"Comparative Tests on Building Stone from College Quarries and on Concrete Building Blocks."

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Comparative Tests on Building Stone
from College Quarries and on Conrrete Building Blocks.

To persons located in parts of Kansas where both stone and brick are difficult and expensive to obtain, this set of experiments, carried on at the Kansas State Agricultural College, will be of particular interest.

Much has been said for and against concrete as a building material; those who look askance at its claims stating that it is impossible to manufacture a cement which will successfully withstand all the varying conditions and trials to which any building material will be more or less subjected. They cite as examples the various fires which have occurred over the country and the behavior of buildings constructed from concrete during such fires.

The object of investigation which forms the body of this thesis is three-fold.

1. To compare the strengths of the stone and concrete blocks.
2. To determine the comparative effects of fire on both materials when subjected to intense heat as they would be in a building.
3. To compare the strengths of the stone and concrete blocks after they had been subjected to the fire test.

The first test was accomplished by treating the blocks and stones as beams supported at the ends and loaded in the middle, the span being 18". The load was applied by means of the 100,000# Riehle Testing Machine in the Mechanical Laboratory. From the breaking load the Modulus of Rupture is easily obtained by means of the formula $F = \frac{MY}{I}$ where F = Modulus of Rupture, M = the bending moment, Y = the distance of the most strained fibre from the neutral axis, and I = the moment of inertia of the section, and this modulus is taken as the basis of comparison between the strengths of the concrete and stone.

The second test was carried out by building a tower from the blocks, upon a brick and concrete base, then firing the tower.

The third test was to have been a repetition of the first, but owing to the fact that neither concrete nor stone withstood the effects of the fire it was impossible to obtain comparative values.

As this whole test is only the second in a series which is to be carried on it would be erroneous to make a final statement to the effect that one of the materials can be used as well or better than the other for building purposes, another reason being that the two kinds of blocks are not similar in form, so that while in the table on page comparisons are made with the stone and concrete reduced to the same dimensions, the comparison is merely approximate as neither material is exactly homogeneous. It is to be gathered then from the foregoing that the two materials were placed as nearly as possible under the same conditions and tested, leaving the observer to judge for himself, from the facts set forth just how far he may commit himself in a statement that either this or that is best for building purposes.

No attempt has been made to test concrete in this thesis as it is usually mixed for building purposes, the mixture, as herein described, being a comparatively dry one.

With these facts in view a description of the tests follows:-

On April 18th the first concrete blocks were made, the machine used being one manufactured by the P. B. Mills Mfg. Co., of Jackson, Mich., and owned by the College.

Eight lots of ten blocks each were made. The blocks were numbered from 1 to 10 and the lots lettered from E to L inclusive.

They were made as follows:-

Lots E and F lettered and numbered E1, E2, E3, ----- E10; F1, F2, F3, ----- F10 in the order in which they were made.

These two lots were made between April 18 and April 23 from Kansas "Iola" or "Sunflower" cement, Kaw river sand, gravel from the same, crushed shale or grit from Joplin, Mo., of 1/2" greatest diameter and crushed limestone rock about the size of an egg, in the following proportions:-

Gravel)
Body - Cement 1, Sand 3, Grit)2
Crushed Rock)

Face - Cement 1, Sand 3

The sand used for the facing was run through a screen of about 1/16" mesh.

Lots G and H lettered and numbered G1, G2, G3, ----- G10; H1, H2, H3, ----- H10.

These two lots were made between April 23 and April 30, and contained the same materials as the two foregoing lots in the following proportions:-

Gravel)
Body - Cement 1, Sand 4, Grit)2
Crushed Rock)

Face - Cement 1, Sand 4.

These two lots differ from the last two in the proportion of sand used.

Lots I and J lettered and numbered I1, I2, I3, ----- I10; J1, J2, J3, ----- J10.

These two lots were made between April 30 and May 2, and were made in the same proportions as lots E and F with the substitution of Western State Cement made at Independence, Kansas, for the Sunflower brand. Also the gravel as a separate element was left out leaving the proportions as follows:-

Body - Cement 1, Sand 3, Grit 1 / Crushed Rock 1 } 2

Face - Cement 1, Sand 3.

Lots K and L lettered and numbered K1, K2, K3, ----- K10; L1, L2, L3, ----- L10.

These two lots were made between May 2 and May 5, and are composed of the same materials as the preceeding two lots, I and J, with the exception of the proportion of sand which was changed to four parts giving for the proportions:-

Body - Cement 1, Sand 4, Grit / Crushed Rock } 2

Face - Cement 1, Sand 4.

In mixing the materials, shovels were used, as trial with both shovel and hoe showed that a much better and more even mixture could be obtained with the former.

The sand was first thrown in the mixing bed and on this was placed the cement. The whole was then thoroughly cut over and shoveled till no streaks of either cement or sand could be distinguished. The mixture was then wetted and the crushed rock and shale thrown in and the whole again thoroughly mixed.

The face was also first mixed dry till no streaks were visible, then wetted till it was of about the consistency of moulding sand. This would seem at first rather dry, but it was found that this percentage of water made the smoothest face.

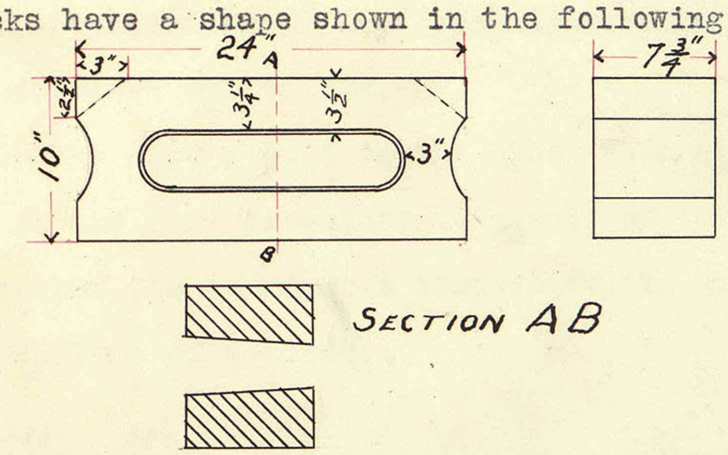
The body of the blocks was made a little wetter than the face in order to give the cement a better chance to hold to the rock and shale.

The face was placed in the machine to a depth of 3/4" and tamped lightly, some of the body was thrown in and tamped firmly. The core being next put in place the rest of the body was shoveled in and the blocks rammed up solid.

After removal from the machine the blocks were placed along the east side of one of the storage buildings so that they were exposed to the sun in the morning, but were shaded in the afternoon, but otherwise exposed to the elements. The blocks were thoroughly sprinkled each morning in order that they might not dry too fast and crack before they were fully set.

Half of the total blocks made were reserved for the fire test, that is; lots F, H, J, and L, so that half of the blocks of each mixture were used in the testing machine and half were taken for the fire test.

Those used for the latter purpose had two of the corners beveled off to facilitate a proper fitting in the tower. The original blocks have a shape shown in the following sketch with dimensions:-



The dotted lines show form of block after corners were removed.

Buckets were used in measuring the materials for the mixture, 1 bucket of cement and the accompanying 3 to 1 proportions of the other materials making about 2 1/2 blocks while the four to one mixture gave about three blocks to each single mixture.

The weights of the materials used are given in the table below:-

Weight of 1 cu. ft. of neat cement = 85#

" " 1 " " " shale or grit = 87 2/3#

" " 1 " " " screened sand = 97#

" " 1 " " " natural " = 101 1/3#

" " 1 " " " crushed rock = 76 1/3#

To get an average result for the weights of the materials, all but the cement were weighed in a box of volume = 3 cu. ft., and 1/3 of the weight taken.

On June 5 and 7 the concrete blocks not reserved for the fire test were broken in the Riehle Testing Machine, the span being 18".

As stated at first, the modulus of rupture was taken as a base for a comparison of the breaking strengths. The modulus of rupture is obtained as follows:-

The core placed in the block when it is made has its sides sloping in the same direction to permit of its ready removal from the block so that the opening is trapezoidal in shape. The following is a cross section of a block.

When the section is massed up it becomes a trapezoid of upper base 6 1/2" and lower base 7" and altitude 7 3/4".

Let b = upper base

and B = lower base

and $\frac{b}{B}$ = n = ratio of upper to lower base.

Then from the formula for finding the moment of inertia of a trapezoid where I = that moment and H = the altitude we have:-

$$I = \frac{BH^3}{24}(n + 1)$$ or substituting values

$$I = \frac{7\ (7.75)^3}{24}\left(\frac{6.5}{7} + 1\right) = 261.8$$

Now let Y = distance of lower base or, (using the term as it occurs in the modulus formula) distance of most strained fibre from the neutral axis,

and S = one half upper base

" S = " " lower "

then $Y = \frac{H\ (2S + S.)}{3\ (S+S)}$ from Applied Mechanics

∴ substituting values we have

$$Y = \frac{7\ 3/4\ (6\ 1/2 + 3\ 1/2)}{3\ (3\ 1/4 + 3\ 1/2)} = 3.8''$$

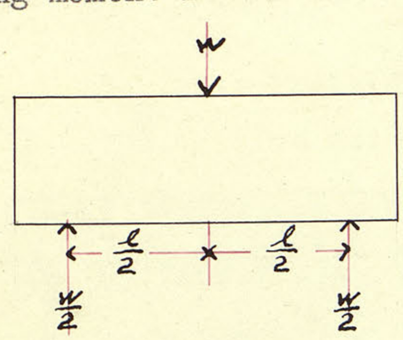
Let M = bending moment

and W = load applied at center

L = distance between supports

F = modulus of rupture

Then we have from applied mechanics the $F = \frac{MY}{I} = \frac{W}{2}\,\frac{l}{2}\,\frac{y}{I} = W\,\frac{ly}{4I}$ for the bending moment M can be seen from the figure below to be $\frac{Wl}{4}$



∴ F = .06532 W.

Then by multiplying the average breaking load of each set by .06532 we will obtain the modulus of rupture in each case.

FE = .06532 x 5713 = 373.1# sq. in.

FG = .06532 x 5744 = 375.3# " "

FI = .06532 x 5340 = 348.8# " "

FK = .06532 x 5082 = 331.9# " "

The results of this test are given below.

CONCRETE BLOCK TEST

Lot No. 1 Group E. Test No. 2.

1. Kind of Blocks, Miles Concrete Building Blocks.
2. Dimensions of Blocks, 24" x 7 3/4" x 10".
3. Depth of Facing, 3/4"
4. Proportions in Body, Cement 1, Sand 3, Grit / Gravel / Crushed Rock) 2
5. Proportions of Face, Cement 1, Sand 3, Gravel 0.
6. Date of Mixing, April 18 to 20 - '06.
7. Manner of Setting, In open air.
8. Special Treatment, None.
9. Kind of Cement, Kansas "Sunflower".
10. Kind of Sand, Kaw River.
11. Kind of Gravel, From above sand.

---Transverse Test---

Date 6 - 5 - '06. Lot No. 1. Time of Setting 46 days.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	$\frac{1}{2}(7+6\frac{1}{2})$x7 3/4	5740	----	
2	"	"	3640	----	All blocks
3	"	"	6160	----	Tested
4	"	"	5210	----	Right side
5	"	"	6590	----	Up
6	"	"	5260	----	
7	"	"	6210	----	
8	"	"	6000	----	
9	"	"	6840	----	
10	"	"	5480	----	
Total	"	"	57130	----	
Av	"	"	5713	373.1	

CONCRETE BLOCK TEST

Lot No. 2. Group G. Test No. 2.

1. Kinds of Blocks, Miles Concrete Building Blocks.
2. Dimensions of Blocks, 24" x 7 3/4" x 10".
3. Depth of Facing, 3/4".
4. Proportions in Body, Cement 1, Sand 4, Grit / Crushed Rock) 2.
5. Proportions in Face, Cement 1, Sand 4, Gravel 0.
6. Date of Mixing, April 23 to 26 - '06.
7. Manner of Setting, In open air.
8. Special Treatment, None.
9. Kind of Cement, Kansas "Sunflower".
10. Kind of Sand, Kaw River.
11. Kind of Gravel, From above sand.

--- Transverse Test---

Date 5 - 7 - '06. Lot No. 2. Time of Setting 42 dys.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	$\frac{1}{2}(7+6\frac{1}{2})\times7\frac{3}{4}$	7040	----	
2	"	"	6740	----	
3	"	"	6720	----	All blocks
4	"	"	4500	----	Tested right
5	"	"	5750	----	Side up
6	"	"	5020	----	
7	"	"	5010	----	
8	"	"	4050	----	
9	"	"	5500	----	
10	"	"	7110	----	
Total	"	"	57440	----	
Av.	"	"	5744	375.3	

CONCRETE BLOCK TEST

Lot No. 3. Group I. Test No. 2.

1. Kind of Blocks, Miles Concrete Building Blocks.
2. Diemensions of Blocks, 24" x 7 3/4" x 10".
3. Depth of Facing, 3/4".
4. Proportions in Body, Cement 1, Sand 3, Grit / Crushed Rock 2.
5. Proportions in Face, Cement 1, Sand 3, Gravel 0.
6. Date of Mixing, May 2 - '06.
7. Manner of Setting, In open air.
8. Special Treatment, None.
9. Kind of Cement, Western States.
10. Kind of Sand, Kaw River.
11. Kind of Gravel, From above sand.

---Transverse Test---

Date 6 - 7 - 06. Lot No. 3. Time of Setting, 35 dys.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture.	Remarks
1	18"	$\frac{1}{2}(7+6\frac{1}{2}) \times 7\frac{3}{4}$	6100	----	
2	"	"	4900	----	
3	"	"	5000	----	
4	"	"	4050	----	All blocks.
5	"	"	4870	----	Tested right
6	"	"	5350	----	Side up
7	"	"	5800	----	
8	"	"	6230	----	
9	"	"	6000	----	
10	"	"	5100	----	
Total	"	"	53400	----	
Av.	"	"	5340	----	

CONCRETE BLOCK TEST

Lot No. 4. Group K. Test No. 2.

1. Kind of Blocks, Miles Concrete Building Blocks.
2. Dimensions of Blocks, 24" x 7 3/4" x 10".
3. Depth of Facing, 3/4".
4. Proportions in Body, Cement 1, Sand 4, Grit / Crushed Rock } 2.
5. Proportions in Face, Cement 1, Sand 4, Gravel 0.
6. Date of Mixing, May 3, - 06.
7. Manner of Setting, In open air.
8. Special Treatment, None.
9. Kind of Cement, Western States.
10. Kind of Sand, Kaw River.
11. Kind of Gravel, From above sand.

---Transverse Test---

Date 6 - 7 - 06. Lot No. 4. Time of Setting 34 dys.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture.	Remarks
1	18"	$\frac{1}{2}(7+6\frac{1}{2})$x7 3/4	5030	----	
2	"	"	5400	----	
3	"	"	5250	----	
4	"	"	4990	----	All blocks
5	"	"	5000	----	Tested right
6	"	"	4800	-----	Side up
7	"	"	5000	----	
8	"	"	4880	----	
9	"	"	4770	----	
10	"	"	5700	----	
Total			50820	----	
Av.	"	"	5082	331.9	

Comparing the average values of these tables it would seem that a 4 to 1 mixture of the Kansas "Iola or "Sunflower gave a stronger block than the 3 to 1 mixture. Tables 3 and 4 or lots K and I, made from the Western States cement, show, both lots, weaker than the two preceding lots. The fact that the first two lots set about 10 days longer than K and I may have something to do with the latter's strength.

The conditions in lots K and I also seem to be a reversal of those found in E and G in that the 4 to 1 mixture shows weaker by an average of 16.9# sq. in. than the 3 to 1 mixture.

On May 15, ten (lot C) of the twenty stones which were to be tested were broken in the testing machine while the other ten (lot D) were reserved for the fire test. These twenty stone were taken from the College quarries just north of the College grounds.

The stone were taken from four ledges, five stone from each ledge.

The first ledge is 28 to 30 inches below the surface of the ground.

The second ledge is 11 inches below the first.

The third ledge is 12 inches below the second.

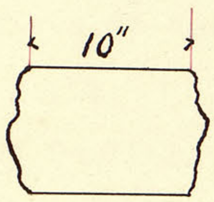
The fourth ledge is 22 inches below the third.

The stone were broken in the same manner as that described for the concrete blocks, and the modulus of rupture is calculated from the same formula, $F = \frac{My}{I}$.

The moment of inertia is calculated for a rectangle.

The stone were not dressed to give a perfect rectangle, only two sides being dressed to give parallel sides. The distance between these sides is 7 3/4" giving for H the altitude of the rectangle of cross-section 7 3/4". The other two sides were left in the rough.

B, the base of the rectangle was taken as the average of several meassurments of the width of the stone. A cross-section of the stone appears from the following sketch:-



Cross section as block lay in testing machine.

The moment of inertia is calculated from the formula $I = \frac{BH^3}{12}$.

The moment of inertia for each stone depends on the average width B.

Y, is taken as $\frac{1}{2}H = 3\ 7/8$, the section being a rectangle.

M as before $= \frac{Wl}{4}$

Following out the formula for one stone, say No. 1 of ledge 1, we have $4F = \frac{Wly}{I}$.

$$I = \frac{BH^3}{12} = \frac{10 \times (7.75)^3}{12}$$

Log W = 4.343014
" l = 1.255275
" y = 0.588271
" Wly = 6.186560
" I = 2.58872
" 4F = 3.59783
4F = 3961
F = 990.2

log. 7.75 = 0.88930
× 3
= 2.66790
log 12 = 1.07918
log $\frac{I}{10}$ = 1.58872
$\frac{I}{10}$ = 38.79
I = 387.9

The modulae of rupture are given in the following tables:-

(See next page)

BUILDING BLOCK TEST

Lot No. 1. Group C. Test No. 2.

1. Kind of Blocks, Limestone.
2. Dimensions of Block, 24" x 7 3/4" x 10" (nominal).
3. Ledge No. 1.
4. Date of Testing, 5 - 15 - 06.
5. Special Treatment,

--Transverse Test--

Date 5 - 15 - 06. Lot No. 1.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	7 3/4 x 10"	22030	990.2	Tested
2	"	7 3/4 x 11½"	16120	630.1	Right Side
					Up
Av.	"	7 3/4x10 3/4	19075	810.1	

BUILDING BLOCK TEST

Lot No. 2. Group C. Test No. 2.

1. Kind of Blocks, Limestone.
2. Dimensions of Blocks, 24" x 7 3/4" x 10" (nominal).
3. Ledge No. 2.
4. Date of Testing 5 - 15 - 06.
5. Special Treatment.

--Transverse Test--

Date 5 - 15 - 06. Lot No. 2.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	7 3/4x11 1/4"	16440	657.	Tested
2	"	7 3/4x10 3/8"	16330	707.5	Right Side
3	"	7 3/4x12"	15550	582.5	Up
Av.	"	7 3/4x 11 1/4"	16106.6	649.	

BUILDING BLOCK TEST

Lot No. 3. Group C. Test No. 2.

1. Kind of Blocks, Limestone.
2. Dimensions of Blocks, 24" x 7 3/4" x 10" (nominal).
3. Ledge No. 3.
4. Date of Testing, 5 - 15 - 06.
5. Special Treatment.

--Transverse Test--

Date 5 - 15 - 06. Lot No. 3.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	7 3/4 x 10"	20030	900.5	Tested
2	"	7 3/4 x 11 1/4"	16180	646.5	Right Side
3	"	7 3/4 x 10 3/4"	23370	977.2	Up
Av.	"	7 3/4 x 11"	19860	841.4	

BUILDING BLOCK TEST

Lot No. 4. Group C. Test No. 2.

1. Kind of Blocks, Limestone.
2. Dimensions of Blocks, 24" x 7 3/4" x 10" (nominal).
3. Ledge No. 4.
4. Date of Testing, 5 - 15 - 06.
5. Special Treatment.

--Transverse Test--

Date 5 - 15 -06. Lot No. 4.

No. of Block	Span	Dimensions of Section	Breaking Load	Modulus of Rupture	Remarks
1	18"	7 3/4 x 10 1/2"	25770	1103.2	Tested
2	"	7 3/4 x 11"	27160	1110.	Right Side
					Up
Av.	"	7 3/4 x 10 1/2"	26465	1106.6	

From the average results of these tables it seems that the blocks taken from the 4th ledge were much stronger than any of the others, while those taken from the second ledge were the weakest of the lot. The first part of the latter statement might be readily accounted for by the fact that the 4th ledge being at greater depth than any of the others has a greater pressure with a result that the stone of the ledge would be more compact and homogeneous.

Lots 1 and 3 seem to have more equal average values, also each has one stone which broke under about 16,000#, the rest breaking from 20,000# to 23,000#. Why this should be the author is unable to state unless the cause be in the character of the stone itself.

To get now a comparison between the strength of the concrete and stone it will be necessary to reduce both to a common basis. The best method to get average results will be 1st: To reduce the dimensions of the stone to those of the concrete blocks and calculate what the breaking strength would have been under these conditions, that is, presumably remove a core of the same dimensions as that in the concrete blocks from the stone blocks and reduce the cross sectional area to that of the concrete blocks. 2nd: To figure what the breaking strength of the concrete blocks would have been had they been left solid and made to the same dimensions as those of the stone blocks.

We have in the case of the stone blocks:-

$$f = \frac{\frac{W \times 18}{4} \times \frac{7\,3/4}{2}}{\frac{B \times (7\,3/4)^3}{12}} = \frac{\frac{Wl}{4} \times y}{\frac{BH^3}{12}}$$

In each case all the formula remains constant but W and B, also we know that the load varies directly as the area. Suppose we have the two cross sectional areas, A, and A_2 and $A_2 = 1/3$ A,. Then if a certain load W, is required to break the stone of cross section A, 1/3 W, will be required to break the stone of cross section A_2

But $A_2 = 1/3\ A$, is equal to the expression

$B_2\ H_2 = 1/3\ B_1\ H_1$ and as $H_1 = H_2$ we have that $B_2 = 1/3\ B_1$ or the load will vary in this case directly as the width of the stone, the modulus of rupture remaining constant. Removing a core from the stone blocks of the form of that in the concrete blocks would be the same as removing a rectangle of 3 1/4" in width and 7 3/4" in height; besides this a width of stone must be removed which will reduce its total width to 10". Performing this operation we have for the average width of the stone in ledge no. 1, 6 3/4". Then the load required to break the stone of cross sectional area 6 3/4" by 7 3/4" will be $\frac{6\ 3/4"}{10\ 3/4"} \times 19075 = 11977$. An average width was taken from the four averages of the last tables which was 11 1/4" so that applying the converse of the above calculation we would have for the load required to break a solid concrete block of cross sectional dimensions 7 3/4" x 11 1/4" $\frac{11\ 1/4}{6\ 3/4} \times 5713 = 8569.5$ for lot E, and as all the concrete blocks would be changed to this dimension (11 1/4) since it is taken as an average width we would have 1.5 x W for each lot for $\frac{11\ 1/4}{6\ 3/4} = 1.5$

The following table gives a comparison of the breaking strengths of the stone and concrete blocks.

It will be noticed that whether the stone blocks are reduced to the dimensions of the concrete blocks or vice versa, in each case the stone has over twice the breaking strength of the concrete according to these figures.

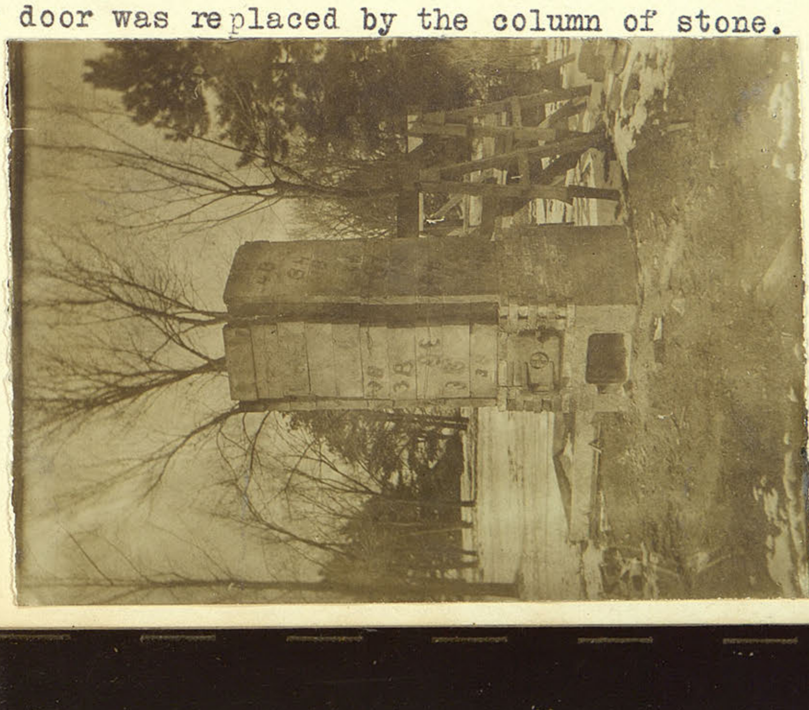
(See next page)

COMPARISON OF STONE AND CONCRETE BLOCKS.

Blocks	Original Breaking Load	Modulus of Rupture	Breaking Load After Reduction (Calculated)
Stone Ledge No.1	19075	810.1	11977
Stone Ledge No.2	16106	649.	9664
Stone Ledge No.3	19860	841.4	12187
Stone Ledge No.4	26465	1106.6	16598
Concrete Lot E	5713	373.1	8569.5
Concrete Lot G	5744	375.3	8616
Concrete Lot I	5340	348.8	8010
Concrete Lot K	5082	331.9	7623

Note: The last columns of above tables show the calculated breaking load when the cross-section of the stone blocks were reduced to the same cross-section as that of the concrete blocks and the cross-section of the concrete blocks were increased to the cross-section of the stone blocks.

The photograph below shows the form of the tower as made in a previous test. In this test the front column of concrete blocks over the fire door was replaced by the column of stone.

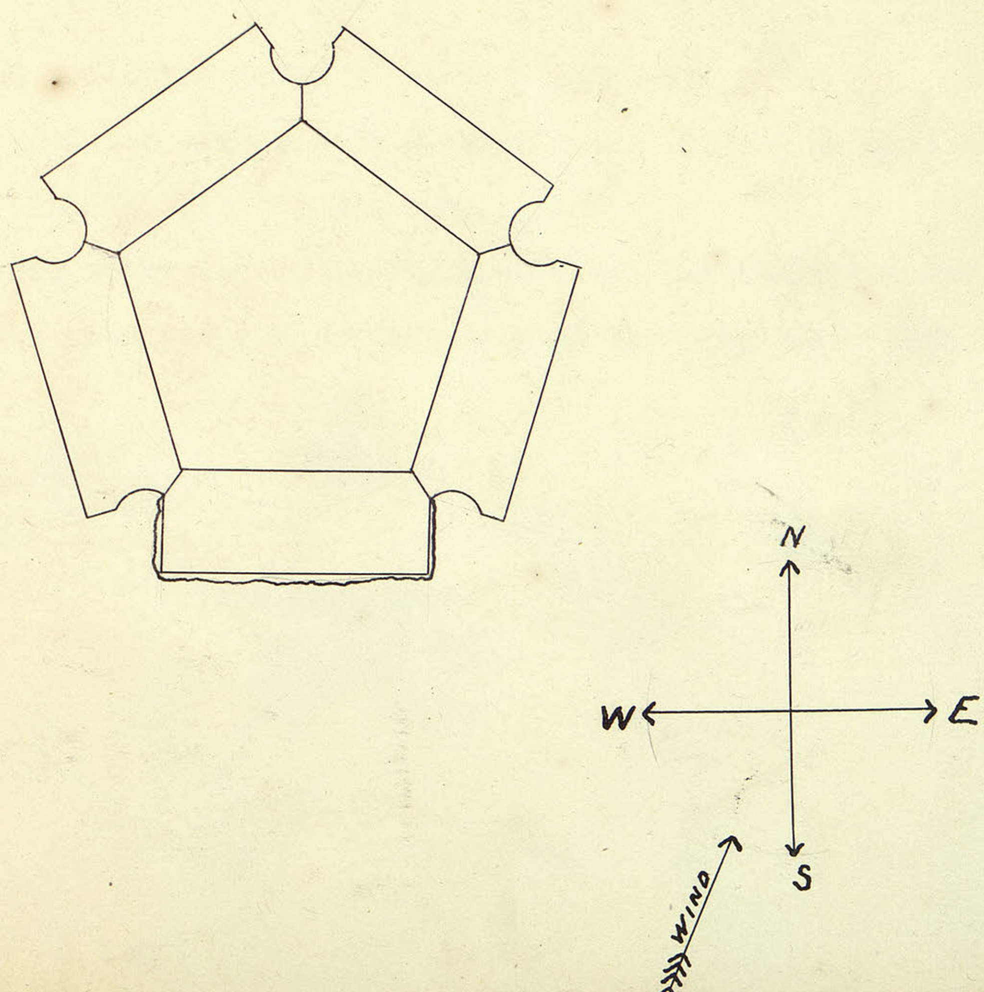


On May 14th those blocks, both stone and concrete, which were reserved for the fire test were built into a fire sided tower face outward over a base of brick and concrete which contained grate bars, fire door, ash door and ash pit.

There were forty concret blocks, lots F, H, J, and L, and ten stones, lot D, fifty blocks in all.

Each lot was placed in a column with No. 1 at the bottom. The stone were placed in a colomn, but no regular order was followed. The vertical joints on the inside of the tower were plastered with lime mortar to make the tower airtight on the sides.

The sketch below shows a top diagramatic view of the tower with points of compass and direction of wind which was light that morning.



On June 3 at 8:15 in the morning a fire was started in the tower and by 8:30 the flames were a foot above the tower. The flames were kept at this height till 11:30, wood being used throughout the three hours. At 10:15 the rock on top of the column was seen to crack, the rest following till by 11 o'clock all the rock were seen to be cracked through the middle.

At 11:30 concrete blocks F10, H9, F7, J6, J7, and L5 were noticed to be cracked through the face. How many were cracked on the side next the fire could not be ascertained on account of the heat.

At 11;30 a heavy stream of water from a fire plug was directed upon the tower and kept running till 12 o'clock.

On June 10, a week later, the tower was torn down and the conduct of the blocks and stone during the fire and water test observed.

The following table is self-explanatory.

All of the stones were cracked clear through so that none could be used in the testing machine.

Those concrete blocks which were not cracked apart were so near that upon attempting to lift them down from the tower they fell apart.

(See next page)

TABLE SHOWING RESULT OF FIRE TEST.

	STONE D		CONCRETE J	CONCRETE L	CONCRETE H	CONCRETE F
LEDGE 2 No 2	Cracked in the fire in the middle	No. 10	Cracked in fire in both sides	Cracked in fire in both sides	Cracked in fire in both sides	Cracked in fire in one end and one side
LEDGE 3 No 1	Cracked in fire in middle	No. 9	Cracked in fire in one side and both ends	Cracked apart in fire in one side and one end	Cracked in fire in both sides	Cracked apart in both ends in fire
LEDGE 4 No 1	Cracked in fire in three pieces	No. 8	Cracked apart in fire in both ends	Cracked apart in fire in both sides	Cracked in fire in one side and one end	Cracked apart in fire in both side
LEDGE 3 No 2	Cracked in fire in middle, one half in small pieces	No. 7	Cracked in fire in one side and both ends	Cracked apart in fire in both ends	Cracked apart in one side and one end in fire	Cracked in fire in one side and both ends
LEDGE 4 No 2	Cracked in fire in six irregular pieces	No. 6	Cracked apart in fire in both sides	Cracked apart in fire in one side and one end	Cracked apart in one side and one end in fire	Cracked apart in both ends in fire
LEDGE 4 No 3	Cracked in fire in three irregular pieces	No. 5	Cracked in fire in both sides	Cracked apart in fire inboth sides	Cracked apart in fire in one end and one side	Cracked apart in fire in both ends
LEDGE 1 No 3	Cracked in fire in small pieces	No. 4	Cracked in fire in both ends and one side	Cracked apart in fire in both sides	Cracked apart in fire in one side and one end	Cracked in fire in one end and one side
LEDGE 1 No 2	Cracked in fire in middle	No. 3	Cracked in fire, two cracks in rough side one in one end	Cracked in fire in both sides	Cracked in fire, twice in one side once in face side	Cracked in fire in one end and one side
LEDGE 2 No 1	Cracked in fire in middle	No. 2	Cracked in both sides and one end in fire	Cracked in fire in both ends	Cracked in fire, two cracks in rough side one in face side	Cracked in fire in one end and rough side
LEDGE 1 No 1	Cracked in fire in middle	No. 1	Cracked in both ends and one side in fire	Cracked in fire in both sides and one end	Cracked in fire in both sides	Cracked in fire in both sides and one end

To give a brief summary then of the test we find two things to be true under the foregoing conditions:-

1. The stone blocks have more than twice the breaking strength of the concrete blocks.

2. Neither stone or concrete withstood the fire test.

It might be advanced that a building would not be under fire alone for three hours at a time, also that an ordinary fire would not last that long. It might be answered that a test is worth nothing unless the material or whatever is being tested is put under the severest conditions likely to be met with.

Also, as stated at first, the test speaks for itself and the reader is at liberty to draw his own conclusions.