



Economy of Flexible and Rigid Pavements with Variation in Subgrade Strength & Traffic

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ABSTRACT

The Paper entitled as "Economy of Flexible and Rigid Pavements with Variation in Subgrade Strength & Traffic" consists of designing the thickness of Flexible and Rigid Pavements using latest IRC recommendations given in IRC 37:2012[1] & IRC 58:2015[2] respectively. In this Paper, the economic analysis has been done on both flexible and rigid Pavements. These cost analysis play a great role on the decision-making stages in selection of pavement types. In this analysis initial cost of flexible and rigid pavements has been done based on Analysis of Rates given in Standard Data Book of MoRTH [3].

The Pavements were designed under different traffic and soil conditions. According to the output of design parameters the layer thickness and costs are calculated.

Keywords- *Pavement / Cost Comparison / Initial Cost*

I. INTRODUCTION

The two most important factors that govern pavement design are soil-subgrade strength and traffic loading. Depending on the strength of sub-grade soil, the layer thickness of flexible as well as rigid pavements is affected. IRC 37:2012[1] uses soil sub-grade strength in terms of CBR; whereas IRC 58:2015[2] uses the same in terms of modulus of sub-grade reaction. In the design of flexible pavements, traffic is expressed in terms of million standard axles (msa); whereas it is expressed in terms of axle load distribution (ALD) in design of rigid pavements. Initial Cost is the major factor in deciding the type of the pavement in design. The planners often think that the flexible pavement is cheaper than the rigid Pavements. In fact this is not always the case. The main objective of this paper is to determination of most economical pavement for specific soil and traffic conditions.

II. DESIGN OF FLEXIBLE AND RIGID PAVEMENT

The thickness design for 7.5 m carriageway road for 2msa, 5msa, 10msa, 20msa, 30msa design traffic has been made as per guidelines of IRC 37:2012[1] and IRC 58:2015[2] respectively. Details of axle load spectrum of rear single, tandem and tridem axles are taken from IRC 58:2015[2]. The design thicknesses obtained in the study are given in table 1 and table 2 respectively.

Table 1. Thickness Variation of Flexible Pavement in mm for Different Combinations of Soil & Traffic.

Soil CBR (%)	Traffic(msa)				
	2	5	10	20	30
2	735	795	820	880	900
4	560	620	700	730	750
6	470	535	655	640	655
8	445	475	550	575	590
10	445	475	550	570	585

As seen from above table 1 that total thickness of flexible pavement decreases up to 8% CBR of sub-grade soil strength after that there is no change in the thickness of the pavement for 2msa to 10msa traffic but for 20msa and 30msa traffic the thickness of the flexible pavement decreases from 8% to 10% CBR of Sub-grade soil.

Table 2. Thickness Variation of Rigid Pavement in mm for Different Combinations of Soil & Traffic.

Soil CBR (%)	Traffic (msa)				
	2	5	10	20	30
2	240	250	260	270	270
4	240	250	250	260	270
6	240	240	250	260	260
8	240	240	250	260	260
10	240	240	250	260	260

As seen from the table 2 that there is no change in the thickness of the rigid pavement for 2msa traffic for any increment of the sub-grade soil strength. For 5msa to 20msa traffic, the thickness of the rigid pavement decreases up to 4% CBR after which increase in the subgrade soil strength does not lead to any change in the thickness of rigid pavement.

II. COST ESTIMATION

The cost estimation has been made based on Rate analyses given in Standard Data Book of MoRTH [3], various rates obtained from rate analysis are given in table 3.

Table 3. Rates for various items

S.NO	Item description	Unit	Rate(Rs)
1	Excavation of existing subgrade soil	m3	63
2	Compacting original ground supporting subgrade	m3	68
3	GSB(Granular Sub-base)	m3	1410
4	GB(Granular base WMM)	m3	1391

5	Prime Coat	m2	35
6	Tack Coat	m2	13
7	DBM(Dense bituminous macadam)	m3	5360
8	BC(Bituminous concrete)	m3	6129
9	BM(Bituminous macadam)	m3	4542
10	SDBC(Semi Dense Bituminous Concrete)	m3	5597
11	DLC(Dry Lean Concrete)	m3	2762
12	PQC(Pavement Quality Concrete)	m3	6706

Table 4. Cost of 1 km Flexible Pavement in Lakh(Rs) for Different Combinations of Soil & Traffic

Soil CBR (%)	Traffic (msa)				
	2	5	10	20	30
2	97	119	128	152	161
4	87	98	119	131	138
6	78	86	105	115	121
8	75	80	97	107	113
10	75	80	97	107	111

Fig.1 Cost Variation of Flexible Pavement for Different Combinations of Soil and Traffic

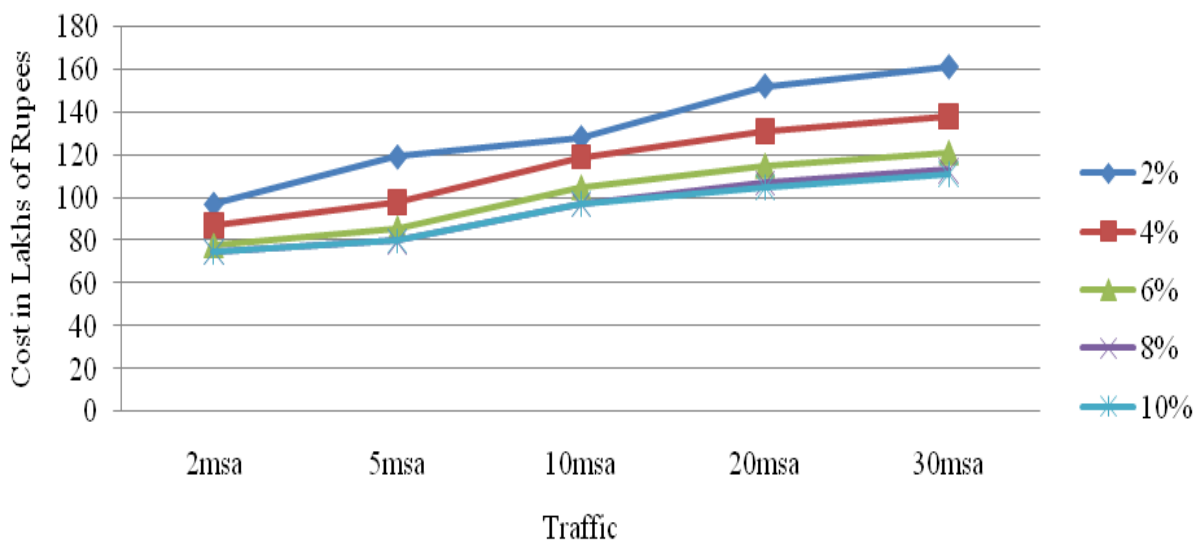
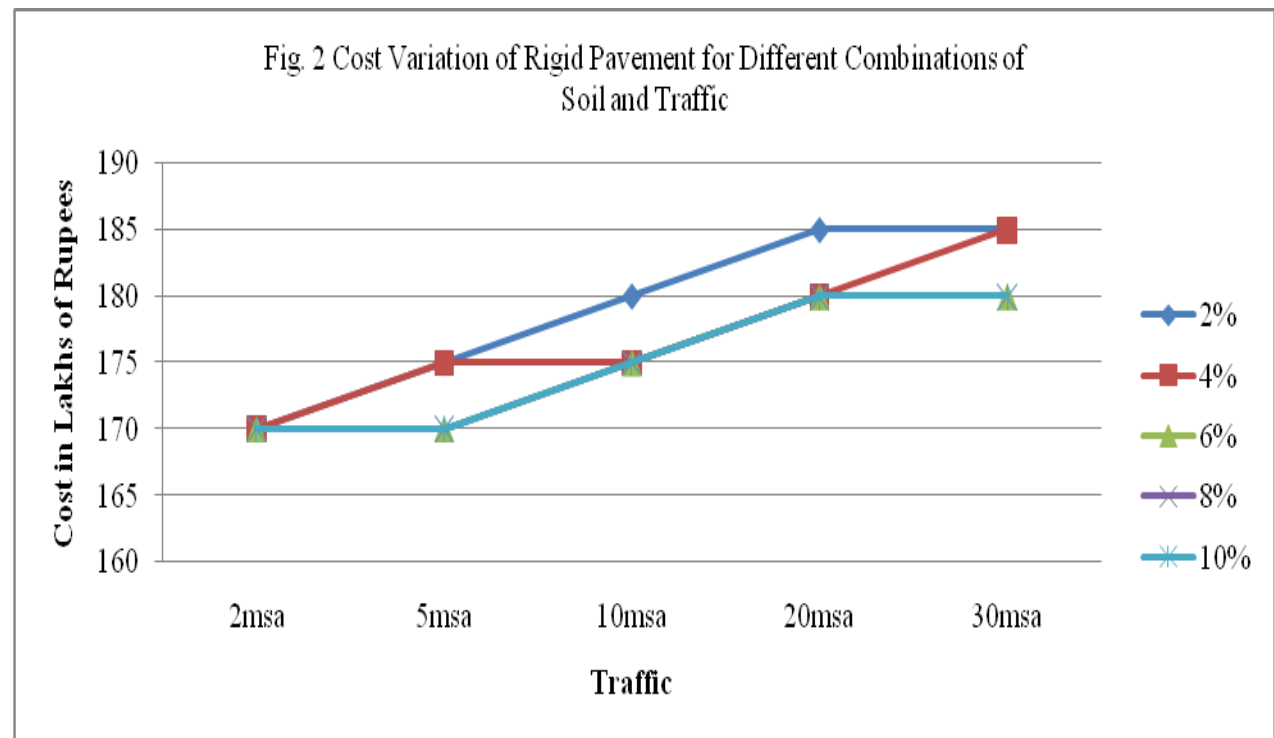


Table 5. Cost of 1 km Rigid Pavement in Lakh (Rs) for Different Combinations of Soil & Traffic

Soil CBR (%)	Traffic (msa)				
	2	5	10	20	30
2	170	175	180	185	185
4	170	175	175	180	185
6	170	170	175	180	180
8	170	170	175	180	180
10	170	170	175	180	180

Fig. 2 Cost Variation of Rigid Pavement for Different Combinations of Soil and Traffic



III. RESULTS AND DISCUSSION

From table 1 it is observed that total thickness of flexible pavement decreases up to 8% CBR of sub-grade soil but after that there is no change in the thickness of the pavement for 2msa to 10msa traffic

From table 1 it is also observed that for 20msa and 30msa traffic the thickness of the flexible pavement gradually decreases from 2% to 10% CBR of Sub-grade soil.

From table 2 it is observed that there is no change in the thickness of the rigid pavement for 2msa traffic for any increment of the sub-grade soil strength but for 5msa to 20msa traffic the thickness of the rigid pavement decreases up to 4% CBR but after which further increase in the CBR of the soil there is no change in the thickness.

From Fig. 1 it is observed that the cost of flexible pavement increases gradually with increase in traffic.



From Fig. 2 it is observed that the cost of rigid pavement increases up to 20msa traffic but after that there is no change in the cost of the pavement apart from 4% CBR Soil.

IV. CONCLUSION

There is no significant variation in the thickness of Rigid Pavement with increase in the value of CBR.

The cost of Flexible Pavement decreases with increase in the value of CBR.

There is no significant variation in the Cost of Rigid Pavement with increase in the value of CBR.

The cost of Flexible Pavement increases with increase in traffic.

The Rigid Pavements can sustain heavy traffic loads with little variation in Pavement thickness.

REFERENCE

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- [2.] IRC: 58-2015 “Guidelines for the Design of Rigid Pavements” Indian Roads Congress, New Delhi, 2015.
- [3.] MORTH (2003) “Standard data book for analysis of rates”, Ministry of Road Transport and Highways, Indian Roads Congress, New Delhi.