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Design of Flexible Pavement by Various Methods and There Cost Analysis

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Abstract

Interstate and asphalt configuration assumes an essential part in the DPR ventures. The attractive execution of the asphalt will bring about higher reserve funds as far as vehicle working expenses and travel time, which has a direction on the general financial plausibility of the undertaking. This project area of study is Hyderabad to Yadhadri road (NH-163) is a wide road in Telangana state. This paper talks about the plan strategies that are generally being taken after and analyzes the "Outline of unbending and adaptable asphalts by different techniques and their cost examination by every strategy". Adaptable asphalt are favored over bond solid streets as they have an incredible preferred standpoint that these can be fortified and enhanced in stages with the development of activity and furthermore their surfaces can be processed and reused for recovery. The adaptable asphalts are more affordable likewise with respect to beginning speculation and support. Albeit rigid asphalt is costly however have less upkeep and having great outline period. The monetary part is completed for the outline asphalt of an area by utilizing the outcome get by plan strategy and their comparing segment layer thickness. It should be possible by drawing examinations with the standard way and reasonable way. This aggregate work incorporates accumulation of information investigation different adaptable and inflexible asphalt plans and their estimation technique is particularly helpful to build who manages interstates.

Keywords: *Design of flexible pavement, Cost analysis, IRC- 64, IRC –37 (R-2012), Estimations etc.*

INTRODUCTION

General

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. Some of the design methods for flexible pavements are Group Index Method, California Bearing Ratio Method, North Dakota Method, Burmister.s Design Method and U.S. Navy Plate Bearing Test Method. Flexible pavements with asphalt concrete surface courses are used all around the world. The various layers of the flexible pavement structure have different strength and deformation characteristics which make the layered system difficult to analyze in pavement engineering. Finite element method is a versatile tool which can easily solve such type of problems. Design charts provide readymade solution to flexible pavement. In the design chart produced the unknown parameter can be obtained from the known parameters. The design chart can be obtained from the detailed finite element analysis by varying parameters like thickness of pavement, elastic modulus of soil and pressure on pavement. From the results of finite element analysis the design charts can be obtained between nodal deflection or/and element stress and thickness of pavement for various pressure for a particular sub grade. Also the design charts can be obtained between nodal deflection or/and element stress and pavement thickness for various soil moduli for a particular pressure.

Flexible pavement

Flexible pavements are those which are surfaced with bituminous (or asphalt) materials. These types of pavements are called “flexible” since the total pavement structure “bends” or “deflects” due to traffic loads. A flexible pavement structure is generally composed of several layers of materials which can accommodate this “Flexible pavements”. There are many different types of flexible pavements. It covers three of the more common types of Hot Mix Asphalt mix types commonly used. Other flexible pavements such as bituminous surface treatments are considered by most agencies to be a form of maintenance and are thus covered under maintenance and rehabilitation. Hot Mix Asphalt mix types differ from each other mainly in maximum aggregate size, aggregate gradation and asphalt binder content or type. Guides are available on dense-graded HMA in most flexible pavement sections because is the most common HMA pavement material. Components make it incapable of sustaining the loads imposed upon its surface.

A highway pavement is a structure consisting of superimposed layers of processed materials above the natural soil sub-grade, whose primary function is to distribute the applied vehicle loads to the sub-grade. The pavement structure should be able to provide a surface of acceptable riding quality, adequate skid resistance, favorable light reflecting characteristics, and low noise pollution. The ultimate aim is to ensure that the transmitted stresses due to wheel load are sufficiently reduced, so that they will not exceed bearing capacity of the sub-grade. Two types of pavements are generally recognized as serving this purpose, namely flexible pavements and rigid pavements. This gives an overview of pavement types, layers and their functions, cost analysis. In India transportation system mainly is governed by Indian road congress (IRC).

METHODOLOGY

Initial cost is generally the major factor in deciding the type of the pavement in design. It is often considered that flexible pavements are cheaper than the rigid pavements. In fact this is not always the case. In the last decade the price of bitumen, the main ingredient of flexible pavement, has increased because of the increase in crude oil prices.

Goliya et. al. (2013) suggested that flexible pavements are preferred over cement concrete roads as they have a great advantage that these can be strengthened and improved in stages with the growth of traffic and also their surfaces can be milled and recycled for rehabilitation. Bruhaspathi (2012) says that if non-conventional pavement design is adopted in the construction of pavement, there will be improved performance of the pavements thus increasing the life and leading to financial savings. Nantung et. al. (2008) suggested that the traffic data includes average annual daily traffic, average monthly and hourly traffic, adjustment factors, axle load spectra, and axle weight and spacing values. Various steps involved in the present study are:

1. Axle load survey which involves survey of types and number of vehicles entering the port road.

2. Determination of necessary parameters required (design traffic, CBR value) by performing various tests on soil.
3. Design of flexible pavement according to IRC 37: 2001.
4. Forecasting the traffic data and design of flexible pavement for the horizon year.
5. Analyzing the existing pavement and checking its suitability for the horizon year.
6. Design of overlay thickness.

Various Design Method of Flexible Pavement

Comparing CBR method, GI method, IRC method, which thickness is suitable, economical for design of the flexible pavement?

Group Index Method

According to this method the thickness of the pavement is determined in reference to the design traffic load in terms of commercial vehicles and the alue of group index, which is formulated on various soil properties as percent fineness, liquid limit, plastic limit, and plasticity index. For a soil, the group index can be found by using the equation:

G.I =0.2 * a + 0.001 * a * c + 0.01 * b * d

G.I=0.2*15+0+0.01*35*10-3+3.5=6.5 Say 7

Where,

a = Portion of percentage passing 200μ sieve between 35 and 75%, represented by a whole number from 0 to 40.

b = Portion of percentage passing 200μ sieve between 15 and 55%, represented by a whole number from 0 to 40.

c = Portion of liquid limit between 40 and 60%, represented by a whole number from 0 to 20.

d = Portion of plasticity index between 10 and 30%, represented by a whole number from 0 to 20.

The sub-grade soil may be rated as poor from figure as the G.I. =7. Traffic value may be taken as heavy. The pavement layer may be designed either using Fig. or using the design chart given. From design chart.

Thickness of Sub-base for G.I. of 7 = 17cm

Combined thickness of surface, base and Sub-base coursed (using curves D for heavy traffic) =47cm

Hence thickness of base and surfacing = 47-17=30cm

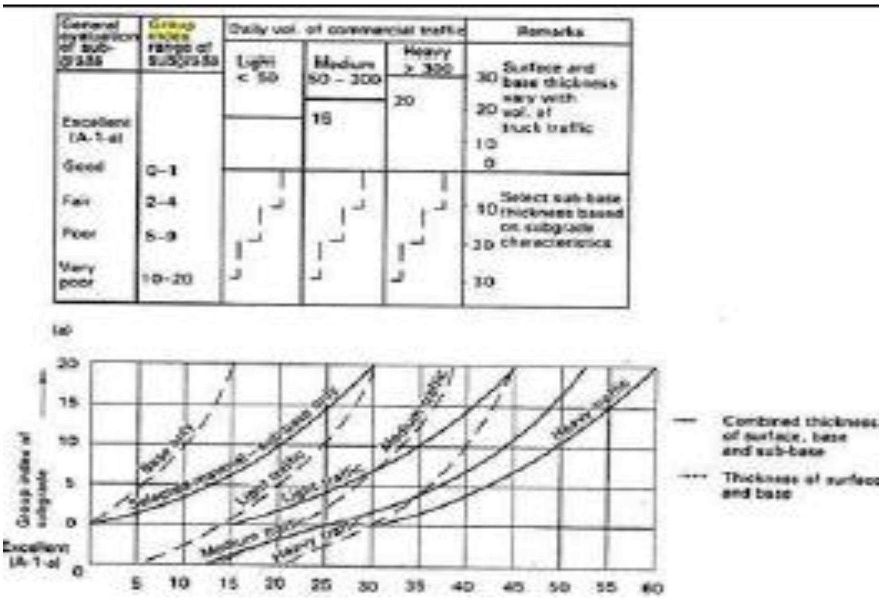

Figure –Thickness Calculation Graph

LITERATURE REVIEW

Overview

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Flexible pavements with asphalt concrete surface courses are used all around the world. The various layers of the flexible pavement structure have different strength and deformation characteristics which make the layered system difficult to analyze in pavement engineering. Finite element method is a versatile tool which can easily solve such type of problems. Design charts provide readymade solution to flexible pavement. In the design chart produced the unknown parameter can be obtained from the known parameters. The design chart can be obtained from the detailed finite element analysis by varying parameters like thickness of pavement, elastic modulus of soil and pressure on pavement. From the results of finite element analysis the design charts can be obtained between nodal deflection or/and element stress and thickness of pavement for various pressure for a particular sub grade. Also the design charts can be obtained between nodal deflection or/and element stress and pavement thickness for various soil module for a particular pressure.

Research Methods

Helwany et.al (1998) in their study illustrate the usefulness of finite element method in the analysis of three- layer pavement systems subjected to different types of loading. The method is capable of simulating the observed responses of pavements subjected to axle loads with different type pressures. The pavement materials are considered as linear elastic, nonlinear elastic, and Viscoelastic. Finite element modeling of pavements has been found extremely useful.

Khan (1998) describes the Group Index Method and California Bearing Ratio Method for design of flexible pavements. In Group Index Method the thickness is obtained by first determining the Group Index of soil. The curves are plotted between Group Index of sub grade and thickness for various traffic conditions. In California Bearing Ratio Method, the curves are plotted between California Bearing Ratio Percent and depth of construction.

Jooste (2002) states that the Semi-Analytical Finite Element Method is an effective method for modeling the load response of structures in which the material properties and problem geometry do not change in one coordinate direction the method offers considerable savings in computational requirements compared to a full three-dimensional finite element analysis. In this paper, the background to, and theoretical basis of the semi-analytical finite element method is presented. The application of the method to a pavement response evaluation is illustrated. It is shown that there is a good agreement between the results obtained with the theoretical solution and those obtained with the semi-analytical finite element method.

Design of Flexible Pavements

Introduction:

One of the most functions of pavement style is to supply a soil structure system which will carry traffic swimmingly and safely with minimum value. The rise in shaft load and extraordinary growth of traffic warrant the maximum amount importance in style, construction and maintenance of roads. During this chapter a glimpse of various approaches of versatile pavement style is narrated. State of the art observe of pavement style with geo-synthetic is additionally mentioned. Finally a technique for style of fiber mat strengthened pavement developed during this study is conferred.

Strategies of versatile Pavement style

There exist variety of strategies for the planning of versatile pavements as summarized by Rao, 2007. These a empirical methodology with or while not a soil strength take a look at, limiting shear failure methodology, limiting deflection methodology, regression methodology supported pavement performance, mechanistic-empirical methodology and style supported theoretical studies.

The use of empirical methodology while not a strength take a look at dates back to the event of Public Roads (PR) soil organization, within which the sub grade was classified as uniform from A-l to A-8 and non-uniform from B-l to B-3. This technique was later changed by the main road analysis Board (HRB, 1945), within which soil were sorted from A-l to A-7 Index was side to differentiate the soil inside every group.

The empirical methodology with a strength take a look at was initial employed by CA main road Department in 1929 (Porter, 1950) .The thickness of the pavement was associated with the CA Bearing quantitative relation, outlined because the penetration resistance of a sub grade soil relative to straightforward rock. The cosmic background radiation methodology of style was studied extensively by the North American nation corps of engineers throughout the globe War II and has become a awfully common methodology of pavement style once the war. The IRC conjointly used this methodology to work out the thickness of individual layer of pavement.

Overview

Indian road congress has specified the planning procedures for fixable pavements supported cosmic background radiation values. The Pavement styles given within the previous edition IRC: 37-1984 were applicable to style traffic up to solely thirty million customary axles (msa). The sooner code is empirical in nature that has limitations concerning relevance and extrapolation. This guideline follows analytical styles and developed new set of styles up to a hundred and fifty msa in IRC: 37-2001.

Scope

These tips can apply to style of versatile pavements for superhighway, National Highways, State Highways, Major District Roads, and alternative classes of roads. Versatile pavements are thought of to incorporate the pavements that have hydrocarbon egression and granular base and sub-base courses orthodox to IRC/Most standards. These tips apply to new pavements.

Criterion

The versatile pavements have been shapely as a 3 layer structure and stresses and strains at crucial locations are computed exploitation the linear elastic model. To relinquish correct thought to the aspects of performance, the subsequent three styles of pavement distress ensuring from of pavement distress ensuing from continual (cyclic) application of traffic masses are considered:

1. Vertical compressive strain at the highest of the sub-grade which may cause sub-grade deformation leading to permanent deformation at the pavement surface.
2. Horizontal tensile strain or stress at rock bottom of the hydrocarbon layer which may cause fracture of the hydrocarbon layer.
3. Pavement deformation inside the hydrocarbon layer.
4. While the permanent deformation inside the hydrocarbon layer is controlled by meeting the combination style needs, thickness of granular and hydrocarbon layers are elite exploitation the analytical style approach so

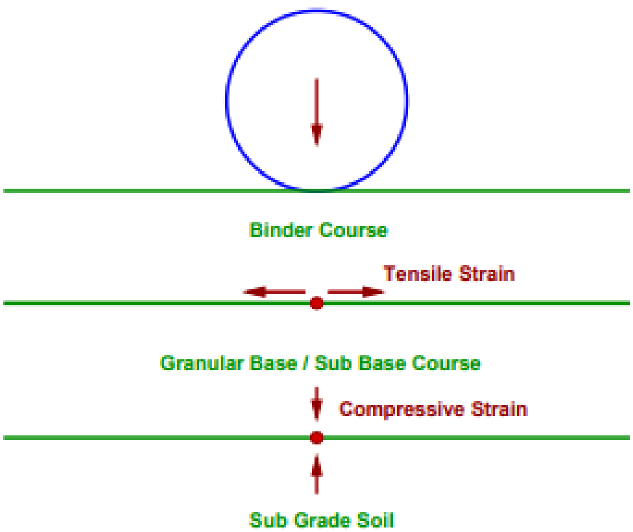

Figure 3.1: Critical Locations in Pavement

That strain at the critical points is 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

$$N_f = 2.21 \times 10^{-4} \times \left(\frac{1}{\epsilon_t}\right)^{3.89} \times \left(\frac{1}{E}\right)^{0.854}$$

In which, Nf is the allowable number of load repetitions to control fatigue cracking,
E (t) is the tensile strain
E is the Elastic modulus of bituminous layer.
The use of the above equation would result in fatigue cracking of 20% o f the total area.

Rutting Criteria: The contribution of rutting from various layers could be different. It is reported that (Chakroborty et al,2003), 46% of rutting take place from bituminous surface and granular base course, while the sub base and sub grade contribute 54% of the total rutting. The vertical strain at sub grade is assumed as the index of rutting to occur in a pavement.

The allowable number of load repetitions to control permanent deformation can be expressed as

$$N_r = 4.1656 \times 10^{-8} \times \left(\frac{1}{\epsilon_z}\right)^{4.5337} \qquad \text{Eqn- 5.2}$$

Nr is the number of cumulative standard axles to produce rutting of 20 mm and Ez is the sub grade strain.

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 guideline. 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 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 carriageway

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 tons 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

a. by studying the past trends of traffic growth, and
b. 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 different 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 different 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. Macro-economic scenario growth rates and composition of NSDP; Road influence area economy, sectoral production and potential; Spatial distribution of economic activities along the corridor; Road influence area, population size and urbanization; Reduction in truck overloading and changes in trucking fleet; Increase in vehicle productivity due to improved road condition; Shift in personalized travel modes over time; and Changes in the inter-modal share of passenger and freight demand. The above mentioned factors are utilized to generate the transport demand elasticity coefficients presented in Table 2.

Table 2 Transport Demand Elasticity Coefficient Based On Nsdp

Mode	2016	2017	2018	2019	2025
Car	1.8	1.7	1.6	1.5	1.4
Buses	1.5	1.4	1.3	1.2	1.2
Trucks	1.6	1.5	1.4	1.1	1.1

The elasticity coefficients recommended by World Bank are summarized in Table 3.

Table 3 Passenger Car Unit

Vehicle Type	**2017**	**2019**	**2025**
Cars	360	490	627
SUV/MUV	292	398	508
Buses	765	981	1234
1-Axle Truck	300	377	466
2-Axle Truck	432	543	670
3-Axle Truck	960	1207	1490
4-Axle Truck	855	1075	1327
Total CVPD	3964	5071	6322

Design of Pavement (for the base year)

Design Traffic Calculations: The design traffic is considered in terms of cumulative number of standard axles (in the lane carrying max. load) to be carried out during the design life of the road. This is expressed in terms of million standard axles (msa).

The cumulative ESAL (equivalent number of standard axles per commercial vehicles) applications (N) over the design life can be computed using the following formula:

$$N = (365 \times [(1+r)^n - 1] \times A \times D \times F) \div r$$

and $$A = P \times (1+r)^x$$

Where,

A = Traffic in the year of completion of construction CV/ Day

N = Cumulative no. of standard axles

D = lane distribution factor

F = vehicle damage factor.

N = design life of road

r = annual growth

x = no. of year between the last count and year completion of construction

P = no. of commercial vehicle as per last count

Deflection values

1.328, 0.765, 1.388, 1.524, 0.858, 1.175, 0.772, 1.421, 0.772, 0.864, 0.528, 1.434, 0.753, 1.357, 1.534, 1.091, 2.156, 1.398, 1.577, 1.812, 1.536, 1.319, 1.056

Pavement temperature = 25oc

Sub grade moisture content = 12.5%

Average annual rainfall =1500 mm

Mean deflection = 1.315 mm

Standard deviation = 0.429 mm

Characteristic deflection = 1.315 + (2 x 0.429) =2.174 mm

Correction for temperature = 0.01 * (35-25) = 0.1 mm

Characteristic deflection after temperature correction = 2.174 + 0.1 = 2.274 mm

Seasonal correction factor = 1.2%

Corrected characteristic deflection = 1.2 * (2.274) = 2.7288 mm

Design traffic = 131msa

Using design traffic and the characteristic deflection values, we refer the overlay design curves prescribed by IRC to get the thickness of the overlay.

Thickness of overlay in terms of BM from the chart = 260 mm

Thickness of overlay in terms of DBM/AC = 260 * 0.7 = 182 mm ~ 185 mm

Provide an overlay of 185 mm thickness with 55 mm AC and 130 mm DBM as its composition.

Design of pavement in the present study

Giroud and Noiray method of flexible pavement design with geo-synthetic is developed for clay sub grade. Since the sub grade material used in the present study is of cohesion less in nature so the same methodology cannot be applied directly. Design method based on Burmister two layer theories is adopted in the present study.

Burmister proposed a method for design of a two layer flexible pavement by the simplifying assumption that the sub grade is the bottom layer and the surfacing, base and sub base combine to form the top layer .Burmister further assumed that the op layer can be treated as an elastic slab infinite in the horizontal plane. The top layer is supposed to be resting on the bottom the bottom layer (in the case of sub grade) which is assumed to be semi infinite solid of lower modulus of elasticity compared to that of the top layer.

To represent the vertical wheel load, the two layer system is assumed to acting upon by a vertical uniformly distributed load (to represent the tyre contact pressure area) a circular area of the of top layer's upper surface.

Burmister computed the vertical displacement at the surface under the centre of the applied load assuming the interface between the two layers is perfectly rough, for various ratios of the modulus of elasticity of the top layer to that of the bottom layer and for various ratios of the"*depth of the top layer to the radius of the circular area of the applied load. The results of these computations are generally shown graphically.

The displacement under the wheel load is a function of the thickness of the top layer. So in the graphical representations a displacement factor Fw is plotted against the thickness of the top layer.

The vertical elastic displacement at the surface under the applied load is given by the following equation:

$\Delta =$ (2pa /E $(1 - \mu^2)$

$\Delta =$ vertical displacement

p = contact pressure

E = modulus of elasticity of bottom layer

a= radius of the circular area

μ = Poisson's ratio

For a flexible plate , $\mu = 0.05$

so, $\Delta = 1.5pa/E$

For a rigid plate

$\Delta = 1.18pa/E$

With further refinement in analyzing the stress in a two layered system Burmister proposed the following equation :

$\Delta = F_w 1.5pa/E$

For a rigid plate

$\Delta = F_w\ 1.18pa/E$

$F_w = F2 =$ Displacement factor , which can be obtained from graphs presented by

The design methodology of coir mat reinforced pavement can proceed according to the mechanistic method as outlined below. Suitability of these coir mat reinforced roads is studied for low volume roads where bituminous layer is absent or even if bituminous layer is provided it is of nominal thickness of non structural in nature which is not assumed to contribute to the strength to the pavement system.

DESIGN AND COST ANALYSIS OF FLEXIBLE PAVEMENTS

Overview

Flexible pavements are so named because the total pavement structure deflects, or flexes, under loading. A flexible pavement structure is typically composed of several layers of materials. Each layer receives loads from the above layer, spreads them out, and passes on these loads to the next layer below. Thus the stresses will be reduced, which are maximum at the top layer and minimum on the top of sub grade. In order to take maximum advantage of this property, layers are usually arranged in the order of descending load bearing capacity with the highest load bearing capacity material (and most expensive) on the top and the lowest load bearing capacity material (and least expensive) on the bottom.

Design procedures

For flexible pavements, structural design is mainly concerned with determining appropriate layer thickness and composition. The main design factors are stresses due to traffic load and temperature variations. Two methods of flexible pavement structural design are common today: Empirical design and mechanistic empirical design.

Empirical design

An empirical approach is one which is based on the results of experimentation or experience. Some of them are either based on physical properties or strength parameters of soil sub grade. An empirical approach is one which is based on the results of experimentation or experience. An empirical analysis of flexible pavement design can be done with or without a soil strength test. An example of design without soil strength test is by using HRB soil classification system, in which soils are grouped from A-1 to A-7 and a group index is added to differentiate soils within each group. Example with soil strength test uses McLeod, Stabilometer, California Bearing Ratio (CBR) test. CBR test is widely known and will be discussed.

Collection of Materials

The materials were obtained from the nearby borrow areas, where plenty amount of material is available for the construction purpose. The material which is collected for testing is different in quality and property, so that the material was separately tested in the laboratory so as to design the soil sub grade.

Grain Size Analysis (IS: 2720 - Part 4)

Grain size analysis is carried out to determine the relative percentages of different sizes of particles in the sample. These sizes control the mechanical behavior of coarse grained soil. Dry method of sieving is used for coarser fractions (retained on 4.75 mm sieve) and wet method is used for finer fractions (retained on 75micron sieve) and pipette method is used for fractions passing 75 micron sieve.

Resilient modulus of soil

The elastic modulus based on the recoverable strain under repeated loads is called the resilient modulus , M_R defined as $M_R = \frac{\sigma_d}{\epsilon_r}$. In which σ_d is the deviator stress, which is the axial stress in an unconfined compression test or the axial stress in excess of the confining pressure in a triaxial compression test.In pavements the load applied are mostly transient and the type and duration of loading used in the repeated load test should simulate that actually occurring in the field. When a load is at a considerable distance from a given point, the stress at that point is maximum. It is therefore reasonable to assume the stress pulse to be a have sine or triangular loading, and the duration of loading depends on the vehicle speed and the depth of the point below the pavement surface. Resilient modulus test can be conducted on all types of pavement materials ranging from cohesive to stabilized materials. The test is conducted in a triaxial device equipped for repetitive load conditions.

Dynamic complex modulus

When the loading wave form is sinusoidal and if there is no rest period, then, the modulus obtained is called dynamic complex modulus. This is one of the ways of explaining the stress-strain relationship of visco-elastic materials. This modulus is a complex quantity and the absolute value of the complex modulus is called the dynamic modulus. This complex modulus test is usually conducted on cylindrical specimens subjected to a compressive have sine loading. The test setup is similar to resilient modulus. The dynamic modulus varies with the loading frequency. Therefore, a frequency that most closely simulates the actual traffic load should be selected for the test.

Correlations with other tests

Determination of resilient modulus is often cumbersome. Therefore, various empirical tests have been used to determine the material properties for pavement design. Most of this test measure the strength of the material and are not a true representation of the resilient modulus. Accordingly, various studies has related empirical tests like CBR test, Tri-axial test etc are correlated to resilient modulus.

Mechanistic-empirical analysis

Mechanics is the science of motion and action of forces on bodies. In pavement design these phenomena are stresses, strains, and deflections within a pavement structure and the physical causes are loads and material properties of the pavements structure. The relationship between these phenomena and their physical causes is described by a mathematical model. The most common of them is layered elastic model.

Advantages

The basic advantages of the Mechanistic-Empirical pavement design method over a purely empirical one are:

1. It can be used for both existing pavement rehabilitation and new pavement construction
2. It can accommodate changing load types

3. It can better characterize materials allowing for

DISCUSSIONS

By observing the above result of pavement by using different flexible and rigid methods, the difference in total thickness and individual component layers are not much. However by close observation the results of CBR method are slightly more because of poor CBR value of sub grade.

The Indian road congress IRC: 37-2001 has received the guidelines for the design of flexible pavements, based on the concept of cumulative STD axle loads rather than the total number of all commercial vehicles as done earlier. The total pavement thickness required is determined using the design charts with the different value of msa (million std. axles).The IRC has also suggested the minimum thickness of the pavement component layers of sub base, base course and surfacing and the combination of various range of cumulative std. axles. So this method is more confidently and widely used in fields due to its relevant simplicity and the appropriate value of different component layers. Now days this method is more popular for design of flexible pavements. But the flexible pavements are design for period of 15 years so the periodical maintenance is much more when compared with rigid pavements.

Thorough analysis of the prevailing pavement is critical to know the prevailing conditions and estimate the art movement state of affairs to keep up property of the road pavement and safe travel. Keeping this seeable, the study started with the shaft load survey on existing pavement and style of pavement for the prevailing traffic. Further, the look traffic is projected for the horizon year exploitation the offered growth rates within the study space and known the specified pavement thickness for the horizon year.

From this analysis, it had been known that the prevailing pavement thickness is shy for taking the traffic masses approaching to the pavement in horizon year. Thence within the next step, the prevailing pavement is meant for the overlay and known the extra thickness needed for the horizon year. Thus, the road pavement within the GHMC space are often deemed safe and property, once these rehabilitation measures area unit adopted.

Future Scope

The pavement is designed as a flexible pavement upon a black cotton soil sub grade, the CBR method as per IRC 37-2001 is most appropriate method than available methodsIt is observed that flexible pavements are more economical for lesser volume of traffic. The life of flexible pavement is near about 15 years whose initial cost is low needs a periodic maintenance after a certain period and maintenance costs very high. The life of rigid pavement is much more than the flexible pavement of about 40 year's approx 2.5 times life of flexible pavement whose initial cost is much more then the flexible pavement but maintenance cost is very less.

- By comparing the method of flexible pavement i.e. Group Index Method & California Bearing Ratio, CBR Method is more efficient than GI. So CBR method is preferred in the design of Flexible pavement.
- From this we are concluded overall thickness of flexible pavement is 480mm, which is determined from IRC method.

CONCLUSION

The present study introduces a decision-supporting model designed to assess and compare four pavement design methods: AASHTO flexible pavement design method, AI flexible pavement design method, AASHTO rigid pavement design method, and PCA rigid pavement design method. The evaluation is carried out for an 8 km road located in Kandahar City, Afghanistan, with a primary focus on their initial construction costs. It is important to note that this model solely considers the initial costs associated with different design methods. It is crucial to understand that the results of the three methods may not be entirely comparable, particularly in two aspects: Fatigue Life Prediction: The prediction of pavement life based on fatigue laws, which involves the relationship between the horizontal tensile strain at the bottom of the asphalt layer and the number of cycles to failure, differs among the methods, Pavement Damage: The ratio between the expected traffic and the number of Equivalent Single Axle Load (ESAL) cycles that the pavement can endure varies among the methods.

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