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RESEARCH ARTICLE

A CASE STUDY: STUDY AND RE-DESIGN OF EXISTING PAVEMENT

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ABSTRACT

Pavement means connectivity, for the development of any nation stretches of road network plays an important part. But conditioned, the stretches must provide better riding surface, required strength, proper drainage, moisture control, rutting resistance, etc. throughout their design life. To ensure structurally strong pavement design guidelines are provided by IRC Codes to determine thickness of constituent layer which can efficaciously serve the purpose for which it is designed.

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INTRODUCTION

As we have veins in our body for circulation of blood to sustain our life, in the same way, pavements are the veins of the nation. They help in a proper movement of man and material which in turn results in the growth and development of the nation. So, these pavements must provide smooth and comfortable riding surface to its traffic.

Pavement (Khanna & Justo, 2001)

An engineered pathway over which traffic moves is referred to a pavement. It must provide smooth textured surface with suitable grade of serviceability to its user. As per the constructional and functional classification of pavements they are categorised in two groups viz.

Flexible Pavement: The kind of pavement which reflects the subgrade deformations to the subsequent layers above to the surface is referred as Flexible Pavement. Flexural strength of the flexible pavement is very low or negligible. Vertical or compressive stresses in flexible pavement are transmitted to lower layers through contact points of granular structure, through grain-to-grain distribution.

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These stresses are maximum at the surface directly under the wheel load and diminishes as distributed to the underlying layers, thus, minimum at the lowest layer. So, inferior material can be used in lower layers as compared to surface layers.

Rigid Pavement: The pavement with surface course of plain cement concrete is known as 'rigid pavement'. It transmits load through slab action. The rigid pavements are analysed through elastic theory. Rigid pavements have high flexural strength that is why the total rigid pavement structure cannot bend or deflect due to traffic loads.

Pavement Design

Pavement design aims to determine the thickness of constituent layers of a flexible pavement viz. Surface Course, Sub base Course and Base Course which can bear the design traffic load efficiently. IRC provides guidelines for the design the flexible pavement on the basis of CBR value of soil subgrade and design traffic.

Literature Review

Papagiannakis and Masad (2007) concluded from his investigation that the pavement design is carried out to estimate structural response of the pavement to traffic load. This heavy load damages the pavement and causes pavement distress. This is the main cause of reduced performance of pavement with time. IRC: 37-2012 Guidelines provide an

analytical approach of design based on performance of existing designs and past experiences if the following simple inputs are known to us then appropriate design could be chosen for given CBR value of soil subgrade.

Jain Saurabh *et al*. (2013) suggested that flexible pavement are favoured more than the cement concrete roads or rigid pavements, as they have great benefit of strengthening and improvement in stages with traffic growth. They concluded that the C.B.R method suggested by IRC is most appropriate as per their investigation.

Present investigation

In present investigation is a case study of a by-pass to NH-9 in Sirsa, Haryana (India). The road was under designed due to which two types of failures are witnessed:

Alligator Cracking: It is a type of structural failure caused by load. It starts as longitudinal cracking along with the travelling wheel path and can take the form of alligator cracking after severe distress due to repeating wheel loads.

Potholes: Small Bowl shaped depression developed on surface course but penetrated to base course. The edges of the hole are very sharp which causes damage to the riding vehicle and sometimes becomes a cause of fatal accident. The main cause is moisture infiltration in interconnected cracks.

The main cause of these two defects is improper design. Due to which redesign is carried out which requires following design inputs:

Design traffic: It includes count of cumulative number of standard axles (8160kg) it requires following information:

- Initial traffic in CVPD (commercial vehicles per day)
- Traffic growth rate during design life
- Design life in number of years
- VDF (vehicle damage factor)
- Distribution of commercial traffic over the carriage way

Initial traffic: For structural design of pavement only commercial vehicles are considered assuming laden weight of three tons or more and their axle loading will be considered. Normally initial traffic is estimated by 7 days 24 hours classified traffic count. In present study, a manual 3-day traffic count of a reference road of Sirsa district of Haryana is carried out to design the pavement for the same.

Traffic Growth Rate: This value can be assigned by studying past trends of traffic growth. In case there is unavailability of traffic data of past years, it is recommended by IRC, to assume on an average annual growth rate of 7.5%. In the present study too it is adopted as the recommendations states i.e. 7.5%.

Design Life: As per IRC recommendations design life should be as follows:

Table 1. IRC recommendations for design life for different types of pavement

Type of Pavement	Design Life(in years)
Arterial roads like NH, SH	15
MDR and Urban roads	20
Other Categories of roads	10-15

Vehicle Damage Factor: It is defined as equivalent number of standard axles per commercial vehicle. VDF varies with axle configuration, axle loading, type of road and from region to region. VDF values are adopted from IRC: 37-2012. In present investigation the VDF value for design of the concerned reference road is taken as 3.5.

Distribution of commercial traffic over the carriage way:

As per IRC: 37-2012 following data can be assumed:

For single lane roads: Design should be based on total number of commercial vehicles in both directions. For 2-Lane single carriageway roads: 75% of total commercial vehicles in both directions are considered for the design. For 4-Lane single carriageway roads: 40% of the total number of commercial vehicles are considered in both directions for design. For dual carriageway roads: In 2-Lane dual carriageway roads 75% of total number of commercial vehicles in each direction are the basis for design whereas in dual three lane and four lane carriageway roads 60% and 40% respectively are the recommendations.

C.B.R Value of Subgrade soil (IS 2720-16, 1988): It is calculated from C.B.R Test carried out as per IS: 2720 Part A.

After getting all above inputs design thickness can be determined as follows: It is a multistep process in which first of all design traffic is calculated from initial traffic by the following formulas:

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

Where, N = Cumulative numbers of standard axles for design in terms of million standard axles (m.s.a)

r = Growth rate
n = Design Life (in years)
D = Vehicle distribution factor
F = VDF
A = Initial traffic in terms of number of commercial vehicles per day

$$A = P(1+r)^x$$

P = number of commercial vehicle in traffic count
x = number of years between last count
In the next step, Pavement thickness is estimated from C.B.R chart of IRC: 37-2012 for corresponding value of N and soil subgrade's CBR value (IRC: 37 2012).

METHODOLOGY

Specifications of the reference road

The details and location of the reference pavement is as follows:

Name of the road: Bye-pass to NH-9

Location: Chattargarhpatti road, Sirsa, Haryana

Benchmark: This is the road to Chaudhary Devi Lal University, Sirsa

State/ Country: Haryana/ India

Length of stretch: 5.27 km

Number of Lanes: Four lane carriageway

Present condition of the road are studied and it is concluded that a redesign is needed for which a traffic survey is carried out:

Commercial vehicle count

Average commercial vehicles per day (P) = 1134cv/day

Temperature data: (Collected from Bahavalnagar 178km from Sirsa and Ludhiana Station 171km from Sirsa). Normal Temperature Variation- 6 to 45˚C. Precipitation Variation – 0 to 11cm

Soil Subgrade Data (IS 2720-16, 1988) (From C.B.R Test):

C.B.R Value = 6%

Optimum moisture content = 25%

Standard Proctor density = 1.61 g/cc

Pavement Design:

After the collection of all the data the actual design for the reference pavement of by-pass is carried out in the following steps:

Computation of design traffic

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

Where, A= P (1+r) ^{x}

We have, P=1134 cv/day
r = 7.5% =0.075
x = 1 year
So, A= 1134 (1+0.075)^{1}
= 1219 cv/day

Now, D = 0.75 for 4-lane carriageway (IRC 37-2012)

n = 15 years
F = 3.5 (IRC 37-2012)
= 30 m.s.a

$$N - \frac{365 \times [(1 + 0.075)^{15} - 1]}{0.075} \times 1219 \times 0.75 \times 3.5$$

Design Thickness

We have N= 30 m.s.a and Subgrade C.B.R =6%. So from C.B.R design charts of IRC 37-2012

Estimated total design thickness = 655mm

Composition of Pavement components

Surface Course = 40mm
Dense Bituminous Macadam =105mm
Base Course = 250mm
Sub- base Course = 260mm

Fig. 1. Designed thicknesses of pavement layers of the reference road

Conclusion

In a nutshell it can be concluded that for better performance throughout the design period of a pavement. It must be structurally strong. Strength is ensured by proper design which must be carried out after proper traffic estimation and calculating all other essential inputs. The reference road is under designed, it is liable to diagonal cracking, rutting and potholes, which not only damages aesthetics but also performance level of the road. The reason behind this is that the present design thickness of reference road is not relevant to bear traffic load. Thus the investigation suggests new thickness which increases durability and can efficiently bears the traffic load during adverse conditions. It reduces the repair cost and improves serviceability.

REFERENCES

Belcher, D. J., Gregg, L. E., and Woods, K. B. 1943. "The Formation, Distribution, and Engineering Characteristics of Soils," Engineering Bulletin of Purdue University, Research Series No. 87, Vol. 27, No. 1, January, 1943.

Hittle, J. E., and Goetz, W. H. 1946. "Factors Influencing the Load-Carrying Capacity of Base-Subgrade Combinations," *Proceedings* Highway Research Board, Vol. 26, pp. 521-543.

IRC: 37 2012. "Guidelines for the design of flexible pavements", Indian Road Congress, New Delhi.

IS 2720-16 1988. "Methods of test for soils, Part 16: Laboratory determination of CBR", Bureau of Indian Standards, New Delhi.

Jain Saurabh *et al*. 2013. "Design of Rigid and Flexible Pavements by Various Metods & Their Cost analysis for each method", Int. Journal of engineering research and applications, vol.3, Issue 5, Sept-Oct, pp. 119-123.

Khanna, S.K & Justo C.E 2001. "Highway Engineering, Nem Chand & Bros Publications, Roorkee (U.A), Eighth Edition.

Papagiannakis, A.T. Masad, E.A. 2007. "Pavement Design and Materials", John Wiley and Sons Inc.,, NJ.

Roy, T.K, Chattapadhyay, B. C and Roy, S. K. 2010. **"***California Bearing Ratio Evaluation and Estimation***"**: A Study of Comparison, (Indian Geotechnical conference) IGC-2010, IIT, Mumbai, pp 19-22.

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