



TOPIC 3

BIM FOR STRUCTURE

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This module is prepared for the Polytechnics students for understanding Structural Modelling using 3D parametric tools. It is structured in step by step approach consist of the following:

Tools and Software to Start Structural Projects

- Opening Projects
- Start New Projects
- Saving Projects

Annotation and Tagging

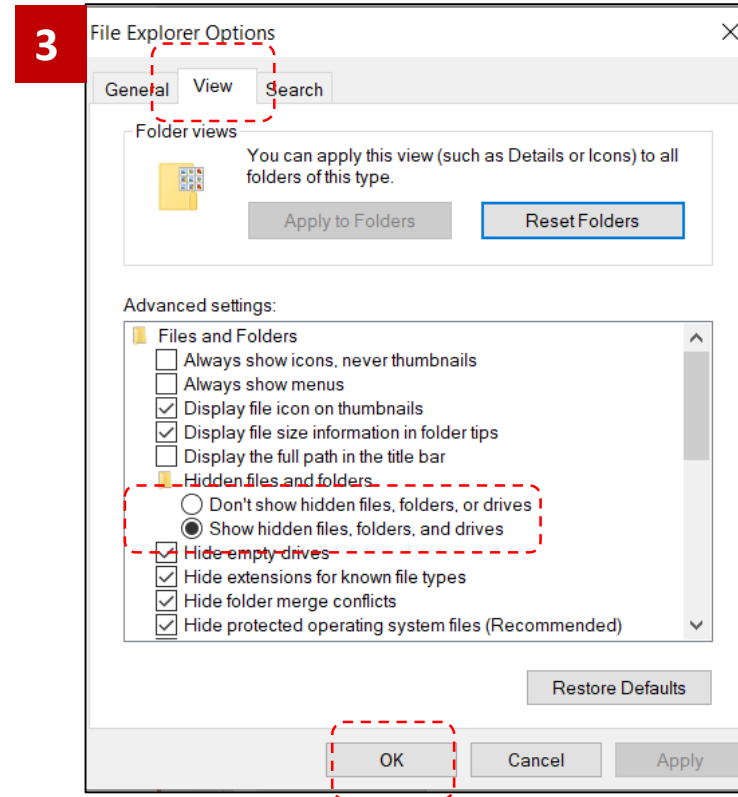
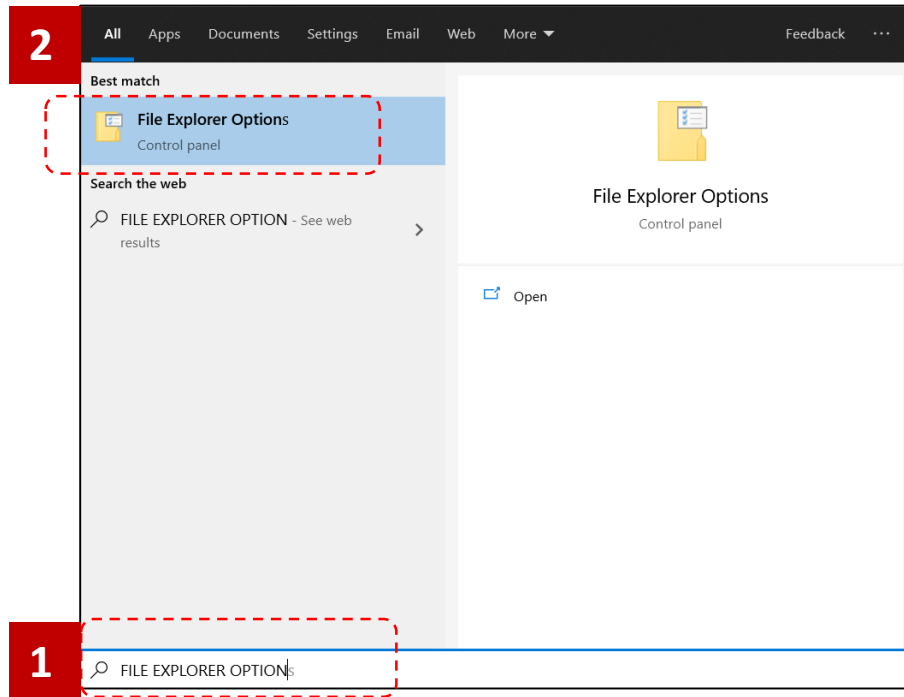
- Tag by Category
- Tag All

Structural Elements

- Columns
- Wall
- Foundations
- Structural Slabs
- Beams
- Framing Systems

TOOLS AND SOFTWARE TO START STRUCTURE PROJECT

START REVIT STRUCTURE MODELLING



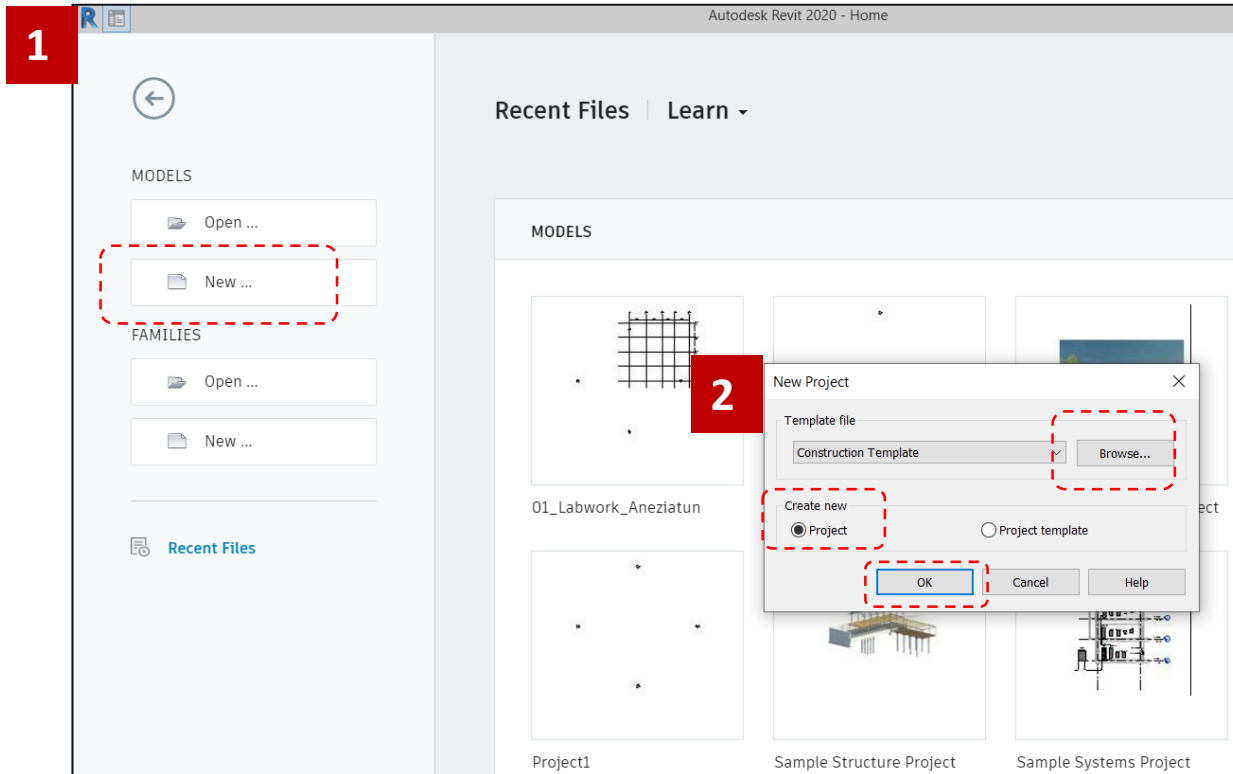
Note:

To bring attention to the **Program Data hidden folder** in C Drive comprises of **Default Libraries, Default Templates and Default Family Templates** that will be used later.

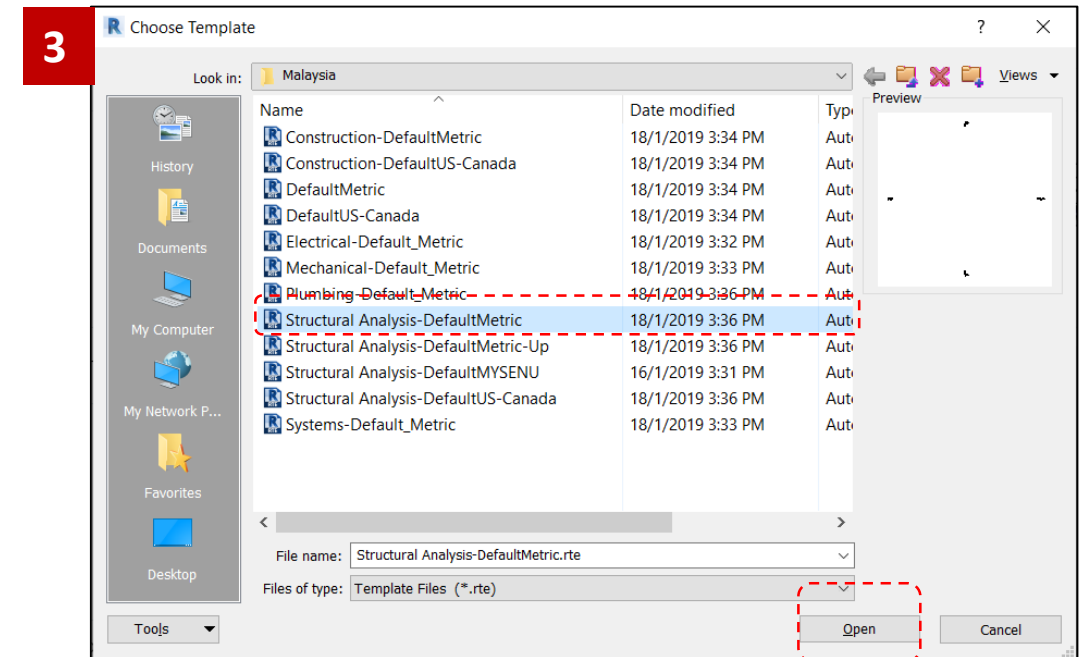
1. Search for **Folder Option** or **File Explorer Options** in programs and files
2. Click **Folder Option** or **File Explorer Options**

3. Click **View** and select **Show hidden files , folders and drives**

OPENING PROJECTS



1. Click **New project**.
2. Select **Browse**.

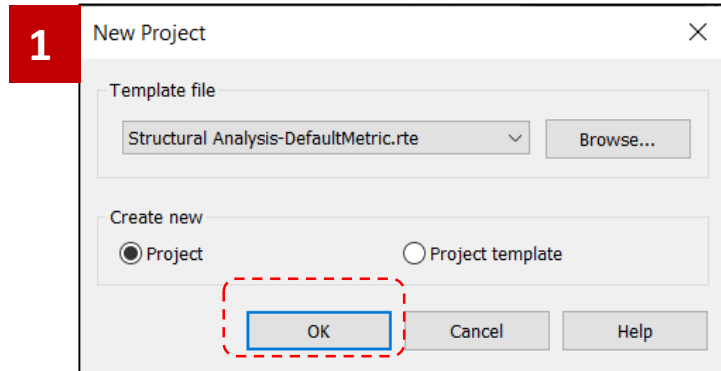


C:\ProgramData\Autodesk\RVT 2021\Templates\English\DefaultMetric

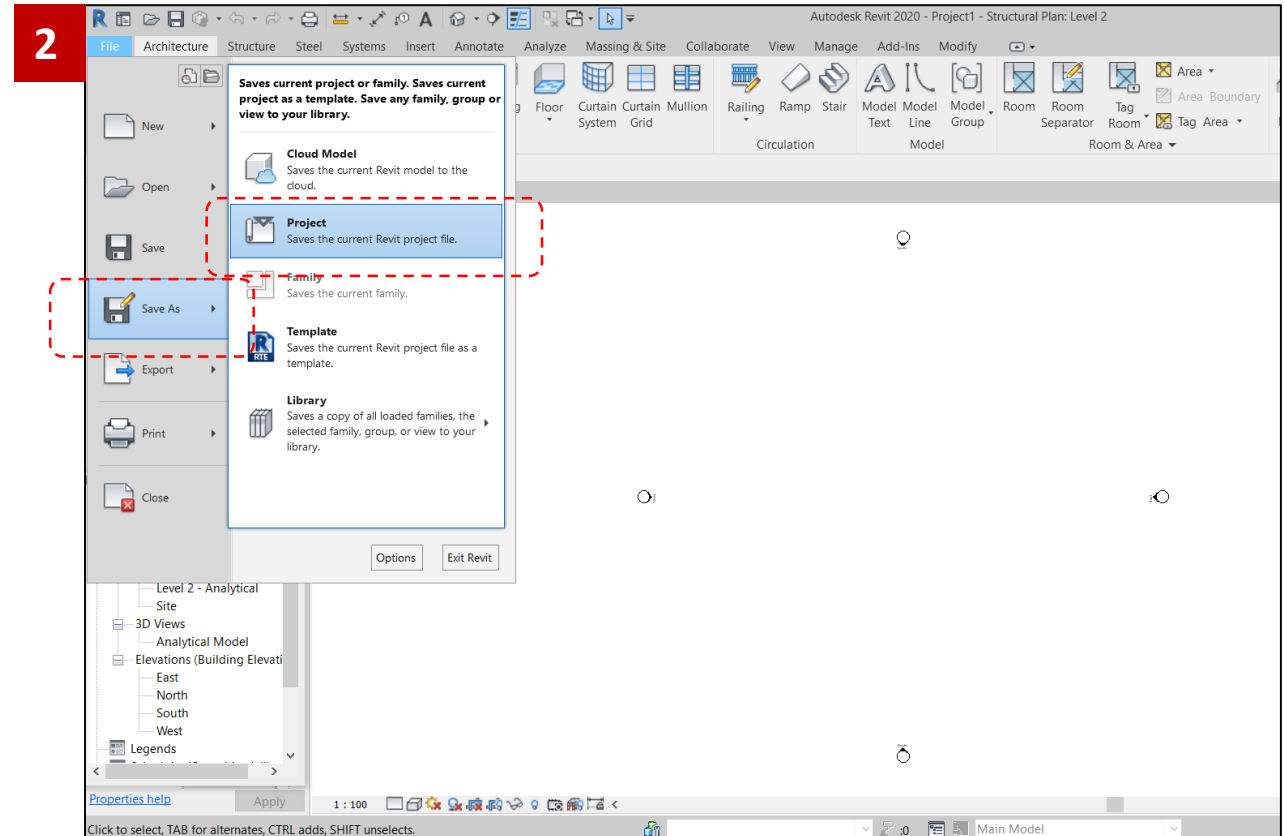
Version

3. Choose **Structural Analysis-DefaultMetric**, Click **Open** and click **OK**.

START NEW PROJECTS



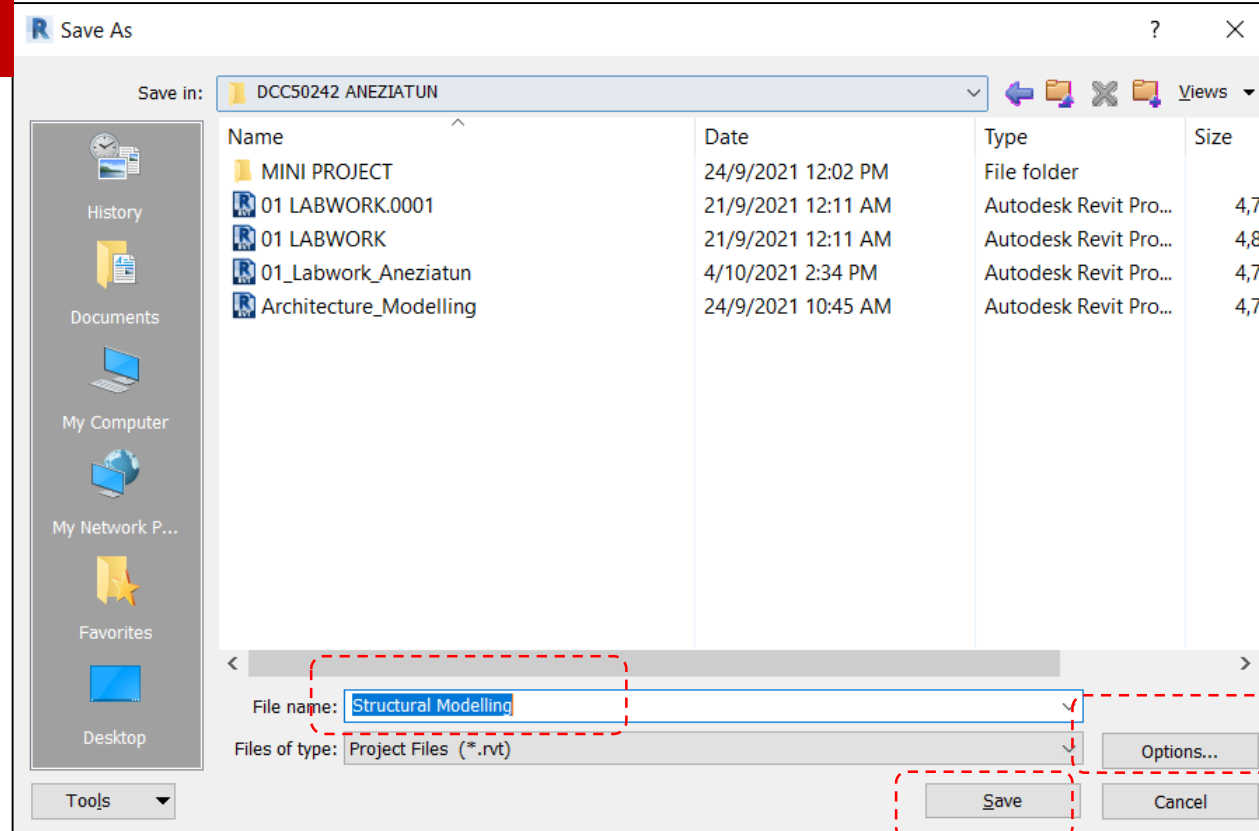
1. To save the project, click on the **File** Tab.



2. Select **Save As**, then select **Project**.

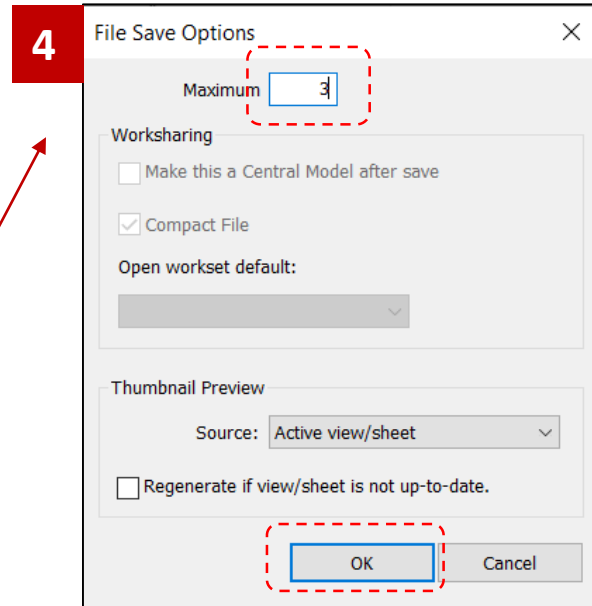
SAVING PROJECTS

3



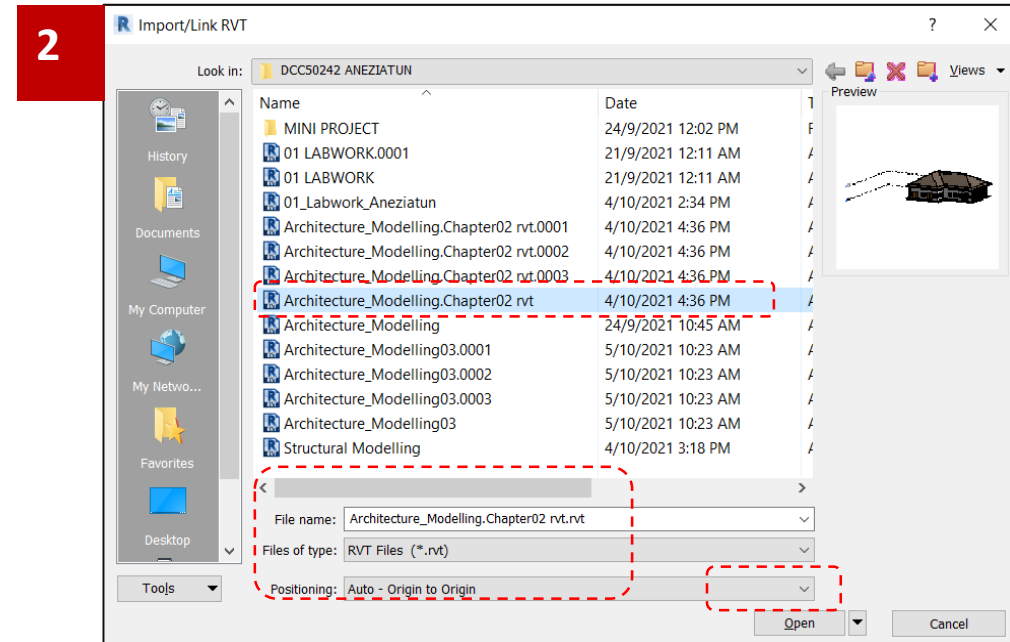
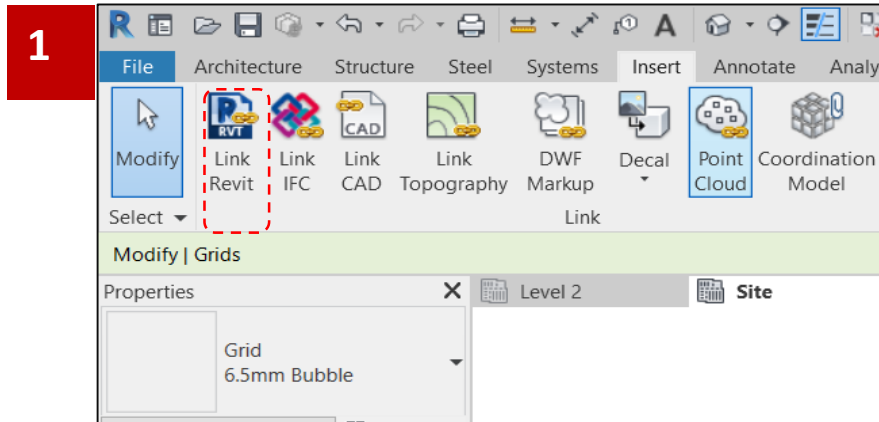
3. Click **Options**, enter the value **1 to 3** on Maximum Backup and click **OK**.

4



4. Change **File name** example **Structural_Modelling** *(or any name regarding your project)* and click **Save**.

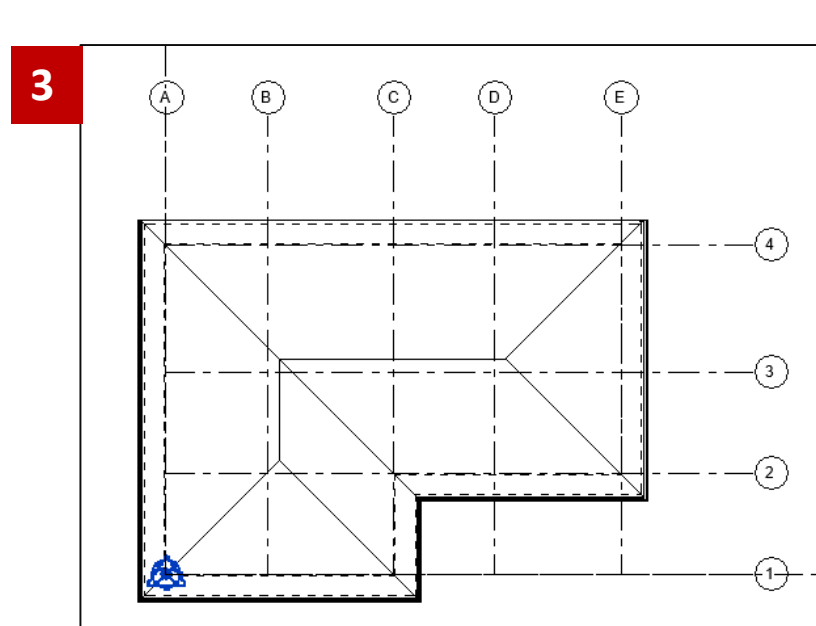
LINK ARCHITECTURAL MODEL



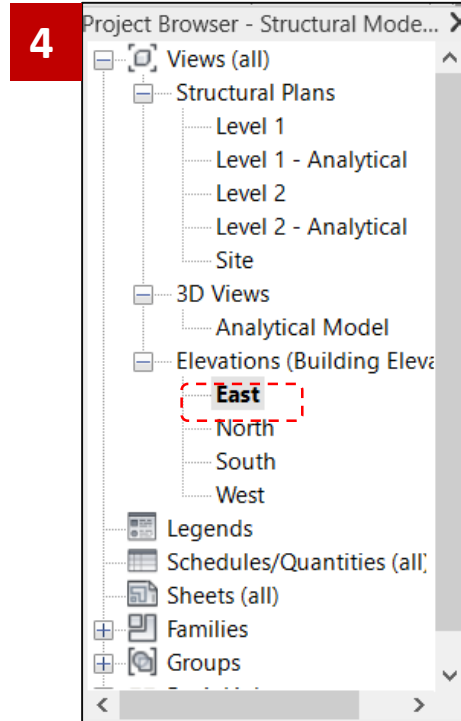
1. Select **Link Revit** in **Insert Tab**.

2. Find the **Architecture Modelling** file created in **Topic 2: BIM for Architecture** and Click **Open**.

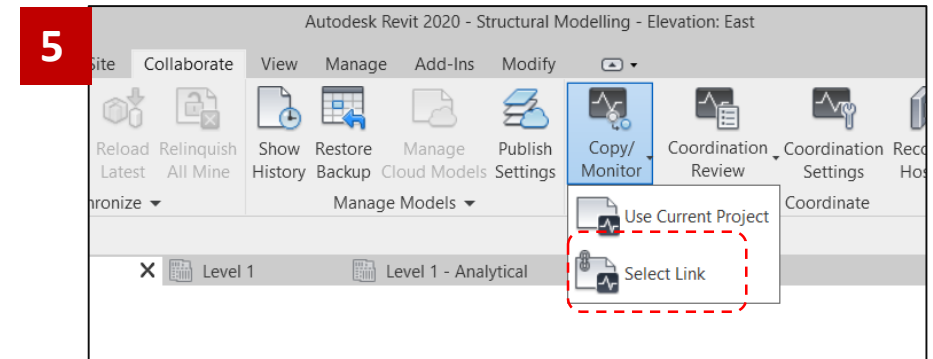
COPY/MONITOR - LEVELS



3. The diagram shows the **Link Architectural Model** that has been added into the drawing area.



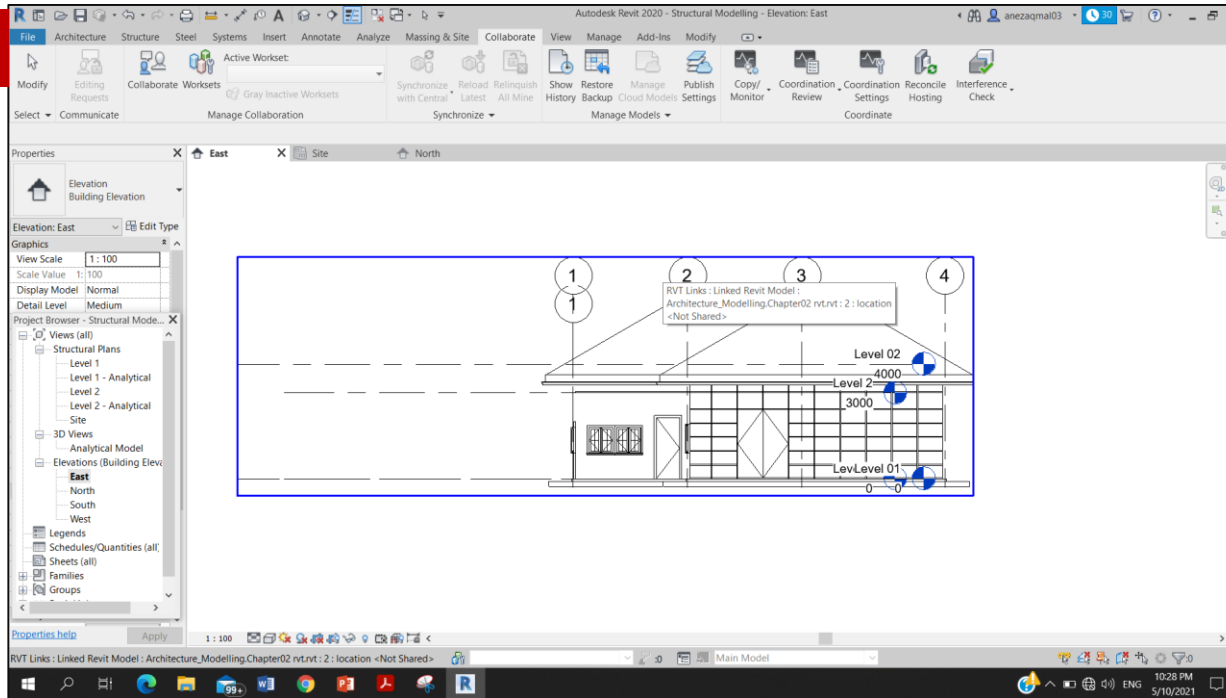
4. On **Project Browser**, double click the **Elevations-East**.



5. On **Collaborate Tab**, Click the **Copy/Monitor** and click **Select Link**.

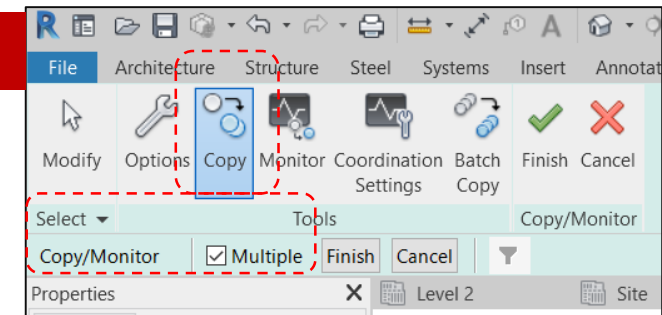
COPY/MONITOR - LEVELS

6



6. Click **the link** as shown in the diagram.

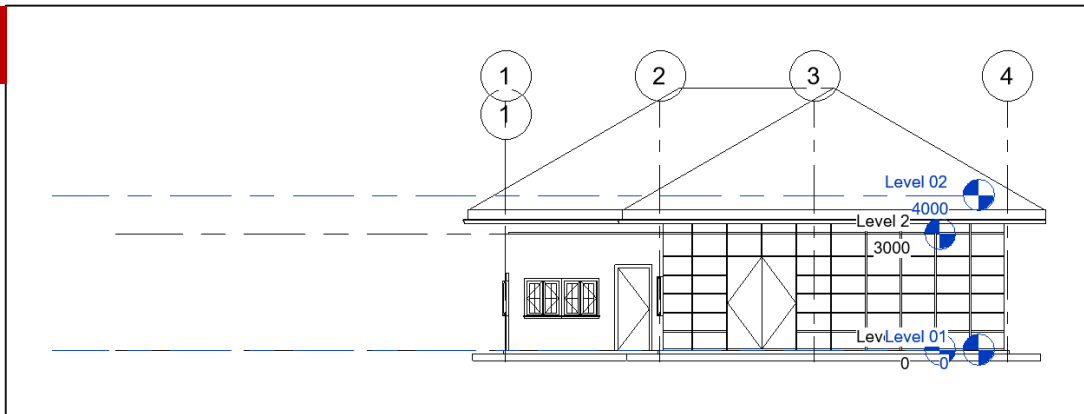
7



7. Click the **Copy** and tick **Multiple** before selecting all in drawing area.

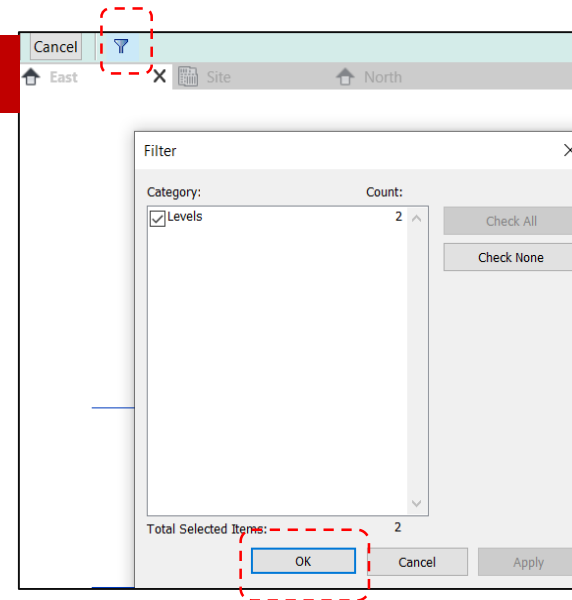
COPY/MONITOR - LEVELS

8



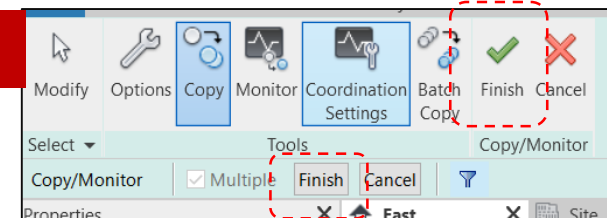
8. Highlight **all Levels** in drawing area.

9



9. On **Option Bar**, click **Filter** to ensure only **Category: Levels** is selected. Click **OK**.

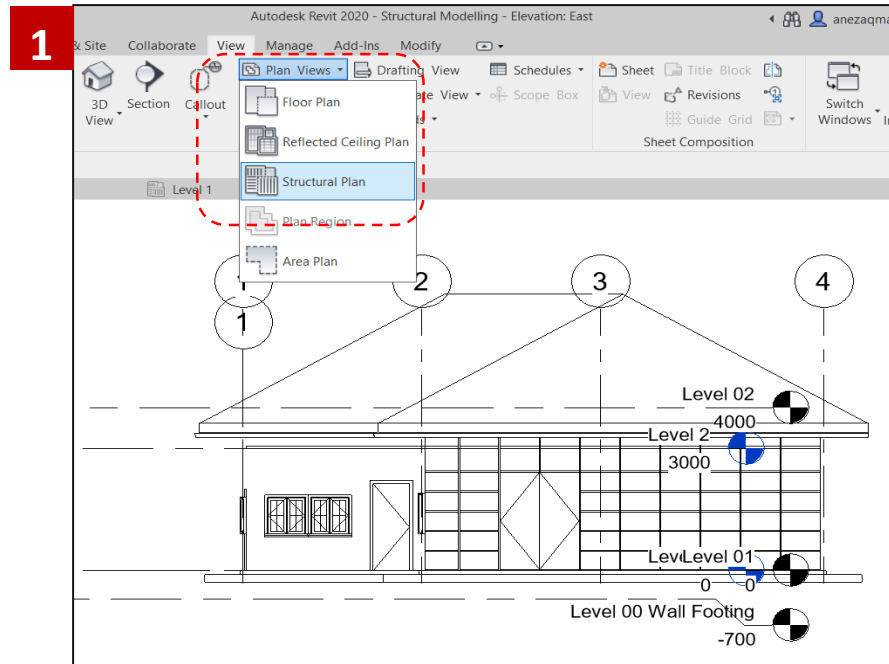
10



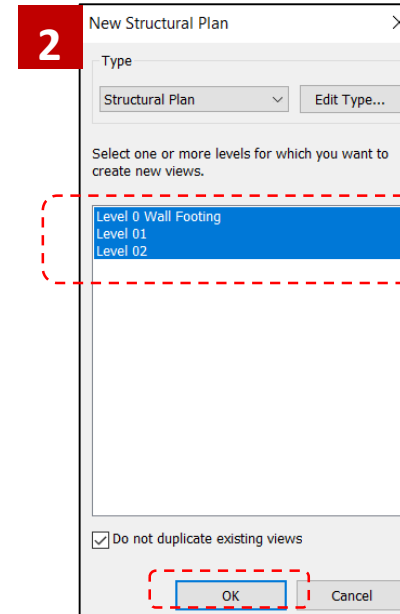
10. Click **Finish** on **Option Bar**, then click the **Finish Edit Mode**.

DRAW: Wall Footing Level

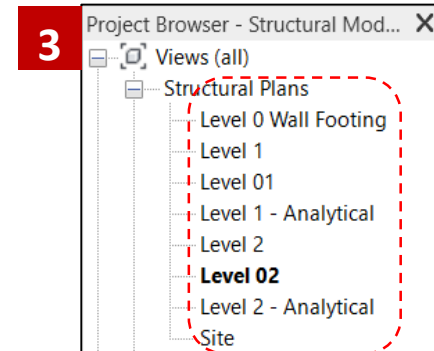
EXERCISE 1 : Create Level 0 Wall Footing with offset -700m.



1. Double click **East-Elevation (Building Elevations)**. Create **Level 00 Wall Footing** for **700mm** (*assume*).



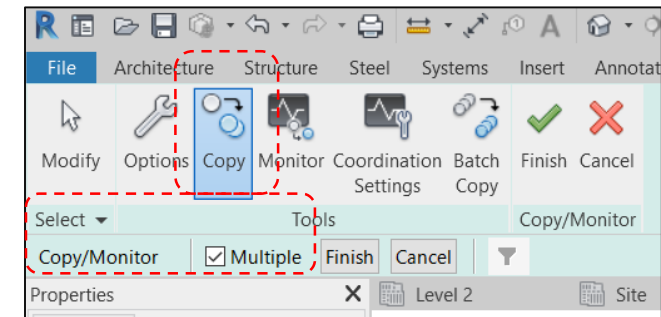
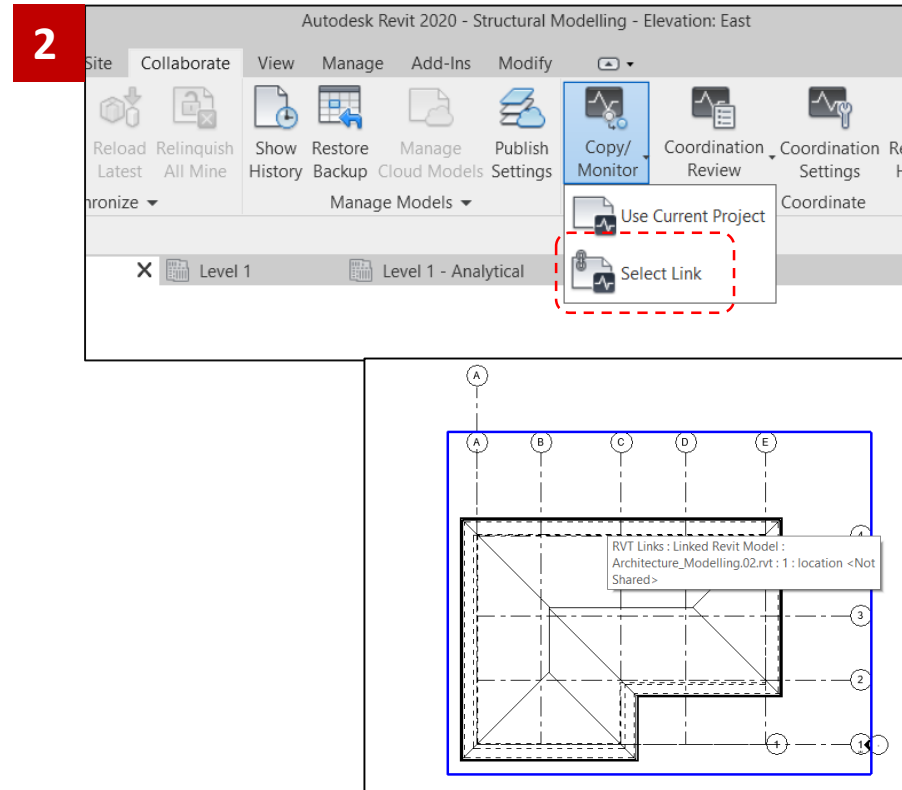
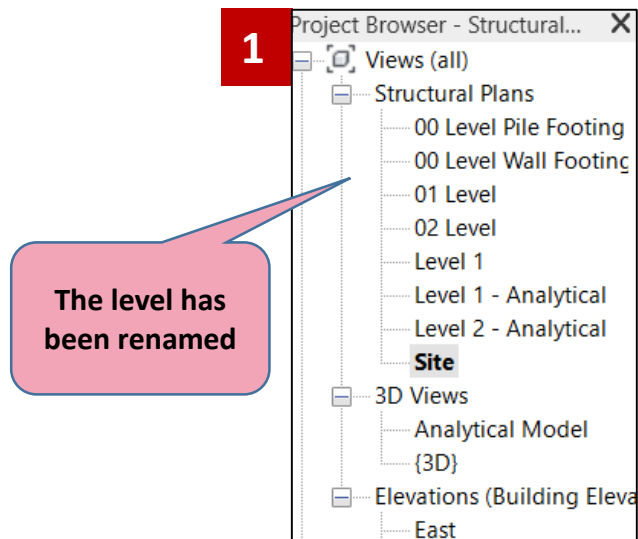
2. If creating **Level by Copy**, select **Plan Views – Structural Plan** on **View Tab**. Select **Level 00 Wall Footing** and tick the box. Click **OK**.



You can rename the level or remain unchanged

3. **Level 0 Wall Footing**, **Level 01** and **level 02** appear under **Structural Plans**.

COPY/MONITOR - GRIDS



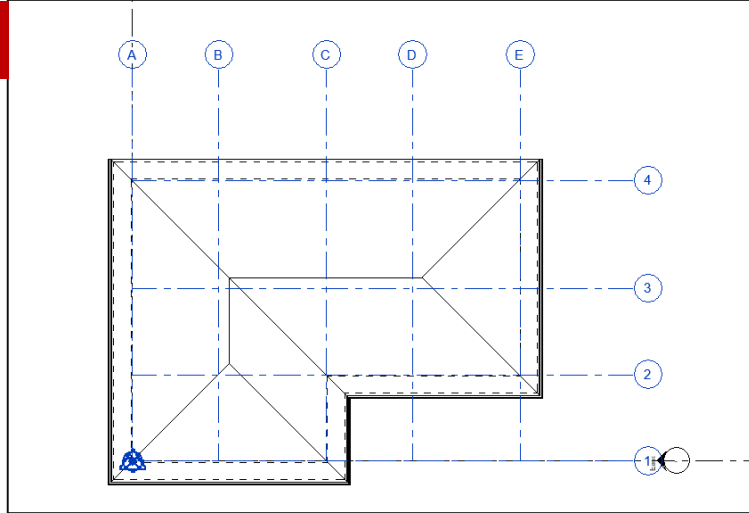
1. On **Project Browser**, double click **Structural Plans – Sites**.

2. On **Collaborate Tab**, Click the **Copy/Monitor** and click **Select Link**. Click the link as shown in the diagram.

3. Click the **Copy** and tick **Multiple** before selecting all in drawing area.

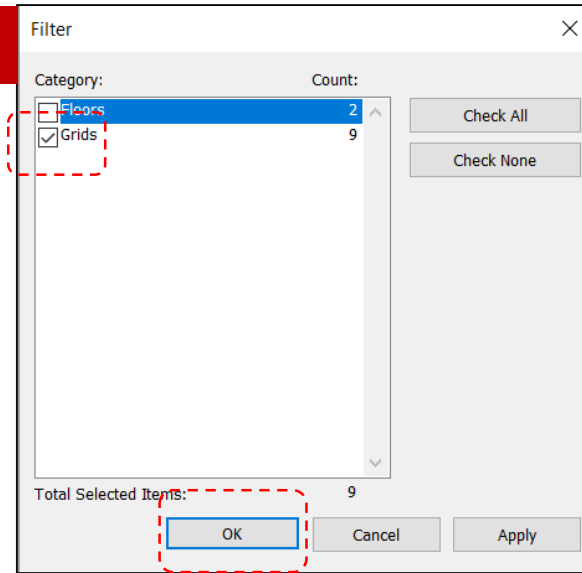
COPY/MONITOR - GRIDS

4

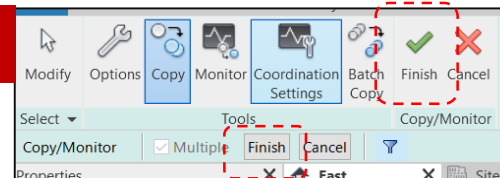


4. **Highlight** all elements in drawing area.

5



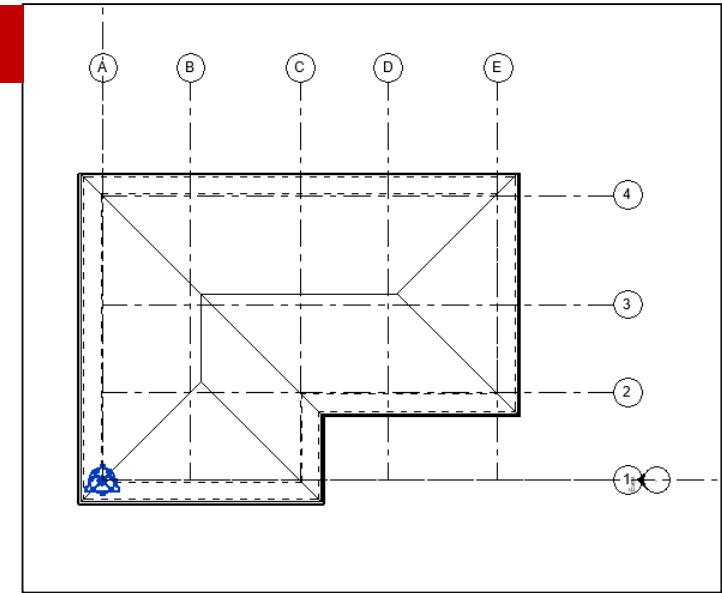
6



5. On **Option Bar**, click **Filter** to ensure only **Category: Grids** is selected. Click **OK**.

6. Click **Finish** on **Option Bar**, then click the **Finish Edit Mode**.

7

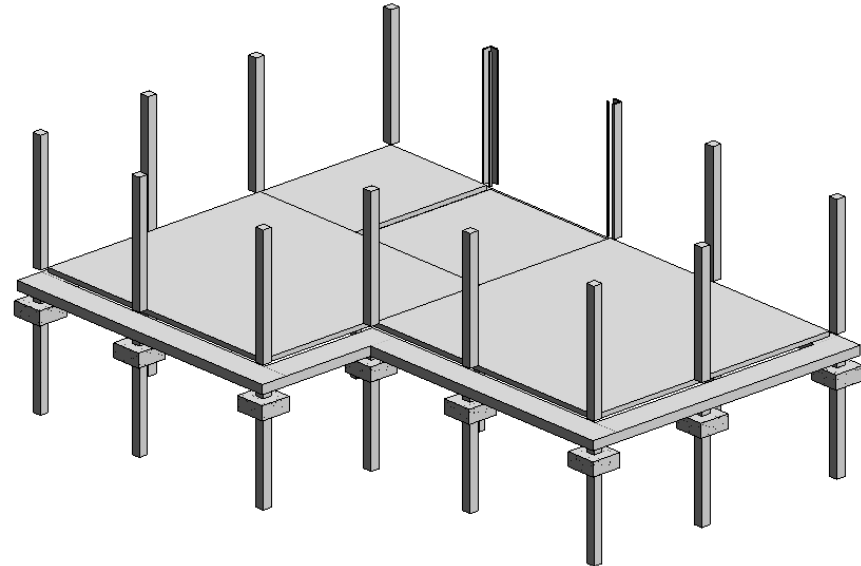
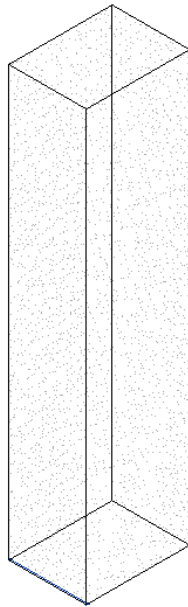
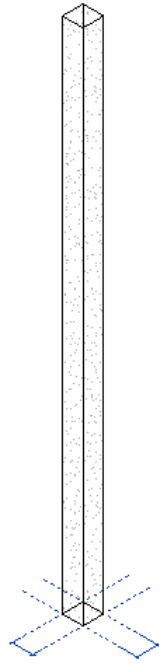
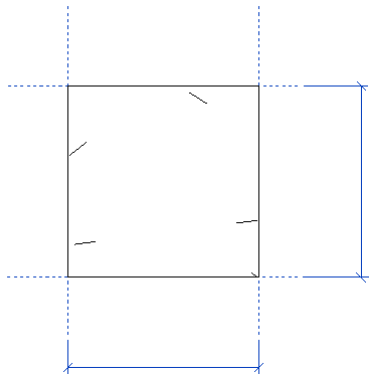


7. The diagram shows the **completed Grids**.

BUILD STRUCTURAL ELEMENTS: STRUCTURAL COLUMNS

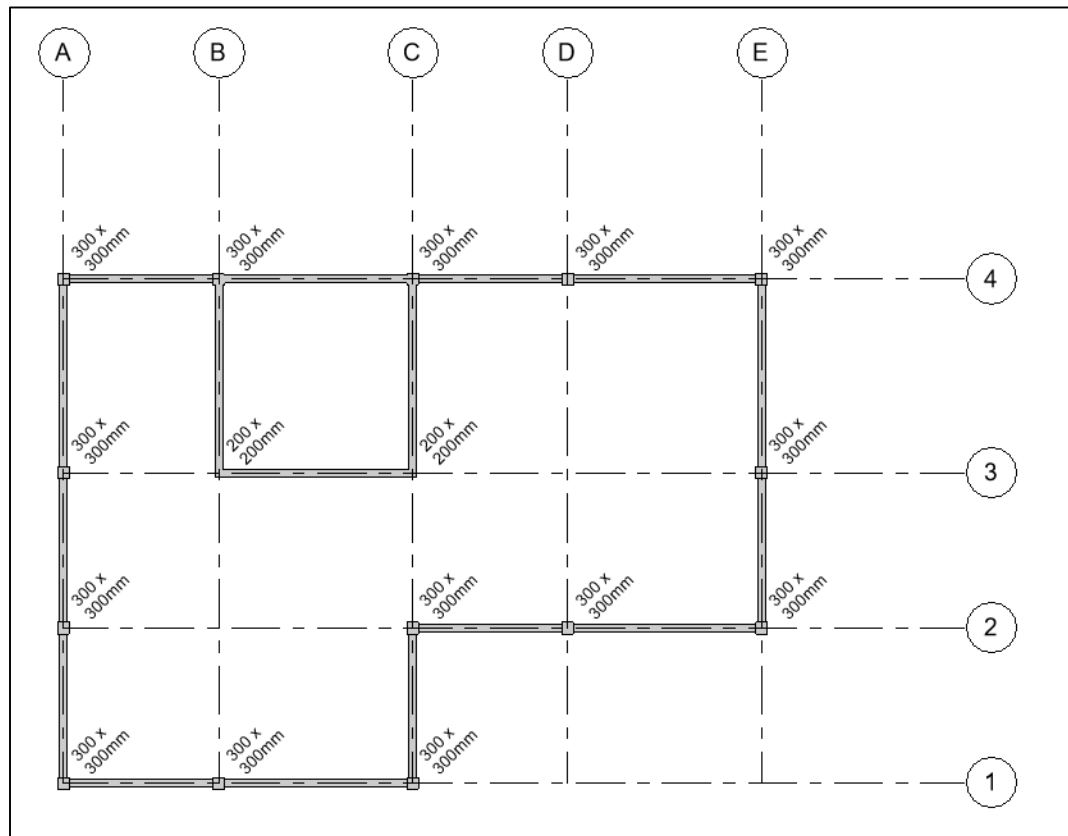
COLUMN

(EXISTING / CUSTOMIZE)

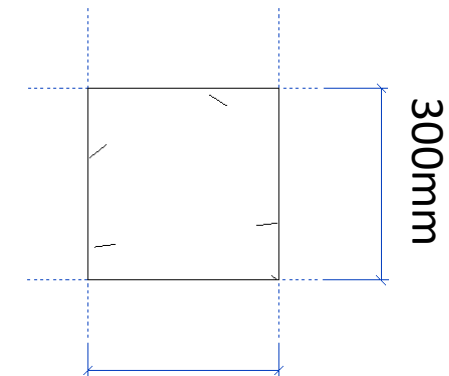


ADDING COMPONENT - Square Column

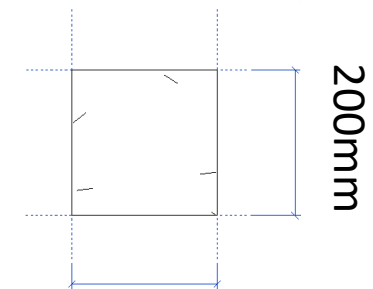
EXERCISE 1 : Adding square column- 300 x 300mm. Column height is 4000mm.



Plan View



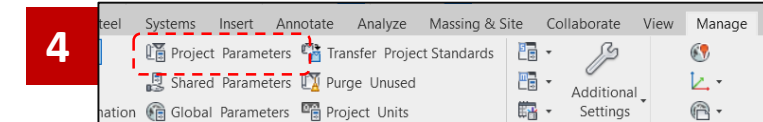
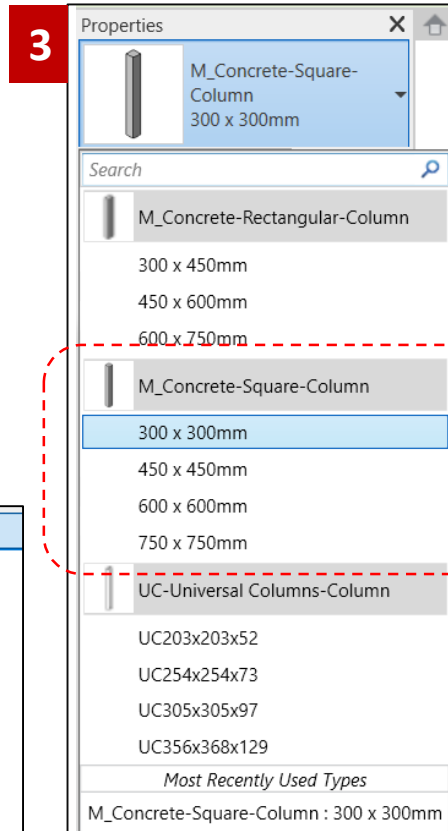
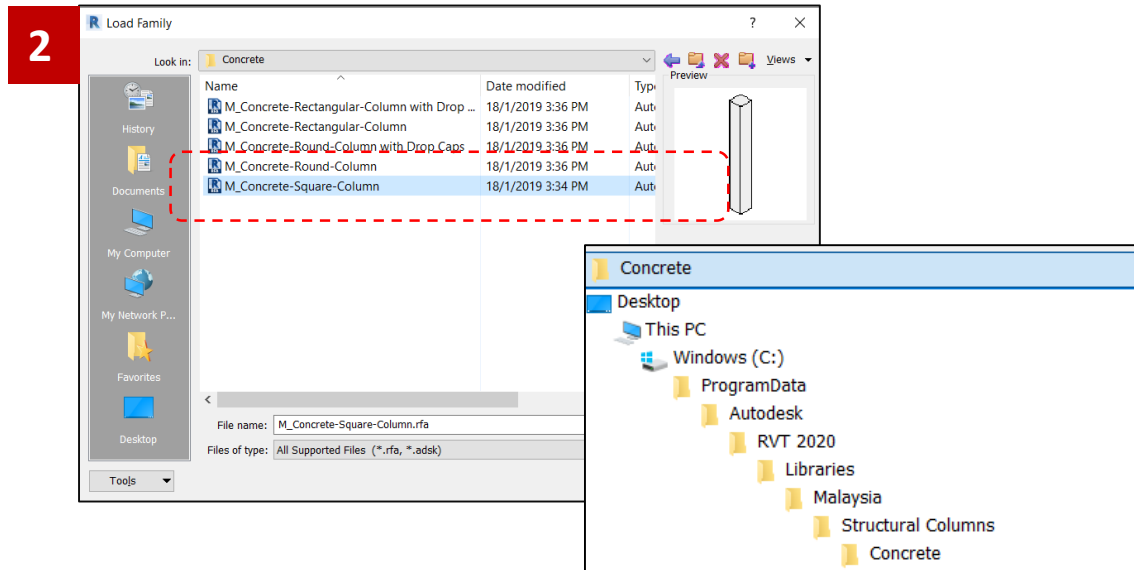
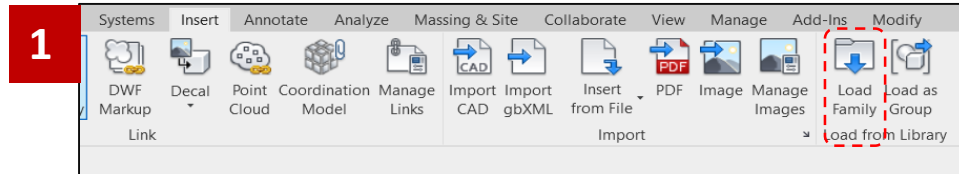
300mm



200mm

Section View

LOAD FAMILY LIBRARY: Square Column



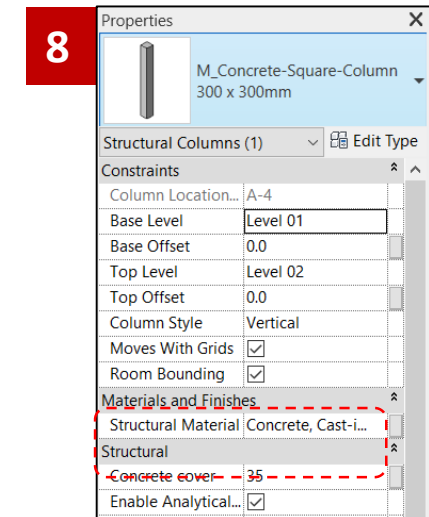
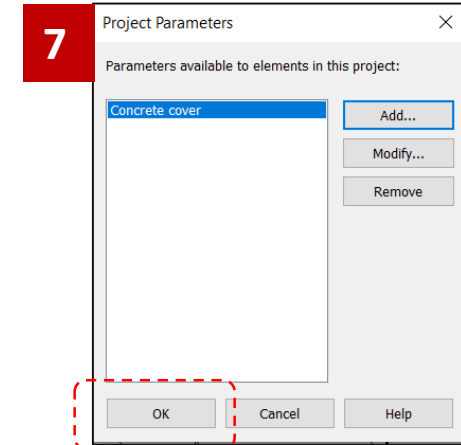
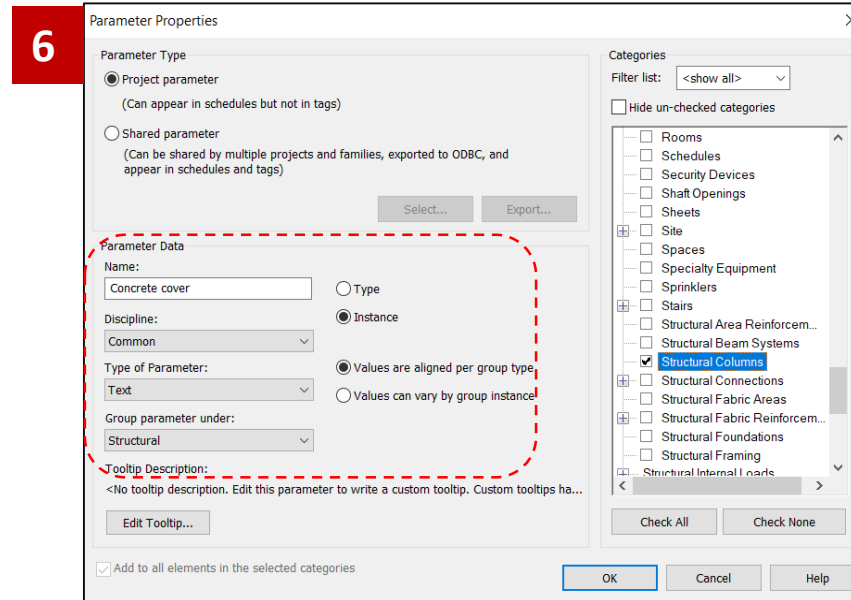
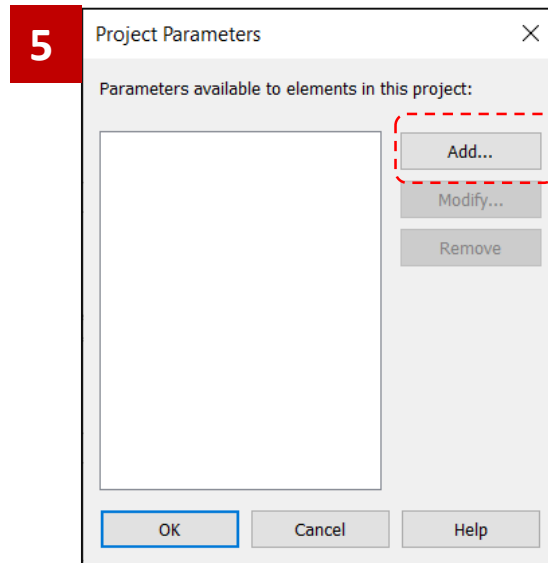
1. On **Insert Tab**, click **Load Family**.

1. Select **M_Concrete-Square-Column** and click **Open**.

3. On **Structure Tab**, select structural column. **M_Concrete-Square-Column 300 x 300mm** appear in Type Selector.

4. On **Manage Tab**, click **Project Parameter**.

LOAD FAMILY LIBRARY: Square Column



5. Click **Add** on Project Parameters pop ups.

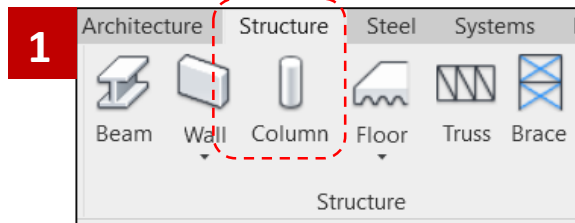
6. Type **Name: Concrete**, **Discipline: Common**, **Type of parameter: Text** and **Group parameter under: Structural**. Tick for **Structural Columns**, then click **OK**.

7. Click **OK** on pop ups.

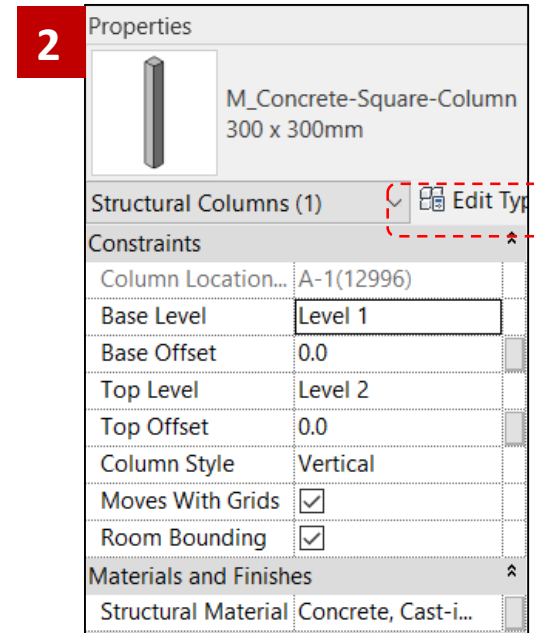
8. Key in the information as shown in diagram. **Structural Material: Concrete- Cast-in-Place-C35** and place the column according to **Key Plan Drawing**

CUSTOMIZE COMPONENT: Square Column

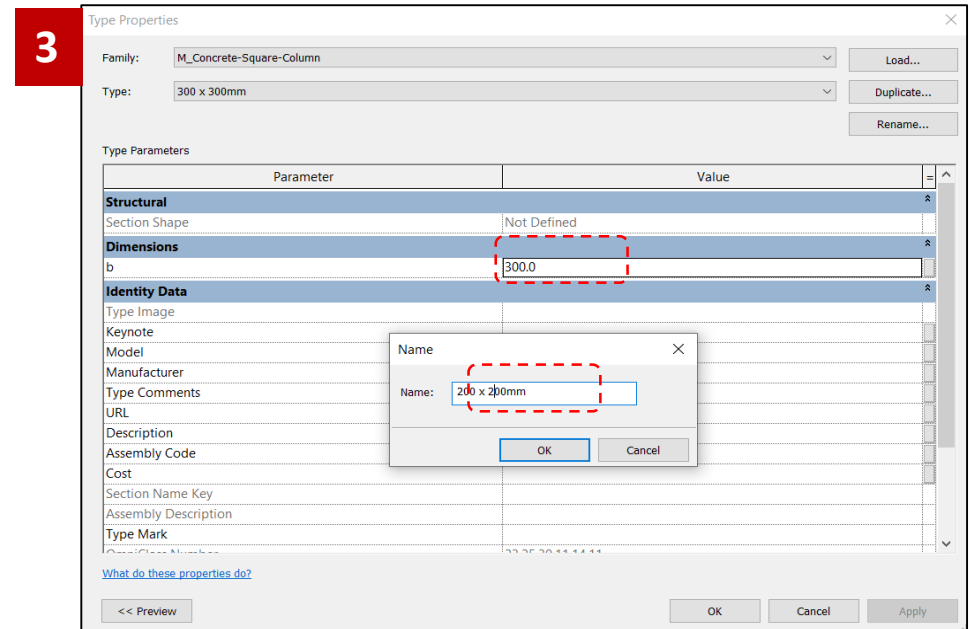
EXERCISE 2: Create square column- 200 x 200mm. Column height is 4000mm.



1. On **Architecture Tab**, click **Structural Columns**.

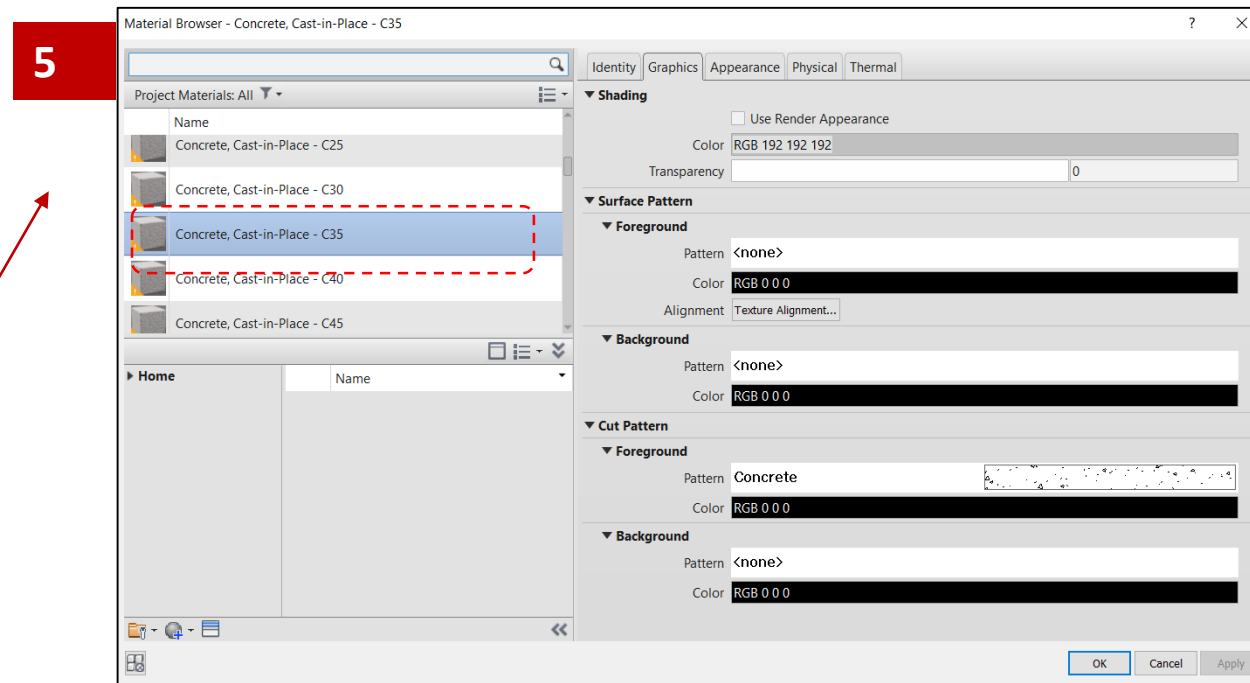
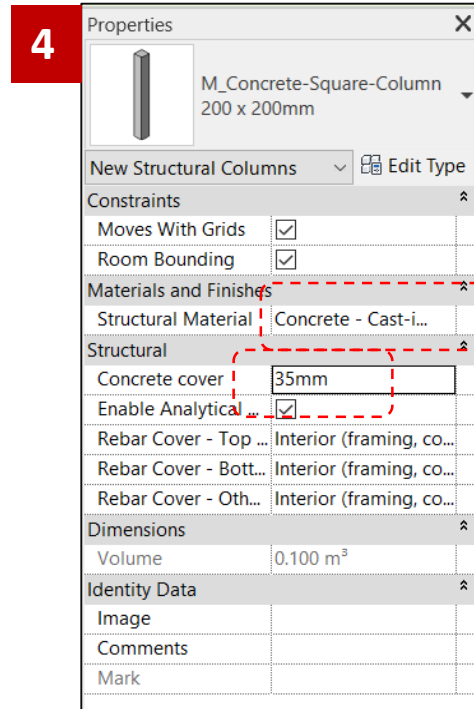


2. Select **M_Concrete-Square-Column 300 x 300mm** in type selector and Click **Edit Type**.



3. Duplicate for **200 x 200mm** and **b** as **200mm**. Key-in **Reinforced Concrete Column** in description and then click **OK**.

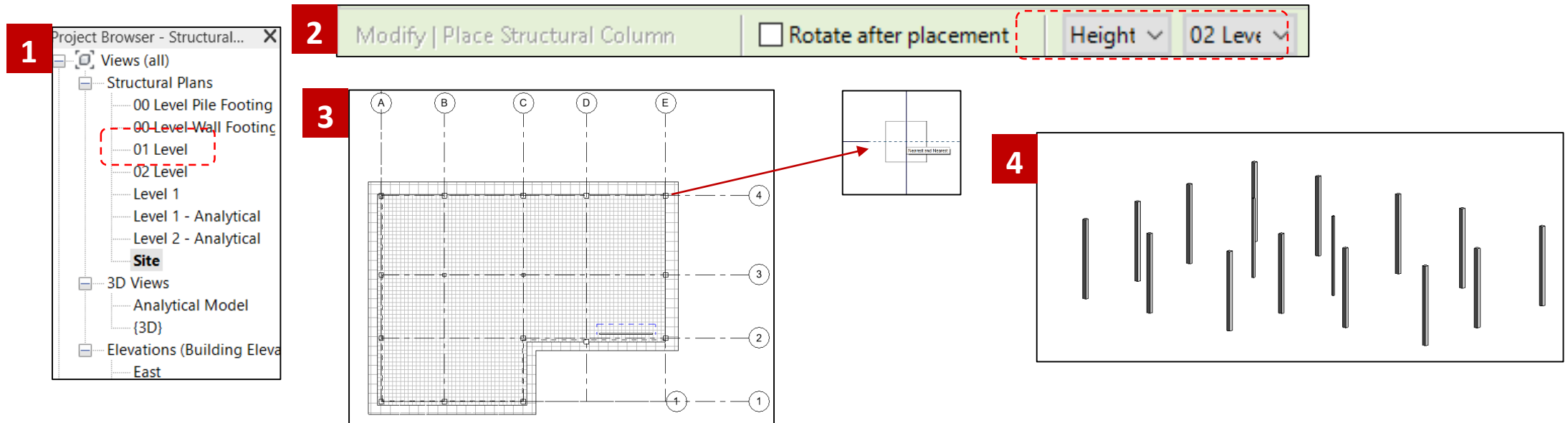
CUSTOMIZE COMPONENT: Square Column



- On Type Selector, select **M_Concrete-Square-Column 200 x 200mm** on Properties palette. On **Structure Material**, Click **More Options**. Concrete cover is **35mm**.
- Change Material to **Concrete- Cast-in-Place -C35**, then click **OK**.

PLACING COMPONENT: Square column

EXERCISE 3: Place the square column- 300 x 300mm and 200 x 200mm in Level 1.



1. Double click **Structural Plans – 01 Level** on Project Browser.
2. On **Structure Tab**, click **Structural Column**. On the Option Bar, ensure **Height** and **Top constraint: 02 Level** are used. Key in the **Concrete Cover** as **35mm**. *(or it can be on 02 Level but ensure “Depth” and “Base constraint: 01 Level”)*
3. Placing the column based on **Column Schedule** provided.
4. The diagram shows the **completed column** added in drawing area.



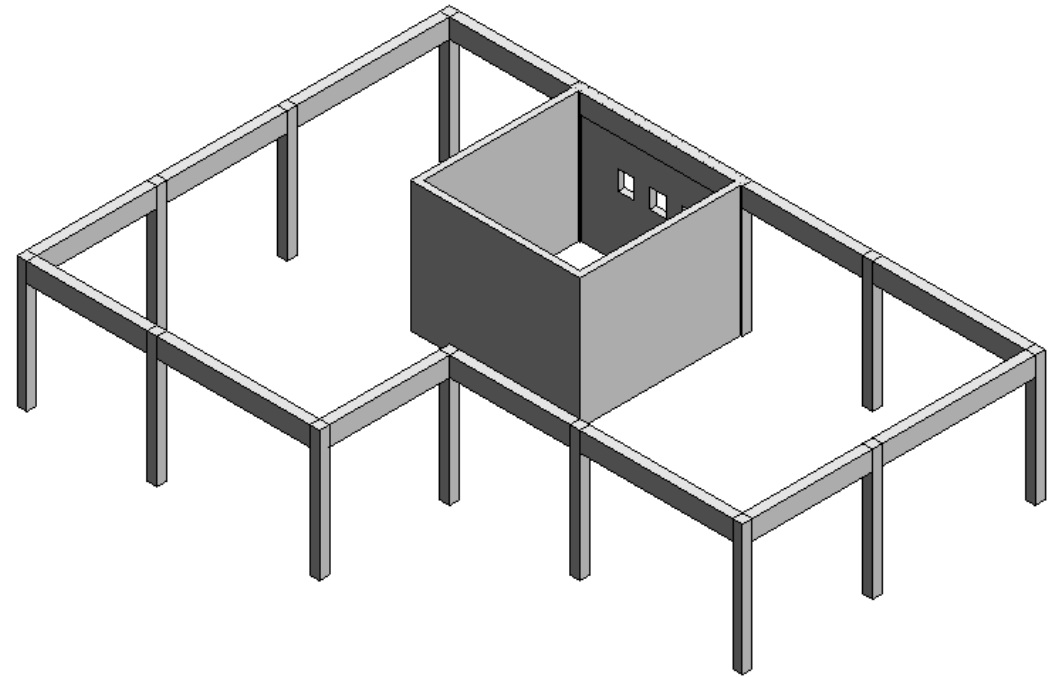
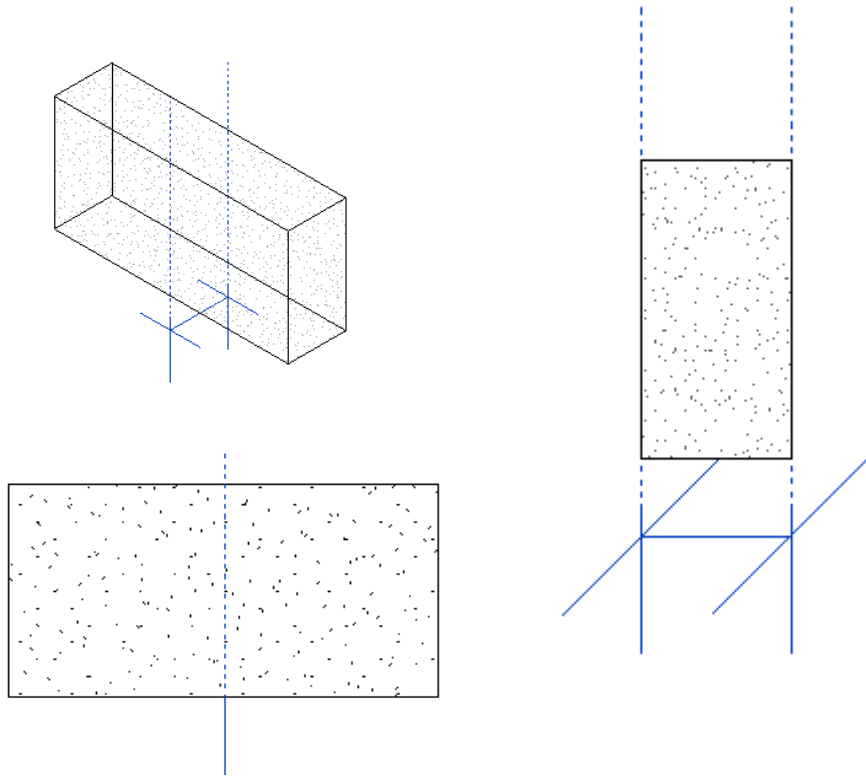
KEMENTERIAN PENGAJIAN TINGGI

POLITEKNIK
MALAYSIA

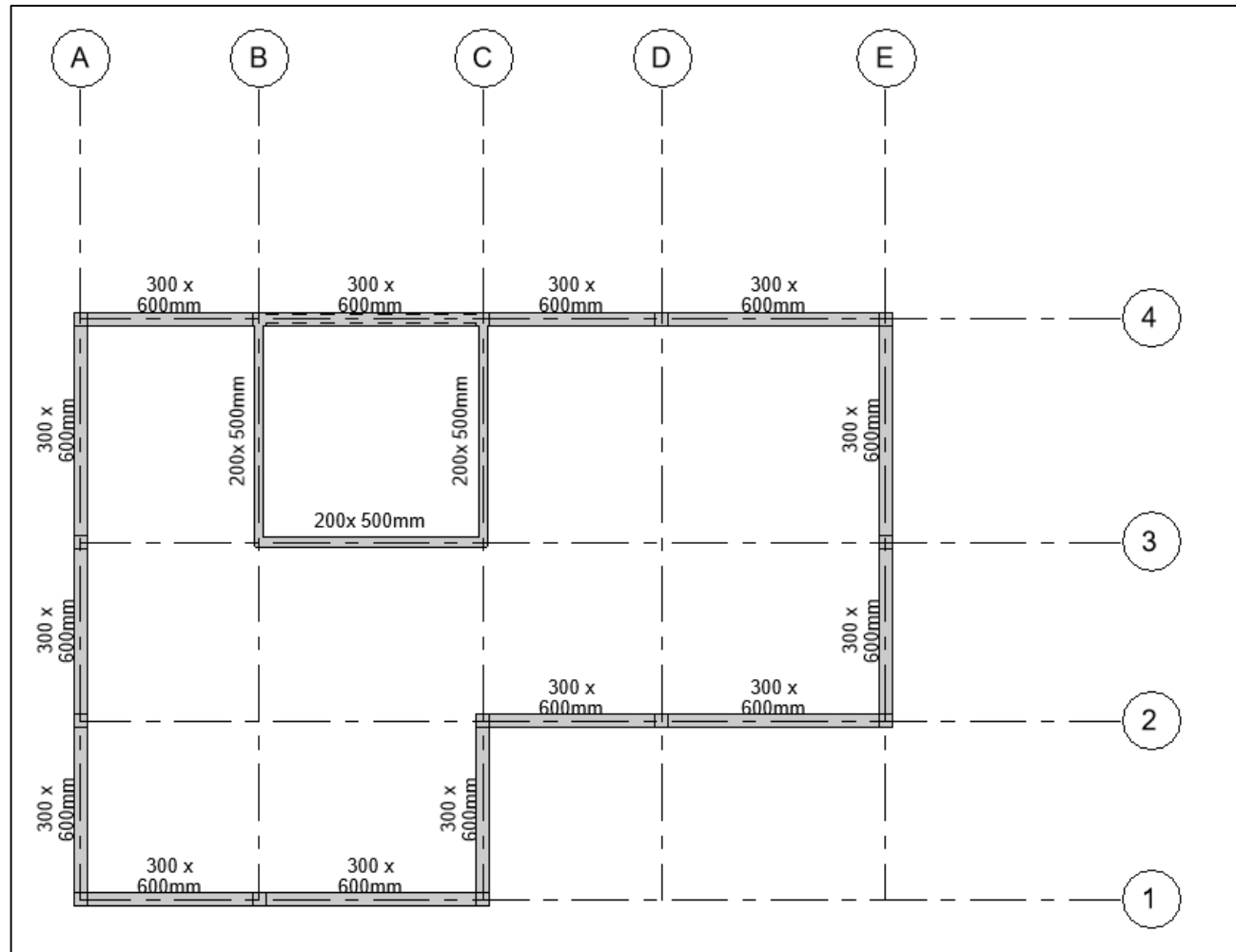
BUILD STRUCTURAL ELEMENTS: BEAMS AND FRAMING SYSTEM

STRUCTURAL FRAMING

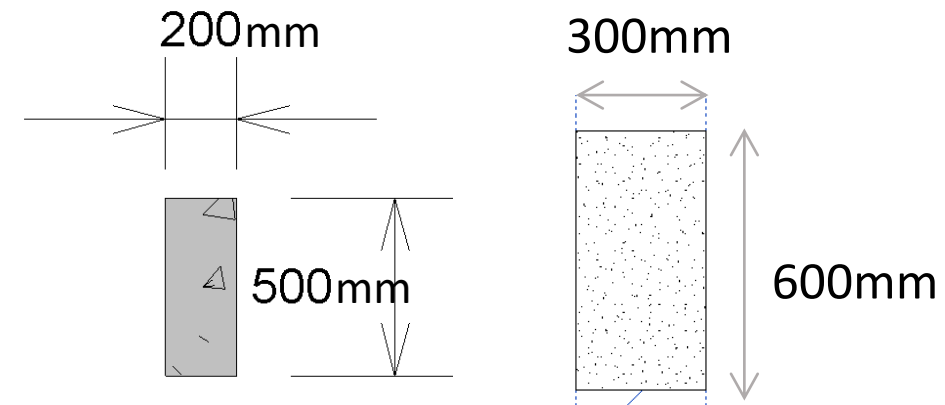
(EXISTING/CUSTOMIZE TYPE)



KEY PLAN DRAWING : Rectangular Beam



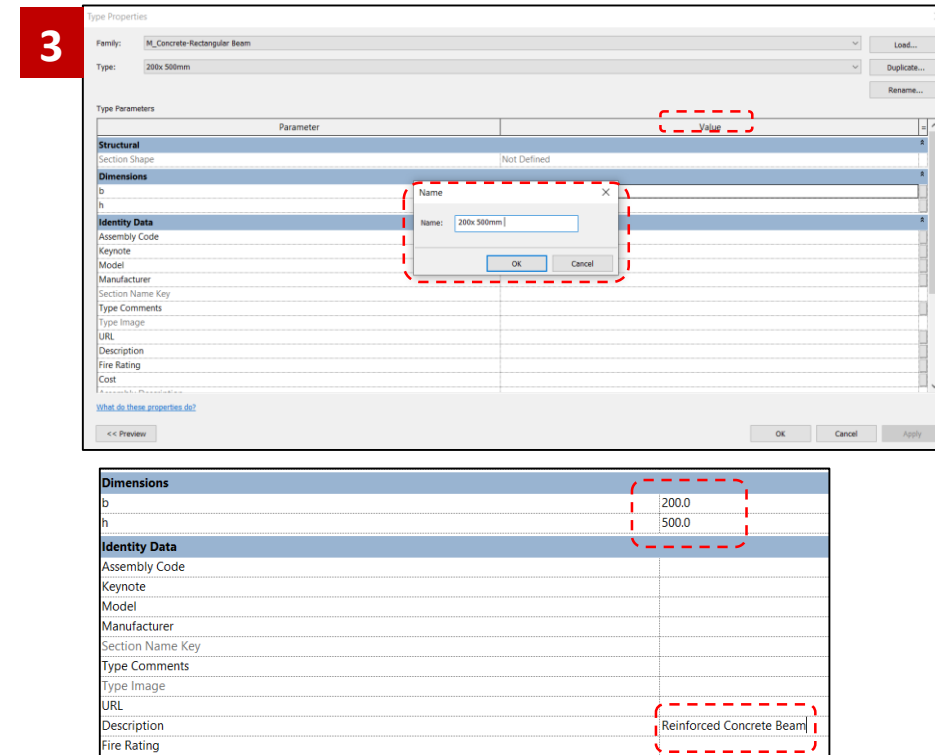
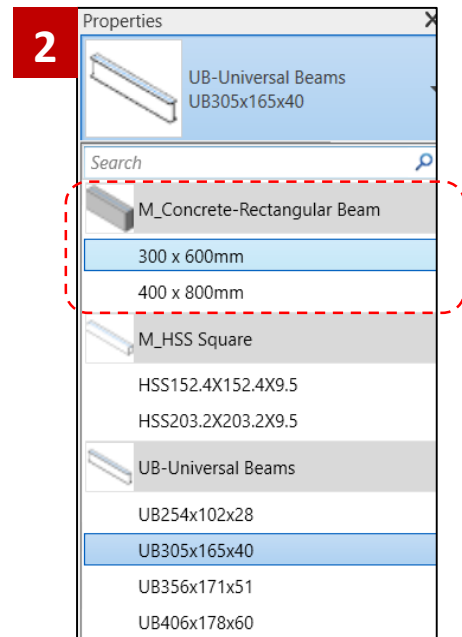
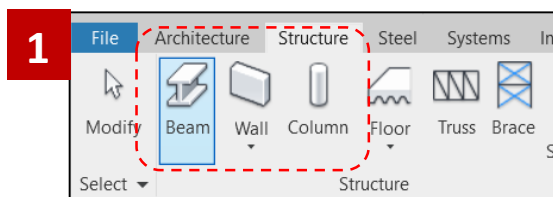
Plan View



Section View

CUSTOMISE COMPONENT : Rectangular Beam

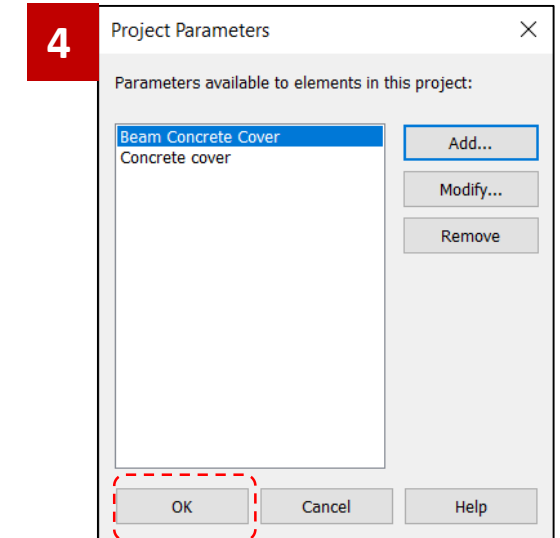
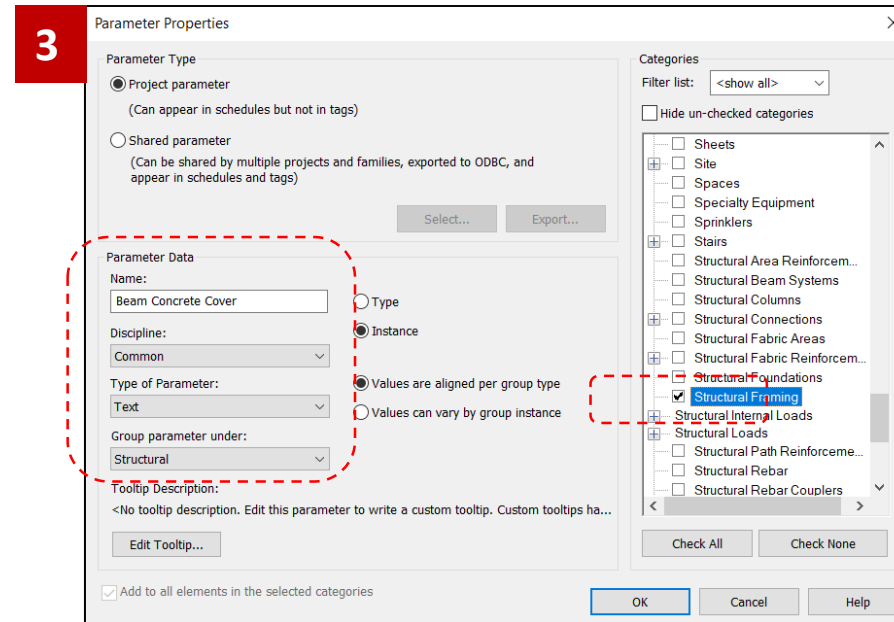
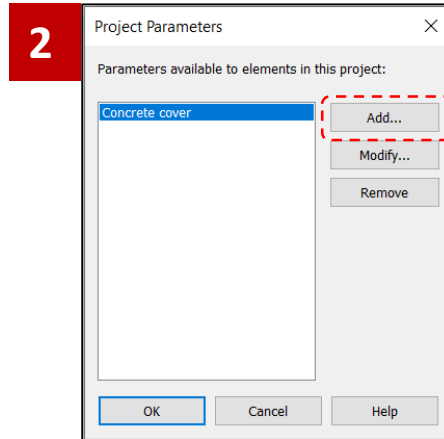
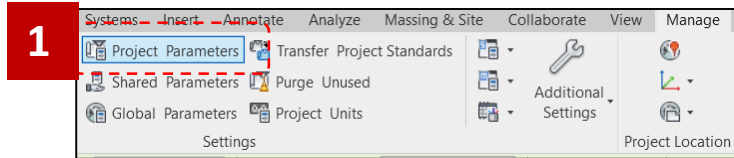
EXERCISE 1: Create rectangular beam for 200mm x 500mm



1. On Structure Tab, select **Structural Framing: Beam**.
2. On Type Selector in Properties palette, select **M_Concrete-Rectangular Beam 300 x 600mm** then click **Edit Type**.

3. Duplicate as **M_Concrete-Rectangular Beam 200 x 500mm** then change b as **200** , h as **500** and Description as **Reinforced Concrete Beam** then click **OK**.

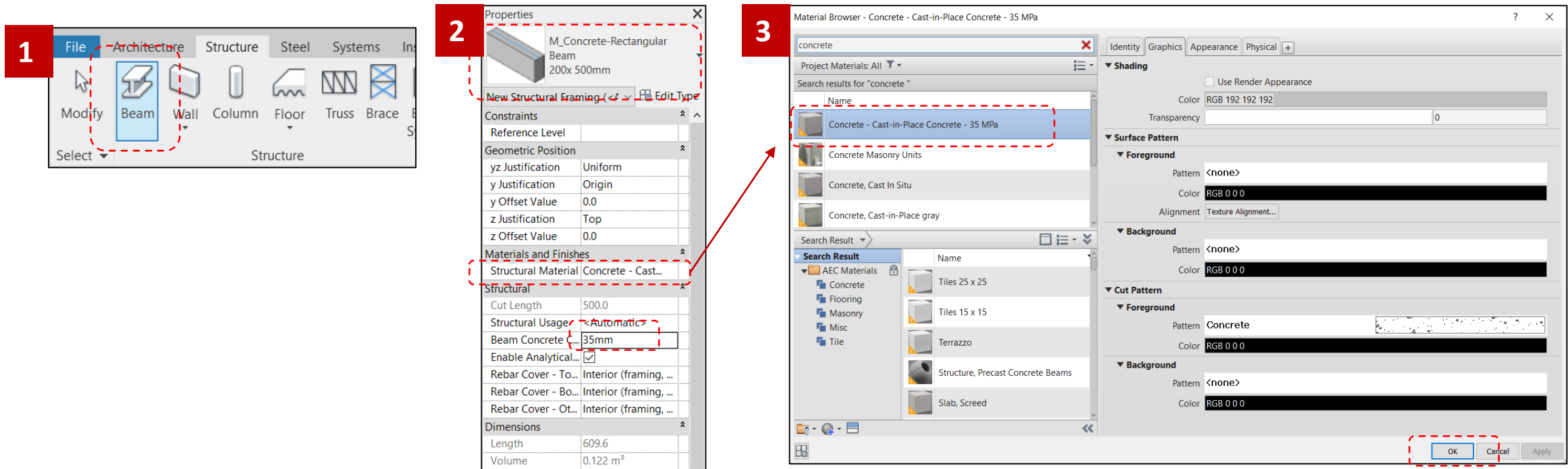
CUSTOMISE COMPONENT : Rectangular Beam



1. On **Manage Tab**, select **Project Parameter**.
2. On **Project Parameter pop up** will appear and click **Add**.

3. Enter information in Parameter Data : **Name – Beam Concrete Cover**, **Discipline – Common**, **Type of Parameter- Text**, **Group parameter under- Structural** and **Categories-Structural Framing**.
4. On **Project Parameter pop up**, click **OK**

CUSTOMISE COMPONENT : Rectangular Beam

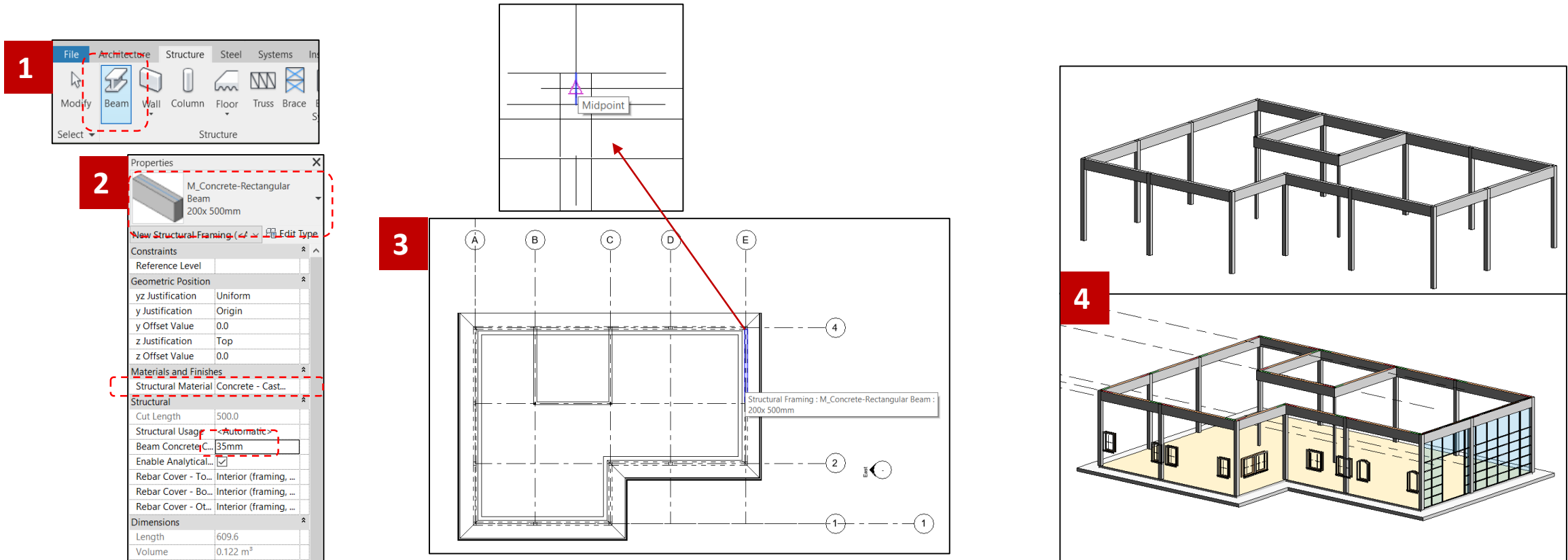


1. On **Structure Tab**, select **Structural Framing: Beam**.

2. On **Properties palette**, select **M_Concrete-Rectangular Beam 200 x 500mm**, enter value of **Beam Concrete Cover : 35mm**.

3. Click **Structural Material for More Options**. Change the material to **Concrete-Cast-In-Place Concrete 35MPa** then click **OK**.

PLACING COMPONENT : Rectangular Beam



1. On **Structure** Tab, select **Beam**.

2. On **Properties** palette, select **M_Concrete-Rectangular Beam 200 x 500mm** and **M_Concrete-Rectangular Beam 300 x 600mm**.

3. **Placing** the beam from column to column in **02 Level** as shown in Key Plan Drawing: Beam.

4. The diagram shows the **completed beam** added in drawing area.



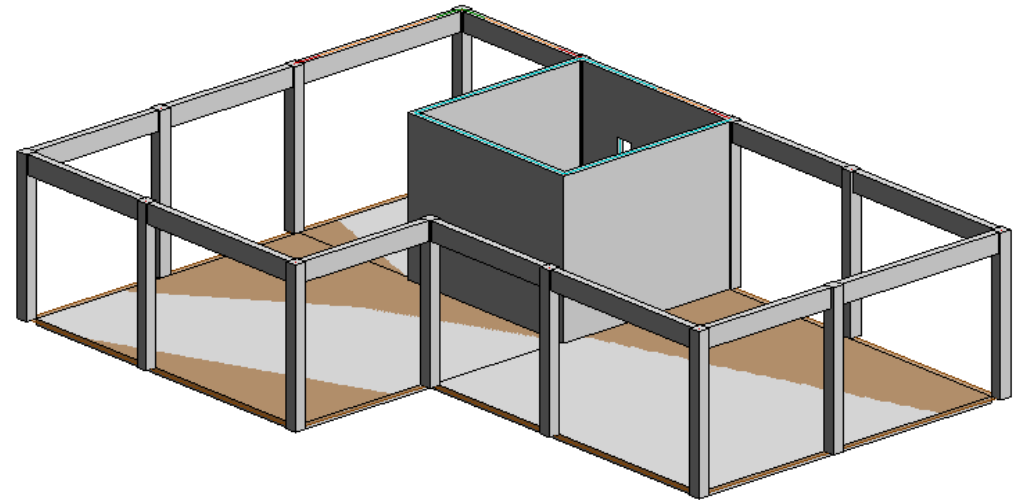
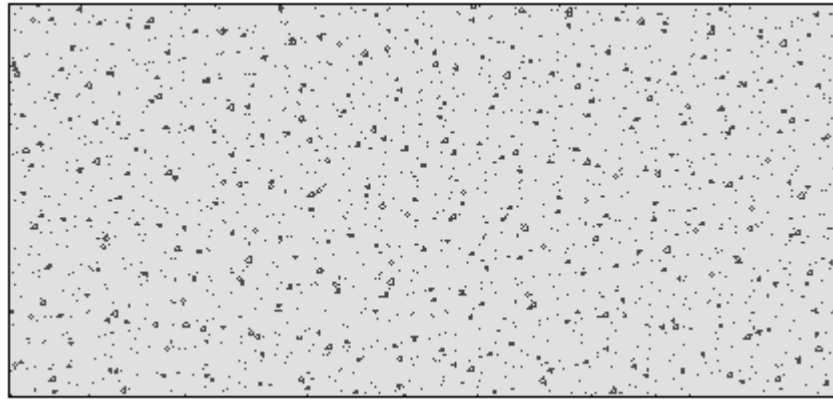
KEMENTERIAN PENGAJIAN TINGGI



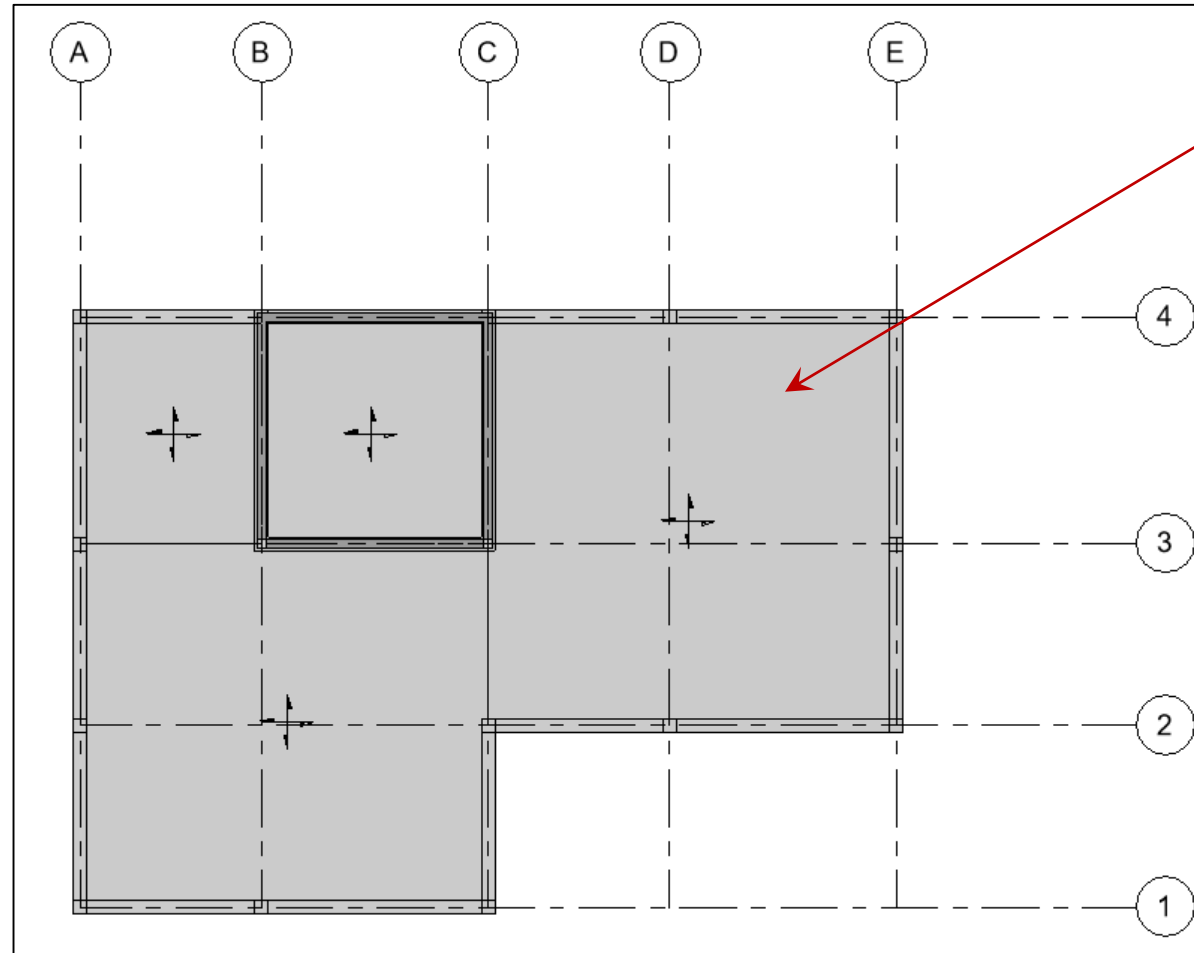
BUILD STRUCTURAL ELEMENTS: **STRUCTURAL SLABS**

STRUCTURAL SLAB

(CUSTOMIZE TYPE)



KEY PLAN DRAWING: **Structural Slabs**

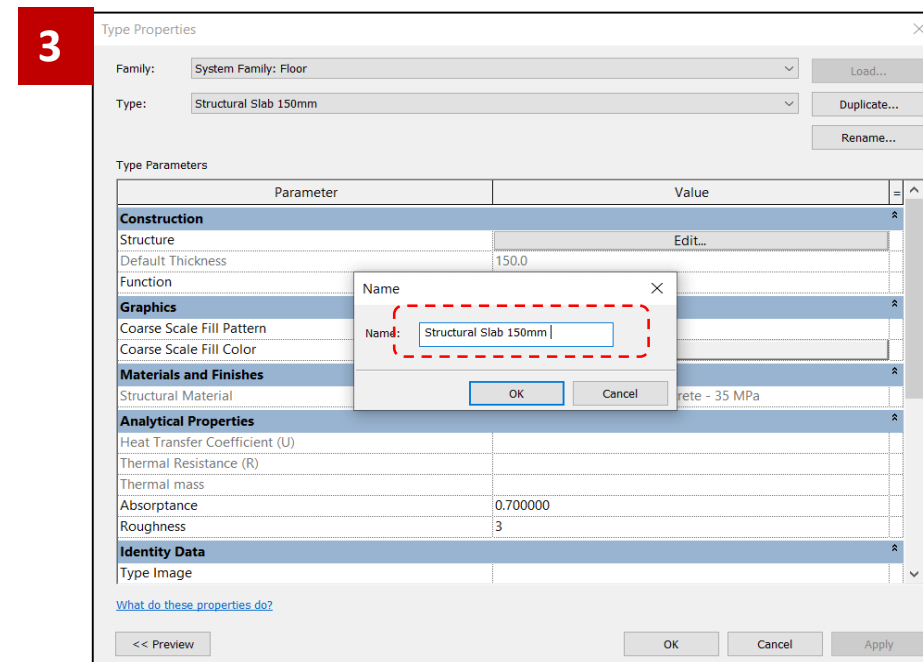
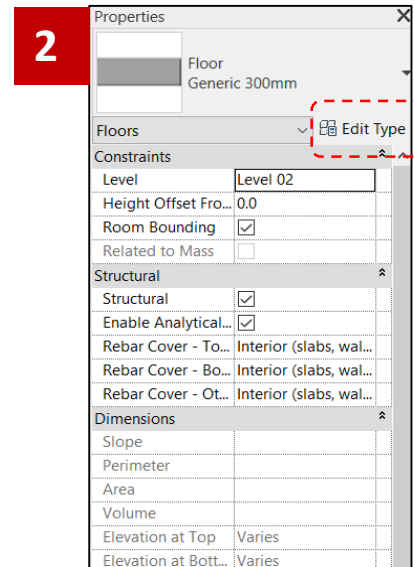
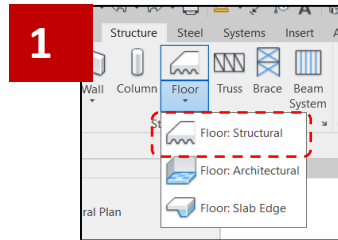


Structural Slab 150mm

Plan View

CREATING COMPONENT: **Structural Slabs**

EXERCISE 1: Create structural slab 150mm

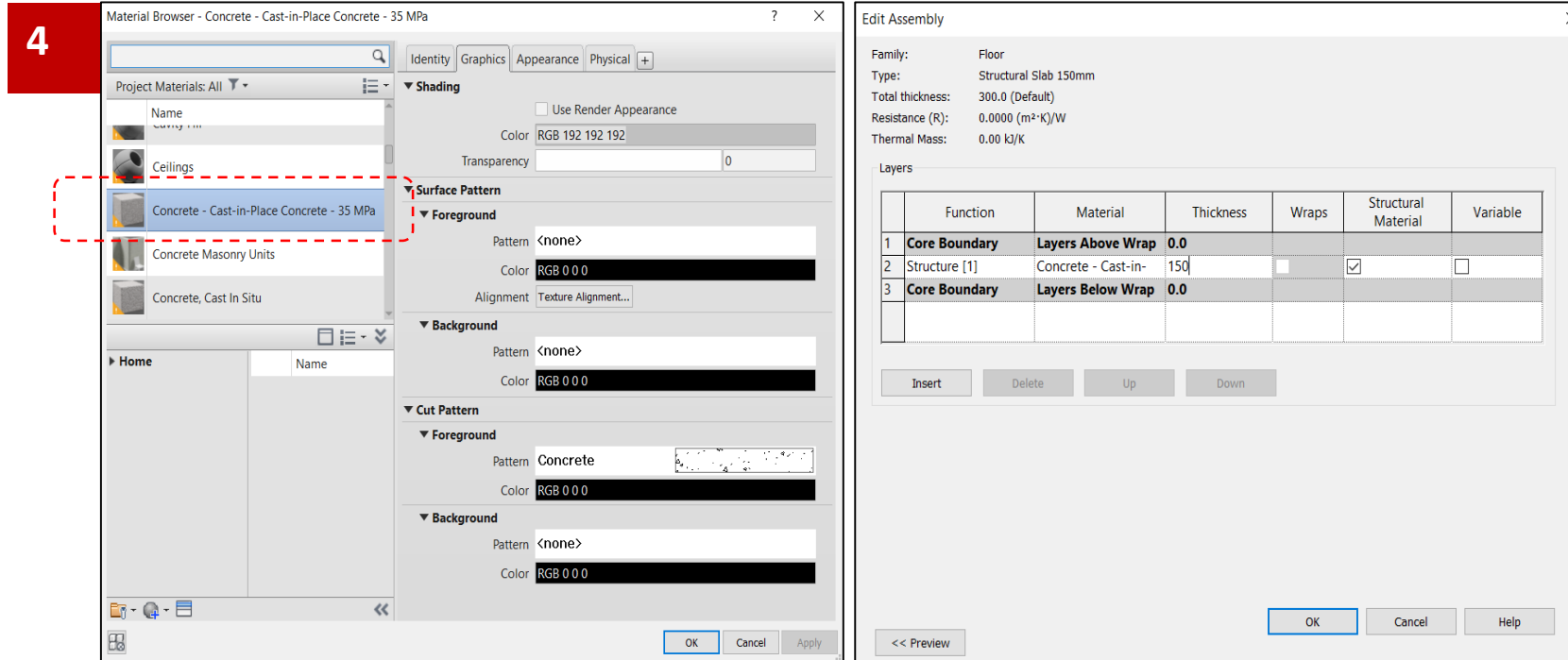


1. On **Structure Tab**, select **Floor – Floor Structural**.

2. Click **Edit Type** on **Properties** palette.

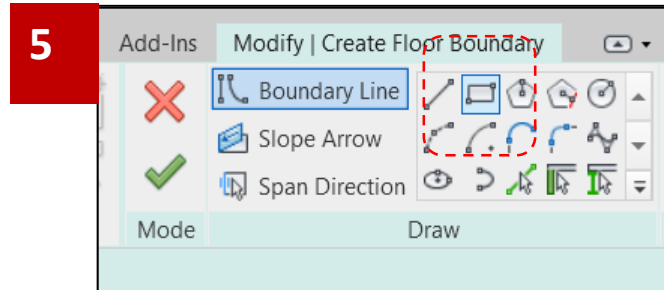
3. Duplicate type as **Structural Slab 150mm**.

CREATING COMPONENT : Structural Slabs

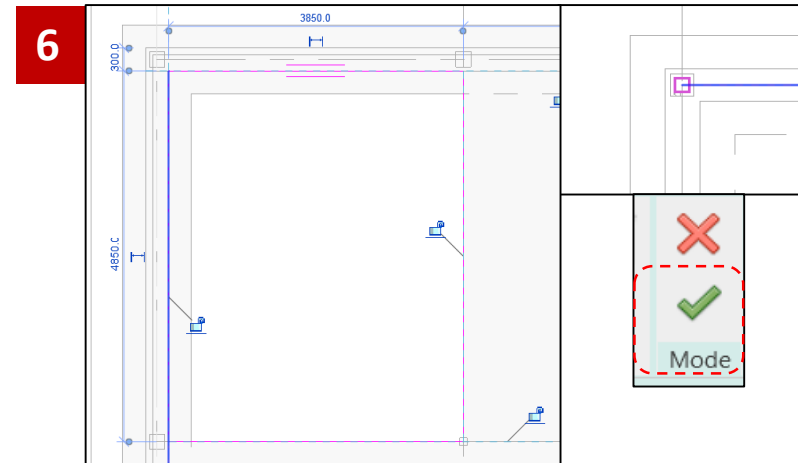


4. Click **Edit** and change material as **Concrete Cast-In-Place - C35** and type thickness as **150mm** and click **OK**.

PLACING COMPONENT: **Structural Slabs**

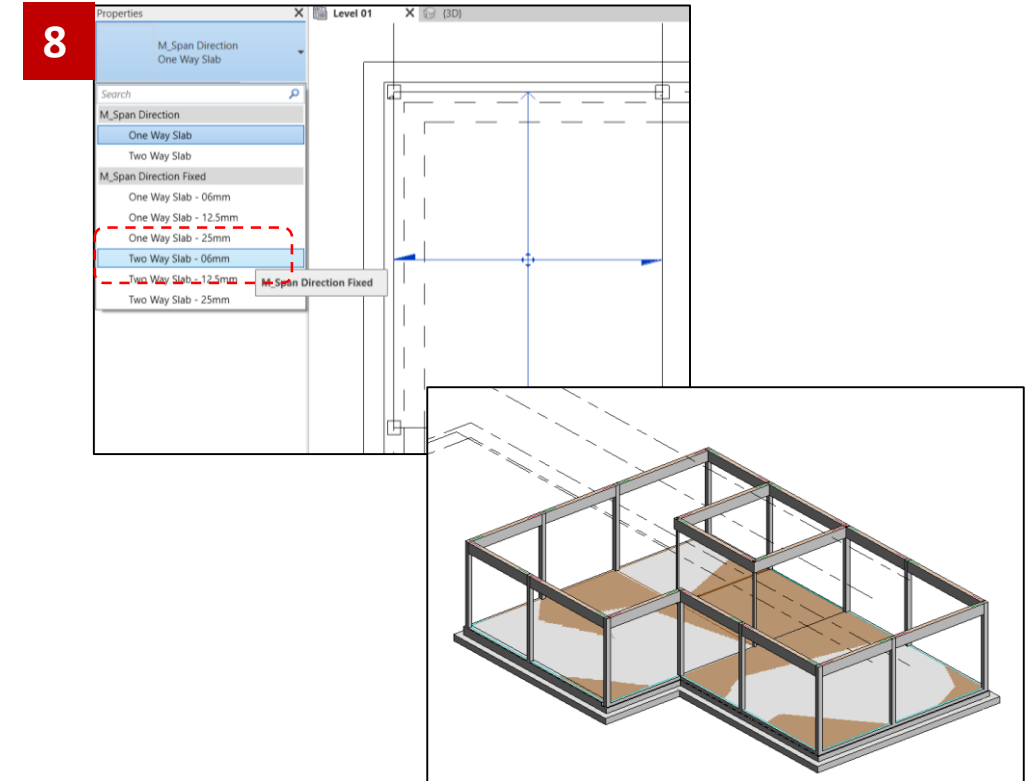
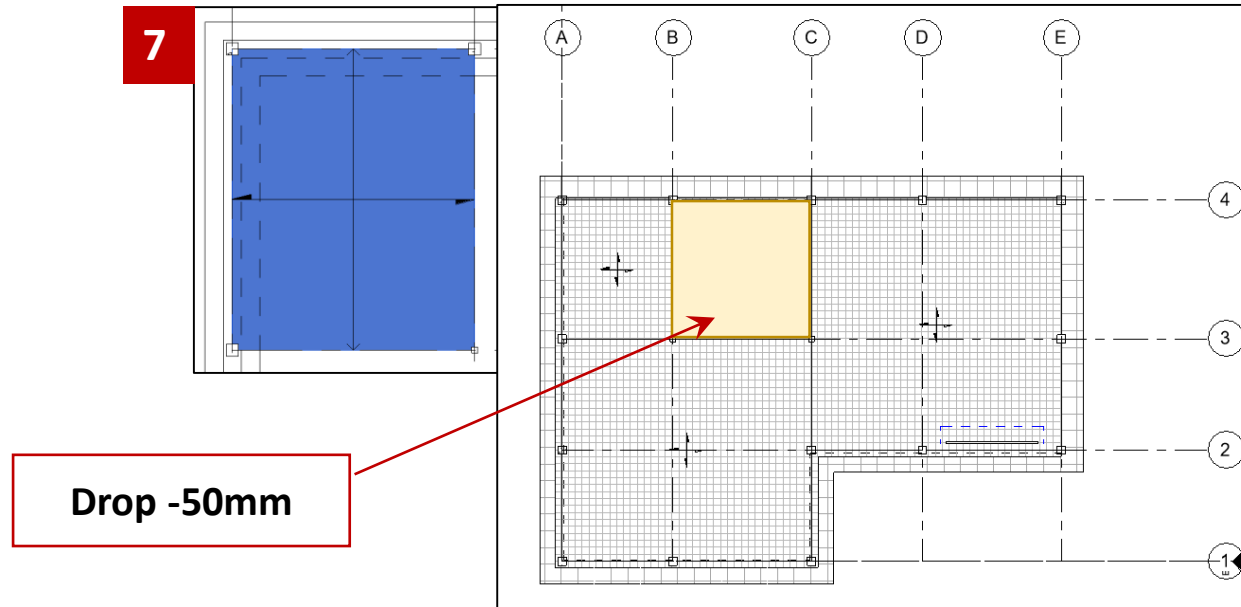


5. On the **Modify Tab: Create Floor Boundary tab**, click the **Rectangle** ribbon.



6. Draw the **Structural Floor in 01 Level** as shown in diagram. Click the **Finish Edit Mode** ribbon after complete.

PLACING COMPONENT: Structural Slabs



7. The diagram shows the Structural Floor is a **Two way slab**. Repeat **Step 5 & 6** for entire floor. Set Height offset from level - **50mm** for section **B-C/3-4**.

8. Change the **Slab Direction Symbol**, click the direction symbol then click **Type Selector** under **Properties**. Select **Two-way Slab – 06mm**.

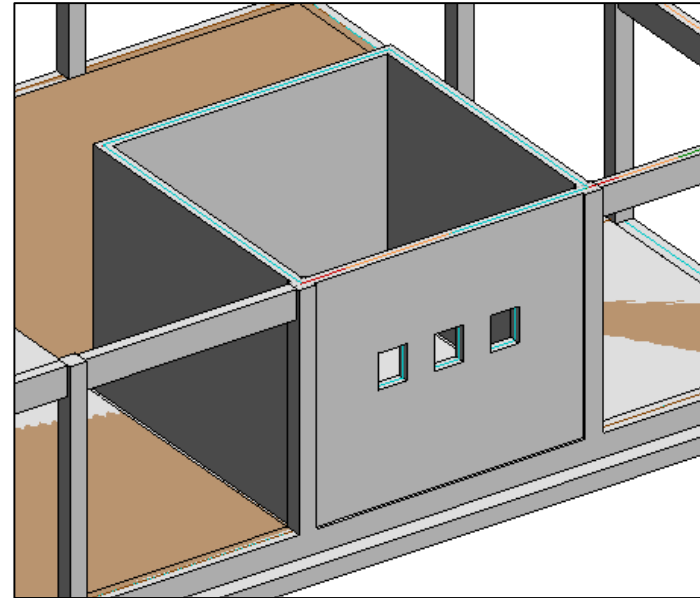
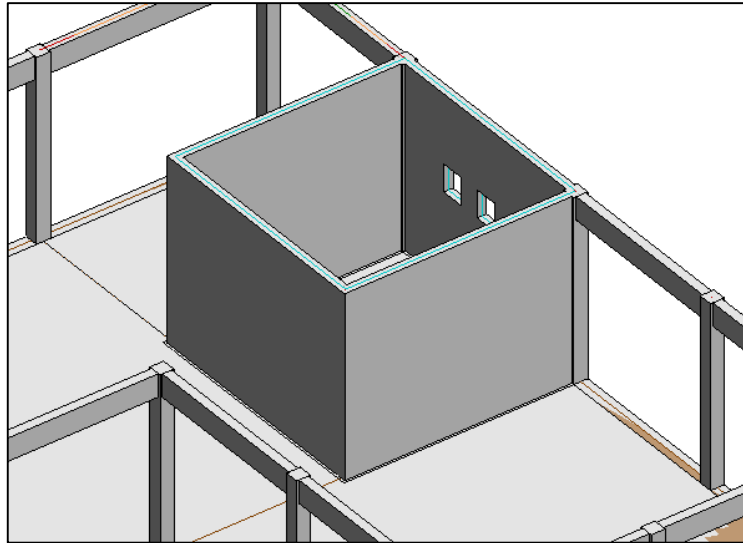


BUILD STRUCTURAL ELEMENTS: **STRUCTURAL WALL**

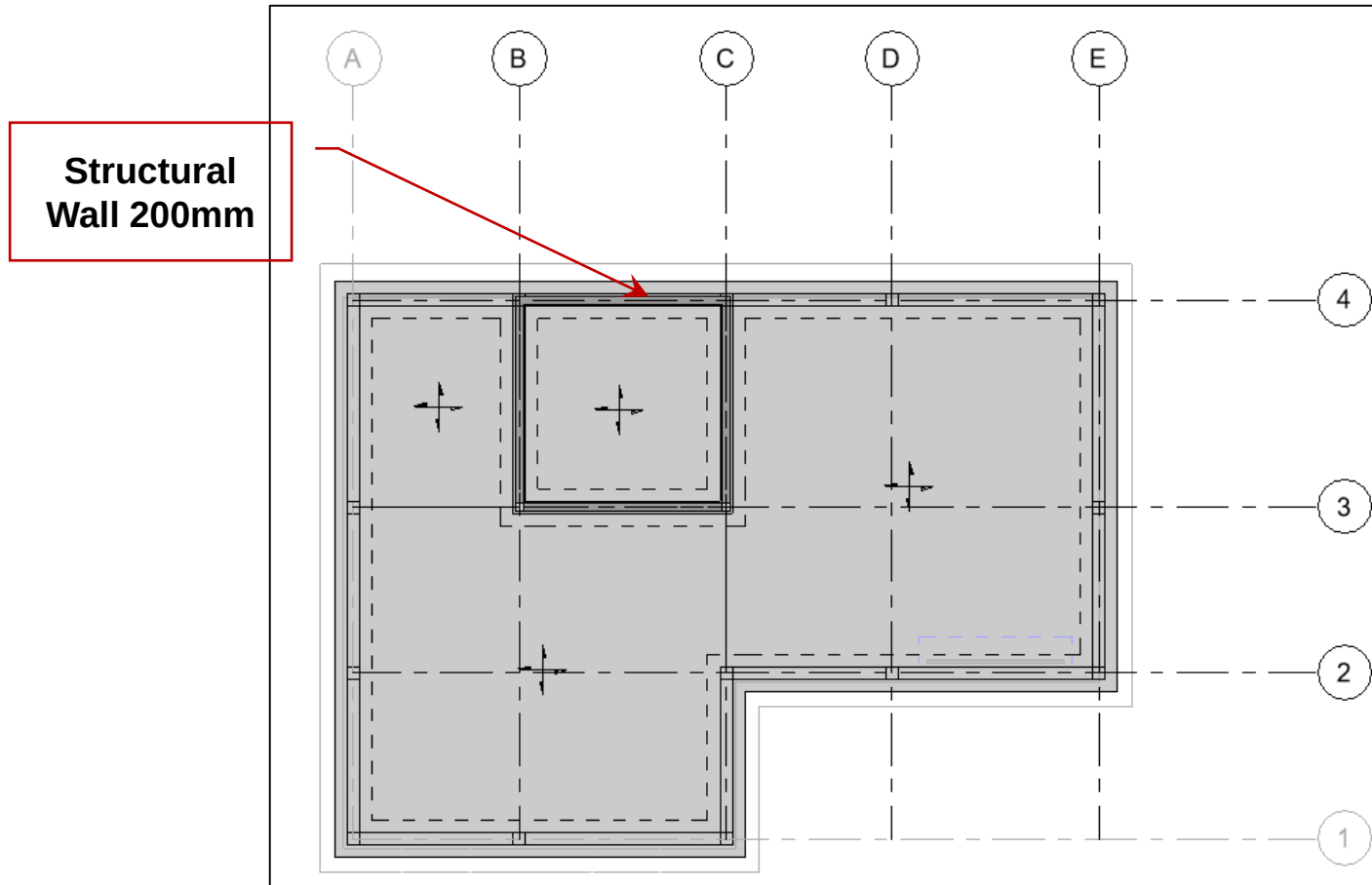


WALL

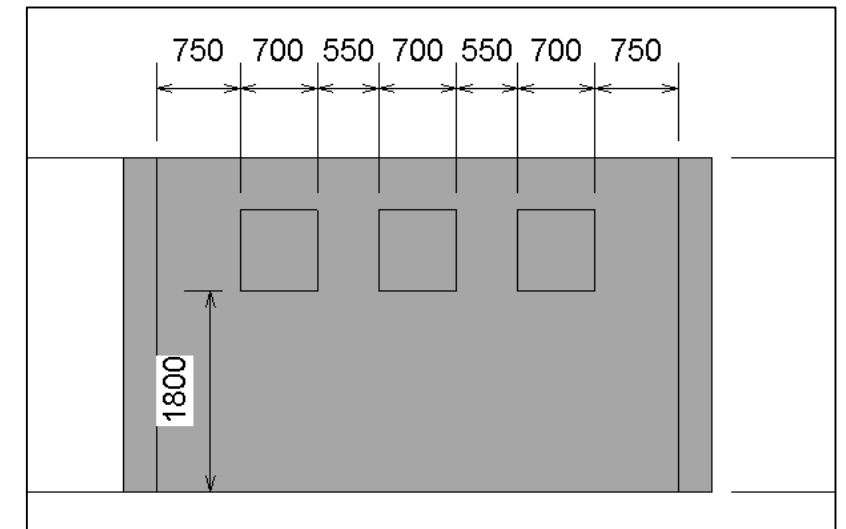
(CUSTOMIZE)



ADDING WALL: Structural Wall



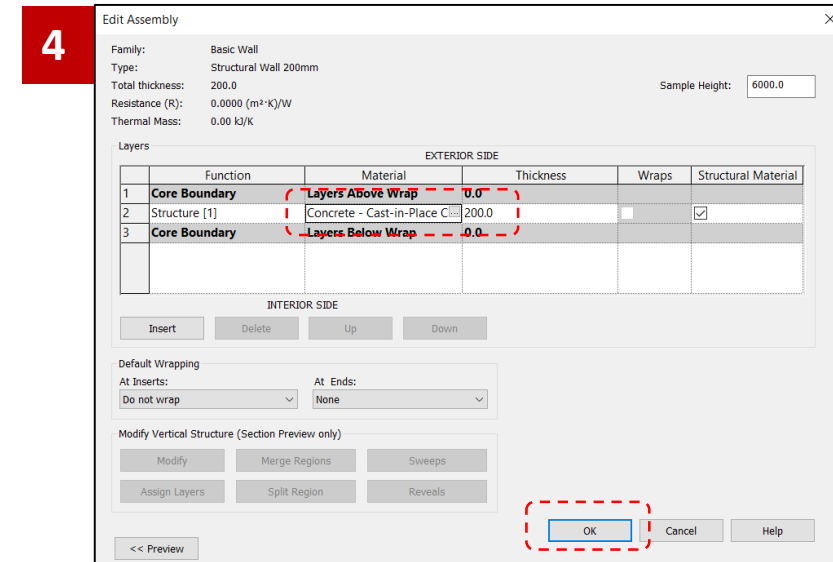
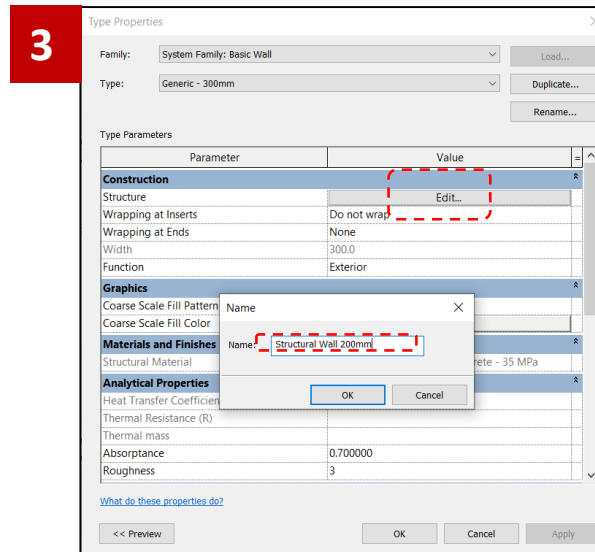
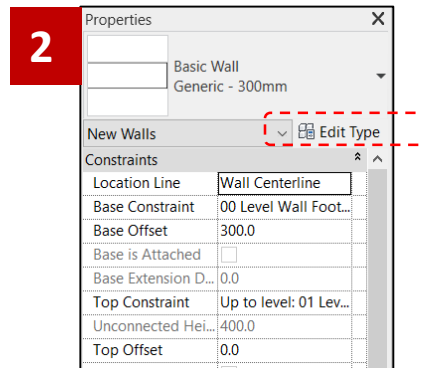
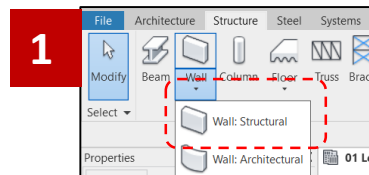
Plan View



North Elevation- Wall Opening

CUSTOMIZE WALL : Structural Wall

EXERCISE 1: Create Structural wall 200mm in Concrete Cast in Place- C35. Structural Wall cover is 35mm



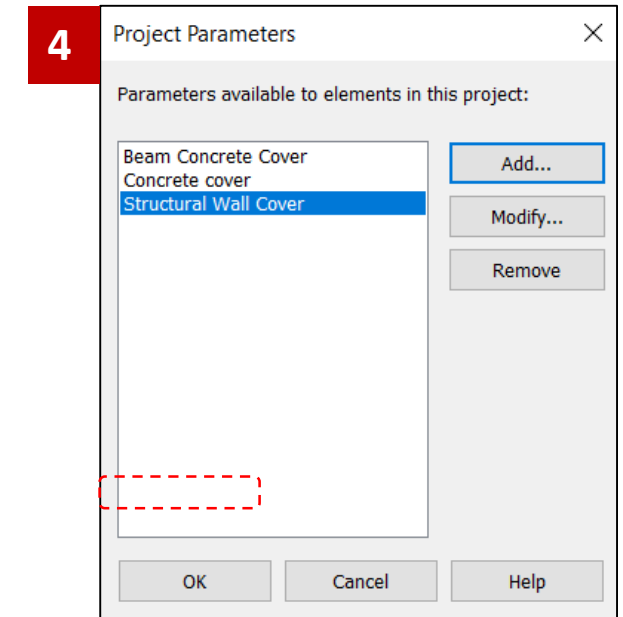
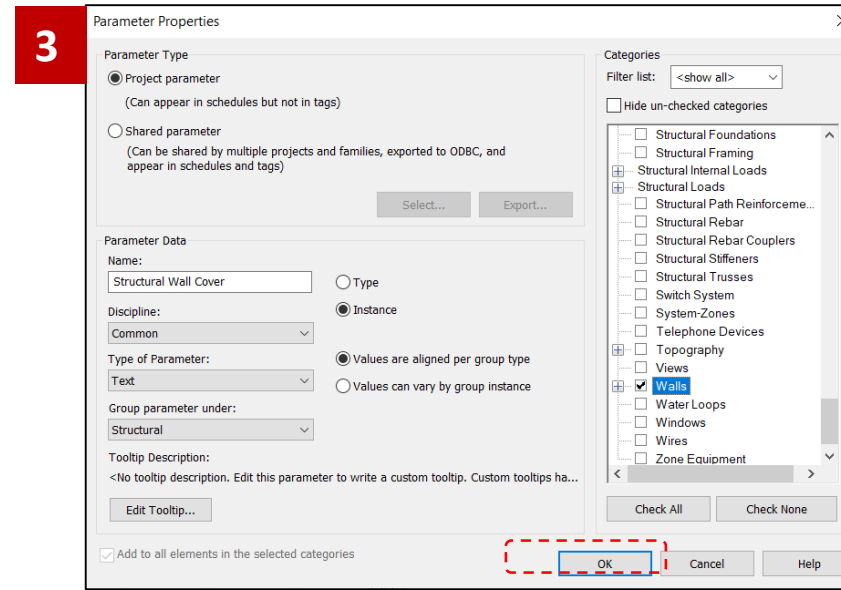
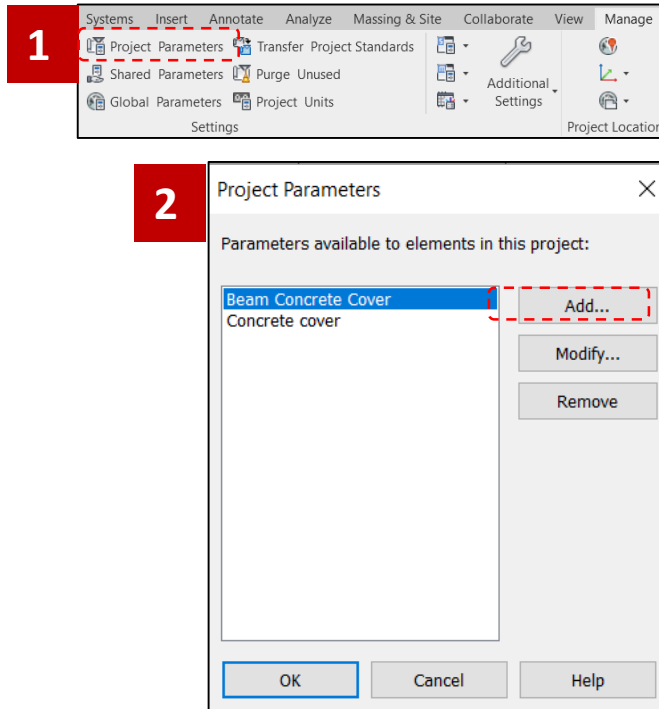
1. On **Structure Tab**, click **Wall: Structural**.

2. On **Properties palette**, click **Edit Type**.

3. Duplicate as **Structural Wall 200mm** and **OK**.

4. Change the material as **Concrete Cast In Place – C35** with thickness as **200mm**.

CUSTOMIZE WALL: Structural Wall



1. On **Manage Tab**, click **Project Parameter**.

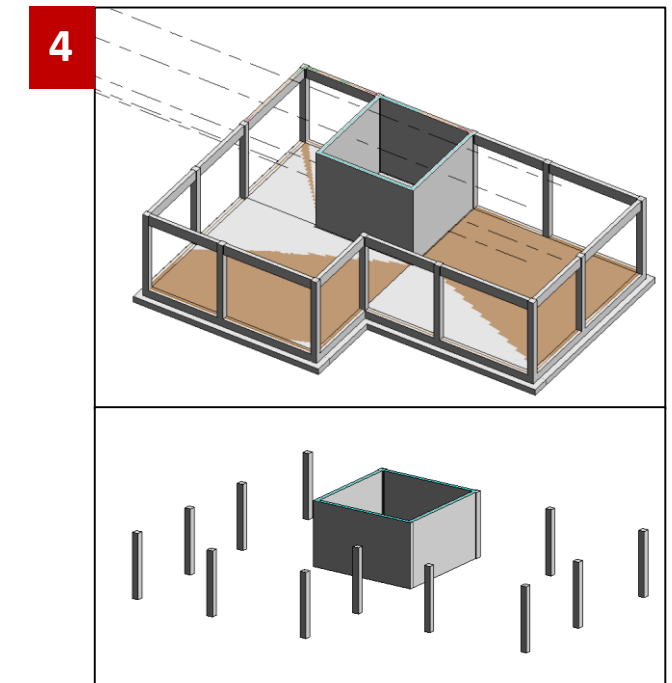
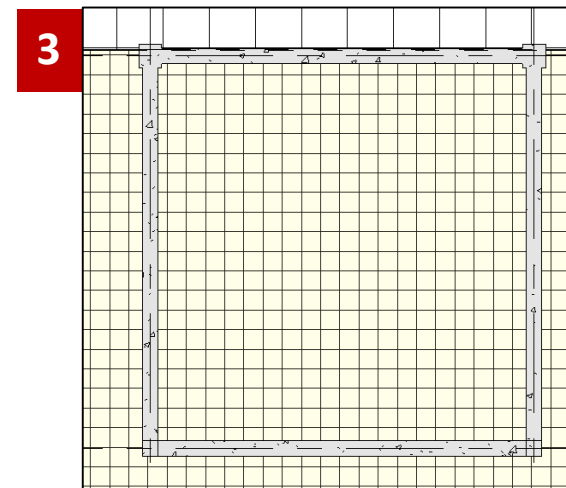
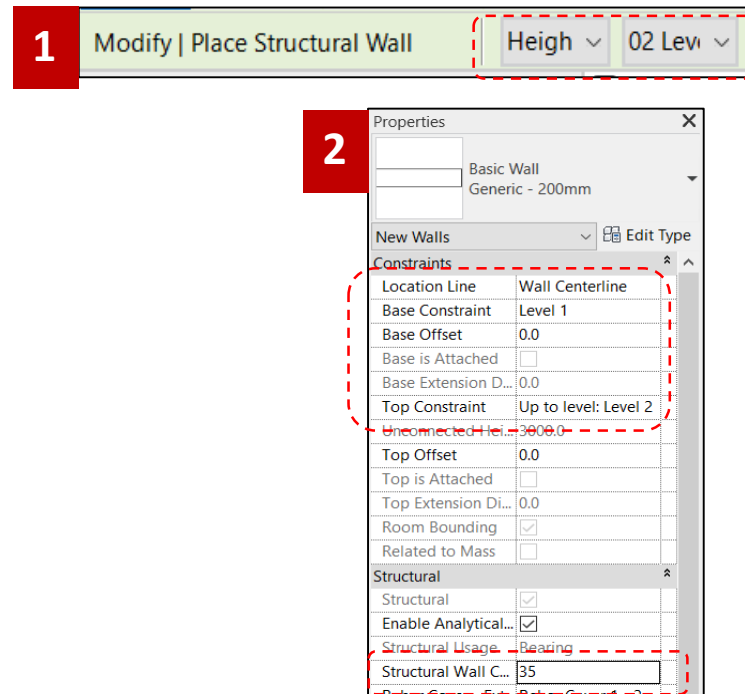
2. On **Project Parameter** pop-ups, click **Add**.

3. Enter the following data as shown in the diagram and click **OK**.

4. Click **OK** in Project Parameter pop-ups.

ADD WALL: Structural Wall

EXERCISE 2: Place structural wall 200mm in section B-C/3-4. Structural Wall cover is 35mm



1. On the **Option bar**, change **Depth** to **Height**.

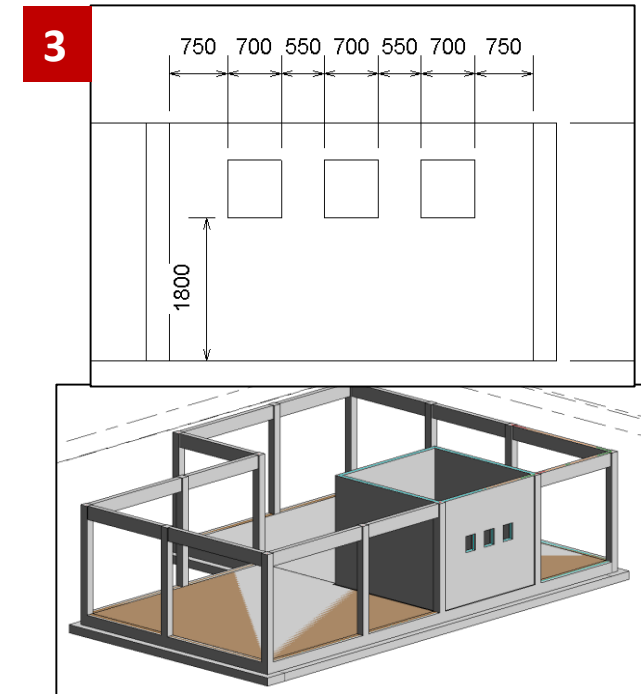
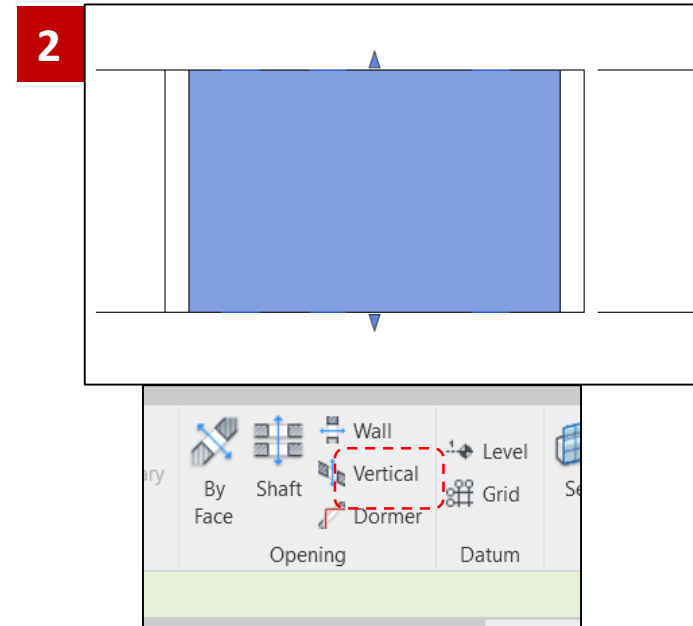
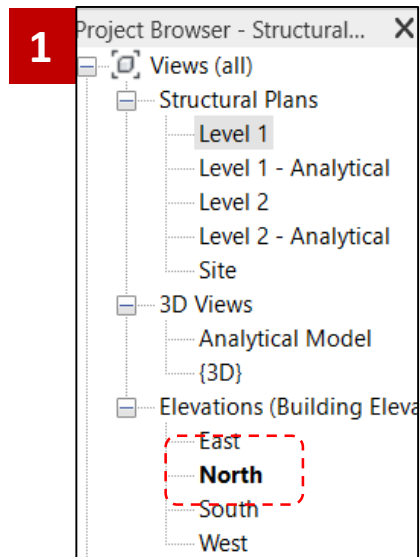
2. Ensure the **Base Constraint : Level 1** and **Top Constraint: Level 2**. Enter **Structural Wall Cover** as **35mm**.

3. Draw the **Structural wall 200mm in Level 1**.

4. The diagram shows the **Structural wall in Level 1**.

DRAW COMPONENT : Wall Opening

EXERCISE 3: Draw the wall opening in structural wall 200mm as in the diagram.



1. Click **North – Elevation (Building Elevation)**.

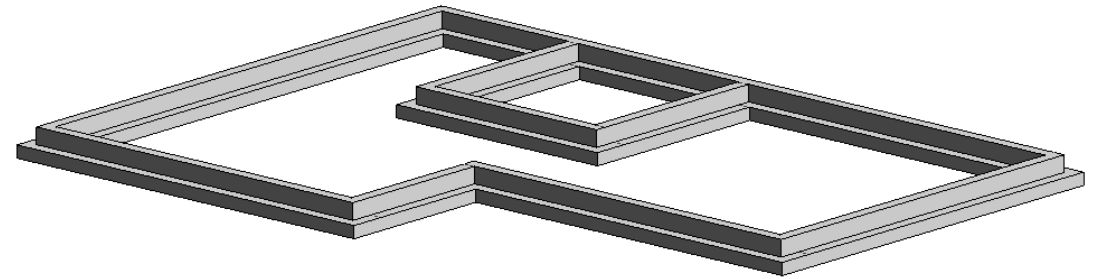
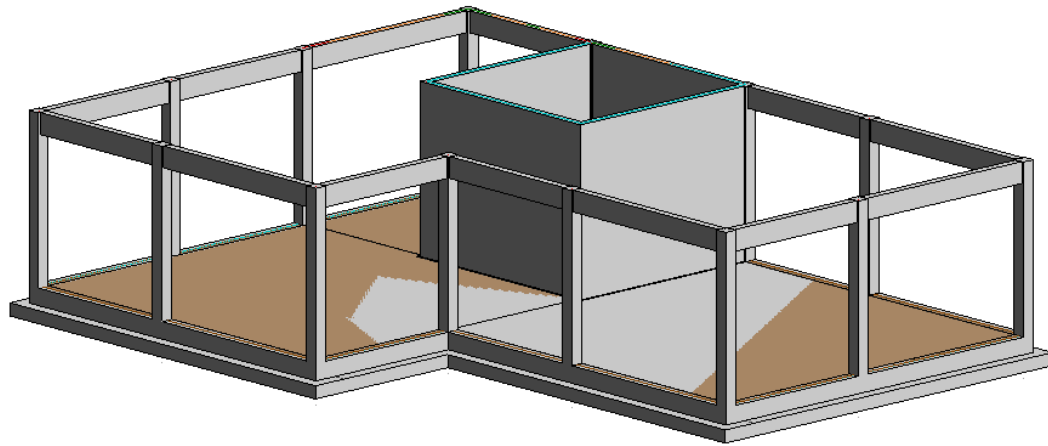
2. Select the wall and click the **Wall Opening**.

3. Draw the **opening** as shown in the diagram.

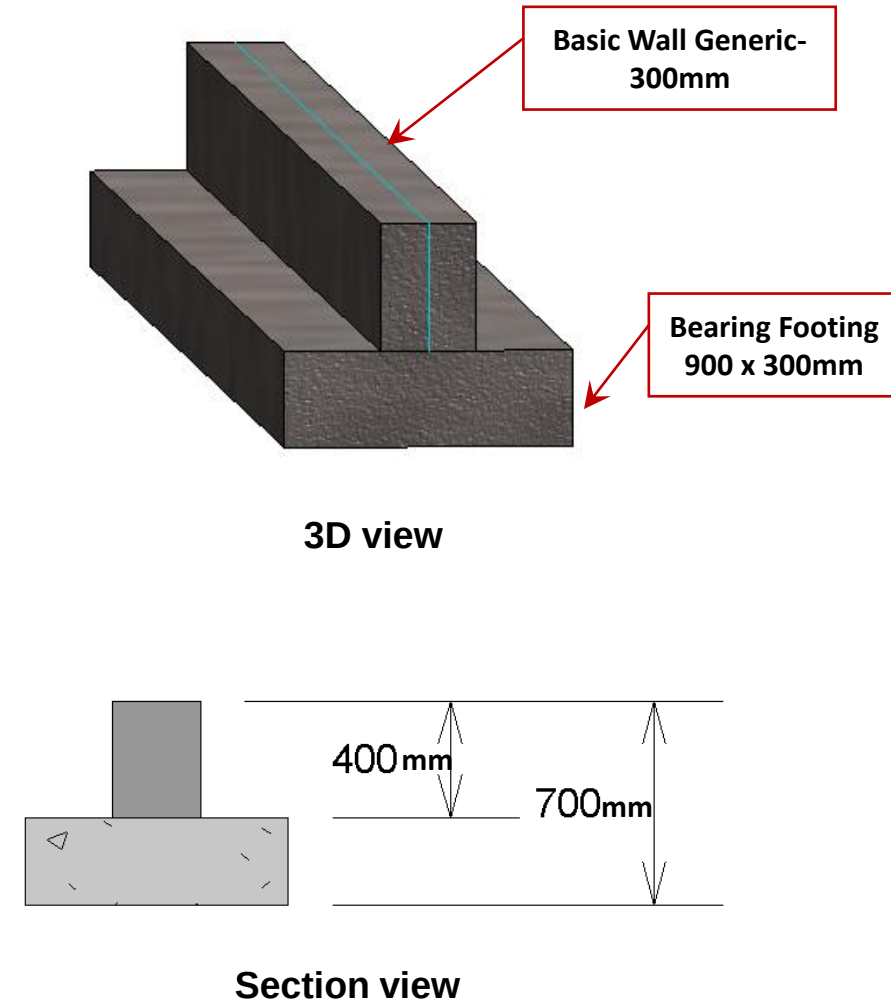
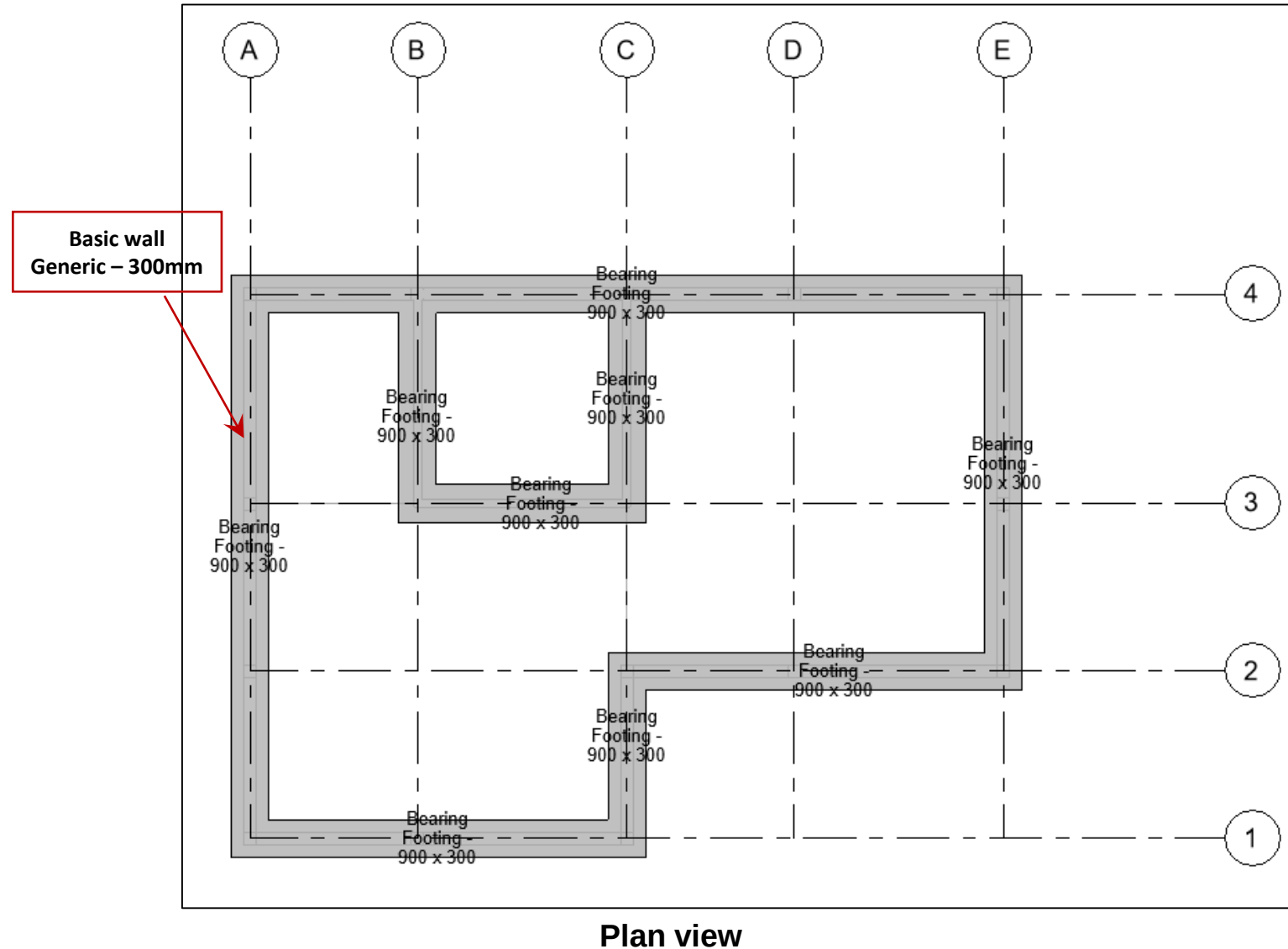
BUILD STRUCTURAL ELEMENTS: **FOUNDATIONS**

WALL FOOTING

(EXISTING TYPE)

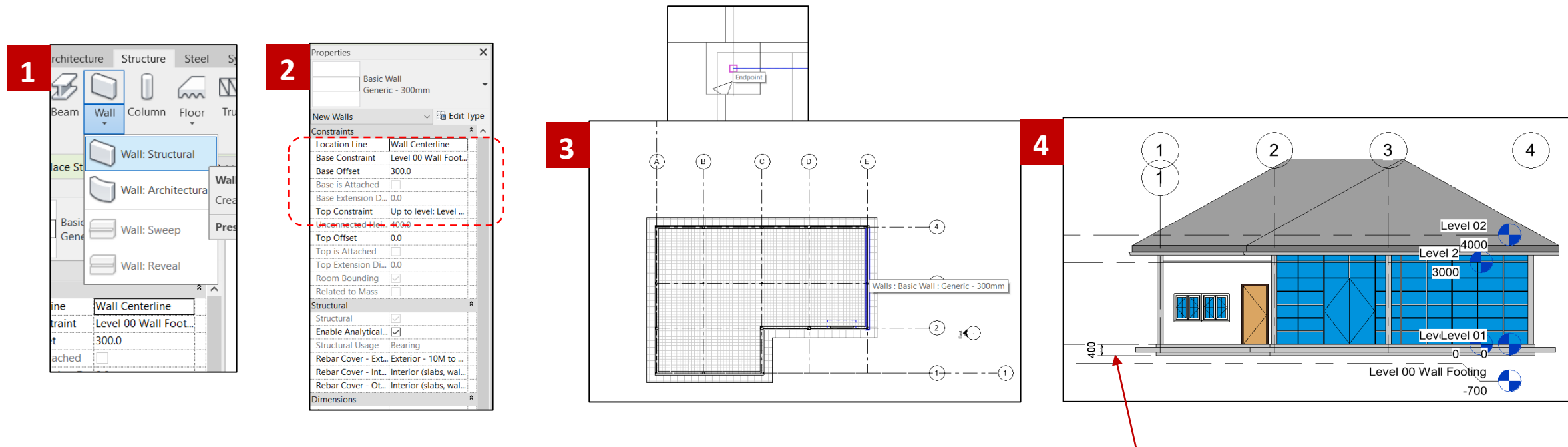


ADDING FOUNDATION: Wall Footings



CREATING COMPONENT: Wall Footings

EXERCISE 1 : Draw structural wall for footing using Basic Wall Generic-300mm.

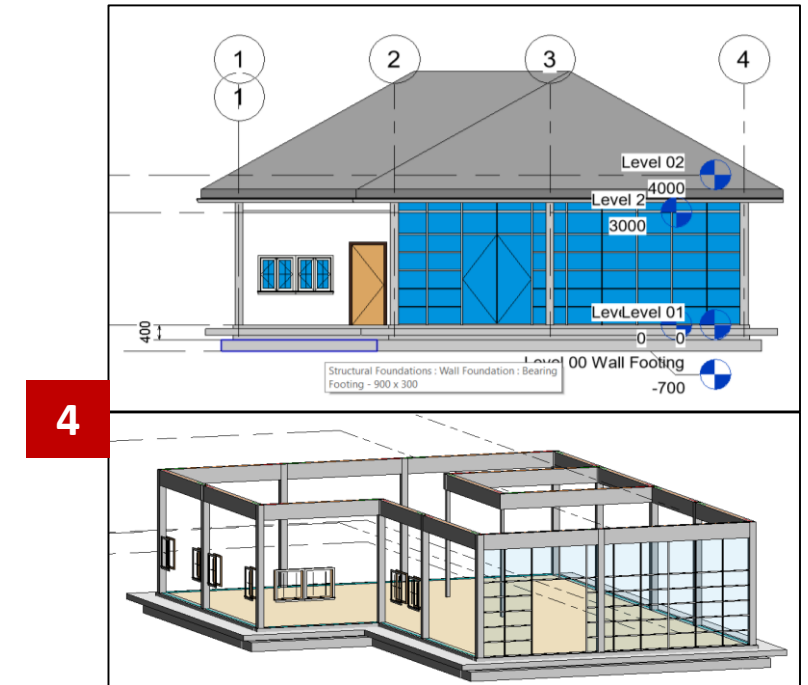
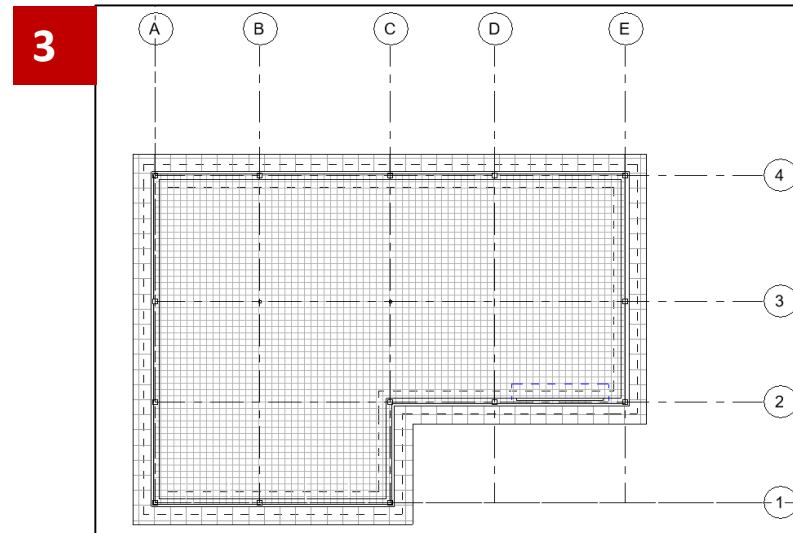
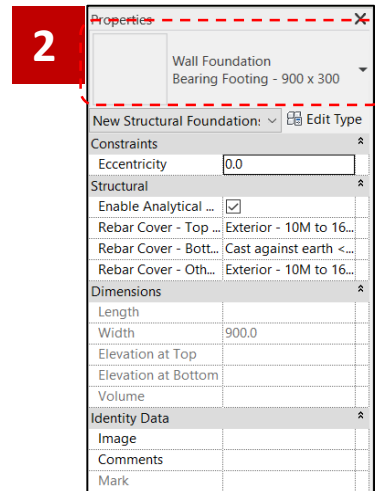
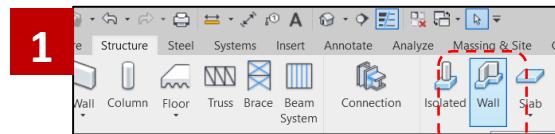


1. On **Structure Tab**, click **Wall: Wall Structural**.
2. On Properties pallette, select **Basic Wall Generic-300mm**. Enter **Base Constraint** as **Level 00 Wall Footing** and **Top Constraint** as **Up to Level: Level 01** . **Base Offset** as **300mm**.

3. Place the wall based on the **Key Plan Drawing**.
4. The diagram shows the completed wall added in drawing area. **(400mm depth from Level 01)**

CREATING COMPONENT: **Wall Footings**

EXERCISE 2 : Adding wall footing 900 x 300mm to structural wall created in **Exercise 1**.



1. On **Structure Tab**, click **Structural Foundation : Wall**.

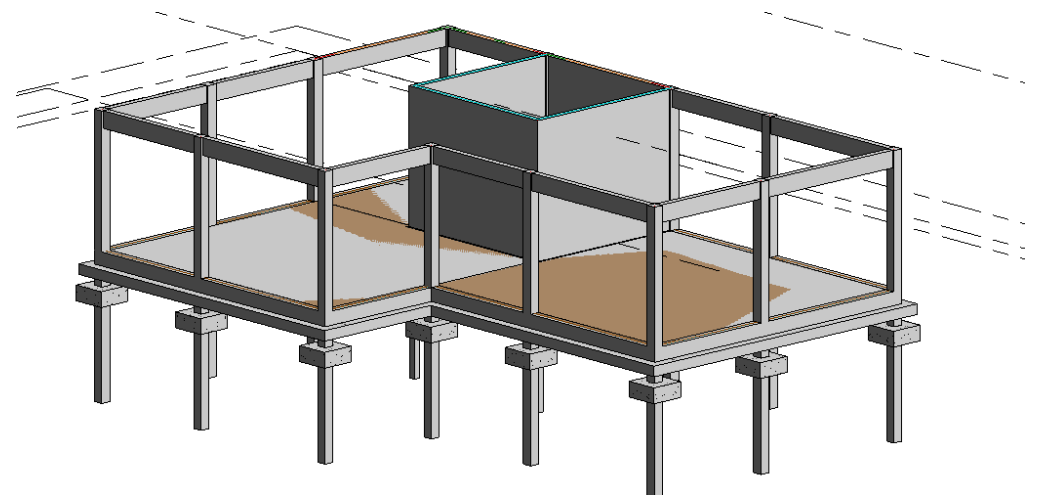
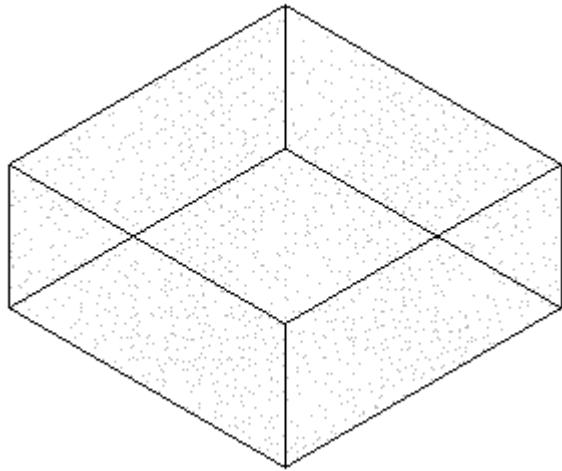
2. On Properties pallette, select **Wall Foundation Bearing Footing – 900 x 300mm**.

3. Place the wall foundation based on the **Key Plan Drawing**.

4. The diagram shows the **completed column** added in drawing area.

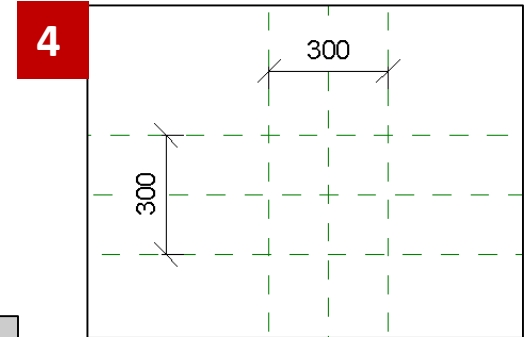
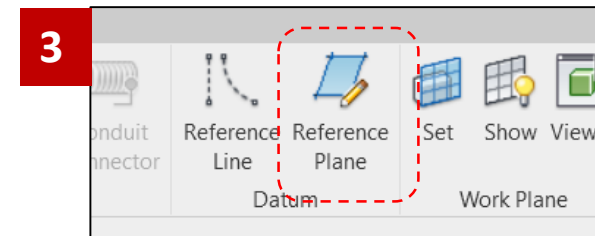
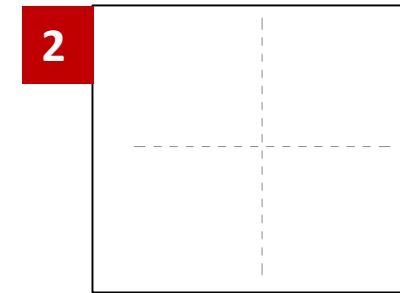
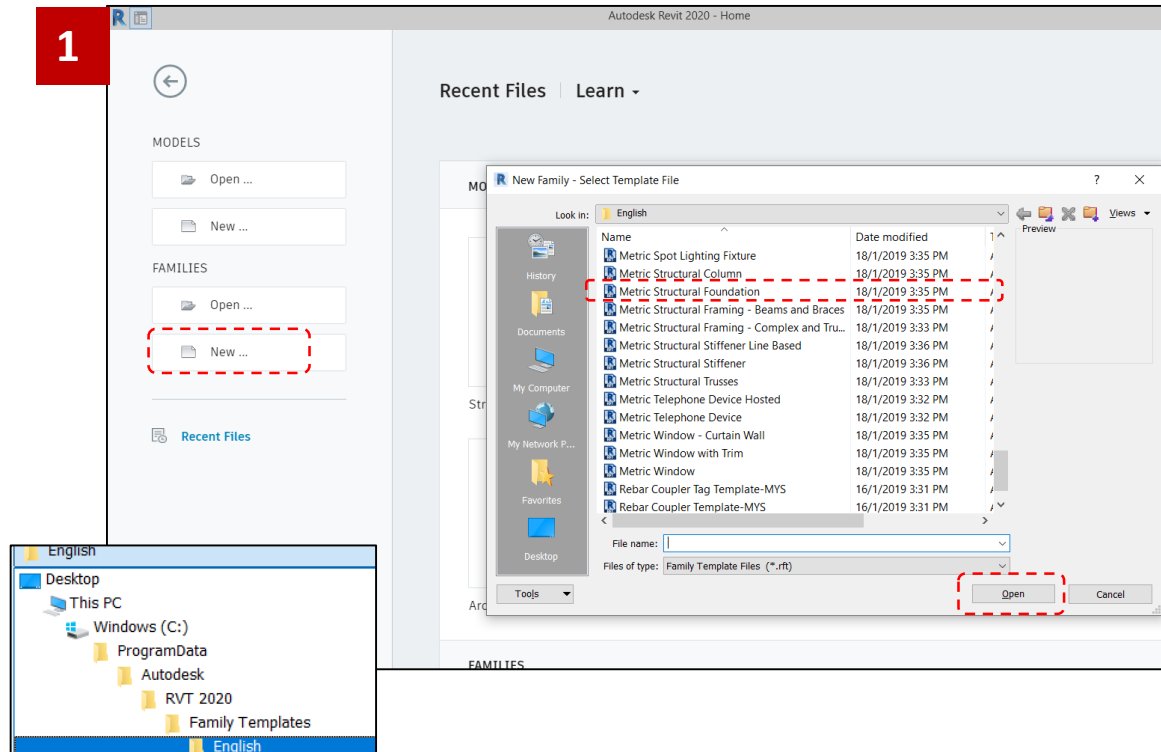
PILE FOOTING *(Additional)*

(EXISTING/CUSTOMIZE TYPE)



CREATING FAMILY : Square Pile

EXERCISE 1: Creating square pile for 200 x 200mm and 300 x 300mm size.



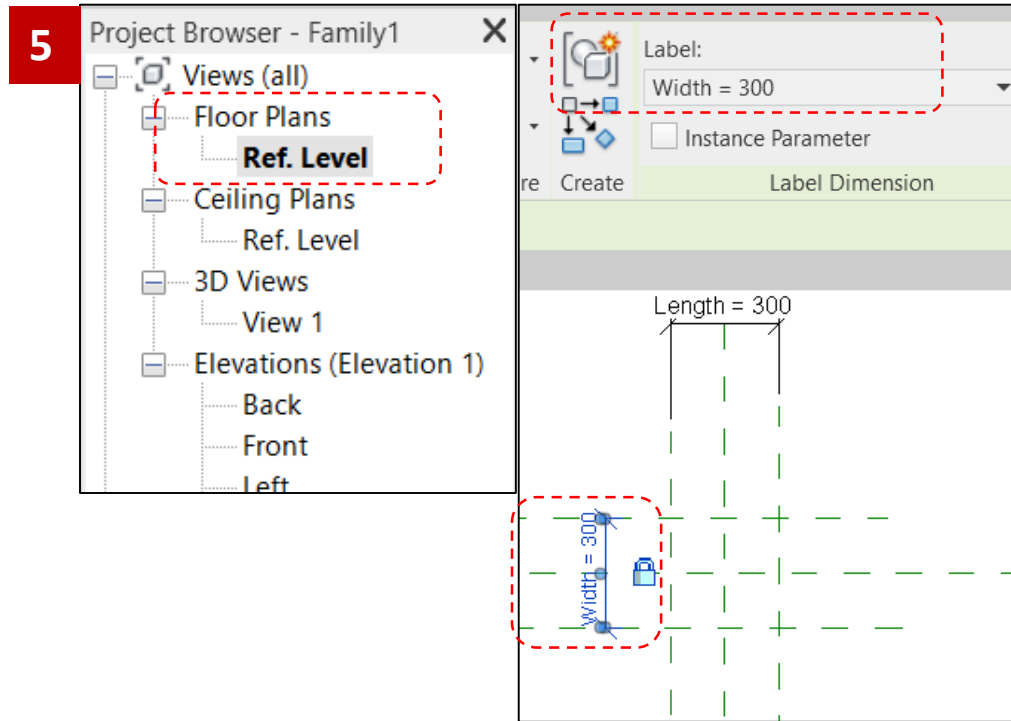
1. Click the **Application Menu** and select **New : Family**. Select **Metric Structure Foundation** and click **Open**.

2. The diagram show the default **Reference Plane** in drawing area.

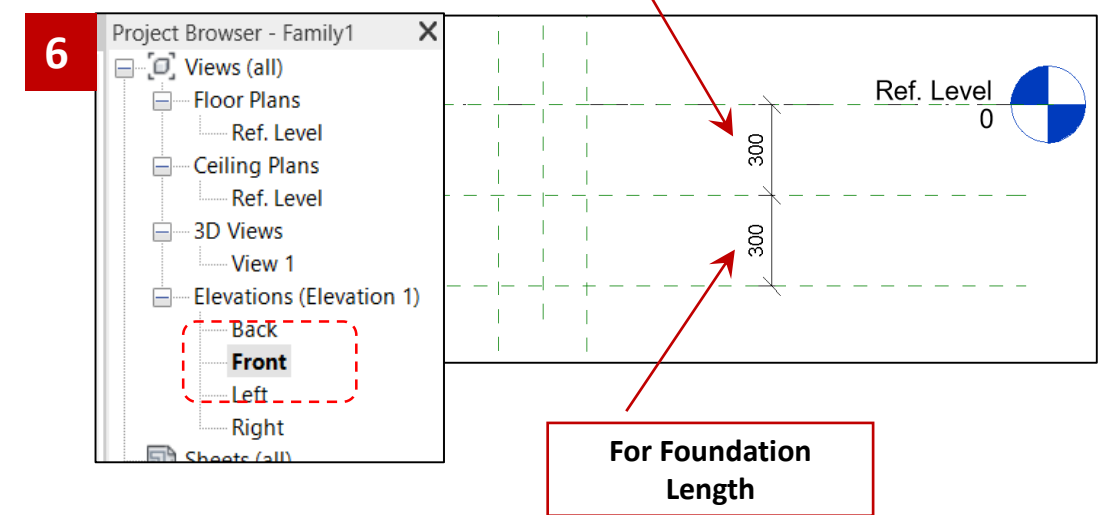
3. On **Create Tab**, click the **Reference Plane**.

4. Draw the **Reference Plane** as shown in diagram. Draw the **dimension**.

CREATING FAMILY : Square Pile

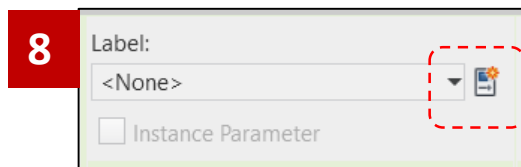
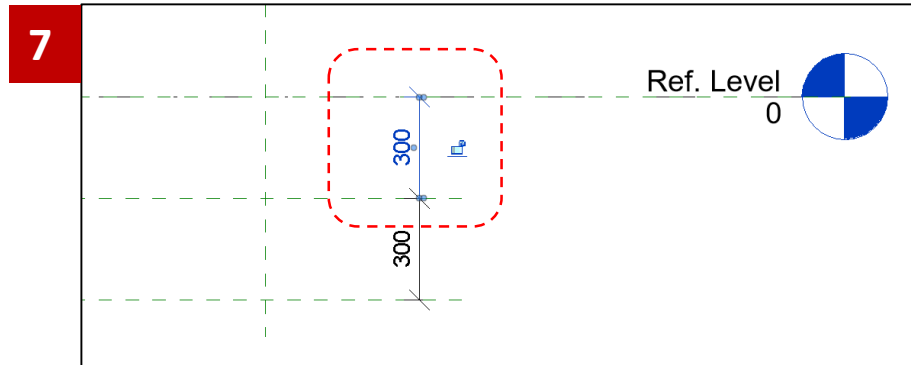


- Double click **Floor Plans – Ref. Level**. Click the **dimension** has been created. On **Label** drop down menu, select **Length and Width**.



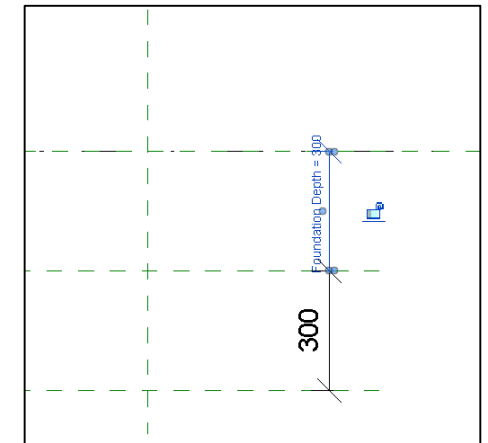
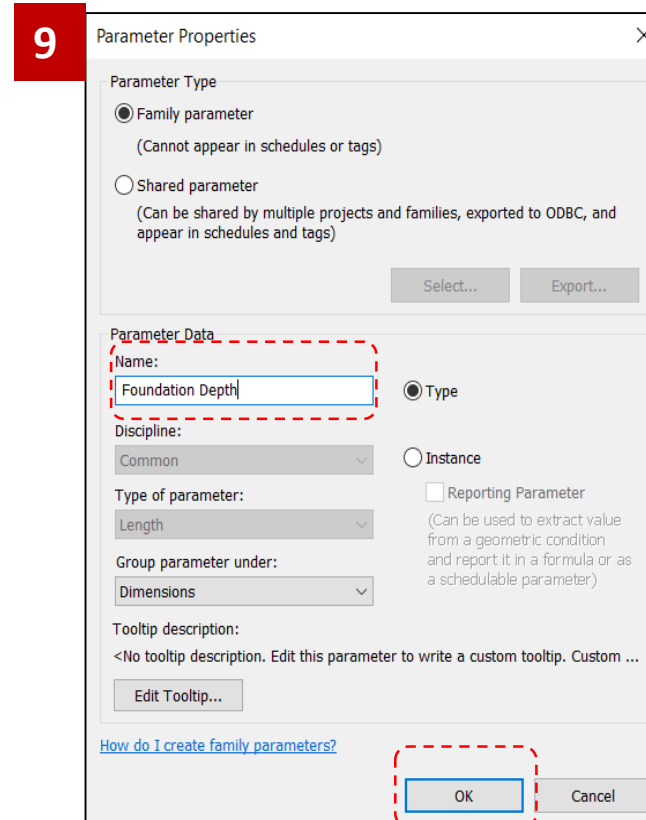
- Double click **Elevation (Elevation 1) – Front** on **Project Browser**. Click the **Reference Plane** on **Create Tab** and draw the **reference plane**. Draw the **dimension** as shown *(or other value according to your project)*.

CREATING FAMILY : Square Pile



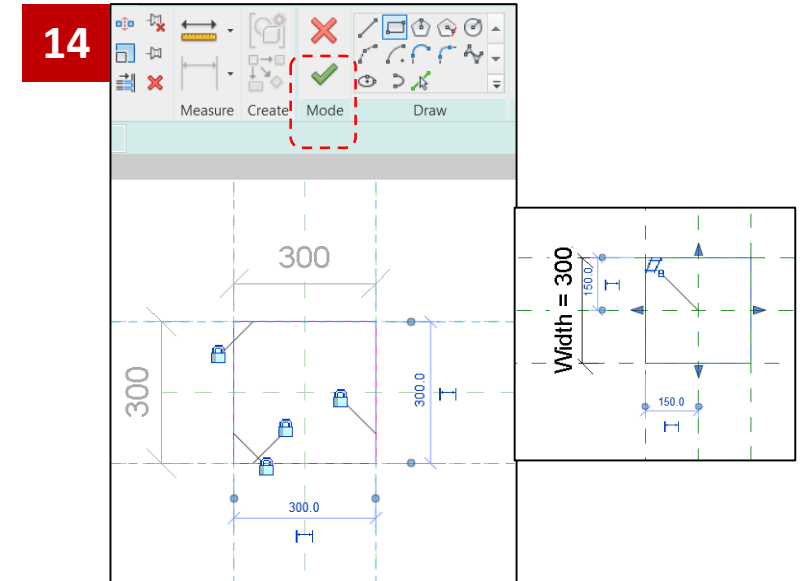
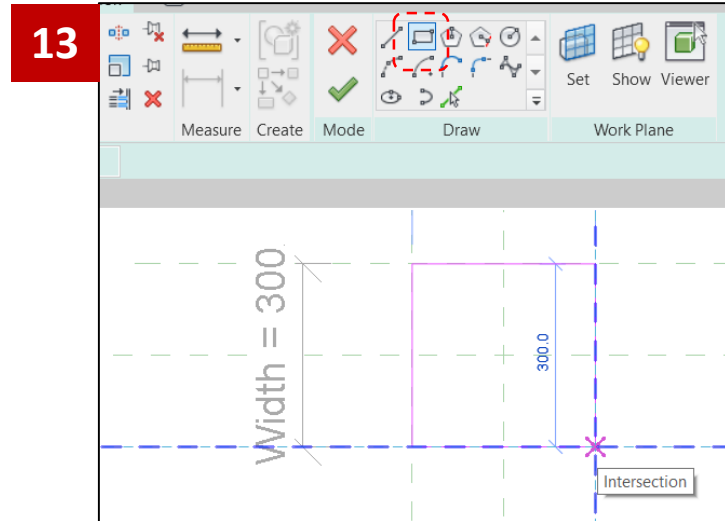
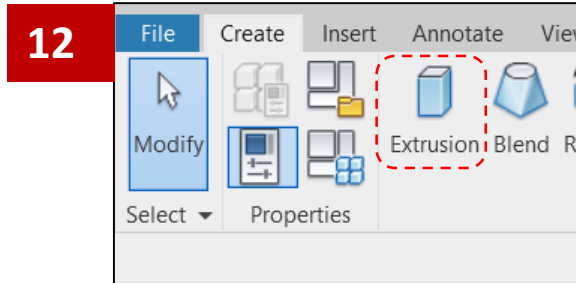
7. Click the **dimension** has been created.

8. Click **Create Parameter**.



9. Enter the **Parameter Data : Foundation Length** as shown in the diagram and click **OK**. The diagram shows the parameters that have been entered.

CREATING FAMILY : Square Pile

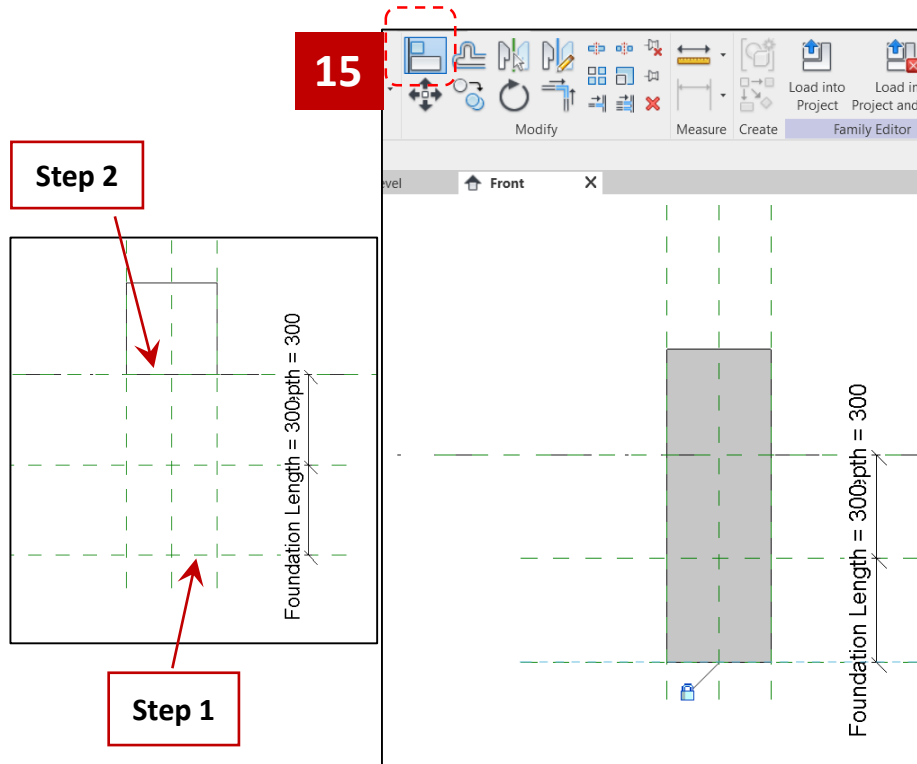


12. Double click **Floor Plans- Ref Level** on **Project Browser**. On **Create Tab**, select the **Extrusion** ribbon.

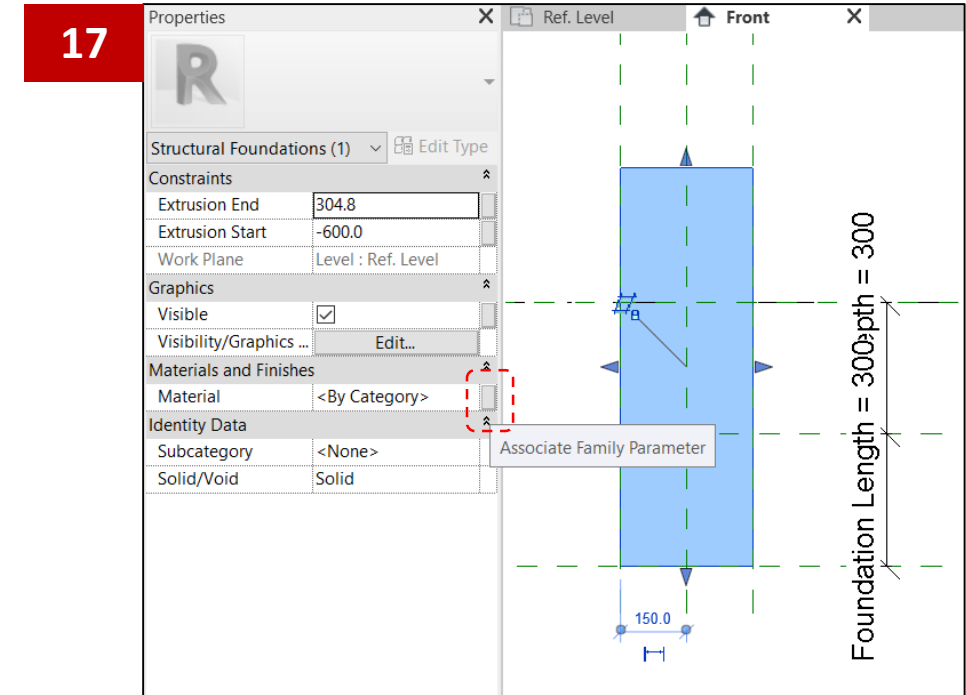
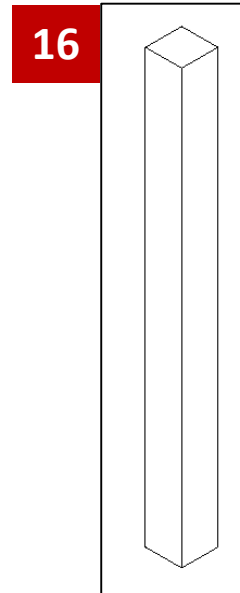
13. Select the **Rectangular** under Draw on **Modify: Create Extrusion**. Draw the **Extrusion Line** as shown in diagram. Click **all the Padlock** to lock them.

14. Click **Finish Edit Mode**.

CREATING FAMILY : Square Pile



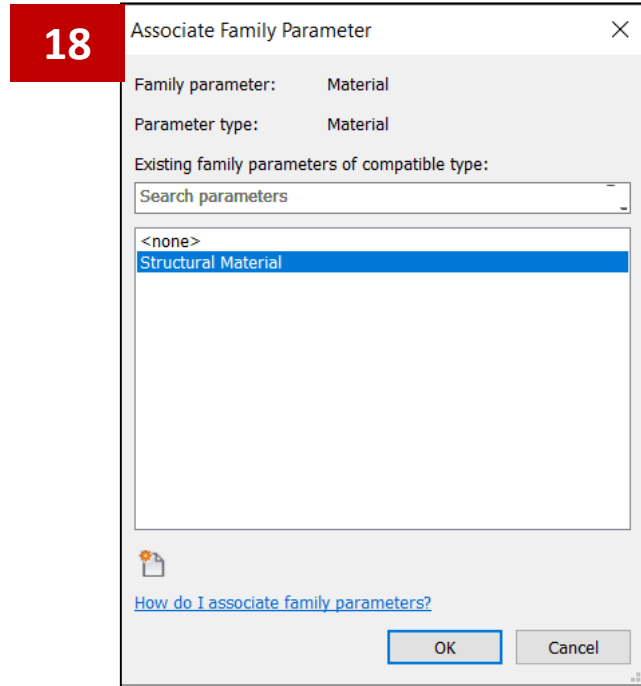
15. Double click **Elevation(Elevation 1) – Front** on **Project Browser**. On **Modify Tab**, click **Align** and click **the bottom line of Reference Plane** and then click **the bottom line of pile**. Click **padlock icon** to lock it.



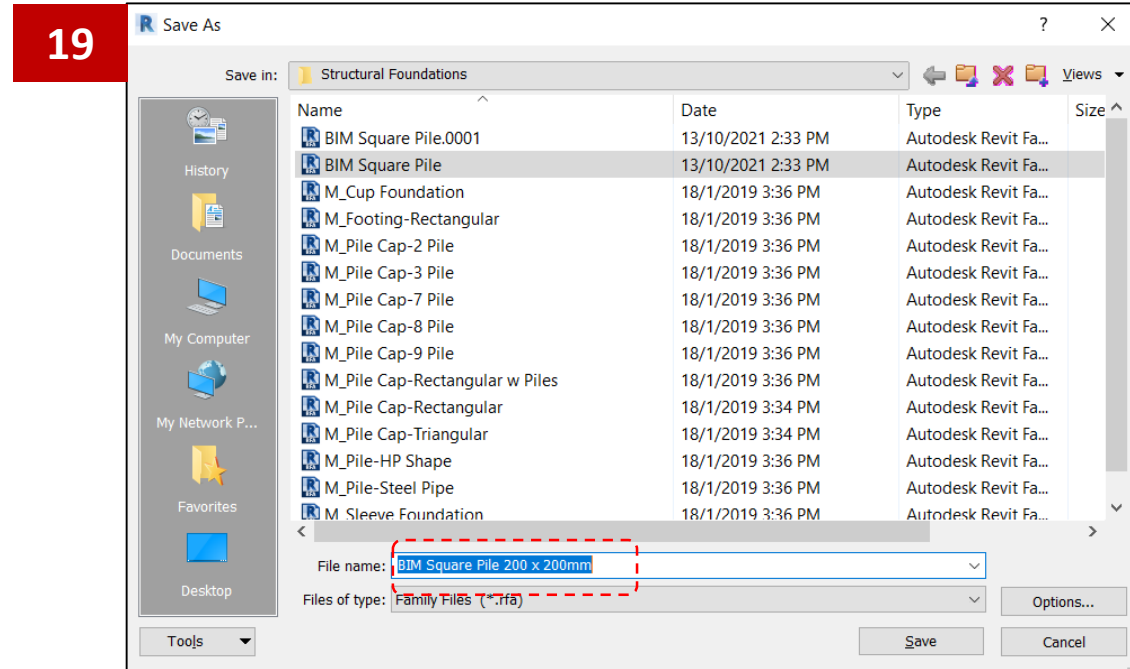
13. The diagram shows the **completed pile**.

14. Click the **Pile Model** and then click **Associate Family** on **Properties palette**.

CREATING FAMILY : Square Pile

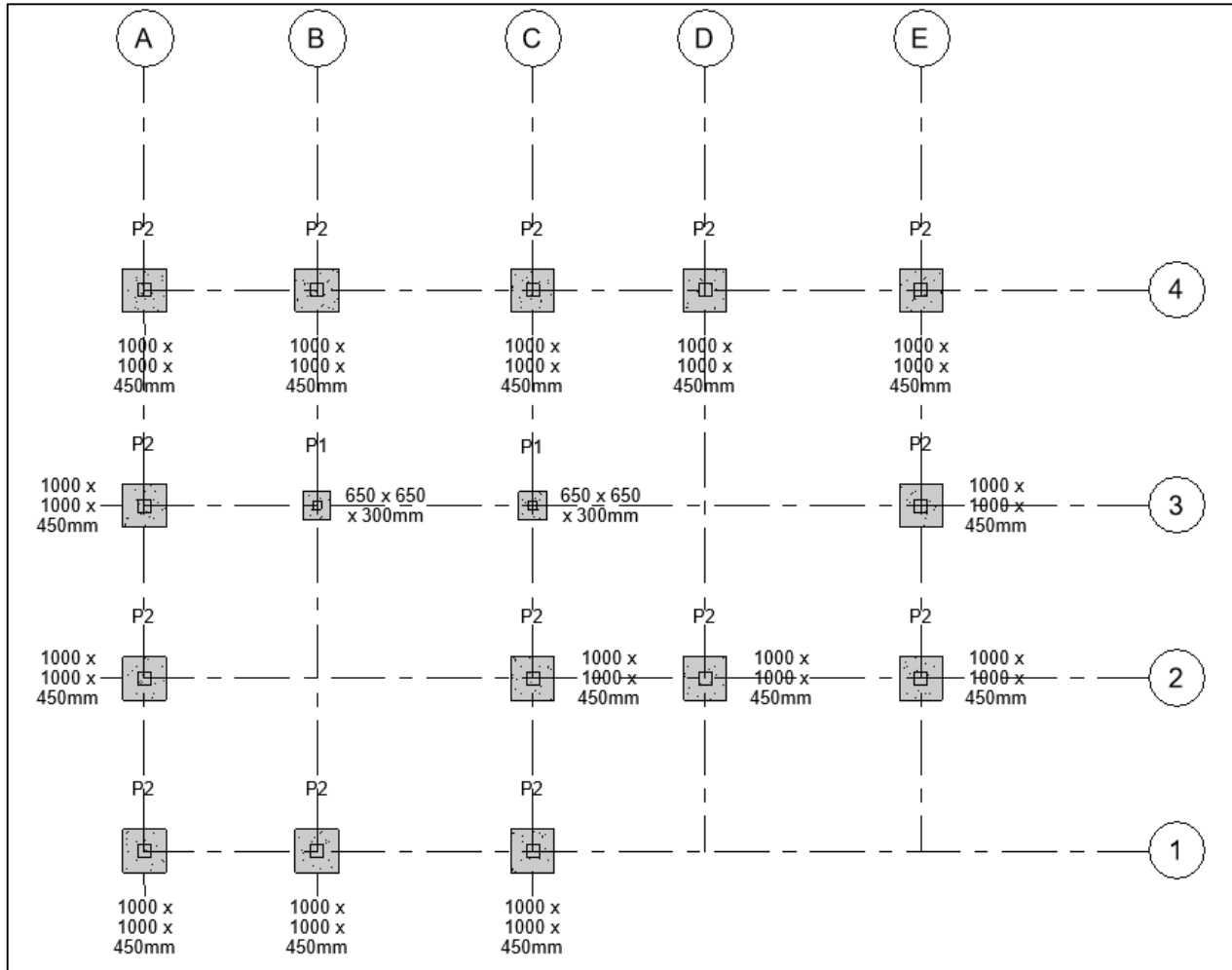


18. **Associate Family Parameter** pop-up will appear. Click **Structural Material** and then **OK**.



19. Click the **Application Menu** and **Save As** followed by **Family Files**. Save the pile name as **BIM Square Pile 300 x 300mm** *(or other name)*. Repeat procedure for **Square Pile 200 x 200mm**.

KEY PLAN DRAWING : Pile Footing

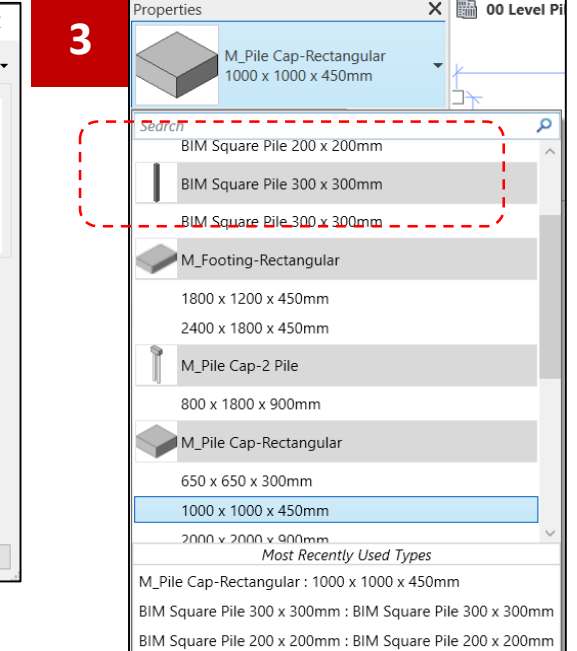
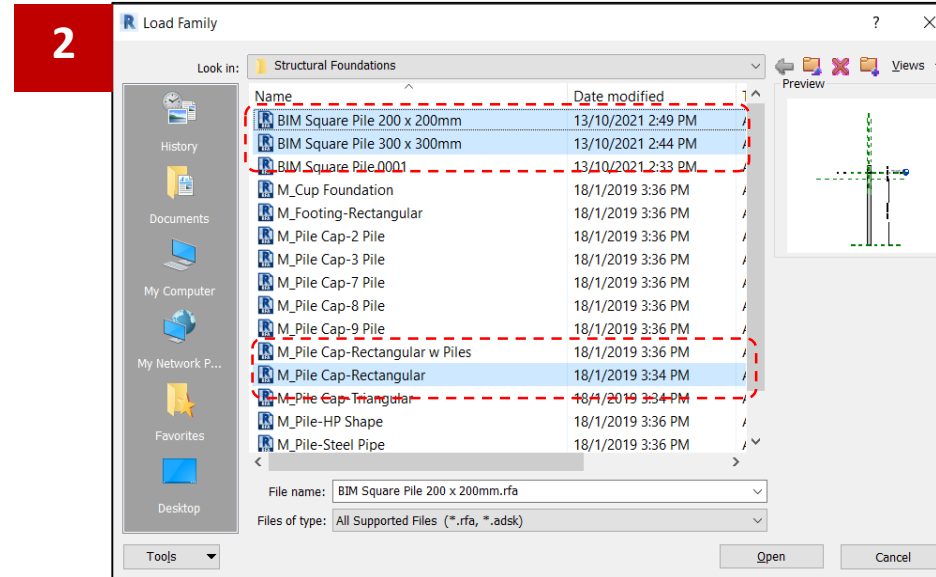
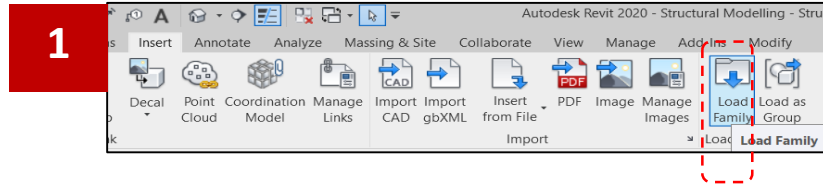


Plan View

	Pile (mm)	Pile cap (mm)
P1	200 x 200	650 x 650 x 300
P2	300 x 300	1000 x 1000 x 450

Pile Schedule

ADDING COMPONENT : Square Pile And Pile Cap



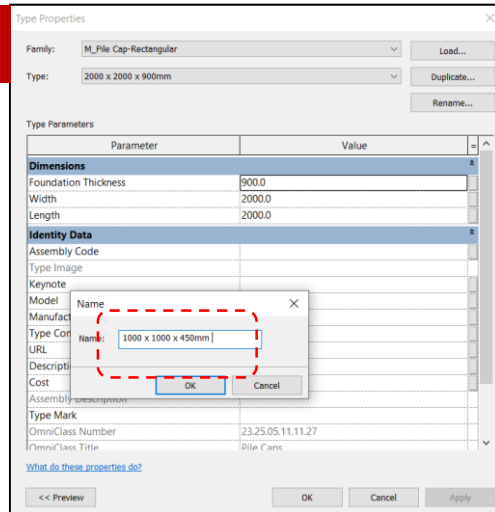
1. To add **foundation family**, click **Load Family** on **Insert Tab**.

2. Find the file in the **family** and click **Open** to load into the project.

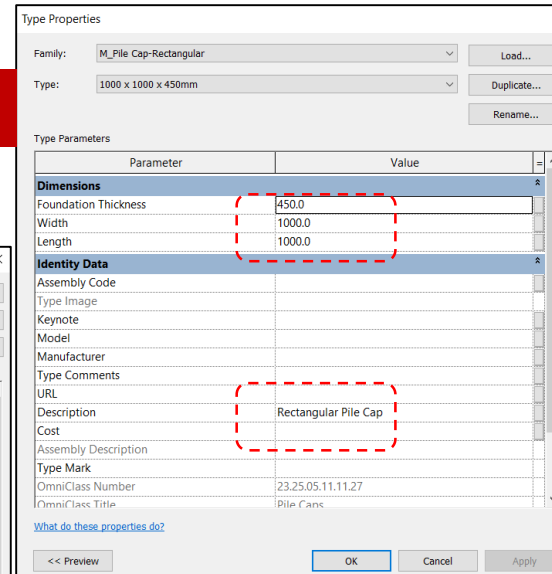
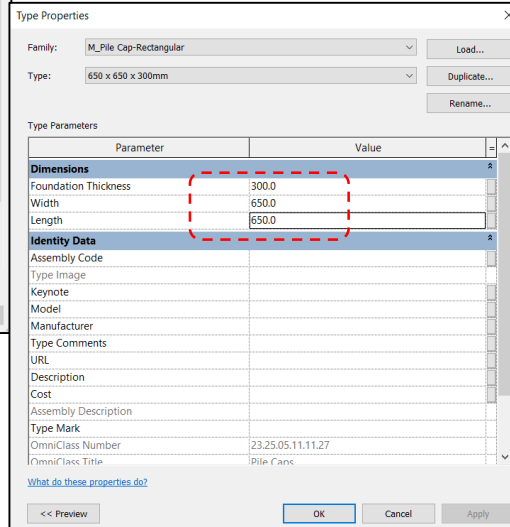
3. Select **Isolated** on **Structure Tab** to ensure the footing have been added into the project.

ADDING COMPONENT: Square Pile and Pile Cap

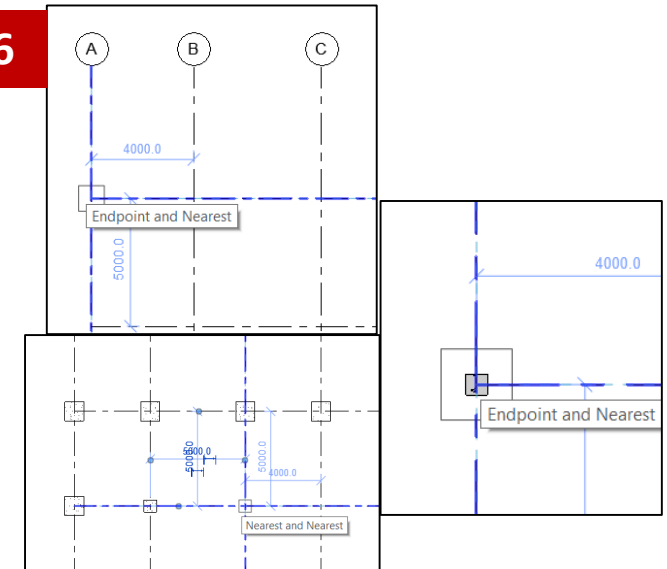
4



5



6

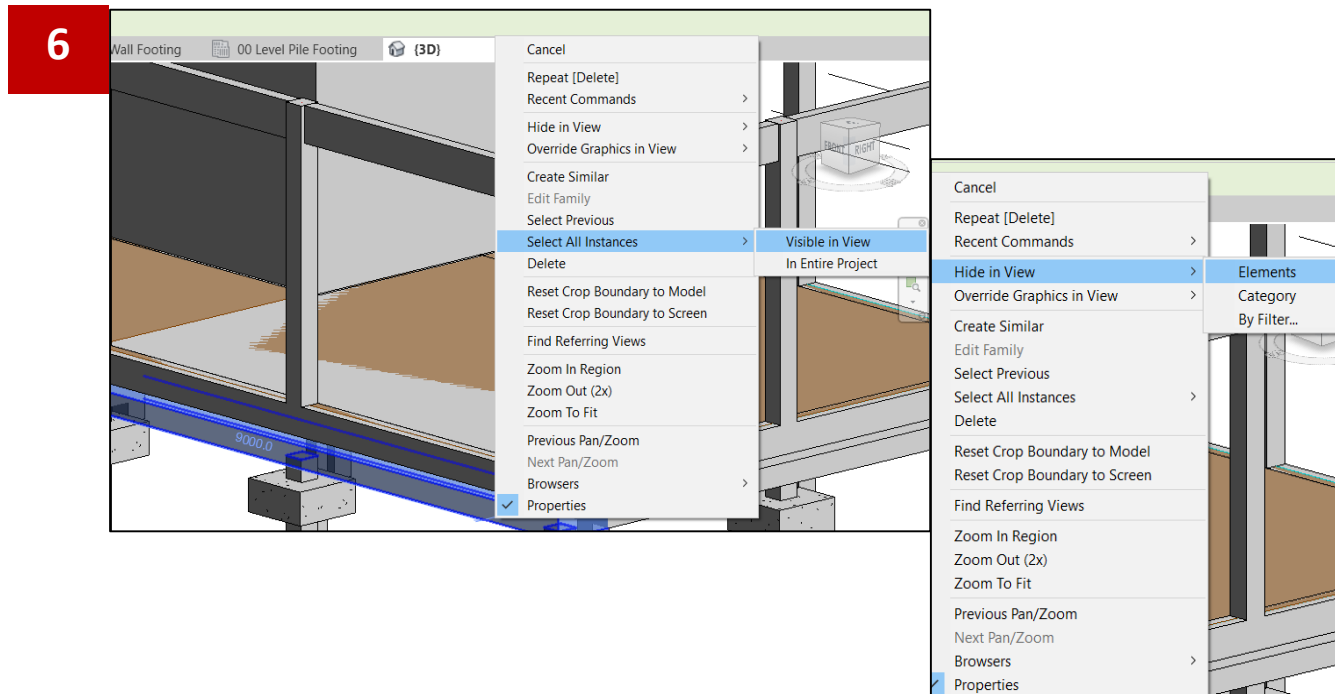


4. Duplicate **M_Pile Cap-Rectangular** for **1000 x 1000 x 450mm** and **650 x 650 x 300mm** size.

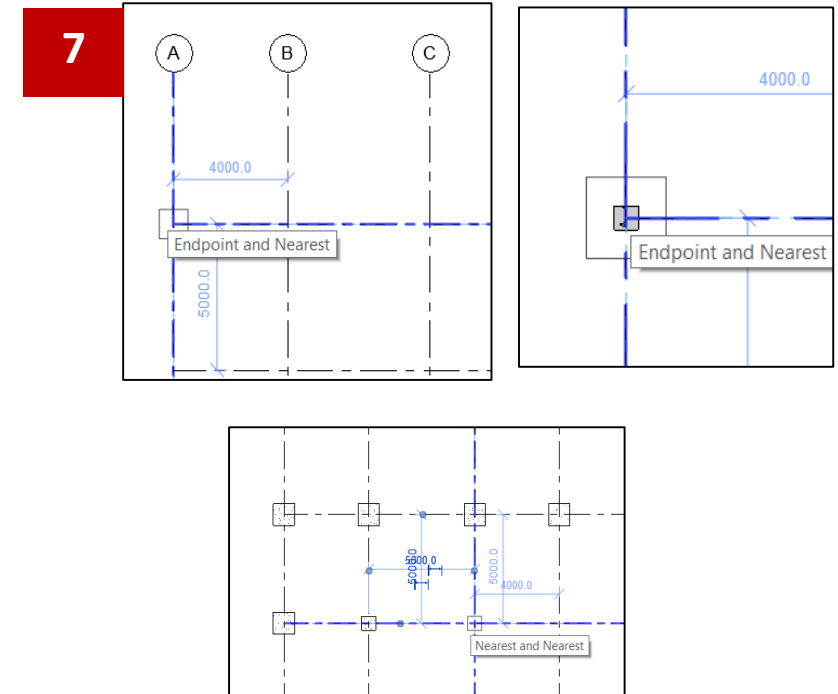
5. Edit the **parameter value** based on the size.

6. Place the pile cap and footing according to **key plan drawing** given.

PLACING COMPONENT: Square Pile and Pile Cap



6. Click the **wall footing component** and **Select All Instances – In Entire Project** and **Hide in View- Element**.

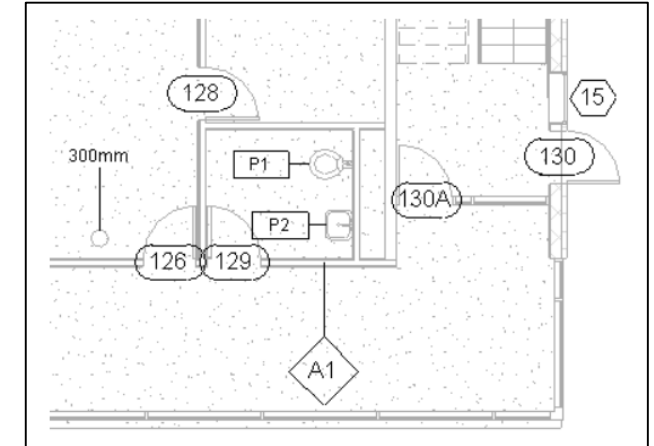


7. Place the pile cap and footing according to **key plan drawing** given.



ANNOTATION AND TAGGING

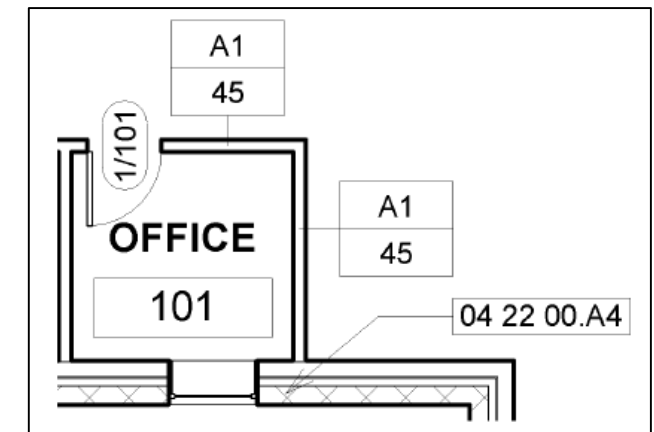
- A **tag** is an annotation for identifying elements in a drawing.
- **Tags** are text labels for elements such as **doors, walls, windows, rooms, and several other objects** that architects typically need to reference in a set of drawings.
- Every category in the family library has a tag. Some tags automatically load with the default Revit template, while others you need to load.
- If desired, you can make your own tag in the Family Editor by creating an annotation symbol family.
- In addition, you can load multiple tags for a family.



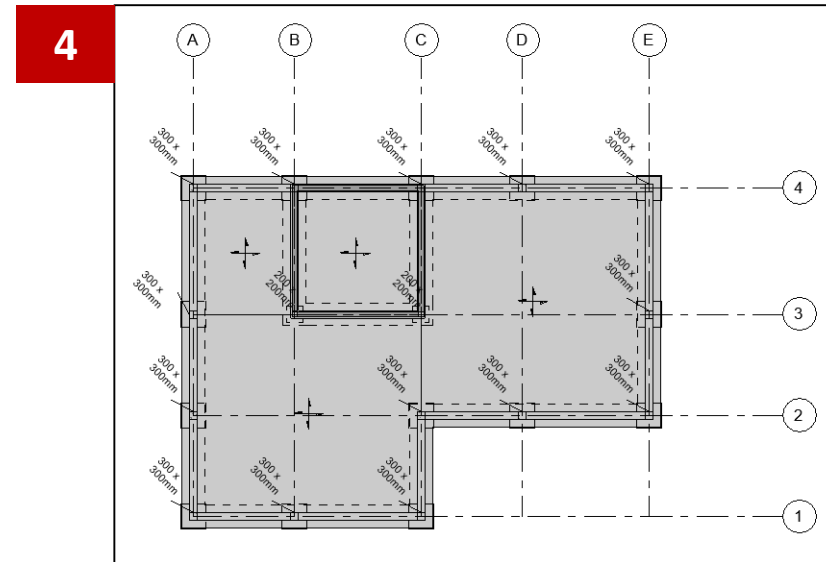
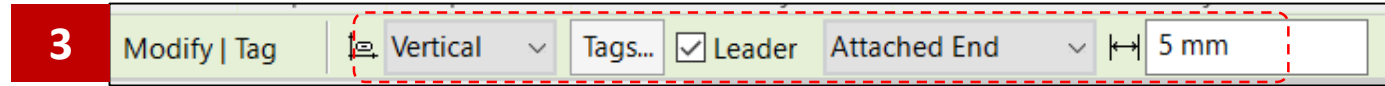
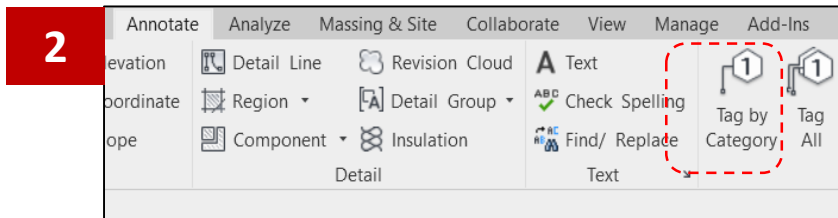
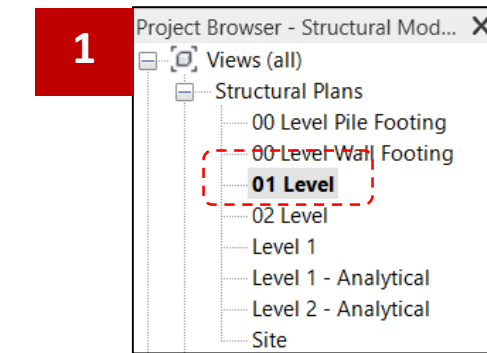
❖ **Annotate tab - Tag panel - Tag by Category**



❖ **Annotate tab - Tag panel - Tag All**



TAG BY CATEGORY : Structural Column

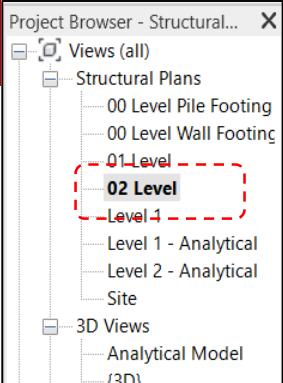


1. Double click **01 Level** on **Project Browser**.
2. On **Annotate Tab**, click **Tag By Category**.

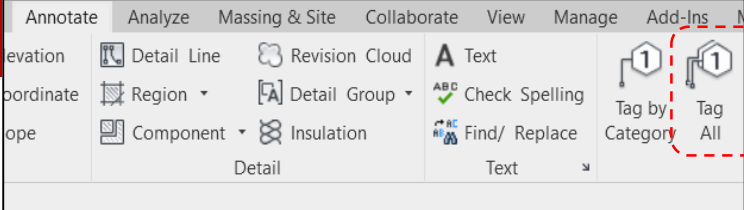
3. On **Option Bar**, modify orientation and dimension for tags. Click the column in drawing area and drag to place the tag. Click again to activate the tag.
4. The diagram shows the **completed Structural Framing tagging**.

TAG ALL: Structural Framing

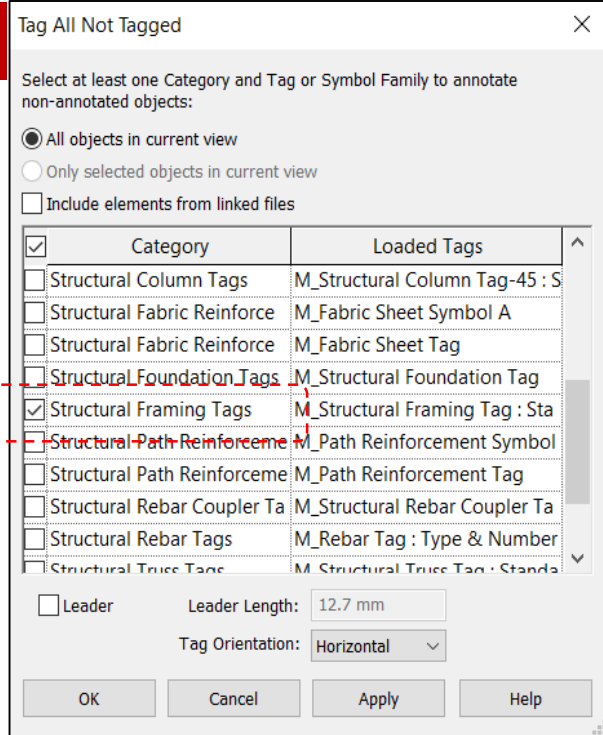
1



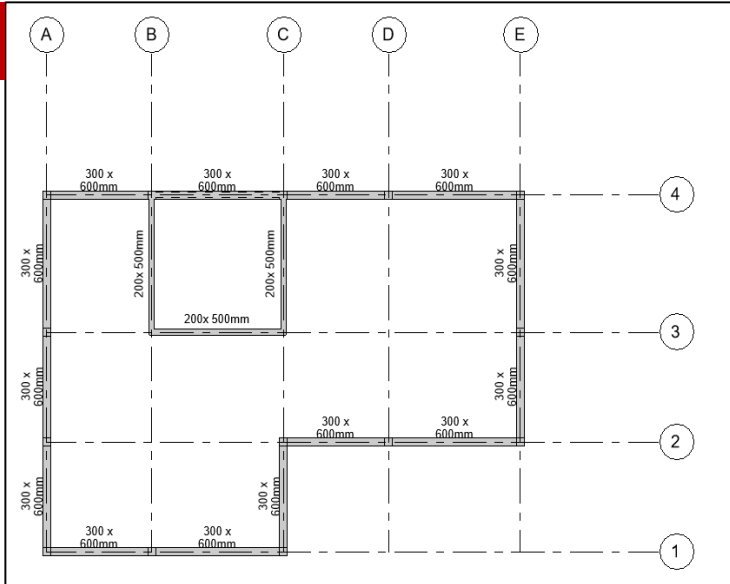
2



3



4



1. Double click **02 Level** on **Project Browser**.

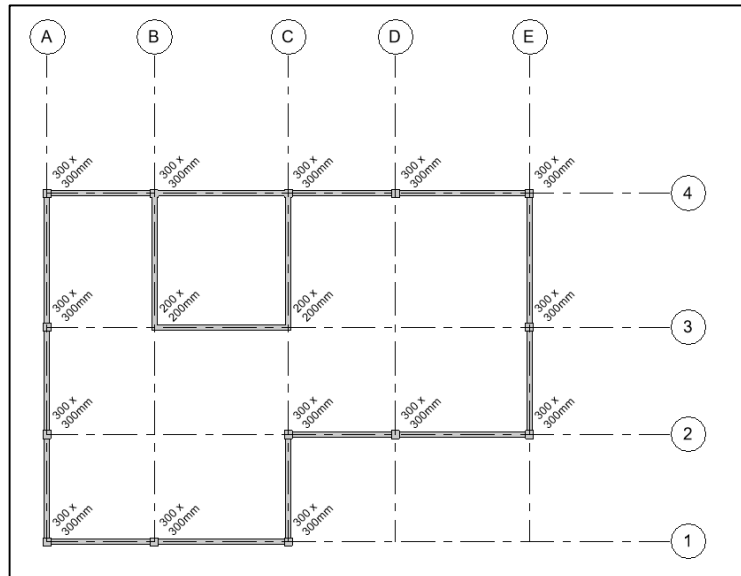
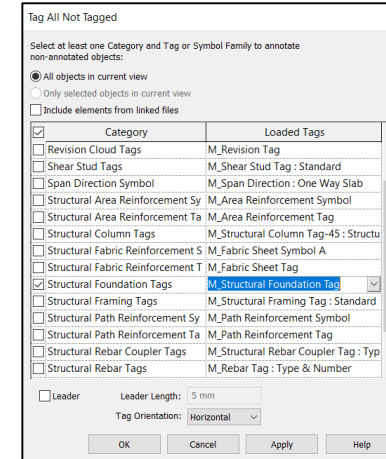
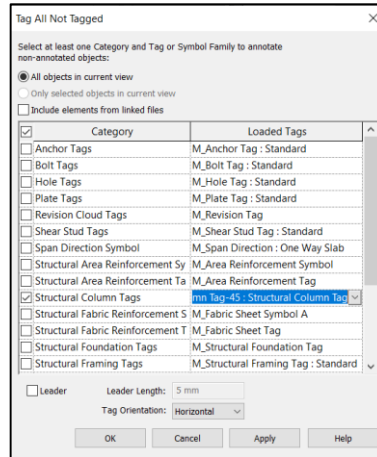
2. On **Annotate Tab**, click **Tag All**.

3. Tick **Structural Framing Tag** and then click **OK**.

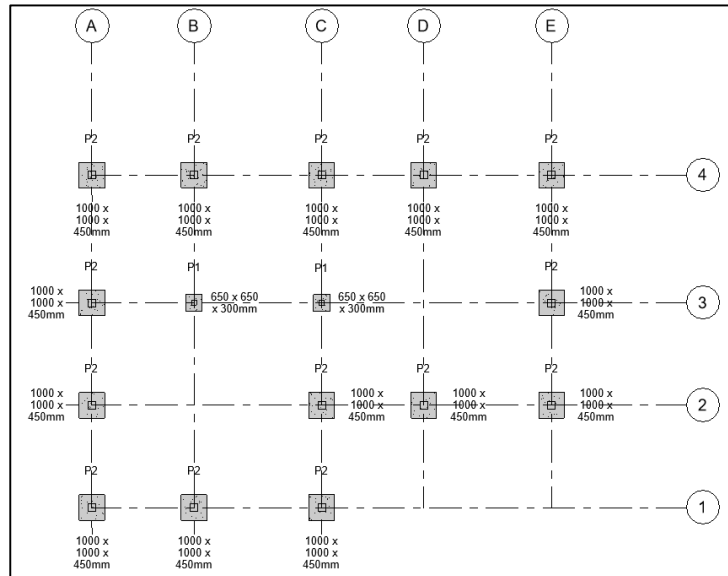
4. The diagram shows the **completed Structural Framing tagging**.

5. Repeat step 2 and 3 for other category.

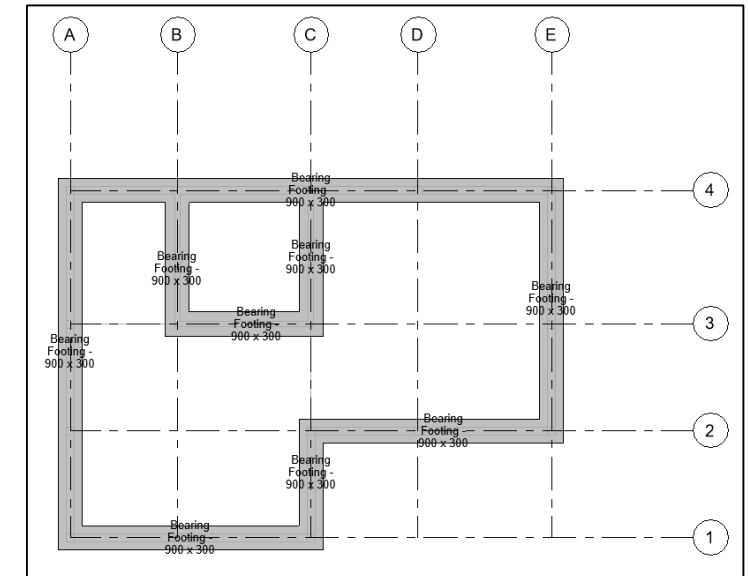
TAG ALL: Other categories



Column Tagging



Pile Footing Tagging



Wall Footing Tagging

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THANK YOU

