

APPLICATION OF LIME-FLYASH STABILIZATION FOR STANDARDIZATION OF URBAN ROAD CONSTRUCTION AT SURAT, SOUTH GUJARAT

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ABSTRACT:

The City of Surat covered by top strata of Black Cotton soil situated in South Gujarat region in India suffered lots due to expansive behaviour of the soil. This soil being expansive with frequent flood occurrence requires special attention for road construction. The Surat Municipal Corporation (SMC) looking after the road construction activity within the city limits constructed the roads with conventional rubble at subbase layers. The roads did not perform well with the expansive subgrade after rains every year. Also as per IRC: 37-2001 Annexure – 4 suggest 0.6 to 1.0 m thick non-expansive cohesive soil (CNS) cushion on the expansive soil for road construction. The old city & drainage of flood did not permit raising formation level of old roads. SMC decided to standardize design with construction procedures for different categories of the roads. The objective was common design and tendering for quick implementation of infrastructure planning of fast growing urban center. Apart from economy and time saved, design was aimed at better performance & durability. The new designs with insitu Lime - Flyash stabilized soil layer as subgrade are prepared with specified construction techniques. The design is performing well with reduction in annual maintenance expenditure of SMC for flexible roads. This design is also utilized by the private developers as standardized design for internal society roads etc.

1.0 INTRODUCTION:

The South West region of India is covered by top soil as black cotton soil. Fig. 1 shows the top soil layer for the country, it indicates that the country has about 40 % top soil as black cotton soil. This soil being the expansive soil requires special attention for pavement design. The IRC: 37 – 2001 has special recommendations for the pavement on expansive soil in Annexure – 4. The city of Surat situated in South Gujarat region of West India is the one of the fastest growing urban centers in India. The city having majority of top soil as black cotton soil, also the city is flooded with frequent floods. The Surat Municipal Corporation (SMC) is looking after the road construction and maintenance activity within



the city limits. The earlier approach for new road construction was having the different road designs for each proposed road. The city with 6 zones (before 2006) having variety of road design for different roads in different zones. The typical design followed by SMC is shown in Fig. 2. It shows that the design is having rubble soling as sub-base layer, above which the aggregate layer provided as base layer and the bituminous macadam layer with seal coat act as top surfacing. The use of rubble as sub-base layer created lots of problems by sinking in subgrade soil due to impact of traffic and dead load, which caused mud pumping during monsoon. It led to the failure of pavement, formation of potholes, ruts etc. The roads were badly damaged after the every monsoon and the maintenance cost were also higher.

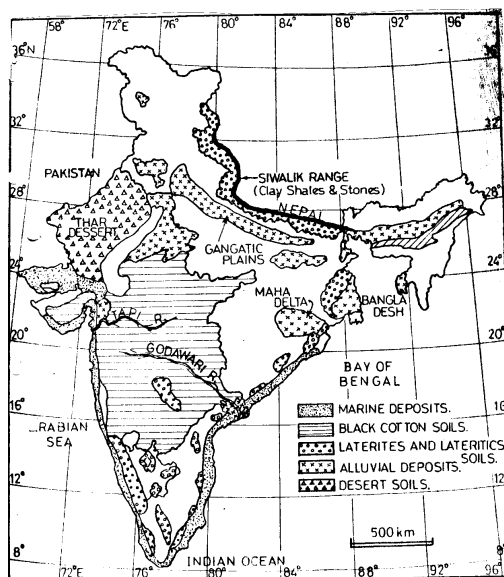


Fig. 1- Map showing the soil deposits in India.

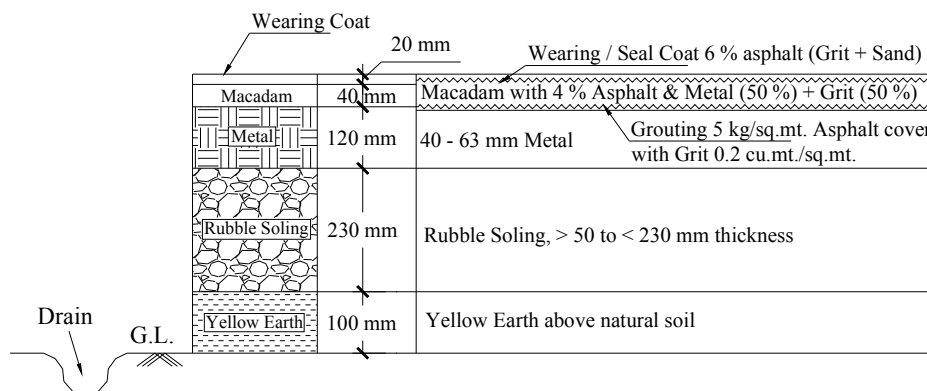


Fig.2- Sketch showing the typical pavement composition executed by SMC pre 1995.

During the year 2002 the SMC has decided to form a committee for standardization of road design for different categories. The committee has the experts of road design from Industry as well as Academic Institutes. The committee has decided to prepare the standardized road design for specified categories of roads for city limits. The roads are categorized as,

- a) Residential Streets, having width less than 12.19 mt (< 40'),
- b) Collector Streets, having width 12.19 to 24.39 mt, Excluding 24.39 mt (40'–80', Excluding 80'),
- c) Sub Arterial Roads, having width 24.39 to 36.58 mt, Excluding 36.58 mt (80'–120', Excluding 120') &
- d) Arterial Roads, having width 36.58 to 60.97 mt (120' to 200').

These categories are common for all the zones. All zones have to follow the common design for each category of the road. This helps in maintaining uniformity for different pavement thickness, its composition etc. for roads within different zones of the city. The pavement design with Lime-Flyash stabilized sub-grade, excluding the top surfacing was entrusted to author². The top surfacing for different category of the road was decided by the other committee members and it has to be followed while designing new pavement thicknesses. In this paper the standardized pavement design for Residential Streets and Collector Streets are discussed. The practice of pavement construction before monsoon and laying top bituminous surfacing after year was considered in design.

2.0 SUBGRADE:

The Surat city is covered in major part by black cotton soil. It is highly plastic clay (CH group) with high expansive potential / shrinkage potential. Nos. of tests was carried out to get the CBR value of existing subgrade layer. The average value observed was Soaked CBR of 1 to 2 %. The recent study by Jigisha (2008) also shows the Soaked CBR value for South Gujarat region as 1.0 to 2.0 %. The IRC:37-2001 Annexure – 4 suggest 0.6 to 1.0 m thick non-expansive cohesive soil (CNS) cushion on the expansive soil for road construction. The old city area & drainage of flood did not permit raising the formation level of roads. As per new road design it has decided to go for insitu soil stabilization with Lime and Flyash. The stabilization has to be done in following steps. (1) Disk harrowing the existing top 100 to 150 mm soil. (2) Apply 10 kg of slaked lime (CaOH, as per clause 402.2.2 of MoRT&H) per sq.m. area. (3) Apply 50 kg Flyash per sq.m. (4) Thoroughly mix the Lime – Flyash with pulverized soil by disk harrowing. (5) Cured the mixed material for 24 hrs with 60 to 70 liter water per sq.m. (6) Compact the cured surface with 8 T static / vibratory rollers as per guidelines of IRC: 37 – 2001. This stabilized subgrade has the minimum CBR value of 4 %. Hence the subgrade CBR = 4% is adopted for all categories road design. The width of stabilization has to be 1 m more than proposed road width for better performance. However when the pavement is in cutting, this additional 1 m width can be dropped, which would mostly found in SMC case. Also the drainage on roadsides is assumed as well planned. Thus drain will not soak subgrade during the rains and a random check on CBR with tolerance + 5 % has suggested for better quality control.



3.0 TRAFFIC:

The vehicle count survey at different locations was carried out to get the existing traffic condition for each category of the roads. Based on the observed traffic composition and future growth of the city the 0.5 to 1.0 msa and 12 msa were considered as design traffic for Residential Streets and Collector Streets respectively.

4.0 PAVEMENT THICKNESS AND ITS COMPOSITION:

Using the CBR = 4 % and the design traffic for both categories of the roads as discussed in above para the detailed design was carried out referring IRC: 37 – 2001. Fig. 2 and 3 shows the pavement thickness with its detailed composition and material specification for Residential Streets and Collector Streets respectively.

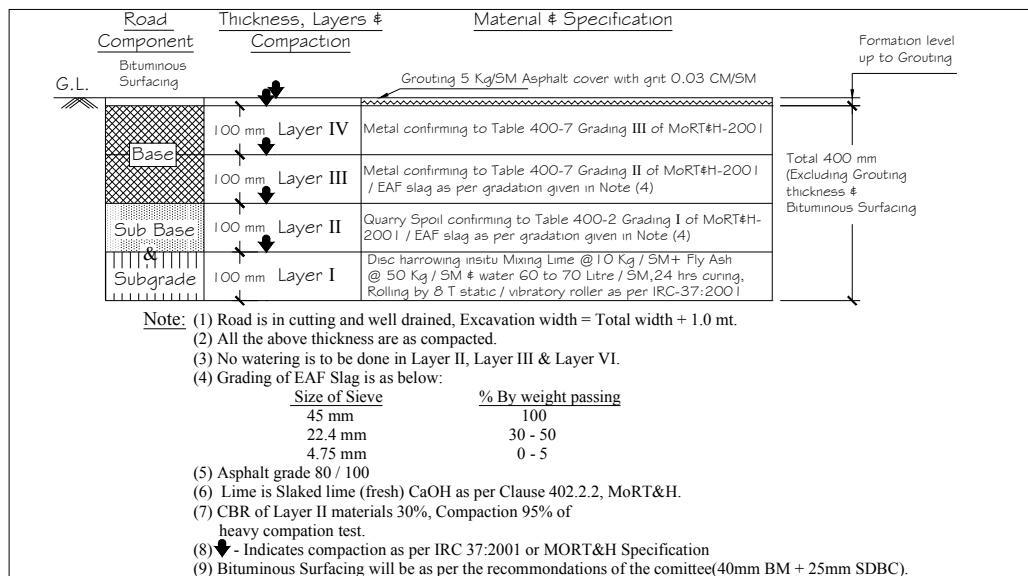


Fig.3- Sketch showing the various layers of Roads having width less than 12.19 mt. - Residential Streets, Surat City Limit.

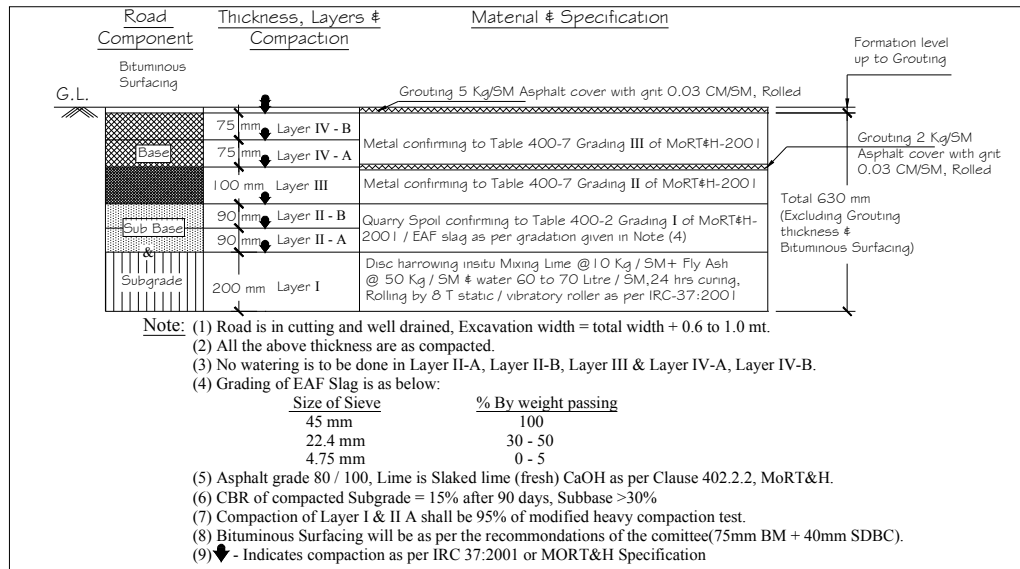


Fig.4- Sketch showing the various layers of Roads having width 12.19 mt. & above, but less than 24.39 mt. – Collector Roads, Surat City Limit.

Based on the budget statement of the SMC it seems that the design is performing well with reduction in annual maintenance expenditure for flexible pavement roads. Also from the local experience and general observation now a days the private developers are also using the same standardized design for internal society roads etc.

5.0 CONCLUSION:

The standardized road width with its specified pavement design will definitely helps the governing authority of any urban area from initial stage of the planning as it has helped to Surat Municipal Corporation. The standardized design has the same cost for construction and it can easily adopted for preliminary planning or tender preparation by any zone or authority for the same city limit. Also the Lime – Flyash stabilization has proves the better economy for typical expansive soil in South Gujarat region by reducing the annual maintenance cost.

6.0 REFERENCES:

1. Jigisha Vashi (2008), “Review of Geotechnical Parameter: CBR and Modulus of Subgrade Reaction (k) for Rigid Pavements”. M.Tech (SMFE) Thesis, SVNIT, Surat.
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