International Journal of Engineering Research and Development
e-ISSN: 2278-067X, p-ISSN: 2278-800X, www.ijerd.com
Volume 11, Issue 11 (November 2015), PP.07-11

A Study On Thin White Topping: An Alternate For Pavement Treatment

Brajesh Mishra
M. Tech., Assistant Engineer, U.P. Cane Development Department, Lucknow, India

Abstract:- Due to rapid urbanization and growth of industries the traffic flow is increasing day by day resulting in heavy loading on existing road network of the country. During last three decades, there is sufficient increase in the road infrastructure resulting in increase of the total length of roads in the country. The road network in India carries more than two third of the freight traffic. Due to repetition of wheel loads, variation in temperature and other environmental effects most of pavements get damaged. Covering of asphalt pavement with a layer of cement concrete is termed as White topping. On the basis of thickness of the concrete layer it can be divided into bonded and unbonded or conventional White topping. When the thickness of the concrete layer is 200 mm or more and not bonded to the asphalt it is called unbonded or conventional White topping. Bonded White topping is of thickness of 50 mm to 150 mm bonded to Asphalt pavement layer and is of two types, thin and ultrathin. The bond is made by texturing the asphalt. Thin white topping is a bonded layer of concrete of thickness 100 mm to 150 mm while an ultrathin layer is 50 mm to100 mm thick. The use of ultrathin white topping (UTW) is preferred for deteriorated asphalt pavements with fatigue and rut distress. The actual thickness of ultrathin white topping is reliant on traffic loading, existing asphalt pavement thickness and grading of concrete.

Keywords:- Conventional White topping, bonded White topping, asphalt pavement, ultrathin white topping (UTW), concrete grade, milling, texture.

I. INTRODUCTION

Covering of asphalt pavement with a layer of cement concrete is termed as White topping. On the basis of thickness of the concrete layer it can be divided into bonded and unbonded or conventional White topping. When the thickness of the concrete layer is 200 mm or more and not bonded to the asphalt it is called unbonded or conventional White topping. Bonded White topping is of thickness of 50 mm to 150 mm bonded to Asphalt pavement layer and is of two types, thin and ultrathin. The bond is made by texturing the asphalt. Thin white topping is a bonded layer of concrete of thickness 100 mm to 150 mm while an ultrathin layer is 50 mm to 100 mm thick. The use of ultrathin white topping (UTW) is preferred for deteriorated asphalt pavements with fatigue and rut distress. The actual thickness of ultrathin white topping is dependent on traffic loading, existing asphalt pavement thickness and grading of concrete. By placing an overlay over existing pavement the load carrying capacity and rideability of pavement can be enhanced.

II. LITERATURE REVIEW

2.1. Overlay Solutions for Rehabilitation and Maintenance

Uses and advantages of Bonded layer of Concrete: Depending upon the condition of existing pavement a type of overlays is chosen. Bonded overlays are opted when the existing pavement is in good structural condition with some surface distress. It is used to eliminate any surface defects, increase structural capacity due to increased traffic, improves surface friction, noise and rideability.

Fig-1: Good condition pavement surface

Concrete Resurfacing of Asphalt Pavements (50 mm to150 mm Thick): Spots of distress that are not visible can be determined through evaluation such as the stiffness of asphalt pavement and subgrade support condition.

Localized areas of weakness can be strengthen through patching. Milling can remove asphalt surface distresses. Asphalt is a good reflector of underlining concrete condition.

Key to Success-

- Bonding is critical.
- Small square panels reduce curling, warping and shear stresses in bond. Milling is done if necessary to correct crown, remove surface distresses, improve bonding.
- 75 mm thick HMA surface must be left after milling. HMA surface temperature should be below 50°C before paving.
- Transverse joint must be sawed one third of its thickness. It is advisable that joints in the overlay should not be placed in the wheel path.
- Curing compound must be applied timely and systematic.

The main objectives of milling is as under-

- to remove significant surface distortions that contain soft asphalt material;
- to reduce high spots to help ensure minimum resurfacing depth and reduce the quantity of concrete needed to fill low spots;
- to roughen a portion of the surface to enhance bond development between the new concrete overlay and the existing asphalt.

Points to be kept in view-

- Direct placement of concrete without milling is recommended when the rutting in existing asphalt pavement does not exceed 50 mm.
- Any ruts in existing pavement are filled with concrete, resulting in a thicker concrete overlay above the ruts.
- A minimum of 75 mm to 100 mm of asphalt should be left after milling because of the reliance on the asphalt pavement to carry a portion of the load.

In short the thickness of overlay can be minimize the by adopting suitable design on the basis of fact that the pavement system behaves as composite structure by virtue of utilization of strength of asphaltic pavement. When the pavement is sufficiently deteriorated, it can only be considered as base. A separation layer normally of one inch thick asphalt is provided to isolate unbonded overlay from underlying pavement to minimize reflective cracking.

Concrete overlays have been used to revitalize bituminous pavements since 1918 in USA. There has been a renewed interest in white topping, particularly on Thin White Topping (TWT) and Ultra-Thin White Topping (UTWT) over Conventional White Topping. Based on the types of interface provided and the thickness of overlay, classification is as follows:

1. **Conventional White topping–**It consists of plain cement concrete overlay of thickness 200 mm or more, which is not monolithic with underlying bituminous layer (lack of bonding).

Fig-2: Deteriorated condition pavement surface

2. **Thin White Topping (TWT) –** It is a PCC overlay between 100 mm to 200 mm of thickness. It is designed either monolithic with underlying bituminous layer or without bonding. High strength concrete, M40 or higher is normally adopted. Joints are kept at a spacing ranging from 0.60 to 1.25 meter.
3. **Ultra Thin White Topping (UTWT) –** It is a PCC overlay of less than 100 mm of thickness. Laying monolithically between overlay & underlying bituminous pavement layer is essential. Milling or scraping to a depth of 25 mm of existing bituminous pavement layer is done to achieve this. Joints are kept at a spacing ranging from 0.60 to 1.25 meter.

2.2. Advantages of White topping

- Thickness is reduced.
- Construction is so speedy with the help of modern equipments and techniques that it can be opened to traffic with in a week of construction.
- Maintenance is minimized as the life of concrete overlay is around 20 years with slight maintenance.
- It is Cost-effective in comparison to bituminous overlays when Life Cycle Cost analysis is performed.
- Service life is improved due to superior riding quality and improved fuel efficiency of vehicles.
- Pre overlay repair is least.
- Road safety aspect is improved due to better reflection of light particularly in city roads.
- Around 20% of electricity will be saved as compared to flexible pavements.
- Lower Operational costs and lower absorption of solar energy.
- Beneficial for environment as concrete roads are much greener and less polluting.

2.3. Applications in India

In recent years places like Mumbai, Indore Nagpur in India, concrete overlays (white topping) on existing flexible pavement have been constructed successfully. During last century several new concrete roads were constructed in South India which were up to the mark for a period over four decades. They were the Bangalore-Mysore road constructed by the then Maharaja of Mysore, the coastal roads in Kerala etc. Due to lack of experience and technology in white topping, these roads were converted to flexible overlays in recent times. Locations where Ultra Thin White Topping (UTWT) / Thin White Topping (TWT) are constructed listed in table below –

Table-1 Locations of Ultra Thin White Topping (UTWT) / Thin White Topping (TWT) in India

S. No.	Location	Year	Approximate length & subbase	Thickness (mm)	Materials, grade of concrete
1	Near Pune Municipal Corporation	2003	20 m, over asphalt pavement	125	FRC, M40
2	CRRI campus road, New Delhi	2004	300 m, over asphalt, DLC and concrete pavement	40- 75	FRC, HPC M35
3	Moolchand & Prembari Underpass, New Delhi	2006	500 m, over reinforced concrete slab	125	FRC, M40
4	HRDC centre Ghaziabad	2006	1.75 KM over M 7.5 DLC laid over asphalt pavement	50	HPFRC, M35
5	Hosur road, Bangalore	2011	Over scrapped bituminous pavement	150	M45
6	Mahul road, Mumbai	2007	30- 50 m over milled asphalt surface	100	M50

III. DESIGN OF PAVEMENT AND CONCRETE MIX

Design of overlay is based on using Westergaard's Equation and warping stress as per IRC:58-2002 and IRC:SP:76–2008. In order to achieve the desired advantages of concrete roads, three essential conditions need to be satisfied.

- Production of concrete in a Ready mixed concrete (RMC) plant or in a dedicated batching plant.
- Using either fixed form or slip form mechanical pavers.
- Strict quality control at site including testing of fresh, hardened and extracted specimens of concrete and tests on pavement quality.

Mix Design: It should meet the following criteria-

- Higher cement content
- Low water cement ratio
- Steel fibers/ synthetics
- Fast track construction
- Durable concrete
- Quick to opening for traffic

IV. CONSTRUCTION PROCEDURE

The following steps is adopted in the construction of Construction-

- Milling and cleaning of surface
- Placement of concrete, finishing and curing
- Early sawing
- Opening to traffic

1- Bonding between concrete overlay and existing bituminous pavement layer in case of Thin white topping (TWT) is at least partly essential where as strong bonding is essential in case of Ultra thin white topping (UTWT). To achieve this any of the following method can be implemented.

- Existing bituminous surface of pavement can be milled to a depth of one inch in order to obtain a uniform surface. Adjustment of cross slope and removal of distortion formed by cracks can also be done by milling.
- On bituminous surface which are hard enough, scrapping of surface to a depth of 10 mm is carried out with tools which have vertical impact control to avoid any possible damage to the subgrade beneath.

A minimum of 75 mm to 100 mm of asphalt should be left after milling because of the reliance on the asphalt pavement to carry a portion of the load.

2- Direct placement of concrete without milling is recommended when the rutting in existing asphalt pavement does not exceed 50 mm. Any ruts in existing pavement are filled with concrete, resulting in a thicker concrete overlay above the ruts.

3- To roughen a portion of the surface to enhance bond development between the new concrete overlay and the existing asphalt

4- Bonding is critical. Small square panels reduce curling, warping and shear stresses in bond (1.5 times thickness).Milling is done if necessary to correct crown, remove surface distresses, improve bonding. 75 mm thick HMA surface must be left after milling. HMA surface temperature should be below 50°C before paving. Transverse joint must be sawed one third of its thickness . It is advisable that joints in the overlay should not be placed in the wheel path.

5- Curing compound must be applied timely and systematic. To ensure effective load transfer across the longitudinal segments as well as transverse construction joints, tie bars and dowel bars are provided.

Fig-3: Surface preparation

Fig-4: Paver machine in operation

Fig-5: Surface texturing action on green concrete

Fig-6: Spraying of curing compound on fresh concrete

Fig-7: Groove cutting in progress

V. CONCLUSIONS

Based on the study on White Toppings the following conclusion can be drawn-

- Construction of White Toppings so speedy with the help of modern equipments and techniques that it can be opened to traffic with in a week of construction.
- Maintenance is minimized as the life of concrete overlay is around 20 years with slight maintenance.
- White Toppings Cost-effective in comparison to bituminous overlays when Life Cycle Cost analysis is performed. Its service life is improved due to superior riding quality and improved fuel efficiency of vehicles. Pre overlay repair is least.
- Road safety aspect is improved due to better reflection of light particularly in city roads. Around 20% of electricity will be saved as compared to flexible pavements.
- Lower Operational costs and lower absorption of solar energy. Beneficial for environment as concrete roads are much greener and less polluting.

Finally it can be concluded that by using modern equipments, advanced techniques and speedy construction, White Toppings provide a sustainable as well as cost effective option for construction, treatment and safeguarding of the pavements.

REFERENCES

[1]. Concrete Overlays – White topping of roads, Cement Manufacturers Association, 2010
[2]. Tentative guidelines for conventional, thin and Ultra-thin white topping, IRC: SP: 76 – 2008, The Indian Roads Congress, New Delhi, 2008
[3]. Handbook on Cement Concrete Roads, Cement Manufacturers Association, 2010
[4]. Michael E. Ayers & Dale Harrington, Selection and use of concrete overlays, The Indian Concrete Journal, May 2010
[5]. Guide to Concrete Overlays – Sustainable solutions for resurfacing and rehabilitating existing pavements, National Concrete Pavement Technology Centre, USA, Sept. 2008.