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Design Of A Typical Village Road

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Abstract - The Extension of rural road net work is of vital importance for bringing the social amenities, education and health within reasonable reach of villagers/tribals and for the expeditious transportation of agricultural produce from tribal villages to market yards and distribution centers. There are 13891 habitations in the state of Gujarat, of which only 11778 habitations are connected by all weather roads. The total length of road network in the state is about 146944 kms (91307 miles). Of the total road length of 146944 kms, the length of BT road is 8819 kms, WBM is 34226 kms and Gravel road is 60768 kms. There are 824 unconnected habitations of which 6134 are having a population of 100 and above. The existing soils, climate and terrain conditions in Panchmahal district of Gujarat state in India are suitable for the development of Agricultural and Horticulture Products. This paper attempts to address the issues relating to design of such a village road through which the all round development of the District can be achieved.

***Keywords*—Rigid Pavement, Flexible Pavement, Habitations, Village Roads**

I. INTRODUCTION

Panchmahal District, situated towards the extreme south east end of the state of Gujarat in India, with an area of 5837 sqm and a total population of 26.99 Lakhs (as per 2011 census). Typical soil present is Black Cotton, mean maximum and minimum temperatures are 42^{0}C and 28 ^{0}C and average annual rainfall is 728.60 mm. The existing surface of the proposed road from MIRAKHEDI @ 37/8 KM TO PANSALOVA (ST) VILLAGE OF GODHRA MANDAL OF PANCHMAHAL DISTRICT is gravel surface with fair geometry. The proposed road is to have Black Top standards from Km 0/0 to 1/7 and Concrete Pavement from km 1/7 to 2/0.

II. FIELD WORK

The details of surveys including inventory studies and investigations carried out during the feasibility study are:

- Traffic surveys, Pavement condition and road inventory surveys.
- Investigations on the existing pavement and sub grade
- Collection of samples from pits adjacent to the existing road and their testing Identification of borrow areas for different types of pavement and bridge construction material, collection of samples and their analysis

The figure below shows the map of Panchmahal District in the state of Gujarat in India.

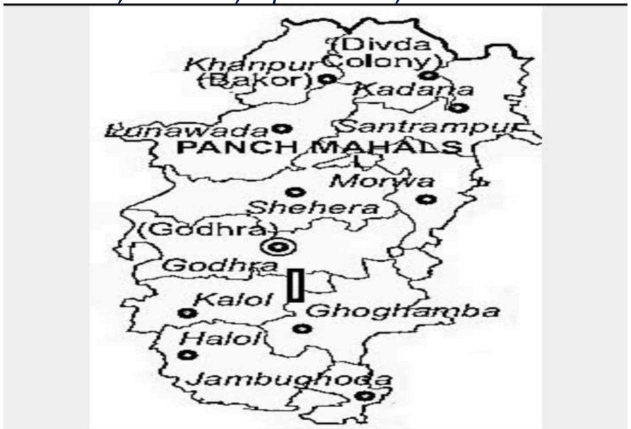

Figure:1 Map of study area

A. Traffic Studies

Traffic surveys were conducted on the project road and traffic volume counts were conducted for 3 days, and the number of vehicles plying on the road was recorded. From the classified traffic volume counts, the number of commercial vehicles (>3T) were considered in the pavement design. The following table gives the details about the number of commercial vehicles per day at present plying on the road and the estimated number of vehicles that will ply on the road at the end of design life.

Table:1 Commercial vehicle volume count

S.No	From	To	Length in Km	Present CVPD	Projected CVPD
1	Mirakhedi @ 37/8 Km	Panasalova	2.00	44	84

B. Road inventory survey

Detailed road inventory surveys were carried out to collect details of all existing road and pavement features along the existing road sections. The data collected included, but not limited to - Terrain (flat, rolling mountainous), Land-use (agricultural, commercial, forest, residential etc.), Carriageway width, surfacing type, Shoulder surfacing type and width, Su-grade/local soil type (textural classification), Horizontal curve: Vertical curve, Cross road type and details, Road intersection type and details, Location of water bodies (lakes and reservoirs), Height of embankment or depth of cutting, Land width - RoW (if available), Culverts, bridges and other structures (type, size, span arrangement and location), Roadside arboriculture, Existing utility services on either side within ROW, General drainage conditions, etc.

C. Pavement condition survey

Condition of the pavement was evaluated based on the field measurements. In case of Bituminous surface roads, primary pavement surface distress indicators like cracking (narrow and wide), patching, raveling, rutting and potholing were estimated visually coupled with physical measurements, and in case of gravel/ WBM roads apart from cracking and potholes, depressions, corrugations and material loss have been estimated. The extent of each distress has been visually estimated for every 200m length of the road in terms of percentage area affected and then averaged for a kilometer length. Edge breaking was also noted in terms of percentage length of road affected and shoulder drop off in terms of depth in millimeters.

As the GTS benchmark levels were not available, the survey was carried out assuming the value of elevation. Open traversing was done on the project road to establish temporary benchmark pillars, and these pillars were established at every 500m interval approximately on existing culverts or other landmarks.

D. Alignment

Utmost care has to be taken in deciding the proposed road alignment as it plays a pivotal role with regards to the total cost of construction. Due consideration has to be given to the following items which economize the cost of construction.

- As far as possible the alignment must pass along the ridges, for easy drain off.

- The alignment must pass through minimum cross drains, must be straight and plain to avoid the horizontal and vertical curves.

- The alignment must preferably pass through the out skirts of the habitation rather than passing through the midway of the habitation.

Generally in rural areas, the alignment is predetermined because there are earmarked tracks. The present road project is for up gradation of the existing Gravel road up to black top standards.

E. Test pits

Sub grade soil samples were collected by digging test pits at the interface of the carriageway and shoulder so that both the pavement and shoulder composition should be known. To determine the field density core cutter was used . Following tests were conducted on soil samples collected from field.

- ❖ The field moisture content was determined by rapid moisture meter at site
- ❖ Grain size analysis was done in laboratory for classification of soils.
- ❖ CBR testing was carried out on the specimens compacted at OMC at 3 different energy levels, on specimens both for un soaked and 4 day soaked

III. DESIGN STANDARDS

A. Introduction

The guidelines prescribed in IRC: SP; 20-2002 are adopted in general. These guidelines are applicable to other district roads and village roads. These roads provide accessibility to the villages in the rural area of the country, Geometric design standards of the rural roads need not be restricted to the minimum set out and milder values than the minimum should be preferred where conditions are favorable and the cost is not excessive.

B. Terrain Classification

The general slope of the country classifies the terrain across the area. The terrain is an important parameter governing the geometric standards and the criteria given in the table below, are used in classifying terrain under these categories. While classifying a terrain, short isolated stretches of varying terrain should not be taken into consideration.

Table:2 Terrain classification recommended by IRC

Terrain classifieds	Cross slope of the country	
Plain	0-10	More than 1 in 10
Rolling	10-25	1 in 10 to 1 in 4

The present road project falls under plain terrain and hence all the design parameters have taken pertaining to plain terrain.

Table:3 Design speeds to be adopted

Road Classification	Design speed km/h	
	Plain Terrain	
	Rulling	Min.
Rural roads	50	40

Normally, ruling design speed should be the guiding criterion for the purpose of the geometric design. Minimum design speed may, however, be adopted where site condition and cost does not permit a design based on "Ruling Design Speed". Hence for the present project a design speed of 50 Kmph is taken.

C. Roadway width

Roadway width, which includes parapet, side drains for rural roads for different terrain conditions shall be as per the guidelines given below.

Table:4 Recommended roadway width

Terrain Classification	Roadway width(m)
Plain & Rolling	7.5

D. Carriageway width

The standard width of carriageway for both plain and rolling as well as in mountainous and steep terrain shall be as per the Table given below.

Table:5 Recommended carriageway width

Road Classification	Carriageway width(m)
Rural Roads (VR)	3.75

The existing carriage way width for the present road project is 3. 75 m.

E. Shoulder width

The width of the shoulders for the rural roads in different terrain should be equal to one half of the difference between roadway width and carriageway width.
For the present road project the shoulder width is as per the requirement.

F. Sight distance

Visibility is an important requirement for the safety of travel on roads. It is necessary that sight distance of adequate length be available in different situations to provide drivers enough time and distance to control their vehicles so that chances of accidents are minimized. Three types of sight distance are relevant in the design of road geometry; Stopping Sight Distance (SSD), Intermediate Sight Distance (ISO) and Overtaking Sight Distance (OSD).

G. Stopping sight distance

The stopping sight distance is the clear distance ahead needed by a driver to bring his vehicle to a stop before collision with a stationary object in his path, and is calculated as the sum of braking distance required at the particular speed and the distance traveled by the vehicle during perception and brake reaction time. Based on the design speed of 50 Kmph the stopping sight distance is calculated to be 60 m.

H. Overtaking sight distance

Overtaking sight distance is the minimum sight distance that should be available to a driver on a two-way road to enable him to overtake another vehicle. The provision of overtaking sight distance is by and large not feasible on hill roads and also not considered for single lane roads. The design values are given in the Table below.

Table:6 Design values of Stopping, Intermediate and Overtaking sight distance

Speed (Mm/h)	Design Values (m)		
	SSD	ISD	OSD
20	20	40	-
25	25	50	-
30	30	60	-
35	40	80	-
40	45	90	165
50	60	120	235

I. Camber

The camber on straight section of road shall be as recommended in the table below. As the present project falls under plain terrain with average annual rainfall of 1015.80 mm > 1000 mm and the surface is of thin bituminous pavement, the proposed camber is 3.50% for the BT stretch and that of 2.5% for the rigid pavement.

At super-elevated road sections, the shoulder should normally have the slope of same magnitude and direction as the pavement slopes subject to the minimum cross-fall allowable for shoulder. The camber for earth shoulder should be at least 0.5% more than that for the pavement subject to the minimum of 4%. However, 1.0% more slope than the camber for the pavement is desirable.

J. Horizontal curve

Horizontal curve consists of circular portion flanked by spiral transition at both ends. Design speed, super elevation and coefficient of side friction affect the design of circular curves. Length of transition curve is determined on the basis of rate of change of centrifugal acceleration or the rate of change of super elevation.

IV. DISCUSSIONS

Pavement Design:-

Based on the field work, the traffic studies, reviewing various IRC codes for Rigid and Flexible pavement design, sub grade CBR and keeping the economics in consideration, the following composition has been suggested for the project under study.

Table:7 Flexible pavement composition

S.No	Road Reach	Present	GSB (mm)	WBM (mm)	Surface (mm) OGPC
1	KM 0/0 to 2/0	84	250	150	20

Table:8 Rigid pavement composition

S.No	Road Reach	Present	WBM (mm)	CC (mm)
1	KM 1/7 to 2/0	84	0	200

V. CONCLUSION

Rigid pavements have a high compressive strength, which tends to distribute the load over a relatively wide area of soil. Other advantages include - Low maintenance costs, Long life with extreme durability, High value as a base for future resurfacing with asphalt, decreasing base and sub grade requirements, Ability to be placed directly on poor soils, No damage from oils and greases and Strong edges.

On the other side, Flexible pavements consist of a series of layers, with the highest quality materials at or near the surface. The strength of a flexible pavement is a result of building up thick layers and thereby distributing the load over the sub grade; the surface material does not assume the structural strengths as with rigid pavements. Some of the other advantages include – adaptability to stage construction, Availability of low-cost type that can be easily built, Easy to repair frost heave and settlement and resistance to the formation of ice glaze.

The choice of pavement type has always been considered a tricky and complicated decision as it not only involves tedious field work, laborious calculations, etc., but also on the various economic and geopolitical influences on the project at the time of Designing-Constructing the road.

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