# English for the Students of Architecture

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## Unit1 Parts of a Building

### 1. Building

A building provides **shelter** against natural elements such as rain, sunshine, and wind. It also provides **security** and **privacy**. A building consists of the following basic parts:

#### 1-1. Foundation

Foundation is necessary to evenly distribute the entire building load on the soil in a way that no settlement takes place. Because of this, foundations need to be built on solid ground.

#### 1-2. Plinth

**Plinth** is normally **constructed** just above the ground level and immediately after the foundation. It raises the **floor** above the ground level and prevents surface water from entering the building.

#### 1-3. Damp Proof Course(DPC)

**Damp** proof course is a layer of water proofing materials such as asphalt or **waterproof cement**. **Walls** are constructed above the damp proof course. Damp proof course prevents surface water from rising into the wall. Dampness reduces the strength of the walls, affects the paint and plaster, and increases the cost of maintenance.

#### 1-4. Plinth Beam

Plinth beam is constructed depending on the type of the structure of building and nature of the soil. It provides more **stability** in regard to settlements of the building and **earthquake** damages.

#### 1-5. Floor

Floor is the surface on which we do most of our activities. Flooring can be done with different materials, but care must be given that the ground below the floor is well **compacted**. Flooring is done to prevent dampness from rising to the top and to have a firm **platform** that can be kept hygienic and clean.

#### 1-6. Walls

Walls are the **vertical** elements on which the roof finally rests. They can be made of different materials like **bricks**, **stone**, **mud**, **concrete blocks** etc. If the walls are very long, columns can be provided to carry the roof. Walls provide privacy and enclosure. They also provide security and protection against natural elements such as wind, rain, and sunshine.

### 1-7. Opening

**Openings** are normally provided in the walls as **doors**, **windows**, and **ventilators**. Doors provide access; windows and ventilators provide light and **ventilation**. **Lintels** are constructed just above the openings. It is normally a stone **slab** or a concrete slab. **Sill** is the part of the wall that is just below the window. Lintels are constructed to hold up the walls above the openings. In earthquake prone areas, a continuous lintel **beam** is provided all over the walls.

### 1-8. Stairs

A **stair** is a sequence of steps which provides a mean of ascent and descent between the floors. The **apartment** or room of a building in which stair is located is called **staircase**. The **space** which is occupied by the stair is called a stairway. There are different kinds of stairs which are used in buildings, like **wooden** stair, **metal** stair, brick stair etc.

### 1-9. Roof

The roof provides protection for the building and the people who are living in it. The roof rests on the walls and requires proper **anchoring** so that wind and other mechanical impacts cannot **destroy** it. A roof can have different shapes but it is always either **flat** or **sloping**. Roof is typical made of RCC, stone slab, tiles etc.

### 1-10. Finishes

External finishes are the most outer **layers** of protection which protect the structure from **weathering**. Internal finishes are the layers which are given on internal faces. They give durability and pleasing appearance to the inside.

**Exercises**:

**I. Match the items in column A with the items in column B.**

| Column A | Column B |
|---|---|
| 1. block ( ) | a. a layer of bricks, stone etc. in a wall |
| 2. cement ( ) | b. one of the levels in a building |
| 3. course ( ) | c. a piece of hard material with straight sides |
| 4. earthquake ( ) | d. a substance used to cover walls and ceiling |
| 5. floor ( ) | e. a substance that becomes hard when it dries |
| 6. mud ( ) | f. not allowing water to enter |
| 7. plaster ( ) | g. a sudden shaking of the earth's surface |
| 8. stability ( ) | h. made of wood |
| 9. waterproof ( ) | i. wet earth that has become soft and sticky |
| 10. wooden ( ) | j. pointing up in a line that forms and angle of $90^0$ |
| | k. the condition of being steady |

**II. Fill in the blanks with the given words.**

**Compacted, destroy, durability, ground, load, paint, platform**
**Privacy, security, shelter, sloping, strength, ventilation, vertical**

1. The soil under the roads must be well……..
2. He lay on the ……..and stared up at the sky.
3. One of the most important features of a good carpet is its……..
4. No one wants another war which might ……. the world.
5. Such weight increases the ……. on the wheels.
6. Walls usually need at least two coats of ……..
7. There are strict……. checks on everyone entering the building.
8. Everybody needs to find food, ……. and safety.
9. Names have been changed to protect the …….. Of people.
10. This salon needs a powerful…….. system.
11. After a long walk, he didn't even have the …….. To stand up.
12. The opposite of horizontal position is ……. position.

**Glossary**

| | |
|---|---|
| anchoring | Providing support |
| apartment | A set of rooms on one floor of a building |
| beam | A long piece of wood or metal used in buildings |
| block | A piece of hard material such as wood or stone |
| brick | A hard block of baked clay |
| building | A house |
| cement | A gray powder made from lime and clay |
| column | A tall structure used to support a building |
| compacted | Compressed |
| concrete | A substance made by mixing sand, cement, and water |
| construct | To build something |
| course | A layer of bricks or stone in a wall |
| damp | A bit wet |
| destroy | To damage something |
| door | Something for entering a building or room |
| durability | Staying in good condition for a long time |
| Earthquake | A sudden shaking of the earth |
| enclosure | An area surrounded by a wall |
| External | Outside of something |
| Finishes | The outer surface of an object |
| flat | Smooth |
| floor | The outer surface of an object |
| Foundation | The solid layer that is put under a building |
| Ground | The surface of the earth |
| Internal | Inside of something |
| light | The energy from the sun or lamp |
| lintels | A piece of something on the top of a window or door |
| load | The amount of weight on something |
| maintenance | The cost of repairing |
| metal | Hard substance such as iron, gold, or steel |
| Mud | Wet soil |
| Opening | A space in something |
| paint | A colorful liquid that you put on surface |
| plaster | A substance used to cover walls |
| Platform | The raise place |
| plinth | A square block used as a base |
| privacy | The state of being free from public |
| roof | The structure that covers the top of a building |
| security | Safety |
| settlement | The process in which a building slowly goes down |
| shelter | A place to live |
| sill | The narrow shelf at the base of a window frame |
| slab | A flat piece of a hard material such as stone |
| Sloping | A surface that is not horizontal |
| soil | The top layer of the earth |

| | |
|---|---|
| space | An empty area |
| stability | The condition of being fixed |
| stairs | A set of steps built for going up |
| staircase | A set of stairs inside a building |
| stairway | Where there is a staircase |
| step | A flat narrow piece of wood or stone |
| stone | A hard mineral substance |
| strength | How strong something is |
| structure | A part of a construction |
| surface | A top layer of something |
| Ventilation | The act of letting fresh air come in |
| Vertical | Upright |
| wall | An upright structure made of stone or brick |
| waterproof | Not allowing water to enter |
| weathering | Changing color or shape over a period of time |
| window | A space of glass in the wall |
| wooden | Made of wood |

# Unit2. Building Materials (1)

The building **materials** which are needed for **masonry** work and the skill of the **mason** are important factors for the final **quality** of the masonry work. Therefore, it is important to use good raw materials. Bricks, stones, concrete blocks, **sand**, and cement are main raw materials for brick masonry.

## 2-1. Bricks

Bricks must be of good quality and without visible **cracks** for those walls which are under the roof. A clear sound which is made when two bricks are struck together shows that they have been burn well.

Generally, the bricks should be of true size and **shape**, with **straight edges** and surface to facilitate laying them into position without using too much **mortar**. Inferior bricks are generally **under – burnt**, **fragile** and very **porous**. Now all over the world, nearly all bricks are of the same shape and size.

Bricks are usually classified as common bricks, **facing** bricks, **solid** bricks, **cavity** bricks, and special shaped bricks. Common bricks, which do not have an attractive **appearance**, are suitable for general building work. Facing bricks which are completely burned, **uniform** in color, and have sharp edges are used in the face of the brick work without any plaster. Solid bricks are those bricks with holes fewer than 25% of their **volume**, in which **frogs** do not exceed 20% of its volume. Cavity bricks are burnt **clay hollow** blocks with holes larger than 20mm wide which exceed 20 % of their volume. Special shaped bricks are usually bricks of various shapes which are suitable for a particular construction.

## 2-2. Quality Bricks

Generally common bricks are grouped into 3 classes in terms of water **absorption** and **crushing** strength.

Bricks should be homogeneous in structure, **compact** and free from holes, **cracks**, **fissures**, air **bubbles**, **lumps**, **pebbles**, stones, particles of **lime** etc. The brick should be rectangular with straight and sharp edges. All bricks should have the same **dimension** and no broken corners or edges. The size of the bricks varies from region to region. Standard size is normally 230*115*70 mm. The quality of bricks can be checked by the following tests:

**Sound test:** The quality of a brick is good if there is a ringing sound when two bricks are struck together.

**Fall test:** A brick should not break when is dropped flat on hard ground from a **height** of about one meter.

**Scratch test:** A good burned brick has surface so hard that the fingernail cannot **scratch** it.

### 2-3. Stones

Building stone are built from various types of **rocks** that are found in nature. They are natural products which are used directly unless they are cut for their size and appearance. Stones are used in almost all parts of constructions such as foundation, walls, floors, roofs, and external and internal finishing.

Generally, walls with well fitted stones which are laid in cement mortar have a strength of about 75% of an equivalent brick wall, and walls made of **rough** stones have a strength of about 50% OF the equivalent brick wall. **Crushed** stones are used in making concrete and **artificial** stones such as concrete blocks.

### 2- 4. Quality of Building Stones

The most important features of building stones are strength, **density**, **durability**, and reasonable **facility** for working. A good building stone must be hard and uniform in texture and color. The quality of stones can be checked based on color, weight, water and appearance. Stones should have uniform color. Red and brown shades and **dotted** color indicate the presence of injurious materials. Basically, if a stone is heavier and its **grains** are more compact, it will be stronger and more durable. Moreover, a stone which adsorbs less water is stronger and more durable since water cannot break it into small pieces. A good building stone should be free from **decay**, cracks, and holes. There are some tests to check the quality of a stone.

**Hammer Test:** Take a hammer and check the stone for its sound. A ringing sound indicates that the stone is of good quality and has no major defect such as holes or cracks.

**Appearance test:** Check the stone for any **defects** such as cracks, **patches** with soft materials, discoloring etc.

**Absorption test:** Weigh a stone and place it for 24 hours into a **bucket** of water. A good building stone should not adsorb water more than 5% of its weight after 24 hours.

### 2 – 5. Concrete Block

Concrete blocks are nowadays very common since they save time. Concrete blocks can be produced by hand and by machine. **Handmade** blocks are usually of lower quality because machine made blocks are better compacted by a **vibrator** table. The specific use of a concrete block defines its size and the quality. Cement and coarse sand with small size aggregates are used with very low water/cement ratio for constructing concrete blocks.

Concrete blocks are classified into two main groups: solid blocks and hollow blocks. Hollow blocks have better thermal properties than solid blocks of the same materials and total thickness. Hollow blocks have certain advantages over bricks. They are only about one-third of the weight of the same number of bricks and they can be laid about four times rapidly. They are of enough strength for most purposes for which ordinary bricks are used.

**2-6. quality of Concrete Blocks**

The basic features of concrete blocks are strength, uniformity in size, and to a certain degree being water resistant. A good concrete block is produced and store under a sunshade, has an appropriate mix ratio(not more than 1:6 for hollow blocks, and 1:10 for solid blocks), contains clean raw materials (sand, aggregates, and water) and fresh cement. It should properly be used for 21 days and handled with care up to the point of use for masonry work.

**Exercise:**

**I. Match the items in column A with the items in column B.**

| Column A | Column B |
|---|---|
| 1. Aggregates ( ) | a. An open container with a handle |
| 2. Bucket ( ) | b. Staying in good condition for a long time |
| 3. Clay ( ) | c. Sand or small stones used in making concrete |
| 4. Decay ( ) | d. A relationship between two amounts |
| 5. Durability ( ) | e. A type of sticky soil |
| 6. Mason ( ) | f. A mixture of cement, sand, and water |
| 7. Pebble ( ) | g. The gradual destruction of building |
| 8. Ratio ( ) | h. Someone who cuts stone into pieces |
| 9. Solid ( ) | i. How thick something is |
| 10.Thickness ( ) | j. A small smooth stone on a beach |
| | k. Having no holes or spaces inside |

**II. Fill in the blanks with the given words.**

Appearance/cavities/compact/dimensions / facility / grain / handmade

1. We'll need to know the exact …… of the room.
2. There were some …….. of sugar on the table.
3. They have changed the …….. Of the whole building.
4. The apartment is very …….. A small family can live there.
5. Most people have some …… in their teeth.
6. She bought a pair of expensive …….. Shoes.

**III. Fill in the blanks with the given words.**

Materials / mortar / porous / resistance / rough / straight / weight

1. The quality of ……..depends on the quality of raw materials.
2. The island has to import oil and other raw ……
3. Her hands were …… from hard work.
4. Most building materials should show …… to weathering.
5. The road was completely ……..
6. The average …….. Of a baby at birth is just over seven pounds.

**Glossary**

| | |
|---|---|
| aggregates | Sand or small stones for making concrete |
| appearance | The way something looks |
| artificial | Not natural |
| bubbles | A ball of air in something |
| bucket | An open container with a handle |
| cavity | A space inside something |
| clay | Sticky earth |
| coarse | Having a rough surface |
| compact | Compressed |
| crack | A gap in something |
| Crushed | Broken |
| Crushing | Hardness |
| decay | The gradual destruction |
| defect | Problem |
| density | The relationship between the mass of something and its size |
| Dimension | The length, width, or depth of something |
| dotted | Full of dots |
| durability | The quality of staying in good condition |
| durable | Continuing for long time |
| edges | Blades |
| facility | The quality of being easy |
| facing | An outer space of a building |
| fissure | A deep crack in something |
| flat | Smooth |
| fragile | Easily broken |
| frog | An empty space in a brick |
| grains | Small sands |
| handmade | Made by hand |
| hollow | Empty space |
| lime | A white substance from limestone for making cement |
| load | pressure |
| lump | A small piece of something solid |
| mason | Someone who cuts stone into pieces for building |
| masonry | The skill of the building |
| materials | The things that are used for making something |
| mix | Combine |
| mortar | A mixture of cement or lime, sand, and water |
| patch | A small piece of material that is used to cover a hole |
| pebbles | A small smooth stone |
| porous | Full of very small holes |
| properties | Features |
| quality | How good or bad something is |
| ratio | A relationship between two amounts |
| raw | In a natural state |
| resistance | Refusing to change |
| rocks | Stones |

| | |
|---|---|
| rough | Not smooth |
| sand | Very small stones |
| scratch | Cut the surface of something |
| shape | Form |
| solid | Having no holes or spaces inside |
| straight | Direct |
| texture | pattern |
| thermal | Related to heat |
| thickness | How thick something is |
| Under-burnt | Not burnt or cooked completely |
| uniform | The quality of being the same |
| vibrator | An equipment that produces a small shaking movement |
| volume | The amount of space that an object fills |
| weight | How heavy something is |
| withstanding | bearing |

# Unit 3

## 3. Building Materials (2)

### 3-1. Sand and Aggregates

Sand and aggregates are very essential building materials. The materials which remain on a 4.75 mm sieve are classified as coarse aggregate, and below that size as fine aggregate or sand. The materials which pass a 75 – micron **sieve** are generally considered to be clay, fine **silt** or fine **dust** in an aggregate.

Sand which contains 90% of **particles** of size greater than 0.06 mm and less than 0.2 mm is fine sand. Sand which contains 90% of particles of size greater than 0.06 mm and less than 2 mm is coarse sand. There are mainly three sources from where coarse aggregates originate, namely natural deposits, crushed stones, and brick aggregates. There are mainly four types of sand, namely **pit** sand, sea sand, river sand, and crushed sand.

The quality of the mortar is directly related to the characteristics and condition of the sand. Sand and aggregates must be free from clay, loam, vegetables, and any other organic materials. Clay or dirt coating on aggregates prevents adhesion of cement to aggregates, slows down the setting and hardening process and reduces the strength of the mortar. Therefore, clay and silt content should not exceed 10% otherwise the sand need to be washed.

### 3-2. Testing the Sand quality

There are three main sand quality- testing methods:

**Visibility test:** check the sand for **impurities** such as organic materials (mud,

leaves, roots etc.). Remove them before using them.

**Hand test:** A sample of sand is rubbed between damp hands. If sand is clean, the hands get slightly **stained**. If the hands get dirty so much, it indicates the presence of too much silt or dirt.

**Bottle test:** Take a bottle and fill it with sand until it is half full. Fill it with clean water until the bottle is three quarters full. Shake it quickly and let it **settle** for about one hour. Clean sand will settle immediately, silt and clay will settle slowly on top of the sand. The thickness of the clay and silt layer should not exceed one-tenth or 10% of the sand below. This test is not applicable to crushed stone sand. Dirty sand should never be used in masonry it will reduce the **adhesive** value of the mortar so much.

Among different kinds of sand, sea sand is unsuitable for mortar since it contains salts which attract and retain **moisture**. In addition, the salt content in the mortar will produce a whitish powder which discolors the brickwork or masonry.

### 3-3. Cement

Cement is a mixture of 60 to 70% lime, 17 to 25% silica, and 3 to 8% alumina which are mixed together with water to form into **slurry** which is subsequently heated, dried, and ground to a very fine powder. A small **proportion** of **gypsum** is added before **grinding** in order to control the **rate** of setting.

Two processes happen when cement is used in masonry work: *setting* and *hardening*. Setting is the process which changes a **fluid** concrete to a solid but it is in a weak **state**. Hardening is the process by which the weak concrete attains strength. When water is added to cement, the cement hydrates and during the chemical reactions, which take place while the cement is setting, an increase in temperature occurs and a considerable quantity of heat is generated.

### 3-4. Types and Quality

There are five different kinds of cements. Cements are classified by their **properties** and chemical composition. The names of these five kinds of cements are: 1) ordinary Portland cement, 2) rapid hardening cement, 3) quick setting cement, 4) blast-furnace slag cement, 5) high alumina cement.

For **ordinary** brick masonry work, it is recommended to use ordinary Portland cement. In order to achieve a good mortar in strength and durability, the following rules should be followed:

Cement can be properly stored in bags for a few months if it is kept in a dry room. Paper bags are better for storing than **jute** bags because paper bags act better against moisture. During the monsoon time, the cement storage plays an even more important role since the relatively higher humidity **accelerates** the **deterioration** process of the cement.

Cement bags should be stored on a raised wooden platform about 15 to 20 cm above the floor level and about 30 to 50 cm away from walls. The cement **pile** should not be more than 10 bags high. The bags should be placed close together to reduce **circulation** of air. A cement bag should never be opened until its immediate use for mixing.

Ordinary Portland cement which has been stored for over six months should not be used for masonry work. The average **reduction** of strength as a result of storage is: **fresh** cement strength 100%, cement after 3 months, strength reduced by 20%, cement after 6 months, strength reduced by 30%, cement after 12 months, strength reduced by 40%, cement after 24 months; strength reduced by 50%.

### 3-5. Testing the Cement Quality

The indication of damaged cement is the presence of large lumps of set cement. These lumps of set cement should not be used, not even if they are ground again. The freshness of cement can be tested by the following tests:

**Lump test**: Check the cement for any lumps and remove them.

**Rubbing test:** When cement is rubbed between fingers and thumb, it should feel like a **smooth** powder.

Setting test: if you are not certain about the quality of cement, you can make a simple setting test. Make a **stiff** paste of neat cement and water and form it into a cake about 75 mm **diameter** and 12 to 15 mm thick. The cake should commence to set in about 30 to 60 minutes. In 18 to 24 hours the cake should be so hard that a fingernail cannot **scratch** its surface.

### 3-6. Water

The quality of a mortar increases as the water content of the mix is decreased. Water lubricates the mixture. However, increased water content will cause a decrease in strength, produce cracks (shrinkage) and decrease density. Therefore, both the quality and the quantity of the water are important for producing a good mortar and brick masonry work.

Almost any natural water that is drinkable and has no taste or odor can be used as mixing water for making cement mortar. Among different kinds of water, rainwater collected from roofs can be used for mixing mortar or concrete. Seawater should not be used as mixing water for cement mortar. Water mixed with any kind of oil shall not be used for mixing mortar or concrete.

Water should be stored where no **contamination** is possible. Water stored in clean **drums** or covered tank is preferred. The age of the water, or the storage time does not **affect** the cement mortar quality. Water of questionable suitability can be used for making cement mortar **cubes**. The water in question should achieve the strength in 7 and 28 days equal to at least 90% of comparable specimens made with drinkable water.

**Exercise:**

I. Match the items in column A with items in column B.

| Column A | Column B |
|---|---|
| 1. Circulation ( ) | a. The act of developing into a bad situation. |
| 2. Deterioration ( ) | b. Substances that are mixed with something else |
| 3. Drum ( ) | c. A soft white substance used to make plaster |
| 4. Gypsum ( ) | d. Qualities that a substance has |
| 5. Impurities ( ) | e. The condition in which something is |
| 6. Properties ( ) | f. The movement of liquid, air etc in a system |
| 7. Proportion ( ) | g. The process of getting less and less |
| 8. Reduction ( ) | h. A large round container for storing liquids |
| 9. Shrinkage ( ) | i. Getting hard and firm |
| 10. State ( ) | j. A part of a number or an amount |
| | k. Decrease in the amount of something |

II. Fill in the blanks with the given words.

**Accelerated/ affect/content / diameter / dust /harden / lubricate**

1. Smoking can ……. children as well as adults.
2. She kept the ……. of the letter secret.
3. Population growth …….. only after 1750.
4. The ……..of the earth is about 13,000 Km.
5. To run better please …….. Moving parts with grease.
6. It will take about 24 hours for the glue to …….

**Ordinary / pile / quantity / scratched / settles / silt / specimens**

1. Nearer the sea and along the river the soil were all fine……..
2. He began to sweep the pieces of glass into a file……..
3. After a minute, the silt in the bottle……. down.
4. Add 50 grams of butter and the same …….. Of sugar.
5. Some of the prisoners had …….. Their names on the walls.
6. This book is good because it is written in friendly, …….. language.

**Glossary**

| | |
|---|---|
| accelerate | Happens faster than usual |
| adhesion | The act of sticking something to something else |
| adhesive | Capability of sticking |
| affect | Have an effect on something |
| Circulation | the movement of something |
| contamination | pollution |
| content | The things that are inside something else |
| cube | A solid object with six equal square side |
| damaged | Harmed or injured |
| deterioration | Becoming worse |
| diameter | A line from one side of a circle to the other side |
| drum | A large round container for storing liquid |
| dust | Dry powder of dirt |
| fluid | A liquid |
| fresh | New |
| grind | To break something into powder |
| gypsum | A soft white substance that is used to make plaster |
| harden | Become firm |
| hydrate | To supply something with water |
| impurity | Something of low quality mixed with something else |
| jute | A natural substance used for making rough cloth |
| loam | Soil consisting of sand, clay, and plants |
| lubricate | Use something to make it move smoothly |
| moisture | Small amount of water in the air |
| ordinary | Usual |
| pile | A group of things that are put on top of each other |
| pit | A hole in the ground |
| powder | A dry substance in the form of very small grains |
| property | A quality of something |
| proportion | A part of a whole |
| quantity | An amount of something |
| rate | The number of times something happens |
| reduction | A decrease in something |
| rub | To move something over something else |
| scratch | To rub your skin with your nails |
| set | To become hard |
| settle | To go down in a liquid |
| shrinkage | The act of becoming smaller |
| sieve | A tool for separating small objects from large objects |
| silt | Mud or soil |
| slurry | A mixture of water and something |
| smooth | Having no holes |
| specimen | An example of something |
| stained | Dirty |
| state | Physical conditions |
| stiff | Firm and hard |

# Unit 4

## Mortar and Concrete

### 4-1. Mortar

Mortar is defined as a material which is composed of fine aggregates and cement and forms a hardened mass after mixing with water. It is used in the **beds** and side **joints** of masonry work in order to **bind** the stones, bricks, or blocks together and distribute the pressure throughout the block work. Mortar is further used also for plastering work and flooring. Good mortar for masonry consists of cement, sand, and water in the correct proportions. When the materials are freshly mixed, mortars have a plastic **consistency** and can be easily worked with **trowels** to fill the joints in masonry. Because of the setting properties of the binding materials such as cement or lime, they set and harden subsequently.

Generally, there are three common types of mortars for masonry and plastering work: cement mortar, lime mortar, and cement- lime mortar. Cement mortar is nowadays the most commonly used mortar for bricks as well as stones or concrete block masonry work. It provides high strength properties. Mix proportion varies according to **requirements** of masonry structure. Lime mortar is a mixture of **quicklime**(burnt limestone), sand in the proportion of 1 part lime and 3 parts sand, and water. Lime mortar was once the principal material used for bedding and jointing bricks and stones. It is used less frequently now as it hardens very slowly and is not easily available in the market. Cement-lime mortar was the most usual general purpose mortar which **comprises** 1 part cement, 2 parts lime, and 9 parts sand. The addition of lime improve the **workability** and makes it easier to use. Cement- lime mortar is mainly used for internal work.

### 4-2. Mortar Sand Granulation

The sand used for every kind of mortar must be clean and free from clay and other organic **matters**. For getting proper mortar, the **granulation** of the sand needs to be correct. Sand without fines (below 0.5 mm) gives a **harsh** mortar with low strength and bad workability. Cement mortar gives the best result when the sand comprises of 0-0.5 mm, 0.5-2 mm, and 2-4 mm in equal proportions.

The sand should be placed on a clean platform and a correct amount of cement should be added to it. Then both sand and cement must be **thoroughly** mixed before water is added. The general rule is that sand and cement should be mixed **dry** together at least 3 times before water is added. This is important for **achieving** the proper **plasticity**.

There are two methods to make sure of the correct mixture: **weight** method, and volumetric method. In weight method, mortar mixtures are expressed in Kilogram of

cement per 1 $m^3$ of cement mortar. For example, PC250 means that 250 kg of Portland cement, 1000 kg of sand and 120 liters of water are used to obtain about 1 $m^3$ mortar. This method is mainly used for large constructions in cities for bridges, hotels and shopping **complexes** etc. in volumetric method, certain volumes of raw materials are used for making mortar. This method is usually used on small and rural construction **sites**. Special care must be given to ensure that the **laborers** measure each time the same volume.

Mortars are **categorized** in mainly three groups in terms of the ratio of cement and sand. In the first group, one bucket of cement is mixed with four buckets of sand to be used in high strength **structural** units or load bearing buildings. In the second group, one bucket of cement is mixed with six buckets of sand for external house walls or other walls **exposed** to severe dampness. In the third group, the number of the bucket of sand increases to eight buckets to be used in highly **stressed** non- structural walls.

**4-3. Do's and Don'ts in Using Mortar**

**Do 1:** Always use clean sand for mortar. Things such as roots, leaves, plastic parts, dust, etc will not bind with cement and **weaken** the mortar. Moreover, sand with high percentage of clay or silt will weaken the mortar because the clay or silt contains too many fines that need to be covered by cement for proper binding.

**Do 2:** Always use fresh and lump- free cement for mortar. Old cement has lost its strength property. For example, cement that has been stored for about six months gain 30% less strength than fresh cement. For good masonry work, strength is important as it influences the overall building quality.

**Do 3:** Always mix the dry ingredients (sand & cement) together before adding water because wet sand particles have the tendency to **stick** together and are therefore cement cannot cover them. This results in reducing the mortar quality because each sand particle should ideally be fully covered with cement. Furthermore, adding water to sand and cement in one go makes mixing the mortar extremely difficult for the laborers.

**Do 4:** Always protect the mortar place from wind and sunshine since wind and sunshine dry the mortar too quickly and accelerate the hardening process before it is being used. This makes the mortar useless for any purpose.

**Don't:** Do not use or re-use mortar that has already hardened. As cement mortar sets relatively quickly (about 30 minutes), it should never be mixed in **huge** quantities. In hardened mortar, the hydration process of the cement has started and re-mixing it destroy the **bond** between cement and sand. This bond cannot **gain** strength again by simply adding fresh water to the mortar.

**4-4. Concrete**

In its simplest form, concrete is a mixture of **paste** and aggregates. The paste, which is **composed** of Portland cement and water, **coats** the surface of the fine and coarse aggregates. Through a chemical reaction which is called hydration, the paste hardens and gains strength to form the rocklike **mass** which is known as concrete. There is a remarkable **trait** for concrete in this process: it' s plastic and flexible when it is newly mixed, strong and durable when it is hardened. These qualities explain why this single material can build **skyscrapers**, bridges, **sidewalks** and superhighways, houses and dams.

The key to achieving a strong, durable concrete is in the careful mixture of the ingredients. A concrete mixture that does not have enough paste to fill all the **voids** between the aggregates will be difficult to place and will produce **rough**, honeycombed surfaces and porous concrete. A mixture with an **excess** of cement paste will be easy to place and will produce a smooth surface; however, the resulting concrete is likely to **shrink** more and be uneconomical.

A properly designed concrete mixture will **possess** the desired workability for the fresh concrete and the required durability and strength for the hardened concrete. Typically, a mix is about 10 to 15 percent cement, 60 to 75 percent aggregate and 15 to 20 percent water. The air in many concrete mixes may also take up another 5 to 8 percent.

Portland cement's chemistry comes to life in the **presence** of water. Cement and water form a paste that coats each particle of stone and sand. Through a chemical reaction which is called hydration, the cement paste hardens and gains strength. The **character** of the concrete is determined by quality of the paste. The strength of the paste, in turn, depends on the ratio of water to cement. The water-cement ratio is the weight of the mixing water divided by the weight of the cement. High – quality concrete is produced by **lowering** the water- cement ratio as much as possible without the workability of fresh concrete.

**Exercise:**

**IV. Match the items in column A with the items in column B.**

| Column A | Column B |
|---|---|
| 10. Achieve ( ) | l. The quality of being changed into any shapes |
| 11. Categorized ( ) | m. A group of buildings |
| 12. Complex ( ) | n. An empty space within something |
| 13. Consistency ( ) | o. To do something successfully |
| 14. Huge ( ) | p. To make weaker |
| 15. Plasticity ( ) | q. Very big in size or amount |
| 16. Presence ( ) | r. A path in two sides of a street for people |
| 17. Sidewalk ( ) | s. To put things or people into groups |
| 18. Skyscraper ( ) | t. The quality of always being the same |
| 10. Weaken ( ) | u. A very tall building |
| | v. Being in a particular place |

**V. Fill in the blanks with the given words.**

**Bind / coat / composed / excess / harsh / joint / matter**

1. We will feel better if you lose the ……..weight.
2. The brick walls of the garden are clean and tidy, but rather ……..
3. A thin layer of a paint you sprayed over the surface of something is a ……..
4. Solid, liquid, and gas are three forms of ……..
5. Water is …….. Of hydrogen and oxygen.
6. What should I use to seal the ……..between the floor and the water.

**Possess / requirement / shrinks / sticking / thoroughly / trait / weight**

1. It is illegal to…….. A gun in Britain.
2. The oil keeps the pasta from …….. together.
3. They looked for the key in the garden…….
4. Potatoes can provide one-third of our daily ……. of vitamin C.
5. It is a mental illness associated with particular personality…….
6. I'm worried about washing that shirt in case it ……..

**Glossary**

| | |
|---|---|
| achieve | To successfully complete something |
| bed | The ground at the bottom of something |
| bind | To form a connection |
| bond | Something that unites two things |
| categorize | To put people or things into group |
| character | A quality of something or somebody |
| coat | To cover something |
| complex | A group of buildings |
| compose | To be formed from a number of parts |
| comprise | To consist of parts |
| consistency | The quality of being the same |
| dry | Without water |
| excess | A large amount of something |
| expose | To show something that is usually covered |
| gain | Get something you want |
| granulation | The division of something into small particles |
| harsh | Rough |
| huge | Very large |
| joint | A place where two parts of an object are linked |
| laborer | worker |
| lower | Reduce something |
| mass | A large amount of something |
| matter | Material |
| paste | A type of glue |
| plasticity | The quality of being easily made into any shape |
| possess | Have |
| presence | When someone or something is present in a place |
| protect | To keep someone or something safe |
| quicklime | A white powder that is made by heating limestone |
| requirement | Something that someone needs |
| rough | Not smooth |
| shrink | To become smaller |
| sidewalk | A path at the side of a street |
| Site | An area where something is being built |
| skyscraper | A very tall modern city building |
| stick | To attach something to something else |
| stress | The physical pressure on an object |
| Structural | Connected with the structure of something |
| Thoroughly | completely |
| trait | A particular quality |
| trowel | A flat tool for spreading cement |
| void | An empty space |
| weaken | To make someone or something less powerful |
| weight | How heavy something is |
| Workability | easiness of working |

## Unit5.

# Green Buildings

### 5-1. Features

Green buildings are structures that are built in a way that maximize the use of materials, minimize the use of resources, and ensure the health of **occupants** and the **surrounding** environment. Such buildings minimize their environmental **footprint** and improve the **well-being** of the people who live and work in those buildings. There are seven topics that should be addressed in the designing and constructing these buildings:

**1) Sustainable sites:** sites should be selected by determining which **site** would have the least environmental threat if a building is made. **Pollution** is the most important factor to be considered. Sites which are chosen should be close to **urban** areas where **infrastructures** are available. This will preserve green space and **wildlife** areas. The availability of public transport is another important factor to consider.

**2) Water efficiency:** the main goal is to increase water efficiency use within the building to reduce the amount of water needed for operations. Some methods which can be designed in a building include efficient **landscaping** and the use of innovative wastewater management technologies.

**3) Energy and atmosphere:** Energy systems should be properly **installed** to save the expensive energies. This should reduce the overall energy use and lower operating costs. A minimum level of acceptable energy performance for the **facility** should be determined.

**4) Materials and resources:** the construction process is highly energy dependent. Particularly through the **manufacture** and transport of materials. The amount of **landfill** waste which is created during construction and operation can be reduced by **efficient** use of materials and recycling.

**5) Indoor environmental quality:** To enhance the well-being of occupants, design should use low emitting materials in construction including **adhesives**, **paints**, and **coatings**. Ventilation systems that promote outdoor air ventilation are better and should not allow for outside pollution to enter the building. Buildings should be designed to maximize the use of natural light for all occupants. Lighting and heating should be designed to manually or automatically turn off to reduce energy consumption.

**6) Innovation in design:** Design decision should be made early in the process since good design can greatly reduce energy consumption of a building. For example, the orientation and location of a building can maximize daylight, shade, and ventilation naturally.

**7) Regional priority:** Design should be maximized to take into account **regional** priorities. In colder climates, buildings could be designed to maximize heating efficiency; in hotter climates, cooling and water usage would gain more important in the design process.

### 5-2. Principles of Sustainable Design

To educate architects to meet this goal of coexistence, a conceptual framework has been developed. The three levels of framework (**principles**, Strategies, and Methods) correspond to the three objectives of architectural environmental education: creating environmental awareness, explaining the building **ecosystem**, and teaching how to design **sustainable** buildings.

We propose three principles of sustainability in architecture. **Economy** of **resources** is concerned with the reduction, reuse and **recycling** of the natural resources that are input to a building. *Life cycle* design provides a methodology for analyzing the building process and its **impact** on the environment. *Human design* focuses on the interactions between humans and the natural world. These principles can provide an awareness of the environmental impact of architectural consumption.

Each of these principles shows a unique set of strategies. Studying these strategies leads students to better understanding of architecture's interaction with the greater environment. This allows them to further analyze specific methods architects can apply to reduce the environmental impact of the buildings they design.

**Exercise:**

**I. Match the items in column A with the items in column B.**

| Column A | Column B |
|---|---|
| 1. Adhesive ( )<br>2. Coating ( )<br>3. Footprint ( )<br>4. Location ( )<br>5. Occupants ( )<br>6. Recycling ( )<br>7. Site ( )<br>8. Threat ( )<br>9. Well-being ( )<br>10. Wildlife ( ) | a. A place where you find something<br>b. Use of energy more than necessary<br>c. Something like glue<br>d. A place where some buildings are built<br>e. All residents who are in a place<br>f. Comfort or easiness<br>g. A layer that cover something<br>h. A possible danger<br>i. Treating something to use it again<br>j. The effect of something<br>k. All animals or plants of an area |

**II. Fill in the blanks with the given words.**

Climates / economy / consumption / facility / landfill / manufactured / orientation

1. Total …….. Of energy reduces by 20% in green buildings.
2. These building materials are not suitable for cold…….
3. All buildings should have private…….. like private bathroom and toilet.
4. The gas fire was turned low in public buildings for reasons of …….
5. Imports of eco-friendly……..materials have increased rapidly.
6. The …….. of the building should be towards the sun.

Outdoor / paint / pollution / principles / regional / resources / surrounding

1. The college is good for students who are interested in……..activities.
2. There are so many ……. variation in design of the buildings.
3. The……. areas have attractive construction sites.
4. The whole house can be enhanced with a fresh coat of……..
5. It's against the ……. of sustainable design to use nonrenewable materials.
6. Most environmental…….. Originates in the developed countries.

**Glossary**

| | |
|---|---|
| adhesive | A substance that sticks two things together |
| climate | The typical weather condition in an area |
| coating | A thin layer of something that covers a surface |
| consumption | The amount of something that is used |
| economy | The careful use of money, time, goods etc. |
| Ecosystem | All the animals and plants in an area |
| efficient | Using something well without wasting it |
| facility | Services that are provided |
| footprint | The effect of something |
| impact | The effect of something |
| infrastructure | The basic systems and structure |
| install | To put a piece of equipment into use |
| landfill | A place where waste is put under the ground |
| landscaping | To make park, garden etc. look attractive |
| location | A particular place in relation to other areas |
| manufacture | To make goods or materials |
| occupants | Someone who lives in a house, room etc. |
| outdoor | Existing outside a building |
| paint | A colorful liquid that you put on a surface |
| pollution | The process of making air, water, or soil dirty |
| principle | The basic idea that a system is based on |
| Recycling | The process using materials again |
| regional | Relating to a particular region of area |
| resources | Useful land, or materials that exist in a country |
| site | An area where something is built |
| Surrounding | near or around a particular place |
| sustainable | To continue without causing damage to the environment |
| threat | A possible danger |
| Well-being | A feeling of being comfortable, healthy, and happy |
| Wildlife | Animals and plants growing in natural conditions |