

# Full Depth Reclamation In Idaho

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## ABSTRACT

In the mid 1990's Idaho Transportation Department (ITD) was struggling with more and more roadways falling into the poor condition category. Years of overlays had left our system with thick pavements and the intrusion of fine material from the subgrade contaminated the base material resulting in weakened base and subbase and large transverse cracks at a regular frequency. In 1994 ITD constructed its first Full Depth Reclamation project using cement as the stabilizing agent. ITD called this process Cement Recycled Asphalt base Stabilization or CRABS. This process was based on the Roadbed Modification process of Nevada DOT. The CRABS process has allowed ITD to improve our roadway ratings by turning thick cracked pavement with little support back into flexible pavements with a uniform stabilized base. ITD requires the Contractor to pulverize all of the asphalt pavement and a small amount of the underlying base and typically mixes in 2% cement by weight of pulverized material into the reclaimed material. ITD collects Falling Weight Deflectometer, FWD data on candidate roadways and uses a mechanistic-empirical design process to determine the CRABS layer thickness and the overlay thickness required to achieve the design life. ITD has constructed nearly 3500 lane miles of CRABS in the past 20 plus years far exceeding other types of Full Depth Reclamation processes and additives.

## DESIGN

ITD developed a process to analyze the existing pavement condition and design a cost-effective solution using mechanistic-empirical methods.

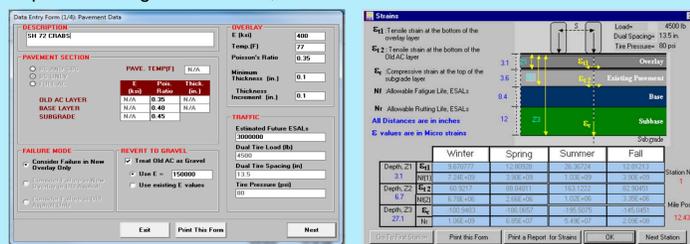
- Collect FWD data on candidate roadways



- Modulus 6 developed by Texas Transportation Institute for Texas DOT to determine the modulus of all the layers

Station	Subgrade	Base	Subbase	AC	ESALS															
0+00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+10	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+20	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+30	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+40	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+50	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+60	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+70	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+80	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
0+90	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0
1+00	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0

- Winflex 2006 a mechanistic-empirical design program developed by the University of Idaho for ITD. A file is created with data from Modulus 6 that is used by Winflex to determine the overlay thickness based on the desired CRABS modulus and thickness. Winflex calculates the tensile strain at the bottom of the overlay and the compressive strain at the top of the subgrade and it determines the allowable fatigue life of each layer in Equivalent Single Axle Loads, ESALs.



- The CRABS design is based on the requirement that all of the existing pavement is pulverized to remove all cracks and mix in a small amount of clean underlying material.
- The material is reduced to a 3-inch maximum particle size and portland cement is added at the rate of 2% by weight of pulverized material.
- The cement is thoroughly mixed into the pulverized material and the moisture content is maintained to ensure full hydration of the cement and compaction is completed full depth of the CRABS layer.
- If any of these do not happen, the strength of the CRABS layer will be reduced and the design life will be compromised.

## SPECIFICATION

ITD created a Supplemental Special Provision, SSP to describe the work, materials, construction requirements, method of measurement and basis of payment for the contractor to bid on. (the Description and Materials portions shown here) Along with a Typical Section, shown below, these convey the necessary information for the Contractor to bid on and construct the project.

### S.S.P. 308 - CEMENT RECYCLED ASPHALT BASE STABILIZATION (CRABS)

**- Description.** This work shall consist of recycling the roadway to the full thickness of existing pavement and a portion of the base layer in accordance with these specifications and in reasonably close conformity with the lines, grades, thicknesses, and typical cross sections shown on the plans or as established.

**Classification.** One of the following CRABS Classes shall be used for the purpose of grade control as specified in the plans.

CRABS Class I shall include the work described in this specification with Class I grade control requirements and field-established elevations.

CRABS Class II shall include the work described in this specification with Class II grade control requirements and with the elevations established.

**- Materials.** Materials shall conform to the requirements specified in the following sections and subsections:

Portland Cement.....Section 701  
Emulsified Asphalt.....Subsection 702.03

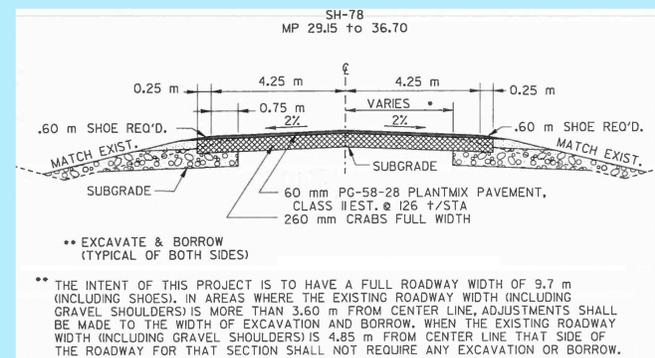
**Acceptance of Portland Cement.** Portland Cement for CRABS will be accepted by certification. Each shipment shall be accompanied by a certificate of compliance and by a copy of the mill test report applicable to the material in the shipment.

At least one sample will be taken from the cement supplied to the project and forwarded to the ITD Central Laboratory for testing to verify the certification.

**Water.** The water source shall be as approved. Water shall be reasonably clear and free from oil and other contaminants.

**Testing.** Density Tests shall be performed using an uncorrected nuclear gage in accordance with the following Standard method.

In-Place Density of Bituminous Mix Using the Nuclear Moisture Density Gauge  
.....WAQTC TM8 Method B, (Direct Transmission only)



This specification is significantly influenced by traffic control considerations. Maintaining traffic during construction affects the contractor's production rate and operation.

## CONSTRUCTION

ITD has determined over the years that the CRABS process is very sensitive to construction technique. The Contractor pulverizes the existing pavement plus some of the base material and introduces enough water into the process to maintain near optimum moisture content and to reduce dust. Next they shape and compact the pulverized material to reduce the volume swell caused by pulverizing. Cement is placed on the pulverized surface at the prescribed rate and it is thoroughly mixed to the design depth. Water is added to ensure the cement is hydrating and the surface is compacted and shaped. The photos below show pulverizing existing pavement, mixing cement, and final rolling respectively.



The pulverized material swells and it is very important to make sure that material stays on the road and is not bladed to the shoulder. The photo below shows CRABS material bladed to the shoulder.



## RESULTS

ITD has used Full Depth Reclamation using cement as the additive for over 20 years. During that time we have constructed nearly 3,500 lane-miles with great success. We have used CRABS for both interstate highways and very low volume roads. Most of them were overlaid with asphalt pavement but we have reconstructed a section of the interstate with concrete after reclaiming the existing asphalt pavement.

Most overlays of the FDR consisted of 2.5 to 3.5 inches of asphalt pavement and 6 to 8 inches of asphalt on the interstate.

Below are two roads that were cement stabilized and were about 10 years old at the time of the photos. The road on the left has low moisture and low traffic. The road on the right has poor drainage and ESALs were underestimated resulting in fatigue damage.

