

Making small garden ornaments in concrete

Concrete is durable and relatively cheap and is therefore suitable for making small garden ornaments. (By “small” we mean weighing not more than about 40 kg - something that one person can lift. The techniques described in this leaflet can also be used for large castings but the process is more complex and lifting devices are needed.)

Rubber moulds can be used for virtually any shape, even with undercuts that would prevent the removal of a rigid mould (see Figure 1). Although mould-making rubber is expensive, a mould can give many satisfactory castings. The making of a rubber mould involves many steps but careful attention to detail will ensure a successful result.

The aim of this leaflet is to explain how to make a rubber mould and cast concrete in it.

This leaflet describes:

- Equipment and materials
- Preparing the pattern
- Making the mould and preparing it for casting
- Casting, including demoulding, repairs and curing
- Colouring the casting

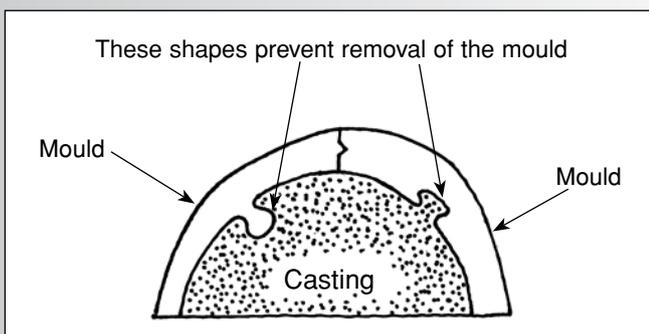


Figure 1: Undercut shapes prevent removal of a rigid mould

1. Equipment and materials

Equipment

- Plastic mixing bowls of various sizes
- Spatulas:
 - A putty knife with the corners of the blade rounded
 - A plasterer’s “small tool” with the handle straightened (use an acetylene flame) and the corners of the blades rounded

- A dentist’s spatula - ask your dentist where to buy one or make a spatula by grinding (cool frequently to prevent the steel from softening) an old screwdriver to form a thin blade about 7 mm wide by 25 mm long on a neck about 2 mm wide

- Spade for mixing concrete - a bricklayer’s trowel with the handle straightened and the blade cut off square and the corners rounded
- 1 litre measuring jug
- Small (15 mm) paint brush
- Felt-tip pen with waterproof ink
- Wooden dowel rods: 15 mm and 5 mm in diameter
- Plastic sheeting, eg garbage bags
- Old cloths

Materials

- Bonding liquid
- Polyurethane varnish
- 16 mm chipboard or wooden planks for base and mould
- 6 mm plywood for “walls”
- Petroleum jelly
- Mineral turpentine
- Shellac dissolved in methylated spirits (200 g in 1 litre)
- Cement complying with SANS 50197-1
- Concrete sand, eg crusher or river sand
- Concrete stone, size 6,7 or 9,5 mm
- Water
- Plaster of Paris - the standard grade is adequate
- Synthetic modelling clay (Plasticine) - obtainable from toy shops
- Modelling wax (microcrystalline wax, which is like the wax used to coat Gouda cheese)
- Mould-making silicone rubber
- White portland cement (for small repairs)
- Polymer emulsion - acrylic or styrene butadiene
- Colouring materials if needed (see section 9)

2. The pattern

The method described below consists essentially of making a negative impression of a rigid solid object, and then filling this negative shape with fresh concrete. The solid object we start with is called a pattern. If you can, you may want to sculpt your own pattern in, for example, wood or plaster of Paris. Or you can use an existing object as a pattern.

If the pattern is made of an absorbent material such as plaster of Paris, allow it to dry completely and apply two coats of bonding liquid to strengthen the surface and then two coats of polyurethane varnish to seal the surface.

Decide on the positions of the mould joints by imagining how the individual pieces of the mould will be removed from the pattern and the casting. For simple shapes, the mould should consist of two pieces of roughly the same size. Where possible mould joints should coincide with sharp edges or raised ridges on the pattern. (On a head, for example, the joint should run along the edge of the ear rather than in front of or behind the ear.) Mark the joint positions on the pattern with a felt-tip pen.

Fix a temporary wooden base to the pattern. The base will form the mould for the ends of the liner and jacket.

3. Making the mould

The complete mould consists of a rubber liner and a concrete jacket as shown diagrammatically in Figure 2. The purpose of the jacket is to ensure that the rubber liner keeps its shape while the concrete is being cast in it. (If only a few castings are to be done, the jacket may be made of plaster of Paris instead of concrete.)

The mould can be made in one of two ways:

- The "jacket-first" method
- The "liner-first" method

The jacket-first method has the advantage that the thickness and shape of the outer surface of the rubber can be well controlled. The advantage of the liner-first method is that the use of less rubber compound may be possible.

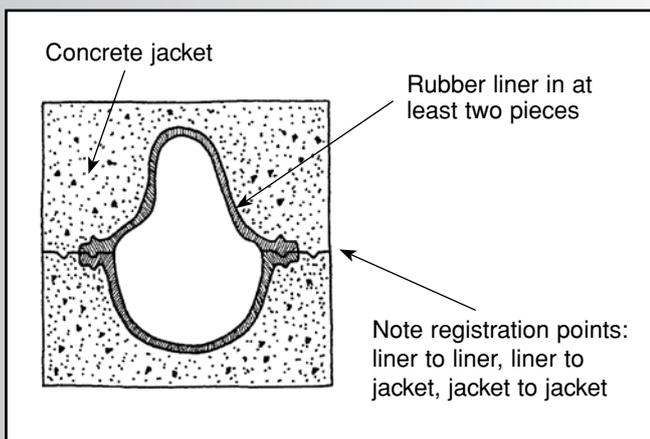


Figure 2. Section through a rubber-lined mould

The following information applies to both methods:

- If possible, make the end of the jacket flat and parallel to the temporary base on the pattern. This will allow the mould to stand upright when the concrete is being cast.
- Although the rubber liner can be "peeled" off the casting, the liner-jacket interface must be shaped to allow separation without binding or distortion of the liner (see Figure 3).
- The release agent, which is used to prevent a casting from sticking to the surface it is cast on, can be a thin coating of thin lubricating oil or petroleum jelly thinned

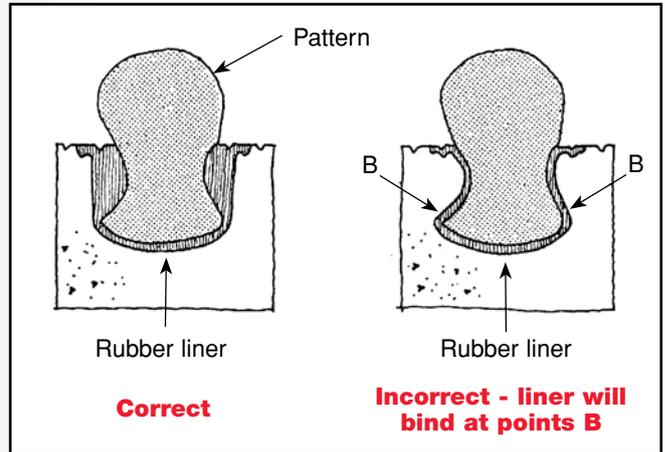


Figure 3: Making provision for separating the rubber liner and jacket of a mould

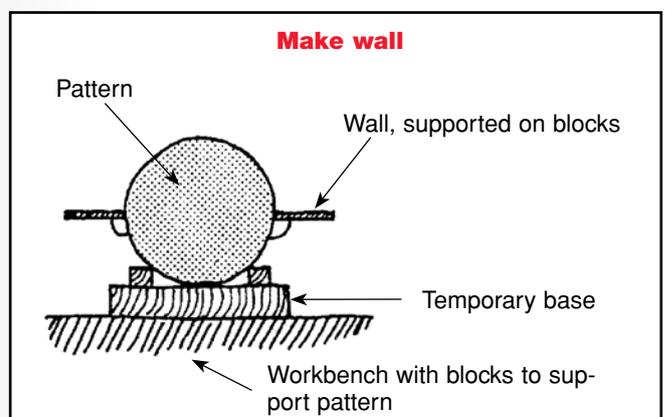
to a milky consistence with mineral turpentine (white spirits). Release agent can be applied with a small paint brush, making sure to remove any excess in corners, etc.

- Where hardened concrete is to have fresh concrete placed on it, it should be given a coat of shellac dissolved in methylated spirits, followed by the release agent described above.
- The mix to be used for the concrete jacket is:
 - 1 cement
 - 1 dry sand
 - 1 stone, size about 6,7 or 9,5 mm
 - enough mixing water to produce an easily workable consistence.

Jacket-first method

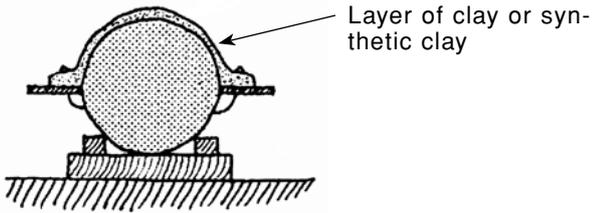
Support the pattern, with temporary base attached, on a table so that the first part of the mould is generally as near horizontal as possible.

Make a wall along the line of the mould joint. A combination of plaster of Paris, modelling wax, synthetic modelling clay and strips of wood may be used.



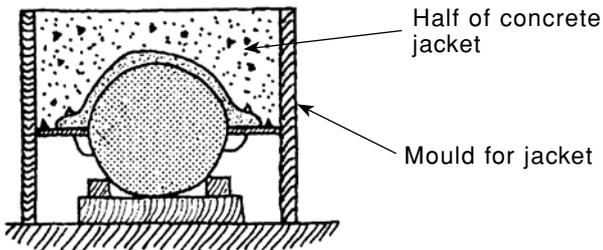
Place a layer of clay or synthetic modelling clay (plasticine) on the pattern. The thickness of the rubber liner will be the same as the thickness of this layer which should not anywhere be less than 5 mm. Remember to make provision for registration (to prevent relative movement) of liner and jacket as shown opposite.

Apply clay wall



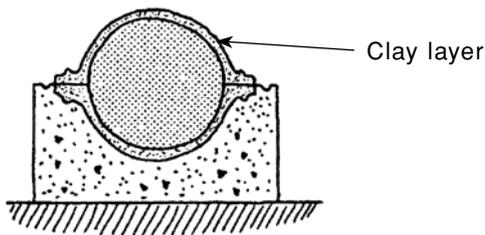
Make a mould for the first half of the jacket, apply release agent to clay layer and mould and cast the concrete. One or more holes through the jacket will be needed. The rubber liner will later be cast by pouring the liquid compound through a hole in the jacket. A hole will also be required at every high point in the liner to allow air to escape as the compound flows into position. The pouring hole should be 15 to 20 mm in diameter and air-escape holes about 5 mm in diameter. These holes should preferably be formed in the jacket concrete when it is cast. Use greased metal rods or wooden dowels which are twisted and removed as the concrete starts to stiffen. If you forget to form the holes at this stage they can, of course, be drilled once the concrete has hardened.

Make mould for jacket, cast first half of jacket



When the concrete has hardened, at least 24 hours after casting, remove the jacket mould. Now turn over the combination of pattern, clay layer and jacket. Apply a clay layer to the second half of the pattern, once again making

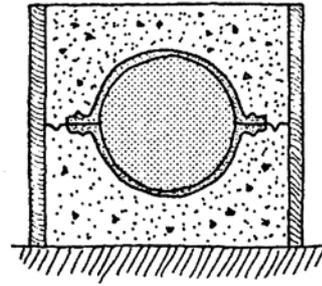
Remove jacket mould, turn over and apply clay layer



provision for registration.

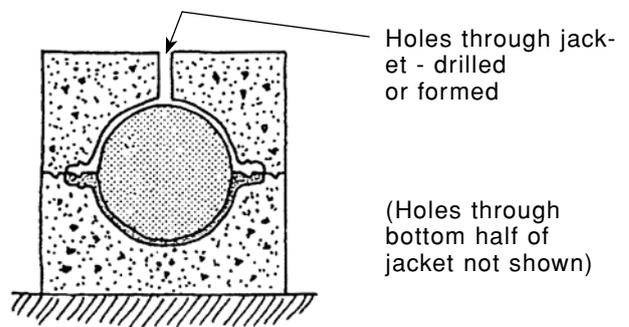
Make a mould for the next piece of jacket, apply release agent and cast concrete with pouring and air-escape holes as described above.

Make mould for jacket, cast second half of jacket



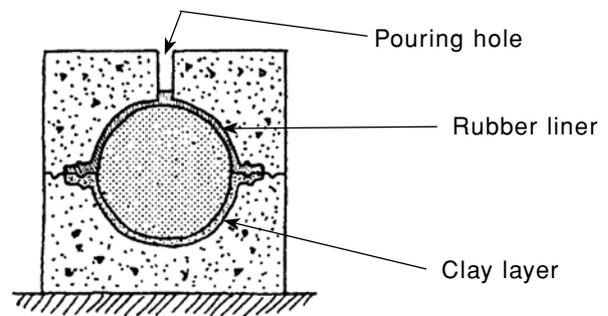
Remove one half of the concrete jacket and carefully remove the clay layer from the same side of the pattern. Apply release agent to the pattern, the edge of the clay on the opposite side, and the interior surface of the jacket. Place the jacket in position.

Remove jacket mould, remove clay layer from one half



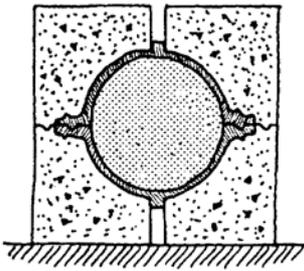
Mix some pourable-grade rubber compound with catalyst as recommended by the manufacturer. Pour slowly through the pouring hole in the jacket. The compound will flow sluggishly to fill the gap left by the removal of the clay. Tilt the assembly slightly to each side for a while to encourage the compound to flow into all areas. Continue to pour in compound until it starts to rise in the pouring and air-escape holes in the jacket.

Cast first half of liner using pourable grade rubber compound



When the first half of the liner has cured, turn the assembly over, lift off the uppermost jacket and remove the rest of the clay. Apply release agent and cast the second half of the liner in the same way as the first. When this has cured, open the mould and remove the pattern. Cut off any liner compound which has set in the pouring or air-escape holes in the jacket.

Turn over, open jacket, remove rest of clay layer, reassemble jacket and cast second half of liner

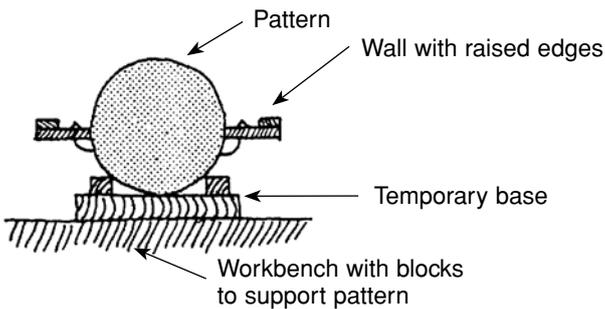


Liner-first method

Support the pattern, with temporary base attached, on a table so that the first part of the mould is generally as near horizontal as possible.

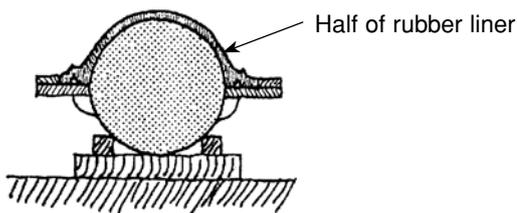
Make a wall along the line of the mould joint. A combination of plaster of Paris, modelling wax, synthetic modelling clay, and strips of wood may be used. The wall should be provided with registration cones and a raised edge. Apply release agent to the pattern and to the wall.

Make wall (supported on blocks), apply release agent



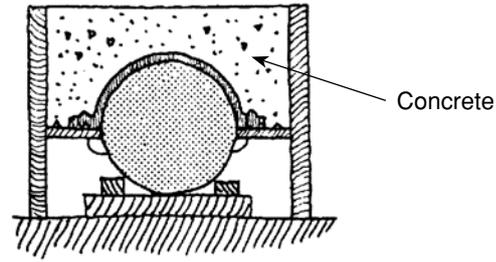
Mix some trowellable grade (also called thixotropic grade) rubber compound with catalyst as recommended by the manufacturer and apply to the pattern and wall with a spatula. The piece of liner must be completed in a single operation and minimum thickness should be 5 mm. When the compound has cured, remove the raised edges from the wall and make a mould for the uppermost half of the jacket.

Apply trowellable (thixotropic) grade rubber liner compound



Apply release agent to the mould but none is required on the rubber liner. Cast the first half of the jacket. When the concrete has hardened sufficiently, remove the jacket mould, turn the assembly over, apply release agent to

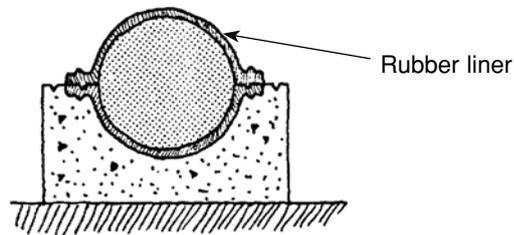
Remove raised edges of wall, make mould for concrete, cast first half of jacket



the pattern and the edge of the liner, and apply the second half of the liner as before.

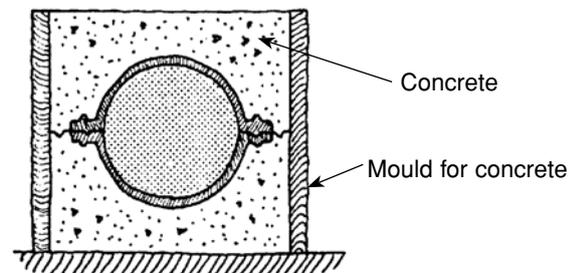
Make a mould for the second half of the jacket, apply release agent where necessary and cast the concrete.

Remove mould and wall, turn over, apply second half of rubber liner



When the concrete has hardened, remove the mould from the jacket, open the mould assembly and remove the pattern.

Make mould for concrete, cast second half of concrete jacket



4. Preparing the mould for casting concrete

Concrete will not stick to rubber. A release agent on the mould liner is therefore not required. It is, however, advisable to coat the meeting surfaces of the liner joint with petroleum jelly before assembling the mould. This helps to seal the joint and prevent loss of water from the fresh concrete during casting.

When assembled, the mould can be kept closed with wire wrapped around it and twisted to force the two halves together. Small moulds may be held together with a number of rubber bands cut from the inner tube of a car tyre.

5. Casting

Mixing the concrete

Mix proportions are:

- 1 cement
- 1 concrete sand
- 1 stone
- enough water to make the concrete sluggishly pourable

or, for small castings use:

- 1 cement
- 2 coarse concrete sand
- enough water to make the concrete sluggishly pourable

The biggest particles in the concrete should not be more than a quarter of the width of the narrowest part of the casting.

In hot weather, keep the cement, sand and stone in the shade and use chilled water for mixing the concrete so that the working time is not reduced by earlier setting of the cement.

Mix the concrete thoroughly in plastic dish using a spade (see Equipment in section 1).

Placing and compacting

Place the concrete in shallow layers in the mould. Compact each layer thoroughly by using the end of a rod with a vigorous up-and-down motion through the layer being compacted to fluidise the concrete and allow air bubbles to escape. (A wooden dowel rod is suitable for small castings while a broomstick may be used for larger castings.) Be particularly thorough near the surface of the mould and in corners. Do not allow the compacting rod to rub against the mould.

It is a good idea to use a light of some sort to inspect the interior of a deep mould while casting the concrete.

Never try to place and compact the concrete in a hurry. At normal temperatures the mixture should be workable for about 1½ hours.

Remember to cast in sockets or nuts if required for anchorages for fixing the completed sculpture to the base.

Continue to place and compact the concrete until the mould is full.

Scrape the concrete off flush with the edge of the mould. Wait for two or three hours for the concrete to stiffen and then trowel the concrete smooth while pressing it down firmly to compact the surface.

Cover the exposed concrete with plastic sheeting.

6. Demoulding

The mould can be opened and the casting removed usually between 24 and 48 hours after casting.

Take care to handle the mould in such a way that the casting and mould are not damaged.

The mould should be cleaned as soon as it is removed from the casting and stored where it will not be damaged.

7. Repairing blowholes

Blowholes, which are small air holes that sometimes form in the surface of the casting, can be filled with a mixture of:

- Cement:
 - 2 parts of the cement used for the casting
 - 1 part of white portland cement (to get a better colour match)
- Mixing fluid:
 - 2 parts water
 - 1 part polymer emulsion (acrylic or styrene butadiene)

Make the mixture to the consistence of toothpaste or slightly stiffer. Fill each cavity carefully with a small spatula and finish off flush with the surrounding concrete. Do not wet the concrete before filling blowholes.

8. Curing

Cover the casting with damp cloths and plastic sheeting and leave covered for at least seven days.

9. Colouring the casting

This can be done in three different ways:

- By including a pigment in the mixture
- By staining the surface
- By painting

Pigmenting

Pigments are integral colouring agents in powder form. Black and shades of yellow, red and brown are based on iron oxides. A green pigment is made from chrome oxide. The colouring power of a pigment depends on purity and fineness and only the best quality synthetic pigments should be used.

Cement, being a relatively fine powder, also has a pigmenting effect. This is why unpigmented concrete made with grey cement normally has a grey colour. The fine particles in sands (which are often iron oxides) may also have a pigmenting effect.

A pigment should therefore always be tested with the specific combination of cement, sand and stone to be used for the concrete.

If a bright colour is required, use white portland cement (which is more expensive than grey) and white or light-coloured sands.

Pigments should always be passed through a fine sieve (a kitchen sieve is suitable) before being added to the concrete mixture. A few small dry stones in the sieve will help to break up lumps.

Pigment dosage, which is normally about 5% of the amount of cement, must be very accurately controlled for uniform results and quantities should be weighed and not measured by volume.

Staining the surface of hardened concrete

Four methods can be used. Note that absolutely uniform colouring (like, for example, a coat of paint) should not be

expected - the colour will always be patchy to some extent because concrete is not uniformly absorbent. In addition, the colour of the base concrete will be visible through the stain. It is worth experimenting to achieve the best results.

Chemical staining

A 10% solution of ferrous sulphate in water is applied to the surface of the concrete with a paintbrush. This causes a chemical reaction in the cement paste at the surface.

A yellowish buff colour results after some time. The treatment can be repeated for a deeper colour. Chemical staining is most effective when it is done soon after the concrete has hardened - ie when the concrete is weeks and not months old.

Staining with pigments

Allow the concrete to dry thoroughly. Drying may take some days.

Mix up some iron oxide or other concrete pigment with water. Proportions are not critical but 20 millilitres in half a litre of water should be satisfactory. The easiest way to mix is to shake up the mixture in a closed wide-mouth bottle with a handful of small stones.

Apply the mixture generously as a wash to the concrete until the whole surface has been wetted. Leave to dry. Excess pigment can later be washed off with water if necessary. The colouring effect is caused by minute particles of pigment lodging in pores in the surface of the concrete and is surprisingly long-lasting.

Staining with acrylic paint

Make a mixture of acrylic paint - either artists' colours or pure acrylic wall paint - and water. One volume of acrylic to ten volumes of water is normally suitable. Apply this as a wash to dry concrete, allow to soak in and remove any excess. Repeat if necessary once the stain has dried. Successive washes may be of different colours. The advantage of using acrylic paints is that a wide range of colours is available.

Using a proprietary stain

These are obtainable, in a limited range of colours, from builders' merchants. Apply in accordance with the manufacturer's instructions. A single coat usually produces a satisfactory finish, while a second coat can result in a rather "varnished" appearance.

Painting

Pure acrylic paints are the most suitable. Uniform colours can be obtained by painting and they will cover the base concrete completely with an opaque coating. Interesting mottled effects are also possible if some of the paint is removed while it is still wet by rubbing with a damp cloth.

Appendix

Suppliers of materials

For small quantities contact:

Chemical Traders of SA (Pty) Ltd
(Stock most materials mentioned in the leaflet)
Tel: 011 828 7800
Fax: 011 828 8881

For larger quantities of specific materials contact:

Light coloured sand

B&E Silica
Tel: 013 665 7900
Fax: 013 665 7910

Delmas Silica
Tel: 013 665 7200
Fax: 013 665 7280

Pigments

Cathay Pigments
Tel: 011 964 2306
Fax: 011 964 1127

Rolfes Colour Pigments
International
Tel: 011 874 0686
Fax: 011 874 0789

Cemcrete
Tel: 011 474 2415
Fax: 011 474 2416

ZZ Chemicals
Tel: 011 482 1854
Fax: 011 482 3250

Lanxess SA (Pty) Ltd
Tel: 011 921 5196
Fax: 011 921 5128

Silicone for making moulds

Designer Ideas CC
Tel: 011 433 1713
Fax: 011 433 2705
Cel: 083 676 9898

Silicone and Technical Products
Tel: 011 452 5164
Fax: 011 609 4164
Tel: 021 534 9055
Fax: 021 534 6611

Silicone Mouldmakers Guild
Tel: 011 433 1713
Fax: 011 433 2705
Cel: 083 676 9898

White Cement

Cathay Pigments
Tel: 011 964 2306
Fax: 011 964 1127

Pudlo
Tel: 021 448 0607
Fax: 021 448 4622

Cemcrete
Tel: 011 474 2415
Fax: 011 474 2416

Union Flooring Tiles
Tel: 011 455 4220
Fax: 011 455 5395

Limeco Trust
Tel: 031 469 1849
Fax: 031 469 1684

Cement & Concrete Institute

PO Box 168, Halfway House, 1685
Tel (011) 315-0300 • Fax (011) 315-0584
e-mail info@cnci.org.za • website <http://www.cnci.org.za>

Published by the Cement & Concrete Institute, Midrand, 1999, reprinted 2002, 2006.
© Cement & Concrete Institute