A DETAILED REPORT ON OPERATION & MAINTENANCE, IMPLEMENTATION OF ADVANCED TRAFFIC MANAGEMENT SYSTEM AND OTHER IMPROVEMENT WORKS ON NATIONAL HIGHWAY-16 FROM ANNAVARAM TO DIWANCHEURUV SECTION (FROM KM 901.500TO KM 830.525)

This report is prepared by the students of

GODAVARI INSTITUTE OF ENGINEERING & TECHNOLOGY (A), RAJAMAHENDRAVARAM

Under the esteemed guidance of

NATIONAL HIGHWAYS AUTHORITY OF INDIA (NHAI)PIU-RAJAMAHENDRAVARAM

A DETAILED REPORT ON OPERATION & MAINTENANCE, ATMS AND OTHER IMRPOVEMENT WORKS ON NH-16

GODAVARI INSTITUTE OF ENGINEERING & TECHNOLOGY (A), RAJAMAHENDRAVARAM

IN ASSOCIATION WITH

NATIONAL HIGHWAY AUTHORITY OF INDIA (NHAI)

WORK DONE IN THE ENTIRE STRETCH FROM

ANNAVARAM - DIWANCHEURUV

FROM Km.830.525 to Km.901.500

2021-2022

GODAVARI INSTITUTE OF ENGINEERING & TECHNOLOGY

(Autonomous)

CHAITANYA KNOWLEDGE CITY, NH-16, RAJAMAHENDRAVARAM, 533296, AP

CERTIFICATE

This is to certify that the report entitled **"A Detailed Report on Operation & Maintenance,ATMS and Other Improvement Works on NH-16 from Km.830.525 to Km.901.500 (Annavaram to Diwancheruv Section)** " is the bonfide work done by group of 20 interns, **B. JAYANTHI(18551A0101), B.V.N.D.SAI VINAY(18551A0103), CH.PREMA LATHA(18551A0105), G.SUSHMA(18551A0106), G.AANANDINI(18551A0108), G.VEERENDRA(18551A0109), I.VINOD KUMAR REDDY(18551A0110), K.YASHWANTH(18551A0113), N.TEJA NAGENDRA(18551A0118), P.SRI CHARAN(18551A0120), P.PRASANTH(18551A0121), S.SAJJAN KUMAR NAIDU(18551A0125), D.UMA DEVI(19555A0105), I.TEJASWI(19555A0108), Y.SUJANA(19555A0117), N.SUBRAHMANYAM(19555A0119), N.SAMUEL KANNA(19555A0120), P.SRINIVASA RAO(19555A0121),P.KANNA BABBU(19555A0122), Y.ROHITH(19555A0130)** who carried out the intership work under our supervision during the year 2021 to 2022.

Signature of the Coordinator

Mrs. M. RAVALI (M.Tech.,)

Department of Civil Engineering

Signature of the Head of the Department

Dr.D.VENKATESWARLU M.Tech.,Ph.D
Head of the Department ,
Department of Civil Engineering

Signature of the Principal

Dr. P M M S SARMA

Principal of GIET(A)

PRINCIPAL
Godavari Institute of Engineering & Technology (Autonomous)
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Signature of the Project Director

Mr. D. SURENDRA NATH

Project Director (NHAI-PIU)
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ప్రాధికార సంస్థ
రాజమహేంద్రవరము

NHAI/PIU-RJY/INTERNSHIP/01 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Ms. **Balla Jayanthi, 18551A0101,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

During the internship the individual has involved in carrying out the following works:

1. Traffic volume studies.
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4. Analysis of data.
5 Suggestions to minimize accidents.
6. Study of soil conditions.
7. Reasons for deterioration of highways.
8. Tests to know the performance of highways.
9. Pavement Condition -Distress /Rutting/Raveling.
10. Improvements Required.
11. Identification of Encroachments.

07/09/22

(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/02 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Boppineedu Venkata Naga Datta Saivinay, 18551A0103,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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NATIONAL HIGHWAYS AUTHORITY OF INDIA
PIU-RAJAMAHENDRY

07/09/22

(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/06 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Gorrela Veerendra, 18551A0109,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/08 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Kukkala Yashwanth, 18551A0113,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/11 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Ponukumati Prasanth, 18551A0121,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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NATIONAL HIGHWAYS AUTHORITY OF INDIA
PIU-RAJAMAHENDRY

(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/12 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Sobha Sajjan Kumar Naidu, 18551A0125,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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NATIONAL HIGHWAYS AUTHORITY OF INDIA ★ PIU-RAJAHMUNDRY ★

07/09/22

(D. Surendra Nath)
Project Director

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NHAI/PIU-RJY/INTERNSHIP/16 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Naidu Venkata Subrahmanyam, 19555A0119,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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NATIONAL HIGHWAYS AUTHORITY OF INDIA * PIU-RAJAMUNDRY *

07/09/22

(D. Surendra Nath)
Project Director

सत्यमेव जयते
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NHAI/PIU-RJY/INTERNSHIP/18 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Panjagala Srinivasarao, 19555A0121,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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NATIONAL HIGHWAYS AUTHORITY OF INDIA * PIU-RAJAHMUNDRY *

07/09/22

(D. Surendra Nath)
Project Director

सत्यमेव जयते
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INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Pappala Kannababu, 19555A0122,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

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9. Pavement Condition -Distress /Rutting/Raveling.
10. Improvements Required.
11. Identification of Encroachments.

NATIONAL HIGHWAYS AUTHORITY OF INDIA * PIU-RAJAHMUNDRY *

07/09/22

(D. Surendra Nath)
Project Director

सत्यमेव जयते
भारत प्रभुत्वं

भारतीय राष्ट्रीय राजमार्ग प्राधिकरण
(सड़क परिवहन और राजमार्ग मंत्रालय, भारत सरकार)
National Highways Authority of India
(Ministry of Road Transport & Highways, Govt. of India)
परियोजना कार्यान्वयन इकाई - टोयोटा शोरूम के बाजु, राजमार्ग 216 ए,
दिवान चेरुवु, राजमहेन्द्रवरम - 533 102. आं.प्र
PROJECT IMPLEMENTATION UNIT - Adjacent to Toyota Showroom,
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భారతీ జాతీయ రహదారుల
ప్రాధికార సంస్థ
రాజమహేంద్రవరము

NHAI/PIU-RJY/INTERNSHIP/20 Dt.07.09.2022

INTERNSHIP COMPLETION CERTIFICATE

This is to certify that Mr. **Yandra Rohith, 19555A0130,** student of Civil Engineering at Godavari Institute of Engineering and Technology(A), Near NH-16,Chaitanya Knowledge City, Rajamahendravaram, Andhra Pradesh, has successfully completed the internship programme in NHAI as part of MOU entered with College for the Stretch of Annavaram to Diwancheruvu Section from 830.525 to Km 901.500 (Package-III) of NH-16" from 11.12.2021 to 05.01.2022 & 23.02.2022 to 31.03.2022.

During the internship the individual has involved in carrying out the following works:

1. Traffic volume studies.
2. Identification of accident prone Zones.
3. Data collection from concerned authorities.
4. Analysis of data.
5 Suggestions to minimize accidents.
6. Study of soil conditions.
7. Reasons for deterioration of highways.
8. Tests to know the performance of highways.
9. Pavement Condition -Distress /Rutting/Raveling.
10. Improvements Required.
11. Identification of Encroachments.

NATIONAL HIGHWAYS ABTHORITY OF INDIA * PIU-RAJAMUNDRY *

07/09/22

(D. Surendra Nath)
Project Director

DECLARATION

We declare that the project report titled "A Detailed report on Operation & Maintenance,ATMS and other improvement works on NH-16 from Km.830+525 to Km.901+500 " is a bonfide work done by us, in partial fulfilment of internship done in collaboration with NHAI and submitted to NHAI and Department of CIVIL ENGINEERING, GODAVARI INSTITUTE OF ENGINEERING & TECHNOLOGY (Autonomous), Rajamahendravaram.

We also declare that this project is a result of our own effort and that has not been copied from anyone.

Place: Rajamahendravaram

Date:

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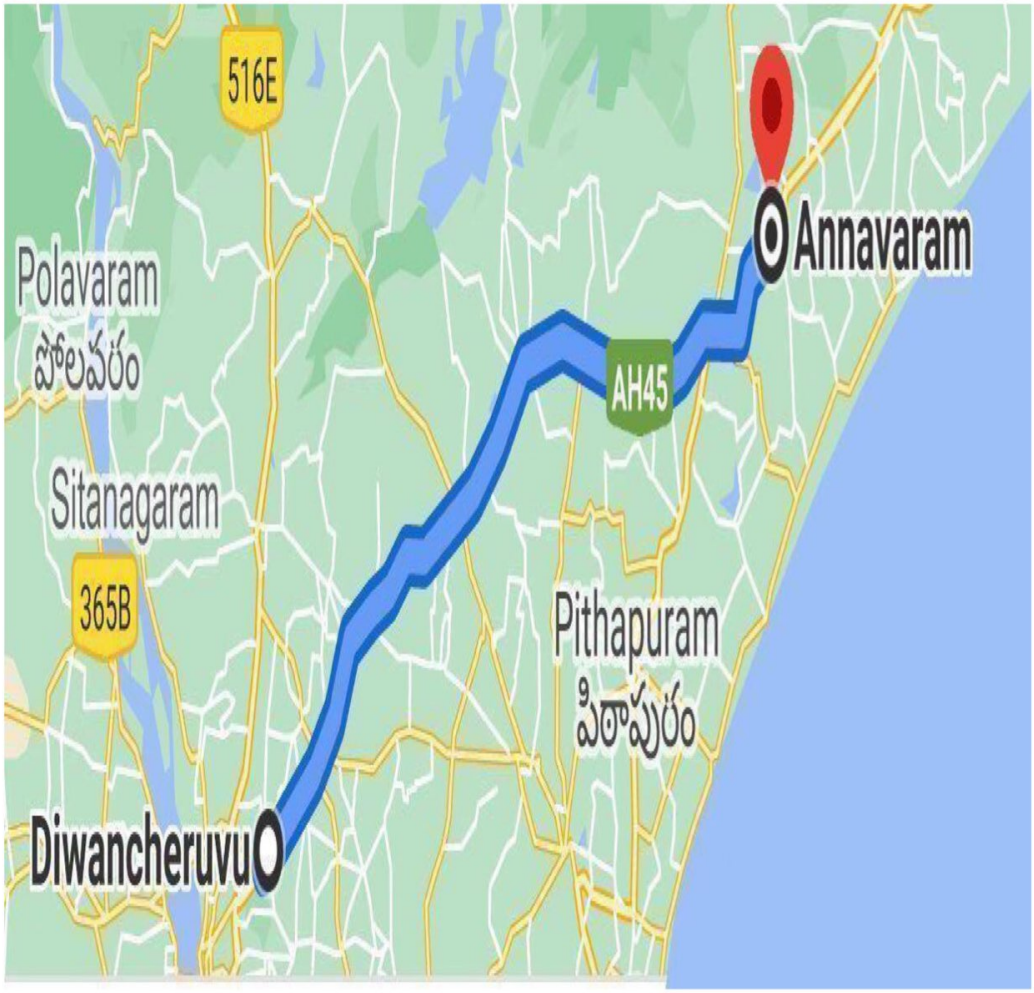
ABSTRACT

National highway maintenance is the process of safeguarding the highway structure and making the pavements to be serviceable. Highway maintenance works can be done in many ways, from pothole repair to re-applying highway surfacing, but the overarching aim is to keep road users safe, manage traffic and maintain upkeep. Pavements of good quality are the most dominant infrastructure for traffic flow. Failures in pavements cause many difficulties to road users. Road maintenance also extends to the repairing of drains beside a road replacement and repair of road signs, and maintenance of green spaces (such as hedge cutting and weeding).Timely maintenance of pavements protects the pavement from future deteriorations. Along the national highways there is need of providing different amenities for safety and comfort of road users.But some of the lands on the right of way are occupied by the encroachers in the form of constructing buildings, shops, sheds and other constructions. In this study during the first phase, a detailed survey is conducted along a given stretch on the highway no NH-16 between Diwancheruvu and Annavaram from 901+500kms to 830+325 kms. In the first phase, pavement failures along the given stretch are identified and maintenance measures are suggested. This may be very useful for future guidance to locate points, to take safety measures. In this report we have done traffic volume count in the main Junctions of Diwancheruvu, Rajanagaram, Kathipudi and Annavaram for 24 hours. OD survey (Origin to Destination) is also done at Krishnavaram Tollgate for 24 hours. The soil samples were collected from different regions in the entire stretch - Diwancheruvu , Rajanagaram , Gandepalli ,Jaggampeta , Yerravaram , Prathipadu , kathipudi , Annavaram. Accidental data was collected from police stations Bommuru , Rajanagaram, Gandepalli, Jaggampeta and Annavaram. The collected data was analysed and a report was prepared on accident prone zones and black spots along the stretch. In the Second phase a survey was done to identify the major and minor roads connected to the National highway,working of ATMS centers, reasons for deteriorations,details of petrol bunks along the highway and encroachments identification was done.

Key points: Deteriorations, Encroachments, Highway Maintenance, Traffic volume studies

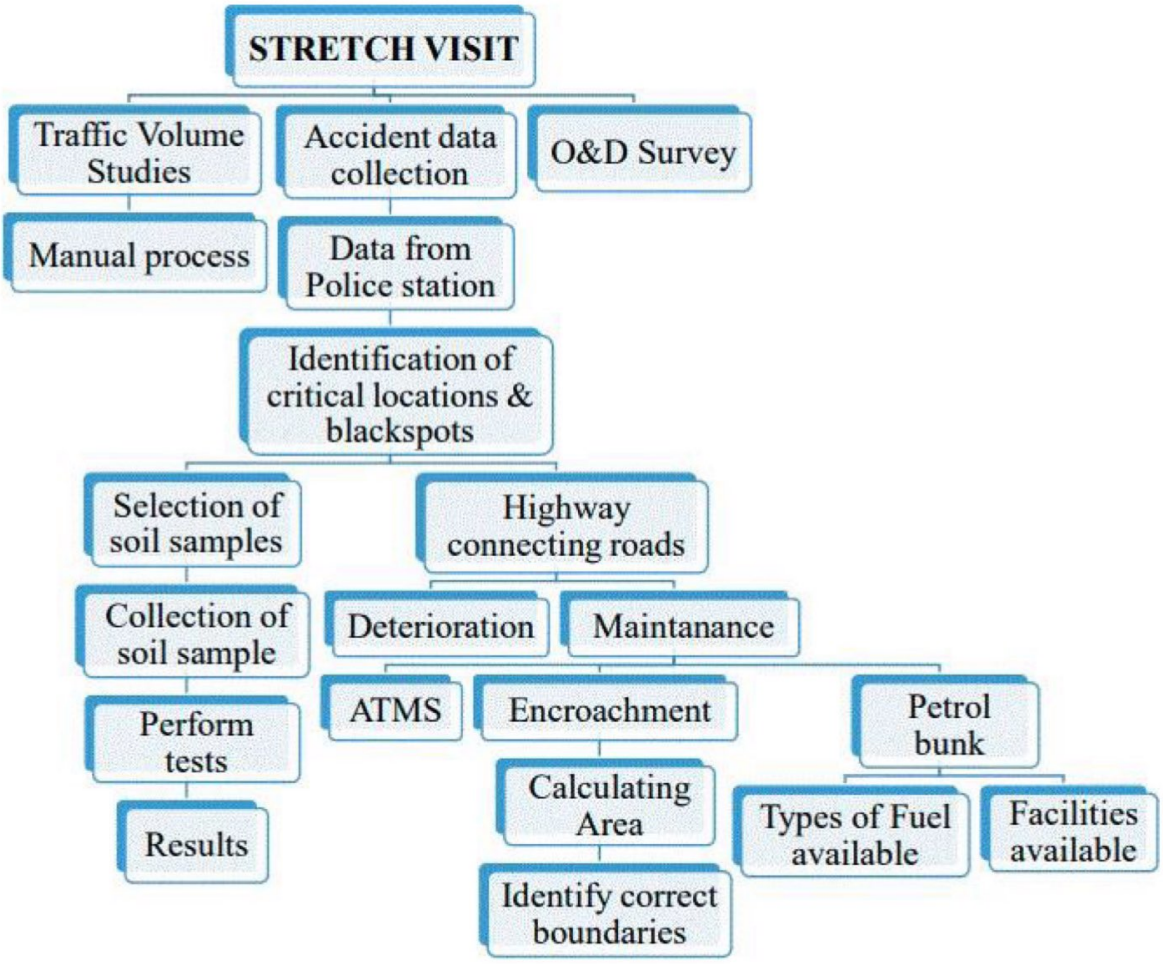
Project Highway Map



Salient Features

Project	Projects comprising of 9 National Highway stretches (Bundle-1): Tolling, Operation, Maintenance & Transfer of Annavaram to Diwancheruvu section on Toll Operate Transfer (TOT) Model
State	Andhra Pradesh
National Highway No.	NH-16
Project Stretch	Km901+500toKm 830+525
Length of the Project	73.00Km
Authority/Client	National Highways Authority of India
Independent Engineer	
Concessionaire	Diwancheruvu Tollway Private Limited
Date of Concession Agreement	7thDec 2021
Location of Toll Plaza	Km.865+553,Krishnavaram Village, East Godavari District
Appointed Date/Toll Commencement Date	24.00hrs of 21stDec2021
Concession Period	2 months from Appointed Date

METHODOLOGY



TRAFFIC SURVEY

TRAFFIC VOLUME STUDIES

Introduction:

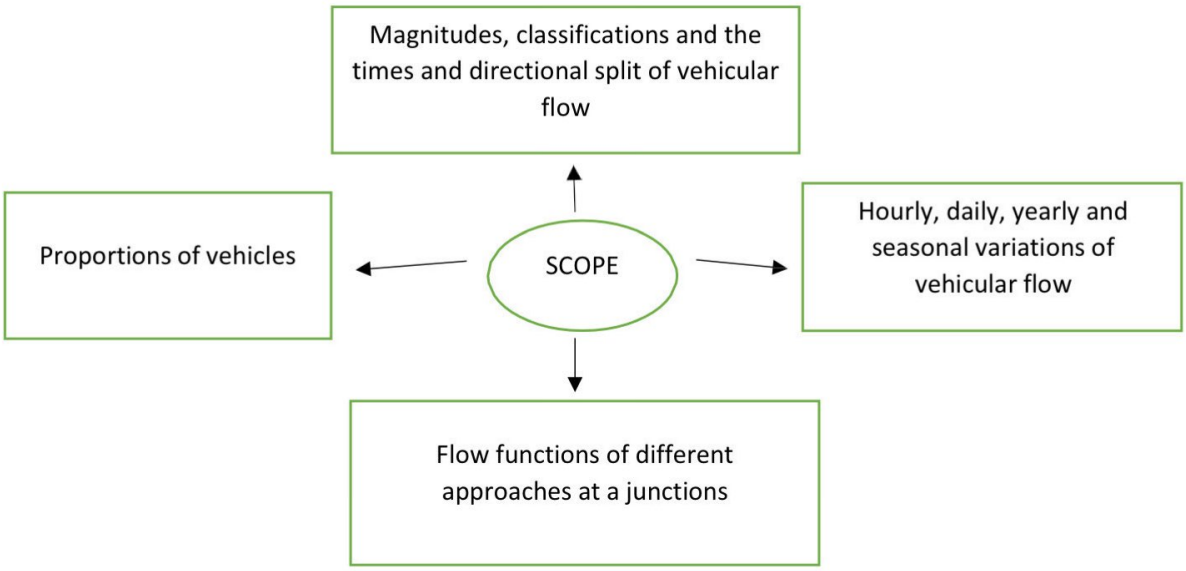
Traffic congestion has been one of the major issues that most metropolises are facing in spite of measures being taken to mitigate and reduce it. In the recent past, traffic congestion has emerged as one of the main challenge for engineers, planners and policy makers in urban areas. Modern social and economic structures, shaped by car-oriented urban development and rapid growth in vehicle ownership, have established congestion as an inescapable reality of urban life. The growing impact of congestion is seen in terms of deteriorating urban air quality besides other adverse effects on quality of urban living.

General:

Traffic Volume Count is counting of the number of vehicles passing through a road over a period of time. It is defined as the procedure to determine mainly volume of traffic moving on the roads at a particular section during a particular time. It is usually expressed in terms of Passenger Car Unit (PCU). Passenger Car Unit (PCU) is a metric used to assess traffic-flow rates on a highway.A Passenger Car Unit is a measure of the impact that a mode of transport has on traffic variables (such as headway, speed, density) compared to a single standard passenger car. This is also known as passenger car equivalent.

Objectives:

1. Vehicle composition
2. Traffic stream properties
3. Average daily traffic
4. Direction distribution
5. Flow fluctuation



Importance of Traffic Volume Studies:

- Increase the efficiency and life of roads
- Reduces traffic volume at a particular section
- Provide better means for development of infrastructures
- Provide better means to utilize other roads in case of special events in the city
- Provide estimate of no vehicles against no of persons

ORIGIN & DESTINATION SURVEY

O&D is the starting point (origin) and end point (destination) of a traveler's directional journey.

- Basic data for determining 'Desired Lines'.
- Establish preferential routes for different trips.
- Showing no. of trips between different zones.
- Desire lines are plotted connecting Origin & Destination.

In this report we have done traffic volume count in Junctions of Diwancheruvu, Rajanagaram, Kathipudi and Annavaram for 24 hours. OD survey (Origin to Destination) is also done at Krishnavaram Tollgate for 24 hours.

Summary of Traffic Volume Studies

The peak hours in each junction is mentioned in the below table:

AREA	Peak hours/timing	Total no. of vehicles passed
DIWANCHERUVU	8am-11am	6703
	2pm-6pm	8779
RAJANAGARAM	8am-12pm	6287
	4pm-9pm	7840
KATHIPUDI	8am-12pm	4559
	2pm-6pm	4482
ANNAVARAM	8am-11am	3744
	1pm-5pm	6327

Table 3.1

Summary of Origin & Destination survey

We have done the origin & destination survey on 21-12-2021 and 22-12-2022 at Toll Plaza. We have concluded that the total number of vehicles passed from all the 10 lanes are 2,128. The below table shows the overall vehicles passed from Toll Plaza.

S. No	Type of Vehicle	No. of vehicles passed
1	2-Axle Truck	357
2	3-Axle Truck	230
3	MAV	143
4	Car/Jeep/Van	1280
5	Bus	118

Table3.2

Period: APRIL-2021 TO DEC-2021

Sl. No.	Type of Accident	Nos. of Occurrence	Casualty / Affected Nos.	Remarks
1	Fatal	16	16	
2	Grievous/Major Injurious	146	77	
3	Minor Injurious	50	93	
4	Non Injurious	00	00	
	Total	**212**	**186**	

Table 4.1

Road accidents Overview

YTD Accidents	Details as per classification of accidents		
	YTD fatalities	YTD Grievous injuries	YTD Minor injuries
212	16	77	119

Table 4.2

PAVEMENT SURVEY

Identification of Critical Locations

Introduction:

Critical locations in infrastructure are roads that, if damaged, would cause a large disruption in the ability of vehicles to navigate a city. Identifying critical locations in a network can be instrumental in protecting a city during acts of terrorism or natural disasters and providing aid if these disasters occur. Our research consists of discovering critical locations in the road network of Indianola, Iowa. While we are concentrating on networks in infrastructure, our findings can beapplied to online, social and even complex brain networks. India nola is a town in central Iowa with a population of 14,782. The town includes a private college and holds the county seat. Twostate highways intersect within the city. There are approximately 411 intersections and 631 separate road segments within the town.

DEFINITION:

Graph theory is the study of graphs and the relationships graphs represent. A graph consists of vertices. Vertices represent objects and edges represent the connection between those objects. Two vertices are adjacent if they are connected by an edge. Two edges are adjacent if they sharea common vertex. Graphs can be directed or undirected. If edges do not specify a direction, normally through the use of arrows, then the graph is undirected. We will be con side ring undirected graphs that model the streets of Indianola, Iowa. The vertices of the graph will represent the intersections and the edges will represent the road segments between those intersections. Within a graph, there are walks, trails and paths. A walk is defined as an alternate sequence of vertices and edges, a trail is a walk in which no edge is repeated, and a path is a trail in which no vertex is visited more than once. The length of a walk, trail, or path is determined bythe number of edges it contains.

Cut Vertices. A cut vertex occurs when the removal of a given vertex and its Incident edges increase the number of connected components of a graph. A bridge Occurs when the removal of an edge increases the number of connected components in a graph.

The critical locations we observed from Diwancheruvu to Annavaram.

1 – Location

Latitude -Longitude (17.1083654 - 81.921124) 17o6’30” N 81o55’16” E Speed Kmph Chennai Andhra I. Altitude -40.66 Accuracy 3.79m - Kolkata Hwy, Pradesh 533294, India.

Figure 5.1

2– Location

Latitude – Longitude (17.1053532 81.9191302) 17o6’19” N 81o55’9” E Speed Kmph Chennai Andhra I Altitude-42.6 Accuracy 3.79m - Kolkata Hwy, Pradesh 533294, India

Figure 5.2

3- Location

Latitude – Longitude (17.1002884 81.9175645) 17o6'1" N 81o55'3" E Speed Kmph Altitude -39.39Accuracy 3.79m AH45, Andhra Pradesh 533294, India

Figure 5.3

4– Location

Latitude -Longitude (17.1046086 81.9185578) 17o6'17" N 81o55'7" E Speed Kmph Chennai Andhra I Altitude -32.39 Accuracy 3.79m - Kolkata Hwy, Pradesh 533294, India

Figure 5.4

5-Location

Latitude -Longitude (17.1197321 81.9279133) 17o7’11” N 81o55’40” E Speed Kmph Altitude -31.96 Accuracy

3.79m 4WCH442, Murari, Andhra Pradesh 533294, India.

Figure 5.5

AT DIWANCHERUVU 902+750

Figure 5.6

NEAR RAJANAGARAM PETROL BUNK 897+500

Figure 5.7

AT RAJANAGARAM JUNCTION 897+450

Figure 5

REASONS FOR DETERIORATION OF HIGHWAYS IN EACH PLACE:

FROM DIWANCHERUVU TO GANDEPALLI:

The Pavement failure are by water intrusion, stress from heavy vehicles, expansion and contraction from seasonal temperature changes, and sun exposure. It is important to keep up with proper maintenance like crack and asphalt sealing to prevent cracks from spreading or forming.

AT DIWANCHERUVU (903+300)

Figure 5.10

AT GIET COLLEGE (900+545)

Figures 5.11

AT RAJANAGARAM (897+520)

Figures 5.12

NEAR ISTS COLLEGE (886+300)

Figures 5.13

NEAR GANDEPALLI VILLAGE (891+270)

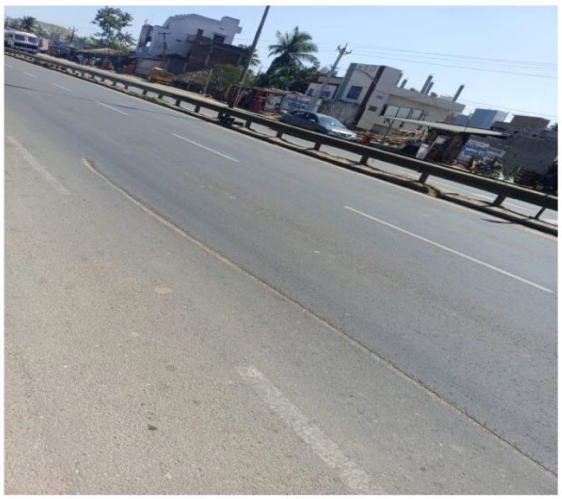
Figure 5.14

FROM GANDEPALLI TO JAGGAMPETA:

Pavement deterioration is the process by which distress (defects) develop in the pavement under the combined effects of traffic loading and environmental conditions.

Near Mallepalli

Near Borrampalem



Near Talluru

Near Mallepalli *Near Gandepalli*

Figure 5.15

FROM JAGGAMPETA TO YERRAVARAM:

No noticeable deterioration was found on these roads.

FROM KATHIPUDI TO ANNAVARAM:

No noticeable deterioration was found on these roads.

PAVEMENT CONDITION

Pavement condition index:

The pavement condition index (PCI) is a numerical index between 0 and 100, which is used to indicate the general condition of a pavement section. The PCI is widely used in transportation civil engineering and asset management, and many municipalities use it to measure the performance of their road infrastructure and their levels of service.

Pavement

Road Pavement/ Pavement is one type of hard surface made from durable surface material laid down on an area that is intended to carry vehicular or foot traffic. Its main function is to distribute the applied vehicle loads to the sub-grade through different layers.

Types of Pavements

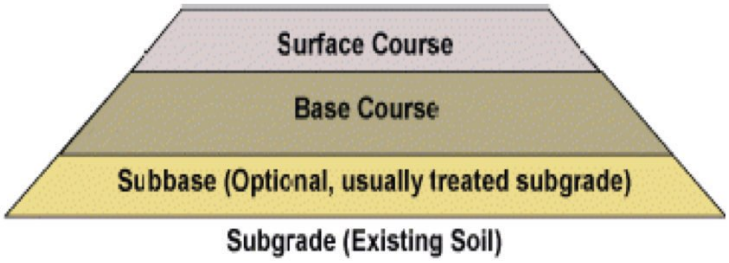
There are two types of pavements based on design considerations i.e. flexible pavement and rigid pavement. Difference between flexible and rigid pavements is based on the manner in which the loads are distributed to the sub grade. Before we differentiate between flexible pavements and rigid pavements, it is better to first know about them. Details of these two are presented below:

1. Flexible Pavement
2. Rigid Pavement

Flexible Pavements

Flexible pavement can be defined as the one consisting of a mixture of asphaltic or bituminous material and aggregates placed on a bed of compacted granular material of appropriate quality in layers over the sub grade. Water bound macadam roads and stabilized soil roads with or without asphaltic toppings are examples of flexible pavements.

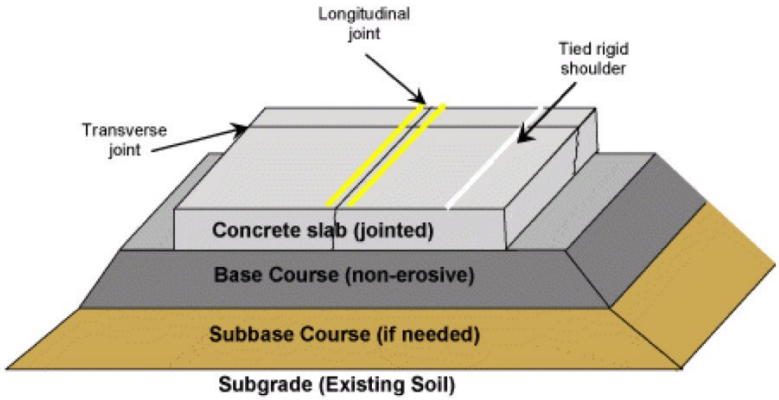
The design of flexible pavement is based on the principle that for a load of any magnitude, the intensity of a load diminishes as the load is transmitted downwards from the surface by virtue of spreading over an increasingly larger area, by carrying it deep enough into the ground through successive layers of granular material.



Flexible pavement

Rigid Pavements

A rigid pavement is constructed from cement concrete or reinforced concrete slabs. Grouted concrete roads are in the category of semi-rigid pavements. The design of rigid pavement is based on providing a structural cement concrete slab of sufficient strength to resists the loads from traffic. The rigid pavement has rigidity and high modulus of elasticity to distribute the load over a relatively wide area of soil.

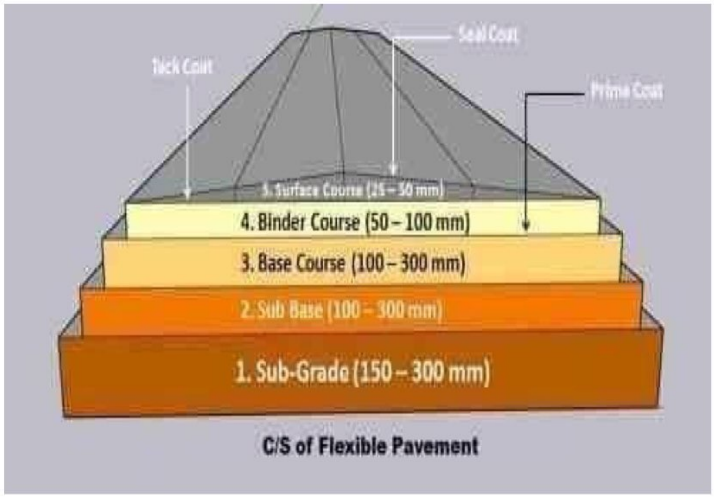


Rigid Pavement Cross-Section

Road Construction Layers (Road Pavement Layers):

Following are pavement layers in road construction,

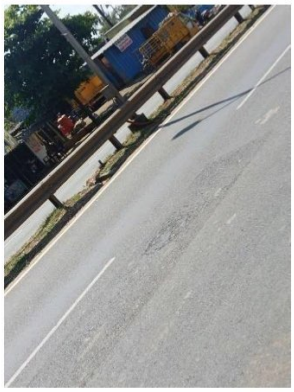
1. Compacted sub grade (150 – 300mm).
2. Sub-base Course (100 – 300 mm)
3. Base Course (100 – 300 mm)
4. Prime Coat
5. Binder Coat (50 -100 mm)
6. Tack Coat
7. Surface Course (25 – 50 mm)
8. Seal Coat.



Flexible Pavement Road Construction Layers

Work done from Gandepalli to Krishnavaram:

The pavement condition is not up to NHAI standards with uneven surfaces and pavement failures. The divider has been damaged at numerous spots although there is no plantation on the divider. The stretches where the pavement has failed are mentioned below with relevant pictures of that location



886+300

886+350

885+300

883+300

880+000 **879+800** **879+600**

883+200 **885+400** **875+300**

870+200 **879+400**

Figure 5.17

Work done from Krishnavaram to Prathipadu

The road condition is looking good and in some places margin lines need to be provided clearly, in some parts of the pavements have problems in verge conditions and median strip is good and clear.

Figure 5.16

SOIL CONDITIONS

Soil Sample collection:

The soil samples were collected from different regions in the entire stretch which are given below

1. Diwancheruvu
2. Rajanagaram
3. Gandepalli
4. Jaggampeta
5. Yerravaram
6. Prathipadu
7. Kathipudi
8. Annavaram

Figure 5.17

ATTERBERG'S LIMIT TEST (LIQUID LIMIT AND PLASTIC LIMIT)

INTRODUCTION:

The Atterberg's limit refers to the liquid limit and plastic limit of soil. These two limits are used internationally for soil identification, classification, and strength correlations. When clay minerals are present in fine-grained soil, the soil can be remolded in the presence of some moisture without crumbling. This cohesiveness is caused by the adsorbed water surrounding the clay particles. At very low moisture content, soil behaves more like a solid; at very high moisturecontent, the soil and water may flow like a liquid. Hence on an arbitrary basis, depending on the moisture content, the behavior of soil can be divided into the four basic states is solid, semisolid, plastic, and liquid.

LIQUID LIMIT TEST:

Sample Calculation:

For Trial No. 01,

Number of blow, N= 47 (recorded during test)

Wt. of container = 41.7 gm

Wt. of container + wet soil = 59.7 gm

Wt. of container + dry soil = 53.2 gm

Water content, w = 56.52%

The flow curve can be obtained by plotting the water content with the corresponding number of blows on semi-log graph paper. The liquid limit of the soil sample can be obtained.

Figure 5.18

LOCATION	NO. OF BLOWS	WEIGHT OF CONTAINER	WEIGHT OF CONTAINER + WET SOIL	WEIGHT OF CONTAINER + DRY SOIL	WATER CONTENT
DIWANCHERUVU	25	41.5	101.5	63.2	17.6
RAJANAGARAM	25	41.5	101.5	45.4	14.38
GANDEPALLI	25	41.5	101.5	54.1	37
JAGGAMPETA	25	41.5	101.5	61	20
YERRAVARAM	25	41.5	101.5	65	15
PRATHIPADU	25	41.5	101.5	54	38
KATHIPUDI	25	41.5	101.5	42.5	59
ANNAVARAM	25	41.5	101.5	50	60

TABULAR FORM:

Table 5.1

Figure 5.19

PLASTIC LIMIT TEST:

Sample Calculation:

For Trial No. 01,

Wt. of container = 7.7 gm

Wt. of container + wet soil = 23.2 gm

Wt. of container + dry soil = 20.9 gm

Wt. of water, Ww = 23.2-20.9 = 2.3 gm

Wt. of dry soil, Ws =20.9- 7.7 = 13.2 gm

Water content, w = 17.42%

Plastic Limit is the average of moisture content of all trials. Plasticity Index (PI) =Liquid Limit (LL)–Plastic limit (PL)

W = (W1 + W2 + W3) /3

TABULAR FORM:

LOCATION	NO. OF BLOWS	WEIGHT OF CONTAINER	WEIGHT OF CONTAINER + WET SOIL	WEIGHT OF CONTAINER + DRY SOIL	WATER CONTENT
DIWANCHERUVU	25	41.5	101.5	91.2	20.6
RAJANAGARAM	25	41.5	101.5	91.5	20
GANDEPALLI	25	41.5	101.5	90.6	22.19
JAGGAMPETA	25	41.5	101.5	88.6	27.38
YERRAVARAM	25	41.5	101.5	89.2	25.78
PRATHIPADU	25	41.5	101.5	83.9	41.50
KATHIPUDI	25	41.5	101.5	91.8	19.28
ANNAVARAM	25	41.5	101.5	85.5	36.36

Table 5.2

Figure 5.20

Figure 5.21

SPECIFIC GRAVITY TEST:

INTRODUCTION

The specific gravity (G_s)of a material is the ratio of the mass of a unit volume of soil solids at a specific temperature to the mass of an equal volume of gas-free distilled water at the same temperature. The specific gravity of soil is usually reported at 20°C.

FORMULA:

Mass of flask + water filled to mark=W1

Mass of flask + soil + water filled to mark= W2 Mass of dry soil= Ws(g)

Water Temperature, T1(°C) = 23°C

Sp. Gravity(Gs)=(W2-W1)/ (W4-W1) -(W3-W2)

TABULAR FORM:

LOCATION	W1	W2	W3	W4	SPECIFIC GRAVITY
DIWANCHERUVU	650	750	1580	1520	2.5
RAJANAGARAM	650	750	1585	1520	2.85
GANDEPALLI	650	720	1554	1520	2.77
JAGGAMPETA	650	745	1577	1520	2.63
YERRAVARAM	650	753	1580	1520	2.32
PRATHIPADU	650	755	1577	1520	2.08
KATHIPUDI	650	748	1579	1520	2.56
ANNAVARAM	650	742	1568	1520	2.27

Table 5.3

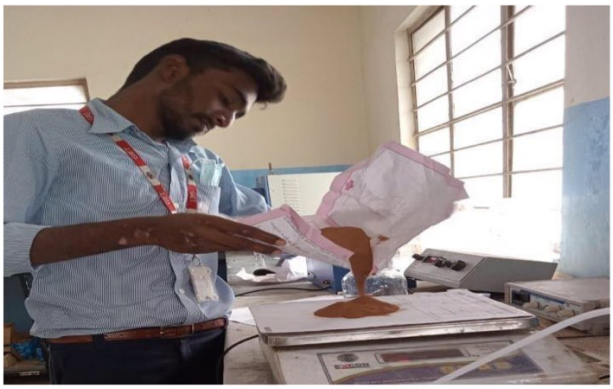


Figure 5.22

SUMMARY:

- The Standard value of Specific gravity should be between **2.50 to 3.00**. Organic matter and porous particles may have specific gravity values below 2.0 and Soil which has heavy substance or particles may have values above 3.0.
- The Specific Gravity of all the soils in different areas is within the standard values.
- The soil in Yerravaram, Prathipadu and Annavaram has a specific gravity below the standard value (2.50) because of the presence of organic matter and porous particles.

DETERMINATION OF MOISTURE CONTENT

INTRODUCTION:

The moisture content of soil also referred to as water content, is an indicator of the amount of water present in soil. Moisture content is the ratio of the mass of water contained in the pore spaces of soil to the solid mass of particles in that material, expressed as a percentage. A standard temperature of 110 ± 5°C is used to determine the mass of the sample.

FORMULA:

Moisture content of the given soil sample = Mw/Ms×100%

RESULTS AND DISCUSSIONS:

LOCATION	W1	W2	W3	WATER CONTENT
DIWANCHERUVU	20	70	68	4.16
RAJANAGARAM	20	70	69	2.06
GANDEPALLI	20	70	68	4.16
JAGGAMPETA	20	70	68.5	6.76
YERRAVARAM	25	75	71	10.12
PRATHIPADU	25	75	74	2.04
KATHIPUDI	25	75	73	8.33
ANNAVARAM	25	75	73	8.33

Table 5.4

SUMMARY:

- The Moisture content in very sandy soil may vary from 3% to 10% from the driest (wilting point) condition to the wettest drained state (field capacity), orfrom 20% to 40% in a clay soil.
- Moisture content of all the soils collected from the above areas varies from 2%to 10%.
- So, the soils collected from different areas are sandy soils.

PARTICLE SIZE DISTRIBUTION OF SOIL

INTRODUCTION:

The grain size analysis test is performed to determine the percentage of each size of grain that is contained within a soil sample, and the results of the test can be used to produce the grain size distribution curve. This information is used to classify the soil and to predict its behavior. The two methods generally used to find the grain size distribution are:

- Sieve analysis which is used for particle sizes larger than 0.075 mm in diameter and
- Hydrometer analysis which is used for particle sizes smaller than 0.075 mm in diameter
- Sieve analysis is a method that is used to determine the grain size distribution of soils that are greater than 0.075 mm in diameter. It is usually performed for sand and gravel but cannot be used as the sole method for determining the grain size distribution of finer soil. The sieves used in this method are made of woven wires with square openings. The list of the U.S. standard sieve numbers with their corresponding opening sizes are provide.

RESULTS AND DISCUSSIONS

TABULAR FORM FOR DHIWANCHERUVU

S.I NO	IS SIEVE (MM)	PARTICLE SIZE (MM)	MASS RETAINED(GM)	CORRECTED MASS RETAINED(GM)	CUMULATIVE RETAINED(GM)	CUMULATIVE % RETAINED	% FINER
1	4.75	4.75	40	40	40	8%	92%
2	2	2	115	75	75	15%	85%
3	1	1	185	70	185	37%	63%
4	0.6	0.6	210	25	210	42%	58%
5	0.3	0.3	325	115	325	65%	35%
6	0.15	0.15	445	120	445	89%	11%
7	0.075	0.075	485	40	485	97%	3%
8	PAN		500	15/500	500	100%	0%

Table 5.5

TABULAR FORM FOR RAJANAGARAM:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	4.25	4.25	32	40	32	6%	90%
2	1	1	110	70	70	10%	82%
3	1	1	170	65	170	34%	60%
4	0.4	0.4	200	20	200	40%	55%
5	0.2	0.2	310	110	310	60%	31%
6	0.11	0.11	420	110	420	84%	10%
7	0.055	0.055	460	35	460	96%	2%
8	PAN		450	14/450	450	100%	0%

Table 5.6

TABULAR FORM FOR GANDEPALLI:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	4.75	4.75	40	40	40	8%	92%
2	2	2	115	75	75	15%	85%
3	1	1	185	70	185	37%	63%
4	0.6	0.6	210	25	210	42%	58%
5	0.3	0.3	325	115	325	65%	35%
6	0.15	0.15	445	120	445	89%	11%
7	0.075	0.075	485	40	485	97%	3%
8	PAN		500	15/500	500	100%	0%

Table 5.7

TABULAR FORM FOR JAGAMPETTA:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	2.12	2.12	25	50	25	9%	91%
2	1	1	105	70	60	20%	84%
3	1	1	175	75	175	37%	67%
4	0.3	0.3	205	30	205	45%	51%
5	0.1	0.1	310	105	310	70%	41%
6	0.09	0.09	450	130	450	85%	18%
7	0.015	0.015	490	45	490	99%	5%
8	PAN		590	16/590	590	100%	0%

Table 5.8

TABULAR FORM FOR YERRAVARAM:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	3.27	3.27	50	40	50	8%	92%
2	5	5	105	70	105	15%	85%
3	2	2	165	75	165	37%	63%
4	0.11	0.11	200	30	200	42%	58%
5	0.5	0.5	315	105	315	65%	35%
6	0.25	0.25	425	110	425	89%	11%
7	0.05	0.05	465	50	465	97%	3%
8	PAN		510	16/500	510	100%	0%

Table 5.9

TABULAR FORM FOR PRATHIPADU:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	3.75	3.75	40	40	40	8%	92%
2	2	2	115	75	75	15%	85%
3	1	1	185	70	185	37%	63%
4	0.6	0.6	210	25	210	42%	58%
5	0.5	0.5	415	115	415	65%	35%
6	0.15	0.15	445	120	445	89%	11%
7	0.075	0.075	485	40	485	97%	3%
8	PAN		500	15/500	500	100%	0%

Table 5.10

TABULAR FORM FOR KATHIPUDI:

S.I NO	IS SIEVE(MM)	PARTICLE SIZE (MM)	MASS RETAINED (GM)	CORRECTED MASS RETAINED (GM)	CUMULATIVE RETAINED (GM)	CUMULATIVE % RETAINED	% FINER
1	4.75	4.75	40	40	40	8%	92%
2	2	2	115	75	75	15%	85%
3	1	1	185	70	185	37%	63%
4	0.6	0.6	210	25	210	42%	58%
5	0.3	0.3	325	115	325	65%	35%
6	0.15	0.15	445	120	445	89%	11%
7	0.075	0.075	485	40	485	97%	3%
8	PAN		500	15/500	500	100%	0%

Table 5.11

TABULAR FORM FOR ANNAVARAM:

-

S.I NO	IS SIEVE(MM)	PARTI CLE SIZE (MM)	MASS RETAINED (GM)	CORRECT ED MASS RETAINED (GM)	CUMULAT IVE RETAINED (GM)	CUMULA TIVE % RETAINE D	% FIN ER
1	4.75	4.75	40	40	40	8%	92%
2	2	2	115	75	75	15%	85%
3	1	1	185	70	185	37%	63%
4	0.6	0.6	210	25	210	42%	58%
5	0.3	0.3	325	115	325	65%	35%
6	0.15	0.15	445	120	445	89%	11%
7	0.075	0.075	485	40	485	97%	3%
8	PAN		500	15/500	500	100%	0%

Table 5.12

Sample Calculation

For #8 sieve,

Sieve weight = 491.8 gm Sieve + soil weight = 504 gm

Weight of soil retained = (504 – 491.8) = 12.2 gm

Percent retained= $2.2/300 × 100 = 4.07%

Cumulative percent retained= 0 + 4.07 = 4.07%

Percent finer= 100 – 4.07= 95.93%

The grain-size distribution of the soil sample can be obtained by plotting the percent finer with the corresponding sieve on semi-log graph paper.

CBR TEST FOR SOIL

INTRODUCTION:

It is the ratio of force per unit area required to penetrate a soil mass with standard circular piston at the rate of 1.25 mm/min. to that required for the corresponding penetration of a standard material. The California Bearing Ratio Test (CBR Test) is a penetration test developed by California State Highway Department (U.S.A.) for evaluating the bearing capacity of sub-grade soil for design of flexible pavement. Tests are carried out on natural or compacted soils in water soaked or un-soaked conditions and the results so obtained are compared with the curves of standard test to have an idea of the soil strength of the sub-grade soil.

FORMULA:

- C.B.R. = (PT/PS) X 100
- 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.

RESULTS AND DISCUSSIONS:

TABULAR FORM FOR DHIWANCHERUVU:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.0	0.2(1)		6.11	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%
15.0	18.4(85.6)		507.63	

Table 5.13

PENETRATION DEPTH (MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.14

TABULAR FORM FOR RAJANAGARAM:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.4	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.0	2(10)		61.16	
2.0	3.6(18)		110.09	
0.4	0.18(0.9)		5.5	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.5	10.2(51)		311.92	15.17%
4.0	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

Table 5.15

PENETRATION DEPTH(MM)	UNIT STANTDARDKGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.16

TABULAR FORM FOR GANDEPALLI:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
4.5	10.2(51)		311.92	15.17%
5.0	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

Table 5.17

TABULAR FORM FOR JAGAMPETTA:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.18

TABULAR FORM FOR YERRAVARAM:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.19

TABULAR FORM FOR PARTHIPADU:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.20

TABULAR FORM FOR KATHIPUDI:

PENETRATION	LOAD DIAL READINGS	TO TAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	**183**	3600

Table 5.21

TABULAR FORM FOR ANNAVARAM:

PENETRATION	LOAD DIAL READINGS	TOTAL LOAD O KGF	CORRECT LOAD KGF	CBR
0.5	0.18(0.9)		5.5	
1.0	0.2(1)		6.11	
1.5	2(10)		61.16	
2.0	3.6(18)		110.09	
2.5	5.2(26)		159.02	11.6%
4.0	8.8(44)		269.11	
5.0	10.2(51)		311.92	15.17%
4.5	12.8(54)		391.14	14.28%
10.0	14.7(73.5)		449.59	14.13%
12.5	16.2(81)		495.41	13.76%

PENETRATION DEPTH(MM)	UNIT STANTDARD KGF/CM SQ	TOTAL STANDARD LOAD (KGF)
2.50	70	1370
5.00	105	2050
7.50	134	2630
10.00	162	3180
12.50	183	3600

Table 5.22

SUMMARY:

- The liquid limit test values for the soil sample are ranging from 50-60.
- The plastic limit test values for the soil sample are ranging from 30-40.
- The Moisture content in very sandy soil may vary from 3% to 10% from the driest (wilting point) condition to the wettest drained state (field capacity), orfrom 20% to 40% in a clay soil.
- Moisture content of all the soils collected from the above areas varies from 2%to 10%.

- So, the soils collected from different areas are silty soils.
- The Standard value of Specific gravity should be between **2.50 to 3.00**. Organicmatter and porous particles may have specific gravity values below 2.0 and Soil which has heavy substance or particles may have values above 3.0.
- The Specific Gravity of all the soils in different areas is within the standard values.
- The soil in Yerravaram, Prathipadu and Annavaram has a specific gravity below the standard value (2.50) because of the presence of organic matter and porous particles.

Figure 5.23

IDENTIFICATION OF ENCROACHMENTS

Encroachments

Encroachment is a real estate situation where a property owner violates contractual property rights by unlawfully entering, building, or extending structures onto their neighbor's land without permission.

Encroachment means any unauthorized occupation of any highway or Land where the construction took place. Encroachments could involve trees, parts of a building, fencing or any other fixtures located on both pieces of property. This also encompasses the placement of fill, the removal of vegetation, or an alteration of topography into such natural areas. Whether the encroachment is intentional or not, the property owner is still liable for violating the contractual property rights of their neighbor. Structural encroachment occurs when a property owner unlawfully builds or extends structures onto their neighbor's land without permission.

"Setting up of these illegal establishments is a punishable offence under control ofnational highways (Land and Traffic) Act, 2002."

Types of Encroachment:

!. Temporary encroachment:

Temporary Encroachment means a new or existing Encroachment on a Highway whether at or above the Highway surface that is used on a temporary basis for no more than six (6) months for purposes including, but not limited to, decorations, planters, canopies, outdoor patios, patios, courier drop boxes, refuse containers, sales kiosks, equipment, equipment for the construction, repair, renovation, alteration, maintenance or demolition of a building and also includes any other Encroachment of a temporary nature.

2. Permanent encroachment:

The encroachment of acquired width of the land of the road results in permanent obstruction to the free movement of traffic and even the pedestrians' safety and security is put at stake. Therefore, the acquired width of the land cannot be permitted to be used for any private purpose.

S.No	CHAINAGE	SIDE	LENGTH	WIDTH	AREA	LENGTH FROM ROAD	TYPE OF STRUCTURE
1	801/1414	RHS	1090	827	9.47	1139	Open fields
2	844/193	LHS	1246	796	6.74	1273	Open fields

Table 6.1

GODAVARI INSTITUE OF ENGINEERING & TECHNOLOGY(A),
N.H.-16,CHAITANYA NAGAR,RAJAHMUNDRY-533296.
NATIONAL HIGHWAY AUTHORITY OF INDIA,
MINISTRY OF ROAD TRANSPORT & HIGHWAYS.

Fig no : 6.2

HIGHWAYS IMPROVEMENTS

IMPROVEMENTS REQUIRED FOR HIGHWAY

We have collected the improvements required for Dhiwancheruvu to Annavaram highway. So, we are hereto give some basic factors to improve in the given stretch. In the given stretch we have total 16 junctions i.e., we have given the factors for each junction below. By this factors we can control rate of accidents.

JUNCTIONS	Improvements required for highway
DHIWANCHERUVU JUNCTION	• Dedicate spaces for pedestrians • Create connected and safe cyclist network. • LED lights have to be fixed for clear vision. • Use data to detect problem area. • Proper plantation has to be maintained on divider to avoidabstraction from opposite vehicle's light.
RAJANAGARAM JUNCTION NEAR KAKINADA ROAD	• Kerb extension. • Repair of functional pavement defects. • Proper plantation has to be maintained on divider to avoidabstraction from opposite vehicle's light. • Reduce traffic speed.
RAJANAGARAM ROAD NAER AIRPORT ROAD	• Longitudinal markings. • Proper indication of sign boards. • Pavement markings. • Proper Kerbs painting.
MURARI JUNCTION	• Create connected and safe cyclist network • Reduce traffic speed. • Proper plantation has to be maintained on divider to avoidabstraction from opposite vehicle's light. • Marked and visible pedestrian crossings.
GANDEPALLI JUNCTION	• Use data to detect problem area • Pavement markings. • Create connected and safe cyclist network • Longitudinal markings.
MALLEPALLI JUNCTION	• Low speed zones • Speed humps
JAGGAMPETA JUNCTION	• Raised pedestrian crossings. • Proper indication of sign boards. • Clear sidewalks. • Proper indication of sign boards.
RAMAVARAM JUNCTION	• Proper indication of sign boards. • Pavement markings

STUDY OF HIGHWAY CONNECTING ROADS

JUNCTIONS:

In existing Project Highway, there are total major junctions and minor junctions. Details of all junctions are provided below.

Major Junctions:

S. No.	Chainage(km)	Type of Junction	Name of Access Road		Surface Type of Access Road	
			LHS	RHS	LHS	RHS
1		Y	Eluru		BT Road	
2	897+050	Y		Rajanagaram		BT Road
3	896+393	X	Gokavaram	Kakinada	BT Road	BT Road
4	895+500	X	Narendrapurem	Samarlakota	BT Road	BT Road
5	894+453	T		Rajanagaram		BT Road
6	886+300	Y	Gadarada		BT Road	
7	885+500	X	N T Rajapuram	Yelamilli	BT Road	BT Road
8	878+200	X	Uppalapadu	Ragampeta	BT ROAD	BT Road
9	879+200	Y		Yelamilli	BT ROAD	
10	872+300	Y	Jaggampeta service road	Jaggampet aservice road	BT Road	BT Road
11	871+100	T	Gurrapalem		CEMENT ROAD	
12	839+567	Y	Tuni		BT Road	
13	838+100	X		Kakinada		BT Road
14	838+200	X		Perumallapuram		BT Road
15	831+230	Y	Annavaram Town		BT Road	

Table 7.1

Minor Junctions:

S. No.	Chainage (km)	Type of Junction	Name of Access Road		Surface Type of Access Road	
			LHS	RHS	LHS	RHS
1	832+071	T	Chinnayapalem		BT Road	
2	833+191	T		Bendapudi		BT Road
3	833+446	T	Bendapudi		CC Road	
4	834+923	T	Village road		BT Road	
5	835+911	T	Village road		BT Road	
6	839+256	T		Mallapuram		BT Road
7	839+711	VUP	Chebrolu		BT Road	
8	842+233	T		Jaganadhapuram		BT Road
9	844+162	Y	Chendurthi		BT Road	
10	846+691	X	Vannepudi	Kodavali	BT Road	BT Road
11	847+199	T	Vannepudi		BT Road	
12	851+510	T		Dharmavaram		BT Road
13	851+980	X	Village road	Dharmavaram	Earthen Road	BT Road
14	853+050	T		Rachapalle		BT Road
15	855+610	Underpass	Prathipadu	Lampakalova	BT Road	BT Road
16	856+915	X	Prathipadu	Village Road	BT Road	Earthen Road
17	858+540	T		Jagganathapuram		BT Road
18	860+120	T		Siripuram		BT Road
19	862+390	X	Pedanapalli	Bhadravaram	BT Road	BT Road
20	863+460	PUP		Yerravaram		BT Road
21	863+550	T		Yerravaram		BT Road
22	864+063	T		Somavaram		BT Road
23	867+770	T	Burugupudi		BT Road	
24	870+113	T	Street Road		BT Road	
25	874+520	Y	Street Road		BT Road	
26	875+340	T	Street Road		BT Road	
27	876+495	T	Talluru		BT Road	
28	877+170	Y	Talluru		BT Road	
29	878+370	T	Village		BT Road	
30	880+980	T		Mallepalli		BT Road
31	881+150	X		Mallepalli		BT Road

32	884+900	X	Village road	Rajapuram	BT Road	BT Road
33	885+200	X	Gandepalli	Gandepalli	BT Road	CC Road
34	886+350	T		Gandepalli village		CC Road
35	892+890	Y		Gonagudem		BT Road
36	8934+450		East Gonagudem		BT Road	
37	897+255	T		Z Medapadu		BT Road
38	900+500	T		Chakradwaraba-ndam		BT Road

Note: BT –Bituminous, CC – Cement Concrete

Table 7.2

Tabular form for VASD's along with Chainage:

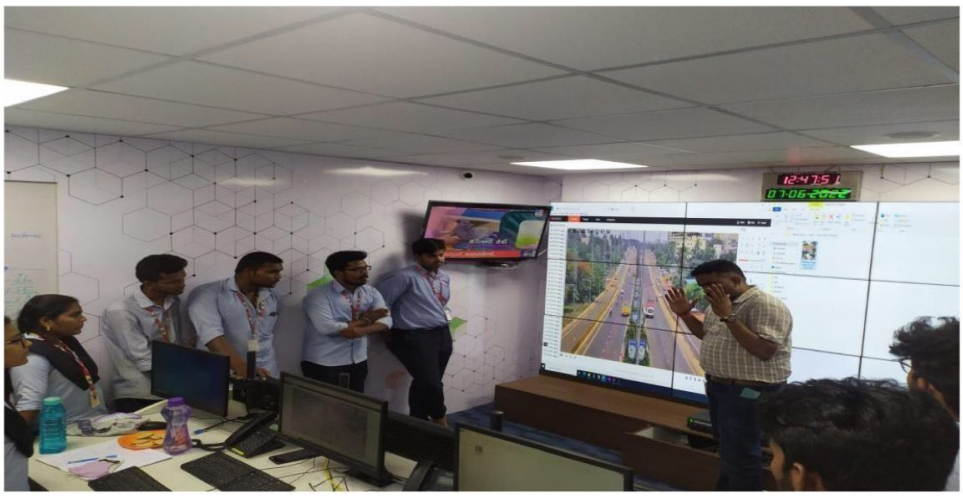
S.No	Name of the camera	Chainage
01	VASD	862.250
02	VASD	862.350
03	VASD	864.850
04	VASD	864.950
05	VASD	869.000
06	VASD	869.100
07	VASD	877.070
08	VASD	877.170
09	VASD	879.600
10	VASD	879.700
11	VASD	881.450
12	VASD	881.550
13	VASD	884.750
14	VASD	884.850
15	VASD	889.920
16	VASD	890.020

Table 9.6

Tabular form for VMS's along with Chainage:

S.No	Name of the camera	Chainage
1	VMS Full	831.250
2	VMS Full	901.370

Table 9.7



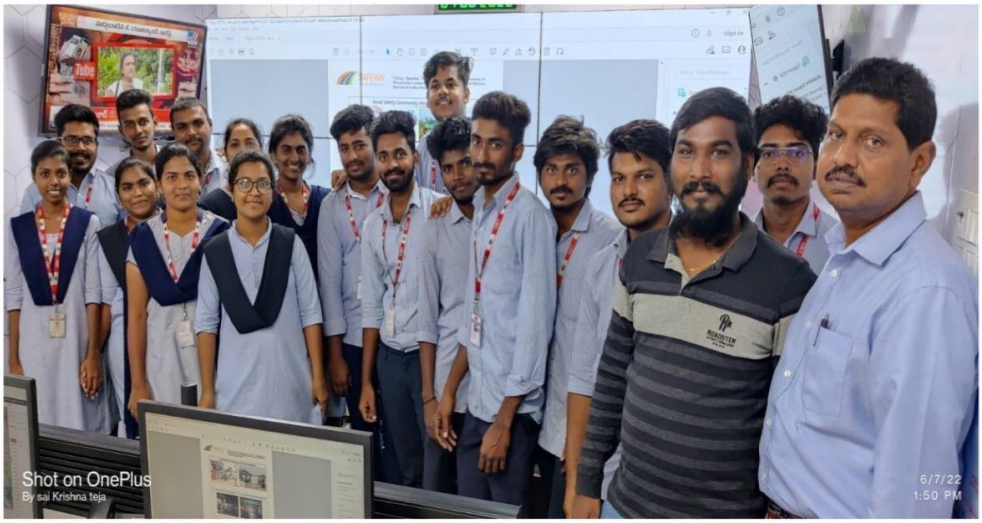


Fig No: 9.1

CONCLUSION

We have done the traffic volume and collected the data at different junctions from Dhiwancheruvu to Annavaram and we have given the number of vehicles passed in a particular time. And we have collected the data at toll plaza also and given the total number of vehicles passed form toll plaza.

- According to our survey from Rajahmundry to Annavaram, most of the vehicles are travelling from Vijayawada and Eluru.
- From Rajahmundry to Annavaram, most of the vehicles are travelling to Tuni and Razam.

- According to our survey from Annavaram to Rajahmundry, most of the vehicles are travelling from Vishakhapatnam.
- From Annavaram to Rajahmundry, most of the vehicles are travelling towards Rajahmundry.

The Accident data was collected form the police stations and we analysed the locations where the more accidents are occurring and we have given the suggestions to minimize and causes to happen the accidents more in a particular locations. By this data we can know the where we can keep black spot boards and danger signs.

From April 2021 to December 2021

- A total of 223 accidents occurred in April 2021 to December 2021.The frequency of occurrence is almost everyday
- 16 of Fatal Accident are recorded and resulted to 16 fatalities.
- 147 accidents are recorded Grievous Accidents and resulted to 77 are Grievous injuries.

- The majority of accidents have been occurred during 09:00AM TO 12PM of 45 Accidents Reported,4 Fatalities, 59 Grievous Injuries,99 Minor Injuries Reported.
- Accidents by Nature was Rear End Collision of 7 Accidents Reported, 2 Fatal, 15 Grievous Injuries,
- 25 Minor Injuries Reported.
- Accidents by Cause was Over speeding of 94 Accidents Reported, 3 Fatal, 17 Grievous Injuries, 25

These are the general suggestions to minimize the accidents on the roads:

- Removal of road debris.
- Place informatory boards in the case of any clogging of drains near roads.
- Thermoplastic pavements markings.
- Guard rails or Traffic barriers should maintain to avoid collision.
- Presence of traffic lights, traffic signs, speed limits and speed dumps for every 50 mts.
- Multi colored retro reflective road studs, delineators were installed.
- Cross slopes should be maintained to drain water.
- Marking longitudinal transverse bar marking ahead of median openings and junctions.
- Road sign about vehicle prohibited on both directions, give way, steed decent.

- Kerbs should be maintained well.
- Plants are needed to be planted on the dividers act as a barrier in order to avoid glare from thevehicles coming in the opposite direction.

We have taken the soil samples from the particular locations, the different types of soils are collected in the stretch and we did various types of tests on the soil. The tests are done to know the strength of the soil and to identify the soil is sufficient to bare the load of road when extended at shoulders.

- The Specific Gravity of all the soils in different areas is within the standard values.
- The soil in Yerravaram, Prathipadu and Annavaram has a specific gravity below the standard value (2.50) because of the presence of organic matter and porous particles.
- The liquid limit test values for the soil sample are ranging from 50-60.
- The plastic limit test values for the soil sample are ranging from 30-40.

We have done the Pavement survey to know the critical locations which causes accidents more and we have given the locations where it happened
The Encroachment data was collected and we have done survey on it and we gave the complete data and planning of a particular locations.
The maintenance of the highway is mainly to repair the damages of the roads and it will includes emergency response protocol, Medical Aid services, and coordinate with control centre.
Advanced Traffic management system (ATMS) it is very important and it includes make emergency calls to control room in case of any accidents, breakdown, fire and ambulance and also road alert alarms etc.
We have collected the number of petrol bunks are located in the stretch i.e. from dhiwnacheruvu to annavaram.There are total 9 petrol bunks on RHS and 12 petrol bunks on LHS.

FUTURE SCOPE

- The majority of existing highways are now four-lane roads (two lanes in each direction),though much of this is being expanded to six or more lanes.
- Transportation in order to provide the safe, efficient, rapid, comfortable, convenient, economical, and environmentally compatible movement of people and goods transport.
- This document also focuses on implementation of comprehensive and integrated AdvancedTraffic Management System(ATMS) on National Highways