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# DESIGN AND ANALYSIS OF 6-LANE PAVEMENT DESIGN

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## ABSTRACT

From Kashmir to Kanyakumari and from Maharashtra to West Bengal, India is connected with national highways. They are crucial for the movement of commodities throughout India's length and breadth. In India, there are currently 96261 km of national highways. They developed into a network that connected the roads in every state of the union. One of the most significant PPP (Public Private Partnership) projects undertaken in India is the NHAI (National Highway Authority of India). They have been given the task of constructing a six-lane portion of the 170.7km-long NH 47 (New NH 66) from Cherthala to Thiruvananthapuram. The current study's goal is to design the pavement for a short section of NH 66 that runs between Cherthala and Thiruvananthapuram. Phase I of this project begins in Thuravoor Thekku and ends at Paravoor (Alappuzha district). It is vital to ascertain the pavement thickness because the soil in this specific section is fragile and there is heavy traffic.

## 1. INTRODUCTION

The NH 47 segment from Cherthala to Thiruvananthapuram will be upgraded to six lanes under the direction of the National Highway Authority of India (NHAI) (New NH 66). The planned road is 170.7 kilometres long. It begins at the Thuravoor junction at kilometre 379.100 on NH-47 and finishes at the Kazhakoottam junction at km 549.801. Alappuzha, Kollam, and Thiruvananthapuram are the three districts that are traversed by this section of road. The route of the road passes through the following populated areas: Cherthala, Mararykulam, Alappuzha, Ambalapuzha, Purakkad, Thottapally, Haripad, Nagiar Kulangara, Kayamkulam, Krishnapuram, Oachira, Vavvakkavu, Karunagapally, Chavara, Neendakara, Kavanadu (Kollam), Mevaram (Kollam), K The current road is typically two lanes wide with concrete shoulders on both sides. The majority of urban areas with Major Junctions have improved their carriageways to 4-lane divided configurations, including the junction with approaches and the existing town portion. There is one new bypass and two others being built at various phases..

The project has been broken up into six construction packages, and our project stretch is Package 1 from Thuravoor- Thekku to Paravoor. Our goal is to design the pavement for the two-lane to six-lane conversion between Thuravoor Thekku and Paravoor. The California Bearing Ratio test

thickness was used to construct the pavement, and a 15-year design life is anticipated for flexible pavement. When designing the pavement, there should be enough thickness to transmit the wheel load strains to the subgrade soil at a safe level. We performed a soil test after gathering soil samples from several places. Pavement thickness is determined using the California Bearing Ratio test. The initial water content of the soil is identified, and the CBR test is carried out at the optimal moisture level. Pavement design may be carried out based on the traffic volume count and CBR value thickness is established.

### 1.1 Highway Widening

The main purpose of a highway pavement is to disperse the applied vehicle loads to the sub grade. A highway pavement is a structure made up of layers of processed materials overlaid atop the natural soil sub grade. The pavement construction should be able to offer a surface with good riding quality, sufficient skid resistance, good light-reflecting qualities, and minimal noise pollution.

The Kerala government has announced plans to convert NH66 to six lanes from the start of 2017, a project that is expected to take three years. National Highway 66, often known as NH66, runs around 1608 kilometres (kilometres) along the western coast of India, passing through the Western Ghats (999mi). The National Highway 66 travels from Panvel, a Mumbai city, to Cape Comorin (near Kanyakumari), travelling through the states of Maharashtra, Goa, Karnataka, Kerala, and Tamil Nadu. By the extension, the upgradation to 4 lane highway with 6m (200ft) and Grade separation is possible.

According to NHAI data, the last stages of development in the districts of Kasargode, Kannur, Malappuram, and Kozhikode include land purchase, building demolition, and tree cutting. Both the Mahe Bypass and the Mukkola- Karode Bypass will be finished by March 2022. In several of these districts, the land levelling process has started. Comparatively speaking, NH66 is the busiest and most important National Highway, thus its expansion or growth is essential. Additionally, the HAM model is used for the expanding process, which includes collecting tolls for a considerable amount of time. For a very long time, NHAI has been notorious for its toll collecting.

**Objectives**

- To understand the present condition of 2 lane and 4 lane road from Thuravoor Thekku to Paravoor.
- To find out the strength of the soil along the project stretch.
- The main aim of this project is to suggest pavement thickness for upcoming NH-66 six lane road from Thuravoor Thekku to Paravoor

- Pavement design of the road.
- To suggest suitable Stabilising agent for increasing the strength of subgrade soil.

## 2. LITERATURE REVIEW

a. Michel Murillo, Otto Mora, Tiana Rosania "Analysis of CBR design value selection methods on flexible pavement design": Colombia case study, International Journal of Engineering and technology .9(2):509- 514, May 2020. Analysis was carried out to observe the variation of a flexible pavement structural thickness, due to the use of different methods to calculate the CBR design value, as an essential variable to estimate the Subgrade Resilient Modulus (Mr) through an empirical correlation

b. Dr. K.S Grover and Er. Amit Kumar Jangid: "A detailed study of C.B. R method for flexible pavement design": IJARSE, Vol No:7 Issue 2, January 2018.According to IRC Recommendations, the California bearing ratio (CBR) value of subgrade is used for design of flexible pavements. The design of pavement may affect by the material which is used as pavement material.

c. Dr. Y. P Joshi, Er. Devendra Kumar Choudhary: "A detailed study of CBR method for flexible. Pavement design, Vol 4, Issue 6, June 2014.As per IRC recommendation, California Bearing Ratio (CBR) is crucial in designing the Flexible Pavement. By CBR, we can determine the sub grade reaction using correlation. Most important parameter for the design of Sub Grade of the Road.

d. J Paul Guyer, P.E., R.A., Fellow ASCE, Fellow AEI: "Introduction to soil stabilization in pavements: Course No. C03-028, Publication by Guyer partners, 2011.This section discusses criteria for improving the engineering properties of soils used for pavement base courses, subbase courses, and subgrades by the use of additives which are mixed into the soil to affect the desired improvement.

e. S. K Khanna, C.E.G Justo: "Highway Engineering", Chapter 7, Design of Highway pavements, March 2011.From this Book we have referred about the objects and requirements of pavements, Types of pavement structure, Design of flexible pavements, Various approaches of flexible pavement design

## 3. LAYOUT OF THE ALIGNMENT

According to NHAI data, the last stages of development in the districts of Kasargode, Kannur, Malappuram, and Kozhikode include land purchase, building demolition, and tree cutting. Both the Mahe Bypass and the Mukkola- Karode Bypass will be finished by March 2022. In several of

these districts, the land levelling process has started. Comparatively speaking, NH66 is the busiest and most important National Highway, thus its expansion or growth is essential. Additionally, the HAM model is used for the expanding process, which includes collecting tolls for a considerable amount of time. For a very long time, NHAI has been notorious for its toll collecting.

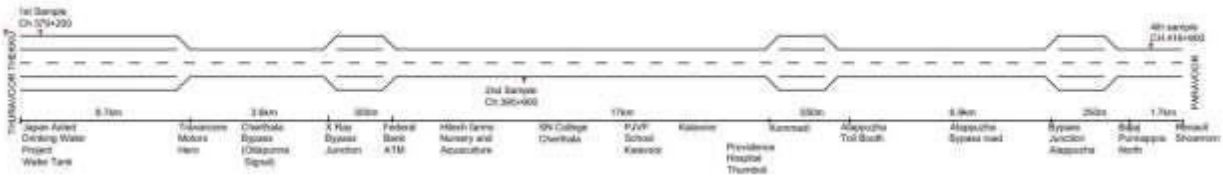

**Fig 1**. Layout of the Alignment

## 4. SITE VISIT

Project Road is a 37.9 km long road in the Alappuzha district that runs from Thuravoor Thekku to Paravoor. The project length is along NH47 from kilometre 379.100 (Thuravoor Junction) to km 417.000 (Paravoor Junction) in the Alappuzha district. The route travels via Cherthala, Mararykulam, and Alappuzha, 3 cities. The current road is typically two lanes wide with concrete shoulders on both sides. Major Intersection has expanded the roadway to a four-lane divided design in most urban areas, including the junction with approaches and along the current town stretch.

**Error!**

**Fig- 2** Starting Point


**Fig-3** Ending Point

STUDY OF TRAFFIC VOLUME

To ascertain the quantity, movements, and types of road vehicles at a certain site, traffic volume studies are carried out. These statistics assist in identifying crucial flow times and identifying how people or big vehicles affect vehicular traffic flow. A road's traffic volume is measured by tallying how many cars pass through it over time. In order to prioritise road development projects like repaving, widening, and other related work, it is essential to analyse traffic volume. Pavement design involves weighing traffic volume and pavement thickness. pavement thickness determined by a soil test called the California Bearing Ratio. Traffic volume was determined by looking at many periodicals that published traffic counts simultaneously. All traffic volume data is gathered from projects completed at NHAI by students from prior years.

| PLACE WHERE SOIL SAMPLE IS TAKEN | NO. OF VEHICLES PER DAY |
|---|---|
| THURAVOOR THEKKU | 1752 |
| S.N COLLEGE CHERTHALA | 1572 |
| PARAVOOR | 1500 |

**Table -1** Traffic Volume

## 5. SOIL COLLECTION

In order to identify the qualities of the soil, a tiny sample of the soil is taken and sent to a lab. Taking soil samples, executing laboratory tests on them, and then interpreting the results are all part of the examination of the soil. With a plunger of standardised area, the CBR test is conducted by determining the pressure necessary to penetrate a soil sample. The pressure that

must be applied to a standard crushed rock material in order to obtain an identical penetration is then subtracted from the measured pressure. The CBR value increases with surface hardness. The California Bearing Ratio (CBR), a penetration test, is used to assess the subgrade strength of roads and pavements**.** In order to determine the thickness of the pavement and its component layers, an empirical curve based on the CBR results is applied.

Depending on the goal and aim of the soil sample, several soil sampling procedures and methods are used. The primary reason for collecting soil samples is for engineering purposes. The strength and percentage of the soil at the proposed location should be measured using a variety of field tests and laboratory tests on the soil sample. A soil sample will be examined while the road is being built. These tests allowed for the scientific determination of each layer's thickness and percentage. The accuracy of soil testing is site-based soil sampling, not laboratory testing. Depending on the test, the soil samples may be disturbed or undisturbed. More work should be put into gathering a flawless soil sample for the laboratory examinations.

**Fig -4:** Soil Collection

## 6. SOIL STRENGTH TEST

### 6.1 Determination of water content by oven dry Method

| PLACE WHERE SOIL SAMPLE IS TAKEN | MOISTURE CONTENT (%) |
|---|---|
| THURAVOOR THEKKU | 12.34 |
| S.N COLLEGE CHERTHALA | 15.07 |
| PARAVOOR | 5.45 |

**Table – 2:** Moisture Content

Depending on the goal and aim of the soil sample, several soil sampling procedures and methods are used. The primary reason for collecting soil samples is for engineering purposes. The strength and percentage of the soil at the proposed location should be measured using a variety of field tests and laboratory tests on the soil sample. A soil sample will be examined while the road is being built. These tests allowed for the scientific determination of each layer's thickness and percentage. The accuracy of soil testing is site-based soil sampling, not laboratory testing. Depending on the test, the soil samples may be disturbed or undisturbed. More work should be put into gathering a flawless soil sample for the laboratory examinations.

### 6.2 Specific Gravity determination by Pycnometer method

| PLACE WHERE SOIL SAMPLE IS TAKEN | SPECIFIC GRAVITY |
|---|---|
| THURAVOOR THEKKU | 2.83 |
| S.N COLLEGE CHERTHALA | 1.0006 |
| PARAVOOR | 0.998 |

**Table – 3:** Specific Gravity

### 7.3. Standard Proctor Test

The method and process used for soil sampling varies depending on the objectives. Soil samples are mostly collected for engineering purposes. To determine the strength and percentage of soil at the chosen location, a number of field tests and laboratory tests for the sol sample should be carried out. During the building of the road, soil samples will be analysed. These experiments allowed scientists to determine the thickness and ratio of each layer. The accuracy of soil testing depends on site-based soil sampling rather than a laboratory. The test will determine if the soil samples are disturbed or not. To obtain the best soil sample possible for laboratory testing, more effort should be made.

| PLACE WHERE SOIL SAMPLE IS TAKEN | OPTIMUM MOISTURE CONTENT (%) |
|---|---|
| THURAVOOR THEKKU | 20.34 |
| S.N COLLEGE CHERTHALA | 21.09 |
| PARAVOOR | 11.45 |

**Table – 4:** OMC Values

### 7.4 California Bearing Ratio Test

CBR is the measure of how quickly dirt penetrates. It is represented as a percentage of the force needed to penetrate a certain area of a standard material. A round standard plunger with a 50mm diameter is used to measure the penetration at a rate of 1.25mm per minute. 2.5 and 5 mm are the primary locations where penetration is measured. The CBR value is most often considered as a reading of 5mm. The table below provides information on various CBR values obtained at several sites within the intended region.

| PLACE WHERE SAMPLE IS TAKEN | CBR VALUE (%) |
|---|---|
| THURAVOOR THEKKU | 4.3% |
| S.N COLLEGE CHERTHALA | 3.28% |

| | |
|---|---|
| PARAVOOR | 13.8% |

**Table – 5:** CBR Value

**Fig-5** CBR Test

## 7. PAVEMENT THICKNESS

Total thickness (T) calculation: To begin, choose the suitable curve from the categorization table in the below chart for the given value of traffic intensity. Now, subtract the total thickness (T) with regard to the chosen curve from the subgrade soil's computed CBR value. Despite its drawbacks, CBR is a popular technique for creating flexible pavements since it is simple to apply and doesn't require any expensive equipment

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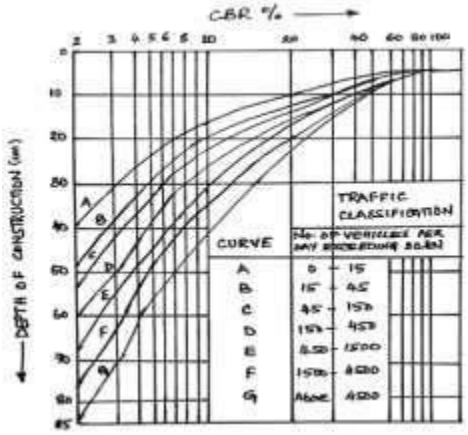


**Fig -6:** CBR Chart

| PLACE WHERE SAMPLE IS TAKEN | DEPTH ABOVE THE SUBGRADE SOIL (cm) |
|---|---|
| THURAVOOR THEKKU | 53 |
| S.N COLLEGE CHERTHALA | 63 |
| PARAVOOR | 30 |

**Table – 6:** Pavement thickness

## 8. PAVEMENT DESIGN

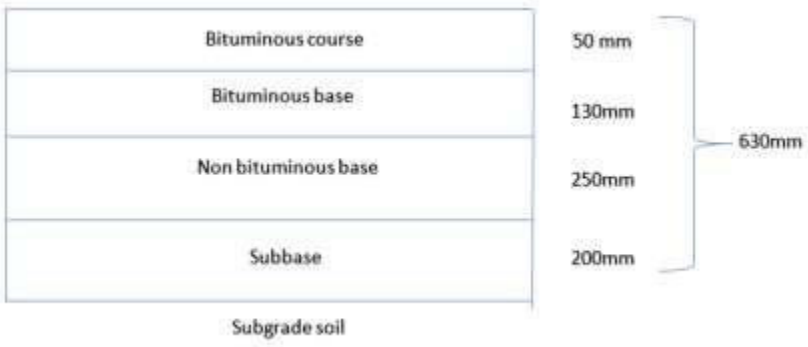

**Fig -7:** Pavement Thickness

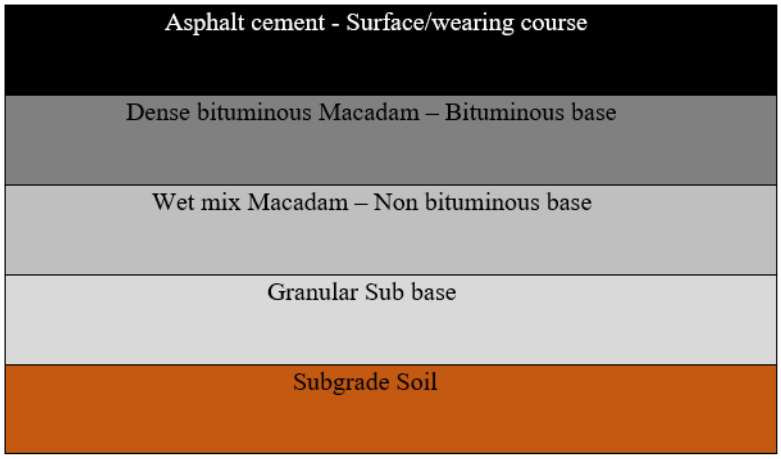


**Fig -8:** Pavement Design

## 9. STABILIZING AGENT

We advise using a stabilizing ingredient like fly ash, cement, lime, or bitumen since the soil is fragile**.**

## 10. RESULT AND DISCUSSION

- OMC of the three samples is 20.34, 21.07, 11.45 respectively.
- CBR values of the three samples are 4.3%,3.28%,13.8%.
- In these first is medium soil, second is weak and third is strong.
- Corresponding thickness are 53cm, 63cm, 30cm.

## 11. CONCLUSION

The pavement thickness for NH-66 (Thuravoor Thekku to Paravoor) in Alappuzha must be determined since the soil is too fragile. By using interconnected soil tests such the oven dry test, Pycnometer technique, Standard Proctor

Test, and C.B.R Test, we were able to measure the pavement thickness. The specific gravity test uses the water content value to calculate the dry density, after which the standard proctor test is conducted using the dry density calculated from the S.P.T graph, and the C.B.R test is conducted using the O.M.C. Pavement thickness is calculated using this C.B.R. value. First among the three samples is medium soil, followed by weak soil and strong soil, with thicknesses of 53 cm, 63 cm, and 30 cm, respectively. We recommend 63 cm of pavement thickness for the stretch since, of these three values, the second one is weak and requires additional thickness. We advise using stabilising agents like fly ash, cement, lime, or bitumen since the soil is fragile.

## 12. ACKNOWLEDGEMENT

This project work is the result of the diligent effort and study we did, which provided us a comprehensive understanding of the relevant field of our profession. We are able to understand how the construction of the highway began, which was a collaborative effort between many personnel, including lab and physical workers.

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## 13. REFERENCES

[1] "International Journal of Engineering and technology", Michel Murillo, Otto Mora, Tiana Rosania, 9(2):509-514, May 2020.

[2] "A detailed study of C.B.R method for flexible pavement design", Dr. K.S Grover and Er. Amit Kumar Jangid, IJARSE, Vol No:7 Issue 2, January 2018.

[3] "A detailed study of CBR method for flexible Pavementdesign", Dr. Y.P Joshi, Er.

Devendra Kumar Choudhary., ISSN:2248-9622, Vol 4, Issue 6, June 2014.

[4] "Highway Engineering"., S.K Khanna, C.E.G Justo., Published by Nem Chand & Bros, Roorkee, U.K, India, March 2011.

[5] "Introduction to soil stabilization in pavements", J Paul Guyer, P.E., R.A., Fellow ASCE, Fellow AEI., Course No. C03-028, Publication by Guyer partners, 2011.