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Structural Evaluation of Flexible Pavement by Benkelman Beam of State Highway -133 of (K-7 to Vavol)

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Abstract: - ***Now Day's Highway Pavement, Bridges, Parking, And Other Commercial Structures Becoming Functionally Deteriorating Due To Repeated Of Vehicular Load And Effect Of Climatic Condition. Non-Destructive Testing Methods Are Desirable To Evaluate Existing Flexible Pavement. In The Study Consisted Of Two Tasks: During Visual Inspection of the Existing Pavement Failures. Second, Investigated The Actual Causes Of These Failures. In The Found That Most Of The Damaged Pavement Sections Suffered From Severe Cracking And Rutting Failures. In The Structure Evaluation Of Flexible Pavement In The Deflection Is Measure By Benkelman Beam. Functional Evaluation Of Pavement Is Like Roughness, Rutting, Crack, Patch, Potholes, And Ravelling. The Present Study Is To Carry Out The Flexible Pavement Condition Index Survey Studies By IRC 81-1997.***

Key Words: - Pavement Evaluation, Benkelman Beam, Deflection, Flexible Pavement, Functional Evaluation

I. INTRODUCTION

Transportation infrastructure play a lead role in economic growth and development of country. India has the second largest highway and road network system on the world. They carry almost 90 percent of the country's passenger traffic 65 percent of its fright. Most highway in India are narrow and congested with poor surface quality. Though highways are well designed as well as properly constructed but still it may require maintenance, the extent which will depend on several factors including the pavement type. The functional deterioration is indicated by the changes in surface condition of the pavement in the form of deterioration in the riding quality, which can be measured by simple methods; it is also possible to restore the surface to original condition of the pavement by providing a profile correction course and a resurfacing layer. Capacity analysis is fundamental to the planning, design and operation of roads, and provides, among other things, the basis for determining the carriageway width to be provided at any point on a road network with respect to the volume and composition of traffic. Scope of transportation system has developed very largely.

A. NEED OF STUDY

A good road management is necessary, and maintenance and rehabilitation action must be taken with good timing. Pavement rehabilitation activities, though not as spectacular as the construction ones, are of major importance for development of transportaion infrastructure. Major economic losses will continue unless improved capabilities for rehabilitation design are provided to meet today's highway traffic needs, as most projects today include rehabilitation design. Improved pavement quality condition.

Fig 1:- Exsiting Pavement Condition

B. SCOPE OF STUDY

- Perform visual inspection by visit of selected road stretch. Check various distress in pavement.

II. LITERATURAE REVIEW

1. Performance Evaluation of Pavement: " A case study on kankot-mavdi road"[1]

In this paper have measured evaluation of flexible pavement deflection by Benkelman beam. .in paper emphasis on performance evaluation of kankot-mavdi road in Rajkot by supplementing research with the use of performance indicator instruments like MERLIN, BBD.

Finally conclusion have based observation for rutting, patch work, potholes and cracks can explain weak spots of pavement. The visual observation and Benkelman beam deflection correlates each other. The overlay thickness in terms of bituminous concrete were found for all stretches. The Benkelman beam study was conducted on all the selection of SH and NH of the road and structural inadequacies were found on all the sections.

2. "Pavement Evaluation by Benkelman Beam of State highway Section (Waghodiya Crossing to Limda)"[4]

In this paper 'structural evaluation of flexible pavement deflection by the Benkelman Beam' is measured. Rebound deflection is used for overlay design. A detailed pavement condition survey is done on State Highway 158 (Waghodiya crossing to Limda) and the road condition is evaluated structurally. Their present study is evaluates the overlay thickness for State Highway 158 Waghodiya crossing to Limda. This studied method in they have carried out visual survey and structural survey. In visual survey find Rutting, Patching and Pothole. And in structural survey find deflection by Benkelman beam deflection test.

Finally, the conclusion based on visual observation for rutting, patchwork, potholes, and cracks are weak spots of pavement was given. Calculate the overlay thickness on existing flexible pavement in terms of bituminous macadam by BBD technique. In the visual observation and Benkelman beam deflection correlates each other as per the IRC-81- 1997 guideline.

III. LOCATION

Pavement condition should is rough or at the stage of failure so that there are some maintenance or rehabilitation.my site is K-7 to Vavol State Highway-133.map of the site shown below. Which is indicate blue line. There

are many college buses, loaded trucks travelling 24 hours on the stretch on the road.so that pavement condition becomes rough, unsafe for road users due to heavy traffic.

The road stretch k-7 circle to Vavol road stretch connected with the SH- 133, Vavol village is located at 23.24^0 N and 72.62^0E Here satellite images of the villages are given below.

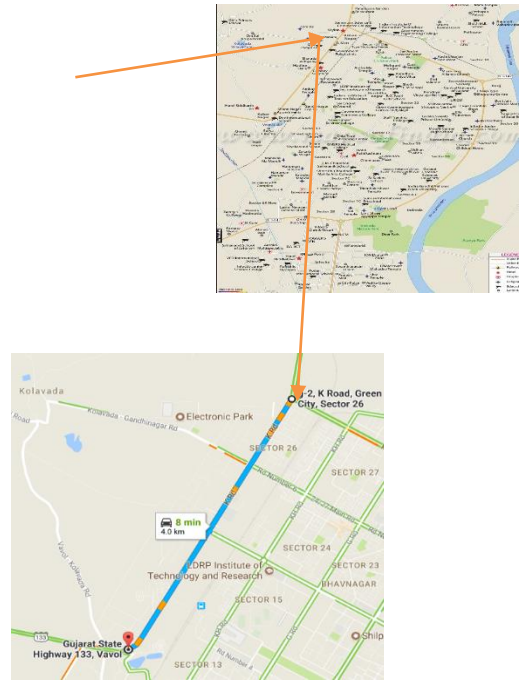
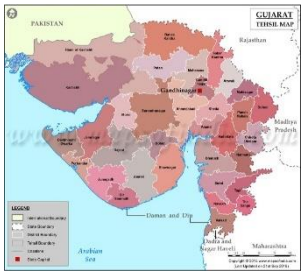


Fig 2:- Loaction And Layout Study Area

IV. DATA COLLECTION

⇨ The salient features of the road section are:(k-7 to vavol)

- Length Of The Stretch: 4.0 km.
- Type Of Pavement: Bituminous
- No Of Lanes: 2 Lane
- Divided/Undivided :- divided
- Type Of Shoulder :- Rough Shoulder
- Width Of Carriageway:- 14.0m
- Surrounding Area:- Rural
- Type Of Traffic:- Mixed Traffic.



A. TRAFFIC SURVEY DATA :-

Traffic volume survey carried out at K-7 circle to Vavol state highway 133 in PCU/day for justification of capacity of the road. The traffic volume was collected for both directions by manual method which is given below chart:

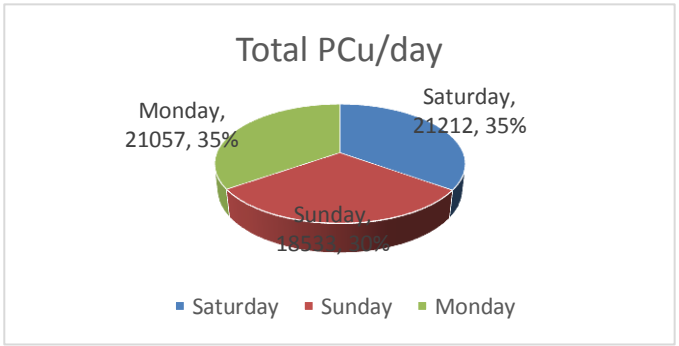


Fig 3:- PCU/Day

B. PAVEMENT CONDITION SURVEY

The functional evaluation survey is conducted on SH-133, from 00/00 to 4/00 km LHS and 00/00 to 4/00 RHS. 4 km length of flexible pavement. In this phase of operation visual observations supplemented by simple measurements for Rut-depth, block crack, patching, hairline crack, alligator crack, longitudinal crack, transverse cracks, pot holes etc. Based on data collected during surface condition survey, the road length shall be classified into sections of equal performance in accordance with the criteria given in Table.

Table I Pavement classification

Length of pavement classification(Km)			
Chainage	Good	Fair	Poor
00/00 to 1/00		1	
1/00 to 2/00			
2/00 to 3/00	1		1
3/00 to 4/00			1
Total	1	1	2

It is observed that 1 km stretch is good, 1 km stretch is fair and 2 km stretch is poor so that only 30% pavement surface condition is good. So, overall condition of surface of pavement stretch is considered as poor.

C. BENKELMANBEAM DATA AND OVERLAY DESIGN

The overlay thickness required over adaptable asphalt might be resolved either by one of the ordinary asphalt plan strategies or by a non-ruinous testing strategy like the Benkelman bar redirection technique. The thickness of adaptable overlay over inflexible asphalts is ascertained utilizing the accompanying relationship h_f equivalent to $2.5(F*h_d - h_e)$, where h_f, he, h_d and F are Flexible overlay thickness, Existing unbending asphalt thickness, Design thickness of unbending asphalt and Factor which relies on modulus of existing asphalt. For computing thickness of bituminous overlay, the accompanying connection is utilized h_b equivalent to $h_f/1.5$, i.e., h_b is equivalent to $1.66 (F*h_d - h_e)$. The Equipment comprises of a thin light emission 3.66m which is rotated to a datum outline at a separation of 2.44 m from the test end. The datum outline lays on a couple of front levelling legs and a back legs and a back leg with customizable stature. The test end of the shaft is embedded between the double back wheels of the truck and lays on the asphalt surface at the focal point of the stacked region of the double wheel stack get together. A dial gage is settled on the datum outline with its shaft in contact with the flip side of the pillar is double the separation between the support and the dial gage axle. Along these lines the bounce back avoidance perusing measured at the dial gage is to be duplicated by two to get real development of the test end because of the bounce back redirection of the asphalt surface when the double wheel load is advanced. A stacked truck with back hub heap of 8170 kg is use for the avoidance contemplate. The outline wheel load is a wheel stack get together of gross weight 4085 kg with an expansion weight of 5.6 kg/cm2 and dispersing between the uncommon tire dividers ought to be in the middle of 30 - 40 mm. The extend of street length to be assessed is first overviewed to evaluate the general state of the asphalt as for the trenches, breaks and undulations. In light of the above asphalt condition overview, the asphalt extends are characterized and gathered into various classes, for example, great, reasonable and poor with the end goal of Benkelman bar redirection contemplates.

D. Correction for Pavement Temperature and Moisture Variation

Stiffness of bituminous layer changes with temperature of binder and the surface deflection of given pavement will vary depending on the temp. Of bituminous layers. At the point when the asphalt comprise of moderately thick bituminous layers like the bituminous macadam or asphaltic cement in the base/fastener/surface course ,varieties in temperature of asphalt surface course cause variety in asphalt redirection under the standard load. The IRC has proposed a standard temperature of 350C and adjustment element of 0.0065mm for each 0C to be connected for the variety from this standard asphalt temperature. The amendment will be negative when the asphalt temperature is over 35°C and positive when it is lower. In any case it is recommended that avoidance studies ought to be completed when the asphalt temperature is over 30°C, if this revision variable is to be connected. An occasional varieties cause variety is sub review dampness. As it is dependably impractical to lead redirection considers amid storm season when subgrade dampness substance is the most noteworthy the IRC has recommended that provisional redress elements of 2 for clayey soils and 1.2 to 1.3 for sandy subgrade soils may receive if the avoidance perceptions are made amid day seasons. The avoidance under the most exceedingly bad subgrade dampness may along these lines into be evaluated by duplicating the late spring redirection esteem by the proper rectification considers.

E. Data Analysis

Deflection value D_o, D_i and D_f are collected in mm then after applying the correction if necessary to the value D_o, D_f and D_i in each section. The rebound deflection is calculated by taking the average of initial, intermediate and final readings and multiplying with the least count of dial gauge 0.025mm.

TABLE II Benkelman Beam Test Observations and Result Benkelman Beam Deflection Analysis

Sr no	Location of test point and identification of lane (KM)	Mean Deflection	Standard Deflection	Characteristic Deflection
1	0.0 TO 1.0	1.26892	0.143154	1.555229
2	1.0 TO 2.0	1.04342	0.124325	1.292071
3	2.0 TO 3.0	1.12006	0.117284	1.354629
4	3.0 TO 4.0	1.13234	0.074144	1.280628

F. OVERLAY DESIGN

The overlay thickness required h_O may be determined after deciding the allowable deflation Da in the pavement under the design load. The design traffic is consider in cumulative standard axles to be carried out for the design life of the road. $\mathbf{Ns = \{365 * A [(1 + r)^x – 1]\} * F / r}$

Where, Ns = Cumulative no. of standard axles (msa)
A = Design traffic = P [1+r] $^{(n+10)}$
r = Assumed growth rate = 7.5%
n = Design life in year
F = Vehicle damage factor
LDF = lane distribution factor

When bituminous concrete or Bituminous Macadam with bituminous surface course is provided as the overlay, an equivalency factor of 2.0 is suggested by the IRC to decide the actual overlay thickness required, thus, the thickness of bituminous concrete overlay in mm will be ho/2 when the value of h_O is determined from above equation.. Present amount of traffic P is CVPD, then design traffic is 2396 CVPD, therefore allowable deflection Da is 1.00 for traffic in between 1500 to 4500. Here characteristic deflection is 1.354629 mm therefore as per IRC: 81-1997 graphical presentation 5 msa 100 of bituminous macadam overlay is required. Another alternative of overlay is 50 mm bituminous macadam with an additional 40 mm bituminous concrete

V. CONCLUSIONS

By conducting the Benkelman beam survey deflection has been examine on the existing road stretch. On the basis of this, overlay and maintenance is decided by calculation of PCI index. As per IRC-81 1997 the overlay design thickness is planned on the basis of the above observation is 94mm.

⇨ Alternative provided on this condition of road are

A. 50 mm bituminous macadam and 40 mm bituminous concrete.
B. 250 mm water mixed macadam and 50 mm bituminous concrete.
C. 300 mm open graded bituminous mix

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