



STUDY ON REHABILITATION OF LOW VOLUME FLEXIBLE PAVEMENTS BY WHITE TOPPING

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ABSTRACT

In India the nature of overlay treatment in the name of maintenance on flexible pavements is generally Hot Mix Asphalt (HMA) as this technology is in for many years. Lack of interest in selecting different resurfacing alternative is seen in road contractors because of ease in construction of HMA overlay and experience gained by them in construction of HMA overlay. White-topping can be a very interesting resurfacing technique for existing asphalt pavements when rutting is the major distress on pavement surface. In the present work an attempt is made to evaluate the structural and functional condition of existing flexible pavements and provide a cost effective rehabilitation solution. A network of six urban roads coming under Tumkur Municipality is selected an extensive field, laboratory investigation, pavement analysis and design of rehabilitation alternative has been carried out. The field work consists of road inventory, traffic studies, MERLIN and BBD studies. PCI is computed based on selected distress parameters (Rut, Patch, Pothole, Cracks). In addition, IRI, BI and characteristics pavement deflections are computed from MERLIN and BBD surveys. Based on PCI, IRI, BI and deflection values pavement rehabilitation measures are considered. The summary of overall condition assessment on functional and structural evaluation in majority of the cases has resulted in 'resurfacing'. In the present study an attempt has been made to design white-topping section and asphalt overlay as a minor rehabilitation alternative for the in-service flexible pavements. The white-topping design has resulted in 5 thin white-topping sections and 1 ultra-thin white-topping section. Strengthening by asphalt overlay has resulted in different overlay thicknesses for selected roads. Finally cost comparison between white-topping and asphalt overlay reveals that for majority of selected roads white-topping proves to be a cost effective rehabilitation solution than the asphalt overlay.

Keywords: White-Topping, Hot Mix Asphalt

I. INTRODUCTION

Road assembling needs enormous framework. In the event of creating nations, there is a deficiency of assets required for new foundation ventures both for building them and all the more essentially towards their upkeep and repairs. The majority of the current asphalts are adaptable in nature having bituminous wearing course. These bituminous asphalts, as a rule, have an issue that they get decayed with time. The greater part of the streets in India display when all is said in done, inadequacies like rutting, splitting, potholes and so forth. Consequently before going in for a proper restoration, execution assessment of the current streets is an outright need. White garnish a moderately thin solid overlay set on troubled black-top asphalt was presented in the



United States in 1918 and its utilization has proceeded through today. In mid 1991, another type of white fixing named as slender white garnish (TWT) and ultra-dainty white fixing (UTWT) developed, which depends on a bond with the troubled asphalt to go about as a solid structure. The initially reinforced white fixing areas were built in October of 1997 by the Minnesota Department of Transportation (Mn/DOT) on I-94 test segments at the Minnesota Road Research office (Mn/ROAD). Outline between customary, slim and ultra-flimsy white garnish lies in the thickness of plain concrete cement (PCC) overlay, joint dividing (piece width) and degree to which it is clung to the current black-top layer.

1.1 PAVEMENT

A main road pavement could be a structure consisting of various layers by using different materials on top of the natural soil sub-grade, whose primary perform is to transfer the applied vehicle masses to the sub-grade. The pavement structure ought to be ready to give a surface of acceptable riding quality, adequate skid resistance, favorable light-weight reflective characteristics, and low pollution. The final word aim is to make sure that the transmitted stresses because of wheel load area unit sufficiently reduced, in order that they're going to not exceed bearing capability of the sub-grade. Two sorts of pavements area unit typically recognized as serving this purpose, specifically versatile pavements and rigid pavements. This chapter provides a summary of pavement sorts, layers, and their functions, and pavement failures. Improper style of pavements ends up in early failure of pavements poignant riding quality. Principle street asphalt could be a structure comprising of different layers by utilizing distinctive materials on top of the normal soil sub-level, whose essential perform is to exchange the connected vehicle masses to the sub-level. The asphalt structure should be prepared to give a surface of satisfactory riding quality, sufficient slide resistance, great light weight intelligent attributes and low contamination. The last word point is to ensure that the transmitted anxieties in light of wheel burden range unit adequately lessened, all together that they're going to not surpass bearing capacity of the sub-grade. Two sorts of asphalts region unit ordinarily perceived as filling this need, particularly adaptable asphalts and unbending asphalts.

1.2 Types of pavements

The pavements are often classified supported the structural performance into two, they are:

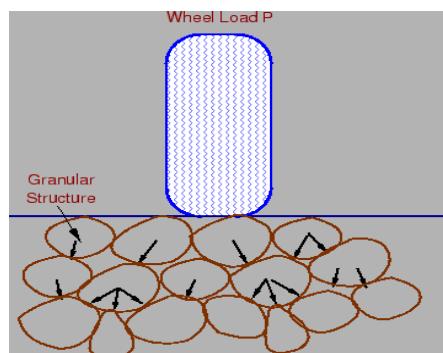
1. Versatile pavements or (flexible pavements) and
2. Rigid pavements.

In versatile pavements, wheel masses area unit transferred by grain-to-grain contact of the combination through the structure. The versatile pavement, having less flexural strength, acts sort of a versatile sheet (e.g. hydrocarbon road). In rigid pavements, wheel masses area unit transferred to sub-grade soil by flexural strength of the pavement and also the pavement acts sort of a rigid plate (e.g. cement concrete roads). Additionally to those, composite pavements are on the market. A skinny layer of versatile pavement over rigid pavement is a perfect pavement with most fascinating characteristics.

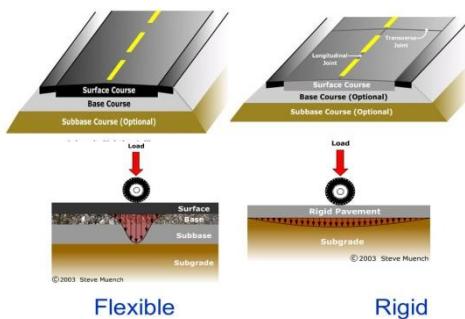
However, such pavements area unit seldom utilized in new construction attributable to high value and complicated analysis needed.

1.2.1 Versatile Pavement Or Flexible Pavements

Flexible pavements can transmit wheel load stresses to the deeper layers by grain-to-grain transfer through the points of contact within the pavement structure



Load transfer in granular structure



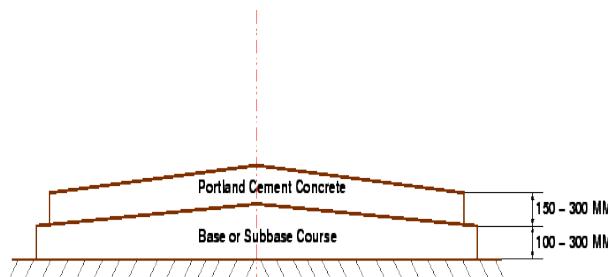
Load deflection on pavements

The wheel load functioning on the pavement is going to be distributed to a wider space, and also the stress decreases with the depth. This stress distribution characteristic, versatile pavement usually has several layers. Hence, the planning of versatile pavement uses the super imposed system. Supported this, versatile pavement is also created in an exceedingly variety of layers and also the prime layer has got to be of very best quality to sustain most compressive stress, additionally to wear and tear. The lower layers can expertise lesser magnitude of stress and inferiority material is used.

1.2.2 Rigid Pavements

Rigid pavements have enough flexural strength to transmit the wheel load stresses to a wider space below. A typical cross section of the rigid pavement is shown.

Compared to versatile pavement, rigid pavements square measure placed either on the ready sub-grade or on one layer of granular or stable material. Since there's just one layer of fabric between the concrete and also the sub-grade, this layer will be referred to as base or sub-base course.



Typical cross section of rigid pavement

**1.3 Hot Mix Asphalt Pavement**

Black-top asphalt alludes to any cleared street surfaced with black-top. Hot Mix Asphalt (HMA) is a blend of around 95% stone, sand, or rock bound together by black-top bond, a result of raw petroleum. Black-top concrete is warmed total, joined, and blended with the total at a HMA office. The subsequent Hot Mix Asphalt is stacked into trucks for transport to the clearing site. The trucks dump the Hot Mix Asphalt into containers situated at the front of clearing machines. The black-top is set, and after that compacted utilizing an overwhelming roller, which is rolled over the black-top. Activity is for the most part allowed on the asphalt when the asphalt has cooled.

1.4 Perpetual Pavement

Joining the all around archived smoothness and security favorable circumstances of black-top with a progressed, multi-layer asphalt outline process... Never-ending Pavement joins the very much archived smoothness and wellbeing points of interest of black-top with a progressed, multi-layer asphalt plan prepare, that with routine upkeep, broadens the valuable existence of a roadway to a large portion of a century or more. Asphalts composed and built as per the Perpetual Pavement idea will last, and last, and last.

1.5 White Topping

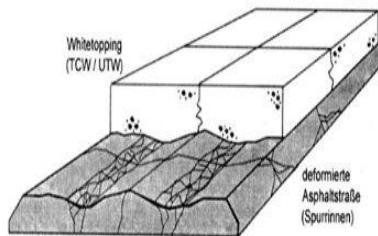
Consists of thin concrete layer (Consists of thin concrete layer type 4 inch or less) on prime of existing asphalt pavement. Specific steps are taken to bond the new concrete to the new concrete to the present asphalt and to the present asphalt and to saw short joint spacing – could or might not contain fibers. This technology uses ash and chemical compound fiber, besides cement and sand that strengthen the paved surface. This composition is claimed to present the white-topping roads a position over hydrocarbon ones. In India, white toppings are being arranged in Bangalore, Mumbai and urban center. “Unlike black lidded roads, with none road cuts. The white efficient, need comparatively less maintenance and have a life of 10-15 years, with none road cuts. The white topping layer keeps the road intact throughout rains, because it prevents water-logging. This technology uses ash and chemical compound fiber, besides cement and sand that strengthens the paved surface. This composition is claimed to present the white-topping roads a position over hydrocarbon,” same a GHMC official

**Pavement****1.6 Pavement Rehabilitation**

Pavement rehabilitation could be a major activity for all road agencies and has many consequences on agency resources and traffic disruptions due to in depth and extended lane closures. The traffic volumes on the first transit, particularly in urban areas, have seen tremendous will increase over the last twenty years, leading in several instances to earlier-than-expected failures of road pavements. The aging of the



interstate transit and alternative primary systems engineered throughout the Nineteen Fifties and Nineteen Sixties has resulted within the expenditure of an oversized portion of road funds on pavement rehabilitation. Efforts still are created to develop techniques and procedures that may end in value effective and longer-lasting pavement rehabilitation to serve the nation's transit well into the twenty first century.



1.7 Asphalt Pavement Rehabilitation

Asphalt pavement rehabilitation usually involves edge and resurfacing of the prevailing asphalt pavement to mitigate the consequences of per ride rutting, cracking, and alternative distresses. Resurfacing thickness might rely on the condition of the prevailing pavement, anticipated future vehicular traffic, and obtainable funding. Below serious vehicular traffic, the expected service lifetime of the restored pavement is usually regarding eight to twelve years. The routine use of stone matrix mixture (SMA) and Super-pave mixes for pavement rehabilitation will definitely facilitate extend the service lifetime of restored pavements. Asphalt pavements also are restored employing a standard concrete overlay or the newer technique of ultrathin white topping (UTW). The UTW technique is of recent origin and long-run performance knowledge don't seem to be nevertheless obtainable.

1.8 Pavement Recycling And Reclaiming

Pavement utilization and reclaiming is another necessary method for rehabilitating asphalt pavements. Construction instrumentation and materials have greatly evolved over the previous few years to permit for affordable, in-place utilization and reclaiming of asphalt pavements.



Reclaimed materials

II. LITERATURE REVIEW

The structural and purposeful conditions of versatile pavements changes with time thanks to continuing effects of its structural adequacy, volume, composition and loading characteristics of traffic, setting, encompassing conditions and also the maintenance inputs provided. The failure of the pavement happens thanks to internal harm caused by traffic inside an operational setting, over a amount of time; it is an abrupt development. Deterioration can even be outlined because the method of accumulation of injury and also the failure of the pavement is claimed to own reached at the limiting stage of utility level. Studies conducted everywhere the



planet have established that although style and construction techniques vary from country to country, the deterioration pattern of pavements shows constant trend.

The structural and practical conditions of versatile pavements changes with time thanks to continued effects of the most deterioration embody cracking, potholes, rutting on wheel path and roughness of paved surface. The physical manifestation of the interior injury (cracking, rutting, potholes etc.) is thought as distress. Proportion of distress provides a sign of the pavement condition. Totally different modes of distress occur either severally or at the same time with mutual interaction.

III. METHODOLOGY

3.1 Edge Raveling

This misery is depicted as the separation of the edge of the asphalt. The asphalt surface considered under this classification reaches out from the external asphalt edge-line checking to a separation one-foot inside the voyaged way. Edge raveling is brought about by an absence of vertical or horizontal backing, a shaky blend, or the impacts of movement burdens. Most roadways have cleared shoulders. Edge raveling is appointed seriousness levels just; the raveling is given a rating other than zero if the condition exists for more than 10% of the asphalt length (on either side of the roadway).

3.2 Upsets Of PCC Pavements

The most extreme troubles in PCC asphalts happen along joints, bringing about joint disintegration and, subsequently, prompting auxiliary disappointment of the asphalt. This area abridges different trouble sorts that happen inside an asphalt piece and prompt basic disappointment. Depictions of the most widely recognized asphalt surface trouble markers distinguished in the undertakings looked into additionally are exhibited.

3.3 Troubled Joints/Cracks

The weakening of cement is inside two feet on either side of a joint or split. Bothered joints/breaks might be brought on by the accompanying four elements:

1. Durability "D"- breaking: A progression of firmly divided hairline breaks paralleling a joint or real split in the solid surface.
2. Spalling The crumbling of piece edges at joint or splits or straightforwardly over fortifying steel. Spalling on researched STH 24 in Greenfield is represented
3. Dowel Assembly: Comes about because of ill-advised situation of dowel wicker container, bringing on the joint to bolt up.
4. Longitudinal Cracks: Created by horizontal withdrawal, sidelong development, and settlement of the roadbed.
- 5.

3.4 Crack Maintenance

Concrete icy pour or hot pour sealant put in a flush-fill or over band arrangement is viewed as generally fitting. For financially savvy, long haul break filler execution (say, somewhere around 5 and 8 years) under the above conditions, a black-top elastic or rubber treated black-top set in either a flush-fill or over band design is viewed as generally proper. The higher nature of these materials and the additional life gave by the over band make for



the most savvy alternatives in this situation. The accompanying Table gives prescribed Crack Treatment Criteria to figuring out which splits to seal and which to fill, given different break qualities. In contrast with split filling, break fixing includes substantially more arranging and uses exceptionally planned materials and more refined gear.

3.5 Crack Performance

Focal and Northern Alberta can encounter flat break developments in abundance of 20 mm. This compelling measure of split development requires an abnormal state of workmanship to guarantee that the break is situated in the focal point of the defeat and the utilization of fantastic changed rubber treated black-top materials. Execution of the split treatment is reliant on three components: introductory asphalt condition, item choice, and creation establishment. It is vital that the break/defeat be as spotless and dry as could be expected under the circumstances. Sealant ought to be connected not long after the split has been steered and cleaned with the hot-air spear.

3.6 Material

There are a wide range of break fixing/filling materials, each with particular qualities. The essential material families and sorts are as per the following:

- Cold-connected thermoplastic materials
- Liquid black-top (emulsion, reduction)
- Polymer-altered fluid black-top

Hot-connected thermoplastic materials

- Asphalt concrete
- Mineral
- Filled black-top concrete
- Fiber zed black-top
- Asphalt elastic
- Rubberized black-top
- Low modulus rubber treated black-top

3.7 Surface Treatment Options

Surface medicines are utilized to dispose of hairline splitting.

For practical, long haul execution (8+ years) seal covering, miniaturized scale surfacing or slurry fixing are viewed as generally proper.

Fogging of slight crumbled splits is likewise an exceptionally viable treatment.

3.8 Crack Repair Options

Break repair is done on splits with great edge crumbling (measuring or lipping). Shower Patching and Mill and Fill are two medications that can be considered for split repair.

For practical, medium-term split repair execution (3 to 4 years) with low to direct movement levels, splash fix and sand/sulfur slurry patch (thermo patch) are viewed as generally proper. Shower fixing ought to just be considered if splits are discouraged more than 10 mm. It can be utilized as a pre overlay treatment.



For financially savvy, long haul break repair execution (5 to 8 years) with low to direct activity levels, Mill and Fill is viewed as generally fitting. Plant and Fill ought to be utilized at areas were risen, or fizzled transverse splits exist. This treatment will enhance the ride and reestablish basic respectability at the repaired areas. Note, Mill and Fill can be utilized as a pre-overlay repair. It ought not be considered if the base of the structure is feeble. A more broad repair is required.

3.9 White Topping Design

The adaptable asphalts being low volume urban streets and private boulevards indicating rutting and unpleasantries, it is suitable to go for white garnish outline. The heap stress in the basic edge district was acquired according to adjusted Westergard's condition by Teller and Sutherland. The sort of overlay thickness and the joints format got for various activity condition from the outline is given in Table 8. The minor restoration outline investigation has brought about 5-Thin white fixing areas and 1-Ultra-dainty white garnish segment. R6 brought about most slender overlay of 100-mm with shorter joint dispersing 1-m×1-m. Whereas, R4 has brought about thicker overlay of 140-mm with biggest joint separating 1.5-m×1.5-m. brought about most astounding basic anxiety blend. The 120-mm (R1 and R2) overlay with various board sizes (1-m×1-m, 1.2-m×1.2-m) indicates increment in basic anxiety blend when contrasted and the 140-mm (R4 and R5) overlays with the distinctive joint separating (1-m×1-m, 1.2-m×1.2-m). This is on the grounds that the heap related anxiety is fundamentally higher in the slight overlay. In any case, for the same overlay thickness (120-mm and 140-mm) with various joint dividing (1-m×1-m, 1.2-m×1.2-m and 1-m×1-m, 1.2-m×1.2m) the basic anxiety mix increments with the expansion in joint separating. This is predominantly because of increment in distorting stresses. The decline in joint dividing diminishes the distorting stress. So to guarantee better execution of white fixing areas amid their configuration life elements like short joint dividing and suitably thick overlays is important. Different components like compelling modulus of black-top base (K), span of relative solidness (l) and nature of the bond between the solid overlay and the black-top (Reduction in hassles) have a critical impact in touching base at the fitting thickness and joint separating of the PCC overlay.

3.10 Asphalt Concrete Overlay Design

The chose street extends were additionally intended for black-top overlay in view of Benkelman shaft avoidance ponders which were completed in the field. The IRC: 81-1997 system was followed in fortifying the current adaptable asphalts by black-top overlay. The sort of black-top solid overlay for the chose streets is exhibited. The outline of bituminous overlay plan uncovers that, R4 involves the most noteworthy number of redundancies of hub burdens (9.0 million) which has brought about most noteworthy diversion (1.76) requiring the most astounding overlay thickness (150-mm). In any case, R3 with most minimal reiterations of axles (1.0 million) and a trademark redirection of 1.28 needs the least overlay thickness (25-mm). This shows that with increment in the redundancies of axles of business vehicles and auxiliary insufficiency the overlay thickness required for fortifying the current asphalt as bituminous cement additionally increments.

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3.13 Cost Analysis

The fundamental rates for things of works are given in Table 10. The rates are material and utilized for calculation of the expense of black-top solid overlay and additionally of white fixing. Elements like possibilities cost, heightening expense and movement redirection cost (5% of development expense) were considered for the bituminous overlay on account of the intermittent upkeep (at regular intervals) to be completed after the configuration life. For white garnish overlay, to accomplish the bond between the current black-top surface and solid it is important to process the surface to a specific profundity by utilizing the proper processing hardware. The expense of development of plain bond concrete incorporates utilization of high review of solid (like M 40) with strands like polypropylene or polyolefin, laying, compaction, completing the process of, curing, joint cutting and joint fixing. The cost examination between white fixing and black-top solid overlay is displayed in Table 11. The expense of black-top solid overlay for R4 (142.44 lakhs) has worked out to be the most noteworthy among different streets while R3 has brought about least cost (9.23 lakhs). The expense of White garnish for R4 (61.61 lakhs) has worked out to be the most elevated among others though R3 has brought about least cost (9.57 lakhs). The expenses for development of meager white garnish for R1 and R2 brought about indistinguishable expense while for the same bars with the black-top overlay has brought about various expense.

**3.14 Methodology For Proposing White Topping**

White Topping can be sorted as underneath:

1.Ultra slight white fixing: Bonding obligatory, processing required, thickness up to 100 mm, least thickness of the current bituminous surface 75 mm (net in the wake of processing), with short joint dividing. It can't be utilized on severely broken bituminous surfaces. Significant surface planning is included Cost-effective for convergences, registration, parking areas and low volume streets continuous with rutting issues because of stop/begin conditions.

2.Meager white fixing: Bonding attractive, however not obligatory, processing alluring but rather thin bituminous overlay of 25-50 mm in lieu of processing can be utilized, thickness between 100 to 200 mm, with short joint dispersing. Utilized for low to direct trafficked hallways.

3.Ordinary white garnish: Similar to another solid asphalt. It can be specifically laid on the current bituminous asphalt without much surface arrangement. Thickness for the most part is equivalent to or more than 200 mm. Be that as it may, Thin White garnish and Conventional White fixing don't have an exceptionally unbending boundary line and a thickness between 150 mm to 250 mm is very regular.

3.15 Crack Density Crack

Thickness is a measure in the matter of how firmly divided the transverse breaks is on a given length of roadway. The accompanying table was created by the Michigan Department of Transportation to decide break thickness.

LINEAR CRACK LENGTH PER 100M PAVEEMENT SECTION	DENSITY
<10METER	LOW
10 – 135 METER	MODERATE
> 135 METER	HIGH

3.16 Break Edge Deterioration

Edge decay is a measure of how much the break edge has weakened. The accompanying table from the Surface Condition Rating Manual for Alberta Transportation can be utilized to decide seriousness of Edge Deterioration.

EDGE DETERIORATION	SEVERITY
CRACK WIDTH <3MM	SLIGHT
CRACK WIDTH 3 – 10 MM	MODERATE
CRACK WIDTH > 10MM	EXTREME

IV. CONCLUSION

An itemized adaptable asphalt assessment has been completed and the accompanying conclusions are drawn from the present examination.

- a. Trench is the significant pain influencing the chose street extends. In view of PCI and IRI values all street segments require- - "Reemerging".



- b. In light of avoidance information and existing hull subtle elements, it is discovered that the current adaptable asphalts are basically lacking remembering the present activity condition. Henceforth the chose streets need auxiliary overlay.
- c. The white topping outline information demonstrates that, R6 with shorter joint dispersing and most slender overlay has brought about most elevated basic anxiety blend while R4with thickest overlay and shorter joint dividing has brought about least basic anxiety mix. Subsequently as the board thickness diminishes, so too ought to the general board size.
- d. From the cost examination amongst white topping and black-top overlay, it is watched that, white topping plan for five streets turns out to be practical than the black-top overlay. Though on one street the expense of white topping is somewhat higher than the black-top solid overlay. This is because of higher beginning cost required in development of plain bond concrete on existing black-top asphalt. Be that as it may, once developed, white topping requires little upkeep dissimilar to black-top solid overlay which experiences intermittent support.

Subsequently before actualizing any option one ought to perform practicality studies and life cycle cost examination to guarantee appropriate basic leadership.

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