

Concrete Tool Importers Ltd

76A OXFORD ST
RICHMOND
NELSON
P. 0800 727 333
P. 03 544 6943
F. 03 544 6940
E. sales@concretetools.co.nz

CONCRETE COMPACTION USING AN IMMERSION VIBRATOR

Once the concrete has been placed, it is ready to be compacted. The purpose of compaction is to get rid of the air voids that are trapped in loose concrete.

How does the air get into the concrete delivered to site? When concrete is mixed a certain amount of air will be entrapped in it. Further air is likely to be entrapped in the concrete while it is being transported and placed in the forms.

Why compact concrete?

It is important to compact the concrete fully because:

- Air voids reduce the strength of the concrete. For every one per cent of entrapped air, the strength falls by somewhere between five and seven per cent. Which means that concrete with only 95% compaction can lose as much as one-third of its strength.

- Air voids increase concrete's permeability. That in turn reduces its durability. For if the concrete is not dense and impermeable, it will not be watertight, it will be less able to withstand aggressive liquids and its exposed surfaces will weather badly. Furthermore, moisture and air are more likely to penetrate to the reinforcement, causing it to rust.

Air voids impair contact between the mix and reinforcement (and, indeed, any other embedded metals). The required bond will not then be achieved and the reinforced member will not be as strong as it should be.

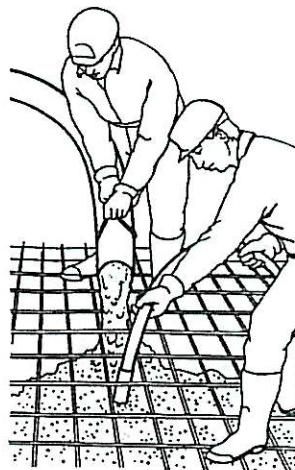
Air voids produce blemishes on struck surfaces. For instance, blowholes and honeycombing might occur.

Summing up, fully compacted concrete is dense, strong and durable, while badly compacted concrete will be porous, weak and prone to rapid deterioration. Sooner or later it will

have to be repaired or replaced. It pays, therefore, to do the job properly in the first place.

Low slump mixes

Stiff mixes contain far more air than workable ones. That is why a low slump concrete requires more compactive effort than one with a higher slump - the compaction needs to continue for a longer time, or more equipment has to be used.



Vibration

To compact concrete you apply energy to it so that the mix becomes more fluid. Air trapped in it can then rise to the top and escape. As a result, the concrete becomes consolidated, and you are left with a good dense material that will, after proper curing, develop its full strength and durability. Vibration is the best and quickest method of supplying the energy. Manual techniques such as rodding are suitable for only the smallest of projects. Various types of vibrators are available for use on site.

Immersion vibrators

The immersion or poker vibrator is the most popular device used for compacting concrete. This is because it works directly in the concrete and can be moved around easily.

Sizes

Immersion vibrators with diameters ranging from 19 to 59mm are readily available, and these are suitable for most reinforced concrete work. Choose the largest one compatible with the formwork and reinforcement being used. Larger vibrator heads are available with diameters up to 150mm - but these are for mass concrete in heavy civil engineering.

Radius of action

When an immersion vibrator is operating, it will be effective over a circle centred on the poker. The distance from the poker to the edge of the circle is known as the radius of action. The radius for pokers of various diameter is given in Table 1.

The actual effectiveness of any poker depends on the workability of the concrete and the characteristics of the vibrator itself. As a general rule, the bigger the vibrator head and the higher its frequency, the greater will be the radius of action.

It is better to judge the effectiveness of the vibrator you are operating from your own observations on the concrete you are compacting as work proceeds on site.

Depth of concrete layer

The concrete layer you are compacting should never be any deeper than the length of the poker head, since it is only the head itself that is vibrating. If the layer is deeper than the head length, there is a danger that the top portion will not be fully compacted. You accomplish nothing by inserting more than the head into the mix.

The time it takes

The length of time it takes for an immersion vibrator to compact concrete fully depends on:

CONCRETE COMPACTION USING AN IMMERSION VIBRATOR

1. The workability of the concrete: the less workable the mix, the longer it must be vibrated.

2. The energy put in by the vibrator: bigger vibrators do the job faster.

3. The depth of the concrete: thick sections take longer.

Using an immersion vibrator

To realise the full potential of an immersion vibrator it is necessary to plan the compaction along with the placing method and technique well in advance so that both operations are carried out as quickly and as economically as possible.

Points to watch:

- Make sure you can see the concrete surface. Lights may be required in thin, deep sections.

- Make sure the vibrator head is inserted into the concrete quickly. As quickly as possible allow it, under its own weight, to reach the bottom of the layer it is compacting. If it sinks in slowly, the top part of the layer will be compacted first forming a barrier through which the entrapped air will find it difficult to escape.

- The vibrator head should extend below the layer you are compacting and into the one underneath by at least 100mm. This will knit the two layers together and any laitence on the top of the lower layer will be mixed into the upper one.

- The whole length of the vibrator head should be in the concrete.

- A little extra vibration will reduce the number of blowholes. This is important when a good finish is called for.

- Leave the vibrator head inserted for the correct length of time.

- Pull it slowly as you withdraw it from the concrete. The object is to ensure that no hole is left behind as the vibrator head leaves the concrete. It is, however, often hard to avoid such a hole, especially with a stiff mix. If a hole remains, place the poker as near to it as possible when you re-insert it to compact the next section, and this should close it. When taking the poker out at the end of the run, withdraw it even more slowly and wiggle it about to ensure that the hole closes properly.

- When you move the vibrator head on to compact the next section, it should not be too far from its previous position. The note to Table 1 will give you guidance on this.

- Make sure the vibrator head does not touch the formwork. Otherwise it will cause a "burn", and mark the surface of the finished concrete. Avoid problems by ensuring the vibrator stays 75 - 100mm from the formwork.

- Make sure the vibrator head does not touch the reinforcement. The danger is that the vibration will be transmitted to concrete that has already stiffened, and the bond between mix and reinforcement could then be affected. Also the poker could become entangled with the reinforcement.

- Avoid, if possible, using the vibrator to make the concrete flow. However, you can sometimes break this rule if you have to pack the mix into inaccessible corners. Place the concrete as near as possible to the corner, and use the vibrator head to make it flow gently into place.

- Never stick a vibrator into the top of a heap of concrete. Heaps should never be allowed to form in

the first place, of course, but accidents do happen, and you then have to disperse the pile. You can use the vibrator for this, but insert it around the edge of the heap. Go carefully, though, to avoid segregation. Start compacting the concrete as soon as the pile has levelled.

How do you know when the vibrator has been in the concrete long enough to give the right compaction?

The vibrator head should be kept in the concrete until no more air bubbles come to the surface of the concrete. At this time the vibrator should be withdrawn slowly ensuring that the hole left by the vibrator head closes up.

Vibration should not be prolonged to the point at which slurry commences to collect on the surface, usually 5 to 15 seconds.

When the slab thickness is 100 mm or less it is difficult not to touch the formwork supporting the concrete with the vibrator.

How can this be avoided? A form or external vibrator is suitable for the compaction of thin slabs. If only an immersion vibrator is available then it should be used with extra care to ensure the formwork is not touched.

Acknowledgements

Good Concrete Practices (A Trainers Guide VHS Video) - NSW Building and Construction Industry Training Council and Concrete Institute of Australia

Concrete on Site Series - British Cement Association

Using a Poker Vibrator - Cement & Concrete Association of New Zealand.

Concrete Tool Importers Ltd
0800 727 333

CONCRETE COMPACTION USING AN IMMERSION VIBRATOR

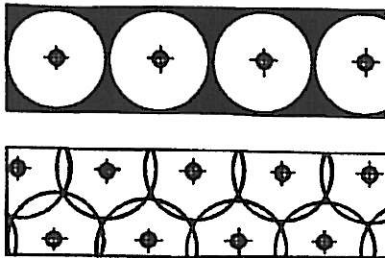
WHICH POKER VIBRATOR TO USE

Table 1

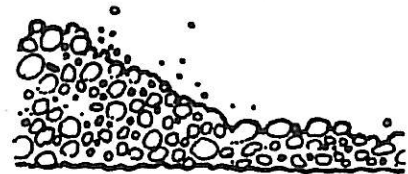
Diameter of head (mm)	Radius of action (mm)	Approximate rate of compaction (m ³ per hour) *	Use in concrete with a slump of ...
19 - 28	80 - 150	Up to 2	50mm or more in very thin sections and confined spaces. May be used in conjunction with larger vibrators where there is reinforcement or other obstructions.
38 - 44	130 - 250	2 - 4	50mm or more in thin columns, walls or other confined spaces
57 - 59	180 - 350	3 - 8	25mm or more in general work, free from restrictions and congestion.

Note: When the vibrator is operating, it will compact concrete within a circle centred at the poker. The distance from the poker to the edge of the circle is known as the **radius of action**. This tells you how far apart the points at which you insert the poker into the concrete should be. For example, when the radius is about 200mm, insertions will be needed at centres of roughly 300mm, and to a predetermined pattern, if all the concrete is to be fully compacted. Spacing of about 450mm (a radius of 250mm) will be required for a 65mm diameter poker on concrete of medium workability.

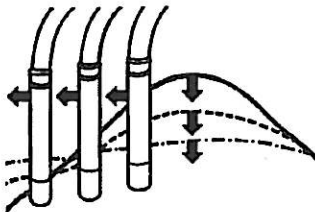
* assuming rapid placing



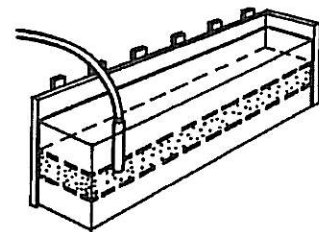
The poker vibrators' radius of action.



Honeycombing caused by under-compaction.



If concrete builds up into heap it should be levelled carefully by vibration.



Concrete should be compacted in layers.

Concrete Tool Importers Ltd
0800 727 333