Building Information Modelling (BIM) Library Components Design Guide
for
Development and Construction Division
of
Hong Kong Housing Authority

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Prepared by Business Information Technology Unit
Development & Construction Division
Housing Department

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1. Introduction

Development and Construction Division (DCD) of Hong Kong Housing Department (HD) is responsible for

- Monitoring Public Housing Construction Programme
- Monitoring Housing Monitoring Information System
- Commenting on territorial / district / local planning studies and planning standards and guidelines
- Reviewing and formulating strategies and policies as well as preparing and implementing pertinent legislation with regard to construction of public housing
- Formulating and implementing corporate procurement, safety and environmental management strategies

DCD is a multi-disciplinary setup with professionals from Architecture, Structural Engineering, Building Services Engineering, Civil Engineering, Geotechnical Engineering, Quantity Surveying, Landscaping, etc. With the implementation of Building Information Modelling (BIM) in DCD, electronic models would be developed and carried throughout the project lifecycle from feasibility studies, schematic design, details design, analysis, construction and maintenance.   Standards and guidelines are important for effective model building, electronic file exchange, data and information compatibility, people communication, not only for in-house staff, but also for our consultants and contractors.

During our development of in-house BIM Standards in year 2008, there was no standards and guidelines widely accepted as the de-facto standards in the industry in Hong Kong. It was prepared based on existing HD CAD standards which has been used, updated and proved to be workable for more than 20 years, also incorporated inputs and best practice from industry. New elements were added in developing this guideline to include additional features provided in BIM which did not exist in two-dimensional (2D) environment. The BIM Standards developed was meant to be software neutral and applicable to any BIM software.

We had removed unnecessary details and retain only essential elements so that make the guideline simple to read and follow. By no mean this guideline is perfect and comprehensive. We wish this could form a basis for continuous improvement as we anticipate that the BIM technology will be changing quickly. We welcome suggestions and expert advice from in-house staff as well as industry practitioners.

Suggestions, comments and other matters related to this document can be written to
Mr. David Mak, Senior Manager / Business Information Technology (Construction)
(email: davidsk.mak@housingauthority.gov.hk) of Housing Department.

2. Design Considerations for creating Revit families

Before creating a family in Revit, users should consider the following questions regarding their intended use of a family

What size(s) does this family come in?
Is this a custom piece of furniture that only comes in one configuration, or is this a window that is available in several preset sizes? Perhaps, this is a bookshelf that can be built in any length from between 600mm to 1500mm wide. This is an important point to consider before building a family, as it will dictate decisions that need to be made in the near future.

How should this family appear in different views?
Is this an object that should be seen from plan view, elevation view, and/or sectional views? Maybe this is a 2D object that should only be seen in plan or elevation. In any case, the way that this object should appear in views will determine how to define its visibility.

Does this family require a host?
Is this family typically attached to another design element - a wall, or maybe a ceiling? Possibly it is a roof mounted mechanical unit. How this family is hosted (or what it does or does not attach to) will determine which template file should be used to start the family.

How much detail should be modelled?
Is this family an electrical wall outlet that will only be seen in interior elevations from a distance, or is it a door family with raised panels and a sidelight that will be seen in an interior rendering of the project? This determination will help decide how much detail to provide in the family.

Where should the origin point be?
Is this a column family that would use the center of the circular base as the insertion point, or is this an accessible toilet that must always be placed some distance off the adjacent wall to meet code? This decision will help users when they start placing geometry.

2.1   9 steps to note when creating a family in Revit

1. Select the appropriate family template.
2. Lay out reference planes to aid in drawing component geometry.
3. Add dimensions to specify parametric component geometry.
4. Add labels to dimensions to create type or instance parameters.
5. Test the new model to verify correct component behaviour.
6. Add geometry in Solids and Voids, locked to reference planes.
7. Specify 2D and 3D geometry display characteristics with sub-category and entity visibility settings.
8. Define family type variations by specifying different parameters.
9. Save the newly-defined family, then load it into a new project and see how it performs.

2.1.1   Step 1: Selecting the appropriate family template (Fig 2.1)
         Templates for family creation are supplied with Autodesk Revit. The various templates cover
         a broad range of possibilities from 2D annotation objects to 3D roof-based spot lights. Each
         template has been pre-configured to aid in the construction of a specific object type. A full
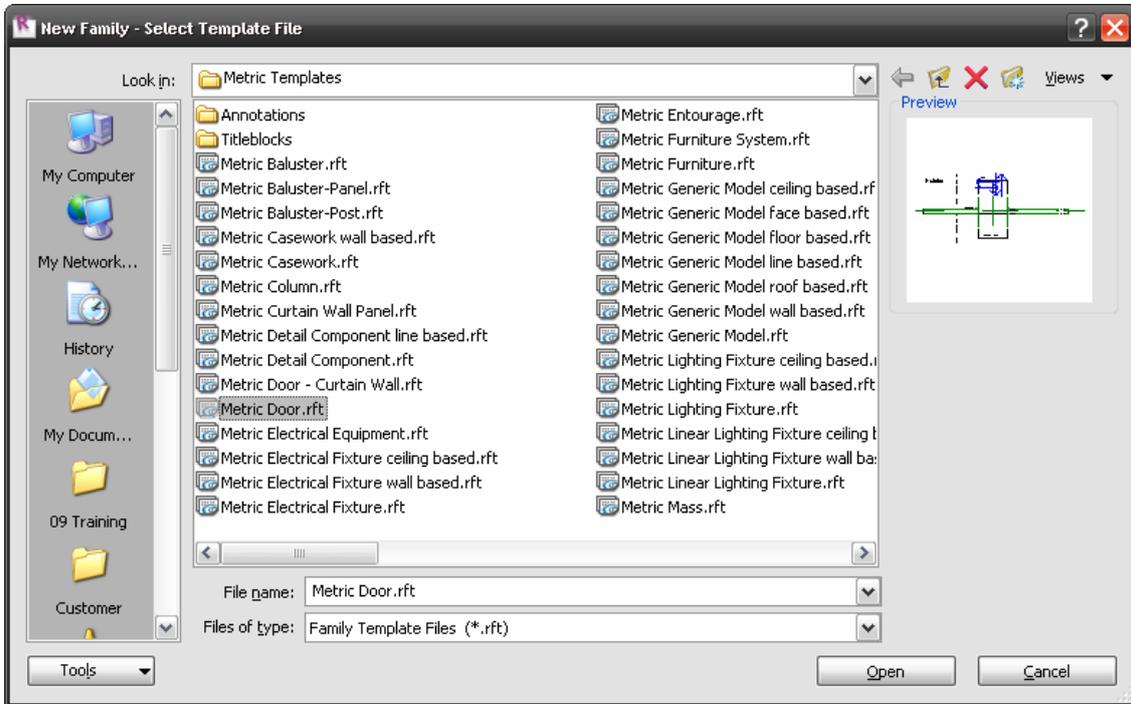   list of template can be found in the path \\housing\divisions\dcd\bim\Templates

Fig 2.1

2.1.2   Step2: Lay out reference planes to aid in drawing component geometry
         After opening the template, the first thing a user should do – before creating model geometry
         - is use Reference Planes and Reference Lines to create construction lines for the geometry
         that will be added later.

         Start in a view that best fits the family being created, such as a plan or elevation. Reference
         Planes should be used as datum lines that extend beyond the edges of the visible drawing
         area. Drawing a reference plane (often called ref planes) in a plan view will also cause that
         same reference plane to be seen in a crossing elevation or section view, because it is literally
         a plane that extends in a horizontal and vertical direction simultaneously.

2.1.3   Step 3, 4 & 8: Creating Type / Instance Parameters
         Reference planes that have been laid out should align with the major axes of the planned
         geometry. Users should begin to add dimensions to specify parametric component geometry.
         Height, width, and depth are three dimensions often used in families, and these dimensions
         and parameters are pre-loaded with many of the templates. Users may need to add more
         dimensions to describe other geometry - for instance; trim, width, and depth are common in a
         Window family.

3.   Naming Conventions

3.1   Referencing for Family

Families are grouped under different categories: Family and Type. The naming conventions are shown as follows. (fig. 4.1)
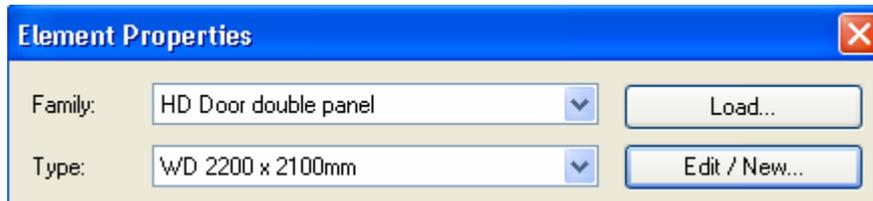

Fig 3.1

Field Family:- The file name of family file. HD is added before the family name to signify Housing Department standards
(e.g. HD Door double panel_01–Family of Housing Department, double panel door)

Field Type   :- Two parts: description of material and size of the family.
(e.g. WD 2200x2100mm – Wooden door in 2200 width and 2100 height)

Notes:
2 type of library: 1) one for drawing production; 2) one for detail 3D model

Standard Flat (e.g. Flat 1P2P_V2009)
Facade (e.g. PCF 1P2P_R01, PCF 1P2P_kit_R01)

kit=Kitchen
V=Version
R=Revision

4. Standard Procedure of creating Libraries

4.1 Types of Families
Once the basic questions listed above are considered, a user is ready to create a new family. There are three types of Autodesk Revit families:

- System families,
- In-place families, and
- Standard component families

4.1.1 System families are predefined within Autodesk Revit, and comprise the basic building components such as walls, floors, and roofs. Users can create their own versions of system families by duplicating an existing version and modifying its properties. Users cannot create new system families.

4.1.2 In-place families are components that are created specifically for a single project only. They are created from within the current project, and cannot be used in other concurrent or future projects. The best time to use an in-place family over a standard component family is when creating a component unique to a specific project. For instance: a reception desk in the lobby of a law firm may have a very unique design featuring curving shapes requested by the client and finishes unique to that lobby. In this situation, an in-place family should be used because there is little chance that this custom-designed piece will be repeated in another project.

4.1.3 Standard component families are the most common families in Autodesk Revit, and are the focus of the remainder of this paper. Standard component families can be placed in project template files so that they preload with each new project, or they can reside in libraries to be loaded on demand. While working in the Family Editor, users can: 1) open an existing family and modify it to suit their needs, or 2) start a new family using the appropriate template. To start a new family, choose the File pull down menu and then select New >> Family. (Fig 4.1)
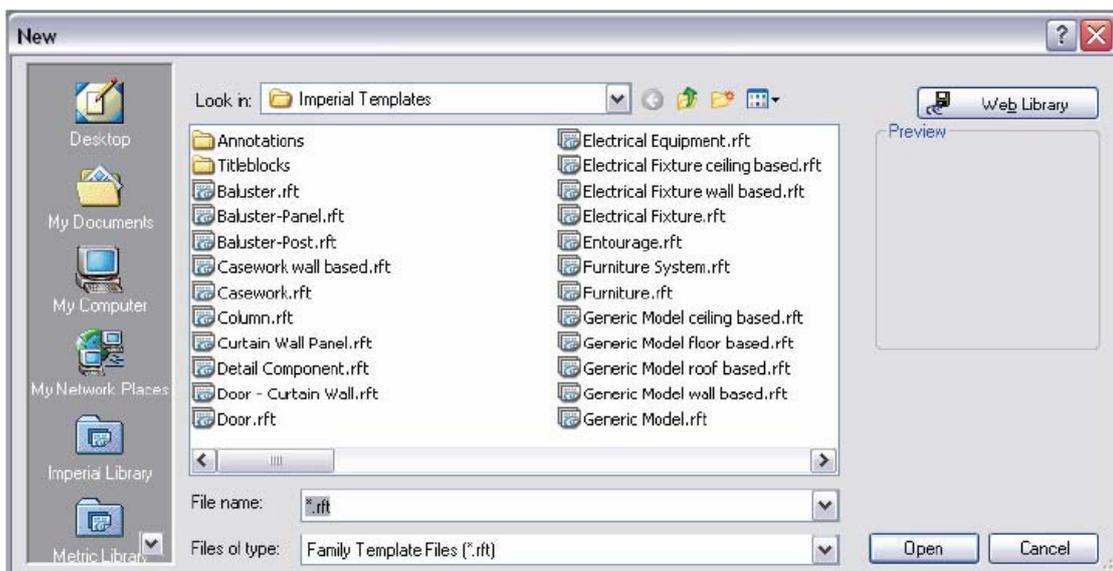

Fig 4.1

4.2 Template

Templates for family creation are supplied with Autodesk Revit. The various templates cover a broad range of possibilities from 2D annotation objects to 3D roof-based spot lights. Each template has been pre-configured to aid in the construction of a specific object type.

To create a family based on a template, browse the list of templates, and choose the one most appropriate to the object being built. If the object does not fall into a specific category, the Generic Model template may be the best choice. After picking the template, the user is ready to launch the Family Editor. (Fig 4.2)
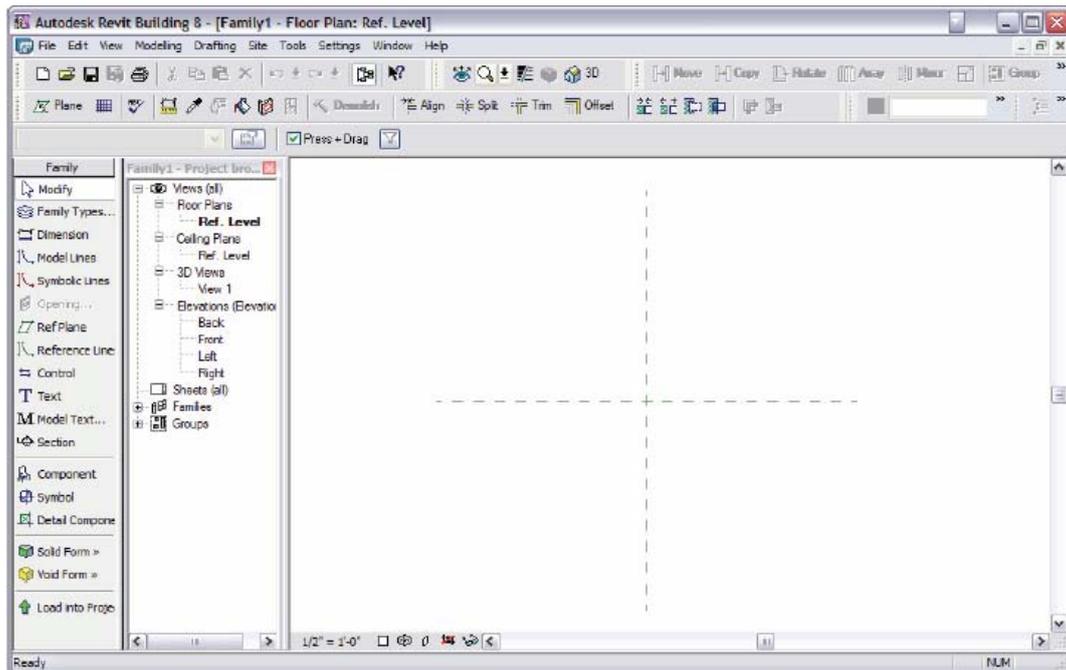
Fig 4.2

4.3 Family Editor

The Family Editor is built into Revit, and is launched by opening an existing family (those with an RFA extension) or by starting a new family from within Revit. The Family Editor launches within the Revit application, and employs the same user interface. The Design Bar on the left of the drawing window changes to a unique set of tools for family creation, and the Project Browser updates to show specific views depending on template selection.

At a minimum, the drawing window will display two crossing Reference Planes - and possibly some dimensions, text, and notes to the designer. The crossing Reference Planes are important because they define the origin of the family. It's a Revit Best Practice to leave these existing items (preloaded from the family template) alone. Users should not move or delete these items, as they play an important role in the family. In fact, there are some items (such as dimensions) in some family templates that cannot be deleted by the user - underscoring the general principal that if an item is in the template when it's first opened, it should be left there.

4.4   Reference Planes

A common mistake among users is to start adding objects and solids at this point. While it's almost time to start modeling, there is still some more preparation that will later serve a significant purpose. After opening the template, the first thing a user should do – before creating model geometry - is use Reference Planes and Reference Lines to create construction lines for the geometry that will be added later. (Fig 4.4)

Start in a view that best fits the family being created, such as a plan or elevation. Reference Planes should be used as datum lines that extend beyond the edges of the visible drawing area. Drawing a reference plane (often called ref planes) in a plan view will also cause that same reference plane to be seen in a crossing elevation or section view, because it is literally a plane that extends in a horizontal and vertical direction simultaneously.
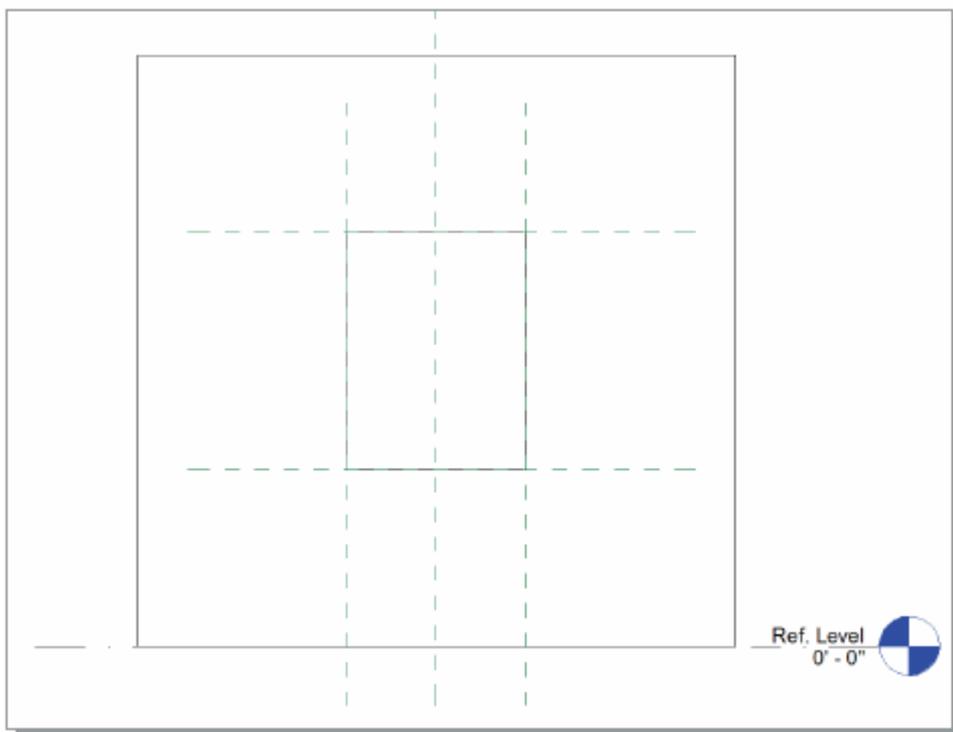
Fig 4.4

Unlike reference lines, reference planes do not have "defined" endpoints. They consist of two associated planes: one parallel to the view and one perpendicular. Ref Lines can be used in rotational control of families, because the endpoint can be constrained. Reference Lines and Planes can be renamed, so that users can easily refer to them at another time.

4.5   Creating Parameters

Reference planes that have been laid out should align with the major axes of the planned geometry. Users should begin to add dimensions to specify parametric component geometry. Start by thinking how the object should be controlled. Height, width, and depth are three dimensions often used in families, and these dimensions and parameters are pre-loaded with many of the templates. Users may need to add more dimensions to describe other geometry - for instance; trim, width, and depth are common in a Window family.

Once the dimensions have been added for the major pieces, users can start adding labels to dimensions, creating parameters. There are two categories of parameters: instance parameters and type parameters. Changing an instance parameter affects the parameters of a single entity (or instance) of an object. Changing a type parameter affects all parameters of the same type.

If there are several instances of the same family loaded into a project, and each individual representation of that family needs to be a different length, then use instance parameters. For example, consider two counter tops in the same project. One instance of the counter top is placed and its length (an instance parameter) is set to 1500mm A second counter top is placed and its length (an instance parameter) is set to 2000mm spanning the distance between two walls. The instance parameters easily allow these two counter tops to be set to different lengths. Instance parameters have another unique characteristic: dimensions that are controlled by instance parameters will display shape handles when selected in a Revit project. Shape handles allow the user to click and stretch the shape of a family to a new position or size by using the mouse. (Fig 4.5.1)
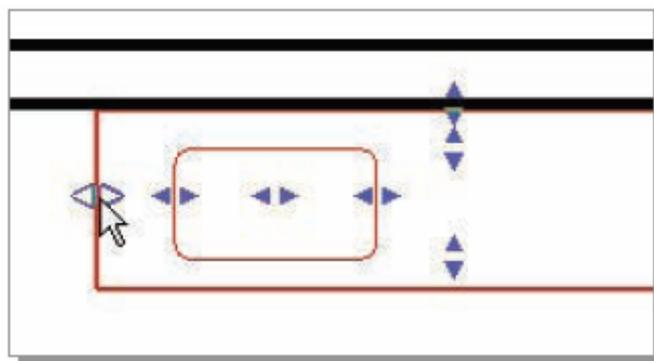

Fig 4.5.1

Type parameters control families at a higher level. They control the predefined types of families used in the project. Use type parameters to load an object repeatedly in a project and control those repeated objects as if they were one. For example, consider a door family. A user places a door repeatedly in the model as a 2100mm tall door, but later decides to change the height of all the doors to 2300mm. Changing one type parameter will cause all of these doors to update their height simultaneously.

To add a parameter, click on a dimension then add a label. (Fig 4.5.2) Once the dimension is labeled, it becomes a parameter. In the Options Bar, a drop down list of available parameters will appear. If the parameter needed is not available, select Add Parameter. When adding a new parameter, specify whether it's an instance or type parameter. After adding the parameter, the dimension changes to include the parameter name and the dimensional length.
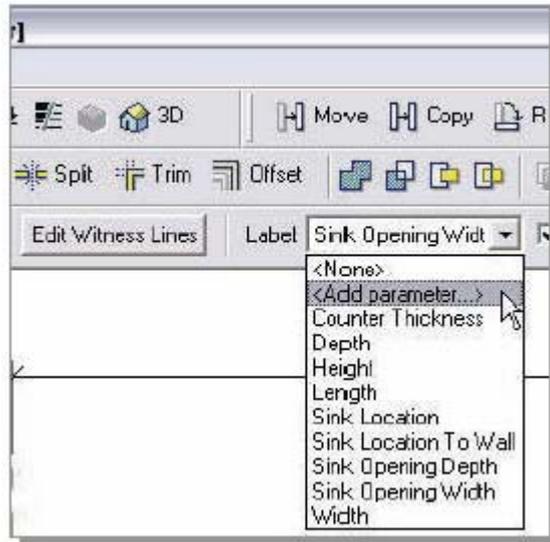
Fig 4.5.2

As parameters are created, they are added to the parameter list in the Family Types dialogue box (selecting by clicking Family Types in the Design Bar). This Family Types dialogue box contains several key areas. Most noticeable is the list of defined parameters in the main window, arranged into logical parameter groups (Construction, Dimensions, and Identity Data in the example in figure below). During creation or editing, users can assign which category is assigned to a parameter. (Fig 4.5.3)
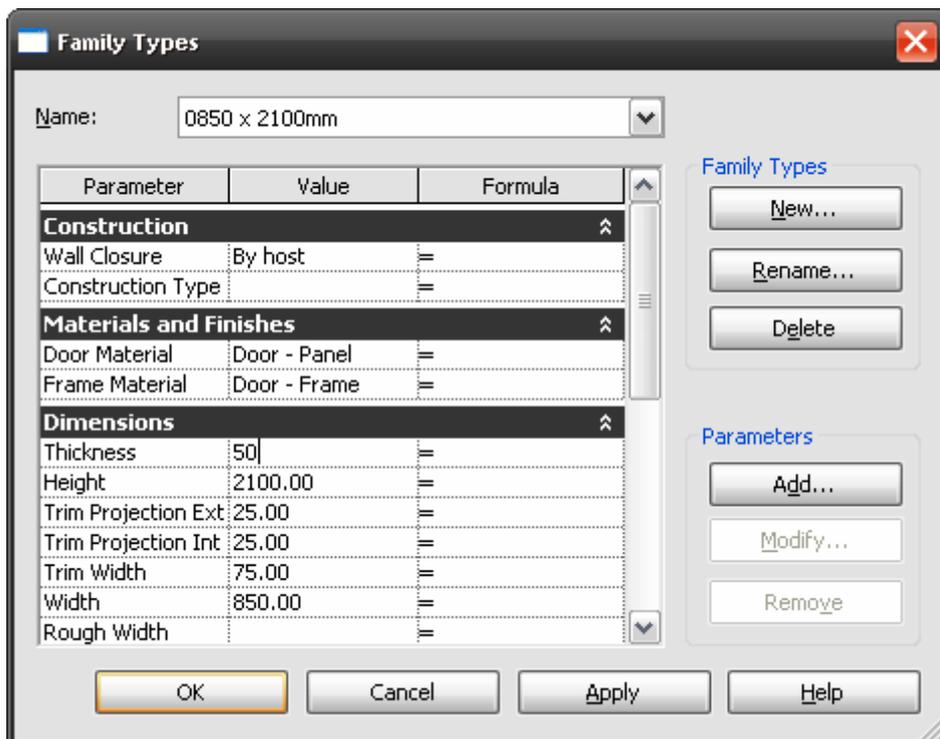
Fig 4.5.3

On the right side of the dialog box, users can create new Family Types, or rename or delete existing Family Types. Revit features Family Types to predefine a set of parameters - making a particular "type" of object. Returning to the door family as an example, several door types can be defined in this dialog box. One type might be a "0850 x 2100mm" door (a door that is 850mm wide and 2100mm tall). Another type might be a "0700 x 2200mm" (700mm wide and 2200mm tall). A user could then define different door of different size in this dialog box.

Family Types allow Revit users to quickly define a multitude of sizes and combinations of an object, based on just one family and one set of parameters.

The lower group of three buttons in the Family Types dialog box is specifically for parameter creation; Add, Modify, and Remove. Click the Add button to launch the Parameter Properties dialog box to add a parameter to this family.

Notice the Parameter Types section of this Parameter Properties dialog box (Fig 5.5.4). There are two types of parameters available in Revit: family parameters and shared parameters. A family parameter is specific only to this particular object and its value cannot appear in a schedule or tag. A shared parameter can be shared across multiple families and projects. Its value can appear in schedules and tags, and can also be exported out to ODBC.

Family parameters are stored within the family file, whereas shared parameters are saved in an external text (TXT) file, typically on a network where other users can access the text file to use the shared parameters.
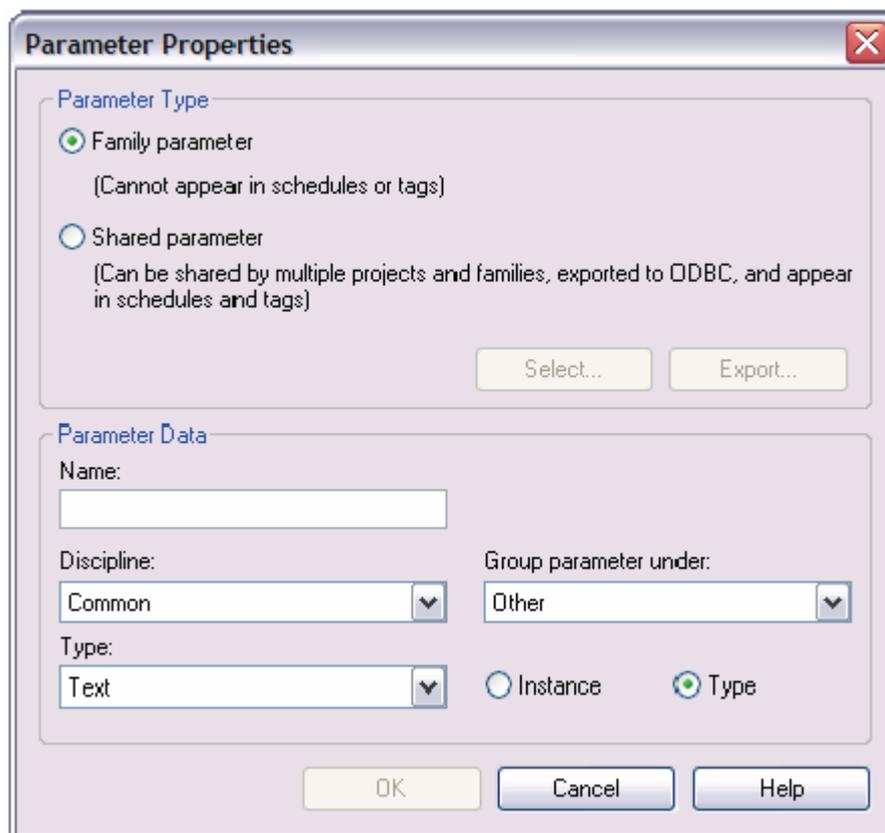
Fig 4.5.4

Parameter data for a family parameter is entered in the Parameter Properties dialog box.:

- Name: The parameter's name is completely left to the user. It's a Revit Best Practice to keep these names simple, short, and concise whenever possible. When using formulas (described later in this paper), these parameter names will have to be retyped exactly as entered here.

- Discipline: A parameter's discipline can be set to Common or Structural.

- Type: This drop-down list contains several pre-defined categories for the value of the parameter, such as Text or Number, or Yes/No.

- Group Parameter Under: This area allows users to classify the parameter in a logical grouping. When the family appears in a project, the parameters are listed in groups of common elements to make it easier to enter the data by logical groups.

- Instance and Type. Select the radio buttons that best fits the parameter.

Once these decisions regarding a parameter are made, enter the necessary data into the fields in this dialog box, and click the OK button, which returns the user to the Family Types dialog box. The user will now see the new parameter listed under the Parameters heading, and organized into the groups defined in the previous step.

To change the parameter, users can click the Modify button, or remove the parameter from the family entirely with the Remove button. Continue to add additional parameters by repeating the steps above to complete the design of the family.

EXAMPLE (e.g. Doors)
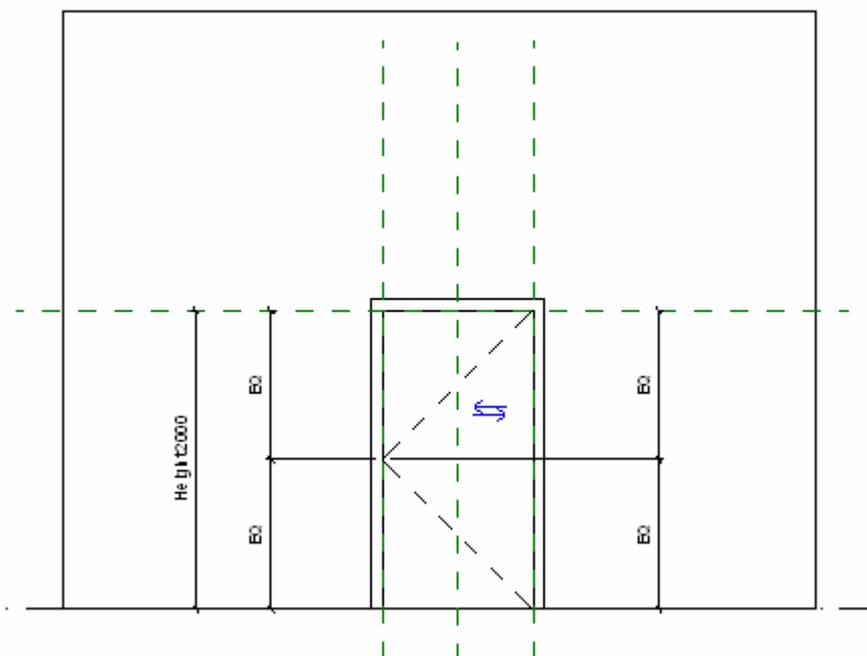
Define new door types with various heights and widths

1. On the Design Bar, click Family Types.
2. In the Family Types dialog box, under Family Types, click New.
3. In the Name dialog box, enter *925 x 2000mm* for Name, and click OK.
4. In the Family Types dialog box, specify the following:
   - o Under Dimensions, enter *2000 mm* for Height.
   - o Enter *925 mm* for Width.
   - o Click Apply.

Define the second new door type.

5. Under Family Types, click New.
6. In the Name dialog box, enter *750 x 2100mm* for Name, and click OK.
7. In the Family Types dialog box, specify the following:
    - o Under Dimensions, enter *2100 mm* for Height.
    - o Enter *750 mm* for Width.
    - o Click Apply.

Define the third new door type.

8. Under Family Types, click New.
9. In the Name dialog box, enter *1220 x 2134mm* for Name, and click OK.
10. In the Family Types dialog box, specify the following:
    - o Under Dimensions, enter *2134 mm* for Height.
    - o Enter *1220 mm* for Width.
    - o Click Apply.
11. Click OK.

You now have three new door types defined within your door family.

12. On the File menu, click Save.

Appendix 1 – Example of component model and its parameters

Door Example

WD2 (Kitchen).rfa

Material and Finishes
Wired Glass: Wired Glass
Plywood: Plywood
Frame: Kitchen Timber
Door: Kitchen Timber

Dimension
Upper Glass Height: 700mm
Push Pull Plate Width: 100mm
Push Pull Plate Height: 300mm
Glass Panel Width: 310mm
Height: 2150mm
Width: 900mm
Door Width: 836mm
Door Thickness: 50mm
Door Height: 2030mm
Lower Glass Height: 630

Identity Data
Source URL: Master drawing

Other
Push Pull Plate Width Post: 93.4mm
Push Pull Plate Height Post: 960mm
Normal Swing: Yes
Large Swing: No
Height Between Glasses: 230mm
Glass Start Height: 172mm
Glass Start Width: 172mm
Frame Projection Ext.: 13mm
Frame Width: 75mm
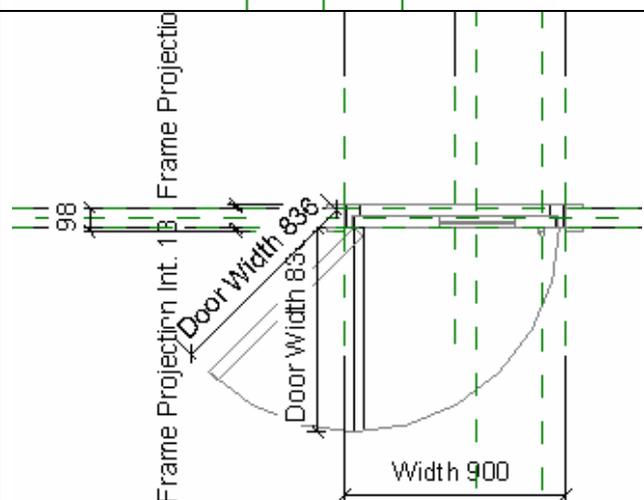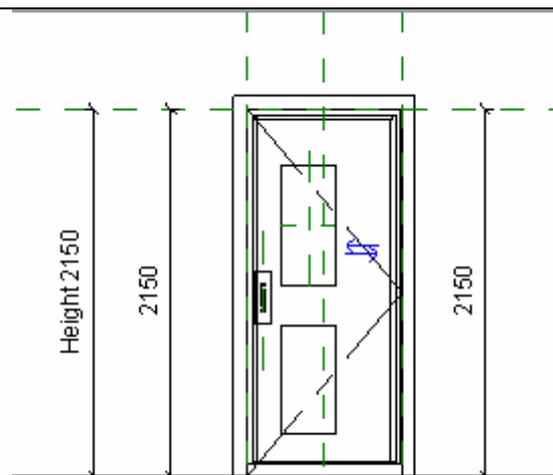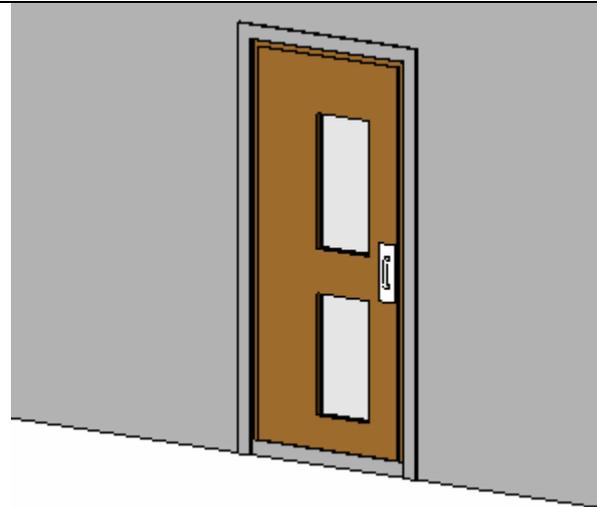
Appendix 2 –Example of Group Models
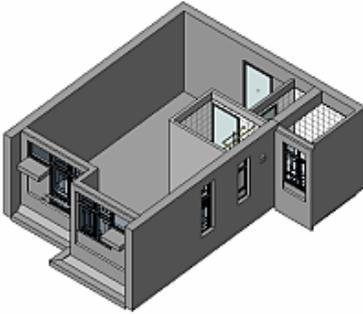
2-3P (1).rvt
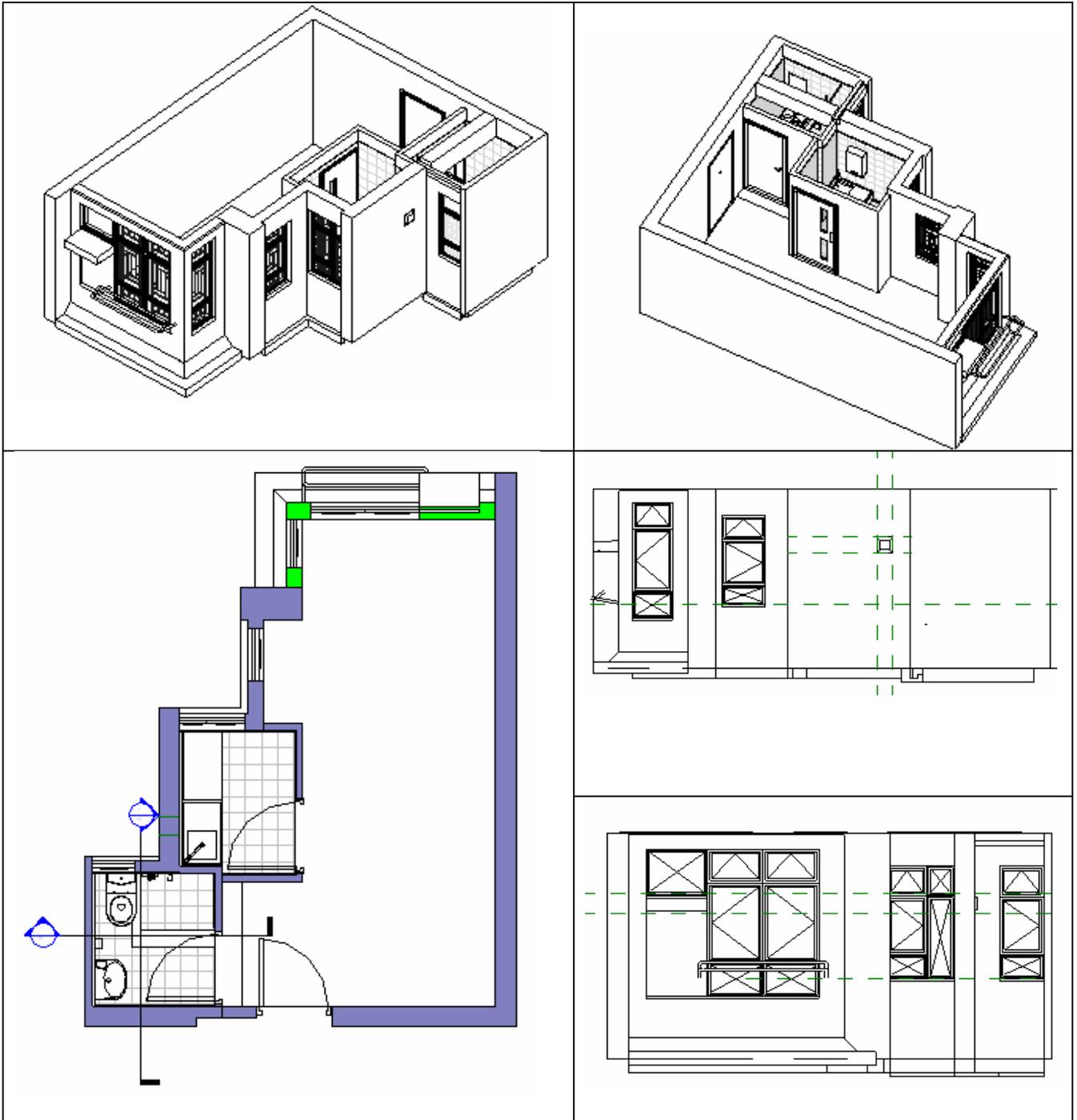
Graphical representation in 3D	Remarks
	1-2P (1a)
	1-2P (1b)
	1B (1)
	2-3P (1)
	2B (1)
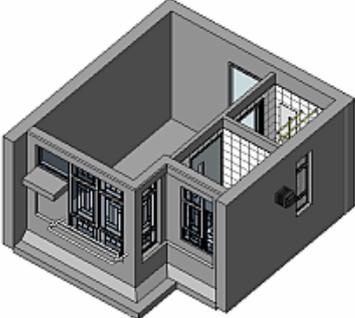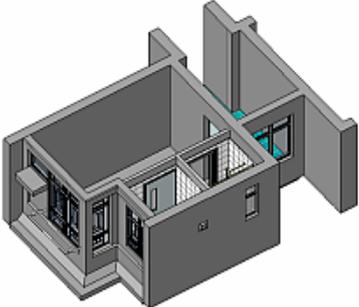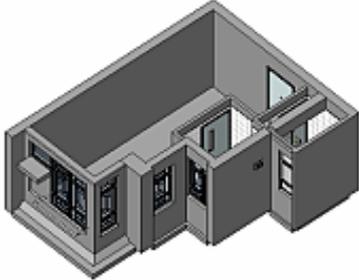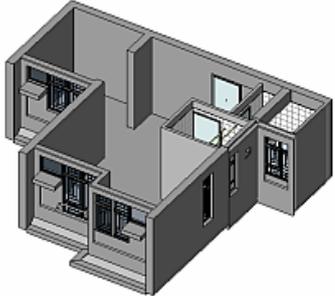
Appendix 3 – Publishing
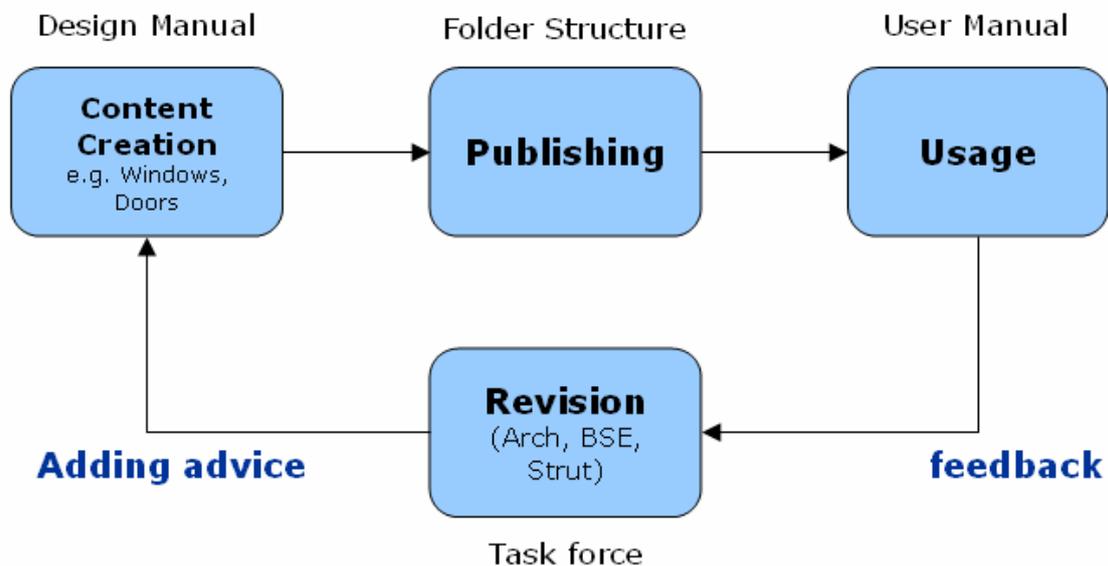
All elements in Autodesk Revit are "family based". The term family describes a concept used throughout Revit to manage data and make changes. Each family element can have multiple types defined within it, each with a different size, shape, material set, or other parameter variables as designed by the family creator. Even though various types within a family can look completely different, they are still related and come from a single source, thus the term family. Changes to a family type definition ripple through the project and are automatically reflected in every instance of that family or type within project.

Users can use the Family editor to create both real-life building components and graphical / annotation components. Families store all of the necessary geometry to display the two-dimensional (2D) and three-dimensional (3D) versions of particular objects. Family element visibility can be dependent of your viewing direction, such as plan, elevation or 3D, as well as the level of detail associated with that view.

Standard of annotation and annotation symbols should be applied to all HD projects. (Already included in the HD default template)

User created families could be stored in their own library (My library). Library path can be set in **Options** under menu **Settings**. (Fig. A3.1)
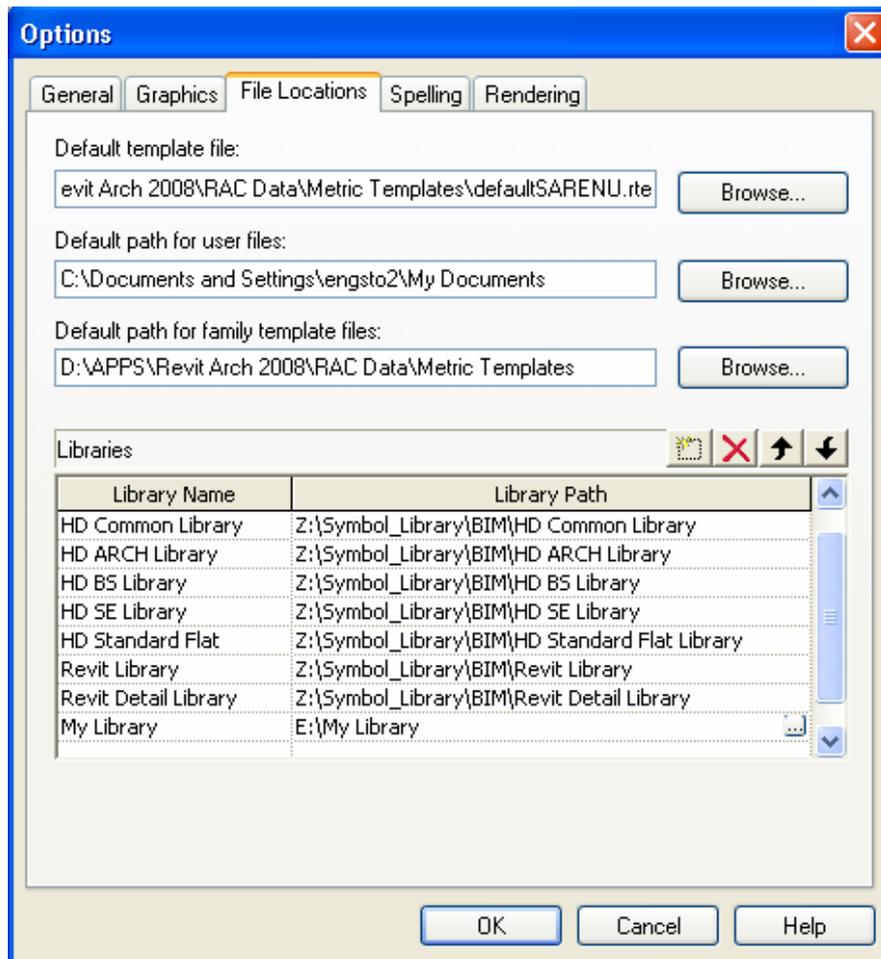
Fig A3.1

User can load pre-set libraries from default path. (Fig. A3.2)

\\housing\divisions\dcd\bim\HD library

There are several types of libraries

> My Library (read write)
> HD Component Library (read only)
> HD Discipline Specific Libraries (read only)
> HD Group Library (read only)
> Revit Libraries (read only)

My Library was used to store user created library components, it may be a custom made use one-time components. If these components could be used for other projects, they should be stored in Discipline specific libraries.

HD Common Library was used to store shared components such as title blocks, annotation symbols, dimension symbols, etc. Most of them would be included in the HD Standard Template (more in Template) and load when users start a new project. In case if users did not start with HD Standard Template, they could load the symbols from this library.

HD Discipline Specific Component Libraries were created for each discipline for storing components frequently used by each disciplines (shown in left menu in the figure). For example, HD ARCH Library, HD BS Library, HD SE Library.

HD Group Models Library was also created for storing typical standard flats e.g. 1P/2P flat, 1B flat, 2B flat, etc.

Revit Library and Revit Detail Library are libraries that come with the software, modified library components should be stored either under discipline specific libraries or users own library (My library)

For library components that could be stored in Discipline specific libraries, they should be submitted to SGWG for checking and approval and pass to STO2 / BT (C) for publishing.
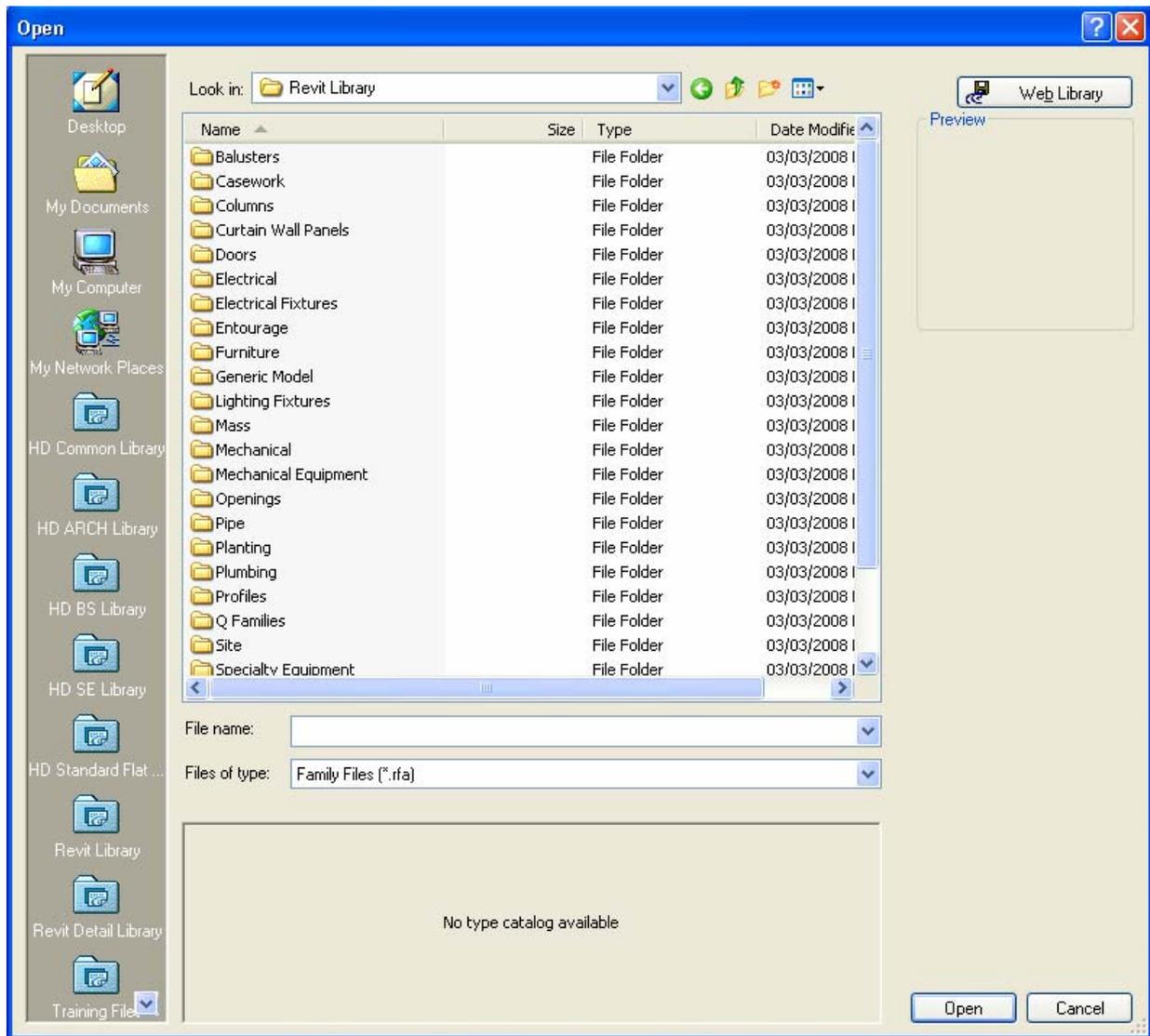
Fig A3.2

Appendix 4 – System Requirements

A4.1   Software requirements: Revit Architectural 2009, Revit MEP 2009 and Revit Structure 2009

A4.2   Recommended hardware requirements for users working on family creation, standard flat, one single floor

- Intel® Pentium® 4, 3GHz, or equivalent AMD Athlon® processor
- Microsoft® Windows Vista™ Enterprise, Business, Ultimate, or Home Premium; Windows® XP Professional, Home Edition, or Tablet PC Edition (SP1 or later); Windows® 2000 (SP4)
- 1 GB RAM
- 3 GB free disk space
- Dedicated video card with 256MB memory
- 1024 x 768 monitor and display adapter capable of 24-bit color
- Internet connection for license registration
- Two-button mouse with scroll wheel
- Microsoft® Internet Explorer® 6.0 or later

A4.3   Recommended hardware requirements for users working on master / combined models, and rendering.

- Intel Core® 2 Duo 2.40 GHz, or equivalent AMD Athlon processor
- Windows XP Professional (SP2 or later)
- 4 GB RAM
- 5 GB free disk space
- 1280x1024 monitor
- Dedicated video card with hardware support for OpenGL® spec 1.3 or later
- Internet connection for license registration
- Two-button mouse with scroll wheel
- Microsoft® Internet Explorer® 6.0 or later