About Rubblization

Reflective cracking is a well-documented phenomenon. It occurs in pavement overlays that were placed over unprepared PCC pavements in poor condition. PCC pavements expand and contract as pavement temperatures increase and decrease. As the joints open they induce tension on the bottom of the asphalt overlay. When the tensile stress exceeds the strength of the asphalt overlay, a crack is initiated in the HMA layer at the PCC interface. The cracks will ultimately propagate to the surface. Left unsealed, the crack will allow moisture into the aggregate base and subgrade resulting in premature failure. Additionally, differential deflection between the approach and departure slabs creates shear stresses that also cause reflective cracking.

The amount of deflection will vary based on the condition of the load transfer units and whether there are voids under the PCC pavement at the transverse joint. The old rule of thumb held that a reflective crack will progress upward through a pavement at the rate of 1 inch per year, however experience has shown that under severe conditions, a reflective crack can reach the surface of a 150-mm (6-in.) overlay in less than one year.

Rubblization is defined as: *breaking the pavement into pieces having a nominal maximum size of 75 mm (3 in.) or less above and 200 mm (8 in.) or less below any reinforcement.* Reinforcement steel within a PCC pavement dissipates a breaker's energy resulting in larger pieces below it. It is essential to debond any steel within the PCC pavement, and both the resonant pavement breaker and the multiple head breaker have shown the ability to achieve adequate debonding. Acceptable pavement rubblization and debonding is achieved when the particle size requirements are met.

The rubblizing process involves the following:
- Remove any existing overlay.
- Install the drainage system (schematic) 2 weeks (minimum) prior to rubblizing the pavement.
- Saw-cut the full thickness of the pavement adjacent to remaining sections.
- Rubblize the PCC pavement.
- Cut and remove exposed steel reinforcement.
- Proof roll fractured PCC.
- Remove and replace soft areas.
- Roll the rubblized PCC at least three passes.
- Place the HMA leveling course and overlay.
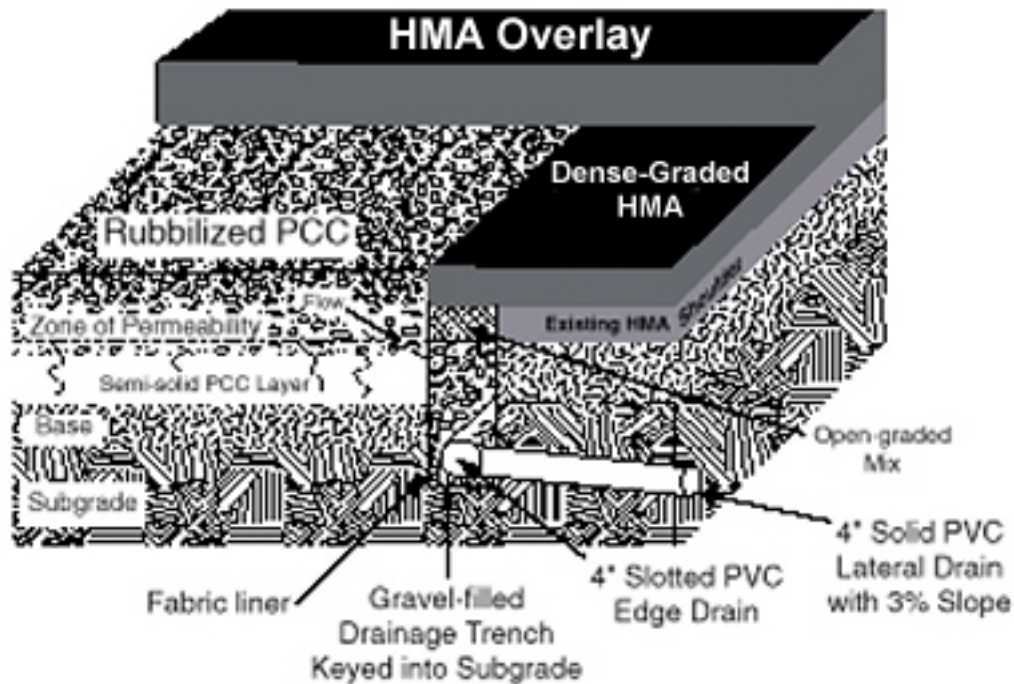
Drainage System Schematic

Complete evaluation of the existing PCC pavement must be made prior to selecting the appropriate rehabilitation technique. Included in the assessment would be percentage and type of steel reinforcement, condition of the existing slabs, differential deflection between slabs, degree of faulting of jointed slabs, environmental conditions, thickness, drainage conditions and estimated future traffic loads. When the evaluation indicates that either JRCP or CRCP are in a deteriorated condition, rubblizing provides the designer with another alternative for properly preparing the PCC for a hot mix asphalt overlay. The rubblizing process reduces the slab to an excellent granular base for the overlay and *eliminates all reflective cracking concerns*.

Rubblizing the PCC pavement however, obviously reduces the structural support of the existing pavement for the overlay. It causes the concrete to perform as a flexible but interlocked system. There is a direct relationship between the back-calculated effective modulus (E_f) of the pavement section and the overall effectiveness of the fracture process in reducing the effective slab modulus and slab action. Sections with stiffer underlayers require more energy from the cracking process to achieve a given level of desired E_f. The lower the E_f, the more efficient the fracture process, thus reducing the potential for future reflective cracking in the HMA overlay.

Studies have shown that the probability for reflective cracking decreases with decreasing effective modulus and increasing overlay thickness. However, because the structural capacity of the concrete is also diminished, the probability for structural failure increases, requiring additional overlay thickness to overcome this loss. Therefore, at any given overlay thickness, there is a critical range of E_f where the probability for both kinds of failure is minimized.
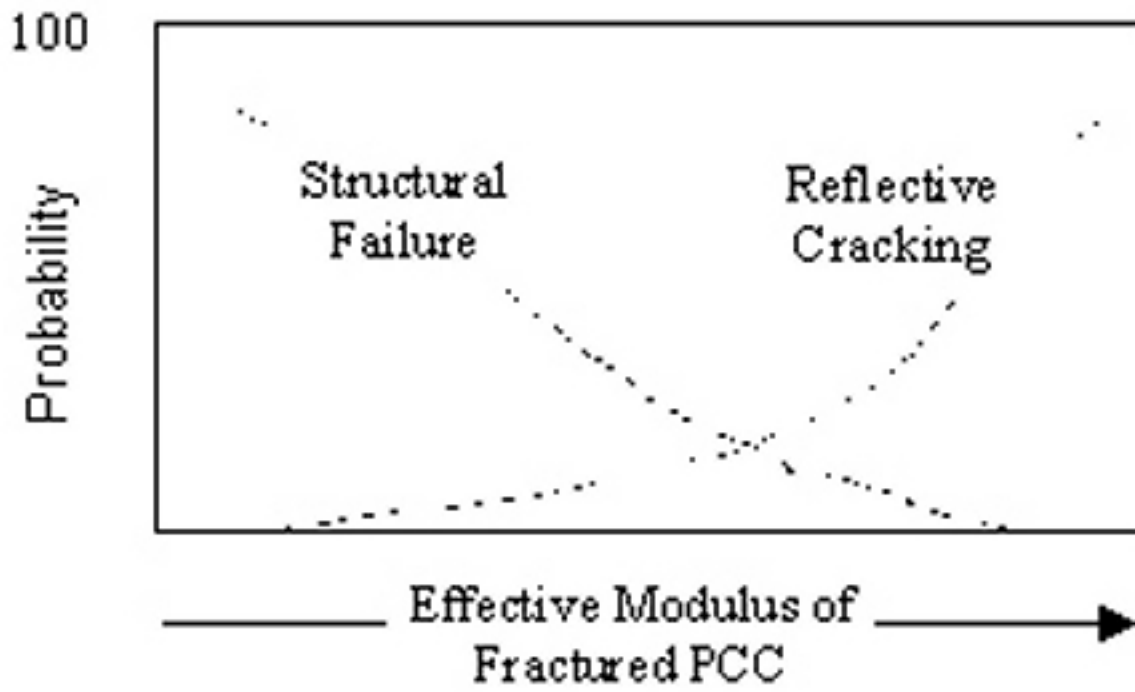
Figure 1 – Critical Range of Moduli