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Design Of Flexible Pavement By Various Method

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Abstract:
Highway planning and pavement design plays an important role in day to day life. In our project we are calculating thickness of flexible pavement by comparing various design methods such as, Group Index method (GI), California Bearing Ratio method (CBR), Indian Road Congress method (IRC). From this design method maximum thickness is adopted for the construction of flexible pavement.

Keywords: GI, CBR, IRC.

1)Introduction:

Flexible pavement consists of several layers or component parts in which sub grade layer is the bottom layer on which the pavement is rest. Another is sub base layer which resist the capillary rise of ground water. The layer is of bolder fixed known as base coarse. Wearing coarse is the top most layer of the pavement, which expose to traffic. Also various tests are conducted on road construction material such as, aggregate, bitumen and soil. By conducting tests on soil and also by traffic volume graph we calculate a thickness of flexible pavement by GI method. By conducting CBR test in the laboratory on soil, we calculate a thickness of road. Depending on CBR percentage a thickness is determine by chart given in IRC: 37-2001.

2)Theory:

Following are the material used for road construction:

1) Aggregate
2) Bitumen

Test conducted on aggregate:

1) Crushing test
2) Impact test
3) Abrasion test
4) Flakiness test
5) Elongation test

Test conducted on Bitumen:

1) Penetration test
2) Viscosity test

3)Group Index Method:

The group index is used in the grading of soils. The higher the value of the group index, the poorer is the sub grade. Lower the value of GI higher the sub grade.

In this method the thickness of the pavement is determine. The value of group index is formulated on various physical properties of soil such as liquid limit, plastic limit, etc. The group index method of pavement design is essentially an empirical method based on physical properties of the sub-grade soil. This method does not consider the strength characteristics of the sub-grade soil and therefore is open to question regarding the reliability of the design based on the index properties of the soil only.

$$\mathbf{G\ I = 0.2a + 0.005ac + 0.01bd}$$

Where,

a = that portion of material passing 0.074mm sieve, greater than 35 and not exceeding 75 percent

b = that portion of material passing 0.074mm sieve, greater than 15 and not exceeding 35 percent

c = that portion of numerical liquid limit greater than 40 and not exceeding 60, expressed as positive whole no between 0-20

d = that portion of plasticity index greater than 10 and not exceeding 30, expressed as positive whole on bet 0-20

4)California Bearing Ratio Method:

The CBR determination may be performed either in the laboratory, typically with a recomputed sample, or in the field. Because of typical logistics and time constraints with the laboratory test, the field CBR is more typically used by the military for design of contingency roads and airfields. The thickness of different elements comprising a pavement is determined by CBR values. The CBR test is a small scale penetration test in which a cylindrical plunger of 3 in2 (5 cm in diameter) cross-section is penetrated into a soil mass (i.e., sub-grade material) at the rate of 0.05 in. per minute (1.25 mm/minute).

8 Observations are taken between the penetrations resistances (Called the test load) versus the penetration of plunger. The penetration resistance of the plunger into a standard sample of crushed stone for the corresponding penetration is called standard load. The California bearing ratio, abbreviated as CBR is defined as the ratio of the test load to the standard load, expressed as percentage for a given penetration of the plunger.

$$\mathbf{CBR} = \left(\frac{\textbf{Test load}}{\textbf{Standard load}}\right) \times \mathbf{100}$$

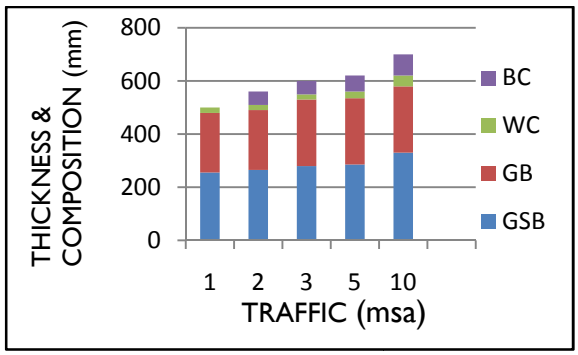
In most cases, CBR decreases as the penetration increases. The ratio at 2.5 mm penetration is used as the CBR. In some case, the ratio at 5 mm may be greater than that at 2.5 mm. If this occurs, the ratio at 5 mm should be used. The CBR is a measure of resistance of a material to penetration of standard plunger under controlled density and moisture conditions. The test procedure should be strictly adhered if high degree of reproducibility is desired. The CBR test may be conducted in re-moulded or undisturbed specimen in the laboratory. The test is simple and has been extensively investigated for field correlations of flexible pavement thickness requirement.

5)Indian Road Congress Method:

The design related to CBR values ranging from 2 per cent to 10 per cent and ten levels of design traffic 1, 2, 3, 5, 10, 20, 30, 50, 100 and 150 msa. The pavement compositions given in the design catalogue are relevant to Indian conditions, materials and specifications. Where any change in layer thickness and specifications, the composition can be suitably modified using analytical approach with in-service performance related information and appropriate design values. For intermediate traffic ranges, the pavement layer thickness will be interpolated linearly. For traffic exceeding 150 msa, the pavement design appropriate to 150 msa may be chosen and further strengthening carried out to extend the file at the appropriate time based on pavement deflection measurements as per IRC: 81.

Plate 1:Recommended design for traffic range 10-150msa

CBR 4%					
Cumulative Traffic (msa)	Total Pavement Thickness (mm)	PAVEMENT COMPOSITION			
		Bituminous Surfacing		Granular Base (mm)	Granular Sub base (mm)
		WC (mm)	BC (mm)		
1	480	20PC	_	225	255
2	540	20PC	50BM	225	265
3	580	20PC	50RM	250	280
5	620	25SDBC	60DBM	250	285
10	700	40BC	80DBM	250	330



6)Conclusion:

1) The thickness of flexible pavement design is commonly depending on wheel load. If the wheel load is more then more is the thickness of flexible pavement.

2) Maximum thickness is adopted after comparing all results of the design methods, which suitable for strength, life span, and other factor.

3) IRC method is more suitable for road construction than GI and CBR method.

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