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Rubblization or Crack/Break & Seat – Things to Consider

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Rubblization or Crack/Break & Seat – Things to Consider

When concrete pavements are overlaid with asphalt pavement, the existing joints and cracks in the concrete reflect through to the surface of the asphalt overlay leading to pavement distresses that reduce pavement service life. The fractured slab techniques crack & seat and break & seat are used to reduce the effective slab lengths to minimize the horizontal movements of the slabs that cause reflection cracks in the asphalt overlay. The fractured slab technique rubblization transforms the slabs into fractured concrete pieces of sizes that eliminates slab action.

While rubblization is the most effective of the fractured slab techniques at controlling reflection cracking in the asphalt overlay, it also reduces the structural support of the fractured concrete layer more than crack/break & seat. Therefore, all else being equal, rubblization requires a greater asphalt overlay thickness than crack/break & seat.

Following are things to consider when evaluating a potential fractured slab and asphalt overlay project with an emphasis on choosing between the range of fractured slab techniques.

1. Applicable fractured slab technique(s) based on type of existing concrete pavement

- Jointed plain concrete pavement (JPCP): crack & seat, rubblization

- Jointed reinforced concrete pavement (JRCP) (aka mesh-reinforced): break & seat, rubblization, crack & seat in certain situations

- Continuously reinforced concrete pavement (CRCP) (aka rebar-reinforced): rubblization

The type of reinforcing steel, if any, in the concrete determines which fractured slab techniques are most effective at reducing/eliminating slab action. Break & seat utilizes more fracture energy than crack & seat to de-bond the concrete from the reinforcing steel thus causing significant surface spalling, whereas crack & seat generally produces little, if any, surface spalling. CRCP requires rubblization to adequately de-bond the concrete from the more substantial rebar reinforcing steel. Crack & seat of JRCP is sometimes used to avoid surface spalling and to maintain greater structural support.

2. Subsurface conditions

The slab fracturing process is affected by the support provided by any base layers and the subgrade. If the support is too low, the process will not be able to produce consistently sized fractured concrete pieces. In situations of low support, best practice is to reduce the fracture energy to produce larger pieces that maintain adequate aggregate interlock. In the most extreme situations, even a wide crack & seat pattern will leave an unstable layer of fractured slab pieces that move excessively under a load.

The Wisconsin Department of Transportation's Facilities Development Manual section "FDM 14-25-15 Concrete Pavement Rubblization" (https://wisconsindot.gov/rdwy/fdm/fd-14-25.pdf#fd14-25-15) includes guidance on how to "determine whether the subgrade, rubblized concrete, and base aggregate layer provide enough support to accommodate the construction process". The figure on the next page represents the relationship between subgrade CBR and the combined thickness of the materials above the subgrade (subbase, base, rubblized concrete) with points in the area above and to the right of the curve representing conditions that will allow for effective rubblization. For example, a

6-inch thick base layer with a 9-inch thick rubblized concrete layer requires a CBR of approximately 3. That same concrete layer directly on subgrade requires a CBR of approximately 6.

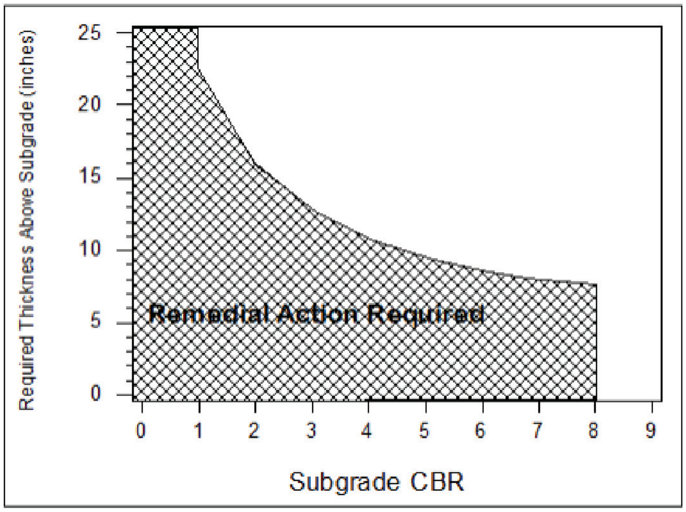

Figure 15.2. ***Subgrade/Base Layer Adequacy***

As points enter the "Remedial Action Required" area, best practice is to utilize a "modified rubblization" process (see description at end of document) or crack/break & seat to retain more of the structural support of the existing concrete slab to compensate for low subgrade/base support. In extreme situations, Antigo recommends that fractured slab techniques not be utilized.

3. Distresses in the existing concrete pavement

The type, severity, and extent of distresses in the existing concrete pavement should be evaluated to determine how they might affect the fractured slab processes. The crack/break & seat process is best suited for slabs with lesser structural distress. Rubblization is generally the better option for more severely distressed slabs. The evaluation of the existing distresses and the evaluation of the subsurface conditions should be performed in tandem.

4. Traffic control and project phasing constraints

A significant difference between the crack & seat process and the processes of break & seat and rubblization is that traffic can usually be allowed back on a cracked & seated concrete pavement prior to the asphalt overlay being placed. The production of tight, hairline cracks that maintain aggregate interlock usually leave a pavement with adequate structure to carry traffic for a short period of time. For example, California Department of Transportation regularly phases crack & seat and asphalt overlay projects to include a few weeks of running traffic on the cracked & seated concrete pavement prior to placement of the asphalt overlay.

Break & seat usually produces a significant amount of surface spalling and rubblization produces a surface of fractured particles like crushed aggregate. Both processes require an asphalt overlay of adequate thickness before traffic is allowed. If construction phasing includes temporarily returning traffic prior to the final design thickness of asphalt being placed, attention should be paid to avoiding damage to the asphalt due to overloading.

Many projects have been successfully constructed utilizing short duration lane closures to fracture and roll the concrete, complete preparation for the overlay, place and compact a base asphalt layer, and then complete any miscellaneous preparations for opening to traffic. In more extreme traffic situations, this process can be completed during nighttime closures to maintain access to all lanes during peak travel periods.

5. Final surface elevation constraints

When a concrete pavement is fractured and overlaid with asphalt, the surface elevation increases. The final surface elevation may be constrained by overpass clearance heights, side slope considerations, and the need to match existing curb & gutter. If a maximum allowable asphalt overlay thickness that meets any constraints is determined, the design overlay thicknesses for the various fractured slab techniques can be evaluated to determine which will meet the surface elevation constraint.Another option is to include surface milling of the concrete pavement prior to or after concrete fracturing to lower the final surface elevation. This option has been used under overpasses when necessary to maintain minimum required clearance heights. This option is also very effective for matching adjacent curb & gutter by milling out a wedge starting approximately 3 inches deep next to the gutter pan and tapering out to zero over approximately 8 feet. This allows for placing the asphalt overlay at the gutter without significantly increasing the surface elevation in that area.

The asphalt overlay design must consider the final thickness of the fractured concrete layer when milling of the concrete layer is included in the design.

6. Investment level and pavement performance timeframe

All else being equal, rubblization requires a greater asphalt overlay thickness than crack/break & seat to accommodate the greater reduction of the structural support of the fractured concrete layer. The rubblization process costs more than crack/break & seat due to lower production rates and more required equipment and labor. These higher initial costs are typically more than offset by a longer pavement service life. However, when designing a project with a shorter desired pavement service life, the lower initial cost of crack/break & seat and less required asphalt thickness might make crack/break & seat the more economical option.

7. Local experience

If an owner, agency, engineer, or contractor has local experience with a fractured slab technique that has performed well for them in the past, that local experience should be taken into consideration when evaluating the next potential fractured slab and asphalt overlay project. Local subsurface conditions, existing concrete pavement conditions, weather conditions, traffic profiles, and typical asphalt pavement production and placement practices may lead to one of the fractured slab techniques being the best for the local conditions.

Another option: modified rubblization

The piece size acceptance criteria in rubblization specifications are generally met when rubblizing over subgrade/base providing fair to good support. At times it is impossible to meet these criteria when support is fair to poor. It is often counterproductive to try to achieve small piece sizes in these situations because the resulting rubblized concrete layer would not provide adequate structural support for the overlay. Experience has shown that a "modified rubblization" that employs less fracture energy in order to produce a somewhat stiffer rubblized concrete layer (larger concrete piece sizes) will maintain enough of the concrete layer's strength to support construction operations and the new asphalt overlay and still effectively eliminate reflective cracking.

Antigo defines modified rubblization as fracturing the concrete full-depth and uniformly across the pavement width resulting in piece sizes and surface appearance in two subcategories as shown below.

Modified rubblization – significant spalling:
Achieve 12-inch minus size pieces at the surface, significant surface spalling, and a surface appearance that ranges from smooth to pulverized. 75% of the pieces at the bottom of the slab shall be 15-inch minus in size.

Modified rubblization – occasional spalling:
Achieve 12-inch to 18-inch sized pieces identified with clearly visible cracks at the surface. Occasional surface spalling may occur.

A note on the range of fractured slab techniques

This document suggests things to consider when evaluating a potential fractured slab and asphalt overlay project with an emphasis on choosing between the range of fractured slab techniques. For purpose of clarity, the document addresses crack & seat, break & seat, and rubblization with these techniques' most common applications in mind. However, there are situations when a less common application may be appropriate. For example, one might choose to break & seat a JPCP to reduce the effective slab lengths more than when using crack & seat if conditions allow for this (e.g., no need torun traffic on the fractured surface, and site conditions allow for a thicker asphalt overlay).

Antigo's concrete breakers, the MHB Badger Breaker and the T8600 Badger Breaker, are uniquely able to produce the full range of concrete fracturing, from crack & seat which induces tight, hairline cracks with minimal surface spalling, to rubblization which transforms the slabs into small, fractured concrete pieces that function like a very high quality aggregate base.

Since its first crack & seat project in 1982, Antigo has completed 75 million square yards of crack/break & seat and 56 million square yards of rubblization through 2021. Please take advantage of that unmatched experience and contact Antigo if you would like to discuss the specifics of a potential fractured slab project.

What can Antigo do for you?

In addition to providing quotations and answering any questions you may have, Antigo is prepared to provide a wide range of information on concrete pavement rubblizing, cracking/breaking & seating, and breaking for removal. Examples of available materials are videos of various breaking processes and project scenarios, lists of owner and contractor contacts familiar with Antigo's capabilities, long-range pavement performance surveys, rubblizing and cracking/breaking & seating specifications, and project histories.

Antigo's experienced staff is always available to provide consultation to owners, engineers, and contractors as they plan concrete pavement rehabilitation and reconstruction projects.

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