STUDY OF IMPROVEMENT AND UPGRADATION OF SH-30 IN THE STATE OF UTTAR PRADESH –FROM AKBARPUR TO BASKHARI

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Abstract - *A road widening project is usually commissioned when the existing road width is not adequate for the traffic, or when extra lanes are needed. Road widening can improve traffic safety and capacity. This project deals with study of improvement and upgradation of SH-30 in the state of Uttar Pradesh –Akbarpur to Baskhari which involves design of flexible pavement as per IRC:37-2012 , design of rigid pavement as per IRC : 58-2015 , cost estimation of flexible pavement and cost estimation of rigid pavement and cost comparison for each method. Rigid pavements have a high compressive strength, which tends to distribute the load over a relatively wide area of soil. There are several advantages of properly constructed rigid pavements -Low maintenance costs, Long life with extreme durability, High value as a base for future resurfacing with asphalt, Load distribution over a wide area, decreasing base and sub grade requirements, Ability to be placed directly on poor soils, No damage from oils and greases and Strong edges.The disadvantages of rigid pavements include -High initial costs, Joints required for contraction and expansion, Generally rough riding quality and high repair costs. 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.*

KEY WORDS**: Design of flexible pavement, Design of rigid pavement, Cost analysis, Estimation.**

1.INTRODUCTION

Lane width has an influence on safety, especially at certain key road locations. Vehicles typically use more of the travel lane on bends than on straight road sections, and head-on crashes can happen on bends when drivers accidentally (or intentionally) 'cut the corner'.

Widening the lanes on a bend can reduce the risk of head-on crashes by giving drivers more room to get around the bend without crossing into the opposing lane. Similarly, widening turn lanes can improve safety, especially for larger vehicles. Widening traffic lanes on straight sections of multi-lane roads can reduce sideswipe crashes.

There are several benefits of road widening like reduced head-on crashes, reduced run-off-road crashes, reduced sideswipe crashes, and improved traffic flow.

Moreover, there are some implementation issues in road widening like a lane that is too wide might be used as two lanes and this can increase sideswipe crashes. Because vehicle speeds increase when roads are widened, lanes should be widened only when it is known that the narrow lane width is causing crashes. Lane widening can be costly, especially if land must be purchased.

- Problem of traffic jam due to insufficient carriageway width
- Traffic count was found to be 14,284 PCU, according to Manual of Specifications & Standards for Four-laning of Highway road widening becomes necessary when traffic count becomes > 10,000 PCU.

2. DESIGN AND COST ANALYSIS OF FLEXIBLE AND RIGID PAVEMENTS

2.1 Design of Rigid Pavement as per IRC :58- 2015

Recommended Procedure for pavement Slab Design
The following steps may be followed for design. Examples of design of different categories of concrete pavements using the current guidelines are given in Appendix VII.

Step 1: Stipulate design values for the various parameters

Step 2: Select a trial design thickness of pavement slab

Step 3: Compute the repetitions of axle loads of different magnitudes and different categories during the design life

Step 4: Find the proportions of axle load repitions operating during the day and night periods.

Step 5: Estimate the axle load repetitions in the in the six-hour period during the day time. The maximum temperature differential is assumed is assumed to remain constant during the 6 hours for analysis of bottom-up cracking.

Step 6: Estimate the axle load repetitions in the six-hour period during the night time. The maximum negative temperature differential during night is taken as half of day-time maximum temperature differential. Built in negative temperature differential of 5^0 C developed during the setting of the concrete is to be added to the temperature differential for the analysis of top-down cracking. Only those vehicles with spacing between the front (steering) axle and the first rear axle less than the transverse joint spacing need to be considered for top-down cracking analysis.

Step 7: Compute the flexural stresses at the edge due to the single and tandem axle loads for the combined effect loads and positive temperature differential during the day time. Determine the stress ratio (Flexural stress/Modulus od Rupture) and evaluate the Cumulative Fatigue Damage (CFD) for single and tandem axle loads.

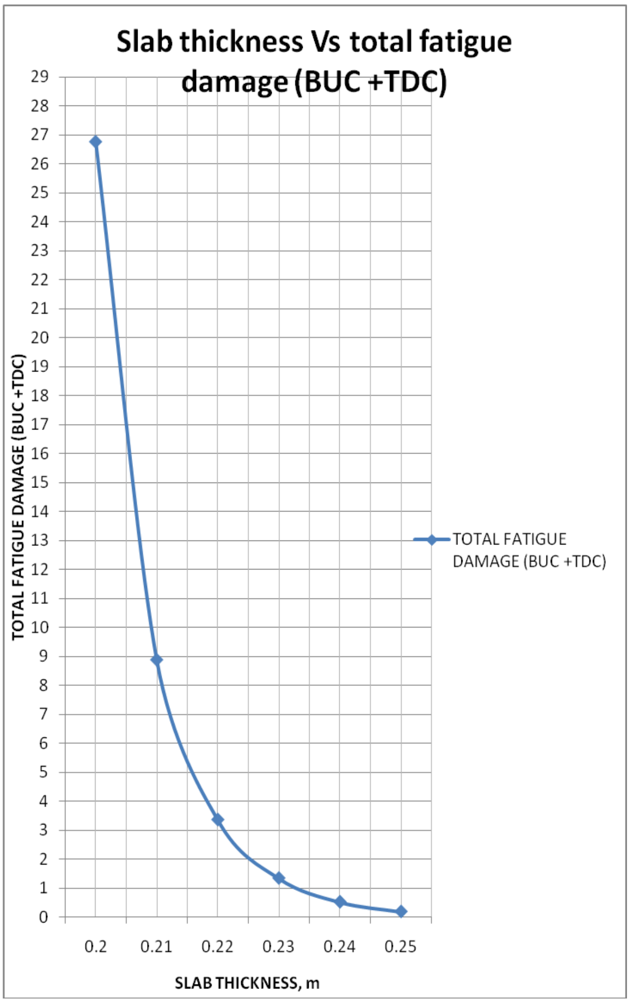
Step 8: Compute the maximum flexural stress in the top surface of the pavement slab with the front axle near the approaching transverse joint and the rear axle close to the following joint in the same panel under negative temperature differential. Determine the stress ratio and evaluate the CFD for differential axle loads for the analysis of top-down cracking.

Step 9: Sum of CFD for the BUC and TDC. If the sum is less than 1.0 the pavement slab is safe against failure cracking.

The entire design process is programmed on an excel sheet and it is included in a CD enclosed with these guidelines. This will enable the designer to make several trials conveniently. The designer has to provide modulus of the subgrade reaction of the foundation supporting the pavement slab, 28 day strength of concrete , temperature differential; traffic data such as rate of traffic growth, axle load spectrum, proportion of single, tandem and tridem axles, proportion of trucks with wheel base less than transverse joint spacing (say 4.5m).All relevant traffic and material data are inputs to the excel sheet.

SLAB THICKNESS, m	TOTAL FATIGUE DAMAGE (BUC +TDC)	REMARKS
0.20	26.758	Unsafe
0.21	8.873	Unsafe
0.22	3.356	Unsafe
0.23	1.336	Unsafe
0.24	0.517	Safe
0.25	0.182	Safe

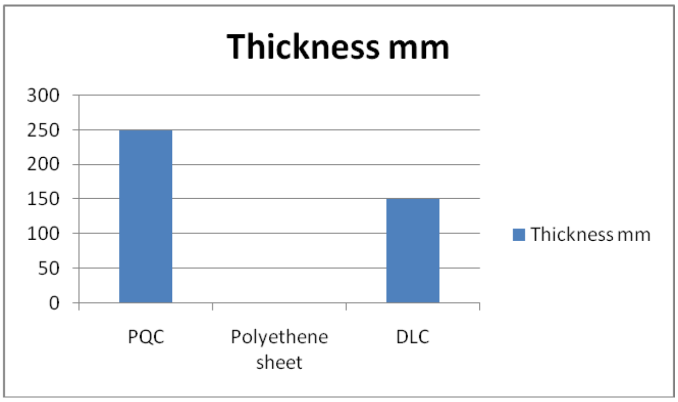
Table 2.1 Total Fatigue Damage



Graph2.1 Cumulative Fatigue damage V/s Slab Thickness

Pavement Layer	Thickness mm
PQC	250
Polythene sheet	0.125
DLC	150

Table 2.2 Pavement Layer Thickness



Graph2.2 Thickness of Pavement Layers

2.2 Design of flexible pavement as per IRC:37-2012

According to IRC:108-1996 :

The best way to arrive at the rate of growth is through a regression analysis. The formula expressing the compound rate of growth of traffic is:

$Pn = Po(l+r)^n$

Where Pn = Traffic in the nth year

Po = Traffic flow in the base year

n = number of years

r = annual rate of growth of traffic, expressed in decimals.

Po=1909

n=2 years , (construction period 2 years)

r=6 %

$Pn=1909(1+6/100)^2$ =2145 CV/day

(Sum of both directions)

(iii) Percentage of Single, Tandem, and Tridem axles are 77 per cent, 19 per cent and 4 per cent respectively

(iv) Traffic growth rate per annum = 6.0 per cent

(v) Design life = 20 years

(vi) Vehicle damage factor = 5.2 (Based on axle load survey)

(vii) CBR of soil below the 500 mm of the subgrade = 3 per cent

(viii) CBR of the 500 mm of the subgrade from borrow pits = 10 per cent

Design crust composition (mm)

GSB =200

G Base = 250

DBM =100

BC =50

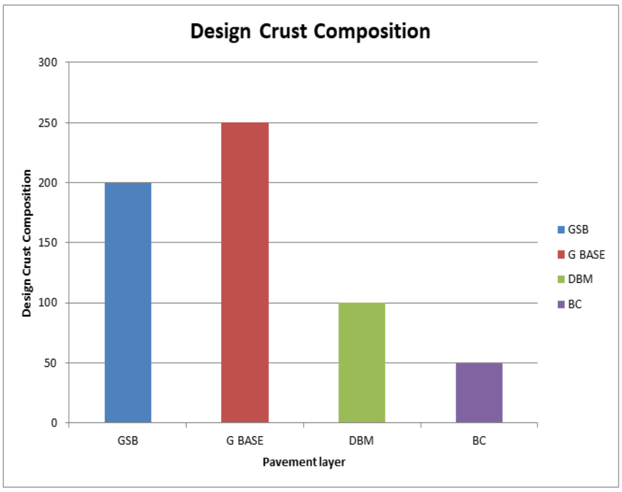
Where,

GSB=Granular Sub Base

G BASE= Granular Base

DBM=Dense Bituminous Macadam

BC=Bituminous Concrete



Graph2.3 Flexible pavement Layers

2.3 Cost of Rigid Pavement

As per UP schedule of rates
- Cost for rigid pavement is **Rs. 1888051479**

2.4 Cost of Flexible Pavement

As per UP schedule of rates
- Cost for flexible pavement is **Rs.1663680979**

3. CONCLUSIONS

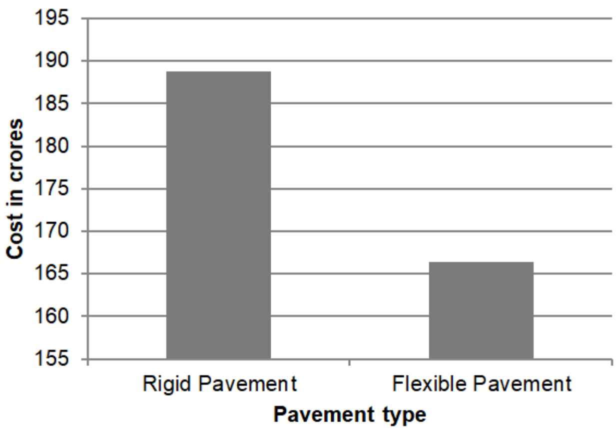
For Rigid Pavement

PAVEMENT LAYER	THICKNESS (MM)
PQC	250
Polyethene sheet	0.125
DLC	150

For Rigid Pavement

PAVEMENT LAYER	THICKNESS (MM)
GSB	200
G BASE	250
DBM	100
BC	50

- After designing and cost estimation of rigid and flexible pavement it is found that
- Cost for rigid pavement is Rs. 1888051479
- Cost for flexible pavement is Rs.1663680979
- By doing a comparative study for both types of pavements ,flexible pavement is found to be more economical.



Graph3.1 Comparison of Costs

Rigid pavements have a high compressive strength, which tends to distribute the load over a relatively wide area of soil.

There are several advantages of properly constructed rigid pavements –

Low maintenance costs, Long life with extreme durability, High value as a base for future resurfacing with asphalt,Load distribution over a wide area, decreasing base and sub grade requirements, Ability to be placed directly on poor soils, No damage from oils and greases and Strong edges.

The disadvantages of rigid pavements include -

High initial costs, Joints required for contraction and expansion, Generally rough riding quality and High repair costs.

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.

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