



UNIVERSITI  
TEKNOLOGI  
MARA

# **CONFERENCE PROCEEDING**

## **ICITSBE 2012**

**1<sup>ST</sup> INTERNATIONAL CONFERENCE ON INNOVATION  
AND TECHNOLOGY FOR  
SUSTAINABLE BUILT ENVIRONMENT**

**16 -17 April 2012**



Organized by:  
Office of Research and Industrial  
Community And Alumni Networking  
Universiti Teknologi MARA (Perak) Malaysia  
[www.perak.uitm.edu.my](http://www.perak.uitm.edu.my)

PAPER CODE: UP 12

## A GEOGRAPHIC INFORMATION SYSTEM (GIS) APPROACH FOR STORING AND MANAGING GEOTECHNICAL PROPERTIES AT BANDAR SERI MANJUNG, DISTRICT OF MANJUNG, PERAK DARUL RIDZUAN

Wan Nur Syazwani Bt W. M<sup>a</sup>, Rusamah Abdul Jalil<sup>b</sup> and Noorsazwan Ahmad Pugi<sup>c</sup>

Faculty of Architecture, Planning and Surveying, Universiti Teknologi MARA (Perak), Malaysia

<sup>a</sup>wannur956@perak.uitm.edu.my

<sup>b</sup>rusam215@perak.uitm.edu.my, <sup>c</sup>noors240@perak.uitm.edu.my

### Abstract

*This paper explains the development of Geographic Information System (GIS) in geotechnical properties. GIS is used in store geotechnical properties such as soil types, soil depth or layer and water level at Bandar Seri Manjung, District of Manjung, Perak Darul Ridzuan. With help GIS technology, geotechnical properties are store in the form of softcopy and people can make quick decision especially during preliminaries construction stage. Spatial analysis is used in the process of modeling, examining, and interpreting the model results. Attribute data information, geographic referenced data are the important item in spatial analysis. The chapter concludes with some discussion of the future prospect about GIS in geotechnical aspect.*

**Keywords:** GIS, Geotechnical, Geographic, Information, System.

### 1. Introduction

Bandar Seri Manjung is located between Sitiawan and Lumut at District of Manjung, Perak Darul Ridzuan. Currently, Bandar Seri Manjung is developed to be administrative capital, commercial building, shopping centre and mall, sport centre, housing and more (Majlis Perbandaran Manjung, 2011). Moreover, Majlis Perbandaran Seri Iskandar (2009) report that, Bandar Seri Manjung consists of 26,160 people in year 2000. However, this amount will increase time to time as there are a lot of new developments in this area.



Figure 1: The Location of Bandar Seri  
Source: Google maps, retrieved on 2012.

## 2. Geographic Information System (GIS)

### 2.1 Definition and benefits

Geographic Information System (GIS) is one of computer system which is can capture, store, query, analyze and display geospatial data (Chong, 2010). Moreover, the system is useful tools, in helping their users to solve geographic problems (Paul, Micheal et al, 2001). In addition, Chang (2010) describes GIS is one of problem-solving tools and Macguire (1991) added GIS is to support spatial decision making.

There are a lot of benefits using GIS especially in geotechnical issue. The most advantages of GIS easy to retrieve analyze and manipulate the data (Beheshti et al, 2001). GIS can cover the large area that geographer or researcher need to explore, even the whole world. Moreover, the large area can easily divide to sub-sub area and then spatial analysis plays the important role. Other than that, GIS is create better communication between construction team, client and also public. This is because normally GIS is map based and the words or sentences will minimize. In relation to geotechnical engineering, the system can help the engineer to display the locations of boreholes on a digital map on the computer screen which is in accordance to their proximity to the general location of a new investigation site (Oloufa, et al., 1995). Thus, before creating a map, GIS elements are the main items need to understand.

### 2.2 Vector Data

Vector is the magnitude and direction of something. In the application of GIS, vectors represent the spatial features such as points, lines, polygons (areas) in x and y coordinates (Chang, 2010). Normally, points represent the location of objects such as boreholes, post office and benchmarks. Meanwhile, lines represent contour, river, stream or either straight or curve lines. Lastly, polygon which is refers to area at the location concerned and for example soil areas, land areas, lakes and forest.

### 2.3 Attribute Data

In GIS, attribute data is important in terms of data management. The attribute data created will link with GIS map. In the attribute data stored in tables and consist of rows and columns. The rows represent the spatial feature and each column describes the characteristics, meanwhile the intersection of column and rows represent the value of a particular characteristic for a particular feature (Chang, 2010).

### 2.4 Data Display and Cartography

The study of a map from various aspects is called Cartography (Chang, 2010). This is including the symbology, colour, data classification and generalization. A well-designed maps are consists those elements and will help the readers understood.

#### 2.4.1 Symbology

Vector data or spatial feature such as points, lines and polygon need to include in the map in order to shows the location and visual variables. Choosing the right symbols is the main concern for data display and mapmaking. In addition, size, pattern, texture or shape also needs to consider in map display. It must be appropriate and nice to see and view.

#### 2.4.2 Colour

The choice of colour will make users more interested with the map. The basic of colour can categorize as value, hue and saturation (Francis, 2008). He also added that colour value is the different degree of darkness or lightness of colour. For example, darker colour refers to highest ranking and the lowest rank shows by light colour. Meanwhile, hue is refers to colour such as yellow, blue, red and more. This is reflecting from different light wavelengths by a surface (Francis, 2008). The application of colour hue is to differentiate between area, types or zoning. Lastly, colour saturation is the purity or intensity of a hue (Francis, 2008).

#### 2.4.3 Data classification

Chang (2010) describes data classification is the method and number of classes to classified the data and map feature. There are several methods to classify the data such as equal interval, geometric interval, equal frequency, mean and standard deviation, natural breaks and used defined (Chang, 2010).

#### 2.4.4 Generalization

This generalization shows in data classification as already being classified. For example, in the class consisting of a group of cities and different population sizes (Chang, 2010), thus generalization is important and useful as the data are varied and needed to group and merge.

### 3. Methodology

In storing and managing geotechnical data, ArcGIS is used in this research. ArcGIS provide a lot of useful tools to apply. The results below show the various ways of geotechnical data are store in ArcGIS.

### 4. Result and Analysis

#### 4.1 Vector Data

The figure below shows the spatial feature of points and polygon. Points are representing the boreholes and polygons represent the area. From the findings, the points patterns are shown are clustered in their own cadastral. However for overall points, the points look dispersed.

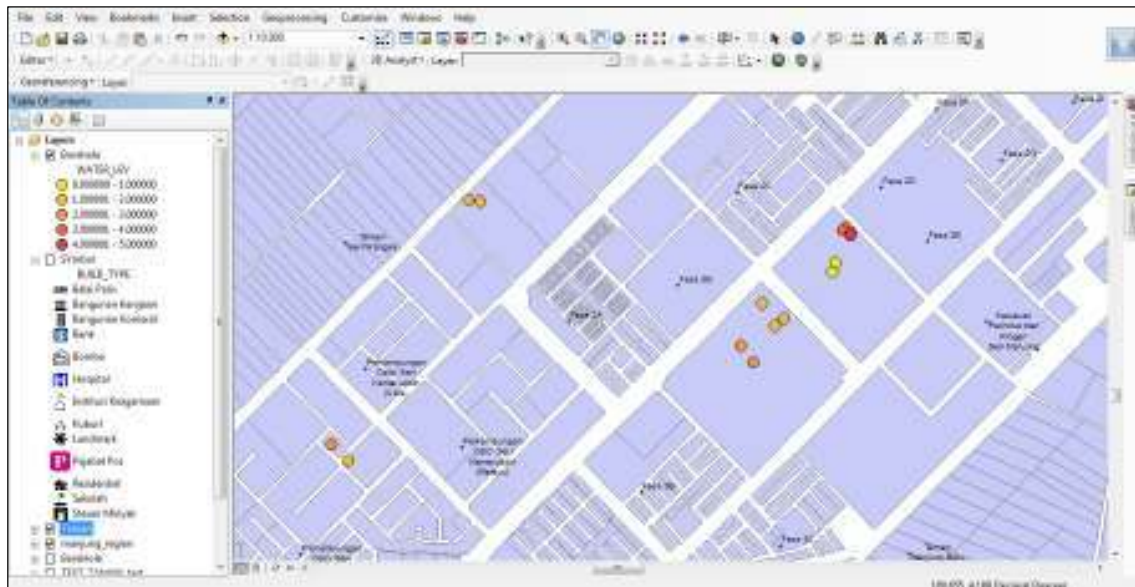


Figure 2: The location of borehole

#### 4.2 Attribute Data

In creating the database, there are a lot of information to be generated from the data. The attribute table is one of the results where the data are stored. From tables 1, this attribute tables can be classified as one-to-one relationship. For example, the value of water level for Hospital Seri Manjung are 1.4,1.2,1.5 and 2.4. The table also shows the dependent variable are the boreholes name, and water level classified as independent variables.

Table 1: The attribute data of boreholes and water level

| FID | Shape * | OBJECTID | BH_NO | LOCATION                | PROJECT_NA                                  | WATER_LEV |
|-----|---------|----------|-------|-------------------------|---|-----------|
| 0   | Point   | 4        | 1     | Hospital Seri Manjung   | 'On Call' Kompleks Hospital Seri Manjung    | 1.4       |
| 1   | Point   | 5        | 2     | Hospital Seri Manjung   | 'On Call' Kompleks Hospital Seri Manjung    | 1.2       |
| 2   | Point   | 6        | 3     | Hospital Seri Manjung   | 'On Call' Kompleks Hospital Seri Manjung    | 1.5       |
| 3   | Point   | 7        | 1     | Hospital Seri Manjung   | Unit Hemodialysis Hospital Seri Manjung     | 2.4       |
| 4   | Point   | 8        | 2     | Hospital Seri Manjung   | Unit Hemodialysis Hospital Seri Manjung     | 2.4       |
| 5   | Point   | 9        | 1     | JPJ Seri Manjung        | Membina Pej. Titi Timbang & Kaw Sita di JPJ | 1.95      |
| 6   | Point   | 10       | 2     | JPJ Seri Manjung        | Membina Pej. Titi Timbang & Kaw Sita di JPJ | 1.25      |
| 7   | Point   | 11       | 1     | SK Dato' Sri Kamaruddin | Membina Bangunan 4 Tingkat                  | 1.26      |
| 8   | Point   | 12       | 2     | SK Dato' Sri Kamaruddin | Membina Bangunan 4 Tingkat                  | 2.16      |
| 9   | Point   | 13       | 1     | SK Seri Manjung         | Pembinaan Makmal Komputer                   | 0.3       |
| 10  | Point   | 14       | 2     | SK Seri Manjung         | Pembinaan Makmal Komputer                   | 0.32      |
| 11  | Point   | 17       | 1     | SK Seri Manjung         | Pej Pendidikan Daerah Manjung               | 2.1       |
| 12  | Point   | 18       | 2     | SK Seri Manjung         | Pej Pendidikan Daerah Manjung               | 3.5       |
| 13  | Point   | 19       | 3     | SK Seri Manjung         | Pej Pendidikan Daerah Manjung               | 3.16      |
| 14  | Point   | 20       | 4     | SK Seri Manjung         | Pej Pendidikan Daerah Manjung               | 4.13      |

Spatial feature

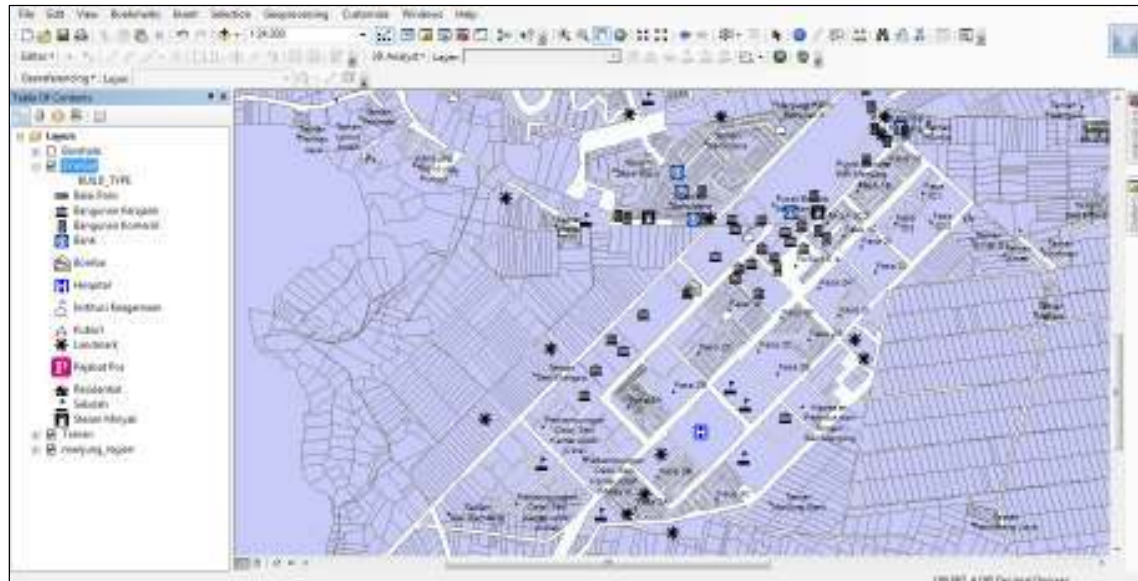
Borehole Name

Water level value

### 4.3 Data Display and Cartography

#### 4.3.1 Symbology

In order to view and more understand the map, the others points vector represent in symbols. In this paper, there are lot buildings such as bank, hospital, police station, post office and others represents in symbols. The symbols are used to communicate information about the spatial attribute and also spatial location.



Types of Symbols

Figure 3: The types of symbols used in this research

### 4.3.2 Colour

Colour is used to distinguish between the values of ordinal and ratio data by using graduated colours. In ArcGIS used the term of graduated to cover choropleth and dasymetric maps (Chang 2010). Moreover, the graduated colour scheme shows the variation in spatial data. Figure 4 shows the different types of colour represent the different values of water level. The dark colour represents the highest water level in this research and the lighter colour show the lowest value of water level.

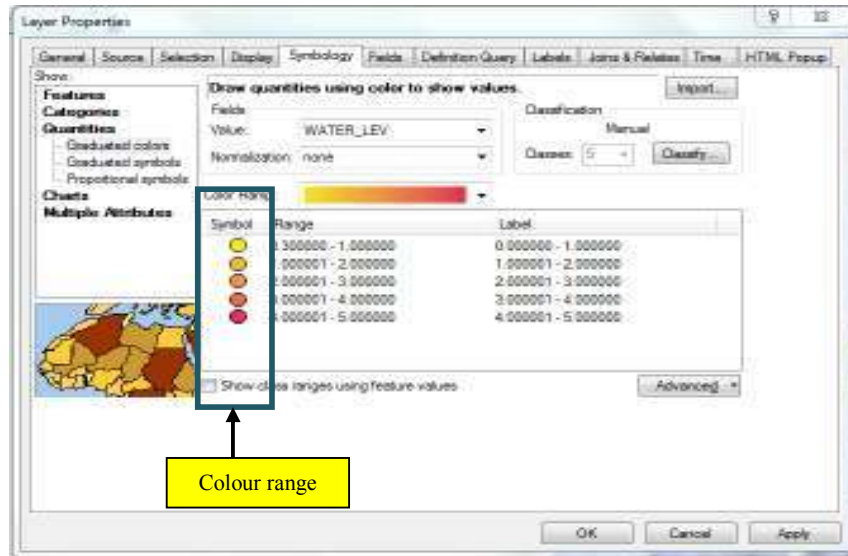


Figure 4: The types of colour used

### 4.3.3 Data classification

For data classification, the class breaks are used. The choice of data classification is to show the values of water level are different for different boreholes. The classification of data produces different map and spatial shape or pattern.

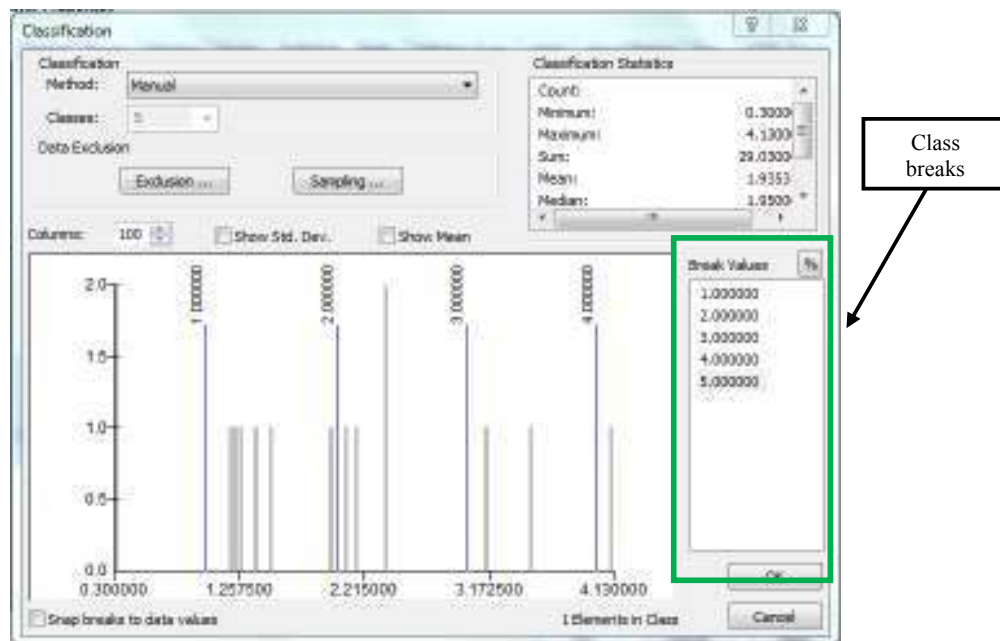


Figure 5: The types class breaks used

## 5. Conclusion

There are many ways to store and managing geotechnical properties by applied varies tools inside ArcGIS. However, before the data are stored, the basic elements of ArcGIS must well understand. These include spatial data, attribute table, data display and cartography. In the future of geotechnical aspect, ArcGIS or others GIS software is used to determine the successful of the projects. Tunnels, dams and bridges are the examples of big project which is need the detail geotechnical investigation. If the geotechnical aspect is insufficient, the structures can collapse or fail.

## Acknowledgement

The deep appreciation goes to research partner, Jabatan Kerja Raya (JKR) Manjung, Majlis Perbandaran Manjung, Majlis Perbandaran Seri Iskandar, JUPEM and Minerals and Geoscience Department Malaysia (Perak) for helping us to complete this paper. Special thanks also to UiTM perak for give us the funding, friends from our department and our beloved family.

## References

- Beheshti R, Michels Ralph., (2001) *The Global GIS: a case Study*, Civil Engineering Informatics, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Automation in Construction 10 (2001) 597-606.
- Chang Kang-Tsung (2010) *Introduction To Geographic Information Systems*, McGraw-Hill International Edition, Fifth Edition.
- Francis H (2008) *A Primer of GIS Fundamental Geographic and Cartographic Concepts* The Guilford Press New York.
- Macquire,D.J (1991) An overview and definition of GIS. In: Macquire, D.J, Goodchild M F,Rhind D W (eds) *Geographical Information System: principles and applications*. Logman, Landon,pp, 9-20,Vol 1.
- Majlis Perbandaran Manjung.
- Majlis Perbandaran Seri Iskandar (2009) *Kajian Profil Bandar Negeri Perak*, Edisi Jun.
- Oloufa A.A, Masaaki Ikeda (1995) An Automated Environment For Soils and Terrain-Dependent Application, Penn State University, Department of Architectural Engineering, 104 Engineering Building "A", University Park and Fujita Corporation, Technical Research Institute, Yokohama, Automation in Construction 4 (1995) 139-146.
- Paul A. L, Micheal F.G et al (2001) *Geographic Information Systems and Science*, John Wiley & Sons, LTD