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A PATH FOR HORIZING YOUR INNOVATIVE WORK

A NEW APPROACH TO PAVEMENT DESIGN USING HIGH DENSITY POLYTHYLENE (HDPE) SHEETS

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Abstract

Due to potholes formed in the road during the rainy session, particularly in rural area. Therefore, necessary that roads built in rural areas are affordable and sustainable. This paper outlines various design procedures that have been known to be used and some of the shortcoming in their approach to specify suitable material properties and layer thickness. Each procedure provides a slightly different solution. Pavements are composite materials that bear the weight of pedestrian and vehicular loads. Pavement thickness, width and type should vary based on the intended function of the paved area. The aim of this paper to propose a new design approach using High Density Polyethylene sheets pavement and pavement thickness and sub grade properties.

[I] INTRODUCTION :

The design of a scheme should enable the maximum use to be made of the material available on the site for capping layer, sub-base or road-base by using a permitted binder. In addition, the use of construction materials from sources that maximize the amount of recycled materials is strongly encouraged.

Generally road is usually provided with a thin binding layers, which requires constant maintenance of potholes formed during the rains. After sometimes road is renewal such as bituminous premix carpet and seal coat. If there is water logging due to lack of drainage, the surface layer may be damaged. There for this condition most required another material use then increasing the life of road.

[II] BASIS OF DESIGN:

The prime factor influencing the structural design of a pavement is the load-carrying capacity required. The thickness of pavement necessary to provide the desired load-carrying capacity is a function of the following five principal variables

• Vehicle wheel load or axle load.

• Configuration of vehicle wheels or tracks.

• Volume of traffic during the design life of pavement.

• Soil strength.

• Modulus of rupture (flexural strength) for concrete pavements

The procedure for design of pavements is generally referred to as the California Bearing Ratio (CBR) design procedure. This procedure requires that each layer be thick enough to distribute the stresses induced by traffic so that when they reach the underlying layer they will not overstress and produce excessive shear deformation in the underlying layer. Each layer must also be compacted adequately so that traffic does not produce an intolerable amount of added compaction.

[III] PRELIMINARY

INVESTIGATIONS :

3.1 General. The sub grade provides a foundation for supporting the pavement structure. As a result, the required pavement thickness and the performance obtained from the pavement during its design life will depend largely upon the strength and uniformity of the sub grade. Therefore, insofar as is economically feasible, a thorough investigation of the sub-grade should be made so that the design and construction will ensure uniformity of support for the pavement structure and realization of the maximum strength potential for the particular sub-grade soil type. The importance of uniformity of soil and moisture conditions under the pavement cannot be over-emphasized with respect to frost action.

3.2 Investigations of Site Characteristics of sub grade soils and peculiar features of the site must be known to predict pavement performance. Investigations should determine the general suitability of the sub grade soils based on classification of the soil, moisture-density relation, degree to which the soil can be compacted, expansion characteristics, susceptibility to pumping, and susceptibility to detrimental frost action. Such factors as groundwater, surface infiltration, soil capillarity, topography, rainfall, and drainage conditions also will affect the future support rendered by the sub grade by increasing its moisture content and thereby reducing its strength. Past performance of existing pavements over a minimum of 5 years on similar local sub grades should be used to confirm the proposed design criteria.

3.3 Soil Conditions Soil conditions should be investigated by a combination of a general survey of sub grade conditions, preliminary subsurface investigations, and soil borings.

[IV] MATERIALS AND METHODS

4.1 High Density Polyethylene sheets: High Density Polyethylene sheets of thickness 0.2mm. Reclaimed HDPE is much cheaper and can be used for cell making to solve disposal problems of used HDPE and at the same time it functions equally well. Plastic sheet manufacturers can supply rolls of strips 50mm to 100mm wide depending upon the depth requirement. The strips can be heat welded to form cells as shown in

Figure. Stitching can be done by bag manufacturers also. Only coarse stitches are needed. Colure of plastic sheets are not important since the cells remain buried and reclaimed HDPE sheets are usually rendered black in color. A pair of strips can be welded at 300mm interval. The third strip is welded to the first pair at 300mm intervals so that the stitches lie at the centre of the previous stitchingings. The third and the fourth ones are again welded like the first two.

Figure 1 Laying of formwork of plastic cell over a compacted sub grade/sub base.

The plastic sheet is made up of high density polyethylene (HDPE) having a thickness of 0.2mm. Iron spikes about 200mm long as shown in Figures may be used to keep the cell walls taut. Additional spikes may be driven at the interior also for preventing.

4.2 Formwork: The formwork of plastic cells as shown in Fig.1. The formwork of plastic cells are stretched and iron spikes are driven at the corners of the cells so that the form work remains taught

Figure 2 placing of zero slump concrete into cells during construction of a road

Since the sub grade/sub base have the proper camber, the top of the cells also will have the same camber. After leveling the concrete, a vibratory/static road roller of 6 to 8 ton capacity is used for compaction. Two static passes followed by two vibratory pass and again two static pass will bring about the necessary compaction. The exact number of passes will depend upon the angularity of aggregates and trials have to be made to determine the number of passes. If vibratory roller is not available, static rolling with more number of passes may bring about the necessary compaction. A little higher water content is needed for

compaction by static roller. The cell walls get curled both vertically and horizontally during the construction to bring about the three dimensional interlocking among the concrete blocks (Figure 3)

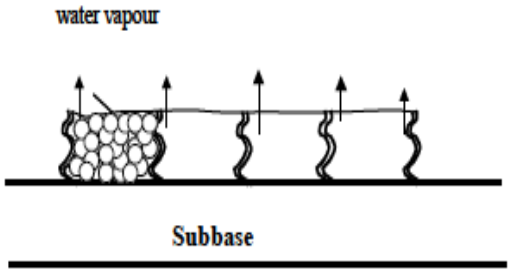

Figure3 Interlocking of blocks

The concrete inside the blocks shrinks and a gap of about 20 microns is formed between blocks. Moisture from the sub grade escapes in the form of water vapors and capillary water but rain water cannot enter from the top during the monsoon.

4.3 Preparation of Sub grade : The sub grade should be prepared as per Specifications for Rural Roads(SRR) (1).If the embankment soil is poor, the top 300mm of the sub grade may consist of good quality material from borrow pits with CBR exceeding five. The existing poor soil also may be stabilized by lime, fly ash, cement etc to increase the strength of the sub grade It should be compacted to at least 100 per cent of Maximum Dry Density as per IS:2729 (Part 7).The CBR of the sub grade and that of the embankment material below 300mm of the sub grade should be determined under soaked condition for evaluation of the effective CBR values for thickness design.

4.4 Preparation of Sub-base:

The sub base may consist of late rite boulder consolidation; water bound macadam, wet mix macadam, jhama brick consolidation, crusher run macadam, lime-fly ash-aggregate mixtures, soil-cement, brick soling with joints filled with sand. Locally available aggregates such as murrum and kankar mixed with lime-fly ash may also be used. Aggregates are not available at a reasonable price in many regions and in that case, soils may be stabilized with lime, cement, fly ash etc to obtain a soaked CBR value of 20 or higher. SRR(1) should be followed for use of different materials. Cement/lime-fly ash stabilized soil may have an elastic modulus close to 1000 MPa or higher and . Details of

mix design of stabilized materials are given in Rural Road Manual (3).

4.5 Concrete: The concrete capable of being compacted by a vibratory roller/static roller can be used for filling up the plastic cells. Since strength is a variable quantity, a mean strength higher than the minimum required should be aimed at so that every part of the pavement has concrete of adequate strength. Concrete must have a characteristic strength of at least 25 MPa at 28 days since flexural strength requirement is not important in cast-in-situ bock pavement.

The concrete mix for laying must have optimum moisture content and necessary strength after compaction and curing. Optimum moisture content can be found as per the clause 1502.8 of SSR (1). Optimum moisture content and maximum density may be determined by preparing cubes with varying moisture contents. Normal concrete with a minimum characteristic strength of 25 MPa can also be used. Pan vibrators will be required for the compaction of concrete.

4.6 Construction

The Zero slumps concrete should be filled into the cells to a depth of about 110mm to 115 mm. It should be ensured that the cells do not collapse while filling up with concrete. Uniformity of level of concrete should be checked before compaction by a roller. The iron spikes should be taken out after the cells are filled up with concrete for reuse elsewhere. The concrete should be rolled in static mode for two passes, and then in vibratory mode for about two passes and again in static mode for better finish. Additional concrete may be applied where necessary for uniformity and rolled.

If the compacted surface of pavement appears to be too dry, additional water should be added during mixing. The surface of the concrete should be covered with wet jute mats or paddy straw after the construction to prevent drying during hot weather. If some hungry surface or honeycombed concrete is visible after rolling, moist cement-sand mortar 1:4 should be broomed-in and one pass of roller in static mode should be given.

In some places level of concrete may be a little higher than the level of plastic cell

after compaction. After passage of time, some cracks may appear along the alignment of the cell walls and with use of traffic, pattern of the cells will reflect on the surface. At some locations, the concrete level may be slightly lower than the top of the plastic cell. The projecting part of the plastic would wear away in course of time due to traffic.

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