IT in Construction

Lecture #7
Building Information Modeling

Introduction to Autodesk Revit
Part 1

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Outline

- BIM Software Packages
- Open BIM/ Closed BIM
- Revit Standing in the Market
- Initial Adjustments
- Introduction to Revit-Architecture
- Introduction to Revit-Structure

BIM Software Packages

BIM Software Market

BIM Modeling Software

Manufacturer Company	3D Modeling
Autodesk	Revit
	Civil 3D
Bentley Systems	ProStructures
	AECOsim
	MicroStation
Graphisoft	ArchiCAD
	MEP Modeler
	BIMx
CYPE Ingenieros	CYPE
Nemetschek	Graphisoft ArchiCAD
Trimble	Tekla Structures
	SketchUp Pro
bimobject	bimObject
Vectorworks	Architect
ACCA	Edificius
Allplan	Architecture
	Engineering
Bricsys	BricsCAD BIM

Collaborative Environment Software

Manufacturer Company	Collaborative Environment
Autodesk	BIM360
Graphisoft	BIM Server
Trimble	Trimble Connect
ACCA	usBIM
Allplan	BIMPlus
Bricsys	Bricsys 24/7
Procore	Procore
Dassault Systèmes	Dassault Systèmes
BuilderTREND	BuilderTREND

Special Service Software

Manufacturer Company	Clash Detection	4D Scheduling	Quantity Takeoff
Autodesk	Navisworks Manage	Navisworks Manage	Navisworks Manage
Bentley Systems		Navigator	
Nemetschek	Solibri Model Checker		
Trimble	Vico Office	Vico Office	Vico Office
ACCA			PriMus IFC
Synchro Ltd.		Synchro Pro	

Manufacturer Company	Energy and Sustainability	Structural Analysis
Autodesk	Green Building Studio	Robot Structural Analysis
	Ecotect Analysis	
Bentley Systems	Hevacomp	RAM
		STAAD
Graphisoft	EcoDesigner	
ACCA		EdiLus

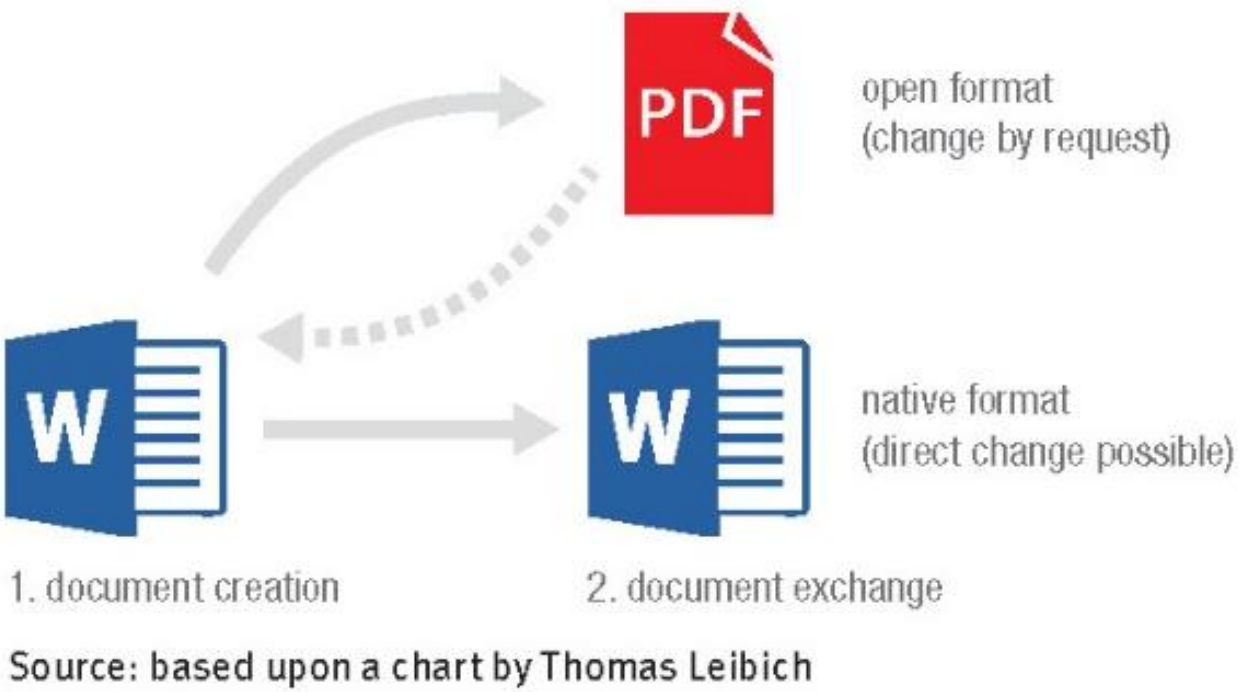
BIMTRACK
revizto
BIM Assure
AUTODESK NAVISWORKS
BIMcollab
SOLIBRI
A NEMETSCHEK COMPANY
simplebim.

Open BIM/ Closed BIM

OpenBIM Necessity

- Variety of BIM based application packages have been produced by different specialized Companies and are used by various parties in different phases and aspects of construction projects,
- OpenBIM is about recognizing the need for vendor-neutral (***non-proprietary***) methods of exchanging information throughout a project (buildingSmart Australia).
- OpenBIM standards, recognizable to each BIM software producer, are required to support the exchange of information in a consistent and transparent way in the construction project,

Open Versus Closed File Format



Open (non-proprietary) pdf versus M.S. Word proprietary file format (Baldwin, 2019)

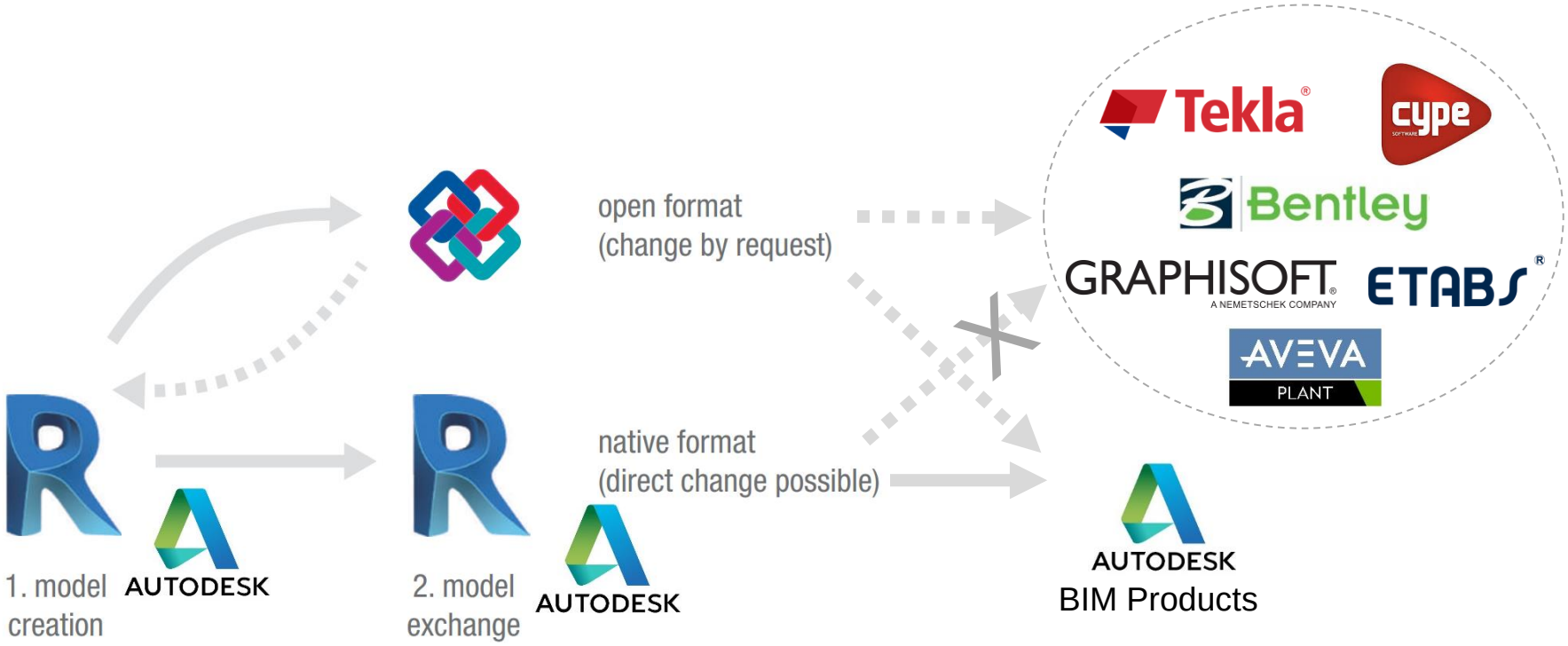
Open BIM Versus Closed BIM

(Baldwin, 2019)

- **openBIM** refers to collaborative processes (namely data exchanges) using neutral and openly available standards.

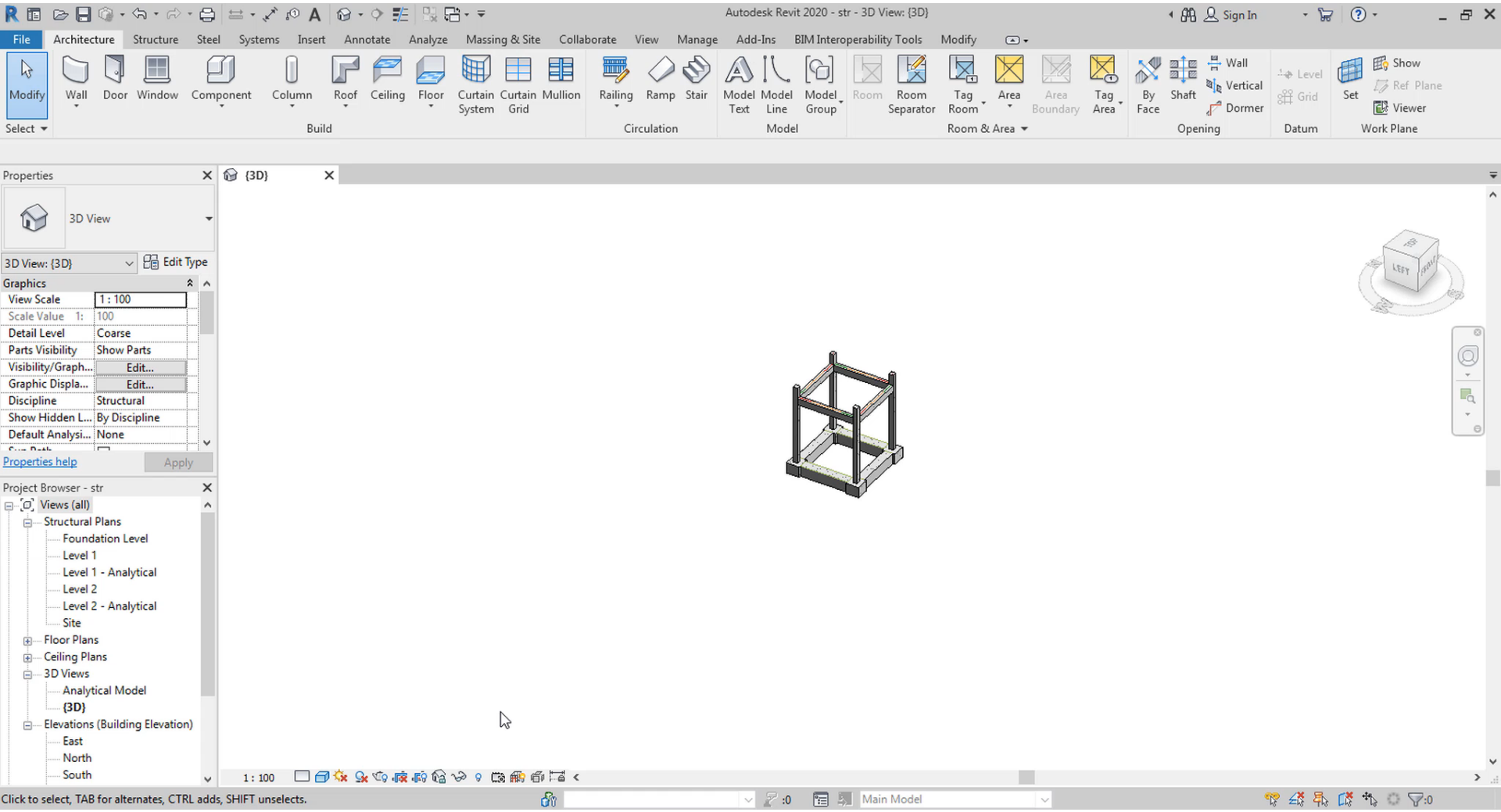
- **closedBIM (also nativeBIM)** refers to collaborative processes (namely data exchanges) that are based exclusively on proprietary systems and commercial file formats,

Open BIM Versus Closed BIM



OpenBIM (non-proprietary) versus Autodesk Revit proprietary format (Baldwin, 2019)

Open BIM Versus Closed BIM



Open BIM Standards-buildingSMART

•buildingSMART International is leading the digital transformation by enabling **better collaboration** and digital workflows through the **solutions** and **standards** it delivers

•Interoperable, **open**, **international standards** for **BIM** that transcend traditional design and construction phases to enable a comprehensive digital environment for the entire project and asset lifecycle offer substantial benefits.

OpenBIM Standards-buildingSMART

(Baldwin, 2019)

Name	Description (function)	Standard
IFC Industry Foundation Classes	Medium for Data Transfer	ISO 16739
MVD Model View Definition	IFC View Filter	buildingSMART MVD
IDM Information Delivery Manual	Standardised Process Description	ISO 29481-1 ISO 29481-2
IFD International Framework for Dictionaries (implemented in the bSDD)	Mapping of Terms	ISO 12006-3
BCF BIM Collaboration Format	Reporting and Tracking	buildingSMART BCF

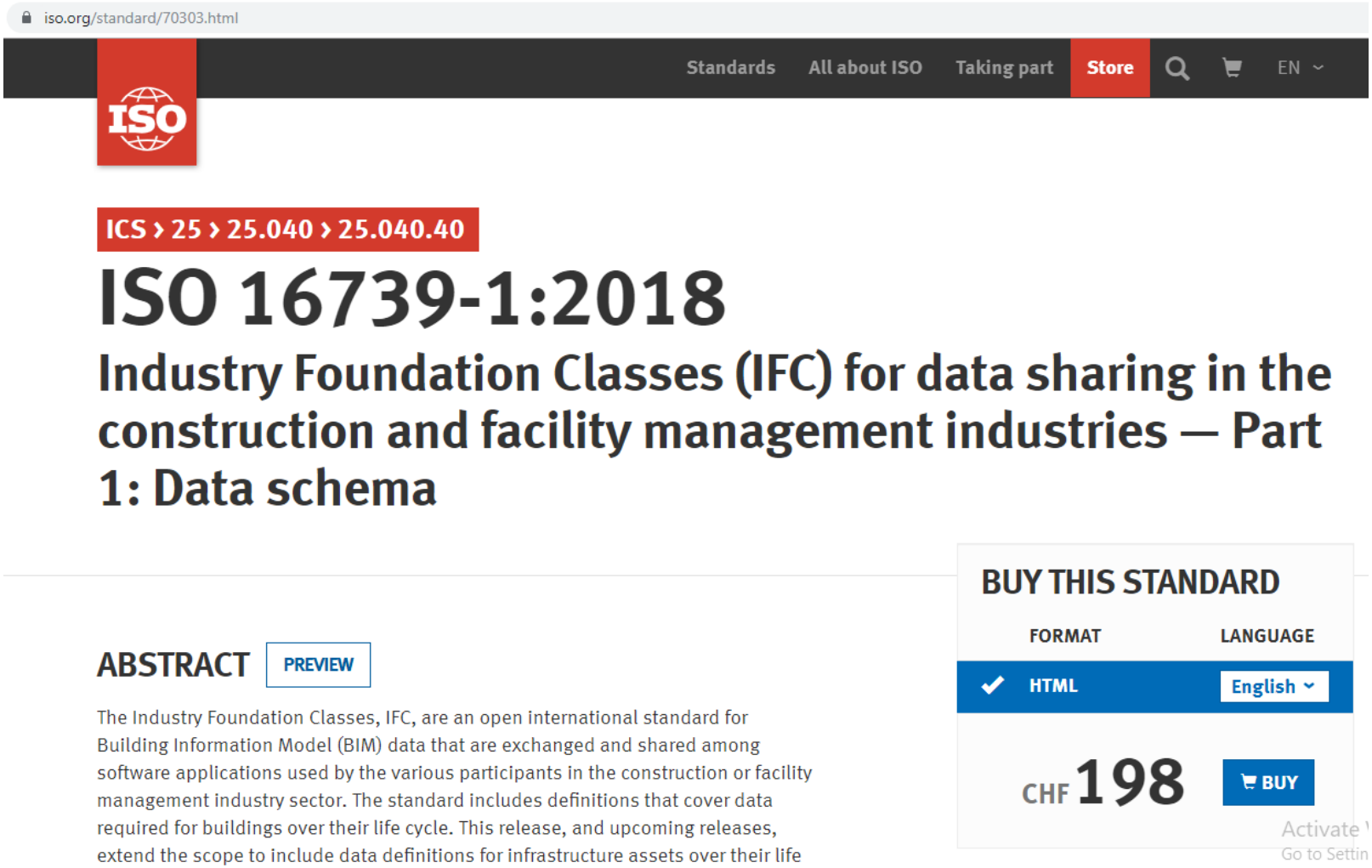
Source: buildingSMART

The buildingSMART openBIM standards

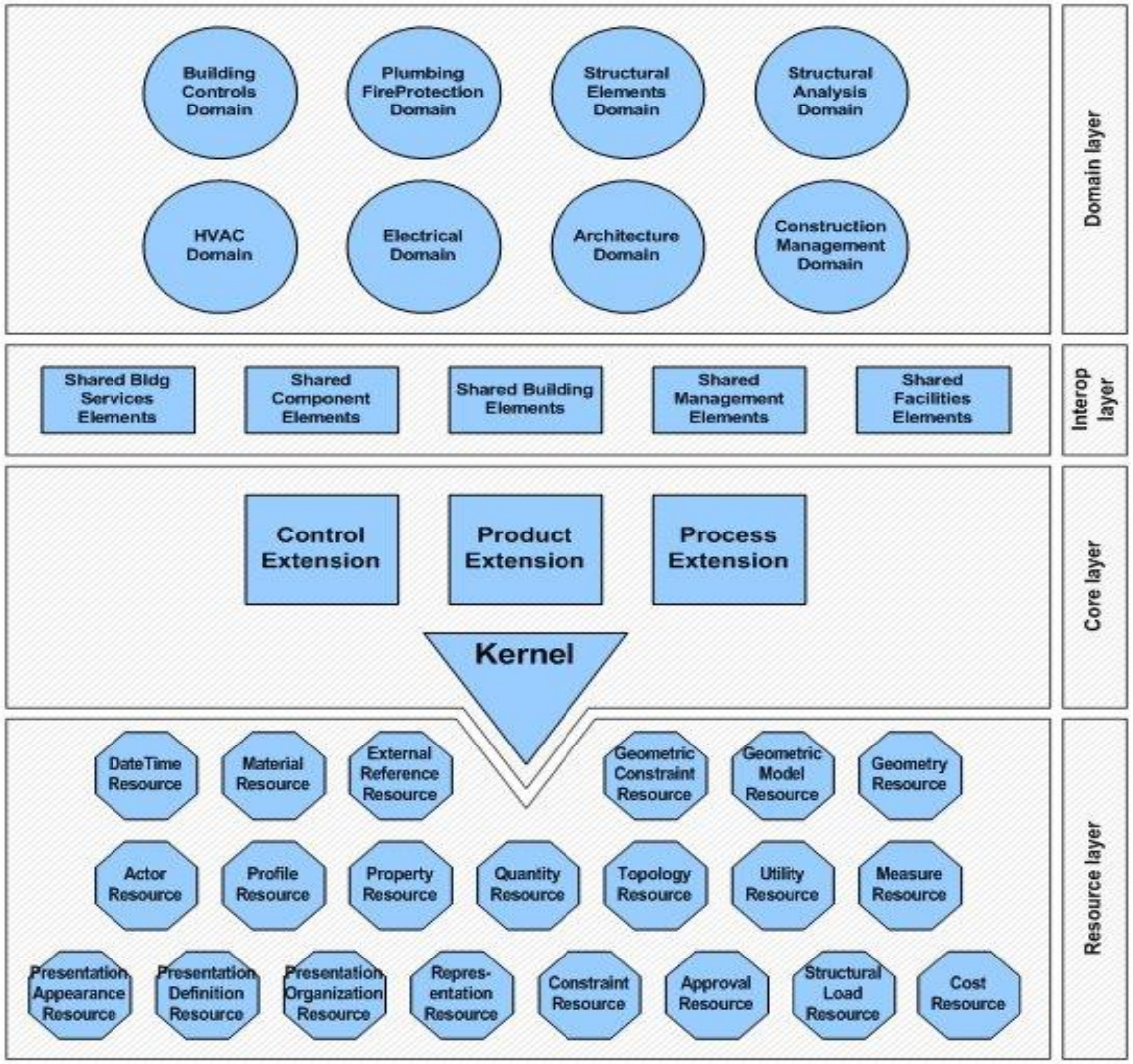
IFC Standard

- The Industrial Foundation Classes (IFC) is a standard for BIM model representation used by different BIM software packages for data exchanging.
- The IFC is registered by international standard organization (ISO) as an official International Standard of: ISO 16739.
- The IFC standard has been revised over time currently IFC ISO 16739:2018 is the latest revision.
- The IFC has become official standard BIM archiving format by the government of the countries such as UK, Norway, Denmark and Singapore.

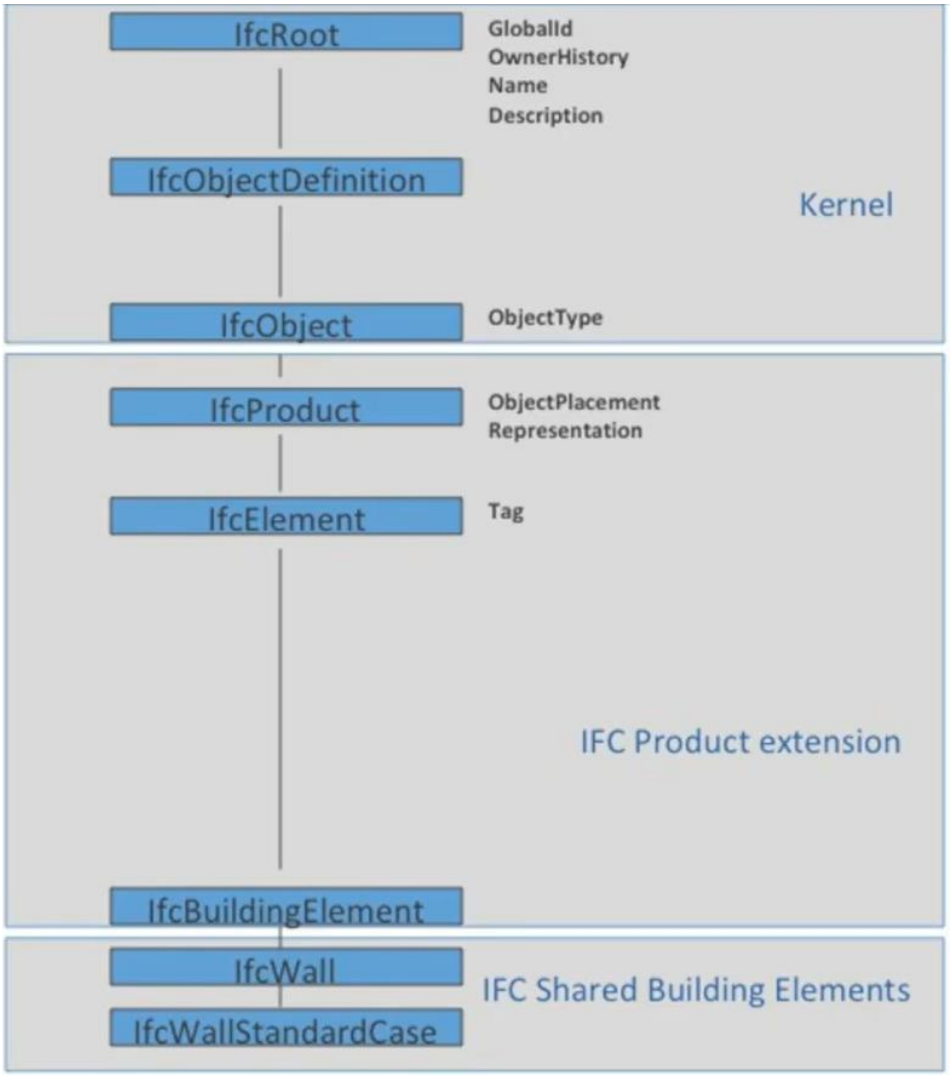
IFC Standard-ISO 16739:2018



IFC Standard-Schema



IFC Standard-Object Hierarchy



IFC Standard

- The IFC is supported by almost all BIM based computer software packages for data import and export
- Only limited number of BIM software packages have chosen IFC as the working file in their working environment
- Most software packages have developed their own version or proprietary file format, such as .rvt for Revit, .pln for ArchiCAD and .edb for ETABS,

MVD

- The model view definition (MVD) defines a filter to view desirable part of IFC schema, i.e., an MVD contains a sub-set of IFC schema
- In reality, no BIM file has entire IFC schema objects/ entities, However, every IFC file you see is an MVD (or a sub-set) of IFC schema objects/ entities.
- buildingSmart regulates MVDs!
- The most fasouse MVDs are Coordination View (IFC2x3), Design Transfer View (IFC4), Reference View (IFC4), and COBie (Construction Operations Building Information Exchange).
- The COBie is going to be discussed in a separate section later on in the course.

IDM

- The information delivery manual (IDM) defines the specification of BIM base process information exchange in the following steps:

  1) Figure out ***who*** exchanges the information, by drawing process maps using appropriate diagrams!

  2) Identify ***what*** information are exchanges, by extracting exchange requirements from the process maps!

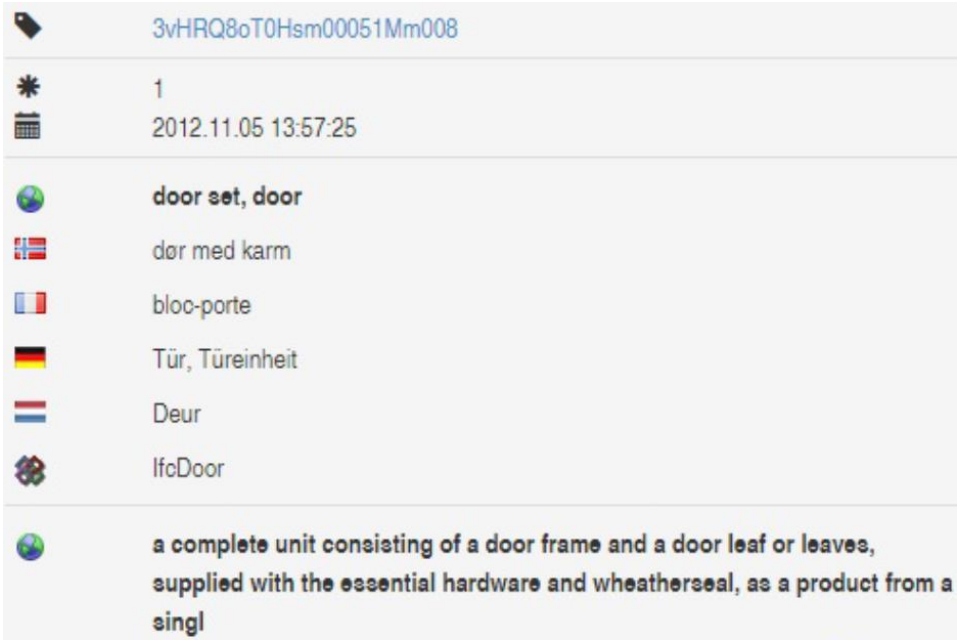
  3) Determine ***how*** the information are exchanged, by determining the specification of the proper MVD based on the identified exchange requirements!

IFD

- Many objects/ concepts/ entities are used in the IFC Schema that open-BIM models need to refer to them.
- The IFD (International Framework for Dictionaries) (ISO12006-3) standard serves as the IFC dictionary and description, by providing a single specific definition of the various objects/ concepts/ entities used in the construction industry in different countries or even in different communities.
- The IFD standard provides a glossary of concepts defined in building information modeling and general information required to facilitate communication between different people involved in the construction industry.
- The IFD provides each of the objects/ concepts/ entities listed in the IFC with a unique Global GUID (or Global Unique Identification) code and a set of names and definitions at different times.

IFD

- The bSDD (buildingSMART Data Dictionary) is an online software package developed by buildingSMART based on the IFD standard.
- buildingSMART also provides a plug in to be used by BIM based software packages



BCF (BIM Collaboration Format)

(Baldwin, 2019)

- Working with IFC has typically been a one-way street. It is great for *exporting* a model for coordination or collaboration.
- IFC does not really translate decisions made in the collaborative environment back into the native software.
- To close the communication loop, the BIM Collaboration Format, or BCF, was developed. BCF serves as a communication channel between the federated IFC models and the native models.
- In simple terms, BCF can be thought of as a messaging tool, a sort of WhatsApp or Telegram for BIM.

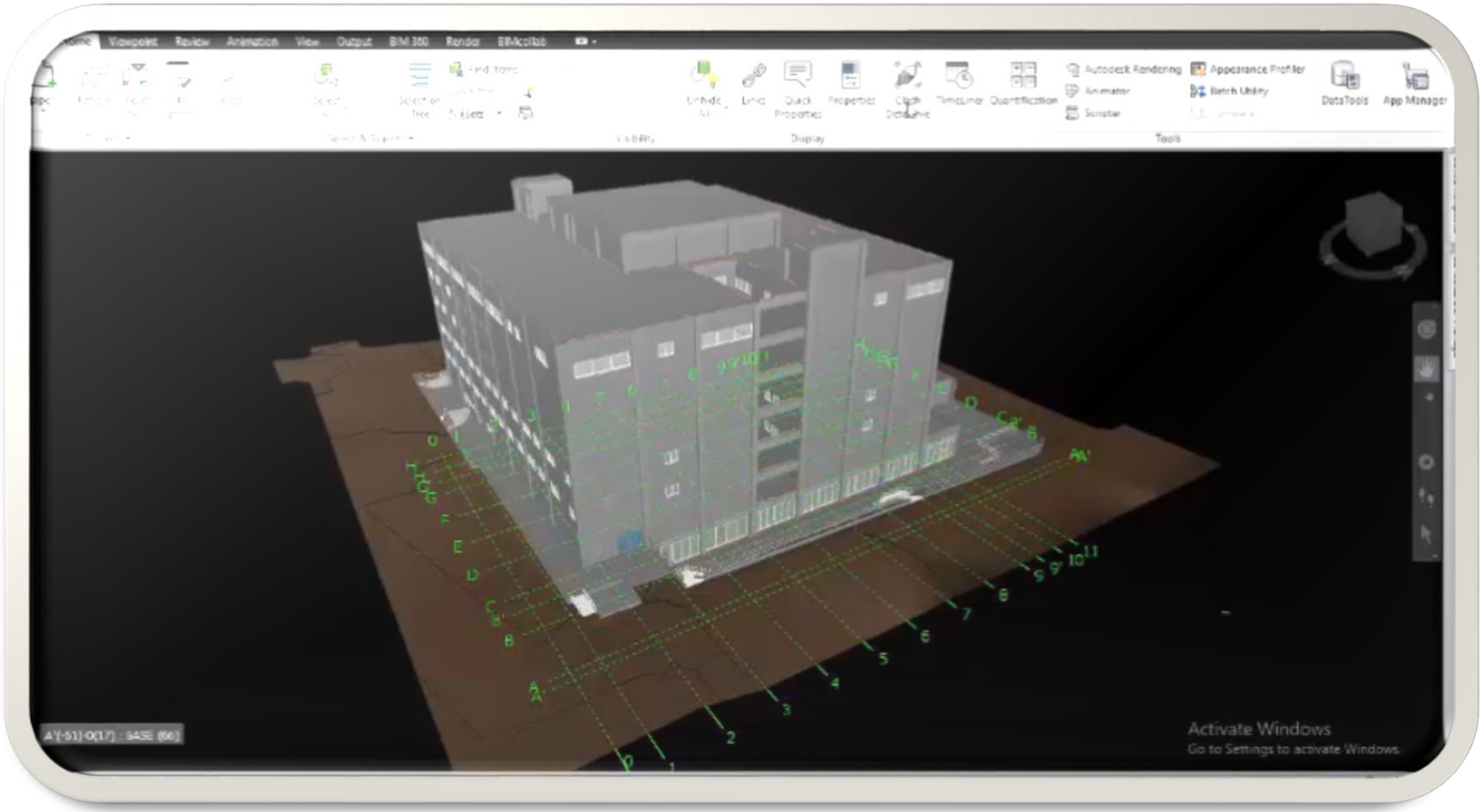
BCF (BIM Collaboration Format)

(Baldwin, 2019)

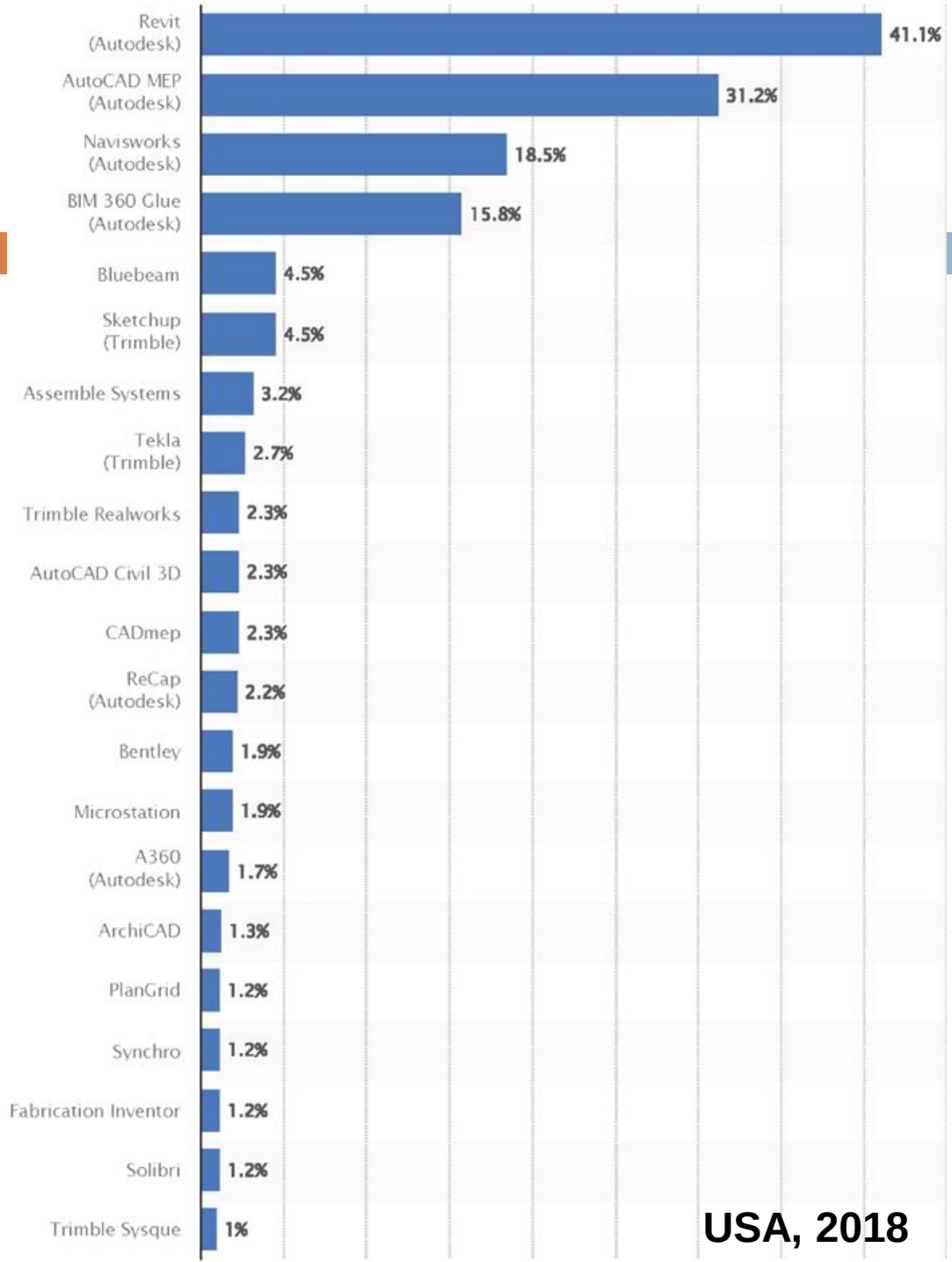
- BCF was primarily designed for defining views of a building model during clash detection and removal process.
- Currently, BCF application is not limited to clash detection application and it is used in a broader range of information management in BIM applications such as space design, delivering process and building maintenance processes!
- BCF is supported natively by modeling software such as ArchiCAD, Tekla Structures, Navisworks, BIMsight, simplebim, and Vectorworks.
- Standalone BCF plugins include BCF Manager, BCFier.
- Cloud services offering BCF based issue tracking include BIMcollab and bimsync

BCF (BIM Collaboration Format)-Sample

- Sample BCF application in a real project



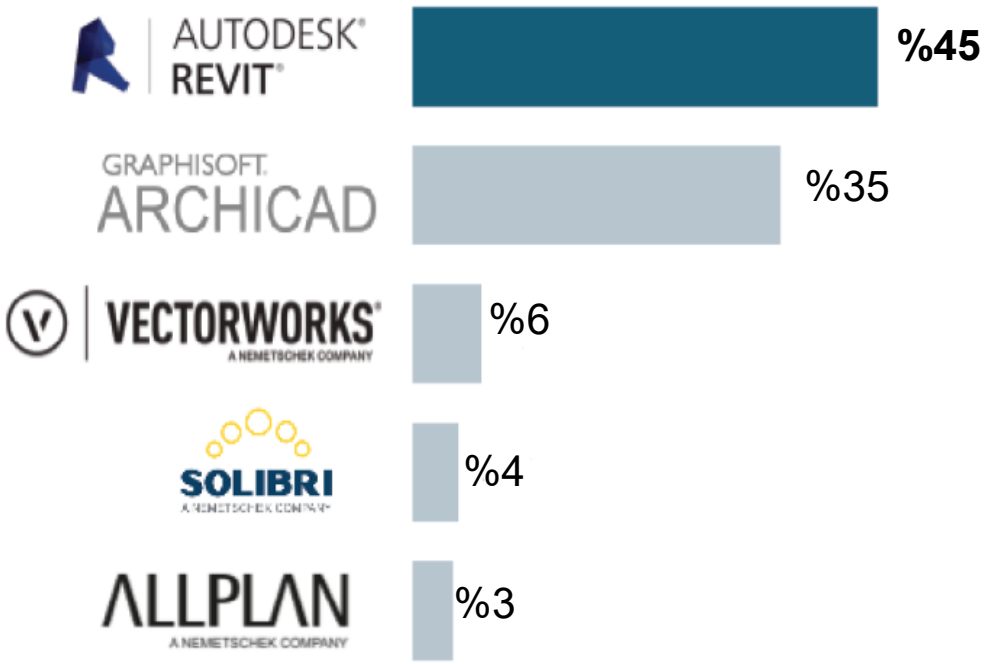
Revit Standing in the Market



Revit, BIM Modeling Market Leader

Revit, BIM Modeling Market Leader

Europe, 2021



Source: www.usp-research.com

Autodesk Revit

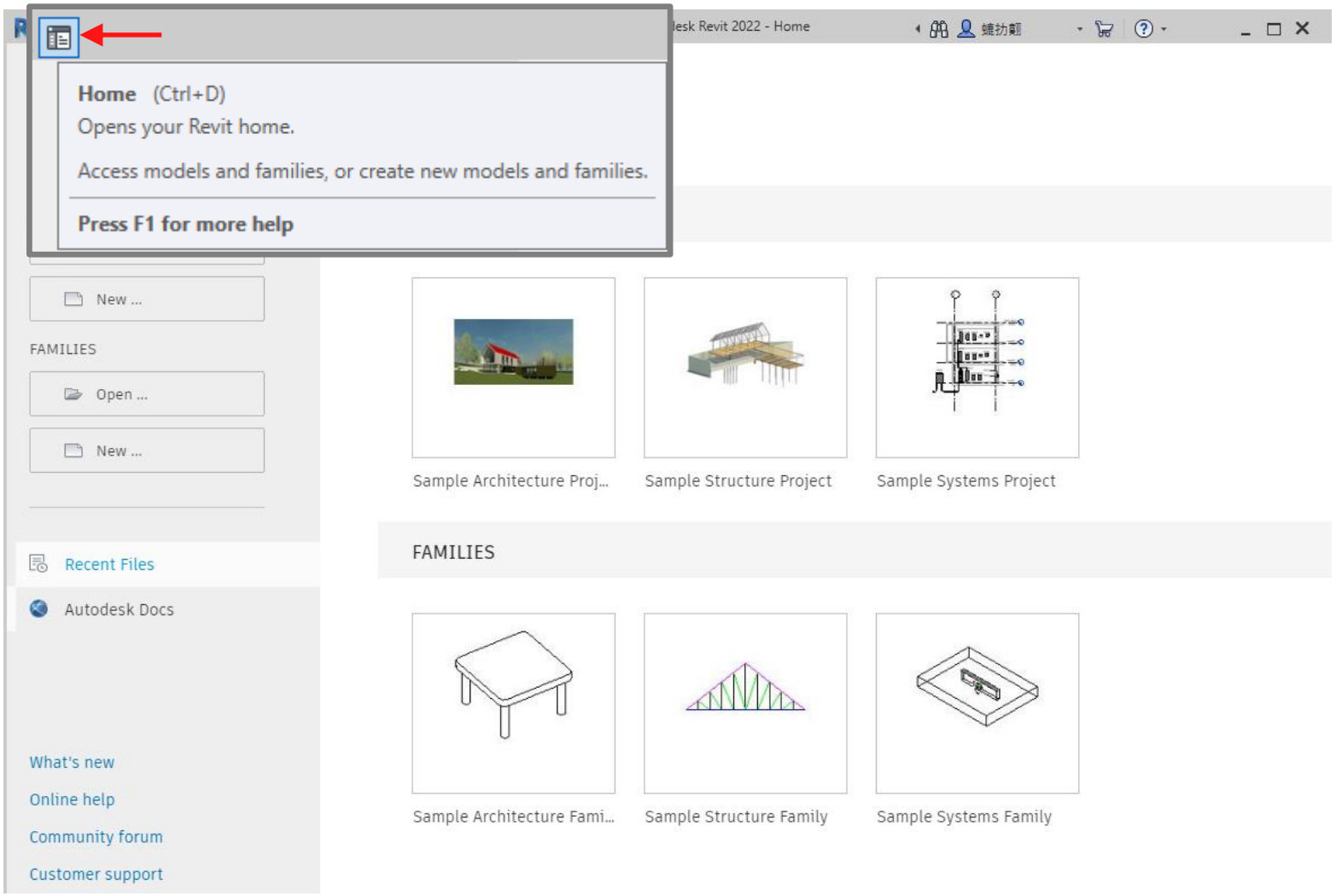
- Revit is software for **Building Information Modeling**. Revit supports a **multidiscipline** design process for collaborative design. Its powerful tools let the user use the intelligent **model-based** process to plan, design, construct, and manage buildings and infrastructure.

Initial Adjustments

Revit Installation

- Revit Installation Guide

Let’s Begin


Home (Ctrl+D)
Opens your Revit home.
Access models and families, or create new models and families.
Press F1 for more help
New ...
FAMILIES
Open ...
New ...
Recent Files
Autodesk Docs
What's new
Online help
Community forum
Customer support
Sample Architecture Proj...
Sample Structure Project
Sample Systems Project
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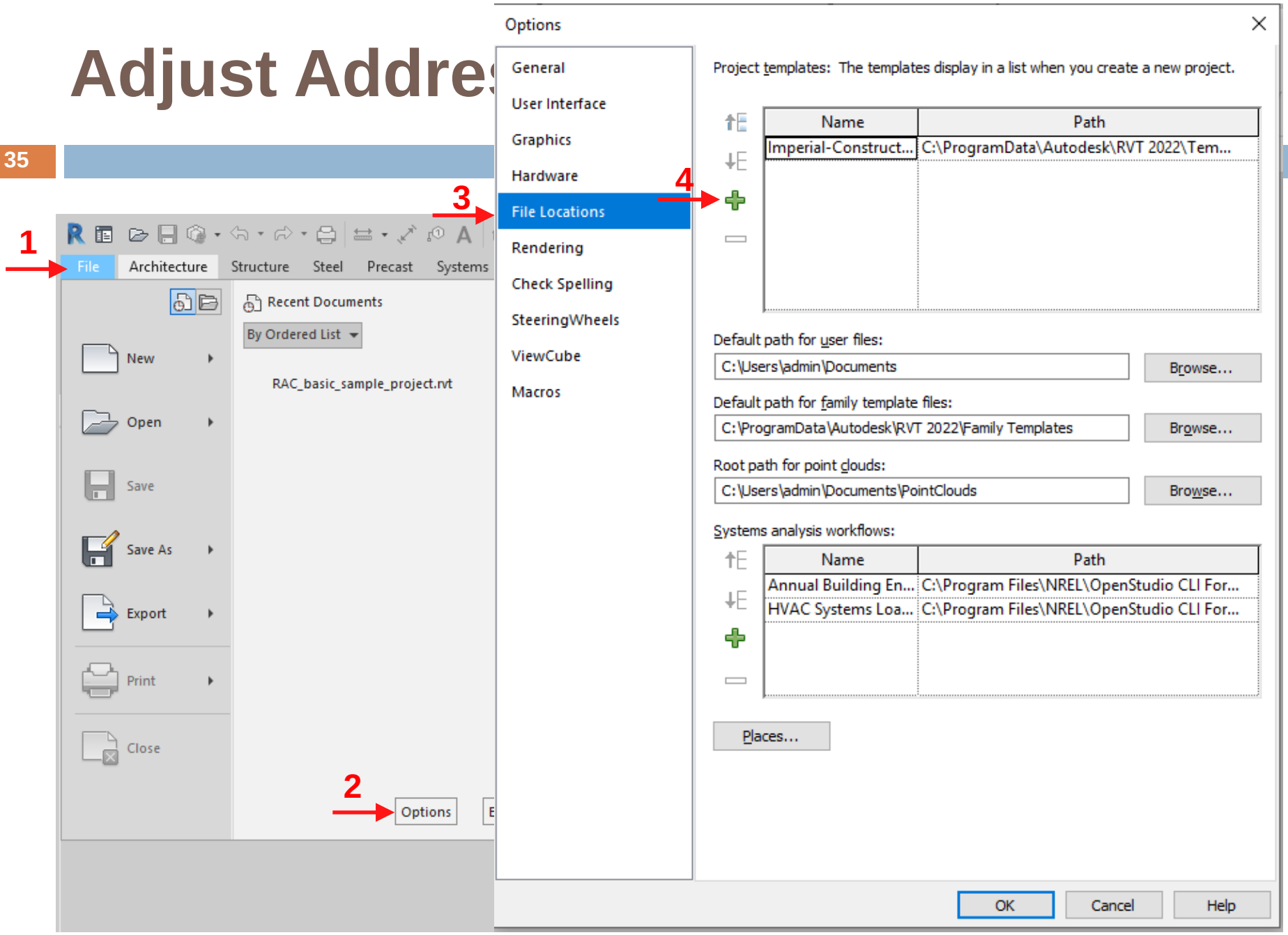
Adjust Addres



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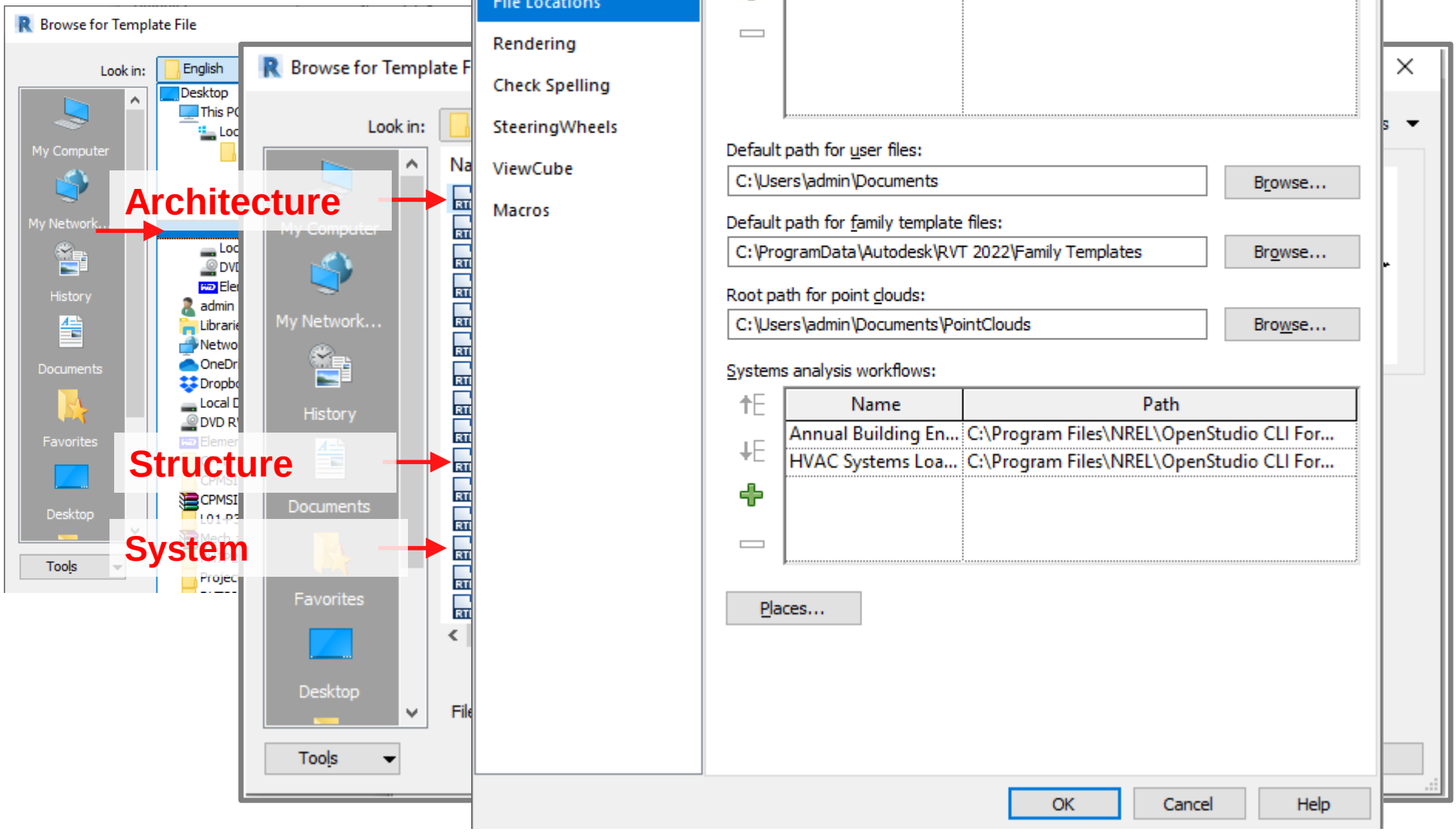
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Look in:
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History
Documents
Favorites
Desktop
Tools
Architecture
Structure
System
Options
General
User Interface
Graphics
Hardware
File Locations
Rendering
Check Spelling
SteeringWheels
ViewCube
Macros
Project templates: The templates display in a list when you create a new project.
Name
Path
DefaultMetric
C:\ProgramData\Autodesk\RVT 2022\Tem...
Default path for user files:
C:\Users\admin\Documents
Browse...
Default path for family template files:
C:\ProgramData\Autodesk\RVT 2022\Family Templates
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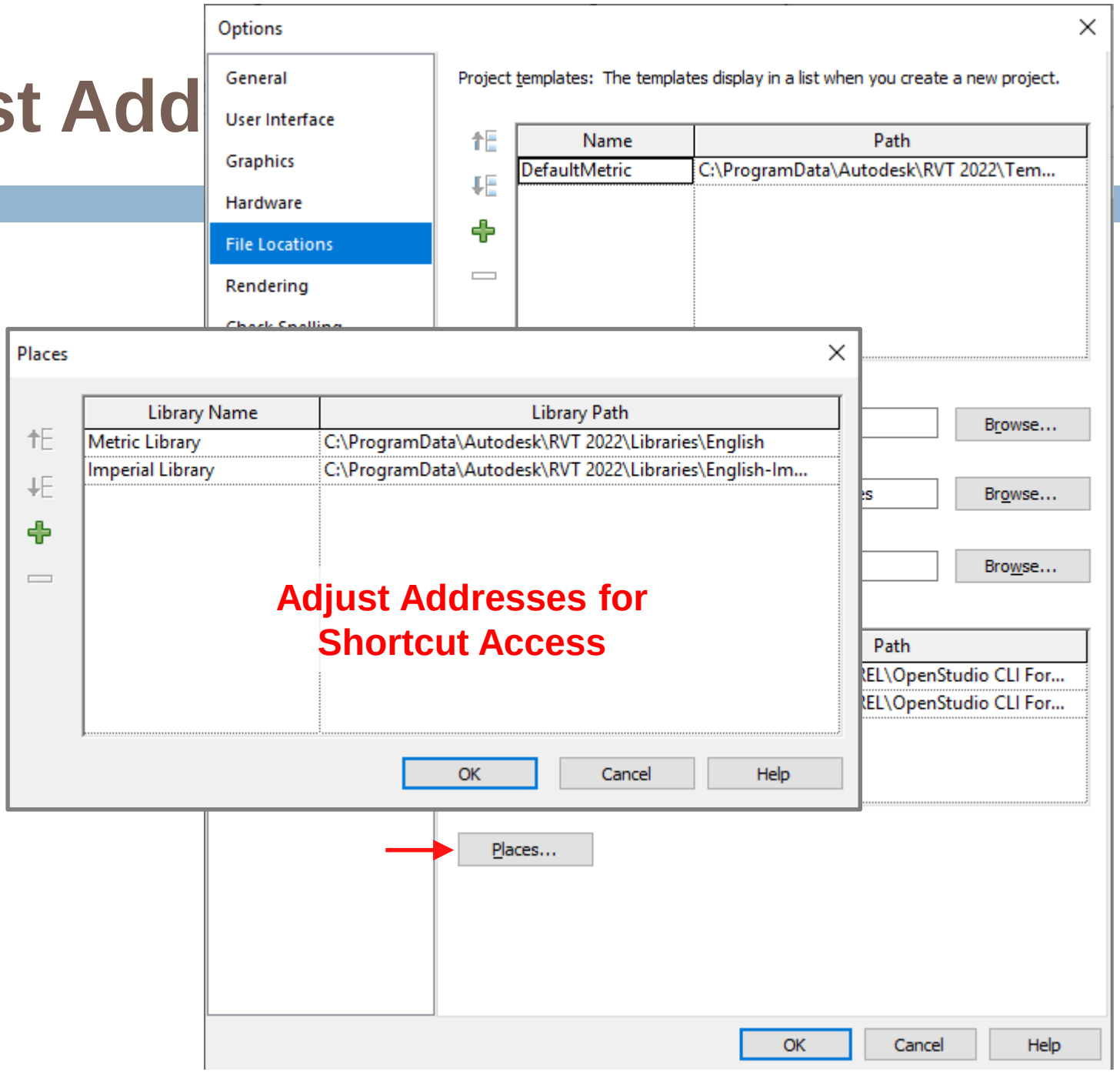
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General
User Interface
Graphics
Hardware
File Locations
Rendering
Project templates: The templates display in a list when you create a new project.
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Browse...
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Path
Places...
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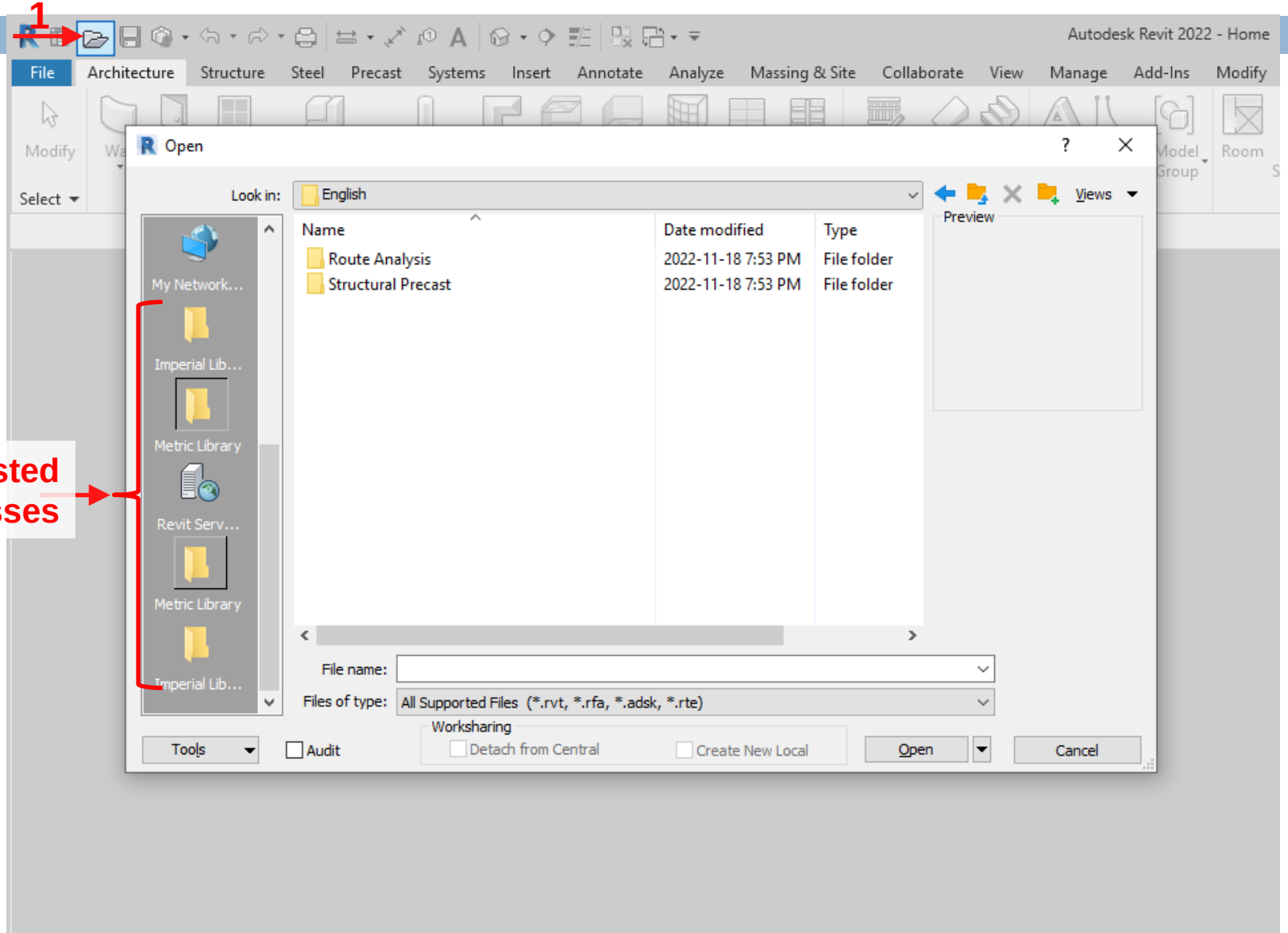
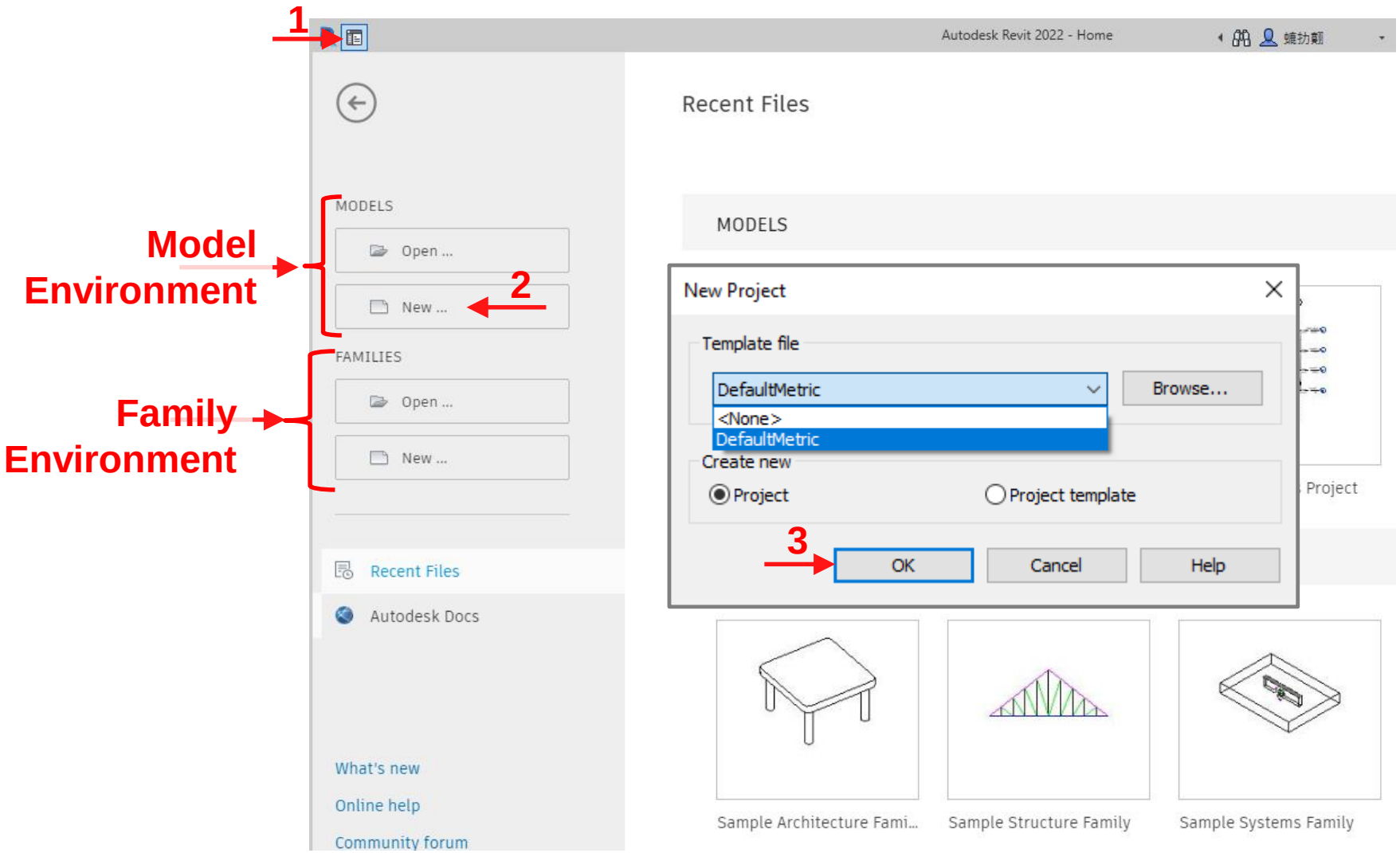
Adjust Addresses for
Shortcut Access

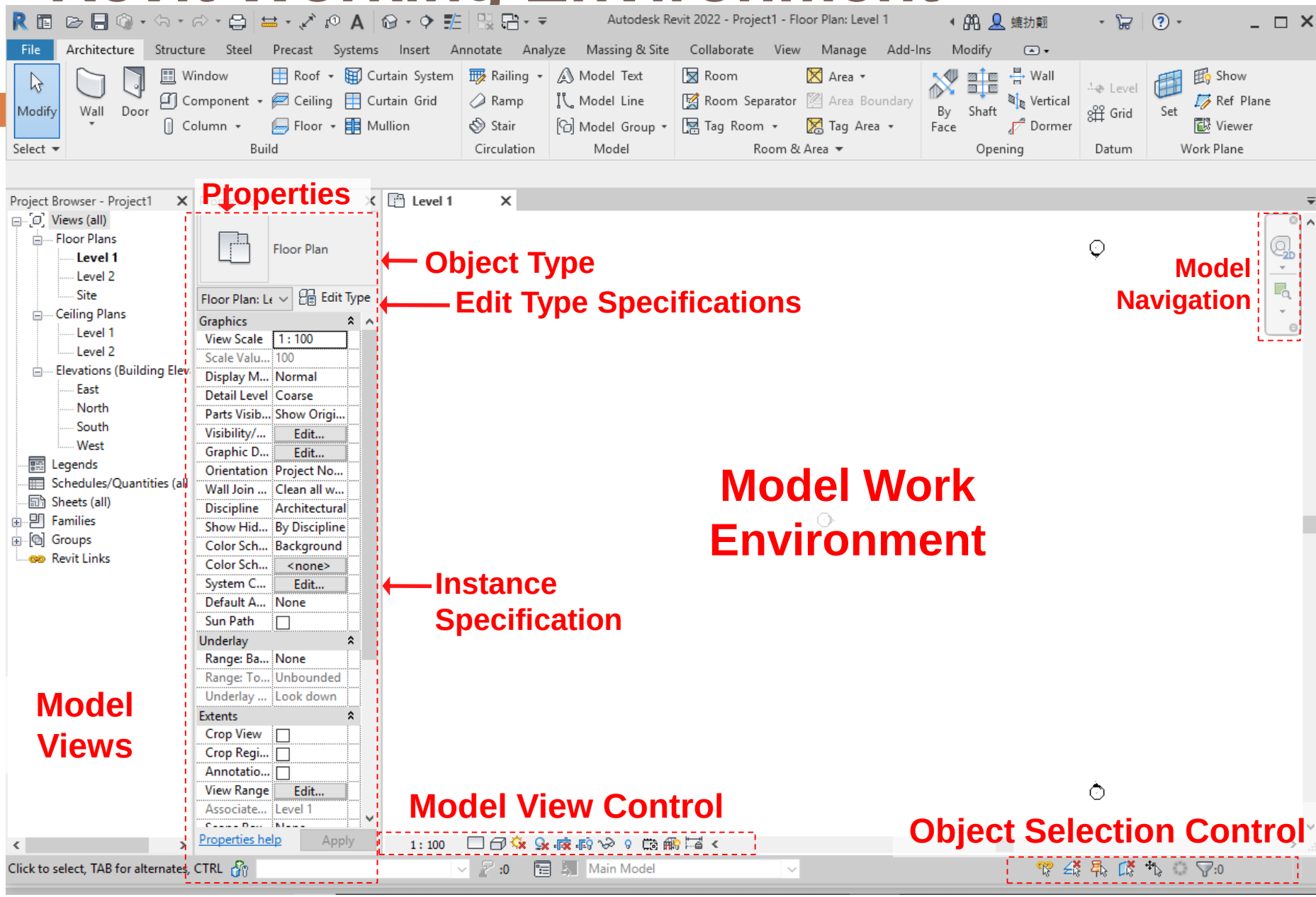
Adjust Addresses



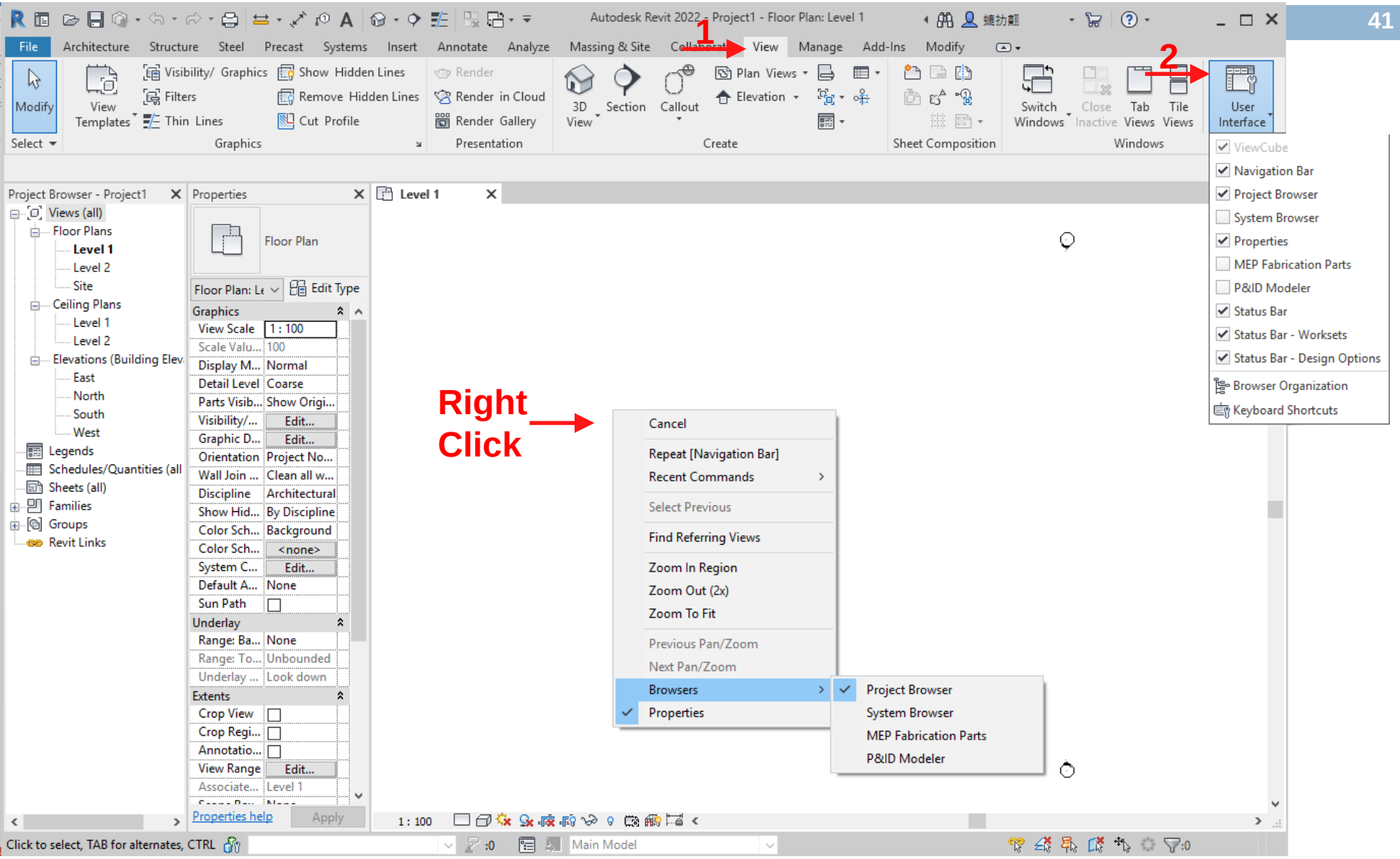
Start Working with Revit



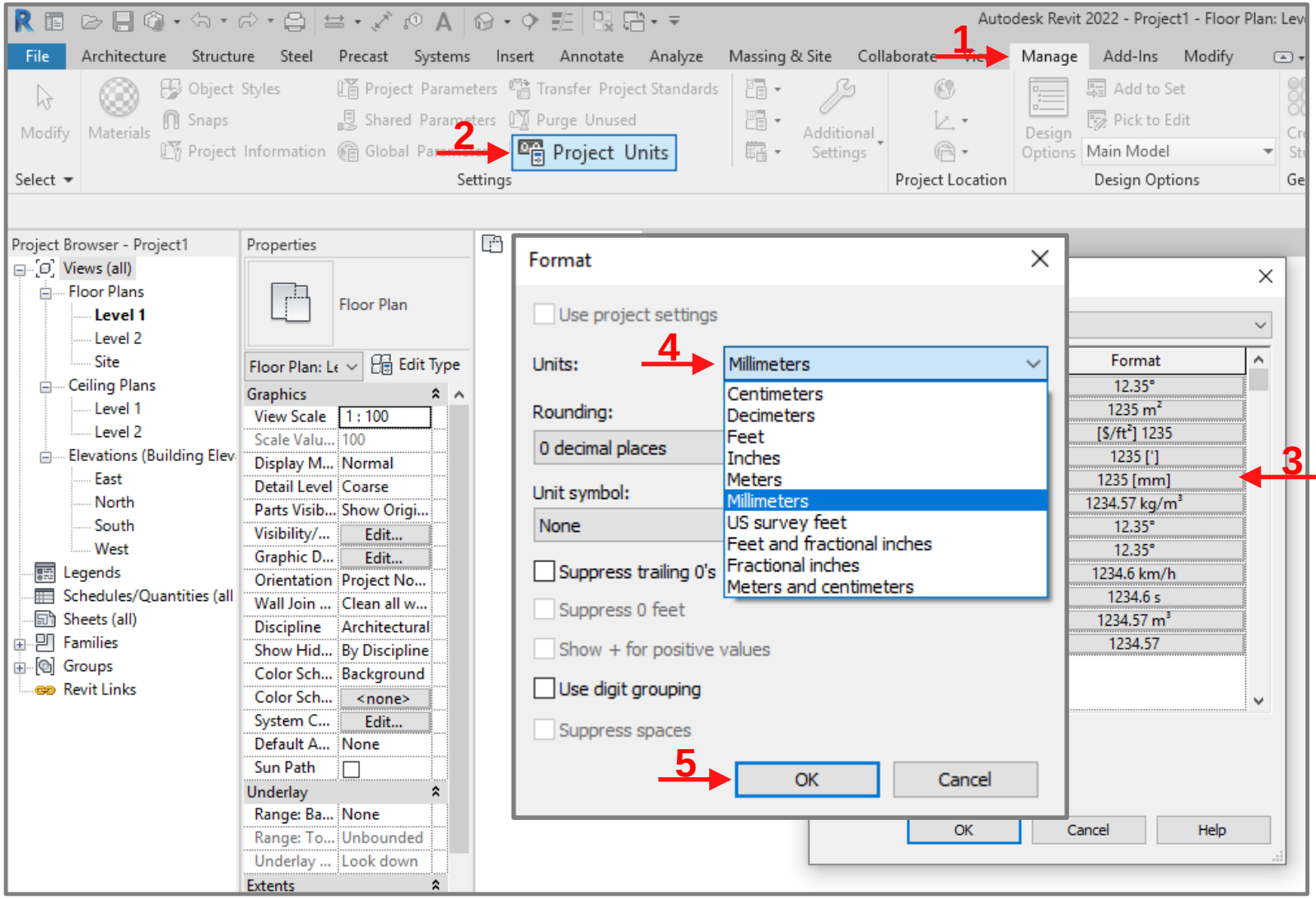
Revit Working Environment



Select/ Remove Working Environment Components

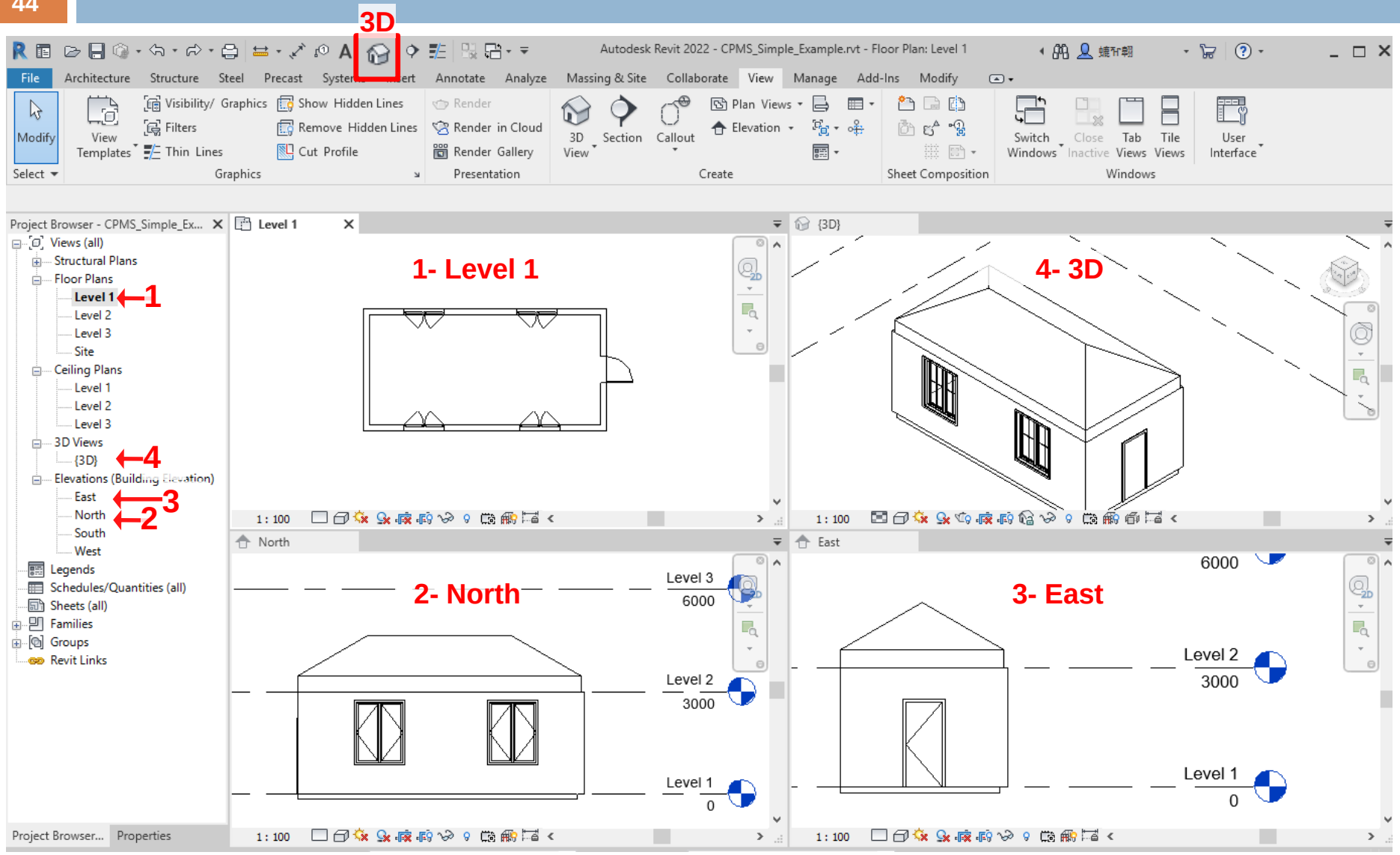


Adjust Model Units

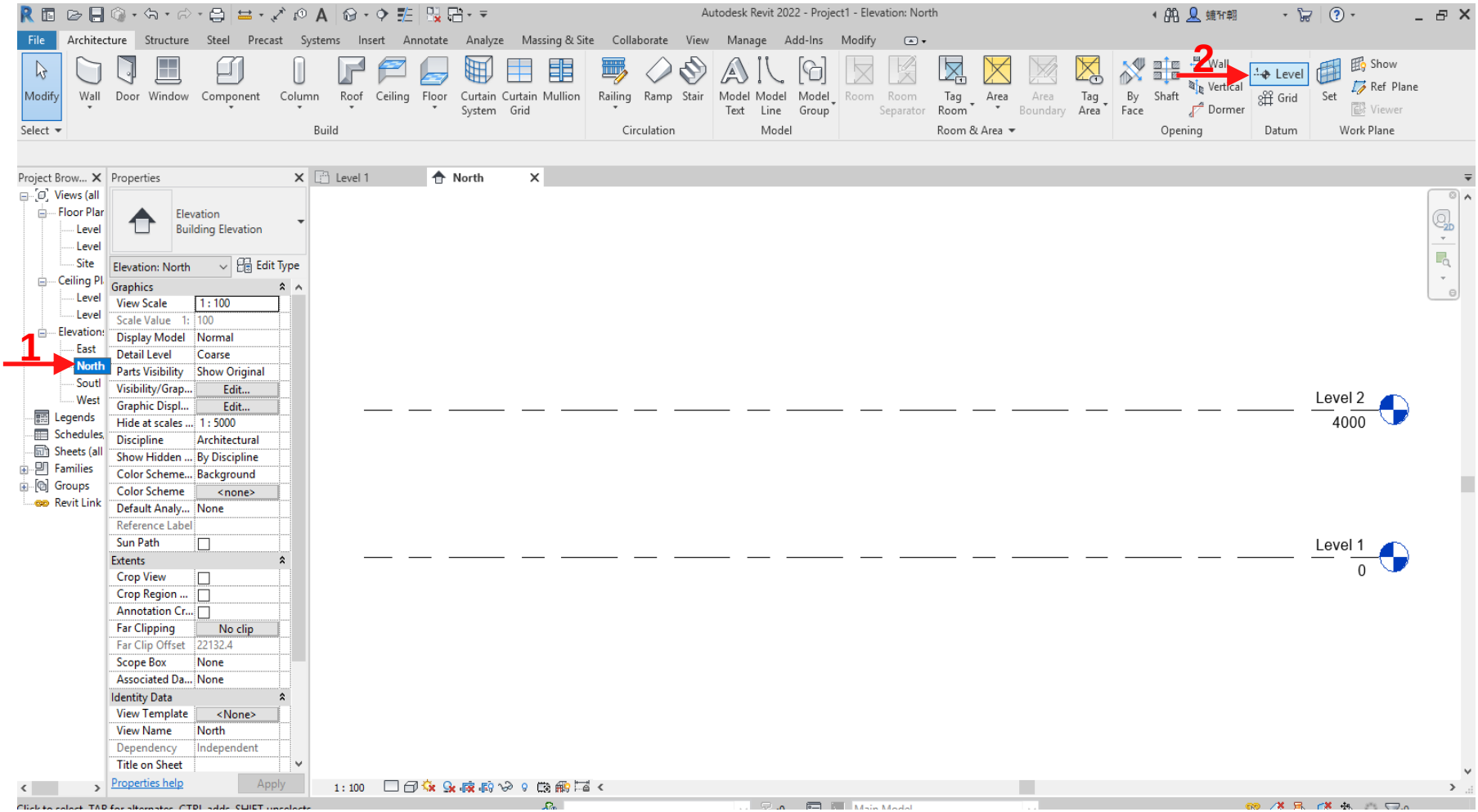


Introduction to Revit-Architecture

Working with Model Views



Levels


Autodesk Revit 2022 - Project1 - Elevation: North
File
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Reference Label
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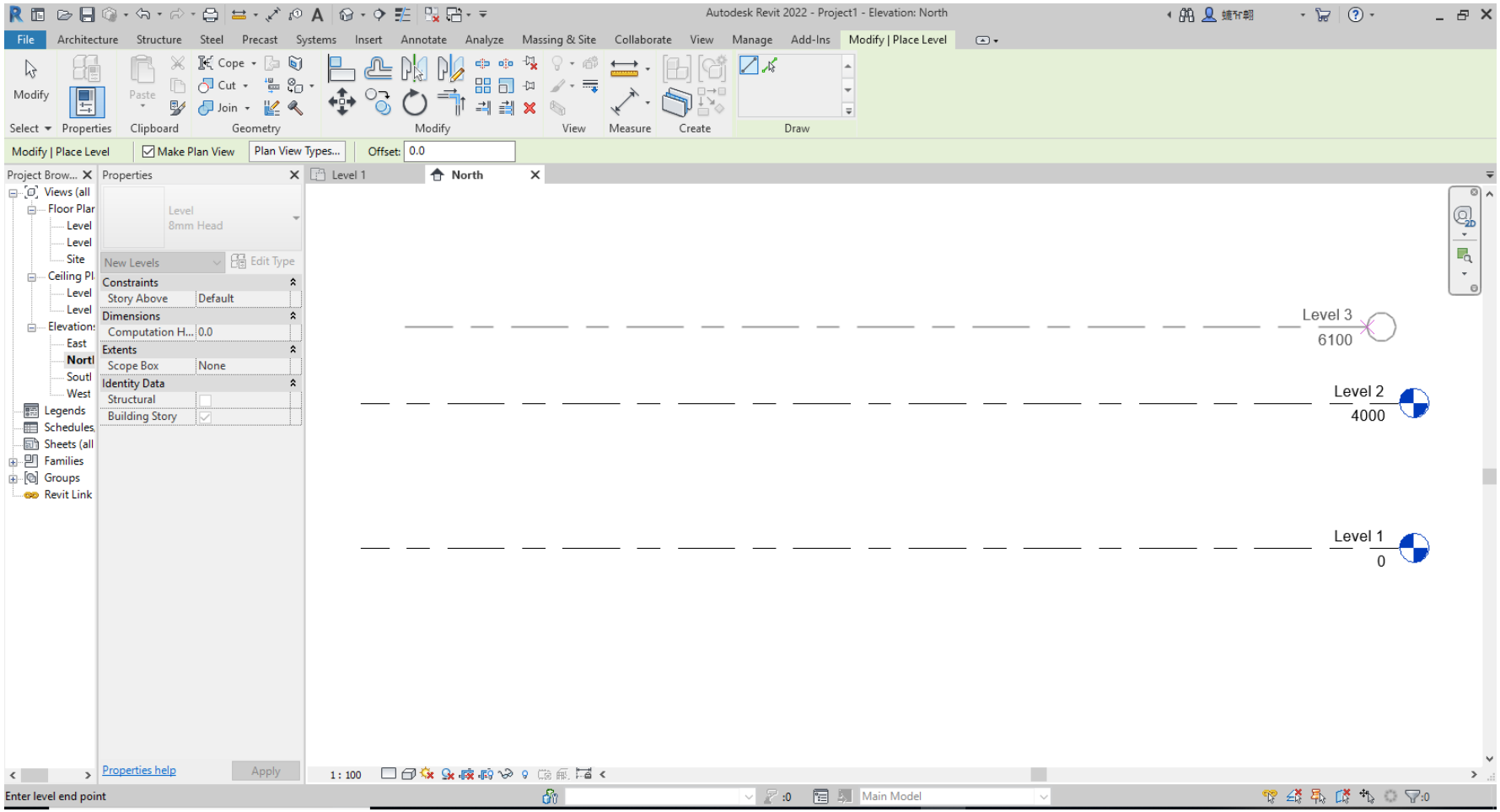
Levels


Autodesk Revit 2022 - Project1 - Elevation: North
File
Architecture
Structure
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Systems
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Manage
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Site
Ceiling Pl
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Story Above
Default
Dimensions
Computation H...
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Level 1
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Level 2
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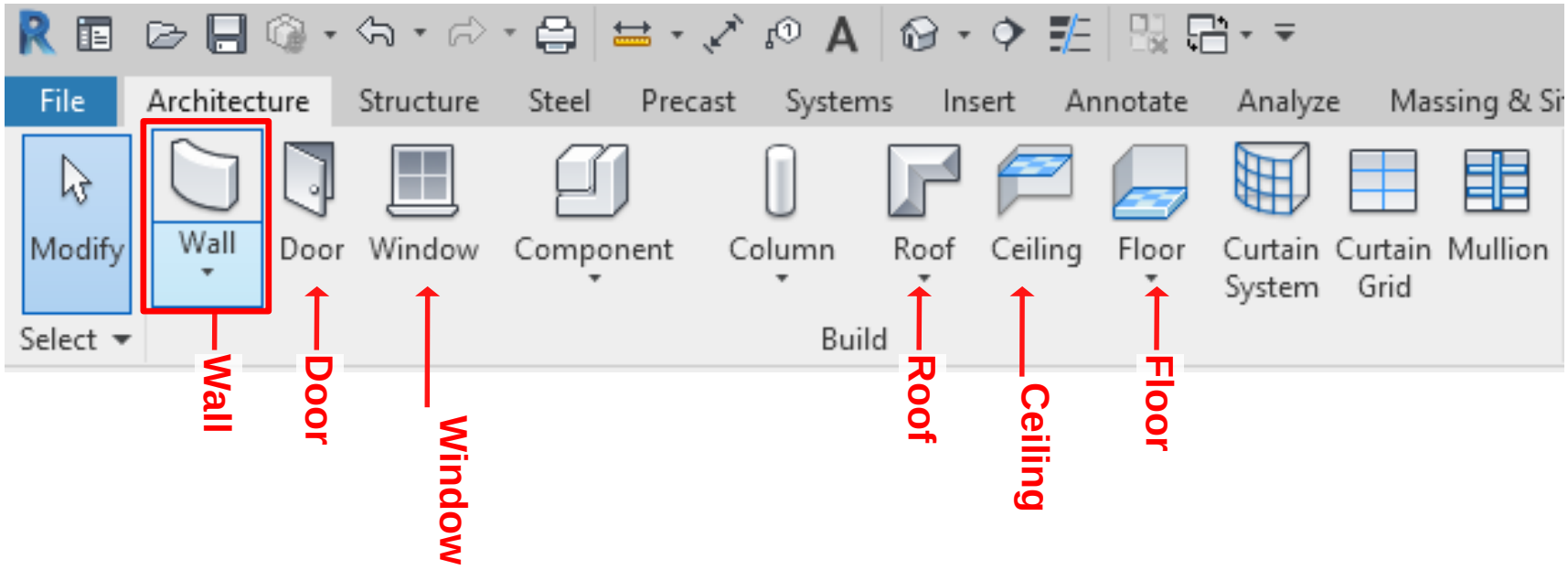
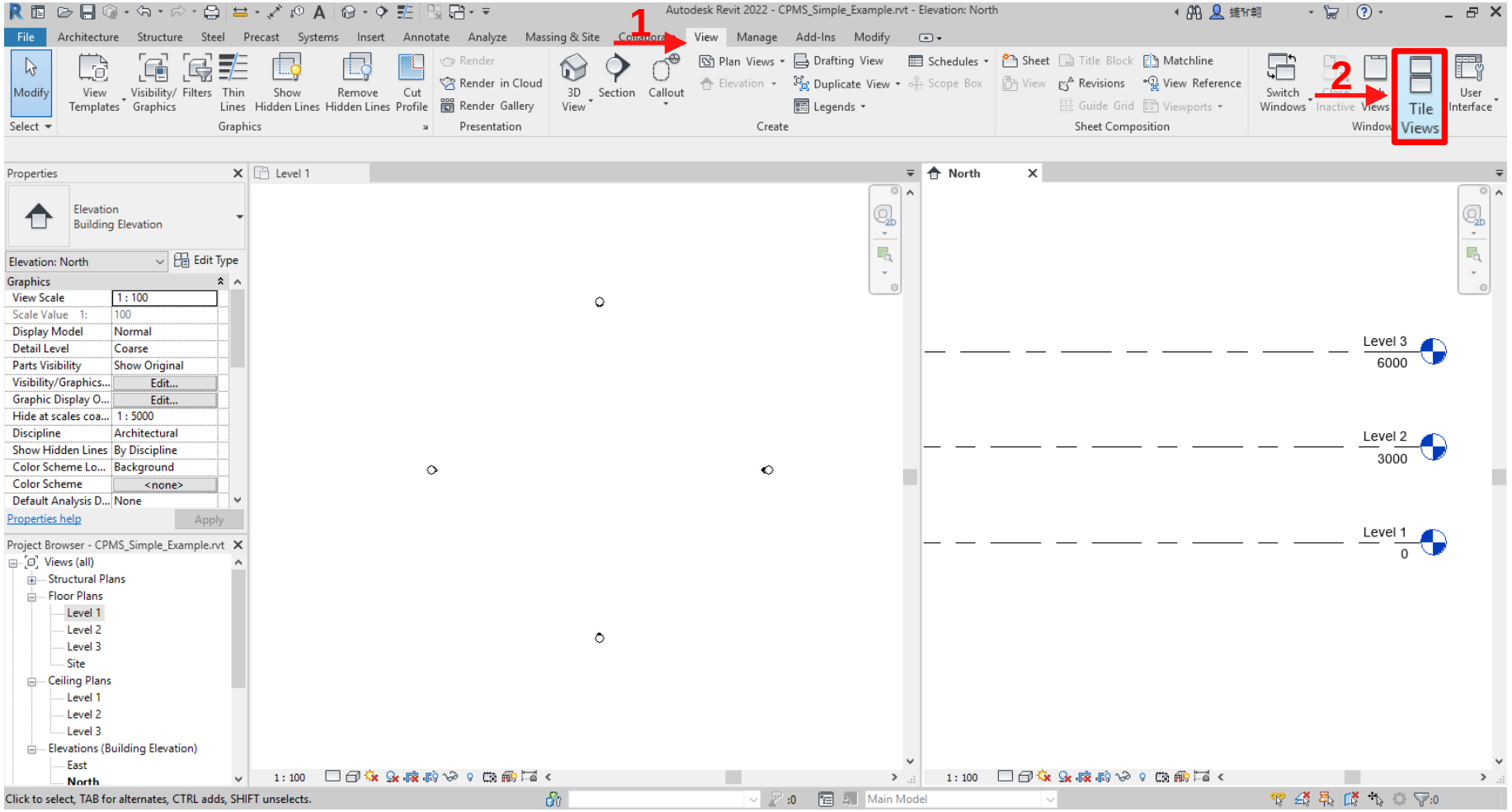
Enter level end point
Main Model

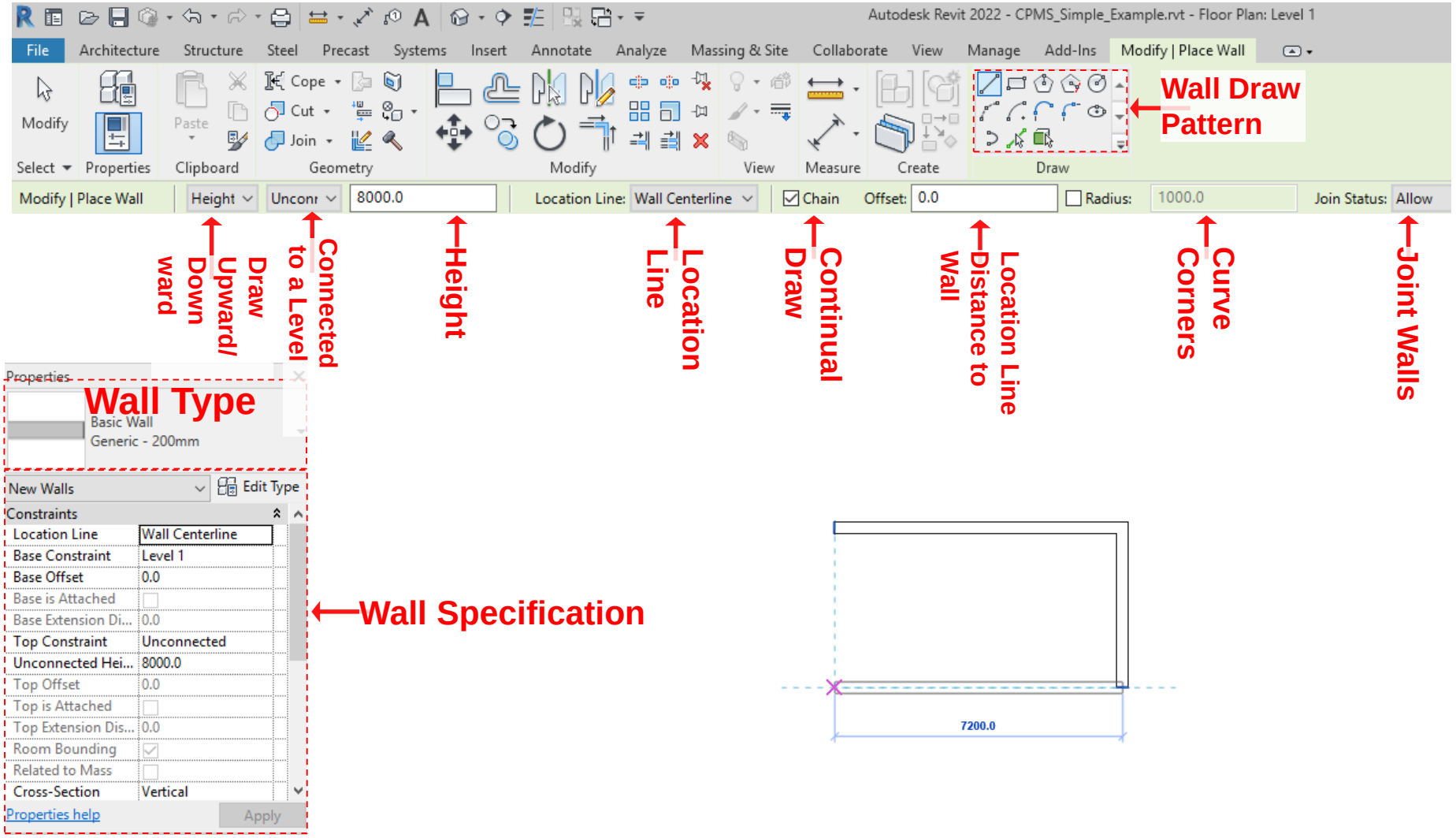
Basic Architecture Model Objects



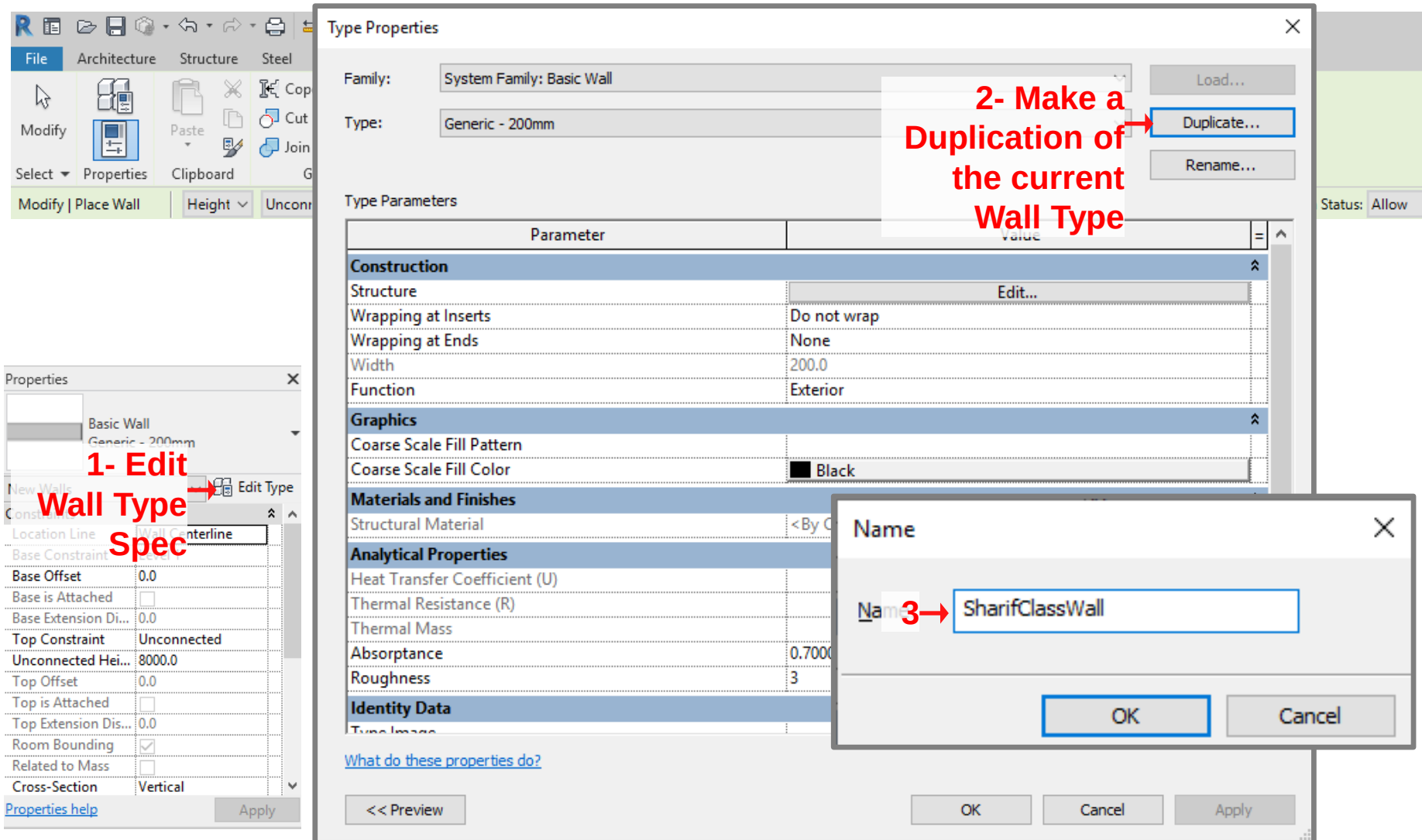
Split Work Environment



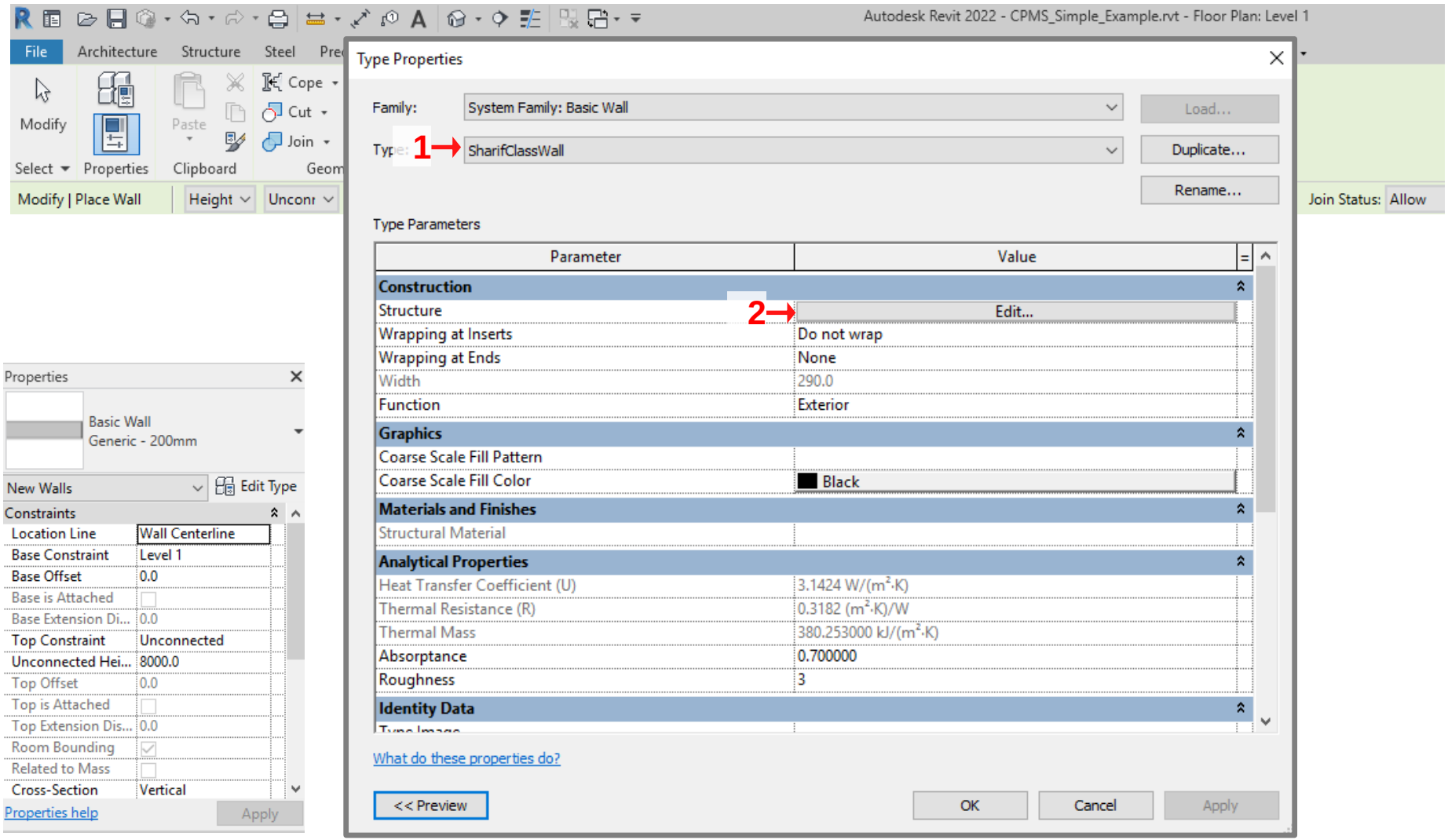
Architectural Wall



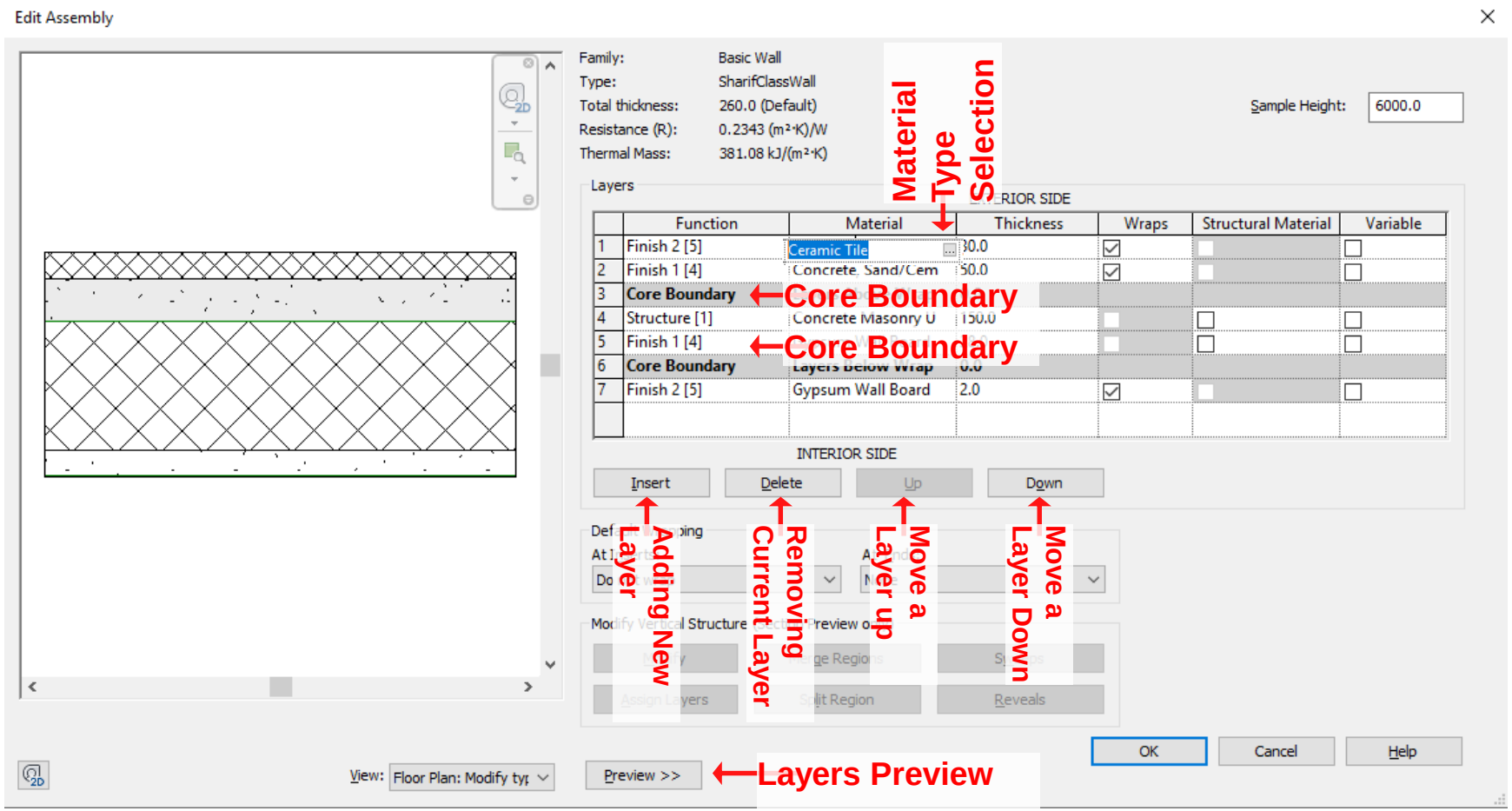
Architectural Wall



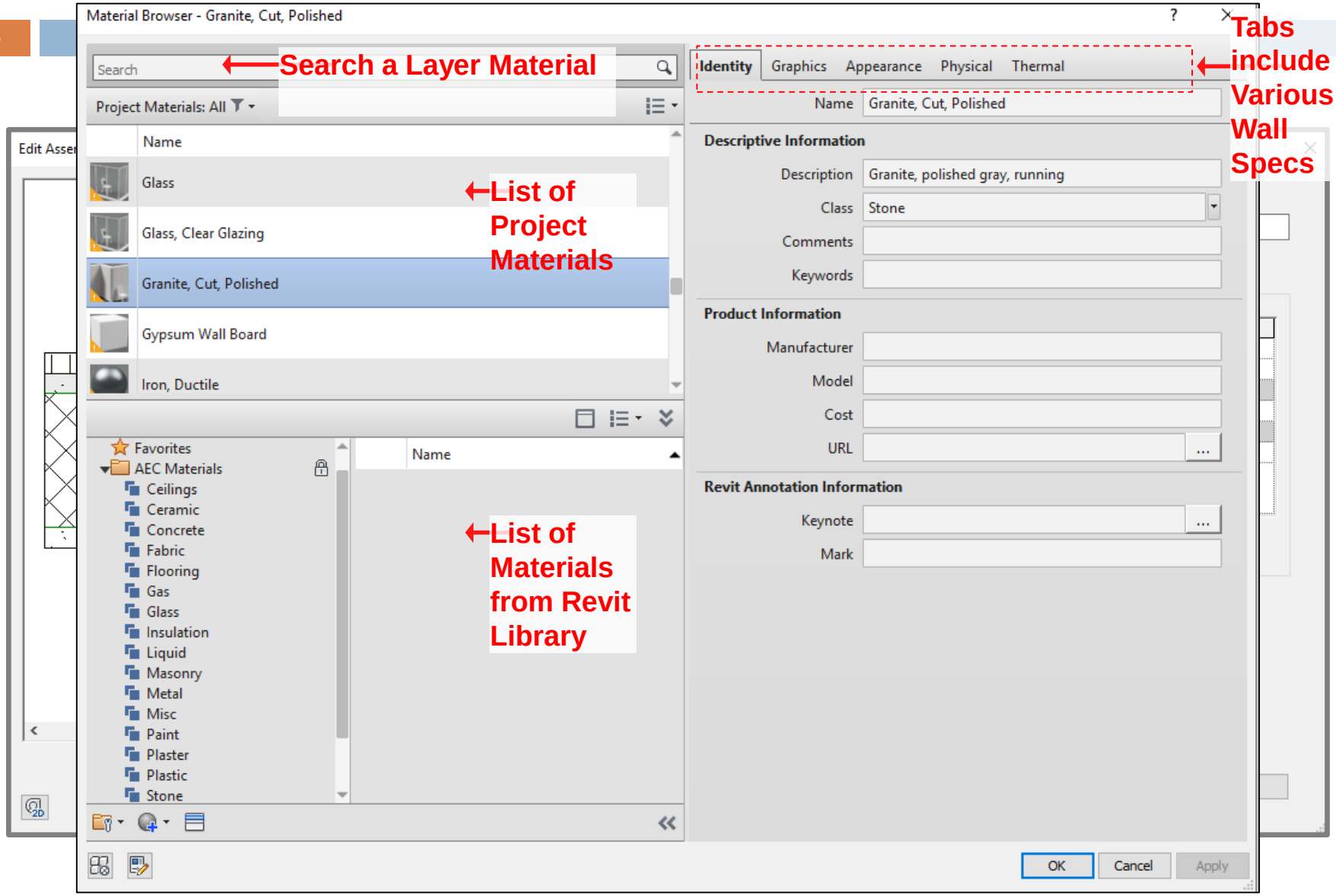
Architectural Wall



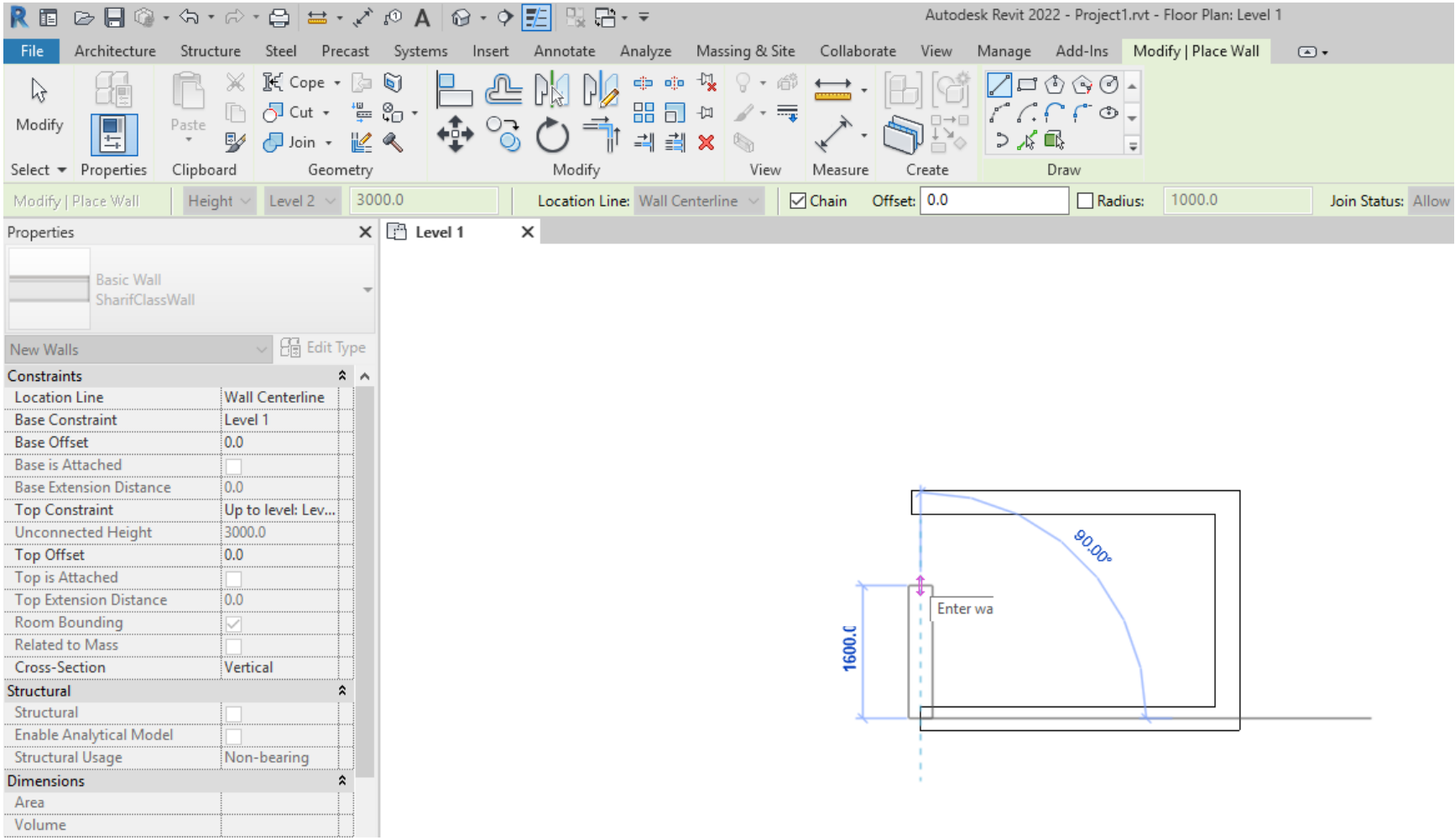
Architectural Wall



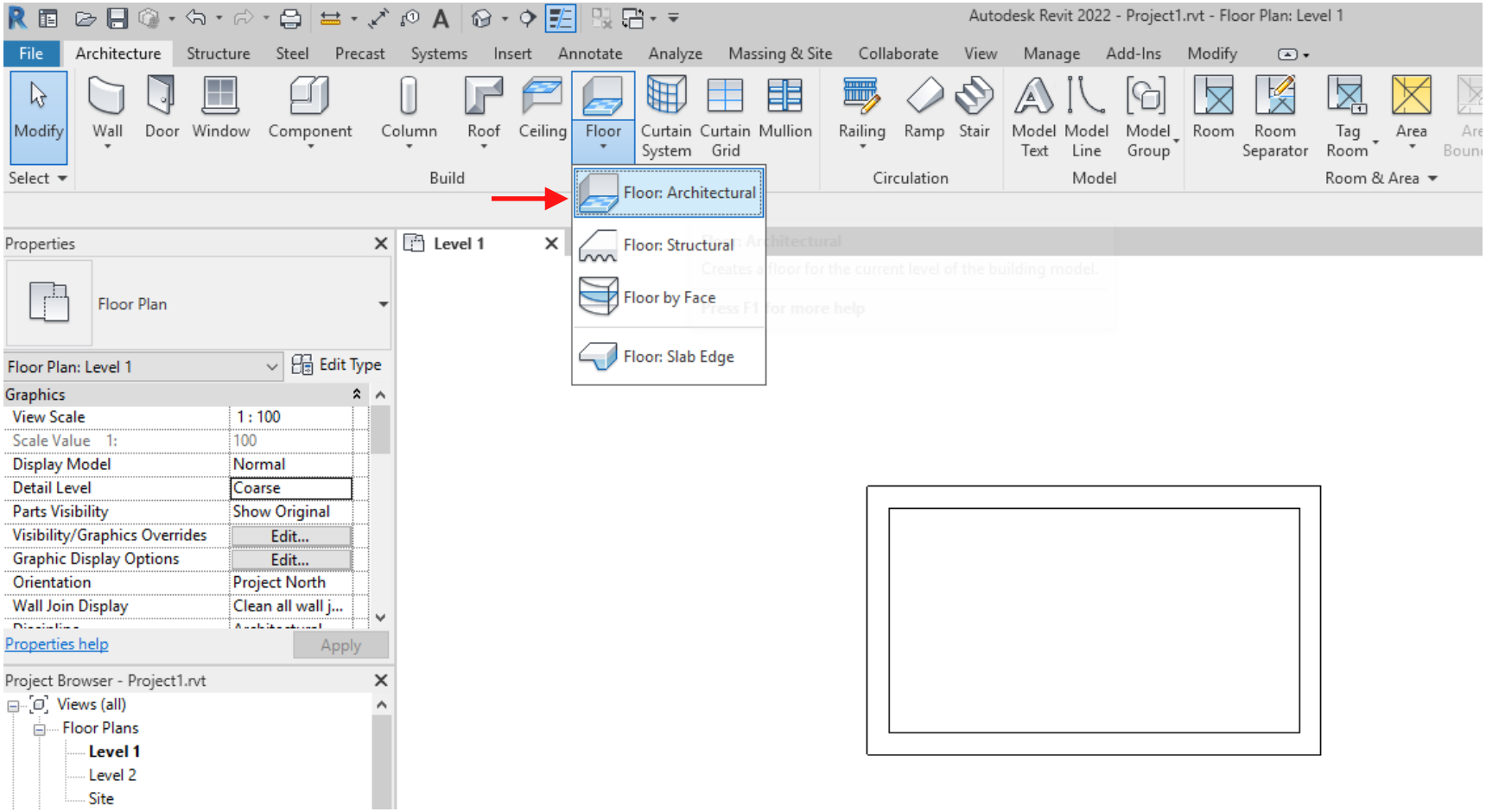
Architectural Wall



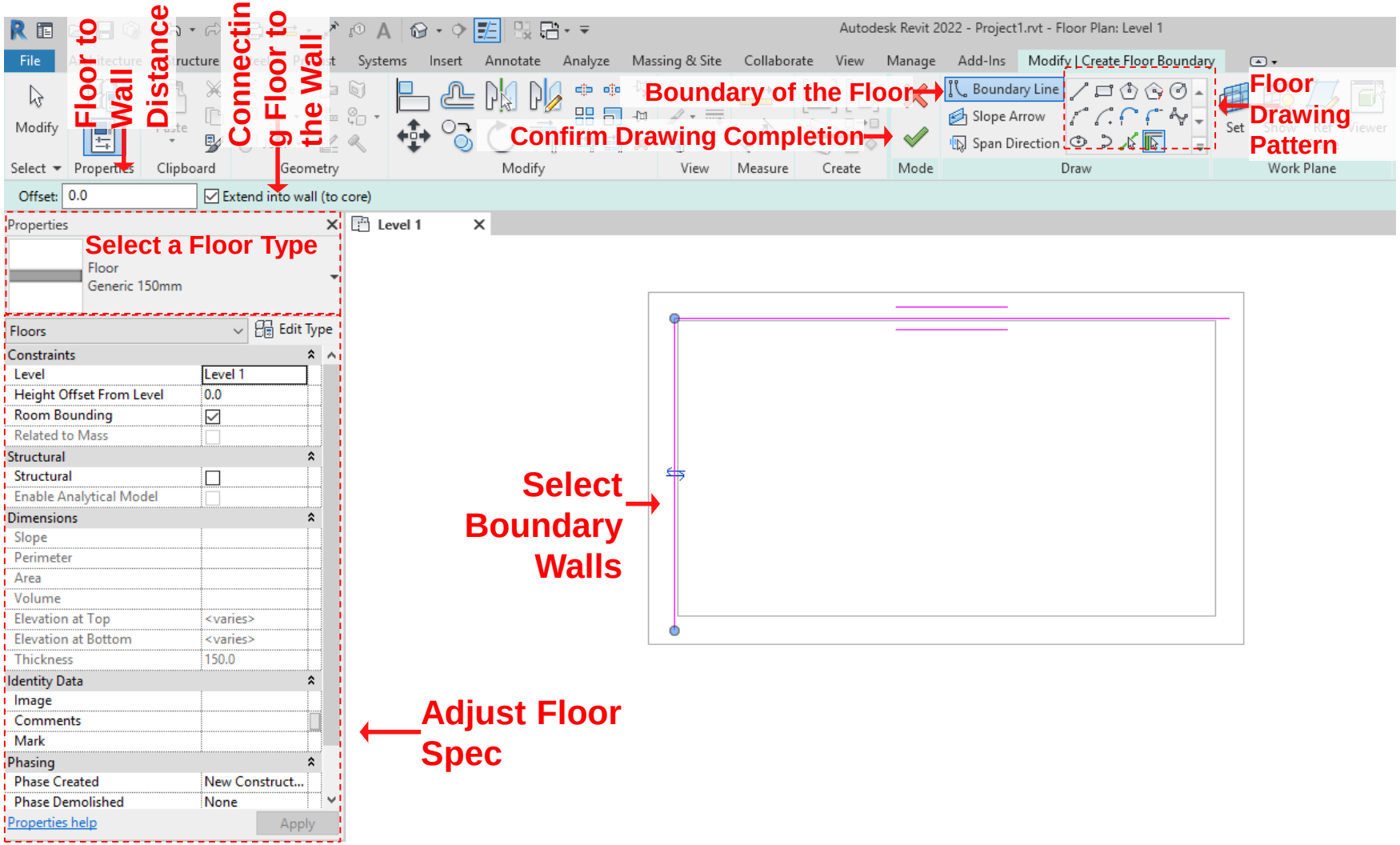
Architectural Wall



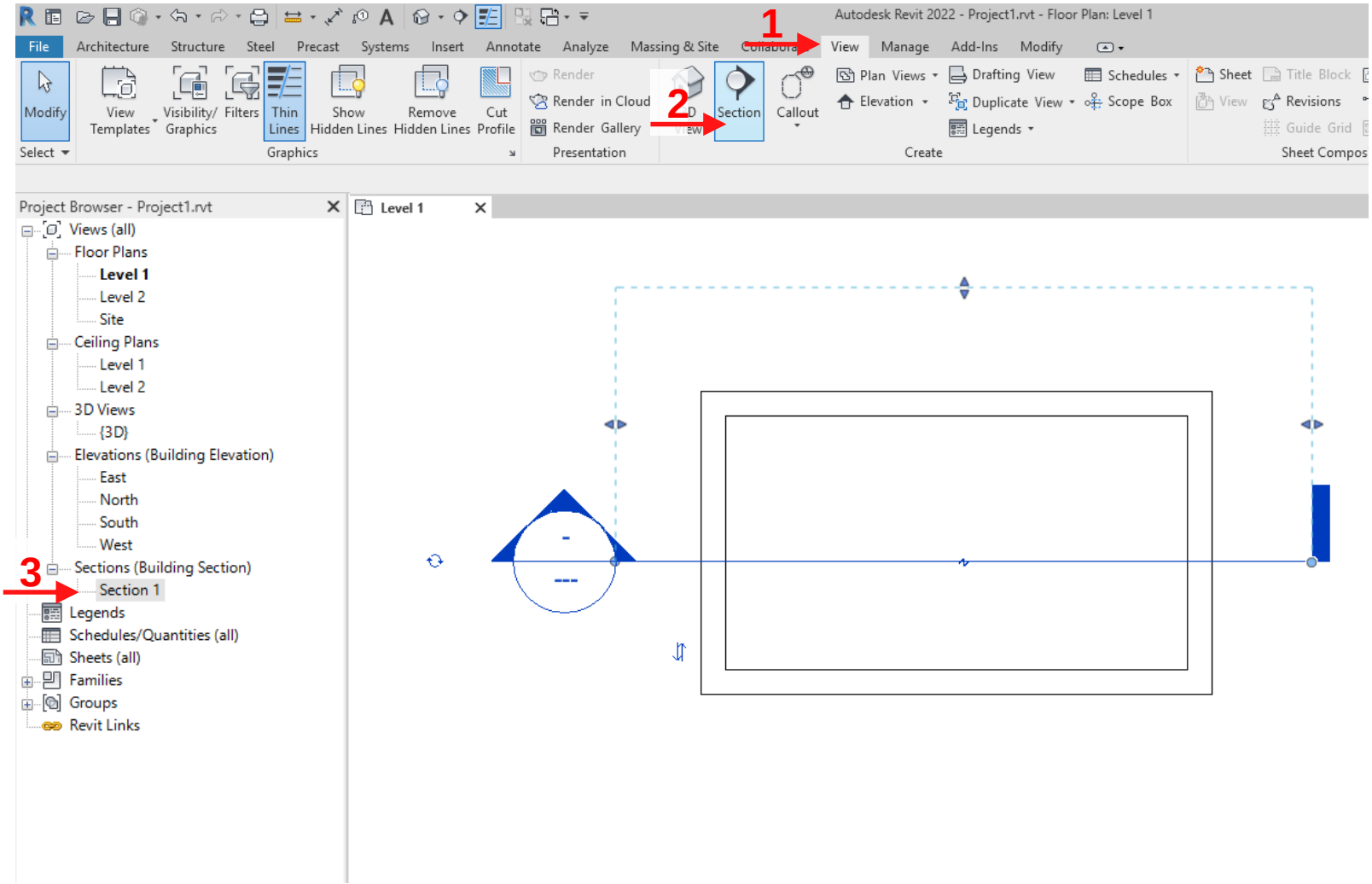
Floor Modeling



Floor Modeling



2D-Sections


1
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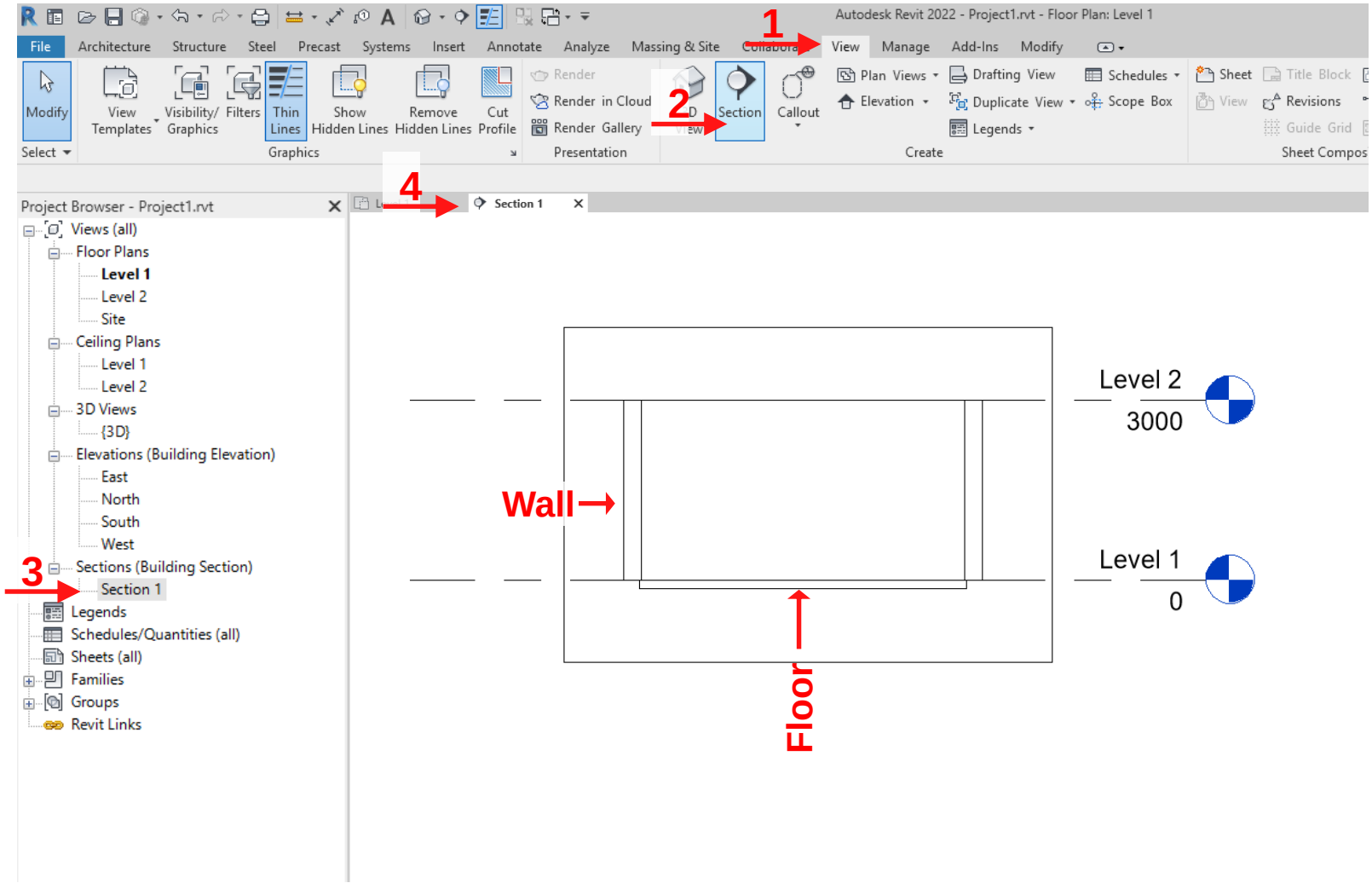
Autodesk Revit 2022 - Project1.rvt - Floor Plan: Level 1
File
Architecture
Structure
Steel
Precast
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Modify
View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
Remove Hidden Lines
Cut Profile
Render
Render in Cloud
Render Gallery
Section
Callout
Plan Views
Elevation
Drafting View
Duplicate View
Legends
Schedules
Scope Box
Sheet
View
Title Block
Revisions
Guide Grid
Select
Graphics
Presentation
Create
Sheet Compos
Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
{3D}
Elevations (Building Elevation)
East
North
South
West
Sections (Building Section)
Section 1
Legends
Schedules/Quantities (all)
Sheets (all)
Families
Groups
Revit Links
Level 1

2D-Sections


Autodesk Revit 2022 - Project1.rvt - Floor Plan: Level 1
File
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Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Modify
View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
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Render Gallery
Section
Callout
Plan Views
Elevation
Drafting View
Duplicate View
Legends
Schedules
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Title Block
Revisions
Guide Grid
Select
Graphics
Presentation
Create
Sheet Compos
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Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
{3D}
Elevations (Building Elevation)
East
North
South
West
Sections (Building Section)
Section 1
Legends
Schedules/Quantities (all)
Sheets (all)
Families
Groups
Revit Links
Section 1
Level 2
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Level 1
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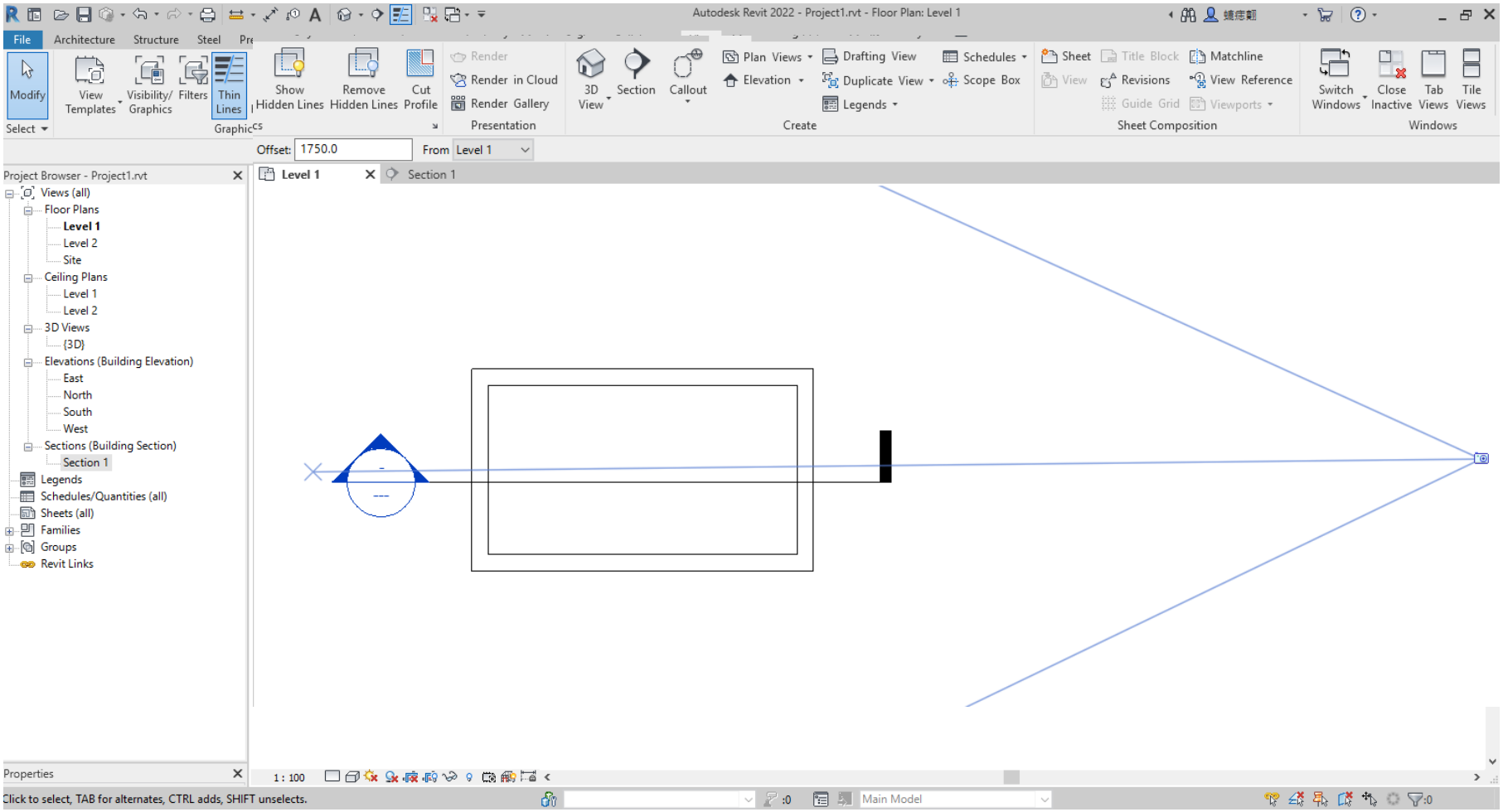
Wall
Floor

3D-Sections


Autodesk Revit 2022 - Project1.rvt - Floor Plan: Level 1
File
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View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
Remove Hidden Lines
Cut Profile
Render
Render in Cloud
Render Gallery
3D View
Section
Callout
Plan Views
Elevation
Drafting View
Duplicate View
Legends
Schedules
Scope Box
Sheet
View
Title Block
Revisions
Guide Grid
Matchline
View Reference
Viewports
Switch Windows
Close Inactive
Tab Views
Tile Views
Select
Graphics
Presentation
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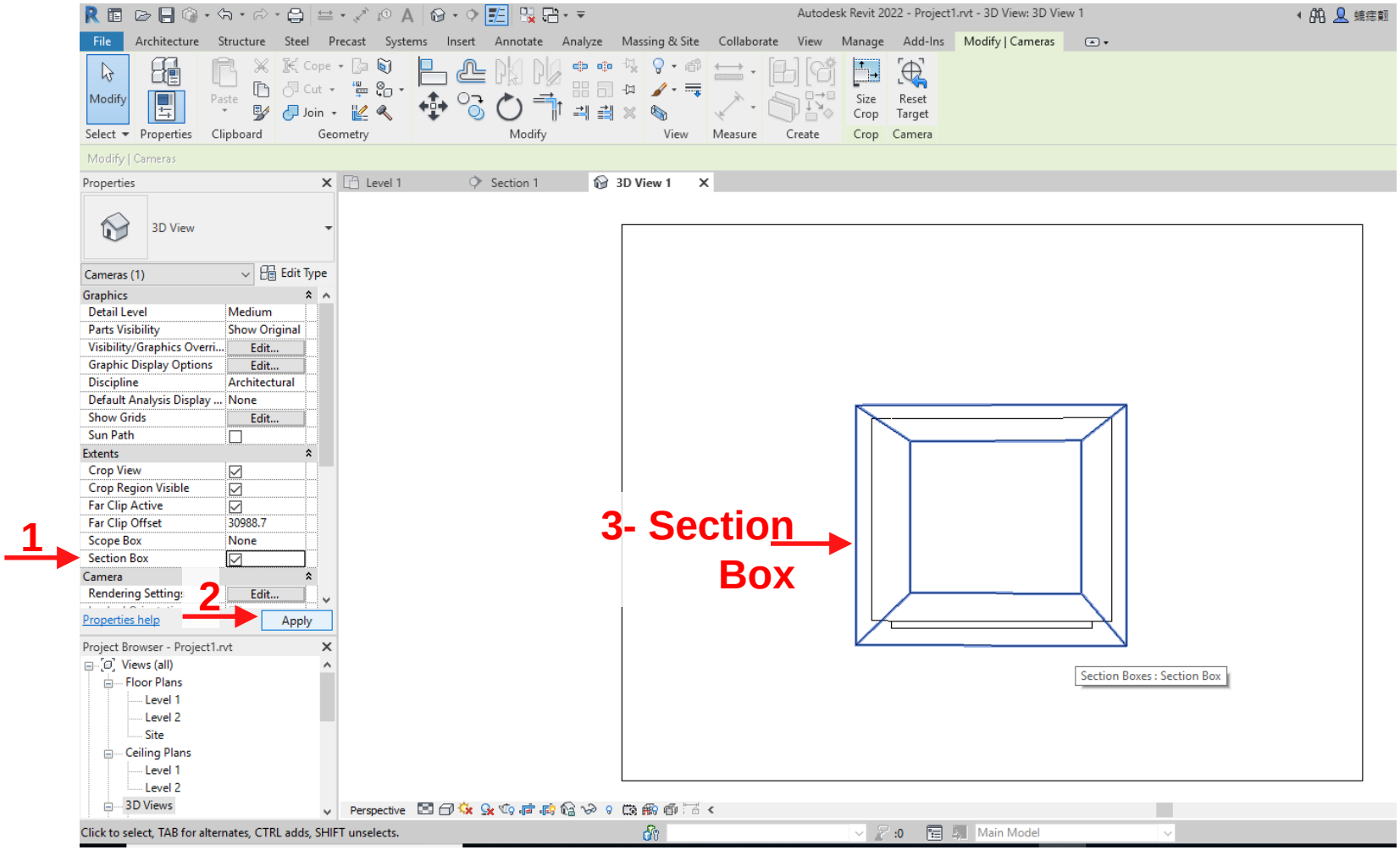
Sheet Composition
Windows
Offset: 1750.0
From Level 1
Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
{3D}
Elevations (Building Elevation)
East
North
South
West
Sections (Building Section)
Section 1
Legends
Schedules/Quantities (all)
Sheets (all)
Families
Groups
Revit Links
Level 1
Section 1
Properties
1 : 100
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.
Main Model

3D-Sections


Autodesk Revit 2022 - Project1.rvt - 3D View: 3D View 1
File
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Steel
Precast
Systems
Insert
Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify | Cameras
Modify
Select
Properties
Clipboard
Geometry
Modify
View
Measure
Create
Size Crop
Reset Target
Crop
Camera
Modify | Cameras
Properties
3D View
Cameras (1)
Edit Type
Graphics
Detail Level
Medium
Parts Visibility
Show Original
Visibility/Graphics Overri...
Edit...
Graphic Display Options
Edit...
Discipline
Architectural
Default Analysis Display ...
None
Show Grids
Edit...
Sun Path
Extents
Crop View
Crop Region Visible
Far Clip Active
Far Clip Offset
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Scope Box
None
Section Box
Camera
Rendering Setting:
Edit...
Properties help
Apply
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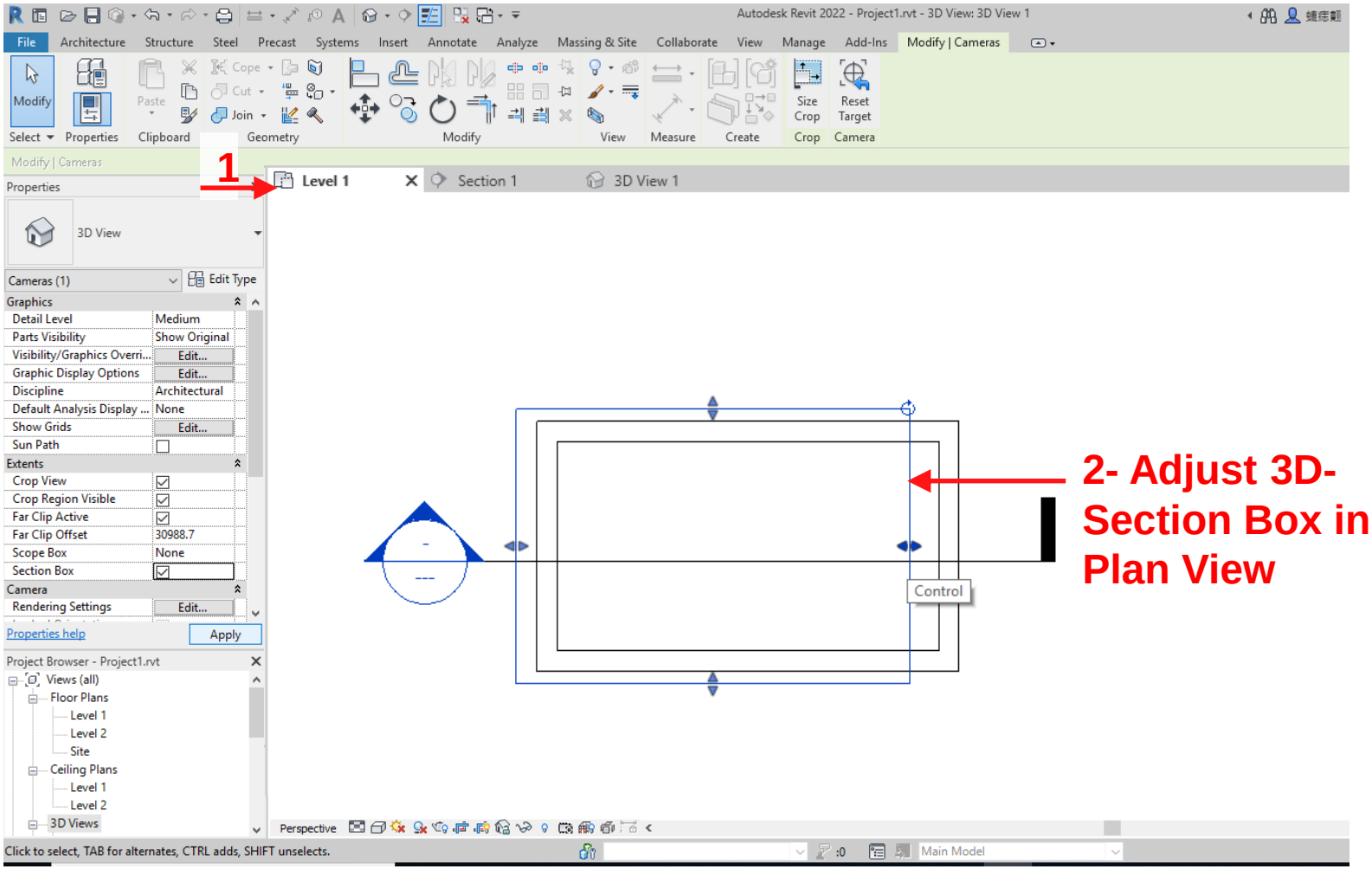
2
Level 1
Section 1
3D View 1
3- Section Box
Section Boxes : Section Box
Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
Perspective
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.
Main Model

3D-Sections


Autodesk Revit 2022 - Project1.rvt - 3D View: 3D View 1
File
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Massing & Site
Collaborate
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Join
Geometry
Modify
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Size Crop
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3D View
Cameras (1)
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Graphics
Detail Level
Medium
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Edit...
Discipline
Architectural
Default Analysis Display ...
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Show Grids
Edit...
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Extents
Crop View
Crop Region Visible
Far Clip Active
Far Clip Offset
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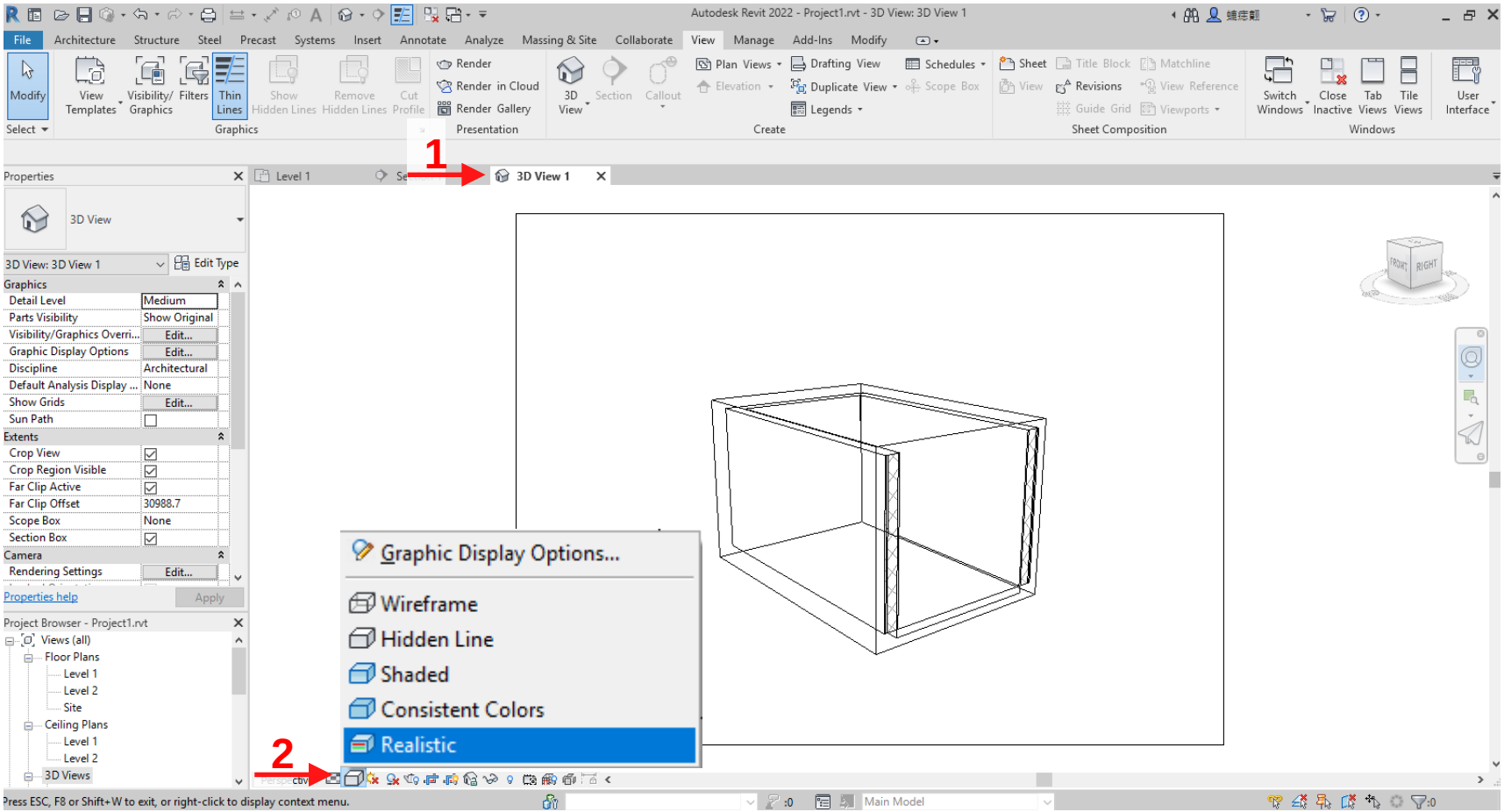
Scope Box
None
Section Box
Camera
Rendering Settings
Edit...
Properties help
Apply
Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
Level 1
Section 1
3D View 1
Control
2- Adjust 3D-Section Box in Plan View
Perspective
Click to select, TAB for alternates, CTRL adds, SHIFT unselects.
Main Model

3D-Sections


Autodesk Revit 2022 - Project1.rvt - 3D View: 3D View 1
File
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Precast
Systems
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Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Modify
View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
Remove Hidden Lines
Cut Profile
Render
Render in Cloud
Render Gallery
3D View
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Callout
Plan Views
Elevation
Drafting View
Duplicate View
Legends
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Scope Box
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Title Block
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Guide Grid
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View Reference
Viewports
Switch Windows
Close Inactive
Tab Views
Tile Views
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Sheet Composition
Windows
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Edit...
Discipline
Architectural
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Show Grids
Edit...
Sun Path
Extents
Crop View
Crop Region Visible
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Far Clip Offset
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Scope Box
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Section Box
Camera
Rendering Settings
Edit...
Properties help
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Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
Level 1
3D View 1
Graphic Display Options...
Wireframe
Hidden Line
Shaded
Consistent Colors
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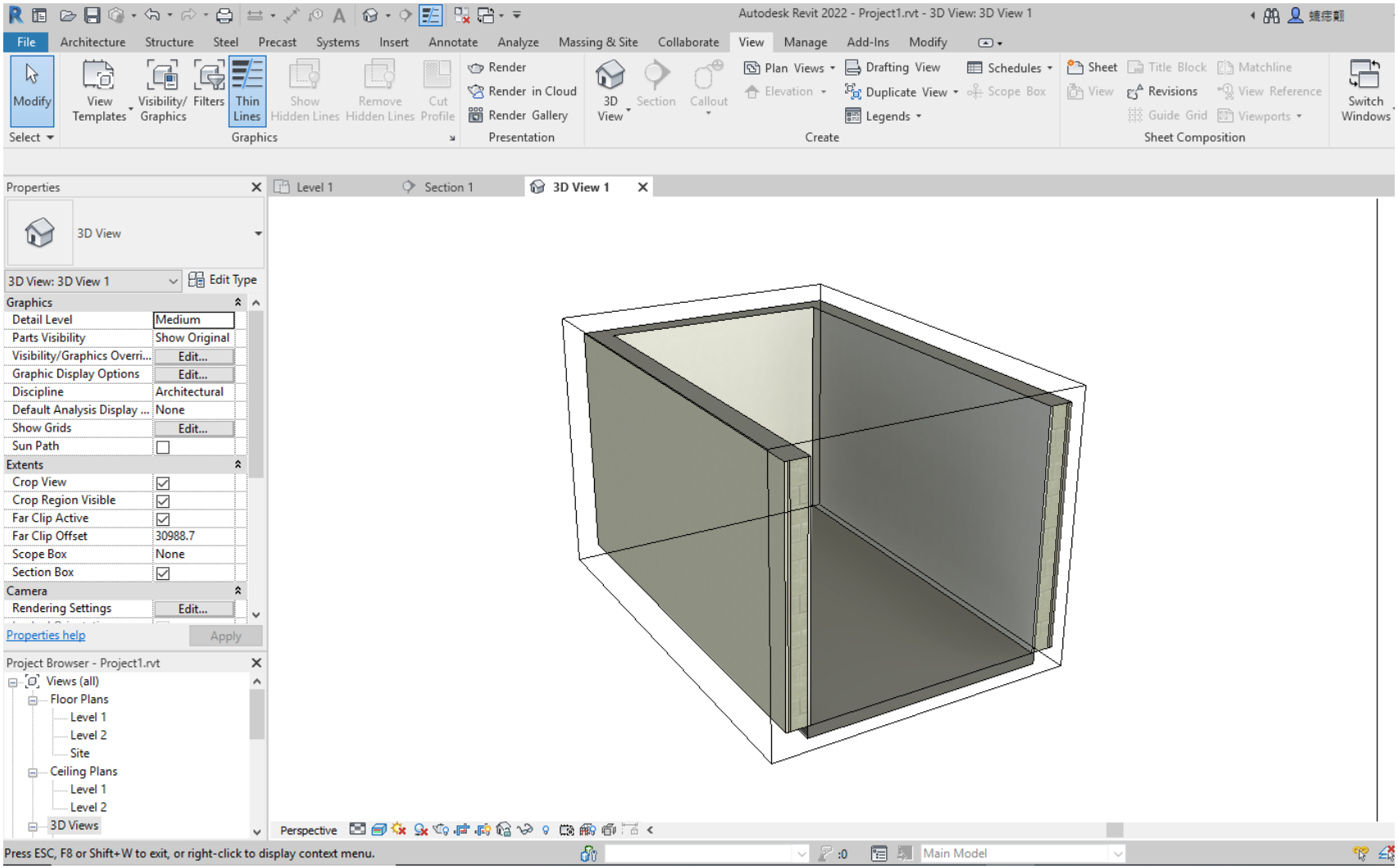
RIGHT
Press ESC, F8 or Shift+W to exit, or right-click to display context menu.
Main Model

3D-Sections


Autodesk Revit 2022 - Project1.rvt - 3D View: 3D View 1
File
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Steel
Precast
Systems
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Annotate
Analyze
Massing & Site
Collaborate
View
Manage
Add-Ins
Modify
Modify
View Templates
Visibility/ Graphics
Filters
Thin Lines
Show Hidden Lines
Remove Hidden Lines
Cut Profile
Render
Render in Cloud
Render Gallery
3D View
Section
Callout
Plan Views
Elevation
Drafting View
Duplicate View
Legends
Schedules
Scope Box
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Title Block
Revisions
Guide Grid
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View Reference
Viewports
Switch Windows
Select
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Presentation
Create
Sheet Composition
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3D View
3D View: 3D View 1
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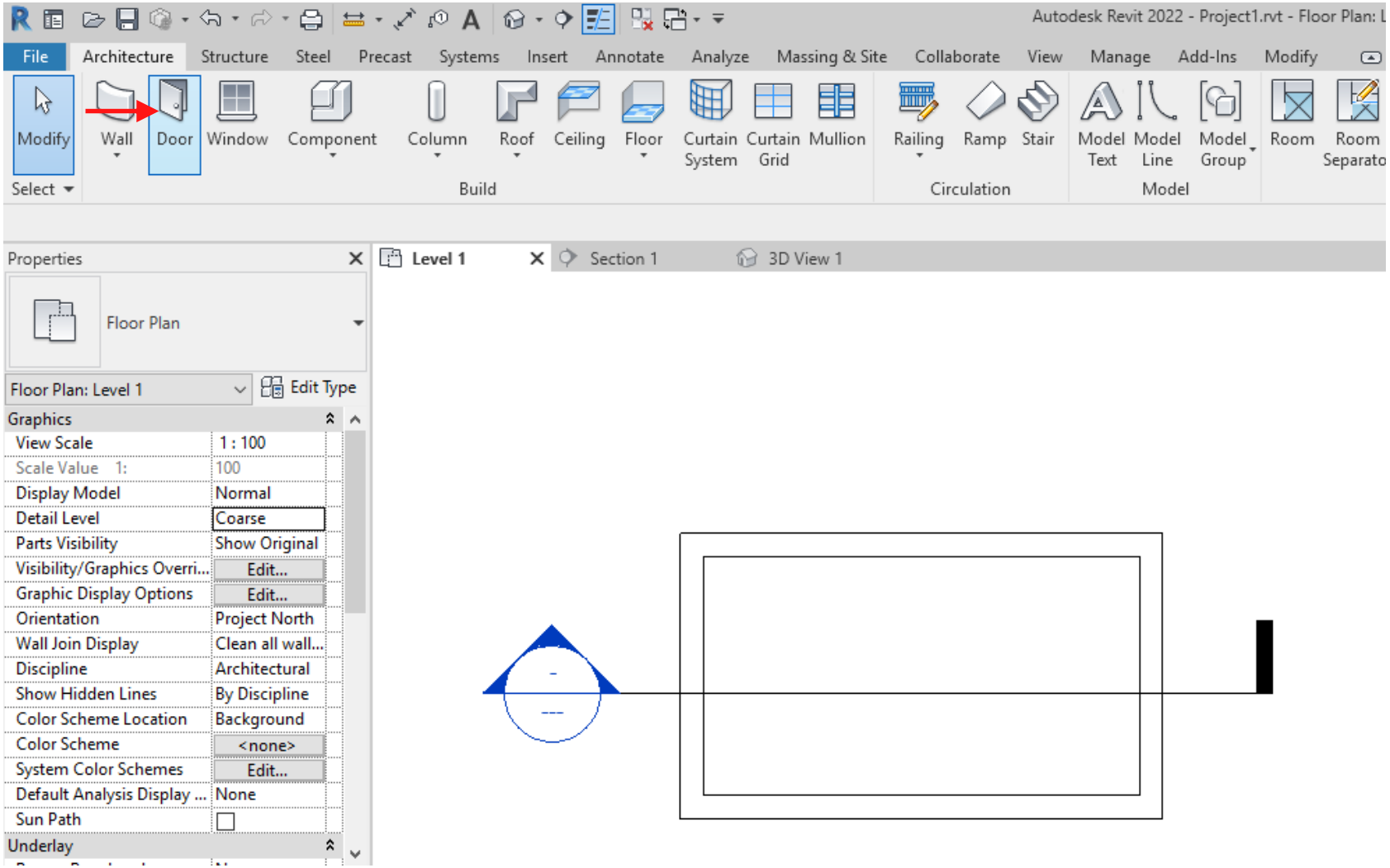
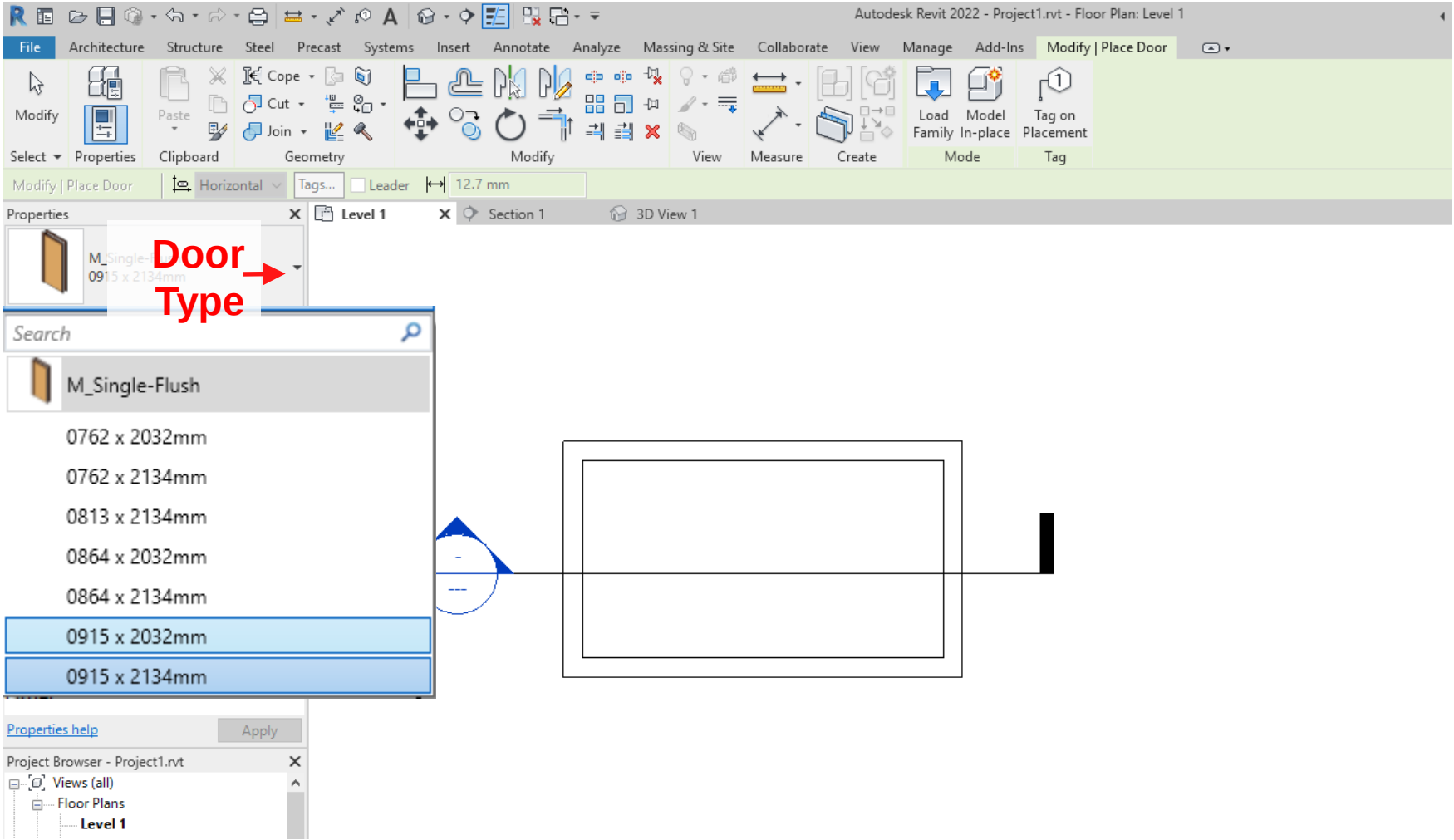
Medium
Parts Visibility
Show Original
Visibility/Graphics Overri...
Edit...
Graphic Display Options
Edit...
Discipline
Architectural
Default Analysis Display ...
None
Show Grids
Edit...
Sun Path
Extents
Crop View
Crop Region Visible
Far Clip Active
Far Clip Offset
30988.7
Scope Box
None
Section Box
Camera
Rendering Settings
Edit...
Properties help
Apply
Project Browser - Project1.rvt
Views (all)
Floor Plans
Level 1
Level 2
Site
Ceiling Plans
Level 1
Level 2
3D Views
Level 1
Section 1
3D View 1
Perspective
Press ESC, F8 or Shift+W to exit, or right-click to display context menu.
Main Model

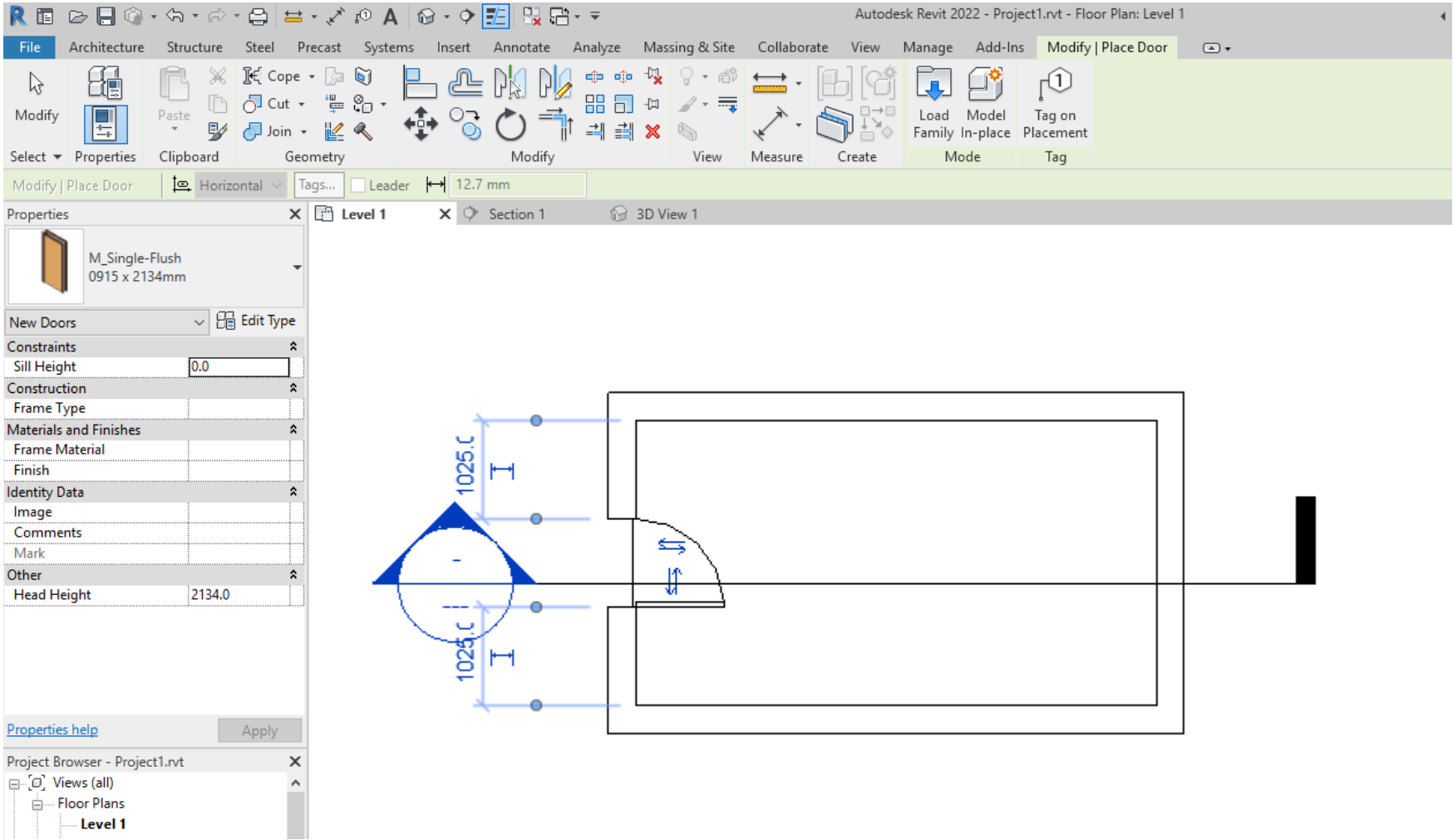
Drawing Doors



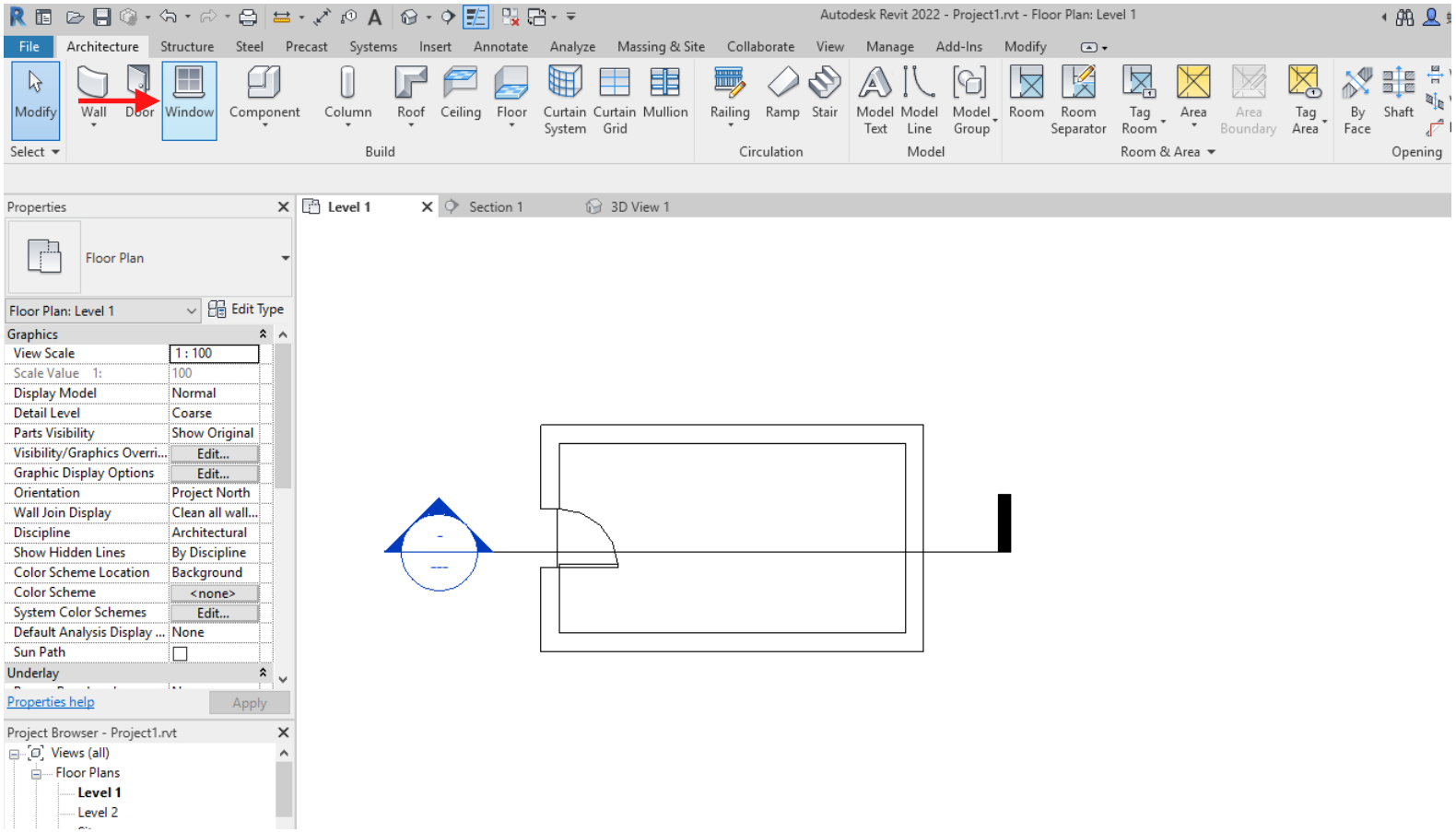
Drawing Doors



Drawing Doors



Drawing Window



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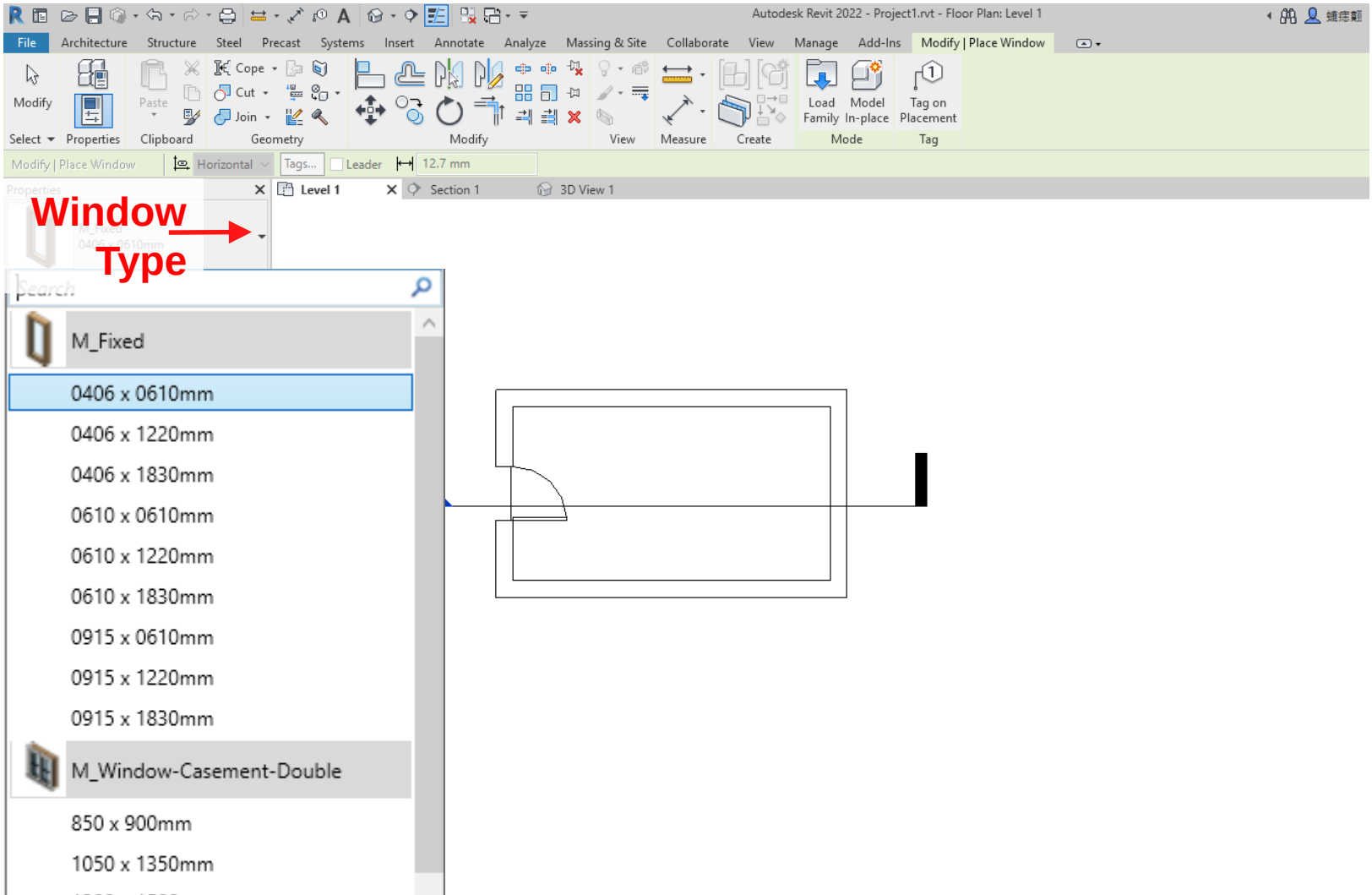

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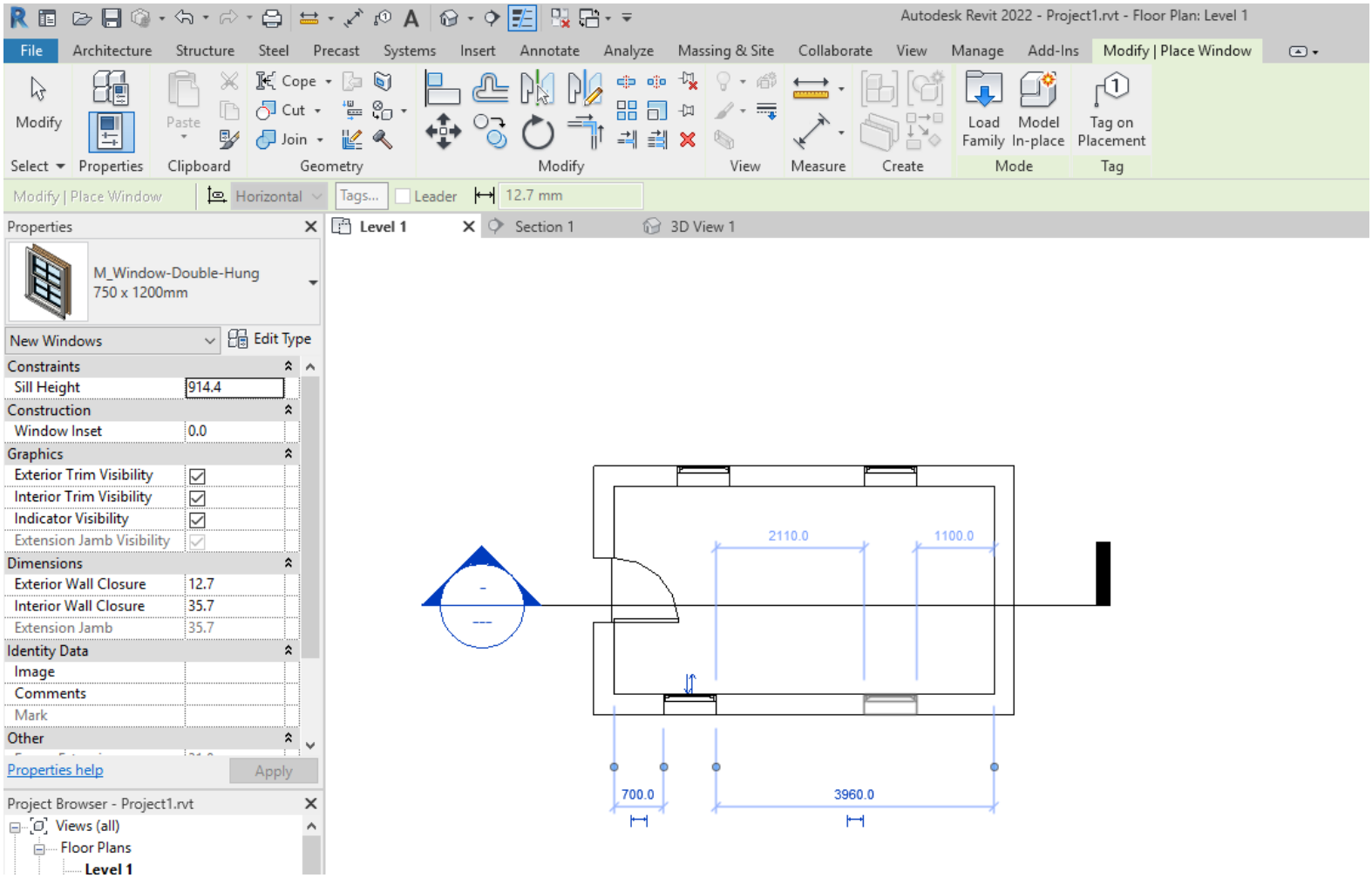
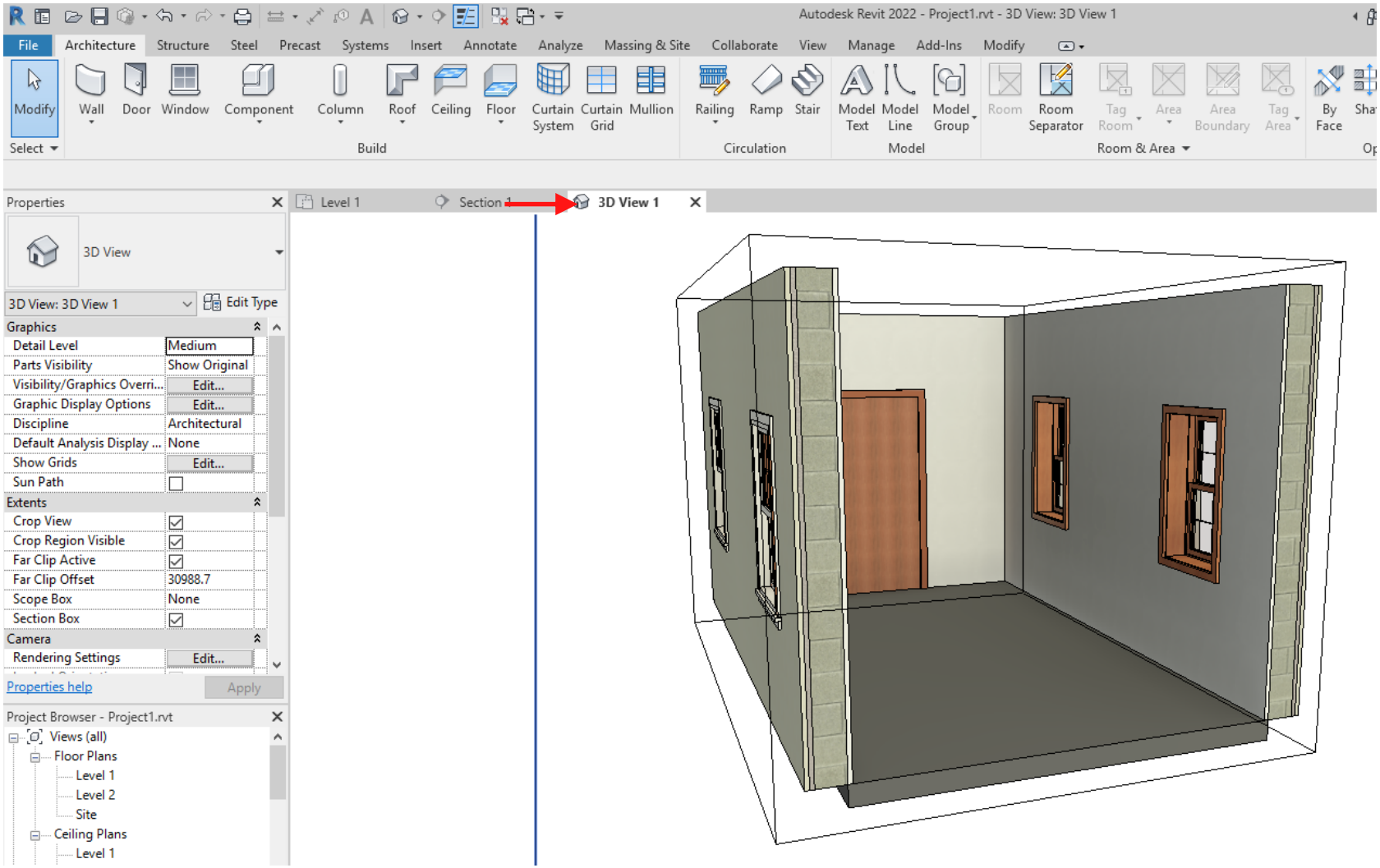
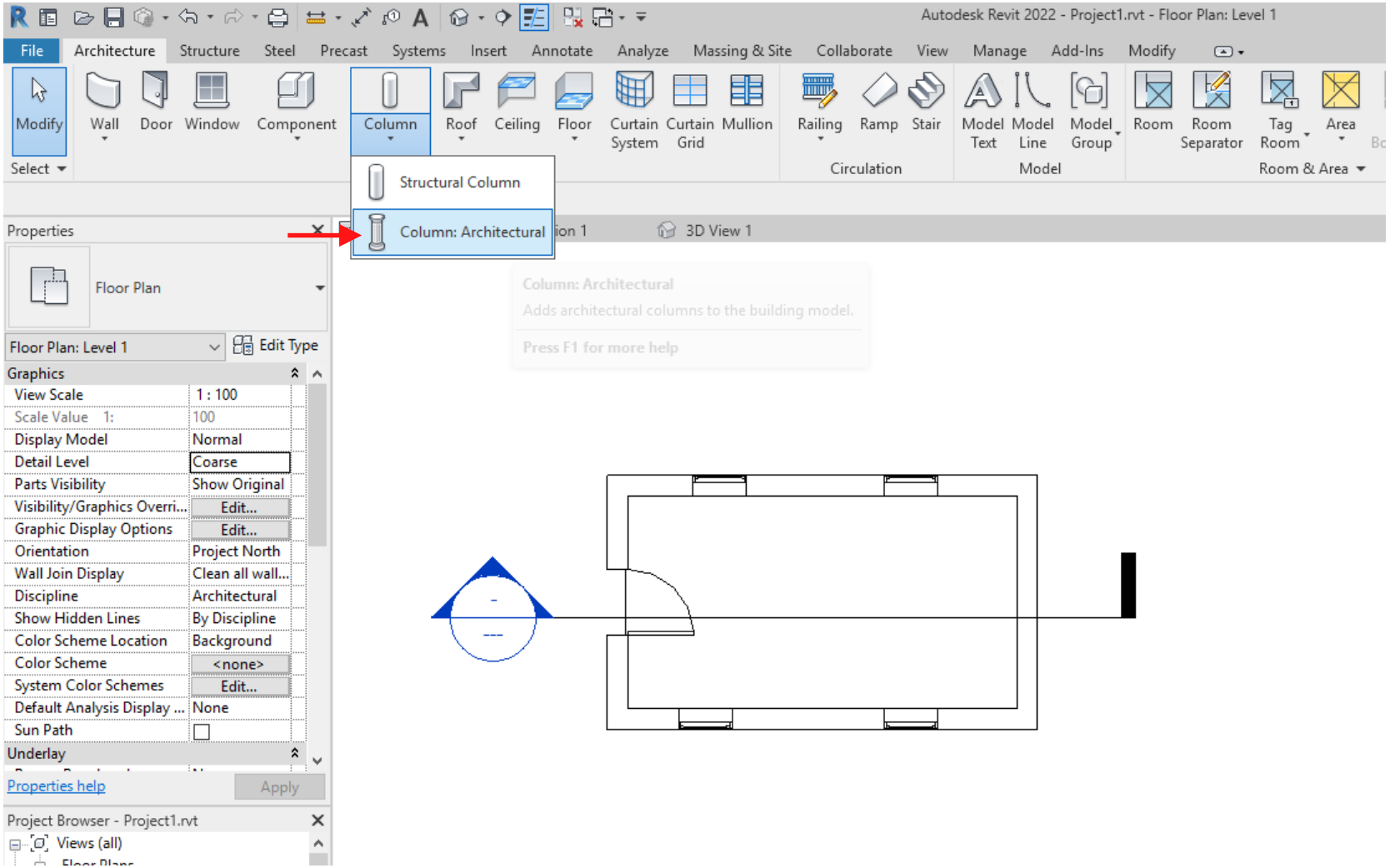


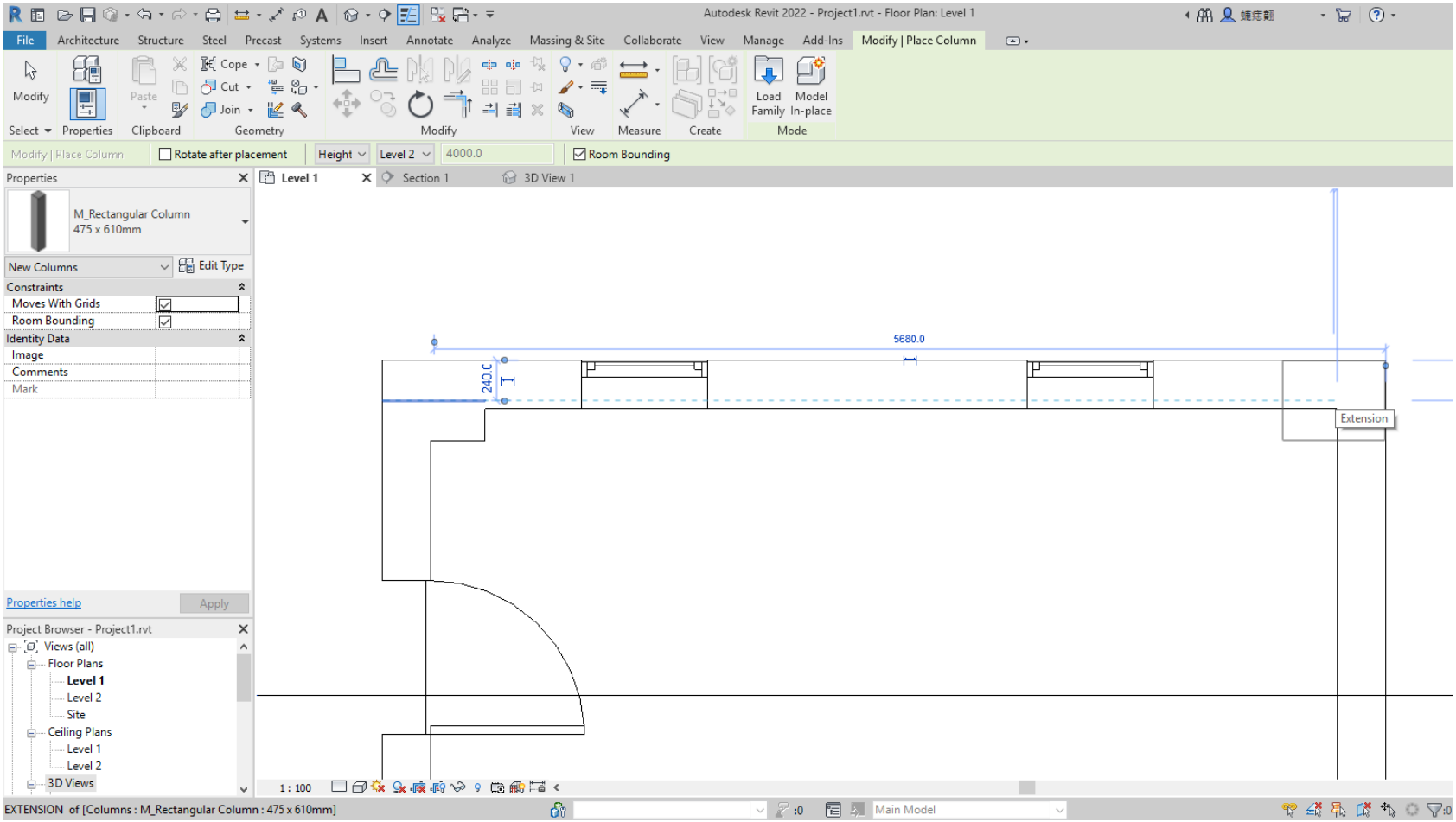
Drawing Window



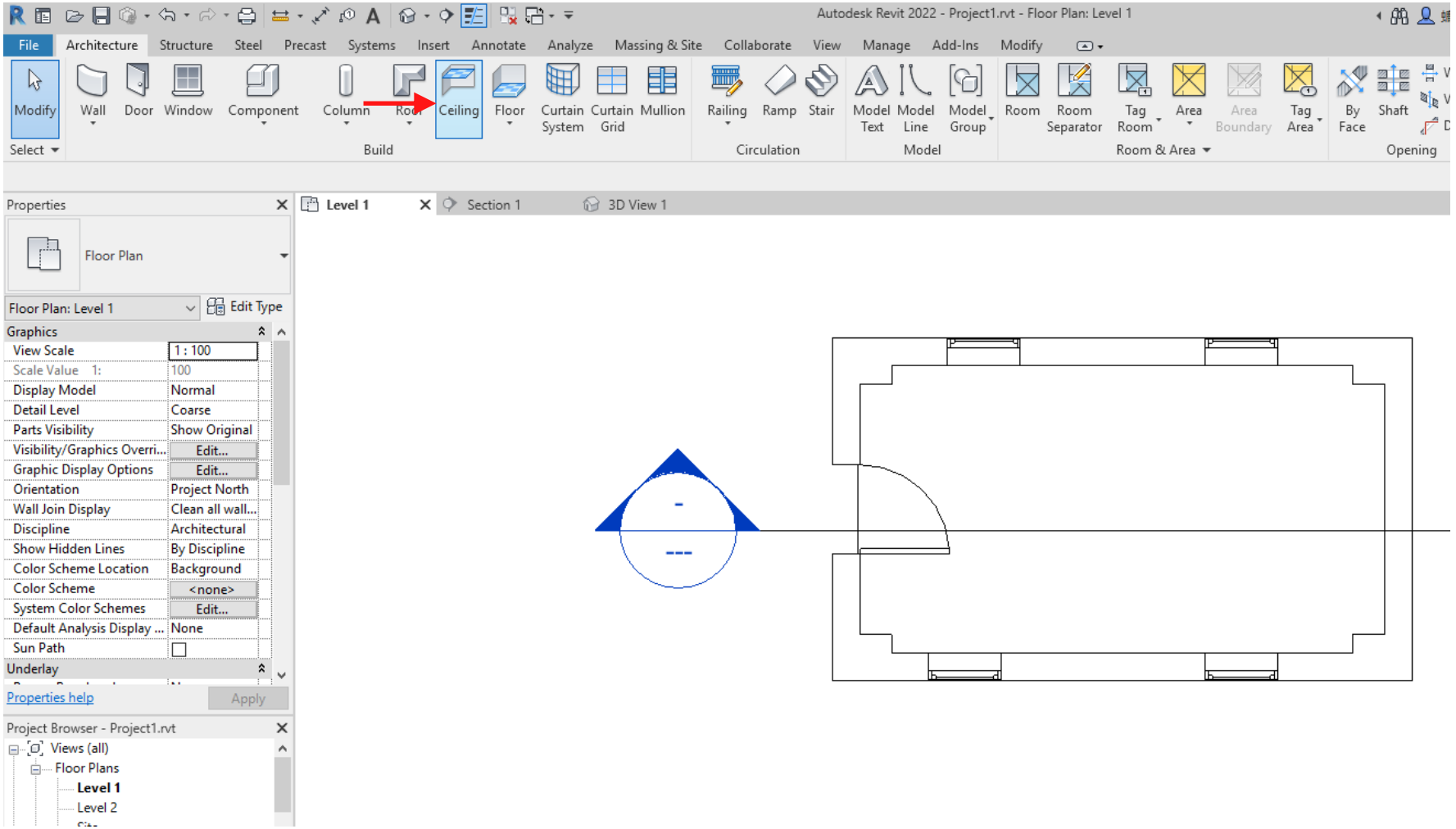
Drawing Columns



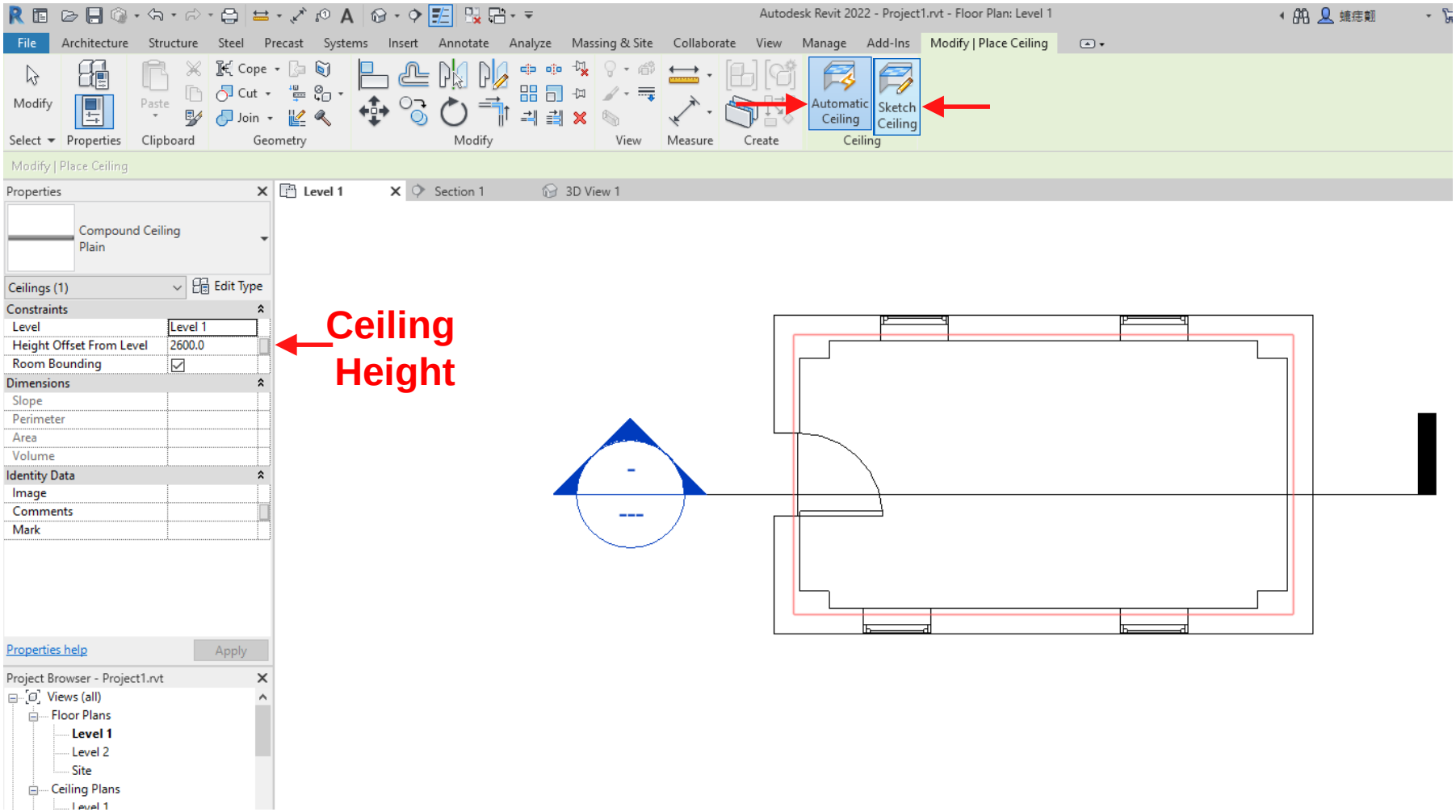
Drawing Columns



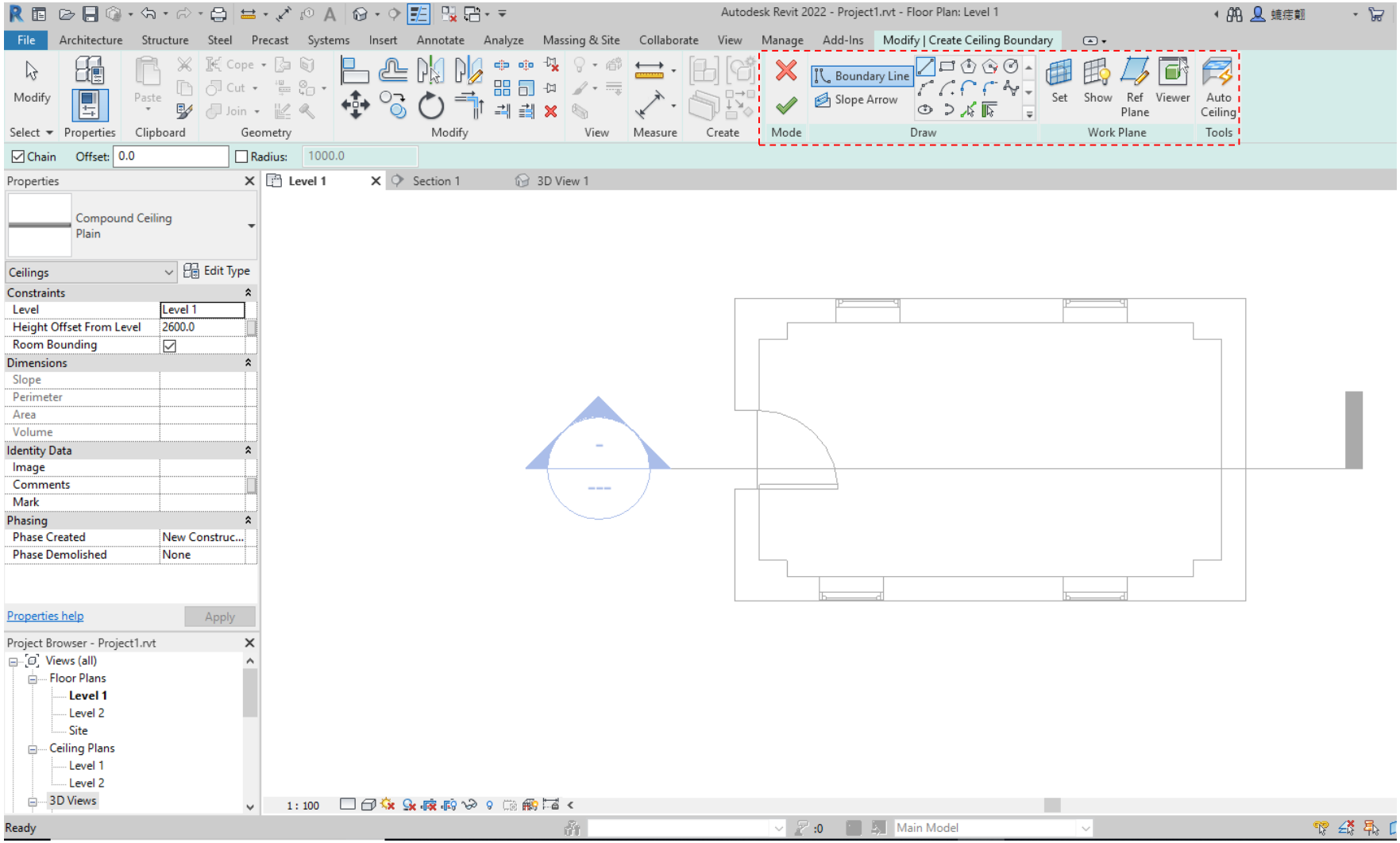
Drawing Ceilings



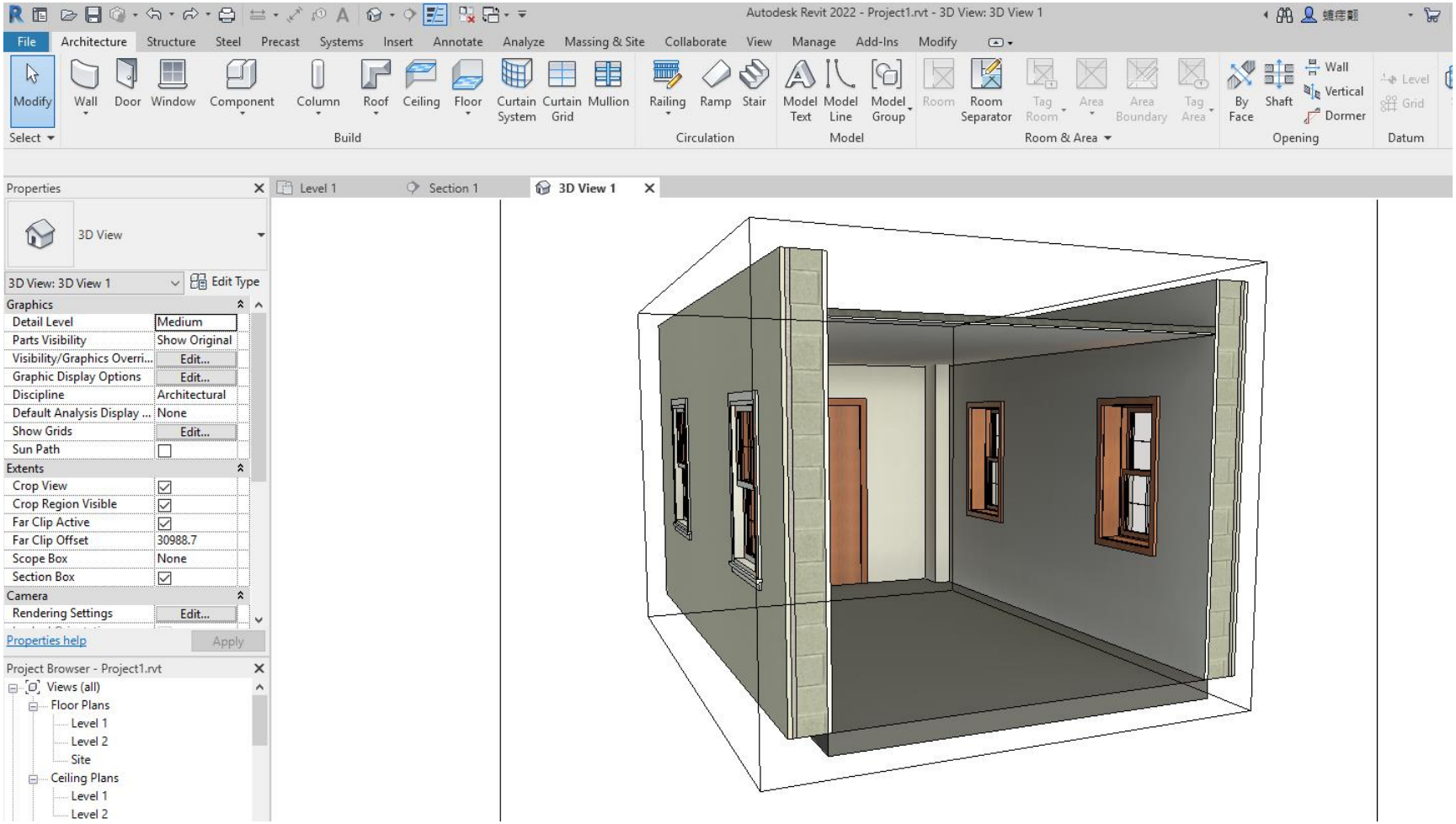
Drawing Ceilings-Automated Tools



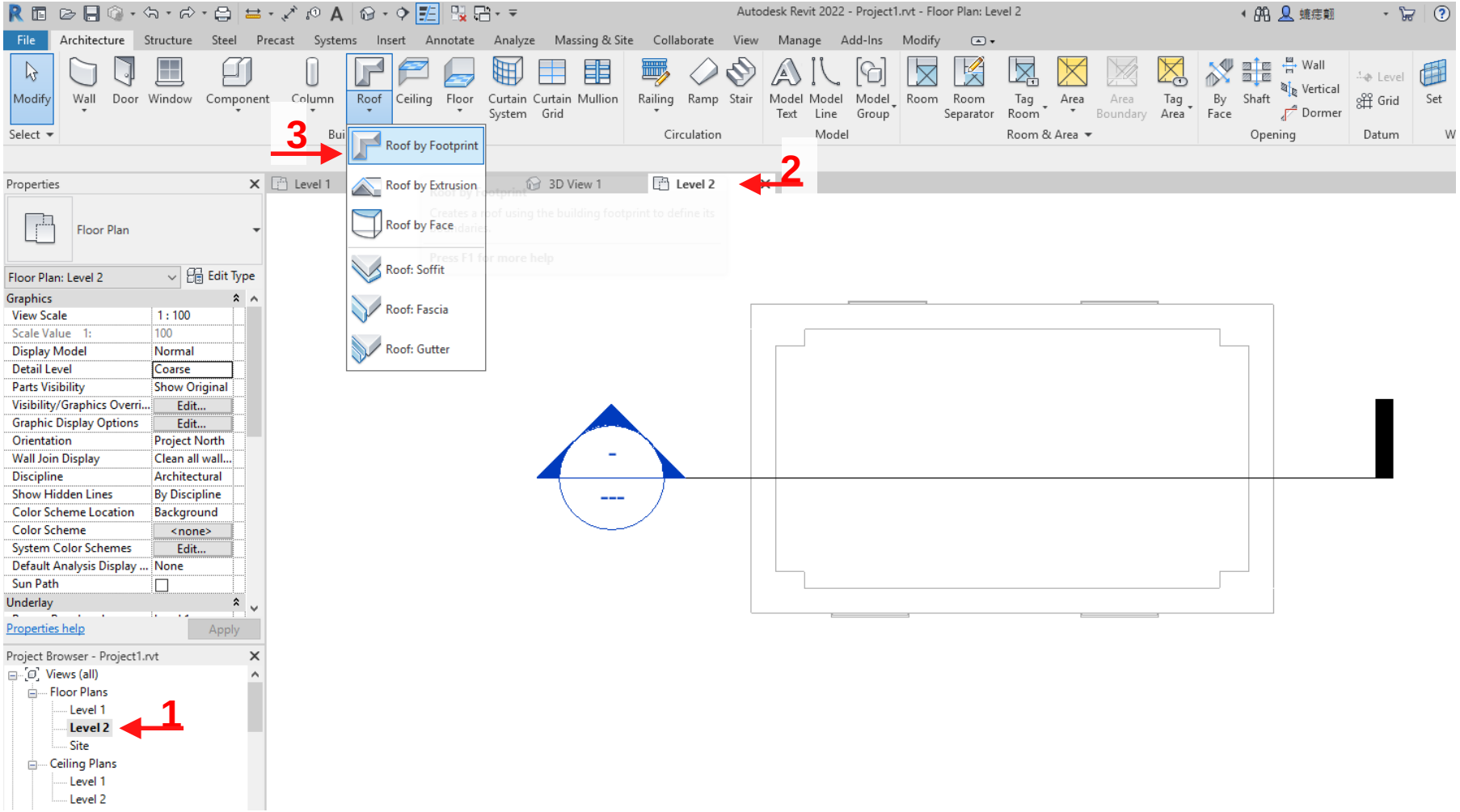
Drawing Ceilings-Manual Tools



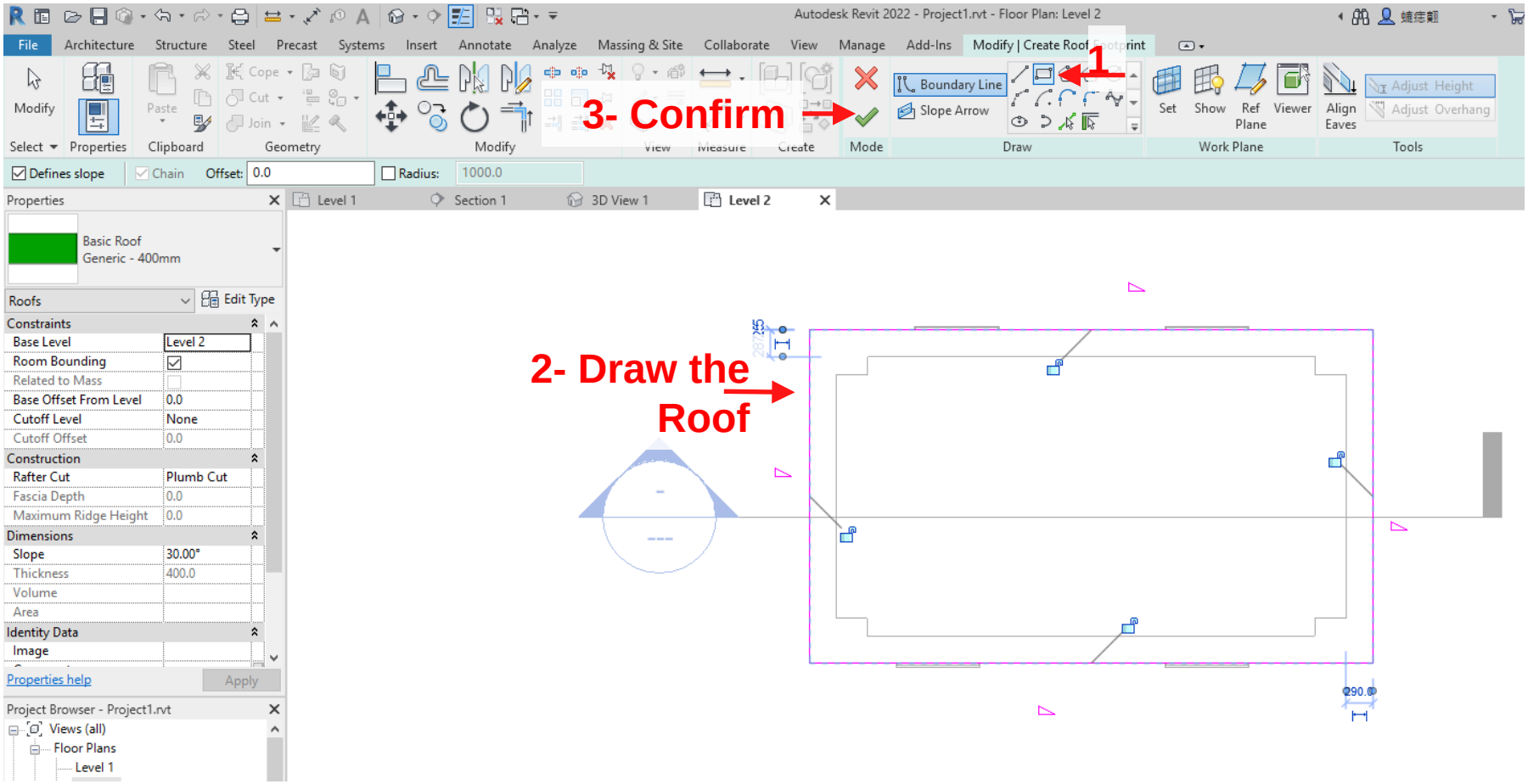
Drawing Ceilings



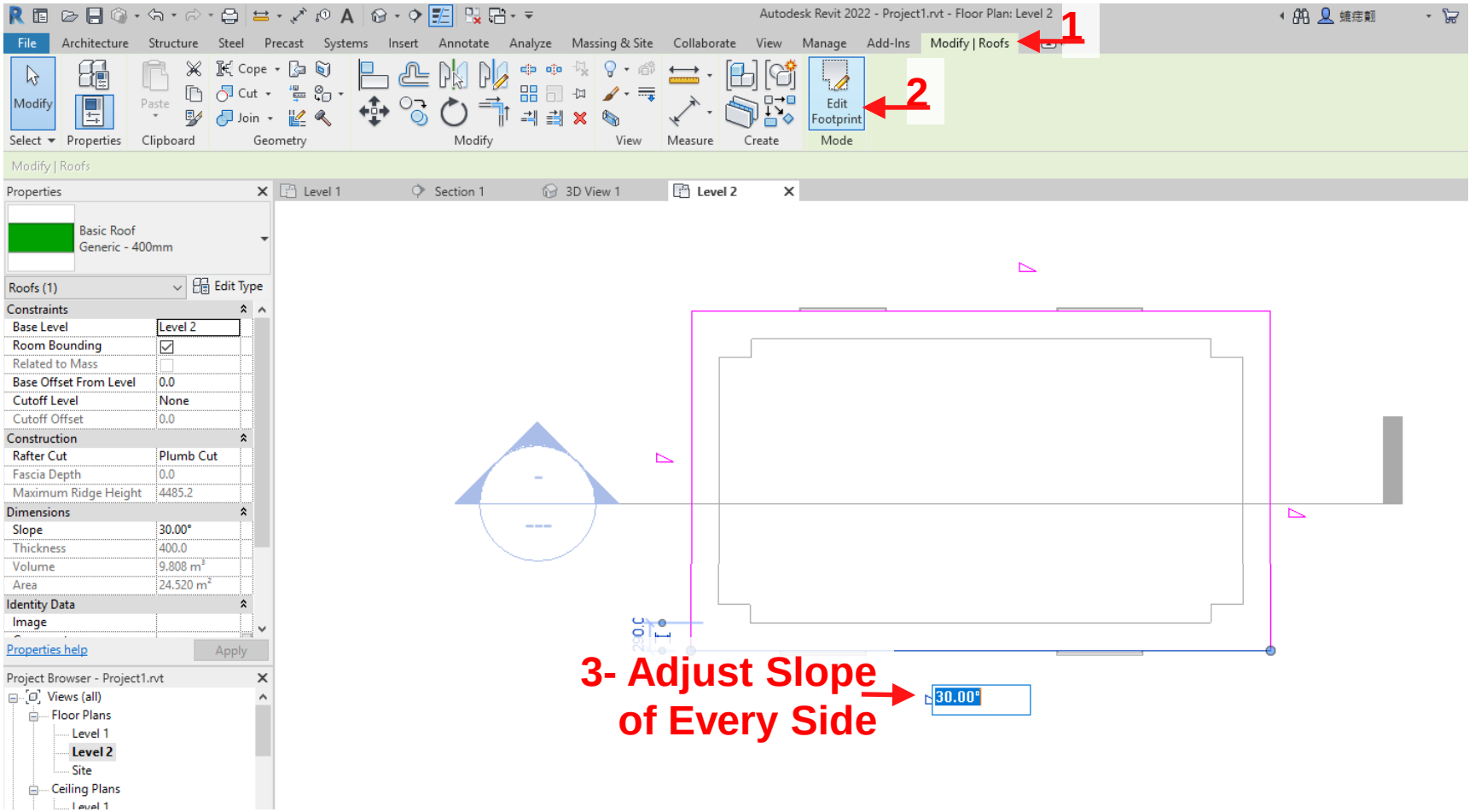
Drawing Roofs



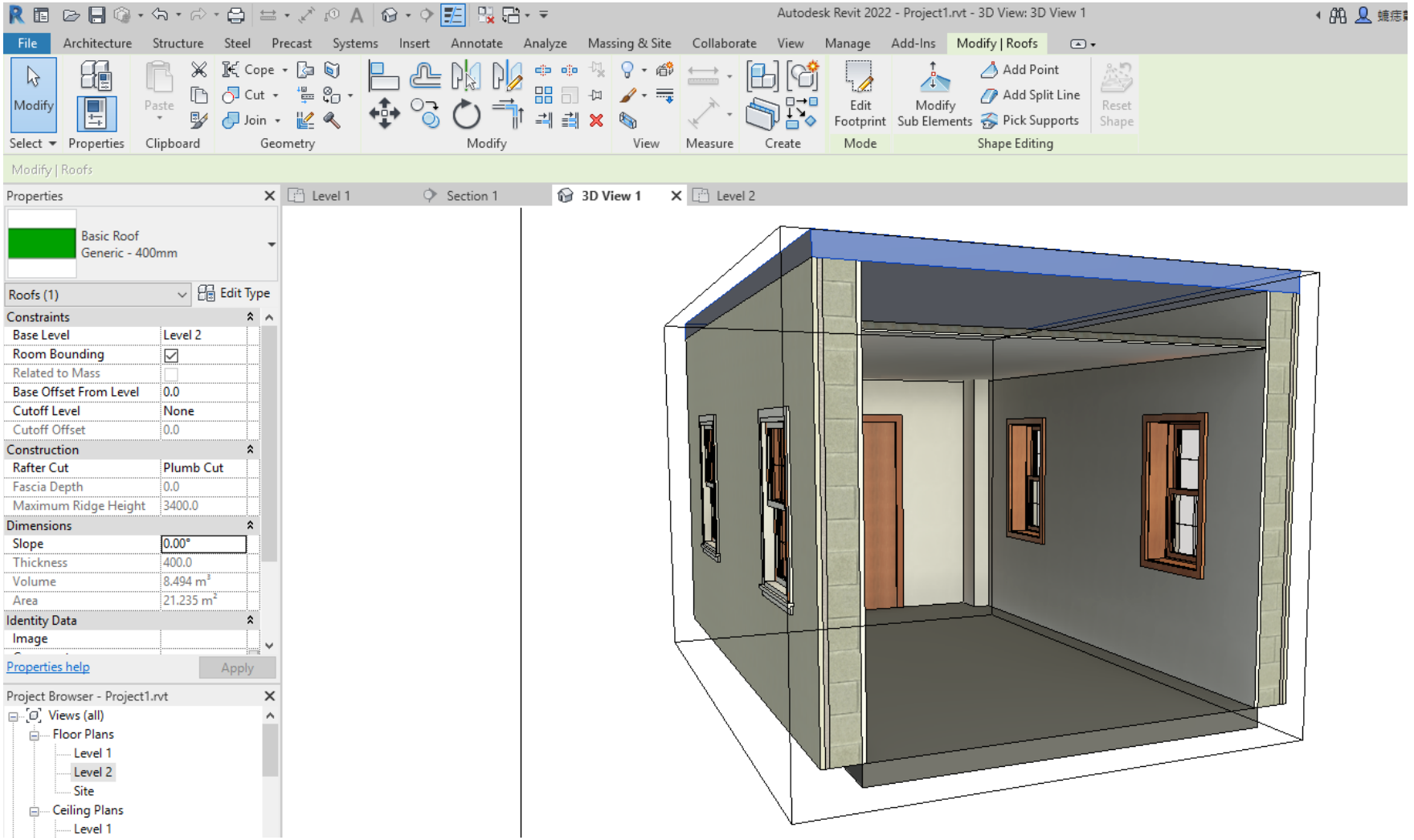
Drawing Roofs



Drawing Roofs

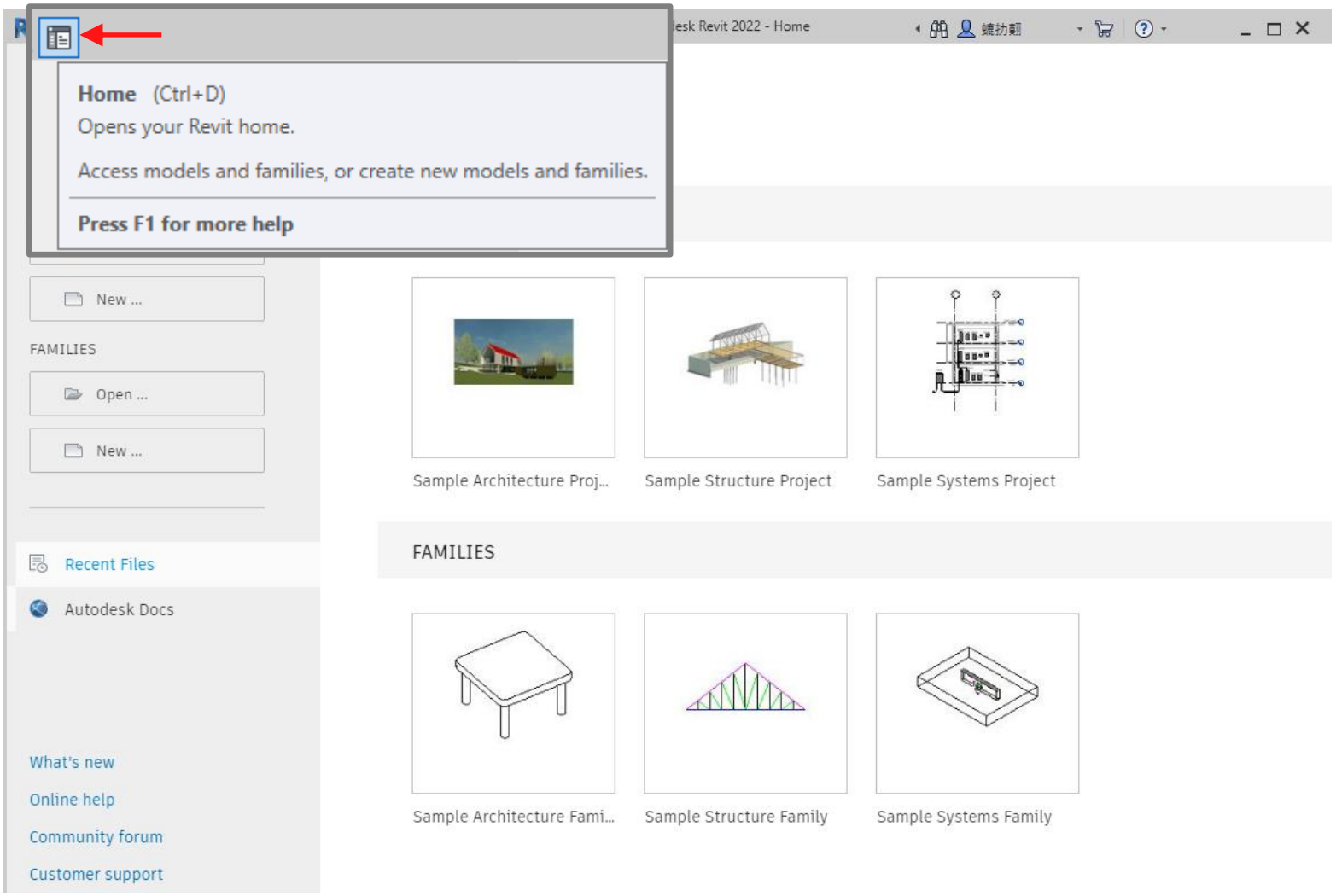


Drawing Roofs

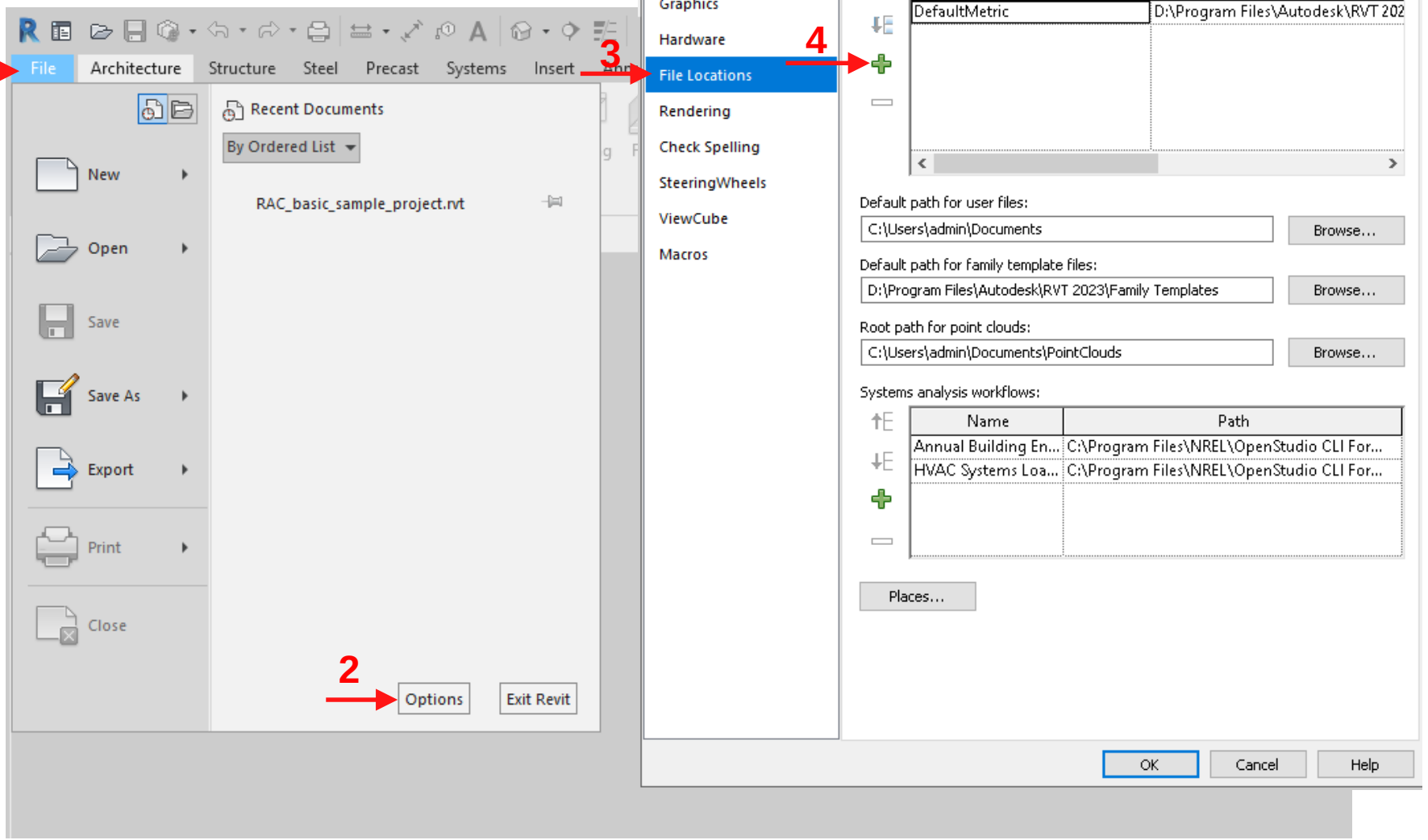


Introduction to Revit-Structure

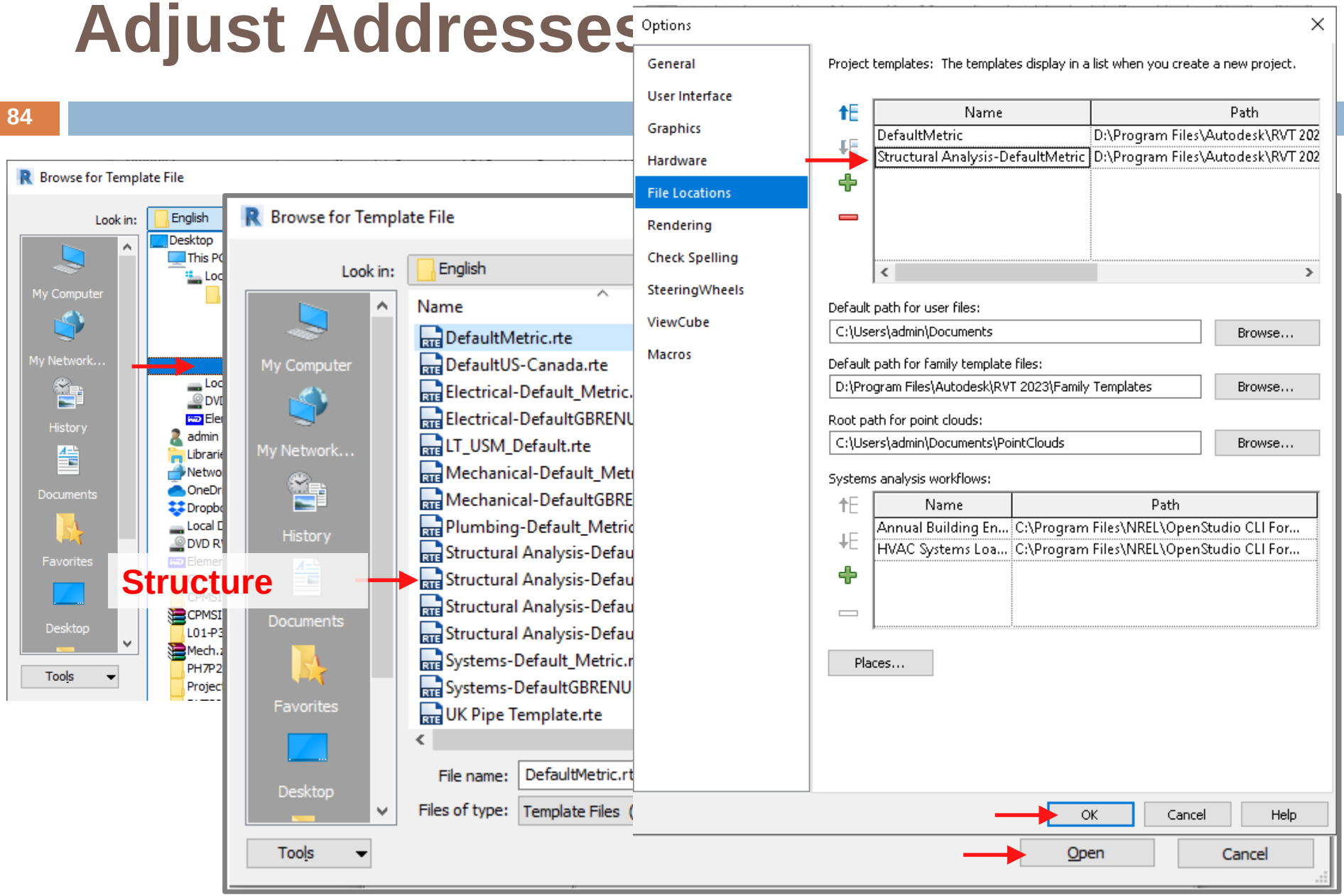
Structure Template Set up



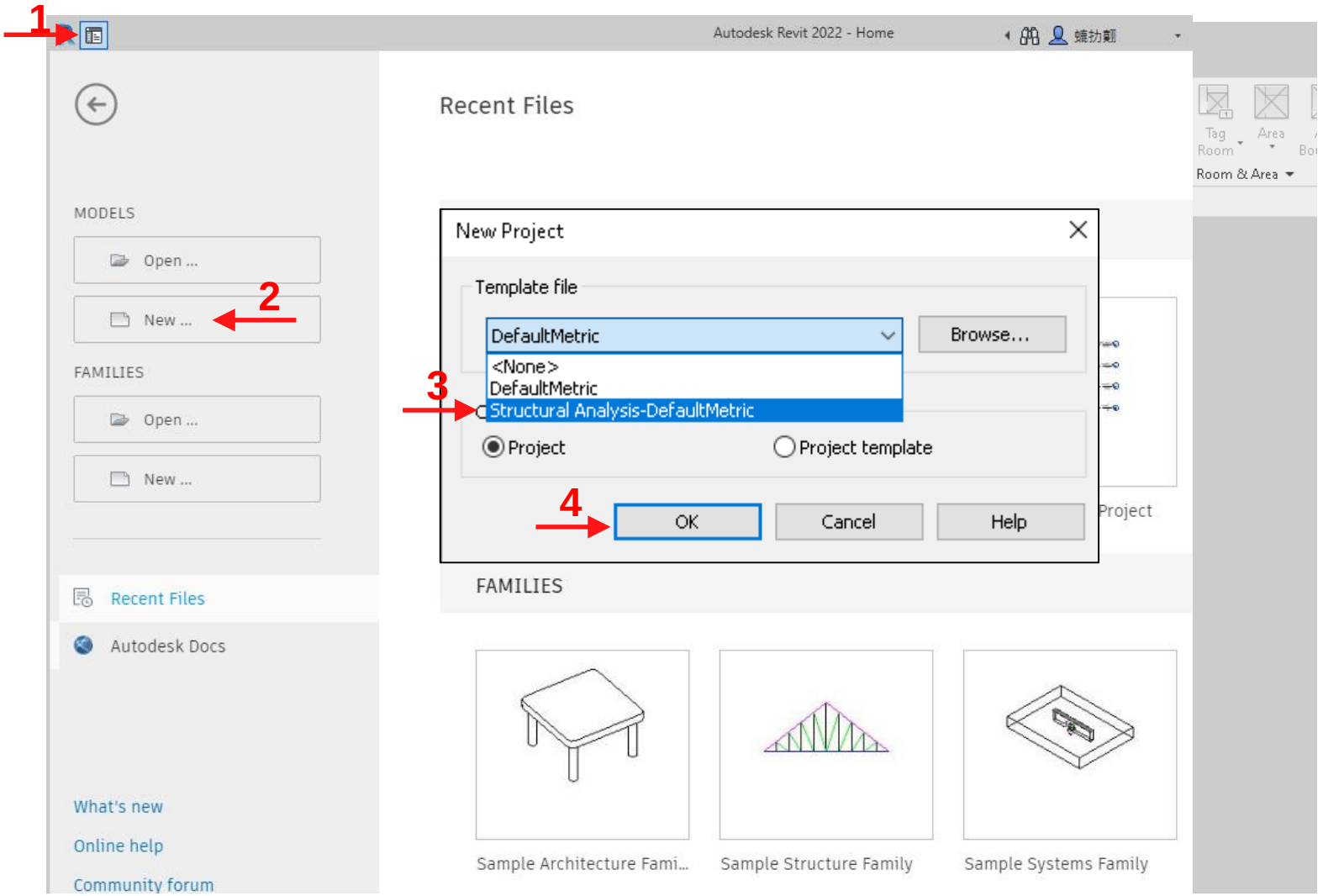
Adjust Addresses



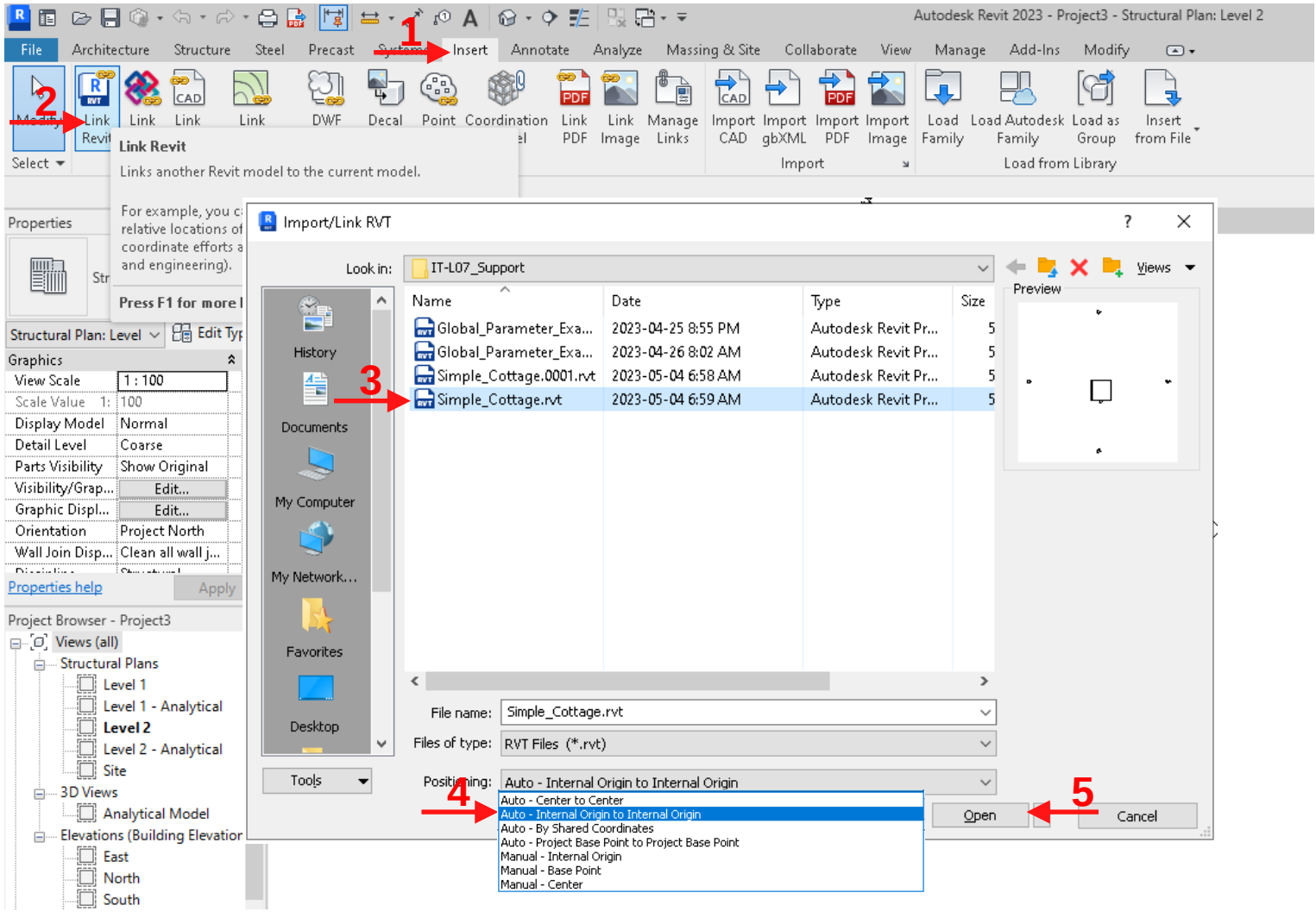
Adjust Addresses



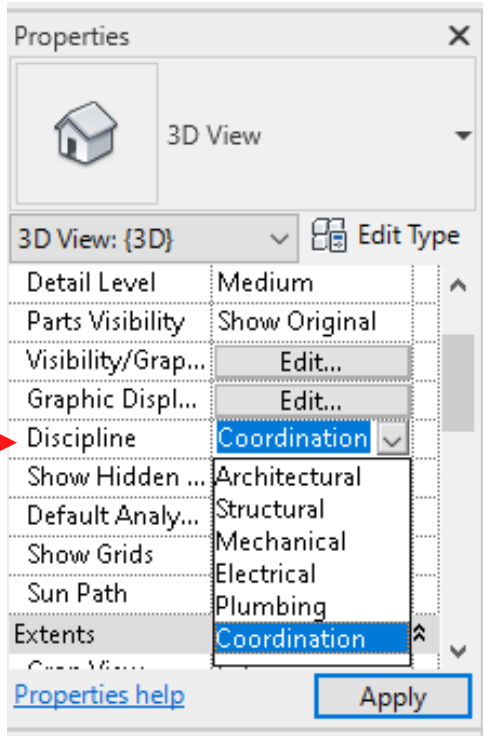
Start Working with Revit



Linking the Architecture File



Adjusting the Linked File



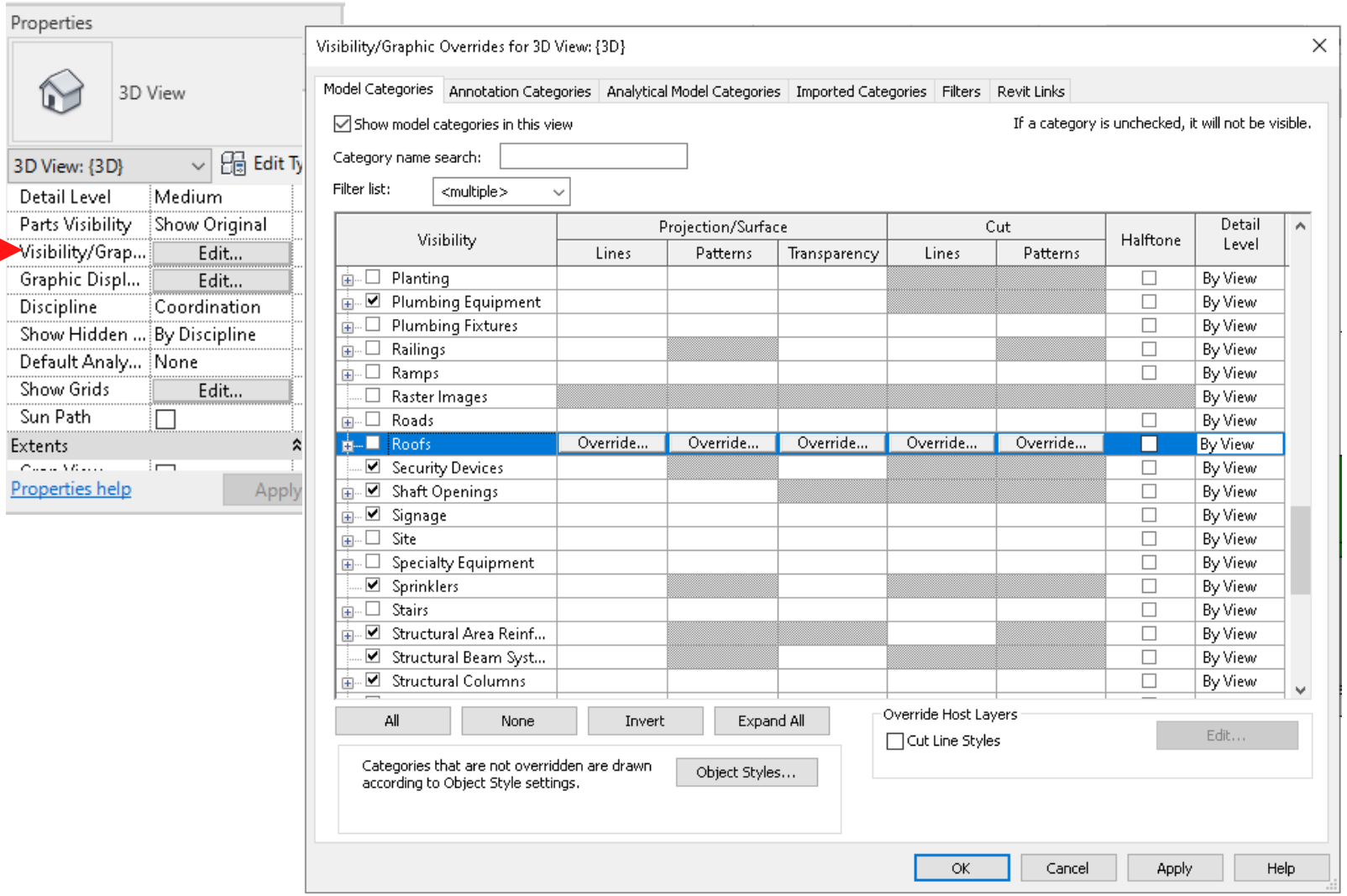
1

Set the *Discipline* to the Coordination to use both Arch. and Struc. elements

Adjusting the Linked File

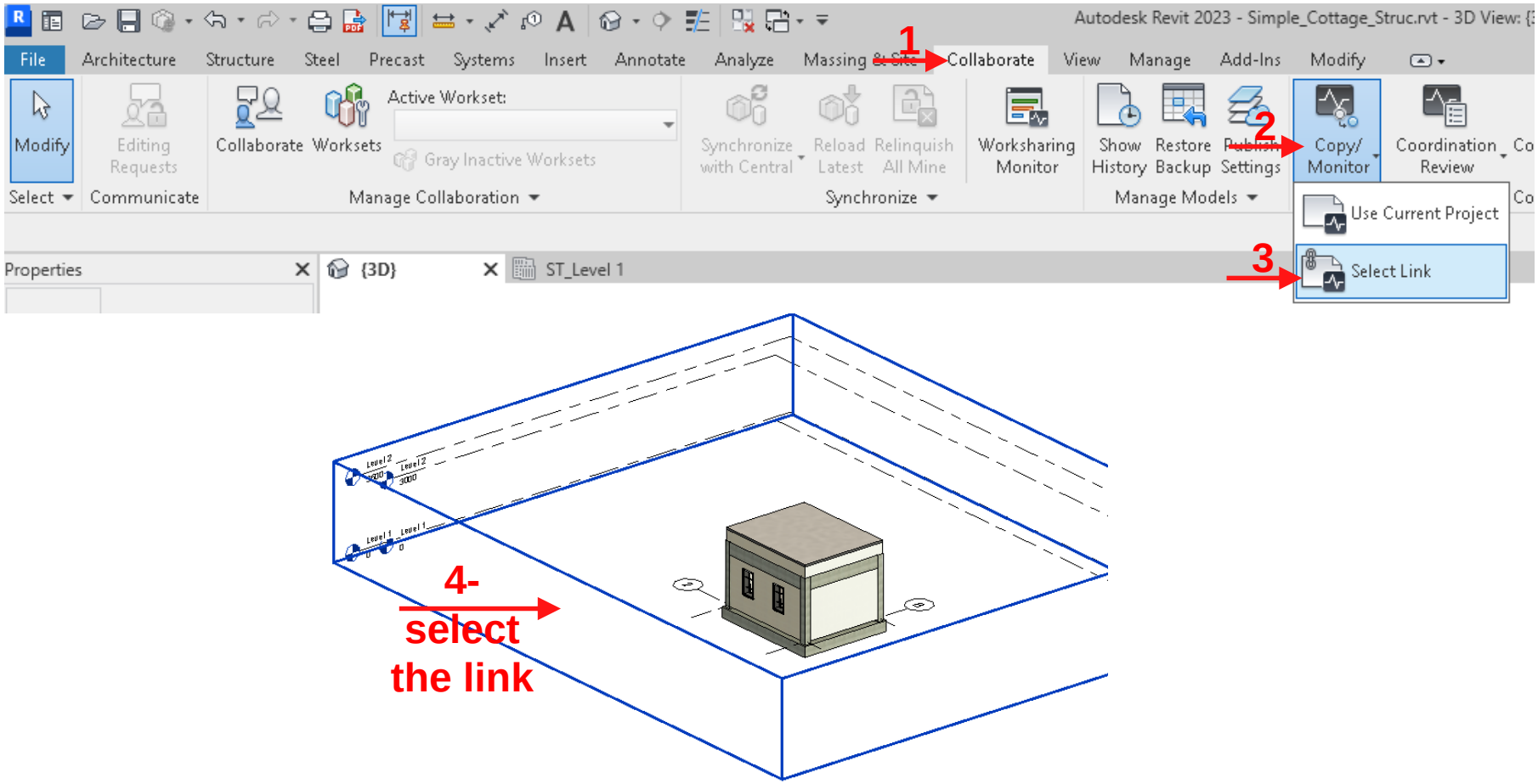
2

Edit *Visibility/ Graphics* to select elements required



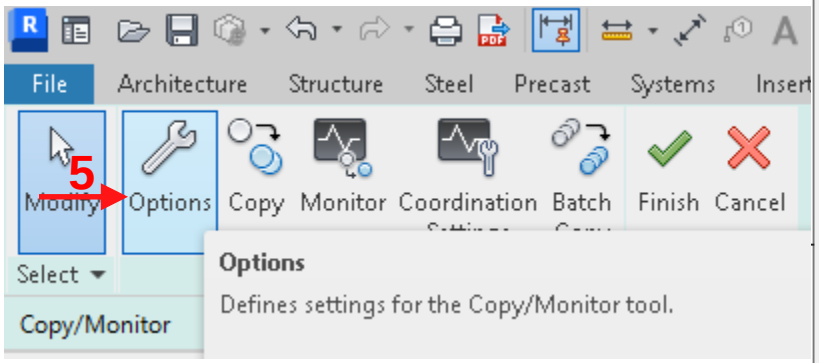
Copy Required Elements from the Link

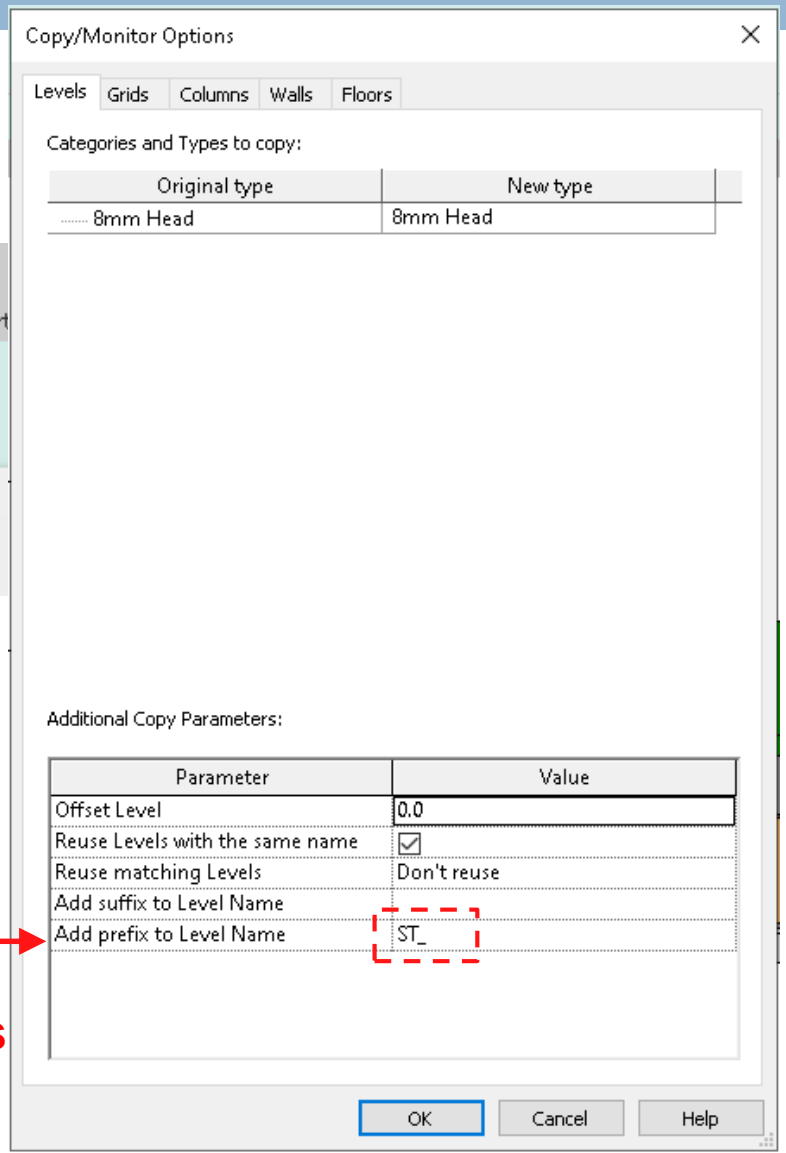
- Example: Copy the elevations from the linked Arch model



Copy Required Elements from the Link

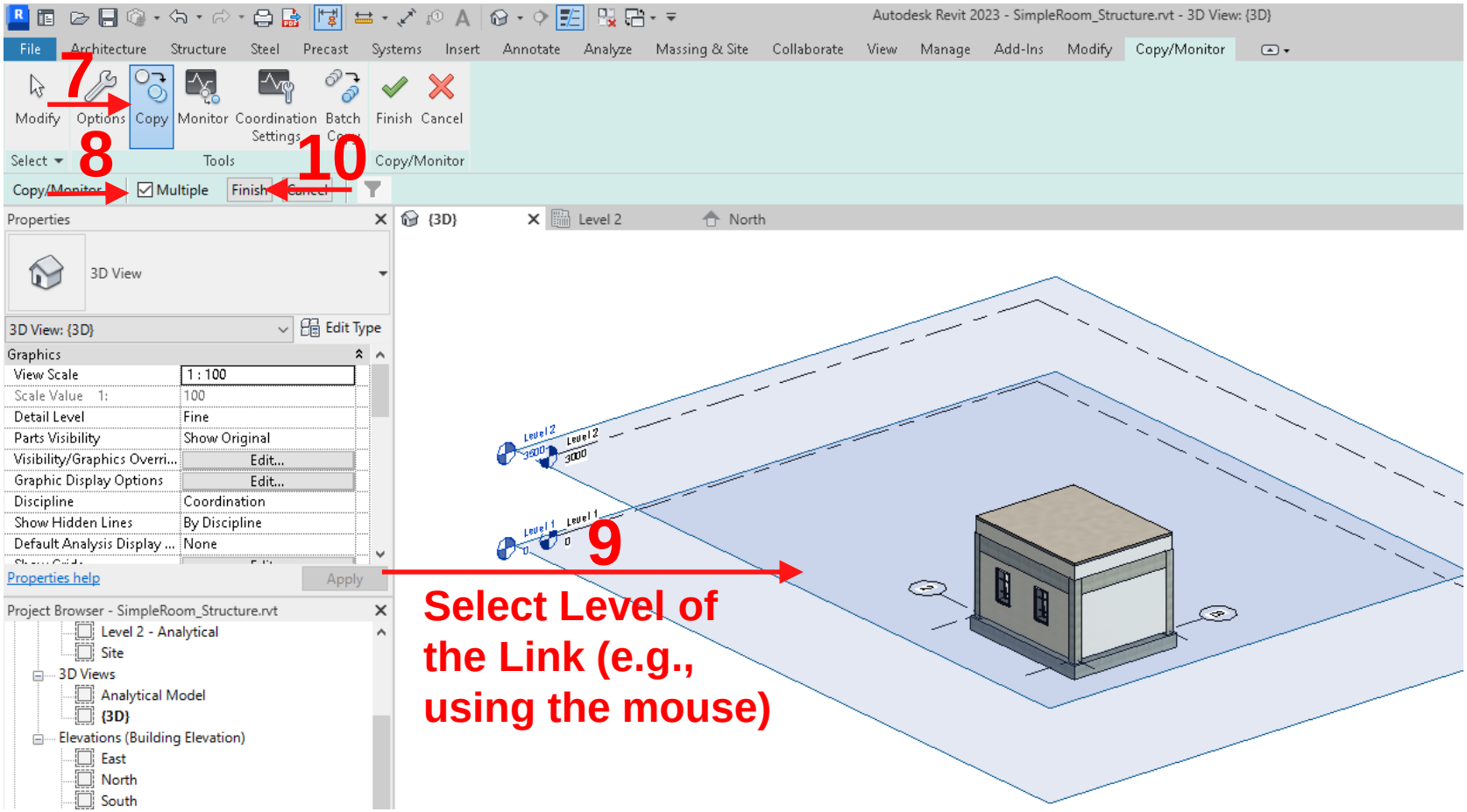
- Example (Cont'd)





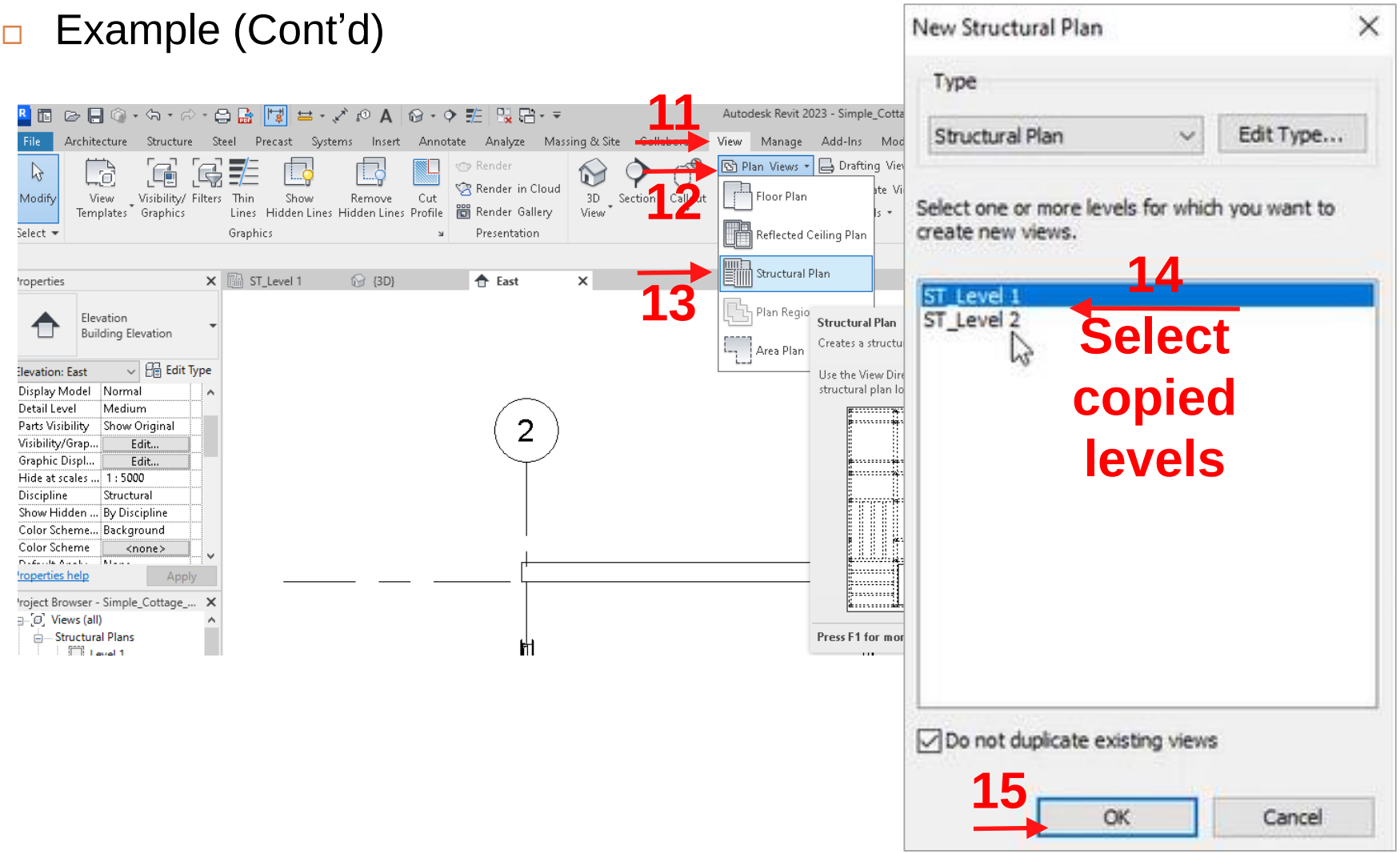
Copy Required Elements from the Link

- Example (Cont'd)



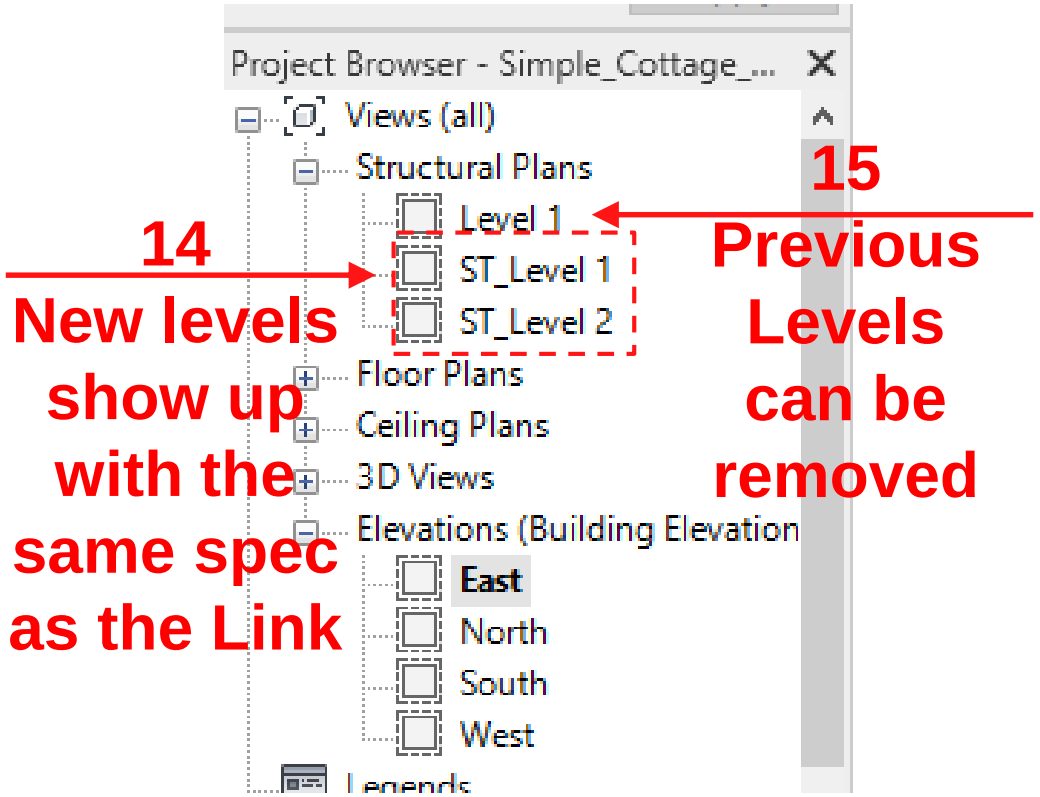
Copy Required Elements from the Link

- Example (Cont'd)



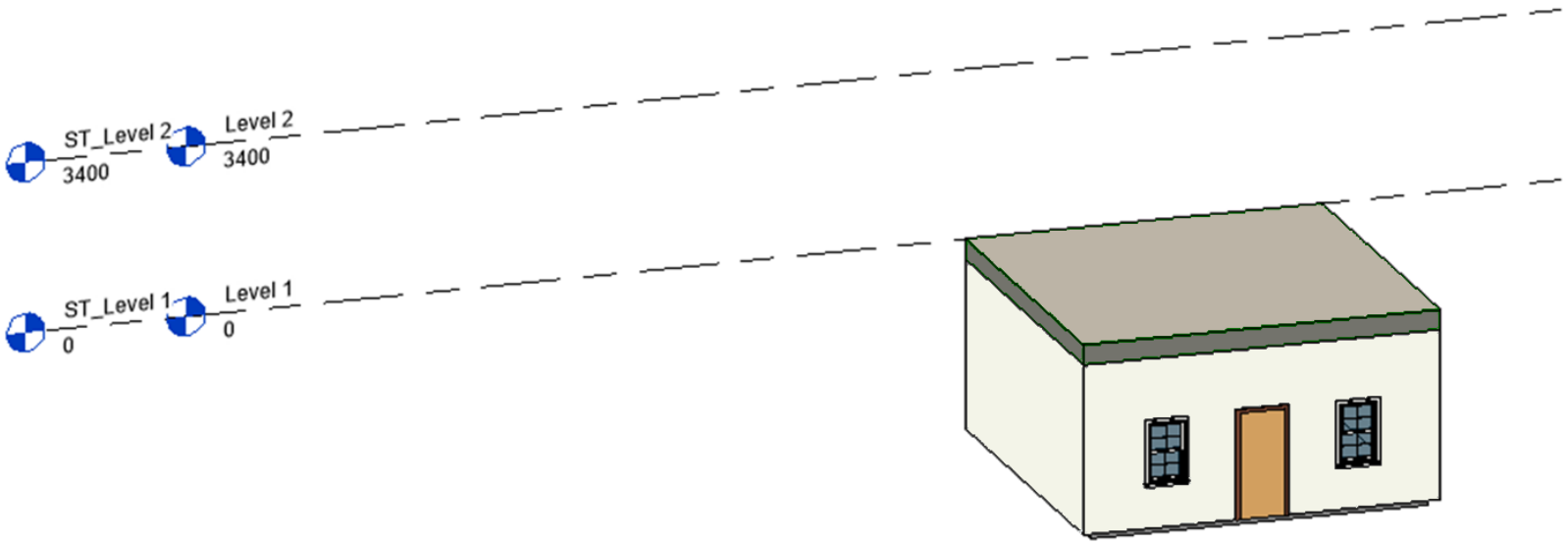
Copy Required Elements from the Link

- Example (Cont'd)

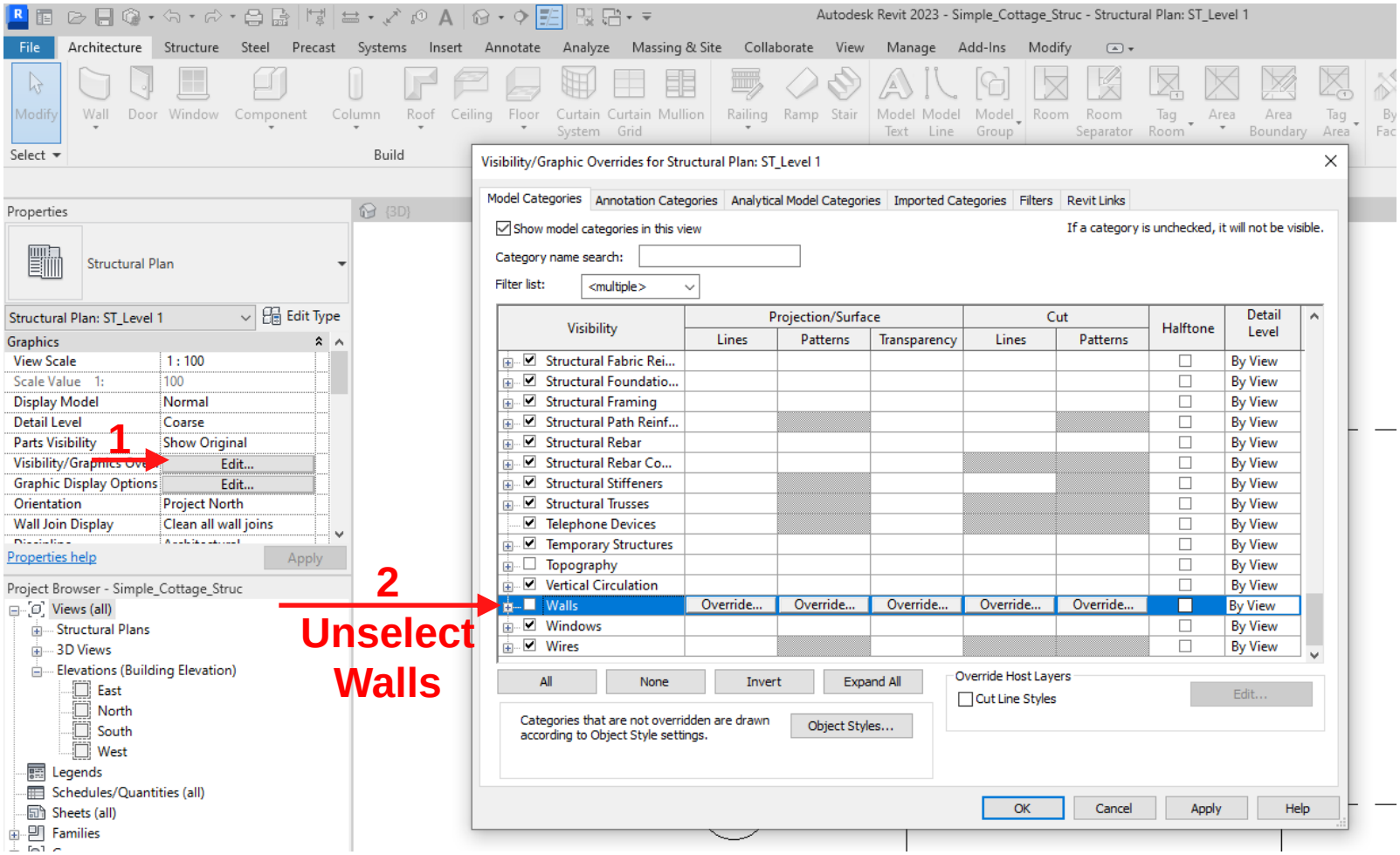


Copy Required Elements from the Link

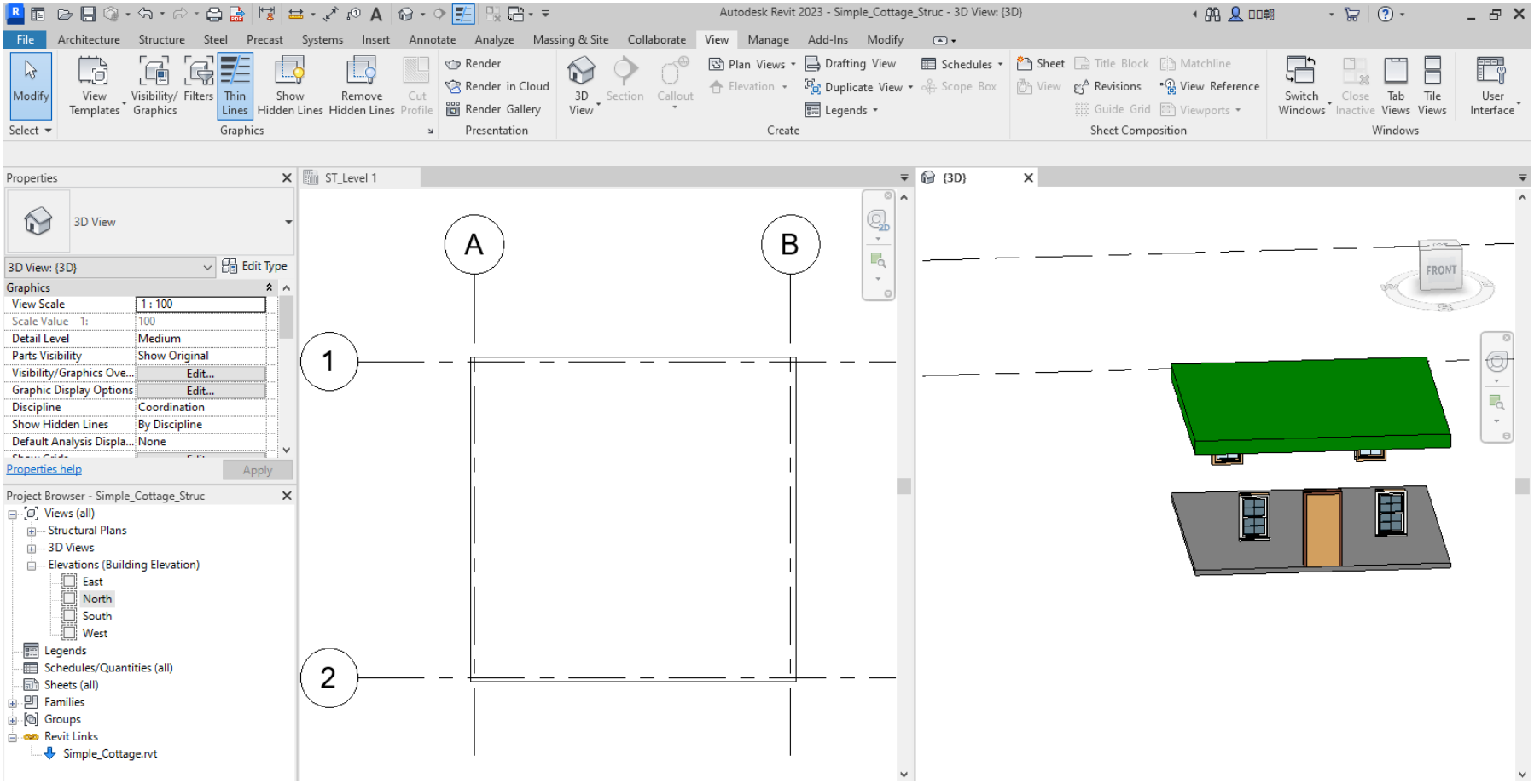
- Example (Cont'd)



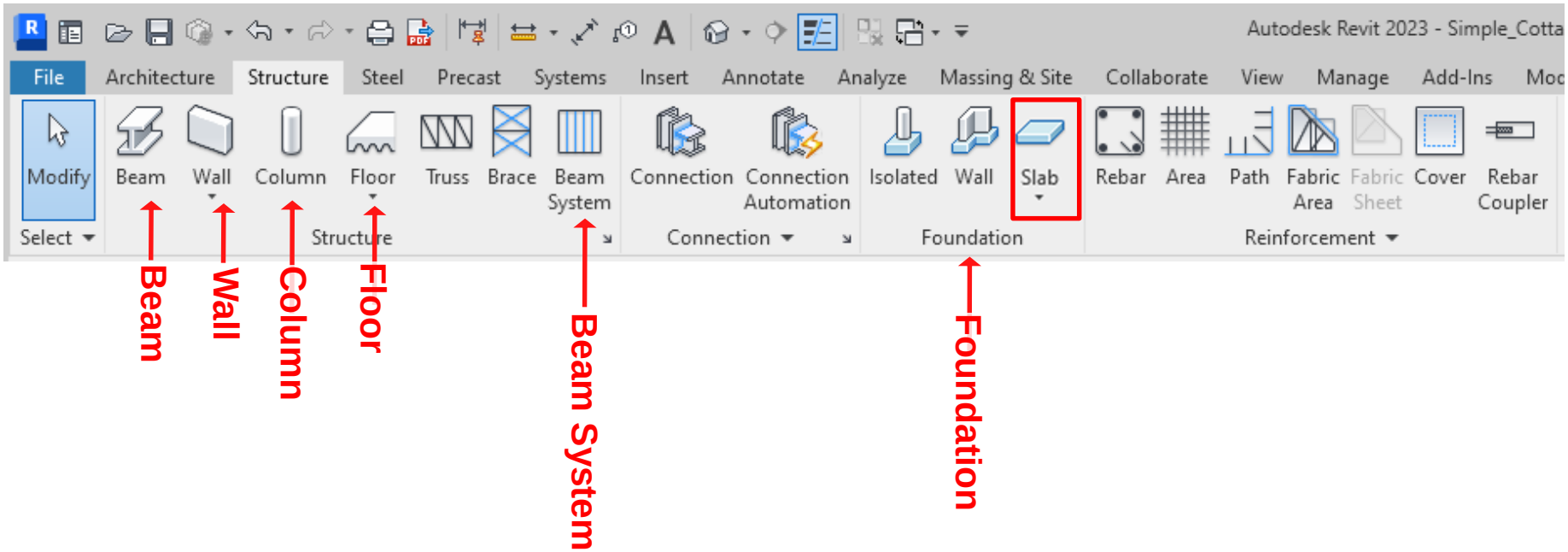
Clear the Room for Structure Objects



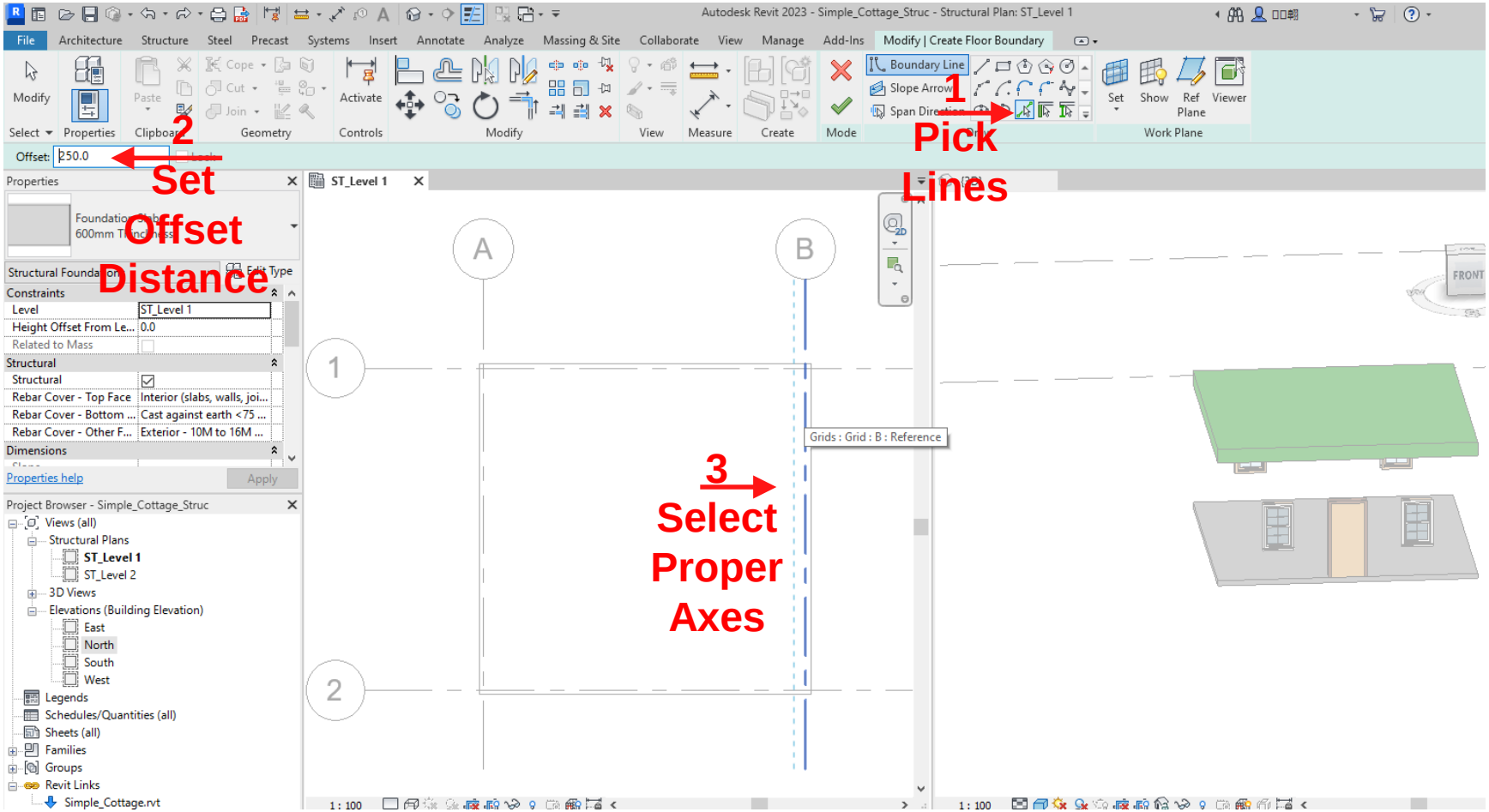
Clear the Room for Structure Objects



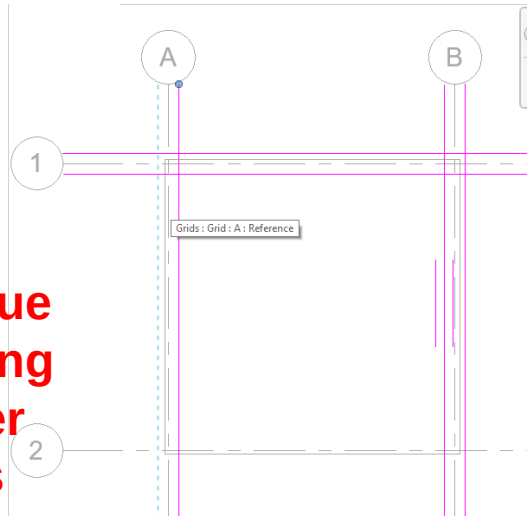
Basic Structure Model Objects



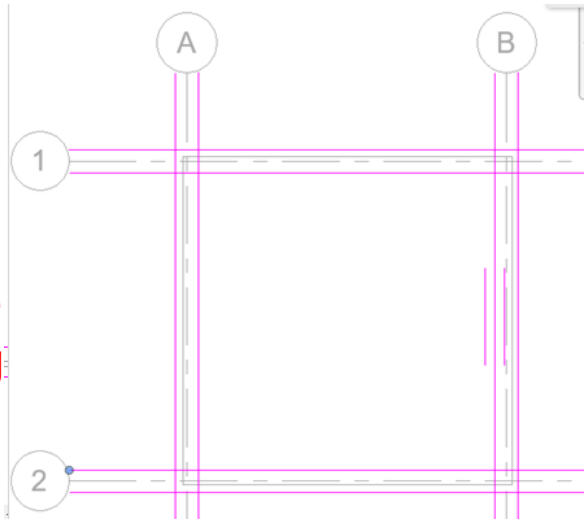
Drawing Foundation



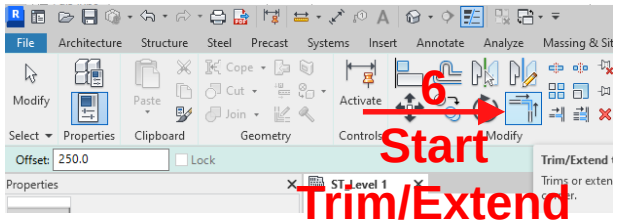
Drawing Foundation



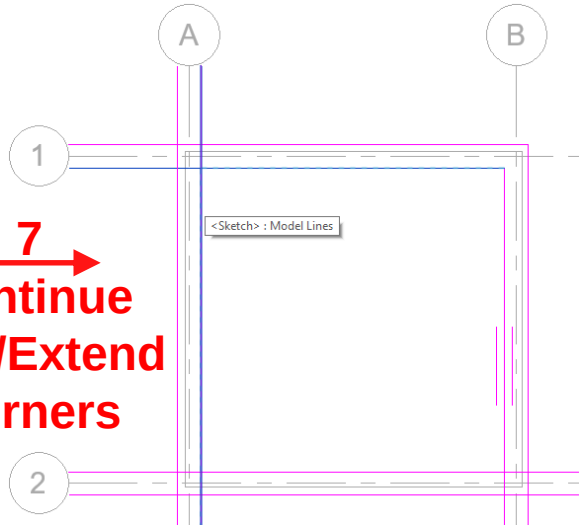
4
Continue Selecting Proper Axes



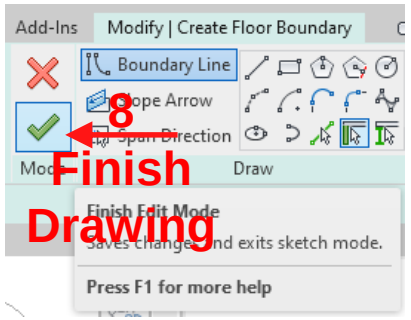
5
Continue Selecting Proper Axes



6
Start Trim/Extend Corners

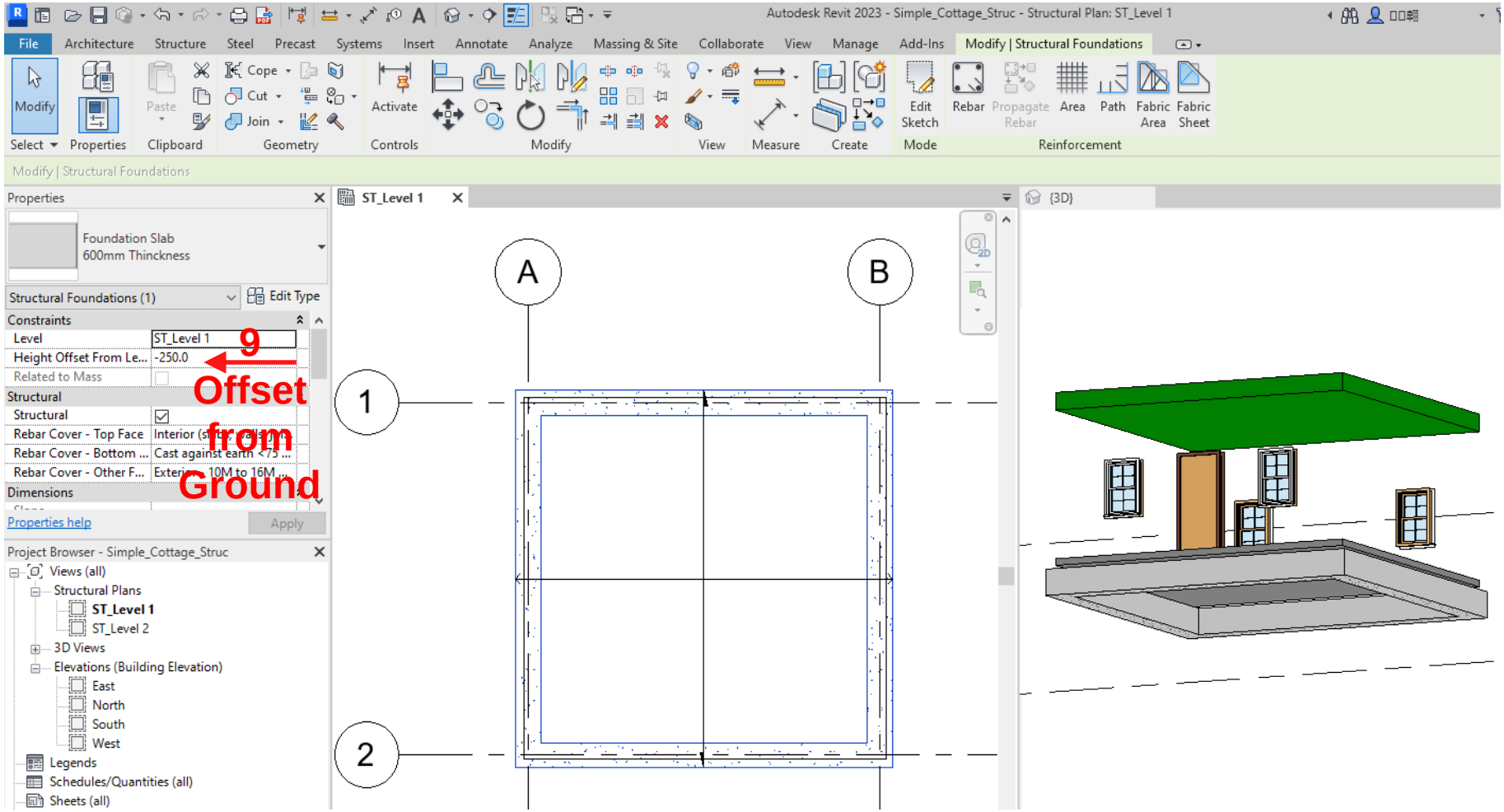


7
Continue Trim/Extend Corners

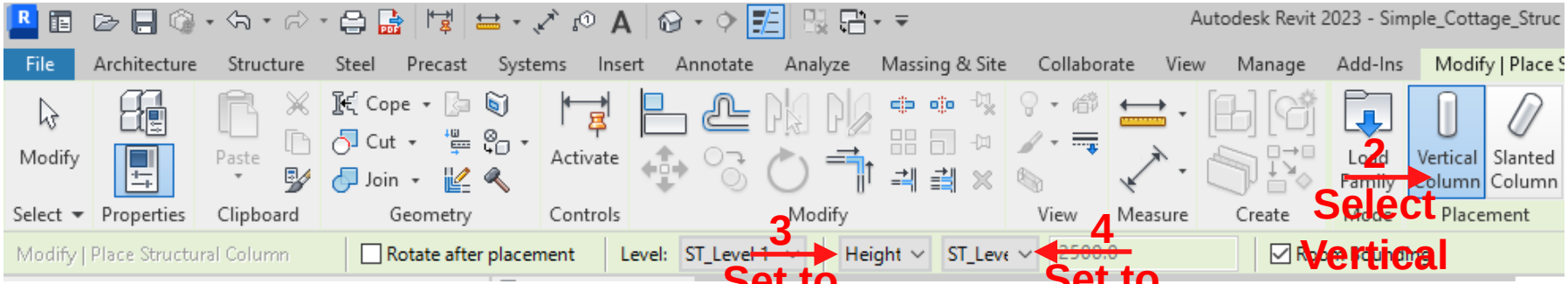


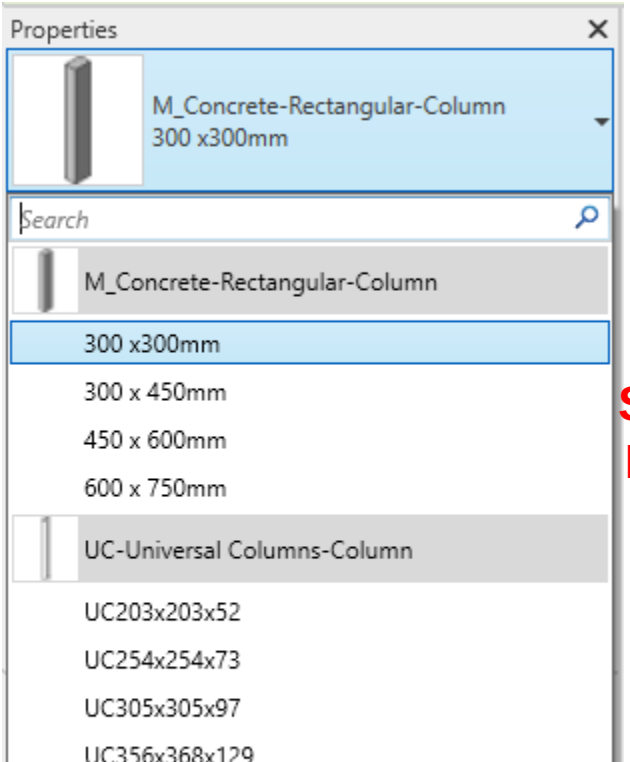
8
Finish Drawing

Drawing Foundation



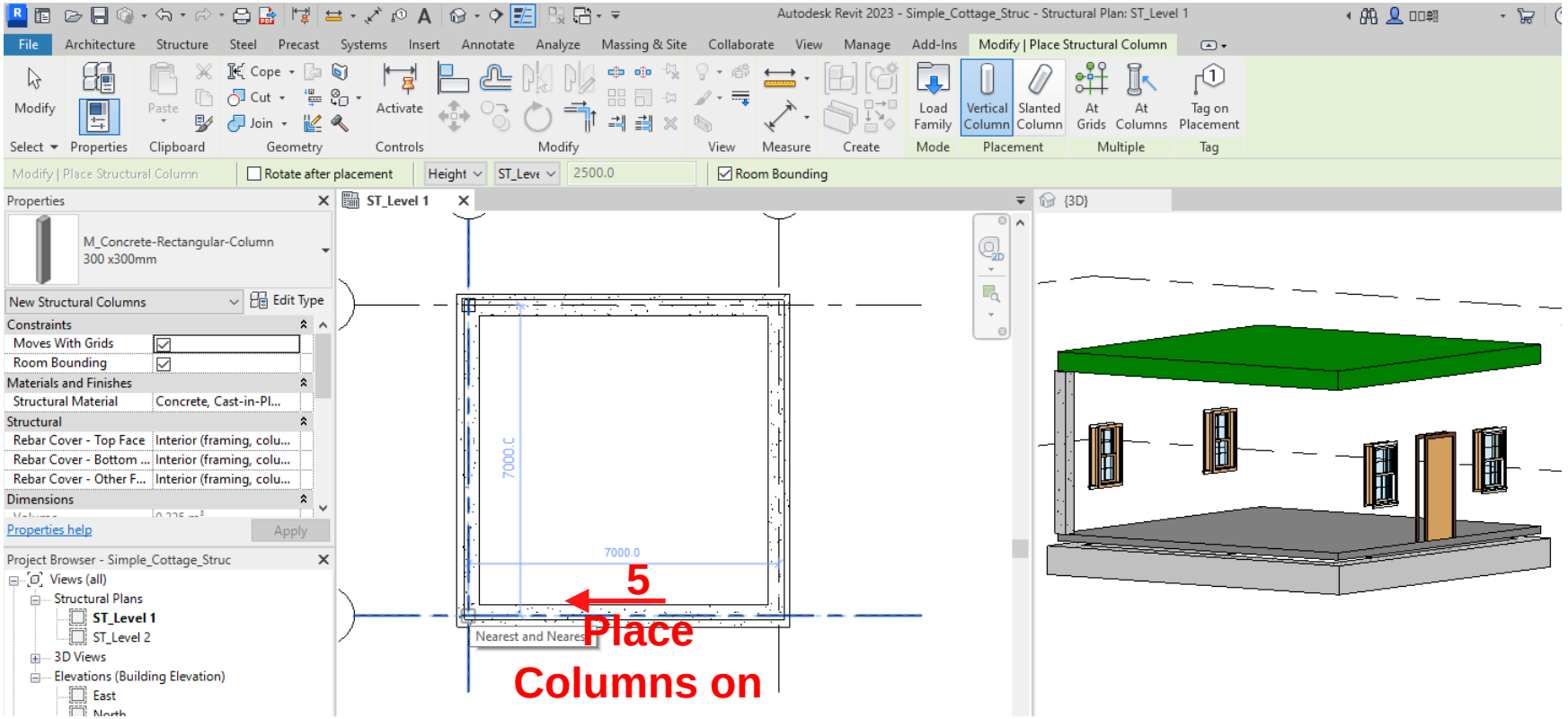
Drawing Columns



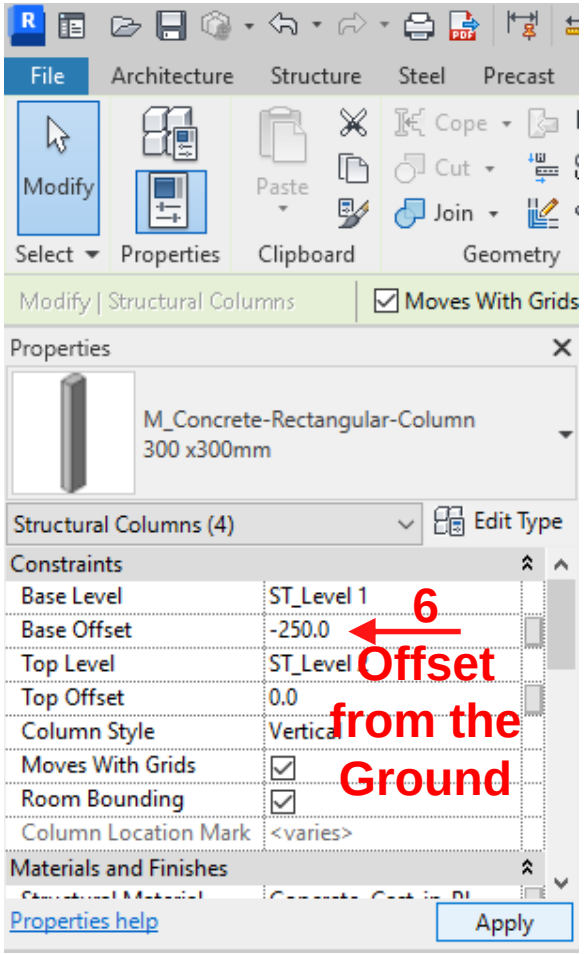


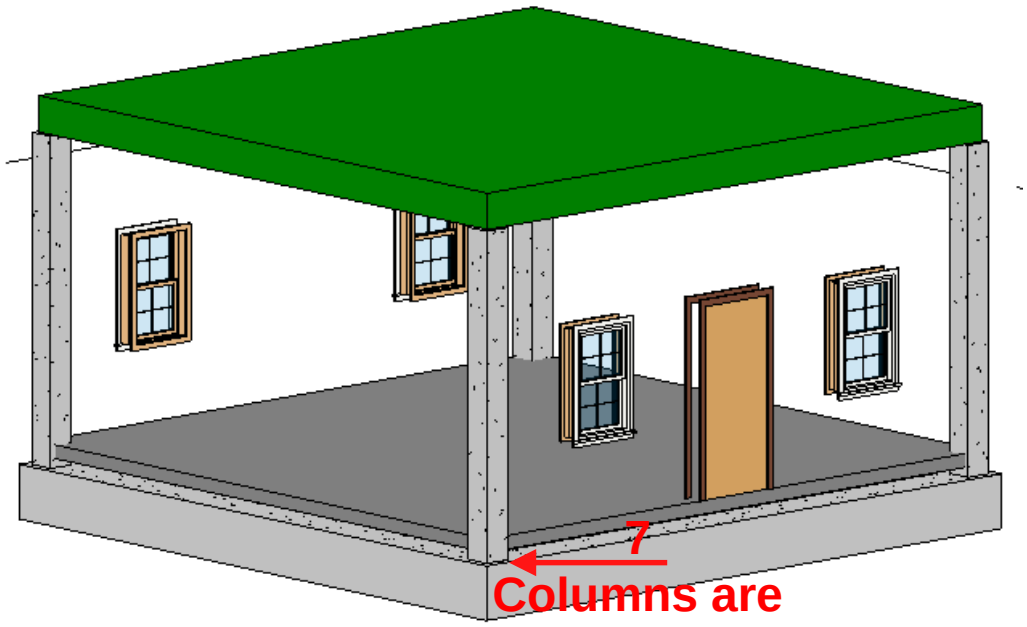
1
Select/define Proper Spec

Drawing Columns

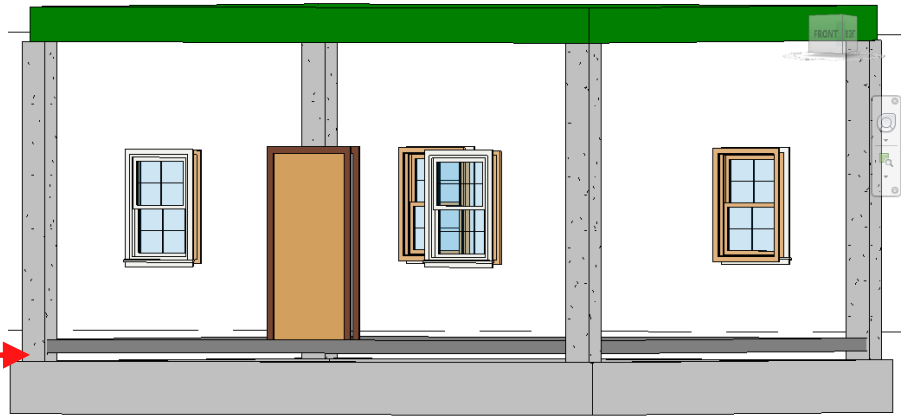


Drawing Columns





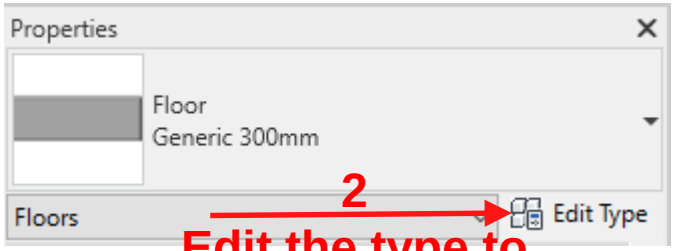
Drawing Floor

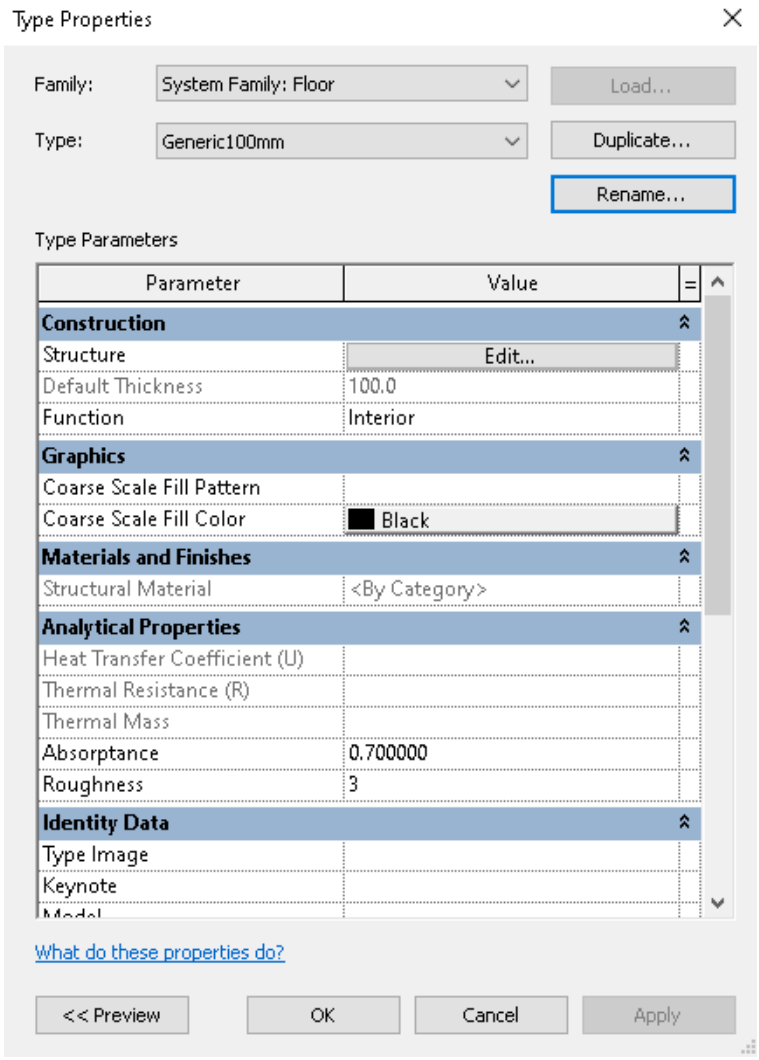


1

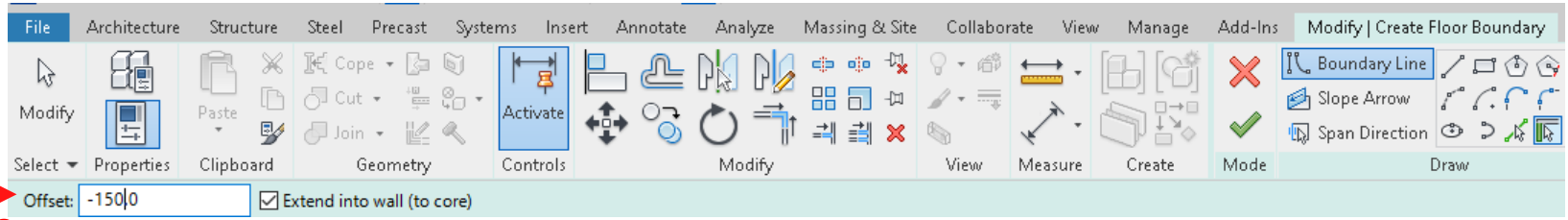
Distance between foundation and Arch. floor is filled by Stuct. floor

Drawing Floor



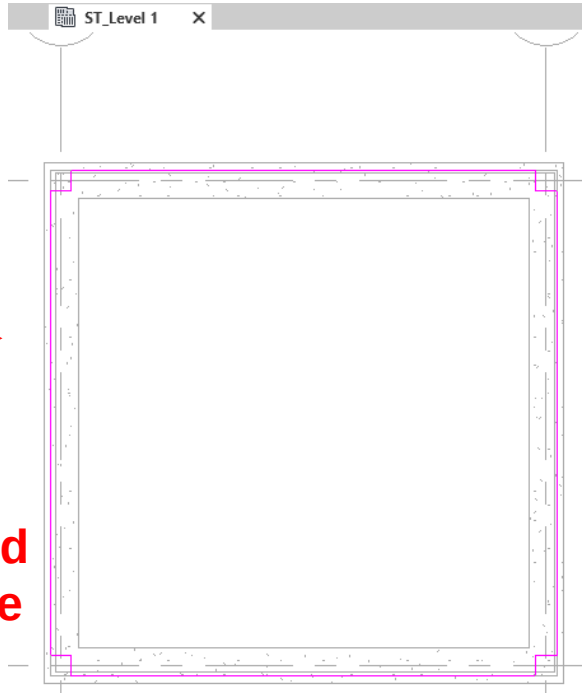


Drawing Floor



3

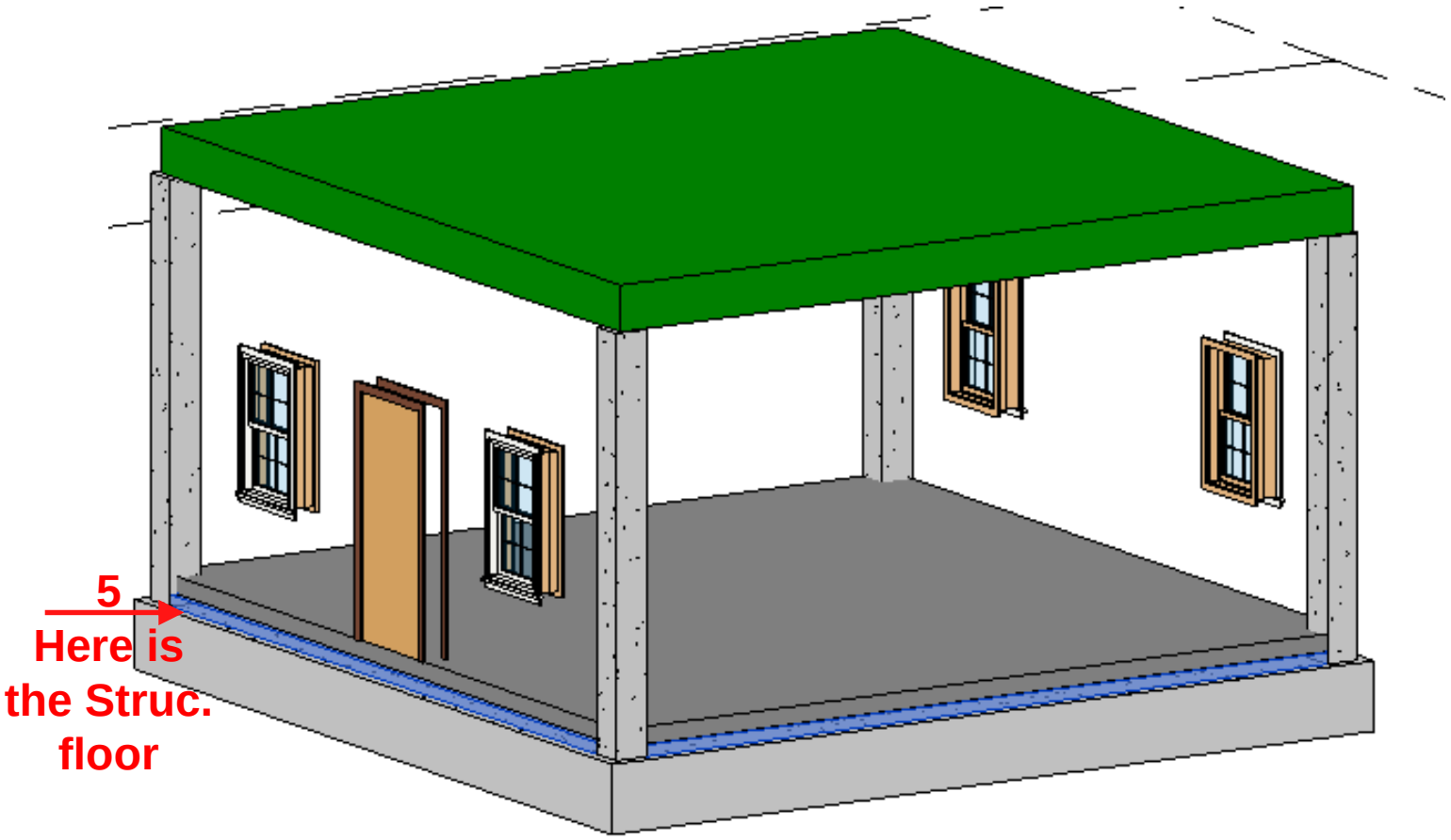
Set the proper offset just under the Arch. Floor



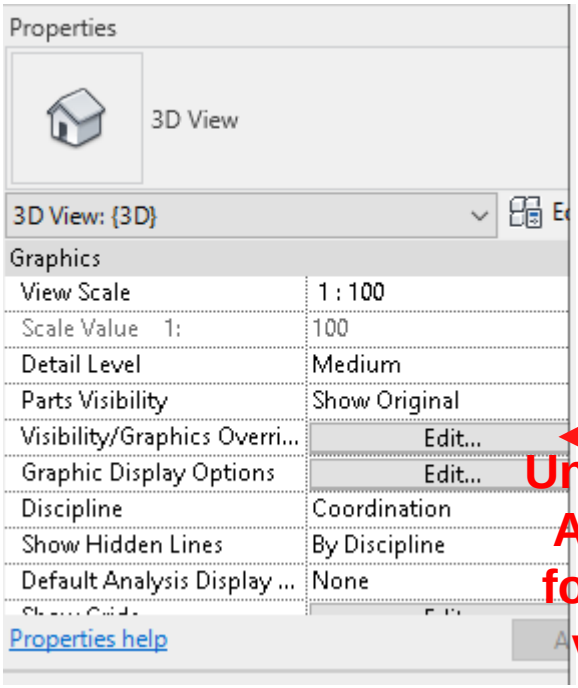
4

Use proper draw tools and push the finish!

Drawing Floor

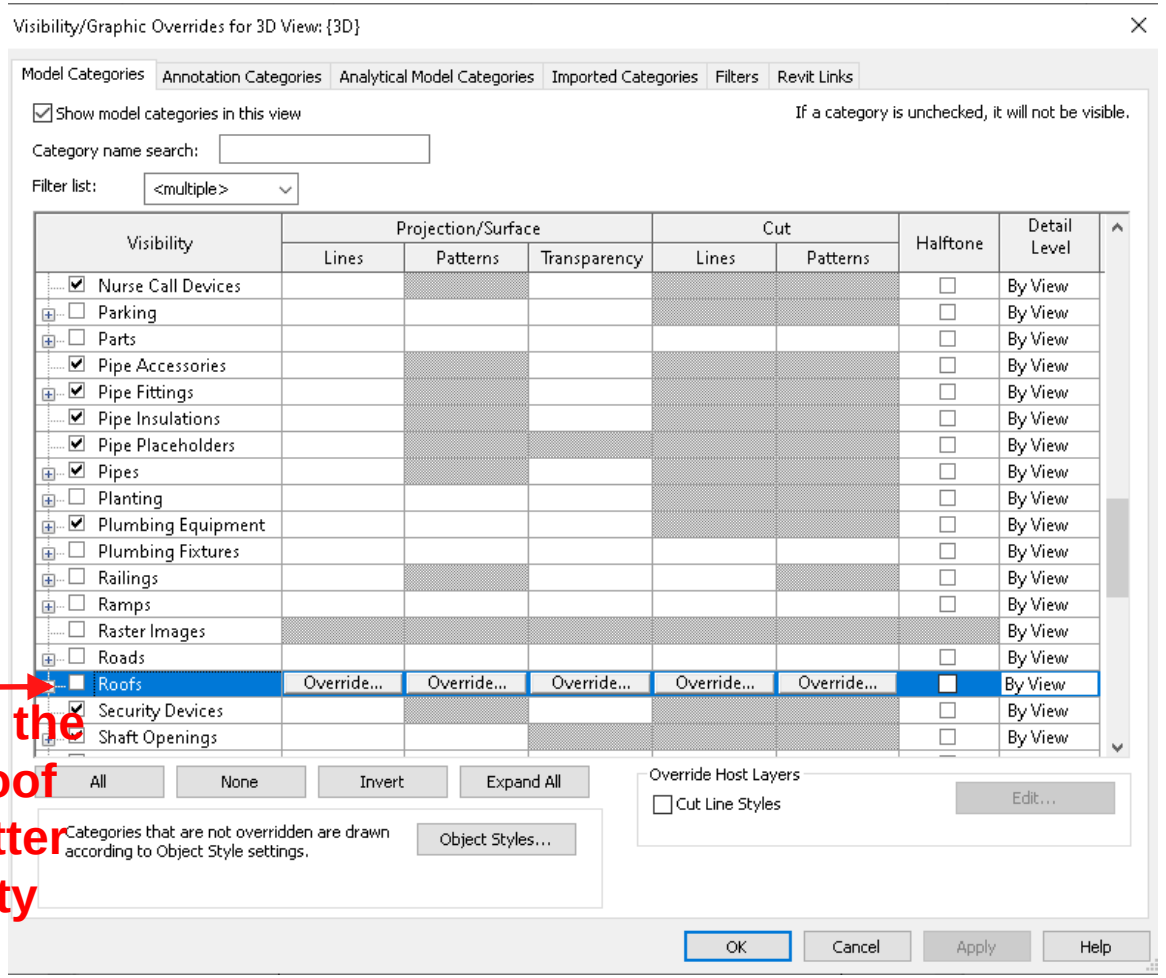


Drawing Beams

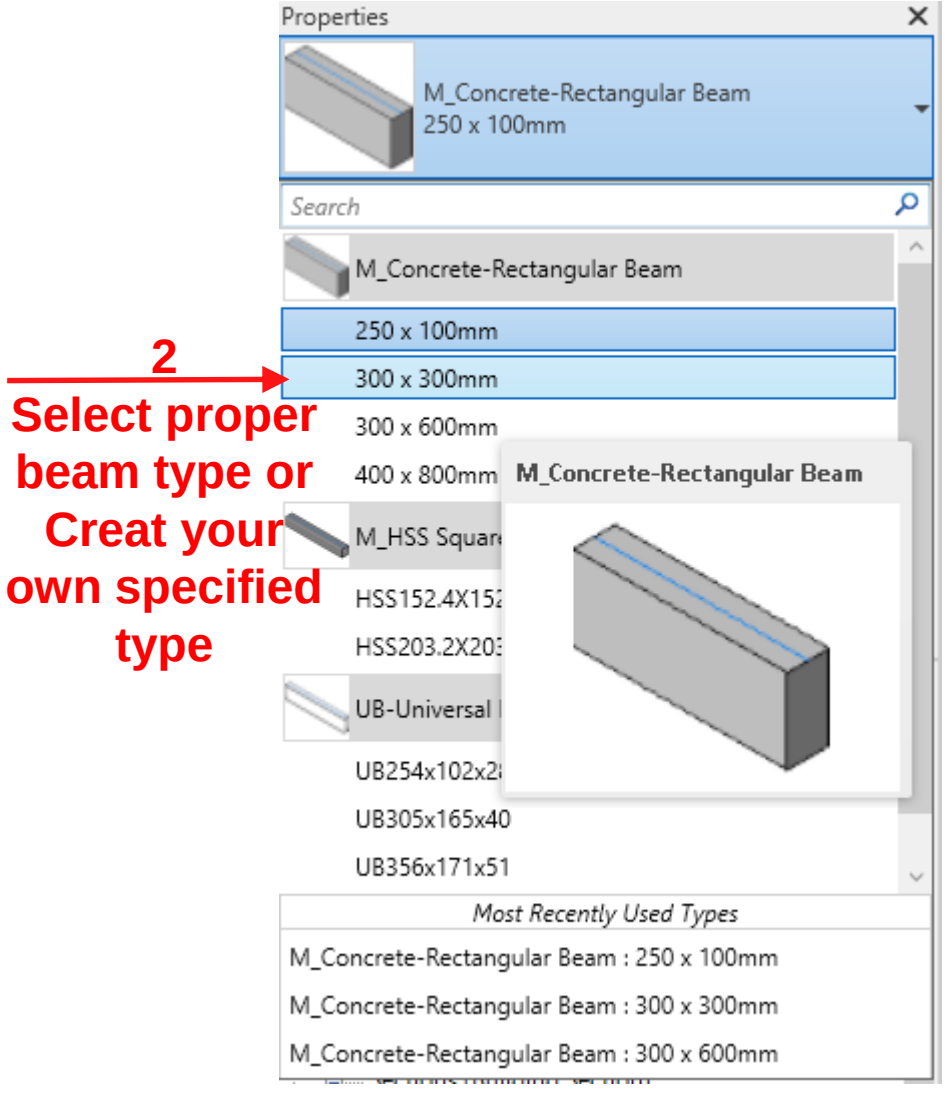


1

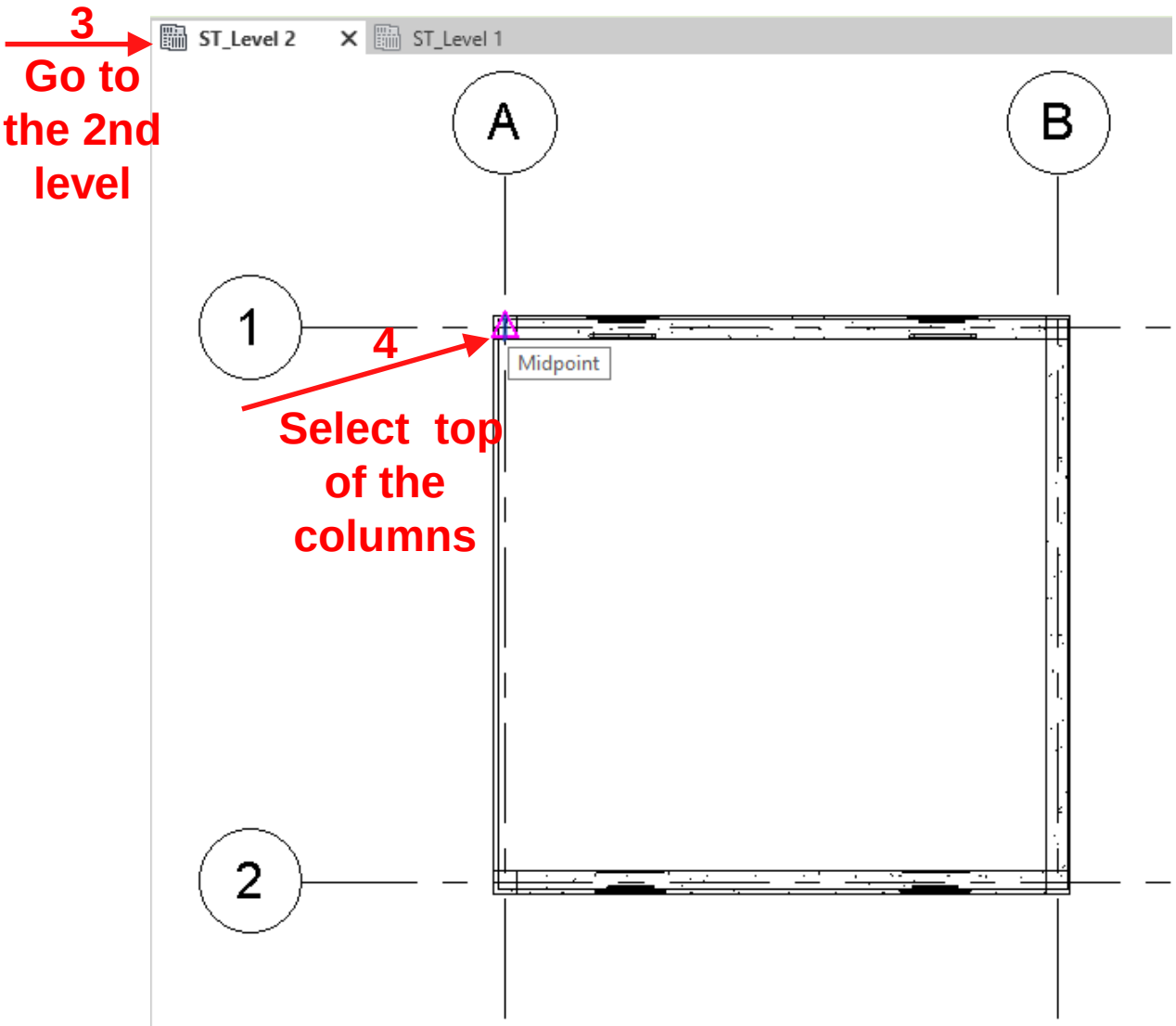
Uncheck the Arch. roof for a better visibility



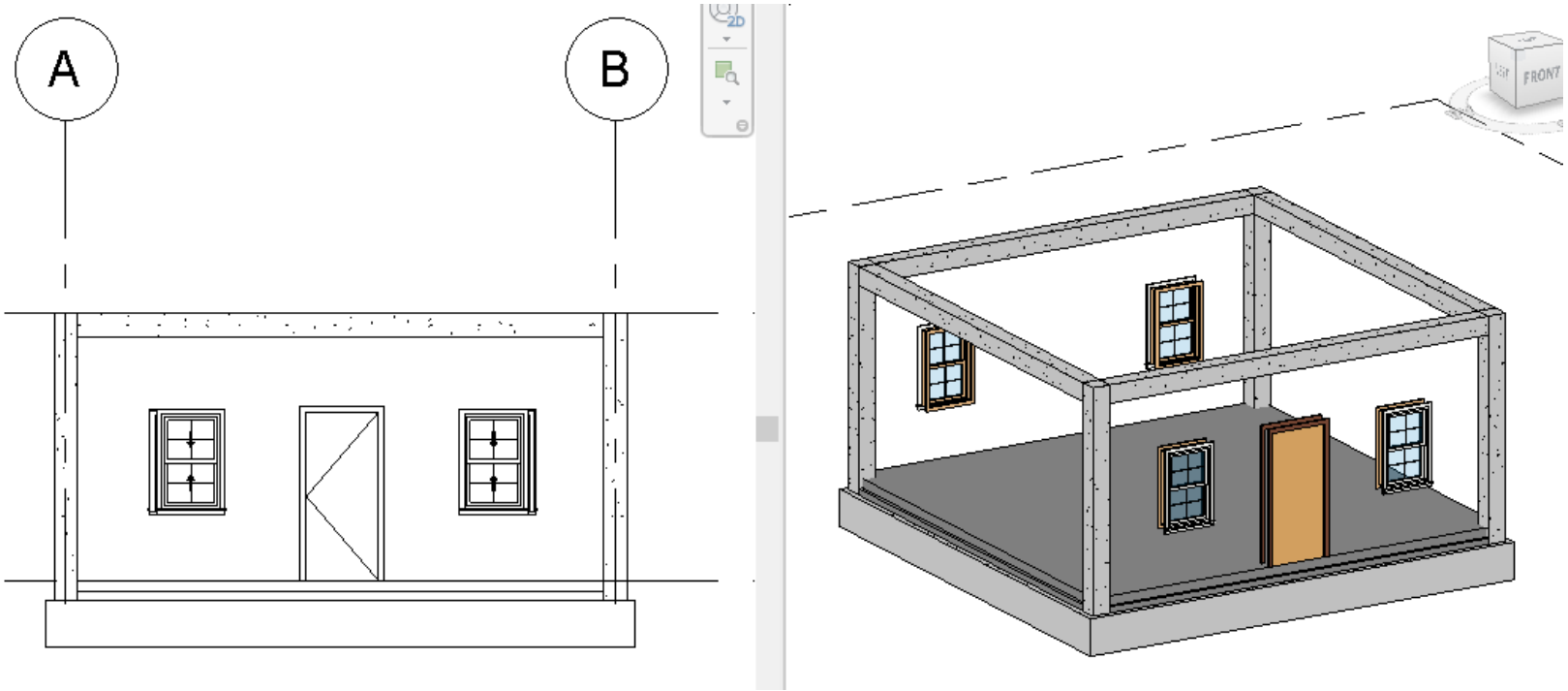
Drawing Beams



Drawing Beams



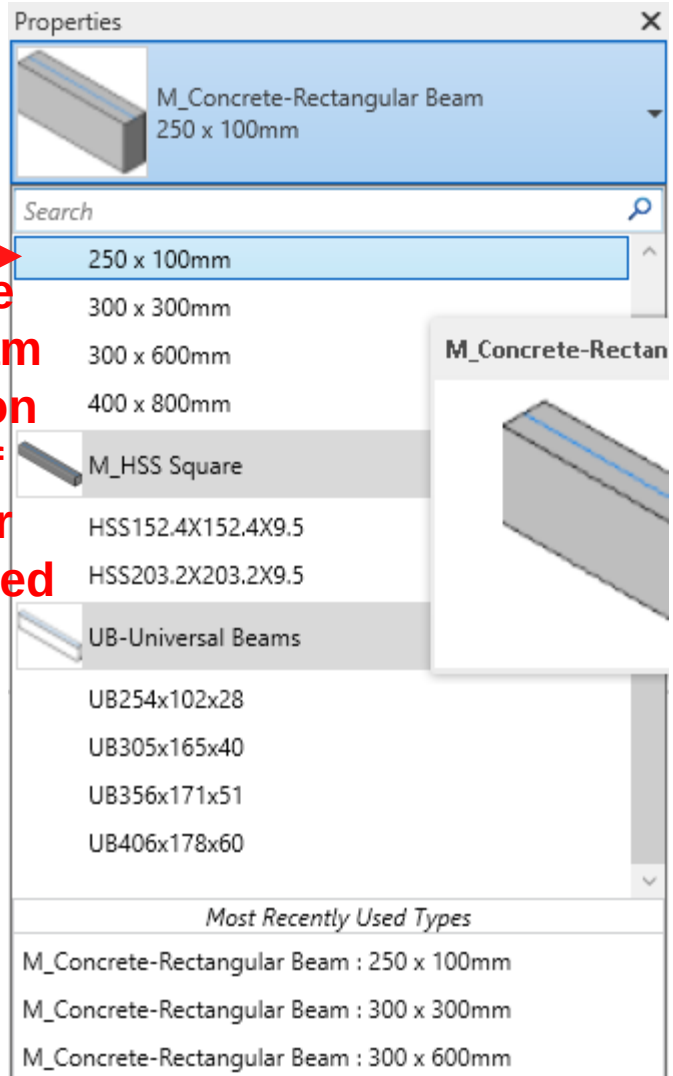
Drawing Beams



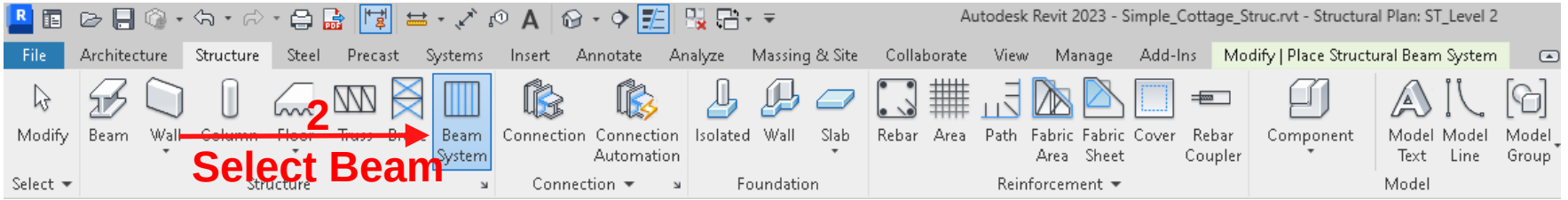
Drawing Beam System

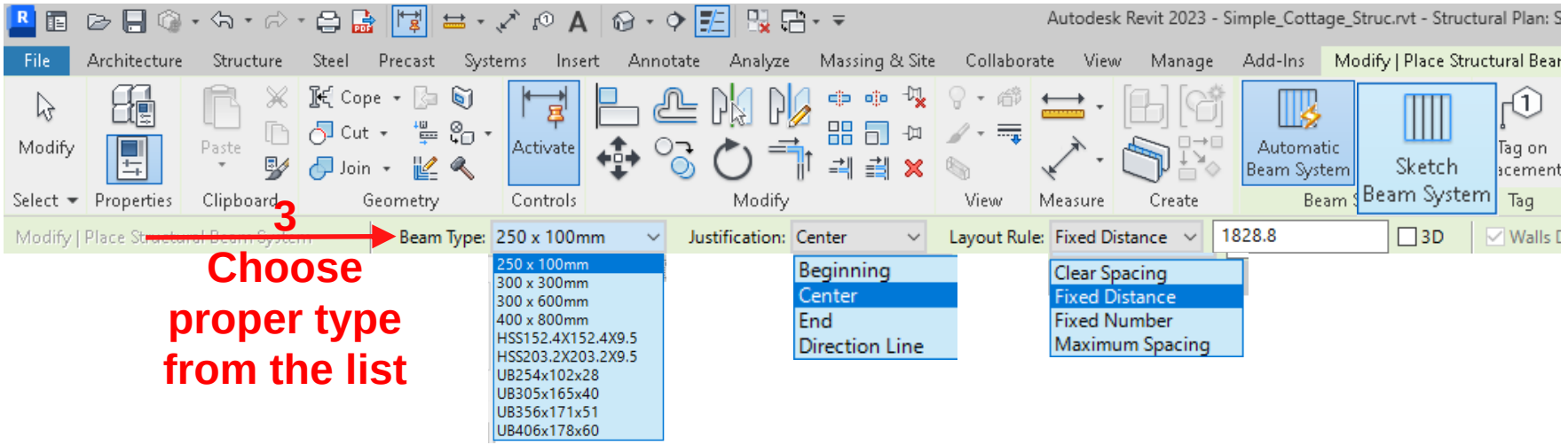
1

Make sure proper beam types are on the list of creat your own specified type

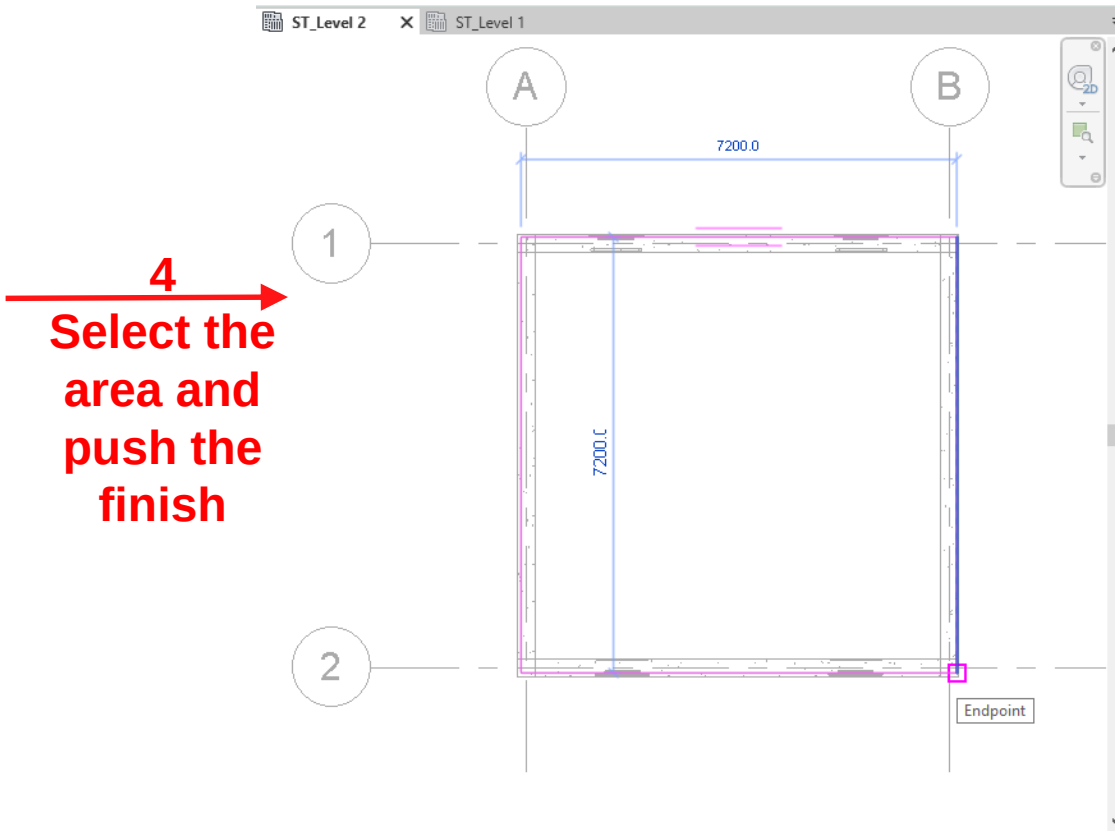


Drawing Beam System

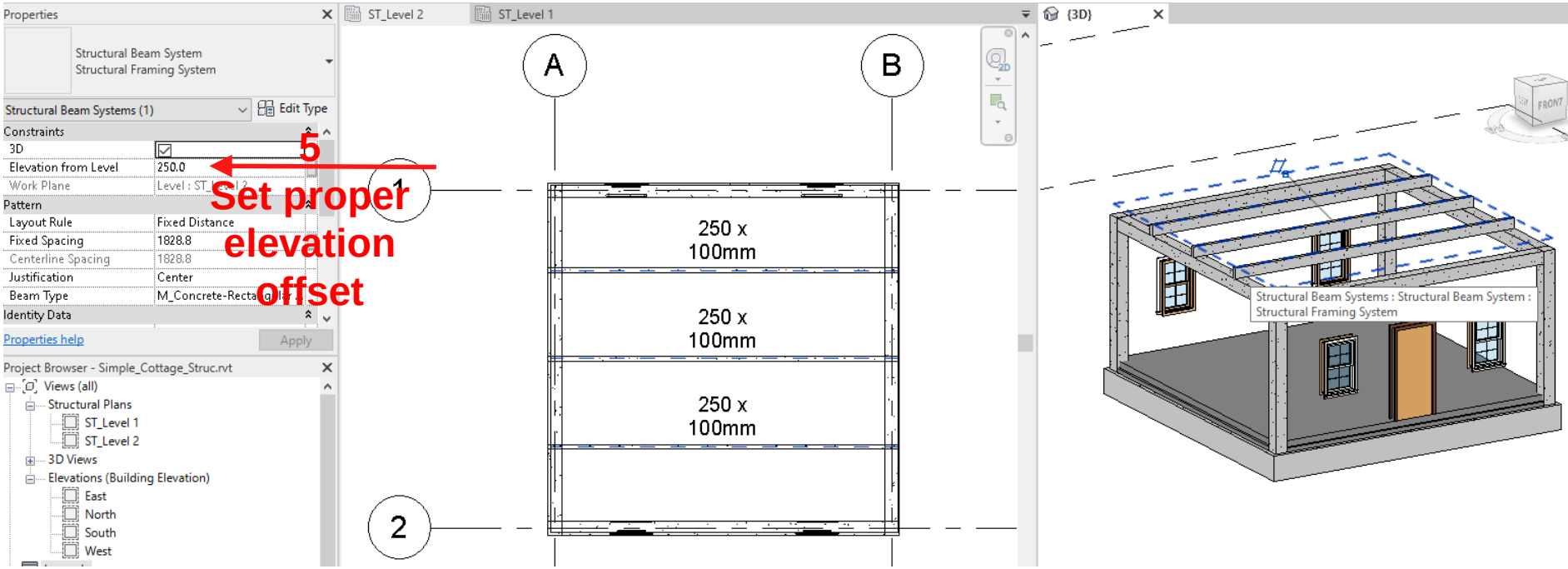




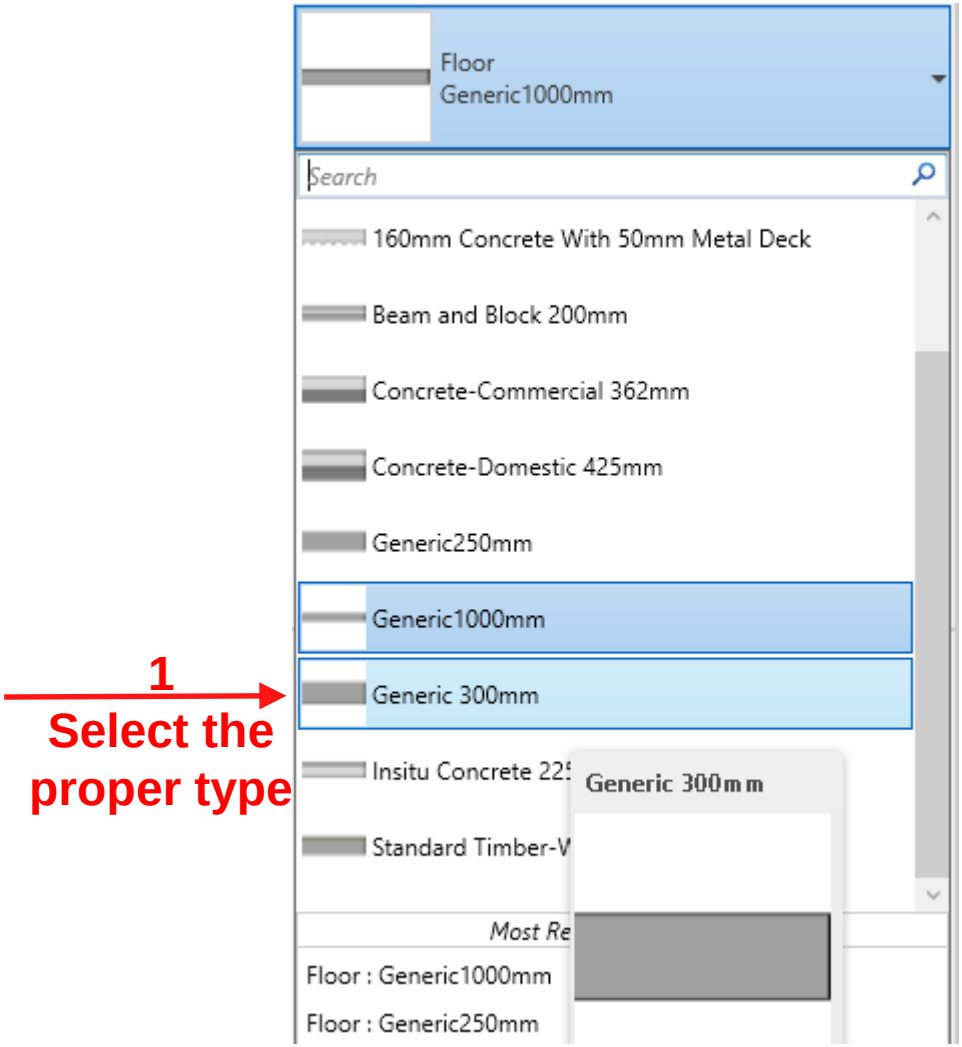
Drawing Beam System



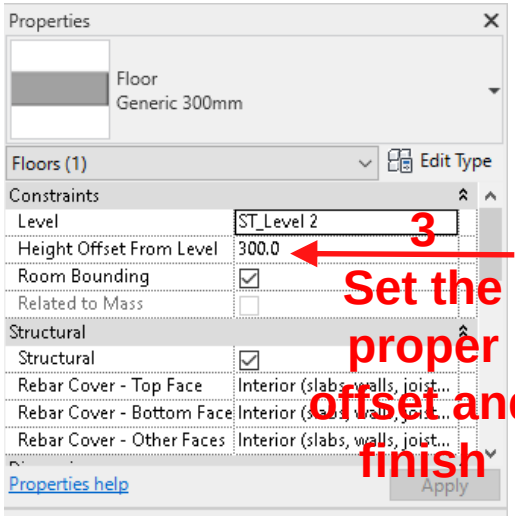
Drawing Beam System



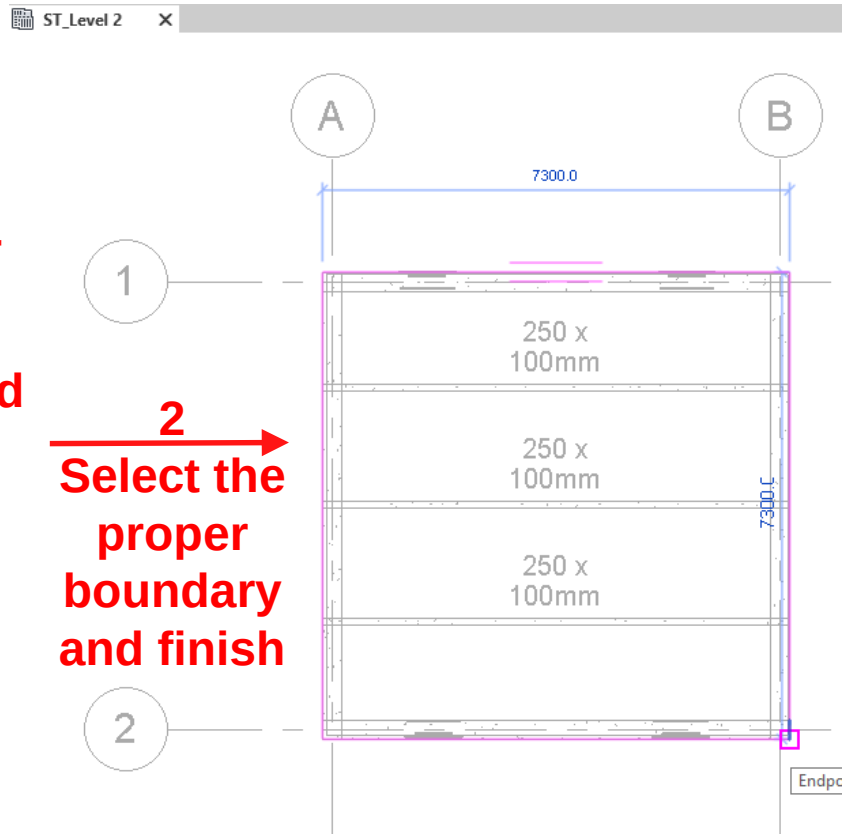
Drawing Structural Roof



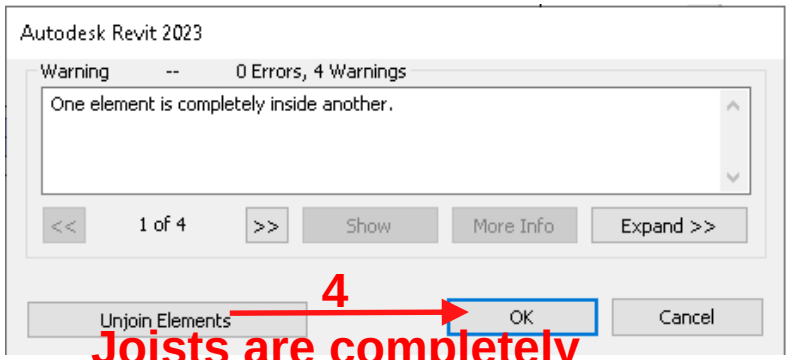
Drawing Structural Ceiling



3
Set the proper offset and finish

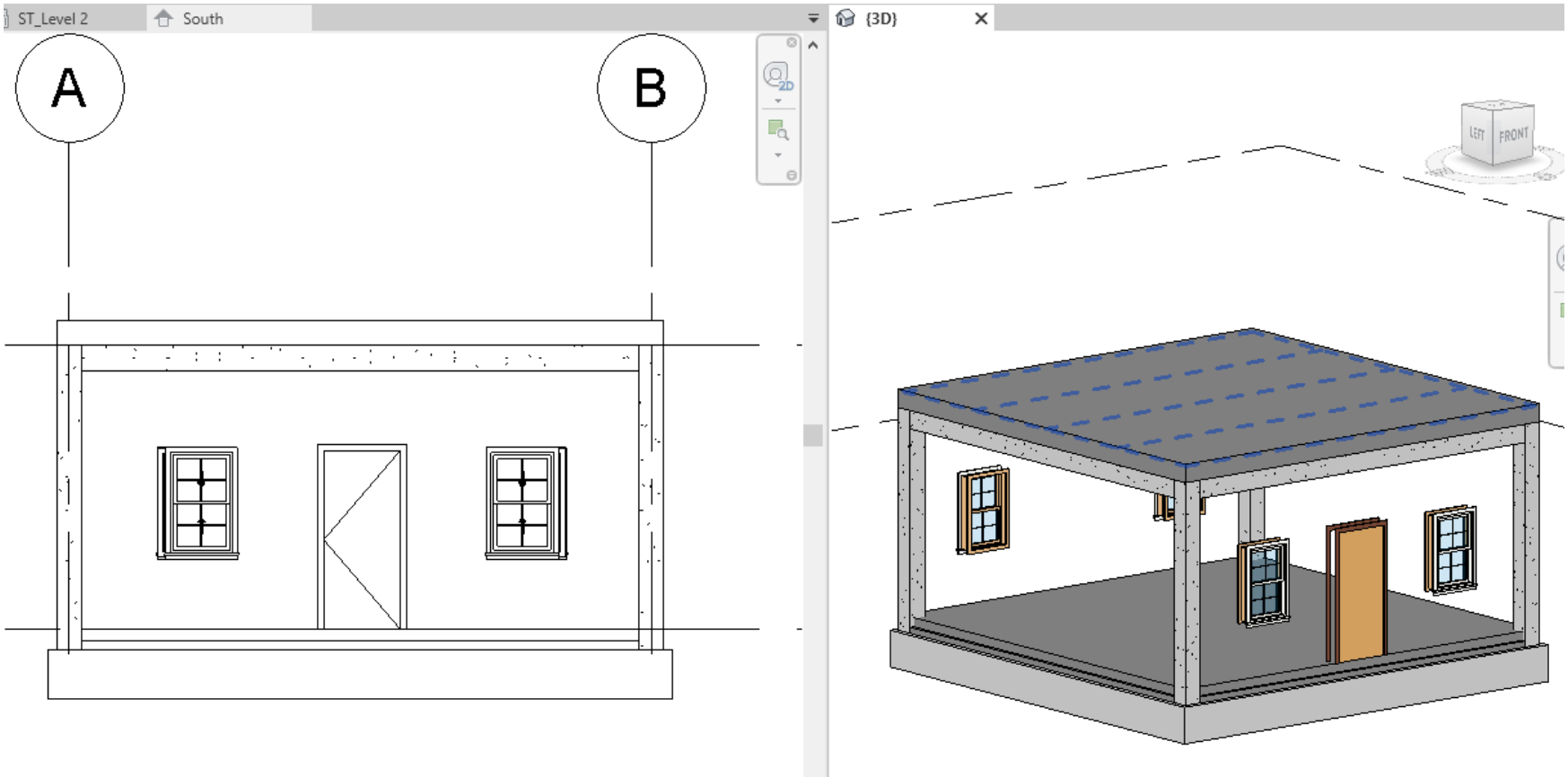


2
Select the proper boundary and finish

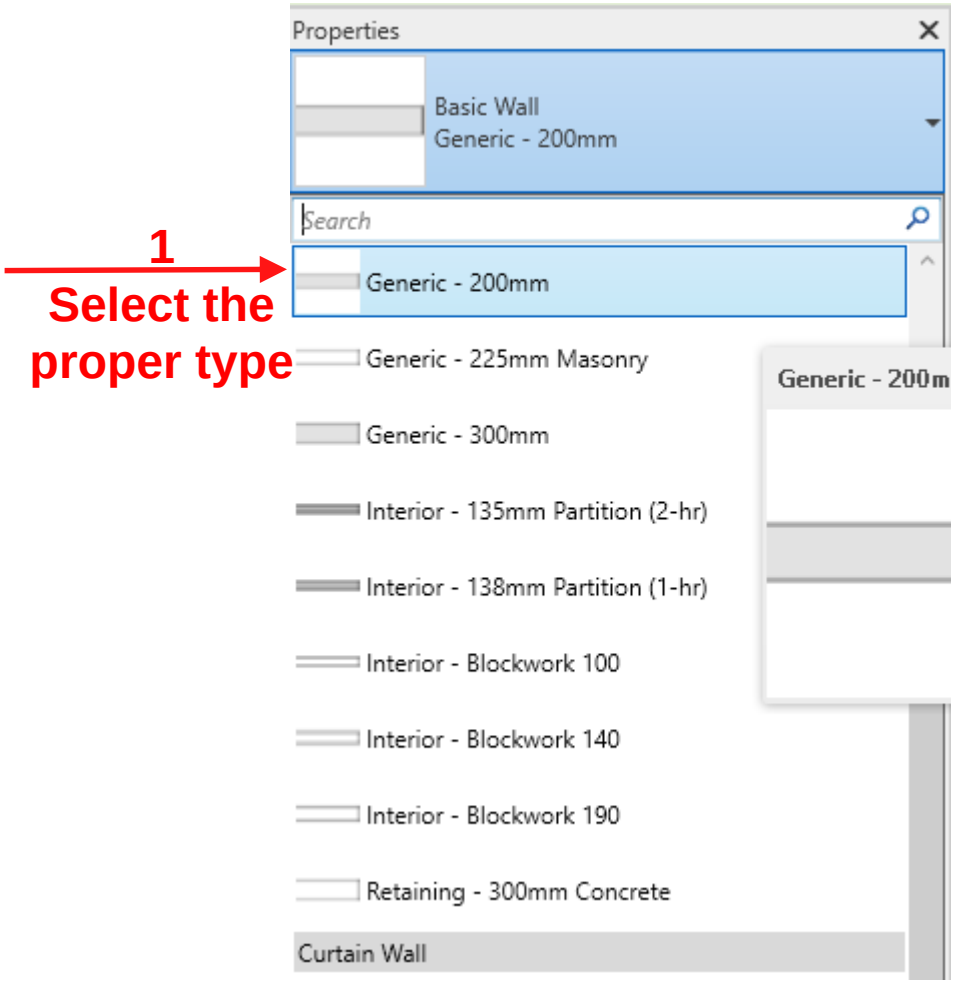


4
Joists are completely buried inside the structural ceiling

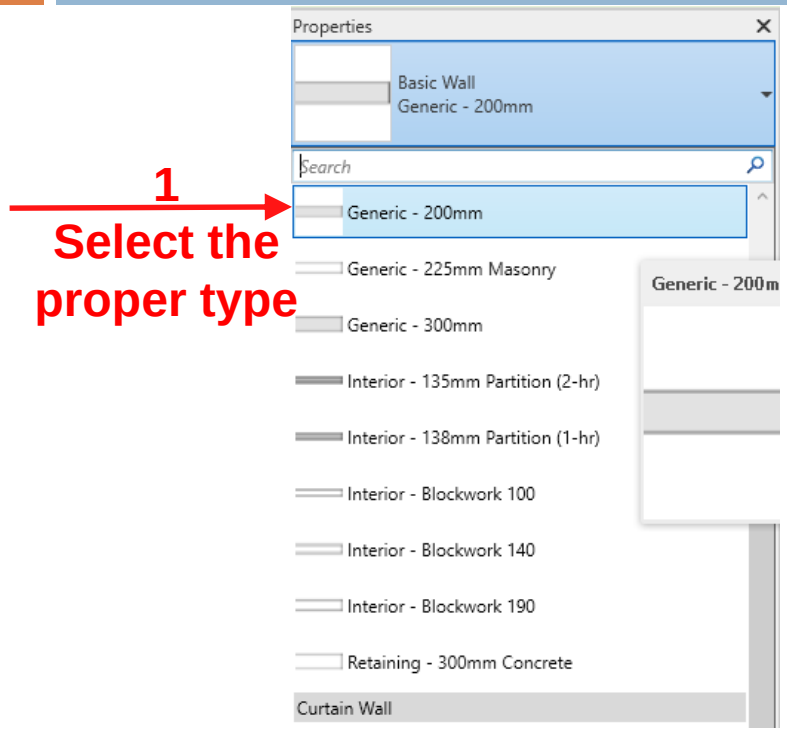
Drawing Structural Ceiling

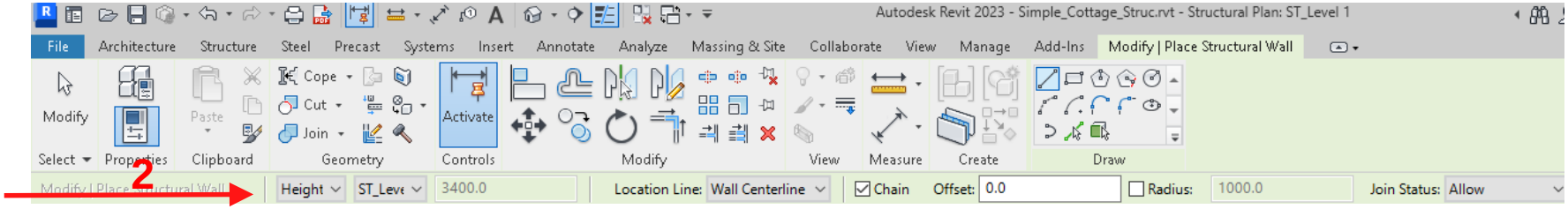


Drawing Wall

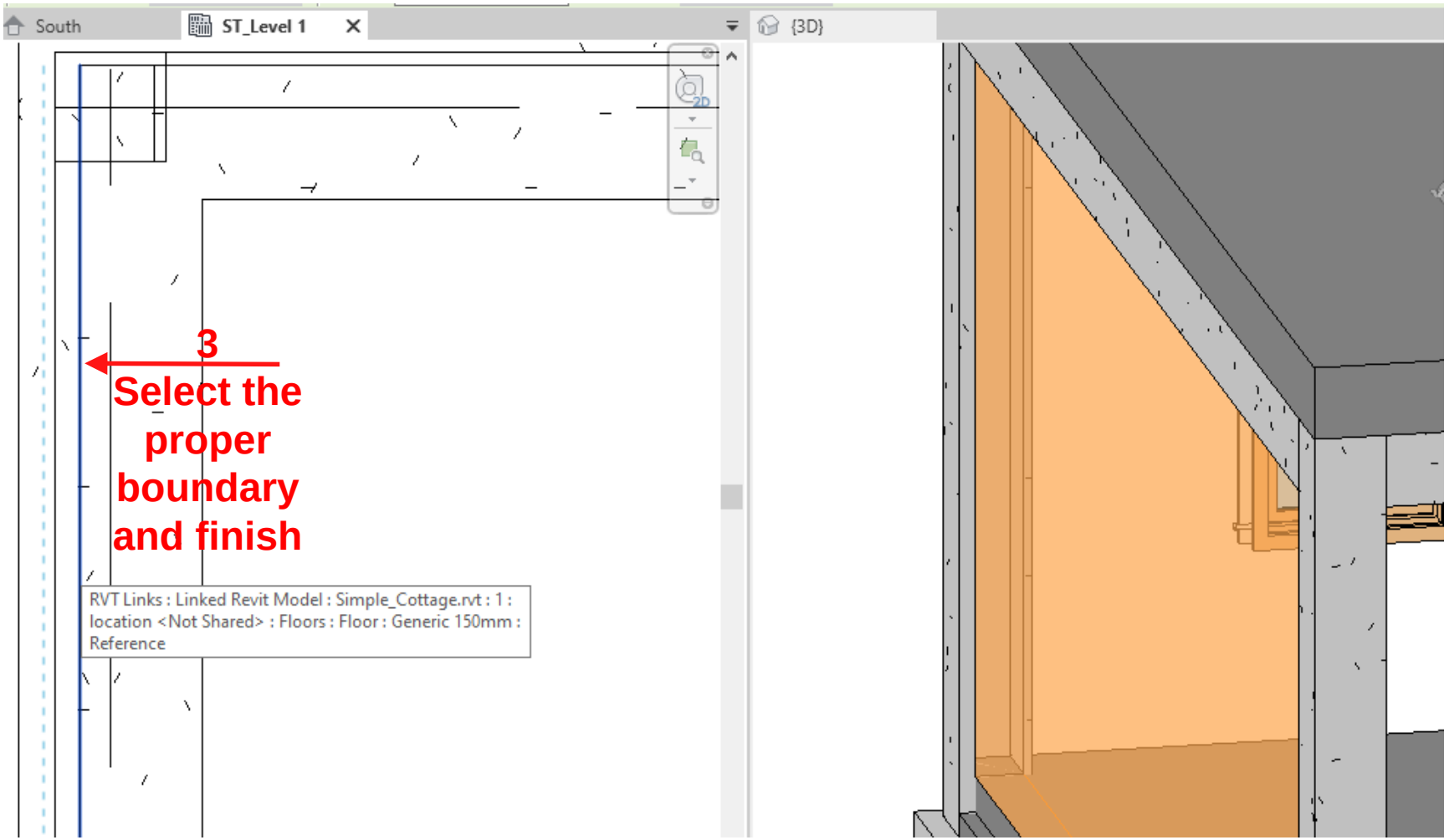


Drawing Wall





Drawing Wall

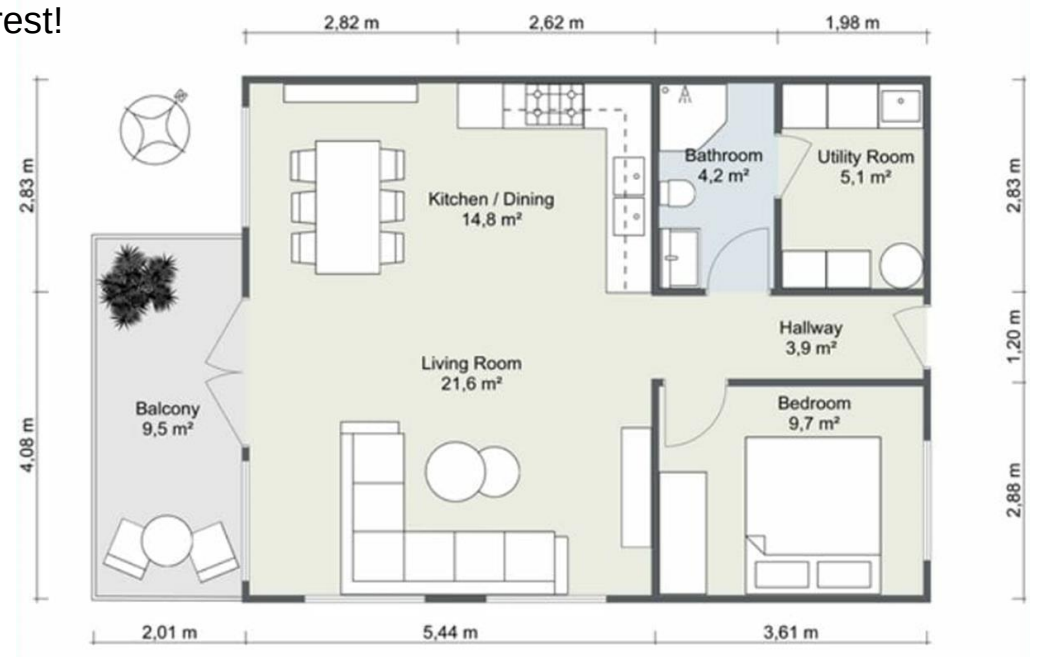


In Class Practice

- Why do we have different approaches for modeling architecture, structure and utility systems in Revit?

Home Assignment

- Draw the following single story building using architecture and structure disciplines in Revit with the following assumptions:
  - Use strip footing foundation with 50cm x 50cm dimension; The columns are 40cm x 40cm; The max. floor height is 340cm; The beams are 30cm x 40cm; The beam system's columns are 15cm x 30cm with 2m distance; The max. floor height is 340cm; The façade is Travertine stone; Total thickness of the envelope walls is 40cm and for internal walls is 20cm with the core material of concrete blocks; Use reasonable assumptions for the rest!



Thanks