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Flexible Pavement

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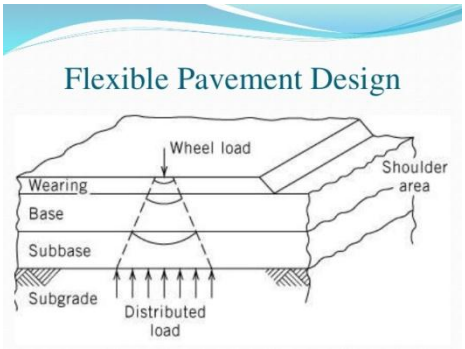
ABSTRACT - *To provide a better road network is necessary, but it is not available at some places. There are some places where the traffic is higher or enough but road network is not available for it. Research area is from Drabshala to Salana which is used by Daily traffic such as Public bus, four wheeler, two wheelers, village people etc. to. The daily traffic is required a proper road but because of lack of maintenance the road becomes damaged and pavement deterioration is taking place like potholes ,rutting, disintegration and surface defects which are studied in this research. Now it is need to be repaired with a proper design. The aim of this research to provide a road design from Drabshala to Salana which should be safe and economical. Traffic data collection soil data collection and soil testing has been carried out.*

INTRODUCTION

1.1 FLEXIBLE PAVEMENT

A Pavement which consists of a mixture of asphaltic or bituminous material and aggregate placed on a good quality and compacted granular material is termed or flexible pavement. The water bound maccadam roads is an example of a flexible pavement. The pavement consisting of a port land cement concrete slab. The cement grounted roads may be termed as semi-rigid pavement.



1.2 SUBGRADE

The essential points of flexible pavement.

- The flexible pavements have low or negligible strength and are rather flexible in their structural action under the loads. The strenes are not transferred from grain to grain to grain the lower layers as in The case of flexible pavement layers.
- The flexible pavements have self heading properties but the rigid pavements do not have any, In other words, whatever deformation occurs in a flexible due to heavier wheel loads, it is or coverable to some extent after some time but it is not so in case of rigid pavement.
- The temperature variation due to changes in atmospheric conditions do not produce stresses in flexible pavement induce heavy stresses in flexible pavement but induce heavey stresses in the rigid pavements.
- The structural capacity of the flexible pavement is influenced by the strength of the sub-grade while the strength of the sub-grade heavenly little influence upon the structural capacity of the rigid pavements.
- The cost of construction of flexible pavements is less as compared to rigid pavements.

1.3 STRUCTURE OF A ROAD

- Sub – grade:- It is the natural soil an which the pavement rests and to which the enter load of the structure as well as that of traffic plying on the surface above is altimately transferred. It is the final cood carrying part of the structure.
- sub-Base:- It is placed immediately above the sub-grade soil and is campoved of hard well-burnt clinker, natural gravel or any other suitable material excavated at or near the site.
- Base:- It forms the structure which may be either rigid as in case of concrete road or flexible composed of broken stone cemented together by materials which allow some degree of flexibility in the pavement. The function of the base is to with stand the high shearing stresses prposed by concentrated loads at the surface and to distribute these loads to under lying layers of pavement or to the sub-grade soil as the case a may be.
- Wearing course or surface course:- In cave of a flexible pavements. It consists of a mixture of bituminous anaterial and aggregate and forms the natural wearing coat. In concrete roads no. separate surface course may usually be provided. The principal functions of the surface cobirse are to water proof of the base against the penetration of surface water and to resist the effects of abrasion and impacts ecused by the wheel roads.

1.4 FLEXIBLE PAVEMENT DEVIGN.

The following are the four universally recognized factor which must be considered in arriving at the rational design of flexible pavement.

- The characteristics of the natural soil which underlying the pavement.
- The volume and character of traffic that will use the highway.
- The moisture which will exist under the clrfliteed pavement and the general drainage conditions of the area.
- The climatio conditions.

PLANNING

Planning for such works would be done by field staff. Planning has to start by all the states to inventorize the network such as it is. The first step could be to start the inventory on the ground by sketching out the alignments and verifying and recording the conditions on the spot as the inventorization proceeds States may sue cadastral maps for planning. Available with capacity of the manpower important parameters for the purpose are:

- The start and end points of the proposed road alignment. Which may be coded from a Habitation master record (to be maintained at Gram Panchayat level and inter level and integrated for the district at Zilla panchayat level). For inter habitation roads, and listed-village roads\paths and field paths of the farm-net.
- The record of Road length, its condition and other relevant data including alignment and Cross Drainage works and the volume of traffic (at Gram Panchayat and Zilla Panchayat level)
- The Convergence Guidelines issued by Division of the ministry should be used as the starting point and the mechanisms already in place should be used for planning. Funding and management processes to the extent permissible once the panchayat level maps are made, they should be subjected to a participatory rural appraisal (PRA) in a Gram Sabha specially called for this purpose and a priontization and desired standard should be recorded for each proposed road for this purpose. “Desired standard” should be categorized into two or three alternatives (Gravel Roads Gravel sealed Roads. Cement Concrete Block or Fly Ash Block or Stone set Pavement) based on traffic and local conditions.
- The priority gradation of the roads would be fixed by the Gram Sabha while the desired surface/standards of these roads (based on traffic and local conditions) will be fixed by the technical agency responsible for constructing the roads in consultation with SRRDA.
- The roads connecting two or more habitations may be unsealed may be unsealed (or thin sealed including gravel sealed)
- Unsealed gravel roads may be provided with surface with gravel of thickness 40- 50 mm over and above the thicknesses of gravel base as indicated in the design charts.
- Thin bituminous sealing of gravel roads in cases of very poor subgrade (CBR2) and traffic in T2 category and poor. Subgrade (CBR<4) and traffic in T3 category may be provided. Thin bituminous surfacing may be in the form of surface dressing or chip sealing.
- Roads within the habitations may be provided with cement Concrete Block pavement or Fly Ash block Pavements or stone set pavements with adequate drainage facilities.
- Farm net roads and intra habitation roads would be executed by the concerned Gram Panchayat. Inter-habitation roads and link roads would be executed by intermediate district panchayat or line department State Government may also make stae specific implementation arrangements.
- Routine maintenance and funding there of including the process of creating the management capacity for the purpose. Would be provided for under framework.
- Quality management procedures would be implemented by (District panchayat or technical department like PWD OR RWD as decided by the State Government.
- The state Government may assign the work of construction and supervision of such roads to any their agency. In general such work may be assigned to Zilla panchayat or intermediate Panchayats or technical department implementing

2.1 LEVERAGING THE IMPLEMENTATIONAL INFRASTRUCTER:

In order to create a uniform and institutionalized framework for managing the non PMGSY Rural Road network it is best to start by leveraging MGNREGA Which in para 1B of schedule 1 to the MGNREG Act provides for taking up of works of “rural connectivity to provide all weather access including culverts and roads within a village wherever necessary” MGNREGA has inbuilt provisions for planning funding supervising and monitoring of the works which if properly utilized provide an excellent starting point for the creation of durable and productive assets However MGNREGA has the limitation of materials component some restriction on use of labour displacing machinery in this context. In this context the following system may be adopted:

- Creating the internal technical capacity. Among the various levels of the PRIs; for example the District

Panchayat needs the services of a Superintending Engineer or Executive Engineer to handle issues of planning. Design, supervision. Monitoring, quality and maintenance management etc. The intermediate /Block panchayat /cluster needs the services of one or more Assistant Engineers to Supervise the work of the junior engineers (ideally in the ration of 1:4): and the Gram panchayat shoul be able to avail the services of a Junior Engineer.

- Wherever the panchayat raj institutions or the department implementing this programme do not have adequate technical capacity. A retired Engineer (or the level of sub-divisional officer) with rural road expertise may be designted as a Block Technical Agency (BTA) and paid a Retainer by the division to check the design and estimate for which appropriate funds must be provided by the state Government
- Where the workload is high a Graduate Junior Engineer may be provided at the cluster level for the local roads by the PRIs or the concerned state Government Department out of its own resources and he may be provided training under the Rural Roads Training Framework.
- BTAs can also function as resource persons to do capacity building for the personnel

PREPARATION OF ESTIMATE

- A Standard Template for Estimate of the work should be formulated and circulated and used. The Estimate should be based on the various ratios of local and transported soil, with various lead distances, both for construction and for maintenance (including replenishment of gravel and restoration of shoulders)
- Detailed estimates should be prepared by the field staff the estimates may also be prepared by PIU engineers further in case of capacity constraints or over work load field staff consultants may be hired for preparing these estimates.
- Detailed Estimate for construction/upgradation of an unsealed engineered road/path comprising formation cutting earth work for embankment including compaction. CDs and protection and base course using local materials; and wearing course with local materials creating unsealed or sealed gravel roads.
- Incase on considerations of traffic or climatic conditions, the road needs to be sealed or built to a higher standard. Which entails a higher materials component or sophisticated machinery at high hiring cost. State founded schemes should have a clear demarcation of the items of works machinery quantity and monitory value to be executed

A common estimate should be prepared for the entire work. For every item. The complete cost of unskilled labour and cost of material and skilled labor should be clearly indicated. In the common estimate itemwise activity wise source of funding would be indicated. Part of the work which is funded by the State schemes may be allowed to be executed through contracts.

Following items may be included in the estimate under contingency:

- Survey design, drawings and estimate preparation
- Preparation of tender documents and NIT publication charges
- Hire charges of vehicles and POL for inspection of works
- Photography video graphy and documentation
- Consumable items related to Quality Control and Planation maintenance
- Any small item left out from estimate due to unforeseen circumstances any additional item that is required to ensure proper use of approved / executed work.
- Quality control of works.
- Payment of testing fees
- Payment of technical Assistants /bare foot technicians may be made from the skilled wage (material component) of the work subject to the condition that all positions of the technical assistants/ bear foot engineers @ 1 for every 2500 cards shall be filled by the State Govt. and suitable provisions shall be made every work estimate and the amount shall be credited in the account form which remuneration of this functionaries is paid. Bare foot technicians to also act as laboratory technicians.

3.1 PAVEMENT DESIGN

Indian roads congress (IRC) has brought out revised and updated “Guidelines for the Design of Flexible Pavements for low volume roads” IRC: SP: 72: 2015. These IRC Guidelines among others provides for design of low volume rural roads of T1 to T3 traffic categories (roads with 10,000 to 1,00,000 Equivalent Standard Axel Load (ESAL application). Which are ideal for non-PMGSY roads also. These roads can be constructed using gravel base, without using water Bound Macadam (WBM) base course and bituminous surfacing . Such roads can perform well for a long time for very low volume traffic with regravelling as maintenance requirement Such roads may be considered for connecting small habitations to Centres of economic educational and health services.

The relevant design thicknesses for different traffic volumes and subgrade strength for T1 to T3 category of IRC SP: 72:2015 are as under for ready reference.

Table 3.1 Design Thickness For different Traffic Volumes and Subgrades Strength

Traffic category	T1	T2	T3
Sub grade strength	10.000-30.000 ESAL	30.000-60.000	60,000-1,00.000
Very poor CBR=2	200 mm GB 100 mm MS	225 mm GB 100 mm MS	350 mm GB 100 mm MS
Poor CBR = 3-4	200 mm GB	275 mm GB	400 mm GB
Fair CBR=5-6	175 mm GB	250 mm GB	275 mm GB
Good CBR=7-9	150 mm GB	175 mm GB	225 mm GB
Very Good CBR = 10-15	125 mm GB	150 mm GB	175 mm GB

GB: Gravel Base of CBR Not less than 80

MS: Modified Soil of CBR not less than 10

IRC SP: 72; 2015 has also brought out than the road should not be designed for subgrade CBR of less than 5. In case sub grade CBR is less than 5 either the improved sub grade material should be used or the material should be stabilized using cement, lime or other

The CBR of the gravel base should be not be less than 80% for using above design charts. The CBR of the sub grade as well as gravel material may be based on Dynamic cone Penetrometer (DCP) values, as is also indicated in IRC SP 72.2015.

As the gravel material of 80% CBR may not be available at all the palces the following simplified chart which allows the use of gravel material of any strength (above 15%) as is also suggested by couple of international experts may be used for design of such very low volume roads. It may also be indicated that in future whenever such roads are to be upgraded to higher category of traffic, the strength of the existing layers should be evaluated material to be reused and additional compaction may be permitted.

Table 3.2 Traffic Category Sub Grade strength

Traffic Category sub grade strength	T1 10,000-30,000 ESAL	T2 30,000-60,000	T3 60,000-1,00,000
Very poor CBR=2	400 mm G1 or 325 mm G2 or 250 mm G3	450 mm G1 or 425 mm G2 or 350 mm G3	500 mm G1 or 450 mm G2 or 375 mm G3
Poor CBR= 3-4	325 mm G1 or 300 mm G2 or 225 mm G3	375 mm G1 or 350 mm G2 or 300 mm G3	450 mm G1 or 400 mm G2 or 350 mm G3
Fair CBR= 5-6	300 mm G1 or 250 mm G2 or 200 mm G3	350 mm G1 or 300 mm G2 or 250 mm G3	400 mm G1 or 350 mm G2 or 275 mm G3
Good CBR=7-9	250 mm G1 or 200 mm G2 or	300 mm G1 or 250 mm G2 or	325 mm G1 or 275 mm G2 or
	150 mm G3	200 mm G3	225 mm G3
Very Good CBR = 10-15	275 mm G1 or 175 mm G2 or 150 mm G3	300 mm G1 or 200 mm G2 or 175 mm G3	275 mm G1 or 225 mm G2 or 200 mm G3

G1: Gravel material with CBR 15-24

G2: Gravel Material with CBR 25-44

G3: Gravel material with CBR 45 and above.

As an alternative design stabilized base and sub-base with an appropriately designed thickness with thin bituminous surfacing have also been provided in IRC: SP: 72: 2015.

Relevant design standards for gravel roads are available in Gravel Roads Manual I.e. IRC: SP: 77: 2008. Where conditions for providing a gravel road are not appropriate brick pavement or stone set pavement can be considered Brick aggregates are already in use as sub-base in Tripura and some parts of Bihar and uttar Pradesh and roads constructed using brick aggregates have performed well.

The Gravel Roads Manual (IRC: SP-77:2008) and the Rural Roads manual (IRC: SP- 20:2002) would be the standard for Category I and Category II roads.

CONCLUSIONS

Based on the present study, the conclusions drawn are presented in three sections as given below:

- Relationship of Pavement Strength and Pavement Composition
- The strength of the pavement represented by the measured deflection at the surface on mature soil sub grades is influenced by the sub grade soil properties and layer composition on an in-service pavement in urban conditions.
- There is good correlation between deflection and Modified Structural Number for various classes of Pavement Condition Index for sub grade soil types SM and SC.
- In the case of pavement in good condition, ie, for the PCI range 60-80, linear relationship give better correlation.
- In the case of soil type SM, power function relationship showed better correlation.
- In general, either power function or linear relationships can be used for finding the deflection in order to arrive at a suitable maintenance option.
- The parameters such as Field Dry Density, Field Moisture Content, Optimum Moisture Content, Maximum Dry Density, Atterberg Limits, CBR, Soil composition and the fraction of Silt & Clay of the subgrade soil have influence on the strength of the pavement.

Field Dry Density and Plasticity Index of the sub grade soil influence the deflection, whereas Maximum Dry Density has got less impact when gravel and silt and clay fractions are considered as variables.

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