Solar PV System Installation and Maintenance

Level-II

Learning Guide -26

Unit of Competence	**Read and Interpret Plans and Specifications**
Module Title	**Reading and Interpreting Plans and Specifications**
LG Code	**EIS PIM2 M07 LO1 LG-26**
TTLM Code	**EIS PIM2 TTLM 01 20v1**

LO1:- Identify types of drawings and their functions

Instruction Sheet	Learning Guide:-26

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics

- Identifying the main types of plans and drawings used in the construction sector
- Identifying key features and functions of each type of drawing
- Recognizing Quality requirements of company operations
- Identifying the Environmental requirements *and controls*

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, **you will be able to:-**

- Identify the main types of plans and drawings used in the construction sector
- Identify key features and functions of each type of drawing
- Recognize Quality requirements of company operations
- Identify the Environmental requirements

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1, Sheet 2, Sheet 3, Sheet 4, Sheet In pages 3, 15, 25, and 26 respectively.
4. Accomplish the Self-check 1, Self-check 2, Self-check 3, Self-check 4 in pages 14, 24,27 and 29 respectively
5. If you earned a satisfactory evaluation from the "Self-check" proceed to Operation Sheet 1in page 30.
6. Do the "LAP test" in page 31.

Information Sheet-1	Identify types of drawings and their functions.

1.1. Introduction

Construction drawings are used to communicate the architectural and engineering design of a construction project. There are two types of construction drawings:

- Pictorial drawings and
- Orthographic projections.

Pictorial drawings are called 'renderings' and are used for presentations and are not intended to show construction details.

Orthographic projections are used in construction projects and show different views of the subject such as a building. Each view is taken from a different reference point and allows all the details of a structure.

The views used in construction drawings are the top, front, side, and back. The top view is called a 'plan drawing'. Front. Side, and back views are called 'elevations .A view of the interior of the building is called 'section or 'interior elevation'.

Reading construction drawings is the gathering of information from a drawing. It involves two principal elements: visualization and interpretation. Visualization is the ability to create a mental image of a building from a set of working drawings. A study of drawing reading principles and learning to sketch will help one visualize construction drawings. Interpretation is the ability to understand lines, symbols, dimensions, notes, and other information on the working drawings.

I. Type of drawings

Drawings are usually arranged in the approximate order of construction. A set of drawings consists of: Civil(C-1,C-2,etc),Structural(S-1,S-2,etc) ,Architectural (A-1,A-2,etc), Electrical (E-1,E-2,etc), Mechanical(M-1,M-2,etc), and Plumbing (P-1,P-2,etc).

Civil engineering drawings (C) include plot or site plans, utilities, easements, grading, and landscape details. The site plan can also include contour lines, walks, driveways, property lines, Building setbacks, and utility locations Structural drawings (S) include foundation, structural steel, building support system, and roof framing system along with sections and details.

Architectural drawings (A) include floor plans, elevations, building sections, door and window schedules, and room finishes. The floor plan is an important drawing because It provides the most important information and acts as a reference for the location of additional sections and details. The floor plan shows floor finishes, walls, doors, stairways, fire places, built-in cabinets and mechanical equipment. The floor plan is an important drawing because It provides the most important information and acts as a reference for the location of additional sections and details. The floor plan shows floor finishes, walls, doors, stairways, fire places, built-in cabinets and mechanical equipment.

Elevations are views of the exterior features of the building .Usually a minimum of four elevation drawings is needed to show the design of all sides of the structure.

Sections ae views showing the building as if It were cut apart. They show walls, stairs and other details not clearly shown in other drawings. Sections taken through the short dimension of a building are known as ‘transverse.

Detail drawings are prepared for complex building components and unusual construction such as an arch a cornice a structural steel connection or a retaining wall. Schedules are lists of materials needed in the construction process. A schedule normally lists the item, an identification mark, size, number required, and any other useful information. Different type of schedules include: door schedules, window schedules, lighting fixture schedules, and room finish schedules.

The Electrical drawings (E) include the electrical wiring, lighting plan, reflected ceiling plan, and panel schedules.

The Mechanical drawings (M) include heating, ventilating, and air conditioning (HVAC) plans, plumbing plans, sprinkler systems, and schedule for pipe and fittings, HVAC equipment, and plumbing fixtures.

The plumbing plan (P) shows the layout for the hot and cold water systems, the sewage disposal system, and the location of plumbing fixtures. Structural framing plans (S) may be included in a set of plans for .The framing of the roof, floors, and various elevation or wall sections.

.READING MEASURING TOOLS

Tools used in construction industry are: framing squares, bench rules, steel rules, and tapes. In the customary (also called English) measurement system, the distances are divided into feet, inches, and fractions of an inch. The rule used with this system is called ‘fractional rule’. In metric system, the divisions are in meters, centimetres, and millimetres. This rule is called ‘metric rule’.

1. Fractional rule –This rule is divided into 16ths. See Figure II.1. In this figure, the inch is divided into 16 parts. Thus, each Small division is 1/16th of an inch.

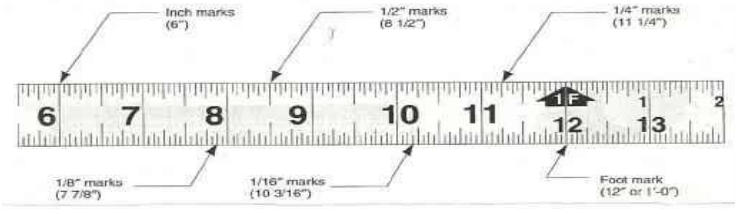

Figure 1: Measuring Tape

2 Metric rule – The basic unit of linear measure in the metric system is the meter (m).Other linear units are either fractions or Multiples of a meter. The most common units are the following:-

Unit	Abbreviation	Equal
Millimetre	mm	1/1000 th m
Centimetre	cm	1/100 th m
Kilometre	km	1000m

Metric dimensions are better to work because they can be added or subtracted more easily than English units. However, the customary system is used almost exclusively In this country. The relationship between the customary and the Metric systems is given below

1 inch = 25.4 millimetres

1 foot = 304.8 millimetres

1 yard (3feet) = 914.4 millimetre

39.37inches = 1 meter

Figure 2: illustrates the above relationship

3. LINES AND SYMBOLS

III.1. Lines - several types of lines are used in construction drawings. These are known as 'alphabet lines' all lines are drawn in the same colour. Some vary in width. Some are solid, others are a combination of broken lines .Each conveys a different meaning.FigureIII.1 illustrates some common lines and are explained below.

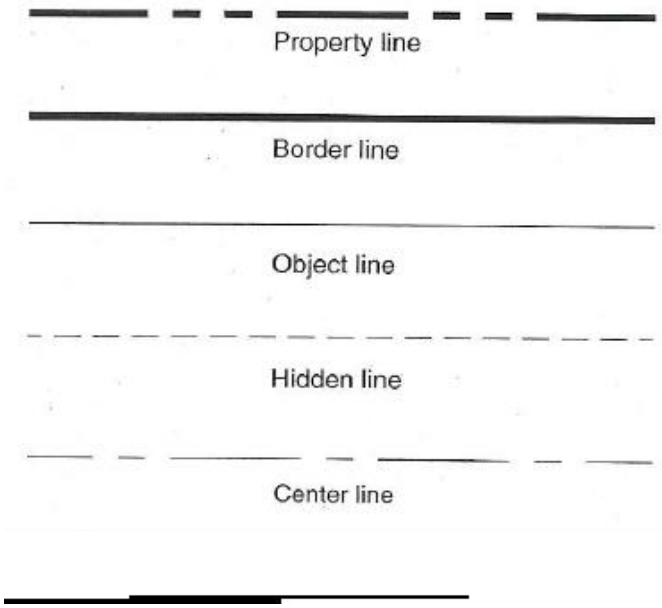

Figure 3: Common Lines

Property line – The property line is an extra heavy line made up of long dashes and alternating with two short dashes.

Border line –Border lines are located near the edge of the sheet of the drawing paper. They are also used to separate the various portions of the drawing such as the title block, notes, and the revision block.

Object line – Object lines represent the main outline of the features of the object, building, or walk .The object line is a heavy, continuous line showing all edges and surfaces.

Hidden line – Hidden lines are medium-weight and are composed of short dashes. They define edges and surfaces that are not visible in a particular view. One must look for another view in the set of drawings to find where these edges occur. Hidden lines are omitted if they do not clarify the drawings, equipment, and fixtures.

The centre line is also used to indicate a finished floor line. The line is light in weight and composed of alternating long and short dashes.

Dimensioning and extension lines – Dimension and extension lines are thin lines that indicate the extent and direction of dimensions. See Figure 4 for an illustration.

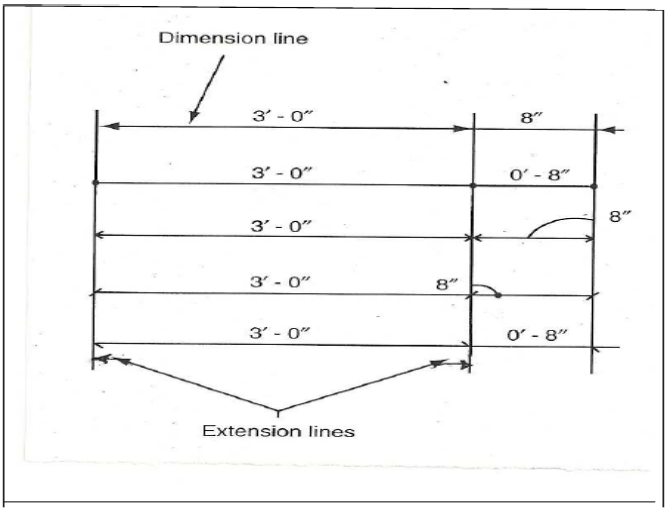

Figure 4: Dimension and Extension lines

Dimension lines extend the length of the distance being measured. A marking device such as an arrow, dot or tick mark, is placed at the end of the dimension line.

Extension lines are drawn perpendicular to the dimension line to specify the features between which the dimension applies.

Break lines – Break lines are used to indicate that an object continues but is not shown on the drawing or to indicate that the object's full length is not shown to save space. See Figure III.3 for an illustration

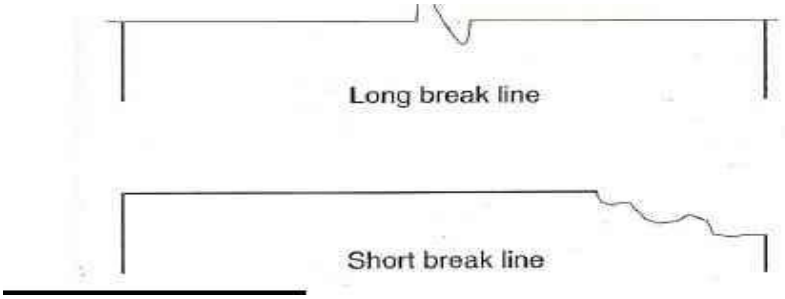

Figure 5: Break Lines

Section cutting lines –Section cutting lines are used with sectional views

See FigureIII.4 for an example.

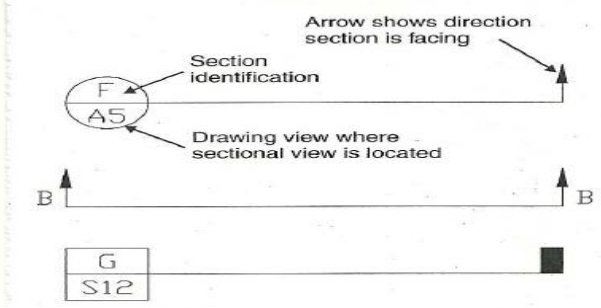

Figure 6: Section cutting lines

A section cutting line marks the part of the drawing being “cut” to create a sectional view. Arrows on the end of the line indicate the direction from which the section is being viewed. If the sectional view is on another drawing, the drawing number is included with the section identification

Section lines and rendering –Section lines, also called ‘crosshatch lines’ are thin lines, usually drawn at a45^0 See Figure 7angl.5 for an example.

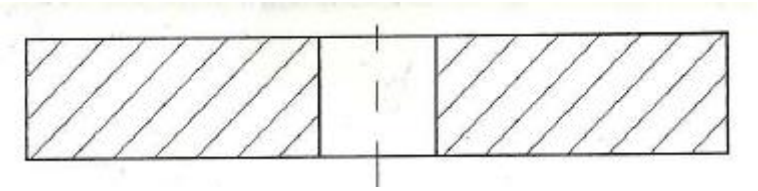

Figure 7: Section line

They are used in a sectional view to show material that has been “cut” by the cutting-plane line.

III.2. Symbols –A number of symbols are commonly used on construction drawings. These symbols represent building materials and fixtures. Normally, symbols are identified in a legend which is a list of symbols and their corresponding meanings. Figure III.6, shown in the next three pages, exhibits the different symbols.

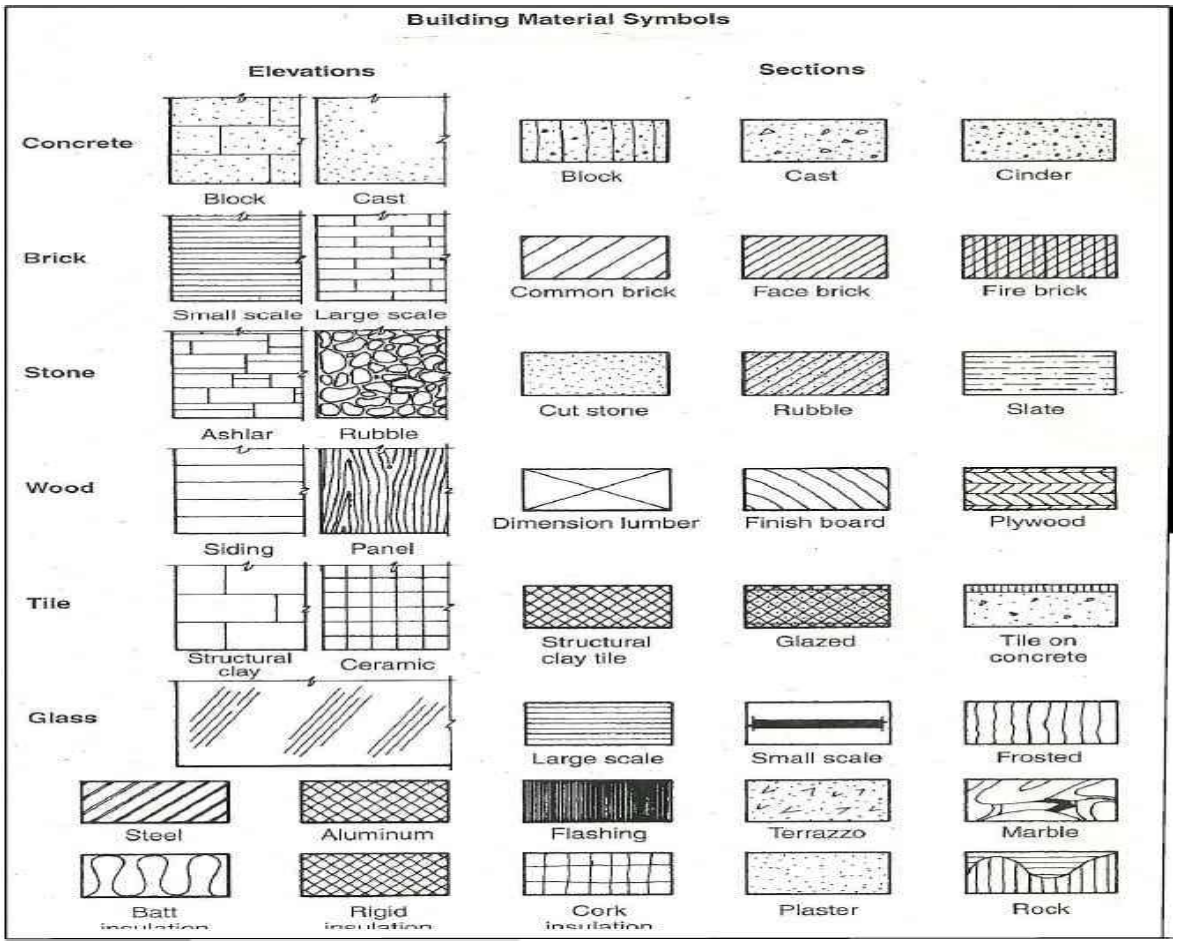

Figure 8: different symbols

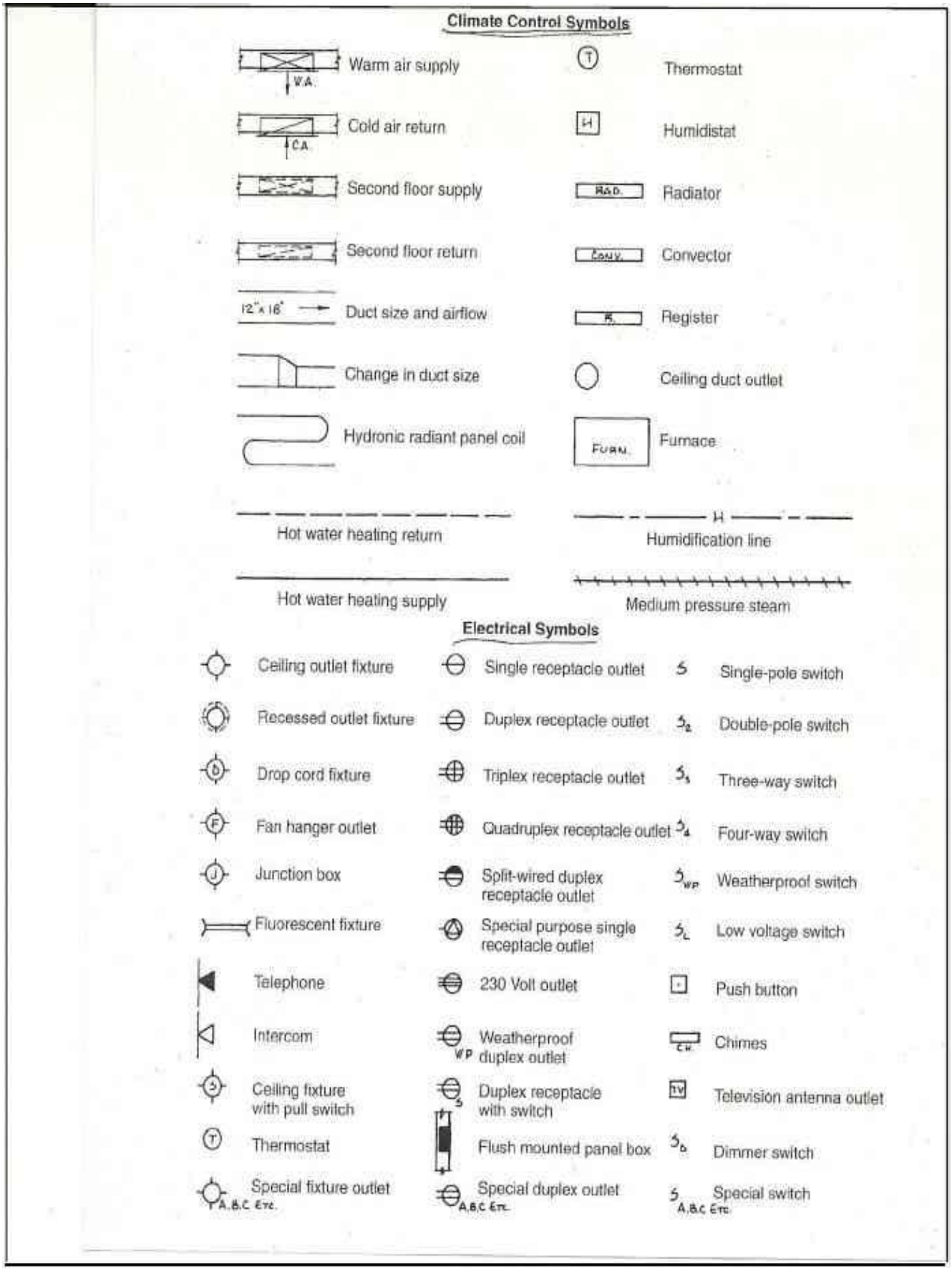

Figure 9: List of Symbols

IV. ORTHOGRAPHIC DRAWINGS

Nearly all drawings used on a construction project are orthographic drawings. They are preferred because more details can be shown. These drawings are created using Orthographic projection, a process by which an object or structure is described using various views. Each view defines one face, or side, of the object. The views of an Orthographic drawing are projected at a right angle (90^0)to each other. The best way to visualize this is by cutting and unfolding a cardboard box as Shown in Figure 10.

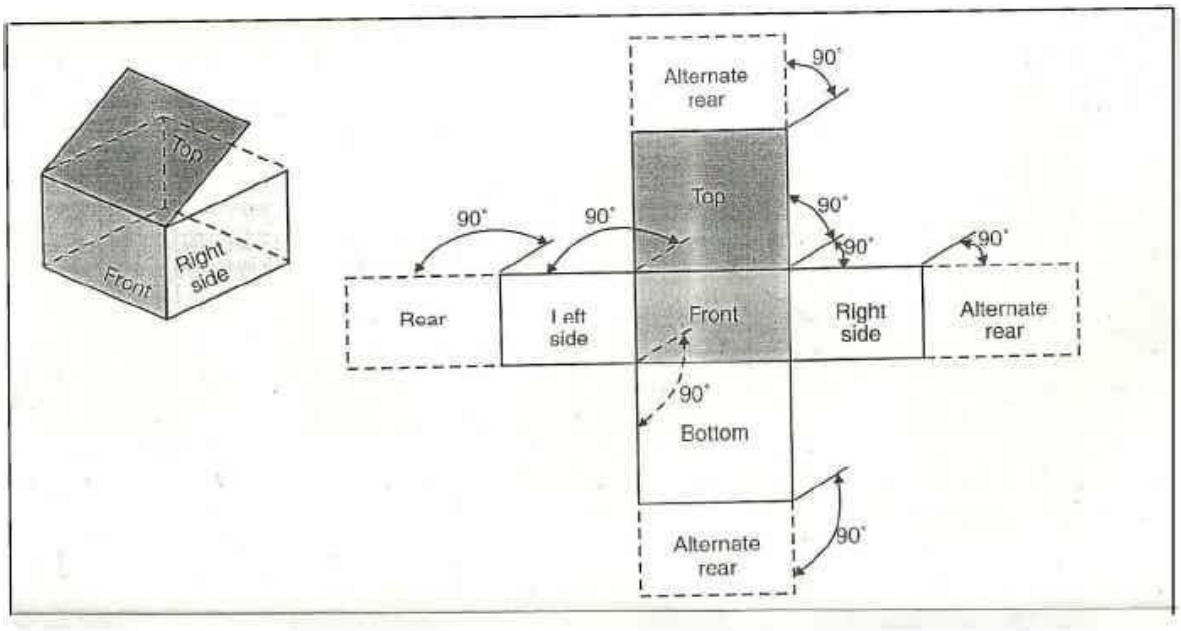

Figure 10: Projection of Orthographic Views

The front view remains in position. The four adjoining views revolve 90^0 around the "folds" bringing them into the same plane as the front view. The rear view is shown next to the left side view, but it could be shown in several alternate positions, as indicated .If an object is placed inside a glass cube and viewed through any of the cube's six sides, only one face of the object can be seen .Each view through aside of the cube would create one orthographic view as shown in Figure 11

IV.1. Creating orthographic drawings

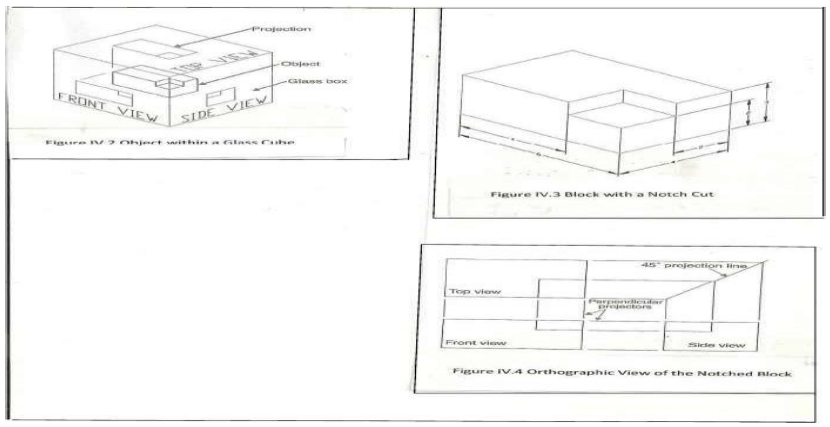

Figure 11: Creating orthographic drawings

Figure 11 shows an object within a glass cube. The cube has six sides and if the object is viewed through any of the sides, only one face of the object would be seen. Each view through the side of the cube would create one orthographic view. Figure IV.3 shows a block with a notch cut into one corner. The orthographic drawing of the block is shown in Figure IV.4. Referring to this figure the procedure listed below is followed for creating an orthographic drawing.

1. Begin by drawing the front view. All views should be drawn to scale. Select the Object's position so that most of the features are located on the front, side, and top. At every edge and feature shown on the front view, perpendicular projectors are drawn in the vertical and horizontal directions. These construction lines are drawn lightly, and erased when the drawing is complete. Draw the top and side views. The projection lines connect common features between views. From the front edge of the top view, draw a horizontal projection line. Draw a vertical projection line from the front edge of the side view.

2. At the intersection of these lines, draw a line at a 45^0 angle. Projection lines for features common to the top and side views will intersect at this line.

IV.2. Construction drawing – For construction drawings, different views of the building such as floor plans and elevations are obtained using orthographic projection.

IV.2.1. Plan views – The top view of the building is called a 'plan view'. Plan views are taken at different levels throughout the building. In complicated buildings, each floor may require multiple plan views to illustrate all construction details.

IV.2.1.1. Floor plan – The floor plan shows the layout of the building and shows walls, doors, windows, rooms, and stairs. Other items such as plumbing and electrical can also be shown if space is available. Floor plans are drawn usually to scale 1/48 or 1/4" = 1 -0". A separate drawing is made for each floor including the basement.

IV.2.1.2. Foundation plan – The foundation plan is similar to the floor plan, except it shows the foundation of the building and includes basement, foundation walls, slabs, piers, and footings.

IV.2.1.3. Framing plan –Framing plan shows the layout of the structural members supporting a floor or roof. A framing plan is often included for each floor. If there is room, detail drawings of the connections between members may be included.

IV.2.1.4. Electrical plan – Electrical plan includes location of receptacles, switches, and fixtures. Another type of electrical plan, the 'reflected ceiling plan' includes ceiling-mounted light fixtures.

IV2.1.5. Plumbing plan – The plumbing plan shows heating and circulating equipment, supply and waste systems, plumbing fixtures, and the spot where the water pipe enters the building.

IV.2.1.5. Mechanical plan – A mechanical plan shows the heating, ventilating, and

Air conditioning system (HVAC) and any mechanical equipment and systems located in the building.

IV.2.2. Elevations – Elevations are orthographic, exterior views of a building and show

Features such as the style of the building, doors, windows, chimneys, and mouldings. Elevations are designated as 'Front', 'Right', 'Left', and 'Rear'. They may be also identified by the plan direction that the elevation faces such as 'East elevation' and 'West elevation' etc.

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IV.2.3. Sections – Besides the plans and elevations, it may be necessary to show the "inside "of A wall, cabinet, or roof structure to clarify construction procedures. When the drawing is an imaginary "cut" through a wall or other feature, it is known as sectional view or section. Sections are provided for walls, cabinets, chimneys, stairs, and other features whose construction is not shown clearly on the plan or elevation. Figure IV.5, shown below, is an example of a sectional view showing construction details.

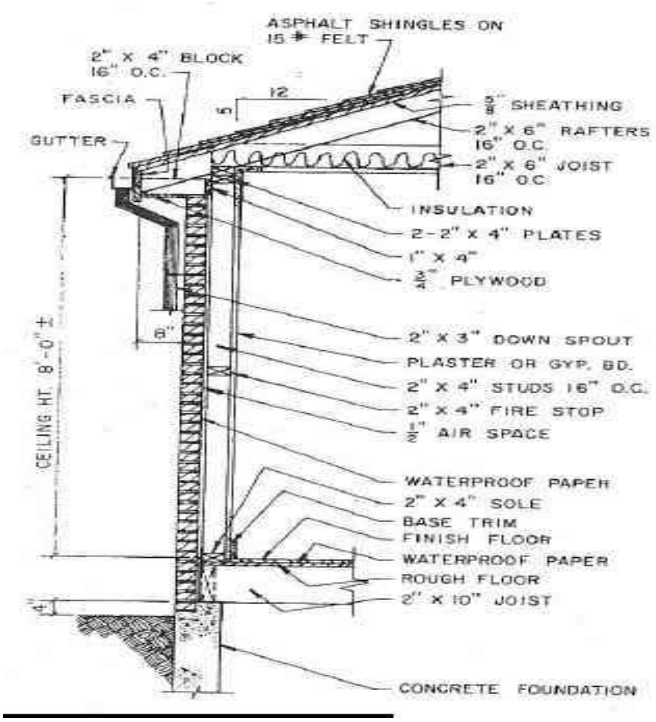


Figure 12: Sectional View

IV.2.4. Details – Due to the scale at which construction drawings are usually made, certain features are not clearly shown on the plan, elevation, or sectional views. These features will require a large -scale illustration to provide information necessary for construction. In these situations a detailed drawing is used. Details are drawn at a larger scale than plans, elevations, and sections and usually take precedence over drawings shown in less detail.

Figure IV.6 is an example for a detail drawing. Detail drawings may be placed on the same sheet as the plan or elevation views or on a separate sheet and referenced by detail and sheet number.

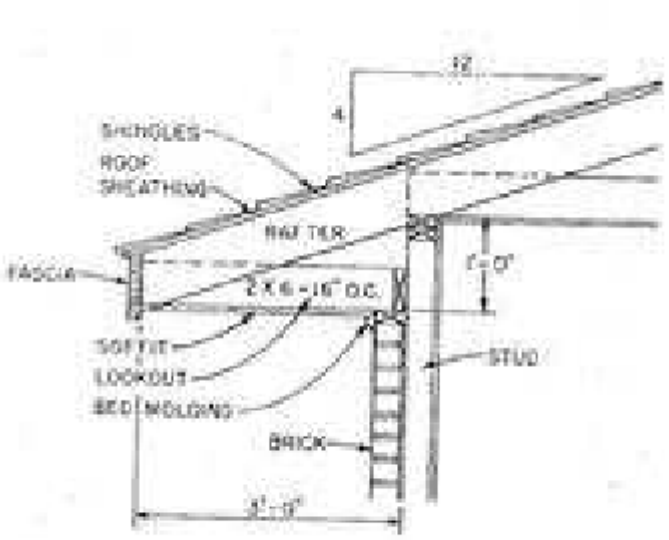


Figure 13: Details of a Cornice

Self-Check -1	Written Test

I. Choose the best option.

-----1. An extra heavy line made up of long dashes and alternating with two short dashes.

a. Border line b. Object line c. Hidden lined. Property line

-----2. Lines located near the edge of the sheet of the drawing paper used to separate the various portions of the drawing such as the title block, notes, and the revision block.

a. Border line b. Object line c. Hidden line. d. Property line

----3. . Represent the main outline of the features of the object, building, or

Walk; heavy, continuous line showing all edges and surfaces.

a. Border line b. Object line c. Hidden line . d. Property line

----4. Lines with medium-weight and are composed of short dashes

A .Border line b. Object line c. Hidden line d. Property line

Note: Satisfactory rating – 2 and above points Unsatisfactory - below 2 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Identifying key features and functions of drawings

2.1. SITE PLAN

The site plan is a vertical plan view of the building site or allotment. It identifies the location, shape, size and orientation of the construction site, and the position of the building or buildings on the site. It may also give other details such as:

- Real property description. (R.P.D.)
- Area of allotment.
- Access roads.
- Service points.
- Contour lines.
- Significant physical features.
- Storm water drainage

The North point is always shown on the site plan to show the orientation of the site and the

Building/s. Site plans are usually drawn to a scale of 1:200 with dimensions given in metres to two (2) decimal places. Refer to Figure 2, and study the site plan and the information it conveys.

Figure 9 is a simple site plan used for orientation purposes only. The North point is indicated and from this you can determine the North, South, East and West boundaries likewise the North, South, East and West sides of the building.

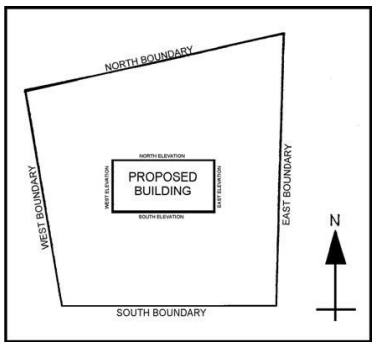


Figure 14: site plan

Only With reference to Figure 10 you will notice that it not only shows the distance the proposed office building is from the boundary lines but also the sewer main, sewer connection, underground power connection and the access drive to the adjacent street.

The position of a proposed future extension is shown in the North East corner. The example site plan shown in Figure 11, in addition to other information, indicates a datum set out point and contour lines. From the contour lines you can determine the fall of the

allotment which in this case falls 2.1m, along the East boundary from North to South and 0.5m along the South boundary from West to East. You can also determine that the finished floor level (F.F.L.) is to be 1400 above the datum set out point.

Figure 15: Examples of various site plans

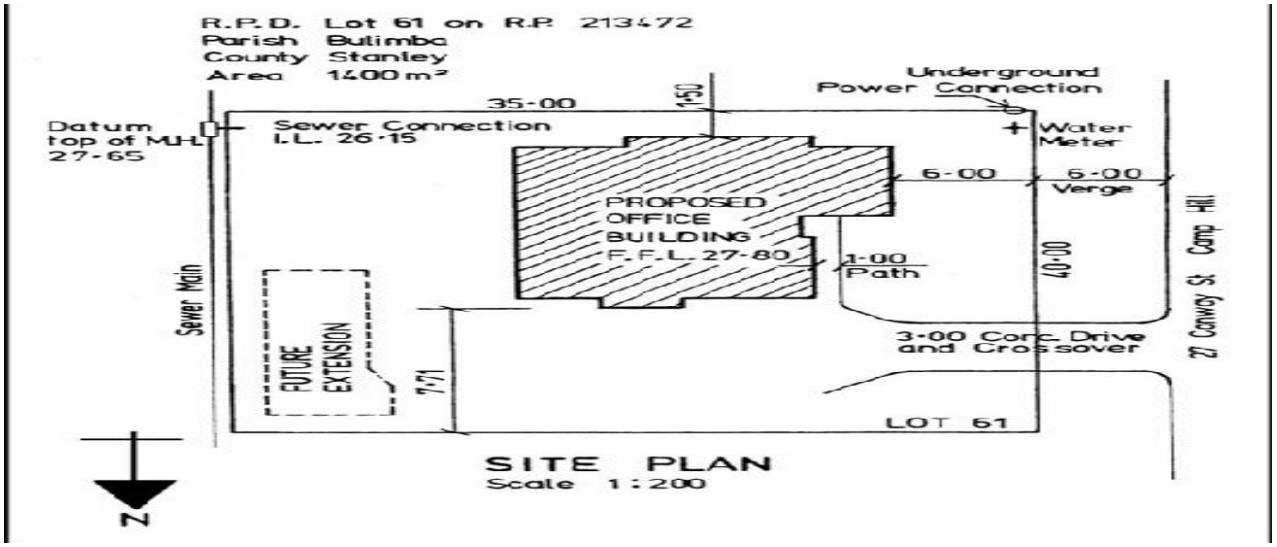


Figure 16: sit plan

2.2. FOUNDATION PLAN

The foundation plan shows:

- Thickness and width of all footings whether strip or isolated
- Thickness of foundation walls
- Size of columns and concrete slab
- Thickness of concrete slab
- Thickness and width of slab thickening - when required to support load bearing walls.

The size and type of reinforcement for concrete footings and slabs is often stated adjacent to the foundation plan. Foundation plans are drawn to a scale of 1:100 and any dimensions are in millimetres. Figure 12 is an example of a typical foundation plan for a brick veneer dwelling.

Note the reference to the construction of the concrete footing and slab.

Other examples appear in Figures 2 and 6.

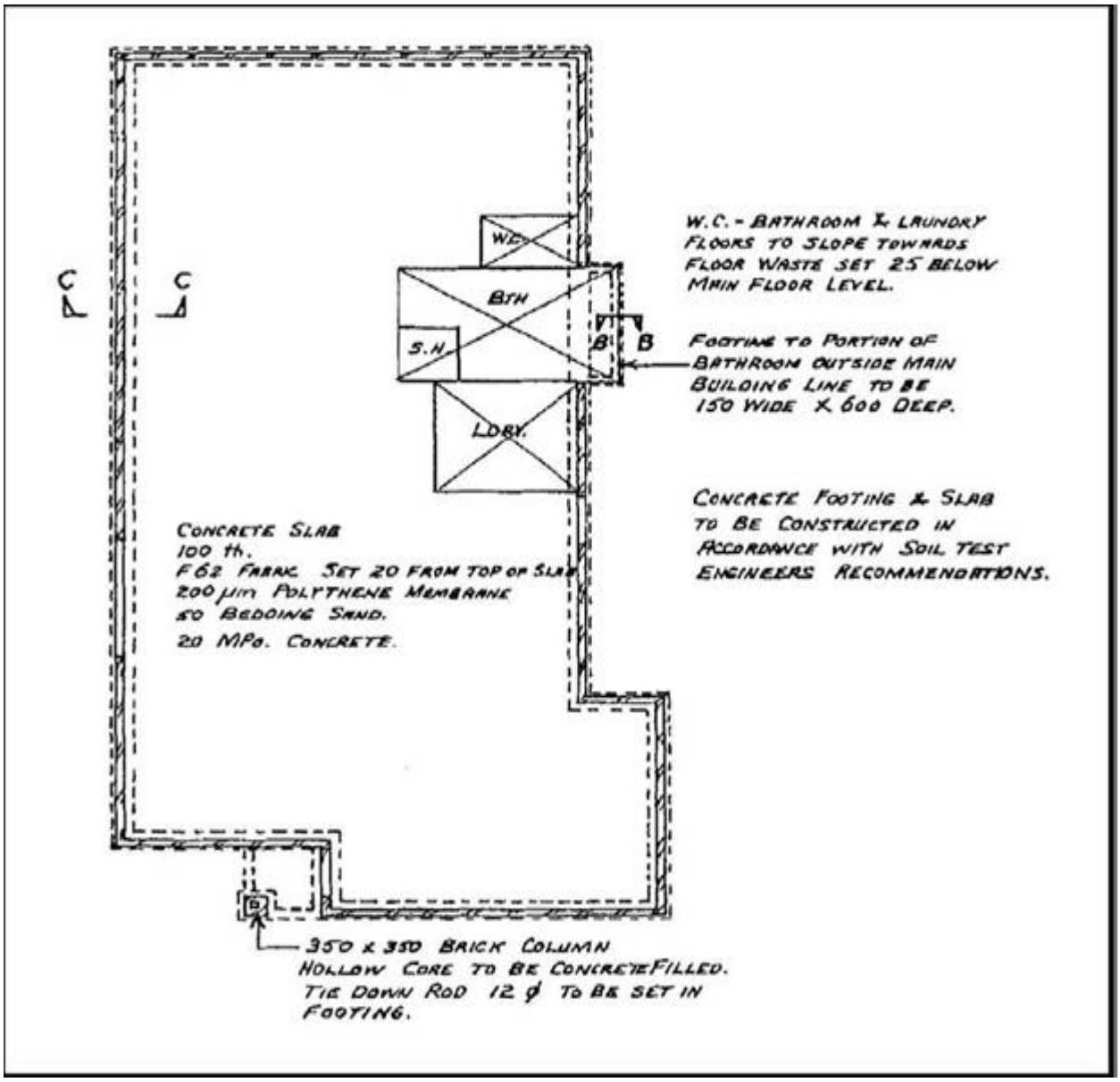


Figure 17: fundamental plan

2.3. FLOOR PLANS

This plan usually gives more information than any other part of the working drawings and includes:

• Overall shape and size;

• Dimensions of individual rooms, patios, verandas etc.;

• Thickness of walls, external and internal;

• Position of openings, windows and doors;

• Roof outline; and

• Position of hanging and strutting beams if applicable.

Floor plans are usually drawn to a scale of 1:100 with the dimensions given in millimetres.

Figure 13 is an example of a floor plan for a timber-framed dwelling sheeted externally with a material other than brick veneer.

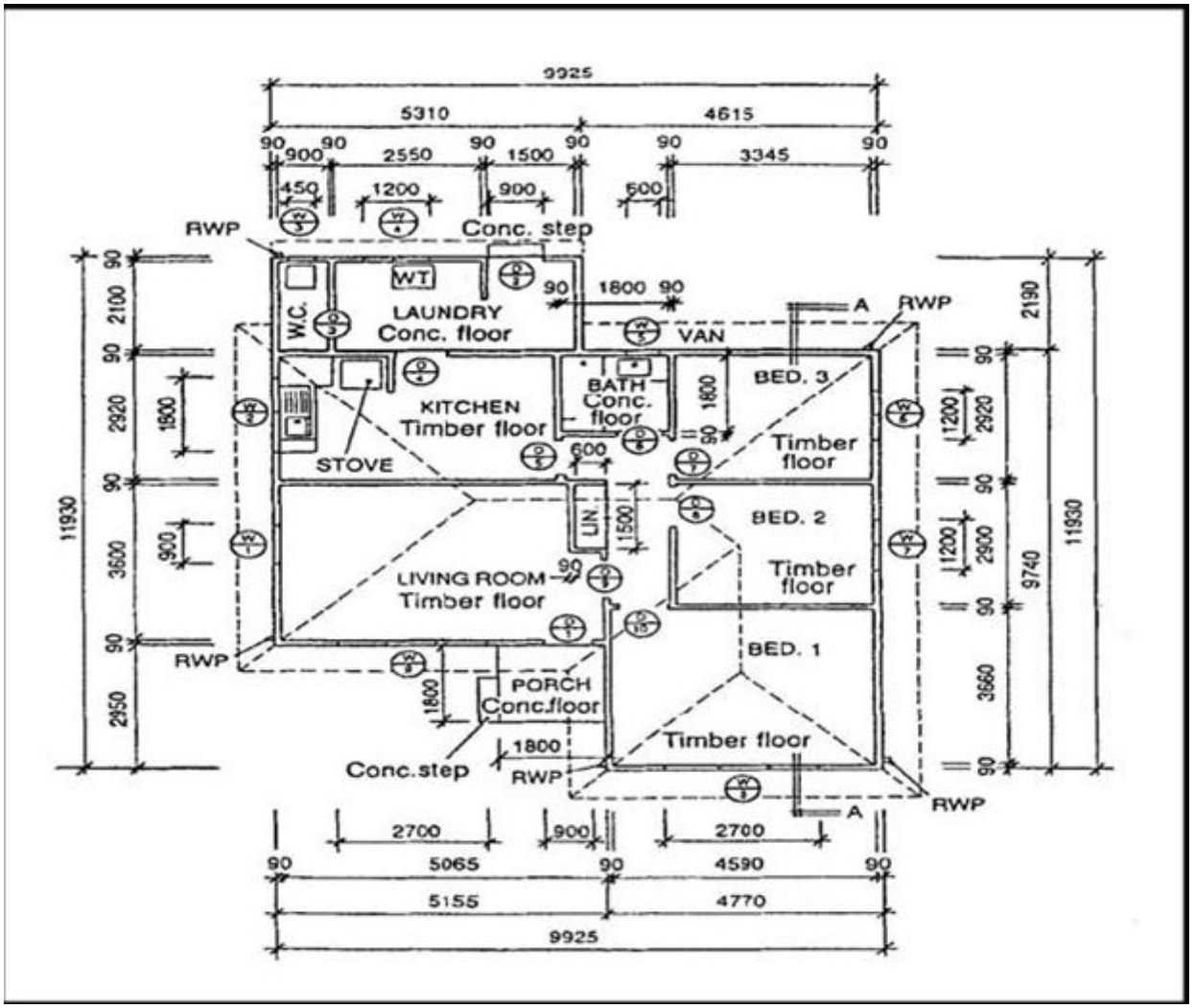


Figure 18: Floor plans

2.4. ELEVATIONS

Most Local Authorities require elevations of the four (4) sides of a dwelling as part of a set of working drawings .Each elevation is named according to the direction it faces for example NORTH, SOUTH, EAST or WEST ELEVATION.

Information shown on or adjacent to elevations is:

- Windows and doors to external walls
- External cladding for example, brick veneer, chamfer boards, fibre cement etc.
- General roof shape and slope (pitch)
- Roof overhang
- Handrail heights to verandas if applicable

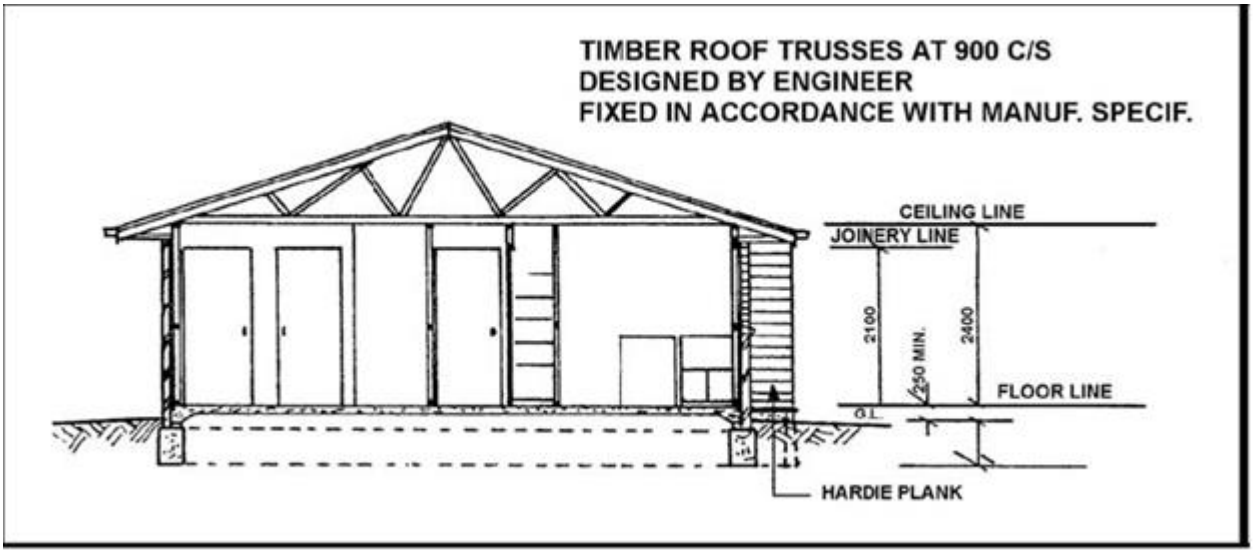


Figure 19: section A, Dwelling

2.5. SECTION DETAILS

These views are used when it is not possible or practical to show specific constructional details on small scale drawings, for example: 1:100 or 1:50 details are usually drawn at scales of 1:20, 1:10 or 1:5 for more accurate drawings the scale maybe 1:1 or 1:2.Figure 16 is a vertical section showing details of the footing and floor slab junction.

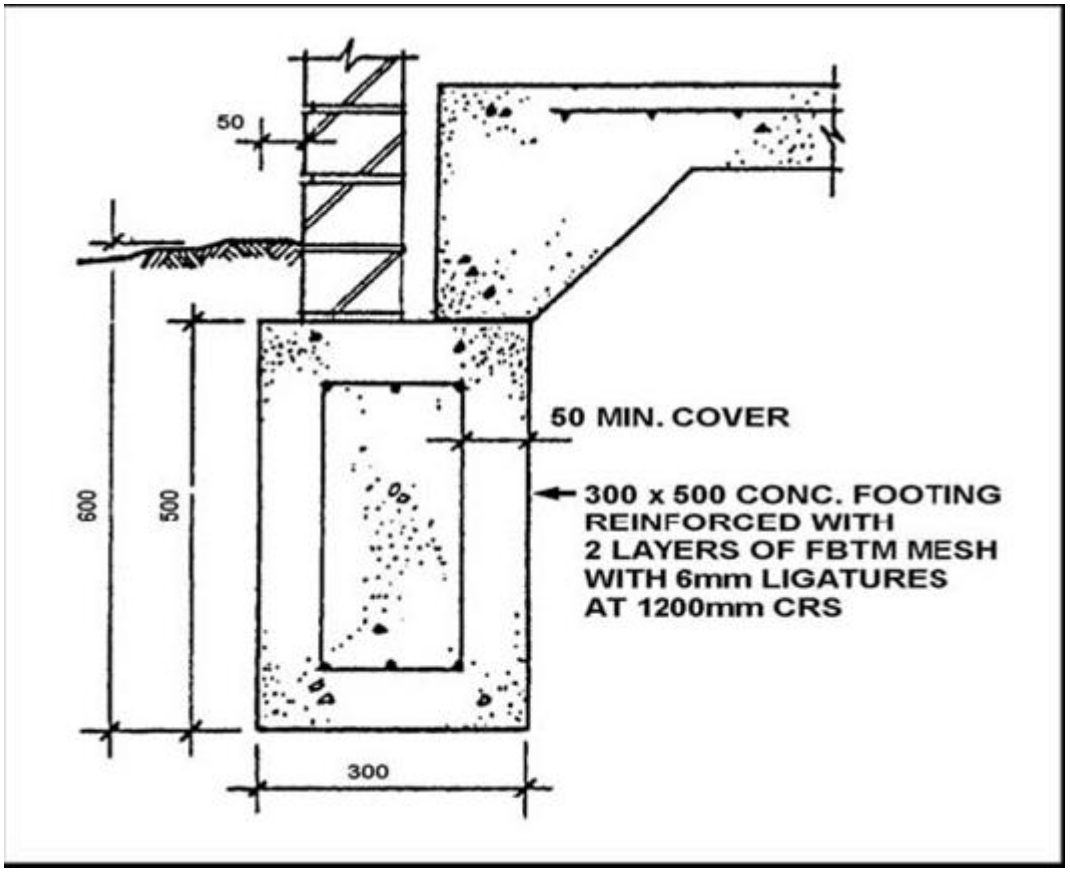


Figure 20: Section B—B footing

2.6. Orthographic Projection

Everyday objects have three (3) dimensions, for example:

- Length
- Breadth or width
- Height.

All of the objects in Figure 20 can be represented pictorially, but the drawings can get very

Cluttered when additional information is added, so another method is used where the object is

Represented by drawing a series of different views. This is called orthographic

Projection

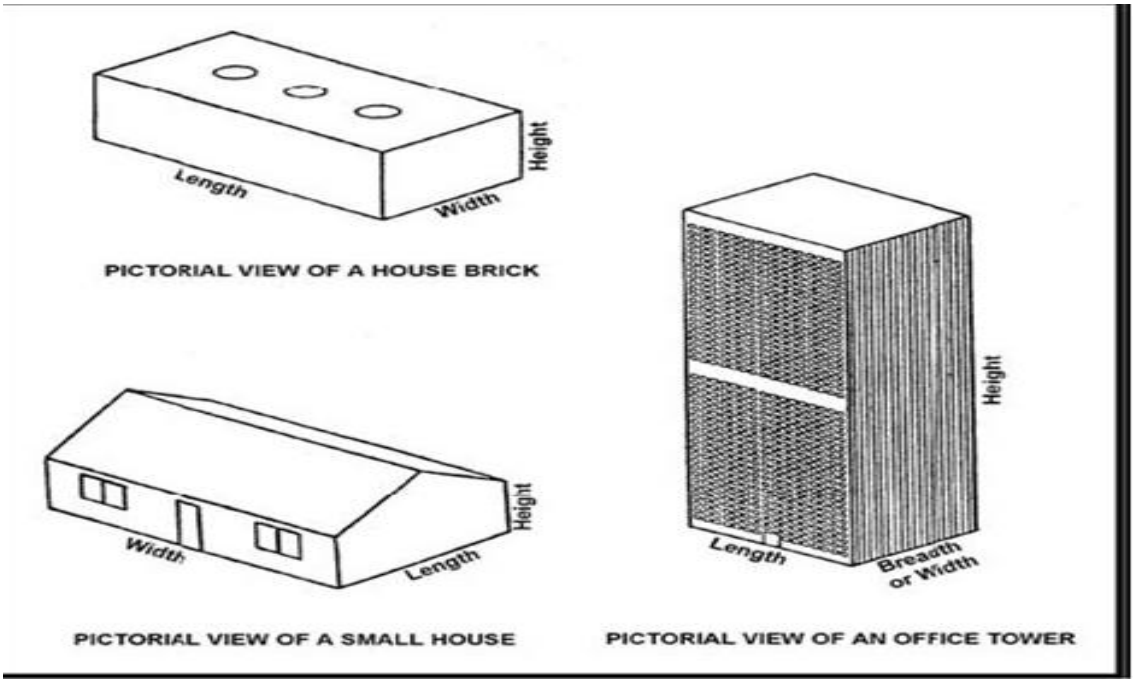


Figure 21: Orthographic projection

Orthographic projection involves drawing three different views of an object.

These are: More views may have to be prepared. This will depend on the complexity of the object

- Front view or front elevation;
- Side view or end elevation; and
- Top view or plan

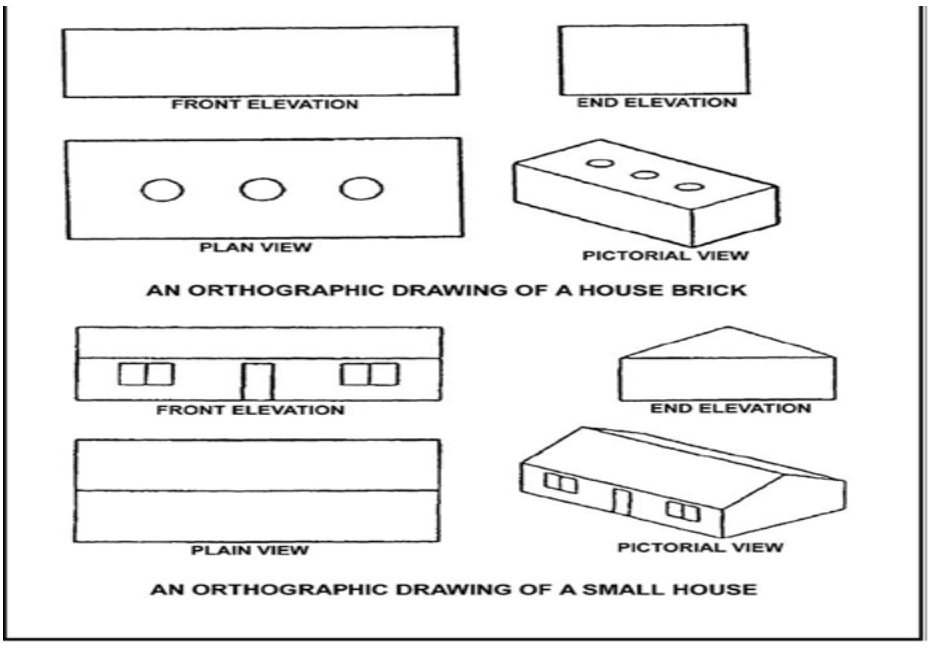


Figure 22: Orthographic views

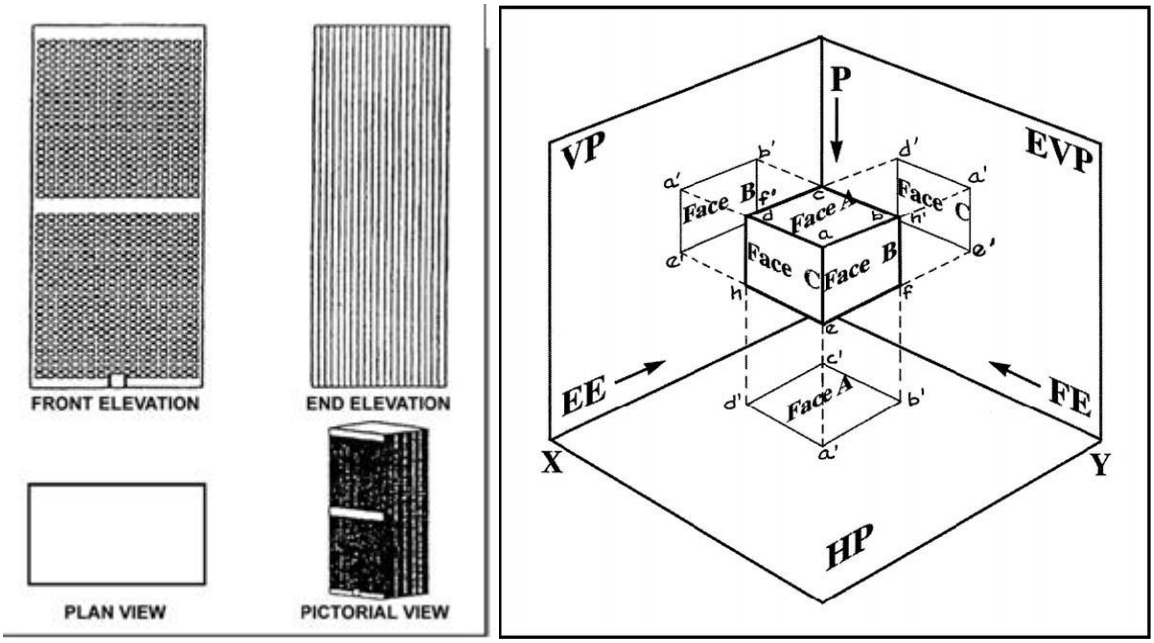


Figure 23: Orthographic drawing of office tower

- **Legend:**

HP -Horizontal Plane VP -Vertical Plane EVP -End Vertical Plane P -Plan FE -Front Elevation

EE -End Elevation

- **Orthographic Projection Procedure**

Orthographic projection is the drawing of plans and elevations on horizontal and vertical planes by projecting lines perpendicular to the respective plane from every point of the object. Working drawings consist of as many views as are necessary to completely define the object.

Figure 23 is a pictorial view of first angle projection, which is used in the building and construction industry. The engineering industry uses third angle projection, which you may have used if you have previously studied a drawing subject

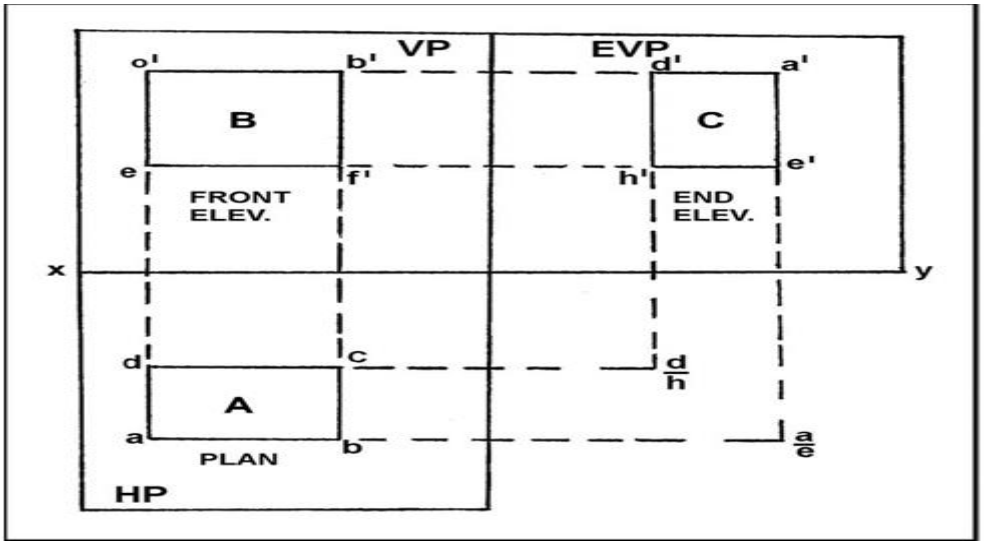


Figure 24: Plane laid out as a flat surface drawing sheet

Each view is one of a group of drawings arranged so that they fully describe the object. In many cases showing three views is sufficient, but depending on the object, four or more Views may be needed to fully describe the object. The views shown, in *Figures 24* and *25* show respectively pictorial and orthographic views of a garage. This type of drawing, **orthographic**, is better than other types of representation because it gives the necessary information to enable the object/building to be constructed. It allows dimensions and details to be shown without making the drawing cluttered with information as you would get in pictorial views.

In orthographic drawing we get:

- ✓ A view showing the top surface, the plan
- ✓ A view showing the front surface, front elevation
- ✓ A view showing the end surface, end elevation

In plans for the construction of dwellings the elevations are usually designated as North, South, East and West. The side of the building facing the cardinal points of the compass are given that respective title. Refer to Figures 26.

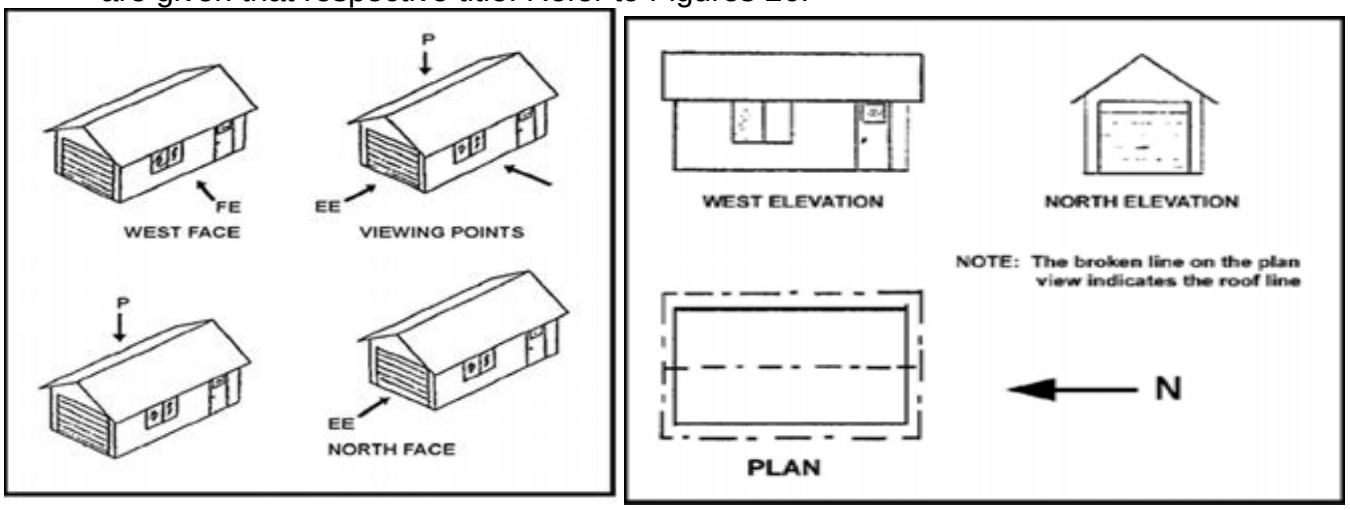


Figure 25Pictorial views – Garage

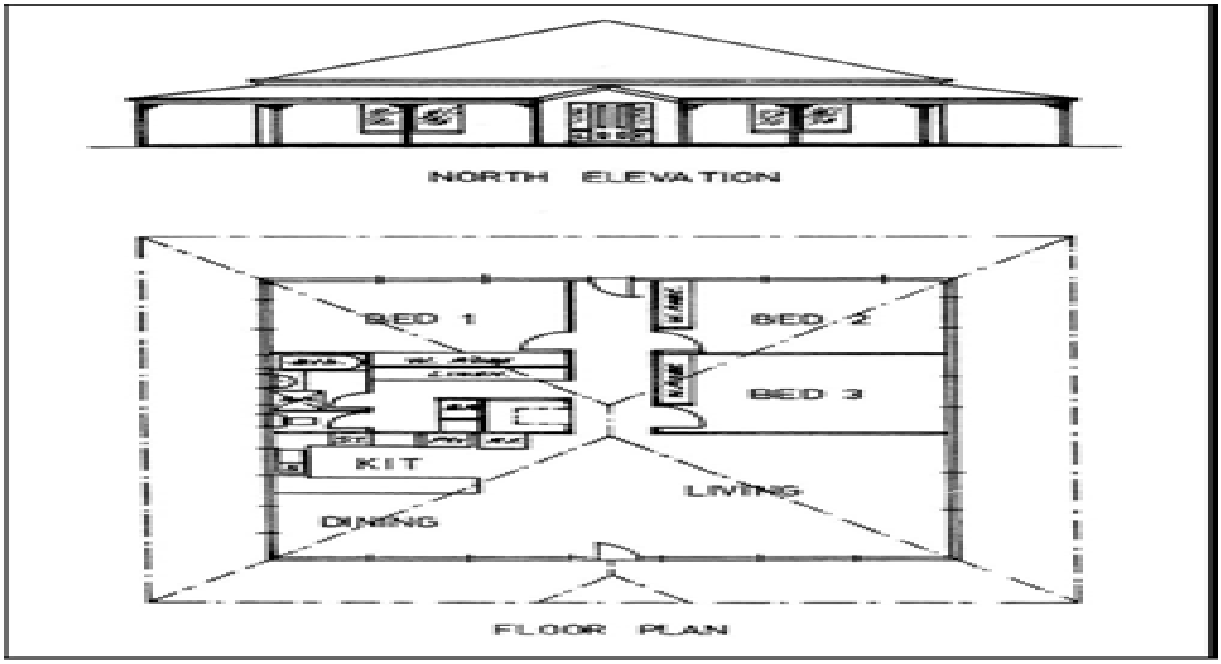


Figure 26: orthographic views –garage

Self-Check -2	Written Test

1. Match column B to column A

A	B
-----1. Site plan	A. Shows area of allotment
-----2. Foundation plan	B. Shows over all shape and size
-----3. Floor plan	C. Shows size of columns and concrete slabs
-----4. Orthographic drawing	D. A view showing the top surface, the plan

Note: Satisfactory rating – 2 and above points Unsatisfactory - below 2 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-3	Recognizing quality requirements of company operations

3.1. Introduction

Quality assurance is important in the engineering and construction industry because of the risk involved in any project. The risk involved in not completing the project on time is high, because many external factors will affect the performance of the project. It is vital that a built-in quality assurance system is developed to avoid any in- efficiency that could result in poor quality of products and service being delivered to the customer. Everyone involved in the engineering and construction business has, in different ways, benefited from a common approach to quality work. Systematic quality work reduces the costs of failure in one's own work and in the final product. The standards can make quality work more efficient by creating uniformity. A contractor's in-house quality assurance system is of utmost importance; it prevents problems and their reoccurrence and allows his or her clients to relax.

One of these quality system standards is the ISO 9000 standard, which has been adopted by a large number of countries around the world and is applied in various industries including engineering and construction

Quality systems involve internal and external aspects .An internal quality system covers activities aimed at providing confidence to the management of an organization that the intended quality is being achieved. This is called a ''quality management system.'' Successful implementation of quality management systems can contribute to an increase in product quality, improvements in workmanship and efficiency, a decrease in wastage, and in- creased profit.

An external quality system covers activities aimed at inspiring confidence in the client that the supplier's quality system will provide a product or ser- vice that will satisfy the client's quality requirements. This is called a ''quality assurance system.'' The quality system can work effectively only when the top executive responsible for engineering or production takes full responsibility for interpretation and implementation of the quality assurance program. A contractor's quality assurance system is very important to her/his clients, who will gain confidence that ''getting it right the first time'' will be the contractor's norm.

ISO 9000 is an international standard intended to provide the generic core of a quality system standard applicable to a broad range of industries and economic sectors. It outlines how a supplier can establish an effective quality system that will demonstrate commitment to quality and ability to meet customer requirements.

ISO 9000 is based on, and is almost identical to, the American National Standards Institute/American Society of Mechanical Engineers (ANSI/ASME) NQA-1, Quality Assurance Program Requirements for Nuclear Facilities, 1989 (Reedy 1994).

The acceptance of ISO 9000 standards in the construction industries is not as wide as in other industries, such as manufacturing. There are special features in the construction industry that limit the implementation of the ISO 9000 standard. The following are some of these features (Phenol 1994; ''Quality'' 1992):

• A construction project is usually a unique collection of people, equipment, and materials brought together at a unique location under unique weather conditions, while most manufacturing is a system of mass production wherein all of these factors are consistent with producing typical products over and over again.

• Performance testing in construction is generally not feasible as a basis for acceptance.

• It is common to have separate contracts for design and construction.

• It is not feasible to reject the whole constructed project after completion while attached to the purchaser's land.

• Decisions to reject a defective part of a constructed project need to be taken promptly before succeeding parts are constructed or installed.

• The number of parties involved in the constructed project's procurement are more than those involved in manufacturing procurement. Achieving quality construction requires effort from all parties. This makes the interface and responsibilities of the various individuals and organizations more complicated than in manufacturing.

• The organizational structure of a construction company varies depending on the nature of the project, while the same structure in a manufacturing company is almost unchanging. This affects the smoothness of communication and interface between the responsible individuals.

• Turnover of manpower in construction is higher than in manufacturing, which affecting the precision of long-term plans.

• Construction projects are very complicated and their execution may take years.

The generic nature of the standards often leads to differences in interpretations. In turn the implementation, use, and impact of ISO 9000 standards can vary from company to company and from country to country. The concept of ISO 9000 has been viewed in various ways; as a means of improving the overall quality of operations; as the requirements of customers to be complied with; as a necessary response to competition; as a way to reduce cost; as a means to improve the flow of activities and coordination in the organization; as a strategy to have better sales through an improved quality image; as a way to maintain competitive edge in the industry, etc.

Self-Check -3	Written Test

Read the following statements and write True or False

1. Systematic quality work reduces the costs of failure in one's own work and in the final product
2. Successful implementation of quality management systems can contribute to an increase in product quality, improvements in workmanship and efficiency.
3. Unsuccessful implementation of quality management systems can contribute to a decrease in wastage, and increased profit

Note: Satisfactory rating – 2 points and above Unsatisfactory - below 2 points

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-4	Identifying environmental requirements

4.1. Environmental management

An environmental management plan may be required for a project, depending on the type of project and where it is located. Environmental management includes the following controls:

Land disturbance – for example management of storm water, dust control and erosion.

Noise and vibration – for example working only during prescribed site operating hours and monitoring noise and vibration levels of vehicles and equipment.

Waste management – for example minimizing waste, sorting waste into the appropriate bins and leaving the site clean and tidy at the end of each day.

Hazardous goods – for example ensuring material safety data sheets (MSDS) are available and ensuring correct storage procedures are followed.

An environmental management plan can be either a separate written document, included in the specifications, or depicted as a plan similar to the project site plan. Everyone involved in a project needs to follow the environmental management plan.

Self-Check -4	Written Test

I. Read the following statements and write True or False.

------1.Environmental management includes land disturbances such as, storm water, Dust control and erosion.

------2. Waste management is not part of environmental requirements.

------3. An environmental management plan can be a separate written document.

------4. Everyone involved in a project needs to follow the environmental management Plan.

Note: Satisfactory rating – 2 points and above Unsatisfactory - below 2 point

Answer Sheet

Score = _____

Rating:

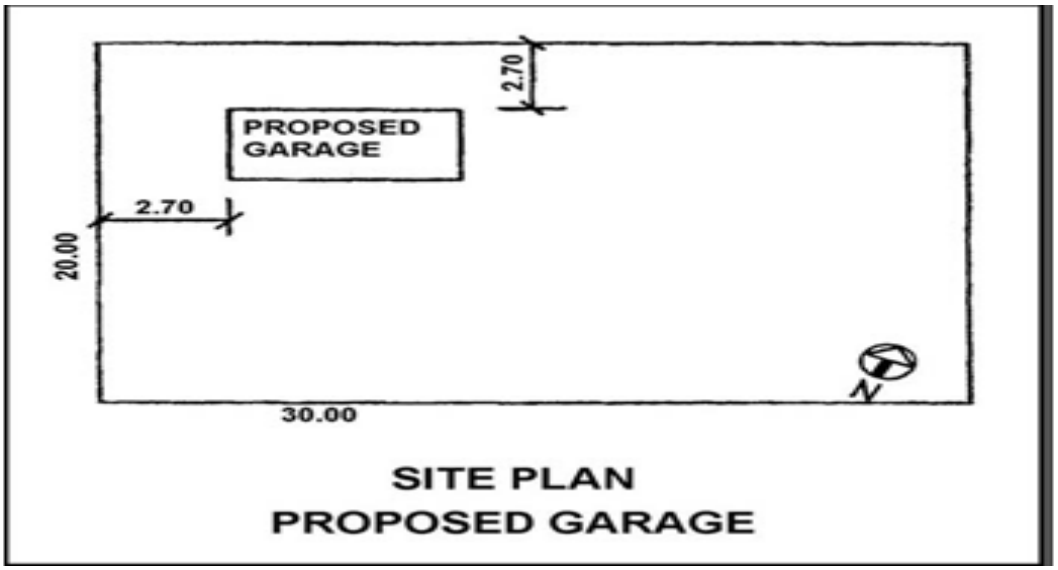
Name: _____ Date: _____

Operation Sheet 1	Key feature & functions of each type of drawing

Operation Title: Site Plan Dimensioning

Procedures:

1. Prepare work place
2. Wear your safety clothes
3. Select drawing instruments & materials.
4. Attach drawing paper to the drawing table.
5. Take all measurement data
6. Transfer the project to the paper attached
7. Check the dimensions for clarity
8. Finally check neatness &quality of your project



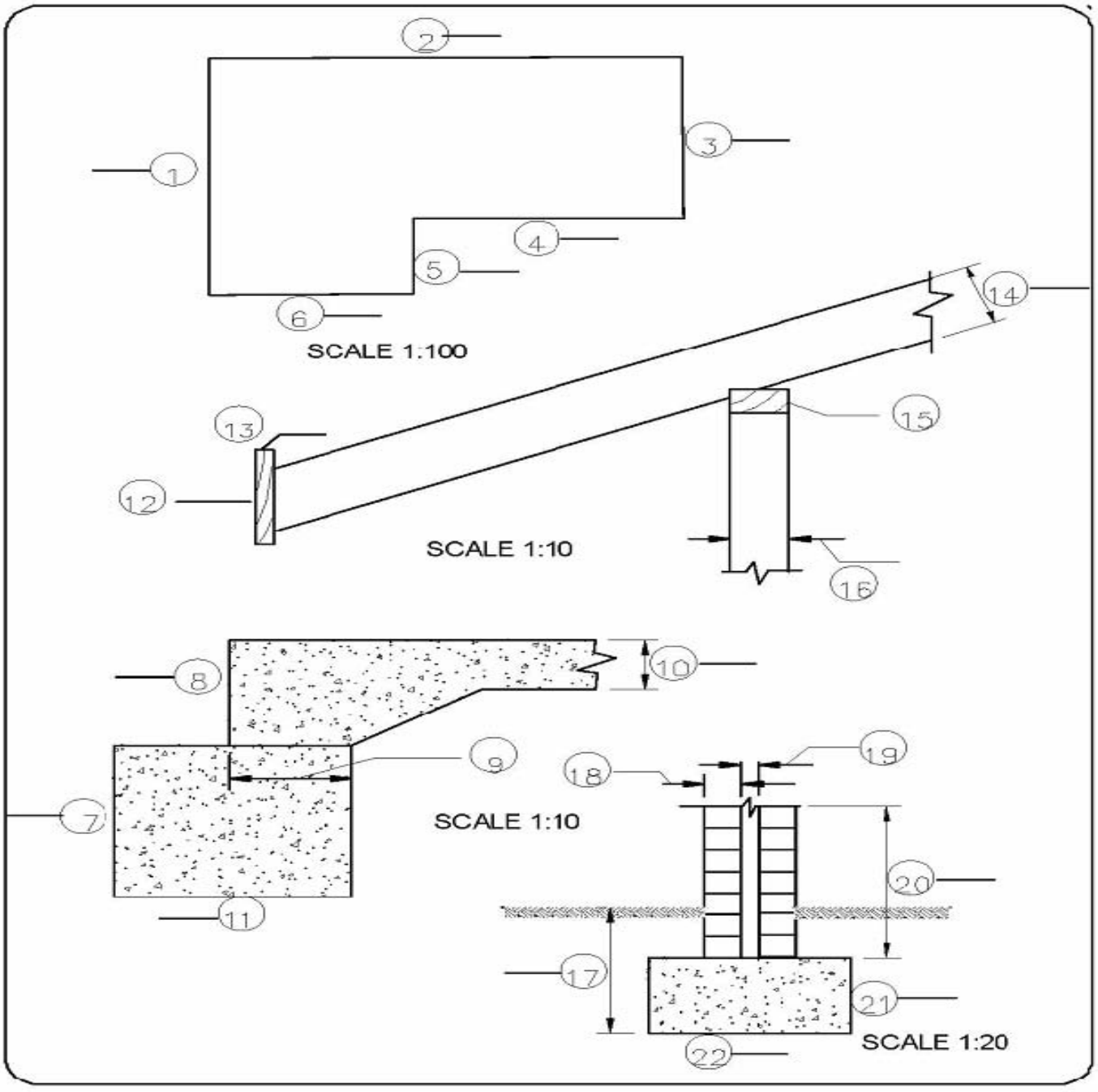
LAP Test	Practical Demonstration

Name: _____ Date: _____

Time started: _____ Time finished: _____

Instructions: Given necessary materials, tools and measuring instruments you are required to perform the following tasks within 2 hours

Task 1 Measure the numbered distances in the nominated scale, then write the measurement in where indicated below.



STUDENT SCALING EXERCISE

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List of Reference Materials

1. https://www.scribd.com/.../reading-and-interpreting-construction-drawings
2. . read and interpret plans and specifications certificate ii in building and construction (pathway – paraprofessional) cpcccm2001a, learner's guide, building and construction government of western australia development of training and workforce development
3. cpcccm2001a read & interpret plans and specifications, student learning resource, training & assessment mentor (tam), australia

Solar PV System Installation and Maintenance

Level-II

Learning Guide-27

Unit of competence:-	**Read and Interpreting Plans and Specifications**
Module Title:-	**Reading and Interpreting Plans and Specifications**
LG Code:	**EIS PIM2 M07 LO2 LG-27**
TTLM Code:	**EIS PIM2TTLM 0120 v1**

LO2:- Recognize amendments

Instruction Sheet	Learning Guide 06

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Checking title panel of project documentation
- Checking amendments of specifications to ensure currency of information

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:-

- Check title panel of project documentation
- Check amendments of specifications to ensure currency of information

Learning Instructions:

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1, Sheet 2, in pages 36 and 40 respectively.
4. Accomplish the Self-check 1, Self-check 2, in pages 39 , and 42 respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to Operation Sheet --

Information Sheet-1	Checking title panel of project documentation

1.1 Introduction

In this section we'll look at title panels, or title blocks – an essential part of all construction drawings.

1.2 Title Panels

A title panel (sometimes called a title block) is found on all drawings. It identifies which project the drawing is for and also gives some specific information about that particular drawing sheet.

Title Blocks (Panels) are found usually in the bottom right hand corner of the plan, and can be vertical as shown here or horizontal as shown below.

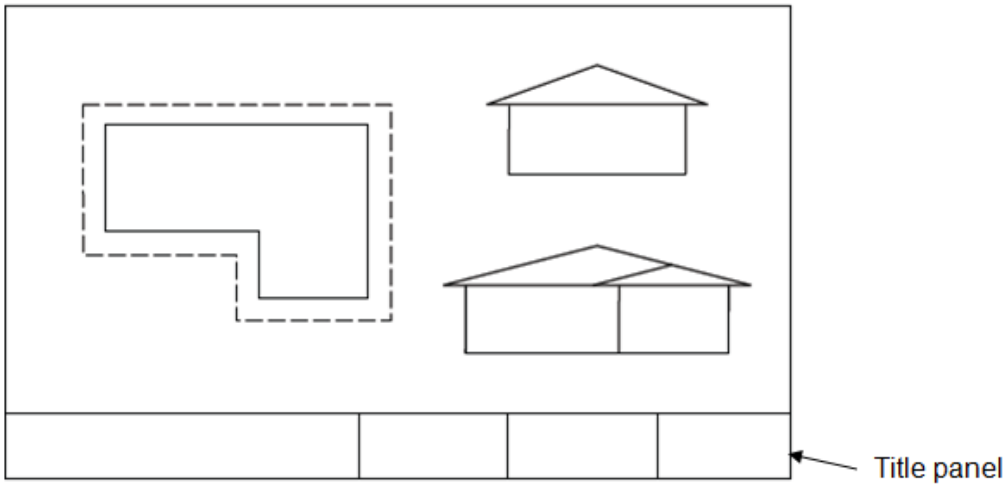


Figure 2.1: Title panel at the bottom of the sheet.

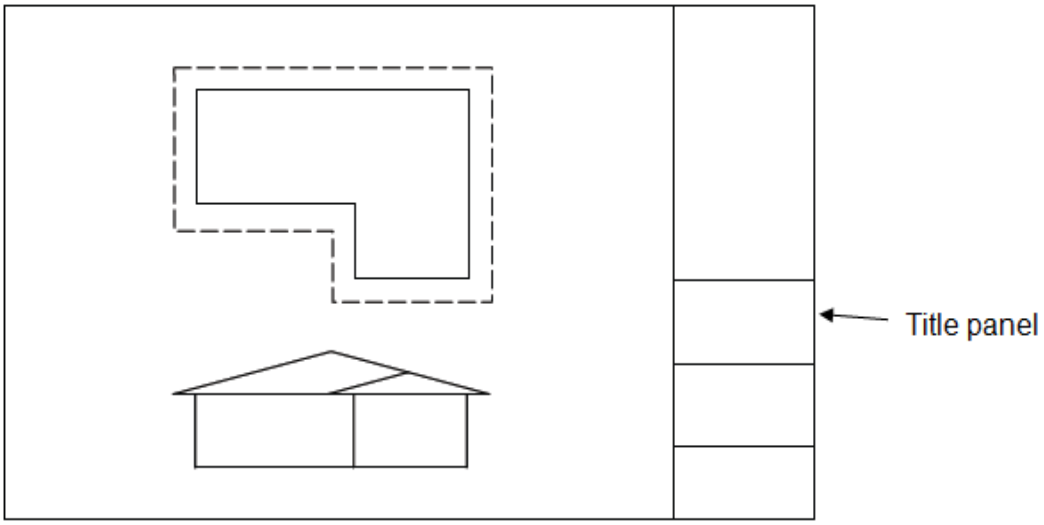


Figure 2.2: Title panel at the right-hand side of the sheet.

Where the title panel is located and what it looks like are decided by the drafting or architectural company. They will usually incorporate company styles, colors and logo. Employees creating drawings will be required to follow company procedures by inserting and completing the title block correctly.

The example of a title block shown on this page shows the relevant details found in the title block of most plans:

For example:

- Client
- Project
- Location
- Consultant
- Drawn by
- Checked by
- Issue or revision code
- Scale
- Date

CLIENT: D. C. Green and Company		
PROJECT: Proposed Child Care Centre		
LOCATION 91 Fir Street BARCALDINE QLD 4725		
PROJECT CONSULTANTS Blake And Brown Consultants Floor 3 125 Black Road INDOOROOPILLY QLD 4068		
ARCHITECT B. J. Smyth 7 Denham Street INDOOROOPILLY QLD 4068		
THIS DRAWING Elevations And Sections **DRAWN:** B.C. **SCALE:** 1:100 **PROJECT NO:** BCA-721		
DRAWN: B.C.	**CHECKED:** J.G.	**ISSUE:** A
SCALE: 1:100	**DATE:** MAY 96	
PROJECT No: BCA-721	**DRAWING No:** WD – 04	

Figure 2.3: A completed title pan

Notes panel

Some drawings have a ‘Notes’ as well as a title panel. The information in this panel is important, and must not be overlooked.

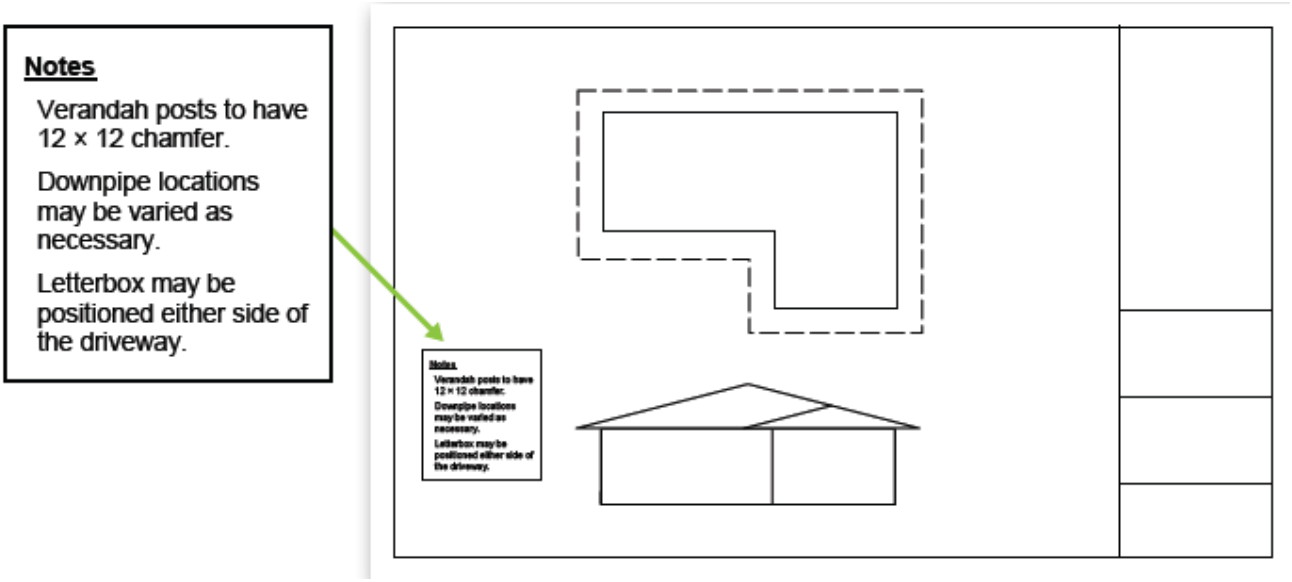


Figure 2.4: A simple drawing sheet with a notes panel.

Self-Check -1	Written Test

Directions: - For the following statements, write TRUE if it is correct or write FALSE if

It is incorrect on another answer sheet.

1. A title panel is NOT giving some specific information about that particular drawing sheet.
2. The title panel is located and what it looks like are decided by the drafting or architectural company.
3. Notes panel and title panel are similar in drawing context.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Information Sheet-2	Checking amendments of specifications to ensure currency of information

2.1 Amendments

An amendment is a change to a project that is decided after the drawings have been finalized. Amendments are sometimes called revisions. These changes could happen because the client requests them (for example, the client may want an extra window in the study) or because the builder realizes something will work better if it's done slightly differently. Either way, they need to be shown on paper so that everyone knows about them, they are constructed correctly and there are no arguments later. So obviously it is important to use the latest version of the plans.

If this means that the building will vary from the way it was shown in the original contract documents, a written instruction will be issued by the architect/client and, if necessary, the drawings will be amended (changed) and re-issued.

On a very large project (such as the Sydney Opera House), there are literally thousands of drawings required and it is a full-time job for a site clerk to ensure that everyone receives up-to-date drawings to work from.

Old, out-of-date drawings should be stamped and stored rather than destroyed, in case there is any dispute at a later date.

2.2 Specifications

A specification is a written description of the building to be constructed. It supplements the information on the drawings and, like the drawings; it is a legal part of the contract between the client and the builder.

A specification might only be a few pages long for a small project such as an addition to a house, or it might be a multi-volume set of bound books for a big project such as a shopping mall or high-rise building.

For a large commercial or industrial project there may be a specification for the architectural features, and additional specifications for the plumbing, electrical and mechanical requirements of the job. For house construction, one specification booklet is usually sufficient.

2.2.1 The purpose of a specification

Drawings are the best way to convey most of the information required for a building project, but a specification is needed to explain anything that cannot be included clearly in the drawings. Specifications are commonly used to communicate the following.

- Fixture and fittings to be used, where things like dimensions, color or model number are important – for example 'Acme 'De Luxe claw foot bath, 1675mm, white'.
- To provide instructions to the builder or trades people for how something is to be done. For example, drawings might show that internal walls are to have a plaster finish, but it is the specification that tells the plasterer how – 'bring walls to a reasonable flat surface by the application of a cement render flat coat while the plaster is setting'. Instructions can also relate to regulations – 'all lintels shall be galvanized treated, in accordance with BCA Clause 3.3.3.4'.
- To provide instructions to the builder about things that may not be part of the finished building but that nevertheless need to happen during the project – for example, safety barriers, disposal of rubbish or protection or adjoining properties.

Specifications usually include a clause about making good any damage to footpaths, fences and any other facilities in the surrounding area of the project.

There will also be a clause that deals with the general quality of the materials and workmanship to be used. This usually reads something like:

All materials are to be new and of best quality and all work is to be carried out to best practice and to the relevant Ethiopian Standard where one applies.

- **Layout**

The specification (or 'spec') for a house is divided into sections (like short chapters) that each deal with a specific trade that will be involved in the project. The sections are usually arranged in the same order that the job will be done in – starting with excavator, concreter and bricklayer through to painter, floor coverer and landscaper at the end.

Each section may contain detailed descriptions specific to that job or it may just contain general instructions about workmanship, quality and so on. In that case, it will refer to a schedule at the end of the specification. The schedule will have details for a particular job; for example, sizes of skirting, paint finishes, types of doors, brand of stove, color of bath and so on.

A section called 'preliminaries' at the start of the specification deals with general things, such as the extent of the work, temporary services, the job sign, site sheds and toilets, temporary fences or hoardings and access for the client during construction.

In project-home building – where the same model is built over and over for different clients – they may use a standard specification and add to that an addition that includes the selections and specific details for each client.

- **Changes**

Sometimes changes, called amendments, might be made to the specification. Amendments could relate, for example, to changes to materials or products used or methods of carrying out specified work. They should be clearly marked so that everyone who needs to notices them. Amendments usually have to be signed or initialed by both the builder and the client to show them both agree.

On rare occasions, the specification may conflict with the drawings. For example, the specification may call for the front door to have a glass panel in the top half, yet the elevation may show no glass in the door. In this case, the builder should contact the architect or client and ask for clarification.

- **Costing**

A section in the specification will deal with 'provisional sums' and 'prime costs'.

Provisional sum items are such things as the oven, bath, toilet suite, tiles and so on, which may not have been selected by the time the contract is signed. In that case, the builder will allow a certain amount in the contract.

When these items are eventually selected by the client, the contract price will be adjusted up or down according to the actual cost.

Prime costs are those costs that the builder can't reasonably be expected to put an exact figure on when tendering for the job. For example, in certain areas the builder may allow a prime cost of so much per cubic metre if rock is encountered during the excavation work. If none is found, then the client doesn't pay any extra, but if it is, the builder will be reimbursed for any extra costs that may arise.

Self-Check 2	Written Test

Directions: - Match the following questions from column “B” to column “A”

Column “A”	**Column “B”**
1. Amendment	A. Provisional sum
2. Specification	B. Covered by the builder
3. Purpose of a specification	C. Official change
4. Costing	D. set of documented requirements
5. Extra cost	E. provide instructions to the builder

Name: _____ Date: _____

Solar PV System Installation and Maintenance

Level-II

Learning Guide -28

Unit of Competence	Read and Interpreting Plans and Specifications
Module Title	Reading and Interpreting Plans and Specifications
LG Code	EIS PIM2 M07 LO3 **LG-28**
TTLM Code	EIS PIM2 **TTLM 01 20v1**

LO3:- Recognise commonly used symbols and abbreviations

Instruction Sheet	Learning Guide:-07

This learning guide is developed to provide you the necessary information regarding the following content coverage and topics

- **Identifying Recognized construction symbols and abbreviations.**
- **Identifying and Locating of legend on project drawings**

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to:-**

- **Recognize construction symbols and abbreviations.**
- **Locate legend on project drawings**

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1 and Sheet 2 in pages 45 and 50 respectively.
4. Accomplish the Self-check 1 & Self-check 2 in pages 49 & 54, respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to Operation

Information Sheet-1	Recognizing construction symbols and abbreviations

1.1. Introduction

Symbols and abbreviations are used to communicate and detail the characteristics of a construction drawing. This list includes abbreviations common to the vocabulary of people who work with construction drawings in the manufacture and inspection of parts and assemblies.

Some drawings need to convey a lot of information. To avoid confusion and to save space, abbreviations and symbols are used. These are standardised (used all over Ethiopia), and you'll find that you soon become used to interpreting what they mean.

In this section you'll be introduced to some of the more common abbreviations and symbols

1.2. Symbols

Each set standard conventions for architectural symbols. Since many new and different types of construction materials, appliances and fixtures are continually being developed and used in construction; many architectural drafters will use symbols of their own design and show their meaning in a legend or symbol chart on the drawing. While there are some different symbols being used, there is an overall acceptance of the symbol conventions.

As a general rule when a symbol is not clear or a new type of material is to be noted on a drawing, a notation should be used with the symbol. This will clarify the communication to the builders. It must be remembered that architectural working drawings must be read by many persons in the building trades. Everything must be clear so no guess work will be involved with the design, ordering of materials or construction phases

Like abbreviations, symbols are used instead of words on drawings to save space. There are a lot of them, but they're standardised (drawn the same way) to avoid confusion, so don't worry. Some of them look a lot like what they represent. For example, the symbol:

- indicates a hotplate in the kitchen

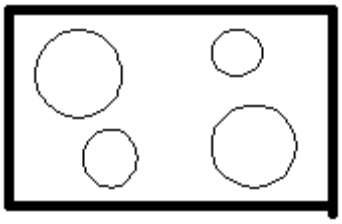


Figure 27: kitchen

- indicates that this is ‘window 8

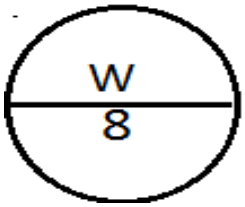


Figure 28: window 8

- indicates that it is a concrete member (perhaps a footing)

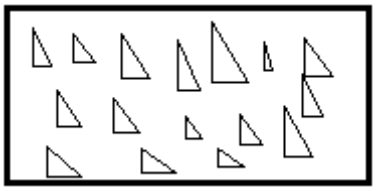
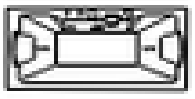


Figure 29: Perhaps a footing

Table 1: Interpreting symbols

No	Represents	standard symbol	Description
1	Bathroom		Is generally containing a toilet, a sink (basin) and either a bathtub, a shower, or both. . It may also be a question of available space in the house whether the toilet is included in the bathroom
2	Toilet		is a piece of hardware used for the collection or disposal of human urine and faces. In other words: "Toilets are sanitation facilities at the user interface that allow the safe and convenient urination and defecation
3	Sink		also known by other names including sinker, washbowl, hand basin, and wash basin is a bowl-shaped plumbing fixture used for washing hands, dishwashing, and other purposes
4	Light		is electromagnetic radiation within a certain portion of the electromagnetic spectrum

5	Shower		A shower is a place in which a person bathes under a spray of typically warm or hot water. Indoors, there is a drain in the floor. Most showers have temperature, spray pressure and adjustable showerhead nozzle
6	Toilet paper		used to clean the anus and surrounding area of faecal material after defecation and to clean the perinea area of urine after urination or other bodily fluid releases
7	Water tap		Its uses include drinking, washing, cooking, and the flushing of toilets
8	Water heater		is a heat transfer process that uses an energy source to heat water above its initial temperature

- **RULES FOR DRAWING SYMBOLS**

- Always use drawing instruments. Never draw the symbols freehand on a working drawing. Use an architectural drawing template to increase the speed and clarity of the symbols. Be certain that the template figures are the same scale as your drawing's scale
- The location of the symbol on the working drawing is closely approximated. If an exact location is required, dimensions must be added to the symbol on the drawing
- Symbols are not drawn to the exact size of the actual item. The general size of the architectural symbols will vary with the scale of the drawing. The symbol should be of convenient reading size, It should not be too small or large
- Material symbols need not cover the full surface, repetitious drawing symbols need not be completely drawn
- Have references for architectural symbols available

1.3. Abbreviations

An abbreviation is a shortened form of a word or phrase, by any method. It may consist of a group of letters or words taken from the full version of the word or phrase, for example, the word abbreviation can itself be represented by the abbreviation abbr., abbrv. In other cases initials are used. Examples include 'WIR' for walk-in robe and 'WC' for water closet (toilet). There might be several recognised abbreviations for the same thing. For example, you may see 'brickwork' shortened to BRK, BWK or just BK

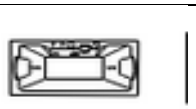
If you come across a new abbreviation in a drawing and you aren't sure what it means, have a look at where it is in the drawing as that will often give you a clue.

Table 2 Interpreting abbreviations

Here are some common abbreviations found in architectural plans			
KIT	Keep It Together	**CPBM**	Control Plane Binding Manager
ENS	Emergency Notification System	**WIR**	Water Industry Research
WC	water closet	**HWS**	Hot Water Supply
MH	Map Hack	**GPO**	General Post Office
FL	foreign language	**PLST**	Plan for Life Sustaining Treatment
CONC	concessionary	**COL**	column
RWP	Random Wall Post	**BM**	Bowel Movement

Self-Check -1	Written Test

Match columns A to column B

	A	B
1	Sink	
2	Shower	
3	Bathroom	
4	Water tap	
5	Toilet	

Note: **Satisfactory rating 3 & above points** **Unsatisfactory below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Information Sheet-2	Locating legend on project drawings

2.1. Introduction

Project drawings the term “as-built drawings” refers to drawings that depict the building and all its components as they were actually constructed. Construction is complex and every project encounters unexpected obstacles and conditions that alter the plans

The Drawing Legend displays a grid of all traces used in a drawing. The drawing legend can be displayed or hidden on a drawing-by-drawing basis. It can be displayed with an opaque or transparent background, with or without a border and/or grid lines. It can be placed anywhere on the drawing

2.2. Standard views used in project drawing

This section deals with the conventional views used to represent a building or structure. See the types of project drawing section below for drawings classified according to their purpose

- ✓ **Floor plan**

A floor plan is the most fundamental architectural diagram, the arrangement of spaces in building in the same way as a map, but showing the arrangement at a particular level of a building. Technically it is a horizontal section cut through a building, showing walls, windows and door openings and other features at that level

The plan view includes anything that could be seen below that level: the floor, stairs (but only up to the plan level), fittings and sometimes furniture. Objects above the plan level (e.g. beams overhead) can be indicated as dashed lines.

Geometrically, plan view is defined as a vertical orthographic projection of an object on to a horizontal plane, with the horizontal plane cutting through the building.

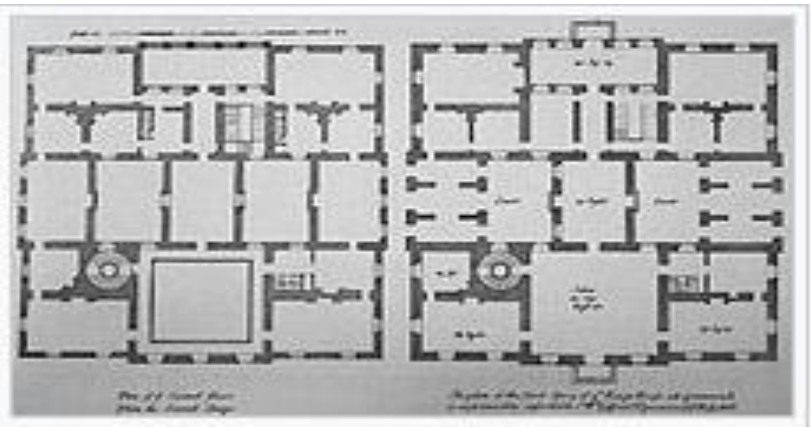


Figure 30: Principal floor plans

- ✓ **Site plan**

A site plan is a specific type of plan, showing the whole context of a building or group of buildings. A site plan shows property boundaries and means of access to the site and nearby structures if they are relevant to the design. For a development on an urban site, the site plan may need to show adjoining streets to demonstrate how the design fits into the urban fabric

Figure 31: Example of a Site plan

- ✓ **Elevation**

An elevation is a view of a building seen from one side, a flat representation of one façade. This is the most common view used to describe the external appearance of a building. Each elevation is labelled in relation to the compass direction it faces, e.g. looking toward the north you would be seeing the southern elevation of the building

Figure 32: Elevation of the principal façade

- ✓ **Cross section**

Also simply called a section, represents a vertical plane cut through the object, in the same way as a floor plan is a horizontal section viewed from the top. In the section view, everything cut by the section plane is shown as a bold line, often with a solid fill to show objects that are cut through, and anything seen beyond generally shown in a thinner line. Sections are used to describe the relationship between different levels of a building.

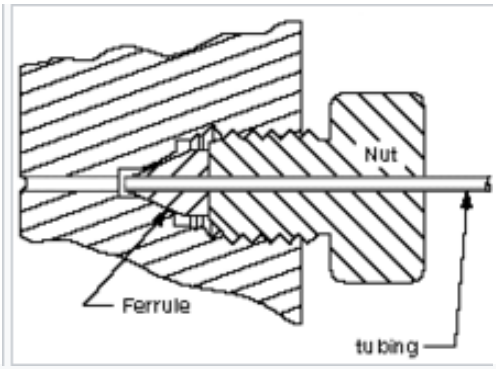


Figure 33: A cross-section view of a compression seal

- ✓ **Isometric and axonometric projections**

Isometric and axonometric projections are a simple way of representing a three dimensional object, keeping the elements to scale and showing the relationship between several sides of the same object, so that the complexities of a shape can be clearly understood.

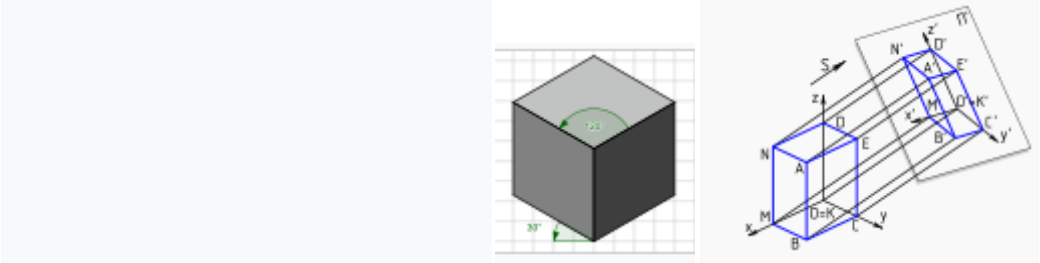


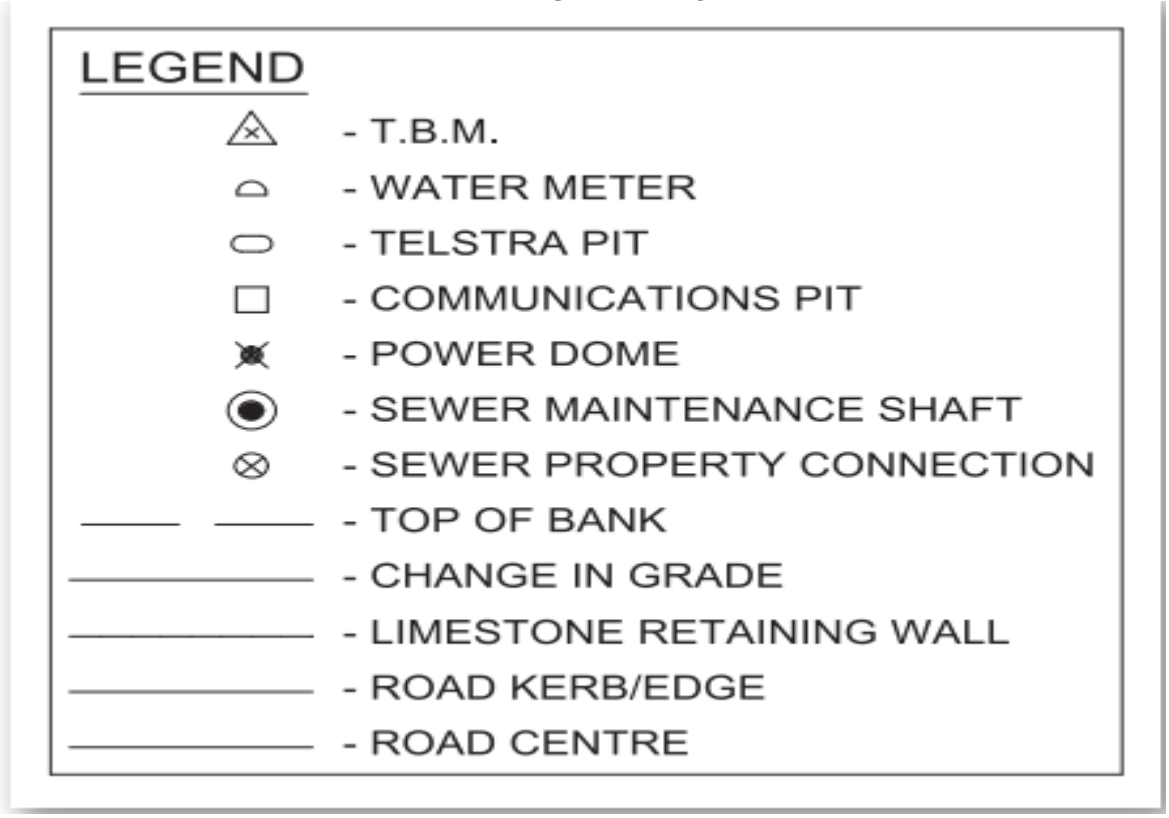
Figure 34: Isometric and axonometric drawing of a cube

2.3. Legend or Symbols

The legend, if used, is generally placed in the upper right-hand comer of a blueprint below the revision block. The legend is used to explain or define a symbol or special mark placed on a blueprint

The legend shown in table is from a site plan. Without this legend, the symbols on the drawing could be misinterpreted. Electrical, hydraulic and engineering drawings commonly have legends on them

Table 3: Legend or Symbols



Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

I. Choose the best answer for the following questions below

1. Includes anything that could be seen below that level: the floor, stairs (but only up to the plan level)

a) Cross section **b)** Elevation **c)** Site plan **d)** Floor plan

2. Solid fill to show objects that are cut through, and anything seen beyond generally shown in a thinner line.

a) Cross section **b)** Elevation **c)** Site plan **d)** Floor plan

3. A view of a building seen from one side, a flat representation of one façade

a) Cross section **b)** Elevation **c)** Site plan **d)** Floor plan

4. A specific type of plan, showing the whole context of a building or group of buildings.

a) Cross section **b)** Elevation **c)** Site plan **d)** Floor plan

5. A simple way of representing a three dimensional object

a) Isometric b) axonometric c)**. a and b** d) **All**

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer questions

List of Reference Materials

1. Acharya, Jitendra. , Thesis Materials management for the construction sector, CEPT.
2. 2. Agarwal, Anil. (2001), “Benchmarking wastage control of construction materials”, NICMAR journal of Construction Management, Vol 16, No.1 , January 2001
3. 3. Baldva, Surbhi. (1997) Thesis , Material management in construction industry, CEPT
4. 4. Buffa, Elwood. , Production inventory systems:

Solar PV System Installation and Maintenance

Level-II

Learning Guide-29

Unit of competence:-	**Read and Interpreting Plans and Specifications**
Module Title:-	**Reading and Interpreting Plans and Specifications**
LG Code:	EIS PIM2 M07 LO4 **LG-29**
TTLM Code:	EIS PIM2**TTLM 0120v1**

LO4:- Locate and identify key features on a site plan.

Instruction Sheet	Learning Guide 08

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics:

- Identifying orientation of the plan with the site
- Locating key features of the site
- Identifying services, main features, contours, datum and accessing site

This guide will also assist you to attain the learning outcome stated in the cover page. Specifically, upon completion of this Learning Guide, you will be able to:-

- Identify orientation of the plan with the site
- Locate key features of the site
- Identify services, main features, contours, datum and accessing site

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1, Sheet 2, Sheet 3, in pages 58, 63, and 67respectively.
4. Accomplish the Self-check 1, Self-check 2, Self-check 3, Self-check in pages 62 66.and 70 respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to Operation Sheet--.

Information Sheet-1	Identifying Orientation of the plan with the site

1.1. Introduction

Good orientation, combined with other energy efficiency features, can reduce or even eliminate the need for auxiliary heating and cooling, resulting in lower energy bills, reduced greenhouse gas emissions and improved comfort. Good orientation starts with the position of the lot in relation to the east and west sides. Normally the lot dictates the shape and orientation of the building; therefore the ideal lot should have the long side facing the north and south axis, while the short side faces the east-west axis. To make the most of the sun for warmth and natural light, your home's main living areas (or any rooms you use a lot) should face north. The main glazing in the house, such as windows and glass doors, should also face north. Anywhere between 20°W – 30°E of true north is fine.

1.2. Site planning and orientation

If use is to be made of the sun's heat, then it has to reach buildings when it is useful. Generally, the sun should be able to reach the collection area between 9 a.m. and 3 p.m. in winter with as little and interference as possible. Trees on the site or the neighbors' site or perhaps those the householder plans to put in, might shade the vital areas of the building. This needs to be checked and the building located to minimize any such interference. During the winter, solar energy comes from approximately northeast at 9 a.m. and north-west at 3 p.m., about 90 degrees.

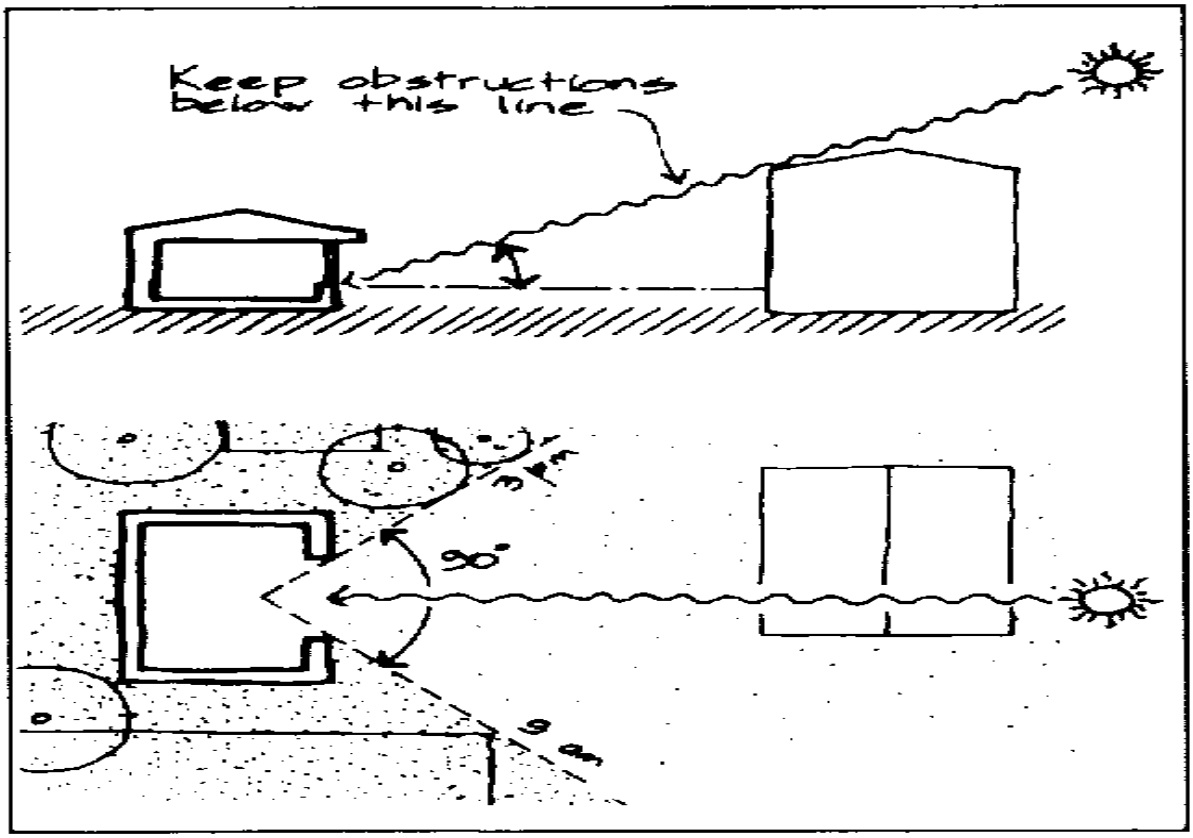


Figure 1. Sketch showing how the sun should have good access to windows that act as solar collectors.

In summer, there are often cool breezes which if directed through a building will help cool it. Weather Bureau information gives details of the direction for a particular area, but this should be checked on-site because other buildings, hills or trees might deflect those breezes to another direction. Likewise in winter, the cold winds should be deflected away from a building. They tend to come from the south, the south-west and the west. With simple local information about a site, it is possible to plan to optimize winter sun and summer breezes and to block winter winds by careful placement of obstructions such as trees, fences, hedges or a garage. If a client has not yet bought a site, then one with the right aspect should be sought. It is most important to remember to let the sun in from the north.

The most straight forward way to use the sun's energy to warm a house is called the "direct-gain system". Here the sun is simply let into the building through correctly positioned and carefully sized windows. When describing the way buildings must face reference is being made to the direction that the main windows face. The windows of living rooms and, if possible, bedrooms should face towards the north. There is some latitude and so anywhere between 30 degrees east or west of north is acceptable. If there is a preference. then about 10 degrees east of north is best, to let some sun in for an early warming.

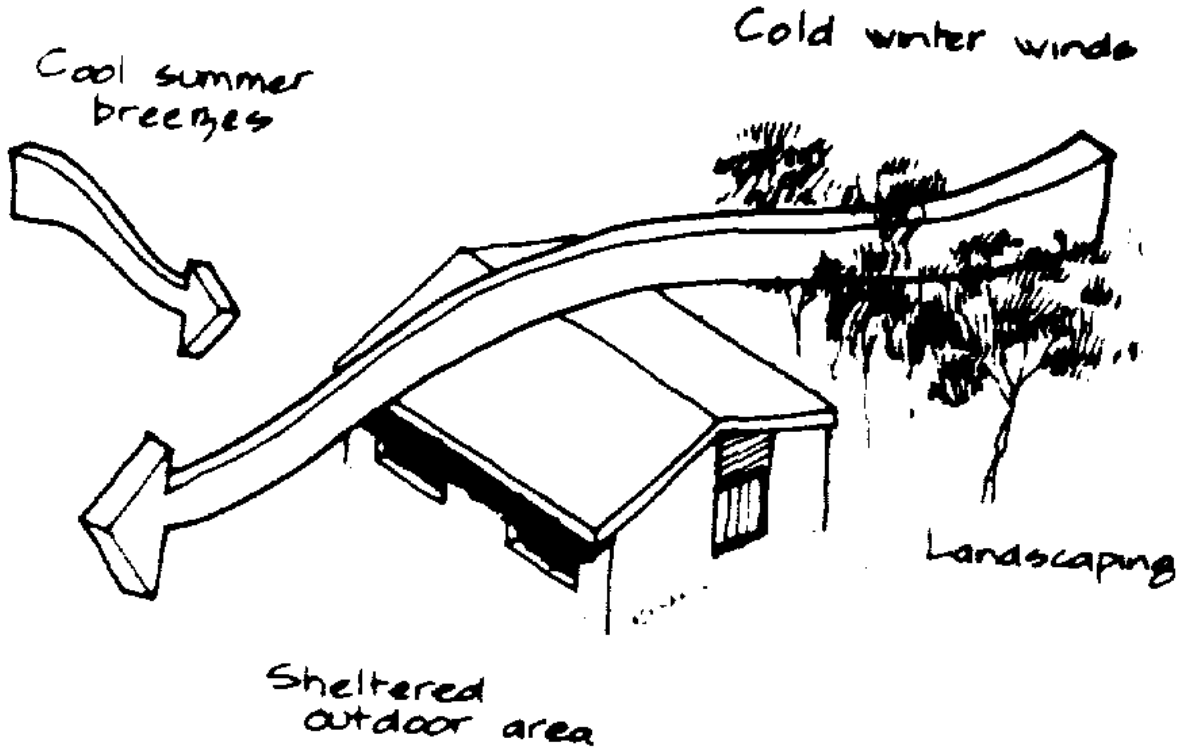


Figure 2. Use of landscaping and the building bulk deflect the cold winter winds to accept cool summer breezes.

It is important to try to avoid windows on the east or west sides, because these sides of a building receive more of the sun's heat in summer than they do in winter. The north side is quite different. It receives more heat in winter than summer, because the sun is high in the sky In summer and low in winter. Therefore, east- and west-facing windows can cause a building to overheat in summer much more so than north- or south-facing windows.

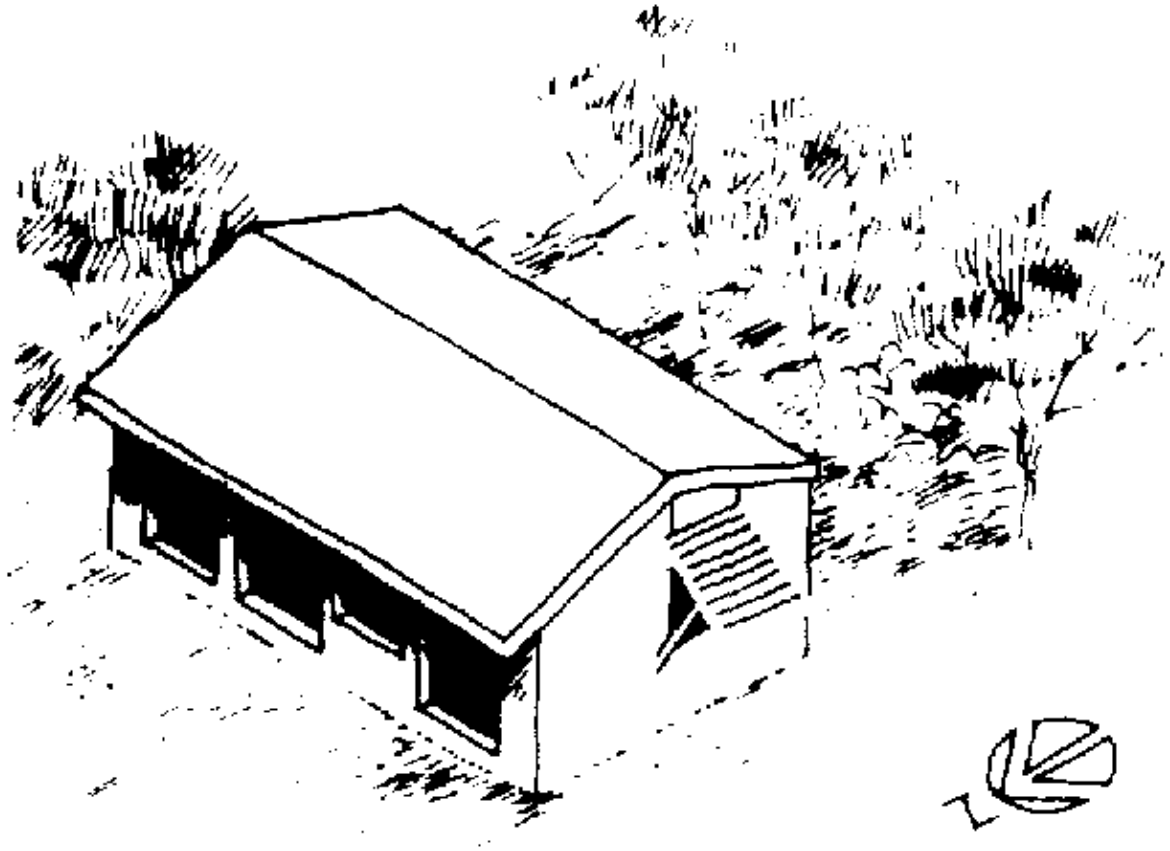


Figure 3. Example of a building having good performance and acceptable internal Conditions.

Shade for north-facing windows is relatively easy with a simple overhang: this will still retain the view. East- and west-facing windows would need a full cover in summer which will restrict the view to the outside throughout most of the summer months.

Glass lets heat out in winter and in in summer by conduction approximately 10 times faster than an insulated wall, and three times faster than a brick-veneer wall. This is another reason for not having windows too large. The rate at which heat passes out through glass is fastest at night when it is very cold, so good curtains with insulating linings should be drawn across after sunset. These curtains should be close-fitting at the floor and the sides and have pelmets at the top. In an office, it may not be practical to do this, so It is necessary to accept that the rooms will be a little colder at night, when normally everyone will have left.

Sunlight through the roof using a clerestory may be practical where normal-level windows cannot be located to face north. Such a solution should be designed so that all the criteria of size and shading apply. Clerestory windows in the roof should be vertical in preference to sky domes and the like. The sun is overhead in summer and so much stronger than in winter on any surfaces near horizontal, such as roofs.

When renovating a building, consideration should be given to moving windows from the east and west sides to the north. Where this is not possible, clerestory windows should be considered. Unfortunately, terrace houses that face east or west are extremely difficult to improve in order to optimize solar energy, if not impossible.

"The sun porch" is another passive solar system which has tremendous potential for many houses, flats and units. Many buildings already have these but they lack a few details. In the 1930s they were called sun rooms and many houses were built with them. It Is important, agaun, that the glass faces north. Such a space with a large area of glass will trap a lot of heat. The space should, therefore, be connected to the rooms needing heath, with a simple exhaust fan at the top and a

return ventilator at the bottom, as indicated in figure 6. The easiest place to install the fan is probably at the top of a window, but the exact position is not too important and will vary for each example. The sun porch then becomes a solar collector. There are many of these in Sydney already, and all that is needed is the fan and ventilators. At night, the temperature drops quite low in sun porches because of the large quantity of glass. Therefore, both the fan and the ventilator at the bottom should have a shutter or flap to be closed at night. Besides being a solar collector, the sun porch also serves as a useful room. This system is ideal for older-style houses where the fabrics and materials may be a delicate color and would otherwise be damaged by lots of bright sunshine coming in all day during the winter.

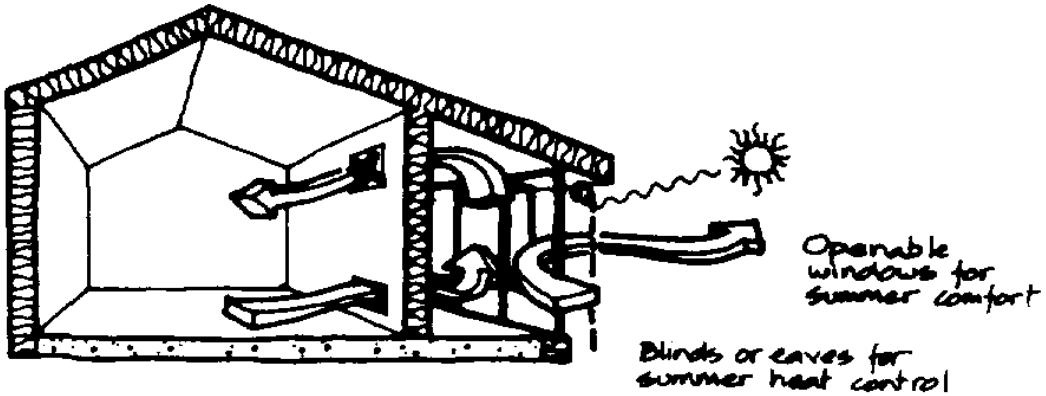


Figure 4. The sun porch concept.

In summer, it is important that the sun porch be well vented to the outside, so that the summer heat does not build up. One way to do this is to have sliding glass windows that allow 50 per cent of the glass to be opened. Another way of controlling the summer heat would be external shutters or blinds.

Self-Check -1	Written Test

Directions: - For the following statements, write TRUE if it is correct or write FALSE if

1. Good orientation starts with the position of the lot in relation to the east and west sides.
2. Windows and glass doors should face towards west.
3. During the winter, solar energy comes from approximately northwest at 9 a.m. and north-east at 3 p.m., about 90 degrees.
4. East- and west-facing windows can cause a building to overheat in summer much more so than north- or south-facing windows.
5. Using the sun's energy to warm a house is called the "direct-gain system".

Note: **Satisfactory rating 3 & above points** **Unsatisfactory below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Information Sheet-2	Locating key features of the site

2.1. Common Features of Local Plans

While local plans vary based on geographic scale, timeframe, and breadth of topics, there are four features common to most local plans:

- an explanation of the purpose of the plan,
- a discussion of existing conditions and trends,
- a presentation of desired outcomes in the form of goals and objectives, and
- an enumeration of policies and actions in support of these goals and objectives. Planners and others involved in plan making have opportunities to address solar energy use in each of these common plan sections.

2.2. Important Site Characteristics for a PV Solar System

You want to get solar for your home but have no idea where it should go? Ideal locations for a home PV Solar System can often vary from site to site. As part of the PV process, most installers conduct a site assessment which allows them to analyze and examine your site and potential solar array placement. Here are the top 5 (amongst many other) variables that we at PPC Solar look at and discuss with homeowners.

- **Out & Away from Shade**
  During the initial site analysis, we investigate the best possible location for the array of panels. One of the first questions we answer is “Does it make sense to install the solar array on the roof?” Sometimes, the roof is not always the best place to install solar, because of obstructions like trees or cooling systems. Shading critically affects solar performance, and determining a shade-free location is fundamental to good PV design.
- **Costs of Solar**
  the reason why we first ask if it makes sense to install the solar array on the roof is because that is usually the least expensive. Reducing groundwork, such as trenching, saves the homeowner money and time. If the angle or orientation of a roof is less than optimal, we can increase the number of solar panels to produce the ideal system output.
- **Orientation & Tilt Angle**
  The orientation and tilt angle come into play when we consider where the array will best take advantage of the sun. Our main priority when designing a system is to provide homeowners with an optimal photovoltaic system, meaning we size a system to offset all electricity consumption. So, with orientation and tilt angle, we can deviate a certain amount, but all deviations can decrease the system output. In Northern New Mexico, the optimal azimuth is 180 degrees true south, and the fixed position tilt angle is 37 degrees Latitude, for maximum annual performance.
- **Ideal Conditions**
  when considering a roof mount solar installation, the condition of the roof is crucial. In the myriad of years that we have been installing solar, we have come across many different roofs. The structure must be adequate and strong. Some key variables that we evaluate are: roof age, roof direction, room on the roof for the array, and roof type.
- **Aesthetics**
  In the Southwest, many homes have parapets, barriers which are an extension of the wall at the edge of the roof, terrace, balcony, etc. For roofs with parapets, the solar panels are installed on tilt-up roof mounted arrays. Parapets can hide the array, preserving the aesthetics for the homeowner. In other cases, when homeowners are concerned about aesthetics, they can choose other mounting options, such as pole mount, ground mount, and carport mount systems.

Figure. 1 Example of a Parapet Wall

1.3. Important Factors When Designing a Solar PV System

In order to be able to receive and compare quotations for installations, the design of the solar **PV** system should be considered. The corresponding decisive factors should be explained in this section.

In general, the following points play a significant role in the profitability of the solar PV system:

- The available mounting surface on the roof.
- Current power consumption
- Size and thus investment costs of the solar PV system
- If necessary, costs of the solar storage batteries
- The amount of the feed-in tariff
- The proportion of the self-consumption and the feed into the utility grid

The first step is to determine the situation on the roof and the available mounting surface. The roof size can be gained from the construction plan if this is available and is precise. However, it is recommended that you measure the roof surface yourself.

However, not every roof is easily accessible. in this case, it is possible to determine the roof surface by using a laser gauge, or you order a solar installer to measure the roof.

Figure 2.roof measurement to decide the available area

If you **subtract** from the available roof surface **shadowed areas,** dormers, windows, and the like, it results in the maximum mounting surface for the solar PV system.

If the dimensions of the solar PV system are known, it is easy to determine via the **number** of solar modules, and approximately how many **kilowatt peaks** the solar PV system will provide.

- **Critical External Factors Influencing System Performance:**

There are 5 critical external factors influencing solar system performance. They are:

- ✓ **Irradiance:-** Solar irradiation is the amount of electromagnetic radiation received from the sun per unit area (usually square meters). In other words, it's the amount of the sun's power detected by a measuring instrument.
  - The higher the irradiance on a solar cell, the more energy a cell will produce**(More sunlight = more electricity)**
- ✓ **Temperature**:- the warmer solar cells get, the less efficient they are.
- ✓ **Shading:-** shaded solar panels produce less electricity.
- ✓ **Soiling**:- Dirty solar panels produce less electricity.

Self-Check 2	Written Test

Directions: - For the following statements, write TRUE if it is correct or write FALSE if it is incorrect on another answer sheet.

1. The warmer solar cells get, the less efficient they are
2. Efficiency of Solar System can often vary from site to site.
3. Roof size can be gained from the site plan
4. Clean solar panels produce less electricity.
5. solar panels are installed on tilt-up roof mounted arrays.

Note: **Satisfactory rating 3 & above points** **Unsatisfactory below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Information Sheet-3	Identifying services, main features, contours, datum and accessing site

3.1. Introduction

The ideal direction that solar panels must face, changes depending on whether you live in the northern hemisphere or the southern hemisphere.
In the northern hemisphere, panels must face south, and north works best for the southern hemisphere.

If panels were placed facing east or west, they would generate a good amount of energy only during the morning or the evening. However, to get the best of both times, you need a north or south-facing system.

3.2. The direction dilemma.

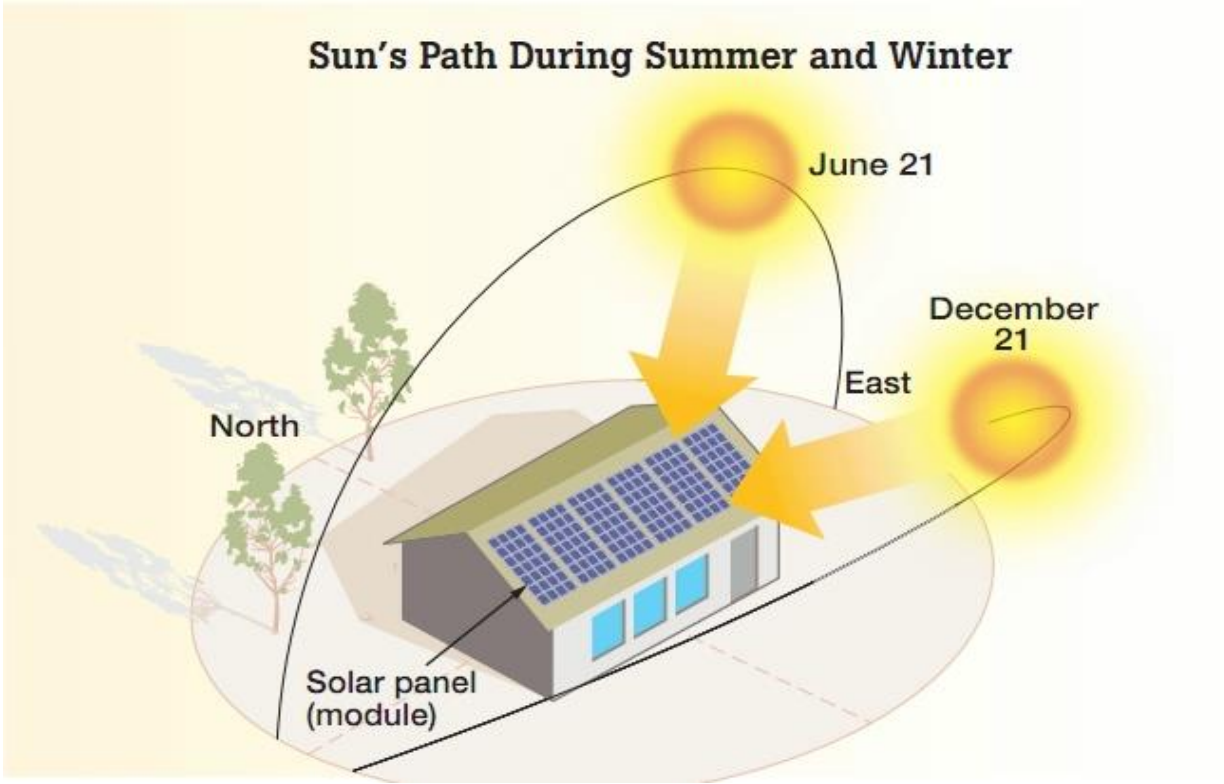


Figure1. Direction of solar panels

3.3. The Tilt Factor.

The fact is that no matter how precisely you calculate the tilt angle for your panels, you will have certain losses. The elusive *optimum angle* of the panel keeps changing throughout the day and across seasons (unless you have installed a solar tracker, in which case, the panel adjusts itself to face the optimum angle at regular intervals of time using an inbuilt algorithm).

So, the best that you can do is calculating an angle that has the ***least average annual loss.***

- **The most common way that has been adopted widely is:**

  - ✓ (latitude * 0.9) + 29 = optimum tilt angle for winter.
  - ✓ (latitude * 0.9) — 23.5 = optimum tilt angle for summer.

In this method, take the latitude: which is an indication of how much you need to tilt the panel by. *Then*, account for the shift in the sun's movement during the summer and the winter by adding some predetermined constants as the sun is lowest in the sky during the winter, and subtracting another predetermined constant during the summer, as the sun is highest in the sky during the summer.

3.4. Calculating the losses.

Let's say that the optimum tilt angle for a certain region is calculated using the approach we just discussed. The losses that this system would incur at any minute can be calculated or measured using instruments such as *pyranometer* (used to measure solar radiation on a surface), *pyrheliometer* (used to measure direct beam solar radiation), sunshine recorder (used to measure the time of sunlight available), and more (gadget stuff).

- **Definition** of **pyranometer**. : an instrument for measuring radiation from the sky by comparing the heating effect of such radiation upon two blackened metallic strips with that produced in the same strips when heated by means of an electric current.
- A **pyrheliometer** is an instrument for measurement of direct beam solar irradiance. Sunlight enters the instrument through a window and is directed onto a thermopile which converts heat to an electrical signal that can be recorded. The signal voltage is converted via a formula to measure watts per square meter.

Declination is basically the angle subtended by a straight line projected from the equatorial plane, and a line from the centre of the sun projected onto the Earth.

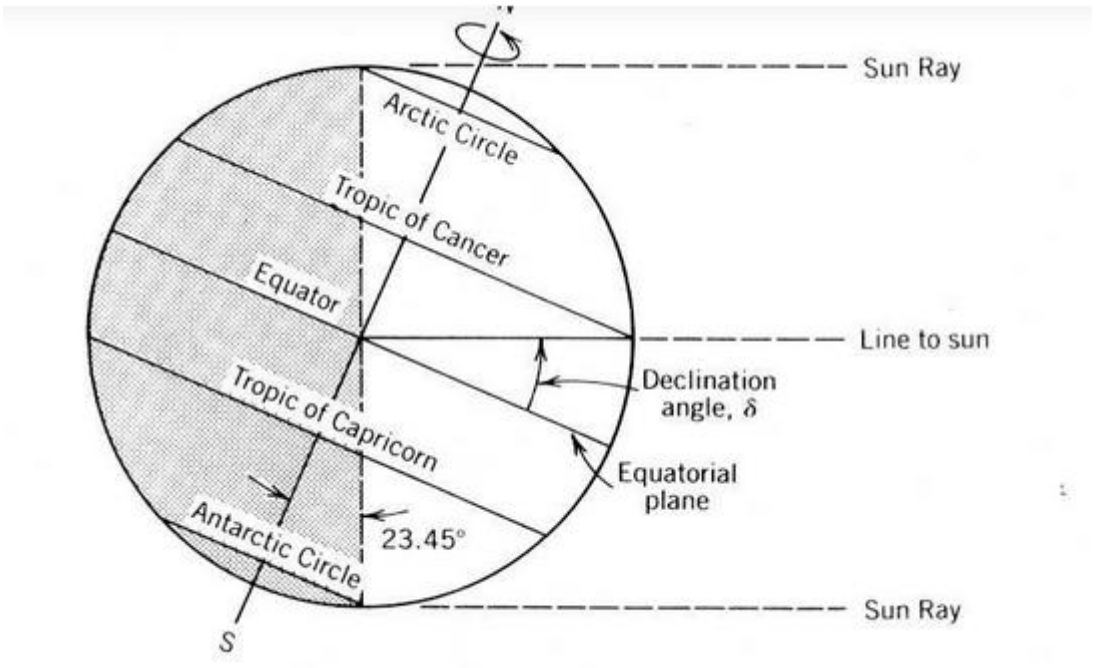


Figure2. Angle declination

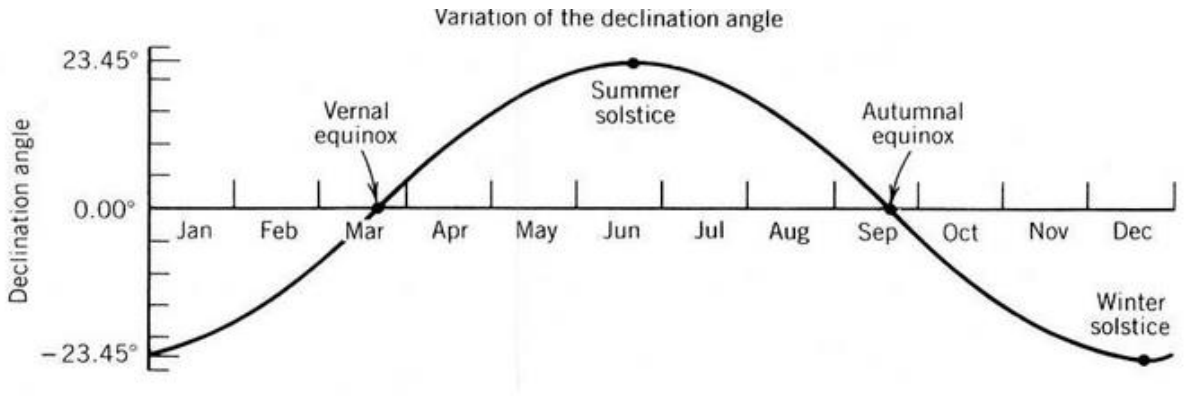


Figure 3. **Angle declination shown by Sine-wave**

The **hour angle** is an expression describing the difference between local solar time and solar noon.

The "**Surface Azimuth Angle**" is measured on the horizontal plane from the true south to the horizontal projection of the normal to the surface.

Solar time is the concept wherein the passage of time is calculated with respect to the apparent position of the sun in the sky.

By using these factors, you will be able to definitively find the angle by which the suns rays are incident on the panel. You can then compare the incidence angle of the sun's rays when the panel is facing the optimal direction, angle, and the incidence angle to when the panel is not facing an optimal angle, directions; and thereby find the percentage losses with respect to changes in direction and/or angle.

3.5. What the future holds in store.

Solar trackers seem to be the most popular option currently being explored. It is an existing technology, but its application is limited to large-scale ground-mounted systems. This is mainly because solar tracker systems are expensive, need more maintenance, and most importantly are not suitable for the wind speeds, and precipitation that they get exposed to on a rooftop.

Self-cleaning, self-maintained tracking systems that incorporate designs that will sustain the conditions on a rooftop are what manufacturers today are working on at their labs.

Self-Check 3	Written Test

Directions: - Match the following questions from column “B” to column “A”

Column “A”	**Column “B”**
…….1. Pyrometer.	A. measures direct sun's energy
……..2. pyrheliometer	B. measures diffused sun energy
……..3.(latitude * 0.9) + 29	C. measured on the horizontal plane
……..4. (latitude * 0.9) — 23.5	D. optimum tilt angle for winter.
..……5. Surface Azimuth Angle	E. optimum tilt angle for winter.

Note: **Satisfactory rating 3 & above points** **Unsatisfactory below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Solar PV System Installation and Maintenance

Level-II

Learning Guide -30

Unit of Competence	Read and Interpreting Plans and Specifications
Module Title	Reading and Interpreting Plans and Specifications
LG Code	EIS PIM2 M07 LO5 **LG-30**
TTLM Code	EIS PIM2**TTLM 01 20v1**

LO5:- Identify project requirements

Instruction Sheet	Learning Guide:-09

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics

- Identifying dimensions for project and nominated locations
- Identifying construction types and dimensions
- Identifying environmental controls and locations
- Identifying location, dimensions and tolerances for ancillary works

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to:-**

- Identify dimensions for project and nominated locations
- Identify construction types and dimensions for nominated locations.
- Identified environmental controls and locations.
- Identified location dimensions and tolerances for ancillary works.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1, Sheet 2, Sheet 3, Sheet 4, in pages 73, 78, 83 & 89 respectively.
4. Accomplish the Self-check 1, Self-check 2, Self-check 3, Self-check 4 in pages 77, 83, 88, and 90 respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to Operation Sheet---

Information Sheet-1	Identifying dimensions for project and nominated locations

1.1. Introduction

This Information Sheet will give you a chance to put into practice what you've learned so far about reading and interpreting plans.

This project grew out of an effort by the Pittsburgh Public School District to analyze student performance and enrolment information called VIPER. In Pittsburgh Public School's case, the decoding of student addresses was vitally important to any geospatial analysis of the student body. The effort associated with this geo-coding was compounded by the unique natural and man-made characteristics of the city of Pittsburgh

1.2. The major problems noted with the existing data were as follow

a) **Short Blocks-** The typical address information in all digital street map data throughout the Ethiopia has contiguous hundreds based ranges for each block (or street segment), e.g., the 100 block would go from 100 to 199. Although all available digital street map data for the City of Pittsburgh adhere to this convention, it is not borne out in reality. There are 20,000 street segments in Pittsburgh and based on our analysis we would estimate that 90% are short blocks

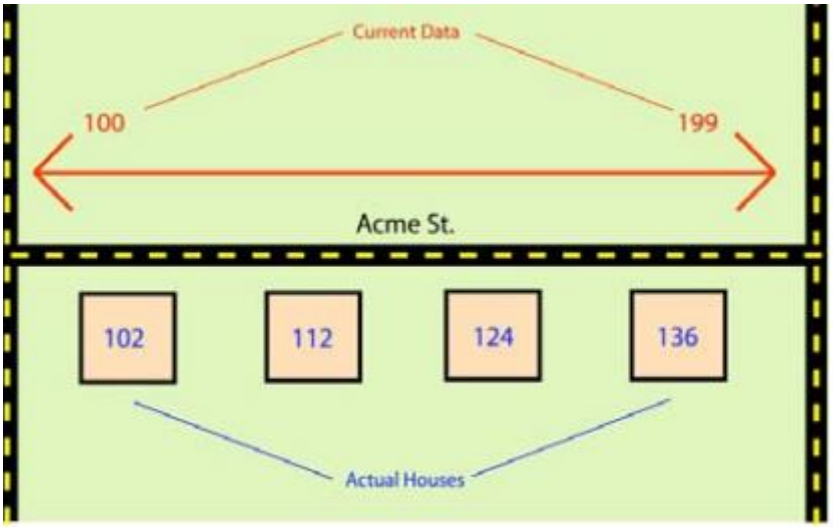


Figure 35: Short blocks

b) **Missing Intervals-** throughout the Ethiopia the street range data is consistently monotonically increasing, i.e., the 100 block, the 200 block, the 300 blocks, etc. This is not true in about 50 % of the contiguous street segments in Pittsburgh where there are often times missing gaps, dramatic jumps in ranges, and even decreasing range

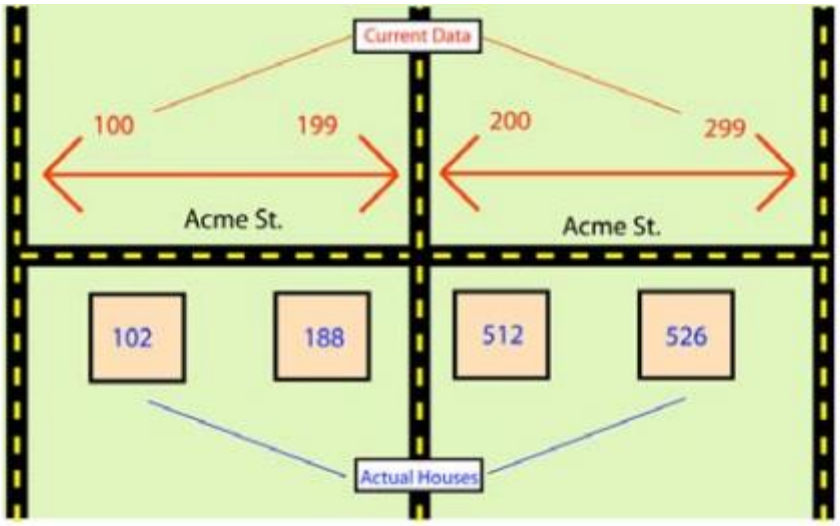


Figure 36: Missing Intervals

c) **Mixed Addresses-** Approximately 20 percent of the street segments in Pittsburgh contain mixed addresses. The predominant problem is 2-digit addresses mixed within a range of 3- and 4-digit address ranges. In many areas the older homes in a street segment will have 2 digit addresses while the newer homes have 3- and/or 4- digit addresses. The available digital street map data either do not or incorrectly reflect this

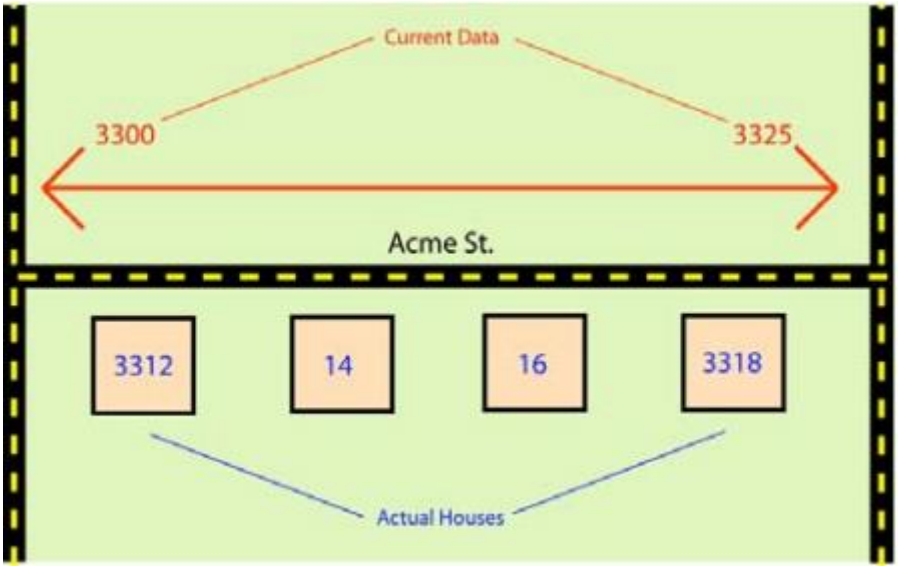


Figure 37: Mixed Addresses

Another problem is that while in most areas even addresses are on one side of the street and odd addresses on the other, this is not true in approximately 5% of the street segments in the City of Pittsburgh

d) **Mixed Ranges-** Approximately 1 % of the street segments in the City contain mixed ranges. An example of this is a segment with the 400 address range on one side of the street and the 500 address range on the other.

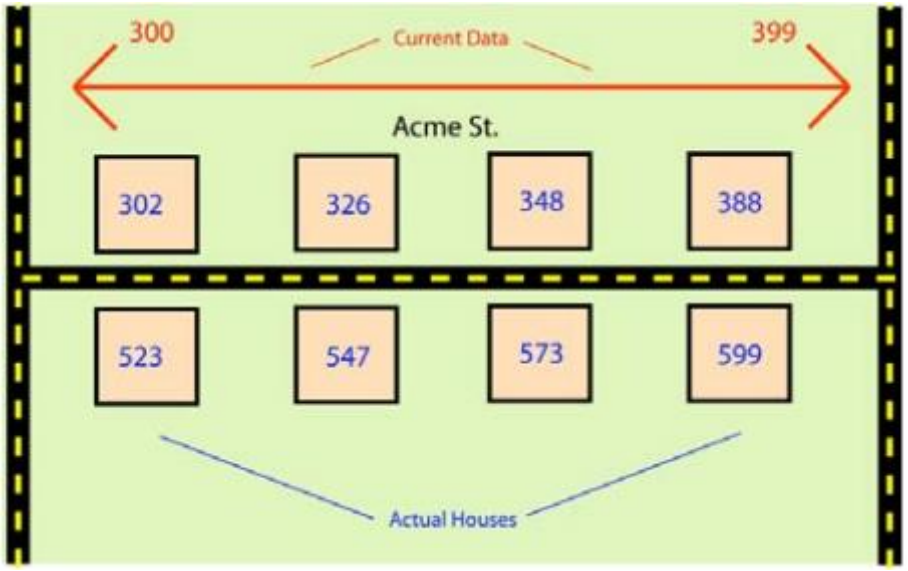


Figure 38: Mixed Ranges

e) **Reversed Sense-** Approximately 5 % of the available digital street map data street segments have a reversed sense wherein the addresses are increasing (or decreasing) in the wrong direction.

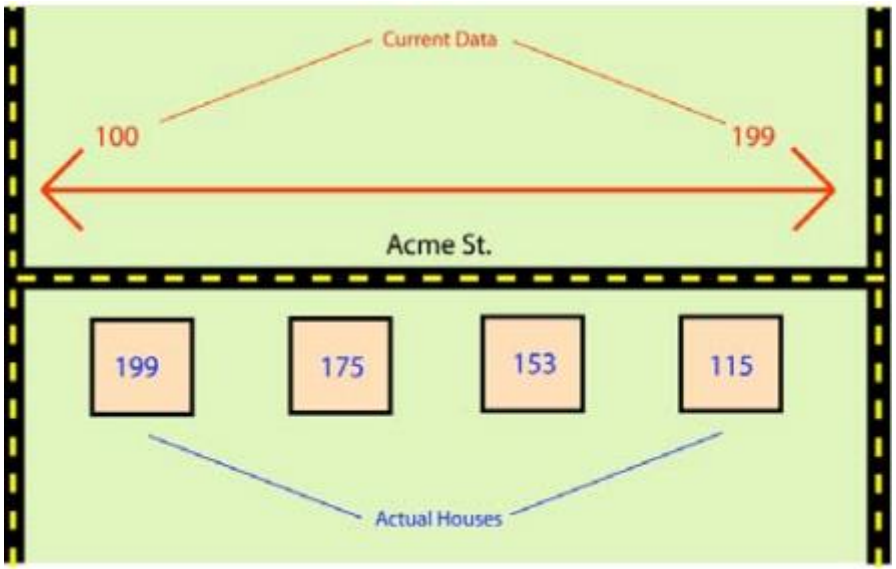


Figure 39: Reversed Sense

f) **Steps and inclines are streets-** in over 300 instances, streets listed as navigable thruways on all available maps for both public and private use are actually what are known in Pittsburgh as “City Steps”. City steps are publicly owned and maintained staircases providing access to physically steep sections of the city. In many cases homes have their main front address located on these steps. Defining which streets are actually steps (and not accessible by vehicle) is crucial in any automatic routing or transportation system.

Figure 40: Steps and inclines are streets

Self-Check -1	Written Test

II. Match columns A to column B

A	B
1. Reversed Sense	**A.** Approximately 5 % of the available
2. Steps and inclines are streets	**B.** Digital street map data
3. Mixed Ranges	**C**. In over 300 instances, streets listed
4. Mixed Addresses	**D**. Approximately 20 percent of the street segments
5. Short Blocks	**E.** Approximately 1 % of the street segments

Note: **Satisfactory rating 3 & above points** **Unsatisfactory below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Information Sheet-2	Identifying construction types and dimensions

2.1. INTRODUCTION

Global Asset Protection Services (GAPS) uses various terms for describing types of building construction. Generally building construction falls into one of three basic types: fire resistive; non-combustible; and combustible etc. These are defined as follows:

2.2. Conventional construction building types

- ✓ **Type I. Fire resistive-** rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. This can be quantified simply as a measure of time, or it may entail a host of other criteria, involving other evidence of functionality or fitness for purpose. Fire-resistance rating: This is the other factor in determining construction class. The building materials used in the construction of the building elements above will have a fire-resistance rating. Fire-resistance rating typically means the duration for which a passive fire protection system can withstand a standard fire resistance test. This can be quantified simply as a measure of time (ex. 0 hours, 1 hour, or 2 hour), or it may entail a host of other criteria involving other evidence of functionality or fitness for purpose.

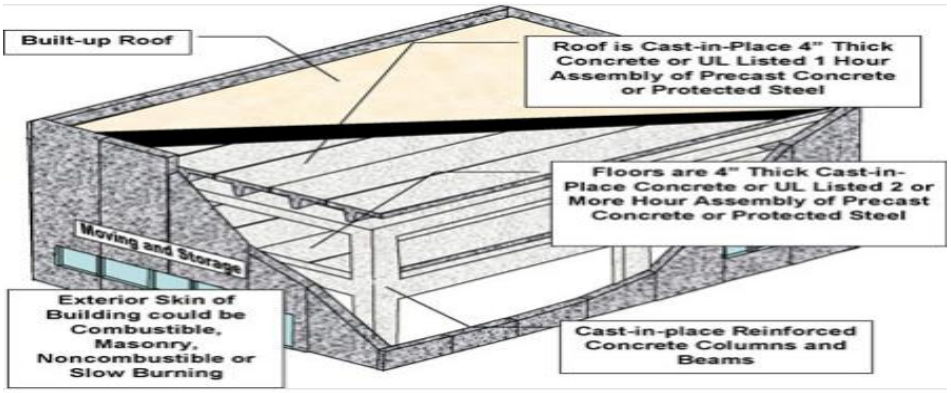


Figure 41: Fire resistive

- **Type II: Non-combustible-** buildings with exterior walls of masonry not less than four inches thick, or. buildings with exterior walls of fire-resistive construction with a rating of not less than one hour, and. Non-combustible or slow-burning floors and roofs regardless of the type of insulation on the roof surface.

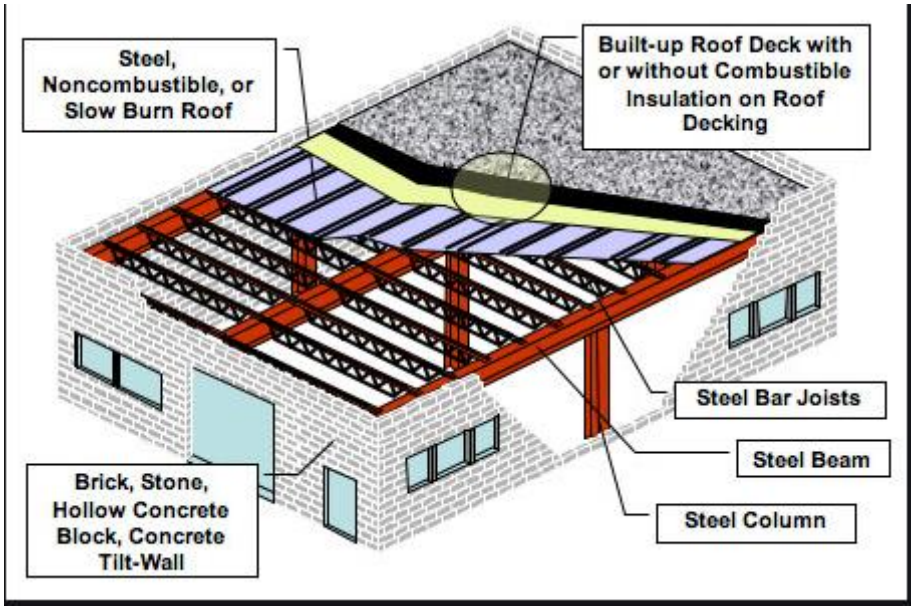


Figure 42: Non-combustible

- **Non-combustible calcified in to two**

- **Heavy Noncombustible-** Buildings are considered to be heavy noncombustible (HNC) if the main structural members are heavy rolled steel, structural shapes or composite structural steel units. A composite unit can be a plate girder or heavy truss fabricated from "I" or "H" shapes with channel and angle shapes for bracing. The floors are of noncombustible construction, normally concrete on steel beams. The roof is noncombustible, constructed of concrete or gypsum plank on steel beams and girders, or a metal deck without a covering or with a listed noncombustible covering. Walls are of noncombustible construction.
- **Light Noncombustible-** Metal deck, noncombustible and combustible construction is similar to light noncombustible where the floors and walls are noncombustible. This would also include those structures that have noncombustible, minimum 1 h fire rated; exterior walls covered with a listed foamed plastic insulation. The main difference between light noncombustible and metal deck is the construction of the roof. Metal deck construction has a built-up roof covering system over the metal deck.

- **Type III: Ordinary-** Ordinary construction is normally defined as walls constructed of unreinforced masonry and the frame, floors & roof constructed of wood.

Figure 43: Ordinary constriction

- ✓ Type IV: Heavy timber- are traditional methods of building with heavy timbers, creating structures using squared-off and carefully fitted and joined timbers with joints secured by large wooden pegs. It is commonplace in wooden buildings through the 19th century. If the structural frame of load-bearing timber is left exposed on the exterior of the building it may be referred to as half-timbered, and in many cases the infill between timbers will be used for decorative effect. The country most known for this kind of architecture is Germany. Timber framed houses are spread all over the country except in the southeast.

Figure 44: Heavy timber frame

Heavy timber construction is a building method that uses large, rustic, heavy sawn timbers or structural glue laminated lumber that is joined together with traditional mortise and tenon joinery or modern metal.

- **Type V: Wood frame/combustible-** is the most combustible of the five building types. The interior framing and exterior walls may be wood. A wood-frame building is the only one of the five types of construction that has combustible exterior walls. This is the typical single-family home construction method. These buildings are built with 2 x 4 or 2 x 6 studs and load-bearing walls, wood floor trusses, or wood floor joist and wood roof framing.

Figure 45: Wood frame construction

2.3. Dimensions of construction- A dimension is a numerical value expressed in an appropriate unit of measure. It is indicated on drawings along with lines, arrows, symbols, and notes to define the size and specification of an object.

Dimensioning is thus a process of incorporating numerical values onto a drawing to enable the sizing of different elements and the location of parts of a building or object. Drawings should be fully dimensioned so that a minimum of computation is required and all the parts can be built without having to scale the drawings to determine an object's size. Duplication of dimensions should whenever possible be avoided unless it adds clarity. Figure shows examples of different types of dimensions

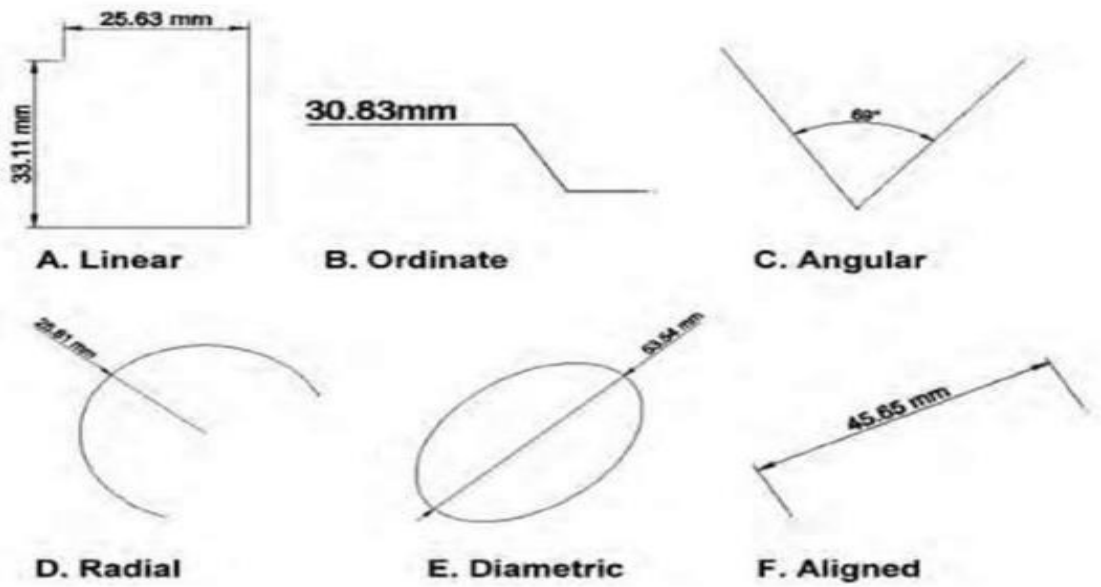


Figure 46: Diagram showing the different types of dimensions

Main entrance door of a residential **building** should be of 1000 mm x 2100 mm in size. Other doors should have a minimum width of 900 mm and a height of 2000 mm.

Size	Dimensions (in ft)	Dimensions (in m)
Small	10 × 12	3.04 x 3.65
Medium	12 × 16	3.65 x 4.87
Large	14 x 18	4.26 x 5.49

- **Good living room size-** A space of 12 x 18 ft (about 3.7 x 5.5m) would fit between 6 and 10 people in a conversation area with about 5 of the seats facing the TV (TV would be better placed in a corner on the fireplace wall than above the fireplace). There's room for 3-seater sofas in medium sized living rooms.
- **Normal size of a master bedroom-** fitted bedroom furniture is constructed in homes with less than 2500 square feet, the average size of the master bedroom is 14 feet by 16 feet or 224 square feet
- **Dimensions of a house-** Standard size house: A standard house size for a family of four people ranges between 60 and 84 square feet. The approximate measurements of the different environments are: - Bedrooms: 9 m² in area and the smaller side must be a minimum of 2.70 m. A double bed measures 1.90 m long and 1.50 m wide.

Figure 47: Dimensions of a house

Self-Check -2	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

I. Say true or false

1. Fire resistive rating typically means the duration for which a passive fire protection
2. Non-combustible construction is normally defined as walls constructed of unreinforced masonry and the frame, floors & roof constructed of wood.
3. Good living room size**-** A space of 120 x 180ft (about 300.7 x 500.5m)
4. The average size of the master bedroom is 14 feet by 16 feet or 224 square feet.
5. The interior framing and exterior walls may be wood.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer questions

Information Sheet-3	Identifying environmental controls and locations

3.1. Introduction

The degree to which individuals, groups or business units can modify and adapt features of their physical workplace to enhance work and business effectiveness. Environmental control provides many benefits

3.2. Environmental controls

The environmental monitoring of works and activities aims to temporarily monitor activities on site, throughout the duration of the works or the development of a project, following the guidelines set out in the proposed Corrective Action Plan and its corresponding Environmental Monitoring Plan.

During the execution of the works on should consider the monitoring of environmental aspects defined in the Environmental Monitoring Plan of the construction site: control of noise levels, control of the quality of water discharged, protection of the environment surrounding the construction site, quality control of extracted topsoil from the working site, etc.

Figure 48: Environmental

The assessment of expected impacts is based on the follow up of those monitoring parameters that determine the quality of all environmental vectors affected:

- **Air quality**- to communicate to the public how polluted the air currently is or how polluted it is forecast to become.

Figure 49: Unhealthy on the Air quality

- **Noise-** is unwanted sound judged to be unpleasant, loud or disruptive to hearing. From a physics standpoint, noise is indistinguishable from sound, as both are vibrations through a medium, such as air or water. The difference arises when the brain receives and perceives a sound.

Figure 50: Aircraft engine noise

- **Hydrology-** is the scientific study of the movement, distribution and management of water on Earth and other planets, including the water cycle, water resources and environmental watershed sustainability.

Figure 51: Water covers 70% of the Earth's surface

- **Geology-** is an earth science concerned with the solid Earth, the rocks of which it is composed, and the processes by which they change over time. Geology can also include the study of the solid features of any terrestrial planet or natural satellite such as Mars or the Moon.

Figure 52: Geological map

- **Geomorphology and soil edaphology-** is the scientific study of the origin and evolution of topographic and bathymetric features created by physical, chemical or biological processes operating at or near the Earth's surface.

Figure 53: Geomorphology

- **Vegetation and flora-** It is a general term, without specific reference to particular taka, life forms, structure, spatial extent, or any other specific botanical or geographic characteristics. It is broader than the term flora which refers to species composition.

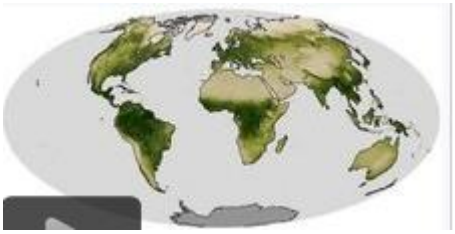


Figure 54: type of plants flora

- **Landscape-** is the visible features of an area of land, its landforms, and how they integrate with natural or man-made features.

  landscape includes the physical elements of geophysical defined landforms such as (ice-capped) mountains, hills, water bodies such as rivers, lakes, ponds and the sea, living elements of land cover including indigenous vegetation, human elements including different forms of land use, buildings, and structures, and transitory elements such as lighting and weather conditions.

Figure 55: Area Tropical rain and boreal forest

3.3. Construction Site - Map Location

A location is the place where a particular point or object exists. A place's absolute location is its exact place on Earth, often given in terms of latitude and longitude. For example, the Ethiopian State Building is located at 40.7 degrees north (latitude), 74 degrees west (longitude).

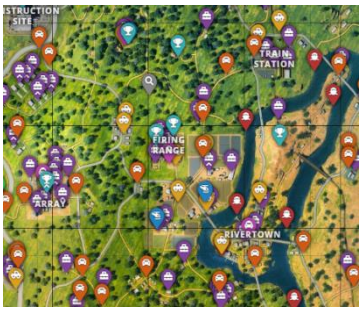


Figure 56: map Location

Self-Check -3	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

II.Say true or false for the following questions

1. The environmental controlling of works and activities aims to temporarily monitor activities on site.
2. Location is exact place on Earth, often given in terms of latitude and longitude
3. Urban planning is unwanted sound judged to be unpleasant, loud or disruptive to hearing.
4. Land uses to communicate to the public how polluted the air currently is or how polluted it is forecast to become.
5. Geology is an earth science concerned with the solid Earth

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer question

Information Sheet-4	Identifying location, dimensions and tolerances for ancillary works

4.1. Introduction

An ancillary area of a building is an area that supports the function/s of the primary areas, that is, it is not part of the primary purpose of the building, but is required in order that the primary purpose can function. Examples of ancillary areas include: Plant rooms. Cleaners' rooms

4.2. Identifying ancillary works

Construction works for utility projects for fluids Construction works for long-distance pipelines Construction works for local pipelines, including ancillary works Construction works for irrigation systems (canals), water mains and lines, water treatment plants, sewage disposal plants and pumping stations Water well drilling and septic system installation works Constructions and construction works for utility projects for electricity and telecommunications Utility constructions for electricity and telecommunications Long-distance electricity power lines and communication lines Local electricity power lines and communication line.

4.3. Location dimensions and tolerances

- ✓ For ancillary works are identified.

1 Job specifications are identified from drawings, notes and descriptions.

2 Standards of work, finishes and tolerances are identified from the project specifications

.

Self-Check -4	Written Test

Directions: Answer all the questions listed below. Use the Answer sheet provided in the next page:

III. Say true or false for the following questions

a. An ancillary area of a building is an area that supports the function/s of the primary areas.
b. Examples of ancillary areas include: Plant rooms. Cleaners' rooms.
c. Construction works for local pipelines, including ancillary works Construction works for irrigation systems.
d. Job specifications are identified from drawings, notes and descriptions
e. Standards of work, finishes and tolerances are identified from the project specifications.

Note: **Satisfactory rating - 3 points** **Unsatisfactory - below 3 points**

Answer Sheet

Score = _____

Rating: _____

Name: _____ Date: _____

Short answer questions

List of Reference Materials

1. Gittinger, J.Price (1982), Economic Analysis of Agricultural Projects (Rev.
2. 2nd Edn.), The John Hopkins University Press, Baltimore and London.
3. Mishra, S.N. (1984), Rural Development Planning – Design and Method,
4. Satvahan Publications, New Delhi.

Solar PV System Installation and Maintenance

Level-II

Learning Guide -31

Unit of Competence	**Read and interpret job specifications.**
Module Title	**Reading and interpreting job specifications.**
LG Code	EIS PIM2 M07 LO6 **LG-31**
TTLM Code	EIS PIM2 **TTLM 0120v1**

LO6:- Read and interpret job specifications.

Instruction Sheet	Learning Guide:-10

This learning guide is developed to provide you the necessary information regarding the following **content coverage** and topics

- Identifying job specifications
- Identifying standards of work, finishes and tolerances
- Identifying Material attributes from specifications.

This guide will also assist you to attain the learning outcome stated in the cover page.

Specifically, upon completion of this Learning Guide, **you will be able to:-**

- Identify job specifications
- Identify standards of work, finishes and tolerances
- Identify Material attributes from specifications.

Learning Instructions:

1. Read the specific objectives of this Learning Guide.
2. Follow the instructions described below 3 to 6.
3. Read the information written in the information Sheet 1, Sheet 2, Sheet 3, , in pages 94, 97 & 101 respectively.
4. Accomplish the Self-check 1, Self-check 2, Self-check 3, Self- in pages 96, 100 and 105 respectively
5. If you earned a satisfactory evaluation from the “Self-check” proceed to Operation Sheet--

Information Sheet-1	Identifying job specifications

1.1. SPECIFICATION

A specification is a written description of the building to be constructed. It supplements the information on the drawings and, like the drawings; it is a legal part of the contract between the client and the builder.

A specification might only be a few pages long for a small project such as an addition to a house, or it might be a multi-volume set of bound books for a big project such as a shopping mall or high-rise building.

Drawings are the best way to convey most of the information required for a building project, but a specification is needed to explain anything that cannot be included clearly in the drawings. Specifications are commonly used to communicate the following.

To provide instructions to the builder or trades people for how something is to be done. For example, drawings might show that internal walls are to have a plaster finish, but it is the specification that tells the plasterer how – 'bring walls to a reasonable flat surface by the application of a cement render float coat while the plaster is setting'. Instructions can also relate to regulations

To provide instructions to the builder about things that may not be part of the finished building but that nevertheless need to happen during the project – for example, safety barriers, disposal of rubbish or protection or adjoining properties.

Specifications usually include a clause about making good any damage to footpaths, fences and any other amenities in the vicinity of the project. There will also be a clause that deals with the general quality of the materials and workmanship to be used. Fixture and fittings to be used, where things like dimensions, color or model number are important.

The specification forms part of the Tender Documents and ultimately part of the Contract

Documents. These specification documents contain a general building specification, along with an accompanying Schedule or Supplement compiled to cater for the needs and requirements of the individual proprietors for their specific house. Items such as the following are spelt out in detail:

- Disposal of excavated materials
- Trees and other items to be protected
- Extent of drainage work
- Extent and finish to concrete
- Type and colour of bricks
- Type of floor sheeting, internal linings and ceilings
- Manufacture and type of door and window frames and sashes
- External and internal joinery designs, door hardware and furniture
- Sizes and details of internal fixing timbers

- Glazing types
- Extent of cupboards and wardrobes etc
- Roof sheeting material and sparking / sisalation
- Make and type of plumbing fixtures and fittings
- Extent of electrical work and type of switches and fittings throughout
- Extent of, type and quality of wall and floor tiling
- Other floor covering and finishes
- Painting and colour selection
- Prime cost items (P.C.I.s)
- Items to be supplied by the proprietor
- Details of other miscellaneous items to be supplied by the builder or the proprietor

This list is a cross section only. It includes the type of information expected to be detailed in a schedule or supplement to a standard builders/proprietors specification document and is not a comprehensive listing.

Self-Check -1	Written Test

I. Say True or False

---1. Drawings are the best way to convey most of the information required for a building project

---2. The specification documents reveal extent of electrical work and type of switches and fittings throughout

---3. A specification is a written description of the building to be constructed

Note: Satisfactory rating – 2 points and above Unsatisfactory - below 2 point

Answer Sheet

Score = _____

Rating:

Name: _____ Date: _____

Information Sheet-2	Identifying standards of work, finishes and tolerances

2.1. Construction Tolerances

Construction tolerances are provided to give the QA inspector an understanding of tolerances that are generally accepted in the construction industry. Any tolerances given in a contract, either directly or by reference, take precedence over generally accepted tolerances. All construction work has tolerances to allow for inherent variances in construction materials and workmanship skills. Many of these variances are an integral part of quality designs, which can be related to minimum required safety factors. Zero tolerance in construction is not feasible. Tolerance is defined as the:

- Permissible range of variation in a dimension of an object
- Permissible variation of an object in some characteristic such as hardness, density, or size
- Permissible deviation from plan alignment, location or grade Tolerances in construction are generally a variation in a dimension, construction limit, or physical characteristic of a material. They are a practical variation related to the function of the material or finished work and commonly accepted standards of the construction industry. Tolerances vary from a fraction of an inch to feet. There is, for example, a great deal of difference in the amount of acceptable tolerance in the invert of a cast-in-place conduit subject to cavitations velocities compared to overfill on an earth fill embankment. Experienced contractors know acceptable (industry standard) tolerances for various types of construction work and, unless advised otherwise, will expect to be permitted to operate within the limits of tolerances in which they are familiar.

The matter of job tolerances and good workmanship is a very important consideration in the inspection of construction work. The Resident Engineer must realize that weather, time, the construction methods and materials often control and even dictate the accuracy and quality of the completed job. Of course, some consideration should have been given to these items in the original preparation of the plans and specifications. Also good specifications will stipulate some working tolerances, which will assist the Resident Engineer. However, appreciation of job tolerances becomes primarily the problem of the Resident Engineer, who must decide and instruct his staff on the accuracy's to be expected of the Contractor on the various operations. This obviously requires experience and good judgment and should include such considerations as the function, stability and appearance of the work; the limits of workability of the materials being used, the mechanical limitations of first-class construction equipment to be used, etc. Probably the most common cause for controversies on the matter of job tolerances results from a Contractor using poor construction equipment or unskilled labour with which the desired final work cannot be produced. This generally requires a positive stand by the Resident Engineer and insistence that the Contractor either improves his present operations or gets something better on the job.

Some tolerances are provided in the Construction Specifications and in ASTM Standards used for testing. The other source for tolerances that construction personnel must be familiar with is the established common usage or practice that represents the industry

standard. The following listed tolerances identify the more significant categories of work with cited references and description. Specific tolerances do not have to be displayed on the drawings or in the specifications, but should be established for each job prior to construction. The designer, project engineer, and QA inspector should have a common understanding of what tolerances will be allowed. It must be recognized when making computations based on measurements involving tolerances that the results will only be as precise as the measurement. Therefore, the numerical precision used should be compatible and consistent with that of the measurement.

In computing test results, for instance, carrying out numbers to places beyond that required by the test procedure is time consuming, provides opportunities for making computational errors, and may imply accuracy that does not exist. It is essential to know the job requirements for accuracy and use the rounding rules that produce the appropriate significant digits in the computations.

Excavation

2.2. Common excavation:

a. **Foundation**—Cut at least to the grade designated on the plans with stable side slopes no steeper than specified. Additional depth by steepening the plan slopes may not be critical as long as this does not complicate dewatering or disposal of materials and the side slopes remain stable.

b. **Channel excavation**—the bottom grade should be at least to grade with possibly 0.5 foot below grade allowed. Drainage channels can typically be more generous on the over excavation due to initial siltation in the completed channel. Side slopes plus or minus 0.2 foot as long as humps or pockets are blended in

c. **Waterways and diversions**—a closer tolerance is needed here to control velocity and erosion. Plus or minus 0.2 foot in the bottom grade may be allowed, as long as ponding does not occur. Side slopes plus or minus 0.2 foot as long as humps or pockets are blended in.

d. **Principal spillway trench**—Bottom grade should be close to that specified. A tolerance, usually plus or minus 0.10 foot, should be sufficient to lay the pipe to grade without excessive shimming, adjusting, or excavation to get the full cradle or bedding section under the pipe.

The principal spillway pipe should be placed within plus or minus 0.05 foot of grade without any unspecified grade reversals.

e. **Auxiliary spillways**—the control or level section must be to plus or minus 0.10 foot (NRCS Technical Release 52). The inlet section is not critical, and plus or minus 0.30 foot will have little effect on function. The outlet channel should have the grade maintained lengthwise throughout the cross section to a tolerance of plus 0.10 foot and minus 0.20 foot. However, it is important that this section not vary significantly from plus or minus 0.10 foot from one side of the outlet channel to the other side.

2.3. **Rock excavation** :

a. Foundation—generally, conformity of rock surface is more important than final line and grade. A tolerance of plus 0.5 foot to minus 1.0 foot is reasonable in most rock. Dental concrete is often needed to gain conformity of surfaces.

b. Principal spillway trench and similar structure foundations—Closer tolerances due to a structure require plus 0.10 foot to minus 0.5 foot. This can be followed by dental concrete for minor adjustments and regular concrete for a pipe sub cradle or working pad to maintain grade.

c. Auxiliary spillway—the tolerance for the level control section needs to be close, about plus 0.10 foot and minus 0.15 foot. If a concrete sill or a control crest is used, tolerance in the level section can be plus or minus 0.05 foot. The inlet channel can be plus 0.5 foot to minus 1.5 foot. The outlet needs to be plus 0.20 foot to minus 0.50 foot lengthwise and plus or minus 0.20 foot from one side to the other side of any given cross section. Where over excavation is required to remove unsuitable materials, it should be directed by the engineer and is typically handled as follows: at the level section, concrete should be used as required in other structural excavation situations. When the rock is to be covered with topsoil and vegetated, use compacted soils with medium plasticity to produce a dense flow-resistant material.

- **Earth fill**

  Finished fill slopes uniformity of grade from top to bottom and across slope is primarily for appearance and aesthetic considerations. Gradual changes of plus or minus 0.3 foot from plan line and grade are considered acceptable if overall appearance is acceptable.

- **Finish work:**

Construction work phase that provides an attractive, completed appearance and provides protection to the building. Finish work includes enclosing interior walls and ceilings, installing finished flooring, cabinetry, doors, mouldings, cover interior and exterior surfaces, and completing plumbing, HVAC, electrical, and communication systems.

Procedures internal wall plastering layers of base coat plastering in finished brick walls tied. This layer is important because it will absorb water from the layers of finish coat that will plastering then that the wall does not look wet .this layer is also aimed at levelling the brick wall bond that are less flat.

Layer finish coat of plaster will plastering later on at thickness of ½' to 1' depending on the uniformity of the wall using a finishing trowel.

Finally, the layers of plaster will plastering with a layer of oil. This mixture consists of masonry cement and water. This layer that will highlight the aesthetic features of buildings constructed. After the layers of cement slurry plastering, it will be painted with water using a brush to paint fine lines formed at the wall to retain moisture in the plastering. This is necessary so that the paint will stick to the walls painted

Figure 57: Martials finish work

Self-Check -2	Written Test

I. Say True or False

---1. Tolerance is the permissible range of variation in a dimension of an object

---2. Finish work **in** Construction work phase, provides an attractive, completed appearance.

----3. Zero tolerance in construction is not feasible

Note: Satisfactory rating – 2 points and above Unsatisfactory - below 2 point

Answer Sheet

Score = _____

Rating:

Name: _____ Date: _____

Information Sheet-3	Identifying Material attributes from specifications

3.1. INTRODUCTION

Materials management is a vital function for improving productivity in construction projects. The management of materials should be considered at all the phases of the construction process and throughout the construction and production periods. This is because poor materials management can often affect the overall construction time, quality and budget. It is important for planning and controlling of materials to ensure that the right quality and quantity of materials and installed equipment are appropriately specified in a timely manner, obtained at a reasonable cost, and are available when needed.

Definition of Construction Material Management: Material management is defined as planning, identification, procuring, storage, receiving and distribution of materials.

The purpose of material management is to assure that the right materials are in the right place, in the right quantise when needed. The responsibility of material management department for the flow of materials from the time the materials are ordered, received, and stored until they are used in the basis of material management.

- Aim of Material Management is to get:
  - ✓ The Right quality
  - ✓ Right quantity of supplies
  - ✓ At the Right time
  - ✓ At the Right place
  - ✓ For the Right cost
- Objectives and Functions of Materials Management Primary objectives can be classified as:
  - ✓ Efficient materials planning,
  - ✓ Buying or Purchasing,
  - ✓ Procuring and receiving
  - ✓ Storing and inventory control
  - ✓ Supply and distribution of materials
  - ✓ Quality assurance
- Secondary Objectives of Materials Management :
  - ✓ Efficient production scheduling
  - ✓ To take make or buy decisions
  - ✓ Prepare specifications and standization of materials
  - ✓ To assist in product design and development
  - ✓ Forecasting demand and quantity of materials requirements
  - ✓ Quality control of materials purchased
  - ✓ Material handling
  - ✓ Use of value analysis and value engineering
  - ✓ Developing skills of workers in materials management
  - ✓ Smooth flow of materials in and out of the organization

3.2. Classification of Construction Material

- **Material Type Details**: Example, Bulk materials; materials that are delivered in mass and are deposited in a container: sand, gravel, topsoil, cement,
  Concrete Bagged materials: Materials delivered in bags for ease of handling and controlled use. Cement Pelleted bagged materials that are placed in pallets for delivery cement.

- **Doors packaged materials:** materials that are packaged together to prevent damage during transportation and deterioration when they are stored. Pipes, tiles, Electrical fitting various construction materials.

- **Process of Construction Material Management** : material planning, materials handling & traffic variety . . . purchasing, store keeping, inventory control receiving, inspection and despatching value analysis, standardization and variety reduction, disposal of scrap and surplus material preservation

- **Material Planning**; Materials planning include measuring, ordering and scheduling. It is emphasized that planning is a very important process to increase the productivity, profit, and assisting the time to complete the construction projects. The productivity of the construction project will be hanged if the material planning process is not implemented properly.

- **Purchasing**: Purchase the materials and have the services from supplier to get the support of operations as the construction project from production to marketing, sales and logistics. For examples, a detailed material list and co-ordination of the purchasing and order of material are significant to assuring the material will available on construction site.
  Purchasing procedure can be described as below:

  Step 1 – Material Indent

  Step 2 – Enquiry to Vendors

  Step 3 – Vendor Comparison

  Step 4 – Vendor Selection and Negotiations

  Step 5 – Purchase Order

  Step 6 – Vendor Evaluation

- **Inventory control department**: The duties of the inventory control department is to decide about the types of ordering system, fixing the safety stock limits, fixing up the reorder level & maximum / minimum stock level.
- **Receiving, inspection and despatching department:** The responsibility of receiving, inspection and despatching department is to receive the materials when delivered by the suppliers. After receiving it, the quantity and quality must be checked. Production parts and materials are checked against blueprints and specifications. Non-production items are also reviewed. When once it is as per the specifications given, the goods will be accepted
- **The Value Analysis and Standardization** the Value Analysis and Standardization offer greatest scope, in reducing the materials cost. It also reduce the number of varieties and also helps in finding the substitute for the materials at lesser cost.
- **Logistics**: Logistics is a concept that stresses movement of the materials and it involve planning, implementing, and controlling the movement and storage of all things from raw materials to the finished for the product to meet client requirements. During construction project, routing of the materials will affect the cost and time to complete the construction projects.
- **Disposal of scrap and surplus material preservation:** Stock control can categorize as a technique planned to be the cover and to ensure all materials or equipment are available when needed. Stock control include raw materials, processed materials, assembly components, consumable stores, general stores, maintenance materials and spares, work in progress and finished products. It is very important as the construction materials were delivery as requested and with the progression by the proper management of stock control.

At the same time, construction activities will generate big amount of the waste and it will cause difficulty to the construction industry. However, with the planning of the material management which is effective will help to reduce the waste of material and increase the profit of the companies.

Problems of Material Management: Organization structure; the coordination and communication between estimating department, research and development department, purchasing department, and plant and machineries department should be maintained at highest level. Main issues in organisation structure: undefined scope, lack of communication between parties involved, incomplete drawings, plans are not completed and details are missing, lack of conformance to requirements , nonstandard specifications that are not commonly used , incomplete / ineffective meetings , difference between plans and specifications , don't communicate exactly.

- **Procurement problem** : Availability of material ,availability of quantity, Price reduction to match competitor's price ,late deliveries materials are not delivered as per schedule ,late or incorrect submittals, Poor communication between parties lack of conformance to requirements , unrealistic delivery dates , re handling of materials ,storage areas are limited or are far from working area ,theft or damaging during handling or other conditions
- **Storage Space**: Large number of materials is required depending on the magnitude of the project. The term storage space implies both enclosed and open space that can be used to keep materials of work safe until the need for it arise. All materials need protection against many threats such as pilferage, theft, damage or loss. Material such as aggregates, bricks/blocks may not require enclosed storage protection than proper outdoor positioning and stacking. However, other materials such as reinforcement bars, steel columns, timber, and galvanized steel for trusses must be protected against contact with water in order to avoid rust/corrosion. The size of proposed building may occupy 60% of the total project site, enabling the remaining 40% to be used for temporary access and site facilities. In such case, the planners must arrange for periodic delivery of certain materials to avoid cluttering the space, and maintain constant operation to keep the security problem. Security of materials onsite is of paramount importance. Gradual pilferage and theft are issues of concern to the project managers. Loss of materials through pilferage and theft represent financial lost to the project as a whole, and in the end it increases the cost of the project. Materials are prone to be stolen despite being in store. And some materials as earlier mentioned may not require indoor storage. Therefore, a well designated vigilante must be maintained 24 hours onsite.
- **Availability of Materials on Market**: Steady flow of materials throughout project duration is among the primary function of material management. However, this can be affected by market availability of the material of work. Occasionally manufacturers can run out of raw material or be affected by government policy to the extent that production may have to be slow or suspended. Unavailability of materials of work on market can affect material management by either increasing competition in material purchase or delay the general work progress.
- **Importance of Materials Management** : Lower prices for material and equipment ,faster inventory turnover, continuity of supply ,reduced lead time , reduced transportation cost, less duplication of efforts, elimination of bulk- passing, reduced materials obsolescence,

improved supplier relationship and better records and information, better inter-department cooperation & personnel development

- **Advantages of Materials Management**: The better accountability part of the material, as well as other departments and no one can blame others. As materials management by a single authority, this can lead to better coordination, because it became the central point of any substance-related problems. Materials management departments to ensure better quality materials provide a request in a timely fashion department. This can lead to a better performance of the organization. A materials management system is usually controlled through a system, therefore, can help decision-making related to the material in the organization. An indirect use of materials management is the development of good quality material, ethical and moral standards in an organization. Maximum company profit and improvement of credibility improved customer service, enhancement of communication, improved quality of staff. Inventory Control for Quantitative Analysis Definition: Inventory control can be defined as, “which ensures the supply of required quantity and quality of inventory at the required time and at the same time prevent unnecessary investment in inventories”
- **Objectives of Inventory Control**: to ensure that the supply of raw material & finished goods will remain continuous so that production process is not halted and demands of customers are duly met; to minimise carrying cost of inventory; to keep investment in inventory at optimum level; to reduce the losses of theft, obsolescence & wastage etc, to make arrangement for sale of slow moving items, ,to minimise inventory ordering cost.
- **Main Techniques in Inventory Control**: The Pareto principle states that 80% of the overall consumption value is based on only 20% of total items. In other words, demand is not evenly distributed between items: top sellers vastly outperform the rest. The ABC approach states that, when reviewing inventory, a company should rate items from A to C, basing its ratings on the following rules:
- **ABC Analysis:** The ABC (Always Better Control) inventory control technique is based on the principle that a small portion of the items may typically represent the bulk of money value of the total inventory in construction process, while a relatively large number of items may from a small part of the money value of stores. The money value is ascertained by multiplying the quantity of material of each item by its unit price.
- **Procedure for ABC Analysis :**

  - Make the list of all items of inventory.
  - Determine the annual volume of usage & money value of each item.
  - Multiply each item’s annual volume by its rupee value.
  - Compute each item’s percentage of the total inventory in terms of annual usage.
  - “A” Category – 5% to 10% of the items represent 70% to 75% of the money value.
  - “B” Category – 15% to 20% of the items represent 15% to 20% of the money.
  - “C” Category – The remaining number of the items represent 5% to 10% of the money value.

  The relative position of these items show that items of category A should be under the maximum control, items of category B may not be given that much attention and item C may be under a loose control.

Self-Check -3	Written Test

I. Say True or False

---1. The purpose of material management is to assure that the right materials are in the right place, in the right quantise when needed.

---2. The importance of materials management is reduced materials obsolescence.

---3. Materials planning include measuring, ordering and scheduling.

Note: Satisfactory rating – 2 points and above Unsatisfactory - below 2 point

Answer Sheet

Score = _____

Rating:

Name: _____ Date: _____