Asphalt Overlays:
Preparation and Application

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Letter of Transmittal

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Mr. Burke,

We are submitting this report "Asphalt Overlays: Preparation and Application" as part of the requirement for the IAPA scholarship.

The purpose of this report is to outline all the areas that go into an overlay paving process. The report goes into detail of the preparation, the types of overlays, the benefits, and even the disadvantages.

We would like to thank Mr. Burke and the entire IAPA for the sponsorship and support for this scholarship and report.

Sincerely,

Diamond Cottman
Jacob Savage

Executive Summary

Many roads in the United States are worn and has surface damage, but remain structurally sound, they just need resurfaced. Asphalt overlays are an option to resurface both concrete and asphalt roads. These overlays are only effective as surface reconditioning not to repair structural damage to roads. In this report all scopes of the overlay process will be covered from beginning to end. There are many parts to the overlay process all including the preparation of existing surfaces, types of overlays, bonding agents to be used, and the benefits of the finished product.

Preparation of Existing Pavement

Roads and highways that are going to have an asphalt overlay to improve the driving surface must go through a process to give good, strong, and lasting bonds. The common practices involve patching and repairing structural damage, prepping the surface, and applying a bonding agent. Illinois Department of Transportation has it own standards and practices for overlays that will be referenced from IDOT BDE 52.4-3 in this report.

Asphalt overlays are used for driving surface improvement and do not repair and structural damage to the pavement, therefore the pavement base must be replaced or look into other options. Cracking and significant damage to the existing pavement will be reflected up through the overlay. If there is a failed section of pavement it must be either partial depth patched or replace the entire section that has failed (pavementinteractive.org)

Surface preparation involves sealing cracks, patching surface imperfections, and restoring a smooth driving surface. Cracks and potholes are examples of repairs that must be taken care of with patching and sealing or else they will be reflected up into the overlay. While bumps and raised imperfections must be handled in the milling or diamond grinding process which are processes for improving surface imperfections. The diamond grinding can only be used on hot mix asphalt to reduce raised areas and level them to the road, but in concrete can be used to take a whole thin layers for preparation of an overlay. (IDOT, BDE Manual)

Diamond Grinding

(https://canada.constructconnect.com/)

Diamond grinding is not effective in the use of reducing an asphalt to its lower layers when trying to improve structural damage to the pavement. This will involve milling down the asphalt. Milling has several uses for the preparation of the pavement; it levels, removes surface imperfections, and can help eliminate differential compaction areas. According to IDOT specifications the milling process must have 3 inches of material left if it is to be used as the only treatment, but the milling must remove the existing pavement at least 1 inch or equal to the existing lift. (IDOT, BDE Manual) This is to remove the damaged surface pavement but leave enough base to start the new lifts of overlay.

Milling operation

(www.elkhartpavers.com)

Benefits of Overlay

Adding an asphalt overlay to an existing pavement has many benefits to apply an asphalt overlay to a road surface. Asphalt overlays are the most common road repairs and that is because of their many benefits and conveniences. The main benefits include the ability to maintain, they are sustainable, and more aesthetic.

Overlays themselves are a type of maintenance to an existing road and can be a regular maintenance to maintain roads as they reach the end of their life cycles. Overlays are also much more cost beneficial which it comes to repair than a concrete road surface because of their ability to be patched. Asphalt has the ability to be patched and diamond grinded to make the surface a better ride. Typical patched include a cold mix or overlaying a small portion that needs work.

Another benefit to overlays is the sustainability of that type of pavement, three important points are that it can be a recycled material, it can be applied as a small layer, and usually more cost effective than other pavements. The product from milling the old asphalt can be used in the manufacturing of the new pavement. This is a more environmentally friendly way of boosting a plant's mix without using new raw materials. Also, they are cheaper than most other forms of resurfacing. According to a study in 2008 by the National Asphalt Paving Association, thin overlays are close to $1000 cheaper, per lane per mile, than micro surfacing and slurry coating. They also last an average of seven years longer than those options (National Asphalt Paving Association).

Finally, a new overlay presents a lot in improved aesthetics compared to the old pavement. While overlays improve the looks of the highway it also helps with the contrast and road noise that is often associated with old roads. While these may not seem as important as structural soundness on the roads the public enjoys a nicer looking and quieter road. There are two figures below that were taken along IL-267, between Rockridge and Greenfield, that shows the contrast in how an overlay project can improve the aesthetics and view of the roads.

There are several disadvantages to overlays in that weather and high volume can take tolls on the surface. Freeze thaw cycles take a toll on asphalt surfaces in that the expanding and contracting can cause warping and cracking which decreases a roads life span. Also, high traffic volumes especially trucks can have a major impact in that they can cause rutting and warping of the asphalt. Overall, overlays are beneficial in cost and lifespan.

(Looking North)

(Looking South)

Asphalt Repair to Il-267
Photos by Jacob Savage (Il-267)

Tack Coat

Overview

To increase the interlayer shear strength between new overlays and existing pavement structures, a type of bonding agent must be used. A wide variety of bonding agents are used in today's industry. Companies worldwide are using various types of tack coats between the layers. Tack coat is a diluted form of asphalt used to ensure the bondage strength between two layers and increase the overall shear strength of the structure. The layers can consist of different materials, such as, hot mix asphalt (HMA) or Portland Cement Concrete (PCC). Choosing the right tack coat is key to the lifespan and performance of the pavement. According to ASTM D8, tack coat is defined as an application of bituminous material to an existing relatively non-absorptive surface to provide a thorough bond between old and new surfacing. Many factors can contribute to the effectiveness of the tack coat. These factors include, but not limited to, the type of tack coat, the rate of application, optimum curing time and temperature. In this section, the various factors will be explained and discussed.

Charge Attraction

According to ASTM D977 and ASTM D2397, anionic and cationic emulsions are commonly used. These emulsions help determine the correct type of tack coat needed for the project. Most aggregates contain positive and negative charged ions. The tack coat materials must have the opposite charge of both the existing pavement and the new overlay to reach its maximum potential bondage strength.

In order to use the correct type of tack coat, the charge of the materials must be considered. For the best bondage, anionic and cationic materials attract because of their negative and positive charges. Cationic emulsifiers are categorized by their curing, or setting, time. Anionic emulsions include slow, medium, and rapid setting, referred to with the letters SS, MS, and RS, respectively (Al-Qadi et al., 2012).

Types of Tack Coat

The type of tack coat used depends on each resurfacing project. The most commonly used type of tack coat materials are hot asphalt cement, emulsified asphalt and cutback asphalt (IDOT, 2012). Research has shown different types of pavement conditions can affect the overall bondage strength. The adhesive bond between the two layers determines the performance of the pavement structure over time. Hot asphalt cement is one of the results of crude oil. Emulsified asphalt is reduced to a liquid and combined with aggregate. The test methods and practices of

emulsified asphalt used in the field are in accordance to ASTM D244. Cutback asphalt and other methods no longer used. Cutback asphalt usage has decreased over the years due to its negative environmental impact.

Rate of Application

Application rate determines the amount of bonding agent material dispersed between the layers. A tack coat is a sprayed application of asphalt material upon an existing asphalt or Portland cement concrete (PCC) pavement prior to an overlay, or between layers of new asphalt concrete (NCHRP, 2018). In the field, tack coat is typically mixed with water to achieve the ultimate distribution of the mixture. Certain distresses in the pavement can be avoided with the proper application. With the introduction of a tack coat with specific application rates, researchers have found the bonding of materials later result it certain distresses in the

Fig. 1.5 – Joint Reflective Cracking, Pavement Tools Consortium

structure (Mohammad et al. 2012). The distresses are caused by debonding of the layers and results in slippage and fatigue cracking. An example of fatigue cracking is shown in Figure 1.5. The cracks occur when a flexible overlay to a rigid pavement that is beneath. Removal of the top layer and replaced by a new asphalt overlay can be the solution to this problem.

Optimum Curing Time

Factors such as temperature can affect the amount of time a bonding agent needs to cure. An emulsifying agent is normally used to reduce the consistency of the asphalt cement for lower temperature usage. The curing times for emulsifiers are categorized as slow, medium and rapid setting time. Al-Qadi et al. (2012) conducted research at the University of Illinois Urbana-Champagne and tested the ultimate shear strength of specific tack coats. They used optimum curing times obtained through various studies. The results of their research can be seen

in Figure 1.6. The longer the curing time, the better the interlayer shear strength (Chen and Huang, 2012).

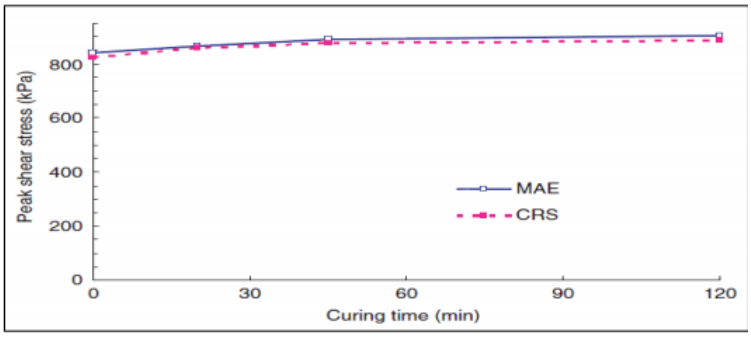

Fig. 1.6 – Effect of curing time on peak stress (Chen and Huang, 2010)

Conclusions

Asphalt overlays are one of the most commonly used road repair techniques throughout the country. It's commonly due to the many benefits that it has to offer for improving the quality, price, and options of the driving surface. This report covered the surface preparation, benefits and disadvantages, and the types of asphalt products that can be used.

Discussed above were the processes that are involved in the preparation of the existing pavement. It starts with patching the pavement and fixing the structural damage within the pavement. Next the future driving surface must be prepared using several options in the diamond grinding and milling operations, these smooth and improve the pavement and get it ready for the application of overlays.

The benefits of these overlays are for being maintainable, sustainable, and improve the aesthetics. The maintainability and sustainability are arguably more important in the quality of the roads, but aesthetics play a role with the public and are very important to projects. The disadvantages are the impacts that weather and high traffic can inflict upon the pavement.

Finally, the types of products that can be used within the projects. This report was focusing on the application of hot mix asphalt product which take into consideration the bond type, rate of application, and curing. These were found within the ASTM standards which govern the overall process of asphalt process.

This report gives the reader a basic concept of the overlay process and application. This report is more specific to the Standards of Illinois because of the use of IDOT materials, but ASTM standards are generally nationwide. If looking for standards in a different state look to that states department of transportation for their preferred methods.

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