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30 YEAR REPORT
ON THE
EXPERIMENTAL TREATMENT OF THE SUBSOIL
UNDER A PORTLAND CEMENT CONCRETE PAVEMENT
IN
SOLANO COUNTY - BETWEEN DENVERTON AND RIO VISTA
III-SOL-53-B

T. E. Stanton
Materials and Research Engineer

May 1951

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30 YEAR REPORT ON THE EXPERIMENTAL TREATMENT OF THE SUBSOIL UNDER A PORTLAND CEMENT CONCRETE PAVEMENT IN SOLANO COUNT - BETWEEN DENVERTON AND RIO VISTA III-SOL-53-B

Reported by T. E. Stanton, Materials and Research Engineer
May, 1951

During 1921-22 twelve sections of poor subgrade material under a Portland cement concrete pavement then under construction on Route 53, Solano County, were experimentally treated with admixtures of Portland cement, hydrated lime, limestone and bitumen in connection with a study of suitable methods for stabilizing adverse subgrades. There was likewise an untreated gravel base.

The subgrade treatment was by day labor under Contract D-411 preliminary to the construction of a 5" x 15' reinforced Portland concrete pavement under Contract 289.

The reinforcing consisted of 5/8" transverse bars on 18" centers with 1/2" longitudinal bars 3" from each edge.

The pavement was widened by 8" x 3' crushed gravel widening strips over which an armor coat was placed in 1937. Prior to the war portions of the section were blanketed with plant-mix. The remainder developed many failures under heavy hauling during the war and required repair immediately thereafter. Asphalt subsealing with a bituminous blanket was required for the worst portions while patching and sealing were adequate for the remainder.

A 1-1/2" blanket of open graded plant-mix was placed over

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seriously failed portions after sub-sealing with 20-30 asphalt.

A rather complete condition report was made by former Materials and Research Engineer C. L. McKesson in 1924.

Because the 1924 condition survey did not indicate that any of the subgrade treatments had been effective, interest in the study ceased. However, because of the present policy of frequently treating subgrades with portland cement it was recently decided that an investigation should be made of the condition after 30 years of a cement treated soil, even though the soil on the above project was of such an adverse nature that it is not in any sense comparable with soils now considered suitable for processing.

The current investigation consisted of coring some of the treated sections and making laboratory tests on the recovered subgrade material, including moisture determinations.

The coring was done during April, 1951 and the results are herein reported.

Included with this report is a copy of a report by Assistant Highway Engineer C. W. Clawson of this department, who had charge of the field work; likewise Table showing the laboratory tests on the soil (Table 2).

The coring disclosed that the original construction had been so poorly conducted that none of the subgrade could be considered as having been treated in the manner contemplated.

The mixing processes had been so crude that there was little apparent intimate mixture of the treatment materials with the underlying soil.

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In the case of the P.C. treatment, almost pure portland cement was found in thin lenses or strata, without any apparent evidence that the soil adjacent to the lenses contained any appreciable percent of cement.

In a few cases where the mixing had been reasonably well done the mixture was in reasonably good condition, adobe or clay balls being bound together with a soil cement matrix.

The original P.C. Base averaged less than the design thickness (5") and some cores did not disclose a thickness of more than 4".

Therefore, in so far as being a test of the longtime performance of a properly constructed treated subgrade, the test was a failure.

On the other hand, there was considerable evidence that where the cement was properly incorporated there was no deterioration of the cement-soil mixture during the 30 year period under observation.

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M E M O R A N D U M

April 6, 1951

TO: T. E. Stanton

FROM: C. W. Clawson

SUBJECT: Cores from X-sol-53-B

In accordance with your instructions, cores were cut on April 3, 4 and 5, 1951, from various sections of Road X-Sol-53-B, on which various types of stabilization methods were attempted. As originally outlined, cores were to be taken from all sections in which cement was used as a stabilizing agent. This schedule was revised by you on the job on April 3, however, to include cores from only those sections in which 10% of cement was added plus the section in which asphalt was used and also the section in which hydrated lime was used.

Cores of the present surfacing, the underlying P.C.C. pavement and cores of the material stabilized by various methods were attempted. A few of the cores of stabilized material recovered were fair but for the most part, the attempts to core the base material were not successful. Samples of the material in the stabilized bases were recovered however, for inspection and such tests as are required by the Laboratory.

As originally planned, moisture samples were taken of the adobe soils underlying the various stabilized areas. A total of four (4) pint jars were taken at each location, two of which are for moisture determinations and combined with the other two jars should provide enough material for grading, plastic and

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liquid limit tests, if required.

Conditions encountered at each section varied widely and given below are brief notes taken at each area cored:

Section B - Asphalt treated subgrade, 12" thickness, Station 283 to 278, Cores AZ-6 and AZ-7

Oil Mix and P.C.C. cores were good. Core AZ-7 had reinforcing steel in the core. Cores of the base material were fairly good, with several large sections recovered. Thickness varied from 11-1/4" in Core AZ-6 to 12" in AZ-7. The material had a distinct odor of asphalt when recovered. Moisture samples were taken from 22" to 26" below the pavement surface.

Section C - 10% cement treated subgrade, 12" thickness, Station 263+50 to Station 258+50, Cores AZ-4 and 5

Oil Mix and P.C.C. cores were good. Cement treated subgrade cores were generally good with several fairly large sections recovered. P.C.C. at Core hole AZ-4 had been subsealed with air-blown asphalt and this melted during the cutting of the subgrade core. Thickness varied from 11" to 12". Moisture samples were taken from 20" to 24" below pavement.

Section A - 10%cement treated subgrade, 6" thickness, Station 253+50 to Station 248+50, Cores AZ-1, 2 and 3

Oil mix and P.C.C. cores were good. Cement treated cores from AZ-1 and 2 were quite poor and crumbled badly. A third core, AZ-3, was cut and the cement treated material core was better than the first two. Thickness varied from 6" to 6-1/2". Moisture samples were taken from 15" to 19" below pavement surface.

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Section 5 - 5% Hydrated lime treated subgrade, 12" thickness, Station 222+00 to Station 217+00, Cores AZ8 and AZ-9.

Oil Mix on Core AZ-8 broke up between present surfacing and P.C.C. AZ-9 oil mix core was good. P.C.C. in AZ-8 was good but in AZ-9, P.C.C. was broken close to a piece of reinforcing steel. Cores of the subgrade material were fair and varied from 5-1/2" to 7-1/2" in thickness. No evidence of treatment below these depths could be detected. Moisture samples were taken from 15" to 20" below pavement surface.

Section 3 - 10% cement treated subgrade, 6" thickness, Station 199+00 to Station 194+00, Cores AZ-10 and 11

The top course of oil mix in both cores was good. Below the present surfacing, an open graded oil mix broke up during coring. P.C.C. core at core hole AZ-10 was good, but at AZ-11 was shattered in several pieces. Reinforcing steel was cut in taking Core AZ-10. From the bottom of the P.C.C. pavement, a 5 to 5-1/2" layer of sandy loam and fine gravel was encountered. Little evidence of any cement in the layer was found, most of it washing away during coring. 5 to 5-1/2" below the bottom of the P.C.C. pavement, a well cemented layer of fine sand and gravel from 1/2" to 1" thick was encountered. This material appeared to be cement and fine gravel and was quite hard. Below the layer is a rather sandy adobe clay layer with no evidence of cement in it. Moisture samples were taken from 15" to 20" below pavement surface.

Section 1 - 10% cement treated subgrade, 12" thickness, Station 177+50 to Station 182+50, Cores AZ-12 and AZ-13.

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Oil Mix and P.C.C. cores were good. AZ-12 had reinforcing steel in it. Core taken at core hole AZ-13 was in one piece, Oil mix and P.C.C. together. Both cors had a layer from 3/4" to 7/8" thick on the bottom of the P.C.C. of what appeared to be a low cement content concrete. This same material was found for a total thickness of from 5-5/8" to 6-1/2" below the P.C.C. pavement. In both core holes below the low cement content layer, adobe soil was encountered. Under this layer at core hole AZ-13, was a 1/4" to 3/8" thick layer of air-blown asphalt. Moisture samples were taken from 16" to 20" below pavement surface.

At no location on the road was the specified 5" thickness of P.C.C. encountered.

A tabluation of cores, thickness and condition is attached.

Charles W. Clawson
Assistant Highway Engineer

CWC:fp
Attachment

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TABLE I

Core No.	Section Fig. 1	Station	Thickness Found			Type of Treatment	Remarks	No. Job Samples of Mtl. under Subgr. Mtl.
			O.M. Surface	P.C.C. Base	Treated Subgrade			
AZ 1	A	250+02	2-3/4"	4-1/4"	6-1/2"	10% Cmt 6" thick	OM & PCC cores good. 1/4" Air blown asphalt subseal under PCC - CTB core very poor-crumbled.	4
AZ 2	A	251+85	3"	4-1/4"	6-1/2"	same	OM & PCC cores good. No Asphalt subseal under PCC. CTB core poor - crumbled.	4
AZ 3	A	251+81	3"	4"	6"	same	OM & PCC cores good. No asphalt subseal. CTB core is fair.	--
AZ 4	C	259+52	3"	4-1/4"	12"	10% cmt. 12" thick	OM & PCC cores good. 1/4" air blown sub-seal under PCC. CTB core dry. CTB core fr.	4
AZ 5	C	260+83	3"	4-3/4"	11"	same	OM & PCC cores good. CTB core fair-one lge. section recovered.	4
AZ 6	8	280+00	4-5/8"	4-3/8"	11-1/4"	Asphalt Treated 12" thick	OM core good. PCC core broken, reinforcing steel in core. Fairly good core of asphalted treated subgr. matl.	4
AZ 7	8	281+00	4	4-1/4"	12"	same	OM core good. PCC core broken, contained re-inforcing steel, fairly good sections of core of asphalt treated subgr. matl.	4

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TABLE I CONT'D -2-

Core No.	Section Fig. 1	Station	Thickness found O.M. Surface	P.C.C. Base	Treated Subgr.	Type of Treatment	Remarks	No. Job Smpls. of Mt. under Subgr. Mtl.
AZ 8	5	220+50	3	4-3/4"	7-1/2"	5% Hydr. lime 12" thick	Good Core - Top course OM. second course broke up- PCC core good. Treated subgr. matl. core in fairly good cond.	4
AZ 9	5	218+86	3-1/4"	4-1/4"	5-1/2"	Same	Good OM core. PCC core broken near a section of reinf. stl. Fair core of tr. Subgr. matl.	4
AZ 10	3	197+35	2-3/8"	4-1/4"	6"	10% cmt. 6" thk.	Top course OM gave good core. Open gr. OM broke up in coring-no core. PCC core shattered in several pieces. Sandy clay loam and gr. to 5" below btm. PCC. No core. Then very hard layer 1/2"-1" thk.well cmt. and.sand. grvl. looks like cmt. and fine grl.	4
AZ 11	3	196+24	2-3/4"	4-1/4"	6	10% ctm. 6" thk.	OM Core good. PCC core shattered. Same cond. below btm. of PCC pavement as in AZ-10.	4
AZ 12	1	180+00	2"	4-1/4"	5-5/8"	10% cmt. 12" thk.	OM & PCC cores gd. Reinf. stl. in PCC 3/4" to 1" of bse. on PCC core. Base seems to be low cmt.content conc. only 5-5/8" thk. Adobe cly below.	4

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TABLE I CONT'D -3-

Core No.	Section Fig. 1	Station	Thickness Found			Type of Treatment	Remarks	No. Job Samples of Mtl. under Subgr. Mtl.
			O. M. Surface	P.C.C. Base	Treated Subgrade			
AZ 13	1	178+70	1-3/4"	4-1/2"	6-1/2"	same	OM & PCC cores good in 1 core. Same CTB as in 12. only slightly thicker. 3/4" -7/8" on base of PCC. 1/4" air blown asphalt under CTB.	4

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X-Sol-53-B

TEST DATA SUMMARY SHEET

TABLE - 2

Sample No. and Test No.	Material	Grading Analysis-% Pass						Bearing Ratio					Wt. Per Cu.Ft.	% Exp.	% H_2O Comp.	P.I.	% Moisture as Rec'd.
		#30	#50	#200	#270	5 M	1 M	0.1"	0.2"	0.3"	0.4"	0.5"					
AZ-1 51-1378	Basement Soil	100	99	92	91	47	22										
	10% C.T. Sg.							9	9	8	7	7	110.8	10.5	20.3	32 17	29.2
AZ-2 51-1379	Soil Basement	95	87	62	58	16	4									10	30.6
	10% C.T. Sg.							17	16	15	14	14	114.6	3.1	16.2	12	
Az-4 51-1380	Basement Soil	99	98	83	80	46	25									21	22.5
	10% C.T. Sg.							5	5	5	4	4	123.6	9.1	12.8	25	
AZ-5 51-1381	Basement Soil	99	97	78	74	38	23									17	20.0
AZ-6 51-1382	Basement Soil	99	98	89	86	55	33									43	26.1
	Asph. Tr. Sg.							8	8	11	15	20	119.8	6.5	10.5	58	
AZ-7 51-1383	Basement Soil	99	98	89	87	55	35									40	23.2
AZ-8 51-1384	Basement Soil	100	99	92	90	53	32									29	22.9
	5% Hyd. Lime Tr. Sg.	[illegible]						9	9	8	8	8	116.2	4.7	15.6	16	

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TEST DATA SUMMARY SHEET

TABLE - 2 CONTD.

Smple No. and Test No.	Material	Grading Analysis-% Pass						Bearing Ratio					Wt. Per Cu.Ft.	% Exp.	% H_2O Comp	P.I.	% Moisture as Rec'd.
		#30	#50	#200	#270	5 M	1 M	0.1"	0.2"	0.3"	0.4"	0.5"					
AZ-9 51-1385	Basement Soil	100	99	95	93	51	25									30	27.6
	5% hyd. Lime tr. Sg.							7	8	8	7	7	116.1	5.7	14.9	16	
AZ-10 51-1386	Basement Soil	96	94	72	65	35	19									19	20.7
	10% CT.Sg.							6	7	6	6	6	123.8	6.5	12.5	20	
AZ-11 51-1387	Basement Soil	98	95	73	68	39	22									20	24.0
	10% C.T.Sg.							19	17	15	14	14	121.8	2.8	13.9	14	
AZ-12 51-1388	Basement Soil	99	98	79	74	44	30									25	21.4
AZ-13 51-1389	Basement Soil	100	98	84	81	41	22									22	25.8

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FIGURE I

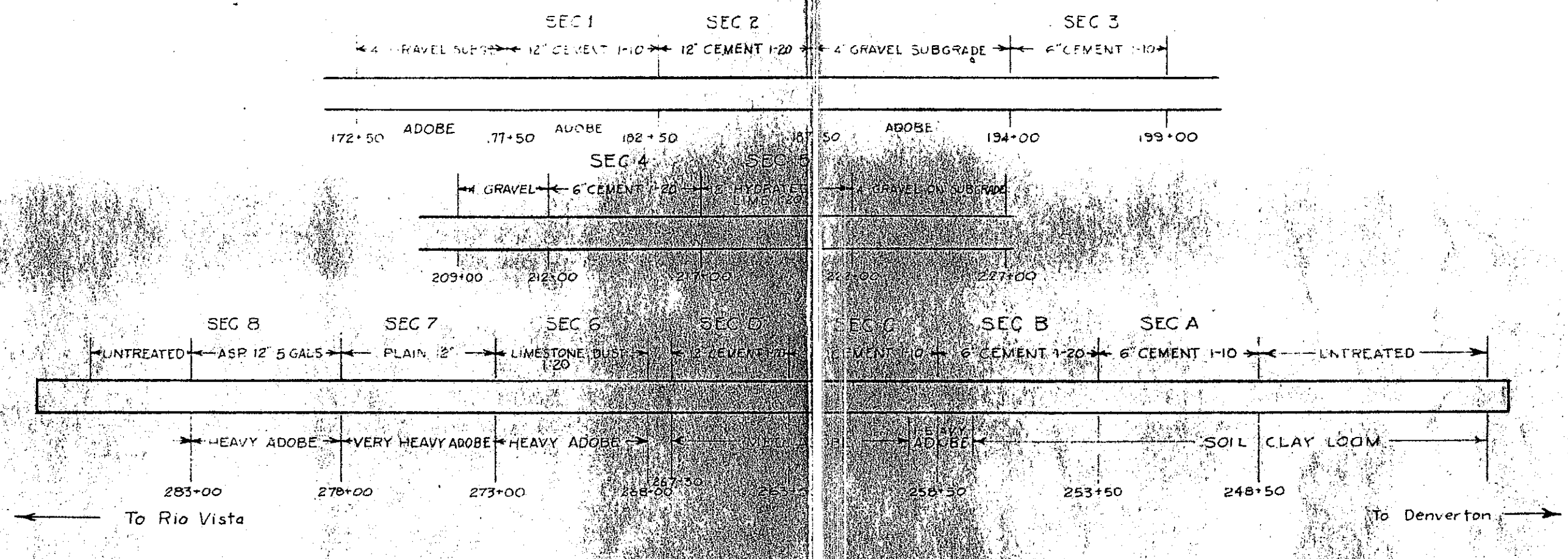

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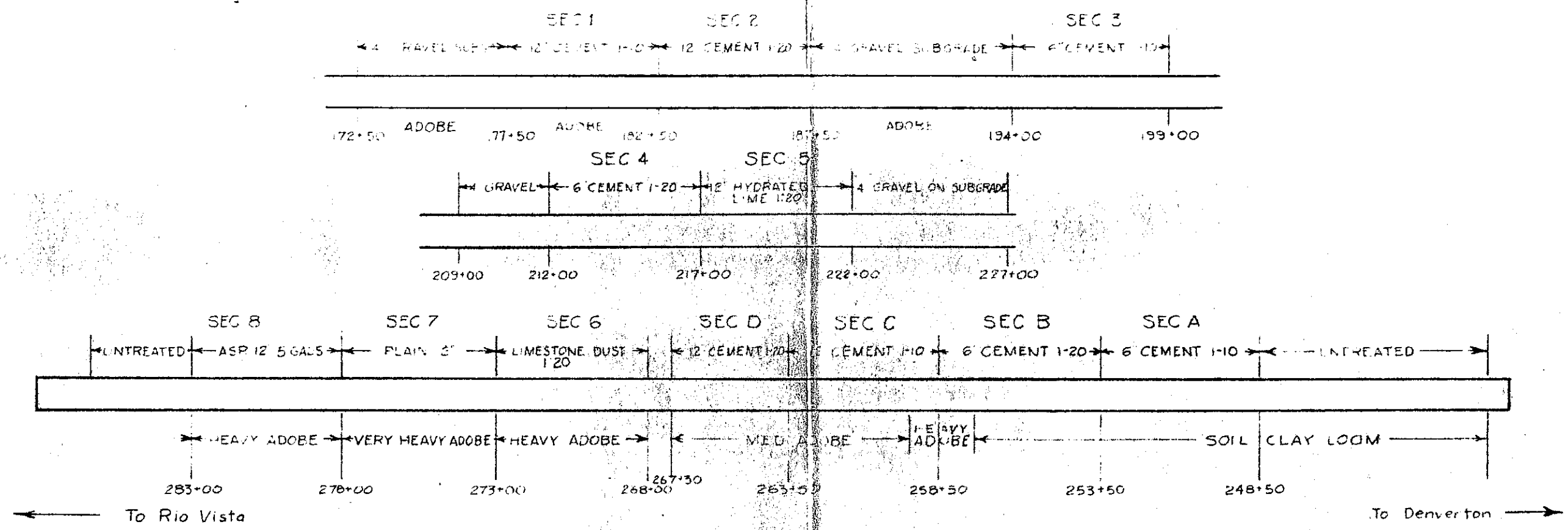
FIGURE I



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