A practical guide for site personnel

Placing, compacting and curing concrete

Good concrete is concrete that has been placed, compacted and cured properly. In simple terms, poor compaction and poor curing – singly or together – produce poor concrete with lower strength and lower durability. By following the procedures below, you will ensure the concrete has the potential to achieve its design strength.

Placing

Before any concrete is placed, rigid, level and clean formwork must be in position and accessible. And you must have all the right equipment ready. If the truck mixer cannot discharge directly into the forms, you will need **skips, barrows** or **pumps**. And you will also require **pokers, external vibrators** or **vibrating beams** to compact the concrete after placing.

Check what testing is required. (*See Site Sampling and Testing poster.*)

Place the concrete carefully in a series of layers of roughly equal depth – normally 300-500 mm – and compact each layer with a vibrator. Never let the mix pile up in large heaps or sloping layers.

Deep beams and columns

With deep walls and columns, don't let the concrete free-fall more than about one metre unless the mix has been designed to be dropped. Instead, use 'letterboxes', a tremie pipe or a pump for placing.

Ensure that poker hoses and power lines are long enough to reach the work.

To avoid tie-bolts, lift the poker out and re-insert.

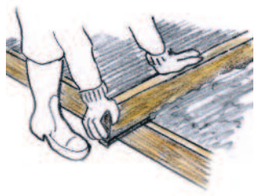
With small columns, it is tempting to pour the concrete in faster than it can be compacted. So use a banker board and shovel, and lower the poker down before adding each 300 mm depth of concrete.

Generally, small columns will not have enough room for more than one poker to be used and it is even sensible to use a single poker for larger columns, removing and re-inserting as necessary.

Slab formwork

Slab formwork should be overfilled by around 15 mm to allow for settlement. Experience will dictate how much surcharge is needed, depending on the thickness of the slab.

However, if light mesh is required near the top of the slab, do not overfill. Instead, tamp the concrete to mesh level with a notched beam, and then lay the reinforcement, cover with more concrete (including a little surcharge), compact and finish. Never tread on the mesh.



Compacting

All fresh concrete contains tiny bubbles of air. If nothing is done to get rid of them, the resultant blowholes or honeycombing weaken the finished concrete and make it less able to resist water penetration. They can also reduce the bond between the concrete and reinforcement.

In general, concrete in the truck has an air content of around 20% and this needs to be reduced to between 2% and 5%, depending on the mix, by vibration.

Every 1% of trapped air reduces the concrete strength by about 6%, so proper compaction is vital.

There are three main types of compacting equipment – poker vibrators, external vibrators and vibrating beams.

When is compaction complete?

Compaction is complete when bubbles stop rising to the surface

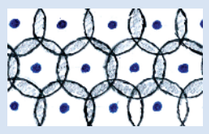
When using a poker, you can also tell by the fact that the sound of the poker stops changing. And with non-air-entrained concrete, a glistening film of mortar on the surface is another good sign

In general, vibrate a bit longer than you think necessary – except for slabs and high-workability mixes, where excessive surface mortar may result

Poker vibrators

Pokers vary in diameter and length. Since the poker must be able to fit easily between the reinforcement, the spacing will sometimes decide what size of poker is needed. The larger the vibrator, the greater the area it can vibrate and therefore the greater the allowable spacing between successive vibrator positions.

Generally the spacing should be around four to six times the poker diameter.



Insert the poker so that it penetrates 100mm into the previously compacted layer underneath. Try not to let it touch the formwork or reinforcement. If high-quality finishes are called for, use a rubber-tipped vibrator to prevent formwork 'burns'. Never use a poker to make concrete flow as segregation may result.

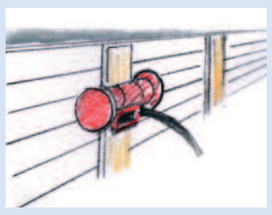
Once air bubbles stop rising, take the poker out and re-insert at the next position, making sure the areas overlap. If in doubt, vibrate a little longer.

External vibrators

When reinforcement is too congested or access too difficult for pokers, external vibrators offer a solution, but formwork will need to be strong enough to withstand the intense vibration. External vibrators are extremely noisy, so wear ear protectors.

Compact in 300 mm layers and, where possible, finish the top 600 mm with a poker.

Watch out for grout loss through joints, loose vibrators and formwork instability.

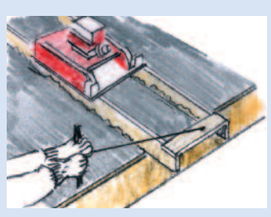


Vibrating beams

Although slabs up to 100 mm thick can be tamped by hand, a vibrating beam drawn across the surface will do the job much better. Slabs thicker than 150 mm should always be compacted by vibrating beams and their edges finished with pokers.

With deep slabs and heavily reinforced slabs, start by compacting with pokers and finish with a vibrating beam. Don't stand on the reinforcement unless it is supported by spacers or stools to stop it bending or moving.

With a double vibrating beam, make sure there is a surcharge in front of both beams. One pass should be enough, as further passes may bring excess cement laitance to the top.



Remember

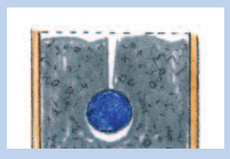
- All compaction equipment must be well maintained, with bearings greased and everything cleaned after use
- Double-check the security of connections on all air lines and power lines
- Clear moisture out of air lines before connecting
- Have a standby vibrator and alternative power supply available
- Don't leave pokers in the same spot for too long and switch them off as soon as they are out of the concrete

Poor compacting =

- **poor concrete**
- **lower strength**
- **lower durability**
- **blowholes**
- **honeycombing**

Problems to avoid

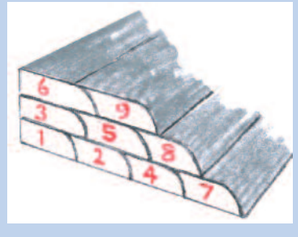
Plastic settlement and voids



After concrete is placed and vibrated, 'bleed' water rises to the surface and the concrete 'settles'. If this settling is restrained by reinforcement or prestressing ducts, a surface crack may form along the reinforcement. To counter this, one answer is to place concrete up to the underside of the ducts, wait half an hour, re-vibrate and then continue placing and compacting.

Re-vibration is fine as long as concrete is still workable enough. To assess this, insert a poker and if it sinks into the concrete and leaves no hole when removed, the concrete can be re-vibrated. In general, the top 600 mm of columns and walls can be re-vibrated between 30-60 minutes after main compaction finishes.

Cold joints in mass concrete



If freshly placed concrete is left too long before the next layer is placed on top or alongside, the layers may not bond properly, resulting in a weak 'cold joint'. To help prevent this, place concrete in the sequence shown.

Don't let concrete harden too much before it is covered by the next layer and always re-vibrate before placing the adjacent fresh material. If void formers are to be surrounded by concrete, drill small holes at regular intervals in the former soffit to let air escape.

Curing

'Curing' is important to preventing concrete from drying out too soon. Well cured concrete is stronger, more resistant to chemical attack and traffic wear, and more watertight. It also withstands freezing and abrasion better.

Most curing is done by using polythene sheeting or a sprayed membrane. Leaving the formwork in place is also possible, except for slabs, where the large surface area will soon dry if left unprotected.

Curing should always start before the concrete begins to dry out.

Covering with polythene sheeting

Airtight polythene sheeting is an efficient way of preventing moisture loss. It should be placed on a slab as soon as the concrete is hard enough to prevent surface damage or marking. Exposed edges and corners must be fixed down well to keep out wind and draughts.

With columns and beams, the sheeting should be tied with tape or cord. If possible, water-spray the concrete the next day and reseal the polythene.

If the slab has a special finish – such as texturing – support the sheeting on lightweight frames to stop it damaging the surface, making sure that all edges are sealed.

Applying a sprayed membrane

Sprayed membranes are designed to form a superficial seal on the concrete, preventing water evaporating. Be careful when selecting a suitable product, as some prevent subsequent adhesion of screeds or applied finishes.

In general, membranes should be applied to damp, not wet, surfaces as they can be absorbed and cause discolouration. If the surface has dried, dampen it before spraying. For even coverage, apply in two directions at right-angles, with the spray head about 300 mm from the surface.

With slabs, a portable walkway may be needed to avoid damage to the concrete surface.

Poor curing =

- **poor concrete**
- **lower strength**
- **lower durability**
- **dusty surface**
- **weaker surface**

SAFETY

The first rule of working with concrete is to be protected.

Ensure that the personnel are wearing adequate safety equipment

- If fresh, wet concrete touches the skin, it can cause alkali burns – some of which, don't cause pain immediately – or dermatitis.
- The longer the skin is in contact with the concrete, the worse the injury will be. So, protect yourself by wearing **safety goggles, waterproof gloves, a sturdy jacket, waterproof trousers and long boots.**
- If concrete does contact your skin, wash immediately and thoroughly with clean water. If your eyes are affected, seek medical help immediately.
- Remove and wash any protective clothes or boots that become impregnated with fresh concrete, but making sure you wash yourself first.
- **Lifting** Fresh concrete is heavy, with a barrow load weighing over 100 kg. So carrying just a small volume may cause physical injury. Follow Health & Safety regulations so that you can place, compact and finish the work before it sets without straining yourself.

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