

# REVIT® ARCHITECTURE 2015 A Hands-On Guide

H. Edward Goldberg, AIA, NCARB



# **Revit® Architecture 2015**

## **A Hands-On Guide**

**H. Edward Goldberg**

**AIA, NCARB**

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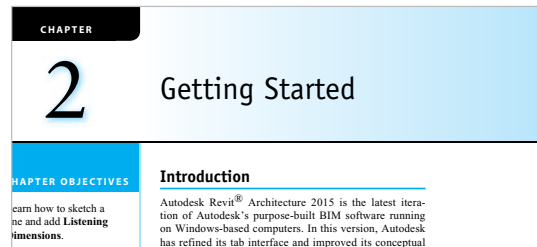
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**I dedicate this book to the women I love:  
my wife, Judith Ellen, and my daughter, Allison Julia.  
I also dedicate this book to my mother who died last year at the age of 100.  
She was a wonderful influence on my life.**

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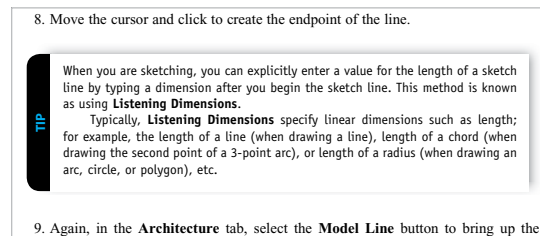
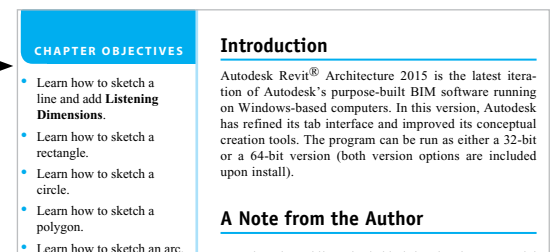
## Features of Revit® Architecture 2015

This text presents a modern approach to using Revit Architecture. That is, it addresses advances in technology and software evolution and introduces commands and procedures that reflect a modern, efficient use of Revit Architecture 2015. Features include:



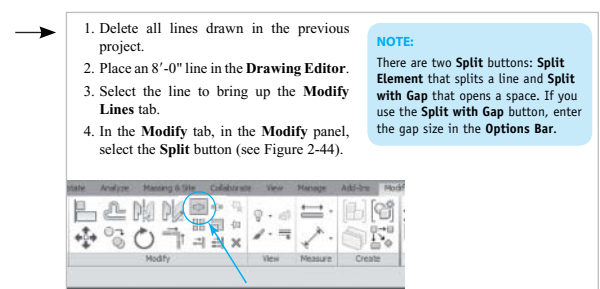
← A **Getting Started** chapter at the beginning of the book allows users to get up to speed in no time to create Revit Architecture drawings.

**Chapter Objectives** with a bulleted list of learning objectives for each chapter provide users with a roadmap of important concepts and practices that will be introduced in the chapter.



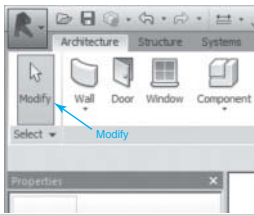
← **Tips** relate the author's experiences to specific chapter content. These will enhance the student's success in the workplace and provide real-life tips and tricks for the problems.

**Notes** present hints, tips, and tricks to enhance productivity.



#### EXERCISE 2-3 SKETCHING A CIRCLE

1. Select the **Modify** button that appears to the top left of all tabs to clear all selections (see Figure 2-37).
2. Using the previous exercise, drag your cursor to form a rectangle around the previous exercises, and left mouse click. This will select the previous objects.
3. With the objects selected, press the **<Delete>** key to delete the objects.



← **Exercises** throughout the chapters provide step-by-step walk-through activities for the student, allowing immediate practice and reinforcement of newly learned skills.

**End-of-Chapter** material, easily located by shaded bars on page edges, includes: →

- Chapter Summary
- Chapter Test Questions
  - Multiple Choice
  - True or False
  - Questions
  - Exercises

#### Chapter Summary

This chapter explained and demonstrated how to render visualizations in Revit Architecture 2015. The concepts behind rendering were explained as well as how to use RPC content.

#### Chapter Test Questions

##### Multiple Choice

Circle the correct answer.

1. A texture map is:
  - a. A picture of a material.
  - b. The location where textures are located.
  - c. The color of a material.
  - d. How shadows are mapped on a surface.
2. Which program reads .AVI files?
  - a. Camtasia
  - b. Windows Media Player
  - c. Mac QuickTime Player
  - d. All of the above
3. When should you use draft quality in Revit Architecture?
  - a. When you want a presentation rendering
  - b. When you want to illustrate the effect of the wind
  - c. When you want a quick rendering result
  - d. When you want to save a rendering
4. The **Show Rendering** button is located in the:
  - a. Application menu.
  - b. View Control Bar.
  - c. Architecture tab.
  - d. Massing & Site tab.
5. The **Daylight** button is located in the:
  - a. Rendering dialog box.
  - b. Create panel > Systems icon.
  - c. Lighting dialog box.
  - d. Sunlight Control Bar

##### True or False

1. **True or False:** The **Region** tool locates the **Region** in which the building is built.
2. **True or False:** You use the **Adjust Exposure** tool before creating a rendering.
3. **True or False:** Elevation renderings cannot be done in Revit.
4. **True or False:** Computer rendering is used to create realistic and photorealistic visualizations.
5. **True or False:** Mesh content renders faster than bitmaps.

##### Questions

1. Where did the concept of rendering come from?
2. Why does the **Yeast** icon symbolize rendering?
3. What commands are used to prepare a **Default 3D View** for rendering as an **Elevation view**?
4. What is mental ray?
5. Which button brings up the **Rendering** dialog box?

#### CHAPTER

# 20

## Tutorial Project

#### CHAPTER OBJECTIVES

How to place a JPG logo in a

#### Introduction

The purpose of this tutorial project is to illustrate the meth-

← The **Tutorial Project** in Chapter 20 illustrates the methodology for creating a set of construction documents in Revit Architecture 2015 while giving practical practice in using Revit Architecture 2015 tools.

## Style Conventions in Revit® Architecture 2015

Text Element	Example
<b>Tab and panel names, palette names, menu items, and dialog box names</b> —Bold and follow capitalization convention in Revit tab or pull-down menu (generally first letter cap).	The <b>Section</b> button in the <b>View</b> tab The <b>File</b> menu
<b>Tab names, tool buttons, and dialog box controls/input items</b> —Bold and follow the name of the item or the name shown in the Revit tooltip.	Choose the <b>Line</b> tool from the <b>Draw</b> panel. Choose the <b>Symbols and Arrows</b> button in the <b>Modify Dimension Style</b> dialog box. Choose the <b>Wall</b> button in the <b>Architecture</b> tab. In the <b>Lines and Arrows</b> tab, set the <b>Arrow size</b> : to <b>.125</b> .
<b>Revit prompts</b> —Dynamic input prompts are set in a different font to distinguish them from the text. Command window prompts are set to look like the text in the command window, including capitalization, brackets, and punctuation. Text following the colon of the prompts specifies user input in bold.	Revit prompts you to <i>Specify first point:</i> <i>Specify center point for circle or [3P/2P/Tr (tan tan radius)]:</i> <b>3.5</b>
<b>Keyboard Input</b> —Bold with special keys in brackets.	Type <b>3.5 &lt;Enter&gt;</b>



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## Instructor Resources

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The **Online Instructor's Manual** provides answers to chapter exercises and tests and solutions to end-of-chapter problems; drawing files to get users started; and lecture-supporting PowerPoint slides.

To access supplementary materials online, instructors need to request an instructor access code. Go to **[www.pearsonhighered.com/irc](http://www.pearsonhighered.com/irc)**, where you can register for an instructor access code. Within 48 hours after registering you will receive a confirming e-mail including an instructor access code. Once you have received your code, go to the site and log on for full instructions on downloading the materials you wish to use.

## Student Resources

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**Pearson Design Central**—Pearson has created an online community where students can share examples of their drawings and obtain resources for their drawing projects. Student data files needed for certain projects in this book can be obtained at **[www.pearsondesigncentral.com](http://www.pearsondesigncentral.com)**. URLs in the margin direct students to the online student data files.

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# About the Author

**H. Edward Goldberg, AIA, NCARB**, is a Renaissance man, being a practicing licensed Architect and Industrial Designer with over 40 years' cumulative experience as a designer, developer, project architect, construction project manager for several national construction companies, owner of a design/build practice, technical writer, author, educator, and AEC industry analyst. He served as Coordinator of CAD and Multi-Media at Carroll Community College, from 1994 to 1999, and as Coordinator of the Industrial Design Program at Towson University, from 2000 to 2003. Ed's lecture and workshop credits include lecturing on the BIM at the National AIA Convention, Autodesk University, AEC Systems Expos, AEC/ST, Design DC, Architecture Exchange East, Associated General Contractors (AGC), Design Build Institute of America (DBIA), and AIA Chapter forums. He has also been featured by the AIA as one of the leading authorities on Digital Technology for Architects, having written the AEC software column for *CADALYST* magazine for nine years. Ed is registered as an Architect in Maryland, Washington, DC, and Virginia. He still designs and/or builds commercial multistory buildings and residential projects and is an expert on the BIM (Building Information Model).

Ed practices what he preaches. Because of his speed and proficiency with design, building, and software knowledge, he is often able to work while the client is watching. Ed believes that including the client at certain points in the design saves time and money.



## Contributors

**Dean R. Camlin, AIA**, wrote the Working with Phasing section of Chapter 17. Dean is the president of Dean Robert Camlin & Associates, Inc. (formerly Melvin A. Arbaugh Architect, Inc.). He is a practicing architect, a member of the American Institute of Architects, and a LEED Accredited Professional. Dean has been using Revit for his commercial and residential projects since the first version appeared in the year 2000, having been one of the first professionals to recognize the value of Revit. Dean has been an Adjunct Instructor of Computer-Aided Drafting and Design at Carroll Community College since 1996.

**Sarah Boisvert** wrote the overview of 3D printing in Chapter 21. She has over 30 years' experience in the design, development, and commercialization of high-technology products utilizing Digital Fabrication including laser machining and 3D printing. Her Market Segmentation graduate work at The Johns Hopkins University led to her expertise in production of high-tech devices.

Sarah is a co-founder of the commercial division of Potomac Photonics, Inc. of Lanham, Maryland, which she joined to commercialize a proprietary RF-discharge excimer laser. Following the sale of the company in 1999, Sarah volunteered in the Fab Lab Network, helping start the new Digital Fabrication Laboratories. She returned to Potomac as Chief 3D Printing Officer in February 2014.

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# Preface

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In the 14 years since it was conceived, Revit has radically changed the architectural design and documentation industry. Not only does this purpose-built solution for Building Information Modeling (BIM), building design, and authoring help architects and designers capture and analyze early concepts, but it also automatically maintains the coordination of the construction documents.

With the release of Revit Architecture 2015, users have access to a robust collection of easy-to-use modeling tools for quick and precise design conceptualization, visualization, and communication. This release supports several new modeling paradigms, including intuitive direct manipulation, robust free-form modeling, and bidirectional parametric control. In addition, some highly specialized patterning and penalization techniques are now more readily accessible. In building design, visualizing forms in their earliest stages enhances a designer's ability to communicate ideas; the ability to analyze and evaluate these forms yields an advantage in predicting and optimizing the real-world performance of the built project. These attributes form a core value of the Building Information Modeling (BIM) process, which Autodesk® Revit® Architecture software is purpose-built to support.

This book is based on the “hands-on tutorial” method, starting with the basic tools and finally working up to a complete building project. As with all well-designed software solutions, there is a methodology behind the operation of the interface, and that methodology is explained through simple exercises. It is the author's intent in these exercises to provide the reader with a particular routine necessary to operate the program professionally.

The topics are presented and discussed in a production-based order. Once the user has successfully completed the basic exercises, he/she can then move on to the final project, which puts all the exercises together and illustrates the development of a real-world project from start to finish. With the exception of the final project, this book deliberately discourages independent design. The author, through many years of experience as an architect and professor, has found that allowing students to design while learning a software program is counterproductive. It is therefore recommended that this book be used in the order that it has been written. This is not to discourage design, but rather to get students “up and running” with the basic program before they move on to more exploratory visions. Please try to become familiar with each exercise before moving on to the next one. You must be open to different ways of operating Revit Architecture. After completing a series of tutorials, it is often helpful to go back and experiment with settings to see what changes happen. Although Revit Architecture is relatively easy to understand, it is a very deep and complex program, and different operators choose to operate it in different ways.

An Instructor's Resource website is available including PowerPoint® presentations and an Instructor's Manual with a proposed curriculum.

## About This Book

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This book can serve as a reference for architects and designers or as a guide. The text traverses, chapter by chapter, through the complete and advanced usage of each of the software's capabilities. Each chapter ends with problems, with answers given in the Instructor's Manual. These problems can be used as test questions, additional exercises, or homework assignments.

## Features New to This Edition

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1. Clearer pictures and diagrams specifically aimed at “hands-on” learners.
2. Revised final building project with new features.
3. Rearrangement of chapters to facilitate a more logical learning methodology.
4. New 2015 Material Browser and Graphic Display Options.
5. New Room and Area exercises.
6. New information on point clouds.
7. New chapter on 3D printing.

## Acknowledgments

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I want to thank all the people at Autodesk for their help on this book. I especially want to thank Michael Anonuevo for his excellent tutorials on massing and modeling; Dean R. Camlin, AIA, for his phasing exercises; and Sarah Boisvert for her article on 3D printing and manufacturing. I also want to thank the following whose contributions helped shape the final text:

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## 1

# The BIM and Revit Architecture

## The Building Information Model and BIM Software

## CHAPTER OBJECTIVES

- Understand the history and concept of **Building Information Modeling (BIM)**.
- Understand the concept of parametric modeling.
- Understand why parametric building modeling matters.
- Understand the concept of the one-model Building Information Modeling concept.



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### Introduction

Thirty-one years ago, Autodesk created AutoCAD and revolutionized architectural drafting for the masses. With the introduction of AutoCAD, production time decreased significantly. Regardless, AutoCAD was only electronic drawing—quicker perhaps, but it still followed the concept of 2D plan, elevation, section, and detail that had been in use for hundreds of years. Today, with Revit Architecture, which is Building Information Modeling (BIM) authoring software, designers are creating buildings in a new way. Instead of depending on 2D views, they are designing buildings virtually. This has several benefits. The first benefit of the virtual building is its ability to allow easy visual examination of the building from any direction. This allows the designer to better visualize his/her design. The next benefit is the ability to test, analyze, and quantify the building. Because the virtual building acts like its real-world counterpart, it is possible to analyze such things as energy usage, shading, and component clashes. Another benefit of the BIM is that it allows the contractors to price and simulate the construction of the building while checking different construction scenarios. This last capability (simulation), often called *4D*, has been used by many of the large construction companies to schedule when and where material should be delivered. Programs such as Navisworks will combine a Microsoft® Project or Primavera schedule with a BIM model allowing construction of a simulation based on these scheduling programs. Finally, because the components of the BIM model are 3D digital models, they



are often prime candidates for automated manufacturing. It is becoming quite common for the steel beams and stairs designed in BIM models to be sent directly to computerized steel cutting and assembly machines. All of this BIM capability, though, does have drawbacks. BIM operators are often no longer just draftspersons; they are also licensed professionals. This is because operators of BIM software must have a much better understanding of how buildings go together. The BIM is opening up new opportunities for those who understand how to build and analyze models. As the BIM and Revit Architecture become an industry standard, new operator definitions such as Virtual Constructor or Virtual Architect may be created.

## Big BIM, Little Bim

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Much has been written about the BIM, but few people really understand its meaning and its impact. Finith E. Jernigan, AIA, 's book *Big BIM little bim* does a good job of explaining the difference between the concept of the BIM (the Big BIM) and the software utilized to create it (the little bim) and is highly recommended reading.

Basically, the Big BIM is defined in this book as “all the information about a project within its property lines to the center of the earth and infinitely to the sky from its inception through construction and use until its final decommission and elimination.” This includes the structures and associated information, weather history, taxes, ground compaction, utilities, manufactures, equipment, and more. Eventually the BIM will include all of the available digital databases of information available through the Internet.

The little bim, as this author interprets Finith E. Jernigan, AIA, is the software used to create the big BIM. To be truly viable, a BIM software solution must contain a modeler capable of quickly and easily modeling a 3D model. If it takes longer to create the 3D model than it would take to draw the model in three views, much of the design benefit of the BIM is lost. To this end, the major BIM software player, Revit Architecture, includes routines that allow for ease of modeling. Since the Building Information Model mimics a real project, some of the real benefits on the design side can only be fully realized when the architect or designer is the computer operator. This issue demands thoughtful attention from many of the large architectural firms that have traditionally used CAD as an electronic drafting tool. They have structured their practices with a hierarchy in which a project architect sketches a concept, and the CAD operator merely acts as a scribe. One of the greatest values of using Revit Architecture at the design stage is the ability for the designer to understand the relationships between the building and its systems virtually instantaneously. This understanding may involve aesthetic, special, performance, or program issues. Until recently, the modeling of virtual buildings has focused primarily on improving drawing productivity in creating construction documents. One of the great productivity features of Revit Architecture software is its ability to generate elevations and sections automatically from the model and have them coordinated and updated whenever a change has been made to the model. Another productivity feature is the ability to create and maintain schedules for objects such as doors, windows, walls, and so on.

## Autodesk Defines the BIM

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According to Autodesk, “(BIM) refers to the creation and use of coordinated, consistent, computable information about a building project in design—information used for design decision making, production of high-quality construction documents, predicting performance, cost-estimating and construction planning, and, eventually, for managing and operating the facility.”

## Parametric Building Modeling: BIM's Foundation

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### What Is Parametric Modeling?

Original CAD engines used explicit, coordinate-based geometry to create graphic entities. Editing these “dumb graphics” was cumbersome and extremely error prone. Documentation was created by extracting coordinates from the model and generating stand-alone 2D

drawings. As graphic engines matured, graphical entities were combined to represent a design element (a wall, a hole, and so on). Depending on the software, the models became “smarter” and were a bit easier to edit. Surface and solid modelers added more intelligence to the elements and enabled the creation of complex forms. However, the result was still an explicit (coordinate-based) geometric model, which was inherently difficult to edit and had a tenuous relationship to extracted drawings that easily fell out of sync with the model. Then parametric modeling engines that used parameters (numbers or characteristics) to determine the behavior of a graphical entity and define relationships between model components arrived. For example, “the diameter of this hole is one inch” or “the center of this hole is midway between these edges.” This meant that the design criteria or intent could be captured during the modeling process. Editing the model became much easier and preserved the original design intent. This was the breakthrough that gave credibility to the concept of a digital design model. The mechanical design world (at the forefront of parametric modeling) made MCAD parametric modeling the status quo for mechanical design. (For more information, refer to the Autodesk Technical White Paper, *Parametric Building Modeling: BIM’s Foundation*, 2007.)

## What about Buildings?

Unfortunately, MCAD parametric modelers do not scale to a building project. They usually rely on two basic technologies to propagate change: history-based (which plays back the design steps for the model each time a change is made) or variational (which attempts to solve all conditions simultaneously with each change). Using these change engines to resolve even a small building is prohibitively slow. MCAD modelers also generally require the user to embed a lot of constraints (such as relationships) so that the change technologies described above can recalculate the result. These “fully constrained” models are suitable for the mechanical design world because the product (manufactured from raw chunks of material) has to be precisely defined—unlike a building, which is generally a collection of prefabricated components with relatively few constraints that really matter to a building designer. The technology that made parametric modeling work for building design, and therefore enabled parametric building modeling, is the context-driven change engine used in the Revit platform for building information modeling.

## Why Does Parametric Building Modeling Matter?

Why is parametric building modeling so vital to BIM? BIM is an approach to building design that is characterized by the creation and use of coordinated, internally consistent, computable information about a building project. Reliable building information is the essential feature of BIM and its digital design processes. BIM solutions that use parametric building modelers provide building information that is more coordinated, more reliable, of better quality, and more internally consistent than object-CAD software that has been repurposed for BIM.

## Purpose-Built for Architecture

Purpose-built BIM applications that use a parametric building modeler, like Revit, deliver this kind of information by design, through the natural operation of the software. When using a CAD solution, the graphical presentation of information (such as drawings or renderings) may look similar to the output of a purpose-built parametric building modeler, but is it coordinated, internally consistent, and reliable? CAD-based technology is rarely used for BIM, due to the extremely high level of effort required to include and coordinate actionable building information such as schedule, cost, design scope, building performance, and so on. More sophisticated, object CAD systems store some (nongraphical) data about a building in a logical structure with the 3D building graphics. Users can extract this data to provide information about quantities and attributes, just as they extract the 2D drawings from the 3D graphics. However, object CAD systems remain anchored to graphics. Because of this, additional tools (and effort) are required to keep the graphical and nongraphical data in sync to assure the integrity and coordination of object CAD models and to deliver the benefits of BIM. One example of such a tool is Solibri Model Checker®, which is designed to identify inconsistencies and errors in data produced from object CAD models before the data is used

for other purposes. The larger the project, the greater the effort required to keep the data coordinated, and the greater the likelihood of inconsistencies. A parametric building model combines a design model (geometry and data) with a behavioral model (change management). The entire building model and complete set of design documents is in an integrated database, where everything is parametric and everything is interconnected. The analogy of a spreadsheet is often used to describe parametric building modeling. A change made anywhere in a spreadsheet is expected to update everywhere automatically. The same is true for a parametric building modeler—real-time self-coordination of the information in every view of the model. No one expects to have to update a spreadsheet manually. Similarly, no one has to revise a document or schedule manually from a parametric building modeler. This bidirectional associativity and immediate, comprehensive change propagation results in the high-quality, consistent, reliable model output that is key to BIM, facilitating digital-based processes for design, analysis, and documentation.

## Documentation

It is Autodesk's opinion that only a purpose-built data architecture built around a parametric building model can provide the immediate and fully coordinated set of accurate and reliable conventional documents. A BIM solution that can coordinate changes and maintain consistency at all times lets users focus on building design versus change management. This built-in change-management capability is critical to the disconnected building process—which is still heavily dependent on construction documentation—providing confidence in drawing deliverables.

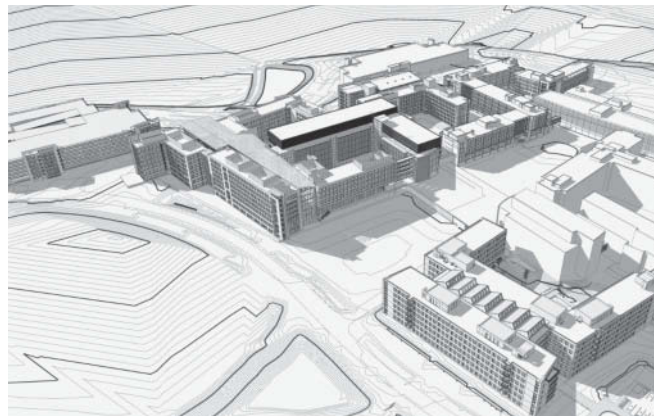
## The BIM and the One-Model Concept

The BIM is also about collaboration, often real-time, with other resources such as owners, engineers, contractors, manufacturers, and so on. This collaboration should increase productivity because more information will be available at the earlier stages of a project, rather than later as is presently done. When informed decisions are made early in a project design, mistakes are reduced, and costs are lowered. Part of this collaboration can also be attributed to the *one-model concept*. In this concept, all of the engineers contribute their part of the model to create a “virtual” whole. For example, the structural engineer creates the structure such as steel frame, and it is integrated into the model being created by the architect. Some contractors have a problem with the one-model concept, preferring to create their own model specifically tailored to their needs. Other contractors prefer to work with the architect or designer during the design process to incorporate their needs into the one-model concept. Regardless how it is done, BIM is the direction in which building design and documentation is going.

The following figures show examples of buildings that have been designed using BIM software (see Figures 1-1 through 1-6).

**Figure 1-1**

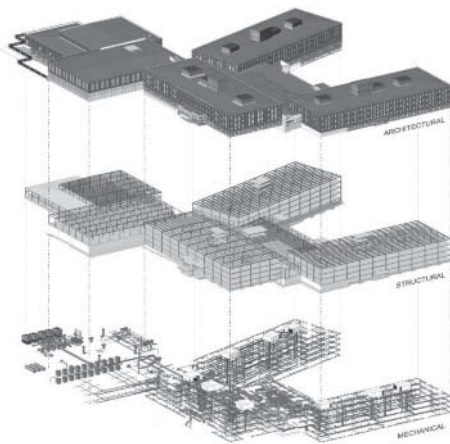
Government Head Quarters  
Campus  
(Courtesy of RTKL Architects, an  
ARCADIS company)





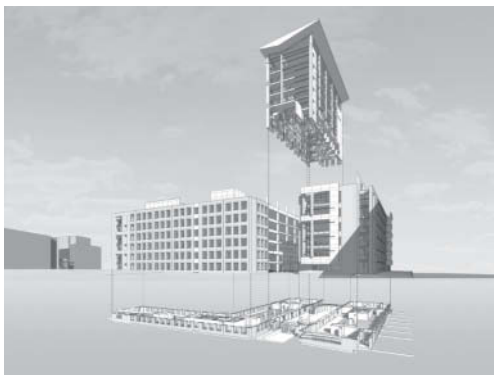
**Figure 1-2**

Self Storage Facility, Pasadena Maryland  
(Courtesy of HEGRA Architects)



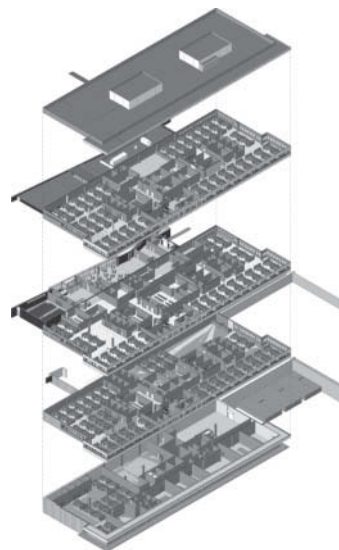
**Figure 1-3**

Government Head Quarters Facility  
(Courtesy of RTKL Architects, an ARCADIS company)



**Figure 1-4**

Government Head Quarters Campus  
(Courtesy of RTKL Architects, an ARCADIS company)



**Figure 1-5**

Mission Critical Office Facility  
(Courtesy of RTKL Architects, an ARCADIS company)

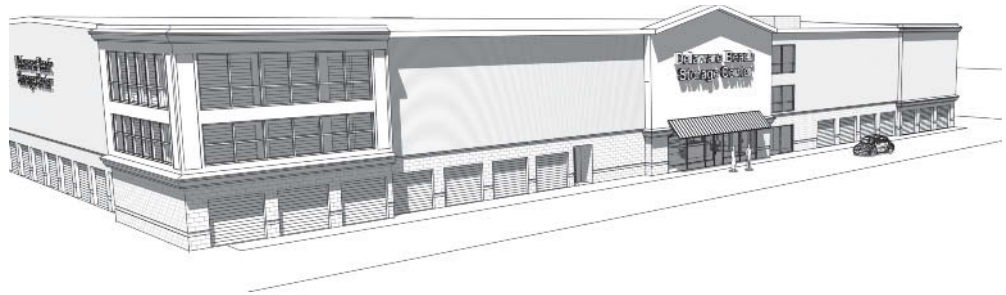


Figure 1-6

Self Storage Facility, Lewes Delaware  
(Courtesy of HEGRA Architects)

## Additional Software and Services

Although Revit has features that speed construction documentation, new values have been found in utilizing the information contained in the BIM model. With Revit Architecture as the base modeling product, you can analyze, estimate, construct, and then finally manage the operation of a project. The following are some of the additional software and services that extend the viability of Revit Architecture.

### e-SPECS<sup>®</sup> for Revit Automated Specifications

[www.e-specs.com](http://www.e-specs.com)

Since 1998, InterSpec has provided leading specification management software as well as specification writing services.

e-SPECS for Revit automates the preparation of construction specifications by extracting the product and material requirements directly from the project's model. e-SPECS solutions integrate the entire project team into the specification development process, streamlining the document coordination process and reducing reliance on inefficient and nonintegrated word processing systems (see Figures 1-7 and 1-8).

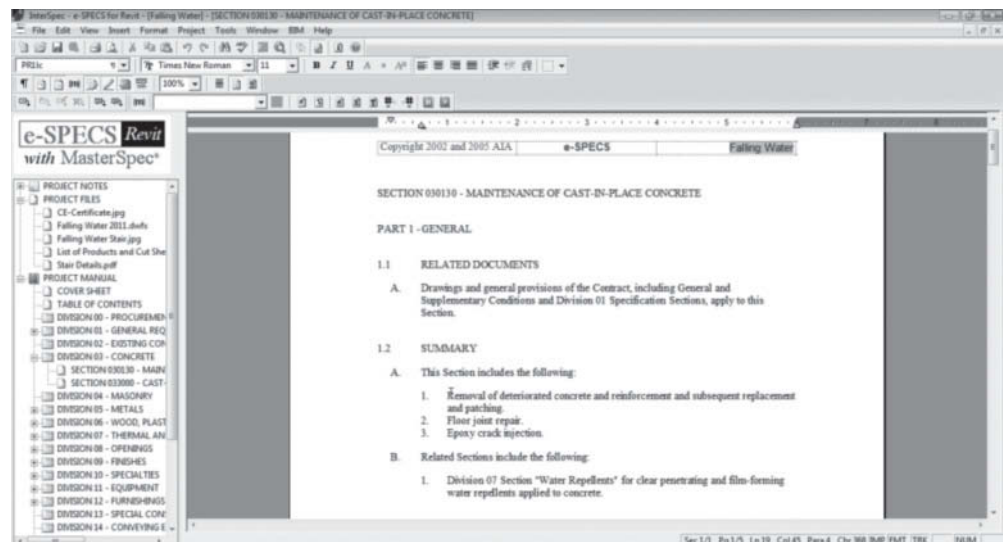


Figure 1-7

e-SPECS MasterSpec page  
(e-SPECS is a product of InterSpec, Inc. Used with permission.)



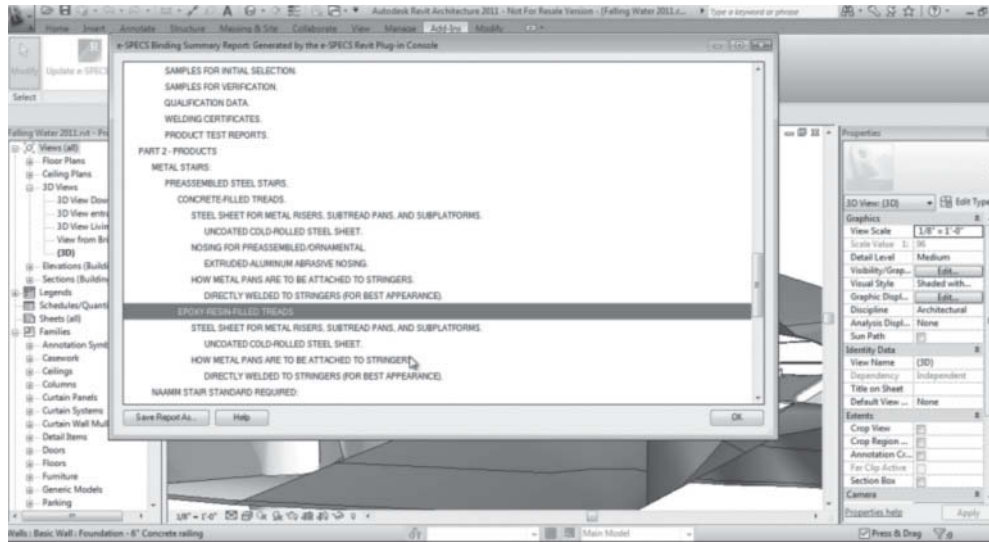


Figure 1-8

e-SPECS software  
(e-SPECS is a product of InterSpec, Inc. Used with permission.)

## IES <Virtual Environment>®

[www.iesve.com](http://www.iesve.com)

IES <Virtual Environment> is a unique, integrated system for building performance assessment. IES <VE> consists of analysis modules that evaluate most building performance properties.

IES's specially developed Revit plug-in toolbar allows Revit Architecture and Revit MEP users to import their 3D BIM models into IES's software and undertake sustainable performance analysis. It works with version 2008 onward and sits as an integrated toolbar. Drop-down menus take you through the Setting Model Properties process step-by-step. All you need is basic information on building type, construction materials, and heating and cooling system types, at either the whole building or room level, depending on what stage you are at in the design process. The Revit plug-in is included in all IES <VE> software installations. If you already have Revit installed on your machine, the toolbar will automatically appear when you next open the application. VE-Ware and VE-Toolkits are designed exclusively for use with this plug-in to undertake early iterative assessments. VE-Gaia and VE-Pro allow you to edit model properties in detail and undertake more advance analyses.

The <VE> Sustainability Toolkit makes it extremely easy for Revit users to undertake a range of building simulation analyses. Within Revit MEP, an interface is launched enabling the user to assign information to the building and individual rooms. This information is then passed through the IES <VE>, and the <VE> Toolkit is displayed. Select any button, and the Toolkit will run the chosen analysis by using the model transferred from Revit. Interrogate the results of the analysis via an html report or conduct a more detailed analysis within the <VE> using one or more of the integrated performance assessment modules (see Figure 1-9).

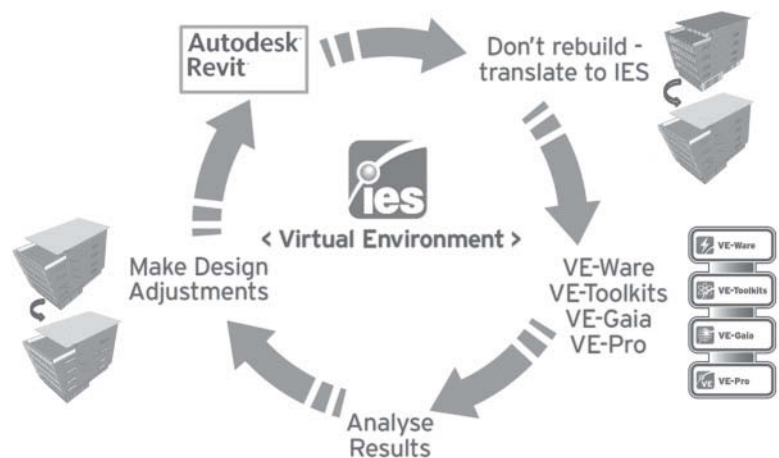


Figure 1-9

<Virtual Environment>  
Sustainability Toolkit  
(Courtesy of IES VE Software)

## Vico Office Suite 5D BIM Environment

[www.vicosoftware.com/products/Vico-Office](http://www.vicosoftware.com/products/Vico-Office)

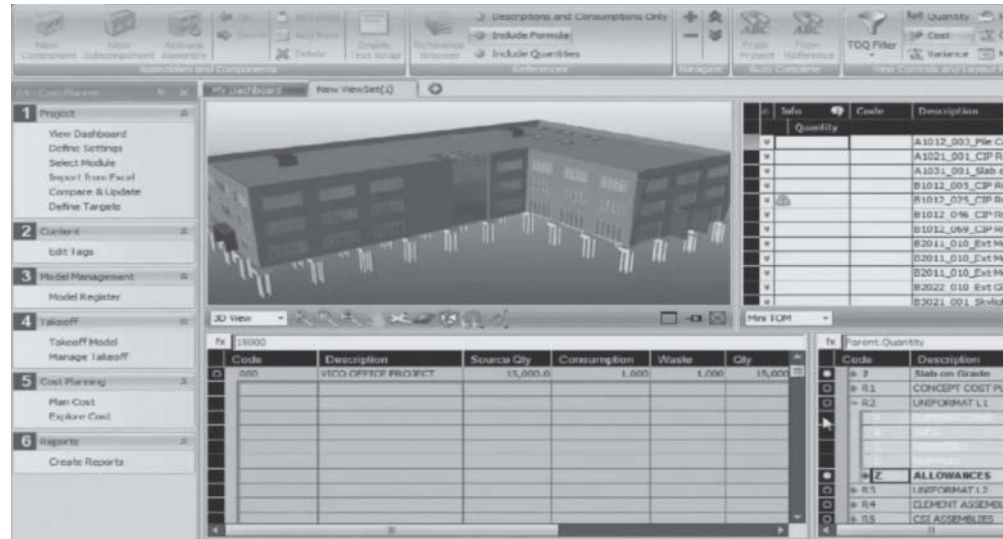
Vico Office™ is purpose-built for construction. It is designed as a tightly integrated, BIM-neutral platform to which multiple types of BIM models can be published, synthesized, and augmented with cost and schedule information. To maximize efficiency and meet the distinctive needs

of the various construction process trades and phases, Vico Office is structured in a modular way, providing you with a tailored, yet expandable, solution and a consistent, easy-to-use environment.

By using Vico Office, building owners and general contractors gain efficient collaboration, improved predictability, risk reduction, cost management, and optimized schedules on large, complex building projects. This software offers project teams the flexibility to specialize in their disciplines while they collaborate (see Figure 1-10).

**Figure 1-10**

Vico Office Suite  
(Courtesy of Trimble Software)



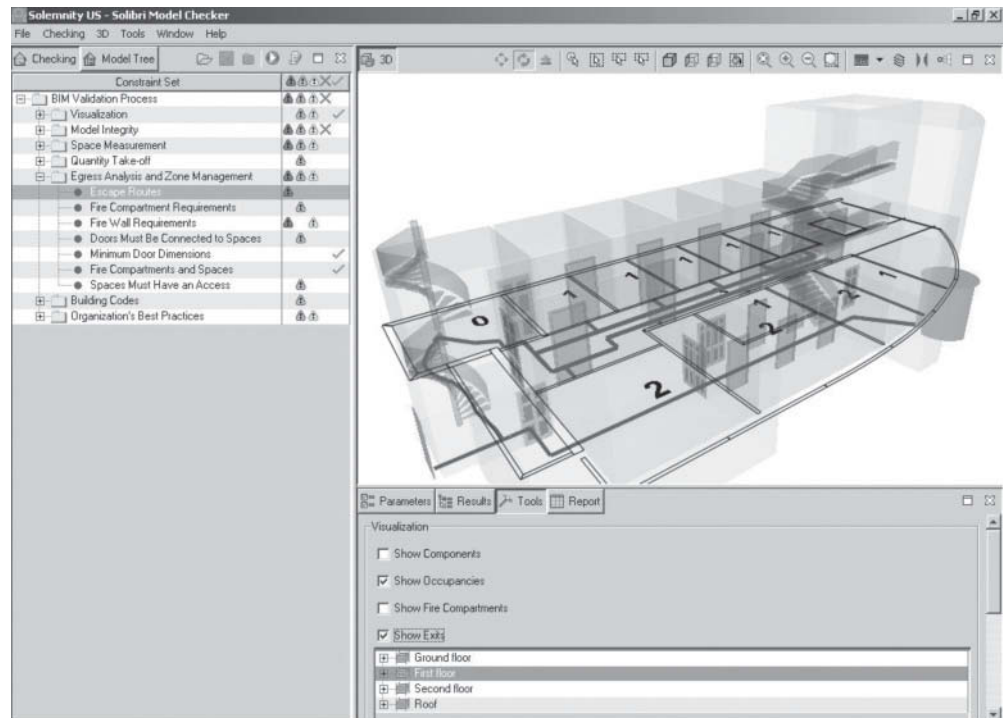
## Solibri Model Checker Version 9®

[www.solibri.com](http://www.solibri.com)

Think of Solibri Model Checker as a spell-checker for virtual models. The program analyzes building models for integrity, quality, and physical security. It checks for potential flaws and weaknesses in the design, highlights clashing components, and determines whether the model complies with building codes and the organization's own best practices. You can set up rules to check just about anything in your BIM model. Figure 1-11 shows Solibri checking fire escape routes.

**Figure 1-11**

Solibri Model Checker  
(Courtesy of Solibri Inc.)

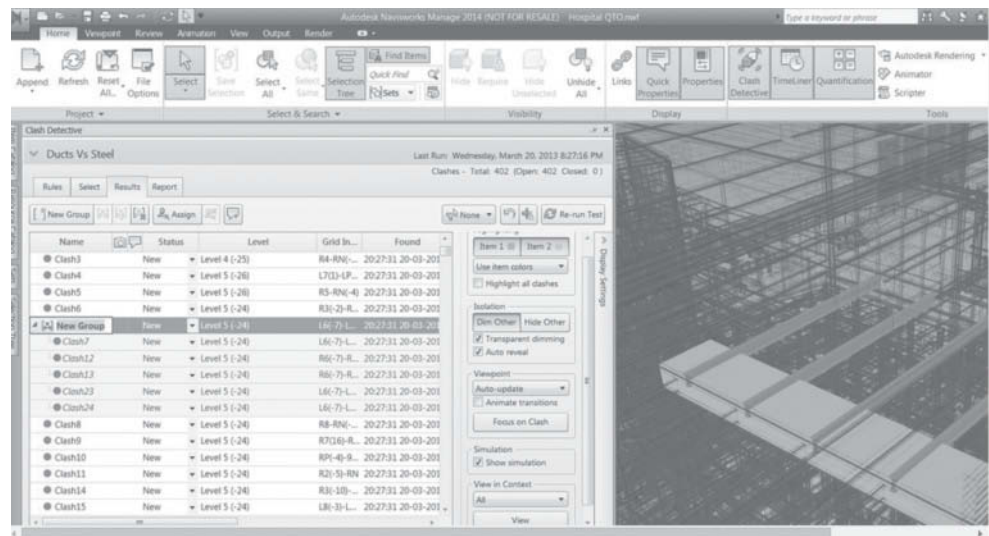


## Navisworks®

[www.autodesk.com/products/autodesk-navisworks-family/overview](http://www.autodesk.com/products/autodesk-navisworks-family/overview)

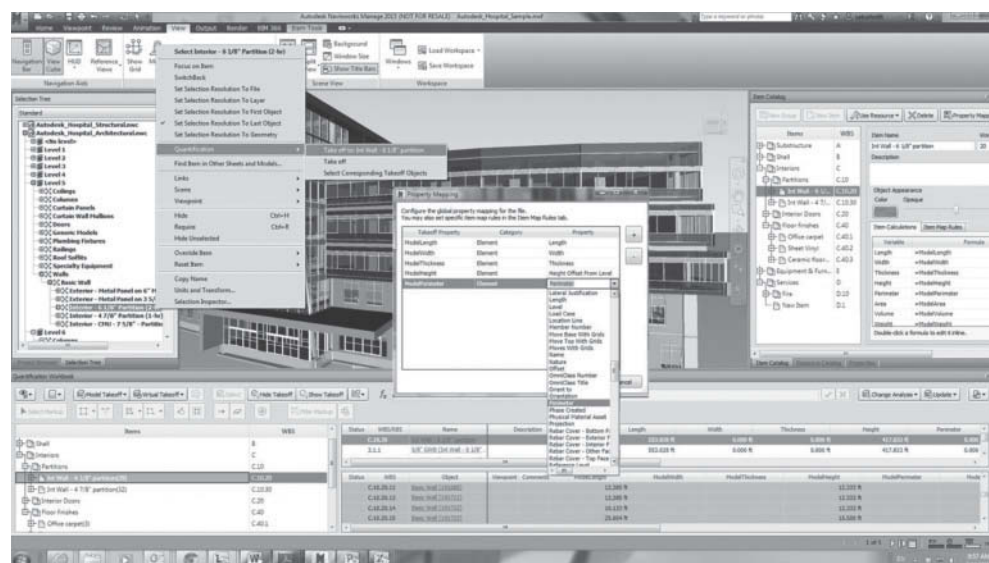
Navisworks project review software enables professionals within the fields of architecture, engineering, and construction to analyze integrated models and data with stakeholders. Its tools help teams coordinate disciplines, resolve conflicts, and plan projects early in the process, before construction or renovation even begins.

This software is capable of importing file formats and models from most of the different BIM software vendors. Using Navisworks, you can bring together models from different disciplines and analyze the entire model. Navisworks comes in two versions: Autodesk Navisworks Manage 2015 and Autodesk Navisworks Simulate 2015. If you buy the Autodesk Building Design Suite Premium, Navisworks Simulate is included. Navisworks Manage includes clash detection and interference checking, whereas Navisworks Simulate does not (see Figures 1-12 and 1-13).



**Figure 1-12**

Navisworks clash detection  
(Courtesy of Autodesk)



**Figure 1-13**

Navisworks analyzes models from different disciplines  
(Courtesy of Autodesk)



**Recommended Books**

- Aubin, Paul. *Renaissance Revit: Creating Classical Architecture with Modern Software*. North Charleston, SC: CreateSpace, 2013.
- Aubin, Paul. *Revit Architecture 2013 and Beyond*. Independence, KY: Cengage Learning, 2012.
- Eastman, Chuck, Paul Teicholz, Rafael Sacks, Kathleen Liston, et al. *BIM Handbook: A Guide to Building Information Modeling for Owners, Managers, Designers, Engineers, and Contractors*. Hoboken, NJ: John Wiley & Sons, 2008.
- Jernigan, Finith E. *Big BIM little bim*, 2nd ed. Salisbury, MD: 4Site Press, 2008.
- Vandezande, James, Eddy Krygiel, and Phil Read. *Mastering Autodesk Revit Architecture 2014*. Hoboken, NJ: Sybex, 2013.

**Websites**

- **AECbytes**

[www.aecbytes.com](http://www.aecbytes.com)

This is the home page for a monthly newsletter containing BIM information, software reviews, and tips and tricks for the AEC industry.

- **ARCAT (Revit content)**

[www.arcad.com/bim/bim\\_objects.shtml](http://www.arcad.com/bim/bim_objects.shtml)

This is a free website containing 3D content based on manufacturers' actual products.

- **AUGI (Autodesk User Group International) and AUGI Forum: Revit**

[www.augi.com](http://www.augi.com)

<http://forums.augi.com/forumdisplay.php?93-Revit>

AUGI is the official Autodesk user group for all Autodesk software.

- **Autodesk Blogs**

[www.autodesk.com/blogs](http://www.autodesk.com/blogs)

Great place to get blogs by Autodesk Revit development staff.

- **Ed's Independent Voice**

[www.hegra.org](http://www.hegra.org)

Monthly newsletter aimed at the digital AEC industry. This newsletter discusses the BIM, and all the new and important BIM software products.

- **HOK BIM Solutions (HOK's buildingSMART community)**

[www.hokbimsolutions.com](http://www.hokbimsolutions.com)

HOK is one of the world's largest architecture firms. HOK's buildingSMART community contains information and help on Revit and the BIM.

- **National BIM Standard**

[www.buildingsmartalliance.org](http://www.buildingsmartalliance.org)

This website has information about the National Institute of Building Sciences (NIBS).

- **Paul Aubin Academy Master Series of Revit books**

<http://paulaubin.com/books>

Paul F. Aubin is an accomplished author of several books on Revit Architecture, AutoCAD MEP, and AutoCAD Architecture.

- **Revit Forum**

[www.revitforum.com](http://www.revitforum.com)

This is a free discussion forum on Revit Architecture, Structural, and MEP questions.

- **The Revit Kid**

<http://therevitkid.blogspot.com>

This popular blog site contains Revit tips and tricks.

- **TenLinks**

[www.tenlinks.com](http://www.tenlinks.com)

This CAD electronic daily magazine includes information about the CAD industry as well as tutorials, tips, and tricks.

- **What Revit Wants**

<http://whatrevitwants.blogspot.com>

This blog offers downloadable experimental add-ins and solutions for Revit.

- **You Tube**

[www.youtube.com](http://www.youtube.com)

Just search on Revit and you will find dozens of video tutorials.

## Chapter Summary

This section discussed the concepts behind the BIM (Building Information Model), BIM software (BIM authoring tools), and the benefits of the BIM.

## Chapter Test Questions

### True or False

*Circle the correct answer.*

1. **True or False:** The BIM is an evolution of CAD.
2. **True or False:** BIM software can be used as traditional 2D CAD.
3. **True or False:** One of the values of the BIM is the ability for the designer to understand the relationships of the building and its systems.
4. **True or False:** The BIM model can be used for manufacturing.
5. **True or False:** Eventually the BIM will include all the digital databases of information available through the Internet.

### Questions

1. What is the difference between the BIM and BIM authoring software?
2. How does BIM software differ from traditional 2D CAD?
3. What does “4D” mean in relationship to BIM software?
4. How can the BIM be used for analysis?
5. What is your interpretation of the Virtual Constructor or Virtual Architect?

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## 2

## Getting Started

## CHAPTER OBJECTIVES

- Learn how to sketch a line and add **Listening Dimensions**.
- Learn how to sketch a rectangle.
- Learn how to sketch a circle.
- Learn how to sketch a polygon.
- Learn how to sketch an arc.
- Learn how to sketch a spline.
- Learn how to split a line (works for lines, circles, arcs, or walls).
- Understand families.
- Understand levels.
- Understand check boxes.
- Understand radio buttons.
- Use and understand contextual menus.
- Use and understand constraints.
- Understand dialog boxes (menus).
- Understand object snaps.

## Introduction

Autodesk Revit® Architecture 2015 is the latest iteration of Autodesk's purpose-built BIM software running on Windows-based computers. In this version, Autodesk has refined its tab interface and improved its conceptual creation tools. The program can be run as either a 32-bit or a 64-bit version (both version options are included upon install).

## A Note from the Author

- There is a philosophy behind the “hands-on” tutorial method used in this text. I have designed these tutorials to give the student an experience of the operation methodology that I feel is effective for learning to operate Revit Architecture, and especially for those who are kinesthetic learners such as I.
- After you have completed a series of tutorials, it is helpful to go back and experiment with settings to see what changes happen.

In my opinion, the operation of any architectural design and documentation software can be analogized both to driving an automobile with a manual transmission and to playing a game of chess. I often remind my new students how difficult it seemed when they first tried to drive an automobile, especially one with a manual transmission. Then I ask them to remember any of the actions they made while driving to class. If they have a car with a manual transmission, do they remember changing gears? The point is this: when one practices using the tools on simple tasks, those tasks (like using a clutch in an automobile) become routine.

Operating Revit Architecture effectively depends on picking the correct tool for a particular task. Chess is a game of strategy, and operating Revit Architecture efficiently is similar to playing chess.

The goal in Revit Architecture is to get the most result with the least effort (keystrokes) and picks. In order to do this, you must be thinking several moves ahead with a clear goal in mind. As with chess, your building project will always be opposing you (as all projects do). Don't be afraid of trying a new strategy (unless you are on deadline), and practice, practice, practice.

Finally, you must be open to learning different ways to operate Revit Architecture. Although Revit Architecture is relatively easy to understand initially, it is a very deep and complex program, and different operators choose to operate it in different ways. Let's get started!

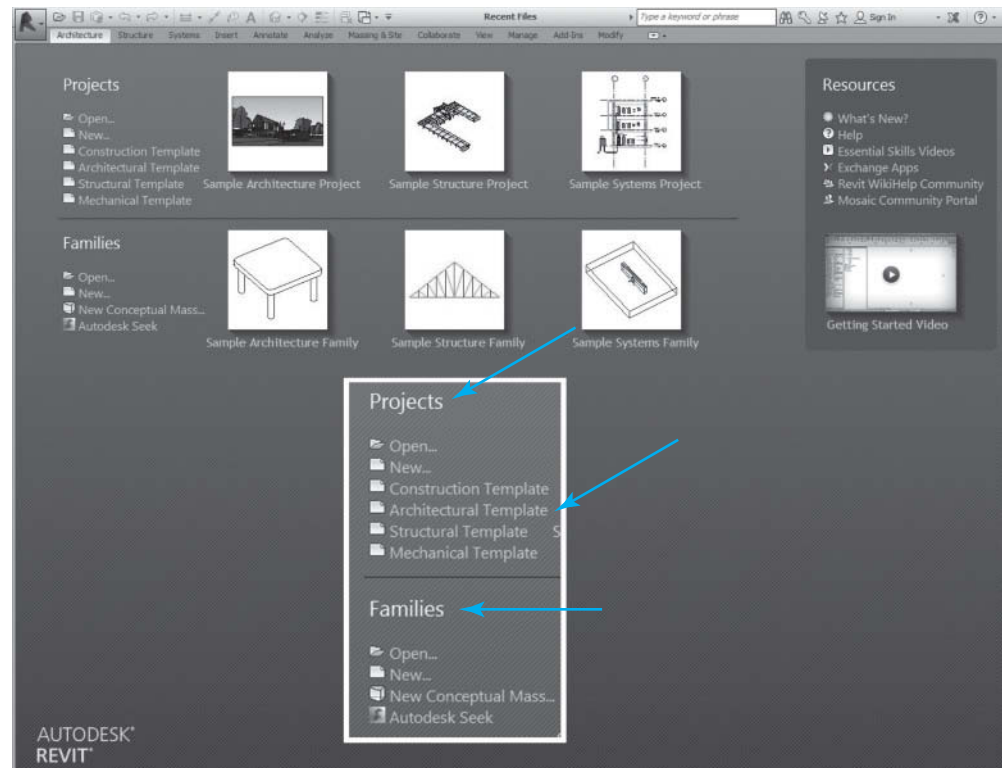
## Creating a Project

Following is the process for creating a new project in Revit Architecture.

1. Whenever you start Revit Architecture 2015, the **Recent Files** screen appears.
2. Select the **Architectural Template** button (under **Projects**) to bring up the **Autodesk Revit Architecture Workspace** (see Figure 2-1).

**Figure 2-1**

The Revit Architecture **Recent Files** screen



3. The **Revit Architecture** interface will appear, and you will be ready to work (see Figure 2-2).
4. Once inside a Revit project, more projects can be created or opened by pressing the **R** (Revit logo) at the top left corner of the interface to bring up the **Application** menu.
5. In the **Application** menu, select **> New > Project** to bring up the **New Project** dialog box.
6. In the **New Project** dialog box, select the **Project** radio button.
7. Select **Architectural Template** from the **Template file** drop-down list.
8. In the **New Project** dialog box, select the **OK** button to create a new project (see Figure 2-3).

### NOTE:

You can open existing projects from either the **Recent Files** screen or the **Application** menu by selecting the **Open** button.

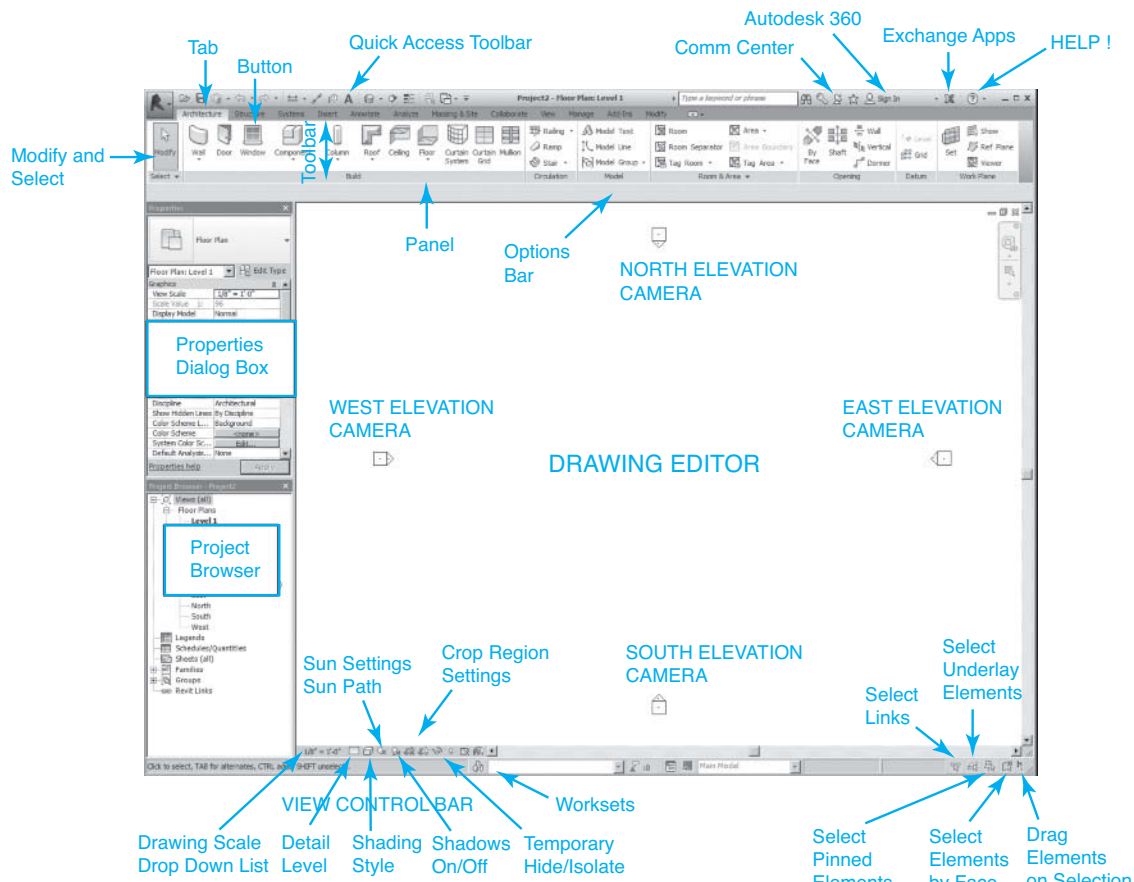


Figure 2-2

The **Revit Architecture** interface

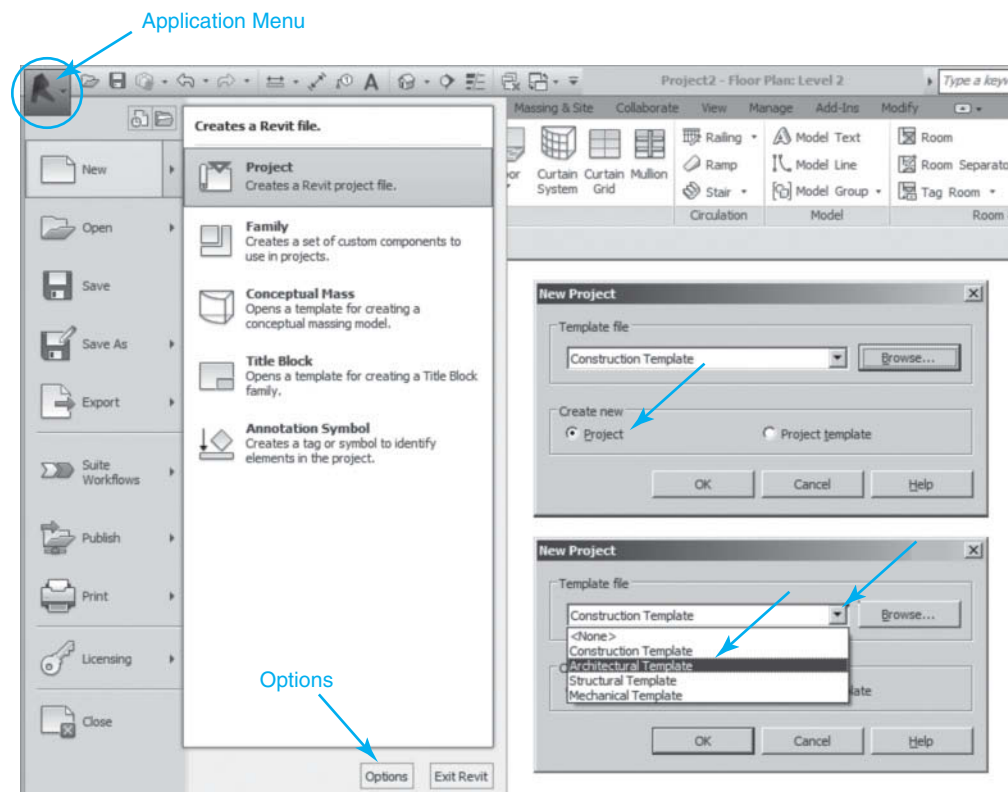


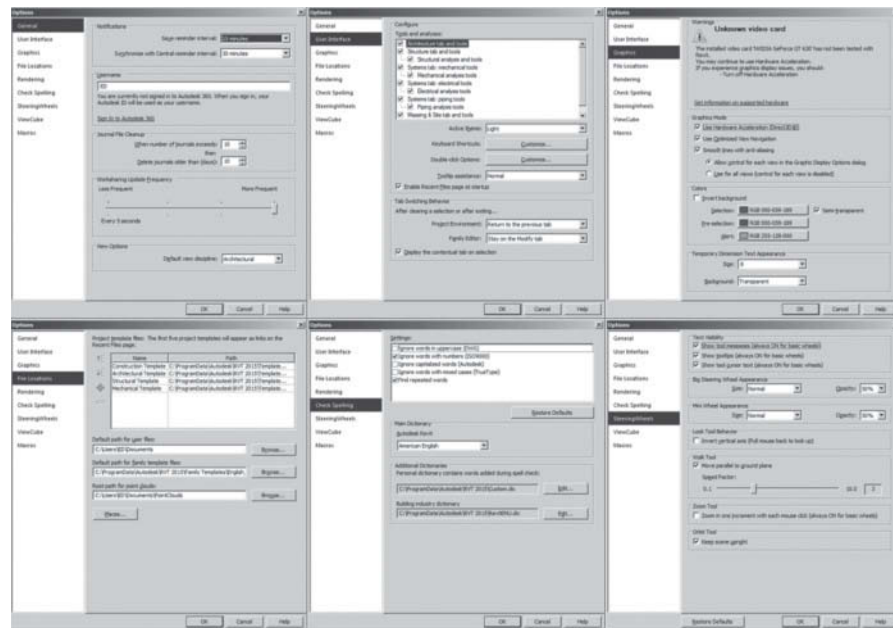
Figure 2-3

Application menu

9. In the **Application Menu** dialog box, select the **Options** button to bring up the general **Options** menus (see Figure 2-4).

Figure 2-4

Options menus



## Tab Menu Interface

The Microsoft-inspired menu interface was new to Revit 2010; it has been refined each year culminating with Revit 2015. The tab displays automatically when you create or open a file. It provides all the tools necessary to create a project and automatically changes when you select an object. The **Tab** interface has the hierarchy of **Tab > Toolbar > Panel > Button**. Each tab contains its toolbar. Buttons activate specific operations you wish to perform, and they are located in panels that are located on a toolbar. The toolbar can be customized by rearranging the panels that contain the buttons desired.

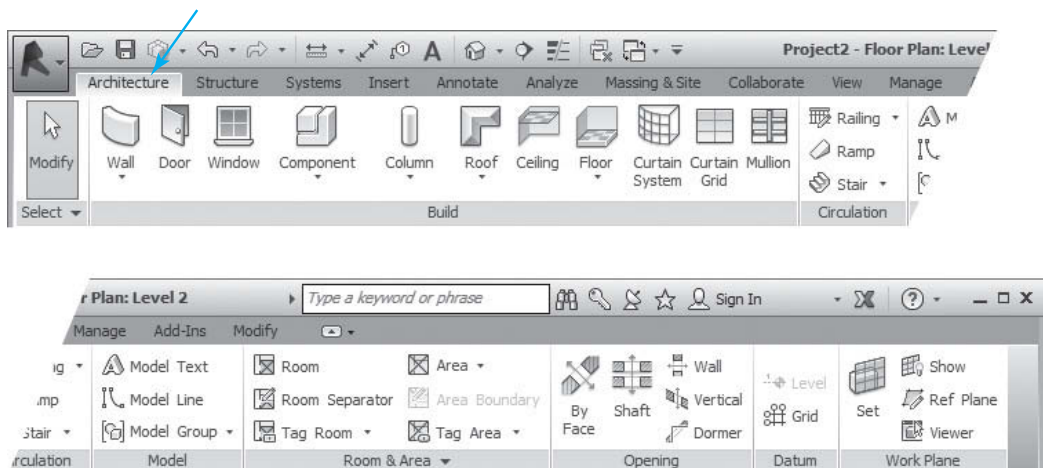
The Revit 2015 **Tab** menu contains twelve tabs: **Architecture**, **Structure**, **Systems**, **Insert**, **Annotate**, **Analyze**, **Massing & Site**, **Collaborate**, **View**, **Manage**, **Add-Ins**, and **Modify**.

### Architecture Tab

The **Architecture** tab contains panels and buttons for creating the building model. Among these are buttons for creating walls, doors, windows, components (objects such as furniture), roofs, stairs, rooms, and area objects. Also included in this tab are **Grid** and **Work Plane** buttons for placing objects (see Figure 2-5).

Figure 2-5

Architecture tab





## Structure Tab

The **Structure** tab contains panels and buttons used for creating, placing, and modifying structural elements and foundations (see Figure 2-6).

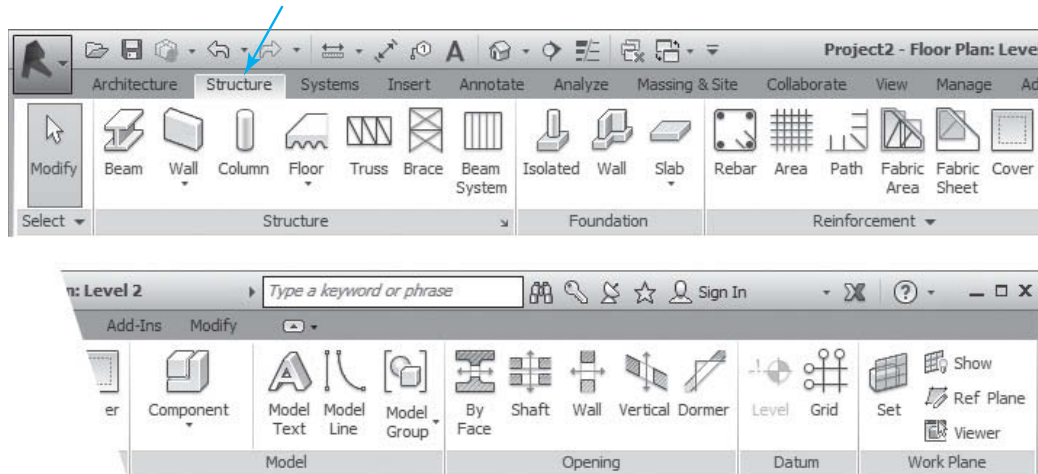


Figure 2-6

Structure tab

## Systems Tab

The **Systems** tab contains panels and buttons for (MEP) HVAC, Plumbing, and Electrical objects. By selecting the arrows in the lower right of each panel, more screens are provided to automate and dictate parameters for the MEP systems (see Figure 2-7).

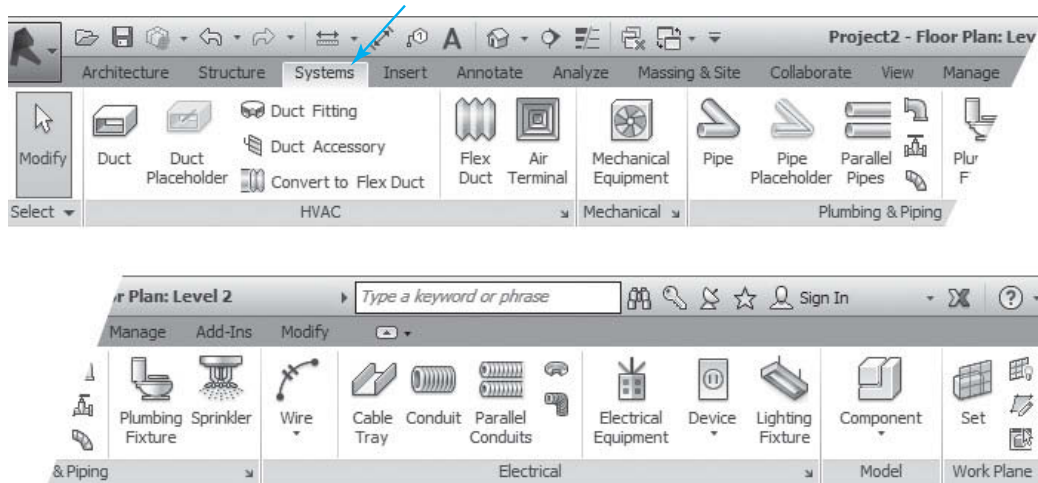


Figure 2-7

Systems tab

## Insert Tab

The **Insert** tab contains panels and buttons for electronically linking and managing files, inserting point clouds from 3D scanners, inserting decals (2D jpgs) on surfaces, and importing images and CAD files. Besides this, it contains the important button to load families and groups (see Figure 2-8).

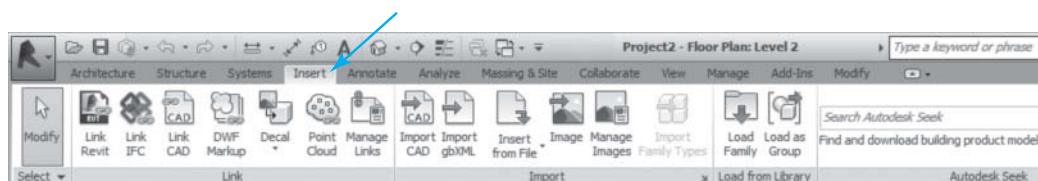


Figure 2-8

Insert tab

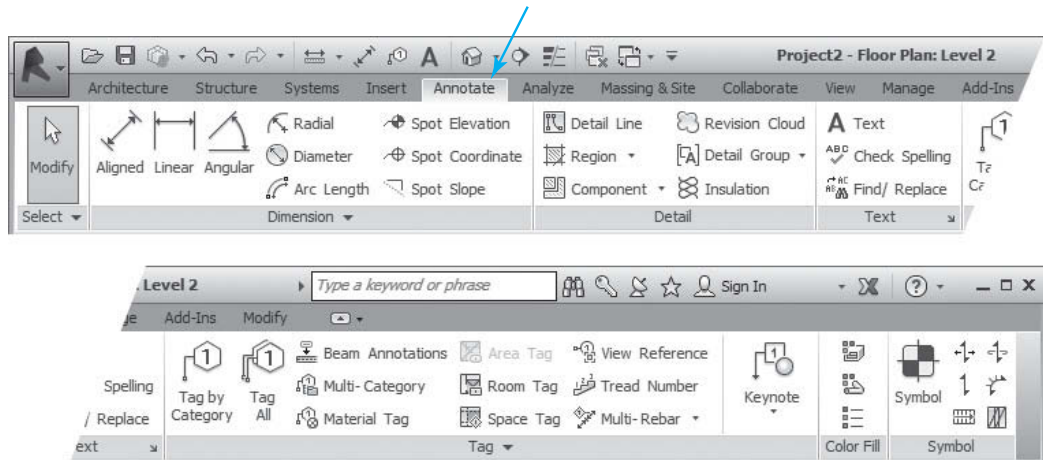


## Annotate Tab

The **Annotate** tab contains panels and buttons for adding 2D annotations to your drawings. Adding dimensions, text, tags, and other *View-specific* objects means that they are used only in plan, elevation, or drafting views (see Figure 2-9).

Figure 2-9

Annotate tab

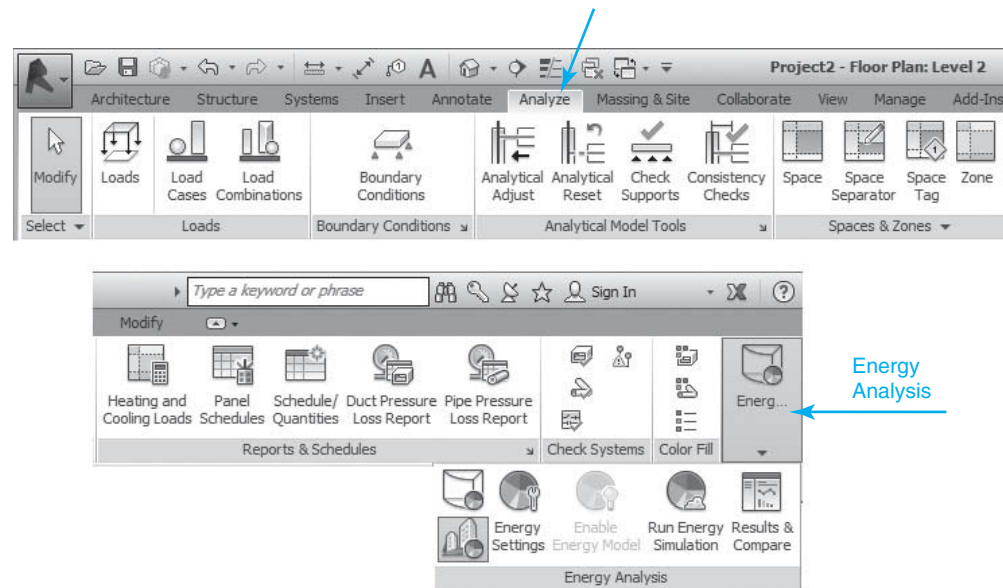


## Analyze Tab

The **Analyze** tab contains panels and buttons used for setting and analyzing Energy Models (see Figure 2-10).

Figure 2-10

Analyze tab

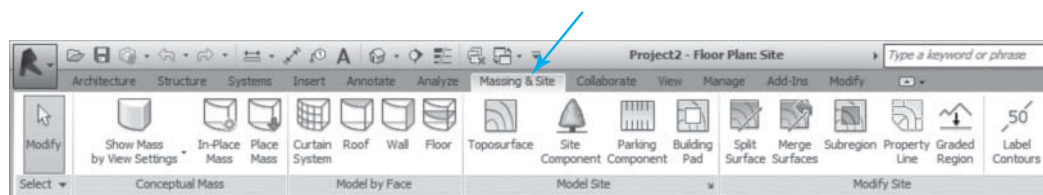


## Massing & Site Tab

The **Massing & Site** tab contains panels and buttons for modeling and modifying conceptual mass families and site elements (see Figure 2-11).

Figure 2-11

Massing & Site tab



## Collaborate Tab

The **Collaborate** tab contains panels and buttons for collaboration with internal and external project team members (see Figure 2-12).

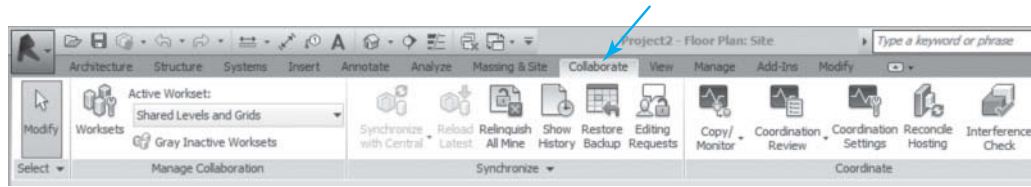


Figure 2-12

Collaborate tab

## View Tab

The **View** tab contains panels and buttons used for managing and modifying the current view and for switching views (see Figure 2-13).

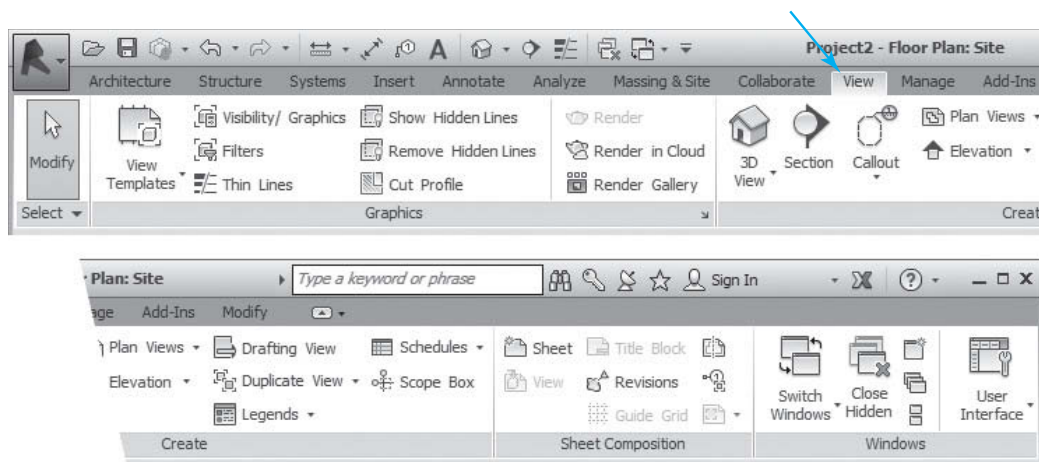


Figure 2-13

View tab

## Manage Tab

The **Manage** tab contains panels and buttons for managing project and system parameters and settings. Here one can locate the **Material Browser**, set the object snap, enter location address, and enter owner information. Additionally, both **Phasing** and **Design Options** panels are located here (see Figure 2-14).

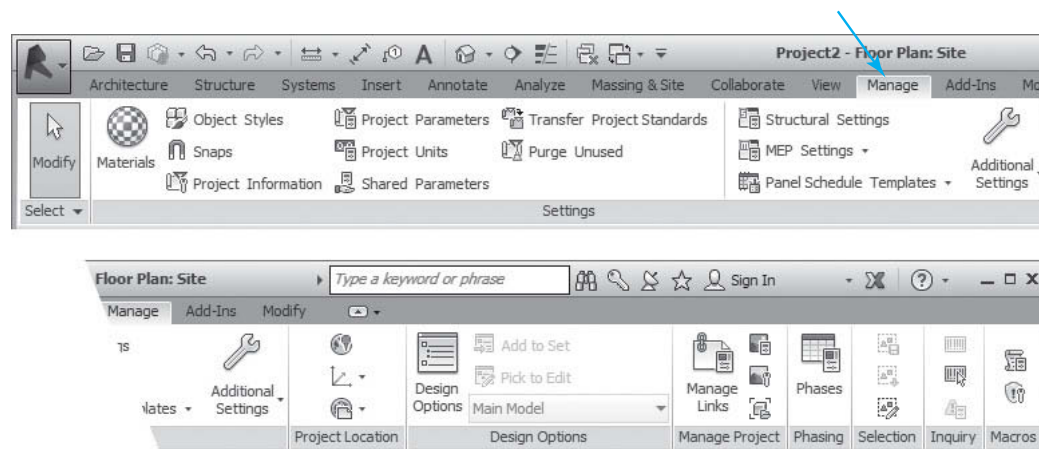


Figure 2-14

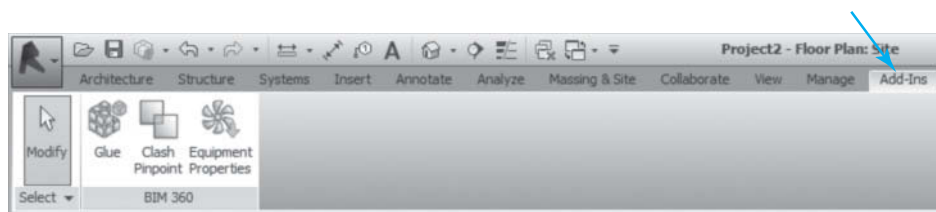
Manage tab

## Add-Ins Tab

The **Add-Ins** tab allows access to external and third-party tools (see Figure 2-15).

Figure 2-15

Add-Ins tab

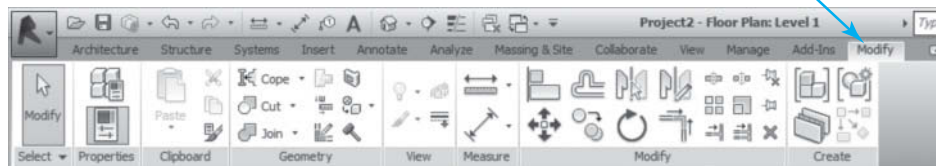


## Modify Tab

The **Modify** tab contains panels and buttons used for editing existing elements, data, and systems. When working with the **Modify** tab, select the button first; then select the objects you want to modify (see Figure 2-16).

Figure 2-16

Modify tab



## View Control Bar

The **View Control Bar** changes slightly depending on the view. It contains controls for the following buttons: **View Scale**, **Detail Level**, **Graphics Style**, **Sun Path**, **Shadows**, **Crop Region**, **Lock View**, **Render dialog menu**, **Temporary Hide/Reveal Hidden Elements**, **Temporary View Properties**, and **Highlight Displacement Sets** (see Figures 2-17 through 2-25).

Figure 2-17

**View Control Bar** changes depending on view

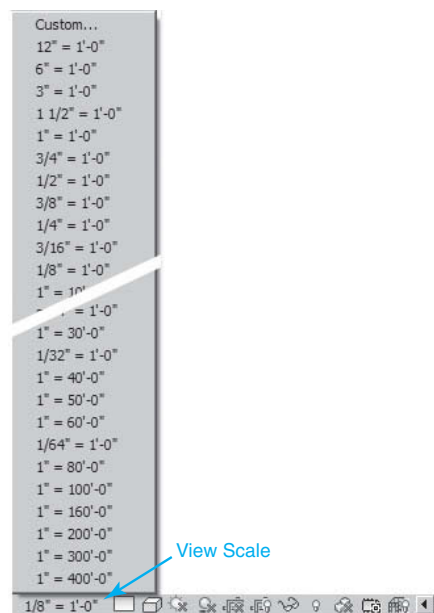
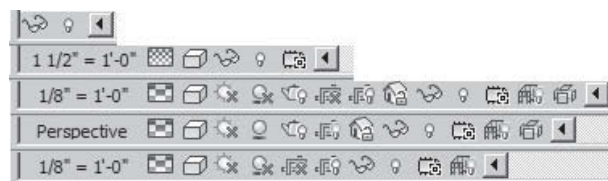


Figure 2-18

View Scale drop-down list

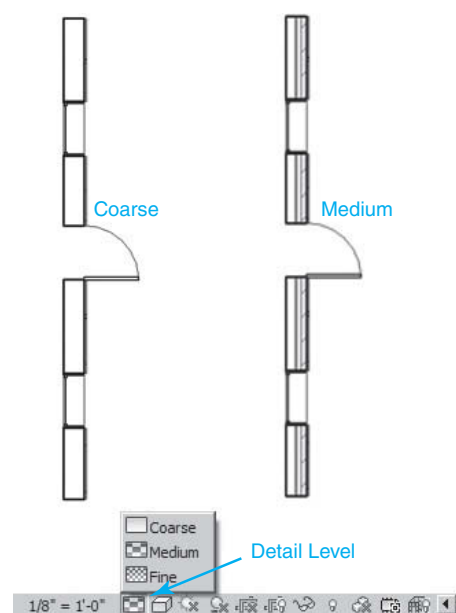
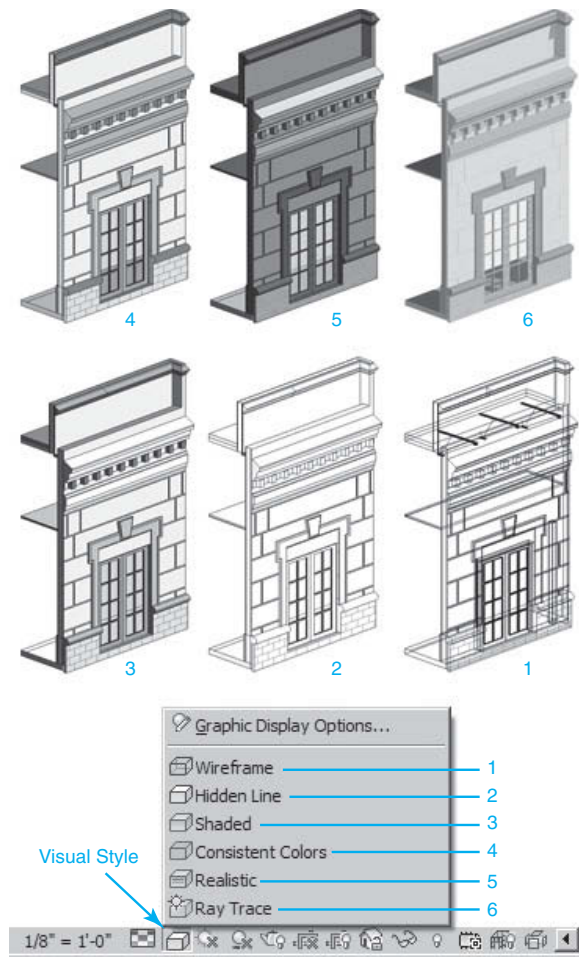
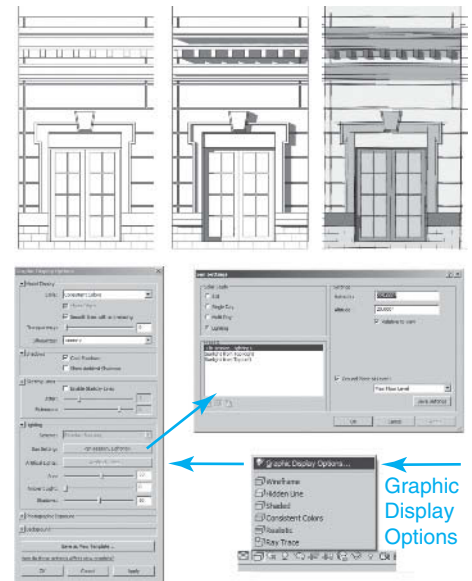


Figure 2-19

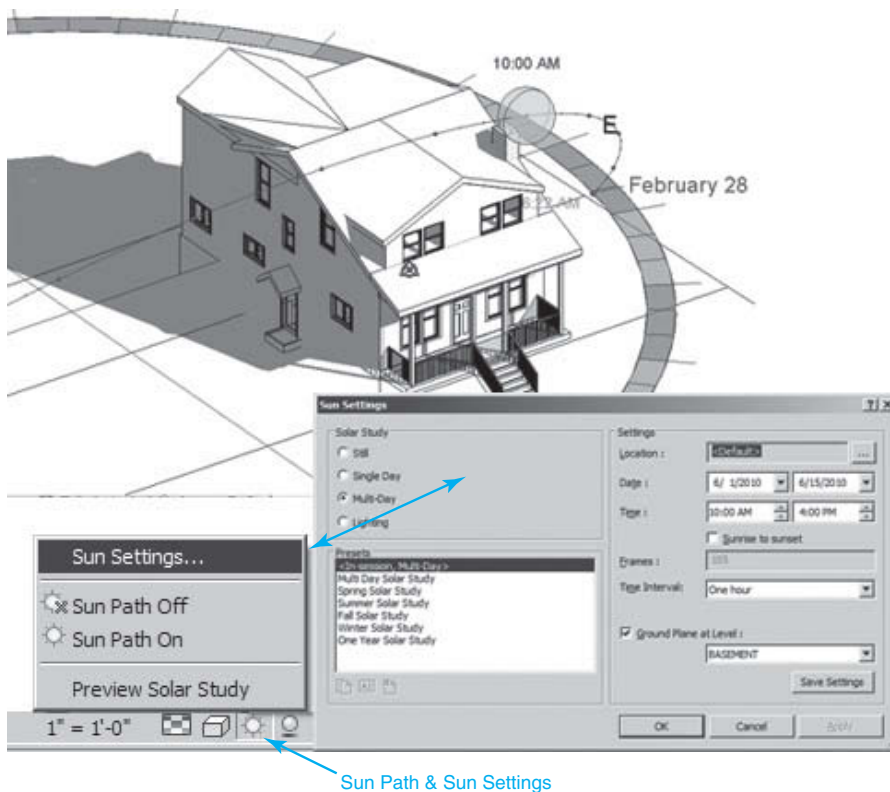
The **Detail Level** button



**Figure 2-20**  
The **Visual Style** button



**Figure 2-21**  
The **Graphic Display Options** button



**Figure 2-22**  
The **Sun Path & Sun Settings** button

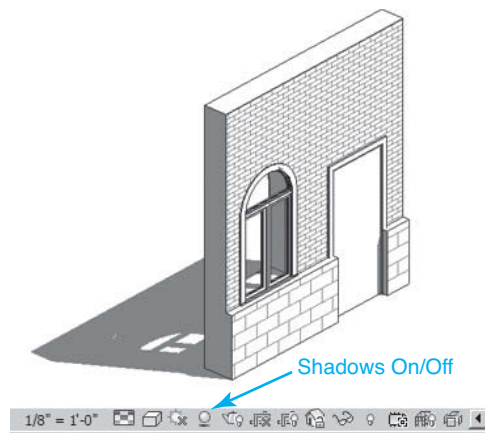


Figure 2-23

The **Shadows On/Off** toggle

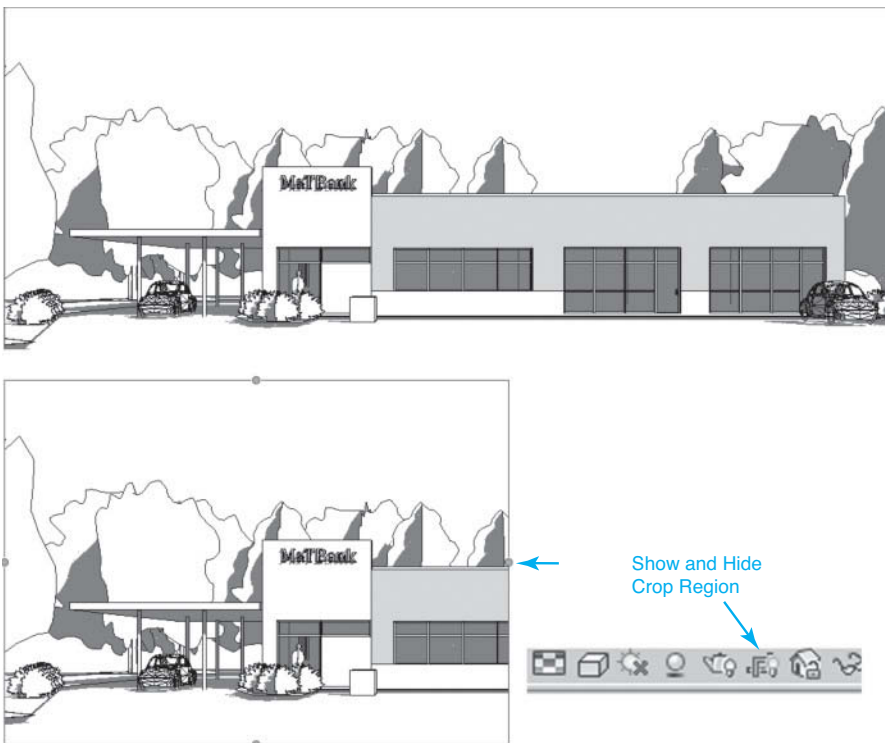


Figure 2-24

**Show/Hide Crop Region** toggle

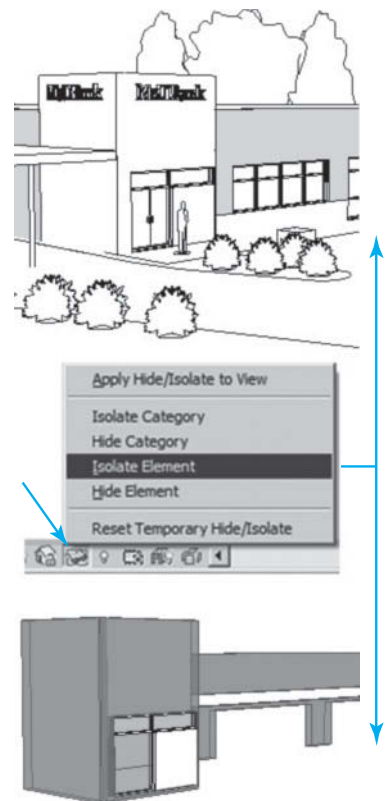


Figure 2-25

**Temporary Hide and Reset** options

## User Interface Button

The **User Interface** drop-down list is activated by selecting the **User Interface** button, always located at the top right end of the tab in all views. If the **Properties Panel** or **Project Browser** disappears, this is the place to go to bring it back (see Figure 2-26).



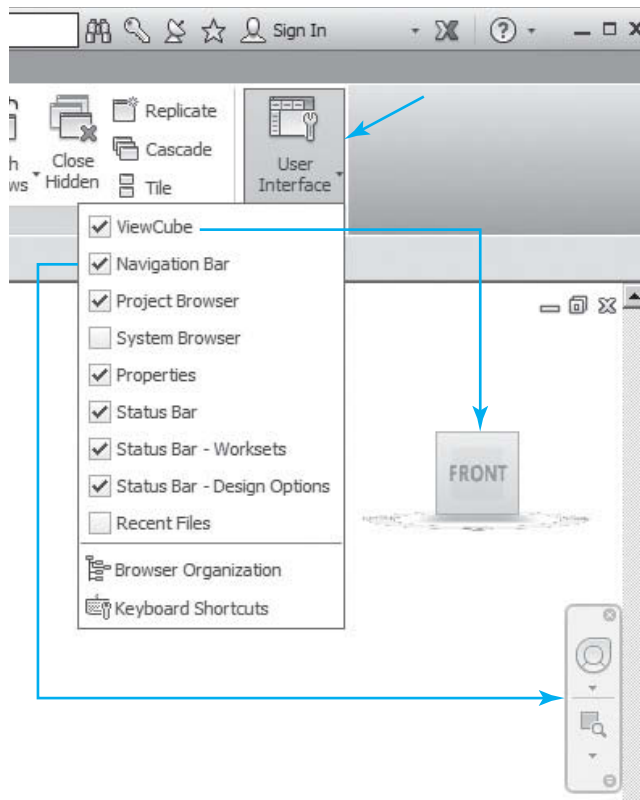


Figure 2-26

The **User Interface** button

## Navigation Wheels

1. When in a view, the **Navigation Bar** will appear if one has checked the **Navigation Bar** check box in the **User Interface** drop-down list.
2. When in a **2D** view, click on the **Magnifier** icon in the **Navigation Bar** to bring up the **2D Wheel**. When in a **3D** view, click on the **Magnifier** icon in the **Navigation Bar** to bring up the **Full Navigation Wheel** (see Figure 2-27).
3. Drag your **Wheel** to the center of your drawing by moving your cursor (the **Wheel** will follow your cursor); then click, hold, and move your cursor over the word **ZOOM**. The workspace will then zoom in toward the center of the **Wheel**. Repeat for the word **PAN** to move the view.
4. The **Rewind** option in the **Wheel** allows one to re-track to any previous view (see Figure 2-28).

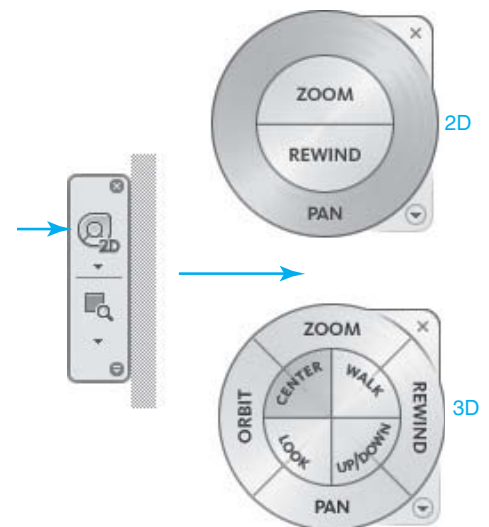


Figure 2-27

**2D and 3D Navigation Wheels**

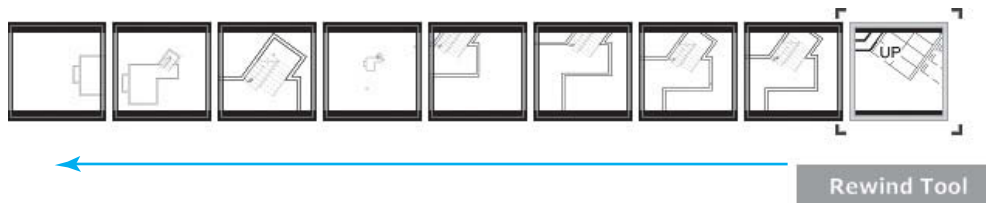


Figure 2-28

The **Rewind** option

5. If you are in a **3D** view, clicking on the **Magnifier** icon will bring up the **Full Navigation Wheel**. Experiment with **ZOOM**, **CENTER**, **ORBIT**, and other options, as you did with the **2D Wheel**. If you click and drag the **CENTER** button to a spot on your model, and then click on the **ORBIT** button, the view will rotate about that center point.

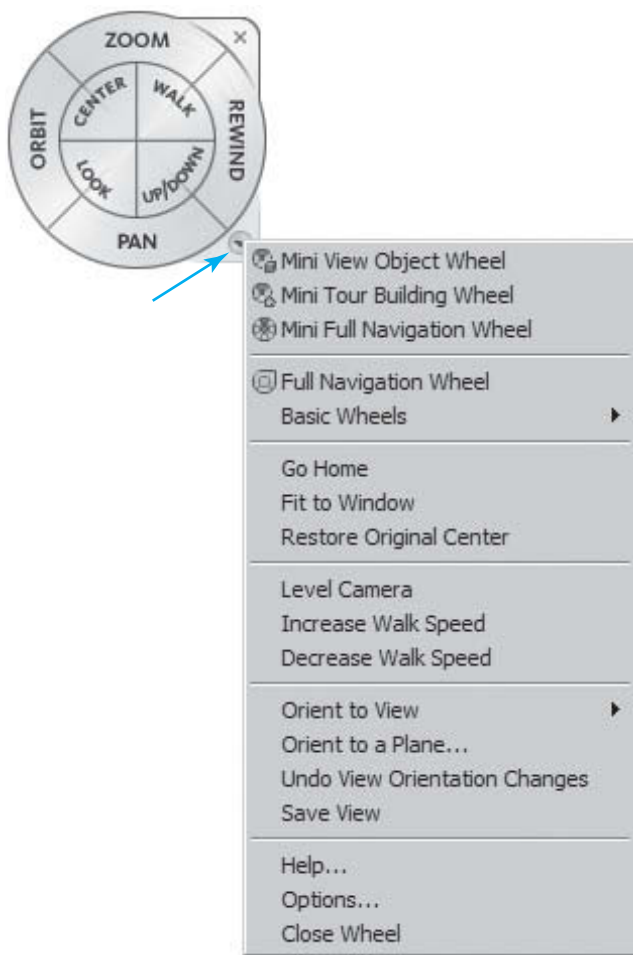
### NOTE:

If you hold down the **<Shift> + w** keys, the **Navigation Wheel** will appear or close.

- In either wheel, click on the lower right drop-down list to show the **Wheel** options. Experiment with the different settings (see Figure 2-29).

Figure 2-29

The Navigation Wheel settings

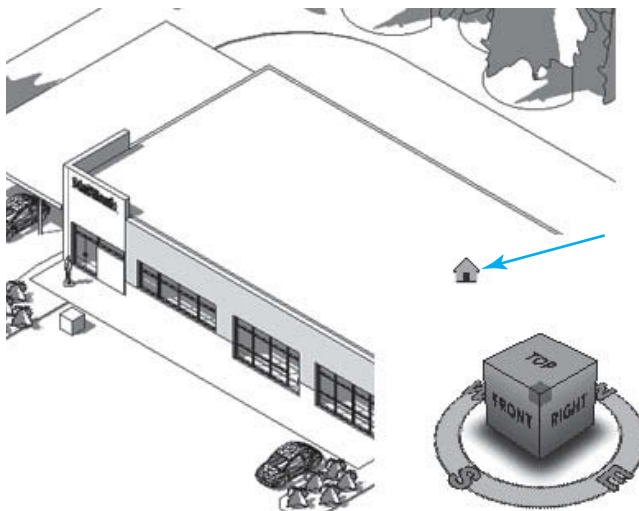


## ViewCube

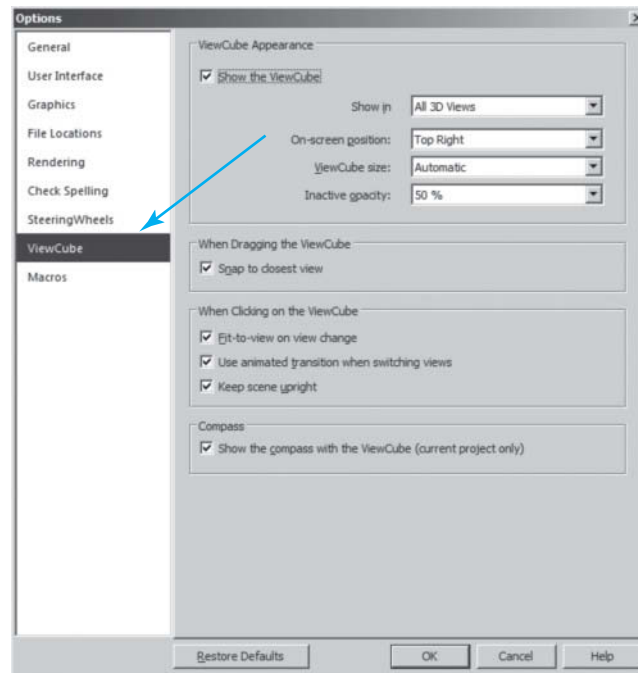
The **ViewCube** appears only when you are in a **3D** or **Camera** view. Clicking on the cube places you in a **Top**, **Front**, **Right**, **Left**, **Back**, or **Bottom** view. Clicking on the **House** icon adjacent to the cube returns you to the **3D** view. Moving the compass “orbits” the view in real time. You can turn the **ViewCube** on or off when you check the **ViewCube** check box in the **User Interface** drop-down list (see Figure 2-30).

Figure 2-30

Select the **House** icon to return to the standard **3D** view



You can modify the **ViewCube** properties by selecting **Options** from the **Application** menu and selecting the **ViewCube** tab (see Figure 2-31).



**Figure 2-31**

The **ViewCube** dialog box

## Sketching and Edit Mode

In earlier releases of Revit Architecture, the term **Sketch mode** was used to refer to the drawing of lines, circles, and so on. The completion of a 2D sketch that resulted in a change in a 3D object was termed as **Finish Sketch** mode. Since Revit 2012, the term **Edit mode** is used more often. Now, when a 3D object is changed by a 2D sketch, the object is said to be in **Edit** mode, and its completion is referred to as **Finish Edit** mode. Regardless, the terms refer to the same process. Because older users often refer to drawing as “sketching,” these two terms can be used interchangeably.

There are several terms specific to the sketching or editing process in Revit Architecture:

- **Sketching and Edit** mode is a process of drawing 2D elements in Revit Architecture.
- **Sketching and Edit** mode is similar to 2D drawing in AutoCAD, and much of the 2D detailing is done with **Sketch** buttons such as **Line**, **Circle**, **Arc**, **Rectangle**, and so on.
- **Sketch-based elements** are those that are typically created using **Edit** mode (for example, floors, ceilings, and extrusions). Other elements, such as walls, are sketched but do not require the use of **Sketch** mode.
- **Sketch and Edit** mode is the environment in Revit Architecture that allows you to sketch elements whose size or shape cannot be determined automatically; for example, when you create or edit a sketch of a roof or a floor. When you enter **Edit** mode, the tab displays only the buttons applicable for the type of sketch you are creating or editing.
- All of the elements that comprise a sketch-based element (such as a roof) are known as the *sketch*.

### EXERCISE 2-1 SKETCHING A LINE AND ADDING LISTENING DIMENSIONS

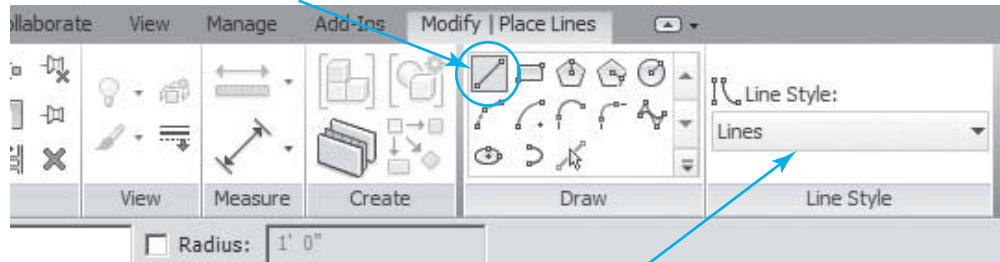
1. Start a new drawing using the **Architectural** template.
2. In the **Project Browser**, double-click on the **LEVEL 1** floor plan to bring it into the **Drawing Editor**.



3. Change the **Drawing Scale** to  $1/4" = 1'-0"$ .
4. Select the **Architecture** tab.
5. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
6. In the **Modify | Place Lines** tab, in the **Draw** panel, select the **Line** button and select **Wide Lines** from the **Lines** drop-down list (see Figure 2-32).

Figure 2-32

The **Line** button and **Lines** drop-down list



7. Click in the **Drawing Editor** to specify the start point of the line.
8. Move the cursor and click to create the endpoint of the line.

## TIP

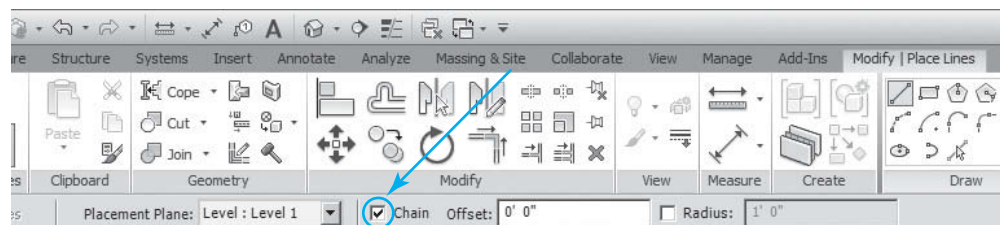
When you are sketching, you can explicitly enter a value for the length of a sketch line by typing a dimension after you begin the sketch line. This method is known as using **Listening Dimensions**.

Typically, **Listening Dimensions** specify linear dimensions such as length; for example, the length of a line (when drawing a line), length of a chord (when drawing the second point of a 3-point arc), or length of a radius (when drawing an arc, circle, or polygon), etc.

9. Again, in the **Architecture** tab, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
10. In the **Draw** panel, select the **Line** button to bring up the **Modify | Place Lines** tab.
11. In the **Modify | Place Lines** tab, in the **Lines** drop-down list, select **Wide Lines**.
12. In the **Options Bar**, check the **Chain** check box (this will allow you to start new lines connected to previous lines (see Figure 2-33).

Figure 2-33

Check the **Chain** check box in the **Options Bar**



13. Click in the **Drawing Editor** to specify the start point of the line.
14. Type the length value. When you type a number, a text box appears. If you need a line that is 8 feet 6 inches long, type the value as **8 6**, and press the **<Enter>** key. The sketch line is drawn the specified length.
15. Press the **<Esc>** key to finish the command, or move your cursor to a new direction and repeat with another value (see Figure 2-34).

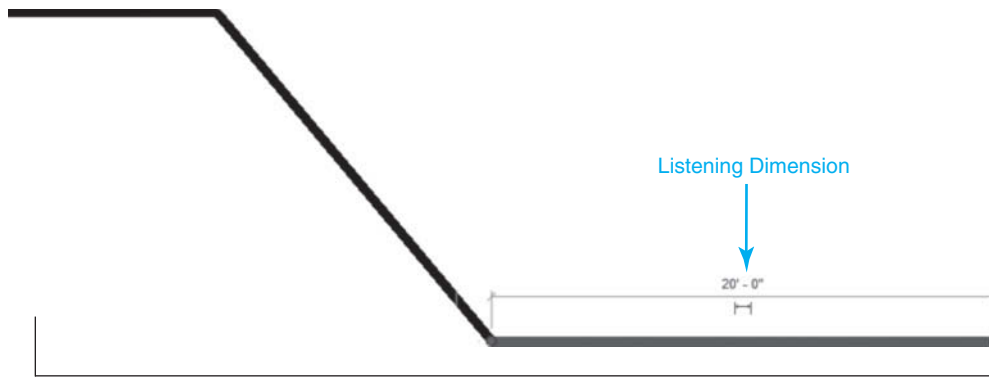


Figure 2-34

Listening Dimensions

**EXERCISE 2-2 SKETCHING A RECTANGLE**

1. Using the previous project, select the **Architecture** tab.
2. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
3. In the **Draw** panel, select the **Rectangle** button.
4. On the **Options Bar**, check the **Radius** check box, and enter **1'-0"** in the **Radius** field.
5. Click to place the rectangle, then drag its corner, and click to place a rectangle with radius corners.
6. Adjust the rectangle either by selecting an edge and dragging it or by entering a new dimension in **Listening Dimensions** (see Figures 2-35 and 2-36).

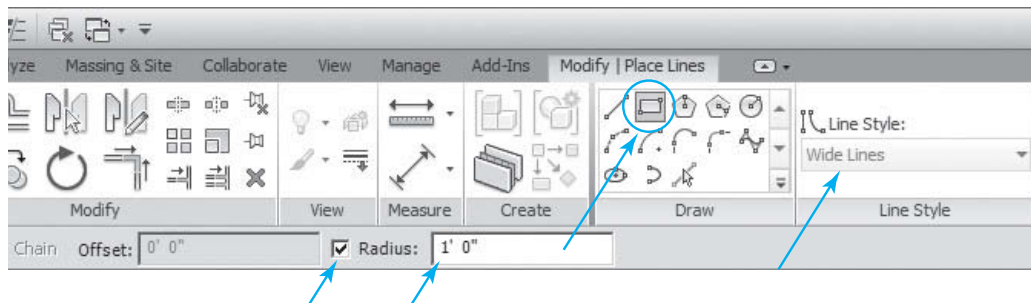


Figure 2-35

Check the **Radius** check box and then enter the **Radius** number in the text box

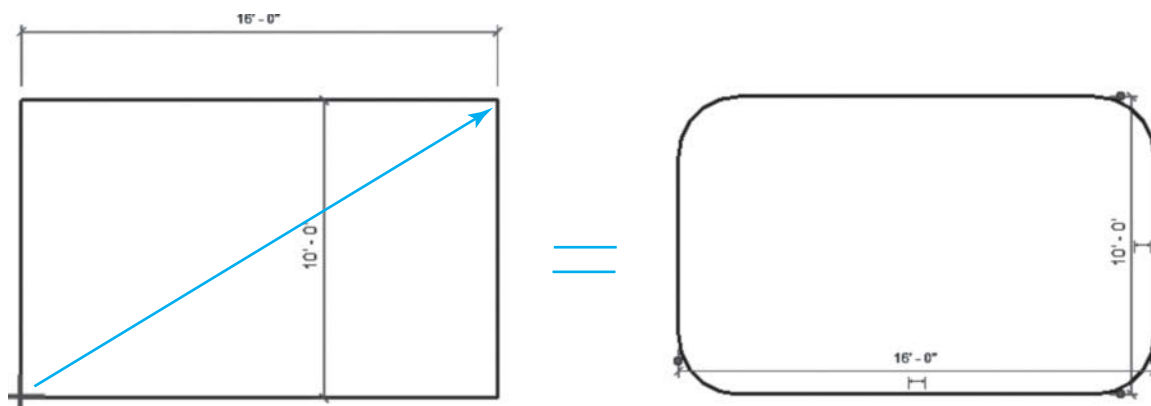


Figure 2-36

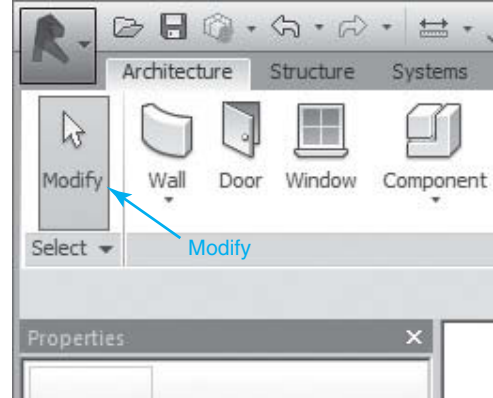
Drag to the upper right, and click to form the rectangle with round corners

**NOTE:**

Don't check the **Radius** check box if you want square corners.

**EXERCISE 2-3 SKETCHING A CIRCLE**

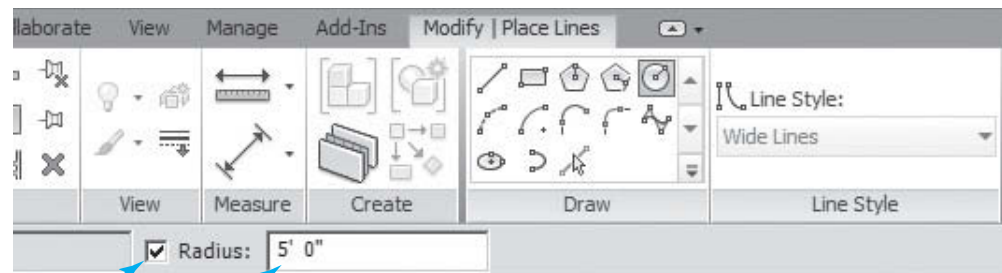
1. Select the **Modify** button that appears to the top left of all tabs to clear all selections (see Figure 2-37).
2. Using the previous exercise, drag your cursor to form a rectangle around the previous exercises, and left mouse click. This will select the previous objects.
3. With the objects selected, press the **<Delete>** key to delete the objects.
4. If you are not sure whether there are objects still out of view, press **ZA** (Zoom All) to extend the view to all objects.
5. Select the **Architecture** tab.
6. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
7. In the **Draw** panel, select the **Circle** button.
8. Click in the **Drawing Editor** to set a center point.
9. Optionally, preselect **Radius** in the **Options Bar** and specify a value. If you specify a radius, placing a circle in the drawing area requires only one click.
10. If you have not already specified a radius, just move the cursor, and click to complete the circle, or type in a dimension in the **Listening Dimension** (see Figure 2-38).

**Figure 2-37**

The **Modify** button is always located at the top left of the interface

**Figure 2-38**

The **Radius** for the circle is located in the **Options Bar**

**EXERCISE 2-4 SKETCHING A POLYGON**

1. Delete any objects from the previous exercise.
2. Select the **Architecture** tab.
3. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
4. In the **Draw** panel, select the **Polygon** button.
5. Preselect **Radius** and **Sides** in the **Options Bar** and specify a value. If you specify a radius, placing a polygon in the drawing area requires only one click.
6. Click in the **Drawing Editor** to set a center point (see Figure 2-39).

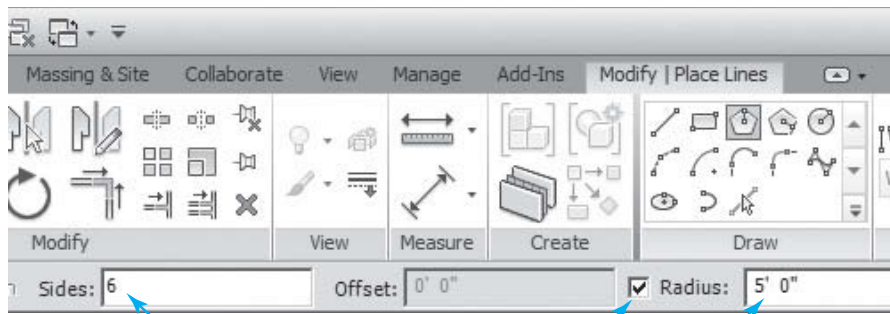


Figure 2-39

The **Radius** and **Sides** for the polygon are located in the **Options Bar**

### EXERCISE 2-5 SKETCHING AN ARC

1. Delete any objects from the previous exercise.
2. Select the **Architecture** tab.
3. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
4. In the **Draw** panel, select the **Start-End-Radius Arc**.
5. Click in the **Drawing Editor** to set a point.
6. Drag to the right and click to set a width.
7. Move your cursor upward or downward and click to set an **Arc**.
8. Notice that the center of the arc is automatically located (see Figure 2-40).

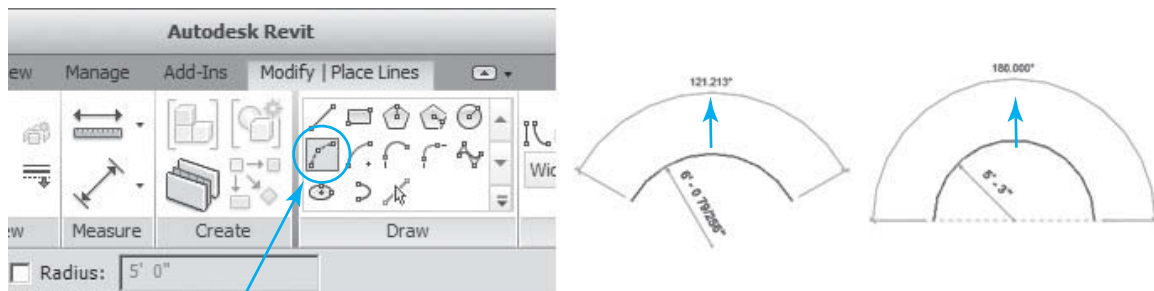


Figure 2-40

The **Start-End-Radius Arc** button in the **Draw** panel

### EXERCISE 2-6 SKETCHING A SPLINE

1. Delete any objects from the previous exercise.
2. Select the **Architecture** tab.
3. In the **Draw** panel, select the **Model Line** button to bring up the **Modify | Place Lines** tab.
4. In the **Draw** panel, select the **Spline** tool (see Figure 2-41).

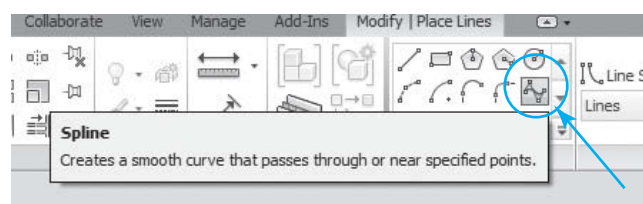


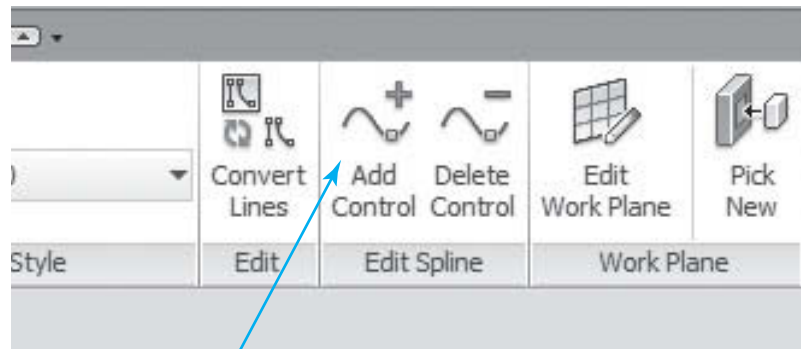
Figure 2-41

The **Spline** button in the **Draw** panel

- Click in the **Drawing Editor** to set a point.
- Place four random points and notice that a free-form line appears. After placing the last point, press the <Esc> key to end the command and create the spline.
- Select the spline to bring up the **Modify | Place Lines** tab.
- Select one of the straight lines between **Control Points**.
- In the **Edit Spline** panel, select the **Add Control** button to add a **Control Point** (see Figure 2-42).

Figure 2-42

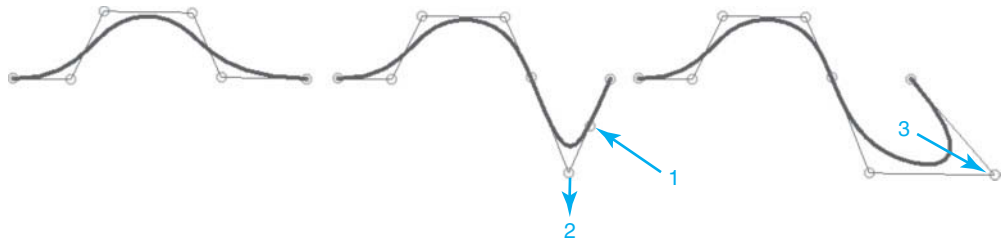
The **Add Control** button in the **Edit Spline** panel



- Drag the new **Control Point** to adjust the curve.
- Repeat, adding or deleting **Control Points** and dragging to change the curve (see Figure 2-43).

Figure 2-43

Moving **Control Points** changes the curve



#### EXERCISE 2-7 SPLITTING A LINE (WORKS FOR LINES, CIRCLES, ARCS, OR WALLS)

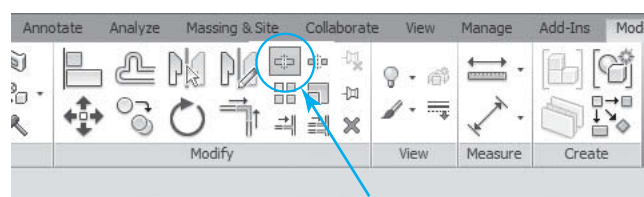
- Delete all lines drawn in the previous project.
- Place an 8'-0" line in the **Drawing Editor**.
- Select the line to bring up the **Modify Lines** tab.
- In the **Modify** tab, in the **Modify** panel, select the **Split** button (see Figure 2-44).

##### NOTE:

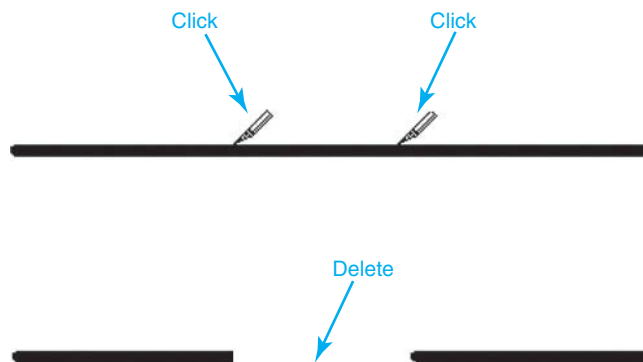
There are two **Split** buttons: **Split Element** that splits a line and **Split with Gap** that opens a space. If you use the **Split with Gap** button, enter the gap size in the **Options Bar**.

Figure 2-44

The **Modify > Split** button



- Click at two places on the line and delete the midsection of the line (see Figure 2-45).

**NOTE:**

If you select the **Split** button, you click in only one spot on the line to split the line into two pieces with no gap.

**Figure 2-45**

Click in two places and delete the midsection

Try splitting other sketch lines (see Figure 2-46).

**Figure 2-46**

Splitting lines

You can get more information on **Sketching**, **Editing**, and **Edit** modes in the Revit Help file.

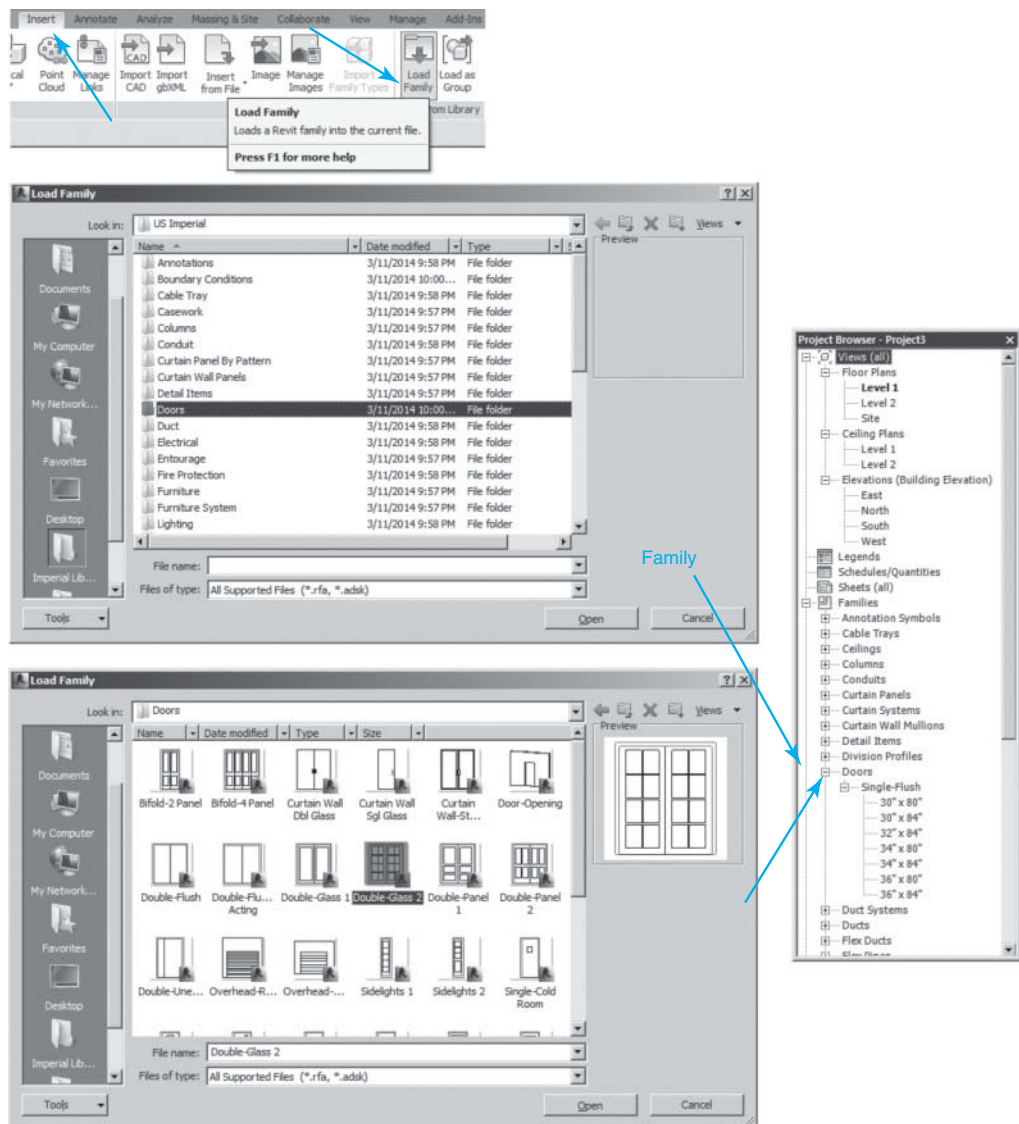
## Families

All objects in Revit Building are “Family based.” The term *Family* describes a concept used throughout Revit Building to help you manage your data and make changes easily. Each **Family** element can have multiple types defined within it, each with a different size, shape, material set, or other parameter variables as designed by the **Family** creator. Changes to a **Family**-type definition propagate through a project and are automatically reflected in every instance of that **Family** type within the project. This keeps objects coordinated and saves you the time and effort of keeping components and schedules up-to-date manually.

- To load a family, select the **Insert** tab.
- In the **Insert** tab, in the **Load from Library** panel, select the **Load Family** button to bring up the **Load Family** dialog box.
- In the **Load Family** dialog box, double-click on the desired **Family** category to open all the families in that category (i.e., Doors, Windows, etc.).
- You can also see all the preloaded families by selecting the category in the lower area of the **Project Browser** (see Figure 2-47).

Figure 2-47

The **Load Family** button and dialog boxes

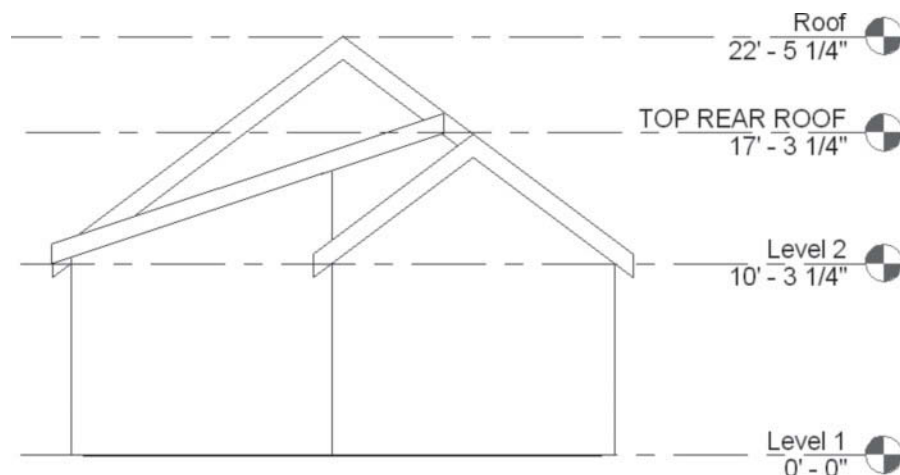


## Levels

*Levels* are horizontal planes that act as a reference for elements, such as roofs, floors, ceilings, and so on. These levels, which are seen only in the elevations, correspond to levels in the **Project Browser**. Adding new levels in any Elevation View will add corresponding levels in the **Project Browser** (see Figure 2-48).

Figure 2-48

Level planes can be viewed only in elevations and sections





## Elements

All objects in Revit Building are referred to as **Elements**. These include, but are not limited to, **Lines**, **Circles**, **Components**, **Walls**, **Window**, **Doors**, **Roofs**, **Stairs**, and so on.

## Check Boxes

Check boxes indicate the **On** or **Off** state of available options. If they are in a group, several check boxes can be selected at the same time (see Figure 2-49).

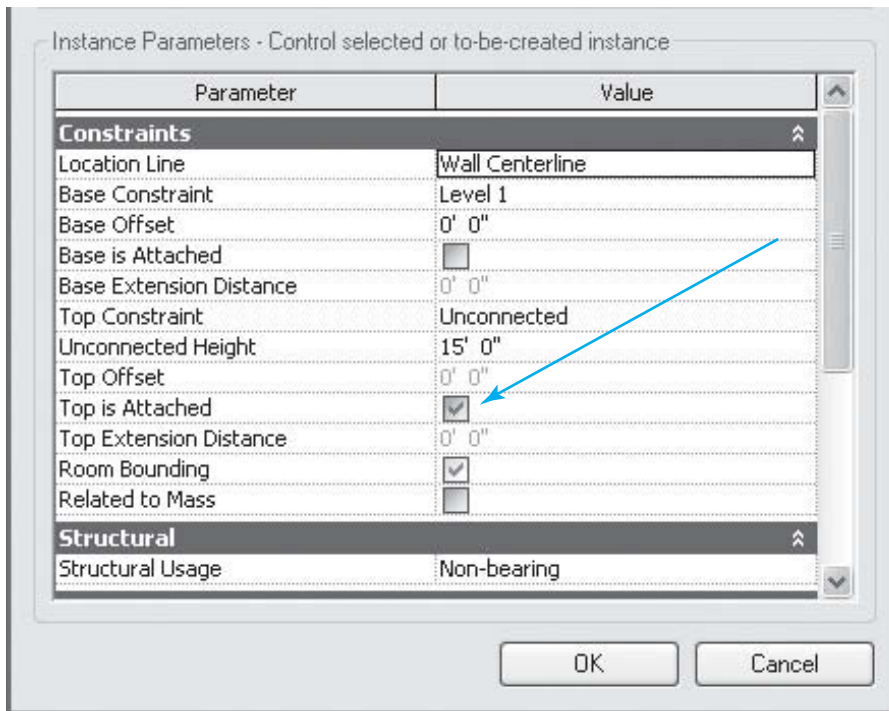


Figure 2-49

Check box

## Radio Buttons

**Radio buttons** (the name comes from the button selectors on car radios) indicate the **On** or **Off** state of available options. Only one button in a group of buttons can be chosen (see Figure 2-50).

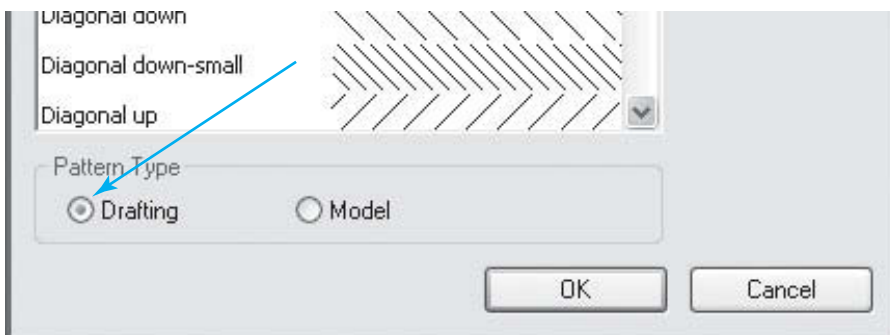


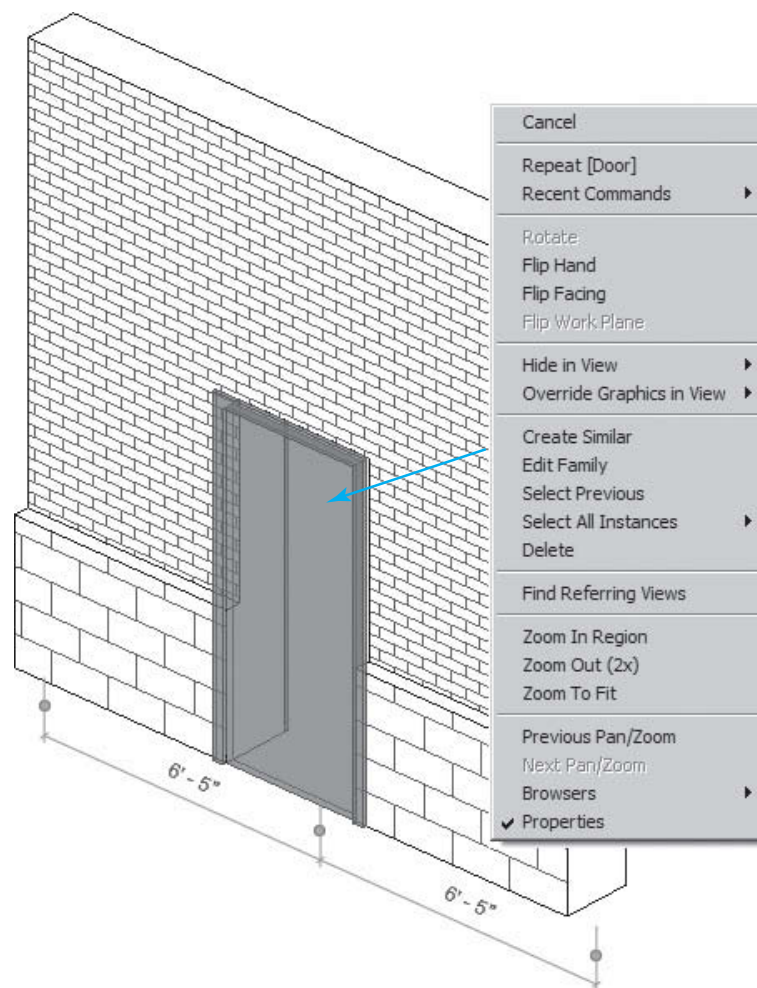
Figure 2-50

Radio button



## Contextual Menus

1. In Revit Architecture, right mouse button (**RMB**) clicking on an object will bring up a menu that contains commands available for that object.
2. Contextual (context-sensitive) menus became popular when Microsoft introduced Windows 95.
3. Revit Building uses these menus to control options and subcommands of various components.
4. Contextual menus typically are summoned by clicking the right mouse button on a specific object, entity, or spot in the interface. Through programming, the appropriate menu or “context” will appear for that object at that point in its command structure.
5. As an example, clicking the right mouse button on a door within a wall will provide all the commands available for the door and its relationship to the wall. **Right mouse clicking** in an empty area of the **Drawing Editor** (drawing area) will also bring up a contextual menu with controls for that view (see Figure 2-51).

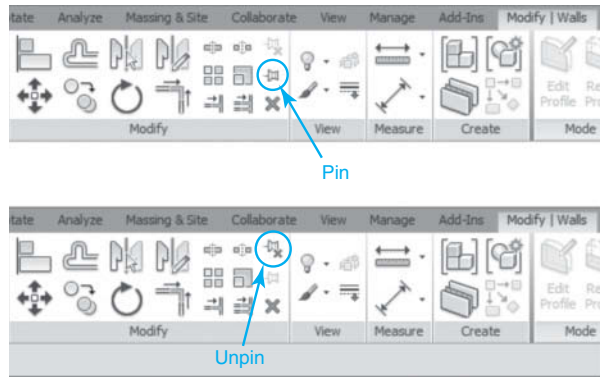


**Figure 2-51**

Contextual menu for a door

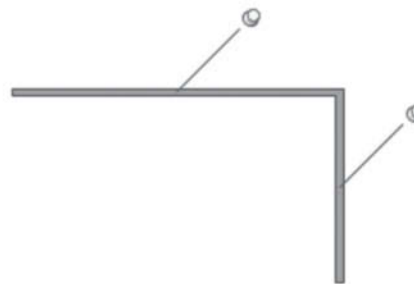
## Constraints (Pins)

Constraints (or Pins) are located in all **Modify** panels. *Pins* are very helpful when you wish to hold an entity such as a wall in place while changing the dimension of an adjacent wall, or just lock a series of elements so that they cannot be changed. Once an entity is pinned (locked in place), it can be unpinned again by going to any **Modify** panel and selecting the **Unpin** button (see Figure 2-52).



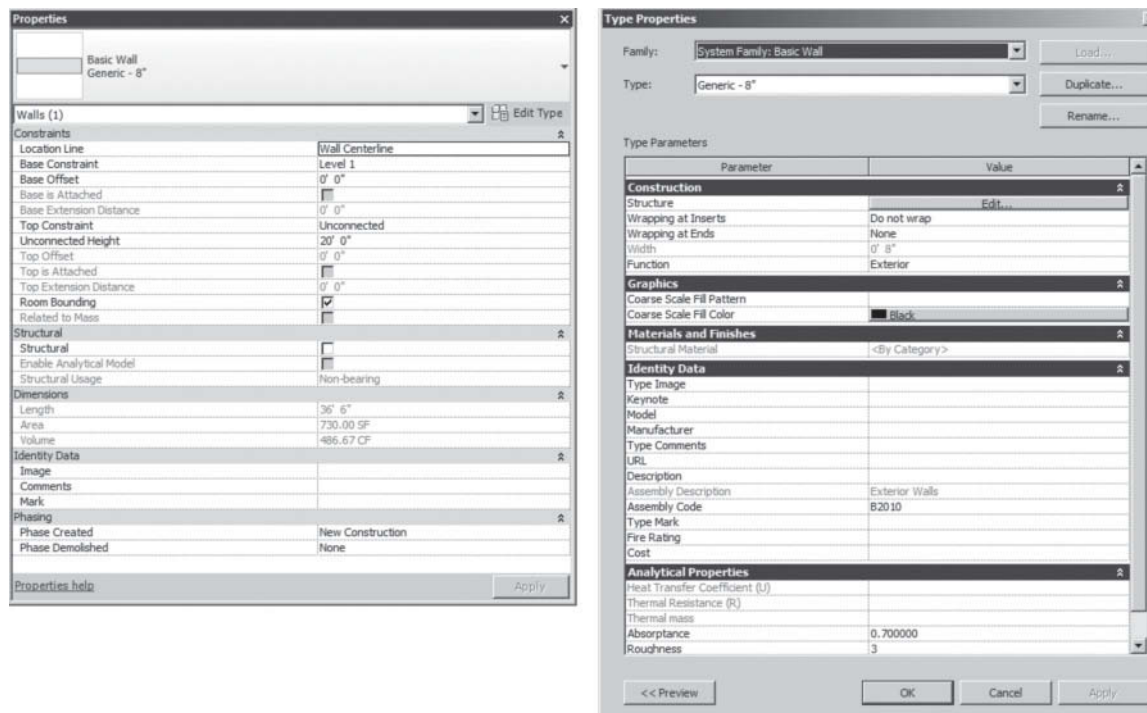
**Figure 2-52**

Constraints (Pins)



## Dialog Boxes (Menus)

1. In Revit Architecture, clicking on an object will bring up dialog boxes (or menus) that contain commands available for that object.
2. Dialog boxes (or menus) contain properties, drop-down lists, selection buttons, text and comment locations, etc. (see Figure 2-53).



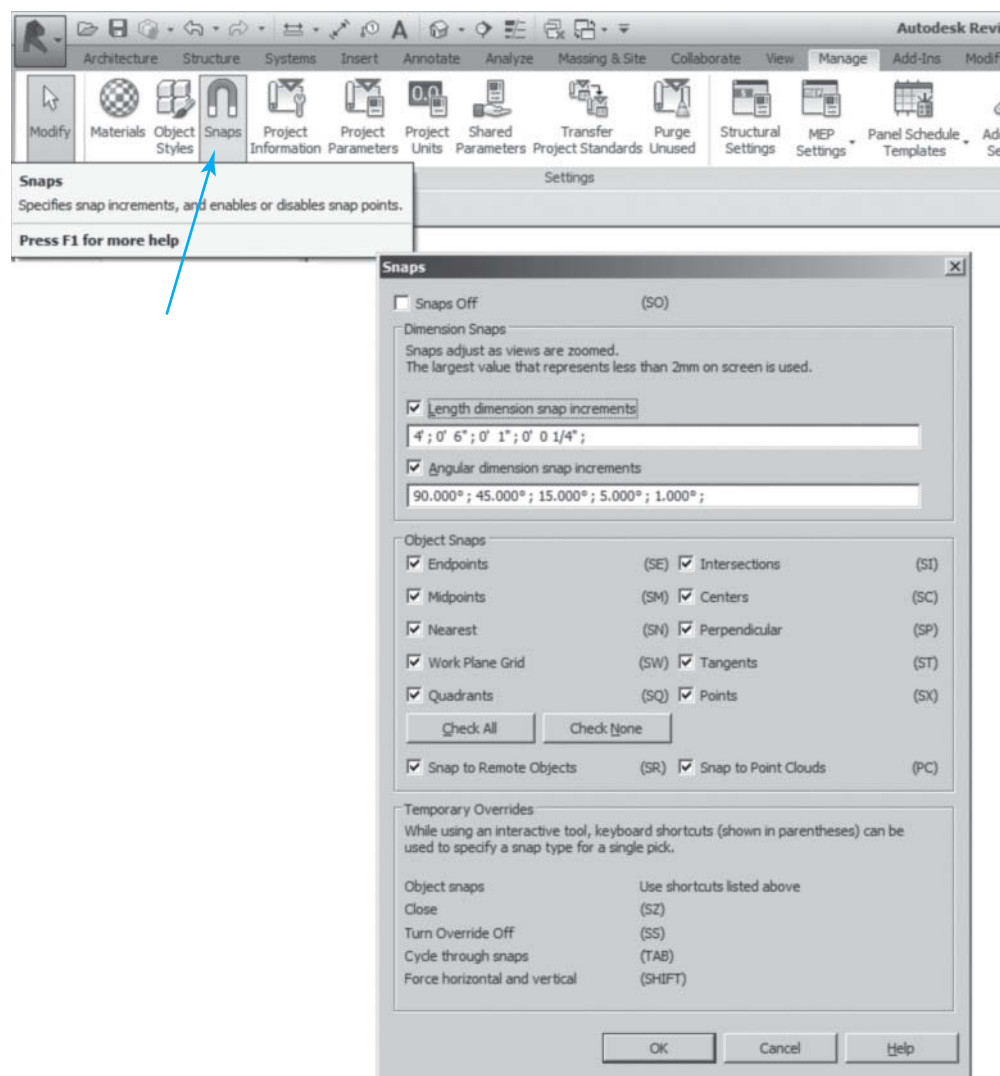
**Figure 2-53**

The **Revit** dialog box

## Object Snaps

*Object snaps* allow you to grab onto objects and lines at predetermined locations, automatically, when doing operations such as **Move**, **Copy**, **Rotate**, and so on. This concept comes to Revit Architecture from the 2D CAD programs. The **Snaps** dialog box can be reached by clicking on the **Snaps** button in the **Manage** tab. With the **Snaps On**, Revit Architecture displays snap points and snap lines to assist in lining up elements, components, or lines with existing geometry. Snap points depend on the type of snap and are represented in the drawing area as shapes (triangles, squares, diamonds, and so on). Snap lines are represented as dashed green lines in the drawing area.

In the **Snaps** dialog box, you can check which snaps you wish to appear automatically when you make an operation. You can enable or disable object snaps and specify dimension snap increments. You can also override snap settings using keyboard shortcuts (see *keyboard shortcuts* in the Help file). Settings are held for the duration of the Revit Architecture session. **Snap** settings apply to all files open in the session but are not saved with a project (see Figure 2-54).



**Figure 2-54**

The **Snaps** dialog box

## Abbreviations

In order to make this text easier to understand, shortcut abbreviations are often used. The following list codifies those abbreviations.

*Please Read Before Proceeding*

<b>Revit or Revit Architecture</b>	Refers to Autodesk Revit Architecture 2015.
<b>Browse</b>	Refers to searching through the file folders and files.
<b>Contextual menu</b>	Refers to any menu that appears when an object or entity is selected with a right mouse button ( <b>RMB</b> ).
<b>Cut Plane</b>	Height at which a plan view is displayed; usually 3'–4'.
<b>Dialog box</b>	Refers to any menu containing parameters or input fields.
<b>Display tree</b>	Refers to Microsoft Windows folder listing consisting of + and – signs. If a + sign appears, then the listing is compressed with more folders available.
<b>Drawing Editor</b>	Refers to the drawing area where drawings and 3D models are created.
<b>Drop-down list</b>	Refers to the typical Windows operating system list. When selected, a series of options appears in a vertical list.
<b>DWG</b>	Refers to an AutoCAD drawing.
<b>Elevation View</b>	Refers to <b>Front</b> , <b>Back</b> , <b>Right</b> , or <b>Left View</b> , perpendicular to the ground plane.
<b>&lt;Esc&gt; key</b>	Refers to the <b>&lt;Esc&gt;</b> key on the keyboard.
<b>Floor Plan View</b>	Refers to looking at a plan from the <b>Top View</b> .
<b>Model, Virtual model</b>	Refers to a 3D representation of a real building or component.
<b>Press the Enter button</b>	Refers to any <b>Enter</b> button in any dialog box on the screen.
<b>Press the &lt;Enter&gt; key</b>	Refers to the <b>&lt;Enter&gt;</b> key on the keyboard.
<b>Press the OK button</b>	Refers to any <b>OK</b> button in any dialog box on the screen.
<b>Project Browser</b>	Refers to the list of views contained in the project.
<b>Properties dialog box</b>	Dialog box that appears when an object is selected. This dialog box contains changeable parametric data about the selected object.
<b>Reference Plane</b>	Custom plane upon which objects are placed.
<b>RMB</b>	Refers to clicking using the right mouse button. This is most often used to bring up contextual menus.
<b>Rfa file</b>	Refers to a Revit Family file.
<b>Rvt file</b>	Refers to a Revit project file.
<b>Section View</b>	Refers to a longitudinal or transverse cut through the model.
<b>Tooltips</b>	Refers to the information that appears when the cursor is held momentarily over an icon.

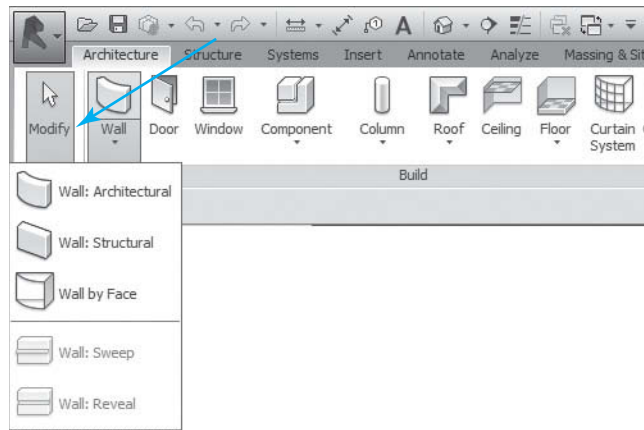
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## 3

## Walls

## CHAPTER OBJECTIVES

- Learn how to change the settings for **Listening Dimensions**.
- Learn ways to place a **Wall** object.
- Use **Pick Lines** on an imported 2D CAD file.
- Learn how to create and modify **Wall** objects.
- Create **Wall Sweeps** and **Reveals**.
- Create and modify **Curtain Walls**.
- Learn how to use **Join Geometry** and **Wall Joins**.
- Modify vertically compound walls.
- Create a profile for a **Wall Sweep**.
- Create a compound wall with the **SWEEP** command.
- Modify **End Caps** and **Insert** conditions.
- Create embedded walls.



## Introduction

*Wall objects are the basis of all buildings.* They enclose space and give the building its character. Because buildings require a vast variety of wall types and configurations, these objects have become very sophisticated in Revit Building. Walls can function as interior, exterior, foundation, and retaining. All walls have a structure that can be defined through the type properties of the wall. In addition, various instance and type properties can be specified to define the appearance of the wall.

## Creating a Wall

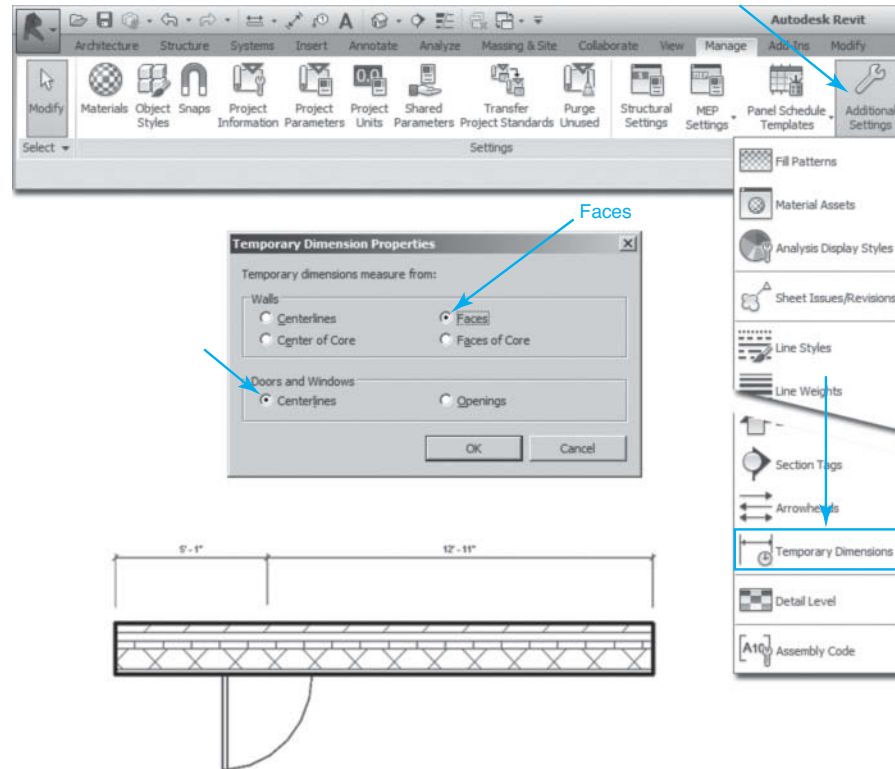
You create a wall by sketching the location line of the wall in a **Plan** view or a **3D** view. Revit Architecture applies the thickness, height, and other properties of the wall around the location line of the wall. The location line is a plane in the wall that does not change, even if the wall type changes. For example, if you draw a wall and specify its location line as **Core Centerline**, the location line remains there, even if you select that wall and change it to another type or change its structure.

**EXERCISE 3-1 CHANGING THE SETTINGS FOR LISTENING DIMENSIONS**

1. Select the **Manage** tab.
2. In the **Manage** tab, in the **Settings** panel, select the **Additional Settings** button to open its drop-down list.
3. In the **Additional Settings** drop-down list, select the **Temporary Dimensions** button to bring up the **Temporary Dimension Properties** dialog box
4. Select the **Walls Faces** and **Doors and Windows Centerlines** (see Figure 3-1).

**Figure 3-1**

The **Temporary Dimension Properties** dialog box

**EXERCISE 3-2 PLACING A WALL OBJECT**

1. Start a new drawing using the **Architectural** template.
2. In the **Project Browser**, double-click **Floor Plans > Level 1** to bring **Level 1** up into the **Drawing Editor**.
3. Set the **Detail** to **Medium** (see Figure 3-2) so that you can see the wall components in **Level 1 Plan** view).
4. In the **Architecture** tab, in the **Build** panel, select the **Wall > Architectural Wall** button to bring up the **Modify | Place Wall** tab.
5. In the **Properties** dialog box, click in the **Wall Type** panel to open the **Wall Type** drop-down list.
6. In the **Wall Type** drop-down list, select the **Basic Wall: Exterior – Brick on CMU**.
7. In the **Modify | Place Wall** tab, in the **Draw** panel, select the **Line** button.
8. In the **Options Bar**, set the **Height** to **Unconnected**; then set the height to **10'-0"**.

**NOTE**

When you set the **Height** to **Unconnected**, the top of your wall will no longer be constrained to the level above.



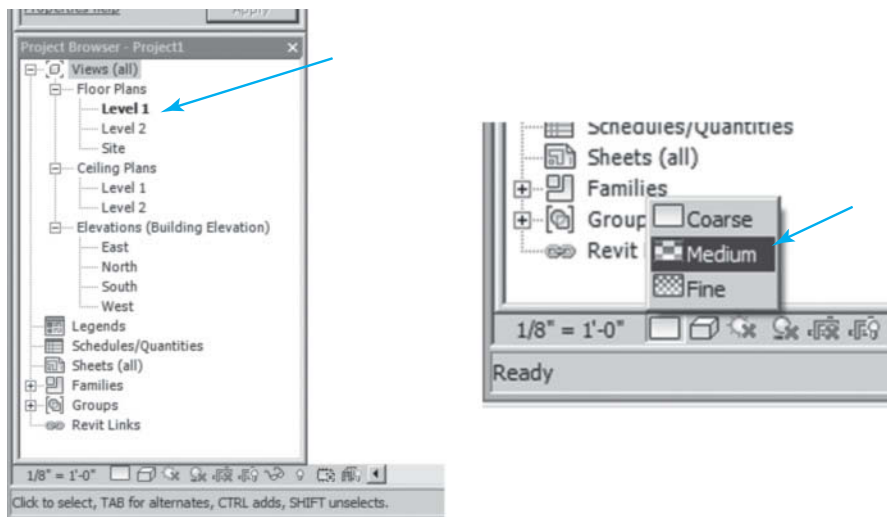


Figure 3-2

Set the **Detail** to **Medium**

9. Set the **Location Line** to **Finish Face: Exterior**, and check the **Chain** check box (see Figure 3-3).
10. Click a spot in the **Drawing Editor**, release the mouse button, move the mouse horizontally, enter **28** (28'-0"), and then press the <Enter> key to place the wall. Press the <Esc> key or select the **Modify** button in the upper left of the interface to finish the command.
11. Notice that the wall is being drawn in relation to the face of the wall; this is the **Location Line**.
12. Again, select the **Wall > Architectural Wall** button from the **Architecture** tab.
13. In the **Options Bar**, change the **Location Line** to **Core Face: Exterior**, and place another **28'-0"** long wall.

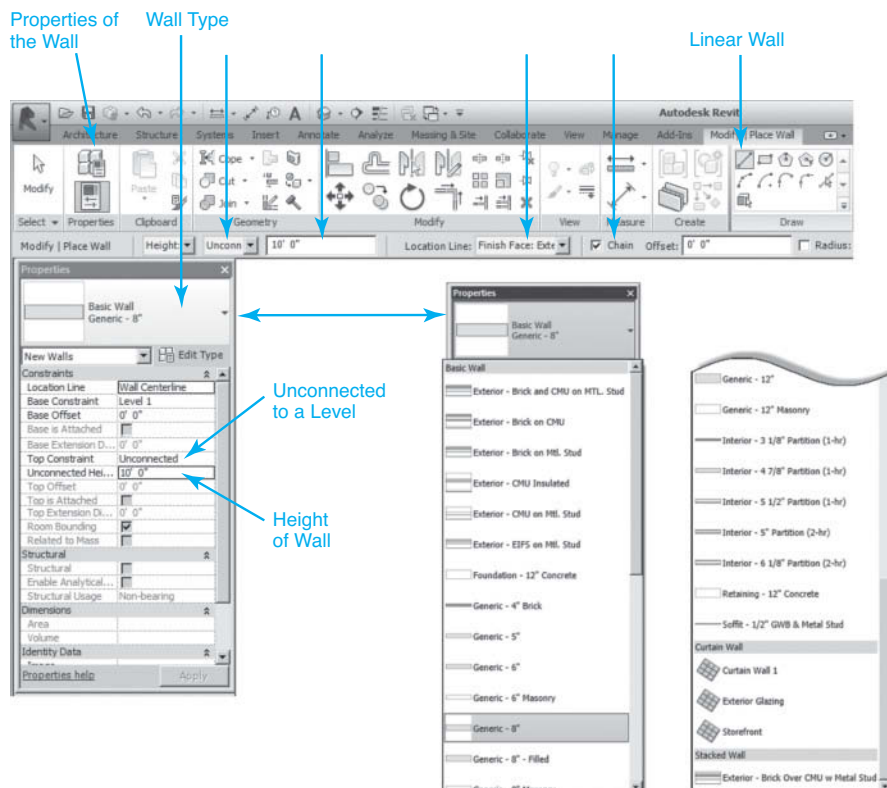


Figure 3-3

Set the **Location Line** to **Finish Face: Exterior**



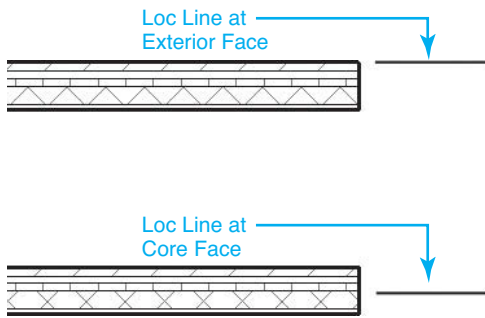


Figure 3-4

Different **Location Lines**

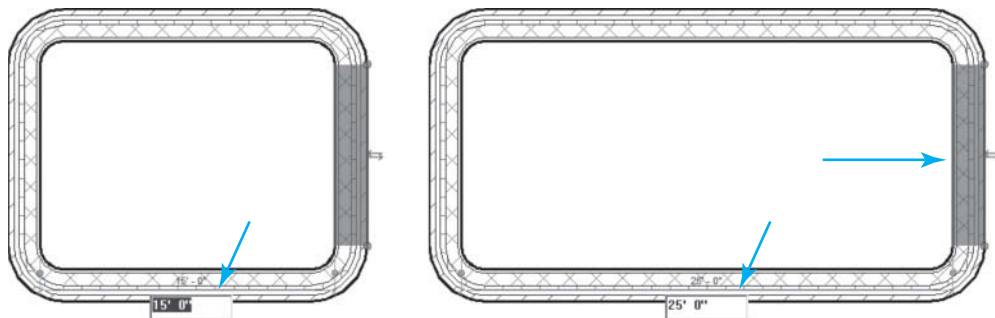
14. Notice that the wall is now being drawn in relation to the face of the CMU core. Repeat with all the different **Location Lines** (see Figure 3-4).
15. Select the walls you placed and press the <Delete> key.
16. Select the **Wall > Architectural Wall** button from the **Architecture** tab.

*Your previous wall properties will still be there.*

17. In the **Options Bar**, check the **Radius** check box, set it to **2'-0"** (2), and then pick the **Rectangle** button.
18. Click a spot, and draw a **15'-0"** (15) rectangle by moving downward to the right, watching the **Listening Dimensions**, and clicking a second time.
19. Select the right vertical wall, click the **Listening Dimension** and change it to **25** (25'-0"), and press the <Enter> key.
20. This time, the vertical wall moves to the right **10'-0"**, and the horizontal walls follow.
21. Repeat these processes, selecting the other line types in the **Draw** panel (see Figure 3-5).

Figure 3-5

The vertical wall moves to the right **10'-0"**, and the horizontal walls follow

**TIP**

A quick way to create any new object is to call for a similar object.

22. Select the wall that you created, right mouse button (**RMB**) click, and select **Create Similar** from the contextual menu that appears.
23. Before placing the wall, be sure to check the **Chain** and uncheck the **Radius** check boxes on the **Options Bar**. (You could now pick any type of line from the **Draw** panel.)
24. Click in the **Drawing Editor** and, moving *clockwise*, click and place the new walls as shown in Figure 3-6.
25. Select the vertical wall shown in Figure 3-7 to expose its temporary dimensions in relation to the left wall.
26. Select the dimension, change it to **24 9** (24'-9"), and press the <Enter> key.

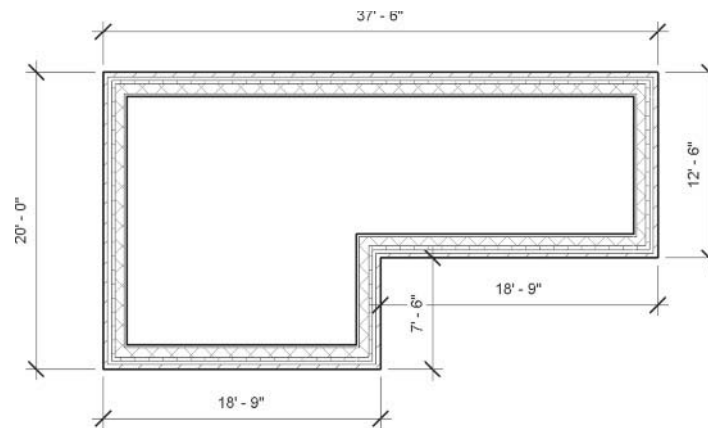
**NOTE:**

If you wish, you can now select another **Wall** type from the **Wall Type** panel.

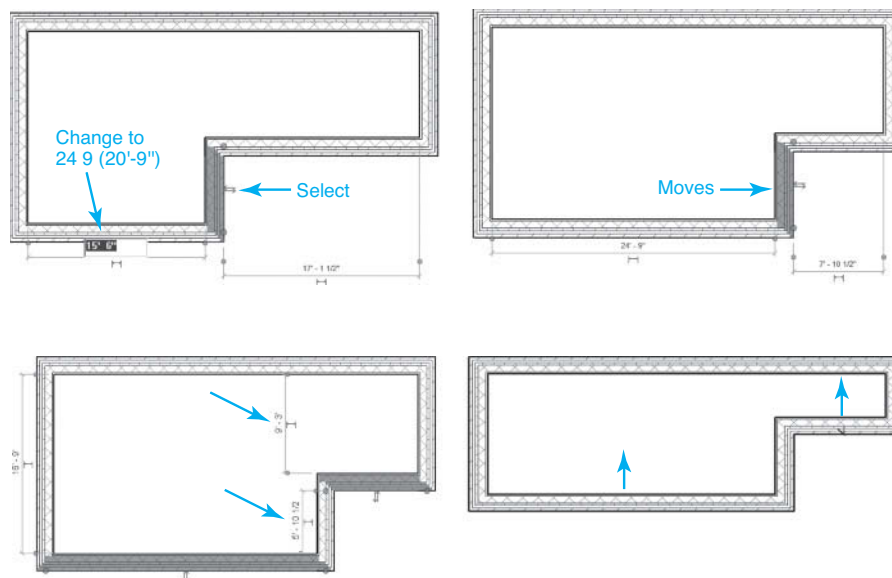
**NOTE:**

In Revit, to enter **Dimensions**, start in feet. To get **24'-9"**, you can enter **24 space 9**. You can also enter **24.75**. For smaller dimensions, **0 space 9** equals **0'-9"**. You can also enter **9"** to get **0'- 9"**, and **24'** to get **24'-0"** (Figures 3-7 and 3-8).

27. Repeat the previous process, changing dimensions on the other walls (Figure 3-8).

**Figure 3-6**

Moving *clockwise*, click and place the new walls

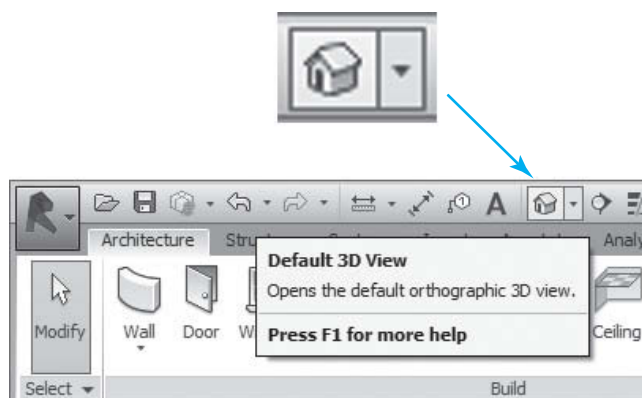
**Figure 3-7**

Change the vertical wall to **24 9** (24'-9")

**Figure 3-8**

Change the horizontal walls

28. Select the **Default 3D View** button on the **Quick Access** toolbar to bring the **3D** view of your walls into the **Drawing Editor** (Figures 3-9 and 3-10).
29. Select the **Navigation Wheel** button to bring up the **Navigation Wheel**.
30. On the **Navigation Wheel**, select **Center** and place a **Pivot Point**.

**Figure 3-9**

Select the **Default 3D View** button

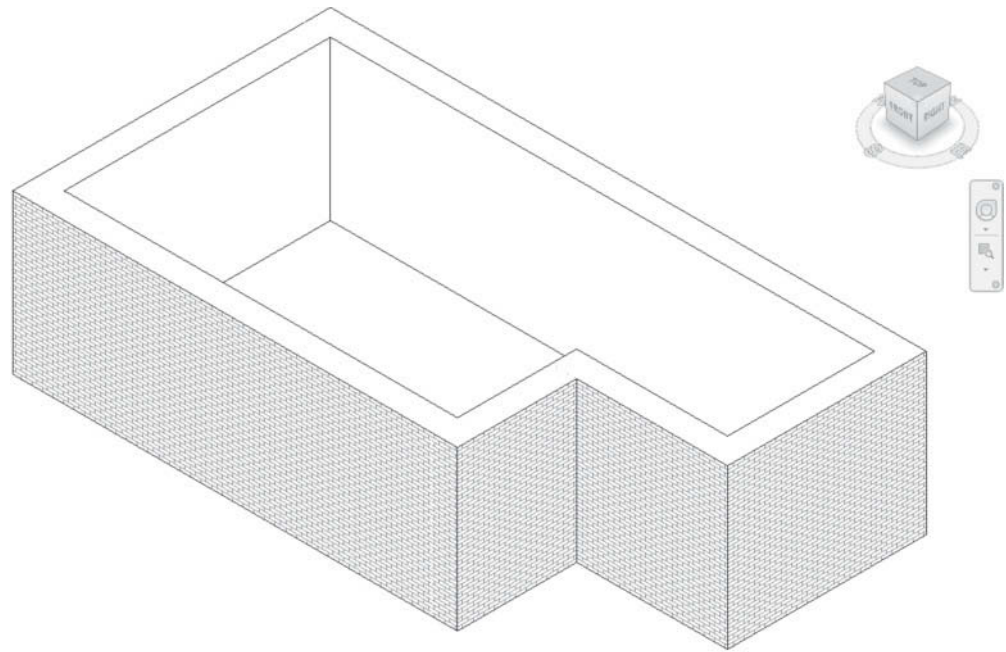


Figure 3-10

## Default 3D View

31. On the **Navigation Wheel**, select **Orbit**, and rotate the model view (see Figures 3-11 and 3-12).
32. Select **Front** on the **ViewCube**; the **Front** view appears.  
As always, keep exploring; click on all the controls that you have been shown (Figure 3-13).
33. Save your file as **PLACING WALLS**.

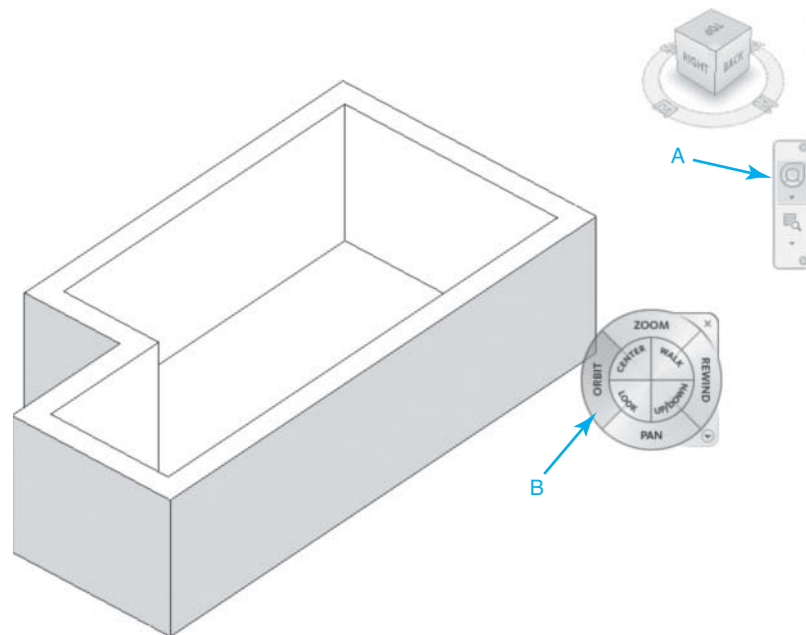


Figure 3-11

Select **Center**, and place a **Pivot Point**

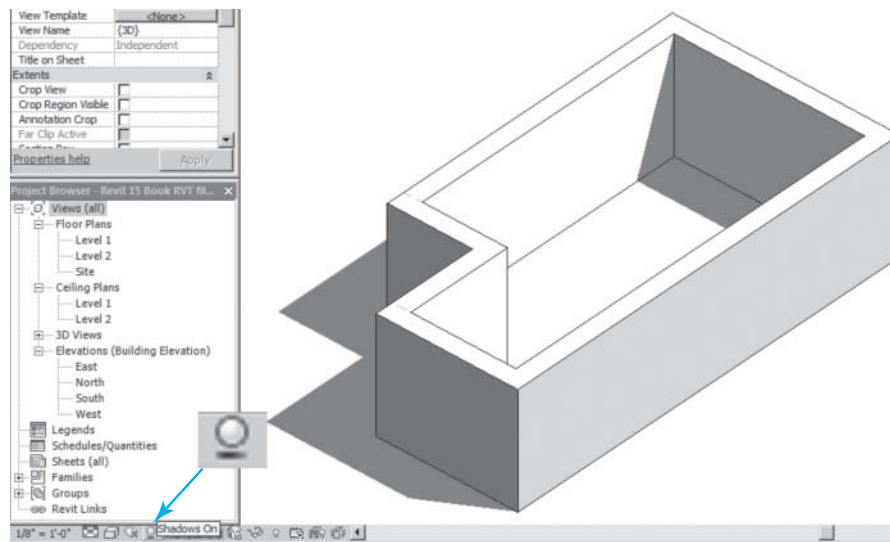


Figure 3-12

Select **Orbit** and rotate the model view

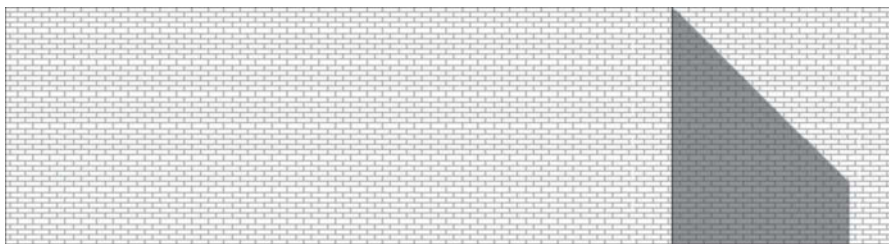


Figure 3-13

Select **Front** on the ViewCube

### EXERCISE 3-3 CREATING WALLS USING PICK LINES ON AN IMPORTED 2D CAD FILE

Using the **Pick Lines** option for creating walls allows you to pick any 2D CAD or line drawing. This is especially useful when you import a DWG, DXF, or MicroStation DGN file.

1. Download the **Carriage house Walls** CAD file from [www.pearsondesigncentral.com](http://www.pearsondesigncentral.com), and place it in a new directory named **WALLS**.
2. Start a new drawing using the **Architectural** template.
3. In the **Project Browser**, double-click **Floor Plans** > **Level 1**.
4. Select **Link CAD** from the **Insert** tab to bring up the **Link CAD Formats** dialog box.
5. In the **Link CAD Formats** dialog box, select the **CARRIAGE HOUSE WALLS** file from the **WALLS** directory.
6. The 2D CAD drawing will now appear in the **Drawing Editor** (see Figure 3-14).

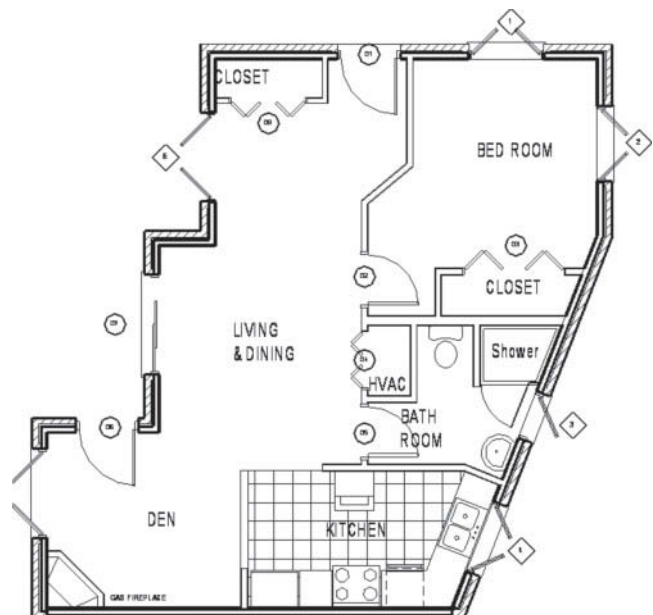


Figure 3-14

2D CAD drawing appears in the **Drawing Editor**

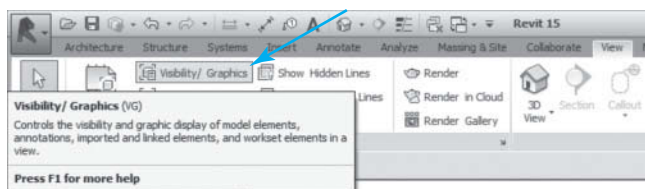


Figure 3-15

Type **VG** to bring up the **Visibility/Graphics Overrides** dialog box

7. Select **Visibility/Graphics** from the **View** tab, or type **VG** to bring up the **Visibility/Graphics Overrides** dialog box (see Figure 3-15).
8. In the **Visibility/Graphics Overrides** dialog box, select the **Imported Categories** tab.
9. In the **Imported Categories** tab, check the **HalfTone** check box for the **CARRIAGE HOUSE WALLS** drawing.
10. In the **Imported Categories** tab, expand the **CARRIAGE HOUSE WALLS** drawing, uncheck all the layers except **A-Wall** and **B-Wall**, and press the **OK** button to close the dialog box.

11. This will turn off all the walls except the A-Walls and B-Walls in the AutoCAD drawing (see Figures 3-16, 3-17, and 3-18).
12. Select the **Architecture** tab, and select the **Wall** button to bring up the **Modify | Place Wall** tab.
13. In the **Properties** dialog box, in the **Type** panel, select the **Basic Wall - Brick on Mtl. Stud** wall.
14. In the **Modify | Place Wall** tab, select the **Pick Lines** button and **Finish Face: Interior** from the **Options Bar** drop-down list. Set the Wall **Height** to **10'-0"** (see Figure 3-19).

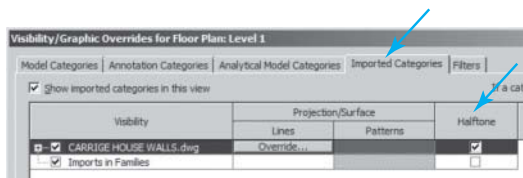


Figure 3-16

Check the **HalfTone** check box

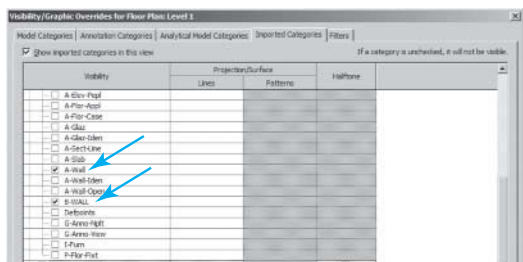


Figure 3-17

Uncheck all the layers except **A-Wall** and **B-Wall**

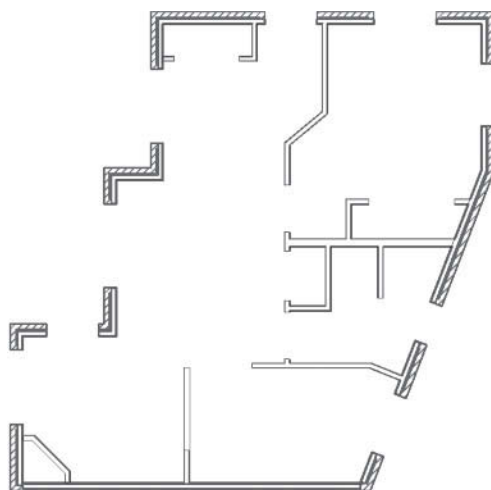
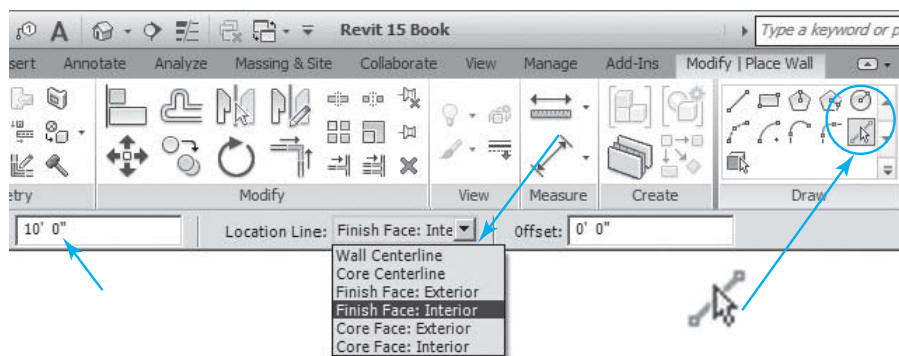


Figure 3-18

A-Walls and B-Walls

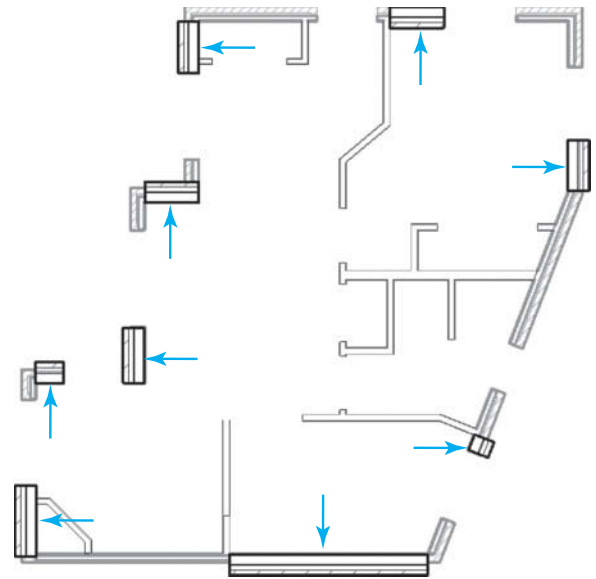
Figure 3-19

Select the **Pick Lines** button



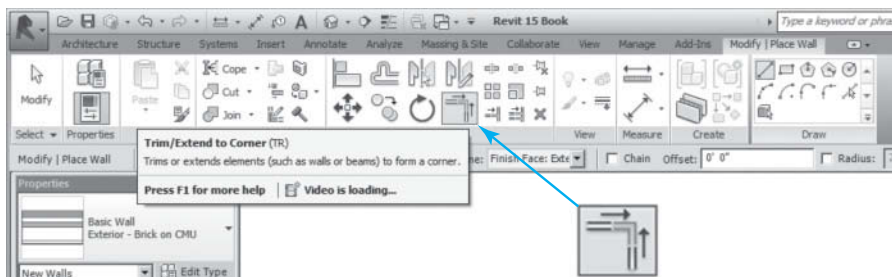


15. Move the cursor over each line in the **Linked.DWG** file as shown in Figure 3-20.
16. Be sure that the blue dashed line that appears is inside the AutoCAD line, not outside, and then click on each line (see Figure 3-20).
17. Select the **Trim** button from the **Modify** panel (see Figure 3-21).
18. Select the endpoints of adjacent walls to **Trim**, and join all the corners.
19. Select the **Default 3D View** button from the **View** tab, and place the model into 3D (see Figures 3-22 and 3-23).
20. Repeat Steps 12 through 19 selecting the **Basic Wall: Interior 4-7/8" partition (1-hr)** wall, to create the interior walls.
21. You will need the **Trim/Extend** tool to help you clean up the walls.
22. In the **Modify | Place Wall** tab, in the **Modify** panel, select the **Trim/Extend** button.



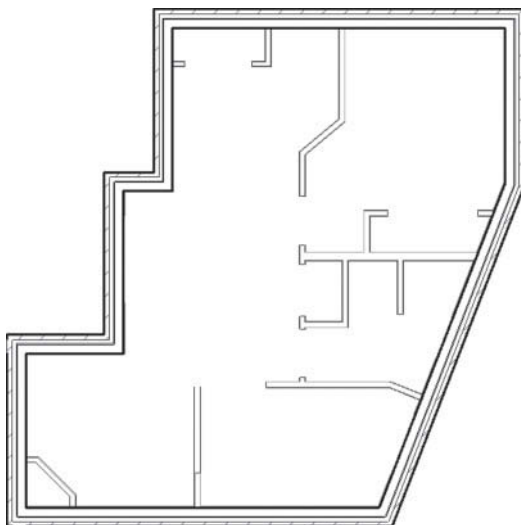
**Figure 3-20**

Be sure that the blue dashed line is inside the AutoCAD line



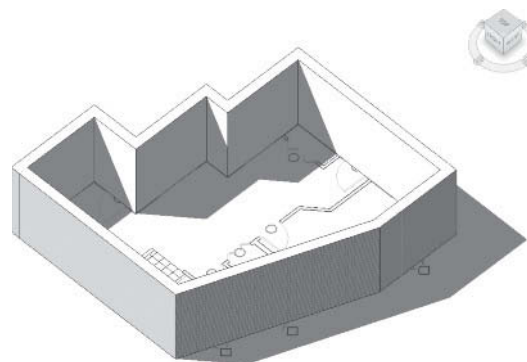
**Figure 3-21**

Select the **Trim** button



**Figure 3-22**

Select the **Default 3D View** button



**Figure 3-23**

The walls in 3D view

23. Use the **Extend** button by first selecting the wall to extend to, then selecting the wall to extend (see Figures 3-24 and 3-25).
24. Again, select the **Default 3D View** button from the **View** tab, and place the model into 3D (see Figure 3-26).
25. You have now traced your 2D CAD drawing and converted it into a 3D Revit model.
26. Save this file as **REVIT WALLS by PICK LINES**.

Figure 3-24

The Trim/Extend tool

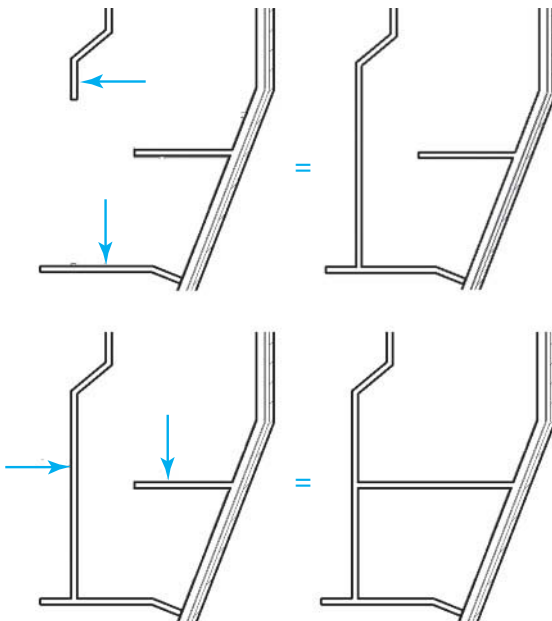
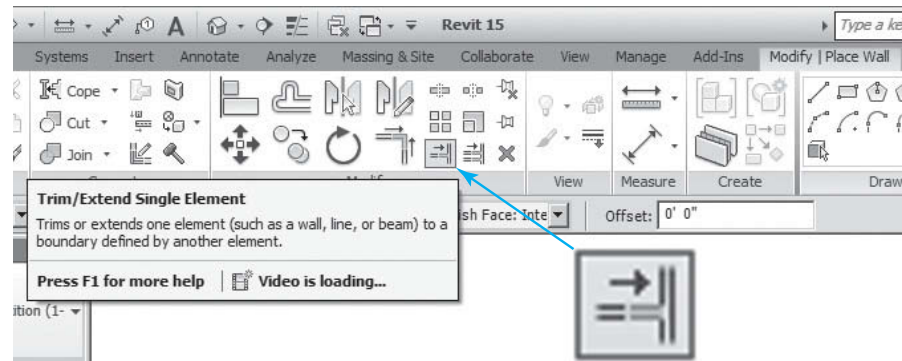


Figure 3-25

Extend the partition walls

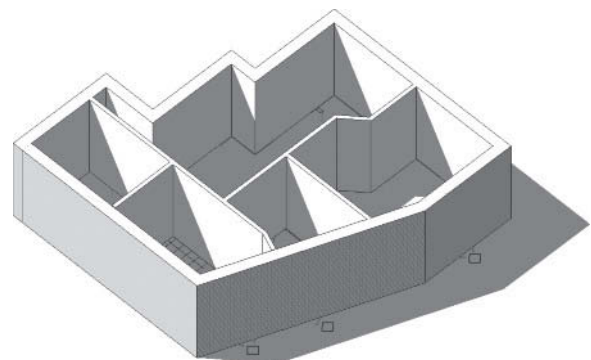


Figure 3-26

Default 3D View

### EXERCISE 3-4 CREATING AND MODIFYING WALLS

Basic **Wall** objects are included with Revit. You can easily create your own specialized walls.

1. In the **Application** menu, select **New > Project** to create a new **Architectural** project.
2. Save the new project as **CREATING WALL TYPES**.
3. Select **Floor Plans > Level 1** in the **Project Browser**.
4. Select **Architecture** tab > **Wall** button to bring up the **Wall Type Selector** in the **Properties** dialog box.

5. In the **Properties** dialog box, select the **Edit Type** button to bring up the **Type Properties** dialog box.
6. In the **Type Properties** dialog box, select the **Duplicate** button and change the name to **TEST WALL** (see Figure 3-27).

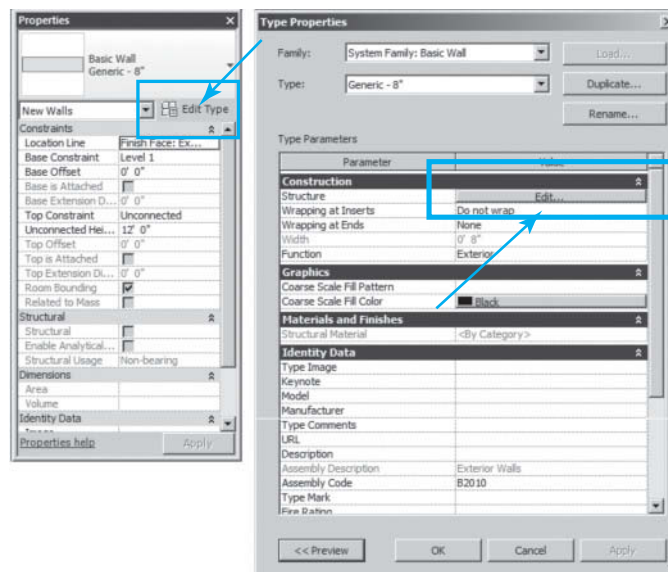


Figure 3-27

The **Type Properties** dialog box

7. In the **Type Properties** dialog box, select the **Edit** button to bring up the **Edit Assembly** dialog box
8. In the **Edit Assembly** dialog box, select the **Preview** button; then set the **Sample Height** to **4'-0"**, and finally select **Section: Modify Type** from the **View** drop-down list. Click in the viewer, and zoom in and fill the view (see Figure 3-28).
9. In the **Edit Assembly** dialog box, focus on the **Layers** section.
10. **Core Boundaries** surround the main support **Structure** of the wall.
11. One adds additional layers of materials to the exterior and interior of the main **Core Boundary**.
12. New layers can be added by pressing the **Insert** button, and using the Up and Down buttons to adjust the layer location in the wall.
13. Press the number **1** button, and then press the **Insert** button to add a new layer on the **Exterior Side** (see Figure 3-29).

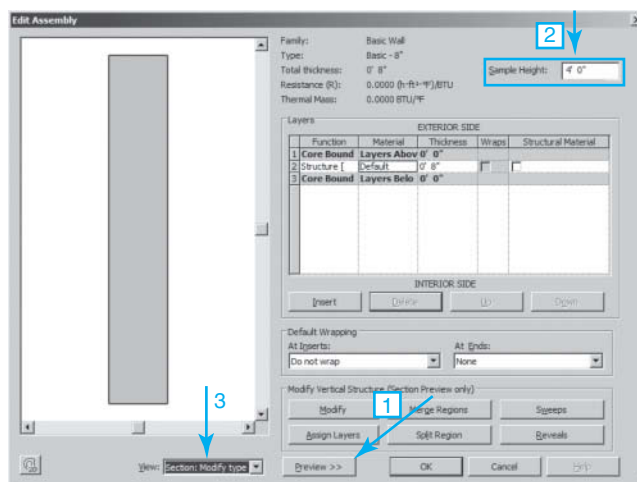


Figure 3-28

The **Edit Assembly** dialog box

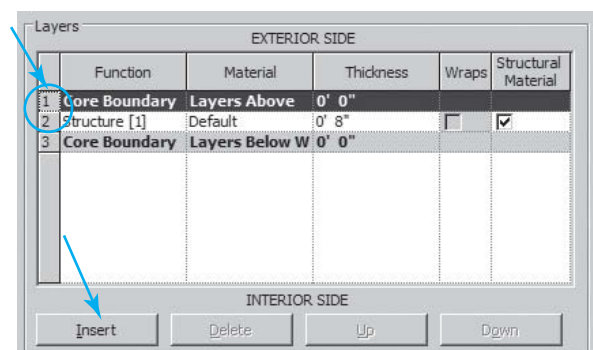


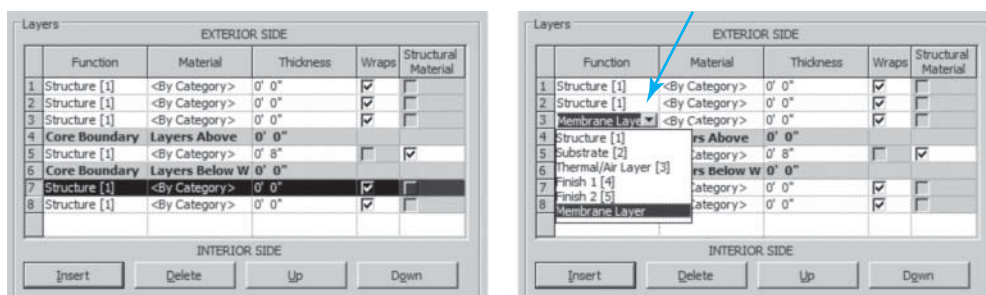
Figure 3-29

The **Insert** button



14. Add three layers on the **Exterior Side** of the **Core Boundary** and two layers on the **Interior Side**.
15. Select the number **3** button, and select **Membrane Layer** from its **Function** drop-down list (see Figure 3-30).

Figure 3-30

Select **Membrane Layer**

Function	Material	Thickness
1 Finish 1 [4]	<By Category>	0' 0"
2 Thermal/Air Lay	<By Category>	0' 0"
3 Membrane Lay	<By Category>	0' 0"
4 Core Boundary	Layers Above	0' 0"
5 Structure [1]	<By Category>	0' 8"
6 Core Boundary	Layers Below W	0' 0"
7 Substrate [2]	<By Category>	0' 0"
8 Finish 1 [4]	<By Category>	0' 0"

Figure 3-31

Change the **Function** of each layer

16. Repeat, changing the **Function** of each layer to match Figure 3-31.
17. Select the **Material** selector for **Layer 5** to bring up the **Material Browser**.
18. In the **Material Browser**, enter **CMU** in the search field, and select **Concrete Masonry Units** from the available selections.
19. Press the **OK** button in the **Material Browser** to return to the **Edit Assembly** dialog box (see Figure 3-32).
20. Repeat and set the **Material** and **Thickness** for the other layers as shown in Figure 3-33.

Figure 3-32

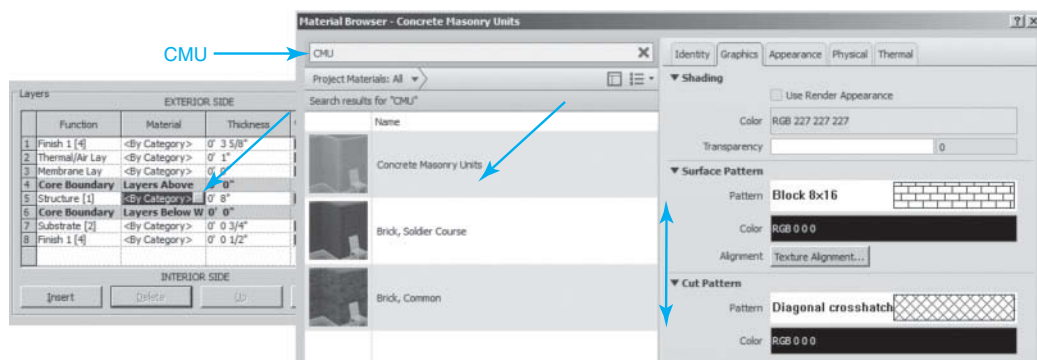
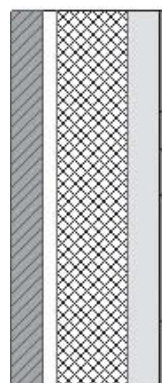
The **Material Browser**

Figure 3-33

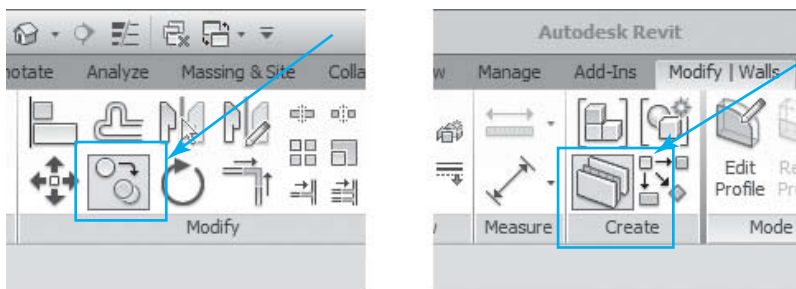
Set the **Material** and **Thickness** for the layers

Thermal Mass: 21.8806 BTU/°F			
Layers			
EXTERIOR SIDE			
Function	Material	Thickness	
1 Finish 2 [5]	Brick, Common	0' 3 5/8"	
2 Thermal/Air Lay	Air	0' 1 1/2"	
3 Membrane Layer	<By Category>	0' 0"	
4 Core Boundary	Layers Above Wr	0' 0"	
5 Structure [1]	Concrete Masonr	0' 8"	
6 Core Boundary	Layers Below Wr	0' 0"	
7 Substrate [2]	Softwood, Lumb	0' 3 1/2"	
8 Finish 2 [5]	Gypsum Wall Boa	0' 0 1/2"	
INTERIOR SIDE			

**NOTE:**

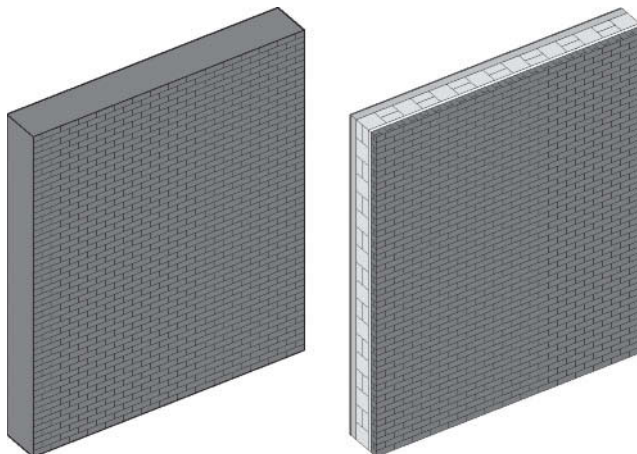
**Membrane Layer** signifies liquid waterproofing, paint, etc. **Thermal/Air Layer** is any air cavity. **Substrate** is any nonstructural member such as wall channels. **Finishes** are any final surface such as gypsum board, metal, brick, etc. The difference between **Finish 1 [4]** and **Finish 2 [5]** is the line thickness in the drawing.

21. Press the **OK** button in the **Edit Assembly** dialog box to return to the **Drawing Editor**.
  22. Change to the **Default 3D View**.
- You have now created a CMU wall with an airspace and brick veneer on the exterior, and metal channels and gypsum board on the interior.
23. Select the wall you created to open the **Modify | Walls** tab.
  24. In the **Modify | Walls** tab, select the **Copy** button, and move a copy of the wall to the right.
  25. Select the second wall, and select the **Create Parts** button in the **Create** panel to show all the parts of the wall (see Figures 3-34 and 3-35).



**Figure 3-34**

Select the **Create Parts** button



**Figure 3-35**

Wall shown with its parts

You now have this type of wall available for placement whenever you need it.

**NOTE:**

Do not use **Create Parts** until you have read this **Create Parts** exercise. Once you use **Create Parts**, you cannot add windows or doors.