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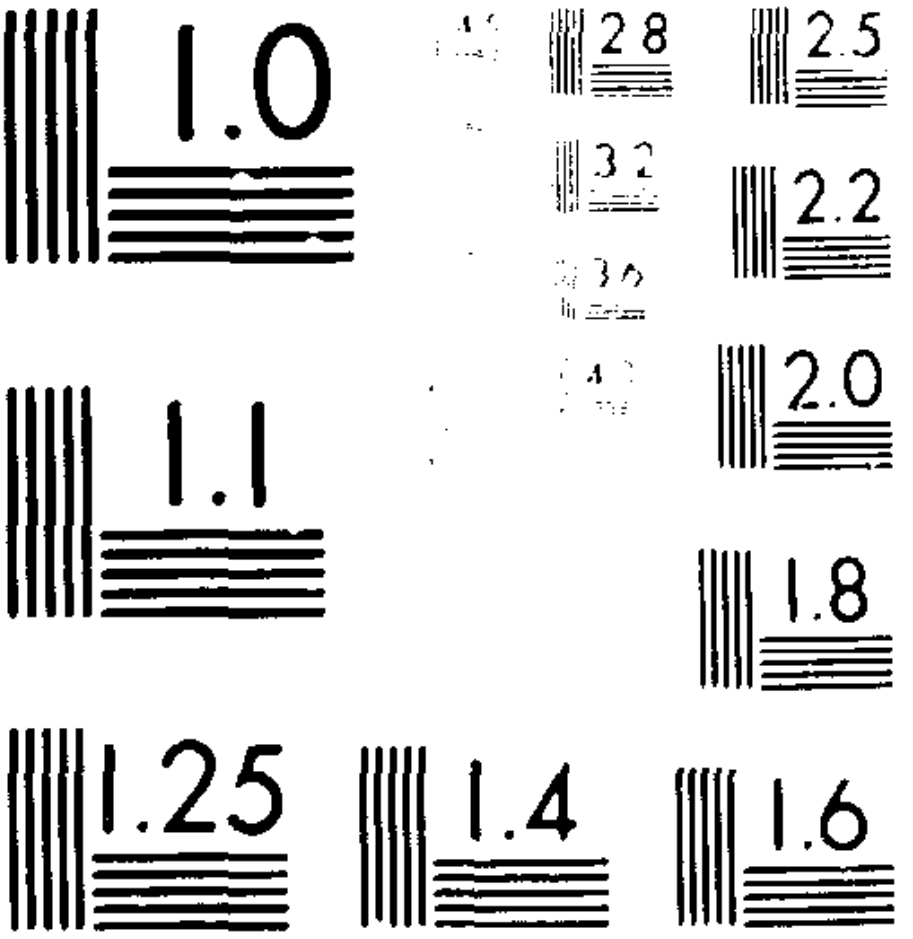

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CONCRETE MASONRY MANUFACTURE*

by

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The subject of concrete masonry manufacture may conveniently be divided into four principle subjects:-

* MARKET
* MATERIALS
* MACHINES
* MEN

1. MARKET

The types of concrete masonry commonly used varies considerably from place to place, as do the uses to which they are put. It is therefore desirable to determine what market is to be aimed for when planning one's production.

In Queensland, blocks are used in every class of building, from small outhouses to the most prestigious buildings, e.g. Parliament House, Churches and Cathedrals, the Commonwealth Games facilities. A high proportion are used in face work - either plain, painted, coloured or split-face. For this reason, there are more blocks produced in Queensland than in the other States of Australia.

However, the market varies considerably within the State. There are, relatively speaking, one hundred times as many blocks used in house construction in Cairns as in Brisbane. Most houses in Cairns are of single-leaf block construction.

In Queensland, most blocks used are 200mm thick in single leaf walls. In Victoria, most blocks used are 100mm thick in cavity walls. This is a matter of custom and climate.

In Europe, the tendency is to use blocks only in walls which are to be rendered or faced in some way so quality of finish is not important. This has a bearing on the type of block machine used.

A feature of concrete block production is the number of different 'specials' produced:-

e.g. 3/4, 1/2. 1/4 length blocks
lintel and bond-beam blocks
cill blocks
pilaster blocks
control joint blocks
screen blocks,

and some of these have to be produced in four different thicknesses - 300mm, 200mm, 150mm and 100mm.

When one adds coloured blocks, split-face blocks, split rib blocks, the total inventory becomes very large. It is a constant requirement to balance the needs of the market with the problems of production. The inventory must be as small as the market will allow, so as to reduce the number of moulds and mould changes involved in production.

In recent years, the concrete masonry industry has been turning its attention to two other types of product - Bricks and Paving units. Although special machines are available to produce these products, they can be made on block machines and can be responsible for a significant increase in sales. Paving units produced vary from thin simply-shaped blocks for domestic use to thicker interlocking blocks suitable for use in any loading conditions.

2. MATERIALS

In order to produce reliably a good quality block, that is one which has adequate strength, is dense (and hence watertight) and has even colour and texture, it is necessary to have reliable sources of

1) aggregate
2) cement
3) water.

(a) Aggregate The plant must be sited near to a source of good aggregate as haulage costs are a major factor in production costs. An average of 91% of the weight of the block is made up of aggregate, because the aggregate/cement ratio varies from 12 to 1 to 8 to 1, depending on the available aggregate quality. In order to minimise the cement content, the aggregate must be tested by sieve analysis and the mix designed to conform to the required grading curve. To maintain these gradings, screening and washing equipment will be required at the aggregate source, and it is important that this be maintained. Broken screens and chutes can cause manufacturing problems.

When selecting a source of aggregate, it is necessary to check that there are adequate reserves. A 3 block machine producing 5,000 blocks in an 8 hour shift will use 80 tonnes of aggregate per shift - assuming it is producing hollow blocks.

Aggregate must be clean and free from clay, organic matter etc., and it must be durable so that it does not dissolve. Shales, sandstones and soft limestones are generally unsuitable. Crushed rocks, river gravel, river and pit sands are usually used. The maximum size of particle used should be not more than a third of the minimum face thickness of the block - normally 10mm aggregate is specified.

There are advantages in using lightweight aggregates if these are available. Pumice and scoria are naturally occuring aggregates commonly used, and in many countries manufactured lightweight aggregates are available.

(b) Cement For maximum economy and quality control, the cement content of the mix must be accurately determined and accurate batching maintained.

(c) Water The water used in the mix must be clean and not contain excessive salts.

Most of the water needed for the mix is contained in the aggregate and only a small amount is added in the mixer. Some skill is required in the control of this added water since the water content of the block must be maintained within close limits to produce a consistently good block.

Mixing As with all concrete work, it is important to maintain correct and adequate mixing procedures.

3. MACHINES

In designing a block plant, the following points need consideration:-

1. the handling and storage of raw materials;
2. the mixing of the materials;
3. the block making machine;
4. the method of handling the block into the racks;
5. the method of curing;
6. the method of cubing for despatch;
7. waste disposal.

Taking these points in order:-

1. Handling and Storage of Raw Materials

It is good policy to have overhead storage and let gravity do the work of feeding the mixer. This allows the materials to drain and avoids segregation. It can be provided either by conveying the materials up into steel tower-like structures, or by making use of a hillside.

On a level site, the materials can be stored on the ground, but segregation will occur; some losses will occur unless a concrete slab is placed over the storage area and a man and machine are required to continually feed small weigh hoppers which supply the mixer with the right quantities of material.

The minimum number of materials to be handled would be coarse aggregate (up to 10mm), sand and cement. In most cases, three aggregates (including sand) have to be provided for, and more if coloured or split block are to be made.

2. Mixing of Materials

Mixers can be either paddle wheel, pan or rotating drum type. Generally the former is preferred for block production in America and Australia, but the Europeans general use pan type.

The mixer must be large enough to keep the machine supplied at its maximum rate of consumption. As a rule of thumb, a 50 cft mixer is required for a 3 block machine.

If multi-coloured products are required, it is desirable to have two separate mixers.

3. The Block Making Machine

Various types and size of machine are available, nearly all of which work on an extrusion process, the mix being placed, vibrated and compressed in a mould which has no base. A steel plate known as a pallet is held under the mould while the product is made and the 'stripper head' pushes the product out vertically downwards, the steel pallet remaining under the product until it is strong enough to be removed generally the day after manufacture. Exceptions to this are:-

1) 'Egg-laying' machines, which are mobile and extrude the product onto a concrete floor slab, and

2) some small machines which form the product in a mould which is upturned. These are commonly used in Australia for making screen blocks, which are of intricate shape.

Block machines from Europe tend to be large-pallet machines, making up to 12 blocks at a time. American-made machines vary in size up to 6 blocks at a time. Whilst the former obviously have a higher rate of production, they are generally used where the blocks produced are not to be used for facework, and naturally enough only where there is a considerable market.

The most common size of machine used in America and Australia would be the 3 block machine. These have been developed and refined since early this century and models from 25 years ago are still available and suitable for reconditioning to a state where they can make an excellent product efficiently. They run at about 4½ cycles per minute, which is equivalent to 810 blocks per hour. In an 8 hour shift, 1 hour must be allowed for cleaning up at the end of the day and 15% of time is lost in downtime, so actual production for the shift would average $\frac{85}{100} \times 7 \times 810$ = approx. 5000 blocks (about 85 tonnes).
Special machines are available for making concrete bricks and concrete pavers, but these products can be also made in a standard block machine.

In conjunction with the machine, the mould parts must be ordered. The number of these will depend on the range of products to be manufactured. These are wearing parts and have to be replaced periodically. It is also necessary to have a stock of spare parts for the machine, so that long periods of break-down are avoided.

4. The Method of Handling the Block into the Racks

For one-block machines the blocks can be man-handled into the racks. For three-block machines, the basic method is to have an off-bearer operated by the machine operator. This handles two pallets at a time and places them in a portable rack which holds 24 pallets, i.e. 72 blocks. This rack is then removed to the kiln, or storage area by fork-lift, which replaces it with an empty rack. In this system, the cured blocks are lifted from the racks by hand.

An advance on the off-bearer is to have an automatic loader/unloader which delivers the block off the pallets onto roller conveyors. This still requires a fork-lift to supply and remove the racks.

More recent developments have been the ABC system, finger-car systems and other fully automatic devices which handle the block from the time it leaves the block until it is cubed ready for storage.

5. The Method of Curing

In order to hasten the hardening of the block due to hydration of the cement, a number of different curing systems have been used - low pressure steam, gas, autoclave, and bubble curing. The autoclave is a very expensive piece of equipment, and the other systems require kilns and boilers, burners or heaters of some kind. It is possible to make block without special curing methods, providing sufficient racks are available and the green block is kept enclosed to prevent too rapid drying out.

If kilns are to be used, each one should be big enough to take no more than two hours production, i.e. 20 racks in the case of a three block machine.

6. The Method of Cubing for Despatch

Cubing is the name for the process of stacking the blocks on the delivery pallets.

This can be done manually, although semi-automatic and fully automatic cubers are now available.

7. Waste Disposal

It is normal to have a wastage factor of 2 to 3% on materials. For a production of 5,000 blocks in an 8 hour shift with a three block machine, this amounts to about 2 tonnes of waste material to be disposed of each shift. This should be borne in mind when locating and designing a block plant, so that a suitable area can be provided as a dumping ground, so reclaiming future block storage areas.

4. MEN

In the running of a block plant with one three-block machine, the following personnel are required:

1 Foreman/mechanic - who supervises the plant, carries out regular and incidental maintenance on the plant, prepares moulds for production etc.

1 Machine Man - who operates the machine and off-bearer (or loader/unloader). He also changes the moulds when necessary during the 1 hour cleaning up time - on average it takes 3/4 hour to change a mould.

1 Mixerman - who operates the mixer and aggregate handling.

1 Front End Loader Driver - if overhead bins are not provided.

2 Fork Lift Drivers- one for assisting in production and one for loading in the despatch area.

1 Stacker per kiln

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