THE NEWS LETTER OF THE BUREAU OF PUBLIC ROADS

VOL. 2, NO. 9 JULY, 1927 A. C. ROSE, EDITOR

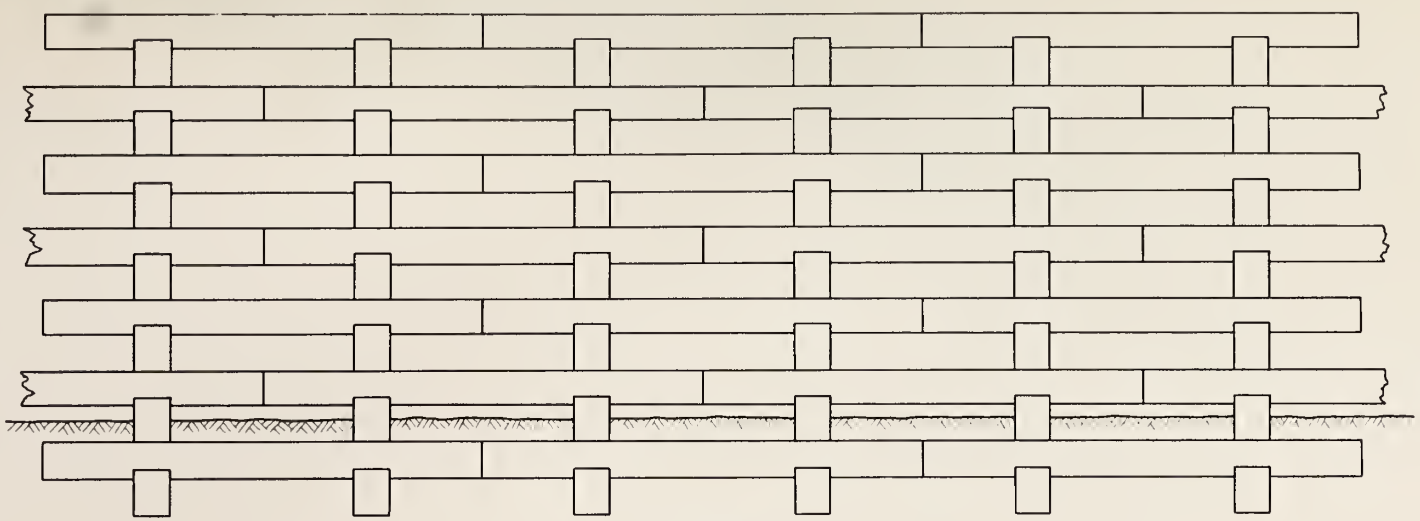
CONTENTS

CONCRETE CRIBBING USED AS RETAINING WALL IN CONNECTICUT

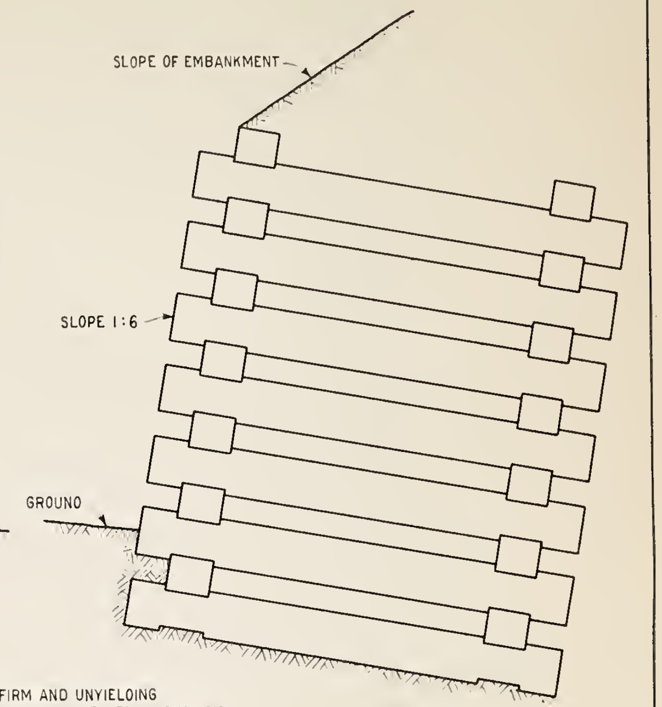
CONTRIBUTED BY H. G. McKELVEY OF THE DIVISION OF CONSTRUCTION

CONCRETE CRIBBING, AS SHOWN IN THE ACCOMPANYING ILLUSTRATION, IS USED TO A CONSIDERABLE EXTENT BY THE CONNECTICUT STATE HIGHWAY COMMISSION AS A SUBSTITUTE FOR THE CUSTOMARY CONCRETE RETAINING WALL. THE CRIBBING TYPE OF CONSTRUCTION COSTS LESS, AND IS EASIER TO INSTALL, THAN A SOLID WALL. IT MAY BE USED EITHER TO RETAIN THE EMBANKMENT, OR THE SIDE SLOPE OF A ROAD IN EXCAVATION. IF THE CRIBBING IS NOT PLACED TO A SATISFACTORY HEIGHT WHEN FIRST BUILT; IT MAY, LATER, BE ADDED TO WITH LITTLE TROUBLE. IF THE SECTION OF ROAD, ON WHICH THE CRIBBING HAS BEEN USED, IS ABANDONED;

OR IF FOR ANY REASON, THE CRIBBING IS FOUND TO BE NO LONGER NECESSARY; THE TIES AND THE STRINGERS MAY BE REMOVED AT A MODERATE COST AND USED ELSEWHERE. THE INSTALLATION OF THE CRIBBING MAY BE ACCOMPLISHED BY A PICK-AND-SHOVEL CREW.



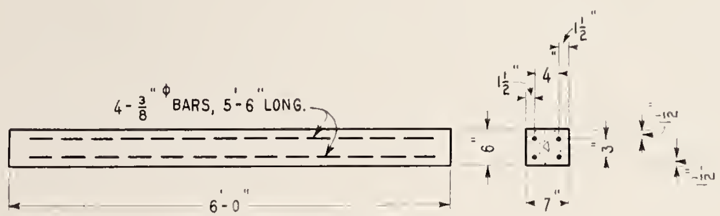
ELEVATION



FOUNDATION TO BE FIRM AND UNYIELDING AND MUST BE APPROVED BEFORE CRIBBING IS LAID.

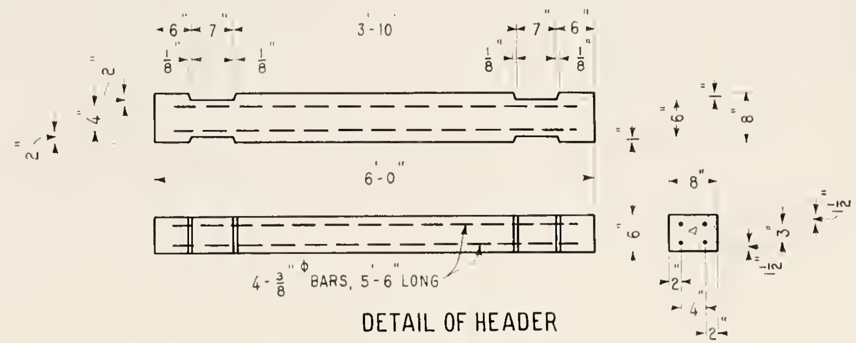
CROSS-SECTION

CRIBBING SHOULD BE FILLED WITH APPROVED MATERIAL IN LAYERS NOT OVER 12" THICK AND TAMPED IN A SATISFACTORY MANNER. THE ERECTION OF THE CRIBBING AND THE PLACING AND COMPACTING OF THE FILL SHOULD PROGRESS SIMULTANEOUSLY.



DETAIL OF STRETCHER

MATERIAL FOR ONE STRETCHER
1.75 CU FT. CLASS "A" CONCRETE.
8.3 LBS. REINFORCING STEEL.

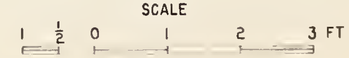


DETAIL OF HEADER

MATERIAL FOR ONE HEADER
1.90 CU FT CLASS "A" CONCRETE.
8.3 LBS REINFORCING STEEL.

NOTE:
ALL CONCRETE TO BE CLASS "A" (1:2:4 MIX).
REINFORCING STEEL TO BE DEFORMED BARS OF AN APPROVED TYPE;
LEAST CROSS-SECTIONAL AREA EQUAL TO A PLAIN BAR OF THE SIZE SHOWN.

TYPICAL CONCRETE CRIBBING



The ties and stringers are cast, during the summer, at the State's repair shops. They cost about $1.25 each. A supply of some 12,000 of the beams are maintained in storage to take care of any emergency that may develop.

A UNIQUE CONTRIVANCE FOR SCREENING AND LOADING GRAVEL SURFACING

Contributed by G. L. McLane, Associate Highway Engineer of District 2

A unique contrivance, for screening and loading gravel, was used in placing a comparatively small amount of surfacing on the Telegraph Pass Cut-off Federal-aid project, on the Phoenix-Yuma, Ariz., route. The contrivance, illustrated in the accompanying photograph, consisted

of a hopper, grizzly, and chute, supported by six wooden posts. A power shovel, which had recently completed the heavy rock cuts on the project, was used to excavate the gravel from an alluvial deposit, and place it in the hopper. The gravel pit, adjacent to the slope of a 15 to 20-foot cut, was satisfactory, except for the large percentage of over-size material.

The contractor believed that it would be economical to waste the over-size material provided the cost of handling could be reduced to a reasonable figure. The accuracy of the contractor's judgment was confirmed by the performance of the screening and loading device. The plant loaded 25 cubic yards of surfacing an hour. To accomplish this it was necessary to handle 34 to 38 cubic yards of pit-run material. The screened surfacing fell through the grizzly into the loading truck beneath; while the over-size material ran from the end of the chute into another truck, in which it was hauled a few hundred feet and then dumped to widen the embankment.

Crushed surfacing-material has been used only recently on Arizona projects; since it has been discovered that, in some cases, the cost of removing the over-size pit-run material, with fresnoes and teams, is in excess of the crushing charges. The use of pit-run material, in the special contrivance just described, effected a greater economy for the small amount of work done than would have been possible with a crushing plant.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

STATUS OF CURRENT FEDERAL AID ROAD WORK

FOR THE FISCAL YEAR ENDING JUNE 30, 1927

AS OF JUNE 30, 1927

[illegible]
M-JUNE, 1927 - A

STATES	BALANCE OF FEDERAL AID FUND AVAILABLE FOR NEW PROJECTS	* UNDER CONSTRUCTION			APPROVED FOR CONSTRUCTION			AMOUNT PAID STATES DURING FISCAL YEAR	COMPLETED AND PAID DURING FISCAL YEAR			AGREEMENTS NOW IN FORCE			P.S.& E. RECOMMENDED FOR APPROVAL BY DISTRICT ENGINEER			STATES
		Federal Aid	Miles Original	Miles Stage	Federal Aid	Miles Original	Miles Stage		Federal Aid	Miles Original	Miles Stage	Federal Aid	Miles Original	Miles Stage	Federal Aid	Miles Original	Miles Stage	
ALABAMA	$ 3,021,963.07	$ 3,219,304.80	393.7	1.9	$ 40,307.19	1.9		$ 1,206,220.03	$ 889,114.85	101.9	4.6	$ 3,210,396.64	392.1	1.9	$ 49,215.35	3.6		ALABAMA
ARIZONA	2,918,225.82	961,236.28	62.7	4.4	347,611.63	19.1		721,244.42	583,396.92	71.0	0.4	1,291,583.47	81.8	4.4	17,264.44			ARIZONA
ARKANSAS	1,687,863.31	1,386,642.91	211.5		284,001.03	19.4		986,717.98	1,858,494.40	237.6		1,400,285.52	221.9		270,358.42	9.0		ARKANSAS
CALIFORNIA	4,106,482.13	3,420,728.79	151.4	0.4	62,014.26	4.5		2,978,864 97	3,963,434.52	248.3	17.3	3,454,295.68	155.5	0.4	28,447.37	0.4		CALIFORNIA
COLORADO	2,673,436.36	3,074,539.39	276.1	9.1	20,057.34	2.9		1,289,506.73	807,010.73	84.0		2,566,804.38	222.6	9.1	527,792.35	56.4		COLORADO
CONNECTICUT	694,246.11	1,478,079.22	63.9		290,040.13	13.0		613,841.51	343,414.74	20.2		1,661,903.24	70.2		106,216.11	6.7		CONNECTICUT
DELAWARE	47,867.01	312,891.57	32.9	1.8	133,352.00	11.0		450,337.15	563,906.82	35.2		291,954.57	32.9		154,289.00	11.0	1.9	DELAWARE
FLORIDA	1,060,766.31	3,897,634.31	196.3	24.8	398,091.78	24.2		1,434,043.79	1,803,550.28	112.2		3,539,607.71	190.3	24.8	756,116.38	30.2		FLORIDA
GEORGIA	1,220,263.91	3,985,165.58	333.7	100.1	104,500.11	0.3	8.0	2,535,285.99	3,436,994.54	379.6	63.3	3,904,311.67	324.4	100.1	185,354.02	9.6	8.0	GEORGIA
IDAHO	639,297.36	1,650,659.48	199.1	17.4	129,336.00	9.3	0.1	1,235,844.70	1,193,414.46	110.8	13.1	1,405,945.79	181.9	16.6	374,049.69	26.5	0.8	IDAHO
ILLINOIS	2,702,710.43	4,867,016.84	356.8		2,635,383.13	167.0		2,427,392.92	2,161,520.86	153 1	2.0	4,119,966.92	308.7		3,382,433.05	234.1		ILLINOIS
INDIANA	379,107.70	7,567,438.31	476.9		946,012.79	68.8	0.6	2,055,735.74	3,066,443.01	198.2	11.6	7,510,169.15	476.9		1,003,281.95	68.8	0.6	INDIANA
IOWA	149,842.89	6,290,951.47	564.6	222.3	694,163.89	44.1	7.7	2,845,968.50	2,469,301.65	369.6	74.3	6,943,957.73	608.7	227.0	41,157.63		3.0	IOWA
KANSAS	476,499.72	5,739,789.74	684.6	7.6	585,824.06	167.0	1.1	2,730,002.55	2,140,340.23	334.6	0.1	4,033,202.87	612.4	8.4	1,492,410.93	239.2	0.3	KANSAS
KENTUCKY	284,075.88	4,494,951.93	416.6	52.8	341,033.44	42.8	4.8	1,420,029.31	1,018,612.50	116.6	14.6	4,351,257.51	417.8	57.6	484,727.86	41.5		KENTUCKY
LOUISIANA	947,557.36	1,935,266.43	140.9		309,000.00	0.9		1,124,562.53	949,152.22	122.8		1,935,266.43	140.9		309,000.00	0.9		LOUISIANA
MAINE	1,250,418.90	992,794.43	74.8		43,956.00	5.6		878,953.95	665,945.28	54.0		1,036,750.43	80.4					MAINE
MARYLAND	87,252.09	373,185.64	33.9		574,800.00	66.6		650,106.91	411,947.05	54.5		373,185.64	33.9		574,800.00	66.6		MARYLAND
MASSACHUSETTS	2,196,417.16	1,540,245.69	92.9		35,235.00	2.3		799,464.35	768,667.53	35.9		1,397,364.57	85.1		178,416.12	10.1		MASSACHUSETTS
MICHIGAN	2,235,102.66	5,428,748.35	365.3	12.6	664,720.00	26.3	6.5	2,692,098.35	2,501,432.69	121.2	25.7	4,994,642.35	356.6	12.8	999,826.00	36.0	6.5	MICHIGAN
MINNESOTA	550,476.43	2,112,898.90	370.0	115.7	3,000.00	19.4		2,690,339.01	3,460,029.11	461.6	114.6	2,105,898.90	387.1	115.7	10,000.00	2.3		MINNESOTA
MISSISSIPPI	777,765.71	3,268,980.98	383.7	14.8	384,875.69	65.2	14.6	1,589,120.64	1,589,760.52	135.1		2,733,313.39	301.4		870,523.28	127.5	29.3	MISSISSIPPI
MISSOURI	988,766.43	3,833,292.27	268.8	47.2	688,525 82	68.4	0.3	4,099,338.56	5,945,011.63	401.6	29.6	3,868,675.58	311.2	37.3	653,142.41	24.0	10.2	MISSOURI
MONTANA	4,387,225.96	1,426,969.48	129.8	5.7	1,874,899.88	305.9	3.4	894,779.83	953,822.80	96.7	62.6	3,199,376.63	425.6	9.0	162,432.53	15.1		MONTANA
NEBRASKA	1,072,492.57	6,216,961.27	1305.1	639.1	1,191,542.77	186.6	227.5	2,370,258.28	2,265,183.87	478.3	238.6	6,190,589.35	1262.5	750.4	1,227,904.69	209.2	166.2	NEBRASKA
NEVADA	840,196.65	1,314,359.67	182.7	26.2				1,083,652.86	2,458,234.09	314.8	11.0	1,306,743.96	182.7	26.2	8,615.72			NEVADA
NEW HAMPSHIRE	142,799.26	460,853.90	30.8		152,536.79	8.8		424,768.85	401,477.98	27.2		449,707.28	30.1		163,682.41	9.6		NEW HAMPSHIRE
NEW JERSEY	117,647.96	1,700,398.66	111.3		88,620.00	5.9		732,592.69	2,397,022.27	26.0		1,414,258.56	92.2		374,760.00	25.0		NEW JERSEY
NEW MEXICO	1,635,135.72	2,686,415.22	233.6					1,110,390.27	597,940.68	78.2		1,913,834.29	216.1		667,580.93	17.5		NEW MEXICO
NEW YORK	4,100,934.90	9,416,593.95	579.8		2,468,927.50	155.6	8.6	4,367,134.87	3,781,998.46	242.3		10,806,428.95	668.4		1,079,092.50	67.0	8.6	NEW YORK
NORTH CAROLINA	965,763.17	1,296,705.92	87.6		649,189.75	36.8	27.9	2,441,688.30	3,341,565.22	202.2	37.5	1,296,705.92	87.6		649,189.76	36.8	27.9	NORTH CAROLINA
NORTH DAKOTA	440,187.20	2,825,402.95	738.9	160.8	931,726.17	320.8	249.6	2,530,261.21	1,714,433.90	522.5	362.9	2,940,743.64	714.8	309.1	816,385.48	344.9	101.3	NORTH DAKOTA
OHIO	4,351,646.92	4,484,341.32	334.3	4.2	326,640.00	20.8		2,580,502.50	1,959,589.73	150.9	13.4	4,366,289.62	326.0	4.2	444,691.70	29.1		OHIO
OKLAHOMA	1,494,408.94	1,714,249.20	261.2	23.0	485,430.65	71.5	15.6	1,339,252.44	957,590.06	89.2	10.1	2,003,622.45	272.3	38.6	196,057.40	50.4		OKLAHOMA
OREGON	718,329.08	1,276,070.18	62.4	35.8	25,696.80	9.9		1,301,855.33	1,448,238.15	115.8		1,212,761.93	67.6	35.8	89,005.05	4.8		OREGON
PENNSYLVANIA	2,219,530.44	4,890,636.70	323.1		1,246,728.54	64.2		3,180,313.25	4,756,888.28	345.5		5,226,777.77	343.0		910,587.47	44.3		PENNSYLVANIA
RHODE ISLAND	643,321.20	338,055.00	22.6		153,338.74	9.3		466,586.24	439,650.00	29.3		443,475.00	29.6		47,918.74	2.3		RHODE ISLAND
SOUTH CAROLINA	400,621.80	2,799,135.49	235.8	19.2	129,766.91	22.9		1,187,023.41	760,665.87	86.5	15.4	2,589,157.51	220.5	14.0	339,743.89	38.2		SOUTH CAROLINA
SOUTH DAKOTA	572,660.78	1,913,591.91	623.6	38.2	393,185.77	131.5	80.5	1,074,687.39	903,698.57	321.7	154.4	2,009,474.41	681.3	72.7	297,303.27	73.8	46.0	SOUTH DAKOTA
TENNESSEE	1,729,212.38	3,614,687.07	226.7	60.4				1,793,804.55	1,274,873.53	88.7	19.1	3,278,903.78	202.7	42.8	335,783.29	23.0	17.6	TENNESSEE
TEXAS	6,185,704.19	6,770,640.89	535.1	200.2	580,397.47	54.7	28.1	4,710,228.42	4,126,705.73	546.2	39.8	6,874,147.13	524.8	212.9	476,891.23	65.0	15.4	TEXAS
UTAH	711,346.79	1,748,044.39	173.6		439,213.87	37.6		830,082.69	668,639.27	82.5		1,690,968.53	172.2		496,289.73	38.9		UTAH
VERMONT	42,607.86	819,113.52	41.7		423,554.61	27.4		625,423.73	331,166.60	18.2		715,793.52	34.8		526,874.61	34.3		VERMONT
VIRGINIA	74,673.64	1,976,028.87	109.4		357,382.24	19.0	4.0	1,868,896.29	2,151,416.14	163.4		2,039,623.15	111.3	4.0	292,787.96	17.1		VIRGINIA
WASHINGTON	1,215,156.05	1,750,600.00	68.2		66,000.00	10.1		1,146,672.36	463,642.49	42.5		1,770,600.00	71.8		45,000.00	6.5		WASHINGTON
WEST VIRGINIA	312,470.32	2,934,191.85	238.2	12.0	325,736.82	26.9		648,202.63	432,685.36	26.6		2,841,704.96	237.1	12.0	418,223.71	28.0		WEST VIRGINIA
WISCONSIN	2,660,332.30	4,592,758.80	375.5	36.2	308,320.00	19.4	16.2	2,357,068.64	1,465,153.17	137.4	7.8	4,115,089.80	336.3	31.0	785,989.00	58.6	19.4	WISCONSIN
WYOMING	804,279.00	1,557,096.95	177.5	66.9				696,804.42	1,098,380.00	182.4	32.8	1,083,316.66	111.6	33.7	473,781.29	65.9	32.2	WYOMING
HAWAII	805,975.36	562,362.64	29.7					253,061.09	97,440.00	6.5		562,362.64	29.7					HAWAII
TOTALS	$ 69,440,956.18	$142,817,679.01	13355.1	1968.8	$ 22,233,674.67	2395.8	704.1	$ 81,371,013.03	$ 83,828,987.66	8431.0	1376.6	$141,316,896.87	$13442.2	2162.3	$ 23,734,456.71	2308.6	495.2	TOTALS

* INCLUDES PROJECTS REPORTED COMPLETED (FINAL VOUCHERS NOT YET PAID) TOTALING: FEDERAL AID $34,877,220.48; MILEAGE ORIGINAL 3262.1; MILES STAGE 746.5

(Not for release)

COMMENTS ON THE 1927 MEETING OF THE A. S. T. M.

Contributed by F. H. Jackson of the Division of Tests

The 30th annual meeting of the American Society for Testing Materials, held at the French Lick Springs Hotel, French Lick, Indiana, during the week of June 20-25, was a memorable one in several respects. The meeting, in addition to marking the twenty-fifth anniversary of the incorporation of the society, was the first ever held west of the Allegheny mountains. For this reason, a considerably larger proportion of the western members than usual attended the various sessions. Highway testing engineers from most of the Mississippi Valley States were in attendance. The Bureau was represented by Messrs. E. F. Kelley, L. W. Teller, F. H. Jackson, and W. J. Emmons, of the Division of Tests.

In addition to the many features of general interest to the representatives of the Bureau, there were several sessions and many committee meetings dealing with subjects of direct interest to the highway engineer. Of perhaps outstanding interest may be mentioned the symposium, on "Field Control of the Quality of Concrete", presented during the final session. Several papers dealing with particular phases of this problem were presented by outstanding authorities such as D. A. Abrams, H. S. Mattimore, R. B. Young, and R. W. Crum. A very interesting discussion followed the presentation of the symposium. This discussion centered largely on what constitutes the most significant strength test for concrete. The subject is of considerable importance to the highway testing engineer at the present time.

Other sessions of interest included the sessions on cement, road materials, corrosion of metals, etc. At these sessions several changes in the standard methods of testing road materials were approved. These included changes in the standard method of making the mechanical analysis of sand, the standard method of test for the distillation of bituminous materials, the standard method of test for the unit weight of aggregates for

CONCRETE, THE STANDARD METHOD OF MAKING AND STORING CONCRETE IN THE FIELD, THE STANDARD METHOD OF TESTS FOR VOIDS IN FINE AGGREGATE FOR CONCRETE, AND THE STANDARD METHOD OF MAKING THE COMPRESSION TEST OF CONCRETE.

AT THE MEETING OF THE COMMITTEE ON CEMENT, THE RESULTS OF PROBABLY THE LARGEST SERIES OF CHECK TESTS OF CEMENT, EVER CONDUCTED IN THIS COUNTRY, WERE PRESENTED BY MR. H. F. GONNERMAN OF THE PORTLAND CEMENT ASSOCIATION. THESE TESTS WERE MADE BY OVER FORTY TESTING LABORATORIES, ON THIRTY-TWO BRANDS OF PORTLAND CEMENT, FOR THE PURPOSE OF DETERMINING THE RELATIVE CONCORDANCE OF THE PRESENT STANDARD METHODS OF TESTING AS COMPARED TO A PROPOSED METHOD OF TEST, WHICH INVOLVES THE USE OF NEAT CEMENT OF FLUID CONSISTENCY IN THE FORM OF A 2-INCH CUBE, INSTEAD OF THE STANDARD BRIQUETTE. A DETAILED REPORT OF THE RESULTS OF THESE TESTS WILL BE PUBLISHED IN THE NEAR FUTURE.

ANOTHER MEETING OF INTEREST TO HIGHWAY ENGINEERS WAS THE ORGANIZATION MEETING OF THE NEWLY FORMED SUBCOMMITTEE ON SCREENS OF THE COMMITTEE ON METHODS OF TESTS. THIS COMMITTEE HAS BEEN CHARGED WITH THE DUTY OF STANDARDIZING, IF POSSIBLE, THE SHAPE OF THE APERTURE IN TESTING SCREENS FOR LARGE-SIZED AGGREGATES, SUCH AS CRUSHED STONE, SLAG, GRAVEL, ETC. ALL TESTING ENGINEERS ARE FAMILIAR WITH THE CONFUSION RESULTING FROM THE PRESENT METHOD OF HAVING BOTH ROUND-HOLE AND SQUARE-MESH SIEVES IN USE.

UNITED STATES DEPARTMENT OF AGRICULTURE
BUREAU OF PUBLIC ROADS

M-1 (1926)
R S A

STATE HIGHWAY SYSTEMS (1)

MILEAGE BUILT TO GRADE AND MILES SURFACED DURING 1926 (2)

STATES. (YEAR ENDS DECEMBER 31 EXCEPT AS NOTED)	TOTAL OF MILES GRADED & MILES SURFACED	EARTH IMPROVED GRADED & DRAINED (4)	NEW SURFACING PLACED (3)				SAND-CLAY AND TOP SOIL		GRAVEL, ETC. TREATED AND UNTREATED		WATERBOUND MACADAM TREATED & UNTREATED		BITUMINOUS MACADAM BY PENETRATION		SHEET ASPHALT		BITUMINOUS CONCRETE		PORTLAND CEMENT CONCRETE		VITRIFIED BRICK		BLOCK: ASPHALT, WOOD, STONE	REVISION OF SURFACED MILEAGE (6)	STATES
			TOTAL — (5)	ON EARTH ROADS (5)	ON WORN OUT: OTHER TYPES	ON WORN OUT: SAME TYPE (RECON)	NEW	RECON.	NEW	RECON.	NEW	RECON	NEW	RECON	NEW	RECON	NEW	RECON	NEW	RECON	NEW	RECON	RECON.		
ALABAMA (7)	495.9	28.7	467.2	346.5	113.7	7.0	44.0	-	350.3	7.0	-	-	7.9	-	-	-	0.3	-	57.7	-	-	-	-	-7.0	ALABAMA
ARIZONA	113.3	38.3	75.0	60.8	9.0	6.2	-	-	59.2	5.2	-	-	9.5	-	-	-	4.0	-	1.0	-	-	-	-	- 91.8	ARIZONA
ARKANSAS	874.0	516.0	358.0	358.0	-	-	-	-	429.0	-	-	-	-	-	-	-	-	-	2.0	-	-	-	-	-	ARKANSAS
CALIFORNIA	265.4	-	265.4	188.9	65.1	41.4	-	-	164.7	15.5	-	-	2.1	6.9	-	-	35.3	5.3	21.9	13.7	-	-	-	-4.3	CALIFORNIA
COLORADO	406.9	111.6	293.3	42.5	26.7	226.1	6.9	-	35.6	226.1	-	-	-	-	-	-	-	-	26.7	-	-	-	-	-	COLORADO
CONNECTICUT (8)	200.6	0.6	200.0	107.5	73.7	18.8	-	-	1.7	2.3	90.8	13.8	27.1	-	-	-	25.5	2.7	36.0	-	0.1	-	-	-13.2	CONNECTICUT
DELAWARE	84.8		84.8	79.8	5.0	-	-	-	22.0	-	-	-	-	-	5.8	-	1.0	-	56.0	-	-	-	-	+ 5.0	DELAWARE
FLORIDA	358.0	8.5	349.5	257.0	90.2	2.3	126.1	-	-	-	186.8	-	1.3	-	16.5	2.3	0.2	-	16.3	-	-	-	-	-76.6	FLORIDA
GEORGIA	386.7	59.1	327.6	192.5	73.0	62.1	104.9	-	89.0	62.1	-	-	27.4	-	11.9	-	-	-	32.3	-	-	-	-	- 0.5	GEORGIA
IDAHO	373.0	103.6	289.4	241.2	22.1	8.1	-	-	232.6	6.1	-	-	-	-	-	-	27.3	-	3.4	-	-	-	-	-	IDAHO
ILLINOIS	407.5	45.7	361.8	358.6	0.1	3.1	-	-	-	-	-	-	-	-	-	-	-	-	352.3	3.1	6.4	-	-	-	ILLINOIS
INDIANA	388.1	9.4	378.7	88.2	211.2	77.3	-	-	5.4	40.8	57.9	38.5	38.9	-	-	-	2.2	-	195.0	-	-	-	-	+206.7	INDIANA
IOWA	993.8	495.1	498.7	447.0	18.7	35.0	-	-	372.6	35.0	-	-	-	-	-	-	-	-	91.1	-	-	-	-	- 6.8	IOWA
KANSAS	1,475.5	(9)1,072.0	403.5	375.7	-	27.8	255.0	-	38.0	-	-	-	10.0	27.9	-	-	-	-	57.0	-	15.7	-	-	-	KANSAS
KENTUCKY (8)	434.8	237.2	197.8	91.9	32.2	73.5	-	-	62.3	27.2	1.7	46.3	24.9	-	-	-	-	-	36.2	-	-	-	-	+1,827.9	KENTUCKY
LOUISIANA	594.5	-	594.5	586.0	8.5	-	-	-	578.7	-	-	-	-	-	0.5	-	13.3	-	2.0	-	-	-	-	+ 299.5	LOUISIANA
MAINE	135.1	-	135.1	87.4	22.3	25.4	-	-	69.7	25.4	-	-	23.1	-	-	-	-	-	16.9	-	-	-	-	-	MAINE
MARYLAND (7)	148.1	-	148.1	126.4	19.1	2.6	-	-	23.6	-	19.6	1.1	-	-	3.3	-	12.6	-	86.4	1.5	-	-	-	+ 17.6	MARYLAND
MASSACHUSETTS (10)	102.8	-	102.8	8.8	76.1	17.9	-	-	0.5	0.6	-	-	41.7	16.9	-	-	12.6	0.1	30.1	-	-	-	(11) 0.4	+ 13.0	MASSACHUSETTS
MICHIGAN	354.1	-	354.1	208.8	128.0	19.3	-	-	138.6	15.2	-	0.1	0.6	-	-	-	22.1	-	173.5	4.0	-	-	-	- 5.1	MICHIGAN
MINNESOTA	1,727.8	315.8	1,412.0	443.5	180.2	788.3	-	-	443.5	788.3	-	-	-	-	-	-	4.9	-	174.9	-	0.4	-	-	- 68.7	MINNESOTA
MISSISSIPPI	584.3	125.7	458.6	453.5	1.1	4.0	-	-	439.8	4.0	-	-	-	-	0.3	-	-	-	14.7	-	-	-	-	+695.8	MISSISSIPPI
MISSOURI	1,187.2	344.5	822.7	822.7	-	-	-	-	342.7	-	-	-	-	-	-	-	-	--	480.0	-	-	-	-	-	MISSOURI
MONTANA	124.2	5.0	119.2	67.5	-	51.7	-	-	101.7	51.7	-	--	-	-	-	-	1.5	-	-	-	-	-	-	-	MONTANA
NEBRASKA	1,476.9	642.1	833.8	833.8	-	-	128.5	-	693.3	-	-	-	-	-	0.5	-	1.3	-	10.2	-	-	-	-	-	NEBRASKA
NEVADA	200.3	10.6	189.7	151.7	-	38.0	-	-	151.7	38.0	-	-	-	-	-	-	-	-	-	-	-	-	-	-2.7	NEVADA
NEW HAMPSHIRE	185.7	16.3	169.4	139.8	21.7	7.9	-	-	129.6	7.6	8.8	-	15.0	-	-	-	5.4	0.3	2.7	-	-	-	-	+ 2.2	NEW HAMPSHIRE
NEW JERSEY	63.7	3.2	50.5	-	50.5	-	-	-	-	-	-	-	-	-	0.4	-	-	-	60.1	-	-	-	-	+115.0	NEW JERSEY
NEW MEXICO	481.9	408.0	73.9	68.6	0.3	5.0	-	-	67.0	5.0	-	-	-	-	-	-	-	-	1.9	-	-	-	-	-	NEW MEXICO
NEW YORK	581.3	15.7	565.8	286.4	264.2	15.0	-	-	21.2	-	3.5	-	40.3	15.0	-	-	8.2	-	477.4	-	-	-	-	-	NEW YORK
NORTH CAROLINA	1,091.6	395.4	696.2	72.4	623.8	-	78.1	-	14.1	-	21.4	-	60.1	-	2.4	-	82.5	-	437.6	-	-	-	-	-	NORTH CAROLINA
NORTH DAKOTA	977.3	437.9	539.4	531.9	-	7.6	-	-	529.5	7.5	-	-	-	-	0.7	-	-	-	1.7	-	-	-	-	-	NORTH DAKOTA
OHIO	2,480.9	69.6	2,411.2	1,426.9	436.8	648.5	-	-	1,483.3	229.5	42.4	177.4	122.1	46.2	7.3	1.0	11.6	2.8	142.4	39.8	53.6	52.0	-	+939.9	OHIO
OKLAHOMA	436.5	200.4	236.1	236.1	-	-	-	-	129.4	-	-	-	-	-	-	-	-	-	102.6	-	4.2	-	-	-	OKLAHOMA
OREGON	374.6	81.0	293.6	240.4	13.1	40.1	-	-	776.6	40.1	-	-	-	-	-	-	3.3	-	9.7	-	-	-	-	- 28.4	OREGON
PENNSYLVANIA	1,045.0	293.7	751.3	504.2	178.2	68.9	-	-	12.6	3.3	214.4	59.9	12.9	0.4	0.2	4.8	10.7	0.1	430.8	0.3	0.8	0.1	-	+392.8	PENNSYLVANIA
RHODE ISLAND	49.9	-	49.9	31.7	18.2	-	-	-	3.5	-	6.9	-	19.9	-	1.8	-	2.6	-	15.2	-	-	-	-	+ 14.0	RHODE ISLAND
SOUTH CAROLINA	632.0	47.9	584.1	467.8	100.3	16.0	345.4	-	150.4	16.0	-	-	-	-	9.1	-	38.2	-	25.0	-	-	-	-	+181.3	SOUTH CAROLINA
SOUTH DAKOTA	472.9	28.1	444.8	442.9	1.9	(12)	-	-	442.9	(12)	-	-	-	-	-	-	-	-	1.9	-	-	-	-	+ 1.9	SOUTH DAKOTA
TENNESSEE	472.7	181.0	291.7	218.3	73.4	-	-	-	42.4	-	28.0	-	88.7	-	-	-	8.1	-	144.5	-	-	-	-	+ 6.7	TENNESSEE
TEXAS	969.0	471.9	497.1	474.9	22.2	-	-	-	195.6	-	11.1	-	186.3	-	4.3	-	22.5	-	77.3	-	-	-	-	-	TEXAS
UTAH	180.4	30.4	150.0	131.8	-	18.2	-	-	131.1	18.2	-	-	-	-	0.2	-	-	-	0.5	-	-	-	-	-0.7	UTAH
VERMONT	139.0	-	139.0	124.0	-	15.0	-	-	100.0	15.0	-	-	7.5	-	-	-	-	-	16.5	-	-	-	-	+ 15.0	VERMONT
VIRGINIA	187.4	21.6	165.8	165.8	-	-	23.9	-	9.0	-	16.6	-	64.4	-	-	-	-	-	61.9	-	-	-	-	+113.2	VIRGINIA
WASHINGTON	126.7	30.5	96.2	64.6	28.8	4.8	-	-	73.7	3.3	-	-	5.8	-	1.5	-	-	-	10.4	1.5	-	-	-	+ 0.4	WASHINGTON
WEST VIRGINIA	494.0	-	494.0	469.6	16.7	7.7	-	-	162.7	-	-	-	203.3	4.6	-	-	12.5	-	107.8	-	-	3.1	-	-	WEST VIRGINIA
WISCONSIN	1,016.2	54.2	962.0	442.4	162.6	357.1	19.9	3.6	299.0	343.5	33.2	10.0	3.8	-	-	-	-	-	249.0	-	-	-	-	-	WISCONSIN
WYOMING	233.1	103.7	129.4	128.0	-	1.4	-	-	129.4	1.4	-	-	-	-	-	-	-	-	-	-	-	-	-	-0.7	WYOMING
TOTALS	26,652.3	7,060.0	19,492.3	13,663.7	3,182.6	2,646.0	1,132.7	3.6	9,748.0	2,040.9	743.1	345.1	1,014.6	117.7	66.7	8.1	369.7	11.1	4,339.4	63.9	81.2	55.2	0.4	+4,541.4	TOTALS

NOTES:
(1) HIGHWAYS UNDER CONTROL OF STATE HIGHWAY DEPARTMENTS ONLY.
(2) MILEAGE OF NEW SURFACING PLACED AND RECONSTRUCTED SURFACES SHOWN.
(3) THE FOUR COLUMNS BELOW SHOW TOTAL SURFACING PLACED DURING YEAR: MADE UP OF NEW SURFACE ON EARTH ROADS AND REPLACEMENT OF WORN OUT SURFACES, PART OF LATTER ON OTHER TYPE SURFACES AND PART AS RECONSTRUCTION OF SAME TYPE.
(4) ROADS FULLY IMPROVED TO AN ESTABLISHED GRADE AND DRAINED, READY TO SURFACE.
(5) THE NET INCREASE OF SYSTEM SURFACED MILEAGE IS REPRESENTED BY THE NEW SURFACING PLACED ON EARTH ROADS WITH ADDITIONS OR DEDUCTIONS SHOWN IN THE LAST COLUMN.
(6) THESE REVISIONS ARE COMBINATIONS OF SURFACED MILEAGE RESULTING FROM (a) LEGAL ADDITIONS TO SYSTEM (b) RELOCATION OF ROADS IN CONSTRUCTION AND (c) CORRECTIONS DUE TO RESURVEY.
(7) MILEAGE AS OF SEPTEMBER 30, 1926.
(8) MILEAGE AS OF JUNE 30, 1926.
(9) LARGE AMOUNT DUE TO LOW COST CONSTRUCTION IN WESTERN KANSAS.
(10) MILEAGE AS OF NOVEMBER 30, 1926.
(11) STONE BLOCK PAVEMENT RECONSTRUCTION
(12) REPORTED 1010.7 MILES OF LIGHT RECONSTRUCTION. NOT RECORDED HERE.

(Not for release)

HAWAIIAN CONCRETE PAVEMENT BUILT WITH RAIN SHEDS

Contributed by H.G. McKelvey of the Division of Construction

Compiled from a report submitted by E. S. Wheeler, Senior Highway

Engineer in charge of the Bureau's work in Hawaii

Rain sheds were used to protect the pavement and workmen, during unfavorable weather, in the construction of the Volcano Road - Hawaii Federal-aid project 2-B - in the district of Puna. The pavement consisted of 6.5 miles of plain concrete, 16 feet wide, and with an 8-5-8 cross section. The project terminates near the Kilauea Crater, in the southeastern sector of the territory, and forms part of a belt highway, skirting the shore-line of the Island of Hawaii.

The rainfall, which was almost incessant during part of the construction, was of such volume that some sort of protection was necessary to prevent interruption of the work. To overcome possible delays caused by the inclement weather, the contractor built a moveable shed, large enough to house the paver and finisher, and also a train of lower shed units. All of the sheds were run on rollers, bearing on the side forms, and were pulled forward at the proper time by the paver. This arrangement of moveable sheds provided cover for the laborers, and protected the green concrete until such time as the surface could not be pitted by rain; when the coat of curing soil could be applied.

The forward large shed was constructed 16 feet high in the clear, 50 feet long, and of the same width as the pavement, as shown in Figure 1-(Top). The shed was mounted on flanged wheels, gauged to fit the side forms. This main shed was large enough to house the entire mixing and finishing equipment, in addition to the laborers. For further protection, against wind and rain entering from the sides and ends, awnings were provided on three sides.

Following the large main shed and connected to it by cables was a train of 8 lower protective sheds, (figure 1-bottom), each 30 feet long and 2 feet 6 inches high, mounted in the same manner as the large shed, and covered with a cheap quality of roofing material. These minor sheds were of the flat A-type construction

FIGURE 1-(TOP)- MAIN RAIN SHED USED FOR HOUSING THE MIXER, FINISHER, AND CREW.

(BOTTOM)- TRAIN OF SMALLER SHEDS, FOLLOWING THE MAIN SHED AND PROTECTING THE CONCRETE, UNTIL THE CONCRETE IS HARD ENOUGH TO RESIST PITTING [illegible] RAINFALL.

AND RESTED UPON LIGHT BRIDGING, PARALLEL TO THE AXIS OF THE ROAD. IN ORDER TO MAKE LAPPING POSSIBLE, EVERY ALTERNATE SHED WAS MADE 6 INCHES HIGHER THAN THE ADJACENT SHEDS. THE SHEDS WERE CABLED TOGETHER AND, AS THE PAVEMENT WAS LAID, THE ENTIRE TRAIN WAS HOOKED TO THE PAVER, OR FINISHER, AND MOVED FORWARD THE REQUIRED DISTANCE. WHERE THE GRADE WAS STEEP ENOUGH, FOR THE TRAIN TO BE MOVED BY GRAVITY, CARE WAS TAKEN TO CHOCK THE WHEELS OF THE SHEDS AFTER EVERY MOVE. IN ORDER THAT THE TRAIN MIGHT FUNCTION SMOOTHLY, AND NOT LEAVE THE SIDE FORMS, THE SHEDS WERE BUILT FAIRLY RIGID AND THE FORMS SET TRUE TO LINE AND GRADE.

IN APRIL AND MAY OF THIS YEAR, ALTHOUGH IT RAINED DAILY DURING THE CONSTRUCTION OF A PORTION OF THE PAVEMENT, NO TIME WAS LOST DUE TO WEATHER CONDITIONS, BECAUSE OF THE ADEQUATE PROTECTION AFFORDED BY THE SHEDS.

(Not for release)

STATUS OF UNITED STATES ROUTES 75 AND 85

Contributed by F. W. Mills of the Division of Design

United States Route 75 is 71 per cent improved with gravel and the higher types of surfacing. Another 22 per cent consists of earth, and graded and drained roads, and the balance is unimproved. There are no large mileages of continuously-surfaced road on the route. The total length of the route - which almost bisects the United States in a north-and-south direction - is 1,617 miles.

A detailed statement of the condition of the road as determined by the Bureau survey follows:

UNITED STATES ROUTE 75

State	City or town	Type	Miles	Total
Minnesota	From the U.S.-Canadian			
	boundary near Noyes			
	via Hallock	Concrete, and		
	Warren	city pavement	7.86	
	Crookston	Gravel	422.14	
	Ada	Graded earth	10.02	440.02
	Moorhead			
	Breckenridge			
	Wheaton			
	Ortonville			
	Madison			
	Pipestone			
	Luverne			
	to Iowa State line			
Iowa	From Minn. State line			
	via Rock Rapids	Concrete, and		
	Le Mars	city pavement	54.00	
	Sioux City	Gravel	80.00	
	Onawa	Graded and		
	Missouri Valley	drained	53.00	187.00
	to Nebr. State line			
	at Council Bluffs			

UNITED STATES ROUTE 75 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
NEBRASKA	FROM IOWA STATE LINE			
	AT OMAHA			
	VIA PLATTSMOUTH	GRAVEL	70.26	
	AUBURN	EARTH	29.74	100.00
	TO KANS. STATE LINE			
	NORTH OF SABETHA			
KANSAS	FROM NEBR. STATE LINE			
	VIA SABETHA	CONCRETE,		
	TOPEKA	BRICK, AND		
	CARBONDALE	CITY PAVE.	49.5	
	LYNDON	BITUMINOUS		
	BURLINGTON	MACADAM	29.5	
	YATES CENTER	GRAVEL	48.5	
	NEODESHA	GRADED AND		
	INDEPENDENCE	DRAINED	78.9	
	HAVANA	UNIMPROVED	49.5	255.9
	TO OKLA. STATE LINE			
OKLAHOMA	FROM KANS. STATE LINE			
	VIA BARTLESVILLE	CONCRETE	77.51	
	TULSA	BITUMINOUS		
	SAPULPA	CONCRETE	11.81	
	OKMULGEE	GRAVEL	50.41	
	HENRYETTA	GRADED EARTH	50.12	
	WETUMKA	UNIMPROVED	61.40	
	COALGATE			251.25
	ATOKA			
	DURANT			
	TO TEX. STATE LINE			
TEXAS	FROM OKLA. STATE LINE			
	VIA SHERMAN			
	MCKINNEY			
	DALLAS	PAVEMENT	95.00	
	CORSICANA	GRAVEL	158.00	
	BUFFALO	EARTH	130.20	383.20
	MADISONVILLE			
	HUNTSVILLE			
	CONROE			
	HOUSTON			
	TO GALVESTON			
		TOTAL MILES		1,617.37

SUMMARY OF TYPES
UNITED STATES ROUTE 75

	MILES	PER CENT
HARD SURFACE PAVEMENTS, INCLUDING CONCRETE, CITY PAVEMENT, BITUMINOUS CONCRETE AND MACADAM	325.18	20.1
GRAVEL	829.31	51.2
EARTH, AND GRADED AND DRAINED ROADS	351.98	21.8
UNIMPROVED	110.90	6.9
TOTAL	1,617.37	100.0

UNITED STATES ROUTE 85 IS 42 PER CENT IMPROVED WITH GRAVEL AND THE HIGHER TYPES OF SURFACING. ANOTHER 32 PER CENT CONSISTS OF BLADED EARTH, AND GRADED AND DRAINED ROADS, AND THE BALANCE IS UNIMPROVED. THE TOTAL LENGTH OF THE ROUTE - WHICH EXTENDS IN A NORTH-AND-SOUTH DIRECTION, JUST EAST OF THE ROCKY MOUNTAINS - IS 1,551 MILES.

A DETAILED STATEMENT OF THE CONDITION OF THE ROAD AS DETERMINED BY THE BUREAU SURVEY FOLLOWS:

UNITED STATES ROUTE 85

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
NORTH DAKOTA	FROM THE U.S.-CANADIAN BOUNDARY NORTH OF AMBROSE VIA AMBROSE TO A POINT ON U.S. HIGHWAY ROUTE 2 WEST OF WILLISTON			
	VIA ALEXANDER	GRADED AND		
	WATFORD CITY	DRAINED	135.00	
	MIDWAY	UNIMPROVED	121.00	256.00
	AMIDON			
	BOWMAN			
	TO S. DAK. STATE LINE			

UNITED STATES ROUTE 85 (CONTINUED)

STATE	CITY OR TOWN	TYPE	MILES	TOTAL
SOUTH DAKOTA	FROM N.DAK. STATE LINE			
	SOUTH OF SWARTWOOD			
	VIA BUFFALO	GRAVEL	26.03	
	BELLEFOURCHE	BLADED EARTH	34.00	
	SPEARFISH	UNIMPROVED	95.00	155.03
	DEADWOOD			
	LEAD			
	TO WYO. STATE LINE			
WYOMING	FROM S. DAK. STATE LINE			
	SOUTHWEST OF BUCKHORN			
	VIA NEWCASTLE	GRAVEL, OR		
	LUSK	SELECTED		
	LINGLE	MATERIAL	74.5	
	TORRINGTON	GRADED	157.4	
	CHEYENNE	UNIMPROVED	47.1	279.00
	TO COLO. STATE LINE			
COLORADO	FROM WYO. STATE LINE			
	SOUTH OF CHEYENNE			
	VIA GREELEY	CONCRETE, AND		
	BRIGHTON	CITY PAVEMENT	107.86	
	DENVER	BITUMINOUS		
	CASTLE ROCK	MACADAM	35.31	
	COLORADO SPRINGS	GRAVEL	110.6	
	PUEBLO	GRADED EARTH	65.23	319.00
	WALSENBURG			
	TRINIDAD			
	TO N.MEXICO STATE LINE			
	AT RATON PASS			
NEW MEXICO	FROM COLO. STATE LINE			
	AT RATON PASS			
	VIA RATON			
	MAXWELL			
	WAGON MOUND	CONCRETE, AND		
	LAS VEGAS	PAVEMENT	55.41	
	ROMEROVILLE	CRUSHED STONE	68.82	
	SANTA FE	GRAVEL	169.07	
	ALBUQUERQUE	GRADED EARTH	100.1	
	LOS LUNAS	UNIMPROVED	148.6	542.00
	SOCORRO			
	HOT SPRINGS			
	CABALLO			
	TO LAS CRUCES			
			TOTAL MILES	1,551.03

Summary of Types
United States Route 85

	Miles	Per cent
Hard Surface pavements, including concrete, city pavement, and bituminous macadam	198.58	12.8
Gravel and crushed stone	449.02	29.0
Earth, bladed, and graded and drained	491.73	31.7
Unimproved	411.70	26.5
Total	1,551.03	100.0

[illegible]

[illegible]

[illegible] [illegible] [illegible]

[illegible] [illegible] [illegible]

Tests of High-Strength Cements Made in Germany

(From Der Bauingenieur, March 19, 1927, page 213)

Translated and abstracted by C. S. Jarvis, of the Division of Design

A number of tests, involving 16 brands of high-strength cement, were conducted during 1926 by the German Concrete Association. Tensile and compressive tests were made on normally dry, and sloppy mixtures of cement mortar, and gravel concrete, at 65° F., and at 32° F.; and also on cement stored for a period of 6 months. The investigations were further extended to include admixtures of tufa, a natural hydraulic cement found among the volcanic deposits so abundent along the lower Rhine.

The results of the tests indicated that:

1. The high-strength cements should reach or exceed, at 3 days, a compressive strength of 3,550 pounds per square inch; and, at 28 days, 7,100 pounds per square inch. The corresponding tensile-strength values, at 3 and 28 days, should be 355 and 640 pounds per square inch.

2. The 6-months storage of the cements caused a considerable reduction in both the tensile and compressive strengths at 3 and 28 days.

3. A freezing temperature reduced both the tensile and compressive strengths, considerably, at 3 days, but to a much lesser degree at 28 days.

4. An excessive amount of water in the mixture reduced both the tensile and compressive strengths, considerably, at 3 days, but much less at 28 days.

5. The tensile and compressive strength values of tufa cement mortar and concrete were less than those obtained with similar amounts of portland cement.

Tests of 1:3 Cement Mortar Using Standard Sand

Mixtures of one part cement to three parts of standard sand were moistened with water equivalent to 8 per cent by weight of the

DRY INGREDIENTS. SPECIMENS MOLDED FROM THIS MORTAR WERE TESTED FOR TENSILE AND COMPRESSIVE STRENGTH AT 3 AND 28 DAYS. THE MOLDED SPECIMENS WERE MAINTAINED ONE DAY IN AIR AND THEN IMMERSED TWO DAYS IN WATER FOR THE 3-DAY TEST; OR 6 DAYS IN WATER, AND 21 DAYS IN AIR FOR THE 28 DAY TEST.

FIGURE 1-(TOP) ILLUSTRATES THE MINIMUM, AVERAGE, AND MAXIMUM COMPRESSIVE STRENGTHS FOR THE 16 BRANDS OF CEMENTS AS GIVEN IN TABLE 1. THE FULL LINES REPRESENT THE STRENGTHS ATTAINED BY FRESHLY-MANUFACTURED PRODUCTS, AND THE BROKEN LINES - INDICATING SOMEWHAT LOWER VALUES - ARE FOR THE CEMENT STORED FOR SIX MONTHS IN A DRY WAREHOUSE. THE DATA SHOW THAT THE MINIMUM COMPRESSIVE STRENGTHS RECORDED BY THE FRESHLY-MANUFACTURED CEMENT, AT 3 AND 28 DAYS, WERE 3,650 AND 7,530 POUNDS PER SQUARE INCH, RESPECTIVELY; WHILE THE CORRESPONDING AVERAGE VALUES WERE 4,840 AND 8,900 POUNDS PER SQUARE INCH.

FIGURE 1-(BOTTOM) AND THE DATA IN TABLE 1 SHOW THAT THE MINIMUM TENSILE STRENGTHS OF THE 1:3 MIXTURES OF FRESHLY-MANUFACTURED CEMENT AND STANDARD SAND WERE, AT 3 AND 28 DAYS, 370 AND 640 POUNDS PER SQUARE INCH, RESPECTIVELY; WHILE THE CORRESPONDING AVERAGE VALUES WERE 442 AND 717 POUNDS PER SQUARE INCH.

TESTS OF 1:3 CEMENT MORTAR USING RHINE SAND

HIGHER STRENGTHS WERE INVARIABLY OBTAINED WHEN RHINE SAND GRADING FROM 0 TO 5 MILLIMETERS (0.2 INCH) WAS SUBSTITUTED IN THE MORTAR FOR THE STANDARD SAND. THE AVERAGE INCREASES IN COMPRESSIVE STRENGTH, AT 3 AND 28 DAYS, WERE 29 AND 31 PER CENT RESPECTIVELY; WITH CORRESPONDING INCREASES IN TENSILE STRENGTH OF 41 AND 23 PER CENT.

TESTS OF CONCRETE MIXTURES

TESTS WERE THEN MADE OF THE HIGH-STRENGTH CEMENTS IN CONCRETE MIXED IN THE PROPORTIONS OF $1:2\frac{1}{3}:2\frac{1}{3}$ BY VOLUME. THE FINE AND COARSE AGGREGATES WERE OBTAINED BY SCREENING RIVER GRAVEL INTO SIZES VARYING FROM 0 TO 5 MILLIMETERS (0.2 INCH), AND FROM 5 TO 20 MILLIMETERS (0.79 INCH). FOR COMPRESSIVE TESTS ON EACH BRAND OF CEMENT, THERE WERE PREPARED TWELVE 8-INCH CUBICAL SPECIMENS, MIXED WITH $9\frac{1}{3}$ PER CENT OF WATER TO PRODUCE A RELATIVELY DRY CONCRETE. ANOTHER 12 SPECIMENS WERE MIXED WITH $15\frac{1}{2}$ PER CENT OF WATER TO PRODUCE A SLOPPY CONCRETE. THE FORMS WERE REMOVED AFTER BEING UNDER A MOIST COVERING FOR THE FIRST 24 HOURS. ONE HALF OF THE TEST SPECIMENS WERE THEN CURED IN AIR AT ORDINARY TEMPERATURES, 57° TO 68° F., AND THE OTHER SAMPLES WERE KEPT IN COLD STORAGE AT 32° F.

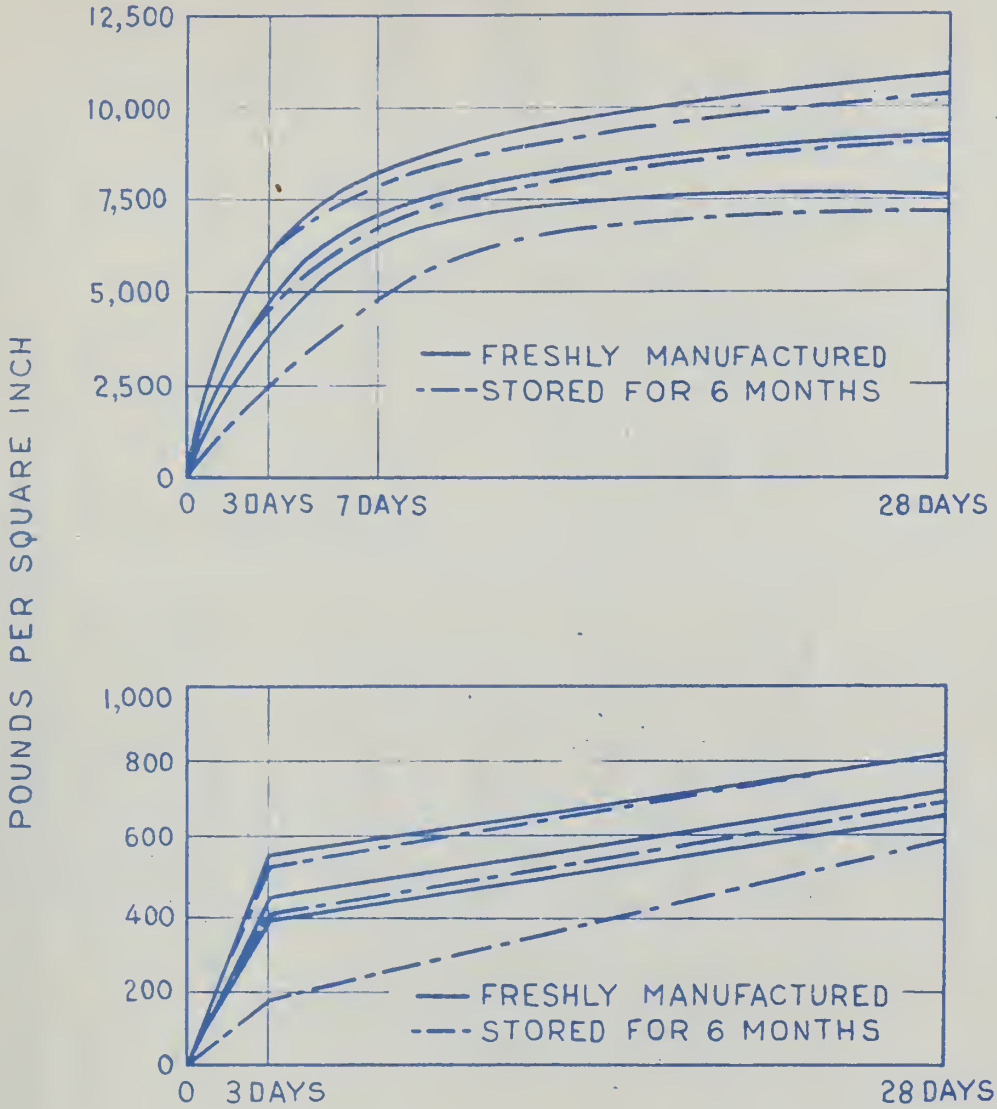


FIGURE 1 - (TOP) - MAXIMUM, MEAN, AND MINIMUM COMPRESSIVE STRENGTH OF 16 SAMPLES OF HIGH-STRENGTH CEMENT.

(BOTTOM) - MAXIMUM, MEAN, AND MINIMUM TENSILE STRENGTH OF 16 SAMPLES OF HIGH-STRENGTH CEMENT.

TABLE 1. - TENSILE AND COMPRESSIVE STRENGTHS OF SEVERAL GERMAN HIGH-STRENGTH PORTLAND CEMENTS

Proportions	Aggregate	Compressive strength in pounds per square inch: Minimum, 3 days	Compressive strength in pounds per square inch: Minimum, 28 days	Compressive strength in pounds per square inch: Average, 3 days	Compressive strength in pounds per square inch: Average, 28 days	Tensile strength in pounds per square inch: Minimum, 3 days	Tensile strength in pounds per square inch: Minimum, 28 days	Tensile strength in pounds per square inch: Average, 3 days	Tensile strength in pounds per square inch: Average, 28 days	Remarks
1:3	Standard sand	3,850	7,530	4,840	8,900	370	640	442	717	Fresh cement; cured at 65°F.
1:3	Do	2,280	6,980	4,270	8,840	178	584	392	684	Cement used after 6-months storage; cured at 65°F.
1:3	Rhine sand	--	--	6,250	11,660	--	--	624	882	Fresh cement; cured at 65°F.
1:2½:2½ water 9½ per cent	Rhine sand and gravel	--	3,920	2,710	4,720	--	--	--	--	Fresh cement; cured at 65°F.
Do	Do	--	--	1,815	4,200	--	--	--	--	Cured at 32°F.
Do	Do	--	--	1,490	3,260	--	--	--	--	Cement stored 6 months; cured at 65°F.
1:2½:2½ water 15½ per cent	Rhine sand and gravel	--	1,851	1,112	3,110	--	--	--	--	Fresh cement; cured at 65°F.
Do	Do	--	--	656	2,700	--	--	--	--	Cured at 32°F.
Do	Do	--	--	635	1,830	--	--	--	--	Cement stored 6 months; cured at 65°F.

Table 1 gives the results of all the tests as reported except that the values are expressed in the English equivalents of the metric units. The data indicate that the dry concrete, cured at an ordinary temperature, attained a minimum strength at 28 days of 3,920 pounds per square inch, with an average strength of 4,720 pounds per square inch; while the corresponding figures for the sloppy concrete were 1,851 and 3,110 pounds per square inch, or 61 and 89 per cent of the dry-concrete values, respectively. The dry-concrete specimens cured at 32° F., attained strength equaling, at 3 and 28 days, 67 and 89 per cent, respectively, of the mixtures of a similar consistency cured at 65° F. The sloppy-concrete specimens, at 3 and 28 days, attained values of 59 and 87 per cent, respectively, of the mixtures of similar consistency cured at 65° F. These figures indicate that the effects of low temperatures and high moisture contents are more pronounced during the first few days of curing. The various brands of cement showed practically the same resistance to low temperatures.

The experiments with concrete cured at normal temperatures were then duplicated with the same brands of cements after 6 months of dry storage. The lumps, that had formed while in storage, were not removed, and the cement was used just as it was found. The resulting strengths for the dry mix, at 3 and 28 days, were 55 and 69 per cent, respectively, of the results secured with the freshly-manufactured product; while the corresponding values for the sloppy concrete were 57 and 59 per cent.

Tests of Tufa Cement

In connection with the foregoing experiments, tests were conducted on tufa cement taken from volcanic deposits so abundant along the lower Rhine.

The normal Portland cement, such as was used in the foregoing tests, was called Cement A; the substitution of tufa cement for 20 per cent of normal cement was called Cement B; and the addition of one-third of a bag of tufa to one bag of Portland cement constituted Cement C. In all the mixtures in this series of tests, 1-1/3 parts Cement C were compared with one part of either Cement A or Cement B.

The data in Table 2 indicate that tufa cement mortar, and concrete, showed less tensile and compressive strength than mortar, or concrete, made with similar proportions of Portland cement. The

TABLE 2. - TENSILE AND COMPRESSIVE STRENGTHS OF TUFA CEMENT AS COMPARED WITH PORTLAND CEMENT

Proportions	Aggregate	Average compressive strength in pounds per square inch		Average tensile strength in pounds per square inch		Remarks
		3 days	28 days	3 days	28 days	
1:3 water 8 per cent	Standard sand	3,000	7,700	328	655	Portland cement A; cured at 65°F.
Do	Do	2,700	6,850	250	700	Tufa cement B; cured at 65°F.
1:1/3:3	Do	3,280	9,050	378	784	Tufa cement C; cured at 65°F.
1:3 water 8 per cent	Rhine sand	4,200	9,850	485	798	Portland cement A; cured at 65°F.
Do	Do	4,350	7,700	335	805	Tufa cement B; cured at 65°F.
1-1/3:3	Do	3,060	8,850	399	784	Tufa cement C; cured at 65°F.
1:2½:2½	Rhine sand and gravel	2,500	4,200	---	---	Portland cement A; cured at 65°F.
Do	Do	1,710	4,230	---	---	Portland cement A; cured at 32°F.
1:2½:2½	Do	1,400	3,020	---	---	Tufa cement B; cured at 65°F.
Do	Do	840	3,000	---	---	Tufa cement B; cured at 32°F.
1-1/3:2½:2½	Do	1,425	3,500	---	---	Tufa cement C; cured at 65°F.
Do	Do	940	3,130	---	---	Tufa cement C; cured at 32°F.

INCREASED RICHNESS OF MIXTURES CONTAINING CEMENT C PRODUCED GREATER STRENGTH IN THE MORTARS MADE WITH STANDARD SAND, AS COMPARED WITH THE STANDARD PORTLAND-CEMENT MIXTURE; BUT SHOWED LESS STRENGTH IN THE MORTARS CONSTRUCTED WITH RHINE SAND. THE 1-1/3: 2-1/2:2-1/2 CONCRETE MIX WITH CEMENT C ALSO SHOWED CONSIDERABLY LESS STRENGTH THAN THE SAME MIX WITH CEMENT A.