Unit CSA–L10cc30
MIX CONSTRUCTION MATERIALS

LEARNING OUTCOMES
LO1/2: Know how to and be able to prepare to mix construction materials
LO3/4: Know how to and be able to gauge and mix construction materials
LO5: Be able to store construction materials and components
LO6: Be able to restore the work area on completion of the work activities
INTRODUCTION

The aim of this chapter is to:

- help you to gauge and mix different types of construction materials.

PREPARING TO MIX CONSTRUCTION MATERIALS

Whether you are dealing with ready-mixed materials or mixing them on site it is vital that adequate safety precautions are taken.

The cement in concrete can burn the skin and is dangerous to the eyes. Skin contact with fresh, wet concrete, mortar or screed is often the cause of allergic or irritant dermatitis and it can also cause cement burns.

Above all, fresh, wet construction materials are very heavy. One cubic metre weighs 2.5 tonnes. This means it can cause strains and other injuries if not handled in the correct way.

Hazards and risk assessment

Each different type of construction material has its own potential hazards. Many of the materials can cause:

- irritation to the respiratory system if the dust is inhaled in the case of material such as dry cement
- irritation to the skin and particularly making the skin more sensitive or causing chemical burns in the case of wet cement
- damage to the eyes, leading to serious and potentially irreversible injuries in the case of wet cement.

Cement can cause problems whether it is wet or dry.

<table>
<thead>
<tr>
<th>Law</th>
<th>Key points</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control of Substances Hazardous to Health Regulations (1999) and Management of Health and Safety at Work Regulations (1999)</td>
<td>These require the employer to make an assessment of any health risks and then either prevent or control exposure to these risks.</td>
</tr>
<tr>
<td>The Construction (Health, Safety and Welfare) Regulations (1996)</td>
<td>All construction sites must have suitable and sufficient washing facilities, with hot and cold running water. They also need to have facilities so that you can change and dry your clothing.</td>
</tr>
<tr>
<td>Personal Protective Equipment at Work Regulations (1992)</td>
<td>Your employer has to provide you with suitable PPE. It needs to be properly maintained and replaced when needed. You should also be trained in how to use it.</td>
</tr>
<tr>
<td>Manual Handling Operations Regulations (1992)</td>
<td>Your employer should make arrangements so that whenever possible you do not have to manually handle materials or equipment. If necessary risk assessments should be carried out.</td>
</tr>
</tbody>
</table>

Table 5.1 Laws covering hazards when using construction materials
Information sources

There are four laws that relate to the hazards when using construction materials, including cement, mortar, plaster or concrete. These are briefly outlined in Table 5.1.

The type of information available about construction materials could include:

- Manufacturers’ technical information – this information will tell you how to get the best out of the material, such as proportions to use and setting times. Importantly it will also include health and safety advice.
- Written and oral instructions – the work method statement should provide you with all the basic information that you need. Any additional specific or particular advice or guidance will be given to you verbally by experienced members of the team.
- Basic drawings and specifications – most construction jobs will have drawings and clear specifications stating the scope of the job and the materials that you should use.
- Health and safety legislation and official guidance – plays an important role in protecting you.

Materials and components

Each particular job will require you to use particular types of material. For example, you may be required to mix mortar for bedding, jointing or pointing. This could mean that you would have to use ordinary Portland cement, sand and water. In addition you might need a plasticiser, a retarder or accelerator and, perhaps, a pigment or colouring agent. The actual mortar mix may depend on what it is going to be used for. If it contains a plasticiser or lime it will be more workable. If it contains cement it will stiffen up and set quicker. If it needs to be very strong it will contain cement, sand and water.

It is therefore very important to know what you are mixing the materials for and what properties are expected of them when they are mixed. This may mean that they need to:

- be workable for the maximum amount of time
- have sufficient strength to withstand weight once dry
- provide a good bond
- be durable to cold weather
- be sealed so they do not let in rainwater or draughts
- be of a colour that is complimentary to other building materials being used, such as bricks.

If you need to refresh your memory about the different materials and components then refer back to Chapter 3.

PRACTICAL TIP

The Health and Safety Executive produces a number of information sheets. Their Construction Information Sheet Number 26 looks at cement and highlights health effects and hazards. This can be found at www.hse.gov.uk/pubns/cis26.pdf.
GAUGING AND MIXING CONSTRUCTION MATERIALS

One of the main materials that you will be using on site will be concrete. This is a mixture of cement, fine and coarse aggregates and water. Once they have been correctly mixed and poured into place the concrete will then set. As we will see, concrete is just one of the different types of materials that you will have to mix on a regular basis. The other common ones are mortar and plaster.

The mixes can be specified either by weight or volume. There are some different basic ways in which you can gauge and mix these materials to match your instructions. Each of them takes a different amount of time to prepare when you are hand mixing.

The other major concern will be how much time you have before the mix becomes unworkable. This means that it is important to only mix what is immediately needed, taking into consideration its setting time.

As with any work on a construction site, the first thing to do is to ensure that you have the right PPE and that you are working in a safe way.

PPE

When you are mixing construction materials it is important to remember the following:

- Never eat, drink or smoke when you are working with materials.
- When you have been working with dry materials you should get into the habit of washing or showering afterwards and using skin moisturiser.
- You should remove any contaminated clothing, including footwear and watches after you have been mixing materials. These should be cleaned before you wear them again.
- If you could be exposed to dust then you should wear some type of respiratory protection, such as a dust mask.
- The dust can also affect your eyes. If you are working with either dry or wet mixes wear approved glasses or safety goggles.
- For skin protection make sure you wear resistant gloves, boots and closed, long-sleeved protective clothing.
- If you are kneeling for any length of time you should wear kneepads, along with waterproof PPE if it is wet.
Correct use of PPE
PPE should be supplied to you by your employer. However, it is your responsibility to use it in the correct way. Make sure that you do not expose yourself to unnecessary dangers by ignoring PPE. Even if the job is only likely to take you a few minutes, failing to wear the right PPE could lead to an injury or a long-term physical problem. If you should be wearing protective clothing, dust masks, eye protection or any other form of PPE then make sure you do wear it.

It is also important to make sure that you store and maintain your PPE properly. If it is worn, broken or lost you should have it replaced.

In Chapter 1, we looked at the importance of PPE for most of the jobs on site. Refer back to this chapter now if you need to refresh your memory.

Safe working practices
You will be working with potentially hazardous materials. Just moving them around can lead to injury.

Some simple precautions, such as wearing the right PPE and being aware of what you are doing can go a long way towards making sure that you are working safely. It will make sure that you are protecting yourself and also others.

What is a hazard?
These are examples of situations that could become hazardous:

- If wet concrete or mortar falls into your boots or gloves or even soaks through your protective clothing you could be burned. The injury could take months to heal and you might need a skin graft.
- Inhaling dust created by moving or mixing materials can cause choking and problems with breathing.
- A clear working area should be set up so that you do not have to work around obstacles that could cause you to trip or slip.

Fires and fire extinguishers
In Chapter 1, we looked at fire hazards in the workplace. We also looked at fire and emergency procedures and the different types of fire extinguishers and their correct uses.

Recording accidents
Accident reporting and the laws related to it, along with the documentation, can be found in Chapter 1.

Dealing with emergencies
The correct way to deal with emergencies on site, records and the individuals involved was covered in Chapter 1.
Gauging and mixing materials

It is important to look at exactly how you gauge and mix concrete and mortars either by hand or using a mixer. It is likely that you will be using a range of different hand tools, mixing machines and equipment.

Each different type of mix has a particular set of ingredients. Gauging basically means proportioning materials. The mixes are given three numbers. For concrete this might mean:

- 1 – use one part cement
- 2 – use two parts fine aggregate or sand
- 4 – use four parts coarse aggregate or stone.

These are volumes or ratios and in this case 1:2:4.
Equipment used for mixing and how to use it

When mixing you can measure materials by volume or by weight. If you are measuring by volume you can use the following equipment:

- A shovel – this is bad practice as it is a crude way of gauging the amount of material you are using. This is because the amount of material on a shovel can vary. There is more sand in a shovelful than there is if you have a shovel of aggregate.

- A bucket – this is a better way because if the bucket is full it will have the same volume, whatever the material.

- A gauge box – this is a wooden box, which is made to size. The boxes do not have bottoms and once you have gauged the material, you can remove the box and shovel the material into the mix.

You can also measure by weight and there are tables that you can refer to that will show you how much material you will need by weight to create a cubic metre of concrete.

Mixing by weight is considered to be a slightly more accurate method. You can use a weight batch mixer. This records the weight of the materials as they are shovelled into the hopper. Then you just have to look at the calculations for the weights of the required mix and add the materials to the mixer. Caution: be careful if the material (e.g. sand) has been allowed to get wet as this will add to its weight.

Another alternative is to use an increasingly popular method known as the dry silo system. A stand-alone silo is delivered with ready-mixed materials to the site. They are still dry. Then it is only necessary to add the correct amount of water to the silo to produce the required amount of wet material.

You might mix the materials with a shovel. If you are mixing larger quantities, you might use a machine. Mixing construction materials using machines requires some additional equipment and materials. A good example would be mortar mixing, in which case you would need:

- the mixer – if it is petrol or diesel it will also need fuel. If it is electric then a waterproof cable connecting it to a generator or mains supply will be needed

- measuring equipment

- wheelbarrows, buckets and shovels to move the mortar to where it is needed

- the materials being mixed. For mortar this would be:
  - Portland cement
  - plasticiser
  - sand
  - water.

DID YOU KNOW?

Dry silo mortar systems hold around 33 tonnes of dry mortar. This is the equivalent of 23 cubic metres of mixed mortar.
All of this equipment and materials should be placed close to the working area so that the mortar can be mixed and quickly moved to the area as needed. This also means having all of the ingredients for the mortar mix close to where the mixing is taking place. A good example of this can be seen in Fig 5.6.

![Figure 5.6 Placement of materials and equipment for mixing mortars by machine](image)

**Basic calculations**
Calculating the exact mix you need to produce particular materials will depend on a number of things:

- the strength of the material you need
- what the material is being used for
- the specification for the job
- the required hardening time of the material.

**Weight calculations**
Table 5.2 shows you the weight of materials that are needed to produce different strengths of 1 cubic metre of concrete.
<table>
<thead>
<tr>
<th>Strength in kg/cm²</th>
<th>Water/Cement Ratio</th>
<th>Cement kg</th>
<th>Fine Aggregate (Sand)</th>
<th>Coarse Aggregate (Stone)</th>
<th>Water (Litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>350</td>
<td>0.52</td>
<td>355</td>
<td>880</td>
<td>950</td>
<td>185</td>
</tr>
<tr>
<td>300</td>
<td>0.58</td>
<td>320</td>
<td>910</td>
<td>950</td>
<td>186</td>
</tr>
<tr>
<td>250</td>
<td>0.66</td>
<td>280</td>
<td>940</td>
<td>950</td>
<td>185</td>
</tr>
<tr>
<td>200</td>
<td>0.74</td>
<td>245</td>
<td>970</td>
<td>950</td>
<td>182</td>
</tr>
<tr>
<td>150</td>
<td>0.86</td>
<td>210</td>
<td>1,000</td>
<td>950</td>
<td>181</td>
</tr>
</tbody>
</table>

* The table gives the total amount of water needed. However, if the sand and stone are very wet then the amount of water required will have to be reduced.

Table 5.2

In the table the first column shows the required strength of the concrete. This means that the concrete will have to support that load. The higher the number, the greater the load the concrete will have to support.

The other figures in the table relate to the ratios of materials needed. If, for example, the concrete strength was specified as being 250 kg/cm² then the following are required:

- 280 kg of cement
- 940 kg of sand
- 950 kg of stone
- 185 litres of water.

This would give you a water to cement ratio of 0.66.

**Gauging mortar**

When you are producing mortar it is important that the mortar mix is the same throughout the whole job. You want a consistent strength and look. This often means that measuring the mix using shovels is too inaccurate.

The way around this is to get the proportions right by weight, although you can use gauge boxes and buckets to get the right proportion by volume.

If mortar is proportioned by volume you will see a ratio in the specification, as can be seen in the Table 5.3.

<table>
<thead>
<tr>
<th>Mortar type and ratio</th>
<th>Actual ingredients</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cement/lime mortar 1:1:6</td>
<td>One part cement, one part lime, six parts sand</td>
</tr>
<tr>
<td>Cement mortar 1:6</td>
<td>One part cement and six parts sand</td>
</tr>
<tr>
<td>Lime mortar 1:6</td>
<td>One part lime and six parts sand</td>
</tr>
</tbody>
</table>

Table 5.3 Mortar ratios

Note, however that lime is rarely used in modern bricklaying, though it may be used for specialist or heritage jobs. Note that hydrated lime is extremely alkaline, which means it will burn skin. Ensure you wear appropriate PPE when using it. Examples of the ingredients needed for each of these types of mortar can be seen in Fig 5.7, Fig 5.8 and Fig 5.9.
Concrete

Concrete can be mixed either by hand or using a mixer. Again you will see a ratio mix, which, for example, might be 1:2:4. This means that for every one part of cement you will need two parts fine aggregate or sand and four parts coarse aggregate.

Figs 5.10–5.17 show how the process of mixing these ingredients works in practice.
Figure 5.11 Materials for the mix

Figure 5.12 Mixing the sand (or fine aggregate) and coarse aggregate – first place half of the sand or fine aggregate then half the coarse aggregate

Figure 5.13 Placing the cement – place around half of the cement on top of the sand (or fine aggregate) and coarse aggregate
Figure 5.14 Turning over concrete – use a shovel to mix the concrete at least three times until you have a uniform colour

Figure 5.15 Making a hollow for the water

Figure 5.16 Adding water and mixing

Figure 5.17 A chopping motion is used to mix the materials
Characteristics, uses and limitation of materials

Remember the following:

- Mortar mixes – a 1:4 mix means that it is one part cement to four parts sand. This is the strongest mix and is used on engineering bricks. A 1:6 or 1:8 ratio is normal for bricks or blocks.

- Sand – this has grains that are smaller than 5 mm and are classed as a fine aggregate. The sand needs to be clean and free of any organic matter.

- Course aggregates – this means gravel or crushed rock. These have grains that are larger than 5 mm.

- Water – always use potable (drinking) water and never use water from ponds, water tanks or any other source. Only drinkable water will be free from pollutants and organic matter.

Possible defects

Construction defects cost around £20 billion per year in repairs and rebuilds. Although much of this cost is due to poor drawings, incorrect instructions and poor communication, some of it is because of defects in materials.

Should you come across hardened bags of cement or splits in cement bags then the material is probably not suitable for use. Sand and other aggregates that have become contaminated will not be suitable either. If these aggregates have soil or plants in them then once they are added to the mix these organic materials will rot and weaken the concrete.

You should always report any defects that you come across directly to your supervisor or site manager. They will be able to make a judgement as to what to do with the materials and whether or not they are still suitable for use.

Many defects can easily be avoided by:

- correct and secure storage on site (this means keeping bags of cement and other materials dry)

- checking for defects when the materials are delivered (rejecting torn or damaged bags or any materials with other obvious defects)

- only using freshly mixed materials.

Maximum time for use of mixed mortar, concrete and plaster

The maximum time to use mixed materials is very dependent on the weather conditions. In hot, drier weather the material is likely to have a shorter usage time.
Mortar tends to have a maximum usage time of around two hours.

Concrete is workable for around one-and-a-half hours, but in hotter conditions this could be as little as one hour.

Plaster usually sets within one-and-a-half hours but if it is cold then it can take as long as two hours.

**Preparation times for hand-mixing**
Mixing time will vary depending on the amount and type of materials that you are using. The most important thing to ensure is that all of the particles that make up the mix produce a consistent wet material.

Mortar can generally be mixed within two to three minutes in a mixing machine.

Each manufacturer will suggest their hand and machine mixing times. Multi-purpose concrete, for example, which includes a ready dry mix of cement, graded sand and aggregate mixed with water in a machine between three and five minutes. But this can take longer by hand, as you need to get the right workability and consistency.

**Manual handling and lifting**
It is important to remember that when you are moving construction materials around, particularly bags of cement, you should avoid carrying anything heavier than 20 kg. Try to use lifting equipment, such as wheelbarrows. Move larger quantities of material using pallet trucks or larger wheelbarrows.

In Chapter 1 there is lots of information and advice about manual handling.

If you’re having trouble, always ask for help. It’s better to ask and find out than to blunder on and make mistakes. By getting the help you need, you’ll learn the skills properly, you’ll avoid wasting time and money, and you’ll have a better chance of succeeding in your future career.

**Suitable working areas**
Space can often be a problem on site. But whether you are mixing by hand or using a machine you need enough space to have all of the mixing equipment next to the materials. In addition to this you need to be close to where the materials are going to be used.

As we have already seen, if you place the materials and equipment close to where you are working this will provide you with quick access to the things you need so that you can work more efficiently. It will also mean that once they are mixed they have to be carried shorter distances.
Protecting the work and its surrounding area

Many on-site activities can cause damage to the local environment. The effect can be even worse if waste materials are disposed of in the wrong way. For example, you should not hose down concrete slurry so that it goes into the main sewers.

The other issue is that you should protect the materials that you are using, ensuring you protect cement or mortar from the weather and interference while you are using them or if you need to leave them out. It also means that you do not leave piles of these materials around the site.

In each of Chapters 6, 7, and 8 that look at block walling, brick walling and cavity walling, there is useful advice about protecting the environment and the work that you are doing. You should turn to these chapters to see how it is relevant to the job you are doing.

Minimising damage

Freshly mixed materials should be protected from the elements also during use. The danger is that additional water from rain could weaken the mixture. It is also important to make sure that any mortar or cement that has been laid is protected until it has hardened properly.

The material has to cure before it is ready to do the job that it has been specified to do.

Maintaining a clean workspace

Mixing areas are likely to be used to produce a range of different construction materials. It is good practice to begin with a clean and clear area. In doing this you will make sure that whatever mix you are
creating has not been polluted by other ingredients from a previous mix. It will also mean that any other polluting materials, such as organic matter like soil, will not get into the mix.

You must also make sure that any hand tools or mixing machines are clean. Tools such as shovels and wheelbarrows that are being used on a regular basis to mix materials will rust. Timber parts will rot, so they all need to be thoroughly cleaned and dried after each day’s work. Mixing boards should be scrubbed down between each different mix.

It is also good practice to give trowels and other metal tools a coat of linseed oil from time to time to prevent them from going rusty.

Dust will get everywhere and this means that the exposed parts of any mixing machines will tend to accumulate cement dust. These should be cleaned on a regular basis.

PRACTICAL TIP
When you are cleaning and maintaining tools, always follow the manufacturer’s instructions. Mixers should be serviced daily. This will ensure that they last longer and are easier to use. This may mean lubricating, cleaning with water and a stiff brush and checking oil levels.

Disposing of waste
The person or company running the construction site has what is known as a ‘duty of care’. This means that they have to take responsible steps when they are dealing with waste. Therefore if they arrange for someone to come to collect the waste, they must check that this person is an authorised collector who will dispose of it properly.

Sustainability and recycling
In Chapter 3, we looked at sustainable construction. But even when you are working on the smallest project you need to be aware of the waste that you are creating. The UK government is keen to stop the huge amount of waste going into landfill sites. Many materials that are used in construction can be reused. The following are some examples:

- Aggregates, concrete, crushed bricks and stones can be used to build noise bunds.
- Rubble can be used as foundation material for roads, car parks and tracks.
- Soil can be used for landscaping on other sites.
- Wood waste can be used for footpaths, tracks and bridleways.
## 1. MIX CONSTRUCTION MATERIALS

**OBJECTIVE**

To gauge and mix different types of construction materials.

**MIXING MORTAR BY HAND ON SITE**

Small quantities of mortar will often be mixed by manual means rather than by using a mechanical mixer.

A clean, hard surface should be used for mixing the materials. A concrete surface can be cleaned effectively after mixing but will stain if mixing occurs directly on it.

An alternative surface would be a large piece of plywood board which is free from debris or anything that may contaminate the mortar mix.

The materials used are gauged using a bucket, or a gauge box if one is available, and the materials are allowed to fall into a pile in the middle of the mixing area.

<table>
<thead>
<tr>
<th><strong>STEP 1</strong></th>
<th>Select a clean, hard surface if possible or use a large piece of plywood board for mixing on.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>It is better to use a large piece of plywood board even if you have a smooth concrete surface, to prevent the mortar staining the concrete.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th><strong>STEP 2</strong></th>
<th>Measure out the correct amount of materials for the mortar mix. In this case you are going to make 1:6 (1 part cement to 6 parts sand) mortar mix.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Before the mortar can be mixed, the ingredients have to be measured in their correct proportions (see page 123).</td>
</tr>
</tbody>
</table>

| **STEP 3** | Once you have accurately measured out the correct proportions of materials, using a shovel, repeatedly turn (three times) the ingredients into a pile making sure that all the materials are thoroughly mixed together. |

| **STEP 4** | Form a hole or indentation in the middle of the pile of dry mix. |

<table>
<thead>
<tr>
<th><strong>STEP 5</strong></th>
<th>Add water to the mix. Allow the water to soak into the mixed materials, and then add more water.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The water should be ‘drinkable’ and not contaminated.</td>
</tr>
<tr>
<td></td>
<td>Mix the materials with the water from the middle until all the water has been incorporated into the mix.</td>
</tr>
</tbody>
</table>

**TOOLS AND EQUIPMENT**

- Plywood board
- Gauge box
- Shovel
- Wheelbarrow
- Bucket

**PPE**

Ensure you select PPE appropriate to the job and site where you are working. Refer to the PPE section of Chapter 1.

**PRACTICAL TIP**

**Warning**
When water is added to cement it gets hot and can cause chemical burns so be very careful when mixing it.
Adding more water to the mix will make the mortar easier to lay but it will reduce the strength by up to 30 per cent.

**Step 6** The materials are then turned repeatedly until the mix is a fatty workable mass.

The mix is now ready for use.

### Mixing Mortar by Machine

Before using any machine you need to be familiar with the manufacturer’s instructions where they apply with regard to:

- setting up the machine, leaving a safe working space around it, and ensuring it is level
- carrying out initial checks
- checking if any fuel tank is full (it is dangerous to fill petrol or diesel tanks on any machine when the engine is hot)
- whether it requires oil
- ensuring that any electrical connection is 110V or that a 110V transformer is available
- ensuring that the transformer is close to the 240V connection, reducing the amount of cable carrying 240V to a minimum
- ensuring the cable is carried overhead in a safe position, away from water, barrow runs, etc.
  and is fully unwound off the drum. If not, the cable can overheat and ignite, if the mixer is left running for long periods of time
- making sure there is no damage to cables, plugs or the transformer casing.

When you are satisfied that the mixing area is safe, follow the mixing sequence.

### Tools and Equipment

- Plywood board
- Wheelbarrow
- Shovel
- Mixer
- Bucket
- 110V transformer
- Gauge box
- 110V electrical lead

### PPE

Ensure you select PPE appropriate to the job and site where you are working. Refer to the PPE section of Chapter 1.

### Step 1

Start up the mixer.

### Step 2

Add about three-quarters of the total mixing water required.

### Step 3

Add two-thirds of the sand required.

### Step 4

Add the total quantity of cement.

### Step 5

Add the remaining third of sand.

### Step 6

Add the remaining water until the correct consistency is achieved.

### Step 7

Allow a further mixing time of two to three minutes.

### Step 8

Tip the mixture into the wheelbarrow for transporting it to the work area.

### Practical Tip

Mortar should be used within two hours of mixing. Small quantities of water can be added in hot weather to retain ‘workability’ but mortar should never be remixed after the initial set has commenced.
Concrete

Mixing concrete by hand or machine uses exactly the same methods but uses:

- cement (a binding material)
- sand (fine aggregate)
- gravel (course aggregate)
- water (should be drinkable grade).

Storing Construction Materials and Components

Aggregates are often stored in bays, as can be seen in Fig 5.20. Each different material or component needs a different method of storage. But this will all depend on how big the site is. It will also depend on how long you will be working on the site. If you are working on the site for a considerable amount of time then more permanent and effective storage should be organised.

This does leave a problem for small sites because space may be limited and proper facilities may not be easily available.

Correct Storage

For sand and aggregates the use of storage bays is good practice on larger, long-term sites. For smaller sites, steel sheets and timber battens can be used.

On some larger sites purpose-built concrete bases are often constructed, with solid partition walls. Whichever method is being used the following points are good practice for the storage of aggregates:

- They should be kept clean and should be free of contaminants, such as debris and soil.
- They should not be allowed to get too wet, so storing them at a slight angle will encourage the water to drain away.
- Each different type of aggregate should be stored so it does not mix with another type of aggregate.

Storing cement presents another list of problems. On large sites, cement tends to be stored in large silos. This arrangement works very well. For smaller sites, the cement is delivered in bags and these need to be stored properly. For cement, good practice includes:

- making sure that the bags are stored in a well-ventilated and waterproof shelter
making sure they are not stacked more than five bags high to prevent the weight of the bags compacting the ones below, so making the cement unusable. This is called warehouse setting.
• making sure they are stacked on pallets and not on the ground
• making sure the oldest bags of cement are used first and making sure that new and old bags are not mixed when deliveries are made.

Plaster should always be stored in a warm, dry place. Plaster will always attract moisture. If the plaster is exposed to damp and cold conditions it can set in the bag.

**Damaged materials and components**

In the previous section, we looked at ways in which you should report defects in materials. Remember that you need to routinely check the following:

• Dates on bags of cement or plaster. Always use the older bags first and do not use the bags that are out of date.
• Check any bags of cement or plaster, for example, which have been damaged or left open as they may not be suitable for use. Check to see if they have hardened or are damp. If they are, set them aside, as they should not be used.
• Make sure you are using the correct aggregates and that they have not been mixed with other materials. This will affect the mix that you are attempting to make.
• Also check materials have not become contaminated with soil or plant material.

**RESTORING THE WORK AREA**

As we have already seen, it makes life much easier when you begin the day with a clean and tidy work area. Getting into the habit of cleaning up after yourself at the end of the working day will mean that you can start work the following morning with a clean work area. This includes dealing with any waste that you may have created. Always make sure that the waste is disposed of in the correct way and that you do not unnecessarily pollute the environment.

**Cleaning the mixer**

The mixer must be cleaned thoroughly and carefully using plenty of water and a few shovelsful of gravel. Add the water first and then the gravel. Clean it out as soon as you can, as dried mortar is difficult and time-consuming to remove.
Do not attempt to clean the mixer using broken bricks as these may damage the mixer or at least reduce its working life.

Drain the water and gravel carefully, disposing of it according to the rules of your site. Don’t just tip it out or down a drain.

Some sites use pressure washers to clean mixers – do not try to use one yourself without training.

Always immobilise the mixer at the end of a working day by disconnecting the power supply and/or storing the starting handle in a secure area.
TEST YOURSELF

1. Which law requires construction sites to have suitable and sufficient washing facilities?
   a. Control of Substances Hazardous to Health
   b. Personal Protective Equipment at Work Regulations
   c. Construction (Health, Safety and Welfare) Regulations
   d. Management of Health and Safety at Work Regulations

2. If a cement mix has a ratio of 1:3:6, how many parts of sand are required?
   a. 1
   b. 3
   c. None
   d. 6

3. If you are mixing concrete and the sand is wet, which of the following should you do?
   a. Reduce cement
   b. Add more sand
   c. Add more water
   d. Reduce the amount of water that you add

4. Lime mortar consists of which of the following?
   a. 1 part cement, 1 part lime, 6 parts sand
   b. 1 part cement, 6 parts sand
   c. 1 part lime, 6 parts sand
   d. 2 parts lime, 4 parts sand

5. If you see a ratio mix for concrete at 1:2:4, how many parts coarse aggregate are needed?
   a. 1
   b. 2
   c. 3
   d. 4

6. You have been asked to mix some concrete. Which of the following water sources should you use?
   a. Rainwater
   b. Pond water
   c. River water
   d. Drinking water

7. Under most normal conditions for how long is concrete workable?
   a. ½ hour
   b. 1 hour
   c. 1½ hours
   d. Most of the day

8. When storing cement on a large construction site, which of the following is good practice?
   a. Storing the bags outside under a plastic sheet
   b. Stacking the bags so that they take up the minimum amount of space
   c. Stacking the bags on the ground so they are stable
   d. Storing them in a waterproof shelter

9. What are the ingredients of ballast?
   a. Fine and coarse aggregates
   b. Sand and cement
   c. Crushed rubble
   d. Broken bricks

10. Which of the following is the least accurate way of gauging the amount of material you are using?
    a. Gauge box
    b. Shovel
    c. Bucket
    d. Unopened bag