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Rehabilitation and Repair of Concrete Overlays

Dan King[1, *] and *Peter* Taylor[1]

[1]National Concrete Pavement Technology Center, Iowa State University, Ames, Iowa, USA

Abstract. Concrete overlays are a growing solution in the United States for pavement rehabilitation and preservation. Many different overlay types and designs can be used based on existing conditions and to achieve a variety of design goals. Recent performance studies have indicated that concrete overlays are capable of providing an extended service life of 35 years or more. However, the intended design life of an overlay may be shorter, and in some cases, overlays experience early distresses and failures. Because many agencies are new to concrete overlays, there is a growing need to identify best practices for rehabilitation and repair of these pavements. This paper presents a survey of typical short- and long-term distresses that have been observed on US concrete overlay projects. Common failure modes vary based on overlay type and design details, and distresses frequently depend on local materials and climate conditions. Best practices and case studies for rehabilitation and repair of concrete overlays are identified, offering options both for extension of concrete overlay service life as well as rehabilitation or reconstruction with a new pavement surface.

1 Introduction

Pavement rehabilitation and preservation have grown in importance in the United States thanks to the aging of existing infrastructure, increasing traffic demands, funding constraints, and the need to reduce the environmental impacts of new construction. In recent years, concrete overlays have emerged as a useful tool to meet these challenges and improve the condition of existing roadways in a cost-effective, sustainable fashion.

Concrete overlays consist of a new concrete pavement layer constructed on top of an existing concrete, asphalt, or composite pavement [1]. Thanks to their versatility and adaptability, they can be used in a wide variety of design situations and fulfil both short- and long-term service life objectives [2].

Overlays are typically categorized based on the underlying pavement surface and whether they are bonded to that surface. For example, an overlay of asphalt which is bonded to the existing surface may be classified as “concrete on asphalt–bonded” (COA–B). Design details (including bonding) vary depending on the existing pavement condition, traffic loading, geometric constraints, and desired design life [3].

Bonded overlays are generally used when the existing pavement is in relatively good condition and typically range from 100 to 150 mm in thickness. Unbonded overlays are usually constructed when the existing pavement is in relatively poor condition and are most often 150 mm thick or greater. Unbonded concrete overlays of concrete (COC–U) require an asphalt or geotextile fabric interlayer to relieve stresses from saw cut joints in the existing pavement [1, 3].

Concrete overlays were developed over many decades, with wide-scale adoption beginning in the 1980s through 2000s and accelerating since 2010. Today, over 24,000 lane-km of concrete overlays have been built in the US, and they account for about 12% of all concrete pavements constructed annually [2].

2 Overlay performance

As concrete overlays have matured as a pavement rehabilitation solution and become more widely-used in the US, highway agencies have sought to better understand the long-term performance and possible failure modes of these overlays. With increasing amounts of data available on these pavements, a number of performance studies have been carried out in recent years.

The state of Iowa has built the largest network of concrete overlays in the country. Over 7,000 lane-km of overlays have been constructed since the late 1970s, primarily on rural highways [2]. These overlays provide an excellent data set for documenting performance thanks to the large sample of projects, which encompasses all types of overlay designs, and the availability of historical automated pavement condition data. A comprehensive performance study completed in 2017 indicated excellent performance of Iowa’s overlays, finding an average projected service life of 35 years before major rehabilitation would be required [4, 5].

Further performance studies have also been conducted in the neighbouring states of Illinois and Minnesota, which also have long histories of concrete overlay construction. In Illinois, data collected from thicker unbonded concrete overlays (COC–U and COA–U) constructed on interstate highways have indicated projections of satisfactory performance for greater than 30 years, even while these pavements have exceeded predicted traffic volumes [6]. A separate study of thinner COA–B projects, which were constructed more recently,

* Corresponding author: deking@iastate.edu

indicated that most projects were on track to fulfil a 15- to 20-year service life [7].

Similar findings were documented in Minnesota. Analysis of pavement condition data have projected an expected performance life of approximately 35 years on heavily-trafficked unbonded concrete overlays [8]. A similar study of thinner COA–B projects constructed primarily on lower-volume highways projected a 20-year service life before major rehabilitation [9].

The overall documented performance of concrete overlays in the US has been very satisfactory to date. That said, each of the aforementioned performance studies has documented projects that have experienced significant distresses, early and unexpected failures, and the typical wear and tear as overlays reach the end of their intended design life [4–9].

3 Needs for rehabilitation and repair

As a growing number of state and local highway agencies across the US construct concrete overlays, these pavements play an increasingly larger role in the nation's highway system. Many concrete overlays have demonstrated good performance to date with relatively little maintenance [2]. However, with wider-scale adoption in recent years, there is a greater need to understand the most common distress patterns and failure modes for concrete overlays.

While some performance issues in concrete overlays are common to all types of concrete pavements, others are unique and may present challenges to agencies that lack experience with overlays. Also, typical repair methods for similar distresses in conventional concrete pavements may not apply, or may need to be altered for overlays.

In addition to fixing problems, rehabilitation and repair can help extend the service life of concrete overlays. Well-timed preservation treatments can maximize the value of concrete overlays in terms of life cycle cost and life cycle assessment. Finally, agencies also need to understand the best ways to handle concrete overlays when they have reached the end of their functional service life.

This paper provides a survey of typical short- and long-term distresses and failures in concrete overlays and the corresponding best practices for rehabilitation and repair. A number of case studies are reviewed to provide examples and inform selection of the most appropriate methods for performing repairs and extending performance life. Finally, guidance is provided for when to opt for major rehabilitation or reconstruction of a concrete overlay with a new pavement surface once the overlay has reached the end of its service life.

4 Distresses and rehabilitation methods

4.1 Durability of concrete materials

4.1.1 Description

Durability-related distresses caused by deleterious reactions and mechanisms within the concrete matrix are some of the most common failure modes in all types of concrete pavements. Concrete overlays are no exception to this trend. The 2017 Iowa performance study found that materials- and durability-related distresses were the most frequent cause of early deterioration in observed performance of concrete overlays [5].

Examples of these types of distresses include D-cracking, alkali-silica reaction (ASR), and freeze-thaw damage. The distresses that may emerge at a given project are a function of the local climate and materials. For example, Iowa is in a wet-freeze climate, so D-cracking and freeze-thaw damage are common if non-durable aggregates or mixtures are used. Since most of the mechanisms behind durability-related distresses require the presence of water, distresses tend to manifest at or near saw cut joints because they are usually the main source of water infiltration into the pavement.

Two concrete overlays in Iowa with early age durability distresses are pictured in Figures 1 and 2. In Figure 1, map-cracking alongside a transverse joint suggests issues with either aggregate durability (D-cracking) or reactivity (ASR). In Figure 2, spalling of the transverse joints and at the joint intersections indicates that they have remained saturated due either to poor drainage or a poor-quality mix and were damaged during freeze-thaw cycles.

To prevent distresses caused by durability of concrete materials, it is important to use high quality aggregates, durable mix designs (e.g. low w/cm, optimized paste content), and to ensure adequate drainage.

Fig. 1. Map-cracking at transverse joint.

Fig. 2. Spalling of transverse joint and at joint intersections.

4.1.2 Repair

The best method for addressing joint spalling, such as the example shown in Figure 2, depends on the severity of distress and overlay thickness. When distress is limited to the upper half of the overlay, partial-depth repairs can successfully restore the pavement surrounding the joint. Partial-depth repairs are good options in thicker unbonded overlays, but in practice they may not be feasible for thinner bonded overlays, (e.g. 100 mm) where it may be difficult to limit repairs to the top 50 mm. Thinner overlays also tend to have a significantly greater saw cut joint length due to shorter slab designs [2]. If spalling is present in a large number of joints, partial-depth repairs may be cost-prohibitive. Partial-depth patches may be constructed with conventional concrete mixtures or with rapid-set materials.

In bonded overlays, or when distress extends below half the thickness of any overlay, full-depth patching and slab replacement of the total thickness of the overlay are the best methods to repair joint spalling. For thinner overlays, milling out the overlay at an affected area and inlaying with new concrete may also be viable [10].

Full-depth patching and slab replacement in concrete overlays should not be performed with asphalt. Differential thermal expansion and/or bonding between the asphalt patch and concrete overlay may cause significant movement and distress in the patched area and adjoining areas of the concrete overlay [11].

If an overlay is affected by a materials-related distress, especially issues related to aggregate durability or reactivity such as D-cracking or ASR, full-depth panel replacement may be able to buy some time for the pavement at early/isolated stages of distress. However, in the long-term, the processes underlying these distresses cannot be reversed and the overlay will ultimately need major rehabilitation or reconstruction. (See section 5, "End of concrete overlay service life.")

4.2 Cracking

4.2.1 Description

Early age cracking in concrete pavements may be caused by a number of issues, including traffic loading, improper or inadequate design, construction problems, and underlying support conditions. This section focuses on cracking related to overlay design and construction issues. Other types of distresses, such as debonding and asphalt stripping, may also lead to premature cracking, but will be covered in more detail in subsequent sections.

One of the most straightforward causes of early age cracking in concrete overlays is insufficient thickness for the traffic loading. This issue may result simply from an inadequate overlay thickness design, but it can also occur during construction if inconsistencies in the profile of the existing pavement surface are not corrected or accounted for, resulting in sections of the overlay being constructed thinner than they were designed [11].

Cracking may also result from an improper joint spacing design. Guidelines for joint spacing of concrete overlays differ from those of conventional pavements, especially for thinner bonded overlays which frequently do not have dowel bars for load transfer. Overlays less than 150 mm thick often have shorter joint spacing designs than conventional pavements (e.g. 1.8 m x 1.8 m, as opposed to slabs 3.5 m to 4.5 m in length and 3.5 m wide) to help reduce stresses in thin slabs [3].

If joint spacing in these thin overlays is too large, cracking may result from shrinkage stresses or from a loss of support due to curling and warping [10]. Transverse, longitudinal, and/or corner cracking may all develop depending on the overlay design and loading configuration. An example of longitudinal and corner cracking on a COC–U overlay where excessive joint spacing was suspected is shown in Figure 3.

Fig. 3. Early age cracking on a COC–U overlay [5].

Cracking may also occur if joints fall in the wheel path. In such a case, high stresses can develop at free/unsupported slab corners, especially if there are no dowel or tie bars in the overlay, leading to corner cracking like that shown in Figure 4 [11].

Fig. 4. Cracking on a COA–B overlay with longitudinal joints in the wheel path [11].

Concrete overlays can also develop cracking caused by insufficient support. This condition may result from distresses or variability that leave certain areas of the underlying pavement too thin or too weak. To avoid this type of cracking, it is important to complete the necessary repairs to the existing pavement and ensure that it is structurally sound enough to support the overlay, especially if it is a bonded overlay [10].

Reflective cracking may occur in COA overlays if a working crack in the existing asphalt pavement is not repaired prior to overlay. In COC–B overlays, reflective cracks will propagate into the overlay if saw cut joints are not matched to joints and cracks in the existing pavement. In COC–U overlays, the interlayer prevents reflective cracking from saw cut joints, but cracking may still develop over transverse or longitudinal cracks in the existing concrete pavement that exhibit significant faulting caused by underlying support issues.

4.2.2 Repair

Guidelines for repair of cracked slabs are generally straightforward. In slabs with a single crack without vertical displacement or faulting, cracks may be routed and sealed to prevent spalling and infiltration of water and incompressible materials. However, if a crack is working and exhibits vertical displacement, full-depth slab replacement is warranted. Slabs that have developed multiple cracks should also be removed and replaced.

If cracking resulting from inadequate overlay thickness or non-uniform or inadequate support, the repair can be made deeper than the original thickness of the overlay, up to the full depth of the original pavement. This practice allows for poor materials underneath the overlay to be removed and for an increase in the thickness of concrete at the repair location.

If significant fatigue cracking develops from long-term accumulation of traffic loads, the pavement will eventually need more significant rehabilitation. (See section 5, "End of concrete overlay service life.")

4.3 Roughness

4.3.1 Description

Pavement roughness, also described as smoothness or ride quality, is an important property because it is often the aspect of pavement performance that is perceived most directly by the traveling public. Excessive pavement roughness in terms of the International Roughness Index (IRI) is often defined as greater than 2.7 m/km [5], though ride can become unpleasant for drivers well before then.

All pavements tend to become rougher as they age, but there are a few contributing factors specific to concrete overlays. Because overlays often have a higher surface area-to-volume ratio than full-depth concrete pavements, they may be more susceptible to curling and warping [3], increasing roughness. As mentioned in section 4.2.1, excessive joint spacing may contribute to curling and warping, which can also lead to early age cracking.

Another factor is that concrete overlays 150 mm thick or less rarely have dowel bars to provide load transfer [3]. Loss of aggregate interlock due to shrinkage or under the accumulation of heavy traffic loads can certainly contribute to pavement roughness.

It is also possible for faulting to develop in concrete overlays. Faulting has been observed on a number of concrete overlay projects, often thin overlays without dowels for load transfer [7, 9, 12]. The mechanisms are likely different from conventional concrete pavements, where pumping and erosion of subbase material usually contribute to faulting. In concrete overlays, faulting may be caused by shifting or tilting of panels under loading due to the viscoelastic behaviour of underlying asphalt, or stripping or erosion of asphalt that leads to deterioration underneath the joints [10]. (Stripping is discussed in more detail in section 4.5.)

4.3.2 Repair

Diamond grinding is a very common method for restoring smoothness on concrete pavements that has been used successfully on many concrete overlay projects [3, 5, 9]. Diamond grinding can be very successful as a long-term solution for restoring smoothness to overlays that developed a rough ride gradually due to age or due to curling and warping. However, if the roughness was caused by loss of support, load transfer and/or faulting, diamond grinding may only restore smoothness for a short amount of time before the issues reoccur.

While its application may be limited to overlays at least 150 mm thick, dowel bar retrofit (DBR) has been used to successfully restore load transfer to a faulted COA–U overlay in Minnesota, pictured in Figure 5 [12]. This overlay was 165 mm thick and developed faulting within just a few years due to heavy traffic loads. To accommodate the thinner slab, dowels were smaller (25 mm) than those typically used for retrofitting full-depth concrete pavements (30 to 40 mm) to ensure adequate cover. Like most DBR projects, the surface was diamond ground at the end to restore smoothness.

Fig. 5. Crew performing dowel bar retrofit on a COA–U pavement section in Minnesota [12].

4.4 Panel movement and buckling

4.4.1 Description

One unique distress type found in concrete overlays is panel movement, also referred to as panel migration, sliding, shifting, or joint misalignment. Panel movement describes the phenomenon when portions of the concrete overlay begin to move independently from the surrounding system. Panel movement is observed when saw cut joints that were placed monolithically across the pavement slab come out of alignment with each other. An example is pictured in Figure 6.

Fig. 6. Panel movement with transverse joints coming out of alignment with each other across several rows of panels [7].

Panel movement is observed most frequently in relatively thin concrete overlays (125 mm or less), as tie bars are often omitted from these designs due to their reduced thickness. Movement almost always results in misalignment of the transverse joints, since expansion and contraction of concrete pavements occurs primarily in the longitudinal direction.

There are multiple potential causes of panel movement. First, when transverse joints are left unfilled or unsealed (or sealant is lost), incompressible materials may fall into the joints as they open up during cooler temperatures. When temperatures heat back up, the joint may not be able to fully close because of the incompressibles, causing panels at these locations to shift in the direction of least restraint. Panels may also be prone to differential movement if there is non-uniformity in the degree of friction or bond between an overlay and the asphalt surface. [10].

These behaviours may be exacerbated if saw cut joints are not activated, causing dominant active joints to move more than intended [10]. In practice, panel movement often appears to result from a combination of these factors.

Panel movement is not always immediately accompanied by distress. However, if stresses continue to build due to increasing temperatures or the presence of moisture, movement is eventually arrested by restraint. If movement occurs toward the end of a concrete overlay project where it meets a full-depth asphalt pavement, the concrete overlay may shove the asphalt and cause a bump where the two pavement sections meet.

If stresses build up to a sufficient level in the middle of an overlay section, they may lead to compression failure at a transverse joint, or more dramatic buckling (or blow up) of the pavement across a row (or rows) of panels (Figure 7) [10]. Buckling may occur when extended periods of high temperatures drive significant expansion.

It should be noted that buckling can occur without first observing panel misalignment if the entire width of a slab moves together. However, these phenomena are often grouped since they are frequently observed together in concrete overlays, and panel movement may be a leading indicator of buckling.

Fig. 7. Buckling in a COA–U overlay [10].

4.4.2 Repair

Buckling within the overlay generally needs to be repaired immediately after it occurs since it can pose a significant hazard to traffic. Panels at the affected site are removed and replaced to the depth of the overlay.

Even though stresses are relieved once buckling occurs, the overlay may be prone to future reoccurrences. The best method to prevent future slab migration and buckling may be to seal or fill transverse joints with elastic materials, or re-fill them if the existing sealant has been lost. Some agencies have attempted to place expansion joints in overlays to accommodate panel movement, but in most instances these expansion joints have closed quickly and differential movement resumed at other locations.

As fibre-reinforced concrete is used more widely in concrete overlays, especially thinner overlays, it is possible that fibres may be able to prevent or mitigate panel sliding [7]. While synthetic macro-fibres are not as strong as tie bars, they may be able to provide a degree of reinforcement across longitudinal joints as well as keep cracks tighter underneath transverse joints.

4.5 Debonding

4.5.1 Description

In bonded concrete overlays, significant distresses can result from debonding between layers. The bond in these overlays is a critical part of the thickness design, so loss of bond can lead to immediate problems.

Debonding may be caused by inadequate preparation of the existing pavement surface before construction. Generally, bonded overlays of asphalt or concrete should only be placed when the existing pavement surface is in reasonably good condition or has been restored to good condition. Debonding can also occur at slab corners under high curling/warping stresses.

Since very thin overlay surfaces can be left carrying significant traffic loadings if debonding occurs, cracking usually develops very quickly. An example of fatigue cracking that developed after delamination at the bond interface in a COC-B overlay is pictured in Figure 8.

Fig. 8. Cracking after debonding of a COC–B overlay [10].

4.5.2 Repair

Localized instances of debonding will often lead to slabs with multiple cracks, requiring full-depth patching/slab replacement as discussed in section 4.2.2. Widespread debonding that leads to fatigue cracking like in Figure 8 will require major rehabilitation or reconstruction, which is discussed in section 5.

4.6 Asphalt stripping

4.6.1 Description

Stripping refers to when the bond is lost between asphalt binder and aggregate particles, leading to erosion and weakening of asphalt layers. Stripping of HMA layers can occur within the existing asphalt pavement underneath a COA overlay, but is more frequently a problem in COC-U overlays with asphalt interlayers.

Stripping occurs under heavy traffic loading, especially in the presence of water that becomes trapped within asphalt layers or at the bottom of the asphalt interlayer [10]. HMA mixtures with poor drainage characteristics are generally more susceptible to stripping. Stripping is also more likely to occur if the pavement does not have an adequate drainage system or if subdrains are not properly maintained, leading to more frequent saturation of the pavement structure.

Stripping within an existing asphalt pavement or within the asphalt interlayer of a COC–U leads to a loss of support underneath the concrete overlay [10]. As discussed in section 4.2.1, loss of support in the underlying layer can lead to all types of slab cracking depending on the load condition and location of the stripping/erosion. Stripping of asphalt may also play a role in faulting, as discussed in section 4.3.1. An example of longitudinal cracking in a COC–U overlay caused by stripping within the interlayer is pictured in Figure 9.

Fig. 9. Stripping of an asphalt interlayer (exposed in the foreground) leading to longitudinal cracking in COC–U [10].

Best practices to prevent stripping include ensuring adequate drainage of the overlay system, including preventative maintenance of subdrains and and filling or sealing joints that have not been filled. Both dense-graded and permeable asphalt interlayers have demonstrated good performance against stripping over time.

Using a geotextile interlayer may also be a more favourable alternative. Geotextiles have only been introduced relatively recently in the US for COC–U applications, but through approximately 10 years of performance they have done very well to date [3].

4.6.2 Repair

Stripping that leads to a loss of support and cracking in the overlay requires full-depth slab replacement. In these instances, pavement removal must continue to sufficient depth to remove all deteriorated material underneath the overlay. In a COC–U overlay, the interlayer may be re-established with a geotextile in lieu of new HMA.

4.7 Longitudinal cracking at widening units

4.7.1 Description

Concrete overlays are sometimes constructed with integral widening, where outer portions of the new driving lane and/or paved shoulder extend outside the surface of the existing pavement. Widening the pavement provides improved safety for drivers and reduces edge stresses in the new overlay. These widening units can be from 0.6 to 2 m in width, are generally tied to the mainline portions of the overlay, and are sometimes constructed with increased thickness.

On these widened concrete overlays, longitudinal cracking has sometimes been observed to develop in the outer wheel path or paved shoulder. An example of this type of cracking is pictured in Figure 10. Cracking in the wheel path is sometimes isolated to individual slabs or may run continuously through a series of panels.

This cracking frequently appears to be caused by heaving underneath the shoulder and/or widening unit. In many of these cases, the cross slope has been observed to decrease between the crown and outside of the travel lane when it was designed to be constant, indicating that the edge of the pavement is rising. This movement may lead to cracking if the pavement is not tied properly at the joint between the mainline and widening/shoulder.

Fig. 10. Longitudinal cracking in the outer wheel path on a concrete overlay with an integral widening unit [11].

To mitigate the potential for this type of cracking to develop, placement of a stable and drainable subbase underneath the widening unit can help prevent heaving from the shoulder. When possible, tie bars between the mainline and widening should be placed at the mid-depth of the overlay (as opposed to the bottom) to help the longitudinal joint at this location act properly as a hinge. Cracking may also result from overdesigned (too-large) tie bars that also restrain the joint from hinging.

4.7.2 Repair

When these cracks first appear, they are usually not severe and do not immediately impact pavement performance. Non-working cracks may be routed and sealed. However, as the overlay ages and continues to carry traffic, these cracks can spall and cause deterioration at joint intersections. In these cases, full-depth patching should be performed to the original depth of the overlay to preserve pavement condition and prevent distresses from becoming disruptive.

5 End of concrete overlay service life

Proper selection and application of the rehabilitation and repair methods outlined in section 4 can be helpful in extending the life of concrete overlays and ensuring good serviceability over time. Eventually, however, concrete overlays will reach a point of terminal decline in performance. It is important for agencies to be able to recognize when major rehabilitation and reconstruction with a new pavement surface is the best alternative, and what types of options can be used.

5.1 Typical conditions

Agencies that collect automated pavement condition and ride quality data often integrate these data into asset management decision-making tools. It is common for these tools to have trigger values that prompt selection of rehabilitation treatments. However, most agencies likely do not have enough data specific to the various types of concrete overlays to have a unique model for them.

In some of the performance studies referenced in section 2 [4–6, 8, 9], the authors defined end of service life for a concrete overlay in terms of a pavement condition or pavement serviceability index value that was based on indices used for conventional concrete pavements. A terminal value for IRI was also sometimes selected to represent end of service life in these studies, typically 2.7 m/km.

These types of values can work well as a quick reference, but may not provide enough information to make an informed decision as to when reconstruction with a new pavement surface is required. For example, an overlay with some degree of faulting and a roughness of 2.7 m/km, but that is otherwise in good structural condition can likely be diamond ground to extend service life for a significant number of years. The large data set of projects collected in the Iowa performance study [4, 5] identified a number of projects that are continuing to serve for several years after hitting the performance values that were used to define end of service life in the study.

Examples of concrete overlays that have been reconstructed over the years can provide good points of reference for what type of conditions require full reconstruction. One such example is a COA-B project on a US highway in Illinois pictured in Figure 11. In a survey done at the time the photo was taken, the overlay was 13 years old and had developed cracking in about 26.3% of slabs [7]. Fatigue damage was clearly evident by the number of panels with multiple cracks, and there was also widespread spalling of joints and cracks. This overlay was reconstructed via complete removal and replacement one year later.

Other overlay projects in Illinois and Iowa have been reconstructed when reaching greater than 15% slabs cracked, a pavement condition index value of less than 20/100, and/or an IRI greater than 2.7 m/km [5, 7].

Fig. 11. Example of concrete overlay condition with 26.3% slabs cracked and significant fatigue damage [7].

5.2 Options for major rehabilitation and reconstruction

A number of options for major rehabilitation are available depending on the design details of the overlay, agency needs, and available resources. Most methods fall into two main categories: overlay with a new concrete or asphalt surface, or total reconstruction.

Concrete overlays can be overlaid with concrete or asphalt according to the same best practices for performing an overlay of a conventional concrete pavement. The main benefits of performing an additional overlay include a lower up-front cost and usage of new raw materials, the ability to take advantage of the equity already built into the existing pavement structure, and an accelerated construction process.

Thin concrete overlays that do not have tie steel can also be milled out and replaced with a new overlay or inlay, provided the underlying pavement is still in good condition [3]. A concrete overlay may also be rubbilized in place to serve as a platform for a new overlay.

An example of a 36-year old COA-U overlay in Iowa that received a second concrete overlay (now COC-U) is pictured in Figure 12. A geotextile interlayer was used to separate the old concrete overlay from the new overlay.

The main drawbacks of performing another overlay are primarily tied to grade. The pavement section must be free of restraints against raising the grade (e.g. intersections and driveways), and depending on the overlay thickness, the side slopes may need to be corrected to remain within safety restraints.

Fig. 12. Construction of a new COC–U overlay in Iowa over an existing COA–U overlay.

Removal and replacement of the entire concrete overlay system and reconstruction with a new pavement is also an option. This option makes sense for agencies when it is not feasible to further raise the grade, or if there is significant structural deterioration of the overlay, the underlying pavement layer, and/or the foundation.

The main drawbacks to total reconstruction are cost, the use of more raw materials, and a slower construction process. However, existing pavement materials can be recycled for use as base or subbase layers in the new pavement, or even as recycled aggregates for a new concrete or asphalt pavement, helping reduce the environmental impact of reconstruction.

6 Conclusions

Concrete overlays become a popular pavement rehabilitation strategy in the United States. As more overlays are constructed and early projects begin to reach an extended service life, it has become increasingly necessary to understand the most appropriate methods for rehabilitation and repair of concrete overlays themselves.

Many distresses in concrete overlays are similar to those in full-depth concrete pavements and can be repaired in a similar fashion. However, the best repair strategies may be different in some cases, and there are a number of concrete overlay distresses that are uncommon in conventional concrete pavements. With a better understanding of the best methods for repairing concrete overlays, it is possible to improve performance over the life of the pavement and help make them more economical and sustainable in the long term.

Finally, it is also important to understand when a concrete overlay has reached the end of its functional service life. and needs to undergo major rehabilitation or reconstruction with a new pavement surface. A variety of methods are available for major rehabilitation or reconstruction of concrete overlays with a new pavement surface, providing agencies with many options

7 Further Information

For thorough explanations on how to assess pavement condition and distress severity, as well as how to specify and perform the repair methods discussed in this paper, the National CP Tech Center's "Guide for Concrete Pavement Distress Assessments and Solutions" [10] is an excellent resource for practitioners working with concrete overlays and all types of concrete pavements.

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