



CITY SCHOOLS DIVISION OF DASMARIÑAS

TLE

TECHNICAL DRAFTING



TLE

Technical Drafting

QUARTER 3

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Guide in Using Learner's Learning Resource

For the Parents/Guardian

This learning resource is designed to assist you as the learning facilitator at home. It provides you with activities and lessons' information that the learners need to accomplish in a distance learning modality.

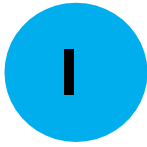
For the Learner

This learning resource is designed to guide you in your independent learning activities at your own pace and time. This also aims to help you acquire the competencies required by the Department of Education (DepEd) at the comfort of your home.

You are expected to answer all activities on separate sheets of paper and submit the outputs to your respective teachers on the time and date agreed upon.

LESSON 1

Draft Structural Layout and Details



What I need to know?

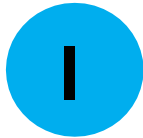
LO 1. Draft foundation plans (*TLE_ICTTD912SL-IIIa-b-1*)

- Indicate the locations of wall footings, footings and columns in drafting the floor plan.
- Draw in a larger scale details of wall footings, footings and columns.

This lesson is designed to help you prepare a layout of a good foundation plan design based on architectural drafting standards.

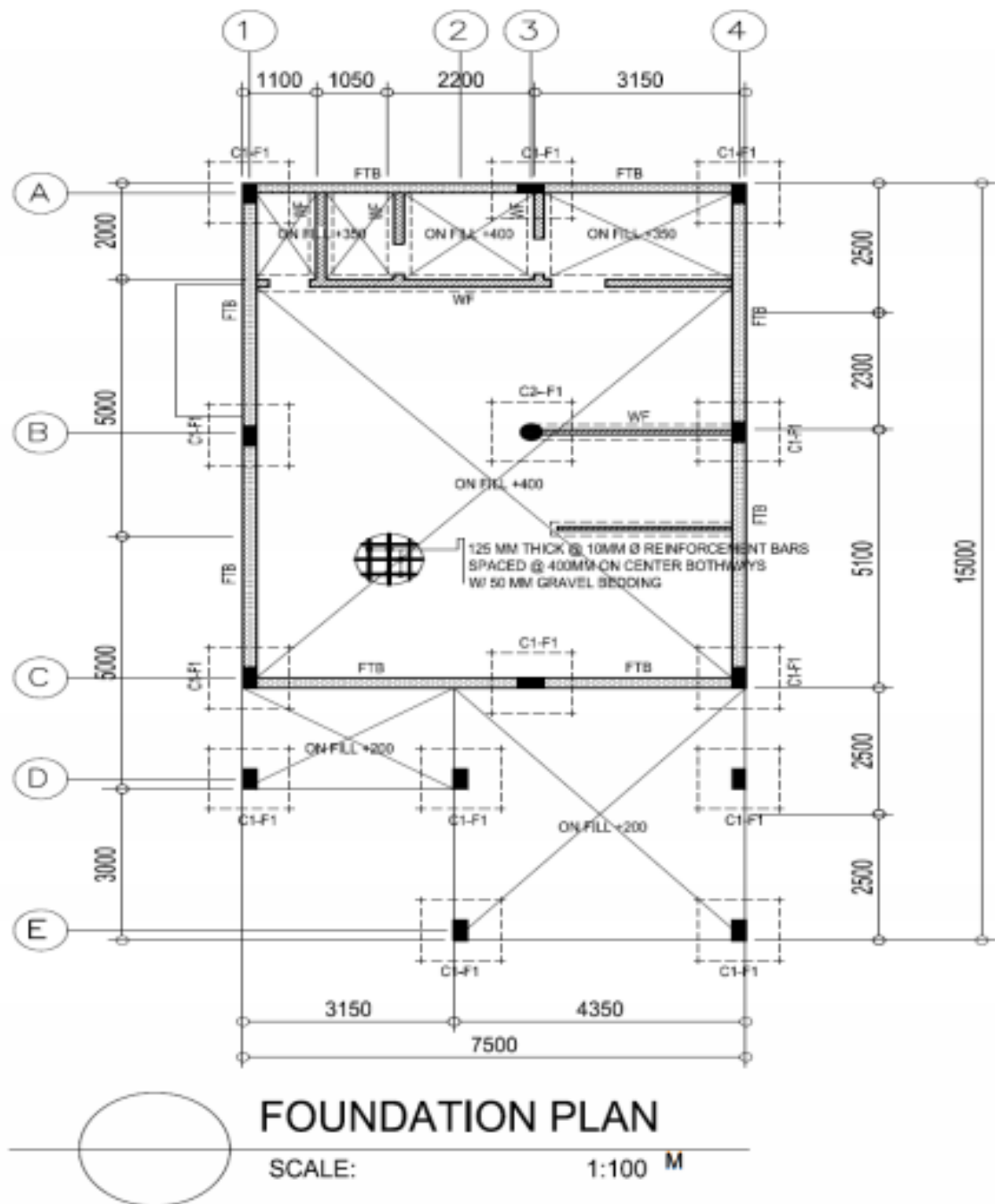
After going through this learning resource, you are expected to:

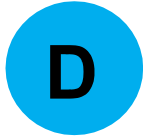
1. identify the different types of foundation
2. recognize the foundation members
3. draw details of columns and footings
4. draft foundation plan.



What's new?

The foundation plan is a plan view drawing, in section, showing the location and size of footings, piers, columns, foundation walls, and supporting beams. The foundation plan is drawn from information presented on the floor plan, plot plan, and elevation plan drawings.





What I know?

Learning Task 1: Pre-test

Choose the letter of the best answer. Write the letter of your answer on a separate sheet of paper.

- _____ 1. Distributes the weight of a building over large area.
a. Foundation b. lintel c. pier d. walls
- _____ 2. Footing which supports a wall by extending along the entire length of the wall is _____.
a. cantilever footing b. isolated footing
c. combined footing d. wall footing
- _____ 3. Footing which supports two-column loads or sometimes three-column loads not in a row.
a. cantilever footing b. isolated footing
c. combined footing d. wall footing
- _____ 4. Footing which supports a row of three or more columns is _____.
a. cantilever footing b. continuous footing
c. combined footing d. wall footing
- _____ 5. Footing which supports a wall by extending along the entire length of the wall
a. cantilever footing b. isolated footing
c. combined footing d. wall footing
- _____ 6. The most common type of reinforced concrete floor system
a. flat slab b. ribbed floor
c. one-way solid slab d. two-way solid slab
- _____ 7. Supports two-column loads and consists of two footings connected together by a beam often called strap.
a. cantilever footing b. isolated footing
c. combined footing d. wall footing
- _____ 8. Refers to the load (combined total weight) of people
a. dead load b. live load c. load bearing d. wind load
- _____ 9. Usually built after the completion of the main structural framework of the dwelling unit.
a. ceiling b. post c. stairway d. wall construction
- _____ 10. Amorphous silica cement that hardens as silica gel by reacting chemically with alkali in water.
a. pozzolan cement b. union cement
c. northern cement d. standard cement



What is in?

Learning Task 2: Stop and Think

Look at the figure below and answer the essential questions.



1. What does the picture imply?
2. What are the reasons of structure collapses?
3. How does having a good and suitable foundation affect the building design and its strength?

Foundations are important components in the construction of a building. The function of foundation is to transfer structural loads from a building safely into the ground.

PURPOSES OF FOUNDATION

1. To distribute the weight of the structural over large area to bring down the intensity of load at its base below the safe bearing capacity of the sub-soil.
2. To support the structures.
3. To distribute the non-uniform load of the super structure, uniform to the sub-soil.

CAUSES OF FOUNDATION MOVEMENT

There are instances wherein foundation may settle or move. The movement of the foundation may be due to the following causes.

1. **Soil bearing capacity failure** are defined as foundation failure that occurs when a share stresses in soil exceed the shear strength of the soil.



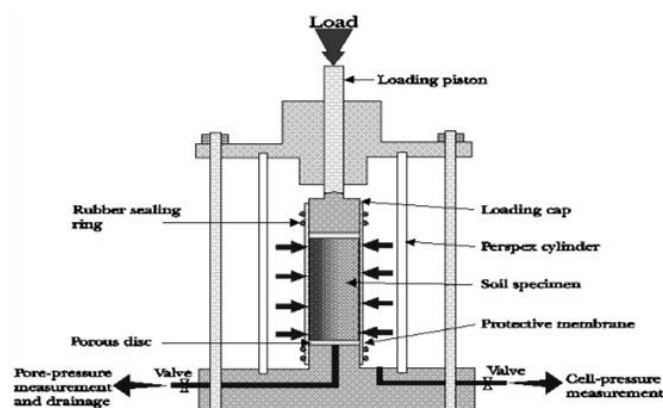
2. **Failure or deflection of the foundation structure**

There is a difference between a deflection and failure of foundation, according to Roddies. A limited deflection and settlement in foundation that cause certain amount of cracking could be a deflection. A failure, on the other hand, is caused by an excessive settlement and deflection that can cause serious damage to ceiling, floor finishing and partitions of home.



3. **Shear distortion of the soil** The shear stresses prevent collapse and help to support the geotechnical structure. Shear stress may cause volume change. Failure will occur when the shear stress exceeds the limiting shear stress (strength).

4. **Compression of the soil** There are other factors that contribute to the settlement of the foundation but these are indirectly related to the superstructure load imposed on the soil.

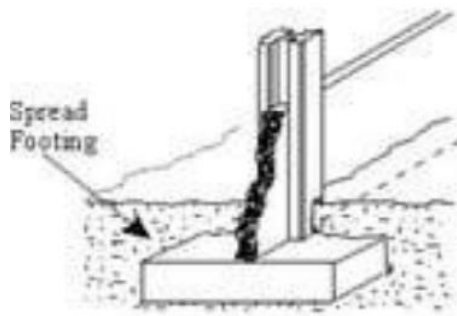


D

What is it?

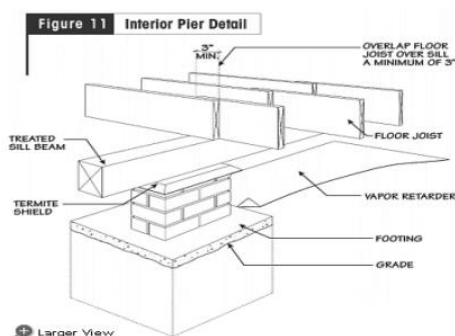
TYPES OF FOUNDATION

1. **Spread Foundation** includes all those types where the load is distributed into the soil by slender vertical members of timber, concrete, or steel called piles.

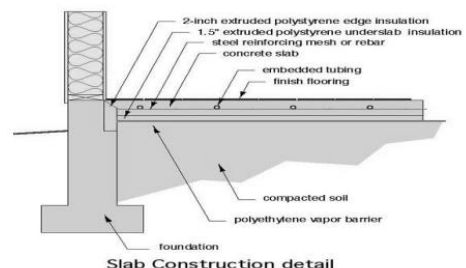


Sample Spread Foundation

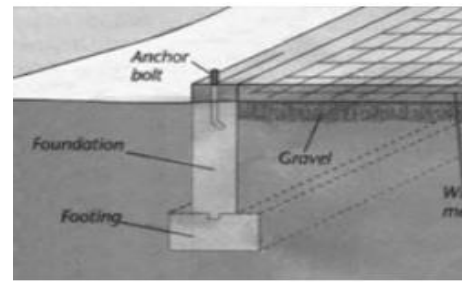
2. **Pier Foundation** is the one where the load is distributed into the soil by slender vertical members of timber, concrete or steel called piles. It is in this foundation where concrete piers are carried down through the soil of inadequate bearing power until a satisfactory foundation bed is reached.



3. **Slab Foundation** is a solid slab of concrete poured directly on the ground with footings placed where extra support is needed.



4. **T- Foundation** - consists of a footing upon which is placed a concrete wall or a concrete block wall forming an inverted T. This type of foundation is popular in structures with basement.



T-Shaped

Image source:concretenetwork.com

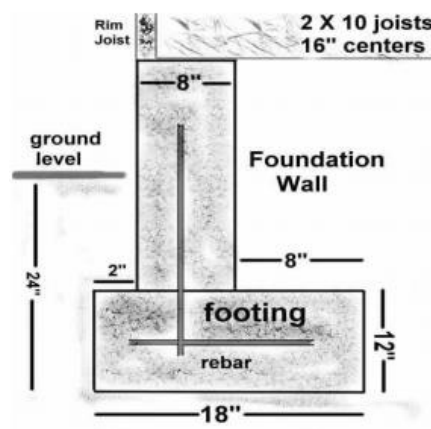
5. **Mat Foundation** - assembles a mat in that the foundation is spread over the entire area of the building floor.



FOUNDATION MEMBERS

The structural members of the foundation vary according to the design and size of the foundation.

1. **Footing** – is a portion of the foundation of a structure which directly distributes the weight of a building over large area. Concrete is commonly used for footings because it can be poured to maintain a firm contact with the supporting soil.



2. **Foundation walls** - the function of the foundation wall is to support the load of the building above the ground line and to transmit the weight of the house to the footing.



3. **Piers and Columns** - are vertical members usually made of concrete, brick, steel, or wood. They are used to support the floor systems and can be used as sole support of the structure.

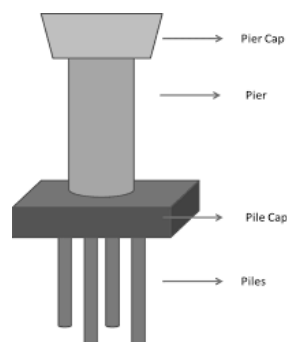


Image source: civiltoday.com

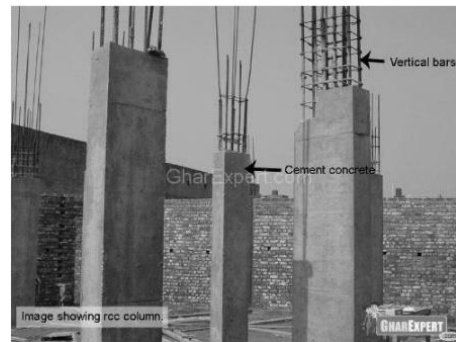
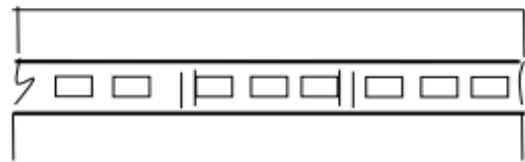


Image source: gharexpert.com

Footings and columns carry the load of the building resting on the foundation.

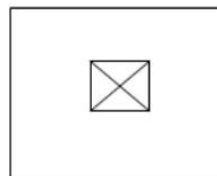
KINDS OF FOOTINGS

1. **Wall footing** is a footing which supports a wall by extending along the entire length of the wall.



Wall Footing

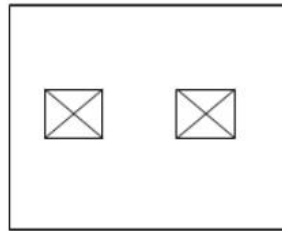
2. **Isolated footing** is one which supports a single column, post, pier, or other concentrated load.



Isolated Column Footing



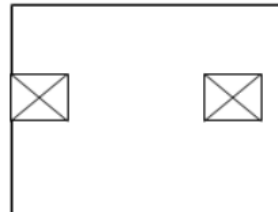
3. Combined footing is one which supports two column loads, or sometimes three column loads not in a row.



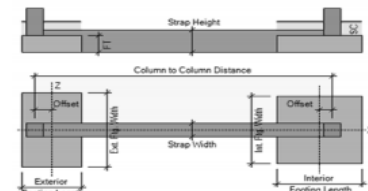
Combined Column Footing



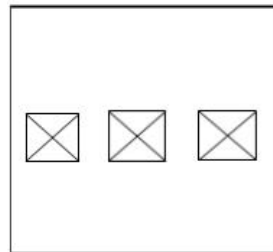
4. Cantilever footing is one which supports two column loads and consists of two footings connected by a beam often called a strap.



Cantilever Footing



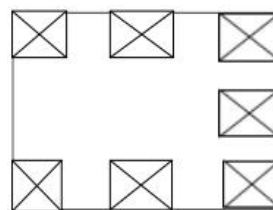
5. Continuous footing is one which supports a row of three or more columns.



Continuous Footing



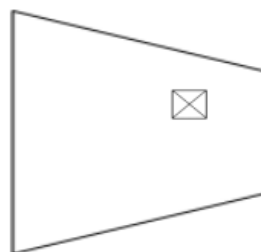
6. Raft or mat footing is one which extends under the entire building area and supports all the wall and column loads from the building.



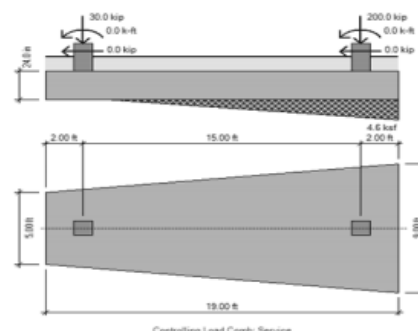
Raft or Mat Footing

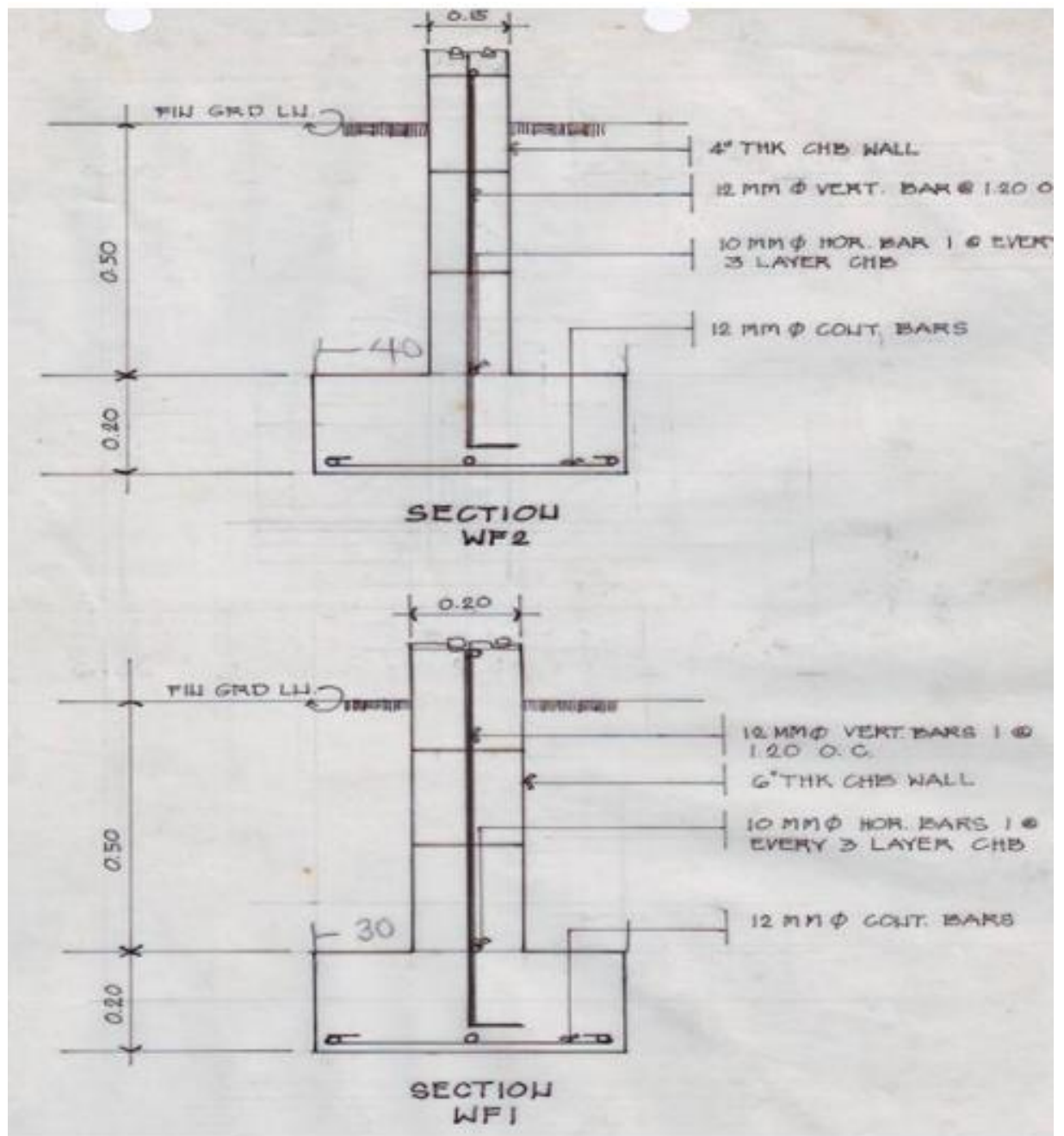


7. Trapezoidal footing which may be used to carry two columns of unequal loads when distance outside the column of the heaviest load is limited.

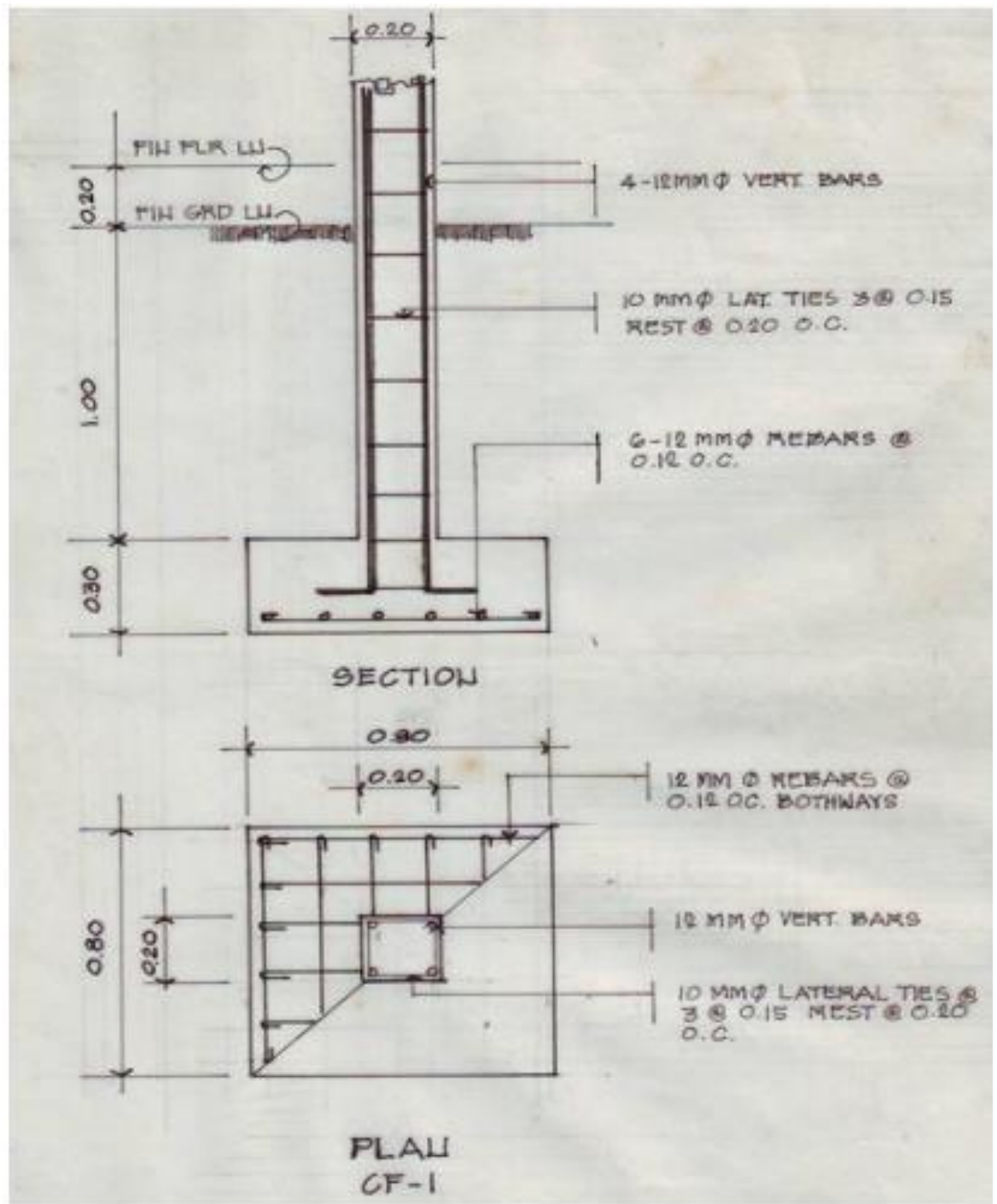


Trapezoidal Footing

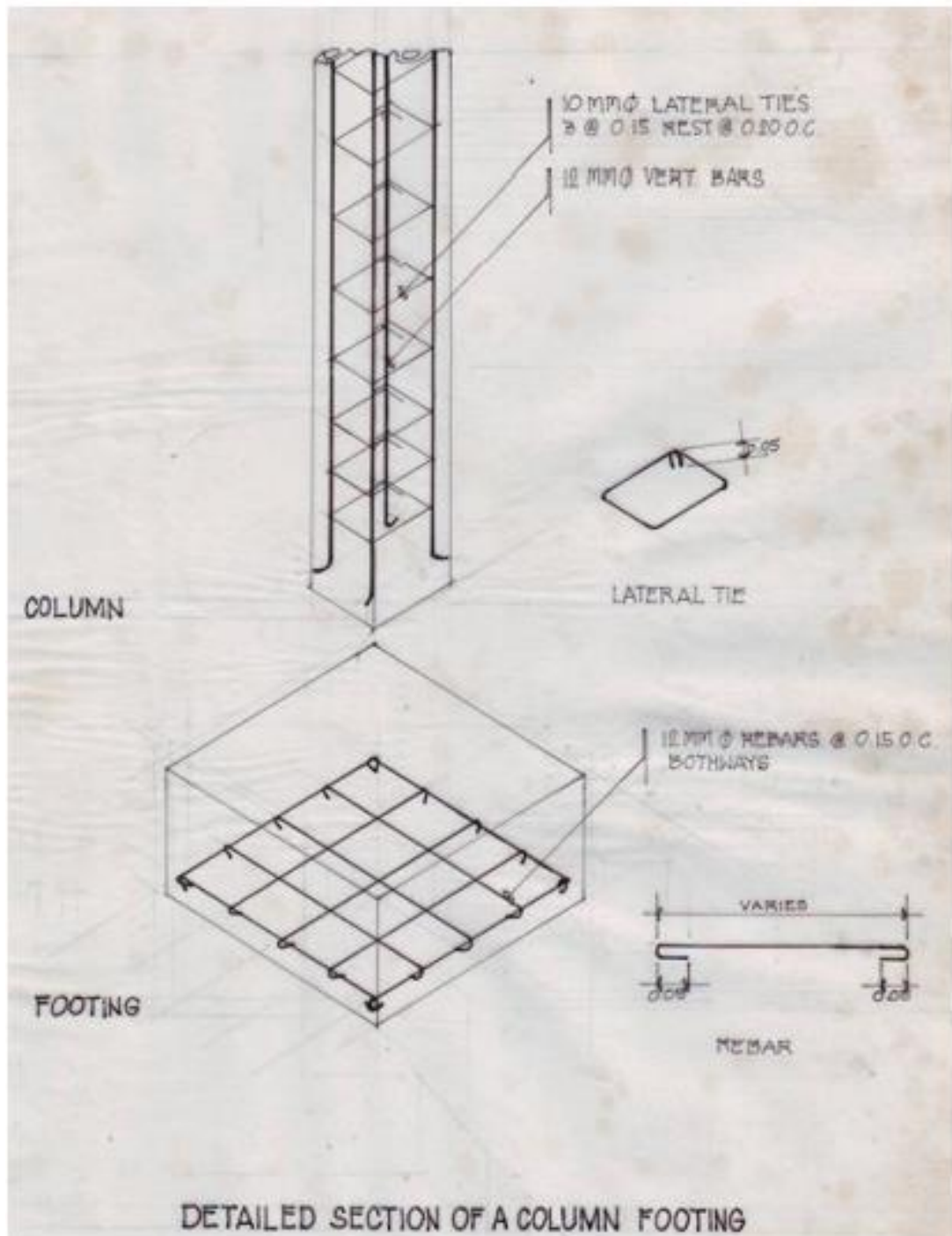




DETAIL OF WALL FOOTING



DETAIL OF COLUMN FOOTING



E

What is more?

Learning Task 3: Name Me!

I. Read each item carefully. Identify the correct answer for each item.

- _____ 1. A type of foundation where the load is distributed into the soil by slender vertical members of timber, concrete or steel called piles.
- _____ 2. It consists of a footing upon which is placed a concrete wall or a concrete block wall forming an inverted T.
- _____ 3. It includes all those types where the load is distributed into the soil by slender vertical members of timber, concrete, or steel called piles.
- _____ 4. It assembles a mat in that the foundation is spread over the entire area of the building floor.
- _____ 5. It is a solid slab of concrete poured directly on the ground with footings placed where extra support is needed.
- _____ 6. Failure will occur when the shear stress exceeds the limiting shear stress
- _____ 7. These are indirectly related to the superstructure load imposed on the soil.
- _____ 8. A failure that occurs when a share stresses in soil exceed the shear strength of the soil.
- _____ 9. It is caused by an excessive settlement and deflection that can cause serious damage to ceiling, floor finishing and partitions at home.
- _____ 10. Its function is to transfer structural loads from a building safely into the ground.

A. Enumerate the following.

- Give the three (3) foundation members
- What are the (3) purposes of foundation

II. Match the kinds of footings in Column A with its corresponding picture in Column B.

A

1. Cantilever footing
2. Trapezoidal footing
3. Wall footing
4. Combined footing
5. Isolated footing
6. Continuous footing
7. Mat footing

B

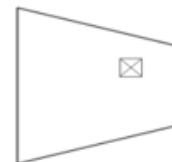
a.



b.



c.



d.



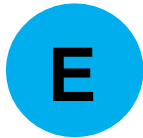
e.



f.



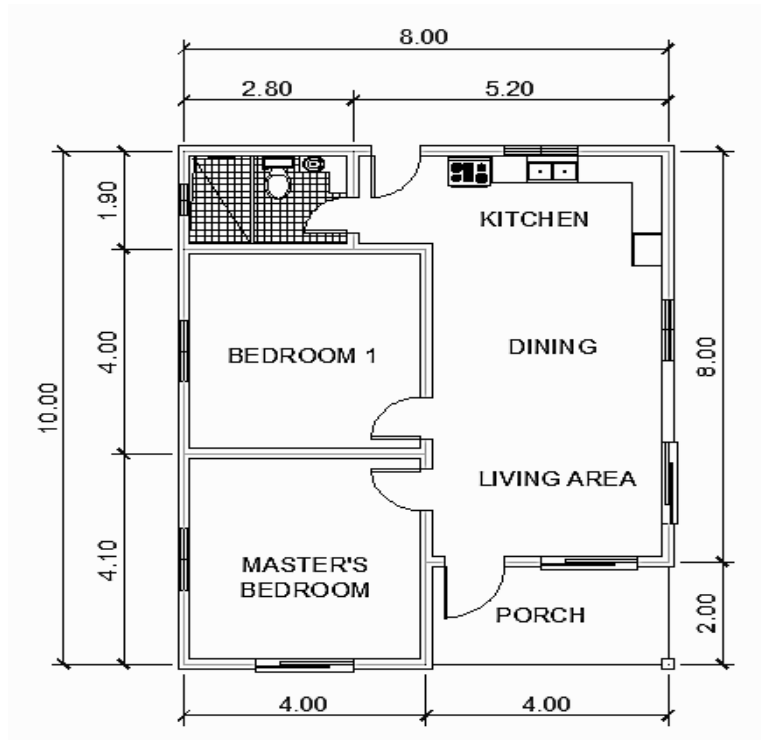
g.



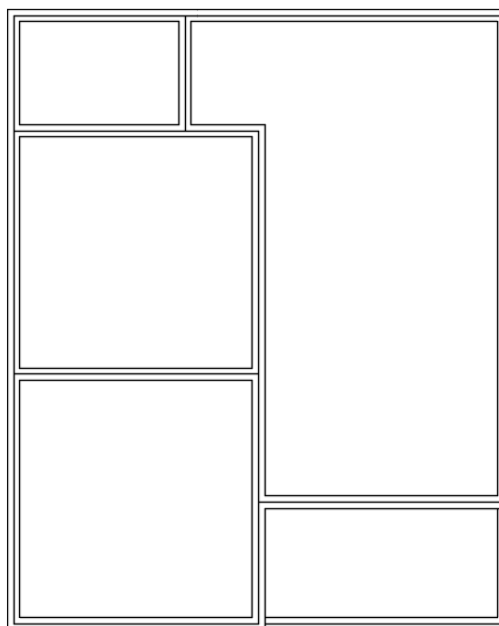
What I can do?

The following are the steps in drawing a roof plan.

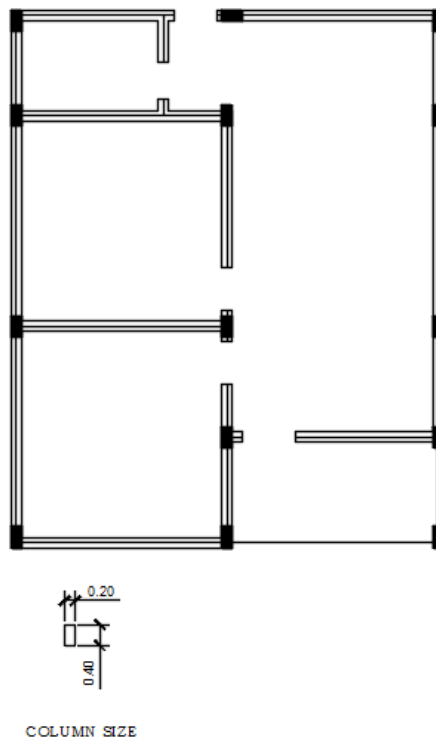
1. Given: A scaled floor plan.



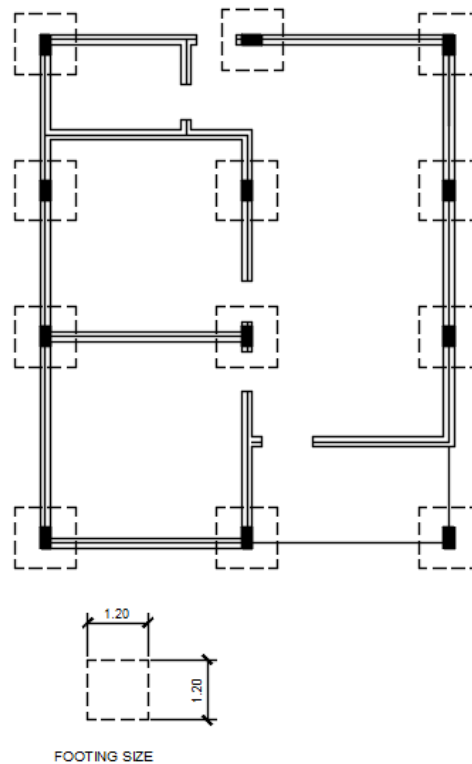
2. Draw or trace the given scaled floor plan using solid lines without doors and windows for the perimeter.



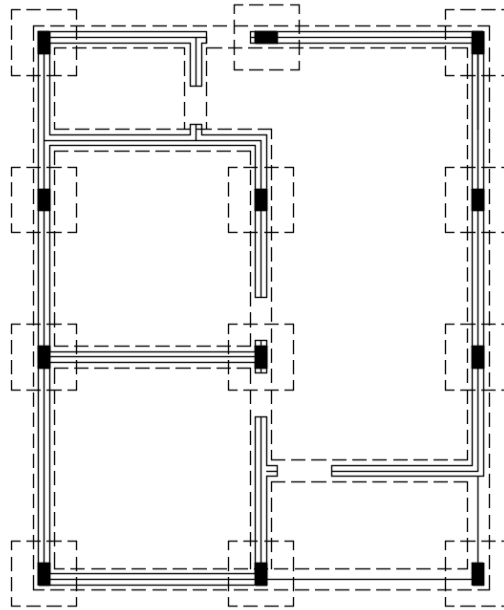
3. Assign 0.2 m. x 0.4 m. column.



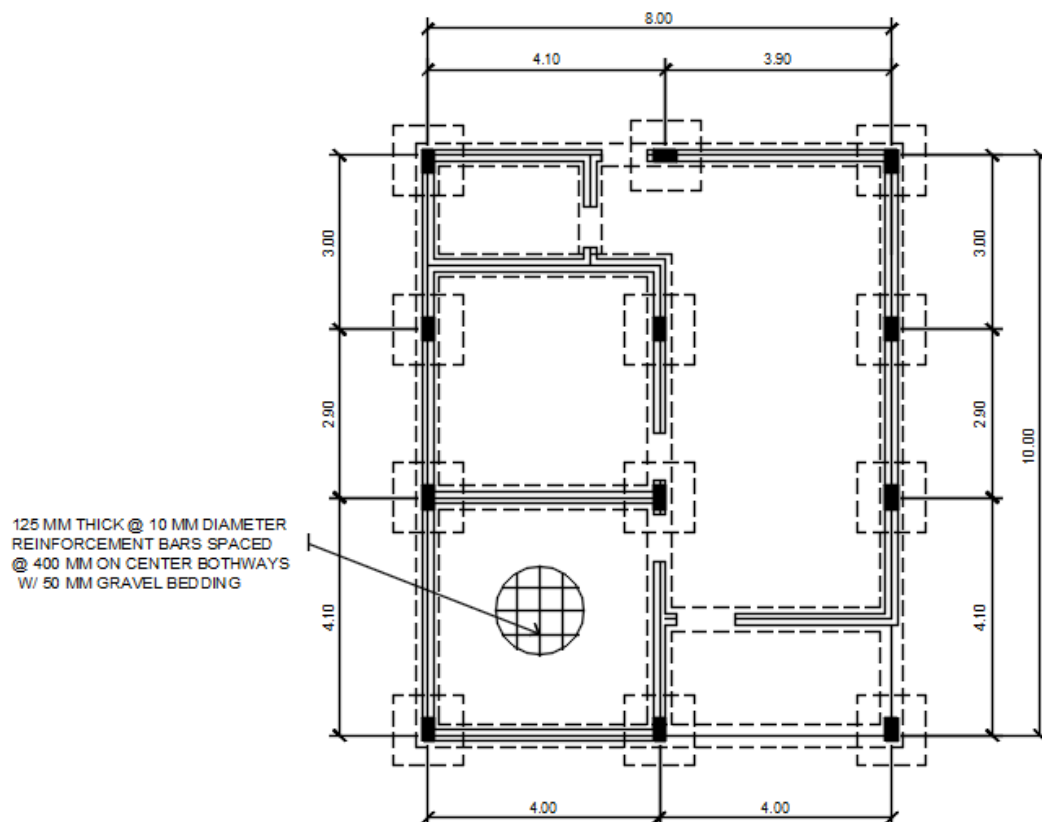
4. Assign 1.20 m. x 1.20 m. footing aligned with the column.



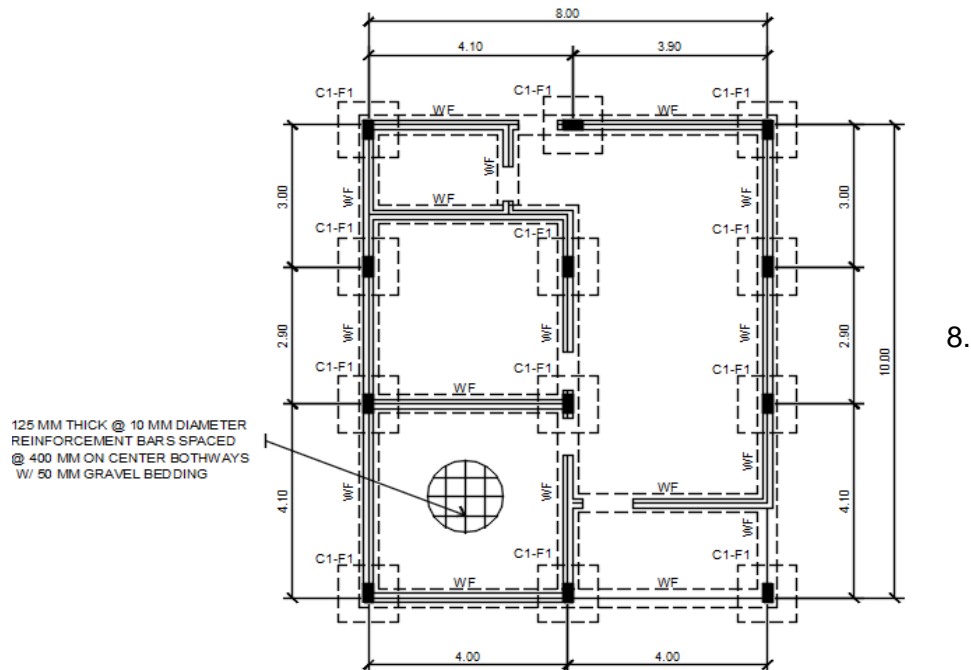
5. Draw a hidden line for wall foundation with a distance of 0.4 m.



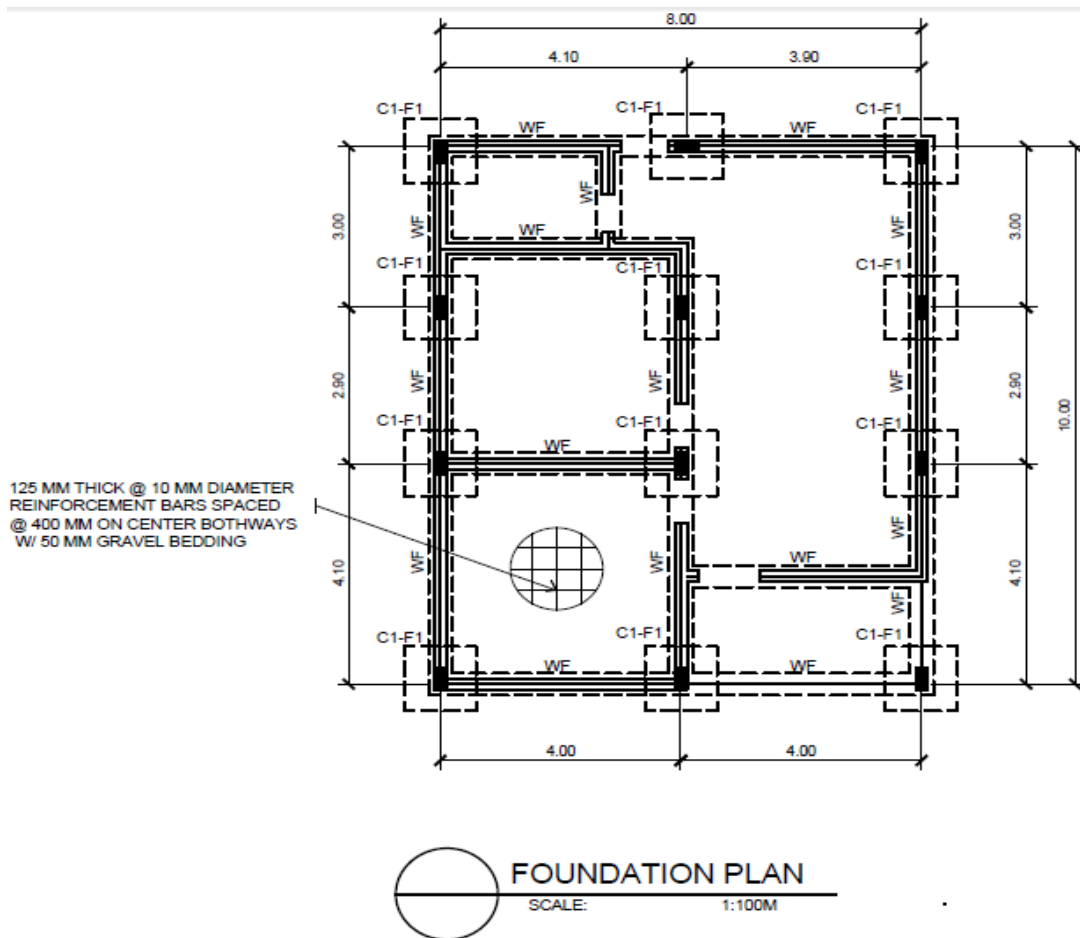
6. Put dimensions, from one column to another column.



7. Complete the plan by putting labels. Follow the abbreviations;
 *C1 – F1 – for Column 1- Footing 1, *WF – for wall footing



Finalize the plan by supplying the drawing title and scale used in the drawing.





What else can I do?

Learning Task 4: Draft a Foundation Plan

Materials Needed:

- Oslo Paper
- Triangle/ruler/T-square
- Pencil and eraser
- Templates

Instructions:

- Using the floor plan below, draft a foundation plan by following the steps previously discussed. Follow the given requirements and specifications below.



GROUND FLOOR PLAN
SCALE 1:100



SECOND FLOOR PLAN
SCALE 1:100

- 0.20 m. x 0.40 m. column size
- 1.20 m. x 1.20 m. footing size
- 0.40 m. wall footing distance

- Use 1:100 scale.
- Label and dimension your plan, as necessary.

Your output will be evaluated according to the following criteria.

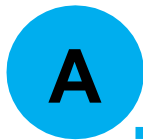
Criteria	7 points	5 points	3 points
Line Technique /Layout	All lines were drawn according to standards and drawing was laid out properly	At least 3-5 lines were not drawn according to standards and drawing was laid out fairly well	More than 5 lines were not drawn according to standards and drawing was improperly laid out
Accuracy	All measurements and notations/symbols needed were accurately done	At least 3-5 measurements and notations/symbols needed were inaccurately done	More than 5 measurements and notations/symbols needed were inaccurately done
Criteria	3 points	2 points	1 point
Neatness	Finished output was neatly done, with no erasures nor any smudges	Erasures/smudges are observable on the finished output	Finished output has so many erasures/smudges present
Time Management	Finish the task ahead of the given time/date	Finish the task on the given time/date	Unable to finish the task on the given time/date



What have I learned?

1. The foundation plan is a plan view drawing, in section, showing the location and size of footings, piers, columns, foundation walls, and supporting beams.
2. The foundation plan is drawn from information presented on the floor plan, plot plan, and elevation plan drawings.
3. The purposes of foundation is to distribute the weight of the structure over a large area, support structures and distribute the non-uniform load of the supe structure.
4. The movement of foundation maybe caused by soil-bearing capacity failure, failure or deflection of the foundation structure, shear distortion and compression of the soil.
5. The types of foundation are spread, slab, pier, mat and T-foundation.
6. The foundation members consist of footing, column or pier and foundation walls.
7. The structural members of the foundation vary according to the design and size of the foundation.

8. The kinds of footings are wall footing, isolated, combined, cantilever, continuous, raft or mat footing and trapezoidal footing.
9. The floor plan should be the main basis in planning and designing a plan.



What can I achieve?

Learning Task 5: Posttest

Read each item carefully. Choose the letter of the best answer and write it on a separate sheet of paper.

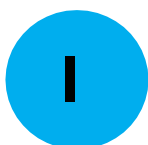
1. The pressure intensity beneath the footing depends upon _____.
 - A. Rigidity of the footing
 - B. Soil type
 - C. Condition of the soil
 - D. All the above
2. When do combined footings are used in foundation?
 - A. To transfer load of an isolated column
 - B. Distance between the columns is long.
 - C. Two column loads are unequal.
 - D. All the mentioned
3. The following are the purposes of a foundation EXCEPT for one.
 - A. To support structure
 - B. To offer protection from the elements for people
 - C. To distribute non-uniform load of the structure
 - D. To distribute the weight of the structure over a large area
4. What is the cause of foundation's movement when a share stresses in soil exceed the shear strength of the soil?
 - A. Compression of the soil
 - B. Distortion of the soil
 - C. Soil bearing capacity failure
 - D. Deflection of the foundation structure
5. What type of footing is used in the picture?
 - A. Continuous footing
 - B. Cantilever footing
 - C. Isolated footing
 - D. Trapezoidal footing



6. Which of the following is a member of a Foundation?
 A. Column B. Truss C. Tiles D. Stairs
7. Arrange the steps in drafting a foundation plan.
I. Assign 0.2 m. x 0.4 m. column.
II. Draw or trace the given scaled floor plan using hidden lines without doors and windows
III. Complete the working drawing by supplying the required dimensions with proper dimensioning and labels
IV. Assign 1.20 m. x 1.20 m. footing aligned with the column.
V. Draw a hidden line for wall foundation with a distance of 0.4 m.
- A. V, IV, III, II, I B. IV, I, III, V, II C. II, I, IV, V, III D. II, IV, V, I, III
8. Which of the following is the standard size of column for residential unit?
 A. 0.2 m. x 0.4 m. B. 1.2 m. x 1.2 m. C. 0.1 m. x 0.2 m D. 8m. x 8 m.
9. What does WF means in foundation plan?
 A. Wall foundation B. Water flow C. Waste flow D. Wet foundation
10. Which of the following is not a type of footing?
 A. Wall C. Truss
 B. Isolated D. Mat

LESSON 2

Draft Floor Framing Plan



What I need to know?

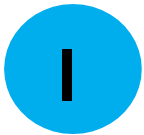
LO 2. Draft structural floor framing plans (TLE_ICTTD9-12SL-IIIc-e-2)

- Draft structural floor framing plans based on floor and foundation plans using timber, concrete, or steel construction.
- Draft structural floor showing sizes, shapes, and detailed connections.

This lesson is designed to guide you to be familiar to the different features as well as the standards in drawing a floor framing plan.

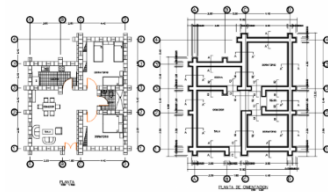
After going through this learning resource, you are expected to:

1. identify the different types of floor systems;
2. recognize bars sizes used in constructions and
3. draft floor framing plan.



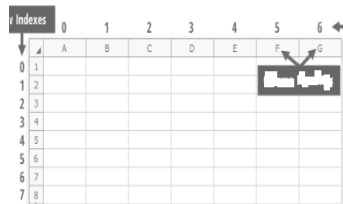
What is new?

Learning Task 1: 2PICs 1 WORD. Shown are two photos in a grid, both of which share a common word. Figure out the common word based on word length, which is provided to you, and a selection of possible letters. Write your answers on separate sheets of paper.



1.

UTAFOINOND



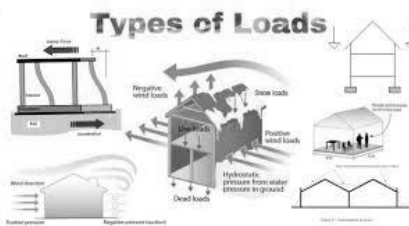
2.

MONCLU



3.

OINOTGF



4.

ADSOL



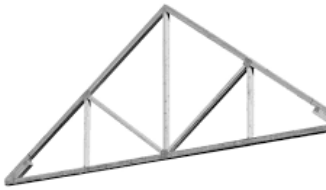
5.

TEELS



6.

IHP



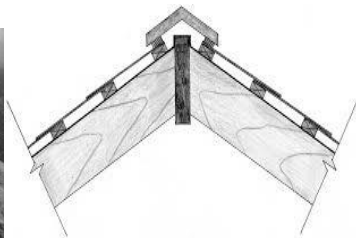
7.

RSUTS



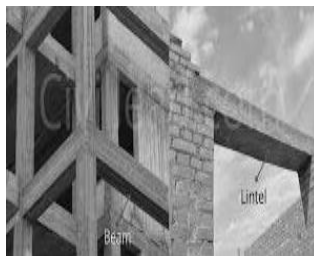
8.

LVEYLA



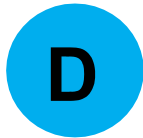
9.

GEIDR



10.

AEMB



What I know?

Learning Task 2: Fill Me In!

A. **Directions:** Fill in the blanks with the correct answers. Write your answers on a separate sheet of paper.

- _____ 1. It is a material other than cement that is used as ingredient in concrete.
- _____ 2. It is the bonding agent that reacts with water to form a stone hard substance.
- _____ 3. It is an artificial stone as a result of mixing cement, fine, and coarse aggregates and water.
- _____ 4. Supports the transverse load with each end resting on a support.
- _____ 5. A load consists of combined total weight of people.
- _____ 6. The most common reinforcement for construction is the steel bar.
- _____ 7. Walls that support or carry loads as in exterior walls.
- _____ 8. The minimum clear distance between adjacent steel bars shall not be less than ____.
- _____ 9. Refers to the load or strength of the wind.
- _____ 10. These are sold or bought specifically by their length.

Learning Task 3:

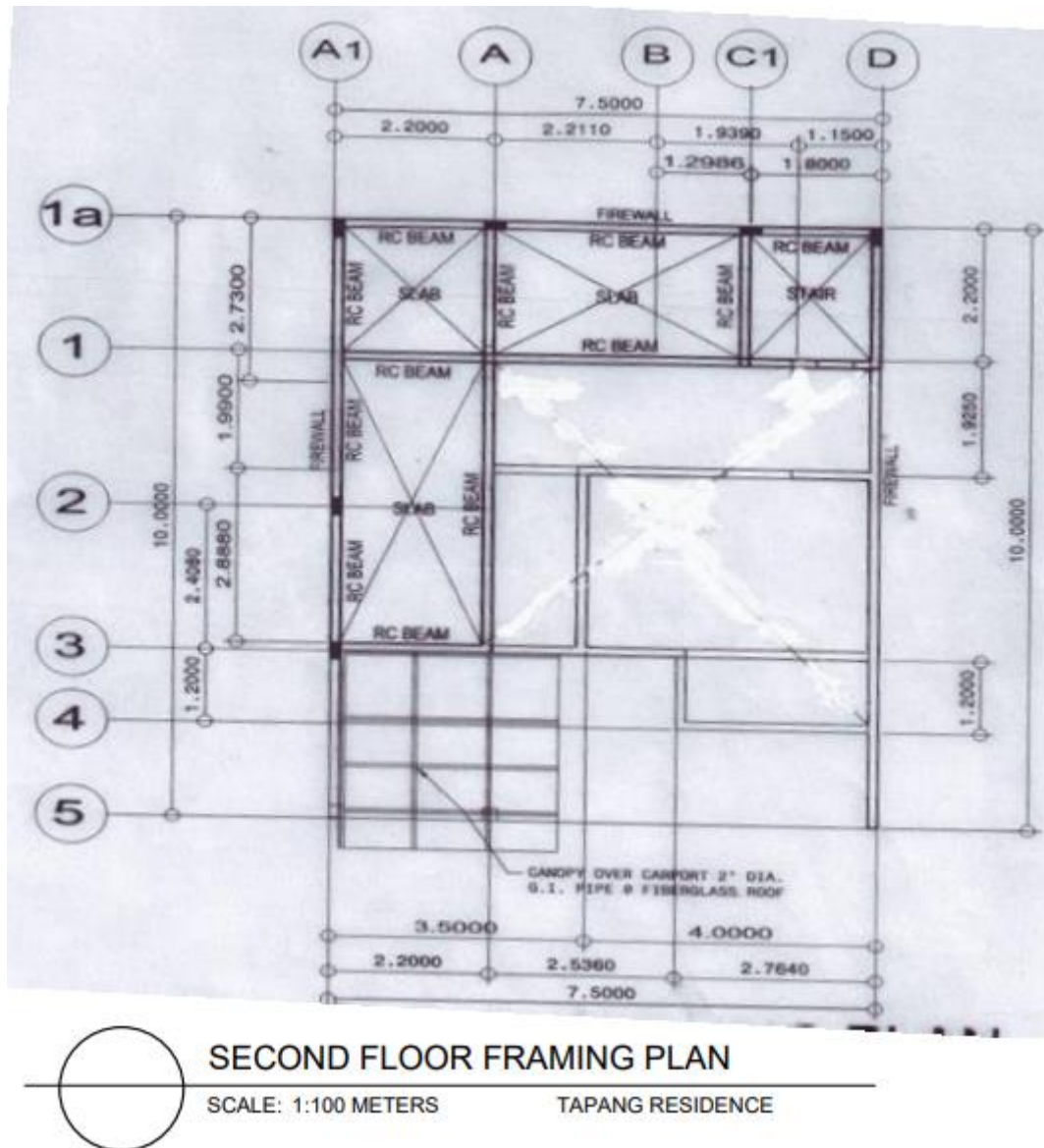
Essential Questions: In your own words, explain and answer the questions below. Write your answers on a separate sheet of paper.

- 1. What do you think are the importance of structural design? List down at least 3 importance of structural design.
- 2. Why do we need to Draft Floor Framing Plan before its construction?

D

What is it?

Floor Framing Plans provide structural information such as spacing and direction, as well as the floor heights and stair openings.



Concrete

The structural members of a building are constructed using concrete, which is an artificial stone. It is a result of mixing cement, fine and coarse aggregates, and water. This is known as plain concrete. If there is a reinforcement embedded in order that they act together in resisting forces, it is called reinforced concrete.

Cement is the bonding agent that reacts with water to form a stone-hard substance. It is of two types: the hydraulic cement and the Portland cement.

Joseph Aydin introduced Portland cement in 1824. Portland cement is categorized as to its type, whether for general construction or where high early strength or resistance is required. Pozzolana cement is amorphous silica that hardens as silica gel by reacting chemically with alkali in water. The name is derived from Pozzolona, Italy where this was found.

Water suitable for drinking is satisfactory for concrete mixing. Admixture, on the other hand is a material other than cement that is used as ingredient in concrete, before or during mixing. The ability of concrete to flow freely and fill all voids is known as workability of the concrete mixture. Workability is sometimes described as consistency, plasticity, and mobility. Consistency is the degree of wetness or slump while plasticity refers to the ease with which fresh concrete is molded and mobility refers to the flow or movement of the mixture. Concrete should be proportioned correctly to obtain a good mixture required for a particular work. The strength of concrete is measured in its ability to resist stresses such as compressive, tensile flexural, and shearing stress.

Concrete Proportion:

The right proportioning of the ingredients in concrete provides a balance for economy, workability, strength, durability, and appearance.

Class of Mixture	Cement 40 kg.	Sand		Gravel	
		Cu.Ft.	Cu.M.	Cu.Ft.	Cu.M.
AA	1	1 ½	.043	3	.085
A	1	2.0	.057	4	.113
B	1	2 ½	.071	5	.142
C	1	3.0	.085	6	.170

Concrete for building construction is mixed in two different ways:

1. On the job site – hand mixing
2. Ready mixed concrete – by mobile or stationary mixers

Concrete hardens or settles at about two to three hours after the concrete has been mixed. The hardening of concrete depends upon the chemical reaction between the cement and water. The building code provides that concrete shall be maintained above 10°C temperature for at least 7 days after placing and three days for high early strength concrete.

Reinforced Concrete

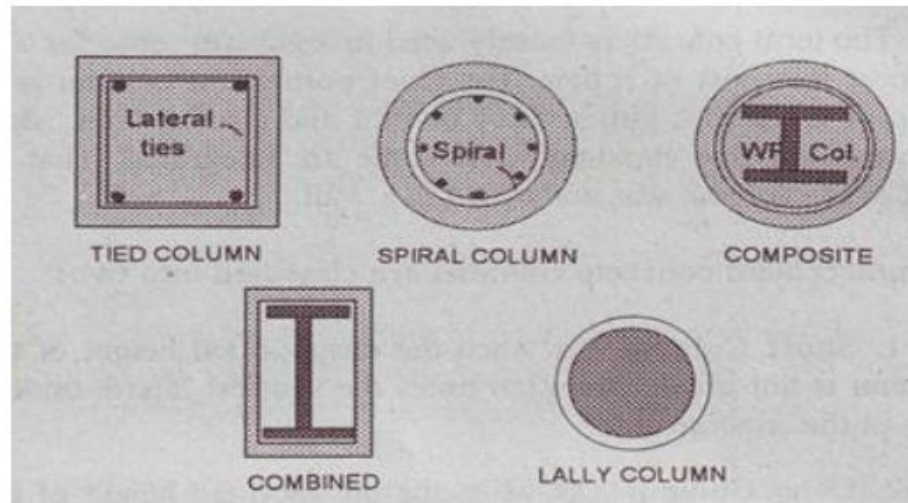
It is a concrete with reinforcement bars embedded. The columns and the footings are the most common examples of a reinforced concrete. The main purpose of a column is to support a beam or girder, floor or roof. Reinforced concrete columns are of two kinds.

1. *Short column* – unsupported height is not greater than 10 times the shortest lateral dimension of the cross section.

2. *Long column* – unsupported height is more than 10 times.

Columns are classified according to the types of reinforcement:

1. Tied column reinforcement
2. Spiral reinforcement
3. Composite reinforcement
4. Combined reinforcement
5. Lally column reinforcement



The Reinforced Concrete Floor

The floor system of a building refers to the girders, beams, and the floor slab. The floor slab carries both the live and dead load, that is, the human occupants and all unmovable objects. These loads are transmitted to the beams then to the columns.

A beam supports the transverse load with each end resting on a support while girder is a beam that supports one or more smaller beams. Beams are classified as simple, continuous, and semi-continuous beam while cantilever beams are supported on one end and the other projecting beyond the support.

A concrete beam even if forced from carrying live or concentrated load has to carry its own weight. This is the distributed load and the gravitational effect of its own weight will cause the structure to sag or bend. On the other hand, a bending moment is the tendency of a force to cause rotation at an axis. It is classified as positive and negative bending.

The Reinforced Concrete Slab

Reinforced concrete slab is classified as:

1. One-way solid slab
2. Two-way solid slab
3. Ribbed floor
4. Flat slab or Girder less floor.

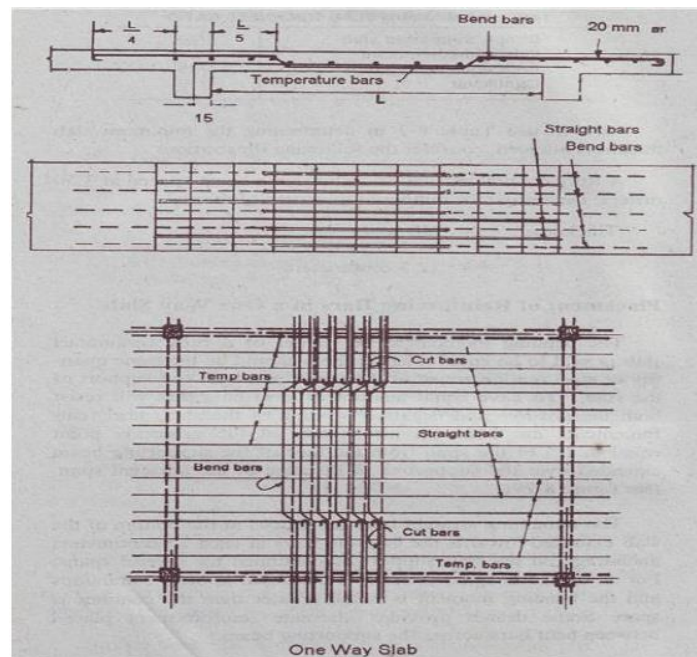
The type of floor system has its advantages depending on these considerations:

1. Spacing of column
2. The magnitude of the loads to be supported
3. The length of the span
4. Cost of construction

A *one-way slab* is the most common type of reinforced concrete floor system. This is supported by two parallel beams. Unlike beams and girders, the floor slab needs no web reinforcements. The bending moment of a slab at the center is equal, hence the same quantity of reinforcement should be at the center and at support.

The American Concrete Institute code provides that the thickness of the slab shall not be less than 10cm nor less than the perimeter of the slab divided by 180. The reinforcement shall not be more than 3 times the slab thickness and the ratio of reinforcement shall be at least 0.0025.

The other most common type of slab used in building residential dwelling is the *two-way slab* where all four sides are supported, either by beams or girders, the reinforcement bars are placed in two directions at right angle to each other. The reinforcement transmits the load of the floor to the side support



Reinforced Steel Bars

The most common reinforcement for most construction is the steel bar. It is designed to act together with concrete in carrying the building load even in simultaneous deformation; otherwise, it might slip out from the concrete if there is no sufficient bond.

Steel can be structurally used in two ways; as reinforcement whereby it is pre-assembled before concrete pouring; and as stressed steel, where heavy tension forces are applied before pouring.

Originally, steel bars were in English measure and their diameters were standardized from $\frac{1}{4}$ ", $\frac{3}{8}$ ", $\frac{1}{2}$ ", $\frac{3}{4}$ " . etc. For convenience, a number is assigned for each size such as no. 2 for $\frac{1}{4}$ and so on.

Bar Spacing

The spacing of bars shall be in accordance with the provisions of the American Concrete I:

1. The minimum clear distances between adjacent steel bars shall not be less than 25 mm.
2. When beam reinforcements are placed in two layers the clear distance shall be 25 mm.
3. Lateral ties shall be no.3 bars spaced 16 times the longitudinal bar diameter.
4. The clear spacing between spirals shall not exceed 7.5 or less than 2.5 cm. 10 mm minimum diameter.

Bar Splicing, Cutting, and Bending

In building construction, tension bars may be spliced by:

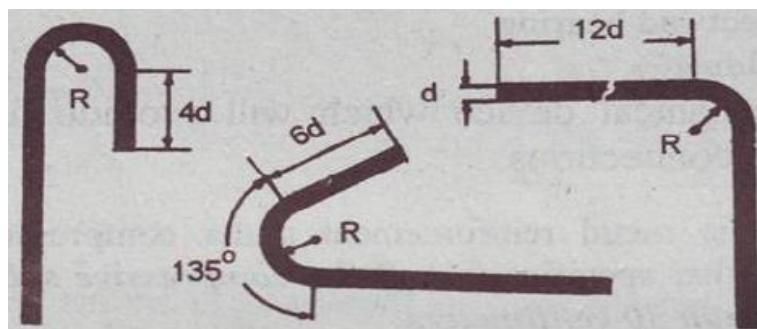
1. Welding
2. Tying
3. Sleeves
4. Mechanical devices w/c provide full positive connection between bars.

□ **Compression bars are spliced by using the following process:**

1. Lapping
2. Direct and bearing
3. Welding
4. Mechanical devices w/c provide full positive connection.

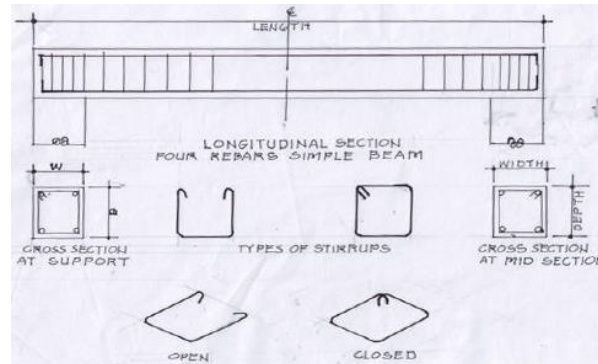
Minimum diameters of bend for Standards Hook

BAR SIZE	MINIMUM DIAMETER
No. 3 to 8	6 Bars Diameter
No. 9 to 11	8 Bar Diameter
No. 14 to 18	10 Bar Diameter



MINIMUM DIAMETERS OF BENDS FOR BARS

For simple concrete beams and girders, the steel reinforcement consists of 4 longitudinal bars and stirrups. Either the closed type or the U-type stirrups is secured by wires. The stirrups take care of the diagonal tension and also keep the steel reinforcements in their proper position.



FOUR REBARS CONCRETE BEAM

Concrete Floor Slabs

Concrete floor slabs are common as flooring and are usually reinforced with deformed reinforcing bars. Most codes require the top of the slab to be at least 6" to 8" (0.15 to 0.20) thick above grade for the ground floor specifications that are to be included. Slabs plans include the thickness of the slab, size and spacing of reinforcing bars and concrete pounds per square inch (PSI).

Steel Reinforcing Bars

Steel reinforcing bars or rebars are incorporated in concrete and other masonry constructions. They are used to prevent cracking when tension, compression, and other forces are applied.

Round rebars are most common in reinforced concrete construction. They may be plain or deformed. Deformed bars have lugs on their surface for increased bond between concrete and steel. The end of the bars is bent to determine the hooks.

Deformed and plain rebars are commercially sold in length of 6.0 meters. Other lengths may also be made available by manufacturers to meet specific needs of consumers.

Rebars are bought or sold specifically by their diameter. The most common sizes of rebars for residential units are 0.9mm and 0.10mm for stirrups and 0.12mm and 0.16mm for vertical members. See the Table of Specifications below.

Bar No.	Diameter In.	Gross sectional area-In ²	Perimeter In.	Unit weight per ft. lb.
2	1/4 = 0.250	0.05	0.79	.076
3	3/8 = 0.375	0.11	1.18	.171
4	1/2 = 0.500	0.20	1.57	.304
5	5/8 = 0.625	0.31	1.96	.474
6	3/4 = 0.750	0.44	2.36	.683
7	7/8 = 0.875	0.60	2.75	.929
8	1 = 1.000	0.79	3.14	1.214
9	1-1/8 = 1.125	0.99	3.53	1.545
10	1-1/4 = 1.250	1.23	3.93	1.956
11	1-3/8 = 1.375	1.48	4.31	2.415
14	1-3/4 = 1.693	2.40	5.50	3.477
18	1-1/4 = 2.250	4.00	7.07	6.182

TABLE 1.

Steel bar designations and their English equivalents and metric sizes (in diameters).

BAR	ENGLISH	METRIC
Designation	Size (Diameter)	Size (Diameter)
No. 2	1/4"	8mm
3	3/8"	10
4	1/2"	12
5	5/8"	16
6	3/4"	20
8	1"	25
10	1 1/4"	32
12	1 1/2"	40

Figure 1. Shows how a 12 mm. rebars are bent.

Guide for bending and cutting of rebars based on its diameter 12 mm.

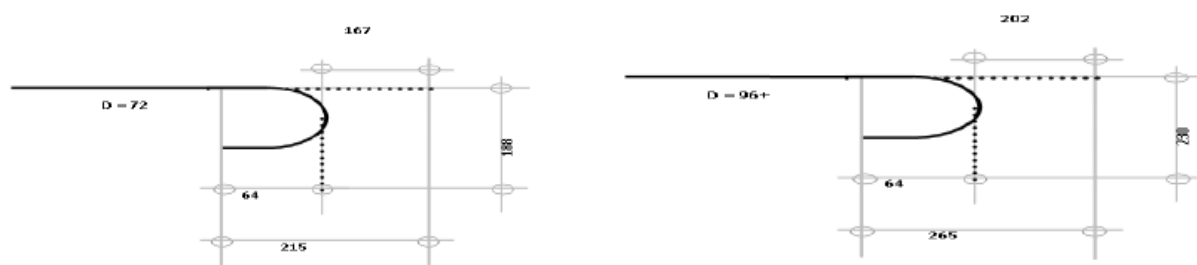


Figure 2.

Detail of one span RCB (Reinforced Concrete Beam) with four rebars.

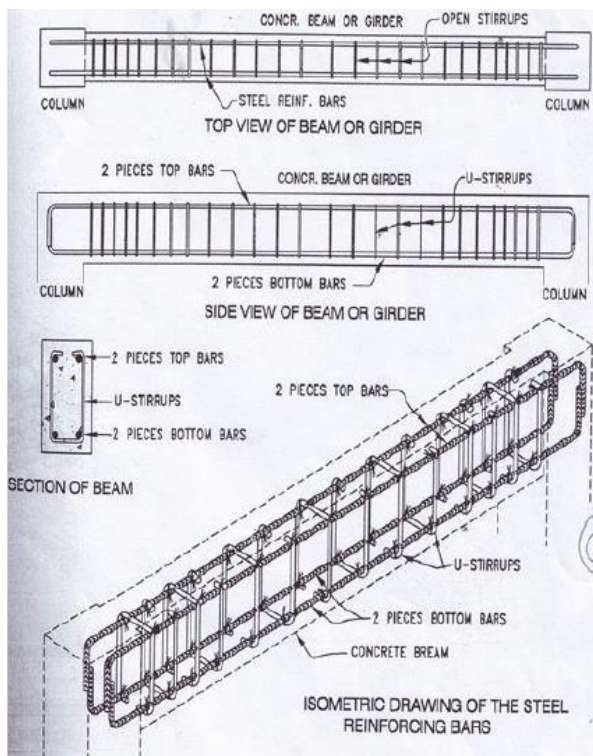
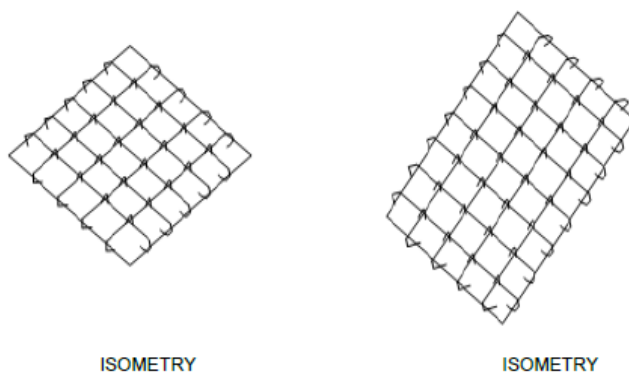


Figure 3.

Sample arrangement of steel reinforcing bars in concrete footing



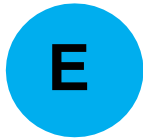
Kinds of Loads:

1. *Live load* - refers to the load (combined total weight) of people.
2. *Dead load* - is the load of wood, steel, and furniture.
3. *Wind load* - is the load or strength of wind.

Kinds of Walls:

Walls are important components of a building; they may be made of wood, or concrete.

1. *Load Bearing Wall* – walls that support or carry loads as in exterior walls.
2. *Non-Load Bearing Wall* – does not carry or support a load as in partitions or interior walls.



What is more?

Learning Task 4: Check this out!

Write your answers in a separate sheet of paper.

A. Identify what is being described in each statement.

1. It is a result of mixing cement, fine and coarse aggregates and water.
2. It is a material other than cement that is used as ingredient in concrete, before or during mixing.
3. It is a bonding agent that reacts with water to form a stone-hard substance.
4. A concrete with reinforcement bars embedded.
5. A class mixture of concrete proportion that has .043 Cu. m. of sand and .085 Cu. m. of gravel.
6. The most common type of reinforced concrete floor system.
7. The most common reinforcement for most construction.
8. The minimum diameter for bar size number 14 to 18.
9. These are commonly used for flooring and are usually reinforced with deformed reinforcing bars.
10. The most common sizes of rebars for residential units are ____ mm and ____ mm. for stirrups.

B. Enumerate the following.

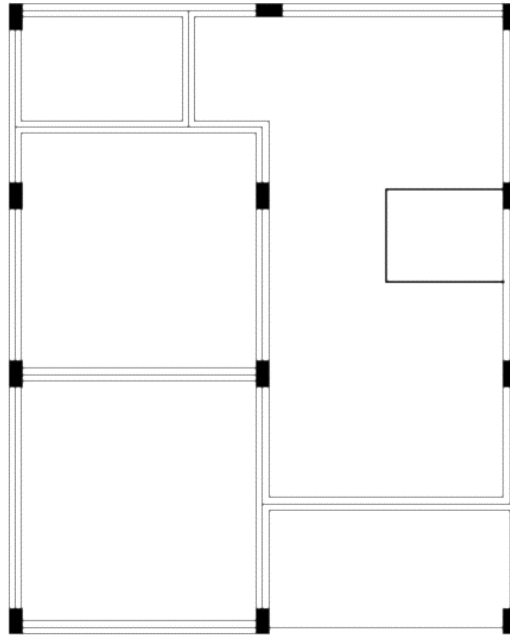
1. Give the two reinforced concrete columns.
2. Five columns that are classified according to the types of reinforcement.
3. Processes where compression bars are spliced.

E

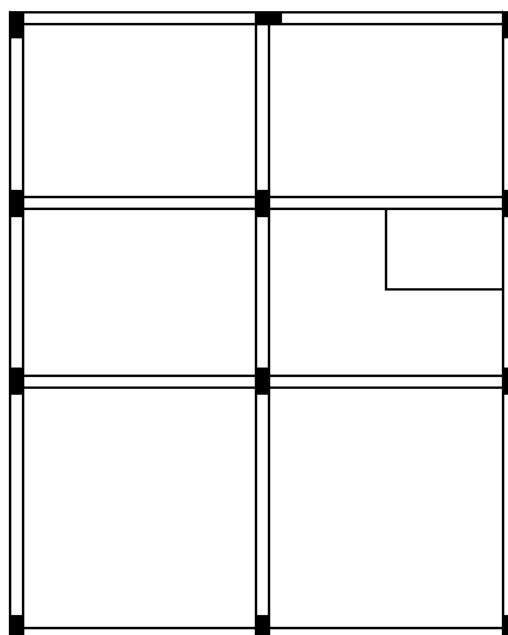
What can I do?

The following are the steps in drafting a floor framing plan.

1. Prepare and set the floor plan.
2. Trace the walls and columns from the floor plan using sketch lines. Draw object lines for stair outline.



3. Assign and draft the beam using object lines. Normally we draw beam along the column.

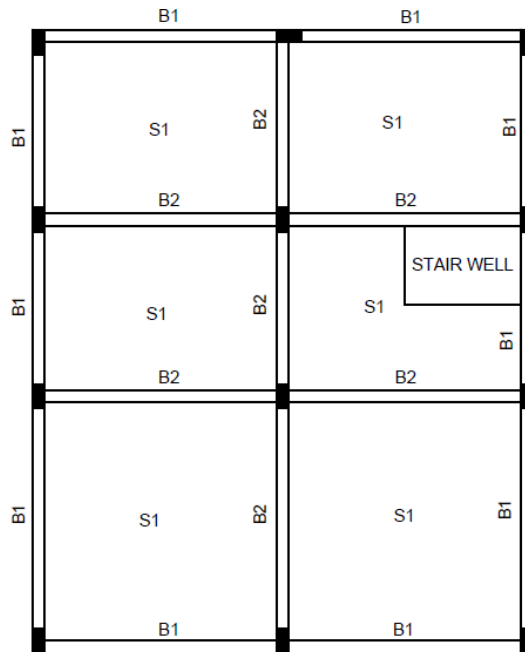


4. Put labels. Use the following:

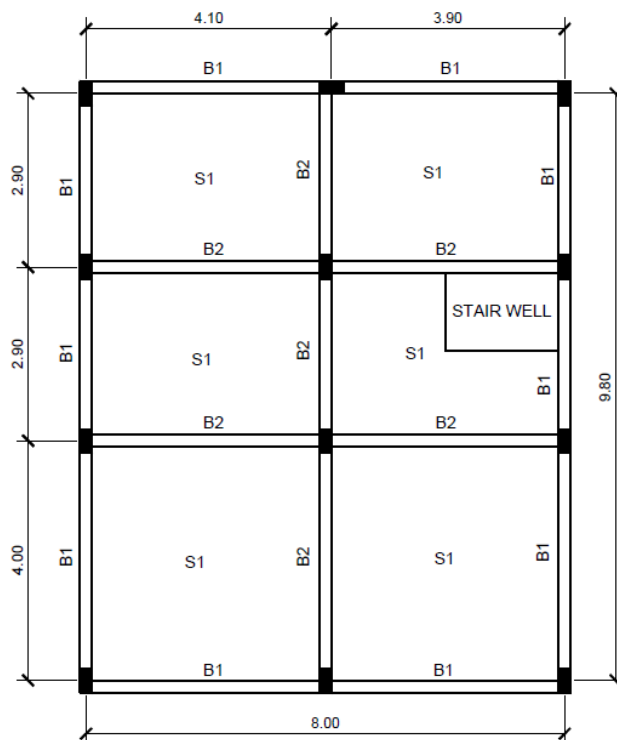
S1- Stand for Slab

B1 - Stands for Beam1

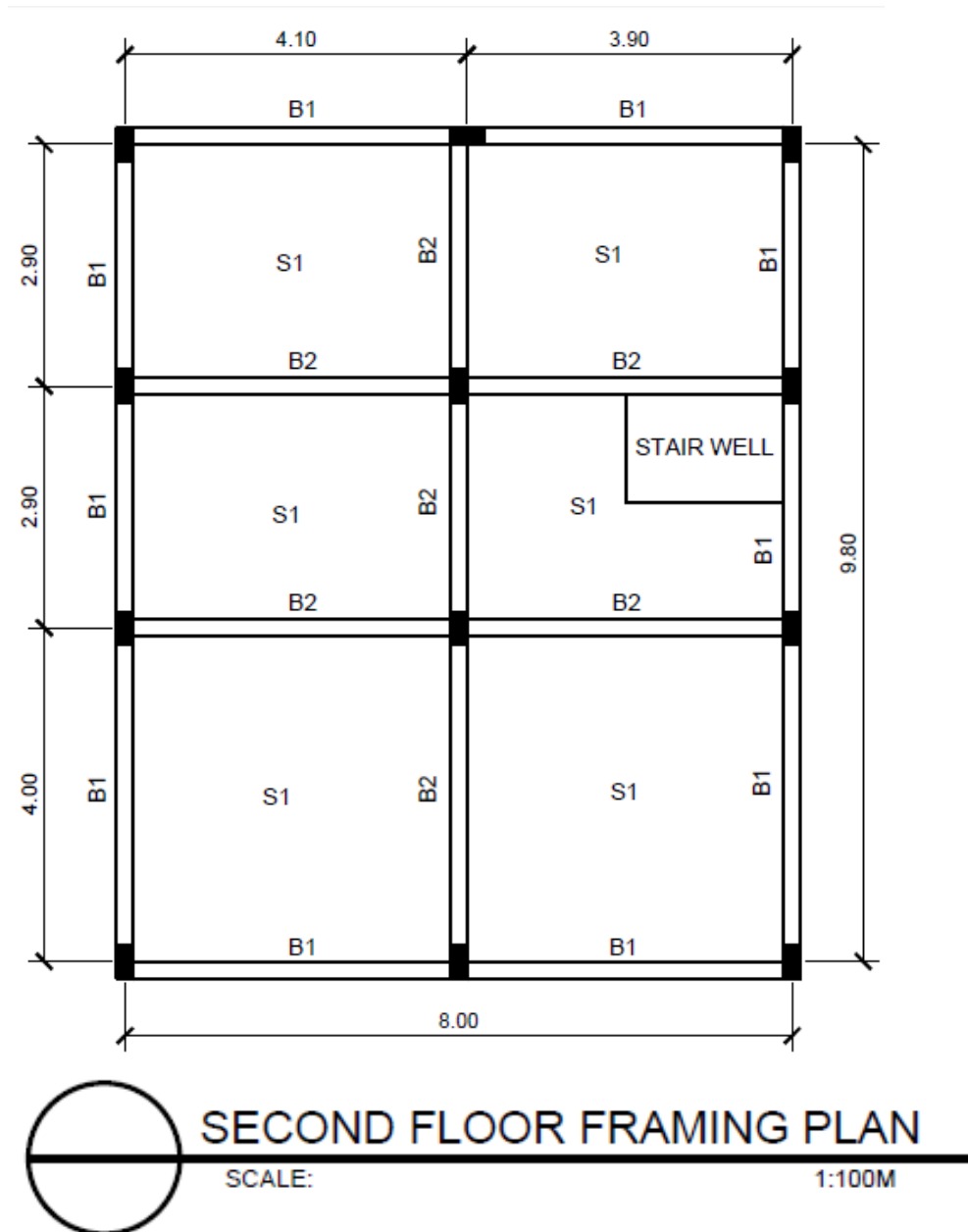
B2 - Stands for Beam 2



5. Add dimensions.



6. Finalize your drawing by erasing unnecessary lines and supplying important details such as the drawing title and the scale used.





What else can I do?

Learning Task 5: Draft Floor Framing Plan

After discussing all the necessary knowledge and skills required to draft a floor framing plan, it is now the right time for you to showcase and apply what you have learned.

Materials Needed:

- T-square/Triangles/Ruler
- Circular Template
- Oslo Paper
- Pencil and Eraser

Instructions:

1. Draw the corresponding floor framing plan of the floor plan on page 21.
 - Label the important details such as S1 for slab, B1 and B2 for Beam 1 and 2.
2. Indicate the dimensions.
3. Your output will be evaluated according to the following criteria below.

Criteria	7 points	5 points	3 points
Line Technique/ Layout	All lines were drawn according to standards and drawing was laid out properly	At least 3-5 lines were not drawn according to standards and drawing was laid out well	More than 5 lines were not drawn according to standards and drawing was improperly laid out
Accuracy	All measurements and notations/symbols needed were accurately done	At least 3-5 measurements and notations/symbols needed were inaccurately done	More than 5 measurements and notations/symbols needed were inaccurately done
Criteria	3 points	2 points	1 point
Neatness	Finished output was neatly done with no erasures nor any smudges	Erasures/smudges are observable on the finished output	Finished output has so many erasures/smudges present
Time Management	Finish the task ahead of the given time/date	Finish the task on the given time/date	Unable to finish the task on the given time/date

A

What have I learned?

1. Floor Framing Plans provide structural information such as spacing and direction, as well as the floor heights and stair openings.
2. The structural members of a building are constructed using concrete, which is an artificial stone.
3. The right proportioning of the ingredients in concrete provides a balance for economy, workability, strength, durability, and appearance.
4. Concrete for building construction is mixed in two different ways; hand mixing and ready mixed concrete.
5. The floor slab carries both the live and dead load, that is, the human occupants and all unmovable objects.
6. A beam supports the transverse load with each end resting on a support while girder is a beam that supports one or more smaller beams.
7. The most common reinforcement for most construction is the steel bar.
8. Concrete floor slabs are common as flooring and are usually reinforced with deformed reinforcing bars.
9. Rebars are bought or sold specifically by their diameter. The most common sizes of rebars for residential units are 0.9mm and 0.10mm for stirrups and 0.12mm and 0.16mm for vertical members.
10. The three kinds of load are dead load, live load and wind load.

A

What can I achieve?

Learning Task 6: Posttest

Read each item carefully. Choose the letter of the best answer and write it on a separate sheet of paper.

1. Which of the below utility cannot be provided underneath a floor?
A. Plumbing B. Sound proofing C. Air-conditioning D. Gas lines
2. Which of the below is a problem with floors?
A. Noise B. Stains C. Vibrations D. Projections
3. These kind of load refer to wood, steel and furniture
A. Wind B. Solar C. Live D. Dead

4. Compression of bars are spliced by using the following process EXCEPT for one.
 - A. Heating
 - B. Mechanical devices which provide full positive connection
 - C. Lapping
 - D. Welding

5. The most common sizes of rebars for residential units for vertical members.

A. 1.80 and 1.20 mm.	B. 0.80 and 0.14mm.
C. 0.12 and 0.16 mm.	D. 0.5 and 0.9 mm.

6. A reinforcement that is embedded in order that they act together in resisting forces.

A. Reinforced concrete	B. Reinforced bars
C. Reinforced roof	D. Reinforced wall

7. The spacing of bars shall be in accordance with the provisions of the American Concrete I:

A. True	B. False
---------	----------

8. A structural member that carries both the dead and live load

A. Roof	B. Wall	C. Floor slab	D. Reinforcement bars
---------	---------	---------------	-----------------------

9. It is the most common type of reinforced concrete floor system.

A. Flat slab	B. Ribbed floor
C. Two-way slab	D. One-way slab

10. It is the most common reinforcement for most construction.
 - A. Sand
 - B. Gravel
 - C. Steel bars
 - D. Cement

LESSON 3

Draft Roof Framing Plan

I

What I need to know?

LO 2: Draft Roof Framing Plan (TLE_ICTTD9-12SL-IIIc-e-2)

- Draft structural roof framing plans based roof plans using wood or steel construction.
- Draft structural roof framing showing sizes and detailed connections.

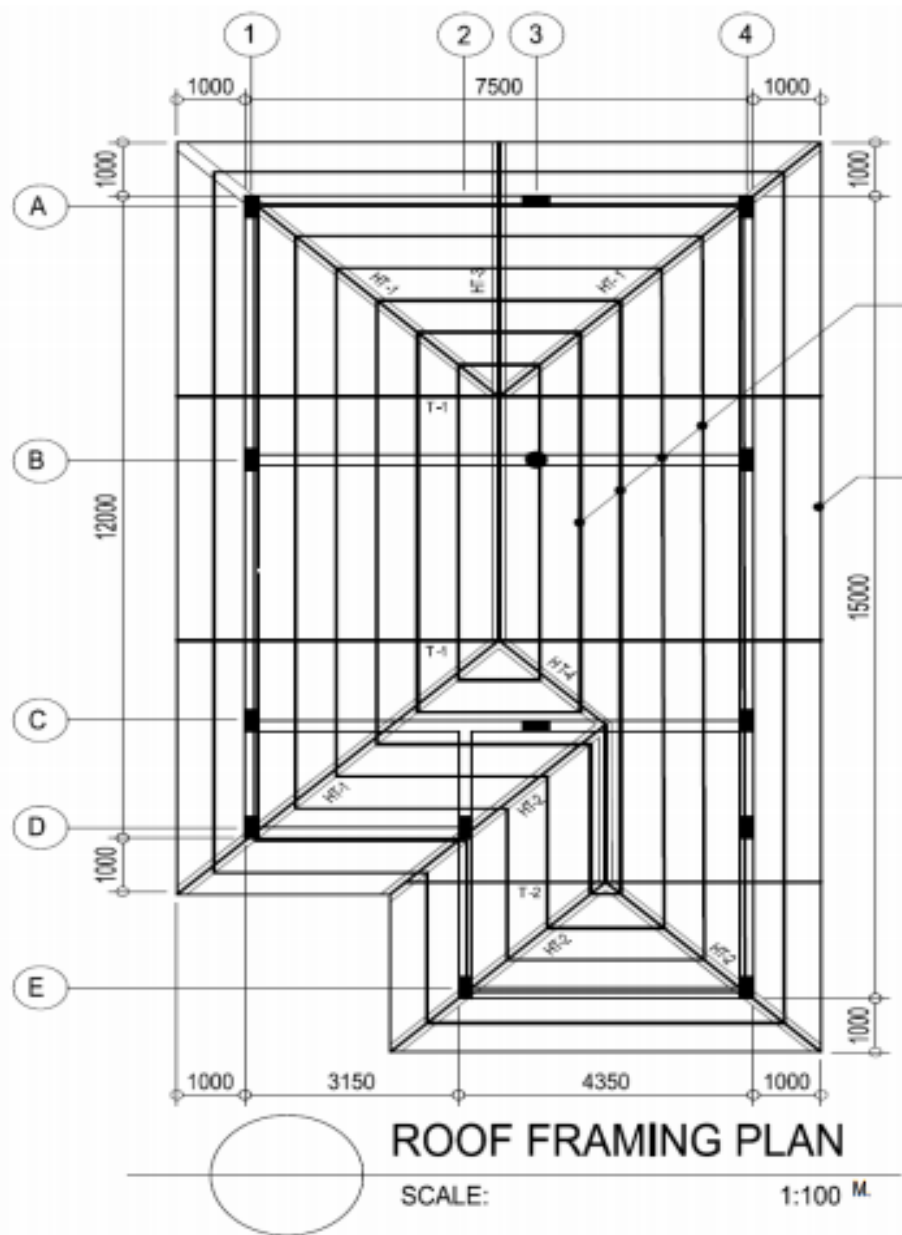
This lesson is designed to familiarize you on how to present a roof framing plan. After going through this learning resource, you are expected to:

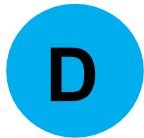
1. Determine the different types of roof framing system used in residential houses;
2. Recognize the types of rafters; and
3. Draft roof framing plans

I

What's new?

The Roof Framing Plan show the construction of the rafters used to span the building and support the roof. The size, spacing, roof slope and all of the details are also shown in the plan. In a pre-cast or cast-in place concrete floor and roof framing, a structural plan should indicate the symbols, location of bearing walls, beams and columns and the direction and size of steel reinforcing bars, the direction of the span and the size and thickness of required structural members.

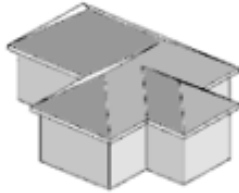




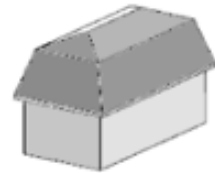
What I know?

Learning Task 1: Name Me

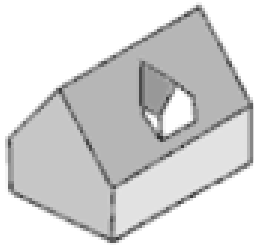
Identify the following Types of Roof.



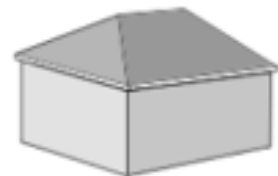
1. ____ and ____



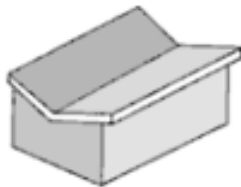
2. ____



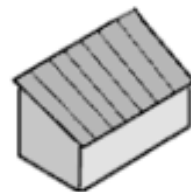
3. ____



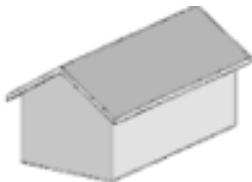
4. ____



5. ____



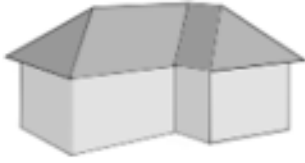
6. ____



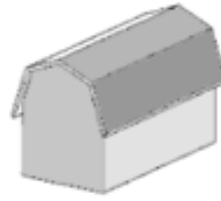
7. ____



8. ____



9. _____ - _____



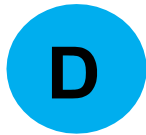
10. _____

D

What is in?

Learning Task 2: Essential Questions: In your own words, explain and answer the questions below. Write your answers on a separate paper.

1. What do you think is the difference between a roof plan and a roof framing plan?
2. Why do we need to Draft Roof Framing Plan before its construction?



What is it?

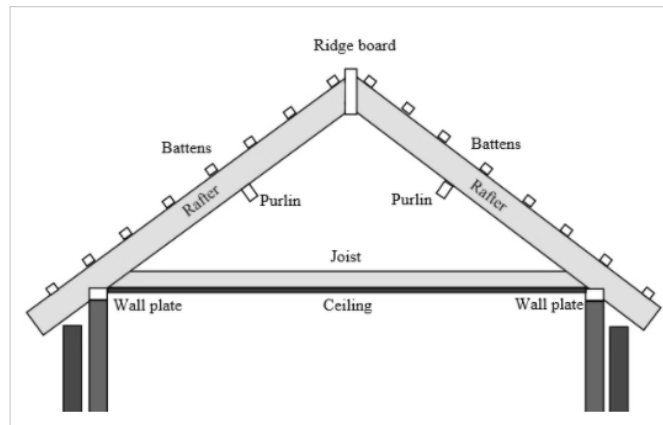
The Roof Frame

The roof framing in a residential dwelling is of three types commonly used which are:

1. Rafter type

A rafter is a structural component that is used as part of a roof construction. Typically, it runs from the ridge or hip of the roof to the wall plate of the external wall. Rafters are generally laid in series, side by side, providing a base to support roof decks, roof coverings and so on.

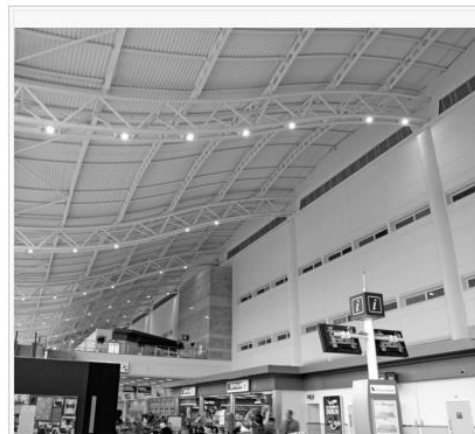
Rafters are typically made of timber or steel and can be concealed within the roof structure, or can be left exposed to the spaces below. They may have battens laid on top of and perpendicular to them, to fix the roof covering to.



2. Truss type

A truss is essentially a triangulated system of straight interconnected structural elements. The most common use of trusses is in buildings, where support to roofs, the floors and internal loading such as services and suspended ceilings, are readily provided. The main reasons for using trusses are:

- Longspan
- Lightweight
- Reduced deflection
- Opportunity to support considerable load.



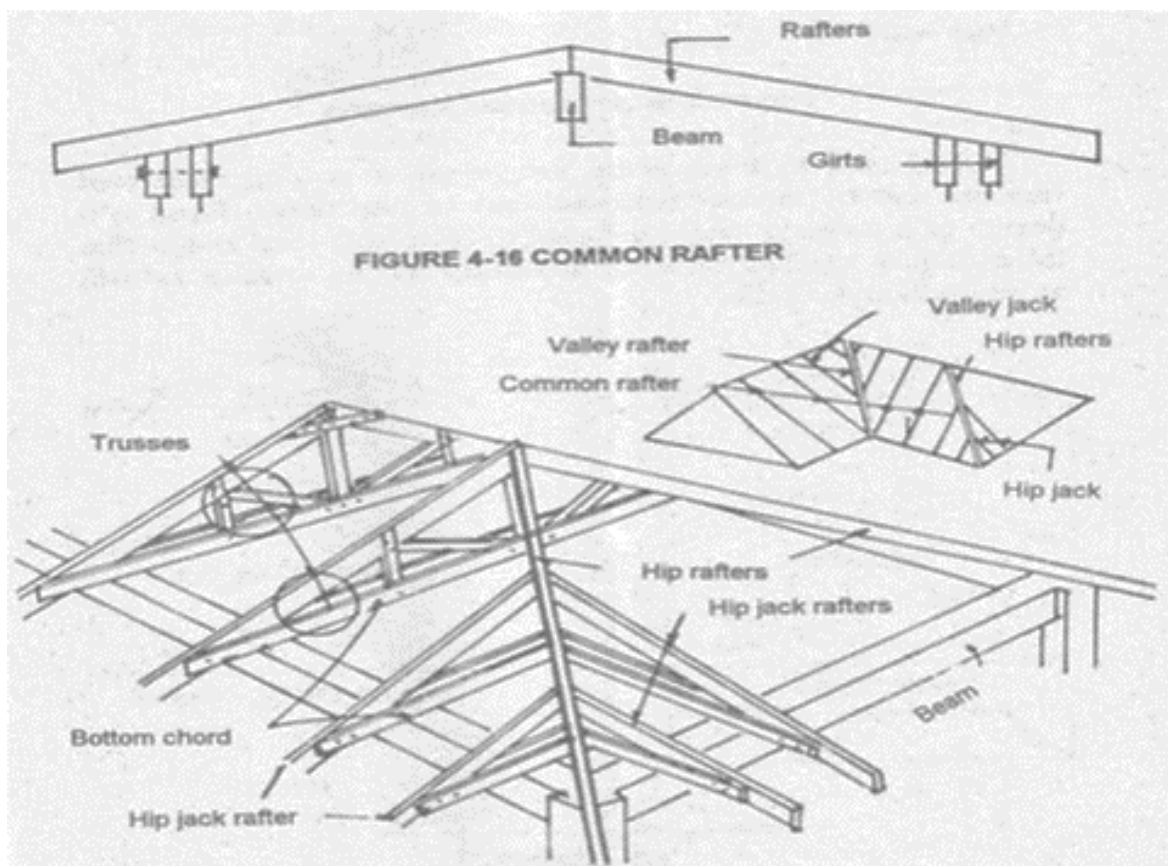
The
are:

3. Laminated

A laminated roof construction and a method of forming the same wherein the roof comprises a supporting deck having a water-proof intermediate membrane upon which is superimposed a heat resistant sandwich-type foam panel.

Rafters used for the framing are also classified as:

1. Common rafter - extend at right angles from the plate to the ridge.
2. Hip rafter - are laid diagonally from the corners of a plate to the ridge.
3. Valley rafter – does not extend from the plate or girts to the ridge.
4. Octagonal rafter - are those placed on an octagonal.
5. Jack rafters - this makes up the frame between the hip rafter and the girt.
 - Jack Rafter is of two (2) types: valley jack and cripple jack.
 - a. Valley jack - is the frame between the ridge and the valley rafter.
 - b. Cripple jack - is that between the hip and valley rafter.

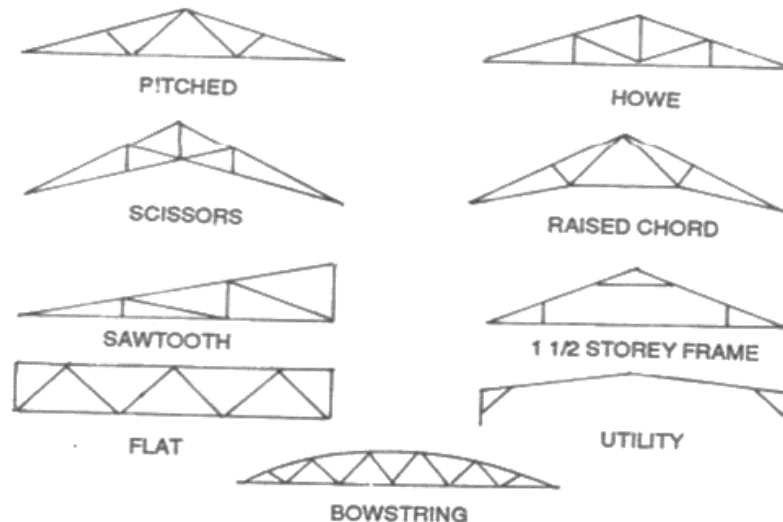


The Truss

The truss is a material that is important in a roof plan. It is a built-up frame used on an unsupported long span roof system. It is designed with a series of triangles to stiffen the structure and distribute the roof load and to stay rigid and with flexibility and strength.

Trusses used in building construction are of two types:

1. Light trusses which include the following:



a. Pitched truss

These are triangulated plane frames spaced at suitable centers. To prevent spreading, the rafters, which form the top edge of the truss are connected at their feet by a tie member.

b. Howe truss

A Howe truss is a truss bridge consisting of chords, verticals, and diagonals whose vertical members are in tension and whose diagonal members are in compression. The Howe truss was invented by William Howe in 1840, and was widely used as a bridge in the mid to late 1800s.

c. Scissor truss

This type of truss is best known for creating the vaulted ceilings that today's homeowners love. Instead of horizontal lower chords, a scissor roof truss has lower chords that slope up, creating the peak for a vaulted ceiling.

d. Raised chord truss

Raised chord trusses are trusses with that centre portion of the bottom chords raised substantially above the level of supports.

e. Saw tooth

Saw-tooth truss are used in multi-bay buildings. It is typical to include a truss of the vertical face running perpendicular to the plane of saw-tooth truss.

f. 1 ½ storey frame

This is a type of roof truss with an open space at its bottom center to accommodate a living space.

g. Utility

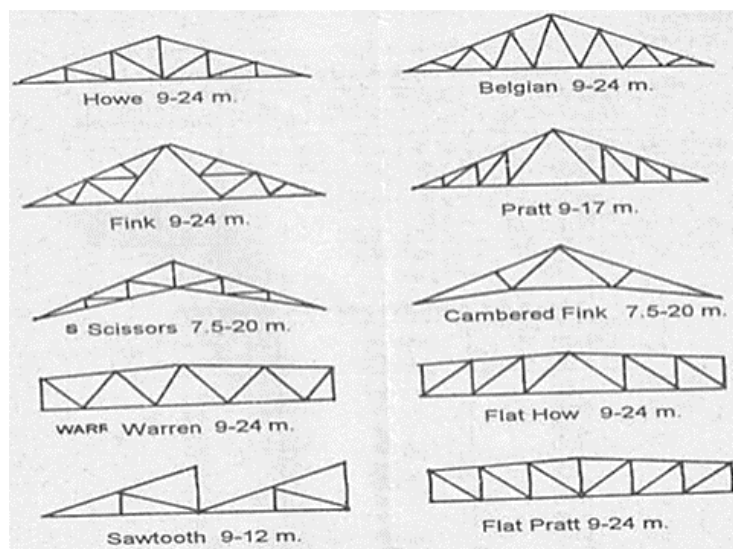
h. Flat truss

Flat truss is designed for flat roofs. They're built similarly to floor trusses, with a great deal of support since they don't feature any slope to shed precipitation or help bear a load.

i. Bow string

Bow string are similar to conventional "common trusses" except for the top chord, which is constructed in a parabolic design. Bowstring trusses resemble the arched shape of an archery bow. The curved top chord and the horizontal bottom chord intersect each other at both ends.

2. Heavy trusses include the following which are used in industrial buildings and they are longer:



a. Belgian truss

A symmetrical truss especially used in supporting large sloping roofs in the form of three isosceles triangles – one in the center with its base along the horizontal tie and each of the outer two having its base along the sloping sides of an upper chord.

b. Fink truss

A very common roof truss type with a "W" shape between the chords. It is a very simple but efficient shape and can be used in all manner of projects.

c. Pratt truss

A Pratt truss includes vertical members and diagonals that slope down towards the center, the opposite of the Howe truss.

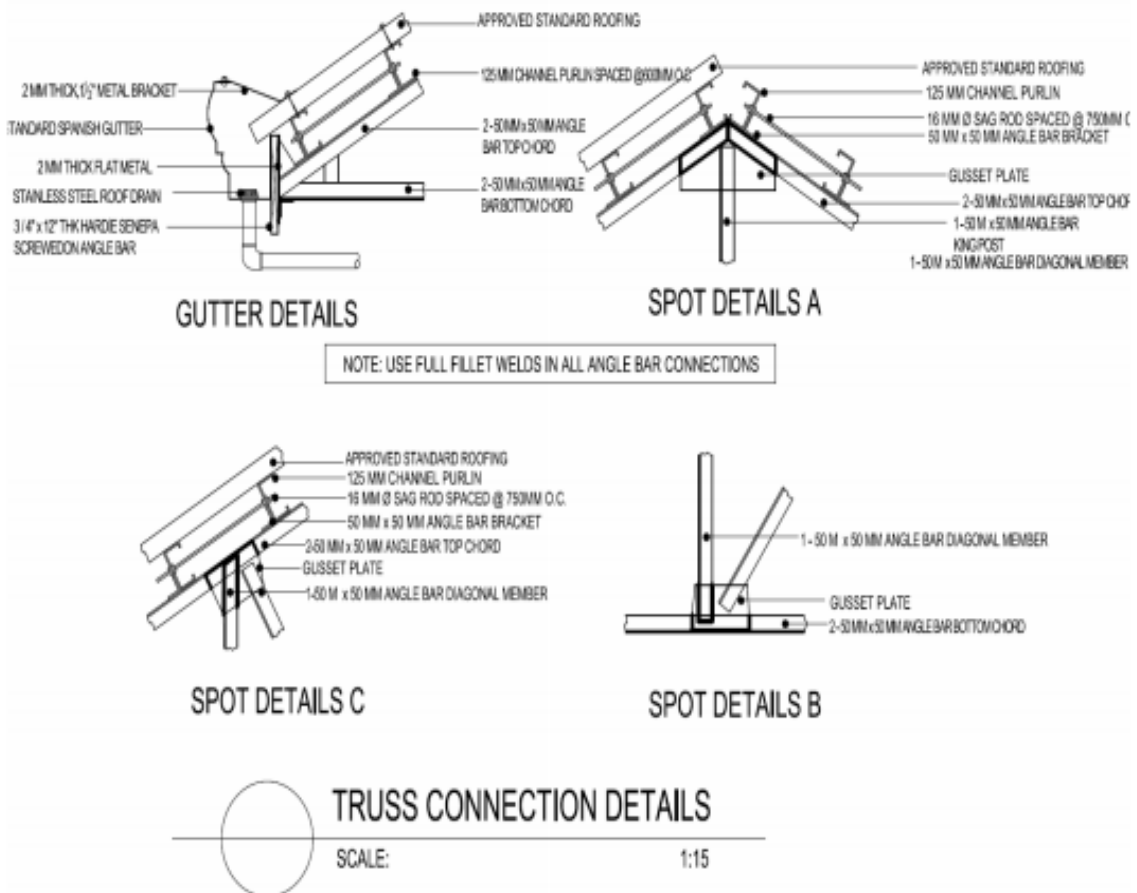
d. Cambered truss

Trusses improve on traditional rafter design by forcing an upward bend into the chords of trusses. This is referred to as "camber". A camber helps to resist loads.

e. Warren Truss

A warren truss or equilateral truss is a type of engineering truss employing a weight-saving design based upon equilateral triangles.

ROOF FRAMING SHOWING THE DIMENSION OF EACH MEMBER





What is more?

Learning Task 3: Check it Out!

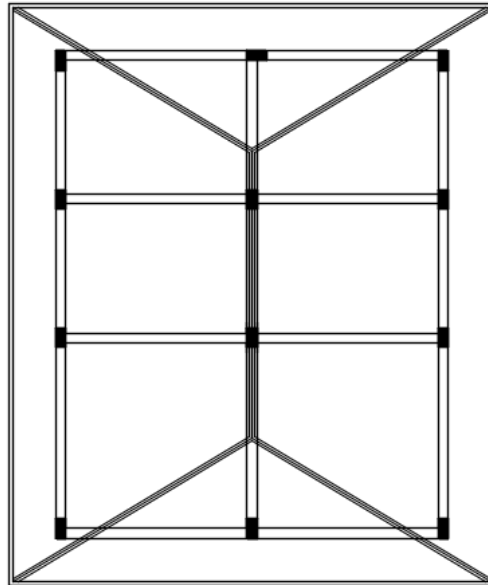
- A. Identify the term being described in each item.
1. A type of engineering truss employing a weight-saving design based upon equilateral triangles.
 2. They are built similarly to floor trusses, with a great deal of support since they don't feature any slope to shed precipitation or help bear a load.
 3. These types of trusses are used in multi-bay buildings.
 4. It is a built-up frame used on an unsupported long span roof system.
 5. A truss that resembles the arched shape of an archery bow.
 6. A very common roof truss type with a "W" shape between the chords.
 7. A structural component that is used as part of a roof construction.
 8. A plan that shows the construction of the rafters used to span the building and support the roof.
 9. Rafters that are laid diagonally from the corners of a plate to the ridge.
 10. A rafter which is the frame between the ridge and the valley rafter.
- B. List down the following.
1. Three types of roof framing system
 2. Five rafters used in roof framing
 3. Types of light trusses
 4. Types of heavy trusses

E

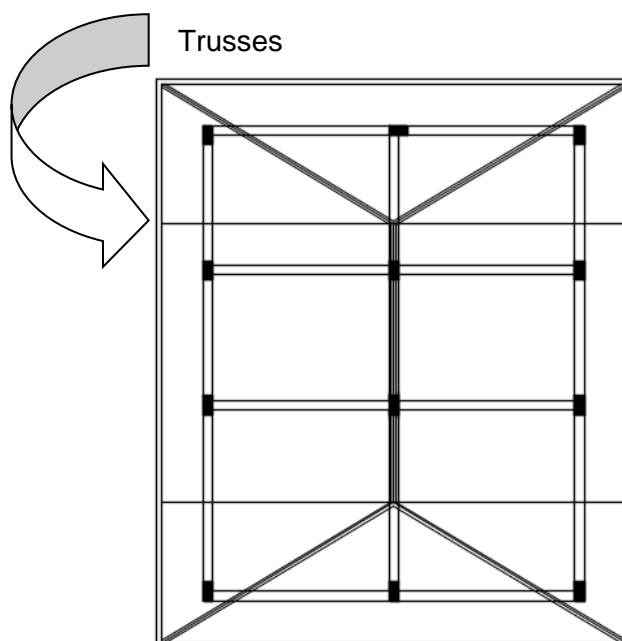
What can I do?

Below are the steps in drafting a roof framing plan.

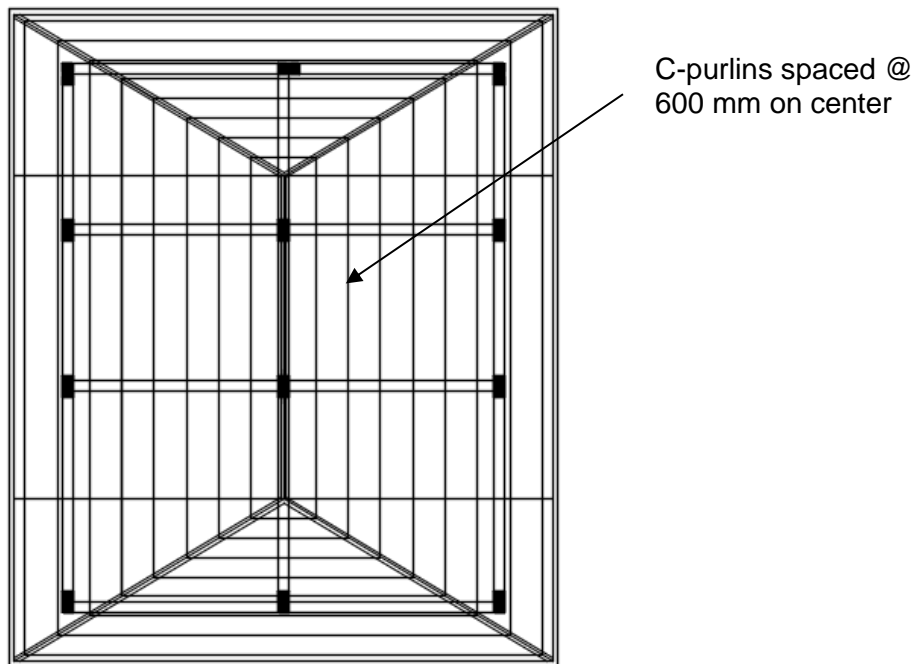
1. Prepare and set the floor plan.
2. Trace the Roof Plan. (The Roof Plan below were drawn from the previous Quarter 2 Learning Resource of Technical Drafting)



3. Draw trusses



4. Draft C-Purlins spaced @ 600mm On Center.

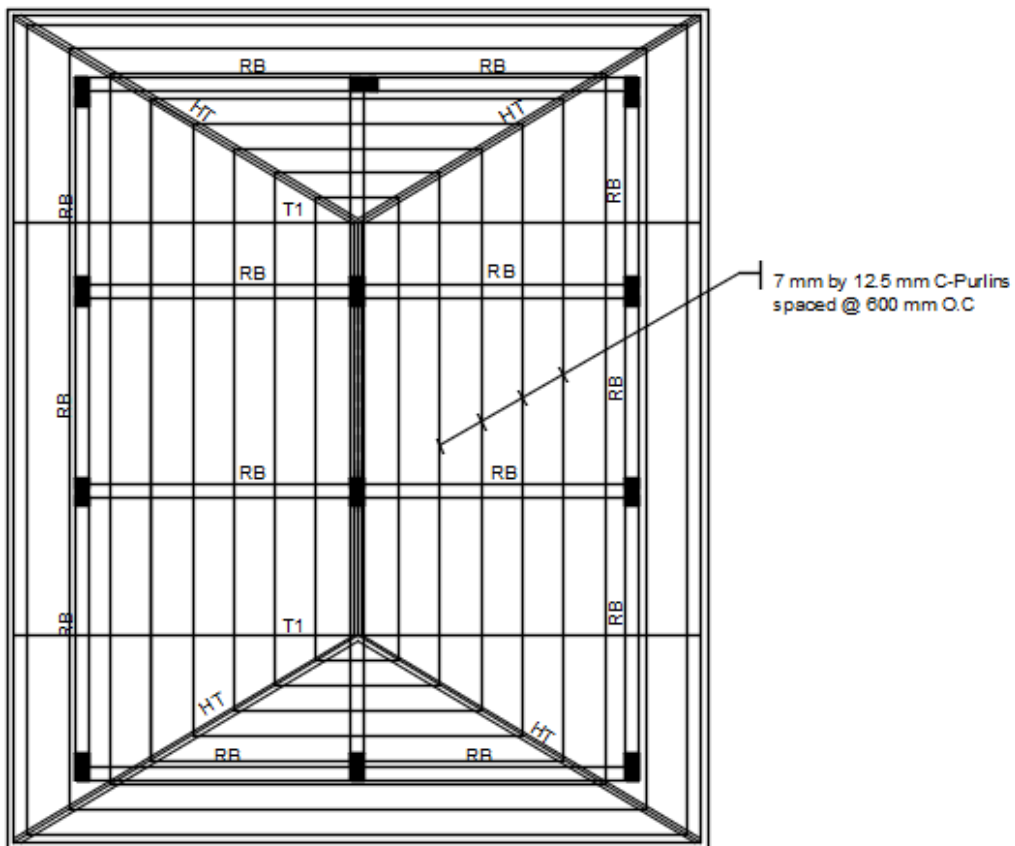


5. Put labels. Use the following:

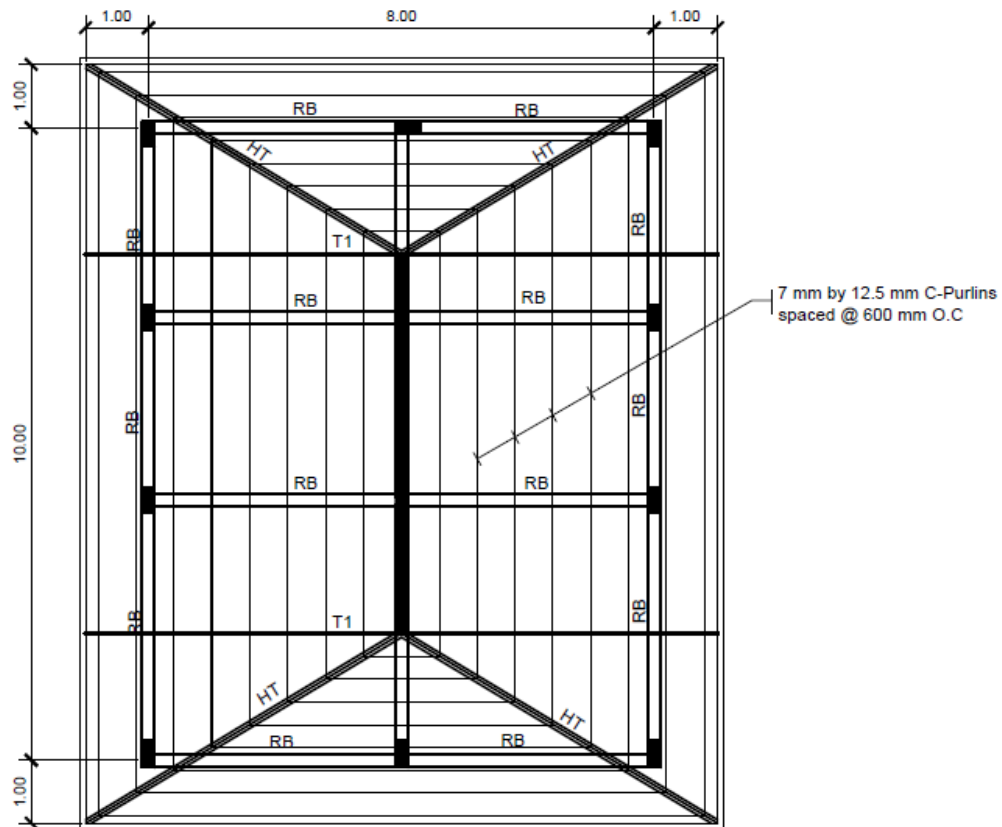
HT- Hip Truss

T1 - Truss

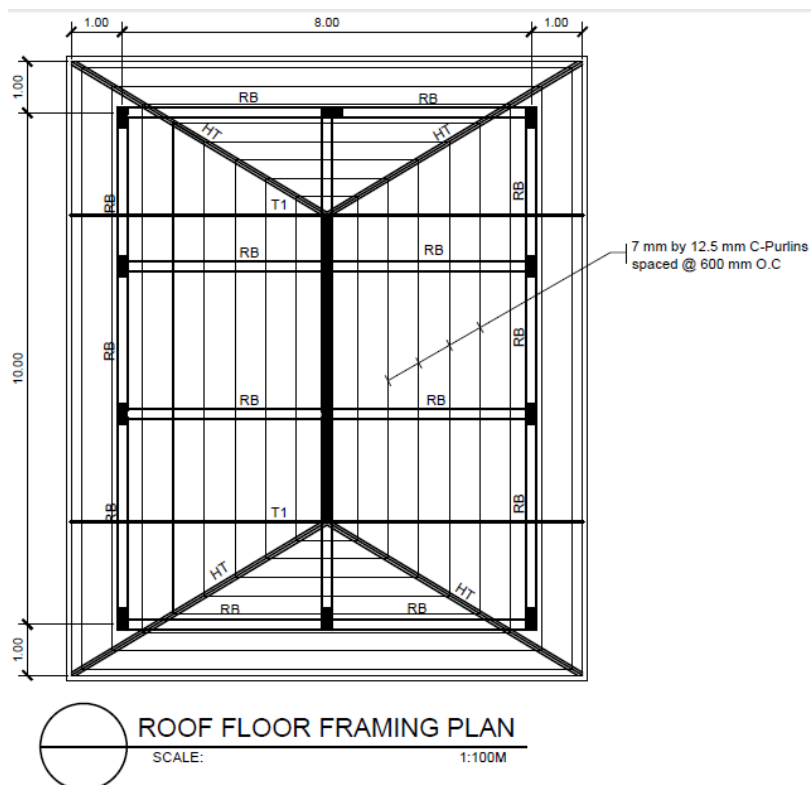
RB - Reinforcement Bar



6. Add dimensions



7. Finalize your drawing by erasing unnecessary lines and supplying the drawing title: ROOF FRAMING PLAN and the scale used.





What else can I do?

Learning Task 3: Draft Roof Framing Plan

After discussing all the necessary knowledge and skills required to draft a roof framing drawing, it is now the right time for you to showcase and apply what you have learned.

Materials Needed:

- T-square/Triangles/Ruler
- Circular Template
- Oslo Paper
- Pencil and Eraser

Instructions:

1. Draw the roof framing plan of the floor plan on page 21. Follow the given requirements and specifications below.
 - Use C-purlins spaced @ 600mm on center
2. Indicate the dimensions and label the essential information.
3. Your output will be evaluated according to the following criteria below.

Criteria	7 points	5 points	3 points
Line Technique/ Layout	All lines were drawn according to the standards and drawing was laid out properly	At least 3-5 lines were not drawn according to standards and drawing was laid out well	More than 5 lines were not drawn according to standards and drawing was improperly laid out
Accuracy	All measurements and notations/symbols needed were accurately done	At least 3-5 measurements and notations/symbols needed were inaccurately done	More than 5 measurements and notations/symbols needed were inaccurately done
Criteria	3 points	2 points	1 point
Neatness	Finished output was neatly done with no erasures nor any smudges	Erasures/smudges are observable on the finished output	Finished output has so many erasures/smudges present
Time Management	Finish the task ahead of the given time/date	Finish the task on the given time/date	Unable to finish the task on the given time/date

A

What have I learned?

1. The Roof Framing Plan show the construction of the rafters used to span the building and support the roof. The size, spacing, roof slope and all of the details are also shown in the plan.
2. The roof framing in a residential dwelling is of three types commonly used which are rafter, truss and laminated type.
3. The main reasons for using trusses are for long span, lightweight, reflected deflection and because of opportunity to support considerable loads.
4. Rafters used for the framing are also classified as common, hip, valley, octagonal and jack rafter.
5. Trusses used in building construction are of two types; the light and heavy trusses.
6. The truss is a material that is important in a roof plan. It is a built-up frame used on an unsupported long span roof system.
7. Light trusses include the following: pitched, howe, scissors, raised chord, saw tooth, 1 ½ storey frame, flat, bowstring.
8. Heavy trusses include the following: fink, Belgian, pratt, warren, flat howe, flat pratt and cambered truss.

A

What can I achieve?

Learning Task 5: Posttest

Read each item carefully. Choose the letter of the best answer and write it on a separate sheet of paper.

1. Which of the following best define a roof framing plan?
 - A. It is a plan showing the relationships between rooms, spaces, traffic patterns.
 - B. It shows the construction of the rafters used to span the building and support the roof.
 - C. It is the plan of a ceiling that gets projected on a flat plane directly below.
 - D. It is the side view of a building.
2. A _____ is defined as the uppermost part of the building which is constructed in the form of a framework to give protection to the building against rain, heat, snow, wind, etc.

A. Roof	C. Rafters
B. Truss	D. Lintels

3. The _____ are the inclined members of a truss.

A. Rafters	C. Eaves
B. Cleats	D. Gable

4. A piece provided at the Ridge line of a sloping roof is known as the _____.

A. Truss	B. Rafter	C. Ridge	D. Wall plate
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5. The Framework, usually of triangles design to support the roof covering for ceiling over rooms.

A. Roof Truss	B. Roof valley	C. Roof covering	D. Wall plate
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6. Any rafter which is shorter than a common rafter.

A. Common rafter	B. Jack rafter	C. Hip rafter	D. Valley rafter
------------------	----------------	---------------	------------------

7. The piece which are placed horizontally on the principal rafter to carry the common rafter.

A. Pitch	C. Eaves
B. Purlins	D. Gable

8. Which of the following is the distance spaced on center of C-purlins?

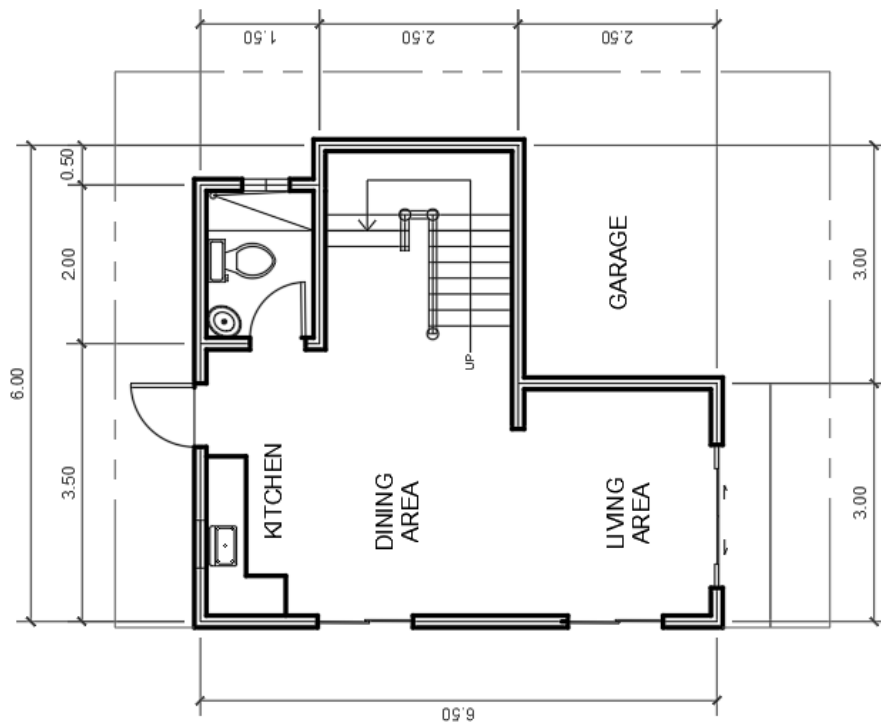
A. 600 mm	B. 200 mm	C. 1.20 mm	D. 280 mm.
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9. The drawing of roof framing plan must be based upon what type of plan.

A. Elevation drawing	C. Section drawings
B. Floor framing	D. Roof Plan

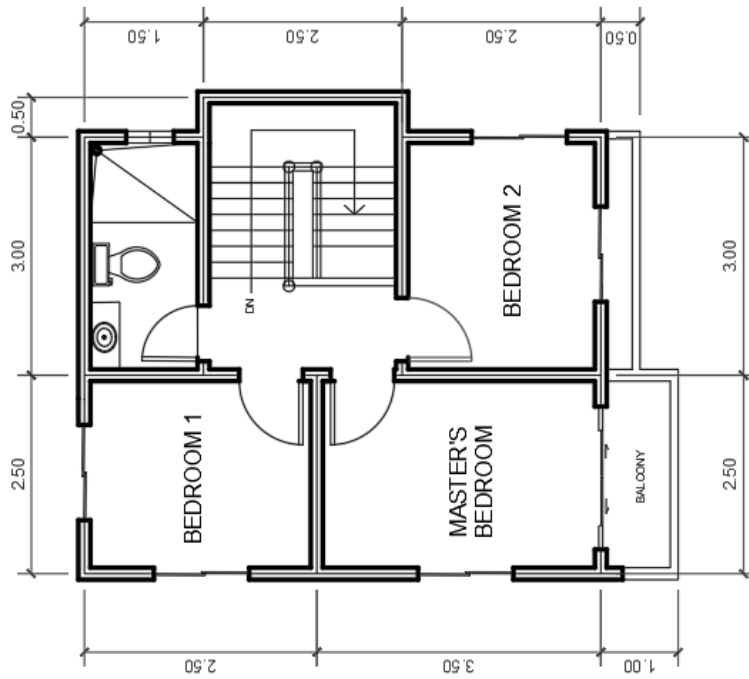
10. Light trusses that resemble the arched shape of an archery bow.

A. Saw-tooth	B. Howe truss
C. Bowstring	D. Fink truss



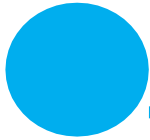
GROUND FLOOR PLAN

SCALE 1:100



SECOND FLOOR PLAN

SCALE 1:100



References

Books/Publications

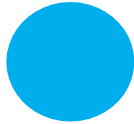
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Videos

- *Draw a Typical Floor Framing Plan*. 2018. <https://www.youtube.com/watch?v=tphiSIllqy4s>
- *Part 2. Roof Framing Plan. Hip Roof style* <https://www.youtube.com/watch?v=d6n6tzruKEU>



Answer Key

1. E
2. D
3. C
4. B
5. C
6. F
7. A

B. Matching Type:

1. Spread
2. T-foundation
3. Pier foundation
4. Mat foundation
5. Slab foundation
6. Shear distortion of the soil
7. Compression of the soil
8. Soil bearing capacity failure
9. Failure of the foundation structure
10. Foundation

A.
Learning Task 3: Name Me!

1. A
2. D
3. A
4. B
5. D

Learning Task 1: Pre-test

LESSON 1 DRAFT FOUNDATION PLAN

- A.
1. Concrete
2. Admixture
3. Cement
4. Reinforced concrete
5. Class AA
6. One-way slab
7. Steel bars
8. 10 bar diameter
9. Concrete floor slabs
10. 0.9 and 0.10 mm.

Learning Task 4: Check This Out!

1. Foundation
2. Column
3. Footing
4. Loads
5. Steel
6. Hip
7. Truss
8. Valley
9. Ridge
10. Beam

Learning Task 1: 2 Pics 1 Word

LESSON 2 – DRAFT FLOOR FRAMING PLAN

6. D
7. B
8. A
9. A
10. C

Learning Task 5: Posttest

- B.
1. Short and long column
2. Tied column, spiral, composite,
combined, lally reinforcement
3. Lapping, direct and bearing,
welding, mechanical devices
w/c provide full positive
connection

1. Admixture
2. Cement
3. Concrete
4. Beam
5. Live load
6. Steel bar
7. Load bearing wall
8. 25 mm
9. Wind load
10. Rebars

Learning Task 2: Fill Me In!

1. Footing, piers and column.
2. To distribute the weight of the
structural over large area
To support the structures.
To distribute the non-uniform
load of the super structure.

B.

6. C
7. A
8. B
9. C
10. A

Learning Task 6: Post Test

1. D
2. C
3. D
4. A
5. C
6. A
7. A
8. C
9. D
10. C

LESSON 3 – DRAFT ROOF FRAMING PLAN Learning Task 1: Name Mei 1. Hip and Valley 6. Shed 2. Mansard 7. Gable 3. Dormer 8. Flat 4. Hip 9. Cross-hipped 5. Butterfly 10. Gambrel

Learning Task 3: Check This Out! A. 1. Warren 2. Flat Truss 3. Saw tooth 4. Truss 5. Bowstring 6. Fink 7. Rafter 8. Roof Framing Plan 9. Hip Rafter 10 Valley Jack

B. 1. Rafter, truss and laminated Roof system 2. Common, hip, valley, octagonal and jack rafter 3. Pitched, howe, scissor, sawtooth, raised chord, 1 ½ storey frame, flat, utility, bowstring 4. Belgian, warren, cambered fink, pratt, flat howe, flat pratt

Learning Task 5: Post Test 1. B 2. A 3. A 4. C 5. A 6. B 7. B 8. A 9. D 10. C