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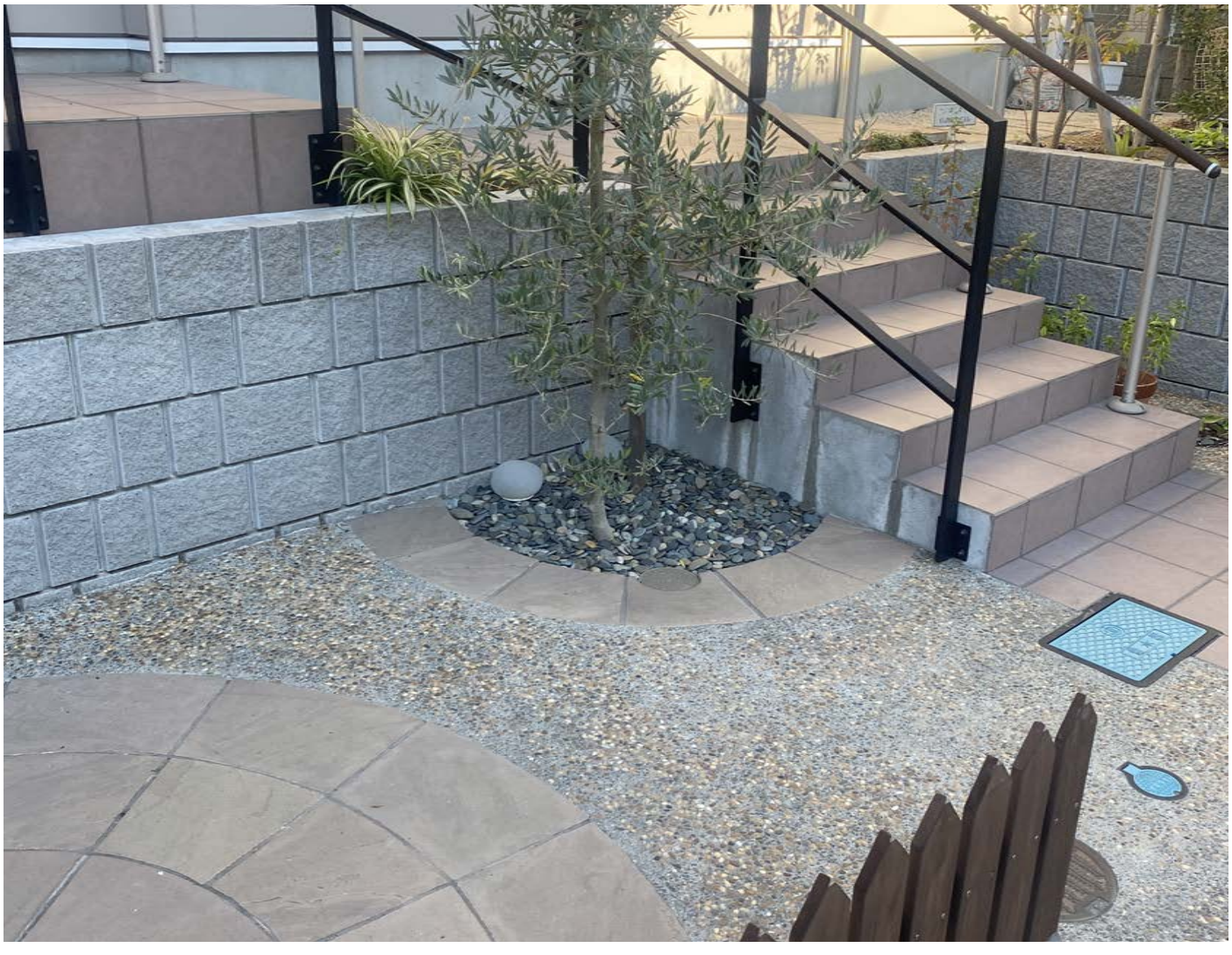
LESSON 1 APPLICATIONS FOR CEMENT AND CONCRETE

Concrete is a versatile substance with a multitude of applications like buildings, moulded furniture and décor, garden pools and ponds, pathways, driveways, roads, floors, and foundations.

Introduction

Cement is a binding material. It is the material of choice in building where it is commonly used in building construction, engineering, and landscaping. When combined with aggregates (typically sand and/or stone) and mixed with water, it creates concrete or mortar.

When it is first mixed, concrete is pliable and can be shaped. As it cures, it hardens. Hardening takes place because of a chemical reaction between water and cement. This is called hydration. Most mixes harden within the first 12 hours, but they continue to become harder over the next few weeks. Typically, mixes have reached their optimal strength at 4 weeks (28 days).



Suggested Tasks: ▼

Throughout this course you will be provided with suggested tasks and reading to aid with your understanding. These will appear in the right hand column.

Remember: these tasks are optional. The more you complete, the more you will learn, but in order to complete the course in 20 hours you will need to manage your time well. We suggest you spend about 10 minutes on each task you attempt, and no more than 20 minutes.

Cement

Cement is a powder made by heating up raw materials containing calcium in a kiln to create dark pellets called ‘clinkers.’ These are then mixed with gypsum to create a fine grey coloured powder.

The raw materials may be various combinations of limestone, seashells, chalk, clay, and other materials including shale and iron. These are ground into small pieces up to 2cm diameter before they are heated to temperatures as high as 1.649°C (3,000°F).

The final product commonly contains a mix of calcium, silicon, aluminium, and iron and is called ‘Portland cement’, ‘normal Portland cement’ or ‘type 1 cement’.

Storage

Cement can become useless if it gets wet before use. Cement bags are made of several layers of paper and are neither waterproof nor airtight.

Bags should be stored as follows:

1. In dry and waterproof places
2. Where humidity is low
3. On a dry floor - or raised on boards or pallets
4. Stacked lengthwise and crosswise in alternate layers
5. Never more than 10 bags high - otherwise it can go lumpy inside the bag due to pressure
6. Never too close to walls (leave a 30 cm gap) to allow for ventilation around them.

Cement does have a shelf life. Usually, it is recommended to use cement within 3 months. As cement ages in the bag, it begins to lose strength. Therefore, when using cement, it is advisable to take the oldest bags first. If bags have been stored unopened in optimal conditions they may still be fine at 6 months though the cement may need to tested before using. This is particularly important for structural work because the older the cement is, the greater the risk of defects such as cracks.

Opened bags are even less airtight and the contents can absorb moisture from the air so these will not last as long. Once the powder becomes damp it will harden and become lumpy. Covering bags with a plastic sheet or waterproof tarpaulin at the end of the day can extend the usable life of the cement.

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Suggested Task

Compare the ingredients in two bags of cement from two different manufacturers.

If you have access to bags of cement, you might be able to do this by reading the ingredients lists on the bags.

Alternatively, search online and compare the ingredients of standard cement provided by two different manufacturers.

Are there any differences? If so, why do you think they are different?

Cement Terminology

Different types of cement can have different characteristics. Physical requirements that may be variable between different cements include strength, heat of hydration, setting time, air content, expansion, and fineness.

The terminology used to describe cement is not always clear and precise. Different terminology may be used in different countries, and even in different sectors of the construction industry.

Type 1, 2 or 3 Cement

Cement is sometimes differentiated into types 1, 2 and 3 (or I, II and III):

1. **Type 1 Cement** - This is normal Portland cement and is for general use.

2. **Type 2 Cement** – This is used for construction in water, or in soils that can be more corrosive because they contain moderate amounts of sulphur or are prone to heating up a lot.

3. **Type 3 Cement** - This is another type of Portland cement. However, it has a higher early strength compared to type 1 because it contains finer particles. This means it can absorb more water for the equivalent surface area which makes it stronger during curing i.e., cement which dries out too quickly loses strength. Within the first few days of curing, type 3 cement reaches a higher percentage of its strength after 4 weeks than does type 1 cement.

Mortar

Mortar is a mix of sand, cement, and water - or sand, cement, lime, and water. Mortar mixes vary. A general all-purpose mix may be 1 part water, to 2 parts cement to 3 parts sand (measured by volume).

Mortar Variations

Mortar mixes for different situations are:

1. For laying bricks or blocks in an inland location, where humidity may be low and temperatures may be more variable: 5 or 6 parts sand to 1 part cement and 1 part builders lime

2. For laying bricks or blocks in coastal areas: 3 parts sand to 1 part cement to 0.25 parts lime.

3. For internal rendering above the damp course: 5 parts sand to 1 part cement and 1 part lime

4. For internal rendering below the damp course: 3 parts sand to 1 part cement

Using Mortar

When using mortar to lay bricks, or for any other work, it is important to continually clean excess from surfaces, perhaps wiping with a damp cloth.

Rake vertical joints first, then horizontal joints, to minimise spreading excess mortar.

A further cleaning can be done 5 to 7 days after laying the mortar, once it is dried. This may be done using a brush or high-pressure cleaner.

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Suggested Task

Contact or visit a local supplier of cement. As them whether they stock type 1, 2 and 3 cement.

Ask someone who works there and who is knowledgeable about cement to explain to you their understanding on the differences between these cement types, and how each is used.

Make notes.

Be aware, mortar can also cause skin or respiratory irritation. For safety reasons, do the following:

1. If at all sensitive, avoid direct contact between skin and mortar, grout, or slurry, by wearing appropriate protective clothing and PVC gloves.

2. If mortar gets on your skin, wash it off promptly.

3. If mortar, cement powder, or lime gets into your eyes, wash it immediately and urgently with an eyewash solution, and then rinse with water.

4. Always be prepared and have a first aid kit handy.

5. When handling any dry or dusty materials (in cement, lime, or aggregate); wear eye protection and a respiratory mask.

6. Whenever cutting concrete (e.g., with a concrete saw), keep it wet to control dust.

7. Be careful when handling anything heavy (e.g., shovelling aggregate or cement, or carrying bags of cement). Know and respect your limitations. Know how to lift safely. Use appropriate machinery and handling equipment.

Concrete

Concrete can be worked with either as precast units or poured ‘in situ’ (on site). In situ jobs are situations where the concrete is poured and allowed to dry in its final location (e.g., the foundation of a building).

Precast concrete is used in a range of construction situations where it can save time. Examples of precast concrete units include concrete blocks (used in construction), culvers and drainage pipes (used in civil engineering), and paving slabs (used in landscaping).

Mixes

Concrete is made by mixing cement with a fine aggregate (i.e., sand) and a coarse aggregate (stone or gravel). The percentage of cement in the overall mix typically may vary from around 10% to 25%.

The relative proportion of materials in the mix depends upon the characteristics of materials used; the strength of concrete required, and where it will be used.

Some sands are finer than others, and some coarse aggregates might be larger or cleaner than others. Aggregates available in one area may be a different type of stone to elsewhere. Some aggregate stone may be harder and other stone (e.g., scoria) may be more porous.

How Much Water?

If concrete has too much water mixed in (and is too runny), it may not be as strong after it dries. If insufficient water is mixed in, it can be difficult to work with.