DESIGN OF A NEW ROAD PROJECT AT NILAI

BY

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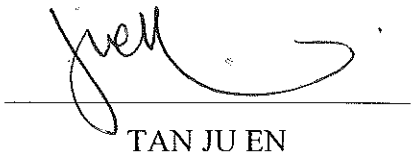
DECLARATION

I hereby declare that the entire work embodied in the Project Report entitled **"Design of a New Road in Nilai"**, has been carried out by me under the supervision and guidance of MrSudesh Nair Baskara. The matter and content in this report incorporates the results of independent investigations brought out by me. To the best of my knowledge, no part of this project has been submitted for any Degree or Diploma to the University of Inti, Nilai.



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ABSTRACT

This project is based on the research and design made throughout the semester. The title of this project is "Design of a New Road Project in Nilai." This report is structured into sixsections with each into its divided subsections.

The first section, **1.0 INTRODUCTION** introduces briefly about roads as well as the purpose and objective of this project done.

The second section,**2.0 INTRODUCTION OF NEW ROAD PAVEMENTS** consists of studies about road and highway pavements. It shows the requirements of an ideal pavement. It introduces the two main types and qualities of road pavements which is the flexible and rigid pavement.

The next section,**3.0 RESEARCH ON FLEXIBLE PAVEMENT** shows the studies and researches done before the main objective of this project, which is to design a road in Nilai. The research is based on the flexible pavement since it is chosen as the type of pavement used in this design. The researches include on the types of flexible pavement, coating layers on a flexible pavement, components of flexible pavements as well as the possible failures for flexible pavement.

The fourth, which is the most important section of this project is**4.0 ROAD DESIGN PROJECT IN NILAI**. After all the researches and studies, this section shows the methods and techniques used to design the new road. The road is designed using the flexible pavement as the selected pavement type. An experiment of the average daily traffic was made. With collected and selected data, the thickness of the each layer of pavement was calculated using the JKR method which follows the specific standard measurements of Malaysia. As the road is designed with horizontal and vertical curves in it, the calculation of the length as well as the speed limit of each curve were made.

The fifth section, **5.0 CONCLUSION**, concludes the report with the final information and results obtained and techniques used.

The last section, **6.0 REFERENCES**, shows all the books and website links used as references to the studies and researches made for this entire project.

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1.0 INTRODUCTION

In today's modern society, where an increasing amount of people travel with luxurious and costly vehicles, the high standards and performance of good quality roads and highways have been expected more. This is where civil engineers play an important role in designing roads whereby the considerations ofmaterials and elements of a pavement and ideal angles of horizontal and vertical curvestake place.

As a new park a few kilometers away from Inti International University in Nilaiis to be constructed with no existing roads connected, this design of a new road is to be carried out to provide a high performance and good service to the people. This new road will be connected to the existing T-junction road beside Inti University. The existing road is shown in *FIG – 2* while the designed road structure is shown in *FIG – 3*.

2.0INTRODUCTION OF ROAD PAVEMENTS

A road pavement is a structure of different layers of processed materials laid on the foundation of natural soil or sub-grade, mainly for vehicles to travel. Its main function is to distribute the applied traffic loads to itself. Pavement is the actual travel surface of a road or highway, designed to grant friction for vehicles and to withstand heavy traffic loads transferring them from upper surface to the soil below.

2.1REQUIREMENTS OF AN IDEAL PAVEMENT

A good quality pavement is important in road and highway traffic.
These are the following requirements an ideal pavement should have:

1. The pavement should be thick enough to distribute the wheel load stresses to a safe value on the sub-grade.
2. The structure of it should be strong enough to withdraw all types of stresses acted upon.
3. The surface of the pavement should have an adequate coefficient of friction to prevent vehicles from skidding.
4. The road surface should be smooth enough to provide comfort and safety to road users even at higher speed.
5. The pavement should be designed in a way where there is least noise from moving vehicles.
6. The surface of the pavement should be dust proof so that there is clear visual for road users.
7. The surface of the pavement should be impervious so that no liquid can go through and destroy the sub-grade soil below.
8. The pavement should be designed in a way it has long design life and at the same time low maintenance cost.

2.2TYPES OF ROAD PAVEMENT

There are a few types of pavement in the constructing of roads or highways and all hard roads usually fall into two categories namely: 'flexible pavement' and the 'rigid pavement'.

1. **Flexible pavement**

   It is surfaced with bituminous or relatively thin HMA (hot-mix asphalt) materials over one or more unbound base courses resting on the subgrade.

2. **Rigid pavement**

   It is surfaced with PCC (Portland Concrete Cement) on a gravel base and sub-base with reinforced steel and transverse joints.

2.2.1 QUAITIES OF FLEXIBLE PAVEMENT

- The deformation in the sub-grade soil is transferred to the upper layers.
- The design is based on load distributing characteristics of the component layers.
- Flexible pavementhas low flexural strength and is poor to resist deformation.
- Its completion cost is low.
- It needs a sub base course which means the surface cannot be directly laid on the sub-grade soil
- Expansion joints are not needed as the pavements have the ability to contract and expand
- Flexible pavement can be used for traffic within 24 hours after completion
- It is easily damaged by oil and certain chemical

For flexible pavements, the wheel load stresses are transmitted to lower layers grain by grain through the points of contraction each layer.

As stress decreases with depth, flexible pavement normally has many layers and is designed with the concept of layered system. In addition to wear and tear, the layer on top of a flexible pavement has to be of best quality to be able to sustain maximum load stress.

Whereas the lower layers can be of lower quality as they experience lesser magnitude of stress.

The deformation of the lower layers in flexible pavement is transferred to the surface layer. Flexible pavement is supposed to be designed in a way where the stresses produced in each layer are kept well below the allowable stresses of each pavements layer.

2.2.2 QUALITIES OF RIGID PAVEMENT

- Unlike Flexible pavement, the deformation of sub-grade soil is not transferred to subsequent layers.
- Rigid pavement has high flexural strength and is strong to resist deformation.
- Its completion cost is high.
- Rigid pavement doesn't need sub base course. The surface course can be directly laid on the subgrade course.
- As the ability to contract and expand is less in concrete, expansion joints are needed.
- Rigid pavement road can be only used after 14 days of curing.
- Unlike flexible pavement, it is not easily damaged by oil and grease.

As rigid pavements have sufficient flexural strength, the deformation of sub-grade soil cannot be easily transferred to subsequent layers. Instead, the wheel load stresses are transmitted to a wider area below. Unlike flexible pavement, rigid pavements are directly laid on either sub-grade, granular or a stabilized material. Unlike flexible pavement, Rigid pavements are designed by plate theory instead of layer theory and constructed by Portland cement concrete (PCC).

3.0 RESEARCH ON FLEXIBLE PAVEMENT

In this research, it covers on what a flexible pavement is, including the properties of it. Researches will be based on what type of flexible pavement there are, what components and materials there are on each layer as well as the possible failures and the causes of them.

3.1TYPES OF FLEXIBLE PAVEMENTS

There are a few types of construction that have been used in building flexible pavement and there are as below:

1. **Conventional layered flexible pavement**

Conventional layered flexible pavement is done whereby it is designed by layered system. As Stress decreases with depth, the expensive and higher quality materials are placed in the top and cheap and low quality materials are placed below.

2. **Full-depth asphalt pavement**

Full-depth asphalt pavements are constructed by placing bituminous materials directly on sub-grade soil. The pavement obtains its strength from the asphalt layers instead of the stone base.

3. **Contained rock asphalt mat (CRAM)**

Contained rock asphalt mat is a type of construction whereby a dense or open aggregate layer is placed between two asphalt layers. This method reduces the vertical compressive strain on sub-grade soil and protects from surface water.

3.2COATING LAYERS ON A FLEXIBLE PAVEMENT

Typical coat layers of a conventional layered flexible pavement consist of:

1. **Seal coat**

Seal coat is a treatment used on flexible pavement where asphalt are sprayed on the road surface followed by aggregate. It functions as a protection towards the surface from water going through old or cracked pavement. The asphalt covers old surface and the aggregate carries the traffic.

This treatment helps reduce potholes and prevents old asphalt pavements from getting worse. It also helps renew worn pavement surface at a relatively low cost. Seal coat is also used to provide skid resistance.

2. **Tack coat**

Tack coat is also known as bond coat. It is light spray application of tar or asphalt, usually emulsion diluted with water. This coating must be thin, cover the entire surface uniformly and set fast.

Its main objective is to ensure bond between the existing pavement surface and a new pavement surface. This is important as loss of bond between the layers can cause crescent shaped cracks or de-bonding to occur which leads to the reduction of the pavement life.

3. **Prime coat**

Prime coat is where a thin hot mix layer or chip seal is to be applied evenly to the surface of sub-base or sub-grade soil. It hinders the penetration of moisture into sub-grade. Unlike tack coat, it penetrates into lower layers, fills up the gap and acts as water-prove surface.

The principle function of prime coat is to protect the subgrade from moisture and weathering. The prevention of water entry prevents failure of the pavement.

3.3COMPONENTS OF FLEXIBLE PAVEMENTS

Flexible pavement contains layers in contact whereby the surface load is distributed to the soil. These layers are different components with different materials in it. The main components are as below:
(Diagram shown in *FIG – 4*)

1. SURFACE COURSE

It is the top layer provided by bituminous or a thin asphalt layer. It is made up of a mixture of various selected aggregates bound together. It serves as protection for the underlying base course from traffic and water and at the same time adequate tire friction.

2. BASE COURSE

The base course which is beneath the surface course is usually constructed out of aggregate and HMA (Hot-Mixed Asphalt). It provides additional load distribution to the

pavement foundation, the subbase, and the subgrade, and contributes to drainage and frost resistance. It is important for the base to be thick and solid enough as it prevents failure in the subgrade and sub base, resists vertical pressures and volume changes caused by fluctuations in its moisture content.The materials for the base course generally fall into two main classes: stabilized and granular. The stabilized bases usually consist of crushed or uncrushed aggregate bound with a stabilizer, such as Portland cementor bitumen.

3. SUBBASE COURSE

This layer is located between the base course and the subgrade. It is not always needed or used in pavement designs. The quality of the materials of this layer is lower than the base course but better than subgrade soils. As it is subjected to lower load stressed, the material requirements are not as strict as for the base course. The materials used for this layer are generally granular materials like crushed aggregate, or sand or engineered filled materials like cement.It provides a foundation for the base course and functions primarily as structural support, to distribute loads so that excessive stresses are not transmitted through the foundation to the subgrade.

4. SUBGRADE COURSE

Subgrade is known as the formation level and is the native material underneath a constructed road. Subgrade soils are subjected to lower stresses than the courses above it as load stresses decrease with depth. It is important that the combined thickness of the courses above the subgrade is great enough to reduce the stresses occurring in it so that they will not cause excessive distortion or displacement to the subgrade soil layer.

3.4RESEARCH ON POSSIBLE FAILURES FOR FLEXIBLE PAVEMENTS

Proper designs are important as improper designs can lead to early failure of pavements affecting mainly the riding quality. The key to having a good and proper maintenance of road or highway pavement is to know the possible failure of it as well as the cause of the possible failure. There are certain basics with respect to pavement failure that have existed and occurred ever since pavements were first discovered. The most common and possible failures are: fatigue cracking, rutting, and thermal cracking.