Basic trades for small island nations

Working with Concrete

Student workbook
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Contents

What is this course for? 4

What does the course cover? 4

How is the course put together? 5

Student Workbook 5

Video 6

The role of your trainer 6

Projects 7

Modules

Concrete

Choosing concrete 8

Mix and lay concrete 20

Blocks

Introduction to concrete blocks 68

Build with blocks 82

Student checklist 119
What is this course for?

This course is a basic introduction to working with concrete and concrete blocks. It is intended for school leavers and community groups who have limited knowledge or experience of concrete work.

It helps you to:

- think about the type and quantity of materials you need for a job plan
- follow the steps to mix and lay concrete
- plan and build a wall made from concrete blocks
- use simple tools.

You will work with materials and tools that are available locally to carry out basic concrete and block projects.

When you have finished this course you should be able to work on simple projects on your own. You will still need to work under supervision for more complex concrete or block construction — such as those involving structural work, steel reinforcing, safety or compliance with building standards.

What does the course cover?

*Working with Concrete* covers two main topics that are covered as four separate modules:

**Choosing concrete**

You learn about cement and what goes into concrete. You find out what types of materials are available locally and where to get them from. You learn about different mixes of concrete for different jobs.

**Mix and lay concrete**

You work out the size and thickness of concrete for a job — and how much you will need. You prepare the ground and formwork for a simple concrete project. You mix concrete, by hand and by mixer, then pour, compact, screed, finish and cure the concrete.
Introduction to blocks

You learn about the types and sizes of concrete blocks that are available locally and what they can be used for. You think about the need for reinforcement and foundations for a job.

Build with blocks

You firstly work with “dry” blocks. You practice how to fit blocks together in different patterns and learn how to use simple levels and alignment tools to keep the blocks plumb and square.

You work out quantities and costs of blocks for a project and the need for foundations and any steel reinforcing. You learn about when you must ask for expert or engineering help.

Finally you lay blocks with mortar, finish the joints and fill the blocks to the project design.

How is the course put together?

The course is a basic introduction for people who know little about making concrete or laying blocks.

The course must be led by a trainer or experienced trades person who can show you the steps, teach you how to use tools correctly and guide you with your developing skills.

The course will work best with small groups of students who can talk about things and learn from each other.

Student workbook

Your workbook has exercises, pictures and explanations as well as space to make your own notes

The four modules in your workbook have separate sections for most of the big steps — such as preparing your site mixing, and pouring concrete. Your trainer will work through each section with you, talking about the tools and materials and showing you how to use them.
You should not use the modules to learn on your own, but they should make good notes for you to look back at later on.

There is a Student Checklist at the back of the workbook for you to tick-off the work you do.

Video

The video for this course shows you the various steps involved in preparing, mixing and laying concrete and building with concrete blocks. It shows examples of the materials and tools you need and how to use them.

The role of your trainer

Your trainer for this course is a competent tradesperson with knowledge of concrete and construction methods and skills in using the tools. They will show you how to work with concrete correctly and tell you how well your skills are developing.

Your trainer will:

- Have samples of cement, blocks and materials, tools and equipment for you to work with
- Lead you through the course
- Explain the written material
- Show you
  - types of concrete and how to work with them
  - how to use plans
  - types of blocks and how to build with them
  - how to use tools correctly and safely
- Watch you work and tell you how you are doing
- Complete your student checklist to record the work you have done.
Projects

During the course you will work on a project that uses the skills you have learned. You will get to make something like:

- a path or piece of roadway
- a concrete slab for a small building
- a low wall
- the base for a water tank

This course tells you a lot about concrete and tools, but you need to be able to really lay concrete and use the tools – not just talk about them.

The course books and your trainer can show you how to use a float, but you need lots of practice to develop any skill in using that float. Take plenty of time for practice during the activities.

Whenever you can, work with two or three other students. You can watch and give each other feedback on how you are doing.
What you will learn

When you have finished this introduction module, you should be able to:

- Understand the different types of cement and concrete
- Say what materials are used to make concrete and where to get them from
- Choose the right type of concrete for a job.

Things you need before you start

Materials
None

Tools or equipment
None

Course resources
Course video
Video player
Introduction

The main things you will learn in this module are:

- where cement comes from and how it is made
- how cement and concrete work
- the types of cement, sand and rock you have available
- the right type of concrete for a job.

When you have finished this module you will be ready to start on the rest of the course. The three other modules will show you:

- how to prepare, lay and finish off a concrete path or slab
- background information on concrete blocks
- how to prepare and build a block wall.

What do we use cement and concrete for?

In big towns and cities, concrete is used for tall buildings, bridges, highways.
What is it used for where you live?

Here are some ideas:

- Paths and roads
- Making bricks/blocks
- Buildings –floors and walls
- Holding posts in the ground

What other uses do you know?

The names we call things

Some places use different names for things.

That is OK, but we need to be sure we are all talking about the samethings.

In this course, we will use these names:

This is concrete

It is used to make paths and foundations

Some people just call it cement

What do you call it?
We will call this a concrete block.

Some people call it a brick.

What do you call it?

We will call this grey paste between the blocks mortar.

Some people call it cement. What do you call it?

We will use "cement" to mean the grey powder that comes in bags.

What is cement and concrete?

How is cement powder made?

Cement is a grey powder.

It is made by heating limestone rock to about 3000 degrees and then grinding it into a fine powder.

How does cement work?

Cement is mixed with sand and water to make mortar.

Cement is mixed with sand, water and rock to make concrete.

When cement is mixed with water there is a chemical reaction. This makes the cement go hard and stick (bond) to the sand and rock.
It is not the same as mud that goes hard as it dries. Dried mud is not very strong and it will turn back to mud if it gets wet.

In fact, new concrete should be kept wet/moist for the first few days to stop it drying out too quickly.

Concrete can be hard enough to walk on in a few hours but:

- it reaches 60% of its final strength after 3 days
- it keeps getting stronger for months — and even years.

**Types of cement and concrete mixes**

**Mortar**

is used for holding bricks/blocks together

It is made from cement powder mixed with sand and water

**Concrete**

is used for solid paths or floors

It is made from cement powder mixed with water, sand and rock (aggregate).

Changing the amounts of cement, sand and aggregate that you put in a mix makes different types of concrete for different job.
Activity

Your trainer will show you some examples of local mortar and concrete. Study the examples. See if you can find pieces of rock in the concrete, and grains of sand in the mortar.

What goes into concrete?

Cement

Comes in bags. Usually 20Kg and 40Kg. It is usually a general purpose grade of “Portland cement”. This is usually written on the bag or it may just say “GP”.

Special cements are sometimes used for difficult jobs—quick setting for example. Store cement bags in a dry place and off the ground they must not get wet or damp.

Sand

Sand is best when it is:

• clean—not muddy or dusty
• not salty—can give problems
• sharp—has a ‘gritty’ feel rather than smooth

Some places have restrictions on where you can dig sand and rock.

Stone/rock

This is called “aggregate” in some places. It can be crushed rock or river gravel. Some places use crushed coral.

It is best when it is

• clean—not muddy or dusty, no bits of wood, leaves or roots
• A good mix of sizes—from 2mm to 20mm.

The biggest size depends on what the concrete is for.
Water

Clean water is best.

If you can drink the water then it is OK for concrete.

Do not use sea water. The salt in it can weaken the concrete. It will also rust any reinforcing you use.

Additives

Sometimes things are added to the concrete, to:

- make it smoother and easier to use
- add colour
- slow down or speed-up the setting time
Activity

Work with others on this activity.

Answer these questions:

• What is mortar used for?

• What is it made of?

• What do you call a mix of water, sand, cement and rock?

• Why should you not use sea water?

Find out:

Cement

• Where can you buy your cement from?

• Where is the cement made?

• What size are the cement bags?

• How much do they cost?
Sand
- Where can you get good sand from?
- What does it cost?

Rock/aggregate
- Where can you get suitable rock from?
- What does it cost?
- What places are you not allowed to dig sand or rock?
Different concrete mixes

Different amounts of cement, sand, rock (aggregate) and water make concrete with different properties.

- Concrete needs to be workable so that it can be handled, poured, compacted and levelled.
- The finished concrete needs to be strong to carry loads and be able to resist wear and the weather.

As a guide:
- The more cement paste (water and cement mixed) in the mixture, the easier it is to work.
- The more cement in the mixture, the stronger the concrete.
- Extra water weakens the concrete.
- Less cement weakens the concrete.

Cement is the most expensive part of the mix — but it is needed for strength.

So —

The different proportions in concrete are a balance between:

cost, workability and strength of the final concrete.

Too wet

Too dry
Mix amounts for different uses

**General purpose concrete** is best for most jobs that will not take much load or wear—such as footpaths.

**Paving concrete** is better for jobs that will take more load, such as large slabs, roadways. It uses more cement, so it is stronger—but it costs more.

**Bedding concrete** is economical for jobs like fence posts where strength is not too important. It uses less cement.

Here are some suggested “recipes” for the types of concrete:

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</tr>
<tr>
<td>bedding</td>
<td>cement 1 sand 4.5 20mm rock 4.5</td>
<td>0.200 cubic metres</td>
<td>cement 10kg 0.75 bucket sand 35 litres 4 buckets rock 35 litres 4 buckets water (approx) 7.5 litres</td>
<td>cement 0.4 bucket sand 2 buckets rock 2 buckets water 3.7 litres</td>
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</table>
Activity

Work with others on this activity

Choose the type of concrete you would use for:

1. a footpath up to a house

2. a concrete slab for a water tank

3. a fence post in the ground.

Say why you chose each type of concrete.
What you will learn

When you have finished the workbook sections in this module on mixing and laying concrete, you should be able to:

- Work out the size of a job and how much concrete you need
- Get the ground ready for a concrete slab
- Build formwork
- Mix concrete by hand — and in a mixer
- Pour and compact concrete
- Level and finish concrete
- Let concrete cure correctly.

Things you need before you start

Tools or equipment
You will need tools to mix and to lay concrete:

- measuring and marking tools
- spade, shovel, pick
- timber for formwork
- mixer, bucket or measure
- wheelbarrow
- screed, float and finishing trowel
- hose or water can and polythene sheets

Course resources
Course video. This shows you concrete being mixed, laid and levelled.
How do we make and lay concrete

Here are the main steps to make and lay concrete.

Each step is covered in more detail in a workbook section later.

*Concrete is a mix of sand, cement, stone/rock and water.*

They are mixed in different amounts for different jobs

**MIX together**

to make concrete

by hand or in a mixer
Pour the concrete
into a prepared site

Compact the concrete
to make sure it fills all the spaces and get air bubbles out

Level the concrete
to get a flat surface.
And finish it to get a smooth surface

Finally Cure the concrete
keep it damp for a time while it gets hard
Now work through each workbook section

Each section shows
How to do that step

Your trainer will show you:
- examples of tools and equipment
- how to use the tools to work the concrete
- the dangers to watch out for — and the safe way to do things.

You will:
- Practice mixing and pouring
- Mix, lay and finish concrete on a project or real job
- Work in groups of 2 or 3 people.
  - talk to each other
  - help each other to get things right
  - check that others are doing things safely.
Plan for concrete

What you will learn

When you have finished this section, you should be able to:

- Work out how thick the concrete must be for a job
- Say when you need steel reinforcement
- Work out the amount of concrete needed for a job

Things you need before you start

Materials

Paper and pencil

Tools

Paper and pencil
Introduction

This course deals only with simple, small concreting jobs. For example paths or driveways and small slabs and foundations.

Big jobs or commercial jobs need experts to work out the loads and stresses and the right concrete mixture and construction.

All house or structural concrete work needs plans and specifications drawn by a qualified engineer. Local council permits may be needed as well.

You must have expert assistance for any large job, house or where the safety of people is concerned.

But, very small jobs are easy to do. They just need a little planning.

To plan your concrete, you need to:

- work out the size and shape of the area to be concreted
- work out how thick it should be
- think about steel reinforcing
- decide the type of concrete mix
- work out the amounts of water, cement, sand and rock you will need.

The size and thickness of a finished job

How big does the concrete need to be?

- a walking path needs to be about a metre wide — maybe more
- a driveway for cars will be at least 2.5 metres wide
- a concrete slab has to be the size of your planned building or yard area.
What shape is it?

It may be a simple shape

or it may be a more complicated curved path

Draw a sketch plan. Write in the measurements
How thick does it need to be?

On good firm soil, here are some examples of how thick the concrete should be:

- Path: 75 mm
- Road: 150 mm
- Driveway: 100 mm
- House slab: 120 mm

On sand or other soft soil you may need much thicker concrete.

Have a look at the concrete paths and roads where you live. How thick are they?
What about reinforcement?

Concrete is very strong when squashed

but it is weak when it is pulled apart

Reinforcement with steel bars or mesh will give concrete more strength

Reinforcement will not stop a concrete path or drive from cracking, but it will stop it breaking up if it does crack. It is a good idea if the concrete is going to be used by cars and trucks— or if the ground is likely to move.

Slabs for a house and foundations for a wall should always include steel reinforcing. The reinforcing may also attach to the block walls. For foundations for houses and walls over one metre high, you must ask for expert advice and engineering plans of where to place the reinforcing steel.
Types of steel in reinforcing

Bars are often 12, 16 or 20mm thick

Steel must be clean — no grease, dirt or deep rust

Reinforcing must be put in the right place to get most strength — and with enough concrete covering to stop the steel rusting. Steel should be at least 30–40mm from the top and bottom surfaces.

The steel mesh or bars are put on supports and fixed so they won’t move when the concrete is poured and compacted.
Work out how much concrete you need

A simple drawing will help work out the amount of concrete you need.

The amount of concrete you need = area x thickness (area multiplied by thickness).

For example from the path plan above:

the path is 1.2 metres wide and 4 metres long the concrete will be 120mm thick.

So the calculation is:

$$1.2 \times 4 \times 0.1 = 0.48 \text{ cubic metres}.$$  

Use the chart on the different concrete mixes to work out how much cement, sand and rock you need.
The area of an odd-shaped or rounded path or slab can be harder to work out.

If you draw a rough plan on a paper that is marked out in 1 metre squares — it’s easy!

Like this:

Add up the number of squares covered.

For part squares, just ‘guess’ how much is covered (for example a half, or 75%, or ‘nearly all’). Add these all together and you will be very near to the amount you need.

The example here adds up to about 7.25 square metres. You could use smaller squares for a smaller job.
1. **For each of these, work out the amount of concrete you would need:**
   - a path that is 1 metre wide, 5 metres long and 100mm deep
   - 4 postholes that are 300mm square and 450mm deep

   Use the chart on the *different concrete mixes* to work out how much cement, sand and rock you need.

2. **Work together with other students and your trainer on your project**

   Fill in these on your concrete project planning sheet (at the back of the course):
   1. Draw a sketch plan for the project
   2. Measure and mark the sizes and shape
   3. Decide how thick the concrete needs to be
   4. Work out:
      - how much concrete you need
      - the type of concrete
      - the amount of water, cement, sand and rock
      - the reinforcing you need.
Getting your site ready

What you will learn

When you have finished this section, you should be able to:

- Prepare the ground
- Make the formwork to hold the concrete

Things you need before you start

Materials
- Plans for your concrete
- Timber for framing

Tools
- Tape measure, string line for marking
- Pick, shovel or spade for digging
- Spirit level, hammer and nails to build the framing
Introduction
Before you can pour your concrete, you need to

- mark out where the concrete will go
- dig out the ground and make it solid
- make a frame, like a mould, for the wet concrete.

Preparing the site

Measure and mark out the area for the concrete
Work from your plan or drawing.

- **Mark the area**
  Measure the edges for your concrete and mark the ground.
  You can make marks in the ground — but strings between pegs or pieces of timber are better, and they can show the level you need as well.

- **Decide where the surface level of your concrete needs to be**
  Maybe:
  level with a step?  
  or  
  a wall?

When you have worked out the surface level, you will see how much digging out or filling you need to be able to lay the right thickness of concrete.
• **Dig away the ground**
  • to the right depth
  • make room for the formwork
  • remove any roots, grass or plants.

You must have firm ground or soil under the concrete.

If the soil is soft or sandy, dig deeper and fill with crushed rock to the level you need.

If there are just patches of soft soil

**dig them out**

fill with harder stuff.

If you have to fill-in deep areas, fill with rock — or old blocks or pieces of concrete. Cover with sand and compact it all down to make it hard and level.
Underlay

Concrete slabs under houses can have an underlay on the ground under the concrete to stop water rising through the slab and making the building damp.

This underlay is usually a heavy plastic sheet put on the ground just before the concrete is poured.

Some places with very sandy soils use plastic sheeting under most new concrete work.

Formwork

This is sometimes called boxing or shuttering.

Formwork is a mould that holds the wet concrete in place while it hardens.
Formwork needs to be:

- strong enough to support the wet concrete
- well made

so you get the shape you want
- made in a way that you can take it off easily when the concrete has set

Formwork is usually made of timber

Old, scrap or used timber is fine — but it needs to be:

- straight
- strong and
- clean

Note: any marks on the formwork timber will show on the finished concrete.

Use strong pieces of timber for the formwork — up to 100 x 50mm to support the top of the sides for deep concrete.

Use pieces of bent ply-wood to make curves.

Place the formwork so that the timber is in line with your marks — or string lines.

Hammer stakes of scrap timber into the ground about every 500mm to support the outside of the frame.
Here is a more complicated frame

**Surface level**

Your formwork also sets out the level for the concrete.

You may want the concrete surface flat and level for inside work

For outside work, slope the surface of the formwork the way you want the rain to run off the concrete
Make the slope about 25mm for every 1 metre long

Support for a post in the ground

You could use the hole in the ground as the formwork or you could make a simple frame around the top of the hole. This would be good in very soft or sandy soil.

When you have finished your formwork, check:

- Is it lined up with your marks or lines?
- Is it strong enough to hold the wet concrete?
- Will you be able to take it off easily when the concrete is cured?
- The depth inside the formwork. Do you need to dig out or fill in the ground to get the right thickness of concrete?
Underlay and reinforcing

If your job needs it:

- Lay plastic sheeting (underlay) on the ground inside the formwork
- Place your steel reinforcing as shown on your plans. Look back to the Plan for concrete section on how to do this. Your trainer will show you how to support the steel and wire it together.

Activity

Work with other students on your project.

Complete the Reinforcing and Formwork parts of your Project planning sheet.

Then:

1. Mark out the ground from your plan.
2. Decide and mark the finished surface level you want.
3. Prepare the ground.
4. Dig or fill the ground to get the correct depth for your concrete.
5. Build strong formwork from the timber you have available

Place any plastic sheeting and steel reinforcing if this is needed.
Mixing concrete

What you will learn

When you have finished this section, you should be able to:

- Measure the correct amounts of water, cement, sand and rock
- Mix concrete by hand
- Mix concrete in a mixer

Things you need before you start

Materials

Water, cement, sand and rock

Tools

Shovel, bucket
A board or wheel-barrow
Mechanical concrete mixer
Introduction

Before you can mix your concrete, you need to:

- Know the type of concrete you are making and the right amounts of water, cement, sand and rock you need
- Know the amount of concrete you need
- Get all the material and equipment together.

Measuring materials

Use a bucket or a box to measure

It is important to get the \textit{right} amounts of cement, sand, rock and water.

A shovel is \textit{not good} for measuring.

A shovel of cement is not the same size as a shovel of rock
Here are the quantities you need for the different types of concrete:

**General purpose** concrete is best for most jobs that will not take big loads or wear — such as footpaths.

**Paving concrete** is better for jobs that will take more load, such as large slabs, roadways. It uses more cement, so it is stronger — but it costs more.

**Bedding concrete** is good for jobs like fence posts where strength is not too important. It uses less cement so it is cheaper.

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**Mixing**

Concrete can be mixed in a mechanical concrete mixer or by hand on a board or in a wheel-barrow.

A common size of concrete mixer will make 50 litres in one load (or ‘mix’). You will need about 20 mixes to make 1 cubic metre of concrete. Check on the size of mixer you have.

A ‘mix’ by hand on a board or wheel-barrow is about half the size of the mixer — about 25–30 litres. You will need about 30–40 hand mixes to make 1 cubic metre.

Hand mixing is very hard work, so only use it for very small jobs, or if you have a lot of helpers!

**Safety note**

Avoid getting cement or wet concrete on your skin if you can. The cement will dry your skin and can cause alkaline ‘burns’.

Wear boots and gloves if at all possible.

Also avoid breathing cement dust — it can harm your lungs.
Using a concrete mixer

A concrete mixer does a better job than mixing by hand — and it’s not such hard work.

Mixers can be run by petrol, diesel or electric motors. Find out how to operate your mixer correctly and safely.

1. Start or turn on the mixer

2. Put in about 2/3 of the water you need

3. Add the stone/rock, then the sand and then the cement

4. Mix together until it all looks the same

5. Add the rest of the water a bit at a time until you get a mix that is workable but not too wet. Use the least water you can

6. Mix for another 2 minutes

7. Pour out and make the next batch.

Don’t forget to wash out the mixer as soon as you have finished.
Mixing by hand

Hand mixing is really hard work. It is best if you only use it for small amounts.

1. Measure all the sand, cement and into a wheel-barrow or onto a board.

2. Mix them together until it all looks the same colour.

3. Gather it all into a heap and make hollow and a hollow in the middle.

4. Add the water slowly into the hollow and a hollow in the middle.

5. Make into a heap again, add more water and mix.

6. Do this until you have a mix that is workable but not too wet.

7. Keep turning and mixing for about 2 minutes.

8. Use the concrete and make the next batch.
Activity

Work with other students on your project.

1. Work out what type of concrete, and how much you need.
2. Work out the quantities of cement, sand and rock and water.
3. If you have a concrete mixer, find out how to work it correctly and safely.

When your formwork is built and you are ready to start laying your concrete, mix your first ‘mix’. 

Pour and compact concrete

What you will learn

When you have finished this section, you should be able to:

- Pour mixed concrete into formwork
- Compact concrete correctly
- Screed or level the surface

Things you need before you start

Materials

Mixed concrete

Tools

- Shovel or spade
- Wheel-barrow
- Rake or piece of wood for compacting
- A long straight piece of timber for screeding
**Introduction**

Before you can pour your concrete, you need

- Formwork ready and checked
- Batches of mixed concrete arriving quickly and regularly
- All the material and equipment ready.

Work as quickly as you can with wet concrete.

You must get all the formwork filled, compact the concrete to remove air bubbles and then level the surface before the concrete starts to harden, or ‘go-off’.

If you are working on a big job, plan how you can pour the concrete in stages. For example, you could pour a long pathway in small stages by putting a piece of timber across the formwork to divide it into sections.
Pouring concrete

Always use mixed concrete as soon as you can.

Your site must be ready before you mix the concrete.

Don’t waste time

Start placing loads from a corner at one end of the slab

Like this ✔ not this ✗

Fill to the full depth
Add the next batch into the 'wet' edge until the formwork is full.

**If you have to stop for a time....**

Use a finishing timber strip like this

Make sure it is level with the top of your formwork — and strong enough to hold the wet concrete

Do not leave a rough edge of concrete like this to go hard.

You cannot join on new concrete to a hard edge of concrete once it has ‘gone off’.

If you stop at a timber strip, you will have to complete the compacting, levelling and finishing for the work you have done — before your concrete ‘goes off’.
Compact and level concrete

Compacting pushes the concrete down into all the gaps and lets air bubbles get out.

It also makes the concrete

Compact as soon as the concrete is poured and while it is workable.

Compact by:

pushing down all over the area

- with a shovel
- or the back of a rake
- or a piece of timber

tap the sides of the formwork or boxing
Pour and compact concrete

**Screeing**

Screeing makes the surface of the concrete level with your formwork. It also helps to compact the concrete.

Use a heavy *and straight* piece of timber across the boxing/formwork

move the timber up and down to compact

When you have the surface level and with no holes in the concrete, stop. If you keep on screeing you will make a lot of water come to the surface.

**Note**

Very thick concrete slabs or commercial construction work need more compacting than the methods we show here. They use some form of mechanical vibration to make the concrete settle and get all the air bubbles out. These machines need special skills and they are not included in this course.
Activity

Work with other students on your project.

1. If it is a large job, work out what ‘stages’ you can pour it in. Add any finishing (or separating) timbers to your formwork.

2. Pour the concrete to fill the formwork.

3. Compact to pack down and get the air out.

4. Screed to make level with the formwork.
Finish and cure concrete

What you will learn

When you have finished this section, you should be able to:

- Finish your concrete to the type of surface you need
- Put joints in the concrete if needed
- Cure the concrete before use

Things you need before you start

<table>
<thead>
<tr>
<th>Materials</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Poured and levelled concrete</td>
<td></td>
</tr>
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</table>

<table>
<thead>
<tr>
<th>Tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>A long straight piece of timber for screeding</td>
</tr>
<tr>
<td>A wooden float</td>
</tr>
<tr>
<td>A large brush</td>
</tr>
<tr>
<td>A metal finishing trowel</td>
</tr>
</tbody>
</table>
**Introduction**

To complete your concrete, you need to

- finish the surface to the type of surface you need
- make any joints
- allow the concrete to cure.

**Finishing**

Makes the surface look the way you want. You may want a surface that is:

**Rough**

This gives plenty of grip in the wet for tyres, walking or animals.

First finishing (your final screeding) will probably be enough. The surface will be slightly rough and it will have lines across it.

**Finished**

This is a hard, even and smooth surface. It looks good and will wear well. Second finishing with a wooden float will be enough.

**Polished**

This is a hard, very fine surface that almost shines. Good for floor slabs inside buildings. It can be very slippery outside in the wet.

Final finish with a metal finishing trowel.

**Jointing**

Jointing concrete helps to control cracking as the concrete dries out, or the ground settles.

**Curing**

Keeps the concrete wet or damp while the cement chemical reaction makes the concrete harder.
**Finishing concrete**

Finishing does two things:

- It levels and compacts the surface of the concrete
- It makes the surface look the way you want.

Finishing is done in stages:

**The first finishing**

This is what you did in “levelling”.

Screeding the concrete may give a good enough finish for rough work or paths

It will have lines left by the screed

After screeding, water will come to the surface.

This is called “bleed water”.

Wait until the bleed water has dried before you do any more finishing.
Second finishing

The second finish stage is called “floating”. This helps:

- close up any cracks
- push the larger bits of rock below the surface
- level the surface to a smooth finish.

Float the surface when the bleed water has gone and the surface is hardening — but is still slightly soft.

A float — is usually made of

Move the float all over the surface in big

The concrete surface should now be

You can make a good non-slip surface at this stage by dragging a brush very gently across the surface.
Final finishing

This stage is called ‘Trowelling’

It is done when the concrete surface just starts to set hard.

It gives a fine smooth finish that is good for inside work but you do not need it for many jobs. Outside, it can be too slippery when it gets wet.

Trowelling makes the surface smooth and almost makes it shine. It also makes the concrete harder wearing.

A metal finishing trowel

Move the trowel all over the surface in big sweeps.

Each sweep overlaps.

For a really hard and fine surface:

- trowel a second time when the concrete has hardened more.
Grooving or Jointing

Concrete shrinks as it dries and this can cause cracks.

Putting joints in the concrete slab can help to control the cracks.

Joints should be no more than 2.5 metres apart.

There are two ways to make joints:

Put in thin strips of timber — or plywood — between the sides of the formwork as the concrete is poured

or

Pull a thin piece of metal across the concrete as it starts to set

Make a groove about half the depth of the concrete.

Round off the edges for a neat joint.

If you have one, use a grooving tool like this

Jointer

If the concrete does crack later — the cracks will be at the bottom of the grooves
Protect the surface

The surface will be hard enough to walk on after a few hours — or overnight.

Until the concrete is hard:

Cover the surface if rain is likely. Better still, don't pour concrete if it is going to rain!

Keep children and animals off !!!
Curing concrete

Concrete may be hard enough to walk on after a few hours — or by next morning. But the chemical reaction that makes cement strong will keep going for days — or even months.

If concrete dries out too quickly, it can be weak and not harden properly. This can be a big problem in hot weather.

Curing keeps the concrete damp while it gets hard and strong.

Concrete that is cured properly is less likely to crack. It will wear better and will be much stronger.

When?

Start curing soon after finishing the surface — as soon as the surface is hard enough to not be damaged.

How long for?

Cure concrete to keep it moist for:

- at least 3 days for common jobs, and
- 7 days for better strength and wear.
There are two ways to cure:

Cure by applying water

Use a fine spray of water over the concrete — but not too much or the surface could be damaged.

but

- the concrete must be moist all of the time. Hosing it once or twice a day and letting it dry in between is no good
- this way can use a lot of water.

Cure by keeping the moisture in

Keep the formwork/boxing in place as long as possible — it helps keep in moisture.

Cover the concrete with plastic sheets to slow down water loss

— but avoid black sheets — they can make things hotter!

Overlap the sheets and hold them down with sand, rocks or timber

Regularly check that the concrete is still moist under the sheets. If it’s dry, lift the sheets, add water and replace.
Curing compounds

Curing compounds can be applied to concrete soon after finishing. They are sprayed or painted on the surface and help slow the loss of water. They are effective — but very expensive.

Activity

Work with other students on your project.

1. Decide what type of surface, or level of finish, you need. Finish your concrete to that standard.
2. Make joints/grooves as required.
3. Clean up tools and equipment.
4. Cure the concrete for at least three days.

Finally

5. Remove formwork and clean-up the site.
6. Stand back and enjoy looking at your finished job!
Planning sheet for my concrete project

Plan or Picture
what will my finished concrete look like?

Draw a plan
show the measurements

Do I need:
• expert advice or help?
• engineering plans?
• Council or Island permits?

How much concrete will I need?
How long is it? __________ metres (m)
How wide is it? __________ metres
Area is: Long x Wide = __________

or Area from a grid plan: = __________

How thick must it be? 75mm 100mm 120mm 150mm or __________

So.
The amount I need is __________ __________ __________ = Cubic metres
long x wide x thick

or __________ x __________ = __________
area from my grid thick

Remember:
all your measurements must be in the same units: metres (m) or millimetres (mm)
What mix type of concrete do I need?

- bedding
- general purpose
- paving

So.

I need ____ cubic metres of _______type concrete.

To make this amount of concrete, I will need:

_____ bags of cement

_____ sand

_____ rock/stone

_____ litres of water

How many hand or mixer mixings will this take?

(1 Cu mtr takes 30 hand or 20 mixer mixings)

Do I need reinforcing?

Type ______

Amount ______

What formwork will I need?

draw a plan of the formwork (boxing/shuttering)

size and lengths of timber I need _________

How many people will I need?_________
What tools will I need?

Tick the tools you need and write in how many

Ready the site:
- spade
- pick
- tape measure
- level

Formwork
- hammer/nails
- timber/saw

Concrete
- shovel
- buckets
- wheel barrow
- concrete mixer
- mixing board
- rake
- straight timber board — screed
- floats — wood
  — metal
  others?

Safety
- boots
- gloves
Introduction to concrete blocks

What you will learn

When you have finished this module you should be able to

- Say what types of blocks you can make or buy.
- Know some of the good and bad things about different blocks.
- Choose the right blocks for a job.

Things you need before you start

Materials

Tools or equipment

None

Course resources

Course video

Video player
What is a concrete block?

Concrete blocks can be in all sorts of shapes and sizes.

Some are solid  
Most are hollow

Here are some examples.

In some countries they are called “bricks”. Their proper name is a “concrete masonry unit”. In this course, we will call them blocks.

Here are the names for parts of a block:

- **Top face**
- **Bottom face**
- **Cores**
- **Sides**
- **Tapered cores (narrow at top)**

The hollow cores in most blocks are smaller at the top — so the top face of the block has wider edges.
Blocks are joined together with a wet paste called *mortar*.

Some places call this paste “cement”.

In this course we will call it *mortar* and use the name ‘cement’ for the grey powder used to make both concrete and mortar.

The hollow blocks in a wall can be filled with concrete or steel reinforcing rods to make them stronger.
**What are blocks used for?**

They can be used to:

- Make walls
- Build houses
- Make steps
- Support water tanks
Activity

What are blocks used for in the area where you live?

Write down or draw five things
**Good things about blocks**

Blocks are:
- strong
- quick to work with
- not attacked by rot and insects
- last a long time

Any others?

**But . . .**

*Blocks are heavy*

*$ * *

*Blocks cost money!*
Where do our blocks come from?

Concrete blocks can be made in big numbers by a machine.

Look at:

The video to see a block making machine working in Tarawa, Kiribati and how blocks are made by hand in Vanuatu.
Activity

Work with your friends and other students. Find out the answers to these questions:

Where do the blocks we use come from?

☐ Near where we live?

☐ Fiji?

☐ Australia?

☐ New Zealand?

☐ Somewhere else?

Where?

Where do we buy them from?

Can we make our own?
Types of blocks

Concrete blocks can be made in lots of shapes and sizes.

In big towns a block making plant may make many different types, but in most places you can only buy, or make, one or two types of block.

Here are some examples

A standard hollow block with shaped end faces Some people call it a ‘stretcher’

A standard hollow block with flat end faces

Also called ‘stretcher’
**Sizes**

**Standard sizes**

Most standard blocks are 400 mm long and 200mm high

The most common width is also 200mm — but blocks that are 150mm and 250mm wide are sometimes made.

**Note on 'nominal' sizes**

All these sizes shown above are nominal sizes. They are the sizes you will see shown at the store, or talked about by the people who work there.

“Nominal” is a term used by most trades people to mean “about this size” or it will be this size when it is finished”

The actual sizes or concrete blocks are usually 10mm smaller than the nominal.

So a standard block is actually 190mm x 190mm x 390mm – like this

This allows for 10mm of mortar in each joint to bring the size back to 200 x 200 x 400.
**Half sizes**

These blocks are the same height and width as standard blocks — but only half as long.

If they are available, half-blocks are very useful for ends of walls. You don’t have to cut standard blocks to fit.

In the next module you will see how to fit blocks together and how to choose the blocks you need.
Introduction to concrete blocks —

Activity

Work with others on this activity.

What types and sizes of blocks can you buy, or make, where you live?
Write them down — or draw them.

How much do they cost?

How can you get them to the place where you want to build?
Bad blocks

When you buy blocks, watch out for these sort of faults:

Don’t buy them if you can help it!
Steps in building with blocks

When you make a wall or other construction with blocks you do each of these steps:

1. **Plan and design**
   - work out how the wall goes together and the amounts you need

2. **Make foundations**
   - to support the wall

3. **Collect materials and tools**
   - get everything you need

4. **Mix mortar**
   - ready to lay blocks

5. **Lay blocks level and straight**

6. **Finish**
   - joints and surfaces

7. **Fill cores**
   - around any reinforcing

8. **Clean up**
   - tools and all around the work area
Build with blocks

What you will learn
When you have finished this module on planning and building with blocks, you should be able to

- Work out the size of a job and how many blocks you need
- Work out how to fit the blocks together
- Keep blocks level, square and plumb
- Mix mortar
- Build a wall using blocks and mortar.

The sections in this module are:

- Design and plan for blocks
- How to fit blocks together
- Laying blocks with mortar

Things you need before you start
Tools or equipment
You will need tools to lay bricks:

- measuring and marking tools
- spirit level and string line
- bucket or mixing board
- trowel
- finishing tool

Course resources
Course video. This shows you blocks being laid and levelled.
Now work through each section

Each section shows

- How to do that step
- The equipment, tools and materials you need
- Safety issues

Your trainer will show you:

- Examples of tools and equipment
- How to use the tools to work the blocks
- The dangers to watch out for — and the safe way to do things

You will:

- Practise laying and levelling blocks
- Lay blocks with mortar on a project or real job
- Work in groups of 2 or 3 people
  - talk to each other
  - help each other to get things right and make good joints
  - check that others are doing things safely.
Design and plan for blocks

What you will learn

When you have finished this section, you should be able to:

- Work out how many blocks you need
- Plan how the blocks will fit together
- Describe the type of foundations and reinforcing you need
- Ask for expert help with your plans at the right time.

What do I need to plan for?

Before you start building with blocks you need to know:

- The size and shape of what you are building
- How many blocks to buy or make — and what type
- How much cement/mortar you will need
- How the blocks will go together
- The size of the foundations needed for the blocks
- What reinforcing you need.
Design and plan for blocks

### Warning

Badly designed and poorly built walls can be very dangerous. When they are exposed to high winds, heavy rain, waves or earth movement they can break and fall down.

Well placed steel or concrete reinforcing can make walls very strong, but you need an expert to tell you how much to put in — and where to place it.

You **must** have expert help in the design and planning for any block wall over 1 metre high or 5 metres long.

You must have qualified engineering plans:

- For walls over 1.5 metres high or 10 metres long
- Walls for any house or work building

You may need government permits or local authority approval for your plans. This varies from country to country — check what is required in your place.

---

**Things about the wall I am building**

You need to know:

- The size and shape of the wall
  - How long?
  - How high?
  - How thick?
  - Does it have a simple end or does it join another wall at a corner?

- What is the wall for?
  - A low wall? A retaining wall? A house?

- What loads will be on the wall?
- What regulations apply to it?
- Where will I build it?
- What type of earth or ground underneath?
**Numbers of blocks**

Most buildings use the *stretcher bond* pattern for the layers of blocks. This is a simple and strong way to build. You will try out some other patterns in the next section.

*Stretcher bond wall*

![Stretcher bond pattern for blocks](image)

You will need

- standard full blocks for most of the wall
- some half-blocks for the ends of walls

You may be able to make or buy half-blocks — or you may have to cut full blocks to size.

**To work out the number of blocks you need you could;**

Mark the sizes of the blocks accurately on your plan. Then count the number of full and half blocks for each layer and multiply by the number of layers.

For this wall (above) it would be 22 full and 6 half blocks. Count them for yourself.

* or *

If you don’t have an accurate plan, measure and mark the length of the wall onto the ground, place blocks along your marks — and count them. Remember to leave space for the mortar.

* or *

Calculate by dividing the length of wall by the nominal length of your blocks and then multiply by the number of layers.

If you are free to make your wall to any length that you like, design it to fit the size of standard blocks. It will save a lot of block cutting later.

If you use 400mm standard blocks, the wall in the diagram above will be exactly 2 metres long. If the wall had to be 3.8 metres for some reason, you would have to cut one block in each layer to make things fit.
Foundations

All block walls need good foundations in the ground to support them. Foundations are made of concrete.

The size of foundations depends on:

- the size and purpose of the wall — high, strong walls need big foundations
- the type of soil or earth underneath — soft or loose soil needs wider, deep foundations

Foundations for a house and any load-bearing walls must have steel reinforcing placed in the concrete.

Your trainer will talk to you about the type and size of foundations you will need where you live.

Here are some very general guidelines:

<table>
<thead>
<tr>
<th>Wall height (mm)</th>
<th>Foundation thickness (mm)</th>
<th>Foundation width (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>150</td>
<td>250</td>
</tr>
<tr>
<td>800</td>
<td>200</td>
<td>300</td>
</tr>
<tr>
<td>1000</td>
<td>200</td>
<td>400</td>
</tr>
<tr>
<td>1200</td>
<td>200</td>
<td>500</td>
</tr>
</tbody>
</table>

Foundations can be just for the wall or they could be a part of the concrete slab for a building.
Reinforcing

Most concrete block structures need some reinforcing. This helps to

- make them stronger
- fight wind or waves
- stop cracking along the mortar joints
- stop the wall leaning or falling from its foundations
- bind the walls and floor of a building together.

Low walls can be reinforced with concrete poured into the cores of the blocks.

Walls over 1 metre high should have steel reinforcing rods placed in the cores, then filled with concrete.

Houses and all structural walls must have steel reinforcing tied to steel in the foundations.

As a rough guide, 12mm steel bars need to be placed at least every 600mm along the wall and across the wall every 1000mm high. The cores around the steel are filled with concrete.

Here is a diagram of typical reinforcing in a wall and foundations:
Activity

Work with others — and your trainer.

Your trainer will give you a project to work on.

Work out the answers for these questions for your project. Write or draw your answers.

What type of blocks will you use? Full and half blocks?

How many of each type?

What size will the foundations be?

What reinforcing
  • will be in the foundations?
  • will be in the block wall?

Draw a plan of the wall, showing
  • the size and depth of foundation
  • the length and height of the wall
  • how the blocks will be laid
  • where the concrete or steel reinforcing will be placed.

Look at

Video — It shows types of blocks and block making
How to fit blocks together

What you will learn

When you have finished this section, you should be able to:

- Lay dry blocks to make a wall
- Keep the wall level and square
- Cut blocks to size.

**Note** In this session you work with blocks with no mortar—to see how things go together and how you can keep them straight and level.

The tools you need to keep blocks level and straight are described at the back of this section.

Layers of blocks

Blocks can be put together in different ways to make a wall.

The pattern they make is called the *bond pattern*.

The most common pattern is the *Stretcher bond* (also called the *half bond*).

![Diagram of Stretcher bond]

It looks good and it is strong because the up and down joins are not all in a line.
Another pattern is the *Stack* bond — like this

```
+---+---+---+---+---+
|   |   |   |   |   |
+---+---+---+---+---+
|   |   |   |   |   |
+---+---+---+---+---+
|   |   |   |   |   |
+---+---+---+---+---+
|   |   |   |   |   |
+---+---+---+---+---+
```

The up and down joins are all in a line so the wall is weaker and the joins could crack. Some build this way — just to have a different ‘look’.

**Activity**

Build some dry blocks together using the *stretcher* and then the *stack* bond patterns.

- Make them about 4 blocks high
- Push them from the side and see how the stretcher bond holds together even without mortar

What happens when you push the stack bond?

What other bond patterns can you make with the blocks you have?

You can make quite a lot of patterns by mixing different sizes of blocks — Try standing a block on its end. These patterns are really only any good for decoration.

You can even lay the block on its side — so the hollow core is showing. You can see some blocks like this on the video. They are for decoration — and to let plants grow out of a garden.

In this course we will build using the stretcher bond pattern.
Layout of a simple wall

This wall needs a half-block at the end of each second layer.

Think about the hollow cores. They will still be all in a line.

Layout of a corner

The blocks from the two walls fit and lock together — no half blocks are needed if you are using standard 200mm blocks.
How do I keep walls square and level?

Walls that are level, square and well finished look good and show that you have done a good job!

— More importantly, well built walls are stronger and will last longer.

Walls must be upright — sometimes called "plumb and level"

It takes a lot of care not to build walls like these:
Simple steps to keep blocks in line

The tools you need are described at the end of this section.

The way to keep blocks in line is to build inwards from the ends or corners of the wall.

**Step 1**

Lay the two end blocks exactly in place on the foundations

use a spirit level to check that each one is level

check the blocks are at the correct height with a tape measure (or height or gauge stick)

— remember there will be mortar below the block

You now have the corner blocks exactly right.
**Step 2**

Put a string line between the two blocks — running along the top edges.

![String line between blocks](image)

**Step 3**

Lay the blocks in between the end blocks using the string line as a guide for level and straight.

Check blocks with a spirit level — this way.

![String line used for checking](image)

That is the first layer done.
**Step 4**

Now do the same steps for the next layers above.

But also check that the end or corner blocks are exactly on top of the block below and that they are upright (or plumb). Use a spirit level — or a plumb-bob — to check

Some experienced block layers like to build the ends, or corners, to four or five blocks high before they put in the blocks between.

This gets most of the difficult work set out first.

Then use a string line between the ends to keep the other blocks in line. On the second layer upwards, you can use pins for the string line pushed into the mortar instead of the separate line sticks.
Activity

Work on level ground and use blocks with no mortar.

1. Build a wall corner four blocks high using the stretcher bond pattern. Like this:

Make sure the corner is level and plumb.

2. Build a wall at least five blocks long and three blocks high.
   - Use a spirit level, tape measure and string line
   - Follow the steps above to make sure your wall is level, straight and upright (plumb)

Remember — this is good practice to see how things work. It will be more difficult when you use mortar and the blocks move about.
**Cutting blocks**

You may need to cut a standard concrete block to a special size or fit.

For example, you may need to cut a half-block or make a channel in a row of blocks for reinforcing.

The best and neatest way is to cut the block with a grinder or power saw fitted with a concrete-cutting blade.

You can also cut blocks by hand using a hammer and bolster.

---

**Safety note**

Whichever way you cut blocks, you **MUST WEAR EYE PROTECTION**. Concrete chips **WILL** fly — and they can blind you.

---

**Cutting blocks by hand**

Use a club hammer and a bolster.

The **club hammer** has a short handle and a heavy head (around 1–2 kg). Woodworking or engineering hammers are too light for this work.

A **bolster** is a special, wide chisel with a hard steel blade. The blade is usually about 100 — 120mm wide. Good bolsters have a wide plastic protective grip to help protect your hand if you miss………
To cut a block:

Measure the place where you need to cut the block and mark carefully all the way around the block.

Put the block onto a hard surface — such as another block or you can lay the block onto a bed of firm wet sand.

Put the bolster chisel on the mark and strike firmly with the club hammer — but not too hard. Do this again along the line of your mark — and gradually go around all four sides. You are trying to weaken the block and make it to crack along your marks.

When you have gone all the way around, go round again but hitting harder with the hammer. Keep doing this, and the block will crack all the way through.

Chip off the rough edges with the bolster, or the hammer.

To cut out part of a block face, use the hammer with a smaller bolster (or cold-chisel) and chip out small pieces at a time.
Cutting with a power saw

Power saws for concrete can be electric or petrol driven. They can be mounted on a bench — or held in both hands.

They all cut with a special cutting disc that spins at a very high speed.

These saws can be very dangerous.

Do not try to use a power saw unless you have had special training and experience in setting up the saw and how to use it.

Always use eye protection — and wear a dust mask if you have one (a piece of cloth over your mouth and nose will do). You will not believe how much dust is in one block! — and the dust is bad for your health.

Mark the block all the way around.

Cut along the marks on each side until the block is cut through.

Activity

1. Cut blocks to size using a club hammer and bolster.
   
   Try cutting first using old or broken blocks!
   
   Once you get the ‘feel’ of it, try cutting a half block from a full size block.

   Make sure you wear eye protection — and make sure other students wear it too!

2. If you have one available, cut a block using a power saw.
   
   Get your trainer to show you exactly how to use it correctly and safely. They can be very dangerous if you do not use them correctly.

   You will need eye protection and a dust mask.

   Keep other students out of the way.
Tools to keep blocks level and straight

Tape measure
Use the tape measure to check and mark length, height, positions of blocks.

Height stick
You can make this simple tool for yourself.
Use it to keep each layer of blocks at the correct height.

Measure and mark along the timber the correct height of each layer of your blocks.

For a standard concrete block this will be at every 200mm. (Remember, that is 190mm for the block and 10mm for the mortar). If you have blocks of a different size, use that size instead.

On this example, the marks are at 200, 400, 600, 800 and 1000mm.

You could leave the marks in pen or pencil, but it is better cut along the marks with a saw or a sharp knife — and go around the timber on all sides.

You will be able to see the marks easily — even when the timber is wet or dirty.

It is good idea to mark the top of the stick in some way — so that you know which way up it should be.
Levels can be made of metal, wood or plastic. You can damage them easily if you drop them. Be careful when you use them — and keep the edges clean of mortar or they will give a wrong reading.

**Spirit level**

Use the spirit level to check that blocks are level — like this

and upright, or ‘plumb’ — like this

Levels can be made of metal, wood or plastic. You can damage them easily if you drop them. Be careful when you use them — and keep the edges clean of mortar or they will give a wrong reading.

**String line**

Some people call this a ‘builders line’.

The string line is used to set the level and alignment of blocks in a layer.

Fix it tightly between the end/corner blocks, so that the line runs along the top outside edge.

Here the line is running between two pegs or sticks.
Lay the rest of the blocks on that layer so that their top outside edge *just* touches the string line.

You can buy a line and fixings, or you can make your own.

The string should be thin and strong. Natural string or Dacron is best. Nylon is not good because it will stretch and sag.

You can use wooden blocks like these to help the line keep to the edge of the block.

For the second layer of blocks — and upwards from there — you can use pins to fix the end of the line. A thin piece of wood or a nail is OK. Push them into the soft mortar at the side or back of the blocks.

Or you could move the string line up taller stakes or posts.
Lay blocks with mortar

What you will learn

When you have finished this section, you should be able to:

- Mix mortar
- Lay blocks with correct mortar joints.

How do I mix mortar?

Mortar is a wet paste made of sand and cement. It
- fills the gaps between blocks and
- sticks the blocks together.

Mortar is made from 4 parts sand and 1 part cement mixed with water.

Add a small amount of hydrated lime (up to half a part) or a commercial additive, if you have it. This makes the mortar smoother and easier to work with.

You can mix mortar in a cement mixer – or by hand. Look back to “Mixing Concrete” in the Concrete part of this course on how to mix with a mixer.
To mix a small amount of mortar by hand:

1. Put the dry sand and cement on a board and mix them together very well with a trowel or shovel.

2. When mixed properly, all of the mix will be the same colour.

3. Make a heap of the mix and make a hole in the middle.

4. Put water in the hole.

5. Lift the dry mix into the water — a little bit at a time until all the water is used up.

6. Mix it all together. Keep mixing for at least five minutes.
7. The mortar needs to be a paste like mashed plantain or taro.

If the mortar is too dry it won’t spread or stick to the blocks properly. If it is too wet, the water will separate from the sand and the mortar will run off the blocks.

Add more water or sand/cement until your mix is right.

Only mix enough mortar for the number of blocks you can lay in about 30 minutes. In hot weather, the mortar will start to “go off” and be unworkable in less than 40 minutes.

You can work with the mortar straight from the mixing board, but many tradespeople put the mortar into a bucket. It is easier to carry in a bucket and the mortar lasts a little bit longer before it goes off.
**Trowels**

A good trowel is the most important tool when you are working with mortar and blocks. You will use your trowel to

- mix small batches of mortar
- spread mortar onto blocks
- tap blocks into place with the handle
- clean off spare mortar
- clean up

Look after your trowel:

The blade must be ‘shiny’ clean or the wet mortar will catch and make the trowel difficult to use. Never let mortar go hard on the blade.

Dry the trowel — and cover in grease or oil if you will not use it for a while — but clean it before using it again.

**Mortar joints**

The mortar joint running along the top and bottom of the blocks is called the *bed* joint. The up-and-down, vertical joints are sometimes called “perpends” by tradesmen.

All finished joints should be 8–10mm thick.
**To make joints**

Making joints looks very simple when you see it done by an expert!

You:

- spread a bit more mortar than you need
- place your block into the mortar
- push and tap the block to the exact position you need
- cut off any mortar that squeezes out.

It takes a lot of practice to do this quickly, accurately and with a good-looking finish, but you can get good results if you work slowly and carefully and follow the steps in this course.
**Bed joints**

For the bottom layer of blocks, spread a layer of mortar about 12–15mm thick and a little wider than your blocks onto the concrete foundations.

Make lines in the mortar with your trowel — like this:

Place a block onto the mortar and gently tap to get the height, position and level you need.

For all other block layers, put the mortar along the top surface of the blocks. Remember the wide face of the block should be at the top.

Use the trowel to pick up a ‘sausage’ of mortar from your bucket and lay it onto the blocks.
Place a block onto the mortar and gently tap to get the right height, position and level you need.

Cut off mortar that squeezes out of the joint.
Upright joints (perpend or head joints)

Pick up ‘sausages’ of mortar and push or spread them onto the end shell of the block.

You can mortar the block that is in place on the wall, or mortar the end of block you are going to place.

Push the block into place in the mortar and make it level.

Cut off mortar that squeezes out of the joint.

Make all adjustments to the block while the mortar is soft. If you move the block once the mortar has “gone off” you will break the bond of the joint. If this happens, take off the block — and all the mortar, and start again.

Don’t try to re-use mortar that has been squeezed out of the joints. It will be too dry and have bits in it — and it won’t bond properly.

Mix and stir the mortar in your bucket every few minutes. This will mix the water and sand together again and keep the mortar ‘workable’.
Finishing joints

About 20 –30 minutes after you lay the blocks, the mortar will start to go hard and it will be firm if you touch it.

This is the time to ‘finish’ the joint.

Finishing a joint:

- makes the surface of the mortar harder so it lasts longer and keeps out water
- pushes the mortar against the top and bottom surfaces of the blocks
- makes the joint look neater.

A finishing tool

Make a finishing tool for yourself
from a piece of scrap round 12mm reinforcing steel.

Bend it into the shape of an “S” like this — and then push it along the joints

Use a jointer (finishing tool).

Push it along each bed joint first and then the upright joints.

Scrape off any spare mortar with a trowel — or brush lightly with a stiff brush.

Your finished joint should look like this
Activity

Mix a batch of mortar.

Practise taking rolls of mortar from a bucket
- lay on the top face for bed joints
- spread onto the ends of blocks

Push blocks into the mortar and tap gently with the handle of the trowel to get a 10mm finished joint.

Did you have enough mortar to fill the joint?

or

Did you have a lot of mortar squeezed out and wasted?

Practise putting in different amounts of mortar until you get it about right
- a well filled joint of 10mm, without too much wastage.
Laying blocks

You have just practised making mortar and laying it to make bed and upright joints.

Earlier, you practised building with blocks with no mortar — and how to keep the layers level and plumb.

Now you can put these together — and lay blocks for a wall.

Work with the project and plan supplied by your trainer.

You will need to make and lay the foundations if this has not been done already. You may have made the foundations in the earlier Concreting part of this course.

You worked out the number of blocks and mortar you will need in an earlier activity.

Get everything ready and put it near your wall before you start:

- Blocks
- Tools
- Mix for your mortar

Lay the first layer of blocks on the foundations, leaving space for the mortar. Mark the position of the blocks on the foundations.

Move the blocks out of the way.

Spread a bed of mortar — use plenty for this first course.

Put the two end/corner blocks in place. Check they are

the right way up — with the thicker face
shell on top exactly on your marks
level
the right height.
Place the rest of the blocks for this first layer.

- Mortar the end faces and push down into the mortar bed.
- Check alignment with your marks on the foundations — or use a string line.
- Adjust the blocks by tapping them with the handle of the trowel.

Build the two ends/corners of your wall, two or three blocks high. Check each layer for:

- bed mortar thickness (10mm)
- height (height stick)
- level and plumb (spirit level)

Fill in the wall between the ends/corners:

- Use a string line between corner blocks to align each layer
- Bed and end mortar each block.

Cut off extra mortar from all joints with a trowel as you go.

Once the mortar has started to harden, finish the joints with a jointer.
Planning sheet for my concrete block project

Plan or Picture
what will my finished job look like?

Draw a plan
show the measurements
What foundations do I need?

Do I need:

expert advice or help?
engineering plans?
Council or Island permits?

How many blocks will I need?
What size of blocks will I use?

How long are the walls? _________ metres (m)  That is ___ blocks for each layer.

How high are they? _________ metres

So.
The number of blocks I need is  = ________

Remember:
all your measurements must be in the same units: **metres (m)** or **millimetres (mm)**
Do I need reinforcing?
what type __________
what spacing in the wall __________
amount __________

How much mortar do I need?

How many people will I need?
What tools will I need?

Tick the tools you need

how many?

Ready the site

- tape measure
- level
- wheelbarrow

Cutting blocks

- hammer/bolster
- or power saw

Building and levelling

- trowel
- tape measure
- height stick or gauge
- spirit level
- string line and pegs
- jointer (finishing tool)

Mortar

- trowel
- mixing board
- bucket or mortar board

Safety

- boots
- gloves
Student Checklist

has completed the course “Working with Concrete”.
I have worked with them through the course and I have seen them complete the exercises and activities I have marked on this checklist.

Trainer Name ____________________________________________
Signed __________________________________________________

Choosing concrete
For their own area, village or island, the student can:
- Identify the different types of cement and concrete [ ]
- Say how cement and concrete are made [ ]
- Say where their cement, sand and rock come from [ ]
- Choose suitable concrete for a job [ ]

Mix and lay concrete
For each section the student can:
- Identify the basic tools available [ ]
- Choose and use the best tools for a job [ ]
- Clean tools and equipment after use [ ]

Plan for concrete
- Draw a sketch plan for a job [ ]
- Work out how thick the concrete should be [ ]
- Say when steel reinforcement is needed [ ]
- Decide the type of concrete [ ]
- Work out the amounts of cement, sand, rock and water [ ]
**Getting a site ready**
- Prepare the ground
- Mark the place where the concrete will go
- Dig out the ground, make it solid and level
- Make the boxing (formwork)
- Build strong timber framing
- Check frames are level and in the right place
- Place any underlay or reinforcing

**Mixing concrete**
- Measure out the correct amounts of water, cement, sand and rock
- Correctly mix a batch of concrete by hand
- Correctly mix a batch of concrete in a mixer
- Follow safety precautions

**Pour and compact concrete**
- Place concrete batches correctly into the formwork
- Compact concrete to remove all air bubbles
- Screed the concrete to make it level with the formwork

**Finish and cure concrete**
- Say what type of surface can be made with each of screed, wooden float, brush, finishing trowel
- Finish the concrete to the type of surface needed
- Make joints in the concrete where needed
- Follow correct steps to cure the concrete
- Remove formwork from finished concrete
Introduction to blocks
The student can:
- Identify the common types and sizes of blocks available
- Say where to get blocks from
- Choose the correct blocks for a job

Build with blocks
The student can:
- Say what the steps are in building with blocks

Design and plan for blocks
- Know when expert advice is needed in design of block walls
- Say when reinforcing is needed
- Say what type and size of foundations are needed
- Plan how the blocks will fit together
- Work out the amount and cost of blocks needed for a job
- Ask for expert help with plans at the right time

Fit blocks together
- Lay dry blocks in different patterns to make a wall
- Use spirit level and lines to keep the wall level, even and square
- Cut blocks to size

Lay blocks with mortar
- Mix mortar correctly
- Pick up and spread mortar with a trowel
- Spread mortar to get correct thickness for a joint
- Place blocks and level into position
- Cut off excess mortar
- Finish joint with a jointing tool

Fill blocks
- If required, fill the block cores with concrete