

12. Rough in: A rough guide where all the wiring will go during the construction.  
Fit out: It's the finishing process such as power points casings.

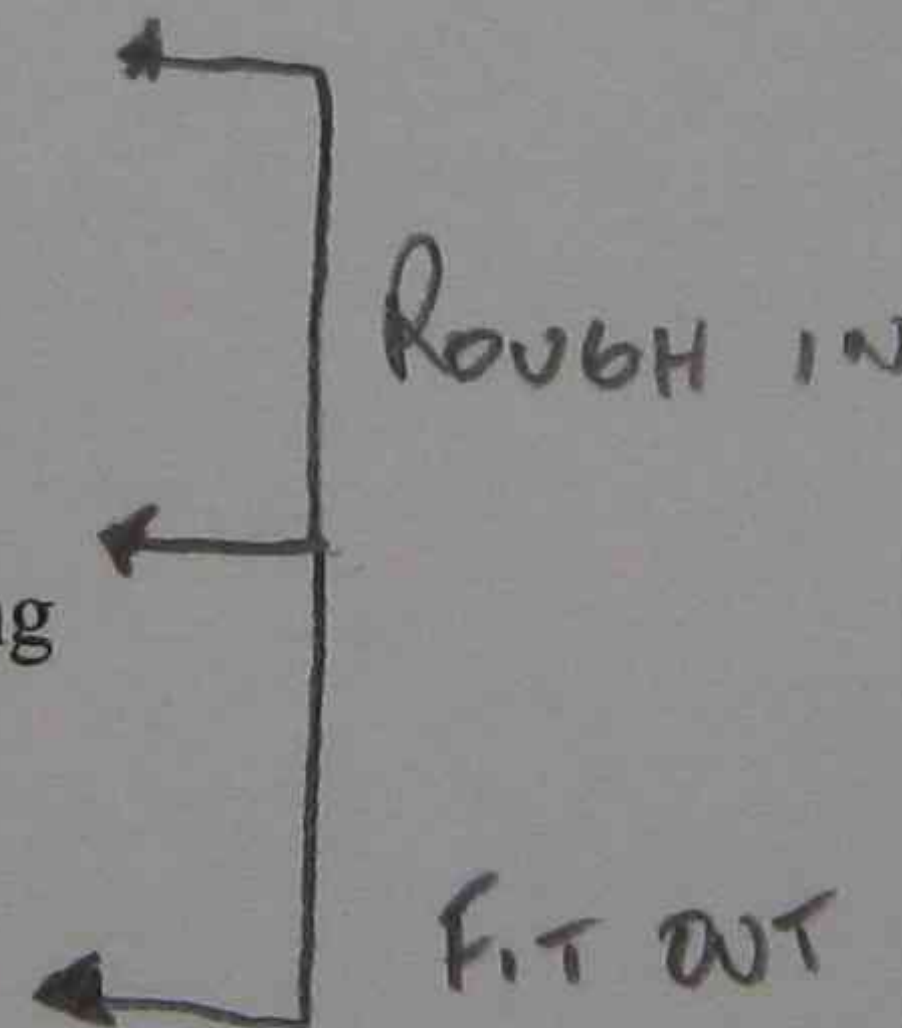
13.

- Builder
- Bricklayer
- Plumber
- Tiler
- Electrician
- Interior wall liner
- Painter

14. Protecting against been drilled into the wiring.

15.

- Setting out
- Footings
- Base
- Floor
- Walls
- Roof
- Cladding
- Interior lining
- Tiling
- Painting
- Finishing



16.

17. a. Where the Main Switch Board will be located.  
b. Where power points outlet will be located.  
c. For any underground wiring.  
d. To make sure no wiring will be placed near any pipe work.

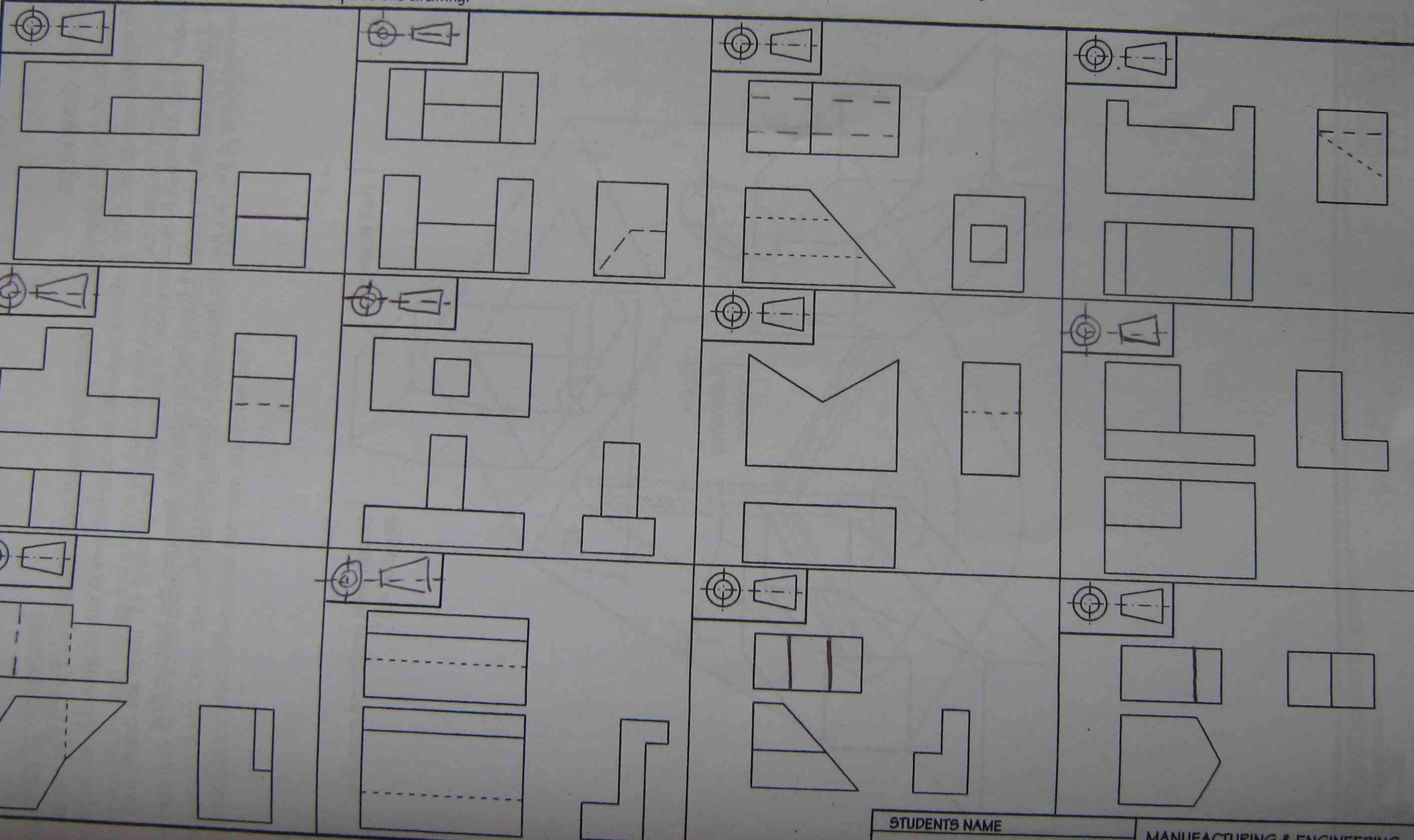


Type

3

## Exercise 24

Below is a series of drawings, some complete, with no projection symbol, and some with missing lines with the projection symbol showing. In each supply the missing information to complete the drawing.



STUDENT'S NAME

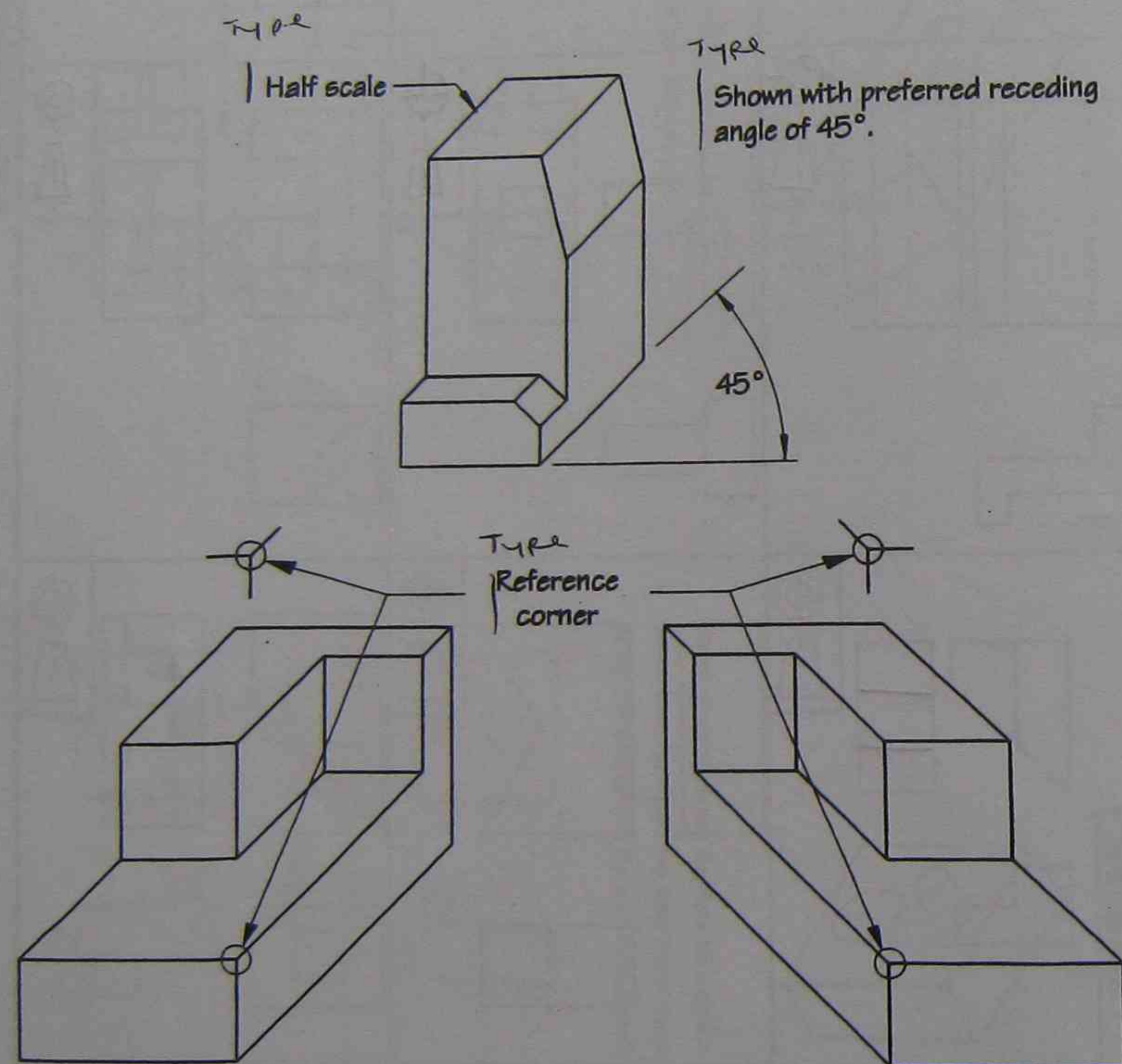
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## Oblique drawings

This method of drawing objects is not very common and is not often used in technical publications.

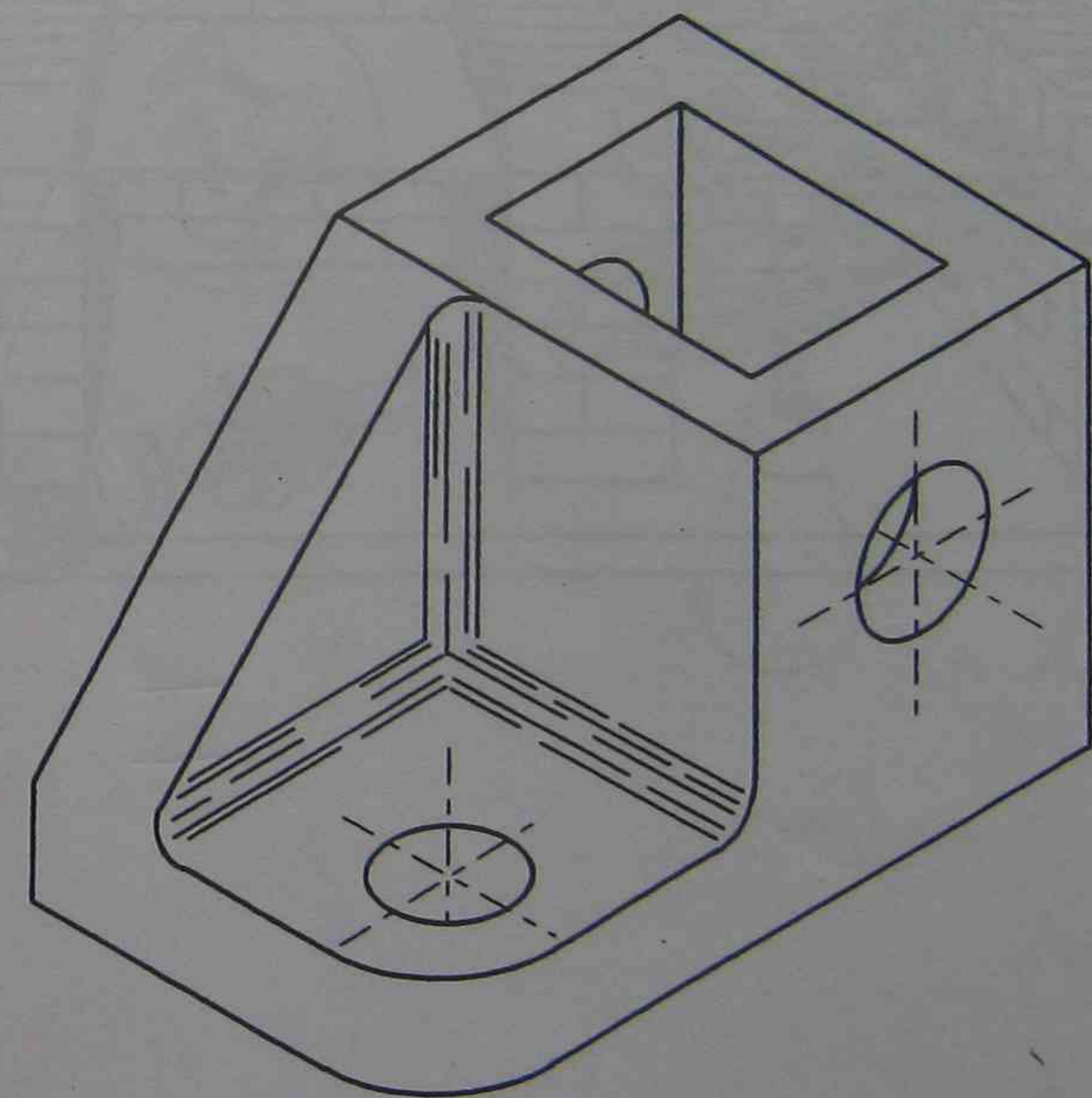
To make these drawings look somewhere in proportion, the receding  $45^\circ$  lines are drawn half size. This is not a set rule about 45° and half size lengths, however, the feature that identifies oblique is the fact that the front edge is drawn horizontal.



## Isometric drawings

These are by far the most common pictorial drawings that are found in technical publications. All lengths are drawn full size and all edges recede at  $30^\circ$  from the horizontal as shown below. All circles and arcs on all faces are elliptical and no faces are a true shape.

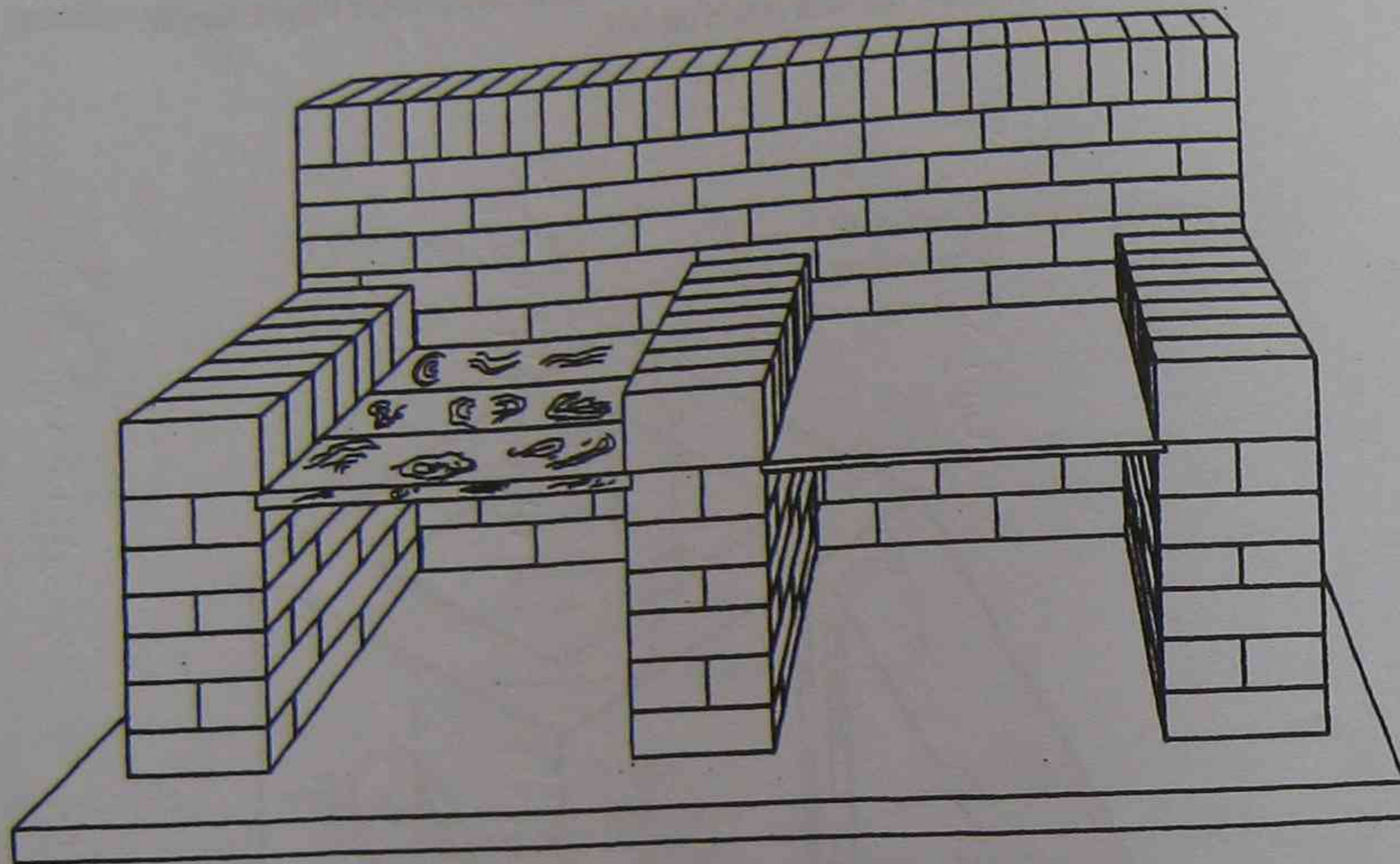
The best way to do an isometric drawing is to imagine a box that would exactly hold the item you want to draw. Draw the box, using light construction lines, to show the height, length and width of the item. Then draw the item inside the box.





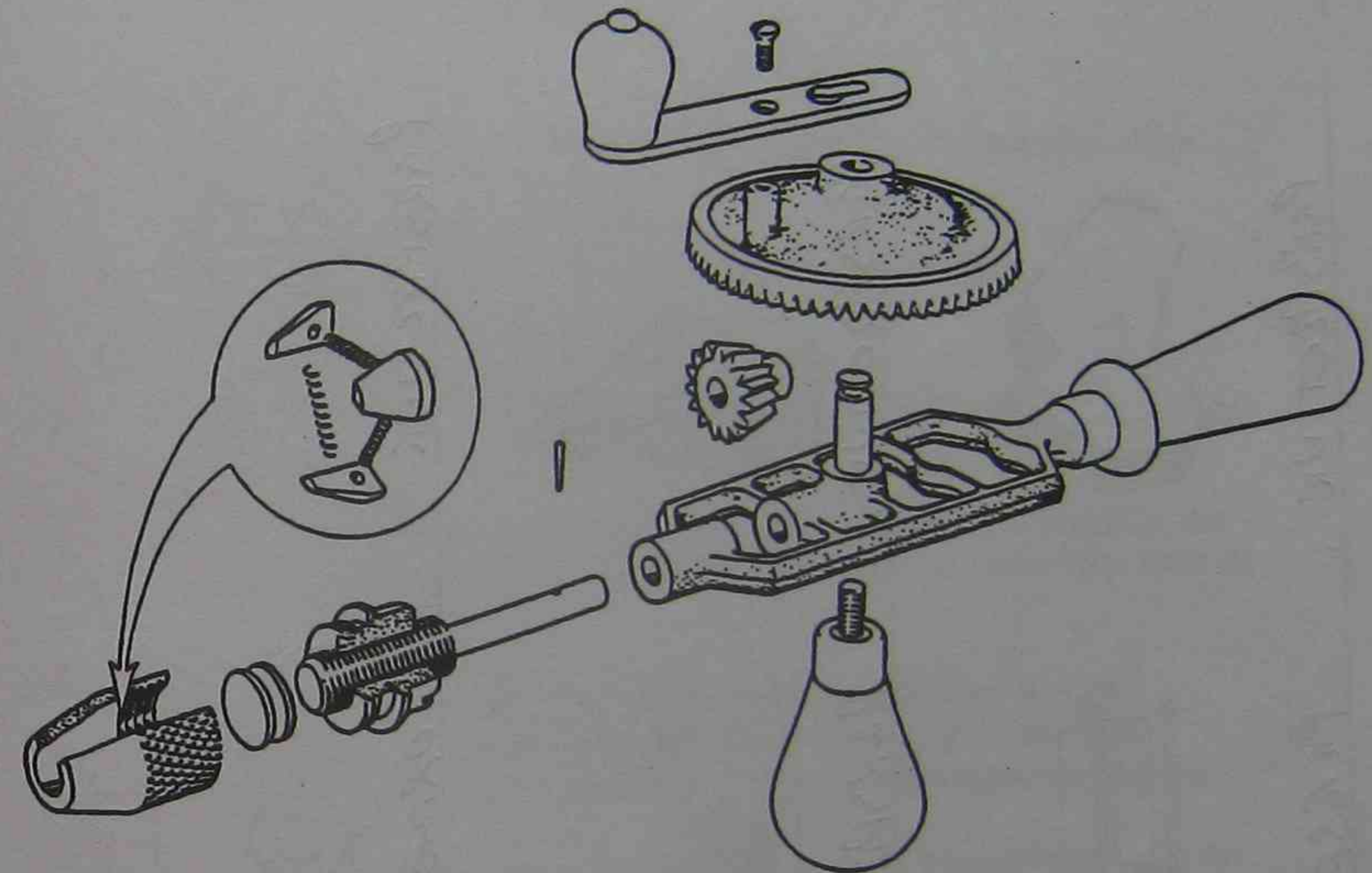
## Perspective

A method widely used to show construction and buildings as they appear to the eye on completion. The example below is a single point perspective. The lines of projection from the front eventually meet at one point.



## Exploded view

This method is particularly good for showing those, who have little or no experience with reading diagrams, and with the ability to comprehend the assembly or dis-assembly of a mechanical component.

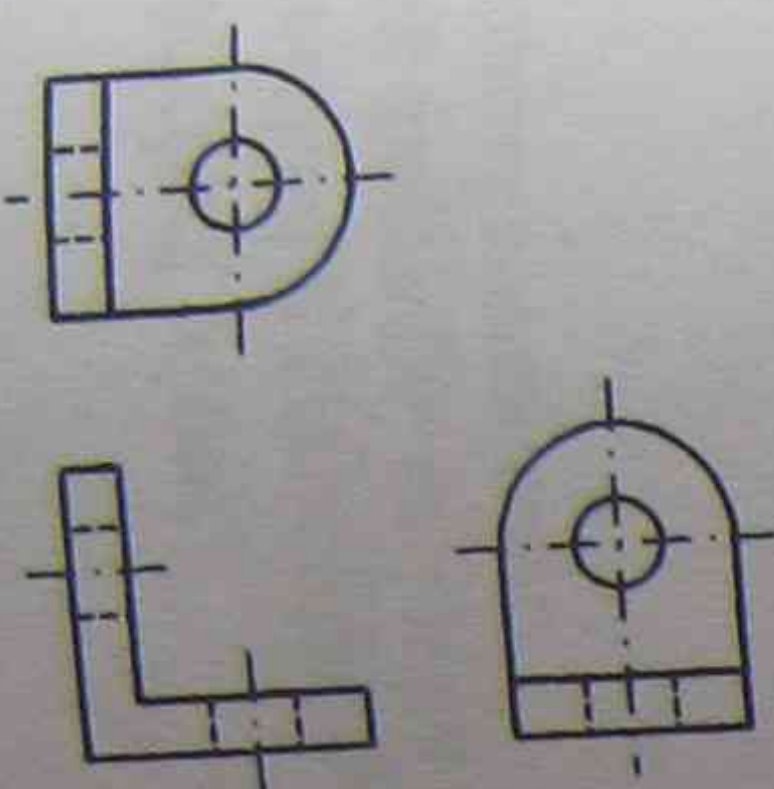




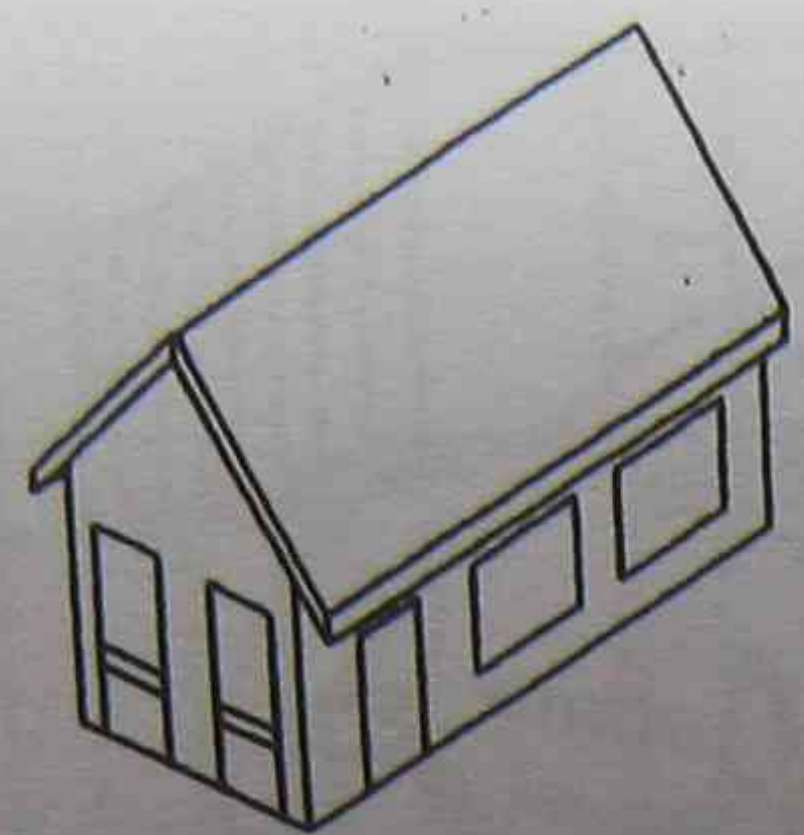
102

Exercise 4

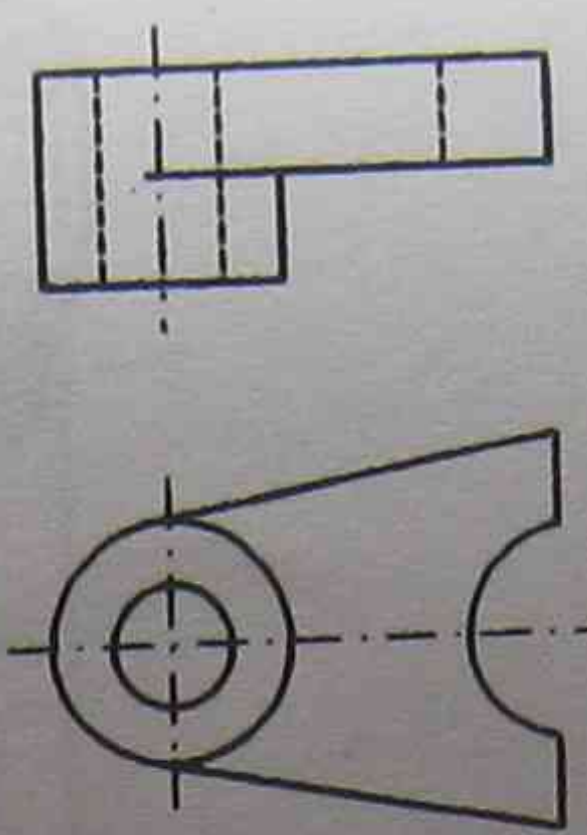
Name the pictorial methods used to produce the drawings shown. Place your answer on the line provided.



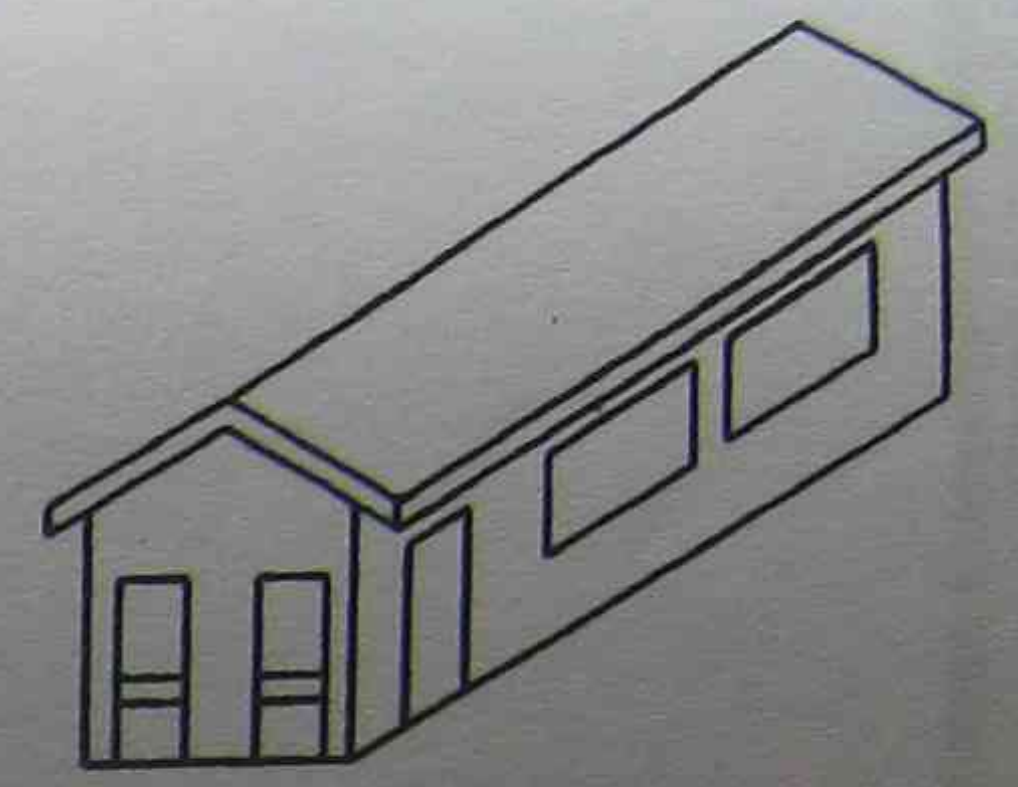
ORTHOGONAL



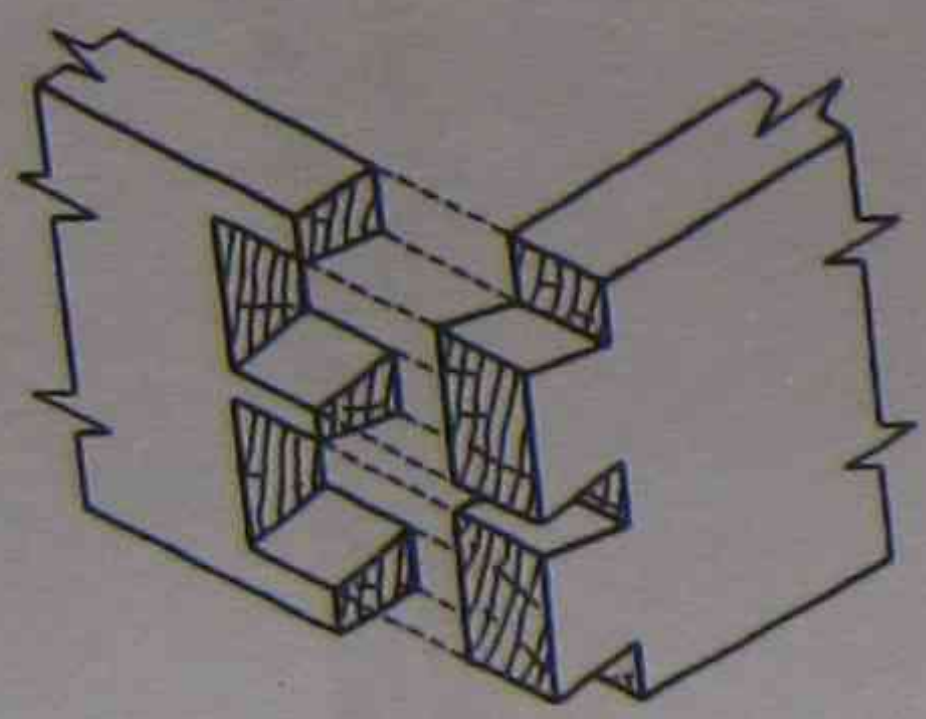
PERSPECTIVE



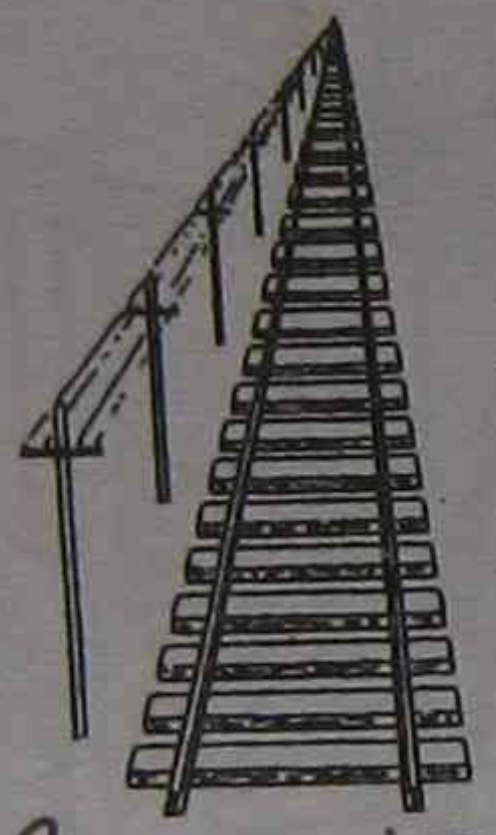
ORTHOGONAL



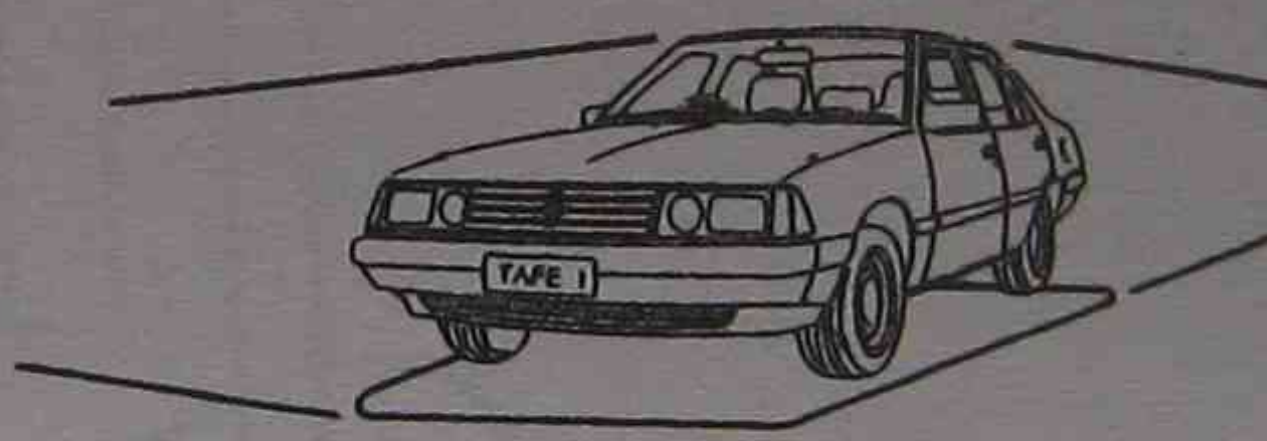
PERSPECTIVE



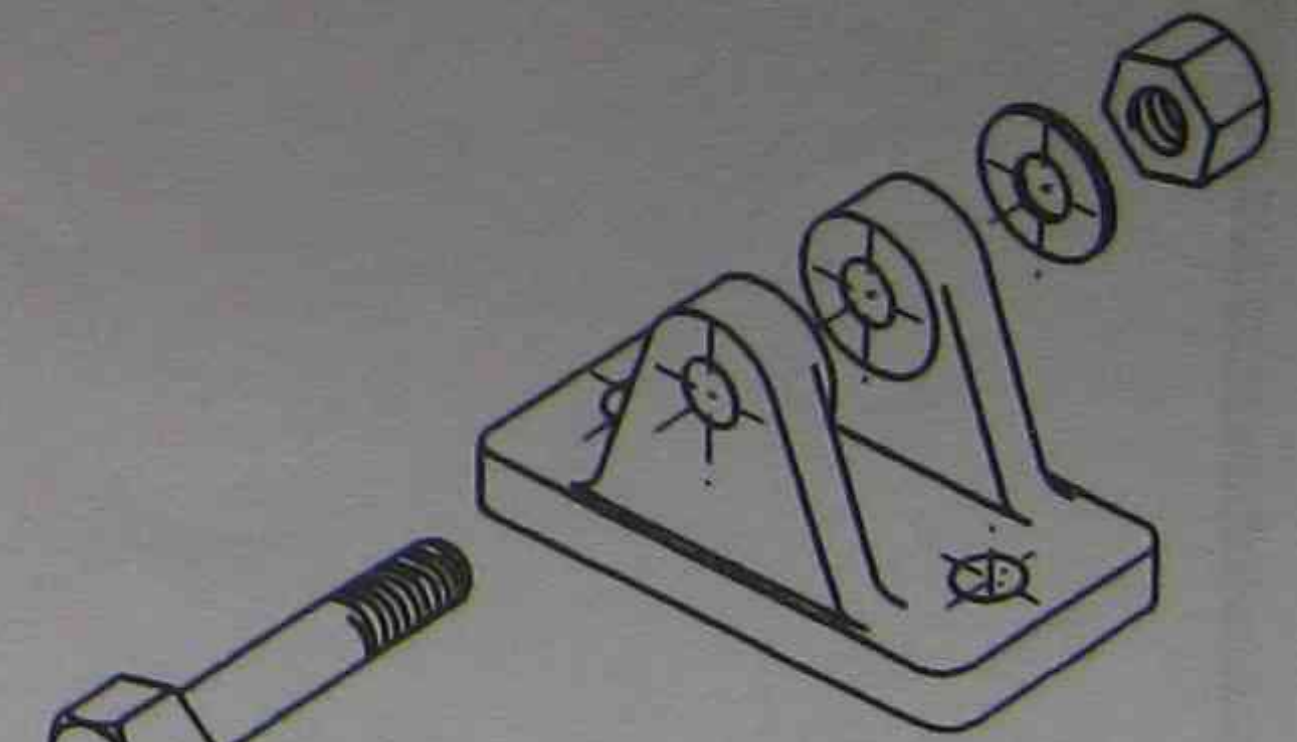
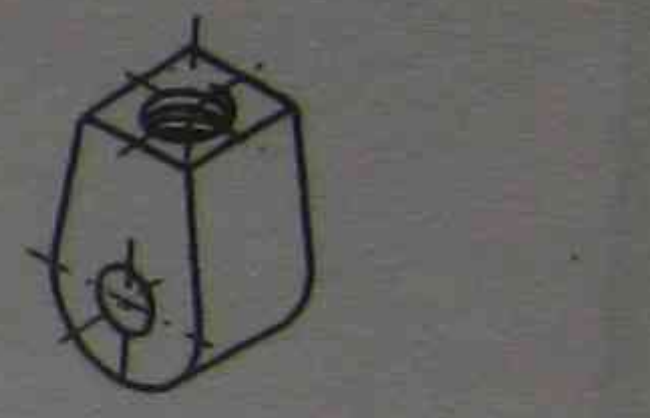
ISOMETRIC



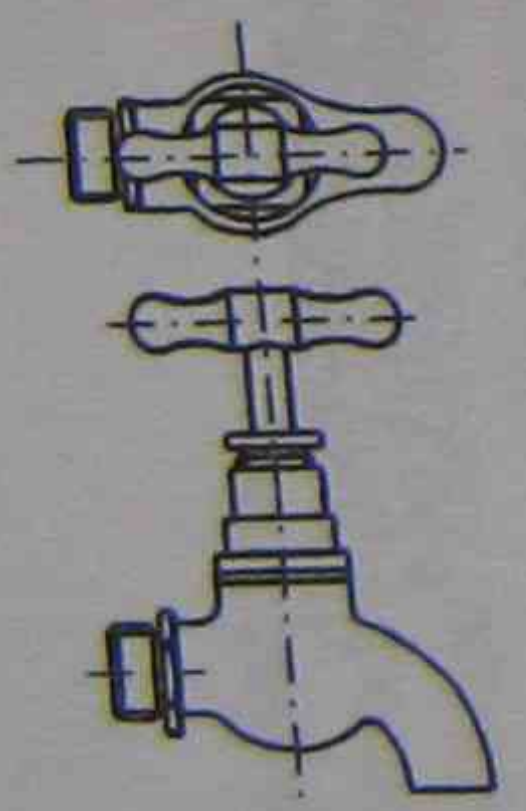
PERSPECTIVE



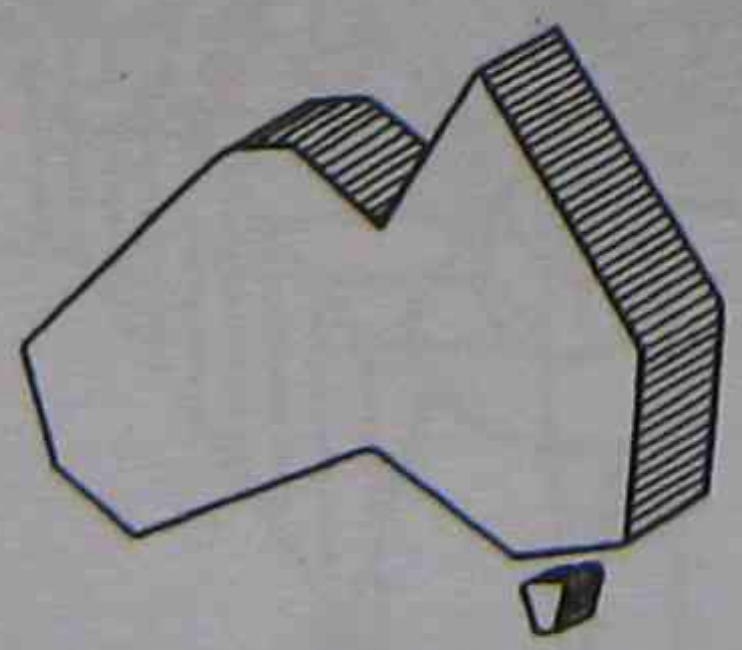
PERSPECTIVE



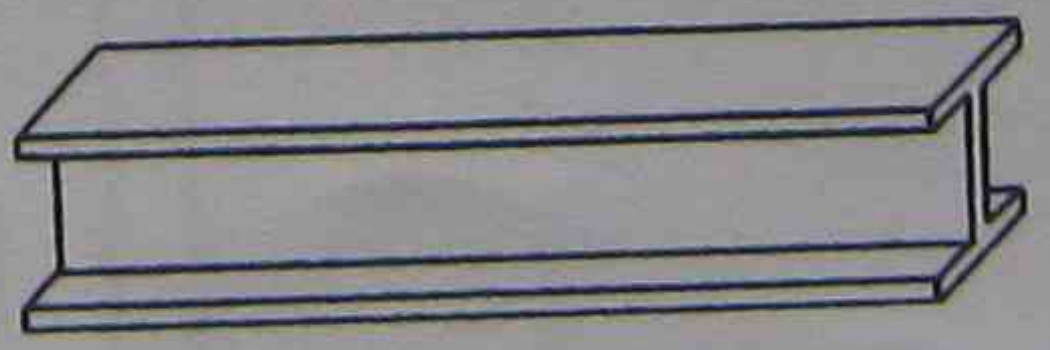
EXPLODED



ISOMETRIC



PERSPECTIVE



PERSPECTIVE



## Free hand sketching.

Freehand sketching is an important method of communication at all levels of engineering because it allows you to describe things that you can't always describe in speaking or writing. Tradespersons use sketching skills to record and express ideas about a job to fellow tradespersons, apprentices, supervisors and engineers.

Sketching is a clear way to record technical ideas that may be needed later for manufacture or for reference. A sketch is not a rough drawing. It should be a clear image with its sizes in proportion, clearly dimensioned and labelled.

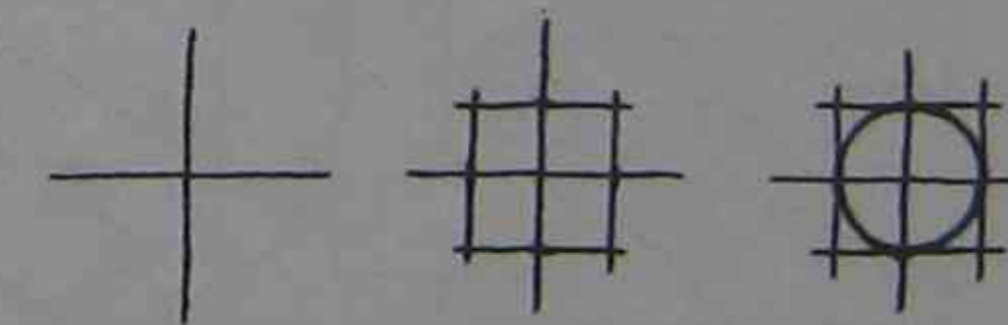
Freehand sketching can be used to:

- give information from the field or factory to the drawing office. This happens where equipment needs repairing or changing.
- give the designer's ideas to the draftsman
- make sketches of the layout and views needed for mechanical drawing
- design sketches to see if an idea will work
- aid discussion between engineers and tradespersons
- give a picture which will help to interpret a complex orthogonal drawing

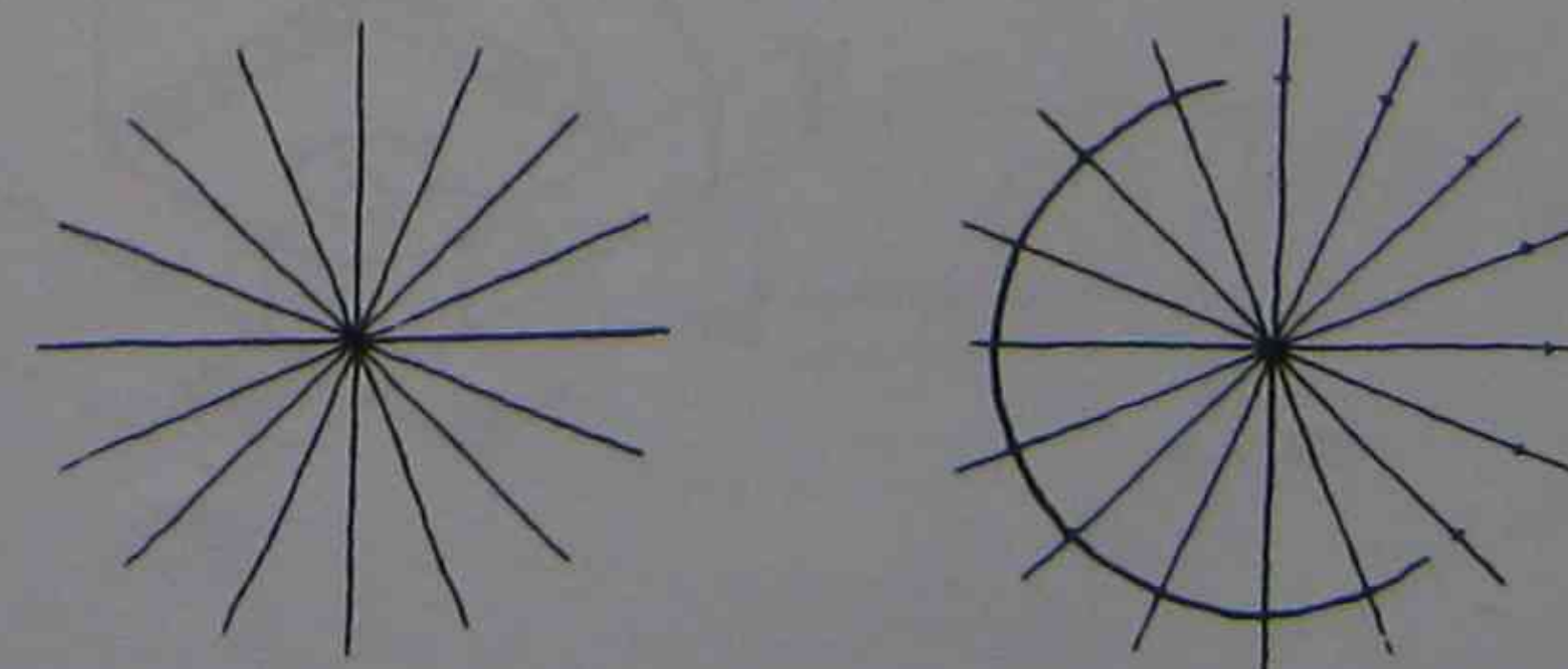
## Methods of sketching

It is important to keep the sketch in proportion to the object. Use a H to HB pencil for the sketch and 3H for dimensions. Hold the pencil lightly about five to six centimetres from the point.

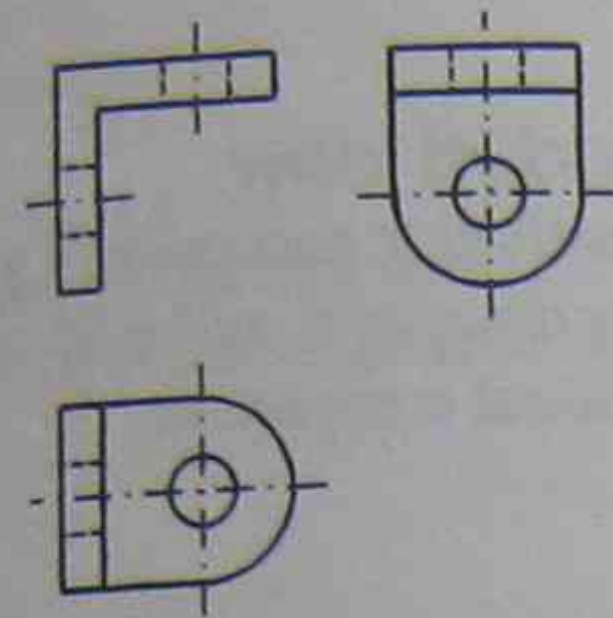
- when drawing horizontal lines, your hand should slide along from left to right.
- use a combined finger and wrist movement from top to bottom for vertical lines
- inclined lines may be drawn as either horizontal or vertical lines by repositioning the paper
- when drawing small diameter circles draw light horizontal and vertical lines. From the centre, where the lines cross, mark off the radii and draw a box. Join the points with a smooth even curve.



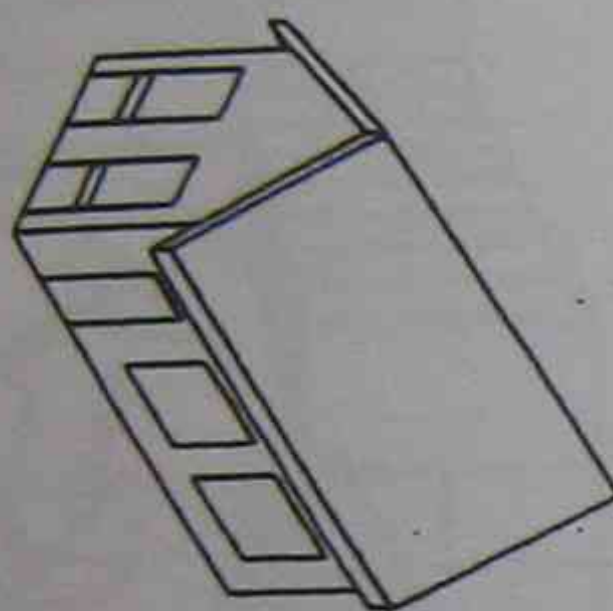
- for large diameter circles, draw light horizontal, vertical and slanting lines. Mark the estimated radius on all lines and join the points with a smooth even curve.



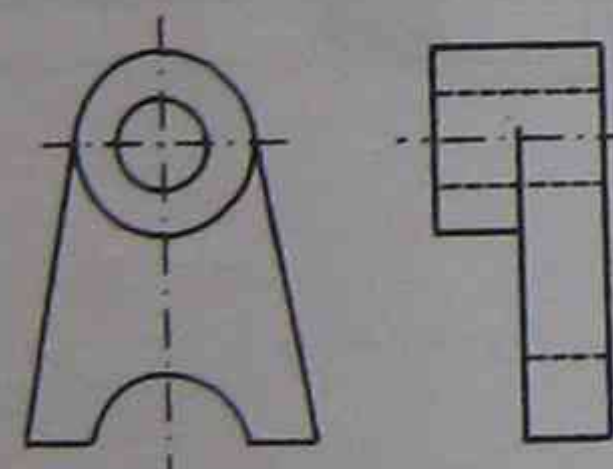
Exercise 4  
Use the pictorial methods used to produce the drawings shown. Place your answer on the line provided.



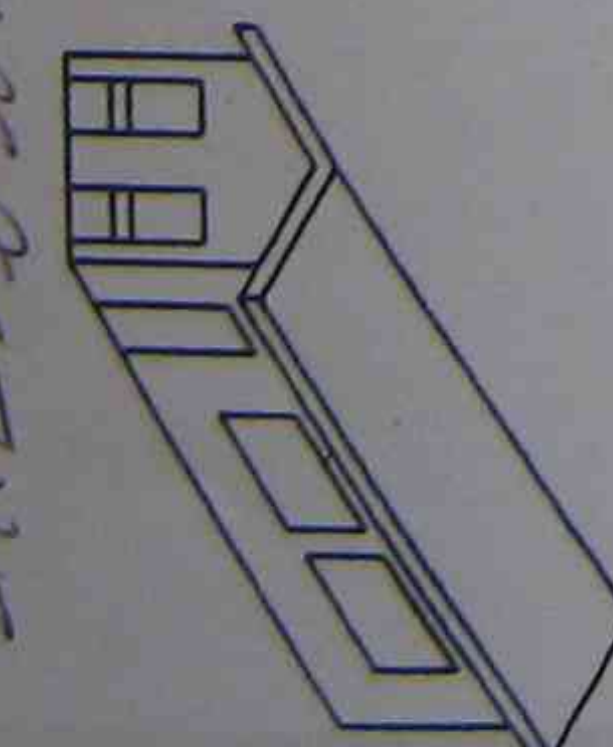
ORTHOGONAL



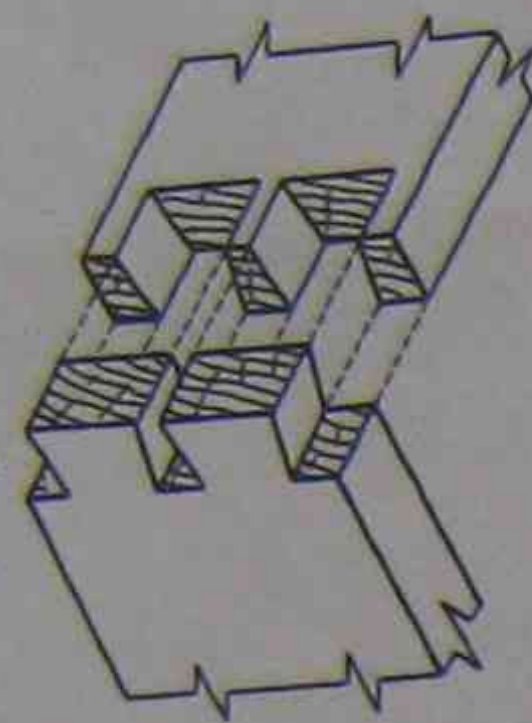
PERSPECTIVE



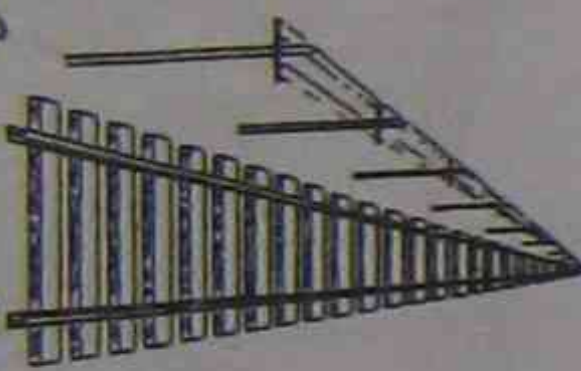
ORTHOGONAL



PERSPECTIVE



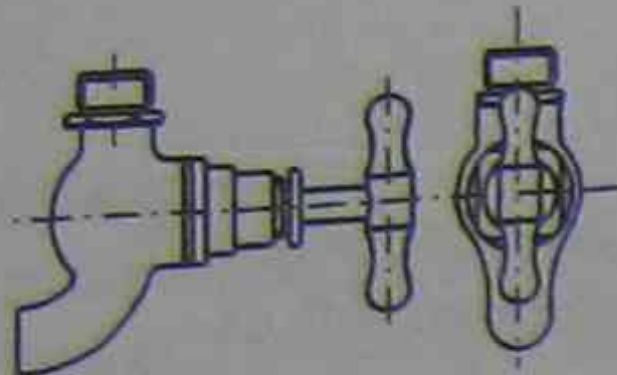
ISOMETRIC



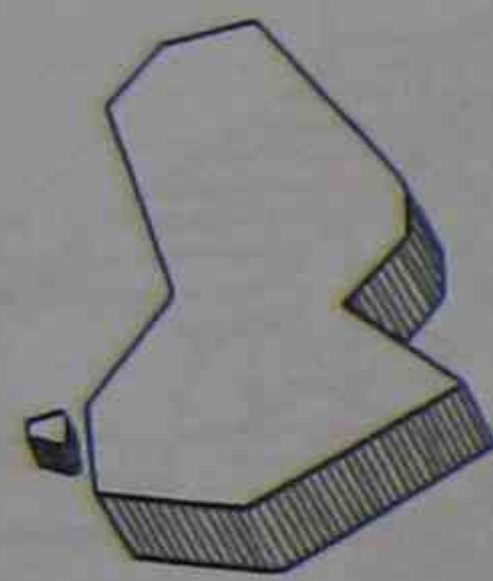
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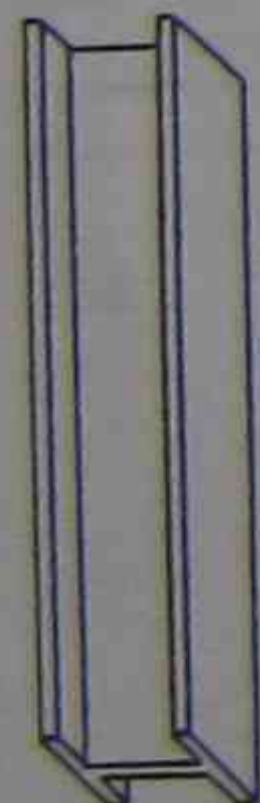
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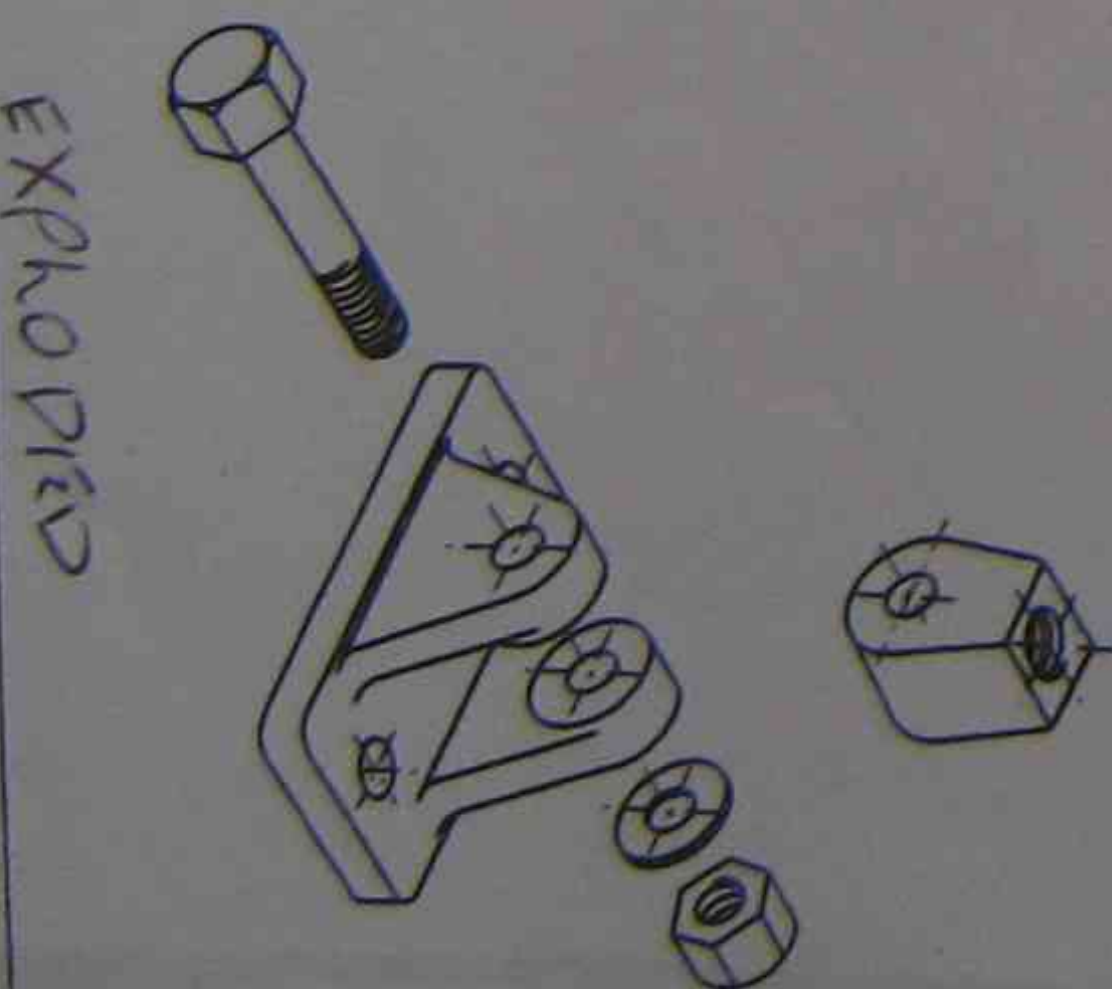
ISOMETRIC



PERSPECTIVE



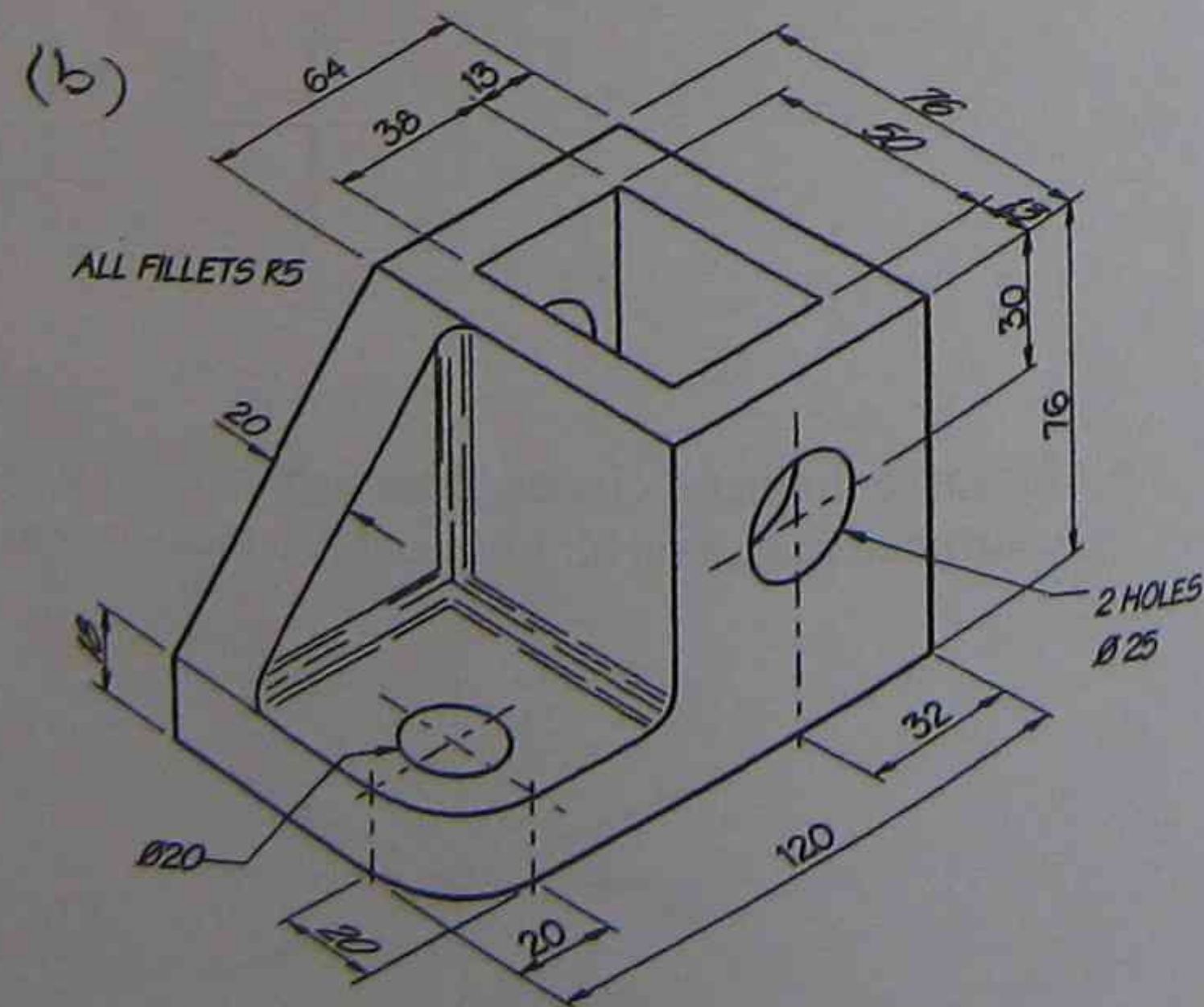
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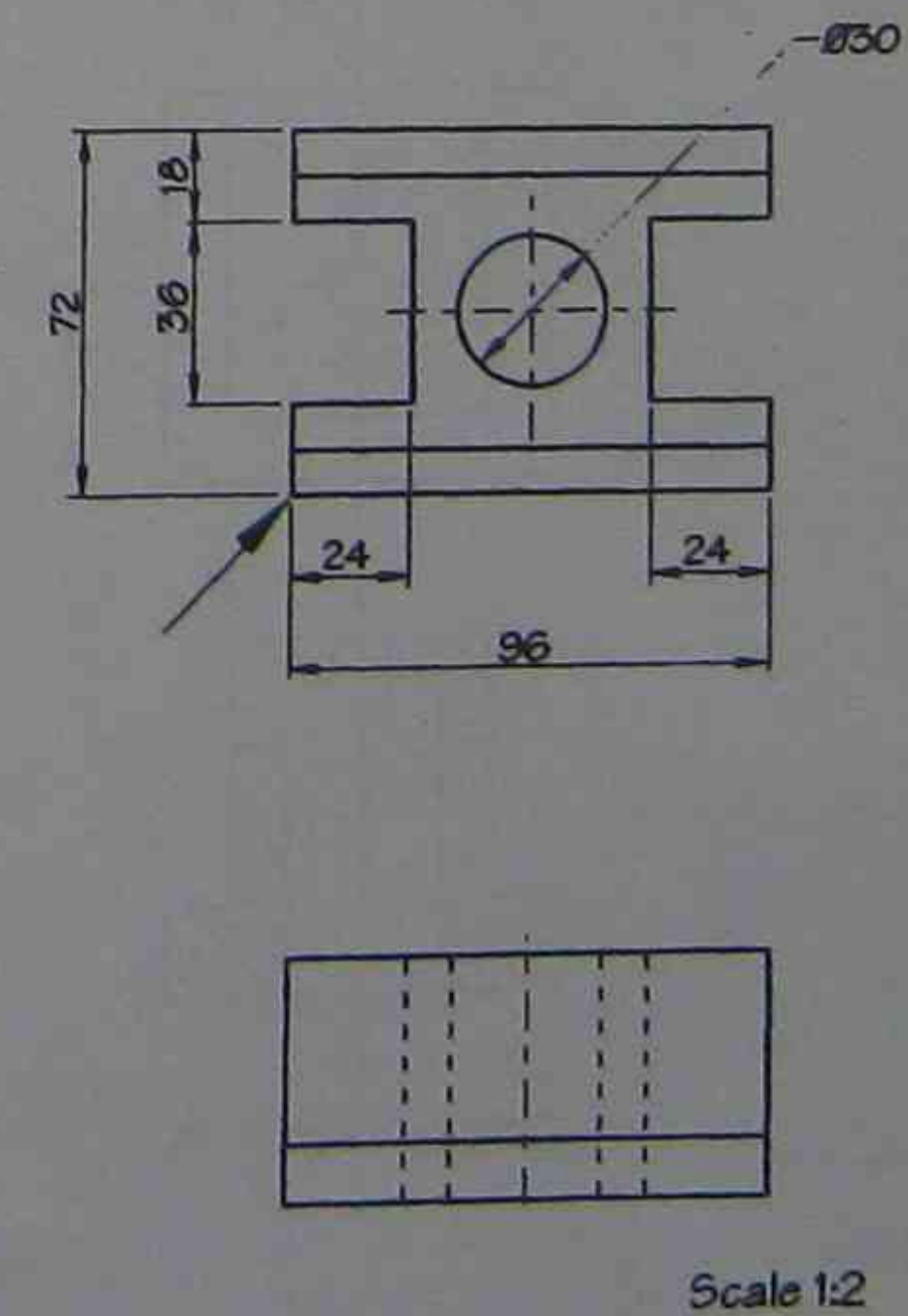
EXPLODED



**Exercise 5**  
Draw in freehand a front, top and left hand side view of the following two isometric drawings. . Add all dimension required. Ensure the object is drawn to the correct proportions. Your teacher may supply grid paper to assist your drawing.



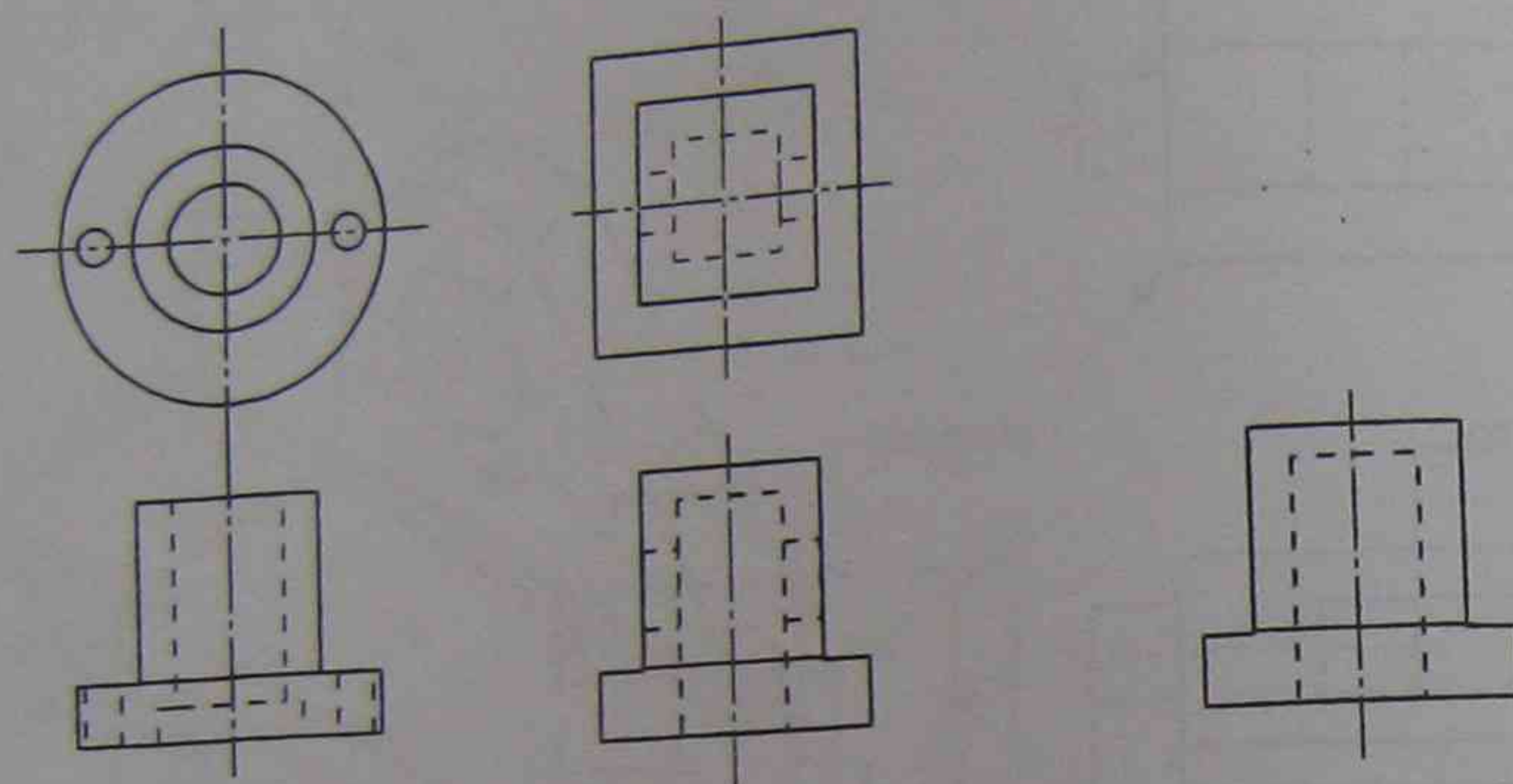
Make an isometric drawing of the following two objects shown when viewed in the direction of the arrow. Dimension lines are not required. Your teacher may supply isometric grid paper to assist your drawing.



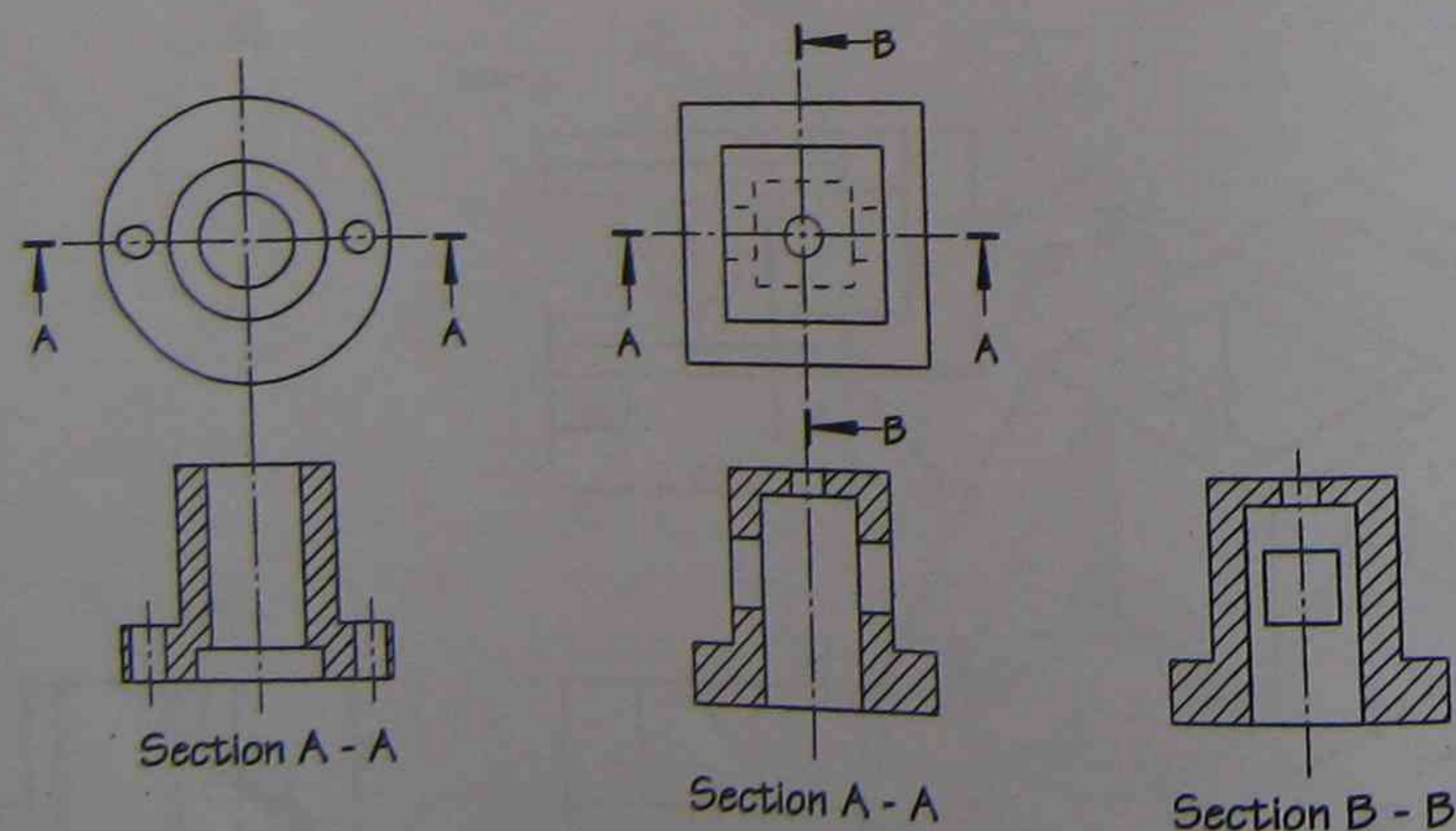


## Sectioning

When drawing objects in orthogonal projection the internal or hidden features are shown as hidden outlines.



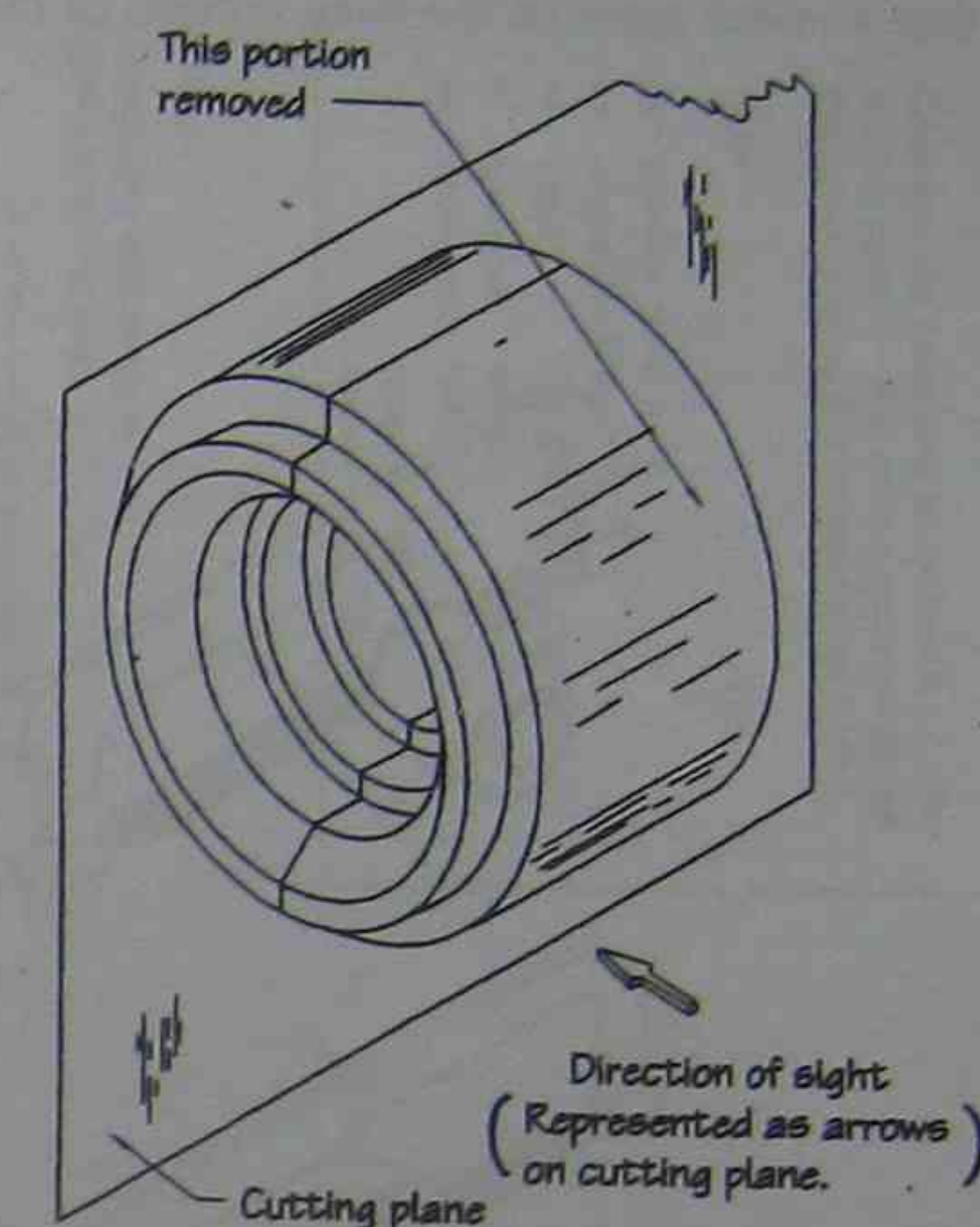
By using a drawing method known as "Sectioning" the same objects can be redrawn in such a way as to show normally hidden internal features as full outlines.



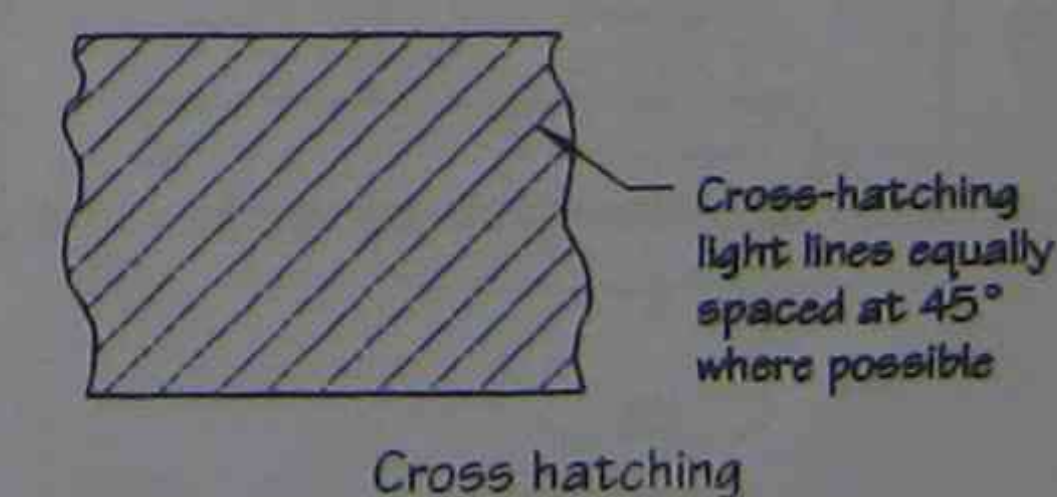
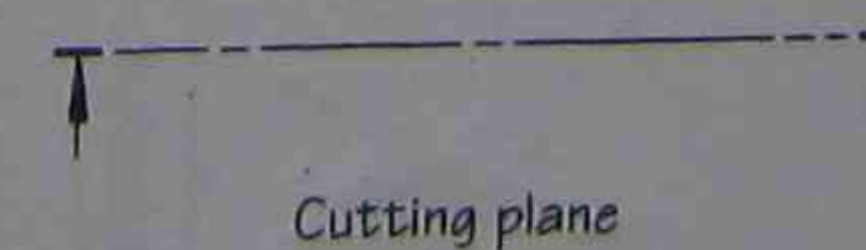
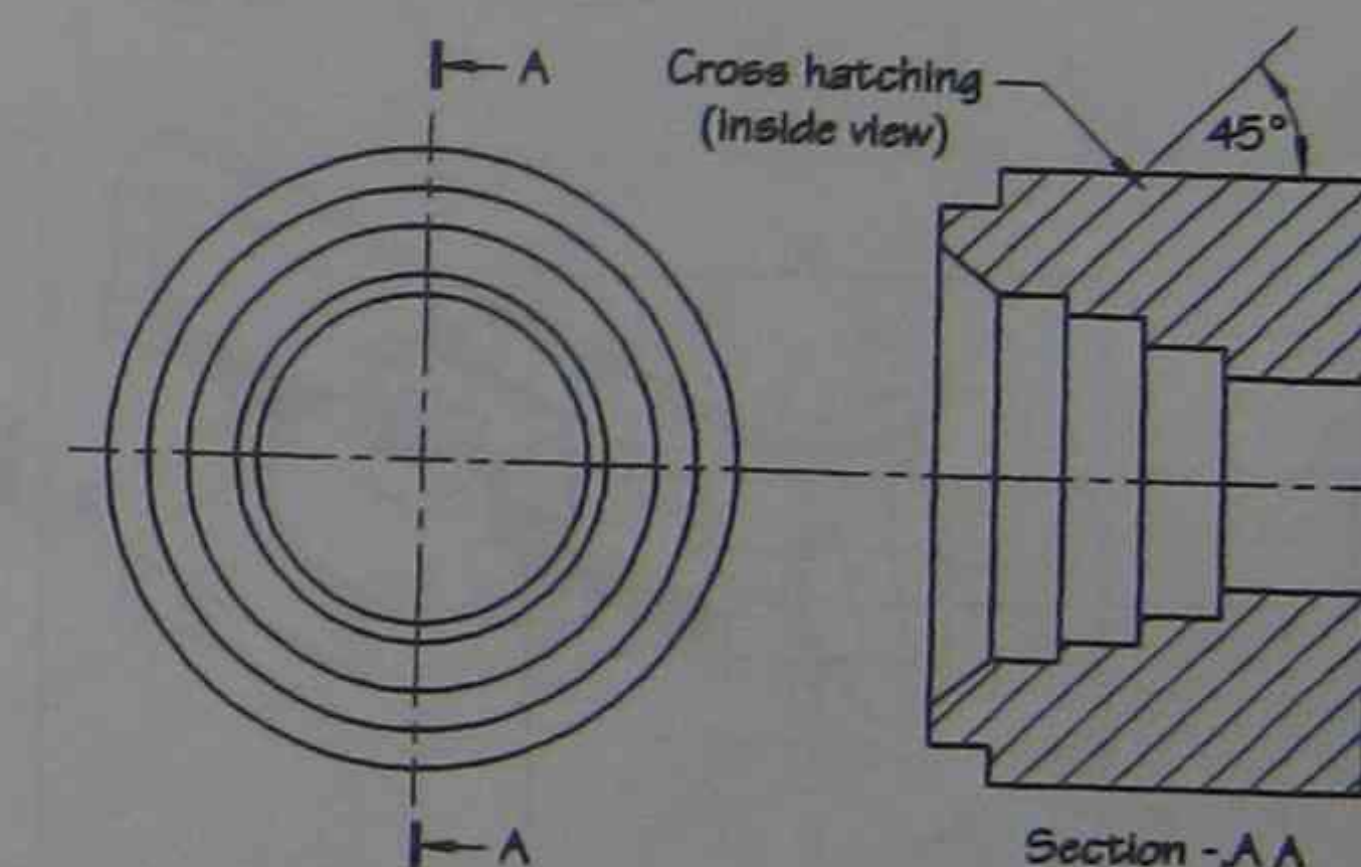
A sectional view is obtained by imagining an object as being cut by a 'cutting plane'

The front portion of the object is removed in order to reveal clearly the features.

EA601-7-1



In order that the features cut out by the cutting plane stand out on the drawing a technique known as **cross hatching** is used. Cross hatching is a series of light inclined lines usually at 45° to the horizontal.





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# Exercise 7

## TPE

Complete the front view as section A - A. The cutting plane A - A is to be positioned to cut the top view along the horizontal centreline.

Add:

- cutting plane A - A
- cross hatching
- title: ADJUSTABLE GUIDE
- material: bronze
- tolerances: UNO
- linear  $\pm 0.15$
- angular  $\pm 0^\circ 30'$

Hint:

Scribe line with dividers 2mm from long edge.

Hidden outline - (comparison)

CUTTING PLANE A - A

DO NOT SCALE

ISSUE	DATE	ZONE	CHANGES	ECN	BY	CKD
AMENDMENTS						

UNLESS NOTED OTHERWISE TOLERANCES ARE:		MATERIAL		FINISH	
LINEAR	$\pm 0.15$ UNO	BRONZE			
ANGULAR	$\pm 0^\circ 30'$				

DRAWN		CHECKED		APPROVED		RECEIVED	
JD		DS		WL			

MANUFACTURING & ENGINEERING ESD

SCALE: 1:1

DRIVING NO. EA061 - 7 - 1

A3

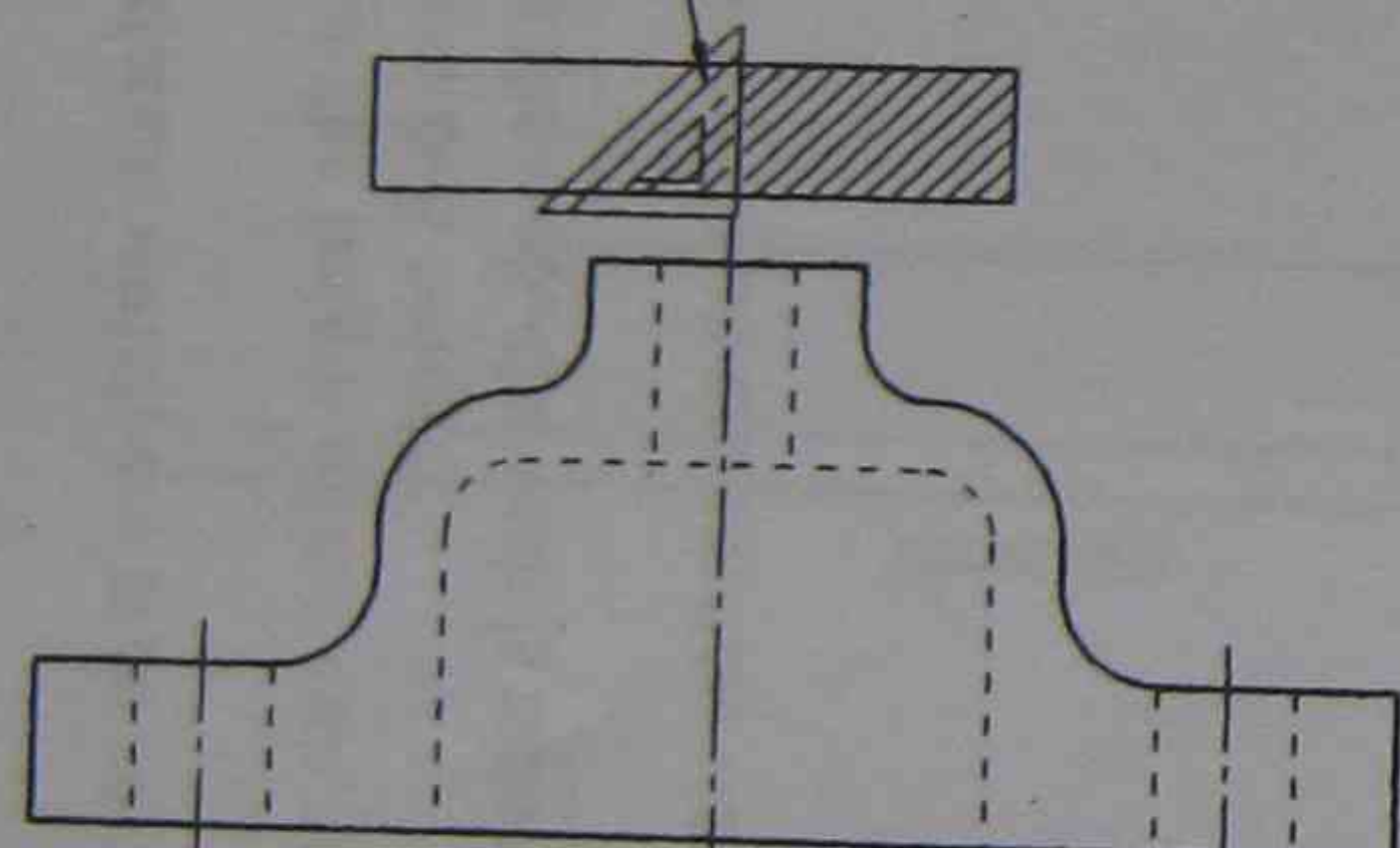


## DO NOT SCALE

Add:

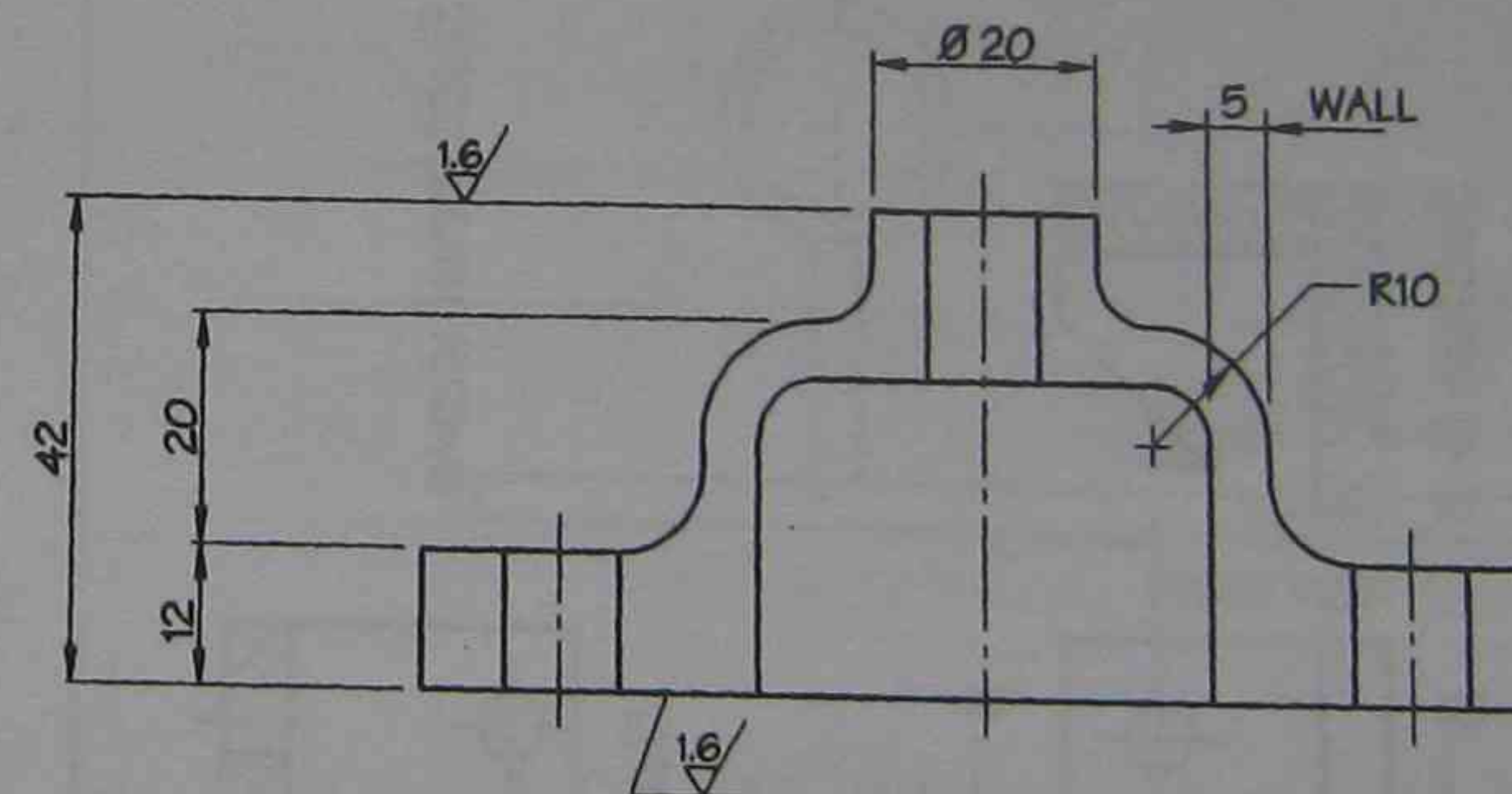
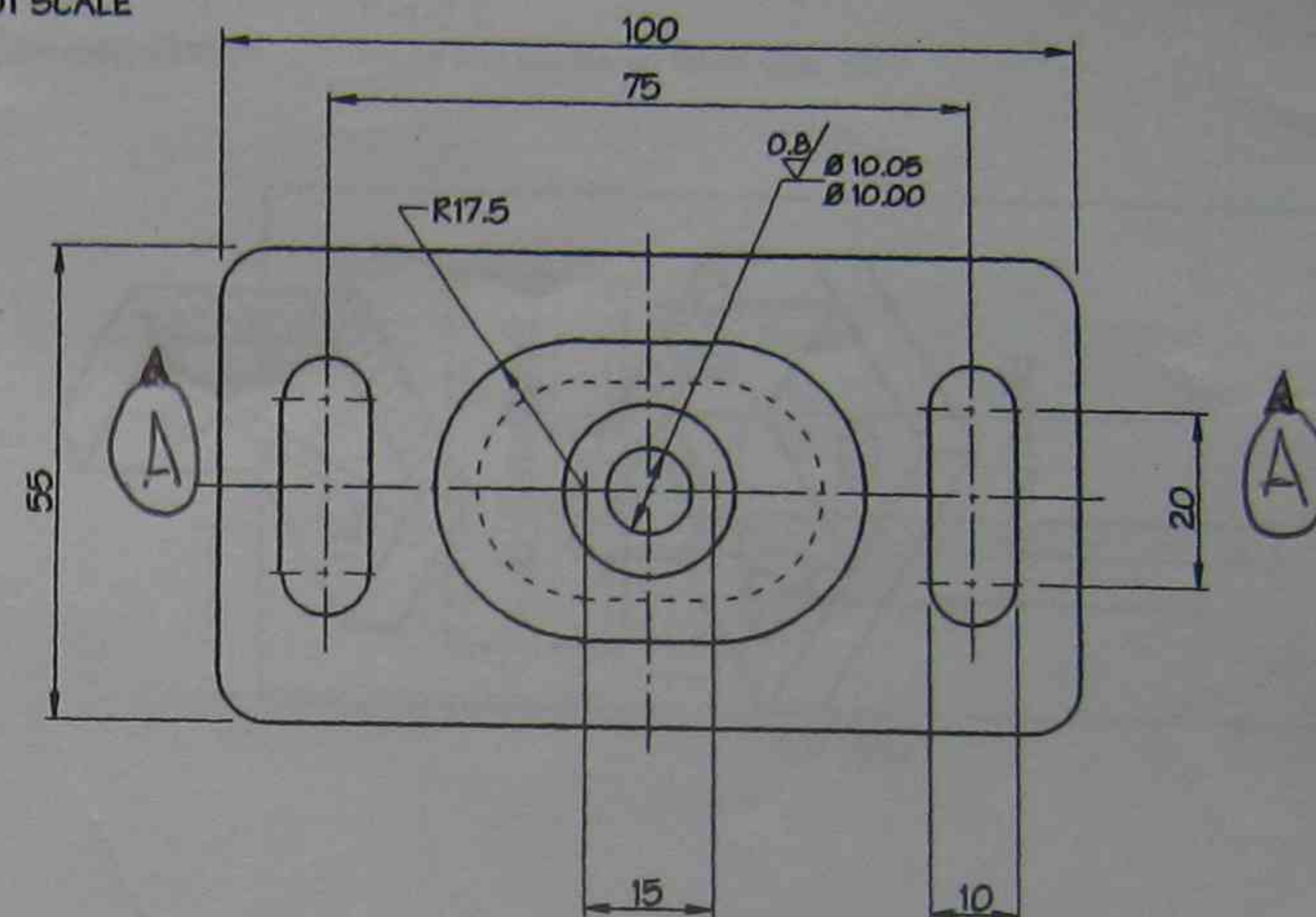
- ➡ cutting plane A - A
- ➡ cross hatching
- ➡ title: ADJUSTABLE GUIDE
- ➡ material: bronze
- ➡ tolerance: UNO
- linear  $\pm 0.15$
- angular  $\pm 0^\circ 30'$

Scribe line with dividers  
2mm from long edge.



Hidden outline - (comparison)

CUTTING PLANE A-A

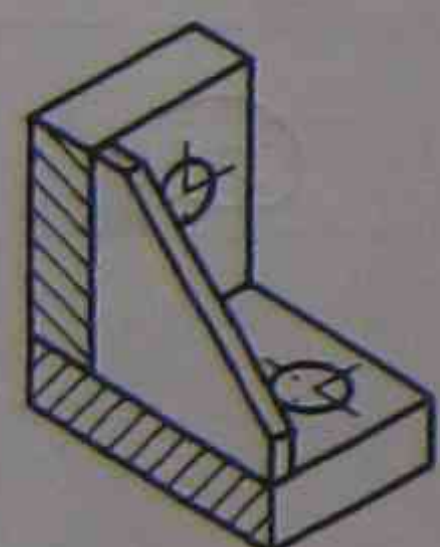
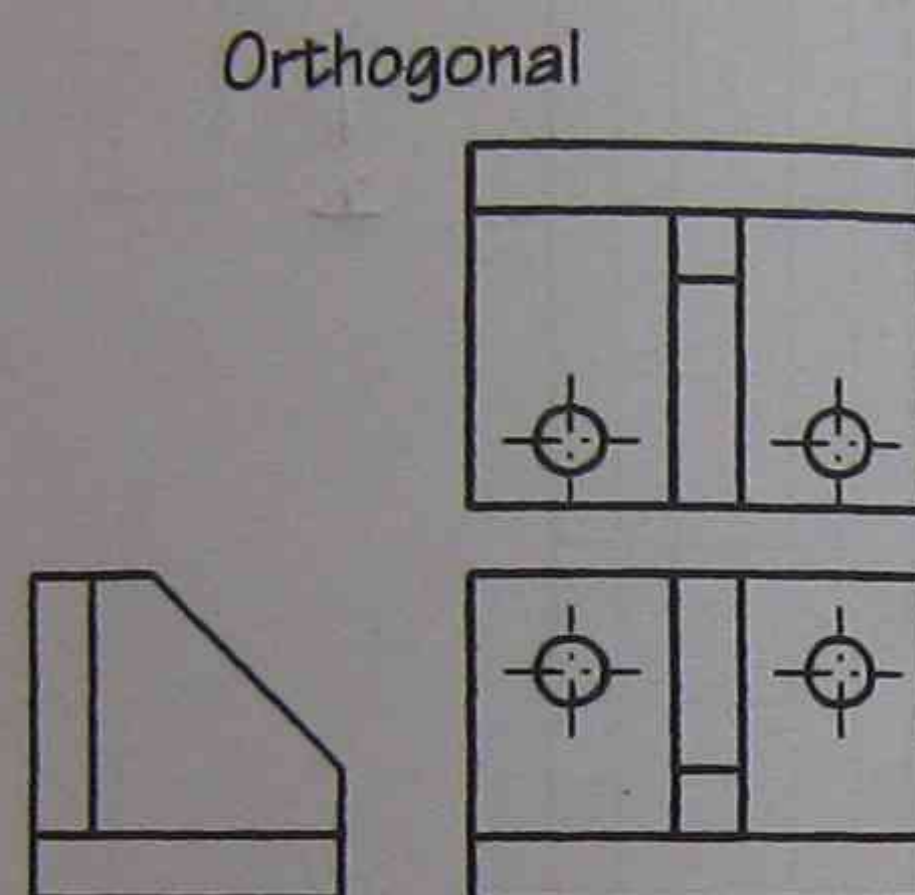
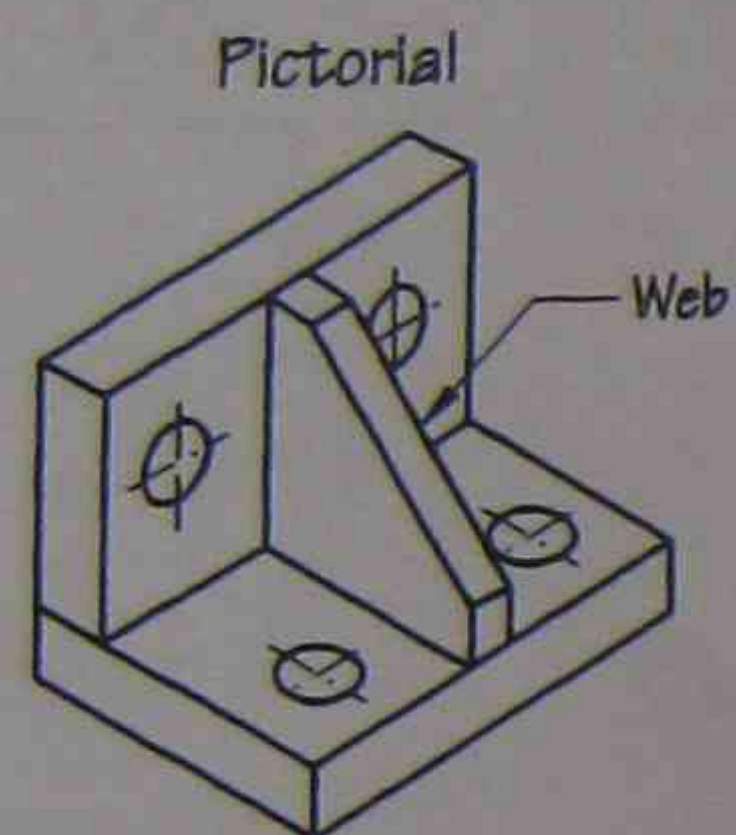
[illegible]



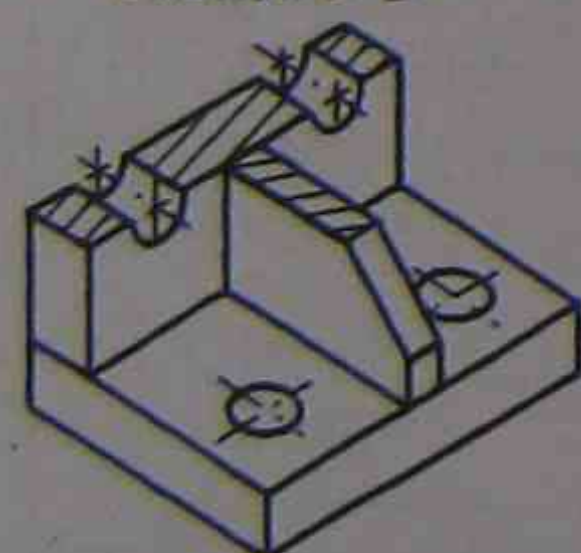
## Sectioning webs

A web is a support piece between two surfaces, which are at an angle to each other. When sectioning webs:

- when the cutting plane cuts through the length of the web, the web is not cross hatched in the section view (Section B-B below)
- when the cutting plane cuts across the web, the web is hatched in the section view (Section A-A below)
- Hidden details (like holes) are not shown on the section view

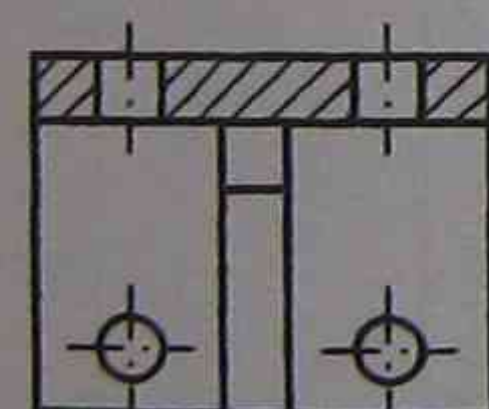


Section B-B

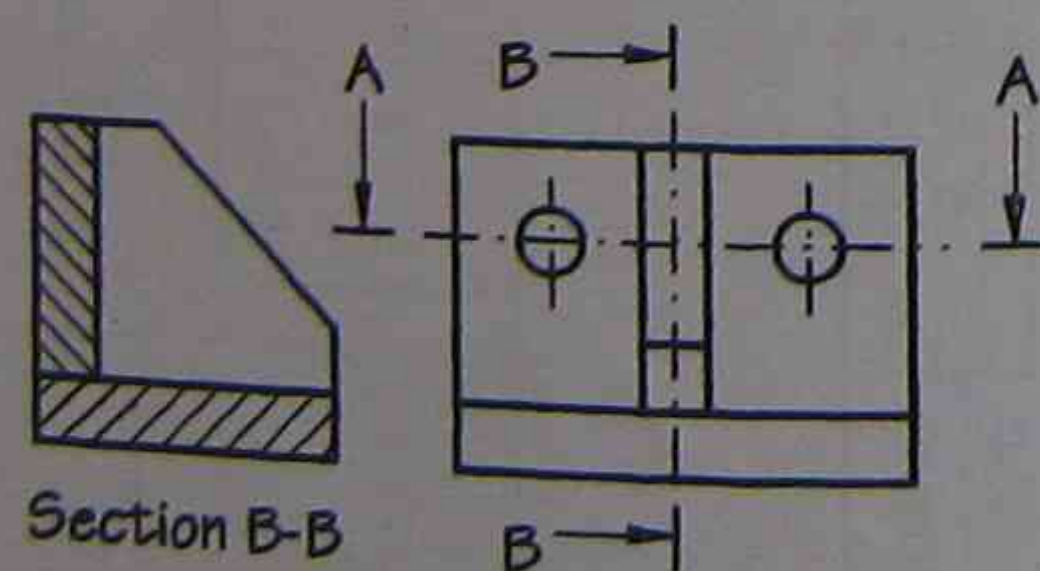


Section A-A

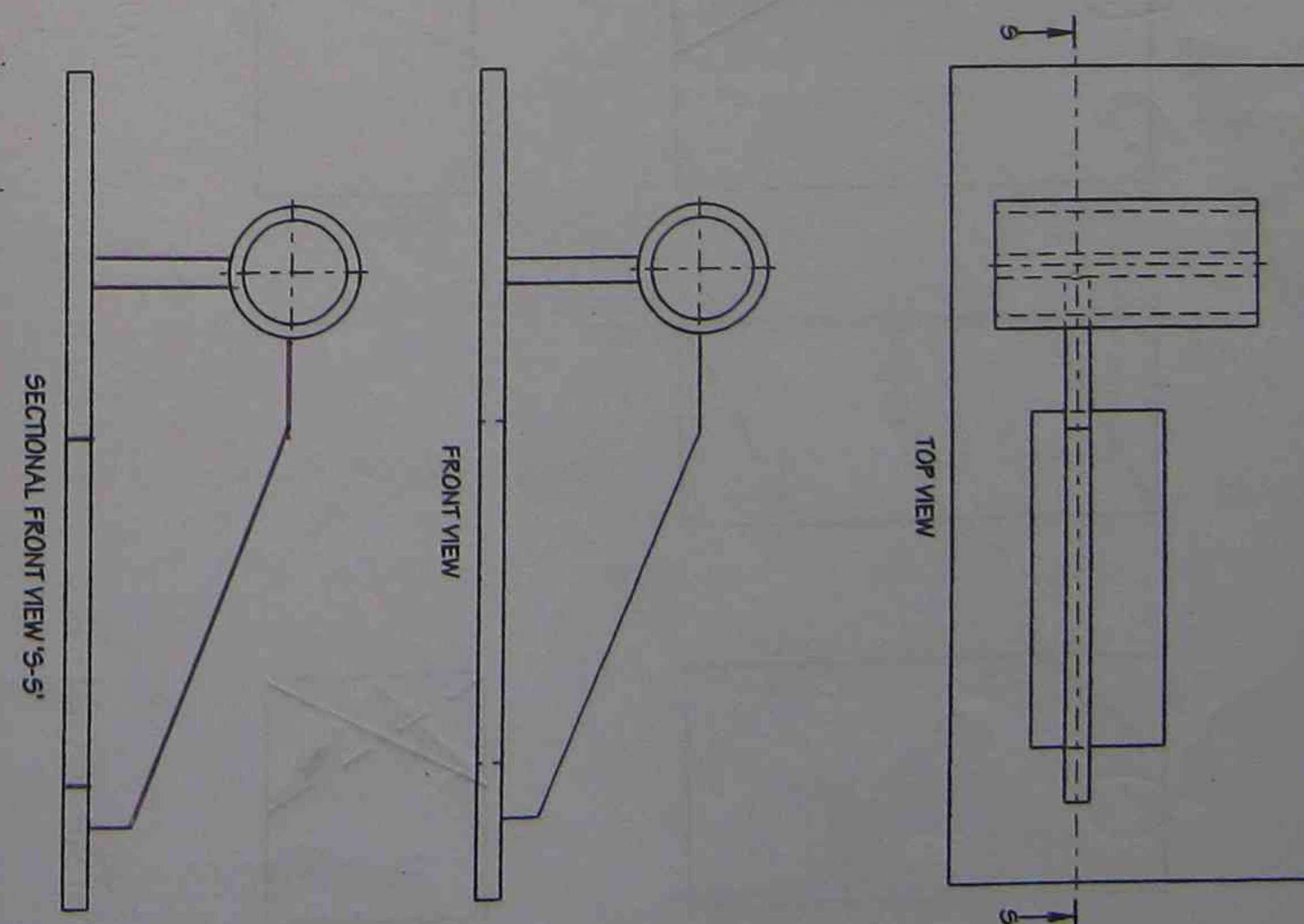
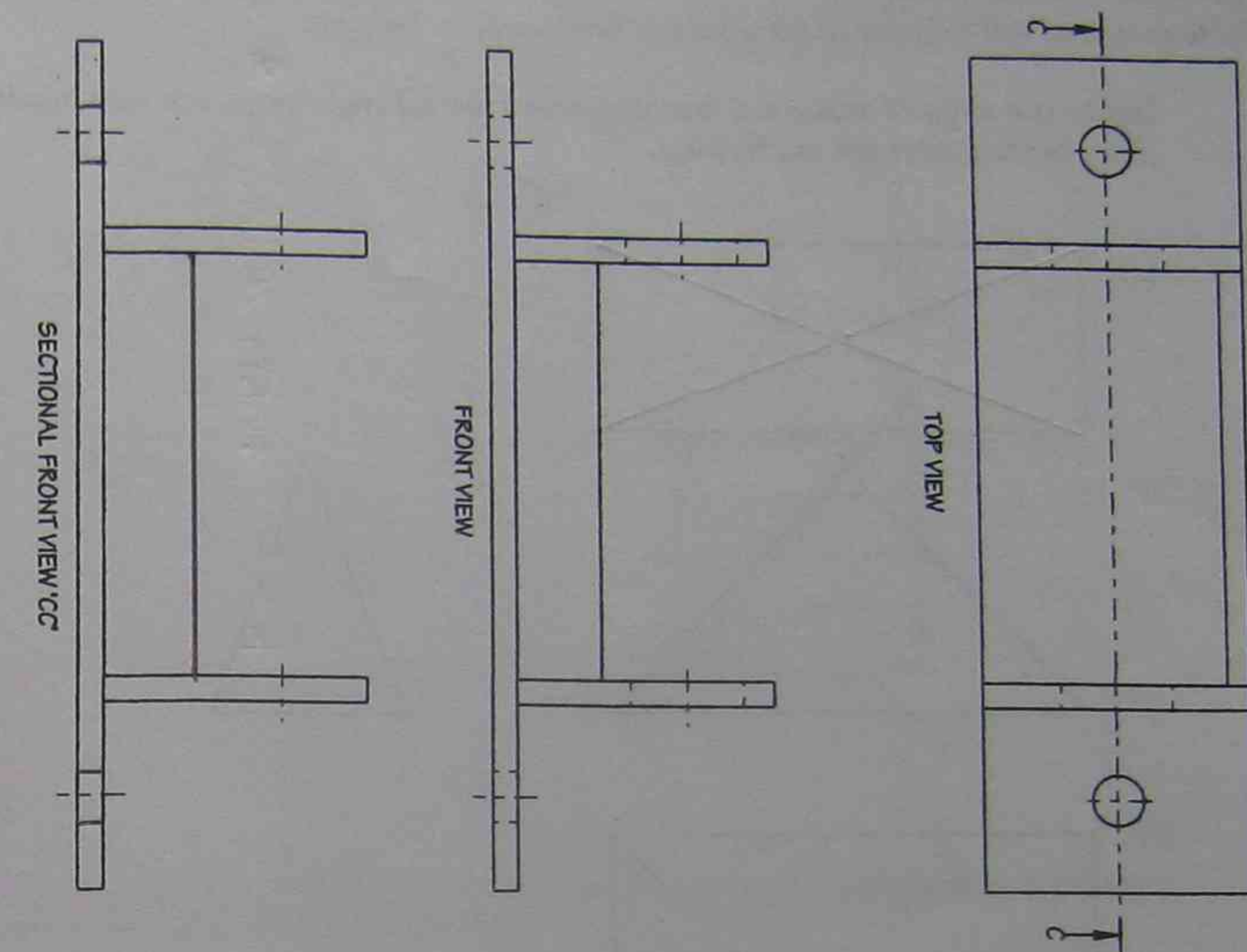
Sectional views



Section A-A



Section B-B

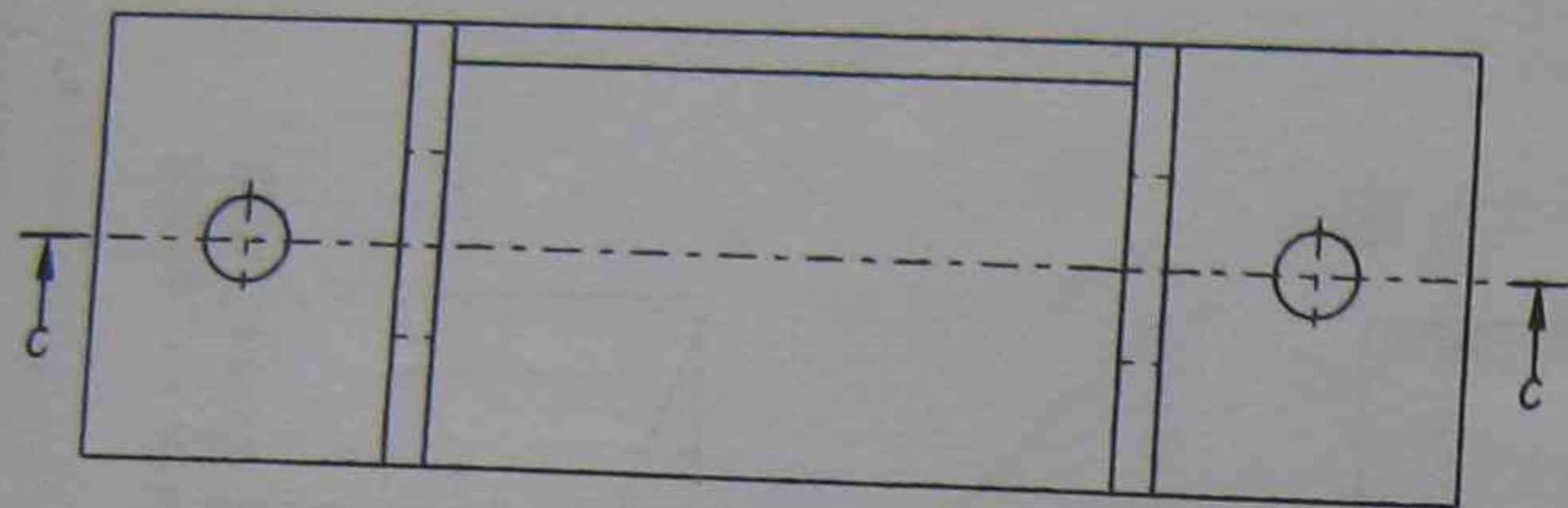
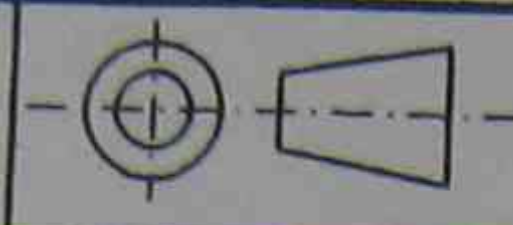


STUDENTS NAME

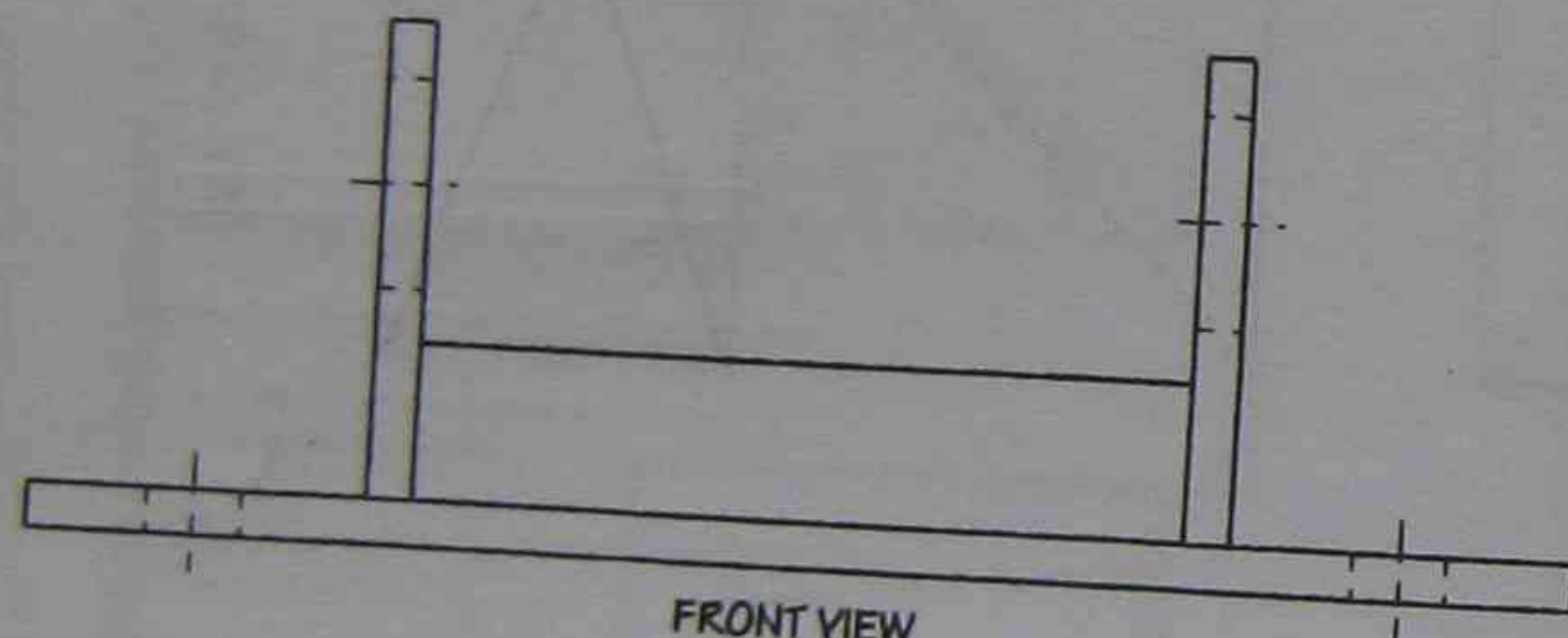
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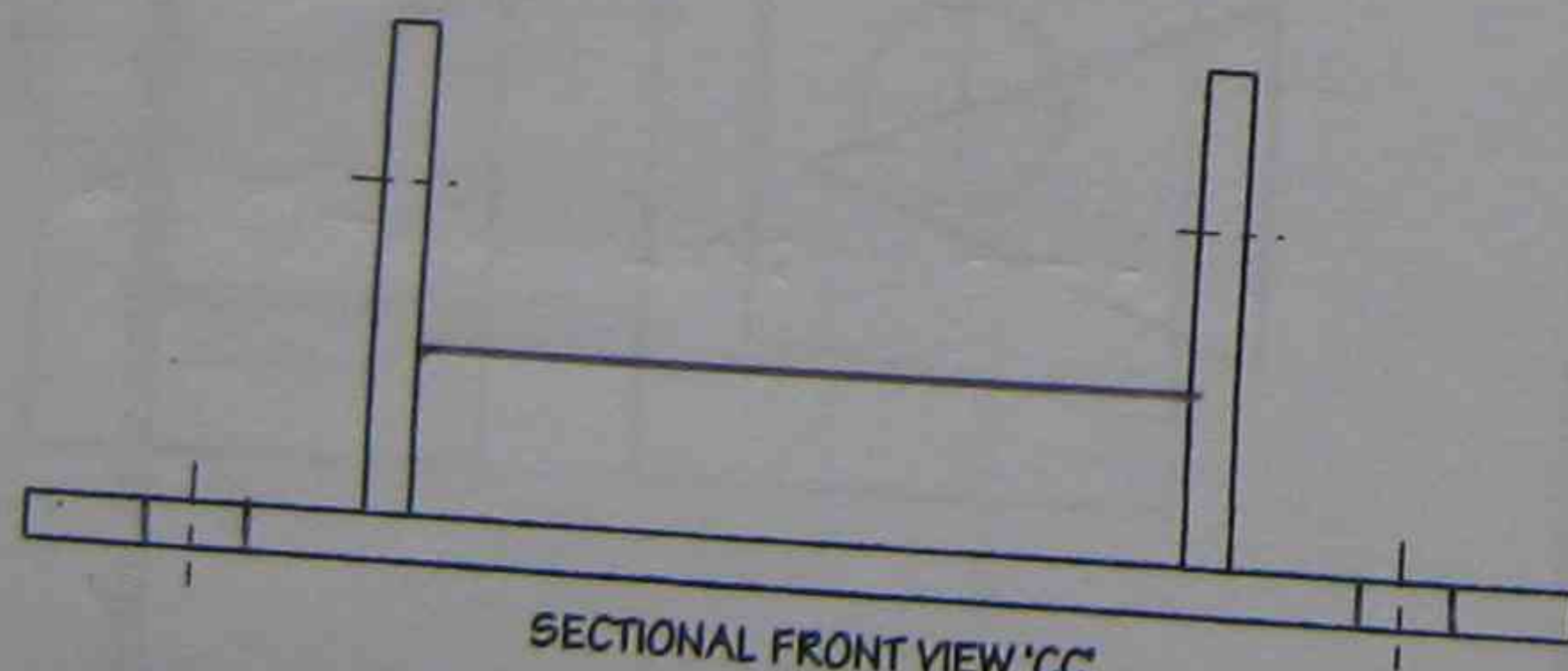
8 TYPE .  
Exercise: ~~5-5~~ Complete the sectional front view 'CC'.



TOP VIEW

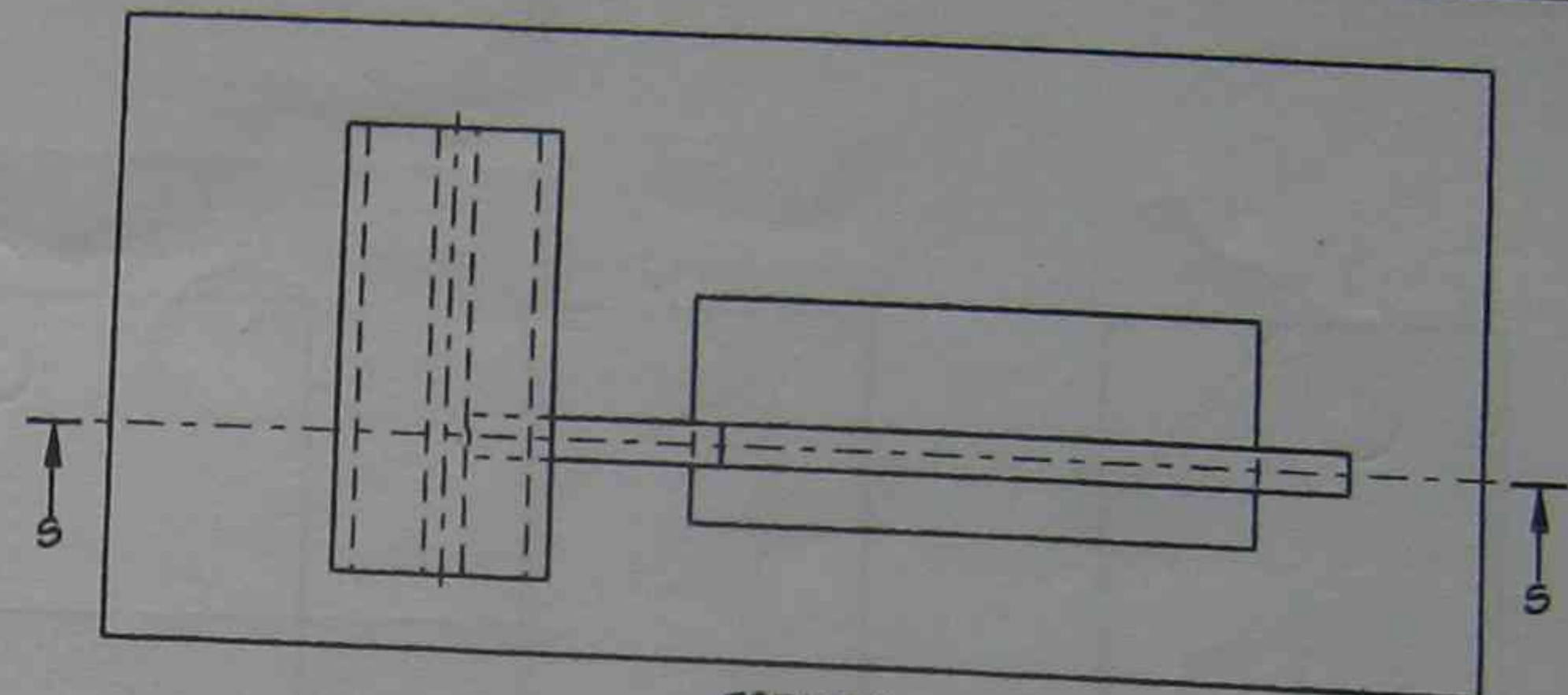
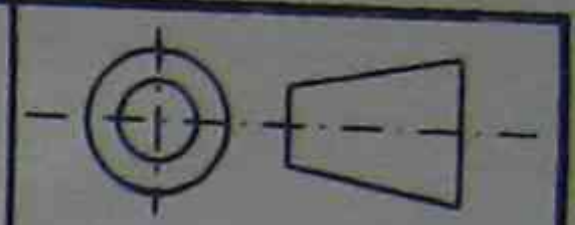


FRONT VIEW

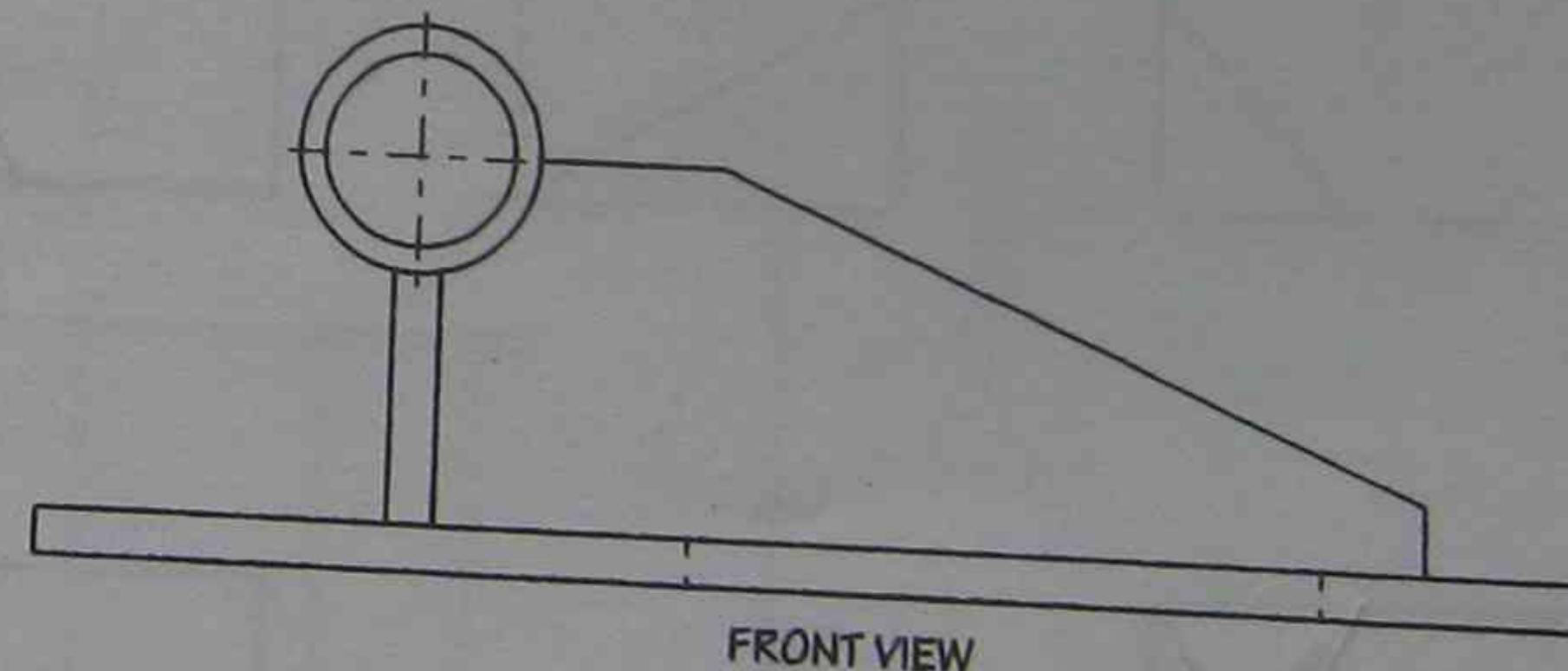


SECTIONAL FRONT VIEW 'CC'

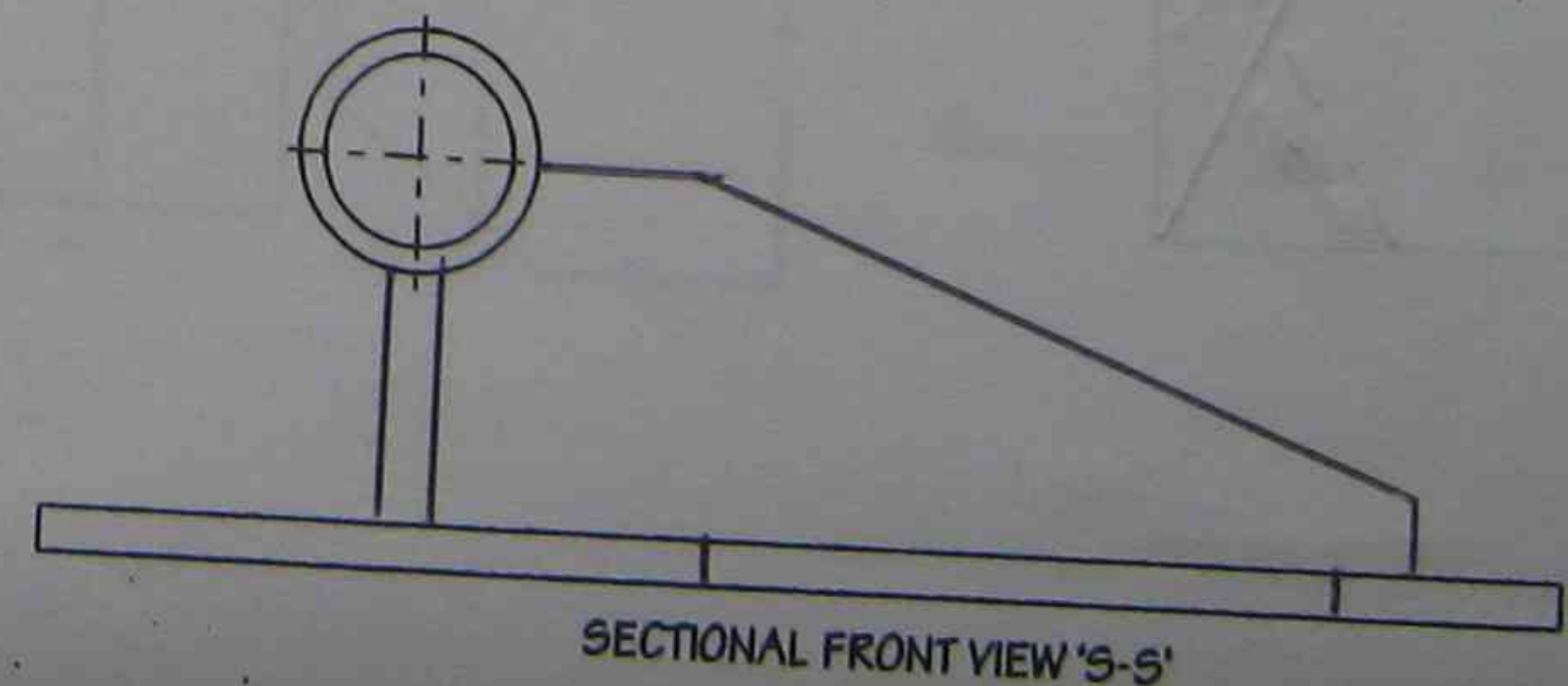
9 TYPE  
Exercise: ~~5-5~~ Complete the sectional front view 'SS'.



TOP VIEW



FRONT VIEW



SECTIONAL FRONT VIEW 'S-S'

STUDENTS NAME

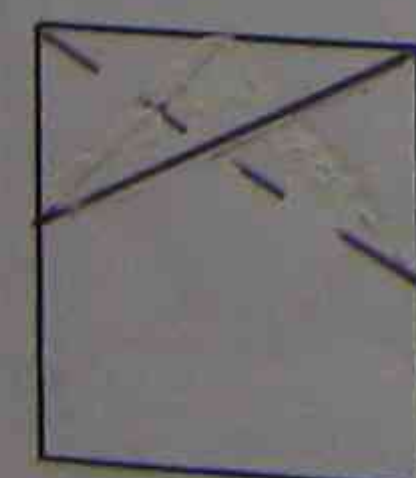
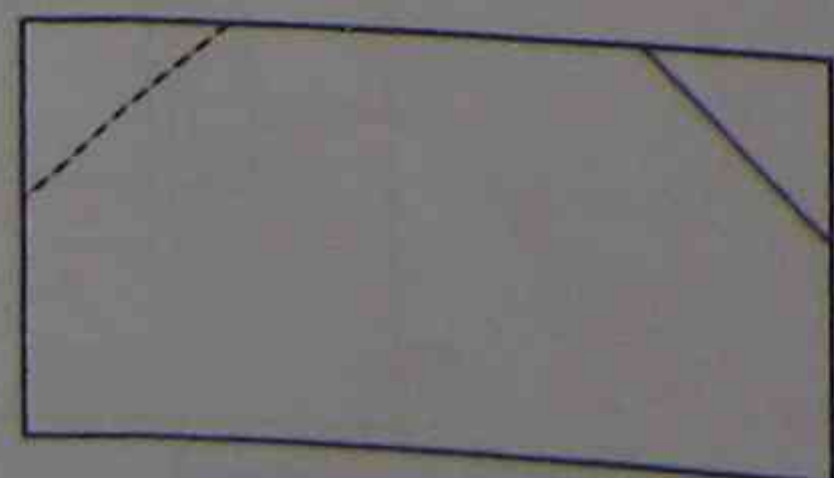
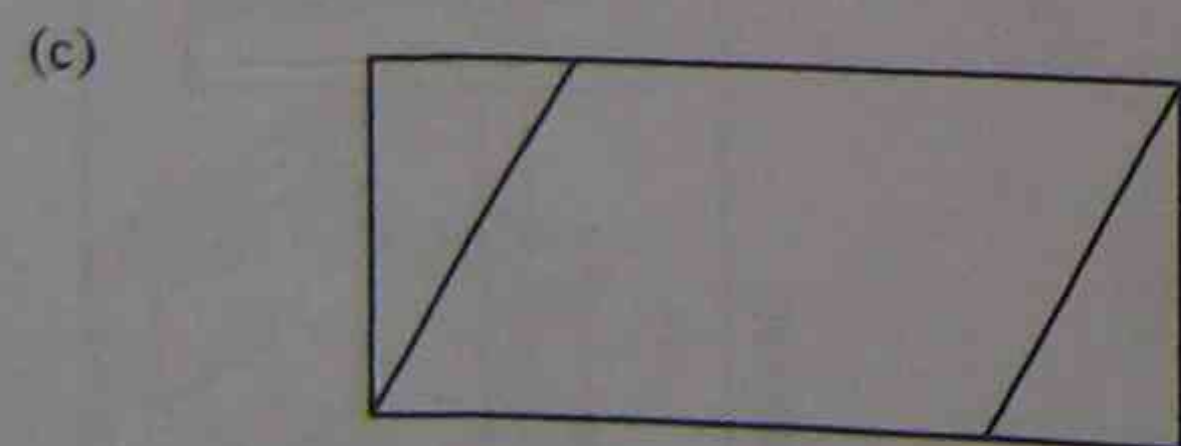
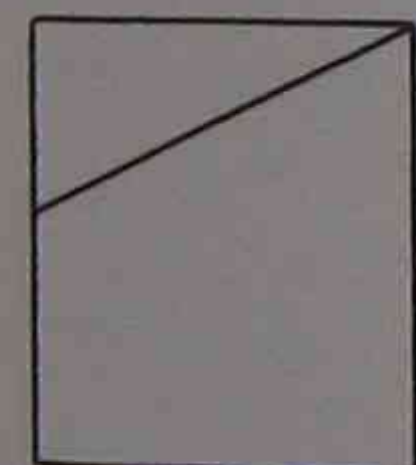
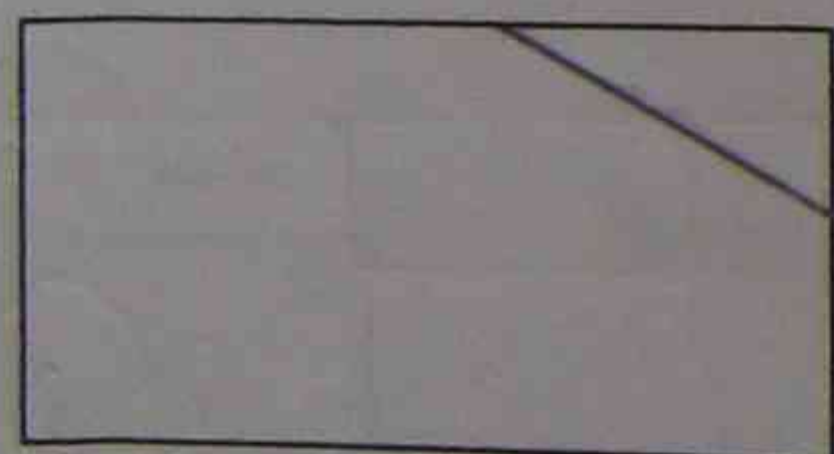
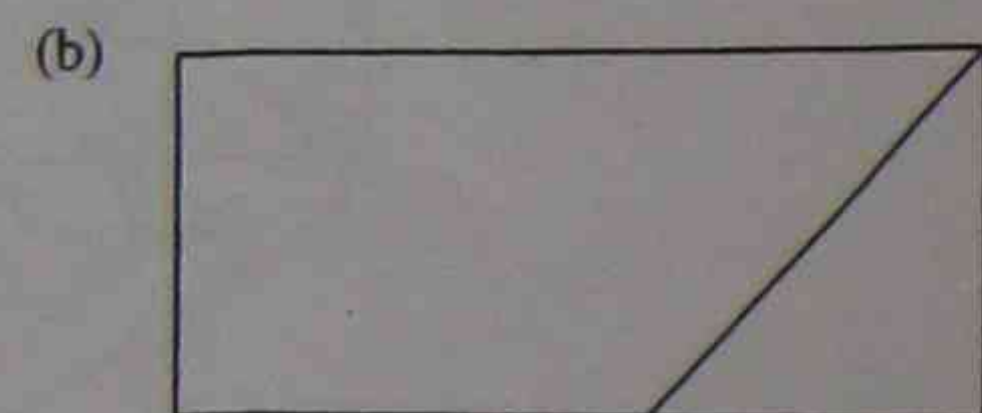
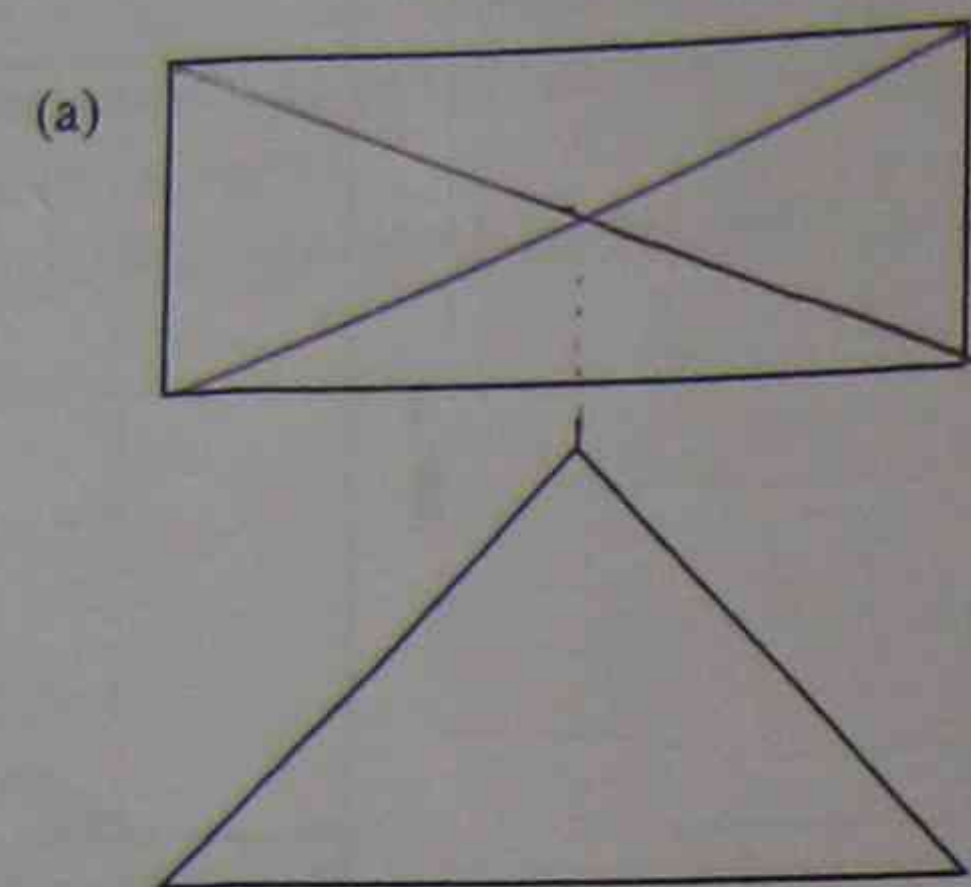
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## Review Questions

These questions will help you revise what you have learnt in this topic.

1. Below is a series of orthogonal drawings drawn in third angle projection with missing lines. In each, complete the drawing.



2. Using projection techniques, add the missing lines to the top view of the third angle projection drawing of figure 4 below.

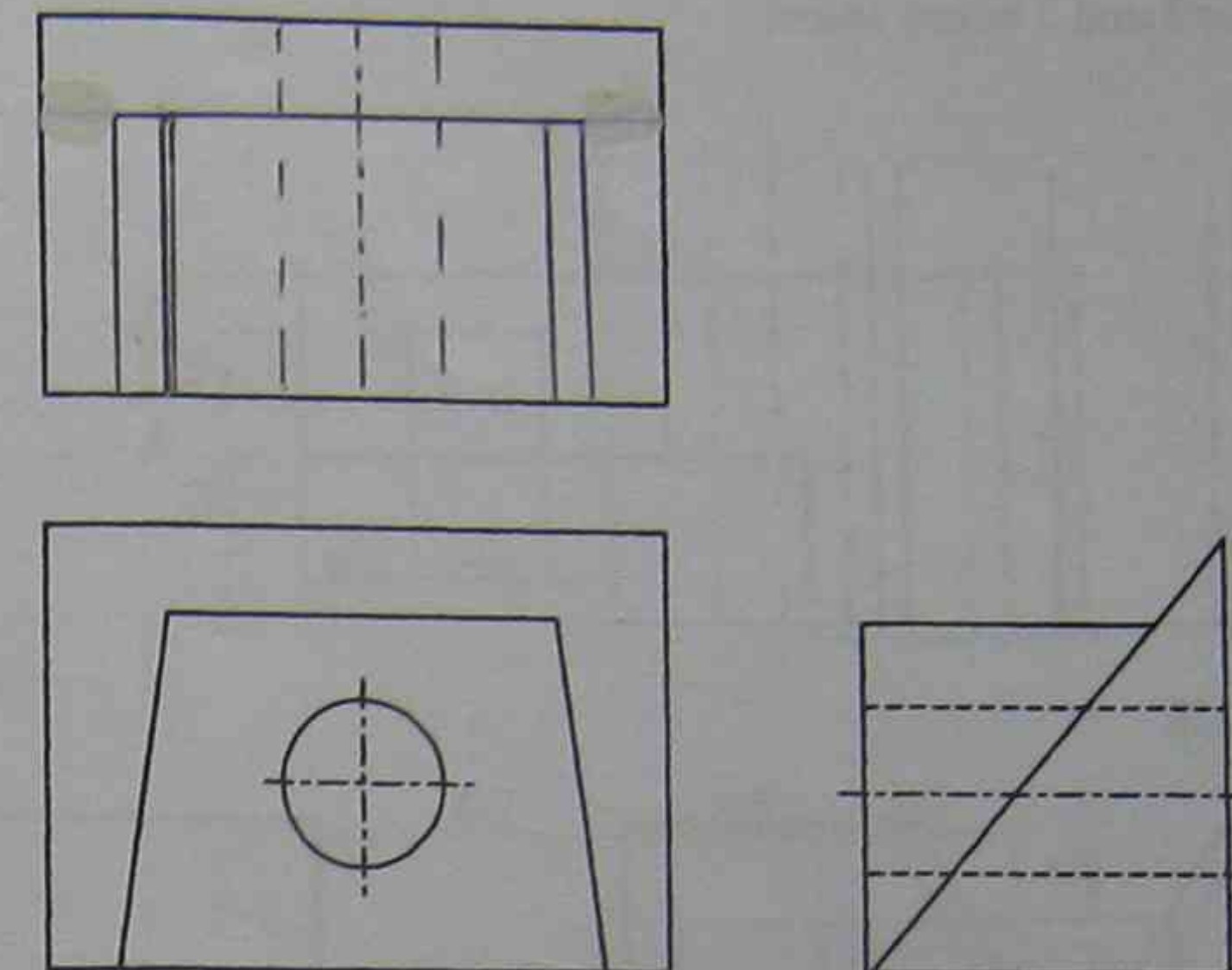


Figure 4

3. Using projection techniques, add the missing lines to the top view of the third angle projection drawing of figure 5 below.

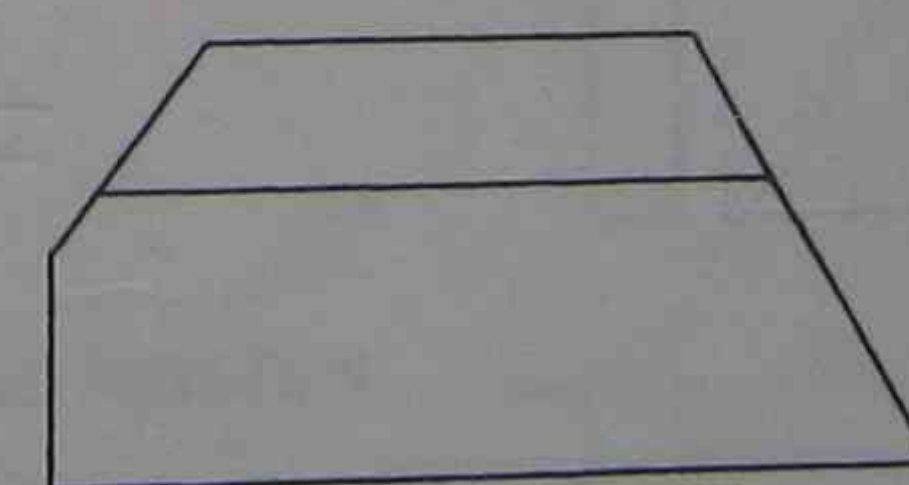
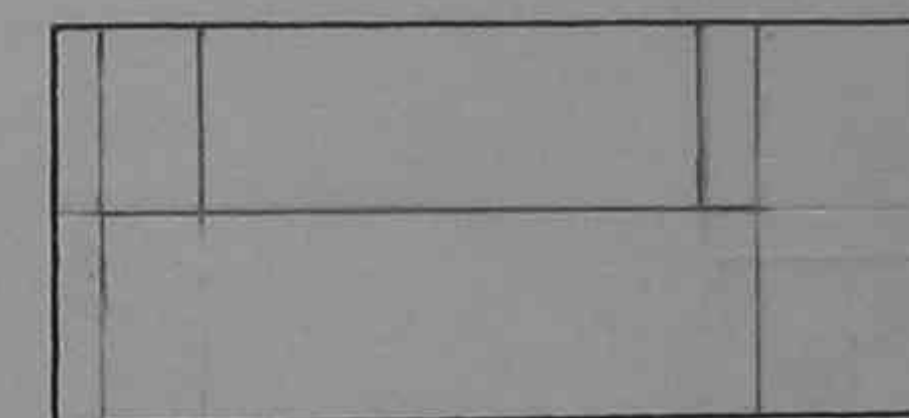


Figure 5



4. Using projection techniques, add the missing top view of the third angle projection drawing of figures 6 and 7 below.

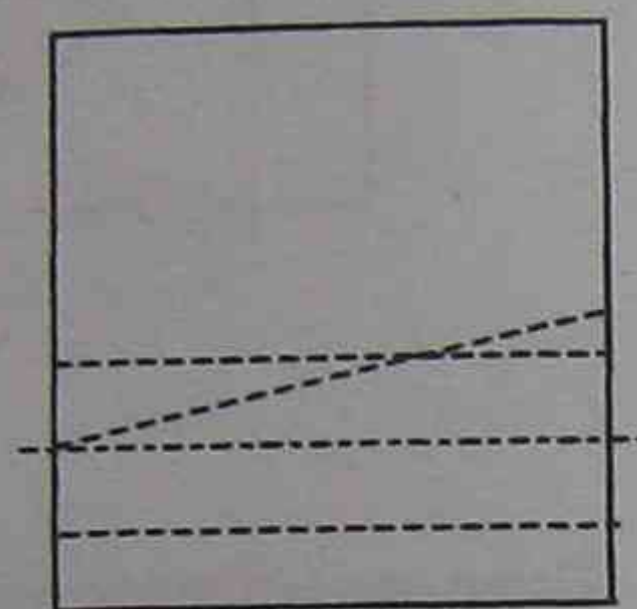
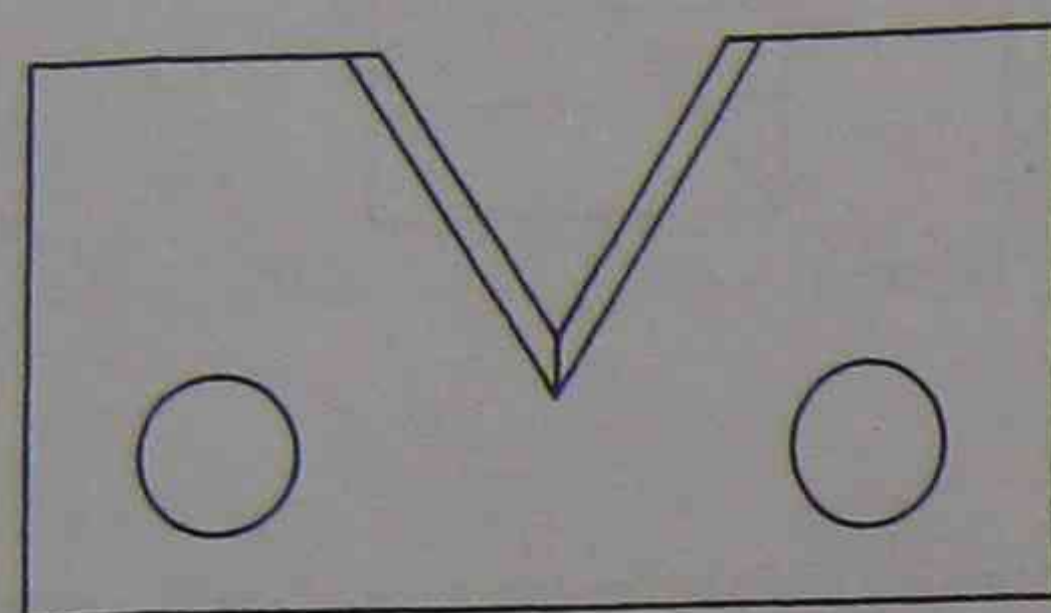
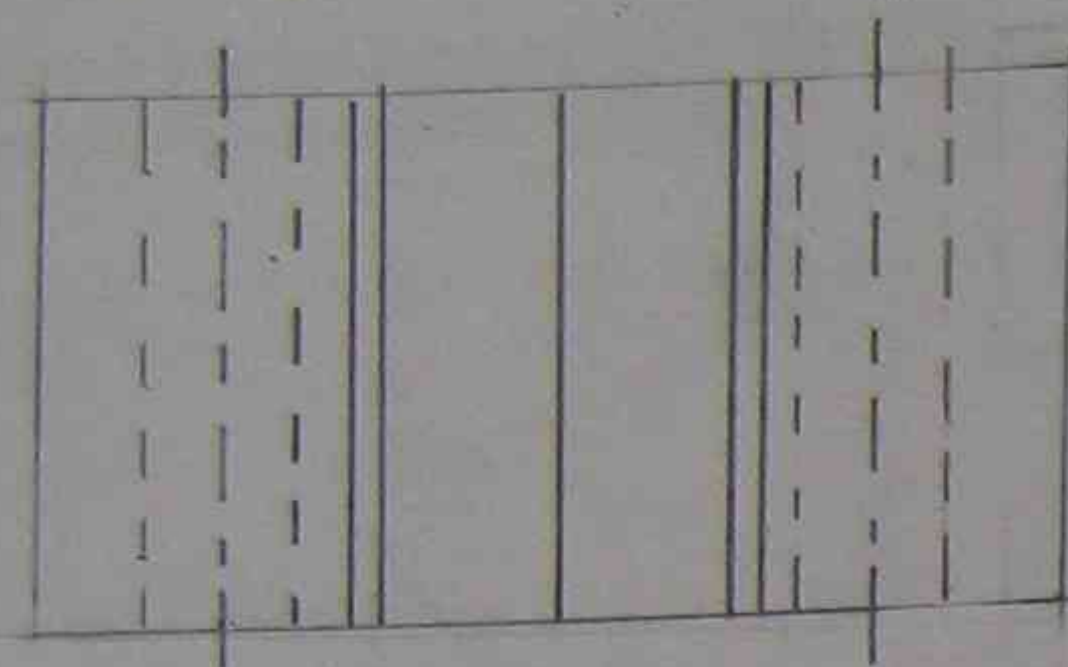


Figure 6

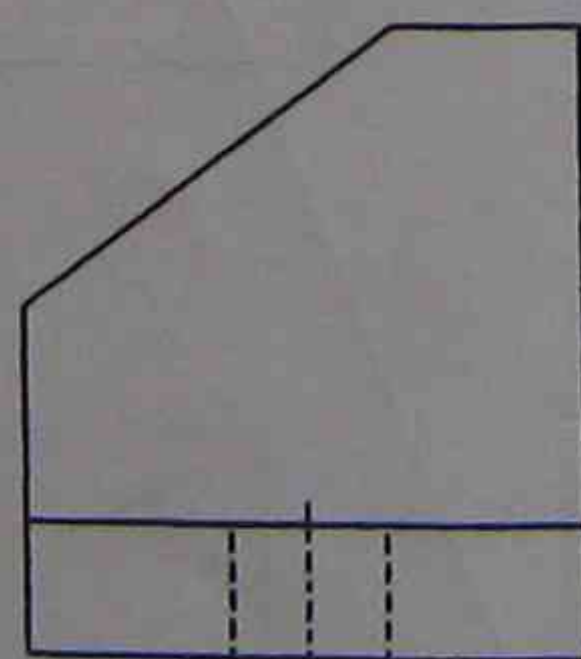
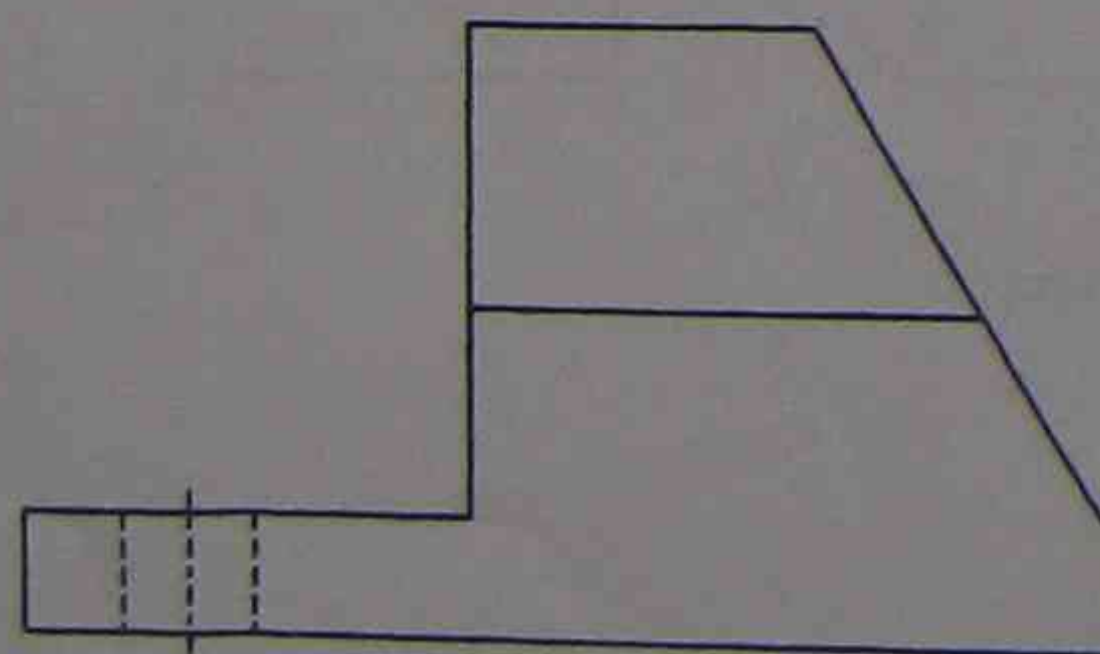
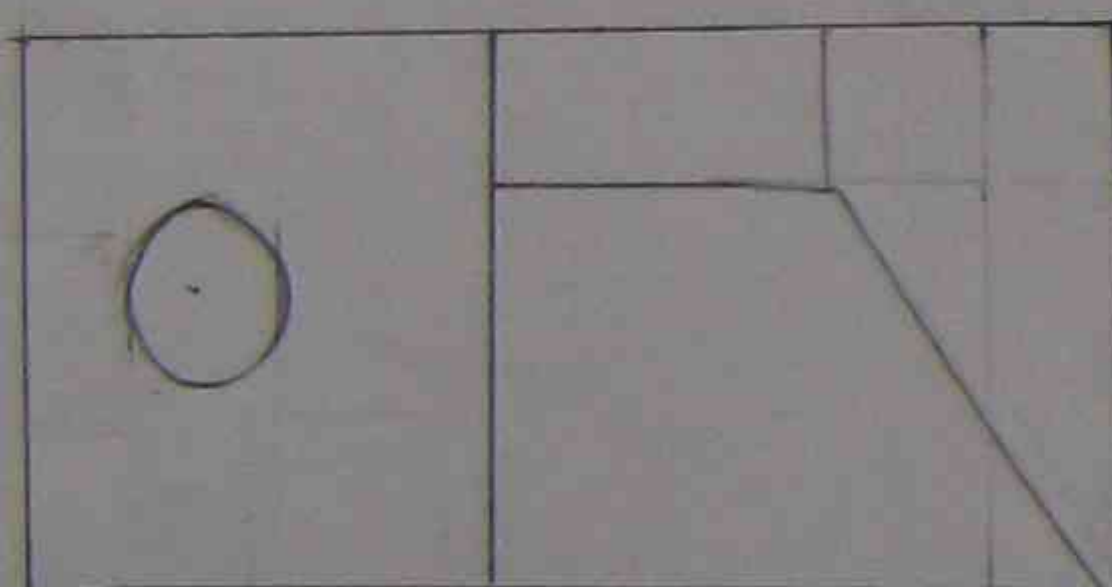
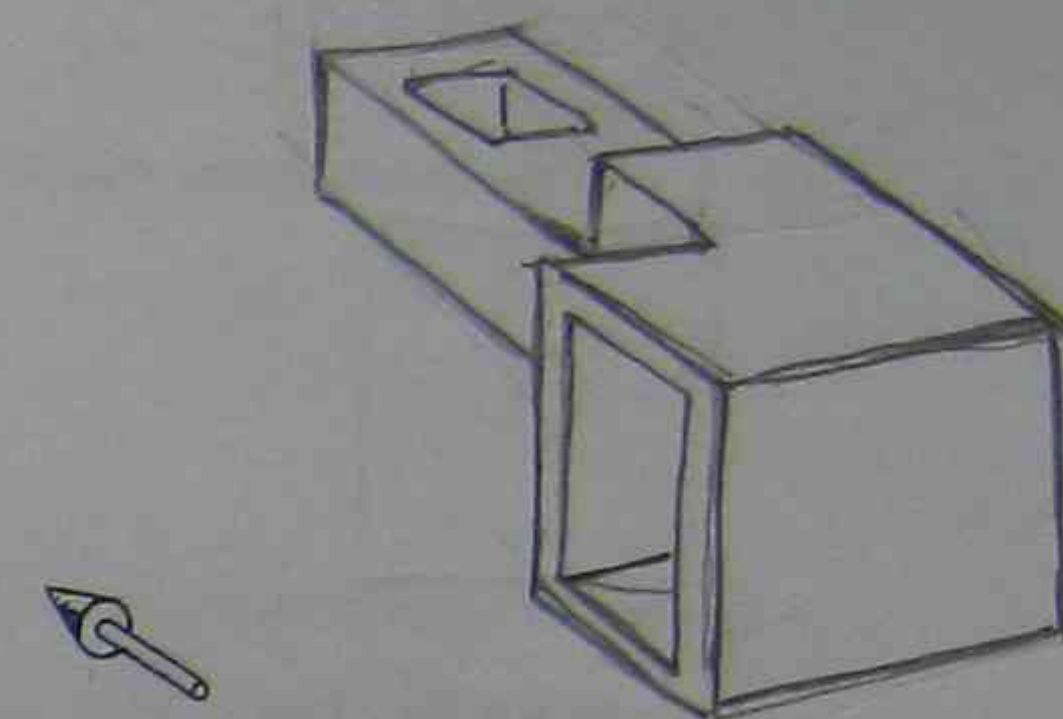
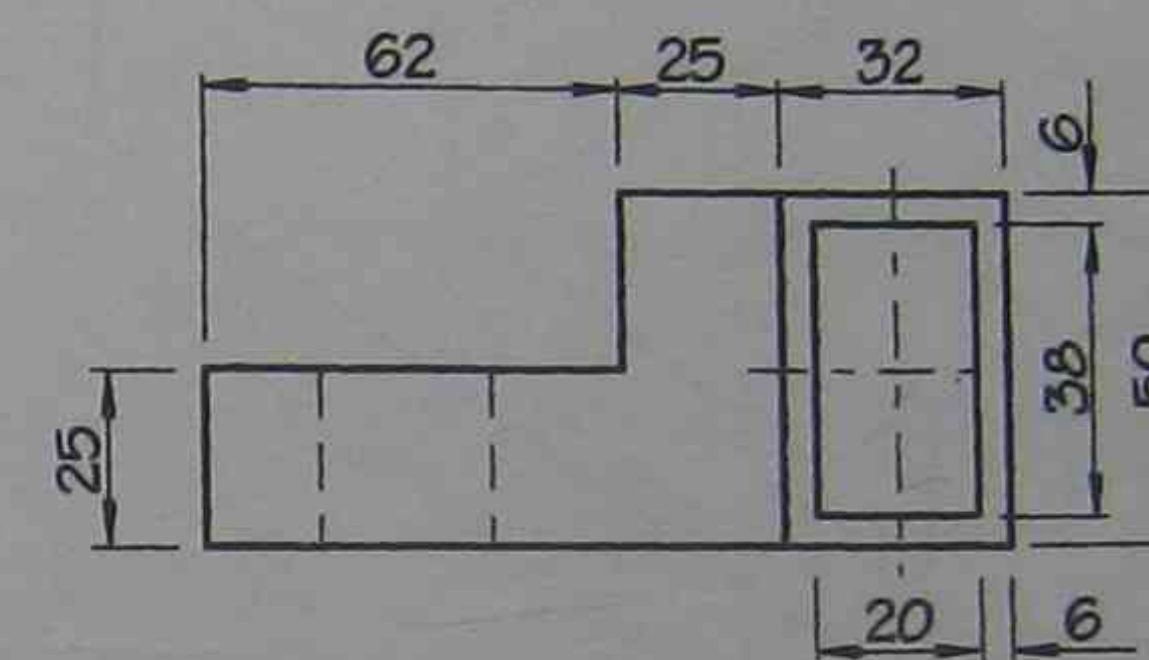
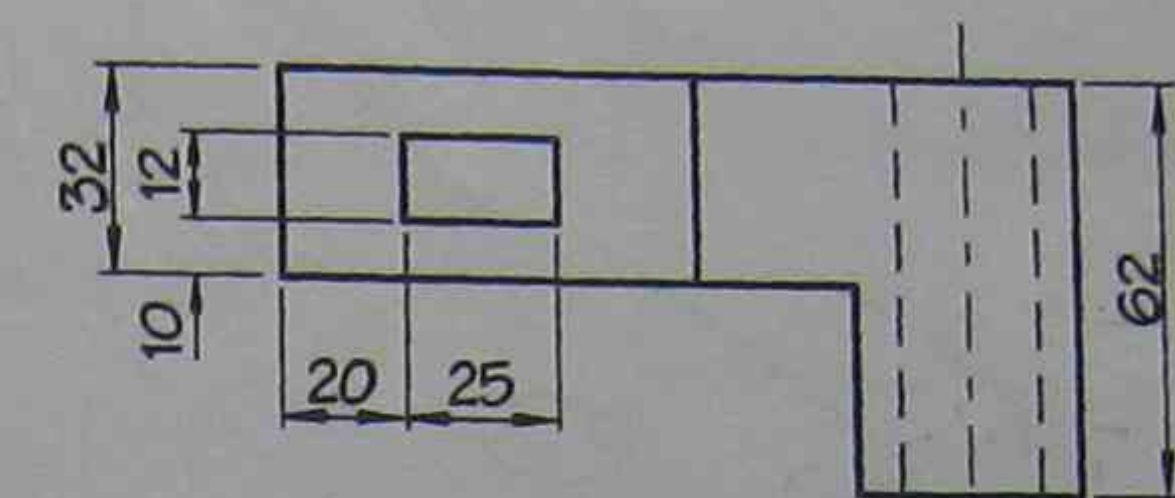


Figure 7

5. <sup>A FRECHAND</sup> Draw an isometric drawing of the third angle projection drawings shown below

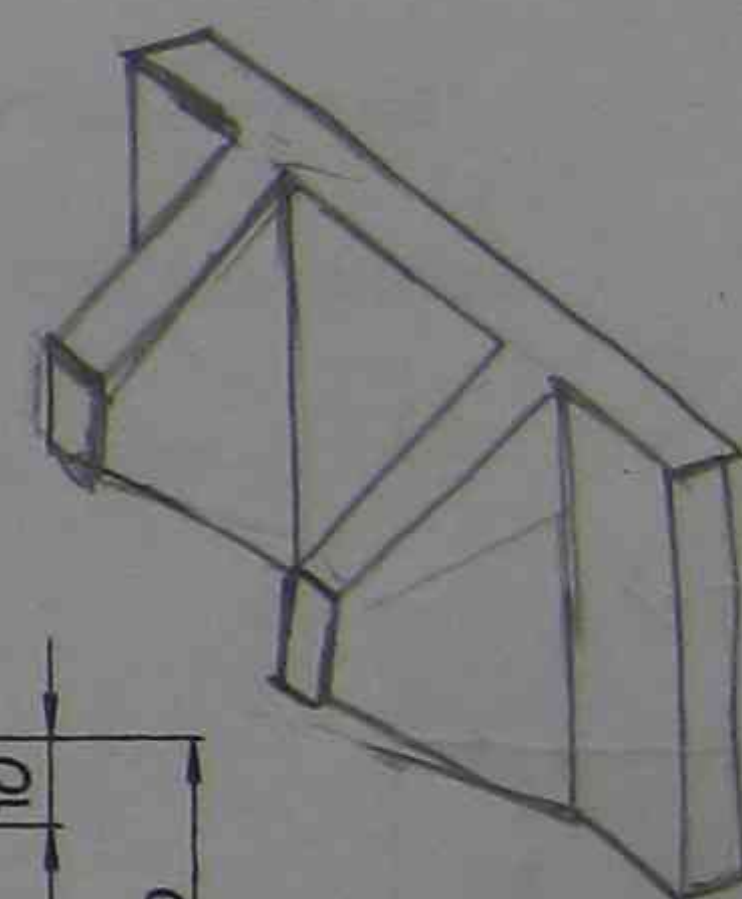
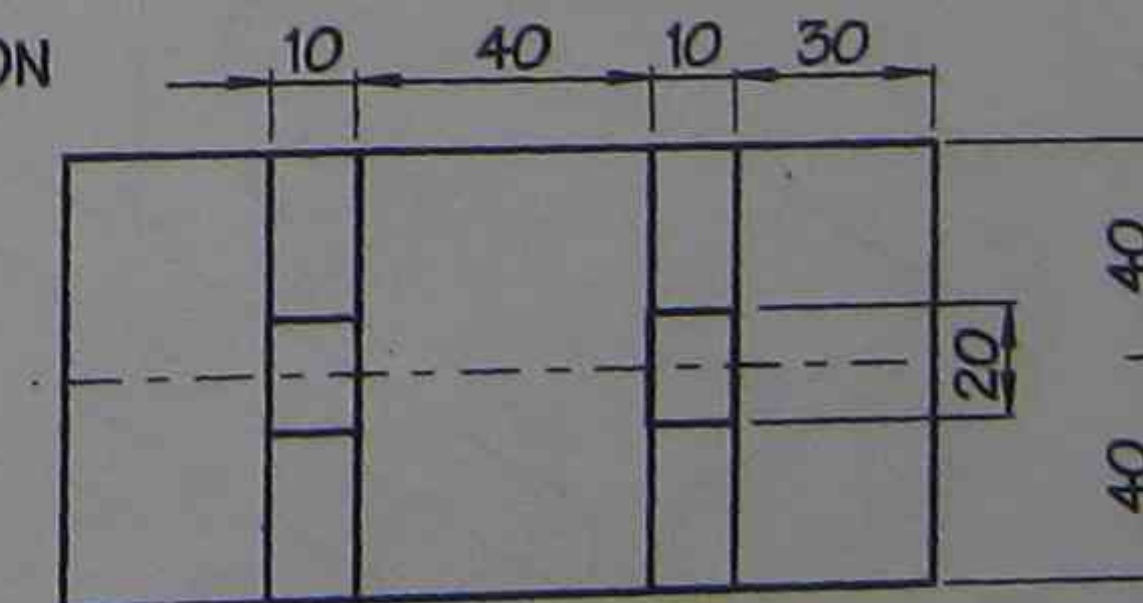
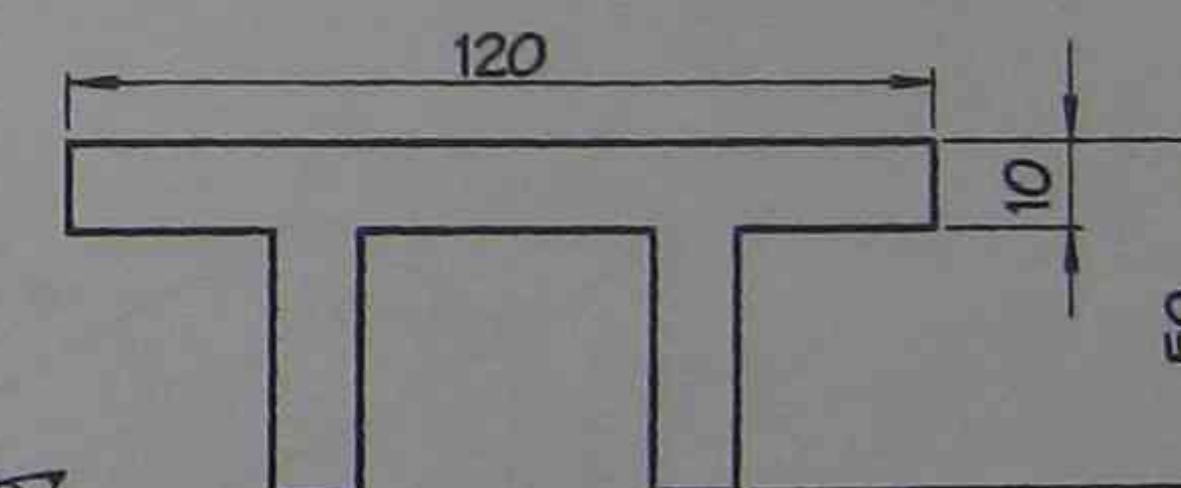
(a)



VIEWING DIRECTION

Figure 9

(b)



VIEWING DIRECTION

VIEWING DIRECTION

Figure 10



68

Draw in freehand a front, top and right hand side view of the following two isometric drawings.

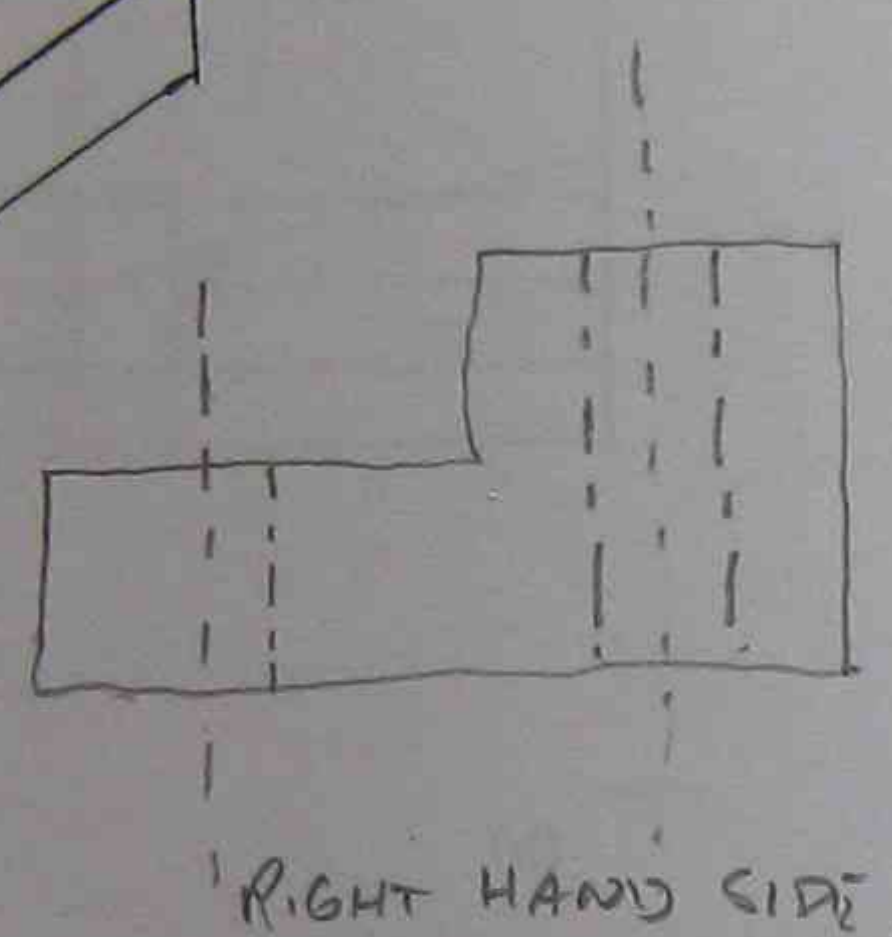
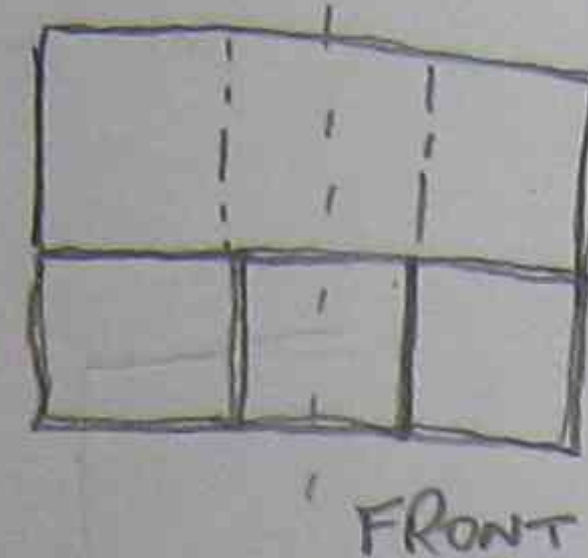
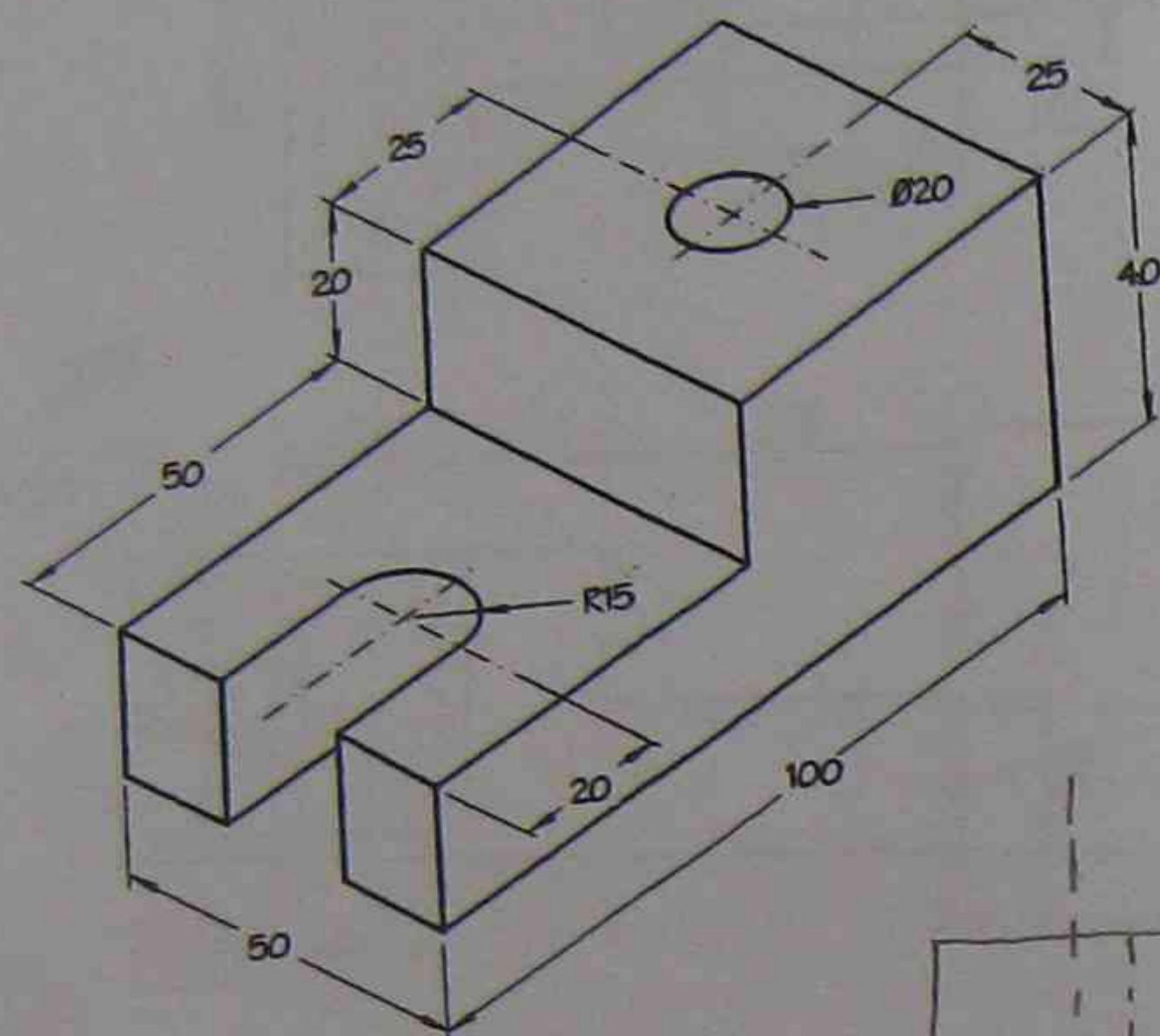
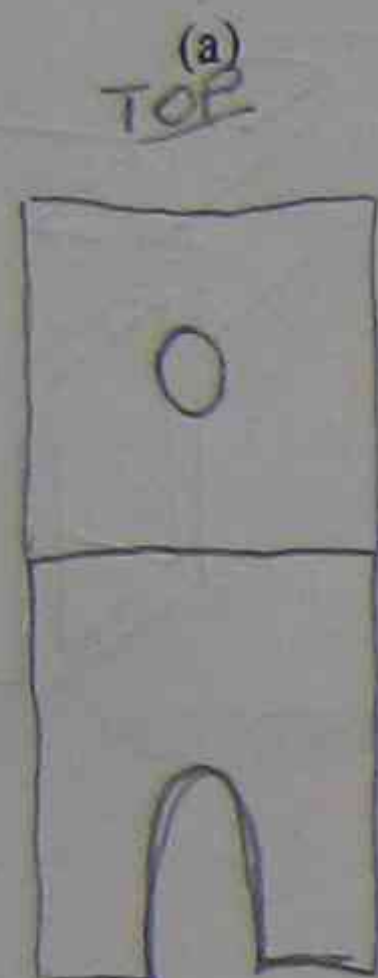


Figure 9

TOP

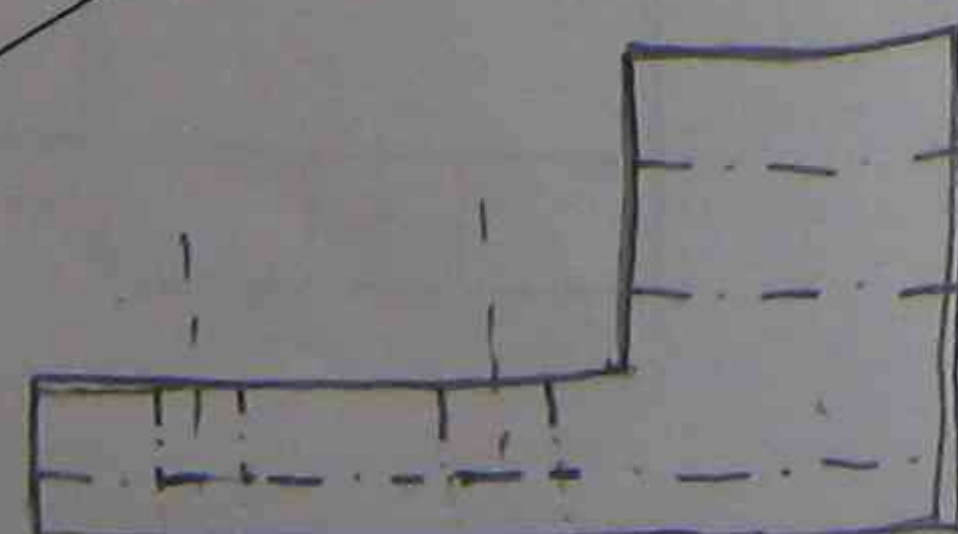
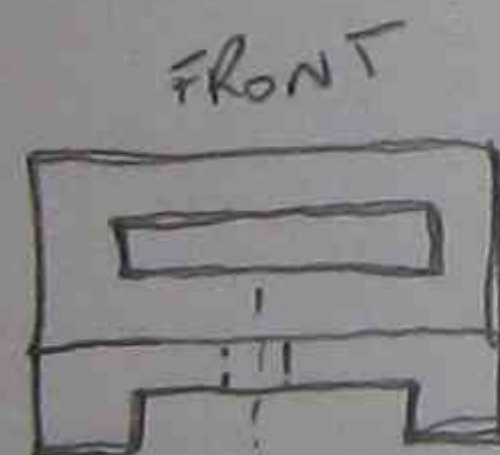
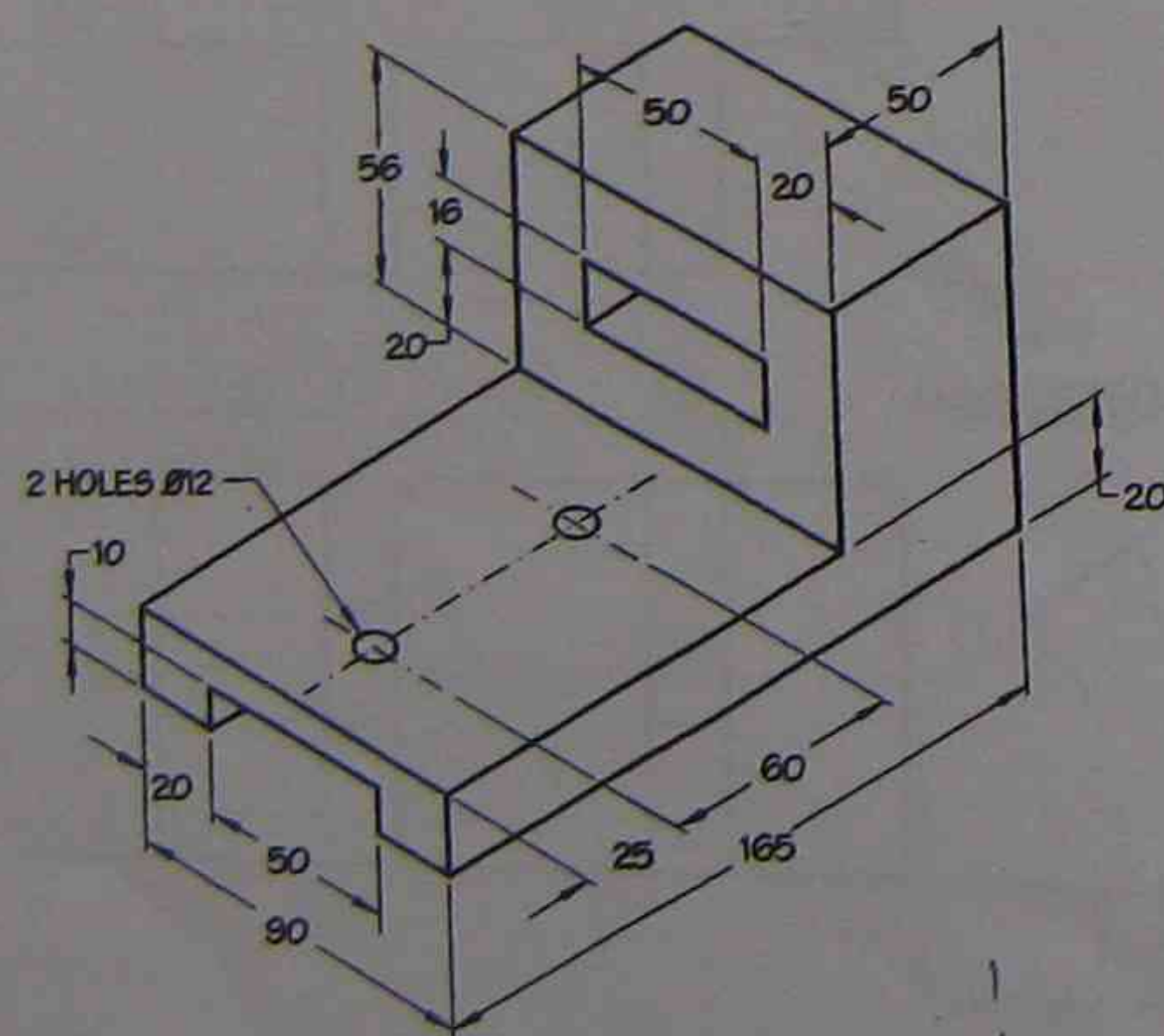
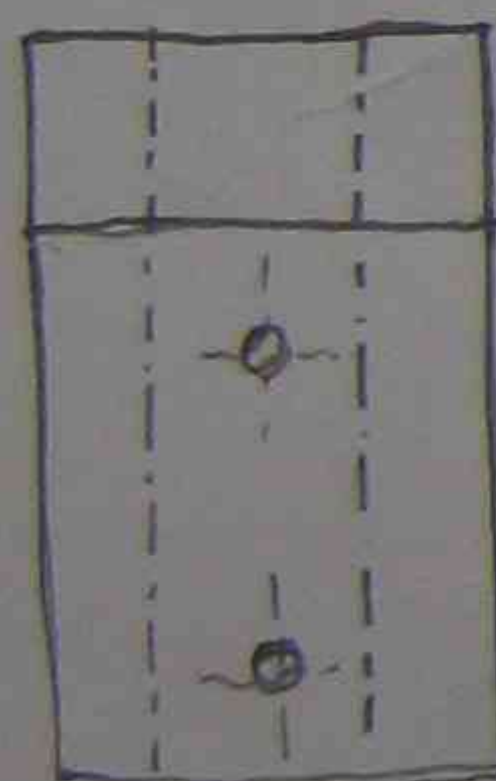


Figure 10

### 3 Architectural Drawings

#### Purpose

In this topic you will learn how to read and interpret architectural drawings for the locations of electrical circuits, accessories and appliances.

#### Objectives

At the end of this topic you should be able to:

- identify and distinguish between site plans, floor plans, detailed drawings and standard drawings
- use an architectural floor plan to determine the power and lighting layouts required in a domestic installation.
- use a site plan to locate the service point, consumers mains, main switchboard, distribution boards and/or builders supplies.
- use standard drawing scales to determine the actual lengths represented by dimensions on an architectural drawing.
- draw given dimensions to scale
- identify electrical symbols used with location diagrams
- read and interpret a floor plan to determine the location of the electrical accessories and appliances.
- use Australian standard symbols on a floor plan to show the location of the accessories and appliances as detailed in an electrical schedule.
- identify and locate luminaire switch positions from an architectural floor plan.



## Introduction.

The installation of electrical services is a major part of any new building. Being able to correctly interpret a floor plan that shows the location of all electrical accessories and appliances to be installed is an essential task for an electrician who is involved in the installation of electrical wiring and equipment. This may include the installation of the following:

- lighting
- power
- heating (water, cooking and space)
- air-conditioning
- computing
- communications
- security
- audio-visual

There are two levels of drawing:

- **design drawings** where the ideas on room relationship, size and stylistic treatment are considered.
- **working drawings** that set down the finalised design together with all the information a builder or tradesperson needs to know in order to construct the work.

## The plan/working drawing

The working plan consists of:

- floor plan
- site plan
- elevations (front, rear and sides)
- section
- details

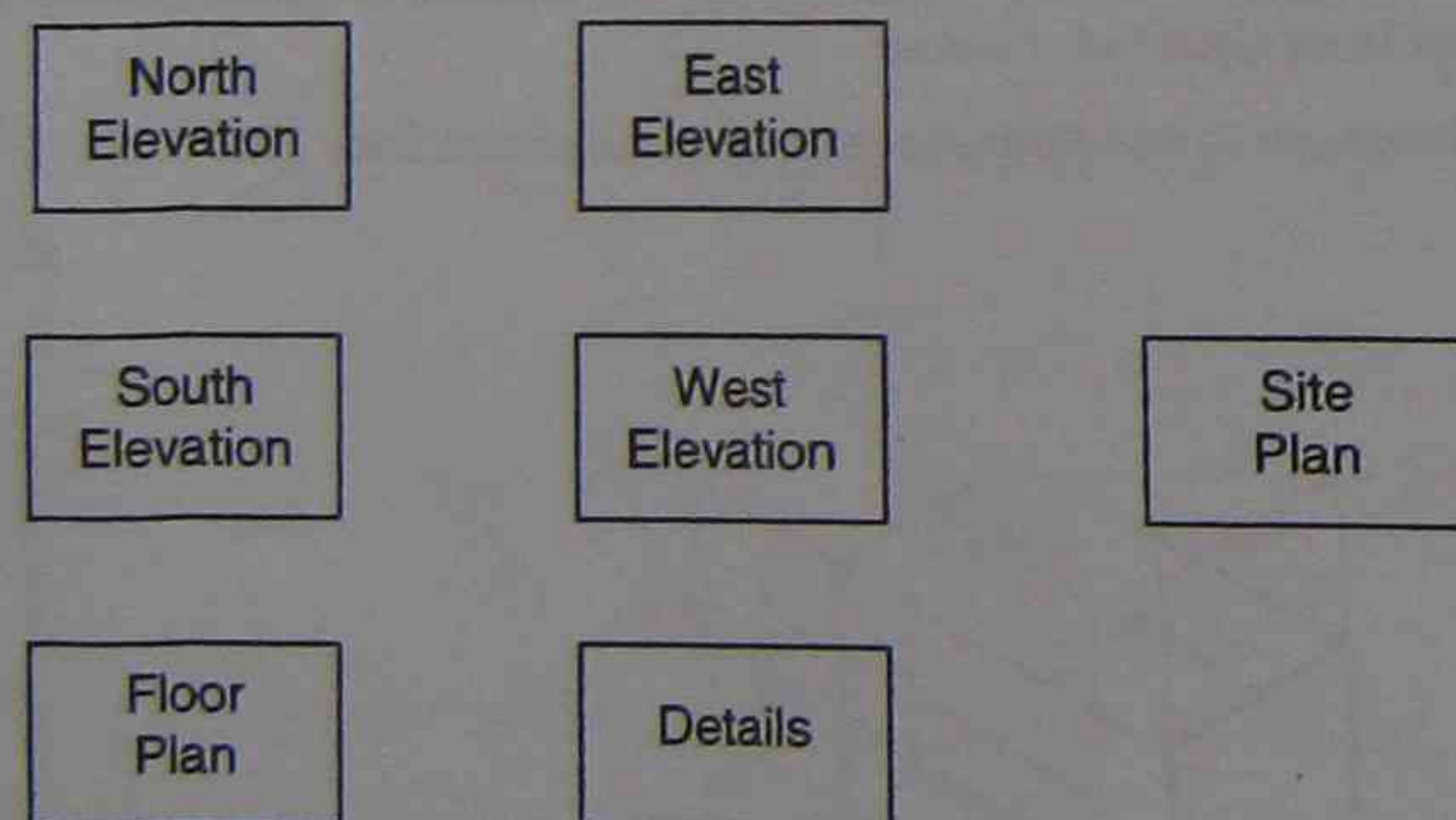


Figure 1 General layout of drawing sheet

**Floor plan:** a horizontal section through a building as viewed from above, showing the actual outline or shape of the building. Generally the view used by most electricians in carrying out their work. Information associated with a floor plan would include dimensions, wall thickness, position of windows and doors and width of openings. It also details positioning of electrical accessories and appliances.

**Site plan:** shows the outline of the building lot and the position of the building on the lot. Roads, services and other physical details may be shown.

**Elevations:** are views of the various sides of the building and show each side of the building as viewed at right angles. Sometimes the elevations are named in accordance with the building orientation, for example, north elevation, west elevation.

**Section:** a side view as if an exterior wall were removed. More correctly it is a 'cut' through a building at a certain point. Shows heights and internal structures that are not evident in the plans or elevation views.

**Details:** are larger scale drawings that show details of specific parts of a building or details relating to the installation of equipment such as the footing detail.

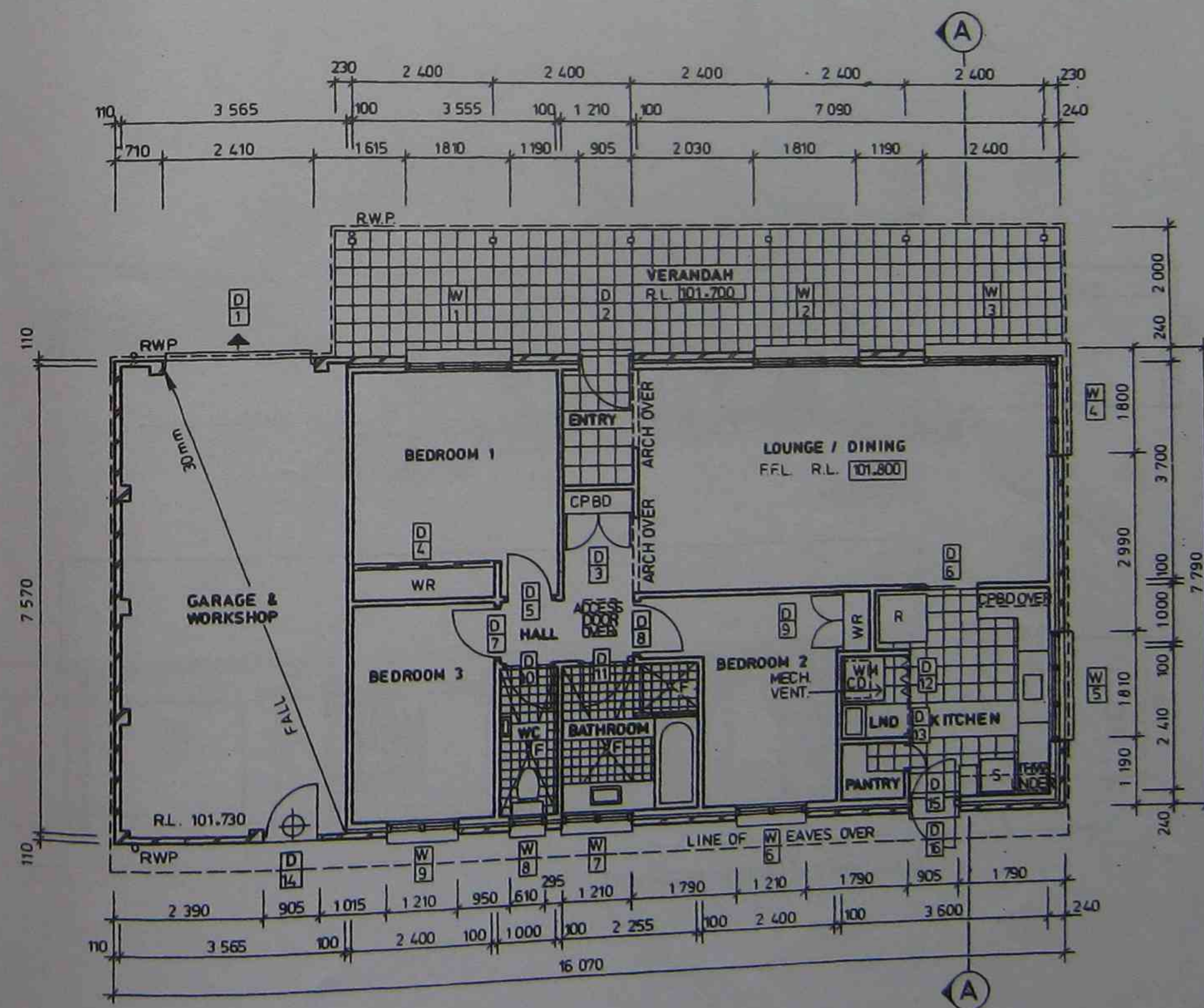
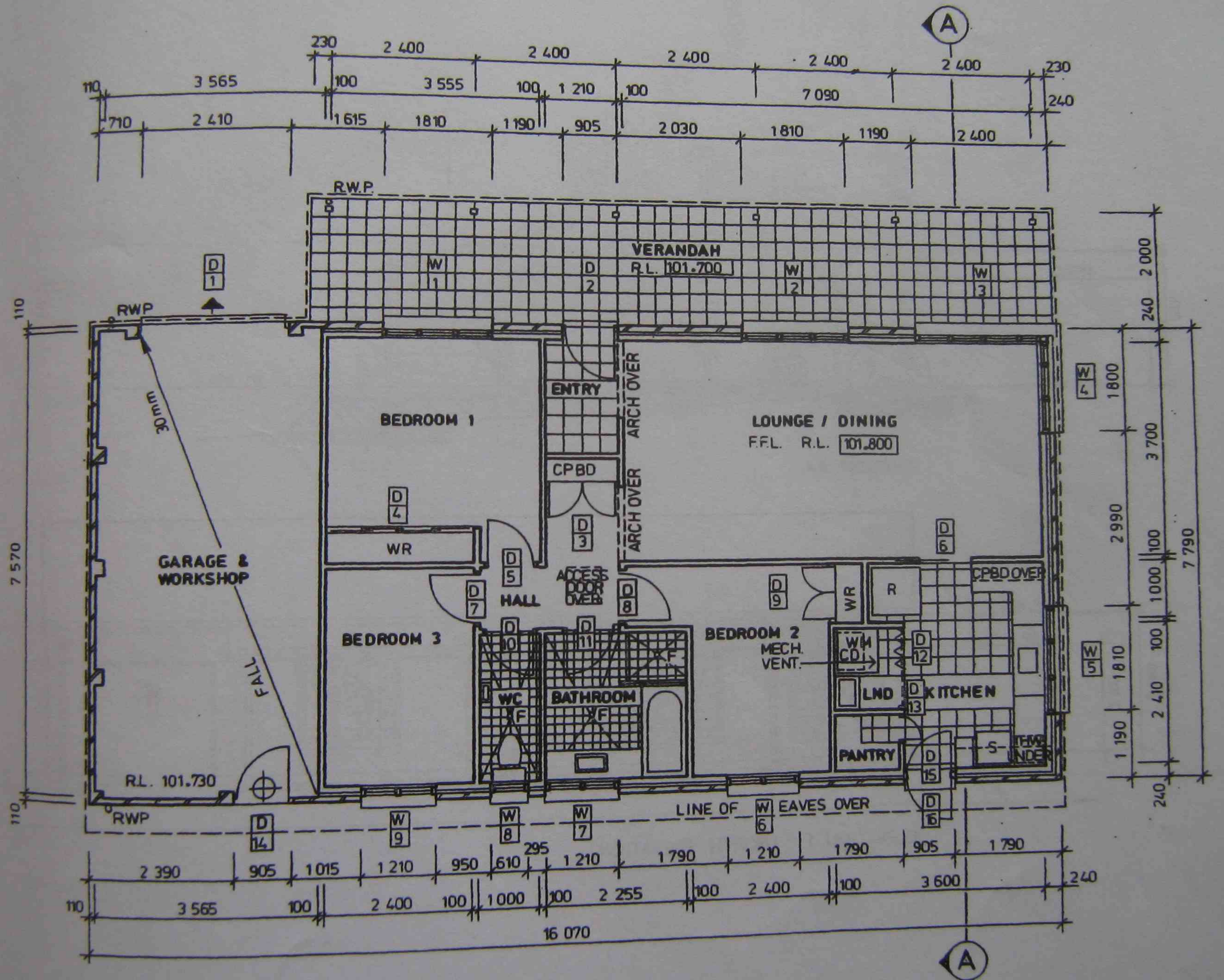
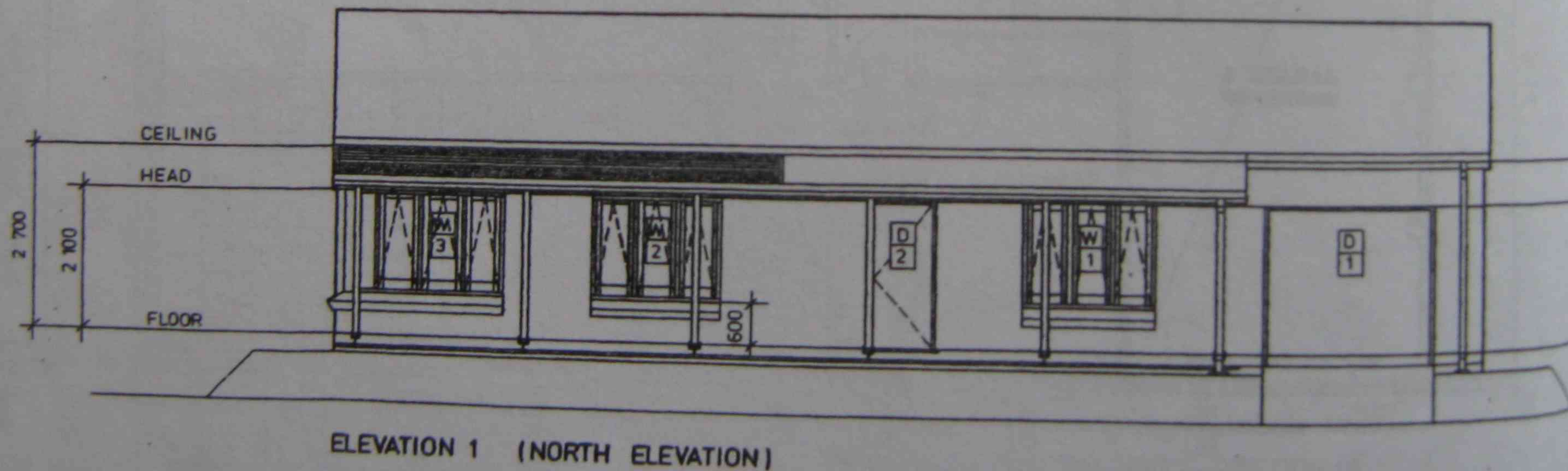
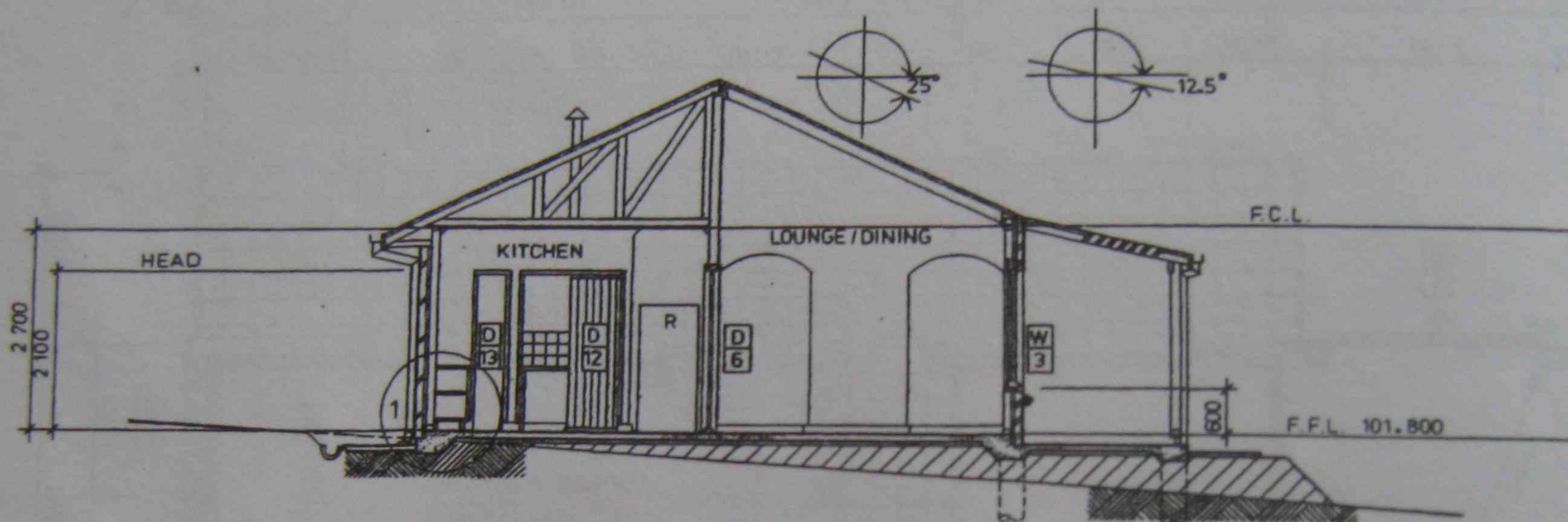


Figure 2 Floor plan











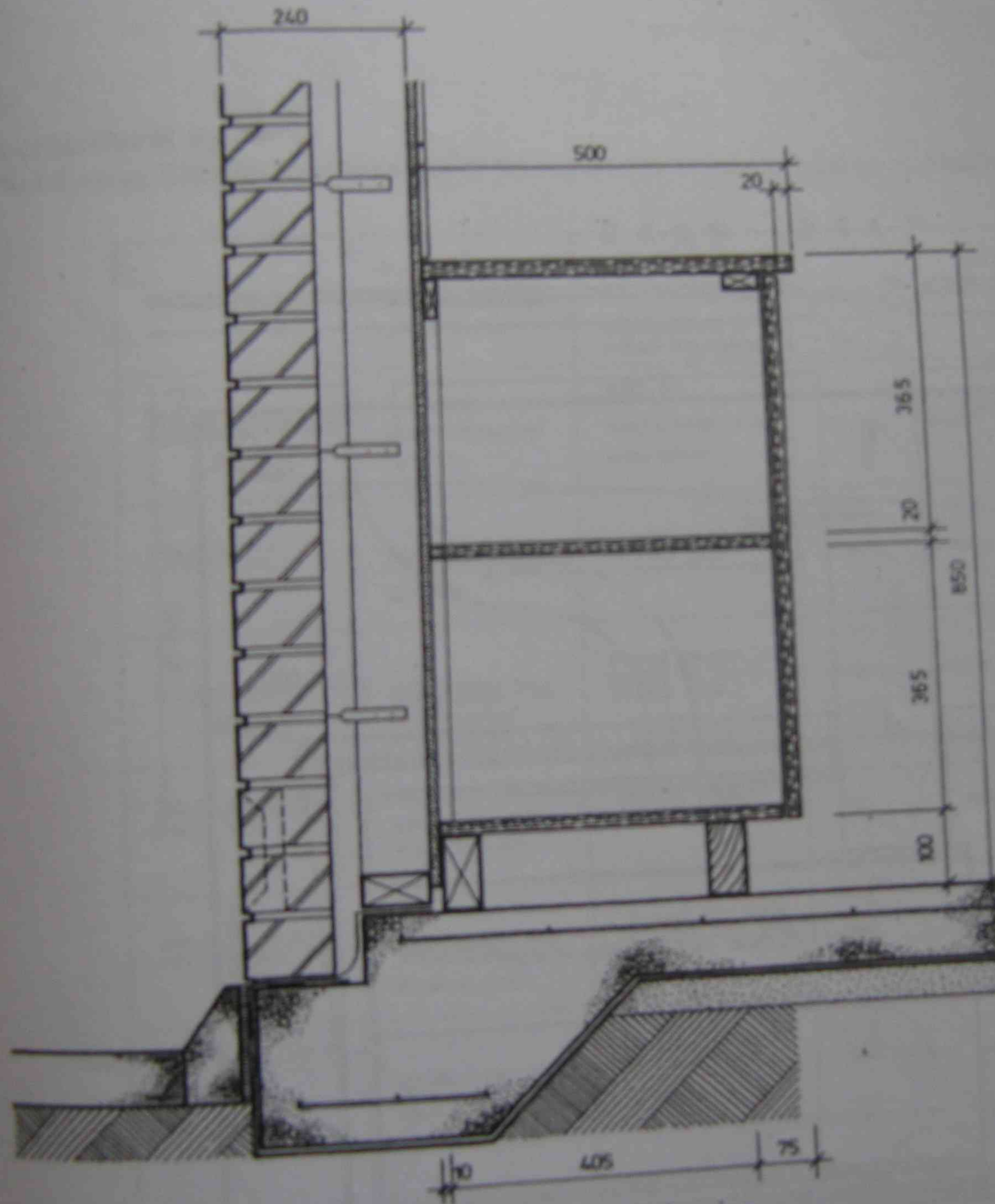


Figure 4 Detail drawing



## Architectural symbols

The following diagrams show examples of the conventions (symbols) used on architectural drawings.

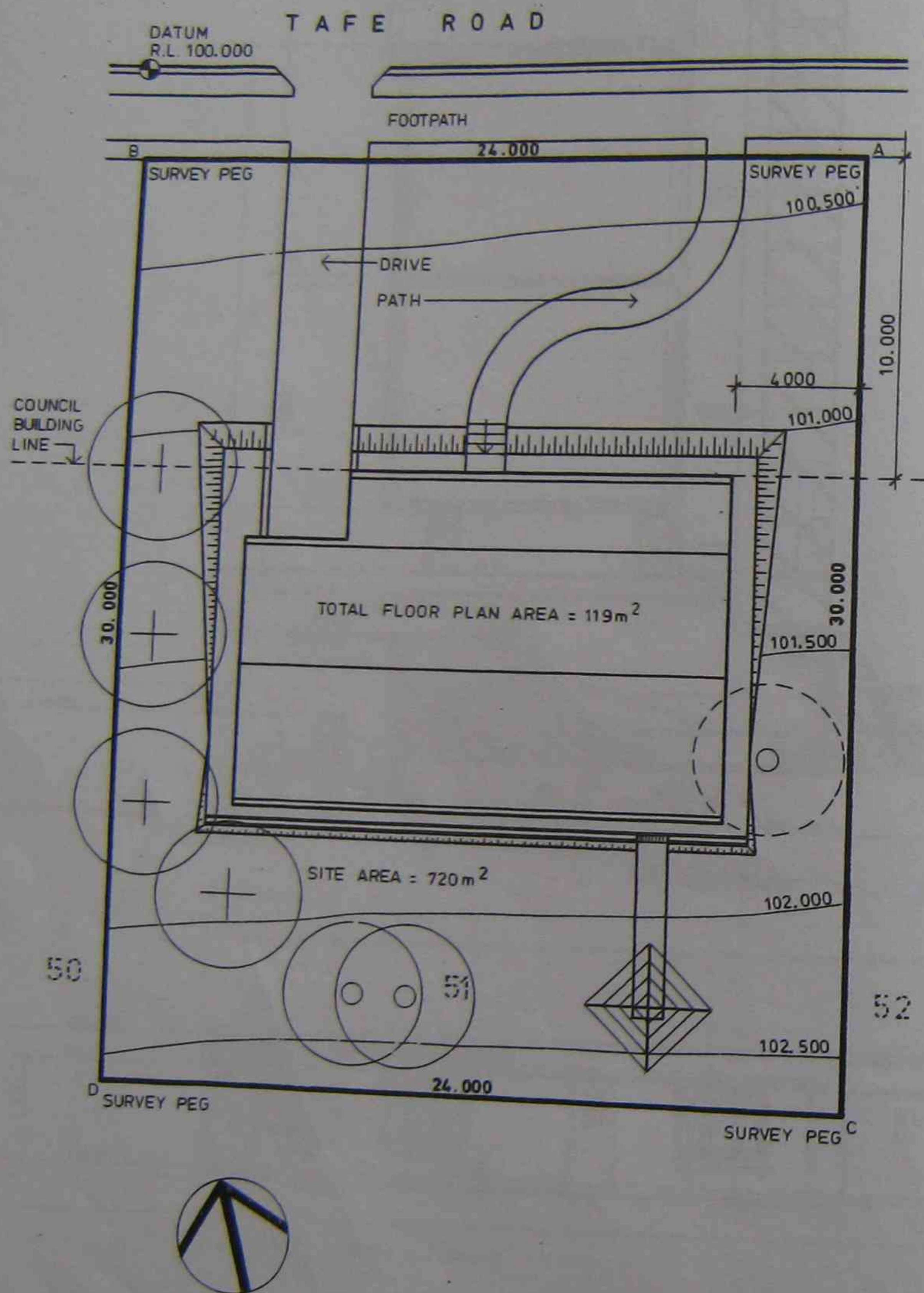


Figure 5 Site plan

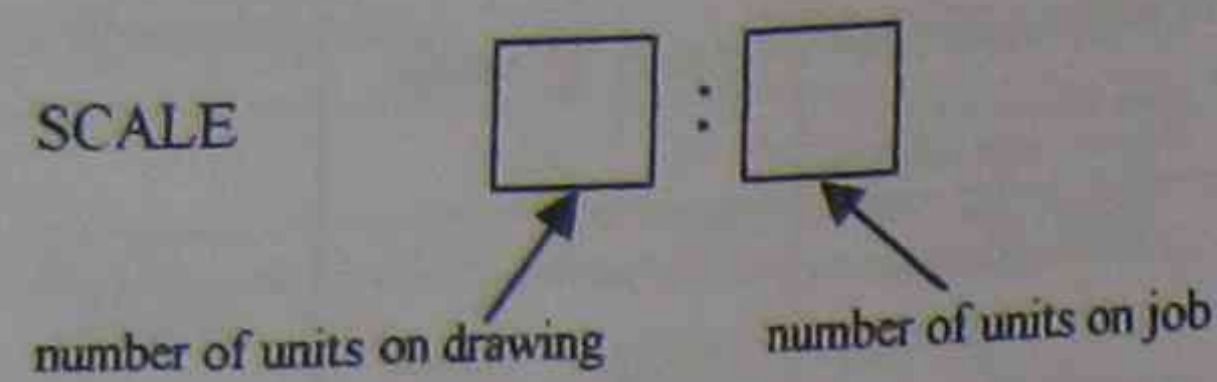
TIMBER STUD	'Shaded grey' Chrome yellow	SINGLE SWING DOOR Arcs continued to indicate doors to fasten	
BRICKWORK SINGLE SKIN	Vermilion	SINGLE SWING DOOR Alternative	
BRICKWORK-CAVITY WALL	Vermilion	SINGLE DOUBLE-ACTING DOOR	
BRICK VENEER	Chrome yellow and vermillion	SINGLE SWING DUTCH OR STABLE DOOR	
CONCRETE BLOCK SINGLE SKIN	Prussian green	PAIR OF DOUBLE-ACTING DOORS	
CONCRETE BLOCK CAVITY WALL	Prussian green	IN-AND-OUT DOOR WITHOUT MULLION	
CONCRETE	Hooker's green deep	IN-AND-OUT DOOR WITH MULLION	
STONE	Vandyke brown	REVOLVING DOOR	
EXISTING WALL (Alterations, Additions) Alternatives a, b NOTE: Colour new work.	a. Heavy black for prominence b. Light outline New work Ghosted	SLIDING DOORS 'A' - Sliding into a pocket 'B' - Sliding exposed on wall face	
GLAZED PARTITIONING		VERTICALLY OPENING DOORS	
WINDOW IN SINGLE SKIN WALL		ROLLING SHUTTER	
WINDOW IN CAVITY WALL (Internal skin)		UP AND OVER DOOR	
WINDOW IN CAVITY WALL (External skin)		FOLDING DOOR OR PARTITION CENTRED ON TRACK	
		FOLDING DOOR OR PARTITION TO ONE SIDE OF TRACK	
		SHOWER CURTAIN DRAPERIES, ETC	

Figure 6 Symbols representing walls, windows and doors



## Architectural scales

The scale ratio of a drawing is expressed by inserting the word SCALE followed by two numbers separated by a colon in the appropriate portion of the title block.



Site plans	1:100	1:500	1:200	
Floor plans	1:200	1:100	1:50	1:20
Elevations	1:200	1:100	1:50	1:20
Sections	1:200	1:100	1:50	1:20
Details	1:10	1:5	1:2	1:1 (full size)

Table 1 Common scales used in the construction industry

### Exercise 1

The lines shown in Table 2 represent dimensions from a drawing. For each line, measure its length in millimetres. Then determine the length the line must be drawn to for each of the scales shown and record these in Table 2

No.	Dimensioned line	Scale		
1		1:50	1:10	1:20
2		4.25m	0.75m	1.7m
3		3.1m	0.63m	1.22m
4		2.1m	0.52m	1.02m
5		2.05m	0.4m	0.8m
6		1.5m	0.3m	0.6m
7		1m	0.2m	0.4m
8		1.7m	0.35m	0.7m
9		2.7m	0.53m	1.1m
10		1.3m	0.25m	0.51m

Table 2

### Exercise 2

On each of the ten lines shown in Table 3 mark the dimensions according to the specified length and scale for that line.

All measurements should start from the dimensioning symbol near the left hand side of the table and end with a similar symbol at the correct position along the line

No.	Line marked off to scale	Length	
1		10 500	1:100
2		9 750	1:100
3		5 000	1:50
4		4 450	1:50
5		6 700	1:200
6		890	1:10
7		58	1:1
8		12 000	1:500
9		3 475	1:100
10		1 280	1:50

Table 3

### Electrical Services

When carrying out the installation of electrical services to a building, the electrician is generally required to interpret:

- **site plans:** to determine the location of the service point, consumers mains and sub mains, main switchboard and distribution boards, temporary builder's supply and other services such as gas, water, sewerage and telephone.
- **floor plans:** to determine the location of main switchboard and distribution boards, socket outlets (10 A, 15 A and 20 A), lighting points and associated switches, telephone and television outlets, appliances (range, hot plates and water heaters).
- **detail drawings:** to ascertain installation details for specific appliances or pieces of equipment.

The combination of the drawings mentioned above and the specifications for electrical wiring form the complete instructions for the electrical installation. The types of information contained in the electrical specification are:

- wiring methods and materials
- general method of layout
- type and make of accessories to be used
- mounting height of switches and outlets



## Electrical architectural symbols

The location of all appliances and accessories that form part of the electrical installation are shown with the use of symbols on the floor plan. The symbols used generally have little or no resemblance to the actual appearance of the item represented.

The symbols used are specified in AS/NZS 1102.8 Graphical Symbols for Electrotechnology, Location Symbols – Power Supply Systems and Electrical Services for Buildings and Sites.

The centre of the symbol represents the centre of the appliance or accessory. To correctly locate items of equipment dimensions must be taken off the plan to the centre of the symbol. It is not always necessary to locate accessories in exactly the position shown on the plan, particularly socket outlets which are usually fixed to wall studs closest to the position shown on the plan.

The following diagrams show examples of the symbols used on electrical service sheets.

ELEMENT	SYMBOL	ELEMENT	SYMBOL
TELECOMMUNICATIONS, RADIO, TV APPARATUS		MISCELLANEOUS APPARATUS & APPLIANCES	
SOCKET SYMBOL FOR TELECOMMUNICATIONS GENERAL SYMBOL		THERMAL FIRE ALARM DETECTOR HEAD	
TELEVISION		WATCHMAN SYSTEM DEVICE OR KEY OPERATED SWITCH	
RADIO		MOTOR - GENERAL SYMBOL	
SOUND		GENERATOR - GENERAL SYMBOL	
AERIAL (Antenna) - GENERAL SYMBOL		CEILING FAN	
LOUDSPEAKER		RECTIFIER UNIT, D.C. POWER SUPPLY	
RADIO RECEIVING SET		ELECTRIC BELL	
GENERAL SYMBOL AMPLIFYING EQUIPMENT		ELECTRIC BUZZER	
TELEVISION RECEIVING SET		SIREN	
MICROPHONE		HORN	
TELEPHONE OUTLET - WALL		CODING OF CABLES	
TELEPHONE INSTALLED ON WALL		E	
TELEPHONE OUTLET - FLOOR		F	
TELEPHONE INSTALLED ON FLOOR		T	
TELEPHONE SYMBOLS MAY BE ENCODED TO PROVIDE SPECIAL INFORMATION e.g. Intercom		V	
THROUGH SWITCHBOARD		S	
DIRECT LINE		L	
DISTRIBUTION POINT (Frame, box or block) For use on plan view of each floor		SL	
SWITCHBOARD, 40 LINE PMBX		ROUTING & CODING OF CONDUCTORS	
SWITCHBOARD, 2+6 TABLE TYPE PMBX		WIRING LINE OR CABLE GENERAL SYMBOL	
AUTOMATIC EXCHANGE EQUIPMENT		LINK BETWEEN A SWITCH AND ITS ASSOCIATED REMOTE SOCKET OR EQUIPMENT - ALTERNATIVE SYMBOL	
		UNDERGROUND LINE	
		OVERHEAD LINE	
		CONSUMER'S MAINS	
		UNDERGROUND SUB MAINS	

ELEMENT	SYMBOL	ELEMENT	SYMBOL
LUMINAIRES & DOMESTIC APPLIANCES		SWITCHES AND PUSH BUTTONS	
LUMINAIRE - GENERAL SYMBOL		ONE WAY SWITCHES, SINGLE, TWO AND THREE POLES	
LUMINAIRE FIXED TO WALL		SINGLE POLE PULL SWITCH	
THE NUMBER AND POWER OF LAMPS IN A GROUP MAY BE SPECIFIED e.g. Luminaire For Three 40W Lamps	3x40W	MULTI-POSITION SWITCH FOR DIFFERENT DEGREES OF LIGHTING	
LUMINAIRE WITH BUILT-IN SWITCH		TWO-WAY SWITCH	
EMERGENCY LIGHTING LUMINAIRE e.g. Standby or Escape Lighting		INTERMEDIATE SWITCH	
SIGNAL LAMP		LIGHT DIMMER, e.g. Switch With Variable Control	
WARNING, ALARM OR PANIC LAMP		PERIOD LIMITING SWITCH	
SPOTLIGHT		TIME SWITCH	
FLOODLIGHT		REMOTELY CONTROLLED EQUIPMENT	
LAMP WITH REFLECTOR		PUSH BUTTON	
LUMINAIRE FOR FLUORESCENT LAMP		LUMINOUS PUSH BUTTON	
Example LUMINAIRE FOR THREE FLUORESCENT LAMPS	3x40W	RESTRICTED ACCESS PUSH BUTTON	
ALTERNATIVE SYMBOL		MANUALLY OPERATED FIRE ALARM	
DISCHARGE LAMP		SOCKET OUTLETS	
AUXILIARY APPARATUS FOR DISCHARGE LAMP - Only Used When Apparatus Is Separated From The Luminaire		SOCKET OUTLET - GENERAL SYMBOL Symbol May Be Coded, e.g. 15A=15 Ampere, W.P. = Weatherproof	
ELECTRICAL APPLIANCE - GENERAL SYMBOL. Accepted Abbreviation May Be Used To Specify, e.g. HWS, Hot Water Service R Electric Range GD Garbage Disposal EF Exhaust Fan Disposal FH Fan Heater H Elec. Heater AC Air Conditioner		MULTIPLE SOCKET OUTLET e.g. For 'n' Plugs	
ELECTRIC HEATER - ALTERNATIVE SYMBOL GRAPHIC CODING		SWITCHED SOCKET OUTLET	
DISTRIBUTION BOARDS		SOCKET OUTLET WITH PROTECTIVE EARTH CONTACT	
MAIN SWITCHBOARD	MSB	SINGLE PHASE SOCKET SWITCHED AND EARTHED	
METER BOARD	MB	SOCKET OUTLET WITH PROTECTIVE INTERLOCKING SWITCH	
DISTRIBUTION BOARD	DSB	MULTI-PHASE SOCKET OUTLET	
MANUAL TELEPHONE EXCHANGE	PBX	MISCELLANEOUS	
AUTOMATIC TELEPHONE EXCHANGE	PABX	POINT OF ATTACHMENT	POA
FIRE INDICATOR BOARD	FIB	EARTH	
		BATTERY	
		LIGHTNING ARRESTER	

Figure 7 Symbolic representation for electrical service sheets



necessary to locate accessories in exactly the position shown on the plan.  
which are usually fixed to wall studs closest to the position shown on the plan.

The following diagrams show examples of the symbols used on electrical service sheets.

ELEMENT	SYMBOL	ELEMENT	SYMBOL
TELECOMMUNICATIONS, RADIO, TV APPARATUS		MISCELLANEOUS APPARATUS & APPLIANCES	
SOCKET SYMBOL FOR TELECOMMUNICATIONS GENERAL SYMBOL		THERMAL FIRE ALARM DETECTOR HEAD	
TELEVISION		WATCHMAN SYSTEM DEVICE OR KEY OPERATED SWITCH	
RADIO		MOTOR - GENERAL SYMBOL	
SOUND		GENERATOR - GENERAL SYMBOL	
AERIAL (Antenna)-GENERAL SYMBOL		CEILING FAN	
LOUDSPEAKER		RECTIFIER UNIT, D.C. POWER SUPPLY	
RADIO RECEIVING SET		ELECTRIC BELL	
GENERAL SYMBOL AMPLIFYING EQUIPMENT		ELECTRIC BUZZER	
TELEVISION RECEIVING SET		SIREN	
MICROPHONE		HORN	
TELEPHONE OUTLET - WALL		CLOCK Coding is permissible, e.g. B Battery      S Slave D Digital      ~ Synchronous M Master      SK Spring reserve	
TELEPHONE INSTALLED ON WALL		CODING OF CABLES	
TELEPHONE OUTLET - FLOOR		E	ELECTRIC POWER
TELEPHONE INSTALLED ON FLOOR		F	TELEPHONY
TELEPHONE SYMBOLS MAY BE ENCODED TO PROVIDE SPECIAL INFORMATION e.g. Intercom		T	TELEGRAPH OR DATA CIRCUIT
THROUGH SWITCHBOARD		V	VIDEO CIRCUIT
DIRECT LINE		S	AUDIO CIRCUIT
DISTRIBUTION POINT (Frame, box or block) For use on plan view of each floor		L	LIGHTING
SWITCHBOARD, 40 LINE PMBX		SL	STREET LIGHTING
SWITCHBOARD, 2+6 TABLE TYPE PMBX		ROUTING & CODING OF CONDUCTORS	
AUTOMATIC EXCHANGE EQUIPMENT		WIRING LINE OR CABLE GENERAL SYMBOL	
		LINK BETWEEN A SWITCH AND ITS ASSOCIATED REMOTE SOCKET OR EQUIPMENT-ALTERNATIVE SYMBOL	
		UNDERGROUND LINE	
		OVERHEAD LINE	
		CONSUMER'S MAINS	
		UNDERGROUND SUB MAINS	



on electrical service sheets.

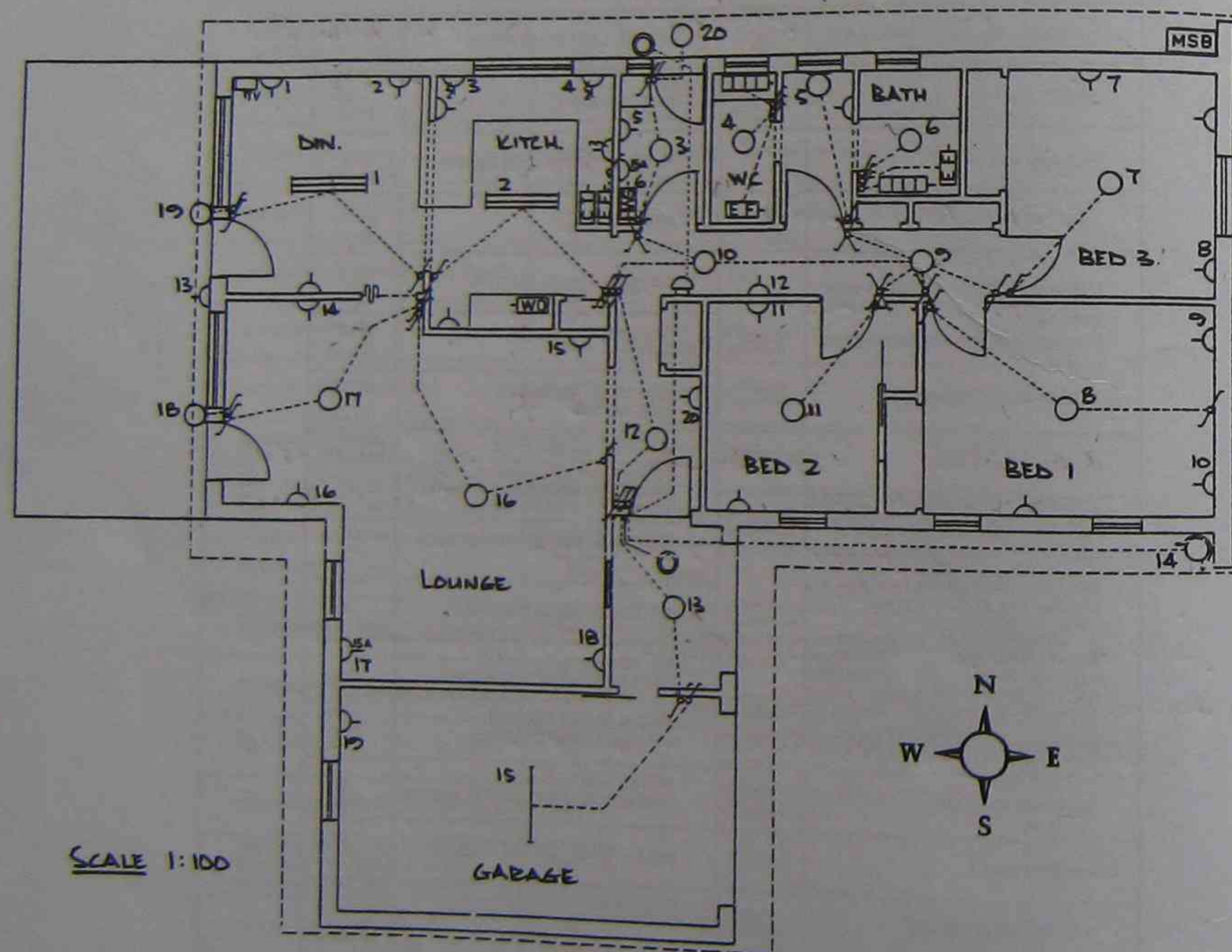
ELEMENT	SYMBOL	ELEMENT	SYMBOL
LUMINAIRES & DOMESTIC APPLIANCES		SWITCHES AND PUSH BUTTONS	
LUMINAIRE - GENERAL SYMBOL		ONE WAY SWITCHES, SINGLE, TWO AND THREE POLES	
LUMINAIRE FIXED TO WALL		SINGLE POLE PULL SWITCH	
THE NUMBER AND POWER OF LAMPS IN A GROUP MAY BE SPECIFIED e.g. Luminaire For Three 40W Lamps	3x40W	MULTI-POSITION SWITCH FOR DIFFERENT DEGREES OF LIGHTING	
LUMINAIRE WITH BUILT-IN SWITCH		TWO-WAY SWITCH	
EMERGENCY LIGHTING LUMINAIRE e.g. Standby or Escape Lighting		INTERMEDIATE SWITCH	
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LAMP WITH REFLECTOR		PUSH BUTTON	
LUMINAIRE FOR FLUORESCENT LAMP		LUMINOUS PUSH BUTTON	
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AUXILLIARY APPARATUS FOR DISCHARGE LAMP-Only Used When Apparatus Is Separated From The Luminaire		MULTIPLE SOCKET OUTLET e.g. For 'n' Plugs	
ELECTRICAL APPLIANCE-GENERAL SYMBOL. Accepted Abbreviation May Be Used To Specify, e.g. HWS, Hot Water Service		SWITCHED SOCKET OUTLET	
R Electric Range GD Garbage Disposal		SOCKET OUTLET WITH PROTECTIVE EARTH CONTACT	
EF Exhaust Fan		SINGLE PHASE SOCKET SWITCHED AND EARTHED	
FH Fan Heater H Elec. Heater		SOCKET OUTLET WITH PROTECTIVE INTERLOCKING SWITCH	
AC Air Conditioner		MULTI-PHASE SOCKET OUTLET	
ELECTRIC HEATER - ALTERNATIVE SYMBOL GRAPHIC CODING		MISCELLANEOUS	
DISTRIBUTION BOARDS		POINT OF ATTACHMENT	
MAIN SWITCHBOARD		EARTH	
METER BOARD		BATTERY	
DISTRIBUTION BOARD		LIGHTNING ARRESTER	
MANUAL TELEPHONE EXCHANGE			
AUTOMATIC TELEPHONE EXCHANGE			
FIRE INDICATOR BOARD			



### Exercise 3

From the floor plan of Figure 8 (scale 1:100) determine the location of the 20 socket outlets shown numbered on the floor plan. List and record in Table 4 the following information for each outlet:

- outlet details (eg single 10 A or double 10 A)
- room in which the outlet is located (eg lounge, kitchen, bedroom 1)
- location details (eg western wall, 500 mm from north-west (NW) corner)



Outlet No.	Outlet details	Room in which outlet is located	Location details
1	GENERAL 10A	DIN.	NW (CORNER)
2	"	"	NE "
3	MULTIPLE SOCKET	KITCH.	NW (CORNER)
4	"	"	NE "
5	GENERAL 10A	LAUNDRY	WEST 900mm FROM N wall
6	15 A	LAUNDRY	WEST WALL NEXT TO HUS
7	10 A	BED 3	NORTH WALL
8	"	"	SE WALL (CORNER)
9	"	BED 1	E (CORNER)
10	"	"	SE (CORNER)
11	"	BED 2	N WALL
12	"	CORRIDOR	SOUTH WALL ADS. BED 2 WALL
13	" TERRACE	OUTSIDE	W WALL
14	"	LOUNGE	NW WALL
15	"	"	NE WALL (CORNER)
16	"	"	SWALL 1m FROM W DOOR
17	15 A	"	W CORNER
18	10 A	"	SE (CORNER)
19	"	GARAGE	W (CORNER)
20	10 A	CORRIDOR	OPPOSITE LOUNGE DOOR EAST

Table 4 Details of outlets

Figure 8 Floor plan showing location of electrical accessories.



#### Exercise 4

From the floor plan of Figure 8 determine the location of all the lighting points. List in Table 4, the following information for each lighting point:

- switch details (eg one-way, two-way)
- room in which the lighting point is located (eg lounge, kitchen, bedroom 1)
- location details (eg room centre or western wall, 500 mm from north-west (NW) corner)

Light No.	Switching details	Room in which light is located	Location details
1	FLUORESCENT	DIN.	Room Centre
2	"	KITCH.	"
3	LUMINAIRE	LAUNDRY	"
4	"	WC	"
5	LUMINAIRE FIXED	BETWEEN WC & BATH.	N WALL.
6	LUMINAIRE	BATH	Room Centre
7	"	BED 3	"
8	"	BED 1	"
9	"	CORRIDOR	1.2m from BED 3 W
10	"	"	3m from LIGHT No 9 W
11	"	BED 2	Room Centre
12	"	ENTRANCE	"
13	"	PORCH	PORCH CENTRE.
14	LAMP WITH REFLECTOR	OUTSIDE	SE (CORNER)
15	FLUORESCENT	GARAGE	Room Centre
16	LUMINAIRE	LOUNGE	Room Centre
17	"	"	NW ROOM CENTRE.
18	LUMINAIRE FIXED	TERRACE	E 2m S on E WALL.
19	"	"	E 5m S on E WALL.
20	LUMINAIRE	OUTSIDE	NORTH FACING WALL.

Table 5 Lighting points and switching arrangements

#### Exercise 5

From the floor plan of Figure 8 identify five different types of appliances to be installed. List the following information in Table 6 for each appliance:

- type of appliance (eg wall oven, hot water service, heater)
- room in which the appliance is located (eg lounge, kitchen, laundry)
- the symbol used to identify the appliance

Type of appliance	Location	Symbol
HWS	LAUNDRY	[HWS]
WALL OVEN	KITCH.	[W/O]
TV	DIN.	TV
EXHAUST FAN	KITCH WC, BATH	[E/F]

Table 6 Appliances

#### Exercise 6

On the floor plan of Figure 9 draw the location of all lighting points and switching positions as detailed in the electrical schedule shown below. The following points will help you:

- the floor plan shown in Figure 9 is drawn to a scale of 1:100
- when locating symbols make the centre line of the symbol correspond to the centre line of the lighting point
- show switching positions for all lighting points, taking into account the type of switching required according to the schedule and the practical location for switches

#### Electrical Schedule - Lighting

Room	No. of Points	Switching	Location details
Porch	2	One-way	Wall brackets each side of door
Living	1	Two-way	Room centre
Dining	1	One-way	Room centre
Kitchen	1	Two-way	Room centre
Family	1	Two way	Room centre
Terrace	1	One-way	Terrace centre
Toilet	1	One-way	Room centre
Bath - laundry	1	One-way	Room centre
Bedroom 1	1	One-way	Room centre
Bedroom 2	1	One-way	Room centre



### Exercise 7

On the floor plan in Figure 9 draw the locations of all socket outlets as detailed in the electrical schedule shown below. Note the following points;

- when locating symbols make the centre line of the symbol correspond to the centre line of the outlet
- be sure to correctly distinguish between single and double 10 A and 15 A outlets, by the use of appropriate symbols.

Electrical Schedule – Socket outlets

Room	No. of outlets	Type	Location details
Kitchen	1	Double 10 A	Southern wall 300 mm from SE corner
	1	Double 10 A	Southern wall 300 mm from SW corner
	1	Single 10 A	Eastern wall 500 mm from NE corner
Dining	1	Double 10 A	Western wall 450 mm from SW corner
Living	1	Double 10 A	Northern wall 300 mm from NW corner
	1	Single 10 A	Northern wall 300 mm from NE corner
	1	Single 15 A	Western wall 300 mm from SW corner
Bedroom 1	1	Single 10 A	Western wall 500 mm from NW corner
Bedroom 2	1	Double 10 A	Centre southern wall
Bath-laundry	1	Double 10 A	Centre eastern wall

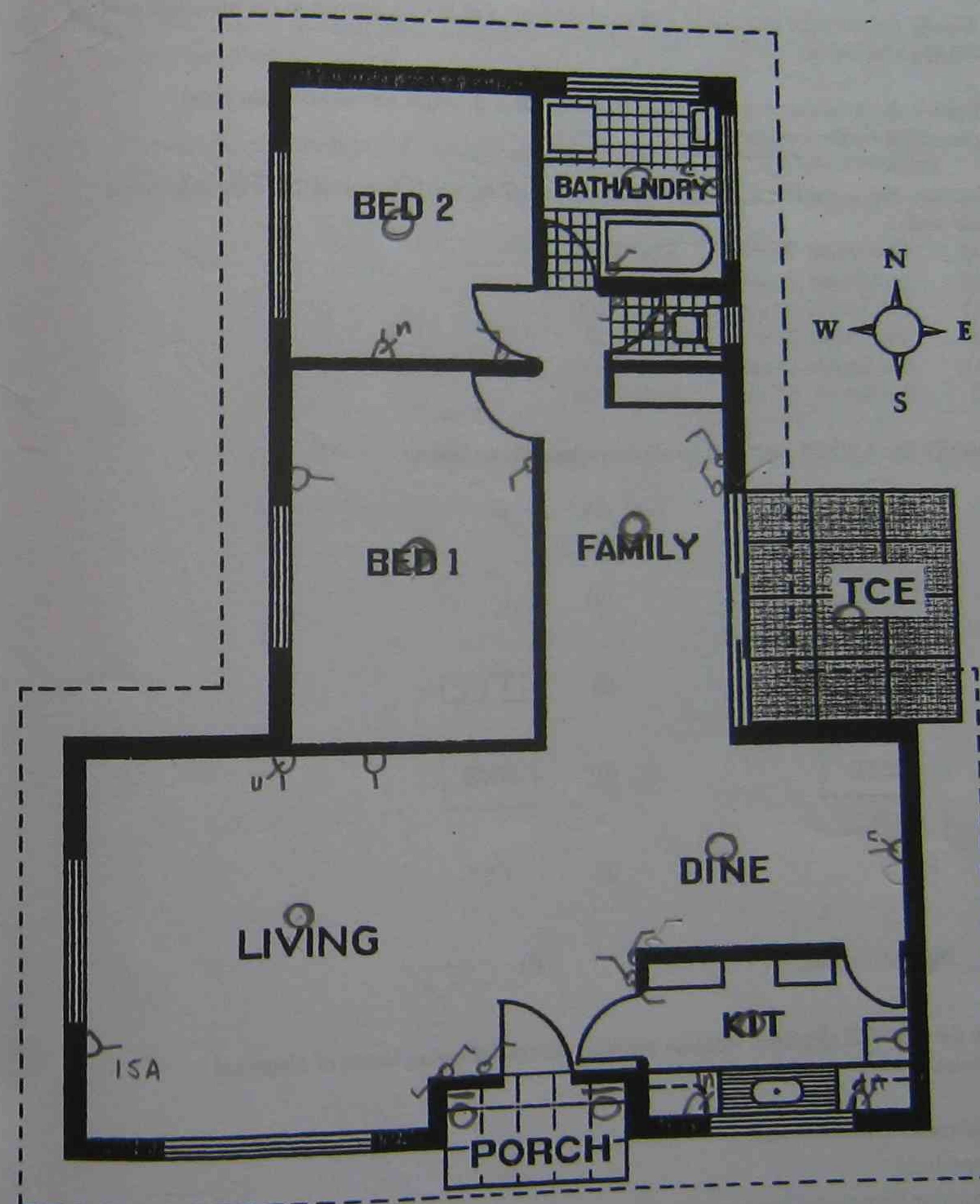


Figure 9 Floor plan







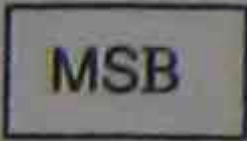
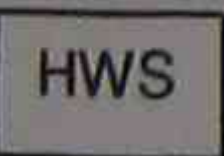

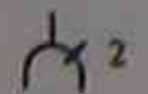




## Review question

These questions will help you revise what you have learnt in this topic.

- Briefly describe the difference between a site plan and a floor plan.
- Briefly describe the function of a detailed drawing. Relate your answer to the installation of electrical services.
- Draw a diagram showing the method used on a floor plan that shows one light point controlled by three switches.
- Indicate the actual lengths of the following lines taking into account the drawing dimension and scale:
 

(a)	line length 75 mm	Scale 1:100
(b)	line length 5 mm	Scale 1:100
(c)	line length 60 mm	Scale 1:200
(d)	line length 27 mm	Scale 1:50
(e)	line length 13 mm	Scale 1:500
(f)	line length 3.5 mm	Scale 1:100
- Identify the AS/NZS electrical location symbols shown below.
 

(a) 	(b) 
(c) 	(d) 
(e) 	(f) 
(g) 	(h) 
(i) 	(j) 
(k) 	(l) 
- Draw the AS/NZS electrical location symbols for the following items of electrical equipment.
  - luminaire, fixed to wall
  - spotlight
  - tubular fluorescent luminaire, two lamps
  - distribution board
  - meter board
  - electric range
  - exhaust fan
  - pushbutton
  - intermediate switch
  - 15 A socket outlet

- Explain why the 'point of entry' is not shown on the floor plan of a domestic installation.
- Briefly explain the meaning of the term 'standard drawing'.
- List five parts of an electrical installation that may have their location (or route) determined from a site plan.
- Who has the responsibility of determining the cable routes for the various circuits of a domestic installation?



## Architectural Drawings

### Review questions.

### Answers

1. Floor Plan: Outline of shape of building showing all dimensions and detailed info.  
Site Plan: The position of the building on the lot.

2. Is the installations of specific equipment installed shown on the plans.

3.

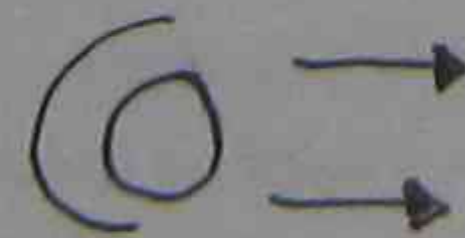


4. a. 7.5mm  
b. 500cm  
c. 3m  
d. 150mm  
e. 550cm  
f. 350cm
5. a. Luminaire  
b. Two way switch  
c. Floodlight  
d. One way switch  
e. Fluorescent Lamp  
f. Electrical Heater  
g. Main switch Board  
h. Two way switch  
i. Hot Water System  
j. Socket Outlet  
k. Multi Socket  
l. Phone Outlet - Wall

6. a.



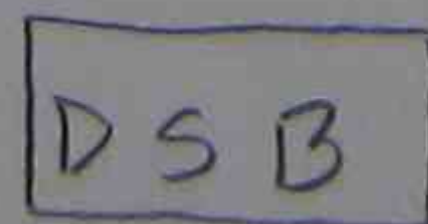
b.



c.

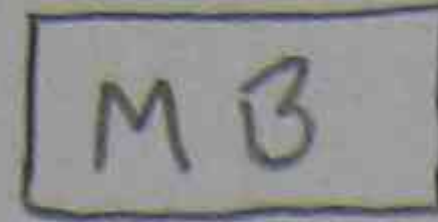


d.

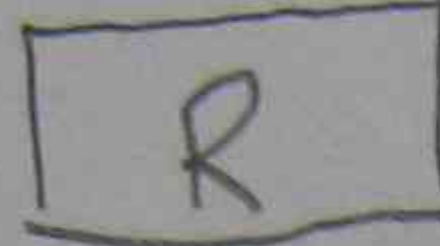




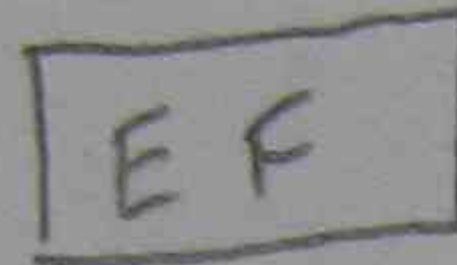
e.



f.



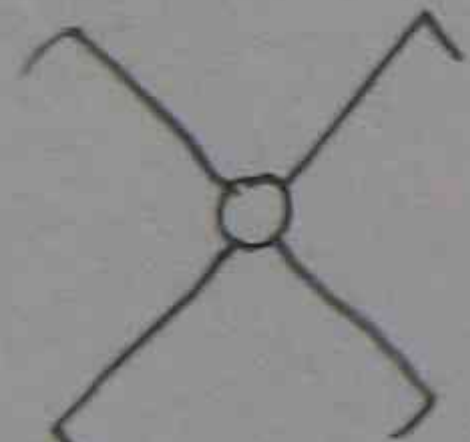
g.



h.



i.



j.



7. Point of entry refers to the high-voltage electrical system into a home beyond the meter.
8. Standard Drawings are symbols which are recognised by others in the same industry.
9.
  - Lights
  - Switch
  - Distribution Board
  - Socket Output
  - Appliances
10. A certified Electrician in conjunction with the builders and supervisors.



## 4 Building Structures, Materials and Sequencing

### Purpose

In this topic you will learn about building terms and structures and the materials used in construction of different building types. You will also learn about the constructional sequence and intertrade relationship in the building sequence.

### Objectives

At the end of this topic you should be able to:

- identify and describe the different types of footings and materials used.
- identify and describe the different types of floors and materials used
- identify and describe the different types of walls (external) and materials used
- identify and describe the different types of roofs and materials used
- identify and describe the different types of interior linings and materials used
- list the sequence of each constructional stage for brick, brick veneer and timber cottages.
- identify the stages at which the electrical first and second fixing occurs in the constructional sequence.
- list areas of cooperation between electrical and other building trades.

### Introduction.

Prior to the commencement of any building or structure, plans and specifications are drawn which contain details regarding:

- type and arrangement of structure, including fittings
- position of the building on the site.

The details contained within these plans and specifications are used to determine the:

- type of wiring system
- type of supply system (underground or overhead)
- cables routes
- location of all fittings and appliances

### Building structures

All buildings are constructed in the following steps:

- foundations
- footings
- floors
- walls
- roof

### Foundations

The foundations are the actual ground on which the building is constructed. Depending on the type of footings and ground it is prepared by levelling, trenching, backfilling etc. to Building Regulations.

### Footings

The footings consist of all the concrete strips, stumps, slabs and brick walls used to support the building.

**Stumped footings** consist of timber, concrete or steel posts or stumps to raise the building above the ground. They are employed mainly on sloping blocks or in hot climates for greater cooling.

### Exercise 1

Names the arrowed parts on the diagram of Figure 1.

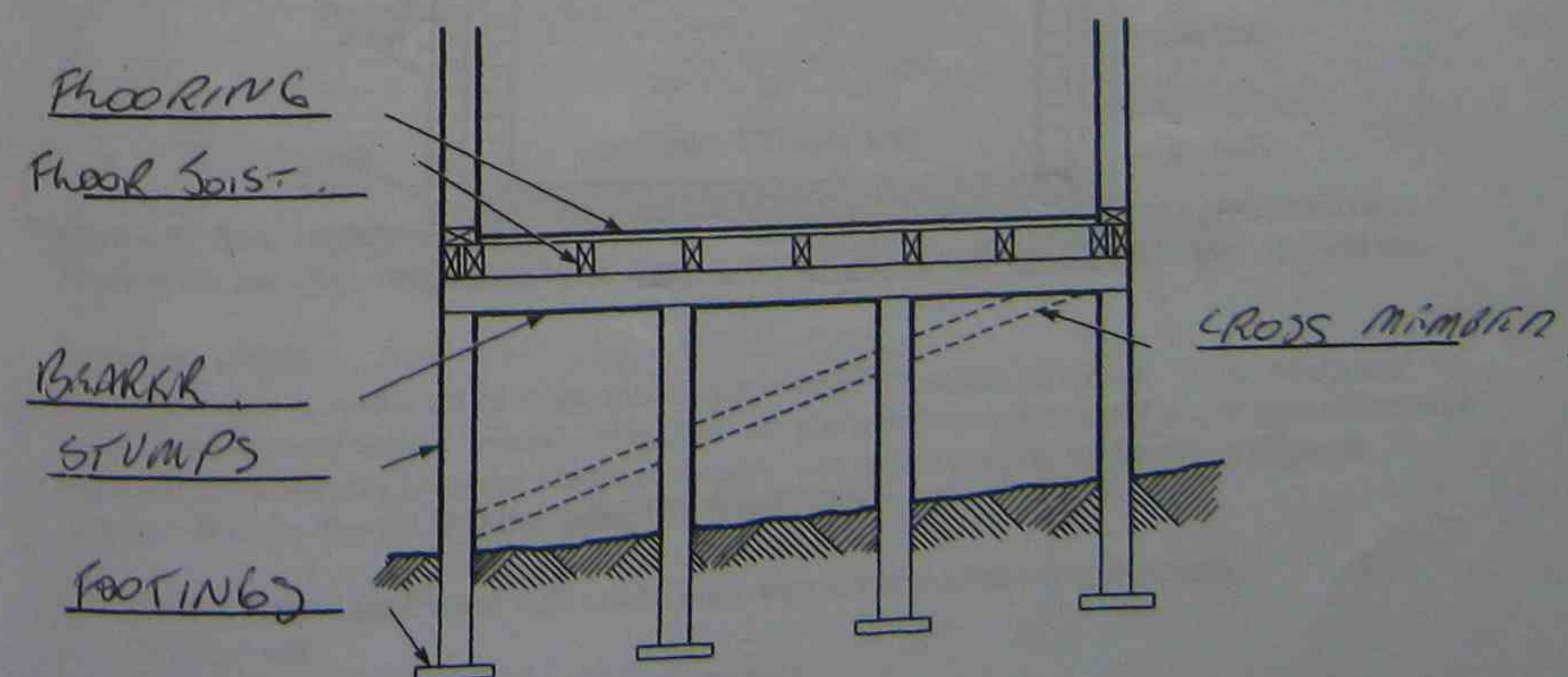


Figure 1 Stumped footings



**Strip footings** usually consist of a continuous reinforced concrete pour around the building as a base for the external walls. Concrete pads and brick or concrete piers support the floor and inner walls.

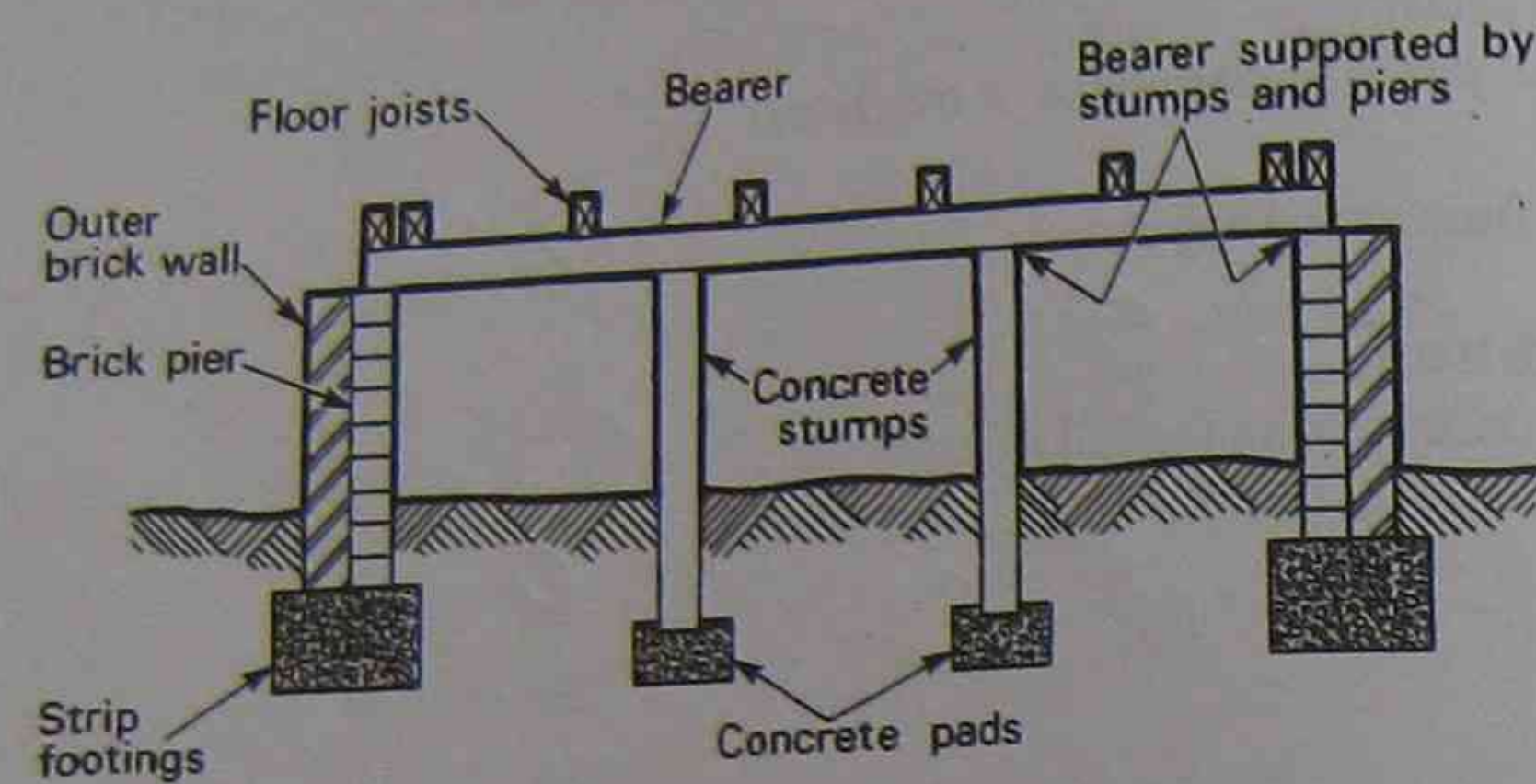


Figure 2 Strip footings

**Concrete slab footings** not only act as the support but also as the floor for the building. Some services involving plumbing, electrical, communications and gas must be installed before the pour.

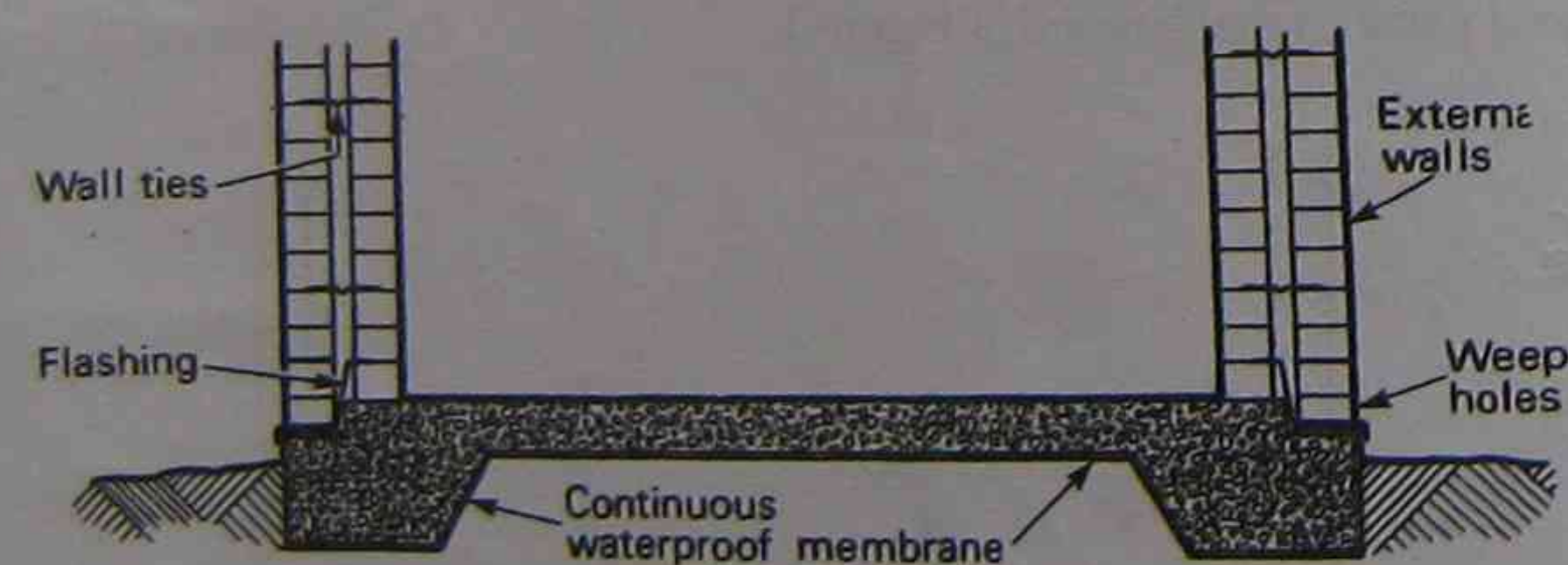


Figure 3 Concrete slab footings

## Floors

Timber floorboards or sheets are the most common type of floorings. The floor is constructed so that **the external and internal piers support bearers**. Floor joists are nailed to the bearers and tongue and groove timber boards or flooring sheets are then nailed to the joists.

### Exercise 2

Name the arrowed parts on the diagram of Figure 4.

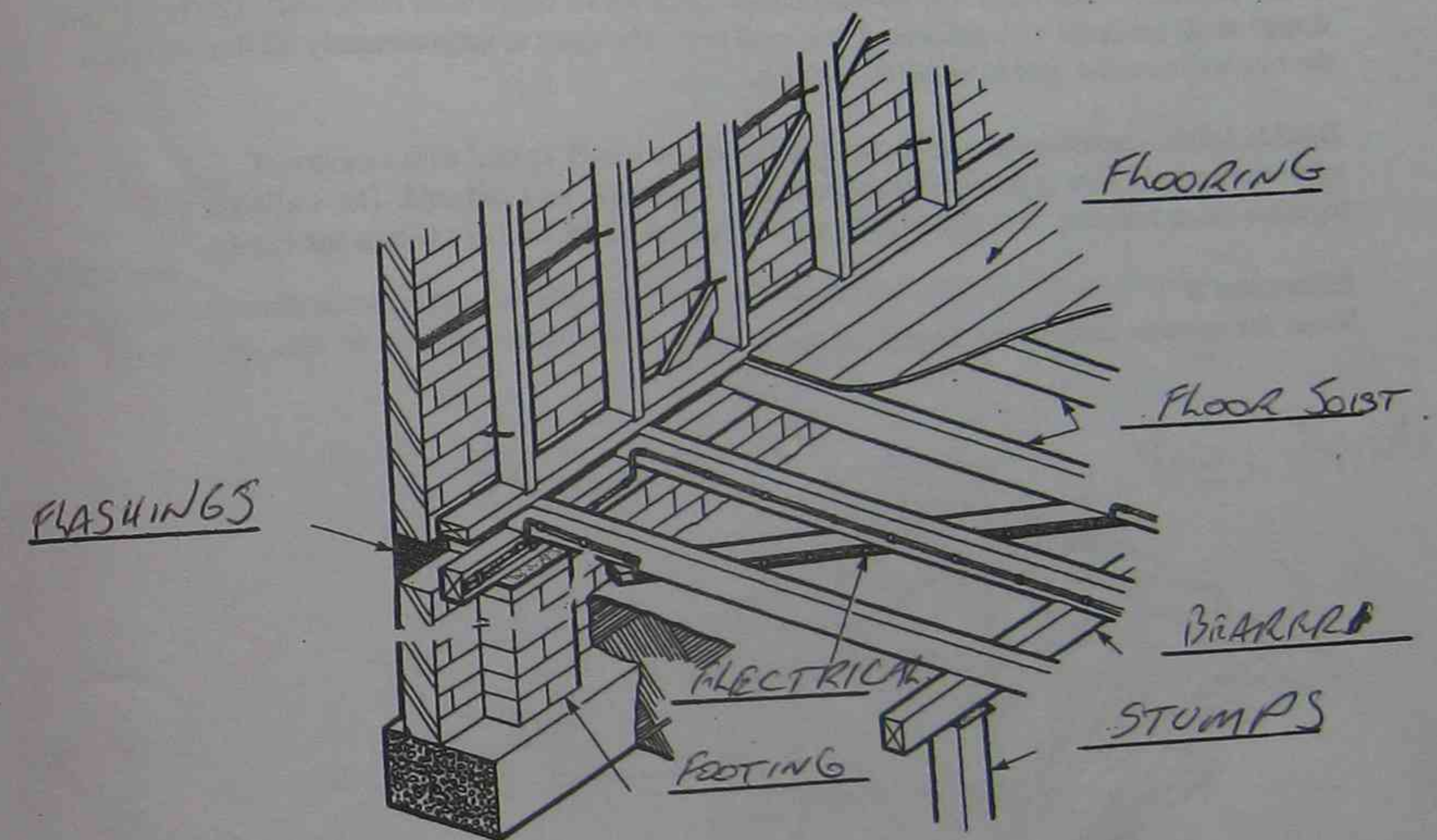


Figure 4 Timber floor

**Concrete floors** are as described previously, the slab mechanically screeded for a smooth surface. Multi-floor buildings may have extra timber or concrete floors depending on building type and use.

## Internal walls

**Framed wall:** - constructed of timber, aluminium or steel. It consists of vertical 'studs' which are fixed to the top and bottom 'plates'. 'Noggings' are placed between each stud where required to stop the studs from warping from the weight of the roof. The wall is kept square by fitting diagonal 'braces'. It is the internal wall that carries the weight of the roof.

The internal face of the framed wall can be lined with any of the following materials:

- Plasterboard
- Fibrous cement sheets (bathrooms and laundries)
- Lath and plaster

**Brick walls:** - the bricks are laid in rows called 'courses' cemented together and are rendered or left as a 'feature' depending on the desired effect.



### External walls

**Framed wall:** - constructed exactly the same as internal walls except the outside face is covered with a water proof lining such as:

- weatherboards
- fibrous cement sheets
- stucco
- sheets of brick tiles
- treated metal panels
- aluminium or plastic cladding

**Brick veneer:** - constructed with an inner timber frame with a single brick outer wall. The brick and timber walls are fixed with galvanised iron 'wall ties'. The space of approximately 50 mm between the two walls can be used to install any cabling.

**Double brick:** - constructed with an inner and outer brick wall, spaced with a cavity of approximately 50 mm to provide insulation against dampness, heat and cold. The walls are tied together using wall ties. It is permitted to rest TPS cables on the wall ties within the cavity.

### Exercise 3

Name the arrowed parts on the diagram of Figure 5.

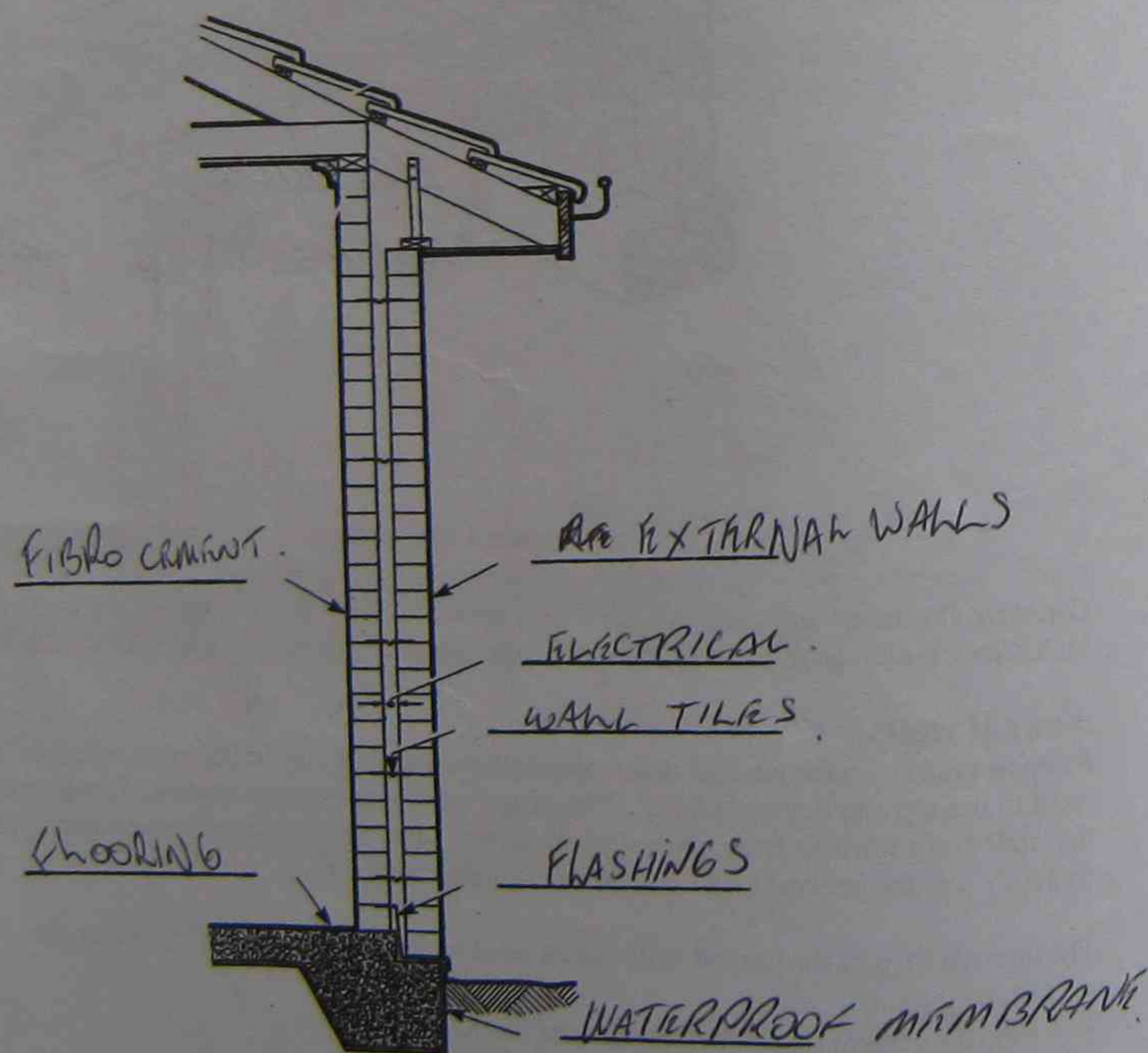


Figure 5 Double brick wall

### Roofs

Then roof is the covering to give protection to the lower part of the building. Timber is the most common material used to construct domestic roofs. Common terms used in roofing are:

- rafters
- ceiling joists
- top wall plate
- purlins
- valley rafter
- roof battens
- struts
- ridge
- hanging beam
- tom
- fascia
- hip
- hip rafter

### Exercise 4

Using the list of terms above, write the term next to its corresponding arrow on Figures 6 and 7 below. Some terms may be used more than once.

Figure 6

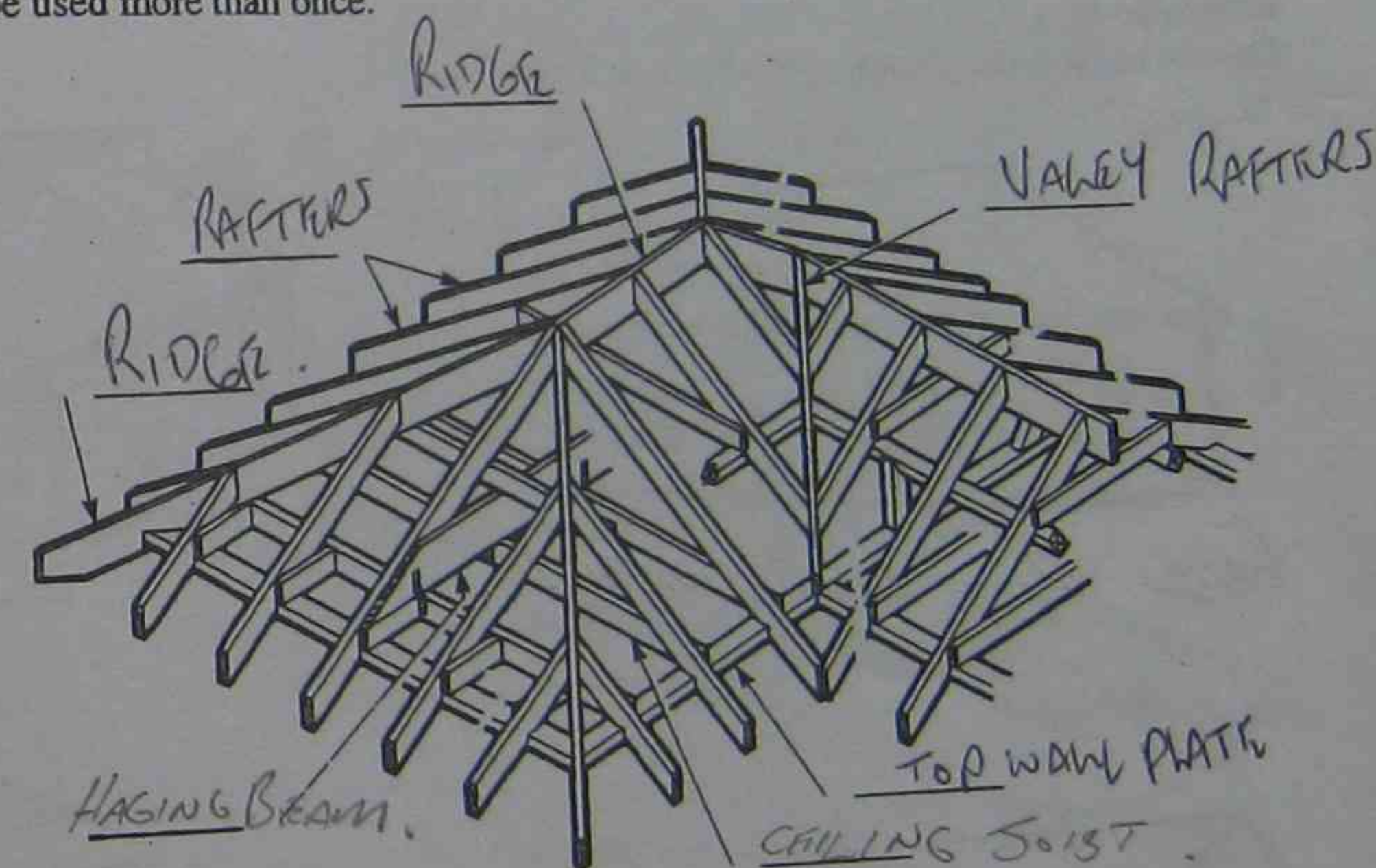
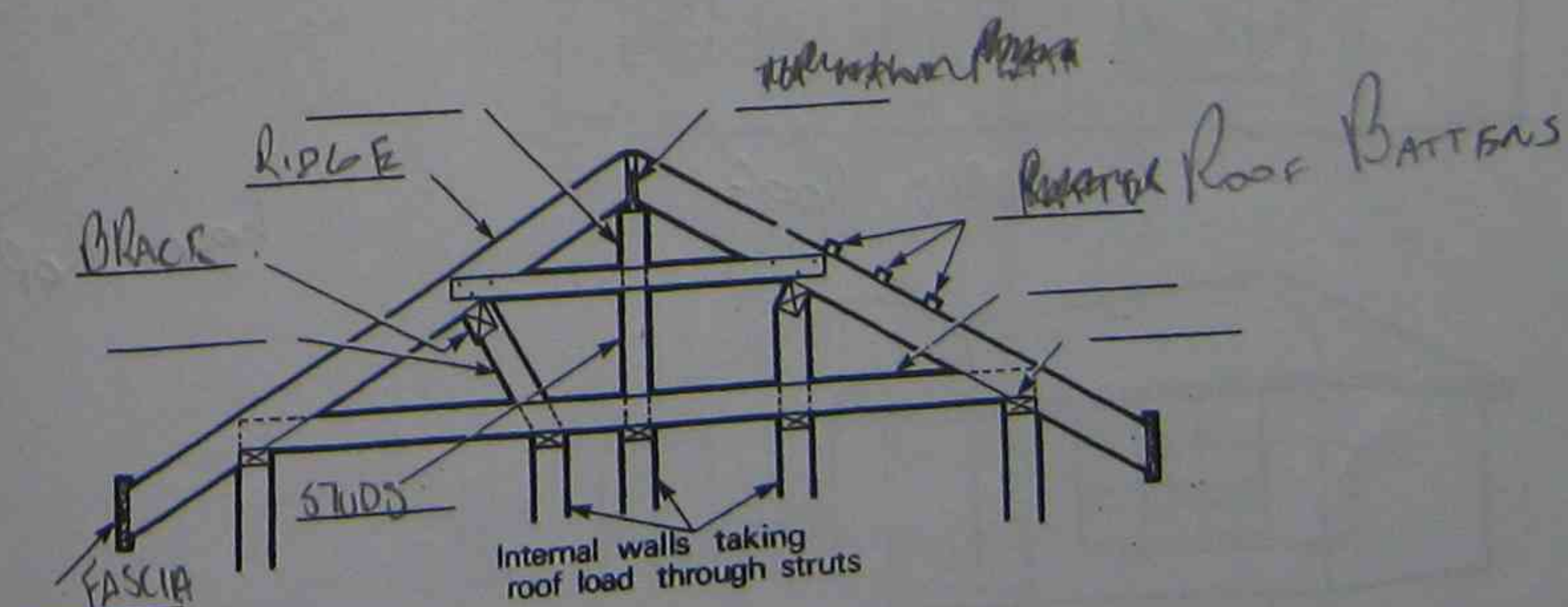


Figure 7





### Roof covering

Roof covering used includes:

- terracotta tile
- galvanised steel
- fibrous cement sheeting
- malthoid on timer base
- colour bond sheeting

### Roof types

Roof designs include:

- flat roof
- skillion roof
- low slope shed roof
- gable roof
- gable roof with dormer
- hipped roof
- gambrel roof
- mansard roof

### Exercise 5

Identify the following roof types shown in Figure 8.

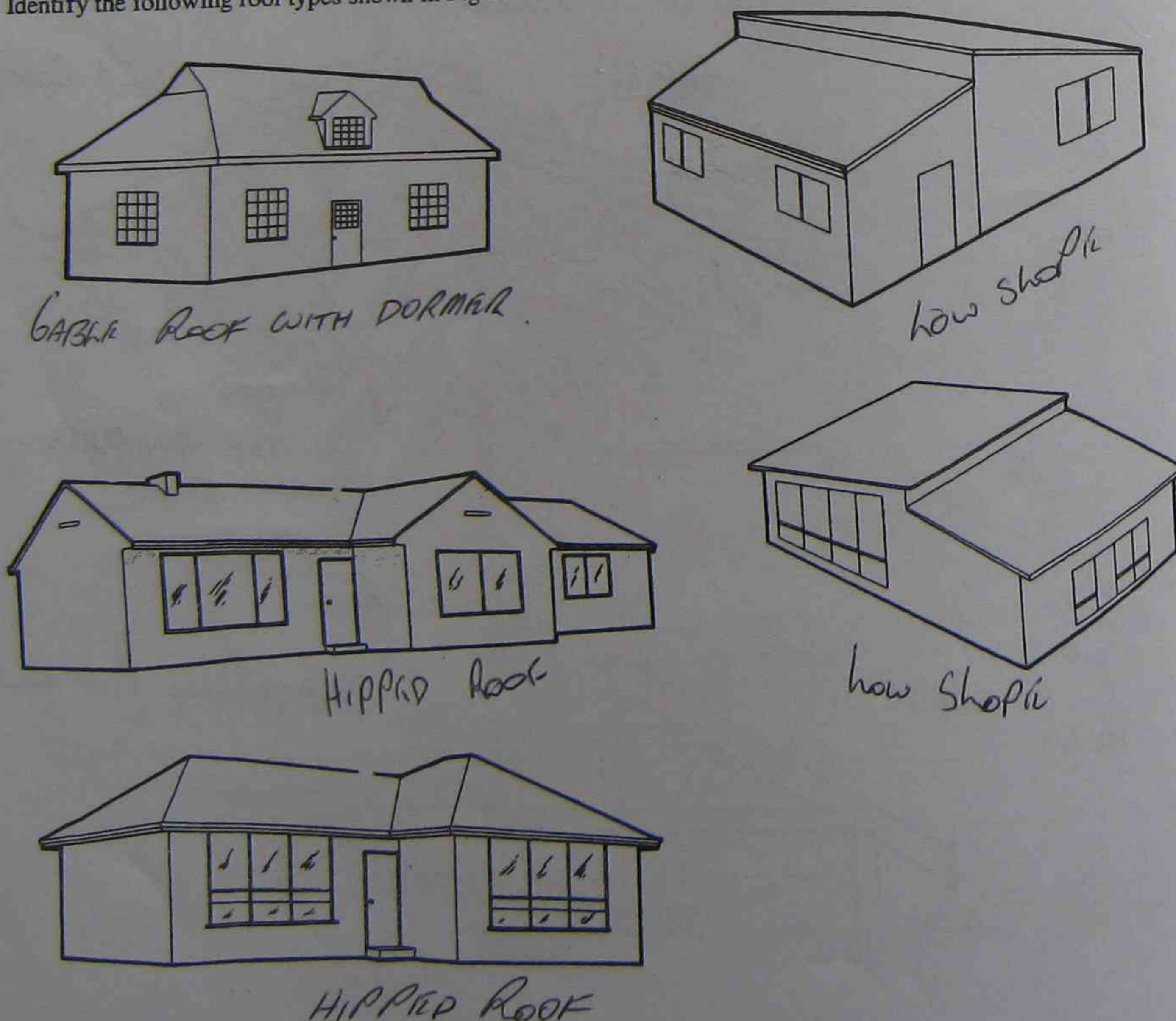


Figure 8 Roof diagrams

### Structural Integrity

When installing wiring and equipment an electrician should ensure that any actions taken do not affect the structural integrity, fire integrity or contravene any building codes or regulations. The following points should be observed:

- consult with the builder or architect if unsure of the consequences of any alterations to the building
- the removal of any structural material will weaken the structure
- plan wiring routes using the shortest possible path
- holes drilled for wiring to pass through a wall, floor or roof should be made as small as possible
- never interfere with any damp course or waterproofing
- when installing equipment, make sure that the weight or any vibration will not affect the structures integrity

### Construction sequence

An electrician must know the structural details of a building to ensure that all wiring is hidden (where practical) and must also know the appropriate times within the building sequence to install wiring and fit equipment such as switchboards, appliances and accessories.

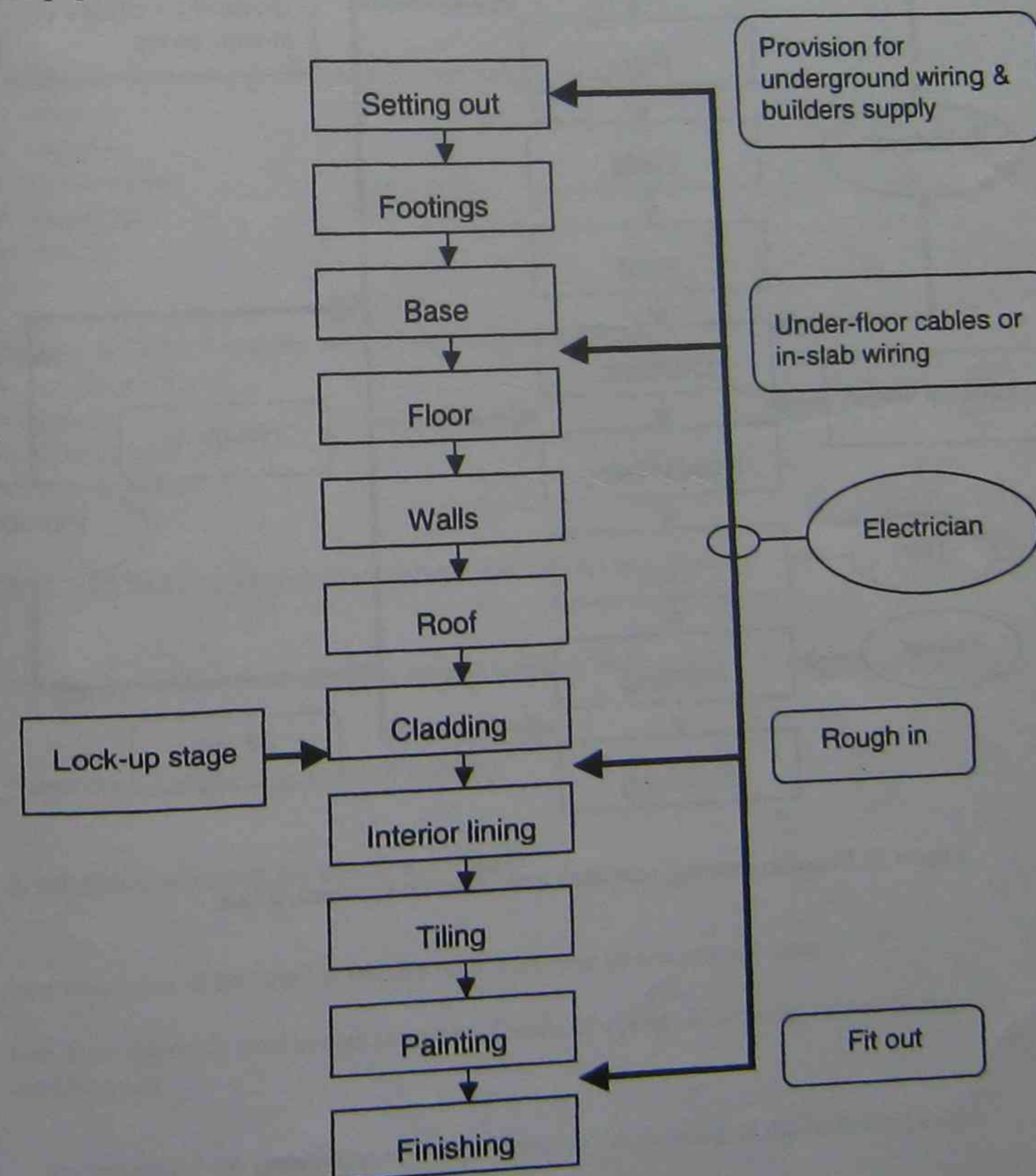


Figure 9 Points in the construction sequence where the electrician needs to perform work



### Inter-trade relationship

The electrician must work in with all construction workers including the:

- builder
- bricklayer
- plumber
- tiler
- interior wall liner (plasterer)
- painter

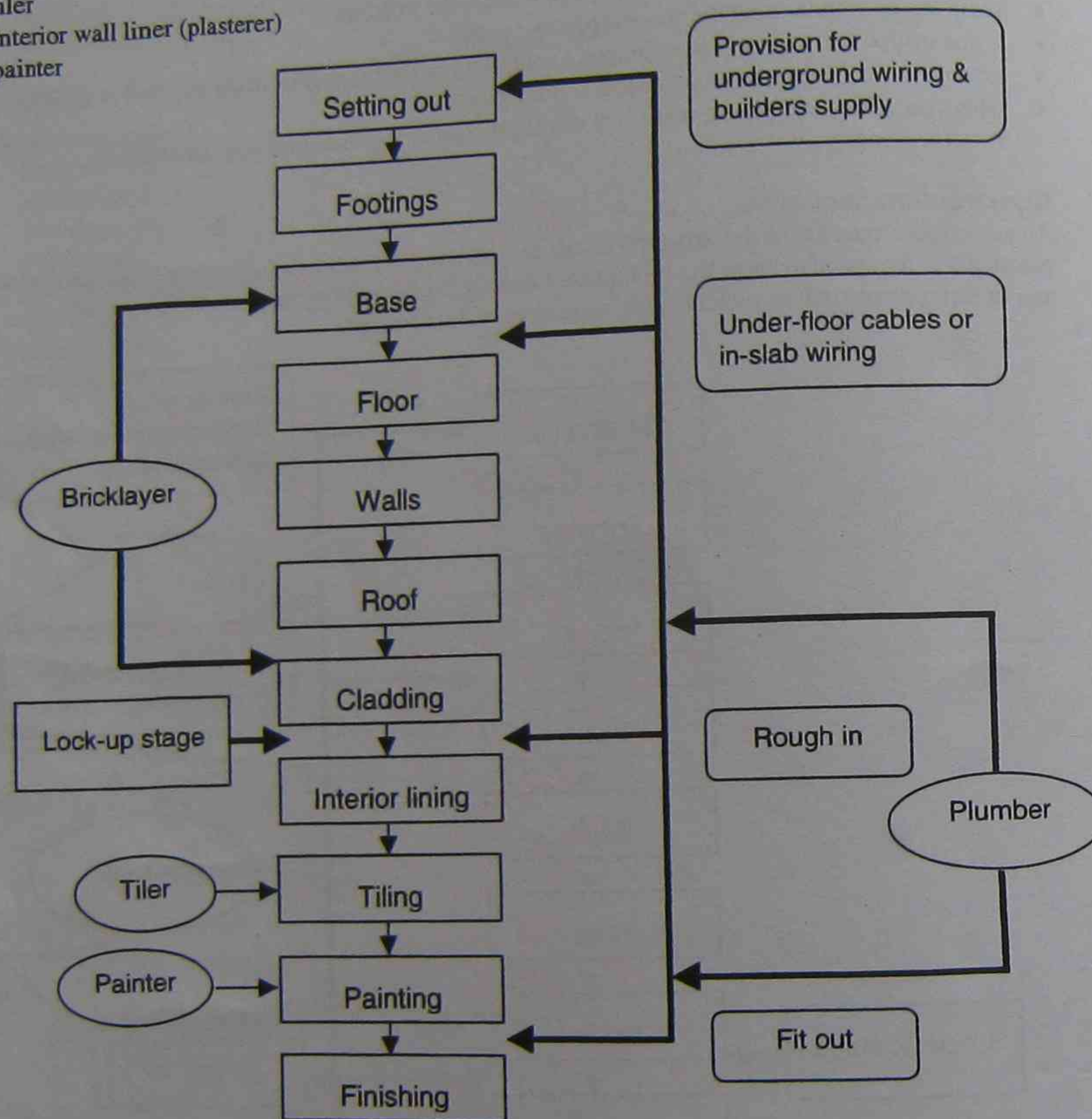


Figure 10 Diagram showing how each trade fits into the construction

### Review questions

These questions will help you revise what you have learnt in this topic.

2. Name the five main parts of a structure.
3. State two reasons why the concrete slab footing is sometimes used in preference to the stump footing.
4. Define the following terms used in timber floor construction:
  - floor joists
  - bearers
  - pier
  - floorboard
4. Define the following terms used in framed wall construction:
  - studs
  - top plate
  - bottom plate
  - noggings
  - braces
5. Define the following terms used in brick wall construction:
  - single brick wall
  - course
  - feature wall
  - rendered wall
6. How wide is the cavity between the brick wall and the framed wall?
7. What purpose does the wall cavity serve in a double brick wall?
8. Name three common types of roof covering.
9. In what circumstances are trussed roofs used?
10. List two types of material an internal wall frame can be constructed from.
11. List four materials used to clad the external walls of a house built using timber frame construction.
12. In relation to the installation of wiring, describe the meaning of the following terms:
  - (a) First fixing (rough in)
  - (b) Second fixing (fit out)



13 List the six main areas of house construction.

14. When installing wiring in the cavity of a cavity wall, explain why it is important that the cables don't touch both the internal and the external walls.

15. The following is a list of constructional stages of a timber-framed cottage. Write these in the correct sequence.

- |             |                   |
|-------------|-------------------|
| / base      | / footings        |
| / cladding  | / interior lining |
| / finishing | / painting        |
| / floor     | / setting out     |
| / roof      | / tiling          |
| / walls     |                   |

16. Indicate on your list from question 4 the point where an electrician carries out the first and second fixings (rough in and fit out).

17. Listed below are four tradespeople an electrician may work with on a building site. Give one reason why the electrician may need cooperation from each of them.

- |     |            |
|-----|------------|
| (a) | bricklayer |
| (b) | plasterer  |
| (c) | concreter  |
| (d) | plumber    |

### Building Structure, Materials and Sequencing

#### Review Questions.

#### Answer

1.

- Foundations
- Footing
- Floors
- Walls
- Roof

2. It's used on level blocks, and it can be used in any climate.

3.

- Floor Joist: it's designed to support the floor.
- Bearers: Carries or supports the floor.
- Pier: Various vertical supporting structures
- Floorboards: Are timber boards laid side by side to make a floor.

4.

- Studs: Upright post in the framework of a wall for supporting plasterboards.
- Top plate: The top horizontal member of a building frame to which the rafters are fastened.
- Noggins: A short horizontal wooden beam used to strengthen upright posts in the framework of a wall.
- Braces: A device, such as a supporting beam in a building.

5.

- Single Brick Wall: One line of bricks vertically and horizontally to make a wall.
- Course: A continuous layer of building material.
- Feature Wall: It's the main wall that all the attention is devoted.
- Rendered Wall: To coat with plaster or cement a brick work..

6. 50mm

7. To provide insulation against dampness, heat and cold.

8.

- Terracotta tiles
- Galvanised Steel
- Colour bond sheeting

9. It's a common structure used in pitched roof design.

10.

- Plasterboards
- Lath & Plaster

11.

- Weatherboards
- Stucco
- Sheets of brick tiles
- Fibro cement sheets