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EVALUATION OF SUBGRADE SOILS USING SELECTED IN-SITU DEVICES

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ABSTRACT

One of the reasons of pavement failure is weak subgrade, which causes rutting, alligator cracking, and upheaval. To prevent subgrade failure, adequate compaction as in the specification must be carried out. Proper quality assurance and quality compliance (QA/QC) procedure must be followed to ensure that compaction is carried out adequately. Existing Public Work Department (PWD) Specification for Road Work (JKR/SPJ/88) relating to compaction only require in-situ field density test and moisture content to ensure that compaction is carried out correctly. There is no specification on the determination of subgrade strength although the strength of subgrade in terms of elastic modulus is important as input in pavement design. Therefore, there is a need to obtain the in-situ subgrade strength to ensure that the pavement is correctly designed. This research details a study on road subgrade using three types of in-situ devices undertaken on six 150-metres length flexible pavement subgrade test sections. The devices used in this study include the in-situ CBR, Dynamic Cone Penetrometer (DCP) and Portable Falling Weight Deflectometer (PFWD). Tests using these devices were carried out at specified spacing on the test sections to determine the subgrade CBR, DCP-PR in (mm/blow) and elastic modulus values. The results obtained for laboratory CBR (unsoaked and soaked), in-situ CBR, DCP-PR in (mm/blow) and modulus subgrade were analysed and correlated to develop models to relate the values obtained. It was found that there is a reasonable relationship between the in-situ CBR and the laboratory unsoaked CBR values. The relationship between in-situ CBR with the DCP-PR in (mm/blow) values was found to be conclusive as high positive values of correlation were obtained. The relationship between in-situ CBR with the P-FWD modulus values was found to be inconclusive. The relationship obtained between DCP and P-FWD is a positive correlation. It is recommended that DCP test be included in all PWD road construction specification so that the subgrade strength of the pavement could be checked to meet the desired requirement.

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CHAPTER ONE
INTRODUCTION

1.1 BACKGROUND OF STUDY

The structural design of the highway pavement layer components is generally referred to as pavement design. One of the important factors that affect pavement design is subgrade soils characteristics. The importance of subgrade soils characterization in pavement design is less critical compared to other areas of civil engineering but the consequences of the failure of these structures are generally more critical and could possibly lead to loss of lives (Hassan, 1996).

From previous experience premature failures occur due to inadequate pavement structural strength such as weak base, sub-base and subgrade. Pavement failure caused by weak subgrade includes rutting, alligator cracking, and upheaval. To prevent subgrade failure, adequate compaction as in the specification must be carried out. Proper quality assurance and quality compliance (QA/QC) procedure must be followed to ensure compaction is carried out adequately.

1.2 PROBLEM STATEMENT

Existing Public Work Department (PWD) Specification on Road Work (JKR/SPJ/88) relating to compaction only require in-situ field density test and moisture content test to ensure that compaction is carried out correctly by the contractors. The in-situ compaction test only implies that adequate strength is achieved when it is compacted at 95%. Also, new pavement design procedures based on mechanistic design methods require the strength of subgrade in terms of elastic modulus as input in pavement design. Therefore, there is a need to obtain the actual in-situ strength of subgrade achieved in order to ensure that the pavement is correctly design.

Therefore, in-situ subgrade strength (in terms of California Bearing Ratio (CBR) or Resilient Modulus) is required to ensure that the pavement is correctly designed. Various devices are available to measure the strength of subgrade such as Dynamic Cone Penetrometer (DCP), Portable Falling Weight Deflectometer (PFWD), in-situ CBR, Geogauge, Plate Load Test and so on. This study try to explore in-situ strength for subgrade soils and compare to the laboratory results. These devices