



VISWAJYOTHI

COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE New Delhi & Affiliated to APJ Abdul Kalam Technological University

TM

Vazhakulam P.O., Muvattupuzha
Ernakulam Dist., Kerala - 686 670
Tel: 0485 2262211 / 44
Email: vcet@vcet.org
www.vcet.org

Metric 3.1.3

Number of Department having Research Projects funded by government and non-government agencies during the year

Table of Contents

SL. NO.	CONTENTS	PAGE NO.
1	Email confirmations regarding funding approval from IEEE SIGHT	2
2	Email communication for releasing fund (NHAI)	3
3	Detailed Report of NHAI Projects	5
4	Application of Funded Projects (IEEE SIGHT)	105



6/23/22, 4:41 PM

IEEE Mail - IEEE AP-S & IEEE HAC CFP Funding Decision (#22-APHAC-11)



Anish Jose <anishmj@ieee.org>

IEEE AP-S & IEEE HAC CFP Funding Decision (#22-APHAC-11)

1 message

Betsy Toland <b.toland@ieee.org>

Thu, Jun 23, 2022 at 6:37 AM

To: ANISH M JOSE <anishmj@ieee.org>, ANJALY SAJI <anjalsaji00@ieee.org>

Cc: hac-projects <hac-projects@ieee.org>, aps.sight@gmail.com, "Ms. Mini Ulanat" <mini.ulanat@gmail.com>, Bijoy Jose <bijoyaj@gmail.com>

Dear Anish M Jose and Anjaly Saji,

Thank you very much for your proposal named **LIGHT UP - Spread Light In Darkness (#22-APHAC-11)** in response to the IEEE AP-S & IEEE HAC Call for Proposals on Signal Processing Technologies for Local Community Challenges. We appreciate you answering the call to propose solutions to issues in your local community.

OFFER & CONDITIONS

The IEEE AP-S & IEEE HAC Proposal Evaluators would like to provide support for this project in the amount of **US \$4,000.00**. These funds must be used per the budget submitted with your proposal.

IEEE AP-S and IEEE HAC assume that the project will follow the correct protocols and safety codes as outlined in applicable law for your area of residence.

Please note the [Message from IEEE on coronavirus COVID-19](#), particularly "We request that all members avoid conducting in-person activities in areas impacted by the coronavirus threat and instead maximize the use of our online and virtual alternatives."

REPORTING

One of the requirements for this Call for Proposals is that the project team provide:

- An update on the project's progress at 3 months, and
- A final report on the project's progress and use of funding within two months of its completion, ideally with photos or video for communications purposes.

Once the reporting is assigned, you will receive an email notification from the online funding portal where you entered your application.

PLEASE CONFIRM

1. that you accept the terms of this offer,
2. that the funds can be routed through the [IEEE Kerala Section](#) via their IEEE custody account - **We request acknowledgement from the Section Chair or Treasurer (copied on this message) that the funds will be received from us to disburse for your project.**
3. that you accept the start and end dates of **15-July-2022 – 15-January-2023**. This should allow sufficient time for transfer of funds (non-financial activities can be undertaken until the funding is transferred). If you complete your project before the established end, or will need additional time to complete implementation, please contact hac-projects@ieee.org.

Upon receipt of these confirmations, we can prepare the award documents for your signature and proceed with funding.

Congratulations!

IEEE AP-S & IEEE HAC Projects Program Evaluators

- - -

Betsy Toland

IEEE Corporate Development, Admin

supporting **IEEE HAC, SIGHT, IEC, Africa**

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8/16/23, 11:37 AM

Viswajyothi College of Engineering & Technology Mail - Request for releasing remuneration reg



head civil vjcet <head.civil@vjcet.org>

Request for releasing remuneration reg

1 message

head civil vjcet <head.civil@vjcet.org>
To: nhaitvm@gmail.com

Wed, Sep 14, 2022 at 2:45 PM

The Project Director,
Project Implementation Unit,
Thiruvananthapuram

Ref: NHAI/RO- Kerala/PIU- TVPM/15161/2020/1009

Dear Sir,

Greetings from the Department of Civil Engineering of VJCET!

Concerning the MoU entered between your esteemed office and Viswajyothi College of Engineering and Technology, a team of students had undertaken their project work based on the construction and 6-laning of Thuravoor Thekku to Paravoor road, Alappuzha of 39 km Stretch of NH66 connecting Paravoor to Thuravoor. The students are:

1. Afzin Rafeek
2. Shalbin Shaji
3. Thasli K. Moideen
4. Risma Rasheed

All the listed students are from Semester 8 of the Department of Civil Engineering at VJCET.

They had undertaken an internship related to it for 27 days; the details of which are listed below:

Sl.No.	Period	No. of days	Details of work undertaken
1	09/03/2022	1	Visit to project stretch of Thuravoor Thekku to Paravoor
2	19/03/2022	1	Collection of Soil samples
3	23/03/2022 to 25/03/2022:	3	Experimental investigation- Oven dry method and Pyconometer Test
4	28/03/2022 to 08/04/2022	11	Experimental investigation- Standard Proctor Test
5	11/04/2022 - 22/04/2022	11	Experimental investigation- California Bearing Ratio Test
TOTAL		27	

It would highly be appreciated if your esteemed office could release the stipendiary remuneration in this regard.

The Account details are:

Account Holder : PRINCIPAL
Account number : 0335053000001199
IFSC Code : SIBL0000335
Bank : South Indian bank
Branch: Vazhakulam

Thanking you,

Sincerely yours,

Dr. Shine George, PhD (NITC), AITP, MIE.
Associate Professor & Head,
Department of Civil Engineering





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8/16/23, 11:40 AM

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head civil vjcet <head.civil@vjcet.org>

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To: nhaitvm@gmail.com

Thu, Sep 15, 2022 at 2:26 PM

The Project Director,
Project Implementation Unit,
Thiruvananthapuram

Ref: NHAI/RO- Kerala/PIU- TVPM/15161/2020/1009

Dear Sir,

Greetings from the Department of Civil Engineering of VJCET!

Concerning the MoU entered between your esteemed office and Viswajyothi College of Engineering and Technology, a team of students had undertaken their project work based on the construction and 6-laning of Thuravoor Thekku to Paravoor road, Alappuzha of 39 km Stretch of NH66 connecting Paravoor to Thuravoor titled " Environmental and Social Impact Assessment (ESIA) of NH66, Thuravoor Thekku to Paravur" .

The students are:

1. Sandra Libu, (VJC18CE092)
2. Catherine Jiji K, (VJC18CE038)
3. Aswathy K S, (VJC17CE040)
4. Vishnu K Saji, (VJC18CE107)

All the listed students are from Semester 8 of the Department of Civil Engineering at VJCET.

They had undertaken an internship related to it for 35 days; the details of which are attached alongwith:

It would highly be appreciated if your esteemed office could release the stipendiary remuneration in this regard.

The Account details are:

Account Holder : PRINCIPAL
Account number : **0335053000001199**
IFSC Code : SIBL0000335
Bank : South Indian bank
Branch: Vazhakulam

Thanking you,

Sincerely yours,

Dr. Shine George, PhD (NITC), AITP, MIE.
Associate Professor & Head,
Department of Civil Engineering



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project schedule-1.pdf
99K



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ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF NH66

(Thuravoor Thekku to Paravur, ch: 379.100km to 417.000km)

PROJECT REPORT

by

CATHERINE JIJI K (VJC18CE038)

SANDRA LIBU (VJC18CE092)

ASWATHY K S (VJC17CE040)

VISHNU K SAJI (VJC18CE107)

in partial fulfillment for the award of degree of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
THIRUVANATHAPURAM**



DEPARTMENT OF CIVIL ENGINEERING

**VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY
VAZHAKULAM**

JUNE 2022

**VISWAJYOTHI COLLEGE OF ENGINEERING AND
TECHNOLOGY, VAZHAKULAM**

Department of Civil Engineering



BONAFIDE CERTIFICATE

This is to certify that the Project report entitled “**ENVIRONMENTAL AND SOCIAL IMPACT ASSESSMENT (ESIA) OF NH66 (Thuravoor Thekku to Paravur)**” is a bonafide record of the work done by **CATHERINE JIJI K (VJC18CE038)**, **SANDRA LIBU (VJC18CE092)**, **ASWATHY K S (VJC17CE040)**, **VISHNU K SAJI (VJC18CE107)** in partial fulfillment of the requirements for the award of the **Degree of Bachelor of Technology in Civil Engineering** of APJ Abdul Kalam Technological University (KTU), Thiruvananthapuram.

Project guide
Mrs. Devina Vipinan
Asst. Professor
CE Department, VJCET

Project Coordinator
Mr. Appu John
Asst. Professor
CE Department, VJCET

Dr. Shine George
HOD
CE Department, VJCET

Date: 06/06/2022

Place: Vazhakulam

**VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY,
VAZHAKULAM.**

Department of Civil Engineering

Vision

Building Professionally Competent and Motivated Engineers in the Arena of Civil Engineering with High Professional Ethics.

Mission

1. To promote a better teaching learning process through academically proficient faculties, full-fledged laboratories and excellent infrastructure facilities.
2. To equip the graduates with knowledge, research and practical skills in modern construction practices and techniques.
3. To inculcate knowledge of sustainability in various domains of Civil Engineering.
4. To nurture Civil Engineers into ethically strong and responsible leaders to address global challenges through quality education.

Program Educational Objectives

Our Graduates

1. Shall tackle the multiple responsibilities of analysis, design and construction of traditional and modern systems in compliance with various codes of practices and to meet the current technical challenges.
2. Shall be proficient in the use of relevant software packages for planning, designing, scheduling, executing and controlling of civil engineering projects, with an urge for life-long learning.
3. Shall function effectively with individual capabilities as well as with a collective strength as a professional team with good communication skills.

Program Outcomes

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

1. Ability to utilize civil engineering principles and software that are appropriate to solve technical problems; prepare design and construction documents; create structural systems; produce drawings, reports and quantity estimates related to the Civil Engineering domain.
2. Ability to utilize modern surveying methods for land measurement and/or construction layout and to conduct standardized field /laboratory tests related to Civil Engineering.

ACKNOWLEDGEMENT

On the occasion of presenting the project report, we wish to express our deep and profound feeling of gratitude towards a number of persons who have contributed to the successful completion of our project.

First of all, we express our deep gratitude to lord almighty, the supreme guide, for bestowing his blessings through each phase of our work. It is our privilege to render our heartfelt thanks and gratitude to our beloved Manager, **Msgr. Rev. Dr. Cherian Kanjirakombil**, Director **Rev. Fr. Paul Nedumpurath** and Principal **Prof. Dr. K.K. Rajan** for providing us the opportunity to do this project during the fourth year (2022) of our B-tech degree course. I also express our heartfelt gratitude to the National highway authority of India (NHAI) for giving us this opportunity to be a part of this project. I also express our gratitude to **Mr. P. Pratheep** (Project Director, NHAI) and **Mr. Jinesh Raman** (Senior Quantity Surveyor, NHAI) for their guidance and cooperation. **Dr. Shine George** (H.O.D. Department of Civil Engineering, VJCET) for rendering all possible help and support during our project. I also express our sincere thanks to our Project Coordinator **Mr. Appu John** (Asst. Prof. Department of Civil Engineering) for their guidance and support. We are deeply thankful to our project guide **Mrs. Devina Vipinan** (Asst. Professor, Department of Civil Engineering) and our guide **Mrs. Neena M Joseph** for the indubitable part she played during the course of our project and for guiding us. Last but not the least I am grateful to all the staff members of VJCET for their cooperation and help extended during the course of our project. I would like to thank all our friends and family members for their encouragement, inspiration and moral support without which this work would have never been possible.

CATHERINE JIJ K
SANDRA LIBU
ASWATHY K S
VISHNU K SAJI

CONTENTS

SI NO.	DESCRIPTION	PAGE NO.
	ACKNOWLEDGEMENT	iv
	CONTENTS	v
	LIST OF FIGURES	vii
	LIST OF TABLES	viii
	ABSTRACT	ix
1	INTRODUCTION	1
	1.1 Project description	1
	1.2 Project location	1
2	OBJECTIVES	3
3	LITERATURE REVIEW	4
4	EIA METHODOLOGY	7
5	DESCRIPTION OF ENVIRONMENT	8
	5.1 General	8
	5.2 Study area	8
	5.3 Physical environment	8
	5.3.1 Soil characteristics	8
	5.3.2 Seismicity	11
	5.3.3 Air environment and quality	11
	5.3.4 Water resources	12
	5.4 Biological environment	14
	5.4.1 Protected areas	14
	5.4.2 Population density	14
	5.4.3 Tourism	14
	5.4.4 Vulnerable groups	14
6	ENVIRONMENTAL IMPACTS AND MITIGATION	16
	6.1 Urban heat islands	16
	6.2 During construction phase	16
	6.3 Heavy machineries and vehicular movement	16
	6.4 Noise	17

	6.5	Generation of construction waste	17
	6.6	Influx of workforce	17
	6.7	Contamination of soil	17
	6.8	Generation of dust	17
	6.9	Water quality	18
	6.10	Animal crossing	18
	6.11	Hot mix asphalt	18
	6.12	Relocation of petrol pumps	19
	6.13	Vegetation loss	20
7		SOCIAL IMPACT ASSESSMENT	21
	7.1	Social environment	21
	7.2	Scope of land acquisition	21
	7.3	Social Impact analysis	22
	7.4	Social impact survey outcome analysis	23
		<i>7.4.1 Commercial</i>	23
		<i>7.4.2 Residential</i>	23
		<i>7.4.3 Compensation</i>	24
8		CONCLUSIONS	19
		REFERENCES	20

LIST OF FIGURES

FIG NO.	DESCRIPTION	PAGE NO.
5.1	Soil sample collection	9
5.2	collection spot	9
5.3	Water resources	12
5.4	collected water	12
5.5	testing in laboratory	13
5.6	testing in laboratory	13
6.1	dust in leaf	18
6.2	animal crossing NH66	18
6.3	nearby trees	20
6.4	nearby trees	20
7.1	school	22
7.2	mosque	22
7.3	commercial ownership pie chart	23
7.4	commercial relocation pie chart	23
7.5	Residential ownership pie chart	23
7.6	residential relocating pie chart	23
7.7	Compensation pie chart	24

LIST OF TABLES

TABLE NO.	DESCRIPTION	PAGE NO.
1.1	Package details	7
5.1	Soil quality analysis	8
5.2	Air quality analysis	9
5.3	Water quality analysis	11
7.1	Public structures	17

ABSTRACT

The National Highways Authority of India (NHAI) has been entrusted with the 6 laning of Chertalai to Thiruvananthapuram Section of NH47 (new NH-66) (from km 379.100 to km 551.900 under NHDP Phase III in the State of Kerala. The project stretch of NH 47 begins at Thuravoor Junction near Cherthala Town and ends at Kazhakottam Junction near Thiruvananthapuram totalling a length of 172.80 km in Kerala State. Generally, the existing road is two lanes with paved shoulders on either side. This is further widened to 6 lanes of 45m width. The environment and social impact assessments of package 1 (from Thuravoor Thekku to Paravur length-37.9 km) is conducted. Physical environmental parameters such as air quality, soil quality and water quality are analyzed. Study on vegetation removal is conducted and the effects on the flora and fauna are analyzed. Vulnerable groups and communities are identified and the impacts on them is analyzed. Impacts are classified into pre-construction, during construction and post-construction phases and mitigation measures are suggested.

CHAPTER 1

INTRODUCTION

1.1 Project description

The National Highways Authority of India (NHAI) has been entrusted with the assignment of preparation of Detailed Project Report for 6 laning of Chertalai to Thiruvananthapuram Section of NH47 (new NH-66) (from km 379.100 to km 551.900 under NHDP Phase III in the State of Kerala. The project stretch of NH 47 begins at Thuravoor Junction near Cherthala Town and ends at Kazhakottam Junction near Thiruvananthapuram totalling a length of 172.80 km in Kerala State. This stretch of road passes through three districts viz. Alappuzha, Kollam and Thiruvananthapuram. The road passes through urban areas viz. Chertalai, Marary Kulam, Alappuzha, Ambalapuzha, Purakkad, Thottapally, Haripad, Nagiar Kulangara, Kayamkulam, Krishnapuram, Oachira, Vavvakkavu, Karunagapally, Chavara, Neendakara, Kavanadu (Kollam), Mevaram (Kollam), Kottiyam, Chathanoor, Paripally, Kallambalam, Attingal, Manglapuram, Pallipuram and Kazhakottam.

Generally the existing road is two laned with paved shoulders on either side. At most of the urban locations in the presence of Major Junction, carriageway has been upgraded to 4 lane divided carriageway configuration including the junction with approaches and also along the existing town section.

1.2 Project location

The project has been divided into the six construction packages. The details are as follows:

Package	Design Chainage		Length (km)	Location	District
	From(km)	To(km)			
Package-1	379.100	417.000	37.90	Thuravoor-Paravoor	Alappuzha
Package-2	417.000	454.500	37.50	Paravoor- Kottankulangara	Alappuzha
Package-3	454.500	486.000	31.50	Kottankulangara- Start of kollam Bypass	Alappuzha and Kollam
Package-4	486.000	517.250	31.25	Start of kollam Bypass- Kadambattukonam	Kollam
Package-5	517.250	547.080	29.83	Kadambattukonam- Kazhakuttam jn	Trivandrum
Package-6	547.080	549.801	2.721	Kazhakuttam jn Technopark Jn.	Trivandrum
Total			170.701		

Table 1.1 Package details

Source: Final Detailed Project Report, VOL-I Main Report (Package I)

CHAPTER 2

OBJECTIVES

- Assessing environmental impacts
- Study different quality parameters of - air, water, soil
- Assessing Social impacts – questionnaire.
- Conduct study to determine whether EIA is required
- Prediction of long term and short-term impacts
- Evaluate the feasibility of the project.

CHAPTER 3

LITERATURE REVIEW

3.1 DRAFT EIA REPORT Bangalore – Chennai Expressway-Phase-III, NATIONAL HIGHWAY AUTHORITY OF INDIA. (JANUARY 2021)

The Environment Impact Assessment study has been conducted for the proposed Phase-III of Bangalore-Chennai Expressway (BCE) in Andhra Pradesh and Tamil Nadu to investigate and assess the environmental concerns, potential environmental impacts associated with the project and their mitigation measures. The Environmental Impact Assessment (EIA) study covers anticipated potential impacts during different stages of the project viz., Design & Preconstruction Phase, Construction Phase and the Operational Phase and accordingly the mitigation measures have been suggested.

Several mitigation measures have been suggested along with the agency responsible for planning, execution, supervision and monitoring of the Environment Management Plan for pre-construction, construction and operation stages to avoid or mitigate the adverse impacts.

Pre-construction Phase

Pre-construction activities include acquisition of land and structures, relocation of utilities, removal of trees, relocation/compensation of common property resources viz. temple, hand pumps, obtaining Environmental Clearance, Consent to Establish from APPCB, TNPCB etc. NHAI/Concessionaire and concerned departments shall be responsible for those activities.

Construction Phase

Construction activities during this phase include setting up of Construction Camp, setting up of plants namely crusher plant, concrete batching plant, hot mix plant; clearing and grubbing, collection, storage and utilization of topsoil, identification of borrow pit & aggregate quarry (if other than those identified by design consultant), operation of the quarry, plantation on either side of the proposed expressway & at median, environmental protection & monitoring. Concessionaire shall be responsible for obtaining consent for establish and operate of those plants. Concessionaire shall also be responsible for implementation of the environmental protection measures during construction. The Independent Engineer/Authority Engineer shall be responsible for monitoring & supervision of the Concessionaire's activities as per Contract

& report it to PIU, NHAI time to time. Project Implementation Unit (PIU), NHAI shall be responsible for regulatory compliance.

Operation Phase

Operation phase activities include environmental monitoring and monitoring of survival rate of the plantation etc. The Independent Engineer/Authority Engineer and Concessionaire shall be responsible for those activities.

2. Land Acquisition and Resettlement Plan Monitoring Report. KAZ: CAREC Transport Corridor 1 (Zhambyl Oblast Section) [Link to the Western Europe–Western People’s Republic of China International Transit Corridor] Investment Program, Project 1 (Taraz–Korday Section in Zhambyl Oblast), Final External Monitoring Report Loan 2503-KAZ October 2013.

Project Background

ADB together with Japan International Cooperation Agency and Islamic Development Bank is financing the Central Asia Regional Economic Cooperation (CAREC) Transport Corridor I (Zhambyl Oblast Section) [Western Europe–Western People’s Republic of China International Transit Corridor] Investment Program. With this background, Government of Republic of Kazakhstan has received a loan from Asian Development Bank (ADB) up to \$700 million for implementing the Central Asia Regional Economic Cooperation (CAREC) Transport Corridor 1 Program (the Program). The program entails the rehabilitation, improvement or construction of several road sections along the Western Europe-Western China transit corridor and is financed through a Multi-tranche Financial Facility (MFF)).

AN INDEPENDENT ASSESSMENT OF THE RESETTLEMENT PROCESS BY EXTERNAL MONITOR

In line with the requirement of the Investment Program, the External Monitoring Consultant has carried out an independent assessment of the resettlement process on the basis of outcome of LARP implementation. In brief, the following tasks have been carried out by the External Monitoring Consultant for objective reporting of external monitoring of LARP implementation:

- assessment of institutional arrangement of Executing Agency in terms of their capacity to implement and monitor the LARP implementation.
- appraisal of LARP report in terms of its appropriateness
- study of entitlements of APs under LARP Framework
- examination of Consultation and Disclosure
- review of grievances redressal mechanism
- review and verification of internal monitoring reports, prepared by the Implementing Agency (IA);
- review and updating of the socio-economic baseline census information of predisplaced persons;
- identification and selection of impact indicators and impact assessment survey through sample surveys with affected persons.

CHAPTER 4

EIA METHODOLOGY

The EIA procedure carried out simultaneously with design of the project road and methodology is shown in below. The important findings of the assessment provided important feedback to the design team, especially in terms of the sensitive receptor, Forest and wildlife area, archaeological sites and religious properties. It helped in modification of the designs report and incorporated mitigation measures, wherever the impacts are avoidable.

Data Review - draw together and review available data

Screening - determine the need for EIA

Scoping - identify significant issues, determine the subject matter of the assessment and the methodologies for undertaking the assessment

Baseline Surveys - undertake surveys and monitoring to identify existing environmental conditions

Consultation - provide information to consultees and the public about the Scheme so that parties can make informed contributions to the development of the Scheme and EIA process, and take account of issues raised by consultees

Preparation of detailed report – Final detailed report is prepared based on the above results

CHAPTER 5

DESCRIPTION OF ENVIRONMENT

5.1 General

As a precursor for the prediction of various types of environmental impacts likely to arise due to implementation of the project, it is essential to establish the baseline environmental status in the area. Details of baseline environment parameters are required for decision making for the project.

5.2 Study area

The terrain which includes in chainage from 379.100 to 417.000 is plain.

The entire length of the road is passing through built up and commercial areas along with few agricultural areas. There is substantial built-up areas with prominent urban settlements located on the project road.

Field observations, secondary data and Local inquiries indicated that some road stretches get submerged during heavy rains. There are many valleys locations/ dip portion where additional culverts are felt necessary for the effective drainage. There are number of culverts in the stretch mainly slab type. Most of the culverts are not visible as there is heavy vegetation on both sides of the road throughout. Many culverts are in fully / partially choked condition due to development of built up are along the road.

The total of existing culverts after compiling the data is found to be 25 (Pipe 1 nos., Slab 17 nos. & Box 7 nos.). Many of these culverts has been found to be partially choked and seem inadequate.

The culverts are also old and seem to be structurally as well as hydraulically poor. Many of these structures shall be replaced preferably by Box Culverts for better hydraulic performance.

5.3 Physical environment

5.3.1 Soil characteristics: Soil from random locations is collected and tests are conducted. Various parameters like nitrogen phosphorous, iron, etc, are tested. Excess amount of these parameters can result in fertility loss. It is clearly visible that most of the parameters are present

in very less amount. From this we can expect that the widening will not affect the soil characteristics hardly.



Fig 5.1 soil sample collection source: self



Fig 5.2 collection spot source: self

Table 5.1 soil quality analysis

NO.	PARAMETERS	VALUE	LIMIT
1	Moisture	3.21%	-
2	pH	7.92%	6.5 to 9
3	Nitrogen as N (on dry basis)	0.14%	5%
4	Phosphorous as P ₂ O ₅ (on dry basis)	0.87%	20% to 50%
5	Potash as K ₂ O (on dry basis)	0.73%	50% to 60%
6	Calcium as Ca (on dry basis)	0.38%	70% to 80%
7	Magnesium as Mg (on dry basis)	0.21%	0.05% to 0.5%
8	Iron as Fe (on dry basis)	0.07%	0.2% to 55%

(IS 6092 part 2 to part 5)

Soil organic matter contains an average of about 50 percent carbon and **5 percent** nitrogen.

The total phosphorus content of most surface soils is low, averaging only **0.6%** phosphorus. The main symptom of excessive phosphorus in soil is **stunted plant growth**. Amount of **phosphorus** slowly drops as time goes on. P will stay in the soil for as long as **four to six months** before plant uptake.

Growers should maintain a calcium percent base saturation level of **70 to 80 percent** for optimum soil conditions and plant performance. Calcium base saturation levels above 80

percent can mean you're short on potassium or magnesium. If present, these deficiencies should be addressed through a fertility program.

Soil usually contains **between 0.05 and 0.5% total Mg** but only a small proportion is in forms available for plant uptake.

Iron is a commonly occurring metallic element, with typical soil concentrations ranging from 0.2% to 55% (20,000 to 550,000 ppm). Iron is essential for plant growth, and is generally considered to be a micronutrient. Iron is considered the key metal in energy transformations needed for syntheses and other life processes of the cells.

5.3.2 seismicity: There is no significant confirmed earthquakes in or near Alappuzha during May 2021

5.3.3 Air environment and quality

An ambient air quality sampling location, Kalarcode, was established for assessment of the existing status of air environment within the study area.

Table 5.2 Air quality analysis

PARAMETERS	AMOUNT PRESENT	PERMISSIBLE LIMIT
Ozone	70µg/m ³	100µg/m ³
Coarse Particulate matter	10 µg/m ³	45 µg/m ³
Fine particulate matter	4 µg/m ³	15 µg/m ³
Nitrogen dioxide	4 µg/m ³	25 µg/m ³
Carbon monoxide	224 µg/m ³	10 mg/m ³
Sulphur dioxide	1 µg/m ³	40 µg/m ³

(The ministry of Environment and Forest (MoEF), Govt. of India, G.S R826 (E), 16/11/2009)

Particulate Matter are inhalable pollutant particles with a diameter less than 10 micrometres. Particles that are larger than 2.5 micrometres can be deposited in airways, resulting in health

issues. Exposure can result in eye and throat irritation, coughing or difficulty breathing, and aggravated asthma. More frequent and excessive exposure can result in more serious health effects.

Fine Particulate Matter are inhalable pollutant particles with a diameter less than 2.5 micrometres that can enter the lungs and bloodstream, resulting in serious health issues. The most severe impacts are on the lungs and heart. Exposure can result in coughing or difficulty breathing, aggravated asthma, and the development of chronic respiratory disease.

Presently (19-05-2022) it shows excellent condition but air quality will be severely affected at the time of construction.

Major parameters which will affect at the time of construction are coarse particulate and fine particulate matter because of the emerging of dust. But it is a temporary impact and only lasts for short period.

5.3.4 Water resources

The existing road is far from existing water bodies, large ponds so there is no chance of affecting severely. However, some branches of rivers and canals are located nearby the highway. The quality of those resources is analysed.

Water samples are collected from nearby resources and are tested in the laboratory. From the results, turbidity, iron, BOD & DO does not satisfy the standards. Construction may result in the increase of these parameters beyond their permissible limit. Those parameters which are already above the limit can get more worse. It can also result in loss of soil fertility indirectly.



Fig 5.3 water resources



Fig 5.4 collected water

Source: self

Table 5.3 Water quality analysis

(Standard: IS: 10500 2012)

NO.	PARAMETERS	VALUE	STD LIMIT
1	Colour	3 Hazen units	5 Hazen units
2	Odour	-	-
3	Turbidity	6.1 NTU	5 NTU
4	pH	8	6.5-8.5
5	Total dissolved solids	317.6 mg/L	500
6	Total hardness	130 mg/L	300
7	Calcium hardness	32.04 mg/L	75
8	Magnesium hardness	12.14 mg/L	30
9	Alkalinity	120 mg/L	200
10	Sulphates	16.24 mg/L	200
11	Chlorides	99.26 mg/L	250
12	iron	.58 mg/L	.3
13	BOD	6.0 mg/L	0
15	DO	4.3 mg/L	6.5 - 8



Fig 5.5 testing in laboratory



Fig 5.6 testing in laboratory source: self

5.4 Biological Environment

5.4.1 Protected areas: A Protected Area is a clearly defined geographical space, recognized, dedicated and managed through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values. Protected areas include national parks, wilderness areas, community conserved areas, nature reserves and so on are a mainstay of biodiversity conservation, while also contributing to people's livelihoods, particularly at the local level. Utmost care must be taken while fixing the alignment near wildlife sanctuaries and National Parks. Such areas are not present in the area under consideration.

5.4.2 Population Density: Alappuzha district has a population density of 1,504 inhabitants per square kilometre .it is the second highest population density in Kerala. Its population growth rate over the decade 2001-2011 was 0.88%. Alappuzha has a sex ratio of 1100 females for every 1000 males, and a literacy rate of 95.72%. Out of the total Alappuzha population for 2011 census, 53.96 percent lives in urban regions of district.

5.4.3 Tourism: Tourism is one of the fastest growing sectors with highest contribution in State's revenue. The sector has increased the standard of living and provided platform to local artisans. The state has variety of tourist attractions such as handicrafts, wildlife sanctuary, heritage places, and lakes.

Infrastructure assets, particularly road infrastructures are levers for economic growth and development, hence a country's competitiveness heavily depends on the provision and maintenance of infrastructure assets. The tourism sector, which is highly dependent on a good transportation system and mobility, is a source of revenue to many countries. Hence, road infrastructure is pivotal to a thriving and sustainable tourism industry.

A good and effective transportation network is also a good marketing strategy for the traveling agencies that facilitate travels and organise tourism activities for individuals and organisation.

5.4.4 Vulnerable groups: Vulnerable populations include the economically disadvantaged, racial and ethnic minorities, the uninsured, the homeless, and It may also include rural residents, who often encounter barriers to accessing healthcare services. The vulnerability of these individuals is enhanced by race, ethnicity, age, sex, and factors such as income, insurance

coverage (or lack thereof), and absence of a usual source of care. Their health and healthcare problems intersect with social factors, including housing, poverty, and inadequate education.

There are no such vulnerable groups included in the considered area.

CHAPTER 6

ENVIRONMENTAL IMPACTS AND MITIGATION

6.1 Urban heat islands

An urban heat island, or UHI, is a metropolitan area that's a lot warmer than the rural areas surrounding it. Heat is created by energy from all the people, cars, buses, and trains. Urban heat islands are created in areas like these: places that have lots of activity and lots of people.

There are many reasons for UHIs. When houses, shops, and industrial buildings are constructed close together, it can create a UHI. Building materials are usually very good at insulating, or holding in heat. This insulation makes the areas around buildings warmer.

Night time temperatures in UHIs remain high. This is because buildings, sidewalks, and parking lots block heat coming from the ground from rising into the cold night sky. Because the heat is trapped on lower levels, the temperature is warmer.

Urban heat islands can have worse air and water quality than their rural neighbours. UHIs often have lower air quality because there are more pollutants (waste products from vehicles, industry, and people) being pumped into the air. These pollutants are blocked from scattering and becoming less toxic by the urban landscape: buildings, roads, sidewalks, and parking lots.

Water quality also suffers. When warm water from the UHI ends up flowing into local streams, it stresses the native species that have adapted to life in a cooler aquatic environment.

6.2 During construction phase

During construction phase environmental impacts are likely to result primarily from operation of heavy machinery and equipment's, vehicular movement and from influx of workforce. The potential pollutant sources for construction phase and their characterization have been discussed in the subsequent section.

6.3 Heavy Machineries and Vehicular movement

The operations of construction vehicles, diesel generators and machineries will contribute to Suspended Particulate Matter (SPM), Sulphur and Nitrogen dioxides (SO₂ and NO_x), Carbon monoxide (CO) and other hydrocarbons (HC). handling and transportation of materials during the construction phase also creates emission.

6.4 Noise

during construction phase, noise will be generated from operating heavy machineries and from vehicular movement. All the generator sets will be equipped with exhaust mufflers and acoustic enclosures and subjected to periodic preventive maintenance.

- Provision of Noise barrier
- By maintaining a steady stream flow of traffic and by segregating slow and fast modes
- By removing traffic bottlenecks

6.5 Generation of construction waste

Some amount of waste will be generated from the batching plant, hot mix plant and from the demolition of the building and other structures within the proposed ROW. Some of the material will be recycled and used for back filling. Material which cannot be recycled will be considered as Construction and Demolition waste and has to be disposed off as per the existing rules.

6.6 Influx of Workforce

Sewage effluent will be generated during this phase from construction camps. Solid waste generated during the construction phase from the camps is expected to comprise of food waste and recyclables viz. packaging material etc.

6.7 Contamination of Soil

Oil spillage from heavy machineries can contaminate soil.

6.8 Generation of dust

Mainly dust will be emitted during material transport and during loading-unloading activities which is planned to be controlled by periodic water sprinkling and by adopting good engineering practices.



Fig 6.1 dust in leaf source: self

6.9 Water quality

Generation of exhaust gases and fluid leakages from vehicles drains to nearby resources which results in contamination.

6.10 Animal crossing

Widening increases chance of hitting animals while crossing. For crossing wide roads, it takes greater time for them to cross which directly increases the chance of hitting



Fig 6.2 Animal crossing road source: self

6.11 Hot mix asphalt

Highway industry is also adopting several measures to reduce its carbon footprint. One of such measures is cold mix asphalt technology (CMA). CMA does not require any heating of

material. This is achieved by using asphalt emulsion and cutback as binding material. Since these materials are liquid at room temperature, they do not require any heating for mixing and compaction. This gives many environmental and economic benefits to CMA over hot mix asphalt (HMA).

Benefits of the Cold Mix over Hot-mix Asphalt:

- Durability and strength equivalent to using hot mix
- Permanent repair compared to traditional cold-mix which is only a temporary fix
- No Priming required
- Works even when water is present
- Works at low ambient temperatures (hot-mix cannot be used in cold weather as the asphalt will cool too much prior to compacting)
- Instantly ready for traffic – and in fact product cures and hardens more quickly with compaction forces. Rapid access over the surface reduces down time where there are time critical schedules
- Limited mess than other brands – product will not stick to or stain hands or shoes even when bucket is freshly opened
- No drift of bitumen to the surface requiring surface preparation prior to any further overlay
- Reduced labour time and therefore cost
- No requirement for special equipment
- Environmentally beneficial as it reduces carbon emission and noxious fumes avoid wastage
- Cold Mix is fast, permanent, easy to use and environmentally preferable cold asphalt product. However, for constructing new roads hot mix technology is better suited. Contractor/Concessionaire shall utilise the same where ever suitable.

6.12 Relocation of petrol pumps

The considered area contains six petrol pumps which needs to be replaced to other location. This process leads to cutting and filling according to the area. Also, there is risk factor in replacing storage tank of fuel.

6.13 Removal of trees and vegetation

There are approximately 976 big trees present on the side of the road which will be cut for widening of the road. If the entire right of way is considered, the number becomes almost double.



Fig 6.3 nearby trees

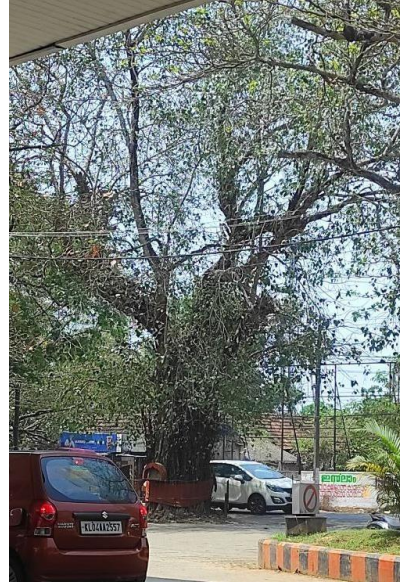


Fig 6.4 nearby trees source: self

CHAPTER 7

SOCIAL IMPACT ASSESSMENT

7.1 Social Environment

Social impact assessment (SIA) is a method to analyse the social impacts associated with plans, policies, projects, and other developments. The technique is used to study the social effects of planned development interventions; however, it can also be used to study the social impacts of any unexpected interventions such as demographic variations, natural disasters, etc. The objective of social impact assessment is to achieve sustainable development outcomes. This section of the report discusses about project's potential impact, scope of land acquisition, key effects in terms of assets acquired and displaced persons and impact on cultural and common property resources.

7.2 Scope of land acquisition

The project will entail acquisition of 49.93 Ha of private land from around 1200 households in 16 revenue villages. The land acquisition activities are in progress in this project stretch. 3A notified for entire land to be acquired and 3D schedule has done for around 40% of the total land required for this construction package. Details related to land acquisition for this project s summarised in table 7.1.

Table 7.1 land acquisition details

Name of District	Name of Taluk	Name of Villages	Land Acquisition in Ha		
			Private	Govt.	Total
Alappuzha	Cherthala	Thuravoor South	2.6482	0.1257	2.7739
		Pattanakad	4.1144	0.1424	4.2568
		Kadakarapally	0.0728	0.004	0.0768
		Vayalar East	1.9726	0	1.9726
		Cherthala North	6.9925	0.7101	7.7026
		Cherthala South	6.391	1.3219	7.7129
		Kokoathamangalam	0.4758	0.049	0.5248
		Thanneermukom North	1.6922	0.0554	1.7476
		Mararikulam North	2.3404	1.0903	3.4307
		Kanjikuzhi	5.4966	0.264	5.7606
	Ambalappuzha	Kalavoor	4.6992	0.7022	5.4014
		Pathirapally	5.0058	0.0495	5.0553
		Mannancherry	2.0138	0.0976	2.1114
		Komalapuram	1.7828	0.5352	2.318
		Aryad South	0.7475	0.0226	0.7701
		Paravoor	3.4834	0.2937	3.7771
Total			49.929	5.4636	55.3926

Source: Final Detailed Project Report, VOL-I Main Report (Package I), NHAI

Table 7.1 Public structures

property	chainage
school	383.900
mosque	386.500
church	380.700
mosque	381.550
church	385.500

Widening result in the demolition of these structures which creates imbalance in the social activities of adjoining communities.

- Extra care should be taken while dealing with, religious and communal properties
- By providing underpass for smooth and safe travel of local populace
- Providing noise attenuation measures along schools and hospitals
- Avoiding direct impact on sensitive receptors

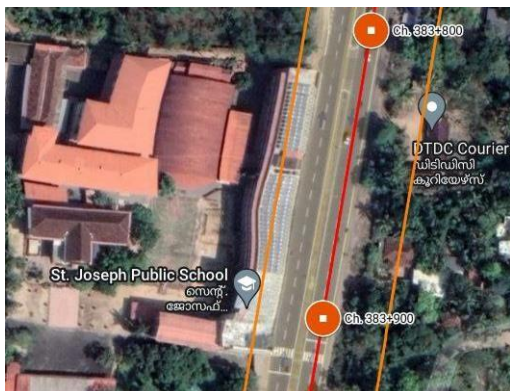


Fig 7.1 school



Fig 7.2 Mosque

source: self

7.3 Social Impact analysis

Social Impact analysis was assessed with a questionnaire. Questionnaires for both commercial properties and residential properties are prepared.

Compensations for the land given to the title holders have been given promptly. But the greater percentage of stakeholders express unsatisfaction in the compensation.

Compensation for tenants have not given and the delay has caused uncertainty among them. Few citizens who are partial to development and growth show satisfaction in the project. The

compensation provided to the people is as per land values of 2013, which is significantly less than the present land value. Many of the residents had to migrate and others had to cram into the remaining land. This resulted in disruption of their daily activities and increase in day-to-day travel distance to work and back.

7.4 Social impact survey outcome analysis

7.4.1 Commercial

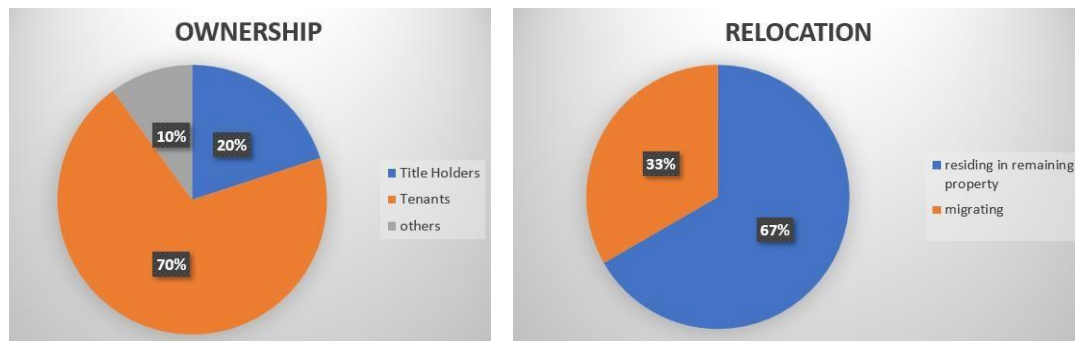


Fig 7.3 commercial ownership pie chart Fig 7.4 commercial relocation pie chart
source: self

Majorities are tenants and a 10% of unregistered small establishments are there which does not have any considerations in providing compensation. 67% reside in the remaining property and 33% have migrated.

7.4.2 Residential

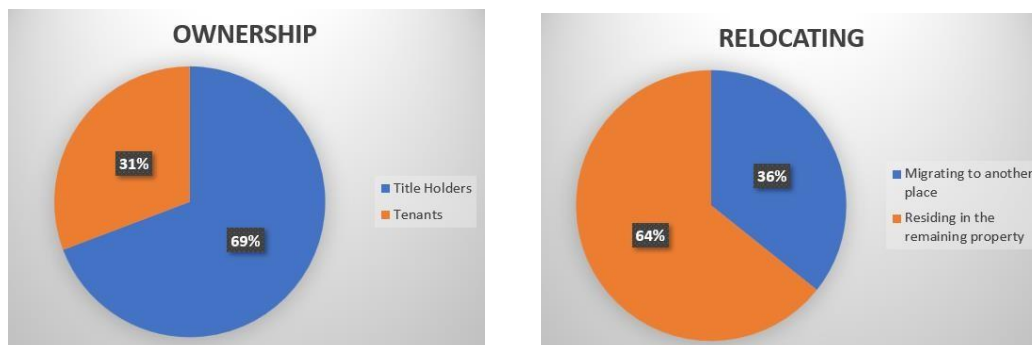


Fig 7.5 Residential ownership pie chart

Fig 7.6 Residential relocating pie chart

Source: self

69% are title holders and remaining 31% are tenants. Out of 69% of title holders, 64% reside in the remaining property and 36% are migrating to another place.

7.4.3 Compensation

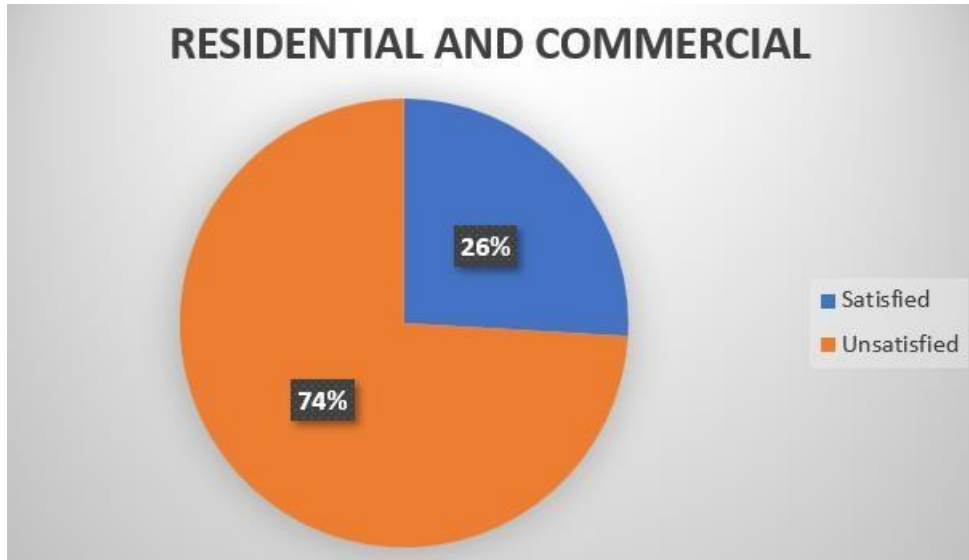


Fig 7.7 compensation pie chart

source: self

74% of the title holders are unsatisfied with the compensation and remaining 26% satisfied ones are those who value development over compensation.

CHAPTER 8

CONCLUSIONS

Impacts of road expansion on environment are identified and Quality parameters of air, water and soil have been analyzed.

The project does not seem to be imposing heavy impacts on environmental parameters but it creates a greater impact on title and non-title holders. Financial and psychological impacts on title and non-title holders are analyzed and mitigation measures for the impacts have been introduced.

- Introduction of a wider highway will expand the development opportunities in the adjoining areas.
- The impact on environment will be limited as long as proper construction practices are adopted.
- Majority of residents are unsatisfied with the compensation; some residents have moved forward with litigation.
- People who have owned small commercial establishments for decades have been removed without compensation since their property is not officially registered in government documents.
- Waste materials can be used for landfilling or proper management wants to be done.
- Land value is as of 2013 scheme, significantly less than the present value. It will be more satisfying if the present value is given to the stakeholders.

About 5 petrol pumps, 2 educational institutions, 5 religious places and 3 water tanks are situated very closely to the road. Almost every structure mentioned above are affected by the widening process.

There are 976 trees that must be removed as part of construction. To compensate this, trees must be planted which leads to positive impacts in environment like reduces heat, reduces soil erosion which finally results in less turbidity level of water resources.

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**PAVEMENT DESIGN FOR THE CONVERSION OF 2 LANE TO 6 LANE
OF THURAVOOR THEKKU TO PARAVOOR ROAD (NHAI)**

PROJECT REPORT

by,

AFZIN RAFEEK(VJC18CE006)

RISMA RASHEED (VJC18CE082)

SHALBIN SHAJI(VJC18CE097)

THASLI K MOIDEEN (VJC18CE105)

in partial fulfilment for the award of degree of

BACHELOR OF TECHNOLOGY

in

CIVIL ENGINEERING

APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

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DEPARTMENT OF CIVIL ENGINEERING

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Of

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DEPARTMENT OF CIVIL ENGINEERING

VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY

VAZHAKULAM

JUNE 2022

**VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY
VAZHAKULAM**

Department of Civil Engineering



BONAFIDE CERTIFICATE

This is to certify that the Project Report entitled “**PAVEMENT DESIGN FOR THE CONVERSION OF 2 LANE TO 6 LANE OF THURAVOOR THEKKU TO PARAVOOR ROAD (NHAI)**” is a bonafide record of the work done by **AFZIN RAFEEK(VJC18CE006), RISMA RASHEED (VJC18CE082), SHALBIN SHAJI(VJC18CE097), THASLI K MOIDEEN (VJC18CE105)** in partial fulfillment of the requirements for the award of the **Degree of Bachelor of Technology in Civil Engineering** of APJ Abdul Kalam Technological University (KTU), Thiruvananthapuram.

Date: 2/6/2022

Place: Vazhakkulam

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**VISWAJYOTHI COLLEGE OF ENGINEERING AND TECHNOLOGY,
VAZHAKULAM.**

Department of Civil Engineering

Vision

Building Professionally Competent and Motivated Engineers in the Arena of Civil Engineering with High Professional Ethics.

Mission

1. To promote a better teaching learning process through academically proficient faculties, full-fledged laboratories and excellent infrastructure facilities.
2. To equip the graduates with knowledge, research and practical skills in modern construction practices and techniques.
3. To inculcate knowledge of sustainability in various domains of Civil Engineering.
4. To nurture Civil Engineers into ethically strong and responsible leaders to address global challenges through quality education.

Program Educational Objectives Our Graduates

1. Shall tackle the multiple responsibilities of analysis, design and construction of traditional and modern systems in compliance with various codes of practices and to meet the current technical challenges.
2. Shall be proficient in the use of relevant software packages for planning, designing, scheduling, executing and controlling of civil engineering projects with an urge for life-long learning.
3. Shall function effectively with individual capabilities as well as with a collective strength as a professional team with good communication skills.

Program Outcomes

1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design / development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.
4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes

1. Ability to utilize civil engineering principles and software that are appropriate to solve technical problems; prepare design and construction documents; create structural systems; produce drawings, reports and quantity estimates related to the Civil Engineering domain.
2. Ability to utilize modern surveying methods for land measurement and/or construction layout and to conduct standardized field /laboratory tests related to Civil Engineering.

ACKNOWLEDGEMENT

This project work is the product of hard work and experience and it goes a long way in shaping a person in his respective profession. If words can be considered as a token of acknowledgement and symbols of love, then these words play a vital role in expressing our gratitude.

First and foremost, we express our sincere thanks to our project guide **Mrs. Finu John**, (Assistant Professor of Civil Engineering ,VJCET) for her endeavor's in providing constant guidance and encouragement throughout this project. Next, we thank our class tutor, **Mr. Appu John**, (Asst. Prof. Department of Civil Engineering, VJCET) for his valuable encouragement throughout the completion of this work. We also extend our special thanks to **Mrs. Neena M Joseph, Mrs. Anu Paul and Mrs. Amrutha S** for taking time to clear our doubts during this project period despite their busy schedule. With a great respect, we express our gratitude to **Dr. Shine George** (Head of the Department, Civil Engineering, VJCET) for all the proper guidance and encouragement that helped us to complete this project. We are also thankful to **Dr. K.K Rajan**, our honored Principal for providing great facilities for the success of this project. Last but not the least; we are grateful to our **friends** and **parents** for their valuable motivation and support. We wish to express our deep sense of gratitude to all staff members of Civil Department for their keen interest and valid support. Above all, we thank **God Almighty** for giving us the blessings to take over this venture.

AFZIN RAFEEK

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CONTENTS

SL .NO	DESCRIPTION	PAGE NO.
	ACKNOWLEDGEMENT	vii
	CONTENT	viii
	LIST OF FIGURES	xii
	LIST OF TABLES	xiii
	ABSTRACT	xiv
1.	INTRODUCTION	1
2.	LITERATURE REVIEW	3
3.	OBJECTIVE AND SCOPE	6
	3.1. Objectives	6
	3.2. Scope	6
4.	METHODOLOGY	7
	4.1. Site visit	7
	4.2. Layout of alignment	8
	4.3. Study of traffic volume	9

4.4. Soil collection	9
4.4.1. Sampling tools and accessories	10
4.4.2. Sampling procedure	10
5. SOIL STRENGTH TESTS	12
5.1. Determination of water content by Oven dry method	12
5.1.1. Apparatus required	13
5.1.2. Preparation of sample	13
5.1.3. Procedure to determine water content in soil	13
5.1.4. Results obtained	14
5.2. Specific gravity determination by pycnometer method	15
5.2.1. Equipment for specific gravity test	15
5.2.2. Procedure	16
5.3. Standard Proctor test	19
5.3.1. Equipment required	20
5.3.2. Procedure of standard proctor test	20
5.4. California Bearing Ratio test	26
5.4.1. Objective	26

5.4.2. Apparatus required	27
5.4.2.1. CBR Test Apparatus	27
5.4.2.2. CBR Mould with Base Plate, Stay Rod and Wing Nut	28
5.4.2.3. Weights	28
5.4.3. Procedure	29
5.4.3.1. Preparation of test Specimen	29
5.4.3.2. Procedure of penetration test	30
5.4.4. Recording during CBR test	31
5.4.5. Calculation	32
5.4.6. Graphs between load versus penetration	33
5.4.7. Pavement thickness determination	34
5.4.8. IRC Recommendation	35
6. PAVEMENT THICKNESS	37
6.1.CBR Method recommended by IRC	37
6.2. Flexible Pavement design procedure	38
7. PAVEMENT DESIGN	40
7.1. Pavement components	40

	7.1.1. Subgrade	40
	7.1.2. Sub-base course	40
	7.1.3. Base course	41
	7.1.4. Surface course	42
8.	STABILIZING AGENT	44
	8.1. Mechanics of soil stabilization	44
	8.2. Investigation for stabilized roads	45
	8.3. Soil stabilization methods	45
	8.3.1. Mechanical stabilization	45
	8.3.2. Soil-cement stabilization	45
	8.3.3. Soil-Lime stabilization	46
	8.3.4. Stabilization of soil using bituminous materials	46
9.	RESULT AND DISCUSSION	47
10.	CONCLUSION	48
	REFERENCE	49

SL NO.	LIST OF FIGURES	PAGE NO.
4.1	Starting and ending points	8
4.2	Starting and ending points (satellite view)	8
4.3	Alignment Layout	8
4.4	Collection of samples	11
5.1	Water content determination	14
5.2	Pycnometer	16
5.3	Specific gravity determination	18
5.4	Standard proctor test	19
5.5	Graphs of standard proctor test	25
5.6	C.B.R test Apparatus	27
5.7	C.B.R Mould	28
5.8	Weights in C.B. R	29
5.9	Plot of load v/s settlement	33
5.10	Graphs of CBR test	34
5.11	C.B.R Test	36

6.1	C.B.R Design chart	38
6.2	Layers of soil above subgrade	39
7.1	Pavement layer composition	43

SL. NO	LIST OF TABLES	PAGE NO
4.1	Traffic volume	9
5.1	Oven dry method values	14
5.2	Specific gravity determination	17
5.3	Standard proctor test values	23
5.4	Standard load values at penetration	27
5.5	Recordings at C.B.R Test	31
6.1	Depth of construction	39

ABSTRACT

The National Highways connects India from Kashmir to Kanyakumari and from Maharashtra to West Bengal. They are very important for transportation of goods across the lengths and breadths of India. Presently, the length of National Highways in India is about 96261 km. They spread through all the states like a network, providing road connectivity throughout the country. NHAI (National Highway authority of India) is one of the most important PPP (Public private partnership) project undertaken in India. They have been entrusted with the project of 6 laning of Cherthala to Thiruvananthapuram section of NH 47 (New NH 66) of length 170.7km. The Current study is aimed at doing the pavement design of small phase of NH 66 that connects Cherthala to Thiruvananthapuram. This phase (phase I) starts from Thuravoor Thekku to Paravoor (Alappuzha district). Since the soil in this particular stretch is weak and there is a considerable traffic congestion, it is necessary to determine the pavement thickness.

CHAPTER 1 INTRODUCTION

The National highway authority of India (NHAI) have been entrusted with the project of 6 laning of Cherthala to Thiruvananthapuram section of NH 47 (New NH 66). The project road length is 170.7km. It starts from km 379.100 of NH-47 at the junction of Thuravoor and ends at Kazhakoottam junction at km 549.801. This stretch of road passes through three districts viz. Alappuzha, Kollam and Thiruvananthapuram. The road passes through urban areas viz. Cherthala, Mararykulam, Alappuzha, Ambalapuzha, Purakkad, Thottapally, Haripad, Nagiar Kulangara, Kayamkulam, Krishnapuram, Oachira, Vavvakkavu, Karunagapally, Chavara, Neendakara, Kavanadu (Kollam), Mevaram (Kollam), Kottiyam, chathanoor, paripally, kallambalam, attingal, manglapuram, pallipuram and kazhakoottam. Generally, the existing road is two laned with paved shoulders on either side. At most of the urban locations in the presence of Major Junction carriageway has been upgraded to 4 lane divided carriageway configuration including the junction with approaches and also along the existing town section. There are two bypasses under different stages of construction and one new bypass.

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub grade, whose primary function is to distribute the applied vehicle loads to the sub grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favourable light reflecting characteristics, and low noise pollution.

In the beginning of 2017, Kerala government has announced the six laning of NH 66 in the state as a major agenda and said to be completed in three years. National Highway 66, commonly referred to as NH 66 is a 4 lane 1,608 km (999 mi) long busy National Highway that runs roughly north–south along the western coast of India, parallel to the Western Ghats. It connects Panvel (a city south of Mumbai) to Cape Comorin (Kanyakumari), passing through the states of Maharashtra, Goa, Karnataka, Kerala and Tamil Nadu. The NHAI has received the approval to upgrade the complete stretch of highway, from start to end, to a four-lane highway, which will be 60 m (200 ft) and grade separated. Out of four states through which the highway goes, Karnataka and Maharashtra have received approval from the centre for the 60 m (200 ft) wide highway. Kerala and Goa have requested a narrower width of 45 m (148 ft), and there are protests against the highway being widening in these states.

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

According to NHAI sources, the land acquisition process is in its final stages in various districts. The preliminary work demolition of buildings and felling of trees has started in Kasaragod, Kannur, Malappuram and Kozhikode districts. The construction of the Mahe Bypass and the Mukkola-Karode Road will be completed by March 2022. The fastest progress is seen in Malappuram and Kasaragod districts. Land levelling too has begun in many of these districts. NH 66 has one of the highest vehicle densities in the state compared to sections of the highway in other states, so its development is vital for the overall development of the state, also the HAM model to be followed in widening will be instrumental in collecting the funds for the development. NHAI has been infamous for their heavy and long tenure of toll collection in the state.

The project has been divided into the six construction packages and Package-1 of Thuravoor-Thekku to Paravoor is our Project stretch. Our aim is to Design pavement for the conversion of two lane to six lane from Thuravoor Thekku to Paravoor. Pavement was designed on the basis of thickness obtained from California Bearing Ratio test and it is expected for the design life of 15 years for flexible pavement and design life of 30 years for rigid pavement. Pavement design should have sufficient thickness to distribute the wheel load stresses to a safe value on the subgrade soil. We have collected soil samples from different locations and conducted soil test. California Bearing Ratio test is used to find Pavement thickness. Initial water content of soil is determined and at Optimum Moisture Content CBR test is performed. Based on Traffic Volume count and CBR value thickness is determined, hence pavement design can be performed.

CHAPTER 2 LITERATURE REVIEW

2.1 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

In this paper a comparative 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 (M_r) through an empirical correlation. The Asphalt Institute Method and the Mean Criterion Method were applied to calculate the Design CBR value of a homogeneous roadway division from a representative track section located in the Bolivar Department, Colombia. As a result, the Design Percentiles of the CBR design unit were expanded for the Asphalt Institute method, thus, allowing the approach of more reliable and safe designs, considering that this method limits the selection percentiles to three traffic levels.

2.2 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. Black Cotton soil is expansive soil which expand when it contacts with water and this is the major reason of failure of black cotton soil strata. The engineering properties of black cotton soil may be used by fibre, ash, lime and sludge etc. CBR value depends on the liquid limit (WL), Plastic limit (Wp), plasticity index (Ip), maximum dry density, optimum moisture content, shrinkage, swelling pressure, degree of expansiveness and permeability of soil or mix specimen. These tests are performed in laboratory of University Teaching Department, Rajasthan Technical University, Kota. This research paper deals with design of flexible pavement by using black cotton soil with different percentage of Kota stone slurry. In this research, the Kota stone slurry is mixed from 5% to 30% in black cotton soil. The engineering parameters are also determined by performed tests. For studying the behavior of black cotton soil with different

percentage of Kota stone slurry, the Atterberg's limits (Liquid limit, Plastic limit, Plasticity Index, Sieve analysis, standard proctor test, California Bearing Ratio are performed.

2.3 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) value of subgrade is used for design of flexible pavements. California Bearing Ratio (CBR) value is an important soil parameter for design of flexible pavements and runway of air fields. It can also be used for determination of sub grade reaction of soil by using correlation. It is one of the most important engineering properties of soil for design of sub grade of roads. CBR value of soil may depends on many factors like maximum dry density (MDD), optimum moisture content (OMC), liquid limit (LL), plastic limit (PL), plasticity index (PI), type of soil, permeability of soil etc. Besides, soaked or unsoaked condition of soil also affects the value. These tests can easily be performed in the laboratory. the estimation of the CBR could be done on the basis of these tests which are quick to perform, less time consuming and cheap, then it will be easy to get the information about the strength of subgrade over the length of roads, By considering this aspect, a number of investigators in the past made their investigations in this field and designed different pavements by determining the CBR value on the basis of results of low cost, less time consuming and easy to perform tests. In this study, attempts have been made to seek the values of CBR of different soil samples and correlate their CBR values for the design purpose of flexible pavement as per guidelines of IRC: SP: 37-2001.

2.4 Previous year project of CED students, VJCET: "Traffic speed and flow analysis":2021

The NH 66 is a busy National Highway passing through Kerala, due to its growing importance government has proposed to develop it into a six-lane highway. In this work we are conducting speed studies of this NH 66 to develop a speed model for different category of vehicles. The studies are done on a portion of this highway from Thuravoor Thekku to Paravoor. For this the data is to be collected from nine different locations of this stretch, this include width, no of lanes, shoulder width flow data and speed data. The speed data is collected by using speed application.

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

The entire data is to be arranged in an excel sheet for processing and further needs. SPSS software can be used to develop multi linear regression models for all category of vehicles. PCU factor is to be used to predict the total volume in PCU unit and average speed. In the models thus formed characteristics of the proposed six lane highway are to be substituted to predict the operational speed for proposed six lane highway.

2.5 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. These criteria are also applicable to roads and airfields having a stabilized surface layer. This discussion covers the appropriate type or types of additive to be used with different soil types and procedures for determining a design treatment level for each type of additive.

2.6. 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.

CHAPTER 3

OBJECTIVES AND SCOPE

3.1 Objectives

- i** The main aim of this project is to suggest pavement thickness for upcoming NH-66 six lane road from Thuravoor Thekku to Paravoor.
- ii** To understand the present condition of 2 lane and 4 lane road from Thuravoor Thekku to Paravoor.
- iii** To find out the strength of the soil along the project stretch.
- iv** To find out the thickness of the six-lane road yet to be constructed from Thuravoor Thekku to Paravoor.
- v** To suggest suitable Stabilising agent for increasing the strength of subgrade soil.

3.2 Scope

Scope of the Project is to design suitable pavement cross section for the NH-66 Road from Thuravoor Thekku to Paravoor.

CHAPTER 4 METHODOLOGY

- i Literature Review.
- ii Site Visit.
- iii Prepare a Layout of the alignment.
- iv Study the Traffic Volume.
- v Collect 4 samples from the entire stretch.
- vi Soil strength test.
- vii Find out Thickness of Road above each soil sample.
- viii Identifying suitable Stabilising agent.

4.1. Site Visit

Project Road is from Thuravoor Thekku to Paravoor of length 37.9 km of Alappuzha district. It starts from km 379.100 of NH-47 at the junction of Thuravoor and ends at Paravoor at km 417.00. This stretch of road passes through Alappuzha district. The road passes through urban areas viz. Cherthala, Mararykulam, Alappuzha. Generally the existing road is two laned with paved shoulders on either side. At most of the urban locations in the presence of Major Junction, carriageway has been upgraded to 4 lane divided carriageway configuration including the junction with approaches and also along the existing town section.

We have visited the site to understand present condition of two lane four lane roads. The land acquisition process is in its final stages in various districts. The preliminary work demolition of buildings and felling of trees has started in Kasaragod, Kannur, Malappuram and Kozhikode districts. The fastest progress is seen in Malappuram and Kasaragod districts. Land levelling too has begun in many of these districts. NH 66 has one of the highest vehicle densities in the state So its development is vital for the overall development of the state.

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)



Fig 4.1: Starting and Ending points (Self taken)



Fig 4.2: Starting and Ending points (Satellite View)

4.2 Layout of the alignment

Project road stretch from Thuravoor Thekku to Paravoor is being analyzed and carefully studied about 2 lane and 4 lane roads and their difference at different junctions. At four locations four lane merges to two lanes. Two lane roads are most prominent in this stretch. Based on our visit we prepared a layout and decided different location for soil sample collection.

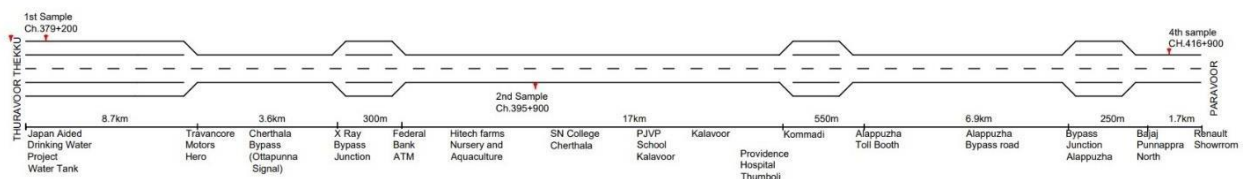


Fig 4.3: Alignment Layout (Autocad drawing)

4.3 Study of traffic volume

Traffic volume studies are conducted to determine the number, movements, and classifications of roadway vehicles at a given location. These data help to identify critical flow time periods, determining the influence of large vehicles or pedestrians on vehicular traffic flow. Traffic Volume Count is counting of number of vehicles passing through a road over a period of time. Objective of the traffic volume studies is to decide priority for improvement of roads like relaying of roads, widening of roads and other works. Design of pavement takes place by comparing pavement thickness and traffic volume. Pavement thickness obtained from California Bearing Ratio soil test. Traffic volume obtained from studying different journals publishing traffic count at same.

Table 4.1 Traffic volume

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

4.4 Soil collection.

Soil sampling is the process of taking a small sample of soil, which is then sent to a lab to determine the Soil characteristics. The analysis of the soil is carried out by taking samples of the soil and performing laboratory tests, which is then followed by an interpretation of the results. The CBR test is performed by measuring the pressure required to penetrate a soil sample with a plunger of standard area. The measured pressure is then divided by the pressure required to achieve an equal penetration on a standard crushed rock material. The harder the surface, the higher the CBR value. The California bearing ratio test is penetration test meant for the evaluation of subgrade strength of roads and pavements. The results obtained by these tests are used with the empirical curves to determine the thickness of pavement and its component layers.

The method and procedure for obtaining soil samples vary according to the purpose of sampling. Analysis of soil samples may be needed for engineering purposes. The results of even very carefully conducted soil analysis are as good as the soil sample itself. Thus, the efficiency of soil testing service depends upon the care and skill with which soil samples are collected. It is to be noted that the most important phase of soil analysis is accomplished not in a laboratory but in the field where soils are sampled. Soils vary from place to place. In view of this, efforts should be made to take the samples in such a way that it is fully representative of the field.

4.4.1 Sampling tools and accessories

Depending upon the purpose and precision required, following tools may be needed for taking soil samples.

- A spade for taking samples.
- A clean bucket or a tray or a clean cloth for mixing the soil.
- Plastic bags of specific size.
- Copying pencil for markings and tags for tying plastic bags.
- Soil sample information sheet.

4.4.2 Sampling procedure

Prepared a layout of the areas to be covered showing different sampling unit boundaries. A plan of the number of samples and manner of composite sampling is entered on the alignment, different places being designated by Sample 1,2,3. A slice of the plough layers cut at intervals of 15 to 20 steps or according to the area to be covered. Collect at least 10 to 15 samples from each sampling unit and place in a bucket or tray.

Based on our visit we prepared a layout and decided different location for soil sample collection. Project road stretch from Thuravoor Thekku to Paravoor is being analyzed and carefully studied about 2 lane and 4 lane roads. Decided soil sample collection places at regular intervals. We have collected first soil sample of 20 kg soil from Chainage 379+200 near Japan Aided Drinking Water near Thuravoor. Second soil sample of same weight from Chainage 387+200 near Travancore motors X-Ray Junction. Third soil sample is taken from Chainage 416+900 at Paravoor near Renault Showroom. We have taken 20kg soil sample from each location for soil tests like Standard Proctor Test and California Bearing Ratio test.

Soil is taken at a depth of 1 to 1.5 m in each location. Soft soil at the top portion is usually removed as it causes Improper compaction. Soil is dig with spade in a rectangular pattern towards required depth and suddenly packed the samples properly. Before sending soil samples to the testing

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Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

laboratory, it should be ensured that proper identification marks are present on the sample plastic bags as well as labels placed in the plastic bags.



Fig 4.4(: Collection of samples (Self taken))

CHAPTER 5

SOIL STRENGTH TESTS

The analysis of the soil is carried out by taking samples of the soil and performing laboratory tests, which is then followed by an interpretation of the results. Soil test may refer to one or more of a wide variety of soil analysis conducted for one of several possible reasons. Soil testing involves collecting soil samples, preparation for analysis, different testing, interpretation of analysis results, and finally determination of Thickness of pavement and recommendations to increase strength of soil. Soil testing is primarily done to test the bearing capacity. The chemical and physical composition of the soil is checked during this process. The soil must have the ability to withstand the weight of the construction. The common soil test for road construction includes classification of soil, particle size distribution, moisture content determination, Standard Proctor test, California Bearing Ratio test. Initial water content of soil is determined by Oven Dry Method and Specific gravity determined by Pycnometer test. Through Standard Proctor Test Optimum Moisture Content is determined. OMC is used for California bearing Ratio test. Based on CBR percentage thickness is determined and hence pavement can be designed. Pavement design Soil samples collected from three different locations of 37.9 km of Thuravoor Thekku to Paravoor. In order to design pavement, thickness compared with traffic volume. Soil samples undergoes soil test to determine thickness.

5.1 DETERMINATION OF WATER CONTENT BY OVEN DRY METHOD

Oven dry method is the most accurate and simplest method for water content determination. In this method complete drying of soil sample occur and water content in sample is calculated accurately by a maintained temperature in the oven. To determine the water content in soil by oven drying method as per IS: 2720 (Part II) – 1973. The accurate measurement of the moisture content of a soil is an important step in characterizing its engineering behavior. However, the oven-drying method can cause some chemical reaction (oxidation or loss of water of crystallization) to occur in certain soil types. Water content, which is also called moisture content, is the quantity of water contained in a material, such as soil. Water content of any soil sample is defined as the ratio of weight of water to the weight of solids present in that sample. We also multiply it by hundred because it is usually expressed as percentage. This is a laboratory test because we need an oven for this test to perform and certainly, we cannot carry an oven into the field. It is the simplest and the most commonly adopted method for the determination of water

content. Its procedure is very simple, just take out a sample from soil, take its weight and put it into the oven for 24 hours then take it out and take its weight again. The difference of weight will be the weight of water present in the soil sample.

5.1.1 Apparatus required

- i Thermostatically controlled oven maintained at a temperature of $110 \pm 5^{\circ}\text{C}$
- ii Weighing balance, with an accuracy of 0.04% of the weight of the soil taken
- iii Air-tight container made of non-corrodible material with lid
- iv Tongs

Size of particles more than 90 percent passing through IS Sieve	Minimum quantity of the soil specimen to be taken for test (g)
425 μm	25
2.0mm	50
4.75mm	200
9.50mm	300
19mm	500
37.5mm	1000

Quantity of soil required for test based on particle size

5.1.2 Preparation of Sample

The soil sample contains particle size of 4.75mm sieve hence we use soil quantity of 170 gram onwards. The soil specimen should be representative of the soil mass. The quantity of the specimen taken would depend upon the gradation and the maximum size of particles.

5.1.3 Procedure to determine Water Content in Soil

1. Clean the container, dry it and weigh it. (Weight 'W1').
2. Take the required quantity of the moist soil specimen in the container and weigh it (Weight 'W2').
3. Place the container in the oven till its weight becomes constant (Normally for 24hrs.).
4. When the soil has dried, remove the container from the oven, using tongs.
5. Find the weight 'W3' of the container and the dry soil sample.

5.1.4 Result obtained;

The water content obtained by calculating the moisture content of the soil by subtracting the weight of the dry soil from the weight of the moist soil, and then dividing by the weight of the dry soil. Although the measurement is simple, it is important to determine soil moisture content in order to better understand soil characteristics.

$$w = [W2-W3] / [W3 -W1] * 100\%$$

Table 5.1 Oven dry method values

Water content: Oven dry method			
Container no	1	2	3
Weight of container (w1)	42.63	39.52	18.64
Weight of container (w1) +moist soil (w2)	170	154	154
Weight of container+ dry soil(w3)	156	139	147
Weight of water, Ww=w2-w3	14	15	7
Weight of dry soil, Ws=w3-w1	113.37	99.48	128.36



Fig 5.1: Water content determination (Self taken)

Moisture content is expressed as a percentage of the oven-dry weight of the soil. For example, if 170-gram moist soil sample weighs 156 grams after drying with weight of container 42.63 gram, the percentage of moisture is calculated by dividing weight of water to weight of dry soil. Weight of water is the difference of moist soil and dry soil and weight of dry soil is the difference of dry soil and weight of container. Thereby, weight of water obtained as 14 and weight of dry soil as 113.37 gram. Moisture content in percentage obtained as 12.34. Therefore, initial water content of Sample 1 is 12.34%.

5.2 SPECIFIC GRAVITY DETERMINATION BY PYCNOMETER METHOD

The Pycnometer is used for determination of specific gravity of soil particles of both fine grained and coarse-grained soils. The determination of specific gravity of soil will help in the calculation of void ratio, degree of saturation and other different soil properties. This test is specified in IS: 2720 (Part 4) – 1985. A soil's specific gravity largely depends on the density of the minerals making up the individual soil particles. To determine the specific gravity of soil solids by Pycnometer bottle method. Specific gravity is the ratio of the mass of unit volume of soil at a stated temperature to the mass of the same volume of gas-free distilled water at a stated temperature.

5.2.1 Equipment for Specific Gravity Test

The major measuring equipment in this test is Pycnometer. This is a glass jar that is fitted at its top by a conical cap made of brass. It has a screw type cover.

- Pycnometer
- Balance accurate to 1 g
- Glass rod
- Distilled water.



Fig 5.2: Pycnometer (self taken)

The specific gravity of whole mix is the average specific gravity of all solid particles present in that mix. This test method covers the determination of the specific gravity of soil solids that pass 4.75 mm sieve.

5.2.2 Procedure

1. Clean and dry the pycnometer and weigh it along with the conical cap (W_1 in gm).
2. Select about 200 gm of dry soil free of clods and put the same into the pycnometer. Weigh it (W_2 in g) with cap and washer.
3. Fill the pycnometer with distilled water up-to half its height and stir the mix with a glass rod. Add more water and stir it. Fit the screw cap and fill the Pycnometer flush with the hole in the conical cap and take the weight (W_3 in g).
4. Remove all the contents from the pycnometer, clean it thoroughly and fill it with distilled water. Weigh it (W_4 in g).
 - a. The specific gravity of soil is determined with the following formula.

$$G = \frac{W_2 - W_1}{(W_2 - W_1) - (W_3 - W_4)}$$

Where, W_1 =weight of Pycnometer in grams.

W_2 =weight of Pycnometer + dry soil in grams.

W_3 =weight of Pycnometer + soil + water grams.

W4=weight of Pycnometer + water grams

The specific gravity of whole mix is the average specific gravity of all solid particles present in that mix. Higher the specific gravity, higher will be the load carrying capacity of soils. The value of specific gravity for the existing soil falls in the range 2.6 to 2.75. A pycnometer allows measuring the volume and the density of solid objects in a non-destructive manner. Specific gravity test by pycnometer helps in understanding how porous the soil is or how many voids it contains, thereby we can do Standard Proctor test and California Bearing Ratio Test for finding thickness.

Table 5.2: Specific gravity determination

	Sample 1			Sample 2		
	1	2	3	1	2	3
Weight of Pycnometer, W1	662	662	662	664	664	664
Weight of Pycnometer, W1+dry soil, W2	862	859	859	864	864	864
Weight of Pycnometer, W1 +dry soil + water, W3	1.585	1.587	1.587	1.584	1.583	1.587
Weight of Pycnometer +water W4	1.457	1.457	1.457	1.457	1.457	1.457
Specific gravity= $\frac{W2-W1}{W3-W1} - \frac{W3-W4}{W2-W1}$	2.77	2.94	2.94	1.0006	1.0006	1.0006

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

	Sample 3		
	1	2	3
Weight of pycnometer, W1	663	663	663
Weight of pycnometer, W1+dry soil, W2	864	863	863
Weight of pycnometer, W1 +dry soil+ water, W3	1.587	1.395	1.603
Weight of pycnometer +water, W4	1.457	1.457	1.457

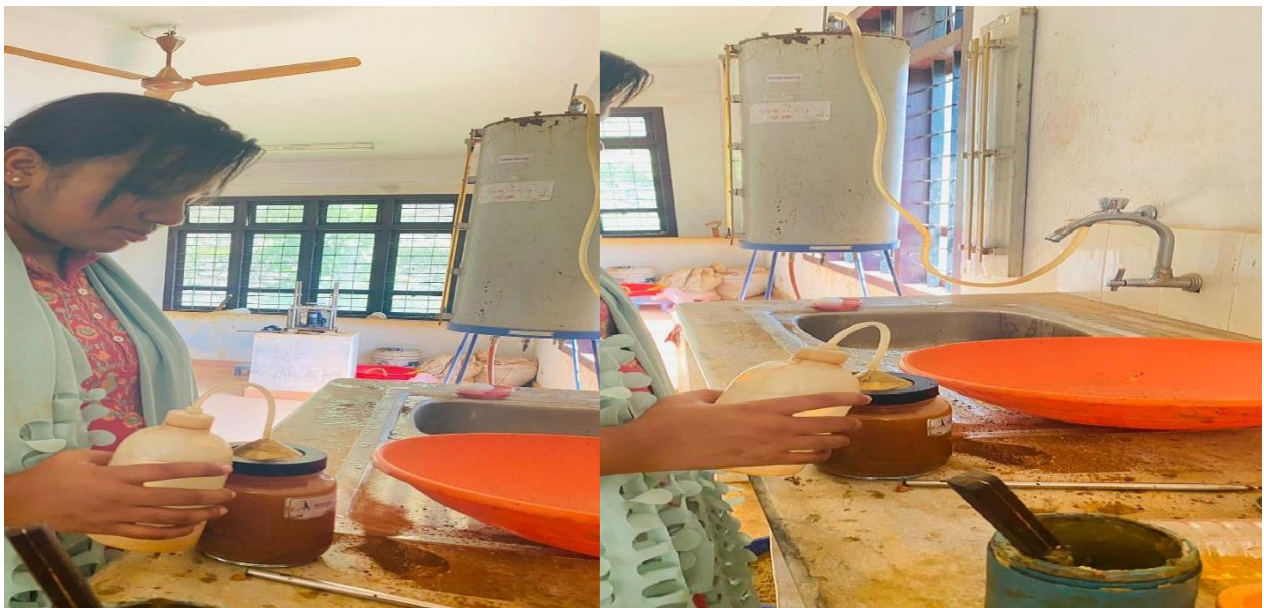


Fig 5.3: Specific gravity Determination (self taken)

5.3. STANDARD PROCTOR TEST

Standard Proctor Test is carried out to study or understand the soil's compaction characteristics with variable moisture content. The test is performed to estimate the maximum load the soil could bear hence ultimately reducing the voids present in the soil. Standard Proctor test or Proctor compaction test establishes the variation of the unit weight of soil and degree of compaction with the moisture content. It also helps us find out the optimum moisture content for the highest practical density. The Proctor compaction test is a laboratory geotechnical testing method used to determine the soil compaction properties, specifically, to determine the optimal water content at which soil can reach its maximum dry density.

The degree of the compaction depends on the soil properties, the type and amount of energy provided by the compaction process and the soil's water content. For every soil, there is an optimum amount of moisture for which it can experience its maximum compression. In other words, for a given compactive effort, a soil is reaching its maximum dry unit weight, at an optimum water content level. The standard Proctor test includes a 0.95-liter volume cylindrical mould in which the soil mass is placed and compacted in 3 layers. Each layer is compressed by dropping 25 times a 2 kg weight falling from an elevation of 30 centimeters. The Proctor compaction test consists of compacting soil samples at a given water content in a standard mould with standard compaction energy. The Proctor test can be used to determine optimum moisture content for compacting soil such as road bases.



Fig 5.4: Standard Proctor test (self taken)

5.3.1 Equipment required

We can perform a Standard Proctor test with the following equipment:

- 4-inch mould and a 2-inch-high removable collar and base
- 5.5-pound standard Proctor compaction hammer that can drop 12 inches
- Two moisture content cans
- Digital balance
- Spray bottle
- Metal spoon
- Knife
- Steel straightedge
- Large mixing pan
- Graduated cylinder (250 mL)
- Sample extractor

5.3.2. Procedure of Standard Proctor test

1. Weigh the empty mould.

Begin by weighing the Proctor mold while it's still empty. Take off the collar before you put the mold on the scale, then note the empty weight on a data sheet.

2. Record the mould height and diameter

Use a caliper to record the mold's dimensions so you can determine the volume. Take three measurements of the diameter, equally spaced, and average them together; then do the same with the height to determine an accurate measurement.

3. Transfer the soil into the large mixing pan

Obtain a sample of air-dried soil you want to measure, and weigh out approximately 3000 grams on the scale.

4. Calculate the amount of water to add to the soil

How much water you should add to the soil is determined using the following equation: First, subtract the initial moisture content (all the water trapped in the air-dried soil) from the final moisture content. Multiply the result by the weight of the soil. This will give you the weight of the water.

This can be expressed as follows:

Weight of water = weight of soil, or 2,000 grams x (final moisture content minus the initial moisture content). In one example, the final or target moisture content is 15%, and the initial moisture content is 2.5%.

For this example, the amount of water needed to add to the soil for the test is 250 mL (with mL being equivalent to grams).

5. Pour the water into the spray bottle

Take water from the tap and measure it using the graduated cylinder; once you've obtained the right amount, pour the contents into the spray bottle.

6. Spray water onto the soil

Add the water to the soil using the spray bottle, mixing the entire contents into the mixing pan and stirring the soil regularly until you get a uniform consistency and color throughout the sample. Set the sample aside for 15 to 30 minutes.

7. Secure the collar back on the mold

To prepare for the next phase of the test, place the collar back on top of the Proctor mold and secure it.

8. Place some of the soil in the compaction mold

Use the spoon to add soil to the mold until you've got enough so that, when it's compacted, it will fill just over one-third of the compaction mold.

9. Set the mold on a hard surface

Choose a sturdy surface like a concrete floor.

10. Use a Proctor hammer to compact the mold

You should space the blows evenly over the surface of the soil to ensure the entire soil sample

is evenly compacted. Drop the Proctor hammer onto the soil sample 25 times. The 5.5-pound Proctor hammer, also known as a rammer, is set at a height of 12 inches for each blow. This compaction process reduces the number of air voids in the sample.

11. Scarify the surface of the sample

Take the compacted soil back to your original working area and scarify the soil, using a spoon to make small scratches on the surface in preparation for adding a second layer of soil. This will ensure that the new layer adheres well to the first.

12. Add more soil to the top of the mold

Add more soil from the mixing pan. This time, add enough that the total amount will fill just over two-thirds of the mold's height with the collar attached when compacted.

13. Repeat steps 9 and 10

Compact the soil again on a hard surface, using the Proctor hammer as before.

14. Remove the collar

Returning to your primary work area, set the mold on a table and remove the collar. The soil should fill the entire mold and extend slightly above the rim.

15. Use the straightedge to trim excess soil

Use your straightedge to scrape off the excess soil so the surface is level with the top of the rim. You may see some voids on the surface. Fill these with some of the remaining material from your pan, and scrape again.

16. Weigh the mold without the collar

Remove any loose soil particles that have gathered on the base and weigh the mold and soil without the collar.

17. Extract the sample from the mold

Remove the base of the mold and insert the mold, still containing the soil, in the extractor. By pumping the extractor handle, you will be able to remove the soil from the mold without damaging the sample.

18. Cut the soil compact with a knife

Split the sample lengthwise with a knife, then into pieces small enough to fit in the moisture cans.

19. Weigh soil pieces from the top and bottom

Remove smaller samples from the top and bottom, placing these in the moisture cans and weighing them. Using these specific sections of the sample will help you determine the moisture.

20. Place the cans in the oven for 24 hours

Put the cans in the oven, and leave them there for 24 hours to dry. After 24 hours, you can remove them and record the dry weight of the soil. You can then calculate the dry unit weight and moisture content of the specimen.

SAMPLE 1

Table 5.3: Standard proctor test values

OBSERVATION NO.	1	2	3	4	5
Weight of Mould	3.654	3.654	3.654	3.654	3.654
Weight of mould + Compacted soil	5.789	5.558	5.64	5.714	5.725
Weight of compacted soil	1824	1904	1986	2060	2071
Bulk density ($Y=W/V$)	1.824	1.904	1.986	2.06	2.071
Water Content	0.1434	0.1634	0.1834	0.2034	0.2234
Dry Density ($Y_d=Y/1+w$)	1.595	1.636	1.678	1.711	1.69

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

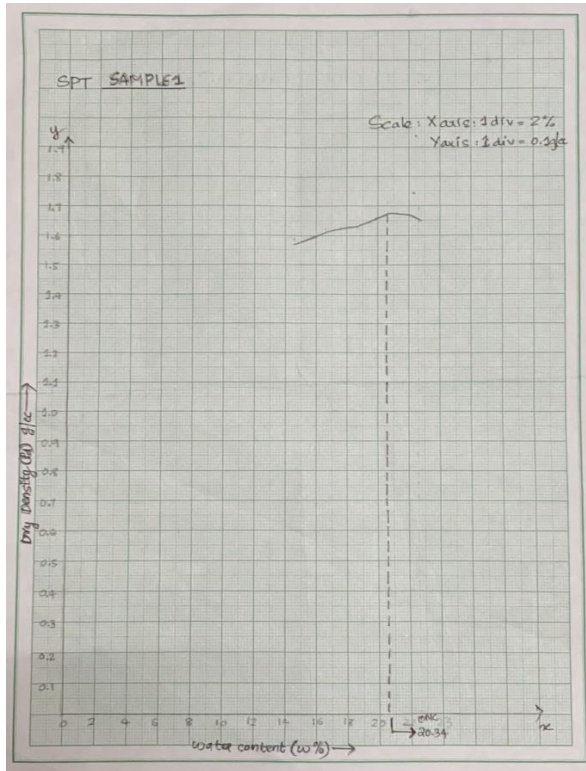
SAMPLE 2

OBSERVATION NO.	1	2	3	4	5
Weight of Mould	3.684	3.684	3.684	3.684	3.684
Weight of mould + Compacted soil	5.448	5.577	5.641	5.684	5.664
Weight of compacted soil	1764	1893	1957	2000	1980
Bulk density ($Y=W/V$)	1.764	1.893	1.957	2	1.98
Water Content	0.1507	0.1707	0.1907	0.2107	0.2307
Dry Density ($Y_d=Y/1+w$)	1.532	1.616	1.643	1.6519	1.608

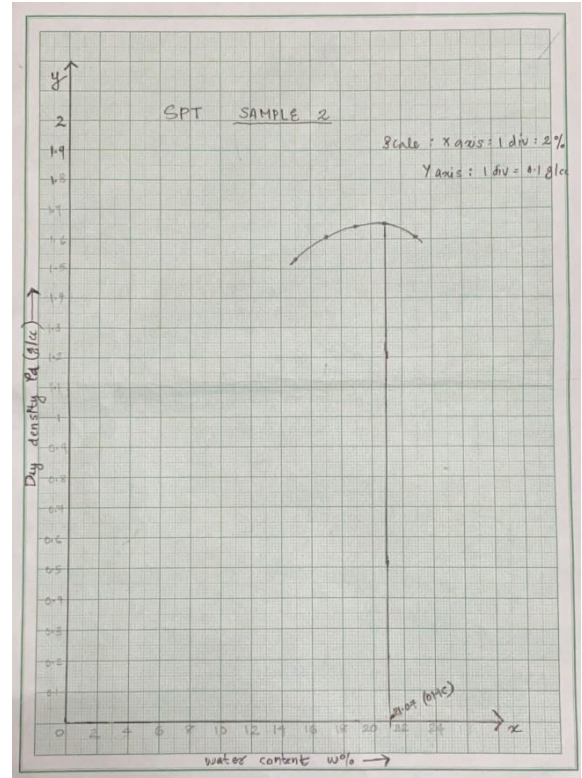
SAMPLE 3

OBSERVATION NO.	1	2	3	4	5
Weight of Mould	3.692	3.692	3.692	3.692	3.692
Weight of mould + Compacted soil	5.687	5.826	6.051	6.043	5.687
Weight of compacted soil	1.995	2.134	2.359	2.351	1.995
Bulk density ($Y=W/V$)	1.995	2.134	2.359	2.351	1.995
Water Content	7.45	9.45	11.45	13.45	7.45
Dry Density ($Y_d=Y/1+w$)	1.8566	1.949	2.116	2.072	1.8566

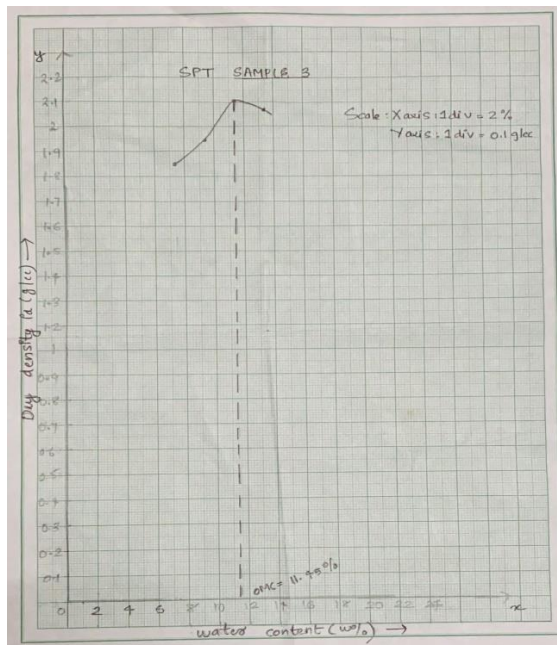
Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)



SAMPLE 1



SAMPLE 2



SAMPLE 3

Fig 5.5: Graphs of Standard Proctor test

5.4. CALIFORNIA BEARING RATIO TEST

In 1928 California Division of Highways in the USA developed CBR method for pavement design. The majority of design curves developed later are based on the original curves proposed by O. J. Parter. At the beginning of the second world war, the Corps Engineer of USA made survey of the existing method of the pavement design and adopted CBR method for designing military airport pavements. One of the chief advantages of CBR method is the simplicity of the test procedure.

The CBR tests were carried out by the California State Highway Department on existing pavement layers including subgrade, subbase and base course. Based on the extensive CBR test data collected on pavement which behaved satisfactorily and those which failed, an empirical design chart was developed correlating the CBR value and the pavement thickness. The basis of the design chart is that a material with a given CBR required a certain thickness of pavement layer as a cover. A higher load needs a thicker pavement layer to protect the subgrade. Design curves correlating the CBR value with initial pavement thickness cover were developed by California State Highway Department for wheel loads of 3175 kg and 5443 kg representing light and heavy traffic. Later the design curve for 4082 kg wheel load was obtained by interpolation for medium traffic

5.4.1 Objective

CBR is the ratio expressed in percentage of force per unit area required to penetrate a soil mass with a standard circular plunger of 50 mm diameter at the rate of 1.25 mm/min to that required for corresponding penetration in a standard material. The ratio is usually determined for penetration of 2.5 and 5 mm. When the ratio at 5 mm is consistently higher than that a value, then 5 mm value is taken. The following table gives the standard loads adopted for different penetrations for the standard material with a C.B.R. value of 100%.

Table 5.4. Standard load values at penetration

Penetration of Plunger (mm)	Standard Load (kg)
2.5	1370
5.0	2055

For Railway Formation purpose, the test is performed on remoulded specimens which are compacted dynamically.

The methodology covers the laboratory method for the determination of C.B.R. of remoulded /compacted soil specimens in soaked state.

5.4.2. Apparatus Required

5.4.2.1. CBR Test Apparatus

Consisting of Loading machine with capacity of at least 5000 kg and equipped with a movable head or base which enables Plunger of 50 mm dia. to penetrate into the specimen at a rate of 1.25 mm/ minute.



Fig 5.6: CBR Test Apparatus(google)

5.4.2.2. CBR Mould with Base Plate, Stay Rod and Wing Nut

Cylindrical mould of Inside dia. 150mm and height 175mm with a detachable perforated base plate of 235mm dia. and 10mm thickness. Net capacity - 2250 ml; conforming to IS-9669:1980 (Reaffirmed-2016). Detachable extension collar of 60 mm height, Spacer Disc 148 mm in diameter and 47.7 mm in height along with handle.

One annular metal weight and several slotted weights weighing 2.5 kg each, 147 mm in diameter, with a central hole 53 mm in diameter.



Fig 5.7: C.B.R Mould(google)

5.4.2.3: Weights

Compaction Rammer with weight 4.89 kg with a drop 450 mm.



Fig 5.8: Weights in C.B.R.(google)

5.4.3. Procedure

5.4.3.1. Preparation of Test Specimen:

1. Remoulded specimens are prepared in the laboratory by compaction. The material used in the remoulded specimen shall pass 19 mm I.S. sieve. Allowance for large material shall be made by replacing it by an equal amount of material which passes a 19mm I.S. Sieve but is retained on 4.75 mm sieve.
2. The dry density for a remoulding shall be either the field density or the value of the maximum dry density estimated by the compaction test (Heavy Compaction Test as per IS 2720 (Part-8) - 1983, for Railway Formation). The water content used for compaction shall be the optimum water content or the field moisture as the case may be.
3. Dynamic Compaction: A representative sample of the soil weighing approximately 4.5 kg or more for fine grained soil and 5.5 kg or more for granular soil shall be taken and mixed thoroughly with water. If the soil is to be compacted to the maximum dry density at the optimum moisture content, the exact mass of the soil required shall be taken and the necessary quantity of water added so that the water content of the soil sample is equal to the determined optimum moisture content.
4. Fix the extension collar and the base plate to the mould. Insert the spacer disc over the base. Place the filter paper on the top of the spacer disc.

5. Apply Lubricating Oil to the inner side of the mould. Compact the mix soil in the mould using heavy compaction. i.e. compact the soil in 5 layers with 55 blows to each layer by the 4.89 kg rammer.
6. Remove the extension collar and trim the compacted soil carefully at the level of top of mould, by means of a straight edge. Any holes developed on the surface of the compacted soil by removal of the coarse material, shall be patched with the smaller size material. Remove the perforated base plate, Spacer disc and filter paper and record the mass of the mould and compacted soil specimen. Place a disc of coarse filter paper on the perforated base plate, invert the mould and compacted soil and clamp the perforated base plate to the mould with the compacted soil in contact with the filter paper.
7. Place a filter paper over the specimen and place perforated plate on the compacted soil specimen in the mould. Put annular weights to produce a surcharge equal to weight of base material and pavement, to the nearest 2.5 kg.
8. Immerse the mould assembly and weights in a tank of water and soak it for 96 hours. Mount the tripod for expansion measuring device on the edge of the mould and record initial dial gauge reading. Note down the readings every day against time of reading. A constant water level shall be maintained in the tank throughout the period.
9. At the end of soaking period, note down the final reading of the dial gauge and take the mould out of water tank.
10. Remove the perforated plate and the top filter paper. Weigh the soaked soil sample and record the weight.

5.4.3.2. Procedure for Penetration Test

1. Place the mould assembly with test specimen on the lower plate of penetration testing machine. To prevent upheaval of soil into the hole of the surcharge weights, 2.5 kg annular weight shall be placed on the soil surface prior to seating the penetration plunger after which the remainder of the surcharge weights shall be placed.
2. Seat the penetration piston at the center of the specimen with the smallest possible load, but in no case in excess of 4 kg so that full contact of the piston on the sample is established.
3. Set the load and deformation gauges to read zero. Apply the load on the piston so that the penetration rate is about 1.25 mm/min.
4. Record the load readings at penetrations of 0.5, 1.0, 1.5, 2.0, 2.5, 4.0, 5.0, 7.5, 10 and 12.5 mm.

5. Raise the plunger and detach the mould from the loading equipment. Take about 20 to 50 g of soil from the top 30 mm layer and determine the moisture content.

6. Observation and Recording

5.4.4. Recordings during CBR Test

Table 5.5: Recordings at C.B.R Test

SAMPLE 1

PENETRATION	NO. OF DIVSIONS	CORRESPONDING LOAD
0	0	0
0.5	0/0/4 = 4	193.61
1	0/1/0 = 5	242.01
1.5	0/1/4 = 9	435.61
2	0/1/5 = 10	484.02
2.5	0/2/2 = 12	580.824
4	0/3/4 = 19	919.638
5	0/4/3 = 23	1113.246
7.5	0/6/4 = 34	1645.668
10	0/8/2 = 42	2032.884
12.5	0/10/0 = 50	2420.1

SAMPLE 2

PENETRATION	NO. OF DIVISION	CORRESPONDING LOAD
0	0/0/0	0
0.5	0/0/3	145.2
1	0/1/0	242.01
1.5	0/1/1	290.41
2	0/1/2	338.81
2.5	0/1/5	484.02
4	0/2/3	629.23
5	0/3/1	774.44
7.5	0/4/0	968.05
10	0/5/1	1258.47
12.5	0/6/1	1500.48

SAMPLE 3

PENETRATION	NO: OF DIVISION	CORRESPONDING LOAD
0	0/0/0	0
5	0/0/4	193.61
1	0/2/0	484.02
1.5	0/3/3	871.24
2	0/5/3	1355.27
2.5	0/8/0	1936.1
4	0/15/0	3630.2
5	0/19/2	4595.06
7.5	1/5/2	4211.03
10	1/16/2	6873.18
12.5	2-7-01	7550.82

5.4.5. Calculation

If the initial portion of the curve is concave upwards, apply correction by drawing a tangent to the curve at the point of greatest slope and shift the origin. Find and record the correct load reading corresponding to each penetration.

$$\text{C.B.R.} = (\text{PT}/\text{PS}) \times 100$$

where PT = Corrected test load corresponding to the chosen penetration from the load penetration curve.

PS = Standard load for the same penetration taken from the table above.

C.B.R. of specimen at 2.5 mm penetration =

C.B.R. of specimen at 5.0 mm penetration =

The C.B.R. values are usually calculated for penetration of 2.5 mm and 5 mm. Generally, the C.B.R. value at 2.5 mm will be greater than at 5 mm and in such a case/the former shall be taken as C.B.R. for design purpose. If C.B.R. for 5 mm exceeds that for 2.5 mm, the test should be repeated. If identical results follow, the C.B.R. corresponding to 5 mm penetration should be taken for design.

7. Graph

5.4.6. Graph between Load versus Penetration.

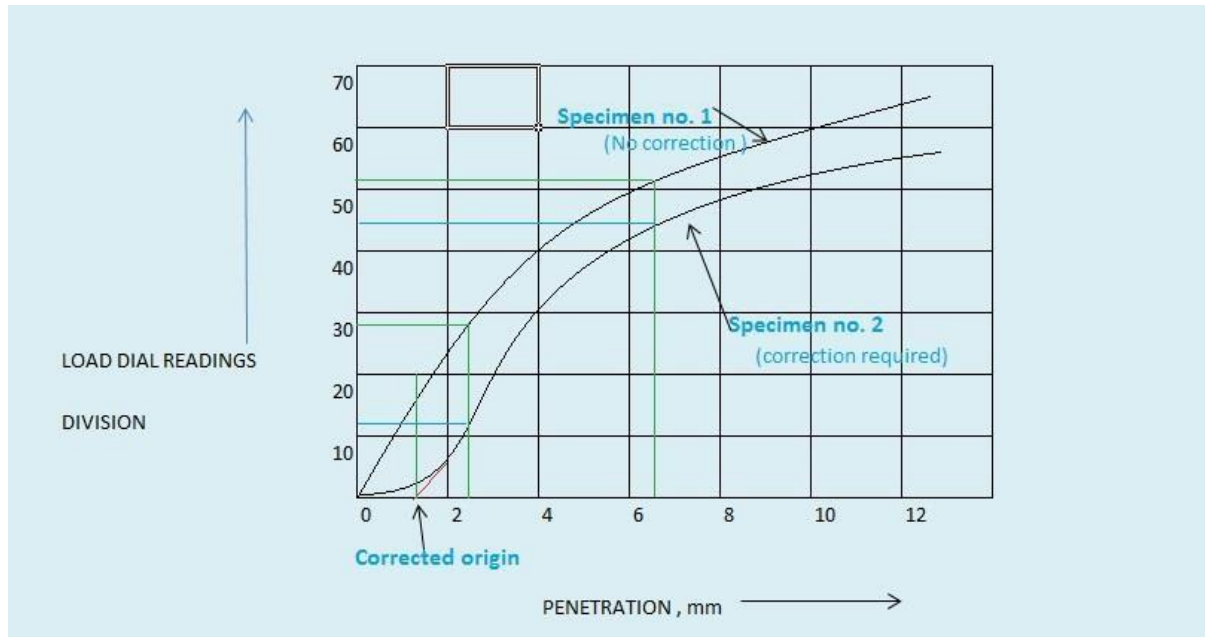
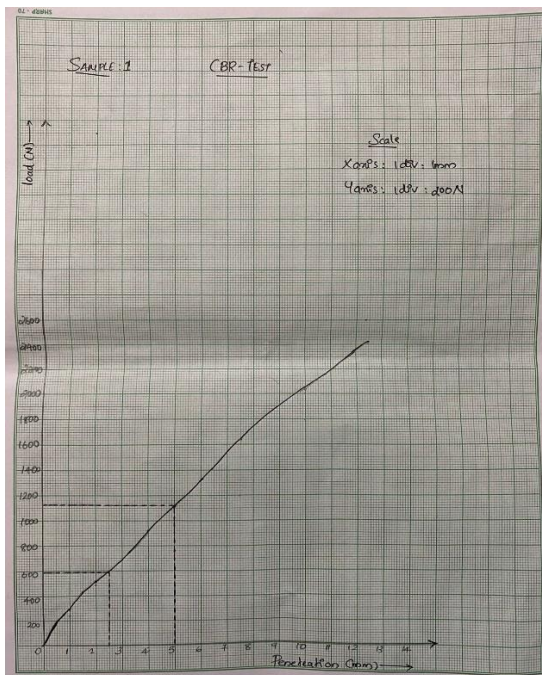
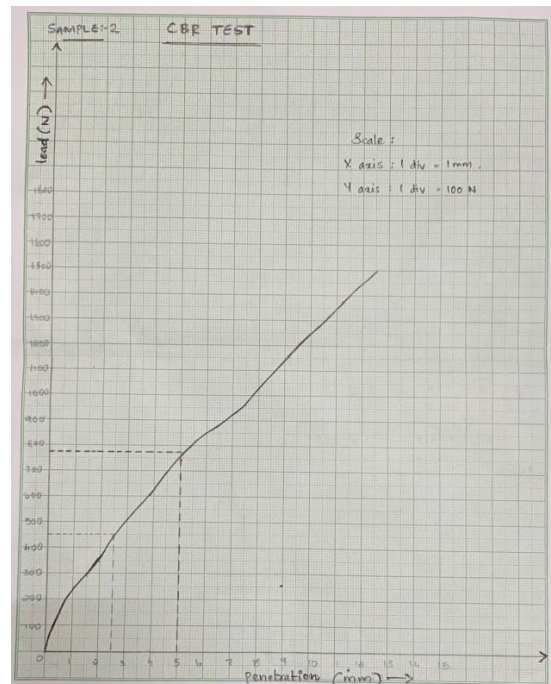


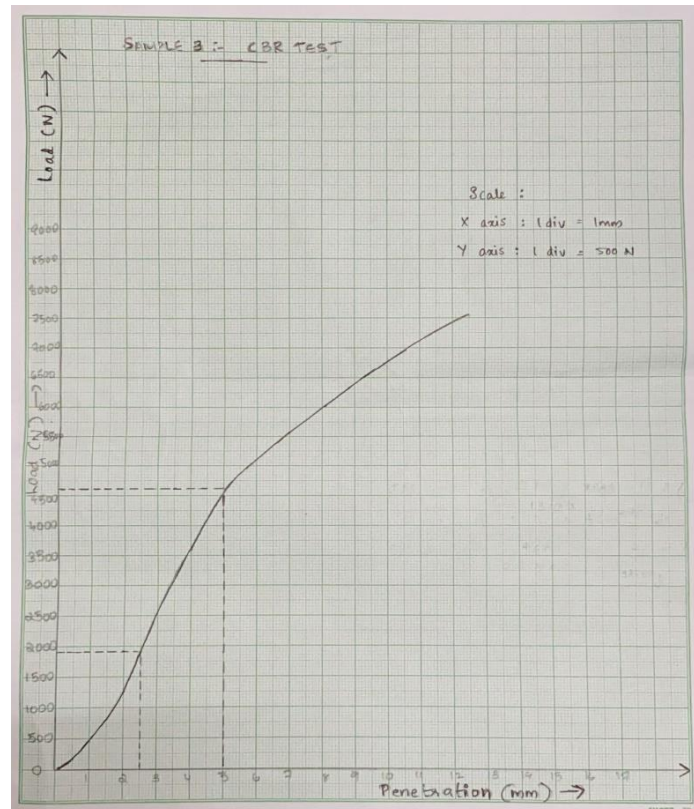
Fig. 5.9: Plot of Load versus Settlement (Google)



SAMPLE 1



SAMPLE 2



SAMPLE 3

Fig. 5.10: Graphs of C.B.R Test

The Indian Road Congress has recommended a CBR design chart for tentative use in India. Different curves A, B, C, D, E, F, G have been given based on the volume of commercial vehicles.

5.4.7. Pavement thickness Determination

In order to design a pavement by CBR method, first the soaked CBR value of the soil subgrade is evaluated. Then by taking the anticipated traffic into consideration (as given in 6.2.1). Thus, the total thickness of the flexible pavement needed to cover the subgrade of the known CBR value is obtained. In the case there is a material superior than the soil subgrade, such that it may be used as a sub base course then the thickness of construction over this material could be obtained from the design chart knowing the CBR value of the sub base. Thickness of the sub base course is the total thickness minus the thickness over the sub case.

The CBR method is flexible pavement design is based on the strength parameters of subgrade soil and subsequent pavement material.

5.4.8. IRC Recommendation

Some of the important points recommended by the IRC for the CBR method of design (IRC:37-1970) are given below.

(a) The CBR tests should be performed on remoulded soils in the laboratory. In-situ tests are not recommended for design purpose. The specimens should be prepared by static compaction wherever possible and otherwise by dynamic compaction. The standard test procedure should be strictly adhered to.

(b) For the design of new roads, the subgrade soil sample should be compacted at OMC, to proctor density whenever suitable compaction equipment is available to achieves this density in the field; otherwise, the soil sample may be compacted to dry density expected to be achieved in the field. In the case of existing roads, the sample should be compacted to field density of the subgrade soil (at OMC or at a field moisture content)

(c) In new construction the CBR test samples may be soaked in water for four days period before testing. However, in areas with arid climate or when the annual rainfall is less than 50 cm and the water table is too deep to affect the subgrade adversely and when thick and impermeable bituminous surfacing is provided, it is not necessary to soak the soil specimen before carrying out CBR test. Whenever possible the most adverse moisture condition of the subgrade should be determined from the field study.

(d) At least three samples should be tested on each type of soil at the same density and moisture content. If the maximum variation in CBR values of the three specimens exceed the specified limits, the design CBR should be the average of at least six samples. (The specified limits of max variation in CBR are 3% for CBR values up to 10 % 5 for values 10 to 30 and 10% for values 30 to 60%).

(e) The top 50 cm of subgrade should be compacted at least up to 95 to 100% of proctor density;

(f) An estimate of the traffic to be carried by the road pavement at the end of expected life should be made keeping in view the existing traffic and probable growth rate of traffic.

Pavement of major roads should be designed at least for 10 years life period and the following formula may be used in such cases for estimating the design traffic

Where A = Number of heavy vehicles per day for design (laden weight > 3 tones)

P = Number of heavy vehicles per day at least count

t = Annual rate of increase of heavy vehicles.

Pavement design for the conversion of 2 lane to 6 lane road of Thuravoor Thekku to Paravoor road (NHAI)

n = Number of years between the last count and the year of completion of construction.

The value of P in the formula should be the seven-day average of heavy vehicle found from 24 hours counts. If the reliable value of growth factor r is not available a value of 7.5% may be assumed for roads in Rural areas.

(g) The traffic for the design is considered in units of heavy vehicles (of laden weight exceeding 3 tons) per day in both direction and are divided into 7 categories A to G. The suitable design curve should be chosen from the Table given in the design chart, after estimating the design traffic. The design thickness is considered applicable for single axle loads up to 8200 kg and tandem axle loads up to 14500 kg. For higher axle loads, the thickness values should be further increased.

(h) When sub base course materials contain substantial proportion of aggregates of size above 20mm, the CBR value of these materials would not be valid for the design of subsequent layers above them. Thin layer of wearing course such as surface dressing or open graded premixed carpet up to 2.5cm thickness should not be counted towards the total thickness as they do not increase the structural capacity as the pavement.



Fig 5.11: C.B.R Test (self taken)

CHAPTER 6

PAVEMENT THICKNESS

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favorable light reflecting characteristics, and low noise pollution. The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the subgrade. Basically, all hard-surfaced pavement types can be categorized into two groups, flexible and rigid. Flexible pavements are those which are surfaced with bituminous (or asphalt) materials and a rigid pavement has concrete surface. This gives an overview of pavement types, layers and functions as well as the cost analysis. Most of the Indian highways system consists of flexible pavement; there are different methods of design of flexible pavement. The California Bearing Ratio (CBR) test is an empirical method of design of flexible pavement design. It was developed by the California Department of Transportation before World War II. Flexible pavement design by CBR method is used to determine the total thickness of pavement. Generally, CBR method of flexible pavement design is based on the strength parameter of subgrade soil. there are two methods to design the pavement from CBR (California bearing ratio) value. They are 1. CBR method recommended by California state of highways 2. CBR method recommended by IRC.

6.1 CBR method recommended by IRC (Indian road congress):

In this method, the chart contains several curves (A, B, C, D, E, F, and G) which represents the different levels of traffic intensities. Based on this we will find out the layer's thicknesses.

Data required for design:

- a. CBR value of soil subgrade,
- b. Traffic intensity

6.2. Flexible Pavement Design Procedure:

Calculation of total thickness (T): In this step, firstly for the given value of traffic intensity select appropriate curve from classification table which is shown in the below chart. Now, from the calculated CBR value of subgrade soil take the total thickness (T) with respect to selected curve. CBR is a widely used method to design the flexible pavements, beside all the limitations it is easy to perform and still does not need any big instruments etc.

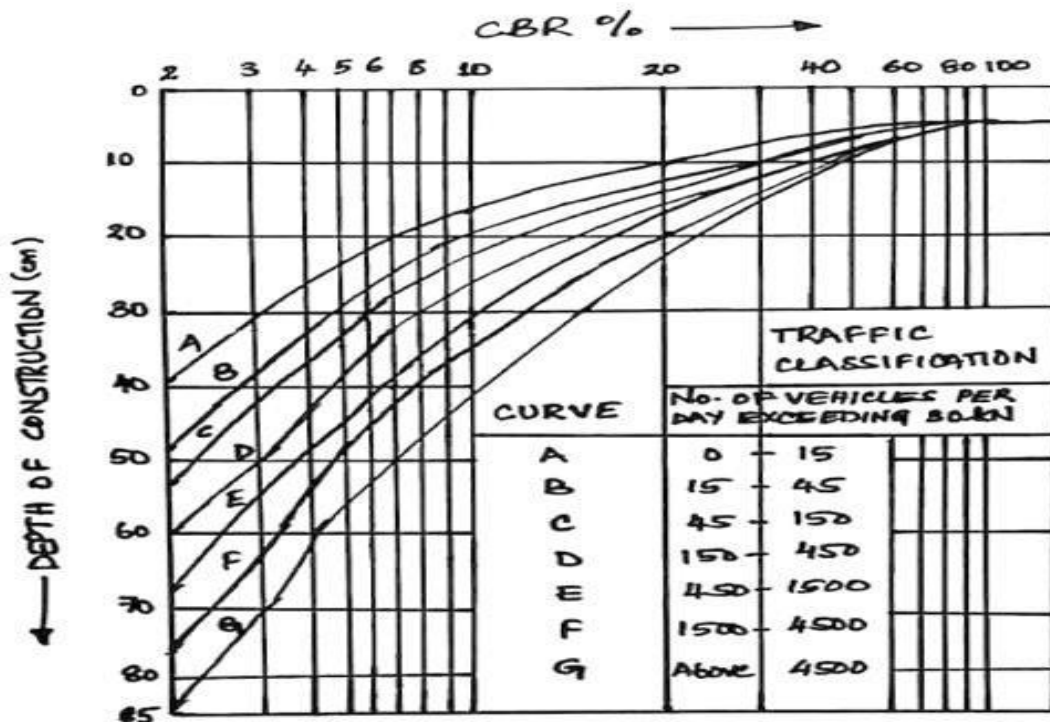


Fig 6.1: C.B.R Design Chart (Recommended by IRC)

All the traffic volume data is collected from the project done by previous year students who have done project at NHAI. We have identified that the traffic classification of these three samples come under the curve F (Fig 6.2.1).

Table 6.1: Depth of construction

SAMPLE PLACE	CBR %	DEPTH OF CONSTRUCTION ABOVE SUBGRADE SOIL
THURAVOOR THEKKU	4.3%	53cm
S.N COLLEGE CHERTHALA	3.28%	63cm
PARAVOOR	13.8%	30cm

Above all 63cm i.e., 630 mm is the highest value therefore we suggest a pavement thickness of 630mm above the subgrade soil from Thuravoor Thekku to Paravoor (Chainage 379+100 to 417+ 000).

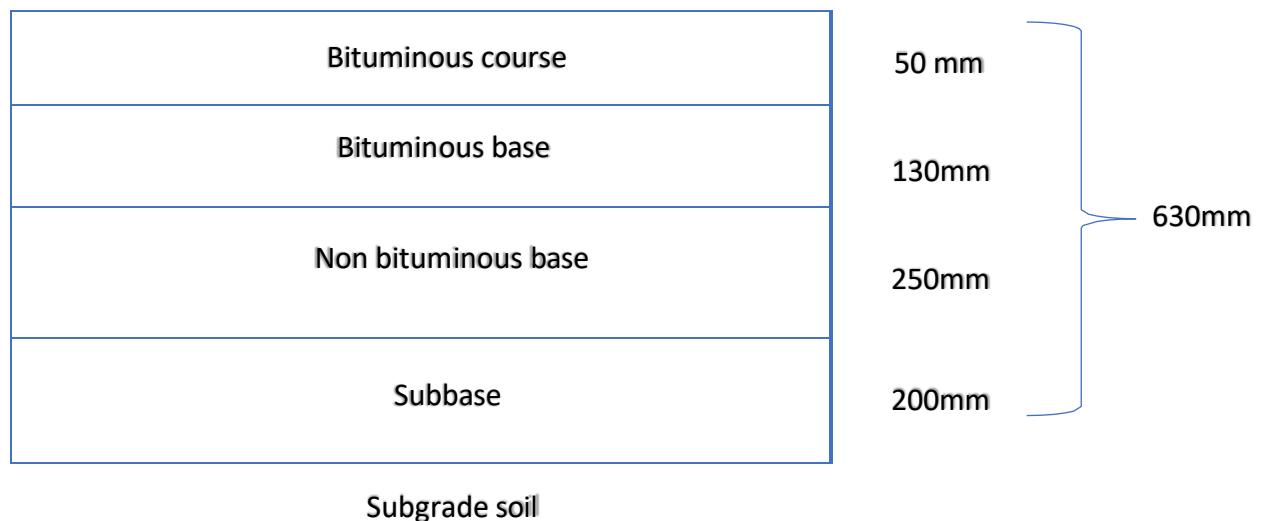


Fig 6.2: Layers above the subgrade soil (Drawn)

CHAPTER 7

PAVEMENT DESIGN

Pavement design is the major component in the road construction. Nearly one-third or one-half of the total cost of construction, so careful consideration should be taken in design of pavement.

7.1. Pavement components

7.1.1. Subgrade:

The sub grade is a layer of natural soil prepared to receive the layer of pavement materials placed over it. The loads on the pavement are ultimately received by the soil sub grade for dispersion to the earth mass. It is essential that at no time, the soil sub grade is *Over stressed*. It means that the pressure transmitted on the top of the sub grade is within the allowable limit, not to cause excessive stress condition or to deform the same beyond the elastic limit. Therefore, it is desirable that at least top 50 cm layer of the subgrade soil is well compacted under controlled condition of optimum moisture content and maximum dry density. It is necessary to evaluate the strength properties of the soil sub grade. This helps the designer to adopt the suitable values of the strength parameter for design purpose and in case this supporting layer does not come up to the expectation, the same is treated or stabilized to suit the requirement. Main functions of subgrade soil are:

- To provide support to the pavement as its foundation.
- Top 30 cm of the cutting or embankment at formation level in rural roads consider as subgrade.
- A minimum of 100% of standard proctor compaction should be attain in subgrade.
- For clayey soil 95% and moisture content of 2% in excess of optimum value.
- Soil below subgrade should be compacted to 97% of standard proctor compaction.

7.1.2. Sub-base course:

These layers are made of broken stones, bounds or unbound aggregate. Some times in sub base course a layer of stabilized soil or selected granular soil is also used. In some places boulder stones or bricks are also used as sub base or soiling course. However, at the sub base course, it is desirable to use smaller size graded aggregate or soil aggregate mixes or soil aggregate instead of large boulder stone soiling course of brick on edge soiling course, as these have no

proper interlocking and therefore have lesser resistance to sinking into the weak sub grade soil when wet. When the sub grade consists of fine-grained soil and when the pavement carries heavy wheel loads, there is a tendency for these boulder stones or brick to penetrate into the wet soil, resulting in the formation of undulation and uneven pavement surface in the flexible pavement. Sub base course primarily has the similar function as of the base course and is provided with inferior materials than of base course. The functions of these base course vary according to type of pavement. Selected materials placed on subgrade which is compacted to 98% of IS heavy compaction. Function of sub-base is to distribute the stresses over a wide area of the subgrade imposed by the traffic. Materials:

- CBR of 15%
- Passing through 425 microns IS sieve
- L.L<25 and P.I <6

Waste material such as Fly ash, Iron and steel slag Recycled concrete Municipal waste are also used. When subgrade is silty or clayey soil and annual rainfall of area is more than 1000 mm, a drainage layer of 100 mm then formation width should be provided. Granular Sub-base (GSB) consists of laying and compacting well graded material on prepared sub-grade in accordance with the specifications.: GSB layer is intermediate layer in between Sub-grade and Wet mix macadam. GSB layer is laid in roads and highway works due to its properties.

7.1.3. Base course: to with stand high stress concentrations which develop due to traffic under the wearing surface. Different types of base course used are:

1. WBM
2. Crusher-run macadam
3. Dry lean concrete
4. Soft aggregate base course
5. Lime-fly ash concrete

Here we use Wet Mix Macadam (WMM), it consists of laying spreading and compacting of clean, crushed, well-graded granular materials on a prepared and approved Granular sub-Base. The material is well mixed with water and rolled to a dense mass.it is the non-bituminous base layer.

Dense Bituminous Macadam (DBM) is used as bituminous base layer. Base course layer in a bituminous pavement consists of mineral aggregates such as gravel, stones and sands bonded together with bituminous materials. This layer is used as the foundation on which surface course or binder is placed. It is binder course used for roads with a greater number of heavy commercial vehicles and a close-graded premix material having a voids content of 5-10 per cent.

7.1.4. Surface Course:

It consists of binder course and surface layer.

Binder course layer is an intermediate layer between base course and surface layer. It is the first layer in case of two-layer bituminous resurfacing. Bituminous binder course is made of bituminous-aggregate mixture, also called as levelling course. Its function is to distribute the load from the surfacing into the base course.

The surface course is the upper layer in roadway. The term 'wearing course' is sometimes used, however this term is slightly different as it can be used to describe very thin surface layers such as chip seal. In flexible pavements, the upper layer consists of asphalt concrete, that is a construction aggregate with a bituminous binder. The wearing course is typically placed on the binder course which is then laid on the base course, which is normally placed on the subbase, which rests on the subgrade. The purpose of the wearing course is to give a smooth riding surface that is dense. It resists pressure exerted by the tyres and takes up wear and tear due to traffic. Wearing course has offers a water tight layer against the surface water infiltration. In flexible pavement, normally acts like a base course as well as wearing courses. There are many types of surface treatments employed as wearing course. The type of surface depends up on the availability of material plants and equipment and up on the magnitude of surface loads There are various different types of flexible pavement wearing course, suitable for different situations. Thickness of surface course depend upon the traffic volume and type of material used for it. For gravel roads extra thickness should be provided because of lost in thickness due to the traffic action. Bituminous wearing courses must be made up of good quality aggregate with aggregate impact value not exceeding 30 % in order to reduce degradation of aggregates by crushing. There is no test for evaluating the structural stability of the wearing course. However, the bituminous mixes used in the wearing course are tested for their suitability otherwise. The term stability is as associated with such evaluation. Most

popular test use is Marshall stability test where in the optimum content of bitumen binder is worked out based on the stability density, VMA and VFB of the given grading of the aggregate mixtures. The test has been discussed in article 6.4.2. Plate bearing test beam test are also sometimes made use of for evaluating the wearing course and the pavement as a whole.

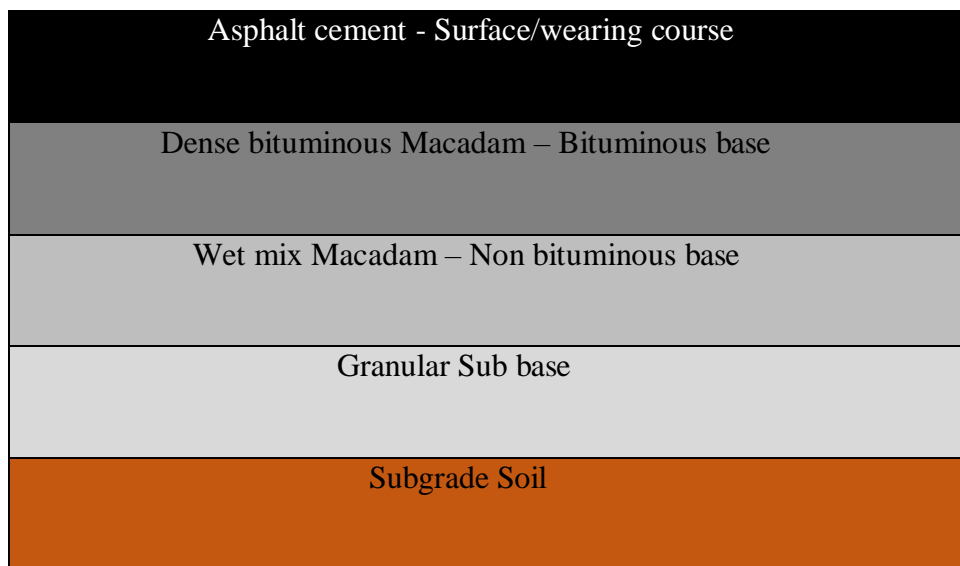


Fig 7.1: Pavement layer composition

CHAPTER 8

STABILIZING AGENT

In developing countries like India, the biggest handicap to provide a complete network of road system is the limited finances available to build road by the conventional methods. Therefore, there is a need to resort to one of the suitable methods of low-cost road construction followed by a process of stage development of the roads to meet the growing needs of the road traffic. Thus, apart from affecting economy in the initial construction cost of lower layers of the pavement such as sub-base course it should be possible to upgrade the low-cost roads to higher specification at a later date without involving appreciable wastage, utilizing the principle of pavement construction in stages.

The construction cost can be considerably decreased by selecting local materials including local soil for construction decreased by selecting local materials including local soil for the construction of the lower soil for the construction of the lower pavement such as sub -course. if the stability of the local soil is not adequate for supporting wheel loads, the properties are improved by soil stabilization techniques. Thus, the principle of soil stabilized road construction involves the effective utilization of local soils and other suitable stabilization agents.

8.1. Mechanics of soil stabilization

The term soil stabilization means the improvement of the stability bearing power of the soil by the use of controlled compaction; proportioning and or the addition of suitable admixture or stabilizer. soil stabilization deals with physical physio-chemical and chemical methods to make the stabilized soil serve its purpose as pavement component material. The basic principle in soil stabilization may be stated as:

- (a) Evaluating the properties of given soil
- (b) Deciding the method of supplementing the lacking property by the effective and economical method of stabilization
- (c) Designing the stabilized soil mix for intended stability and durability
- (d) Considering the construction procedure by adequately compacting the stabilized layer

Soil stabilization may result in any one or more of the following changes:

- (1) increase in stability, change in the properties like density or swelling, change in physical characteristics
- (2) change in chemical properties
- (3) retaining and desired minimum strength by water proofing

8.2. Investigation for soil stabilized roads

The various field and laboratory investigations needed for soil stabilized road construction may be listed as

- (1) Investigation of route and alignment
- (2) Soil survey and field identification of soil
- (3) Survey for availability of materials and transportation
- (4) Laboratory tests on soil
- (5) Soil classification

8.3 Soil stabilization methods

The methods of soil stabilization which are in common use are:

- (1) Mechanical soil stabilization
- (2) Soil – cement stabilization
- (3) Soil -lime stabilization
- (4) Soil- bitumen stabilization

8.3.1. Mechanical soil stabilization

Correctly proportioned material (aggregate and soil) when adequately compacted to get a mechanically stable layer, the method is called mechanical stabilization. Thus, the two-basic principle in this method of stabilization are:

- (1) Proportioning
- (2) Compaction

8.3.2 Soil – Cement Stabilization

Soil – cement is an intimate mix of soil, cement and water which is compacted to form a strong base course. Cement treated or cement modified soil refers to the

compacted mix when cement is used in small proportions to impart some strength or to modify the properties of the soil .

In granular soil, the mechanism of stabilization is due to the development of bond between the hydrated cement and the compacted soil particles at the point of contact. In fine grained soil the stabilization is due to reduction in plasticity and formation of matrix enclosing small clay lumps. Degree of stabilization depends on the nature of soil, proportion of cement compacting moisture cement and the dry density of the compacted mix. By the increasing percentage of cement added, there is an increase in the strength and durability of soil-cement and a decrease in volume change, moisture movement and plasticity.

8.3.3. Soil – Lime Stabilization

Soil lime has been widely used either as a modifier for clayey soil or as a binder. Several cases both actions of lime may be observed. When clayey soils with higher plasticity are treated with lime, the plasticity index is decreased and the soil becomes friable and easy to be pulverized, having less affinity with water. All these modifications are considered desirable for stabilization work. Lime also imparts some binding action even in granular soils. In fine grained soils there can also be pozzolanic action resulting in added strength.

8.3.4. Stabilization of soil using bituminous materials

The basic principles in bituminous stabilization are water proofing and binding. By water proofing the inherent strength and the other properties of the soil could be retained. In case of the cohesionless soils the binding, action is also important. Generally, both binding and water proofing actions are provided to soil. In granular soil the coarser grains may be individually coated and stuck together by a thin film of bituminous materials. But in fine grained soils bituminous materials plug up the voids between small soil clouds, thus water proofing the compacted soil- bitumen. Most commonly used materials are cut back and emulsion. As heating of large quantities of soil and bitumen is not possible, a suitable grade of cutback is chosen depending upon the climatic conditions and mixing problems. Emulsions also may be used, especially in places when there is scarcity of water for construction purposes. After the soil-bitumen (cut back or emulsion) is compacted, the layer is cured during which the water and volatiles evaporate and the mix hardens. Bituminous stabilized layer may be used as a sub-base or base course of ordinary roads and even as surface course for roads with low fall regions.

Dept. of Civil Engineering, Viswajyothi College of Engineering and Technology, Vazhakkulam

CHAPTER 9
RESULT AND DISCUSSION

- OMC of the three samples are 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.

CHAPTER 10

CONCLUSION

For NH-66 (Thuravoor Thekku to Paravoor) Alappuzha it is very necessary to determine the pavement thickness, since the soil is too weak. We have determined pavement thickness by inter-related soil test such as oven dry test, Pycnometer method, Standard proctor test and C.B.R Test. The value of water content is used in specific gravity test, specific gravity value is used to determine the dry density, from this standard proctor test is done and O.M.C determined from the S.P.T graph is used to do the C.B.R Test. This value of the C.B.R is used to determine the pavement thickness. Among the three samples first one is medium soil, second is weak soil and third is strong soil and we got the thickness as 53cm, 63cm, 30cm respectively. Among these 3 values the 2nd one is weak and need more thickness i.e. 63 cm so we suggest 63 cm pavement thickness for the stretch. Since the soil is weak, we suggest to use stabilizing agent such as Fly ash, cement, Lime or bitumen.

REFERENCE

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VISWAJYOTHITM

COLLEGE OF ENGINEERING & TECHNOLOGY

Approved by AICTE New Delhi & Affiliated to APJ Abdul Kalam Technological University

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LIGHT UP - Spread Light In Darkness

IEEE AP-S and IEEE HAC: AP-S-Relevant Technology for Local Community Challenges

IEEE VJCET SB

SHARON ALICEA D

Mr. Anish Jose

Viswajyothi College of Engineering
Ernakulam, Kerala 686670

anishmj@ieee.org
O: 94471 22163

Application Form

Administrative Information

Primary Applicant Name:*

ANISH M JOSE

Primary Applicant Email:*

anishmj@ieee.org

Primary Applicant is affiliated with which IEEE OU:*

IEEE VJCET SB, Viswajyothi College Of Engineering And Technology

Primary Applicant IEEE Member Number:*

95412652

Primary Applicant IEEE Member Grade:*

Please note that the primary applicant must be an IEEE Member or higher grade.

Member

Co-Applicant Name:

ANJALY SAJI

Co-Applicant Email:

anjalysaji00@ieee.org

Co-Applicant is affiliated with which IEEE OU:

IEEE VJCET SB, Viswajyothi College Of Engineering and Technology

Co-Applicant IEEE Member Number:

96173819

Co-Applicant IEEE Member Grade:

Student Member

Project Name*

LIGHT UP - Spread Light In Darkness

In what country will your project take place?*

If more than one country, please select the primary country, or country where you will begin implementation.

India

Funding requested in USD*

Awards of up to US\$3,000 will be made to selected projects that present a convincing plan to a) understand the real needs of a local community or local stakeholder organization and b) complete in no more than six months' time a pilot project utilizing AP-S-relevant technology to address those local community challenges. (Funding up to US\$ 5,000 may be approved for convincing projects on pressing issues challenging an underserved community.)

\$4,998.74

IEEE Organizational Unit (Section)*

Which IEEE Section is acting as the fiscal agent to receive approved funding? Please do not list an AP-S Chapter.

IEEE KERALA SECTION

OU Contact (Section Chair):*

Ms. Mini Ulanat

OU Contact (Section Chair) Email:*

miniu@ieee.org

SECTION 1: Project Overview and Background**Which of the following areas does your project address:***

- Information and Communications Technology (ICT)
- Sensors
- Sustainable Power Sources
- Other issue of pressing community need

If you selected "Other issue of pressing community need" in the previous question, please explain.

Humanitarian need of community

Request category:*

Is this a new submission or a request for additional funds for replication/scaling of a completed AP-S or HAC project?

New Submission

Additional IEEE HAC Funding Opportunities:

Have you or another member of your project team submitted any proposal (for this project or another project) to another IEEE HAC Projects funding opportunity? This could include the IEEE Region 10 and HAC Call for Proposals or the IEEE EDS and HAC Call for Proposals, or the HAC/SIGHT Calls for Proposals. If so, please state the title of the other proposal.

N/A

Executive summary of project, including location, needs, and intended solution.*

If this is a request for additional funds, please include your project number (if applicable) and summarize the results of your successfully executed HAC/SIGHT COVID project or AP-S project.

As a part of IEEE APS and IEEE HAC project call we the volunteers of IEEE SB VJCET and IEEE SIGHT VJCET under the guidance of local government visited the forest area of Pooyamkutti, Kuttampuzha Grama Panchayath. We took a survey on all the issues faced by the people. There are 250 families living in the forest. Most of them work for daily wages outside the forest, and they reach their home late during the night which includes women and men. For them reaching their community through the scary forest is very difficult. There is not even one street light throughout their journey. We feel that this was a basic necessary to provide safety in night. We discuss the issue with the volunteers. So we are here with LIGHT UP - Spread Light In Darkness. The aim of our project is to set a smart street light system in the forest which uses solar energy and works on IoT implemented using wireless communication. The primary and main advantage of IoT is monitoring. IoT mainly aids to be helpful to people in their daily life by making their devices communicate with each other in an efficient manner thereby they will be receiving alert messages about the production of solar energy, working of street lights, efficient time of light, battery life term and also alert messages will be send through mobile application incase of any issues with the production of light by the street light. The use of wireless communications enable our systems to be more efficient as the chance of them getting affected by natural calamities as other site is a forest area and we have possibilities of natural calamities. Taking the case of our location where the project is to be implemented the use of solar energy is the best and most efficient way to obtain energy to power our smart solar system as it is readily available as well as is of less maintenance.

So we believe that by the successful implementation of our project LIGHT UP their life on their forest will be improved and they can walk through the forest at night.

Check up to three relevant UN Sustainable Development Goals (SDGs) that the project addresses.*

<https://www.un.org/sustainabledevelopment/sustainable-development-goals/>

- Goal 7: Affordable and Clean Energy
- Goal 8: Decent Work and Economic Growth
- Goal 9: Industry, Innovation and Infrastructure
- Goal 10: Reduced Inequalities
- Goal 11: Sustainable Cities and Communities
- Goal 15: Life on Land

SECTION 2: Stakeholder Mapping and End-user Engagement

Who are the stakeholders and how will they be engaged in the project?*

We the volunteers of IEEE SB VJCET are planning to implement a project at Forest Area of Pooyamkutty Settlement Area Kuttampuzha Grama Panchayath. In this project, the main stakeholders are the volunteers who are taking initiative for it. They will be engaged by being part of the project implementation and will have technological experience by learning about one of the fast-growing technologies IoT (Internet of things) and about wireless communication which is now applicable in most of the technologies. The next stakeholders are the community in the forest. Most of the people in that locality work for the daily wages so they reach their home very late. By enabling vision, the use of light at night delivers several benefits to people. Such benefits include greater safety for pedestrians and drivers, reduced fear of crime, more use of outdoor facilities after dark, enhanced economic growth, the creation of built and natural environments that are a source of beauty and entertainment. Women and children will be able to travel at night safely. Forest officials who work there will also find it easy during their duties at night. This project will also be an inspiration for the younger generations who will find an interest in the new technology, and we will be engage them in this project by giving them training sessions for those who are interested.

Pooyamkutty - Manikandanchal
<https://maps.app.goo.gl/bCZrK3w7BzeL5dMz7>

SECTION 3: Project Assessment

Please explain the technology that will be used in the project.*

The objective of the project is to setup a wireless smart streetlight system. Taking a look into the present ways of implementing a smart street light system would include the use of sensors and wired equipment's for implementing the same. We would like to bring up IoT, wireless communication and also solar energy usage in our project. The primary and main advantage of IoT is monitoring. IoT mainly aids to be helpful to people in their daily life by making their devices communicate with each other in an efficient manner thereby saving and conserving energy and cost. Thereby using such a technology will help us to continuously monitor and track working of our smart street light system also the provision to receive notifications in case of any fault will enable our system to become more efficient. It gives us a constant monitoring and also it will give us constant alerts of the production rate and working of the street light through the applications connected through mobile phones. Wireless communication involves the transmission of information over a distance without the help of wires, cables or any other forms of electrical conductors. As our community is a forest area there are risk of destroying the wired communication by all means so we are providing wireless communication which is more beneficial. Taking the case of our location where the project is to be implemented the use of solar energy is the best and most efficient way to set up the street light that works on solar light.

Please upload the completed Project Assessment Matrix, which measures outputs and outcomes.*

Please **download** the file [Project Assessment Matrix Template 2021-JUL.xlsx](#), open and enter your data, **SAVE** with a NEW file name, and upload in the space provided.

22-APHAC-11 MATRIX - LIGHT UP.xlsx

Will your project use open source and result in open source resources for others to use?*

Please explain.

Yes, our project tries to put up open resources for others to use as the first priority. Solar based smart street lights working on IoT will be great benefit for the community. These techniques can be passed on to future generation as we will be progressing towards a complete smart world. Thus this project is a great provider of open resources for the people of the settlement to use and develop their own life. We believe that the project will be a great opportunity and a great recourse for them.

Please describe any similar projects being implemented in the region where you will be working.*

Are there any similar projects being implemented by other IEEE volunteers, institutions, organizations, or the government in the region where you will be working? If so, what are they?

Schnell installed the decorative poles in major peaks of Ernakulam and West Kochi Covers area of 3000 meters using wired network.

<https://www.facebook.com/101174535465585/posts/263550799227957/?flite=scwspnss>

Solar Street Light

<https://www.intelizon.com/solar-street-lights-across-india/amp/>

But here we are planning to provide wireless network and controlling the lamps with IoT technology in a remote forest area.

SECTION 4: Project Implementation Plan

Project work plan and milestones*

Please outline the proposed project work plan, expected timelines, and milestones associated with successful implementation of the proposed objectives.

Do not duplicate what is in the executive summary or project assessment.

We had seen the project call on 15/01/2022 and was so happy that the project submission date was extended then we planed for an idea.

Fortunately we came to know about the need of the community in pooyamkutty forest ,Kuttampuzha Gramapanchayath, Ernakulam, Kerala on19/01/2022.

The very next day 20/01/2022 we held an Execom meeting to discuss this problem. After understanding the problem, we were planning to discuss more on this faced by that area and finally reached at an idea.

Thus we contacted the panchayath on 23/01/2022 for taking permission for the project to be worked on, we explained our idea they were really impressed.

On 24/01/2022 we called on an Execom meet for the further discussion and making up the project.

By 26/01/2022 we formed the core team for the project implementation and we planned to visit the site.

On 28/01/2022 we visited pooyamkutty forest area along with the forest officials and gave an idea to the villagers and they were so happy to know that we had included their needs to make it beneficial.

After that we worked with the plan and on 3/02/2022 An online meeting including the village authorities were kept as an informative session which had conveyed and explained the project idea, plans, implementation time and local support

By 06/02/2022 We arranged a meeting of project team members to discuss about the project and finalize the budget of the project.

On 08/02/2022 We conducted a survey report to estimate the requirements .
We informed APS Kerala chapter and the Kerala session chair about the project on 12/02/2022 and they offered to provide all sort of support.
As these were successfully carried out we decided to apply for the project.
Till half of May, we are planning to give our Student Team different training webinars based on the current field so that they can be well aware of the situation.
The training will definitely help the team to implement the project also. So we can implement the project at the end of August.

Are there any restrictions in place that would impact the execution of your project?*

For example, mobility restrictions due to COVID-19, shelter in place, etc. Please share details of mitigation plan.

Currently there is no restrictions in place at the moment .As we are in unlock stage of COVID19. Even if there comes a situation where our team could not be at the place of implementation , we will be giving guidance and training to local stakeholders for further implementation of the project. So as to make our project complete.

Implementing Team*

If readily accessible, provide short profiles for each member of the proposed implementation team (IEEE and non-IEEE) that justifies how their participation will support achieving the objectives of the proposal. The profiles should explain the relevance of their expertise and previous field work experience (particularly in the beneficiary country). Please describe any previous relevant team collaborations.

Er. Anish M Jose -Branch counsellor of IEEE student branch, Assistant Professor of Electronics and Communication Department,95412652
Anjaly Saji -IEEE SB VJCET, Chair and project coordinator, has good knowledge in IoT,96173819
Sebin Jaison -IEEE SB VJCET, Treasurer who plans all the budget of the project and has good knowledge in solar panels,97633770
Alen Salu -IEEE SIGHT VJCET, Chair and has good knowledge in wireless communication,96173822
Amruthesh PS -IEEE volunteer, has a good knowledge in technical field,97632514
Navaneeth V Nair -IEEE SIGHT VJCET Design head and has good knowledge in solar panels,97617546
Antony Cijo - IEEE volunteer, has a good knowledge in software handling,97617588
Dany Tomy -IEEE volunteer and has a good knowledge in solar panel implementation,98239697
Sandra Theresa Mathew - IEEE volunteer and is excellent in project planning and documentation,97617698
Milan K Biju - IEEE SIGHT VJCET, Vice Chair and is excellent wireless communication,96173838
Alwin Sony - IEEE volunteer and has completed internship in IoT,97617663
Riya Vincent - IEEE volunteer and knows basic of wireless communication and IoT,98239760
Agnal Roy- IEEE volunteer and has completed internship in wireless communication,98240602
Pooja Ashok - IEEE volunteer and has completed internship in Solar panels and its implementation,97617288
Alex Sebin - IEEE volunteer and has completed internship in IoT,97617529
Riya Benny - IEEE volunteer and has good knowledge in solar panels,96174124

Is the Implementing Team an IEEE SIGHT Group? If so, please list the name and number of your Group.*

(Please note, it is not required to be part of a SIGHT group but forming a group is highly encouraged. You can direct any questions about the formation of new SIGHT Groups to sight@ieee.org.)

Yes all the members of the implementation is part of IEEE SIGHT VJCET - SBA64351S

Describe the potential risks and unintended consequences associated with this project.*

This should include, but not be limited to, risk to people, property, and IEEE reputation. How will these be mitigated? Make sure to explain what measures will be taken to prevent safety hazards. Please be as detailed as possible. Highlight any political or economic risk associated with the country in which the project is located. The IEEE Office of Risk and Insurance Management Services (ORIMS) may review proposals to assess risk and provide guidance.

The project is undertaken in the forest area of Kuttampuzha Gram Panchayat. The backward community of Poyamankutty settlement are in dire need for a street light system to solve the difficulties associated with night travel while reaching home after work because most of the people their works for a daily wages. The people in the region offers full corporation and support to this project. The site of the project is a forest area of Kuttampuzha Gram panchayat, is observed and viewed by the project team. All training sections and workshops of the project is done taking in consideration of Covid protocols. The installations of the solar street lights are handled by implementation team after taking proper training session and supported by the technical faculties of VJCET. A forest guide accompanies the project team during each visit. A team from the forest area also provides help to the project team in transportation and other important matters. A small training section was conducted for the project team by the people in order to familiarize the with the forest and to gain apt knowledge to overcome the difficulties of weather . A major problem associated with the project is transportation expenses. We have a lot of materials of the installation of street light which has to be transported with makes transportation cost little expensive. We will have the support of the forest officials for the transportation of the resources.

Are any approvals needed to undertake this project?*

This could include approval from the local government, community entity, Institutional Review Board, and so on. If so, please include as attachments. If these approvals have not yet been secured, please explain your plan to do so.

If no approvals are necessary, please state that explicitly.

Letter from Panchayat.pdf

Starting from our institution we have collected permission letter. We have discussed the plan with the local government and they were very much impressive. They have given us the approval letter and also the lead from the community has also give us a letter. We have contacted the forest officers to explain the project. They were also supportive and helped in all ways while visiting the site. They told us that only the letter from the local government is required for the site visiting as well as implementation of our project.

We will be uploading the letter from the local government here. All other permission letters will be shared in the drive link given below:

https://drive.google.com/drive/folders/1BEpH91H8Wt7Z63zg_s6lmewwgOQfN-10?usp=sharing

SECTION 5: External Collaboration

External organizations:*

What external organizations, such as NGOs, government organizations, companies, etc., are you collaborating with? For each, please provide:

- Name of collaborating organization
- URL

Panchayath members of Kuttampuzha Grama Panchayath.

What are the roles and responsibilities of the external organizations and IEEE?*

Please attach any documentation. **Applicants are strongly encouraged to provide a letter of support from any organization with which they are working.** If there is a need for a legal agreement, please note that here.

Letter from the community.pdf

They have given us the letter from the local head to enter the tribal area.

We have all the support from the local government and the forest officers to implement the project in the location

Ensuring the sustainability and proper utilization of the project to share the benefits of the advancement of technology to the people.

Helping the project team in the impact assessment of the project.

SECTION 6: Requested Funding

IEEE AP-S and IEEE HAC prioritize support of direct project costs, including necessary equipment, materials, supplies, and travel. Travel expenses must comply with IEEE Travel and Expense Reimbursement Guidelines. Given current circumstances, travel expenses should be minimal to zero.

No reimbursement of volunteer salaries will be provided. Reimbursing the salary of anyone contributing to the project must be carefully justified. Associated salary costs should be clearly explained and not constitute any more than a minor part of the overall budget proposed.

No indirect costs will be considered for funding, including but not limited to overhead expenses, Facilities & Administrative (F&A) costs, tuition, etc.

Completed IEEE AP-S and IEEE HAC Projects Application Budget Form*

Please download, complete, and submit the IEEE AP-S and IEEE HAC Projects Application Budget Template 2021, renaming the file to Name of Proposal (or abbreviation) to avoid potential confusion.

*Awards of up to *US\$3,000 will be made to selected projects that present a convincing plan to a) understand the real needs of a local community or local stakeholder organization and b) complete in no more than six months' time a pilot project utilizing AP-S-relevant technology to address those local community challenges. (*Funding up to US\$5,000 may be approved for convincing projects on pressing issues challenging an underserved community.)*

Please check to ensure that the total amount requested in the budget is the same as the response to the question "Funding Requested in USD" earlier in this form.

Note that all amounts should be stated in US Dollars.

22-APHAC-11 BUDGET - LIGHT UP.xlsx

Budget Justification*

Please use this area to provide additional information on any budget line items that need further explanation. Do not simply list expenses. This is meant to be a narrative. Also, if your project is to be co-funded by one or more other entities, please explain whether this funding is confirmed or what your plan is to confirm it.

The budget of our project is \$4998.74 it includes IoT modules, gsm module, battery, solar panels etc and the main expenses of money is in the transportation of materials to the settlement area and the labour

charges. For setting up the pole basement we need experts who been working in this field and for setting up the pole there also skills labours must be there. The material cost and other cost like solar panel, machinery rents etc are increasing rapidly. For the entire IoT technology it requires \$1390.14. For the installation of the poles for street light is requires \$1625.18 and for the installation of solar street light it requires \$1825.27. The transportation of these materials, machinery, safety equipment's cost \$258.15. The total will be \$5098.74. \$100 will be taken from our student branch making it a total of \$4998.74

What, if any, mandatory bank fees would be incurred with a transfer of funds from HAC to the OU?

Does Not Apply

SECTION 7: Additional Information

Disclose any potential conflicts of interest regarding this proposal.*

Please note: project teams must abide by the IEEE Principles of Business Conduct. Project leads and any other members of project teams with decision-making authority must complete the Principles of Business Conduct/Conflict of Interest disclosure prior to receiving funding.

Project team members are abide by the IEEE Principles of Business Conduct and we here attach the link to the drive containing our disclosure.

https://drive.google.com/drive/folders/1iQ3EsCoszF0anR135UN_v9OAMjshhxZ0?usp=sharing

Videos and/or Photos:

HAC encourages the submission of videos and/or photos that introduce the project team, demonstrate the need identified, or explain the technological solution to be implemented.

LIGHTUP.mp3

Here is the link to the Video of introduction of our team members in good quality.

<https://drive.google.com/drive/folders/1-zD9p8Mrx4xM54Oj6RB20lzEOM10aYeM?usp=sharing>

Any supplementary materials that further demonstrate worthiness of the project

Could include photos, videos, publications, letters of community support, etc.

Allowed File Types: doc, docx, pdf, mp3, mp4, avi, mov

SURVEY REPORT LIGHT UP.docx

A survey report of the area is attached here.

Also the photos of the community is attached is the below drive link:

https://drive.google.com/drive/folders/1W4RzMnxlp_kM1g2bl_YNJ1aIgWYHd1FJ?usp=sharing

Proposal Submission

By signing this application, I confirm that:

- A. all team members named in this proposal consent to this application being signed on their behalf;
- B. all individuals and organizations named in this proposal have consented to either participate in or cooperate with this proposal as presented should it be selected for support;
- C. to the best of the proposers' knowledge, this proposal is aligned with national policy in the country or countries where project activities will take place, and the proposers will ensure that any necessary ethical approval will have been secured before IEEE AP-S and IEEE HAC funds are released;
- D. Any proposal which (i) is incomplete, (ii) does not utilize AP-S-relevant technology, (iii) requests less than US\$500 or more than US\$3,000 (more than US\$3,000 may be considered for convincing projects), (iv) has a primary applicant with an ongoing or incomplete AP-S or IEEE HAC Project, or (v) for which a completed IEEE AP-S and IEEE HAC Projects Application Budget Form is not submitted will not be reviewed.
- E. All proposals must disclose if an identical or similar proposal is currently under evaluation for funding elsewhere.
- F. the proposers individually and collectively indemnify IEEE, IEEE staff, IEEE AP-S, the IEEE Humanitarian Activities Committee and IEEE HAC Projects Committee members from any liability associated with review of this proposal or subsequent implementation of their project;
- G. the proposers individually and collectively acknowledge that any decision by IEEE AP-S and IEEE HAC Projects as final;
- H. I acknowledge that the information provided on this form will be processed according to the **IEEE Privacy Policy**.

SIGNATURE*

(On behalf of all named proposers – please sign by typing your full name and IEEE Member number)

ANISH M JOSE 95412652

DATE OF SIGNATURE*

02/28/2022

File Attachment Summary

Applicant File Uploads

- 22-APHAC-11 MATRIX - LIGHT UP.xlsx
- Letter from Panchayat.pdf
- Letter from the community.pdf
- 22-APHAC-11 BUDGET - LIGHT UP.xlsx
- LIGHTUP.mp3
- SURVEY REPORT LIGHT UP.docx

IEEE HAC/SIGHT Project Assessment Matrix 2021

PROJECT NAME: LIGHT UP - Spread Light In Darkness

OBJECTIVE: To set a smart street light system works on solar energy which uses IoT network and connected using wireless communication.

<i>Internal Project #</i> 22-APHAC-11	INDICATOR	DEFINITION <i>How is it calculated?</i>	BASELINE <i>What is the value at project inception?</i>	TARGET <i>What is the target value?</i>	ACTUAL <i>Value at project close.</i>
OUTPUT: Increased access to renewable power	Number of solar panels installed at the end of the project	Total number of signals contracts for the solar panels	0	1.5	
OUTPUT: Solar power rechargeable batteries	Number of solar powered batteries adopted by the community increases by the end of the project	Total number of signals contracts for a new solar powered battery	0	7	
OUTPUT: Safety at night	Total estimated number of solar panels implemented to provide safety in night	Calculated on the basis of total estimated of families living with a total margin of 280 families	0	250 families	
OUTCOME: Constant monitoring the activities	Calculated on the basis of 10T programming which constitutes of total working and technical aspects of the project	Calculated on the basis of data recovered and to inspect and develop better program for prolific working	0	250 families	
OUTCOME: Awareness of newer technology to the youth	To provide more in depth knowledge in newer technology to the youth	Calculated on the basis of people obtaining knowledge in depth about newer technology	0	80 students	

IEEE HAC/SIGHT Project Ass

PROJECT NAME:				
OBJECTIVE:				
<i>Internal Project #</i> 22-APHAC-11	DATA SOURCE <i>How is it measured?</i>	FREQUENCY <i>How often measured?</i>	RESPONSIBLE <i>Who measures?</i>	REPORTING <i>Where is/was it reported?</i>
OUTPUT: Increased access to renewable power	From the database of IOT based program implemented in the street light and via panchayat	Midway of the project	Project Team	To project team,HAC Projects Committee and HAC Assessment Committee
OUTPUT: Solar power rechargeable batteries	Measured by considering the capacity of battery and power consumed by the streetlight via solar energy	Midway of the project	Project Team	To project team,HAC Projects Committee and HAC Assessment Committee
OUTPUT: Safety at night	From panchayat and data source from IOT program	Project close	Authorities	To project team,HAC Projects Committee and HAC Assessment Committee
OUTCOME: Constant monitoring the activites	From IOT based program	Project close	Authories and community people	To project team,HAC Projects Committee and HAC Assessment Committee
OUTCOME: Awareness of newer technology to the youth	Panchayat and school student records	Midway of the project	Project Team	To project team,HAC Projects Committee and HAC Assessment Committee



VISWAJYOTHI COLLEGE OF ENGINEERING & TECHNOLOGY

(Approved by AICTE, Affiliated to APJ Abdul Kalam Technological University, Kerala)

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25-02-2022

To
The President
Kuttampuzha Grama Panchayath
Kuttampuzha, Kerala

Sir,
Sub: Request for the permission of a technical project.

IEEE Student Branch of Viswajyothi College of Engineering and Technology, Vazhakulam, along with the guidance of the members of Kuttampuzha Grama Panchayath, have go forth the project "LIGHT UP - Spread Light in the Darkness". This project will include the implementation of Smart Street Light System at Pooyamkutty Tribal Settlement Area and improve the quality of their life. The entire process of the project implementation will be done by the project team members of IEEE SB VJCET.

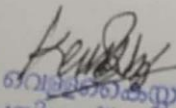
Kindly grant us the permission to implement the above mentioned project as early as possible.

Thank you

With Kind Regards,




Principal


കാഞ്ഞിരം വെളിച്ചം കമ്മ്യൂണിറ്റി
പ്രസിഡന്റ്
കുട്ടമ്പുഴ ഗ്രാമപഞ്ചായത്ത്
ഫോൺ: 0485-2588222

The student members of IEEE SB VJCEET Vazhakulam was about to set up the project at Pooyamkutty Settlement area at Kuttampuzha Panchayath. The project intended to provide an smart street light system to remove their insecurity by brightness. They have contacted us in phone calls and listened to all the problems faced by us. After that they visited our area and conducted a detailed survey on the issues. They decided to set up a smart street light system so that in the night it will help us to walk through the locality. They have checked all the technicalities for the implementation of the project. The permission and all the support has been given and I gave my word to ensure the sustainability for the same.



Fo. Kuriakose Kannampalliyil

Vicar
St. George's Church
Pooyamkutty.

EEE Antennas and Propagation Society and IEEE Humanitarian Activities Committee (AP-S and HAC) Projects Application Budget Form 2021

DATE: 28-Feb-22 [Date you submit Grant Application - DD MM]

PROJECT ID #: 22-APHAC-11 [OFFICE USE ONLY]

PROJECT TITLE: LIGHT UP - Spread Light In Darkness [Insert the same title as the one on your Grant Application.]

Enter details and amounts in the appropriate columns. **All amounts must be shown in US Dollars.**

Funding Received or Expected from other sources	USD Amount	Funding Amount Requested from AP-S and IEEE HAC	USD Amount
	\$ 100.00		\$ 4,998.74

FUNDING RECEIVED or EXPECTED from OTHER SOURCES		EXPENSES			
List the details of other funding, income or resources expected or received:		List and Group ALL Project Expenses		Expenses to be Paid from AP-S & HAC Grant (in US Dollars)	Expenses to be Paid from Other (in US Dollars)
Source of Funding/Resources	Amount/Value				
FROM SB FUND	\$ 100.00	SOLAR PANNEL FOR IOT CONNECTION	\$ 251.75		
		EA SWITCH GSM MODULE	\$ 548.25		
		BATTERY	\$ 256.41		
		CURRENT SENSOR TO DETECT LAMP FAULT	\$ 37.30		
		BUCK CONVERTOR MODULE	\$ 13.05		
		ANTENNA	\$ 13.99		
		LABOUR CHARGE IN IOT INSTALLATION	\$ 46.62		
		WEATHERPROOFING ENCLOSURE	\$ 231.23		
		POLE	\$ 820.51		
		MACHINERY	\$ 39.96		
		PIPES AND FITTINGS	\$ 186.48		
		PIT LABOUR CHARGE	\$ 11.89	\$ 100.00	
		POLE BASEMENT	\$ 466.20		
		SOLAR PANNEL FOR LIGHT SOURCE	\$ 433.56		
		BATTERY BOX	\$ 83.92		
		BATTERY	\$ 519.34		
		WIRING	\$ 93.24		
		LED LIGHT 40W	\$ 200.46		
		SOLAR CHARGING CONTROLLER	\$ 405.59		
		PIPE AND FITTINGS	\$ 79.25		
		TRANPORTATION OF MATERIALS	\$ 199.80		
		SAFETY EQUIPMENTS	\$ 33.30		
		TOOL KIT AND OPERATIONAL MANUAL	\$ 26.64		
Funding requested from AP-S and IEEE HAC	\$ 4,998.74	Total Expenses to be allocated to AP-S and IEEE HAC Grant	\$ 4,998.74		
Funding requested from Other Sources	\$ 100.00	Total Expenses to be allocated to Other Sources of funding			\$ 100.00
Total Project Funds Requested	\$ 5,098.74	Total Project Expenses	\$ 5,098.74		

SURVEY REPORT LIGHT UP

We IEEE SIGHT volunteers under the guidance of counsellors, local government authority officials and forest officers visited Forest Area of Pooyamkutty Settlement Area Kuttampuzha Grama Panchayath. Kuttampuzha panchayat is a tribal colony with around 250 families with a population of 590 including 80 number of students. Survey was conducted to know the lighting facilities available among the rural people. Even though India is one of the world's fastest growing economies, the growth is not visible in many rural communities when it comes to basic necessity especially lighting. In India, there are many causes of inequality but the main causes are poverty, gender, religion, and cast. Lack of better transportation, steady electricity, water supply and lack of vicinity of educational institutions are analysed in detail. It is an irony to point out that amidst all the development indices like urban development ie, metro, sky-city, smart-city etc, the tribes of Kuttampuzha colony, are marginalized and kept away from all the mantras of development. The socio-economic and educational deprivation that they face is exposed in detail elsewhere. Majority of people in kuttampuzha are either daily wage workers at the local level or outside. But due to lack of education, lack of skill in wage work and lack of technological modernization in farm work; they are not capable enough to come out of the trap of poverty and backwardness. They undertake agriculture, small wage works and daily survival without the availability of modern-day technology. It is our responsibility to improve lifestyle of these rural people. Lighting is a basic necessity that need to be considered with a very high priority .Thus we decided to provide them with smart street light system.





Location Pics were we plan to implement the Project

DATA AND METHODOLOGY:

The data for the survey was collected through two phases – primary and secondary ways. Primary data include that there are 250 families a total 590 population among them 80 are students. Through various interactions with people in that locality, the ministry of human resources, and the backward community it was found that these people face difficulties such as illiteracy and lack of education poverty, exploitation of labour, non-representation in services and untouchability, women’s safety, denial in the government services, transportation difficulties. Most of the people in that locality work for the daily wage so they reach their home very late. These areas have so many pocket roads which are dark and unsafe for traveling especially for women and children. Therefore, we the student volunteers of IEEE SB VJCET brings up the project ***Light up “Spread light in the darkness”***

This project is mainly establishing smart streetlights system by using IoT (internet of things), wireless communication. As it is working with the help of IoT lights can be monitored by their amount of work, the energy produced by solar, its lifetime, etc. After the implementation of this project, the insecurity faced by the localities will be reduced. As these lights are produced through solar energy there will not be any issues in the case of electricity and antennas will be placed in case of network instability.

The locals of Pooyamkutti settlement area are confronted with many challenges and difficulties when it comes to their daily life which

1. Land alienation
2. Lack of skilled job
3. Education
4. Lack of transport and communication
5. Health
6. Denial of government services.

Among these lack of transport and communication facilities is one of the major problems faced by them as it intensify their alienation and accessibility to other resources. Other than this it is a necessity to ensure safe and secure path through the forest for both the locals of Pooyamkutti as well as the outsider, in case of emergency situations. A major fraction of the locals of Pooyamkutti are daily wage workers who have to commute daily through this remote forest. Hence, the installation of fully automatic street lights is going to make a remarkable change in their lives.

Pooyamkutti, being a remote area, its locals are deprived of basic living standard. When the world is running for flying cars and digital currencies, people here do not even have an idea about basic technologies. So this is one way in which technical knowledge of the locals can be improved. Also, the youth in this area would also be inspired by these fascinating technologies which can eventually lead to the overall technical growth in the area. Lack of skilled workers being a problem in this area, our team can conduct a training session regarding the technologies used in this project if the locals are interested.

Light up is a crucial project for the people of Pooyamkutti as it is going to make some remarkable changes in their daily life and technical knowledge. The design and idea of the project was discussed with the local administrators and forest officers of the region and they were so impressed and interested in this. Besides that the locals of Pooyamkutti were absorbed by this idea as this is something crucial for their day-to-day life. The natives of pooyamkutti have always been an alienated backward community. We believe we can impact the life of the people of Pooyamkutti by project light up and refine their lives.



Location of Pooyamkutti,Kuttampuzha