DESIGN OF RIGIDPAVEMENTS WITH M25 GRADE OF CONCRETE AND MIXING WITH FLY ASH AT ABRCET

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ABSTRACT: India is on developing and requires well infrastructure. Infrastructure projects such as highways, railways, water reservoirs, reclamation etc. requires earth material in very large quantity. In urban areas, borrow earth is not easily available which has to be hauled from a long distance. Quite often, large areas are covered with highly plastic and expansive soil. But construction of buildings, roads, airfields and underground structures on hard stratum (rich in engineering properties) have no problem or damage from soil point of view and gives better life. If the soil is loose soil or expansive soil (poor in engineering properties) the structures will face severe damage due to the strains causes in them following alternate swelling & shrinkage. Expansive soils swell when wet & shrink when dry, causing major problems for foundations, roads, pipe lines, excavations. Variations in the moisture regime during monsoon and summer are the causes for this alternate swelling and shrinkage.

Extensive laboratory / field trials have been carried out by various researchers and have shown promising results for application of such expansive soil after stabilization with additives such as sand, silt, lime, fly ash, etc. As fly ash is freely available, for projects in the vicinity of a Thermal Power Plants, it can be used for stabilization of expansive soils for various uses. The present work describes a study carried out to check the improvements in the properties of expansive soil with fly ash in varying percentages. Laboratory tests like grain size analysis, plastic limit, liquid limit, specific gravity, optimum moisture content, maximum dry density, CBR of soil with 5%, 10%,15% and 20% of fly ash have been carried out and results shows that at the 15% adding of fly ash there is an improvement in compaction characteristics of CBR values.Now-a-days, the role of Rigid pavements are constructed is important in rural and urban areas for transporting.

So we are designing and construction of rigid pavement by using M25 grade of concrete with relevant thickness for pedestesians and low traffic vehicles. A rigid pavement is constructed from cement concrete or reinforced concrete slabs. Grouted concrete roads are in the category of semi-rigid pavements.

Keywords: Rigid pavements

INTRODUCTION

Although pavement design has gradually evolved from art to science, empiricism still key role plays an important role even up to the present day. Prior to the early 1920s, the thickness of pavement was based purely on experience. The same thickness was used for a section of highway even though widely different soils were encountered. As experience was gained throughout the years, various methods were developed by different agencies for determining the thickness of pavement required. It is neither feasible nor desirable to document all the methods that have been used so far. Only a few typical methods will be cited to indicate the trend. Some technical terms will be used in this introductory and review chapter. It is pre- summed that the students using this book as a text are seniors or graduate students who have taken courses in transportation engineering, civil engineering materials, and soil mechanics and are familiar with these terms. In case this is not true, these terms can be ignored for the time being, because most are explained and clarified in later chapters.

Analytical Solutions Analytical solutions ranging from simple closed-form formulas to complex derivations are available for determining the stresses and deflections in concrete pavements.

Historical Developments Merits: However, a simple influence chart based on solid foundations was developed by Pickett and Badaruddin (1956) for determining the edge stress.

Numerical Solutions All the analytical solutions mentioned above were based on the assumption that the slab and the subgrade are in full contact . It is well known that, due to pumping, temperature curling, and moisture warping, the slab and subgrade are usually not in contact. With the advent of computers and numerical methods

Summary of Literature Review

The literatures disclosed that design and construction of rigid pavements. We have to follow some recommendation for design and construct the rigid pavements. Based on CBR of subgrade, traffic volume and lifetime of pavements. The long-term performance of a newly constructed concrete (rigid) pavement relies on good construction practices and proper pavement design and selection of materials. Premature failures of rigid pavements are often the result of poor construction practices or improper application of design principles and materials. This Guide not only discusses related topics in the design and construction of new jointed plain concrete pavements (JPCPs), but also presents some tips in using the current pavement related Standard Plans and corresponding Special Provisions that a pavement engineer will need to design and build a long lasting concrete pavement.

DESIGN AND CONSTRUCTION OF RIGID PAVEMENTS

TYPES OF RIGID PAVEMENTS

A typical rigid pavement consists of a granular subbase, a base course and a relatively thin concrete slab as wearing course. The base course may be any of these: Dry Lean Concrete (DLC), Paved Lean Concrete (LC), Porous Concrete (PC), and Asphalt Concrete (AC). Sometimes the base course is termed as subbase and the granular subbase is called Eventual Draining Layer.

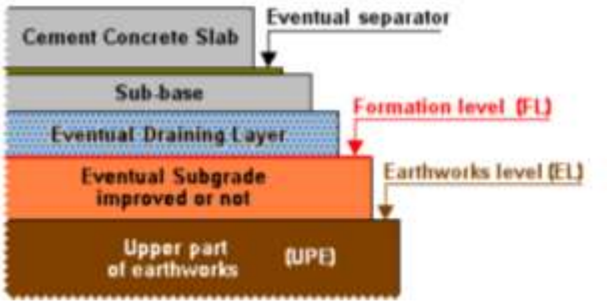

Figure.1 Typical Rigid Pavement

SURVEY INVESTIGATION

Survey investigation is very important for any type of project including roads, irrigation projects ,railway etc., the investigation is carried out in four stages.

•Map study
•Reconnaissance survey
•Preliminary survey
•Final location and detailed survey

MAP STUDY

If the topographic map of the area is available , it is possible to suggest the likely routes of the road .the Indian topographic maps are available from survey of India ,With 15 or 30 meters contour intervals .the main features like rivers ,hills, valleys etc are also shown on these maps .by carefully study of such maps it is possible to have an idea of several possible alternative routes so that further details of these may be studied later at the site.

The probable alignment can be located on the map from the following details available on the map.

•Alignment avoiding valleys, ponds or lakes .
•When the roads has to cross a row of hills, possibility of crossing through a mountain pass.
•Approximate location of bridge site for crossing the rivers, avoiding bends of the river if any.
•When a road is to be connected between two stations ,one of the top and other on the foot of the hill, then alternate routes can be suggested keeping in view the permissible gradients .

RECONNAISSANCE SURVEY

In the second stage of surveys for road location is the reconnaissance to examine the general character of the area for deciding the most feasible routes for detailed studies .a routes of the

Map in the field .only simple instrument like abney level ,tangent clinometers ,barometers etc., is used .all the relevant details not available in the map are collected and noted down.

•Valleys ,ponds ,lakes ,marshy land ,rigid hills ,permanent structure and other obstruction along the route which are not available in the map.

•Approximate values of gradient ,length of gradient and radius of curves of alternative alignments.
•Number type of cross drainage structures ,maximum flood level and natural ground water level along probable routes .
•Soil type along the routes from field identification test and observation of geological features .
•Sources of construction materials ,water and location of stone quarries .
•When the road passes through hilly or mountain terrain ,additional data required the geological formation ,type of rocks ,dip of strata ,seepage flow etc. may be observed so as to decide the stable and unstable sides of hill for road alignment.

A rapid reconnaissance of the area ,especially when it is vast and the terrain is difficult may be done by aerial survey .from the details collected during the reconnaissance ,the alignment proposed after study may be altered or even changed completely. As a result of the reconnaissance a few alternate alignments may be chosen for further study based on Practical considerations observed at the site.

PRELIMINARY SURVEY

The main objectives of preliminary survey are
•To survey the various alternative alignments proposed after the reconnaissance and to collect all the necessary physical information and details of topography drainage and soil.
•To compare the different proposals in view of thr requirements of good alignment .
•To estimate quantity of earth work materials and other construction aspects and to work out the cost of alternate proposals
•To finalize the best alignment from all considerations.
The preliminary survey may be carried out by any one of the following methods

PRIMARY TRAVERSE

The first step in the preliminary survey is to establish the primary traverse following the line recommended in the reconnaissance .for alternative alignment either secondary traverse or are open traverse no adjustment of errors is possible later ,so the angles should be very accurately measured by theodolite .the length of the center line should be measured by using very good and accurate chaining methods or by tachometric or by modern instruments.

TOPOGRAPHICAL FEATURES

After establishing the center line of preliminary survey ,the topographical features are recorded .all geographical and other man made features along the transverse and for a certain width on either side are surveyed is generally decide by survey party ,but the absolute minimum width is the land width of proposed alignment.

LEVELLING WORK

Leveling work is also carried out side by side to give the central line profile and typical cross sections to obtain the approximate earth work in the alternate alignment.

TRAFIC SURVEY

Traffic surveys conducted in the region from the basis for deciding the number of traffic lanes and road way width ,pavement design and economic analysis of road project .traffic volume counts of the classified vehicles are to be carried out on the all the existing roads in the region ,preferably for 24 hours per day for 7 days origin and destination surveys are very useful for deciding the alignment of roads .this study may e carried out on a suitable samle of vechicle users or drivers .in addition the required traffic data may also be collected so that traffic forecast could be made for 10 to 20 year periods

AERIAL PHOTOGRAPHIC SURVEY

Ii is suited for preliminary survey, especially when the distance and area to be covered are vast the survey is done as follow
•Taking aerial photographs of the strips of land to e surveyed with the required longitudinal and lateral overlaps.

FINAL LOCATION AND DETAILED SURVEY

The alignment finalized at the design office after the preliminary survey is to be first located on the field by establishing the center line .next detailed survey should e carried out for collecting the information necessary for preparation of plans and construction details for the road project.

LOCATION

The center line of road finalized in the drawing is to be translated on the ground during the location survey .this location survey .this done using a total station and by staking of center line .the location of the center line should follows ,as closely as practicable, the alignment finalized after the preliminary

DETAILED SURVEY

Temporary bench Marks are fixed at intervals of about 250 mts and at all adrainage and underpass structures .levels along the final center line should be taken at all staked points leveling work is of great importance as the vertical alignment ,earth work calculations and drainage details are to e worked out from the level nodes .the cross section levels are taken up to the desired width ,at intervals of 50 to 100 meters in plane and 50 to 70 meters in rolling terrain .the cross sections may be taken at closer intervals at horizontal curves ,all river crossings ,valleys etc.,

All topographical details noted down and also plotted using convectional sings adequate hydrological details are also collected and recorded.out to

A detailed soil survey is carried to enable drawing out the soil profile .the depth up to which soil sampling is to be done may be 1.5 to 3 meter below the ground line or Finished grade line of the road which ever is lowered .

MAPPING AND DESIGN OF GEOMETRIC

Mapping and designing of geometric is the second step of the project, which include s generation of contours by the data collected from the total station instrument in preliminary survey .this generation of contours is done by using surfer software.

Surfer software is a contouring and 3d surface mapping program that runs under Microsoft windows .it quickly and easily converts your data into outstanding contour ,surface ,wire frame ,vector images shaded relief ,and post maps .virtually all aspects of your maps can customized to produce exactly the presentation you want .producing publication quality mps has never been quicker or easier .surfer counter maps give you full control over all map parameters .you can accept the surfer intelligent defaults to automatically create a contour map ,or double click a map easily customize map features.

Display contour maps over any contour range and contour interval or specify only the contour levels you want to display on the map .and with surfer you can add color fill between contours to produce dazzling displays of your maps or produce gray scale fills for dramatic black and white printouts .surfer image maps use different color to represent elevation of a grid file. create image maps using any grid file format. GRD,DEM ,SDTS ,DDF and GTOP 30 HDR . surfer automatically blends colors between percentage values so you end up with a smooth color gradation over the map. this map can be exported in the auto cad and useful in many ways.

DESIGN GEOMETRIC

This part includes the preparing the longitudinal and transverse sections of the road alignment which are the vertical control of the project .these longitudinal and transverse cross sections are generated in the AUTO – CAD using different lisp programs .These longitudinal sections are useful in knowing the existing features of ground level.

Cross sections are useful in calculating the earth work quantities were the ground level is uneven on either side of the road .It is also useful in generating the grid were structures has to be constructed .This data is useful in designing of horizontal curves.

(longi c/s drawings)

SOIL INVESTIGATIONS

In the soil survey ,a detailed investigation is required both physically as well as by way of testing soil samples from each kilometer of the alignment as per the IRC:SP 19,2001.This will not only have the initial cost savings but also in the subsequent maintenance s the design will be more appropriate for the site condition .soil investigation of the site as part of drainage for the road ,both in terms of sub-surface drainage as well as the cross drainage that will be required .

STRESSES IN RIGID PAVEMENTS

The major portion of the load carrying capacity of the rigid pavement is derived from the concrete slab as the modulus of elasticity of concrete slab is much greater than that of the base or subbase materials; this mechanism is often termed as slab or beam action.

Wheel loads, temperature changes, changes in moisture and changes in volumes of base, subbase and subgrade are the causes for the stresses in the rigid pavements. The degree of continuity of subgrade also plays a vital role in deciding the magnitude of stresses. Hence the stresses in the rigid pavements are broadly categorized as wheel load stresses, stresses due to restrained temperature and moisture deformations, stresses due to volume changes of the supporting materials and stresses due to permanent deformations of the subgrade or loss of support through pumping, a condition where ejection of water and subgrade (or base) material through joints and cracks or at the pavement edge takes place due to deflection of the slab after accumulation of free water under the slab. The estimation of stresses by the mathematical analysis is based on certain assumptions regarding continuity and elasticity of the materials.

Westergaard's equations are commonly used to estimate wheel load stresses [90]. These stress equations for the three typical regions of the cement concrete pavements in kg/cm2 are given equations

Interior stress

$\sigma i=(0.316Pwh^2/)[4\log10(lrbr/)+1.069]$

Edge stress

$\sigma e=(0.572Pwh^2/)[4\log10(lrbr/)+0.359]$

Corner stress $\sigma c=(3Pwh^2/)[1-(ar\sqrt{2}/lr)0.6]$

where,

h = Slab thickness (cm),

Pw =Wheel load (kg),

ar = Radius of wheel load distribution (cm),

lr =Radius of relative stiffness (cm) and

br=Radius of resisting section (cm).

$lr=[EC\, h3/(12\, K)(1-\mu 2)]1/4$

$br=(1.6ar2+h2)0.5-0.645\, h$

(for ar ≤ 1.724h) and if ar > 1.724h then br = ar

K = Modulus of sub-grade reaction (kg/cm3)

The warping stresses in the three regions of a rigid pavement, expressed in kg/cm2 are given by equations

Interior stress $\sigma wi=0.5Ec\,\alpha\,[(Cx+\mu Cy)(1-\mu 2)/]$

Edge stress$\sigma we=0.5Cx\,EC\,\alpha\,t$ or

$\sigma we=0.5Cy\,EC\,\alpha\,t$,

whichever is higher

Corner stress $\sigma wc=0.333[Ec\,\alpha\,t\,(arlr/)0.5]/(1-\mu)$

where

EC = Modulus of elasticity of concrete (kg/cm2),

α = Thermal coefficient of concrete per ºC,

t = Temperature difference between top and bottom ends of slab in degree ºC,

μ =Poisson's ratio for the material of the slab and Cx and Cy are the coefficients based on the ratios of L x/lr and Ly/lr

L x and Ly are the dimensions of the slab along X and y directions (along the length and width of the slab) respectively.

The frictional stress, expressed in kg/cm2 is given by equation

$\sigma f=[0.5\,W\,Ls\,f]/104$

where

W = Unit weight of concrete (kg/m3),

Ls =Slab length and

f = Coefficient of subgrade restraint

The critical condition of the stress is obtained by the combination of load, warping and frictional stresses. Following combinations are generally tried:

At edge

Load stress + warping stress – frictional stress during summer

Load stress + warping stress + frictional stress during winter

At corner

Load stress + warping stress.

In reinforced concrete pavements the stresses in the dowel and tie bars are also significant. From the experience all over the world, it is found that only stress responsible for the performance of the joints of the dowel bars is the bearing stress in the concrete. Maximum bearing stress between the concrete and the dowel bar is obtained from equation

$\sigma_{max}=Ki\,Pt(2+\beta\,z)/(4\,\beta 3EdI)$

where $\beta=(Kibd4Ed/I)1/4$

β =Relative stiffness of the dowel bar, Ki = Modulus of dowel/concrete interaction (kg/cm2/cm),

bd = Diameter of the dowel bar (cm),

z =Joint width (cm),

Ed =Modulus of elasticity of the dowel (kg/cm2),

I = Second moment of area of the dowel cross section (cm4) and

Pt = Load transferred by the dowel bar.

Tie bar of a slab develops tensile stress which depends on the frictional force between the bottom of the adjoining slab and the soil subgrade.

DESIGN OF RIGID PAVEMENTS

There are several methods of pavement design, developed by various professional organizations based on their years of experience in design and construction. With this great diversity, the pavement design is more of an art than science [91]. The work of Westergaard in developing the analytical methods and research in the physical properties of pavement concrete is till date the greatest contribution in the field of rigid pavement analysis and design. The high-water mark of rigid pavement design was the development of design method for air field pavements by the Ohio River Division Laboratory of the U.S. Army Corps of Engineers. Some of the methods which have been acclaimed worldwide are Portland Cement Association (PCA) method, Corps of Engineers method, AASHTO method, Yield-line method, Load Classification Number (LCN) method and Federal Aviation Agency (FAA) method. To reflect the current knowledge on the subject of pavement design, the guidelines for the design of plain jointed rigid pavements were revised in India by Indian Road Congress [92]. The early approach to the design of rigid pavements by IRC was based on Westergaard's analysis. The prominent features of the revised guidelines are estimation of flexural stress due to single and tandem axle loads along the edge, inclusion of cumulative damage concept and revision of design criteria for the design of dowel bars. The factors that govern the design are: single or tandem axle loads, repetition of the loads, tyre pressure and lateral placement characteristics of commercial vehicles.

COMPOSITION AND STRUCTURE OF RIGID PAVEMENT

Rigid pavements normally use Portland cement concrete as the prime structural element. Depending on conditions, engineers may design the pavement slab with plain, lightly reinforced, continuously reinforced, prestressed, or fibrous concrete. The concrete slab usually lies on a compacted granular or treated subbase, which is supported, in turn, by a compacted subgrade. The subbase provides uniform stable support and may provide subsurface drainage. The concrete slab has considerable flexural strength and spreads the applied loads over a large area.

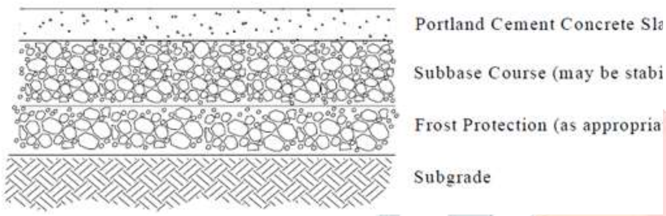

Fig Typical Rigid Pavement Structure

Transfer of wheel load to foundation in rigid pavement structure

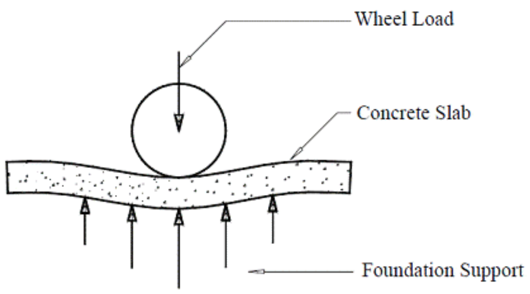

Fig Transfer of wheel load to foundation in rigid pavement structure

a) **Concrete Slab** (Surface Layer). The concrete slab provides structural support to the aircraft, provides a skid-resistant surface, and prevents the infiltration of excess surface water into the sub base.

b) **Sub base**: The sub base provides uniform stable support for the pavement slab. The sub base also serves to control frost action, provide subsurface drainage, control swelling of sub grade soils, provide a stable construction platform for rigid pavement construction, and prevent mud pumping of fine-grained soils. Rigid pavements generally require a minimum sub base thickness of 4 inches (100 mm).

c) **Stabilized Sub base**: All new rigid pavements designed to accommodate aircraft weighing 100,000 pounds (45,000 kg) or more must have a stabilized sub base. The structural benefit imparted to a pavement section by a stabilized sub base is reflected in the modulus of sub grade reaction assigned to the foundation.

d) **Frost Protection Layer**. In areas where freezing temperatures occur and where frost-susceptible soil with a high ground water table exists, engineers must consider frost action when designing pavements. Frost action includes both frost heave and loss of subgrade support during the frost-melt period. Frost heave may cause a portion of the pavement to rise because of the non-uniform formation of ice crystals in a frost-susceptible material (see Figure 3). Thawing of the frozen soil and ice crystals may cause pavement damage under loads. The frost protection layer functions as a barrier against frost action and frost penetration into the lower frost-susceptible layers.

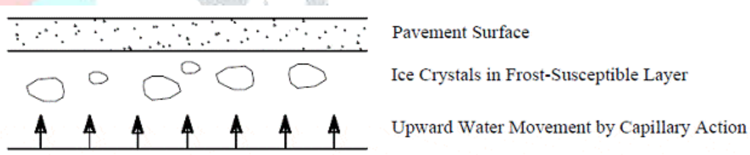

Fig Formation of ice crystals in frost-susceptible soil

e) Sub grade: The sub grade is the compacted soil layer that forms the foundation of the pavement system. Sub grade soils are subjected to lower stresses than the surface and sub base courses. These stresses decrease with depth, and the controlling subgrade stress is usually at the top of the sub grade unless unusual conditions exist. Unusual conditions, such as a layered sub grade or sharply varying water content or densities, may change the locations of the controlling stress. The soils investigation should check for these conditions. The pavement above the sub grade must be capable of reducing stresses imposed on the sub grade to values that are low enough to prevent excessive distortion or displacement of the sub grade soil layer.

Since sub grade soils vary considerably, the interrelationship of texture, density, moisture content, and strength of sub grade material is complex. The ability of a particular soil to resist shear and deformation will vary with its density and moisture content. In this regard, the soil profile of the sub grade requires careful examination. The soil profile is the vertical arrangement of layers of soils, each of which may possess different properties and conditions.

Soil conditions are related to the ground water level, presence of water-bearing strata, and the properties of the soil, including soil density, particle size, and moisture content, and frost penetration. Since the sub grade soil supports the pavement and the loads imposed on the pavement surface, it is critical to examine soil conditions to determine their effect on grading and paving operations and the need for under drains.

MIX-DESIGN

In this project we aim to design and construction a rigid pavement for the College of ABR Engineering College in KANIGIRI.

LOCATION:

CHINAIRLAPADU VILLAGE is located at distance of 5 km from heart of KANIGIRI. And is left side from the KANIGIRI to KANDUKUR road.

TEMPERATURE:

Tropical and monsoonal climate prevail in this locality the seasonal Minimum and maximum temperatures vary from 16 to 46.

NECEESITY:

The project area soil contains low in strength mainly which is blocking cotton soil having low CBR value of 2.89.

In this project,

DESIGN AND CONSTRUCTION OF A RIGID PAVEMENTS of length 200m.

SOIL INVESTIGATION

In the soil survey, a detailed investigation is required both physically as well as by way of testing soil samples from each kilometer of the alignment as per the IRC: SP 19, 2001.This will not only have the initial cost savings but also in the subsequent maintenance is the design will be more appropriate for the site condition .Soil investigation of the site as part of drainage for the road both in terms of sub-surface drainage as well as the cross drainage that will be required.

MODIFIED PROCTOR TEST

Result The MDD is 2.016 g/cc An OMC 12%

Cement

Cement shall be Type GP Portland cement complying with AS 3972. When submitting details of the nominated mix in accordance with Clause Contractor shall nominate the brand and source of the cement. On approval of a nominated mix by the Superintendent, the Contractor shall use only the nominated cement in the work. Documentary evidence of the quality and source of the cement shall be furnished by the Contractor to the Superintendent upon request at any stage of the work.

Admixtures

Chemical admixtures and their use shall comply with AS 1478. Admixtures shall not contain calcium chloride, calcium formate, or triethanolamine or any other accelerator. Admixtures or combinations of admixtures other than specified below, shall not be used. An air-entraining agent shall be included in the mix and the air content of the concrete shall comply with Clause 5.03.4.

The desired values of M25 grade are according IS standards are as follows

A-1	Stipulations for proportioning	
1	Grade Designation	M25
2	Type of cement	OPC 53 grade confirming to IS-12269-1987
3	Maximum nominal aggregate size	20mm
4	Minimum cement content	310 kg/m^3
5	Maximum water content	0.45-0.75
6	Workability	50-75mm (slump)
7	Exposure condition	Normal
8	Degree of supervision	Good
9	Type of aggregate	Crushed angular aggregate
10	Maximum cement content	540 kg/m^3
11	Chemical admixture type	Super plasticizer confirming to IS-9103

A-2	Test data for materials	
1	Cement used	Coro Mandan king OPC 53 Grade
2	Sp. Gravity	3.15

	of cement	
3	Sp. Gravity of water	1.00
4	Chemical admixture	BASF chemicals company
5	Sp. Gravity of 20mm aggregate	2.884
6	Sp. Gravity of 10mm aggregate	2.878
7	Sp. Gravity of sand	2.605
8	Water absorption of 20mm aggregate	0.97%
9	Water absorption of 10mm aggregate	0.83%
10	Water absorption of sand	1.23%
11	Free moisture of 20mm aggregate	Nil
12	Free moisture of 10mm aggregate	Nil
13	Free moisture of sand	Nil
14	Sieve analysis of individual coarse aggregates	Separate analysis done
15	Sp. Gravity of combined coarse aggregates	2.882
16	Sieve analysis of fine aggregates	Separate analysis done

A-3	Target strength for mix proportioning	
1	Target mean strength	42N/mm^2
2	Characteristic strength	30N/mm^2
A-4	Selection of water cement ratio	
1	Maximum water cement ratio	0.45
2	Adopted water cement ratio	0.42
A-5	Selection of water content	
1	Maximum water content	186 lit
2	Estimated water content for 50-75mm slump	160 lit
3	Super plasticizer	0.5% by wt. of cement
A-6	Calculation of cement content	
1	Water cement ratio	0.42
2	Cement content (160/0.42)	380 kg/m^3 Which is greater than 310 kg/m^3
A-7	Proportion of volume of coarse aggregate & fine aggregate content	
1	Vol. of C.A as per table 3 of IS 10262	62.00%
2	Adopted vol. of C.A & F.A	62.00% & 38.00%
A-8	Mix calculations	
1	Volume of concrete in m^3	1.00
2	Volume of cement in m^3	0.12
	(Mass of cement)/(sp. Gravity of cement)*1000	
3	Volume of water in m^3	0160
	(Mass of water)/(sp. Gravity of water)*1000	
4	Volume of admixture @ 0.5% in m^3	0.00160
	(Mass of admixture)/ (sp. Gravity	

	admixture)*1000	
5	Volume of all in aggregate in m^3	0.718
	Sr. no. 1-(sr. no. 2+3+4)	
6	Volume of C.A in m^3	0.445
	Sr. no. 5*0.62	
7	Volume of fine aggregate in ^3	0.273
	Sr. no. 5*0.38	
A-9	Mix proportions for 1cumec of concrete (SSD Condition)	
1	Mass of cement in kg/m^3	380
2	Mass of water in kg/m^3	160
3	Mass of F.A in kg/m^3	711
4	Mass of C.A in kg/m^3	1283
	Mass of 20mm in kg/m^3	924
	Mass of 10mm in kg/^3	359
5	Mass of admixture in kg/m^3	1.90
6	Water cement ratio	0.42

For pavement construction for rural roads it is recommended (IRC-44 for concrete mix design) that the characteristic 28 day compressive strength should be at least of 30Mpa, The characteristic 28 day flexural strength shall be at least 3.8Mpa.

Design Procedure for Rigid Pavement at ABR Engineering College

STEP: 1

Wheel load:

From the traffic volume data 50 vehicles per day the wheel load acting on the pavement is 3T.

Design wheel load p = half of the single axel load

STEP: 2

The soaked soil sample CBR value of sub grade is -2.89% so from the IRC: 58-2002 table

The value for 2.89% is = 2.723 kg/cm²/cm

The effective k-value is obtained by increasing 20% =1.2 x2.723 =3.2676 kg/cm²

STEP: 3

Sub base:

The CBR value of sub grade is less than 6.0 kg/cm²/cm so we have to provide DLC (dry lean concrete) of thickness 100 mm.

STEP: 4

Separation layer between sub base and pavement is of thickness 125 microns polythene

STEP: 5

Concrete strength:

The assumed grade of concrete is M25

The flexure strength of concrete is Fr= 0.7

= 3.830mpa=38.3 kg/cm²

90 days flexure strength of it is 20% of 28 days of strength

= 1.2 x 3.830= 46.00 kg/cm²

STEP: 6

Thickness of the slab:Try thickness of the 80 mm concrete slab over the sub base

STEP: 7

Edge Load stress:

<u>Due to load:</u>

Load stress in the edge region

μ =Poisson's ratio=0.15

I = radius of relative stiffness, mm

h = thickness of the concrete slab =15mm

k= modulus of sub grade reaction= 3.2676 kg\cm2

I=89 mm b=radius of equivalent pressure distribution

a=radius of area of contact of wheel

q= tire pressure s= c/c distance between two tires =31 cm

Temperature stress:

Temperature stress at the critical edge region may e obtained as per Westargaad's analysis using Bradbury's coefficient from the following equation.

Ste = temperature stress in edge region, kg/c

E= modules of elasticity of concrete= 3 x 10^5 kg/cm²

T = maximum temperature differential during day between top and bottom of the slab = 19°c

α= coefficient of thermal expansion of cement concrete per =10×10^{-6}/°c

C = Bradbury's coefficient, which can ascertained directly from Bradbury's chart against values of L/I and B/I

L = slab length or spacing between consecutive contraction joints, =450 cm

W=slab width, or spacing between longitudinal joints, = 350cm

μ =Poisson's ratio

h = thickness of the concrete slab =15 mm

k = modules of sub grade reaction = 3.082 kg/cm³

I= 89 mm

The Bradbury's coefficient

Charts for determination of coefficient c= 5.0561
From the figure temperature stress is 20kg/cm²Therefore total stress =edge load stress + temperature stress
=load stress + temperature stress
= 5.11 + 20= 25.11 kg/cm²
Which is less than 46kg/cm², therefore the flexure strength .so the pavement thickness 15mm is safe under the combined action of wheel load and temperature.

Hence ok

Check for corner stress

Corner stress is not critical in a dowelled. The corner stress can calculated from the following formula Therefore corner stress wheel load= 3 tonesE =3x10^5 kg/cm² h=20cm
μ=0.15
k=3.2676kg/cm^3

a = radius of area of contact of wheel considering a single axle dual wheel,
p= 3 tones
s= c/c distance between two tires=31 cm q= tire pressure
a= $(101.71+264.30)^{0.5}$= 19.13 cm
Therefore corner stress= 17.20 kg/cm^2
Therefore corner stress is less than the flexure strength of the concretei.e. =47kg/cm^2
And the pavement thickness of 80 mm assumed is safe against the corner stress.

THICKNESS FOR PRESENT ROAD

From all these conditions, in this project we are fixing thickness of rigid pavements the following conditions occurred: Rural area-Low traffic -Mainly pedestrians -Good subgrade reaction-Climate
Process
The reliability of rural area is in between 80 to 90 %, from table 5.1 ESAL = 1200 Climate Region =Rural %R = 90
Asphalt Base option selected. The solution is:
Thickness = 8cm

So the thickness of rigid pavement is 8cm

CONCLUSIONS

Based on discussion of experimental test results, a few of major conclusions can be listed with regards to the design and construction of rigid pavements by using m25 grade of concrete.

- As the part of the engineering curriculum projects done by the students really them in the understanding the subjects what we learned through the course
- This project was entirely about the designing of the aspects of the pavements which is the really made us to think about the different considerations that we take for designing the pavements
- Our project is entirely based upon the rigid pavements a different scenario in the design and construction compared to the flexible pavements
- We learned how to the actually a structure is designed what are the code books to be followed for the standard considerations that was to follow while designing the structures. How to the relate them partially, what are the different tests that has for be done for the designing materials that we are say to opt while constructing.
- We got the knowledge of how to manage a team and what is the team of while completing the project.

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