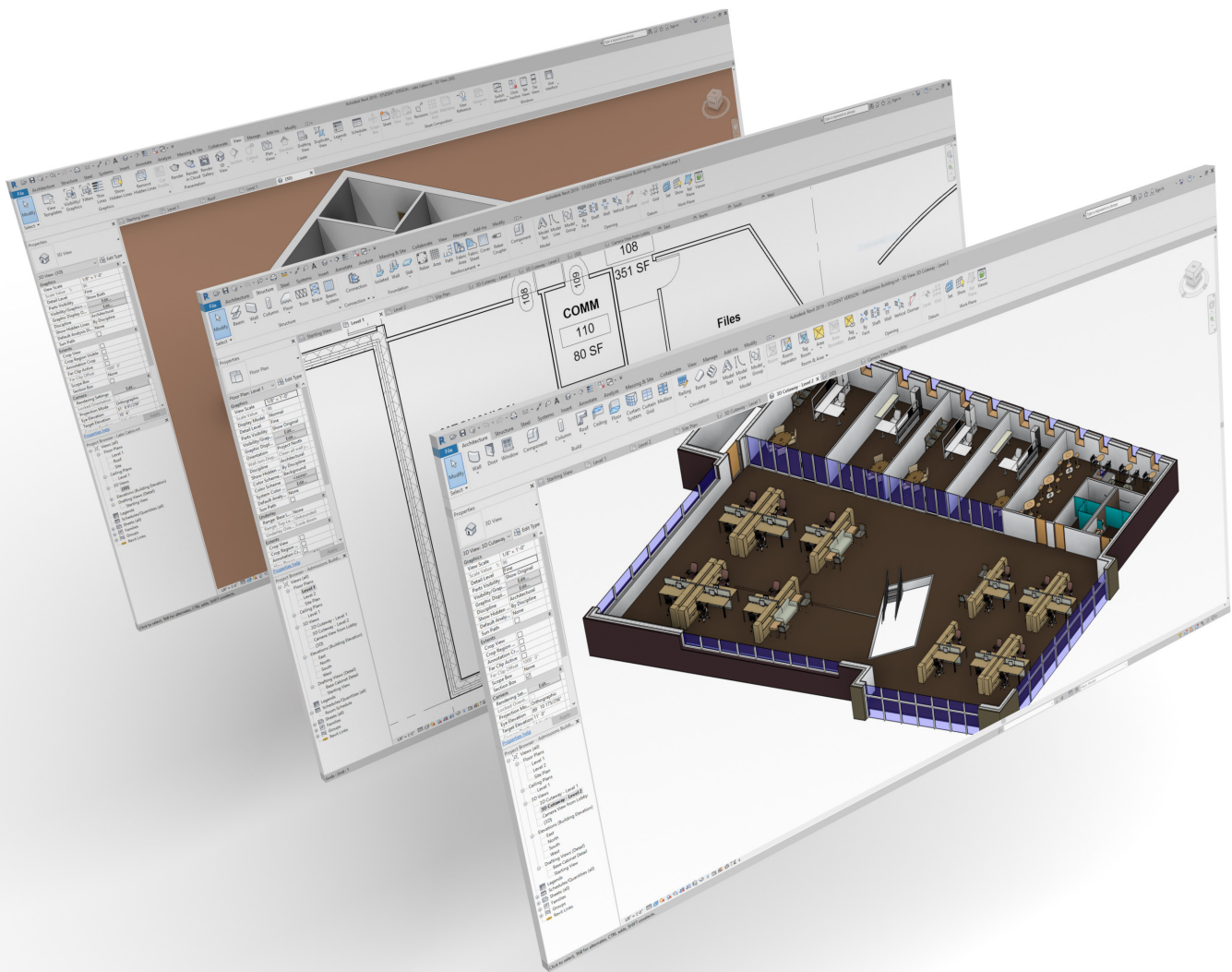


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2.0 Revit Fundamentals



What is Autodesk Revit?

Autodesk Revit (Architecture, Structure and MEP) is the world's first fully parametric building design software. This revolutionary software, for the first time, truly takes architectural computer aided design beyond simply being a high-tech pencil. Revit is a product of Autodesk, makers of AutoCAD, Civil 3D, Inventor, 3DS Max, Maya and many other popular design programs.

Revit can be thought of as the foundation of a larger process called **Building Information Modeling** (BIM). The BIM process revolves around a virtual, information rich 3D model. In this model all the major building elements are represented and contain information such as manufacturer, model, cost, phase and much more. Once a model has been developed in Revit, third-party add-ins and applications can be used to further leverage the data. Some examples are Facilities Management, Analysis (Energy, Structural, Lighting), Construction Sequencing, Cost Estimating, Code Compliance and much more!

Revit can be an invaluable tool to designers when leveraged to its full potential. The iterative design process can be accomplished using special Revit features such as *Phasing* and *Design Options*. Material selections can be developed and attached to various elements in the model, where one simple change adjusts the wood from oak to maple throughout the project. The power of schedules may be used to determine quantities and document various parameters contained within content (this is the “I” in BIM, which stands for Information). Finally, the three-dimensional nature of a Revit-based model allows the designer to present compelling still images and animations. These graphics help to more clearly communicate the design intent to clients and other interested parties. This book will cover many of these tools and techniques to **assist** in the creative process.

What is a parametric building modeler?

Revit is a program designed from the ground up using state-of-the-art technology. The term parametric describes a process by which an element is modified and an adjacent element(s) is automatically modified to maintain a previously established relationship. For example, if a wall is moved, perpendicular walls will grow, or shrink, in length to remain attached to the related wall. Additionally, elements attached to the wall will move, such as wall cabinets, doors, windows, air grilles, etc.

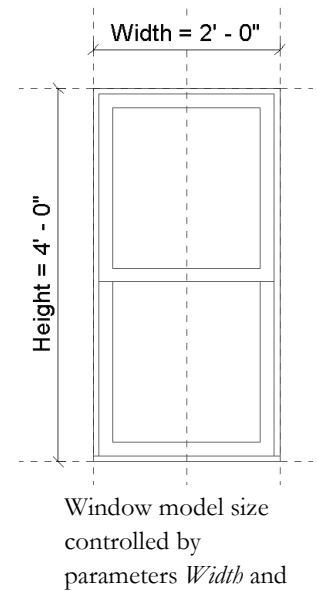
Revit stands for **Revise Instantly**; a change made in one view is automatically updated in all other views and schedules. For example, if you move a door in an interior elevation view, the floor plan will automatically update. Or, if you delete a door, it will be deleted from all other views and schedules.

A major goal of Revit is to eliminate much of the repetitive and mundane tasks traditionally associated with CAD programs allowing more time for design, coordination and visualization. For example: all sheet numbers, elevation tags and reference bubbles are updated automatically

when changed anywhere in the project. Therefore, it is difficult to find a mis-referenced detail tag.

The best way to understand how a parametric model works is to describe the Revit project file. A single Revit file contains your entire building project. Even though you mostly draw in 2D views, you are actually drawing in 3D. In fact, the entire building project is a 3D model. From this 3D model you can generate 2D elevations, 2D sections and perspective views. Therefore, when you delete a door in an elevation view you are actually deleting the door from the 3D model from which all 2D views are generated and automatically updated.

Another way in which Revit is a parametric building modeler is that parameters can be used to control the size and shape of geometry. For example, a window model can have two parameters set up which control the size of the window. Thus, from a window's properties it is possible to control the size of the window without using any of the drawing modify tools such as Scale or Move. Furthermore, the parameter settings (i.e., width and height in this example) can be saved within the window model (called a Family). You could have the 2' x 4' settings saved as "Type A" and the 2' x 6' as "Type B." Each saved list of values is called a Type within the Family. Thus, this one double-hung window Family could represent an unlimited number of window sizes! You will learn more about this later in the book.



Example of window family rendered using Enscape, a real-time rendering add-in for Revit

Trial Software

If you do not have access to Revit to practice for the ACU exam, you can download a trial version. Autodesk offers a free 30-day trial of Revit. To learn more, follow this link:

<https://www.autodesk.com/products/revit/free-trial>

Below are the minimum system requirements to run Revit:

| | |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <p>OPERATING SYSTEM ¹</p> | <p>Microsoft® Windows® 7 SP1 64-bit: Enterprise, Ultimate, Professional, or Home Premium</p> <p>Microsoft Windows 8.1 64-bit: Enterprise, Pro, or Windows 8.1</p> <p>Microsoft Windows 10 Anniversary Update 64-bit (version 1607 or higher): Enterprise, or Pro</p> |
| <p>CPU TYPE</p> | <p>Single- or Multi-Core Intel® Pentium®, Xeon®, or i-Series processor or AMD® equivalent with SSE2 technology. Highest affordable CPU speed rating recommended.</p> <p>Autodesk Revit software products will use multiple cores for many tasks, using up to 16 cores for near-photorealistic rendering operations.</p> |
| <p>MEMORY</p> | <p>4 GB RAM</p> <ul style="list-style-type: none"> • Usually sufficient for a typical editing session for a single model up to approximately 100 MB on disk. This estimate is based on internal testing and customer reports. Individual models will vary in their use of computer resources and performance characteristics. • Models created in previous versions of Revit software products may require more available memory for the one-time upgrade process. |
| <p>VIDEO DISPLAY RESOLUTIONS</p> | <p>Minimum: 1280 x 1024 with true color</p> |

| | |
|------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------|
| | Maximum: Ultra-High (4k) Definition Monitor |
| VIDEO ADAPTER | Basic Graphics: Display adapter capable of 24-bit color Advanced Graphics: DirectX® 11 capable graphics card with Shader Model 3 |
| DISK SPACE | 5 GB free disk space |
| MEDIA | Download or installation from DVD9 or USB key |
| POINTING DEVICE | MS-Mouse or 3Dconnexion® compliant device |
| BROWSER | Microsoft® Internet Explorer® 7.0 (or later) |
| CONNECTIVITY | Internet connection for license registration and prerequisite component download |

Student Software

Students can download a free 3-year version of Revit at www.students.autodesk.com. Be sure to use your school email address. When using the educational version and logged in to Autodesk A360, using your school email address, you have access to unlimited cloud credits for rendering.

The student version of the software is intended for learning purposes only; it is against the licensing agreement to use a student version for any professional work. If found using student licenses to do professional work, you may be subject to legal action from Autodesk.

The system requirements for the student version are the same as the trial version listed above.



3D model of lunch room created in Interior Design using Autodesk Revit 2019

Why use Revit?

Many people ask the question, why use Revit versus other programs? The answer can certainly vary depending on the situation and particular needs of an individual or organization.

Generally speaking, this is why most companies use Revit:

- Many designers and drafters are using Revit to streamline repetitive drafting tasks and focus more on designing and detailing a project.
- Revit is a very progressive program and offers many features for designing buildings. Revit is constantly being developed and Autodesk provides incremental upgrades and patches on a regular basis.
- Revit was designed specifically for architectural design and includes features like:
 - Photo Realistic Rendering
 - Phasing (different design over time)
 - Design Options (different designs within the same time period)
 - Live Schedules
 - Quantity Schedules
 - Material Takeoff Schedules
 - Sheet Index Schedule
 - Cloud Rendering via *Autodesk 360*
 - Analysis via *Autodesk 360*
 - Conceptual Energy Analysis
 - Daylighting Analysis
 - Structural Analysis

File Types and their extensions:

Revit has four primary types of files that you will work with as a Revit user. Each file type, as with any Microsoft Windows based program, has a specific three letter file name extension; that is, after the name of the file on your hard drive you will see a period and three letters:

| | |
|------|------------------------------------------------------------------------------------|
| .RVT | Revit project files; the file most used Backup files .RVT.0001, .RVT.0002, etc. |
| .RFA | Revit family file; loadable content for your project |
| .RTE | Revit template; a project starter file with office standards preset |
| .RFT | Revit family template; a family starter file with parameters |

A few basic Revit concepts:

The following is meant to be a brief overview of the basic organization of Revit as a software application. You should not get too hung up on these concepts and terms as they will make more sense as you work through the tutorials in this book. This discussion is simply laying the groundwork so you have a general frame of reference on how Revit works.

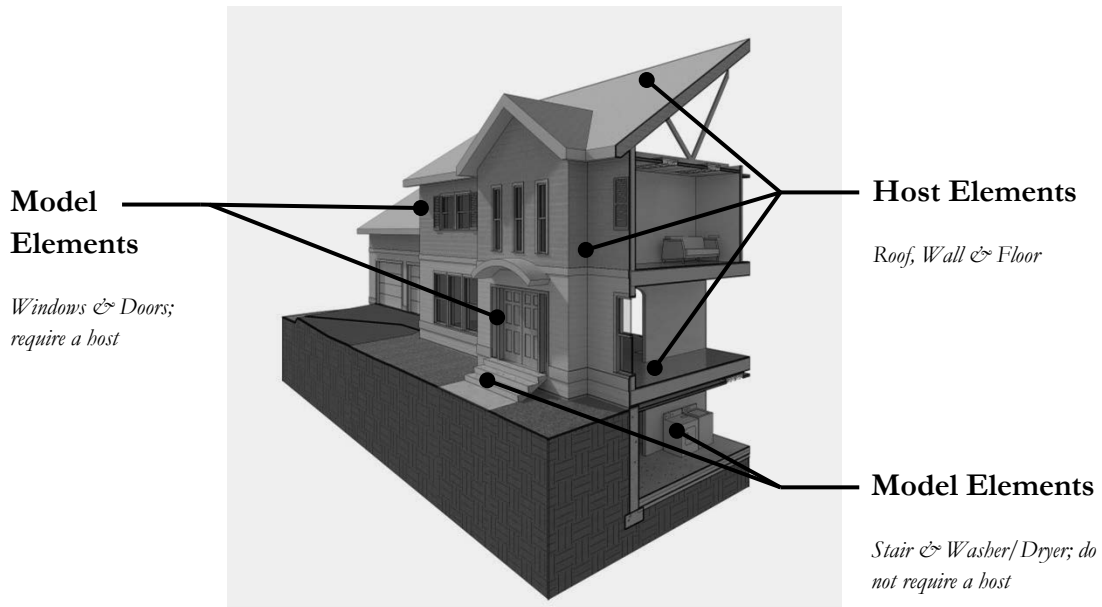
The Revit platform has three fundamental types of elements:

- Model Elements
- Datum Elements
- View-Specific Elements

Model Elements

Think of *Model Elements* as things you can put your hands on once the building has been constructed. They are typically 3D but can sometimes be 2D. There are two types of *Model Elements*:

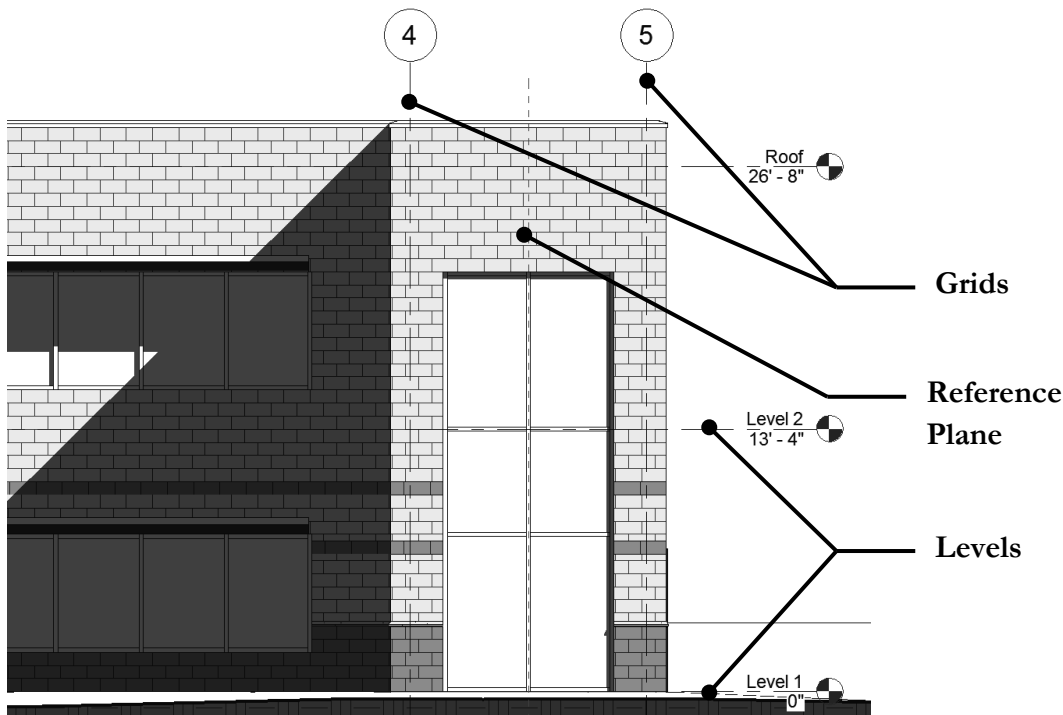
- **Host Elements (aka System Family)** Walls, floors, slabs, roofs, ceilings. These are items that can only exist within a project—they cannot be loaded from a file.
- **Model Components** (Stairs, Doors, Furniture, Beams, Columns, Pipes, Ducts, Light Fixtures, Model Lines) – Options vary depending on the “flavor” of Revit.
 - Some *Model Components* require a host before they can be placed within a project. For example, a window can only be placed in a host, which could be a wall, roof or floor depending on how the element was created. If the host is deleted, all hosted or dependent elements are automatically deleted.



Datum Elements

Datum Elements are reference planes within the building that graphically and parametrically define the location of various elements within the model. These features are available in all “flavors” of Revit. These are the three types of *Datum Elements*:

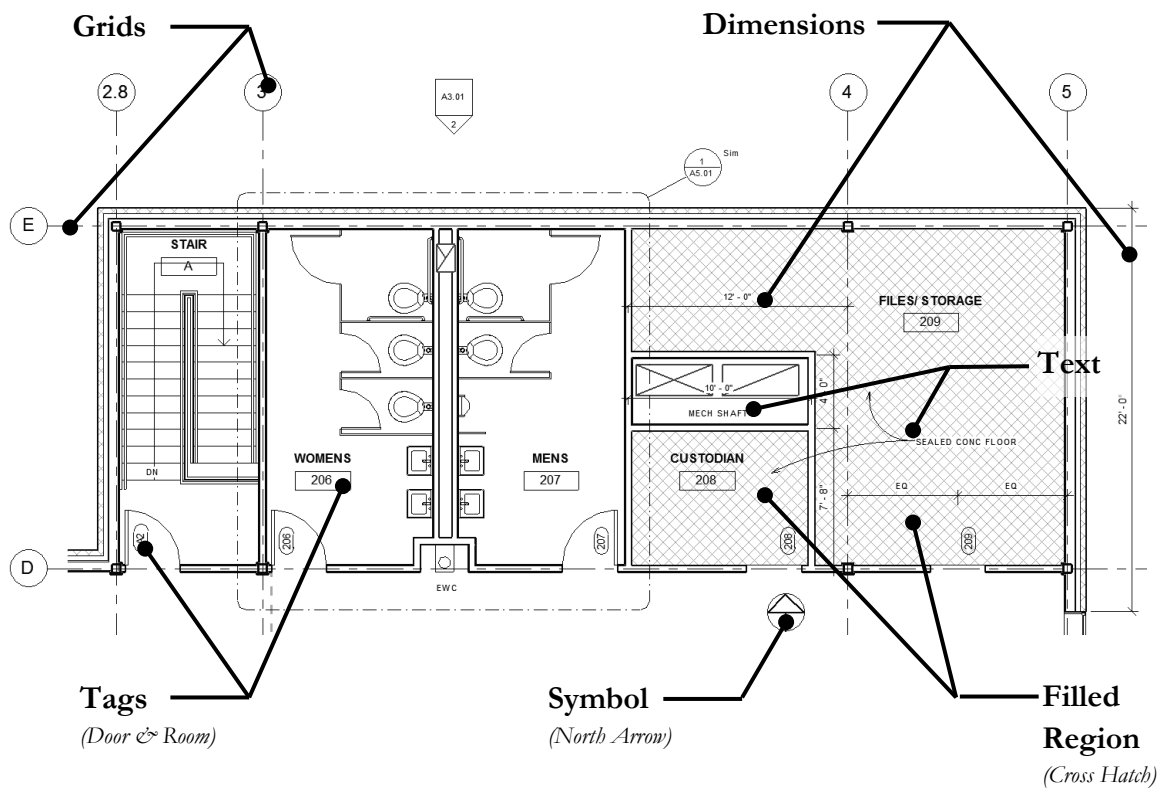
- **Grids**
 - ❖ Typically laid out in a plan view to locate structural elements such as columns and beams, as well as walls. Grids show up in plan, elevation and section views. Moving a grid in one view moves it in all other views as it is the same element. (See the next page for an example of a grid in plan view.)
- **Levels**
 - ❖ Used to define vertical relationships, mainly surfaces that you walk on. They only show up in elevation and section views. Many elements are placed relative to a *Level*; when the *Level* is moved those elements move with it (e.g., doors, windows, casework, ceilings). **WARNING:** *If a Level is deleted, those same “dependent” elements will also be deleted from the project!*
- **Reference Planes**
 - ❖ These are similar to grids in that they show up in plan and elevation or sections. They do not have reference bubbles at the end like grids. Revit breaks many tasks down into simple 2D tasks which result in 3D geometry. *Reference Planes* are used to define 2D surfaces on which to work within the 3D model. They can be placed in any view, either horizontally or vertically.



View-Specific Elements

As the name implies, the items about to be discussed only show up in the specific view in which they are created. For example, notes and dimensions added in the architectural floor plans will not show up in the structural floor plans. These elements are all 2D and are mainly communication tools used to accurately document the building for construction or presentations.

- **Annotation elements** (text, tags, symbols, dimensions)
 - Size automatically set and changed based on selected drawing scale
- **Details** (detail lines, filled regions, 2D detail components)



The Revit platform has three fundamental ways in which to work with the elements (for display and manipulation):

- Views
- Schedules
- Sheets

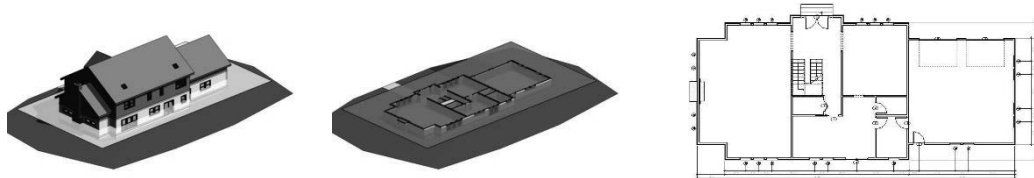
The following is a cursory overview of the main ideas you need to know. This is not an exhaustive study on views, schedules and sheets.

Views

Views, accessible from the *Project Browser* (see Page 5-4), is where most of the work is done while using Revit. Think of views as slices through the building, both horizontal (plans) and vertical (elevations and sections).

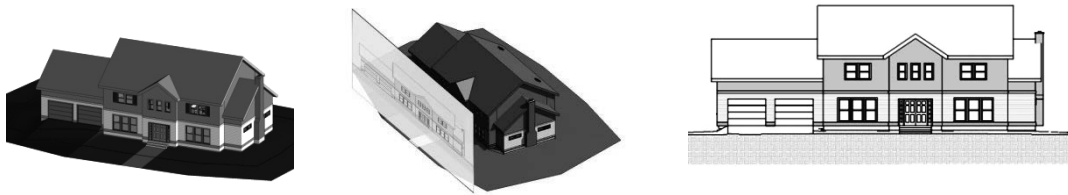
- **Plans**

A *Plan View* is a horizontal slice through the building. You can specify the location of the **cut plane** which determines if certain windows show up or how much of the stair is seen. A few examples are architectural floor plan, reflected ceiling plan, site plan, structural framing plan, HVAC floor plan, electrical floor plan, lighting [ceiling] plan, etc. The images below show this concept; the image on the left is the 3D BIM. The middle image shows the portion of building above the cut plane removed. Finally, the last image on the right shows the plan view you work in and place on a sheet.



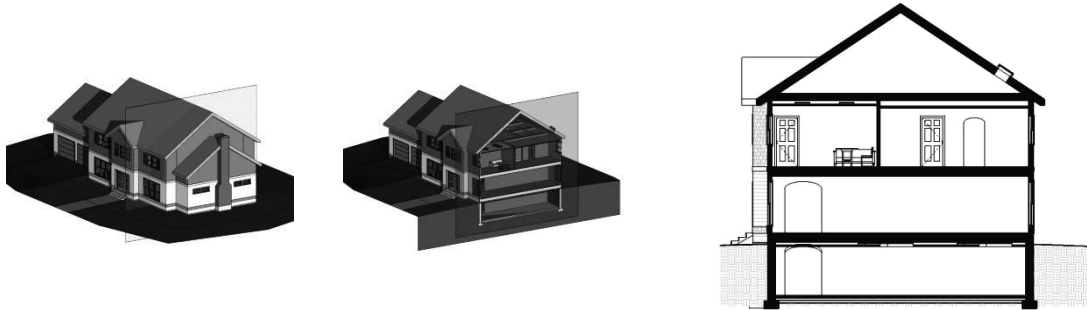
- **Elevations**

Elevations are vertical slices, but where the slice lies outside the floor plan as in the middle image below. Each elevation created is listed in the *Project Browser*. The image on the right is an example of a South exterior elevation view, which is a “live” view of the 3D model. If you select a window here and delete it, the floor plans will update instantly.



- **Sections**

Similar to elevations, sections are also vertical slices. However, these slices cut through the building. A section view can be cropped down to become a wall section or even look just like an elevation. The images below show the slice, the portion of building in the foreground removed, and then the actual view created by the slice. A setting exists, for each section view, to control how far into that view you can see. The example on the right is “seeing” deep enough to show the doors on the interior walls.



- **3D and Camera**

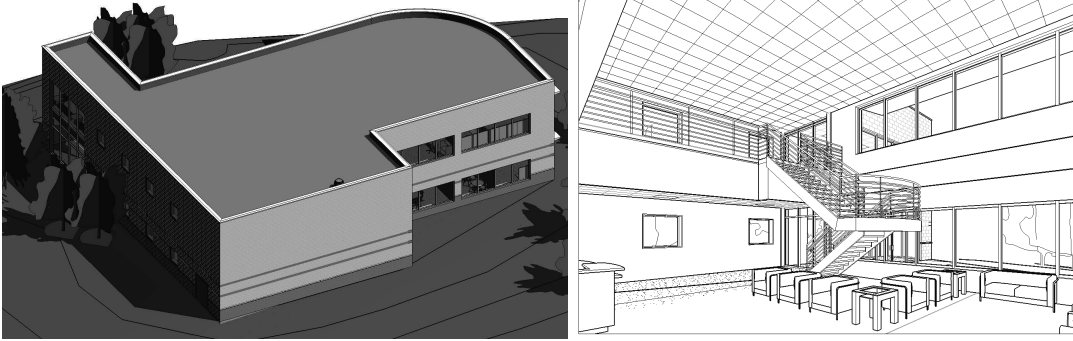
In addition to the traditional “flattened” 2D views that you will typically work in, you are able to see your designs more naturally via 3D and Camera views.

A **3D view** is simply an axonometric view; i.e., three-dimensional but without perspective.

A **Camera view** is a true perspective view; cameras can be created both in and outside of the building. Like the 2D views, these 3D/Camera views can be placed on a sheet to be printed. Revit provides a number of tools to help explore the 3D view, such as Section Box, Steering Wheel, Temporary Hide and Isolate, and Render.

You can use the View Cube in 3D views to toggle the view between axonometric and perspective projections

The image on the left is a 3D view set to “shaded mode” and has shadows turned on. The image on the right is a camera view set up inside the building; the view is set to “hidden line” rather than shaded, and the camera is at eye level.



Schedules

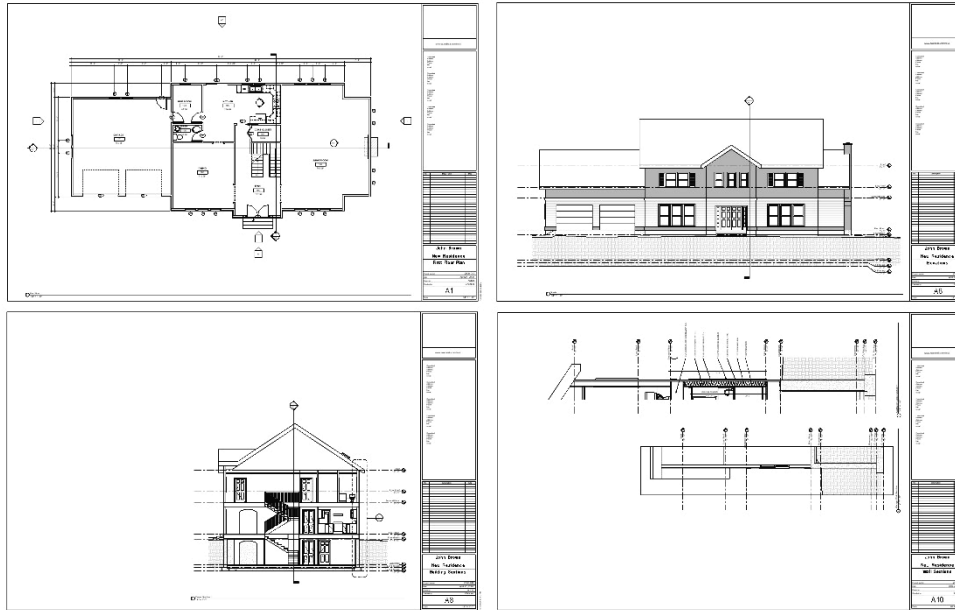
Schedules are lists of information generated based on content that has been placed, or modeled, within the project. A schedule can be created, such as the door schedule example shown below, that lists any of the data associated with each door that exists in the project. Revit allows you to work directly in the schedule views. Any change within a schedule view is a change directly to the element being scheduled. Again, if a door were to be deleted from this schedule, that door would be instantly deleted from the project.

Think of schedules as a “non-graphical” view of model elements. You are viewing the model; you are just not seeing the graphic part of the model. You are only viewing the information about an element, not the graphic representation.

| DOOR AND FRAME SCHEDULE | | | | | | | | | | | | | |
|-------------------------|---------|----------|------|------|-------|------|----------|--------------|-------------|-----------|-------------|------------|---------------------|
| DOOR NUMBER | DOOR | | | | FRAME | | DETAIL | | | GLAZING | FIRE RATING | HDWR GROUP | |
| | WIDTH | HEIGHT | MATL | TYPE | MATL | TYPE | HEAD | JAMB | SILL | | | | |
| 1000A | 3' - 8" | 7' - 2" | WD | | HM | | 11/A8.01 | 11/A8.01 | | | | | |
| 1046 | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 11/A8.01 | 11/A8.01 SIM | | | | 34 | |
| 1047A | 6' - 0" | 7' - 10" | ALUM | D15 | ALUM | SF4 | 6/A8.01 | 6/A8.01 | 1/A8.01 SIM | 1" INSUL | | 2 | CARD READER N. LEAF |
| 1047B | 8' - 0" | 7' - 2" | WD | D10 | HM | F13 | 12/A8.01 | 11/A8.01 SIM | | | 80 MIN | 85 | MAG HOLD OPENS |
| 1050 | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | | 33 | |
| 1051 | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | | 33 | |
| 1052 | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | | 33 | |
| 1053 | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | | 33 | |
| 1054A | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | - | 34 | |
| 1054B | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | - | 33 | |
| 1055 | 3' - 0" | 7' - 2" | WD | D10 | HM | F21 | 8/A8.01 | 11/A8.01 | | 1/4" TEMP | - | 33 | |
| 1056A | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 9/A8.01 | 9/A8.01 | | | 20 MIN | 33 | |
| 1056B | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 11/A8.01 | 11/A8.01 | | | 20 MIN | 34 | |
| 1056C | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 20/A8.01 | 20/A8.01 | | | 20 MIN | 33 | |
| 1057A | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 8/A8.01 | 11/A8.01 | | | 20 MIN | 34 | |
| 1057B | 3' - 0" | 7' - 2" | WD | D10 | HM | F30 | 9/A8.01 | 9/A8.01 | | 1/4" TEMP | 20 MIN | 33 | |
| 1058A | 3' - 0" | 7' - 2" | WD | D10 | HM | F10 | 9/A8.01 | 9/A8.01 | | | - | 33 | |

Sheets

You can think of sheets as the pieces of paper on which your views and schedules will be printed. Views and schedules are placed on sheets and then arranged. Once a view has been placed on a sheet, its reference bubble is automatically filled out and that view cannot be placed on any other sheet. The setting for each view, called “view scale,” controls the size of the drawing on each sheet; view scale also controls the size of the text, tags and dimensions.



Conclusion

With this information on the fundamental concepts Revit is built upon, it is easy to learn more about how to use the software efficiently. The knowledge gained, or refreshed, from this chapter will also aid in navigating the Certification Exam.