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Analysis of Flexible Pavement designed

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ABSTRACT *this is flexible pavement ongoing research about the deflation in flexible pavement, disintegration and surface defect which and maintains the flexible pavement .in the past .lots of work have already studies the problem of maintaining the flexible pavment all over the world . In the present time to provide a better road network is necessary .but is not available at same palace .there are some places where the traffic is higher on enough but road network is not available for it. Research area from axis college room Kanpur Venus College which is used by daily non traffic used to college .college bus, two wheeler, four wheelers, only college teachers and maid student used .any other palce to visit a flexible road visit. There are proper road of lack of maintenance the road damaged place like*

Keyword: Road Design, Flexible pavement

Introduction:

The flexible pavements consist of wearing surface built over a base course and they rest on compacted sub grade. The design of a flexible pavement is based on the principle that a surface load is dissipated by carrying it deep into the ground through successive layer of granular materials. Flexible pavements with asphalt concrete surface courses are used all around the world. Various methods for development of design charts have been discussed. In Group Index Method the total thickness of pavement (surfacing, base and sub base) is determined. Also the thickness of sub-base is determined. The CBR method is probably the most widely used method for the design of flexible pavement. The CBR method is based on strength parameter of the material and is, therefore, more rational than the Group Index Method. North Dakota Method is similar to the CBR method. Pavement thickness is found from the design curve which is between pavement thickness and cone bearing ratio. The Bur mister's Design Method is based on the concept of two-layer system, consisting of road surfacing, base course and the sub-base as top layer of thickness h, and the sub-grade as bottom layer of infinite extent. In this method, the thickness corresponding to deflection of 5 mm has been recommended by Bur mister as the required thickness of pavement. U.S. Navy Plate Bearing Test Method is also based on Bur mister's two-layer theory

Flexible pavement:

Flexible pavements are those, which on the whole have low flexural strength and are rather flexible in their structural action under the loads. The flexible pavement layers reflect the deformation of the lower layers on to the surface of the layer.

A typical Flexible pavement consists of four components:

1. Surface course
2. Base course
3. Sub base course

Fig-1 Soil sub grade

Methods of Design of Flexible Pavements:-

In the design of flexible pavements, it has yet not been possible to have a rational design method wherein design process and service behavior of the pavement can be expressed or predicted theoretically by mathematical laws .Flexible pavement design methods are accordingly either empirical or semi empirical. In these methods, the knowledge and experience gained on the behavior of the pavements in the past are usefully utilized.
There are some various methods used to design of flexible pavement:

1. Group Index Method
2. California Bearing Ratio Method
3. California R Value or Stabile meter method
4. Tri axial test method
5. McLeod method
6. Bur mister method

General:

The design method, the GI, CBR, Stabile meter and McLeod methods are empirical methods. The Tri axial test method is a theoretical method using empirical modifications as suggested by Kansas State highway Department and therefore may be considered as a semi-empirical method. Bur mister method is a theoretical approach using elastic two-layer THEORY.

Futures Scope:

These guidelines will apply to design of flexible pavements for Expressway, National Highways, State Highways, Major District Roads, and other categories of roads. Flexible pavements are considered to include the pavements which have bituminous surfacing and granular base and sub-base courses conforming to IRC/ MOST standards. These guidelines apply to new pavements

Design criteria:

The flexible pavements has been modeled as a three layer structure and stresses and strains at critical locations have been computed using the linear elastic model. To give proper consideration to the aspects of performance, the following three types of pavement distress resulting from repeated (cyclic) application of traffic loads are considered:

1. Vertical compressive strain at the top of the sub-grade which can cause sub-grade deformation resulting in permanent deformation at the pavement surface.

2. Horizontal tensile strain or stress at the bottom of the bituminous layer which can cause fracture of the bituminous layer.

3. Pavement deformation within the bituminous layer.While the permanent deformation within the bituminous layer can be controlled by meeting the mix design requirements,

Fig 2. Critical Locations in Pavement

Those strains at the critical points are within the allowable limits. For calculating tensile strains at the bottom of the bituminous layer, the stiffness of dense bituminous macadam (DBM) layer with 60/70 bitumen has been used in the analysis.

Failure Criteria:

A and B are the critical locations for tensile strains (t). Maximum value of the strain is adopted for design. C is the critical location for the vertical sub grade strain (z) since the maximum value of the(z) occurs mostly at C. Fatigue Criteria: Bituminous surfacing of pavements display flexural fatigue cracking if the tensile strain at the bottom of the bituminous layer is beyond certain limit. The relation between the fatigue life of the pavement and the tensile strain in the bottom of the bituminous layer was obtained as

$$N_f = 2.21 \times 10^{-4} \times (1/E_x)^{3.89} \times (1/E)^{0.854}$$

in which, N_f is the allowable number of load repetitions to control fatigue cracking and E is the Elastic modulus of bituminous layer. The use of equation 28.1 would result in fatigue cracking of 20% of the total area. Rutting Criteria The allowable number of load repetitions to control permanent deformation can be expressed as

$$N_r = 4.1656 \times 10^{-8} \times (1/E_x)^{4.5337}$$

N_r is the number of cumulative standard axles to produce rutting of 20 mm

Design procedure:

Based on the performance of existing designs and using analytical approach, simple design charts and a catalogue of pavement designs are added in the code. The pavement designs are given for sub grade CBR values ranging from 2% to 10% and design traffic ranging from 1 msa to 150 msa for an average annual pavement temperature of 35 C. The later thicknesses obtained from the analysis have been slightly modified to adapt the designs to stage construction. Using the following simple input parameters, appropriate designs could be chosen for the given traffic and soil strength:

- Design traffic in terms of cumulative number of standard axles; and

- CBR value of sub grade

Design traffic:

The method considers traffic in terms of the cumulative number of standard axles (8160 kg) to be carried by the pavement during the design life. This requires the following information:

1. Initial traffic in terms of CVPD

2. Traffic growth rate during the design life

3. Design life in number of years

4. Vehicle damage factor (VDF)

5. Distribution of commercial traffic over the carriage way.

Initial traffic:

Initial traffic is determined in terms of commercial vehicles per day (CVPD). For the structural design of the pavement only commercial vehicles are considered assuming laden weight of three tones or more and their axle loading will be considered. Estimate of the initial daily average traffic flow for any road should normally be based on 7-day 24-hour classified traffic counts (ADT). In case of new roads, traffic estimates can be made on the basis of potential land use and traffic on existing routes in the area.

Traffic growth rate:

Traffic growth rates can be estimated (i) by studying the past trends of traffic growth, and (ii) by establishing econometric models. If adequate data is not available, it is recommended that an average annual growth rate of 7.5 percent may be adopted.

Design life:

For the purpose of the pavement design, the design life is defined in terms of the cumulative number of standard axles that can be carried before strengthening of the pavement is necessary. It is recommended that pavements for arterial roads like NH, SH should be designed for a life of 15 years, EH and urban roads for 20 years and other categories of roads for 10 to 15 years.

Vehicle Damage Factor:

The vehicle damage factor (VDF) is a multiplier for converting the number of commercial vehicles of deferent axle loads and axle configurations to the number of standard axle-load repetitions. It is defined as equivalent number of standard axles per commercial vehicle. The VDF varies with the axle configuration, axle loading, terrain, type of road, and from region to region. The axle load equivalency factors are used to convert deferent axle load repetitions into equivalent standard axle load repetitions. For these equivalency factors refer IRC:37 2001. The exact VDF values are arrived after extensive field surveys

Vehicle distribution:

A realistic assessment of distribution of commercial traffic by direction and by lane is necessary as it directly affects the total equivalent standard axle load application used in the design. Until reliable data is available, the following distribution may be assumed.

Single lane roads:

Traffic tends to be more channelized on single roads than two lane roads and to allow for this concentration of wheel load repetitions, the design should be based on total number of commercial vehicles in both directions.

Two-lane single carriageway roads:

The design should be based on 75 % of the commercial vehicles in both directions.

Four-lane single carriageway roads:

The design should be based on 40 % of the total number of commercial vehicles in both directions.

Dual carriageway roads:

For the design of dual two-lane carriageway roads should be based on 75 % of the number of commercial vehicles in each direction. For dual three-lane carriageway and dual four-lane carriageway the distribution factor will be 60 % and 45 % respectively.

Pavement thickness design charts:

For the design of pavements to carry traffic in the range of 1 to 10 msa, use chart 1 and for traffic in the range 10 to 150 msa, use chart 2 of IRC:37 2001. The design curves relate pavement thickness to the cumulative number of standard axles to be carried over the design life for different sub-grade CBR values ranging from 2 % to 10 %. The design charts will give the total thickness of the pavement for the above inputs. The total thickness consists of granular sub-base, granular base and bituminous surfacing. The individual layers are designed based on the the recommendations given below and the subsequent tables. (WBM) or wet mix macadam (WMM) or equivalent confirming to MOST specifications. The materials should be of good quality with minimum thickness of 225 mm for traffic up to 2 msa an 150 mm for traffic exceeding 2 msa.

Bituminous surfacing :

The surfacing consists of a wearing course or a binder course plus wearing course. The most commonly used wearing courses are surface dressing, open graded premix carpet, mix seal surfacing, semi-dense bituminous concrete and bituminous concrete. For binder course, MOST specifies, it is desirable to use bituminous macadam (BM) for traffic upto o 5 msa and dense bituminous macadam (DBM) for traffic more than 5 msa

Pavement composition:

Sub-base Sub-base materials comprise natural sand, gravel, laterite, brick metal, crushed stone or combinations thereof meeting the prescribed grading and physical requirements. The sub-base material should have a minimum CBR of 20 % and 30 % for traffic upto 2 msa and traffic exceeding 2 msa respectively. Sub-base usually consist of granular or WBM and the thickness should not be less than 150 mm for design traffic less than 10 msa and 200 mm for design traffic of 1:0 msa and above.

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Designed:

Design the pavement for construction of a new bypass with the following data:

1. Single lane carriage way

2. Initial traffic in the year of completion of construction = 400 CVPD (sum of both directions)

3. Traffic growth rate = 7.5 %

4. Design life = 15 years

5. Vehicle damage factor based on axle load survey = 2.5 standard axle per commercial vehicle

6. Design CBR of sub grade soil = 4%.

Designed details :

1. Distribution factor = 0.75

2. N =365 × (1 + 0.075)15 − 1)/ 0.075

× 400 × 0.75 × 2.5

= 720000

= 7.2 msa

3. Total pavement thickness for CBR 4% and traffic 7.2 msa from IRC:37 2001 chart1 = 660 mm

4. Pavement composition can be obtained by interpolation from Pavement Design Catalogue (IRC:37 2001).

(a) Bituminous surfacing = 25 mm SDBC + 70 mm DBM

(b) Road-base = 250 mm WBM

(c) Sub-base = 315 mm granular material of CBR not less than 30 %

The design procedure given by IRC makes use of the CBR value, million standard axle concept, and vehicle damage factor. Traffic distributions along the lanes are taken into account. The design is meant for design traffic which is arrived at using a growth rate.

Site Selection:

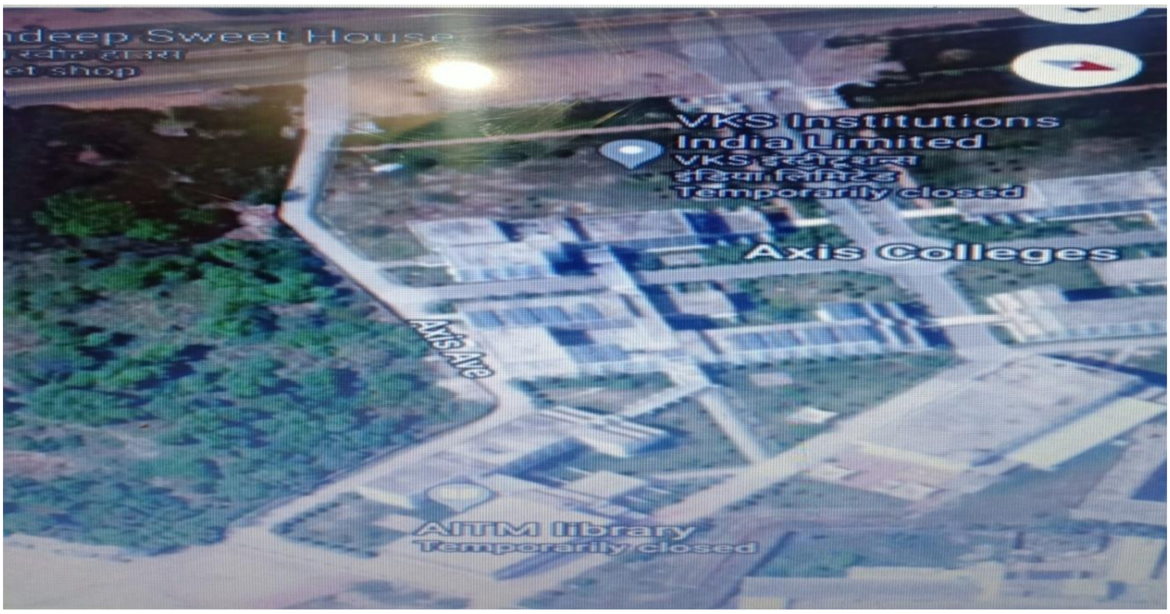

Fig 3

1. Total length of Road = 750 m

2. Road Width = 3.7 m

3. After selection of the final center line of the road investigation for soil and other materials require.

4. for construction are carried out in respect of the likely sources and the availability and suitability of materials.

5. They are site selection for the flexible pavement In axis college rooma Kanpur I locate the Allahabad road

6. Mostly use the in road in student in college teachers and other staff there is no traffic problem

Site Survey:

➢ Topographic Survey

Survey was done and temporary bench mark was established. Levels for cross sections have been taken at every 10 m intervals at different location

➢ Traversing.

Traverse survey was done, chain survey starting ordinance was according to the co-ordinates of other reference temporary bench mark was established.

➢ Leveling.

All leveling for establishing bench mark are carried out having accuracy +5 and -5 mm/km. We started the work by assuming arbitrary level. As no GTS benchmark was available on the nearby location of the road.Levelling work is carried over using a technical instrument named AUTO LEVEL, by taking an initial bench mark of 224.34 m from the standard railway mean sea level of the AXIS COLLEGES ROOMA KANPUR.

Auto Level.

An Auto Level is similar to the dumpy level, with its telescope fixed to the tribranch. For more precise leveling of the instrument a spirit level of the instrument a spirit level attached to the telescope. It is used to the measure the reduced level of the any plane

Soil Tests:

From the soil and material investigations, the CBR values are found to be more than 10%. From the quarry and borrow area investigations, the good quality material required for the construction is available

Fig 4. ***Collection of Soil Sample from the Site***

Fig 5. Clean The Soil Surface For Collect Sample.

Moisture content of soil:

For the determination of moisture content of soil, we will adopt oven dry method, this method is used to determine the water content in soil by oven drying method as per IS: 2720 (Part II) – 1973.

The water content (w) of a soil sample is equal to the mass of water divided by the mass of solids.

Calculation (1)

Fig 6. Weight of soil

Weight of core cutter with soil = 3.151 Kg

Weight of soil stored in the core cutter;:

= (weight of soil with core cutter)-(weight of core cutter without soil)
= (3.151)-(0.978)
= 2.173 Kg

The measured dimension of core cutter are given below,

Height of core cutter = 12.7 cm
Diameter of core cutter = 10 cm
Thickness of core cutter = 5 mm
Due to this we have to calculate volume of core cutter
*d*2*h* = 4

= X(0.10)2 X(0.127) 27
.009965 m3

So, unit weight of soil given below,

= (weight of soil) / (volume of soil)
= (2.173)/(0.0009965)
= 2180.6332 Kg/m3
= [2180.6332X0.01] KN/m3
= 21.80 KN/m3

CONCLUSIONS:

Design of flexible pavement as per IRC-37and quality control methods for construction of fully access control express highway as ORR.

As per the Design of the pavement the thickness of each layers are observed as follows:
Sub Grade: 500mm.
GSB: 200 mm WMM.
250 mm.
DBM: 130mm.
BC: 50mm.

- For the above design the material properties of the aggregate and bitumen methodology as per the standards of ISO 9001:2008 code Quality control methods.
- Quality management used in the project as per the guidelines of network methods (Ganpt, bar charts, mile stone chats, critical part method and program evaluation review technique).
- Tests conducted as per the IS code and are within the allowable limits.
- Quality control of the project comprises of material and

The design procedure given by IRC makes use of the CBR value, million standard axle concept, and vehicle damage factor. Traffic distributions along the lanes are taken into account. The design is meant for design traffic which is arrived at using a growth.

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