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Comparative study on Design of flexible pavement by various methods (GI method & CBR method)

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Abstract: In the project report, an attempt is made to design a road, based on the principles of pavement design and cost analysis of y two methods (Group Indexed and CBR Method). On the existing alignment of the road, soil samples are collected for the determination of soil characteristics like consistency limits, sieve analysis, C.B.R. values etc. Based on this the thickness of the pavement (flexible) is designed. The alignment of the road is also designed and fixed by surveying and leveling. The total road length being 497 meters of which, one section is 247m, other is 200m and the third section is 50m. The site selected for this study is of village road near Korba, Korba district of Chhattisgarh, India.
Keywords: GI Method, Flexible Pavement, CBR Method, Liquid Limit Test, Plastic Limit, Standard Proctor test, OMS & MDD.

I. INTRODUCTION

In the economic and proper construction of highways, the proper design of the corridors of different traffic congestion and small distances is essential. The science of paving is relatively new.

In India, previously the road crank was made for some logical details but mostly for the knowledge of a road engineer. The contagious size of the passages has been used leading to costly and wasteful failures as in some cases, the size of the corridors was insufficient and in some cases expensive. With no proper building codes, the construction of roads was not very prosperous in almost all cases. Therefore a clever way of designing and calculating the durability of the crust on the basis of the balance of road loads and lower load capacity etc, will lead to the construction of roads economically.

The surface of the paved road should be stable and flexible, allowing the loads of heavy road wheels to move in a non-slip direction. The road should be in the middle of a long profile so that fast cars can travel safely and comfortably at design speed.

The road surface is considered to be more efficient or higher, if it is able to distribute the load on the wheels over a larger area at the depth of each layer unit. The elasticity of the paved road should be within the permissible limits, so that the pavement can support a large number of repetitive loads during design.

It is always desirable to build a trench above ground level to keep the ground dry even during the rainy season. At high moisture content, the soil becomes weak and soft and begins to pour under heavy tire loads, thus increasing the strong resistance.

II. LITERATURE REVIEW

Kyungwon Park et. al (2007) Applicability of the International Roughness Index as a Predictor of Asphalt Pavement Condition. This note establishes the relationship between the surface distress of an asphalt pavement and its roughness, as conveyed respectively by the pavement condition index _PCI_ and the international roughness index _IRI_. The Data Pave software provides the roughness of varied roadway pavement sections from the North Atlantic region that were investigated under the long term pavement performance _LTPP_ study. The Micro PAVER1 software system computes the condition of the same sections using cross-referenced distress data from Data Pave. A transformed linear regression model predicts pavement condition given roughness. It confirms the acceptability of the IRI as a, albeit not the sole, predictor variable of the PCI whereby the former accounts for the majority, close to 59%, of the variations in the latter. Further, an analysis of variance confirms the existence of a strong relationship between both variables.Hein et. al (2009) Pave road mapping The process of concrete terrorists interacting. This paper describes the procedures used to create the ICP stone pressure guide in accordance with the Micro PAVER protocol. This paper provides a comprehensive overview of the development of ICP trauma guidelines summarizes the results of the analysis and provides an example of the use of procedures to obtain a road traffic situation model developed using ICPs. A detailed study of the theatres was completed and included a list of common types of concrete entrances and composite images. The impact of each suffering on the performance of the paved road was determined in consultation with the industry and other construction professionals. Influence operations were then designed for each type of severity and magnitude to allow for "deduction" calculations. Traction rates are included to specify a complete road position (PCI) for a road section.

The curve curves are then verified by inspecting the municipal roadway road which is constructed using interlocking concrete paint. Members of the Interlocking Concrete Pavement Institute (ICPI) are urged to identify areas for field inspection for investigation. A total of 83 pavement sections have been inspected at locations throughout North America to ensure curve drag. Comparison of PCI predicted prices compared to PCI estimated values showed a positive correlation.

J. RajendraPrasada et. al (2013) Relationship Development between Roughness (IRI) and Visible Surface Distresses: A PMGSY Road Study. Sharpness is universally accepted as a measure of the working condition of the paved road. It creates the smoothness and smoothness of the paved road and is related to safety, as well as ease of driving. It is determined using an international index (IRI), which is a measure of the shape of the paved area, and depends on the amount of other active stress present on the surface of the road. The current study focuses on building relationships between complexity and other additional pressures of PMGSY pathways. Accordingly, eight PMGSY roads have been selected in the Jhunjhunu and Churu districts of Rajasthan, India. Grief data was collected every 50m respectively. Evil data was collected using Bump Integrator, which was measured using MERLIN for a few selected study modes. Inequality data was also collected in the newly constructed paved method, and the value obtained as such was subtracted from the perceived inequalities in extensions, to obtain the full effect of stress on the paved road system. The regression equation was then based on the amount of IRI and the apparent difficulty based on data collected in the field.

ArySetyawan et. al (2015) Predict the remaining life of the road using the road condition indicator. Many factors cause road damage so that the remaining life of existing roads and long-term road maintenance is unexpected. The purpose of this paper is to assess road conditions and damage and to calculate the remaining life of the road in the East Line of South Sumatera, as well as to assess the relationship between the two values. This study included a five-part trajectory test with a variety of deformities and a detailed overhaul of road conditions using the Pavement Condition Index (PCI), while the service life prediction using the deviation data obtained from the Falling Weight Deflectometer ratings. The combination of the + PCI value with the remaining life service, psychologically established, created a regression model to find the relationship and the coefficient of integration. Results showed that road sections I, II, III, IV, and V had a PCI value of 56.1 (good), 37.8 (bad), 9.3 (excellent), 39.0 (bad), and 95.0 (excellent) respectively and the remaining service lives respectively are 2.39 years, 0.65 years, 4.43 years, 0.11 years and 3.57 years. The correlation between PCI value and paved road service life y = 4,1872ln (x) -14.728, with coefficient co 0.88 which is a strong level of relationships.

III. METHODOLOGY

In this study three samples of soils had been collected in the location of the site (work site) for each test. The following tests were performed to understand the engineering properties of soil are as follows:

1) Index Properties Test: Liquid Limit Test, Plastic Limit Test, Specific gravity Test, Sieve Analysis Test.
2) Standard Proctor test
3) CBR Test

The above tests were conducted as per IC code provision to obtain the Index Properties, Maximum Dry density of soil, OMC and CBR Value. For each test 3 samples are collected which gives more appropriate value.

A. Design of Pavement Thickness

There will be two methods consider for design of pavement thickness Group Index Method and CBR Method. The Design of pavement thickness is done for all 3 different samples and maximum obtained thickness is consider from the method.

1) Group Index Method

a) Sample 1

Sieve analysis:

Mass of soil taken =500gm

Mass of soil passing through 75μsieve = 6gm

$$\text{Percentage finer} = \left(\frac{\text{mass of soil passing through 75μ sieve}}{\text{Mass of soil taken}}\right) \times 100$$

$$= (6/500) *100 = 1.2\%$$

Liquid limit = 24%

Plastic limit =14.28%

$$GI = 0.2a + 0.005ac + 0.01bd$$

Where,

a = percentage of material passing through IS 200(75 μ) sieve more than 35 and less than 75

b = percentage of material passing through IS 200(75μ) sieve more than 15 and less than 55

c = liquid limit more than 40 and less than 60

d = plastic limit more than 10 and less than 30

Here,

a=1.2 – 35=0

b =1.2 – 15 =0

c=24 – 40 =0

$$d = 14.28 - 10 = 4.28$$
$$GI = (0.2 \times 0) + (0.005 \times 0 \times 0) + (0.01 \times 0 \times 0)$$
$$= 0$$

Assuming the traffic to be medium, 50 to 300 vehicles per day.

From the design charts, the combined thickness of surface, base and sub-base course = 23cm

The thickness of base and sub-base courses =20cm

b) Sample2

Same procedure is follows for other two sample and the result Obtained is as follows:

From the design charts, the combined thickness, of surface, base and sub-base course = 23cmThethickness of base and sub-base courses =20cm

c) Sample3

From the design charts, the combined thickness, of surface, base and sub-base course = 23cm

The thickness of base and sub-base courses =20cm

2) CBR Method

a) Sample1

CBR corresponding to 2.5 mm penetration = $(\frac{74.4}{1370}) \times 100 = 5.4$ %

Assume, Average Daily Traffic (ADT) =300

Annual rate of growth of traffic (r) =8%

Time taken for pavement construction (n) = 1

Year No. of vehicles for design (A) =P $(1+r)^{(n+10)}$

$$= 300 \left(1 + \frac{8}{100}\right)^{(1+10)}$$

$$= 699.49 \text{ vehicles/ day}$$

$$= 700 \text{ vehicles/ day}$$

Therefore, Design Curve E is to be used for design as the design traffic volume is in the range 450 to1500 vehicles/day.

Using the design chart, the total pavement thickness over sub-grade having CBR of 5.4% is obtained as 40 cm for curve E.

Thus 40 cm of pavement materials is required to cover the natural soil sub-grade having 5.4% CBR value.

Therefore, the thickness of base and sub-base courses are 12.5 cm and 22 cm having CBR value 55% and 25% using the design chart.

The CBR values for the gravel and road material are assumed as follows:

Type of material	Suggested CBR values (%)
Gravel	25
Road metal	55

b) Sample2

Thus 45 cm of pavement materials is required to cover the natural soil subgrade having 4.9% CBR value.

Therefore, the thickness of base and subbase courses are 13 cm and 25 cm having CBR value 50% and 25% using the design chart.

The CBR values for the gravel and road metal are assumed as follows:

Type of material	Suggested CBR values (%)
Gravel	25
Road metal	50

c) Sample3

Thus 38 cm of pavement materials is required to cover the natural soil subgrade having 5.8% CBR value.

Therefore, the thickness of base and subbase courses are 11cm and 22 cm having CBR value 47% and 25% using the design chart.

The CBR values for the gravel and road metal are assumed as follows:

| Type of material	Suggested CBR values (%)
Gravel	25
Road metal	47

IV.RESULTS

1) *Design Thickness of Pavement:* Provide the greater of the two values obtained in each case for safety.
2) *Group Index Method:* The thickness of base and sub-base courses =20cm
3) *CBR Method:* Hence, provide a sub base of 25 cm thickness, base course of 15 cm thickness and wearing course of 7cm thickness (as obtained from the curves recommended by IRC)
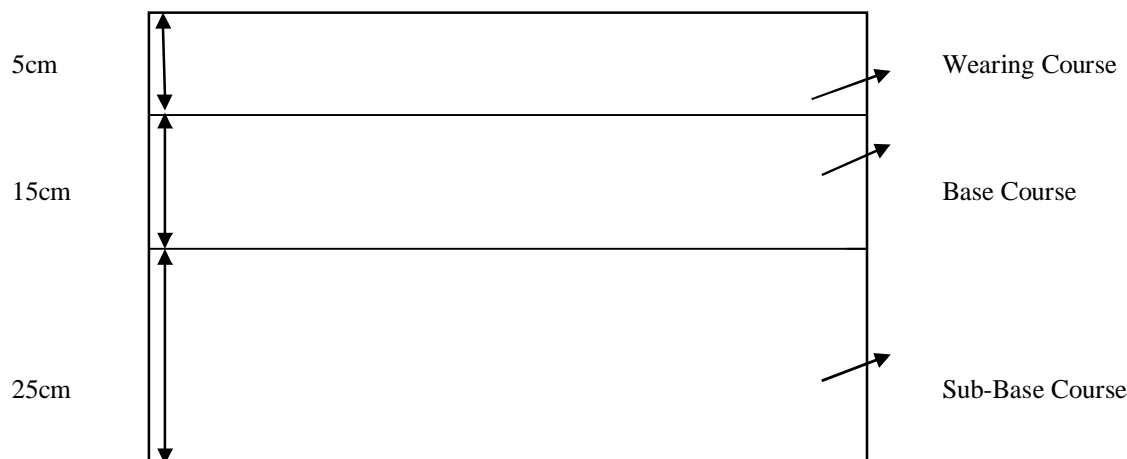
V. CONCLUSIONS

A.   The Group Index Method gives combined thickness of surface, base course and subbase course.
B.   The CBR method gives separate values of thickness of wearing course, base course and sub bsae course.
C.   Hence above results shows that the CBR method is better because it gives details thickness of each course, hence its better to use CBR Method over Group Index Method.
D.   The CBR Method gives better estimation of materials used in different course of road.
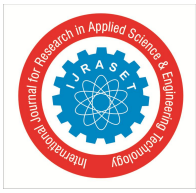
REFERENCES

[1] AbhayTawalare,K.VasudevaRajuVisvesvarayaNationalInstituteof Technology,Nagpurndia"PavementPerformanceIndexforIndian ruralRoads"(2016)

[2] ArySetyawan, JolisNainggolan, ArifBudiartoVisvesvaraya Transportation Infrastructure Research Group, UNS,Solo 57126, Indonesia,Procedia Engineering 125 (2015) 417 – 423 "Predicting the remaining service life ofroadusingpavementconditionindex"(2015)

[3] KyungwonPark; NatachaE. Thomas, and K. Wayne Lee,Ph.D., P.E. "Applicability of the International Roughness Indexasa Predictor of Asphalt Pavement Condition"(2007)

[4] J. RajendraPrasada, ShaliniKanugantib, Pooja N. Bhanegaonkarc, Ashoke Kumar Sarkar, ShriniwasArkatkard"Development of Relationship between Roughness (IRI) and Visible, Surface Distresses : A Study onPMGSYRoads"(2013)

[5] YogeshU.Shah, S.S. Jain, DeveshTiwari, M.K. Jain."Development of Overall Pavement Condition Index forUrbanRoadNetwork."(2013)

[6] Alexandru-octavianamarie,Andreiradu,NicolaeTaranuandVasileboboc"EvaluationofageneralPerformanceIndexforFlexibleRoadPavements"(2013)

[7] Hein, david k., p. Eng. Aho, brian "Development of a pavement condition index Procedure for interlockingconcretepavements"(2009)

[8] "IRC 37-2001" : Guidelines for the design of flexible pavements.

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