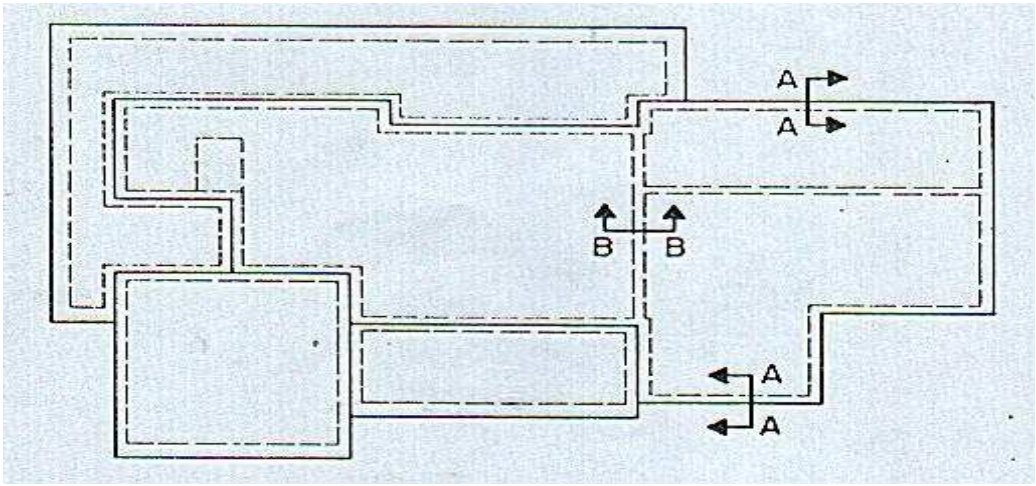
UNESCO-NIGERIA TECHNICAL &
VOCATIONAL EDUCATION
REVITALISATION PROJECT-PHASE II

NATIONAL DIPLOMA IN CIVIL ENGINEERING TECHNOLOGY



CIVIL ENGINEERING DRAWING I
CEC 209

YEAR 2- SE MESTER 3

THEORY/PRACTICAL

CEC 209

CONTENT INDEX

WEEK ONE 1.1 LAYOUT OF DRAWING OFFICE

The drawing office is generally regarded as the heart of any manufacturing organization products, components, ideas, layouts or schemes which may be presented by a designer in the form of rough freehand sketches or developed stage by stage on the board are translated into working drawings by the draughtsman. The drafting office is the starting point for all engineering work. Its product the engineering drawing is the main method of communication between all people concerned with the design and execution of projects. Drawing is accepted as the universal means of communication and BS 308:1972 is the current standard for engineering drawing practice.

The equipment for manual drafting is varied and is steadily being improved.

A good drawing communicates an exact requirement, or specification which can form part of a legal contract between the client and the executioner or between supplier and user.

Engineering drawings can be produced to a good professional standard if the following points are observed.

(a) Line work must be of uniform thickness and density

(b) Use instruments, never mix freehand sketching with machine drawing

(c) Include on the drawing only the information which is required to ensure accurate clear communication

(d) Where possible, use only standard symbols and abbreviations

(e) Use drafting aids and template for repetitive work

(f) Ensure that the drawing is correctly dimensioned and labelled with no unnecessary details

Care and consideration given to small details makes a big contribution towards perfection, but that perfection itself is no small thing. An accurate, well delineated engineering drawing can give the draughtsman responsible considerable pride and job satisfaction.

1.2 Freehand sketching, is a necessary part of drafting because the drafter in industry frequently sketches ideas and design prior to making instrumental drawings. Drafters also use sketches to explain thoughts and ideas to other people in discussion. The practice in sketching helps the students to develop a good sense of proportion and accuracy of observation.

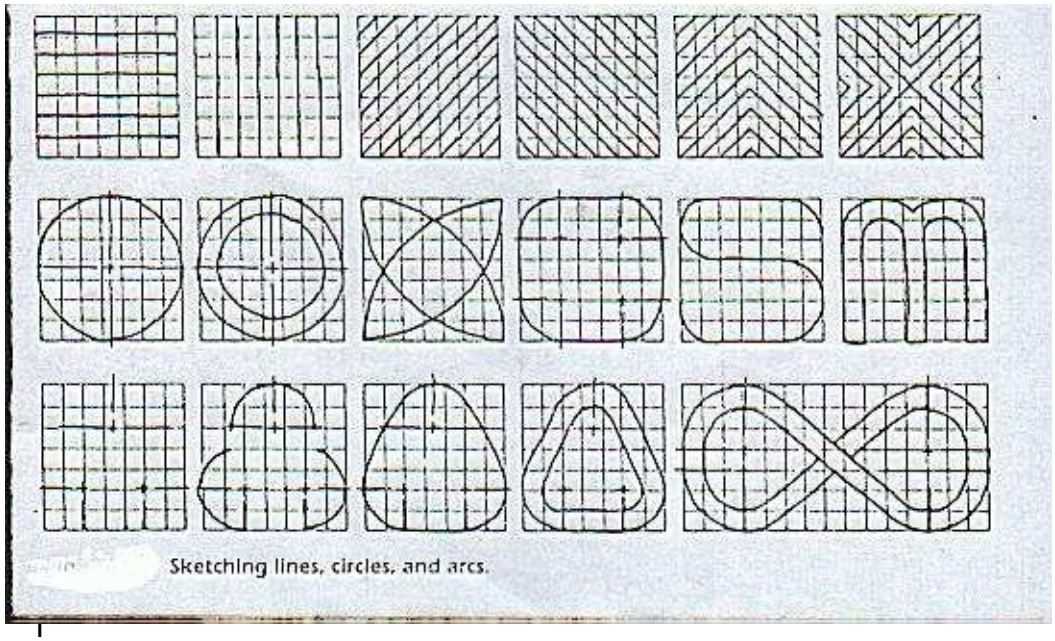


Fig 1.1 Freehand sketching

The general principle of drawings is that structural engineer and designer communicate their requirements through the detailer to the contractor in a clear, concise and unambiguous manner.

Condition on the construction site are very different from those in the drawing office and drawings should be prepared in a manner which takes account of this fact (dirt, weather, and folding) thus quality prints is required or plastic film.

The written descriptions on drawings should be as brief as possible, consistent with completeness and the lettering should be clear and not too small.

Each drawing should give all the information (together with reference to associated drawings) necessary for the construction of the portion of the work shown

Coursework / practical

1) Students are required to prepare drawing office layout plan
2) Students to be conversant with the development in drafting machines and drawing instruments
3) Freehand drawing exercises to be perfected in sketch drawings

WEEK TWO

2.1 DRAWING AS A MEANS OF INSTRUCTIONS AND COMMUNICATION

Since the earliest times people have used drawings to communicate and record ideas so that they would not be forgotten. The earliest form of writing such as the Egyptian hieroglyphics were picture form. The word graphics mean dealing with the expression of ideas by lines or marks impressed on a surface. A drawing is a graphic representation of a real thing.

Drafting therefore is a graphic language because it uses picture to communicate thoughts and ideas. Because these picture are understood by people of different nations, drafting is referred to as a universal language.

Drawing has developed along two distinct lines with each form having different purpose.

2.2 Artistic drawing: Concerned mainly with the expression of real or imagined ideas of a cultural nature.

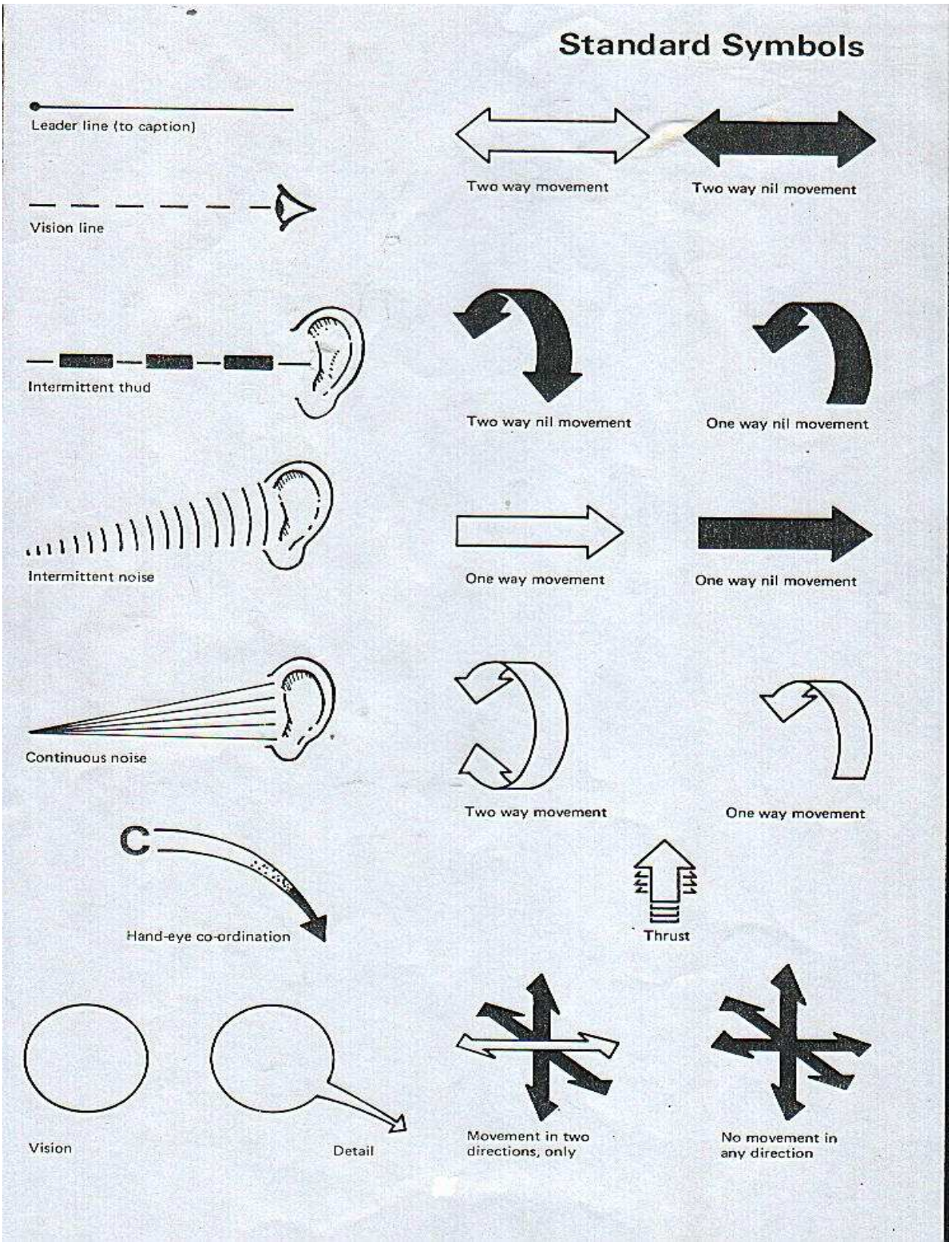

Standard Symbols
Leader line (to caption)
Two way movement
Two way nil movement
Vision line
Intermittent thud
Two way nil movement
One way nil movement
Intermittent noise
One way movement
One way nil movement
Continuous noise
Two way movement
One way movement
C
Hand-eye co-ordination
Thrust
Vision
Detail
Movement in two directions, only
No movement in any direction

fig 2.1. Signs

2.3 Technical drawing: Concerned with the expression of technical ideas or ideas of

practice nature.

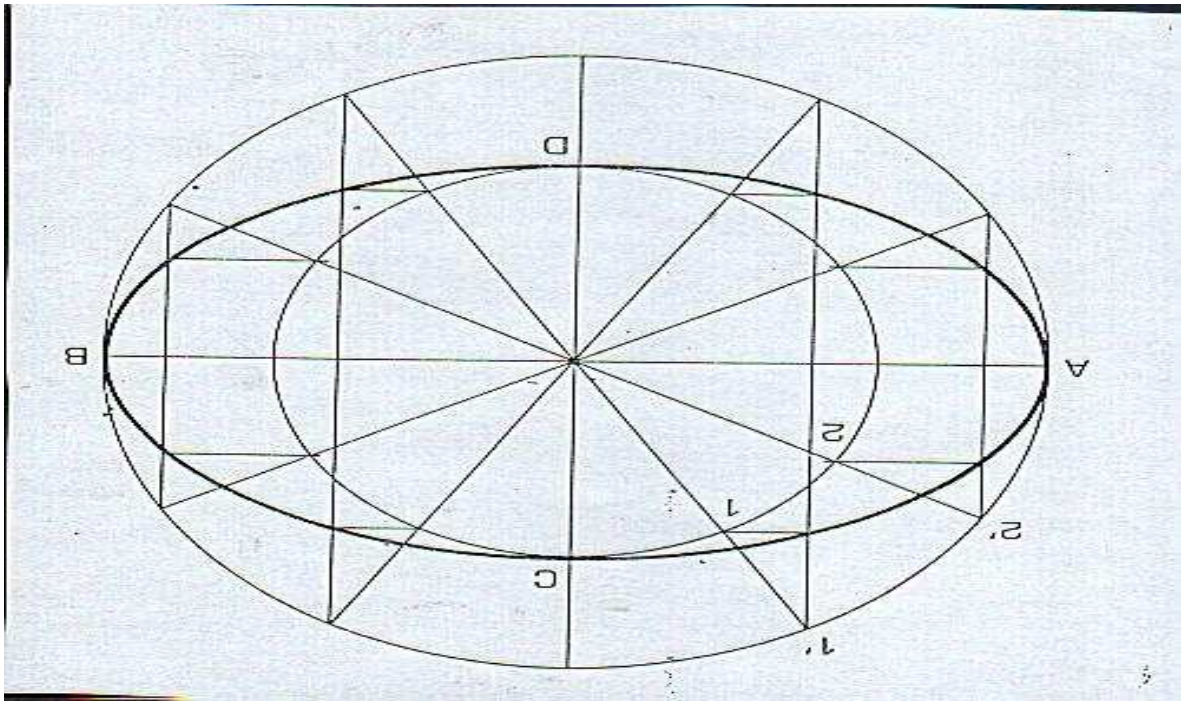


Fig 2.2 Technical drawing

Even highly developed word language are inadequate for describing the size, shape, and relationship of physical objects. For every manufactured object there are drawings that describe it physical Shape and relationship of physical objects completely and accurately: thus communicating engineering concept to manufacturing for this reason drafting is referred to as the language of industry. Drafters translate the idea, rough sketch, specifications and calculation of engineers, architects and designer into working plans.

Coursework / practical

Students are required to discuss in writing “drawing as a means of communication between professionals in civil engineering and building projects.

WEEK THREE

3.1 DRAWING STANDARDS

Engineering drawing practice recommends drawing layout, type of line, lettering, methods of projection, sections, scales and the conventional representation of common features. The international organization for standardization (ISO) on engineering drawing practices specified in BS 3429: the following:

Table 3.1: Drawing sheets

Designation	**Size (MM)**	**Minimum frame border with (MM)**
AO	841 x 1189	25
A1	594x 841	20
A2	420 x 594	20
A3	297 x 420	15
A4	210 x 297	15

3.2 TITLE BLOCK

Should contain essential information required for the identification, administration and interpretation of the drawing. It is recommended that the title block should be at the bottom of the sheet with the drawing number in the lower right land corner. Adjacent to this number should be the title and issue (Alteration) information.

Some basic information required are:

Name of firm

Drawing number

Descriptive title of the drawing

Original scale

Date of the drawing

Signatures

Issue information

Unit of measurements

Notes/warning notes “DO NOT SCALE”

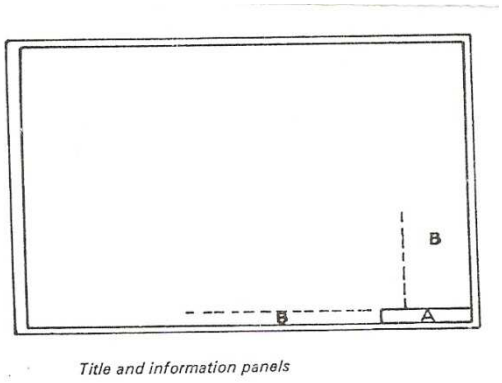


Fig.3.1 Title block

3.3 CONSTRUCTIONAL DRAWING

Show only the projection of the assembly and sufficient dimensions and other information to describe the component parts of the construction. Some details may be shown in the part list on the drawing example sizes of the section of the material.

GRID SYSTEM (OR ZONING)

In order that a particular dimension or feature on a large drawing be readily located, it is desirable to the grid reference system based on numbered and lettered division in the margins.

REVISIONS

It is most important that all revisions should be indicated on the drawing and that each new issue be identified by a change in the date, issue number or letter. The convenient method of recording a revision is a table on the drawing in which details of the revision are given.

KEY PLAN

A method particularly applicable to structural work is to include on each individual sheet of a series of drawings a small key plan or elevation or both conveniently placed near to the title block, indicating in bold lines to which part of the whole work the particular sheet refers.

LINES

All lines should be dense and bold. It should be of consistent density and reflectance

Each type of line should be of consistent thickness and in a accordance with the recommendation given in the code.

3.4 LETTERING

The characters should be uniform and capable of being produced by hand, stencil or machine. The characters on the drawing should remain legible in reduced copy.

Which ever style is adopted it must be legible and unambiguous characters.

Capital letters are preferred to lower case as they are less congested and are less likely to be misread when reduced in size.

Fig. 3.2 Lettering

3.5 ABBREVIATIONS

Where required, abbreviations are the same in the singular and plural. Capital letters are shown, lower case letters may be used where appropriate.

Full stops are not used except when the abbreviation make a word which may be confusing. Example the abbreviation for the word “number” is NO.

3.6 SCALES

The scale is the ratio of the linear dimension of an element of an object as represented in the original drawing, to the real linear dimension of the same element of the object itself.

Enlargement scale:- where the ratio is larger that full scale (1:1) e.g 2:1, 50:1.

Reduction scale:- where the ratio is smaller than full scale (1:1) e.g 1:2, 1:50

Full size should be indicated by 1:1 Enlargement scale by x:1

And reduction scale 1:x

The complete designation of a scale consists of its ratio preceded by Original Scale

Scale to be chosen for the drawing depend on the size of the drawing sheet and the size of the object to be depicted. It should be large enough to permit easy and clear interpretation of the information . Details that are too small for clear dimensioning in the main representation should be shown in a separate view to a larger scale.

Coursework / practical

Students are given exercises on means of standardization of drawing to make it an international language like the use of standard notations, abbreviations, scale, labelling, dimensioning, etc

WEEK FOUR

4.1 THEORY OF SHAPE DESCRIPTION

Pictorial (3 –dimensional) drawing of objects are sometimes used

- Orthographic projection
- Pictorial drawing :- Isometric
  : Oblique
  : Perspective

When looking at objects, we normally see them as 3- dimensional having width, depth and height.

Or

Length, width and height

The choice of term depends on the shape and proportions of the object e.g pole

Lying on the ground:

Description: diameter and length

Standing erect: description: diameter and height

In general distances from left to right are referred to as width or length. While distance from front to back as depth or width, and vertical distance (except when small in proportion to the others) as height

4.2 PICTORIAL VIEWS

Pictorial drawing represent the shape with just one view and are frequently used for illustrative purposes e.g for installation and maintenance works. Drawings, of do-it-yourself projects,

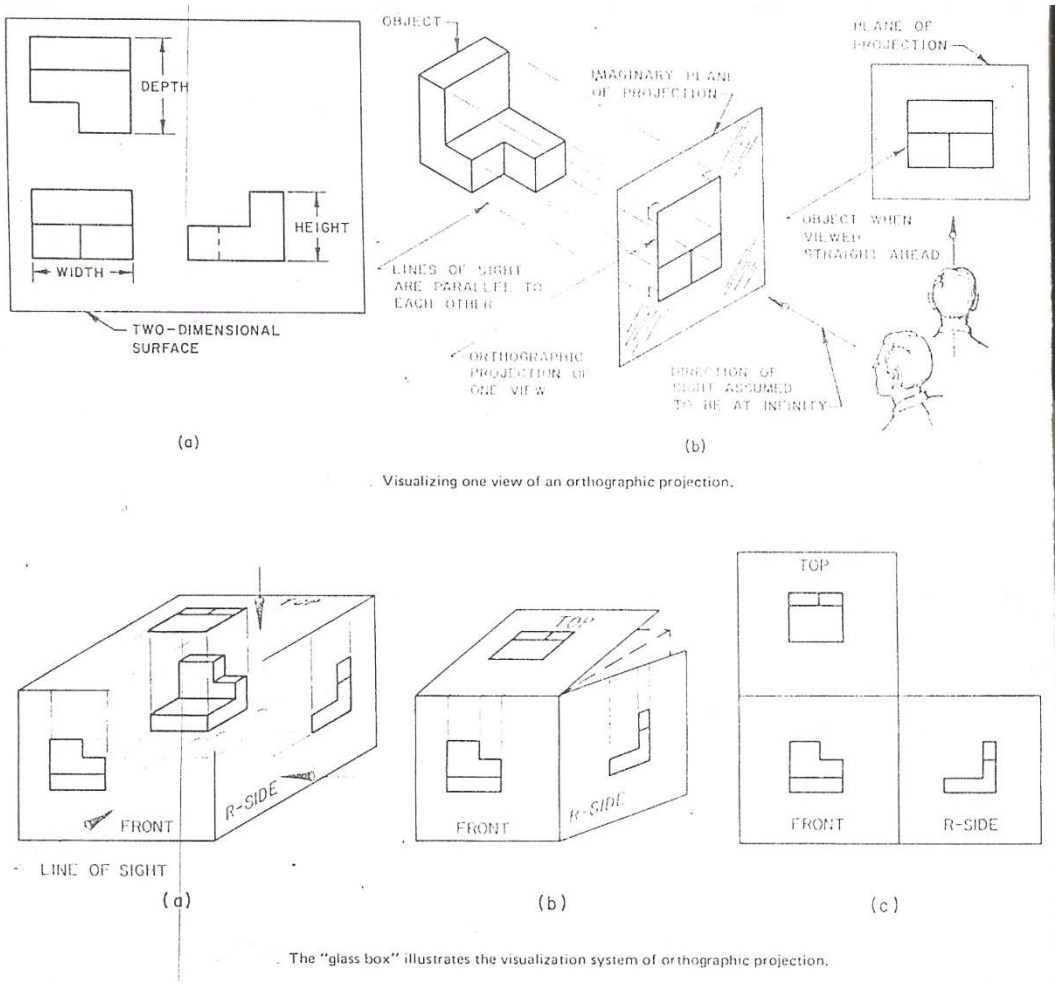


Fig. 4.1 Projections

Orthographic Projection Drawing (Third Angle)

An orthographic view is what you would see looking directly at one side or face of the object

4.3 PROJECTIONS

The two system of projections are:

First Angle (European):

In the first angle projection each view shows what would be seen by looking on the far side of an adjacent view.

Third Angle (American)

In the third angle projection each view shows what would be seen by looking on the near side of an adjacent (view).

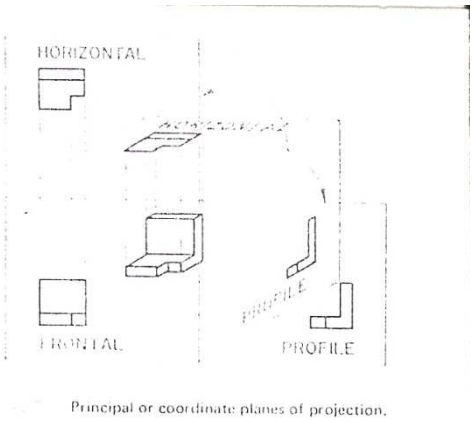


Fig. 4.2 Views

AUXILIARY VIEWS

Objects having inclined faces may have such faces projected to show the true shape of the inclined surface.

VIEWS ON DRAWINGS

It is necessary before commencing a drawing to have a clear mental picture of the views to be shown. The number should be minimum necessary to ensure the drawing cannot be misunderstood.

A view which shows no more than a diameter or thickness is unnecessary if this information can be shown by a note.

REPETITIVE INFORMATION

Repeated illustration of identical features may be avoided by drawing one and indicating the position of the others by their centre lines.

The detailing of a small area should suffice for a larger area of a continuous pattern.

HATCHING: May be omitted where the meaning of the drawing is clear without it. When necessary, thin lines should be used at a well defined angle preferably 45^{o} to the axis or to the axis of the section. Spacing between the hatching lines

should be chosen in proportion to the size of the hatched section preferably not less than 4mm.

Coursework / practical

Students to read and exercise on theory of shape description, projection and views of objects earlier studied in technical drawing lessons

WEEK FIVE **5.1 ARCHITECTURAL DRAWINGS**

Table 5.1 Symbols

MATERIAL	PLAN	ELEVATION	SECTION
EARTH	NONE	NONE	
CONCRETE			SAME AS PLAN VIEW
CONCRETE BLOCK			
GRAVEL FILL	SAME AS SECTION	NONE	
WOOD	FLOOR AREAS LEFT BLANK	SIDING PANEL	FINISH FRAMING
BRICK	FACE COMMON	FACE OR COMMON	SAME AS PLAN VIEW
STONE	CUT RUBBLE	CUT RUBBLE	CUT RUBBLE
STRUCTURAL STEEL		INDICATE BY NOTE	SPECIFY
SHEET METAL FLASHING	INDICATE BY NOTE		SHOW CONTOUR
INSULATION	SAME AS SECTION	INSULATION	LOOSE FILL OR BATT BOARD
PLASTER	SAME AS SECTION	PLASTER	STUD LATH AND PLASTER
GLASS			LARGE SCALE SMALL SCALE
TILE			

Architectural material symbols used on drawings.

Designing a house to be acceptable to the client involves a study of the needs of the family planning to occupy the house. Certain information must be obtained if the architect is to adequately plan to meet the needs of his client.

1. The family group and special needs
   - number in the family and their ages
   - Special needs of children and adults
   - Family customs

- Occupation and hobby

2. Style and construction types
   - Single –storey, 2 – storey, bungalow building
   - type of construction; wooden frame, brickwork, stone, style of roof and roofing materials.
3. The lot and its features
   - Size and shape
   - Trees, rocks, etc
4. Financial considerations

STAGES OF THE DESIGN

1. Preliminary design – sketch drawings, site visits and investigation of the subsurface. Feasibility study of the site, cost of each alternatives, aesthetic
2. Approvals: the promoter and variety of statutory bodies.
3. Detailed design: the preparation of the working drawings
4. Contract document:- Drawing are combined with specification and bill of quantities to give the contractor sufficient information to price and construct the permanent work or to execute the project

ARCHITECTURAL WORKING DRAWING

Consists of:

- Roof and plot plans
- Foundation/basement plans
- Floor plans
- Section
- Elevation
- Framing details

5.2 FLOOR PLAN:

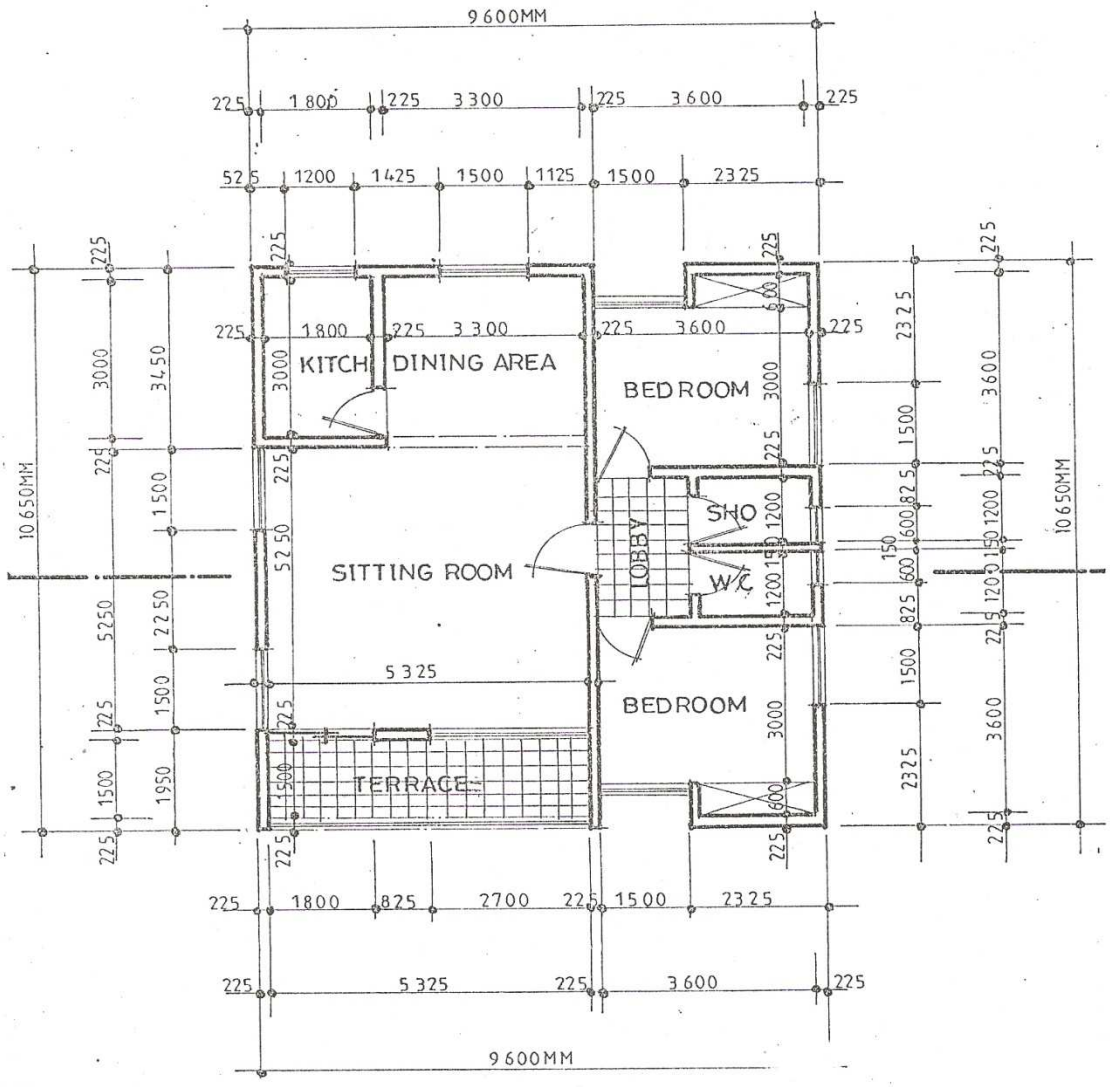


Fig 5.1 Floor plan

The floor plan is a fully dimensioned and graphic description of the layout of one floor. It includes the location of all features such as walls, doors, windows and built-ins.

It may include the layout and location of the electrical system, plumbing fixtures

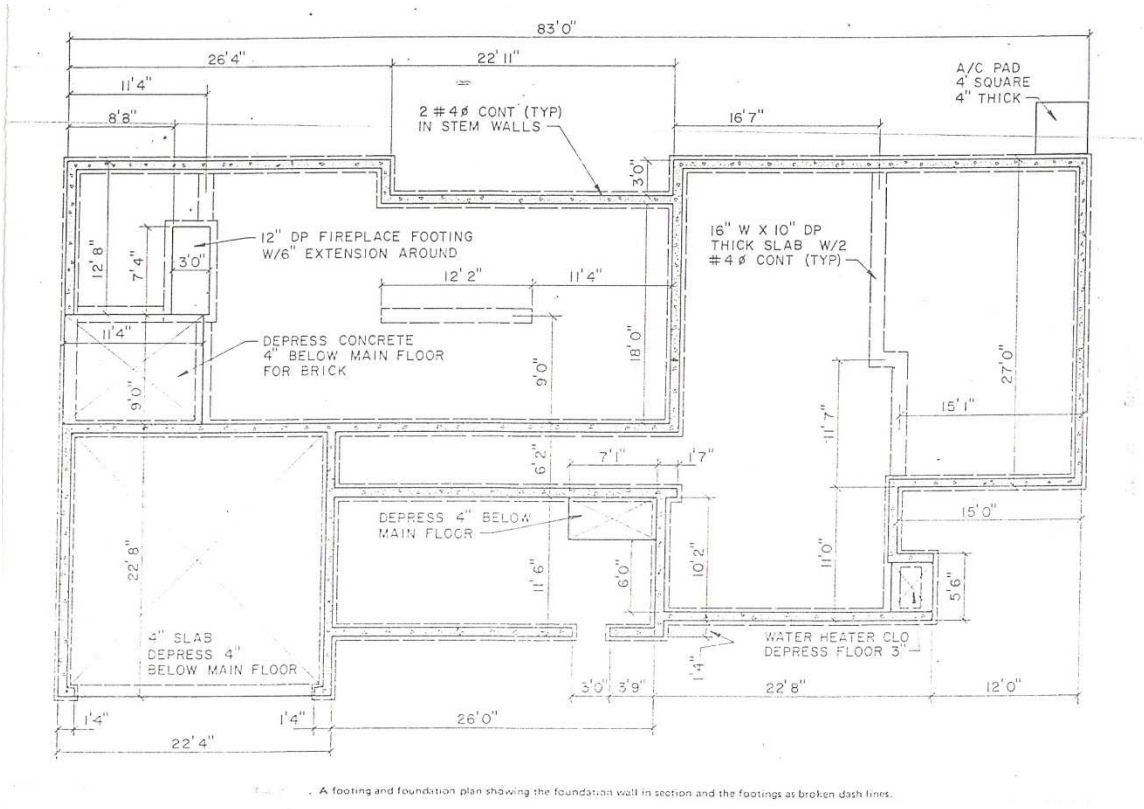
It also contains reference to details section contained in other drawings or sheets.

ROOF AND PLOT PLAN

The compass direction north is indicated by an arrow. The overall dimensions of the plot and those locating the house, other building, walks, drives and prominent feature such as rock - outcrops, trees, etc.

The roof plan is the view from above and the roof extension beyond the walls of the house is shown in phantom lines.

5.3 FOOTING AND FOUNDATION PLAN



A footing and foundation plan showing the foundation wall in section and the footings as broken dash lines.

Fig 5.2 Footing plan

The plan can be drawn by placing tracing paper directly over the floor plan and tracing the outline of the floor plan. The foundation wall is shown is a visible line. The footing outline is represented by a broken dash line Beams below the floor level (used to support bearing walls) or footings for piers and columns are also shown on the plan as broken dash lines.

When a concrete slab foundation is used (no footings) the inner line of the slab foundation wall and other beam below the floor are shown in hidden lines- when the foundation and slab floor are poured at the same time.

Coursework / practical

(Weeks 5 -12)

Practical projects

Students are expected to prepare a working drawing for a building construction project : one – bedroom flat, two – bedroom flats or three – bedroom flat etc, including the side plan or plot plan, footing or basement plan, sections, elevations and framing details of wardrobes, kitchen unit door and window schedules etc

WEEK SIX

6.1 BASEMENT FLOOR

The basement plan may also be prepared by tracing the floor plan including whatever details required. Opening for doors and windows are shown and called out for listing in a schedule.

Framing plans. Roof framing plan, floor joist framing plan, ceiling joist framing plan.

6.2 ELEVATIONS

All sides must be shown unless they are identical and this information is noted on the drawing.

Elevations show the floor line, ceiling line, and first floor joist line as centre lines.

6.3 SECTIONS

Through wall section, fire place section stairway elevation.

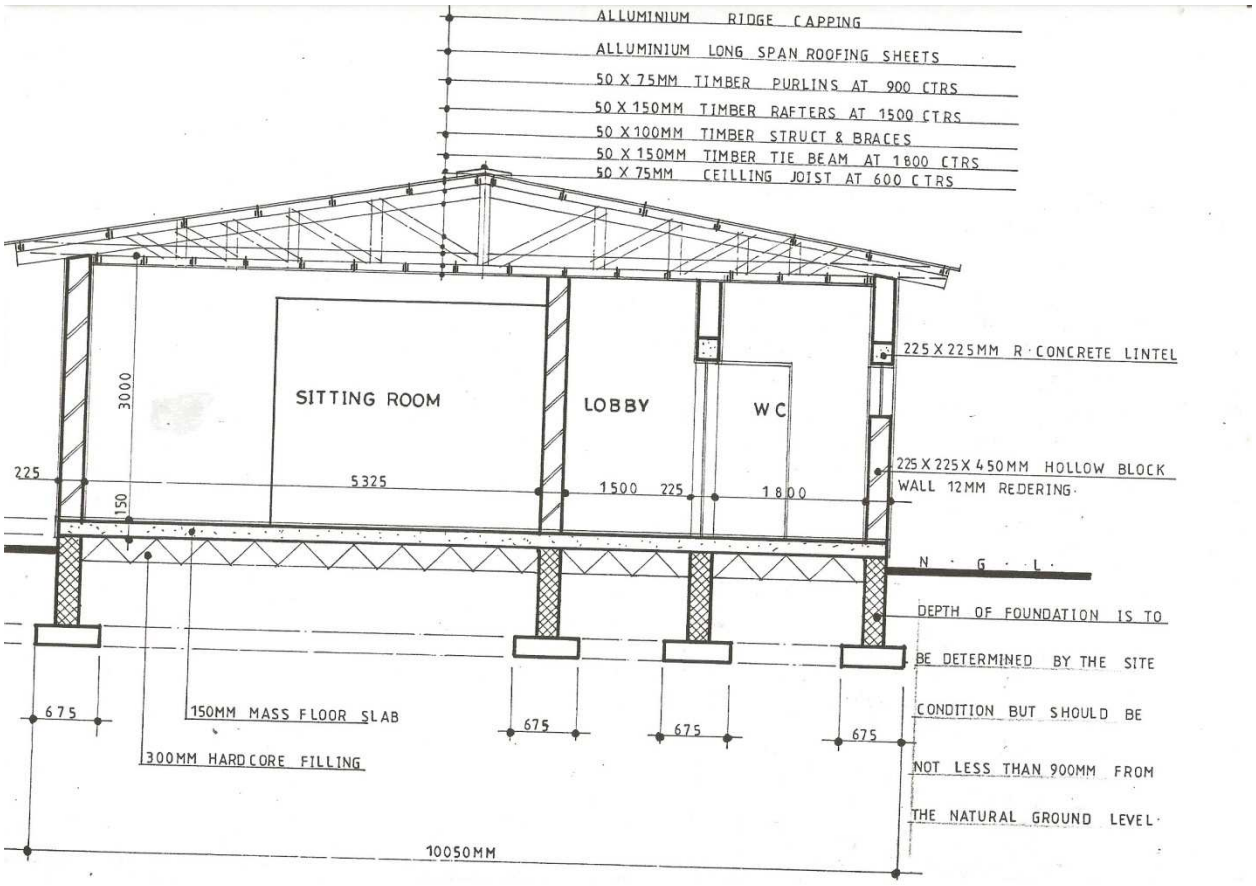


Fig. 6.1 Sections

DETAIL DRAWINGS:

Details of kitchen units, cabinets and built- in, shelf, door and window schedule

COURSEWORK/PRACTICAL

Students to draw section and elevation of building project.

WEEK SEVEN 7.1 STRUCTURAL BEHAVIOR OF REINFORCED CONCRETE

A structure can be subjected to any of the following conditions regardless of it structural materials

1. Bending
2. Buckling
3. Stretching
4. Twisting
5. Shearing

The force set up in the member by these condition are:

a. Tension
b. Compression
c. Torsion
d. Shear

Since reinforced concrete is a composite materials there is also the question of the transfer of stress from the reinforcement to the concrete and for this to be effective the concrete must grip the reinforcement securely. This is known as bond and is related to tension, compression and shear forces.

Majority of reinforced concrete members are subject to several of the conditions noted above rather than one condition only.

Foundations: Are mostly subject to bending and shearing, the latter being usually the critical conditions for depth. Where tied together by beams, stretching in the beam may occur.

Columns: are mostly subject to bending and buckling, the latter being usually the critical conditions for size. Where subject to side pressure from winding loading they can be subject to shearing.

Beams: Are mostly subject to bending and shearing, the former being usually the critical conditions for depth. (slender in relation to their span they can be subject to buckling. If subject to heavy eccentric loadings they can be subject to twisting.

Retaining Walls: are mostly subject to bending and shearing, the former being usually the critical condition for thickness. Where subject to loading from above they may be subject to buckling.

Slabs:Are mostly subject to bending, this being critical in determining depth.

In the case of flat slabs, the shearing at column heads can be critical and in 2-way spanning slabs twisting can occur at corners of slab panels.

Shell: are mostly subject to buckling and /or stretching and these dictate the thickness. Where concentrated loads occur, they may be subject to shearing and where openings occur they may be subject to twisting.

Considering each of these condition in turn a size of member and its reinforcement can be determined

Coursework / practical

Students are to revise structural mechanics to deterring critical stress locations of foundations, beams, columns, slabs, walls, stairs and other structural elements

WEEK EIGHT

8.1 DETAILING REINFORCED CONCRETE

The work of detailer start from a knowledge of the areas of steel required at the various points in the structure and the rules governing the conversion of these areas into actual bar sizes and distribution.

Drawings are prepared so that the structural designer can communication his requirements through the detailer to the contractors' workmen in a clear concise and unambiguous manner.

Details should be simple, and bars should have as few bends as possible. Simplification leads to fewer errors and easier comprehension of the designers intension.

The detailer must consider the spacing of bars and ensure that the concrete can be placed and compacted without difficulty.

When referring to reinforcement on drawings, the sequence of description should be as follows:

Number, types, size, mark, centres, location or comment,.

To describe 20 high yield bars of 10mm size at 150mm centre in the top of slab 20 Y10- - 63 – 150T 63 is bar mark

8.2 THICKNESS OF LINES

Lines should be of the approximate thickness given below:

Concrete outlines	-	0.4mm
Main reinforcing bar	-	0.6mm
Reinforcing bars: links and stirrups	-	0.4mm
Dimension lines	-	0.2mm

8.3 GRID LINES

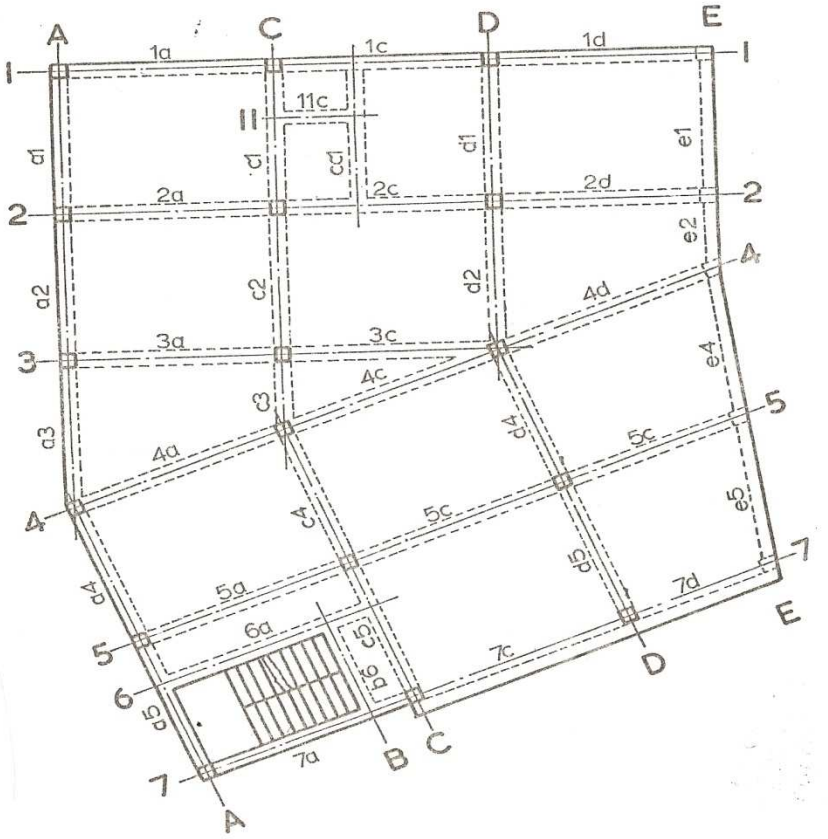


Fig. 8.1 Grid lines

The method of numbering beams and column should be related to grid lines. Grid lines in one direction should be marked A, B, C etc and in the other direction 1, 2, 3 etc

Column are numbered by the intersection of lines thus: D4 at the intersection of line D and line 4.

Beam can be simply described as beams on line 4 or if more details is required: beam 4a. 4b in one direction beam at, a1, a3 in the other direction.

Coursework / practical

Students should be given exercises on putting structural element on grid.

WEEK NINE

9.1 BAR SCHEDULES

Scheduling is the listing of bars required for the reinforcement of concrete, using standard forms. Scheduling of reinforcement is an essential part of the detailers job, being the method by which bars or fabric reinforcement is ordered for quantity, shape and size.

Schedules are prepared by the detailer and used by the builder, the supplier, iron bender and quantity surveyor.

The schedules are referenced in their top right –hand cover with a six character reference comprising the drawing number (001 to 999), followed by the sheet number (10 to 99). And a revision letter (A to Z), which is more than adequate for most jobs.

9.2 BAR SCHEDULE SHEET

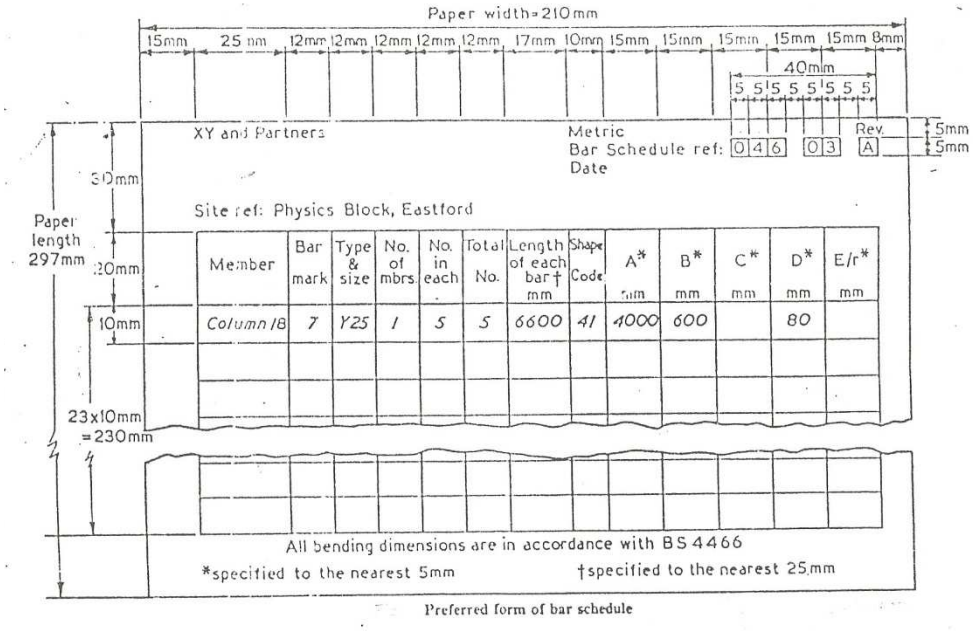


Fig. 9.1 Bar schedule sheet

Members: - means the structural element for which the bars are scheduled.

Bar mark: - means the serial number allocated to the bar on the detail drawing.

Types and size:- The type of steel used and its diameter.

Number of members:- Means the number of similar elements that go to make up the structure

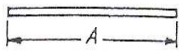
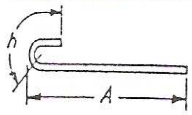
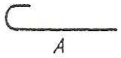
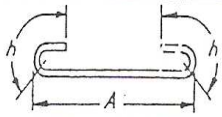
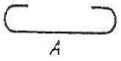
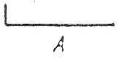
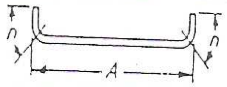
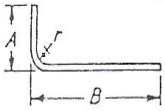
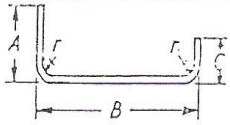
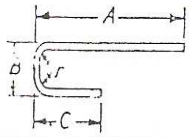
Number of bars in each:- Means the number of similar bars of this marks in the member

Total number:- Mean the product of members and the number in each

Length of each bar:- being the overall length in millimeter allowing for bending tolerance, specified to the nearest 25mm multiples.

Shape: This shows the bending of the bar with critical dimensions indicated. The closing dimension is omitted to allow for bending tolerance.

9.3 Bending Shapes

Shape code	Method of measurement of bending dimensions	Total length of bar (L) measured along centre line	Dimensions to be given in schedule
20		A	Straight
32		$A + h$	
33		$A + 2h$	
34 *		$A + n$	
35 *		$A + 2n$	
37 *		$A + B - \frac{1}{2}r - d$	
	If r is non standard use shape code 51.		
38 *	 or 	$A + B + C - r - 2d$ $A + B + C - r - 2d$	 or 

r = standard radius of bend (see Clause 7) unless otherwise stated.

*For these shapes in particular the effect of a positive cutting tolerance increasing the actual length of the 'free' leg or legs by up to 25 mm should be considered.

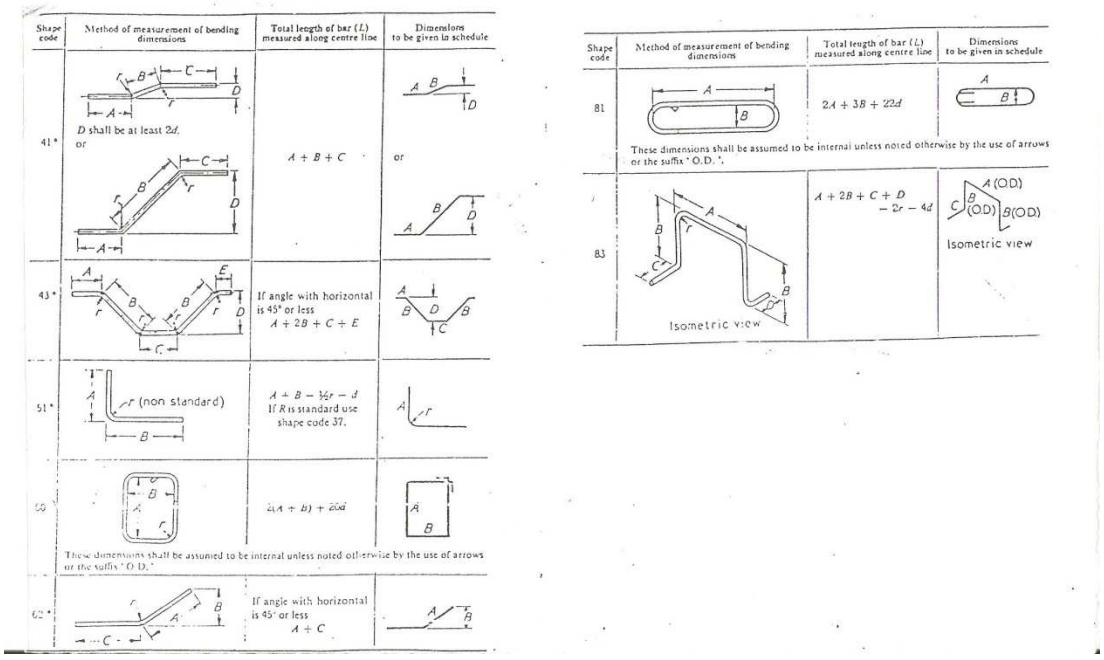


Fig. 9.2 Bar bending shapes

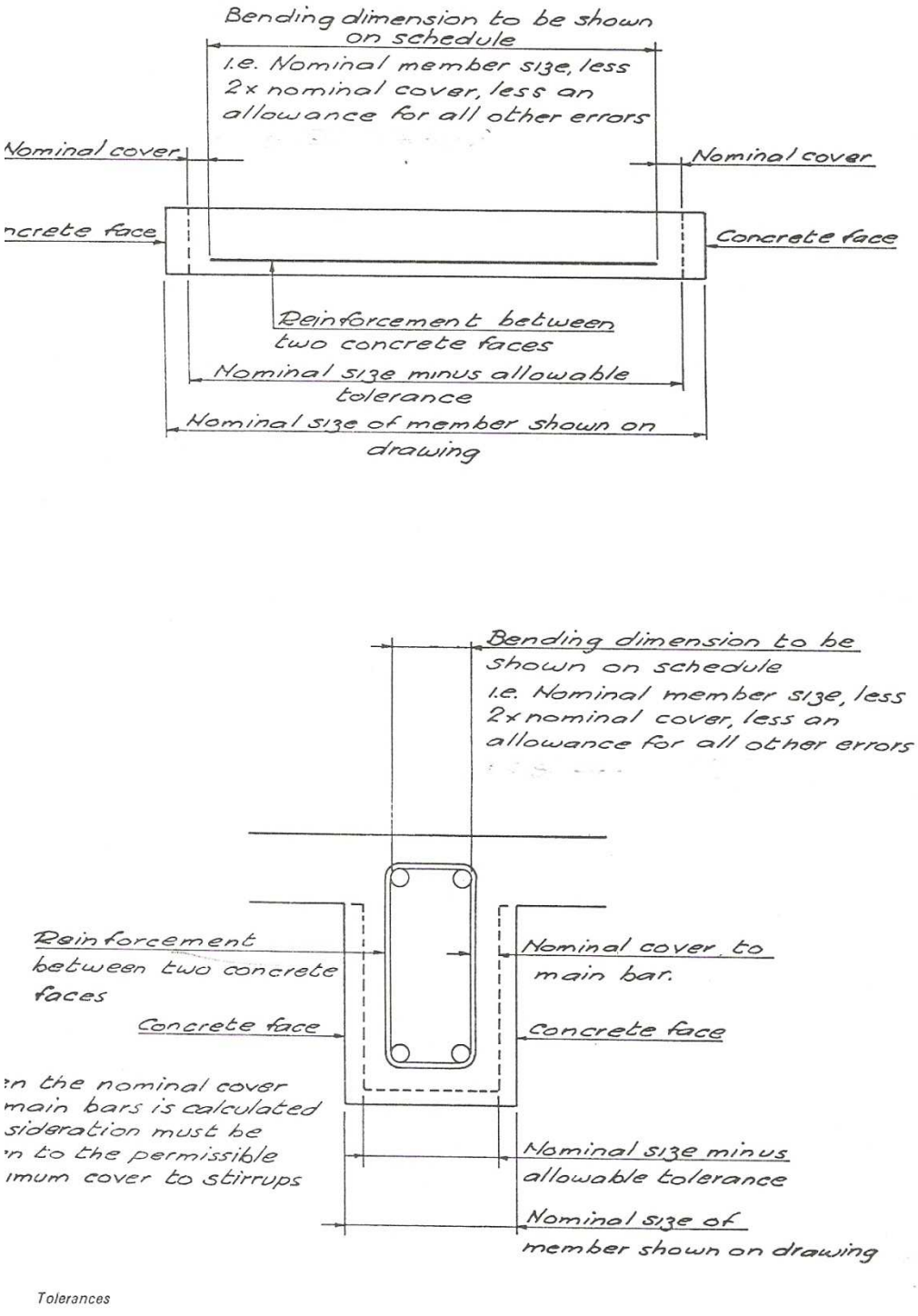


Fig. 9.3 Bending tolerance

Coursework / practical

(Weeks 9 – 10)

1) students are to prepare bar bending schedule sheet
2) students are to be taken on excursion to project sites where reinforcement bars have been put in place ready for casting

WEEK TEN

10.1 *Basic Presentation Procedure*

1. A sensible scale should be adopted e.g
   - General arrangement drawings 1:100 or 1:50
   - Simple wall and slab details 1.50
   - More complex slab details and slab and wall sections 1.20
   - Beam and column elevations 1:20
   - Beam and column sections 1:20 or 1:10
2. Grid lines, where used, should run in sequence on plans, numbers 1, 2, 3, etc, from top to bottom and letter A, B, C, etc. from left to right of the drawing so that beams and columns, and also floor bays, can be easily referenced when shown in isolation on details drawings or called up on schedule sheets.
3. Plans, elevations and sections should be clearly defined.
4. Sections through plans should always be taken looking a) to the left b) upwards
5. Section through elevations always be taken looking a) to the left b) downwards.
6. Certain standard abbreviations may be used in calling up reinforcement e.g for type of reinforcement

Mild steel round bars	R
High tensile round bars and	
High tensile square twisted bars	Y
Other types	X

7. The bar mark and size should be grouped into a single numeral where the diameter precedes the bar mark thus:

Bar dia in millimeter	bar marks
6	60-699
	and 6100-6999
8	801-899
	and 8100-8999

Coursework

Students to draw reinforcement details for foundation and prepare its bar bending schedule sheet

WEEK ELEVEN

11.1 FOUNDATION DETAIL

Detailing and preparing the bar bending schedule of foundation

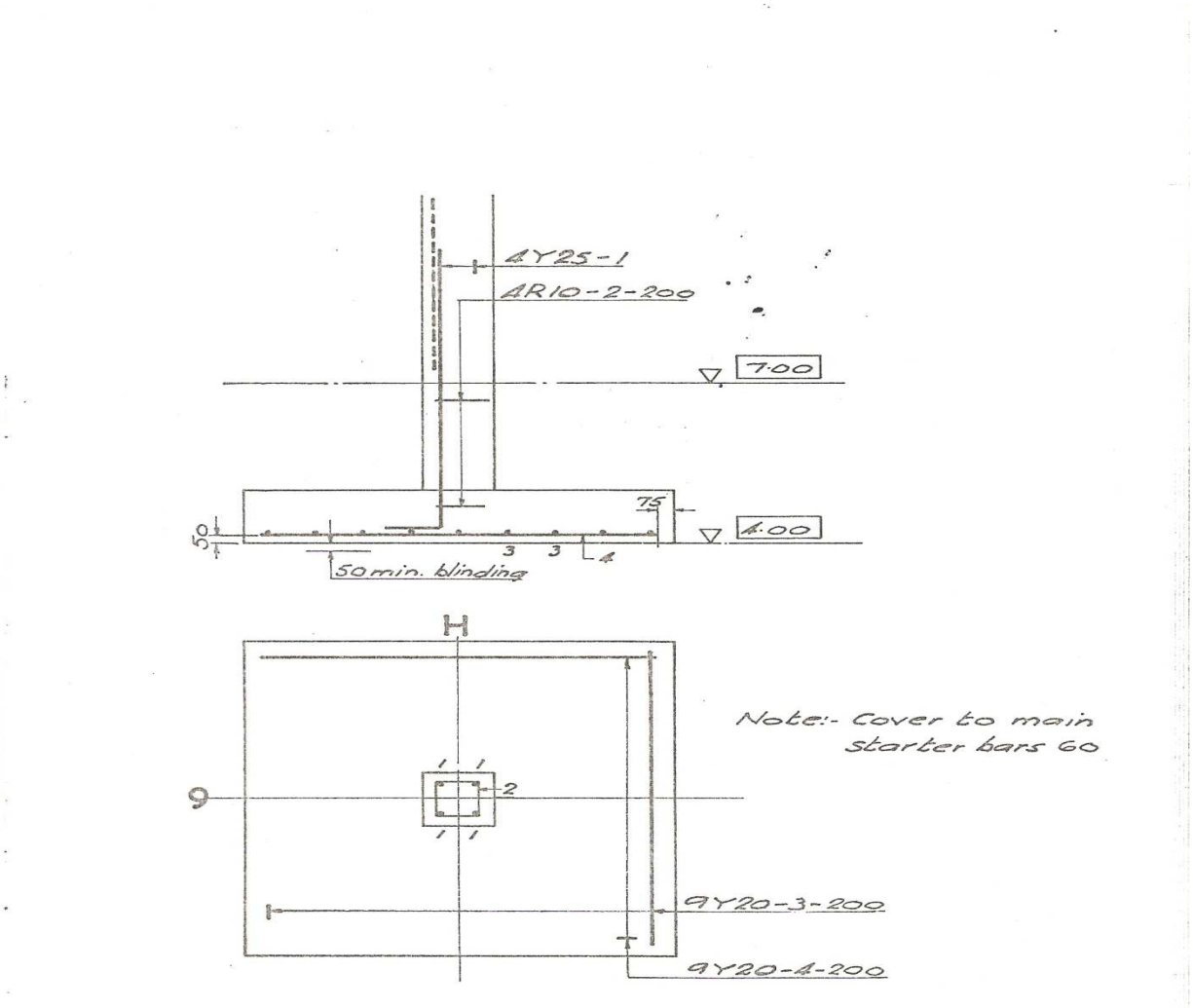


Fig. 11.1 Foundation

Coursework

Students to draw reinforcement details for foundation and prepare its bar bending schedule sheet

WEEK TWELVE

12.1 BEAMS AND COLUMNS DETAIL

Detailing of Beams and column and preparing their bar bending schedule

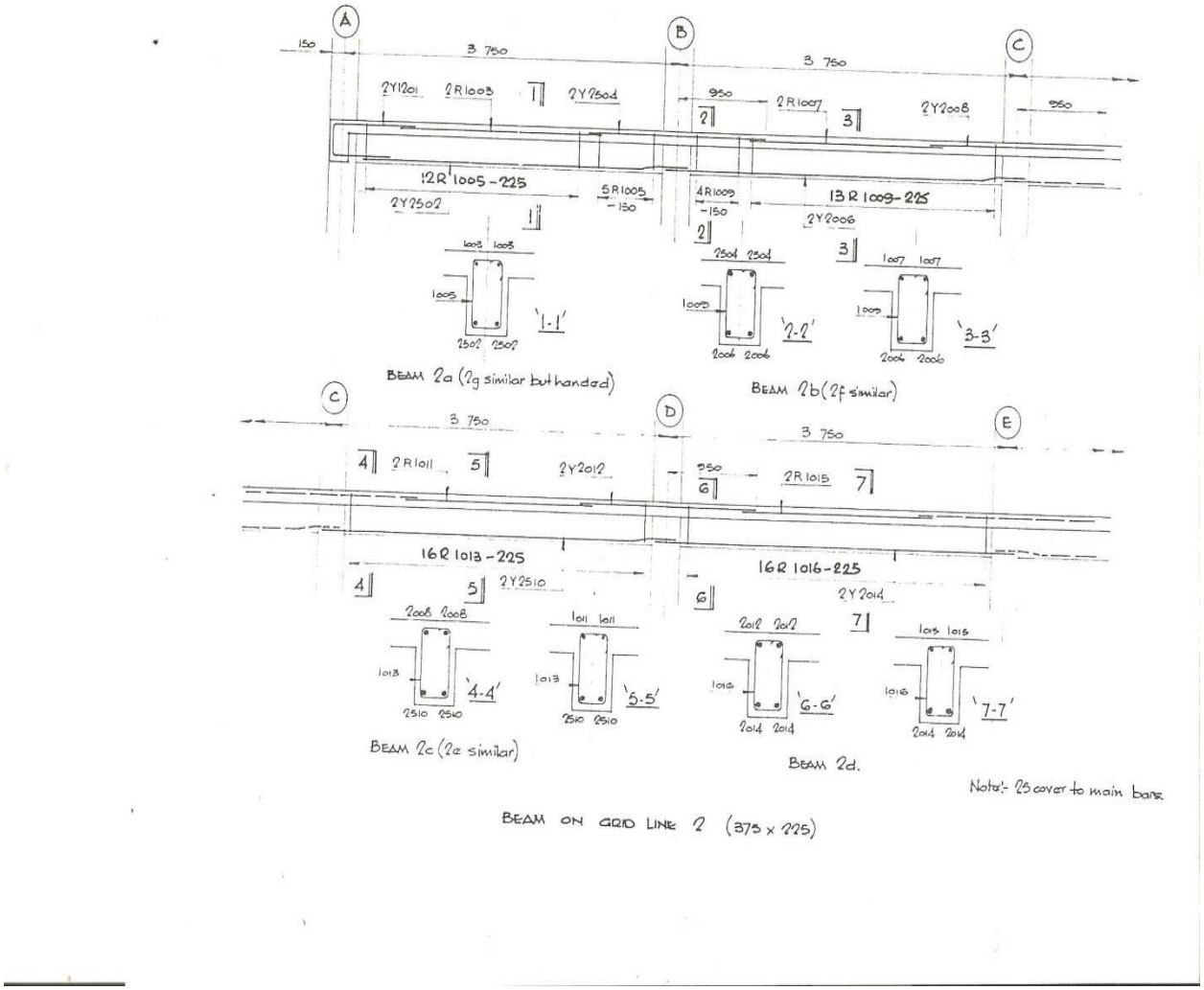


Fig 12.1 Beam

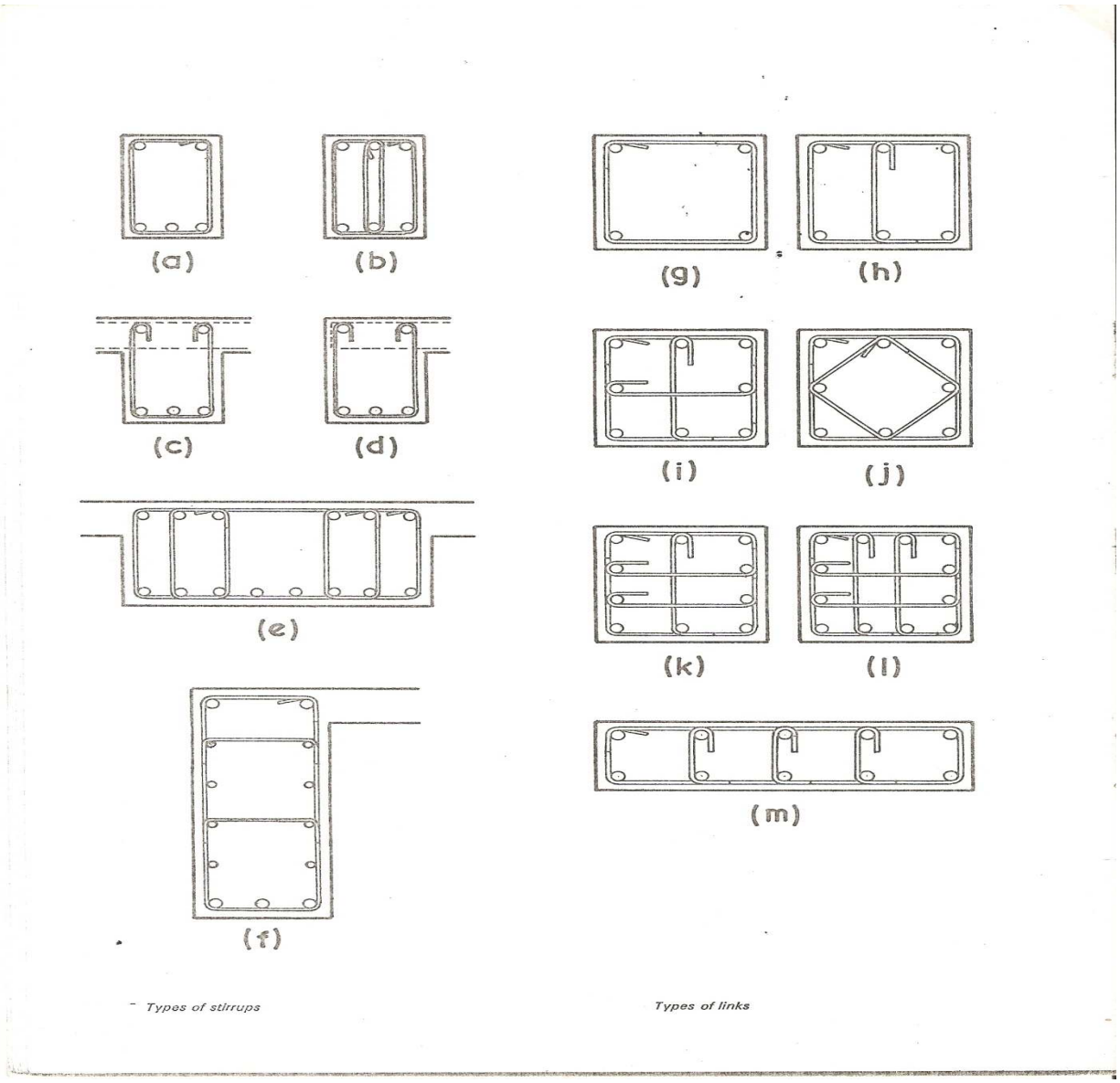


Fig. 12.2 Links and stirrups

12.2 Column Details

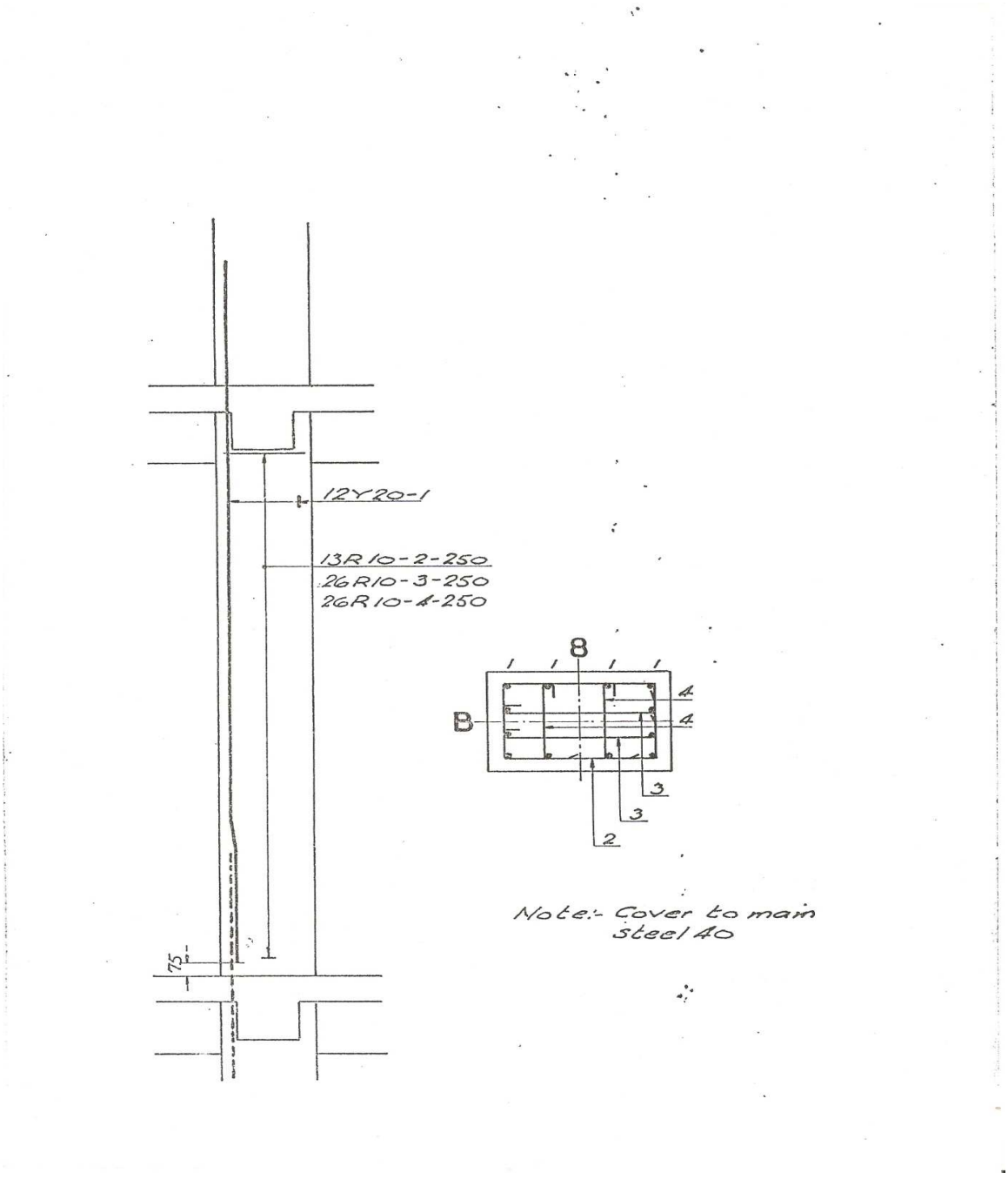


Fig 12.3 Column

COURSE WORK

Students to draw reinforcement details for beams and columns and prepare their bar bending schedule sheet

WEEK THIRTEEN **13.1 SLABS AND WALL DETAIL**

Detailing of slabs, and wall and preparing their bar bending schedules sheet

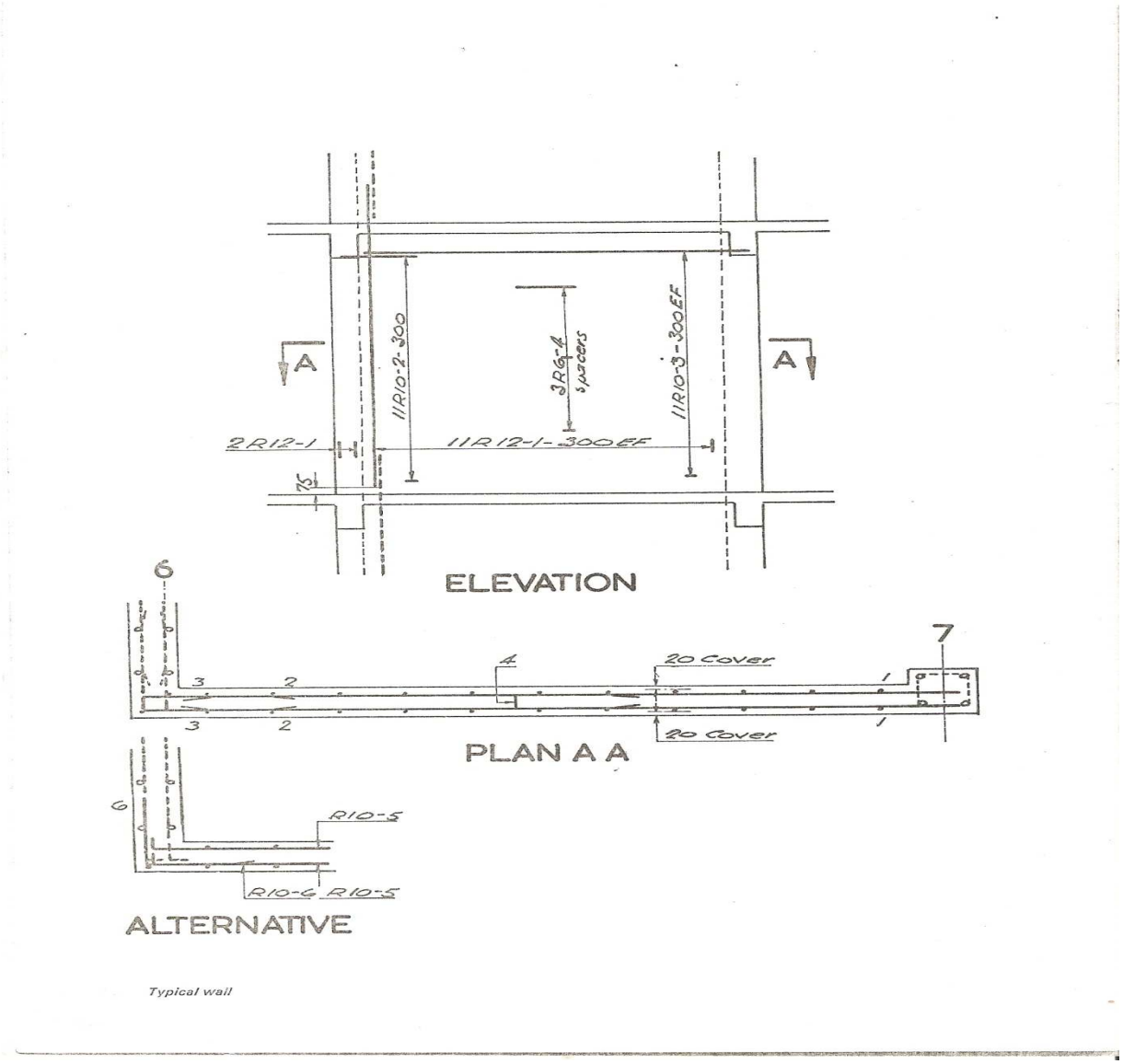


Fig. 13.1 Slab

COURSE WORK

Students to draw reinforcement details for slabs and walls and prepare their bar bending schedule sheet

WEEK FOURTEEN

14.1 USE OF COMPUTER FOR DRAWING

Students are to be introduced to computer aided drawing (CAD) and its use in the detailing of structural element

\

WEEK FIFTEEN

15.1 USE OF COMPUTER FOR DRAWING

Students are to be introduced to computer aided drawing (CAD) and its use in the detailing of structural element

Course Work

Students to be taken on excursion to civil engineering project sites