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REHABILITATION STUDY OF NH34 KABRAI TO MAUDAHA THROUGH THE 35.00 KM SECTION LENGTH

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Abstract - *In NH34 Kabrai to Maudaha (35Km), Bundelkand (Utter Pradesh), the road traffic volume has increased manifolds during the post independence period. The traffic axle loading may also in many cases be much heavier than the specified limit. As a result of which, the existing road network has been subjected to severe worsening leading to premature failure of the pavements. The study used a method of (Full Depth Asphalt) published by (Asphalt Institute Manual for flexible Pavement) to design the thickness of the overly layers required for the rehabilitation of the roadway. The study concluded that the thickness of the overlay layers (105mm) implemented in different ways.*

1. INTRODUCTION

Pavement deterioration is a serious problem for road and traffic highway sector in India. The developing countries have lost precious infrastructure worth billions of dollars through the deterioration of their roads. If they do not immediately being to do much more to preserve their roads, they will lose billions more.

Department of Transport investigates some of the factors that cause highway failure. These factors were; the number and weight of axle loads, quality of sub-grade, pavement thickness, poor construction material, poor design and construction, poor workmanship and poor supervision of construction work and changing seasons contribute to pavement fatigue. The effect of poor drainage on road condition and found that the increase in moisture content decreases the strength of the pavement. Therefore, poor drainage causes the premature failure of the pavement.

The main purpose of the rehabilitation study for a roadway is conclusion thickness and type layers of overlay according to the scientific and technique study based on traffic volume characteristics and analysis of the axial loads for heavy vehicles, taking into account the traffic generated, traffic attracted due to rate of traffic flow and the design life of the road. Rehabilitation study takes into account the economic factors in order to determine the thickness of the layers as well as the safety and convenience for road user.

1.1 AREA OF STUDY

This study was conducted to the highway section length (35.00 Km) joint between Kabrai to the Maudaha, NH34. This section classify as multilane highway with single-lanes in each direction, separated by a median. The rehabilitation study was done to the both direction, which suffer from several distresses and damage in several parts of it. The roadway width is (3.75) m in each direction. The study noted many of the failures causes in the pavement asphalt layer as follows:-

1.1.1 Rutting

Rutting is defining as a decline in the roadway pavement surface and channels in the path of vehicles tires. Rutting is a functional failure in the asphalt layers and be a construction failure in case of rutting reach high intensity. Rutting has been appeared with respect to the axial load, compaction and pavement layers thickness which transverse due to flexibility of layers .Rutting can be show clearly after falling rain causing danger to the movement of vehicles. (Fig.1)

Figure (1): Rutting Failure in Study Area

1.1.2 Lane Shoulder Drop

It is defined as the different in elevation between pavement layer and shoulders surface, often surface shoulder less than road path elevation. It has been observed that this kind of failure in most of the road section. (Fig.2)

Figure (2): Lane Shoulder Drop Failure in Study Area

1.1.3 Alligator/Fatigue Cracking

They are a nested cracks occurred as a result of the fatigue collapse of asphalt pavement layer under the influence of

higher axial loads .Cracks starting under the asphalt surface layer then appear on the surface while continue in all directions in form of sharp angles. Our study has been spotted that the appearance of these cracks in term of heavy vehicles path in the study area. (Fig.3)

Figure (3): Alligator Cracking Failure in the Study Area

1.1.4 Reveling and Weathering

Reveling is a gradual disintegration of the pavement surface layer, followed by the expulsion of the gravel place turn out led to disjoint in mixture materials like a dismantled stone materials. Weathering is the loss of overlying asphalt material in the pavement surface. These failures indicate that the material has hardened asphalt or asphalt concrete which used is weak in quality and workability. These types of failure have been observed in the study area. (Fig.4)

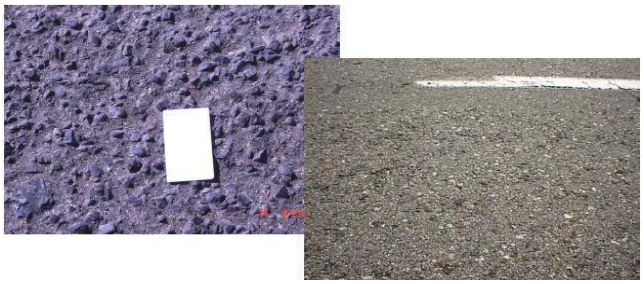

Figure (4): Reveling & Weathering Failure in the Study Area

1.1.5 Pot holes

It is a grooves show on the road surface, vary in terms of the depth and width, and occur as a result of the broken or disintegration of asphalt pavement surface, potholes will be widening due to the presence of moisture and vehicles loads. (Fig.5)

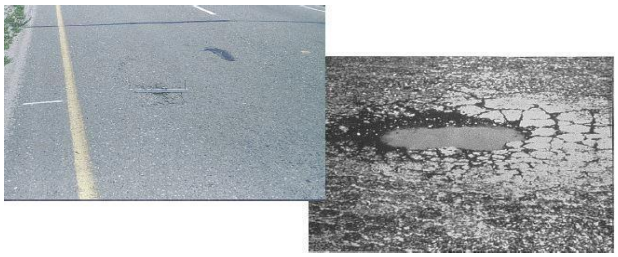

Figure (5): Potholes Failure in the Study Area

2. METHODOLOGY

Rehabilitation of this section various group of process to taken and reclamation of this failure in NH34 Kabrai to Maudaha Through the 35Km section length.

2.1 Data Collection

Data has been collected through field survey and traffic study include the condition of the road, area of failure, types and classification of vehicles due to number and types of axles. Stations of traffic count have been made in order to estimate peak hour volume (PHV), percentage of heavy vehicles (HV %) and average annual daily traffic (ADT). Calculating of (ADT) based on the specifications of the General Authority for Roads and Bridges according to type of roadway with K coefficient (0.12).

	Pc	Bus	Trucks					
			Type 2	Type 3	Type 2-S2	Type 3-S2	Type 3-S3	Total
Hourly Volume (Veh. /hr.)	1092	13	76	58	45	34	9	1325
ADT*	9100	109	630	486	362	279	75	
percentage of trucks for each type %		0.98	0.98	5.60	4.55	3.22	2.59	0.679
Total percentage of trucks %			17.70					

Table (1): Average Traffic Volume in Study Area

ADT = K*DHV ----------

2.2 REHABILITATION OF THE SECTION LENGTH

The main purpose of the rehabilitation study for a roadway is conclusion thickness and type layers of overlay according to the scientific and technique study based on traffic volume characteristics and analysis of the axial loads for heavy vehicles, taking into account the traffic generated, traffic attracted due to rate of traffic flow and the design life of the road. Rehabilitation study takes into account the economic factors in order to determine the thickness of the layers as well as the safety and convenience for road user .Test pits of (50*50) cm for full depth pavement course and sub grade was done for each (1.50)Km to determine thickness of existing pavement for the purpose of rehabilitation study. Sample of all pit holes sent to the civil engineering department laboratory to carry out some of the characteristics in terms of depth, type, class, proportion of asphalt, stability as well as California Bearing Ratio (CBR) for sub base and sub grade layers. Figure (6).show test pit holes, while results of test pit show in Table (2).


Figure (6): Method of taking the Test points in the Area

	Station	Sub grade	Sub base		Asphalt layer					
					Base Course			Binder Course		
		CBR	Thick (cm)	CBR	Thick cm	Stability KN	Asphalt Content (%)	Thickness cm	Stability KN	Asphalt Content (cm)
1	0+00	5.30	34	49	10	4.2	4.21	7.51	5.25	4.61
2	1+50	6.60	31	51	10	3.5	4.23	5.02	5.53	5.82
3	3+00	5.40	33	40	11	4.35	4.17	5.03	5.64	4.57
4	4+50	7.40	32	43	11	4.6	4.17	6.01	5.81	4.48
5	6+00	6.10	41	51	12	4.5	4.17	6.55	5.75	4.65
	8+00	5.20	32	40	11	4.01	4.21	6.10	5.72	5.10

Table (2): Laboratory Test Pits Results

2.3 CALCULATION OF EQUIVALENT AXIAL SINGLE LOAD (EASL)

The study was evaluated the effect of axial loads thus knowing standard coefficient of equivalent axial single load by using method (Asphalt Institute Manual Method for Flexible Pavement) then determine (Overlay) thickness. Table (3) shows the distribution of loads according to the vehicles axial load while tables (4, 5) indicate (ESAL) for all types of heavy vehicles in the study area.

Truck Type	Maximum Axle Load (Ton)					
	No. of Axles					
	1	2	3	4	5	6
Type-2	7	13				
Type-3	7	20				
Type2-S2	7	13	20			
Type 3-S2	7	20		20		
Type 3-S3	7	20		27		

Table (3): Legal Load due to Truck Types

Truck Type	ADT	(EASL)			
		Equivalent Factor (Empty Trucks) **	(Empty Trucks)	Equivalent Factor Legal Load Trucks) **	(Legal Load Trucks)
Type-2	625	0.07	43.75	7.52	4700
Type-3	491	0.1	49.1	4.17	2047.47
Type2-S2	366	0.185	67.71	11.07	4051.62
Type 3-S2	275	0.175	48.125	12.845	3532.375
Type 3-S3	75	0.20	15	10.82	811.50
Total			223.685		15142.965

Table (4): Traffic Volume for Heavy Vehicles

**AASHTO 2002 Axle Load Equivalency Factor for Tandem & Single Axles

Assuming that (60%) of heavy vehicles using the road which are loaded while (40%) an empty. So

EASL/Day = 15142.965*0.60 + 223.685*0.40

= 9175.253 Veh/day

= 9175.253*365

= 3348967.345

As mentioned that the roadway design life (15) years and rate of growth (6%).

Annual growth rate = 23.28

EASL = 3348967.345*23.28

= 77963959.79

Assume that the percentage of heavy vehicles in the design lane = (50%)

=77963959.79 * 0.5

= 38981979.9

The percentage of heavy vehicles in the design lane = (50%)

= 38981979.9*0.5

EASL = 19490989.95

2.4 DESIGN OF OVERLY THICKNESS LAYERS

According to the (Asphalt Institute Manual) (MS-17). The thickness of asphalt overlay layers is calculated by using the following equation.

To = Tn – Te

Where:

To = Thickness of overlay (mm).

Tn = Thickness that a new pavement (after overlay) would require for expected traffic (ESAL) and subgrade resilient modulus (MR). (mm).

Te = Effective thickness of the existing pavement structure (mm).

In order to get the value of (Tn) used (Figure 7) based on the value Resilient Modulus (MR) for subgrade layer (MPa) which is calculated as following :-

MR = 10.30* CBR

From laboratory tests the value of (CBR =6.033) for (Subgrade)

MR = 10.3 * 6.033

= 62.1399 MPa

Enter the figure (9). Using the value of EASL and MR in order to determine (Tn).

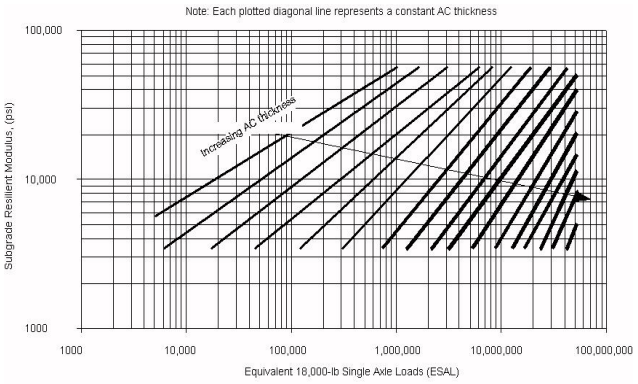

Figure (8): Show How to Choose the Thickness of the Rehabilitation Layers in the Study Area

(AASHTO 2002)

From figure (8)

Tn =325 mm.

In order to calculate (Te), a conversation factor must be calculated too, so the conversation factor for sub base (0.2), while for asphalt course (0.9). (Asphalt Institute Manual 1981).

Te = 350*0.2+170*0.6

= 223 mm.

T0 = Tn - Te

= 325 – 223

= 102 mm

Use T0 = 105 mm.

3. CONCLUSIONS

3.1 The study have been concluded that the (Full Depth Asphalt) method by (Asphalt Institute

Manual for Flexible Pavement) is an efficient way to calculate and design thickness of overly layers which is built on the basis of field studies and laboratory analytical as well as it is an appropriate way to provide safe in the implementation.

3.2 According to the study of traffic characteristics, analysis of axial loads for heavy vehicles and calculation of (ESAL) under the above method that the thickness of the layers of rehabilitation layer for a section length of study area (105 mm) Implemented as follows:-

3.2.1 Scraping and cleaning rutting failure areas using mechanical skimmer.

3.2.2- Clean up the failure areas of roadway section using compressed air.

3.2.3 Spray tack coat according to road and bridge organization specification (SORB).

3.2.4 Construction and compaction a leveling asphalt layer 50 mm thickness along roadway section, taking into account the slope and elevations after treated of all pot holes in the study area.

3.2.5 Construction and compaction a surface course asphalt layers (55mm) thickness under (SORB) specification.

3.2.6 Construction and compaction a layer of type (B) subbase thickness ranges (10-15cm) compacted well to avoid the difference in the elevation between shoulders and the roadway edge, taking into account the leveling and elevations.

3.3 It was found that when the rehabilitation study have been done for this section of roadway the operational speed will be increase thus the level of service (LOS) increase too and rise from (E) to (C) through the analysis of the traffic data using the program (Highway Capacity System 2000) (HCS) which get a great benefits to the passengers and frights.

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