

Ten STEPS

TO BUILDING A REINFORCED
CONCRETE SLAB-ON-GROUND

*Following these ten steps
will give you a top-class
steel-reinforced concrete
slab-on-ground —
the preferred footing
and flooring solution
for housing.*

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PLAN how to place the concrete

2

PREPARE the ground

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FIX the edge formwork

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FIX steel reinforcement in the beams

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10

CURE the concrete slab



STEEL
REINFORCEMENT
INSTITUTE
OF AUSTRALIA

Reinforcing Australian Construction

A message on the importance of **QUALITY**

REINFORCED CONCRETE is a wonderful material, and is ideal for permanence and quality. The purpose of this brochure is to show the correct way to build a quality reinforced slab-on-ground, in an easy Ten Steps.

We all know someone who could use a bit of advice to do things in a faster and better way. Maybe that someone is you; if so, the Ten Steps can save you real time and money.

Reinforced concrete is like any other product or system, in that there is a right way and a wrong way to use it.

This is the right way for slab-on-ground. So take the time to study these simple Ten Steps, it's in your interest.



Along the way you will
see a few **QUALITY** reminders.

Next, obtain the right advice before you build. Only an experienced, qualified, person can classify the site in order for the design of the concrete slab-on-ground to be suitable for the bearing conditions. The Engineer is as much part of the project team as the Concretor or Builder, and has a valuable role to play even with the simplest slab-on-ground designs.

The Structural Team

- The geotechnical consultant
- The engineer
- The architect or designer
- The builder
- The concretor
- The pre-mix concrete supplier
- The reinforcement processor.

Don't forget to arrange for any underfloor services such as plumbing and drainage, electrical conduits etc.

Try to prepare all of the site before the slab-on-ground is formed up, as it may restrict access later on to other parts of the site.

WHAT IS reinforced concrete?

Since as long ago as the late 19th century, engineers have overcome some of the natural deficiencies of concrete by reinforcing the material with steel bars or welded wire fabric (mesh).

Concrete is a very hard and tough material, but it is brittle and has low resistance to stretching forces (low tensile strength). Steel reinforcement can be easily introduced into a concrete structural member before the concrete is poured. This is much more difficult with natural rock or fired clay products, which are also brittle and have low tensile strength. Because steel and concrete expand and contract at the same rate and are quite compatible, the composite material which results after the concrete sets and hardens around the steel has the strengths of both. Reinforced concrete combines the solidarity of the rock with the resilience of steel.

Reinforced concrete is capable of accepting both compressive and tensile loadings and is therefore ideal for a wide range of applications in modern home construction.

WHY BUILD a reinforced concrete slab-on-ground?

For more than 25 years, the reinforced concrete slab-on-ground has been a way of life in many parts of Australia for the residential building industry, progressively replacing the limestone footings and suspended timber systems that had been the traditional approach for more than half a century.

The reasons for the popularity of reinforced concrete slabs are many. Briefly they offer:

- Low costs in terms of both initial cost and maintenance.
- The thermal insulation properties of a concrete slab reduce heating and cooling costs because concrete's mass reduces the daily extremes of temperature.

- Reinforced concrete floors are non-combustible and will help to contain the spread of fire without emitting dangerous fumes.
- Floor coverings laid on a firm level concrete floor will have a much longer life.
- Concrete floors will not rot and are not adversely affected by moisture, insects or fungal growth.
- Good integration of indoor and outdoor areas.
- Quieter living.

Builders and tradesmen also find that reinforced concrete slabs provide a firm, safe building platform.

HOW do you design a reinforced concrete slab-on-ground?

The current Australian Standards (Codes) are AS 2870 *Residential Slabs and Footings* and AS 3600 *Concrete Structures*. All states have legislated these standards.

WHAT IS reinforcement?

According to AS 3600, reinforcement shall be deformed Class N bars or Class L or Class N welded wire mesh, with a yield strength of up to 500 MPa, except that fitments may be manufactured from Class L wire or bar, or plain Class N bar. Trench mesh is a form of welded wire mesh. All reinforcement shall comply with AS 1302, AS 1303, AS 1304 or AS/NZS 4671. Most new steel reinforcement will be manufactured to AS/NZS 4671.

AS 2870 already permits the use of welded wire mesh complying with AS/NZS 4671 but is being amended to reference the new standard directly.

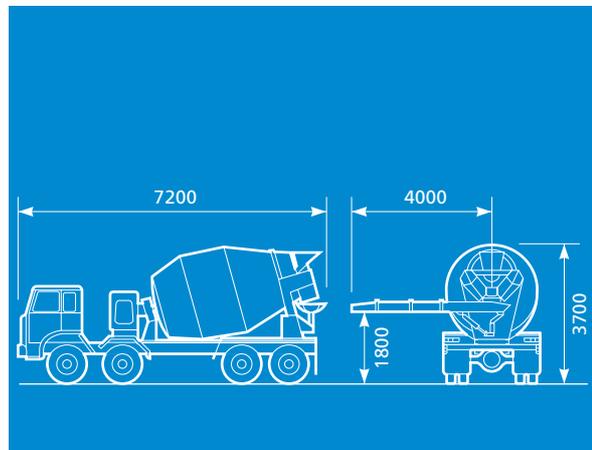


ONLY STEEL reinforcement has the strength to reinforce slab-on-ground. Avoid claimed substitutes for steel.

1

PLAN how to place the concrete

Concrete must be placed quickly and simply. Direct from a mixer truck is easiest and best. To do this the truck has to back-up to two or three sides of the job. Site huts, excavated soil, stacks of materials and setout pegs must be located so as to give trucks enough room to move.



When site access is limited, consider using superplasticised concrete which flows easily. As this 'flowing' concrete can be pushed, using a shovel, three times as far as ordinary concrete, the mixer truck may need to back-up to only one side of the job. As superplasticised concrete will impose higher loads on the formwork and can move steel reinforcement as it 'flows' into place, it is necessary to have stronger formwork and well-tied steel reinforcement. Remember that all concrete, even superplasticised concrete, must be properly compacted as it is placed.

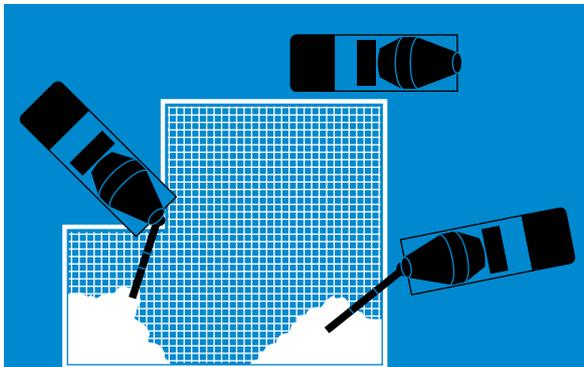
When a mixer truck cannot get close to the slab, means of transporting the concrete to its final position include pump, tipper, dumper and wheelbarrow.

On restricted or hilly sites a mobile crane with a hopper or bucket can be used. Concrete pumps are also a popular method of placing concrete especially on restricted sites: those with hydraulic booms are particularly suitable. The crane must be located on firm ground and parked between the road and the job so the crane boom and the bucket can swing between a mixer truck and the job.

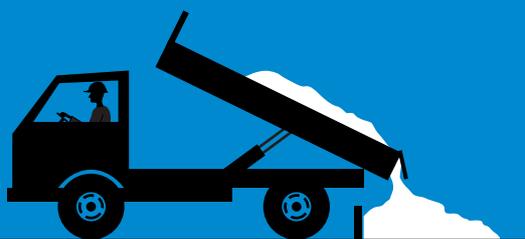
Most crane buckets hold over half a cubic metre while the crane boom can reach over 20 metres.

Cranes don't need much site clearance and buckets deliver concrete into the middle of large slabs without anything having to be dragged or carried over the steel reinforcement and formwork.

Pumps can push concrete over 200 metres in a straight line but if the supply line rises or bends, the pumping distance is less. Extra workmen for placing and finishing the concrete may be needed because the pump must work continuously and supply the concrete quickly.



MAKE SURE you signpost your site and give clear directions for delivery.



Tipper, up to 2 m³ – 10 trips



Dumper, 0.5 to 1 m³ – 20 to 40 trips



Wheelbarrow up to 1/50 m³ – 1000 trips

Trips required to move 20 cu metres of concrete



NEVER add water to concrete on site. Extra water will make the slab weak, dusty and liable to crack.

Concrete pump delivery on limited-access sites



TOP Truck and pump for smaller slabs

ABOVE Where longer reach is required use a truck-mounted pump with boom

PRE-MIXED CONCRETE

Pre-mixed concrete is available throughout metropolitan areas and in most country towns. When ordering from the manufacturer, state the purpose for which the concrete is required, the quantity and the time of delivery. High-grade concrete costs a little more but can be finished sooner and gives better surface finish. Never use less than Grade N20 (20 MPa) and for fast, good finishes use Grade N25 or N32 concrete.

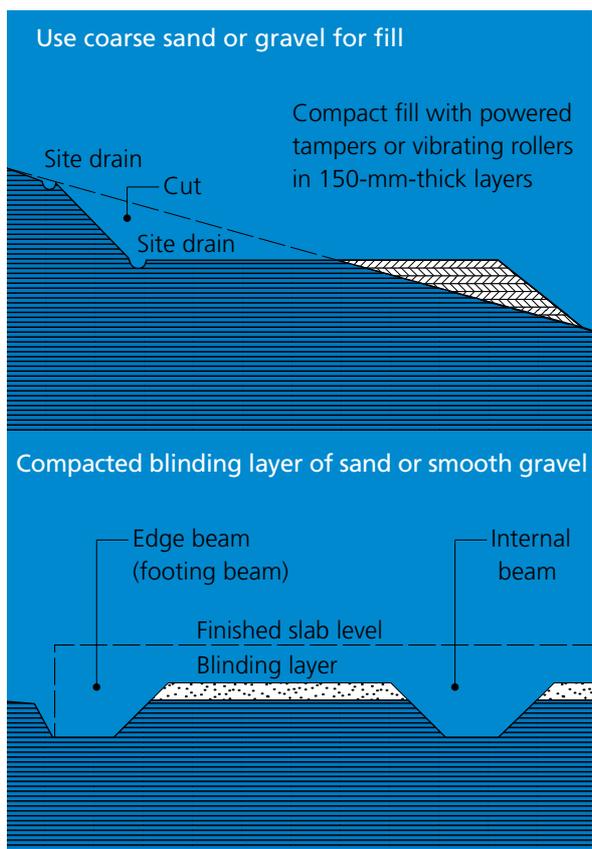
It is essential when dealing with premixed concrete to begin placing and compacting the concrete as soon as the truck arrives.

It takes approximately 30 minutes for two experienced men to place 1 cubic metre of pre-mixed concrete. This is a useful guide to estimate the time for a job.

Tell the pre-mixed-concrete supplier if a pump is to be used, so that a suitable mix will be supplied.

2

PREPARE the ground



Scrape off the top soil with grass roots in it, then level and compact the sub-soil which has been uncovered.

Sloping sites will need to be cut and filled where the slab is to be placed. Most soil can be used for fill. Clay fill is not recommended. If the site is clay, cut material should be removed and granular filling (coarse sand or gravel) used to fill the low side of the site.

The Building Code of Australia sets requirements where fill is proposed. Check with your local authority if you plan to fill.

Dig out the shape of the beams for the slab (and any necessary surrounding drainage trenches) in the prepared ground.

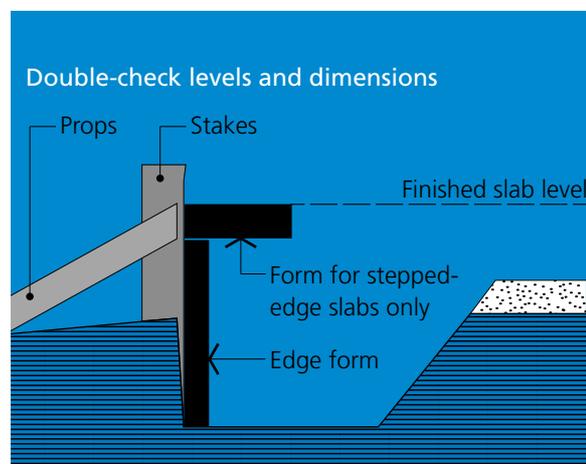
3

FIX the edge formwork

Form the edge of the slab and any steps in the slab where the floor has a step-down.

The formwork must be well staked in place (usually at 1 metre maximum spacing) and thick enough so as not to bend under the load of fresh concrete placed against it. Formwork must be rigid.

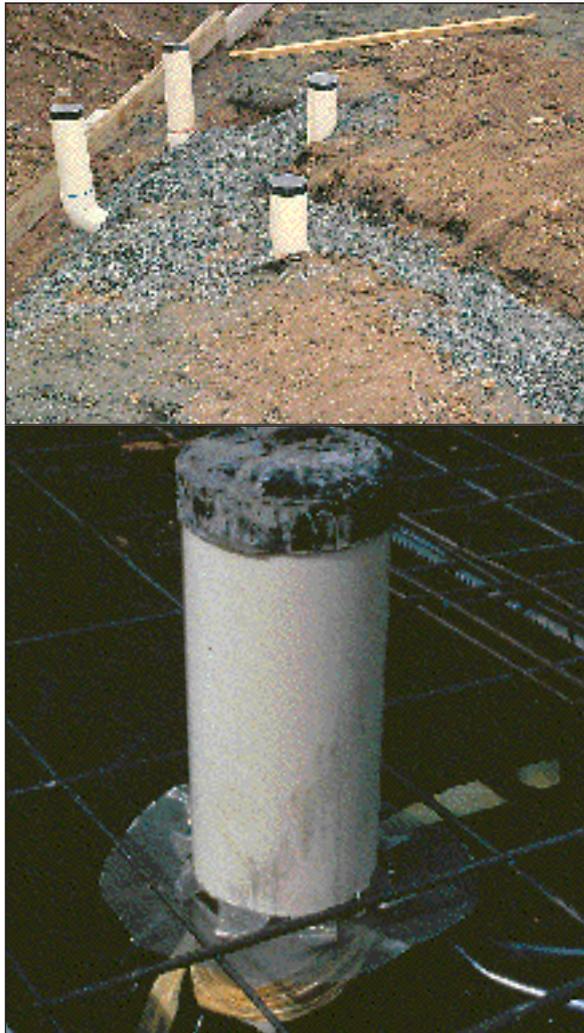
Double-check the level dimensions and shape of the formed area before any concrete is placed.



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4

INSTALL service pipes



Drainage and water-supply pipes which are to be covered by the slab must be installed by a plumber at this stage.

Termite collars have to be fitted to all pipes passing through the slab, where the slab is used as the barrier against termite attack.

Concretors must take great care not to move these drainage pipes once they have been set in position.

5

LAY concrete underlay

The vapour barrier underlay membrane for a concrete slab must be a sheet of impermeable material, resistant to ultraviolet deterioration and impact during construction. It is safest to use a known brand which is stamped as being 'suitable for use as a concrete underlay'.

Place the underlay over the prepared ground and lap it up over the edge formwork. Use as wide an underlay as possible (it is sold in rolls up to four metres wide) so that few joints are needed.

Make sure the underlay folds down into the beam trenches and laps up over the top of the formwork. *Free edges of underlay must be firmly secured before the concrete is placed.*

At joints, the underlay should be lapped at least 200 mm and held in place with small pieces of tape at about one-metre centres. Continuous taping of joints is required by some local regulations. Where possible, the lapping should occur in the trenches.

Where drainage and service pipes rise through the slab the underlay should be cut, turned up and taped around the pipe. To prevent debris from entering the pipe, a piece of underlay should then be placed over it and taped to the turned-up underlay.



6

FIX reinforcement in the beams



A slab-on-ground has thickened edges which are called edge-beams. Sometimes slabs also have internal beams which act as stiffening beams or wall supports. All these beams need steel reinforcement fixed near the bottom – this is called bottom-steel.

Trench mesh is the usual type of bottom-steel – a single layer or a double layer (one directly on top of the other separated by a fitment or ligature) as required by the building plans. 40-mm minimum concrete cover to the reinforcement is required (up to 75 mm may be specified if soil has aggressive ground water). In some areas greater depth and heavier reinforcement is required.

Bottom-steel must be placed on bar chairs or trench mesh spacers.

Trench mesh should have a half-a-metre minimum overlap. Full-width overlap at corners. (It is a sound precaution to wire the mesh together at these overlaps.) The steel reinforcement must be chaired in its proper position to act effectively.



NEVER try to pull reinforcement up, or walk it in while the concrete is being poured. This practice is forbidden and can lead to total slab failure.

7

FIX reinforcement in the slabs

Top-steel is needed over the whole area of a slab-on-ground. The main reason for this top-steel is to control the cracking which inevitably occurs as the concrete dries out.

Fabric sheets (6 x 2.4 m standard size) are usually used as top-steel and are set on bar chairs with bases prior to curing the concrete so as to leave a minimum of 20 mm concrete cover above the steel reinforcement.



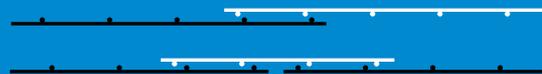
DON'T try to save on steel. You can't add it later! Cracks in slabs are controlled by steel.

Any floor-heating services or electrical wiring conduit to be embedded in the slab, should be secured at this time. If hot water heating pipes are to be embedded in the slab, the slab thickness may need to be increased.

Slab fabric should be lapped by one full panel of fabric so that the two outermost transverse wires of one sheet overlap the two outermost transverse wires of the sheet being lapped.

Holding down bolts for wind bracing and other ancillary fixtures are usually positioned at this stage.

Lapping of fabric



8

PLACE and compact the concrete

Order concrete by strength-grade and slump. Never use less than N20 grade concrete (20 MPa strength, with 20 mm nominal maximum aggregate size and 80 mm slump). Never order concrete with a slump of more than 100 mm. In fact 80-mm slump is better. It may be slightly harder to work into place, but it can be finished sooner and will shrink less.

The slump of concrete is a rough measure of the amount of water in the mix. If water is added the mix will become sloppy and easier to work into place – but the concrete will be weaker, crack more and have a poor surface finish. For this reason no water should be added to concrete during the placement and finishing operations.

Place each load of concrete next to the previous load. Start at one end and work along the slab making sure that each new load is well mixed into the load before.



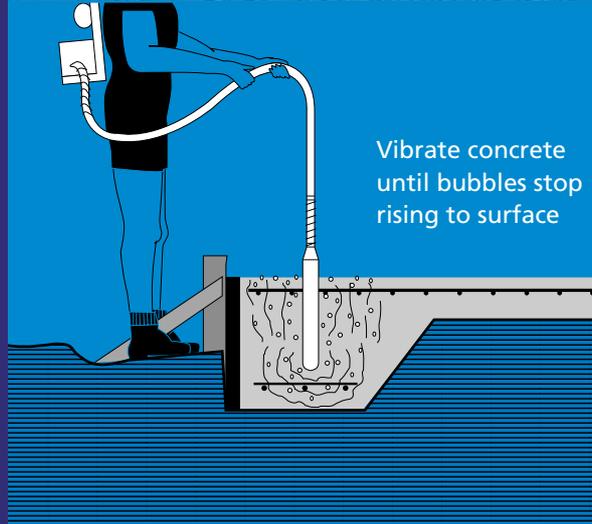
TRY NOT to pour concrete on hot days when it is windy, the result can be poor concrete. Ask advice from your supplier.

Do not let concrete free-fall more than one metre from a chute, pipe or bucket when it is being placed.

Level the surface of the concrete with a screeding board. It is important to move the screeding board with a sawing and chopping motion as this helps to compact the concrete.

A mechanical vibrator should be used to compact the concrete. Poke the vibrator into the concrete every half metre over the length of the beam and hold it in place until the concrete settles and bubbles stop rising to the surface.

Hold the vibrator straight up and be careful not to move the steel reinforcement, or damage the underlay or formwork.



9

FINISH the slab surface



When the concrete compaction and screeding is done, the slab should be roughly floated with a trowel to give a smooth surface. After floating, the slab should be left to set hard enough so that a man standing on his heels will not sink more than 5 mm into the concrete.

Free water (bleed water) will rise to the surface of the slab after it is levelled. Wait until the surface water dries before doing the final float or trowel finishing. On a cold day the bleed water may have to be dragged off by pulling a rope or hose over the surface.

Never spread dry cement or sand over the slab to absorb the bleed water as this will make the finished surface weak and dusty.

A mechanical 'helicopter' is the best tool to get a good finish on a slab. Make one pass with the helicopter over the whole slab starting where the concrete was first placed. Then go back and make a second pass over the whole slab working up and down the length of the slab instead of across it.

Do not try to finish the slab by moving the helicopter around in one area for too long.

Wood or steel hand-floats and trowels do a good job too – if there is no helicopter – but however it is done, the whole surface should be worked over twice.

Save finishing time by finishing the slab only to the standard needed for the type of floor finish to be used. If tiles are to be laid in mortar then slabs need only to be screeded. A wood float finish is good enough for carpet, while steel or sponge trowelling is needed for floors which are to have tiles glued to them.

10

CURE the concrete slab

Concrete must be protected against loss of moisture as soon as the surface is sufficiently hard to resist spoilage. This process is known as curing. *If concrete is not cured it will dry out too fast, lose strength and the surface may crack and turn dusty.*

Curing involves holding water in the concrete – allowing the concrete to gain its full strength.

One way is to cover the slab with sheets of plastic or building paper and hold the sheets down with planks. Leave the sheets in place at least 3 days – it may be necessary to gently spray some more water under the sheets after the first day.

This method also has the advantage of protecting the slab from possible rain damage.



LACK of curing can ruin the job. Curing compounds only cost a few cents per square metre.

Another way is to spray onto the slab a special chemical called a 'curing compound' which stops water drying out of the concrete too fast.

Use a good quality curing compound, as there are some which are much better than others.

Curing compounds should be sprayed over the slab with a double coat straight after the surface finishing.

If at a later date it is the intention to add floor coverings to the slab then take care in the selection of the curing compound as some will not accept adhesives.

NOTE Safety footwear should be worn



CAUTION! You can lose half the strength if you:

- don't compact
- add water
- don't cure.

CONCLUSION As can be seen, planning, preparation, steel reinforcement, placing, finishing and curing all play an integral part in the construction of a reinforced concrete slab-on-ground. Failure to follow any of these steps may lead to the following problems occurring:

- Non-level floors;
- Plastic cracking (cracks occur prior to final set of concrete);
- Post-hardening cracking (drying shrinkage, foundation movement);
- Dusting of concrete surface.

Note: In some circumstances controlled cracking of concrete is acceptable; all concrete has a natural tendency to shrink with cracking being one of the results of such shrinkage.

Further information can be obtained from the Steel Reinforcement Institute of Australia or the Australian Pre-Mixed Concrete Association.

The APMCA has published the following technical brochures which can be obtained from your nearest APMCA office:

TB 95/1 *Cracks in Concrete due to Plastic Shrinkage and Plastic Settlement*

TB 95/2 *Hot Weather Concreting*

TB 96/1 *Management of Concrete Drying Shrinkage*

TB 95/2 *Cold Weather Concreting.*



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The Steel Reinforcement Institute of Australia is a national non-profit organisation providing information on the many uses of steel reinforcement and reinforced concrete. Since the information provided is intended for general guidance only, and in no way replaces the services of professional consultants on particular projects, no legal liability can be accepted for its use.



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