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Thin Concrete Overlays for Roads

Likheeth J[1], Raghavendra Mahesh[2]

Post Graduation Student, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bangalore, India[1]

Post Graduation Student, Department of Civil Engineering, Dayananda Sagar College of Engineering, Bangalore, India[2]

Abstract: For the rehabilitation of degraded road pavements, thin concrete overlays have become a popular choice. These overlays, which are typically 1 to 4 inches thick, offer a number of advantages, including increased structural capacity, higher longevity, and less maintenance requirements. Thin concrete overlays increase resistance to cracking and rutting and lengthen the lifespan of deteriorating pavements by restoring their capacity to carry weight. Additionally, they provide design flexibility by allowing for the alteration of color, thickness, and texture. They also save money over the long run by requiring fewer repairs down the road and little surface preparation. As a beneficial and long-lasting solution for repairing road surface, thin concrete overlays are used.
To summaries, thin concrete overlays provide an innovative and sustainable solution to repairing and prolonging the service life of road pavements. They are a vital asset in contemporary pavement rehabilitation practices because of their capacity to improve structural capacity, durability, and aesthetics while offering affordable alternatives. The creation of durable and long-lasting road infrastructure can benefit greatly from additional research and application of thin concrete overlays.

Keywords: Overlays, Thin white topping, Asphalt, Ultra thin white topping.

I. INTRODUCTION

The necessity for effective and economical pavement repair techniques is becoming more and more critical as road infrastructure ages and deteriorates. A promising method for restoring and extending the useful life of damaged road pavements is the use of thin concrete overlays. These overlays, which are made of thin concrete layers that are typically 1 to 4 inches thick, have many advantages over conventional rehabilitation methods. A cost-effective and long-lasting solution to the problems caused by ageing pavements is to use thin concrete overlays. They are a desirable alternative for road authorities and transportation organizations around the world because of their higher structural capacity, increased longevity, and decreased maintenance needs.

Restoring the load-carrying capacity of degraded pavements is one of the main benefits of thin concrete overlays. These overlays allow the roadways to handle higher traffic volumes and stop future deterioration by fortifying the current pavement structure. The concrete overlay's high flexural and compressive strengths assist prevent cracking, rutting, and other types of distress, extending the pavement's overall resilience and lifetime.

The good bonding qualities of thin concrete overlays with the underlying pavement also help to create a durable interface and reduce the risk of delamination or debonding. By working together as a single structural system, the overlay and the existing pavement are able to effectively distribute loads and minimize stress concentrations.
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II. LITERATURE REVIEW

The literature review paper related to thin concrete overlays was carried out, the main objective is to find a best possible conventional method for the overlays of the roads.

Sachin B. Chintawar et al.[1] Utilizing modern tools and techniques, White Topping was built so quickly that it could be opened to traffic after just one week. Because concrete overlay has a life expectancy of about 20 years with minimal maintenance, maintenance is kept to a minimum. When a life cycle cost analysis is done, white toppings are more affordable than bituminous overlays. Superior riding quality and increased fuel efficiency of cars increase their service life. Repair before overlay is least. The aspect of traffic safety is enhanced by increased light reflection, especially on metropolitan streets. Approximately 20% less electricity will be used than with flexible pavements. Lower operational

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expenses and less solar energy absorption. favorable for the environment because concrete roads are far less polluting and greener.

S. Tayabji et al.[2] This study discusses how thin concrete overlays can offer reasonably priced options for rehabilitating old asphalt, concrete, and composite pavements. The case studies that are provided show the wide range of uses for thin concrete overlays. These applications are the result of wise technical choices and a commitment to keep looking for new ways to expand upon existing technologies. The success of these cutting-edge applications will give pavement engineers additional resources they can rely on to efficiently and affordably renovate existing pavements. Thin concrete overlays have the major benefit of preserving the existing pavement, which drastically cuts down on construction time for the rehabilitation activity and encourages sustainable rehabilitation methods.

Yawar Mushtaq et al.[3] In this paper, thin concrete overlays can be used to restore ageing asphalt, concrete, and composite pavements in an affordable manner. The case examples offered illustrate the various applications for thin concrete overlays. These applications are the product of intelligent engineering decisions and a constant search for fresh approaches to advance and improve existing technologies. If these innovative applications are a success, pavement engineers will have access to new tools that will help them rehabilitate ageing pavements quickly and economically. The main advantage of thin concrete overlays is that they preserve the existing pavement, which substantially reduces construction time for the restoration activity and promotes environmentally friendly rehabilitation techniques.

R. Y. Patil et al.[4] The design charts for Thin White Topping with varying thickness of cement treated foundation and various subgrade CBR are created for rural roads. Existing local material can be used in the Cold In Place Recycling process, and cement stabilization will increase the subgrade and subbase's strength. Based on field tests, the performance evaluation rating for pavement built with CTB utilizing the CIPR technique and Thin White Topping is good after two years of construction. No surface rutting, cracking, potholes, or other flaws are visible. For various thicknesses of cement-treated foundation and various subgrade CBR for rural roads, thin white topping thickness design charts of M30, M35, and M40 are produced. The Thin White Topping pavement structure is advised as a pavement design choice for low-volume rural roads because it has a superior load carrying capacity over suitable base support. An efficient and sustainable alternative is to build rural roads with CTB utilizing the CIPR method.

Vinay H N et al.[5] The main issue affecting the chosen road segments is ruts. Based on PCI and IRI readings, "Resurfacing" is necessary for all road sections. It is determined that the existing flexible pavements are structurally insufficient taking into account the current traffic condition based on deflection data and existing crust details. As a result, the chosen roadways require structural overlay. According to the white topping design data, R4 with the thickest overlay and longest joint spacing had the lowest critical stress combination, while R6 had the highest critical stress combination and the shortest joint spacing. Therefore, the overall panel size should also decrease as the panel thickness does.
The white topping design for five roads shows to be more cost-effective than the asphalt overlay, according to the cost comparison between white topping and asphalt overlay. On one road, however, the price of white topping is a little more expensive than the asphalt concrete overlay. This is because installing plain cement concrete over an existing asphalt surface has a greater initial cost. Contrary to asphalt concrete overlay, which needs regular maintenance, white topping requires little upkeep once it has been installed.

Venkata Jogarao Bulusu et al.[6] The stresses evaluated with IRC equations are 40 to 50 percent greater than the stresses estimated with PCA equations for an 8 T single axle load and 0 to 22 percent higher for a 16 T tandem axle load. The thickness requirement for TWT rises as a result. The cost savings compared to traditional concrete pavement may not seem significant when thickness requirements are higher. TWT technology adoption might not be aided by this. Likewise, the PCA equations were created for the typical American traffic conditions, where there is little to no overloading, and may or may not be totally appropriate for the overloading traffic conditions in India.

Ganesharaju Naidu et al.[7] Since 2003, conventional white topping, ultra-thin, and thin white topping pavements have been constructed in India, although no detailed evaluation of their effectiveness has been done. With the help of the FWD test, the road roughness test, the BBD test, and concrete cores for compressive strength, their performance has been assessed for Indian traffic and climatic circumstances in this study. A visual inspection survey has also been used to evaluate the pavement's performance. The results of these tests and visual inspection surveys are within acceptable limits, which shows that the pavements' short-term performance is satisfactory. The LTE of the transverse joints is typically determined via FWD deflection measurements. However, because of its expensive cost and maintenance challenges, FWD use has been fairly restricted in India up to this point. As a result, there is a need to find a FWD test substitute that is less expensive and uses technology that is readily available. In this study, loaded and unloaded slab deflections were measured using two Benkelman beams operating concurrently, and LTE was estimated. LTE numbers from this study have been compared to FWD test findings, values from other researchers' use of the KENSLAB computer programme, and values from the FE model. Life Cycle Cost Analysis has been done for stiff pavement, flexible pavement, UTW, and traditional white topping. This analysis demonstrates that traditional white topping is more affordable than rigid pavement and flexible pavement that has been repaired using flexible overlays. When UTW is contrasted with rigid pavement (low volume traffic example) and flexible pavement that has been renovated using flexible overlays, UTW is found to be the most cost-effective option.

M. Pasetto et al.[8] The study focused on how various PCC-AC connections can help with UTW recovery. Studies of shear bond strength and flexural responses were conducted on double-layered systems with four different interlayer configurations. The results showed that interfaces had a significant impact on system performance.
Even when combined with fine gravel, the use of bituminous emulsion between cement and asphalt concrete was rather unsuitable; among the tested solutions, the direct application of UTW over AC was the most successful one (brushing the AC surface did not seem to imply significant differences, and it undoubtedly did not improve the system characteristics); the interface properties affected the flexural failure mechanisms of samples in the following ways: Interlayer delamination (interface failure) was observed in systems with low interface bond strength (see emulsion-systems); Because no information on the post-crack phases and the ductility/fragility can be gathered, the simple assessment of flexural stiffness modulus was not totally able to predict the genuine mechanical characteristics of double-layered systems.

III. CONCLUSION

Concrete overlays have evolved as a highly successful and long-term alternative for repairing and extending the service life of road pavements. With their thin layer of concrete, these overlays provide a number of benefits that make them a top choice for transportation companies and road authorities. Thin concrete overlays offer a practical solution to the problems presented by deteriorating pavements. They allow the infrastructure to handle greater traffic volumes and stop further deterioration by restoring the load-carrying capacity of damaged roadways. Longer-lasting pavements are produced as a result of their strong flexural and compressive strength, which increases durability and resistance to rutting, cracking, and other types of distress. Additionally, thin concrete overlays have superb bonding qualities with the preexisting pavement, assuring a trustworthy interface and reducing the chance of delamination or debonding. This strong bond enables the overlay to work as an integrated structural system, distributing loads evenly and reducing stress concentrations. Over time, thin concrete coverings can reduce costs. They may be built using standard paving equipment with little surface preparation, which cuts down on construction costs and time. The overlays' increased sturdiness and prolonged service life also lead to less maintenance requirements, which further lowers total expenses.

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