State of California 5066 Business and Transportation Agency

Memorandum

To : Mr. D. L. Spellman

Date: May 11, 1970

File : M&R No. 645195

From : Mr. J. H. Woodstrom
Department of Public Works—Division of Highways

Subject: Project on Consistency Loss Between Plant and Paver

This is a final report on the project entitled "Consistency Loss Between Plant and Paver."

This project was started July 1969, to investigate reported excessive losses of concrete between central mix plants and slip-form pavers. Special emphasis was placed on finding a project where the phenomenon of false set may have been involved; however, none was found to a degree detrimental to concrete placement. The variables which were measured and recorded to determine their effect on consistency loss were aggregate source, cement content, type of admixtures used, temperatures of the air and the concrete, haul distance, wind velocity, relative humidity, length of time between mixing and placing on the grade, and cement source.

In all, there were 16 series of measurements taken on seven different paving contracts. Each series of measurements consisted of obtaining the above indicated data on five different trucks leaving the plant and measuring the penetration and the concrete temperature in concrete from the same trucks when deposited on the grade.

The number of series of tests on any one project varied from one series to five series. The penetration loss varied from no loss in one series, to as much as 1-1/4-inch loss in another series. However, the average loss for the entire study was 1/2-inch. On no project was the loss found to be excessive, and all concrete that was tested was adequately handled by the slipform pavers.

The four variables which appeared to have the most effect were haul distance, relative humidity, ambient temperature, and concrete temperature. These variables were prepared for computer analysis and statistical evaluations were made. Other factors, such as cement source, aggregate source, cement setting characteristics, did not appear to have a great effect. Correlation of the four variables statistically evaluated with reference to penetration loss were, in general, very poor. This may have been caused by

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the limited amount of data. The best correlation was found to be in the temperature of the concrete. Correlation in this case was found to be 0.52. It would not be realistic from the limited data obtained to state that control of concrete temperatures within certain limits would result in control of consistency. However, one project had problems with consistency loss causing the concrete to hang up in the dump trucks and having to be washed out. When the concrete was below 85°F, this problem was reduced considerably, and if the concrete was above 85°, the problem was compounded considerably.

On a project where there was a very minimal amount of penetration loss, the haul was approximately the same as on the project where the maximum penetration loss was observed; however, the concrete was covered with tarps on the former, which may have had an effect. The haul in either case was approximately 10 miles and time between mixing and placing was 30 minutes.

The test data is given in Table 1 and the plots of the four variables against penetration loss that were analyzed statistically are given in Figures 1 through 4.

Mr. Leigh Spickelmire of the Construction Department and the investigators, Mr. Jim Coan and Mr. Carl Sundquist, have discussed the data and are in agreement that it is of no value to continue the study along the lines presently pursued. Therefore, this project will be discontinued. It was decided however, to contact all area construction engineers and if a job with excessive consistency loss can be found, the same test procedure would be used on this project and would be done under contract control rather than as research.

Cooperation of the State personnel and the Contractor's personnel was excellent with the exception of a project on Highway 8 in Imperial County. The work was arranged through the Operations Engineer and the Resident Engineer on the job. Two series of tests were planned on this project, and in the middle of the second series, the Contractor on the job, Mr. J. Matich, stopped the testing.

Approximately $3300 have been spent on this project, and it can be closed out at this time.

Original Signed
J. H. WOODSTROM

J. H. Woodstrom
Senior Materials and Research Engineer

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cc: LSSpickelmire
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Attachments

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TABLE I

Consistency Loss Test Data

Haul Dist. (Mi.)	Ambient Temp. (°F)	Relative Humidity (Percent)	Wind Vel. (MPH)	Plant Data Conc. Temp. (°F)	Plant Data Avg.* Pen. (In.)	Street Data Conc. Temp. (°F)	Street Data Avg.* Pen. (In.)	Avg. ** Pen. Loss (In.
Project 10-Mer-152								
5-1/2	90	39	0-2	---	1-1/4	85	5/8	5/8
5-1/2	102	27	0-2	86	1-5/8	86	1	5/8
5	82	41	3-5	80	1-1/4	81	7/8	3/8
Project 02-Sis-5								
10.8	73	45	0-2	79	2	80	1-1/8	1
10.8	88	42	0-2	82	1-7/8	83	1-1/8	3/4
10	54	60	0-2	77	1-3/8	77	1	3/8
10	61	60	0-2	78	1-5/8	79	7/8	3/4
Project 03-Sac-880/80								
10.3	78	43	0-2	80	1	80	1	0
10.3	99	27	3-5	84	1-1/8	86	7/8	3/8
Project 04-Ala-580								
3	76	44	0-8	77	1-1/8	77	3/4	3/8
3	87	35	0-4	79	7/8	80	3/4	1/8
Project 06-Kin,Fre-5								
4.4	62	36	0-2	70	7/8	71	3/4	1/4
4.4	71	38	0-2	74	1-1/8	73	7/8	1/4
Project 09-Ker-58-90.0/103.4								
3.1	49	76	10-14	70	1-1/8	70	1-1/8	0

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Project 11-Imp-8								
2	65	22	0-2	67	1-1/8*	68	5/8*	1/2**
2	77	20	0-2	67	***1-3/8	69	7/8*	1/2****

* Average of fifteen readings.
** Average penetration loss for five trucks.
*** Average of twelve readings.
**** Average penetration loss for four trucks.

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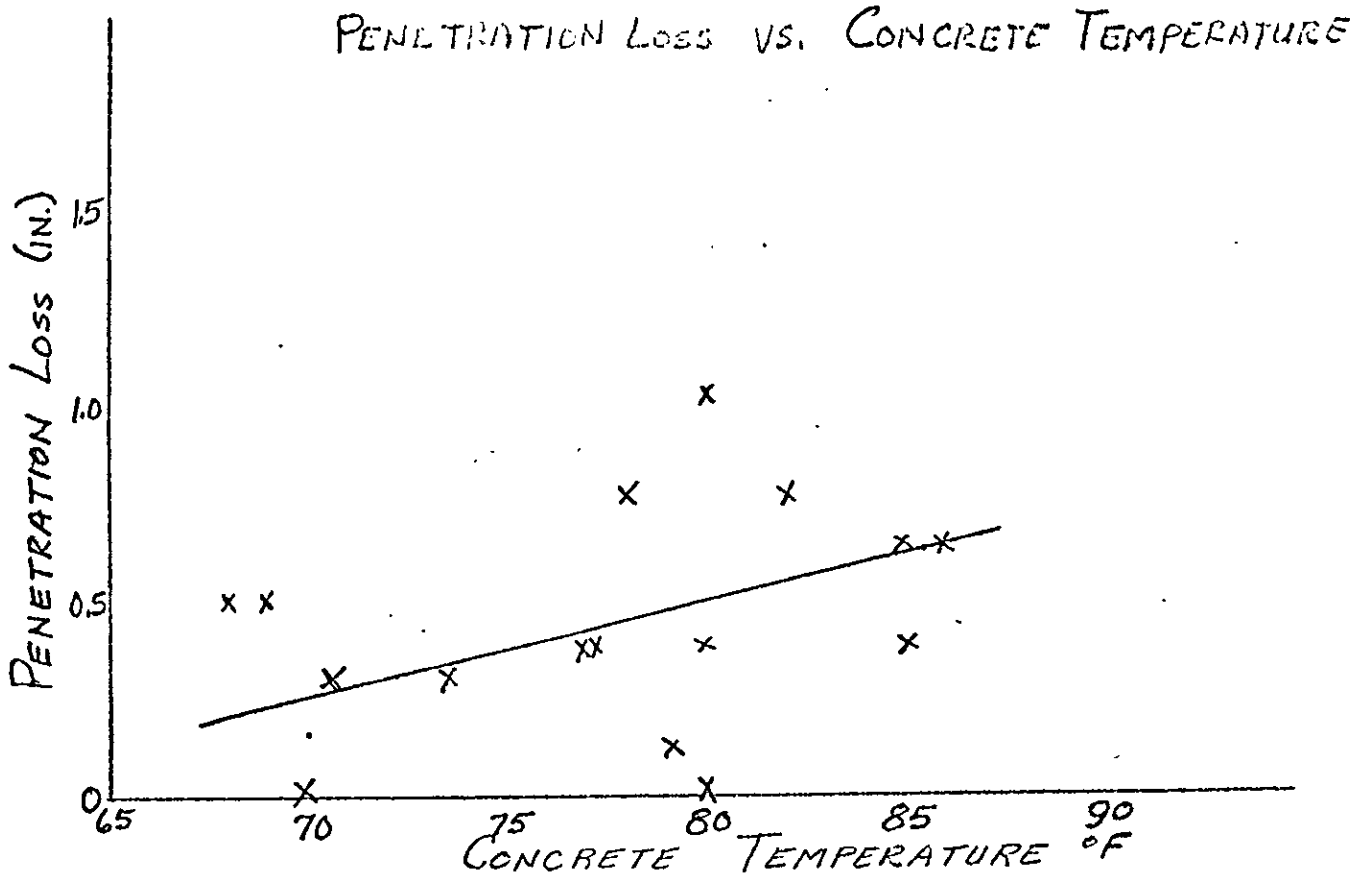

FIGURE 1

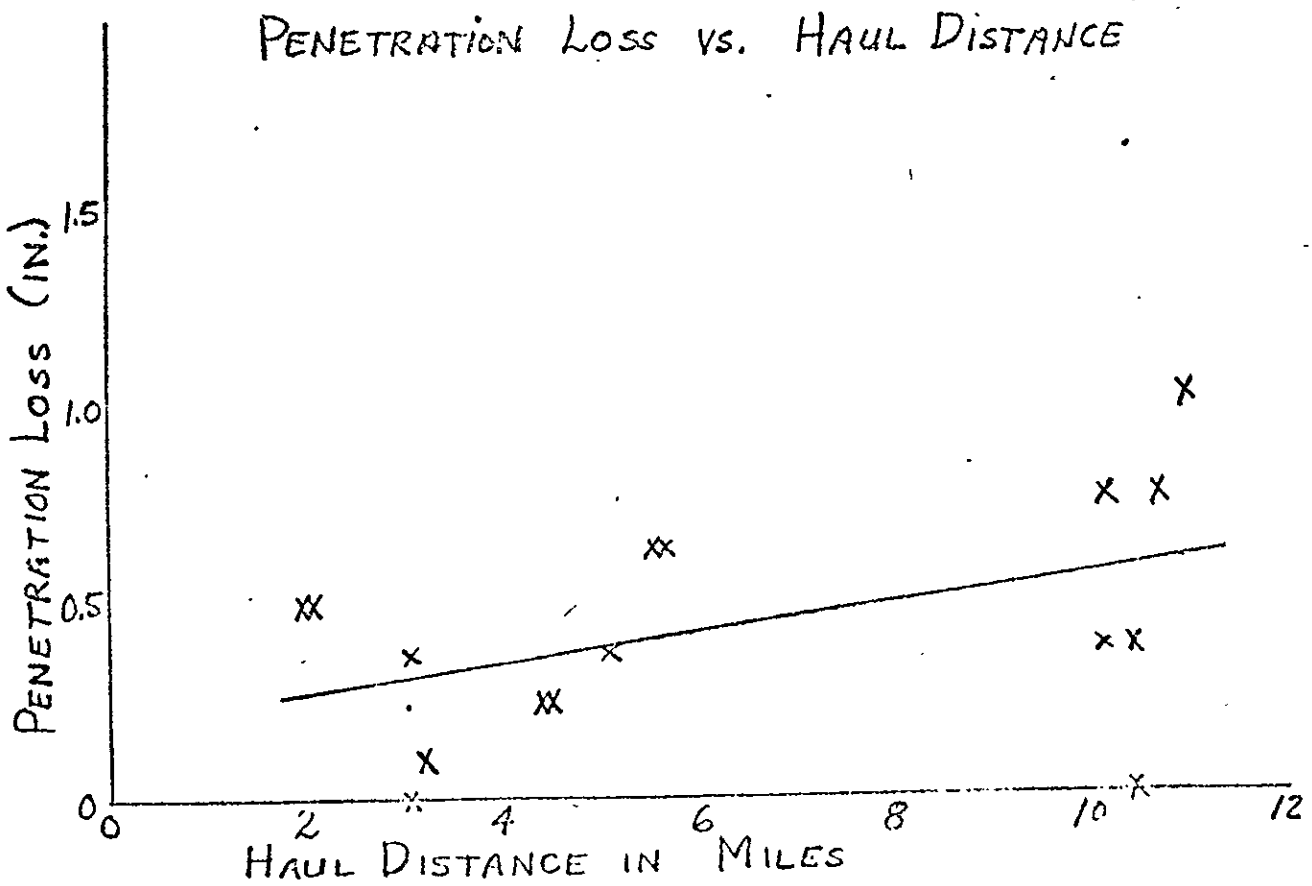

FIGURE 2

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PENETRATION LOSS VS. RELATIVE HUMIDITY

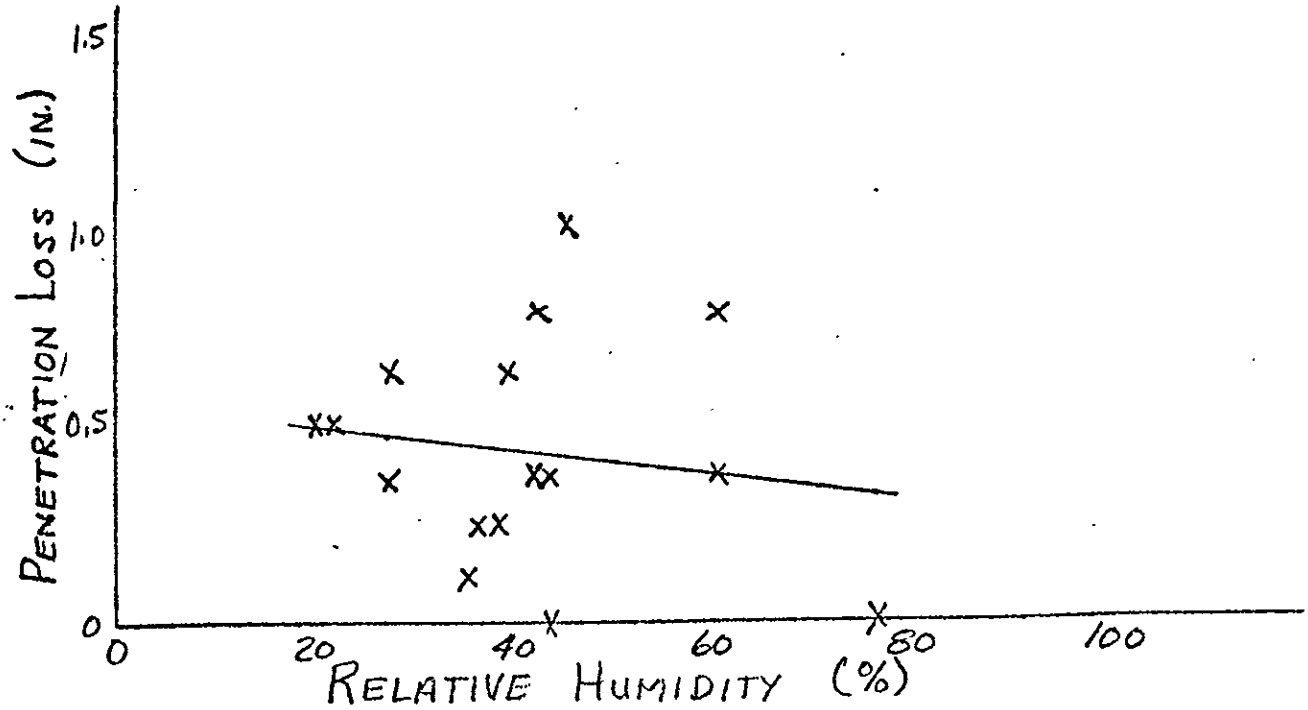

FIGURE 3

PENETRATION LOSS VS AMBIENT TEMPERATURE

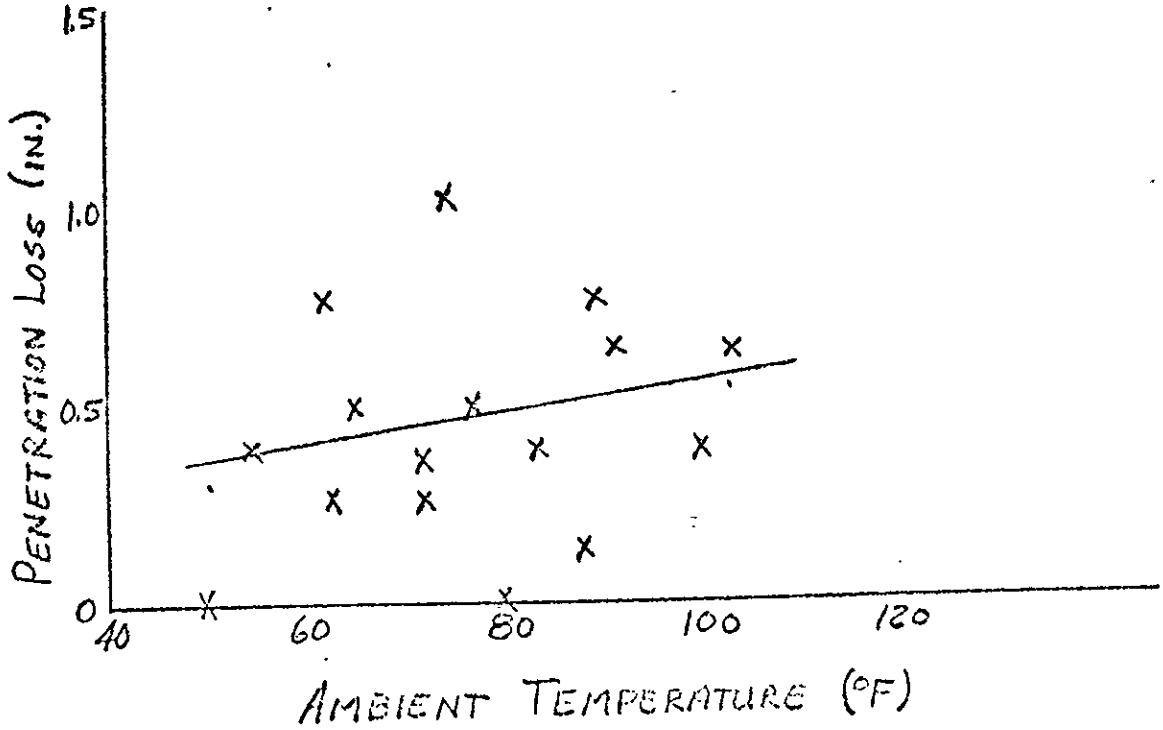

FIGURE 4.

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