NEVADA TRANSPORTATION T2 CENTER

StreetWise

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FULL-DEPTH RECLAMATION WITH CEMENT SAVES MONEY AND NATURAL RESOURCES

Recycles failed asphalt roads into strong and durable pavement base

When asphalt pavements fail, determining the best rehabilitation procedure can be difficult. A simple asphalt overlay or a "mill and fill" approach can improve the appearance of the pavement surface but may do little to correct the underlying problems that caused the failure in the first place. Within a short period of time the problems will likely reappear.

Long-term solutions to failed asphalt pavements include a thick structural overlay or complete removal and replacement of the existing base and asphalt surface. Both methods can be very expensive and wasteful of virgin aggregates.

A third choice, recycling the failed asphalt pavement through a process called full-depth reclamation (FDR), using portland cement, can provide the benefits of reconstruction without the substantial costs and environmental concerns.

This procedure pulverizes the existing asphalt and blends it with underlying base, subbase and/or subgrade materials, which are mixed with cement and compacted to provide a new stabilized base. A new surface is then applied, which completes the FDR process, providing a new roadway structure using recycled materials from the failed pavement.

Because of cement stabilization, the new base will be more uniform, stronger and provide better long-term performance than the original pavement.

"Characteristics of asphalt rehabilitation strategies" complete chart on page 2

The cost advantages of recycling materials from the original pavement are obvious. However, there are other environmental advantages that are important to the FDR process:

- Conservation of new aggregates that must be quarried and transported to the site.
- Conservation of land areas that would be used to dispose of the asphalt and base materials from the failed pavement.
- Reduced air pollution, traffic congestion and damage of nearby roadways resulting from hauling new materials to the site and disposal of old materials.

Determining when FDR is appropriate

FDR is most appropriate under the following conditions:

- The pavement is seriously damaged and cannot be rehabilitated with simple resurfacing.
- The existing pavement distress indicates that the problem likely exists in the base or subgrade.
- The existing pavement distress requires full-depth patching over more than 15 percent to 20 percent of the surface area.
- The pavement structure is inadequate for current or future traffic.

Serious damage or base failure

An engineer can evaluate the reasons for pavement failure by observing the types of distress that are visible. For example, alligator cracking, deep depressions or soil stains on the surface are all signs of base or subgrade problems in the pavement structure.

Excessive patching

Although patching is often necessary to keep a road serviceable, it can be expensive. In fact, once the area of full-depth patching exceeds 15 –20 percent, simple math proves it less expensive to use FDR than to perform the patching. Of course, the final product achieved with FDR is far superior to a road that is severely patched.

Inadequate pavement structure

Often the traffic patterns on a road will change over the years. This sometimes results in roads that originally were constructed for light traffic but are now significantly under-

Continued on page 2

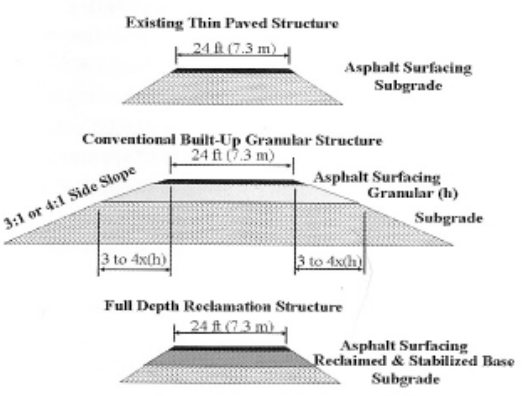
Characteristics of Asphalt Rehabilitation Strategies		
Solution	***Advantages***	***Disadvantages***
Thick Structural Overlay	• Provides new pavement structure • Quick construction • Only moderate traffic disruption	• Elevation change can present problems for existing curbat gutter and overhead clearances • Large quantity of material must be imported • Old base/subgrade may still need improvement • High cost alternative
Removal and Replacement	• Provides new pavement structure • Failed base and subgrade are eliminated • Existing road profile/elevation can be maintained	• Long construction cycle requiring detours and inconvenience to local residents/businesses • Increased traffic congestion due to detours construction traffic • Rain or snow can significantly postpone completion • Large quantity of material must be imported • Old materials must be dumped • Highest cost alternative
Full-depth reclamation with cement	• Provides new pavement structure • Fast construction cycle • No detours • Minimal change in elevation, thus eliminating problems with curb/gutter, overhead clearances • Minimal material transported in or out • Conserves resources by recycling existing materials • Local traffic returns quickly • Rain does not affect construction schedules significantly • Provides moisture • Provides moisture and frost-resistant base • Least costly alternative	• May require additional effort to correct subgrade problems • Some shrinkage cracks may reflect through bituminous surface

Continued from page 1

designed for existing and future traffic loads.

When this happens, a road often is "built up" by increasing the thickness of the existing pavement structure. However, increasing the pavement thickness also requires building up and extending the shoulders because a reasonable shoulder slope needs to be maintained for safety. This can require significantly more right-of-way.

An alternative exists with FDR where the pavement can be strengthened by "building the pavement down." By reclaiming the existing pavement into a stabilized base, the road is strengthened without the requirement of more right-of-way.



Using FDR to "build the pavement down"

Special considerations when using FDR

Because the pulverized asphalt from the existing pavement (called reclaimed asphalt pavement, or RAP) is blended with the underlying base materials, the thickness of reclaimed asphalt cannot exceed the depth of reclamation for an extended length (short sections of full-depth asphalt, like a patch, are allowed).

If a long section of thick asphalt is selected for reclamation, the asphalt layer can be partially milled and the RAP stockpiled for future use. The remaining asphalt in the old pavement is then reclaimed and blended with the base.

Another consideration when evaluating FDR is the existence of large rocks (larger than 4 inches in diameter) in the base or subgrade. If this material is within the depth of reclamation, the costs of reclaiming may be higher because the contractor must take into account the slower and more difficult construction that is posed by the rocks.

Design and construction: Simple and fast

The basic procedure is simple. The complete recycling process can be finished in one day, and traffic can be maintained throughout construction. The procedure includes the following steps:

Site investigation

The site should be investigated to determine the cause of failure. Core samples or test holes should be used to determine layer thicknesses and to obtain samples of

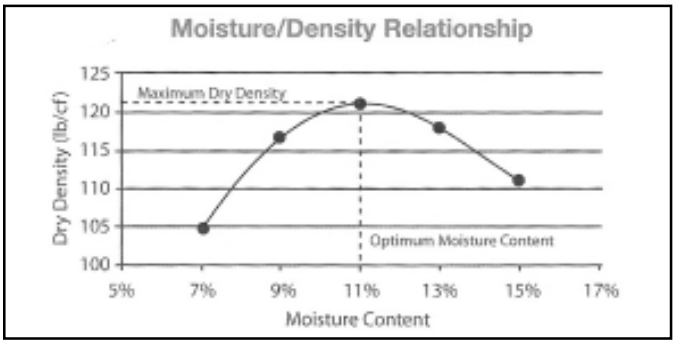
the material to be recycled. Material sampling should include the asphalt surface, base course aggregate and subgrade soil.

Thickness design

Pavement thickness can be determined by using the Portland Cement Association's *Thickness Design for Soil-Cement Pavements*. Other methods, such as the American Association of State Highway and Transportation Officials' *Guide for Design of Pavement Structures,* also can be used.

Laboratory evaluation

Material samples from the site should be pulverized in the laboratory to create an aggregate-soil mix that will be similar to that expected from the reclamation process. The mix design procedure is the same as that performed for soil cement. This includes the determination of maximum dry density and optimum moisture content. If unconfined compressive strength is used to determine cement content, a seven-day strength of 300 to 400 psi (2.1 to 2.8 Mpa) is recommended.



Determining the maximum dry density and optimum moisture content

Construction

The construction process for full-depth reclamation is straightforward. It requires the following equipment:

- pulverizer/mixer
- cement spreader
- roller
- grader
- water truck

Pulverizing

The process begins by pulverizing the existing asphalt pavement. As discussed earlier, the depth of pulverizing should be more than the thickness of the existing asphalt.

Modern equipment can pulverize to depths exceeding 18 inches, but the difficulty lies with getting compaction deeper than 12 inches. If the depth of pulverization exceeds 12 inches, then the material should be windrowed and compacted in two lifts after treatment.

Pulverization can occur safely in urban areas with curb and gutter, manholes and valve covers. The manholes, valve covers and other buried obstructions are removed below the depth of the pulverization.

Wooden or steel plates are used to cover and protect the structures during the processing operation. More than one pass of the pulverizing equipment may be necessary to achieve the required gradation.

Grading, shaping and widening

Once the existing roadway has been pulverized and blended together, the material is graded to the desired elevation and shape. When working between the curb and gutter, there may be a need to remove some of the pulverized material and haul it away in order to leave room for the pavement surface layer.

When the reclaimed road is being graded, it is an ideal time to make improvements to the road crown, grade, drainage and super elevation because after stabilization the improvements will be permanent. It is also an excellent time to perform road widening. Stabilizing the entire roadway creates uniformity of the pavement base that greatly reduces maintenance compared to roads that are widened without being reclaimed.

Cement placement

Often following grading and shaping, the pulverized material will be compacted to accommodate traffic during construction and improve uniformity for subsequent cement placement and mixing operations.

Usually cement is spread in a controlled manner by spreader trucks that are designed for this operation. Placing the cement in an uncontrolled manner by blowing under pressure should be avoided.

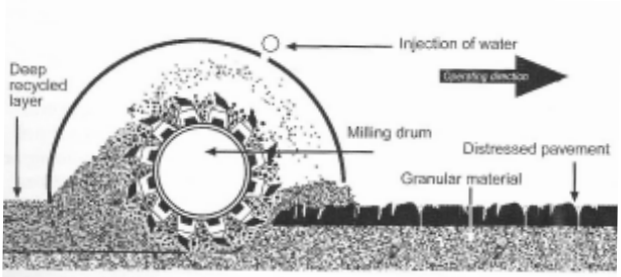
Cement is most commonly applied dry but also can be applied in a slurry form. Most specifications call for the application of cement in terms of weight per area (e.g., pounds of cement per square yard).

The most important time for dust control is when cement is poured on the ground. Special enclosures can be used to minimize the amount of dust when cement is applied. Except for very windy days, dust should not be a problem once the cement is on the ground.

With a slurry application, it is necessary that the slurry be dispersed uniformly over the placement area so that it will not pool or run off in any manner.

Mixing

Mixing is performed by the declaimer either by injecting the proper amount of moisture into the mixing chamber or by placing water on the ground with a water truck in a separate operation (diagram on the back page). In either case, obtaining the correct amount of moisture is very important in achieving the target compaction.



Inside a declaimer

Compaction and final grading

After the materials are well mixed, it is time for compaction and final grading. Smooth-wheeled vibrating rollers or tamping rollers can be used to provide initial compaction. Smooth-wheeled or pneumatic-tire rollers can be used to complete the operation. Once the cement is mixed with water and the pulverized base material, the maximum time allowed for compaction is two hours.

Curing

Proper curing is very important to the quality of the final product. If the base is allowed to dry, it will develop cracks, and the continued gain in strength over time will be compromised.

The cement-treated base must be kept moist a minimum of seven days following compaction. Proper curing can be achieved by continuous water spraying or application of an approved sealing compound or membrane. If the road will have an asphalt surface, a bituminous prime coat can be applied at any time. It will act as a curing membrane.

Surfacing

The cement-treated base (CTB) that results from the FDR process can have any type of pavement surfacing (e.g., chip seal surface treatment, hot mixed asphalt or concrete). The surfacing can be applied as soon as the CTB is stable (does not rut or shove) under construction traffic. The time required for this can range from four to 48 hours.

Traffic can be placed on the CTB in the same time frame as long as repeated applications of heavy trucks are not involved. In many cases with low-volume roads, traffic is allowed to run on the compacted base until the project is ready for surfacing. For conditions where heavy truck traffic is involved, up to seven days may be required to make sure the base has gained sufficient strength for a high volume of heavy trucks.

For additional information, contact the Nevada T² Center at the address shown below.

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