Days.	7, 14 and 28 days in air at 60° Fahr.	24 hours in air at 60° Fahr., then in water.
7	443	685
14	525	787
28	775	875

Experiment C1.—

Sand and Cement Tests (3 to 1): Same as Experiments A, B, and C.

Days	Normal test	A	B	C
7	200	163	.....	220
14	277	270	.....	250
28	353	342	B2. 317; B7. 305; B14. 243	322

Experiment D.—Effect of Alternate Frost and Thaw.—The briquettes were allowed to remain for 24 hours under damp flannel, then in water for three days (60° Fahr.), then in water at the cold stores (temperature varying from 29° to 60° Fahr.). The briquettes were changed every three days.

Days	Neat	3 to 1	Normal Neat	3 to 1
14	787	252	787	277
28	813	322	875	353

Experiment E.—This test was the same as A or D, but the briquettes were gauged with warm water; temperature, 100° Fahr.

Days	Neat	3 to 1	A Test Neat	3 to 1
7	352	133	610	163
14	705	205	...	270
28	728	230	905	342

Experiment F.—(Salt-Water Immersion).—Nine briquettes were mixed with fresh water, and, after 24 hours, were immersed in sea-water, and broken at 7, 14 and 28 days.

Days	Neat (20% water)	3 to 1 (10% water)	Normal Neat	3 to 1
7	770	242	685	200
14	742	278	787	277
28	812	360	875	353

Experiment G.—Nine briquettes were mixed with sea-water (same test as before).

Days	Neat	3 to 1	Normal Neat	3 to 1	Mixed with fresh water and immersed in sea-water Neat	3 to 1
7	693	180	685	200	770	242
14	775	287	787	277	742	278
28	773	293	875	353	812	360

Initial set, 9 minutes; final set, 6 hours.

Experiment H.—Nine briquettes were mixed with sea-water, and, after 24 hours under damp flannel, were immersed in fresh water for the remainder of the time.

Days	Neat	3 to 1	Normal Neat	3 to 1
7	628	150	685	200
14	733	255	787	277
28	713	297	875	353

Experiment K.—Same test as A, but the briquettes were kept in a temperature of 15° Fahr. in cold storage.

Days	K.—Heavy Frost Neat	3 to 1	A.—Light Frost Neat	3 to 1	Normal Neat	3 to 1
7	405	57	610	163	685	200
28	595	145	905	342	875	353

The briquettes were taken from the cold stores to the laboratory, two miles away, and were broken in a temperature of 60° Fahr., 45 minutes after leaving the cold stores.

Experiment L.—The briquettes, 24 hours after gauging, were put into water at 60° Fahr. for 6 days, then placed in the cold stores at a temperature of 15° Fahr. for the remainder of the time.

Days	Briquettes placed in air at 60° Fahr. for a day or two after having been in cold stores at 15° Fahr. for 28 days. Neat	3 to 1	Neat	3 to 1	Neat	3 to 1
28	700	217	875	315	905	342

Experiment M.—The briquettes were put directly into the cold stores at 29° Fahr. for 7 days.

Days	Neat	Normal—Neat
7	480	685
28	595	875

Experiment N.—The briquettes were made with neat cement, and placed, some in the air at a temperature of 60° Fahr., and others in air at a temperature of 29.3° Fahr. (2.7° of frost). In 15 minutes those in air at 60° Fahr. were still soft, while those subjected to frost had just frozen hard at the expiration of that time. Briquettes mixed with sand and cement (3 to 1) were subjected to a similar test. At the expiration of 15 minutes those in a temperature of 60° Fahr. were still soft, while those in a temperature of 29.3° Fahr. had just frozen hard; and at a temperature of 27° Fahr. (5° below freezing point, Fahr.) were frozen very hard, indeed, at the expiration of that time.

Conclusions from the Foregoing Experiments.—These investigations have led the writers to the following conclusions:

(1) That light frost occurring 24 hours after the cement has been gauged, as indicated in Experiment A (3° of frost, or thereabouts), is detrimental to freshly mixed Portland cement, but only for a short time, and that at the end of 28 days it has quite regained its normal strength. If the frost occurs immediately after the cement has been gauged, the effect is more detrimental, and would appear to be permanent (see Experiment M). A minimum quantity of water should be added in frosty weather.

(2) That heavy frost (17° of frost, or thereabouts) has a most injurious effect (permanent) upon freshly mixed cement (neat), and cement mortar, as shown in Experiment K.

(3) That a light frost (3° of frost, or thereabouts), as indicated in Experiment A, does not affect cement or cement mortar if it has attained 2 days' set previous to the occurrence of the frost (Experiments B, C, and D).

(4) That the detrimental effect of light frost upon cement mortar (3 to 1) occurs more immediately than upon neat cement, but that cement mortar recovers from the ill effects of frost more rapidly than neat cement. At the end of 14 days it has quite recovered (Experiment C).

(5) That the mixing of cement or cement mortar with warm water (temperature, say, 100° Fahr.), which is sometimes done in frosty weather, and has been recommended by some engineers,* has a permanently injurious effect upon

* Minutes of Proceedings, Inst. C.E., London, Vol. CXXXIV, p. 384.