The small-scale manufacture of concrete bricks and blocks for masonry is well suited to small businesses. Production can be done in the open, the process is simple and equipment relatively inexpensive.

The aim of this publication is to provide the information needed to set up and run a blockyard to manufacture concrete bricks and blocks on a small scale.

Aspects dealt with include: selecting and establishing a site, selection of equipment, materials for blockmaking, trial mixes and production.

Bricks and blocks are masonry units and are referred to as such in SABS standards. Units may be solid or hollow. The difference between bricks and blocks is size. In this brochure “block” is used throughout, but the same principles apply to brick.

Selecting a site

In selecting a site, consider location, access, ground slope and size. These are discussed below.

Location

This should be considered in relation to:

• Supply of raw materials
• Power for mixers
• Location of the labour force
• Security
• Availability of services (i.e. water, sewerage, electricity etc.)

Access

The site must be accessible to trucks delivering materials and collecting finished blocks.

Ground slope

Ideally, the site should be level or nearly so. Steep slopes make handling and production difficult. Terracing a steep slope is expensive.

Size

The site should be big enough for aggregate stockpiles, cement storage, production (slab or stationary machine), block stacking, staff facilities and on-site access.

Establishing the site

The site should have space for stocking aggregates and storing cement, a production area, a stacking area, staff facilities, an office and access between different areas and facilities. These are discussed in detail.

Aggregate stockpiles

Aggregates must be stockpiled in such a way that they do not become contaminated by soil, leaves or other foreign material. Different aggregates must be kept separate and rainwater must be able to drain away.

Ideally, therefore, aggregates should be stockpiled on a concrete slab. This is not done, the layer of aggregates in contact with the soil should not be used for production. Aggregates must not be stockpiled under trees. Partitions should be erected between different types of aggregate. Stockpiles should be on a slight slope so that rainwater does not collect in the aggregates.

Cement storage

The best way to store cement is in a silo. For most small-scale blockyards, however, cement will be delivered in bags.

Cement in bags should preferably be stored in a weatherproof room. Bags should be stacked on a plastic tarpaulin or on closely spaced wooden strips so that they do not absorb damp from the floor. The storeroom should be big enough to hold at least a week’s supply of cement. If it is not possible to provide a storeroom, cement in bags should be stored in stacks raised above the ground and completely covered with tarpaulins.

Production area

The size of this area depends on the method of producing blocks.

A stationary machine, which forms blocks on pallets, needs a relatively small area with a space around it for operators. A mobile “egg-layer” machine needs a fairly large slab on which blocks are made. Details of such a slab are discussed below.

Construction of a production slab

Area

A flat concrete slab, big enough for at least one day’s production, is required. As a guideline, a slab 50 m² in area is suitable for the production of 1 000 bricks or 200 blocks.

Slope

Normally, block production is carried out in the open and the concrete slab should have a minimum slope of 1 in 100 to ensure proper drainage.

Thickness

The minimum thickness of the slab is normally 125 mm. However, in the case of temporary works or works using a small hand machine, a thickness of 100 mm could be used. Large production machines may require a minimum slab thickness of 250 mm.

Concrete

For concrete ordered from a readymix supplier such as AfriSam Readymix, specify a strength of 30 MPa at 28 days and 19 mm slump. For concrete ordered from a readymix supplier such as AfriSam Readymix, specify a strength of 30 MPa at 28 days and 19 mm slump. If the concrete is to be compacted by mechanical vibration and 125 mm for hand compaction. A wooden floated finish permits easier removal of blocks.

If you mix the concrete yourself, you should use a mix design that yields a 30 MPa concrete strength. Details of the mix design for this strength concrete are contained in AfriSam Cement’s product brochure for the particular type of cement you are using.

Joints

To prevent uncontrolled cracking of the slab, it should be divided into panels. These panels should be square or as close to square as possible. A construction joint is shown below. The half-round keyway prevents differential settlement of adjacent slabs. The dimension “A” of the half-round is indicated in the table below.

Equipment

Blockyard equipment consists essentially of a means of moulding blocks, a concrete mixer and various general-purpose tools and equipment. These are discussed below.

Blckmaking equipment

There are two basic types of equipment, depending on the method of moulding the blocks:

• Stationary machines that mould blocks, one or more at a time, on pallets.
• “Egg-layer” machines that mould blocks on a concrete slab.

Some advantages and disadvantages of stationary and “egg layer” machines are given in the following table.

<table>
<thead>
<tr>
<th>Type of machine</th>
<th>Factors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stationary</td>
<td>A relatively small space is needed for production.</td>
</tr>
<tr>
<td>“Egg-layer”</td>
<td>A fairly large slab is needed for the production of blocks. The slab is expensive and increases the size of the site necessary for the blockyard.</td>
</tr>
</tbody>
</table>

Pallets are not necessary.

Some hand-operated machines for making bricks need only a few pallets because bricks are removed from the pallet directly after moulding. For both types, equipment available includes small hand-operated devices (which have limited output) and a range of electrically powered machines of high output.

Concrete mixer

It is possible to make blocks on a small scale without a concrete mixer (hand mixing) has the advantages of reducing the amount of capital required and providing employment, but it may limit output and is not always thorough. Hand mixing should be done with shovels on a concrete slab or flat steel sheet. Never mix directly on the ground because this results in contamination of the mix.

A pan mixer is the only type of mixer machine suitable for blockyards. Pan mixers, with a forced mixing action, can cope with the semi-dry mix and require less mixing. Pan mixers do not work because they cannot mix the semi-dry concrete.

The output of the mixer should match that of the blockmaking machine. A mixer of adequate capacity for making hollow units may have insufficient capacity for solid units.

Miscellaneous equipment

This includes wheelbarrows, batching containers, trolleys (for moving blocks), shovels, hoes/pipes and plastic sheeting for covering the blocks while curing.

Some advantages and disadvantages of stationary and “egg layer” machines are given in the following table.

<table>
<thead>
<tr>
<th>Slab thickness (mm)</th>
<th>Joint spacing (mm)</th>
<th>Dimension “A” (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>3.00</td>
<td>20</td>
</tr>
<tr>
<td>125</td>
<td>3.75</td>
<td>25</td>
</tr>
<tr>
<td>150</td>
<td>4.50</td>
<td>30</td>
</tr>
<tr>
<td>200</td>
<td>6.00</td>
<td>40</td>
</tr>
</tbody>
</table>
Materials

Cement

AfriSam’s High Strength Cement, All Purpose Cement and Co Building Cement comply with SANS 1050:1993 and can all be used successfully for blockmaking. Cement type S2,5 N will develop strength more slowly than 42,5 N and may affect production rates if used in the same mix proportions.

Aggregates

Sand and stone are used for most block production. Gritty or hard-burn ash often contains harmful impurities and should not be used as aggregate unless it is found to be acceptable by laboratory tests. Good quality grit can be used instead of sand or stone but blending with sand or stone may be necessary as well. All aggregates should be clean and not contain excessive amounts of clay or organic matter such as leaves, roots or humus.

The following aggregates may be considered:

• Fine sand with particles mainly smaller than 1 mm; pit, fine river or dune sand.
• Coarse sand with the biggest particles approximately 5 mm in size; crusher, pit or coarse river sand
• Stone with a maximum size of 13 mm for bricks or solid blocks or 10 mm for hollow blocks.

It is normally possible to make blocks with coarse sand on its own. Alternatively, combinations of aggregates may be used:

• A blend of fine sand and stone.
• A blend of coarse sand and fine sand.
• A blend of fine sand, coarse sand and stone.

For small-scale production, the best aggregate or combination of aggregates is normally found by trial and error. AfriSam can provide assistance where necessary.

Water

Water that is fit for drinking is suitable. Most river and stream water may be used. Water that is fit for drinking is suitable. Most river and stream water may be used.

Production

Ordering and stockpiling materials

Aggregates and cement should be ordered in good time. Blocks should be sufficient to prevent stoppages due to lack of material.

As a rough guide, using an aggregate cement ratio of 8:1 by loose volumes, three and a half bags of cement and a cubic metre of aggregate will be enough to make about 400 standard bricks.

The number of blocks produced from the same quantity of material will depend on block size and whether they are solid or hollow.

Batching

Bagged cement should be batched by the full bag. Cement supplied in bulk may be weighed (preferably) or batched by loose volume.

It is important to batch all materials accurately. Batching containers such as wheelbarrows, drums and wooden boxes should be loosely filled to the brim and struck off flush. To avoid errors, there should be enough containers for a full batch to be made without using any container more than once. Dented or broken containers must not be used.

Mix proportions may be adjusted once all properties are understood.

Water content

Water content is critical. The mixture must be wet enough to hold together when compacted, but it should not be so wet that the blocks slump (sag) when the mould is removed. A common mistake is the use of mixes that are too dry, resulting in incomplete compaction. Moisture content is approximately right when ripple marks start on a steel rod or the back of a shovel when it is rubbed against some of the mixture. The water content is just optimum when ripple marks start appearing on blocks when they are removed from the mould.

Mixing

Hand mixing using shovels should be done on a level concrete slab or steel plate. First spread the aggregate out 50 to 100 mm thick. Then distribute the cement and stone, if any, over the entire sand.

Mix aggregate and cement until the colour is uniform. Spread the mixture out, sprinkle water over the surface and mix. Continue with this process until the right amount of water has been mixed in.

For machine mixing, first mix aggregate and cement and then add water gradually while mixing until water content is correct.

Retempering

The concrete mix should be used within a maximum of two hours of being mixed and must never be retempered by mixing in additional water, as this reduces the resultant strength of the mix.

Moulding

Attention must be given to compacting the concrete in the moulds of the blockmaking machine adequately. Too little or poor compaction should be avoided, as it results in greatly reduced strengths.

The mould should be removed carefully so that the fresh blocks are not damaged. Fresh blocks should be protected from rain and from the drying effects of the sun and wind during the first day with plastic sheets or any suitable covering.

In some cases it may be necessary to protect blocks from frost damage. Covering with plastic sheeting with the edges held down is normally sufficient.

To minimise breakages in cold weather, increase the cement content of the mix or the curing period before moving blocks.

Curing

The day after production, blocks should be removed from the production slab or pallets and stored in the stacking area, ready for curing. Stacks should be carefully built to avoid chipping edges and corners.

Curing is the process of maintaining a satisfactory moisture content and a favourable temperature in the blocks to ensure hydration of the cement and development of optimum strength.

In the South African climate it is normally sufficient to cover blocks with plastic sheeting to prevent moisture loss, or to spray blocks with water.

Blocks should be cured for at least seven days.

Trial mixes

The aim is to find a mix that will produce blocks that have an acceptable texture and are strong enough but as cheap as possible. Because cement is more expensive than aggregates, the lower the cement content, the cheaper the block. However, the cement content influences the strength and an optimum cement content should be obtained by trial and error on site.

Look out for breakages to corners and edges of cured blocks. If blocks break when handled, they are clearly too weak. Strengths can also be assessed by knocking together two blocks after they have been cured and knocked out. A ringing sound indicates good strength while a hollow thud probably means that the blocks are too weak. Ideally, blocks should be laboratory tested for strength.

Quality control

Three aspects should be monitored to ensure quality masonry units, namely, strength, dimensions and shrinkage.

Strength

Quality of blocks should be controlled so that strengths are adequate (to avoid breakages or rejection by customers) and mixes are as economical as possible.

Ideally, blocks should be regularly tested for strength and mixes and production processes modified if necessary.

If testing is impracticable or unaffordable, block strength should be periodically assessed by noting whether corners and edges, or even whole bricks, tend to break in handling. Knocking two mature bricks together can also assess strength.

Dimensions

The length and width of the units are determined by the mould and will not vary greatly however. The height can vary and should be monitored using a simple gauge. Units of inconsistent height will lead to difficulties during building and possibly cause rain penetration.

Shrinkage

Concrete masonry units shrink slightly after manufacture. In order to avoid this happening in the wall, cured blocks should be allowed to dry out for at least seven days before being used for construction.

Conclusion

AfriSam hopes that this guide is useful in establishing and maintaining a successful brick or blockmaking business, producing units of the highest quality with economical viability. For further assistance in this regard, please contact AfriSam Customer Service.

A detailed ‘Safety Data Sheet’ and ‘Guide to the safe use of cement and concrete’ is available on request.

Committed to sustainable development

AfriSam is committed to sustainable development, which includes legal compliance, the optimal use of resources, waste reduction, reduction of fossil fuels, the minimisation of environmental degradation and pollution, employee training and stakeholder engagement.

CO2 rated cement

AfriSam introduced a CO2 rating system on all its cement products, which indicates the Carbon Footprint of each product relative to the world average calculated by the World Business Council for Sustainable Development (WBCSD). This is now printed on every cement bag that AfriSam produces, to enable consumers to make informed and responsible decisions on the products they purchase.

Delivering on quality in a responsible way

With the increasing environmental awareness of our customers, we not only offer quality products but customer peace of mind through our commitment to sound environmental stewardship.