

POLYMER EPOXY OVERLAY ON CONCRETE BRIDGE DECK

**Presented by
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Epoxy

- Epoxy is a thermosetting polymer formed from reaction of an epoxide “resin” with polyamine “hardener”. Epoxide (resin) materials have high strength and low shrinkage during curing. Epoxy is generally used as an adhesive and suitable for bonding porous & non-porous materials.
- Based on the nature of bridge crack repairs, epoxy can be used as (1) Epoxy Overlay and (2) Epoxy Injection.
- Epoxies have been in use in the US for over 40 years as concrete bridge deck overlays.

Bridge Deck Showing Epoxy Overlay



Bridge Pier Wall Showing Epoxy Injection

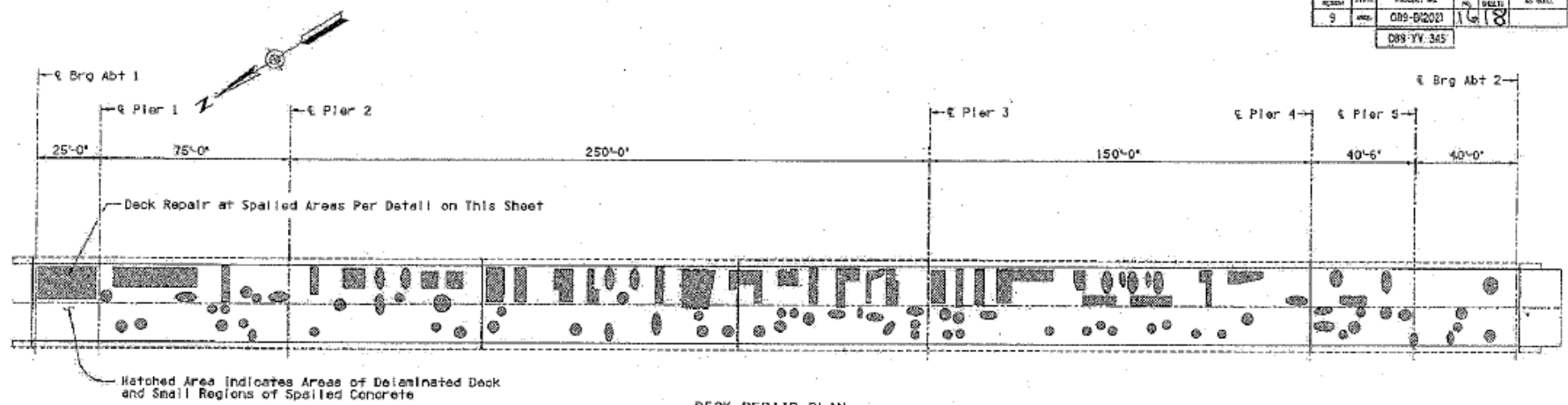


**Hell Canyon Bridge, AZ
on SR89 at MP 345.68
Structure #483**

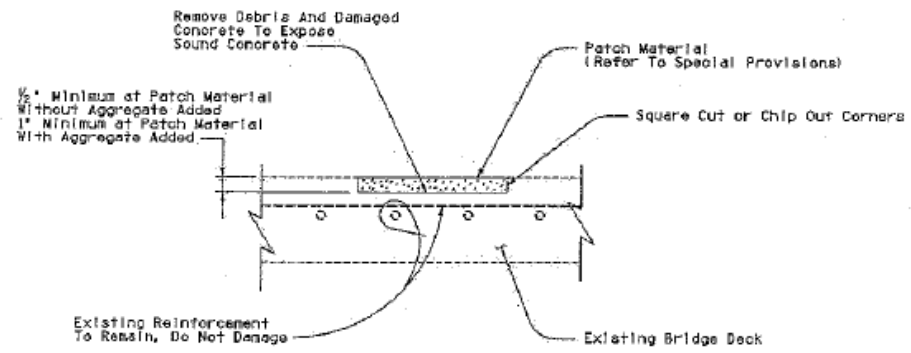


Deck Repair Plan

PROJECT NO.	DATE	PROJECT NO.	DATE	BY
SR 89	345.68	483	16	18
089-YV-345				



DECK REPAIR PLAN
Scale: 1" = 20'-0"



DECK REPAIR DETAIL
Not To Scale

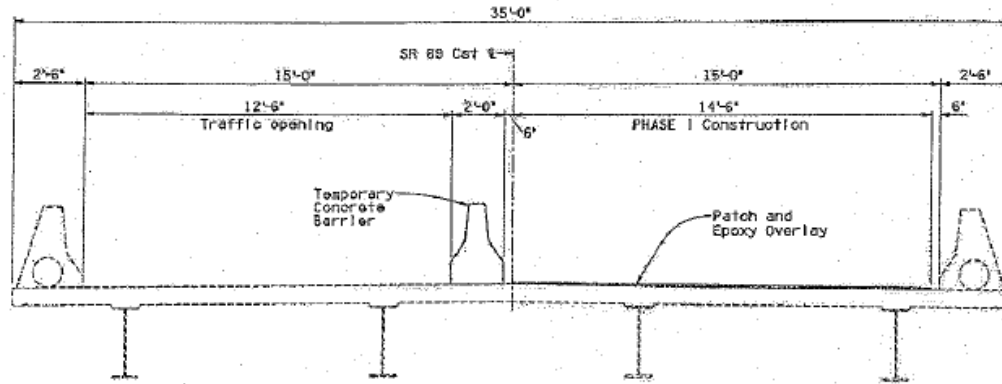
NOTES:

1. Drawing is based on preliminary deck observation on 2/12/08. Several areas as shown indicate delamination of concrete deck.
2. Repair work will be performed under a Force Account. Engineer will determine areas and extent of repairs during construction.

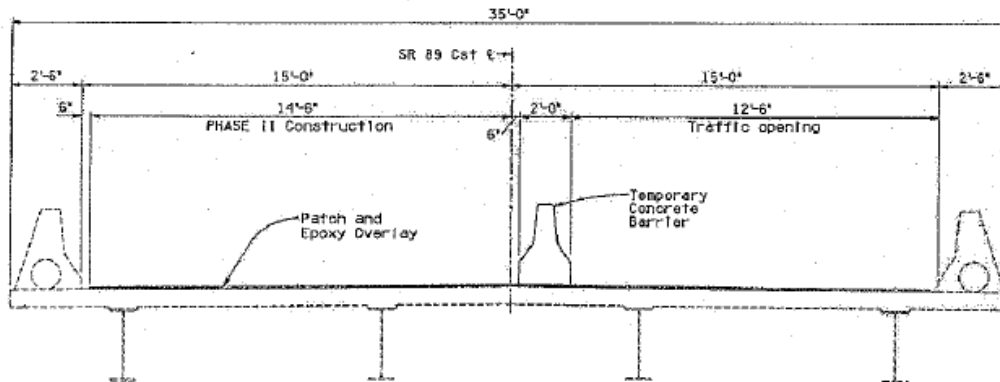
DESIGN	DATE	BY	ARIZONA DEPARTMENT OF TRANSPORTATION INTERNAL TRANSPORTATION DIVISION BRIDGE GROUP	PRELIMINARY STAGE V Review NOT FOR CONSTRUCTION OR RECORDING
DESIGN	DATE	BY	STA 897+ HELL CANYON BRIDGE DECK REPAIR PLAN	
DESIGN	DATE	BY	HELL CANYON BRIDGE	
SR 89	345.68	483		Drawn: S.J.L. 03 OF 3
TRACS NO. H 6382 01 C			089-B(202)	DF

Phasing Plan

SCALE	DATE	PROJECT NO.	SHEET NO.	TOTAL SHEETS	AS BUILT
9	APR 08	089-8(202)	118		
			089 YV 345		



PHASE I
Scale: 1/2" = 1'-0"



PHASE II
Scale: 1/2" = 1'-0"

CONSTRUCTION PHASING:

- PHASE I - Maintain a single lane of traffic on the east half of the bridge. Patch and epoxy overlay the west half of the bridge deck.
- PHASE II - Switch the single lane of traffic to the west half of the bridge. Patch and epoxy overlay the east half of the bridge deck.

DESIGN	DATE	SCALE	PROJECT NO.	ARIZONA DEPARTMENT OF TRANSPORTATION INTERMODAL TRANSPORTATION DIVISION BRIDGE GROUP	PRELIMINARY STAGE V NOT FOR CONSTRUCTION OR RECORDING
DATE	SPEC	SIM	08/03	STA 897+	
08/03			07/01	HELL CANYON BRIDGE CONSTRUCTION SEQUENCE	
TYLIN INTERNATIONAL Civil and Structural Engineers			SR 89 345.63 483	HELL CANYON BRIDGE	
TRACS NO. H 6382 01 C			089-8(202)		118 of 118

Purposes:

- To seal cracks of the bridge deck.
- To prevent water and chloride ions from salt to penetrate the concrete.
- To protect corrosion in the deck's reinforcing steel due to moisture intrusion.
- To make deck impermeable seal to air, chemicals and other contaminations.
- To restore the concrete structures to its original strength and increase skid resistance.
- To ensure rapid bridge deck overlay techniques.
- To ensure not having any significant additional dead loads on the existing deck.
- To ensure longer life span of bridge deck approximately 10 - 15 years.

Materials:

- Epoxy or Epoxy Urethane shall be utilized. Epoxy or Epoxy Urethane resin base and hardener shall be composed of a two-part, 100% solids, thermosetting, moisture-insensitive, flexible and high elongation compound.
- Aggregates should have passing 100% through Sieve #4 and retained 30-75% on Sieve #8.
- Aggregate for all layers shall be bauxite, crushed porphyry, aluminum oxide or other similarly hard & durable aggregates as recommended by the manufacturer and approved by the Engineer.

Properties of the Proper Material:

- Compressive Strength
- Flexural Modulus
- Tensile Elongation
- Viscosity
- Adhesive Strength
- Gel Time
- Permeability to Chloride Ion
- Absorption
- Thermal Compatibility

Equipment:

- **Air compressor:**

Air compressors shall be equipped with oil traps to eliminate oil from being blown onto the bridge deck during possible shot-blasting and air cleaning.

- **Trucks:**

Trucks shall be clean and equipped with traps to eliminate fluids from falling onto the bridge deck.

The distributor shall accurately blend the epoxy resin & hardening agent and uniformly apply at the specified rate to the bridge deck. Also aggregate spreader shall be propelled for its uniform application.

The vacuum truck shall be self-propelled.

Construction Requirements:

- **Submittal:**

A submittal from the Contractor about the epoxy Manufacturer's recommended construction procedures and requirements to the Engineer for review and approval.

- **Surface preparation:**

The deck should be free from oil, grease, rust, soot and other foreign materials and laitance.

The deck surface preparation sequence is as follows:

- 1) Mill to a depth of $\frac{1}{4}$ to $\frac{1}{2}$ inch;
- 2) Scarify to a level surface;
- 3) Shot-blast to clean and create a smooth surface and
- 4) Broom and clean with compressed air to remove debris & dust before Polymer Epoxy Overlay application.

**Hell Canyon Bridge, AZ
Saw Cutting at Deck Spall
Areas**



09/29/2009

Removal of Delaminated Deck Concrete



09/29/2009

**Prepared Deck Surface for
Patch Work**



Mixing of Epoxy Materials



09/30/2009

Mixing Of Epoxy Materials



09/30/2009

**Aggregate is being added
to the Mix**



09/30/2009

Placing of Epoxy Mixed Concrete at Deck Patch



09/30/2009

**Epoxy Deck Patching is
being done manually**



09/30/2009

**Completed Epoxy Deck
Patch**



09/30/2009

Construction Requirements (cont):

- **Placing overlays (Epoxy / Epoxy Urethane):**

It is comprised of a minimum two layers . 1st layer shall have coverage 2.5 gallons/100 sft and the 2nd layer shall have coverage not less than 5.0 gallons/100 sft.

- **Aggregate:**

Aggregate shall be applied uniformly to the bridge deck at least 10 pounds per SY as a 1st course and during 2nd course at least 14 pounds per SY may be applied by using a self-propelled aggregate spreader per manufacture's requirements.

- **Curing:**

Vehicles are not permitted on the finished overlay until the epoxy manufacturer's specified curing time is elapsed.

Construction Requirements (cont):

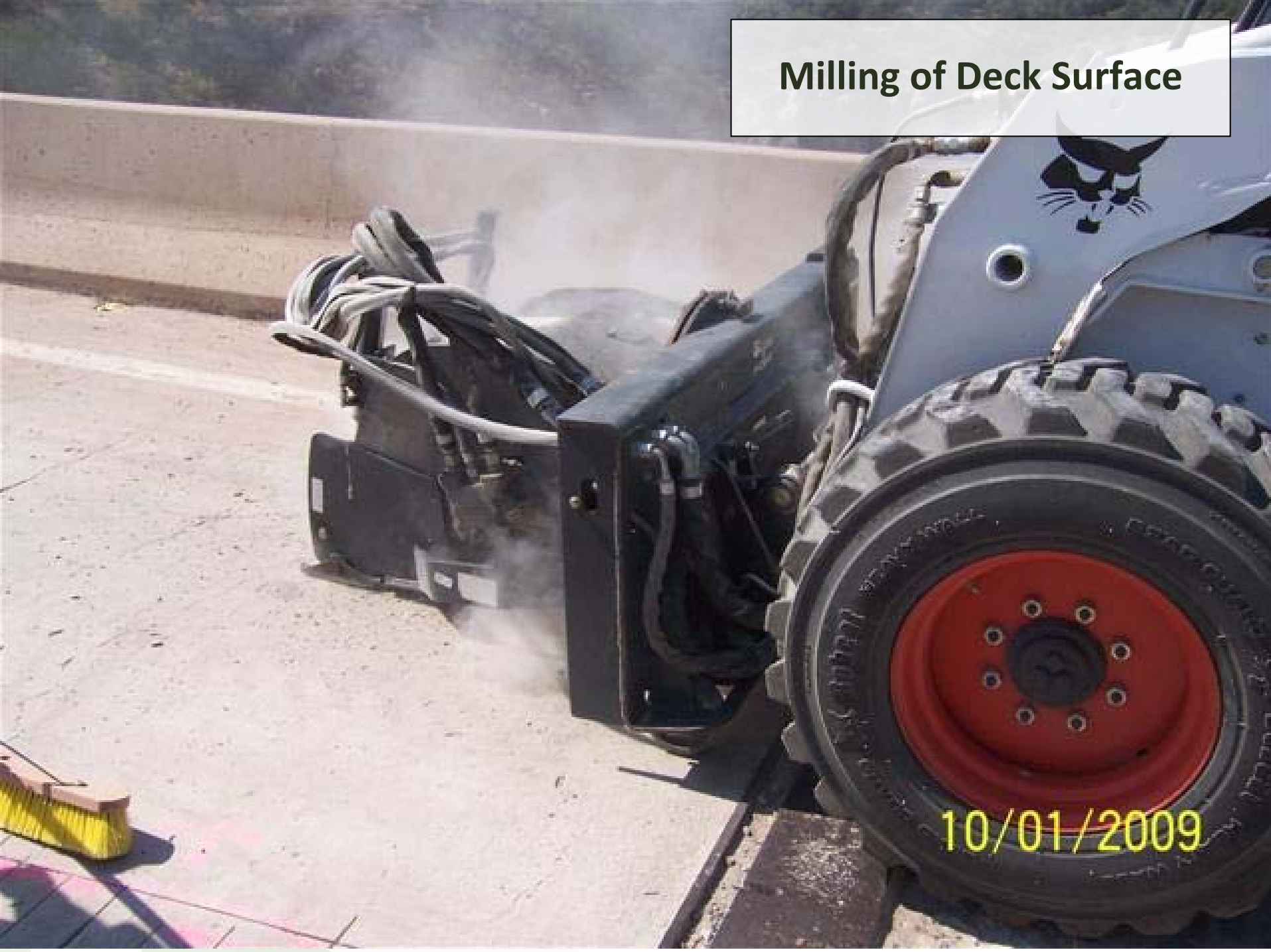
- **Determination of Delamination and the Sealing of Cracks and Joints:**

The entire overlaid surface shall be sounded by use of chain drags or other mechanical devices after the curing.

- **Final Surface Texture:**

The minimum thickness of polymer concrete overlay shall be 3/8 inch. The surface texture shall be uniform and must have skid resistance greater than 33 as measured by ASTM E274.

Milling of Deck Surface



10/01/2009

Surface Preparation: Shot Blast Equipment



Bridge Deck Showing Grinding of Exposed Rebar



Bridge Deck Showing Surface Preparation



Bridge Deck Showing Surface Preparation



Bridge Deck Showing Typical Cracks on Prepared Surface



Bridge Deck Showing Map Cracks on Prepared Surface



Bridge Deck Showing Epoxy Application for Sealing of Cracks



Bridge Deck Showing Epoxy Application for Sealing of Cracks



Bridge Deck Showing Crack Treatment



Bridge Deck Showing Epoxy Application



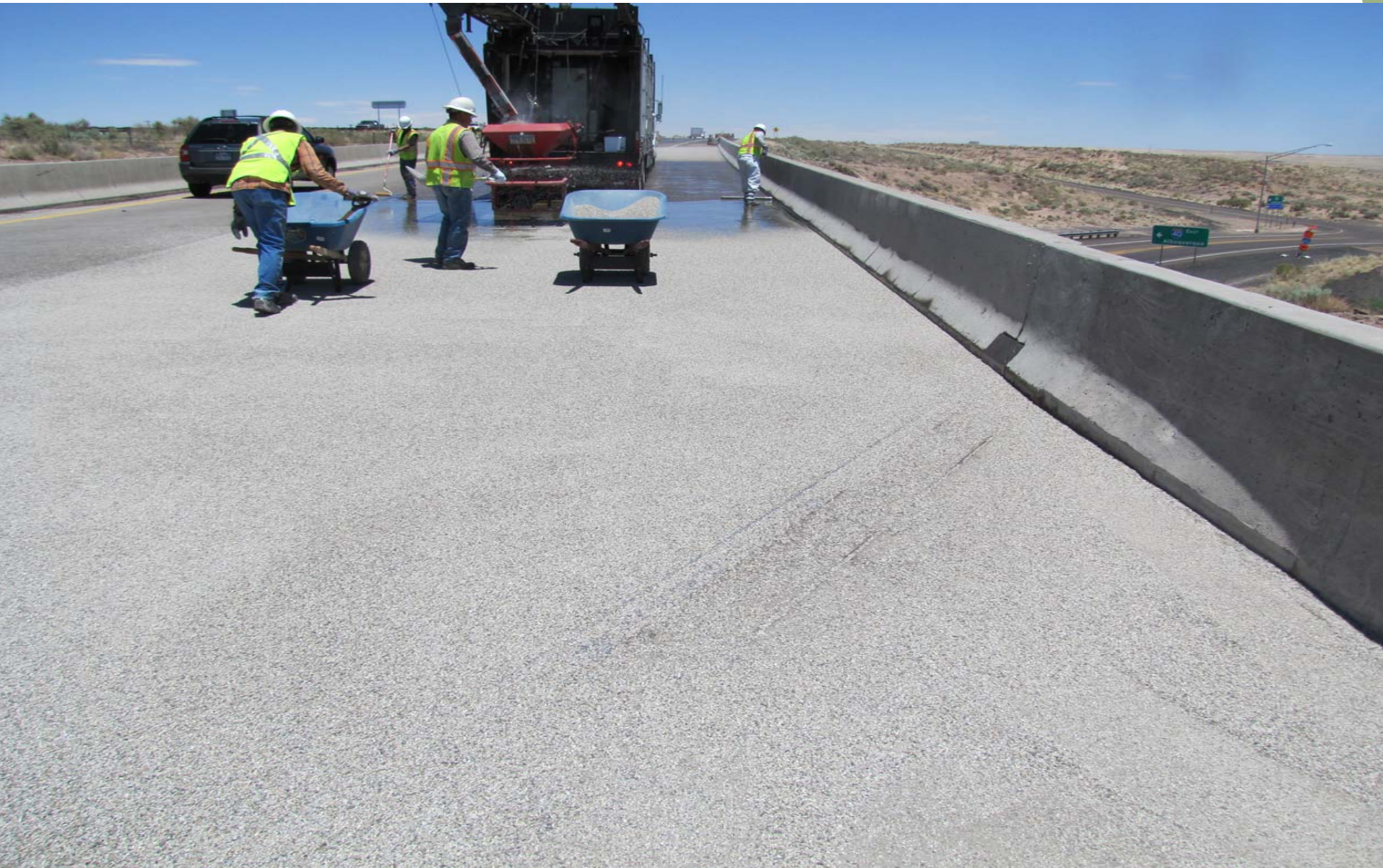
Bridge Deck Showing Spreading of Epoxy



Bridge Deck Showing Spreading of Epoxy and Aggregate



Bridge Deck Showing Spreading of Aggregate



Bridge Deck Showing Spreading of Aggregate



Bridge Deck Showing Epoxy Overlay Partly Completed



Bridge Deck Showing Removal of Tape from Joints



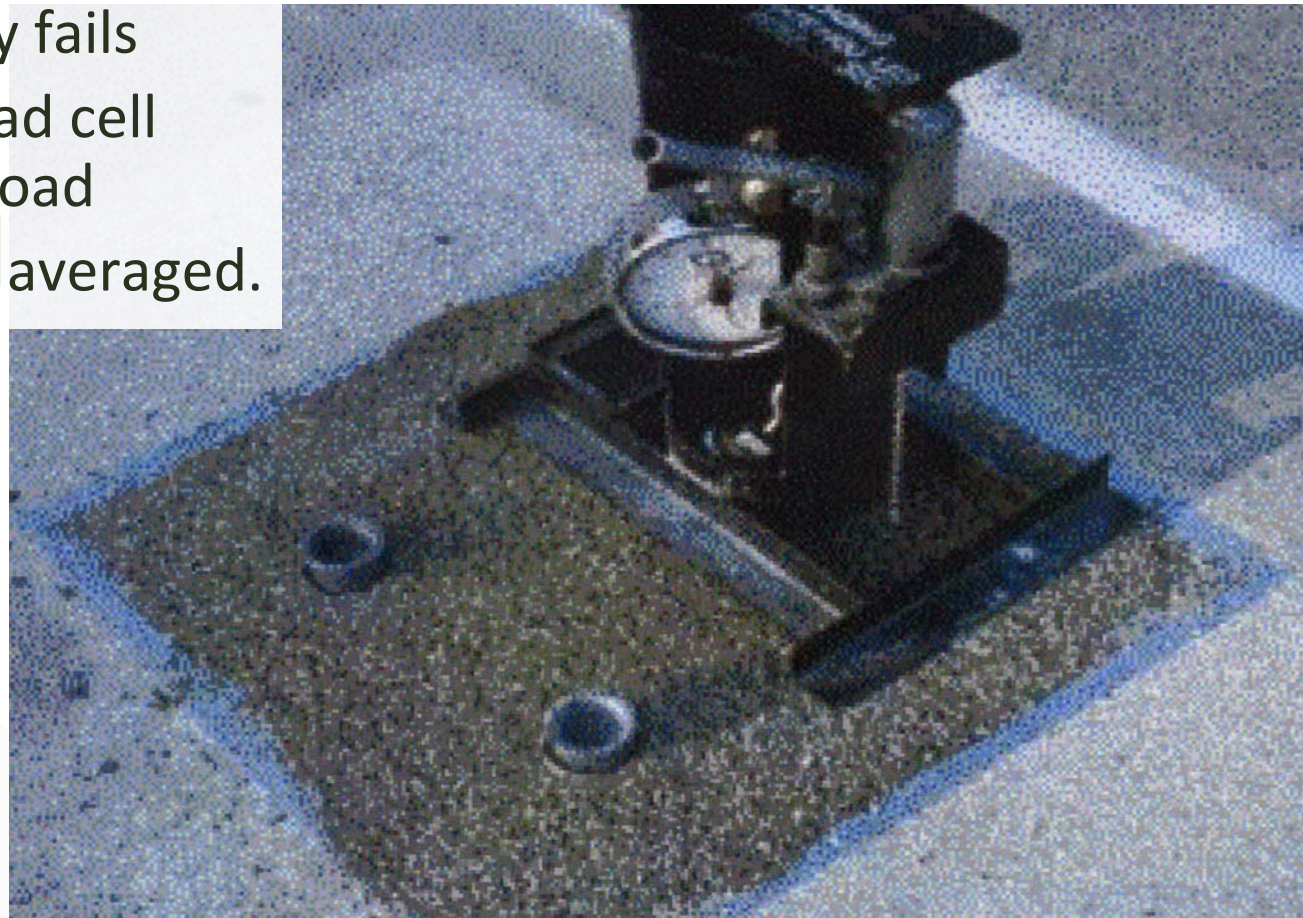
Bridge Deck Showing Sweeping of Excess/Loose Aggregate



Testing of Epoxy Overlays

Overlay Tensile Adhesion Test:

- Load cell is hooked to cap
- The core is loaded
- The cored overlay fails
- Red needle on load cell indicates failure load
- Three results are averaged.



Method of Measurement and Payment

- Epoxy Overlay is measured by the square yard (S.Y.) and payment is made based on this actual field measurement.
- Payment for Epoxy Overlay includes all material, labor, and equipment required to cleaning, preparing and applying a two coat overlay system including miscellaneous clean-up.

Limitations:

- Temperature (Epoxy is not good when temperature is less than 50 degree F)
- Storage temperature for Resin Material shall be maintained within 50 degree F to 90 degree F in a dry area
- Weather condition (Not good at wet condition)
- Aggregate shall be dry and stored in a dry, moisture free atmosphere.
- Mixing and Placing time (Not good with thin solvents and placing of mix more than 5 minutes of mixing)
- Apply to dry concrete surfaces
- Curing time (usually 8-10 hours) to be maintained strictly

Common Failure Causes:

- Existing concrete strength is too low for good polymer bond
- Concrete is contaminated with chemicals used for concrete curing or surface sealing
- Improper surface preparation
- Poor application procedure used
- Loss of broadcast aggregate
- Excessive broadcast aggregate wear
- UV sensitivity which can cause some polymers to become brittle over time
- Modulus of polymer too high to withstand thermal cycle stresses.
- Freeze-thaw degradation
- Presence of air bubbles in the epoxy mix
- Presence of moisture on the deck during epoxy application

Safety and Environmental Issues:

(A) Safety:

- Never store materials in extremely high temperatures
- Have copies of manufacturers MSDS (Material Safety Data Sheet) on job site
- Review proper mixing procedures
- Supply recommended personal protective equipment

Safety and Environmental Issues:

(B) Environmental:

- Read MSDS for any VOC (Volatile Organic Compound) and hazardous chemicals
- Prevent spills or discharge thru joints or drains
- Proper disposal of unused resins and powders
- Proper disposal of empty drums and containers



Thank You

Questions?