Unbonded Concrete Resurfacing of Asphalt Pavements

—previously called conventional whitetopping—

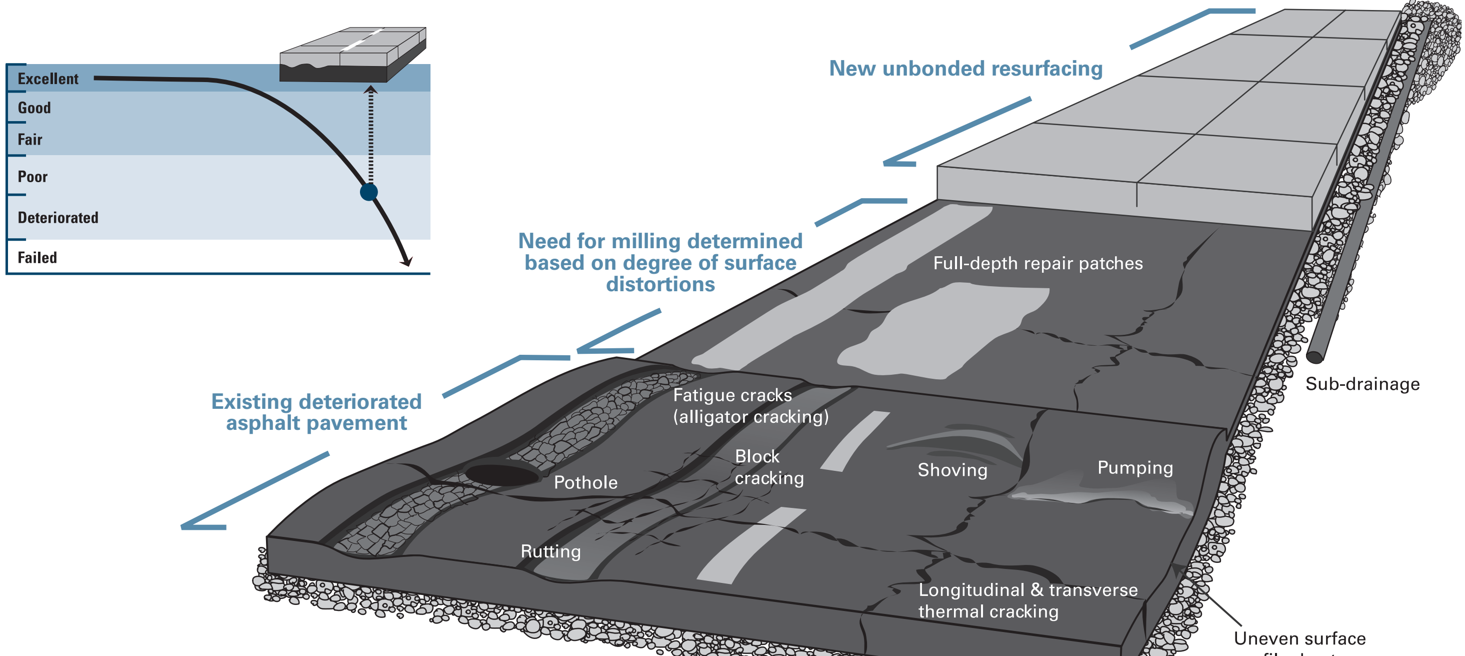

Figure 5. Unbonded concrete resurfacing of poor-to-deteriorated condition asphalt pavement

Uses

Unbonded concrete resurfacing is an excellent rehabilitation option for asphalt pavements that exhibit significant deterioration such as severe rutting, potholes, alligator cracking, shoving, and pumping. When properly designed and constructed, the unbonded resurfacing will increase the load-carrying capacity and extend the pavement life significantly.

This type of resurfacing is designed essentially as a new concrete pavement on a stable base course, assuming an unbonded condition between the layers. Unbonded concrete resurfacing projects are typically 4–11 in. (10.2–27.9 cm). Unbonded resurfacing can be designed as jointed plain concrete pavements (JPCP) or continuously reinforced concrete pavements (CRCP).

Unbonded concrete resurfacing typically does not require extensive preoverlay repairs, but spot repairs of certain severely deteriorated areas may be necessary to minimize the risk of localized failure in the resurfacing.

Performance

Unbonded resurfacing of asphalt pavements has been successfully used in many states, with over 30 years of good to excellence performance in states such as California and Iowa. Uniform base support is an important factor affecting performance. Though this resurfacing type does not rely on bonding, some partial bonding between the resurfacing and existing asphalt pavement can contribute to better performance of the pavement.

Resurfacing Process

STEP 1. PAVEMENT EVALUATION

An evaluation of the existing asphalt pavement is necessary to ensure it is a good candidate for an unbonded resurfacing; to identify what, if any, pre-resurfacing repairs are necessary; and to determine key inputs to the resurfacing design. A visual distress survey should be conducted and cores should be taken. On high truck volume roadways, falling weight deflectometer (FWD) testing should be considered to aid in the analysis.

The evaluation establishes whether the existing asphalt and its subbase can provide a uniform platform for the unbonded resurfacing and, if not, what actions are necessary to obtain that uniformity if an unbonded resurfacing is to be used. In addition, the evaluation determines the existing pavement's structural contribution as a stable base. The foundation support value should be determined to establish a thickness design that accounts for the contribution of the asphalt layer and its subbase.

STEP 2. RESURFACING DESIGN

Unbonded resurfacing is designed similarly to new concrete pavements on a stable base, assuming an unbonded condition between the layers. The asphalt serves as a stable base and contributes to the load-carrying capability of the unbonded resurfacing through increased bending stiffness of the resurfacing. The AASHTO Design Guide 1993 provides an approach to assessing the potential structural contribution of the existing asphalt to the unbonded resurfacing.

Resurfacing Thickness

Unbonded resurfacing thicknesses typically range from 6 to 11 in. (15.2 to 27.9 cm) when placed on primary roads and as thin as 4 in. (10.2 cm) on low-volume roads. The required resurfacing thickness is affected by the desired load-carrying capacity and service life, as well as the condition of the asphalt base.

The thickness can be determined using an established design procedures for new concrete pavements, such as the AASHTO Design Guide 1993 and the ACPA StreetPave program. In addition to these procedures, ACPA has developed simple design charts to help determine the unbonded resurfacing thickness design. Using these charts, the overlay slab thickness is determined based on the number of trucks per day, the concrete's flexural strength, and the base's *k*-value.

Mixture Design

Conventional highway mixtures are typically used in unbonded resurfacing of deteriorated asphalt. These mixtures can be used with accelerator admixtures to provide the early strength required

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to place traffic on the resurfacing within a short time period. Early opening can also be aided by use of maturity measurements.

Joint Design

The load transfer design is the same as for new concrete pavements. Doweled joints are used for unbonded resurfacing of pavements that will experience significant truck traffic, typically pavements 8 in. (20.3 cm) and thicker.

A maximum joint spacing in feet of 2 times the slab thickness (6 in. [15.2 cm] or greater) in inches is often recommended for unbonded resurfacing. A 6 in. (15.2 cm) resurfacing would thus receive 12 ft (3.7 m) joint spacing. The maximum recommended spacing is typically 15 ft (4.6 m). For pavements less than 6 in. (15.2 cm) thick, the maximum spacing in feet is 1.5 times the slab thickness in inches.

Drainage Design

Properly designed, constructed, and maintained edge drains help reduce pumping, faulting, and cracking. When an asphalt separator layer is used, adequate drainage may be important to minimize stripping due to pore pressure.

Designing Different Sections

Portions of a project with significantly different existing pavement and subbase conditions can be broken into separate sections and designed to specifically address those given conditions.

Table 6. Possible pre-resurfacing repairs for unbonded resurfacing of asphalt pavements

Existing pavement condition	Possible repairs to consider
Area of subgrade failure	Remove and replace with stable material
Severe distress that results in variation in strength of asphalt	Remove and replace with stable material
Potholes	Fill with lean or plain concrete or asphalt
Shoving	Mill
Rutting ≥ 2 in. (5.1 cm)	Mill
Rutting < 2 in. (5.1 cm)	None or mill
Crack width ≥ 4 in. (10.2 cm)	Fill with lean concrete or flowable fill
Crack width < 4 in. (10.2 cm)	None

STEP 3. PRE-RESURFACING WORK

Pre-resurfacing Repairs

Unbonded resurfacing generally requires only minimal preoverlay repairs of the existing asphalt. If significantly distressed areas are not shifting or moving and the subbase is stable, costly repairs typically are not needed, particularly with an adequately designed resurfacing. See table 6.

Direct Placement

Direct placement without milling is recommended when rutting in the existing asphalt pavement does not exceed 2 in. (5.1 cm). Any ruts in the existing pavement are filled with concrete, resulting in a thicker resurfacing above the ruts.

Milling

If surface distortions in the existing pavement are 2 in. (5.1 cm) or greater, milling may be considered. The two main objectives of milling prior to unbonded resurfacing are (1) to reduce high spots to help ensure minimum resurfacing depth and (2) to remove significant surface distortions that contain fractured asphalt material. Spot milling of only the parts of the project with significant distortion is often adequate. Over-milling is not recommended since it reduces the structural value of the pavement.

The amount of asphalt removal depends on the types and severity of distresses and the quality of support. Usually 1–2 in. (2.5–5.1 cm) is removed. It is not necessary to completely remove ruts, but it is recommended that milling leaves less than 1 in. of distortions. No special effort is required to encourage bonding between the resurfacing and the underlying asphalt surface.

Surface Cleaning

Before concrete placement, the asphalt surface should simply be swept. Remaining small particles are not considered a problem.

STEP 4. CONSTRUCTION

Concrete Placement

When the surface temperature of the asphalt is at or above 120°F (48.9°C), surface watering can help reduce the temperature and minimize the chance of fast-set, shrinkage cracking. No standing water should remain on the surface at the time of resurfacing.

Conventional concrete paving practices and procedures are followed for placing, spreading, consolidating, finishing, and curing the unbonded resurfacing. Because of the variation of the thickness of concrete, the concrete material is bid on a volume (cubic-yard) basis. Some states also include a bid item for placement, measured on a square-yard basis.

Joint Sawing

Timely joint sawing is necessary to prevent random cracking. Transverse joints can be sawed with conventional saws to a depth of between T/4 (min.) and T/3 (max.). When there is evidence of some wheel rutting on the existing asphalt pavement, saw-cut depth is of particular concern for unbonded resurfacing because the distortions in the underlying asphalt pavement can effectively increase the slab thickness (see figure 6). Transverse joint saw-cut depths for early-entry sawing should not be less than 1¼ in. (3.2 cm). Longitudinal joints should be sawed to a depth of T/3.

Future Repairs

The recommended repair option for unbonded resurfacing is full-depth repair of distressed areas.

Key Resources

ACI Committee 325 (2006), FHWA (2002a), and ACPA (1998)

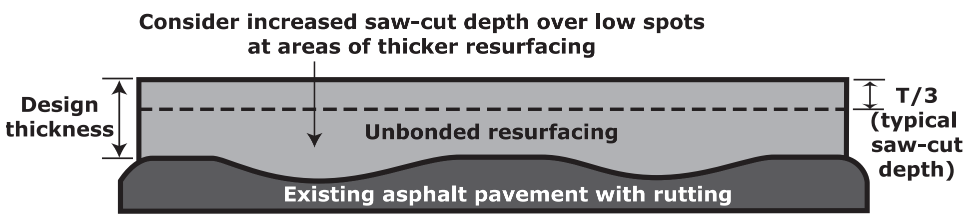

Figure 6. Consider asphalt rut depth when determining saw-cut depth (ACPA 1998)

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