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Portland Cement

The Canadian Portland Cement Company,

Limited.

Office: Deseronto, Ontario.

Works:

Strathcona, Ontario.

Marlbank, = Ontario.

St. Lawrence Portland Cement Company,
Montreal, Que.

Capacity of Works:
500,000 Barrels per annum.

The Canadian Portland Cement Company, Limited.

Officers:

E. W. RATHBUN, - - PRESIDENT.

JAMES DOBSON, - - - 1st VICE-PRESIDENT.

E. WALTER RATHBUN, 2nd VICE-PRESIDENT.

F. G. B. ALLAN, - - - MANAGING DIRECTOR.

H. McMURRICH RATHBUN, SEC'Y-TREASURER.

Board of Directors:

E. W. RATHBUN, - DESERONTO.

JAMES DOBSON, - - PHILADELPHIA, PA.

W. D. MATTHEWS, - TORONTO.

M. J. HANEY, - - - TORONTO.

E. WALTER RATHBUN, DESERONTO.

R. T. HOPPER, - - MONTREAL.

C. A. MASTEN, - - TORONTO.

R. C. CARTER, - - MONTREAL.

F. G. B. ALLAN, - DESERONTO.

Introductory

The Canadian Portland Cement Company, Limited, in June, 1900, acquired the Portland Cement interests of the Rathbun Company, of Deseronto, and of the Beaver Portland Cement Company, of Montreal.

The Manufacturing Staff connected with the Rathbun Company's Portland Cement Works, and the production of the well-known Brand of Portland Cement, "Rathbun's Star," for the past ten years, have been put in charge of our manufacturing operations.

With raw materials equal to the best, with the most modern machinery and process of manufacture, with a staff familiar by long experience with the raw materials used and their manufacture into high-grade Portland Cement, we feel we can offer cement to the public which cannot be surpassed, and which has already acquired the very highest reputation for excellence.

In presenting this small pamphlet to our friends, we trust they will find the few notes it contains on Portland Cement, its uses and characteristics, of some interest.

The Canadian Portland Cement Company, Limited.

SALES AGENTS.

The Canadian Portland Cement Company, Limited, have appointed the Rathbun Company their Sales Agents, and any information regarding prices, tests, etc., can be promptly furnished by

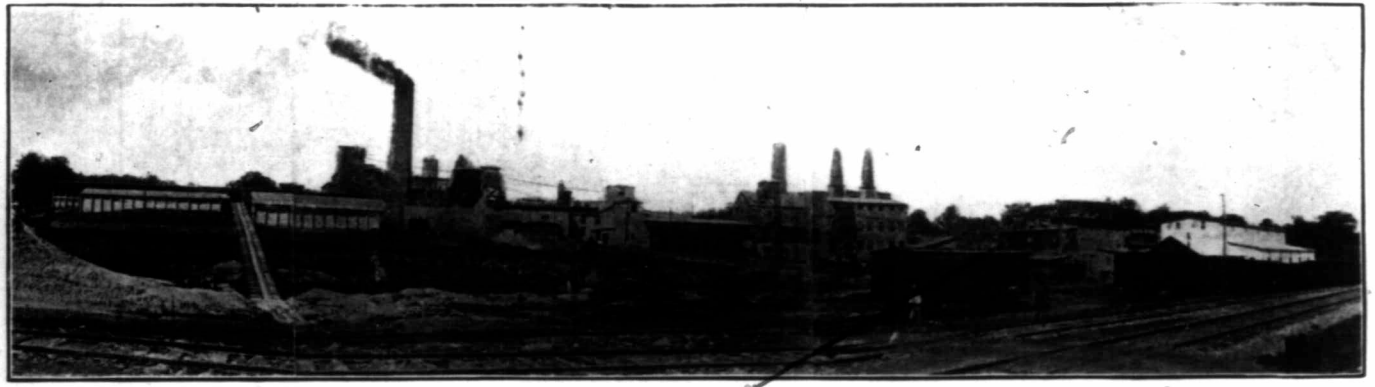
The Rathbun Company's Agents at

310 and 312 Front Street West,
Toronto, Ontario.

BROCKVILLE, ONTARIO.
KINGSTON, "
BELLEVILLE, "
PETERBORO', "
LINDSAY, "
OSHAWA, "
GANANOQUE, "
PICTON, "
NAPANEE, "
CAMPBELLFORD, "

AND BY

ST. LAWRENCE PORTLAND CEMENT COMPANY,
MONTREAL, QUE.



THE CANADIAN PORTLAND CEMENT CO.

STRATHCONA WORKS.

Portland Cement

Portland Cement is a material which hardens in the presence of water.

It consists of a mechanical mixture of marl and clay (or other materials containing the requisite chemical constituents), calcined to incipient vitrefaction, the resulting clinker being ground to a fine powder.

The chief chemical components of a good Portland Cement may be said to range as follows :—

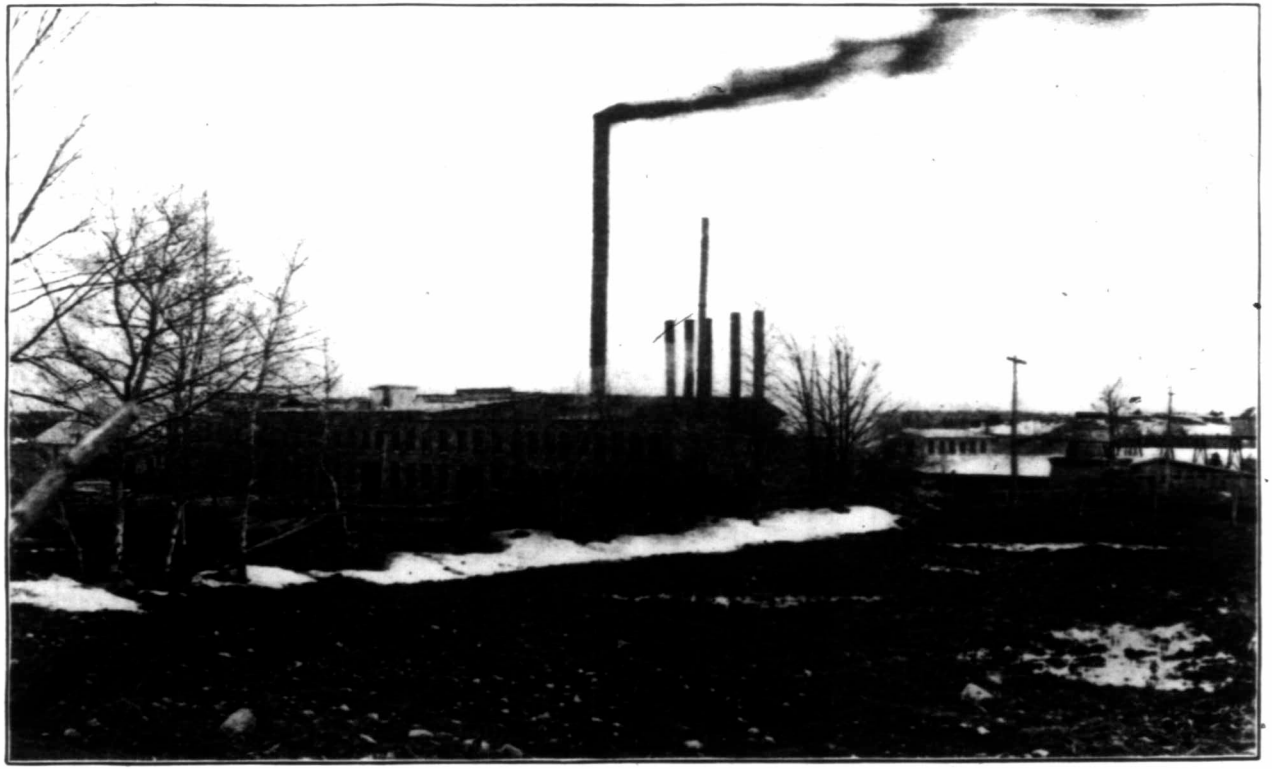
Silica	from	20	to	26 per cent.
Oxide of Iron and Alumina	"	8	"	14 "
Lime	"	58	"	65 "

These generally make up about 96 per cent. of the whole, there being, in addition, small proportions of magnesia, sulphuric acids, alkalies, etc.

Portland Cement can be manufactured from any raw materials containing the requisite chemical components, but undoubtedly the most uniform product can be made from marl lime on account of its regularity of analysis.

According to the nature of the raw material each manufacturer determines the correct composition of his product within the above limits, and this composition must be kept uniform by constant chemical analysis. In considering the qualities of Portland Cement the following points are to be especially noted :—

No. 1—Constancy of volume, or soundness.
" 2—Strength.
" 3—Fineness of grain.
" 4—The time of setting and hardening.



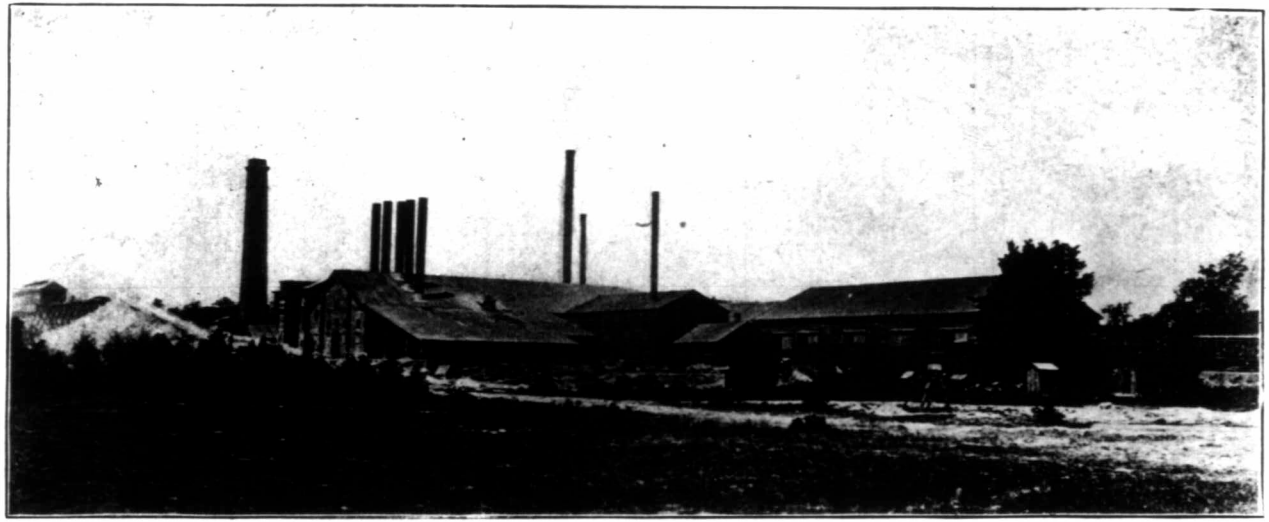
THE CANADIAN PORTLAND CEMENT CO.
MARLBANK WORKS.
North View.

Constancy of Volume, or Soundness.

There is really no such thing as "constancy of volume" either in the case of Portland Cement or natural stone, since either of these materials will expand and contract when subjected to a change of temperature. With good Portland Cement, however, the expansion and contraction owing to change of surrounding temperature is very slight, different kinds of natural stone being affected to a very much greater extent. Bad Portland Cement, however, is liable to show a very dangerous quality of cracking or swelling. This swelling shows itself in strong expansion, which will destroy the cohesion of the Portland Cement mortar and lead to its crumbling to pieces. *The swelling does not show itself until after the cement has set*, but the poorer the quality of cement in this respect, the sooner the swelling will develop after it has set. This fault is also developed quicker in water than in air. Test pats of an unsound cement kept under water will not only swell and expand, but will curl and develop cracks around the edges. *It is characteristic of expansion cracks that they run from the thin edges towards the centre of the pat and are widest on the edges and narrow towards the centre.* A sound cement may leave the piece of glass upon which the pat has been made, but it should show no signs of curling or cracking at the edges.

While dealing with the characteristics of unsound cements it might be well to refer to one or two peculiar appearances which develop both in the laboratory and in practice, and which are sometimes erroneously considered as indicating a swelling or unsound cement.

Cracks similar to those produced by swelling will appear when test pats or briquettes are placed in water too soon; that is, before the setting of the cement has been completed. *Test pats or briquettes should never be put in wateru ntil set hard.*



THE CANADIAN PORTLAND CEMENT CO.

MARLBANK WORKS.

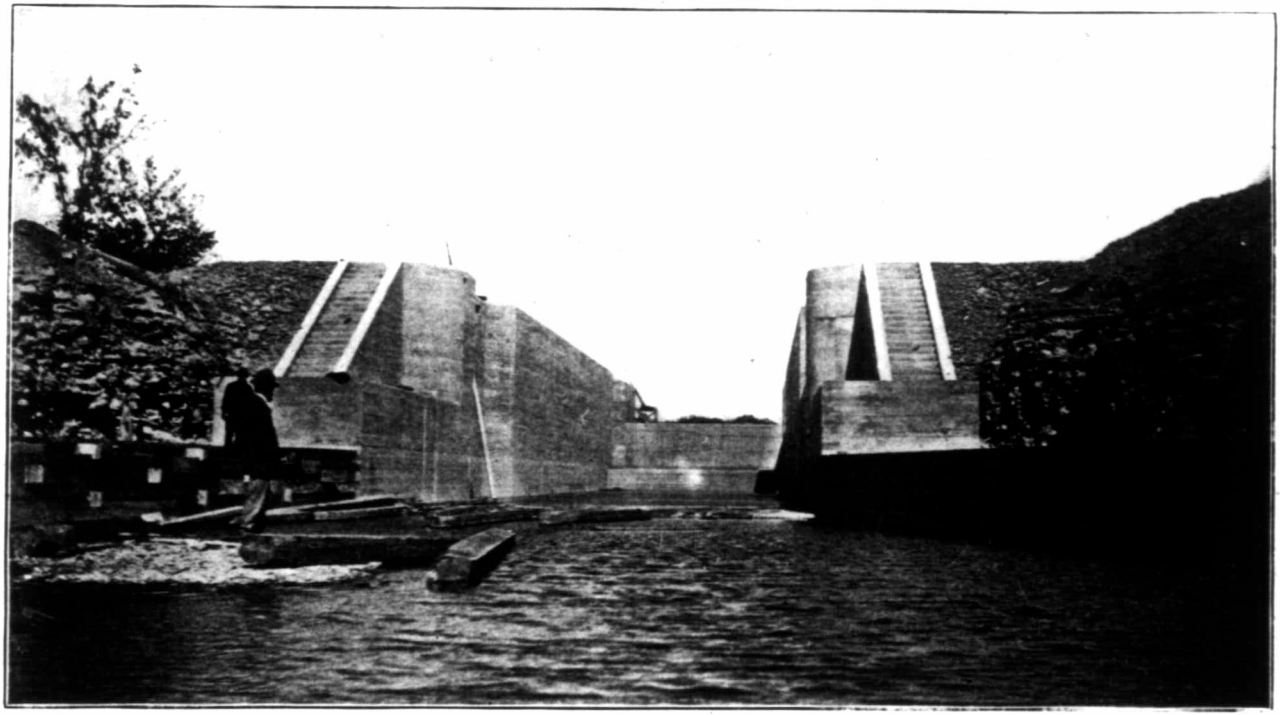
South View.

Neat Portland Cement mortar exposed to the air diminishes in volume, so that a pat subjected to rapid drying in draughts of air or in sunshine or to lack of the necessary precaution of keeping it moist until set and properly hardened, will invariably develop so-called "*shrinkage cracks.*" These "*shrinkage cracks*" in no sense denote a fault in the cement and can be distinguished in the test pats of cement from the expansion cracks by the fact that *they appear during the setting and show themselves as irregular curved lines extending over the middle and thickest part of the pat.*

As already stated, the formation of these shrinkage cracks is due to the faulty handling of the cement and has nothing to do with its quality.

In addition to shrinkage cracks developing under the above-described faulty method of handling test pats, it will also result in the test pats becoming soft and easily crumbled, while a pat made from identically the same sample of cement, but properly handled by being kept moist during the setting and first stages of hardening, will be faultless in all respects.

"*Hair cracks*" sometimes appear on cement work that has been exposed in the open air to frequent changes of temperature and wet and dry weather. These "*hair cracks,*" which appear as fine lines on the face of the work, occur chiefly when a pure cement or a mortar too rich in cement has been used. With intelligent working and the addition of sufficient sand, these "hair cracks" do not appear. In this respect it might be pointed out that mortar made from neat cement is not water-proof, as shrinkage cracks and hair cracks are bound to appear in such work and finally lead to the destruction of the cement. By the addition of one part sand to the cement these shrinkage and hair cracks can be avoided and a weather-resisting mortar obtained.



CONCRETE LOCK WALLS, TRENT VALLEY CANAL.
BUILT WITH "RATHBUN'S STAR."

Strength.

Portland Cement, as now manufactured, obtains within a few days as high a degree of strength as Portland Cement of a few years ago attained in the same number of months.

When cement is used for building purposes it is subject to compression, but is usually tested for its tensile strength. In well-equipped laboratories machines are provided for making tests for compression strength, and it is more satisfactory to have such tests made in conjunction with the tensile tests. For rough calculation, compression strength of cement can be figured at from eight to ten times the tensile strength.

As already mentioned, Portland Cement manufactured with the care, and under the processes now in use in modern well-equipped factories, will show a very high degree of strength at early dates. This is especially the case when the cement is tested for *tensile strength neat* (that is, without the addition of sand to the cement), and sometimes there is heard the complaint that a cement which shows a very high tensile strength at seven days neat has not attained a corresponding increase of strength at later dates. Providing the sample of cement has proved satisfactory in the test for soundness and constancy of volume, this lack of increase in the neat tensile strength is not due to deterioration in the cement, but to the increase in hardness and its consequently increased "brittleness." Under the above conditions, should anyone question the good quality or value of the cement simply on account of its failing to show an increase in the neat tensile test, let them take the same cement and mix it with three parts of standard sand and then test it for tensile strength as a mortar, and they will find that when tested as a mortar it will show a continued increase in tensile strength up to any period. The fact of mixing the sand with the cement

THE GREAT NORTHERN RAILWAY BRIDGE OVER OTTAWA RIVER.
BUILT WITH "ENSIGN."

overcomes the brittleness which is the cause of the neat tensile tests failing to show an increase. As cement should never be used in practice in the neat state, this brittleness is not a defect in the cement. Again, the same sample of cement if tested for its compression strength, even in the neat state will show continually increasing compression strength to any period. Consequently a cement, all other qualities being right, that shows continually increasing tensile strength when tested as a mortar, or increasing compression strength when tested neat, can be counted upon as absolutely reliable, irrespective of the results of the neat tensile strength.

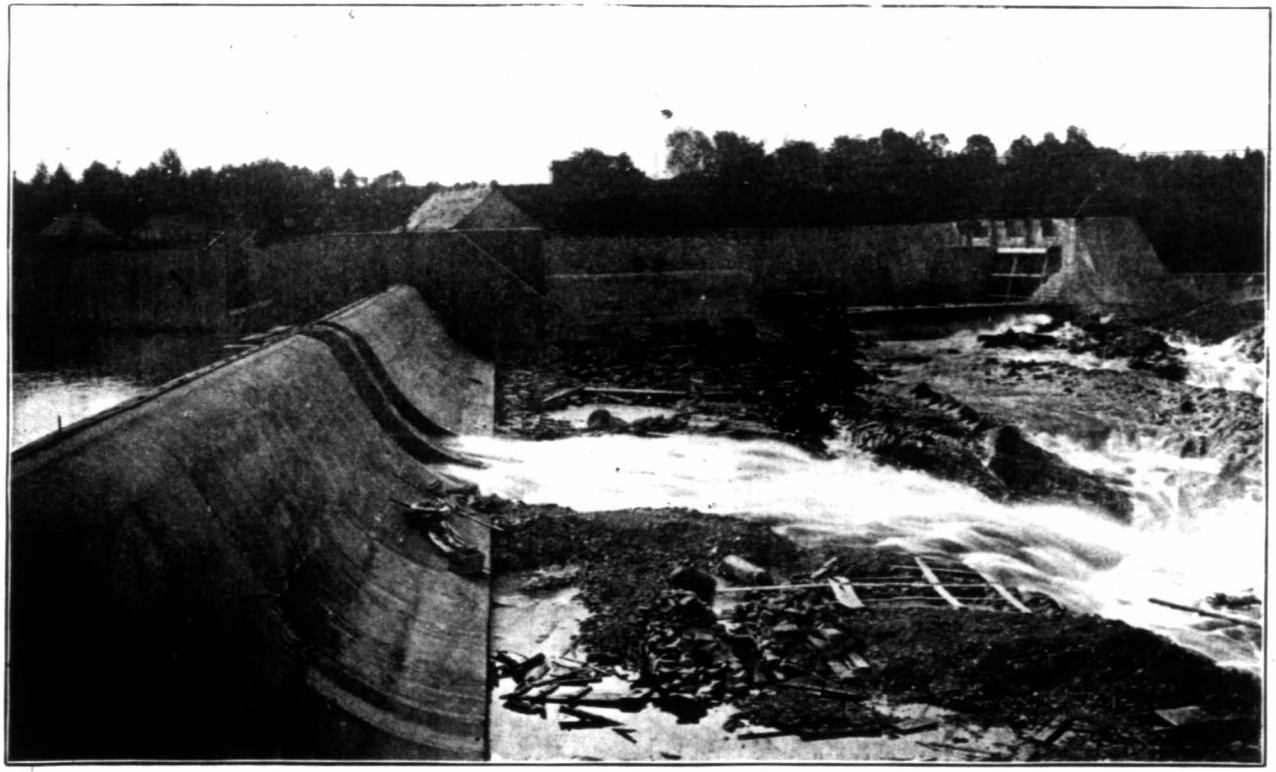
A cement that shows a falling off in tensile strength when tested as a mortar, or in compression strength when tested neat, is by all means to be avoided, and a cement giving such results will undoubtedly be found to fail in the test for soundness, or constancy of volume.

Fineness of Grain.

The fineness of grinding of Portland Cement largely determines its value, as the finer cement is ground the greater will be its capacity for enveloping the sand, gravel or broken stone with which it may be mixed. It is also a well-established fact that nothing except the impalpable powder has any cementing value. Anything in the nature of grit, such as is retained on a sieve with 40,000 holes to the square inch, is of no more value than so much sand. Users of Portland Cement should, therefore, give special attention to the fineness to which the cement they are purchasing is ground.

Setting and Hardening of Cement.

After water has been thorougly mixed with Portland Cement, a plastic paste is produced, which in turn becomes hard. The change from the plastic paste to the hard mass

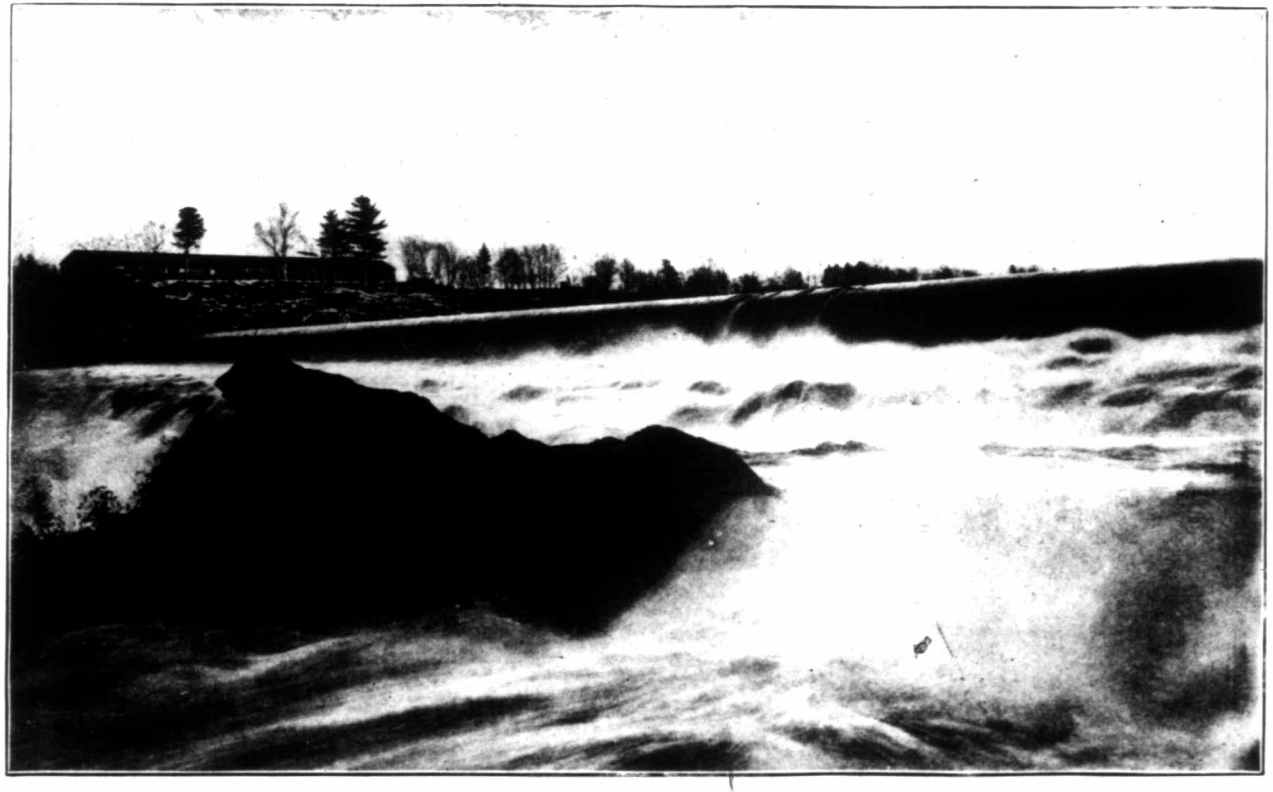


POWER DAM AT CHAUDIÈRE, QUE.
BUILT WITH "BEAVER."

is termed "setting," and the time required for this change is termed "the time of setting." When once a Portland Cement mortar has begun to set, it should not be disturbed; consequently it is of importance to know how long a cement that is being used can be manipulated before the setting actually begins. Should a mortar begin to set before it is put in place and this set mortar is mixed anew with water, the value of the cement is destroyed, and an unjust complaint may be made that the cement does not harden or possess any strength. Care should be taken to only mix up such a quantity of mortar as can be used before the cement begins to set. Remnants of mortar which have become set should be thrown away and under no circumstances be again worked up with water.

It is possible to procure slow or quick-setting cements, and except in very exceptional cases, where a quick-setting cement may be a necessity, it will be found that a *slow-setting cement will give the best results.* Slow-setting cements can be made to set more quickly by using warm water and also by limiting the water used to the smallest possible quantity.

A Portland Cement may be "set," but may not have attained much strength or hardness. The "hardening" process begins to take place immediately after the "set" has developed, and continues almost indefinitely. In order for this "hardening" process to proceed satisfactorily, it is necessary that the cement shall not be disturbed, once the "setting" has begun, and that it shall be protected from two rapid drying out. The latter point cannot be too carefully provided for. *If the cement is deprived of the necessary water, it can never reach its full hardness.*



POWER DAM AT CHAUDIÈRE, QUE.
BUILT WITH "BEAVER."

Portland Cement Mortar

To obtain good results great care must be taken in the preparation of the mortar. The sand should be clean and coarse, very fine sand usually being objectionable. When it can be obtained, a sand consisting of grains of various size, from fine to coarse, will give the best results, as this will give a dense mortar free from voids.

Only perfectly clean water should be used for mixing the mortar.

Measure accurately the correct proportions of sand and cement. "Guess work" mixtures should never be made, as the mortar will inevitably be of varied composition, at times too weak from too large a quantity of sand, and at other times wasteful owing to an unnecessary proportion of cement having been added.

Having measured the correct quantity of sand and spread it out, scatter the correct amount of cement evenly over it. The two materials should then be thoroughly mixed together in the dry state so that the mass appears of uniform color.

Now add clean water and thoroughly work it into the mass.

For ordinary use the mortar should be of such consistency after the water has been added as will allow it to stand stiffly on a trowel.

The proportion of sand used in the mortar will vary as the class of work for which it is required. For work requiring great resistance to wear, extraordinary strength or impermeability, 1 to 2 parts of sand to 1 of cement should be used. For ordinary building mortar, plastering, foundations, etc., 3 to 4 parts of sand to 1 of cement are often employed.

CITY HALL BUILDINGS,

TORONTO.

BUILT WITH "RATHBUN'S STAR."

One barrel Portland cement of 350 lbs. net has the capacity to cover when used with

1	barrel of	sand,	63	square feet	1 inch thick.
1	"		84	"	¾ "
1	"		126	"	½ "
2	barrels of	sand,	97	"	1 "
2	"		129	"	¾ "
2	"		194	"	½ "
3	"		130	"	1 "
3	"		173	"	¾ "
3	"		260	"	½ "

Portland Cement Concrete.

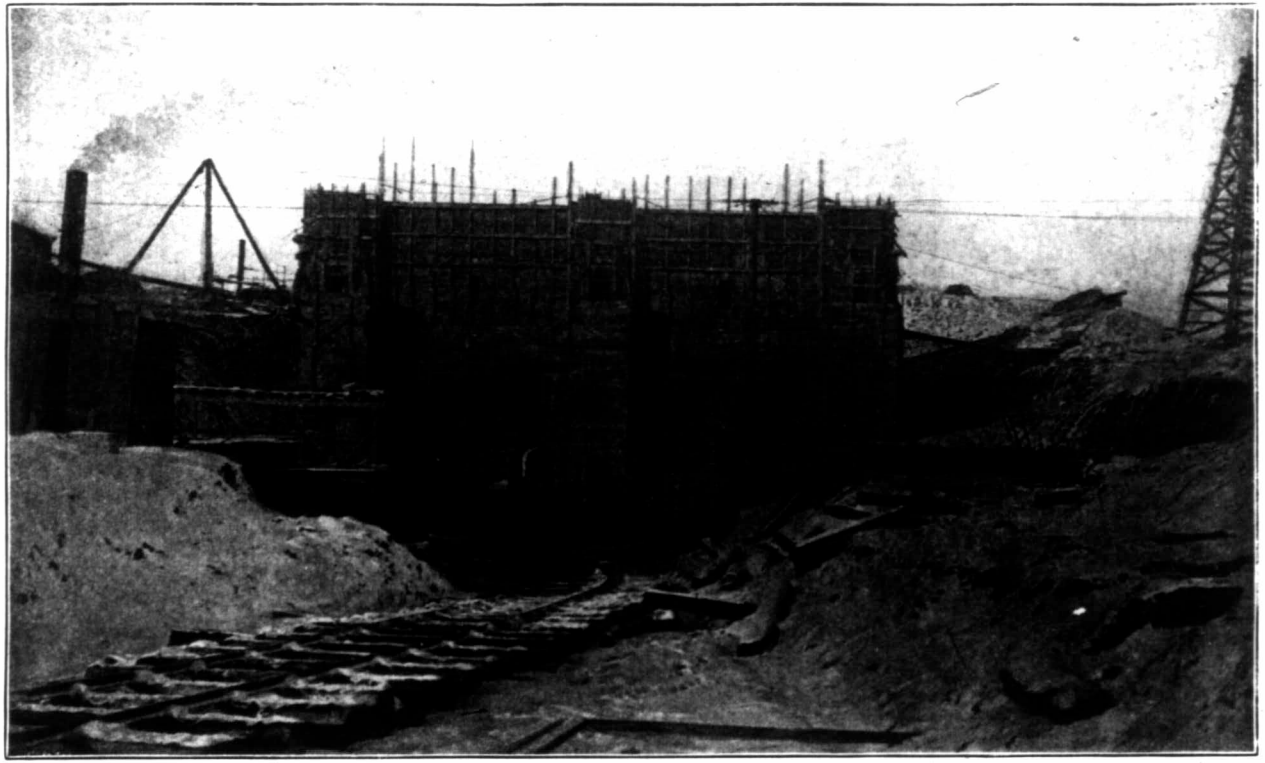
Owing to the excellent results obtained from Portland Cement Concrete, its use has become very extensive. Concrete is a mixture of Portland Cement, sand and gravel or broken stone, which, with the addition of the necessary water, becomes bound together into a hard, solid mass.

In order to get the full benefit of the binding properties of the Portland Cement, it is absolutely necessary to use clean water, sand and stone. Any loam or dirt will destroy the adhesion of the materials in the concrete.

Do not use soft sandstone or broken bricks. Good gravel or crushed limestone that will pass through a two-inch ring are the most suitable.

For the preparation of concrete decide upon the proportion of cement, sand and stone, and provide means of accurately measuring them.

To prepare the concrete, first thoroughly mix the cement and sand together in the dry state. Then add the necessary quantity of water and work it well into the mass. The correct quantity of broken stone or gravel, which has first been thoroughly washed down to remove all dirt, is then added to the mortar, and the whole mass



CONCRETE LIFT LOCK, TRENT VALLEY CANAL,
IN WHICH ABOUT 10,000 BARRELS "BEAVER" HAVE BEEN USED.

is thoroughly mixed by turning with the shovel three or four times, until the broken stone or gravel is evenly distributed.

Now deposit the concrete promptly in position and vigorously stamp the mass until it becomes elastic and a little water shows on the surface. Concrete, when ready to put in position, should have the appearance of moist earth and stone, but with thorough stamping after it has been put in position, water can be brought to the surface.

The use of too much water is to be avoided, as it makes the concrete too spongy to permit of vigorous stamping, and consequently the mass will be less dense and weaker.

After the concrete has been put in position and thoroughly stamped, be careful not to meddle with it further, as any disturbing of the bed while the setting process is taking place will destroy the work.

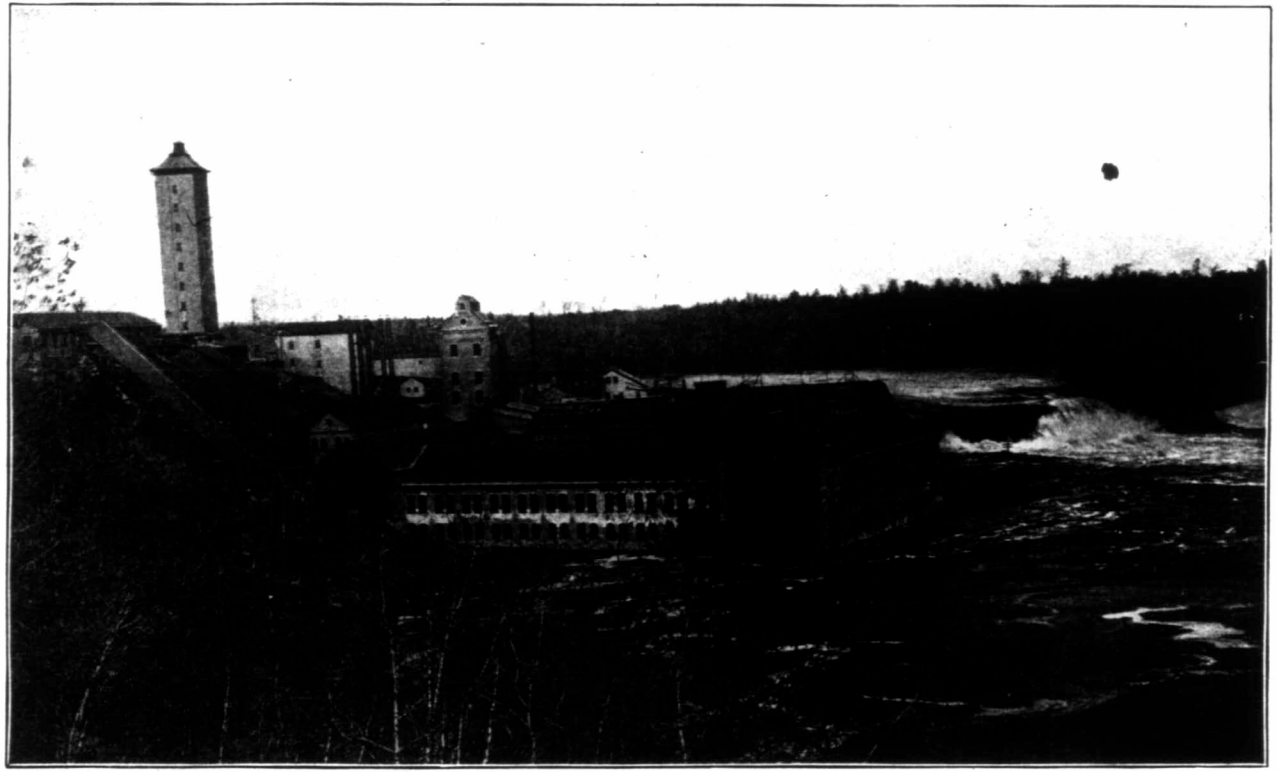
Concrete should be deposited in layers not exceeding six inches in thickness, and as far as possible each layer should be deposited before the layer previously placed has set.

Concrete adheres very closely to iron and steel, and their use to strengthen and tie different parts of concrete together is a common practice and of great value.

Temperature has a great deal to do with the hardening of concrete. In dry summer weather it sets very much faster than in cool weather. Concrete can be used in nearly all places where stone masonry is now used. It is a very convenient form for arch construction, and is stronger than the ordinary stone or brick arch.

In concrete work slow-setting cements will be found to give the best results.

Unless concrete is in a damp place or protected from the sun, it should be frequently sprinkled very lightly with water for several days after being laid.



WORKS OF LAURENTIDE PULP CO., GRANDE-MÈRE.

BUILT WITH "ENSIGN." *23,000 BARRELS USED.*

Large masses of concrete should be divided in blocks in order to provide for the expansion and contraction which will take place with changes of temperature in winter and summer. If this precaution is not taken, unsightly cracks are liable to appear.

The strength and cost of concrete within certain limits is dependent upon the proportion of the ingredients. Where a rich mixture is required, such as foundations for heavy machinery, bridge piers or retaining walls, which require great strength, it may be necessary to use 1 part of cement to 2 parts of sand and 5 parts of broken stone. Where a rich mixture is not necessary, 1 part Portland Cement, 4 parts sand and 8 parts broken stone can be used with excellent results. *On an average the cement required per cubic yard of concrete is a little less than one barrel.*

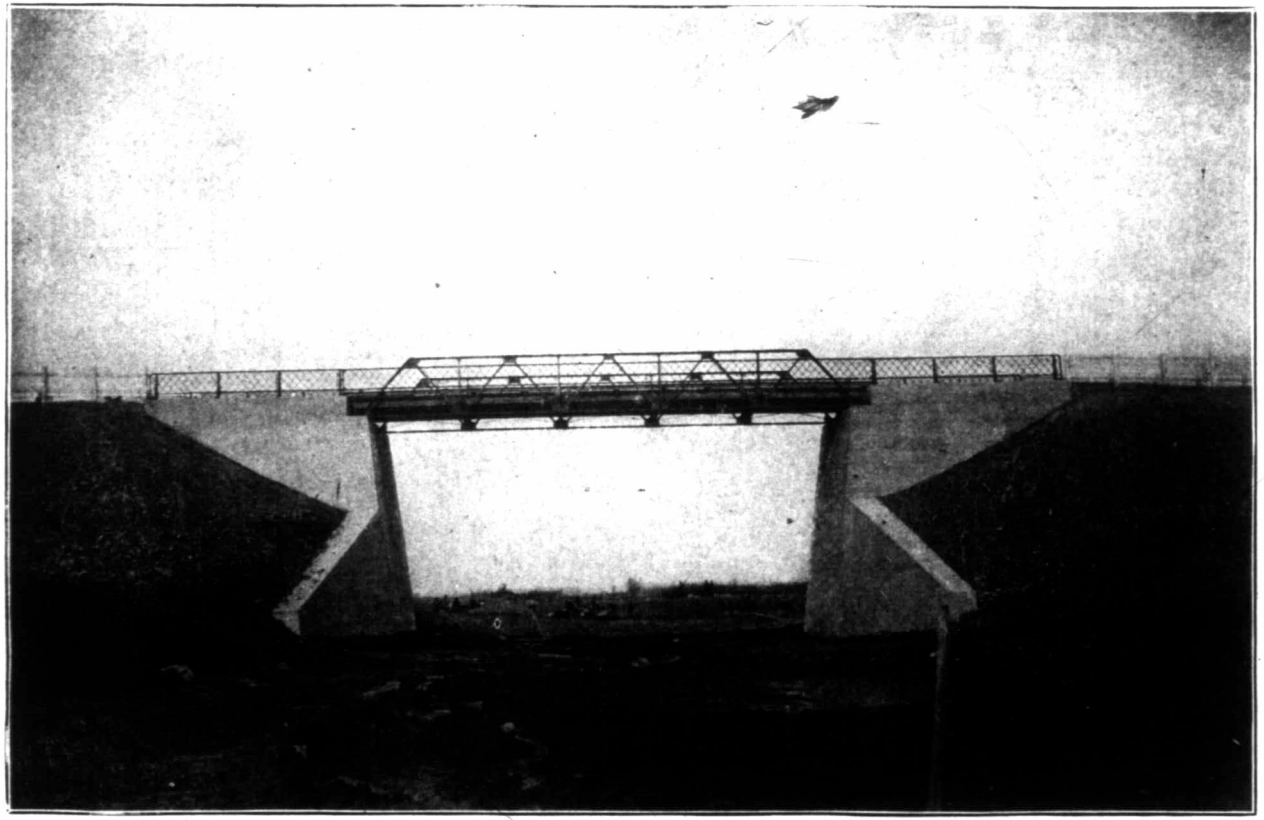
Portland Cement Floors and Sidewalks.

Sidewalks and floors are generally built in two layers, the lower bed of concrete from three to six inches thick, on top of which is placed a wearing or finishing coat of rich mortar usually about one inch thick.

The composition of the lower bed of concrete will vary according to the service to which the walk or floor will be subject. For heavy duty a mixture of 1 part cement, 3 parts sand and 6 parts gravel or broken stone can be recommended. For lighter and less important work, 1 part cement, 5 parts sand and 10 parts broken stone or gravel will answer.

A suitable mixture for ordinary requirements is 1 part cement, 3 parts sand and 7 parts broken stone or gravel.

The wearing or finishing coat consists of 1 part cement to 1 part sand, or 1 part cement and 2 parts sand, according to whether the walk or floor is subject to excessive travelling. Under ordinary conditions 1 part cement to 2 parts sand will give excellent results.



CONCRETE BRIDGE PIERS (33 FT. HIGH), TRENT VALLEY CANAL.
BUILT WITH "RATHBUN'S STAR."

For outdoor work to insure durable cement walks or floors, prepare a foundation from 10 to 12 inches deep of broken stone or cinders, well rammed, levelled, and moistened, so that they will not absorb water from the concrete. Such foundations will provide a drainage and should prevent the breaking of a walk by the expansion of the soil in severe frost.

For indoor work on dry ground, it is sufficient to level and stamp down firmly.

To make a good standard floor or walk, on top of this foundation deposit a layer of concrete 4 inches thick, the concrete having been made in the proportion of 1 part Portland Cement, 3 parts sand and 7 parts broken stone. Stamp this concrete until water appears on the surface. Then cover the concrete immediately with a layer of mortar 1 inch thick, composed of 1 part Portland Cement, 2 parts sand. The mortar is spread with a straight-edge and finished to a smooth surface quickly and with as little trowelling as possible. Too much trowelling of the top dressing of a floor or walk frequently results in a thin scale chipping off the surface. Be sure that the top dressing is laid almost immediately after the concrete is put in place, as the two bodies will then become a homogeneous mass. If the top dressing should be laid after the concrete has thoroughly set, it is liable to become a separate layer and lose the additional strength given by the two being well knitted.

In dry weather it is very important that a canvas or some other covering should be spread over the work and kept thoroughly wet for several days to prevent too rapid drying out, as from this cause shrinkage cracks and lack of hardness may result.

Cement expands and contracts with changes of temperature in the same way as iron, stone and other materials. For this reason, if proper precautions are not taken,

FORESTERS' TEMPLE BUILDING, TORONTO.
BUILT WITH "RATHBUN'S STAR."

irregular and unsightly cracks will appear in the walk or floor, especially in wide surfaces. This can be avoided by dividing the floor or sidewalk into blocks, which should not exceed from 25 to 36 square feet in area. The joints in the concrete must correspond with those cut on the surface layer.

A quick-setting cement should never be used for floors or sidewalks or work which requires trowelling or finishing off, as such cements begin to set before they can be worked, and most unsatisfactory results will be obtained.

Portland Cement, which takes from three to five hours to set, allows plenty of time for the proper working, and gives the very best results. *One barrel of Portland Cement will make about 40 square feet of sidewalk or floor when laid according to the above specifications.*

Cement Plastering, Etc.

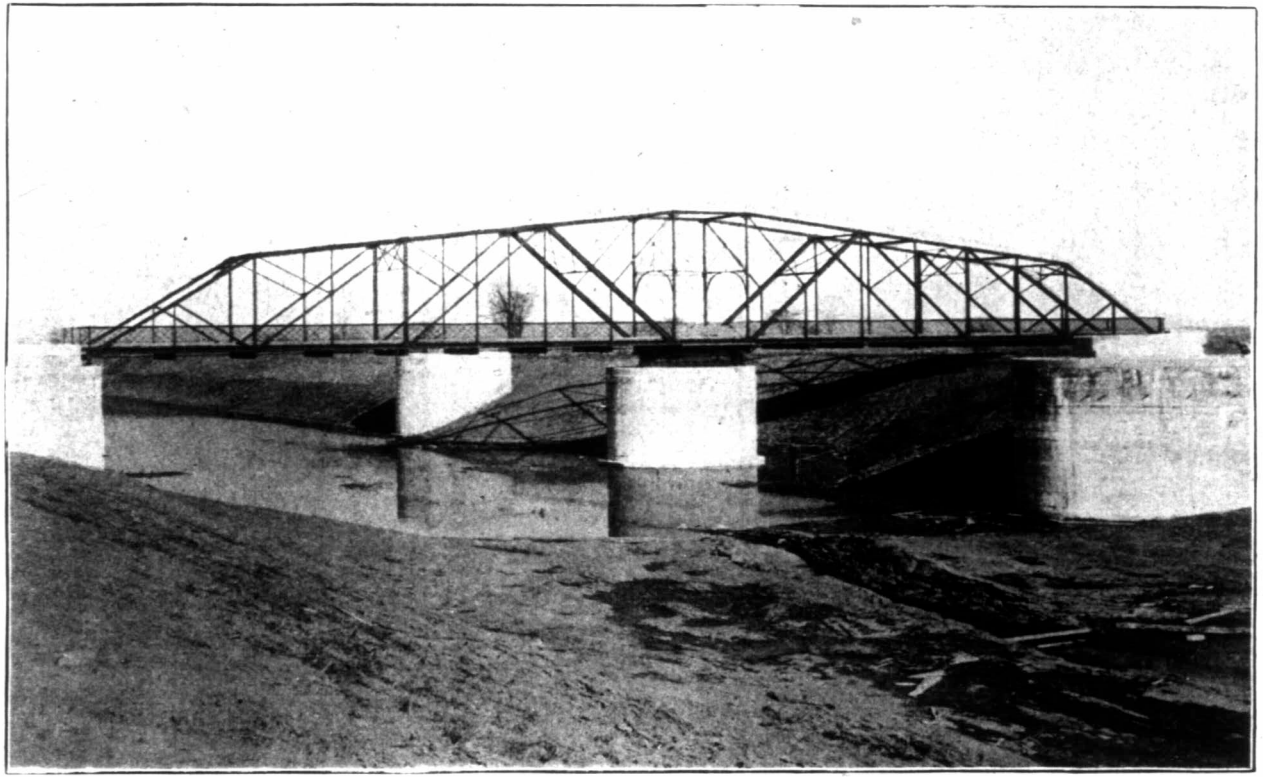
When cement mortar is used for plastering, the surface of the wall must first be thoroughly cleaned and the joints racked out and the whole surface washed down and repeatedly wetted. After the mortar has been applied, the walls should be frequently sprinkled with water from the end of a broom or brush during the day the work is done.

On no account should plastering work be attempted out of doors during freezing weather.

When cement mortar is used for laying brick, the bricks should be completely immersed in water for some minutes before being used ; simply wetting the brick is not enough.

In dry weather stone being laid with cement mortar should also be thoroughly wetted before use.

Unless these precautions are taken, the moisture in the mortar necessary for the proper hardening of the cement will be absorbed by the stone or brick, and the mortar will become almost valueless.



CONCRETE BRIDGE PIERS, SOULANGES CANAL.
BUILT WITH "RATHBUN'S STAR."

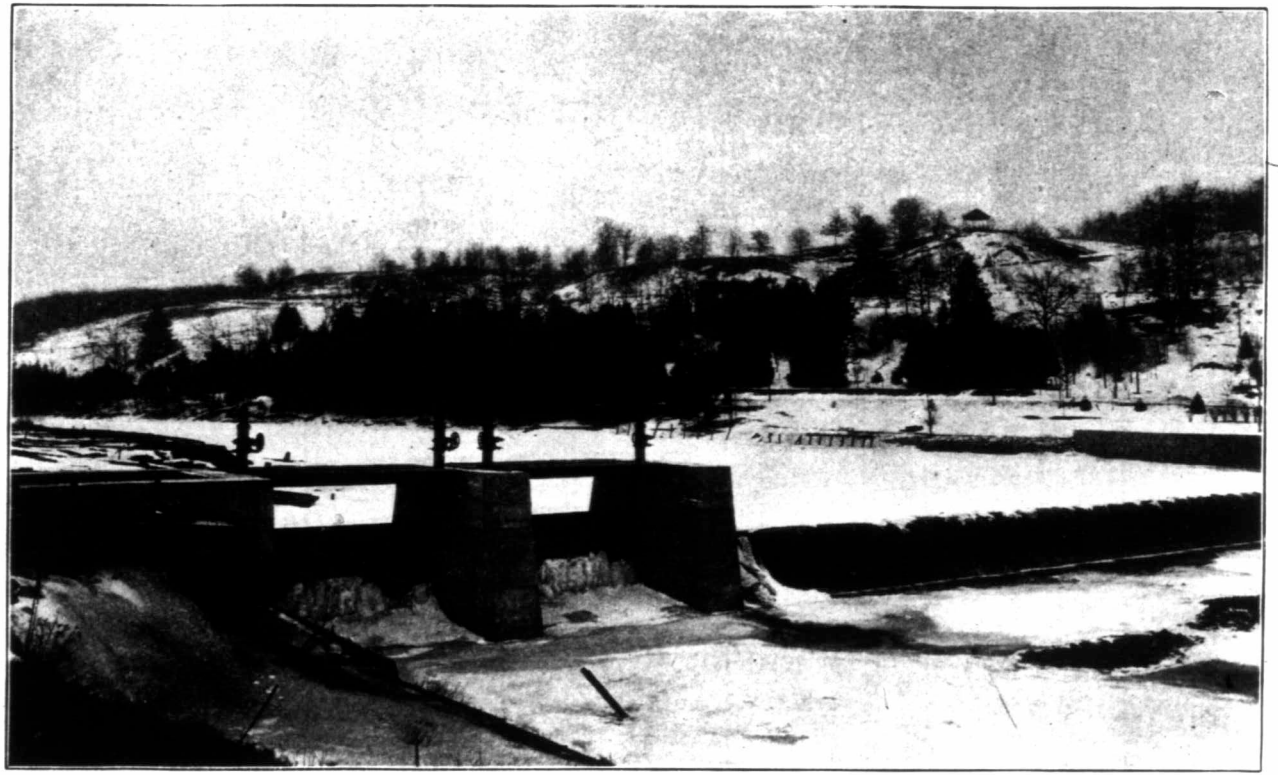
Use of Cement in Hot or Cold Weather.

There is no difficulty in carrying on Portland Cement work and have it properly harden in either very hot or cold weather. In hot weather the only precaution necessary is to see that the water required by the cement for hardening is not absorbed by the atmosphere or the bodies surrounding the cement work. To this end it is necessary to keep new work thoroughly moist for several days.

Portland Cement is less affected by frost than any other hydraulic material. It is only during the setting of Portland Cement that injury can occur, and if water is sparingly used in the preparation of the mortar very excellent results can be obtained in freezing weather. In very cold weather it is also advisable to heat the water and sand, which, with the quantity of water reduced to the lowest limit, will hasten the setting of the cement. It must be remembered, however, *that cement work done in cold weather will at first show but very little strength, but will finally reach its normal hardness.*

Testing Cement.

A quite common occurrence among some workmen, with a view to testing cement, is to mix a small quantity with some proportion of sand ; place it upon a *dry board*, which is set aside, but *exposed to the rays of the sun or a very dry atmosphere.* The board and the atmosphere very quickly absorb the moisture from the small body of mortar so that it is impossible for it to more than partially harden, and the cement, which may be first-class but slow-setting, is pronounced worthless. A cement which may be worthless, but quick-setting, or sufficiently rapid in its action to use the water before it can be absorbed by the board and the atmosphere, is pronounced "first-class." The only safe and fair method for arriving at the value of a Portland



WATER WORKS DAM, LONDON, ONT.
BUILT WITH "BEAVER."

Cement is to have it tested in a well-equipped cement laboratory, where accuracy and proper conditions are carefully observed.

Miscellaneous.

Ordinarily one barrel Portland Cement should be sufficient to make mortar to lay 1,000 bricks with ¼-in. joint.

For plastering cisterns, 1 part Portland Cement, 2 parts sand will give excellent results.

For sewer pipe and building stone, use 1 part Portland Cement to 4 parts sharp, clean sand. Put in mould and stamp well, using minimum quantity of water.

Sand and gravel, dry—

1 cubic foot weighs from .... 100 to 110 lbs.
1 " yard " .... 2,700 " 2,900 "

Limestone, broken in pieces from 1 to 2-inch size—

1 cubic foot weighs about ..... 90 lbs.
1 " yard " " ..... 2,430 "

Portland Cement, loose, 1 cubic foot weighs 70 lbs.
" " packed, 1 " " 110 "
1 barrel = 3 ½ cubic feet.

Useful Tables for Reference in Calculating Cement Mixtures.

Avoirdupois Weight.

27.34 grains = 1 dram.
16 drams = 1 ounce.
16 ounces = 1 pound = 7,000 grains.
2000 pounds = 1 ton.

Long Measure.

12 inches = 1 foot.
3 feet = 1 yard.
5½ yards = 16½ feet = 1 rod.
40 rods = 1 furlong.
8 furlongs = 320 rods = 1760 yds. = 5280 ft. = 1 statute mile.
66 feet = 4 rods = 1 chain.
80 chains = 1 mile.

Cubic Measure.

1728 cubic inches = 1 cubic foot.
27 cubic feet = 1 cubic yard.

Linear Measure.

1 centimetre = 0.3937 in.
1 decimetre = 3.937 in. = 0.328 ft
1 metre = 39.37 in. = 1.0936 yds.
1 dekametre = 1.9884 rds.
1 kilometre = 0.62137 mile.

Linear Measure—continued.

1 in. = 2.54 centimetres.
1 ft. = 3.048 decimetres.
1 yd. = 0.9124 metre.
1 rd. = 0.5029 dekametre.
1 mile = 1.6093 kilometres.

Square Measure.

1 sq. centimetre = 0.1550 sq. in.
1 sq. decimetre = 0.1076 sq. ft.
1 sq. metre = 1.196 sq. yds.
1 are = 3.954 sq. rds.
1 hectar = 2.47 acres.
1 sq. kilometre = 0.386 sq. m.

1 sq. in. = 6.452 sq. centimetres.
1 sq. ft. = 9.2903 sq. decimetres.
1 sq. yd. = 0.8361 sq. metre.
1 sq. rd. = 0.2552 are.
1 acre = 0.4047 hectar.
1 sq. mile = 2.59 sq. kilometres.

Weights.

1 gram = 0.0527 oz.
1 kilogram = 2.2046 lbs.
1 metric ton = 1.1023 English tons.

1 oz. = 28.35 grams.
1 lb. = 0.4536 kilogram.
1 English ton = 0.9072 metric ton.


THE
MILN-BINGHAM
PRINTING CO.,
TORONTO,
CANADA.

Portland Cement

"Rathbun Star"

"Beaver"

"Ensign"