Job Report

Cold Foam In-Place Recycling Project

Highway 20, State of California

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1. Brief description:

1.1 Background

On the 20th January 2000, Wirtgen opened discussions with Caltrans, District 3, to explore the possibility of developing a Cold Foam In Place Recycling (CIFPR) project.

Caltrans had identified a section of highway 20 that was due for rehabilitation and suggested that this be a good candidate for a recycling project.

The current design strategy for the section would call for milling off the existing Asphalt and placing overlays and reconstructing, as follows:

18mm	**(OGAC 9.5mm)**
90mm	**(DGAC 19mm type A)**
PRF	
45mm	**(DGAC 19mm Type A) Levelling course**
225mm	**AB (Class 2)**
330mm	**AS (Class 2)**
708mm	**Total**

The initial benefits of CIFPR were identified as:

- **Structural integrity: The process produces a thick 9" (225mm) bound layer.**
- **Subgrade is not disturbed**
- **Shorter construction window required than full reconstruction**
- **All of the pulverized existing AC and aggregate base would be recycled, thereby saving considerable "virgin" aggregate from being hauled to the site.**

In order to progress the project it was agreed that Wirtgen would employ the expertise of A.A.Loudon & Partners to carry out initial site investigations to establish if the proposed section was suitable for CIFPR and if so to determine a mix design compatible with the existing materials and the Caltrans design requirements.

1.2 Site Investigation / Mix Design

Pavement investigation concerns the gathering of available information, traffic analysis and the implementation of appropriate methods of investigation in order to provide sufficient data to carry out the pavement design. These include:

i) Study of available information.

In this instance Caltrans were able to provide, as built data, traffic estimates, pavement deflection data and core samples from the existing pavement.

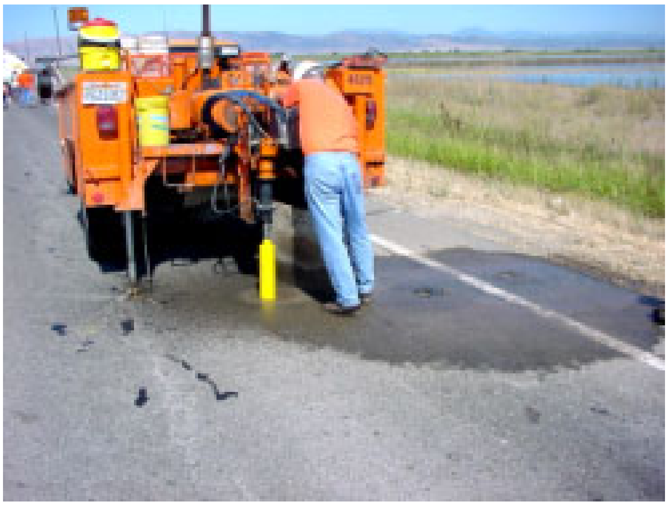
ii) Analysis of Design traffic.

For the section on highway 20 an anticipated Traffic index of 11 was given, this relates to a structural capacity requirement for 6.6 million standard axle loads (ESAL's)

iii) Methods of Investigation, include

- Visual assessment
- Dynamic Cone Penetrometer survey
- Testpits
- Core Sampling
- Deflection Measurements
- Laboratory testing.

Pavement saw cut, then test pit excavated to reveal pavement structural makeup.



Caltrans coring sections of highway 20.

Dynamic Cone Penetrometer Survey.
Using computer programs the DCP measurements are analysed to provide, in-situ CBR, UCS and elastic moduli estimates, as well as giving an indication of pavement balance and structural capacity.

Samples from the testpits were subjected to laboratory testing, to establish the quality of the materials in the existing pavement layers, and in the underlying subgrade.
Typical tests include, sieve analysis, plasticity and CBR.
The results from these tests together with samples of the materials were used to formulate the mix design.
Using a Wirtgen WLB10, Foamed Bitumen laboratory portions of the samples were prepared by mixing them with various percentages of foamed bitumen to determine the optimum percentage of foamed bitumen to be added to meet the desired design requirement.

The WLB10 is used to:

- Determine the foaming properties of different bitumen types.
- Producing samples by injecting foamed bitumen directly into the laboratory mixer
- The quality of mixtures to be produced in the field can be defined exactly.
- Information on the material properties such as load bearing capacity can be obtained before the construction work starts.

The specimens were prepared using standard compaction methods

The specimens were then cured

Once cured the specimens were subjected to various tests to assess their engineering properties as well as their susceptibility to moisture.

The final mix design for the CIFPR project was determined to be:

- Recycled the existing pavement to a depth of 9" (225mm)
- Add Foamed Bitumen to the pulverized material at a rate of 2.5% by mass
- Add 1.5% water by mass to assist with the Foamed Bitumen dispersion and facilitate compaction.

1. Highway condition prior to Recycling

1.1 Traffic.

The anticipated traffic was given as a traffic index of 11, implying a structural capacity requirement of 6.6 million equivalent standard axles (ESAL's)
The current Average Daily Traffic (AADT) was given as 5000 vehicles, of which 20% were heavy with an average of 1.8 ESAL's per heavy vehicle.

1.2 Pavement failure.

Pavement failure / distress tended to be more asphalt-aging related (thermal cracking).

Start of Project looking West.

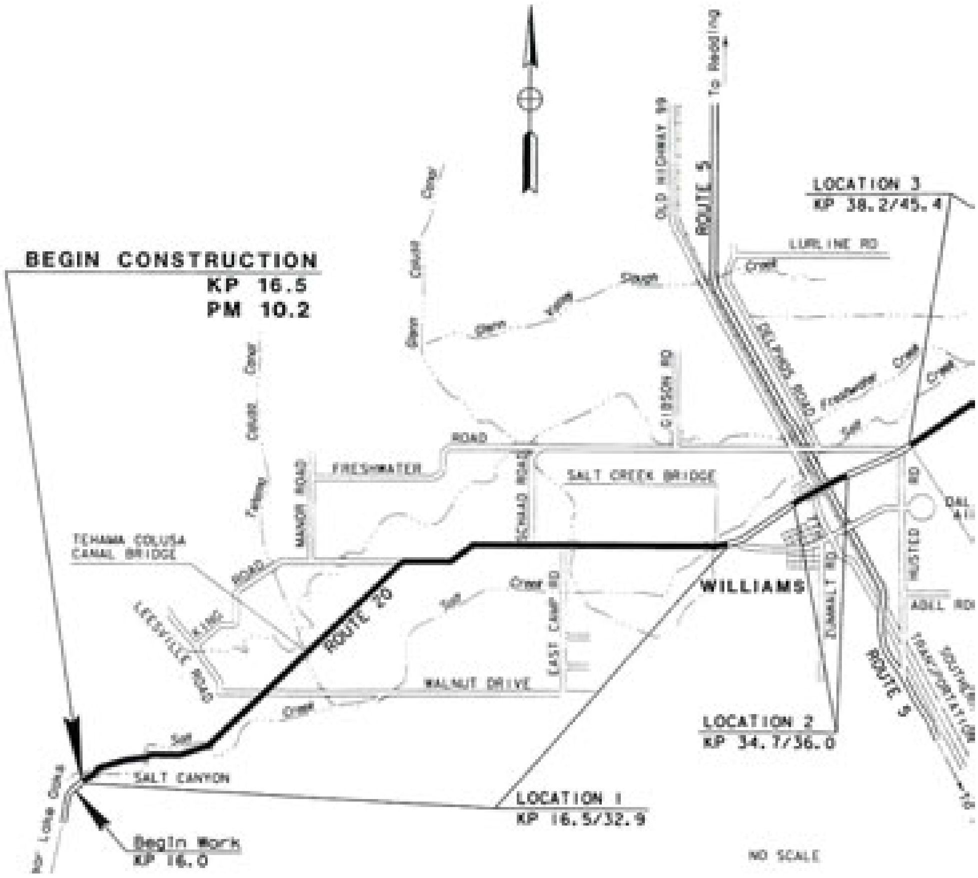
Extensive crack sealing and cut outs.

Approximately half way through section looking East.

Extensive crack sealing, base failure and shoulder failure.

3. Location / Project size

3.1 Location Map



Section of Highway 20, West of Williams, within the Caltrans District 3 area.

Total length of Foam Recycling Project 10.04 miles 16.2kms

Total area of Foam Recycling Project 131,480 sqm 1,419,984 sqft

4. Construction Plan

The section for the CFIPR process was divided into 4 parts:

Week 09th July, 5 days	Foam recycle 10.04 miles, starting from the East, Recycling the West bound lane.
Week 16th July, 4 days	Pave the West bound Recycled lane with 46mm Asphalt.
Week 23rd July, 5 days	Foam recycle 10.04 miles, starting from the East, Recycling the East bound lane.
Week 30th July, 4 days	Pave the East bound Recycled lane with 46mm Asphalt.

5. Cold Foam In-Place Recycling (CFIPR) Process

5.1 Recycling Train

Two Wirtgen WR2500 Recyclers were used working in echelon.

Each WR2500 recycler was coupled with:

- Bitumen supply tanker, in front, bitumen heated to a temperature of 350 deg F. The supply tanker is pushed by the WR2500
- Water cart, in rear. The Water cart is pulled by the WR2500

The lead WR2500 was fitted with an 8ft (2.5m) cutter and the following WR2500 fitted with a 10ft (3.0m) cutter. The road width varied from 21.5ft (6.6m) to 31.5ft (9.72m) therefore, it was always possible to recycle one half of the road in one pass. The Wirtgen foam spray bar system is fitted with 16 jets, it is possible to cut off jets so as not to “double dose” the recycled material with bitumen. In the picture above the lead machine is working with all 16 jets spraying to a width of 8ft (2.5m), the following machine is working to width of 4.5ft (1.4m) with 8 jets spraying.
Foam spray jets can be switched on or off from the cabin to accommodate varying road widths.

5.2 Initial Compaction

Two vibrating Pad Foot compactors followed immediately behind the recyclers for initial compaction of the recycled material.

Each Pad Foot compactor was fitted with a front blade, which allowed the compactor to blade the recycled material even on their reverse pass.

5.3 Grading / Shaping

Following the initial compaction, a motor grader was used to cut the recycled material to the desired levels.

Motor grader cutting recycled material level.

Followed by steel drum compactor.

Recycled material cut to finished level, ready for final compaction and finish.

5.4 Compaction

Final compaction was achieved using a plain steel single drum vibrating compactor.

5.5 Water

Two water carts were employed on the site:

1) Used to keep recycled material moist
2) Used in the surface finishing operation

The recycled material is constantly watered to keep the surface moist.

The water cart makes it's run between traffic flow changes.

The second water cart working with the Pneumatic tyred Roller on surface finish.

5.6 Final compaction / Surface Finish

While the recycled surface is WET, the Pneumatic Tyred Roller is used to create a surface slush effect, which knits together the finer particles at the surface.

This process locks in the larger particles and avoids surface raveling.

The resulting finish provides an excellent smooth surface for traffic to run on.

5.7 Sweeper

The final operation on the recycled lane is to sweep the edge clear of any loose material.

5.8 Finished Recycled Lane

Finished recycled lane with center road marking flaps in place.

The lane was opened to traffic 3 hours after completing the finishing operation.

Recycled lane surface finish for traffic to run on.

6. Asphalt wearing course

Monday 23rd July.

The West bound lane (on right of photo) has been paved with 46mm of asphalt.

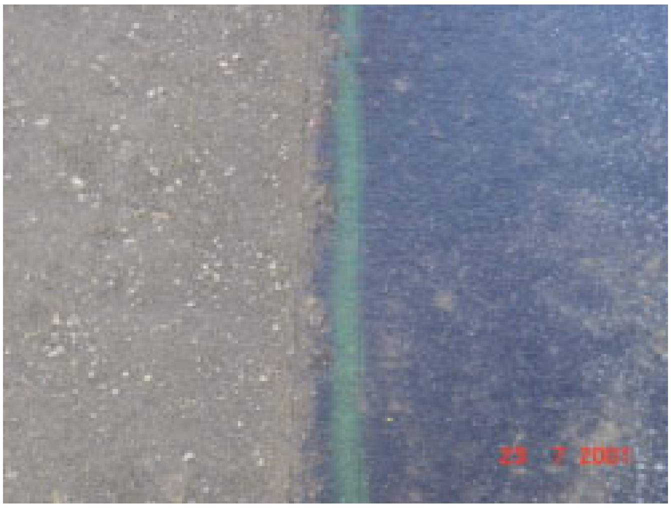
The recycling operation has started on the East bound lane (on left of photo)

7. Longitudinal Joint between lanes.

The East bound lane being recycled.

The recycler cuts up to the edge of the adjacent paved lane.

By offsetting the cabin to the right (flush cut) side of the WR2500 the operator has perfect vision to maintain a straight longitudinal joint.



Longitudinal joint between asphalt surface on right and recycled surface on left.

8. Application shots.

8.1 Recycling with traffic

View of the recycling train on the West bound lane.

This view is between traffic flow changes.

Traffic is convoyed through the work site safely.

There is no interruption to the recycling operation and traffic delay is minimal.

8.2 Sharp bend with Super Elevation

Sharp bend with 14% Super Elevation

Average asphalt thickness to be recycled 9” (225mm).

First recycler enters bend, with traffic under convoy in adjacent lane.

Both recyclers working in the bend with traffic

Grading and compaction operation on the recycled material

Finished recycled surface, after trafficking

8.2 Deep Asphalt sections

Sections of the pavement, up to 10” + (250mm +) of asphalt.

9” (225mm) asphalt

Varying depths of asphalt were found, ranging from 4.5” (114mm) to 10” (250mm)

9. Before and After views

9.1 View from project start point looking West

June 2000

July 2001

Left lane Recycled finish

Right Lane Asphalt finish

9.2 View on pavement section before foothills, looking West.

June 2000

July 2001

West bound (right hand) lane has been
Recycled and is under traffic.

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