TRADE OF PLASTERING

PHASE 2

Module 1

SLABBING, RENDERING, FLOATING AND SKIMMING

UNIT: 4

Rendering Walls

Produced by

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Introduction

Welcome to this section of your course which is designed to introduce you the learner, to identify backgrounds, interpret drawings and building symbols, and calculations

Unit Objective

By the end of this unit each apprentice will be able to:

- Identify backgrounds and characteristics of walls
- Identify and interpret drawing elements and practices
- Interpret representation of building materials
- Interpret and draw quadrilaterals
- Dispose of waste in the correct manner
- Calculate areas for rendering
- Use calculator

1.0 Identify Backgrounds and Characteristics of Walls

Key Learning Points

- Different types of backgrounds and characteristics of walls
- Composition and mixing of materials, i.e. sand/cement/lime
- Aggregates, types of aggregate suitable for plasterwork and rendering

1.1 Different Types of Backgrounds

Some typical backgrounds are:

- Main walls - brickwork, masonry, concrete, or a combination of the materials.
- Solid partition walls - breeze, pumice, burnt-tile or plaster blocks.
- Stud partitions or joist ceilings - wood laths, metal lathwork, plaster boards, fibre boards or plaster slabs.
- Fire resisting ceilings - reinforced concrete, burnt-tile blocks, or a combination of the two or patent hollow-tile units.
- Suspended ceilings - metal lathwork wired or clipped to mild-steel bars or rods or to one of the patent steel fixings.

What Plastering Involves

Preparation of surfaces is vital to the success of good plasterwork, and the various backgrounds must be approached and treated accordingly

Economy

In many cases plastering is the cheapest way of finishing a structure, avoiding the labour and expense of first-class brick or stonework. Once done, the surface only requires to be kept in fair repair to ensure weather-tight walls. The periodical painting takes little time, and in the long run, will prove less costly than repointing the brick, entailing the preliminary process of raking out joints and cutting out soft crumbling bricks etc.

Fire Resistance

Plaster forms a natural barrier to fire. Plastered surfaces will not burn nor facilitate the spread of flame and the high degree of resistance which plastering affords against the passage of heat and flame is another very important reason for its widespread acceptance. Steel beams, stanchions etc., are sometimes encased in plasterboard and plastered providing excellent resistance to fire.

1.2 Composition of Materials

Sand for Plastering

Sand is a fine aggregate formed by the natural disintegration of rock or it is artificially created by crushing stone or gravel to the required sizes. Only small amounts of crushed stone sand are used in the plastering industry, its use being confined to special cement work on the whole. Natural sand has been formed over the centuries by the action of wind, rain, frost and running water to break down rocks into small particles. These small grains varying in size, have been washed by the action of the seas and rivers and deposited in certain areas which have in turn been moved inland due to past changes to the earth's formation. This the reason for large pockets or deposits of sand many miles inland. The two main types of sand available at present are pit sand from inland quarries and river sand obtained by dredging. Sea sand is unsuitable because of the risk of efflorescence due to the presence of salt. Crushed stone often contains too much fines.

Pit Sand

Pit sand varies in quality, even in the same pit. In some parts the sand may be quite clean and well graded, while in others it is contaminated by impurities washed down from the surface, or is not well graded. Where there is a possibility of contamination the sand should be washed. Most pits have washing plants, and the sand can be bought with a guarantee of cleanness.

It must be remembered that a dirty sand will give a weak mortar. A quick test for cleanliness is to rub some sand between the hands. If the hands are left with a brown stain then the sand is most probably too dirty and further tests must be made.

Sand must be well graded. This means that the sand has the right proportion of course and fine particles. Too many coarse particles will make the mortar fall apart and difficult to spread, and too many fine particles make the mortar **"Stodgy"** and again not too easy to use.

River Sand

River Sand is suitable for plastering because it is free from clay, when well graded it is ideal for external work for its water-proofing qualities. It is taken from rivers by means of dredging. **The only disadvantage of river sand is that the water may be contaminated by industrial refuse.**

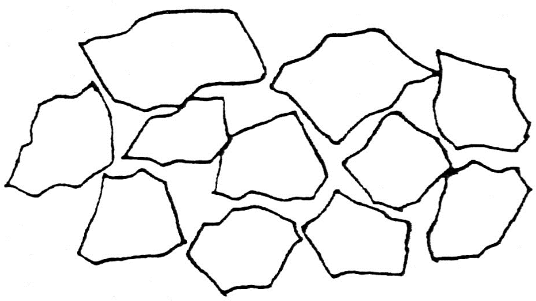
Sea Sand

This sand contains salt, which is liable to cause efflorescence. The salt being gradually drawn to the surface and there appearing as a crystallisation. Even where concrete is concealed, the salt crystal may cause trouble by spoiling decorations or by exerting pressure in the interface between concrete and plaster or rendering.

Desert Sand

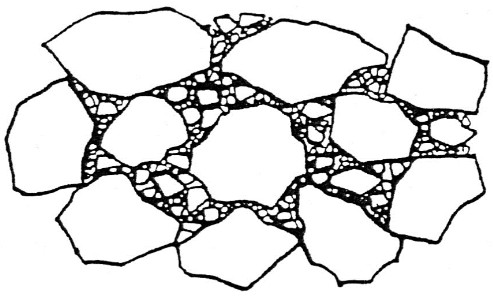
This sand is usually windblown. In most cases it is unsuitable on account of it being fine and uniform in particle size.

A good sand should contain a suitable proportion of large, medium and small sized grains. The reason for this can be seen in the figures below.



Sketch of a sample of BADLY graded sand

Note the voids or spaces between the particles of sand.



Sketch of a sample of WELL graded sand

Note that large voids are filled with medium and small sized grains.

If the sand is composed of large particles only, then there will be many spaces or voids between the grains. This type of sand would require a lot of lime or cement to make a strong, dense mix. As a result the mix would be expensive and, because of extra shrinkage, would not be strong enough. A well graded sand has medium sized grains to fill in the larger voids and small sized grains to fill in the smaller voids.

The functions of a sand are:

- To induce the mix to shrink uniformly during the process of setting and hardening, irregular shrinkage being a general cause of cracking.
- To lower the cost of the mixed material by providing the biggest bulk of the mix.
- To assist workability, particularly on thicker applications such as floating coats.

1.3 Cements

Portland Cement

Portland cement is an artificial cement invented by Joseph Aspden in 1824. He named his new cement Portland because of its resemblance to Portland stone when set.

The raw materials used in the manufacture of Portland cement are limestone or chalk and clay, or shale, roughly in the proportions of 78% limestone: 22% clay.

Portland cement is manufactured by two different methods, the wet and dry processes.

In the wet process, the separate materials are quarried, crushed, ground, mixed into a slurry and then combined together. At this stage, the slurry is tested for its chemical constituents and adjusted as necessary.

This corrected slurry is fed into a rotary kiln to be burned to a cement clinker. The rotary kilns are in the form of horizontal cylinders about 120m long and 4.2m in diameter. The kiln itself revolves once every minute. A slight incline is allowed in the length of the kiln to allow the material inside it to travel gradually through during manufacture.

Heat is applied at the lower end of the kiln, often by powdered coal and forced air. The temperature is approximately 1650°C at this portion of the kiln, becoming progressively cooler towards the far end.

In its passage through the kiln, the slurry is dried, heated and burned until the materials fuse into a new chemical combination known as cement clinker.

This is now passed into a clinker store to cool. After cooling, it is mixed with 1-5 per cent of raw gypsum and then ground until at least 90 per cent of it will pass through a 170 sieve. This sieve contains 28,900 holes per square of 25mm sides. The purpose of the gypsum is to prevent a flash set of the mixed cement.

In the dry process of manufacture, the raw materials contain only a small proportion of water, resulting in cost savings. Many of the newer plants use this method.

All cement manufactured in Britain is made to conform to British Standards Specifications, and this includes strict standards of fineness, chemical composition, strength and setting times.

Setting time is the period between the addition of water and the time when the mix stiffens. The initial set should not be less than 45 minutes, and the final set not more than ten hours.

Hardening commences after the final set and, providing sufficient moisture is available for continued hydration (chemical action between water and cement), will continue indefinitely. To ensure conditions as described above, all important cement work should be 'cured' by restricting the moisture loss or providing sufficient moisture for hardening to continue long enough to achieve the desired strength.

Other Types of Portland Cement

White Portland Cement is manufactured from pure limestone and white china clay. Special precautions to prevent contamination by iron or other staining agents have to be taken during the manufacturing process.

Coloured Cements are obtained by mixing pigments with white cement for light tones, and with ordinary Portland cement for darker colours. Coloured cements are also pre-mixed with special graded sands and only require the addition of water.

Cullamix is designed for use with Tyrolean textured work, and for certain types of plain floated and stippled work.

Rapid Hardening Portland Cement hardens quicker than ordinary Portland cement due to finer grading and burning at a higher temperature during manufacture. The extra manufacturing costs are responsible for its higher price. Its setting time is no quicker than ordinary Portland cement, but after the final set, hardening takes place more rapidly.

The addition of 2% of calcium chloride to ordinary Portland cement increases the rate of setting and hardening. Calcium chloride should not be added to quick setting cements.

Due to faults arising from past misuse of calcium chloride, great care must be taken to prevent incorrect usage.

Weatherproofing and Water-Repellent Cements are composed of ordinary Portland cement plus very finely ground materials which result in a more complete pore filling mix to give a dense impervious mass when set.

Masonry Cement is ordinary Portland cement plus an addition of finely ground materials which help to plasticize the mixed cement. With this type of cement, a fatty mix with good workability can be obtained without the use of putty lime or other separate plasticizers.

High Alumina Cement

Is not a Portland cement and is manufactured from bauxite and clay. It is black in colour; it sets and hardens more quickly than ordinary Portland cement, and is also resistant to certain sulphates and weak solutions of acids. The trade names for high alumina cement are Ciment Fondu and Lightning.

Different grades of cement should not be mixed and used together, particularly Portland Cement and High Alumina Cement because of the serious adverse reactions.

Lime

The manufacture and use of lime for mortar and plaster are among the most ancient arts known to man. Lime was used by the ancient Egyptians for plaster, some of which has endured until today. The Romans too used lime in this respect and many of their great buildings still stand as monuments to the durability of this building material.

One of the most important characteristics of lime is the degree of flexibility it imparts to mixes. This flexibility is essential to help offset the movement that occurs during and after construction i.e. vibration due to traffic or foundation settlement. Lime also confers on mixes in which it is used, the valuable properties of plasticity and workability. These give ease of application with good adhesion to the surfaces on which the mixes are applied. A property allied with workability is that of good water retention.

Lime is "tight-fisted" against the suction of porous backgrounds to which it may be applied. The mix containing lime in such instances will not readily part with its water content, therefore affording ample time for the working of the mix before it loses its workability.

Production of Lime

The raw material from which lime is manufactured is found either in the form of chalk or limestone. These materials are either quarried (open-cast mines) or mined from deeper deposits. The main chemical constituent of chalk or limestone is **Calcium Carbonate** which comprises 85-100% of the material chalk and limestone of this quality is what is usually used to produce **Hydrated Lime**. The first step to produce hydrated lime is the crushing of the chalk or limestone, which is then placed in kilns and heated up to 2500°F.

This is a calcining process similar to that used in the manufacture of cement or plaster. During calcining the **Calcium Carbonate decomposes, Carbon Cioxide Gas** is driven off and a material known as **Calcium Oxide**, or more commonly called "quicklime" remains. The change may be written in the form of a chemical equation or formula so: **CaCO3 + Heat = CaO + CO2 Calcium Carbonate + Heat = Calcium Oxide + Carbon Dioxide**

This material **"Quicklime"** is very caustic and has very violent reaction when contacted to water which is sufficient to actually boil the water. This reaction is used in a controlled fashion (the temperature being kept to an even 212°F) to **"Hydrate"** the quicklime or **"Slake"** it, to use a more commonly used term. The hydration or slaking is represented by the following chemical equation or formula: **CaO + H2O = Ca (OH) 2 Calcium Oxide + Water = Calcium Hydroxide (Hydrated Lime)**

Storage

Hydrated Lime should be stored in cool, dry, draught-free conditions to avoid the absorption of CARBON DIOXIDE from the atmosphere which can occur to a considerable degree even through paper sacks.

1.3 Aggregates Suitable for Plasterwork and Rendering

Shingle

Small, sharp cornered, this plastering aggregate is used principally for dry dash, though it can on occasion be used for rough casting if mixed with other material i.e., sand. When used for Dry Dash it should be free of sand or any fine dusty material which might cause unsightly patches in the finished surface.

Pea Gravel

Pebbles that comprise this aggregate are mainly rounded in shape making it a very suitable material for rough casting. Mixed with specific portions of sand, cement and lime, it is applied to surfaces in a wet mix. Pea Gravel could of course be used for dry dash but on account of the round nature of the pebble it would offer little in the way of safe adhesion if used for this type of finish.

Spa

This consists of fine chips of white or light-coloured aggregate. Very suitable as a dry dash material if free of dust or very fine particles, which might cause unsightly patches on the surfaces when completed.

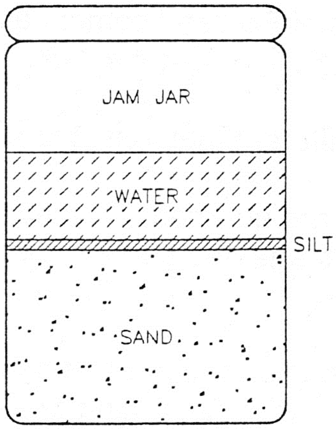
Stone Aggregate

As can be surmised from its title this is used chiefly for cast stone work. ("Cement Pressings" is another term used to describe this type of aggregate)

Field Tests on Aggregates

An essential requirement for all aggregate to be used in concrete or plaster is that it be clean. This is particularly important in the case of sand and a simple test which can tell you if the sand meets this requirement is known as the "jam jar" test. The procedure for this test is as follows:

- Place about 50mm of sand in a 1lb jam jar.
- Pour in water until there is about 25mm of water above the sand.
- Shake the jar well.
- Leave to stand for 3 hours.
- A layer of clay will form on top of the sand. This can be measured and should not be more than about 3mm.



While a three hour period is specified and the water will then be clear, one can, with reasonable experience, judge whether or not the amount of clay is excessive after 10/15 minutes.

This test can be carried out if one suspects that a truck load of sand is dirty. Ten minutes is a reasonable time for a truck to wait and this is certainly preferable to having to remove an unsatisfactory load after it has been tipped.

Note: This test is not suitable for crushed rock sands or coarse aggregate.

2.0 Identify and Interpret Drawing Elements and Practices

Key Learning Point

- Characteristics of drawings - lines, lettering and preferred scales

2.1 Characteristics of Drawings

Before commencing a drawing it is important to have knowledge of the materials and equipment available and to know the correct procedures. In general most drafting techniques will apply to architectural drawings.

Drawing Papers Standard Sizes (mm)

- A0 - 841 × 1189
- A1 - 594 × 841
- A2 - 420 × 594
- A3 - 297 × 420

There are many qualities of drawing paper and the selection will depend upon the nature and purpose of the work.

Cartridge Paper: A wide range of cartridge paper is available, suitable for pencil or ink. They vary in terms of type, thickness, surface finish and quality.

Detail Paper: Suitable for preliminary drawings/sketching.

Tracing Paper: There are also many qualities of tracing paper. It is used for tracing and copying by photocopying machines. It is suitable for pencil or ink.

Pencils: Pencil leads are produced in a variety of hardness ranging from 9H to 5B. The drawing media used will determine the type of pencil that should be used.

Ink: Drawing ink can be obtained in a range of colours, e.g. Black, Green, Red etc.

Other Materials Available: Erasers, Drafting Tape.

Equipment: There is a wide range of drafting equipment available e.g. tee-squares, set-squares, drawing boards, drafting machines and print making equipment.

Rules for Mechanical Drawing

1. Hands and instruments must be clean.
2. A 2H pencil is used for drawing lines.
3. The pencil point must be sharp.
4. Guide lines must be drawn lightly.
5. All dimensions must be accurate.
6. Eraser must be used as little as possible.
7. All necessary construction lines must be seen.
8. All work must be neat and tidy.

2.2 Types of Line

The types of line for drawings recommended by the British Standards Institution in BS 308: 1972 are shown. Two line thicknesses are recommended: thick, 0:7mm wide; and thin, 0.3mm wide. These widths can be attained by using tubular ink pens, but for pencil drawings the recommendation can be interpreted as meaning that thick lines should be approximately twice as wide as thin lines.

The visible outlines of the object are drawn in continuous thick lines. They should be the most prominent lines on the drawing.

The hidden outlines of the object are represented by lines made up of short thin dashes. The dashes and the gaps between them must be consistent in length and approximately to the proportions as shown. At corners and tangent points of arcs, dashes should meet.

The continuous thin line is used for dimension lines, projection lines, leaders for notes, hatching or section-lining, the outlines of adjacent parts and revolved sections, and fictitious outlines.

The limits of partial views and sections are shown by continuous irregular lines when the line is not an axis. These lines are thin and re drawn freehand.

Centre lines and the extreme positions of moveable parts are shown by thin chain lines. These comprise long dashes alternating with short dashes, not dots, proportioned approximately as shown. The lengths of the dashes and their spacing may be extended for very long lines.

Cutting planes for sections are represented by chain lines, thick at their ends and at changes of direction, thin elsewhere.

Thick chain lines indicate surfaces which have to meet special requirements. The lengths of the parts of these lines and the spacing between them should be similar to those of thin chain lines.

Example	Type of Line	Line Width MM	Example of Application
A	Continuous (think)	0.7	Visible outlines and edges.
B	Continuous (thin)	0.3	Fictitious outlines and edges. Dimension and leader lines. Hatching. Outline of adjacent parts. Outline of revolved sections.
C	Continuous Irregular (think)	0.3	Limits of partial views or sections when the line is not an axis.
D	Short Dashes (thin)	0.3	Hidden outlines and edges.
E	Chain (thin)	0.3	Centre lines. Extreme positions of moveable parts.
F	Chain (think ends, changes of direction, thin elsewhere)	0.7 0.3	Cutting planes.
G	Chain (think)	0.7	Indication of surfaces which have to meet special requirements.

2.3 Lettering

The essential features of lettering on drawings are legibility, uniformity and the ability to be produced rapidly. Legibility and speed are achieved by the use of block, single-stroke style which may be either upright or sloping. Students are recommended to use the upright style as it is easier to produce. Single-stroke lettering has all the strokes of uniform thickness, and each stroke is produced by one movement of the pencil. Capital letters are preferred to lower case ones, being less congested and less likely to be misread when reduced in size or prints. Lower-case letters should, however, be used when they are part of a standard symbol, code or abbreviation.

Example:

A B C D E F G H I J K L M N O P Q R S T U V W X Y Z

Abcdefghijklmnopqrstuvwxyz

1 2 3 4 5 6 7 8 9 0

A C D E F G H I J L M N 0 P Q R S T U V X Y Z

Abcdefghijklmnopqrstuvwxyz

1 2 3 4 5 6 7 8 9 0

0.5 2.6 3800 14 970

Rules for Lettering

1. Lettering is freehand in mechanical drawings.
2. A HB pencil is used.
3. Lettering is between guide lines.
4. Each letter must be properly shaped.
5. Letters of each word must be close but not touching.
6. The words must have definite spaces between.
7. Spelling must be correct.
8. Ornamentation must be avoided.

2.4 Preferred Scales

Most common scale is 1:50, where 1mm is equal to 50mm.

This line is 60mm long; on a scale of 1:50 this is equal to 3000mm or 3M.

1:20 -1mm is equal to 20mm (This scale can be used for detail drawings such as details of block work) 1:100 -1mm is equal to 100mm.

Laying Out Drawing Sheet

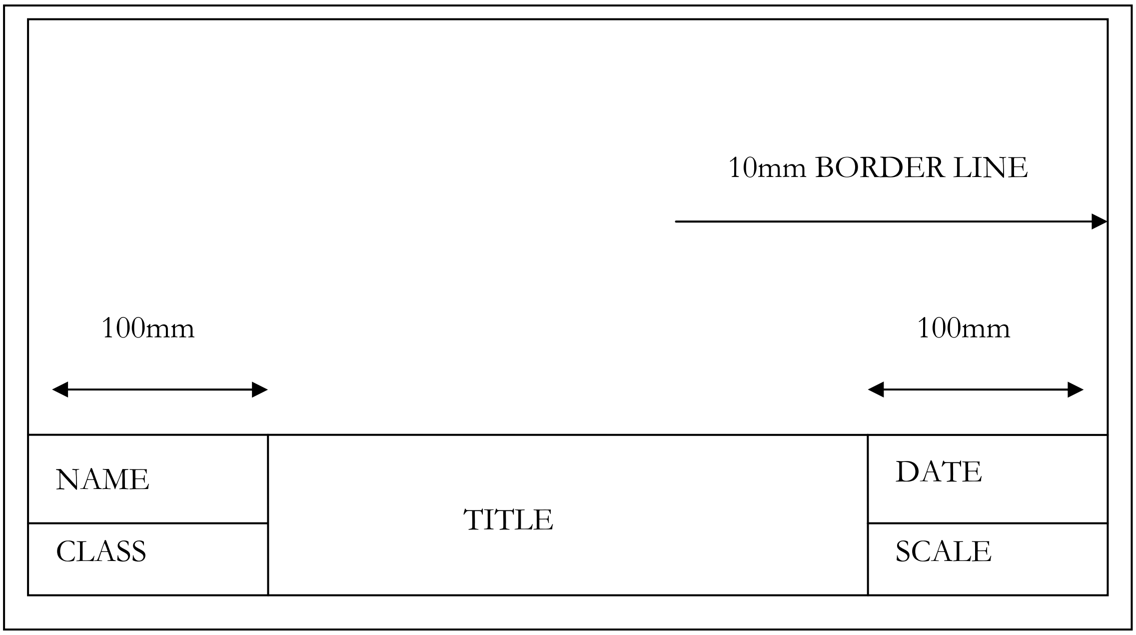


Figure 1. Drawing sheet

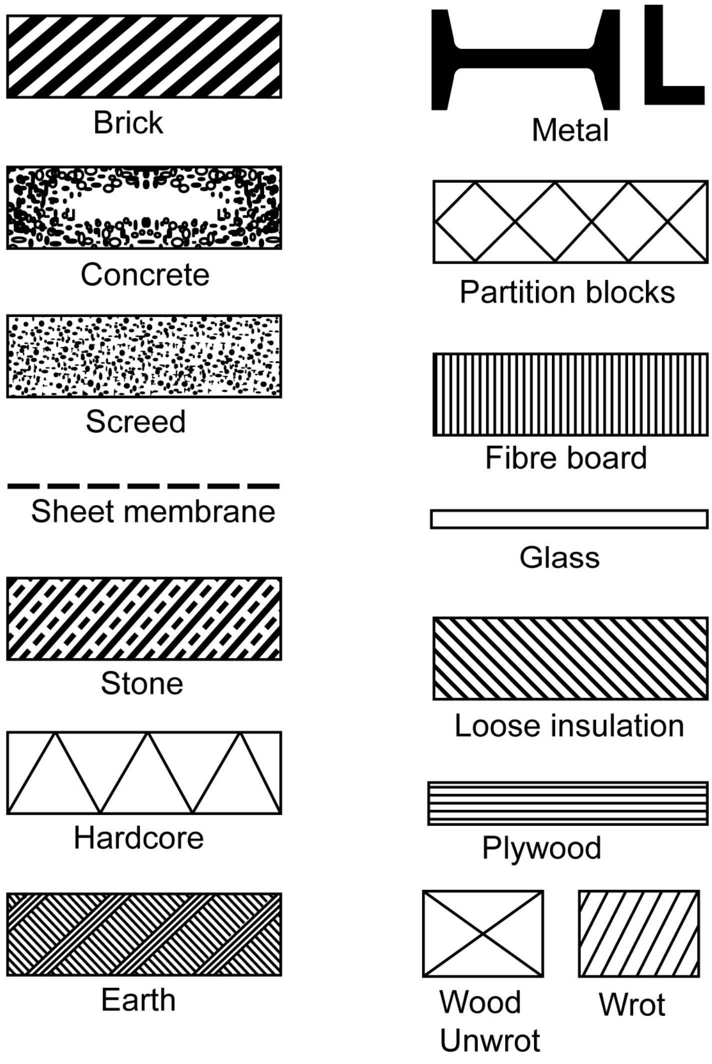
3.0 Interpret Representation of Building Materials

Key Learning Point

- Drawing symbols of building materials

3.1 Drawing Symbols

Hatching



4.0 Interpret and Draw Quadrilaterals

Key Learning Point

- Construction of basic quadrilaterals

4.1 Basic Quadrilaterals

Quadrilaterals

A quadrilateral is a figure bounded by four straight lines, as in Figure 2 below.

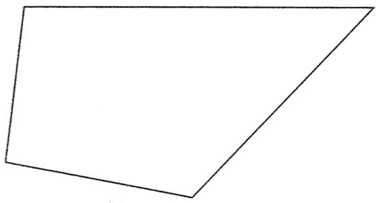


Figure 2

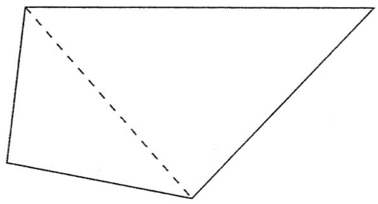


Figure 3

It can be split into two triangles with a diagonal line, as in Figure 3.

The sum of the angles in a triangle is 180 °, therefore the sum of the four angles in a quadrilateral must be 360 °. If three of the angles are known, the fourth can be found.

Example:

In the quadrilateral shown in Figure 4 find the size of the angle *x*.

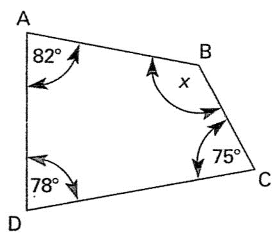


Figure 4

We know the sum of the angles ABCD is 360 °, therefore

X = 360 ° - (82 ° + 78 ° + 75 °)

= 360 ° - 235°

= 125°

The following are all examples of quadrilaterals.

Parallelogram

In a parallelogram the sides that are opposite each other are of equal length and are parallel to each other (Figure 5). The angles that are opposite to each other are also equal. Providing one of he angles is known, the other three can be found. The diagonals AD and BC bisect each other and the parallelogram to form two congruent triangles. The area of a parallelogram can be found by multiplying the base by the **perpendicular** height (this means at *right angles* to the base).

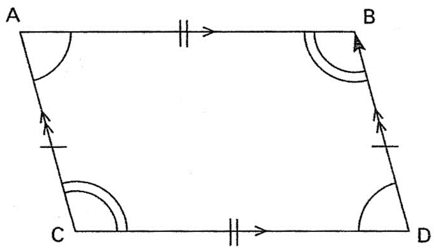


Figure 5

Example:

Find the area and the angles *x*, *y*, and *z* for the parallelogram in Figure 6.

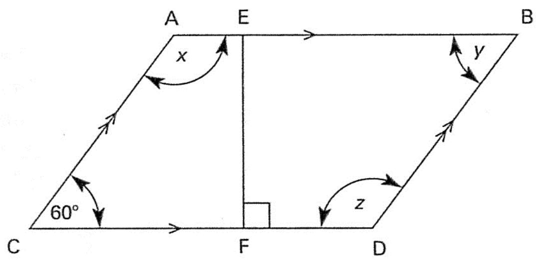


Figure 6

Area: If the base CD = 6m and the line EF = 3m

Area = CD x EF

= 6m x 3m

= 18m²

Angles: As the angle ACD equals 60°, then the angle opposite *y* must also equal 60°. The sum of the four angles is equal to 360° and angles *x* and *z* are opposite and equal.

Therefore

$x + z = 360° - (60° + 60°)$

$= 240°$

And as they are equal

$240° \div 2 = 120°$

$x = 120°$

$z = 120°$

Rectangle

In a rectangle all the angles are right angles, as shown in Figure 7. The two sides opposite each other are parallel and equal in length. The two diagonals AD and CB are equal in length and bisect each other. The diagonals bisect the rectangle to form two congruent triangles.

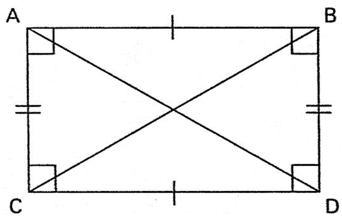


Figure 7

Square

A **square** (Figure 8), is a rectangle with all its sides equal in length. The two diagonals AD and CB are equal in length and bisect each other. The diagonals intersect at 90° and bisect the square to form congruent triangles. The area of a square = L^2, where L is the length of one side of the square.

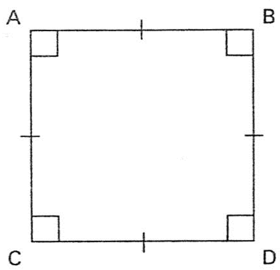


Figure 8

Note: The fact that two diagonals of a rectangle or a square are equal in length can be used to good effect for testing for squareness a variety of building components, from the building lines of a new building to the door frames to be fitted in it (see Figure 9). If the two diagonals are of equal length then the corners of the building or door frame are at 90°.

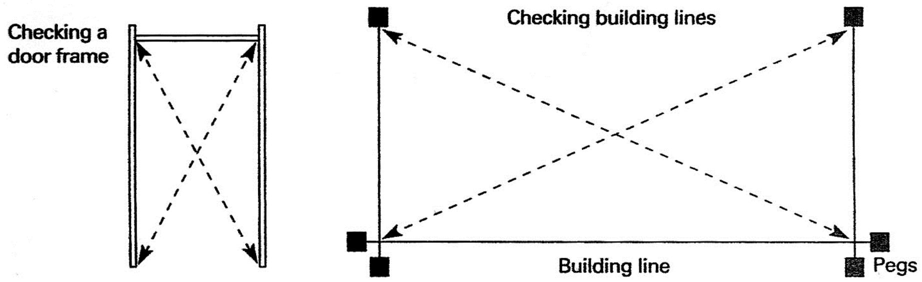


Figure 9

5.0 Dispose of Waste in the Correct Manner

Key Learning Point

- Importance of good housekeeping and segregation of waste

5.1 Waste

The ETB is committed to a **Waste Recycling Policy**

Please adhere to the rules of this Policy

Waste bins are located within the Training Centre and outside, for the re-cycling of waste materials. A sign on each bin will indicate the type of waste material, which should be placed into that particular bin.

These bins are then emptied into the appropriate skip located at the rear of the building.

Video titled: "*Environmental Awareness Reducing Waste at Work*".

6.0 Use of Calculator

Key Learning Point

- Proper use of calculator

6.1 Use of Calculator

Calculators are manufactured in a wide and constantly changing variety of models. Do not be tempted, into buying one that has many more functions than you require. Remember, a calculator will only compute the information that is entered into it and there can be a tendency to press the wrong keys on some of the smaller or multi-functioned calculators.

7.0 Basic Numeracy

Key Learning Point

- Basic numeracy - indices, factors, prime, HCF and LCM

7.1 Metric and Imperial Systems

Length

- To "measure from end to end" (either along a straight line or an arc)
- To measure the distance between any two points we need a unit of measure.

Measurement Units

- Decimal System
- Metre - Decided in Paris, 1789.
    - Metre/100 = Centimetre (One hundredth part)
    - Metre /1000 = Millimetre (One thousand part)
    - Metre x 1000 = Kilometre (A thousand)
- 10mm = 1cm 100cm's = 1m 1000m = 1km

Imperial To Metric Conversion

Comparisons between imperial and metric units made using the following information:

- 1 inch = 25.4 mm
- 12 inches = 1 foot = 0.3048m or 304.8mm
- 3 feet = 1 yard = 0.9144m or 914.4mm
- 1m = 1.0936 yards or 3.281 feet
- 1 $yard^2$ = 0.836 m^2
- 1m^2 = 1.196 $yard^2$ or 10.76 $feet^2$
- 1m^3 = 1.31 $yard^3$ or 35.335 $feet^3$
- 1 gallon = 8 pints
- 1 pint = 20 fluid oz (ounces)
- 1 litre = 0.22 gallons or 1.76 pints
- 1ml = 0.035 fluid oz
- 1 ton = 2240lb (pound)
- 112lb = 1cwt (hundredweight)
- 14lb = 1st (stone)
- 1lb = 16oz (ounces)
- 1 tonne = 2205lb
- 1kg = 2.2lb
- 30g = 1oz

Examples

350 feet = 350 x 0.3048m = 106.7m

12 yards = 12 x 0.9144m = 10.973m

1 gallon = 1 ÷ 0.22 litres = 4.545 litres

10lbs = 10 ÷ 2.2kg = 4.545kg

The old British Imperial System had no uniformity. The Decimal System involves only 10's, 100's, 1000's etc.

SI Units

This system involves a unit known as the metre, and multiples and decimal fractions of the unit:

- 1 Kilometre = 1000m
- 1 Hectometre = 100m
- 1 Decametre = 10m
- 1 Metre = 1m
- 1 Decimetre = 1/10m = 0.1m
- 1 Centimetre = 1/100m = 0.01m
- 1 Millimetre = 1/1000m = 0.001m

The Systeme International d'Unites (the international system of units) is essentially a metric system. It is based upon six fundamental units which are:

- Length - the metre (m)
- Mass - the kilogram (kg)
- Time - the second (s)
- Electric Current - the ampere (A)
- Luminous Intensity - the candela (cd)
- Temperature - the kelvin (K)

For many applications some of the above units are too small or too large and hence multiples and sub-multiples are often needed. These multiples and sub-multiples are given special names which are as follows

7.2 Factors

The factors of any whole number are the whole numbers that divide exactly into the given number.

- 4 is a factor of 12, because 4 divides into 12.
- 6 is also a factor of 12, because 6 divides into 12.

1 is a factor of every number. Every number is a factor of itself.

To find all the factors of a number, write out all the pairs of factors that make that number and then write down every number that occurs. Always start with 1 and the number itself, Then try 2, then 3, then 4 and so on in pairs and stop when the pair factors begin to repeat.

Example:

Find the factors of (a) 32 and (b) 40

Solution:

Write down all the pairs of factors

(a) 32

1 X 32

2 X 16

4 X 8

As the next pair is 8 x 4, this means we have all the factors.

Therefore the factors of 32 are:

1, 2, 4, 8, 16, 32

(b) 40

1 x 40

2 x 20

4 x 10

5 x 8

As the next pair is 8 x 5, we have all the factors.

Therefore the factors of 40 are:

1, 2, 4, 5, 8, 10, 20, 40

Exercises:

Find the factors of each of the following:

a) 8

b) 15

c) 18

d) 28

e) 48

f) 90

Multiplication Factor Prefix Symbol

1 000 000 000 000 = 10^{12} tera T

1 000 000 000 = 10^{9} giga G

1 000 000 = 10^{6} mega M

1 000 = 10^{3} kilo k

100 = 10^{2} hecto h

10 = 10^{1} deca da

0.1 = 10^{-1} deci d

0.01 = 10^{-2} centi c

0.001 = 10^{-3} milli m

0.000 001 = 10^{-6} micro µ

0.000 000 001 = 10^{-9} nano n

0.000 000 000 001 = 10^{-12} pico p

0.000 000 000 000 001 = 10^{-15} femto f

0.000 000 000 000 000 001 =10^{-18} atto a

Where possible, multiples and sub-multiples should be in the form 10n where n is an integer. Thus 5000 metres should be written as 5 kilometres and not as 50 hectometres. Double prefixes are not permitted in the SI system. For example, 1000km cannot be written as 1kkm but only as 1Mm. Again, 0.000,006km cannot be written as 6μkm but only as 6mm.

Examples:

1) Express 203 560 kg as the highest multiple possible.

203 560 kg = 203 560 × 103 grammes

= 203.560 × 103 × 103 grammes

= 203.560 × 106 grammes

= 203.560 mega grammes

= 203.560 Mg

(It is usually better to use 203.560 Mg rather than 0.203 560 Gg)

2) A measurement is taken as 0.000 000 082 m. Express this measurement as a standard sub-multiple of a metre.

0.000 000 082m = 82 ÷ 1 000 000 000m

= 82 ÷ 109 m = 82 × 10^{-9} m

= 82 nm

(It is better to use 82 nm rather than 0.082 pm)

Exercise

Express each of the following as a standard multiple or sub-multiple.

1) 8000 m	6) 0.000 001 3 m
2) 15 000 kg	7) 0.028 kg
3) 3800 km	8) 0.000 36 km
4) 1 891 000 kg	9) 0.000 064 kg
5) 0.007 m	10) 0.003 6 A

Answers: (1) 8 km, (2) 15 Mg, (3) 3.8 Mm, (4) 1.891 Gg, (5) 7 mm,

(6) 1.3 mm, (7) 28 g, (8) 360 mm, (9) 64 mg, (10) 3.6 mA

7.3 Prime Numbers

A prime number is a whole number greater than 1 that has only two factors, 1 and itself.

For example, 5 is a primary number as it only has two factors, 1 and 5.

The first fifteen prime numbers are:

2, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31, 37, 41, 43, 47

Note:

1 is not considered a prime number as it has only one factor, i.e. 1.

2 is the first prime number, and it is the only even prime number: all other prime number are odd. There is an infinite number of prime numbers.

7.4 Highest Common Factor

The highest common factor of two or more numbers is the largest factor that is common to each of the given numbers.

This means the highest common factor of two or more numbers is the largest number that will divide exactly into each number.

Example 1:

The highest common factor of 6 and 8 is 2, as 2 is the highest number that will divide exactly into 6 and 8.

To find the highest common factor, use the following steps:

- Write down the factors of each number.
- Write down the common factors of each number and select the largest.
- If the number is small, the highest common factor can be written down from Inspection. For example, the highest common factor of 12 and 16 is 4.

Example 2:

Find the highest common factor of36, 60, and 84.

Write out the factors of each number.

- Factors of 36: 1, 2, 3, 4, 6, 9, 12, 18, 36
- Factors of 60: 1, 2, 3, 4, 5, 6, 10, 12, 15, 20, 30, 60
- Factors of 84: 1, 2, 3, 4, 6, 7, 12, 14, 21, 28, 42, 84

The common factors are 1, 2, 3, 4, 6 and 12

Therefore the highest common factor of 36, 60, and 84 is 12.

Exercise:

Find the highest common factor of the following:

a) 16, 36

b) 14, 35

c) 8, 12, 20

d) 48, 80, 120.

8.0 Calculate Areas for Rendering

Key Learning Points

- Calculation of areas and volumes using metric system

8.1 Calculations

Calculate:

The floor area of a room 12m × 7m.

What is the area of a ceiling 9.6m long by 4.3m wide?

Answer: $84m^2$ and $41.28m^2$

Volume

Volume is the amount of space in any container, no matter its shape.

Note: Volume is always in cubic metres m^3.

The volume of a rectangular tank is: Length X Width X Height.

To find the volume of a rectangular tank which is 2m long, 3m wide and 1m high: 2m X 3m X 1m = $6m^3$?

Volume is always in m^3, so the measurements you use must always be in metres, before you do any calculations.

Find the volume of the rectangular container, length 2m, width 450mm, height 750mm.Two of the measurements are in mm (millimetres). These must be converted into metres. Since every 1000mm makes up a metre, divide the number of mm by 1000 to give metres.

So 450mm ÷ 1000 = 0.450mAnd 750mm ÷ 1000 = 0.750m

Now the calculations are as before:

Volume is 2m X 0.450m X 0.750m = $0.675m^3$

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