IN-DEPTH STUDY OF COLD IN-PLACE RECYCLED PAVEMENT PERFORMANCE

VOLUME I - FINAL REPORT

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16. Abstract

Oregon has developed a mix design procedure for cold in-place recycled (CIR) asphalt concrete pavements. The procedure involves estimation of an initial emulsion content based on gradation of recycled asphalt pavement (RAP), asphalt content of RAP, and penetration and viscosity of recovered asphalt. When an estimated emulsion content is determined, Marshall-sized specimens are prepared for a range of emulsion contents with the range centered on the estimated emulsion content. Hveem and Marshall stability, resilient modulus, and index of retained modulus (IRM) tests are performed on the specimens and a design emulsion content is selected based upon these results. Because of variations in RAP properties, continual need for field adjustments, and the difficulty of interpreting mix property test results, only the estimation part of this procedure is currently implemented.

This paper describes the mix design procedure and presents lab results demonstrating the difficulty of choosing emulsion content based on Hveem and Marshall stability, resilient modulus and IRM. Data comparing design emulsion content with actual emulsion contents used in the field are presented. Selection of water content is discussed. Test results of mix properties monitored over time are presented, demonstrating the curing of the emulsion. Performance data for CIR pavements constructed from 1984 through 1988 are presented as well as initial results of an attempt to use lime during recycling to correct a stripped pavement. A construction and inspection manual is presented as a separate document (Volume II, FHWA, OR-RD-91-02B).

Significant findings as a result of this study include the following:

1) Field performance of CIR has been good, with a few exceptions. Proper project selection is extremely important.
2) Estimation procedures for determining emulsion content serve as a good starting point for field operations. Continual monitoring and adjustment of emulsion content is required in the field.
3) It is difficult to relate Hveem and Marshall stability, resilient modulus, fatigue and IRM laboratory testing to field construction conditions for CIR.
4) Mix property test results indicate that the stiffness and fatigue properties of recycled mixtures increase over a period of years.
5) Addition of 1% and 2% lime to RAP from badly stripped pavement produced better IRM results than the RAP without lime.
6) Review of existing projects suggests service lives for low volume roads of 6 to 8 years for CIR with chip seal when projects are properly selected.

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DISCLAIMER

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1.0 INTRODUCTION

1.1 Background

Oregon has implemented cold in-place recycling (CIR) techniques for low volume roads as one alternative to conventional asphalt concrete pavement rehabilitation practices since 1984. The initial success of the early CIR projects (1984-85) prompted a joint research effort in 1986 between the Oregon State Highway Division (OSHD) and Oregon State University (OSU). This effort focused on developing improved mix design procedures and construction guidelines for cold in-place recycling. The work on this research effort was completed in June 1988 (1,2) and resulted in a recommended mix design procedure.

Only part of the procedure has been implemented (3). The component of the procedure that has been implemented consists of estimating the emulsion and water contents. This procedure has been validated by the 1986 study as well as by extensive field experience. The component not implemented consists of fabricating standard 2-1/2 × 4 in. briquettes from recycled asphalt pavement (RAP) obtained with a 16-in. mill and subjecting these briquettes to mix property tests to determine the appropriate amount of emulsion to be added to the mix. Invariably, the results have predicted emulsion contents in excess of that actually used in the field. Field experience indicates instability problems if excess emulsion is added.

1.2 Purpose

This study, initiated in December 1988, had the following specific objectives:

1) Verify and/or modify the mix design procedure for selecting the content of recycle agent and water content for field projects. This will be based on evaluating projects constructed during the 1988 and 1989 construction seasons.
2) Verify and/or modify the mix design criteria for stability, resilient modulus, and moisture sensitivity.

3) Examine selected projects constructed during the 1984 through 1988 construction seasons and estimate the life expectancy of CIR treatments using standard and high float emulsions.

4) Investigate whether mixes which have previously exhibited stripping can successfully be corrected by recycling.

5) Verify the validity of the Total Liquids Test -- OSHD TM-126 (1) -- to establish the optimum total liquids content in the field.

It is the purpose of this final report to provide detailed information regarding the progress made in achieving these objectives. Objectives 1, 2, and 5 are addressed in Chapter 2. Chapter 3 discusses objective 3 and Chapter 4 deals with objective 4. Conclusions and recommendations for implementation are summarized in Chapters 5 and 6. Appendix A contains construction reports from 1989 ODOT projects. Appendix B is a compilation of recent CIR specifications from western states. Volume II is a "Construction and Inspection Manual" for CIR as practiced by ODOT in 1990.

2.0 MIX DESIGN PROCEDURE

The final report (2) for ODOT's 1986-1988 studies suggested the mix design procedure shown in Figure 2.1 where the CIR pavement will become part of the structural design to upgrade the surface. The suggested criteria for selection of the final emulsion content were those presented in Table 2.1. This approach provided a "starting point" emulsion content based on tests for gradation, asphalt content, and asphalt hardness of preliminary samplings of millings from a 16-in. mill. Laboratory specimens were to be prepared and tested for mechanical properties to determine the emulsion content resulting in the best mix properties, varying the emulsion content around this "starting point." The design emulsion content should result in mix properties meeting the criteria of Table 2.1.

It is the opinion of field personnel that the "estimated initial emulsion content and water content" at the top of Figure 2.1 are adequate predictors of the emulsion content and water content to be used in the field. Consequently a comparison of field values with values from the estimation procedure was made. These data are presented in Sections 2.1-2.4.

Sections 2.5 and 2.6 present the results of the investigation of the complete mix design process proposed in Figure 2.1, as well as analysis of Marshall test results. Section 2.7 discusses the resulting recommendations for mix design and Section 2.8 discusses field adjustments.

2.1 Selection of Amount of Recycle Agent - Estimation Procedure

The procedure to select the amount of emulsion (recycle agent) to be added to a recycled mixture evolved from the 1986 OSU/OSHD study (1,2). This procedure is essentially an estimation process which begins with a base emulsion content to which adjustments are made based on the results of laboratory tests conducted on a sample taken from the pavement to be recycled using a 16-in. mill. It has been found through experience with the CMS-2S and HFE-150 emulsions that a base emulsion content of 1.2% is a good starting point (3). Adjustments are then made to this base content according to the softness of the extracted asphalt, gradation of millings as produced by the 16-in. mill, and the percent of recovered asphalt from the sample.

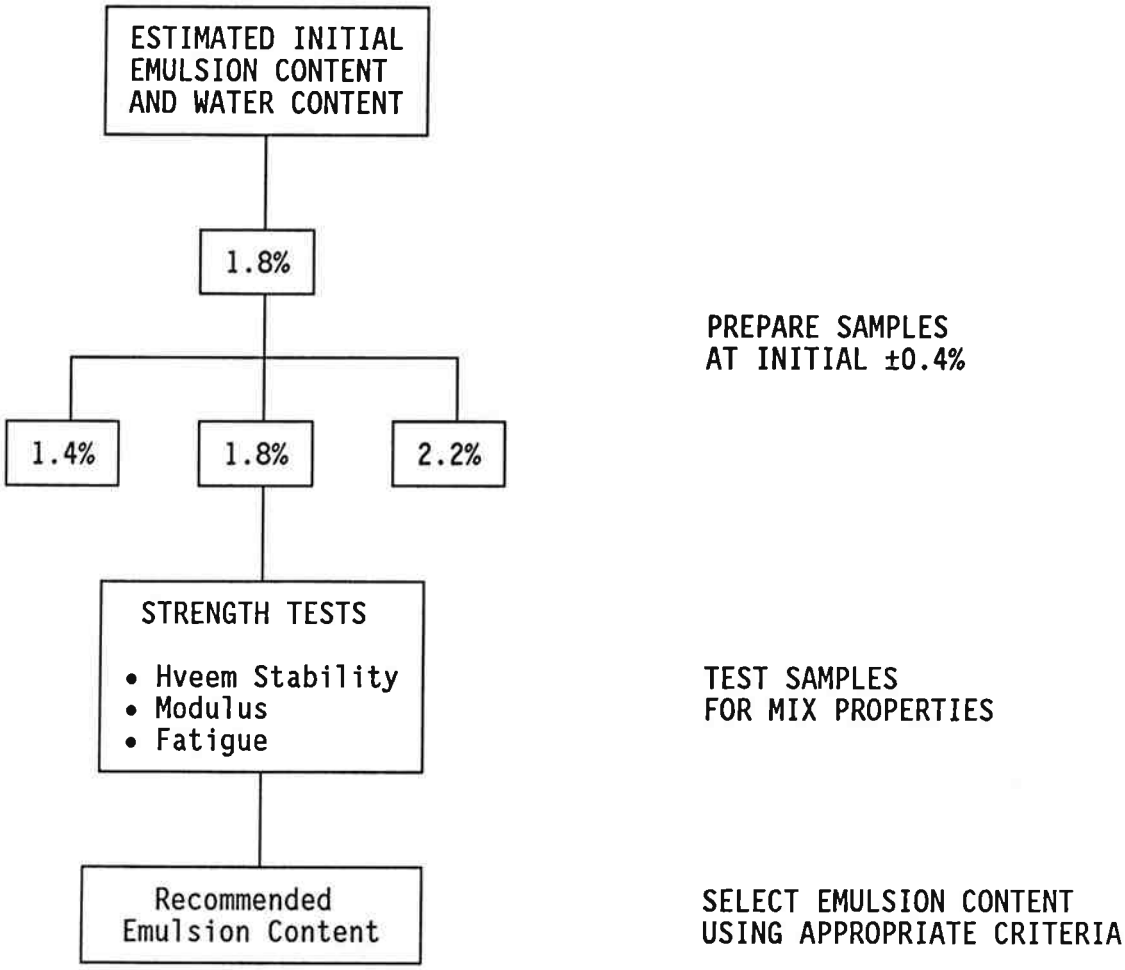


Figure 2.1. Suggested Mix Design Process - 1986-88 Study (from Ref. (2)).

Table 2.1. Suggested Mix Design Criteria, 1986-88 Study (from Ref. (2))

Property	Recommended Value
Hveem stability	> 10 after 2nd compaction
Resilient modulus @ 77°F	150,000-300,000 psi
Modulus ratio @ 77°F after saturation	> 0.60
Fatigue life @ 100 με @ 77°F	> 5,000

The penetration (ASTM D5) (4) and/or the absolute viscosity (ASTM D2171) (5) laboratory test results are used to determine the softness of the extracted asphalt and the RAP gradation is determined for only three screens -- 1/2-in., 1/4-in., and #10. The percent of recovered asphalt is determined via the Abson method (ASTM D1856) (4). From these laboratory test results, the added emulsion content (based on dry weight of millings) can be determined through the use of Figure 2.2 and the following equation:

$$EC_{EST} = 1.2 + A_G + A_{A/C} + A_{P/V}$$

where

EC_{EST} = estimated emulsion content, %

1.2 = base emulsion content, %

A_G = adjustment for gradation, %

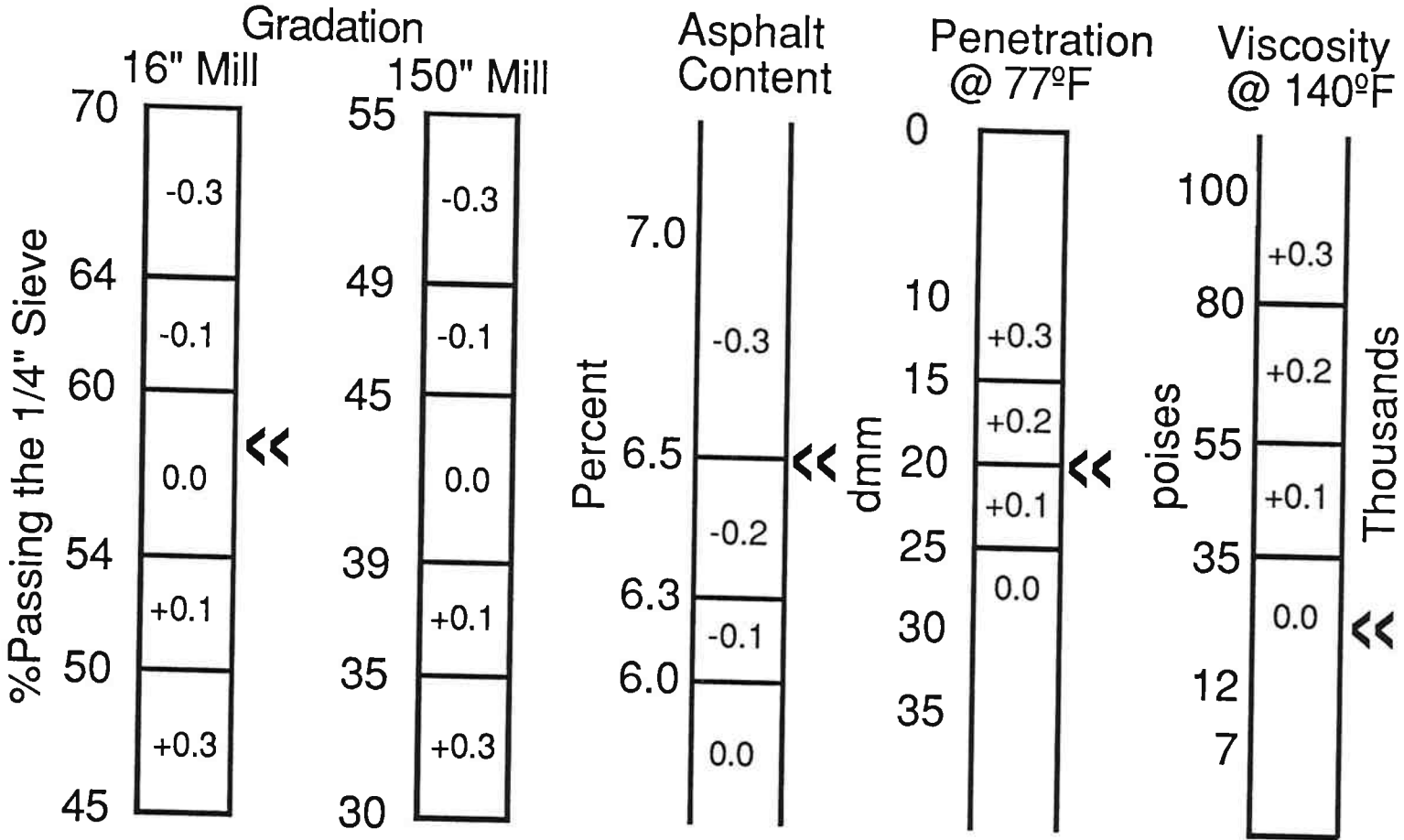
$A_{A/C}$ = adjustment for residual asphalt content, %

$A_{P/V}$ = adjustment for penetration or viscosity, %

It should be noted that for borderline cases (those that fall on a boundary) in Figure 2.2, the adjustment resulting in a lower estimated emulsion content (EC_{EST}) should be used. Also, where there exists a discrepancy between the adjustments for penetration and absolute viscosity, the adjustment resulting in a lower estimated emulsion content (EC_{EST}) should be used. The example in Figure 2.2 clarifies the use of the chart and the equation.

2.2 Verification of Selection of Emulsion Content - Estimation Procedure

To accomplish one of the objectives of this study -- to verify and/or modify the procedure for selecting the content of recycle agent for field projects -- the above estimation procedure was carried out on samples taken from three projects recycled during the 1989 construction season and compared to the actual emulsion content that was used in the field during construction. The three projects enlisted for this purpose were:



Example:

Given:

58% passing the 1/4" screen on the 16" mill, 6.5% residual asphalt, a penetration of 20 dmm, and a viscosity of 19,000 poises.

Adjustments (for borderline cases, use adjustment producing lower emulsion content):

0.0% for gradation, -0.3% for asphalt content, and 0.0% for penetration/viscosity

Estimated Emulsion Content:

1.2% + 0.0% - 0.3% + 0.0% = 0.9%

Figure 2.2. Emulsion Content Adjustments for Gradation, Asphalt Content, and Asphalt Softness.

1) Stag Hollow Creek Road (Yamhill-Newberg Hwy): Region 2,

2) Umpqua Jct.-The Dalles-California Hwy (East Diamond Lake Hwy): Region 4, and

3) Horse Ridge-Crooked River Jct. (Central Oregon Hwy): Region 4.

Table 2.2 gives a comparison of the emulsion contents that were determined using the estimation procedure with those used during construction.

Comparing the estimated emulsion contents with those actually used in the field for the Stag Hollow Creek Road project, it may be seen that the average actual emulsion content does not vary significantly from the average estimated content; however, the variability of the estimated contents is much higher (coefficient of variation of 35%) than the variability of the actual emulsion contents (coefficient of variation of 5%). Actual contents exceeded estimated by as much as 0.8% emulsion and fell short of estimated content by as much as 0.4% emulsion.

For the Umpqua Jct.-The Dalles-California Hwy project, it is clear that the emulsion contents predicted by the estimation process correspond very closely to those used during construction. The predicted emulsion content for the Horse Ridge-Crooked River Jct. project is the same as that used in the field for one sample location (MP 23.00) and is within 0.2% for another (MP 24.00), but estimated emulsion contents are 0.7-0.8% lower for the other two locations. The large difference between actual and estimated emulsion contents for the two locations at the east end of this project (near mile points 33.70 and 34.70) resulted from considerable adjustment due to low temperatures during construction. The cold temperatures meant that additional emulsion was required to maintain workability during laydown and compaction.

A review of coefficient of variation (CV) in Table 2.2 shows low values for actual emulsion contents. This is indicative of a construction process that is not likely to be making severe adjustments up and down over short distances. It is really not realistic to expect the kinds of changes predicted by the estimated design emulsion contents for the Stag Hollow Creek Rd. project. The high variability of estimated emulsion contents for this project indicates wide variation in the existing pavement materials and should be a good warning that such a project is not an optimal candidate for recycling.

Table 2.2. Comparison of the Estimated and Actual Emulsion Contents on Three CIR Projects

Project	Mile Point	Emulsion Content, %		
		Estimated	Actual	Diff.*
Stag Hollow Creek Rd-Wapato Rd (Yamhill-Newberg Hwy)	1.03 WB	1.2	1.2	0.0
	2.57 WB	1.0	1.2	-0.2
	4.56 WB	1.4	1.3	0.1
	6.56 WB	1.7	1.3	0.4
	3.59 EB	1.6	1.3	0.3
	4.79 EB	0.5	1.3	-0.8
	5.55 EB	1.6	1.2	0.4
	7.13 EB	1.3	1.3	0.0
	8.20 EB	0.8	1.1	-0.3
	9.00 EB	0.6	1.2	-0.6
	9.82 EB	0.8	1.3	-0.5
	Avg	1.14	1.25	-0.11
	Std Dev	0.40	0.07	
	CV	35%	5%	
Umpqua Jct-The Dalles-California Hwy (East Diamond Lake Hwy)	2.49 WB	1.0	1.2	-0.2
	14.24 WB	0.9	0.9	0.0
	1.64 EB	0.9	1.0	-0.1
	7.18 EB	0.9	1.2	-0.3
	11.70 EB	1.0	0.9	0.1
	Avg	0.94	1.00	-0.06
	Std Dev	0.05	0.11	
	CV	5%	11%	
Horse Ridge-Crooked River Jct. (Central Oregon Hwy)	23.00 WB	1.6	1.6	0.0
	34.70 WB	0.6	1.4	-0.8
	24.00 WB	1.4	1.6	-0.2
	33.70 EB	0.6	1.3	-0.7
	Avg	1.05	1.48	-0.43
	Std Dev	0.46	0.13	
	CV	43%	9%	

*Diff. = Design - Actual

Although the CV of estimated emulsion contents for Horse Ridge-Crooked River Jct. was high, it really only reflected two different pavement types at opposite ends of the project. Consequently, this project was an acceptable candidate. The East Diamond Lake Hwy. project provided the least variability in estimated emulsion contents and was the best candidate for recycling.

2.3 Selection of Water Content

In the 1986 OSU/OSHD study, the amount of water to be added to a particular recycled mix was determined by subtracting the emulsion content from the total liquids content (the amount of moisture to provide a saturated surface damp condition). To better quantify the total liquids content, the modified Oregon State Highway Division test method OSHD TM-126 (1) was used in the current study -- a test to determine how much total liquids a particular recycle mix can tolerate. Thus, once the estimated emulsion content (EC_{EST}) is determined as described in Section 2.1, the modified OSHD TM-126 test is conducted on a mix to determine the total liquids content. Briefly, the Total Liquids Test is conducted as follows (see OSHD-TM-126 for complete details):

1) Samples are prepared at the final estimated design emulsion content and at incremental water contents (e.g., 0.5, 1.0, 1.5%) and each sample weight is recorded.
2) Each sample is placed and rodded in a split mold in two lifts.
3) Each sample is gradually compressed to a total load of 25 kips - one minute to achieve 20 kips plus one half minute to achieve the additional 5 kips. The 25 kip load is held for one minute.
4) The specimen weights are then determined. The difference between the initial sample weight and the weight of the compacted specimen is the liquid loss.

The total liquids content that results in a liquid loss of 1 to 4 ml (1 to 4 grams) is used as the design total liquids content. From this, the water content can be calculated (total liquids content minus estimated emulsion content). It should be pointed out that this test is used for determining total liquids and cannot directly determine the water content (i.e., the water must be calculated).

2.4 Verification of Selection of Water Content

The above procedure for selecting the amount of water to be added to the recycled mixture for the purposes of mix design was carried out on three projects to accomplish one of the objectives of the current study -- to verify and/or modify the procedure for selecting the water content for field projects. The three projects used for this purpose were as follows:

1) Stag Hollow Creek Road (Yamhill-Newberg Hwy): Region 2,

2) Umpqua Jct. - The Dalles-California Hwy (East Diamond Lake Hwy): Region 4, and

3) Horse Ridge - Crooked River Jct. (Central Oregon Hwy): Region 4.

Table 2.3 gives a comparison of the water contents that were determined in the laboratory using the Total Liquids Test to the range of water contents that were used in the field during construction. As indicated, the water contents predicted by the Total Liquids Test were much higher than those used for construction for one project, but quite close for the other two projects. For the Stag Hollow Creek Rd.-Wapato Rd. project, the water contents predicted by the Total Liquids Test were 1.0-2.2% higher than those used in the field. For the Umpqua Jct.-The Dalles-California Hwy project the maximum variation between design and actual was 0.2%. Actual field additions of water on the Horse Ridge-Crooked River Jct. project ranged from 0.7% less than to 0.1% more than the design.

The Stag Hollow Creek Rd.-Wapato Rd. project was not a successful CIR project. The majority of the project involved shaded areas and inadequate base. One result of these factors was a high moisture content in the RAP material in the field. It is suspected that the difference in actual water added and water predicted by the Total Liquids Test in the laboratory may be explained by the high in situ moisture content of the field materials. By the time the design millings were used in the laboratory test they may have lost much of their moisture content -- something which did not happen in the field. Consequently, less water had to be added in the field to result in the required total liquids content.

The other two projects were in more arid areas where water in the RAP was not as significant a factor. It is probably for this reason that agreement between design and actual water additions for these two projects was much better.

Table 2.3. Comparison of the Design and Actual Water Contents on Three CIR Projects

Project	Mile Point	Water Content, %		
		Design	Actual	Diff.*
Stag Hollow Creek Rd-Wapato Rd (Yamhill-Newberg Hwy)	1.03 WB	2.3	0.8	1.5
	2.57 WB	2.5	0.8	1.7
	4.56 WB	2.1	0.8	1.3
	6.56 WB	1.8	0.8	1.0
	3.59 EB	1.9	0.6	1.3
	4.79 EB	3.0	0.8	2.2
	5.55 EB	1.9	0.8	1.1
	7.13 EB	2.2	0.8	1.4
	8.20 EB	2.7	0.8	1.9
	9.00 EB	2.9	0.8	2.1
	9.82 EB	2.7	0.8	1.9
	Avg	2.36	0.78	1.58
	Std Dev	0.40	0.06	
	CV	17%	7%	
Umpqua Jct-The Dalles-California Hwy (East Diamond Lake Hwy)	2.49 WB	2.1	1.9	0.2
	14.24 WB	2.0	2.0	0.0
	1.64 EB	2.1	2.2	-0.1
	7.18 EB	2.1	2.0	0.1
	11.70 EB	2.0	2.0	0.0
	Avg	2.06	2.02	0.04
	Std Dev	0.05	0.10	
	CV	2%	5%	
Horse Ridge-Crooked River Jct. (Central Oregon Hwy)	23.00 WB	1.4	1.5	-0.1
	24.00 WB	1.6	1.5	0.1
	34.70 WB	2.4	2.1	0.3
	33.70 EB	2.4	1.8	0.7
	Avg	1.95	1.71	0.24
	Std Dev	0.46	0.25	
	CV	23%	14%	

*Diff = Design - Actual

2.5 Sample Preparation

One of the purposes of the current study is to implement mix property tests to aid in establishing the proper amount of emulsion to be added to a particular recycle mix. Although this was also one of the purposes of the 1986 study, it was soon realized that the results of certain mix property tests gave estimates of the emulsion content that were too high (2). It is the intent of the current study to revisit the mix property tests used in the 1986 study to further investigate the possibility of using these tests as part of the mix design procedure for CIR mixtures (see Figure 2.1). Marshall stabilities and flow were also investigated.

Briquettes were prepared with RAP from two pavements that were recycled during the 1989 construction season (Stag Hollow Creek Rd.-Wapato Rd. and Umpqua Jct.-The Dalles-California Hwy.). The briquettes were then tested for Hveem and Marshall stability, diametral modulus, and fatigue. The sample preparation procedures used to fabricate the specimens is as follows:

1. Split the millings into approximately 15,000 gram batches.
2. Screen the sample on the 1-in. sieve. Reduce all materials retained on the 1-in. sieve such that 100% of the sample passes the 1-in. sieve using a hammer or chisel.
3. Determine the gradation of the 15,000 gram sample using the 1/2-in., 1/4-in., and #10 sieves. This is the RAP gradation for the 16-in. mill.
4. Determine the adjusted gradation (for the 150-in. mill) through the use of Figure 2.3.
5. Batch five 1100 gram ± samples of the millings at the adjusted gradation for the 150-in. mill.
6. Using the remaining material, determine the optimum total liquids content using OSHD TM-126 with the modification that the optimum total liquids content occurs at a liquid loss of 1-4 ml (1-4 grams).

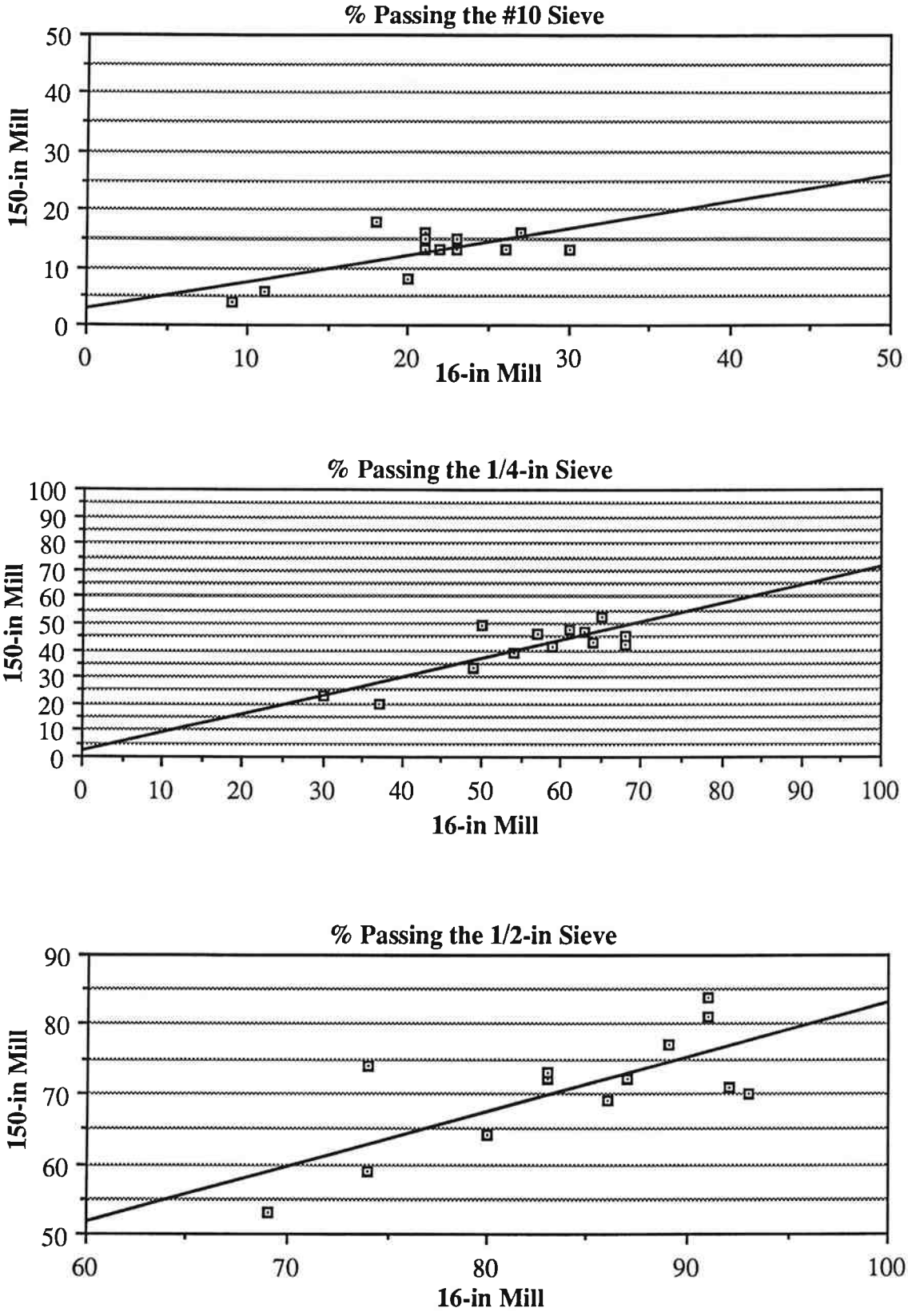


Figure 2.3. Determination of the Adjusted Gradation (for the 150-in. Mill) from the Gradation of the 16-in. Mill.

7. Calculate water contents (based on dry weight of millings) to be added to the samples for each emulsion content using the following equation:

$$\%water = \%total\ liquids - \%emulsion$$

8. Prepare briquettes with emulsion contents at the estimated emulsion content (EC_{EST}), at EC_{EST} - 0.3%, at EC_{EST} + 0.3%, at EC_{EST} + 0.6%, and at EC_{EST} + 0.9%.
9. Heat the five 1100 gram samples to 140°F ± for 1 hour.
10. Add the water (calculated above) to the five samples and thoroughly mix by hand.
11. Add the emulsion contents to the premoistened millings. The emulsion is to be preheated to 140°F ± for 1 hour and mixed thoroughly into the batch by hand.
12. Dump the material into a 12-in. × 17-in. baking pan and allow to cure for 1 hour at 140°F ± to simulate the average time elapsed between the paver laydown and the initial compaction during actual construction.
13. Mold the samples using standard Hveem or Marshall procedures to produce 2.5-in. ± briquettes as described below:
    a) Preheat molds to 140°F ±.
    b) Compact the samples with compactive effort sufficient to produce briquettes with 10-15% air voids.
    c) Cure the briquettes overnight at 140°F ± and recompact 75 blows at 300 psi for the Hveem method or 25 blows per side for the Marshall method.
    d) Lay the molds on their side and cure the briquettes for 24 hours at 140°F ± prior to extrusion.
    e) Extrude the briquettes using a compression testing machine.
    f) Lay the briquettes on their side to maximize surface exposure and cure for 72 ± 24 hours at room temperature prior to testing.
    g) Determine bulk gravity.

This procedure is essentially the same as that used during the 1986 study except for:

1) the range of emulsion/water contents tested, and

2) the compactive effort used in the Hveem method for specimen fabrication.

In the 1986 study, specimens were prepared with three emulsion contents (namely, EC_{EST} and $EC_{EST} \pm 0.4\%$) while in the current study specimens were fabricating using five emulsion contents (EC_{EST}, $EC_{EST} \pm 0.3\%$, $EC_{EST} + 0.6\%$, and $EC_{EST} + 0.9\%$). Thus, the range in emulsion content was increased in the current study relative to that used in the 1986 study. In addition, the compactive effort used in the Hveem method was reduced to 75 blows at 300 psi in an attempt to produce briquettes with voids contents in the range of 10-15% (similar to the voids contents of CIR pavements in the field). As will be discussed below under fatigue results, the compactive effort was still too high, resulting in unrealistically low air voids. Reduction of the compactive effort used in the Marshall method was unnecessary since the compactive effort established by the 1986 study provided the appropriate voids contents (10-15%). Thus, the compactive effort for the Marshall method of compaction used in the 1986 study was also used in this study.

2.6 Development of Mix Design Criteria

A laboratory study was undertaken to verify and/or modify the mix design criteria that evolved from the 1986 study (see Table 2.1). Marshall stability and flow were also included. In the laboratory study, test specimens were fabricated with RAP, as described in the previous section, from two projects constructed during the 1989 construction season. These projects were:

1) Stag Hollow Creek Rd.-Wapato Rd. (Yamhill-Newberg Hwy), and

2) Umpqua Jct.-The Dalles-California Hwy (East Diamond Lake Hwy).

The specimens fabricated from samples from these projects were then subjected to laboratory tests to evaluate their mix properties (resilient modulus, fatigue, Marshall stability and flow, and Hveem stability) over time in order to determine mix design criteria for the recycled mixtures. It was the intent that these design criteria would aid in establishing the appropriate emulsion content for field projects.

2.6.1 Resilient Modulus

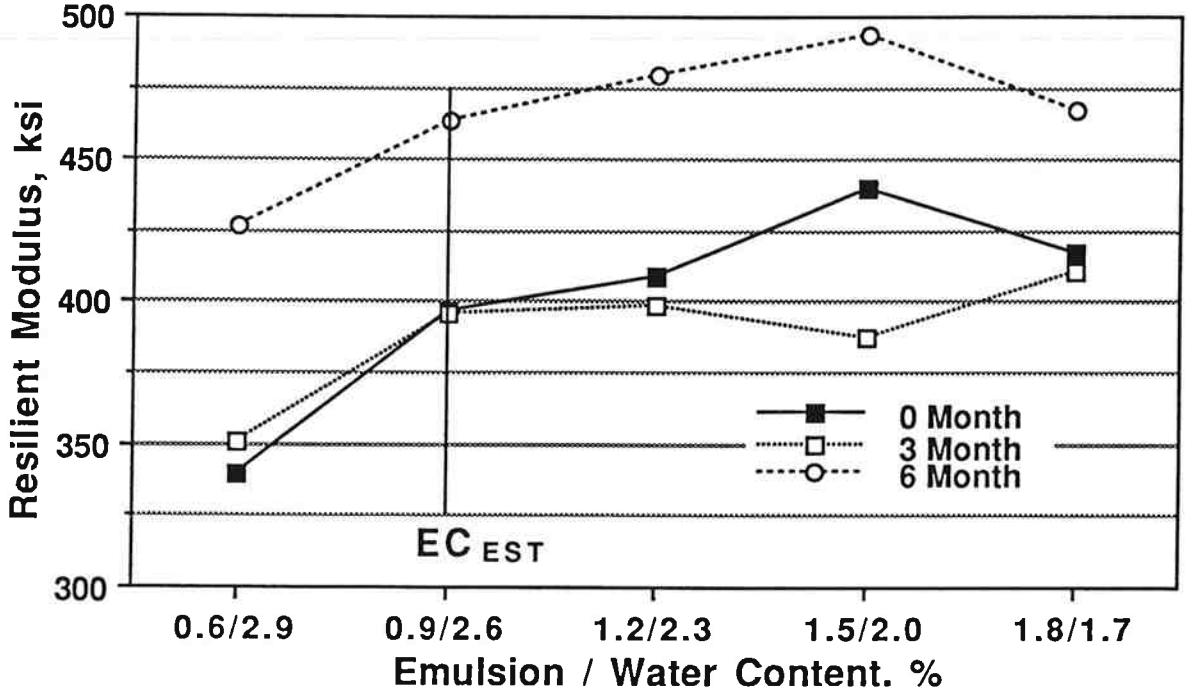
Diametral resilient modulus tests (ASTM D4123) were conducted on laboratory-fabricated specimens at periods of 0 (shortly after compaction), 3, and 6 months at the OSHD laboratory where the specimens were cured in the ambient temperature of the laboratory (~25°C) between test periods. The modulus tests were conducted at a test temperature of 25°C using a pulse load duration and frequency of 0.25 s and 1/3 Hz, respectively and a pulse load magnitude to induce a tensile strain of 100 micro-strain ($\mu\epsilon$). The results of these tests are summarized in Table 2.4 and shown graphically in Figure 2.4. As indicated in Figure 2.4a, the peak modulus for the Umpqua Jct.-The Dalles-California Hwy project occurs at an emulsion content of 1.5% for the 0 month test results; about 0.6% higher than that of the estimated emulsion content (EC_{EST}) as determined by the estimation procedure (Section 2.1). The 3 month test results essentially duplicate the 0 month test results while the 6 month test results show an increase in modulus across all emulsion/water contents. It was expected that the modulus would increase over time and that the peak modulus would shift to the left in Figure 2.4 (i.e., over time, the peak modulus was expected to increase as well as correspond to a lower emulsion content). However, it is clear that the peak modulus only showed an increase over time and that it occurred at the same emulsion content.

For the Stag Hollow Creek Rd.-Wapato Rd. project, the peak modulus (see Figure 2.4b) occurred at an emulsion content of 1.7%; again, 0.6% higher than that predicted by the estimation process described in Section 2.1. The 3 month test results, although somewhat lower than the 0 month test results, also show that the peak modulus occurs at the 1.7% emulsion content. The results of the 6 month tests indicate both an increase in modulus for all emulsion/water contents and a reduction in the emulsion content corresponding to the peak modulus. That is, the peak modulus occurs at the 1.4% emulsion content; a reduction of 0.3% relative to the 0 and 3 month test results.

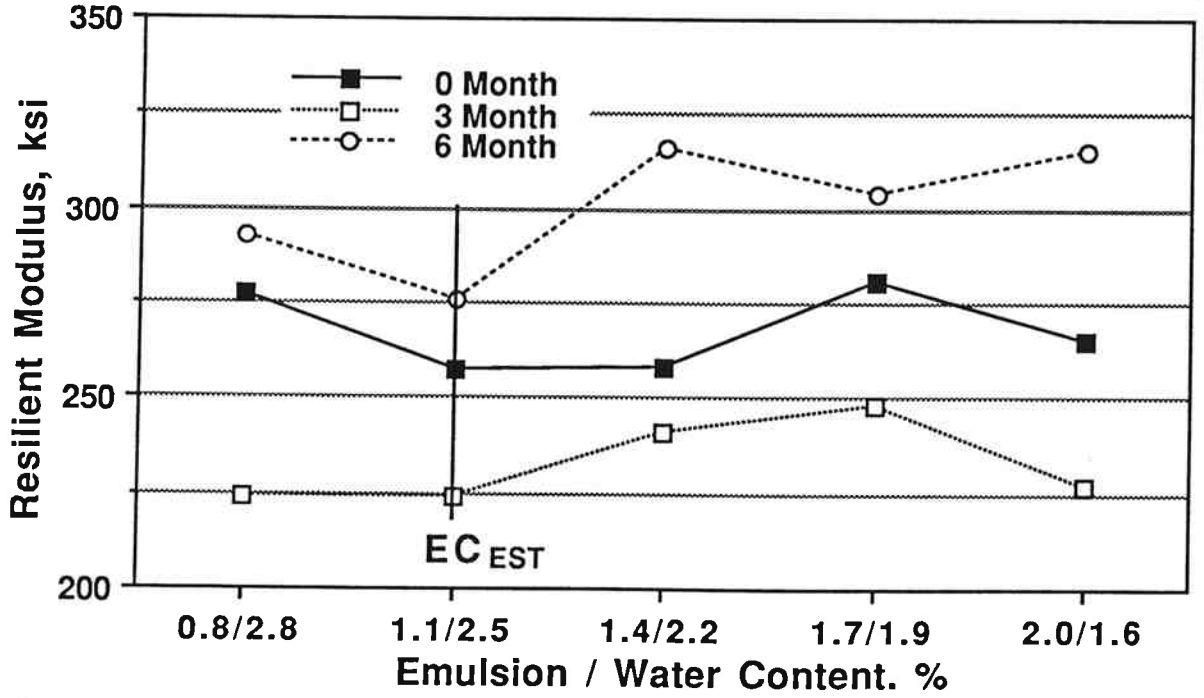
Although the above results do not conclusively confirm what was expected (that the peak modulus should correspond to lower emulsion contents over time), it can be said that for both projects the peak modulus at the 0 month test period corresponded to an emulsion content that was a constant value greater (about 0.6%) than that predicted by the estimation procedure described in Section 2.1. This is

Table 2.4. Summary of Resilient Modulus of Mix Design Samples

Project	Emulsion/Water Content (%)	Resilient Modulus, ksi		
		0 Month	3 Month	6 Month
Umpqua Jct-The Dalles-California Hwy (East Diamond Lake Hwy)	0.6/2.9	339	351	427
	0.9/2.6	397	396	463
	1.2/2.3	409	399	479
	1.5/2.0	440	387	493
	1.8/1.7	417	411	467
Stag Hollow Creek Rd-Wapato Rd (Yamhill-Newberg Hwy)	0.8/2.8	277	224	293
	1.1/2.5	257	224	276
	1.4/2.2	258	241	316
	1.7/1.9	281	248	304
	2.0/1.6	265	227	315



a) East Diamond Lake Hwy



b) Stag Hollow Creek Rd

Figure 2.4. Resilient Modulus of Mix Design Samples.

potentially useful information in that it was desired to establish a shift factor to be applied to the emulsion content corresponding to the peak modulus of the 0 month test period since it was previously known and expected (2) that the peak modulus obtained shortly after compaction (0 month) would predict an emulsion content that was too high. Hence, the above results would indicate that a shift factor of minus 0.6% should be applied to the emulsion content corresponding to the peak modulus as obtained shortly after specimen fabrication. However, since the relative change in modulus between emulsion contents is small, use of a peak modulus to predict an emulsion content may be difficult (i.e., definitive trends showing a peak modulus may be nonexistent).

2.6.2 Fatigue

Fatigue tests were conducted at the 0 and 3 month test periods. The fatigue tests were conducted as described in Reference (6) using a test temperature of 25°C, a pulse load frequency of 1 Hz, a pulse load duration of 0.1 s, and a pulse load magnitude to induce an initial tensile strain of 100 με. The results of these tests are given in Table 2.5 and shown graphically in Figure 2.5. As indicated in Table 2.5, several tests during the 3 month test period were terminated due to excessive fatigue lives (greater than 150,000 repetitions). It was decided to terminate the tests after 150,000 repetitions to prevent excessive wear and tear on the test equipment. Thus, 5 of the 6 fatigue tests for the 3 month test period were terminated since they did not fail after 150,000 load repetitions. Because of this, the fatigue tests for the 6 month test period were not conducted since little information would be gained from the results.

Table 2.5 also shows air voids data for the fatigue specimens. These specimens were fabricated in the ODOT lab using Hveem compaction methods with compactive effort of 75 blows at 300 psi. This compaction resulted in air voids at the lower end of the range of expected field values (10-15%) for the Umpqua Jct.-The Dalles-California Hwy. project and well below field values for the Stag Hollow Creek Rd. project. These low air voids helped contribute to the long fatigue lives shown by this testing program. Obviously the compactive effort needs to be reduced further if Hveem compaction is to be used.

Table 2.5. Summary of the Fatigue Results for Laboratory Prepared Samples

Project	Test Period (Months)	Sample ID	Bulk Gravity	Rice Gravity	% Voids	Modulus (ksi)	Average Modulus (ksi)	Fatigue (reps)	Average Fatigue (reps)
Umpqua Jct-The Dalles-California Hwy 1.1% Emulsion 2.5% Water	0	1	2.358	2.624	10.1	621	560	35974	40787
		2	2.355	2.624	10.2	542		39479	
		3	2.356	2.624	10.2	518		46909	
	3	4	2.335	2.624	11.0	435	504	164230*	137000+
		9	2.359	2.624	10.1	507		78900	
		10	2.350	2.624	10.4	571		168000*	
Stag Hollow Creek Rd-Wapato Rd 0.9% Emulsion 2.6% Water	0	27	2.381	2.494	4.5	447	406	239080*	110000+
		28	2.410	2.494	3.4	354		58136	
		29	2.404	2.494	3.6	416		33258	
	3	35	2.289	2.494	8.2	350	373	167000*	162000*
		36	2.285	2.494	8.4	370		165120*	
		37	2.268	2.494	9.1	399		154320*	

*Test intentionally stopped

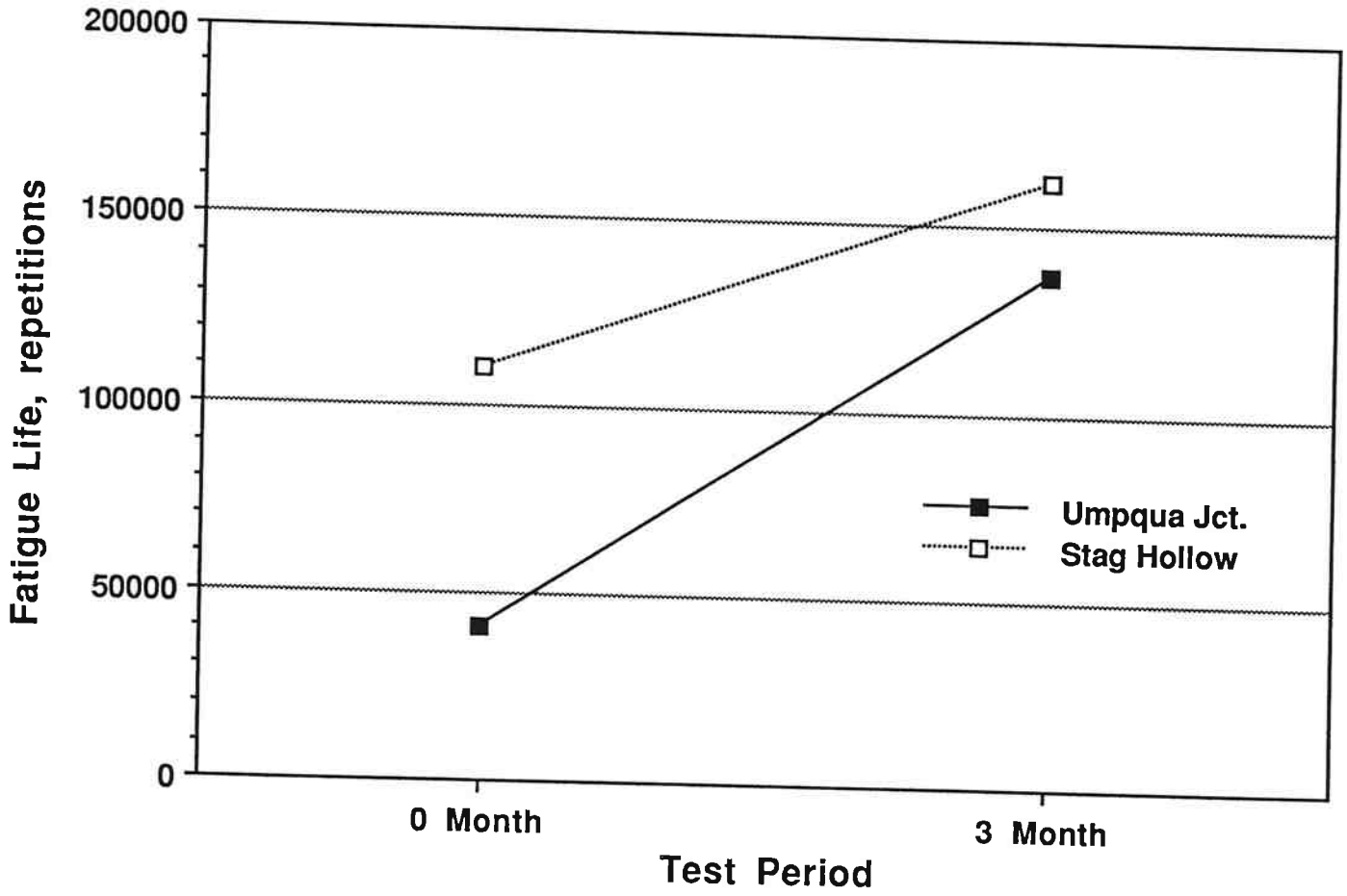


Figure 2.5. Fatigue of Mix Design Samples.

2.6.3 Hveem Stability

Hveem stability tests, conducted in accordance with ASTM D1560 (5), were performed at periods of 0, 3, and 6 months on laboratory-fabricated test specimens that were cured, between test periods, in the ambient conditions of the laboratory. The results of these tests are presented in Table 2.6 and shown graphically in Figure 2.6. The results generally indicate, for both projects, an overall decrease in stability with increased emulsion content (see Figure 2.6). Selection of emulsion content with maximum Hveem stability for the 0 month test period would produce emulsion contents at or within 0.3% of the content predicted by the estimation procedure for both projects.

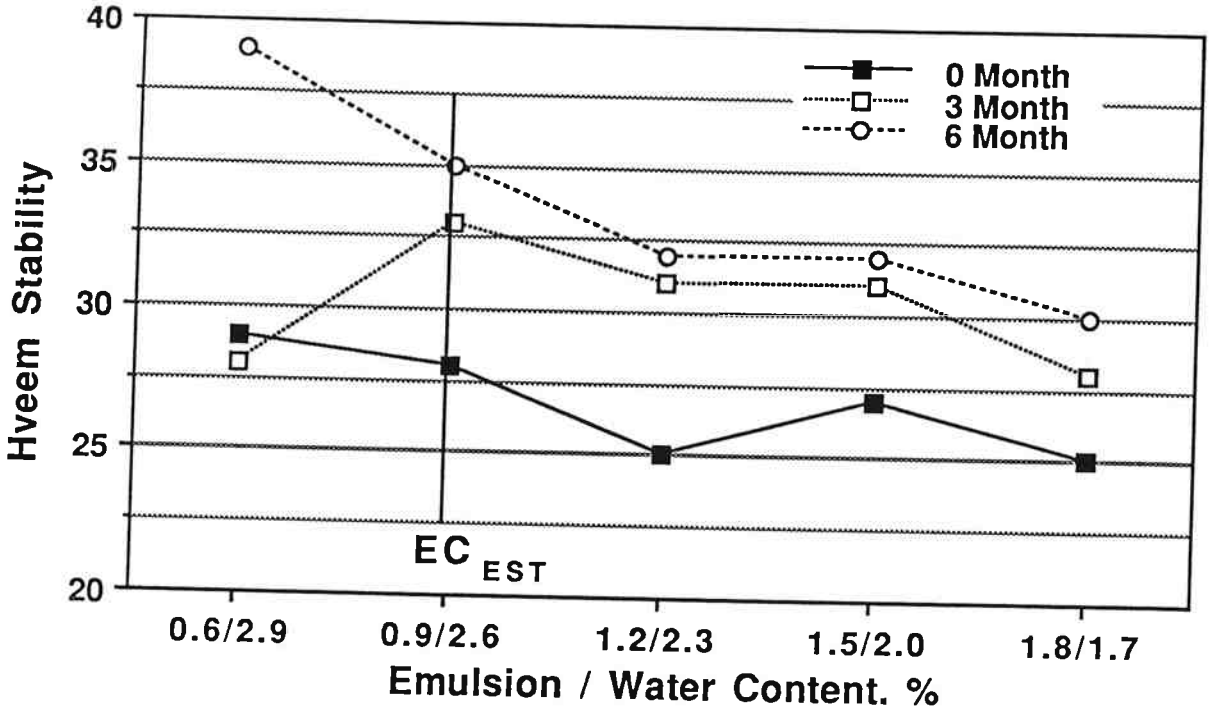
2.6.4 Marshall Stability

Tests for Marshall stability, conducted in accordance with ASTM D1559 (5), were conducted at 0, 3, and 6 month test periods. The specimens were cured in the ambient temperature of the laboratory (~ 25°C) between test periods. Table 2.7 summarizes the test results while Figures 2.7 and 2.8 depict these graphically. As indicated in Figure 2.7, the East Diamond Lake Hwy. specimen results show a general initial decrease in stability with increased emulsion content followed by a distinctive peak for all test periods. The flow values for this project show a general increase with increased emulsion content for all test periods.

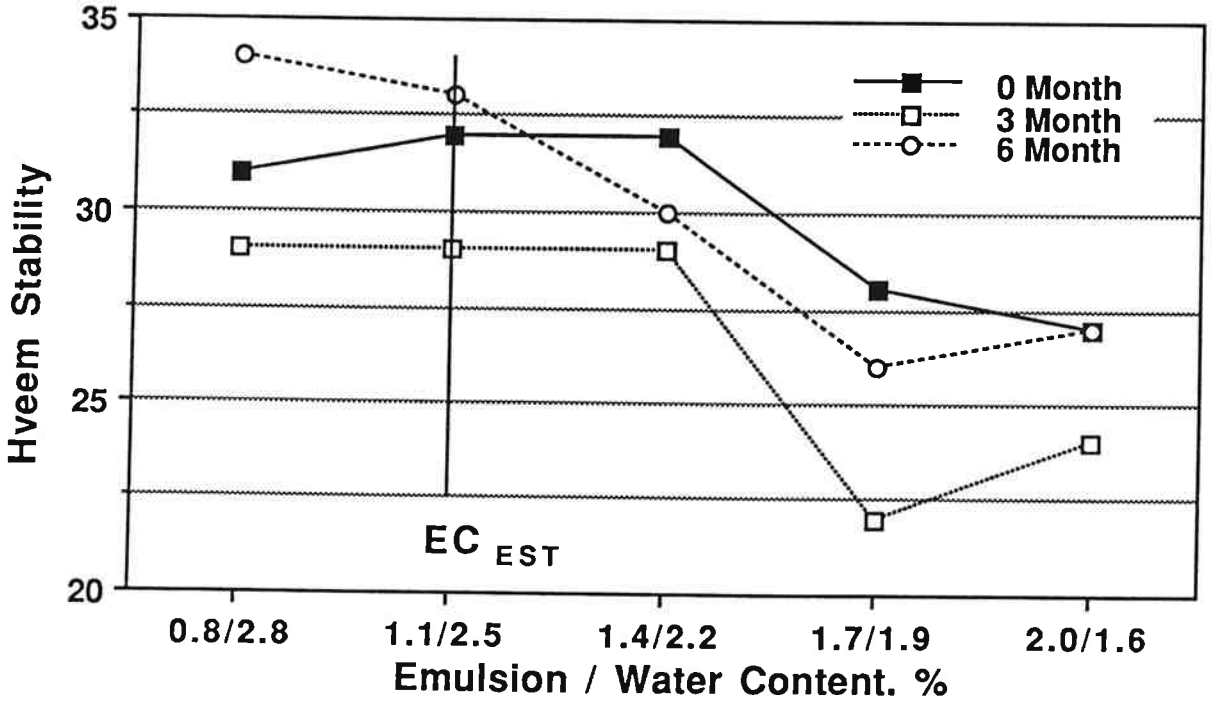
The stability results for the Stag Hollow Creek Rd.-Wapato Rd. project show a dual peak situation for the 0 and 3 month test periods with the first peak corresponding to the emulsion content predicted by the estimation procedure described in Section 2.1 (see Figure 2.8). The second peak for the 0 month test results corresponds to an emulsion content 0.9% higher than that predicted by the estimation procedure while that for the 3 month test period corresponds to an emulsion content that is 0.6% higher. The 6 month test results show a single peak which is 0.3% higher than that predicted by the estimation procedure. Stabilities do not change drastically over the range of emulsion contents tested. The flow values for this project for all test periods show a general overall increase with increased emulsion content.

Table 2.6. Summary of Hveem Stability Results for Mix Design Samples

Project	Emulsion/Water Content (%)	Hveem Stability		
		0 Month	3 Month	6 Month
Umpqua Jct-The Dalles-California Hwy (East Diamond Lake Hwy)	0.6/2.9	29	28	39
	0.9/2.6	28	33	35
	1.2/2.3	25	31	32
	1.5/2.0	27	31	32
	1.8/1.7	25	28	30
Stag Hollow Creek Rd-Wapato Rd (Yamhill-Newberg Hwy)	0.8/2.8	31	29	34
	1.1/2.5	32	29	33
	1.4/2.2	32	29	30
	1.7/1.9	28	22	26
	2.0/1.6	27	24	27



a) East Diamond Lake Hwy

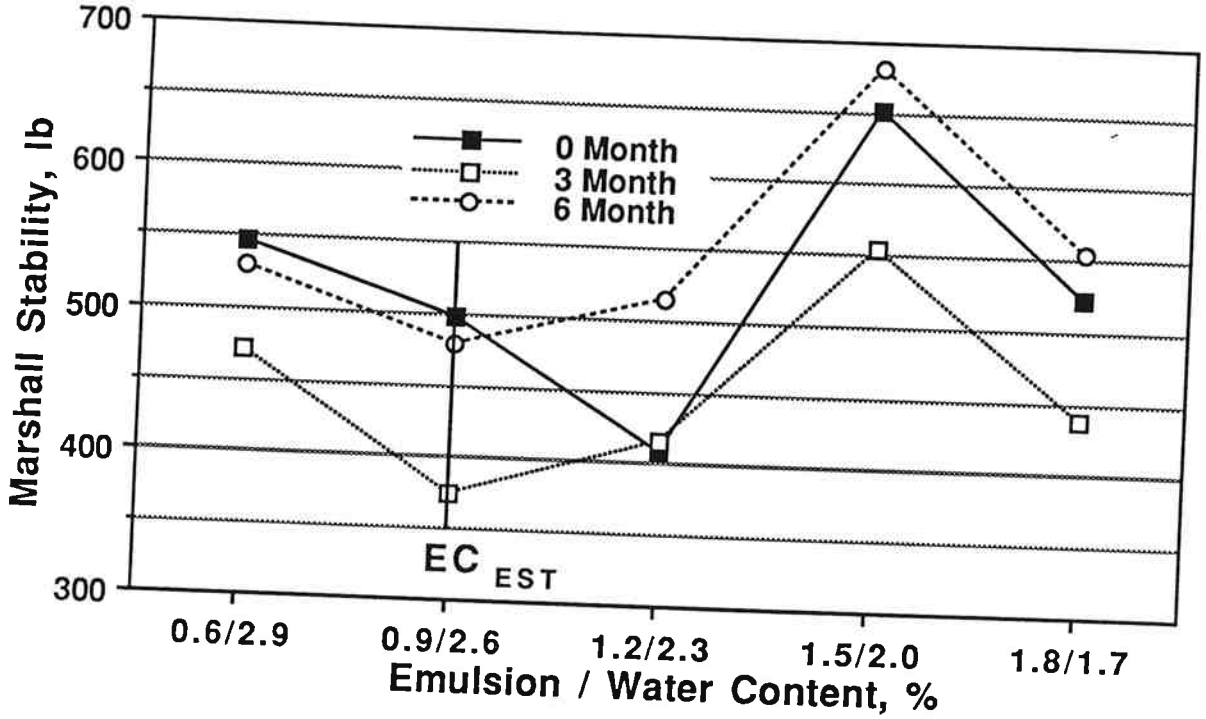


b) Stag Hollow Creek Road

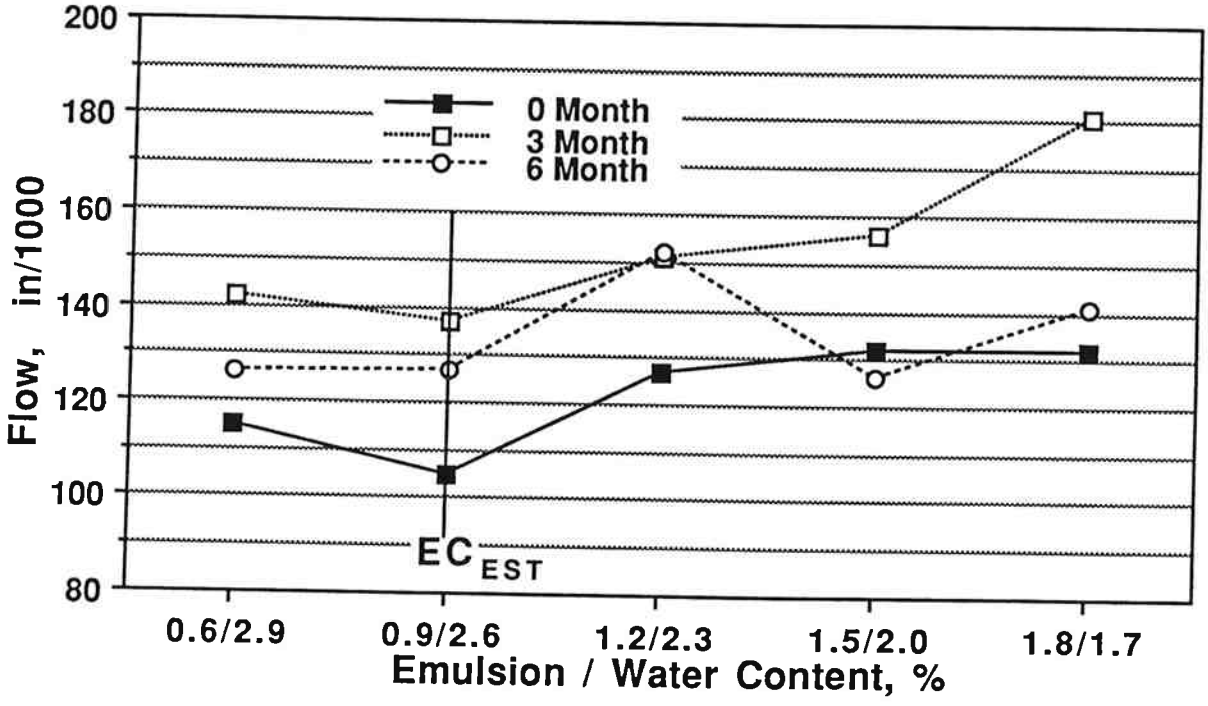
Figure 2.6. Hveem Stability of Mix Design Samples.

Table 2.7. Summary of Marshall Stability Results for Mix Design Samples

Project	Emulsion/Water Content (%)	ϕ Month Air Voids (%)	Marshall Stability, lb			Flow, in/1000		
			0 Month	3 Month	6 Month	0 Month	3 Month	6 Month
Umpqua Jct-The Dalles-California Hwy (East Diamond Lake Hwy)	0.6/2.9	15.9	546	472	530	105	142	126
	0.9/2.6	17.0	498	375	480	105	137	127
	1.2/2.3	16.4	409	415	515	127	151	152
	1.5/2.0	15.1	652	554	681	132	156	126
	1.8/1.7	15.4	522	438	555	132	181	141
Stag Hollow Creek Rd (Yamhill-Newberg Hwy)	0.8/2.8	16.5	269	334	475	119	162	178
	1.1/2.5	15.8	301	364	512	130	169	222
	1.4/2.2	14.8	291	352	536	139	151	221
	1.7/1.9	13.3	303	384	527	120	192	194
	2.0/1.6	13.3	362	345	482	188	169	270

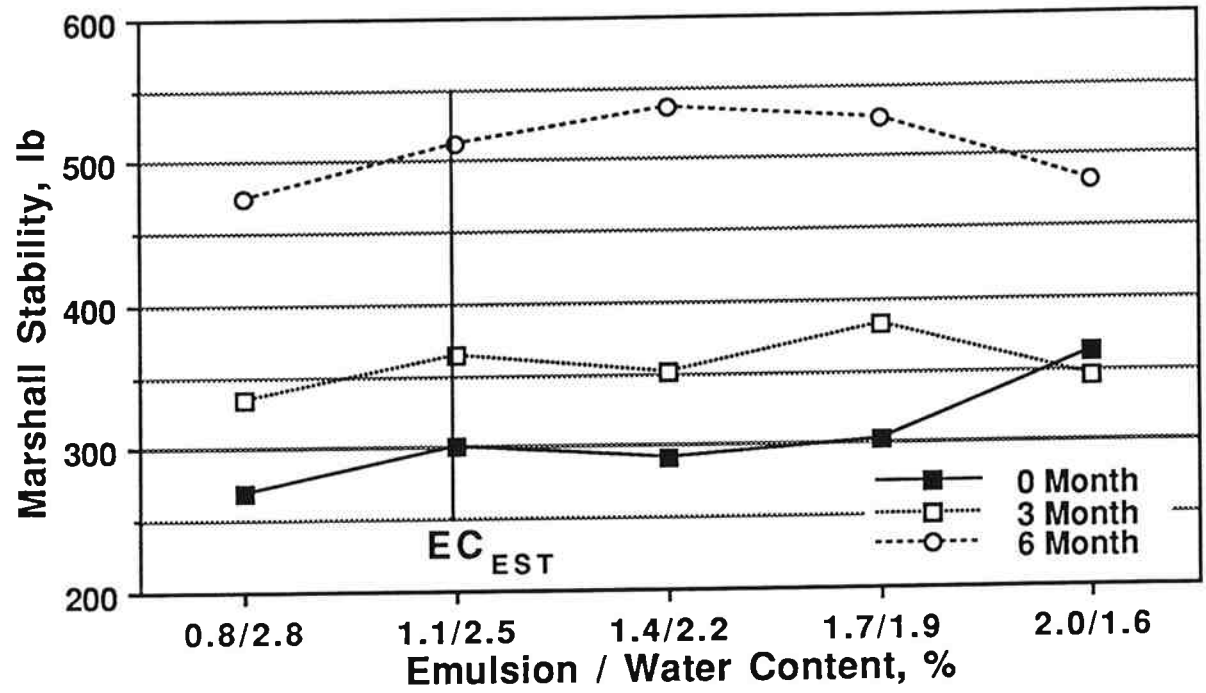


a) Stability

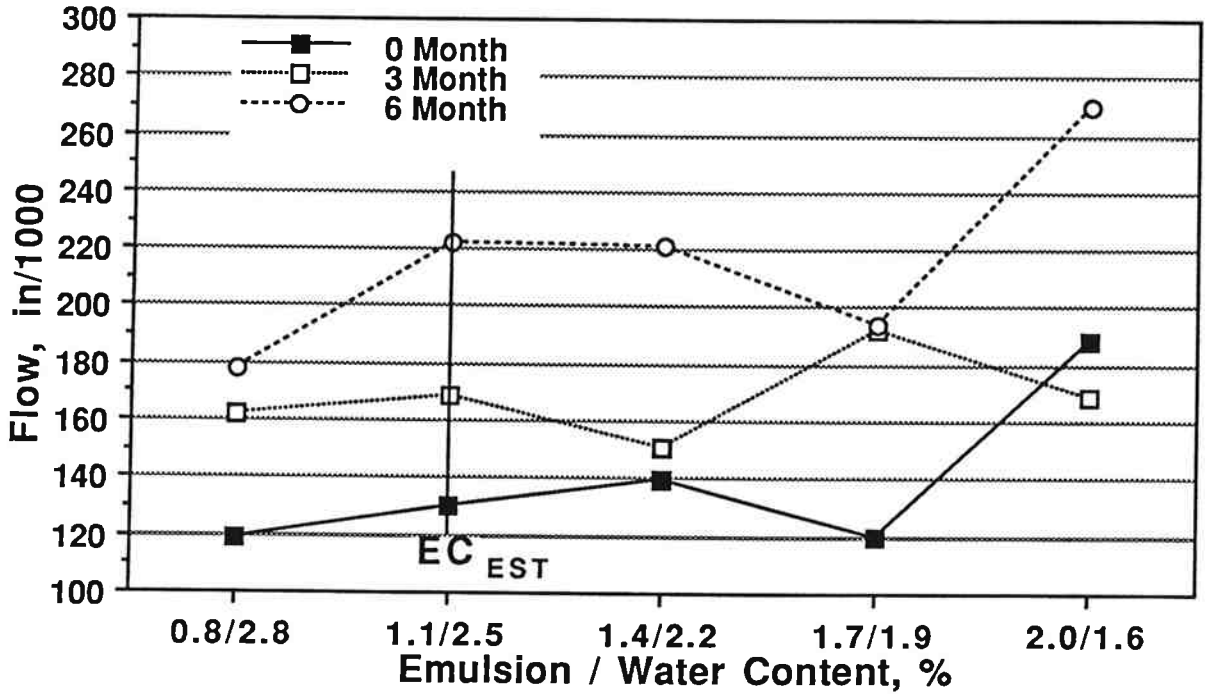


b) Flow

Figure 2.7. Marshall Stability for Mix Design Samples - East Diamond Lake Hwy.



a) Stability



b) Flow

Figure 2.8. Marshall Stability for Mix Design Samples - Stag Hollow Creek Road.

From the stability results, it is apparent that prediction of the emulsion content to be used in the field would be a difficult task since definitive trends in the data are, at best, fair to poor. Also specifying a minimum stability appears unwarranted since the maximum stabilities between the two projects differ significantly (i.e., 652 lb for the East Diamond Lake Hwy. project and 362 lb for the Stag Hollow Creek Rd.-Wapato Rd. project obtained during the 0 month test period). It should be pointed out, however, that the actual field installation of the Stag Hollow Creek Rd.-Wapato Rd. project has not performed well for reasons other than the mix design (improper project selection, inadequate base support).

2.6.5 Summary

It is apparent from the above results that use of mix property test results, for the purpose of predicting an emulsion content for field projects, is a difficult task. That is, none of the above mix property test results can, by themselves, or taken together, accurately predict the same emulsion content that is predicted by the estimation procedure (described in Section 2.1) which has been shown to be a good indicator of a starting point in the construction of recycled cold in-place mixtures.

2.7 Mix Design Procedure Resulting from Current Research Project

To be useful for mix design purposes, laboratory specimens need to be tested within a short time period after fabrication. For the current research, this suggests that zero-month test results are of most interest. Examination of the previously discussed zero-month test results for Hveem stability, Marshall stability and flow, resilient modulus, and fatigue shows no clear advantage over the results of the estimation procedure. Trends are hard to find, and when found, tend to contradict field experience. To illustrate, when zero-month test results are examined, the following is observed:

1) Modulus tests for the Stag Hollow Creek Rd. project show a "flat" curve which is not useful in choosing an optimum emulsion content. Use of peak modulus results for the East Diamond Lake project would result in excessive emulsion content.
2) Use of Marshall stability results in excessive emulsion content. Use of minimum Marshall flow results would predict reasonable emulsion contents (0.9% for East

Diamond Lake versus 0.9% by estimation and 0.9-1.0% actually used in the field; 0.8% for Stag Hollow versus 1.1% by estimation and 1.2% actually used in the field).

3) Maximum Hveem stability probably produces the best results, suggesting 0.6% for East Diamond Lake versus 0.9% by estimation and 0.9-1.0% actually used in the field, and 1.1% for Stag Hollow versus 1.1% by estimation and 1.2% actually used in the field.

Field experience indicates that when errors have been made in design emulsion content, they have generally been made by adding excessive emulsion, resulting in instability. This is particularly true when recycled pavements possess a fine gradation, rich asphalt content, or soft asphalt. Although the estimation process takes these factors into account, testing of laboratory briquettes for Marshall and Hveem stability, Marshall flow, modulus, and fatigue do not show any improvement over the estimation process and, of course, require additional time and expense. Consequently, ODOT's current design philosophy for CIR projects is to not go beyond the estimation procedure. This produces an acceptable starting point for field operations. Field adjustments as described below can then be quickly made to achieve mixture proportions which result in a recycled pavement which is constructible and will withstand the critical period of traffic during initial curing.

Gains in strength properties and fatigue lives obtained from curing of the emulsion will never be achieved if the mixture does not go down and stay down. Consequently, the constructibility of the CIR mix design becomes the overriding criterion and ODOT's experience is that the estimation process is the most efficient method of mix design likely to result in a constructible CIR mixture.

It is concluded that the estimation procedure for determining emulsion content presented in Section 2.2 and the method for determining water content described in Section 2.3 are the most efficient procedures for determining "mix designs" to be used as starting points for construction operations.

2.8 Field Adjustments

The mix design procedure discussed above provides a good starting point for construction. Field adjustments must be expected, however, due to the variability of the RAP and weather conditions. Field

adjustments are often made to recognize: (1) differences in RAP gradation, (2) isolated fat spots or unstable mixtures, and (3) visual appearance of the mat 2 to 3 hours after rolling. The field adjustments to the final estimated design emulsion content developed by ODOT are described in detail below:

1) RAP Gradation. RAP gradation should be checked frequently during construction. If differences from the RAP gradation used to estimate the emulsion content occur, the emulsion content is changed as described above (i.e., using Figure 2.2).

2) Isolated Fat Spots and Unstable Mixes. Isolated fat spots and unstable mixes should be noted ahead of the mill. The emulsion content is dropped 0.2% in areas that appear slightly fat and dropped 0.4% in areas that are obviously unstable and rutted. These adjustments are made only if field samples are not taken at the exact locations of the distress.

3) Visual Appearance. Minor adjustments of ±0.1% to ±0.2% may be made by visual appearance of the mat after initial compaction. Additional emulsion should be added (up to +0.2%) if the mat remains brown or is prone to raveling. On the other extreme, the emulsion content should be reduced 0.2% if the mat is very black and shiny and no raveling is apparent.

2.9 Summary of Findings

Significant findings include:

1) The procedure described in Section 2.1 (estimation procedure for emulsion content) and Section 2.3 (total liquids test) are believed to be the most efficient methods for providing a starting point for proportioning emulsion and water into the CIR mixture in the field.

2) Laboratory testing for diametral modulus, diametral fatigue, Hveem stability, and Marshall stability and flow show no advantage for "mix design" over the "estimation" procedure of Section 2.1.

3) Field adjustments to CIR mix designs or estimations will be required to accommodate variations in field materials and conditions.

3.0 PERFORMANCE DATA

One of the objectives of this research project was the evaluation of the performance of and estimation of life expectancy for CIR treatments using standard and high float emulsions. The following types of data were compiled and analyzed, and are discussed below:

1) Visual inspection by ODOT personnel.
2) Visual inspection by OSU research team.
3) Deflection data (Dynaflect) by ODOT personnel.
4) Diametral resilient modulus and fatigue, and Marshall stability and flow for field cores taken by ODOT personnel in 1988 and 1989.
5) Estimates of service lives by ODOT Region 4 Engineer and District Maintenance Supervisors (DMS's).

Items 1 and 5 were obtained for most of the CIR projects constructed between 1984 and 1988. Data collection for items 2 through 4 was confined primarily to ten of these projects which were selected for most intensive study.

This chapter begins with a summary discussion of the ten projects selected for most intensive study, in which all data available for these projects is summarized. Section 3.2 provides a summary of "visual inspection" for all CIR projects. Section 3.3 summarizes all deflection data for CIR projects. Various mix properties from the CIR projects are discussed in Section 3.4. Estimated service lives and life cycle cost analysis are presented in Sections 3.5 and 3.6, respectively. Section 3.7 discusses risks associated with CIR projects. Finally, performance "findings" are summarized in Section 3.8.

3.1 Performance Summary for the 10 Projects Selected for Intensive Study

The ten projects chosen for intensive study are listed in Table 3.1 which also includes construction information (i.e., project length, class of recycle, type of emulsion used, etc.). All projects were constructed using either CMS-2S or high float emulsions (HFE). The CMS-2S is a cationic medium set emulsion with up to 12% naphtha.

It should be pointed out that the Sand Shed-Mt. Bachelor project was one of the first surface recycling jobs constructed in Oregon. Since formal mix designs were unavailable in 1984, emulsion and water contents were established in the field using trial-and-error techniques by experienced paving personnel. The remaining projects (1985-1988) were constructed based on the results of formal mix designs which have evolved over time. (Reference 3 details the evolution of the mix design practices used in Oregon for CIR.)

A summary for the 10 projects selected for more intensive study is presented in Table 3.2. Most of these projects were inspected by the OSU research team in May, 1990. Summary discussions of these 10 projects are presented below.

Sand Shed - Mt. Bachelor (1984): Although this project was a Class III recycle job, visual inspection indicated that it had a fair overall condition rating in both 1989 and 1990. The project has had signs of some fatigue (alligator) cracking and potholes, minor rutting and flushing, and has had some patching. It is expected to have a service life of 9 years without significant patching. This project has little truck traffic. The photograph of Figure 3.1 gives an indication of the surface condition of this project.

This section was fairly typical of CIR treatments in that deflections increase 7% after CIR. Five years after construction, cores indicated air voids of 7.7%, and some of the highest modulus, fatigue, and Marshall stability values of the projects tested. Since experience indicates strengthening of CIR treatments with age and the curing of the emulsion, and since this is ODOT's oldest project, this is not surprising. This has been a very successful project.

Table 3.1. CIR Projects (1984-1988) Chosen for In-Depth Evaluation

Year	Highway	Project Name	Length (mi.)	Recycle Depth (in.)	Emulsion Type (Content)	Class of Treatment	Surface Treatment
1984	OR 372	Sand Shed-Mt. Bachelor	5.0	1.5	CMS-2S (1-2%)	Class III	Surface left open winter of 1984, chip sealed in 1985
1985	OR 20	Drews Gap-Lakeview	11.0	1.5-2	CMS-2S (1-2%)	Class I	Polymer chip seal
	OR 49	Harney Co. Line-Hogback Summit	30.7	1.5-2	CMS-2S (1-2%)	Class I	Chip seal
1986	OR 53	MP 79.2-Wasco Co. Line	17.3	2-4	CMS-2S (1%)	Class I	Polymer chip seal
	OR 41	MP 89.6-Jct. OR 19	8.7	1.5-2	CMS-2S (1.4-1.5%)	Class I	Chip seal
	OR 270	Lakeshore Dr.-Greensprings Jct.	6.4	2.5-4	CMS-2S (1.4%)	Class I	Chip seal
	OR 372	Lava Springs-Sand Shed	5.7	2	CMS-2S (1%)	Class I	Chip seal
1988	OR 426	Jct. Klamath Falls-Malin Hwy-CA Line	2.8	2	CMS-2S (0.5%)	Class I	None
	OR 42	MP 13.27-Moro	4.8	2	HFE-150 (1.0%)	Class I	Polymer chip seal
	OR 22	Fort Klamath-Crooked Creek	5.7	2	HFE-150 (1.1%)	Class I	Sand seal

NOTES:

1. Class I refers to recycling a uniform pavement designed and built to specifications.
2. Class II refers to recycling a pavement with significant patching or of minimal design.
3. Class III refers to full depth reclamation.

Table 3.2. Summary Data for 10 Selected Projects

Project	Year Constr.	Range of Change In Defl. Bef/Aft CIR	Air Voids (%)		Average Modulus		Fatigue Life (1000 cycles)		Marshall Stability (lb)		Marshall Flow (in./100)		Life as Wearing Course		Total Expected Life as Wearing Course	Condition Rating		Research Team's Evaluation of Project
			1988	1989	1988	1989	1988	1989	1988	1989	1988	1989	Before Sig. Patching	After Sig. Patching		1989	1990	
Sand Shed-Mt. Bachelor	1984	7%		7.7		713		138		2410		17			9	fair	fair	very successful
Drews Gap-Lakeview	1985	-16% to 34%	5.8	5.2	499	531	62	98	1196	2049	22	20	2	6	8	fair-good	fair	successful
Harney Co. Line-Hogback Summit	1985	-1% to 5%	8.8	10.1	508	485	109	176+	788	1607	33	19	2	5	7	fair-poor	good	marginal
M.P. 79.2-Wasco Co. Line	1986	-2% to 18%	10.8	7.4	377	526	54	150+	1106	1181	21	18	1	2	3	fair-poor	fair	unsuccessful
M.P. 89.6-Jct. OR 19	1986	-26% to -17%	9.8	6.6	607	479	47	58	928	1372	22	17			8	good	fair	very successful
Lakeshore Dr.-Greensprings Jct.	1986	-5% to 6%	12.9	13.0	530	727	79	250+	1171	1597	24	17	3	6	9	good	fair	successful
Lava Springs-Sand Shed	1986		11.3	13.3	451	487	59	119	1392	1625	29	18			6	good	fair	very successful
Jct. Klamath Falls-Malin Hwy-CA Line	1988		10.1	9.1	603	780	28	41	1028	1816	21	19			7	good	fair	successful
M.P. 13.27-Moro	1988	23% to 51%	12.4	11.7	253	445	18	26	683	1566	26	17					good	successful
Fort Klamath-Crooked Creek	1988		14.5	12.9	490	501	11	24	595	1023	24	17			8	good	fair	successful

Figure 3.1. Sand Shed-Mt. Bachelor Typical Surface Condition, May 1990.

Drews Gap - Lakeview (1985): In 1989, this project had a fair-to-good condition rating with minor distress, mainly thermal cracking, and some flushing in the wheel tracks. The 1990 rating was still fair. It is expected to have a service life of 8 years, although significant patching was required on portions of the project after only 2 years. Figure 3.2 shows both the surface condition at the location of cores and an example of a full-width transverse crack on this project.

Changes in deflection with the CIR treatment were highly variable, increasing in some cases and decreasing in others. Air voids were the lowest of any of the projects studied. All mechanical test results were favorable 4 and 5 years after construction. This has been a successful project.

Harney Co. Line - Hogback Summit (1985): This project is divided into three sections for discussion purposes as follows:

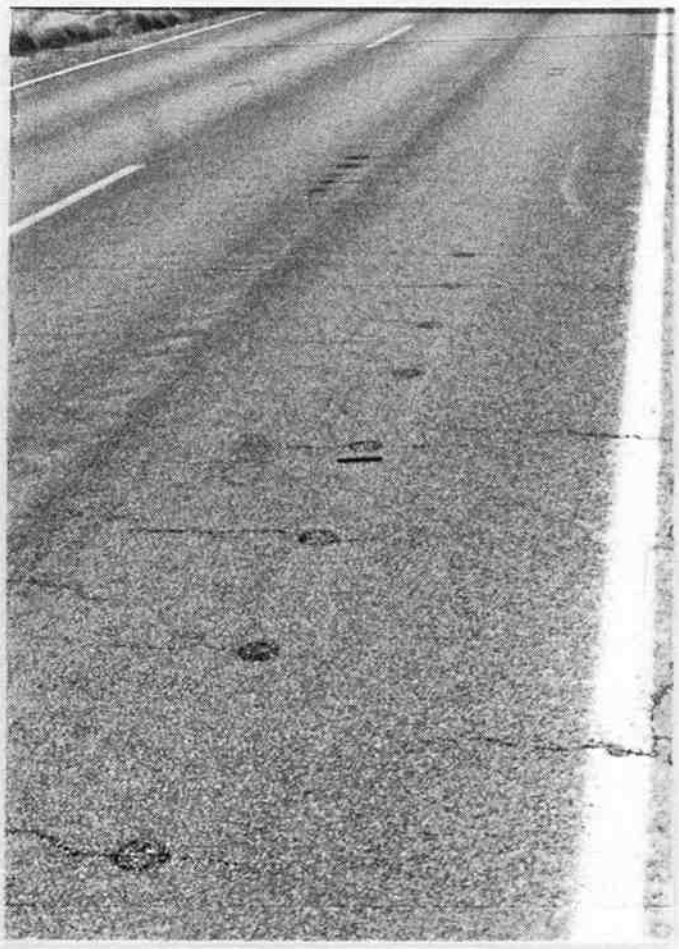
1) Harney Co. Line - Bacon Camp Rd.,
2) Bacon Camp Rd. - MP 57, and
3) MP 57 - Hogback Summit.

The first section had a fair condition rating in 1989 with minor distress (minor rutting, flushing, and fatigue cracking). However, between mile posts 39 and 41, sections of the pavement were gone and some areas showed bare gravel while others were fat with asphalt. Between mile posts 44 and 47 the pavement looked fine with no potholes but had slight bleeding problems. Figure 3.3 shows the surface condition in May 1990 at mile post 42.2.

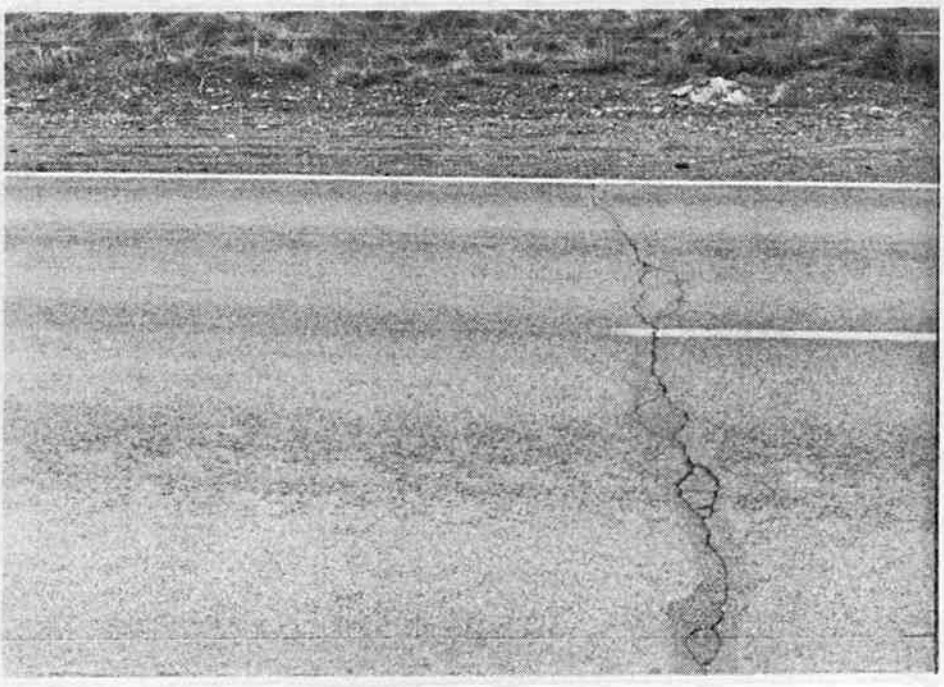
The second section had a fair condition rating in 1989, but looked dry, with some of the pavement falling apart in large potholes. Consequently, major maintenance work had been required on this section.

The third section had a poor condition rating in 1989 with more pronounced rutting and thermal cracking relative to the other two sections. Although the pavement looked acceptable visually, the surface had a rough texture resulting in poor ride characteristics.

It is interesting to note that the condition ratings made in 1988 and 1990 gave overall ratings to this total project of good. The differences in surface ratings are understandable. The research team inspected this project in May 1990. Clearly there are areas where localized failures have required



a) At Location of Cores



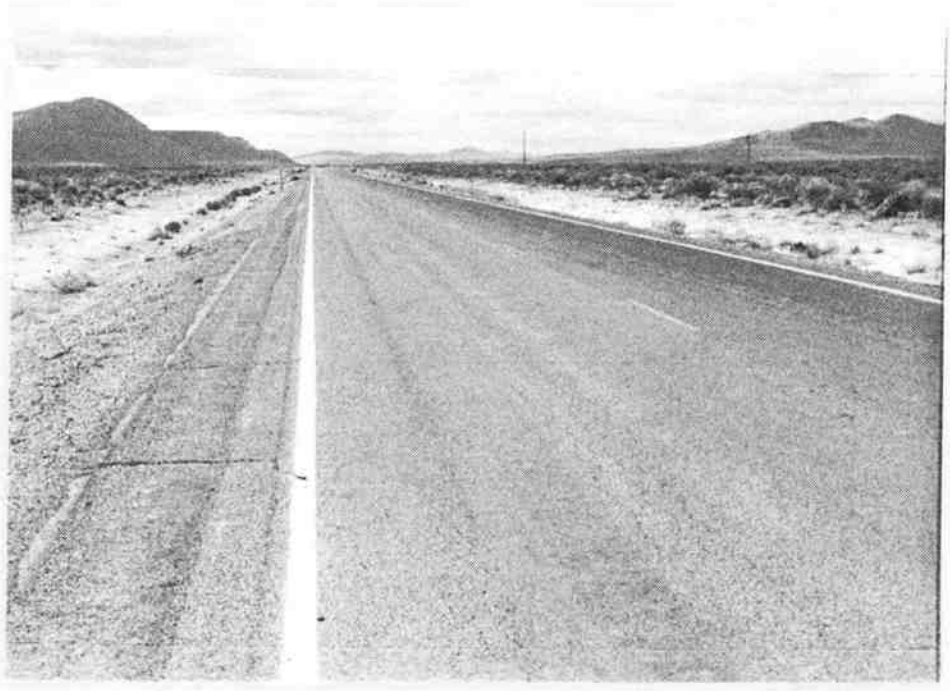
b) Typical Transverse Crack

Figure 3.2. Drew's Gap-Lakeview Surface Condition, May 1990.

a) M.P. 42.2 Southbound - 7/8-Inch Rut and Alligator Cracks

b) M.P. 42.2 Southbound Lane - Alligator Cracks

Figure 3.3. Harney Co. Line-Hogback Summit Surface Condition, May 1990.



c) M.P. 42.2 Northbound Lane

Figure 3.3. Harney Co. Line-Hogback Summit Surface Condition, May 1990 (continued).

maintenance. Many of these are related to base failures. Still, the condition of this section is much better than that of many non-recycled sections of this highway.

This project in excess of 30 centerline miles is expected to have a total service life of 7 years. Significant patching began in some sections after only 2 years. Deflections for this project changed very little with the CIR treatment. Mechanical properties of cores tested are indicative of the better performing sections of this project. The high fatigue lives of the cores could not be predicted by observation of field performance. This project's performance has been marginal.

MP 79.2 - Wasco Co. Line (1986): This project was divided into two sections for inspection purposes with both sections showing distress. In 1989, one section had a fair condition rating while the other had a poor rating. Both projects received fair ratings in 1990. Significant maintenance work has been required to maintain these ratings. Because this project was intensively studied in the 1986 study (1,2), substantial effort was given to the investigation of the cause or causes of the failure of this project. It was determined that the pavement was recycled with too high of an emulsion content and that a polymer chipseal was placed too soon.

This project was visited in August of 1990 when a section of this project was getting CIR treatment, this time with a target addition of 3% lime. Stripping has been a problem. It was hoped that recycling with lime could stabilize this problem.

During the August 1990 visit, the entire length of the 1986 recycle project was examined, with the conclusion that only about 30% of the original project was still serving as a wearing course, and most of that was heavily patched. As previously noted, sections had been inlaid.

The deflections and mechanical properties measured for this project give no indication that the majority of the project was a failure, except perhaps the 1989 Marshall stabilities which are relatively low for 3 year old pavements. The majority of the project had a service life of only 3 years, with maintenance beginning the first year. This project was unsuccessful.

MP 89.6 - Jct. OR 19 (1986): In 1989 this project had a good condition rating. Only minor distress (some rutting and flushing) was apparent and the pavement had experienced only minor maintenance work. The surface condition had fallen to fair in the 1990 rating.

Deflection readings for this project were unusual in that both readings decreased after CIR treatment. This was also only one of two projects showing a decrease in modulus between 1988 and 1989 cores.

Service life is predicted to be 8 years, with no significant patching experienced to-date. This has been a very successful project.

Lakeshore Dr. - Greensprings Jct. (1986): In 1989, this project had a good condition rating with only minor distress. Some fat spots were apparent and cracks in the shoulders were beginning to spread into the recycled pavement. Also, some signs of raveling had appeared in the eastbound lane.

In 1990, the surface condition rating had dropped to fair, but there were still no signs of serious distress. Figure 3.4 presents photographs of a typical section of this project.

The air voids for this project are the highest of the 1986 projects cored, but mechanical properties still look good. Service life is predicted to be 9 years with significant patching experienced in some areas after only 3 years. This has been a successful project.

Lava Springs - Sand Shed (1986): This project was rated good in 1989 and fair in 1990. This project has experienced no significant patching to-date, and is expected to have a service life of 6 years. Figure 3.5 shows the contrast between the recycled travel lane and the non-recycled shoulder area.

No unusual results are apparent from mechanical testing. This has been a very successful project.

Jct. Klamath Falls - Malin Hwy - CA line (1988): In 1989 this project had a good condition rating after having been in service through one winter. No maintenance work had been performed and only minor distress (fatigue cracking) was apparent. It should be noted that the original pavement was stripped. The surface condition rating had fallen to fair in 1990, but service life is still expected to be 7 years and no significant patching has been experienced to-date. Air voids were relatively low and modulus and 1989 Marshall stability were relatively high, given the age of the pavement. This is a successful project.

MP 13.27 - Moro (1988): 1989 -- This project was inspected independently in 1989 with the conclusion that the pavement had a consistent gradation and asphalt content throughout the project. However, areas in the wheel paths had started to show signs of wear and had a somewhat smooth

a) M.P. 66.8 Westbound

b) M.P. 66.8 Eastbound

Figure 3.4. Lakeshore Dr.-Greensprings Jct. Surface Condition, May 1990.

Figure 3.5. Lava Springs-Sand Shed, May 1990. Non-recycled shoulder on left and recycled travel lane on right.

appearance. ODOT's 1990 rating for this section was good. No forecast of service life was available. This project was unusual in that deflection increases after CIR were substantial. This is a successful project.

Fort Klamath - Crooked Creek (1988): In 1989 this project had a good condition rating. However, the pavement had some segregation problems as well as some ravelling, bleeding, and cracking. The 1990 rating was fair. Figure 3.6 shows a picture of a typical section of this project. Expected service life is 8 years. This project had the highest air voids and lowest fatigue life and stability of the '88 projects which were cored. This is a successful project.

3.2 Visual Inspection

Table 3.3 presents descriptive and surface rating information developed by ODOT personnel for the majority of CIR projects constructed by ODOT between 1984 and 1988. These projects were constructed in the high desert environment of ODOT's Region 4. The ten projects selected for more intensive study are noted by †. Surface condition ratings are presented for both spring 1989 and spring 1990. It should be noted that the raters were rating the visible surface present in 1989 and 1990. This means that in some cases, they were rating CIR treatments which had been patched, overlaid, or in two cases (MP 79.2-Bridge Cr and Bridge CR-County Line) inlaid. Because of this factor, the information presented later in this report in the service life section is considered of more value than the information presented in Table 3.3.

The percent of CIR projects rated good and better was 38% in 1989 and 34% in 1990. The percent of CIR projects rated fair and better was 79% in 1989 and 85% in 1990. Again, the reader must remember that in some cases, maintenance or overlays have been required to achieve these ratings.

3.3 Deflection Data

Deflection data have been obtained over time on nine of the ten projects selected for more intensive study. Data were not available for the Lava Springs - Sand Shed project. Table 3.4 presents

Figure 3.6. Ft. Klamath-Crooked Creek, May 1990, New Chip Seal.

Table 3.3. Performance Evaluation

Year Built	Section	Hwy No.	M.P.	M.P.	Length (mi.)	Depth of CIR (in.)	Emulsion Used	Original Pavement	Spring 1989							Spring 1990 Overall Rating	Notes
									Rut Depth (in.)		Thermal Crack Spacing (ft)	Flushing	Fatigue Cracks	Maint. Work	Overall Rating		
									Lt.	Rt.							
1984	Fremont Hwy-(N. Lane)	19	8.0	8.6	0.6	1.5	CMS-2S	C		1/16	20-60	–	minor	minor	fair	–	Delete from study.
	Fremont Hwy-(N. Lane)	19	16.8	18.3	1.5	1.5	CMS-2S	C	3/16	5/16	20-60	heavy	minor	major	poor	–	Delete from study.
	Sand Shed-Mt. Bachelor†	372	16.6	21.6	5.0	1.5	CMS-2S	C	1/16	3/16	occasional	minor	minor	minor	fair	fair	Intermittent CIR between mile points.
1985	Sisters-Dry Creek	15	93.2	99.0	5.8	2	CMS-2S	C	1/8	1/16	30-50	heavy	minor	–	poor-fair	fair	
	Dry Creek-Warm Rd	15	99.0	105.0	6.0	2	CMS-2S	0-11	1/8	3/16	30	–	minor	–	fair	fair	
	Warm Rd.-Redmond	15	105.0	111.9	6.9	2	CMS-2S	B	1/8	1/8	15-30	–	minor	–	fair-good	fair	
	Summit Drews Gap-Lakeview†	20	81.8	92.8	11.0	1.5	CMS-2S		1/16	1/8	30-100	minor	minor	minor	fair-good	fair	
	Harney Co. Line-Bacon Camp Rd†	49	35.1	49.0	13.9	1	CMS-2S	variable	1/8	3/16	130	minor	minor	major	fair	good	Maintenance due to delamination.
	Bacon Camp Rd-M.P 57†	49	49.0	57.0	8.0	1	CMS-2S	variable	3/16	1/8	–	–	minor	major	fair	good	
	M.P. 57-Hogback Summit†	49	57.0	65.8	8.8	1	CMS-2S	variable	3/16	3/16	100	–	minor	major	poor	good	
	O'Neil-Prineville*	370	9.5	17.7	8.2	1	CMS-2S	0-9?	3/16	1/8	70-30	minor	minor	minor	poor	–	Grader laid.
1986	Pilot Butte-Powell Butte Jct	7	1.1	4.3	3.2	2	CMS-2S	B	1/16	1/16	–	–	–	–	good	–	Overlaid w/1.5 in. AC; condition before overlay.
	Horse Ridge-Fort Rock Rd	7	16.1	21.0	2.9	3	CMS-2S	B	1/8	3/16	20	minor	minor	–	fair-good	good	
	G.I. Ranch-Harney Co. Line	7	75.0	84.0	9.0	1.5	CMS-2S	C	3/16	3/16	30-120	minor	–	minor	fair-good	fair	US 20 test section.
	Dairy-Wild Horse Cr	20	19.0	25.0	6.0	1.5	CMS-2S	C	5/16	1/8	–	heavy	–	major	poor	fair	Maintenance due to base failure; polymer seal.
	Sprague R. Rd-Sycan Marsh Rd	20	35.9	42.2	6.3	1.5	CMS-2S	C	1/8	3/16	60	minor	–	minor	fair	fair-poor	Polymer seal.
	Sycan Marsh-Bly	20	42.2	54.0	11.8	1.5	CMS-2S	C	1/8	3/16	–	minor	–	minor	fair	fair-poor	
	Powell Butte-Houston Lake Rd	41	6.8	16.5	9.7	1.5	CMS-2S HFE-150	variable	3/16	1/4	100	–	minor	major	poor	very good	No seal initially; pavement flushed when sealed; overlaid w/OGEM in 1989.
	Ochoco Dam-Ranger Station	41	249.9	35.5	10.6	1.25	CMS-2S	oil mat	1/16	3/16	–	minor	–	minor	fair	good	Overlaid w/OGEM in 1989.
	Keys Cr Summit-Whiskey Cr	41	73.4	81.6	8.2	2	CMS-2S	C?	1/16	1/16	–	–	–	–	good	good	Overlaid w/OGEM in 1989.
	M.P. 89.6-Jct John Day Hwy†	41	89.6	98.4	8.8	1.5	CMS-2S	oil mat	3/16	1/16	–	minor	–	minor	good	fair	Chip sealed in 1986.
	M.P. 79.2-Bridge Cr†	53	79.2	86.9	7.7	1.5	CMS-2S	B	3/16	1/8	occasional	minor	–	signif.	fair	very good-fair	Early polymer seal; recycled w/too much emulsion.
	Bridge Cr-County Line†	53	86.9	96.5	9.6	1.5	CMS-2S	C	1/8	3/16	60	minor	–	signif.	poor	very good-fair	Early polymer seal; recycled w/too much emulsion.
	Lake Shore Dr-Gr. Spgs. Hwy†	270	62.4	68.8	6.4	1.5	CMS-2S	B	3/16	1/8	–	minor	minor	–	good	fair	
	Tub Springs Rd-Antelope*	293	9.0	13.5	4.5	1-1.5	CMS-2S	oil mat	1/16	1/8	–	minor	–	–	good	–	
	McKay Cr-Prineville*	380	23.7	26.3	2.6	1.5	CMS-2S	B2-oil mat	1/8	1/4	–	minor	minor		fair-good	–	Partially (1 mi.) overlaid in 1986.
	Jct Ochoco Hwy-Desch. Co. Line	371	0.0	7.6	7.6	.75-1.5	HFE-150 CMS-2S	C & B & oil mat	1/4	3/16	–	heavy	minor	minor	fair-good	fair	
	Desch. Co. Line-Jct Cent. Ore.	371	7.6	18.0	10.4	.75-1.5	CMS-2S	oil mat	1/8	3/16	30-80	–	minor	minor	fair-good	fair	
	Lava Springs-Sand Shed*†	372	11.0	16.6	5.6	2	HFE150	B	1/8	3/16	60-100	–	minor	–	good	fair	

*CIR done by State forces
†10 selected projects

Table 3.3. Performance Evaluation (continued).

Year Built	Section	Hwy No.	M.P.	M.P.	Length (mi.)	Depth of CIR (in.)	Emulsion Used	Original Pavement	Spring 1989							Spring 1990 Overall Rating	Notes
									Rut Depth (in.)		Thermal Crack Spacing (ft)	Flushing	Fatigue Cracks	Maint. Work	Overall Rating		
									Lt.	Rt.							
1987	Fort Rock Rd-Crooked R. Hwy*	7	21.0	30.2	9.2	2	several	B	N/A	1/8	60-90	–	minor	–	poor-good	–	East lane only; overlaid w/OGEM in 1988.
	Whiskey Cr-M.P. 89.6*	41	81.6	89.6	8.0	1-2.5	CMS-2S	variable	1/8	1/8	–	heavy	–	minor	good	good	
	Jct Hwy 97-Tub Springs Rd*	293	0.0	9.0	9.0	1.25-2	CMS-2 EB HFE-150 WB	oil mat	1/16	1/8	–	minor	–	–	good	fair	
	Jct Hwy 97-Rammes Rd*	380	0.0	9.0	9.0	1.75-2	CMS-2S NB HFE-150 SB	oil mat	3/16	1/8	–	minor	minor	–	fair	fair	No base.; recycled w/too much emulsion.
	Conant Basin Rd-Shotgun Rd*	380	20.7	29.8	9.1	1.5-2	CMS-2S	variable	1/8	1/8	–	minor	–	–	good	fair	Overlaid w/0-9 in 1987.
1988	Shaniko Jct-Quaale Rd	4	67.2	75.6	8.4	1.5	HFE-150	B	1/8	3/16	–	–	–	–	poor-fair	good	M.P. 67.2-69.2 (SB) failed due high asphalt - 2 in. ruts.
	Shaniko Jct-Qualle Rd	4	75.6	78.6	3.0	1.5	HFE-150	0-11	1/16	1/8	–	–	minor	–	good	good	
	Shaniko Jct-Qualle Rd	4	78.6	80.0	1.4	1.5	HFE-150	0-11	0	0	–	–	–	–	good	good	
	M.P. 152-CA Line*	19	152.0	157.7	5.7	2	CMS-2S	B?	3/16	3/16	–	minor	minor	major	poor	poor	Unstable.
	Houston Lake Rd-Prineville*	41	16.5	18.0	1.5	2	HFE-150 HFE-150S	B & C	1/16	1/16	–	–	–	–	good	good	Scheduled to be overlaid w/AC.
	Prineville-Ochoco Dam*	41	19.4	24.9	5.5	2	HFE-150	B & C & oil mat	1/16	1/8	–	minor	–	minor	fair-good	good	Overlaid w/OGEM in 1989.
	Ochoco Ranger St-Rich Cr*	41	35.5	45.0	9.5	2	CMS-2S HFE-150	variable	0	1/16	–	–	–	–	good	fair	
	Wheeler Co. Line-W. Brand Cr*	41	50.1	60.3	10.2	2	HFE-150	variable	1/8	0	–	–	–	–	good	fair	
	Lake Abert-Valley Falls*	49	87.0	89.9	2.9	1-1.5	CMS-2S	oil mat	3/16	1/4	–	minor	minor	major	poor	fair	Fat oil mat.
	Merrill-Jct Hatfield Hwy*	50	13.7	16.3	2.6	2	CMS-2S	B	1/8	1/16	100-200	minor	–	–	good	poor	
	Jct Ochoco Hwy-Burma Rd	380	0.0	11.8	11.8	2	HFE-150	C?	1/8	1/16	–		minor	–	fair	poor-good	No seal - raveled.
	Burma Rd-Conant Basin Rd	380	11.8	20.7	8.9	2	HFE-150	C?	1/16	1/16	–		–	–	good	poor-good	Sealed in 1988.
	Malin Hwy-CA Line†	426	0.0	2.4	2.4	2	CMS-2S	Mod-B w/seal	1/8	1/8	–		minor	–	good	fair	Stripped.
	Crater Lake Hwy (Ft. Klamath-Crooked Cr)†	22	90.07	95.4	5.3	2	HFE-100S	E							good	fair	

*CIR done by State forces
†10 selected projects

Table 3.4. Deflection Data for Selected Projects

Project	Year Recycled	M.P.	Date Deflected	Deflection* (mils)	Equiv. Benkleman Beam	Before or After CIR	Change from Before to After
Sand Shed-Mt. Bachelor (Century Drive)	1984	17.49 SB	8/84	1.43	34.13	Before	7%
			8/85	1.53	37.19	After	
			7/86	1.75	44.11	After	
			6/89	1.86	47.59	After	
		17.58 NB	8/84	1.53	37.05	Before	7%
			8/85	1.64	40.33	After	
			7/86	1.80	45.61	After	
			6/89	1.95	50.47	After	
Harney Co. Line-Hogback Summit (Lakeview-Burns Hwy)	1985	36.00 SB	5/85	1.29	30.02	Before	5%
			8/85	1.36	32.02	After	
			7/86	1.30	30.28	After	
			8/87	1.40	33.24	After	
			5/89	2.12	56.46	After	
		36.09 NB	5/85	1.39	32.83	Before	5%
			8/85	1.46	34.85	After	
			7/86	1.39	32.77	After	
			8/87	1.47	35.19	After	
			5/89	2.27	61.71	After	
		60.00 NB	8/84	2.43	67.88	Before	-1%
			8/85	2.40	66.81	After	
			7/86	3.03	91.81	After	
			8/87	2.68	77.20	After	
			5/89	2.08	54.76	After	
		60.33 SB	8/84	1.35	31.71	Before	0%
			8/85	1.35	31.67	After	
			7/86	1.33	31.07	After	
			8/87	1.36	31.81	After	
			5/89	1.95	50.31	After	
		64.26 SB	5/89	1.72	43.16	After	
Drews Gap-Lakeview (Klamath Falls-Lakeview Hwy)	1985	86.02 EB	7/84	0.93	20.00	Before	-16%
			4/85	1.39	33.14	Before	
			8/85	1.17	26.81	After	
			7/86	1.09	24.31	After	
			5/89	1.12	25.19	After	
		86.11 WB	7/84	0.82	17.27	Before	-14%
			4/85	1.22	28.13	Before	
			8/85	1.05	23.32	After	
			7/86	0.86	18.38	After	
			5/89	0.95	20.55	After	
		87.40 WB	5/89	1.14	25.67	After	
		93.50 EB	7/84	1.46	35.05	Before	0%
			7/86	1.46	35.12	After	
			5/89	1.51	36.64	After	
		94.00 WB	7/84	1.63	40.13	Before	34%
			6/85	1.28	29.63	Before	
			7/86	1.72	42.86	After	
			5/89	1.81	45.88	After	

*Average of 11 readings

Table 3.4. Deflection Data for Selected Projects (continued)

Project	Year Recycled	M.P.	Date Deflected	Deflection* (mils)	Equiv. Benkleman Beam	Before or After CIR	Change from Before to After
M.P. 79.2-Wasco Co. Line (Warm Springs)	1986	88.00 SB	4/86 10/86 9/87 5/89	0.66 0.65 0.71 0.76	13.27 13.19 14.45 15.91	Before After After After	-2%
		88.19 NB	4/86 10/86 9/87 5/89	0.71 0.77 0.72 0.80	14.63 16.11 14.93 16.82	Before After After After	9%
		88.28 SB	4/86 10/86 9/87	0.74 0.71 0.67	15.27 14.51 13.61	Before After After	-4%
		88.47 NB	4/86 10/86 9/87	0.62 0.63 0.63	12.54 12.74 12.60	Before After After	2%
		88.56 SB	4/86 10/86 9/87 5/89	0.56 0.55 0.52 0.57	11.07 10.67 9.99 11.15	Before After After After	-2%
		88.75 NB	4/86 10/86 9/87 5/89	0.57 0.67 0.68 0.79	11.31 13.65 13.97 16.51	Before After After After	18%
		89.90 NB	5/89	0.81	17.04	After	
Lakeshore Dr-Greensprings Jct (Lake of the Woods)	1986	63.28 EB	4/86 10/86 9/87 5/89	1.29 1.33 1.19 1.46	29.90 31.06 27.09 34.75	Before After After After	3%
		63.36 WB	5/89	1.18	26.83	After	
		63.47 WB	4/86 10/86 9/87 5/89	1.40 1.33 1.12 1.42	33.02 30.92 25.22 33.59	Before After After Afte	-5%
		63.56 EB	4/86 10/86 9/87 5/89	1.21 1.28 1.08 1.41	27.60 29.52 24.02 33.48	Before After After After	6%
		63.75 WB	4/86 10/86 9/87 5/89	1.13 1.18 1.03 1.27	25.50 26.84 22.60 29.33	Before After After After	4%

*Average of 11 readings

Table 3.4. Deflection Data for Selected Projects (continued)

Project	Year Recycled	M.P.	Date Deflected	Deflection* (mils)	Equiv. Benkleman Beam	Before or After CIR	Change from Before to After
M.P. 89.6-Jct OR 19 (Ochoco Hwy)	1986	96.40 WB	6/89	2.50	70.02	After	
		96.91 EB	6/84 6/86 10/86 6/89	1.30 1.81 1.34 2.42	30.39 46.25 31.60 67.01	Before Before After After	-26%
		97.00 WB	6/84 6/86 10/86 6/89	1.41 1.52 1.26 2.69	33.75 37.26 39.07 77.36	Before Before After After	-17%
Jct Klamath Falls-Malin Hwy-CA State Line (Hatfield Hwy)	1988	0.75 SB	5/89	2.51	70.85	After	
		0.75 NB	5/89	2.41	66.99	After	
		1.00 SB	5/89	2.43	68.08	After	
		1.25 SB	5/89	2.74	79.62	After	
		1.25 NB	5/89	2.80	81.97	After	
Fort Klamath-Crooked Creek (Crater Lake Hwy)	1988	90.50 WB	5/89	2.29	62.50	After	
		90.50 EB	5/89	2.37	65.15	After	
		91.00 WB	5/89	2.67	77.06	After	
		91.00 EB	5/89	2.57	72.69	After	
		94.00 EB	5/89	2.37	65.50	After	
MP 13.27-Moro (Sherman Hwy)	1988	17.30 SB	7/85 7/87 4/89	0.55 0.74 0.91	10.80 15.32 19.56	Before Before After	23%
		17.39 NB	7/85 7/87 4/89	0.50 0.70 1.06	9.58 14.40 23.39	Before Before After	51%
Horse Ridge-Crooked River Jct (Central Oregon Hwy)	1989	23.00 EB	5/89 6/90	1.29 2.5	27.78 70.02	Before After	94%
		23.00 WB	5/89 6/90	1.16 2.49	26.36 69.74	Before After	115%
		29.91 EB	6/85 6/87 5/89 6/90	1.14 1.50 1.54 1.61	25.57 36.31 37.41 39.55	Before Before Before After	5%
		30.00 WB	6/85 6/87 5/89 6/90	1.03 1.18 1.22 1.50	22.68 26.92 27.96 35.95	Before Before Before After	23%

*Average of 11 readings

Table 3.4. Deflection Data for Selected Projects (continued)

Project	Year Recycled	M.P.	Date Deflected	Deflection* (mils)	Equiv. Benkleman Beam	Before or After CIR	Change from Before to After
Umpqua Jct-US 97 (East Diamond Lake Hwy)	1989	5.00 WB	5/89 6/90	2.05 1.75	54.08 43.87	Before After	-15%
		5.00 EB	5/89 6/90	2.09 1.84	55.44 46.95	Before After	-12%
		5.50 WB	5/89 6/90	2.01 1.71	52.62 42.64	Before After	-15%
		5.50 EB	5/89 6/90	2.21 1.77	59.34 44.71	Before After	-20%
Hackett Dr-Crescent (The Dalles-CA Hwy)	1989	185.00 SB	6/89 6/90	2.73 2.87	79.27 84.74	Before After	5%
		185.08 NB	6/89 6/90	2.97 3.11	89.06 95.02	Before After	5%
		185.82 SB	6/87	2.13	56.08	Before	
		185.91 NB	6/87	2.46	68.77	Before	
Stag Hollow Creek Rd-Wapato Rd (Yamhill-Newberg Hwy)	1989	1.26 EB	4/84 8/86 5/89 6/90	2.22 2.04 1.28 1.89	61.70 54.76 29.54 48.31	Before Before Before After	48%
		1.35 WB	4/84 8/86 5/89 6/90	2.31 2.12 1.33 1.20	64.17 57.20 31.13 27.18	Before Before Before After	-10%

*Average of 11 readings

deflection data for these projects as well as data for four projects constructed during the 1989 construction season.

In all cases the deflections are the average of 11 readings obtained using the ODOT Dynaflect. The deflections are those recorded for geophone number one adjusted to a standard pavement temperature of 70°F. Equivalent Benkelman Beam values are also presented in Table 3.4.

The changes in deflection from the last available deflection prior to CIR treatment and the first measurement after CIR are presented in the last column of Table 3.4. It may be noted that in most cases, the change in deflection resulting from CIR treatment is less than ten percent. When all of these change values are averaged, the mean change in deflection for CIR treatments is an increase in deflection of 9%. In the best case, deflections measured after CIR were 26% less than before. In the worst case deflection measured after CIR increased 115%.

Examination of the deflection data leads to the conclusion that CIR can not be expected to increase the stiffness of the pavement section. Although on average, CIR resulted in slightly increased deflections, the increase was small, essentially maintaining the stiffness of the existing pavement.

3.4 Mix Properties

To aid in the evaluation of cold recycled pavement performance, mix properties have been investigated over time. Mix property tests have been conducted on cores taken in fall 1988 and fall 1989 from the 10 projects being intensively evaluated for life expectancy of recycled pavements. Table 3.5 shows the mile points and locations (relative to centerline of the pavements) that the cores were taken from each project. The tests performed on these cores included:

1) gravities,
2) asphalt coating,
3) diametral modulus, fatigue, and permanent deformation, and
4) Marshall stability and flow.

This section summarizes the results of these tests.

Table 3.5. Core Locations and Properties

Project	Highway	Year Constructed	Test Period	M.P. & Location	Bulk Gravity	Rice Gravity	% Voids	Asphalt Coating	
								%	Notes
Sand Shed-Mt. Bachelor	OR 372	1984	Fall 88	not cored					
			Fall 89	22.00, 7'L	2.273	2.462	7.7	100	Sufficient
Drews Gap-Lakeview	OR 20	1985	Fall 88	87.40, 9'L	2.116	2.247	5.8	95	
			Fall 89	87.40, 9'L	2.152	2.270	5.2	90	Sufficient
Harney Co. Line-Hogback Summit	OR 49	1985	Fall 88	64.50, 8'R	2.030	2.226	8.8	85-90	
			Fall 89	64.20, 9.5'R	2.005	2.230	10.1	30-45	Dry
M.P. 79.2-Wasco Co. Line	OR 53	1986	Fall 88	89.90, 7'L	2.273	2.549	10.8	85-90	
			Fall 89	89.90, 8'L	2.381	2.571	7.4	50	Dry
M.P. 89.6-Jct OR 19	OR 41	1986	Fall 88	96.40, 8.5'L	2.241	2.484	9.8	85-90	
			Fall 89	96.40, 7'L	2.338	2.502	6.6	30-45	Dry
Lakeshore Dr-Greensprings Jct	OR 270	1986	Fall 88	63.36, 9'R	2.132	2.448	12.9	85	
			Fall 89	63.36, 9'R	2.141	2.461	13.0	75-80	Dry-sufficient
Lava Springs-Sand Shed	OR 372	1986	Fall 88	14.60, 8.5'L	2.134	2.405	11.3	90-95	
			Fall 89	14.60, 7'L	2.088	2.409	13.3	65-70	Dry-sufficient
Jct Klamath Falls-Malin Hwy-CA Line	OR 426	1988	Fall 88	1.00, 10'R	2.159	2.402	10.1	80	
			Fall 89	1.00, 10'R	2.190	2.410	9.1	40	1.4-in.+ uncoated
MP 13.27-Moro	OR 42	1988	Fall 88	16.00, 9.5'R	2.235	2.551	12.4	85-90	
			Fall 89	16.00, 9'R	2.283	2.585	11.7	95-100	Sufficient
Fort Klamath-Crooked Creek	OR 22	1988	Fall 88	94.00, 9'R	2.002	2.342	14.5	85-90	
			Fall 89	94.00, 8'R	2.034	2.335	12.9	40	Dull

The density (gravity) and asphalt coating results are also summarized in Table 3.5. The results generally indicate:

1) Voids are between about 5 and 13% with several of the older (pre-1987) projects showing voids contents of 10% or less.

2) Asphalt coating ranges between 30 and 100% (from dry or uncoated to sufficiently coated). Five of the ten projects were reported with asphalt coating of 50% or less when 1989 cores were examined. This is a dramatic change from examination of 1988 cores which showed the minimum coating observed to be 80%. Nothing in the field performance of these projects would indicate such a change has taken place. The most likely explanation is that it is difficult to interpret asphalt coating for recycled asphalt pavements.

The modulus and fatigue test results for the field cores are summarized in Table 3.6. Changes in modulus and fatigue values between the 1988 and 1989 cores are shown graphically in Figure 3.7. Resilient modulus tests were conducted in accordance with ASTM D4123 (5). The tests were conducted at 23°C, at a pulse load frequency of 1 Hz, with a pulse load duration of 0.1 sec, and at a pulse load magnitude to induce a tensile strain of 100 microstrain ($\mu\epsilon$). The fatigue tests were conducted according to the procedure described in Reference 6 and under the same loading conditions and temperatures as that of the modulus tests. The results of these tests generally indicate:

1) Moduli of 1988 cores range between about 250 and 600 ksi.

2) Moduli of 1989 cores range between about 450 and 800 ksi.

3) Four projects show little change in modulus, four projects show dramatic increase in modulus, and one project shows about a 20% decrease in modulus.

4) Fatigue lives of 1988 cores range between about 10,000 and 110,000 cycles to failure.

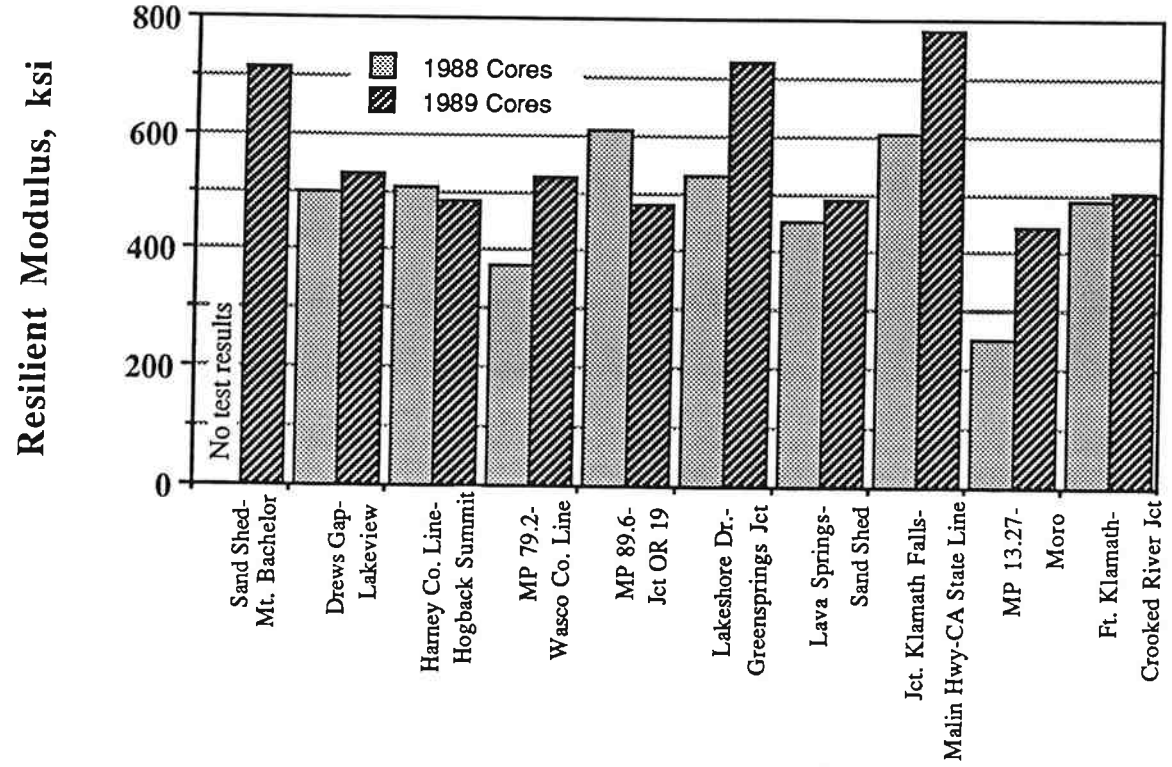
5) Fatigue lives of 1989 cores range between about 24,000 and lives in excess of 150,000 cycles to failure.

6) Fatigue lives for 1989 cores increased compared to 1988 cores in all cases, and dramatically in most cases.

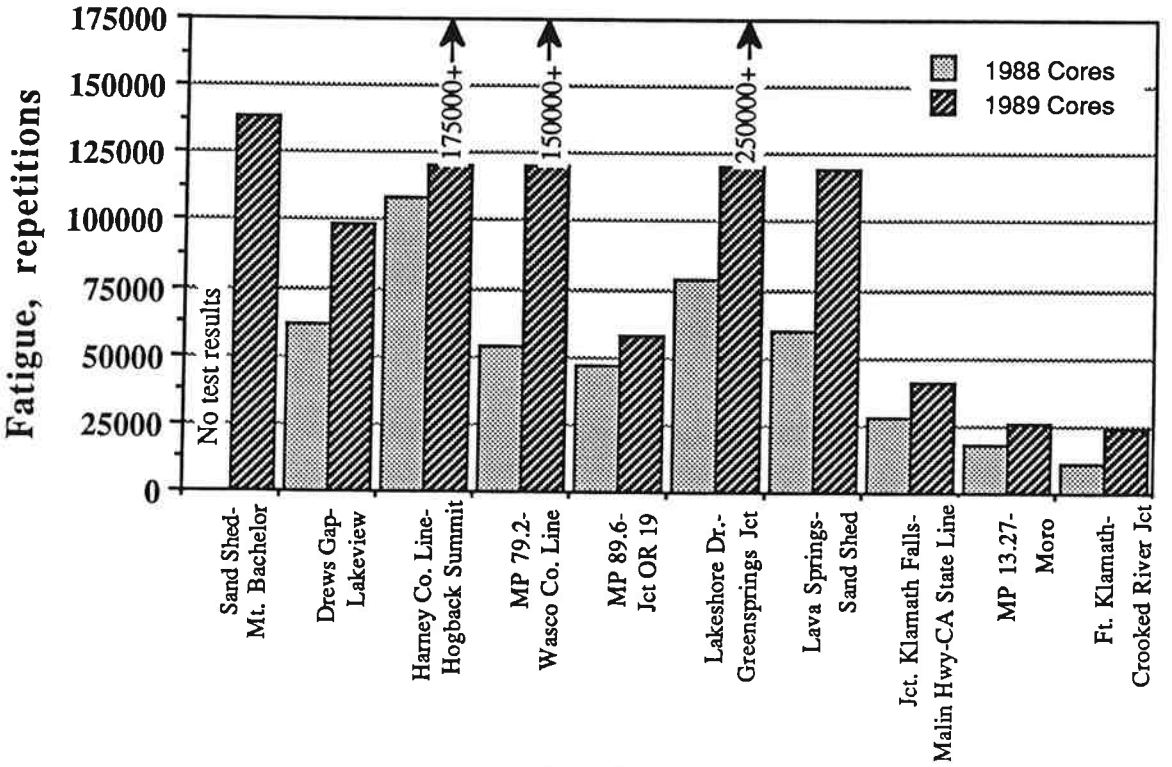
Table 3.6. Modulus and Fatigue Results

Project	1988		1989		1988		1989	
	Resilient Modulus (ksi)	Average Modulus (ksi)	Resilient Modulus (ksi)	Average Modulus (ksi)	Fatige Life (reps)	Average Fatigue (reps)	Fatigue Life (reps)	Average Fatige (reps)
Sand Shed- Mt. Bachelor	Not cored in fall 1988		757 501 882	713	Not cored in fall 1988		**** 138184 85983*	138184
Drews Gap- Lakeview	467 535 494	499	550 562 481	531	51046 72798 61571	61805	** 73860 122291	98076
Harney Co. Line- Hogback Summit	453 558 514	508	395 530 529	485	111276 108712 106608	108865	192473* 159821 ***	176147+
M.P. 79.2- Wasco Co. Line	371 351 410	377	518 527 535	526	45929 68725 47240	53965	150100* ** **	150000+
M.P. 89.6- Jct OR 19	588 586 646	607	399 492 546	479	31536 69347 40360	47081	73030 61343 39355	57909
Lakeshore Dr- Greensprings Jct	545 513 533	530	749 771 661	727	69519 94655 72018	78731	46034 542379* 160561	250000+
Lava Springs Sand Shed	433 467 452	451	520 506 436	487	72099 67633 38015	59249	151231 94114 111563	118969
Jct Klamath Falls- Malin Hwy-CA Line	628 563 617	603	815 821 704	780	30885 24767 28909	28187	38444 24209 58803	40485
M.P. 13.27-Moro	187 246 326	253	462 466 409	445	23416 22523 8499	18146	41553 14600 22344	26166
Fort Klamath- Crooked Creek	495 520 456	490	475 522 506	501	14110 8096 10267	10824	28026 22800 20219	23682

*Test intentionally terminated due to excessive fatigue life, **test equipment failure, ***purposely did not test due to excessive fatigue life of other cores, ****localized failure near the loading strip.



a) Resilient Modulus



b) Fatigue

Figure 3.7. Changes in Modulus and Fatigue.

Table 3.7 summarizes the Marshall stability and flow values from tests of the field cores. The results are depicted graphically in Figure 3.8. These tests were conducted in accordance with ASTM D1559 (5) at 60°C. The results generally indicate:

1) Stabilities for the 1988 cores range between about 600 and 1400 lbs.
2) Stabilities for the 1989 cores range between about 1000 and 2400 lbs.
3) All but one project show significant increases in stabilities from 1988 to 1989 cores. The other project shows only a slight increase.
4) Flow values for the 1988 cores range between 21 and 33 in/100.
5) Flow values for the 1989 cores range between 17 and 20 in/100.
6) All projects show decreases in flow from 1988 to 1989 cores, and in most cases the decrease is substantial.

The increases in modulus, fatigue life, and Marshall stability over time are likely due to the continued curing of the emulsion and the hardening of the original asphalt in the RAP material, as well a probable decrease in air voids due to compaction under traffic. The two oldest of the nine projects for which both '88 and '89 cores were available, Drew's Gap-Lakeview and Harney Co. Line - Hogback Summit, still showed significant increases in fatigue life and stability between the third and fourth years after construction.

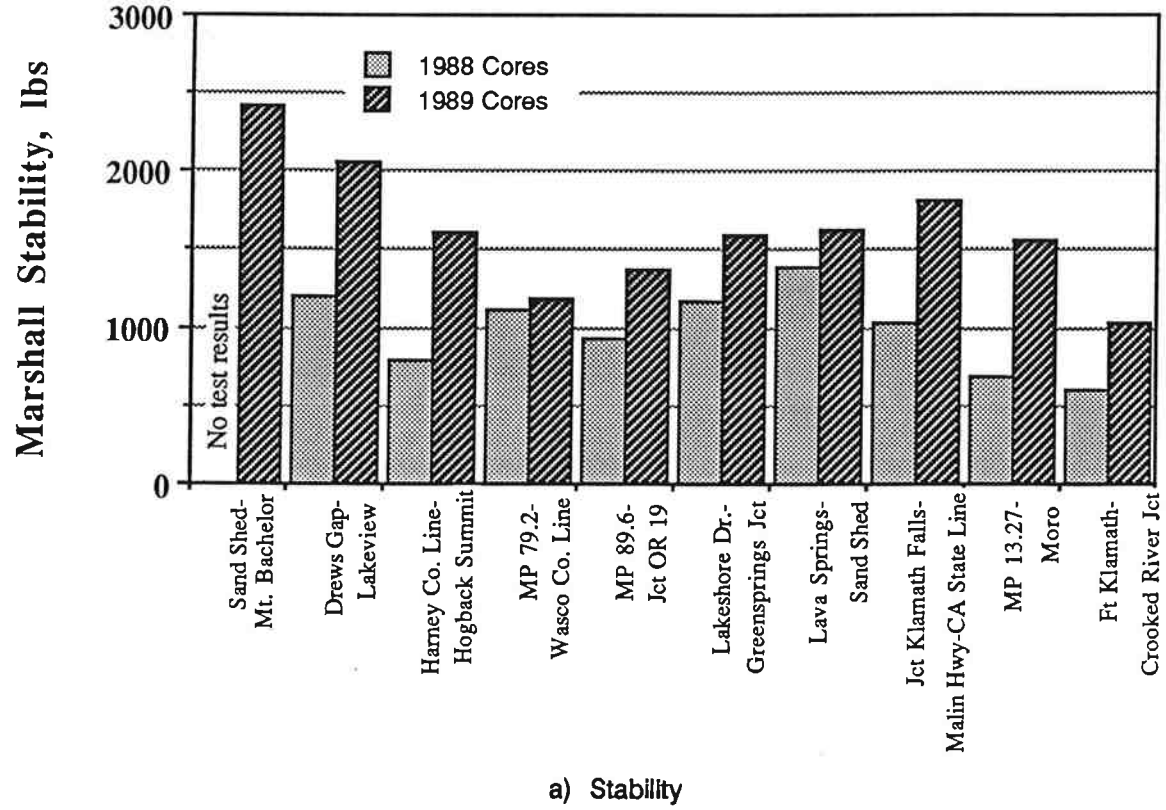
3.5 Estimated Service Lives

At the end of summer 1990, the District Maintenance Supervisors (DMS's) and Region 4 Engineer were asked to make their best estimate of the service lives of the CIR projects constructed from 1984 to 1988 (see Table 3.2). Thus, in most cases, two estimates of service lives were obtained. When the estimates did not agree, the more pessimistic of the estimates was used. Table 3.8 summarizes these estimates.

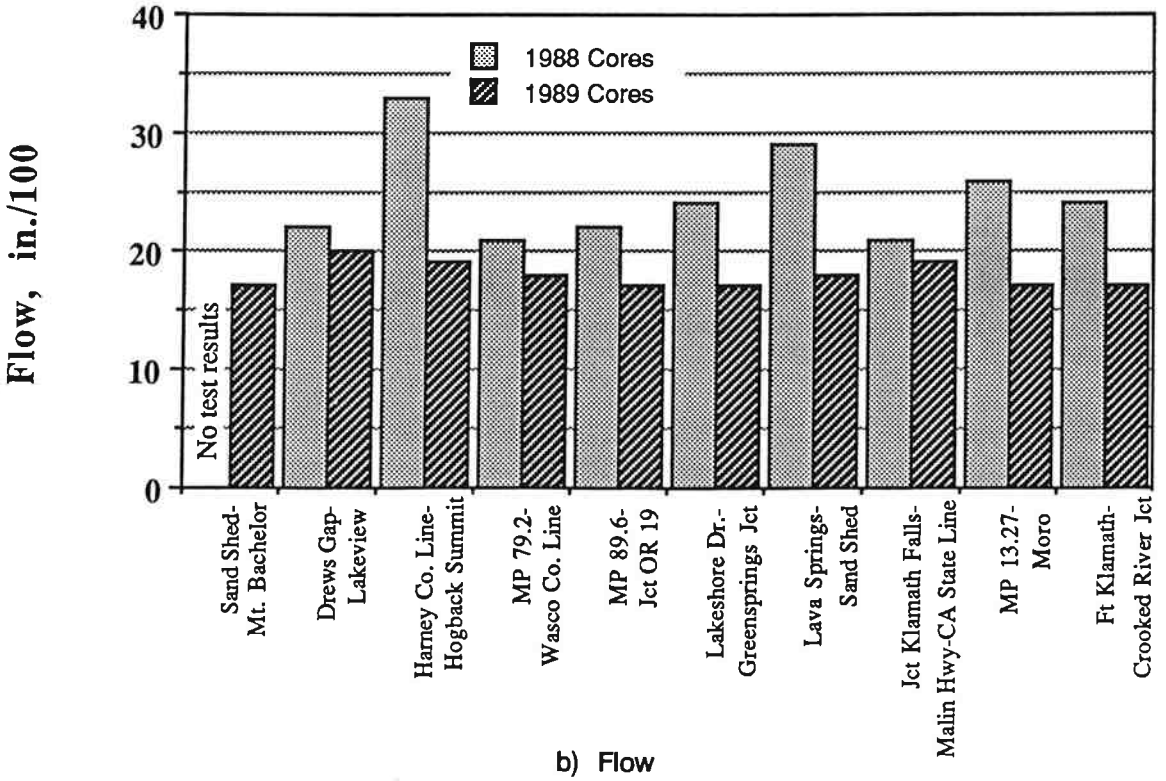
The 47 projects for which service life estimates were obtained were divided into six categories, depending upon whether the CIR treatment has been overlaid or inlaid or is serving as a wearing course, and whether the CIR treatment has experienced "significant" patching. Of the 47 projects, 13 have been

Table 3.7. Marshall Stabilities and Flows - Field Cores

Project	1988		1989		1988		1989	
	Marshall Stability	Average Stability	Marshall Stability	Average Stability	Flow (in/100)	Average Flow (in/100)	Flow (in/100)	Average Flow (in/100)
Sand Shed- Mt. Bachelor	Not cored in fall 1988		2454 2365 2412	2410	Not cored in fall 1988		17 17 16	17
Drews Gap- Lakeview	1251 1142 *	1196	2274 1693 2180	2049	22 23 *	22	18 21 19	20
Harney Co. Line- Hogback Summit	774 859 731	788	1542 1771 1508	1607	30 37 31	33	20 20 16	19
M.P. 79.2- Wasco Co. Line	1127 1107 1084	1106	1240 1102 1202	1181	22 19 21	21	19 18 15	18
M.P. 89.6- Jct OR 19	1007 934 844	928	1214 1429 1473	1372	20 23 22	22	16 18 17	17
Lakeshore Dr- Greensprings Jct	1167 1131 1216	1171	1722 1456 1614	1597	21 28 22	24	16 18 16	17
Lava Springs Sand Shed	1762 1219 1194	1392	1396 1714 1764	1625	34 23 31	29	18 20 17	18
Jct Klamath Falls- Malin Hwy-CA Line	897 1104 1084	1028	1553 2079	1816	22 23 18	21	21 17	19
M.P. 13.27-Moro	663 760 625	683	1467 1641 1589	1566	25 35 18	26	17 18 16	17
Fort Klamath- Crooked Creek	563 602 620	595	1085 1062 921	1023	24 25 24	24	18 17 17	17



a) Stability



b) Flow

Figure 3.8. Changes in Marshall Stability and Flow.

Table 3.8. Estimated Service Lives of CIR Projects

Category	Number of 1984 Constr. Projects	Number of 1985 Constr. Projects	Number of 1986 Constr. Projects	Number of 1987 Constr. Projects	Number of 1988 Constr. Projects	Total Number of Projects	Number of HFE Projects	Life as Wearing Course Before Sig. Patching (yrs)	Life as Wearing Course After Sig. Patching (yrs)	Total Life as Wearing Course (yrs)	Years Without Maint. So Far (yrs)	Life as Base Course After Overlay and Before Next Overlay (yrs)
Projects Currently Serving as Wearing Course												
Without Significant Maintenance	1	1	5	4	3	14	3			7.9	4.5	
With Significant Maintenance	1	6	5	1	5	18	2	1.9	4.7	6.6		
Projects Which Have Been Overlaid												
Immediate Overlay	1		1		3	5	3					6.6
Served as Wearing Course Prior to Overlay												
Without Significant Maintenance			1	1	2	4	2			1.8		8.5
With Significant Maintenance		1	3			4		1.5	2.0	3.5		7.0
Projects Which Have Been Inlaid			2			2		2.0	1.0	3.0		
	3	8	17	6	13	47	10					

overlaid, 2 have been inlaid, and 32 are serving as wearing courses. Only the 2 projects requiring inlays are considered failures. Of the 32 projects which are serving as wearing courses, 14 (44%) have not had "significant" patching so far (average age of 4.5 years) and are projected to have total average service lives of 7.9 years. The projects currently serving as wearing courses and having experienced "significant" patching first required maintenance after an average of 1.9 years and expect total service lives of 6.6 years.

The data are inconclusive regarding the relative merits of CMS-2S and HFE-150. The early projects were all done with CMS-2S. Of the CIR treatments currently serving as wearing courses, the average service life expectancy is 7.2 years, which is exactly the average life expectancy of the five HFE projects included among these thirty-two sections. Again, for the sections serving as wearing courses, the HFE projects are slightly over-represented in the "without patching" group (3 of 14) and slightly under-represented in the "with" patching group (2 of 18). The difference is inconclusive, however.

3.6 Life Cycle Cost Analysis

Life cycle costs were analyzed for all of the cases covered in Table 3.8 and compared to the alternate of a hot mix overlay. Equivalent annual cost analysis was chosen to simplify the comparison between alternates of differing economic lives. It is assumed that when an alternate's economic life is reached, the same cycle will be repeated, essentially in perpetuity.

Table 3.9 summarizes the inputs and outputs from the life cycle cost analysis. The construction costs shown are based on analysis of costs for "surface preservation" jobs by Region 4 of ODOT. Construction costs represent total project costs divided by area of surface "preserved" in 1989-90 dollars. The maintenance costs shown are the best estimates based on information from the Surfacing Design Unit of Oregon DOT and from conversations with district maintenance personnel. The timing of expenditures is based on the summaries presented in Table 3.8. The Equivalent Annual Costs of the different types of CIR experience in Oregon are presented in the last column of Table 3.9. An interest rate of 8% was used.

Table 3.9. Life Cycle Cost Analysis

	Category	Expenditures	For	Timing	Life Cycle (yrs)	Equivalent Annual Cost ($/mi)
Projects Currently Serving as Wearing Course	Without Significant Maintenance					
	a) optimistic assumptions	$2.10/sy	CIR with chip seal	Initial	8	$5100
	b) pessimistic assumptions	$2.10/sy $4000/mi/yr	CIR with chip seal Maintenance	Initial Annually after 5th year	8	$6500
	With Significant Maintenance	$2.10/sy $1200-$4000/mi/yr	CIR with chip seal Maintenance	Initial Annually after 2nd year	7	$4700-7200 $6300-7900
Projects Which Have Been Overlaid	Immediate Overlay	$3.06/sy	CIR with 2" OGEM	Initial	7	$11,000
Served as Wearing Course Prior to Overlay	Without Significant Maintenance	$2.10/sy $2.88/sy	CIR with chip seal 2" OGEM with chip seal	Initial After 2nd year	10	$10,800
	With Significant Maintenance	$2.10/sy $1200-$4000/mi/yr $2.88/sy	CIR with chip seal Maintenance 2" OGEM with chip seal	Initial End of years 2 through 3 End of 4th year	11	$9700-10,600
Projects Which Have Been Inlaid		$2.10/sy $1100-$4000/mi/yr	CIR with chip seal Maintenance	Initial After 1st year	3	$17,600-20,300
2" Hot Mix Overlay Alternate		$5.25/sy $1250-$4000/mi/yr	2" hot mix overlay Maintenance	After 10th year	12	$13,200-13,600

Notes:

Interest rate = 8%
Costs are for 1989-90
OGEM = Open-Graded Emulsion Mix

Table 3.9 shows that all of the CIR experiences, except the two inlaid projects, have a clear cost advantage over the alternate of 2 inches of hot mix overlay. Costs of successful CIR projects vary from 37% to 82% of costs for the hot mix alternate. Only the two failed (inlaid) CIR projects resulted in higher costs than the hot mix alternate. These costs do not consider user costs. Only costs to ODOT are considered. No credit is given to the increased structural section of the hot mix overlay option.

The cost-effectiveness of CIR compared to the hot mix overlay was not sensitive to changes in interest rate. The successful CIR alternates were always preferred when interest rates were varied between 0 and 20%. Increasing interest rates favor the CIR alternates. Maintenance costs would have to rise to $17,500/mile/year (from the estimated $1200 to $4000/mile/year) before the CIR alternates with maintenance early in their life cycles would lose their attractiveness compared to the hot mix overlay alternate.

CIR is most cost-effective when sites are relatively remote and haul distances are greatest, and when hot-mix suppliers are scarce or non-competitive. CIR becomes less cost-effective in areas of short haul distance and haul time and where several competitive local hot-mix suppliers are within short distance.

CIR has energy conservation advantages. Consequently, as petroleum and energy costs increase, CIR becomes more cost-effective with respect to hot mix because of savings in hauling costs, aggregate processing costs, and heating costs. CIR typically uses about 1% emulsion addition, which is significantly less than the 5 to 7% of asphalt typically added to hot mix. Since asphalt is a petroleum derivative, this also improves the cost-effectiveness of CIR in periods of rising petroleum costs.

3.7 Risk

There is risk associated with CIR treatments. Not all of ODOT's experiences with CIR have been favorable. For the 47 projects listed in Table 3.9, the worst experience resulted in portions of the project being inlaid after three years due to stripping problems with the aggregate. In hindsight, it would have been better to inlay the pavement at the time of the CIR treatment instead of performing the CIR.

However, even though this was a bad experience, knowledge was gained and progress was made at a relatively low cost.

Experience in ODOT's Region 2 during the 1989 construction season has indicated that the greatest risk associated with CIR is improper project selection. During 1989, projects were chosen for recycling which were at best marginal. Sections had inadequate base and were experiencing base failures. Sections had AC pavement thickness of less than 2 inches. Attempts were made to widen paving surfaces either by thinning out the pavement or incorporating unbound shoulder rock into the pavement. Existing pavement material had high moisture content. Areas of "eternal shade" were extensive on the projects chosen. (Construction reports for these projects are included in Appendix A.) Failures resulted and the pavements required blade-patching through the winter and were overlaid during the summer of 1990. Even with these "failures," it can be said that the CIR eliminated any need for a levelling course.

3.8 Summary of Findings

Significant findings include:

1) Generally, deflections before and after CIR are about the same. No structural improvement should be expected with CIR.
2) Generally, for CIR projects over time,
   a) modulus increases,
   b) diametral fatigue life increases,
   c) Marshall stability increases, and
   d) Marshall flow decreases.
3) Only 2 of 47 Region 4 projects for which service life data were available were clear failures. These two failures were 1986 projects.
4) Life cycle cost analysis indicated that with the exception of the 2 failures noted above, life cycle costs for CIR projects ranged from 37% to 82% of the 2-inch hot mix overlay alternate, when no credit is given to the hot mix overlay for increased structural section.

5) Not all pavements may be effectively recycled. Proper project selection is extremely important.

4.0 RECYCLING OF PAVEMENTS EXHIBITING STRIPPING

This chapter describes the efforts afforded to the accomplishment of one of the objectives of this study -- to establish whether mixes which have previously exhibited stripping can successfully be corrected by recycling. More specifically, presented below is a description of the project selected for evaluation and why it was selected, the results of the mix design moisture sensitivity tests, the method of introduction of anti-strip agent, and the performance of the recycled pavement after 1 year in service.

4.1 Project Selection and Description

The project selected for the purpose of determining whether or not stripped pavements can be corrected by CIR is just north of the town of Gilchrist on US 97 (The Dalles-California Hwy.). The project was selected in an area that consists of about five miles of extensive stripping within two successive overlays (a B- or C-mix overlay placed around 1982 followed by an E-mix overlay in 1985 and a chip seal in 1986). Milling and plug patching work indicated extensive stripping in both overlay lifts (see Figure 4.1).

Originally, the entire section from Hackett Dr. to Crescent on US 97 was scheduled to be recycled. It was subsequently decided to mill out the stripped material and inlay with a Class F hot mix. However, a short (1/2-mile) section of the stripped pavement was reserved for recycling. In this short section of the Hackett Dr.-Crescent project the pavement was recycled with 1% lime anti-strip additive in the northbound lane and 2% lime in the southbound lane. Thus, the recycled portion of the Hackett Dr.-Crescent project consisted of about a 1/2 lane-mile section of 1% lime additive and a 1/2 lane-mile section of 2% lime additive. The pavement was recycled during the summer of 1989.

4.2 Mix Design with Moisture Sensitivity Tests

The mix design (estimation) procedure described in Section 2.1 was carried out on millings from the Hackett Dr.-Crescent project and laboratory fabricated specimens were prepared at the estimated design emulsion content (EC_{EST}) and at $EC_{EST} \pm 0.3\%$. The water content for the specimens having the

a) Stripping in the Inner Wheel Track

b) Stripping in Both Wheel Tracks

Figure 4.1. Photographs Showing the Typical Severity of Stripping on the Hackett Dr.-Crescent Project.

estimated design emulsion content (EC_{EST}) was determined via the procedure described in Section 2.3. The total liquids content for the specimens prepared at EC_{EST} ± 0.3% was held constant to correspond to the total liquids content established for EC_{EST}. For example, the total liquids content for EC_{EST} was determined to be 3.7%. Thus, the total liquids for EC_{EST} - 0.3% was also 3.7% with an increase in water content of 0.3% (corresponding to the decrease in emulsion content of 0.3%).

Four sets of specimens were prepared for evaluation. Three of the sets were prepared from millings obtained before lime was added in the field while the fourth set was prepared from millings as received which contained 2% lime. For the millings obtained before lime was added in the field one set of specimens was fabricated without adding lime, one set was fabricated with 1% lime additive, and the third set was fabricated with 2% lime additive.

After fabrication the test specimens were subjected to Oregon's standard test procedure (OSHD TM-315) for moisture susceptibility. The results of these tests are summarized in Table 4.1 and shown graphically in Figure 4.2. The results generally indicate:

1) For all emulsion contents, the addition of 1% lime results in an improvement in the freeze-thaw modulus ratio relative to the mix without lime.
2) The addition of 2% lime results in an improvement in the freeze-thaw modulus ratio relative to the mix with 1% lime in two of three cases. This is in spite of the fact that the 2% specimens had higher void content.
3) The 2% lime specimens fabricated from as-received material produced higher modulus results than did the specimens fabricated from lab mixed materials. This is likely related to the much lower air void contents for the as-received specimens.
4) There is a clear trend of increasing freeze-thaw modulus with increasing lime content.

4.3 Method of Introducing Anti-Strip Agent

The method chosen to introduce the anti-stripping agent (lime) was that of belly-dumping quicklime (CaO) as shown in Figure 4.3. Thus, during the recycling process, quicklime was belly-dumped immediately ahead of the milling machine (a single unit process was used for recycling on this project).

Table 4.1. Summary of Moisture Sensitivity Test Results for the Hackett Dr-Crescent Section

Treatment	Emul/Water Content (%)	% Voids	Modulus, ksi			Ratios, %	
			Uncond	Vac Sat	Frz-Thaw	Vac Sat/ Uncond	Frz-Thaw Uncond
No Lime	0.6/2.9	5.4	171	145	59	85	35
	0.9/2.6		175	150	81	86	46
	1.2/2.3		177	178	99	101	56
1% Lime Added	0.6/4.4	5.6	199	149	112	75	56
	0.9/4.1		189	154	128	82	68
	1.2/3.8		196	159	136	81	69
2% Lime Added	0.6/5.9	8.0	198	156	133	79	67
	0.9/5.6		180	132	121	73	67
	1.2/5.3		204	190	171	93	84
2% Lime As Rec'd	0.6/4.4	3.1	280	264	175	94	63
	0.9/4.1		229	223	161	97	70
	1.2/3.8		216	235	153	109	71

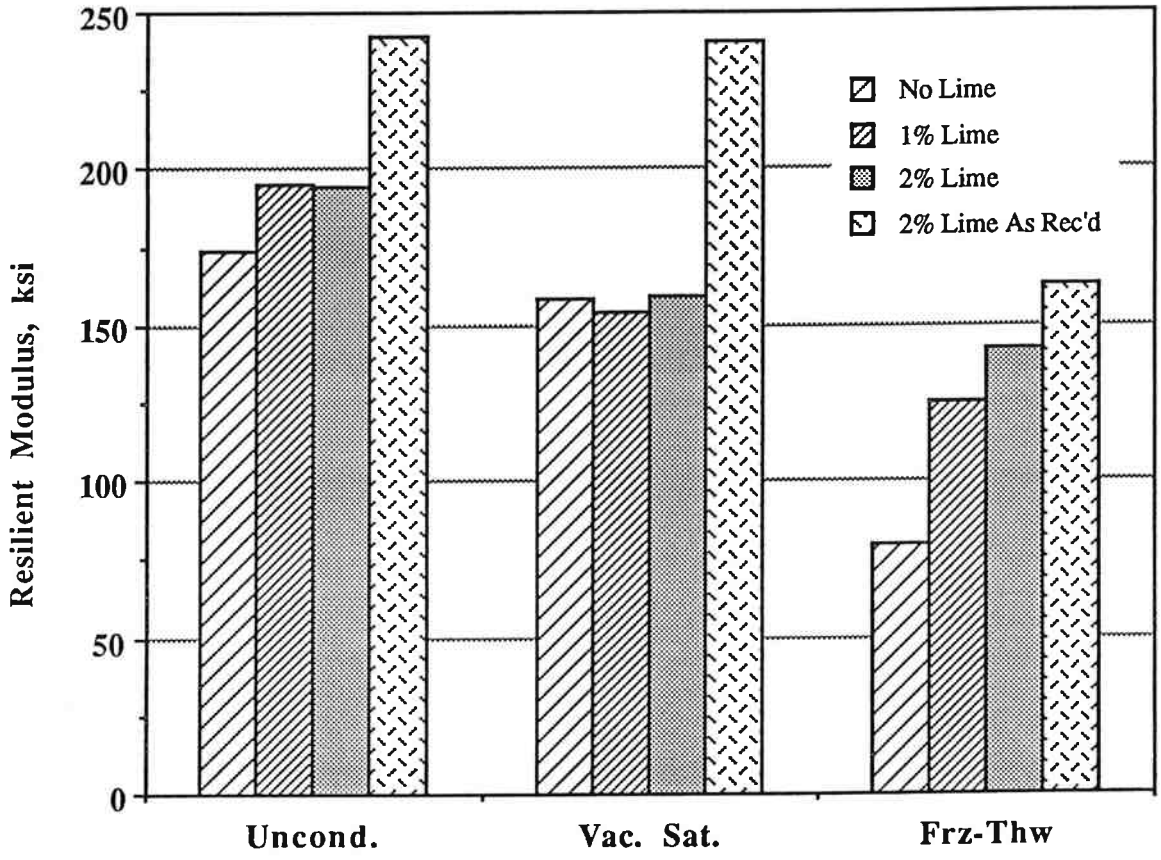


Figure 4.2. Moisture Sensitivity Results, Hackett-Crescent Average Values.

a) Overview of Lime Addition Process

b) Closeup of Lime on Surface Prior to Milling

Figure 4.3. Method of Lime Addition - Hackett Dr to Crescent.

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M | T | W | T | F | S: X

DATE: 6/24/89

PROJECT NAME (SECTION): HORSE RIDGE - HWY #37 Jct.

CONTRACT NO: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. COMPTON

F.A. PROJECT NO: STATE

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	
WIND		STILL	LOW	MED	HIGH
			X		
HUMIDITY		DRY	LOW	MED	HUMID
		X			

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	CHOKE TRUCK
MP 20.90 - 23.55 R	7:00 / 1:30	2	8	1	5		1								1	3			3	1	1

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 20.90-23.55 R		C/R MIXTURE Test	11	18656	128714.67
"	"	Emul Asph Test	12	17.77	238.04
"	"	TACK Quantity	10	4.33	33.57
"	"	CHOKE Quantity	14	10	70.00
"	"	WATER Quantity	6	5536	44466.66

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

TRAFFIC MOVED WELL through the JOB.
NO MAJOR DELAYS OR BREAK DOWNS

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zeuhe

734 3474 6/88

DISTRIBUTION: Original to Project Manager
Copy to Originator

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W | T | F | S
DATE: 6/26/89

PROJECT NAME (SECTION): Horse Ridge
CONTRACT NO.: C10728
HIGHWAY: #20 East
F.A. PROJECT NO.: State
CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					

TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	

WIND	STILL	LOW	MED	HIGH
	X			

HUMIDITY	DRY	LOW	MED	HUMID
	X			

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BROOM	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 29.25 - 34.85 R	9:00 / 12:50	1	3				1										3			1	
MP 34.85 - 29.25 R	12:50 / 5:00	1	3														2			1	

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 29.25 - 34.85 R	Re Roll			
MP 34.85 - 29.25 R	Re Roll			
	~~Flaggers - 12 hrs.~~ Flaggers - 16 hrs	4	16	
	~~Pilot Car - 6 hrs.~~ Pilot Car - 8 hrs	5	8	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

No Traffic Problems Reported

USE BACK FOR ADDITIONAL REMARKS · SEE BACK ☐

PREPARED BY: Stephen B Wilson

734 3474 6/88

DISTRIBUTION: Original to Project Manager
Copy to Originator

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T X W T F S

DATE: 6-27-89

PROJECT NAME (SECTION): Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: #20 West

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		X			

TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	

WIND	STILL	LOW	MED	HIGH
		X		

HUMIDITY	DRY	LOW	MED	HUMID
	X			

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 34.85-29.25 R	8:30/1:30	1	2													1			1	
MP 29.80-26.40 R	1:30/4:00	1	2													2			1	

LOCATION and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
MP 34.85-29.25 R	ReRoll			
MP 29.80-26.40 R	ReRoll			
	Flaggers - 16 hrs.			
	Pilot Car - 8 hrs			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

No Traffic Problems Reported

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Stephen B. Wilson

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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M | T X | W | T | F | S

DATE: 6/27/89

PROJECT NAME (SECTION): DIAMOND LAKE

CONTRACT NO.: C10728

HIGHWAY: #138 Unit '3'

CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton

F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL X	LOW	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 10.10 - 15.00 w/b	8:00/6:30	3	8	26			1					1			1	2		1	4	1
	10.5																			
	8.75																			
	19.25																			

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 10.10 - 15.00 w/b		CIR Mix	11	35933.33	
"	"	Emul Asph	12	32.1	
"	"	Jack	19	9.28	
"	"	Water	6	16660 GAL	
"	"	Choke	14	19.32	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic was moderate average wait in pilot line was 17 min with 37 cars in line.
Lew Scholl and Todd Schultz from ODOT Research stopped to investigate the job. When job is complete please send copies of diaries and field notes (F.I.R.) to them

Hwy. Mat'l Lab
800 Airport Rd
Salem OR 97310
Ph 378-2318

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: David P. Beebe

734 3474 6/88

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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
				X			

DATE: 6-28-89

PROJECT NAME (SECTION): Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: #20 East

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		X			

TEMP	TO 32	32-50	50-70	70-85	OVER 85
			X		

WIND	STILL	LOW	MED	HIGH
		X		

HUMIDITY	DRY	LOW	MED	HUMID
	X			

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES			BROOM	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP 26.40 - 29.80 R/L	8:00/8:45	1	1						1													1				
MP 26.60 - 23.50 R	9:00/1:50	1	2						1										2			1				
MP 23.55 - 21.00 R/L	2:00/4:30	1	2						1										2			1				

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 26.40 - 29.80 R/L		Broomed Shoulder			
MP 26.60 - 23.50 R		Broomed Shoulder & ReRoll			
MP 23.55 - 21.00 R/L		Broomed Shoulder & ReRoll			
		Flaggers - 17 hrs.			
		Pilot Car - 8½ Hrs.			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Light Traffic - No Difficulties

MP 23.55 - 21.00: Only Made One Complete Pass - Both Lanes
4:30 - Stopped ReRoll Because Of Weather & Temperature

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Stephen B. Miller

734 3474 6/88

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Initially the quicklime was left dry which resulted in insufficient breakdown during the milling process. To mitigate this, water was added to the quicklime creating a semi-slurry before the mill processed the lime and pavement. This resulted in improved dispersion of the lime during the milling process.

4.4 Performance

The Hackett Drive-Crescent test section was recycled during the summer of 1989. As of August 1990, the lane with 2% lime appears to be performing better than the lane with 1% lime. Figures 4.4 and 4.5 provide an example of the differences in the two lanes. Figures 4.4 and 4.5 are both taken at the same location, about 1000 feet south of the north end of the project. Figure 4.4 photos are of the 2% lane looking north. Figure 4.5 photos are of the 1% lane looking south. Figure 4.6 shows the worst distress in the two lanes. Figure 4.6a shows the 2% lime lane. Figure 4.6b shows the worst distress on the project, an area of the 1% lime lane which is at the bottom of a superelevation. All photos were taken during May, 1990, after the CIR treatment had been through one winter/spring cycle. This test section was inspected by the research team in both May and August of 1990, with no noticeable deterioration taking place between these two inspections.

Cores for visual observation were taken from this test section in Fall 1989 and Spring 1990. Figure 4.7 shows the location of these cores and a visual comparison of the actual cores from the two time periods. No difference in coating or structure is noticeable for the cores from the two time periods. The cores do not look good. Only the very top surface appears to have been visibly affected by the CIR. The performance has been much better than would be predicted from examination of the cores.

ODOT has been encouraged by the results of this test section. During the 1990 construction season, three additional projects were recycled with lime. One of the projects increased lime content to 3%. One project recycled without recycling agent, using only water and lime. These projects looked good after construction but have not yet, at the time of this writing, been through winter weather.

a) Looking North

b) Close-up

Figure 4.4. 2% Lime Lane Near the North End of the Project.

a) Looking South

b) Close-up

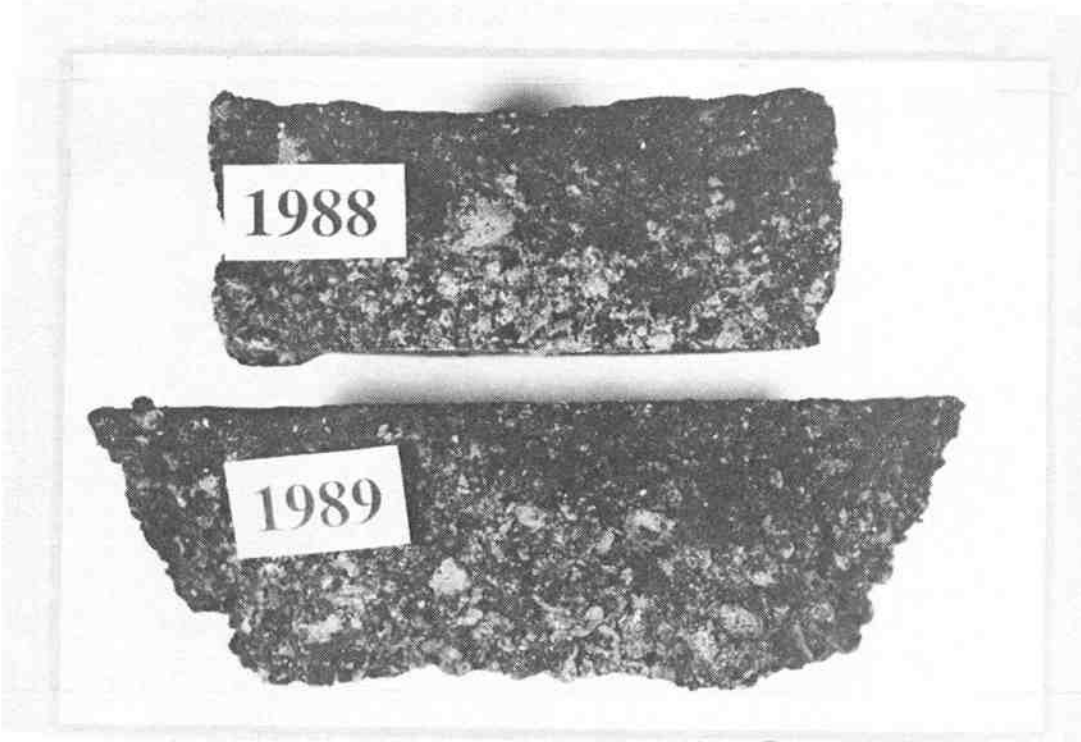
Figure 4.5. Lime Lane Adjacent to Photos of Figure 4.4.

a) 2% Lime Lane

b) 1% Lime Lane

Figure 4.6. Worst Distress, May 1990.

a) Surface Condition at Site of Cores



b) Visual Appearance of 1988 and 1989 Cores

Figure 4.7. Cores.

4.5 Summary of Findings

Significant findings include:

1) Addition of lime to RAP from stripped pavement showed improvements in index of retained modulus for laboratory prepared specimens.

2) For the one test section studied, field performance of stripped pavement recycled with 2% lime has been better than the same stripped pavement recycled with 1% lime.

3) Based on very limited data, it may be possible to "buy time" by recycling stripped pavement with the addition of lime.

5.0 CONCLUSIONS

Conclusions resulting from this study include:

1) Field performance of CIR has generally met the ODOT Region 4 performance expectations. Most CIR pavements required some maintenance or overlay during the first years after recycling, but costs were judged reasonable compared to a 2" hot mix overlay.

2) Not all pavements are good candidates for CIR. **Proper project selection is extremely important.**

3) Estimation procedures for determining emulsion content serve as a good starting point for field operations. Continual monitoring and adjustment of emulsion content is required in the field. More extensive laboratory mix design procedures and testing have not been shown to be any more effective than the estimation procedure.

4) It is difficult to relate Hveem and Marshall stability, diametral resilient modulus, and diametral fatigue laboratory testing to field construction conditions for CIR.

5) Mix property test results indicate that the stiffness and fatigue properties of recycled mixtures increase over a period of years. This is likely due to curing of the emulsion and reduction of air voids under traffic.

6) There is some indication that peak values of modulus and Marshall stability at time 0 occur at emulsion contents about 0.6% greater than the emulsion content indicated by the estimation procedure.

7) Addition of 1% and 2% lime to RAP from badly stripped pavement produced better IRM results than the RAP without lime. Field experience using lime with CIR has been encouraging, but it is still too early to conclusively evaluate its merits.

8) When projects are identified for which CIR is a viable alternative, CIR may very well be the most cost-effective restoration treatment for low volume roads. Life cycle cost

analysis using the data and assumptions presented in this report indicates a clear preference for CIR over conventional hot mix overlays.

6.0 RECOMMENDATIONS FOR IMPLEMENTATION

A "Construction and Inspection" manual was prepared to aid in the implementation of the results of this research project. This manual is included as a companion report in Volume II (8). Although written for those unfamiliar with CIR procedures, this summary of good CIR practice should not be ignored by those with some CIR experience. This manual addresses all of the important issues which have been found to be important to successful CIR projects. These issues include:

1) project selection process,
2) mix design procedure,
3) construction procedures, and
4) field control.

The importance of project selection can not be emphasized enough. Everyone's efforts in mix design, construction, and quality control will be for nought if an unsuitable project is chosen for CIR.

A second area of implementation should be the continued accumulation of service life and cost data, and periodic evaluation of cost-effectiveness of CIR. Sections 3.5 and 3.6 of this report provide an example of data required and procedure for analysis.

The addition of lime during CIR continues to show encouraging results. Pavement has even been recycled with lime and without recycling agent, with apparent success, at least initially. The potential of lime in CIR and the optimum method for its introduction should be further explored.

7.0 REFERENCES

1. HICKS RG, et al., "Development of improved mix design procedures and construction guidelines for cold in-place recycled pavements. Interim Report, Vols. I and II," FHWA-OR/RD-87-6. February 1987.
2. SCHOLZ T, et al., "Development of improved mix design and construction procedures for cold in-place recycled pavements. Final Report, Vols. III and IV," FHWA-OR/RD-89-01. June 1988.
3. SCHOLZ T, et al., "Mix design practices for cold in-place recycled pavements," Symposium on Asphalt Emulsions, ASTM STP 1074. December 1988.
4. ANNUAL BOOK OF ASTM STANDARDS. Roofing, waterproofing, and bituminous materials. Vol 04.04. 1989.
5. ANNUAL BOOK OF ASTM STANDARDS. Road and paving materials; traveled surface characteristics. Vol. 04.03. 1989.
6. SCHOLZ T, "Evaluation of cold in-place recycling of asphalt concrete pavements in Oregon," MS Thesis. Oregon State University. June 1989.
7. SCHOLZ, TV, HICKS, RG, and ROGGE, DF, "In-Depth Study of Cold In-Place Recycled Pavement Performance, Interim Report," TRR 90-2, Transportation Research Institute, Oregon State University, April 1990.
8. ROGGE, DF, HICKS, RG, and SCHOLZ, TV, "In-Depth Study of Cold In-Place Recycled Pavement Performance, Final Report, Vol. II, Construction and Inspection Manual," TRR 90-24, Transportation Research Institute, Oregon State University, December 1990.

APPENDIX A

Construction Reports

1989 Projects

Narrative Report
Region 2 Recycle Projects
Kings Valley & Yamhill Newberg Highways
Contract 10769

This project was an experimental project for Region 2. It consisted of recycling in place the pavement for two separate sections of roadway. One section was on the Kings Valley Highway beginning at Milepost 10.95 and ending at Milepost 23.58. The other section was between Milepost 0.90 (Yamhill) to 9.83 (Newberg) on the Yamhill-Newberg Highway. A contract for this work was awarded to Valentine Surfacing Company of Vancouver Washington and work began on July 27, 1989. All work was completed on September 5, 1989. The project accomplished the goal of preserving the existing surfacing on the two sections of highway and gave Region 2 a sense that this type of resurfacing can work in Western Oregon's climate. The project in general will be discussed in the following paragraph.

TEMPORARY PROTECTION AND DIRECTION OF TRAFFIC

The temporary protection and direction of traffic as set up in the contract worked well for both sections of roadway. We did have to add a second pilot car on the Yamhill-Newberg section in order to keep traffic flowing through the project in a timely manner and to keep the rate of travel pretty slow. There was apparently a lot more traffic on this highway than had been anticipated when the bid items were being estimated, because we overran the Pilot Car item substantially.

PREPARATION OF SHOULDERS

The gravel shoulders were prepared with a slight modification to the specifications. At the start of the recycle work the contractor told us that removing the gravel shoulder material would cause problems with the grade line of the recycle mat and with having enough material to lay back down. We had them prepare the shoulder as specified anyway and very quickly found that the contractors reasoning was correct. For the remainder of the two recycled section we had them surface blade the shoulders to remove any foreign material but did not remove any of the existing shoulder material. We would recommend only surface blading be required in the specifications for future projects with narrow pavement widths for two reasons:

1> The material in shoulder areas is needed to be included and used at the same depth as being ground out in the main roadway. The small amount of shoulder material that

goes through the recycle process doesn't seem to have any detrimental effect on the recycle mat.

2> The recycle train uses a wheel which travels over the shoulder area in conjunction with an electronic sensor in order to smooth up the profile of the existing roadway. Blading out two inches of the shoulder area as specified gave us a very uneven area for the sensing wheel to run on. Blading off only the foreign material from the shoulder area allows the blademan to use the existing pavement as a guide to maintain a halfway decent profile on the shoulder area.

Saw cutting the pavement in areas where the existing pavement was wider than 24' was not necessary either. The milling machine takes care of making a vertical edge and all thats needed is to make sure the edge is tacked very well and the joint thoroughly raked to prevent unevenness between the existing surface and the finished recycle mat.

CONSTRUCTION OF KINGS VALLEY HIGHWAY SECTION } Not in current study

We had very little trouble recycling the existing pavement from MP 16.8 to MP 23.58 but had an increasing amount of difficulty as we progressed to the north. From Maple Grove Jct. (MP 16.8) back to near the Pedee Store (MP 15.6) the old roadway was an oil mat placed over 2" to 4" diced basalt. As the oil mat got thinner an increasing amount of the basalt was kicked out by the grinder teeth and processed through the recycle train. The small hammermill in the recycle train broke the basalt down to about 1 1/2" minus size rock but just barely and experienced a great deal of distress during the process. As the recycle train approached MP 15.6 it became apparent that the recycle process was not feasible and it was discontinued. A 1 1/2" lift of class "B" AC was placed over 3.6 miles of the highway on to the north. The section of recycled pavement turned out pretty good as did the overlay.

CONSTRUCTION OF THE YAMHILL NEWBURG SECTION

The suitability of this section of highway for recycling was only fair for the most part. The existing pavement between MP 0.90 and 7.73 consisted of an old oil mat over some pretty poor base. Many areas in the section had almost no base aggregates and a few had mud pumping up through them. Maintenance forces took care of the soft spots either before the recycle train reached them or in some cases after it passed by. Traffic over the roadway made any soft spots show up right away and also raveled out the recycled pavement in shaded areas and on curves. Maintenance forces spent about $18,000 patching areas that did not hold up under traffic. An anticipated item for maintenance work should be considered in future contracts.

The section of pavement between MP 7.73 and 9.83 consisted of a newer machine placed AC mix and recycled much better. Only minor maintenance activity was required in this area to take care of one or two spots that showed up later.

The Yamhill-Newburg section was a real test for recycling pavement in the Willamette Valley, because of the poor shape of the existing roadway and the curving alignment with shaded corners. It appears that the recycling did provide a major improvement to this section of highway even though maintenance forces did a lot of patching. An evaluation of this section of highway next spring will give us a good picture of how bad a section of roadway can be recycled.

SUMMARY

Guy Johnson worked on the preliminary investigation work, prepared the location data and was the project inspector during construction. He can give some real good coaching to other inspectors on what needs to be watched closely, what adjustments to make and when, and any other aspects of recycling pavement in Western Oregon. We got the best job possible through Guys' efforts and because the contractor was knowledgeable and cooperative about the work. Guy can be contacted if anyone needs technical data other than what's shown below.

At the beginning of this project (MP 22.4, NB) the addition of emulsified asphalt and total water introduced into the CIR mix was set at 1.2% and 1.0% respectively. The sampling of this existing pavement showed a field mix design of 1.5% emulsified asphalt and 2.0% total water. The contractor's project superintendent said the calculated field mix design required too much emulsified asphalt and water. The weather prior to beginning the recycle work was wet with cool temperatures. The existing pavement aggregates were surface saturated and the humidity was near 90%.

After the CIR operation moved approximately 400 feet (MP 22.32, NB), the setting for adding emulsified asphalt was increased to 1.3% keeping the total water at 1.0%. This was done to experiment and see if by increasing the asphalt closer to the calculated field mix design, what results would happen. The CIR mix became excessively oily. More "pug mill balls" (asphalt and fines balling up in pug mill) were appearing and the mix was decreased back 1.2% (MP 22.0, NB), keeping the total water at 1.0%.

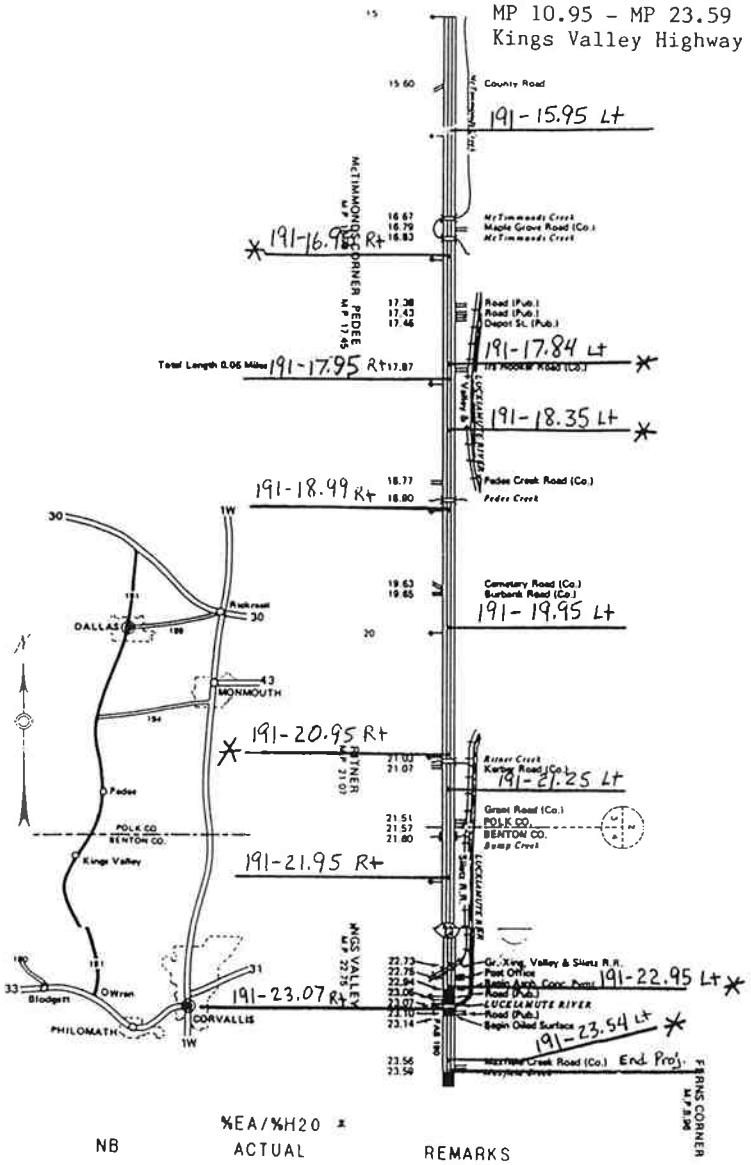
At MP 21.35 NB, the emulsified asphalt was decreased to 1.1% and total water was kept at 1.0%. The field mix design for this area shows a 1.4% emulsified asphalt and 2.1% water.

Throughout the entire project the range of added emulsified asphalt was between 1.0% to 1.4%. The range of total water put into the CIR system was between 0.2% and 1.1%. This does not include the research section on the Yamhill-Newberg Highway between MP 9.10 to Mp 9.65 WB & EB.

For this same project, the calculated field mix design ranged as follows: Emulsified asphalt 0.5% to 2.0%, total water 1.5% to 3.0%. Attached are mile point straight line charts showing the existing pavement sampling sites with associated field mix design on the right side of the page. The left side of the sheet shows the actual field adjustments made during the CIR process.

Michael J. Gardner
Project Manager

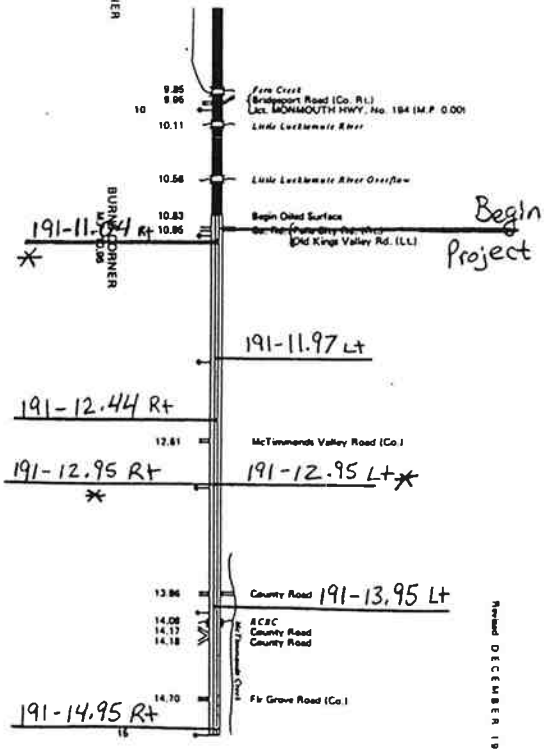
Region 2 Recycle
C10769
Airlie Rd. - Maxfield Cr. Bridge
MP 10.95 - MP 23.59
Kings Valley Highway



SAMPLE SITE (MP)	%EA/%H2O * FIELD MIX DESIGN
11.04 SB	1.2/2.3
12.95 NB	1.8/1.7
12.95 SB	2.0/1.5
16.95 SB	1.5/2.0
17.84 NB	1.4/2.1
18.35 NB	1.7/1.8
20.95 SB	1.4/2.1
22.95 NB	1.4/2.1
23.54 SB	1.2/2.3

NB	%EA/%H2O * ACTUAL	REMARKS
15.60-16.45	1.3/1.0	
16.45-16.67	1.4/0.8	Rip rap base
16.67-19.45	1.3/1.0	
19.45-20.79	1.2/1.0	Up hill grade
20.79-20.80	1.4/1.0	Shaded area
20.80-20.98	1.2/1.0	
20.98-21.05	No Work	Ritner Cr. Br. Sect.
21.05-21.09	1.1/1.0	
21.09-22.00	1.2/1.0	
22.00-22.32	1.3/1.0	
22.32-22.40	1.2/1.0	
22.40-22.60	1.1/0.8	
22.60-23.58	1.2/0.8	

SB		
15.78-16.05	1.3/0.9	
16.05-16.55	1.3/0.7	Shaded area
16.55-16.84	1.4/0.7	Rip rap base
16.84-17.48	1.1/1.0	
17.48-17.86	1.3/0.8	Shaded area
17.86-19.65	1.1/1.0	Sun was out
19.65-20.98	1.3/0.8	Shaded area
20.98-21.05	No Work	Ritner Cr. Br. Sect.
21.05-21.22	1.0/1.0	
21.22-21.50	1.0/0.9	
21.50-23.58	1.1/1.0	



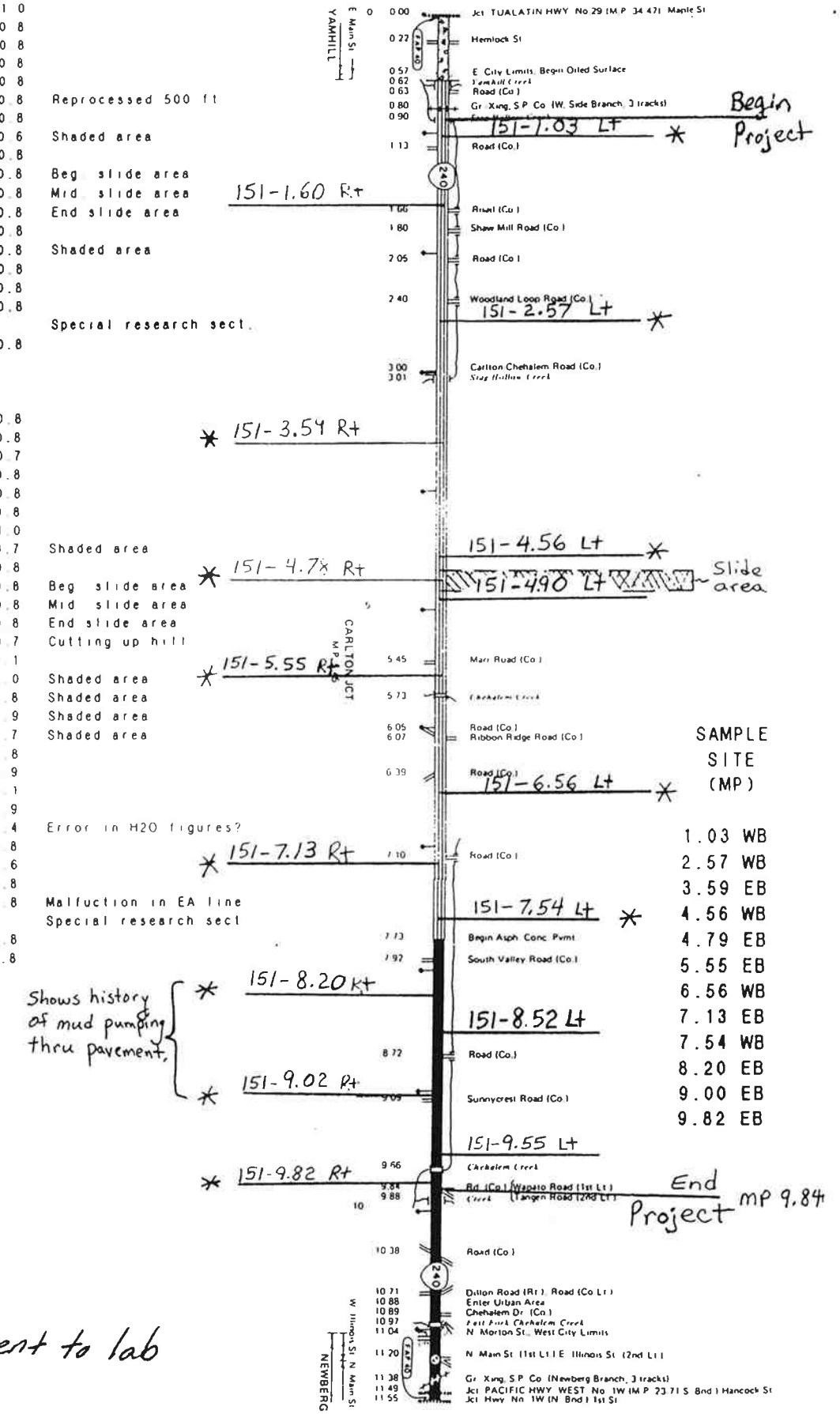
* % emulsified asphalt added / % total water in CIR mix

+ Sample sent to lab

Revised DECEMBER 197

Region 2 Recycle
C10769
Stag Hollow Cr. Bride - Wapato Rd.
MP 0.90 - MP 9.84
Yamhill-Newberg Highway

EB	%EA/%H2O * ACTUAL	REMARKS
0.91-1.20	1.3/1.0	
1.20-1.65	1.2/0.8	
1.65-2.15	1.3/0.8	
2.15-2.25	1.2/0.8	
2.25-3.10	1.0/0.8	
3.01-3.10	0.5/0.8	Reprocessed 500 ft
3.10-3.57	1.2/0.8	
3.57-4.41	1.3/0.6	Shaded area
4.41-4.85	1.3/0.8	
4.85-4.88	1.1/0.8	Beg slide area
4.88-4.91	1.0/0.8	Mid slide area
4.91-5.02	1.1/0.8	End slide area
5.02-6.30	1.2/0.8	
6.30-7.91	1.3/0.8	Shaded area
7.91-8.08	1.2/0.8	
8.08-8.90	1.1/0.8	
8.90-9.13	1.2/0.8	
9.13-9.65		Special research sect.
9.65-9.83	1.3/0.8	
WB		
0.91-1.66	1.2/0.8	
1.66-2.00	1.3/0.8	
2.00-2.45	1.2/0.7	
2.45-2.96	1.2/0.8	
2.96-3.45	1.3/0.8	
3.45-3.85	1.2/0.8	
3.85-4.00	1.1/1.0	
4.00-4.45	1.4/0.7	Shaded area
4.45-4.57	1.3/0.8	
4.57-4.70	1.2/0.8	Beg slide area
4.70-4.86	1.1/0.8	Mid slide area
4.86-5.00	1.2/0.8	End slide area
5.00-5.30	1.3/0.7	Cutting up hill
5.30-5.60	1.2/1.1	
5.60-5.73	1.5/1.0	Shaded area
5.73-6.00	1.4/0.8	Shaded area
6.00-6.22	1.4/0.9	Shaded area
6.22-6.50	1.3/0.7	Shaded area
6.50-6.66	1.3/0.8	
6.66-7.00	1.3/0.9	
7.00-7.25	1.3/1.1	
7.25-7.45	1.3/0.9	
7.45-7.66	1.2/0.4	Error in H2O figures?
7.66-7.83	1.2/0.8	
7.83-8.41	1.2/0.6	
8.41-8.52	1.3/0.8	
8.52-9.13	1.0/0.8	Malfuction in EA line
9.13-9.65		Special research sect
9.65-9.75	1.3/0.8	
9.75-9.83	1.2/0.8	



Shows history of mud pumping thru pavement.

SAMPLE SITE (MP)	%EA/%H2O FIELD MIX DESIGN
1.03 WB	1.2/2.3
2.57 WB	1.0/2.5
3.59 EB	1.6/1.9
4.56 WB	1.4/2.1
4.79 EB	0.5/3.0
5.55 EB	1.6/1.9
6.56 WB	1.7/1.8
7.13 EB	1.3/2.2
7.54 WB	1.0/2.5
8.20 EB	0.8/2.7
9.00 EB	0.6/2.9
9.82 EB	0.8/2.7

* Sample sent to lab

* % emulsified asphalt added / % total water in CIR mix

STATE OF OREGON

INTEROFFICE MEMO

TO:

DATE: 10-31-89

FROM: Dan Olson
Project Manager

SUBJECT: Narrative Report
Region 4 Recycle Project
C10728

Contract was awarded to J. C. Compton Contractor Inc. for $748,990.00 on April 18, 1989.

CIR. work began 6-14-89 on Unit 'C', MP 21.66 to 35.70 of Central Or. Hwy, was completed 6-24-89. } Horse Ridge – Crooked River Jct.

CIR. work began 6-27-89 on Unit A & B MP. 0.00 to 14.81 & 83.41 to 86.01 of East Diamond Lake Hwy. & Umpqua Hwy, was completed 7-22-89. } Umpqua Jct. – The Dalles-CA Hwy

No problems during CIR. work except cool weather. Mix Specified Temp. reached before starting. High Temp. (above 80 degrees) were not present this summer during June & July. Weather caused some severe raveling on all Units. This required additional rolling and Traffic Control. Some regrinding was required.

I have no solution how to handle unseasonable weather conditions.

OGEAC overlay placed on Unit 'C' 7-25-89 to 7-31-89.
Overlay shortened by 1.3 Center Line Miles. Ran out of Stockpiled Aggregate & exceeded Bid quantity by 520 Tons. Also average Liquid Asphalt Content was 7% by weight of mixture. This caused a 200 ton overrun for Emulsified Asphalt in Mixture.

The final project cost should be a 0 to 1% overrun. This is mostly due to shortening overlay because of Aggregate shortage. Also $30,000 of unused Engineering.

All work was completed by Spec. Completion Date (8-7-89).

Final Inspection report rated all three Units as followes, "Quality of work excellent and ride above average".

Oregon Department of Transportation
HIGHWAY DIVISION

AMENDED

PROJECT INSPECTION REPORT

INTERMEDIATE [ ]
FINAL [X]

PROJECT NAME (SECTION)			CONTRACT NO.
Region 4 Recycle			10,728
HIGHWAY		COUNTY	F.A. PROJECT NO.
Various		Deschutes/Klamath	State
CONTRACT TIME ELAPSED	CONTRACT WORK COMPLETED	CONTRACT WORK QUALITY	CONTRACT WORK PROGRESS
100%	100 %	Satisfactory	Satisfactory
INSPECTION DATE		BY	
October 13, 1989		Steve Macnab	
IN COMPANY WITH			
Dan Olson			

REMARKS (SCOPE OF INSPECTION, FINDINGS, RECOMMENDATIONS, INSTRUCTIONS, ETC.)

This project was awarded to J. C. Compton, Inc. and required the in-place recycling of asphalt concrete pavements on two highways: Diamond Lake and the Central Oregon. In addition, the contractor was required to place a thin cold mix overlay on the recycled pavement on the Central Oregon Highway. Materials for this overlay were from current stockpiles at Horse Ridge.

All site work has been completed. There was a slight overrun of asphalt paving quantities on the Central Oregon project, and some State-funded re-recycling on the Diamond Lake Hwy to correct construction defects.

There are no outstanding claims for additional time or compensation, and none are expected at this time. Acceptance of the project is recommended by Region upon successful completion by the contractor of all outstanding items.

The combination of these two projects has provided the road user with 31.5 miles of better highway on these two important routes in Central Oregon. Quality of the final projects was excellent, and the ride above average.

RECEIVED
OCT 23 1989
PROJECT MANAGER

(USE ADDITIONAL SHEETS AS REQUIRED)

FINAL INSPECTION CHECKLIST

8-7-89	DATE OPENED TO TRAFFIC OR IN OPERATION
8-7-89	DATE OF SECOND NOTIFICATION
10/16/89	DATE CONTRACTOR'S NOTICE FOR FINAL INSPECTION RECEIVED
8-7-89	DATE CONTRACTOR REMOVED EQUIPMENT, PLANT, ETC.
1-31-89	ESTIMATED SUBMITTAL DATE OF SEMI-FINAL ESTIMATE

ORIGINAL TO: CONSTRUCTION SECTION
COPY TO: REGION
DISTRICT MAINTENANCE SUPERVISOR
PROJECT MANAGER OR LIAISON (STATE)
PROGRAM SECTION (FINAL ONLY)
FHWA (FINAL F.A. ONLY)
CONSULTANT OR LOCAL AGENCY (IF APPLICABLE)

SIGNED S Hannah

TITLE Region 4 Operations Engineer

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S M T W(X) T F S
DATE: 6/14/89

PROJECT NAME (SECTION): HORSE RIDGE - Hwy #37
CONTRACT NO.:
HIGHWAY: 20 EAST
F.A. PROJECT NO.: STATE
CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		X			
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW	MED X	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES			Roto Mill	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	Choke Truck		
MP 29.45-31.95 R	10:00 / 3:30	2	8	2	6				1	1								1	2				1	1		

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 29.45-31.95 R	CIR Mixture	11	17600	
"	Emul Asphalt	12	16.74+	
"	Tack Coat	10	5.90	
"	Choke	14	10.00	
Pug Mill	Agg. Wet		2147.30	
Pug Mill	Water	6	1097.0 Gal	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Due to weather we were on Rolo til 10:15 AM

Traffic moved well no delays or problems
Will pilot car all night. Due to rain this pm at
end of Shift

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zuehl

DISTRIBUTION: Original to Project Manager
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734 3474 6/88

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M | T | W | T: X | F | S

DATE: 6/15/89

PROJECT NAME (SECTION): HORSE RIDGE

CONTRACT NO.: C10728

HIGHWAY: 20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: S.C. Compton

F.A. PROJECT NO.: STATE

WEATHER

	CLEAR	FAIR: X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70: X	70-85	OVER 85
WIND		STILL	LOW: X	MED	HIGH
HUMIDITY		DRY	LOW: X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 29.45-31.95	10:00/6:00	1	1													1				

LOCATION and/or DESCRIPTION OF WORK	ESTIMATED QUANTITIES: ITEM NO	THIS DATE	TOTAL
MP 29.45-31.95 RE Roll			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

RUNNING pilot CAR & FLAGGERS 24 hrs A DAY
TRYING to SAVE MAT with RE-ROll NO further
work DONE TODAY

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zerbe

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
DAY						X	

DATE: 6/16/89

PROJECT NAME (SECTION): HORSE RIDGE – Hwy #37

CONTRACT NO.: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton

F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					

TEMP	TO 32	32-50	50-70	70-85	OVER 85
			X		

WIND	STILL	LOW	MED	HIGH
		X		

HUMIDITY	DRY	LOW	MED	HUMID
		X		

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP29.45-31.95	10:00/6:00	1	1													1				

LOCATION and/or DESCRIPTION OF WORK		ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
MP29.45-31.95	RE Roll			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

RE-ROLLING MAT to TRY AND SAVE it.
No FURTHER WORK TODAY

RUNNING pilot CAR 24 HRS/DAY til 6:00pm TONIGHT.
THEN TURN TRAFFIC ON it.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Burke

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION · HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M X | T | W | T | F | S

DATE: 6/19/89

PROJECT NAME (SECTION): HORSE RIDGE - Hwy #37

CONTRACT NO.: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: D.C. Compton

F.A. PROJECT NO.: STATE

WEATHER

	CLEAR	FAIR X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES			BROOM	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP29.45-31.95	10:00/12:00	1	1						1																	

LOCATION and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
29.45-31.95	BROOMING LOOSE MATERIAL			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Looks like the mat will be fine. ~~The~~ The contractor will probably regrind from MP 31.5 to 31.95. Before cold mix overlay ~~is~~ The contractor will blade patch heavily rutted areas with a fine 3/8-10 mix.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zahn

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
DAY			X				

DATE: 6/20/89

PROJECT NAME (SECTION): HORSE RIDGE - HWY #37 Jct.
CONTRACT NO.: C10728
HIGHWAY: #20 EAST
CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton
F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW	MED X	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	Choke Truck
MP 31.70 - 31.95 R	9:30 / 10:30		7																		
MP 31.95 - R	10:30 / 7:00	2	8	1	6		1								1	2			2	1	1

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 31.70 - 31.95 R	REGRIND			
MP 31.95 - 34.75 R	CIR MIXTURE	11	1971.2	3731.2
~~EAC~~	Emul Asphalt	13	31.24	47.98
	TACK	10	1.73	7.63
	Choke	14	20	30.0
	WATER	6	1678.66	2775.66

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

TRAFFIC WAS HEAVY • FIRST DAYS MAT HAS REVELLED OUT BUT IS NOT GETTING ANY WORSE. I CHANGED ROLLER PATTERNS TO TRY AND GET THE MAT TO SET UP. WILL TRY HOLDING ROLLER BACK AN HOUR 6/21/89.

TAKING 1½" SCREEN OUT OF SHAKER DECK AS DIRECTED BY BUZZ EPPERDS (BP) TO GET A COARSER MAT. EVERYTHING WILL PASS A 2" SCREEN.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zerba

734 3474 6/88

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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M | T | W (X) | T | F | S

DATE: 6/21/89

PROJECT NAME (SECTION): HORSE RIDGE to HWY #37 Jct.

CONTRACT NO.: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton

F.A. PROJECT NO.:

WEATHER

CLEAR (X)	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85 (X)	OVER 85
WIND		STILL (X)	LOW	MED	HIGH
HUMIDITY		DRY (X)	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	Choke Truck
MP 34.75-31.35 L	8:00/6:00	2	7	1	6		1								1	2			2	1	1

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO.	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 34.75-31.35 L	CIR Mixture	11	24288	61600
	Emul Ash	12	40.51	88.49
	Tack	10	5.18	12.81
	Choke	14	10 CU YDS	40 CU YDS
	Water	6	11.800GAL	4575.66

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic was average some complaints about loose gravel. Asked for loose gravel signs every 2 miles they will be this pm.

Dick Nelson O.K. on using HFE-200 Tomorrow to see if there is a difference. This change due to Albina Fuel running out of HFE-200s

Oil from Albina Fuel was seperated when it arrived on job causing opperation to shut down

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zerbe

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S M T W T F S: T

DATE: 6/22/89

PROJECT NAME (SECTION): Horse Ridge to Hwy #37 Jct.

CONTRACT NO.: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR: X	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY X	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	Chase Truck
MP 26.25 - 31.35 L	800/7:00	2	7	1	6		1								1	3			2	1	1

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 26.25 - 31.35 L		CIR MIX	11	35904	97504
"	"	Emul Asph.	12	54.26	142.75
"	"	Tack	10	7.67	20.48
"	"	Choke	14	10	50.0
"	"	Water	6	11835 GAL	26410.66

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Ran 2 pilot cars during reroll today. All other traffic moved well through the job.

Added a rubber tire roller at 7:00 pm today to aid in compaction effort and relieve stretch marks.

Dan Olson gave go ahead on using HFE-200 for the rest of the job. Check into price difference.

All blade patching will be at contractors expense. Due to it being corrective work.

Must contact Buzz Epperds about soft spot in EB panel and get them corrected before cold mix overlay starts

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zahn

DISTRIBUTION: Original to Project Manager
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734 3474 6/88

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
DAY						X	

DATE: 6/23/89

PROJECT NAME (SECTION): HORSE RIDGE - Hwy #37 Jct.

CONTRACT NO.: C10728

HIGHWAY: #20 EAST

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL X	LOW	MED	HIGH
HUMIDITY		DRY X	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)	Truck Chucks
MP 26.25 - 2	700 /	2	X	1	5		1								1	3			3	1	1

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 26.25 - 20.90	2	CIR Mixture	11	12554.67	110058.67
"	"	Emul Asph.	12	77.52	220.27
"	"	Tack	10	8.76	29.24
"	"	Choke	14	10.00	60.00
"	"	WATER	6	12,520	38930.66

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic moved well through the job no problems
Blanket Rolled yesterdays mat with rubber tire Roller
to set Raveled material.
45 min. Delay ran out of oil on hold til next
load arrives. All oil used today HFE-200

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zuhr

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S M T W(X) T F S
DATE: 6/29/89

PROJECT NAME (SECTION): DIAMOND LAKE
CONTRACT NO.: C10728
HIGHWAY: #138 Unit 'B'
CONTRACTOR AND/OR SUBCONTRACTOR: J. C. Compton
F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		X			
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 6.55 - 10.10 W/B	8:00/4:45	3	8	6	6		1					1			1	2		1	3	1
5.65				2																
	8.75																			

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 6.55 - 10.10 W/B		CIR Mix	11	32633.33	68566.66
" 5.65	"	Emul Asph	12	33.76	65.86
"	"	Tack	10	7.73	17.01
"	"	Water	6	13,005 Gal	29665
"	"	Choke	14	19.32	38.64

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic was heavier then yesterday will probably pick up the rest of the week. Stop order sent out for noon Friday 6/30 to Wed 7/5 8:00 AM.
Dale Allen stopped by discussed job and field adjustments for oil content.
Stopped today at 3:00 pm due to temp. behind paver dropped below 90° and it was threatening to rain.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Daniel P. Zerbe

DISTRIBUTION: Original to Project Manager
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734 3474 6/88

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: DAY | S | M | T | W | T X | F | S

DATE: 6/29/89

CONTRACT NO: C10728

PROJECT NAME (SECTION): DIAMOND LAKE

HIGHWAY: #138 Unit 'B'

F.A. PROJECT NO.: STATE

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

WEATHER

	CLEAR	FAIR	CLOUDY	SHOWER	RAIN X	SNOW
TEMP	TO 32	32-50 X	50-70	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW	MED X	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
VARIOUS	6:00 / 4:00	1			2														1	

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
VARIOUS	INSTALL TEMP SIGNS for WEEK	3		

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

NO WORK TODAY DUE TO RAIN WILL NOT WORK TOMORROW DUE TO 12:00 NOON SHUT DOWN TIME. WILL START UP AGAIN 4/10/89.

RICK RHODES WILL WATCH WORKED AREA NEXT 11 DAYS WILL CONTACT ME IF I'm NEEDED.

CHEMULT MAINTENANCE WILL BE HAULING CHOKE A66 TO STOCKPILE SITE (MP 14.4) A' TOTAL of 120-150 CU YDS NEXT WEEK

PREPARED BY: Daniel P. Beale

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

734 3474 6/88

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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T X F S

DATE: 6-29-89

PROJECT NAME (SECTION): Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: #20 East

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY X	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP 23.55 - 21.00 R/L	10:00/2:00	1	2																2			1				

LOCATION and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
MP 23.55 - 21.00 R/L	Re Roll			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

MP 23.40 & MP 21.45 WB Right: Recycle Appears To Have Failed

Light Traffic - No Problems

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Stephen B Witte

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day (S M T W T F X S) | DATE: 7-14-89

PROJECT NAME (SECTION): Region 4 Recycle (Diamond Lake) | CONTRACT NO.: C10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton | F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL X	LOW	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
Various	8:00/6:30	3	8		6							1		1	1	3		3	3	1
M.P 11.75 –																				
MP 7.05 W/B																				

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
11.75–7.05 WB	CIR MIX	11	34,466.66 ~~10,300~~ sq yds	103033.33 ~~378766.66~~
" "	Emuls. Asphalt	12	1627 T	82.13
" "	Tack	10	7.64	24.65
" "	water	6	11,085 gal	40750 gal.
" "	choke agg	14	~~0~~	3864

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic Control start at 8:00, 10:00 started Reground of west bound Lane. Traffic was light all day, no choke agg used on Reground MAT. started at MP 11.75 ended at 7.05 5:00 pm shut down

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Hamm

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S M T W T F S: S

DATE: 7-15-89

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton, Valentine Surfacing

F.A. PROJECT NO.: STATE

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY X	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
various		3	3	1	6							1		1	1	3		3	1	
MP 7.05 -																				
MP																				

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 7.05 WB CIR Mix	11	35,556.66 yds²	138589.99
Emulsified asphalt	12	36.99 T	119.12 Tons
Tack	10	9.32 T	33.97 Tons
water	6	13,810 gal.	54,560 gal
choke	14	0	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic control started @ 6:30, 7:00 started grinding Regrind from M.P. 7.05 - 5.65 W.B., New recycler from 5.65 - 2.20 end grinding @ 4:60 PM Traffic control ended at 5:30

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Harry

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S X | M | T | W | T | F | S

DATE: 7-16-89

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY X	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW	MED X	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP 7.05 - MP 2.2 WB		1	3																2							

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Extra Rolling By 2 steel wheeled Rollers 5 1/2 hours ended at 3:00 PM, Traffic control for same amount of Time

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Thomas

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M X | T X | W | T | F | S

DATE: 7-18-89

PROJECT NAME (SECTION): Region 4 Recycle Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED.	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP 2.2-MP 83.41	7-4:00	3	7	2	6					1					1			1	3			3	1			

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 2.2-MP 83.41	EIR MIX	11	35,273	173862.99
	Emulsified Asphalt	12	47.23T	166.35
	Tack	10	8.61T	42.58
	Water	6	14080 gal	68,640
	Choke agg.	14	0	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Traffic control started 6:30 - weather questionable - cloudy & cool by 10:00 sun appeared & corrected The compaction problem Reached end of Unit B, ground Through Interchange & completed Unit A West Bound at 3:00 PM

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Harry

DISTRIBUTION: Original to Project Manager
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734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W (X) | T | F | S

DATE: 7-19-89

PROJECT NAME (SECTION): Region 4 Recycle, Diamond Lk. Jct.

CONTRACT NO.: C-10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL X	LOW	MED	HIGH
HUMIDITY		DRY X	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
Recycle M.P. 84.31 To 1.9 MP		3	6	2	6					1					1			1	3			3	2			
Reroll MP. 15.00 To 12.00		1	2																2							

LOCATION and/or DESCRIPTION OF WORK		ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
M.P. 84.31 To MP 1.9	C/R Mix	11	33073.33	2069632
	Emulsified asphalt	12	46.20	212.55
	Tack	10	9.47	52.05
	water	6	~~14810~~ 14810	83,450
	choke agg	14		

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Started East bound lane 7:00 AM; no unusual Problems encountered
Dan Olson visited Job - discussed Regrind of W.B MP 4.9-5.2
With Bill Kaiser ended Grinding at 4:30 MP 1.9 EB of unit
B

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Hanson

734 3474 (7-85)

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day					X		

DATE: 7-20-89

PROJECT NAME (SECTION): Region 4 Recycle Diamond Lake unit B

CONTRACT NO.: C10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR: X	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP:	TO 32	32-50	50-70	70-85 X	OVER 85
WIND:	STILL X	LOW	MED	HIGH	
HUMIDITY:	DRY	LOW X	MED.	HUMID	

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 1.9 & MP 5.65	7-500	3	7	2	5		1					1			1	3			3	2
MP 18-MP 9 Re Roll			2													2				

LOCATION	and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
MP 1.9- 5.56		CIR Mix		26840 yds²	233776.23
E.B		Emulsified asphalt		36.70	249.25
		Tack		8.08	60.13
		water		13,510 gal	96,960 gal
		Choke		0	
		Regrind sq yds		2200 yds²	235976.23

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Started grinding @ 7:00 EB Foggy weather - cleared up about

PREPARED BY

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

734 3474 (7-85)

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W | T | F X | S

DATE: 7-21-89

PROJECT NAME (SECTION): Region 4 Recycle Diamond Lake

CONTRACT NO.: C 10728

HIGHWAY: 138

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

F.A. PROJECT NO.: SPate

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					

TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	

WIND	STILL	LOW	MED	HIGH
		X		

HUMIDITY	DRY	LOW	MED.	HUMID
		X		

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)		
M.P. 5.7 ~ 11.8		3	6	1	5										1			1	3			3	2		

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P 5.7 - 11.8 CIR MIX	11	44,733	280709.23
emulsified asphalt	12	51.49	300.74
Tack	10	10.36	70.49
water	6	22,063 gal	1,19023

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Started east bound Lane at 7:00 Am, Noon a wreck occured at Mile point 5 in the pilot line involving a Ford P.U and a Yamaha Motorcycle and a Ford Bronco, The P.U failed To STOP and squished the Motorcycle between himself and the Bronco, The Riders were not on the Bike when This occured They were struck by The Bikes Trailer and Recieved minor bruises The O.S.P Handled the situation accordingly. day ended at 8:00 Traffic control pulled.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Ramey

DISTRIBUTION: Original to Project Manager
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734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day							X

DATE: 7-22-89

PROJECT NAME (SECTION): Region 4 Recycle Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP: TO 32		32-50	50-70	70-85 X	OVER 85
WIND:		STILL X	LOW	MED	HIGH
HUMIDITY:		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
M.P. 11.8 TO	7-12:00	3	6	1	6		1					1			1	3			3	2
M.P 15																				

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P 11.8-15.00 CIR Mix	11	23,446.67	504155.9
Emulsified asphalt	12	23.54 T	324.28
Talk	10	6.31	76.8
water	6	13,460	132,480

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Started grinding at 7:00 Am East bound at Mile point 11.8 ended Paving at 12:10 Pm at Mile point 15 end of Job without incident

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Thomas

DISTRIBUTION: Original to Project Manager
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734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day		X					

DATE: 07 24 89

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East Diamond Lake

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					

TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	

WIND	STILL	LOW	MED	HIGH
		X		

HUMIDITY	DRY	LOW	MED	HUMID
		X		

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 7.25 - M.P. 4.45	8	1	2													2			1	

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
		Paved			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Large rubber tire roller was broke down for about 45 minutes

Made 6 passes on each panel between M.P. 7.2 and MP 4.5

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark A. Robinson

DISTRIBUTION: Original to Project Manager
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734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day (S M X T W T F S)

DATE: 07 24 89

CONTRACT NO.: C10728

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

HIGHWAY: 138 East Diamond Lake

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED.	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 7.25 - MP. 4.45	8	1	2													2			1	

LOCATION and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Large rubber tire roller was broke down for about 45 minutes
Made 6 passes on each panel between M.P. 7.2 and MP 4.5

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark A. Robinson

DISTRIBUTION: Original to Project Manager
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734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T F S (M)

DATE: 7-25-89

PROJECT NAME (SECTION): Reg 4 Recycle

CONTRACT NO.: 10728

HIGHWAY:

CONTRACTOR AND/OR SUBCONTRACTOR:

F.A. PROJECT NO.:

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85	OVER 85
WIND		STILL	LOW	MED	HIGH
HUMIDITY		DRY	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
		3	4	9	3										1	1		8	3	1

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
		Tack	9	8,10	
		Mix/92 Loads	7	2054,91	?
			14	184,98	?

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Paved 0-16 Rtmp 20,97 to 25,45 = 4,48 miles
started w/oil content @ 6% Changed to 7%
Lots of "grab-backs" (un-oiled aggregate)
P.M. Dan Olson made several changes in oil & aggregate.
Smooth operation except for takeoff.
Signs in place & satisfactory.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: J Driscoll

734 3474 6/88

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M X | T X | W | T | F | S

DATE: 07 25 89

PROJECT NAME (SECTION): Region 4 Recycle – Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East (Diamond Lake

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X	X				
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
MP 4.5 to MP 2.14	6 1/2	1	2																2			1				
MP 2.4 to MP 0.0	1 1/2	1	2																2			1	1			

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Between 11:15 AM to 11:45 AM large rubber tire roller was down to have the fuel filter changed while this roller was stopped so did the steel wheel roller stop!
Made 6 passes on each panel between Mile Posts 2.4 and 4.5
Made 3 passes on west bound panel between Mile Posts 0.0 and 2.4

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Kabenica

734 3474 (7-85)

DISTRIBUTION: Original to Project Manager
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OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day (S M T X W T F S) — DATE: 07 25 89

PROJECT NAME (SECTION): Region 4 Reagle – Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East Diamond Lake

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
	X				
TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	
WIND		STILL	LOW	MED	HIGH
			X		
HUMIDITY		DRY	LOW	MED	HUMID
			X		

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 4.5 to MP 2.4	6½	1	2													2			1	
MP 2.4 to MP 0.0	1½	1	2													2			1	

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Between 11:15 AM to 11:45 AM large rubber tire roller was down to have the fuel filter changed while this roller was stopped so did the steal wheel roller step.
Made 6 passes on each panel between Mile Posts 2.4 and 4.5
Made 3 passes on west bound panel between Mile Posts 0.0 and 2.4

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark A. Fabencia

734 3474 (7-85)

DISTRIBUTION: Original to Project Manager
Copy to Originator

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T X | W | T | F | S

DATE: 7-25-89

PROJECT NAME (SECTION): Region 4 Recycle Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: 20 east

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton

WEATHER

CLEAR X	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
cold plant	7:00-6:00		1		1									1						

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P. 18 Cold Plant — Emulsified Asphaltic Concrete Mix	7	2029.77 Tons	2029.77

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

6:30 Lightweight Trucks, plant Calibrated and Ready; starting @ 6.0% oil in mix, Too Dry percentage up To 7.0% - looking better, Dan Olson P.M visited plant - stop 1/4-10 For test loads, HFE-200 oil cut off by Olson switch To CMS-2S, NO CMS available will use HFE-200 The remainder of The day Rack back To Normal 1/4-10 back in mix end of Production 6:00 PM

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Flaming

DISTRIBUTION: Original to Project Manager
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734-3474 6/88

HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W: X | T | F | S

DATE: 7-26-89

PROJECT NAME (SECTION): Region 4 Recycle - Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: 20 East

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR: X	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85: X	OVER 85
WIND		STILL	LOW: X	MED	HIGH
HUMIDITY		DRY	LOW: X	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
M.P. 18.1 Cold Plant	7:00-	1	1		1									2						

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P. 18 Cold plant — E.A.C Mix	7	2223.07 T	4252.84

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Started Production @ 7:00 Am No Problems or unusual happenings This Day. Last load out @ 6:00 Pm

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Hamm

DISTRIBUTION: Original to Project Manager

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T F S (W marked)

DATE: 7-26-89

PROJECT NAME (SECTION): Region 4 Recycle

CONTRACT NO.: 10728

HIGHWAY: Central oregon

F.A. PROJECT NO.:

CONTRACTOR AND/OR SUBCONTRACTOR: J C Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
—	—	—			

TEMP	TO 32	32-50	50-70	70-85	OVER 85
WIND		STILL	LOW	MED	HIGH
HUMIDITY		DRY	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
mp 20.97 to 26.01	16	2	4	9	3										1	3		9	2	

LOCATION and/or DESCRIPTION OF WORK

flaggers
Pilot Car
AC (coldmix)
Haul/place Cho[illegible]
Tack

7-26-89
Tack truck did not weigh back - last nite
Est 8.50 Tons
J

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, [illegible] damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Paved 20.97 to 26.01 = 5.04 miles / ave 8.39 Tps.
mix ran @ 7% all day - appearance has not changed -
ChokeSeal on tuesday's work needed sweeting in [illegible].
mp 25.45 to 26.01 / 269.65 Ton / 9.12-[illegible] —
Trying to thin down mat - not much luck —
appears to be Crown in 1/4 panel [illegible] & change in
Superelev. 12 Lt to 16 Lt (x in drwg)

PREPARED BY: J [illegible] (signature)

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

734 3474 6/88

DISTRIBUTION: Original to Project Manager
Copy to Originator

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day				X			

DATE: 07 26 89

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East Diamond Lake

F.A. PROJECT NO.: State

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

WEATHER

CLEAR: X	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85: X	OVER 85
WIND		STILL	LOW: X	MED	HIGH
HUMIDITY		DRY: X	LOW	MED.	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
n.t B MP. 0.0 to 2.4	6½	1	2													2			1	
n.t A MP 83.5 to 86.1	1½	1	2													2			1	

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES: THIS DATE	TOTAL
	Reroll			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Steal wheel Roller broke down for about 15 minutes this AM

Made 6 passes on ~~east~~ East bound panel between M.P. 0.0 and 2.4

Made 6 passes on west bound panel between MP 86.1 and 83.5

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: [signature]

DISTRIBUTION: Original to Project Manager

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W | T | F | S | (T = X)

DATE: 7-27-89

PROJECT NAME (SECTION): Region 4 Recycle Horse Ridge

CONTRACT NO.: C10728

HIGHWAY: 20 East

CONTRACTOR AND/OR SUBCONTRACTOR: T.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY X	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES				BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)			
M.P. 18	7:00-	1	2		1												2									
cold Plant																										

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
M.P. 18		E.A.C Mix	8	214304	
cold Plant					

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

No unusual events happen For This Date Made Mix From 7:00 - 5:00 Pm

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Hamm

734 3474 6/88

DISTRIBUTION: Original to Project Manager

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T F S

DATE: 7-27-89

PROJECT NAME (SECTION): Reg 4 Recyle

CONTRACT NO.: 10728

HIGHWAY: Eastern Or Hwy

F.A. PROJECT NO.:

CONTRACTOR AND/OR SUBCONTRACTOR: JC Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85	OVER 85
WIND		STILL	LOW	MED	HIGH
HUMIDITY		DRY	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
mp 26.01	14	2	3	12	3									1	1	3		1/2	2	
Tomp 31:40																				

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
	Flaggers	4	15	est
	Pilot car	5	15	est
	Em As Mix	7	2143.84	
	Choke Rock	14	26 Loads est	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Paved - 5.39 miles / 7.55 Tons/sta
wet rock makes graybacks / oil contents @ 6.3
Base pane / very irregular. yields inconsistant - 9.3 s to 7.3 & inbetween
Wedges. oil was 6.3 not 7.0 - information inconsistant.
Contr plans Sat. work.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: J Dilday

734 3474 6/88

DISTRIBUTION: Original to Project Manager
Copy to Originator

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day					X		

DATE: 07 27 89

PROJECT NAME (SECTION): Region 4 Recyale - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East Diamond Lake

CONTRACTOR AND/OR SUBCONTRACTOR: J.C. Compton

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP: TO 32		32-50	50-70	70-85 X	OVER 85
WIND:		STILL	LOW X	MED	HIGH
HUMIDITY:		DRY X	LOW	MED.	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
Unit A MP 83.5 to 86.1	5	1	2													2			1	
Unit B MP 7 to 11.2	3	1	2													2			1	

LOCATION	and/or	DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
		Reroll			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Finished reroll on unit A. Moved to MP 7 and started reroll on unit B eastbound panel

On Unit "A" Lap joint is to high in the following areas by mile Post. 84.41 to 84.54, 84.78 to 84.82, 84.90 to 84.95 and 85.72 to 85.76 looks like the laydown machine raise the eastbound panel an inch to inch and half to be able to pull the grade

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: [signature]

734 3474 (7-85)

DISTRIBUTION: Original to Project Manager

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT	S	M	T	W	T	F	S
Day						X	

DATE: 07 28 89

PROJECT NAME (SECTION): Region 4 Recycle - Diamond Lake

CONTRACT NO.: C10728

HIGHWAY: 138 East Diamond Lake

CONTRACTOR AND/OR SUBCONTRACTOR: Dan Olson

F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
X					
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY X	LOW	MED.	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 11.2 to MP 19.7	6	1	2													2			1	

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P. 11.2 to 14.7 Reroll on Recycle			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Made 6 passes on the Eastbound panel to finish the reroll on this project

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: [signature]

734 3474 (7-85)

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W | T | F (X) | S
DATE: 7-28-89

PROJECT NAME (SECTION): Region 4 Recycle Horse Ridge
CONTRACT NO.: C10728
HIGHWAY: 20 East
CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton
F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
	X				
TEMP	TO 32	32-50	50-70	70-85	OVER 85
				X	
WIND		STILL	LOW	MED	HIGH
			X		
HUMIDITY		DRY	LOW	MED	HUMID
			X		

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
M.P 18			2		1									1						
cold Plant																				

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P 18 E.A.C Mix	8	459.99 Tons	
cold Plant			

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Load out Belt Broke 10:00 AM - Down The Rest of The Day.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Harry

734 3474 6/88

DISTRIBUTION:

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T F S

DATE: 7-29-89

PROJECT NAME (SECTION): Region 4 Recycle

CONTRACT NO.: 10728

HIGHWAY: Central Oregon

F.A. PROJECT NO.:

CONTRACTOR AND/OR SUBCONTRACTOR: JC Compton

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85	OVER 85
WIND		STILL	LOW	MED	HIGH
HUMIDITY		DRY	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
mp 26.5 to 31.45	15	2	4	10	3							1		1	1	3		9	2	

7-29-89 6 A.M. 7-31-89
Dan - Read!!!
Anticipate
mile Point +32.51
Complete - 1000± tons out of rock
Joe

LOCATION and/or	DESCRIPTION OF WORK
	Flaggers Pilot car AC (Cold mix) Haul/Place

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Ended mp 31.45 plan 900-1000 tons monday
est 400 tons per mile.
Bad laydown in a.m. Gummy mix, mat tearing - increased temp. to 170 but oil out of tank (line to pug) looked like A.C. 20.
Oil Sample for Salem -
no brooming mon. Re: Gary Nick - - -
I think he doesn't want to broom at all.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: J Diddock Jr

734 3474 6/88

DISTRIBUTION: Original to Project Manager

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M | T | W | T | F | S: X
DATE: 7-29-89

PROJECT NAME (SECTION): Region 4 Recycle Horse Ridge
HIGHWAY: 20 East
CONTRACT NO.: C10728
CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton
F.A. PROJECT NO.: State

WEATHER

	CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		X				
TEMP		TO 32	32-50	50-70	70-85 X	OVER 85
WIND		STILL X	LOW	MED	HIGH	
HUMIDITY		DRY	LOW X	MED	HUMID	

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
M.P. 18 cold Plant			2		1									1						

LOCATION and/or DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
M.P. 18 cold Plant — E.A.C Mix	8	2007.96	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

No unusual events or happenings excpt. Possibe bad load of Oil delivered - heated up To improve Characteristics but No Brown Color in oil - possibly broke before load out.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark Ramey

734 3474 6/88

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S M T W T F S

DATE: 7-29-89

PROJECT NAME (SECTION): Region 4 Recycle

CONTRACT NO.: 10728

HIGHWAY: Central Oregon

CONTRACTOR AND/OR SUBCONTRACTOR: JC Compton

F.A. PROJECT NO.:

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
TEMP	TO 32	32-50	50-70	70-85	OVER 85
WIND		STILL	LOW	MED	HIGH
HUMIDITY		DRY	LOW	MED	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
MP 25-45 to 26.46		2	3	10	3							1		1	1			10	2	

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO.	ESTIMATED QUANTITIES THIS DATE	TOTAL
	Flaggers	4	18	
	Pilot Car	5	9	
	Cold mix	7	449.7	
	Choke	14	6	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Short day Pugmill / Hopper belt broke.
Smooth operation —

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: J Dubbock Jr

DISTRIBUTION

734 3474 6/88

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: Day | S | M X | T | W | T | F | S
DATE: 7-31-89

PROJECT NAME (SECTION): Region 4 Recycle Horse Ridge
HIGHWAY: 20 East
CONTRACT NO.: C10728
CONTRACTOR AND/OR SUBCONTRACTOR: J.C Compton
F.A. PROJECT NO.: State

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
	X	X			
TEMP	TO 32	32-50	50-70 X	70-85	OVER 85
WIND		STILL	LOW X	MED	HIGH
HUMIDITY		DRY	LOW	MED X	HUMID

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
M.P 18 cold Plant			2		1									1						

LOCATION and/or DESCRIPTION OF WORK	ESTIMATED QUANTITIES ITEM NO	THIS DATE	TOTAL
M.P. 18 cold Plant E.A.C Mix	B	1064.58 Tons	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

end of Project @ M.P 32.65 - out at 0.1 and Rock, had To make New Design with Line treaded 1/2-1/4 and dirty 3/4-1/4 coarser but acceptable design

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: Mark

734 3474 6/88

DISTRIBUTION

OREGON DEPARTMENT OF TRANSPORTATION — HIGHWAY DIVISION

GENERAL DAILY PROGRESS REPORT

SHIFT: S | M (X) | T | W | T | F | S

DATE: 7-31-89

PROJECT NAME (SECTION): Reg 4 Recycle

CONTRACT NO.: 10728

HIGHWAY: Central Oregon

CONTRACTOR AND/OR SUBCONTRACTOR: JC Compton

F.A. PROJECT NO.:

WEATHER

CLEAR	FAIR	CLOUDY	SHOWER	RAIN	SNOW
		—			
TEMP	TO 32	32-50	50-70	70-85	OVER 85
			—		
WIND		STILL	LOW	MED	HIGH
			—		
HUMIDITY		DRY	LOW	MED.	HUMID
		—			

NUMBER OF PERSONNEL AND MAJOR EQUIPMENT

LOCATION OF WORK	HOURS	SUPERVISORS	OPERATORS	TRUCK DRIVERS	LABORERS	TRAINEES	BACK HOE	BLADE	COMPACTOR	COMPRESSOR	CRANE	DISTRIBUTOR	DOZER	LOADER	PAVER	ROLLER	SCRAPER	TRUCK (DUMP)	TRUCK (PICKUP)	TRUCK (WATER)
mp 31.50 to 32.65	10	2	4	11	3							1		1	1	4		11	2	

LOCATION and/or	DESCRIPTION OF WORK	ITEM NO	ESTIMATED QUANTITIES THIS DATE	TOTAL
	Flaggers	4		
	Pilot Car	5		
	Cold mill	7	~~10645~~ 8	
	Haul Pl[illegible] ae Choke	14	19 loads	

REMARKS - Condition of the traffic control and roadway; important discussions with contractor; rejected work or materials and reasons; delays, difficulties, accidents, utility damages and other unusual conditions or events; arrivals and departures of major equipment; visitors.

Terrible time with paving ran out of rock changed to 42%-3/4 — 58%-1/4-10 @ 9 A.M. 0-16 Lt mp 31.6 ±. Cont'r draining oil tanks oil heavy (slhd?) hard to lay down mat looks ok — Inspected.

Note !!! mp 32.60/0-16 Lt to mp 32.65 0-16 Lt approx 10 tons looked terrible. It may have to be removed.

USE BACK FOR ADDITIONAL REMARKS - SEE BACK ☐

PREPARED BY: [signature] Insp.

734 3474 6/88

DISTRIBUTION: Original to Project Manager
Copy to Originator

APPENDIX B

CIR Specifications

from Various

Western States

ARIZONA

On sheet 12 of 46 add the following:

(SUBC108, 6, 08/18/87)

SECTION 108 - PROSECTION AND PROGRESS:

108.01 Subletting of Contract: of Standard Specifications is modified to add:

Contractors shall not sublet to subcontractors who are not duly licensed contractors in accordance with Arizona Revised Statutes 32-1101 through 32-1170.03.

Further information regarding licensing may be obtained by contacting:

Registrar of Contractors
1818 West Adams Street
Phoenix, AZ 85007
Phone: (602) 255-1502

On sheet 16 of 46, SECTION 202 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS: 202-1 Description: is revised to read:

The work shall include the removal and salvage of guard rail, three cantilever sign structures which includes three changeable message signs, one ground mounted sign structure, which includes three breakaway sign posts and one changeable message sign. The above material shall be hauled to the ADOT Casa Grande Maintenance Yard for storage or as directed by the Engineer. No measurement or additional compensation will be made for removing and hauling the above mentioned material, the cost being considered as included in the price for ITEM 2020001.

All other material designated to be removed such as, fuel tanks, parking aprons; the removal and resetting of cable barrier posts, gas lines to sign structures and any incidental work to these items, shall become the property of the contractor and will be his responsibility for disposal.

On sheet 17 of 46, under ITEM 4090011- COLD RECYCLING (Bituminous Surface): The second sentence in the first paragraph is revised to read:

All materials shall be broken up so that 100% passed the one inch sieve.

DALLIS B. SAXTON, Engineer-Manager
Contracts & Specifications Services

AG/jc
I-10-4-939
Addendum 2
08/24/87

404-3.13 Fog Coat: of the Standard Specifications is revised to read:

The type of bituminous material shall be SS-1, diluted with one part water to one part emulsion, and shall be applied at the approximate rate of 0.1 gallon per square yard.

Blotter material shall be applied to the treated surface in one or more application for a total application of approximately 2 pounds per square yard at a time specified by the Engineer and before opening the roadway to traffic.

ITEM 4090011 - COLD RECYCLING (Bituminous Surface):

The work under this item shall consist of milling the existing pavement to the depth shown on the plans. All materials shall be broken up so that 100% passes the 1 1/2 inch sieve. This may be accomplished by crushing at a central location or by pulverization in-place. Pulverization in-place can be accomplished in a single pass operation to a minimum depth of 2 1/2 inches or a multi-step process can be utilized which consists of milling, windrowing and pulverization.

The crushed or pulverized bituminous material (hereafter called aggregate material) and 1 1/2% mixing water (as a percentage of the total weight of the aggregate material) shall be mixed in either a stationary plant or in a traveling mixer. No blade mixing of the material will be allowed. The allowable moisture content of the mixed aggregate material shall not exceed 3% prior to the addition of the emulsified recycling agent. The aggregate material and emulsified recycling agent (hereafter called asphalt in this item) shall be thoroughly mixed until the asphalt is uniformly distributed throughout and all aggregate particles are completely coated.

If a stationary plant is used, the mixing process shall conform to the applicable portions of Section 406-10.05 of the Standard Specifications.

If a traveling mixer is used, the prepared aggregate material shall be form into one or more windrows. Windrows snall be uniform in size and contain sufficient material to produce the required thickness of compacted pavement. The type of equipment used for mixing the aggregate material shall be self-propelled and capable of adding the asphalt through a metering device immediately prior to or during mixing operations. The material shall be mixed to the satisfaction of the Engineer. If the mixer is not capable of picking up the aggregate material then a front loading pick up machine may be used ot deposit the material into the mixer. The mixer, if capable, may place the bituminous mixture to the dimensions shown on the plans typical section, or it may deposit the material on the roadbed in a uniform windrow ready for placement by a self-propelled laydown machine. The laydown machine shall pick up all the bituminous material and deposit it to the dimensions shown on the plans typical section. In certain areas where all of the existing AC shall be removed, care shall be taken not to pick up the AB and contaminate the mix. If the laydown machine is not capable of picking up the bituminous mix then a front loading pick up machine may be used to deposit the bituminous mixture into the laydown machine.

The contractor shall provide the means to ensure a uniform rate of feed from the cold recyle train to to laydown machine. At the locations where the train stops and a large windrow builds up followed by a gap, the use of a loader may be required.

Because of the sequence of the recyling train, it will be necessary for the contractor to have the means to transport the removed material deposited outside of the trench at the start-up operations back into the trench at the end of the day and at the opposite end of the trench. This process will be required wherever the milling operation start-up at a new location or day.

Regardless of whatever method is used to mill and pulverize the existing pavement, it shall be done in such a manner as to minimize damage to the underlying base materials. If, in the opinion of the Engineer, the base material has been significantly disturbed by the contractor's operations, the contractor shall restore the disturbed areas to proper cross section and recompact to a density of not less than 100 percent of the maximum density determined in accordance with requirements of Test Method AZ 225 of the Materials Testing Manual of the Materials Section.

Regardless of the mixing method used, mixing shall continue until the water is removed in quantity sufficient to provide a compactable mix, estimated to be approximately 1 1/2% (expressed as a percentage of the total weight of the aggregate material).

The handling of recycled material shall at all times be such as to minimize segregation. Any recycled material which displays segregation shall be removed and replaced.

Recycled material shall be placed only when the temperature of the windrowed material from which the recycled material is to be processed is at least 65 degrees F. and the ambient temperature is 65 degrees F, and rising.

If the Engineer determines that weather conditions, either existing or expected, have or may have an adverse effect upon the cold recycling operation, he may require that the work cease or that the work day be reduced.

The recycled material shall be placed and finished by means of a self-propelled paving machine, either in combination with the traveling mixer or as a separate unit.

If a stationary plant is used, the recycled material shall be dumped from the hauling vehicles directly into the paving machine.

When dumping directly into the paving machine from trucks, care shall be taken to avoid jarring the machine or moving it out of alignment. Trucks shall be securely attached to the paving machine while dumping.

Self-propelled paving machines shall spread the mixture without segregation or tearing within the specified tolerances, true to the line, grade, and crown indicated on the project plans. Pavers shall be equipped with hoppers and augers which will place the mixture evenly in front of adjustable screeds.

Screeds shall include strike-off devices operated by tamping or vibrating action which is effective without tearing, shoving or gouging the mixture and which produces a finished surface of an even and uniform texture for the full width being paved. Screeds shall be adjustable as to height and crown and shall be equipped with a controlled heating device for use when required.

Except under certain conditions or at certain locations where the Engineer deems the use of automatic controls impracticable, the recycled material shall be placed and finished by means of self-propelled paving machines equipped with an automatically actuated control system.

The control system shall control the elevation of the screed at each end by controlling the elevation of one end directly and the other end indirectly either through controlling the transverse slope or alternately, when directed, by controlling the elevation of each end independently.

The control system shall be capable of working with the following devices which shall be furnished with the machine:

Ski-type device at least 30 feet in length, supported through the entire length, Short ski, 500 feet of control line and stakes, Joint matcher shoe.

The control line shall be set and maintained taut by the contractor to the grade and alignment established by the Engineer.

Failure of the control system to function properly may be cause for suspension of the paving operations.

Joints:

Longitudinal joints shall be located either at or near the center of a lane, or at or near the center line between two adjacent lanes.

Compaction Equipment:

Compaction equipment shall meet the requirements of Section 406-10.08(B), with the exception of any reference to temperature requirements and except for the following:

The minimum weight for the tandem powered (steel wheel) shall be 12 tons and the minimum weight for the pneumatic tired roller shall be 24 tons.

Compaction:

Compaction shall consist of a specified sequence of passes using specified types of compactors. A pass shall be defined as one movement of a compactor in either direction. Coverage shall be the number of passes as are necessary to cover the entire width being paved.

The rolling sequence, the type of compactor to be used and the number of passes required shall be as follows:

Rolling Sequence	Type of Compactor	Number of Phases with Compactor
Initial	Vibratory Steel	5 (Minimum)
Intermediate	Pneumatic Tired	6 (Minimum)
Finish	Steel Wheel	3 (Minimum)

Compaction will be deemed to be acceptable on the condition that the asphaltic concrete is compacted using the type of compactors ballasted and operated as specified and with the number of passes of the compactors as specified and in a time frame acceptable to the Engineer.

All wheels and tires of compactors and other equipment shall be wiped, when necessary, with an approved product in order to prevent the picking up of the recycled material.

Surface Requirements and Tolerances:

The recycled asphaltic concrete shall be compacted as required, smooth and reasonably true to the required lines, grades, and dimensions.

The finished surface shall not vary more than 1/4 inch from the lower edge of a ten-foot straightedge when the straightedge is placed parallel to the centerline of the roadway.

The aggregate material shall consist of asphaltic concrete removed for recycling reduced to 100 percent passing the 1 1/2" sieve prior to mixing in a traveling or stationary plant.

Emulsified Recycling Agent:

The emulsified recycling agent shall be Emulsified Cyclogen Recycling Agent* ME meeting the following specifications:

Property	Test Method	Specifications
Viscosity @25 deg.C, SFS	ASTM D-244	15-85
Pumping stability	GB method**	Pass
Emulsion coarseness %w	Sieve test, ASTM D-244***	0.1 max.
Sensitivity to fines, %w	Cement mixing ASTM D-244	2.0 max.
Particle charge	ASTM D-244	Positive
Concentration of oil phast, %w	ASTM D-244 (MOD)****	60 min.

** Pumping stability is determined by charging-450 ml of emulsion into a one-liter beaker and circulating the emulsion through a gear pump (Roper29.B22621) having a 1/4" inlet and outlet. The emulsion passes if there is no significent separation after circulating ten minutes.

*** Test procedure identical with ASTM D-244 except the distilled water shall be used in placed of two percent sodium oleate solution.

**** ASTM D-244 Evaporation Test for percent of residue is modified by heating 50 gram sample to 149 deg. C (300 deg. F) until foaming ceases, then cooling immediately and calculating results.

The base material used in the Cyclogen Recycling Agent* me shall meet the following specifications:

Property	Function and Purpose	ASTM Test Method	M**
Viscosity @ 60 deg. C, cSt	Asphalt viscosity adjustment in recycled mix	D-2170	1,000-4,000
Flash Point, COC, deg. C	Handling precaution	D-92	232 min.
Volatility, IBP, deg. C 2 %V, deg. C 5 %V, deg. C	Avoidance of air pollution and hardening by evaporation	D-1160, 10 mm	163 min. 204 min. 221 min.
RTF-C WEIGHT Change, %w		D-2872	2.0 max.
Compatibility, PC/S	Avoidance of syneresis.	D-2006-70	0.5 min.
Saturates, %w	Compatibility with aged asphalt.	D-2007	28 max.
Asphaltenes, %w	Compatibility with aged asphalt.	D-2006-70	7.0 max.
Chemical composition $(PC+A_1)/(S+A_2)$	Durability of asphalt in recycled mix.	D-2006-70	0.6-1.0
RTF-C Ratio***		D-2872	2.5 max.
Specific Gravity****	Calculations	D-70	0.98-1.0

* Meets all requirements of Pacific Coast User-Producer specs fo Asphalt Recycling Agents dated 5-15-79.

** The following suitable pumping temperatures, L - 60 deg. C (14 deg. F), M - 88 deg. C (190 deg. F), H - 93 deg. C (200 deg. F) 22 - 110 deg. C (230 deg. F), and 47 - 121 deg. C (250 deg. F).

*** Viscosity, RTF-C residue @ 60 deg. C cSt/viscosity, original materials @ 60 deg. cSt.

**** For Conversion of the L, M, H, ME & HE Series use 242 gal/ton. For 22 & 47 use 238 gal/ton.'

Method of Measurement:

Cold Recycling (Bituminous Pavement) will be measured by the square yard. Measurement will include any intersections, turnouts, or other miscellaneous items or surfaces.

(PDMPT701, 6, 02/26/87)

SECTION 701 - MAINTENANCE AND PROTECTION OF TRAFFIC: of the Standard and Supplemental Specifications is revised to read:

701-1 Description:

The work under this section shall consist of providing flagging services and pilot trucks, and furnishing, installing, maintaining, moving and removing barricades, warning signs, lights, signals, cones, and other traffic control devices, flagging services and pilot trucks, to provide safe and efficient passage through and/or around the work and to protect workmen in or adjacent to the work zone. The work shall be done in accordance with the requirements of the Arizona Department of Transportation's Traffic Control Manual for Highway Construction and Maintenance, hereinafter the "Traffic Control Manual", and the design details included in the project plans where applicable.

The requirements of the Traffic Control Manual shall be considered as the minimum standards for the protection of workmen and the traveling public.

When a traffic control plan is included in the project plans, this plan shall govern unless an alternate plan acceptable to the Engineer is submitted by the contractor. If no traffic control plan is provided or if the contractor desires to deviate from the provisions for maintaining traffic as described in this section, he shall submit to the Engineer for approval a proposed sequence of operations and a compatible method of maintaining traffic. The proposal shall be submitted early enough to allow at least two weeks for review and approval.

The traffic control and safety plan of the contractor, along with his work schedule and actual operations, shall be such that no condition that is considered to be unsafe shall exist within 30 feet of the edge of the traveled way unless the motorist and workmen are adequately protected and, as a result of effective planning and efficient scheduling of the work, the duration, degree, length, amount, size, etc., of any potentially unsafe condition is minimized.

CALIFORNIA

JVK

10-1.17 RECYCLE ASPHALT CONCRETE.-- Recycle asphalt concrete shall consist of removing portions of existing asphalt concrete surfacing by milling, mixing an emulsified recycling agent with the milled material, and spreading and compacting the mixture in accordance with the details shown on the plans, as specified in the Standard Specifications and these special provisions.

Attention is directed to "Order of Work," elsewhere in these special provisions.

Existing asphalt concrete shall be milled a full lane width to the depth shown on the plans, in one pass, by a method that does not damage the underlying material. The depth of milling shall be within plus or minus 0.03-foot of the depth shown on the plans.

The milled material shall be processed to conform to the following grading before mixing with recycling agent:

Sieve Sizes	Percentage Passing
1 1/2"	100
1"	90-100

The processed material shall be combined with the recycling agent in a mixing machine capable of weighing the material and adding the recycling agent in proportion to the weight of material entering the mixing chamber. The recycling agent shall be added to the milled asphalt concrete within plus or minus 5 percent of the amount of recycling agent ordered by the Engineer.

The recycling agent shall be delivered to the mixing chamber by means of a positive displacement pump. The pump shall be equipped with a positive interlock system which will permit addition of the recycling agent only when material is present in the mixing chamber and will automatically shut off the pump when the machine is stopped.

Each mixing machine shall be equipped with a meter capable of registering the rate of flow and the total delivery of recycling agent introduced into the mixture. The meter shall conform to Section 9-1.01, "Measurement of Quantities," of the Standard Specifications. A valve and nozzle shall be provided in a convenient location in the recycling agent supply line to mixing chamber for the purpose of material testing

Recycling oil used in the emulsified recycling agent shall be the grade designated by the Engineer and shall conform to the specifications listed in Table 1. Emulsified recycling agent shall conform to the specifications listed in Table 2.

TABLE 1

SPECIFICATIONS FOR RECYCLING AGENTS (RESIDUAL)

TEST	TEST METHOD ASTM/ AASHTO	RA 5 min./max	RA 25 min/max.	RA 75 min/max.	RA 250 min/max	RA 500 .min/max
Viscosity @140 degrees F cSt	D2170-1 /T201-2	200/ 800	1000 /4000	5000 /10000	15000 /35000	40000 /60000
Flash Point COC(degrees F)	D92/T48	400/-	425/-	450/-	450/-	450/-
Saturates-Wt. %	D2007/-	-/30	-/30	-/30	-/30	-/30
Residue from RTF-C Oven Test @325 degrees F	D2872 /T240	-/-	-/-	-/-	-/-	-/-
Viscosity Ratio*	-/-	-/3	-/3	-/3	-/3	-/3
RTF-C Oven Weight Change +/-/%	D2872 /T240	-/4	-/3	-/2	-/2	-/2
Specific Gravity	D70 or D1298 /T228	Report	Report	Report	Report	Report

*Viscosity Ratio = RTF-C Viscosity at 140 degrees F. cSt

Original Viscosity at 140 degr

TABLE 2

Specifications for Emulsified Recycling Agent,

Property	Test Method		Requirement
Viscosity @77 degree F./SFS		ASTM D 244	15-85
Pumping Stability	G.E. Method (2)		Pass
Emulsion Coarseness	Sieve Test	ASTM D244(3)	0.1 percent Max
Sensitivity to Fines	Cement Mixing	ASTM D244	2.0 percent Max
Particle Charge		ASTM D244	Positive
Evaporation Residue		ASTM D244(4)	60 percent Min

(1) Pumping stability is determined by charging 450 ml of emulsion into a one liter beaker and circulating the emulsion through a gear pump (Roper 29.B22621) having a 1/4 inch inlet and outlet. The emulsion passes if there is no significant oil separation after circulating 10 minutes.

(2) Test procedure identical with ASTM Designation: D 244 except that distilled warer shall be used in place of 2 percent sodium oleate solution.

(3) ASTM Designation: D244 Evaporation Test for percent of residue is modified by heating a 50-gram sample to 300 degree F. until foaming ceases, then cooling immediately and calculating results.

Test results and Certificates of Compliance shall be furnished for each shipment of emulsified recycling agent in the same manner required for asphaltic emulsions in accordance with the provisions of Section 94-1.05, "Test Report," of the Standard Specifications.

The emulsified recycling agent shall be added at a rate of approximately 1 percent to 3 percent of the dry weight of the processed material. The exact rate will be determined by the Engineer.

When directed by the Engineer, water shall be added to the emulsified recycling agent in quantities which will result in a mixture with up to 50 percent added water, to facilitate uniform mixing of the processed asphalt concrete. Any added water shall be added at the refinery and shall be clean and free of foreign substances and shall not cause an adverse effect on the emulsified recycling agent. The exact quantity of water to be added will be determined by the Engineer. The actual quantity of residual recycling agent in the final mixture will not vary due to the addition of the water.

Mixing operations shall not be performed unless the atmospheric temperature is at least 50 degrees F. and rising and the weather is not stormy. The weather shall be considered stormy when the rate of precipitation exceeds the rate of evaporation.

Before spreading and compacting the completed recycled asphalt concrete mixture, the Contractor shall apply an emulsified asphalt paint binder to any vertical edge of existing asphalt concrete surfacing to remain and to the vertical edge of previously placed recycled asphalt concrete surfacing and other areas as directed by the Engineer.

Placing recycled asphalt concrete shall be accomplished with a self-propelled asphalt paver, conforming to the requirements of Section 39-5.01, "Spreading Equipment," of the Standard Specifications, and shall be capable of spreading the recycled asphalt concrete in one continuous pass without segregation to the lines and grades established by the Engineer.

Should an excess of recycled material develop, such excess material shall be uniformly removed ahead of the paving operation and disposed of as approved by the Engineer.

Compacting of the recycled asphalt concrete shall conform to the provisions in the first three paragraphs of Section 39-6.03, "Compacting," of the Standard Specifications.

No traffic will be permitted on the completed recycled mixture for at least two hours after the recycling agent is added to the mixture.

The recycled asphalt concrete will be tested by lots as defined under California Test 375. The recycled asphalt concrete shall be compacted to an average density of not less than 87 percent of the average density of specimens of the recycled asphalt concrete mixture compacted in the laboratory using California Test 378. Laboratory samples will be taken from the mat behind the paver before initial or breakdown compaction of the mat. The average in-place density will be determined on the day of placement prior to opening the roadway to public traffic in accordance with California Test 375.

If any lot fails to obtain the required 87 percent compaction, the Contractor shall revise his compactive efforts so that the recycled asphalt concrete placed will meet the 87 percent requirement.

Any lot of recycled asphalt concrete that does not meet the first day placement requirement of 87 percent shall be removed and replaced with Type B asphalt concrete as the first order of work on the following day. Removal and disposal of the recycled material, and the furnishing and placing of the Type B asphalt concrete shall be at the Contractor's expense.

When directed by the Engineer, the completed recycled asphalt concrete shall be sealed with asphaltic emulsion (paint binder).

Prior to placing the Type B asphalt concrete overlay, the recycled asphalt concrete shall be compacted to an average density of not less than 92 percent of the average laboratory density of the lot as established under the first day compaction requirements using California Test 378.. The Contractor may request testing for meeting the 92 percent compaction requirement at any time between placement of the recycled asphalt concrete and the placement of the Type B asphalt concrete overlay. The Contractor shall provide traffic control required for this testing at his expense. Any lot of recycled asphalt concrete that does not meet the compaction requirement of 92 percent shall be removed and replaced with Type B asphalt concrete

If the average density for any lot of recycle asphalt concrete is below 92. percent, but above 87 percent, if requested by the Contractor and approved by the Engineer, the lot may remain in place and the Contractor shall pay to the State the amount of reduced compensation for such lot

with low compaction. The State may deduct an amount of reduced compensation from any monies due, or that may become due, the Contractor under the contract. The amount of reduced compensation the Contractor shall pay to the State will be calculated using the square yards of recycle asphalt concrete and tons of emulsified recycling agent represented in the lot with low compaction times the contract price per square yard and ton for the contract items involved, times the following reduced compensation factors:

Average Density Percent	Pay Factor
90-91.9	0.97
88-89.9	0.91
87-87.9	0.80

Unless otherwise allowed by the Engineer, the Contractor shall not place the Type B asphalt concrete overlay on the recycled asphalt concrete until the roadway has been opened to public traffic for a minimum of seven calender days and the moisture content of the recycled material is not greater than 1.5 percent. Any damage to the recycled material shall be repaired prior to placing the asphalt concrete surfacing. Any such repairs will be at the Contractor's expense. Loose aggregate that develops under public traffic on the surface of the recycled asphalt concrete shall be removed when ordered by the Engineer.

Immediately prior to placing the asphalt concrete surfacing, the surface of the recycled asphalt concrete shall be tacked using asphaltic emulsion (paint binder). The emulsion shall be SS1 type and be applied at the approximate rate of 0.04 to 0.06 gallon per square yard. The exact rate will be determined by the Engineer.

Quantities of recycle asphalt concrete will be paid for by the square yard as calculated on the basis of the dimensions shown on the plans and the actual length of pavement recycled. No allowance will be made for pavement recycled in excess of said dimensions, unless otherwise ordered by the Engineer.

Emulsified recycling agent will be measured and paid for by the ton in the same manner specified for asphaltic emulsion as provided in Section 94, "Asphaltic Emulsions," of the Standard Specifications.

The contract price paid per square yard for recycle asphalt concrete shall include full compensation for furnishing all labor, materials (except recycling agent), tools, equipment, and incidentals and for doing all the work involved in recycling asphalt concrete,complete in place, including removing and disposing of excess recycled asphalt concrete, as shown on the plans, as specified in the Standard Specifications and these special provisions, and as directed by the Engineer.

No adjustment of compensation will be made for any increase or decrease in the quantity of emulsified recycling agent required, regardless of the reason for such increase or decrease. The provisions in Section 4-1.03B, "Increased or Decreased Quantities", of the Standard Specifications shall not apply to the item of emulsified recycling agent.

COLORADO

REVISION OF SECTION 406
COLD BITUMINOUS PAVEMENT (RECYCLE)

Section 406 is hereby added to the Standard Specifications for this project as follows:

DESCRIPTION

406.01 This work shall consist of pulverizing the existing bituminous surfacing, to the depth shown on the plans, mixing an emulsified binder agent and water (if required) with the pulverized bituminous surfacing, then spreading and compacting said mixture as shown on the plans and as provided herein, unless otherwise directed.

The Contractor shall furnish all equipment, tools, labor, and any other appurtenances necessary to complete the work.

MATERIALS

406.02 The emulsified binder agent shall be a high float emulsion of the type shown on the plans, with the option, by the Engineer to change one grade, at no increase in price. Any change in grade of binder agent shall be made only with the concurrence of the Engineer. The high float emulsion shall meet the requirements of Section 702 of the Standard Specifications as revised for this project.

The cold recycled bituminous material shall meet the following gradation requirements:

Sieve Size	% Passing
1-1/4"	100
1"	90-100

The sealing emulsion shall be high float emulsion (diluted), emulsified asphalt (SS), or other approved equal.

CONSTRUCTION REQUIREMENTS

406.03 The existing bituminous surfacing shall be cold recycled in a manner that does not disturb the underlying material in the existing roadway.

Recycling operations shall not be performed when the atmospheric temperature is below 50oF., or when the weather is foggy or rainy, or when weather conditions are such that the proper mixing, spreading, and compacting of the recycled material cannot be accomplished.

When commencing recycling operations, the emulsified binder agent shall be applied to the pulverized bituminous material at the initial design rate determined by the Materials Laboratory, based on samples submitted prior to construction. The exact application rate of the emulsified binder agent will be

-continued-

determined, and may be varied as required by existing pavement conditions. An allowable tolerance of plus or minus 0.2 percent of the initial design rate or directed rate of application shall be maintained at all times.

The Contractor may add water to the pulverized material to facilitate uniform mixing with the emulsified binder agent. Water may be added prior to or concurrently with the emulsified asphalt, provided that this water does not cause adverse effect on the emulsified binder agent.

In the event segregation occurs behind the paver, the Engineer may require that the forward speed of the milling operation be reduced and/or that the amount of material going through the crusher be increased and the crusher adjusted to produce more fines. The Contractor may be required to make other changes in his equipment and/or operations, as necessary to obtain a satisfactory end-product.

The Contractor shall demonstrate his ability to obtain a minimum density of 95 percent of a laboratory specimen prepared in accordance with AASHTO T-180, Method D. The Engineer may require a redemonstration of rolling capabilities when a change in the recycled material is observed, whenever a change in rolling equipment is made, or if densities are not being obtained with the rolling pattern being used.

After the recycled material has been spread and compacted, NO TRAFFIC (this includes Contractor's equipment) shall be permitted on the completed recycled bituminous material for at least two hours. The area shall then be opened to all traffic and the pavement shall be allowed to cure until the moisture content is reduced to 1% or less, by total weight of mix before placing the hot bituminous pavement overlay. Recycling operations shall cease early enough each day that all lanes are open to traffic prior to sunset.

After the moisture content of the recycled material has reached one percent or less, the sealing emulsion, if required, shall be applied to the surface at an approximate rate of 0.05 to 0.10 gallon per square yard.

Any damage to the completed recycled bituminous pavement shall be repaired by the Contractor, as directed by the Engineer, prior to placing any hot bituminous surfacing. Said repairs shall be at the Contractor's expense.

Any fillet of fine, pulverized material which forms adjacent to a vertical face shall be removed prior to spreading the recycled mix, except that such fillet adjacent to existing pavement which will be removed by overlapping during subsequent milling operation need not be removed. Vertical cuts in roadway shall not be left overnight.

-continued-

REVISION OF SECTION 406
COLD BITUMINOUS PAVEMENT (RECYCLE)

EQUIPMENT

406.04 The Contractor shall furnish a self-propelled machine capable of pulverizing in-place bituminous materials to the depth shown on the plans, in one pass. Said machine shall have a minimum rotor cutting width of fifteen feet six inches (15'-6"), standard automatic depth controls, and maintain a constant cutting depth. Said machine shall also incorporate screening and crushing capabilities to reduce or remove oversize particles prior to mixing with emulsion. Oversize particles shall be reduced to size by crushing.

The emulsified binder agent shall be applied through a separate mixing machine capable of mixing the pulverized bituminous material and the emulsified binder agent to a homogeneous mixture, and placing the mixture in a windrow. The method of depositing the mixed material in a windrow shall be such that segregation does not occur.

A positive displacement pump, capable of accurately metering the required quantity of emulsified binder agent at rates as low as 4 gal./min., shall be used to apply the emulsified binder agent to the pulverized bituminous material. Said pump shall be equipped with a positive interlock system which will permit addition of the emulsified binder agent only when the pulverized bituminous material is present in the mixing chamber and will automatically shut off when the material is not in the mixing chamber.

Each mixing machine shall be equipped with a meter capable of registering the rate of flow and total delivery of the emulsified binder agent introduced into the mixture.

Placing of the recycled bituminous material shall be accomplished with a self-propelled bituminous paver meeting the requirements of Subsection 401.10, except that the heating of the screed sill not be required. The bituminous recycled material shall be spread in one continuous pass, without segregation, to the lines and grade established.

When a pick-up machine is used to feed the the windrow into the paver hopper, the pick-up machine shall be capable of picking up the entire windrow to the underlying materials.

The number, weight, and type of rollers shall be sufficient to obtain the required compaction while the mixture is in a workable condition except that the pneumatic roller(s) shall be 30 ton minimum weight.

Initial rolling shall be performed with the pneumatic roller(s) and continued until no displacement is observed. Final rolling as required to eliminate pneumatic tire marks and achieve the required density shall be done by steel wheel roller(s), either in static or vibratory mode.

-continued-

Rollers shall not be started or stopped on uncompacted recycled material. Rolling shall be accomplished so that starting and stopping will be on previously compacted recycled material or on existing pavement.

Any type of rolling that results in cracking, movement or other types of pavement distress shall be discontinued until the problem is resolved.

METHOD OF MEASUREMENT

406.05 In-Place Cold Recycling of Bituminous Material shall be measured by the square yard

BASIS OF PAYMENT

406.06 The accepted quantity of In-Place Cold Recycling of Bituminous Material will be paid for at the contract unit price per Square Yard.

Payment will be made under:

PAY ITEM	PAY UNIT
Cold Bituminous Pavement (Recycle)	Square Yard

Bituminous materials will be measured and paid for as provided in Section 411.

Water will not be measured and paid for separately but shall be included in the work.

IDAHO

These signs shall be installed as directed by the Engineer.

ON PAGE 334, SUBSECTION 626.03 - GENERAL

Delete the third, fourth, and fifth sentences of the last paragraph and substitute the following:

One temporary raised pavement marker shall be installed at the same cycle length as permanent marking. Half cycle lengths shall be used on roadways with severe curvature.

ON PAGES 335, SUBSECTION 626.05 - BASIS OF PAYMENT

Add the following:

The provisions of Subsection 104.02 - Variation in Quantities shall not apply to increases or decreases in bid quantities of construction traffic control devices.

ON PAGE 367, SUBSECTION 702.03 - EMULSIFIED ASPHALTS

Delete the specified minimum and maximum values for viscosity for CRS-2R asphalt and substitute the values of 150s minimum and 400s maximum.

SP-1 RECYCLED EMULSIFIED ASPHALT PAVEMENT

Description. This item shall consist of providing all materials and labor to construct a cold inplace recycled (CIR) asphalt concrete pavement using a recycling train.

Materials:

Asphalt - Emulsified asphalt shall be CMS-2S.

Water - Any source of potable water may be used. Any source of non-potable water shall be approved before use.

Recycled Asphalt Pavement (RAP) - Recycled material removed from the existing asphalt pavement shall have a maximum size of 1 1/4 inches prior to entering the mixer unless otherwise directed by the Engineer. Any recycled material larger than 1 1/4 inches shall be separated by screening or other means, broken down by mechanical means to pass a 1 1/4 inch sieve and uniformly reincorporated with the balance of the recycled material.

Recycled material removed from the existing asphalt pavement shall have a maximum size of 1 1/4 inches. Incidental oversize may be allowed by the Engineer if it is not detrimental to the mixture or wearing surface. If the gradation is determined to be detrimental, the Contractor shall take such action necessary to correct the oversize problem. These actions may include reducing the milling speed, adjusting the crusher, changing screen size or other such measures as may be necessary. Failure of the Contractor to be able to provide an acceptable product will cause a rejection of the processing equipment.

Rejects - Rejects are available from stockpiles at designated locations for each project.

Job Mix Formula - The CIR asphalt concrete mixture shall consist of RAP from the existing pavement, emulsified asphalt and water combined in the proportions designated by the Engineer. Variability in the composition of the RAP material may require changes in the proportions of the constituents, as directed by the Engineer. Normally, the emulsified asphalt content will be between 0.4 and 1.8 percent, by weight, and water between 0.5 and 1.5 percent by weight.

Acceptance of CIR Mixture - The CIR mixture will be accepted visually on the grade following initial compaction. Any mixture that ravels or does not provide an acceptable wearing surface shall be corrected. Any area showing an excess or deficiency of emulsified asphalt shall be reprocessed or replaced. Replacement shall be by a method approved by the Engineer. Removal and replacement under these provisions shall be at the expense of the Contractor unless the Engineer determines that the defects, excesses or deficiencies are not caused by or the fault of the Contractor's operations.

Construction Requirements:

Season and Weather Limitations - Inplace recycling of existing asphalt concrete pavement shall not begin until the pavement surface temperature is 70°F and rising. The Engineer may approve an earlier start time if conditions warrant.

Unless otherwise directed, recycled pavement shall cure at least 12 days before * the seal coat is applied.

The Contractor shall stop milling work at the end of each day when the temperature of the mixture behind the paver drops below 90°F or three hours before sunset, or when high temperatures cause the emulsified asphalt to break prematurely, causing the paver to tear the freshly laid recycled pavement.

The milling machine shall begin and end each cut with a vertical cut.

Rate of Progress and Scheduling - The Contractor shall plan and schedule the recycle operation in such a manner that the materials are removed, mixed, replaced and the area open to traffic immediately after initial compaction is completed.

All recycled areas shall be completely backfilled with reprocessed and compacted asphalt concrete materials so the area is open to two-way traffic during all hours of darkness.

Equipment:

Recycling Train - The existing pavement shall be recycled using a recycling train consisting of the following major components: (a) Planing machine or grinder, (b) crusher and (c) pugmill mixer.

(a) Planing Machine or Grinder - The existing pavement shall be removed by a self-propelled planing machine having a minimum 144 inch wide rotary cutter and be capable of removing the existing pavement to a depth of four inches in a single pass.

The unit also shall be capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing pavement or from independent grade control and shall have a positive means for controlling cross slope. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.
* Revised 6-15-90

The unit shall be equipped to discharge not less than 70 gallons of water per minute into the cutting chamber, with fully variable control and meter capable of measuring the rate of feed within five gallons per minute.

(b) Crusher - The crusher shall be of the portable type capable of reducing the oversize RAP materials to the specified size.

(c) Pugmill Mixer - The CIR asphalt concrete mixture shall be mixed in a pugmill type plant capable of providing a mix of RAP, emulsified asphalt and water at a minimum rate of 700 tons/hour to uniform proportions as designated by the Engineer.

Mixing plants shall be equipped with a positive control linking the RAP, emulsified asphalt and water feed in a manner that will maintain a constant ratio of each constituent. The plant shall be equipped with facilities so that the Contractor can verify and calibrate the RAP, asphalt and water quantities by a method acceptable to the Engineer.

The RAP shall be measured by weight and the emulsified asphalt and water may be proportioned by either weight or volume. The equipment shall be capable of feeding and maintaining a constant rate of RAP feed within a tolerance of plus or minus 5% (by weight) of the designated amount and a constant rate of emulsified asphalt and water feeds within plus or minus 0.2% (by weight) of the designated amounts.

The mixing plant shall be equipped with positive displacement pumps and a computerized metering system which can accurately meter the amount of emulsified asphalt and water. The pumps shall be interlocked to a belt weighing system that measures the quantity of RAP material entering the mixing plant. The interlock shall be designed so that emulsified asphalt and water cannot be added until RAP material enters the mixer. Overrides of the interlock system shall be equipped with short duration timers to prevent their continuous use. Overrides shall be used only during start-up periods.

The belt weighing device and computerized metering system shall have readouts that indicate the quantity in tons of RAP, water and emulsified asphalt being fed into the mixer at any given time. Totalizer readouts shall also be provided to allow determination of accumulative quantities of each constituent.

(d) Asphalt Storage and Heating Tanks - Storage tanks shall be equipped with accurate volume measuring devices or manufacturers calibration charts for each storage tank and a thermometer for measuring the temperature of tank's contents.

Between the storage tanks and the liquid asphalt mixing device or recycling equipment, a parallel piping filter system with at least one filter per line shall be used. Filters shall be capable of eliminating solid or semi-solid particles from the emulsified asphalt liquid.

Each filtering line shall be equipped with on-off valves and changeable filter elements.

The emulsified asphalt shall be routed alternately through each filter line for a period of two to four hours, and alternate filters changed on the same frequency unless otherwise directed by the Engineer.

Loads of emulsified asphalt which break prematurely in the storage tanks or haul vehicles or which cause frequent plugging of the filters as determined by the Engineer will be rejected for use.

Asphalt Concrete Pavers - Pavers shall be self-contained, self-propelled units, provided with an activated screed or strike-off assembly, heated if necessary, and capable of spreading and finishing layers of recycled asphalt concrete material in widths applicable to the specified typical sections, and to required thicknesses, line, grades and cross sections.

Extensions added to the paver shall have the same augering and screeding equipment as the rest of the paver.

The paver shall be equipped with a receiving and distribution system of sufficient capacity for a uniform spreading operation and capable of placing the mixture uniformly in front of the screed without segregation of materials.

The paver shall be designed to compensate for minor irregularities of the surface on which it is supported so that such will not be reflected immediately in the surface of the layer being placed. The weight of the paver shall be supported on tracks or wheels, none of which shall contact the mixture being laid. The contact area of the screed or strike-off assembly shall be uniform over the entire width of the strip of mixture being placed.

Pavers shall be equipped with a paver control system which shall automatically control the layer of the mixture to specified cross slope and grade. The control system shall be automatically actuated from independent line and grade control references through a system of mechanical sensors and sensor-directed devices which shall automatically maintain the paver screed in proper position to provide specified results.

The screed or strike-off assembly shall produce a finished surface of the required evenness and texture without tearing, shoving or gouging the mixture.

Rolling - Rollers shall be steel wheel, pneumatic tire, vibratory or a combination of these types as specified. They shall be in good condition and capable of reversing without backlash.

(a) Steel Wheeled Rollers - Steel wheeled rollers shall have a minimum gross static weight of 10 tons and a minimum static weight on the drive wheel of 250 pounds per inch of width. The maximum rate of travel shall be limited to 4 MPH.

(b) Vibratory Rollers - Vibratory rollers shall be a tandem steel wheeled type having a minimum gross static weight of 8 tons and shall be equipped with variable amplitude and frequency controls and shall be specifically designed for compaction of asphalt concrete mixtures. The rollers shall be operated at frequencies of not less than 2,000 vibrations per minute. The maximum rate of travel under vibration shall be limited to 220 ft./min. (2.5 MPH).

(c) Pneumatic rollers - The pneumatic-tired rollers shall have a minimum static weight of 20 tons and shall be self-propelled, tandem or multiple axle, multiple wheel type with smooth-tread pneumatic tires of equal size and air pressure staggered on the axles at such spacings and overlaps as will provide uniform compacting pressure for the full compacting width of the roller and shall be capable of exerting ground pressures of at least 100 pounds per square inch of tire contact area. The maximum rate of travel shall be limited to 5 MPH.

Preparation of Foundation - Just prior to windrowing the recycled pavement mixture, a tack coat shall be applied to the entire profiled area including the vertical edges. Rates of application shall be as directed by the Engineer.

Care shall be taken to minimize the amount of fines on the milled surface that can be detrimental to a proper bond of the tack coat.

Heating Emulsified Asphalt & Water - The temperature of the emulsified asphalt prior to entry into the mixture shall be not less than 135°F nor more than 185°F. Water used for mixing, dust control, or in the rotomilling process shall be 135°F minimum, or as directed.

Mixing - All the various required components of the asphalt concrete mixer shall be utilized and operated in a manner to assure compliance.

The RAP, emulsified asphalt and water shall be measured and introduced into the mixer in the amounts specified in the "job mix formula" or as directed by the Engineer. Furnishing and heating of water will not be paid for separately, but will be considered as incidental to other work in Item SP-1.

Mixing shall continue until the emulsified asphalt and water have been distributed through the RAP to form a uniformly coated mixture.

Control of Line and Grade - The line and grade reference control shall be a floating beam device approximately 30' in length and sensitive enough to provide adequate control on either or both sides of the paver.

Temporary manual control of line and grade for the paver may be permitted by the Engineer.

Spreading - Except for unavoidable delay or breakdown, recycling and placing recycled pavement by the paving machine shall be at a rate sufficient to provide continuous operation of the paving machine. If paving operations result in excessive stopping of the paving machine, as determined by the Engineer, recycling and paving operations shall be suspended until the Contractor can synchronize the rate of recycle with the capacity of the paving machine.

(a) General - The mixture shall be laid on an approved surface, spread and struck off to established grade and elevation. Specified asphalt pavers shall be used to distribute the mixture.

The asphalt mixture shall be deposited in a windrow, then picked up and placed in the asphalt paver.

The loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine nor cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement. The loading equipment shall pick up substantially all of the material deposited on the roadbed and place it directly into the receiving hopper of the paving machine.

In areas where patching, irregularities or unavoidable obstacles make the use of specified equipment impracticable, the mixture may be spread with special hopper equipment with adjustable strike-off or by other equipment and means approved by the Engineer, provided the surface finish is within a tolerance of 0.01 foot of that established.

(b) Drop-offs - Prior to any suspension of operations at the end of each shift, the full width of the area to be paved, including outside shoulders, shall be completed to the same elevation with no longitudinal drop-offs.

If unable to complete the pavement without longitudinal drop-offs as specified above, the Contractor shall, within the specified time constraints, construct and maintain a wedge of asphalt concrete at a slope of 10:1 or flatter along the exposed longitudinal joint located within the area to be paved. Longitudinal joints one inch or less will not require a wedge. The wedge shall be removed and disposed of prior to continuing paving operations. Construction, material, maintenance, removal and disposal of the temporary wedge shall be at the Contractor's expense.

(c) Finishing and Details - Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish the new mixture equal in all respects to the mixture against which it is placed.

Rejects - Immediately prior to the last roller coverage during initial compaction or before opening to traffic, approved reject material shall be applied to the roadway surface at a rate of approximately 4 Lbs./S.Y. as directed.

When the Engineer determines that areas opened to traffic require additional rolling of the raveled areas, the additional rolling will be paid for as "rolling for recompaction". Additional rolling required on the same day as placement will be considered incidental to initial compaction.

Compaction:

(a) General - Immediately after the CIR asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted as described below.

(a-1) Surface Repair - Any displacement of the mat regardless of thickness occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected. Steel and pneumatic roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture.

When the rolling causes undue tearing, displacement, cracking or shoving, the Contractor shall make changes in compaction equipment and/or rolling procedures necessary to alleviate the problem.

(a-2) Rolling - The CIR asphalt concrete mixture shall be compacted with rollers conforming to the requirements previously specified. The type, number and weight of rollers shall be sufficient to compact the mixture.

Normal rolling shall begin at the sides and proceed longitudinally parallel the road centerline, each trip overlapping one-half the roller width, gradually progressing to the center. On superelevated curves the rolling shall begin at the low side and progress to the high side, each trip overlapping one-half the roller width. When paving is in echelon or when abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Rollers shall not make sharp turns on the course being compacted and they shall not stop (except to reverse directions) on the fresh CIR mixture. Alternate trips of a roller shall terminate in stops at least five feet distant longitudinally from adjacent preceding stops.

(b) Initial Compaction - Compaction of the fresh CIR asphalt concrete mixture shall be performed with a minimum of one vibratory and one pneumatic-tired roller meeting the above requirements. Vibratory rollers shall be operated in either vibratory or static mode as directed by the Engineer. The mixture shall be compacted

with at least two coverages by each roller and such additional coverages as the Engineer may direct. This work shall be considered as incidental to other work on Item SP-1; no separate payment will be made.

The overlapping of one-half of roller width on each trip by the rollers as required does not constitute two coverages on that particular area rolled.

(c) Recompaction - After initial compaction and prior to recompaction, the CIR asphalt concrete pavement shall be opened to traffic and allowed to cure. Recompaction shall be performed approximately 7 to 15 days after laydown when directed by the Engineer. Rolling shall not be performed when the surface temperature is less than 90°F.

The entire recycled pavement area shall be recompacted with at least one vibratory roller and one pneumatic-tired roller meeting the above requirements. Each roller shall make at least three coverages and such additional coverages as the Engineer may direct.

Pavement Smoothness:

(a) General - The top surface of CIR asphalt concrete pavement shall be tested with a 12 foot straightedge furnished and operated by the Contractor parallel to or perpendicular to the centerline, and shall not vary by more than 0.01 foot. The Engineer will observe this testing and may require additional testing.

(b) Corrective Action - When tests show the pavement is not within the specified tolerance, the Contractor shall take immediate action to correct equipment or procedures in his paving operation to eliminate the unacceptable pavement roughness.

Any surface irregularities exceeding the specified tolerances shall be corrected by the Contractor within the period of 1 to 3 days (or as directed) following initial compaction using one of the following methods:

(1) Remove, replace or reprocess the surface course.

(2) Grind the pavement surface utilizing the planing machine or grinder to a maximum depth of 0.3 inch.

The cost of all corrective work, including furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective work.

Method of Measurement. The number of square yards of recycled emulsified asphalt mixture shall be based on the paved widths and milled depths shown on the plans and the horizontal measurement along the centerline of the actual length of the pavement recycled.

No allowance will be made for pavement recycled in excess of the paved width and milled depth shown on the plans unless directed by the Engineer.

No change in unit price per square yard will be made for depths deviating from plan depths unless the milled depth is deviated by more than plus or minus 1/4 inch from the nominal thickness called for by the plans and directed by the Engineer. Where the Engineer directs construction of recycled emulsified asphalt concrete to a thickness of more than plus or minus of 1/4 inch from the nominal thickness specified, these areas will be adjusted by converting in 1/4 inch increments to the

equivalent number of square yards of nominal thickness on a proportionate volume basis above or below the specified tolerance limits.

Rolling for recompaction will be measured by the hour of approved rolling.

The quantity of emulsified asphalt in the recycled asphalt concrete mixture or diluted and used for tack coat will be paid for by the tons used and will be measured according to Subsection 109.01 of the Standard Specifications.

The quantity of rejects to be paid for will be the number of cubic yards actually spread on the inplace recycled emulsified asphalt mixture at the rate specified, measured according to Subsection 109.01 of the Standard Specifications.

Basis of Payment. The accepted quantities of Recycled Emulsified Asphalt Pavement Mixture will be paid for at the contract unit price for the items listed below.

Payment will be made under:

Pay Item	Pay Unit
SP-1A - Recycled Emulsified Asphalt Pavement	Square Yard
SP-1B - Emulsified Asphalt in Recycled Mixture	Ton
SP-1C - Rolling for Recompaction	Hour
SP-1D - Rejects	Cubic Yard

Payment, when made at the contract unit price per ton for "CMS-2S Emulsified Asphalt in Recycled Mixture" will be full compensation for all costs of material, labor, freight, tools, water and equipment necessary for the addition of the emulsion as specified.

KANSAS

SECTION 608

COLD RECYCLED BITUMINOUS CONSTRUCTION

608.01 DESCRIPTION.

This work shall consist of milling asphalt pavement, mixing the reclaimed asphalt pavement (RAP) material with liquid binder, then spreading and compacting the mixture in accordance with these Specifications, as shown on the Plans or directed by the Engineer.

BID ITEMS

Cold Recycled Bituminous Material.
Emulsified Asphalt (*).
Asphalt Rejuvenating Agent (*).
Blotter Sand.

* Designated Type and Grade

608.02 MATERIALS.

Processed RAP material shall conform to the following gradation:

Sieve Size (inches)	Percent Retained
1½	0

Blotter sand shall be any fine sand approved by the Engineer.

Materials shall conform to the requirements specified in the Materials Division.

Emulsified Asphalt	Section 1200
Asphalt Rejuvenating Agent	Section 1200

608.03 COLD RECYCLING EQUIPMENT.

(a) Configuration.

Cold recycling equipment shall consist of a unit or a combination of units which will satisfactorily perform the following requirements.

(1) Mill the bituminous pavement and pick up the reclaimed material.

(2) Process the RAP material to meet the specified gradation.

(3) Mix the RAP material uniformly with liquid binder material.

(4) Deposit the mixture in a windrow, paver or load it into trucks.

(b) Performance.

(1) The milling unit shall be capable of milling the asphalt pavement at least four inches deep and twelve feet wide in one pass, unless otherwise specified. It shall have automatic controls capable of maintaining uniform grade and cross slope.

(2) The RAP material processing unit shall be a crusher with a scalper screen, or other approved devices capable of reducing the RAP material to the specified gradation.

(3) The mixing unit shall have a continuous weighing system for the processed RAP material, coupled with a meter to maintain the proper proportion of RAP material and liquid binder. The liquid binder pump shall shut off automatically if delivery of RAP material is stopped.

The mixing unit shall be capable of producing a homogeneous mixture of processed RAP material and liquid binder and depositing the recycled mixture in a windrow, paver or trucks, without segregation.

The liquid metering system shall deliver the specified amount of additive to within 0.2 percentage points of the desired application rate.

Positive means shall be provided for calibration of the weighing and metering devices.

Other equipment necessary to perform this work shall comply to the requirements of Division 150.

608.04 CONSTRUCTION REQUIREMENTS.

(a) Milling and Mixing Operation.

The pavement shall be milled to the required depth and width, in one or more passes. The RAP material shall be processed to the required gradation and thoroughly mixed with the specified amount of binder. Water may be added to the RAP material to facilitate mixing, provided it does not adversely affect the binder. The recycled material shall be deposited in a windrow, paver, or loaded into trucks, without segregation.

When deposited in a windrow the Contractor shall have equipment available to equalize the windrow as directed.

The disposition of material loaded into trucks shall be as shown on the Plans.

(b) Paving Operations.

(1) General.

Normally, the recycled material will be windrowed on the milled surface, spread and compacted in a continuous operation confined to the minimum practical length.

(2) Spreading and Finishing.

The recycled material shall be spread and finished in one or more lifts, reasonably true to crown and grade, with a bituminous paver meeting the requirements of Division 150. If the compacted lift thickness is greater than four inches, more than one spreading operation may be required.

(c) Compaction and Density Requirements.

(1) General.

Compaction and density requirements for each project shall be a minimum of 97 percent of the target density obtained on a test strip at least 500 feet in length and compacted under the following conditions:

(1.1) The mix temperature of the test strip shall be 90 degrees F. or higher.

(1.2) At least two test strips shall be completed to determine the target density and optimum sequence of rollers. These test strips will remain in place as part of the completed work.

(1.3) The depth of the lift shall be representative of the project.

(2) Target density shall be the highest density achieved on the test strip using the rolling procedure approved by the Engineer. The Engineer will use a nuclear meter to establish a density growth curve for each procedure. Rolling shall be discontinued whenever four consecutive passes of the roller(s) fail to increase the density one pound per cubic foot.

(3) The Contractor shall have, as a minimum, the following self propelled rollers for use on the test strips: a double drum vibratory steel roller and a pneumatic tired roller. The vibratory roller may be used in the static mode. The pneumatic tired roller shall weigh at least 25 tons and have a minimum tire pressure of 90 P.S.I. The Contractor shall supply a suitable tire pressure gauge.

(4) When there is a significant change in mix proportions, weather conditions or other controlling factors the Engineer may require construction of another test strip(s) to check target density.

(d) Surface Treatment or Overlay.

(1) The Engineer may require a light application of bitu-

minous material (smoke coat) on the recycled surface, which shall be blotted with fine sand as necessary.

(2) Any subsequent surface treatment or overlay designated in the Contract shall be accomplished in accordance with the applicable section of these Specifications. In addition, they shall not be placed until the moisture content of the recycled mixture is less than 1½ percent unless otherwise approved by the Engineer.

(e) Maintenance of Traffic.

When traffic is to be carried through construction, traffic control shall be accomplished with the requirements of Section 603.03. In addition, material in the recycled section shall be spread and compacted, and the equipment removed from the roadway before sundown to provide two way traffic during the night.

608.05 WEATHER LIMITATIONS.

Milling, adding the liquid binder and laydown will be completed when the ambient air temperature is above 55 degrees F. and only on those days when the ambient air temperature is or is predicted to be above 70 degrees F. Also, the weather will not be foggy or rainy. The above requirement may be waived, but only when so directed in writing by the Engineer.

608.06 METHOD OF MEASUREMENT.

Cold Recycled Bituminous Material shall be measured per 100 foot station, regardless of the pavement depth or width of recycling. Measurement will be along the centerline of the lanes.

Water will not be measured and paid for separately but shall be subsidiary to other items of work.

Emulsified Asphalt and Asphalt Rejuvenating Agent of the type shown in the Contract documents will be measured by the ton as set out in Division 100.

Blotter sand, incorporated into the project will be measured by the cubic yard or ton in the truck at the point of usage.

608.07 BASIS OF PAYMENT.

The accepted quantity of "Cold Recycled Bituminous Material", measured as provided above, will be paid for at the Contract unit price per station.

The accepted quantity of "Emulsified Asphalt" or "Asphalt

Rejuvenating Agent" will be paid for at the Contract unit price per ton.

"Blotter Sand", if required, shall be paid for at the Contract price per ton or cubic yard.

The above prices shall be full compensation for milling, processing, building test strip(s), mixing, spreading, compacting, furnishing and placing all material, for all labor, equipment, tools and incidentals necessary to complete the work.

SUBSECTION 1202

EMULSIFIED ASPHALT

1202.01 DESCRIPTION.

This specification covers emulsified asphalt used for bituminous mixes, surface sealing and tack coat.

1202.02 REQUIREMENTS

(a) General.

Emulsified asphalt shall be an intimate homogeneous mixture of a base asphalt and an emulsifying agent held in suspension in water. Certain emulsified asphalt types may contain some petroleum distillates.

Emulsified asphalt shall be of the type and grade as specified on the plans or in the contract. The Department reserves the right to change grade and class (cationic, anionic) as may be necessary due to aggregate type, road surface or weather conditions. When a change is desired by the Department, written notice of such change will be made to the contractor who shall make the desired change.

Emulsified asphalt shall remain homogeneous and stable during transportation, storage and through any distributing system which might be used. Failure of the material to perform satisfactorily under any of the above situations will be deemed cause for rejection notwithstanding its ability to pass laboratory tests.

The producer shall comply with the applicable requirements of subsection 1206.

(b) Chemical and Physical Requirements.

Emulsified asphalts shall conform to the requirements shown in Tables 4 and 5.

(c) Mixing Grade Emulsions.

Mixing grade emulsions (MS-1, HFMS-1, CMS-1) shall be formulated for use with regional aggregate types. In general, these will be crushed limestone and/or dolomite with sand for the eastern section of the state and sand-gravel with mineral filler for the central and western sections. Emulsions should be formulated for use by both windrow and plant mixing methods and for either damp or dry aggregates. If these conditions cannot be met by a single formulation, the producer shall be

responsible for furnishing an emulsion formulated for the intended end use. For stockpiling purposes, the emulsions shall be formulated so that the material in the stockpile can be easily removed at temperatures as low as 40° F and for an extended period of time after mixing.

1202.03 PREQUALIFICATION OF EMULSIFIED ASPHALTS.

Manufacturers shall comply with the prequalification requirements of subsection 1206.

1202.04 METHODS OF TESTS.

The methods of tests shall be in accordance with the applicable provisions of subsection 1207.

1202.05 BASIS OF ACCEPTANCE.

The basis of acceptance of materials furnished under this specification shall be in accordance with the applicable requirements of subsection 1206.

TABLE 4—SPECIFICATIONS FOR ANIONIC EMULSIFIED ASPHALT

	RS-1H		SS-1H		MS-1		HFMS-1	
	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, Saybolt Furol:								
At 77° F, sec	...	...	10	100	...	...	...	...
At 122° F, sec.	75	300	...	...	100	400	100	400
Residue by Distillation, %	65	...	57	...	65	...	65	...
Oil Distillate, (% by Volume)	...	...	...	...	...	8	...	8
Settlement, 5 Days, % (B)	...	5	...	5	...	5	...	5
Storage Stability Test 1 day, % (C)	...	1	...	1	...	1	...	1
Consistency	(A)	...	...	...	(A)	...	(A)	...
Demulsibility:								
35 ml of 0.02 N CaCl2, %	60	...	...	...	...	...	...	...
50 ml of 0.1 N CaCl2, %	...	...	...	...	75	...	75	...
Sieve Test, % Retained	...	0.50	...	0.50	...	0.50	...	0.50
Tests on Distillation Residue:								
Penetration, 77° F, 100g. 5 sec.	75	150	75	125	300	...	300	...
Solubility, %	97.5	...	97.5	...	97.5	...	97.5	...
Ductility at 77° F, cm	80	...	80	...	...	...	...	...
Float Test at 140° F.	...	...	...	...	...	...	1200	...

(A) Shall be suitable for application through a pressure distributor when heated to a temperature not to exceed 150° F.
(B) The test requirement for settlement may be waived by the Engineer when the emulsified asphalt is used in less than 5 days time.
(C) The 24 hour (1 day) storage stability test instead of the 5 day settlement test may be used as a basis for certification. However, the 5 day settlement test will be conducted and if the material fails to compile a satisfactory compliance record for the 5 day settlement test then permission to ship on a certification basis will be withdrawn.

TABLE 5 - SPECIFICATIONS FOR CATIONIC EMULSIFIED ASPHALT

Type and Grade	CRS-1H		CSS-1H		CMS-1	
	Min.	Max.	Min.	Max.	Min.	Max.
Viscosity, Saybolt Furol: At 77° F, sec	...	...	10	60	...	...
At 122° F, sec	75	300	...	...	100	400
Residue by Distillation, (% by Volume)	65	...	57	...	65	...
Oil Distillate, (% by Volume)	...	3	...	...	...	8
Settlement, 5 Days, % (B)	...	5	...	5	...	5
Storage Stability Test 1 day, % (C)	...	1	...	1	...	1
Consistency	(A)	...	...	...	...	(A)
Sieve Test, % Retained	...	0.50	...	0.50	...	0.50
Particle Charge	Positive		Positive (D)		Positive	
Tests on Distillation Residue: Penetration, 77° F, 100g. 5 sec	75	150	50	100	300	...
Solubility, %	97.5	...	97.5	...	97.5	...
Ductility at 77° F, cm	80	...	80	...	...	...
Viscosity, saybolt Furol, at 180° F, sec	...	...	...	...	300	700

(A) Shall be suitable for application through a pressure distributor when heated to a temperature not to exceed 150° F.
(B) The test requirement for settlement may be waived by the engineer when the emulsified asphalt is used in less than 5 days time.
(C) The 24 hour (1 day) storage stability test instead of the 5 day settlement test may be used as a basis for certification. However, the 5 day settlement test will be conducted and if the material fails to compile a satisfactory compliance record for the 5 day settlement test then permission to ship on a certification basis will be withdrawn.
(D) Current of the particle charge may need to be more than 8 mA.

SUBSECTION 1204

ASPHALT REJUVENATING AGENT

1204.01 DESCRIPTION.

This specification covers the material to be used as a rejuvenating agent to increase the ductility and penetration of the asphalt binder in an existing pavement.

1204.02 REQUIREMENTS.

The asphalt rejuvenating agent shall have a record of satisfactory service. Satisfactory service will be based on the capability of the material to increase the ductility and lower the viscosity of the asphalt binder in the pavement surface. The asphalt rejuvenating agent shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the following physical and chemical requirements:

Viscosity, Saybolt-Furol at 77° F, Sec.	15-100
Residue, % Min.	60
Sieve Tests, % Max.	0.10
Tests on Residue from AASHTO T59 (Residue by Distillation)	
Viscosity, Kinematic at 140° F, cSt	75-250
Asphaltenes, % Max.	0.75
Maltenes Ratio, (See Note)	0.3-0.6

NOTE: Maltenes Ratio = $(PC + A_1)/(S + A_2)$

Where: PC = Polar Compounds
A_1 = First Acidaffins
A_2 = Second Acidaffins
S = Saturates

1204.03 PREQUALIFICATION OF ASPHALT REJUVENATING AGENTS.

Manufacturers shall comply with the prequalification requirements of subsection 1206.

1204.04 METHODS OF TEST.

1204.05 BASIS OF ACCEPTANCE.

The basis of acceptance of materials furnished under this specification shall be in accordance with the applicable requirements of subsection 1206.

NEVADA

Amendment # 1 letter dated 7/3/90

The third paragraph of this subsection of the Standard Specifications is hereby deleted.

401.03.12 Joints. Add the following after the second paragraph of this subsection of the Standard Specifications:

The top lift of plantmix bituminous surface shall be placed so that any longitudinal joints that are constructed shall be within one (1) foot of the traffic lane lines. No two (2) longitudinal joints shall be constructed within the same traffic lane.

401.04.01 Measurement. The third paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

The hydrated lime added to the bituminous aggregates as specified in this Section of these Special Provisions, shall be classified as "Mineral Filler" and shall be measured for payment by the ton.

The first sentence of the sixth paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

The item of "plantmixing miscellaneous areas" shall be measured on a square yard basis in accordance with the fifth paragraph of this subsection.

401.05.01 Payment. The fourth paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

The quantity of hydrated lime added to the aggregates and measured as provided above, shall be paid for at the contract unit price bid per ton for "Mineral Filler", which price shall be considered full compensation for furnishing all labor, materials, tools, supplies, equipment and incidentals necessary to furnish and mix the lime with the aggregates as specified herein and as directed by the Engineer.

Commercial sources shall be construed to mean Contractor-furnished sources and all requirements under this section shall be applicable thereto.

Baghouse fines, if used, will not be measured or paid for directly, but the cost thereof shall be considered included in the contract unit price bid per ton of plantmix bituminous aggregate and no additional compensation will be allowed therefor.

SECTION 402 - PLANTMIX BITUMINOUS SURFACE

402.01.01 General. This work shall also consist of the Contractor furnishing a pavement core drilling machine to be used by the State as hereinafter specified. The Contractor shall perform normal maintenance of said machine.

The pavement core drilling machine shall be on the job-site five (5) working days prior to the Contractor commencing his paving operations. Once the

core drilling machine is no longer required as determined by the Engineer, said machine shall be returned to the Contractor.

The core drilling machine shall conform to the following requirements or an approved equal.

1. The pavement test core drill shall be hand-fed with all accessories.
2. Shall be trailer mounted.
3. Shall have a sliding base.
4. Core size shall be four (4) inch minimum.
5. The engine shall be a (7 H.P.) gasoline or diesel.
6. The transmission shall be a 2-speed, with a sliding gear.
7. The water system will be pressurized.
8. Diamond circular bits shall be furnished to the State as required.

All costs for providing the State with the pavement test core drilling machine, maintenance thereof and the circular diamond bits as mentioned above and all costs for providing water during the core drilling will not be measured or paid for directly but the cost thereof shall be considered included in the contract unit price bid for other items of work and no additional compensation will be allowed therefor.

402.03.02 Rollers. This subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

The requirements of subsection 401.03.04, "Rollers" of the Standard Specifications shall not apply to the construction of Plantmix Bituminous Surface except as noted herein. Instead the following requirements shall apply.

Equipment proposed for use in the compaction of Plantmix Bituminous Surface shall be subject to the approval of the Engineer prior to use. The type and weight of the rollers used shall be such that uniform density is obtained throughout the depth of the layer of material being compacted. At least two rollers, one steel wheel, the other a pneumatic tire, shall be used, and the total number of rollers used shall be sufficient to obtain the required compaction while the mixture is in a workable condition. The pneumatic tire roller shall conform to the requirements of subsection 401.03.04(b). The steel wheel roller shall be either a) a vibratory roller weighing not less than six (6) tons, b) a three-wheel or a three axle tandem roller weighing not less than ten (10) tons, or c) a two-axle tandem roller weighing not less than eight (8) tons. Other approved roller types and weights may be used in addition to the aforementioned rollers, if desired.

402.03.06 Compaction. The requirements of this subsection shall supersede the requirements of subsection 401.03.11 "Rolling", of the Standard Specifications.

(a) General. Immediately after the bituminous material has been spread, struck off, and surface irregularities corrected all in accordance with the

applicable requirements of the specifications, it shall be thoroughly and uniformly compacted by rolling. Rolling shall be performed using the equipment specified in subsection 402.03.02 "Rollers", and the methods hereinafter described.

Initial rolling shall commence at the lower edge and shall progress toward the highest portion of the roadbed. Under no circumstances shall the center be rolled first. Rolling shall be performed in such a manner that cracking, shoving, or displacement will be avoided. All compactive rolling, defined as breakdown and intermediate rolling, shall be completed before the internal temperature at mid-depth of the pad drops below one hundred eighty (180) degrees Fahrenheit.

All rollers shall be in good condition, and the reversing mechanism so maintained that the roller is capable of changing directions smoothly. The roller shall be kept in continuous motion while rolling, and all parts of the pavement shall receive uniform compaction. The speed of the roller shall be slow enough at all times to avoid displacement of the pavement. Any displacement occurring as a result of the roller, or from any other cause, shall be corrected immediately by the use of rakes and fresh mixture when required. To prevent adhesion of the mixture to the rollers, the wheels shall be kept properly moistened.

Compaction of the bituminous mixture shall be evaluated by means of test sections as hereinafter described.

Each lift of each course of bituminous material will be divided into "Test Sections" by the Engineer for the purpose of defining areas represented by each series of density tests. Each test section shall have an area not to exceed 6,600 square yards.

(b) Compaction Requirements of Test Sections. The density of each test section will be based on the result of five (5) nuclear tests taken at randomly selected locations within the sections as per Test Method Nev. T335. The mean density of the five (5) nuclear tests taken in the test section shall be at least ninety-two (92) percent (with no single test below ninety (90) percent) of the "Target" density achieved in the Department's field laboratory using Test Method Nev. T324, "Theoretical Maximum Density (Field Method)". Upon completion of the first test section, and after the material has cooled sufficiently, a core shall be drilled from each of the five (5) locations where the nuclear tests were taken. The density of these cores shall be determined by Test Method Nev. T336. The average of these five (5) core densities shall be correlated to the average of the five (5) nuclear densities as per Test Method Nev. T335. Once this correlation procedure has been satisfactorily completed, the nuclear testing device (described in Test Method Nev. T335) shall be used to determine densities of subsequent test sections.

The recycled bituminous surface shall be tested as stated above except for the following:

The mean density of the five (5) nuclear tests taken in the test sections shall be at least ninety (90) percent (with no single test below eighty-eight (88) percent) of the target density. Acceptance tests for density of the recycled bituminous surface shall be taken the day after the material has been placed and following the final steel wheel rolling.

If, in the opinion of the Engineer, the correlation between the nuclear device and the cores has changed (for whatever reason), the correlation procedure may be repeated.

On the first day of plantmix bituminous placement, the Contractor shall cease production after four (4) hours (maximum) of operation. The placement and compaction of this produced material shall be completed no later than 1:00 p.m. to allow the Department sufficient time to drill cores of the placed material and properly correlate their results with those of the Nuclear Testing Device.

In the event the mean density of the test section or any individual test density falls below the foregoing requirements, action shall be taken by the Contractor to correct procedures so that the required densities are obtained. The Contractor's paving operations shall be limited to four (4) hours of production until suitable procedures indicate that the density specification is being obtained.

If, in the opinion of the Engineer, current procedures are no longer achieving acceptable results, a change in the compaction equipment and/or methods may be required.

(c) Compaction Requirements For Small Sized Areas. In cases where the test section cannot be as specified in (a), the compaction will be accepted on the basis of a single test for every one thousand (1000) square yards of area or fraction thereof. The individual test density shall be at least ninety-four (94) percent of the target density.

402.05.01 Payment. The work describing plantmixing miscellaneous areas in subsection 401.04.01 of these Special Provisions shall be paid for at the contract unit price bid per square yard for "Plantmixing Miscellaneous Areas," which price shall include all the work involved to place and compact the bituminous material complete in place in the accepted work. Materials will be paid for as provided in this subsection of the Standard Specifications.

SECTION 403 - PLANTMIX BITUMINOUS OPEN-GRADED SURFACE

403.02.01 General. Asphalt Cement, Grade AC-20 (Polymerized) shall be the only grade permitted for use in Plantmix Bituminous Open-Graded Surface Aggregate mixtures.

403.03.01 General. This subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

The construction requirements shall conform to the requirements as specified in subsections 401.03.01 through 401.03.13, inclusive, of Section

401, "Plantmix Bituminous Pavements-General," with the exceptions contained in the following four (4) subsections.

403.03.05 Spreading and Finishing. When using polymer modified bituminous material in Plantmix Open-Graded Surface, the Contractor shall be required to place the material in a windrow in front of the spreading and finishing machine.

SECTION 404 - ROADMIX BITUMINOUS SURFACE

404.01.01 General. This work shall consist of recycling asphalt concrete by cold milling the existing roadway surface, mixing an emulsified recycling agent with the cold milled material and then spreading and compacting the mixture as shown on the plans, in accordance with the Standard Specifications and as specified herein. Recycled bituminous surface shall consist of cold milling of the existing bituminous surface to the depths and at the locations shown on the plans and as directed by the Engineer.

The machine used to cold mill the existing bituminous material shall conform to the requirements specified in subsection 202.03.02 of the Standard Specifications. Said cold milling operation shall be done in such a manner that insures the underlying material is not damaged.

The contract bid items of "Premixed Bituminous Paving Material" by the ton and "Haul and Place Premixed Bituminous Paving Material" by Force Account shall be used for replacing any unsuitable material in the existing roadway within the limits of the project as directed by the Engineer.

The Premixed Bituminous Paving Material may be stockpiled at Material Deposit EL15-5. The exact location and the manner in which the material is to be stockpiled shall be determined by the Engineer.

404.02.01 Aggregates. Existing surface shall be cold milled to the depth shown on the plans and shall conform to the following gradation requirements:

Sieve size	Percent by Weight Passing Sieve
1-1/2 Inch	100
1 Inch	90-100

Any coarse material shall be crushed and incorporated back into the mix.

The following requirements shall apply to the Cold Recycled Bituminous Material:

Test	Test Method	Requirements
Stabilometer Value	Nev. T303	30 Min.
Percent Air Voids of Compacted Recycled Bituminous Mixture	Nev.T323A	4 Percent Min. 8 Percent Max.

404.02.02 Bituminous Material. Asphalt cement for bituminous mixtures (Recycled Bituminous Surface) shall be Emulsified Recycling Agent, Type RAE 25. However, the Department reserves the right to change the Emulsified Recycling Agent one (1) grade, at no change in the contract unit price bid for "Emulsified Recycling Agent", Type RAE 25. The Contractor shall furnish the Engineer three (3) one-gallon samples of each of the above grades of asphalt from his supplier not less than twenty (20) days prior to starting paving operations. The type and grade of asphalt to be used in the recycled mixture will be determined by the Department based on a design mix using aggregates milled from the existing roadway within the limits of this project. Once the determination of the type and grade of asphalt has been made, changes shall not be made unless new samples are submitted and a new design mix is approved allowing the use of an alternate type and grade of asphalt.

The emulsified recycling agent, Type RAE 25 shall hereinafter be referred to at the contract bid item of "Emulsified Recycling Agent".

The recycling oil used in the emulsified recycling agent shall conform to the specifications listed in Table 1 and the Emulsified Recycling Agent shall conform to the specifications listed in Table 2 as specified in Section 703 of these Special Provisions.

In the event the Contractor elects to change his asphalt source, paving operations shall cease until the milled aggregates and asphalt samples are submitted and a new preliminary mix design is received from the Department's Materials and Testing Laboratory. Further, prior to resuming paving operations, the Contractor must submit and receive approval of a new job-mix formula based on the new preliminary mix design.

The costs of furnishing asphalt and milled aggregates samples will not be paid for directly but the costs thereof shall be considered included in the contract unit price bid for other items of work.

The emulsified recycling agent shall be applied to the cold milled material at a rate of one-half (1/2) percent of the weight of the pulverized material for the full length and width of the project from milepost EL 74.74 to EL 83.22. The emulsified recycling agent shall be applied to the cold milled material at a rate of one (1) percent of the weight of the pulverized material for the full length and width of the project from milepost EL 96.00 to EL 102.80. The exact rate will be determined by the Engineer and shall be added to the cold milled material to an accuracy of plus or minus two-tenths (± 0.2) percent of the amount determined. The emulsified recycling agent shall be applied to the cold milled material and uniformly mixed to a homogenous mixture by any one of the following methods:

1. The emulsified recycling agent may be applied through the machine used to cold mill the material as part of the liquid used to cool the cutter teeth provided it is applied uniformly across the width of cut and results in a complete and uniform blending of the emulsified recycling agent and the cold milled material.

2. The emulsified recycling agent may be applied through a separate mixing machine capable of mixing a windrow of the cold milled material and the emulsified recycling agent in accordance with the provisions for a roadmixing machine in subsection 404.03.09 of the Standard Specifications.

3. The emulsified recycling agent may be added through a paving machine which is capable of mixing and placing the recycled material in the final position for compacting. If this method is used, the provisions of subsection 404.03.09 of the Standard Specifications shall apply to the mixer-paver machine.

Blade laying of recycled material will not be permitted on this project except under emergency conditions.

Regardless of which method is used, a positive displacement pump which can accurately meter the planned amount of emulsified recycling agent into the cold milled material is to be used. The pump shall be equipped with a positive interlock system which will permit addition of the recycling agent only when material is present in the mixing chamber and will automatically shut off when the machine is stopped.

SS-1, SS-1h, CSS-1 or CSS-1h Emulsion shall be made available during and after the the placement of the cold recycled material before the placement of the plantmix bituminous surface. The SS-1, SS-1h, CSS-1 or CSS-1h Emulsion is to be used as a seal coat in case inclement weather or raveling of the recycled material is encountered, as directed by the Engineer. It shall be applied at an estimated rate of 0.10 gals/square yard as directed by the Engineer. The sand blotter if needed shall be applied at ten (10) pounds per square yard or as directed by the Engineer. The Contractor's attention is directed to subsection 405.03.04 of these Special Provisions for a change in the application rate for the tack coat for the new bituminous surface should this occur.

Cold milled longitudinal joints shall be overlapped four (4) inches.

404.03.09 Mixing. Each mixing machine shall be equipped with a meter capable of registering the rate of flow and the total delivery of emulsified recycling agent introduced into the mixture. The meter shall also be equipped with valves and a nozzle in a convenient location for the purpose of testing. When directed by the Engineer to facilitate uniform mixing of the cold milled material, water shall be added to the emulsified recycling agent in quantities which will result in a mixture not exceeding fifty (50) percent added water. Added water shall be clean and free of foreign substances and shall not cause an adverse affect on the emulsified recycling agent. The exact quantity of water to be added shall be determined by the Engineer. The actual quantity of emulsified recycling agent in the final mixture shall not vary because of added water. Placing of the recycled asphalt concrete shall be accomplished with a self-propelled asphalt paver, meeting the requirements of subsection 401.03.03 of the Standard Specifications and capable of spreading the recycled material in one continuous pass without segregation to the lines and grades established by the Engineer.

The emulsified recycling agent shall be diluted with water. The water is to be heated to one hundred twenty (120) degrees Fahrenheit before mixing with the emulsified recycling agent.

404.03.10 Spreading, Compacting and Finishing. Prior to commencing the cold recycling operation, the Contractor shall have two (2) steel rollers and two (2) pneumatic tired rollers on the job site. One (1) of the steel rollers shall be vibratory. The steel rollers shall be two (2) axle tandems weighing not less than ten (10) tons. One (1) of the pneumatic tired rollers shall be a thirty (30) ton - seven (7) tired roller.

There shall be a minimum of two (2) passes with a thirty (30) ton pneumatic roller when the recycled material is initially spread and finished with a steel roller.

No traffic, including any of the Contractor's equipment will be permitted on the completed recycled mixture for at least two (2) hours after the recycling agent has been added to the mixture.

The following day after the recycled material has been initially spread and compacted, final compaction shall be accomplished with a thirty (30) ton pneumatic tired roller and finished by a steel wheeled roller until the required density is achieved.

The longitudinal joints shall be free of any loose material.

The finished surface tolerances of the cold recycled material shall conform to the requirements specified in subsection 404.03.12 of the Standard Specifications.

All rollers shall be equipped with pads and water systems which will prevent sticking of asphalt mixtures to pneumatic or steel tired wheels. A parting agent which will not damage the recycled mixture as determined by the Engineer may be used to aid in preventing the sticking of the mixture to the wheels. Any type of rolling that results in excessive cracking, movement or other pavement distress as determined by the Engineer shall be discontinued. Rollers shall conform to the requirements of subsection 401.03.04 of the Standard Specifications. The number of passes for each type of roller shall be determined by the Engineer.

Mixing and compacting operations shall not be performed when the atmospheric temperature is below sixty (60) degrees Fahrenheit, when it is anticipated the atmospheric temperature will drop below thirty-five (35) degrees Fahrenheit within forty-eight (48) hours of mixing or during stormy weather. The weather shall be considered stormy when the rate of precipitation exceeds the rate of evaporation. After the recycled material has been spread and compacted, it shall be opened to public traffic and allowed to cure for a minimum of ten (10) calendar days prior to placing the plantmix bituminous surface.

In the event that the recycled material becomes wet as a result of natural precipitation, an additional ten (10) calendar days of curing will be required

after said precipitation ceases before the plantmix bituminous surface may be placed. Any damage to the recycled material shall be repaired prior to placing the plantmix bituminous surface course. Any necessary repairs will be at the Contractor's expense.

404.03.13 Premixed Bituminous Paving Material. The aggregates for "Premixed Bituminous Paving Material" shall conform to the requirements for Type 2 Roadmix Aggregate. Said aggregate shall be mixed with seven (7.0) percent SC-800 liquid asphalt. All the "Premixed Bituminous Paving Material" shall be produced prior to beginning the recycle operation.

404.04.01 Measurement. "Recycled Bituminous Surface (* Depth)" will be measured for payment by the square yard.

The "Emulsified Recycling Agent" will be measured for payment by the ton.

404.05.01 Payment. The accepted quantity of "Recycled Bituminous Surface (* Depth)", measured as provided above, shall be paid for at the contract unit price bid per square yard. This price shall be considered full compensation for furnishing all labor, tools, supplies, materials, equipment and incidentals necessary to complete the work of cold milling the existing pavement, recycling, mixing, placing and compacting the recycled bituminous surface as shown on the plans, as specified herein and as approved by the Engineer.

Should an excess of recycled material develop, such material shall be uniformly removed ahead of the paving operation and disposed of as directed in subsection 107.14 of the Standard Specifications and these Special Provisions. All costs for removing and disposing of the excess material shall be considered incidental to the contract bid item "Recycled Bituminous Surface (* Depth)" and no further compensation will be allowed therefor.

The accepted quantity of "Emulsified Recycling Agent" measured as provided above, shall be paid for at the contract unit price bid per ton. This price shall be considered full compensation for furnishing all labor, materials, supplies, equipment and incidentals necessary to complete the work as approved by the Engineer.

Payment will be made under:

Pay Item	Pay Unit
Recycled Bituminous Surface (* Depth)	Square Yard
Emulsified Recycling Agent	Ton

(* Depth) as indicated on the plans and in the estimate.

SECTION 405 - TACK COAT

405.02.01 Bituminous Material. The first sentence of the first paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

Bituminous material for the tack coat shall be "Emulsified Asphalt, Type SS-1h (Diluted);" however, the Contractor may, at his option, substitute "Emulsified Asphalt, Type SS-1 (Diluted)", "Emulsified Asphalt, Type CSS-1 (Diluted)" or "Emulsified Asphalt, Type CSS-1h (Diluted)."

405.03.04 Application of Bituminous Materials. In the event a seal coat is applied to the recycled bituminous surface as specified in subsection 404.02.02 of these Special Provisions, the application rate for the tack coat for the recycled bituminous surface shall be changed from seven one-hundredths (0.07) gallons per square yard to three one-hundredths (0.03) gallons per square yard.

SECTION 407 - SEAL COAT

407.02.01 Bituminous Material. The area where the asphaltic emulsion is to be used as a prime coat shall be prepared for application in accordance with Section 406 of the Standard Specifications.

SECTION 408 - SURFACE TREATMENT

408.02.02 Screenings. Screenings shall meet the requirements of subsection 705.03.05 of these Special Provisions.

408.03.01 Distributors. Longitudinal joints shall be constructed only on the shoulders, or at the edge of travel lanes.

408.03.03 Rollers. The first sentence of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

There shall be operating with each aggregate spreader a minimum of two (2) pneumatic-tired rollers and one (1) steel-wheel roller. Additional rollers may be required if, in the opinion of the Engineer, the aggregate placement rate exceeds the capabilities of the initial rollers.

408.03.04 Weather Limitations. In addition to the temperature limitations specified in this subsection of the Standard Specifications, screenings shall be placed only between June 1 and September 15 in a given construction season.

408.03.05 Maintaining Traffic. The first sentence of the third paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

When the newly completed surface treatment is open to public traffic, the traffic shall be controlled by use of flaggers and a pilot car for a minimum of twenty-four (24) hours or for such time as deemed necessary by the Engineer as follows:

408.03.07 Application of Bituminous Material. The second paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

Bituminous material shall not be applied at a distance greater than can be immediately covered by screenings.

408.03.08 Application of Screenings. The first paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

Immediately following the application of bituminous material, screenings shall be spread within ten (10) percent of the required rate per yard.

The first sentence of the fourth paragraph of this subsection of the Standard Specifications is hereby deleted and the following substituted therefor:

Screenings shall be surface damp at the time of application, but excess water on the aggregate surface will not be permitted.

Operating the spreader at speeds which cause the screenings to roll over after striking the bituminous covered surface will not be permitted.

The Contractor shall apply bituminous material and screenings to the full roadway width during each day's operation. To accomplish this, the Contractor shall limit his operation to one-half (1/2) of a given roadway at a time and at the end of each working day, the screening operation for both sides shall be brought up to as near a common point as practical as determined by the Engineer. The screening operation shall proceed in the above manner throughout the project.

In order to eliminate hauling over the new surface treatment, screening operations will begin at a point furthest from the material source and then work toward the material source. No turning of trucks will be allowed on the new surface treatment.

The last paragraph of this subsection of the Standard Specifications is hereby deleted.

408.03.10 Removal of Loose Screenings and Surface Maintenance. After the application of screenings, the surface shall be lightly broomed or otherwise maintained as directed for a period of four (4) days or as directed by the Engineer. This light brooming shall be performed to remove loose screenings prior to the end of each day's work or as the first order of work on the morning following application of screenings. The initial brooming shall take place between sunrise and 10:00 A.M. The entire surface that has had screenings applied to it on the previous day shall be broomed. All loose screenings shall be completely removed from the paved roadway surface. After the initial brooming, the screenings shall be sealed with ss-1h as directed by the Engineer. A second brooming will be required within forty-eight (48) hours after the initial brooming. Additional brooming shall be required as often as necessary between the first and fourth day after applying screenings to maintain the surface free of loose screenings. At the end of four (4) days after applying screenings, any excess screenings shall be removed from all paved areas. Sweeping or brooming of the surface treatment shall be performed in such a manner that the screenings set in the bituminous material will not be displaced. Excessive brooming will not be permitted.

Brooming operations shall be at four (4) to six (6) miles per hour with the brush rotating at one hundred fifty (150) rpm ± fifty (50) rpm. The broom shall be equipped with a sprinkler bar for dust control. If operated at night, the broom shall be equipped with tail, stop and directional lights and an amber strobe light. A minimum of two (2) brooms will be required.

Excess screenings which, in the opinion of the Engineer, will interfere with drainage, shall be removed and disposed of by the Contractor at his expense.

Maintenance of the surface for the four (4) day period shall include the distribution of screenings over the surface to absorb any free bituminous material, the covering of any areas deficient in screenings, and to prevent the formation of corrugations. Clean sand may be used in lieu of screenings to cover any excess bituminous material which comes to the surface, at the discretion of the Engineer. The use of roadside material for this purpose will not be permitted.

The Contractor shall provide a water truck to be used for dust control as directed by the Engineer. The water truck shall be of sufficient size with a pressure type distributor equipped with a spray system that will ensure uniform application of water.

The completed surface shall present a uniform appearance and shall be free from ruts, humps, depressions or irregularities due to an uneven distribution of bituminous material or screenings.

408.04.01 Measurement. Any water added to the screenings by the Contractor during production and/or prior to weighing, which is above the natural moisture content of the material deposit, shall be deducted from the quantity measured for payment.

408.05.01 Payment. The cost of providing water and water trucks used for dust control shall not be paid for directly, but shall be considered included in the contract unit price bid for other items of work, and no additional compensation will be allowed therefor.

SECTION 501 - PORTLAND CEMENT CONCRETE

501.02.01 General. Lightweight aggregates specified in subsection 706.03.02 of these Special Provisions and the Standard Specifications shall only be used where lightweight concrete is specified or is approved for use by the Engineer.

Class AA concrete shall be required where the option of Class A or Class AA concrete is indicated in the plans or the Standard Specifications.

SECTION 505 - REINFORCING STEEL

505.03.04 Placing and Fastening. For reinforcing placement in other than deck slabs, the spacing for support units (steel, plastic, mortar) shall not be greater than four (4) feet.

703.03.04 Emulsified Asphalt.

SPECIFICATIONS FOR LATEX MODIFIED RAPID SETTING EMULSION

TEST	TEST METHOD	ANIONIC LMRS-2H	ANIONIC LMRS-2	CATIONIC LMCRS-2H	CATIONIC LMCRS-2
Viscosity @122°F	AASHTO T-59	75-400 SEC		75-400 SEC	
Sieve	"	0.3% MAX.		0.3% MAX.	
Settlement, 5 days	"	5% MAX.		5% MAX.	
Demulsibility	"	60% MIN.		40% MIN.	
Storage Stability Test 1 day	"	1% MAX.		1% MAX.	
Particle Charge	"	--		POSITIVE	
Ash Content	ASTM D3723	0.2% MAX.		0.2% MAX.	
Tests on Residue By Drying:					
Percent Residue	NV 756	65% MIN.		65% MIN.	
Penetration @77°F 100G, 5 Sec.	AASHTO T-49	40-90	90-200	40-90	90-200
Ductility @77°F 5 CM/MIN.	AASHTO T-51	40 CM MIN.		40 CM MIN.	
Torsional Recovery	NV 757	18% MIN.		18% MIN.	

Latex Modified Rapid Setting Emulsion not conforming to the requirements of of the above referenced specifications will be assessed demerits in accordance with the graduated increments of the following schedule. Attention is directed to subsection 109.02, "Scope of Payment", of the Standard Specifications where demerits will be evaluated for damages sustained by reason of any noncompliance.

Test Method	Increment	Demerits (each increment of noncompliance)
T59 (Furol Viscosity at 77°F., and at 122°F.)	3 seconds below min.	1
	10 seconds above max.	1
T59 (Settlement, 5 days, percent difference)	1 percent above max.	1
T59 (Sieve test, percent max.)	0.1 percent above max.	1
T59 (Cement mixing test)	0.5 percent above max.	1
T59 (Particle charge test)	Negative charge	21
Test on Residue by Drying:		
NV756 Percent Residue	5 percent below min.	1
NV757 Torsional Recovery	1 percent below min.	1
T49 (Penetration, 77°F., 100g., 5 sec.)	0.1 millimeter above max. or below min.	1
T44 (Solubility)	0.01 below min.	1
T51 (Ductility 77°F., cm.)	5 centimeters below min.	2

SPECIFICATIONS FOR RECYCLING OIL

TABLE 1

Property	Test Method	RAE-5	RAE-25	RAE-75
Viscosity @ 60° Cc St	AASHTO T 201-86	200-800	1,000-4,000	5,000-10,000
Flash Point, COC, °C	AASHTO T 48-84	375 min.	425 min.	450 min.
RTFC Weight Change, % W	AASHTO T 240-86	4.0 max.	3.0 max.	2.0 max.
RTFC ratio*	AASHTO T 240-86	3 max.	3 max.	3 max.

*The viscosity RTFC residue at 140° F. in cSt/viscosity of original Material at 140° F. in cSt.

SPECIFICATIONS FOR EMULSIFIED RECYCLING AGENTS

TABLE 2

Property	Test Method	Specifications
Viscosity @ 25° C, SFS	ASHTO T 59	15-85
Emulsion coarseness, % W	Sieve Test AASHTO T 59 (MOD) (2)	0.1 max.
Sensitivity to Fines, % W	Cement Mixing AASHTO T 59	2.0 max.
Particle Charge	AASHTO T 59	Positive
Concentration of oil phase, %W	AASHTO T 59 (MOD) (3)	60 min.

(1) Oils used for emulsions must meet specifications listed in Table 1.

(2) Test procedure identical to ASTM designation D244 except that distilled water shall be used in place of 2 percent sodium oleate solution.

(3) ASTM Designation D244 Evaporation Test for percent of residue is modified by heating a 50-gram sample to 300 degree F. until foaming ceases, then cooling immediately and calculating the results.

NEW MEXICO

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Revised November 13, 1986

NEW MEXICO STATE HIGHWAY DEPARTMENT
SPECIAL PROVISIONS
FOR
IN-SITU COLD RECYCLING OF EXISTING SURFACING
SECTION 305

All applicable provisions of the New Mexico State Highway Department's Standard Specifications for Road and Bridge Construction shall apply in addition to the following:

1. DESCRIPTION.

1.1 This work shall consist of pulverizing the existing surfacing to the specified width and depth, mixing an emulsified binder agent and water (if required) with the pulverized surfacing, spreading and compacting said mixture to the specified width and thickness, and sealing of the compacted surface if required. All work shall be as shown on the plans and as provided herein unless otherwise directed by the Project Manager.

The Contractor shall furnish all equipment, tools, labor, all materials (except the pulverized surfacing), and any other appurtenances necessary to complete the work.

2. MATERIALS.

2.1 The emulsified binder agent shall be Polymerized High Float Emulsion of the type shown on the plans with the option, by the Department, to change one grade up or down at a change in unit price based on a difference in invoice prices for the different grades of emulsion. Any change in grade of binder agent shall be made only with the concurrence of the Materials Laboratory Bureau. The Polymerized High Float Emulsion shall meet the requirements of Section 402 - BITUMINOUS MATERIALS of the Standard Specifications.

2.2 The Cold Recycled Material shall meet the following gradation requirements:

Sieve Size	% Passing
1 1/4"	100
1"	90-100

2.3 The Sealing Emulsion shall be High Float Emulsion, CSS-1 h or other approved equal.

3. CONSTRUCTION REQUIREMENTS.

3.1 The existing surfacing shall be cold recycled in a manner that does not disturb the underlying material in the existing roadway.

3.2 Prior to initiating any recycling operations or other inherent work, the Contractor shall clear, grub and remove all vegetation and debris within the width of pavement to be recycled. Disposal of said vegetation and debris shall be as directed by the Project Manager.

3.3 Recycling operations shall not be performed when the atmospheric temperature is below 50 degrees F. and/or when the chill factor is below 35 degrees F., (chill factor shall be determined as per Subsection 401.31 General., part (a) Weather Limitations of the Standard Specifications), or when the weather is foggy or rainy or when weather conditions are such that in the judgment of the Project Manager, proper mixing, spreading and compacting of the recycled material cannot be accomplished.

3.4 When commencing recycling operations, the emulsified binder agent shall be applied to the pulverized material at the rate determined by the Materials Laboratory Bureau based on samples submitted for mix design. The exact application rate of the emulsified binder agent will be determined and varied by the Project Manager as required by existing pavement conditions. An allowable tolerance of plus or minus 0.2 percent of the initial design rate or Project Manager directed rate of application shall be maintained at all times.

The Contractor may add water to the pulverized material for the purpose of cooling the cutting teeth on the milling/pulverizing equipment and/or to facilitate uniform mixing with the emulsified binder agent. Water may be added prior to or concurrently with the emulsified binder agent. A means shall be provided for accurately metering and registering the rate of flow of water into the pulverized material.

Any fillet of fine, pulverized material which forms adjacent to a vertical face shall be removed prior to spreading the recycled mix, except that such fillet adjacent to existing pavement which will be removed by overlapping during a

subsequent milling operation need not be removed.

In the event segregation occurs either in the windrow or behind the paver, the Project Manager may require the Contractor to make changes in his equipment and/or operations. These changes may include, but shall not be limited to, the following: reducing the forward speed of the milling operation; increasing the amount of material going through the crusher; adjusting the crusher to produce more fines; adjusting the height of free fall of material from the mixing unit; and adjusting the amount of water in the mixture. The Contractor may be required to make other changes in his equipment and/or operations, as necessary to obtain a satisfactory end-product.

3.5 The Contractor shall establish a rolling pattern such that a minimum density of 96 percent of a laboratory specimen prepared in accordance with NMSHTD molding and testing procedures is obtained. The Project Manager may require a redemonstration of rolling capabilities when a change in the recycled materials is observed, whenever a change in rolling equipment is made or if densities are not being obtained with the rolling pattern being used.

After the recycled material has been spread and compacted, no traffic (this includes Contractor's equipment) shall be permitted on the completed recycled bituminous base for at least two hours. The area may then be opened to all traffic and shall be allowed to cure such that the free moisture in the recycled material is reduced to 1% or less, by total weight of mix, before placing the surfacing specified in the plans.

The surface of the recycled pavement shall be maintained in a condition suitable for the safe accommodation of traffic. Any loose aggregate that develops on the surface of the recycled pavement shall be removed by power brooming. After the free moisture content of the recycled material is 1% or less, the Project Manager may require that the surface be sealed with emulsion at an approximate rate of 0.05 to 0.10 gallon per square yard in order to control surface raveling. Said emulsion, if used, will be paid for under the Item Sealing Emulsion.

Any unacceptable recycled bituminous base shall be repaired by the Contractor, as directed by the Project Manager prior to placing any subsequent surfacing course. Said repair(s) shall be made at no additional cost to the New Mexico State Highway Department.

4. EQUIPMENT.

4.1 The Contractor shall furnish a self-propelled machine capable of pulverizing in-situ materials to the depth shown on the plans, in one pass. Said machine shall have a minimum rotor cutting width of twelve feet, standard automatic depth controls and maintain a constant cutting depth. Said machine shall also incorporate screening and crushing capabilities to reduce or remove oversize particles prior to mixing with emulsion. Oversize particles shall be reduced to size by crushing, however, the Contractor may, with concurrence of the Project Manager, waste up to a maximum of 2% oversize material prior to adding emulsion. This waste shall generally be limited to that material which is flattened out or "pancaked" rather than broken down by the crusher.

The emulsified agent shall be applied through a separate mixing machine capable of mixing the pulverized material and the emulsified binder agent to a homogeneous mixture and placing the mixture in a windrow. The method of depositing the mixed material in a windrow shall be such that segregation does not occur.

A positive displacement pump, capable of accurately metering the required quantity of emulsified binder agent, down to a rate of 4 gal./min., into the pulverized material, shall be used. Said pump shall be equipped with a positive interlock system which will permit addition of the emulsified binder agent only when the pulverized material is present in the mixing chamber and will automatically shut off when the material is not in the mixing chamber.

Each mixing machine shall be equipped with a meter capable of registering the rate of flow and total delivery of the emulsified binder agent introduced into the mixture. The meter shall be calibrated by the contractor, in the presence of the Project Manager, before commencing recycling operations. Subsequent checks or calibrations of the meter shall be as directed by the Project Manager.

4.2 Placing of the recycled bituminous base course shall be accomplished with a self-propelled bituminous paver meeting the requirements of Subsection 401.32 Equipment Part 3. Bituminous Pavers., except that heating of the screed will not be permitted. The recycled bituminous base shall be spread in one continuous pass, without segregation, to the typical section shown on the plans.

When a pick-up machine is used to feed the windrow into the paver hopper, the pick-up machine shall be capable of picking up the entire windrow down to the underlying materials.

4.3 Rollers shall meet the requirements of Subsection 401.35 Compaction. The number, weight, and type of rollers shall be sufficient to obtain the required compaction while the mixture is in a workable condition except that one pneumatic roller shall be 30 ton minimum weight. All rollers shall be equipped with pads and a water system which prevents sticking of the recycled mixture to the roller wheels.

Initial rolling shall normally be performed with the 30 ton pneumatic roller and continued until no displacement is discerned or until the pneumatic roller has walked out. If necessary, in order to initially seat the mixture, one or two passes with a small pneumatic roller may be made prior to application of the 30 ton roller. Final rolling to eliminate pneumatic tire marks and achieve density shall be done by steel wheel roller(s), either in static or vibratory mode, as required, to achieve specified density.

Rolling shall be performed in accordance with paragraph 3, Section 401.35 Compaction.

Rollers shall not be started or stopped on uncompacted recycled material. Rolling shall be established so that starting and stopping will be on previously compacted recycled material or on existing pavement.

Any type of rolling that results in cracking, movement or other types of pavement distress shall be discontinued until such time as the problem can be resolved. Discontinuation and commencement of rolling operations shall be at the sole discretion of the Project Manager.

4.4 The contractor shall have on hand at all times a rotary power broom maintained in good working order and of a design suitable for removing any aggregate that becomes dislodged from the surface of the recycled pavement.

5. METHOD OF MEASUREMENT

5.1 In-Situ Cold Recycling of Existing Surfacing shall be measured by the Square Yard.

Water will not be measured and paid for separately but shall be included in the In-Situ Cold Recycling of Existing Surfacing work.

The Polymerized High Float Emulsion of the type shown on the plans will be measured by the Ton.

The Sealing Emulsion will be measured by the Ton.

6. BASIS OF PAYMENT.

The accepted quantity of In-Situ Cold Recycling of Existing Surfacing will be paid for at the contract unit price per Square Yard complete and in place.

The accepted quantity of Polymerized High Float Emulsion of the type shown on the plans will be paid for at the contract unit price per Ton complete and in place.

The accepted quantity of Sealing Emulsion will be paid for at the contract unit price per Ton complete and in place.

Payment will be made under:

PAY ITEM	PAY UNIT
In-Situ Cold Recycling of Existing Surfacing . .	Sq. Yd.
Polymerized High Float Emulsion	Ton
Sealing Emulsion	Ton

OREGON

(Warning: SP420 has its own version of SP407-Asphalt Tack Coat printed after 420.91. If the regular version of SP407 is not required for this project, put SP420 version of SP407 in the proper numerical order for Part 400 Special Provisions. If the regular version of SP407 is required for this project, combine the two versions into one SP407.)

SECTION 420 - COLD IN-PLACE RECYCLED (CIR) ASPHALT CONCRETE PAVEMENT

Section 420, which is not in the Standard Specifications, is included for this project by special provision.

Description

420.01 Scope - This work shall consist of constructing cold in-place recycled (CIR) asphalt concrete pavement using Class I and Class II recycling treatments in accordance with these specifications, and in reasonably close conformity to the lines, grades, thicknesses and cross sections shown on the plans or established by the Engineer.

420.02 Definitions and Abbreviations - The following definitions and abbreviations are used in this Section:

(a) Definitions:

Emulsified Asphalt - Emulsified asphalt cement.

Course - See Typical Section on plans.

Coverage - One pass over the entire surface designated.

CIR Asphalt Concrete Pavement - CIR asphalt concrete pavement is a mixture of pulverized existing asphalt pavement (RAP), which has been removed and mixed with recycling agent and water; then relaid; and compacted in a continuous operation.

5-90

Class I Recycling Treatment - Class I recycling treatment is performed on a uniform pavement, previously designed and built to specifications. The CIR mixture produced under Class I is based on a rational mix design method.

Class II Recycling Treatment - Class II recycling treatment is performed on either a pavement with significant maintenance patches over a uniform pavement or a pavement with minimal design

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used in the original construction. The CIR mixture produced under Class II is less uniform than for Class I and is based on either a rational mix design method or mix design guidelines.

Equipment Option A - Performing CIR work using a recycling train.

Equipment Option B - Performing CIR work using a single processing unit.

Mixture - Cold in-place recycled asphalt concrete after all materials are combined and mixed.

Pass - The passing of a roller over a given spot.

Panel - The width of CIR material being removed and placed by the recycling train or single processing unit in a single pass.

Recycling Agent - Material added to RAP to soften and rejuvenate existing asphalt material.

(b) Abbreviations:

CIR - Cold in-place recycled asphalt concrete pavement.

JMF - Job mix formula.

RAP - Reclaimed asphalt pavement.

420.05 Prepaving Conference - Any supervisory personnel of the Contractor and any subcontractor who are to be involved in the recycle and paving work shall meet with the Project Manager, at a time mutually agreed upon, to disucss methods of accomplishing all phases of the recycle and paving work.

Materials

5-90 420.11 Recycling Agent and Water - The Contractor shall provide:

5-90 (a) Recycling agent - Either CMS-2RA or HFE-200RA that has been manufactured from new materials and meets the following requirements:

	CMS-2RA		HFE-200RA	
	Min.	Max.	Min.	Max
Test on Emulsion (AASHTO T 59)				
Viscosity @ 122°F., sec.	50	450	50	-
Sieve Test (%)	-	0.1	-	0.1
One Day Storage Stability (%)	-	1.0	-	1.0
5-90 Residue @ 500°F (%) *	60	-	65	-
Oil Distillate (%)	5	15	0	7
Charge	+ Pass		- Pass	
Test on Residue				
Penetration @ 77°F, cm/100 (AASHTO T 49)	100	250	200	350
5-90 Float Test @ 140°F, sec. (AASHTO T 50)	-	-	1,200	-
Solubility (%) (AASHTO T 44)	97.5	-	97.5	-

(b) Water - Water that conforms to the requirements of 233.11.

(Use the following paragraph when the Contractor will produce choke aggregate.)

(c) Choke aggregate - The material to be used as choke aggregate shall be either clean sand, crushed gravel or quarry rock free of clay, loam or other harmful substances and shall conform to the following:

Sieve Size	Percent Passing
3/8"	100
1/4"	95-100
10	20-40
40	6-18
100	0-5

If approved by the Engineer, crusher rejects may be used provided they do not create any excessive dust conditions.

(Use the following paragraph with Division-furnished material.)

(c) Choke aggregate - Choke aggregate will be furnished by the Division. Material to be used on this project is stockpiled on Division-controlled property located on Highway _____ at M.P. _____.

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(Use bracketed item when Equipment Option A is allowed.)

420.12 Recycled Asphalt Pavement (RAP):

(a) Option A - Recycled material removed from the existing asphalt pavement (using Equipment Option A) shall have a maximum size of 1-1/2 inches prior to entering the mixer unless otherwise directed by the Engineer. Any recycled material larger than 1-1/2 inches shall be separated by screening or other means, broken down by mechanical means to pass a 1-1/2-inch sieve and uniformly reincorporated with the balance of the recycled material.

4-89 **(Use following paragraph when Equipment Option B is allowed.)**

(b) Option B - Recycled material removed from the existing asphalt pavement using Equipment Option B shall have a maximum size of two inches. Incidental oversize may be allowed by the Engineer if it is not detrimental to the mixture or wearing surface. If the gradation is determined to be detrimental, the Contractor shall take such action necessary to correct the oversize problem. These actions may include reducing the milling speed, adjusting the crusher, changing screen size (when screens are used) or other such measures as may be necessary. Failure of the Contractor to be able to provide an acceptable product will cause a rejection of any unsuitable equipment.

420.13 Job Mix Formula (JMF) - The CIR asphalt concrete mixture shall consist of RAP from the existing pavement, recycling agent and water combined in the proportions designated by the Engineer. Variability in the composition of the RAP 5-90 material may require changes in the proportions of the constituents, as directed by the Engineer. Normally, the recycling agent content will be between 0.1 and 1.8 percent, by weight, and water between 1.0 and 3.0 percent by weight.

420.15 Process Control Testing - Process control sampling 5-89 and testing will be performed by the Engineer.

420.16 Acceptance of Mixture - The mixture will be accepted visually on the roadway following initial rolling subject to 420.39(c) Recompaction. Any mixture not acceptably mixed or that ravels shall be corrected by the Contractor as follows:

- Any area showing an excess or a deficiency of 5-90 recycling agent shall be reprocessed or replaced.

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- If raveling occurs, immediate traffic control and additional rolling shall be provided.

Traffic control for rolling, reprocessing, or replacement shall be as directed by the Engineer. This work will be paid for at contract item prices as specified in 109.04A. Items of work not covered by contract items will be paid for as Extra Work. If the Engineer determines the excesses, deficiencies, or raveling are due to the Contractor's operations, the corrective work shall be done at the Contractor's expense.

5-90

Equipment

420.23 Asphalt Concrete Pavers - Pavers shall be:

(a) Self-contained, power-propelled units, supported on tracks or wheels, none of which contact the mixture being placed.

(b) Equipped with augers and an activated screed or strike-off assembly, heated if necessary, which:

- Provides the same augering, screeding, and heating equipment to extensions used on travel lanes as to the rest of the paver.
- Can spread and finish AC in specified widths, thicknesses, lines, grades, and cross section.
- Will not segregate, tear, shove, or gouge the AC.
- Produces a finished surface to specified evenness and textures.

(c) Equipped with a paver control system which:

- Automatically controls AC placement to specified slope and grade.
- Automatically maintains the paver screed in proper position.
- Provides specified results through a system of mechanical sensors and sensor-directed devices that are actuated from independent line and grade control references.

420.24 Compactors - The Contractor shall provide either steel-wheeled, pneumatic-tired, or vibratory rollers capable of reversing without backlash, as specified.

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(a) Steel-wheeled rollers - Steel-wheeled rollers shall have:

- A gross static weight of at least 8 tons.
- A static weight on the drive wheel of at least 250 pounds per inch of width.

If used for finish rolling:

- A gross static weight of at least 6 tons.
- No drivewheel static weight requirement.

(b) Vibratory rollers - Vibratory rollers shall:

- Be equipped with amplitude and frequency controls.
- Be specifically designed to compact AC.
- Be capable of at least 2,000 vibrations per minute.

5-90 If used for finish rolling:

- Have a gross static weight of at least 6 tons.

5-90 - Not be operated in the vibratory mode.

(c) Pneumatic-tired rollers - Pneumatic-tired rollers shall:

- Be self-propelled, tandem, or multiple axle, multiple wheel type.
- Have smooth-tread, pneumatic tires of equal size.
- Have tires staggered on the axles, spaced and overlapped so uniform compacting pressure is provided for the full compacting width.
- Be capable of exerting ground pressure of at least 80 pounds per square inch of tire contact area with a minimum total load of 2800 pounds per tire.

(Use bracketed item when single unit option is allowed.)

420.26 Equipment Options A and B:

Equipment Option A-Recycling Train - (Under this option the) existing pavement shall be recycled using a recycling train consisting of the following major components: (a) Planing machine or grinder, (b) crusher and (c) pugmill mixer.

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(a) Planing machine or grinder - The existing pavement shall be removed by a self-propelled planing machine having a minimum 144-inch wide rotary cutter and capable of removing the existing pavement to a depth of four inches in a single pass.

The unit, also, shall be capable of accurately establishing profile grades within a tolerance of 0.02 foot by reference from either the existing pavement or from independent grade control and shall have a positive means for controlling cross slope elevations. The equipment shall incorporate a totally enclosed cutting drum with replaceable cutting teeth and shall have an effective means for removing excess material from the surface and for preventing dust from escaping into the air. The use of a heating device to soften the pavement will not be permitted.

The unit shall be equipped to discharge water into the
5-90 mixing chamber, with fully variable control and meter capable of measuring the rate of feed within five gallons per minute.

(b) Crusher - The crusher shall be of the portable type capable of reducing the oversized RAP materials to the specified size.

(c) Pug mill mixer - The CIR asphalt concrete mixture shall be mixed in a pug mill type plant capable of providing a
5-90 mix of RAP, recycling agent and water to uniform proportions as designated by the Engineer.

The pug mill shall be equipped with a liner to prevent build-up of materials during the mixing operation.

Mixing plants shall be equipped with a positive control linking the RAP, recycling agent and water feed in a manner that will maintain a constant ratio of each constituent. The plant
5-90 shall be equipped with facilities so that the Contractor can verify and calibrate the RAP, recycling agent and water quantities by a method acceptable to the Engineer.

The RAP shall be measured by weight and the recycling agent and water may be proportioned by either weight or volume. The equipment shall be capable of feeding and maintaining a constant
5-90 rate of RAP feed within a tolerance of plus or minus 5 percent (by weight) or the designated amount and a constant rate of recycling agent and water feeds within plus or minus 0.2 percent (by weight) of the designated amounts.

The mixing plant shall be equipped with positive displacement pumps and a computerized metering system which can accurate-
5-90 ly meter the amount of recycling agent and water. The pumps shall be interlocked belt weighing system that measures the quantity of RAP material entering the mixing plant. The interlock shall be designed so that recycling agent and water cannot be added until RAP material enters the mixer. Overrides of the

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interlock system shall be equipped with short duration timers to prevent their continuous use. Overrides shall be used only during start-up periods.

5-90 The belt weighing device and computerized-metering system shall have readouts that indicate the quantity in tons of RAP, water and recycling agent being fed into the mixer at any given time. Totalizer readouts shall also be provided to allow determination of accumulative quantities of each constituent.

(Use following four paragraphs when single unit option is allowed.)

Equipment Option B - Single Processing Unit:

Under this option the existing pavement shall be processed using a planing machine meeting all of the requirements of a planing machine under "Equipment Option A".

5-90 In addition, the planing machine shall be capable of adding recycling agent and water to the RAP in amounts directed by the Engineer to produce a uniform mixture.

5-90 Positive displacement pumps which can accurately meter the planned amount of recycling agent and water into the pulverized asphalt concrete shall be used. The pumps shall be interlocked to the movement of the machinery used to apply the recycling agent and water to provide that no recycling agent or water can be added when the machinery is not moving.

5-90 The recycling agent and water feeds shall have positive readout capabilities so that the amount of recycling agent and water in tons incorporated into at any given time can be read directly. Totalizer readouts shall also be provided to allow determination of accumulative quantities of water and recycling agent used in the mixture.

5-90 (d) Recycling agent, storage and heating tanks - Storage tanks shall be equipped with accurate volume measuring devices or manufactures calibration charts for each storage tank and a thermometer for measuring the temperature of tank's contents.

Between the storage tanks and the liquid asphalt mixing device or recycling equipment, a parallel piping filter system with at least one filter per line shall be used. Filters shall 5-90 be capable of eliminating solid or semisolid particles from the recycling agent liquid.

Each filtering line shall be equipped with on-off valves and changeable filter elements.

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5-90 The recycling agent shall be routed alternately through each filter line for a period of two to four hours, and alternate filters changed on the same frequency unless otherwise directed by the Engineer.

5-90 Loads of recycling agent which break prematurely in the storage tanks or haul vehicles or which cause frequent plugging of the filters as determined by the Engineer will be rejected for use.

Construction

420.31 Season and Weather Limitations - In-place recycling of existing asphalt concrete pavement shall not begin until the pavement surface temperature is 70°F and rising. The construction of CIR asphalt concrete pavement will not be allowed before May 15 or after August 1, except the Engineer may approve a start-up prior to the pavement surface temperature reaching 70°F under the following conditions:

- The Contractor requests such an early start in writing;
- The Contractor assumes all financial responsibility for correction of raveling problems with the CIR mixture during the early start period. This includes, but is not limited to, the cost of complete recycling, additional choke, rollers, pilot cars and flaggers, etc. as determined by the Engineer.

The Contractor shall stop milling work at the end of each day when the temperature of the mixture behind the paver drops below 90°F or three hours before sunset, whichever occurs first.

Pavement damaged by rain after placement shall be reprocessed, or repaired by other methods approved by the Engineer, at the Contractor's expense.

If recycling and placement operations are not completed by August 1, the Contractor will not be allowed to resume operations until May 15 of the following year.

420.32 Rate of Progress and Scheduling - The Contractor shall plan and schedule the recycle operation in such a manner that the materials are removed, mixed, replaced and the area open to traffic immediately after initial compaction is completed.

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All recycled areas shall be completely backfilled with reprocessed and compacted asphalt concrete materials so the area is open to two-way traffic during all hours of darkness.

420.33 Preparation of Underlying Surfaces - The Contractor shall:

(a) Panel recycling (less than 12' wide) with aggregate shoulders - Blade existing aggregates in shoulder areas away from milling operation so that shoulder aggregates are not mixed with pavement millings.

(b) All projects:

(b-1) Minimize the amount of fines on the milled surface that can be detrimental to a proper bond of the tack coat. If excess fines are on the milled surface, remove by brooming or other method acceptable to the Engineer.

(b-2) Just prior to windrowing the recycled pavement mixture, apply tack coat conforming to Section 407 of these special provisions to the entire profiled area including the vertical edges. Rates of application shall be as directed by the Engineer.

No separate measurement or payment will be made for blading or brooming work required for CIR work.

5-90 420.34 Heating Recycling Agent and Water - The temperature of the recycling agent prior to entry into the mixture shall be not less than 125°F nor more than 185°F.

5-90 The temperature of the water just prior to entry into the mixture shall be not less than 100°F.

420.35 Mixing - All the various required components of the asphalt concrete mixer shall be utilized and operated in a manner to assure compliance with this section.

5-90 The RAP, recycling agent and water shall be measured and introduced into the mixer in the amounts specified in the JMF and as designated by the Engineer.

5-90 Mixing shall continue until the recycling agent and water have been distributed throughout the RAP to form a uniformly coated mixture.

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420.37 Control of Line, Grade and Milling Depth - The line and grade reference control shall be a floating beam device of adequate length and sensitivity to provide adequate control on either or both sides of the paver.

Manual control of line and grade for the paver will be permitted when approved by the Engineer.

5-90 Milling shall be performed at the depth shown on the plans unless otherwise directed by the Engineer. Any area of pavement with deficient asphalt coating caused by excessive milling depth shall be replaced at the expense of the Contractor.

420.38 Spreading and Placing - Except for unavoidable delay or breakdown, recycling and placing recycled pavement by the paving machine shall be at a rate sufficient to provide continuous operation of the paving machine. If paving operations result in excessive stopping of the paving machine, as determined by the Engineer, recycling and paving operations shall be suspended until the Contractor can synchronize the rate of recycle with the capacity of the paving machines.

(a) General - The mixture shall be laid on an approved surface, spread and struck off to established grade and elevation. Specified asphalt pavers shall be used to distribute the mixture.

The asphalt mixture shall be deposited in a windrow, then picked up and placed in the asphalt paver.

The loading equipment shall be self-supporting and shall not exert any vertical load on the paving machine nor cause vibrations or other motions which could have a detrimental effect on the riding quality of the completed pavement. The loading equipment shall pick up substantially all of the material deposited on the roadbed and place it directly into the receiving hopper of the paving machine.

In areas where patching, irregularities or unavoidable obstacles make the use of specified equipment impracticable, the mixture may be spread with special hopper equipment with adjustable strike-off or by other equipment and means approved by the Engineer, provided the surface finish is within a tolerance of 0.01-foot of that hereinafter set forth.

420.39 Compaction:

(a) General - Immediately after the CIR asphalt concrete mixture has been spread, struck off and surface irregularities and other defects remedied, it shall be thoroughly and uniformly rolled until the mixture is compacted as specified.

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(a-1) Rolling - The CIR asphalt concrete mixture shall be compacted with rollers conforming to the requirements of 420.24. The type, number and weight of rollers shall be sufficient to compact the mixture.

Rollers shall move at a slow but uniform speed recommended by the manufacturer with the drive rolls or wheels nearest the paver. Vibratory rollers, when used in the vibratory mode, shall be operated at frequencies of at least 2,000 vibrations per minute. The maximum operating speed of pneumatic rollers shall be 5 MPH.

Normal rolling shall begin at the sides and proceed longitudinally parallel to the road centerline, each pass overlapping one-half the roller width, gradually progressing to the center. On superelevated curves the rolling shall begin at the low side and progress to the high side, each pass overlapping one-half the roller width. When paving is in echelon or when abutting a previously placed lane, the longitudinal joint shall be rolled first followed by the regular rolling procedure. Rollers shall not make sharp turns on the course being compacted and they shall not be parked on the fresh CIR mixture. Alternate passes of a roller shall terminate in stops at least five feet distant longitudinally from adjacent preceding stops.

(a-2) Surface repair - Any displacement of the mat regardless of thickness occurring as a result of the reversing of the direction of a roller, or from other causes, shall be corrected. Steel roller wheels shall be moistened with water or other approved material to the least extent necessary to prevent pickup of mixture.

When the rolling causes undue tearing, displacement, cracking or shoving the Contractor shall make changes in compaction equipment and/or rolling procedures necessary to alleviate the problem.

(b) Initial compaction - Compaction of the fresh CIR asphalt concrete mixture shall be performed with a minimum of two vibratory rollers. Rollers shall be operated in either vibratory or static mode as directed by the Engineer. The mixture shall be compacted with at least two passes by each roller and such additional passes as the Engineer may direct.

(c) Recompaction - After initial compaction and prior to recompaction, the CIR asphalt concrete pavement shall be opened to public traffic and allowed to cure. Recompaction shall be performed between 3 and 15 days after laydown when directed by the Engineer. Rolling shall not be performed when the surface temperature is less than 90°F.

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The entire recycled pavement area shall be recompacted with at least one steel wheeled roller and one pneumatic roller. Each roller shall make at least three passes and such additional passes as the Engineer may direct.

420.42 Joints:

(a) Drop-offs - Prior to any suspension of operations at the end of each shift, the full width of the area to be paved, including outside shoulders, shall be completed to the same elevation with no longitudinal drop-offs.

If unable to complete the pavement without longitudinal drop-offs as specified above, the Contractor shall, within the specified time constraints, construct and maintain a wedge of asphalt concrete at a slope of 10:1 or flatter along the exposed longitudinal joint located within the area to be paved. Longitudinal joints one inch or less will not require a wedge. The wedge shall be removed and disposed of prior to continuing paving operations. Construction, material, maintenance, removal and disposal of the temporary wedge shall be at the Contractor's expense.

Where allowable abrupt or sloped drop-offs occur within or at the edge of the paved surface the Contractor shall provide, at his expense, suitable warning signs as required under Section 111 of the Supplemental Standard Specifications.

(b) Finishing and details - Special care shall be taken at longitudinal joints to provide positive bond and to provide density and finish to new mixture equal in all respects to the mixture against which it is placed.

420.43 Pavement Smoothness:

(a) General - The top surface of CIR asphalt concrete pavement shall be tested with a 12-foot straightedge parallel to or perpendicular to the centerline, and shall not vary by more than 0.02 foot. The Contractor shall furnish the straightedge and operate it under the direction of the Engineer.

When utility appurtenances such as manhole covers and valve boxes are located in the traveled way and they are not required to be adjusted or are required to be adjusted before paving, this tolerance will not apply.

(b) Corrective action - When tests show the pavement is not within the specified tolerance, the Contractor shall take immediate action to correct equipment or procedures in his paving operation to eliminate the unacceptable pavement roughness.

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Any surface irregularities exceeding the specified tolerances shall be corrected by the Contractor within the period of 2 to 5 days following initial compaction using one of the following methods:

- Remove, replace or reprocess the surface course.
- Grind the pavement surface utilizing the planing machine or grinder as hereinbefore set forth to a maximum depth of 0.3 inch.

The cost of all corrective work, including traffic control and furnishing of materials, shall be performed at the Contractor's expense and no adjustment in contract time will be made for corrective work.

420.45 Choke Aggregate Placement - Immediately prior to the last roller coverage during initial compaction as hereinafter specified and before opening to traffic, the Contractor shall place choke aggregate at a rate of approximately 0.001 to 0.003 cubic yard per square yard. Choke aggregate shall be spread by a method that provides uniform coverage across the CIR mat. Any piles, ridges or uneven distribution of choke aggregate shall be eliminated by spreading and/or removing with hand tools or mechanical means as the Contractor elects prior to the final roll or coverage.

420.55 Shoulder Restoration - The Contractor shall restore the aggregate shoulder areas to their original condition in all areas where the aggregate was dislodged, moved, rutted, etc., due to milling and recycle work. Restoration shall include blading and leveling existing aggregate materials as directed by the Engineer.

No separate measurement or payment will be made for shoulder restoration work.

Measurement

5-90

420.81 Measurement - The number of square yards of CIR asphalt mixture shall be based on the paved widths and milled depths shown on the plans and the horizontal measurement along the centerline of the actual length of the pavement recycled.

No allowance will be made for pavement recycled in excess of the paved width and milled depth shown on the plans unless directed by the Engineer.

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No change in unit price per square yard will be made for depths deviating from plan depths unless the milled depth is deviated by more than plus or minus 1/4 inch from the nominal thickness called for by the plans and directed by the Engineer.
5-90 Where the Engineer directs construction of CIR asphalt concrete to a thickness other than plus or minus of 1/4 inch from the nominal thickness specified, these areas will be adjusted by converting in 1/4-inch increments to the equivalent number of square yards of nominal thickness on a proportionate volume basis above or below the specified tolerance limits.

For example, if the plans require a nominal depth of 1-1/2 inches and the Engineer directs a milling depth of 2-1/2 inches, the adjustment will be based on an additional 3/4-inch depth. (2-1/2" less 1-1/2" less 1/4" (tolerance) = 3/4" adjustment)

5-90 The quantity of recycling agent in the CIR asphalt concrete mixture to be paid for will be the number of tons used in the accepted mixture measured as set forth in 109.01.

The quantity of water used in the mixture will be measured as set forth in Section 233.

The quantity of choke aggregate to be paid for will be the
5-90 number of cubic yards (tons) actually spread on the CIR asphalt mixture at the rate specified, measured as set forth in 109.01.

Payment

420.91 Payment - Payment when made at the contract unit
5-90 price per square yard for the item "CIR Asphalt Pavement Mixture" will be full compensation for all equipment, labor and incidentals required to remove and pulverize the existing surfacing, and to mix the materials, place, compact and finish the work as specified.

Payment, when made at the contract unit price per ton for
5-90 "Recycling Agent in Recycled Mixture", will be full compensation for all costs of material, labor, tools and equipment necessary for the addition of the recycling agent.

(Use word "furnish" when Contractor is to supply choke aggregate.)

Payment, when made at the contract unit price per cubic yard (ton) for "Choke Aggregate", will be full compensation for all costs to (furnish,) haul and place choke aggregate as specified.

Payment for water used in the CIR asphalt concrete mixture will be made as set forth in Section 233 and will comprise full compensation for the water used in connection with the recycle work.

(See warning at beginning of SP420.)

SECTION 407 - ASPHALT TACK COAT

Delete Section 407 of the 1984 Standard Specifications and insert the following:

Description

407.01 Scope - This work shall consist of the furnishing of asphalt and the application thereof to a prepared asphalt concrete surface to ensure thorough bond between profiled asphalt 5-90 cement surface and CIR asphalt mixture. The tack coat shall be applied on the areas designated by the Engineer in accordance with these specifications.

Materials

407.11 Asphalt - The asphalt to be used in the tack coat shall be either CMS-2RA or HFE-200RA and shall meet the applicable requirements of 420.11(a). 5-90 The material may be conditionally accepted at the source or point of loading for transport to the project.

Emulsified asphalt in tack shall be diluted prior to application with 15 to 30 percent additional water conforming to the requirements of 233.11, as determined by the Engineer.

Construction

407.31 General - The tack coat shall be applied to the milled surface prior to the time the CIR asphalt mixture is 5-90 placed into the profiled area in a berm.

The tack coat shall be applied to the entire milled surface including the vertical edges.

407.32 Distribution Equipment - The asphalt shall be spread by means of a pressure distribution system capable of applying the tack coat uniformly on surfaces having widths of up to 13 feet at readily determined and controlled rates from 0.05 to 2.0 gallons per square yard with uniform pressure, and with an allowable variation from any specified rate not to exceed 0.05-gallon per square yard.

Distribution system equipment shall include pressure gauges, accurate volume measuring devices or a calibrated tank and a thermometer for running temperature of tank contents. The distribution system shall have a power unit for the pump and a full circulation system for the tank and spray bar.

The spray bar shall be capable of being easily adjustable vertically and laterally.

407.33 Application Rate - Normally, the diluted emulsified asphalt shall be applied to the milled surface at a rate of 0.05-0.20 gallon/sq.yd. as directed by the Engineer.

Measurement

407.81 General - Asphalt used as directed in the asphalt tack coat will be measured by the ton as set forth in Section 109.

Payment

407.91 General - The accepted quantity will be paid for at the contract price per ton for the item "Asphalt in Tack Coat". The water in the tack coat will be measured and paid for in accordance with 233.81 and 233.91.

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