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THE STRENGTH OF CEMENT.

by

J. G. SAVAGE

G. E. EDGERTON.

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Outline.

1. Introduction.
2. Description of Cements.
3. Briquets.
 - (a) Manner of Making.
 - (b) Manner of setting.
4. Apparatus.
5. Data and Curves.
6. Concrete tests.
7. Summary.

THE STRENGTH OF CEMENT.

A knowledge of the values of different brands of cement is becoming more and more desirable as cement and concrete are becoming more and more extensively used in modern engineering constructions. So many different brands of cement are now upon the market that considerable difficulty may be met with in selecting a cement to fill any given specifications.

The following tests were made upon four of the more common cements found in the hands of dealers and contractors at Manhattan, Kansas. The cement tested were two naturals and two Portlands:

(1). Louisville Natural Cement, made in cement works on the Ohio river. By Manhattan dealers it is obtained from wholesale agencies in Kansas City. The cement is of a light brown color with a slight tendency toward purple, the briquette after setting a short time exhibiting a distinct tinge of purple. Its apparent density is about seventy-seven hundredths.

(2). Fort Scott Cement, a natural cement made by the Fort Scott Cement Association at Fort Scott, Kansas. Its color is light brown bordering on yellow, somewhat darker than straw color. Its apparent density is about eighty hundredths.

(3) Iola Portland Cement, made by the Iola Portland Cement Co., at Iola, Kansas. This company has been in existence only about three years; its situation is valuable because of the presence of natural gas which is used as a fuel for calcinating. Its color is a grayish blue. Its apparent density is about one and eighteen hundredths.

(4). St. Louis Cement, a Portland cement made by the St. Louis Portland Cement Co., and know as the "Red Ring Brand". It is slightly darker and rather more bluish than the Iola and has an apparent density of one and sixteen hundredths.

Tests of the tensile and compressive strength of each cement were made upon both neat and mortar (i.e. mixed with sand) specimens. Tension briquet^{ts}s were tested at the ages of one, two, three, four, five and six weeks. Compression briquet^{ts}s were tested at the ages of one, two and four weeks.

The proportions of water and cement necessary to produce the desired plasticity of the neat cement mixtures were determined by preliminary trials. In the case of mortar mixtures, preliminary trials could not give this proportion because of the variation in the dampness of the sand upon the different dates of mixing. The proportions determined for neat mixtures were the same for the two naturals being, by weight, water twenty per cent, cement eighty per cent and the same for the two Portlands, being water thirty per cent and cement seventy per cent.

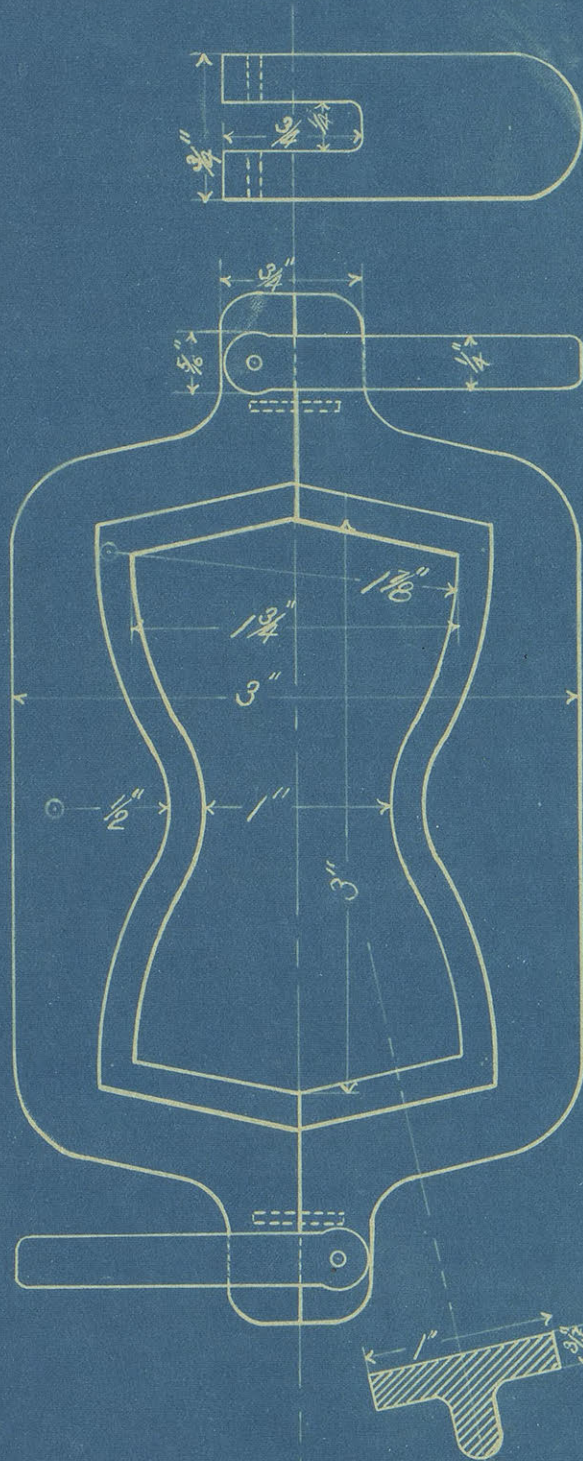
The cement (in case of neat mixture) or the thoroughly mixed sand and cement (in case of mortar mixture) after being wet^d and mixed until the whole was of uniform dampness, was put in the molds, packed sufficiently to force it well into the corners and smoothed with a trowel even with the top of the mold.

The form of mold used in making tension briquettes is the English standard, having a minimum breaking section of one square inch. The compression mold was designed to form a cubical briquette having dimension 2" X 2" X 2". Details and drawings of the tension briquet molds are shown in Fig. 1. Drawings of the compression briquets mold are shown in Fig. 2.

In making briquettes from the natural cement great care was necessary to prevent sett~~ling~~ before all the briquet~~tes~~ were completed. Any sett~~ling~~ of the mixture before the briquet~~tes~~ are completed impairs their strength, consequently quick work is necessary when using the natural cements. The Louisville sets hard in about fifteen minutes while the Fort Scott sets in something over twice that time, and the Portlands require about eight to nine hours.

The testing machines used were for tension, a Fairbank's 1000# cement testing machine and for compression, a Riehle 100,000# testing machine.

TENSION BRIQUETTE MOLD
SCALE FULL SIZE



1

FORM OF COMPRESSION BRIQUETTE MOLD
SCALE: FULL SIZE

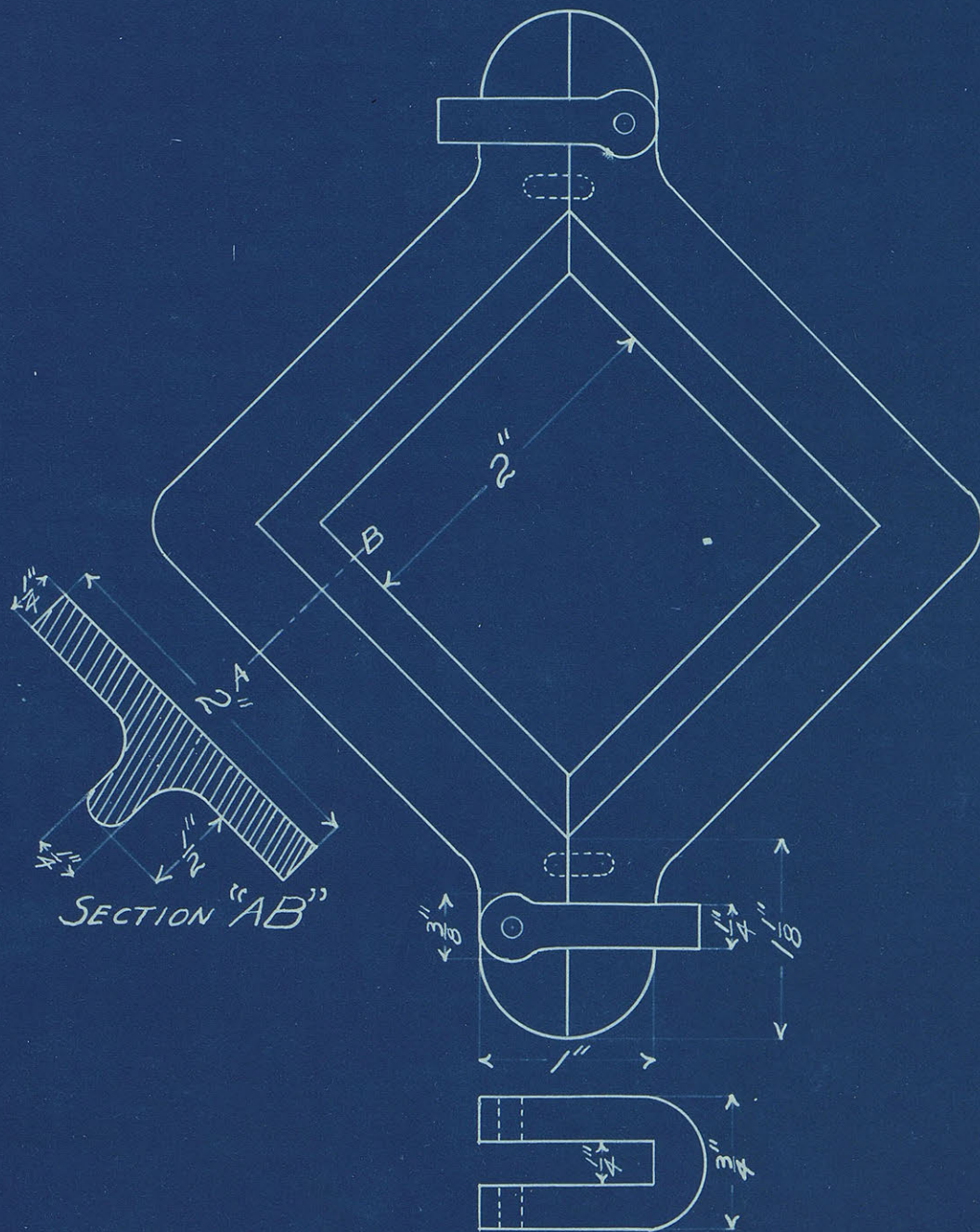


FIG. 2.

LOUISVILLE (NATURAL) CEMENT.

A TENSION

No.	Proportion		Date		Age	Strength	Remarks.
	Water	Cement	Made	Tested	Days	Pounds sq. in.	
1	30	70	Apr. 7	Apr. 14	7	90	
2	30	70	" 7	" 14	7	85	
3	30	70	" 7	" 14	7	79	
4	30	70	" 7	" 14	7	100	
5	30	70	" 7	" 14	7	84	
Av.						87.6	
1	30	70	" 7	" 21	14	84.	
2	30	70	" 7	" 21	14	104	
3	30	70	" 7	" 21	14	87	
4	30	70	" 7	" 21	14	91	
5	30	70	" 7	" 21	14	97	
Av.						93 3/5	
1	30	70	" 6	MAY 4	25	139	
2	30	70	" 6	" 4	25	179	
3	30	70	" 6	" 4	25	146	
4	30	70	" 6	" 4	25	160	
5	30	70	" 6	" 4	25	154	
Av.						156	
1	30	70	" 6	Apr. 27	21	177	
2	30	70	" 6	" 27	21	130	
3	30	70	" 6	" 27	21	169	
4	30	70	" 6	" 27	21	147	

LOUISVILLE (NATURAL) CEMENT (con.)

No.	Proportion		Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	Pounds sq. in.	
5	30	70	Apr. 6	Apr. 27	21	175	
Av.						167 3/5	
1	30	70	" 6	MAY 11	35	183	
2	30	70	" 6	" 11	35	160	
3	30	70	" 6	" 11	35	216	
4	30	70	" 6	" 11	35	225	
5	30	70	" 6	" 11	35	200	
Av.						197	
1	30	70	" 6	" 18	42	165	
2	30	70	" 6	" 18	42	175	
3	30	70	" 6	" 18	42	137	
4	30	70	" 6	" 18	42	164	
5	30	70	" 6	" 18	42	170	
Av.						162	
MORTAR.							
1	15.4	2:1	Apr 20	Apr. 27	7	28	
2	15.4	2:1	" 20	" 27	7	29	
3	15.4	2:1	" 20	" 27	7	29	
4	15.4	2:1	" 20	" 27	7	29	
5	15.4	2:1	" 20	" 27	7	36	
Av.						30 1/5	

MORTAR. (con.)

No.	% Sand to Cement		Date		Age	Strength	Remarks
	Water		Made	Tested	Days	Pounds sq. in.	
1	16.4	2:1	Apr. 18	May 2	14	41	
2	16.4	2:1	" 18	" 2	14	47	
3	16.4	2:1	" 18	" 2	14	36	
4	16.4	2:1	" 18	" 2	14	37	
5	16.4	2:1	" 18	" 2	14	34	
Av.						39	
1	16.	2:1	" 18	" 9	21	91	
2	16	2:1	" 18	" 9	21	58	
3	16	2:1	" 18	" 9	21	59	
4	16	2:1	" 18	" 9	21	51	
5	16	2:1	" 18	" 9	21	65	
Av.						64 4/5	
1	18	2:1	" 16	" 14	28	84	
2	18	2:1	" 16	" 14	28	80	
3	18	2:1	" 16	" 14	28	85	
4	18	2:1	" 16	" 14	28	92	
5	18	2:1	" 16	" 14	28	**	Lost
Av.						85 1/4	
1	18.2	2:1	" 15	" 20	35	60	
2	18.2	2:1	" 15	" 20	35	105	
3	18.2	2:1	" 15	" 20	35	72	
4	18.2	2:1	" 15	" 20	35	65	
5	18.2	2:1	" 15	" 20	35	51	
Av.						71	

MORTAR. (con.)

No.	%		Sand to Cement	Date		Age Days	Strength Pounds sq. in.	Remarks
	Water			Made	Tested			
1	18		2:1	Apr. 13	May 25	42	158	
2	18		2:1	" 13	" 25	42	179	
3	18		2:1	" 13	" 25	42	176	
4	18		2:1	" 13	" 25	42	152	
5	18		2:1	" 13	" 25	42	189	
Av.							171	

B. COMPRESSION. I. NEAT.

No.	%		Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
	Water			Made	Tested			
1	30		70	May 13	May 20	7	643	
2	30		70	" 13	" 20	7	548	
3	30		70	" 13	" 20	7	560	
4	30		70	" 13	" 20	7	583	
5	30		70	" 13	" 20	7	523	
Av.							572	
1	30		70	" 6	" 20	14	824	
2	30		70	" 6	" 20	14	706	
3	30		70	" 6	" 20	14	849	
4	30		70	" 6	" 20	14	775	
5	30		70	" 6	" 20	14	***	Lost
Av.							788	
1	30		70	" 2	" 30	28	1149	
2	30		70	" 2	" 30	28	1146	
3	30		70	" 2	" 30	28	1091	

B. COMPRESSION. I. NEAT. (con.)

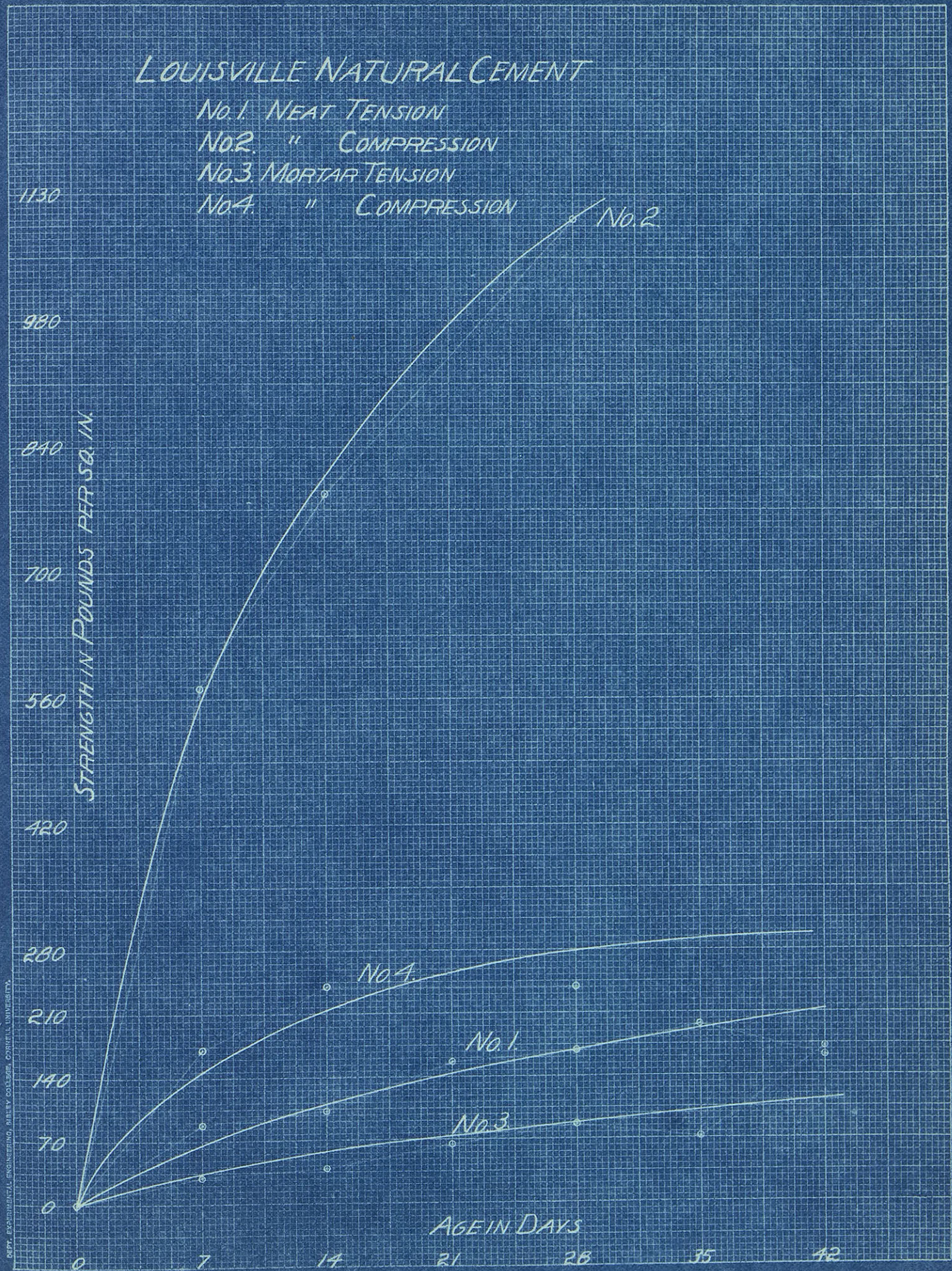
No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
	Water		Made	Tested			
4	30	70	May 2	May 30	28	1130	
5	30	70	" 2	" 30	28	<u>995</u>	
Av.						1102	

II. MORTAR.

No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
	Water		Made	Tested			
1	17	2:1	May 16	May 23	7	183	
2	17	2:1	" 16	" 23	7	155	
3	17	2:1	" 16	" 23	7	154	
4	17	2:1	" 16	" 23	7	173	
5	17	2:1	" 16	" 23	7	<u>173</u>	
Av.						167	
1	16.5	2:1	" 10	" 24	14	193	
2	16.5	2:1	" 10	" 24	14	215	
3	16.5	2:1	" 10	" 24	14	178	
4	16.5	2:1	" 10	" 24	14	199	
5	16.5	2:1	" 10	" 24	14	<u>195</u>	
Av.						196	
1	17	2:1	" 4	Jun. 1	28	240	
2	17	2:1	" 4	" 1	28	243	
3	17	2:1	" 4	" 1	28	247	
4	17	2:1	" 4	" 1	28	205	
5	17	2:1	" 4	" 1	28	<u>252</u>	
Av.						237 1/2	

LOUISVILLE NATURAL CEMENT

- No. 1. NEAT TENSION
- No. 2. " COMPRESSION
- No. 3. MORTAR TENSION
- No. 4. " COMPRESSION



DEPT. EXPERIMENTAL ENGINEERING, SHERIDAN COLLEGE, CORVALLIS, OREGON

R. C. CARPENTER, ITHACA, N. Y.

FORT SCOTT (NATURAL) CEMENT.

A. TENSION.

No.	%		Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
1	30	70	Apr. 12	Apr. 19	7	43	
2	30	70	" 12	" 19	7	32	
3	30	70	" 12	" 19	7	39	
4	30	70	" 12	" 19	7	32	
5	30	70	" 12	" 19	7	<u>32</u>	
Av.						36 3/5	
1	30	70	" 11	" 25	14	66	
2	30	70	" 11	" 25	14	61	
3	30	70	" 11	" 25	14	57	
4	30	70	" 11	" 25	14	57	
5	30	70	" 11	" 25	14	<u>59</u>	
Av.						60	
1	30	70	" 11	MAY 25	21	106	
2	30	70	" 11	" 2	21	114	
3	30	70	" 11	" 2		99	
4	30	70	" 11	" 2	21	111	
5	30	70	" 11	" 2	21	<u>111</u>	
						104 4/5	
1	30	70	" 11	" 9	28	180	
2	30	70	" 11	" 9	28	159	
3	30	70	" 11	" 9	28	178	
4	30	70	" 11	" 9	28	139	
5	30	70	" 11	" 9	28	<u>143</u>	
Av.						159 4/5	

FORT SCOTT (NATURAL) CEMENT. (con.)

No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
1	30	70	Apr. 11	May 16	35	229	
2	30	70	" 11	" 16	35	190	
3	30	70	" 11	" 16	35	166	
4	30	70	" 11	" 16	35	188	
5	30	70	" 11	" 16	35	156	
Av.						185 4/5	
1	30	70	" 11	" 16	42	145	
2	30	70	" 11	" 16	42	157	
3	30	70	" 11	" 16	42	156	
4	30	70	" 11	" 16	42	172	
5	30	70	" 11	" 16	42	130	
Av.						154	

II. MORTAR.

No.	%	Sand to Cement	Date		Age	Strength	Remarks
	Water		Made	Tested	Days	lbs. sq. in.	
1	17.24	2:1	Apr. 20	Apr. 27	7	25	
2	17.24	2:1	" 20	" 27	7	19	
3	17.24	2:1	" 20	" 27	7	20	
4	17.24	2:1	" 20	" 27	7	18	
5	17.24	2:1	" 20	" 27	7	**	Lost
Av.						20 1/2	
1	17	2:1	" 18	May 2	14	30	
2	17	2:1	" 18	" 2	14	29	
3	17	2:1	" 18	" 2	14	29	
4	17	2:1	" 18	" 2	14	27	

II. MORTAR (con)

No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
5	17	2:1	Apr. 18	May 2	14	<u>30</u>	
Av.						29	
1	17	2:1	" 18	" 9	21	64	
2	17	2:1	" 18	" 9	21	45	
3	17	2:1	" 18	" 9	21	40	
4	17	2:1	" 18	" 9	21	70	
5	17	2:1	" 18	" 9	21	<u>70</u>	
Av.						57 4/5	
1	18	2:1	" 16	" 14	28	42	
2	18	2:1	" 16	" 14	28	52	
3	18	2:1	" 16	" 14	28	46	
4	18	2:1	" 16	" 14	28	41	
5	18	2:1	" 16	" 14	28	<u>47</u>	
Av.						46	
1	20	2:1	" 15	" 20	35	29	Broke in clamp.
2	20	2:1	" 15	" 20	35	49	
3	20	2:1	" 15	" 20	35	50	
4	20	2:1	" 15	" 20	35	**	Lost
5	20	2:1	" 15	" 20	35	42	Lost
Av.						43	
1	18	2:1	" 13	" 25	35	68	
2	18	2:1	" 13	" 25	35	79	
3	18	2:1	" 13	" 25	35	75	
4	18	2:1	" 13	" 25	35	85	

II. MORTAR. (con)

No.	% Water	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
5	18	2:1	Apr. 13	Apr. 25	35	**	Lost
Av.						77	

B. COMPRESSION I. NEAT.

No.	% Water	% Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
1	30	70	May 16	May 23	7	250	
2	30	70	" 16	" 23	7	213	
3	30	70	" 16	" 23	7	242	
4	30	70	" 16	" 23	7	340	
5	30	70	" 16	" 23	7	<u>240</u>	
Av.						257	
1	30	70	" 9	" 23	14	345	
2	30	70	" 9	" 23	14	360	
3	30	70	" 9	" 23	14	353	
4	30	70	" 9	" 23	14	355	
5	30	70	" 9	" 23	14	<u>415</u>	
Av.						365 $\frac{3}{5}$	
1	30	70	" 9	" 23	14	480	
2	30	70	" 9	" 23	14	492	
3	30	70	" 9	" 23	14	473	
4	30	70	" 9	" 23	14	502	
5	30	70	" 9	" 23	14	<u>493</u>	
Av.						488	

II. MORTAR.

No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
1	18	2:1	May 16	May 23	7	145	
2	18	2:1	" 16	" 23	7	138	
3	18	2:1	" 16	" 23	7	155	
4	18	2:1	" 16	" 23	7	139	
5	18	2:1	" 16	" 23	7	***	Lost
A v.						<u>144</u>	
1	17	2:1	" 12	" 26	14	164	
2	17	2:1	" 12	" 26	14	199	
3	17	2:1	" 12	" 26	14	195	
4	17	2:1	" 12	" 26	14	163	
5	17	2:1	" 12	" 26	14	<u>197</u>	
Av.						183 3/5	
1	17.7	2:1	" 1	" 2	14	135	
2	17.7	2:1	" 1	" 2	14	85	
3	17.7	2:1	" 1	" 2	14	106	
4	17.7	2:1	" 1	" 2	14	157	
5	17.7	2:1	" 1	" 2	14	<u>152</u>	
Av.						127	

IOLA (PORTLAND) CEMENT.

A. Tension.			I. Neat.				Remarks
No.	%	Cement	Date		Age Days	Strength lbs. sq. in.	
			Water	Made			Tested
1	20	80	Apr. 7	Apr. 14	7	359	
2	20	80	" 7	" 14	7	521	

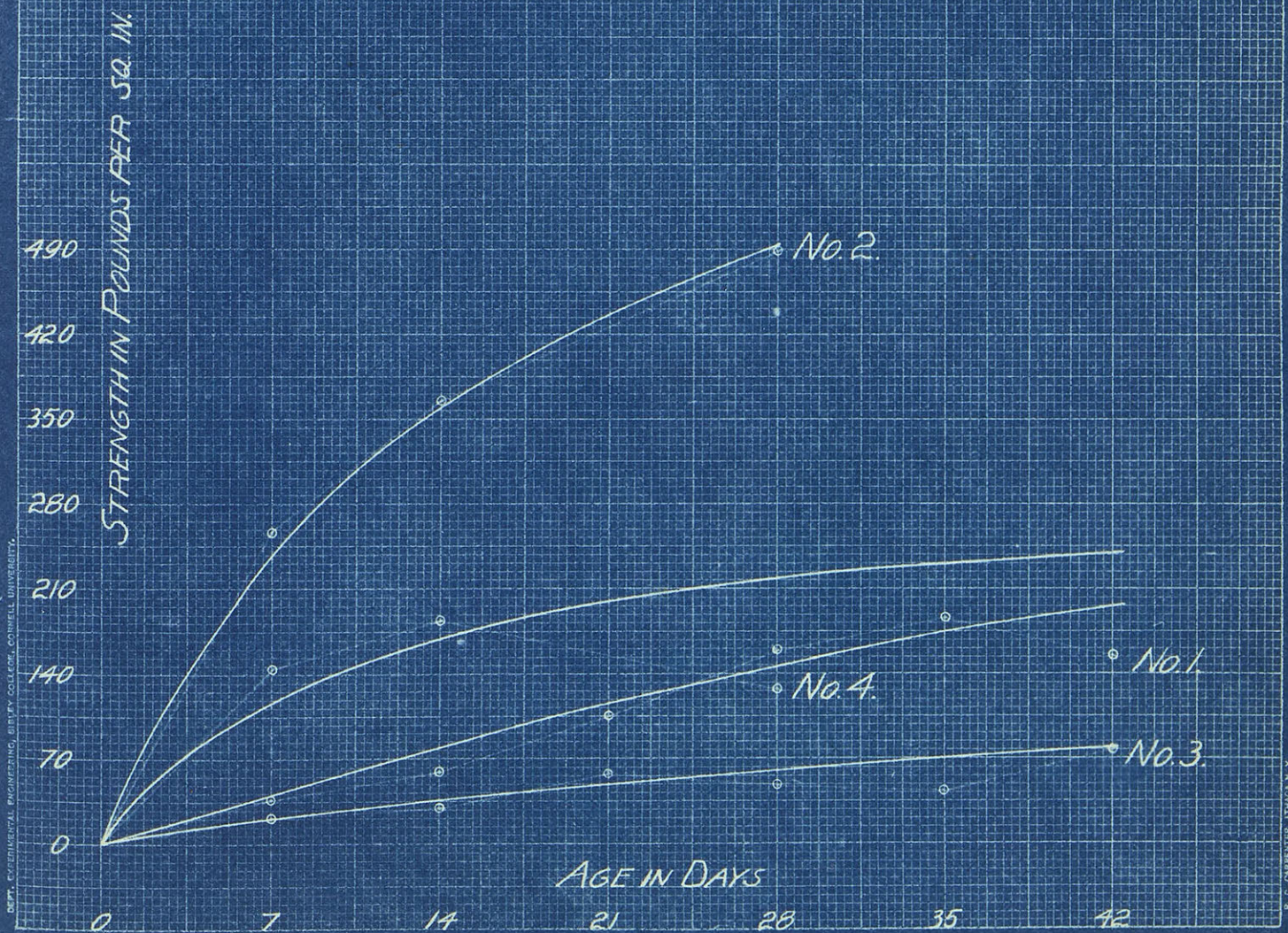
FT. SCOTT NATURAL CEMENT

No. 1. NEAT TENSION

No. 2. " COMPRESSION

No. 3. MORTAR TENSION

No. 4. " COMPRESSION



I. NEAT.

No.	%		Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
3	20	80	Apr. 7	Apr. 14	7	341	
4	20	80	" 7	" 14	7	361	
5	20	80	" 7	" 14	7	<u>320</u>	
Av.						380	
1	20	80	" 25	May 9	14	461	
2	20	80	" 25	" 9	14	517	
3	20	80	" 25	" 9	14	***	Broke in clamp
4	20	80	" 25	" 9	14	614	
5	20	80	" 25	" 9	14	<u>614</u>	
Av.						550 2/3	
1	20	80	" 11	" 2	21	416	
2	20	80	" 11	" 2	21	506	
3	20	80	" 11	" 2	21	427	
4	20	80	" 11	" 2	21	586	
5	20	80	" 11	" 2	21	<u>538</u>	
Av.						494 3/5	
1	20	80	" 8	" 6	28	559	
2	20	80	" 8	" 6	28	531	
3	20	80	" 8	" 6	28	584	
4	20	80	" 8	" 6	28	576	
5	20	80	" 8	" 6	28	<u>541</u>	
Av.						558	

I. NEAT. (con.)

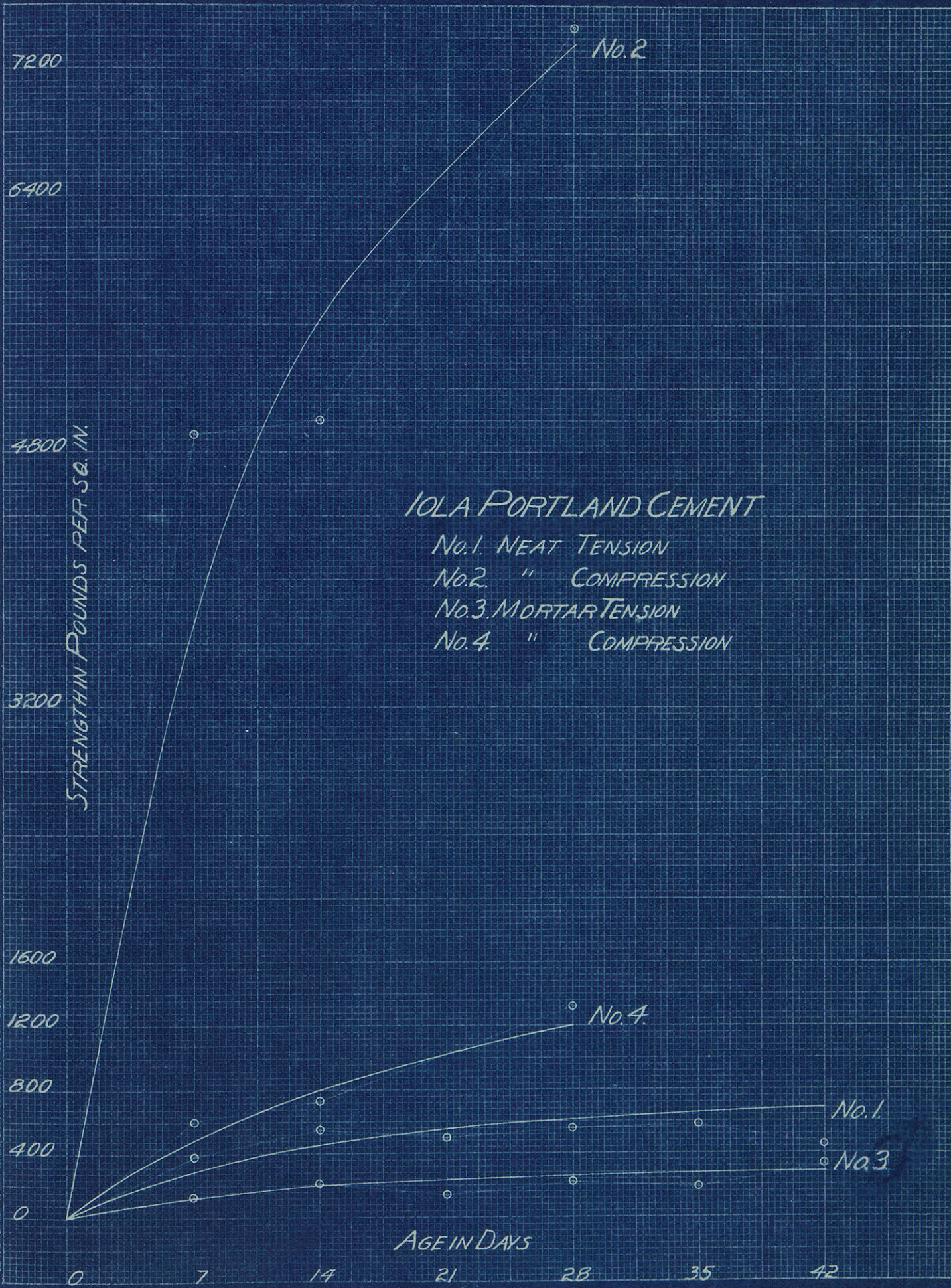
No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
1	20	80	Apr. 8	May 6	28	390	
2	20	80	" 7	" 12	35	456	
3	20	80	" 7	" 12	35	358	
4	20	80	" 7	" 12	35	431	
5	20	80	" 7	" 12	35	<u>580</u>	
Av.						443	
1	20	80	" 7	" 12	35	447	
2	20	80	" 7	" 12	35	412	
3	20	80	" 7	" 12	35	501	
4	20	80	" 7	" 12	35	443	
5	20	80	" 7	" 12	35	<u>431</u>	
Av.						446 4/5	

II. MORTAR.

No.	%	Sand to Cement	Date		Age	Strength	Remarks
	Water		Made	Tested	Days	lbs. sq. in.	
1	11.66	3:1	Apr. 25	May 2	7	120	
2	11.66	3:1	" 25	" 2	7	129	
3	11.66	3:1	" 25	" 2	7	129	
4	11.66	3:1	" 25	" 2	7	156	
5	11.66	3:1	" 25	" 2	7	<u>138</u>	
Av.						134 2/5	
1	11.	3:1	" 22	" 6	14	171	
2	11	3:1	" 22	" 6	14	238	
3	11	3:1	" 22	" 6	14	197	

II. MORTAR (con)

6 No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
4	11	3:1	Apr. 22	May 6	14	230	
5	11	3:1	" 22	" 6	14	<u>179</u>	
Av.						203	
1	12.5	3:1	" 21	" 12	21	114	
2	12.5	3:1	" 21	" 12	21	145	
3	12.5	3:1	" 21	" 12	21	155	
4	12.5	3:1	" 21	" 12	21	124	
5	12.5	3:1	" 21	" 12	21	<u>143</u>	
Av.						136	
1	12.5	3:1	" 18	" 16	28	167	
2	12.5	3:1	" 18	" 16	28	240	
3	12.5	3:1	" 18	" 16	28	222	
4	12.5	3:1	" 16	" 16	28	211	
5	12.5	3:1	" 16	" 16	28	<u>245</u>	
Av.						217	
1	12.5	3:1	" 18	" 23	35	150	
2	12.5	3:1	" 18	" 23	35	202	
3	12.5	3:1	" 18	" 23	35	193	
4	12.5	3:1	" 18	" 23	35	167	
5	12.5	3:1	" 18	" 23	35	<u>209</u>	
Av.						185 1/3	
1	10.5	3:1	" 14	" 26	42	297	
2	10	3:1	" 14	" 26	42	375	
3	10	3:1	" 14	" 26	42	433	



DEPT. EXPERIMENTAL ENGINEERING, SIKES COLLEGE, CORNELL UNIVERSITY.

H. C. CATRETA, ITHACA, N. Y.

II. MORTAR.

No.	%	Sand to Cement	Date		Age	Strength	Remarks
	Water		Made	Tested	Days	lbs. sq. in.	
1	12.5	3:1	May 16	May 23	7	559	
2	12.5	3:1	" 16	" 23	7	538	
3	12.5	3:1	" 16	" 23	7	664	
4	12.5	3:1	" 16	" 23v	7	651	
5	12.5	3:1	" 16	" 23	7	***	Lost
Av.						603	
1	12.5	3:1	" 10	" 24	14	771	
2	12.5	3:1	" 10	" 24	14	738	
3	12.5	3:1	" 10	" 24	14	837	
4	12.5	3:1	" 10	" 24	14	837	
5	12.5	3:1	" 10	" 24	14	658	
Av.						768	
1	13	3:1	" 4	Jun 1	28	1392	
2	13	3:1	" 4	" 1	28	1397	
3	13	3:1	" 4	" 1	28	1158	
4	13	3:1	" 4	" 1	28	1243	
5	13	3:1	" 4	" 1	28	1440	
Av.						1326	

ST. LOUIS (PORTLAND) CEMENT

A. Tension

No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
1	20	80	Apr. 25	May 2	7	458	
2	20	80	" 25	" 2	7	482	

ST. LOUIS (PORTLAND) CEMENT. (CON.)

No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
3	20	80	Apr. 25	May 2	7	505	
4	20	80	" 25	" 2	7	517	
5	20	80	" 25	" 2	7	<u>529</u>	
Av.						498 2/5	
1	20	80	" 26	" 11	14	335	
2	20	80	" 26	" 11	14	225	
3	20	80	" 26	" 11	14	275	
4	20	80	" 26	" 11	14	195	
5	20	80	" 26	" 11	14	<u>280</u>	
Av.						262	
1	20	80	" 20	" 4	21	533	
2	20	80	" 20	" 4	21	602	
3	20	80	" 20	" 4	21	602	
4	20	80	" 20	" 4	21	670	
5	20	80	" 20	" 4	21	<u>768</u>	
Av.						635	
1	20	80	" 12	" 10	28	714	
2	20	80	" 12	" 10	28	666	
3	20	80	" 12	" 10	28	701	
4	20	80	" 12	" 10	28	667	
5	20	80	" 12	" 10	28	<u>750</u>	
Av.						700	
1	20	80	" 12	" 17	35	573	
2	20	80	" 12	" 17	35	613	

ST. LOUIS (PORTLAND) CEMENT (con)

No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
3	20	80	Apr. 12	May 17	35	507	
4	20	80	" 12	" 17	35	831	
5	20	80	" 12	" 17	35	<u>628</u>	
Av.						630	
1	20	80	" 12	" 24	42	760	
2	20	80	" 12	" 24	42	654	
3	20	80	" 12	" 24	42	709	
4	20	80	" 12	" 24	42	833	
5	20	80	" 12	" 24	42	<u>813</u>	
Av.						749 4/5	

II. MORTAR.

No.	%	Sand to Cement	Date		Age	Strength	Remarks
	Water		Made	Tested	Days	lbs. sq. in.	
1	11.5	3:1	Apr. 25	May 2	7	126	
2	11.5	3:1	" 25	" 2	7	114	
3	11.5	3:1	" 25	" 2	7	132	
4	11.5	3:1	" 25	" 2	7	121	
5	11.5	3:1	" 25	" 2	7	<u>93</u>	
Av.						117 1/5	
1	12.5	3:1	" 22	" 6	14	141	
2	12.5	3:1	" 22	" 6	14	139	
3	12.5	3:1	" 22	" 6	14	105	
4	12.5	3:1	" 22	" 6	14	133	
5	12.5	3:1	" 22	" 6	14	<u>142</u>	
Av.						132	

II. MORTAR.

No.	%	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
1	12.2	3:1	Apr. 21	May 12	21	172	
2	12.2	3:1	" 21	" 12	21	153	
3	12.2	3:1	" 21	" 12	21	122	
4	12.2	3:1	" 21	" 12	21	172	
5	12.2	3:1	" 21	" 12	21	<u>154</u>	
Av.						155	
1	13	3:1	" 16	" 14	28	200	
2	13	3:1	" 16	" 14	28	187	
3	13	3:1	" 16	" 14	28	184	
4	13	3:1	" 16	" 14	28	194	
5	13	3:1	" 16	" 14	28	<u>166</u>	
A v.						186 1/5	
1	13	3:1	" 16	" 28	42	182	
2	13	3:1	" 16	" 28	42	182	
3	13	3:1	" 16	" 28	42	222	Neglected to break this set when due, May 21.
4	13	3:1	" 16	" 28	42	193	
5	13	3:1	" 16	" 28	42	<u>106</u>	
Av.						197	
1	13	3:1	" 16	" 28	42	281	
2	13	3:1	" 16	" 28	42	266	
3	13	3:1	" 16	" 28	42	***)	Lost
4	13	3:1	" 16	" 28	42	***)	
5	13	3:1	" 16	" 28	42	<u>***)</u>	
Av.						274	

B. COMPRESSION. I. NEAT.

No.	%	%	Date		Age	Strength	Remarks
	Water	Cement	Made	Tested	Days	lbs. sq. in.	
1	20	80	May 17	May 24	7	5287	
2	20	80	" 17	" 24	7b	4820	
3	20	80	" 17	" 24	7	4265	
4	20	80	" 17	" 24	7	4768	
5	20	80	" 17	" 24	7	<u>4765</u>	
Av.						4776	
1	20	80	" 9	" 28	14	8335	
2	20	80	" 9	" 28	14	4403	
3	20	80	" 9	" 28	14	5582	
4	20	80	" 9	" 28	14	6888	
5	20	80	" 9	" 28	14	<u>****</u>	Lost
Av.						6302	
1	20	80	" 3	" 31	28	7213	
2	20	80	" 3	" 31	28	8370	
3	20	80	" 3	" 31	28	7987	
4	20	80	" 3	" 31	28	7795	
5	20	80	" 3	" 31	28	<u>6370</u>	
Av.						7547	

II. MORTAR.

No.	%	Sand to Cement	Date		Age	Strength	Remarks
	Water		Made	Tested	Days	lbs. sq. in.	
1	12.5	3:1	May 18	May 25	7	490	
2	12.5	3:1	" 18	" 25	7	690	
3	12.5	3:1	" 18	" 25	7	650	
4	12.5	3:1	" 18	" 25	7	723	

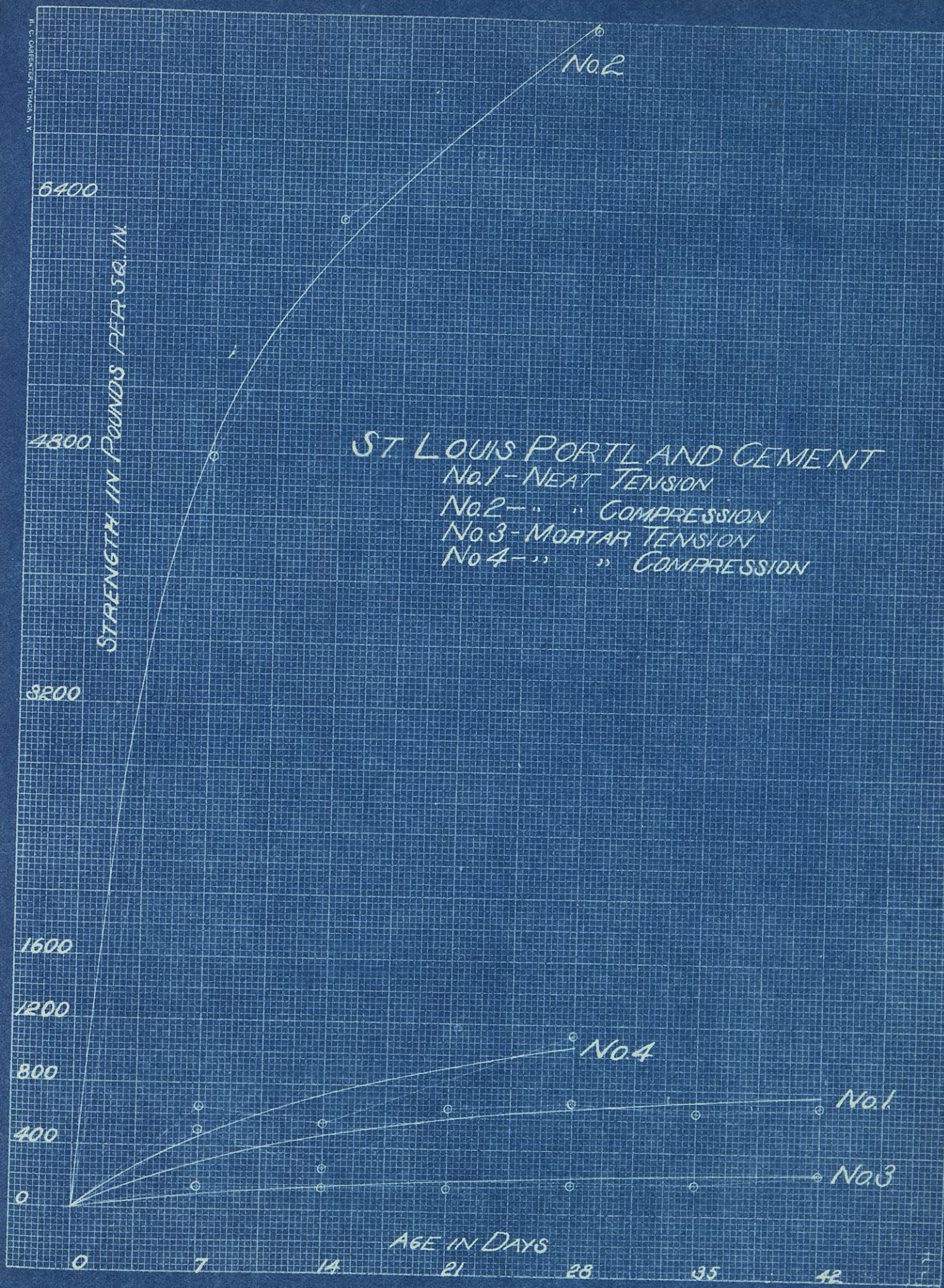
II. MORTAR.

No.	Water	Sand to Cement	Date		Age Days	Strength lbs. sq. in.	Remarks
			Made	Tested			
5	12.5	3:1	May 18	May 25	7	685	
Av.						647	
1	11.1	3:1	" 11	" 25	14	708	
2	11.1	3:1	" 11	" 25	14	622	
3	11.1	3:1	" 11	" 25	14	423	
4	11.1	3:1	" 11	" 25	14	550	
5	11.1	3:1	" 11	" 25	14	489	
Av.						558	
1	11.1	3:1	" 5	Jun. 2	28	1018	
2	11.1	3:1	" 5	" 2	28	1167	
3	11.1	3:1	" 5	" 2	28	2228	
4	11.1	3:1	" 5	" 2	28	900	
5	11.1	3:1	" 5	" 2	28	1325	
Av.						1128	

COMPARATIVE TABLE OF NEAT CEMENT TESTS.

Brand of Cement	Tension in lbs. sq. in.					
	7 day	14 day	21 day	28 day	35 day	42 day
Louisville (nat.)	87.6	93 3/5	156	167 3/5	197	162
Ft. Scott (nat.)	36 3/5	60	104 4/5	159 4/5	185 4/5	154
Iola (Portland)	380	502/3	494 3/5	558	580	446 4/5
St. Louis (Port.)	498 2/5	262	635	700	630	749 4/5

	Compression in lbs. sq. in.					
Louisville (nat)	572	788		1102		
Ft. Scott (nat)	257	363 3/5		488		
Iola (Portland)	4950	5917		7468		
St. Louis (Port.)	4776	6302		7547		



COMPARATIVE TABLE OF MORTAR CEMENT TESTS.

Brand of cement	7 day	Tension in lbs. sq. in.				
		14 day	21 day	28 day	35 day	42 day
Louisville (nat)	30 1/5	39	64 4/5	85 1/4	71	171
Ft. Scott (nat)	20 1/2	29	57 4/5	46	43	77
Iola (Portland)	134 3/5	203	136	217	185 1/5	373
St. Louis (Port)	117 1/5	132	155	186 1/5	197	274

Brand of Cement	7 day	Compression in lbs. sq. in.	
		14 day	28 day
Louisville(nat)	167	240	237 1/2
Ft. Scott (nat)	144	183 3/5	127
Iola (Portland)	603	768	1326
St. Louis (Port)	647	558	1128

TRANSVERSE CONCRETE TEST.

Very few transverse concrete beam tests have ever been made but, since concrete has come into such common use in all kinds of construction work, such tests are becoming of great importance.

The following tests were made on concrete beams having dimensions 4" X 6" X 30", and a composition as follows. cement one part, sand two parts, rock four parts, and enough water to give the proper consistency, the parts being taken by volume. The sand used was sharp sifted river sand, and the rocks were crushed lime stone averaging about one and one-half or two inches in diameter.

The sand and cement were first thoroughly mixed dry, and then enough water added to give a mortar which would clean the trowel or hoe nicely. The stone was dampened and then mixed with the mortar thoroughly, after which the mass was placed in the molds and

tramped until water oozed to the surface. The beams were allowed to set 7 days under cover before breaking. They were tested in a Riehle 100,000 pound testing machine, the load being applied equally distant between the two supports which were twenty-four inches apart.

TRANSVERSE CONCRETE TEST.

Brand of Cement	Section	Load	Modulus of Rupture.
German Portland	3 1/4" X 6"	845#	260
" "	4" X 6"	970#	242.5
Iola	4" X 6"	1230#	307.5
St. Louis	4" X 6"	525#	131.25

The value of f was determined from the formula $f = \frac{M Y}{I}$

Where f = Modulus of rupture.

" M = Bending moment under breaking load.

" Y = Distance of most strained fiber from the ^{neut} natural axis.

" I = Moment of inertia of section.

By a study of the curves for the two natural cements it is seen that the Louisville Cement, in tension, is much stronger, when one and two weeks old, than the Ft. Scott, but at the end of five or six weeks there is very little difference. However the strength of the Louisville mortar is greater in both tension and compression than the Fort Scott, while the neat in compression is more than twice as strong.

Records of tests obtained from the two Portland cement companies give results about twenty-five per cent higher than those obtained from our tests. This is probably due to their patting the briquettes with some mechanical device when molding. The St. Louis Portland cement gives higher results in nearly all the neat tensions

tests; while for the other tests, neat compression, and mortar tension and compression, the results compare well. On the other hand the Iola gave much better results than the St. Louis or even the German Portland, in the concrete beam tests. However, a definite comparison of the relative values of each cement for use in making concrete, would require an average of several beams.

The ratio of the two Portlands neat compression to neat tension average about 10:1, which agrees closely with a ratio given in Johnson's "Materials of Constructions."