Course Agenda

Module 01 **Considering Options and Alternatives**

This module is presented as a lecture followed by an exercise, it provides an insight into working with Design Options in Revit. Topics discussed include:

- Design option terminology and workflows
- Utilising design option sets, considerations when using design options
- Design sets and incorporating design options

This exercise provides a practical example on the use and set-up of design options

Module 02 **Construction Sequencing (Phasing)**

This module introduces the concept of construction sequencing, more commonly referred to as Phasing, it looks at the various stages and how these are used to visually portray each one. Topics covered include:

- Project phasing, properties, and creation
- Phase filters and graphic overrides
- Combining phases, infill and the demolition of elements

This exercise provides a practical example on utilising project phases, filters and the demolish tool

Module 03 **Project Setup and Managing Coordinates**

This module looks to guide a user through the early stages of project set-up, exploring the different approaches which may be applicable to the unique combination of supplied data and scope of work. Topics discussed include:

- Explore the different approaches to starting a project
- Understand how and why we sanitise CAD files prior to use in Revit
- Look at how we establish building models and site models
- Define and manage real-world or defined coordinates

This exercise focuses on the linking of two Revit files, a building and a site model, and the definition of a shared coordinate system between the two

Module 04 **Energy Analysis of a Revit Model**

This module explores the use of how Revit models can be successfully used to simulate energy performance from a very early stage concept model through to a detailed, element-based model with inherent material properties. Topics discussed include:

- Understand the terminology of Energy Simulation
- Learn best practice tips on model creation for energy analysis
- Explore the simplicity of concept mass simulation
- Explore the potential of analysis using detailed material composition

There are two exercises for this module, exploring the two different approaches to energy analysis, starting with an early stage conceptual model, and then looking at a more developed building model with system family composition, data-rich materials, door and window components and room data applied

Course Agenda

Module 05 **Placing Structural Elements**

This module introduces delegates to the basics of structural elements is aimed at those users who are of a non-structural discipline and who have a requirement to show structural elements within their models or to replicate structural designs provided in 2D formats such that they can be used to provide context to other information. It does not cover any analytical topics nor does it go into detail regarding settings or advanced modification of the frame. Topics discussed include:

The placement of:

- Columns, Beams and Bracing members
- Foundations, Strip footings, Slabs, Slab Edges, Piers and Pilasters
- Beam and Truss Systems

Basic modification to the above members

The creation of framing elevations

Placement and modification of beam systems

This exercise starts with the relatively empty project model and takes you through the process of assembling various structural components in order to define a simple frame as shown on the accompanying drawing.

Module 06 **Creating 2D Content Part One**

In this, the first of a series of modules looking at bespoke content creation in the Revit Family Editor, we look at the definition of the simplest of elements. We assume a starting knowledge of Revit although it is not critical to have completed the introduction to Family Editing module in the essentials series. Topics discussed include:

2D Content Creation

Detailing to Replace or Enhance?

A Library of Shapes

Profile Templates

Content Standards and Naming Conventions

In this exercise, we are creating a new library item or Standard Family, which can be used time and again. The exercise is largely self-contained as it uses a default template within Revit to create the library item, although we are going to use a predefined project file as a testing environment for our component.

Module 07 **Nesting Elements to Create Complex Families**

This module forms part of a wider series looking at the family editor in all its capability. The specific principles explored here surround the nesting of components such that an element can contain pre-defined parts and that changing the properties of the whole, will alter the properties of the parts as well. Topics explored here include:

Understand generic library elements

Follow the 10 steps to family creation

Positioning and locking a sub-element

Nesting parameters

Course Agenda

*This exercise comprises of two parts; it begins with a family based upon the standard Revit template file **Metric Generic Model.rft** which will be used to define a parametric shelf. A second family will then be created, based on the Metric Furniture.rft template file*

Module 08 **Creating 2D Content Part Two**

This exercise starts by looking at a manufacturer supplied CAD file in .dwg format, and using that data to influence the creation of a parametric 2D Detail family, similar to what we have done before, with more complex linework but without parametric control as the element will be a fixed size. We will look at rationalising the linework to appropriate levels – in other words, we will decide how little linework that we can get away with to keep our finished element light and simple yet sufficiently precise. Topics explored here include:

- Important Terminology
- Line Weight
- Nesting Principles
- Sanitising CAD Data
- Using CAD data within Revit

There are three exercises in this module, or three parts to the same exercise if we look at it another way. First, we are going to take an example of a manufacturer-supplied element in CAD format and use that as a basis for a detail component, extracting an appropriate level of information. In the second exercise, we will take this detail component and nest that into a profile family, which will in turn be used to generate the geometry for a curtain wall mullion in the third exercise.

Module 09 **Parameters and Formulae**

This exercise introduces the line-base component template which has a start and an end placement point, much like a wall does, as opposed to the single point of placement which is the normal condition for a family element. It adds to the nesting principles covered previously with several formula-driven parameters driving the geometry and how to interact with a host wall, even though the element created, is not a hosted object.

- Understanding Parameters
- Working with Formulae
- Correct Formula Syntax

The example used is a piece of decorative masonry or timber moulding to run around a building. The formulae ensure, not only that more geometry is added as we stretch the moulding, but also that the length of the pattern adjust to maintain an equally divided length, without gaps or overlaps.

Module 13 **Preparing the Analytical Model**

In this module, we look at some basic modelling techniques and best practice - around standard elements and common issues, and we'll look at some simple checks that can be undertaken when placing model elements to ensure the elements analytical component are connecting as you expect them to. Topics explored here include:

- Analytical v Physical model

View, adjust and manage analytical alignment
Nodes and hosted nodes
Auto-detection and projection
Consistency and member support checks

This exercise works through a number of practical examples of the different options available to adjust and align elements in the analytical model. The two main methods used to align analytical members are auto-detection and projection and we'll look at how these are applied in different circumstances. The first exercise considers curved members and the unique issues to consider when working with them.

Module 14 **Creating Parametric Trusses**

In this module, we look at the parametric truss builder in Revit. It is an extremely adaptable and powerful tool, and its potential is becoming increasingly explored and used to develop quite diverse and often complex alternate "framing" systems. Topics explored here include:

Loading and inserting structural trusses
Modifying profiles and properties
Add basic supports
The family editor
Build a parametric truss

The exercise that follows the lecture comprises two parts, in the first part we explore the truss generator and follow on from this by building our very own truss family from scratch.

Module 15 **Applying Loads**

This module provides an insight into using Revit to add design information, such as loads, load cases, load combinations and boundary conditions in the model. We look at analytical view controls, and how to apply different load types to the model prior to any analysis. Topics explored here include:

The type and placement of loads:
- Point, Line
- Area, Hosted

Representation of the load types
Adding loads to the model
Load cases and natures
Load combinations
Boundary conditions

This exercise provides a practical example of creating an analytical structural plan, defining load cases and load combinations, and finally, applying a few different types of loads to a simple frame.

Course Agenda

Module 16 **Working with Parametrics**

This module explains what tools are available to maintain complete control over modelled geometry through the use of parametric rules. You will learn the difference between reference planes and reference lines, and how logical rules and formulae can be used to drive these work planes and hence control the associated geometry of the finished object. Topics explored here include:

- Understanding the terminology of parameters
- Exploring the different types and functions of parameters
- Understanding work planes, reference planes, reference lines and reference points
- How parameters are created and applied

The exercise portion of this module looks at creating a simple steel portal frame which can be manipulated by changing values for span, pitch and height. The simplicity of the form is intentional as we focus on the underlying principles.

Module 17 **Placing Reinforcement**

This module explores the various tools and features available for modelling 3D concrete reinforcement. It considers a number of best practice methods and some of the best tricks, for creating complete, detailed and accurate reinforcement designs using the standard reinforcement modelling, drawing, and scheduling tools for both planar rebar, area and wire fabric mesh. Topics explored here include:

- Valid rebar hosts and reinforcing parts
- Reinforcement and cover settings and rules
- Rebar shape codes and sketching bespoke shapes
- Area, path (aligned and surface) and fabric reinforcement
- Partitioning, numbering and scheduling

The exercise uses a number of short practical examples of how to place planar rebar, structural area and fabric area reinforcement into a number of valid hosts such as concrete foundations, floor slabs and a precast stair. It concludes with scheduling, how to create a new parameter and the use of calculation tool to add a formula combining a built-in parameter with a new mass.

Module 18 **Steel Connections**

This module explores the tools and features available from the Steel ribbon and the workflows used to model 3D steel connections. It considers the different methods available to develop, save and reuse from a connection library. It explores the use of basic individual fabrication elements, modifiers, and parametric cuts, to develop a custom, or user defined connection, then save it to be re-applied as required. And finally, the workflow to modify system connections to create custom connections. The following topics are covered:

- Fabrication Elements – to sketch connections
- Modifiers – fine tune the sketch
- Parametric cuts – automatically mitre and notch elements
- Structural connection settings – hard coded
- Custom connections – user defined from fabrication elements and modifying system connections

The exercise uses the various connection tools located on the steel ribbon to interactively create a column base plate with an anchor rod connection to a foundation pad, then create a custom (user defined) connection from fabrication elements, then how to modify a system connection to create a custom connection for use in the type selector, and finally create a bolt schedule.

Module 19 **RC Detailing**

This module follows on from the Placing Reinforcement module, it explores the workflows and tools used to create RC detailing documentation. Documents include detail drawings of individual elements, assembly drawings, general arrangement drawings and schedules including partitions. The following topics are covered:

- Reinforcement Partitioning
- Preparing Detail Drawings using Multi-rebar annotation and Tags
- Creating an Assembly Views
- Create an Assemble Drawing
- General Arrangement Drawings
- Placing Schedules

The exercise uses practical examples to assign a reinforcement partition number to the stair rebar, then create a detail drawing of the stair and main bar. It then creates an assembly drawing using automated views for one of structural columns and finally, it uses the multi-rebar annotation tool and tags to complete a stair layout, and finally, a General Arrangement drawing of a floor with a reinforcement partition schedule.

Module 20 **Robot Interoperability**

This module explores the workflows available to the structural design team using Revit and Robot Structural Analysis. It takes a frame having loads applied in Revit, into Robot where design codes are used to assign load combinations before running the analysis. The results are then analysed, and design changes made as required, it concludes with the design changes being round-tripped back to Revit using the update model functionality. The following topics are covered:

- Exporting the model from Revit
- Direct Integration to Robot
- Automatic Load Combinations
- Finite Element Mesh and Displacements
- Reinforcement Calculations
- Adjust Member Sizes in Robot
- Update these changes to the Revit model

The exercise provides a practical example of the workflow for exporting a Revit frame complete with loads applied, to Robot Structural Analysis, running an analysis of the frame, performing member design before pushing the updated model back to Revit.