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Functional Evaluation and Overlay Design of Flexible Pavement: A Case Study of Thasra - Hadmatiya Road

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Abstract: A variable, which brings about additional worry in India, is high and low asphalt temperature in a few sections of the nation. Under these conditions, adaptable asphalts have a tendency to end up noticeably delicate in summer and weak in winter. Additionally increment in street activity amid the most recent one decade with an unduly low level of support has added to quickened weakening of street surfacing. To keep this crumbling procedure, a few sorts of measures might be received adequately, for example, enhanced plan, utilization of superior materials and compelling development advances. In this paper we select a Thasra to Hadmatiya Road stretch in Gujarat state which is connected two major village with medium traffic. This asphalt is a Flexible asphalt with bituminous surfacing. The high activity force as far as business vehicles, over-burdening of axles and noteworthy varieties in day by day and regular temperature of the asphalt have been constantly in charge of early improvement of different type of distresses of bituminous surfacing.
Keywords : Bump Integrator, Benkelman Beam, flexible pavement, Roughness Index, pavement unevenness.

I. INTRODUCTION

To conduct roughness tests on the chose extend in Thasra, Gujarat, India. Which is situated at 22.79 N and 73.21 E in between Thasra to Hadmatiya 17 KM by using Bump Integrator? To assess quality on existing asphalt and to plan the thickness of overlay considering present movement by utilizing Benkelman Beam. This road is need to improvement for nearly connected village, where in the movement and over-burdening of the vehicles is on pinnacle. This road is running with more damage and also connected to NH 47 its moves to Indore City. Temperature in this zone is high amid summer the asphalt temperature comes to up to 50 C and shameful seepage offices this prompts part of misery in this asphalt. thus right now is an ideal opportunity comes to discover the causes to this rehashed weakening and the outline of Overlay for this highly distress and damage Pavement.

II. EVALUATION OF FLEXIBLE PAVEMENT

Pavement Evaluation is very important part of the road system community. The operation for maintenance includes the evaluation of condition of road. It also includes solving the problem and selecting the better appropriate steps for maintenance. 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. Various types of failures in pavements ranging from minor and localized failure to major and general failures do take place. Pavement evaluations are conducted to determine functional and structural conditions of a highway section either for purposes of routine monitoring or planned corrective action. Functional condition is primarily concerned with the ride quality or surface texture of a highway section. Structural condition is concerned with the structural capacity of the pavement as measured by deflection, layer thickness, and material properties. The pavement evaluation is necessary at periodic intervals, specially at important road sections as the chosen one. Thus various evaluation tests such as Benkelman beam, and Bump Integrator needs to be carried out to examine the current condition of the road section. Roughness measurements are calculated by Bump integrator Instrument in terms of the International Roughness Index (IRI). Benkelman Beam is used to measure deflection of flexible pavement and by this we can calculate overlay design of flexible pavement as per IRC:81-1997.

III. ROUGHNESS MEASURE BY BUMP INTEGRATOR

Unevenness measurement estimations of the entire length of the test areas were completed using fifth wheel bump integrator at left side. The left wheel ways were distinguished at a separation of 0.6m from the edge of the asphalt. It includes a trailer of single wheel with a pneumatic tire mounted on a case over which on incorporating gadget is fitted. Bump integrator value is normally

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expressed as millimetres per kilometre (MM/KM). For the measurement It is towed by a jeep at a constant speed of 32 kmph under standard tyre pressure of 2.1 kg/cm2 along the designated wheel path. The adjustment of BI unit was completed by CRRI, New Delhi utilizing Dip Stick. For adjustment reason, areas with a wide harshness range were secured to make the activity important. Segments of 100m long were chosen for this reason.

A. Data analysis of bump integrator test

The outcomes gotten with Bump integrator are the Integrator estimation of anomalies in inches (from BI counter reading), The quantity of wheel unrests (from wheel counter). Each arrangement of are required to be changed over to the unevenness file esteem (UI counter) in terms of cm/km. The unevenness list an incentive for the test segment is touched base at by taking mean of UI qualities relating to the three arrangements of readings. The unevenness record esteem is figured by isolating the BI counter values (in cm) by the separation gone in km.

$$\text{Unevenness Index UI} = \frac{\text{Integrator Counter Value (cm)}}{\text{Distance Taveled (km)}}$$

Table I Maximum Permissible Value Of Unevenness Index (Mm/Km) As Per Irc:Sp:16-2004 :

Sr. No.	Type of Surface	Condition of Road Surface		
		Good	Average	Poor
1	Surface Dressing	<3500	3500 - 4500	>4500
2	Mix Seal Surfacing	<3000	3000 - 4000	>4000
3	Semi - Dense BC	<2500	2500 - 3500	>3500
4	Bituminous Concrete	<2000	2000 - 3000	>3000
5	Cement Concrete	<2200	2200 - 3000	>3000

B. Test Result of Unevenness studies

TABLE II VALUE OF UNEVENNESS INDEX (UP SIDE)

Chainage		Wheel RW	Integrator Counter Reading	Unevenness Index cm/km	Remarks
From	To				
00/00	01/00	414	84	233	GOOD
01/00	02/00	413	90	251	AVERAGE
02/00	03/00	431	108	288	AVERAGE
03/00	04/00	426	109	294	AVERAGE
04/00	05/00	423	108	294	AVERAGE
05/00	06/00	412	119	332	AVERAGE
06/00	07/00	415	109	302	AVERAGE
07/00	08/00	400	103	296	AVERAGE
08/00	09/00	404	128	364	POOR
09/00	10/00	410	126	353	POOR
10/00	11/00	402	115	329	AVERAGE
11/00	12/00	423	100	272	AVERAGE
12/00	13/00	415	117	324	AVERAGE
13/00	14/00	421	115	314	AVERAGE
14/00	15/00	420	106	290	AVERAGE
15/00	16/00	420	118	323	AVERAGE
16/00	17/00	404	122	347	AVERAGE
17/00	17/400	158	34	247	GOOD

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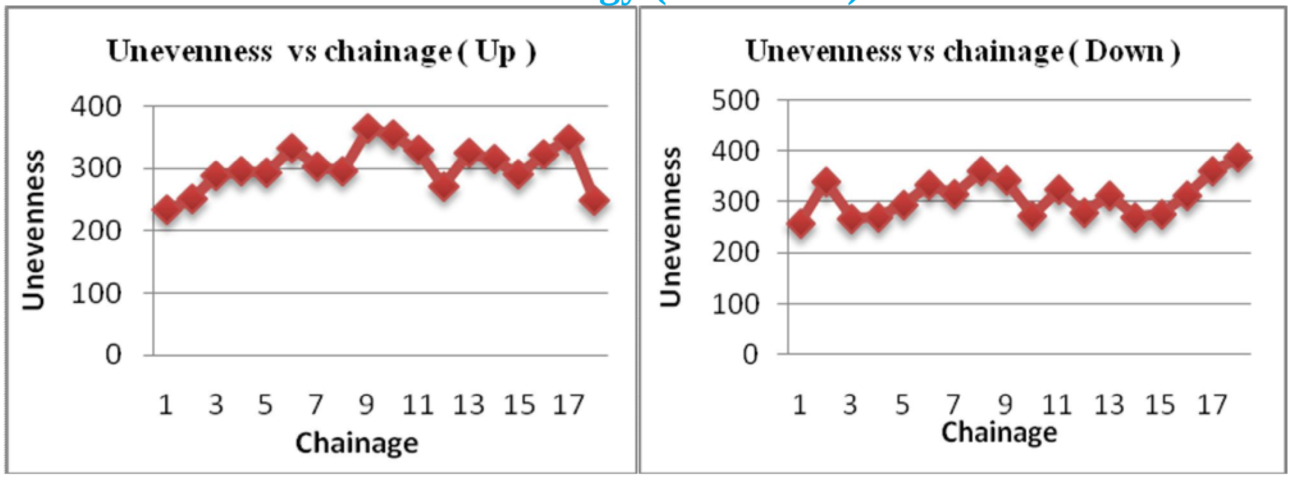

Fig. 1 GRAPH OF UNEVENNES VS. CHAINAGE

Table Iii Value Of Unevenness Index (Down Side)

Chainage		Wheel RW	Integrator Counter Reading	Unevenness Index cm/km	Remarks
From	To				
00/00	01/00	414	93	258	AVERAGE
01/00	02/00	413	122	340	AVERAGE
02/00	03/00	431	100	267	AVERAGE
03/00	04/00	426	100	270	AVERAGE
04/00	05/00	423	108	294	AVERAGE
05/00	06/00	412	119	332	AVERAGE
06/00	07/00	415	114	316	AVERAGE
07/00	08/00	400	125	359	POOR
08/00	09/00	404	120	342	AVERAGE
09/00	10/00	410	97	272	AVERAGE
10/00	11/00	402	113	323	AVERAGE
11/00	12/00	423	103	280	AVERAGE
12/00	13/00	415	113	313	AVERAGE
13/00	14/00	421	99	270	AVERAGE
14/00	15/00	420	101	277	AVERAGE
15/00	16/00	420	114	312	AVERAGE
16/00	17/00	404	127	362	POOR
17/00	17/400	158	53	386	POOR

IV. OVERLAY DESIGN FOR FLEXIBLE PAVEMENT

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).

Benkelman Beam is a gadget which can be helpfully used to gauge the bounce back redirection of an asphalt because of a double wheel stack get together or the plan wheel stack. 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. The stacking focuses on the asphalt for diversion estimations are situated along the wheel ways, on a line 0.9m from the asphalt edge on account of asphalt of aggregate width more than 3.5m; the separation from the edge decrease to 0.6m on smaller asphalts. The quantity of stacking focuses in an extend and the dispersing between them from for the redirection estimations are to be chosen relying upon the target of the venture and the exactness wanted. At least 10 avoidance perceptions might be gone up against each of the chose extend of asphalt. The diversion perception focuses; the review is done in the accompanying strides.

The truck is driven gradually parallel to the edge and halted with the end goal that the left side back double wheel is midway put over the principal point for diversion estimation. Test end of the Benkelman bar is embedded between the holes of the double haggle put precisely over the redirection perception point. At the point when the dial gage perusing is perusing is stationary or when the rate of progress of asphalt diversion is under 0.025mm for every min, the underlying dial gage perusing DO is noted. Both readings of the vast and little needles of the dial gage might be noticed, the substantial needle may likewise be set zero if essential at this stage. The truck is pushed ahead gradually through a separation of 2.7m from the point and halted. The middle of the road dial gage perusing Di is noted when the rate of recuperation of the asphalt is under 0.025mm every moment. The truck is then determined forward through a further separation of 0.9 m and the last dial gage perusing D_f is recorded as some time recently.

Fig. 2 Position of test apparatus and vehicle axle on road

C. 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 35^0C and adjustment element of 0.0065mm for each ^{0}C 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 e received 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

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redirection esteem by the proper rectification considers.

D. 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.

$$\text{Average Deflection } D = \frac{Do + Df + Di}{3} * 0.025 \text{ mm}$$

$$\text{Mean Deflection, } X = \frac{\sum x}{n}$$

$$\text{Standard deviation, } \sigma = \sqrt{\frac{\sum (x-X)2}{n-1}}$$

Characteristic deflection, Dc = X + 2σ and Dc + X + σ

for major roads (NH & SH) for all other roads

Where, x = Individual Deflection, mm

X = Mean deflection, mm

n = No. of deflection measurements

σ = Standard deviation, mm

Dc = Characteristic deflection, mm

Table Iv Benkelman Beam Test Observations And Result

Benkelman Beam Deflection Analysis

Chainage		Mean Deflection	Standard Deviation Deflection	Characteristic Deflection
From	To			
00/00	01/00	0.540	0.413	0.954
01/00	02/00	0.866	0.351	1.217
02/00	03/00	1.084	0.587	1.671
03/00	04/00	1.501	0.573	2.074
04/00	05/00	1.500	0.568	2.068
05/00	06/00	1.639	0.534	2.173
06/00	07/00	1.573	0.642	2.216
07/00	08/00	1.659	0.360	2.019
08/00	09/00	1.605	0.405	2.009
09/00	10/00	1.628	0.516	2.145
10/00	11/00	1.379	0.572	1.951
11/00	12/00	1.451	0.601	2.052
12/00	13/00	1.428	0.467	1.896
13/00	14/00	1.019	0.189	1.208
14/00	15/00	1.100	0.288	1.387
15/00	16/00	1.012	0.141	1.153
16/00	17/00	0.883	0.294	1.177
17/00	17/400	0.832	0.244	1.076

E. 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.

$$N_S = \frac{365 * A\left((1+r)n-1\right)}{r} * F * LDF$$

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 112 CVPD, then design traffic is 252 CVPD, therefore allowable deflection Da is 1.00 for traffic in between 1500 to 4500. Here characteristic deflection is 1.655 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 bump integrator and Benkelman beam survey roughness index and 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.

A. Alternative provided on this condition of road are

1) 50 mm bituminous macadam and 40 mm bituminous concrete.
2) 50 mm water mixed macadam and 50 mm bituminous concrete.
3) 100 mm open graded bituminous mix

REFERENCES

[1] M.O.T (Road wings), "Manual for maintenance of Roads", Indian roads congress, 1983.
[2] Subba Raju, B.H. and Nanda, "Assessment of riding qualities of some of the roads in India", road research bulletin No. 5, Indian road congress.
[3] Khanna, S.K, Arora, M.G. and Nickwada,., "Use of Benkelman beam in the design of Flexible Overlays" National seminar, 20–years design and construction of roads and bridges, vol.1 , Ministry of Transport and shipping, Gov. of India, 1968.
[4] IRC, "Tentative guidelines for strengthening of flexible road pavements using Benkelman beam deflection technique". IRC: 81 -1981, Indian roads congress.
[5] IRC Proceedings, "Seminar on Strengthening of Existing Road Pavements", Indian Roads Congress, 1971.
[6] S.K.Khana and C.E G. Justo, "Highway Engineering", Nem Chand & Bro"s, publication 2001.
[7] IRC: 37-2001, Guide Lines for the Design of Flexible Pavements.
[8] IRC 81:1997 – Guidelines for Strengthening of Flexible Road Pavements Using Benkelman Beam Deflection Technique.
[9] Calibration report on "Axle Mounted bump integrator" By CRRI New Delhi Regional Laboratory PWD Kota, 1995.
[10] L.R. Kadiyali, Principles of Highway Engineering, Khanna Publications.
[11] MTAG (Maintenance Technical Advisory Guide) – Common Distresses on Flexible pavements.
[12] Justo C.E.G. and Ramadas,C.K., "Evaluation of Flexible Pavement and Design of Overlay Thickness",Seminar on Highway Design and Maintainance in Developing Countries,England,1979.