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MAINTENANCE CONSIDERATION IN SLOPE DESIGN

AHMAD SAYUFEI BIN ZAINUDDIN

A project report submitted in partial fulfillment of the
requirements for the award of the degree of
Master of Civil Engineering (Construction Management)

Faculty of Civil Engineering
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NOVEMBER 2008

I declare that this thesis entitled "*Maintenance Consideration in Slope Design – Case Study* " is the result of my own research except as cited in the references. The thesis has not been accepted for any degree and is not concurrently submitted in candidature of any other degree.

Signature : .....

Name : **AHMAD SAYUFEI BIN ZAINUDDIN**

Date : **24 NOVEMBER 2008**

Dedicated to my beloved mother, families and friends;

Fatmah Bt Hashim

Augastinar Mohd Arif

Ahmad Rohaizad

Rohaizah

Ahmad Rohaizam

Rozana

Nur Batrisyia

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In the name of Allah, the Most Gracious and the Most Merciful.

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May Allah bless and bestow us all with good deeds, good health, love, kindness and success in life. Thank you.

ABSTRACT

Currently, most of the slope failure occurred in highways due to inadequate design and lack of maintenance to address current situation. Slopes failures along the highways in Malaysia have been occurring and can be considered as an unpredictable event. One of the good examples is slope failure, which happened in 1996 at KM 303.80 (South Bound) near Gua Tempurung, Perak. The objective of this research is to identify the type of defects that contribute to the slope failure, identify and establish the common failures at various slope angle and to identify common type of slope repair in Malaysia.. Literature review and case study has conducted to achieve the objectives .Based on the case study that has been carried out, there are few types of defects that contribute to the slope failure such as water seepage and collapsed drain. In this case study, slope failures also occurred due to slope angles and height. Stone pitching and rockfill were identified is a common method type of slope repair in highway. A few recommendations need to be addressed by the designers or client when they intend to design a new slope along the highway such as type of vegetation, type of drain, accessibility, etc. In considering all these factors, it will benefit to the owner or client in term of maintenance cost in future. In conclusion, Asset Management has played an important role in future not only for slope along the highway but to other assets such as building, tower, etc. in order to maximize the company profit.

ABSTRAK

Pada masa kini, kebanyakan kegagalan curun di sepanjang lebuhraya adalah kemungkinan disebabkan oleh rekabentuk yang tidak mencukupi dan kegagalan menjalankan kerja-kerja penyelengaraan dengan baik berdasarkan kepada perkembangan dan keadaan semasa. Kegagalan curun di sepanjang lebuhraya di Malaysia sering terjadi dan kejadian ini adalah sukar dijangkakan. Contoh yang terbaik ialah kegagalan cerun yang berlaku di Gua Tempurung, Perak, pada tahun 1996 di KM 303.80 arah selatan. Tujuan kajian kes ini adalah untuk mengenal-pasti jenis-jenis kecacatan yang boleh membawa kepada kegagalan cerun, mengenal-pasti kegagalan cerun disebabkan oleh sudut dan ketinggian yang berbeza dan mengenal-pasti kaedah atau cara pembaikan cerun-cerun yang kebanyakannya digunakan di Malaysia. Kajian kes dijalankan terhadap data-data yang diperolehi dan juga melalui kajian literatur. Berdasarkan kepada kajian yang telah dijalankan, kecacatan yang sering menyebabkan kegagalan cerun adalah *water seepage* dan *collapsed drains*. Di samping itu juga, kegagalan cerun juga biasanya terjadai disebabkan oleh sudut cerun dan ketinggian yang berbeza. Kaedah *Stone pitching* dan *rock fill* adalah dua kaedah yang biasa dilakukan di dalam pembaikan cerun di lebuhraya, Malaysia. Beberapa cadangan telah diutarakan kepada jurutera rekabentuk dan pemilik diantaranya ialah mengambil kira jenis sistem perparitan yang digunakan, jenis tumbuhan atau pokok yang hendak ditanam dan kemudahan akses untuk melakukan kerja-kerja penyelengaraan. Secara keseluruhannya, pengurusan aset pada masa depan adalah penting untuk memaksimumkan keuntungan.

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CHAPTER 1

INTRODUCTION

1.1 Introduction

It has been long recognized that those who design slopes have been given inadequate consideration to the maintenance problems that are related to many designs. Many of new design, maintenance aspects are not taking into account due to cost saving and time constraint approaches only. In order to overcome this problem, the understanding of asset life-cycle process, consisting of asset development and asset management is necessary especially in developing country such as Malaysia.

Designing new assets such as slopes, highways, bridges, culverts, etc, need a proper planning, accurate information based on experiences and good coordination between owner, consultant, asset manager and contractor. On the other hand, concept of concurrent engineering should be implemented between all party involved.

1.2 Background of Study

Currently, maintenance considerations in slope design by consultants or engineers are not taking into account due to cost saving and time constraint. There are few factors that need to be considered during design stage by all parties such as factor of safety, critical potential failure paths, representative shear strength, ground water conditions and effects of erosion (Potter. T, 2000).

Cut slope can be described as a natural material whereby the soil is not homogeneous. It has been constructed according to the required angle and height. Embankment slope is a man made slope whereby the materials should be more or less homogenous (Gue, 1995).

Slope condition assessment is required before any remedial works carried out by the contractor. Inspection and monitoring are the important aspects when carrying out slope condition assessment. There are some methods involved during slope condition assessment. One of the methods is to conduct aerial view inspection. Periodical inspection and general inspection are required in order to identify the maintenance needs of the slope. All inspections were conducted by maintenance engineer and inspectors (PLUS Manual, 2000).

Slope protection or types of slope repairs also play an important role in order to reduce slope deterioration and slope failure along the highways. Understanding of suitable method of slope repair is necessary for engineers. Beside of that the type of vegetation used in slope will also to be considered based on their material characteristics and function (Abd. Rahman, 2007).

1.3 Problems Statement

Slopes failures along the highways in Malaysia have been occurring and can be considered as an unpredictable event. One of the good examples is slope failure, which happened in 1996 at KM 303.80 (South Bound) near Gua Tempurung, Perak and Bukit Lanjan, KM 21.8 (East Bound) in November 2003 due to some unpredictable reasons such as high intensity of rainfall, improper drainage systems, third party activities, slope surface protection, etc. Most of the slope failure occurred in highways due to inadequate design and lack of maintenance to address current situation.

In current practice, the maintenance aspect has not been given a due consideration by the Authorities or Consultants in producing any new design. Maintenance consideration should begin at earlier stage, during the location studies and continue throughout the design process.

1.4 Objective of Research

The aim of this research is to identify the elements or aspects of maintenance that need to be considered during the design stage for slope; To achieve this aim, the following objectives have been develops:

a. To identify the type of defects that contribute to the slope failure;

b. To identify the slope failures at various angles of slope; and

c. To identify the common types of slope repair in Malaysia.

1.5 Scopes of Research

The scope of this study will focus on information gathered through periodical and general inspections at Section C1, from KM 340.00 to KM275.00, North-South Expressway (Bidor to Ipoh Selatan) for three consecutive years (2005, 2006 and 2007).

Secondly, this research will also focus on defects observed during periodical and general inspections at Section C1, from KM 340.00 to KM275.00, North-South Expressway (Bidor to Ipoh Selatan) for three consecutive years (2005, 2006 and 2007).

1.6 Research Methodology

The research methodology of this study involved literature review on journal, research papers, books, proceedings, etc. which were related to the research topic.

Case study was carried out on the slope or embankment along North-South Expressway (PLUS). Refer to the **Figure 1.1** below for the flow chart of the research methodology.

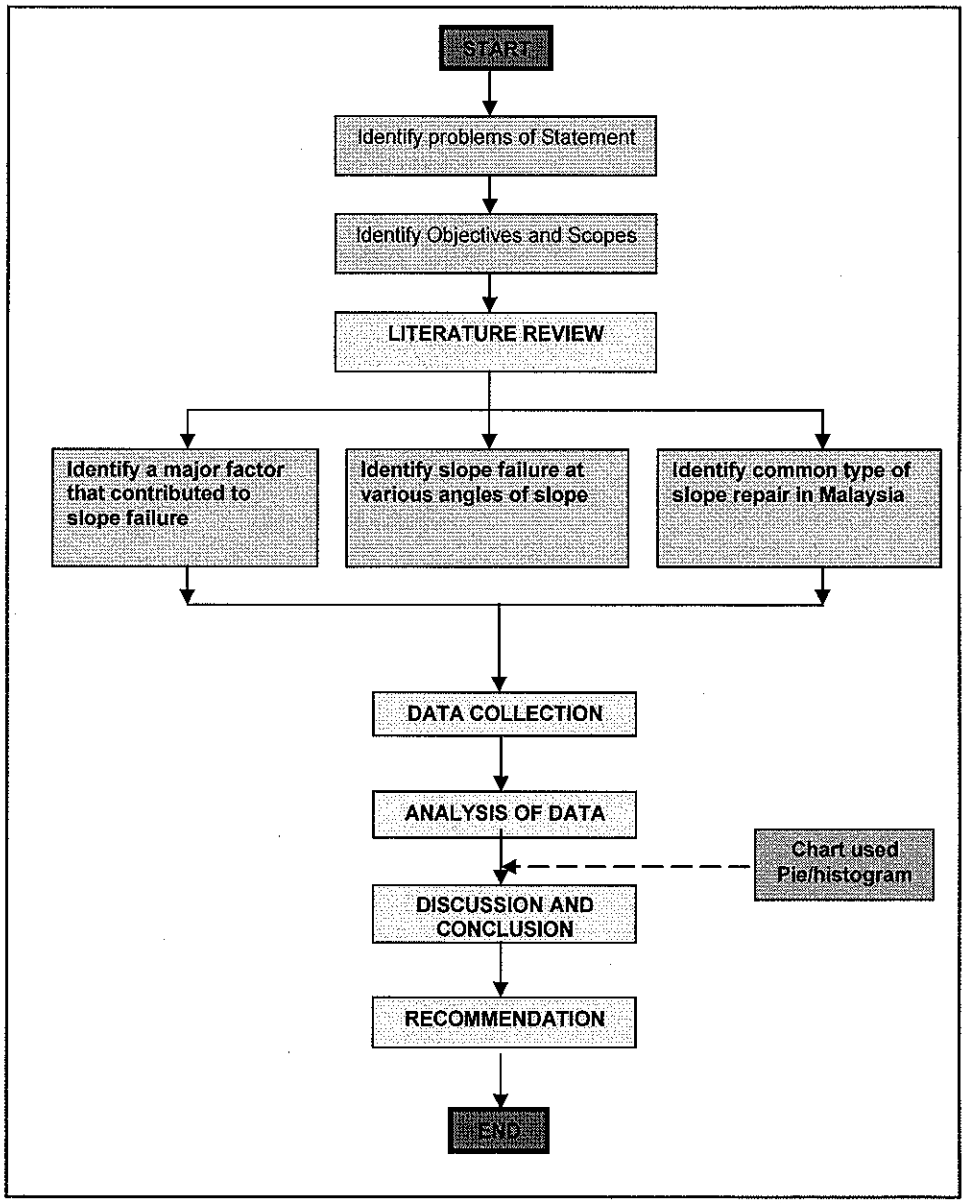

Figure 1.1: Flow Chart of Research Methodology