

# Hitting Rock Bottom: Subgrade and Base Repair for Paving “4R” Projects

By Michael E. Duval, P.E.

**F**eel like your pavement can't handle the stress anymore? Is one more truckload going to crack your resolve? Look no further than the very foundation on which it was built. That's right, you have to start at the bottom. Extending the life of a pavement system in the most cost-effective manner is the objective of pavement “4R” work (Resurfacing, Restoration, Rehabilitation, and Reconstruction). To meet this objective, start off with a pavement condition survey—or Distress Survey—to evaluate failure type, severity, and extent of damage. Evaluating the present condition of the base and subgrade is a critical part of the process. Make sure to take into account effects of existing pavement layers on behavior and performance of the rehabilitated pavement system.

## Understanding Your Failures

“How did I get here?” you may ask. Failures may be “built in” during the initial construction phase, or they may develop after a period of time due to traffic overloading, inadequate drainage, frost heave, or other external factors. Controlling the construction process can substantially reduce subgrade and base imperfections and, through careful design, the harmful effects of traffic and environmental factors can be minimized.

Base and subgrade evaluations include an analysis of design assumptions, limited subsurface investigations, and a selection of appropriate

subgrade properties. Unlike homogeneous materials like steel, it is difficult to assign one strength or stiffness value to a subgrade material. Soil properties vary along the length of the project, resulting in the need for proper engineering judgment. The engineer must account for the changes in moisture, density, and environmental influences. The overall evaluation must determine the ability of in-place materials to satisfy strength and deformation requirements over the life of the refurbished pavements, as cited by the Federal Highway Administration.

## Seeking Help

“Where do I go for help?” Look no further than your own written documentation or work done previously by others. Sources of information that may be used for determining soil properties and original design parameters for the subgrade and base include previous engineering geotechnical reports, the project design drawings, test reports, and county or USDA Soil Reports. Additionally, destructive and nondestructive testing may be necessary to determine the present condition of each pavement layer and to predict the remaining life of the pavement structure.

## Rebuilding the Foundation

You may ask, “How bad is it?” To determine the repairs, you first have to find out the extent of the damage. In some cases, patching localized failures will be all that is required to restore the pavement to an acceptable service level. The failed pavement and base should be removed so that the limits of the excavation are in good, sound material. The subgrade soil can be stabilized as necessary to improve strength and drainage, or it may be over-excavated to remove saturated or soft material. For rigid pavements, the American Association of State Highway and Transportation Officials recommends that new concrete should be placed full depth, without the addition of any new base material. For flexible pavements, replace the base with concrete. In both cases, the subgrade soil should be excavated a minimum of 6 in. below the base and extend under the bottom of the remaining base a minimum of 6 in.; this undercutting, when filled with new



*Well designed, well placed, relatively crack-free pavement*

concrete, will provide a more stable patch and better load transfer across the patch joints.

Patching of these failures is generally considered a “band-aid” approach to pavement rehabilitation, unless the failure is truly isolated. Pavement problems usually tend to be more extensive and therefore require more extensive rehabilitation strategies. In resurfacing solutions, failures are patched prior to constructing the overlay. In this way all detectable subsurface problems may be corrected. However, earlier failures and weak areas, which remain undiscovered, might be overlooked in the rehabilitation project.

Only in recycling and reconstruction alternatives can extensive work be accomplished to stabilize the subgrade and provide required drainage along the entire project length. While these are usually the most costly repair alternatives, they essentially provide a brand new pavement that will have relatively low maintenance costs for many years.

## Successful Rehabilitation

Once the owner—with the engineer’s counsel—has chosen the most cost-effective, feasible alternative, final design begins. During this process, the engineer must keep in mind that the subgrade should provide an all-weather working platform during construction of the base and pavement surface courses. For both subgrade stabilization and base construction, proper equipment and construction methods are fundamental to quality project results. Quality control is another essential ingredient to ensure desired project results. Materials testing alone is not sufficient to achieve this end. Full-time construction monitoring by a qualified, knowledgeable observer is critical to the project success.



*Common pavement crack pattern*



*Failure of pavement patch*



*Severe cracking of pavement and patch*



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