label5.ForeColor = vbWhite
Me.Label5.BackColor = &H8000000D


End Sub
```

```vb
Private Sub Image6_Click()
Dim flName As String


flName = "ch23200-ch26027"


OpenExcel (flName)
End Sub
```

```vb
Private Sub Image6_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)


Me.Label6.Caption = "Soil Profile, 23200 - 26027"
Me.Label6.BackStyle = 1
Me.Label6.ForeColor = vbWhite
Me.Label6.BackColor = &H8000000D


End Sub
```

```vb
Private Sub Image7_Click()
Dim flName As String


flName = "ch26027-ch28420"


OpenExcel (flName)
End Sub
```

```vb
Private Sub Image7_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)


Me.Label7.Caption = "Soil Profile, 26027 - 28420"
Me.Label7.BackStyle = 1
Me.Label7.ForeColor = vbWhite
Me.Label7.BackColor = &H8000000D
```

End Sub

```vb
Private Sub Image8_Click()
Dim flName As String

flName = "ch28420-ch34944"

OpenExcel (flName)
End Sub
```

```vb
Private Sub Image8_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

Me.Label8.Caption = "Soil Profile, 28420 - 34944"
Me.Label8.BackStyle = 1
Me.Label8.ForeColor = vbWhite
Me.Label8.BackColor = &H8000000D

End Sub
```

```vb
Private Sub Image9_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```vb
Private Sub Label1_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```vb
Private Sub Label2_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label3_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label4_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label5_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label6_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label7_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel

End Sub
```

```
Private Sub Label8_MouseMove(Button As Integer, Shift As Integer, X As Single, Y As Single)

ClearLabel
```

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