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ANALYSIS AND EXECUTION OF ROAD WORK CONSTRUCTION ENGINEERING - A REVIEW

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ABSTRACT

This study and the techniques that will be used for the analysis and execution of road work construction engineering are summarized in this research. This study looks at studies on the usage of raw materials in road building, as well as their analysis, such as traffic and soil tests using various methods and equipment, design, and implementation. The case studies were analyzed in the following contexts: case study location, which indicates weather suitability of road construction material; traffic flow factor; economic and environmental feasibility; soil factors, which define the conditions and characteristics of soil; execution process, which defines how the construction work is performed to achieve our suitable goal.

KEY WORDS – Soil tests, traffic flow factor, soil factors, execution process.

INTRODUCTION

Roads are one of the infrastructures that help to keep transportation moving smoothly. The mobility of people has a direct relationship with the growth of numerous fields. A sufficient transportation infrastructure is required to facilitate increased community movement. Users will be comfortable due to the road conditions. Roads play a critical role in economic development and progress, as well as providing significant social advantages.

They are critical to a country's growth and development. Furthermore, a road network is critical in the fight against poverty since it provides access to job, social, health, and education services. The application of engineering, financial, and management approaches to optimize the level-of-service output in exchange for the most cost-effective financial input is what road asset management entails. Indeed, the primary goal is to apply the appropriate treatment at the appropriate moment in order to achieve the required level of service, demonstrating that road infrastructure is a financial asset for society and the economy. The study of road traffic, stone thickness, road alignment, and slope gradient gradually improved road construction techniques, leading to the usage of stones set in a regular, compact pattern and covered with smaller stones to form a solid layer.

Road construction procedures differ based on the type of road being built; here's a step-by-step breakdown of how asphalt and/or concrete roads are built. For starting and finishing a road construction project, there are primarily five steps to follow:

1. PLANNING - Any road building project must begin with planning. It entails examining current and future traffic patterns, doing a cost-benefit analysis to guarantee that the road will serve its intended purpose and conducting soil testing to ensure that the soil is suitable and has the desired qualities. During the initial stage of road building, layout drawings, funding, legal, and environmental difficulties are all dealt out to guarantee the project proceeds smoothly and without financial or legal issues.

2. SETTING OUT -The process of bringing design suggestions from drawings to the ground is known as setting out. It marks the borders of the site, as well as the foundations and other structural elements that are required. A set of boards are placed at intervals along the projected road line in most road construction projects. To manage the excavation levels between the profile boards, a profile board with a set height, also known as a traveller, is used. The traveller is put between two level boards in the sight-line to ensure that it can be viewed before and after the excavation so that levels can be adjusted properly. The level of profile board is measured with a line level, which is a short spirit level hanging on a nylon string, just like any other construction project. The bubble is centered by moving the string up or down.

3. EARTHWORKS - This is by far the most time-consuming part of the road-building process. It comprises removing the topsoil using a tractor shovel, grader, or bulldozer, then scraping and grading the land to expose the underlying earth, also known as formation level. Excavation stops and construction begins at this point. Subgrade is the soil beneath the formation level, and it should be checked for strength before excavation begins. The material may be removed or stabilized if the subsoil's quality is unsatisfactory. Since the strength of the subgrade determines the thickness of the pavement, it is critical to reinforce the sub-grade by removing bad material in cuttings and replacing it with selected fill, ensuring appropriate subsurface drainage, and compacting the subgrade to a high dry density.

4. PAVING - After the subgrade has been prepared and drainage systems have been installed, this road construction phase begins. Paving might be rigid or flexible, depending on the project's specific requirements. Flexible pavements are cheaper to erect and have a higher capacity to expand and contract with temperature variations, so they do not require expansion joints. Rigid pavements have a higher flexural strength, longer design life, and lower maintenance costs, whereas flexible pavements are cheaper to erect and have a higher capacity to expand and contract with temperature variations, so they do not require expansion joints.

5. QUALITY CONTROL - After a road surface is installed, a set of quality tests must be completed before the road construction project can be considered finished. This technique entails inspecting the road to ensure that drainage, grading levels, and other characteristics are satisfactory. The route can now be used by motorists once all of the checks have returned positive results. The majority of roads can last up to forty years, with major upgrades required every decade or so.

ANALYSIS AND EXECUTION OF ROAD WORK: CASE STUDY AND DISCUSSION

The aim of this paper is to examine the different processes that are involved in the construction of road from initial to final stage. The case study presented below. This study mainly involves the two parts:

a) Analysis of road

b) Execution of road work

ANALYSIS OF ROAD

There were five stages of the analysis-

(1) Soil characteristics were obtained through laboratory testing to determine water content, soil type, plastic limit, liquid limit, plasticity index, and granular test results.

(2) Using the Dynamic Penetration Cone tool, calculate the California Bearing Ratio.

(3) The length and width of the intended road segment are measured to determine the route's dimension.

(4) The number of vehicles travelling by the observation point, as determined by direct measurement of light and heavy vehicles. The measurements lasted seven days, from 6:00 a.m. to 8:00 p.m. local time.

(5) The volume and growth of vehicle traffic.

SOIL ANALYSIS

In soil analysis, there are different types of tests are performed to defines and ensure the characteristics of soil and the suitability. There is several soil tests are given below:

California Bearing Ratio Test- The California Bearing Ratio test is performed in a lab. This test determines the soil's load penetration resistance. When a cylindrical plunger is produced to enter the soil at a standard pace, the CBR value is derived by measuring the relationship between force and penetration. The CBR test is used to determine the strength of the subgrade of roads and pavements. This test's CBR value is used with empirical curves to establish the thickness of the pavement and its constituent layers. This is the most extensively used method for flexible pavement design. Despite the fact that the installation of subsoil drains lessens the impact of water on the subgrade, fully soaked CBR testing should be used in road construction.

Compaction Test- Proctor Test- This soil compaction test, commonly known as the Proctor test, determines the mass of dry soil per cubic meter when the soil is compacted over a range of moisture contents, yielding the maximum dry density at the optimum moisture content. When a result, this test reveals the compaction properties of various soils as moisture content changes. This is accomplished by minimizing air spaces in the soil and therefore densifying it. The degree of is determined by the dry density of the soil. At the ideal water content, the dry density is at its highest.

Particle Size Distribution- The particle size distribution of soil is determined with this test, which ranges from coarse sand to fine clay. The results of the particle size distribution test are used to assess the suitability of soil for road construction, airport construction, and other applications. Although permeability tests are more commonly utilized, this test can also be used to predict soil water movement.

Atterberg Limit Test- The liquid and plastic limits of soil are defined by the Atterberg limit. For soil identification, categorization, and strength correlations, these two limits are widely utilized around the world. If fine-grained soil contains clay minerals, it can be remoulded without disintegrating in the presence of moisture. The absorbed water that surrounds the clay particles causes this cohesion. Soil behaves more like a solid at low moisture levels, whereas soil and water may flow like a liquid at high moisture levels. As a result, soil behavior can be classified into four fundamental categories based on moisture content: solid, semisolid, plastic and liquid.

TRAFFIC ANALYSIS

The pavements will be constructed using the latest revision of the Ministry of Road Transport & Highways (MORTH) Specifications for Road and Bridge Works where appropriate. Design Traffic In accordance with IRC: 37-2012, the design traffic loadings have been calculated in the terms of cumulative number of standard axles using the following formulae:

$$N_S = \sum_{i=1}^{DL} \times \sum_{i=1}^{n} \times \frac{365 \times ADT_i \times \left[(1+r_i)^{DL} - 1\right] \times D \times F}{r}$$

Where:

Ns Is the cumulative number of standard axles to be catered for in the design in terms of ESA.

ADT_i Is the average daily traffic for vehicle category "i" in the initial year

r_i is the growth rate for the vehicle category "i"

DL Is the Design Life in years

D Is the Lane Distribution Factor

F Is the Vehicle Damage Factor

Lane Distribution and Directional Distribution Factor

The values adopted for these factors are those that are suggested by IRC: 37-2012. The values used are given below:

• A directional distribution factor of 0.75 has been adopted.

Value for Vehicle damage factor (VDF) for design requirement is considered is 2.5 on higher side.

The Parameter considered for design of new pavement is given below:

Parameters for Design of New Pavement

Parameters	Values considered for Design of New Pavement
Design Life (Years)	15 Years
Initial Traffic (Commercial Vehicles per day in 2014)	437
Traffic Loading in Million Standard Axles (MSA)	10 MSA
Lane Distribution Factor	0.75
Vehicle Damage Factor	2.5
CBR (%) of Subgrade Soil	10.0%

The Recommended Pavement Thickness

The recommended pavement thickness (in accordance with IRC: 37-2012) is given in Table below:

Pavement Composition	Pavement Thickness (in mm)
1. Wearing Course	
(a) Bituminous Concrete (BC)	40
(b) Dense Bituminous Macadam (DBM)	50
2. Base: Wet Mix Macadam (WMM)	250
3. Sub-base: Granular Sub base (GSB)	200
4. Subgrade:	500
Total thickness of Pavement excluding subgrade	540

EXECUTION OF ROAD WORK

In this study we adopted the flexible pavement. Due to easily availability of raw material and equipment's and the cost of the flexible pavement is also economical.

Flexible pavements are made up of numerous layers of asphalt or bituminous material that overlying on a ready subgrade that distributes all of the traffic loads evenly. When subjected to traffic stresses, the entire pavement structure bends or deflects, that is why they are called "flexible."

1) To avoid permanent deformation of the flexible pavement, the thickness of each individual layer must be able to disperse loads; the subgrade is compacted with the sub base on top.

2) A road roller machine is used to lay and compress crushed stone or dry lean concrete as the sub base layer.

3) The sub base should be no more than 15 cm thick and is normally installed after the waterproofing has been completed. The surface layer, which comprises of the base layer and the wearing course, sits on top of the sub base.

4) The wearing layer, which is generally thicker and stronger than the base layer, is the topmost layer of bituminous material. The thickness is determined by the material needs as well as the expected traffic loads.

5) Porous asphalt, hot rolled asphalt, dense bituminous tar macadam, and dense bitumen macadam are all common materials for the wearing course.

6) The sub layer, on the other hand, is typically 6 cm thick and consists of solid bituminous macadam or asphalt. It is used in conjunction with the appropriate cross falls and gradients.

In the management of construction projects, construction analysis, planning, and execution are a crucial and difficult task. It entails selecting technology, defining work tasks, estimating the resources and duration required for specific tasks, and identifying any relationships between the various work tasks. A solid construction plan serves as the foundation for creating a budget and a work schedule.

CONCLUSION

The goal of the study is to come to a conclusion about traffic on the highway, site investigation, construction method based on design obtained from site investigation and traffic analysis, and road work estimation procedure.

Perform a detailed survey of the traffic count, the type of traffic, the road conditions, any channelizing devices present on the highway and their function, and suggest appropriate ways and means for the efficient motion and flow of traffic that results in the least number of accidents and the most vehicle capacity on the roads, even during peak hours.

Perform soil testing to determine the strength, plasticity index, and other properties of the site's soil using methods such as the California bearing ratio (CBR) test, the Atterberg limit test, and others. According to these surveys and analysis we design the road then do the construction work and estimation of the road work.

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