

technical schools will ever produce the finished craftsman that the guilds did. Even where apprenticeship exists, the duty of master to pupil is largely shirked. This is reduced to a minimum in Germany. In that country the boy has to satisfy examiners at the conclusion of his articles that he has mastered his trade. Should it be found that he has not been properly taught, the master pretty soon hears of it, either in the shape of a heavy penalty or the compulsory tuition of the boy for a further period." Thus, agreeing as it does with the views of many of our correspondents in all parts of the world, is worth preserving. We may not return to the system as a whole, but it will not go un lamented.

## Hollow-Concrete Block Construction.

BY SPENCER B. NEWBERRY.

### SECOND PAPER.

**Block Machines.** There are a multitude of machines on the market, and new advertisements appear in every issue of the cement journals. From this we may well believe that money is more easily made by the sale of machines than by their use in block manufacture. Practically all the machines offered are repetitions of the same fundamental design, and differ only in minor mechanical details. A discussion of relative merits and expression of preference would be useless. Each intending purchaser should study the various machines offered and select that best adapted to his needs, giving preference to those of solid and substantial construction and taking care that he gets real value rather than "blue sky" for his good money.

Block machines may be generally divided into two groups—those with horizontal and with vertical cores. The former are usually considered the more convenient for making "faced" blocks though a facing can be put on with either type of machine. The use of a facing of finer, richer or coloured mixture must be called a matter of taste. In the judgment of the writer it does not pay to use a facing as the additional labour and preparation of a separate mixture cost more than to make the whole block of suitable composition to give a good surface. If the facing differs much from the body in composition, also, it is likely not to adhere perfectly, and trouble has been experienced from this cause. However for water-proof and coloured work a facing may be found an advantage, and doubtless many will give preference to a machine which allows this to be conveniently applied.

Machines are provided with face-plates for the production of rock-faced, tool-faced, and plain blocks and various ornamental designs, for borders and friezes are also furnished. Plates for rock-faced blocks should always be cut from a natural stone and several different patterns of each size should be obtained, to avoid monotony in appearance of the work. Many machines are provided with rock-face plates evidently cast from some moulded soft material which yields blocks of a surface more like that of pats of butter than natural stones. Such makeshifts are abominable, and a fraud on the purchaser.

As to size of blocks, most machine-makers appear to have adopted the standard dimensions of 32 in. in length by 9 in. in height, giving two square feet of face to each block. Machines are generally made for blocks 8, 10, or 12 in. in thickness. Some machines are adjustable to allow blocks of either thickness to be made. Where the business will warrant it, however, it saves time to have a machine for each size. An 8-inch wall is abundantly strong for foundations or walls of 2-story dwellings, but in many cities the building code prohibits anything less than 12-inch walls for foundation and first story. There seems to be only small demand for the 10-inch block.

Machines are generally provided with attachments for making corner blocks. Arrangements for making 45 degree and 30 degree angle blocks, for bays and towers, are also desirable.

**Tamping.** This is generally done by hand, by means of iron rammers. Some well-equipped plants use pneumatic tampers, operated by compressed air, with considerable economy in labour and probably some improvement in density. Excellent results can, however, be obtained by hand-tamping, if the mixture is wet enough.

Sticking to the plates may be largely prevented by rubbing the inside surface, when dry, with paraffine, animal or vegetable oil, or soft soap. Mineral oils, such as common lubricating oil are less effective.

**Handling, Hardening, and Storage.** For good results, blocks must be kept under roof, protected from sun and wind, and frequently sprinkled, for at least five days, and preferably for seven days. They may then be piled up outside, and in dry weather should be kept moist by occasional sprink-

ling with hose for at least three weeks more. Blocks should never be built into a wall until at least four weeks old. Freshly-made blocks will be found to shrink more than 1-16 in. in length on seasoning a month, and if put into a building when only a few days old will develop unsightly cracks in the joints or through the blocks themselves.

In handling blocks from the machines the use of three-decked cars on tracks will be found a great saving in time and labour. In a factory so equipped each machine, with two men tamping and one shovelling, will easily make 150 blocks, 32 in. long and 8 in. wide, in ten hours.

### PROPERTIES OF BLOCKS.

**Strength.** Well-made Portland cement concrete, of good sand and gravel or limestone screenings, 1 to 5, will have a compression strength at 4 weeks of over 2000 lbs. per square inch, and at one year of over 3000 lbs. Tests of various mixtures, in 3-inch tubes, at the Case School of Science in Cleveland, showed the following:

sand and gravel 6, were crushed with the following results:—

	Net area.	Max. load.	Stress per sq. in.
1.	49.7 sq. in.	99,700 lbs.	2,000 lbs.
2.	49.7 sq. in.	89,800 lbs.	1,805 lbs.
3.	49.7 sq. in.	76,200 lbs.	1,530 lbs.

Two blocks, 6x8x9 in., 22 months old, showed a crushing strength of 2,530 and 2,610 lbs. per sq. in.

Now a block 8 in. wide and 32 in. long weighs 120 lbs., and has a surface of 174 sq. in. Assuming a crushing strength of 2000 lbs. per sq. in. we find by calculation that 2900 blocks could be piled one upon another before the lowest would give away, making a total height of 2175 ft. Allowing a factor of safety of 5, a height of 435 ft. would be admissible. This shows how greatly the strength of concrete blocks exceeds any demands which could possibly be made upon it. As stated above, if it were not for the question of water absorption, much poorer mixtures than are generally used would give abundant strength. [Where water-proof qualities



NEW PREMISES FOR MR. H. F. STEVENS, CHRISTCHURCH.

[Architect: A. H. Hart.]

### COMPRESSION STRENGTH AT SIX WEEKS

	Strength, lbs. per sq. in.	Specific Gravity.	Water Absorption per cent.
Cement ..... 1 1/2 Sand and gravel 6	3200	2 17	4 16
Cement..... 1 1/2 Hydrate lime .. 1/2 Sand and gravel 6	3880	2 18	4 10
Cement ..... 1 1/2 Limestone screenings .6 (Poured in porous mould)	2000	2 05	5 04

It is very difficult to obtain reliable crushing tests of actual hollow blocks, owing to the difficulty of applying the load uniformly over the whole surface. Three one-quarter blocks, 8 in. long, 8 in. wide, and 9 in. high, 10 weeks old, made of cement 1 1/4, lime 1/2

are no object, and good gravel, containing plenty of coarse pebbles, is to be had, mixtures as poor as 1 to 8 or 1 to 10 will often be found to answer.

### WATER ABSORPTION.

One of the chief faults often observed in work done with concrete blocks is their tendency to absorb water to such an extent as to cause dampness to appear on the interior surface. This is especially noticeable in blocks poor in cement and made too dry. The fault may be overcome by use of suitable materials and sufficient care in manufacture.

(To be continued).

Italian railroad authorities are experimenting with a device for use at railway stations, by means of which all tickets are printed and stamped with their price in the presence of the passenger, a record of each sale being, at the same time, made on a roll of paper inside the machine. Each machine is equipped for printing tickets to more than 400 stations.

Destiny has turned many a man down while he was waiting for something to turn up.