International Journal of Engineering and Advanced Technology (IJEAT)
ISSN: 2249-8958 (Online), Volume-7 Issue-5, June 2018

Preference of Flexible Pavement Crust Type for Traffic 50msa and Above, based on Low Direct Construction Cost.

Harshavardhan N. Shinde

Abstract: ***This paper expedite minimizing the cost of road construction, through analysis done based on the road types cited in IRC 37. There are five flexible road types cited in IRC 37-2012 for different traffic volumes and construction materials at various CBRs ranging from 2% to 15 %. This paper includes the analysis for traffic volume 50msa, 100msa and 150msa. District schedule rates and the specification and standards of the Roads (MORTH Specifications) are used to calculate material, equipment and direct construction cost. Co-relation between the cost, road types, CBRs and Traffic volumes is established, which act as baseline to select the low costing road crust type at a particular site for traffic volume from 50 to 150msa.***

Index Terms: Direct Construction cost, Road Types, Traffic, CBRs, Material and construction cost.

I. INTRODUCTION

Road construction industry has huge impact on the GDP of the country as the all kind of the industrial developments are established alongside the road. As road construction involves huge amount of investment, it requires special attention towards the cost optimizing, cost proportioning, cost variance, baseline costs. The purpose of this project is to find the suitable low coasted road for a particular location.

With 33 lakh Km. of road network the Indian road network second largest in the world. As per NHAI. About 65% of freight and 80% passenger traffic is carried by the roads. The traffic increase rate is drastically increased up to average of 10.16% for last five years so the road infrastructure is vital role to play to accommodate the increased traffic. Which includes higher direct costs and huge financial risk. Many studies were conducted on the cost deviation in construction projects. Endut et al. (2009) in their survey of 359 projects in Malaysia found only 46.8% of public sector and 37.2% of private sector projects were completed within the stipulated budget [1]. The average of cost deviation in road construction is 16.73% and it ranges from 20.33% to 56.01% [2]. The variations between feasibility and contract cost, ranging between 28.5% and +36%. The construction cost form the year 2008-2009, 2009-2010, 2010-2011, 2011-2012, 2012-2013 has increased by 10.61%, 9.00%, 13.21%, 13.26%, 10.24% [3]. Various surveys conducted by Abdul Rahman et al. showed 89% of respondents agreed that their projects had the problem of cost overrun with an average overrun at 5 to 10% over the contract price ,So the problem of cost variance is significant threat to the development of the construction industry and it is very important to choose the best suited low economic construction methods to minimize the construction cost as well as minimize cost variation [4].

IRC 37-2012 has included different types of flexible pavements based on the recent innovations and engineering properties of alternate material crusts for the road construction. For roads having traffic more than 2 msa. Upto 150msa.[7] These are as follows

1. Granular Base and Granular Subbase.
2. Cementitious Base and Cementitious Subbase of aggregate interlayer for crack relief.
3. Cementitious base and subbase with SAMI at the interface of base and the bituminous layer.
4. Foamed bitumen/bitumen emulsion treated RAP
5. Cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base.

As the indirect costs are common in all road types it is possible to get low costed road on the basis of minimum direct construction cost road. This paper would be helpful for selecting best suited minimum costing road crust, on the basis of equipment cost, material cost and direct construction cost for the various subgrade CBRs and for traffic volume more 50msa to 150msa. This could help for tendering and construction budgeting of a road project.

II. DIRECT COST ANALYSIS

Direct cost of construction for different road crusts cited in IRC 37 is calculated by using the specifications and confirming to MoRTH specification quoted in Table no.1 and standards and rates confirming to District schedule rate of Govt. of Maharashtra PWD [8] along with labors and equipment assumed in *Basic approach and general conditions and assumption for the preparation of standard data book* published by NHAI. As the cross drainage works, structural works, road singes and indirect cost will be same for all road crust type the minimal cost approach is applied only for the road crust cost For the same purpose a sample road of 1km length,3.75m width and depths confirming to the road crusts as per IRC is considered. Along with this the overhead charges and contractors profit is considered as 7.5%.

Manuscript published on 30 June 2018.
***** Correspondence Author (s)
Harshavardhan N. Shinde*, MTech, Department of Civil Engineering, IIT Guwahati, India. E-mail: harsh_99999@yahoo.co.in

A. Granular Base and Granular Subbase. (GB and GSB) *type of road crust* consists of Bituminous Concrete, Dense graded Bitumen Macadam, granular sub base and subgrade [7].

B. For the material cost calculations, the specifications considered as per MORTH and The construction equipment, labors are considered as per the standard data book published by NHAI [9]

Table no. 1 Pavement Crust Specification Considerations For Material Cost Calculations.

Sr. no	Pavement Crust Layer	MoRTH Spec.
1	Bituminous Concrete	509
2	Dense Graded Bituminous macadam	507
3	Wet Mix Macadam	406
4	Granular Sub-Base with Coarse Graded Material	401
5	Prime Coat	501
6	Tack Coat	503
7	Aggregate interlayer for crack relief	406
8	Cement treated crushed rock base/sub base m3	403
9	Stress absorbing membrane (SAM) -Crack Prevention Courses	522
10	Recycling of Bituminous Pavement with Central Recycling Plant HOT MIX RAP	517

C. *Bituminous Pavements with Cemented Base and Cemented Subbase with Crack Relief Interlayer of Aggregate (CB, CTSB & Crack relief layer)* consist of Bituminous concrete, Dense graded bitumen (For traffic volume above 30 msa only), Wet mix macadam , cemented base and sub bases. [7].

D. *Cementitious base and subbase with SAMI at the interface of base and the bituminous layer. (CB and CSB with SAMI)* consists of layers of Bitumen concrete, Dense graded Bitumen macadam, SAMI layer, cemented base and cemented sub base [7].

E. Foamed bitumen/bitumen emulsion treated RAP or fresh aggregates over 250 mm cementitious subbase.(RAP) Such road crust consist of BC, DBM, Reclaimed asphalt (RAP) and cemented base [7]..

F. *Cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base. (CB and GSB with crack relief layer)* crust consists of BC, DBM, WMM , CTB and GSB [7].

III. OBSERVATIONS & DISCUSSION

The cost comparisons figures obtained from the detailed cost analysis as per the specification given in the MORTH and the *standard data book* published by NHAI are included below. From the figures it's very easy at preconstruction phase to choose the optimal Direct cost road type and later on checked for viability of road type according to the material equipment availability.

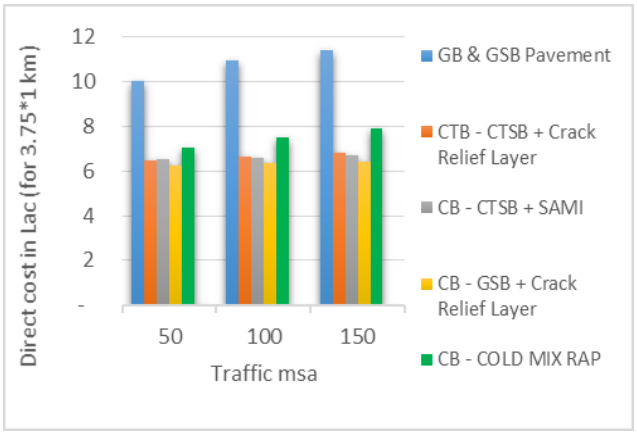

Fig. 1 Cost comparison for 3% CBR

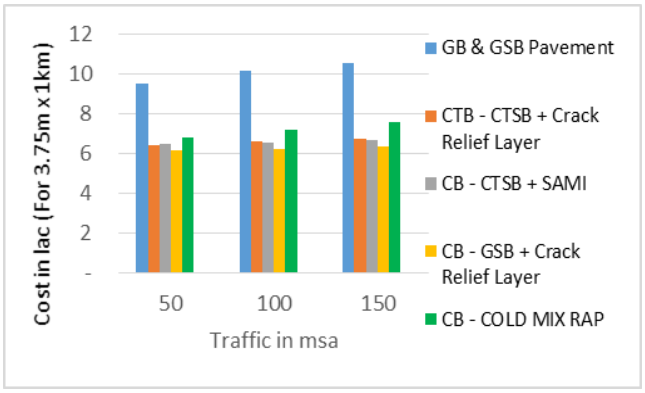

Fig. 2 Cost comparison for 4% CBR

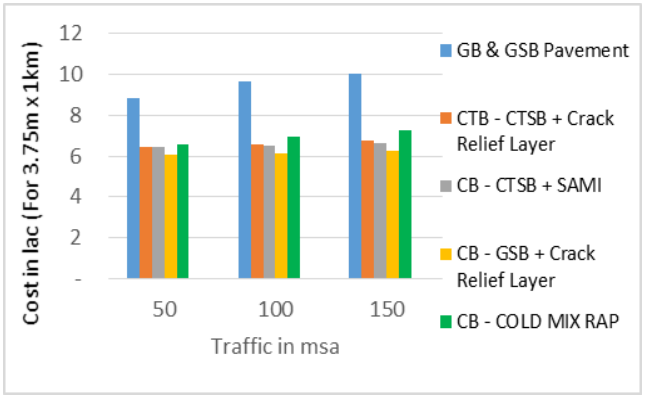

Fig. 3 Cost comparison for 5% CBR

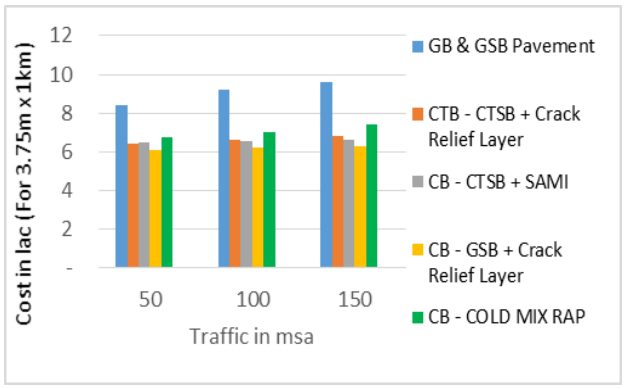

Fig. 4 Cost comparison for 6% CBR

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

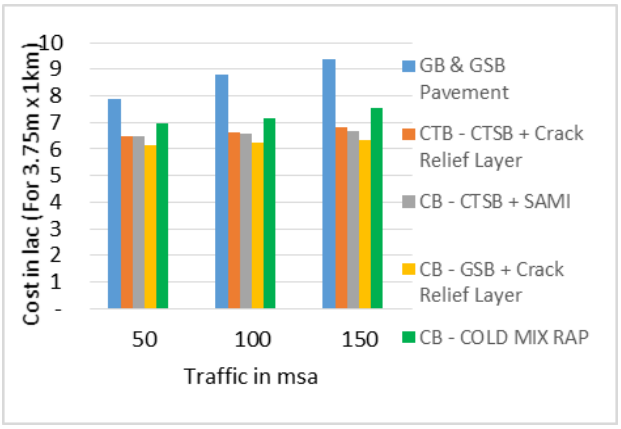

Fig. 5 Cost comparison for 7% CBR

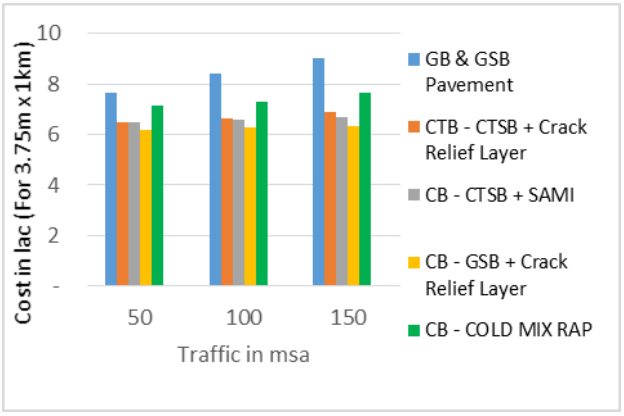

Fig. 6 Cost comparison for 8% CBR

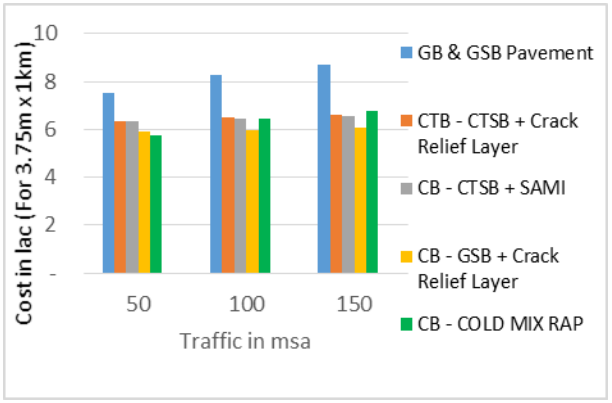

Fig. 7 Cost comparison for 9% & 10% CBR

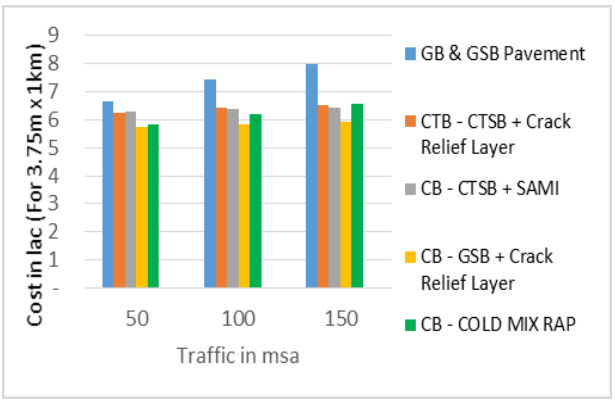

Fig. 8 Cost comparison for 15% CBR

For traffic above 50msa & 3% CBR, most cost efficient road crust cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base. Granular Base and Granular sub base road type is having initial high direct construction cost in all CBRs among five road types cited in IRC 37-2012. At CBR 8% and above with traffic 50msa, Foamed bitumen/bitumen emulsion treated RAP costs minimum as compared to other crust types.

Based on the availability of the material , equipment and site conditions, The preference for road crust for CBR up to 7% and traffic 50-150msa should be given as follows,

1. Cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base.
2. Cementitious Base and Cementitious Subbase of aggregate interlayer for crack relief.
3. Cementitious base and subbase with SAMI at the interface of base and the bituminous layer.
4. Foamed bitumen/bitumen emulsion treated RAP
5. Granular Base and Granular Subbase.

For CBR above 7% and traffic 50-150msa preference should be given as follows,

1. Cementitious base and granular subbase with crack relief layer of aggregate layer above the cementitious base.
2. Foamed bitumen/bitumen emulsion treated RAP
3. Cementitious Base and Cementitious Subbase of aggregate interlayer for crack relief.
4. Cementitious base and subbase with SAMI at the interface of base and the bituminous layer.
5. Granular Base and Granular Subbase.

IV. CONCLUSIONS

For the traffic above 50msa, it is possible to choose road crust easily by considering different site conditions, equipment availability, construction preference so as to get optimum direct construction cost, as the indirect cost and structural as well as drainage work will be costing same in all types of earth crust types cited in IRC 37-2012. The figure presented in this paper can be useful for tendering purpose of road projects located in Maharashtra.

FUTURE SCOPE

The probabilistic approach can be applied to the five road types for the same CBR and traffic volume, so as to get the variance in the material cost and construction cost of the road project. Also the material and equipment cost proportions direct Construction cost, for the different road types as per IRC 37-2012 can be obtained which will be helpful in forming budget of road construction.

REFERENCES

1. Endut, I.R., Akintoye, A. & Kelly, J. (2009). Cost and time overruns of projects in Malaysia. Proceedings of the 2nd Scottish Conference for Postgraduate Researchers of the Built and natural Environment (PRoBE), 16 - 17 November, 2009, Glasglow Caledonian University.
2. Mahamid Ibrahim "Effects of project's physical characteristics on cost deviation in road construction" , *Journal of king Saud Univerisity-Engineering sciences* (2013) vol 25, Page-81-88

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)

3. K. Vamsidhar, D. A. Eshwarswaroop, K. Ayyappapreamkrishna, R. Gopinath Study and Rate Analysis of Escalation in Construction industry, IOSR Journal of Mechanical and Civil Engineering (IOSR-JMCE) e-ISSN: 2278-1684, Volume 11, Issue 2 Ver. V (Mar-Apr. 2014), PP 14-25
4. Abdul Rahman, I., Memon, A.H., Nagapan, S., Latif, Q.B.A.I. & Abdul Azis, A.A (2012). Time and Cost Performance of Construction Projects in Southern and Central Regions of Peninsular Malaysia. IEEE Colloqium on Humanities, Science & Engineering Research (CHUSER 2012), December 3 -4, 2012
5. Al-Zarooni, S. Abdou, A., 2000., "Risk management in pre-design stage and its potential benefits for UAE public projects" . In: Proceedings of the 28th World Congress on Housing Challenges for the 21st Century, 15–19 April, Abu Dhabi, UAE.
6. Ibrahim Mahamid and Amund Bruland, "Cost diviation in road construction projects: The case of Palestine" Construction Economics and Building, Vol 12, No 1 (2012)
7. Guidelines for the design of flexible pavements :IRC 37, July 2012
8. Government of Maharashtra Public Works Department State e-DSR for year 2017-18, w.e.f. 14/06/2017
9. MORTH - Specifications for Road & Bridge Works (5th Revision) 1, 2013

Published By:
Blue Eyes Intelligence Engineering and Sciences Publication (BEIESP)