

Design And Comparison Of Pavement

KALLEPELLI PRANAYA

Assistant professor
Department of civil

VYAVASANI HARIPRIYA

Assistant professor
Department of civil

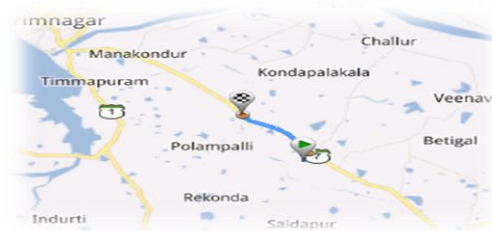
ABSTRACT

The current double carriage way State Highway NO.7 begins from Warangal and closures at Nizamabad going Huzurabad through Karimnagar, Jagityal. The undertaking street begins from Keshavapatnam and closures at Gattu Dudhenapalli. The aggregate length of undertaking street is 10 km. Extent of undertaking work covers getting field information and leading research centre test for the asphalt plan. Data have been gotten from the test did by M S Real expert and worked out according to IRC prerequisites. Field considers are led by LAKHY expert and we got the information and soil tests are gathered from the field to perform research facility test. From these information gathered further plan have been done.

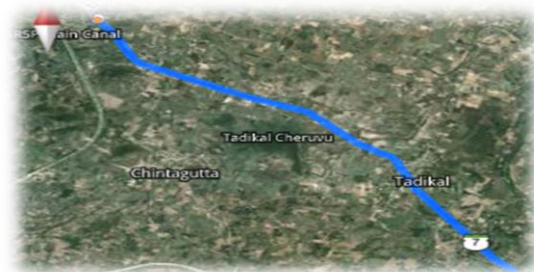
1. INTRODUCTION

GENERAL:-A.P.R.D.C (Andhra Pradesh Road Development Corporation) under direction of Gov. of India has taken up improvement, administration, and upkeep of SH7 example of single path to twofold path of state interstate where the activity volume has expanded essentially and to build the limit of roadway for productive and safe development of movement. It associates with Huzurabad disregarding Karimnagar, Jagityal and Naziabad. SH 7 begins from Warangal and closures at Naziabad. The undertaking street begins from Keshavapatnam and closures at Gattu Dudhenapalli. The SH 7 goes through the inclines, trenches. On either side of street the coconut trees planted in paddy fields can be seen. Some extend of street isn't even with bumps, soak rises, and bends. The quantity of pot openings is more as the area has substantial precipitation and the asphalt condition is reasonable. The development of SH7 has brought about quick improvement of the area in light of which the locale has most elevated education rate contrasted with other district. The venture street begins from Keshavapatnam (51Km) to Gattu Dudhenapalli (60km) which is around 10 km. Building studies led on venture street.

LOCATION MAP:-Area guide of the undertaking street is encased in the following page of this report.



AIM: - Up evaluating existing single path thruway to twofold path utilizing Indian measures and contrasting asphalt plan and two C.B.R. strategies.



OBJECTIVES/SCOPE:-The reason for this exploration is condensed as the targets. The primary target of the investigation is to up-degree of existing single path thruway segments to 2-path separated carriage way setup. The venture as an in part get to controlled office must be built up by directing designing overviews, examinations. This venture incorporates asphalt review, activity overview and soil condition study.

OUTLINE OF PROJECT REPORT:-Following is the framework of the report The venture covers investigation of different plan system and examination embraced according to IRC prerequisite.

METHODOLOGY Visual condition study Carry out C.B.R test Traffic studies Classified movement volume check turning development overview Origin and goal overview Axle stack overview Traffic development rate embraced Road and asphalt condition. Pavement configuration utilizing CBR strategies prescribed by Indian street congress.

2. LITERATURE REVIEW

Map study as per Khanna and Justo:-In the event that the geology guide of the region is

accessible, it is conceivable to propose the probable courses of the street. When it comes maps of the topographic are accessible from the Survey of India, with form interim going from 15 to 30 meters. For the most part waterways, slopes, valleys are appeared in this guide. By the contextual investigation of these guide we get the thoughts of a few conceivable courses the can be interconnected. The likely arrangement can be situated on the guide. Arrangement ought to be stayed away from at whatever point we run over valleys, lakes or lakes. At the point when the street needs to cross a column of slopes, plausibility of intersection ought to be through a mountain pass. Rough Location of scaffold site for the intersection stream ought to be kept up at the short separation for economy, abstain from twisting of the waterway. In this manner from the guide contemplate interchanges courses can be proposed through the guide think about. It gives an unpleasant direction of the courses to be additionally overviewed in the field.

As per DR.L.R.Kadyali and DR.N.B.Lal Observation: As per Khanna and Justo:- It is to look at the general attributes of the territory for choosing the practical courses for natty gritty investigations. Subtle elements gathered amid this overview are: Approximate estimations of inclination length and span of bends of interchange arrangement, Number and kinds of cross seepage structures, Soil writes along the courses from the field ID test, Sources of development material and water, Deciding the steady and shaky sides of the slope for arrangement when it is going through columns of slopes and mountains territories

As per DR.L.R.Kadyali and DR.N.B.Lal:-It begins with field assessment by strolling or driving in a jeep. Points of interest gathered in this review are: Details of course geology of the zone, Length of street along options, Geometrics, for example, inclinations that are attainable, bends and fastener curves, Terrain and soil conditions, Drainages qualities of the territory, Facilities/Resources, Road length going through hilly landscape, Recreation Potential, Strategic thought, Economic Factors, Ecology.

Audit:-The basic audit is from the Reconnaissance overview we get the insights about course geography, length of street choices, inclinations, soil write along the courses from the field distinguishing proof test, Sources of development material and water.

CBR METHOD OF DESIGN: Technique 1:- Configuration is finished by IRC-37:2001 so there is will be no normal survey for the plan as it will be same in each viewpoint.

Technique 2:-As indicated by khanna and Justo

Keeping in mind the end goal to plan asphalt by CBR technique, first the CBR estimation of the dirt sub review is assessed. At that point the surmised configuration bend is picked by mulling over the expected activity. In this way the aggregate thickness of adaptable asphalt expected to cover the sub grade of the known CBR esteem is acquired. An estimation of the movement is done keeping in see the current activity and the development rate of activity.

$$A = P [1+r] (n+10)$$

As per DR.L.R.Kadyali and DR.N.B.Lal:-The dirt quality is estimated by CBR tests. The choice of dampness content is essential, and the technique set down. The thickness is given by 7 bends. The activity is regarding business vehicles every day, the movement is the aggregate no. of vehicles in the two bearings.

Audit:-The regular audit is first the CBR estimation of the dirt sub review is assessed. At that point the inexact outline bend is picked by thinking about the expected activity. Activity is figured by an estimation of the movement is done keeping in see the current activity and the development rate of movement. $A = P [1+r] (n+10)$

3. DETAILS OF PROJECT ROAD

general:- The venture street begins from Keshavapatnam (51Km) and closes at Gattu Dudhenapalli (60Km), the aggregate length of task street is 10 Km which is a piece of State interstate No 7.The arrangement of undertaking street is situated amongst waterways and rock slopes. The task street goes through the congested towns/town i.e. Narasingapuram, mannempalli.

existing project road Landscape :- The task street goes through the diverse landscape .The points of interest of territory that venture street

type terrain	length, km	from, km	t o , k m
plain terrain	5	51	56
plain terrain	5	57	60
total length	10km		

passes is given in beneath table.

Site photographs Plain terrain photographs:-



Photograph of state highway close to canals and granite hills:-



WEATHER:-The atmosphere in this district is damp and hot. Along the task street the normal yearly rain fall is more than 550mm. The undertaking street gets normal precipitation amid blustery season ordered beneath. The normal precipitation and temperature of the locale is given underneath. The underneath said places are greater towns in the locale along the undertaking street..

Place	Rainfall mm	Temperature	
		Actual	Peak
Gattu	20	22°C	47°
Dudhenapalli		23°C	C
Keshavapatnam	20	21°C	49°
			C

DETAILS OF PAVEMENT CONDITION

According to visual condition survey the pavement condition details is given below.



Poor condition



Fair condition



Very poor condition



Good condition

WIDTH OF CARRIAGEWAY:-The typical carriage way width is around 7 m with the

exception of close developed region and access to real towns and urban communities, which changes from 6.5m to 10m roughly. The carriage way width subtle elements are given underneath.

4. SOILANDPAVEMENTINVESTIGATIONS

Reconnaissance survey:-Surveillance study of undertaking street is done for whole length of task by key work force and supporting staff.

Details of pavement investigation:-Examination subtle elements of piece of asphalts Task street asphalt piece is completed at 3 unique areas by burrowing test pits 1m x 1m x 0.8m at edge of existing asphalts. Existing asphalt structure and their thickness are noticed .the information acquired is utilized as info information for HDM-IV examination.

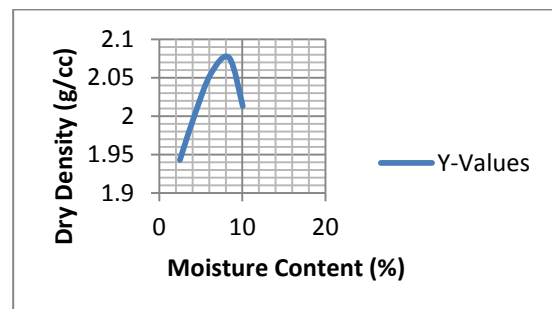
Project road pavement condition:-

Condition	Location, Km	
	From	To
Good	51	53
Poor	57	58
Excellent	54	56
Good	58	60

Soil tests Modified proctor compaction test (is: 2720-part viii) Observations and calculations

Volume of the cylindrical mould $V = \pi r^2 h$
Volume of the cylindrical mould is $V=2253\text{ml}$.
Weight of Rammer (kg) = 4.9
Number of Blows: 55 Number of Layers: 5
Weight of mould (g):5570.

By plotting the graph against water content vs. dry density we can get the OMC:-



From the graph values obtained are MDD (Maximum Dry Density) = 2.79 (g/cc) OMC

Performance of cbr test:-

California bearing test is penetration test developed by the California division of highway.

$$\text{cbr} = \frac{\text{load sustained by the specimen at 2.0 or 5.0 mm penetration}}{\text{load sustained by standard aggregate at the corresponding penetration}} \times 100$$

Condition	Location, Km	
	From	To
Good	51	53
Poor	57	58
Excellent	54	56
Good	58	60

× 100 The cbr value for soil sub grade and compacted soil is obtained below

penetration of plunger, m	load dial reading ,division		
	specimen 1	specimen 2	specimen 3
0.0	0	0	0
0.5	6	3	5
1.0	12	8	9
1.5	25	14	12
2.0	27	18	17
2.5	37	31	34
3.0	39	34	36
4.0	43	38	38
5.0	47	41	40
7.5	57	49	43
10.0	64	56	49
12.5	68	64	58

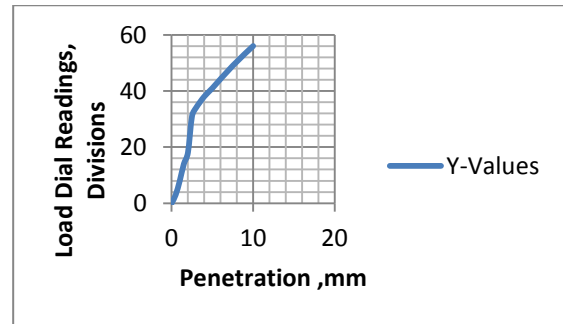
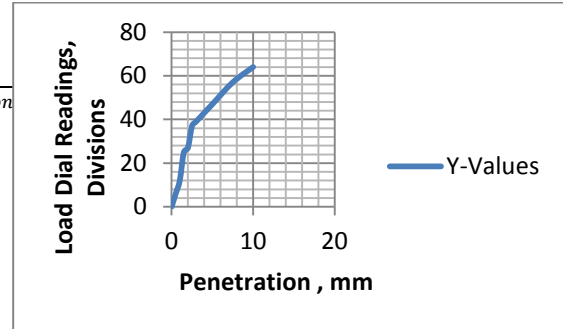
CALCULATIONS

SPECIMEN 1:- Load dial reading @ 2.5mm penetration = 37 division Load @ 2.5 mm penetration = $37 \times \frac{190}{100} = 70.3$ kg C.B.R value for 2.5mm penetration = $\frac{70.3 \times 100}{1370} = 5.13\%$ Load @ 5.0 mm penetration = $\frac{47 \times 190}{1370} = 89.3$ kg CBR value for 5.0 mm penetration = $\frac{89.3 \times 100}{2055} = 4.34$ Therefore CBR value of specimen 1 is 5.13 %

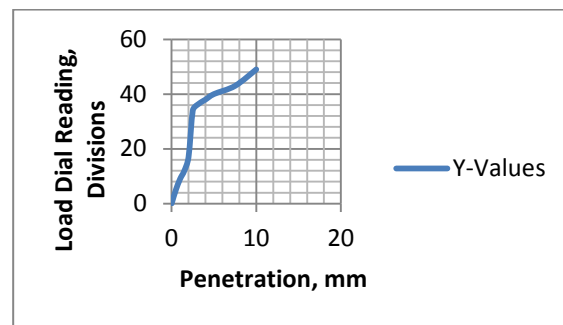
SPECIMEN2:- Load @ 2.5 mm penetration = $\frac{31 \times 190}{100} = 58.9$ CBR value for 2.5mm penetration = $\frac{58.9}{1370} \times 100 = 4.30\%$ Load @ 5.0mm penetration =

(Optimum Moisture Content) = 7.9 (%)

$$\frac{40 \times 190}{76 \times 100} = 76 \text{ CBR value for 5.0mm penetration} = \frac{76 \times 100}{2055} = 3.70\%$$



Specimen 3:- Load @ 2.5 mm penetration = $\frac{34 \times 190}{100} = 64.6$ CBR value for 2.5mm penetration = $\frac{64.6}{1370} \times 100 = 4.71\%$ Load @ 5.0mm penetration = $\frac{41 \times 190}{1370} = 77.9$ CBR value for 5.0mm penetration = $\frac{77.9 \times 100}{2055} = 3.79\%$



Therefore the CBR value for specimen 2 is $\frac{5.13 + 4.3 + 4.71}{3} = 4.72$ CBR value for sub grade soil is 4.72% Reported C.B.R value 4.72 CBR value adopted as 5%

Tests conducted on coarse aggregate impact test:- Impact value of aggregate was found by the formula Aggregate impact value = $\frac{w_2}{w_1} \times 100$

Observations and calculations:

S.NO	DETAILS	VALUES
1	Total weight of aggregate sample filled in cylinder(W1kgs)	0.559
2	Weight of aggregate retained in 2.36mm sieve after test(W2kgs)	0.058

$$\text{Aggregate impact value is} = \frac{0.058}{0.559} \times 100$$

AGGREGATE IMPACT VALUE IS 10.375% not >30% so allowable.

Los Angeles abrasion test:-Abrasion value was found out by the formula

$$\frac{W1 - W2}{W1} \times 100$$

Observations and calculations:-

S.NO	DETAILS	VALUES
1	Weight of sample(W1kgs)	10
2	Weight of sample retained in 1.7mm sieve	8.523

$$\text{Abrasion value} = \frac{10-8.523}{10} \times 100$$

Abrasion value of aggregate sample is **14.77%** not > 30% so allowable.

Water absorption test:-The water absorption of aggregates is determined by measuring the increase in weight of an oven dry sample when immersed in water for 24 hours. The ratio of the increase in weight to the weight of the dry sample expressed as percentage is known as absorption of aggregate.

Observations and calculations:-

Weight of the dry sample (W1) = 200 grams.

Weight of the soaked sample (W2) = 210 grams.

$$\begin{aligned} \text{Percentage of water absorbed} &= \frac{W2-W1}{W1} \times 100 \\ &= \frac{210-200}{200} \times 100 \end{aligned}$$

Percentage of water absorbed is **5%**.

Tests on bitumen penetration method :-

Determination No.	Penetration of bitumen	Grade of Bitumen (Average Penetration)
1	41	(41+39+40)/3=40
2	39	
3	40	

RESULT:

Penetration value of the taken bitumen is 40mm.

Flash and fire point RESULT:-

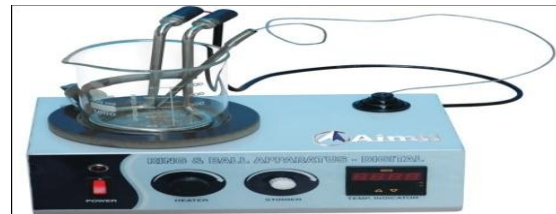
Flash point of the taken bitumen is 120°C
Fire point of the taken bitumen is 120°C

DUCTILITY TEST:-This test is done to determine the ductility of distillation residue of cutback bitumen, blown type bitumen and other bituminous products as per IS: 1208 – 1978.



RESULT:-Ductility value of the taken bitumen is 59cm

SOFTENING POINT:-This test is done to determine the softening point of asphaltic bitumen and fluxed native asphalt, road tar, coal tar pitch and blown type bitumen as per IS: 1205 – 1978.



PREPARATION OF SAMPLE REPORTING OF RESULTS

Record the temperature at which the ball touches the bottom 48°C.

5. TRAFFIC SURVEY AND ANALYSIS

Traffic data:-Summary of manual classified traffic count of seven days (The following classification of vehicles is carried out according to IRC)

TRAFFIC DIRECTION TO -----

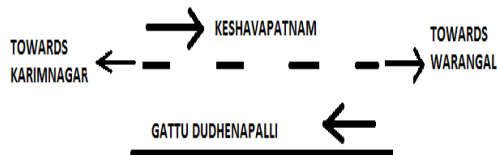
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KESAVAPATNAM

MOTOR BIKE 210

+ motor tricycle etc.

CAR	85
+taxis,etc	
SMALL BUS	30
+ SMALL TRUCK (2axles,single rear tyre) etc.	
Trucks(Multi Axle)	6
3WHEELERS	85
COACHES AND BUSES	25
OTHER/TRACTORS	18
LIGHT COMMERCIAL VEHCILES	25
HCV	15
TOTAL	499



6. PAVEMENT DESIGN

Designs by cbr chart method of cbr Data:-

Soil sub grade C.B.R = 5.6%

Compacted soil C.B.R = 7.95%

Poorly graded gravel C.B.R = 20%

Well graded gravel C.B.R = 95 %

Growth rate =7.5%

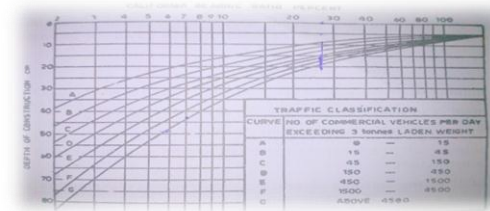
The minimum thickness of bituminous concrete layer surfacing according to IRC (Indian road congress) is 5 cm.

Calculation procedure

$$A = P [1+r]^{(n+10)}$$

$$= 54 [1 + 0.075]^{(5+10)} = 160 \text{ vehicles/day}$$

Therefore Design curve D (of chart given below) is used for design as the traffic volume design is in range above 160.



As the obtained C.B.R value for the soil sub grade

Layer =5%. According to curve D of chart the total pavement thickness is 38cm

Hence 38 cm of pavement material required to cover natural soil sub grade having C.B.R value of 5 %.

Now to compute the thickness of compacted soil

Having C.B.R value of 7.95% value, the design

Curve D of chart is used and the thickness of

Compacted soil layer is 29 cm.

Calculation: - The total thickness of compacted

Soil layer is 38cm-29cm=9cm

As we have considered the poorly graded gravel with 20 % C.B.R value the thickness of layer according to curve D chart is 18cm

Calculation:-The total thickness of poorly grade gravel is 29cm-18cm=11cm

Now to compute the thickness of well graded gravel having C.B.R value of 95% value, the design curve D of chart is used and the thickness of well graded gravel is 8cm .

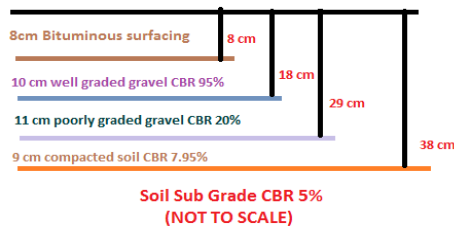
Calculations:-The total thickness of well graded gravel is 18cm-8cm=10cm

So from the above obtained thickness value for each layer the total required thickness for bituminous surfacing will be 8cm.

Calculation: -9cm+11cm+10cm=30m

From the obtained answer subtract the total

Thickness obtained 38cm-30cm=8cm



Designs by cbr catalogue method data:-

Two-lane single carriageway Traffic growth rate per annum = 7.5% Design life= 15 years Vehicle damage factor= 4.5 Design CBR of sub grade soil= 5 per cent

DESIGN CALCULATIONS:- Calculation of number of heavy vehicles per day "A"

$$A = P[1+r]^{(n+10)}$$

P= seven day average of heavy vehicles found from 24hours counts.

$$P = 375/7 = 54$$

$$r = 0.075 \text{ (for 7.5\% growth rate } r = 0.075)$$

$$n = 5$$

$$A = 54 \times [1 + 0.075]^{(5+10)}$$

$$A = 160 \text{ CV/day}$$

$$N_s = \frac{365 \times [(1+r)^n - 1]}{r} \times A \times D \times F$$

$$N_s = \frac{365 \times [(1+0.075)^{15} - 1]}{0.075} \times 160 \times 0.75 \times 4.5$$

$$N_s = 5047929.683$$

$$\therefore N_s = 5.0 \text{ msa}$$

From IRC-37: 2001

PAVEMENT DESIGN CATALOGUE

PLATE1- RECOMMENDED DESIGNS FOR TRAFFIC RANGE 1-10 msa

CBR 5%					
Cumulative traffic (msa)	Total pavement thickness	PAVEMENT COMPOSITION			
		Bituminous surfacing Wearing Course (mm)	Binder Course (mm)	Granular Base (mm)	Granular Sub-base (mm)
1	430	20 PC		225	205
2	490	20 PC	50 BM	225	215
3	530	20 PC	50 BM	250	230
5	580	25 SDBC	55 DBM	250	250
10	660	40 BC	70 DBM	250	300

From the above table

Total pavement thickness is **580mm** Bituminous

Surfacing Wearing Course 25SDBC

Binder Course 55 DBM Granular Base **250mm** Granular sub-base **250mm**

7. CONCLUSION

Catalogue method:

Advantages; - Design can be done for traffic volume more than 4500 CV/DAY but in chart method it is not possible to design traffic more than 4500 CV/day. As we consider traffic growth rate in the design, design will be appropriate for the adopted design life. Vehicle damage factor is considered in the design so that no effect to the pavement in view of vehicle weight as VDF is found by axle load survey.

Disadvantages:- Total pavement thickness obtained in this method was 58cm will is more than of the chart method 38cm. So the method of design is not economic compared to chart method. Pavement design is not based on each CBR of each layer. Best suitable layer cannot be decided as CBR is not done for each layer in this method.

Indian road congress (IRC)

CHART METHOD:

$$A = P [1+r]^{(n+10)}$$

Where

A= number of heavy vehicles per day for design (laden weight > 3tonnes)

P = number of heavy vehicles per day at least count

r = annual rate of increase of heavy traffic n =

Number of years between the last count and the

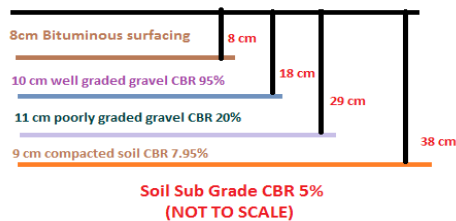
Year of completion of construction.

Where A is the parameter used to determine the

Number of heavy vehicles per day for

Design Characteristic deflection- 0.349 to 1.52C.B.R

For material used has values from 4.6% to 95% The total thickness above sub grade is 55 cm



Advantages:-The pavement design is based on C.B.R value obtained from each material. Based on CBR value the best suitable material for each layer can be decided. The thickness of pavement design obtained is less compared CBR first method which indicates design using this method is economic compared to First method.

Disadvantages:-The major disadvantage of this method is chart do not specify design thickness for road which has flow of commercial vehicles more than 4500. It remains same above 4500 vehicles. The CBR method of pavement design provides the total thickness of the pavement above sub grade and thickness of pavement remains the same irrespective of material quality used in each layer .Hence the material combination should be selected very carefully considering durability and economy of pavement. Vehicle damage factor is not considered in this method which may affect the performance of the pavement.

8. BIBLIOGRAPHY

1. Highway Engineering by **Khanna and Justo** 2009 edition.
2. Highway Engineering by **Dr.Kadyali and Lal** 2011 edition.