Study and Analysis of Road Widening and Strengthening

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ABSTRACT

The high growth number of vehicles will increase the movement and the use of transport infrastructure. Road widening is one of the actions that can be used as the solution. However, this solution also increases the traffic performance.This is because people will switch to use the nee road widened because they believe this road can accommodate the existing traffic volume. For finding out the effects of road widening towards the increasing of traffic performance and road capacity, it is necessary to conduct a research and an analysis.The Road network of any city is its lifeline, and the evaluation of their performance is very necessary for future traffic planning, design, operation, and maintenance etc.Traffic flow is most cities of India is mixed traffic characteristics and the traffic congestion id the common problem in most major cities in India.In this project on "widening and strengthening of the road" and aimsto widen the roads in Ranga Reddy district of Telangana. Under this project, single lane roads are modified as double lane roads. The project includes the improvement of roads connecting a particular area. Total length of the road is 18km.

I. INTRODUCTION

Roads are meant to facilitate mobility the movement of people & goods. However most roads are widened & developed for facilitating vehicles rather than for pedestrians &non motorized vehicle. Road widening is normally carried out when the road is inadequate for the traffic using it, or when extra lanes are needed. Road widening can improve traffic safety and capacity. The widening roads are one of the useful methods to deal with the current long- standing traffic problems. The existing roads in the States are generally flexible pavements and their capacity augmentation by way of widening and strengthening would therefore generally be by provision of flexible pavements only.

II. LITERATURE REVIEW

1.DeepuRazak, Dr. Devinder Sharma, Er. MunishKumar(2018) "Strengthening and Widening of flexible pavement: a case study of Kaithal Rajasthan border section (NH-152/65)" Kaithal – Rajasthan Border NH-152/65 for the stretch of 7.5 km. For structural evaluation the existing pavement condition has carried out by BBD technique and overlay design has carried out as per IRC: 81-1997 guidelines on Kaithal – Rajasthan Border NH-152/65 for the selected stretch of 7.5 km.

2.Mr. G. Venkatesh, Mr. JavedAli (2018) "Strengthening and Extension Of Existing Urban Road For The Development Of Industrial Corrider: A Case Study In Telangana State Highway (Sh-1)"The study highlights the need of pavement evaluation and pavement evaluation measures for the road pavements of Hyderabad – Karimnagar – Ramagundam of state highway -1 also known as "Rajiv Highway" for the stretch of 207 km. The road plays an important role in connecting some of the main regions in Telangana state of Hyderabad, Siddipet, Karimnagar and Ramagundam. "This corridor is expected to play a vital role in the economic development of the Telangana region as the belt is marked by presence of several industrial units." It is a great and well-maintained highway in Telangana.

III. METHODOLOGY

3.1 GENERAL

The detailed site investigation in which road inventory data, traffic flow condition and identify the traffic circulation pattern in & around study area. The traffic survey & Analysis: A Collected data has analysed

to identify roadway segment capacity, based on the IRC Guidelines for the capacity of Urban Road in plain area IRC: 37-2001. Preparation of a conceptual design: A Next step has to propose section specific inventions to be identified and prepare their of implementation plan. Based on the need of urgency.

3.2 DESIGN CRITERIA OF FLEXIBLE PAVEMENT AS PER IRC 37:2001

The flexible pavements have been modeled as a three-layer structure and stresses and strains at critical locations have been computed using the linear elastic model. To give proper consideration to the aspects of performance, the following three types of pavement distress resulting from repeated (cyclic) application of traffic loads are considered: 1. vertical compressive strain at the top of the sub-grade which can cause sub-grade deformation resulting in permanent deformation at the pavement surface. 2. horizontal tensile strain or stress at the bottom of the bituminous layer which can cause fracture of the bituminous layer. 3. pavement deformation within the bituminous layer. While the permanent deformation within the bituminous layer can be controlled by meeting the mix design requirements, thickness of granular and bituminous layers are selected using the analytical design approach so that strains at the critical points are within the allowable limits. For calculating tensile strains at the bottom of the bituminous layer, the stiffness of dense bituminous macadam (DBM) layer with 60/70 bitumen has been used in the analysis.

IV. RESULTS AND DISCUSSIONS

4.1 DATA COLLECTION ON SOIL PROPERTIES

Table 1: Atterberg Limits

Description of index property	Experimental value
Liquid limit	27.8%
Plastic limit	17.89%

Table 2: Particle Size Distribution

IS SEIVE	WT.RETAINEDIN GMS	%WT RETAINED IN GMS	% PASSING
4.75mm	17.66	1.766	98.23
2.36mm	16.79	1.673	96.56
1.18mm	14.02	1.402	95.16
600 microns	10.51	1.051	94.11
300 microns	2.65	0.265	93.85
150microns	21.67	2.167	91.67
75microns	40.62	4.062	87.61

Based on the above properties the IS Soil Classification for the soil sample under test is ‘CL’

From the experimental investigations the specific gravity of collected sample is 2.56

Table 3: Standard Proctor Compaction and Moisture Content

Maximum dry density of the soil sample	2.20g/cc
Optimum moisture content	12%

Table 4: CBR Test proving ring values

Penetration mm	**Load**
0	0
0.5	15
1	31
1.5	44
2	59
2.5	72
3	87
3.5	101
4	115
4.5	121
5	132

The CBR value for collected soil at 2.5mm =5%

4.2 DESIGN OF DOUBLE LANE ROAD FOR EXISTING RAOD

Commercial Vehicle per day(CVPD) is 2815.

Road Inventory Data Has Collected Which Are Given Below:

Name of work: Widening and strengthening of PWD road

Length of stretch: 18 Kms

Type of Pavement: Bituminous

Carriage way width: 7 Mtrs

No.of Lanes: 2 Lanes

Surrounding Environment: Rural & Urban

Existing Road: Single Lane Road

Type of traffic: Mixed traffic

Class of Road :State Highway

Calculation of million standard axles for widening portion:

Ns=365xA[(1+r)x -1] x F /r

=365x2815x(1+0.08)15-1)x4.5/0.08 = 50msa

Where r is traffic growth rate=8%

F is vehicle damage factor = 4.5

4.3 CONSTRUCTION OF ROAD

The Widening of single lane road into double lane that is increasing the width of 1.875m (half of the single lane width) on both sides of the single lane road. Firstly center point of the width of the single lane old road is measured, The Widening of single lane road into double lane that is increasing the width of 1.875m (half of the single lane width) on both sides of the single lane road. Firstly center point of the width of the single lane old road is measured, and marked with pegs. Then place the pegs at distance of 3.75m from the center of the old road without any error to the both sides by joining the pegs we have to form a straight line for excavation work. The Both sides of Newly formed road upto DBM layer. On the DBM layer of newly formed road and old road combinedly laying on BC & SDBC layers.The construction of road completed by 1) Clearing and Grubbing, 2) Excavation, 3) Construction of Subgrade, 4) Construction Granular Sub base, 5)Wet Mix Macadam Construction, 6)Dense Bituminous Macadam Construction, 7)Bituminous Concrete Construction, 8)Semi-Dense Bituminous Concrete Construction.

4.4 Clearing and Grubbing(Acceptance Criteria: Ref. Section 201 of MORTH)

This work shall consist of cutting, removing and disposing of all materials such as trees, bushes, shrubs, stumps, roots, grass etc. and top organic soil not exceeding 100mm in thickness, rubbish etc., which are unsuitable for incorporation in the works, from the area of road and containing embankment, drains, cross-drainage structures and such other areas as may be specified to the drawings or by the Engineer. It shall include necessary excavation, backfilling of pits resulting from uprooting of trees and stumps to required compaction, handling and disposal of cleared materials.

4.5 Excavation for Roadway (Acceptance Criteria: Ref. Section 301 of MORTH)

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and subgrade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions.

4.6 Construction Granular Sub base(Acceptance Criteria: Ref. Section 400 of MORTH)

This work deals with construction of sub grade (minimum 8% CBR) with approved materials as per the terms of contract agreement. Before the doing this work, the materials proposed to be used for sub grade shall be sourced depending upon the suitability and quantum of material availability.

The material used in sub grade shall generally be soil, gravel, a mixture of these and their quality shall be ensured to be free of logs, stumps, roots, rubbish for any ingredients likely deteriorate or affect the stability of the sub grade. The material resulting from the roadway excavation if found suitable will also be used. Material which is having CBR value mentioned in technical specification shall be used in sub grade.

Table 5: Material Specifications for Sub grade Construction

Type of Work	Maximum Laboratory dry unit weight when tested as per IS 2720(Part 8)
Sub grade	Not less than 17.5 KN/cu.m

Table 6: Machinery Equipment for Road Construction

Motor Grader	1 No as a minimum
Tippers	10 - 20 No as a minimum
Water Sprinkler	1 No as a minimum
Vibratory Roller	80 - 100KN 1 No as a minimum

Table 5: Compaction Requirement for Sub grade Construction

Typeof work/Material	Relative compaction as % of maximum laboratory dry density as per IS:IS 2720(part8)
Sub grade	Not less than 97

4.7 Construction Granular Sub base (Acceptance Criteria: Ref. Section 400 of MORTH)

This is the upper layer of sub grade in pavement construction. It deals in compliance to the clause 400 of MORTHspecifications.

Table 6: Material Specifications for Granular Sub base Construction

Liquid limit	Max 25 %
Plasticity index	Max 6
CBR(4 days soaked)	Min 30% @98% MDD
Ten Percent Fines	Min 50KN (Testing as per BS:812)
Gradation	Confirming to grading as per technical specification

Table 7: Compaction Requirement for Granular Sub base Construction

Type of work/Material	Relative compaction as % of maximum laboratory dry density as per IS:IS 2720(part8)
GSB	Not less than 98% of MDD

4.8 Wet Mix Macadam Construction (Acceptance criteria: Ref. Sec. 406 of MORTH)

This is the layer very next to the Granular Sub Base. It deals in compliance to the clause 406 of MORTH specifications. The individual materials gradation shall be checked combined, proportions shall be fixed and combined gradation confirming to table 7(closely-graded) shall be arrived.

Table 8: Gradation requirements of Aggregate for Wet mix macadam

IS Sieve Designation	Per cent by weight passing the IS sieve
53.00 mm	100
45.00 mm	95-100
26.50 mm	-
22.40 mm	60-80
11.20 mm	40-60
4.75 mm	25-40
2.36 mm	15-30
600.00 micron	8-22
75.00 micron	0-8

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6

Table 9: Compaction Requirements for WMM

Type of work/Material	Relative compaction as % of maximum laboratory dry density as per IS 2720 (part8)
WMM	Not less than 98% of MDD

Table 10: Material Specifications for Wet Mix Macadam Construction

Los Angeles Abrasion Value	Max 40%
Aggregate Impact Value	Max 30%
Combined Flakiness and Elongation Index	Max 30
Plasticity index	Max 6
Gradation	Confirming to Table 400-11

4.9Prime Coat Over Granular Base (Acceptance Criteria: Ref. Section 502 of MORTH)

This work shall consist of application of single coat of low viscosity liquid bituminous material to an absorbent granular surface preparatory to any superimposed bituminous treatment or construction.The choice of a bituminous primer shall depend upon the porosity characteristics of the surface to be primed as classified in IRC: 16. These are:

(i) Surfaces of low porosity, such as wet mix macadam and water bound macadam,

(ii) Surfaces of medium porosity, such as cement stabilized soil base,

(iii) Surfaces of high porosity, such as a gravel base.

Table 11: Viscosity requirement and quantity of Bituminous primer

Type of surface	**Kinematic Viscosity of Primer at 60^0C(Centistokes)**	**Quantity per10sq.m (kg)**
Low porosity	30-60	6 to 9
Mediumporosity	70-140	9 to 12
High porosity	250-500	12 to 15

The bituminous primer shall not be applied on a wet surface or during dust storm or when the weather is foggy, rainy or windy. The prime coat for surface treatment should not be applied when the temperature in the shade is less than 10^0C.

Table 12: Machinery Equipment's for Prime Coat

Method	Equipment
Mechanical	pneumatic tired self-propelled pressure distributor
Manual	hand brooms

4.10 Tack Coat (Acceptance Criteria: Ref. Section 503 of MORTH)

This work shall consist of application of a single coat of low viscosity liquid bituminous material to an existing road surface preparatory to another bituminous construction over it. The binder used for tack coat shall be a bituminous emulsion or cutback.The surface on which the tack coat is to be applied shall be cleaned of dust and any extraneous material before the application of the binder, by using a mechanical broom or any other approved equipment/method as specified by the Engineer.

Table 13:Rate of application of Tack coat

Type Surface	**Quantity of liquid Bituminous materialin kg per 10 sq. m. area**
Normal bituminous surfaces	2.0 to 2.5
Dry and hungry bituminous surfaces	2.5 to 3.0
Granular surfaces treated with primer	2.5 to 3.0
Non bituminous surfaces a) Granular base (not primed) b) Cement concrete pavement	 3.5 to 4.0 3.0 to 3.5

4.11 Dense Bituminous Macadam Construction

Fine aggregates shall be the fraction passing 2.36 mm sieve and retained on 75micron sieve, consisting of crusher-run screening, gravel, sand or a mixture of both. These shall be clean, hard, durable, uncoated, dry and free from any injurious, soft or flaky pieces and organic or other deleterious substances.

Aggregate gradation: The combined coarse and fine aggregates and filler (when used) shall produce a mixture to conform to the grading set forth in Table 17. Filler shall consist of finely divided mineral matter such as rock dust, cement. The filler shall be graded within the following limits:

Weather and seasonal limitations: The work of laying shall not be taken up during rainy or foggy weather or when the base course is damp or wet, or during dust storm or when the atmospheric temperature in shade is 10^0C or less

Table 14: Filler graded the limits

IS Sieve	Per cent passing by weight
600 Micron	100
300 Micron	95 - 100
75 Micron	85 – 100

Table 15: Aggregate gradation for Dense Bituminous Macadam

Sieve Designation	Percentage passing the sieve by weight
37.5 mm	100
26.5 mm	90-100
13.2 mm	56-80
4.75 mm	29-59
2.36 mm	19-45
300 micron	5-17
75 micron	1-7

V. CONCLUSIONS

- It is observed from data that average daily traffic (ADT) in PCU/day is more than the IRC recommended for capacity per day of 2 lane for plain rural road.
- Mechanistic pavement design for widening is also proposed which will be having 760 mm of overall depth with surface layer of 200 mm, base layer 200 mm and sub-base layer 250 mm.
- Average daily traffic (ADT) is 2815 PCU/day, it is not more than 15,000 PCU/day of IRC recommended for capacity per day of 2 lane plain rural road from which it has been justified that widening is required on the selected stretch.

- From this study, it can conclude that, the process of road widening has favorably & unfavorably impact on local residents & the environment. Because of road widening local residents get advantages like new sewage lines introduced, saves the commuting time, property value boosted, accidents reduced, economical condition is increased.

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