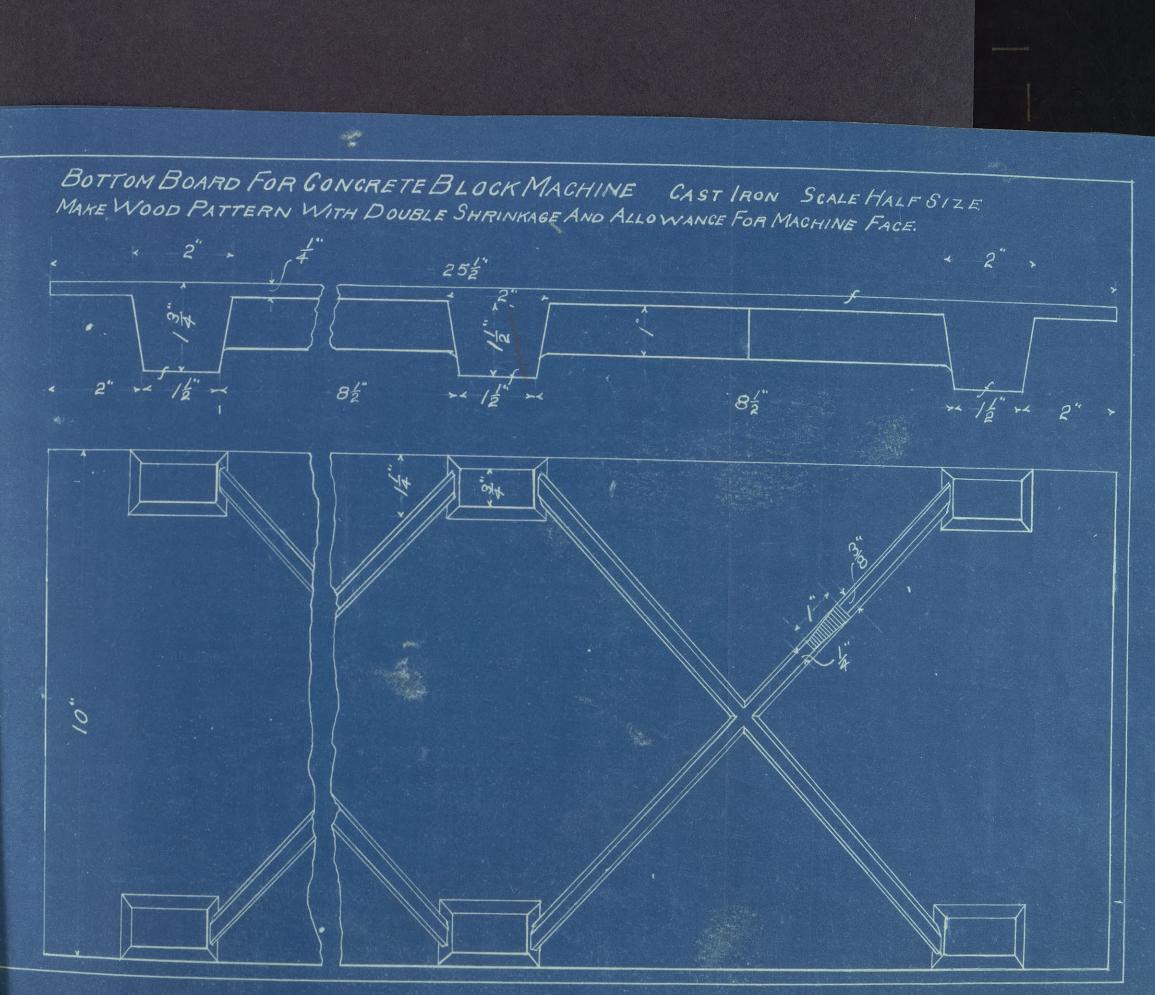
#### THESIS

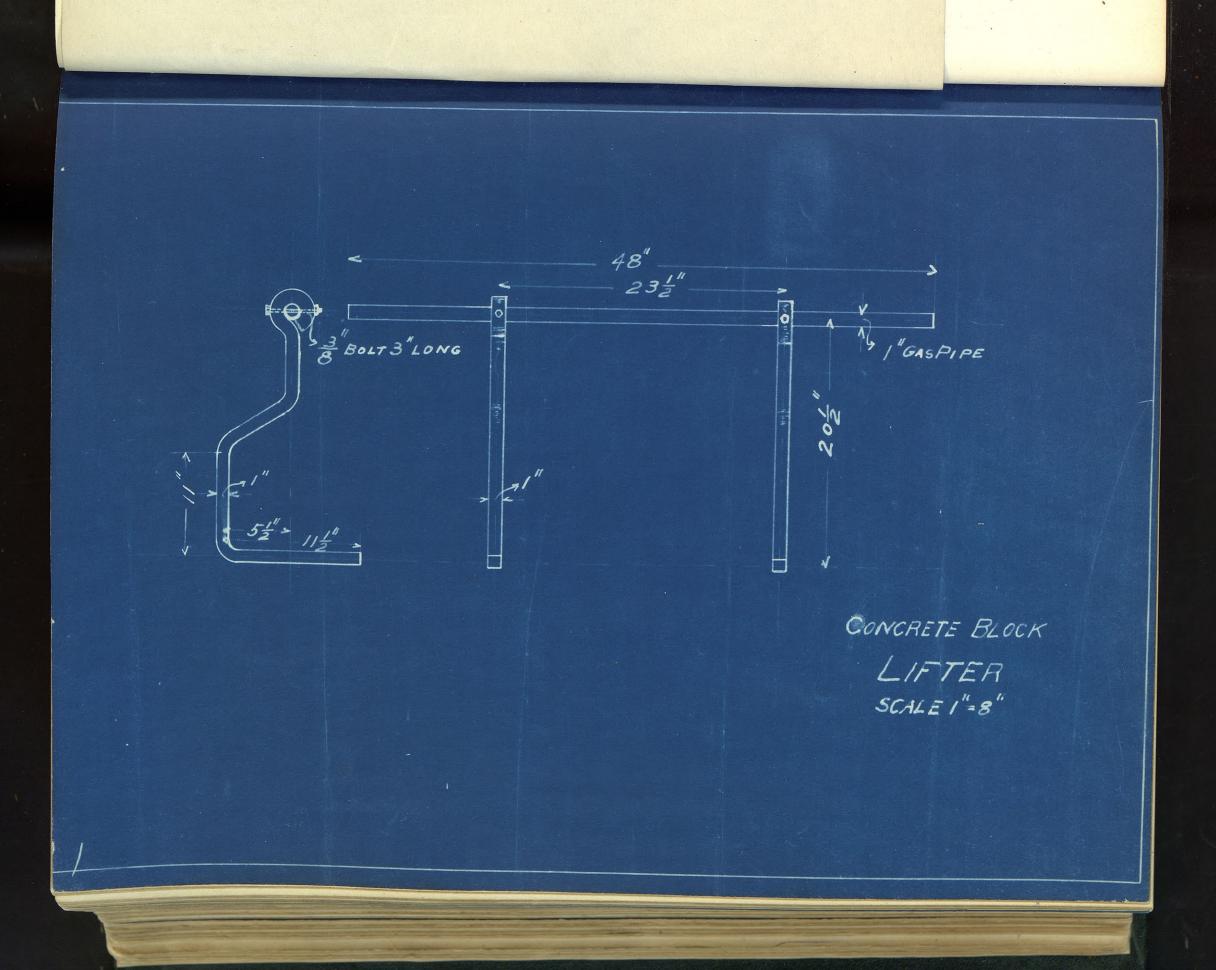
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# COMPARATIVE TESTS OF CONCRETE BUILDING BLOCKS

BY ROY C. BOWMAN A. H. DENNELER



A.H.DENNELER-4-7-07.



The object of this thesis is to determine the relative strength of concrete building blocks, (a) When made of different proportions of cement, sand and grit or gravel. (b) When made wet and dry. (c) When made face down and side down. Also to determine the cost of manufacturing the blocks, their fire resisting qualities and the durability of certain mineral colors when mixed in the face of the blocks.

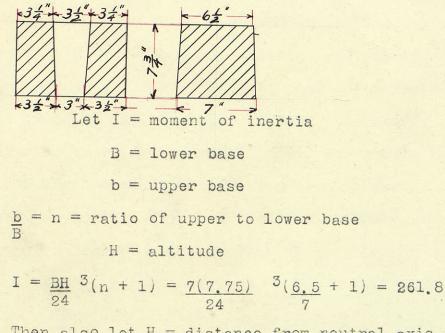
Groups M & N, O & P, I & R, S & T, W & V, and W & X, were made in the fall of 1906 by Mr. A. E. Ridenour for the mechanical engineering department. Some of these blocks were broken in curing so we filled out the groups and made such other blocks as were needed to make a complete test.

#### Standard Mixture

Through all our process of manufacture of blocks we used the standard method of mixing; that is, we first spread out the sand then added the cement. We mixed the two thoroughly until no streaks were seen, and then wet down the mixture and mixed until no lumps were in it. Lastly we added the grit or gravel and mixed as thoroughly as before. Unless otherwise stated, this method of mixing will be followed throughout our work.

At the outset we were troubled with poor cement, freezing weather and defective bottom boards. We first tried soaking the boards in oil which partly stopped their warping. We then designed cast iron bottom boards, as shown in the 1st blue print, the only objectionable feature of these being the weight. This we overcame by designing and using a lifter as shown by the 2nd blue print. 98

In our transverse test we placed the blocks in the Reihle' Testing Machine on knife edges 18" apart, and applied the load centrally. The blocks were tested in the same position as they would go in the building. The relative strength was noted from the modulus of rupture which we calculated from the theory of Goodwin. The theory is as follows: The section of the block is massed up into a trapezoid of the following dimensions;



Then also let  $H_1$  = distance from neutral axis to lower base S = half of upper base

 $S_1 = half of upper base$ 

y = distance from neutral axis to most strained fibre

in tension.

Then 
$$y = H_1 = \frac{H(2S + S_1)}{3(S + S_1)} = \frac{7.75(6.5 + 3.5)}{3(3.25 + 3.5)} = 3.83$$

If M = bending moment at time of rupture

W = central load

L = distance between supports

f = modulus of rupture

Then  $f = My = WLy = W(18 \times 3.83) = .0658W = constant$ I 4I 4 × 261.8

We took the average modulus of rupture of each group and found that the blocks made of the 1 : 3 : 2 mixture and mixed according to the standard method had the highest strength, the modulus of rupture being 268, while that of the 1 : 7 : 2 proportion had a modulus of but 169. The 1 : 3 : 2 mixture being thus 58.6% greater in its ultimate strength than the 1 : 7 : 2 mixture. The 1 : 3 : 2 proportion made by the dry process of mixing, (that is, the standard mixture) also showed an increase of 16% over the same mixture made to the usual concrete consistency.

The groups Y & Z were made of neat Atlas Portland Cement. They were mixed to ordinary molding sand consistency. The modulus of rupture for these groups was 208 lbs. per square inch, which did not justify the additional cost of cement used. It too was not as high as the 1 : 3 : 2 mixture. The modulus of rupture would probably increase with the age of the block.

The special group consisted of ten blocks made of 1 : 2 : 4 proportion. Five were made in the machine with face down, while five were made in a special box and made side down as they set in the building. The side down blocks showed the higher moduli of rupture, the average being 23.2% greater than that for those made with face down.

		Transverse	TECT	
		<i>u</i>	1631	
		711		
	M	Group M		
Date	of making	124 06 Baromete	r 29.39	
Date	of testing	me 1°07 Age	7 Mr. 8 days.	
Kind	of Cement used	atlas.	7 Mo. 8 days.	
Kind	of Sand used	Blue River.		
	of Grit used	A . A.		
Zind	of Crevel used	11 DA Cat Card		
	di Graver used	1 and car compe		
ropo			Grit & Gravel 2.	
		Cement Sand 2		
Cotal :	material used: Body:	Cement Cuft. Sand 12 cuft.	rit & Gravel 8 cuft Water 4 pail 1.6 cuft Water To temper	21
		a ent	11014 Tto	
	Face:	Cement Sand	1.6 Cup Water to Comper	2
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víetho	Face: od of mixing Sta	Dement . Sand	e	2.
Aetho	od of mixing Sta	ndard mylin	L .	2
Aetho	od of mixing Sta	ndard mylin	e.	2.
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Aetho Aetho	od of mixing Und	we ched, cfrom	k. feld every lay.	2.
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fetho	od of mixing <u>Uub</u> od of curing <u>Uub</u> er of hours in fire <u>M</u>	MACHINE TEST.	hlik energ bay.	2.
fetho fetho fumbo	od of mixing <u>Uud</u> od of curing <u>Uud</u> er of hours in fire <u>M</u> Breaking Load.	MACHINE TEST.	k. feld every lay.	2.
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Aetho Aetho Numbo	bd of mixing $Mac$ od of curing $Mac$ er of hours in fire $Mac$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5$	MACHINE TEST. Modulus of Rupture. 305. 270.	hlik energ bay.	2.
Aetho Ietho Numbo No. 1 2	bd of mixing $\mathcal{M}$ od of curing $\mathcal{M}$ er of hours in fire $\mathcal{M}$ Breaking Load. $A \ 6 \ 3 \ 0$ $A \ 0 \ 9 \ 5$ $3 \ 8 \ 1 \ 5$	MACHINE TEST. Modulus of Rupture. 305. 270. 251.	hlik energ bay.	P.
Aetho Ietho Iumbo No. 1 2 3	bd of mixing $\mathcal{M}$ od of curing $\mathcal{M}$ er of hours in fire $\mathcal{M}$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5.$ $3 \ 8 \ 1 \ 5.$ $A \ 1 \ 4 \ 5.$	MACHINE TEST. Modulus of Rupture. 305. 270.	hlik energ bay.	2.
Aetho Aetho Jumbo No. 1 2 3 4	bd of mixing $\mathcal{U}_{\mathcal{U}}$ bd of curing $\mathcal{U}_{\mathcal{U}}$ er of hours in fire $\mathcal{M}_{\mathcal{U}}$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5$ $3 \ 8 \ 1 \ 5$ $A \ 1 \ 4 \ 5$ $3 \ 5 \ 3 \ 0.$	MACHINE TEST. Modulus of Rupture. 305. 270. 251.	hlik energ bay.	2.
Aetho Aetho Numbo No. 1 2 3 4 5	bd of mixing $\mathcal{M}$ od of curing $\mathcal{M}$ er of hours in fire $\mathcal{M}$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5.$ $3 \ 8 \ 1 \ 5.$ $A \ 1 \ 4 \ 5.$ $3 \ 5 \ 3 \ 0.$ $3 \ 6 \ 5 \ 5.$	MACHINE TEST. Modulus of Rupture. 305. 270. 251.	hlik energ bay.	>.
Aetho Aetho Numbo No. 1 2 3 4 5	bd of mixing $\mathcal{M}$ od of curing $\mathcal{M}$ er of hours in fire $\mathcal{M}$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5$ $3 \ 8 \ 1 \ 5$ $A \ 1 \ 4 \ 5$ $3 \ 5 \ 3 \ 0.$ $3 \ 6 \ 5 \ 5.$ $3 \ 7 \ 6 \ 0.$	MACHINE TEST. Modulus of Rupture. 305. 270. 251.	hlik energ bay.	<b>7.</b>
Metho Metho Numbo <u>No.</u> 1 2 3 4 5 6 7	bd of mixing $\mathcal{U}_{\mathcal{U}}$ od of curing $\mathcal{U}_{\mathcal{U}}$ er of hours in fire $\mathcal{M}_{\mathcal{U}}$ Breaking Load. $\begin{array}{c} Breaking Load. \\ \hline 4 & 6 & 3 & 0. \\ \hline 4 & 0 & 9 & 5 \\ \hline 3 & 8 & 1 & 5 \\ \hline 4 & 1 & 4 & 5 \\ \hline 3 & 5 & 3 & 0. \\ \hline 3 & 5 & 5 & 5 \\ \hline 3 & 7 & 6 & 0. \\ \hline 4 & 0 & 0 & 0. \end{array}$	MACHINE TEST. Modulus of Rupture. 305. 270. 251. 273. 232. 240. 248. 264.	hlik energ bay.	<b>7.</b>
Metho Metho Numbo <u>No.</u> 1 2 3 4 5 6 7 8	bd of mixing $\mathcal{M}$ od of curing $\mathcal{M}$ er of hours in fire $\mathcal{M}$ Breaking Load. $A \ 6 \ 3 \ 0.$ $A \ 0 \ 9 \ 5$ $3 \ 8 \ 1 \ 5$ $A \ 1 \ 4 \ 5$ $3 \ 5 \ 3 \ 0.$ $3 \ 6 \ 5 \ 5.$ $3 \ 7 \ 6 \ 0.$	MACHINE TEST. Modulus of Rupture. 305. 270. 251.	hlik energ bay.	>.

		Transnuse	TEST
		Group O.	
Date	of making Och	2406 Barometer	9089
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	the second design of the second s	Blue River.	
Tind	of Crit used	Joplin.	
			1
	of Gravel used		
ropo		Cement Sand 4	Grit & Gravel 2
		Cement Sand 4	
'otal :	material used: Body:	Cements cuff Sand /2 cuff G	rit & Gravel 6 angh Water 3 7 pails 9 cupt Water To temper.
	Face:	Cement .6 cuff. Sand 2	9 cuft Water To temper.
Ietho	od of mixing. Sta	ulard Mixture	-
letho	od of curing Uni	en alud, spr	includ every day.
			includ every day.
		en alud, apr	inblid everyday.
			inblid every day.
			inblid every day.
umbo	er of hours in fire <i>M</i>		inblid every day.
umbo	er of hours in fire <i>M</i> Breaking Load.	MACHINE TEST.	Remarks.
umbo No. 1	er of hours in fire 24 Breaking Load. 4145.	MACHINE TEST. Modulus of Rupture. 273.	
umbo No. 1 2	er of hours in fire Breaking Load. 4145. 4635.	MACHINE TEST. Modulus of Rupture. 273. 305.	
umbo No. 1	er of hours in fire $\mathcal{M}$ Breaking Load. 4145. 4635. 4090.	MACHINE TEST. Modulus of Rupture. 273. 305. 269.	
umbo No. 1 2 3	er of hours in fire <i>M</i> Breaking Load. 4145. 4635. 4090. 4380	MACHINE TEST.           Modulus of Rupture.           273.           305.           269.           288.	
umbo No. 1 2 3 4	er of hours in fire $\mathcal{M}$ Breaking Load. 4145 4635 4090 4380 4730	MACHINE TEST.         Modulus of Rupture.         273.         305.         269.         288.         311.	
umbo No. 1 2 3 4 5	er of hours in fire $24$ Breaking Load. 4145. 4635. 4090. 4380. 4730. 3410.	MACHINE TEST.           Modulus of Rupture.           273.           305.           269.           288.	
umbe No. 1 2 3 4 5 6	er of hours in fire $M_{2}$ Breaking Load. 4145. 4635. 4090. 4380. 4730. 3410. 2930.	MACHINE TEST.         Modulus of Rupture.         273.         305.         269.         288.         311.         224.         196.	
No. 1 2 3 4 5 6 7 8	er of hours in fire $M$ Breaking Load. 4145. 4635. 4090. 4380. 4730. 3410.	Machine Test.         Modulus of Rupture.         273.         305.         269.         288.         311.         224.         196.         247.	
umbo No. 1 2 3 4 5 6 7 8	er of hours in fire $M_{2}$ Breaking Load. 4145. 4635. 4090. 4380. 4730. 3410. 2930. 3745.	MACHINE TEST.         Modulus of Rupture.         273.         305.         269.         288.         311.         224.         196.	

CEMENT AND CONCRETE SERIES

		ransverse	TECT
		1 au vouse	TEST
		Group Q	
Date	of making Ock	25'06. Barometer	AAAF
Date		Barometer	29.98
Date	of testing	ne 1, 07. Age	7 Mo. 7 days.
Kind	of Cement used	attas.	
Kind	of Sand used	3lue River.	
Kind o	of Grit used	Joplin.	
		Mith D b a	1
		Wild cat cree	
Propo	rtions used: Body: (	Cement 1. Sand 2	Grit & Gravel 2.
	Face: (	Cement 1 Sand 2	
Total			
100001	materiar used. Douy:	Cement - J. Sand & Copr. Gr	it & Gravel Scuff. Water 4 pails.
	Face:	Cement 6 Cuff. Sand	water to temper
Metho	od of mixing Sta	endard mitte	re.
Metho	d of curing Un	du shed, sp	
Metho		du shed, sp	
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Metho	d of curing er of hours in fire Breaking Load.	du shed, sp me Action in fire MACHINE TEST. Modulus of Rupture.	rinkled every do
Metho Numbo	d of curing Un er of hours in fire Ma Breaking Load. 3570,	MACHINE TEST.	rinkled every da
Metho Numbo	d of curing $\mathcal{U}_{\mathcal{U}}$ er of hours in fire $\mathcal{M}_{\mathcal{U}}$ Breaking Load. 3570 5600	MACHINE TEST. Modulus of Rupture. 235. 369.	rinkled every do
Metho Numbo	d of curing $\mathcal{U}_{\mathcal{U}}$ er of hours in fire $\mathcal{M}$ Breaking Load. 3570 5600 4250	MACHINE TEST. Modulus of Rupture. 235. 369. 280.	rinkled every do
Metho Numbo No. 1 2 3 4	d of curing $\mathcal{U}$ er of hours in fire $\mathcal{M}$ Breaking Load. 3570 5600 4250 5035	MACHINE TEST. MACHINE TEST. Modulus of Rupture. 235. 369. 280. 332.	rinkled every do
Metho Numbe	d of curing $\mathcal{U}_{\mathcal{U}}_{\mathcal{U}_{\mathcalU}}}}}}}}}}$	Machine Test.         Modulus of Rupture.         235.         369.         280.         332.         292.	rinkled every do
Metho Numbo <u>No.</u> 1 2 3 4 5	d of curing $\mathcal{U}$ er of hours in fire $\mathcal{M}$ Breaking Load. 3570 5600 4250 5035 4490. 4260.	Mu shed, sp         MACHINE TEST.         Modulus of Rupture.         235.         369.         280.         332.         292.         280.	rinkled every da
Metho Numbo <u>No.</u> 1 2 3 4 5 6 7	d of curing $Mm$ er of hours in fire $M$ Breaking Load. 3570 5600 4250, 5035, 4440, 4260, 4050,	Mu shed, sp         MACHINE TEST.         Modulus of Rupture.         235.         369.         280.         332.         292.         280.         267.	rinkled every da
Metho Numbo No. 1 2 3 4 5 6 7 8	d of curing $Mm$ er of hours in fire $M$ Breaking Load. 3570, 5600, 4250, 5035, 4440, 4260, 4440, 4260, 4050, 2796, 1000	Action in fire MACHINE TEST. Modulus of Rupture. 235. 369. 280. 332. 292. 280. 332. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 34. 292. 280. 290. 280. 200	rinkled every do
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CEMENT AND CONCRETE SERIES Transverse TEST Group Date of making Oct. 25, 06, Barometer 30. Date of testing June 1, '07. Age 7 Mo. 7 days. atlas. Kind of Cement used...() Kind of Sand used Blue River Kind of Grit used Jiplin . Kind of Gravel used Wild Cat Creek Proportions used: Body: Cement / Sand 5 Grit & Gravel 2 Face: Cement Sand 3 Total material used: Body: Cement 3 cm/, Sand / 5 cm/, Grit & Gravel 6 cm/, Water 3 paile Face: Cement . 4 cuft. Sand 1.2 Cuft. Water To Temper. Method of mixing Slandard mixture. Method of curing Under shed, sprinkled every day. Number of hours in fire More Action in fire MACHINE TEST. No. Breaking Load. Modulus of Rupture. Remarks. . 1 4475. 295. 3580. 2 236. 240. 3645, 3 4140. 273. 4 238. 5 3620. age 3 Mo 2 days 165. 6 3505, 7 3200. 211. 2865 189, 8 145, 2195. 9 2900. 10 192. average = 218.

Imammende TEST         Group       M.         Date of making       Qett, 31'0'6       Barometer       3 0.45         Date of testing       June 1'0'7.       Age       7 206 1 day         Kind of Cement used       Qetter       Age       7 206 1 day         Kind of Grit used       Jose Paire       Sand T.       Grit & Gravel Lay         Kind of Grit used       Jose Paire       Sand 7.       Grit & Gravel 2.         Face:       Cement 1.       Sand 7.       Grit & Gravel 2.         Face:       Cement 1.       Sand 3.       Sond 3.         Total material used:       Body:       Cement 2.       Sand 1/2 off.       Water 3 pails.         Face:       Cement 4.       Sand 1/2 off.       Water 3 pails.         Method of enring       Mudue of Muister       Material used:       Material and and material and					204
Date of making Och. 31'06 Barometer 30.45 Date of testing June 1'07. Age 7.11 day Kind of Coment used Atlan. Kind of Sand used Atlan. Kind of Sand used Alma Ainer. Kind of Grit used Johlin . Kind of Gravel used Johlin . Kind of Gravel used Johlin . Face: Cement . Mathematical used: Body: Cement 2. Face: Cement . Mathematical used: Body: Cement 2. Face: Cement . Mathematical used: Body: Cement 2. Face: Cement . Method of mixing Standard Musture . Method of enring Mudan Andred, Aprice . Mathematical and . Mathematical and . Mathematical used . Mathematical and . M			hanve	ral TEST	
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Date of testing June 1'07. Age 7 We 1 day Kind of Cement used $atlar$ . Kind of Sand used $Blue Rivee$ . Kind of Grit used $Jeffin$ . Kind of Gravel used $Jeffin$ . Kind of Gravel used $Jeffin$ . Proportions used: Body: Cement 1. Sand 7. Grit & Gravel 2. Face: Cement 1. Sand 3. Total material used: Body: Cement 2 aff. Sand 12 aff. Water 3 parls. Face: Cement 1. Conf. Sand 1.2 aff. Water 3 parls. Face: Cement 1. Sand 1.2 aff. Water 3 parls. Face: Cement 1. Sand 1.2 aff. Water 3 parls. Method of mixing Standard Misture . Method of curing Much shul, sprinbled every day. Number of hours in fire More. Action in fire Machine Test. No Breaking Load Modulus of Reptore Remarks. 1 3375, 222. 2 2670. 176. 3 3370. 221. 4 3575, 235. 3 2195. 210. 6 1355. 89. 9 1100. 72. 10 2110. 139. 10 2110. 139.	Date	of making Oct	- 31'0 (a Par	3018	
Kind of Cement used Cattlar. Kind of Sand used Blue River. Kind of Grit used Julia Cat Creek Proportions used: Body: Cement /. Sand 7. Grit & Gravel 2. Face: Cement I. Band 3. Total material used: Body: Cement 2 off. Sand Acoff. Grit & Gravel 4 off. Water 3 parts. Face: Cement I. Couple. Sand 1/2 off. Water 3 parts. Face: Cement I. Couple. Sand 1/2 off. Water 3 parts. Face: Cement I. Couple. Sand 1/2 off. Water 3 parts. Face: Cement I. Couple. Sand 1/2 off. Water 3 parts. Face: Cement I. Couple. Sand 1/2 off. Water 3 parts. Method of mixing Standard Minsterne. Method of curing Under Sheed, springlub every Mag. Number of hours in fire North. Action in fire $\frac{MaCHINE TEST.}{No. Breaking Load Modules of Ruptere. Bremarks.}$ $\frac{No. Breaking Load Modules of Ruptere. Bremarks.}{S 3 7 5. 2 2 2$	Date	of testing	me 1°07	Are 7 Mr. I Saus	
Kind of Grit used $yylin         Kind of Gravel used       yyling Cart Cuch         Proportions used: Body: Cement /.       Sand 7.       Grit & Gravel 2.         Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 1.2 wft. Water 3 parls.         Face: Cement .       A cuff. Sand 1.2 wft. Water 7.0 temper         Method of mixing       Standard Muisture .         Method of curing       Mudu 2.         Method of curing       Mudu 2.         Method of curing       Modulus of Rupture.         Map       Modulus of Rupture.         Number of hours in fire       Modulus of Rupture.         1       2.3.7.5.       2.2.2.         2       2.6.7.0.       1.7.6.         8       3.3.7.0.       2.2.1.         4       3.5.7.5.       2.3.5.         5       3.1.9.5.       7.9.         6       1.3.5.5.       7.9.         7       3.9.5.5.       7.9.         8       7.8.5.       7.9.         9       11.0.0.<$	Kind	of Cement used.	atlar.	Age	
Kind of Grit used $yylin         Kind of Gravel used       yyling Cart Cuch         Proportions used: Body: Cement /.       Sand 7.       Grit & Gravel 2.         Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 3.         Total material used: Body: Cement 2.       Face: Cement /.       Sand 1.2 wft. Water 3 parls.         Face: Cement .       A cuff. Sand 1.2 wft. Water 7.0 temper         Method of mixing       Standard Muisture .         Method of curing       Mudu 2.         Method of curing       Mudu 2.         Method of curing       Modulus of Rupture.         Map       Modulus of Rupture.         Number of hours in fire       Modulus of Rupture.         1       2.3.7.5.       2.2.2.         2       2.6.7.0.       1.7.6.         8       3.3.7.0.       2.2.1.         4       3.5.7.5.       2.3.5.         5       3.1.9.5.       7.9.         6       1.3.5.5.       7.9.         7       3.9.5.5.       7.9.         8       7.8.5.       7.9.         9       11.0.0.<$				rei	
Proportions used: Body: Cement $/$ . Sand $/$ . Grit & Gravel $2$ . Face: Cement $/$ . Sand $3$ . Total material used: Body: Cement $2ay$ . Sand $/4cy$ . Grit & Gravel $4cy$ . Water $3$ parls. Face: Cement $.4cy$ . Sand $/2cy$ . Water $7b$ temper Method of mixing $Standard$ mixture . Method of curing $Madu abud$ , $prinkled$ every Machine Test. No. Reaking Load. Modulus of Rupture. 1 2375, $222$ , 2 2670, $/76$ , 8 3370, $22/$ , 4 3575, $235$ , 5 2/95, $2/10$ , 6 / 355, $89$ , 7 3956, $260$ , 8 785, $589$ , 10 2//0, $/39$ , 10 2//0, 10 2//0, $/39$ , 10 2//0, $/39$ , 10 2//0, $/39$ , 10 2//0, 10 2/0, 10					
Proportions used: Body: Cement $A$ . Sand $A$ . Grit & Gravel $2$ . Face: Cement $A$ . Sand $3$ . Total material used: Body: Cement $2ayf$ . Sand $Aayft Grit & Gravel Aayft. Water 3 parls.Face: Cement Aayft. Sand Aayft. Water Aayft. Water 3 parls.Face: Cement Aayft. Sand Aayft. Water Aayft.Method of mixing Aaad Aad Aayft. Water Aayft.Method of curing Aad Aad Aayft.Method of curing Aad Aad Aad Aayft.Method of onring Aad Aad Aad Aayft.Method of nors in fire Aaad Aad Aad Aad Aad Aad Aad Aad Aad Aad$	Kind	of Gravel used	1 vild cat c	u.l.	
Face: Cement 1, Sand 3, Total material used: Body: Cement 2auft. Sand 12 uft. Water 3 parls. Face: Cement 4 cuft. Sand 1.2 uft. Water 10 temper Method of mixing Standard Misture. Method of curing Under shiel, sprinkled energy Mag. Number of hours in fire Mone. Action in fire MACHINE TOST. No. Breaking Load. Modulus of Rupture. No. Breaking Load. Modulus of Rupture. No. Breaking Load. Modulus of Rupture. No. Breaking Load. Modulus of Rupture. 1 3375, 222, 2 2 67.0, 176, 3 3370, 221, 4 3675, 235, 3 2195, 210, 6 1355, 89, age 2 Mb / day 7 3956, 58, 4, 4, 4, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5, 5,	Propo	ortions used: Body:	Cement Sand	7. 0400 2	2.00 - 12 - 12 - 13 - 13 - 13 - 13 - 13 - 13 - 13 - 13
Total material used: Body: Cement 2 <i>a</i> ff. Sand <i>Acaff</i> . Grit & Gravel <i>A a</i> ff. Water 3 parks. Face: Cement <i>A cuff</i> . Sand <i>1.2 cuff</i> . Water <i>76 temper</i> Method of mixing <i>Standard Nuisture</i> Method of curing <i>Under Shiel</i> , <i>sprinklel every</i> <i>Mag</i> . Number of hours in fire <i>More</i> . Action in fire <u>MaCHINE TEST.</u> No. <u>Breaking Loud</u> . <u>Modulas of Rupture</u> . <u>Remarks</u> 1 3375, 222, 2 2670, <i>176</i> 3 3370, 2211. 4 3575, 235, 5 3195, 210, 6 1355, 89, <i>age 2 Mo</i> / <i>day</i> 7 3955, 260, <i>a</i> 8 \$855, 58, <i>a</i> 9 11000, 72, <i>a</i> 10 2110, <i>139</i> , <i>a</i>					x
Method of mixing       Mandaid       Mixture         Method of curing       Muchan shell, sprinklek every         Jaq         Number of hours in fire         Machine Test.         Modulus of Rupture.       Remarks.         1       3 3 7 5,       2 2 2,         2       2 67 0,       1 7 6,         3       3 3 7 0,       2 2 1,         4       3 5 7, 5,       2 3 5,         5       3 1 9 5,       2 10,         6       1 3 5 5,       8 9,         7       3 9 5 6,       2 60,         8       8 8 5,       5 8,         9       11 0 0,       7 3 9,	Total				0
Method of mixing       Mandaid       Mixture         Method of curing $Madn shed$ , sprinbled $mey$ $dag$ $Magnetic shed$ , sprinbled $mey$ Magnetic shed $Machine Trest.$ Remarks.         1 $3375$ , $222$ , $227$ ,         2 $2670$ , $176$ , $3375$ , $2227$ ,         3 $3370$ , $2271$ , $43575$ , $235$ ,         5 $2195$ , $210$ , $age 2Me/dag$ 6 $1355$ , $89$ , $age 2Me/dag$ 7 $3956$ , $260$ , $437$ , $437$ , $44$ , $437$ , $44$		Faco:	Coment 4 Canalta	Water 2 part	la.
Method of curing       Under shid, sprinklik every         Mag.         Number of hours in fire         MACHINE TEST.         Machine Test.         Machine Test.         No.         Breaking Load.         Mathine Test.         Remarks.         1       3375, 222, 22, 22, 22, 22, 22, 22, 22, 22,	Mothe	race.	Cement Sa	nd 1,2 cuft. Water 10 Cemper	-
Mag       Number of hours in fire       Action in fire         •       MACHINE TEST.         •       MACHINE TEST.         No.       Breaking Load.       Modulus of Rupture.         1 $3.375$ $2.22$ 2 $2.6770$ $/766$ 8 $3.370$ $2.211$ 4 $3.575$ $2.355$ 5 $3./955$ $2.100$ 6 $/3555$ $8.91$ 7 $39.555$ $2.60$ 8 $8.56$ $5.5$ 9 $/1000$ $7.24$ 10 $2./10$ $13.97$	Meone		andard My	une.	
Mag.       Number of hours in fire       Action in fire         Number of hours in fire       Machine Test.         No.       Breaking Load.       Modulus of Rupture.       Remarks.         1 $3.375$ $2.22$ $2.22$ 2 $2.6770$ $1.76$ $3.370$ $2.21$ 4 $3.575$ $2.35$ $5.5$ $3.1955$ $2.100$ 6 $1.3555$ $5.79$ $2.60$ $4.200$ $4.400$ 7 $39.555$ $2.60$ $4.200$ $4.400$ 8 $8.56$ $5.85$ $4.56$ $4.56$ 9 $1.000$ $7.26$ $4.5600$ $4.5600$			A   A		
Number of hours in fire <i>Hork</i> . Action in fire         •       MACHINE TEST.         •       Machine Test.         1 $3375$ . $222$ .         2 $2670$ . $176$ .         3 $3370$ . $221$ .         4 $3575$ . $235$ .         5 $3/95$ . $210$ .         6 $1355$ . $89$ . $44$ .         9 $1100$ . $72$ . $14$ . $14$ .	Metho	od of curing UM	an shed,	sprinkled every	
No.       Breaking Load.       Modulus of Rupture.       Remarks.         1 $3375$ , $222$ , $2670$ , $176$ , $235$ , $235$ , $235$ , $235$ , $235$ , $5375$ , $235$ , $235$ , $53195$ , $210$ , $43575$ , $235$ , $53195$ , $210$ , $61355$ , $89$ , $240$ , $4ge 2Mb$ , $4ay$ , $73956$ , $260$ , $8885$ , $58$ , $1644$ , $1644$ , $1644$ , $1000$ , $72$ , $1100$ , $72$ , $1100$ , $1100$ , $72$ , $1100$ , $1100$ , $72$ , $11000$ , $110000$ , $11000$ , $110000$ , $110000$ , $110000$ , $110000$ , $110000$ , $110000$ , $110000$ , $11000$	A	ap			
No.       Breaking Load.       Modulus of Rupture.       Remarks.         1 $3375$ $222$	Numb	er of hours in fire <i>Me</i>	Action in fire	······	
No.         Breaking Load.         Modulus of Rupture.         Remarks.           1 $3375$ $222$			······		
No.       Breaking Load.       Modulus of Rupture.       Remarks.         1 $3375$ $222$	·····				
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			MACHINE TEST.		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	No.	Breaking Load.	Modulus of Rupture.	Remarks.	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			222.		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			176		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$			235		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	5		210		
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	6		89.	age 2 Mo / day	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	7	3955	260		
10 2110, 139, "			58,	10 12 11	
		***************************************	72.	1. 1. 0.	
	10		139.	16. 66 (1)	
		1			

205 hansverse TEST Group Special (in box) Date of making Apr, 27,04. Barometer 30.03 Date of testing June 1. 07. Age 1200.9 days. Atlas. Kind of Cement used..... Blue River. Kind of Sand used Johlin. Kind of Grit used Kind of Gravel used Will Cat cuch None Proportions used: Body: Cement / Sand 2 Grit & Gravel 4 Face: Cement Mosaphace Total material used: Body: Cement 1. 3 affand 2.6 affarit & Gravel 5.2 affater 2 faile Face: Cement Sand Water Method of mixing Standard mitture. Method of curing Under shed, sprinkled every day. Number of hours in fire Mone. Action in fire MACHINE TEST. No. Breaking Load. Modulus of Rupture. Remarks. 1 267 4065. 145 2 2210. made efter web 2745. 3 180. age 1 mo 12 days. 4740. 4 312. 4860. 5 320. 6 7 8 9 10 Average 244

2010 hansvere TEST Group Special (in machine) apr 2 2 °67 Barometer 30.03 Date of making June 1, '07. Age 1 Mo. 9 Days. Date of testing atlas Kind of Cement used. Blue River Kind of Sand used Kind of Grit used Kind of Gravel used Proportions used: Body: Cement Sand Z Grit & Gravel 4 Face: Cement No Sander Total material used: Body: Cement 1.3 aff. Sand 26 off. Grit & Gravel 5.2 aft. ater 2 pails. Face: Cement Sand Water Method of mixing Standard mifture. Method of curing Under shed, sprinkled every day Number of hours in fire Mone. Action in fire MACHINE TEST. No. Breaking Load. Modulus of Rupture. Remarks. 3145. 1 207. 2 3190 210. 3460 228. 3 2555. 4 168, make extra web 2705. 5 age : 178, 6 7 8 9 · 10 Average 198.

Group W&X Date of making Barometer	
Group W & X Date of making Barometer	
Date of makingBarometer	
Date of makingBarometer	
Date of makingBarometer	
Darometer	
Date of testing from 4 '0 7 Age	
Kind of Cement used atlas	
Kind of Sand used Slue pine	
Kind of Grit used Joplin	
Kind of Gravel used Wild Cat Cuck	
Proportions used: Body: CementSandGrit & Gravel	
Janu	
Total material used: Body: Cement 2,5 aft Sand 7.5 aft Grit & Gravel 5. aft Water 5 pails Face: Cement 2 aft Sand . 0.6 aft Water To temper	
Face: Cement, 2 cuft Sand Ob cuft Water To temper	
Method of mixing Standard mixture will enough	
water added to make it of usual concrete consiste	-
Method of curing Under shed	d'
Number of hours in fire <i>House</i> Action in fire	
Action in life	
· · · · · · · · · · · · · · · · · · ·	
MACHINE TEST.	
No. Breaking Load. Modulus of Rupture. Age Remarks.	
1 4195 276 7 Mo. 6 days	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
$\begin{array}{c ccccccccccccccccccccccccccccccccccc$	
3 5 4135 272 6 " 26 "	
<u>6 3800 250 6 24 1</u>	
7 2640 174 6 21	
4 8 2365 221 1 "12 "	
<u>9 1750 144 8 10</u>	
-10 3430 226 / 1 1 7 11 Average 225	
average 225	

				20
		$\widehat{\Gamma}$		
		housance	TEST	
D. I	21.	Group Y 4-Z		
Date	of making	~ 1, 06. Barometer	30.47	
Date	of testing	Age	7 Mo. 3 days,	
Kind	of Cement used	allas.		
Kind	of Sand used	1 sene lerve		
Kind	of Grit used	1 Coplin		
			et.	
Propo			Grit & Gravel	
		Cement I Sand O		`
Total :	material used: Body:	Cement 8 7 tuf Band O G	rit & Gravel & Water 5 pails	
	Face:	Cement 8 3 confront G	Water	
	Face:	Cement 8 7 uf Sand O G Cement Sand	Water	
Metho	Face:	Cement Sand	Water	
Metho	Face:	Cement Sand	Water	
Metho Metho	Face:	Cement Sand and anisti du ched, spr	Water me, m/clid every day.	
Metho Metho	Face:	Cement Sand	Water me, m/clid every day.	
Metho Metho	Face:	Cement Sand and anisti du ched, spr	Mater	
Metho Metho	Face:	Cement Sand	Mater	
Metho Metho	Face:	Cement Sand and anisti du ched, spr	Water	
Metho Metho Numbe	Face: Dd of mixing Dd of curing er of hours in fire Breaking Load.	Cement Sand Sand Sand Sand Sand Machine Test. Modulus of Rupture.	Mater	
Metho Metho Numbe	Face: Face: $\mathcal{G}$ of curing $\mathcal{G}$ er of hours in fire $\mathcal{M}$ Breaking Load. 2470. 3660.	Cement Sand Sand Sand Sand Machine Test. Modulus of Rupture. 163. 241.	Water	
Metho Metho Numbe	Face: Face: $d \circ f mixing$ $M$ d of curing $Mer of hours in fire MBreaking Load.2470$ , 3660, 4320,	Cement Sand Sand Sand Sand Sand Machine Sand Machine Sand Machine Sand Machine Test. Modulus of Rupture. 163. 284.	Water	
Metho Metho Numbe	Face: $d c f mixing \qquad flat d of curing \qquad magnetic er of hours in fire \qquad magnetic Breaking Load. 2470,3660,4320.3750.$	Cement Sand and Anipta An ohed, spr One Action in fire MACHINE TEST. Modulus of Rupture. 163. 241. 284. 297.	Water	
Metho Metho Numbe	Face: Face: d of curing $Md of curing$ $Mer of hours in fire MBreaking Load.2470,3660,4320.3750.3850$	Cement Sand Sand Sand Sand Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Test. Modulus of Rupture. 162. 289. 297. 253.	Water	
Metho Metho Numbe <u>No.</u> 1 2 3 4 5	Face: $d c f mixing \qquad flat d of curing \qquad magnetic er of hours in fire \qquad magnetic Breaking Load. 2470,3660,4320.3750.$	Cement Sand and Anipta An ohed, spr One Action in fire MACHINE TEST. Modulus of Rupture. 163. 241. 284. 297.	Water	
Metho Metho Numbe <u>No.</u> 1 2 8 4 5 6	Face: Face: d c f mixing for the formula of curing for the formula of the for	Cement Sand Sand Sand Sand Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Sand Machine Test. Modulus of Rupture. 162. 289. 297. 253.	Water	
Metho Metho Numbe <u>No.</u> 1 2 3 4 5 6 7	Face: Face: d c f mixing $d f curing$ $d f curing$ $d f curing$ $d f curing$ $d f f curinger of hours in fire MBreaking Load.2470$ , 3660, 4320, 37550, 3750, 3750, 3750, 37550, 3755	Cement Sand and all might du check, spr oul Action in fire MACHINE TEST. Modulus of Rupture. $163.241.284.297.253.247.187.$	Water	

Group.	Modulus of rupture.
Μ.	268.
0.	256.
Q.	0.00
	262 .
S.	218.
	· · · · · ·
υ.	168.
Special.	
Box.	244.
Machine.	198.
W&X .	225
Y&Z.	223 .

Table of Averages.

209

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#### Fire Test.

In the fire test the blocks were placed on a specially constructed five sided furnace, used in previous tests by Mr. R. A. Seaton and Mr. R. L. Hammaker. Each of the groups were piled one on top of the other in order of number, thus each group composed one side of the furnace. The furnace was fired with wood for an hour and a half. Water was then turned onto the whole pile, the fire extinguished and the results were noted as shown by the following data sheets. At the end of half an hour we noted that some of the blocks were cracked on the outside. At intervals after that we noticed that other blocks were cracking and this continued until at the end of the test there were only ten blocks that were not cracked. However, these crumbled to pieces on being taken down. The blocks on the top were the first to crack thus showing that the fire was probably the hotter at this portion of the furnace.

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CEMENT AND CONCRETE SERIES

	<					
Fire TEST						
Group 71 Date of making Oct 24'06 Barometer 29.39						
Date of making 012406 Barometer 29,39						
Date of testing June 10'07 Age 7 Mo 17 days Kind of Cement used atlac						
Kind of Sand used Blue River						
Kind of Grit used Joplin						
Kind of Gravel used wild cop creek.						
Proportions used: Body: Cement / Sand 3 Grit & Gravel 2						
Face: Cement / Sand 2						
Total material used: Body: Cement 4 Sand 12 MGrit & Gravel Saft Water Apails						
Face: Cement Scrift Sand 1.6 cuft Water To temper						
Method of mixing Standard mixture	C. S.					
Method of curing Under shed, sprinfled every day						
Number of hours in fire 1.5 hus Action in fire after 30 min. Hz was						
broken. at the end none of them was, lest						
all having crached						
Machine Test.						
No. Breaking Load. Modulus of Rupture. Remarks.						
4						
5						
6						
8						
9						

2.41

				212		
		Pire	TEST			
		Group				
	Date of making Oct 24'06 Barometer 29.89					
Date o	of testing	~ 10 07 A	re 7 Mo. 17 days			
Kind o	of Cement used	attas				
Kind o	of Sand used	Blue River				
Kind o	of Grit used	Joplin				
Kind o	of Gravel used	Wild cap c	neh			
Propor	rtions used: Body: (	Cement Sand	4 Grit & Gravel 2			
	Face: (	Cement Sand	4	X		
Metho	Face: d of mixing <u>Stan</u>	Coment is cup Sand	Grit & Gravel buff Water 33 pails 2.4 upt Water To temper re held every day.			
	mp mere c	rached on fa	30 min for of the			
y y	ne an n	u blocks. men	brotzen.			
No.	Breaking Load.	MACHINE TEST.				
1	Dicaking Doad.	Modulus of Rupture.	Remarks.			
2			ge. 2 mo Maayo			
3						
5						
6						
8						
9						
10						

CEMENT AND CONCRETE SERIES

FireTEST						
Group						
Date of making Och 26'06 Barometer 29.98						
Date of testing fune 10 '07 Age 7 Mo. 16 days. Kind of Cement used Atlas						
Kind of Sand used Blue River						
Kind of Grit used						
Kind of Gravel used Mildred Cuela						
Proportions used: Body: Cement / Sand Z Grit & Gravel Z	-					
Face: Cement 1 Sand 2						
Total material used: Body: Cement Acuft Sand Scuft Grit & Gravel Scift Water & pails	,					
Face: Cement bluft. Sand 1-2 auft. Water To temper.						
Method of mixing blandard mixture						
Method of curing Under shed, ofrinkled every day.						
Number of hours in fire 1, 5 his Action in fire In a short time three						
of the blocks were erached and all were						
broken by the end of the fire.						
Machine Test.						
No. Breaking Load. Modulus of Rupture. Remarks.						
1						
2 3						
4						
7						
8 9						
10						

CEMENT AND CONCRETE SERIES

7							
Pire TEST							
Date	Group Date of making Oct 25'06 Barometer 30.00						
Date	Date of testing June 10 '07 Age 7 Mo 17 days.						
Kind	Kind of Cement used Allas						
Kind	of Sand used	Blue River	······				
Kind	of Grit used	Johlin					
Kind	of Gravel used	1 tel cat Cra	eh				
			5 Grit & Gravel 2				
		Vement Sand					
Total			Grit & Gravel 6 Cuft Water 3 pails				
	Face:	Cement A cuft Sand	1.2 cuft Water To temper				
Metho	od of mixing Sta	undard origt	me.				
Metho	od of curing Una	In shed, opri	infiled every day.				
Numb	er of hours in fire	The Action in fine of a	o min. three of the				
			and of test all				
Ine	re broke	~ .	g our and				
		Machine Test.					
No.	Breaking Load.	Modulus of Rupture.	Remarks.				
1							
2			age I NO 11 days.				
4			······································				
5							
8 9			16 46 <sup>4</sup> 1				
10							

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CEMENT AND CONCRETE SERIES

		Pire	TEST			
	Group					
Date of making	Date of making Oct 31 06 Barometer 30.48					
Date of testing	Date of testing fine 10'07 Age 7 Mo 11 days Kind of Cement used Attas					
Kind of Cement	used	lttas	······			
Kind of Sand us	sed (	She River				
Kind of Grit use	ed	Joplin				
Kind of Gravel	used	Wild cat c	uch			
			7 Grit & Gravel 2			
		nent Sand				
Total material u				3 haily		
	Face: C	ement A Cut Sand	Grit & Gravel <u>1 cuft</u> Water 1.2 cuft Water B To			
Method of mixir	o Stan	dard mit	water jo c	reper.		
			ne,	·····		
Method of curin	. Und	n shed she	inteled every	1 1 1 1		
-izeciloù er eurin			enny	any.		
Number of hour	s in fino 1.5-	has notion in and	a for our	+		
two bloc		- bropen a	a fan on	ulle		
en to-t	ant	- to to to la	at the	- L		
	100000	N	por anacci	no est		
		MACHINE TEST.	1			
No. Brea	king Load.	Modulus of Rupture.	Remarks.			
1 2			(100 17/10 27			
3		······	age 1 100 21	uays		
4						
6						
7						
8						
10				<u>¢e</u>		

#### Capacity of Machine

On June 3rd we made an all day run to determine the number of blocks that could be made by four men, two at the machine and two mixing the body. In 8 hours we made 65 blocks. Our work was delayed somewhat by having to wash the grit. The men were not used to the work and would probably do more had they been hardened to it. At any rate, the tamping would be very strenous work if more than the above number of blocks were made in 8 hours.

#### Coloring

In the test we have made over one hundred colored blocks. Several different colors were used; some proving satisfactory, others fading when exposed to the action of the air and water. The colors used were; German Vandyke Brown, Ultra Marine Blue, Italian Burnt Sienne, Judian Red, Lamp Black, Deep Perma Red and White. The results as noted to date are given on the following data sheets. The color test is not complete as yet, but observations will be made at intervals to determine to what degree the colors are permanent when exposed to the weather for long periods of time.

CEMENT AND CONCRETE SERIES 217 COLOR TEST Color Deep Perma Rid Date of making June 3, '07 Barometer 29.84 June 11, '07 Age 8 days. Date of observation Coloring materials used aleefs Perma Red. BODY: Proportions: Cement Sand 3 Grit & Gravel 2 Total...... Cement 1.2 with Sand 3.6 Grit & Gravel 2.4 cuff Water 1 fail. FACE: Mixture:.... Cement & cuft; Sand & cuft; 3# 103, of Kleep; Perma Rid: Water to temper. Method of mixing Standard mixture. Method of curing Under shed, sprinkled every day Results as noted to date of observation Time blocks were me in this group. at the time of maki the color was a very drep maroon ? color gradually bud ighter until aroon 1 it is a light on the blocks are sumbered A. 155.

CEMENT AND CONCRETE SERIES

COLOR TEST Color alech Permaned Date of making June. 3'07 Barometer 29.89 Date of observation June 11, '07, Age 8 days Coloring materials used Liep Perma Red BODY: Proportions: Cement Sand 3 Grit & Gravel 2 Total....... Cement 24 coft Sand 7.2 coff Grit & Gravel 4.8 coff Water 2 pails FACE: Mixture:.... Cement 1/3 cuft; Sand Zaff; 2#1207 of allef Perma Red, Method of mixing Standard mixture. Method of curing Unkn shed, sprinklidenery day. Results as noted to date of observation the color of first max a deep maroon yet lighter than that of eiding Jage because of less coloring prec material ? - the gave It has changed to a very little lighter color to da this groups die ande ten blocka. 9 R 6-15.

CEMENT AND CONCRETE SERIES 219 COLOR TEST Color Light Brown June 3'04. Barometer 29.89 June 11.'07. Age 8 days Date of making Date of observation Coloring materials used Italian Burt Sherma, BODY: Proportions: Cement / Sand 3 Grit & Gravel 2 Total..... Cement 2. 4 Cuffsand 7.2 cuffGrit & Gravel 48 cuffWater 2 fails FACE: Mixture:.... Cement Scuff; Sand Zeuff; 2#120; of Italia Burnt Sima, Method of mixing Standard mixture. Method of curing Under ched, sprinkled every day. Results as noted to date of observation In this group made ten block mumber BI to 10. The color at making u a light "Terra Cotta" and is protien the came at date of absende

CEMENT AND CONCRETE SERIES COLOR TEST Color Light Brown Date of making June 3, '0 1, Barometer 29,89 Date of observation June 11'07, Age 8 days. Coloring materials used Italian burnt Sienda. BODY: Proportions: Cement 1 Sand 3 Grit & Gravel 2 Total..... Cement 2.9 cuft, Sand 7.2 cuff. Grit & Gravel 49 cuff. Water 2 pails. FACE: Mixture:.... Cement 1/2 cuft; Sand 3 cuft; 5#8 3 Italian; Burnt Sienna; Water to Temper Method of mixing Standard mixture. Method of curing Under ahed, aprinhled every day. Results as noted to date of observation In this group me made ten blocho mulicin g B107020. the color is the same as used in preceding group except that more terial is used. The of the clocomy ma color is the same as at the make which was a dark "terra Cotta"

#### CEMENT AND CONCRETE SERIES

COLOR TEST Color Medium Red. Date of making apr. 107 Barometer 32. Date of observation June 11'07. Age 2 Mo. 10 days. Coloring materials used Red Chide of Iron. BODY: Proportions: Cement / Sand & Grit & Gravel 2 Total...... Cement 1.5 coft. Sand 7.5 coft. Grit & Gravel 3 coft. Water 2 fails FACE: Mixture:.... Cement 30<sup>#</sup>; Sand 60<sup>#</sup>; 34<sup>#</sup>Red opide grion. Method of mixing Standard mixture. Method of curing Under a hed, sprinkled every day. Results as noted to date of observation In this group we made ten blocks mucheri 9 C1510 at time of making they were as a good andim hed but soon big to gade until at date of obser they are of a fawn color.

CEMENT AND CONCRETE SERIES	000
COLOR TEST	222
01	
Color Blue	
Date of observation	
Date of making 4 6 '01 Barometer 3 2 Date of observation fine 11 '0 7 Age 2 Mo. 15 days Coloring materials used Ultra Marine Blue.	
BODY: Proportions: Cement / Sand 5 Grit & Gravel 2	
Total Cement 1.6 cuff. Sand 8 cuff. Grit & Gravel 3.2 cuff. Water 2 pails. FACE: Mixture: Cement 25#; Sand 50# 1# Ultra Marine Blue.	
FACE: Mixture: Cement 25 <sup>th</sup> ; Sand 50 <sup>th</sup> / Fultra Marine Blue	
Water to temper. Method of mixing Standard Mixture.	N.
Method of mixing schubard mighter	
Method of curing Under ahed, prinkledenery day	
Results as noted to date of observation In this group me	
made ten blochos mabering DI 5/0	
but the last three erached in the	
curing. The color was of a dark	
blue when made but has faded	
our to a sign sing one.	
×	

CEMENT AND CONCRETE SERIES

COLOR TEST Color White Date of making May 6'07 Barometer 31.50 Date of observation June 11'07 Age 1710. 5 days Coloring materials used Updated line & Marbledduct BODY: Proportions: Cement / Sand 3 Grit & Gravel 2 Total...... Cement Z'sch Sand 70 ff. Grit & Gravel 43 ch Water 2 pails. FACE: Mixture:.... Cement 32#; Sand 32#; 16# Mayble dust. 8 # Hydrated lime ; Method of mixing Standard mixture. Method of curing Under ched, sprinkled every day. Results as noted to date of observation In this group me made ten block munkering E1510. The first five were made smoothed face tot and o ne date in the last give more ma de ston e Raced and 20 days later. Both e u ana dails when e but aft they steadily became lighter until on they are of a fearl grey color the ever block be

CEMENT AND CONCRETE SERIES

COLOR TEST

Color Dark Brown Date of making May 6'07 Barometer 30.02 Date of observation free 11'07 Age 1200 5 kays. Coloring materials used German Vandyfre brown. BODY: Proportions: Cement / Sand 3 Grit & Gravel 2 Total..... Cement 3 Cuff. Sand 9 cuff. Grit & Gravel 6 cuff. Water 25 fails FACE: Mixture:.... Cement % cuft; Sand 13 cuft; 5# yerman; Vandyle Brown, Method of mixing Standard mixture. Method of curing Under shed, sprinkled every day. Results as noted to date of observation There are thirteen blocks. in this group anothering FIto 13. at making they were of a dark brown color but have become lighter until now they resemble day, send store

225 COLOR TEST Color Dark Brown Date of making free 3, '07 Barometer 29. 89 Date of observation I fine 11, 07. Age 8 days Coloring materials used German Vandylie trou BODY: Proportions: Cement / Sand 3 Grit & Gravel 2 Total...... Cement 25 auft, Sand 7 cuff. Grit & Gravel 43 cf Water 2 pails FACE: Mixture:.... Cement 18#1 42; Sand 18# 4#82 9 Serma Vandyfee Browth Method of mixing Standard mixture. Method of curing Under shed, sprinkled every day Results as noted to date of observation The color was of a dark brown, afarently black, at making but it I space a very dal on show rown at date of abservation made Tim blocks mumberi 14 5 2 3

CEMENT AND CONCRETE SERIES

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#### COLOR TEST

Color Black Date of making June 3 '07 Barometer 29.89 Date of observation I June 11'07, Age 8 days Coloring materials used Jamp Bleck. BODY: Proportions: Cement Sand 3 Grit & Gravel 2 Total...... Cement 2 suft. Sand Tayl. Grit & Gravel 4 geft Water 2 fries. FACE: Mixture:.... Cement Suft; Sand Zauft; 1#100 Lauf Black Method of mixing Standard mixture. Method of curing Under shed, sprinkled every day Results as noted to date of observation We made to blocks, in this group muching &, to 10, at date of making they were of a good black color & motchenge can be noticed to date of observa mehler Canadade and a course

# CEMENT AND CONCRETE SERIES

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#### COLOR TEST

Color Dark Red fune 3'07 Barometer 29,89 Date of making Date of observation June 11°07. Age 8 days, Coloring materials used I Indian Red.

BODY: Proportions: Cement / Sand 3 Grit & Gravel 2 Total...... Cement 25 cuft Sand Touft, Grit & Gravel 43 aft Water 2 paile. FACE: Mixture:.... Cement 1/2 enft; Sand 2 cuft; 4 2 1903, Ina, Red.

Method of mixing Standard mixture

Method of curing Under ched, sprinkled every day

Results as noted to date of observation a very deep wine red color when made the color has become a very little lighten since made, In this group we made ten blocks omnering HI, tila,

in france

#### Conclusions,

It is evident from the test that the M & N group (1:3:2) proportion, by standard method of mixing is the strongest. The 1:3:2 mixture by wet process did not show as high a modulus as the 1:3:2 made by standard method and for practically the same length of making.

From our tests we decided that the 1 : 3 : 2 mixture by the wet process is not economical on account of the length of time it takes to make a block. It takes 24 hours to make each block and besides this there is a danger of breaking the block when removing the core. If a large number of blocks are needed it is easily seen that it would take a long time to make them with one machine. However, if only a few are needed they can be made all right. They are excellent for use where it is desired to keep out moisture as they do not absorb moisture as readily as do the blocks made by the dry process.

We conclude that the W & V group is of little value in building purposes, because the blocks could not be handled roughly without danger of breaking. This is due to the fact that there is not cement enough in the 1 : 7 : 2 proportion for the amount of sand and gravel used.

Our fire test has proved beyond a doubt that the blocks will not withstand a fire. Two tests by fire had been made previously and our results were practically the same as the others. A small fire might do no perceptible damage, yet it must surely weaken the blocks. A fierce fire lasting for any length of time would destroy the blocks. We also must infer, since all of the blocks broke, that the ratio of the mixture did not make any diff-

erence in regard to their ability to withstand fire.

From the results shown by the ten blocks made to test the relative values of force down and side down tamping, we conclude that the side down tamping is the more effective. Since five blocks of each kind were tested and the blocks were made alternately face down and side down from the same mixture, the test would seem to be a fair one. When tested side down (as the blocks are placed in the building), the blocks showed an average of 18% greater than the modulus of rupture of those of the face down.

In the color test, the weaker proportion of coloring is a failure. It fades out rapidly and the effect is soon lost. The better proportions we believe will hold color to an extent of usefulness, but the expense of the amount of coloring material would make them uneconomical. The white is a good color and for fancy places on a house would make a very nice block, but the cost of materials for the coloring would raise the price too high for its use any where else. The Blue will not hold and the German Vandyke Brown cannot be depended upon to any great extent. Our observation shows that the blocks of a very dark brown color when made, after standing a month, lose a large part of their former color.

In the cost of production, we must figure from a supposition of four men working 8 hours and making 65 blocks. The cost of material will be that of 14 cu. ft. of cement, 42 cu. ft. of sand, and 28 cu. ft. of grit. The cost of the labor was four dollars (\$4.00). These items all figured up and divided by the total of blocks made, give us the cost per block. Previous work along this line shows that dressed stone of same dimensions, cost one dollar apiece.