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# THE NEWS LETTER

OF THE

## BUREAU OF PUBLIC ROADS

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OCTOBER, 1928

A. C. ROSE, EDITOR

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## SNOW-REMOVAL REPORT FOR THE WINTER OF 1927-28

CONTRIBUTED BY H. G. MCKELVEY OF THE DIVISION OF CONSTRUCTION

COMPILED PRINCIPALLY FROM DATA COLLECTED FROM THE 36 STATE  
HIGHWAY DEPARTMENTS WITHIN THE HEAVY-SNOWFALL AREA

DURING THE WINTER OF 1927-28 SNOW WAS REMOVED FROM 111,645 MILES OF MAIN HIGHWAYS IN THE 36 STATES LYING WITHIN THE AREA OF HEAVY-SNOWFALL, ACCORDING TO REPORTS OF THE AUTHORITIES IN CHARGE OF THE WORK RECEIVED BY THE BUREAU OF PUBLIC ROADS. THE TOTAL COST OF THE SERVICE AS REPORTED, WAS SLIGHTLY IN EXCESS OF FIVE MILLION DOLLARS, AVERAGING APPROXIMATELY \$45 A MILE.

REVIEWING THE SNOW-REMOVAL REPORTS OF THE PAST SEVERAL SEASONS IT APPEARS THAT THE INITIAL RAPID EXTENSION OF MILEAGE CLEARED IS AT AN END AND THAT HEREAFTER INCREASE IN MILEAGE WILL BE LIMITED MAINLY TO THE ADDITION OF NEWLY IMPROVED ROADS. AS SHOWN BY TABLE 1, THE MILEAGE OF THE PROGRAM DURING THE PAST SEASON EXCEEDED THAT OF THE PREVIOUS YEAR BY ONLY 4.6 PER CENT, AS COMPARED WITH A GAIN OF 15 PER CENT A YEAR AGO AND INCREASES OF 50 PER CENT OR MORE IN EACH OF THE SEVERAL PREVIOUS YEARS.

THE SAME GENERAL TENDENCY IS TO BE OBSERVED IN RESPECT TO THE TOTAL COST OF THE SNOW-REMOVAL PROGRAM - AN INCREASE OF LESS THAN 9 PER CENT IN THE LAST YEAR AS COMPARED WITH INCREASES OF 24, 106, AND 93 PER CENT RESPECTIVELY IN THE THREE PRECEDING YEARS.

THE AVERAGE COST PER MILE CLEARED DURING 1927-28 WAS ABOUT 4 PER CENT GREATER THAN THE AVERAGE COST OF THE PREVIOUS YEAR, WHICH IN TURN REPRESENTED AN ADVANCE OF NEARLY 8 PER CENT OVER THE COSTS OF THE PRECEDING SEASON. SINCE THE WINTER OF 1925-26, THE EXPENDITURE PER MILE HAS INCREASED ONLY FROM \$40.38 TO \$45.18. IN THE THREE YEARS PREVIOUS TO THE SEASON OF 1925-26 THE COST PER MILE WAS LESS THAN \$30.

AS THERE IS LITTLE DOUBT THAT THE WORK OF REMOVAL HAS BEEN CONDUCTED WITH INCREASING EFFICIENCY EACH YEAR, THE INCREASE IN COST PER MILE PROBABLY REFLECTS A TENDENCY - ONCE THE BENEFITS OF CLEARING HAVE BEEN DEMONSTRATED - MORE AND MORE COMPLETELY TO REMOVE THE SNOW THAT FALLS. UNDOUBTEDLY THE WORK DONE AT AN AVERAGE COST OF \$45.18 A MILE IN 1927-28 REPRESENTED A MUCH MORE COMPLETE SERVICE THAN THAT WHICH IN 1922-23 WAS DONE AT A COST OF \$28.12 A MILE. IN THIS CONNECTION IT MAY BE OBSERVED THAT THE REPORTS FOR THE PAST SEASON INDICATE THAT THE SNOWFALL IN 22 OF THE 36 STATES WAS UNUSUALLY LIGHT. HAD THE PRECIPITATION IN THESE STATES BEEN HEAVIER THE AVERAGE COST PER MILE FOR THE LAST YEAR WOULD DOUBTLESS HAVE BEEN HIGHER.

*[The page contains extremely faint and illegible text, likely bleed-through from the reverse side of the document. The text is scattered across the page and does not form any recognizable words or sentences.]*

TABLE 1.- SNOW-REMOVAL MILEAGE AND EXPENDITURES IN THE 36 HEAVY-SNOWFALL STATES DURING THE FIVE-YEAR PERIOD FROM 1923 TO 1928

WINTER	TOTAL MILEAGE OF ROADS CLEARED OF SNOW	INCREASE OVER PRECEDING YEAR	PER CENT	TOTAL COST OF SNOW REMOVAL	INCREASE OVER PRECEDING YEAR	PER CENT	AVERAGE COST PER MILE	INCREASE OVER PRECEDING YEAR	PER CENT
1922-23	27,096			\$ 762,159			\$ 28.12		
1923-24	41,302	52	52	946,262	24	24	22.91	-18.5	-18.5
1924-25	62,167	50	50	1,826,813	93	93	29.39	28.3	28.3
1925-26	93,006	50	50	3,757,663	106	106	40.38	37.4	37.4
1926-27	106,721	15	15	4,641,037	24	24	43.50	7.7	7.7
1927-28	111,645	4.6	4.6	5,043,779	8.7	8.7	45.18	3.9	3.9

Date	Particulars	Debit	Credit
1880	To Balance		
1881	By Balance		
1882	By Balance		
1883	By Balance		
1884	By Balance		
1885	By Balance		
1886	By Balance		
1887	By Balance		
1888	By Balance		
1889	By Balance		
1890	By Balance		
1891	By Balance		
1892	By Balance		
1893	By Balance		
1894	By Balance		
1895	By Balance		
1896	By Balance		
1897	By Balance		
1898	By Balance		
1899	By Balance		
1900	By Balance		



IN THE SIX YEARS SINCE THE FIRST SNOW-REMOVAL REPORT WAS ISSUED THERE HAS BEEN A STEADY IMPROVEMENT IN THE MACHINES AND EQUIPMENT AVAILABLE FOR THE WORK AND AN INCREASING AMOUNT OF EQUIPMENT HAS BEEN EMPLOYED IN EACH SUCCESSIVE YEAR. THE LATTER FACT IS INDICATED BY TABLE 2. SINCE 1922 THE NUMBER OF TRUCK PLOWS IN USE HAS MULTIPLIED OVER 18 FOLD - FROM 184 TO 3,412. THE NUMBER OF TRACTOR PLOWS HAS INCREASED IN THE SAME PERIOD FROM 281 TO 1,275. THE FACT THAT THE TOTAL NUMBER OF BOTH TYPES OF PLOWS - 4,687 IN 1927-28 - MULTIPLIED MORE THAN 11 FOLD IN THE SIX-YEAR PERIOD DURING WHICH THE MILEAGE OF ROAD CLEARED INCREASED ONLY ABOUT 4 FOLD IS ANOTHER INDICATION OF THE GREATER COMPLETENESS OF REMOVAL. THE USE DURING THE PAST SEASON OF LESS THAN HALF THE NUMBER OF GRADERS EMPLOYED DURING THE PREVIOUS YEAR SEEMS TO INDICATE THAT THE GRADER HAS BEEN FOUND LESS EFFECTIVE THAN THE TRUCK AND TRACTOR PLOWS.

#### TREND TOWARD STATE CONTROL

IN 17 OF THE 36 STATES IN WHICH SNOW WAS CLEARED FROM THE HIGHWAYS IN 1927-28, ALL WORK DONE WAS UNDER THE SUPERVISION OF THE STATE HIGHWAY DEPARTMENT. IN 15 OTHER STATES WORK WAS DONE BY BOTH THE STATE AND THE COUNTIES OR OTHER LOCAL GOVERNMENTS. IN SOME OF THESE STATES THE STATE HIGHWAY DEPARTMENT COOPERATED WITH THE LOCAL AUTHORITIES, IN OTHERS THE COUNTIES INDEPENDENTLY CLEARED CERTAIN ROADS UNDER THEIR JURISDICTION AND SO ADDED TO THE MILEAGE CLEARED BY THE STATE. IN ONLY 4 STATES IN 1927-28 WAS THE WORK DONE SOLELY UNDER LOCAL CONTROL.

IN 1922-23, THE FIRST YEAR FOR WHICH REPORTS WERE RECEIVED, THE WORK WAS DONE EXCLUSIVELY BY THE STATE IN 11 STATES, BY BOTH THE STATE AND THE LOCAL GOVERNMENTS IN ONE STATE, AND EXCLUSIVELY BY THE LOCAL GOVERNMENTS IN 8 STATES. SINCE THAT YEAR THERE HAS BEEN A STEADY TREND TOWARD INCREASED ACTIVITY BY THE STATE AND DECREASED ACTIVITY BY THE LOCAL GOVERNMENTS AS INDICATED BY TABLE 3.

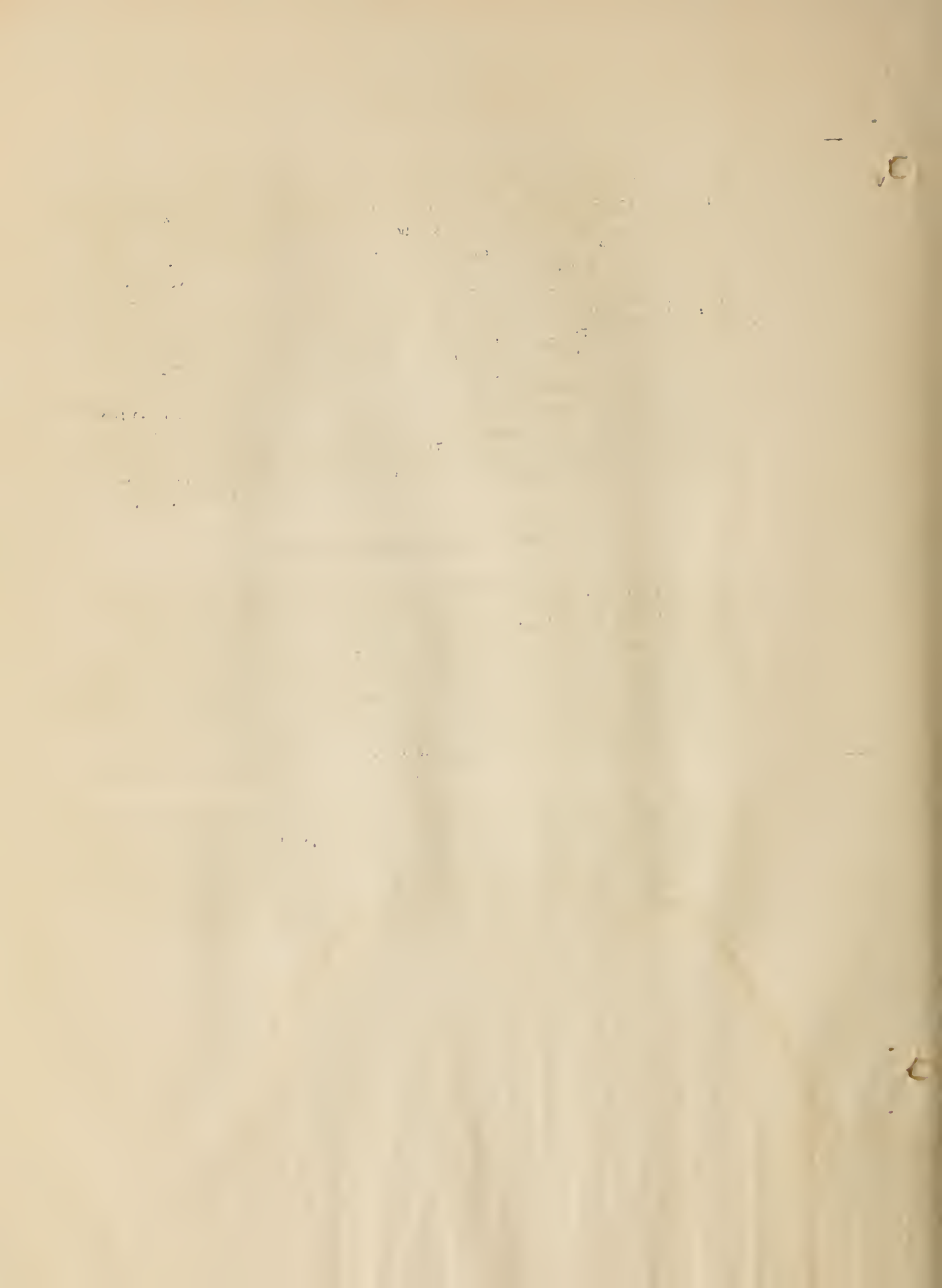




TABLE 2.- EQUIPMENT USED IN SNOW-REMOVAL OPERATIONS IN THE 36 HEAVY-SNOWFALL STATES DURING THE SIX-YEAR PERIOD FROM 1922 TO 1928 BEGINNING WITH THE WINTER OF 1922-23

WINTER	NUMBER OF:			INCREASE			NUMBER OF:			INCREASE			TOTAL NUM-:			INCREASE			MISCELLANEOUS EQUIPMENT							
	TRUCK	PLOWS	PRECEDING YEAR	OVER PRECEDING YEAR	TRACTOR	PLOWS	PRECEDING YEAR	OVER PRECEDING YEAR	TRUCK AND TRACTOR	BER OF TRACTOR	PRECEDING YEAR	OVER PRECEDING YEAR	TRUCKS	TRACTORS	GRADERS	TRUCKS	TRACTORS	GRADERS	TRACTORS	PLOWS	PRECEDING YEAR	OVER PRECEDING YEAR	TRACTORS	PLOWS	GRADERS	
			PER CENT				PER CENT				PER CENT										PER CENT					
1922-23	184				281				405																	
1923-24	1,227	567	46	287	30	10	274	1,514																		
1924-25	1,456	19	1	446	55	15	26	1,902																		
1925-26	2,546	75	3	803	80	24	76	3,349																		
1926-27	2,827	11	0	1,069	33	12	16	3,896																		
1927-28	3,412	21	0	1,275	19	7	20	4,687																		

1. The first part of the document discusses the importance of maintaining accurate records. It emphasizes that proper record-keeping is essential for ensuring the integrity and reliability of the data collected. This section also outlines the various methods used to collect and analyze the data, highlighting the challenges faced during the process.

2. The second part of the document focuses on the results of the study. It presents a detailed analysis of the data, showing the trends and patterns observed. The findings indicate that there is a significant correlation between the variables studied, which supports the hypothesis of the research. The authors also discuss the implications of these findings for future research and practice.

3. The third part of the document provides a conclusion and summarizes the key points of the study. It reiterates the importance of the research and the need for further investigation in this area. The authors express their gratitude to the funding agencies and the participants who made the study possible.

4. Finally, the document includes a list of references and a bibliography. These references provide a comprehensive overview of the literature related to the study, allowing readers to explore the topic in greater depth. The references are carefully selected to represent the most relevant and recent work in the field.

TABLE 3.- CONTROL OF SNOW REMOVAL

WINTER	NUMBER OF STATES		
	CONTROL EXCLUSIVELY BY STATE	CONTROL BY STATE AND LOCAL GOVERNMENTS	CONTROL EXCLUSIVELY BY LOCAL GOVERNMENTS
1922-23	11	1	8
1923-24	21	2	13
1924-25	21	3	12
1925-26	14	16	4
1926-27	10	19	7
1927-28	17	15	4

Table with 3 columns and 10 rows, containing faint text and numbers. The text is illegible due to blurriness.



## SNOW-REMOVAL COSTS

TO DETERMINE APPROXIMATELY THE COST OF SNOW REMOVAL, THE BUREAU OF PUBLIC ROADS HAS MADE A BRIEF STUDY DURING THE PAST YEAR OF THE EXPENDITURES IN THOSE STATES AND COUNTIES WHERE RECORDS WERE MOST READILY AVAILABLE. THE TERRITORIES SELECTED ARE FAIRLY REPRESENTATIVE, AND THEIR COSTS IN EACH CASE HAVE BEEN REDUCED TO A COST PER INCH-MILE OF SNOW REMOVED.

THESE FIGURES ARE NOT EXPECTED TO SUPPLY A RELIABLE SCALE WITH WHICH TO ESTIMATE THE COST OF SNOW REMOVAL FROM RURAL HIGHWAYS GENERALLY, BUT IT IS BELIEVED THAT THEY WILL SUGGEST WITHIN REASONABLE LIMITS, THE PROBABLE COST OF WORK OF THIS NATURE IN AREAS OF SIMILAR SNOWFALL AND TEMPERATURE AND LIKE WORKING CONDITIONS.

WHILE THE AVERAGE TOTAL DEPTH OF SNOWFALL OVER THE ENTIRE AREA DURING THE SEASON IS EMPLOYED IN CALCULATING THE COST PER INCH-MILE FOR ITS REMOVAL, IT IS WELL KNOWN THAT IT IS NEVER NECESSARY TO REMOVE ALL THE SNOW THAT FALLS. WHEN THE TEMPERATURE IS ABOVE THE FREEZING POINT DURING OR AFTER THE STORM THE SNOW MELTS RAPIDLY AND DOES NOT NEED TO BE REMOVED. ALSO IT IS THE PRACTICE IN MOST STATES NOT TO REMOVE SNOW WHICH FALLS TO DEPTHS OF LESS THAN 2 INCHES. FOR THESE AND SIMILAR REASONS THE COSTS PER INCH-MILE REPORTED HEREAFTER ARE PROBABLY LOWER THAN THE TRUE COSTS OF THE WORK ACTUALLY PERFORMED.

HOWEVER, IT WILL BE OBSERVED THAT THE COSTS REPORTED IN MANY INSTANCES INCLUDE CAPITAL INVESTMENTS WHICH RIGHTLY SHOULD BE CHARGED TO THE WORK OF SEVERAL YEARS, BUT WHICH, BECAUSE OF THE INADEQUACY OF ACCOUNTING METHODS EMPLOYED, IT IS NOT POSSIBLE SO TO DISTRIBUTE WITH SUFFICIENT ACCURACY TO WARRANT THE ATTEMPT. THE INCLUSION OF THESE ITEMS WOULD TEND TO INCREASE THE COST.

FOR THESE AND OTHER REASONS THE COSTS WHICH ARE PRESENTED HEREAFTER SHOULD BE REGARDED AS ROUGH APPROXIMATIONS. SO REGARDED, IT IS BELIEVED THAT THEY WILL BE FOUND USEFUL UNTIL SUCH TIME AS MORE ACCURATE ANALYSES MAY BE POSSIBLE.





METHODS AND COSTS OF SNOW REMOVAL IN IOWA.

IOWA IS DIVIDED INTO 9 ENGINEERING DISTRICTS. SNOW REMOVAL FROM THE STATE HIGHWAYS IS DIRECTED BY THE MAINTENANCE ENGINEER OF THE STATE HIGHWAY DEPARTMENT THROUGH THE VARIOUS DISTRICT ENGINEERS. THESE ENGINEERS USUALLY APPOINT ASSISTANT DISTRICT ENGINEERS TO TAKE CHARGE OF SNOW REMOVAL AND OTHER MAINTENANCE WORK, AND THESE ASSISTANT ENGINEERS IN TURN SUB-DIVIDE THE DISTRICTS INTO MAINTENANCE SECTIONS, CONSISTING OF FROM ONE TO THREE COUNTIES, WHICH ARE PLACED IN CHARGE OF MAINTENANCE SUPERINTENDENTS. NUMEROUS COUNTIES REMOVE SNOW FROM COUNTRY ROADS, BUT THIS REPORT COVERS STATE WORK ONLY.

TABLE 4 SHOWS THE SNOWFALL, TEMPERATURE, COST OF SNOW REMOVAL PER INCH-MILE OF ROAD, EQUIPMENT USED, AND OTHER DATA FOR THE ENTIRE STATE OF IOWA, SEGREGATED BY DISTRICTS. DISTRICT NO. 5 IS LOCATED IN THE SOUTHEASTERN PART OF THE STATE WHERE THE WEATHER AND OTHER CONDITIONS PREVAILING DURING THE PAST WINTER CONTRIBUTED TOWARDS REDUCING THE COST OF THE REMOVAL WORK TO A MINIMUM. BECAUSE OF THE UNUSUALLY LOW TOTAL COST OF THE WORK, THE DATA WERE NOT CONSIDERED REPRESENTATIVE AND THE AVERAGE PER INCH-MILE WAS NOT COMPUTED.

THE MILEAGE UNDER THE CAPTION "ROAD CLEARED" INCLUDES THE ROADS IN EACH DISTRICT WHERE SNOW REMOVAL MAY BE REQUIRED, BUT CERTAIN SECTIONS MAY BE SO LOCATED TOPOGRAPHICALLY AS TO MAKE LITTLE IF ANY CLEARING WORK NECESSARY DURING THE SEASON, WHILE OTHER SECTIONS MAY NEED STRENUOUS EFFORTS IN ORDER TO KEEP THEM OPEN AND PASSABLE.

THE STATE REPORTS THAT 90 PER CENT OF THE ROADS IN THE VARIOUS DISTRICT PROGRAMS WERE PROTECTED FROM DRIFTING CONDITIONS WITH SNOW FENCE OR BY OTHER MEANS, WHERE SUCH PROTECTION WAS CONSIDERED NECESSARY. FOR DISTRICTS 1, 2, 3, 4, 7 AND 8, IT HAS BEEN ESTIMATED THAT 80 PER CENT OF THE WORK WAS ON INITIAL OR PATROL CLEARING, AND 20 PER CENT ON WIDENING OPERATIONS. FOR DISTRICT 5, ALL OF THE WORK REPRESENTS INITIAL CLEARING, AND FOR DISTRICTS 6 AND 9, 90 PER CENT WAS INITIAL AND 10 PER CENT WIDENING WORK. THE TOTAL COST ITEMS INCLUDE PURCHASE OF EQUIPMENT; PURCHASE, INSTALLATION AND REMOVAL OF SNOW FENCE, WAGES PAID LABORERS, FOREMEN, AND MOTOR DRIVERS, AND THE SALARY OF THE MAINTENANCE SUPERINTENDENT. OF COURSE, TO MAKE THE COST PER INCH-MILE MORE RELIABLE AND USEFUL, THE AMOUNTS EXPENDED FOR EQUIPMENT, SNOW FENCE, AND FOR THE OTHER ITEMS SHOULD BE SHOWN SEPARATELY BUT THOSE DATA ARE NOT AVAILABLE FOR THE PAST SEASON.

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TABLE 4. - SNOW-REMOVAL DATA - SEASON OF 1927-1928 - FOR THE STATE OF IOWA

DIVISION No.	AVERAGE SNOWFALL-1927-28	MEAN TEMPERATURE	ROAD CLEARED	WIDTH CLEARED	TOTAL COST	COST PER INCH-MILE	EQUIPMENT										MILES		
							INCHES	DEGREES	MILES	FEET	TRUCKS	DISPLACE-ROTRARY	TRUCKS	TRUCKS	TRUCKS	DISPLACE-ROTRARY		TRACTORS	TRACTORS
1	19.9	36.0	865	28	\$ 38,510	\$2.24	25	-	2	-	46	25	36	60					
2	32.9	32.1	750	28	50,474	2.05	24	2	2	3	47	15	22	130					
3	20.9	33.5	812	28	32,083	1.89	12	1	4	1	14	22	16	84					
4	12.0	37.7	697	28	12,412	1.48	12	1	4	1	14	22	16	29					
5	16.6	39.1	796	28	1,903		9	-	5	-	14	44	18						
6	12.8	36.9	812	28	23,649	2.28	21	-	3	-	23	21	18	36					
7	24.6	33.5	822	28	39,315	1.94	15	1	6	-	30	20	23	89					
8	32.4	33.2	754	28	64,416	2.64	15	1	8	-	23	26	24	135					
9	8.5	38.5	773	28	23,152	3.52	10	-	1	-	20	37	40	35					
TOTALS			7,081		285,914		143	6	35	5	231	232	213	598					

NOTE: THE FIGURES FOR AVERAGE SNOWFALL, MEAN TEMPERATURE, AND COST PER INCH-MILE ARE APPROXIMATE.

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## METHODS AND COSTS OF SNOW REMOVAL IN NEW YORK

THE STATE OF NEW YORK EXPERIENCES GENERALLY CONSIDERABLE SNOWFALL. ITS REMOVAL FROM THE MAIN HIGHWAYS IS ACCOMPLISHED BY THE COUNTIES OR TOWNSHIPS, AND IN SOME INSTANCES BY BOTH. IN TABLE 5 ARE GIVEN DATA ON THE COST PER INCH-MILE FOR SEVERAL COUNTIES IN THE WESTERN, CENTRAL, AND EASTERN SECTIONS OF THE STATE.

CHAUTAUQUA COUNTY LIES ALONG THE SHORE OF LAKE ERIE, AND IN THE EXTREME SOUTHWESTERN PART OF THE STATE. APPROXIMATELY 60 PER CENT OF THE WORK INVOLVED CONSISTED OF INITIAL OR PATROL CLEARING, AND 40 PER CENT OF WIDENING OPERATIONS. ABOUT 30 PER CENT OF THE TOTAL EXPENDITURE WAS FOR THE PURCHASE OF EQUIPMENT; 18 PER CENT WAS FOR THE PURCHASE, INSTALLATION AND REMOVAL OF SNOW FENCE; 17 PER CENT WAS FOR WAGES OF LABOR, FOREMEN, MOTOR DRIVERS AND FOR SUPERINTENDENCE; 10 PER CENT COVERED DEPRECIATION, UPKEEP OR RENTAL OF EQUIPMENT, INSURANCE ON LABOR, ETC., AND 25 PER CENT WAS FOR SUCH ITEMS AS GASOLINE, OIL, GARAGE CHARGES, AND MATERIALS. THE SUPERINTENDENT OF HIGHWAYS IN CHARGE OF THIS COUNTY CONTENDS THAT THE COST OF SNOW-REMOVAL WORK DOES NOT DEPEND SO MUCH ON THE DEPTH OF FALL AS UPON THE DIRECTION AND INTENSITY OF THE WIND DURING THE PRECIPITATION. ATTENTION IS CALLED TO THE FACT THAT THE COST PER INCH-MILE FOR THIS COUNTY WAS COMPUTED FROM A TOTAL COST ABOUT 30 PER CENT OF WHICH WAS USED FOR THE PURCHASE OF EQUIPMENT, AND 18 PER CENT FOR THE PURCHASE AND MANIPULATION OF SNOW FENCE.

THE MAIN HIGHWAYS OF CATTARAUGUS COUNTY, ADJOINING CHAUTAUQUA COUNTY ON THE EAST AND FORMING A PART OF THE SOUTHERN TIER OF THE STATE, WERE COVERED WITH A TOTAL OF APPROXIMATELY 55 INCHES OF SNOW DURING THE PAST WINTER. THE AGGREGATE COST INDICATED FOR THE REMOVAL WORK INCLUDES THE AMOUNTS SPENT FOR LABOR, FOREMEN, MOTOR DRIVERS, AND SUPERINTENDENTS; ESTIMATED AMOUNTS TO COVER OVERHEAD EXPENSE, UPKEEP OF EQUIPMENT, INSURANCE ON LABOR, AND MISCELLANEOUS ITEMS. SEVENTY PER CENT OF THE WORK WAS INITIAL OR PATROL CLEARING, AND 30 PER CENT WAS THE WIDENING OF PRELIMINARY CUTS. IN ADDITION TO THE TOTAL SHOWN, THE COUNTY EXPENDED \$7,300 FOR THE PURCHASE OF NEW EQUIPMENT AND SNOW FENCE. THE INSTALLATION AND REMOVAL OF SNOW FENCE WAS ACCOMPLISHED BY THE TOWNSHIPS. IT IS REPORTED THAT 50 PER CENT OF THE MILEAGE IN THE PROGRAM WAS PROTECTED BY SNOW FENCE.



THE STATE OF TEXAS, COUNTY OF DALLAS, ss. I, the undersigned, a Notary Public in and for said State, do hereby certify that the within and foregoing is a true and correct copy of the original of the same as the same appears from the records of said County.

IN WITNESS WHEREOF, I have hereunto set my hand and the seal of said County, at Dallas, Texas, this 10th day of May, 1902.

NOTARY PUBLIC IN AND FOR THE STATE OF TEXAS



TABLE 5.- SNOW-REMOVAL DATA - SEASON OF 1927-1928 - FOR THE STATE OF NEW YORK

COUNTIES	EQUIPMENT									
	TRUCKS	TRACTORS	DIS-ROTARY	TRUCKS	TRACTORS	DIS-ROTARY	TRACTORS	TRACTORS	TRACTORS	TRACTORS
AGE	MEAN	ROAD	WIDTH	TOTAL	COST	PER	INCH-	PLACE-	MENT	PLOWS
SNOW-	FALL	1927-28:	INCHES:	DEGREES:	MILES	FEET	INCH-	PLACE-	MENT	PLOWS
53.2	37.5	161	24	40,500	\$4.73	8	1	4	9	4
55.5	38.0	310	18	26,205	1.52	13	-	4	17	4
80.7	35.7	400	10	112,542	3.49	60	-	18	60	19
37.5	35.5	125	16	5,537	1.18	6	-	6	6	6
87.1	36.3	305	22-30	18,182	0.63	23	-	-	23	2
85.5	35.2	125	30	15,000	1.40	2	-	7	-	-
TOTALS		1,426		\$217,966		112	1	39	3	115
										35
										147

NOTE: THE FIGURES FOR AVERAGE SNOWFALL, MEAN TEMPERATURE, AND COST PER INCH-MILE ARE APPROXIMATE.

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THE TOTAL COST OF THE WORK IN ERIE COUNTY, SURROUNDING THE CITY OF BUFFALO, MAY BE SEPARATED INTO THE FOLLOWING ITEMS: 43.9 PER CENT FOR THE PURCHASE OF EQUIPMENT AND SNOW FENCE; 34 PER CENT FOR THE INSTALLATION AND REMOVAL OF SNOW FENCE, WAGES OF LABOR, FOREMEN, AND MOTOR DRIVERS, AND SALARY OF SUPERINTENDENTS; 22.1 PER CENT FOR THE INSURANCE OF LABOR AND FOR MISCELLANEOUS EXPENSES. IT IS BELIEVED THAT THE HIGH COST PER INCH-MILE IS ACCOUNTED FOR LARGELY BY THE FACT THAT APPROXIMATELY 66 PER CENT OF THE TOTAL COST WAS EXPENDED ON PURCHASE OF EQUIPMENT, INSURANCE OF LABOR, ETC. ANOTHER FACTOR THAT SHOULD BE CONSIDERED IS THAT THIS COUNTY INCLUDES HILLY TERRAIN WHICH IS RESPONSIBLE FOR CONSIDERABLE DRIFTING.

NIAGARA, THE EXTREME NORTHWESTERN COUNTY OF THE STATE, BOUNDED ON THE WEST BY THE NIAGARA RIVER, AND ON THE NORTH BY LAKE ONTARIO, EXPERIENCED AN AVERAGE DEPTH OF 37.5 INCHES OF SNOW DURING THE WINTER OF 1927-28, AND A MEAN TEMPERATURE OF 35.5 DEGREES. THE DATA IN TABLE 5 SHOW THAT \$5,537 WAS EXPENDED ON SNOW REMOVAL WORK FOR THE ENTIRE SEASON. FORTY-SEVEN PER CENT OF THAT SUM WAS USED FOR THE INSTALLATION AND REMOVAL OF SNOW FENCE AND THE REMAINDER FOR THE WAGES OF LABOR, FOREMEN AND MOTOR DRIVERS, THE SALARY OF SUPERINTENDENTS, ESTIMATED AMOUNTS FOR OVERHEAD, EQUIPMENT DEPRECIATION, UPKEEP, OR RENTAL, INSURANCE OF LABOR, AND OTHER MISCELLANEOUS ITEMS. WIDENING WORK WAS ACCOMPLISHED BUT THESE COSTS WERE NOT SEGREGATED FROM THE OTHER WORK. ALL ROADS WERE PROTECTED FROM DRIFTING WHERE SUCH PROTECTION WAS NECESSARY.

ONONDAGA COUNTY, WHICH INCLUDES THE CITY OF SYRACUSE, IS WELL ORGANIZED FOR THE REMOVAL OF SNOW FROM ITS RURAL ROADS. WITH REGARD TO THE DATA SHOWN IN TABLE 5, 75 PER CENT OF THE ROADS ON THE PROGRAM WERE PROTECTED FROM DRIFTING; 30 PER CENT OF THE WORK REPRESENTED INITIAL OR PATROL CLEARING; AND 70 PER CENT WIDENING ACTIVITIES. THE TOTAL FUNDS EXPENDED COVER THE FOLLOWING ITEMS: \$5,326 FOR THE RENTAL AND REPAIR OF EQUIPMENT, AND ALSO FOR DEPRECIATION, CARRYING CHARGES AND INTEREST ON THE INVESTMENT; \$1,824 FOR THE MANIPULATION OF THE 8 MILES OF SNOW FENCE HANDLED BY THE COUNTY; \$7,367 AS WAGES OF LABOR, FOREMEN, AND MOTOR DRIVERS; AND \$3,665 FOR SUPPLIES AND OTHER EXPENSES.

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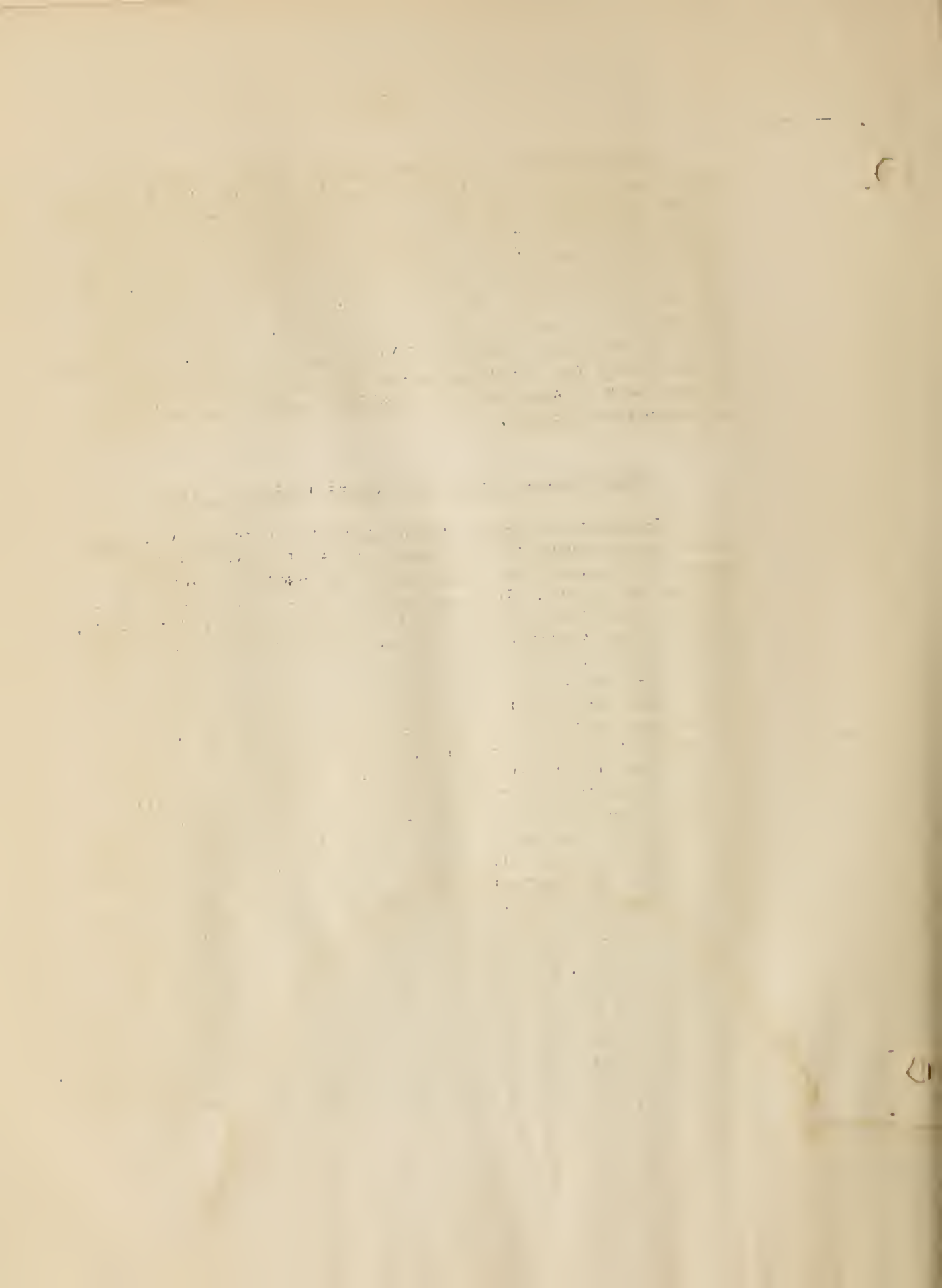
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WARREN COUNTY IS SITUATED WITHIN RATHER A MOUNTAINOUS TERRITORY LYING ON THE SHORE OF LAKE GEORGE AND EAST AND SOUTH OF THE ADIRONDACK STATE PARK. THE TOTAL COST SHOWN IN TABLE 5 FOR THE SNOW-REMOVAL WORK INCLUDES PERCENTAGES PAID FOR THE INSTALLATION AND REMOVAL OF SNOW FENCE; WAGES OF LABOR, FOREMEN, AND MOTOR DRIVERS, AND SALARIES OF SUPERINTENDENTS; BUT EXCLUDES EXPENDITURES MADE FOR THE PURCHASE OF EQUIPMENT OR ITS UPKEEP, THE INITIAL COST OF SNOW FENCE, AND AMOUNTS ESTIMATED FOR OVERHEAD EXPENSE, OR MISCELLANEOUS ITEMS, SIX MILES OF SNOW FENCE WERE PROVIDED WHERE DRIFTING CONDITIONS WERE SERIOUS, AND AN AMPLE WIDTH OF CLEARED ROADWAY WAS MAINTAINED THROUGHOUT THE WINTER.

#### SNOW-REMOVAL METHODS AND COSTS IN RHODE ISLAND

THE STATE OF RHODE ISLAND EMPLOYS A SNOW-REMOVAL FORCE CONTINUOUSLY THROUGHOUT THE WINTER SO AS TO HAVE PERSONNEL ALWAYS IN READINESS TO OPERATE WHEN THE SNOW HAS FALLEN TO THE REQUIRED DEPTH. THE SNOW-REMOVAL WORK IS IN CHARGE OF A NUMBER OF DISTRICT ENGINEERS, WITH HEADQUARTERS AT PROVIDENCE, WORKING UNDER A MAINTENANCE SUPERINTENDENT WHO REPORTS TO THE CHIEF ENGINEER. THE EQUIPMENT WHEN NOT IN USE IS STORED AT A CENTRAL SHOP OR AT VARIOUS DIVISION SHOPS SCATTERED OVER THE STATE. WHEN THE FALLING SNOW REACHES A DEPTH OF 2 INCHES, EACH FOREMAN NOTIFIES HIS DIVISION ENGINEER THAT HE IS BEGINNING OPERATIONS ON HIS SECTION. DURING A STORM EACH DISTRICT ENGINEER REMAINS AT HIS HOME OR OFFICE UNTIL ALL OF HIS FOREMEN HAVE REPORTED AND THEN GOES INTO THE FIELD TO SUPERVISE THE WORK. WHEN THE STORM ENDS AND THE INITIAL CLEARING IS COMPLETED, THE FOREMEN TELEPHONE TO THE PRINCIPAL OFFICE THAT THE ROADS IN THEIR RESPECTIVE SECTIONS ARE OPEN. UNDER THIS METHOD OF PROCEDURE, THE DATA INDICATE THAT SNOW REMOVAL COST THE STATE AN AVERAGE OF \$4.55 PER INCH-MILE FOR THE SEASON OF 1927-28. THE MEAN TEMPERATURE FOR THE STATE LAST WINTER WAS ABOUT 44 DEGREES. THE AVERAGE WIDTH OF THE PLOWED CUT, AFTER WIDENING, WAS 24 FEET. APPROXIMATELY 60 PER CENT OF THE COST WAS EXPENDED ON INITIAL CLEARING AND 40 PER CENT ON WIDENING. THE TOTAL COST UPON WHICH THE COST PER INCH-MILE WAS BASED REPRESENTS EXPENDITURES FOR LABOR, FUEL AND OIL, BUT DOES NOT INCLUDE ANY CHARGE FOR EQUIPMENT OR ITS DEPRECIATION, OVERHEAD, OR INSURANCE. ABOUT 80 PER CENT OF THE COST WAS FOR LABOR AND 20 PER CENT FOR FUEL AND OIL.







### SNOW-REMOVAL METHODS AND COSTS IN CONNECTICUT

THE STATE OF CONNECTICUT IS DIVIDED INTO ELEVEN REPAIR DISTRICTS EACH IN CHARGE OF A SUPERVISOR OF REPAIRS WHOSE DUTIES INCLUDE THE REMOVAL OF SNOW UNDER THE GENERAL DIRECTION OF THE STATE ENGINEER OF MAINTENANCE. THE STATE CONFINES ITS SNOW-REMOVAL WORK TO THE STATE HIGHWAYS. IN SOME INSTANCES THE TOWNS CLEAR THEIR LOCAL ROADS, BUT DATA ON SUCH WORK ARE NOT INCLUDED IN TABLE 6 WHICH GIVES THE INFORMATION FOR THE STATE WORK ONLY. THE SNOW-REMOVAL EQUIPMENT IS OWNED BY THE STATE AND LOANED TO THE VARIOUS MAINTENANCE DISTRICTS ON A RENTAL BASIS. PLOWS AND TRUCKS ARE ALLOTTED TO EACH DISTRICT, BUT WHEN NOT NEEDED AT THESE LOCATIONS ARE WITHDRAWN AND REALLOTTED TO OTHER DISTRICTS WHERE A HEAVY SNOWFALL HAS OCCURRED.

THE TOTAL COST OF THE WORK FOR THE DIFFERENT DISTRICTS INCLUDES WAGES PAID LABOR, FOREMEN, AND MOTOR DRIVERS, EQUIPMENT DEPRECIATION, UPKEEP AND RENTAL, AND OTHER MISCELLANEOUS ITEMS, BUT OMITTS COSTS INVOLVING THE PURCHASE OF EQUIPMENT, THE PURCHASE OR HANDLING OF SNOW FENCE, CHARGES FOR SUPERINTENDENCE, OR ANY ESTIMATED AMOUNTS FOR OVERHEAD EXPENSE, OR INSURANCE OF LABOR. BOTH INITIAL AND WIDENING WORK WERE CARRIED ON, BUT NO SEGREGATION OF COST OF THESE ACTIVITIES WAS MADE.

THE COST PER INCH-MILE FOR DISTRICT No. 7 IS HIGH BECAUSE THIS DISTRICT LIES IN THE BERKSHIRE HILLS REGION AT THE NORTHWESTERN CORNER OF THE STATE, WHERE HEAVY DRIFTS ARE ENCOUNTERED. FURTHERMORE, ALTHOUGH IT IS ESTIMATED FROM THE UNITED STATES WEATHER BUREAU DATA THAT AN AVERAGE OF 27.6 INCHES OF SNOW FELL OVER THE ENTIRE DISTRICT DURING THE SEASON, THE STATE RECORDS SHOW THAT 63 INCHES OF SNOW FELL IN CERTAIN SECTIONS OF THE DISTRICT.

The first part of the document  
 describes the general principles  
 of the system. It is divided into  
 several sections, each dealing  
 with a different aspect of the  
 subject. The first section  
 discusses the importance of  
 the system, while the second  
 section describes its structure.  
 The third section discusses the  
 various methods of application,  
 and the fourth section discusses  
 the results of the system.

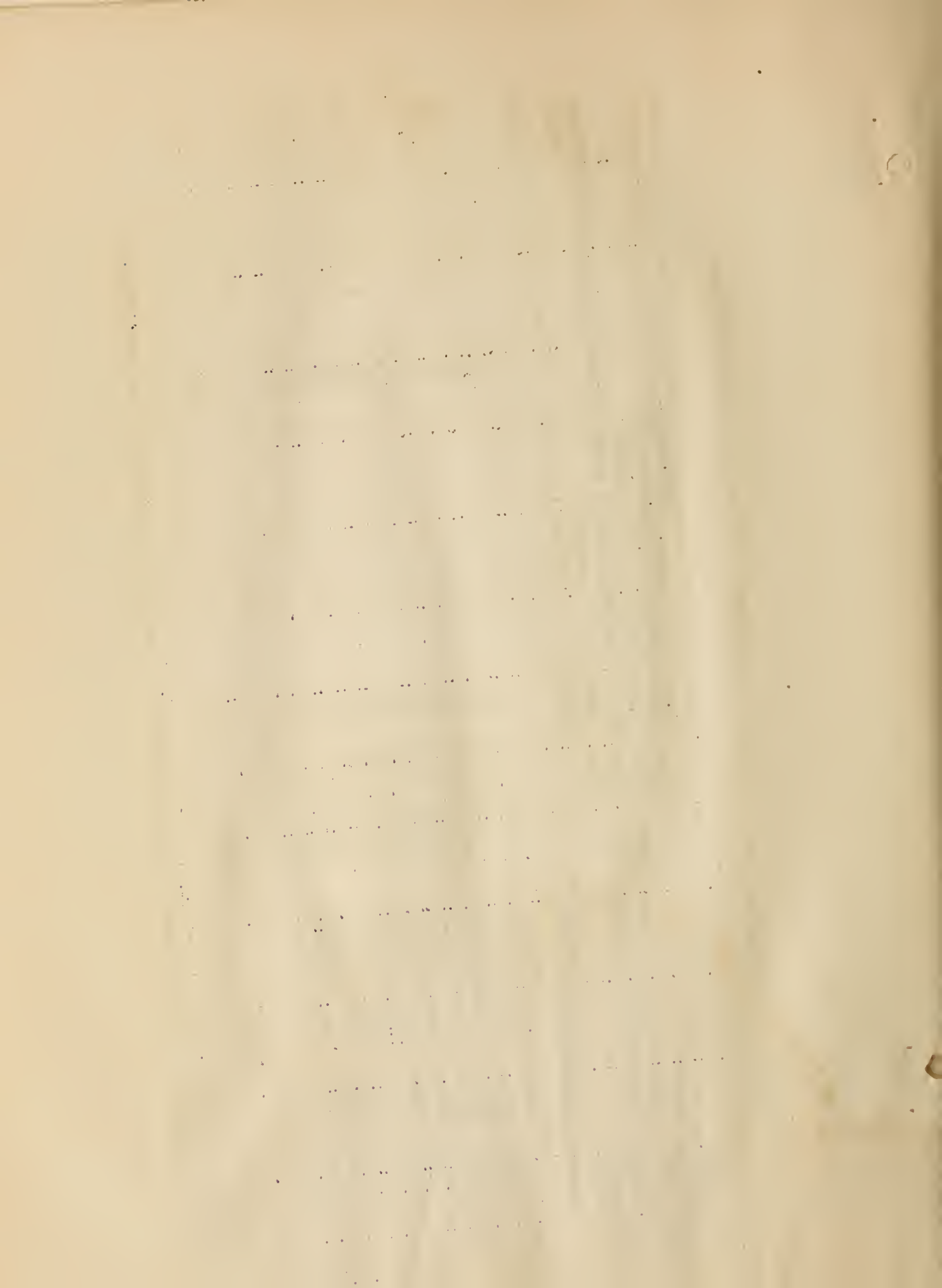
The second part of the document  
 describes the details of the  
 system. It is divided into  
 several sections, each dealing  
 with a different aspect of the  
 subject. The first section  
 discusses the importance of  
 the system, while the second  
 section describes its structure.  
 The third section discusses the  
 various methods of application,  
 and the fourth section discusses  
 the results of the system.



TABLE 3.- SNOW-REMOVAL DATA - SEASON OF 1927-1928 - FOR THE STATE OF CONNECTICUT

: AVER-																				EQUIPMENT	
DIS-	AGE	MEAN								COST	TRUCK	TRACTOR	TRACTOR	TRACTOR							
TRICT:	SNOW-	TEMPER-	ROAD	WIDTH	CLEARED:	COST	INCH-	PLACE-	PLOWS	DIS-	ROTARY	DIS-	ROTARY								
No. :	FALL :	ATURE :	CLEARED:				INCH-	PLACE-	PLOWS	PLACE-	PLOWS	TRACTORS:	TRACTORS:	GRADERS:	SNOW						
: 1927-	:	:	:	:	:	:	MILE :	MENT :	:	MENT :	:	:	:	:	:	:	:	:	:	:	FENCE :
: 28 :	:	:	:	:	:	:	PLOWS :	PLOWS :	:	PLOWS :	:	:	:	:	:	:	:	:	:	:	:
:	INCHES:	DEGREES:	MILES :	FEET :	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	:	MILES :
1 :	14.2 :	39.2 :	181 :	26-50 :	\$ 3,062 :	\$1.19 :	25 :	- :	- :	- :	- :	17 :	- :	- :	- :	- :	- :	- :	- :	- :	- :
2 :	14.9 :	40.4 :	192 :	26-32 :	4,429 :	1.55 :	25 :	- :	- :	- :	- :	18 :	- :	- :	- :	- :	- :	- :	- :	- :	1.5 :
3 :	15.0 :	40.6 :	163 :	26-32 :	6,972 :	2.85 :	25 :	- :	- :	- :	- :	16 :	- :	- :	- :	- :	- :	- :	- :	- :	0.8 :
4 :	13.7 :	40.7 :	149 :	26-32 :	3,088 :	1.11 :	25 :	- :	- :	- :	- :	13 :	1 :	- :	- :	- :	- :	- :	- :	- :	0.1 :
5 :	17.9 :	40.2 :	185 :	26-32 :	6,336 :	1.91 :	25 :	- :	- :	- :	- :	14 :	- :	- :	- :	- :	- :	- :	- :	- :	- :
6 :	17.0 :	39.8 :	239 :	26-32 :	5,703 :	1.40 :	25 :	- :	- :	- :	- :	21 :	- :	- :	- :	- :	- :	- :	- :	- :	- :
7 :	27.6 :	37.7 :	210 :	26-32 :	19,019 :	3.28 :	25 :	- :	- :	- :	- :	32 :	4 :	- :	- :	- :	- :	- :	- :	- :	8.5 :
8 :	20.5 :	39.8 :	127 :	26-32 :	5,455 :	2.10 :	25 :	- :	- :	- :	- :	19 :	1 :	- :	- :	- :	- :	- :	- :	- :	- :
9 :	23.5 :	38.3 :	177 :	26-32 :	4,386 :	1.05 :	25 :	- :	- :	- :	- :	17 :	- :	- :	- :	- :	- :	- :	- :	- :	0.8 :
10 :	26.0 :	39.0 :	150 :	26-32 :	4,335 :	1.11 :	25 :	- :	- :	- :	- :	15 :	- :	- :	- :	- :	- :	- :	- :	- :	0.6 :
11 :	29.6 :	37.0 :	178 :	26-32 :	8,950 :	1.70 :	25 :	- :	- :	- :	- :	20 :	1 :	- :	- :	- :	- :	- :	- :	- :	0.2 :
TOTALS :			1,951 :		71,765 :		275 :					202 :	7 :								12.5 :

NOTE: THE FIGURES FOR AVERAGE SNOWFALL, MEAN TEMPERATURE, AND COST PER INCH-MILE ARE APPROXIMATE.



### SNOW-REMOVAL METHODS AND COSTS IN WEST VIRGINIA

WEST VIRGINIA REPORTS SNOW-REMOVAL OPERATIONS FOR THE NORTHERN PART OF THE STATE ONLY. WITHIN THIS SECTION ONE OF THE ENGINEERING DIVISIONS, LOCATED IN MOUNTAINOUS TERRITORY, KEPT 271 MILES OF ITS ROADS CLEAR OF SNOW FOR THE SEASON OF 1927-28 AT AN AVERAGE COST OF 45 CENTS PER INCH-MILE. THE MEAN TEMPERATURE FOR THE WINTER WAS 41.5 DEGREES, AND OPEN ROADS WERE MAINTAINED AT A WIDTH OF 16 FEET. THE WORK WAS DONE WITH 23 TRUCK DISPLACEMENT PLOWS, ONE ROTARY PLOW WITH A TRUCK MOUNT, AND TWO ONE-MAN GRADERS. THE AVERAGE SEASONAL SNOWFALL OVER THE ENTIRE DIVISION WAS 53.2 INCHES, AND \$6,440 WAS THE TOTAL EXPENDITURE FOR ITS REMOVAL. TWENTY-EIGHT PER CENT OF THIS AMOUNT WAS CHARGED AGAINST EQUIPMENT DEPRECIATION; 44 PER CENT WAS FOR THE HIRE OF LABOR, FOREMEN, AND MOTOR DRIVERS; 4 PER CENT FOR SALARY OF SUPERINTENDENTS; 6 PER CENT ESTIMATED FOR OVERHEAD EXPENSE; 17 PER CENT FOR EQUIPMENT UP-KEEP, GAS, OIL, TIRE REPAIR AND GARAGE RENT, AND 1 PER CENT FOR HANDLING SNOW FENCE.

### SNOW-REMOVAL METHODS AND COSTS IN ARIZONA

ARIZONA SUBMITTED SNOW-REMOVAL DATA FOR ONLY ONE ENGINEERING DIVISION. THIS DIVISION LIES IN THE CENTER OF THE STATE BETWEEN MARICOPA COUNTY ON THE SOUTH AND GRAND CANYON NATIONAL PARK ON THE NORTH. DURING THE WINTER OF 1927-28, THE SNOWFALL AVERAGED 24.8 INCHES AND THE MEAN TEMPERATURE WAS 46.7 DEGREES. THE SECTIONS OF ROAD CLEARED WERE NOT CONTINUOUS BUT WERE SCATTERED OVER THE DIVISION IN AREAS WITH VARIABLE DEPTHS OF SNOWFALL. THE AGGREGATE LENGTH OF ROAD CLEARED EQUALED 146 MILES WITH AN AVERAGE WIDTH OF 18 FEET. THE EQUIPMENT USED CONSISTED OF 3 DISPLACEMENT PLOWS MOUNTED ON TRACTORS, AND 7 GRADERS PULLED BY MOTOR TRUCKS. EIGHTY-FIVE PER CENT OF THE ACTIVITIES WERE CONFINED TO INITIAL CLEARING OR PATROL WORK AND 15 PER CENT TO WIDENING OPERATIONS. THE WORK COST \$2,715, OR AN AVERAGE OF 75 CENTS PER INCH-MILE. THE SUM TOTAL WAS SEGREGATED AS FOLLOWS: 33 PER CENT FOR HIRE OF LABOR, FOREMEN, AND MOTOR DRIVERS; 47 PER CENT FOR EQUIPMENT DEPRECIATION, UPKEEP OR RENTAL; AND 20 PER CENT FOR GAS, OIL AND GREASE. SNOW FENCES AND OTHER DRIFT-PREVENTIVE MEASURES WERE NOT EMPLOYED.

The first part of the document  
 discusses the general principles  
 of the system and the  
 various components involved.  
 It is divided into several  
 sections, each dealing with  
 a specific aspect of the  
 overall design. The first  
 section covers the basic  
 concepts and the second  
 section describes the  
 hardware requirements.  
 The third section details  
 the software architecture  
 and the fourth section  
 discusses the implementation  
 details. The final section  
 provides a summary of the  
 project and the conclusions  
 drawn from the study.

The second part of the document  
 provides a detailed description  
 of the system architecture.  
 It includes a block diagram  
 showing the flow of data  
 between the various  
 components. The diagram  
 illustrates the interaction  
 between the user interface,  
 the database, and the  
 processing modules. The  
 text explains the role of  
 each component and how  
 they are integrated into  
 the overall system. It  
 also discusses the security  
 measures implemented to  
 protect the data and the  
 system from unauthorized  
 access. The third part of  
 the document describes the  
 testing and validation  
 process. It details the  
 test cases used to verify  
 the system's functionality  
 and the results of the  
 tests. The final part of  
 the document provides a  
 conclusion and a list of  
 references.



## SNOW-REMOVAL METHODS AND COSTS IN WISCONSIN

WHILE THE SNOW-REMOVAL DATA FOR WISCONSIN ARE SEGREGATED INTO THE NINE ENGINEERING DIVISIONS OF THE STATE HIGHWAY COMMISSION, THE WORK IS ACCOMPLISHED BY THE VARIOUS COUNTIES WITHOUT THE FINANCIAL AID OR THE ACTIVE CONTROL OF THE STATE AUTHORITIES. WINTER MAINTENANCE OF THE MAIN HIGHWAYS IS IN CHARGE OF THE RESPECTIVE COUNTY HIGHWAY COMMISSIONS WITH FUNDS PROVIDED BY THE COUNTIES. IN SOME INSTANCES THE TOWNSHIPS CLEAR THEIR ROADS, USING TOWN FUNDS, BUT SUCH ACTIVITIES ARE NOT INCLUDED IN THIS REPORT.

AS MAY BE SEEN IN TABLE 7, THE ROADS OF ALL DIVISIONS, WITH THE POSSIBLE EXCEPTION OF THOSE IN DIVISION 9, WHERE LIGHT SNOWFALL WAS REPORTED DURING THE PAST WINTER, WERE PROTECTED FROM DRIFTS WITH GENEROUS SECTIONS OF SNOW FENCE. LIKEWISE, WITH THE EXCEPTION OF DIVISION 5 AND THE OTHER DIVISIONS SHOWN BLANK UNDER THE CAPTION "WIDTH CLEARED", MORE OR LESS WIDENING WORK WAS ACCOMPLISHED. FOR DIVISION 3, 25 PER CENT OF THE TOTAL COST WAS FOR WIDENING ACTIVITIES; DIVISION 4, 35 PER CENT; DIVISION 7, 60 PER CENT; AND IN DIVISION 8, 26 PER CENT OF THE COST COVERED THIS CLASS OF WORK.

DIVISIONS 3, 4 AND 8 REPORT THAT THEIR TOTAL COST FOR SNOW-REMOVAL WORK INCLUDES PURCHASE OF EQUIPMENT IN THE PROPORTIONS OF 25, 30, AND 15 PER CENT RESPECTIVELY. DIVISION 7 REPORTS THAT THEIR TOTAL COST DID NOT INCLUDE THE PURCHASE OF EQUIPMENT AND THE REMAINING DIVISIONS MADE NO REPORT CONCERNING THIS ITEM. DIVISION 3 SUPPLIED THE INFORMATION THAT THE COST OF SUPERINTENDENCE IS PAID FROM GENERAL COUNTY FUNDS, AND DIVISION 7 STATES THAT AMOUNTS PAID SUPERINTENDENTS AND ESTIMATED CHARGES FOR OVERHEAD ARE NOT INCLUDED IN THE TOTAL COST OF SNOW-REMOVAL WORK; BUT THE OTHER DIVISION REPORTS GENERALLY INDICATED THAT THEIR RESPECTIVE TOTALS INCLUDED THE SALARY OF SUPERINTENDENTS. FOR ALL THE DIVISIONS REPORTING, INCLUDING 3 AND 7, THE TOTAL COST INCLUDED, AS A RULE, AMOUNTS FOR THE PURCHASE AND HANDLING OF SNOW FENCE; WAGES PAID LABOR, FOREMEN, AND MOTOR DRIVERS; ESTIMATED PERCENTAGE FOR OVERHEAD EXPENSE; EQUIPMENT DEPRECIATION, UPKEEP, OR RENTAL; INSURANCE OF LABOR; AND OTHER MISCELLANEOUS ITEMS.



TABLE 7.- SNOW-REMOVAL DATA - SEASON OF 1927-1928 - FOR THE STATE OF WISCONSIN

DIVISION No. : 1927-28	AVERAGE : MEAN	ROAD : TEMPERATURE	CLEARED : MILES	WIDTH : FEET	TOTAL : COST	EQUIPMENT										MILES	
						TRUCK : TRACTORS	DIS- ROTARY	DIS- ROTARY	PLOWS : PLACE-	PLOWS : PLACE-	TRACTORS : TRUCKS	TRACTORS : TRUCKS	TRACTORS : TRUCKS	TRACTORS : TRUCKS	TRACTORS : TRUCKS		TRACTORS : TRUCKS
1	37.8	2,555	18	\$ 19,800	0.34	21	-	19	1	30	26	42	30	30	26	42	30
2	32.2	3,000	-	59,276	0.72	54	-	21	-	54	21	-	90	54	21	-	90
3	57.5	33.6 *2,100	16	80,000	0.66	32	-	15	1	30	13	-	69	30	13	-	69
4	47.4	33.7 : 2,400	22	77,761	0.69	24	-	9	-	24	11	5	48	24	11	5	48
5	51.9	33.6 : 1,500	10	45,000	0.58	7	-	2	-	12	12	9	63	12	12	9	63
6	62.2	30.2 : 2,146	-	52,485	0.39	15	-	15	-	16	15	-	54	16	15	-	54
7	81.1	29.2 *1,533	22	80,000	0.64	12	-	15	2	16	21	-	129	16	21	-	129
8	73.3	28.9 : 1,826	20	63,576	0.47	14	-	14	-	14	16	3	65	14	16	3	65
9	27.4	37.8 : 425	-	5,000	0.43	1	-	2	-	-	-	-	6	-	-	-	6
TOTALS		17,495		492,998		181		112	4	196	135	59	554				

\* INCLUDES COUNTY ROADS OTHER THAN TRUNK HIGHWAYS.

NOTE: THE FIGURES FOR AVERAGE SNOWFALL, MEAN TEMPERATURE, AND COST PER INCH-MILE ARE APPROXIMATE.

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6

ALTHOUGH THE COST PER INCH-MILE, AS SHOWN BY TABLE 7, VARIES TO SOME EXTENT IN THE DIFFERENT DISTRICTS, THE FIGURES ARE REASONABLY UNIFORM, WHEN THE DIFFERENT LOCAL CONDITIONS ARE TAKEN INTO CONSIDERATION. THE SIMILARITY IN THE FIGURES IS ALSO VERY CLOSE IN VIEW OF THE FACT THAT NO SCIENTIFIC COST ACCOUNTING METHODS WERE USED.

#### GENERAL SNOW-REMOVAL STATISTICS

THE ATTACHED TABLE OF GENERAL STATISTICS SHOWS THE KIND OF MILEAGE CLEARED AND TOTAL COST OF SNOW-REMOVAL WORK TOGETHER WITH THE EQUIPMENT USED DURING THE WINTER OF 1927-28 IN THE 36 STATES WITHIN THE HEAVY-SNOWFALL AREA. THE DATA WERE COLLECTED FROM THE STATE HIGHWAY DEPARTMENTS, WITH ONE OR TWO EXCEPTIONS WHERE THE COUNTIES FURNISHED THE INFORMATION. IT SHOULD BE BORNE IN MIND THAT THE DATA INCLUDE THE WORK DONE BY THE STATES AND THE ONE OR TWO COUNTIES MENTIONED, ON THEIR MAIN HIGHWAYS, BUT DO NOT INCLUDE SIMILAR WORK DONE BY THE VARIOUS COUNTIES AND TOWNSHIPS ON THEIR LOCAL ROADS, OR SNOW-REMOVAL OPERATIONS CARRIED ON BY MUNICIPALITIES, TRANSPORTATION COMPANIES, PUBLIC INSTITUTIONS AND DIVERS BUSINESS AGENCIES.

THE AVERAGE COST PER MILE FOR SNOW REMOVAL, WHICH HAS BEEN GIVEN IN PREVIOUS YEARS, HAS BEEN OMITTED FROM THIS TABLE.

THE ATTACHED MAP SHOWS THE AVAILABLE DATA WITH REGARD TO THE LOCATION OF THE MAIN ROADS WHICH WERE KEPT OPEN FOR WINTER TRAFFIC DURING THE SNOW SEASON OF 1927-28. THE INFORMATION FOR MAINE WAS NOT RECEIVED IN TIME TO BE SHOWN ON THIS MAP.

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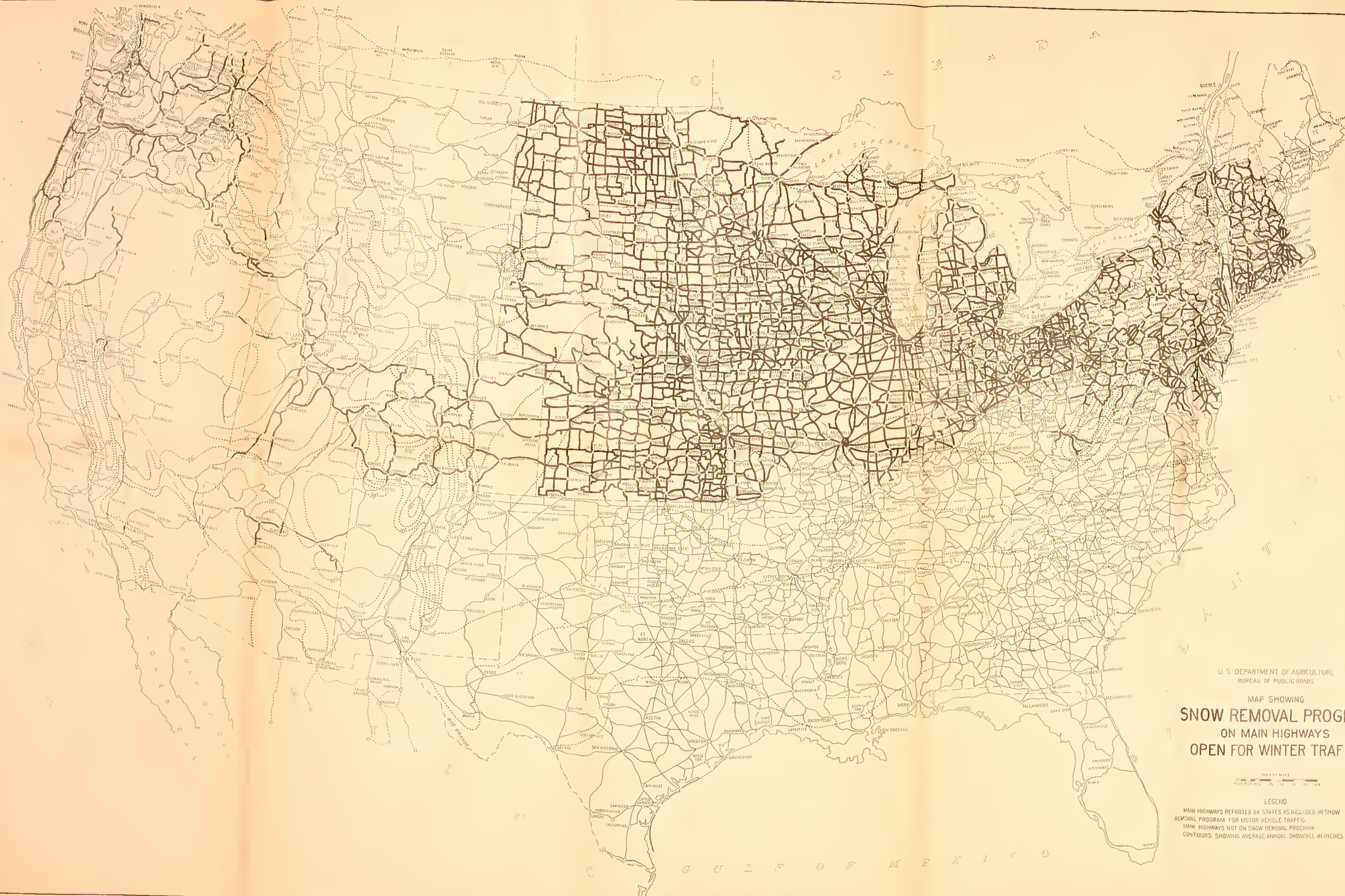
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U. S. DEPARTMENT OF AGRICULTURE  
BUREAU OF PUBLIC ROADS

MAP SHOWING  
**SNOW REMOVAL PROGRAM**  
ON MAIN HIGHWAYS  
OPEN FOR WINTER TRAFFIC



LEGEND

MAIN HIGHWAYS REPORTED BY STATES AS INCLUDED IN SNOW REMOVAL PROGRAM FOR MOTOR VEHICLE TRAFFIC ———

MAIN HIGHWAYS NOT ON SNOW REMOVAL PROGRAM - - - - -

CONTOURS SHOWING AVERAGE ANNUAL SNOWFALL IN INCHES ·····

G U I O F M E X I C O











## CAPPING SPECIMENS FOR COMPRESSION TESTS OF CONCRETE

CONTRIBUTED BY F. H. JACKSON OF THE DIVISION OF TESTS  
(NOT FOR RELEASE)

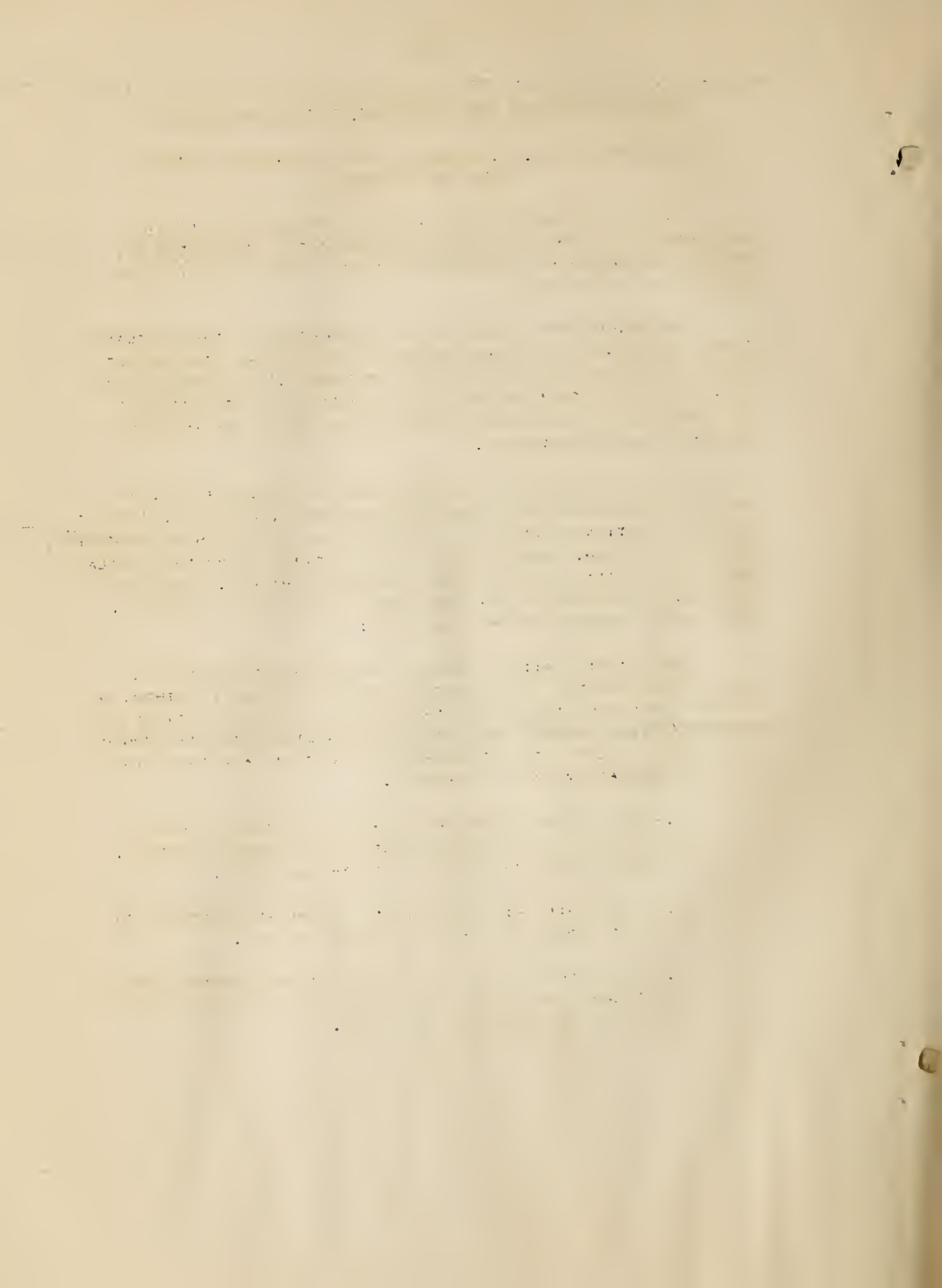
A RECENT INSPECTION OF A NUMBER OF CONCRETE TESTING LABORATORIES BY THE WRITER HAS INDICATED THAT THE METHOD OF CAPPING SPECIMENS FOR COMPRESSION TESTS IS NOT SO WELL STANDARDIZED AS IS DESIRABLE.

NUMEROUS TESTS, MADE IN THE LABORATORY OF THE PORTLAND CEMENT ASSOCIATION FOR THE PURPOSE OF DETERMINING THE EFFECT OF END CONDITION OF CYLINDERS UPON THE RESULTS OF COMPRESSION TESTS, INDICATE THAT NOT ONLY THE SMOOTHNESS OF THE CAP BUT THE CHARACTER OF THE CAPPING MATERIAL HAS QUITE AN INFLUENCE UPON THE RESULTS OBTAINED.

THESE STUDIES HAVE BEEN PUBLISHED AS BULLETIN 14, OF THE STRUCTURAL MATERIALS RESEARCH LABORATORY, ENTITLED, "EFFECT OF END CONDITION OF CYLINDER ON COMPRESSIVE STRENGTH OF CONCRETE", AND COPIES OF THIS PUBLICATION MAY BE OBTAINED FROM THE PORTLAND CEMENT ASSOCIATION, 33 WEST GRAND AVENUE, CHICAGO. AMONG THE CONCLUSIONS BEARING ON THIS PARTICULAR PHASE OF THE SUBJECT, THERE MAY BE MENTIONED THE FOLLOWING:

WHEN TESTED WITHOUT BEDDING, THE STRENGTHS OBTAINED VARIED FROM ABOUT 80 TO 95 PER CENT OF THE STANDARD METHOD, DEPENDING UPON THE RICHNESS OF THE CONCRETE. WITH ALL TYPES OF SHEET MATERIALS BETWEEN THE TOP OF THE CYLINDER AND THE SPHERICAL BEARING BLOCK, THE STRENGTHS WERE LESS IN ALL CASES THAN FOR THE STANDARD METHOD OF CAPPING.

- 1.- FOR BEAVER BOARD THE STRENGTHS OBTAINED VARIED FROM ABOUT 90 TO 100 PER CENT OF THE STANDARD METHOD, DEPENDING UPON THE RICHNESS OF THE CONCRETE.
- 2.- FOR WHITE PINE BOARD, MILL BOARD AND LEATHER, THE STRENGTHS WERE LESS THAN FOR BEAVER BOARD.
- 3.- FOR OTHER SHEET MATERIALS, SUCH AS BLOTTING PAPER, SHEET LEAD, AND RUBBER, THE STRENGTHS WERE LESS THAN WHERE NO BEDDING AT ALL WAS USED.



THIS MATTER IS CALLED PARTICULARLY TO THE ATTENTION OF THE MATERIALS ENGINEERS, DUE TO THE FACT THAT CERTAIN LABORATORIES ARE STILL USING BLOTTING PAPER, BEAVER BOARD, AND OTHER SHEET MATERIALS OF A SIMILAR NATURE FOR CAPPING SPECIMENS IN LIEU OF THE STANDARD METHOD AS OUTLINED IN A.S.T.M. STANDARD METHOD OF TEST C 39-27, WHICH REQUIRES A NEAT CEMENT CAP.

THE TESTS ABOVE REFERRED TO, HOWEVER, INDICATE THAT PLASTER OF PARIS OR MIXTURES OF PLASTER OF PARIS AND CEMENT GAVE ESSENTIALLY THE SAME RESULTS AS THE STANDARD METHOD OF CAPPING. THE BUREAU ACCORDINGLY WOULD APPROVE EITHER CEMENT OR PLASTER CAPS OR A COMBINATION THEREOF BUT WOULD NOT CONSIDER AS GOOD PRACTICE THE USE OF ANY SHEET MATERIAL SUCH AS CARDBOARD OR BLOTTING PAPER.

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GRADER CUTTING EDGES STANDARDIZED  
BY THE MISSISSIPPI VALLEY STATE HIGHWAY ASSOCIATION

COMPILED FROM A REPORT SUBMITTED BY G. L. CAMPEN  
OF DISTRICT 5

STANDARD SPECIFICATIONS FOR CUTTING EDGES OF BLADE GRADERS WERE ADOPTED BY THE MISSISSIPPI VALLEY STATE HIGHWAY ASSOCIATION AT A MEETING OF THE COMMITTEE ON THE STANDARDIZATION OF CUTTING EDGES, HELD IN THE MAYFAIR HOTEL IN ST. LOUIS, MO., ON SEPTEMBER 4, 1928. THERE WERE PRESENT AT THIS MEETING THE CHAIRMAN - W. H. ROOT, ENGINEER OF MAINTENANCE OF THE IOWA STATE HIGHWAY COMMISSION - W. F. ROSENWALD, ENGINEER OF MAINTENANCE OF THE MINNESOTA DEPARTMENT OF HIGHWAYS; C. P. OWENS, ENGINEER OF MAINTENANCE OF THE MISSOURI STATE HIGHWAY COMMISSION; GEORGE L. CAMPEN, OF THE BUREAU; N. M. KEISER OF THE AUSTIN WESTERN MANUFACTURING COMPANY, CHICAGO, ILL.; J. A. HANRATTY OF THE RUSSEL GRADER MANUFACTURING COMPANY, MINNEAPOLIS, MINN.; U. G. SMITH OF THE GALLION MANUFACTURING COMPANY, GALLION, OHIO; W. R. ADAMS OF THE ADAMS GRADER COMPANY OF INDIANAPOLIS, IND.; O. W. SCHMIDT OF THE CASWELL GRADER COMPANY OF KANSAS CITY, MO.; AND W. N. PATTON OF THE EMPIRE PLOW WORKS OF CLEVELAND, OHIO.

AT THE REQUEST OF THE CHAIRMAN, MR. ROSENWALD EXPLAINED THAT THE MEETING WAS CALLED FOR THE PURPOSE OF ADOPTING UNIFORM STANDARDS FOR THE CUTTING EDGES OF ROAD GRADERS. THE SPEAKER STATED THAT THE VARIOUS STATES WITHIN THE ASSOCIATION FOUND IT BURDENSOME TO CARRY A LARGE STOCK OF CUTTING EDGES SIMPLY BECAUSE THE BLADES WERE NOT MADE INTERCHANGEABLE FOR THE VARIOUS MAKES OF MACHINES. HE PROPOSED A STANDARD SIZE AND SPACING OF BOTH THE MOLD BOARDS AND THE CUTTING EDGES SO THAT A 6, 8, 10, OR 12-FOOT BLADE WOULD FIT ANY OF THE CORRESPONDING SIZES OF MOLD BOARDS MANUFACTURED BY THE VARIOUS COMPANIES. IN RESPONSE TO THEIR QUESTION AS TO WHETHER THIS STANDARDIZATION WOULD BE MADE TO INCLUDE THE BLADES AND MACHINES USED BY COUNTIES AND LOCAL AUTHORITIES, THE MANUFACTURERS WERE INFORMED THAT THE RECOMMENDATIONS OF THE COMMITTEE WERE INTENDED TO APPLY ONLY TO EQUIPMENT PURCHASED BY THE STATE HIGHWAY DEPARTMENTS IN THE MISSISSIPPI VALLEY STATE HIGHWAY ASSOCIATION. MR. ROOT INTERPOSED, HOWEVER, THAT PROVIDED THE MANUFACTURERS IN ATTENDANCE EXPRESSED THEIR APPROVAL OF THE PROPOSAL, THE MATTER WOULD BE SUBMITTED AT AN EARLY





DATE TO THE EXECUTIVE COMMITTEE OF THE AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS THROUGH MR. F. R. WHITE OF IOWA AND MR. C. M. BABCOCK OF MINNESOTA, BOTH MEMBERS OF THE COMMITTEE. MR. ROOT EXPRESSED THE BELIEF THAT THE A.A.S.H.O. COMMITTEE TO WHICH THE PROPOSAL WOULD BE REFERRED WOULD BE FAVORABLE TO BRINGING THE SUBJECT BEFORE THE ENTIRE MEMBERSHIP OF THE ASSOCIATION BUT HE EXPLAINED THAT IT WOULD BE NECESSARY FOR THE STATE HIGHWAY DEPARTMENTS TO SIGNIFY THEIR ACCEPTANCE BY LETTER BALLOT BEFORE THE PROPOSAL COULD BE FORMALLY ADOPTED.

AFTER SOME DISCUSSION BY THE MANUFACTURERS, WHICH BROUGHT OUT THE NEED FOR SLIGHT CHANGES IN THE PLAN SHOWING THE PUNCHING OF THE MOLD BOARD AND CUTTING EDGES, AS SUBMITTED BY MR. ROSENWALD, THE MANUFACTURERS AGREED TO COMPLY WITH THE REQUIREMENTS SET FORTH BY THE COMMITTEE. SHOULD THE PROPOSAL BE ADOPTED BY THE MEMBERS OF THE A.A.S.H.O., THE MANUFACTURERS AGREED TO STAMP EACH CUTTING EDGE WITH THE LETTERS "S.H." INDICATING THAT THE BLADE SO MARKED WAS INTENDED TO BE USED BY A STATE HIGHWAY DEPARTMENT.

MR. C. P. OWENS OF MISSOURI, WHO ACTED AS SECRETARY OF THE COMMITTEE, IS TO PREPARE A FULL REPORT OF THE MEETING.

