Since the days of Aspdin the use of cement has expanded in a rapidly increasing ratio. In 1850, six pounds of cement was used per capita in the United States, while in 1902 the consumption was 119 pounds per capita. In a period of eight years, ending with 1902, the consumption of cement in that country increased 2,600 per cent. In the course of his history man has passed through the stone age, the bronze age, the iron age, and the steel age, and now it appears that we are entering what may be called the plastic age, in which asphalt, plaster and cement play large parts.

In Canada the use of cement has increased in almost the same degree. The production of cement in this country has increased from 70,000 barrels, in 1887, to 720,000 barrels, in 1903, while the imports during the year ending June, 1903, were the equivalent of 735,000 barrels. These imports came from the following countries in the order named: Belgium, Great Britain, United States, Germany, Japan, Holland.

In the preparation of this article extracts have been made from a paper by F. W. Huber, of the United States Geological Survey, which appeared in the California Journal of Technology, and also from a publication of the Canadian Portland Cement Co., Limited.

NOTES ON CONCRETE.

(Concluded.)

From the above it appears that pit sands (rounded and made up of different sized grains), are more desirable than crushed granite or quartz (sharp); that a little clay is probably not detrimental; that coarse sand or crushed stone gives a higher tensile strength than fine sand, and that the rounded pit sand or the crushed limestone gives better results when subjected to abrasion than clean, sharp granite sand.

Stone.

Specifications generally require that stone for concrete should be broken to pass a 2-inch ring and screened, and it has been considered as essential that the edges should be sharp to secure a bond. Now it is common practice to use gravel in place of broken stone, and the superiority of coarse pit sand over crushed quartz indicates that the practice is good. Gravel and sand pumped from river beds or taken from pits is frequently used and mixed directly with cement to form the concrete. Such concrete possesses the advantage of making a more dense mass with less labor than when using broken stone.

General.

The above considerations indicate that the old style of specification of 1 to 2 to 4 and 1 to 3 to 5, etc., where each ingredient was specified with rigid exactness, must be modified if we are to secure the best results for the least money. It is obvious that each locality and enterprise, where concrete is to be used, offers a separate problem which must be studied in detail by an experienced competent engineer. It is not difficult to point to the waste of very large sums of money in engineering works—where large masses of concrete of rich proportions have been used—where at least one-fourth the cost per cubic yard might have been saved without the slightest detriment to the work.

The provision of strongly braced, very substantial forms is very necessary where concrete is laid above ground, and—if a smooth face is desired—dressed two-inch lumber should be used, the face concrete put in wet and carefully worked with a spade against the form to get the mortar face homogeneous. It is difficult to brace forms to allow of a greater height than three or four feet of concrete being laid in one day, and the surface of this lift should be well wetted down next morning and covered with a little mortar before depositing the regular mixture.

Concrete is especially applicable to mining on account of the facility of handling and placing it underground in confined spaces for such purposes as tunnel linings, supporting columns, machinery foundations, shaft linings, dams, stoppings, and fireproof structures above and below ground.

Reinforced Concrete.

The reinforcing of concrete with steel, which has recently come into such general use, where lightness and strength are desired in a permanent structure, makes it practicable to use concrete for many purposes for which a short time ago lumber would be exclusively used. The expense of a building constructed of a steel or timber frame with concrete floors, walls and roofs is in most localities very moderate considering the advantages in durability and fire risks secured.

There are many systems of reinforcing concrete advertised extensively, and they probably all possess considerable merit either in strength or convenience in use; but it is questionable if plain, round steel bars, properly proportioned and located to take the strains, are not as good, considering the cost.

Experiments show that clean, straight, round steel bars have an adhesive strength when embedded in cement mortar of about 250 lbs. per square inch of surface; that steel or iron bars are perfectly preserved from corrosion when embedded in good wet laid cement concrete, and that rust—unless in form of scale—does not damage the metal for such use.

The writer conducted tests with two concrete floors, one, (A), 2⅞-in. thick by 4-ft. 7-in. span, reinforced with 3-16-in. round steel rods laid 8-in. C to C, across and lengthwise, and tied with wire at intersections; and (B) 4-in. thick by 4-ft. 1-in. span, reinforced with expanded metal No. 10 gauge. (A) was composed of National cement 1 part, coarse pit sand 1½, and limestone ¾-in., mesh and under 2½; (B) was Atlas cement 1 part, pit sand 2, and pit graved 5. A 28-day test showed deflections as follows:

(A).

Lbs.	Ft.	
1,500	0.002	
3,620	0.006	
4,220	0.008	No cracks showing.
4,220	0.012	One-half hour later. No cracks showing.
000	0.006	

=2,110 lbs. per sq. ft. without sign of failure.

(B).

Lbs.	Ft.	
3,000	0.001	
6,000	0.004	
7,500	0.006	
10,500	0.013	
13,250	0.014	
14,000	0.017	Showed hair cracks on under side.
000	0.005	

=3,500 per sq. ft.

By comparing the loads carried by the two floors per square foot, the span, and thickness of the floors tested, it will be seen that—though the concrete is richer in the thinner floor—it compares very favorably with the more expensive one.

A great advantage of using concrete is that with competent supervision unskilled workmen can very quickly be trained to do the work, and the employer is thus freed from the difficulty and expense of using skilled union labor.

It is a common statement that concrete cannot be made water tight. The writer can show an eight-inch reinforced concrete wall (cement, sand and gravel), which—under a head of seven feet of water—shows a dampness in spots only on the lower side, and no precaution was taken to make it water-tight other than good, honest workmanship. He can also show concrete retaining dams that show not even a dampness on the outside when subjected to a head of fifteen feet of water, and has built a three-foot concrete wall on an old concrete foundation five feet under water which, when retaining a head of seven feet of water against it, showed a very few small trickles of water leaking through it.

THE PRATT RETURN STEAM TRAP.

The accompanying cut shows the latest style of high pressure trap now on the market, known as the Pratt Return Steam Trap, and which is handled by The Canadian Fairbanks Company, Limited, for Canada.

The most careful managers of steam plants aim to secure the greatest saving in coal and water possible and are con-