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PLANNING AND DESIGN OF A RURAL ROAD USING SATELLITE IMAGES

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Abstract

The main objective of present study is to prepare plan for rural road for the selected village and to design as per code. Work involves selecting the best alignment for mudichur village which is selected for the study to connect it to the state highway, to design the village road as per IRC code and also to prepare the cost estimation for the study area.Planning was done by including various processes such as Map collection, Map study, Route selection, Surveys and Traffic survey. The required map both topographical map and satellite images were collected using Google earth. The design was done as per IRC 37 – 2001 and the results were obtained.

Keywords: IRC(Indian road congress), PCU(Passenger car Unit), AADT(Annual Average daily Traffic)

1. Introduction

1.1 Background

The selected study area is Mudichur and its surrounding village areas. Mudichur and its surrounding villages are located near Tambaram. Nearby places of study area are Vandalur, Mannivakkam and Perungalathur. It is a recently developing village due to nearby industries and factories. The exact study area is certain places of Mudichur village

i.e., Indra nagar, Gundumedu, Ranga nagar, Mahan agar and other places which are not having a proper road. The main objective of the study is to connect those places to both NH45 and Mudichur road which existing nearby. The reason for laying the new rural road is to make the short and correct route to the people to facilitate them. By thus the economic status of the people will also develop. This road will be having multiple uses. The existing road is not in good condition and also with long distance so there will be the need for construction of new road to make benefit to the village people by thus improving their economic status and also to overcome the various disadvantages because of the already existing road.

1.2 Need For Study

The basic need for the study is to learn the concept beyond the planning and design of a new rural road. Also to study the various steps involved in the planning such as reconnaissance, preliminary and detailed survey. By thus various steps in surveying also will be clearly studied. Apart from this design of a road also will be studied which include geometric and pavement design. Finally the cost estimation will also be done to know the value of the project. Hence the complete knowledge about a road project will be gained.

2. Literature Review

2.1 Planning And Design Of Nallambakkam Village Road (Via) Kattur, Near Rathinamangalam

Location And Classification**:** This road branches at Km 34/8 of GST road (NH45) on the left side at Urapakkam village. This road is maintained by Chengalpatu division. Total length of this road is 12.4Km

Importants And Necessity: This road passes through many agricultural villages. This road is used for carrying the agricultural products to the nearby markets. Along this road many metal and gravel quarries are located. Also many blue metal crushers are functioning on this road. Hence there is heavy vehicular traffic through out the day. Hence it is proposed to design the pavement

Pavement Design: The design traffic intensity is calculated based on Clause 3.3.6 of IRC: 37 – 2001

Total thickness	-	635mm (CBR = 5%)
GSB	-	250mm
WBM	-	300mm
DBM	-	60mm
SDBC	-	25mm

The estimated cost of the project is Rs. 620.00 lakhs

1.2 Codes And Guidelines

- IRC: 37-2001 design of flexible pavement[4]

3. Planning

3.1 Introduction

Planning is considered as a pre-requisite before attempting any development programme. This is particularly true for any engineering work. Planning of any road involves following processes

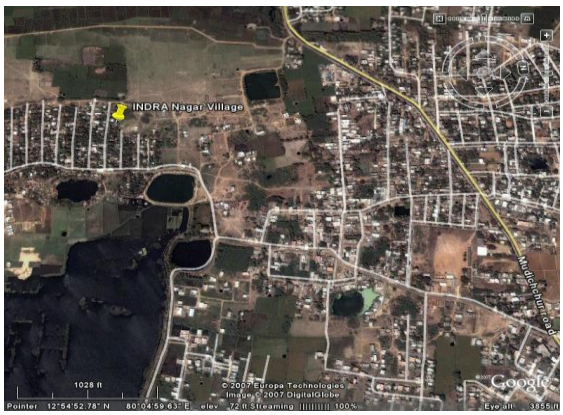
- Map collection
- Map study
- Route selection
- Reconnaissance survey
- Preliminary survey
- Choosing the best alignment
- Traffic survey
- Final location survey

3.1.1 Map Collection

The required map both topographical map and satellite images were collected using Google earth.

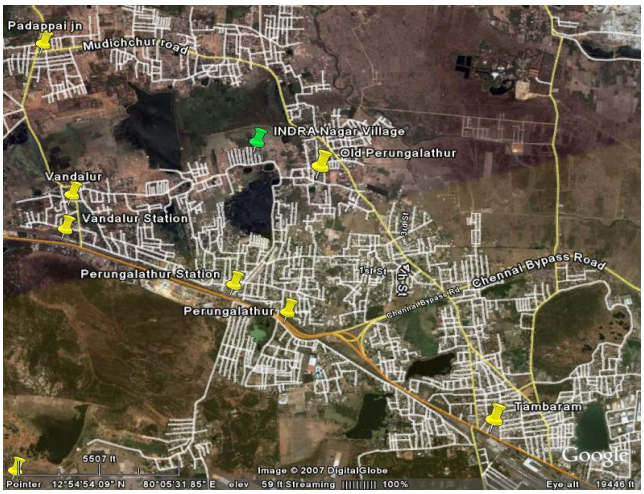
3.1.2 Map Study

From the map collected, it is possible to suggest the likely roots of the road. The main features like lake, hills, agricultural fields[8,9], population centre were studied using the collected maps to get the general idea about the project



Convert feet to meter in this map (make round iu.e 800)

North direction must be straight



Compass

3.*1.3Route Selection*

Route selection has done to finalize the alignment. Following factors were considered

Population

The population to be served was found by field survey and also by population data from concerned village panchayat

AREA	POPULATION
Mudichur	1252
Madhanapuarm	654
Indra Nagar	1052
Maha Nagar	148
Gundu Medu	1278
Ranga Nagar	132
Kurinchi Nagar	143

Total population to be served 4659

- Existing road network

The study area is located near tambaram. The existing road network was studied from the map.

- Topography

The terrain and other topographical data were studied by topographical maps. The terrain of the study area is plain terrain

- Sub grade condition
- Environmental factors
- Availability of materials

3.1.4 Reconnaissance

From the route selection numbers of possible alignments are chosen. In the reconnaissance, preliminary studying of various possible routes was done to get the general idea about the alignment[2]. Assessment was made on following

- Topography
- Soil condition
- Materials Availability
- Water Source
- Climatic condition
- Population centres

3.1.5 Preliminary Survey

Preliminary survey was carried out to choose the final alignment. Merits and demerits of each alignment is studied during the preliminary survey.

3.1.6 Choosing the Best Alignment

Based on the reconnaissance[10] and preliminary survey the Alignment #3 is chosen because

- Population density is high
- Trip generation is more
- Flat terrain
- Good soil condition
- Less obligatory points
- No sharp curves
- Used for future expansion

3.1.7 Traffic Survey

Traffic survey has done to find the flow of traffic. Traffic study has done on working day. Traffic study has done at link roads (i.e.) Perungalathur and Indra nagar road[1].

Passenger Car Unit (PCU)

The PCU is equivalence factor applied to convert heterogeneous vehicle to homogeneneous form. It is necessary to bring all type of vehicle to a common unit

Car, Van, Lcv	Bus	Truck/Trailer	Two-wheeler	Cycle	Animal drawn	Others
1	2.8	2.8	0.8	0.5	8	1

3.1.8 Final Location Survey

After selecting the alignment transulation on paper in the ground forms is a part of the final location survey. The points of transit and intersection falling on the centre line should be properly marked and referenced. Levels may be taken and longitudinal and cross sectional data obtained.

4.Geometric Design

4.1 Introduction

MANUAL ON ROUTE LOCATION, DESIGN, CONSTRUCTION AND MAINTENANCE OF RURAL ROADS (IRC Special Publication 20) was followed and the following results were obtained

4.2 Terrain Classification

The terrain is classified as a **Plain terrain**[3].

4.3 Design Speed

- Ruling design speed - 50 km/h
- Minimum design speed[3] - 40 km/h

4.4 Road Land Width

From Table. 2 of the manual

- Road land width - 10m

4.5 Building Line And Control Line

From Table.3 of the manual,

- Setback distance - 3m

4.6 Roadway Width

From Table. 4 of the manual,

- Roadway width - 7.5m

4.7 Carriageway Width

The width of carriageway was taken from Table. 6 of the manual.

- Carriageway width - 3m

4.8 Road Way Width At Cross Drainage Structure

From Table.5 of the manual,

- Road way width at cross drainage structure - 4.25m

4.9 CAMBER

The camber or cross-fall on straight sections of roads is taken from Table. 7. Since Water Bounded Macadam road is seleted,

- Camber - 2.5 % (1 in 40)

4.10 Side Slopes

The side-slope was taken from Table. 8.

- Side-slopes - 1 : ½ : 1

4.11 Horizontal Curves

In general, horizontal curves should consist of a circular portion flanked by spiral transition at both ends. Length of transition curves is determined on the basis of rate of centrifugal acceleration and super elevation[2].

4.12 Minimum Radius

Minimum radius of circular curves is given in Table. 10 of the manual.

- Minimum radius - 60m

4.13 Vertical Alignment

Grades: The gradients are taken from Table. 14.

- Gradient - 1 in 30

4.14 Formation Level

The formation level should be kept about 0.45m above the adjoining country level.

4.15 Sight Distance

Vehicles need good visibility for stopping and over-taking manoeuveres.

From Table. 15,

- Safe stopping distance - 45m.

5. Pavement Design

5.1 Types Of Pavement

The following general types of pavement are prevalent on low cost rural roads

i. Roads with ordinary earth surface
ii. Roads with improved surface, but not black-topped
iii. Roads with black-topped surface

The proposed pavement type is Roads with black-topped surface

5.2 Materials And Type Of Construction

The materials and types of construction frequently used for forming the pavement of rural roads can be grouped under the following categories

i. Ordinary earth
ii. Low-grade aggregates
iii. Soil-aggregate mixtures
iv. Mechanical stabilization of local soil
v. Soil-lime and soil-lime-fly ash stabilization
vi. Cement soil stabilized courses
vii. Bitumen soil stabilized courses
viii. Water bound macadam
ix. Brick soling
x. Bituminous surfacing and dust palliatives
xi. Cement concrete

The proposed type of construction is Water bound macadam

5.3 Water Bound Macadam

Water bound macadam is one of the most common specifications adopted for sub-base construction, base and surfacing courses[2]. The physical requirements of coarse aggregates, which are normally broken stone, crushed slag, overburnt brick metal, kankar, or laterite, are given in table

SI. No.	Construction Type	Test	Test Methodology	Demand
1.	Granular subbase	Los Angeles Abrasion Value* Or Aggregate Impact Value*	IS: 2386 (Part IV) IS: 2386 (Part IV) Or IS: 5640**	atmost. 60% atmost 50%

2.	Base course with bituminous surfacing	(a) Los Angeles Abrasion Value* Or Aggregate Impact Value* (b) Flakiness ndex***	IS: 2386 (Part IV) IS: 2386 (Part IV) Or IS: 5640** IS: 2386 (Part I)	Max. 50% Max. 40% Max. 15%
3.	Surfacing course	(a) Los Angeles Abrasion Value* Or Aggregate Impact Value* (b) Flakiness Index***	IS: 2386 (Part IV) IS: 2386 (Part IV) Or IS: 5640** IS: 2386 (Part I)	Max. 40% Max. 30% Max. 15%

Notes:

* Aggregates may satisfy the requirements of either the Los Angeles test or Aggreate Impact Value Test.

** Aggregates like brick metal, kankar and laterite which get softened in presence of water, should invariably be tested for impact value under wet conditions in accordance with IS: 5640.

*** The requirement of Flakiness Index shall be enforced only in the case of Crushed/ broken stone and crushed slag. The procedure set forth is IS:2430

Type of Coarse Aggregate

Property	Requirements for pavement layer (Maximum value in Percent)		
	Sub-base	Base coarse	Surfacing Coarse
Los Angeles Abrasion Value	60	50	40
Aggregate Impact Value	50	40	30
Flakiness Index	-	15	15
Property	Requirements for pavement layer (Maximum value in Percent)		
	Sub-base	Base coarse	Surfacing Coarse
Los Angeles Abrasion Value	60	50	40
Aggregate Impact Value	50	40	30
Flakiness Index	-	15	15

5.4 Design Of Flexible Pavements

In the design of flexible pavements, it has yet not been possible to have a rational design method wherein design process and service behavior of the pavement can be expressed or predicted theoretically by mathematical laws[4].

Following are the various methods of flexible pavement design

i. Group Index methodology
ii. California Bearing Ratio approach
iii. California R value or stabilometer method
iv. Triaxial test methodology
v. McLeod strategy
vi. Burmister method

California Bearing Ratio method (CBR method) is followed

5.5 CBR Method

Pavement design by CBR method was done by following IRC: 37-2001 DESIGN OF FLEXIBLE PAVEMENT.

Tto design a pavement by CBR method, first the CBR value of the soil subgrade is evaluated. Then the appropriate design curve is chosen by taking the anticipated traffic into consideration. Thus the total thickness of flexible pavement needed to cover the subgrade of the known CBR value is obtained. Thickness of the sub base course is the total thickness minus the thickness over the sub-case[7].

5.5.1 CBR Test

To design the pavement as per CBR method, the value of CBR percent is needed. To find the CBR percent, CBR test is conducted. This is a pen test developed by the California Division of Highways, as a method for evaluating the stability of soil subgrade and other flexible pavement materials. The test results have been correlated with flexible pavement thickness requirements for highways and air fields[7]. The procedure for CBR test is described below,

- Soil sample is compacted in CBR moulded in five layers with 55 blows of 5kg rammer
- Surcharge weights are placed above the sample
- Load is applied and Dial Gauge readings were noted
- A graph is plotted between Penetration(mm) and Load dial readings

Penetration of plunger (mm)	Load dial readings (divisions)
0	0
0.5	6
1.0	15
1.5	21
2.0	31
2.5	38
3.0	40
4.0	46
5.0	51
7.5	56
10.0	61
12.5	67

CALCULATION

Load dial reading at 2.5mm penetration =38 divisions
Proving ring constant =1.03 kg / divisions
Load at 2.5mm penetration = 38 x 1.03 =39.14 kg
CBR rate at 2.5mm piercing = (39.14)(100) / 1370
= 2.86 %
CBR rate at 5.0mm piercing =(51)(1.03) x 100 / 2055
= 2.56 %

CBR value = 2.9 %

PAVEMENT THICKNESS DETERMINATION

From the calculation

CBR Percent = 2.9 %

Traffic Classification = 150 to 450 commercial vehicles per day

From the CBR design chart Curve 'D'

Total thickness of pavement = 500 mm

LAYER	THICKNESS	SIZE OF MATERIAL
GRANULAR SUB BASE (GSB)	180 mm	90-40mm Coarse Aggregates
WATER BOUND MACADAM (WBM)	250 mm	63-40mm Coarse Aggregates
DENSE BITUMINOUS MACADAM (DBC)	50 mm	50-20mm Coarse Aggregates
SURFACE COURSE (SC)	20 mm	20mm stone grit with binding road tar no3

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