Discussion of “Full Rubblization” & “Modified Rubblization”
Rubblization Defined

“The intent of rubblizing concrete pavement prior to a pavement overlay is to produce a structurally sound base which prevents reflective cracking by obliterating the existing pavement distresses and joints. . . . It is not a typical granular material and it is not an engineered material like crushed aggregate base course.”

From “Rubblizing Concrete Pavement” section of Wisconsin DOT Construction & Materials Manual
Obliterating the existing pavement distresses and joints
Rubblized Pavement Behavior

“A rubblized and compacted PCCP is an assemblage of PCC segments that form a tightly keyed, interlocked, high-density material layer. A rubblized PCCP layer is fractured, lacks continuity, and cannot sustain flexural stress. However, it possess high shear strength and rutting resistance. It is not a typical granular material.”

Professor Marshall Thompson inspecting rubblized pavement
Early Research

“In summary, the most significant concept relative to the philosophy of Fractured Slab Techniques, illustrated by Figure 62, is that in order to achieve the best possible performance at minimum cost, the fracturing process should yield an effective modulus as high as possible while satisfying the $E_{cr}$ criteria of having less than 5% of the project area exceed the critical threshold level of 1000 ksi.”

Early Research

Figure 62: Influence of PCC Fractured Modulus and HMA Overlay Thickness Upon Structural and Reflective Crack Failure
The previous slides describe the rubblized concrete layer and how its properties effect the performance of an asphalt overlay. Though the particle sizes of the rubblized concrete do not necessarily determine these properties, **ALL** rubblization specifications use particle sizes to define rubblization acceptance criteria. The required particle sizes vary by specification but the general emphasis is on achieving small particles. Very few specifications emphasize the concept of “producing a structurally sound base”.
The PCS/Law report emphasized the “significant concept” of rubblizing the concrete slabs to the degree necessary to achieve an effective modulus low enough to eliminate reflective cracking yet high enough to provide adequate support for the asphalt overlay.

The PCS/Law critical threshold of 1000 ksi was a provisional value back in 1991. The report states, “(F)uture studies pertaining to this parameter will hopefully lead to a more accurate assessment of the proper value to be used in design.” More recent FWD analyses typically report modulus values for the rubblized concrete layer in the 50 to 100 ksi range for typical 9 to 12-inch thick highway pavements.
Rubblization in Practice

The particle size acceptance criteria 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 particle 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 produces larger particle sizes that maintain enough of the concrete layer’s strength to support construction operations and the new asphalt overlay is still effective in eliminating reflective cracking.
Antigo uses the following descriptions to distinguish between “full rubblization” and “modified rubblization”:

1. “Full rubblization”: typical 2” minus particles at surface, 6” - 12” particles at bottom of slab
2. “Modified rubblization”: 12” minus particles on surface, significant surface spalling, surface appearance ranges from smooth to pulverized, 75% 15” minus particles at bottom of slab
“Full Rubblization”
“Modified Rubblization”
“Modified Rubblization”
“Modified Rubblization”
“Modified Rubblization”
WisDOT addresses “modified rubblization” in engineer guidance

“Attention must also be paid to constructability. Even if it is possible to produce small particle sizes, the resulting layer must still provide a working platform for paving operations and a stable foundation for the pavement overlay. In cases of isolated, very weak subgrade, subgrade correction may be appropriate. Another way to compensate for weak subgrade is to modify the rubblizing pattern to produce larger particle sizes which maintain more of the existing concrete pavement’s structural support. Experience has shown that segments of twelve to eighteen inches in the lower half of the slab are still effective for eliminating reflective cracking.”

From “Rubblizing Concrete Pavement” section of Wisconsin DOT Construction & Materials Manual
WisDOT addresses “modified rubblization” in rubblization specification

“The engineer may direct or allow larger maximum particle dimensions.”

From “Section 335 Rubblized Pavement” of Wisconsin DOT 2008 Standard Specifications
Intermediate base layer with weak subgrades

The majority of rubblization and asphalt overlay projects in Iowa have been constructed over subgrades providing low support. A “modified rubblization” pattern is typically chosen by the engineer. This situation has also commonly been addressed in the design phase by including an intermediate base layer of crushed stone or RAP on the rubblized layer prior to the asphalt overlay. This layer provides additional structural support and a uniform surface for the asphalt overlay.
Crushed stone layer over rubblized concrete
RAP layer over rubblized concrete
Airfield rubblization research recommends “modified rubblization” on marginal pavements

“On marginally stable and thin PCCP, the MHB offers the advantage of being able to lower the hammer drop height and separate the impacts (by increasing the speed) to allow the PCCP to be broken in a less aggressive manner that produces a more suitable surface for an HMA overlay. This “modified rubblization” technique with the MHB typically results in fractured concrete pieces larger than the sizing criteria normally allowed for rubblization, but still can provide full-depth fracture through the slab and a surface suitable for an HMA overlay.”

“The feasibility test at Tullahoma illustrated this technique.”

Tullahoma Airport test: “modified rubblization” pattern
Tullahoma Airport test: “modified rubblization” test hole
Research finds that rubblization & asphalt overlay performing well

3 recent studies of the pavement performance of rubblization and asphalt overlay projects found good performance and no evidence of reflective cracking:


