MICHIGAN
STATE HIGHWAY DEPARTMENT
Charles M. Ziegler
State Highway Commissioner

PERFORMANCE AND COST INFORMATION RELATIVE TO MICHIGAN EXPERIMENT IN SNOW AND ICE REMOVAL BY RADIANT HEAT

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PERFORMANCE AND COST INFORMATION RELATIVE TO MICHIGAN EXPERIMENT IN SNOW AND ICE REMOVAL BY RADIANT HEAT

This is a second progress report on the experimental heated pavement project located on M-102 at the west limits of Ferndale, a suburb of Detroit. The report describes the performance of the system during the winter of 1948-49 and includes operating costs as furnished by the Detroit Public Lighting Commission. Complete installation details are covered in Research Laboratory Report No. 120 and, therefore, they will not be repeated here.

The Detroit Public Lighting Commission completed installation of wiring and electrical equipment and had the system in operation by the 1st of December, 1948. During the month of December, the system was practically in constant operation to check performance of the system and make necessary adjustments in electrical circuits in order to obtain the desired wattage per square foot in the heating grid. Records on snow and ice melting started December 12, 1948.

Comments on Performance

In general, the system performed very satisfactorily considering the unusually light snow and ice conditions which were experienced this past winter. Unfortunately, however, as far as the experiment is concerned, Michigan did not have a normal winter season and, therefore, it is impossible to know how satisfactory the method would work under typical winter conditions.

Figures 1 and 2 show both the heated concrete and bituminous sections during a sleet storm. Note how areas over heating elements are free of ice. Figures 3 to 10 show how the heated pavement appeared during snow storms. In all cases, the melted area did not extend beyond the limits of the heating element. Since the experimental sections were practically

flat as to grade, water from the melting snow and ice was displaced by moving traffic, whereas, in a normal installation, drainage would be provided to prevent splashing and carry over of free water.

In the bituminous section, several spalled areas appeared over the heating elements. See Figure 8. These spalled areas are due to displacement of patches placed during construction. The contractor experienced some trouble in installing grids between courses in the bituminous surface. Similar conditions can be overcome on future installations by observing certain precautions while placing and rolling bituminous material over the grids.

No difficulty was encountered in placing the heating elements in the concrete section or subsequent to it.

Cost of Operating System

The Detroit Public Lighting Commission has furnished complete costs for electric power consumed during snow and ice conditions starting with December 12 and extending to the last snow fall on March 19, 1949. Complete cost data for operation of the heating system for 1948-49 winter season are presented in Table I.

These data also disclose that the power consumption on the bituminous section was approximately nine per cent more than that for the concrete section. The matter of increased power consumption on the bituminous section is being given further consideration because it is not certain whether it might be due to inherent thermal properties of the materials or installation and operating conditions, or a combination of both factors.

A summary of maintenance costs for snow and ice removal on four maintenance sections on Eight Mile Road is presented in Table II. This information will serve for comparing operating costs of the two methods of

snow and ice removal. In Table III, an attempt has been made to arrive at comparative cost figures in terms of cost per hour of operation and cost per mile of two-lane pavement. The cost per hour per equivalent section for snow and ice removal on Eight-Mile Road by normal maintenance methods for the past winter season is .012 dollars as compared to $1.31 by the electric methods and, on a "per mile" basis, the costs are $64.65 and $7058 respectively.

Practical Considerations

In the event that the method becomes an actuality in ramp construction on the John Lodge or Edsel Ford Expressways, the following facts must be considered relative to estimated operating costs for 1000-ft. heated sections which, it is understood, will be approximate length of ramp sections.

In the first place, according to the Weather Bureau, the normal snowfall for Detroit is 39.7 inches. The snowfall for the 1948-49 winter was 10.3 inches, or approximately one-third. Therefore, under normal winter conditions, it can be expected that the total cost for electricity for a normal winter season will be slightly higher than the cost shown in Table III. The duration of the storm is more important than the depth of snow since cost is dependent on time of operation rather than depth of snow.

Secondly, any possible changes in power rates must be considered. Finally, if it should be desirable to increase the area of heating grids to provide a greater width of bare pavement surface, the heating cost would, of course, increase in proportion.

With these facts in mind, it seems reasonable to expect that it would cost approximately $1,000 to $1500 to heat a 1,000-ft. ramp under normal winter conditions at Detroit Public Lighting Commission's rate, using the same grid area as that contained in the experimental project.

TABLE I

SUMMARY OF OPERATING CONDITIONS AND COSTS FOR PAVEMENT HEATING EXPERIMENT ON EIGHT MILE ROAD, DETROIT

Data furnished by Detroit Public Lighting Commission

SYSTEM IN OPERATION From	To	Operating Time in Hours	CONCRETE SECTION Energy Consumed	Total Cost P.L.C. rate	BITUMINOUS SECTION Energy Consumed	Total Cost P.L.C. rate	Cost per hour	Snowfall in inches	Average Mean Temp. F.
DECEMBER									
2:00AM 12/12/48	2:00PM 12/13/48	36.00	1440*		1440*			Sleet	40
5:50PM 12/28/48	1:30PM 12/30/48	43.65	1150		740			0.50	35
Summary for December		79.65	2590	60.52	2180	51.30	1.40	0.50	
JANUARY									
10:15AM 1/ 4/49	1:20PM 1/ 4/49	3.08	60		-			Sleet	40
10:45AM 1/ 6/49	12:30AM 1/ 7/49	13.75	340		200			T	37
5:55AM 1/10/49	1:40PM 1/10/49	7.75	240		-			T	32
11:15AM 1/18/49	1:30PM 1/18/49	2.25	No reading		-			T	41
5:20PM 1/23/49	6:00AM 1/24/49	12.66	340		160			0.1	34
4.35PM 1/25/49	12:00PM 1/31/49	163.42	4030		5240			4.5	23
Summary for January		202.91	5010	114.92	5600	125.07	1.18	4.6	
FEBRUARY									
12:01AM 2/ 1/49	10:35AM 2/ 2/49	34.58	950		1240			T	19
4:30PM 2/ 3/49	4:10PM 2/ 4/49	23.66	820		680			2.7	28
12:56PM 2/10/49	9:35AM 2/11/49	20.65	820		1080			0.2	22
4:02PM 2/21/49	7:26AM 2/22/49	15.40	520		340			T	32
1:12AM 2/28/49	12:Noon 2/29/49	34.80	430		430			0.2	24
Summary for February		129.09	3540	81.90	3770	87.07	1.31	3.1	
MARCH									
12:01AM 3/ 1/49	1:00PM 3/ 1/49	13.00	690		1030			0.1	20
10:07AM 3/ 2/49	1:35AM 3/ 3/49	15.46	460		280			T	28
6:30AM 3/10/49	1:20PM 3/11/49	30.83	580		800			1.3	27
3:12PM 3/16/49	8:25AM 3/17/49	17.21	240		680			0.4	25
8:16PM 3/18/49	1:45PM 3/19/49	17.48	700		680			0.3	23
Summary for March		93.98	2670	62.32	3470	80.32	1.52	2.1	

*Estimate by Detroit Public Lighting Commission T = Trace

TABLE II

SUMMARY OF SNOW REMOVAL AND ICE CONTROL COSTS ON EIGHT MILE ROAD

SEASON 1948 - 49

(Data Submitted by Maintenance Division)

SECTION	ITEM OF WORK	LABOR	MATERIAL	EQUIPMENT	TOTAL	LENGTH (Miles)
M 102-1	Snow Removal	$ 43.06	$	$ 26.19	$ 69.25	7.50
	Ice Control	240.83	1028.41	155.06	1424.30	
	TOTAL	283.89	1028.41	181.25	1493.55	
M 102-2	Snow Removal	$ 4.57	$	$ 5.12	9.69	2.10
	Ice Control	199.93	127.92	41.05	368.90	
	TOTAL	204.50	127.92	46.17	378.59	
*M 102-3	Snow Removal	$ 33.98	$	$ 41.14	75.12	7.20
	Ice Control	189.47	870.54	140.11	1200.12	
	TOTAL	223.45	870.54	181.25	1275.24	
M 102-4	Snow Removal	$ 42.81		$ 48.96	91.77	1.70
	Ice Control	71.84	146.60	38.84	349.05	
	TOTAL	114.65	146.60	87.80	440.82	

AVERAGE LABOR RATES - WAYNE COUNTY

1948 - 49

Laborer I - 1.47) - (Common Labor)
Laborer II - 1.57) - (Common Labor)
Laborer III - 1.65) - (Semi-Skilled)

Skilled Laborer - 2.24

Average Rate per hour - $1.73

*Maintenance Section containing heating experiment

April 29, 1949
Leon Luke

TABLE III

COMPARATIVE COST DATA FOR SNOW AND ICE CONTROL

REGULAR MAINTENANCE VERSUS RADIANT HEAT

Regular Maintenance Costs

Maintenance Section No.	Labor Cost -Table II- Dollars	Hours of Operation*	Total Maintenance Costs -Table II- Dollars	Cost per hour Dollars	Length of Sections in Miles	Equivalent Length of Two Lane Highway in Miles	Cost 1 Mile Two Lane Highway - Dollars
102-1	283.89	164	1493.55	9.11	7.5	22.5	66.4
102-2	204.50	118	378.59	3.21	2.1	6.3	60.1
102-3	223.45	129	1275.24	9.88	7.2	21.6	59.0
102-4	114.65	66	440.82	6.68	1.7	5.1	86.4
TOTAL	826.49	477	3588.20		18.5	55.5	
UNIT COSTS			$\frac{3588.20}{477} = 7.52$			$\frac{3588.20}{55.5} = 64.65$	

* Determined by dividing Labor Cost by Average hourly rate of $1.73 as determined in Table II.

Radiant Heating Costs for Experimental Section

D.P.L.C. rate	- -	505.63	663.43	1.31	0.094	0.094	7085.00

FIG. 3. CONCRETE SECTION. TYPICAL CONDITION OF SNOW COVERED PAVEMENT AT ENDS OF HEATED AREAS.

FIG. 4. CONCRETE SECTION. MELTED AREAS IN FOREGROUND, SALTED AREA IN BACK AND PARALLEL.

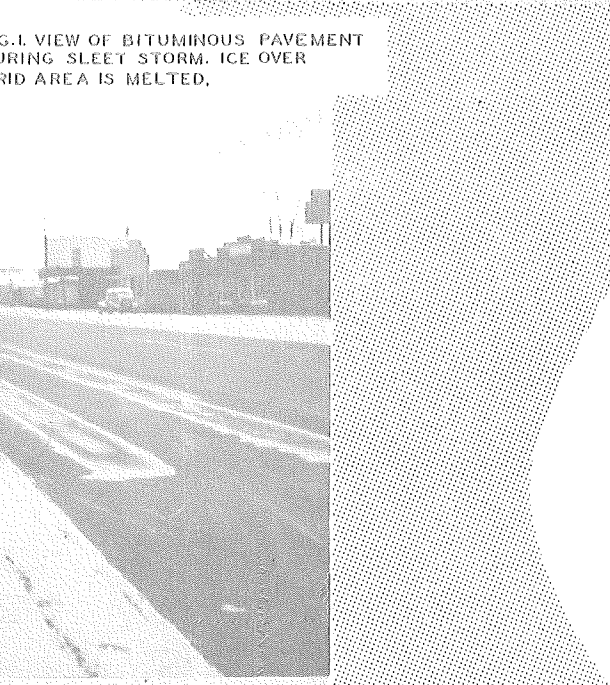

FIG. 1. VIEW OF BITUMINOUS PAVEMENT DURING SLEET STORM. ICE OVER GRID AREA IS MELTED.

FIG. 2. VIEW OF CONCRETE PAVEMENT DURING ICE STORM. NOTE ICE IS MELTED OVER GRID.

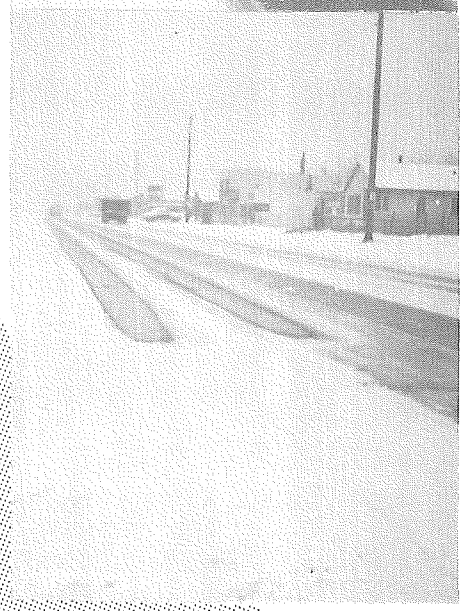

FIG. 5. CONCRETE SECTION. HEATED AREAS FREE OF SNOW. SNOW COVERING SALTED AREA IN BACKGROUND.

FIG. 8. BITUMINOUS SECTION, NOTE SPALLED AREA OVER HEATING ELEMENT. ELEMENT IS EXPOSED, DUE TO BULGING AND MOVEMENT OF WIRE GRID DURING CONSTRUCTION.

FIG. 9. BITUMINOUS SECTION. HEATED AREA CLEAR; BALANCE OF SURFACE COVERED WITH SLUSH. 1-26-49.

FIG. 6. CONCRETE SECTION DURING ICY CONDITION, NOTE BARE SURFACE OVER HEATING ELEMENTS, BARE AREA SAME WIDTH AS ELEMENTS - 18 INCHES. NOTE UNMELTED AREA AT JOINTS 12-12-48

FIG. 10. CONCRETE SECTION. UNDER SAME SNOW CONDITIONS AS IN FIG. 9. 1-26-49.

FIG. 7. CONCRETE SECTION. SIMILAR CONDITIONS AS MENTIONED UNDER FIG. 6. 12-12-48.