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Remedial Measures on Frequently Failure Length of Existing Road

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Abstract -The main function and objectives of the Highway Research division are to study modern trends in design and construction of roads, modify techniques if necessary to suit local conditions and carry out field and laboratory experiments and to provide suitable specifications with special reference to the nature of the locally available material; to assess strength and other properties of construction materials, in particular to investigate the properties of local soil and locally available inferior aggregate with a view to evolve cheap type of rural roads and to study characteristics of various binders like bitumen, tar etc. and their rational use in road construction with locally available aggregates; to study trends of traffic and suggest solutions to problems in view of present trends of increasing speed of traffic; to tackle the problem of road safety in relation to the geometric of highway and psychology of road users (making roads safe for all types of traffic); to carryout research connected with standards and specifications for road building plant and machinery and also to design instruments for road test; to assist the Public Works Divisions in the state, in the solution of important highway problems; to carryout basic research on all aspects of road and traffic engineering.

Accordingly this problem was referred by the Executive Engineer, Public Works Division, Nandurbar for field and laboratory investigation and inspection of road length of Ankleshwar Burhanpur Road (SH- 4) having chainage 129/00 to 149/300 and bye pass 0/500 to 4/600.

For this, inspection of the site, field investigation, field tests, field samples, testing of samples is done in divisional laboratory of MERI Nashik, collecting field data interpretation of field and laboratory investigations and suggesting the remedial measures are completed.

The various causes of failures from investigations are :

(1) Failure due to an inadequate crust thickness of existing road pavement.
(2) Failure due to weak subgrade i. e. low bearing capacity of soil.
(3) Failure due to saturation of subgrade due to under seepage of water and failure due to inadequate road side drainage provision.

Crust required for structural failure length is works out to 930 mm while Crust required for surface failure length is works out to 210 mm. Road side gutters should be provided both side, properly sloped to the cross drainage structure.

Keywords : Structural failure & surface failure

I. INTRODUCTION

Problem related to frequently failure road length in Maharashtra state are regularly referred to Highway Research Division, M.E.R.I. Nashik for permanent remedies..The problem is referred by the Executive Engineer, P.W. Division, Nandurbar for field investigation, laboratory investigation and inspection for the road length of Ankleshwar Burhanpur Road (SH- 4) having chainage 129/00 to 149/300 and bye pass 0/500 to 4/600.

II. OBJECTIVE

Objective of the study was to Investigate and suggest the remedial measures on frequently failure road length.

III. METHODOLOGY

For the study; Inspection of the site, doing field investigation, taking field tests, collecting field samples, testing of samples in divisional laboratory of MERI, collecting field data from field office, interpretation of field and Laboratory Investigations and suggesting the remedial measures are carried out.

IV. FIELD INVESTIGATION

The road length of Ankaleshwar Burhanpur Road, SH-4, get damaged severely in every year. It is major link connecting industrial area of Gujarat state to Dhule and Nandurbar Dist. Heavy multi axle trailers, trucks and tankers are passing from Gujarat Industrial area to Dhule dist. having width of pavement 5.5 m. This road length passes through black cotton soil and sugarcane area. Longitudinal profile shows that road top level was almost at same level of irrigated land on both sides of the road.Traffic intensity of this length is 23318 metric ton per day in May 2007 (C.V.D. 1982 Nos).

4.1 Existing crust thickness

To assess the existing crust thickness, the trial pits of 1.00 m X 1.0 m were taken up-to sub grade level in staggered manner on both side of carriage way.

4.2 Pavement condition survey

This preliminary Survey was carried out by visual inspection. The pavement condition in respect of Height of Bank, surface condition, shoulders, drainage arrangement was reported as bellow.

"Table No.1. Pavement condition survey data"

S.N	Pavement surface parameters	Condition
1	Height of Bank	0.5 to 1.5 m.
2	Pavement surface condition.	Very poor.
3	Shoulder	Average width 1 to 1.5 m. Shoulder condition was bad. At many places shoulder level was above Bituminous Top level.
4	Drainage condition.	Inadequate drainage arrangement. Heavy stagnation of water during rainy and winter season.
5	Present Traffic position	Heavy traffic including multi axles loaded vehicles.
6	Situation	Road passes through Black cotton Area and Irrigated lands along both sides.
7	Rainfall	Annual 1200 mm
8	Traffic	1982 C.V.D. as per census in May 2007.

4.3 Cross section and longitudinal profile

In the present situation, continuous cracks and deformations were noticed in over all section. Sinking of the pavement was noticed particularly at wheel track at many places.

4.4 Existing drainage arrangements.

Present drains were inadequate. There was heavy stagnation of water during rainy and winter season at many places.

V. LABORATORY INVESTIGATION

One of the aspects behind road failure is a weak subgrade, therefore sub soil investigation is done to know the engineering properties. Since the variation in the moisture content of the subgrade soil play vital role in the performance of the road, data concerning existing moisture content and field dry density were collected. Subgrade soil samples from trial pits were collected for laboratory investigation. Following laboratory tests were carried out on the subgrade soil :-

Mechanical Analysis.	Field density test (F. D. D.)
Atterbergs limit (LL & PL)	Proctor Test
Free Swelling Index	C.B.R. at F. D. D. and F. M. C.

Out of total length, 8.90 km surface failure was observed. For this length Benkelman Beam Test was carried out and overlay required was calculated.

VI. INTERPRETATION AND DISCUSSION OF FIELD AND LABORATORY INVESTIGATIONS

6.1 Field Investigation

a) Existing crust thickness.

Existing crust was variable which was found to be 270 mm average which was inadequate to traffic intensity.

b) Pavement condition survey.

It was noticed during inspection that road was suffering from heavy sinking, deterioration, cracking resulting in undulations over the wider area, involving structural and surface failure.

Height of bank is negligible and lack of adequate camber and inadequate drainage provision leads to stagnation of water on road surface.

6.2 Laboratory Investigation

Subgrade soil investigation.

a) Mechanical analysis shows that subgrade soil contain 92% Silt + clay.

b) The Atterberg limit : Liquid limit up to 60%,Plasticity Index up to 35 his shows that subgrade was having high plasticity and largely affected by moisture due to stagnation of water and inadequate road side drainage.

c) Free swelling index was in the range of 65 to 80 % indicates that soil was of expansive nature.

d) Field Dry Density was minimum 1.29 gm/cc and maximum 1.66 gm/cc. Maximum Dry Density (M.D.D.) was Average 1.49 gm/cc indicates that density of soil was less than 1.75 gm/cc (which is minimum required for any soil for good subgrade).
e) Field moisture content (F.M.C.) 10 to 22% and optimum moisture content (O.M.C.) 14 to 22% shows that soil gets saturated due to stagnation of water.
f) C.B.R. value at F.D.D./ F.M.C. condition is less than 2% indicates that soil is weak soil with very low bearing capacity and not suitable to take heavy loads. Therefore subbase improvement is necessary.

Above field and laboratory investigation, reveals that sub-grade soil was weak with expansive nature which behaves poorly in the presence of water due to inadequate drainage arrangements. These need additional measures to improve its behavior and there by pavement condition up gradation.

VII. PAVEMENT DESIGN

A)For structural failure portion
Data :

Two lane carriage way, Initial Traffic: 1982 C.V.D. (May 2007), Design life : 15 years, Growth rate : 7.5% Annual, Vehicle Damage factor (V. D. F.) : 4.5 (Plain terrain with B.T. surface), Design C.B.R. of sub grade soil upto 2% .

Design calculations.
Initial traffic in design lane.= Initial traffic X Distribution factor = 1982 X 0.75 = 1487
Cumulative number of standard axles to be considered for design = 64 M.S.A.
Total pavement thickness for CBR – 2% and for traffic 64 M.S.A.= 930 mm
Pavement composition (For structural failure)

Hard murum layer	= 450 mm
Hard murum + Raw sand	= 200 mm
Wet mix macadam	= 250 mm
Built up spray grout	= 75 mm
Bituminous Macadam	= 50 mm
Carpet with liquid seal coat	= 25 mm

B) For surface failure portion
Overlay required for surface failure : Overlay required using Benkelman Beam Deflection Technique
in-terms of Bituminous Macadam = 210 mm

VIII. DISCUSSION ON CAUSES OF FAILURES AND SOLUTIONS

The various causes of failures(prima facie) from investigations are :
(1) Failure due to an inadequate crust thickness of existing road pavement.
(2) Failure due to weak subgrade i. e. low bearing capacity of soil.
(3) Failure due to saturation of subgrade due to under seepage of water and failure due to inadequate road side drainage provisions.

8.1 Solutions to rectify Failure due to inadequate crust thickness

The existing crust thickness was average 270 mm which was quite inadequate for present day traffic intensity i.e.1982 C.V.D. There was no subbase provided of suitable granular material of min. 30% C.B.R. The total crust required for present day traffic is 930 mm.

8.2 Solutions to rectify Failure due to weak subgrade

Subgrade was of clayey and expansive nature having low bearing capacity i.e. poor strength (C. B. R. less than 2%) and gets deformed under heavy load leading to various surface irregularities like depression, cracking, rutting, heaving etc. For this subgrade material should have dry density more than 1.75 gm/cc.

8.3 Solutions to rectify Failure due to inadequate drainage arrangement

Present drains were inadequate and unsufficient deep. Existing drain was seen in chocked condition. There was heavy stagnation of water during rainy and winter season. For this adequate roadside gutters are to be provided.

IX. CONCLUSION

(1)The material used for subgrade construction should have dry density more than 1.75 gm/cc.
(2)It should be ensured prior to actual execution that material to be used satisfies C.B.R. value and other prescribed physical requirements.
(3)Granular sub base material confirming to clause 401 of MORT & H specification and Bridge work are recommended for use.
(4)Drainage: Road side gutters should be provided both side, properly sloped to the cross drainage structure. The width and the depth should be as per standard and the bottom of the side gutter should below the toe of the road embankment.
(5)Crust required for structural failure length is based on C. B. R. method (I.R.C. 37–2001). Crust required for surface failure length is based on overlay required as per Benkelman Beam method (IRC 81 -1997)
(6)Execution of work shall be carried out strictly as per guide lines given in "Specifications Book for Road and Bridge works" by Ministry of Road Transport and highway 2001.

REFERENCES

1)IRC 37 – 2001 : Guidelines for Design of Flexible Pavement
2)IRC 81 – 1997 : Guidelines for Design for strengthening of existing flexible pavement using Benkelman Beam Deflection Technique.

ABBREVIATIONS

C.V.D. : Commercial Vehicles per Day
S.H. : State Highway
L.L. : Liquid Limit
P.L : Plastic Limit
M.D.D. : Maximum Dry Density
F.D.D. : Field Dry Density
F.M.C. : Field Moisture Content
C.B.R. : California Bearing Ratio
V.D.F. : Vehicle damage Factor
M.S.A. : Million Standard Axles
I.R.C. : Indian Roads Congress
MORT&H : Ministry of Roads Transport and Highways