ADVANCED MANUAL

exactal
precision estimating

The costX Family of Products

CostX®

CostX® is Exactal's premium product. More companies are using CostX® for their complete estimating solution and receiving strong returns on their investment. CostX® is a powerful project costing tool that enables estimators to use the most advanced on-screen measurement system while embracing BIM to deliver better results to clients. It can reduce take off time by up to 80%.

CostX® 2D

CostX® 2D does not support 3D/BIM drawings or allow for auto-revisioning, but still contains Exactal's world-leading on-screen 2D takeoff and integrated workbook. If your company does not receive 3D/BIM drawings but still wants to take advantage of the faster, smarter and more accurate estimating solution on the market, CostX® 2D is the best choice for you.

CostX® Takeoff 2D

CostX® Takeoff 2D is Exactal's most basic product but still allows you to use the world-leading on-screen 2D takeoff, meaning you can measure areas, lengths and counts in a few clicks. If you have only used manual measurement and Excel® before and want to start off with something simple, CostX® Takeoff 2D may be the best choice for you.

FEATURES	CostX®	CostX® 2D	CostX® Takeoff 2D
BIM models/3D drawings	•		
2D drawings (incl PDFs)	•	•	•
Auto Revisioning	•		
Workbooks	•	•	
Subcontractor Comparison	•	•	

CostXL

CostXL allows you to link CostX® data directly into your Excel® spreadsheets

CostX® Live

CostX® Live gives you access to live CostX® data on the go through the web.

FREE

CostX® Viewer

CostX® Viewer makes it easy to freely share your CostX® projects with anyone.

Call us now for a **FREE** demonstration of our estimating solutions.

INTERNATIONAL www.exactal.com sales@exactal.com

Australia
BRISBANE / MELBOURNE
www.exactal.com.au
+61 (0) 7 3300 6222
sales.AU@exactal.com

Hong Kong
www.exactal.com.hk
+852 5804 4622
sales.HK@exactal.com

New Zealand
AUCKLAND
www.exactal.co.nz
+64 (0) 9 309 2026
sales.NZ@exactal.com

Singapore
www.exactal.com.sg
+65 3106 2322
sales.SG@exactal.com

United Kingdom
LONDON / NEWCASTLE
www.exactal.co.uk
+44 (0) 203 597 7566
sales.UK@exactal.com

exactal precision estimating

A DIMENSIONEERING COMPANY

Contents

1 Introduction 8

1.1 CostX® Product Range 8

1.2 CostX® Training Options 8

1.3 CostX® Help Files 8

2 Drawing Files 9

3 2D Drawing Files 9

3.1 Raster and Vector Files 9

3.2 PDF Files 10

3.3 CAD Formats 10

3.4 Model Space and Paper Space 11

3.5 X-Refs 14

3.6 2D DWFTM, DWFxTM and DWGTM from Revit® 15

3.7 What to Ask For (2D only) 16

3.8 Scaling 16

3.9 Units of Measure (UoM) 17

4 3D Drawing Files 18

4.1 3D Drawings and BIM Models 18

4.2 CostX® and BIM Models 19

4.3 DWFx™ files from Revit® 19

4.4 Revit® Model Structure 20

4.5 DWFx™ Files - What to Ask For 21

5 Industry Foundation Classes (IFC) 22

5.1 The IFC Standard 23

5.2 The IFC Model Structure 24

5.3 IFC Model Entity Definitions 25

5.4 Property Sets 26

5.5 Proxies 26

5.6 Quantities in the IFC 2x3 Coordination View 26

5.7 Base Quantities 27

5.8 Quantities in the IFC Standard 29

5.9 Quantities in IFC4 30

5.10 IFC Files and CostX® 31
5.11 IFC – Issues to Consider 32
5.12 IFC Files - What to Ask For 32
6 3D Measurement and BIM Quantities 33
6.1 Importing 3D Drawings and 3D BIM Model Views 33
6.2 3D Drawing Navigation 33
6.3 BIM Model Navigation - Model Trees 35
6.4 Model Schedules 36
6.5 Setting/verifying Units of Measure (UOM) for 3D Drawings 37
6.6 3D Measurement (3D Point Mode) 38
6.7 Import BIM Dimensions (3D Object Mode) 40
6.8 CostX® BIM Templates 40
6.9 The Model Definition Tool (Model Maps) 42
6.10 Create Object-based Dimension Groups 47
6.11 XNumber Feature 48
6.12 Formula Syntax 49
6.13 Assemblies 54
6.14 User-Defined Model Properties 56
6.15 Cost Coding a BIM Model 59
6.16 Quantities Audit 60
6.17 Drawing Sets 62
6.18 Duplicate Object IDs 63
6.19 BIM Dimensions – Workbooks 63
7 Measurement Approach 64
7.1 Measurement Structure 64
7.2 Naming Convention 64
7.3 Measurement Approach 64
7.4 Capturing Typicality 65
7.5 Dimension Group Filtering 65
7.6 Rebar Mode 65
7.7 One To Many 65
7.8 Standard Dimension Groups 66

8 Templates 67
8.1 Templates ... 67
8.2 Based On ... 67
8.3 Merging ... 67
8.4 Dimension Groups ... 67
8.5 CostX® Templates ... 68
8.6 Bill of Quantities Workflow ... 68
8.7 Phraseologies ... 69
9 Revisions 71
9.1 Revisions ... 71
9.2 2D Drawing Revisions ... 71
9.3 3D Drawing Revisions ... 74
10 Zones 80
10.1 Use of Zones ... 80
10.2 Creation of Zones ... 80
10.3 Measuring Zones ... 80
10.4 Changing Zones ... 80
10.5 Zone Filters ... 81
10.6 Zones and Workbooks ... 81
10.7 Default Zone Precedence ... 81
11 Coding 82
11.1 Coding ... 82
11.2 Code Libraries ... 82
11.3 Coding Workbooks ... 82
11.4 Coding Rate Build-ups ... 83
11.5 Generating Workbook Grouped by Code ... 83
12 Workbook Tools 84
12.1 Reference ... 84
12.2 Workbook by Dimension Groups ... 84
12.3 Locking ... 84
12.4 Named Cells ... 84
12.5 Cell Protection ... 85
12.6 Rounding Options and Decimals Display ... 85

12.7 Workbook Functions 85
12.8 HLOOKUP and VLOOKUP functions in workbooks 85
12.9 Secondary Quantities 86
13 Reports 87
13.1 Drawing Reports 87
13.2 Export Dimensions to Excel® 87
13.3 Export Workbook 87
13.4 Workbook Reports 87
13.5 Standard, Custom and System Reports 88
13.6 How to Copy a Report 89
13.7 How to modify a Standard Report 90
13.8 How to customise a System or Custom Report. 91
14 Rate Libraries 93
14.1 Rate Libraries 93
14.2 To Manually Create a Rate Library 94
14.3 Importing a Rate Library from Excel® (CSV) 95
14.4 Rate Build-Ups 96
14.5 Rate Functions in Workbooks 96
14.6 Rate Descriptions in workbooks 97
14.7 Project-Specific Rate Libraries 99
14.8 Import Buildsoft Price List 99
14.9 CostX® Values 99
15 Exporting and Importing 100
15.1 Exporting Projects and Buildings 100
15.2 Importing Building with Drawing Files 100
15.3 Exporting and Importing Reports 100
16 Integration into CostXL 101
16.1 Opening CostXL 101
16.2 Using CostXL Data 102
16.3 Show Dimensions 102
16.4 Edit Function 103
16.5 Other CostX® data 103
16.6 CostXL Functions 104

16.7 Refresh Data 104
17 CostX® Networking 105
17.1 Network Features 105
17.2 Network Administration 105
18 CostX® Customisation 106
18.1 CostX® Options 106
18.2 User defined Quick Access Toolbar 108
19 System Administration 109
20 Further Information 110
20.1 Additional Reading 110
20.2 Free Training Videos 111
20.3 Process Flow Charts 111
1. Getting Started 112
2. Drawings and Measurement 112
3. Workbooks (not available in CostX® Takeoff 2D) and Template Files 112
4. Reports (not available in CostX® Takeoff 2D) 112
5. Working with 3D Building Information Models (CostX® Only) 112
6. Revisioning with 2D Drawings (CostX® Only) 113
7. Subcontractor Comparison (not available in CostX® Takeoff 2D) 113
8. Coding (not available in CostX® Takeoff 2D) 113
9. Workbooks (not available in CostX® Takeoff 2D) 113

Acknowledgements

buildingSMART® copyright images and documents reproduced with kind permission of buildingSMART® International.

Exactal gratefully acknowledges the contribution and assistance of the following individuals and organisations in the preparation of this document:

Mr. Dana K. "Deke" Smith, National Institute of Building Sciences and buildingSMART® Alliance Washington DC
Matthew Johnson, Powe Architects Brisbane
David Shorter, Graphisoft Sydney
Jeffrey W. Ouellette, Nemetschek Vectorworks Inc.Columbia MD

1 Introduction

This document provides a descriptive overview of the key functions of CostX® and the principles of measurement and workbook structure involved in using CostX®.

Readers will gain a better understanding of the concepts described within this manual if they have a prior basic familiarity with CostX®, gained either by reading the Introduction to CostX® manual (essential) or having had some previous exposure to CostX® (not essential).

1.1 CostX® Product Range

The CostX® Family of Products ranges from fully-featured CostX® through to CostX® Takeoff 2D, which are available at differing price points. This manual describes the key features of CostX® but not all features are available in all products. Refer to the table below for a comparative overview of product features.

FEATURE / PRODUCT	CostX®	CostX® 2D	CostX® Takeoff 2D
BIM models/3D drawings	●		
2D drawings (incl PDFs)	●	●	●
Auto Revisioning	●		
Workbooks	●	●	
Subcontractor Comparison	●	●	

1.2 CostX® Training Options

CostX® training courses are available either on-line or can be delivered in your office by one of Exactal's CostX® Product Specialists. Training material includes comprehensive manuals, videos, sample files and worked examples.

Courses include structured Introductory and Advanced training modules. The Introductory Course concentrates on the import and manipulation of 2D CAD and alternate drawing files and use of the CostX® measurement tools. It also covers initial project setup, and, dependent upon the version of CostX® being used, introduces workbooks, rate libraries, reports and 3D files. Advanced modules look at Revisioning (design change updates), Subcontractor Comparisons, Workbook Tools (zoning for functional areas, advanced rate libraries, sorting by multiple codes), and 3D Measurement including automatic quantities generation from 3D BIM models (CostX® only).

1.3 CostX® Help Files

In addition to the training manuals, CostX® contains very comprehensive Help Files. They are easily accessed at any time whilst you are working in CostX® by using the F1 key, or clicking the help icon which is in the top right hand corner of the screen.

2 Drawing Files

A major advantage of all versions of CostX® is that they support the widest possible range of 2D and 3D drawing file types, including;

- Various 2D raster image files - BMP, GIF, JPEG, JPG, PNG, TIF, PDF
- 2D and 3D PDF Files
- 2D and 3D DWG™, DXF™ and DWF™ from Autodesk® AutoCAD®
- 2D and 3D DWF/DWFx™ from Autodesk® Revit®, AVEVA PDMS™ and other supporting applications
- 2D DGN™ from Bentley® Microstation®
- 3D 12Da from 12D Model®
- 3D IFC Files from all supporting applications such as Graphisoft® ArchiCAD®
- 3D SketchUp

Because CostX® loads such a wide variety of drawing types, it is very useful as a universal drawing viewer. Other viewer software includes Autodesk® DWG TrueView™ for DWG™ files and Autodesk® Design Review for DWF™ files. These allow you to view, mark-up, convert, export and print drawing files. To view PDF files there is Adobe® Reader® and for IFC files, DDS-CAD Viewer.

3 2D Drawing Files

3.1 Raster and Vector Files

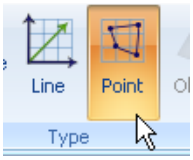
Graphics files exist in either raster or vector format. A raster file is an image made up of a grid of pixels (called a bitmap) eg. a photograph or a scanned copy of a drawing. Raster images are resolution dependent, which means they cannot be enlarged on screen (ie. zoomed in) without loss of image quality. Raster file sizes are dependent on the number of pixels involved. Because large bitmaps require large file sizes, there are several compressed formats that have been developed such as JPEG and GIF.

Vector graphics is the use of geometrical primitives such as points, lines, curves and shapes or polygons, which are all based on mathematical equations, to create images on a computer screen. This means they can contain various levels of embedded drawing intelligence, and can be scaled up (zoomed in) without loss of resolution. Vector file sizes are dependent on the amount of data in the drawing.

Essentially, a vector file is a drawing, whereas a raster (image) file is a picture of a drawing.

All CAD programs are based on vector graphics. However the drawings are often published and issued in one of the raster image formats which means that the inherent resolution and intelligence is lost. CostX® can deal with both formats but uses different modes of measurement for each, reflecting the nature of the image data available. Point Mode is basically a measurement overlay on top of the drawing, whereas Line Mode attaches to the vector lines within the drawing. In this way, CostX® utilizes vector data to improve the speed and accuracy of measurement, and is able to exploit drawing intelligence. Hence vector files are preferred to raster files. If you have no choice but to use raster files it is important to establish the scale either by entering it (if known) into the Drawing Properties or by using the Calibrate function (see 3.8 “Scaling” below). This is relevant because most raster images are scaled to an arbitrary size to fit onto a page and since they are images, there is no useful geometry available to verify the scale. In the case of a fax or scan, the scale may also have been distorted during transmission.

Some drawings contain a combination of raster and vector components. CostX® will provide a warning when such drawings are loaded.



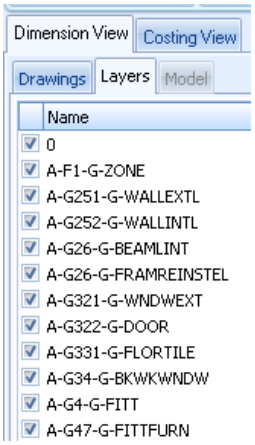
CostX® also provides an option to work in Point Mode from a vector drawing to enable measurements to be taken without attaching to drawing lines. Simply click the "Point" button to switch between modes.

3.2 PDF Files

Currently, the most common standard for document exchange is PDF (Portable Document Format) which is an open standard that enables documents to be published in a format which is independent of the software that created them. PDF files can be either raster or vector, but which type they are will not be apparent until you open them. The standard published output from CAD programs is a vector PDF which contains vector co-ordinates but little else of the embedded intelligence of the CAD files from which it is generated. This means that measurement can be done in Line Mode but advanced CostX® tools which rely on CAD intelligence are not available. Hence a vector PDF is preferable to a raster PDF but still not as useful as a CAD file.

3.3 CAD Formats

The 2D CAD formats (DWG™, DWF™) are capable of being rich in content and CostX® can exploit this intelligence with various advanced measurement tools. These include:

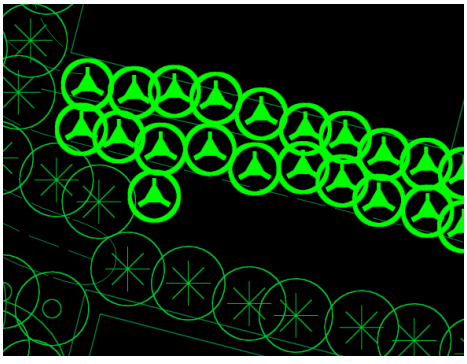


Layers

Designers use layers to collate and categorise objects or entities within a drawing, eg. walls on one layer, doors on another. The final drawing is made up of all the layers stacked on top of each other. When designers export a set of drawings for distribution they often do not enable the layers which means downstream users can only view the complete drawing. However, if the layers are enabled, CostX® can filter the display to make viewing and measurement much quicker and easier. Layers can also be enabled in a vector PDF export from CAD, but are not available in raster images.

Blocks

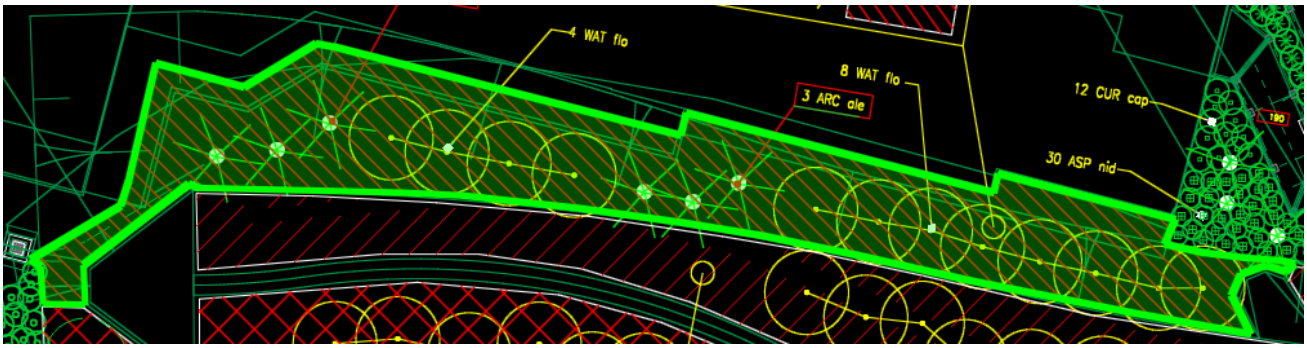
A block is a pre-defined grouping of lines, arcs and circles to depict a typical object, eg. a door, or a collection of objects such as a typical furniture layout. Instead of having to re-draw the object multiple times, the designer can simply select the relevant block. CostX® makes use of blocks by counting all instances of a typical block with a single keystroke. The designer needs to enable block data when exporting CAD files. Block data is not available in PDF files.



A single click multiple Block count

Polylines

CAD drawings are made up of lines and arcs. The polyline command allows designers to group a series of lines or arcs into a single continuous entity. For example, four separate lines could be drawn to depict four walls to enclose a room. However, if these lines were drawn as a polyline, then the closed polyline would represent the room bounded by the four walls. Polylines can be made up of any combination of lines and arcs to create highly complex shapes, and are used by designers because it is quicker and easier to select and manipulate a whole complex shape in one go rather than each of its component parts. If polylines have been used, CostX® is able to read them and automatically return the area and perimeter of the shape, no matter how complex, with a single keystroke which is clearly a very powerful function.



A single click Polyline area measure

The default export condition for CAD files is often configured to strip intelligence out of published files, which means the designer actively has to reset the export options if the intelligence is to be retained. Presumably the default is based on the assumption that the intended recipients simply don't have tools that can read digital drawing files, or may be an attempt to protect perceived copyright.

In any event, it is quite possible to ask for drawings with all intelligence retained, and generally if it is understood that there is nothing untoward in the request, the designers are happy to comply. Often their concern is that the drawing may be altered if they issue it in an "active" format, so they need to understand that CostX® is not CAD software so you will only be viewing the drawing in a "read only" environment which does not enable you to make changes.

Although CostX® supports numerous file formats, as there are a number of CAD software houses producing a variety of file types, CostX® has been optimised to the most widely used, which is the DWG™ format produced by AutoCAD®. Most alternate file types can be converted for export as a DWG™ but again it may need to be explained that there are a number of settings that could need to be changed or enabled to retain the intelligence.

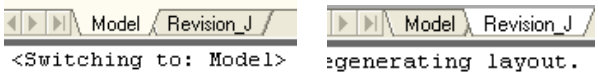
3.4 Model Space and Paper Space

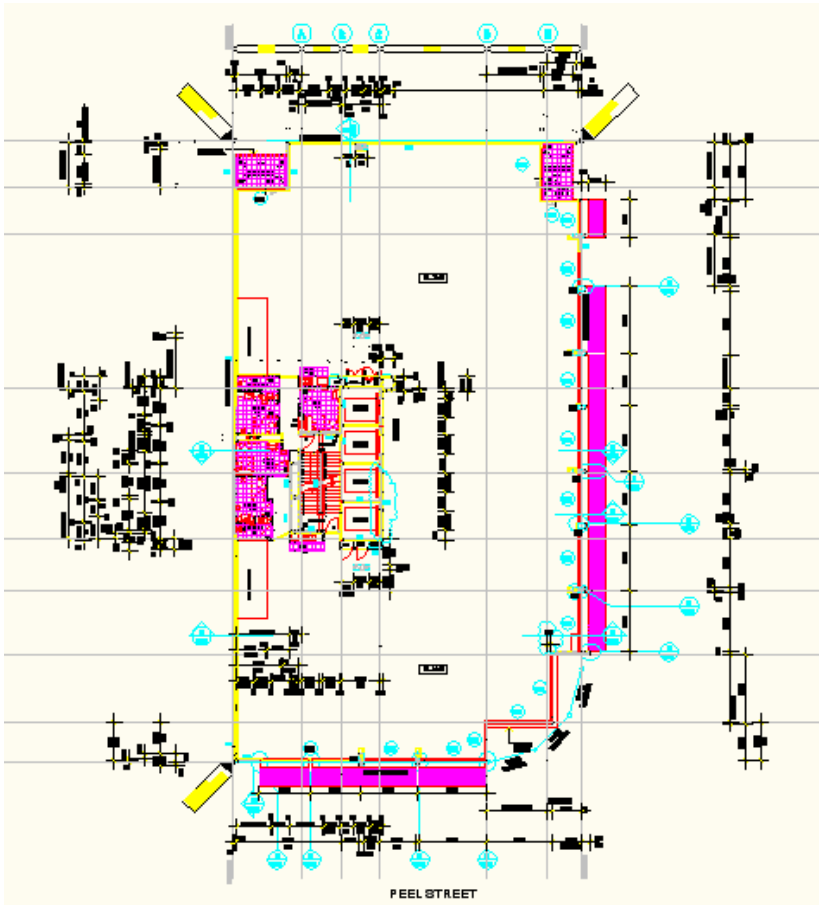
Another important aspect of CAD files is the concept of Model Space and Paper Space. Model Space is literally the digital space in which a virtual 1:1 model of the project is drawn up, whether in 2D or 3D. When plans, sections and elevations need to be issued they have to be scaled down to fit on 2D paper sheets for viewing or plotting purposes. Paper Space is where this happens, and also where the drawings are arranged and managed, and information such as title blocks and legends is added. The Paper Space view accesses the required design information via "viewports" to Model Space. A Paper Space sheet will therefore be to a nominated scale eg. 1:200, and it will comprise single or multiple viewports to selected model space views or details, plus additional information which is drawn on directly.

A typical DWG™ file will contain tabs which house the alternate Model Space and Paper Space views.

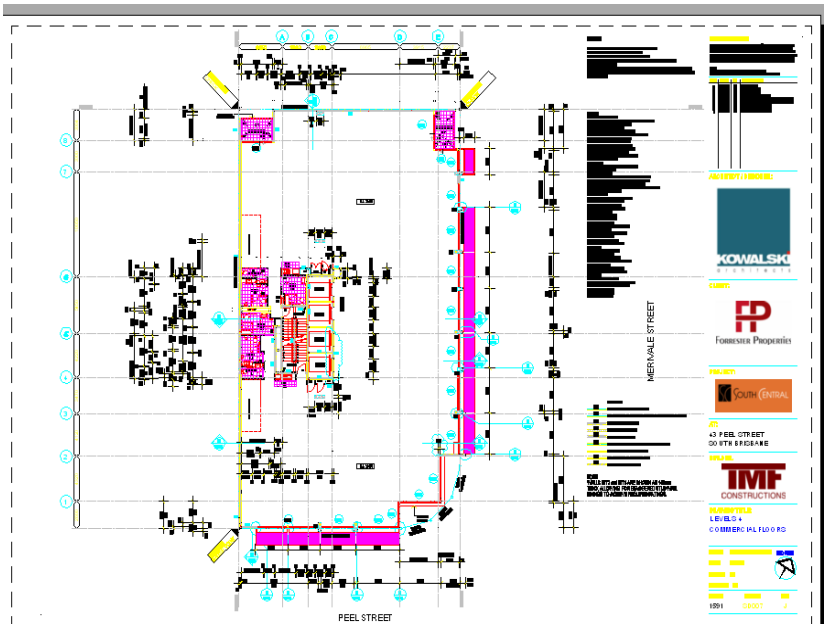
CostX® typically looks for Model space views since these contain the active model and hence are the most accurate with no scaling required as they are at 1:1. If the file contains both Model Space and Paper Space, CostX® provides an option to load either or both. It is also possible to view the full DWG™ file to verify its Model and Paper space components by using the free viewer software "DWG TrueView™".

In the following example opened in DWG TrueView™, the DWG™ file can be seen to contain two tabs. The "Model" tab contains the 1:1 working model and the "Revision J" tab contains the scaled Paper Space view and incorporates the title block and legend.





View of the Model Space "Model" tab in DWG TrueView™.



View of the Paper Space "Revision J" tab in DWG TrueView™.

Generally, when adding a DWG™ file into CostX® which contains both Model Space and Paper Space views, Model Space would be selected. This can however sometimes mean that useful information which has been drawn directly onto the Paper Space view may not appear.

If you decide to load the Paper Space view, be aware that although it is to a nominated scale, the direct viewports to the Model Space will usually be at 1:1 whereas the lines and other information drawn directly onto the Paper Space sheet will be scaled at the nominated scale. Therefore the Paper Space sheet may contain a number of differing scales, even though it all looks the same. When adding the drawing you should set the Drawing Properties to the nominated scale.

CostX® is able to differentiate between viewport data and drawn data on a Paper Space sheet. If the data is held in a viewport, CostX® will determine the scale (normally 1:1) based on the underlying vector data. If you are using Point mode without the Snap function (which means CostX® is not reading the vector data) CostX® will interpolate the correct scale.

If the data is drawn on the sheet it will be at the nominated scale and CostX® will apply the scale as set in the Drawing Properties.

Therefore, when you click to measure a line, CostX® will scale the line according to its source. This means that viewport lines and drawn lines need to be measured separately, and cannot be combined in a single dimension. (They can of course be measured as separate dimensions in the same Dimension Group). To make it easier to see which lines are selectable, after the first click, the non-selectable lines from other viewports / paper are faded automatically and then on completion of the dimension, the full colour is restored.

When loading a Paper Space view it is therefore important to verify the intended scale, and enter the scale in the Drawing Properties dialogue. Crucially, be sure to then verify the scale using the "m" key check on several known X and Y dimensions, especially if using Point mode without the Snap feature.

Preferably, work in CostX® from the Model view. If desired, it can sometimes be worthwhile to print a set of the Paper space views in A3 or A4 simply to use as a reference. Do not, of course, use these hard copies for measurement purposes.

3.5 X-Refs

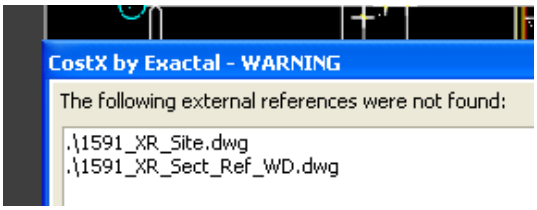
Another aspect of CAD workflow which needs to be understood is the use of External References – called X-Refs. An X-Ref is an 'external reference' to another AutoCAD® drawing file. Basically this means that one file can reference many other files and display them as if they were all one file.

X-Refs are used in larger projects for many reasons:

- They keep the file sizes down.
- They allow many users to work on individual components of a project.
- Every time an X-Ref is loaded, it is the most recent version of the drawing.
- X-Ref's can be updated, added, or unattached from the main drawing at any time.
- You can X-Ref drawings that they themselves X-Ref other drawings (nesting).

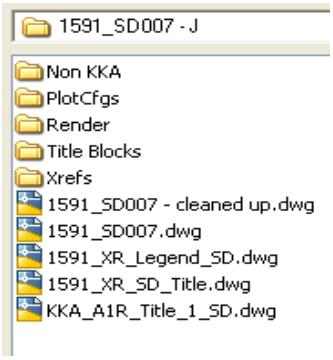
X-Refs enable project information which is relevant to multiple drawings to be held in a separate single file from where it can be referenced by each of the multiple drawing files, rather than having to replicate the information separately on each file. Typically, such information may include title blocks and company logos, or building sections or site datum data.

If X-Refs have been used, then when the drawing file is transmitted the X-Ref files need to accompany it or they cannot be accessed and will not appear in the view. Sometimes when loading a drawing into CostX® a warning message may appear if X-Ref files cannot be located.



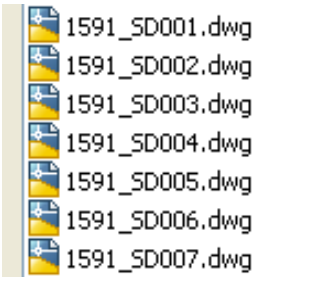
This is not necessarily a problem if the missing data relates to logos or titles - or even, as in this case, a site location reference and a Section reference which are not relevant to the measurement to be taken from the subject drawing - so it is sometimes acceptable to proceed. However it is of course highly advisable to determine the nature of the missing data and obtain any missing files.

A typical drawing file folder incorporating X-Ref files may look like this, for the drawing SD 007 - J.



In this case, the relevant drawing file is 1591_SD007.DWG. This is the only one that needs to be loaded into CostX® for measurement, but all the accompanying files must be kept in the same file path so that they can be accessed by CostX® to link to the X-Refs and enable the X-Ref data to be displayed in the drawing view. This creates a file storage issue, can complicate the transfer process, and needs a level of management.

An alternative is to request that when the drawings files are exported from CAD the binding of X-Refs option is used. The "Binding" option simply means that all the files are consolidated (or "bound") into the drawing files with the result as shown here, which is obviously far simpler to manage. However, be aware that binding can alter some CAD references within the drawing files, so be wary of bound X-Refs if using the CostX® revisioning facility.



3.6 2D DWFTM, DWFxTM and DWGTM from Revit®.

Revit® is highly sophisticated 3D CAD modelling software. Rather than drafting plans and elevations, a 3D virtual model is created within Revit® from which 3D and 2D "views" may be generated and viewed on-screen, and 2D "sheets" may be published in a variety of formats. The model can be accessed and shared by various design disciplines to provide a level of interoperability which supports "BIM" – Building Information Modelling. (See Section 4 below). When designing in Revit®, a menu of "objects" (walls, doors, windows, etc) is used instead of drafting using lines. Each of the objects is held in a database which contains detailed properties (also called "parameters") about the objects. These properties, or parameters, can be accessed to create comprehensive schedules.

Many designers currently use Revit®, but routinely issue the 2D drawing sheets as basic PDFs because Revit® model files are in RVT format which can only be read by the Revit® program.

However, Revit is also able to export in CAD formats such as DWG™ and DXF™, and in a format called DWF™ (Design Web Format) or DWFx™. Essentially DWFx™ is an open format read-only file which contains restrictions on some of the model data provided – however it is still data rich.

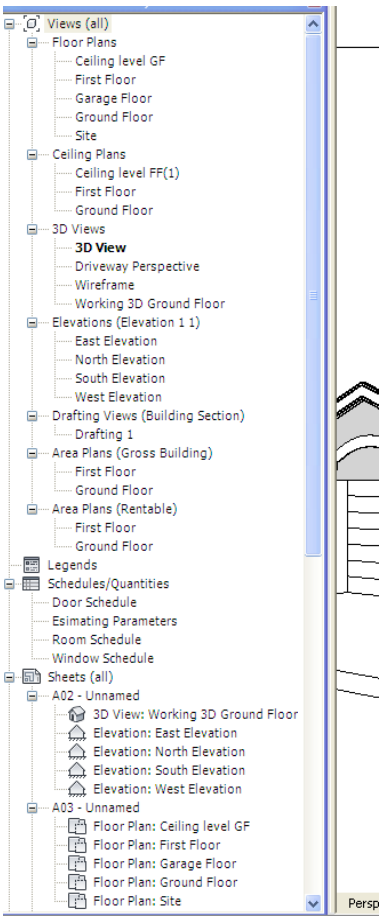
DWFx™ files are not a replacement for CAD formats such as DWG™ because DWF™ was developed as a secure file format by Autodesk® to issue design data to non-Revit® or CAD users for them to view, review, or print design files. DWF™ files are highly compressed and hence smaller and faster to transmit than design files. Designers can publish individual sheets or multi-sheet 2D drawing sets from multiple 3D drawing views, all within a single DWFx™ file.

Views and Sheets

The BIM model is a virtual representation of a physical model and as such can be viewed from any angle. In the same way that you might take photographs of a physical model from different directions, within the CAD program "views" can be generated of the virtual model. Views can be 3D such as perspective or orthographic projections, or 2D such as plans, sections and elevations. Because they are all views of the single model, changes made on one view will appear on all the others. The designer will create many such views as a design aid but not all will be intended for issue.

When the designer wishes to publish drawings, selected views will be placed onto "sheets" which can then be printed. Sheets will contain title blocks and the view will be scaled so that when printed onto paper the sheet will conform to industry standard paper sizes (eg 1:200 @ A3). By placing views onto sheets, the designer creates a construction set of documents.

The image here shows the Revit® browser for a typical building for which a series of 3D and 2D views and sheets have been created.



CostX® is able to read DWF™, DWFx™ and DWG™ files. However, the DWF™ exports have the advantage that the file is a single multi-sheet file whereas the DWG™ export creates an individual file for each view. Also the Designer is likely to prefer to issue files in a non-CAD format. However, it is possible that 2D DWG™ files of specific views may have better CostX® measurement functionality eg. use of layers, polylines and blocks, than their 2D DWF™ equivalents.

3.7 What to Ask For (2D only)

1. Check what design package the designers have used to draft the building, eg. AutoCAD®, Revit®, ArchiCAD®, or Microstation®. These are some of the more common products in use today.

2. If Revit® is the design package request a multi-sheet DWFx™ export with 2D sheets of all plans, elevations and sections. Initially use the DWFx™ files, but if additional measurement functionality is required then ask for a DWG™ file for the relevant sheet(s).

3. In all other situations request DWG™files (all competent design packages will output to DWG™ format) with layer and block information switched on and all rooms and areas set as polylines. If the revisioning facility will not be required on the project, the binding of X-Refs option could also be used to consolidate the file set.

4. In some cases PDF files are standard mandated output, in which case if you cannot convince the design team to change, then request vector PDF files with layers.

5. If you receive raster image files, always enquire if the vector equivalents or DWG™ source files can be obtained in their place. Sometimes in the early feasibility or sketch design phase only hand drawn sketches are available. If so, in order to maintain a digital, paperless workflow, these should be scanned and added into CostX® as image files.

6. Request that all files are optimised as recommended in the Exactal document “Digital Drawing Files for Measurement Purposes – Simple tips for a collaborative approach to improved drawing file intelligence”.

If working in 3D as well as 2D, refer to Sections 4.5 and 5.10 below.

3.8 Scaling

Drawing scales should always be checked and verified, even when working in 1:1 Model space. To do this, simply verify a known dimension by using the ”Measure Distance” button or the “m” key. For scaled drawings, if the scale is known, enter it into the drawing properties when adding the drawing. Then when the drawing has been loaded verify the scale using a known dimension (preferably a figured dimension but otherwise the width of a door opening or similar). If an incorrect answer is returned, the correct scale needs to be calculated and the drawing properties amended accordingly. If Point Mode is to be used on a Paper Space viewport, first verify the scale by measuring a known dimension in Point Mode.

For PDF drawings or image files with an unknown scale, use the Calibrate function. Calibrate can only be used prior to taking any dimensions, after which the button is disabled unless you delete all the dimensions. The calibration will be calculated to numerous decimal points. You can use the calibrated result, or use calibrate to identify the scale then click the “Reset Calibration” button to cancel the calibration and then open Drawing Properties and insert the scale, eg. rather than using a calibration of 199.8442 you could Reset Calibration and then insert a scale of 1:200.

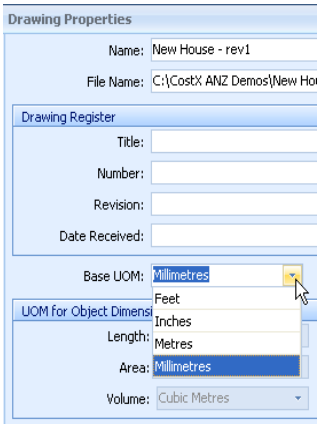
The other major benefit of inserting the scale is that the scale can later be amended in Drawing Properties which will automatically adjust all dimensions measured from the drawing so far, whereas a calibration factor cannot be reset once dimensions have been measured from the drawing.

3.9 Units of Measure (UoM)

It is important to understand the concept of Units of Measure (UoM). There are two aspects: the UoM of the Drawing, ie. how it was drafted; and the UoM of the Building, ie. the units that you are going to take measurements in. The two can be completely different as CostX® automatically converts dimensions from the Drawing UoM to the required Building UoM.

The UoM of the drawing (DWG™) file is simply notional units. In other words it is not defined as any common UoM (eg. metres, inches, millimetres) or anything other than units. When a drawing is first designed, the author will generally work using a scale setting where 1 unit = 1 common UOM (eg. 1 unit on the drawing represents 1 millimetre). Hence the scale is referred to as 1:1. Therefore a wall that is 5000 units long may represent a 5000 mm wall. This will often be described within the text on the drawing so others can take measurements etc.

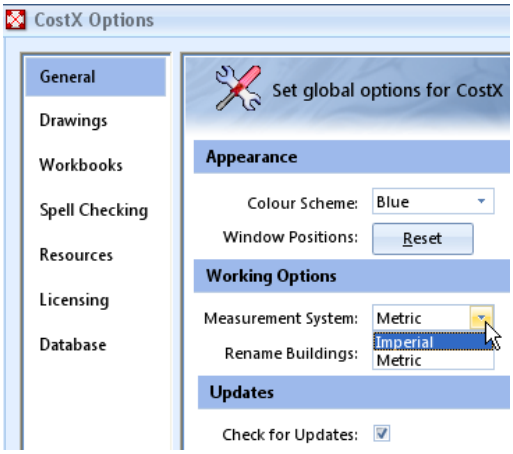
There is no way to automatically identify the UoM that 1 Unit represents from the drawing file itself. Typically metric countries use mm (or sometimes m for civil drawings), and the USA uses inches.



Since CostX® allows the Building UoM to be user defined, (ie. the units you want the measurements to be taken in), CostX® automatically converts dimensions to Building UoM from the Base (Drawing) UoM – however, for this to be accurate the Base UoM has to be set correctly on the drawing properties. CostX® assigns a Base UoM when the drawing is loaded but this may be altered by the user.

The setting that CostX ®assigns into the Base UoM when the drawing is loaded is based on a number of factors.

When the first drawing is added on a computer, CostX® looks at the **Measurement System** option and uses either mm or inches as a default. To preset the default units, select either the Imperial or Metric Measurement System option located in the General section of the CostX® Options button found under the Main Menu. If Imperial is selected, units default to Feet and Inches throughout the program. If Metric is selected, units default to Metres (Building UoM) and Millimetres (Base UoM) throughout the program as these are the most common. These defaults may be overridden if required for specific projects.



When subsequent drawings are added, CostX® uses the same Base UoM as was used previously because generally they will be consistent.

PDFs are slightly different. PDF files are automatically calibrated to the UoM (mm or in) based on the Measurement System setting (metric or imperial). Even if the PDF drawing has text with measurements written in inches, if the Measurement System setting is metric then the UoM will be set to mm. In this situation CostX® automatically calibrates the drawing to reflect the UoM as mm, and therefore the resulting metric measurements will be correct if the PDF has been scaled or calibrated as described above.

As always, after the drawing has loaded, check a known dimension using the “m” key to verify the settings.

4 3D Drawing Files

(Not available in 2D versions)

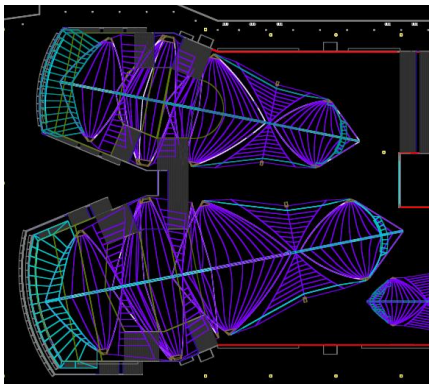
4.1 3D Drawings and BIM Models

It is important to understand the difference between BIM models and 3D Drawings.

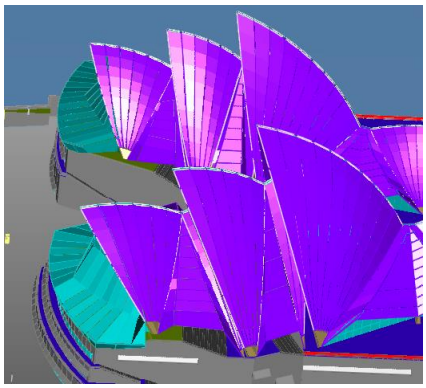
3D Drawings

Traditional 2D and 3D CAD programs use vector graphics to replicate the human process of drawing on paper. Vector graphics is the use of geometrical primitives such as points, lines, curves and shapes or polygons, which are all based on mathematical equations, to represent images. This is distinct from raster graphics, which is the representation of images as an array of pixels as is typically used for the reproduction of photographic or scanned images.

Regardless of whether it is rendered in 2D or 3D, a vector based CAD drawing like the following example of an AutoCAD® DWG™ file is simply a collection of lines, arcs and text.



2D Plan View



3D View

Because they are based on geometric data, these graphical models cannot describe the physical attributes of the entities they represent, nor the relationship of the entities to each other. To overcome this limitation, design-related industries have developed object-based data model applications, specific to their operating environment, that can represent the physical and performance attributes of entities in addition to their graphical properties.

In the case of the AEC (Architecture, Engineering, Construction) industry this translates to a data model built around building entities and their associated inter-relationships. The interface remains graphic, but geometry is only one of the properties of the entities, which will also contain physical and performance data such as spatial relationships, geographic information, quantities and properties of the building components.

The objects within the model are termed “intelligent” because the database defines their properties and their behavioral relationship with other objects. A door knows that it is a door, and when it is placed into a wall the wall knows it has to have an opening to suit that particular door. The parametric properties are inter-related. If the door size is changed, the wall opening will change to suit. All of the physical and functional characteristics of the building model are held in the central database. As the model develops, all of the objects within it parametrically adapt themselves to the new design. These models are therefore rich in information that can be extracted and used for a variety of analyses to assist in design, construction and operational optimization.

BIM Models

The process of optimising the design by interrogating and analysing the data within the model is referred to as Building Information Modelling (BIM). Consequently, the data model for a building is often referred to as a "BIM model".

Since the database holds all the information for each of the model objects, it will always represent the latest iteration of the design – and crucially, as a database, it is capable of being interrogated in various ways to extract differing types of data. Hence, the more data that is added to it, the wider the range of analyses such as building performance, schedules and costs that can be leveraged from it to select the best options.

This means that if multi-disciplinary teams are using a common software platform, they can use the model-based technology to share building data and collaborate on design, construction and lifecycle management. Detailed design information can be quickly and easily created which improves efficiency and saves time and money, and the design can be tested and proven before work starts on site, saving time and money particularly in early clash detection.

Ultimately, the implementation of BIM has the potential to allow all team members to contribute to the creation of better buildings, delivered faster and more reliably, with reduced environmental impact over the entire building life cycle. This is why many industry authorities are actively campaigning in support of BIM, and governments worldwide are starting to mandate the use of BIM.

4.2 CostX® and BIM Models

CostX® is able to view data models in DWF™, DWFx™ and IFC format and utilise the database information to automatically generate quantities. These formats are explained in more detail below. Of course, the quality of the output is reliant on the parametric coding of the objects within the database. Currently, 3D CAD is often used primarily for design visualisation and the database might be minimally populated because the model is only intended to be used to generate 2D plans, elevations and sections and the data model is not intended to be shared. However, the situation is rapidly changing as advances in software technology allow other team members to find selective ways to model elements in BIM, and interrogate the model database to suit their needs. Now, with CostX® the quantification and estimating disciplines are also able to participate in the collaborative BIM team effort and designers are responding to this change by increasing the amount of object data held in the database.

However, for estimating or scheduling purposes it will generally be necessary to augment the BIM data with additional measurement from 2D or 3D drawing views.

4.3 DWFx™ files from Revit®

Many designers currently use 3D CAD software to create BIM models, but because they cannot share the data models with third parties, the output will generally be limited to drawing views (but not object data) exported to graphical CAD formats such as DWG™, or 2D drawings printed to paper or PDF.

To enable Revit® users to better communicate with other team members and stakeholders, Autodesk® developed an open file format called DWF™ (Design Web Format) or more recently DWFx™. First introduced in 2D form in 1995, DWF™ has continued to evolve and now all Autodesk® and a variety of third party design applications can publish data-rich 3D models in DWF™ and DWFx™ format. DWF™ is a proprietary product, but is an open format insofar that Autodesk® publishes the specification and makes code libraries available to developers of other applications with a DWF™ Toolkit.

DWFx™ files differ from CAD formats such as DWG™ because DWFx™ is a read-only secure file format which enables Revit® design data to be issued to non-Revit® and non-CAD users. Similar to Portable Document Format (PDF), the files can be viewed and printed but they cannot be edited. They are also highly compressed and hence smaller and faster to transmit than their source design files, but do not contain the complete model data.

Designers can publish individual sheets or multi-sheet 2D drawing sets from multiple 3D drawing views, all within a single DWFx™ file and they can edit the data so that the content of the DWFx™ is limited to only what they want the recipient to see.

Section 9 of the Exactal document "Digital Drawing Files for Measurement Purposes" contains suggestions for how designers can improve the content of DWFx™ files for estimating purposes.

4.4 Revit® Model Structure

Within the Revit® object library, information about the model objects (also termed Elements), is classified into a hierarchical structure of Categories, Families, and Types. The data held about the objects is referred to as the Type Parameters. When placed into a building model, the occurrence of the object within the model is called an Instance. The data determining the behaviour of the object in a particular instance is referred to as Instance Parameters. The Instance Parameters will usually include certain dimensional data (quantities) of the object.

The following extract from the Revit® Architecture 2010 User's Guide overviews the classification system.

Revit Architecture

Revit Architecture 2010 User's Guide > Revit Essentials > What Is a Project? > Building with Elements >

Categories, Families, and Types

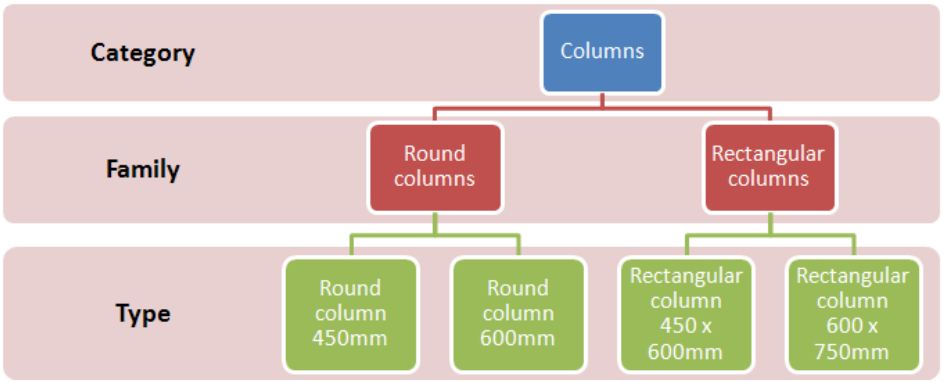
Revit Architecture classifies elements by categories, families, types, and instances.

Category: A category is a group of elements that you use to model or document a building design. For example, categories of model elements include walls and beams. Categories of annotation elements include tags and text notes.

Family: Families are classes of elements in a category. A family groups elements with a common set of parameters (properties), identical use, and similar graphical representation. Different elements in a family may have different values for some or all properties, but the set of properties—their names and meaning—is the same. For example, six-panel colonial doors could be considered one family, although the doors that compose the family come in different sizes and materials. Structural members (such as w shapes) are another family. See Revit Families.

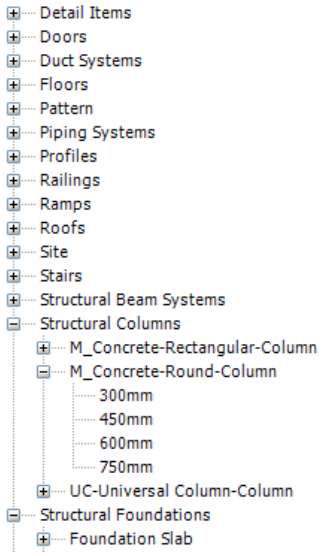
Type: Each family can have different types. A type can be a specific size of a family, such as a 30" X 42"(A0) title block or a 32" x 84" (910 x 2110) door. A type can also be a style, such as default aligned or default angular style for dimensions. A family can have several types. For example, a table may be available in several sizes. Each size table is a different type within the same family.

Instance: Instances are the actual items (individual elements) that are placed in the project and have specific locations in the building (model instances) or on a drawing sheet (annotation instances). Each instance belongs to a family and, within that family, a particular type.

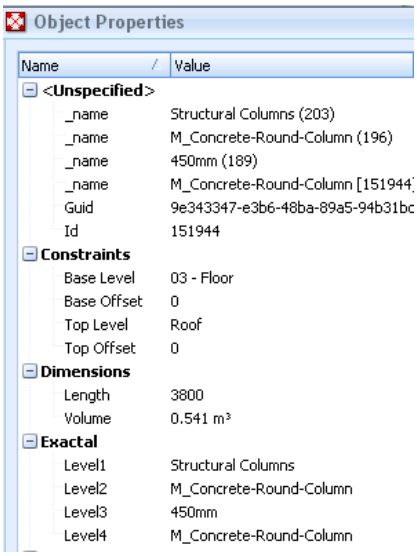


The image on the left below shows the family structure within the Revit® browser for a typical building. As an example, Structural Columns=Category, M_Concrete-Round-Column=Family name, 450mm=Family Type.

When a DWF/DWFx™ file is opened in CostX®, the properties of each model object can be viewed (image on the right below) and used to extract data from the model using any combination of object properties. Users have the option to either define Model Maps to customise the data extraction from the model, or to generate automatic quantities using the standard CostX® BIM templates.

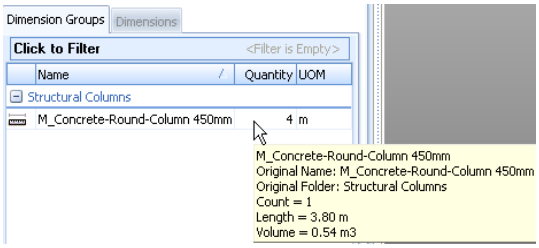


Revit® browser showing Family hierarchy



Column Properties viewed in CostX® including Length and Volume properties

CostX® ships with a selection of BIM templates. The templates are XSLT files which have been written specifically to automatically extract and sort data from 3D DWF/DWFx™ model files. The default template is called "Revit® General" and this template extracts the data and categorises it in accordance with the Revit® family hierarchy to create a list of dimension groups using the Revit® category to name the dimension group folder, and the Revit® family name + family type to name the dimension group. The quantity will generally be drawn from the first dimension property. Refer to Section 6.8 below for more detail.



Because this template relies on the model data being presented in standard Revit® family categories, it will generally only produce satisfactory results when used with a DWF/DWFx™ file exported from Revit®.

4.5 DWFx™ Files - What to Ask For

Even if you first receive paper drawings or PDFs, check if the designers have used Revit® 3D BIM software to draft the building. If so, request a multi-sheet DWFx™ export with a default 3D model view (or series of 3D views each showing different elements) and 2D sheets of all plans, elevations sections and details. Use the 3D views to import BIM dimensions, then use the 2D sheets to check and augment the quantities. Ask for additional DWG™ files for any individual sheet where additional measurement functionality may be required. (see item 3.7 above).

Request that all files are optimised as recommended in the Exactal document "Digital Drawing Files for Measurement Purposes – Simple tips for a collaborative approach to improved drawing file intelligence".

5 Industry Foundation Classes (IFC)

BIM provides a means to achieve a knowledge-based, integrated approach to building design, procurement and ownership. The concept of BIM is to combine and share centralised model-based data with a view to reducing waste, improving productivity and producing better buildings.

The BIM software primarily used by building designers includes Revit® by Autodesk®, MicroStation® by Bentley®, ArchiCAD® by Graphisoft® and Vectorworks® Architect by Nemetschek Vectorworks Inc. All have a native file format (RVT, DGN, PLN and VWX respectively). These file formats and their underlying data models are proprietary and cannot communicate directly with each other. This lack of interoperability between these and other major software platforms operating in the buildings network has long been seen as a major constraint to the widespread adoption of BIM.

The International Alliance for Interoperability (IAI) was established in 1995 as a non-profit industry led organization with the goal of establishing industry-wide, vendor neutral open standards for BIM file interoperability. In 2005 the IAI was reconstituted as buildingSMART® International.

The data model standard published by buildingSMART® for open BIM interoperability is IFC. Adopted as an ISO standard, IFC is intended to be a common format to enable data sharing and exchange across multiple applications and disciplines. The IFC schema has as its scope "*to define a specification for sharing data throughout the project life-cycle, globally, across disciplines and across technical applications*". Given such a wide-ranging scope, the IFC schema is inherently complex, and broader than is usually required by any specific discipline at any particular point in the project life cycle. Therefore most practical IFC implementations are governed by what is termed a Model View Definition which is a subset of the IFC schema that contains the data specification for a particular use case, or exchange scenario (See 5.1 below).

Applications such as Revit® and ArchiCAD® are built around their own proprietary data model and are optimised to interact with it. In contrast, the IFC data specification is a neutral encapsulation of all relevant building data, regardless of the interface system. In other words, just as Revit® has internal rules and parametric programming to express the relationship between a column and a beam, based on their geometric kernel and parametric constraint system programming, IFC specifies a neutral representation of the same relationship, based on its own open geometry and data standards (STEP and EXPRESS). The purpose of IFC is to provide a neutral nexus for translations between dissimilar systems.

IFC-compliant applications can either export, import, or both export and import, IFC data models and re-use or edit the data. Because each of the proprietary data model formats have their own architecture, the import and export process usually involves mapping or translating the data between their internal schema and the IFC schema – and back again. Owing to these differing data structures, the translation process can involve data loss because of the lack of appropriate place holders for certain data. In practice, this means that “round-tripping”, ie. exporting an IFC from an application, and then re-importing back in again, may not re-create the original model in its original format, and certain features may no longer work. This is not so much an inherent failing of the data system itself, but arises more from the way IFC has been implemented in the host authoring application. Consequently, buildingSMART® has launched a certification program aimed at improving the quality and robustness of IFC implementations. The “IFC Certification 2.0" process is a detailed quality control of the IFC interfaces of participating software developers.

However, at this point, differences in the authoring application’s import/export routines and differing standards of implementation will often result in an IFC that does not match the source file and therefore potentially may not satisfy the full intent of the data exchange.

5.1 The IFC Standard

The currently implemented IFC standard is IFC 2x3 Edition 3 (Feb. 2003) as amended by IFC 2x3 TC (Technical Corrigendum) 1 (July 2007). TC1 did not significantly change the core data structure of the IFC 2x3 exchange file and both versions can be used for IFC implementation and certification.

IFC4 (formerly called 2x4) was released on 12 March 2013, published as ISO Standard 16739. It will be the basis for upcoming IFC solutions and incorporates numerous improvements and enhancements over the current IFC 2x3 release. Implementations will start appearing in authoring applications from 2014 onwards.

As stated earlier, IFC cannot replicate the authoring functions of the various proprietary BIM applications, nor is that its intention. It is a file format whose purpose is to facilitate cross-discipline data sharing and exchange by providing a broadly based, vendor-neutral repository for data relating to building objects and their associated geometry, properties, and relationships.

The process of sharing data via the IFC format is termed an IFC Exchange. In practical terms, the need to convert the host data to IFC format and the fact that the IFC is structured to support a multiplicity of data types across a wide range of disciplines can lead to a high level of complexity in the IFC model. IFC exchanges therefore follow what is termed an “Exchange Requirement” which specifies the data that needs to be present in any given exchange and thereby limits the scope of the exchange to more manageable proportions.

The buildingSMART® Standard for Processes, formerly called the IDM (Information Delivery Manual), defines typical exchange requirements for a given discipline or scenario, so that different audiences can focus on the data relevant to them. The standard specifies what data is needed, by whom, and at what point in time. An associated IFC View Definition, or MVD (Model View Definition) defines a subset of the IFC schema that will satisfy the specified exchange requirements. In other words, when you open an IFC governed by an MVD, you are only seeing selected parts of the information which goes to make up the entire data model.

The MVD provides implementation guidance for all IFC concepts (classes, attributes, relationships, property sets, quantity definitions, etc.) used within the subset. It thereby represents the specification for the IFC export by BIM applications, so that their exports satisfy the exchange requirements.

The official buildingSMART® MVD for the AEC industry is the IFC2x3 Coordination View Version 2.0. This can be extended with add-on model view definitions to support additional exchange requirements which currently include:

- The Quantity Take-off add-on view which adds the ability to transmit base quantities for selected spatial, building, building service and structural elements.
- The Space boundary add-on view - it supports the use of BIM in thermal and energy analysis by adding building element to space relationships.
- The 2D Annotation add-on view - it supports the exchange of additional 2D element representations and annotations of building models
- The IFC2x3 Structural Analysis View
- The IFC2x3 Basic FM HandOver view

For further information refer to http://buildingsmart-tech.org/specifications/ifc-view-definition. Work is currently underway in defining the first IFC4 based BIM work flow support definitions (MVD).

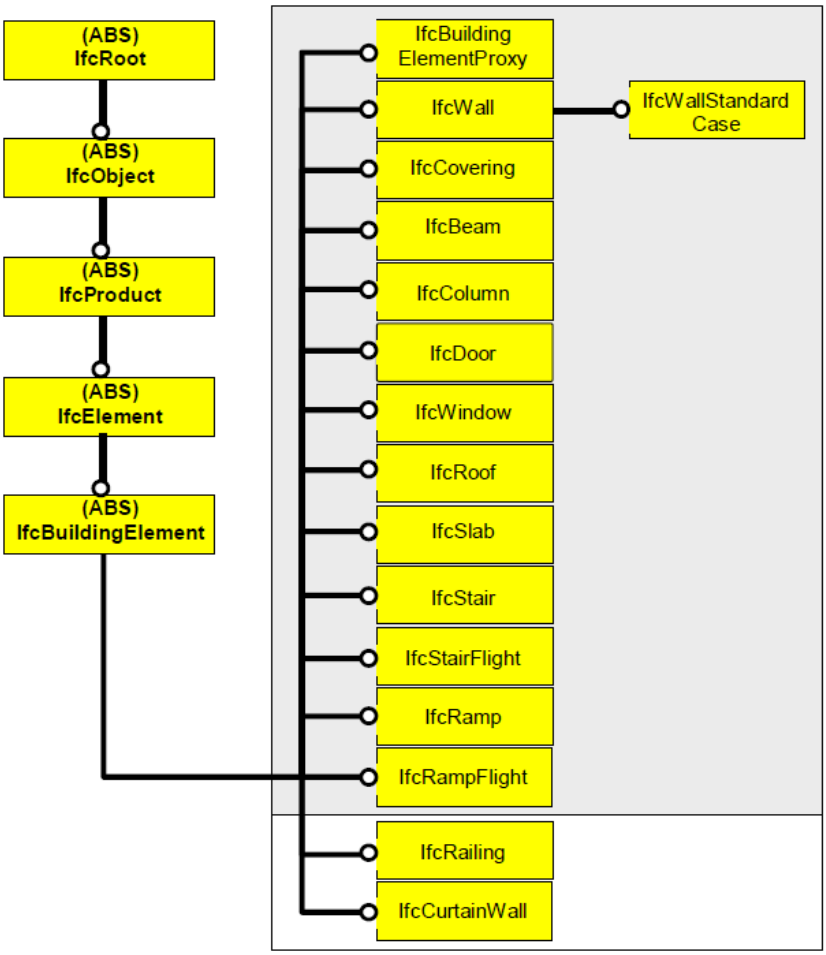
For further details refer to www.buildingsmart.tech.org

5.2 The IFC Model Structure

As described above, the IFC format is a neutral data schema that makes it possible to exchange information between different proprietary software applications. In essence, it defines a structure for the way that the information covering the many disciplines that contribute to a building throughout its lifecycle can be held, categorised and presented.

It is important to have an appreciation of this structure to enable you to navigate through the IFC and find the information you want.

An IFC Model is made up of various entities. The entities may be physical such as walls, doors, etc. or can be abstract such as spaces, activities, organization, etc. All will have a range of properties such as name, geometry, materials, relationships, etc. The IFC schema specifies the hierarchy of these properties, as shown in the following diagram.



Hierarchy Chart of Building Elements (buildingSMART® IFC 2X3 Model Implementation Guide v.2.0)
(ABS) = Abstract Entity

Each building entity (eg. IfcWall) is defined as a subtype of IfcBuildingElement, which in turn is a subtype of IfcElement and so on, up to the root entity IfcRoot. Attributes are associated with each entity, so that IfcWall inherits most of its attributes from its parent entities (termed supertypes).

All the upper level entities are abstract, which means they cannot of themselves exist as an instance. The IfcWall entity, however is not abstract which means it can be “instantiated” to create instances of the wall object within the building model.

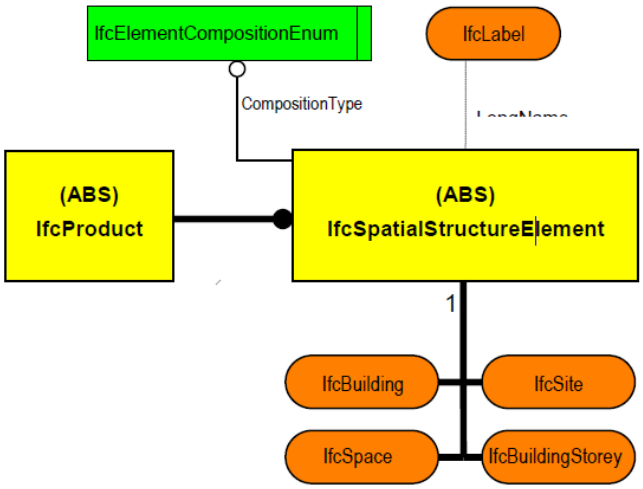
5.3 IFC Model Entity Definitions

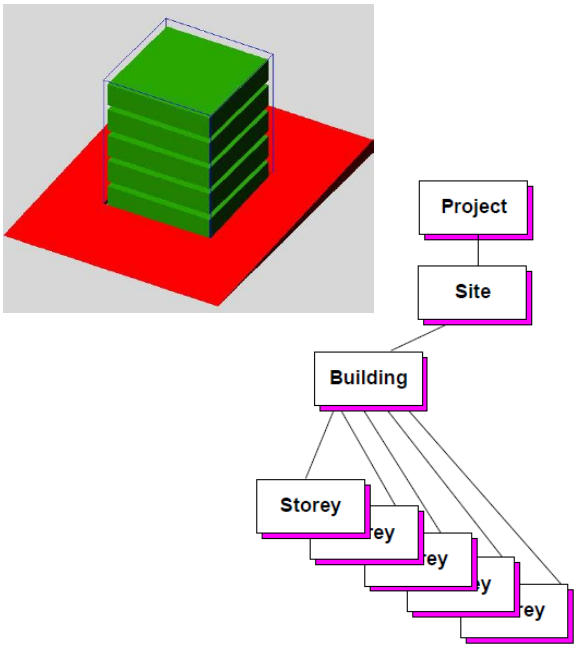
At the most fundamental level, IFC defines all entities as rooted or non-rooted. Rooted entities derive from IfcRoot and have an identity (with a GUID – Globally Unique Identifier code) with attributes for name, description and revision control. Non-rooted entities do not have an identity and instances only exist if referenced from a rooted instance. IfcRoot has three attributes: IfcObjectDefinition relating to object occurrences and types; IfcRelationship which defines relationships between objects; and IfcPropertyDefinition which captures extensible properties about objects.

IfcProject encapsulates an overall project and includes contextual data such as name, description, default units, currency, etc. A valid IFC file must include a single IfcProject instance to which all other objects can relate. A project can include multiple buildings, stages, etc. and can also reference and draw data from other projects such as product types.

IfcProduct is the base class for physical objects with subdivisions for spatial elements, physical elements, structural analysis components, and others. Products may have associated definitions for materials, shape representations, placement in space and quantities. Spatial elements include IfcSite, IfcBuilding, IfcBuildingStorey and IfcSpace. Building elements include IfcWall, IfcBeam, IfcDoor, and others.

Various relationships can be associated with these types of entities. An aggregation relationship can collect spaces into a storey, whilst a containment relationship can locate one entity inside another. This means that any building element – wall, beam, column, door, etc – can be associated with any spatial element – a site, a storey, or a space.





Definition of Spatial Elements (buildingSMART® IFC 2X3 Model Implementation Guide v.2.0)

Whilst the IFC is structured to accommodate these relationships, the responsibility for creating them lies with the authoring application that exports the IFC. If the correct associations are not explicitly made in the source file, they cannot proceed in the IFC and hence may not appear in a downstream application. Thus, how a model file is prepared for export to IFC is extremely important and is a critical factor in the ultimate success of the IFC exchange process.

5.4 Property Sets

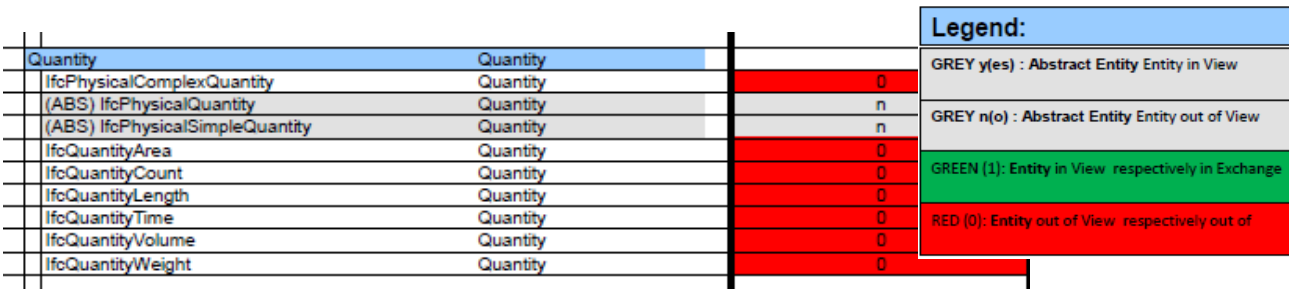
Some properties of an object are absolute. These fixed properties are termed Attributes. Other properties are more variable because they may be seen or interpreted differently by different parties, or may be contextual, or assigned to an object by a relationship. These types of properties can be grouped together as a "Property Set" and added to the object as additional parameters to suit particular situations. The properties within a set can be either standard (conforming to the rules of the IFC schema) in which case the set name will begin with the prefix "Pset_" or they can be custom, which means they are created by the exporting application and the names of these sets will normally include the name of the authoring application.

5.5 Proxies

When BIM applications export to IFC, the data has to be mapped from the host schema into the IFC schema. Many architectural object classifications have direct IFC counterparts and will be mapped accordingly, eg. an object having a Wall-subtype in ArchiCAD® will be classified as IfcWall. If an object has no corresponding IFC element type it will be exported as a Proxy. The default setting is to export the proxy as a general solid object in a generic IfcBuildingElementProxy element. As a general solid object, it has geometry but no properties which is obviously undesirable and therefore to be avoided. It is possible to map objects to alternate IFC elements prior to export, to reduce the number of proxies, or proxies can be defined with geometry and property sets to behave like regular entities.

5.6 Quantities in the IFC 2x3 Coordination View

When exporting an IFC file, IFC-compliant architectural BIM software maps the IFC export to the requirements of the IFC2x3 Coordination View v2.0 model definition. The main purpose of the Coordination View is to allow sharing of model data between the architectural, structural and MEP disciplines for coordination purposes. The view definition does not specify requirements for export of dimensions (termed "out of view").



Quantity	Quantity	
IfcPhysicalComplexQuantity	Quantity	0
(ABS) IfcPhysicalQuantity	Quantity	n
(ABS) IfcPhysicalSimpleQuantity	Quantity	n
IfcQuantityArea	Quantity	0
IfcQuantityCount	Quantity	0
IfcQuantityLength	Quantity	0
IfcQuantityTime	Quantity	0
IfcQuantityVolume	Quantity	0
IfcQuantityWeight	Quantity	0

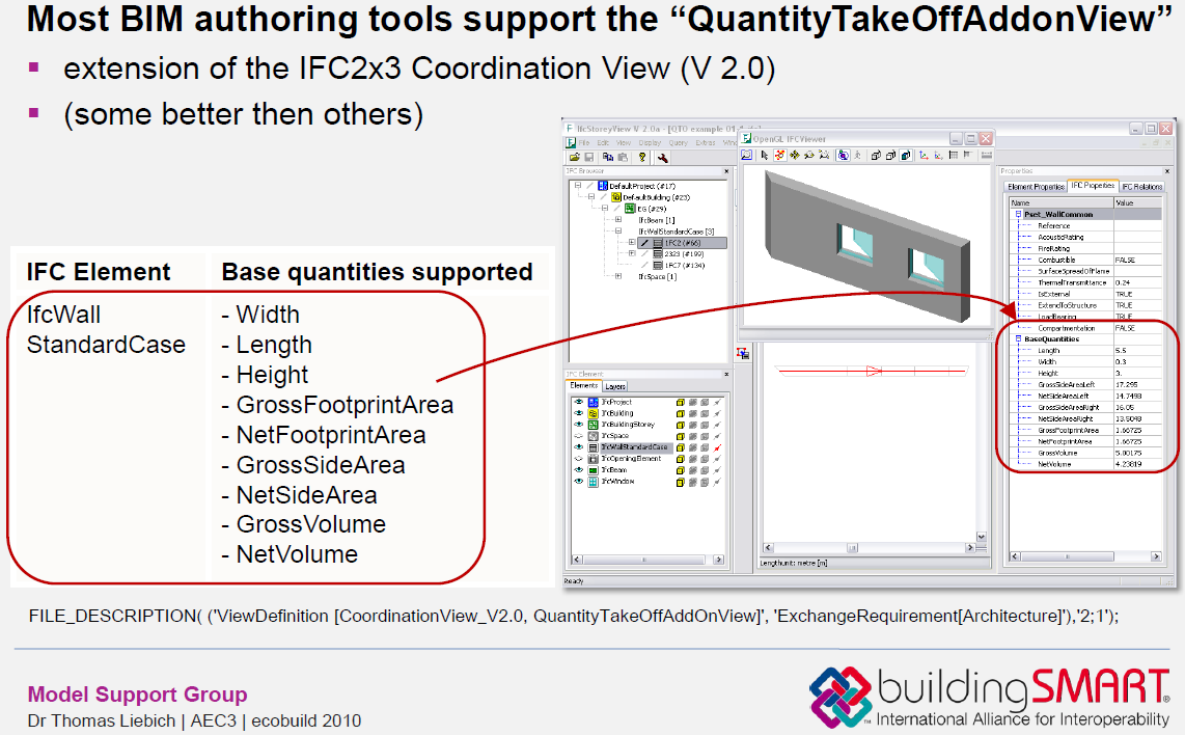
Quantity Properties Out of View (buildingSMART® IFC 2X3 Coordination View Definition v.2.0)

Generally, this will mean that a standard IFC exported from architectural BIM software will not include explicit quantity data, unless the Quantity Take-Off add-on view extension has been used to include Base Quantities in the export (see 5.7 below). Note that some IFC Viewer software such as Solibri® Model Viewer calculates quantities and displays them as entity properties. These quantities are not an attribute of the IFC file, and have been separately calculated by the Viewer program from the IFC geometry. Consequently, the same IFC opened in CostX® (or other IFC Viewers such as Data Design System® DDS-CAD) will not have those quantities. Because the quantity values have not been explicitly defined and recorded, based on the original model and intentions of the model author, their accuracy is entirely dependent upon the calculations undertaken by the Viewer program and the data it uses as the basis of the calculations.

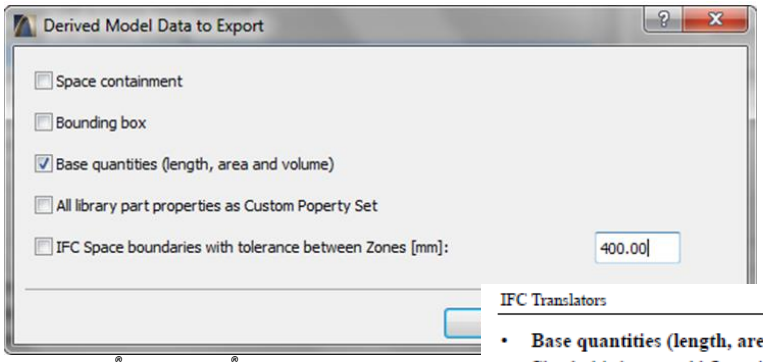
5.7 Base Quantities

In 2006 buildingSMART® commenced work on a definition of model-based quantities to create an open standard for quantification of building spaces and elements, termed "Base Quantities". These are described in the buildingSMART® document "Information Requirements for Model-based Quantities - Definition of Base Quantities" dated 2010-12-08 reproduced in the Appendix.

To augment the IFC 2x3 Coordination View definition, the Quantity Take-off add-on view adds the ability to transmit Base Quantities for selected spatial, building, and structural elements.



Currently, Base Quantities can generally be included in an IFC 2x3 export as a tick-box export option.



Graphisoft® ArchiCAD® 15 Export Options

IFC Translators

- **Base quantities (length, area and volume)**

Check this box to add Quantity Takeoff parameters to Wall, Column, Beam, Slab, Roof (slab) and Zone elements in the IFC file. This data is useful in the Interoperability with cost estimation applications.

For example, the following quantities (IfcElementQuantity) can be exported together with a Wall:

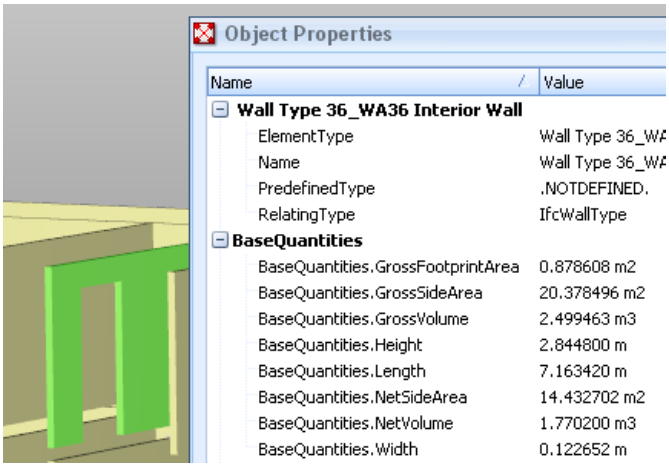
- Height,
- Perimeter,
- Gross volume,
- Net volume (volume reduced e.g. by columns embedded into the wall),
- Gross Floor Area (doors are not considered),
- Net Floor Area (area reduced by door footings),
- Gross Wall Area (openings are not considered),
- Net Wall Area (area reduced by openings).

IFC 2X3 Reference Guide for ArchiCAD® 15

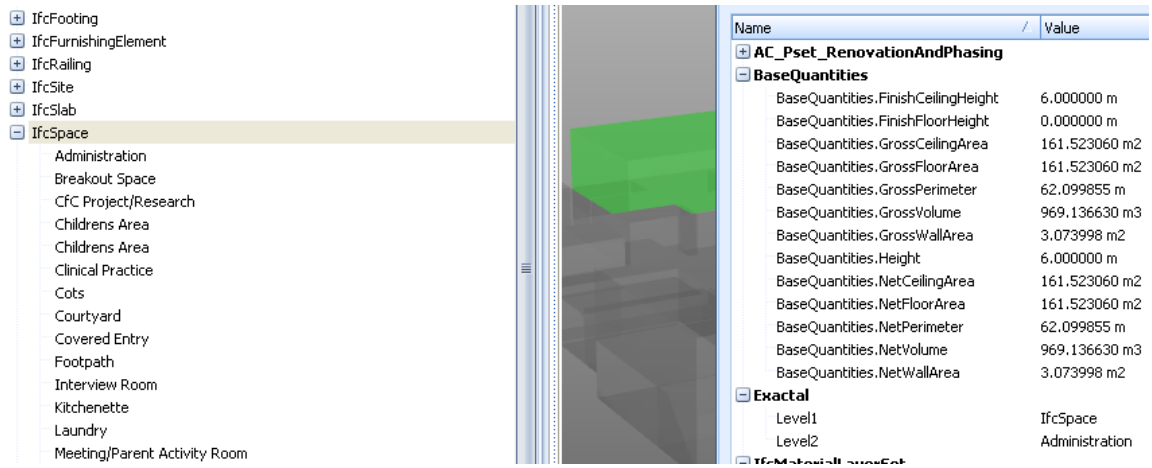
Base Quantity definitions have only been written for selected elements, and Base Quantities are only included in the export for those elements. The elements are:

- Spaces
- Walls
- Openings
- Windows
- Doors
- Slabs
- Beams
- Columns
- Members
- Coverings
- Curtain Walls
- Ramps
- IfcRailing

No Base Quantities are provided in the IFC for excluded elements such as Casework and Plumbing. Footings and Roofs do not have Base Quantity definitions as these are “container” elements, meaning they are an aggregation of sub-components (slabs, beams, etc). The sub-components can contain their own quantity information but when aggregated into IfcRoof or IfcFooting the quantities are not identified. These will be available in the IFC4 release.



Example of Wall Base Quantities



Example of Space Base Quantities

It is also possible for Base Quantities to be manually entered by the end user, overriding any automatic calculation in the authoring application. The Base Quantity specification only indicates the standardized means of measuring and recording the quantity data, to eliminate possible errors in receiving applications that may miscalculate any automatic derivation from the given geometry.

5.8 Quantities in the IFC Standard

Although the Coordination View Definition does not include quantities, quantity definitions are supported in the IFC 2x3 standard so in some cases an IFC file exported under a different MVD may include quantity properties as core attributes. The quantity definitions are broadly generic to provide flexibility to meet the particular requirements of local or regional methods of measurements, and the different purposes for which quantities may be needed. Quantities can be assigned to objects through the IfcElementQuantity class. This is defined in the IfcProductExtension schema. Each instance of IfcElementQuantity can contain one or more instances of IfcPhysicalQuantity, which defines the various forms of quantity properties. Five types of quantities are defined, which apply to spaces as well as objects.

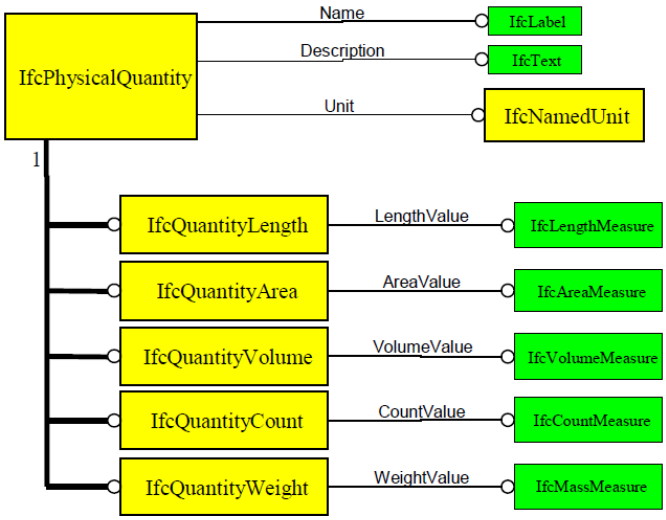
- Length (as IfcQuantityLength)
- Area (as IfcQuantityArea)
- Volume (as IfcQuantityVolume)
- Count (as IfcQuantityCount)
- Weight (as IfcQuantityWeight)

Each type of IfcPhysicalQuantity has a value attribute that is defined according to the equivalent defined data type within the IfcMeasureResource schema e.g. the value of an IfcQuantityLength is given by an IfcLengthMeasure.

Each instance of IfcPhysicalQuantity must have a name that defines the context for its usage. For example, a wall may have several area measures. These could have context names such as footprint area, left wall face area, right wall face area etc. The areas would be given by three instances of the area quantity subtype, with different Name string values. The Name attribute defines the actual usage or kind of measure. The interpretation of the name label has to be established within the actual exchange context.

Additionally, each quantity may have an associated informative description that can be used to explain or further qualify the Name attribute. Each instance of IfcPhysicalQuantity may also have a unit, subject to a separate set of rules.

If the unit is given, the value for unit overrides the global setting of the project-wide units within IfcProject.UnitsInContext. If the value for unit is omitted, then the unit defined within UnitsInContext is used. In order to find the applicable unit, a measure type is provided for each measure value.

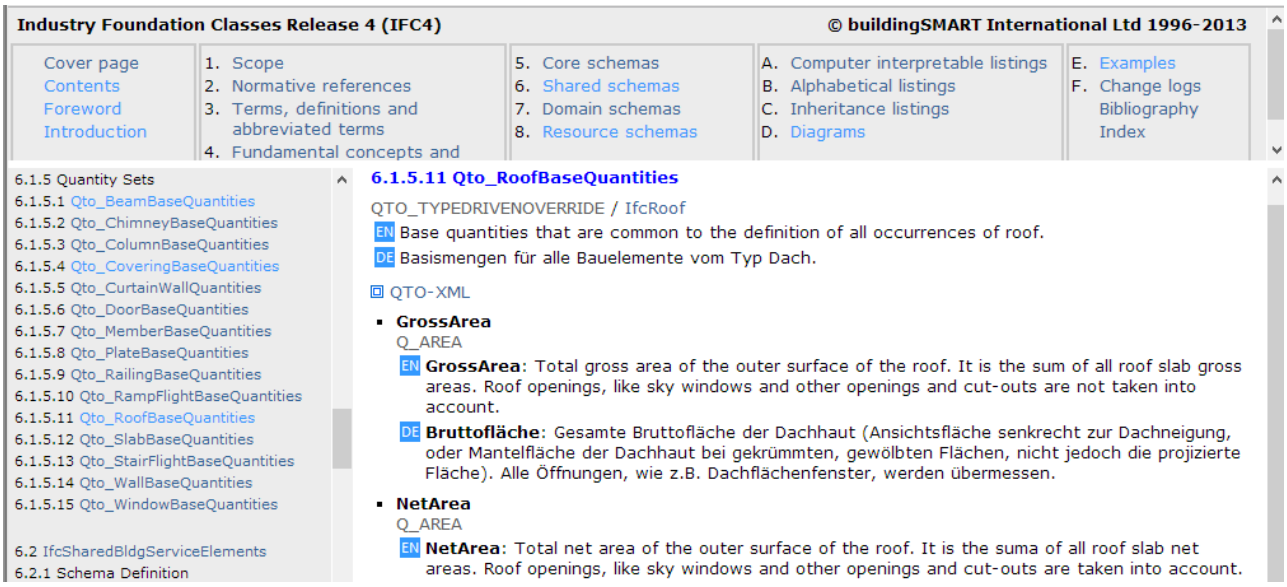


Definition of Physical Quantity (buildingSMART® IFC 2X3 Model Implementation Guide v.2.0)

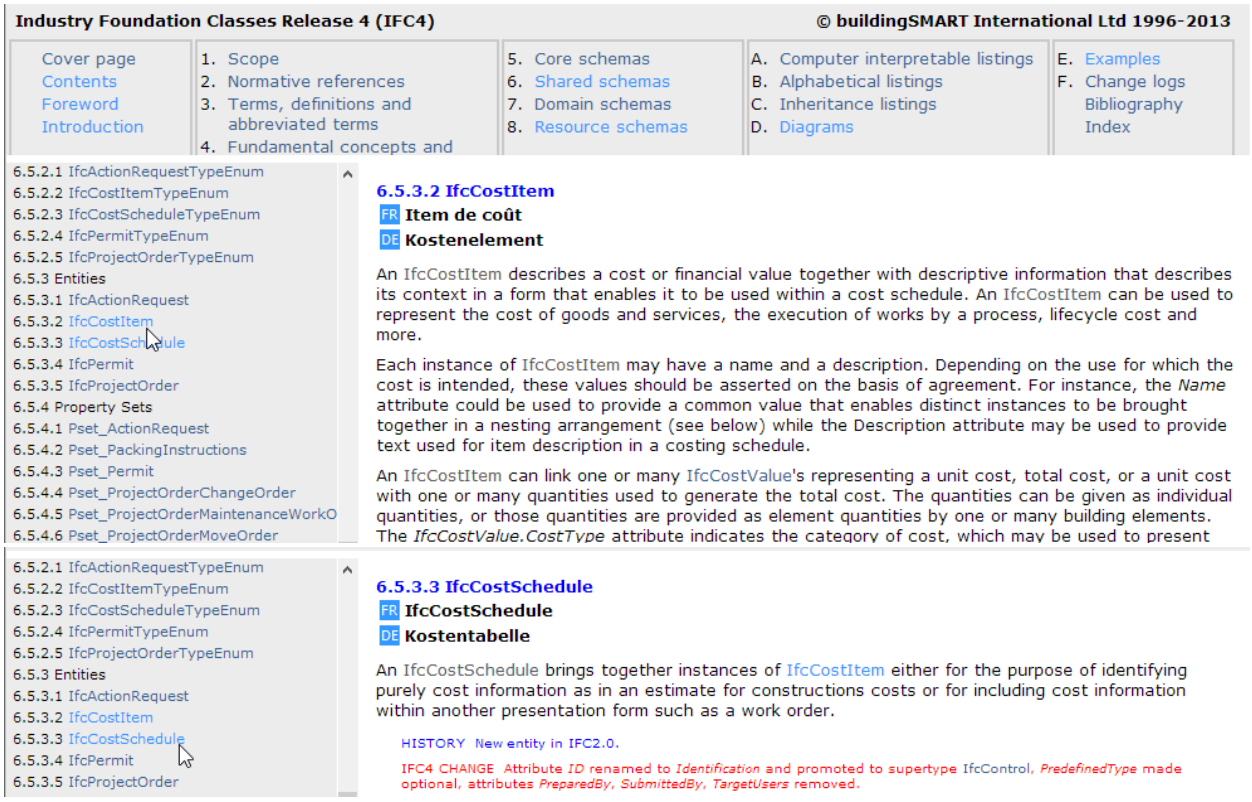
5.9 Quantities in IFC4

For details of the new IFC4 standard, refer to http://www.buildingsmart-tech.org/specifications/ifc-releases/ifc4-release/buildingSMART_IFC4_Whatisnew.pdf. Two changes relating to support for new BIM workflows and 5D model exchanges which should appear in IFC4 implementations are stated as:

- *Standardized quantities for QTO - Definition of international base quantities, defined as separate XML schema + configuration files linked to IFC spec.* This includes the welcome addition of a BaseQuantities Definition for IfcRoof Element.



- *Major efficiency improvement for 5D - Similar rework for cost items and construction resources, now linked to schedule and BIM.* This relates to the definition of cost items within 4D schedules.

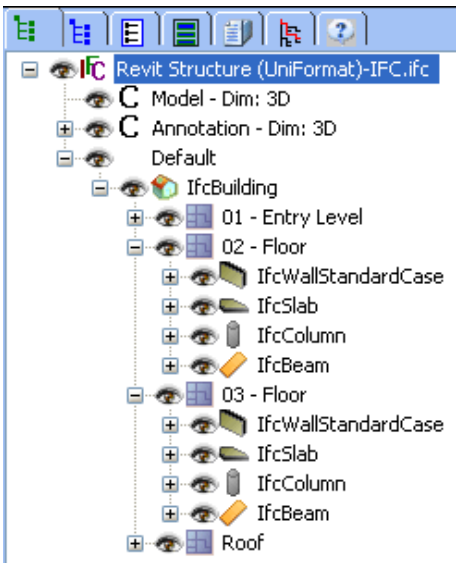


5.10 IFC Files and CostX®

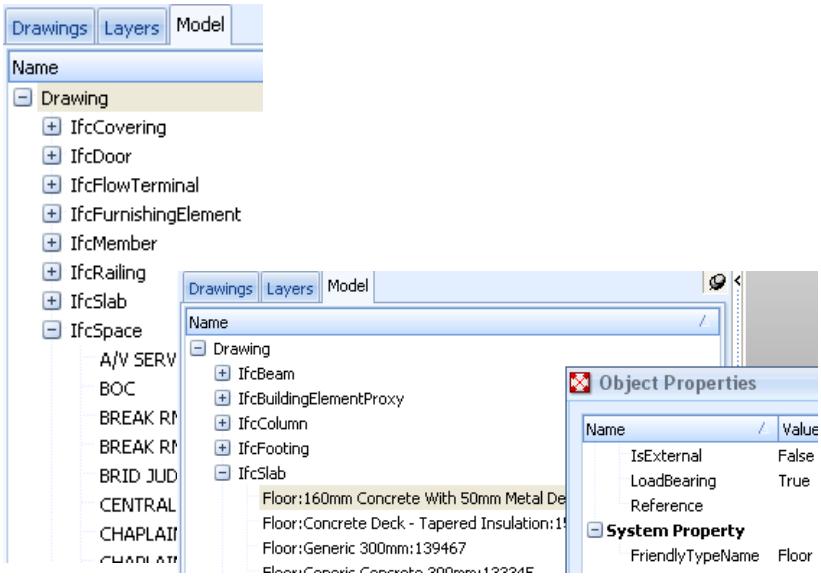
Owing to differences in implementation by the various authoring applications and the multiplicity of supported data types, IFC file configuration and data content will differ between projects. Consequently it is difficult to define a standard for automatic quantities extraction via a CostX® BIM Template. Data extraction from an IFC file is therefore supported with Model Maps and Object-based Dimension Groups (see 6.7 below).

As described in 5.3 above, the IFC Model defines Spatial Elements and Physical Elements in terms of their individual properties and their relationship with each other. IFC Viewers browse the model by space then by objects within the space. In the IFC Viewer example below, the Spatial Elements IfcBuilding and IfcBuildingStorey (01 – Entry Level, 02 – Floor, etc) form the main branches of the model tree, with each storey (space) containing its associated building elements. The CostX® Model view is different and groups the model data by object types (with spaces included as a type) as this avoids repetition and is better suited to measurement purposes. Spatial data is of course retained in the object properties so the model can be filtered by space by use of the right click custom filter options (see 6.2 below) and the spatial data can be referenced in Mapping Definitions (see 6.9 below).

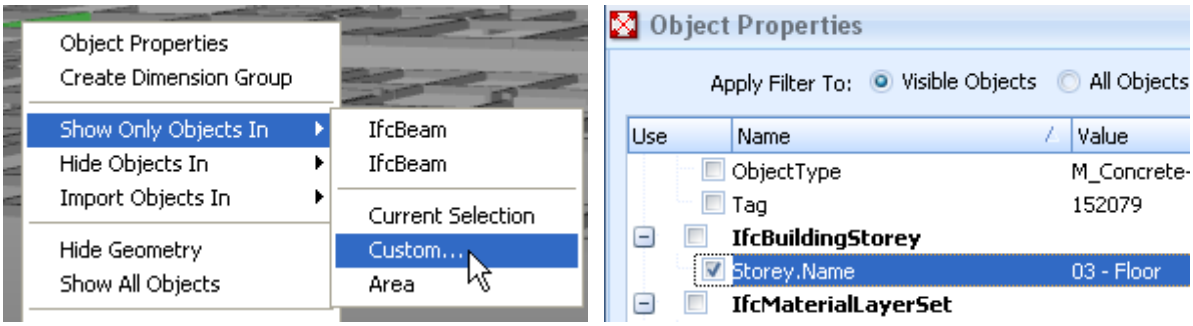
To assist in model navigation and provide greater flexibility in the creation of Model Maps, CostX® also generates an IFC "FriendlyTypeName" as an identifier for objects within each element.



IFC Viewer Model View



CostX® Model Views and FriendlyTypeName



Use Right click Custom filter to filter the CostX® view by IfcBuildingStorey

5.11 IFC – Issues to Consider

- IFC is an open standard data specification. The responsibility for populating the data model with the appropriate parametric properties and relationships lies with the authoring application that exports the IFC.
- As an open standard, IFC by definition cannot exactly replicate a closed proprietary system, since the proprietary data schema is not publicly available. Hence an IFC is not an exact copy of a proprietary data model, but is an alternate representation based on its own open geometry standard (STEP).
- Proprietary data models need to be mapped to their corresponding IFC categories which may involve translation routines, override settings, and creation of additional IFC-specific parameters.
- Objects that do not have corresponding place-holders in the IFC schema may need to be manually mapped to an alternate IFC element prior to export. If this is not done they will be exported as a general solid object Proxy (IfcBuildingElementProxy), which means that the geometry gets exported but not the properties.
- Different standards of IFC implementation by the various authoring applications can lead to data loss in the IFC exchange.
- Export of quantities is not part of the IFC 2X3 Coordination View definition. Consequently, a standard IFC export from most IFC-compliant applications in the AEC industry will not include quantity data unless the Base Quantity add-on is used. A MVD for IFC4 has not yet been written but when published is expected to include Base Quantities by default.
- Base Quantity definitions have currently only been written for selected building elements and spaces, and the quantities included in a Coordination View IFC with Quantity Take-Off add-on will be limited to those elements.
- Although IFC is a robust and powerful file format, IFC exchanges often suffer from poor implementation and a lack of education. buildingSMART® and others are working to improve that situation and as the AEC industry generally moves to greater acceptance of IFC it will begin to realize its unfulfilled potential.

5.12 IFC Files - What to Ask For

Even if you first receive paper drawings or PDFs, check if the designers have used Revit® 3D BIM software to model the building. If so, a DWF/DWFx™ export is preferred to an IFC for measurement purposes because it is more tightly integrated with the Revit® model. Refer to Section 4.5 above for details.

If the designers have used an alternate BIM software such as ArchiCAD® or Microstation® request an IFC 2X3 Extended Coordination View export with Base Quantities, or IFC4 when available. Prior to export they should ensure that objects are mapped to their correct IFC categories, which may involve use of translation routines, override settings, and creation of additional IFC-specific parameters.

In addition to the IFC, request a full 2D set of plans, sections, elevations and details in 2D DWG™ format as described in item 3.7 above. Use the 3D view to import any available BIM dimensions, then use the 2D sheets to check and augment the quantities.

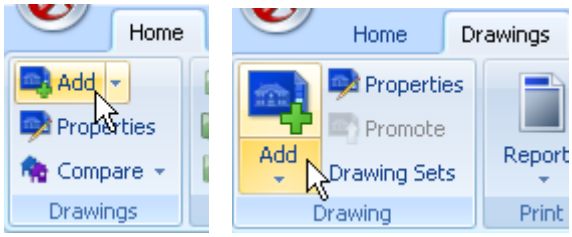
Request that all files are optimised as recommended in the Exactal document “Digital Drawing Files for Measurement Purposes – Simple tips for a collaborative approach to improved drawing file intelligence”.

6 3D Measurement and BIM Quantities

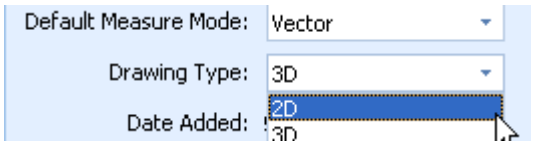
6.1 Importing 3D Drawings and 3D BIM Model Views

CostX® can be used to load, view and filter 3D drawings such as DWG™, SKP or DGN™ files, and 3D BIM model views in DWF™, DWFx™ or IFC format. You can measure areas, lengths and counts on screen, or automatically import dimensions from BIM models via default BIM templates, customized Model Maps, or special object-based Dimension Groups.

- The "Add" button in the Drawings section of the Home ribbon or the Drawing section of the Drawings ribbon is the default import setting for all image, 2D and 3D drawing files.
- It will also import a 3D view from a DWF™, DWFx™ or IFC BIM model file. The DWF™ or DWFx™ may be single view, or multi-view comprising multiple 3D and 2D views and sheets. The 3D view can be used to generate dimensions from the BIM data and the 2D views and sheets can be used to measure additional quantities in 2D mode.



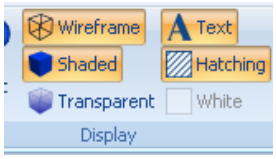
- Some 3D drawings can be switched between 2D and 3D in the Drawing Properties box.



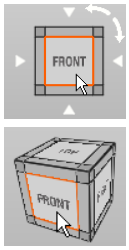
6.2 3D Drawing Navigation

The CostX® Dimension View features an easy to use 3D viewing navigation system, including a view cube for rotating and aligning the drawing and the ability to move through a building to see the 3D model from any position or angle. Individual drawing objects can be shown and hidden (e.g. hide the roof to access the interior of the building) and the whole building can be shown in shaded, transparent or wireframe mode.

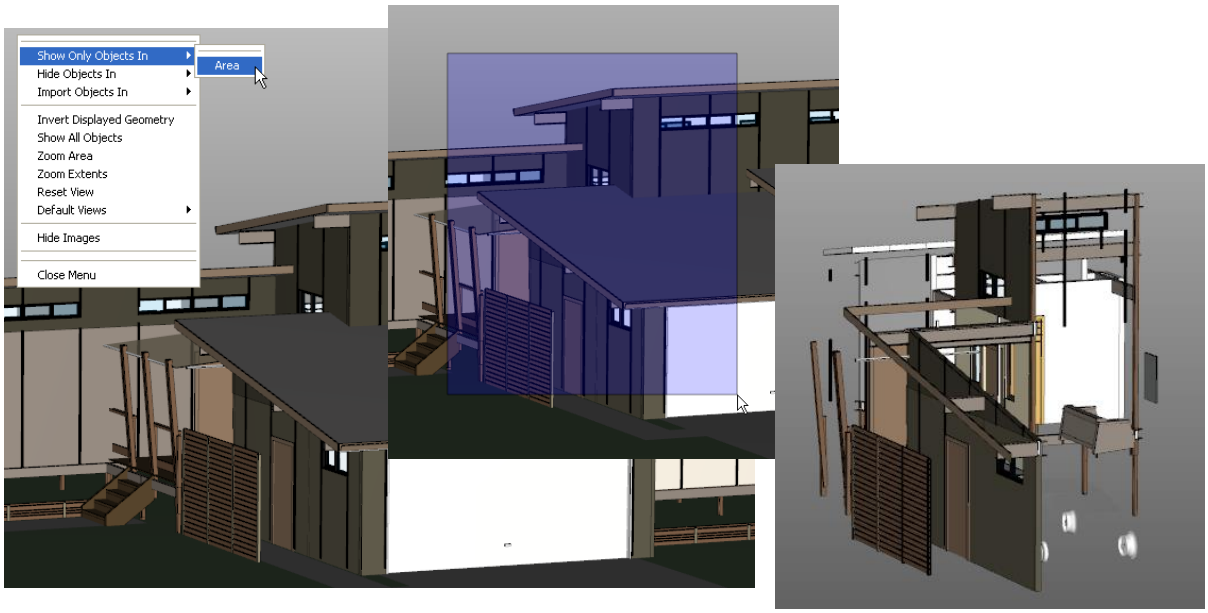
The navigation tools include:



- Display control buttons on the Drawing ribbon and in the View section of the Home ribbon. These icons can be selected simultaneously or separately and provide different views. Transparent mode is useful for identifying hidden measured objects. Wireframe views are not always available in some drawing files;
- Similarly to a 2D drawing you can zoom in and out via the mouse wheel. You can also click and hold the wheel to pan around the drawing. It is also possible to rotate the drawing by holding the left click on the mouse and moving the mouse;
- Click on the view cube arrows or facets to rotate or reset the building views;
- Hold the "E" key (the "eye" function) and move the mouse forward or backward (ie. cursor up and down on the screen) to move through the building;
- The Layers tab provides layer functionality, similar to 2D drawings.



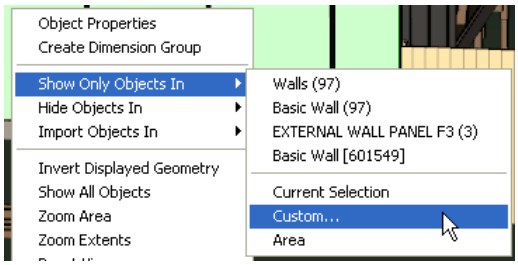
- A right mouse click menu provides more tools. Right click in a blank area of the drawing view, and by clicking on the Area field, portions of the model can be isolated by dragging a rectangle over a selected area to isolate the area for display and BIM import.

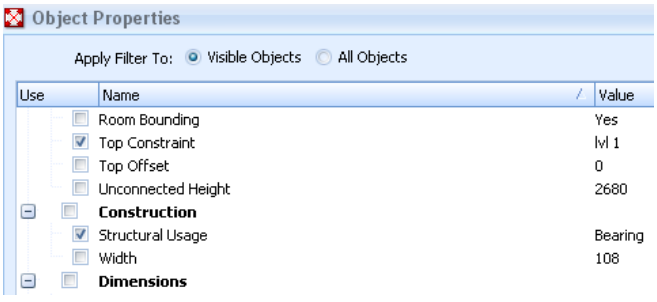


- For individual objects hover the cursor over a drawing object to select (highlight) it – then right click to open menu options.

- Object Properties displays the parametric properties of the selected object. Create Dimension Group relates to measurement (refer 6.10 below).

The filter section of the menu allows specific objects or groups of objects to be filtered to Show, Hide or Import. The filtering may be by default family grouping, or by custom parameters. Simply click on the required field to display the entire family (eg. Walls) or filter by the family type, name or object. The Area selection tool is also available.





The Custom parameters are selected by clicking the Custom field, and then checking the relevant boxes in the Object Properties box which opens. In this example, only the Bearing walls at lvl 1 will be displayed.

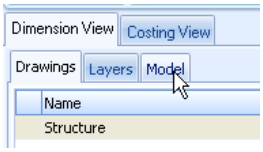
- Show All Objects recovers all hidden objects. Reset View is useful to recover a view, eg. after using the eye function.

- Ghost View shows hidden objects in a faint outline, which helps to identify the placement of displayed objects within the building.

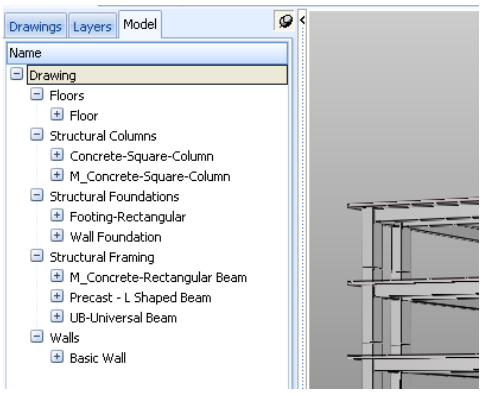
6.3 BIM Model Navigation - Model Trees

The Model Tree is accessed via the Model Tab which provides an at-a-glance view of the entire hierarchical structure of the objects within a 3D BIM model, and the data within it. The tree format of the tab allows any part of the model to be easily selected, progressively filtered, and displayed. This can be used to audit a model to determine what data is available for measurement purposes.

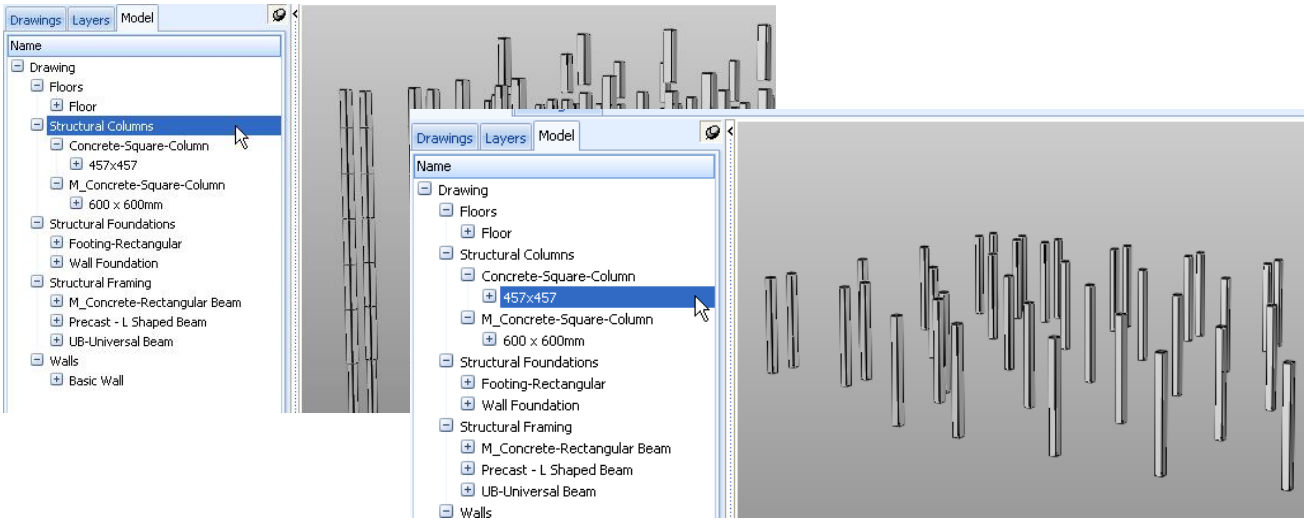
To use this feature, first add a 3D BIM file (eg. DWFx™ or IFC), then click on the Model tab.



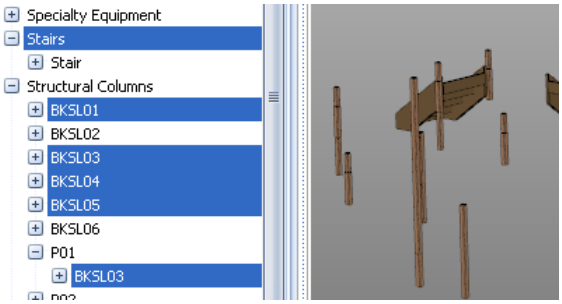
The hierarchical structure of the drawing objects will be displayed in a tree format. Each section may be expanded to reveal the object hierarchy.



Click on any item to filter the display. As you drill down through the tree hierarchy, the filtering becomes successively more precise.

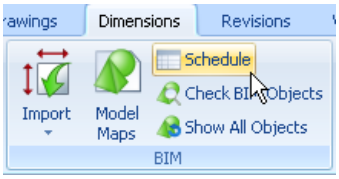


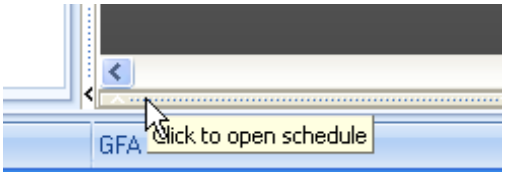
Multiple branches of the Tree may be selected simultaneously. Simply hold the Ctrl key and click on the desired branches, or select one branch then hold the Shift key and click on another branch to multiple select all intervening branches.

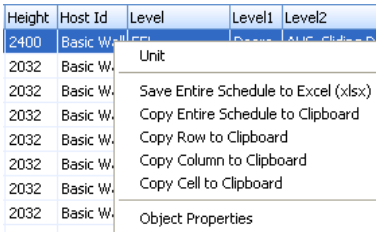


6.4 Model Schedules

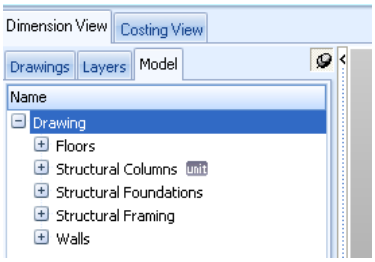
A Schedule Pane in the lower half of the viewing screen lists all the parametric properties of the model objects selected in the Drawings and Model Tabs. This is the same data shown when the right click “Object Properties” menu option is used. To open the Schedule pane, click on the Schedule button in the BIM section of the Dimensions ribbon, or click on the Expand bar at the bottom of the screen. You can also drag the Expand bar to increase the size of the pane. The Schedule provides a valuable insight into the amount of data built into the model, how it has been structured, and what is available for measurement or specification purposes. A right click menu also has options to save or copy data to your clipboard for pasting into other programs. Hence it is possible to filter the drawing view to, say, doors or windows, save or paste to Excel®, and publish the Schedule. There is also an option to display the Object Properties of the object on a selected row. To close the Schedule, simply click on the bar.





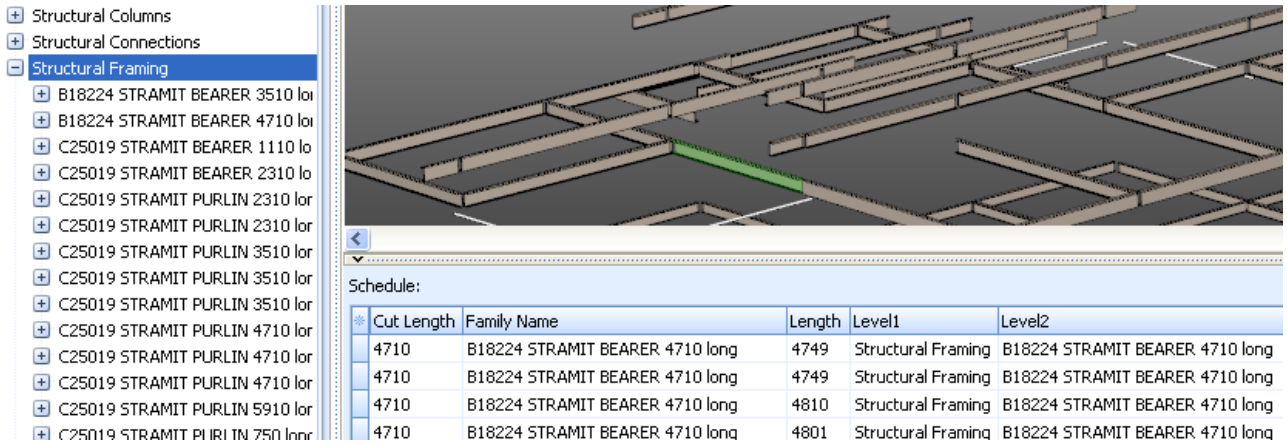


To see what data is available in a model, open the Model tab and select the highest level of the Model tree (Drawing) to display all objects.



Then open the Schedule pane. The parametric properties of all objects in the model will be scheduled. It will be immediately apparent that different objects have data assigned in different fields. For larger models the Schedule can take some time to generate so it can be preferable to filter the view as described next prior to opening the Schedule.

With the Schedule pane open, click on branches of the Model Tree to select elements or objects to display. The Schedule data will update each time to display the properties of the selected objects. Opening the elements and selecting their sub-branches will filter the Schedule data still further, all the way down to individual objects. By this means the user can determine what data is available to customise the measurement of particular objects.

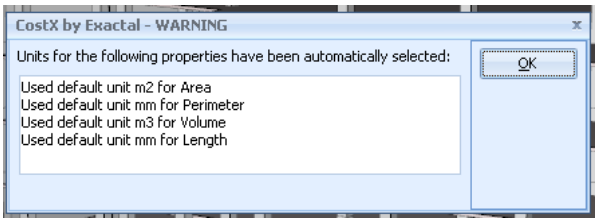


Whilst in the Model Tab, moving the cursor over a displayed object will highlight the corresponding line in the Schedule; and clicking a line in the Schedule, will highlight the corresponding object. This assists with Model and Schedule navigation. When in the Drawings Tab, the Schedule right click menu also includes options to Isolate an object or Show All objects.

6.5 Setting/verifying Units of Measure (UOM) for 3D Drawings

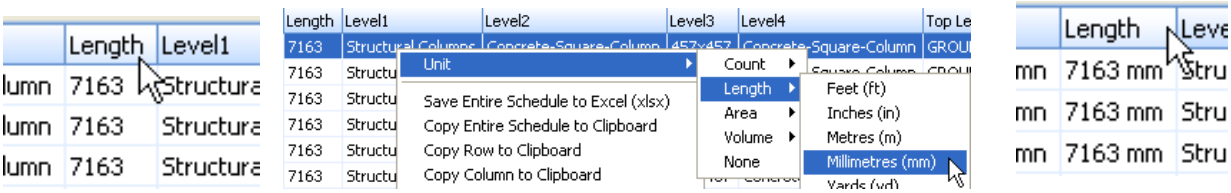
When a drawing is loaded, the Base UOM and UOM for Object Dimensions settings are retained from the last previous import, and should be verified to ensure they are applicable to the new drawing (refer Section 3.9 above). This is important when working with 3D models because UOM in BIM models are commonly not defined. There is no way to automate this verification, which needs to be done by the user.

When the Import Dimensions Using BIM Template function is used, CostX® will automatically select standard UOM settings and a warning notice will advise of the units selected.

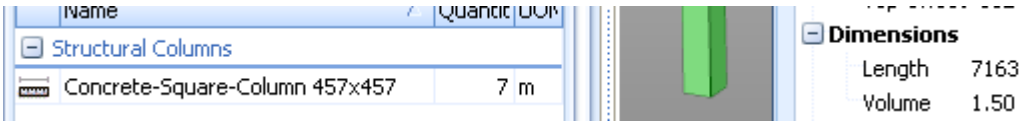


The resultant quantities should always be reviewed, and it will be immediately apparent if the UOM needs to be changed.

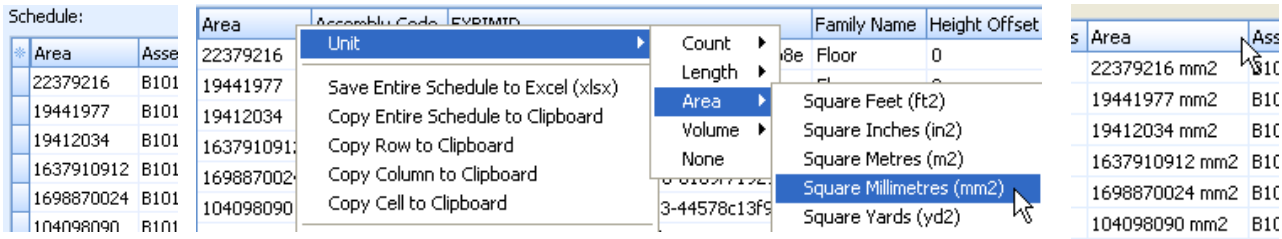
The Schedule Pane is used for reviewing and assigning Units of Measure to all dimension fields. This is done by moving the cursor to the column heading and using the right click menu options to assign the units, and must be done whilst in the Model Tab, not in the Drawings Tab.

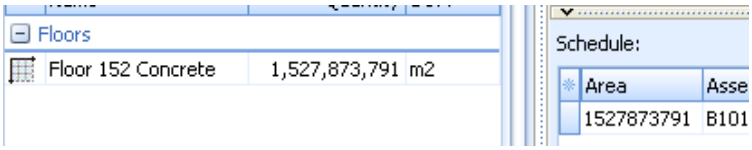


In this example, no UOM was defined in the model for length data so the right click menu was used to assign mm. However mm had in fact already been automatically selected by CostX® so the quantity was correct because mm is the default standard for most metric drawings.

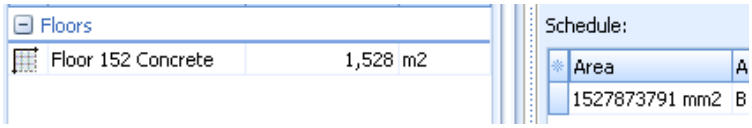


However, in the same model, Area data was scheduled in mm2 rather than m2 so it was necessary to assign the correct UOM to the Area field, as below, to obtain the correct quantity.





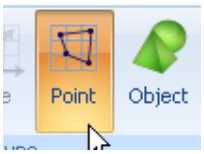
Quantity before correction



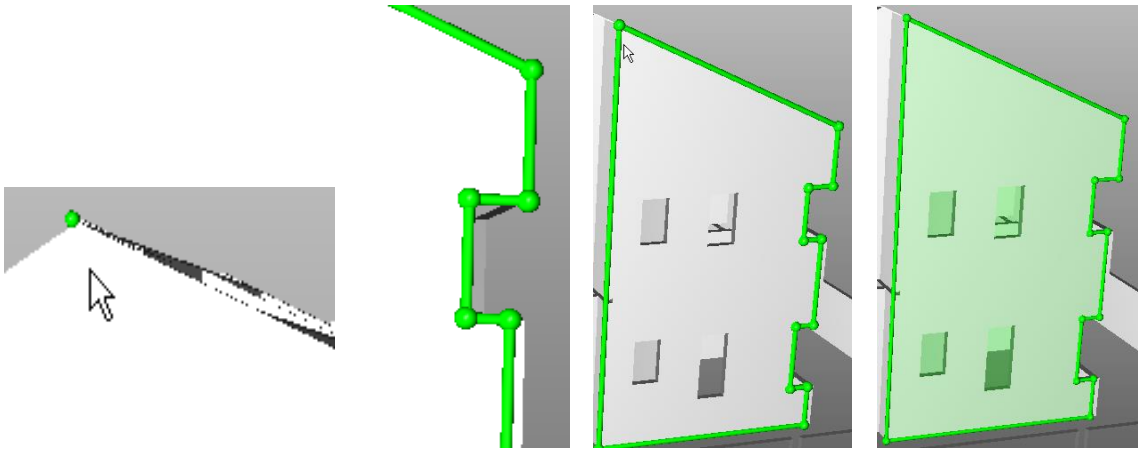
Quantity after correction

6.6 3D Measurement (3D Point Mode)

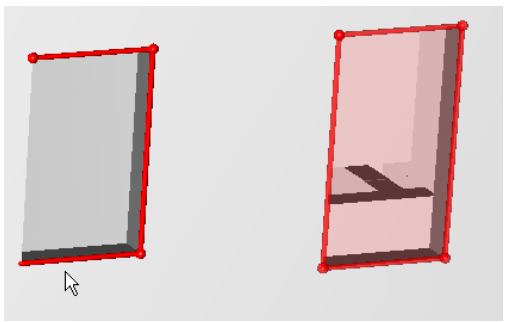
The 3D measurement tool allows areas, lengths and counts to be easily taken off 3D drawings. 3D measurement is slightly different to 2D because reference points have to be established to determine the location of the dimension in 3D space. This is done by selecting node points (angles or intersections) at the edges of object surfaces to define the extents of the measured dimension.

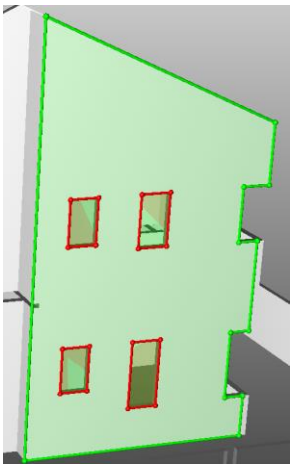


- Create or select a Dimension Group to measure into.
- Click on the Point button in the Type section of the Dimensions ribbon. 3D Measurement cannot be undertaken if Object Mode is enabled (see 6.7 below).
- To measure areas, hover the cursor over the plane of the object to be measured. A small green selection point will appear at node points (angles or intersections) of object surfaces. CostX® can measure between all such points occurring in the same plane of the 3D object. Click to start the measurement at the required selection point, then move to the next point, click, and move on. In the final segment move the cursor towards the original starting point and then press Enter to complete the area.

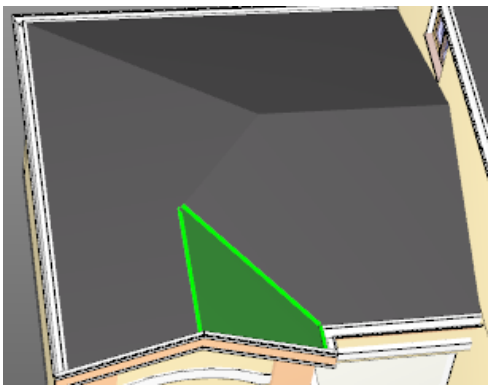


- Negative measurements can be taken in the same way by clicking the negative button on the Dimensions tab. Then click the Both button to display the complete measurement.

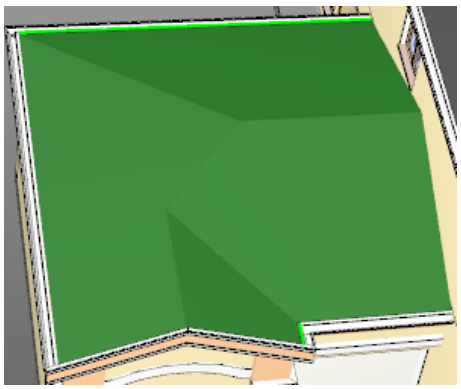




- The 3D Quickpoint feature allows the face area of walls, floors, roofs, etc. or any face in a single plane 3D drawing to be captured in a single click. Select the area Dimension Group to measure into, then hold the Shift key, point the cursor to the area, and click. Ctrl plus Shift will join adjacent areas. To capture the area of multiple surfaces of a single object, hold the “L” key and click.

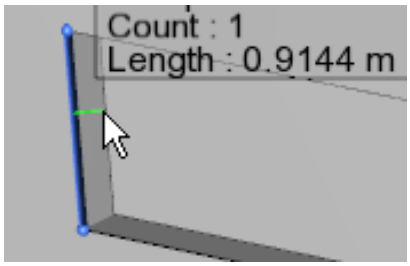


3D Quickpoint (Shift Key)

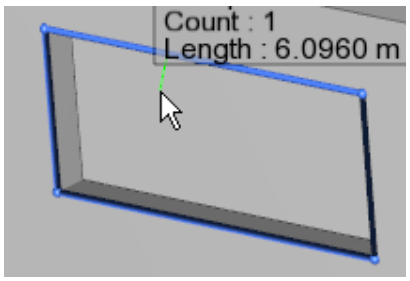


3D Surface Area ("L" Key)

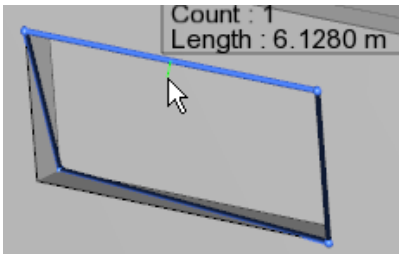
- Lengths are measured by clicking on a selection node to start the length, then moving the cursor to a selection node at the other end of the length to be measured. When a blue connecting line appears, left click the mouse to capture the length. Hold the Ctrl key to continue to another selection point and combine multiple segments into a single length. Be careful to select points in the correct plane of measurement.



Point to point length measurement

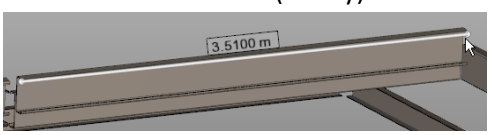


Combined length in same plane (front face of wall opening)



Combined length in mixed planes (front face to back face)

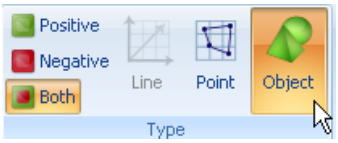
- 3D Quickpoint also works for lengths. When in a length Dimension Group, hold the Shift key to capture the length of a line or surface edge in a single click.
- To measure counts, hover the cursor over a selection node, and when a green point appears, left click the mouse to register the count.
- The Measure Distance (M key) tool is also available for 3D drawings.



6.7 Import BIM Dimensions (3D Object Mode)

CostX® has the ability to extract data from BIM model files or multi-sheet 3D and 2D DWF™ and DWFx™ files, with several extraction methods available. As described earlier, BIM models often contain dimensional data such as lengths, areas and volumes. The opportunity therefore exists to use this dimensional data for quantification purposes, instead of measuring the quantities.

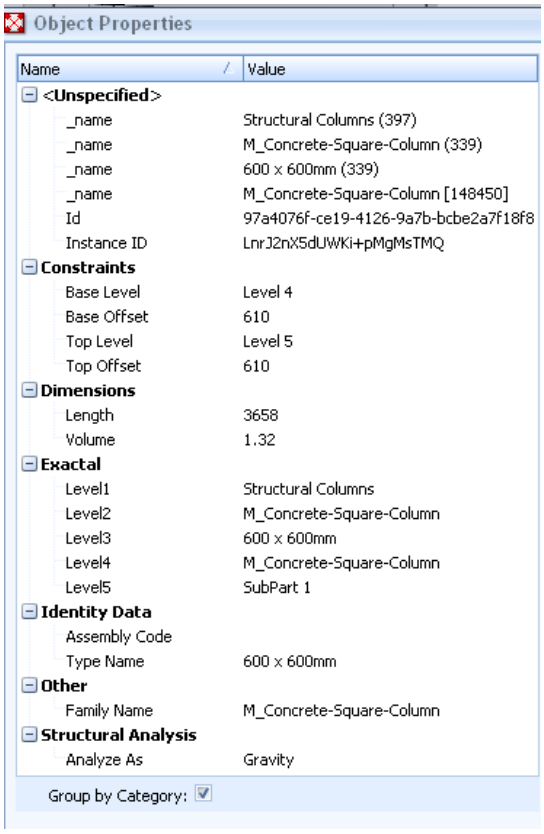
In order to access the object data required for the BIM import, CostX® Object mode needs to be enabled by clicking the Object button in the Type section of the Dimensions ribbon. CostX® will generally default to Object mode when a 3D file is loaded.

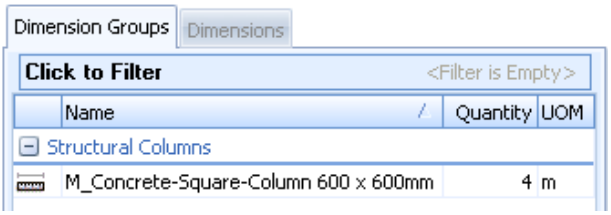


There are three options available for data extraction: 1) by use of CostX® BIM Templates; 2) by use of Model Maps; 3) by creation of special object-based Dimension Groups.

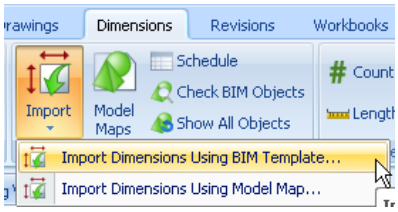
6.8 CostX® BIM Templates

CostX® ships with a selection of BIM Templates. These templates are XSLT files which have been written specifically to extract and sort data from 3D DWF™ and DWFx™ model files. The extracted data can be sorted by using various object parameters and the default template, called "Revit® General", categorises the data in accordance with the Revit® object hierarchy of Element Category, Family name and Family type (refer Section 3.4 above). By using the "Import Dimensions Using BIM Template" button and selecting the Revit® General template, CostX® will create a list of dimension groups using the Revit® Category to name the Dimension Group folder, and the Revit® Family Name + Family Type to name the dimension group, and import the relevant dimension property as a quantity. An example is shown here, to the right and below.

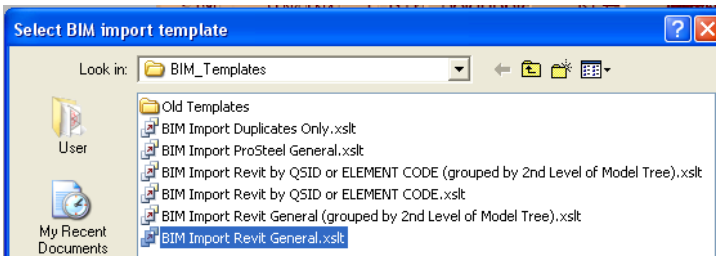


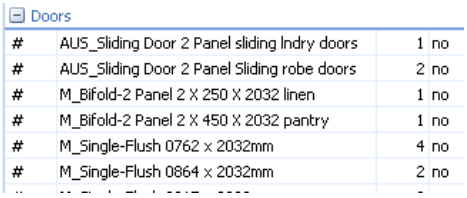


- Use the Add button to import a 3D DWF™ or DWFx™ view. For ease of measurement, the right click menu may be used to filter the view to show only the required category of objects.
- In the Dimensions ribbon click the Import button drop-down arrow and select "Import Dimensions Using BIM Template".

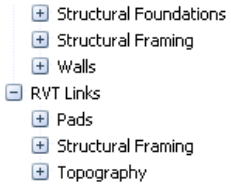


- A dialogue box will open listing the available BIM Templates which map the Revit® model parameters, generate the dimensions, and sort them into Dimension Group folders and Dimension Groups. "Revit® General" will name the folders by Category, and the groups by Family Name and Type. Select the required Template, click Open, and CostX® will automatically create the Dimension Groups populated with the dimensions of all objects displayed in the drawing view.

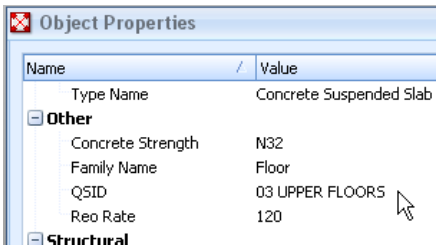


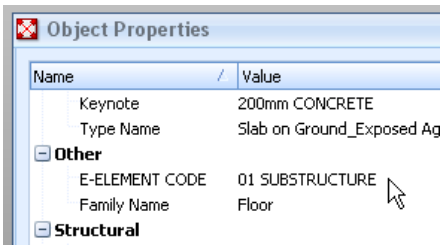


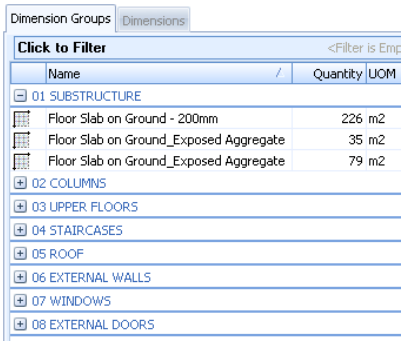
- In Revit®, it is possible to combine two or more models into a single consolidated model. When a model is combined, an additional heading "RVT Links" is inserted at the top level of the family naming hierarchy. In this situation, the BIM templates with the suffix "(grouped by 2nd level of Model tree)" should be used.



- In addition to default properties, designers are able to add additional data to objects called Shared Parameters. An example of a Shared Parameter may be an elemental coding which may be named QSID or Element Code. If the designer has done this, the template "by QSID or ELEMENT CODE" will sort the dimensions into QSID or Element folders instead of by Category. These and other additional parameters may also be added in CostX® as a User Defined Model Property (see 6.14 below).







- These BIM templates are written around model data being presented in standard Revit® family categories and will generally only produce satisfactory results when used with DWF™ and DWFx™ files exported from Revit®. For IFC files, Model Maps or object-based Dimension Groups should be used.

- The ProSteel template is optimized for DWF™ files exported from Bentley® ProSteel®. The Duplicates Only template only extracts objects with a duplicate ID (see Item 6.17 below). The User Defined Only template only extracts objects that have had user properties added (see 6.14 below).

6.9 The Model Definition Tool (Model Maps)

The Model Definition Tool allows users to configure a Model Map to extract data from a BIM model using any combination of object properties. This means that instead of generating quantities using the standard CostX® BIM templates, users have the option to define Model Maps to customise the quantities extraction.

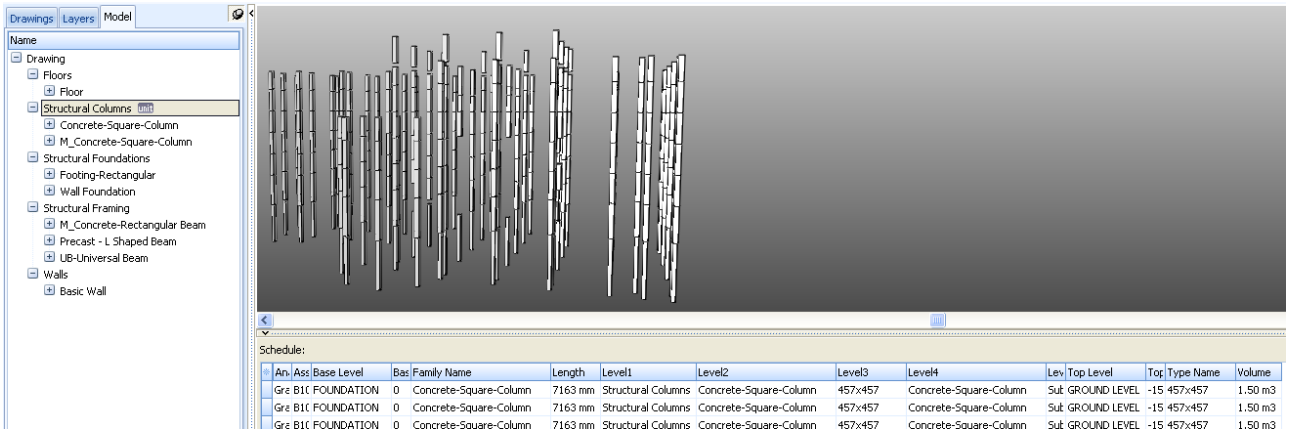
Model Maps

The CostX® BIM templates rely on the data in BIM models being configured in a consistent manner (eg. by Family Name and Type) which is why they are optimized for DWF/x™ files from Revit®. However, different authoring applications configure their data in different ways, and DWF/x™ or IFC files from different applications will present differently. Hence a standard template cannot be applied and the CostX® user will need to interrogate the data model to access the data relevant to them. The Model Maps allow users to determine what specific data will be extracted from the object properties within any model to generate quantities, so they are not reliant on the generic settings in the CostX® BIM templates. By filtering down through the Model tree, the data extraction can be at whole of drawing, category, sub-category, group or object level. At object level, the definition will be unique to the selected object, whereas at the higher levels the data extraction will relate to all sub-sets below the selected branch of the tree.

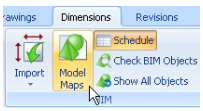
Hence the Model Maps feature can be used to tailor data extraction to a specific object or group of objects, or can be used at a higher level to replicate the BIM template approach and create unique mapping templates specific to the way a particular designer has configured their object libraries.

Basic Model Definitions

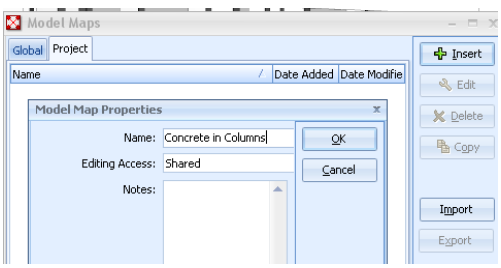
In the following example, the same Structural Columns shown in the BIM template example above have been selected for measurement. From the Schedule data, the column headings show that Length and Volume data is available, as well as Base level, Top level and size (Level3 heading).



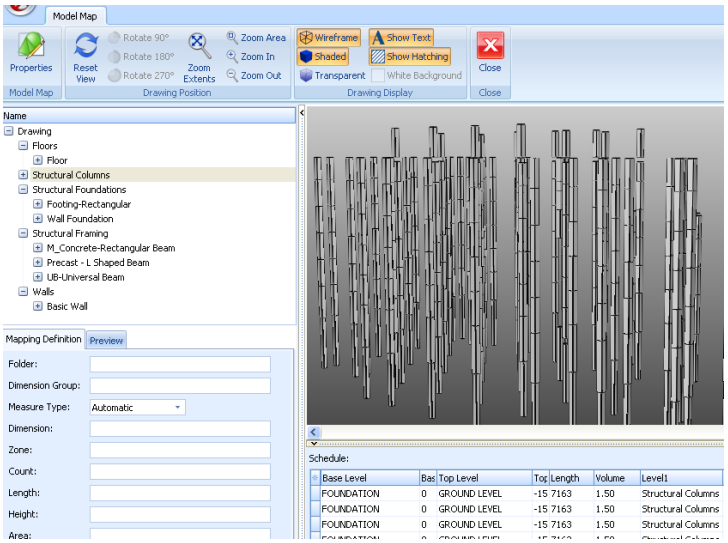
- Click the Model Maps button in the BIM section of the Dimensions ribbon.



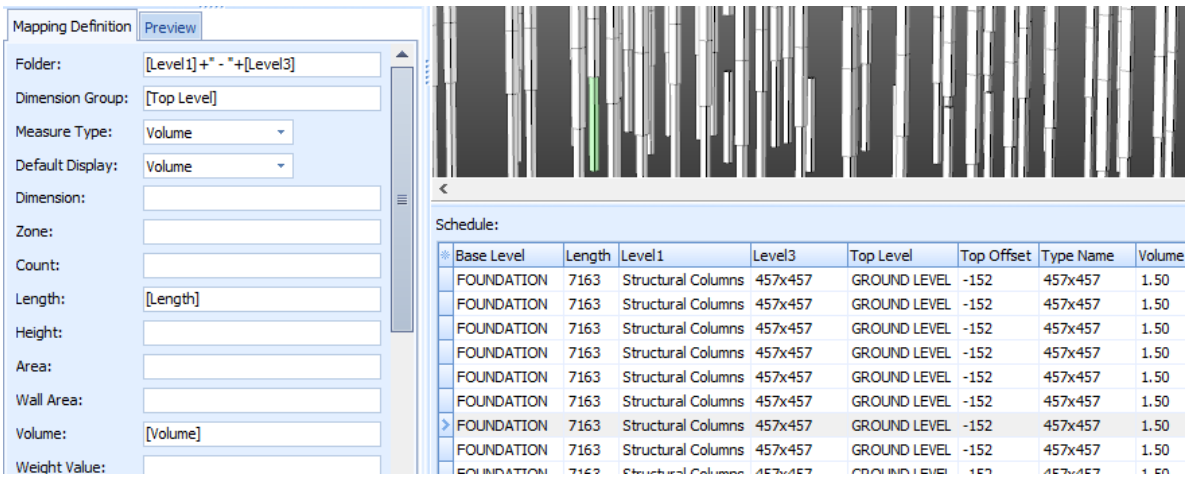
- A dialogue box then opens in which users can select from a list of existing Model Maps, or create (Insert) a new one. Model Maps can be assigned as Global or may be Project specific. Existing Model Maps may be edited, but will then be over-written. In the example here, a new Model Map with the name “Concrete in Columns” has been created.



- The Model Map ribbon and view opens, which displays the Model Tree, the filtered Model view, the Schedule, and the Mapping Definition tab.

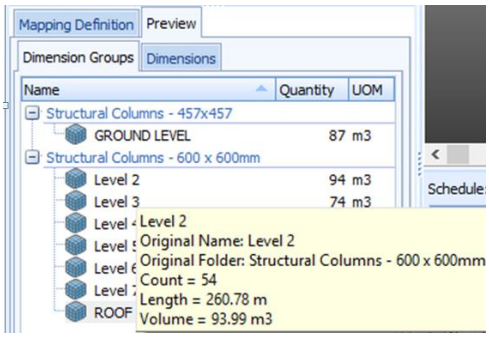


- To assign the Model Definition, the user filters to the Structural Columns branch of the model tree, and then drags and drops the required data field from the Schedule into the corresponding field in the tab. Use the "+" symbol to concatenate data. Free text in double quotes may also be entered, or a combination of both. In the example below, the Level1 and Level3 data will be combined to name the dimension group folder, the Top Level data will categorise the dimension group, and the Measurement Type will be volume, using the data from the Volume field in the Schedule.

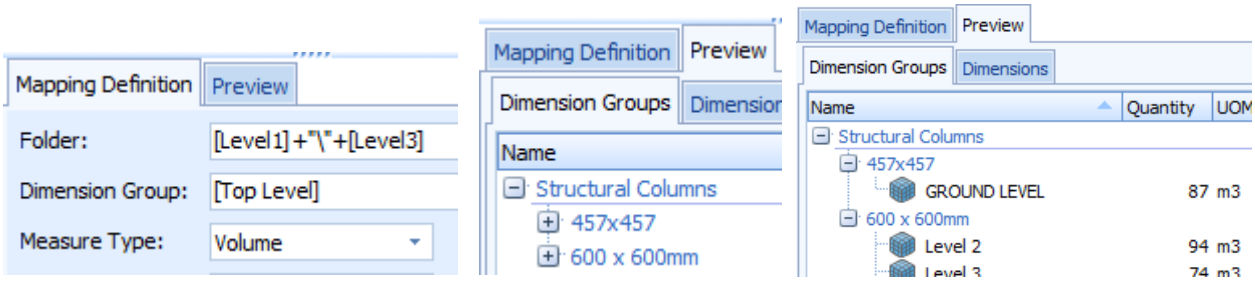


Note that the Length property has also been defined, to return both length and volume quantities. The Default Display setting determines which is displayed in the Dimension group.

- The Preview tab provides a preview of the resultant dimensions.

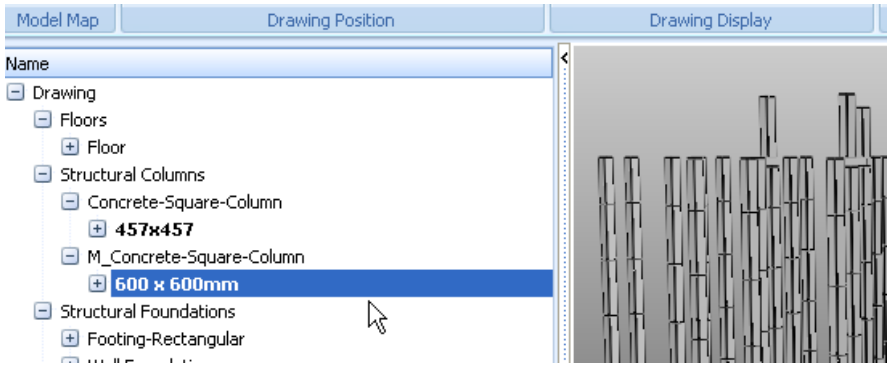


- Dimension group sub-folders can be created by inserting a \ character in the name path

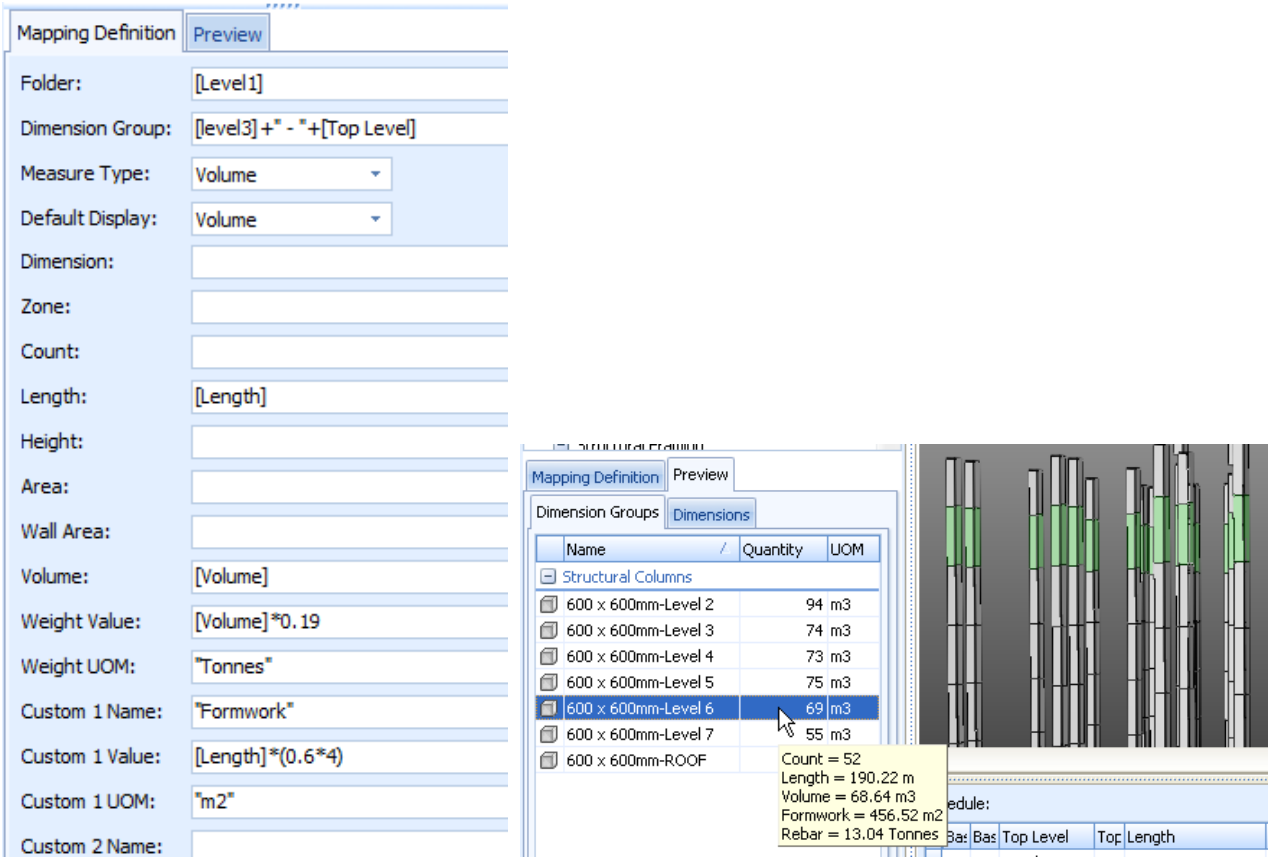


Custom Model Definitions

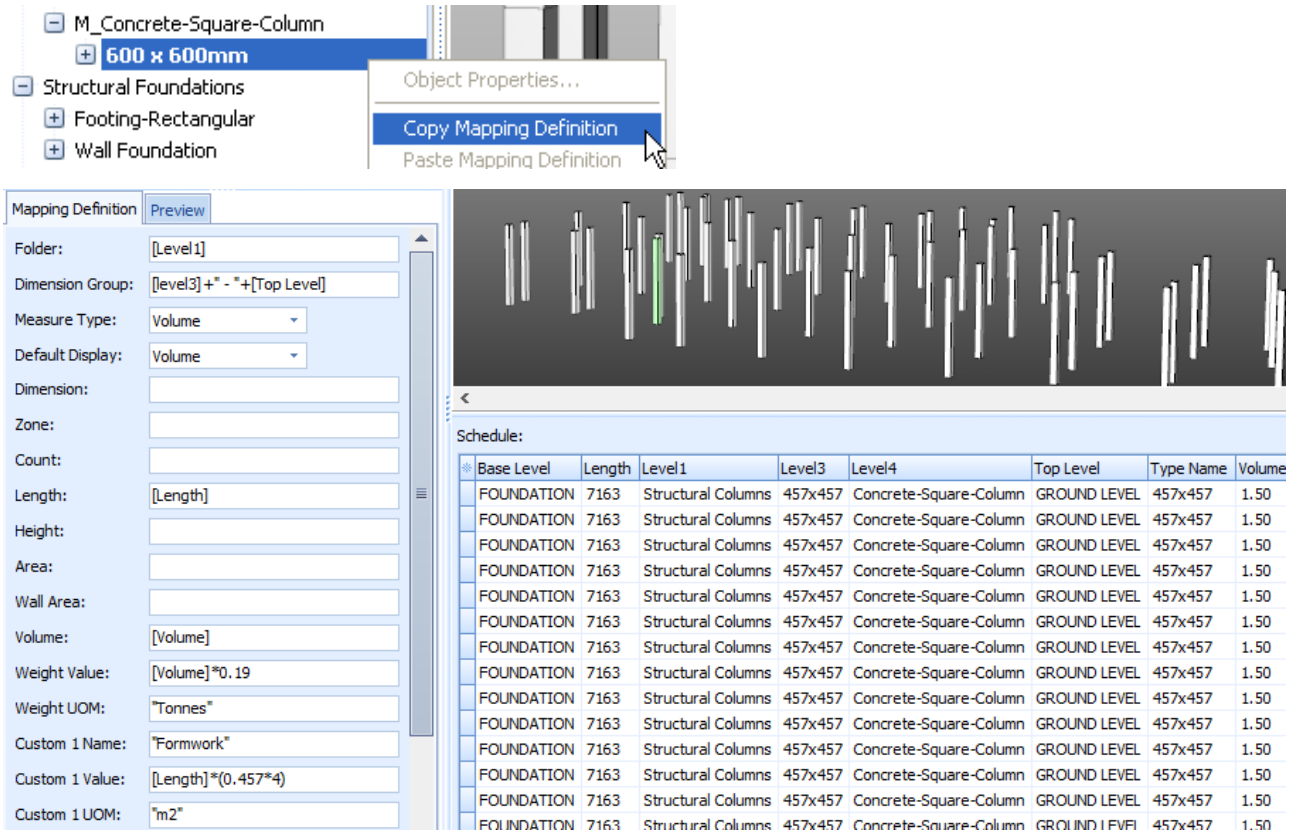
The Custom fields allow additional model data to be brought into Dimension groups. In the following example, the Model Tree has been filtered to display the 600 x 600mm Columns.



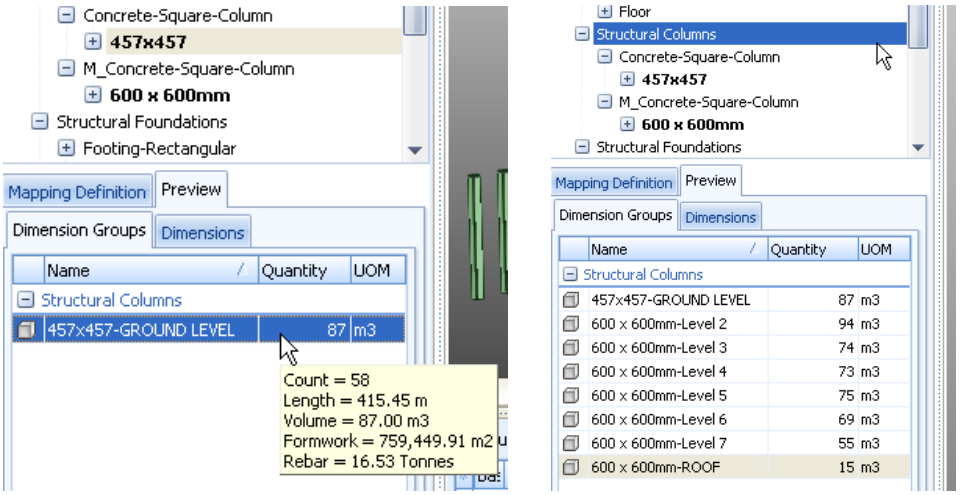
A new Model Map has been inserted, named Column Measure. The Model Map has been configured as follows, to measure the columns by Volume, separated by building Top Level, and also to show a Formwork area and rebar weight in Tonnes (using a factor of 190kg/m3).



Whilst still in the same Model Map view, the definition can be copied (right click menu), then the tree filtered to the 457 x 457mm columns, the definition pasted, and the Model Map fields edited to be configured in the same way as the 600 x 600 mm columns.



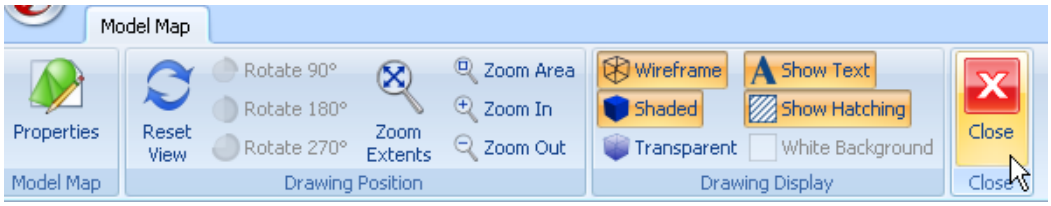
The Preview can then be filtered to the Structural Columns heading to view all columns in the group.



No actual measurement takes place whilst in the Model Map screen. After previewing, you can return to the Mapping Definition tab and continue to amend and preview various measurement configurations. Each change will overwrite the previous settings and be saved as it is entered.

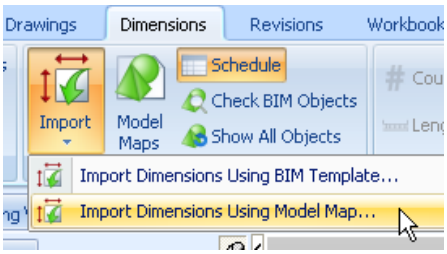
It is important to observe the correct syntax when creating model definitions. Model properties must be enclosed in square brackets eg. [Family Name]. Free text including spaces must be in double quotes eg. “Formwork”. Separate pieces of text may each be joined with a + sign, eg. [Level3] +“ - ”+ [Top Level]. Mathematical formulas can be enclosed in round brackets eg. [Length]*(0.5*4). Complex formulas including “IF” statements are also supported. “IF” statements support =, <, <=, >=, > and != (does not equal) for value comparisons. Example IF([Thick]<=150,[Area],0). Also refer to Section 6.12 below.

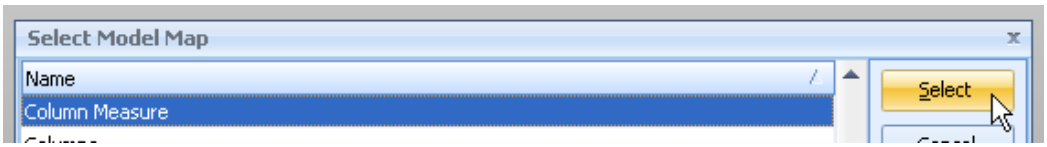
When you are satisfied with the Model Definition, exit Model Map mode by clicking the Close button on the Model Map ribbon.



Importing Dimensions Using the Model Map

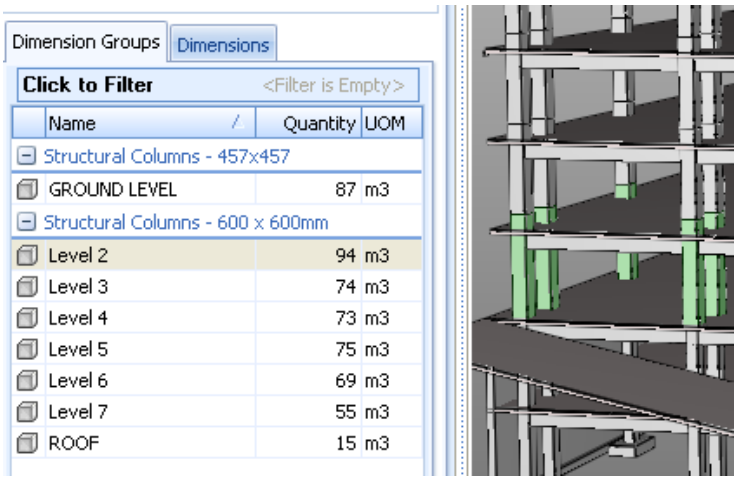
Whilst in the Dimension view, select the Import Dimensions Using Model Map option under the Import button in the Dimensions ribbon. A Select Model Map box will open. Select the required Model Map by clicking on its name to highlight it, then click the Select button.





The drawing view does not need to be filtered because the Model Map will only import the data applicable to the objects filtered in the Model Tree at the time the Model Map was created. However, those objects must be displayed in the view in order for the Model Map to work.

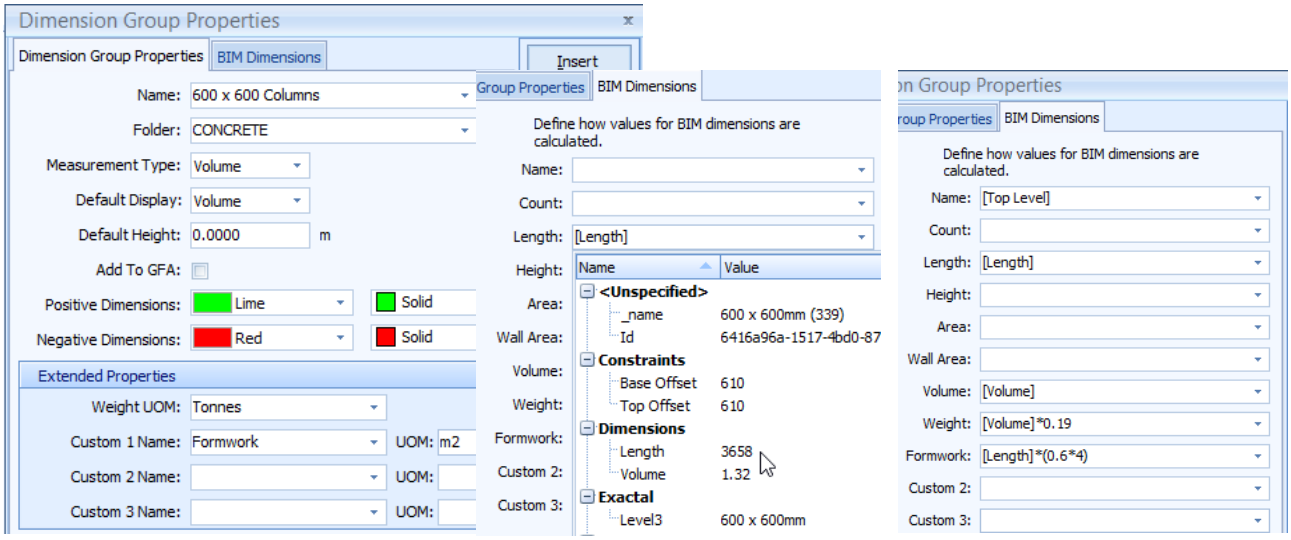
The Dimension Groups and Folders will be automatically created, populated with the dimension data as defined by the Model Map as shown in the preview.



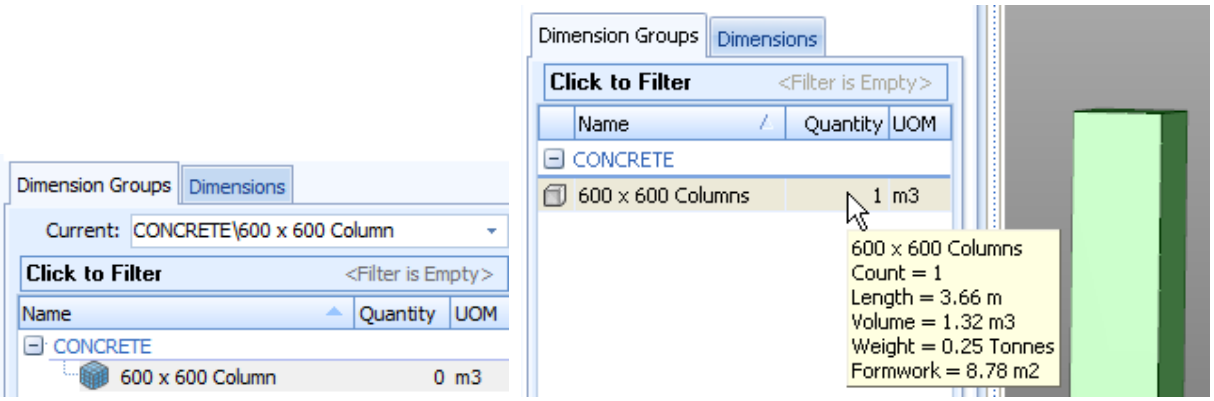
6.10 Create Object-based Dimension Groups

In Object Mode, special Dimension Groups can be created which draw their dimensional data from object properties rather than by measurement.

- Use the Add button to import a 3D DWF™, DWFx™ or IFC view. For ease of measurement, the right click menu may be used to filter the view to show only the required category of objects.
- Hover the cursor over an object to select (highlight) it, then right click and select Create Dimension Group. Enter the Dimension Group properties in the top section of the dialogue box, and, in a similar manner to mapping definitions, add any Custom Parameter names and UOM in the lower section. Then open the Object Properties tab and select the data source for the measurement parameters by using the drop down arrows and then clicking on the relevant data field. Then click Insert.

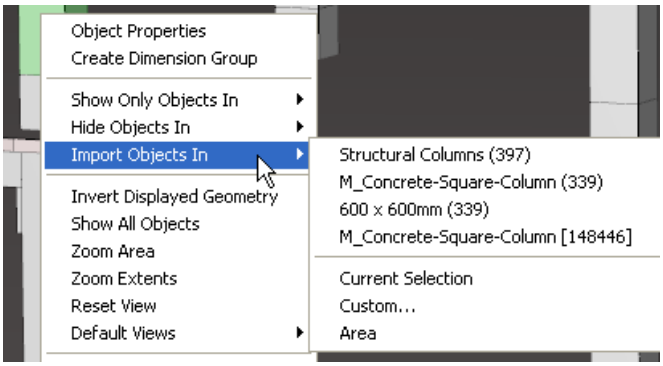


- A Dimension Group will be created which will be initially empty, but is ready to receive data from objects in the model according to the configuration entered in the Object Properties fields. With the Dimension Group selected, it is now possible to click on the objects to be measured in the drawing view and CostX® will retrieve the data from the object properties and use it to populate the Dimension Group. Note that it will do this for any object, so be careful to only click on the required objects. Also note that it may be necessary to open the schedule and assign units (see section 6.5 above) such as mm to the length property to ensure that quantities are correctly calculated.



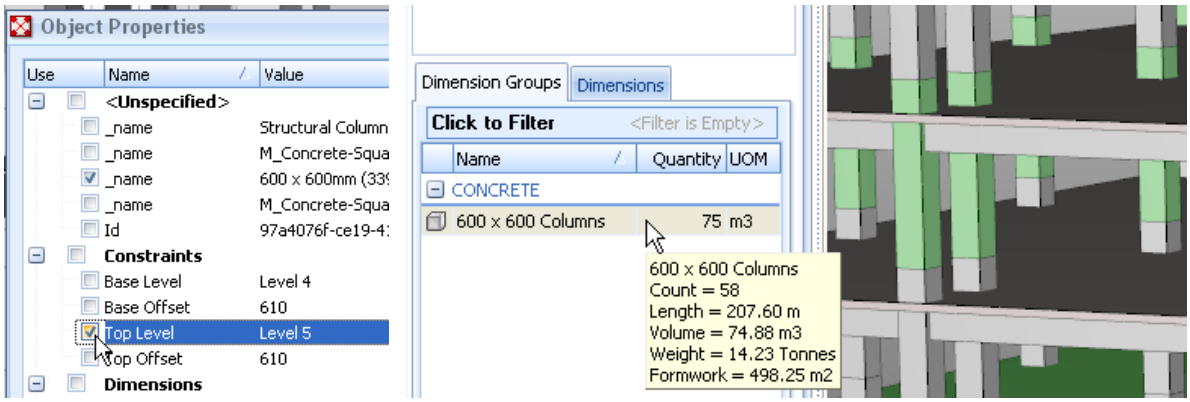
As an alternative to clicking on the objects to be measured, one of the right click filter menu options "Import Objects In" enables objects to be selected based on a set of filtering criteria.

- With the Dimension group selected, select (highlight) an individual object by hovering the cursor over it, then right click to open the menu and move the cursor over the "Import Objects In" option.



- Simply click on the required field (eg. Family Type 600 x 600mm to measure all 600 x 600mm columns).The Area selection tool is also available.

  The Custom parameters are selected by clicking the Custom field, and then checking the relevant boxes in the Object Properties box which opens. In this example, only the 600 x 600mm Columns at Level 5 will be measured.



6.11 XNumber Feature

Model definition formulas in Model Maps or Object-based Dimension Groups can reference dimensions or other numbers which form part of a text string, eg. a Family Name or Type description. For example, for a column with the Family Name "600 x 300mm" a dimension of 600 or 300 can be derived to multiply by the length of the column to calculate the face area.

In the mapping definition field, the formula XNUMBER(text, index) will return the index number found in the text. If no index is specified, the first number will be returned. If no number is found at the specified index, 0 will be returned. In the column example, the formula would be XNUMBER([Family Name]) to return a value of 600mm or XNUMBER([Family name],2) to return a value of 300mm.

The XNUMBER function is also available in Workbooks and CostXL®.

6.12 Formula Syntax

The formulas available for use in Model Map definitions and object-based Dimension Group properties are generally based on the functions and formulas used in Excel®.

Properties

To retrieve the value of a property from a BIM object, the property name must be enclosed in square brackets. For example:

[Width]	retrieve the value of the Width property of the measured BIM object.

To use only a specified number of characters from the property, use the LEFT or RIGHT function. The left function specifies the number of characters to use from the left side of the property, and the right function specifies the number of characters to use from the right side, as shown below. The first parameter is the property in square brackets and the second is the number of characters.

LEFT([Category],20)

RIGHT([Family Name],20)

If the same property name exists with multiple categories, an exclamation mark can be used to separate the category and name in the property specification:

[Profile!Construction]	retrieves the value of the *Profile* property in the *Construction* category
[Profile!Identity Data]	retrieves the value of the *Profile* property in the *Identity Data* category
[Start Date!Construction]	retrieves the value of the *Start Date* property in the *Construction* category

On rare occasions, the same property name can exist under multiple paths in the BIM data. Slashes can be used to specify the correct point in the BIM hierarchy for the desired property value:

[\\IfcWall\Plaster\NetVolume]	retrieves the *NetVolume* specified against *IfcWall\Plaster* on the BIM object
[\\IfcWall\Brickwork Clay\NetVolume]	retrieves the *NetVolume* specified against *IfcWall\Brickwork Clay* on the BIM object.

Literal text can be included in the expression by enclosing it in double quotes. If the text already has a double quote (”), place a second double quote in front of it.

For example: “Marble” would result in Marble.

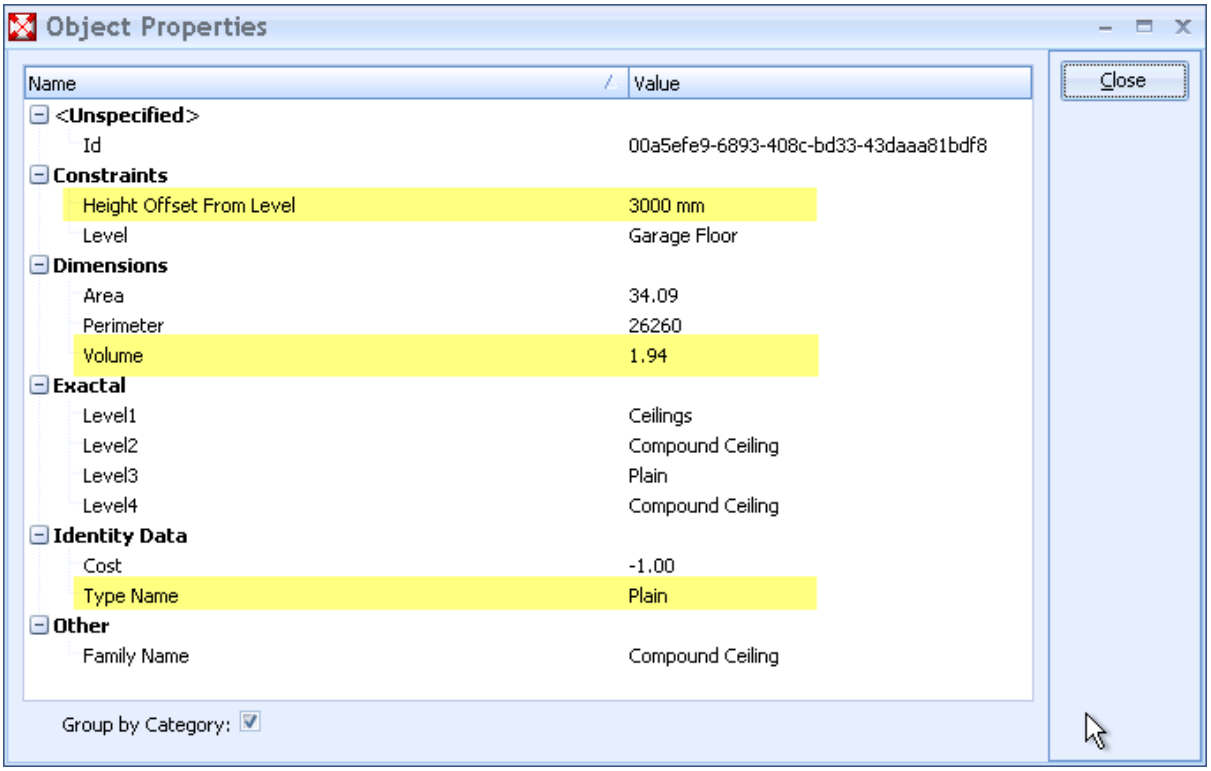
“Faux “”Travertine””” would result in Faux “Travertine”.

Supported Functions and Operators

Operators: /, *, +, -, (,), <, >, <=, >=, OR, AND, !=, TRUE, FALSE, “” for strings, [] for properties.

Functions: LEFT (), RIGHT (), IF (), XNUMBER()

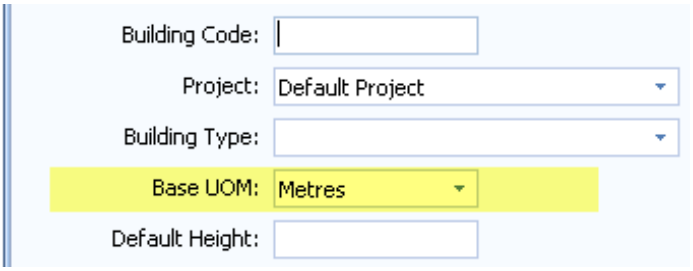
Worked Examples



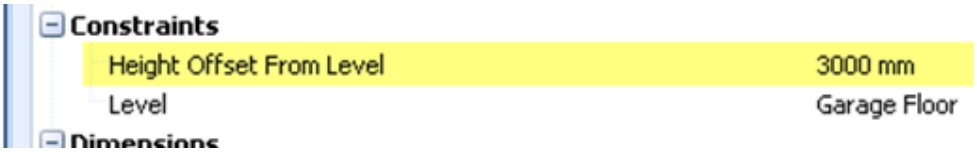
To retrieve the value of a property from a BIM object, the property name must be enclosed in square brackets. For example:

[Type Name] retrieve the value of the *Type Name* property – would give "Plain"

Extracted numerical quantities are always converted into the appropriate building units as they are extracted from the BIM objects. For example, suppose the example object is being used in a building that uses metres as its Base UOM:

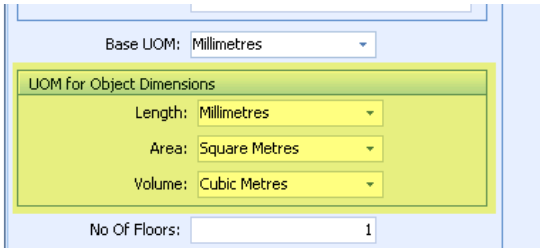


If we were to extract the Height Offset from Level property, it would be converted from the millimetre value stored in the object property, to a metre value, which matches the building unit.

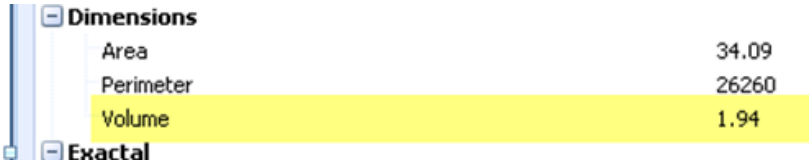


[Height Offset from Level] retrieve the value of the *Height Offset from Level* property – would give "3 m"

If no unit is specified in the BIM property value, the values specified in the drawing properties are used as the default units for the quantities. Suppose the drawing is configured as follows:

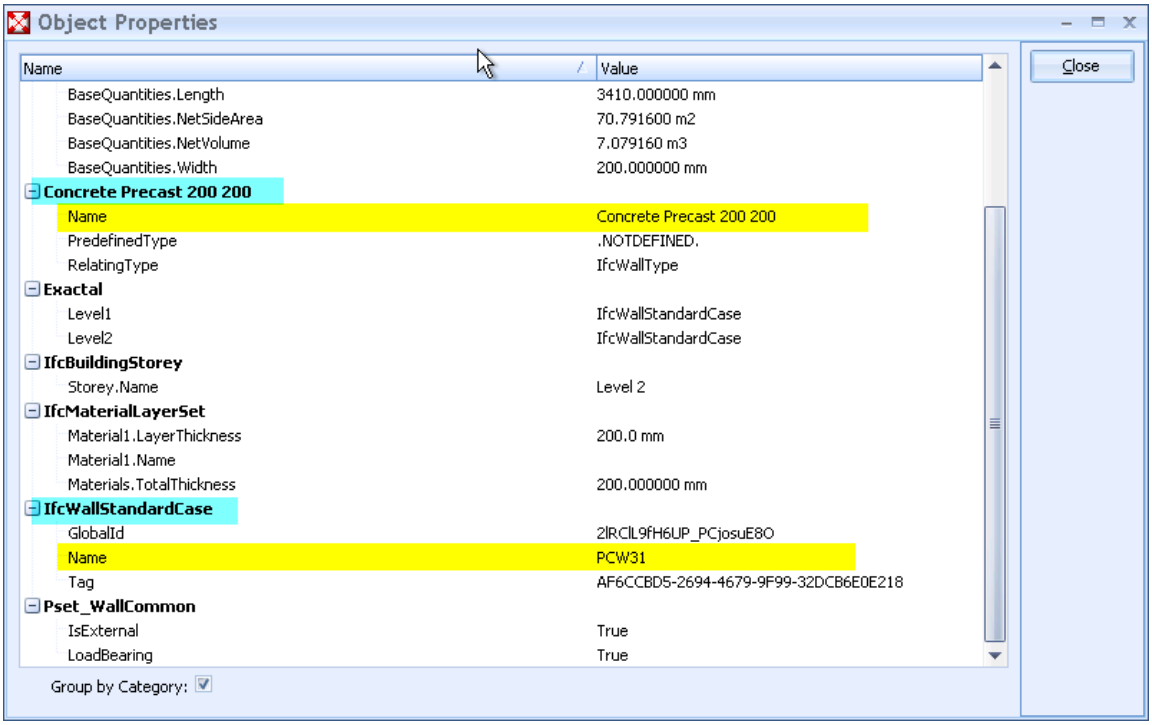


If we retrieve the value of the Volume property, which has no units included in the property value, it will assume that the value is in Cubic Metres as set in the drawing properties (also see 6.5 above):



[Volume]	retrieve the value of the *Volume* property of the measured BIM object – would give "1.94 m^3".

Properties Including Categories



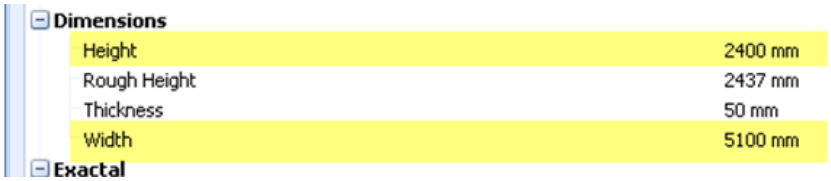
In the sample properties for the wall shown above, the Name property exists in both the "Concrete Precast 200 200" and "IfcWallStandardCase" categories. We can no longer just say [Name], as this doesn't make it clear which of the two Name properties we want to use. To differentiate between them, an exclamation mark can be used to separate the category and name in the property specification.

[IfcWallStandardCase!Name]	retrieves the value of the *Name* property in the *IfcWallStandardCase* category
[Concrete Precast 200 200!Name]	retrieves the value of the *Name* property in the *Concrete Precast 200 200* category

Combining Properties

In many cases, none of the properties contain the required values, but a calculation using one or more properties can be used to get the required value. CostX® supports the four basic arithmetic operators: +, -, *, and /, as well as brackets ().

Example 1



For example, suppose we want the area of the door with the properties as shown above. To calculate the area of the door, we need get the product of the height and the width. To do this, we need to use a formula that multiplies the properties together:

[Height]*[Width]

Each property will be evaluated, and then the resulting quantities multiplied together to give the final answer (assuming the building is being worked in metres):

[Height]*[Width] → 2.4m * 5.1m → 12.24m2

The formula to be used for the area is therefore [Height]*[Width], which gives a resulting quantity of 12.24m2.

Example 2

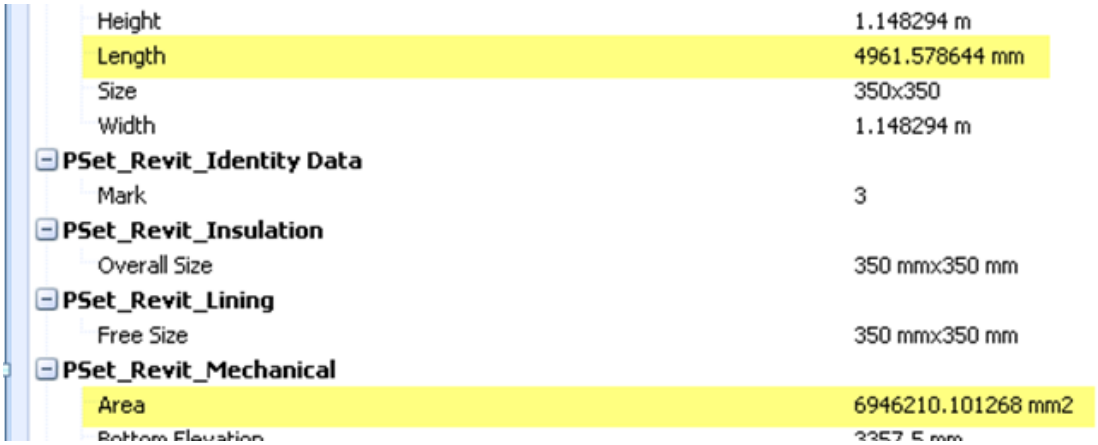
The properties for the duct above don't give a height for the duct. We can calculate this from the object properties by subtracting the Bottom Elevation from the Top Elevation. To do this, we need to use a formula:

[Top Elevation] - [Bottom Elevation]

Once again, each property will be evaluated, and the final value calculated. This will work as follows, again assuming the building is using metres:

[Top Elevation] – [Bottom Elevation] → 3.6575m - 3.4075m → 0.25m

Example 3



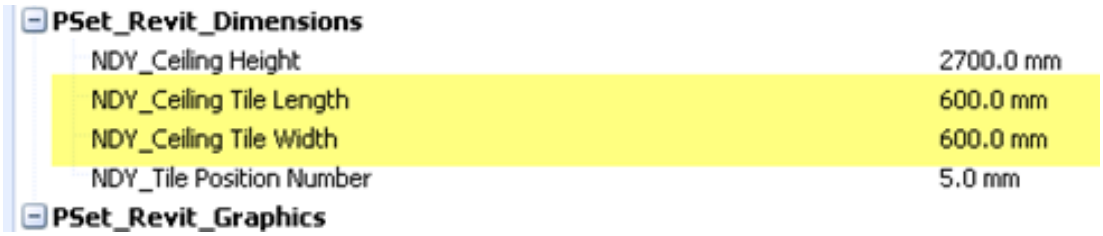
Consider another duct. In this case, we want to know the external height of the duct. The object properties do provide us with a height; however, this height is the interior height of the duct and the thickness of the duct is not provided by any of the available object properties. The only way for us to determine the exterior height is to divide the area by the length. This can be done using the following formula:

[Area] / [Length]

The steps CostX uses to determine the value of this formula, working in metres, are:

[Area] / [Length] → 6.946210101268 m2 / 4.961578644 m
→ 1.399999999933 m

Example 4



Suppose we want to calculate the perimeter of the ceiling tile in use with the fire sprinkler whose properties are shown above. To do this, we need to add twice the length to twice the width of the tile. The formula for calculating this is as follows:

2*[NDY_Ceiling Tile Length]+2*[NDY_Ceiling Tile Width]

→ 2*0.6m+2*0.6m → 2.4m

Or alternatively:

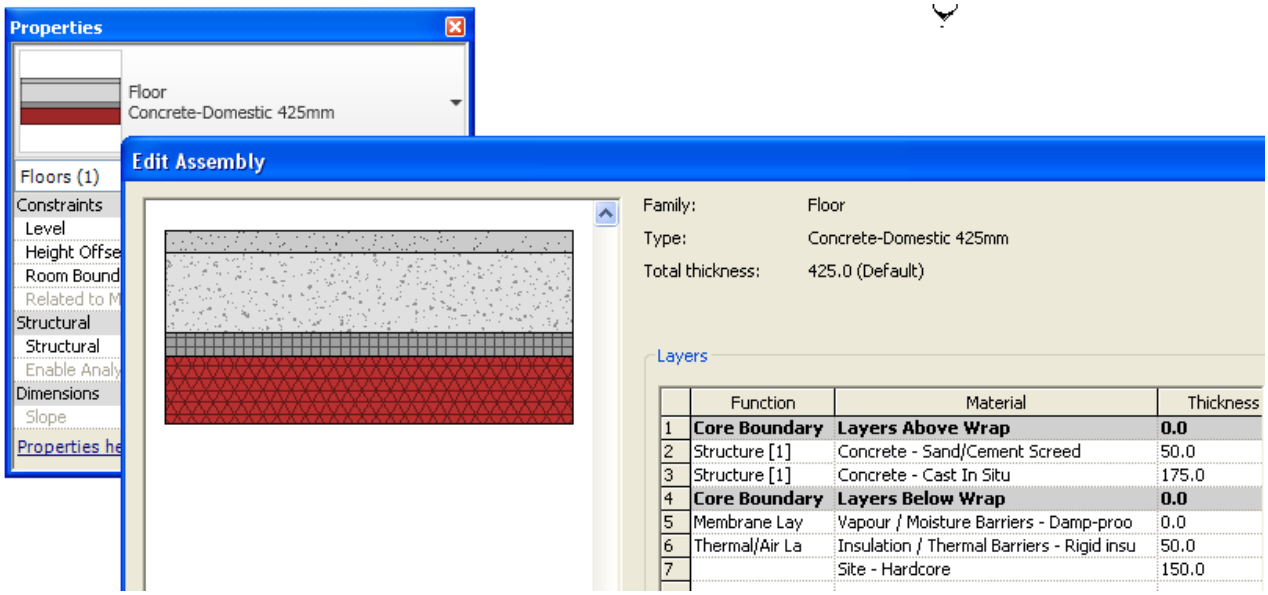
2*([NDY_Ceiling Tile Length]+[NDY_Ceiling Tile Width])

→ 2*(0.6m+0.6m) → 2.4m

Each gives a resulting quantity of 2.4m in a building that uses metres as the building unit.

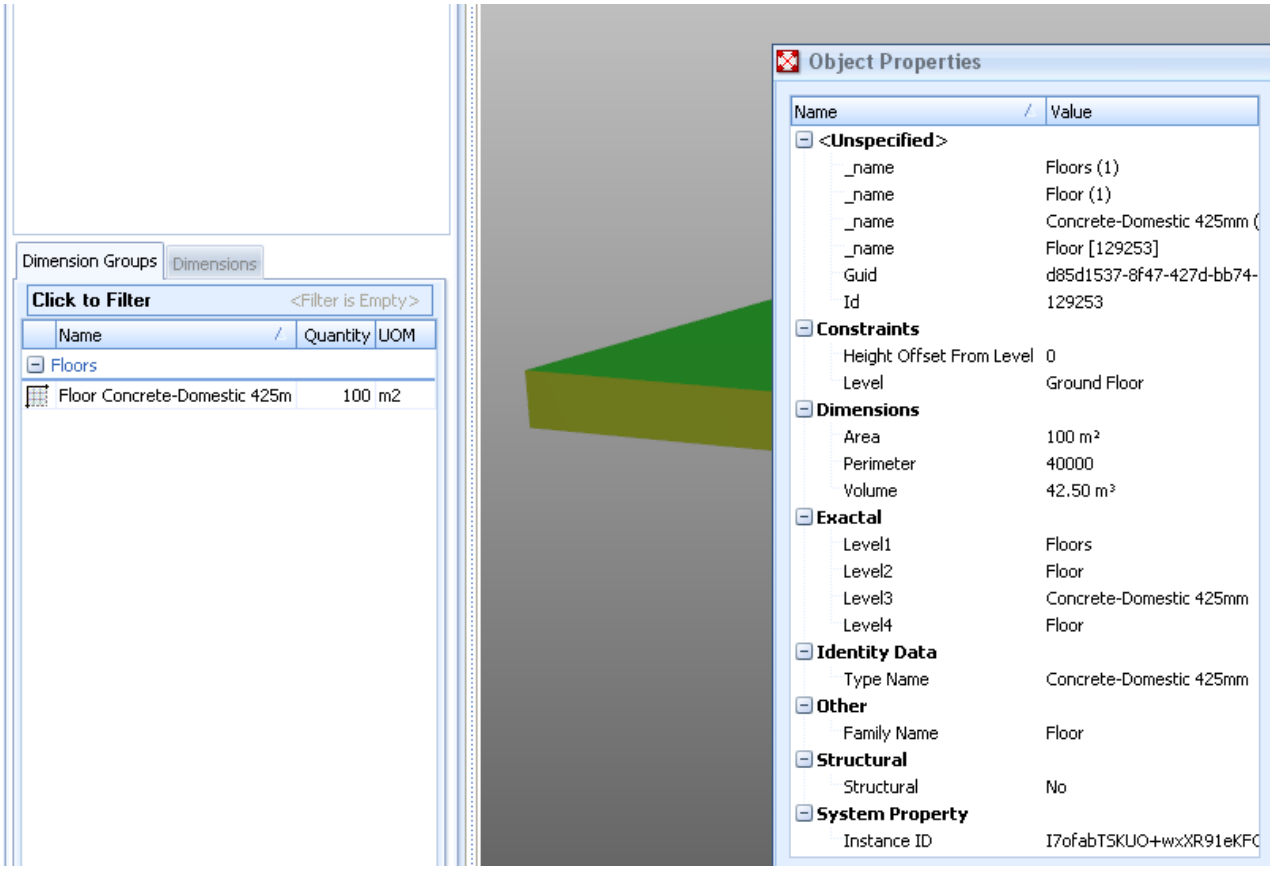
6.13 Assemblies

In Revit®, multiple elements can be combined into a single assembly that can be independently scheduled, tagged, and filtered. Most model elements can be included in assemblies, and layered elements such as walls, floors, flat roofs, etc are invariably modelled as assemblies.



Floor Assembly in Revit 2012®

When exported to a DWF/DWFx™ an assembly such as the floor shown above appears as a composite whole and its component parts, or layers, are not separately identified within the 3D DWFx™ view and are not represented on 2D views and sheets.



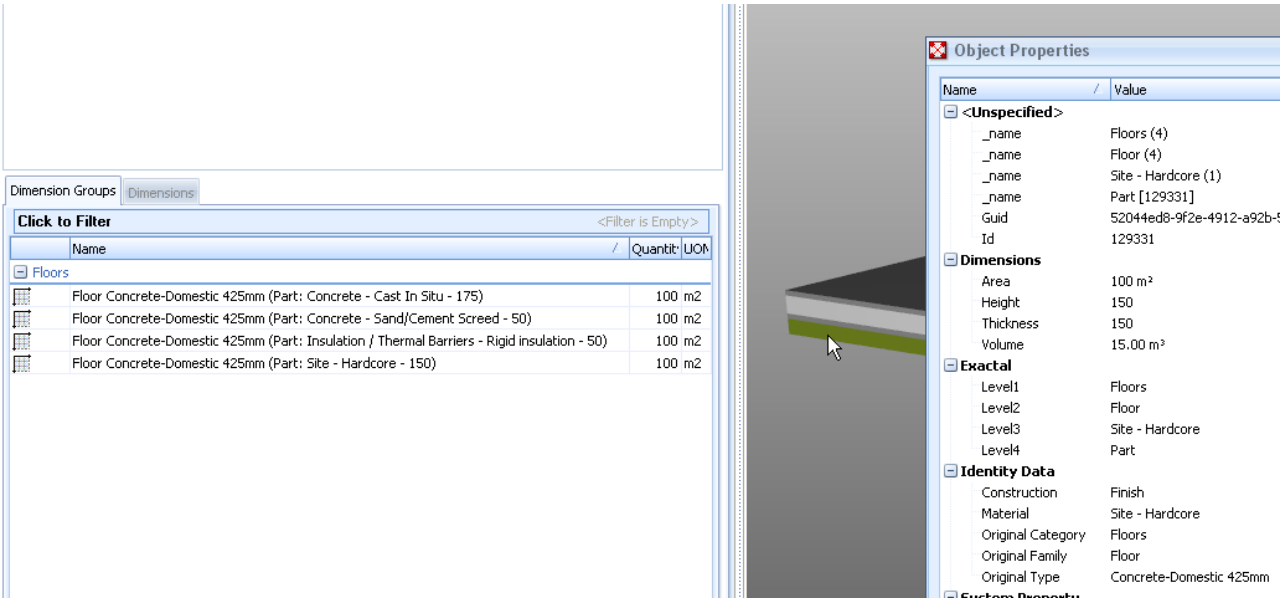
CostX® screen shot of composite slab assembly

It is important to obtain full details of the assembly components so that each can be individually itemised. To assist in this the designer could be requested to provide additional information in the form of details or schedules.

Alternatively they could use the Revit® "Parts" function which will break the layered assembly into its constituent layers. The layer data will then be available in the DWF/DFWx™ export. Typically this might apply to elements such as:

- Walls (excluding stacked walls and curtain walls)
- Floors (excluding shape-edited floors)
- Roofs (excluding those with ridge lines)
- Ceilings
- Structural slab foundations

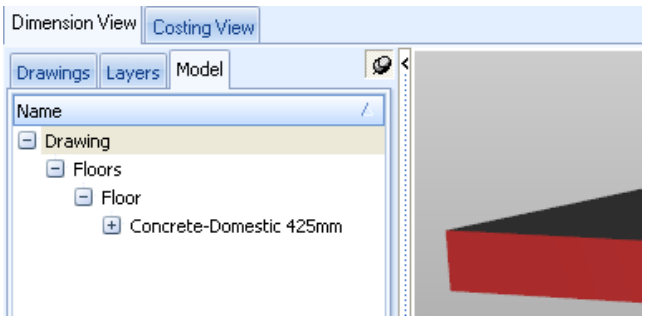
The disassembled slab will now import with the "Revit® General" BIM Template in separate constituent Parts, as follows.



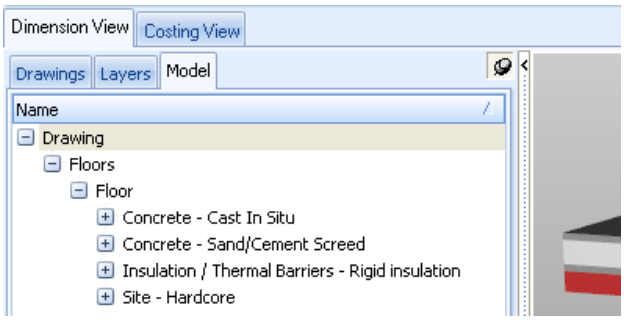
CostX® screen shot of disassembled slab Parts – dimensions imported with "Revit® General" BIM Template

Each layer of the assembly is an individual Part with its own discrete Object Properties. The Identity Data properties have been expanded to contain details of the individual layer and this data is available for the BIM Template to create the separate Dimension Groups.

The Parts properties can also be viewed as branches of the Model Tree.

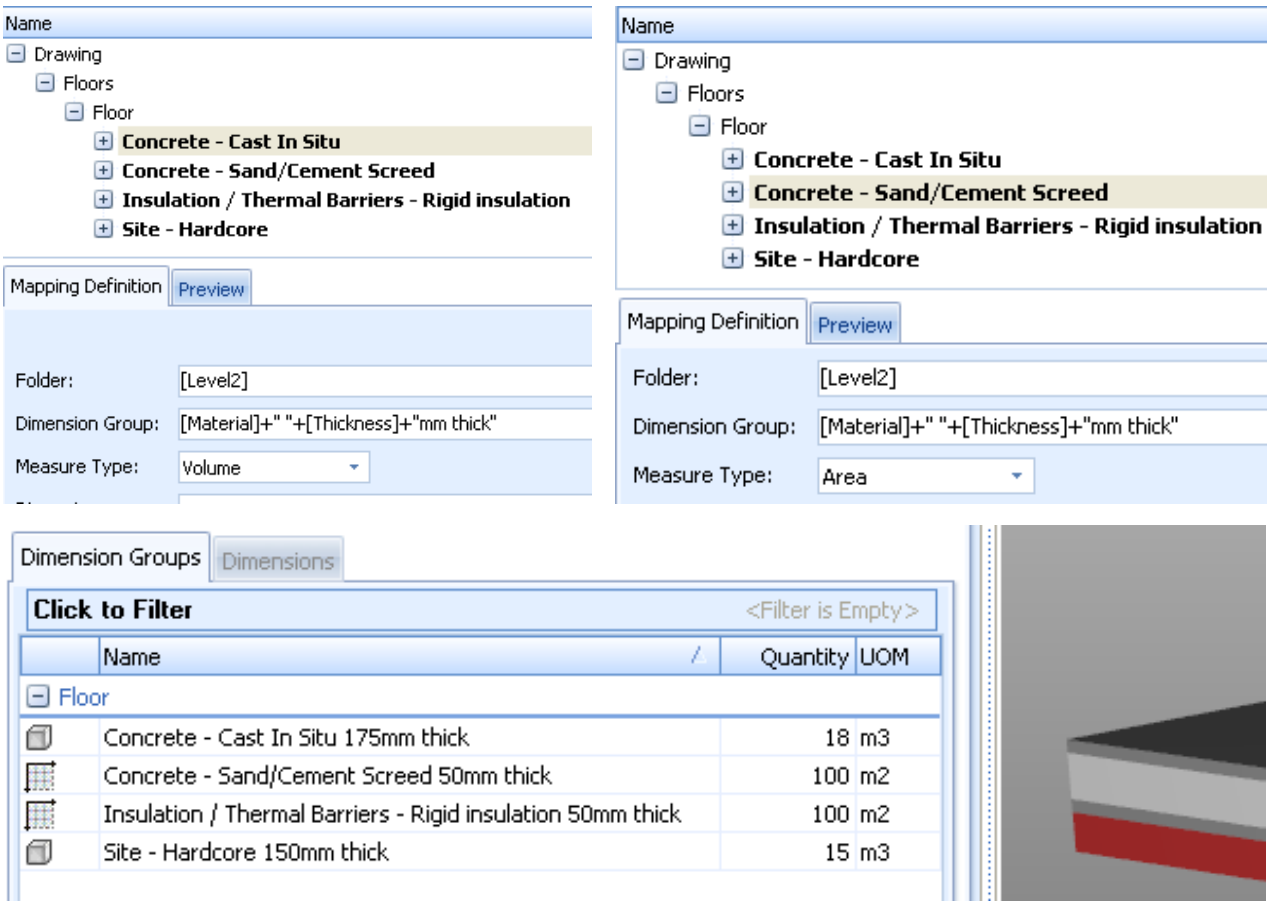


Model View – Assembly



Model View – Parts

The Parts properties can readily be used to create mapping definitions for Model Maps.

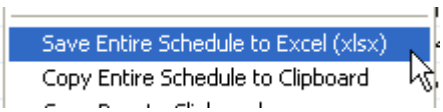


CostX® screen shot of disassembled slab Parts – dimensions imported with Model Map

6.14 User-Defined Model Properties

This powerful feature allows a CostX® user to insert additional data into the BIM Properties Schedule, which will attach to the corresponding object within the model. The data can then be used for measurement purposes as part of the normal CostX® BIM workflow via CostX® BIM Templates, Model Maps and object-based Dimension Groups. Examples of user-defined data might include elemental or trade coding, additional dimensions, formula calculations, life-cycle data, etc.

- To use this feature, first add a 3D BIM file (eg. DWFx™ or IFC).
- Open the Schedule pane. If desired, first filter the view to show only selected elements or objects to which additional data is to be added.
- Right click over the Schedule and select "Save Entire Schedule to Excel (xlsx)".



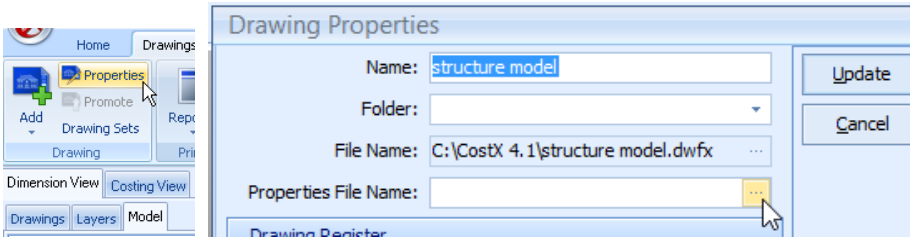
- An Open File dialog box will open. Select a name and location for the xlsx file and click Save.
- If the xlsx file doesn't open automatically, open it in Excel®. The spreadsheet is a copy of the CostX® schedule, with each row corresponding to an object in the model (identified via its unique identifier code in the EXBIMID column), and each column containing object properties. New columns for additional property data may now be inserted into the spreadsheet, with the additional data specific to each object being inserted into the applicable row in the spreadsheet.

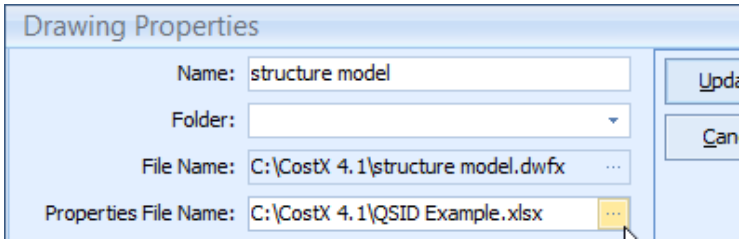
- For ease of working in the spreadsheet, data may be filtered or sorted, and columns may be deleted to reduce clutter. The deleted data is not lost (because it is an attribute of the model file in CostX®) it is simply being removed from the spreadsheet. However, be careful not to delete the EXBIMID column as this is required to tag the additional data to its intended object.
- In the example below, a new column headed QSID has been added so that elemental coding can be inserted against each object.

K78

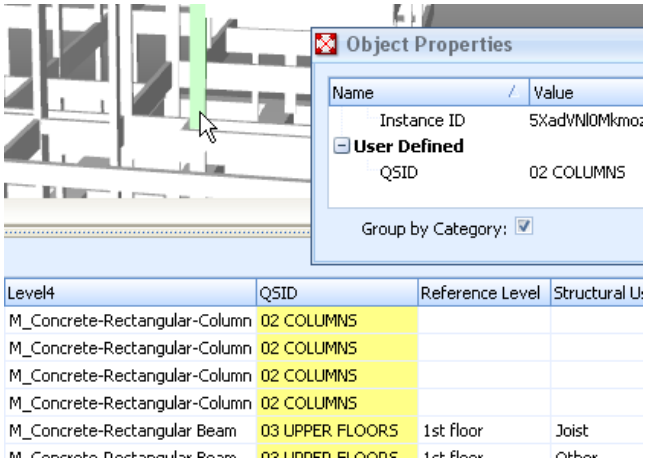
	A	B	C	D	E	F	G
1	EXBIMID	Level3	Level4	Reference	Structural Usage	Top Level	QSID
54	dc60a269-fcc9-4afb-b229-78ada8b0	300 x150	M_Concrete-Rectangular-Column			roof beam level	02 COLUMNS
55	dc60a269-fcc9-4afb-b229-78ada8b0	300 x150	M_Concrete-Rectangular-Column			roof beam level	02 COLUMNS
56	dc60a269-fcc9-4afb-b229-78ada8b0	300 x150	M_Concrete-Rectangular-Column			roof beam level	02 COLUMNS
57	dc60a269-fcc9-4afb-b229-78ada8b0	300 x150	M_Concrete-Rectangular-Column			roof beam level	02 COLUMNS
58	dc60a269-fcc9-4afb-b229-78ada8b0	300 x150	M_Concrete-Rectangular-Column			roof beam level	02 COLUMNS
59	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Joist		03 UPPER FLOORS
60	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
61	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
62	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
63	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
64	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
65	5a1df41a-74ee-4d7a-a261-681e18c(	125x400	M_Concrete-Rectangular Beam	1st floor	Other		03 UPPER FLOORS
66	dc60a269-fcc9-4afb-b229-78ada8b0	125x500	M_Concrete-Rectangular Beam	roof beam	Other		05 ROOF
67	dc60a269-fcc9-4afb-b229-78ada8b0	125x500	M_Concrete-Rectangular Beam	roof beam	Other		05 ROOF

- When the adjustments are complete, save and close the amended xlsx file.
- Return to CostX® and open the Drawing Properties dialogue by clicking the Properties button or by double-clicking on the drawing name. In the Properties File Name box click on the ellipsis (…) button to open an Open File dialog box and navigate to the saved xlsx file. Click Open to attach the file to the drawing properties and then click Update to close the Drawing Properties box.

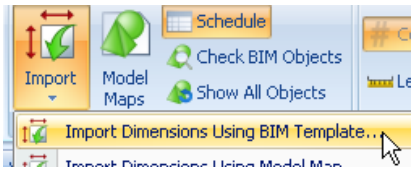


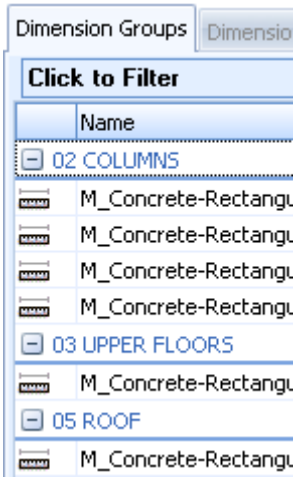


- The Schedule will re-load and the new data automatically maps to its host objects. The added columns will be highlighted in yellow and will also appear in the Object Properties as User Defined properties.



- The additional data is now available for measurement purposes. For example, a QSID column added in this way could be used with the QSID BIM Template or in a Model Map definition to group Dimension Groups into elemental folders.





- ***NOTE:*** *adding user-defined properties in this way does not alter the source DWFx™ drawing file, it only changes the drawing properties within CostX®. However, within CostX®, changing a properties file has the same implications as changing a drawing file. Therefore, user-defined properties can only be added prior to import of any BIM dimensions or measurement of any quantities, because a drawing file cannot be changed after quantities have been measured from it. When an Excel® external properties file is attached to a drawing in CostX® it automatically gets locked as read-only, and cannot subsequently be edited and re-attached.*

  If it is desired to add additional properties to the same drawing after import or measurement of dimensions, there are two options:

  1) delete the existing Dimension Groups and re-measure them after updating the properties. If the dimensions were based on BIM imports this can be done relatively easily. To update the properties, either delete the existing external properties file and create a new one, or copy the existing read-only file and edit the copy. Then open the drawing properties and attach the new or edited file.

  2) add a Building Revision and promote the drawing file, using the same drawing file but with updated user-defined properties. This process is described in Section 9.3.

6.15 Cost Coding a BIM Model

By entering cost codes into a BIM model, it is possible to use a model map in combination with a rate library (as described in Section 14.6) to automatically generate a priced estimate complete with item descriptions by following a few simple steps. The process is as follows:

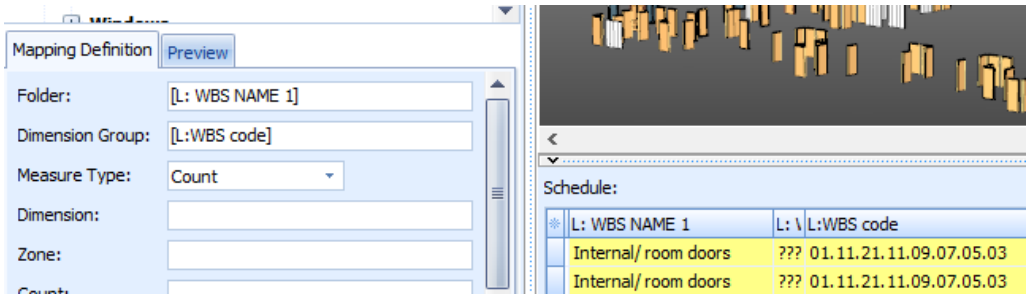
- Create a Rate Library (See Section 14.2) complete with item descriptions and rates. Each rate item will have a unique code.

Item Code	Description	Group	UOM	RATE
01.11.21.11.09.07.05.03	Door-Bifold_4-Panel_Flush	Internal/ room doors	no	2,500.00

- Add user-defined properties to the BIM model as described in 6.14 above. Insert the appropriate cost code from the Rate Library into the BIM Schedule against the relevant object in the model.

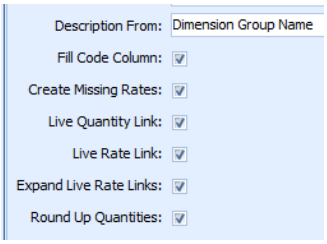
AB	AC	AD	BV	
Level2	Level3	Level4	L:WBS/Cost code	L: WBS NAME
Doors	Door-Bifold_4-Panel_Flush_	1600x2000	01.11.21.11.09.07.05.03	Internal/ room doors
Doors	Door-Bifold_4-Panel_Flush_	1600x2000	01.11.21.11.09.07.05.03	Internal/ room doors
Doors	Door-Bifold_4-Panel_Flush_	1600x2000	01.11.21.11.09.07.05.03	Internal/ room doors

- Define a model map which uses the cost codes to name the Dimension Groups.



- Import the BIM dimensions using the model map.

- Generate a workbook from the Dimension Groups. Select “Rate Description” in the Description From: box and tick the Live Quantity Link and Live Rate Link boxes (See Section 14.6).



- Tick the other boxes as required (eg. Expand Live Rate Links if the rates have build-ups).

- Click OK and a workbook will be generated which uses the quantities from the model and the descriptions and rates from the Rate Library to create the estimate.

	Code	Description	Quantity	Unit	Rate	Sub-
		Internal/ room doors				
	A:Code	B:Description	C:Quantity	D:Unit	E:Rate	F:Subtotal
1		Door-Bifold_4-Panel_Flush 1000 x 2000	164	no	2,500.00	410,000

Note that if you do not have a Rate Library, one can automatically be created as follows:

- Create a Rate Library (See Section 14.2) but at this stage do not create any rate items, leave the library empty.
- Follow the remaining steps as detailed above.
- When generating the workbook, tick the Create Missing Rates box. The workbook will be generated without any descriptions or rates, but at the same time the Rate Library will be automatically populated with a blank rate item for each object in the model.
- Go to System Administration, open the Rate Library and edit the new rate items to include descriptions and rates. It may be quicker to export the library to Excel® to do this, and then re-import it (See Section 14.3).
- Repeat the process as detailed above.
- This Rate Library will also be available for all future models. The Create Missing rates box will add additional items into the rate Library for all new objects in subsequent models.

If the rate items have coded build-ups, the workbook rate functions described in Section 14.5 can be used to analyse the estimate.

By implementing a process similar to that described above, it is possible to co-ordinate Rate Libraries with model Object libraries to achieve a very high level of automation to the process of generating comprehensive , fully priced estimates from BIM models.

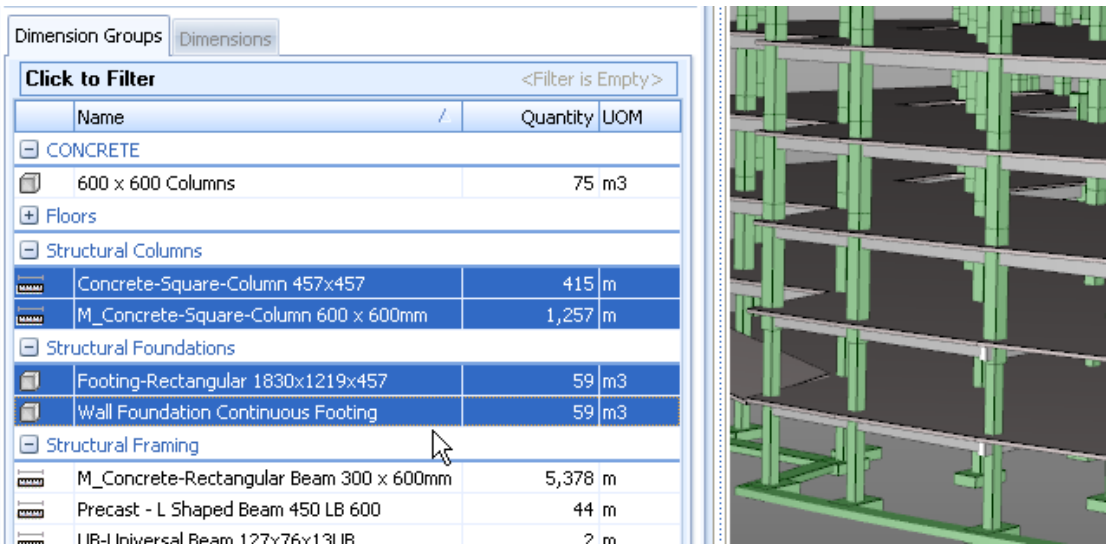
6.16 Quantities Audit

It is important to note that BIM dimensions are generated from the properties of the model objects that are visible in the drawing view. A 3D view will capture all objects but with 2D views in Object Mode it is necessary to have a selection of views from various angles to ensure all objects are visible. A wireframe view is useful for this purpose.

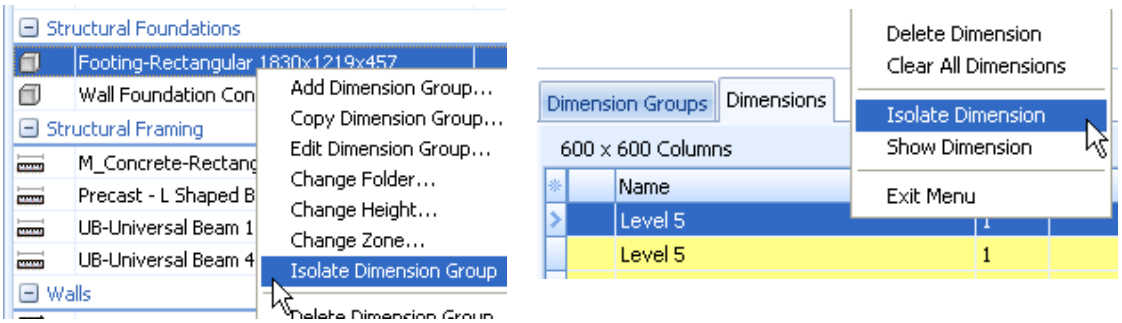
However, even if all objects are visible, the quantities will only represent objects that the designer has incorporated into the model. The earlier in the design stage, the greater the number of missing objects, despite the fact that the 3D view may appear impressively advanced. Therefore, any BIM dimensions generated at an early stage of the design will not represent the full scope of works of the building because not all objects have yet been added to the model, ie. the design is incomplete. It is also common for designers to add additional details and notes onto the 2D sheets, so there may be information on the sheets that has not been added into the data model. Hence when using BIM dimensions, it is critical to identify the missing scope items so that additional quantities and items can be measured and priced in the workbook to make proper allowance for the work yet to be designed.

Review Dimensions

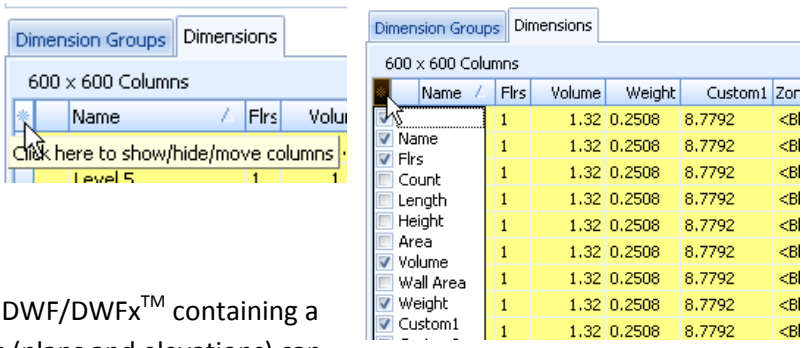
When Dimension Groups or Folders are selected either individually or cumulatively (by holding the Ctrl key and clicking on them), the dimensions are highlighted in green on the drawing view and may be reviewed.



The drawing view can also be filtered or set to Transparent to assist in identifying the location of objects. There are also right click menu options to Isolate Dimension Group or the Dimensions tab can be opened and individual dimensions may be isolated.



The data displayed in the Dimensions tab can also be configured as required. Click on the * button and check the required fields.

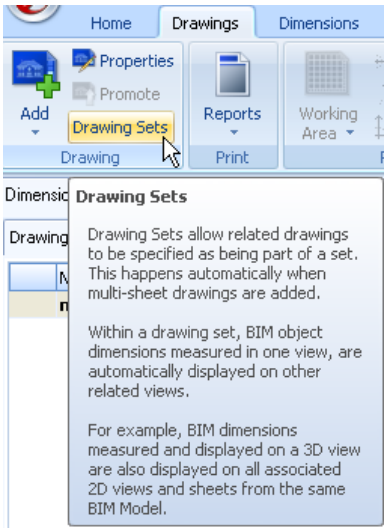


Additional Measurement

Instead of a single 3D view, a multi-view DWF/DWFx™ containing a 3D view and a set of 2D views and sheets (plans and elevations) can be imported. The BIM dimensions are taken from the 3D view, and then additional quantities can be added to the BIM dimensions by creating new Dimension Groups and Folders and measuring from the various views and sheets either in Object Mode or manually in 3D or 2D in Vector mode.

Additional DWF/DWFx™, DWG™, PDF or image files can also be added at any time to augment the model data and to form a basis for additional measurement.

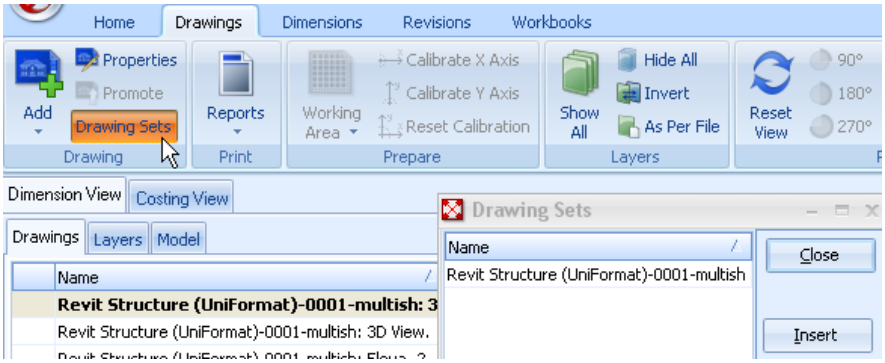
6.17 Drawing Sets



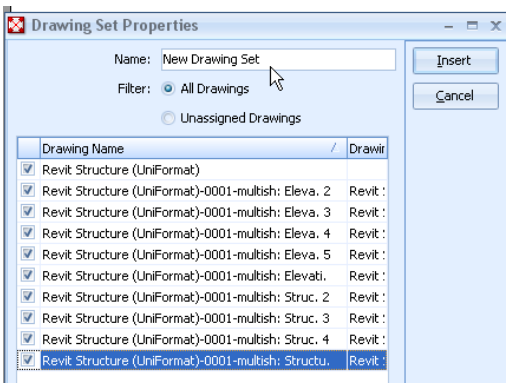
When a multi-view DWF/DWFx™ is added to CostX®, the component views and sheets are defined as a Drawing Set. This means that object-based dimensions imported from any view or sheet also display in all the other views and sheets in the set.

It is also possible to add disparate views and sheets from the same model as separate DWF/DWFx™ files and then subsequently bind them together as a Drawing Set so that objects previously imported in one view display on all the newly added related views. This only applies to imported BIM dimensions, not to measured dimensions.

Sets created automatically are named using the name prefix in the Drawing Properties. To display Drawing Sets, click the Drawing Sets button.



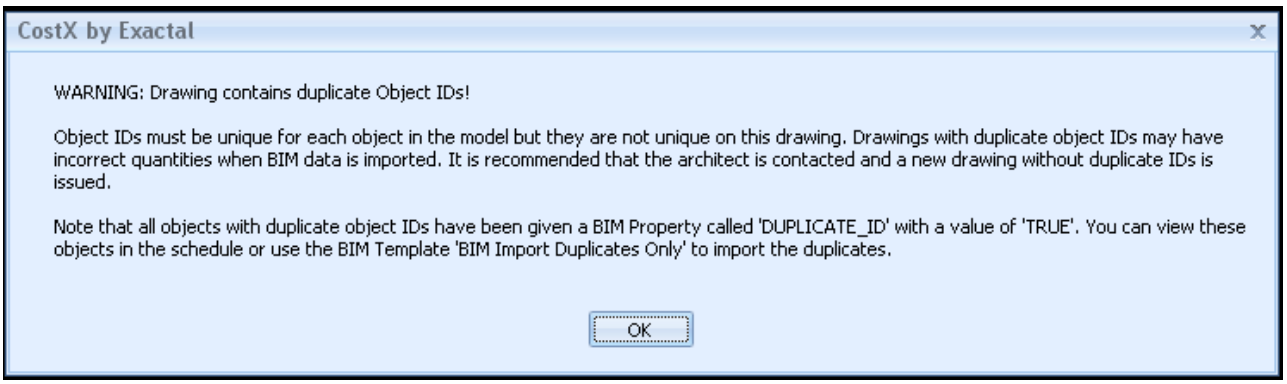
To bind together separate DWF/DWFx™ files from the same model into a Drawing Set, firstly Add the new drawings. Then click the Drawing Sets button to open the Drawing Sets box, then click “Insert” to open the Drawing Set Properties box. Enter a name for the new Drawing Set and select the drawings to be included in the set.



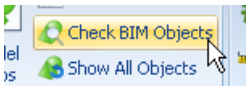
BIM dimensions imported from the original drawing will now also display on all the associated newly added drawings within the Drawing Set. Drawing sets can be created at any time, including after the dimensions have been imported. This means that if additional drawings are obtained in order to import some additional dimensions or measure some additional quantities, previously imported BIM dimensions can be displayed on the new drawings.

6.18 Duplicate Object IDs

All objects within a BIM model are identified by a GUID – Globally Unique Identifier code. The GUID is used to match the properties held in the model database, such as dimensions, to the applicable objects displayed in the drawing view. Normally, every object will have its own unique GUID. However, similar to X-Refs in 2D CAD drawings, it is possible to link multiple instances of a typical object or group of objects into a model. If the multiple instances all have the same GUIDs, the dimension properties will only apply to the original instance, not to the multiplicity of instances. For example, if a typical apartment layout were to be repeated twenty times in a model, and the GUIDs were duplicated, the quantities would only apply to one rather than twenty. If a model with duplicate IDs is opened in CostX®, a warning with recommended action will open as shown below. The Exactal document "Digital Drawing Files for Measurement Purposes – Simple tips for a collaborative approach to improved drawing file intelligence" offers advice to designers on how to remove duplicate IDs.



The Check BIM Objects button on the Dimensions ribbon will also identify duplicate or unused objects in Dimension groups.



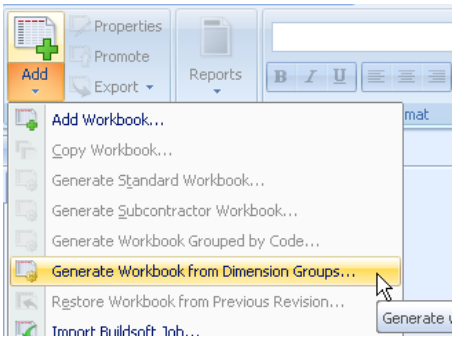
6.19 BIM Dimensions – Workbooks

(Not available in CostX® Takeoff 2D)

Within the Costing View, there are a number of different ways the quantities can be transferred to the workbook.

The first example is to create a workbook in the standard format by basing it on a previous job, then dragging and dropping the dimension groups into the appropriate cells. Alternatively, if the family names are going to be used regularly, workbook templates with link formulas to those names may be set up. Rate libraries linked to those same named items could also be established to automate the pricing process.

Another method is to create a workbook from the dimension groups. To do this click the Add workbook drop down menu and select Generate Workbook from Dimension Groups.



This will generate a two level workbook with live linked quantities. The dimension group folder names will be shown on the first level and the dimension group name and quantities will be shown on the second level.

The quantities can be identified using the right click Show Dimension Group function.

7 Measurement Approach

7.1 Measurement Structure

The Dimension Group format is user-defined so dimensions can be measured in elemental, trade or other format as desired. Dimension groups are arranged into Dimension Group folders and sub-folders. Sub-folders are created by inserting a \ symbol into the folder name. Multiple sub-folders may be created but the total length of the Dimension Group name path including all folder and sub-folder names is limited to 250 characters. Naming or numbering protocols should be established so that Dimension Group format is consistent and individual Groups are easily located.

7.2 Naming Convention

CostX® sorts in an alphanumeric sort order. This should be considered when creating new Dimension Groups and Folders, workbooks or when naming drawings.

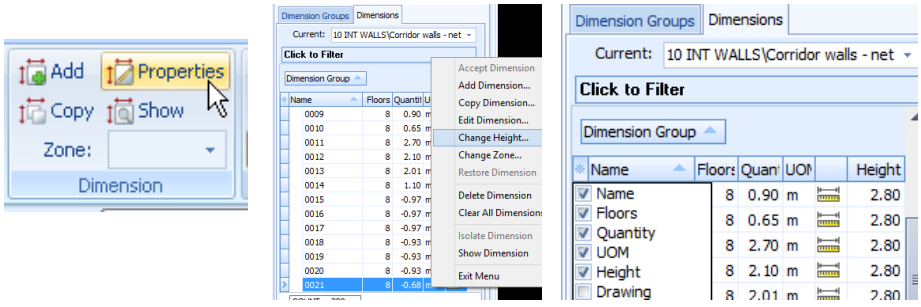
CostX® automatically uses the drawing file name as the drawing name. The file name is often quite obscure such as a drawing number. A list of drawing numbers in the drawing name pane can provide little information so it may be advisable to change the name, for example to 'A-Ground Floor' or 'S-Column details'. The prefix letter allows the association of discipline making it possible to locate architectural drawings (A) or structural drawings (S) quicker as they will be grouped together.

Drawings may also be grouped into folders and sub-folders. Sub-folders are created by inserting a \ symbol into the folder name. Multiple sub-folders may be created but the total length of the drawing name path including all folder and sub-folder names is limited to 250 characters.

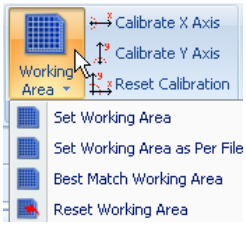
7.3 Measurement Approach

In 2D it is advisable to try to measure quantities from plan. This is so that as many quantities as possible are captured in one place, making reviewing the information easier. If windows are captured on elevation, each elevation must be checked to ensure all windows are measured. Whereas, if the windows are taken from plan then a single plan can be viewed when checking the items measured. In addition, due to building shape the full extent of an item may not be shown on elevation or the item may be at an angle so the extent captured may not be correct.

In some cases it may be possible to measure an item from elevation but it is advisable to generally capture vertical items from plan, eg. in linear for windows or walls, or as a count for stacks, and apply a height either under the Dimension Group Properties or in the workbook quantity sheet. It can be helpful to create separate Dimension Groups for like items that have differing heights, in which case stating the height in the name of the Group is useful. It is also possible to apply differing heights to individual dimensions within the same Dimension Group, either by amending the dimension properties or using the right click menu options. The Dimensions column filter can be set to display Height, and positive and negative dimensions can be displayed.



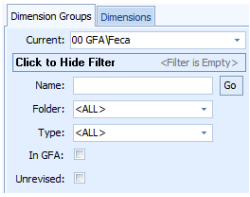
7.4 Capturing Typicality



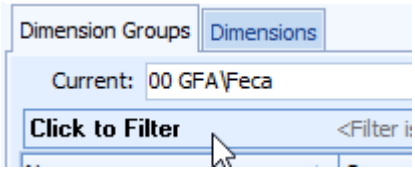
Note that the multiple floors function can also be used for typical units or the like. If there is a typical floor plan containing several unit types which are repeated on other floors, rather than using the multiple floors function, simply reload the typical floor plan for each unit type, inserting the number of units rather than the number of floors and alter the duplicate drawing name to reference the relevant unit. Then isolate the subject unit on each drawing using the "Set Working Area" function on the Drawings ribbon.

Then add a further duplicate typical floor plan set to the number of floors and on this drawing measure the common areas such as corridors and stairwells.

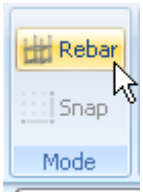
7.5 Dimension Group Filtering



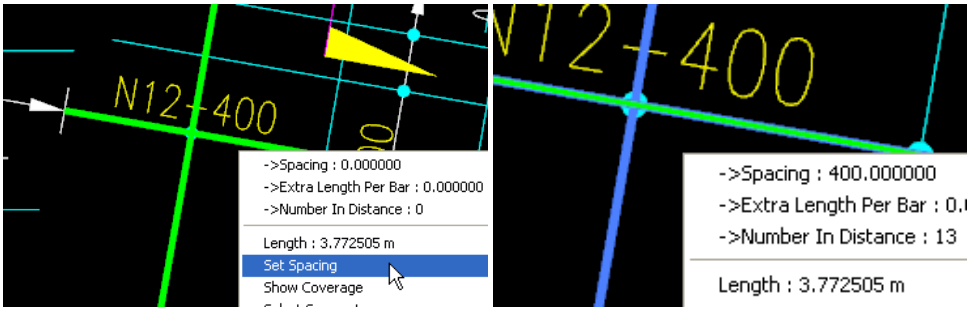
Larger projects can require numerous dimension groups. To locate and isolate a particular dimension group the filter function can be used. Also refer to the CostX® Introductory Manual Section 5.4 for more information on configuration options for the dimensions list.



7.6 Rebar Mode



This function is used for measuring reinforcing steel (rebars) but can also be used for repetitious items such as purlins. First select a Dimension group with a length measurement type, then click the "Rebar" button on the Dimensions ribbon. Then click to select the spacing line which determines the distance covered, and secondly click the intersecting length line of the item being measured. Both intersecting lines will now be highlighted. Right click, select set spacing and enter the spacing. The number of bars is calculated from the spacing and multiplied by the length of the selected bar to give a total length. It is also possible to show coverage (right click) and also add additional lengths to bars for hooks, etc.

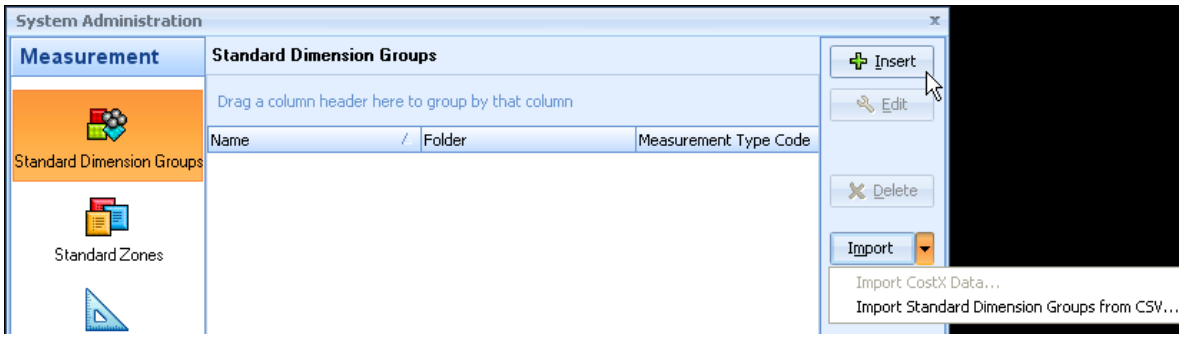


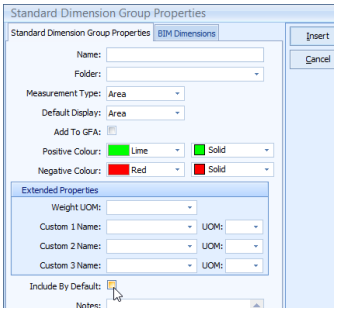
7.7 One To Many

Dimensions captured in CostX® include complementary quantities. This means a Dimension Group for a room floor area (m2) will also capture the perimeter of this room. If a height is included in the Dimension Group Properties then the wall area (perimeter x height) can also be captured eg. for wall finish and the volume (area x height) eg. for ventilation. The number of area or length dimensions measured is also captured. By planning the measurement process it is possible to use one measurement to calculate numerous quantities, thus reducing the number of measurements required.

7.8 Standard Dimension Groups

A library of Standard Dimension Groups and Folders can be established in System Administration. Click the "Insert" button and insert the details in the Standard Dimension Group Properties box.

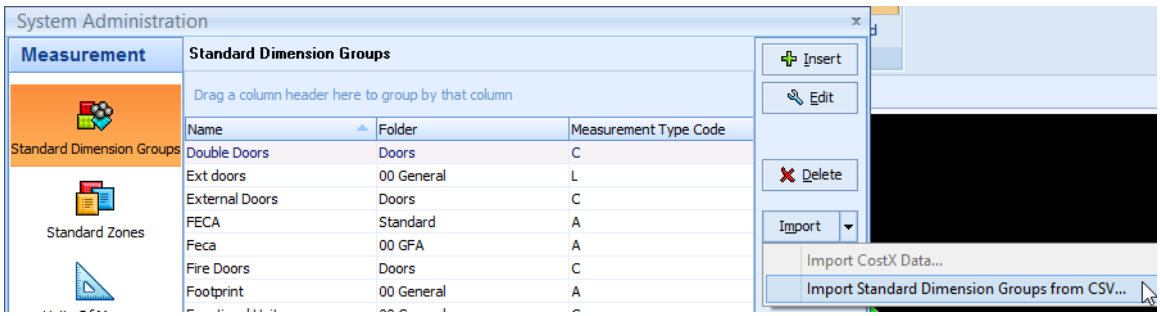


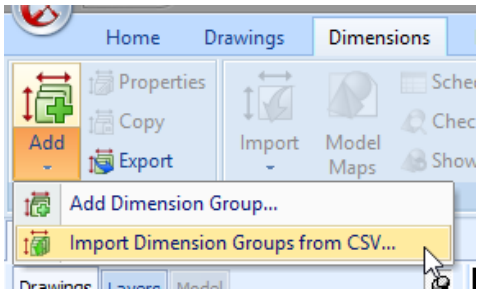


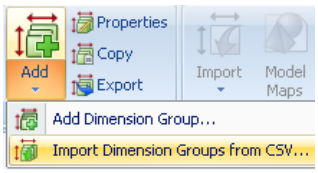
A Default Height box is not included because the height is job specific. When a Building is created and includes Standard Dimension Groups, the Group Properties can be edited and a height can be inserted at that point.

If the Include by Default box is ticked, the Standard Dimension group will automatically be included with every new Building.

Standard Dimension Group libraries may be exported and imported into CostX® and may also be created in Excel® and imported into CostX® as a CSV file. A CSV file of Dimension Groups can also be imported directly into a CostX® Building.







The CSV format is as follows and is the same for both imports. The data should be entered into the CSV columns left to right, starting with column A. Note that column headings are **NOT** required in the CSV. Also do not leave any blank rows. Only the first three columns are compulsory.

Folder, Name, Measurement Type, Default Display, Default Height, Add to GFA, Weight Unit, Custom 1 Name, Custom 1 Unit, Custom 2 Name, Custom 2 Unit, Custom 3 Name, Custom 3 Unit, Positive Colour Name, Negative Colour Name, Positive Fill Style, Negative Fill Style, Include by Default, Notes

The values to be entered for colours and fill styles are as listed in the drop-down menu options in the Dimension Group Properties box.

8 Templates

(Workbooks not available in CostX® Takeoff 2D)

8.1 Templates

Dimension Groups and Workbooks can always be created from scratch. However by creating templates to follow, a lot of time can be saved plus a quality rigour is introduced by standardizing the templates to company standards. By using templates the 'live links' from Dimension Groups to workbooks are already in place and as a result the tasks required are only the capturing of quantities and costing of workbooks. The detail of an estimate or cost plan is determined by the information available and the time available to undertake the work. The use of templates provides a standard platform from which to complete the work and the template used should be best matched to the level of detail required. For example sketch drawings and a brief scope of works are likely to form the basis of a Unit Rate or Elemental Cost Plan, whereas detailed drawings and a full specification can be used for scheduling. The templates should be retained in a discrete Project folder and strict protocols introduced to ensure they are not overwritten.

8.2 Based On

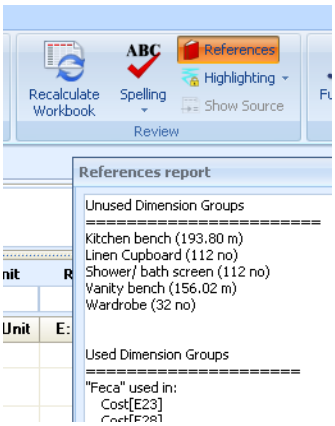
For new buildings, create a Building name relevant to the subject project and use "based on" so the new building will then have all the template details on it but the template remains unchanged.

8.3 Merging

Merging can be used when a building already exists, to bring in a template or previous project to add to the work already undertaken, or to combine a number of separate buildings into a single consolidated building. When merging, it is better to create copies of the files to be merged and merge the copies so that the originals are retained. Either merge one copy into the other, or create a new empty building and merge all the copies into it. Merging should only be done once because if it is repeated, all the dimensions will also be repeated, ie. doubled. Hence it is better to merge when work is complete and unlikely to be amended. When merging, Dimension Groups get combined but workbooks do not – the incoming file will create new workbooks. Like-named Dimension Groups are combined unless there is a mismatch - eg the assigned height in Dimension Group properties – in which case the incoming Dimension Group is automatically re-named and the workbook linkages in the incoming workbook updated to reflect the new name. To reinstate the linkages to the original Dimension Groups, delete the re-named Dimension Groups, delete the new workbook, and replicate the new workbook from the incoming template by using "based on" rather than "merge".

8.4 Dimension Groups

When creating templates, all folders need to have content within their Dimension Group item or will not be retained. A simple number can be used eg 01. When the Dimension Group is used simply replace the number with the Dimension Group description. To check which Dimension Groups (or whether all created Dimension Groups) have been used in the estimate/schedule use the "References" button on the Workbooks ribbon.



8.5 CostX® Templates

CostX® includes with some basic templates to assist with getting underway in Cost Planning and Estimating. However it is important for user companies to develop their own templates to embed their own working practices and quality protocols. Generally, a template structure can follow a progressive approach so that the information available at each stage will determine which template should be used.

8.6 Bill of Quantities Workflow

Templates can also be used for Bills of Quantities or scheduling, however as these are based on more detailed information and are generally far more project specific, a generic template approach may not be appropriate. Instead a set of protocols and procedures and use of a Master SMM Template or Standard Phraseology can be used such as the following example;

Initial Set Up

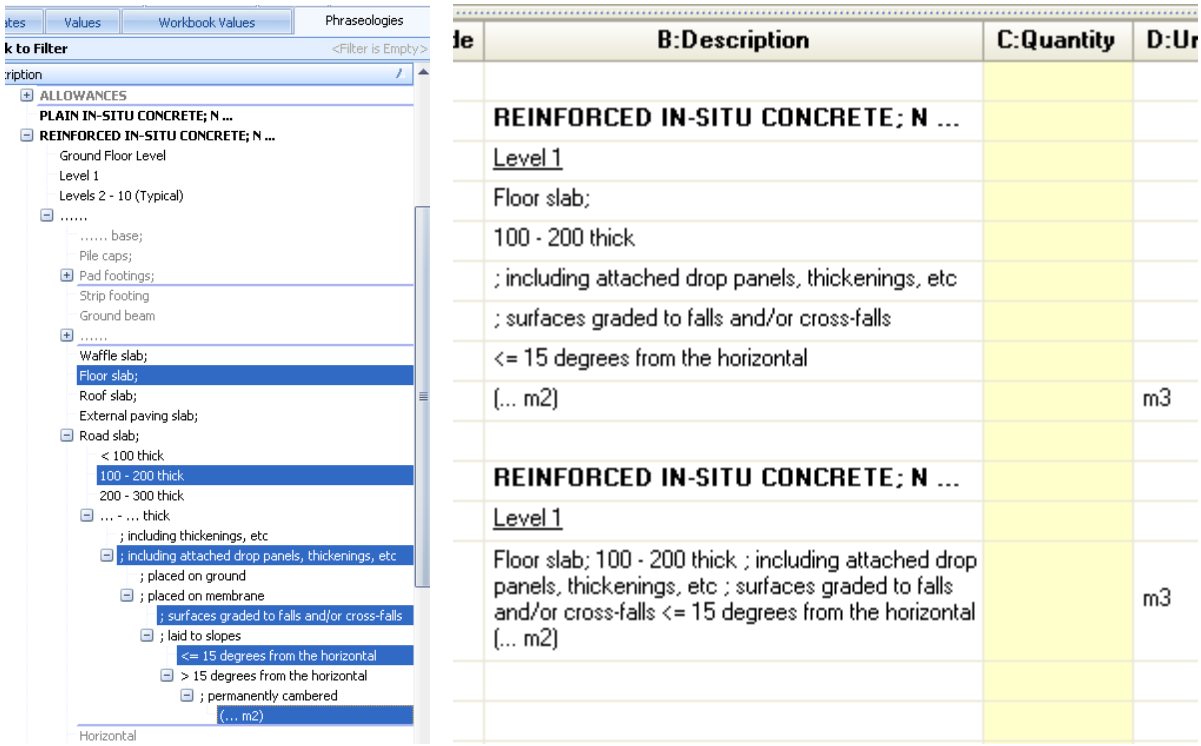
- Determine Project and Building naming/numbering protocol.
- Load drawings and specification on to server.
- Load up drawings for general use by team into the CostX® building. Users can load any additional drawings required for individual trades. Use naming protocols and check scales.
- Use “Based On Workbook” to load a copy of the SMM template into a master workbook in the CostX® building.
- Team members create a separate workbook for the trade to be measured and copy and paste their measurement trade from the master workbook to the trade workbook.

Measurement

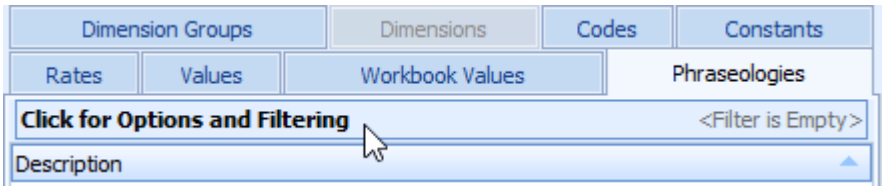
- Write job specific Preambles, General Items, Allowances and Measurement clauses in the workbook.
- Create Dimension Groups to follow the bill items. When setting up a Dimension Group the Folder will be the Trade name and the Name will be the measured item. The height option for vertical members may be used, or instead put into the Dimension Group title with the length measured from the drawing and the height to be added in the workbook. The latter tends to make workbook review easier as the dimension trail is more apparent. Descriptions in the Dimension Groups can be written in short.
- When dragging and dropping the quantity to the workbook, the rounding can be set in the Add Quantity box.
- Area measurements can be placed in the D column and a 1.00 placed in column E, likewise a cubic measurement will have a dimension in columns D, E & F.
- Column G is for factors rather than columns C, D, E or F. Column C is for numbers/timesing.
- Steelwork or reinforcement can be measured length in column D, weight (kg/m) in column E and the conversion to tonnes 0.001 in column G. The default for each column is two decimal points, as the weight and conversion are in three decimal places, change this by using the ribbon button.
- Although the brief description comes with the quantity when you drag and drop, additional annotation can be used to identify location if necessary.

8.7 Phraseologies

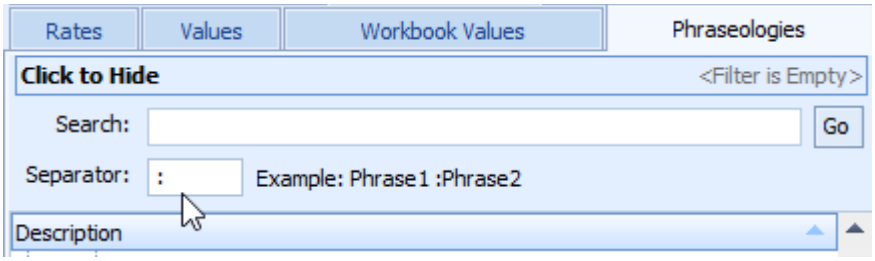
Standard phraseologies or model description libraries may be imported into CostX® and accessed via a Phraseologies tab. Click on the text to select it, and hold the Ctrl key to select multiple text strings to build detailed descriptions. Release the Ctrl key, and drag and drop the text into the workbook. Each string of a multiple selection will be placed on a separate line in the workbook. To combine the strings into a single description, move the cursor to the destination cell, then hold the Alt key, move the cursor slightly so that the blue highlighted workbook cells compress to a single cell, then click.



When joining text using the ALT key, it is possible to choose which separator character to use between the words or phrases. The default is for the separator to be a space. Use the Click for Options and Filtering button. This also provides a search function.



In the Separator: box, insert the required separator character.



Phraseologies are created in Excel® and imported into CostX® via CSV files.

A	B	C	D	E	F	G	H	I	J	K	L	M
6.1		IN-SITU CONCRETE										
			PLAIN IN-SITU CONCRETE; N ...									
			REINFORCED IN-SITU CONCRETE; N ...									
				Ground Floor Level								
				Level 1								
				Levels 2 - 10 (Typical)								
				.....								
					..... base;							
					Pile caps;							
					Pad footings;							
	m3					<= 1 m2 on plan						
	m3					> 1 m2 on plan						
	m3						; placed between excavated faces					
	m3						; placed between excavated face and formwork					
					Strip footing							
					Ground beam							
					.....							
	m3					; placed between excavated faces						
	m3					; placed between excavated face and formwork						
					Waffle slab;							
					Floor slab;							
					Roof slab;							
					External paving slab;							
					Road slab;							
						< 100 thick						
						100 - 200 thick						
						200 - 300 thick						
						... - ... thick						
							; including thickenings, etc					
							; including attached drop panels, thickenings, etc					
								; placed on ground				
								; placed on membrane				
									; surfaces graded to falls and/or cross-falls			
									; laid to slopes			
										<= 15 degrees from the horizontal		
										> 15 degrees from the horizontal		
											; permanently cambered	
	m3											(... m2)

The format of the Excel® file is as follows:

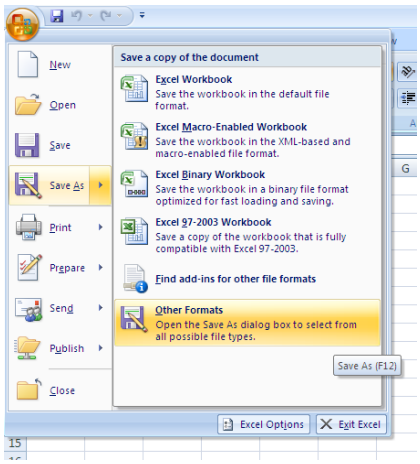
Column A; Item code (Optional)

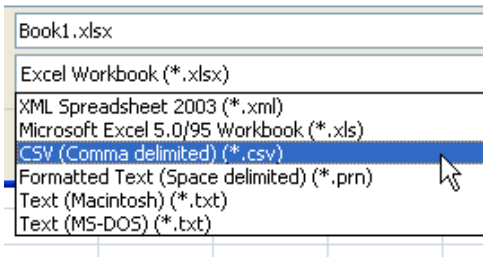
Column B; Unit of Measure (only inserted against the lowest level description)

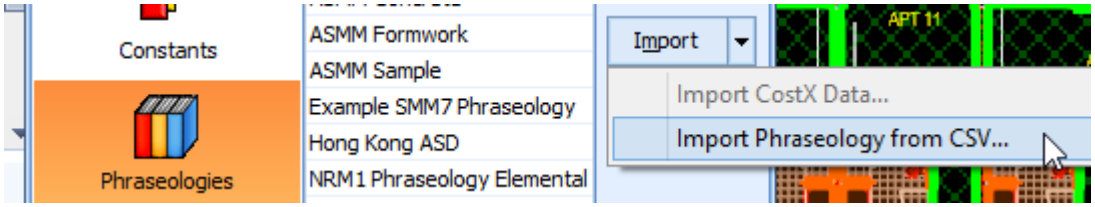
Column C; Main Heading (highest level description)

Column D onwards; Headings, sub-headings, descriptions, etc. each on a consecutive row and placed sequentially in Columns D,E,F,G etc to form branches in the Phraseologies tab tree structure.

Once the Excel® sheet is correctly formatted it should be “Saved As” “Other Formats” and saved as a .csv (Comma delimited) file, then you can import it into CostX®.





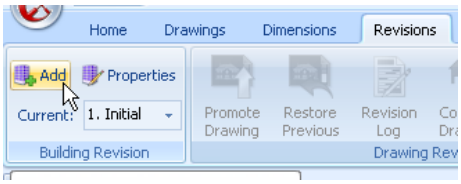


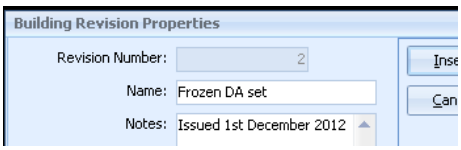
9 Revisions

(Not available in 2D versions)

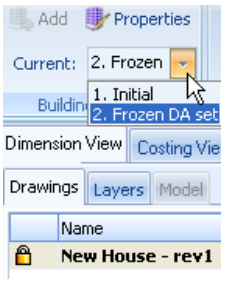
9.1 Revisions

The Building Revisions function in CostX® enables the scope of a project to be managed and tracked. During the course of a project, designs progressively change as design work proceeds or in response to unforeseen circumstances. As revised drawings are progressively issued to reflect the design changes, the Building Revision status in CostX® can be incremented at which point the existing drawings and workbooks are locked, and the drawings "Promoted" from the previous to the new issue. Previously measured quantities then get updated in accordance with the drawing changes. The Revision tool can also be used even if the drawings have not changed, to lock cost plans or estimates at milestone issue points.





All Buildings are set to "Initial" by default. The first Revision added will be allocated Revision Number 2, with each subsequent Revision numbered consecutively. A new Revision is created by using the "Add" button on the Revisions ribbon. A Building Revision properties box will open, which will show the revision number and provides fields for the user to name the Revision and add notes. Click "insert" to create the Revision. This immediately locks the existing drawings (indicated by a padlock symbol), preventing any further measurement, and will also lock the current workbooks.



Drawings, dimensions and workbooks from previous revisions may be viewed at any time by using the "Current:" drop down selection list located in the Building Revision section of the Revisions tab, creating a comprehensive audit trail. A comparison can also be carried out between current and previous drawings or workbooks.

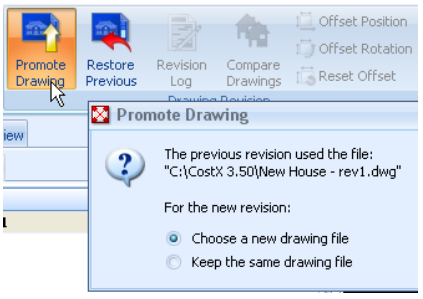
More information can be found in the Revisions FAQ section of the Help files.

9.2 2D Drawing Revisions

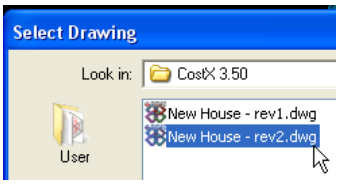
After a Building Revision has been created, the existing drawings are then "Promoted" to their later issue. CostX® superimposes the dimensions that were measured on the previous version of the drawing to the same locations on the promoted version of the drawing, and displays them for comparison by the user so a decision can be made to retain, adjust, or re-measure them. Any vector mis-match (ie. where a dimension no longer aligns because the drawing has changed) is highlighted on screen to assist in the comparison, which is done for all area, length and count dimensions. When the adjusted dimensions are accepted, the dimension group quantities are automatically updated.

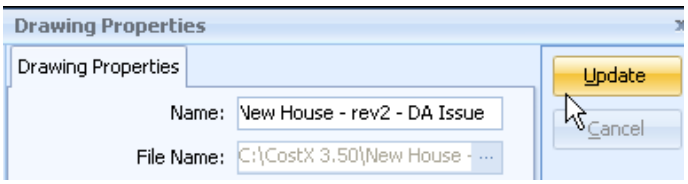
Revise 2D Dimensions

- Add a Building Revision as described above. The drawings will all be locked.
- Select the drawing to be promoted. Then click the "Promote Drawing" button in the Drawing Revision section of the Revision ribbon.



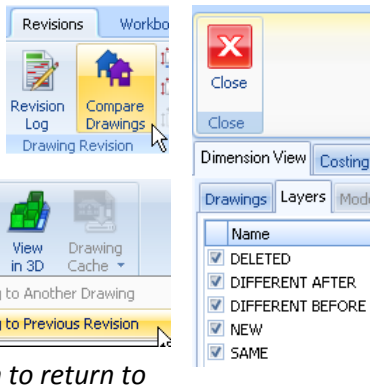
- At this point, you can choose a new drawing file (ie. the revised version of the drawing) or keep the same drawing file (ie. the existing version of the drawing). The latter might be used when, for example, only selected drawings get updated and you still need to measure from the non-updated drawings, so in those cases you keep the same drawing.
- If you choose a new drawing file, an Open File dialog box opens so you can select the revised drawing file. Then click Open. The revised drawing file will load and the Drawing Properties box will open. The drawing Name will be carried forward from the existing version of the drawing, so at this point, if desired, you can amend the name. Click Update to accept the new drawing.





The new drawing will be displayed with the dimensions measured from the previous version of the drawing superimposed over it, ready for you to make the necessary adjustments.

Note: *After a drawing has been promoted, it can be useful to get an understanding of the overall extent of changes before starting to adjust the individual dimensions. To do this, click the "Compare Drawings " button or the "Compare" button on the Drawings ribbon to compare the two versions of the drawing.*



Use either Match Objects, Match Line, or Overlay modes for the comparison. With the former two options, the Layers tab can be used to highlight or isolate aspects of the changes.

Exit Layers mode by clicking the Drawings tab and then click the Close button to return to normal drawing mode where the dimensions can be revised.

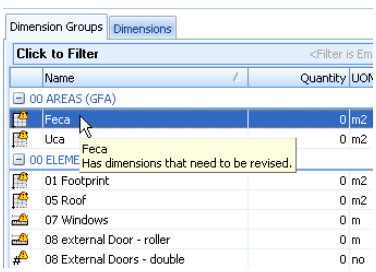
Adjustments in Revise Mode

When dimensions are initially captured via the sticky cursor, they attach to drawing lines which define a length, or the border of an area, or to register a count. In Revise Mode, CostX® identifies where lines have been moved, deleted or added in the revised drawing. These changes directly impact on the dimensions which are attached to the original location of the lines. CostX® enables the dimension attachment to the line to be re-established in its revised location, and the dimension updated accordingly, or the dimension deleted if it is no longer required.

When a drawing is promoted, all Dimension Group totals will reduce by the amount of the dimensions taken from that drawing. If all drawings contributing to the Dimension Group are promoted, the total will reduce to zero. The zero figure only relates to the revised version of the drawing, pending adjustment or acceptance of the existing dimensions, which have been retained and can be viewed by opening the Dimensions tab.

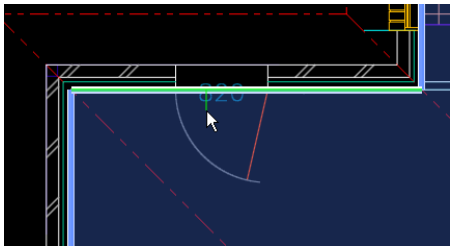
The drawing and each dimension group will be tagged with a caution icon to show that they contain un-revised dimensions.

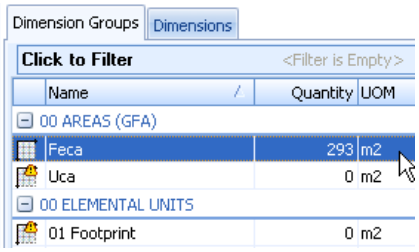
The dimensions measured from the previous version of the drawing will be superimposed onto the revised version. Where dimensions match up with the revised drawing they will show in green, but where a line has moved so that the dimension no longer matches up, it will show in yellow.



Each Dimension Group now needs to be revised by accepting the dimension as shown on the revised drawing, or amending the measurement to relocate the dimensions to their revised locations. This is done via mouse click on the superceded (yellow highlighted) line, and then either hold the click and drag the line to its new location, or release click and then click on the new location.

In order to revise the area dimension below, the previous measurement shown in yellow is relocated to its new position on the revised drawing by a simple click and drag or click and drop, and the quantity will automatically update.

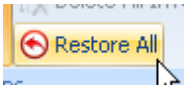




If the re-attachment is successful the line will turn green highlighted. Then the new dimension can be validated by right click “Accept” or by clicking the “Accept All” button on the ribbon. At this point the green highlighting will fade, the caution tag will disappear and the revised dimension will appear in the Dimension Group.

Dimensions that are no longer required, (eg. if an item has been deleted from the revised drawing) are removed by use of the “Delete All Invalid” button or the “Delete Dimension” right click menu option. Dimensions that have not changed can simply be accepted.

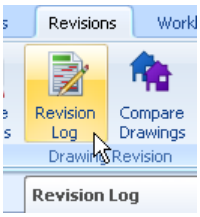
Any dimensions that are not validated will remain at zero, but can be validated or adjusted later (until the revised drawing is again promoted, at which point they would be lost). In the meantime you can continue to measure new items or dimensions as usual.



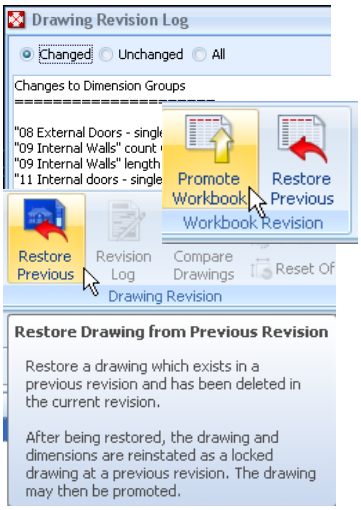
If you accept a dimension but then wish to undo the change, click the “Restore Mode” button. This will display the dimension in its original location. To restore the dimension, click the “Restore All” button or use the “Restore Dimension” right click menu option. Then click on the “Restore Mode” button again to close Restore mode.

If the revisioning exercise appears to be onerous, a judgement can be made that it may be quicker to delete the dimension and simply remeasure the item in normal measurement mode from the revised drawing.

A Revision Log button will list all the changes.



After the validation exercise is complete, the locked workbook can now be promoted by use of the “Promote Workbook” button and all linked quantities will be updated to the revised figures.



To undo the revisioning and restore the previous drawing version, delete the revised drawing. The drawing title will disappear from the Drawings list. Then click the “Restore Previous” button and a box will open from which the previous version of the drawing can be selected and re-loaded. The restored drawing will still be locked, but can be promoted again to the same or a different drawing file. Workbooks can similarly be restored.

9.3 3D Drawing Revisions

A new revision is created using the “Add” button on the Revisions ribbon. This immediately locks the existing drawings and models, preventing any further import or measurement, and will also lock the current workbooks.

After a Building Revision has been created, the existing 3D drawings and models can be “Promoted” to their later issue.

After a drawing has been promoted to a new revision, all Dimension Group totals will reduce by the amount of the dimensions taken (either measured manually or imported) from that drawing. If all drawings contributing to the Dimension Group are promoted, the total will reduce to zero. The zero figure only relates to the revised version of the drawing, as the existing dimensions are retained in the previous building revision.

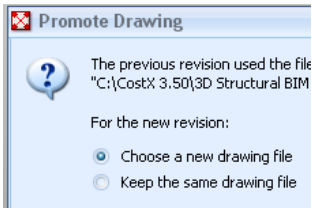
For dimensions previously measured manually in 3D Point Mode, the revisioning process is similar to 2D drawings as described in 9.2 above. When the drawing gets promoted, the drawing title and each Dimension Group containing measured or manual dimensions will be tagged with a caution icon to show that they contain un-revised dimensions. CostX® superimposes the dimensions that were measured on the previous version of the drawing to the same locations on the promoted version of the drawing, and displays them for comparison by the user so a decision can be made to retain, adjust, or re-measure them. Any vector mis-match (ie. where a dimension no longer aligns because the drawing has changed) is highlighted on screen in yellow to assist in the comparison, which is done for all area, length and count dimensions. When the adjusted dimensions are accepted, the Dimension Group quantities are automatically updated.

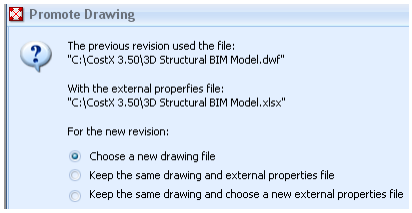
For BIM dimensions previously imported from a 3D BIM model, the process of revising the dimensions after the model gets promoted is different because CostX® is able to automatically update the dimensions in accordance with the properties of the revised model. This is done as a separate step after the drawing file has been promoted, by use of a “Promote BIM Dimensions” button.

Revise 3D Dimensions and Promote BIM Dimensions

- Add a Building Revision as described above. The drawings will all be locked.
- Select the 3D drawing to be promoted. Then click the “Promote Drawing” button in the Drawing Revision section of the Revision ribbon.
- At this point, you can choose a new drawing file (ie. the revised version of the drawing) or keep the same drawing file (ie. the existing version of the drawing). The latter might be used when, for example, only selected drawings get updated and you still need to measure from the non-updated drawings, so in those cases you keep the same drawing.

  If the drawing being promoted already has external properties attached (refer Section 6.14) a third option is also offered, which is to keep the same drawing file but attach (choose) a new external properties file. External properties which were added to the previous version of the drawing can then be added to the revised version of the drawing. Each of these options is described in more detail below.

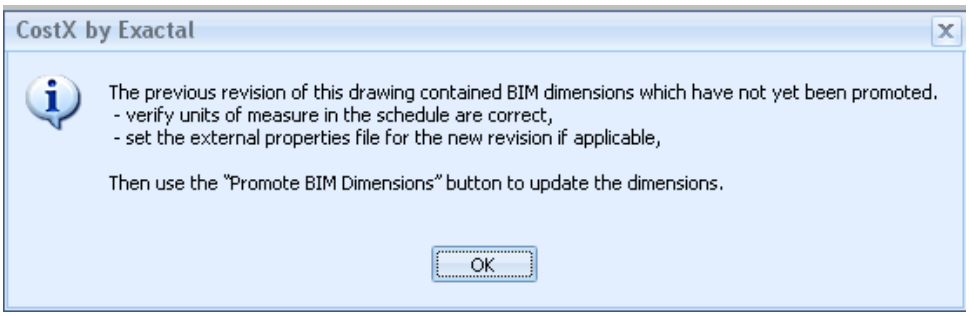




"Choose a new drawing file"

If you choose a new drawing file, an Open File dialog box opens so you can select the revised drawing file. Then click Open. The revised drawing file will load and the Drawing Properties box will open. The drawing Name will be carried forward from the existing version of the drawing, so at this point, if desired, you can amend the name. Click Update to accept the new drawing.

- All imported BIM dimensions for that drawing will revert to zero. Any measured or manual dimensions will be tagged with a warning icon.
- If any BIM dimensions were previously imported from the model, these do not get updated at this stage. Instead, a box will open referring you to the 'Promote BIM Dimensions" button which needs to be used to update BIM dimensions after a model has been promoted.



This is only a prompt so click OK to proceed. However, before promoting the BIM dimensions, there are two optional interim steps:

1) If any units were previously assigned to the original Model Schedule (refer Section 6.5), these do not get cleared when the model is promoted. Instead, they are retained and applied to the new Schedule. If the object properties are consistent between the previous and revised versions of the model, the retained units will most likely be valid for the revised file. However, if object properties have been amended, or new objects with different properties have been added into the model, the units may need to be amended or relocated. Units can be assigned or amended at any time, but the reason for doing this now is to ensure that the UOM of the dimensions when they get promoted are consistent with when they were previously imported. Open the Model Schedule, review the assigned units, and amend or add units as required via the right click menu. Then close the Schedule.

2) At this point there is also the opportunity to insert an external properties file (refer Section 6.14). If you wish to do this, open the Schedule and follow the steps as detailed in Section 6.14. The reason for doing this now, before promoting the BIM dimensions, is so that CostX® can include these changes as part of the revision. If they are not done now, they cannot be added later (except as a subsequent revision) because CostX® does not allow drawing or model properties to be changed after quantities have been measured or imported from it.

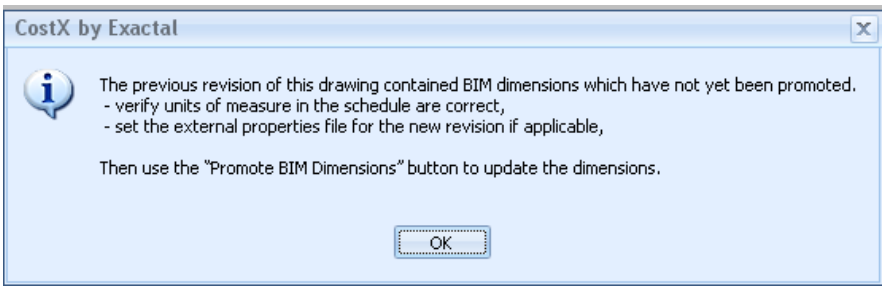
- The existing imported dimensions and Dimension Groups now need to be updated according to the properties in the revised model (as augmented by an external file if the opportunity was taken to add one). Click on the "Promote BIM Dimensions" button on the Revisions ribbon.

- Dimension groups tagged with a warning icon contain manually measured dimensions. These dimensions need to be revised and accepted in the same manner as 2D drawings. This can be done before or after the BIM Dimensions are promoted.

"Keep the same drawing and properties files"

All existing dimensions are retained using the same drawing and external properties files.

- All imported BIM dimensions for that drawing will revert to zero. Any measured or manual dimensions will be retained.
- If any BIM dimensions were previously imported from the model, these do not get updated at this stage. Instead, a box will open referring you to the 'Promote BIM Dimensions" button which needs to be used to update BIM dimensions after a model has been promoted.



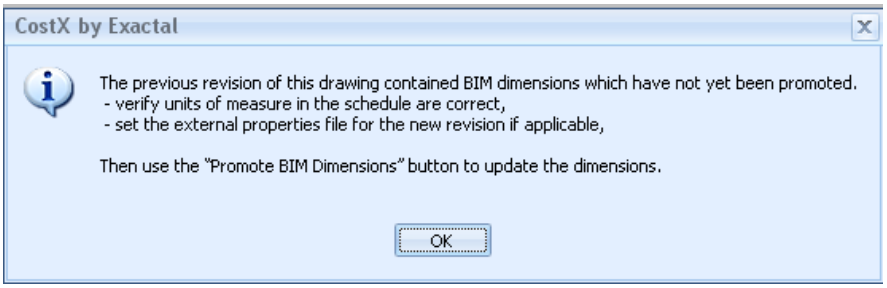
This is only a prompt so click OK to proceed.

- Click on the "Promote BIM Dimensions" button on the Revisions ribbon.

"Keep the same drawing and choose a new external properties file"

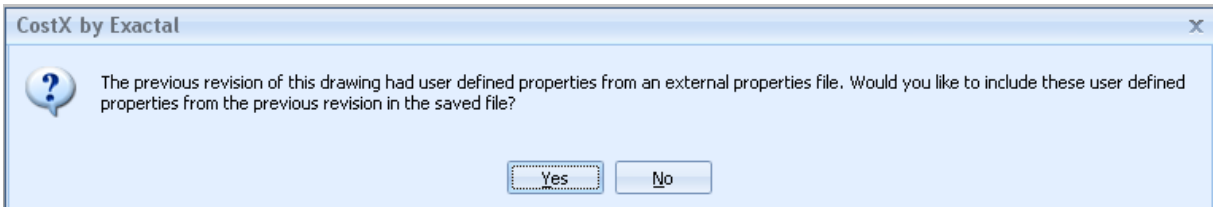
A File Open dialog box does not open to allow a new file to be selected. Instead, the same drawing is set in the Drawing Properties.

- All imported BIM dimensions for that drawing will revert to zero. Any measured or manual dimensions will be retained.
- If any BIM dimensions were previously imported from the model, these do not get updated at this stage. Instead, a box will open referring you to the 'Promote BIM Dimensions" button which needs to be used to update BIM dimensions after a model has been promoted.

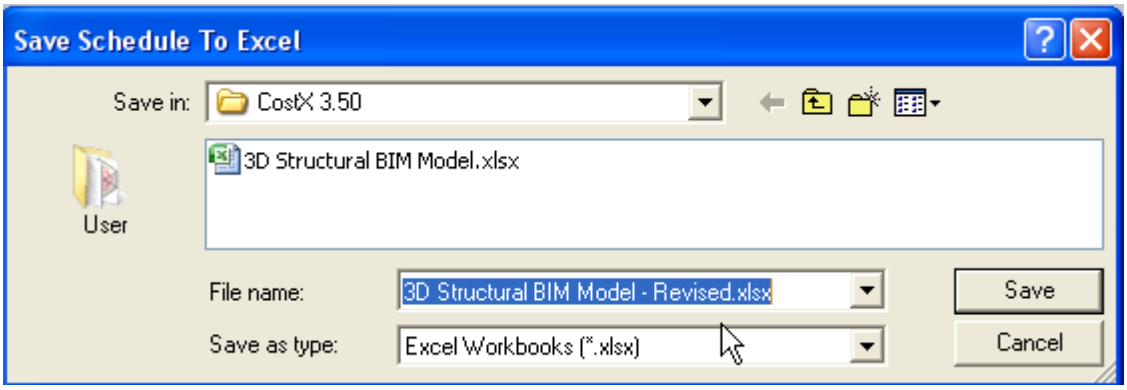


This is only a prompt so click OK to proceed. At this point (before promoting the BIM dimensions) you can update the previous external properties file, save it with a different name, and re-attach it to the drawing as follows:

- Open the Schedule. Right click over the Schedule and select "Save Entire Schedule to Excel (xlsx)". A box will open as shown below. Select Yes.



- A File Open dialog box will open to the location of the existing external properties file. The existing file should not be over-written because it relates to the previous revision which is retained in the system. Therefore, amend the file name and then click Save.



- The renamed xlsx file will open in Excel®. The spreadsheet is a copy of the CostX® schedule, with the external properties data from the previous revision added to the far right of the schedule, with the data specific to each object being inserted into the applicable row in the spreadsheet.

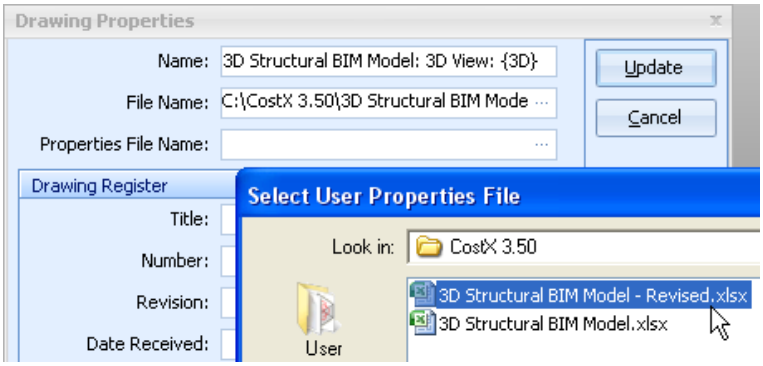
V	W	X	Y
Type Name	Volume	QSID	
150mm Concrete With 50mm Metal Deck 2	14.212 m³	UPPER FLOORS	
Concrete Deck - 400mm with Tapered Insulation 2	996.288 m³	ROOF	
Concrete-Commercial 362mm	630.076 m³	SUBSTRUCTURE	
Generic 225mm	351.857 m³	UPPER FLOORS	
Generic 225mm	350.716 m³	UPPER FLOORS	
M_Concrete-Round-Column	0.569 m³		
M_Concrete-Round-Column	0.569 m³		
M_Concrete-Round-Column	0.569 m³		
M_Concrete-Round-Column	0.569 m³		
M_Concrete-Round-Column	0.569 m³		
M_Concrete-Round-Column	0.569 m³		

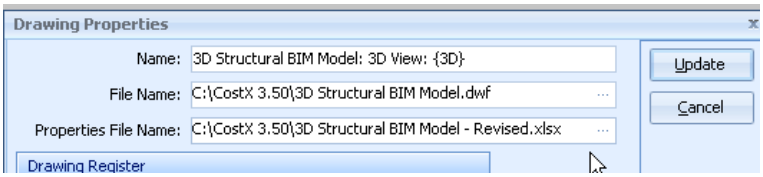
- The spreadsheet can now be edited to include additional data.

V	W	X	Y
150mm Concrete With 50mm Metal Deck 2	14.212 m³	UPPER FLOORS	
Concrete Deck - 400mm with Tapered Insulation 2	996.288 m³	ROOF	
Concrete-Commercial 362mm	630.076 m³	SUBSTRUCTURE	
Generic 225mm	351.857 m³	UPPER FLOORS	
Generic 225mm	350.716 m³	UPPER FLOORS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Concrete-Round-Column	0.569 m³	COLUMNS	
M_Pile Cap-2 Pile	1.296 m³	SUBSTRUCTURE	
M_Pile Cap-2 Pile	1.296 m³	SUBSTRUCTURE	

- When the editing is complete, save and close the Excel® file.

- Open the Drawing Properties. In the Properties File Name box click on the ellipsis (…) button to open a File Open dialog box and navigate to the saved xlsx file. Click Open to attach the file to the drawing properties and then click Update to close the Drawing Properties box.



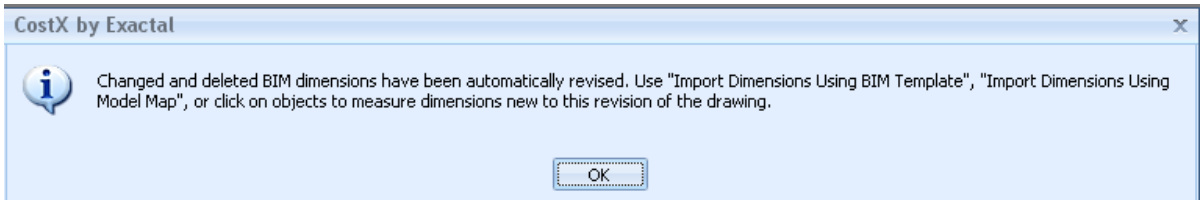


- The Schedule will re-load and the external properties data will automatically map to its host objects. The added columns will be highlighted in yellow and will also appear in the Object Properties as User Defined properties.

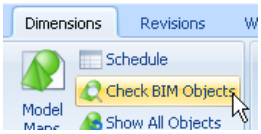
- The existing imported dimensions and Dimension Groups can now be promoted, as augmented by the new external file. Click on the "Promote BIM Dimensions" button on the Revisions ribbon.

Promote BIM Dimensions

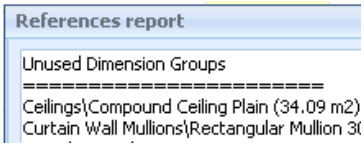
When the "Promote BIM Dimensions" box is clicked, CostX® will process the revised model properties by scanning for each object's GUID (refer Section 6.17) and comparing these to the previous model file. If the dimension properties of objects with the same GUID have changed they are revised accordingly, and if the GUID no longer exists its dimensions are deleted. Objects with a new GUID are skipped. A prompt box will then appear, click OK.



The "Import Dimensions Using BIM Template" or "Import Dimensions Using Model Map" (whichever was previously used) should now be run again to pick up the new GUID objects that have been added into the revised model, or they can be manually measured.



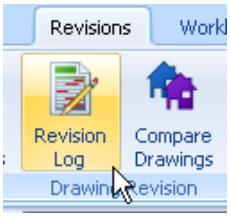
The "Check BIM Objects" button on the Dimensions ribbon will identify any duplicate IDs or objects with no corresponding Dimension Group.

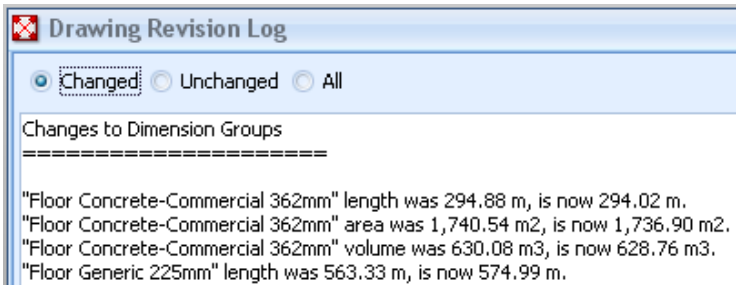


The workbook can now be promoted and all existing linked quantities will be updated. Use the "References" button on the Workbooks ribbon to identify all new Dimension Groups (ie. new objects added into the revised model). Add the necessary new items into the workbook to incorporate the new Dimension Groups.

Revision Log

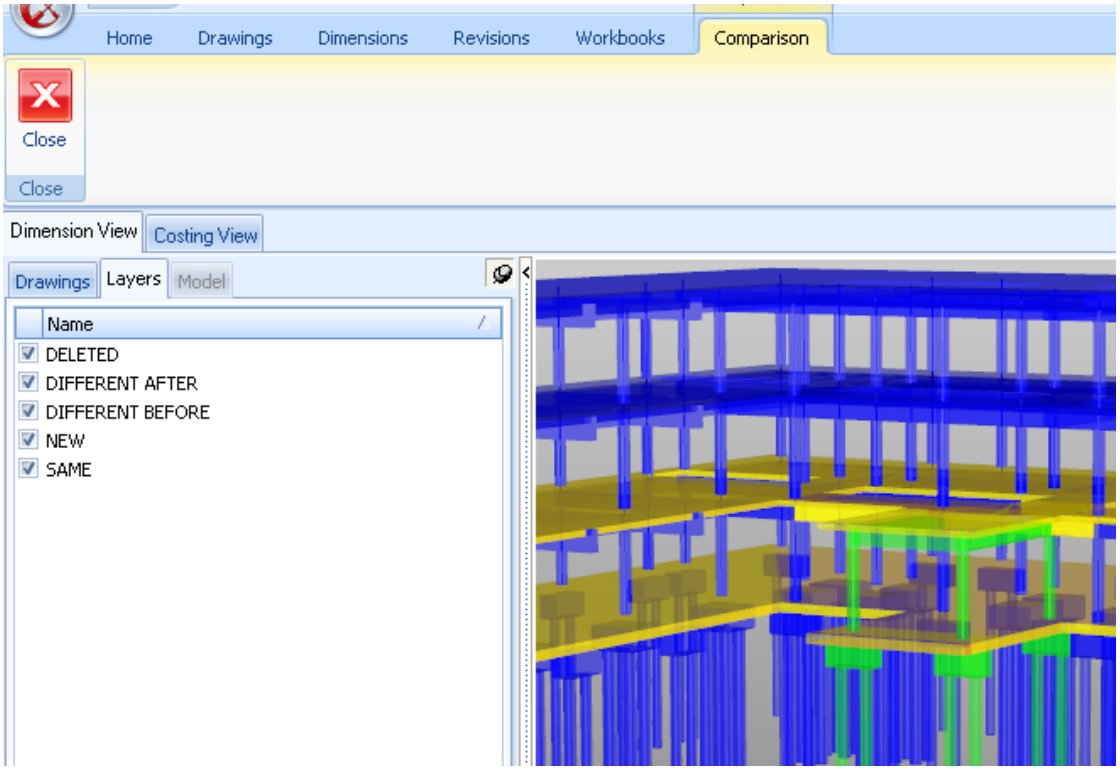
The “Revision Log” button will list all the changes as a comparison between the previous and revised object dimension properties.





Compare Drawings

Each model revision can be visually compared against others by use of the “Compare Drawings” button or the “Compare” button on the Drawings ribbon The Match Objects option should be used. Use the Layers tab to filter the comparison display, which can also be printed by use of the Reports button in the Drawings Tab. Click the Close button in the Comparison Tab to return to the Drawings view.



Bypass Revisioning

In cases where the revised drawing and model may differ significantly from the previous issue, and owing to the speed and ease of importing BIM dimensions via BIM Templates or Model Maps, a two-step process could be considered:

1) add a revision to identify and record changes that have occurred in the drawing and model files and lock the existing revision; promote the drawing but do not promote the BIM dimensions:
2) delete the existing Dimension groups (for imported BIM dimensions) and re-import the BIM dimensions from the revised drawing and model file. The Dimension Groups will then be fully consistent with the latest revision and not be a mixture of previous and revised model properties.

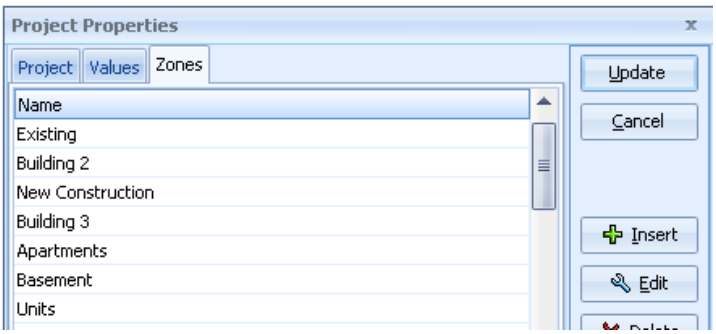
10 Zones

10.1 Use of Zones

Zones allow the capturing of measurements against specific attributes eg. different departments, basement, podium, tower, or Stage 1, Stage 2, etc. This eliminates the need to have a separate building for each cost centre.

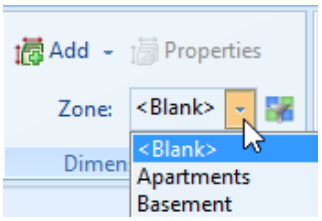
10.2 Creation of Zones

Zones are created with the Project at System administration level so need to be determined at project set up stage. Either insert new zones or the zones already in existence may suffice. New zones can also be added later in Project Properties and existing zoned dimensions can be re-allocated. Zone names are limited to 100 characters.



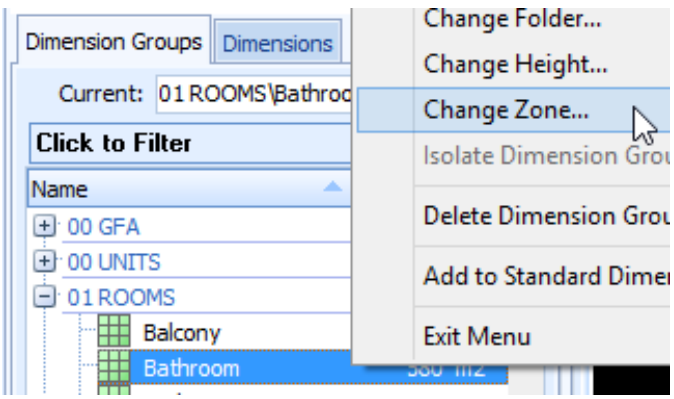
10.3 Measuring Zones

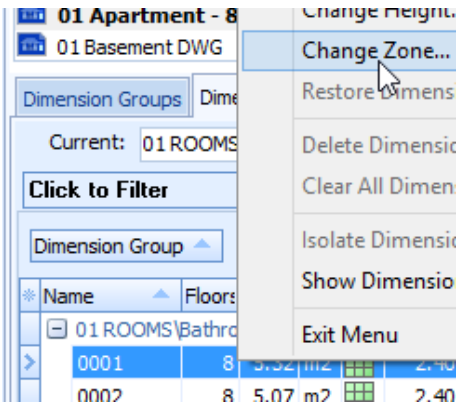
Prior to measuring a dimension, select the relevant zone from the drop-down list in the Dimensions ribbon. Upon opening CostX® this defaults to “No Zone” (blank), however once a zone is selected then all measurements taken from then on are assigned to that zone. A different zone can be selected at any time, in which case all subsequent dimensions will be assigned to the new zone. If working with multiple zones, try to ensure that dimensions are captured in the correct zone otherwise they will have to be changed afterwards.



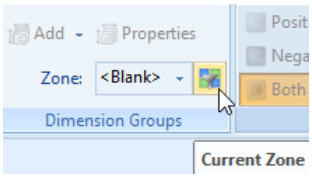
10.4 Changing Zones

The zone of a Dimension or a Dimension Group can be changed from the right mouse click menu.





10.5 Zone Filters

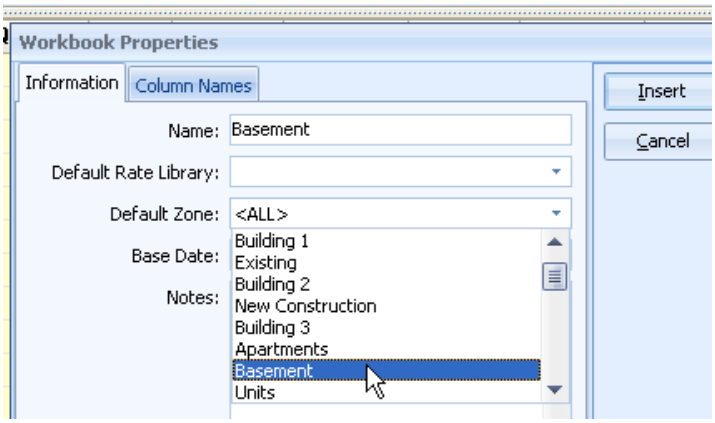


Located on the Dimension ribbon to the right of the Zone drop down box, this filter allows viewing of a selected zone to check correct dimension allocation and verify zone content.

10.6 Zones and Workbooks

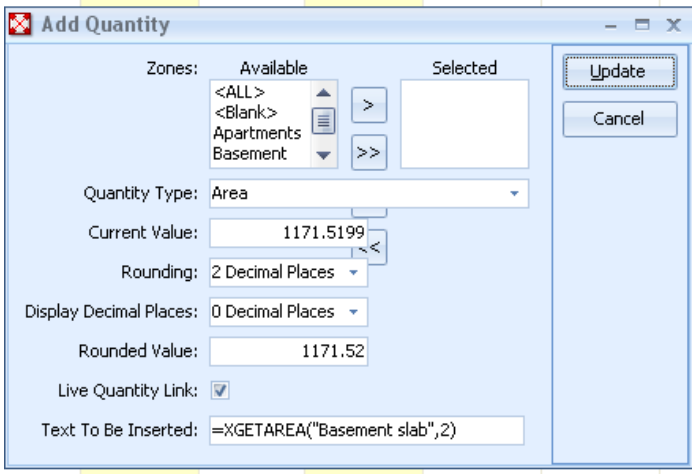
(Not available in CostX® Takeoff 2D)

Workbooks contain a zone filter function so that zone-specific workbooks and reports can be created. When a workbook is created in a building, the default setting is to have no zones applied so it will display global quantities, ie <All> zones. To create zone specific workbooks, add another workbook based on the global workbook but with a Default Zone applied. This can be done for each zone. The dimensions displayed in the workbook will be only those which were assigned to the same zone at the time of measurement.



10.7 Default Zone Precedence

Dimensions are assigned to zones at the time of measurement, whilst in the Dimension View. When a dimension is dragged and dropped into a workbook, it carries its zone property with it. The Add Quantity box also has an optional “Zones:” selection function. The purpose of this function is to over-ride the Default Zone setting of the workbook, such that the quantity being added can be included in a workbook with a different Default Zone. However the dimension value will only ever be the value associated with the selected zone, even if the Default Zone of the workbook is “All”. Consequently, it is generally not necessary to use the zone selection function when dragging and dropping a dimension unless there is a specific requirement to over-ride the workbook Default Zone setting for that dimension.



11 Coding

(Workbooks only – not available in CostX® Takeoff 2D)

11.1 Coding

Coding allows sorting and creation of workbooks by code and printing of workbooks by code.

CostX® allows coding on cost sheets, eg. to categorise estimate line items by element or trade; on quantity sheets to differentiate quantities eg. by location; and on rate sheets or in rate libraries to sort rate items eg. by labour, plant or material.

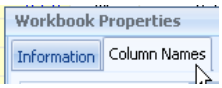
In addition, codes can also be combined with zones to add another parameter to the quantities captured. This enables the workbooks to be further analysed.

11.2 Code Libraries

In order to utilise the coding feature in CostX®, code libraries need to be established. This initial step provides the framework for the coding of workbooks or rate libraries. Code Libraries have two levels, a code group and a code description. A group can contain multiple descriptions, for example both Columns and Upper Floors can form part of the group Superstructure. Each code description must have a unique code and it is this code that is placed in the workbook or rate library for CostX® to reference. It is advisable to avoid using non alphanumeric characters (& * # – %) in the code. Alphanumeric codes are clearer and preferred. Code libraries can be setup under System Administration. It is possible to export and import EXF file code libraries and import code libraries from Excel® .CSV files.

11.3 Coding Workbooks

The A column or 'Code' column is the most visible column to use for coding, however as this column is used for section, page and/or item references when generating reports, eg. in a Bill of Quantities, it is advisable to use the workbook user columns to the right such as the I or J columns for coding. These columns can be re-named in Workbook Properties.



Codes can be manually typed into the code column, or dragged and dropped from the Codes tab in the Dimension Group window.

It is possible to have multiple codes in a cell, which is particularly useful in assigning the same heading to items in different code locations. Multiple codes are separated by a semi-colon (;) in the cell. Note that an item with two codes is replicated, not split. Therefore if concrete has been measured in m3 in an elemental estimate and separate supply and place trade sorting is required, the code for both supply and place would be placed after each concrete measurement. When the workbook is generated by code, a copy of the concrete item will appear in both supply and placing, i.e.: replicated.

Simple trade coding in Column J

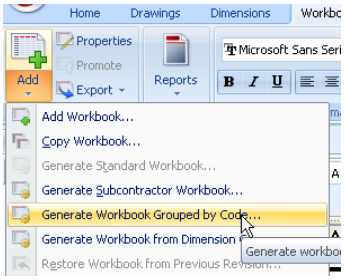
	SB	Substructure	6,131	m2	76.02	466,102	
	A:Code	B:Description	C:Quantity	D:Unit	E:Rate	H:Total	J:Trades
22		Compacting; Filling; Blinding with 50mm of sand	1,172	m2	5.70	6,680	1
23		**Insitu Concrete**					2;3;5
24		**Insitu concrete construction generally**					2
25		N32 concrete to ground beams	22	m3	251.70	5,537	2
26		N32 concrete to slab on ground	235	m3	235.30	55,296	2
27		**Formwork for instu concrete**					3
28		Sides of foundation not exceeding 250 mm high	366	m	31.01	11,350	3
29		**Reinforcement for insitu concrete**					5
30		Bar reinforcement in slab on ground	21.10	t	3,400.00	71,740	5
31		T-11 trech mesh in ground beams	101	m2	15.22	1,537	5

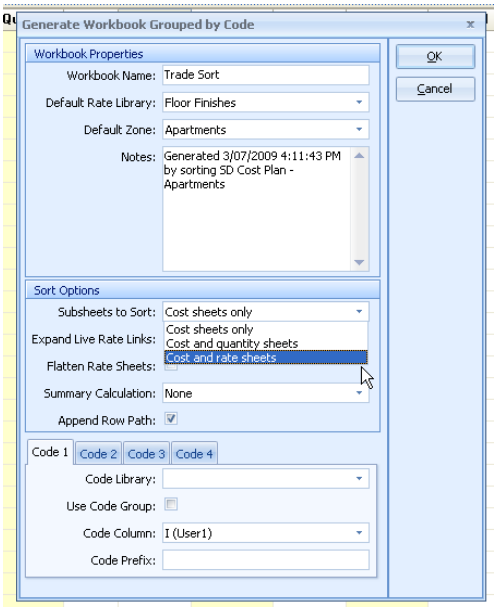
11.4 Coding Rate Build-ups

The User columns are available within rate build-ups and can be coded. This is particularly useful when using composite rates for elemental items, for example a wall rate build-up may contain timber studs (carpentry), Linings (plasterboard) and Paint (Applied finishes). Rate build-ups can also be coded with labour, plant and material coding. Note that the columns being used should correlate with those of the workbook. Also see Section 14.5.

11.5 Generating Workbook Grouped by Code

To utilise the coding feature it is necessary to generate a new workbook based on code, which is available from the drop down menu under the "Add" button on the Workbook ribbon.





After naming the new workbook it is necessary to select the rate library (if coded) to use, then select which sub-sheets to sort (cost only, cost and quantity or cost and rate – depending on which levels coding has been applied to), then the Code library and finally the Code Column, ie. the column in which the codes have been entered.

Up to four levels of coding may be specified to create a sort hierarchy. For each code, the relevant library and column must be specified. If cost and rate sheets are to be sorted and the coded rate or rate build-up is linked to a rate library, tick the "Expand Live Rate Sheets" box. If the Use Code Group box is ticked, an additional Code Group summary level is introduced.

When "OK" is clicked, an entirely new workbook is created but the two workbooks are not linked. This is important, as changes to either the original or the coded workbook will not affect the other. However, live links are retained in the new workbook, so where live link information is adjusted, such as a quantity in a dimension group, then this adjustment will be reflected in the sorted workbooks by simply doing a 're-calc'. Therefore it is advisable to select a primary base workbook to which any changes will be made, and then generate a new workbook each time a code generated workbook is required. Locking code generated workbooks is a good measure to ensure changes are only made to the primary workbook.

All workbooks generated by code place an optional location reference in parenthesis at the end of each description. This enables the relevant item to be located in the original workbook. Each number represents a level or location, hence a reference (3.1) will be located in row 1 in the second level of row 3. Where a letter is indicated, such as Q, then the item is located in the quantity sub-sheet of the relevant column. Hence in the case of (3.1Q) the original item is located in row 1 in the quantity build-up to row 3. Tick the "Append Row Path" box to enable this feature.

The sorting of workbooks based on code can also be carried out on workbooks that have already been sorted.

12 Workbook Tools

(Not available in CostX® Takeoff 2D)

12.1 Reference

On the Workbook ribbon there is a tab called “Reference”, which shows if and where a dimension group has been used.

This can be used to check what dimension groups have or have not been used and also provides a useful “unused dim groups” report and a “zero cost” (unpriced items) report. When a workbook is recalculated, an Invalid Links warning identifies which cells contain a link formula for which there is no source data (eg. a dimension group with no quantities, or an empty rate library item).

12.2 Workbook by Dimension Groups

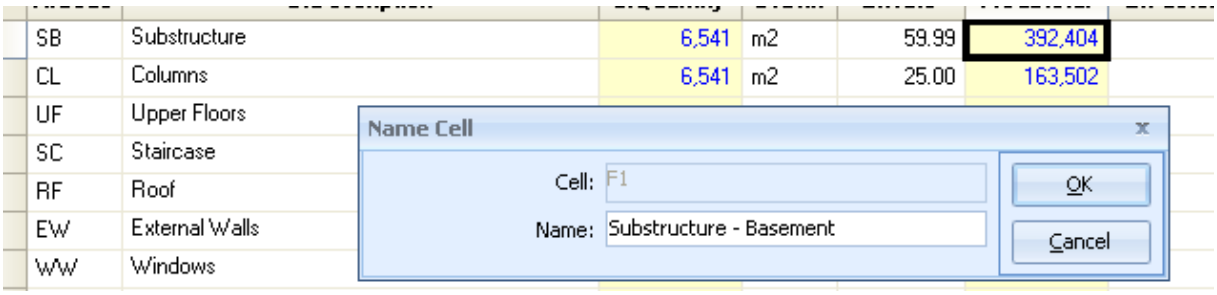
Workbooks may be generated by Dimension Groups which can be useful if you require a copy of the dimension groups, for referencing or for checking. It does not generate workbook items for zero quantity dimension groups. Also see Sections 6.15 and 14.6 regarding the use of cost-coded Dimension Groups to auto-generate priced estimates.

12.3 Locking

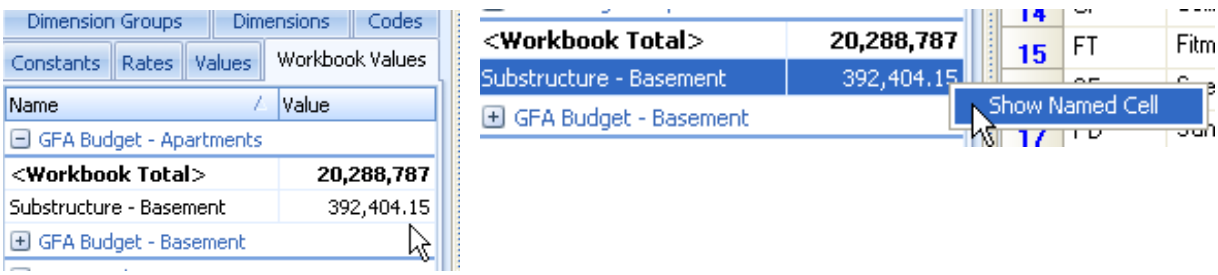
Workbooks may be locked under the Properties button (or double click on Workbook name) – tick the “locked” box. This is good practice upon completion of the work and is an alternative to promoting if there will be no further revisions. If files are to be exported for viewing it is good practice to lock or promote them.

12.4 Named Cells

Cells within workbooks may be named so that they can be referenced via a live link in other cells in the workbook, and by other workbooks within the same building. This is done by right clicking on the subject cell and selecting “Name cell”



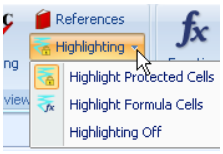
The named cell is then listed in the ‘Workbook Values” tab under the dimension groups from where it can be dragged and dropped into any other workbook. Right click on the value to “Show Named Cell”.



12.5 Cell Protection

Workbook cells may be locked to retain data. Use the "Protect Cell" button on the Workbook ribbon for individual or groups of cells (hold left mouse click to select groups of cells).

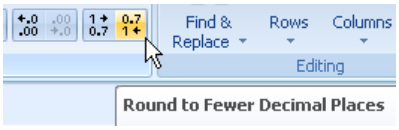
To protect linkage to sub-sheets, select "Protect Hierarchy" from the right mouse click menu.

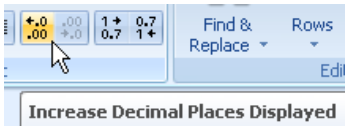


The "Highlighting" button highlights either formula cells or protected cells.

12.6 Rounding Options and Decimals Display

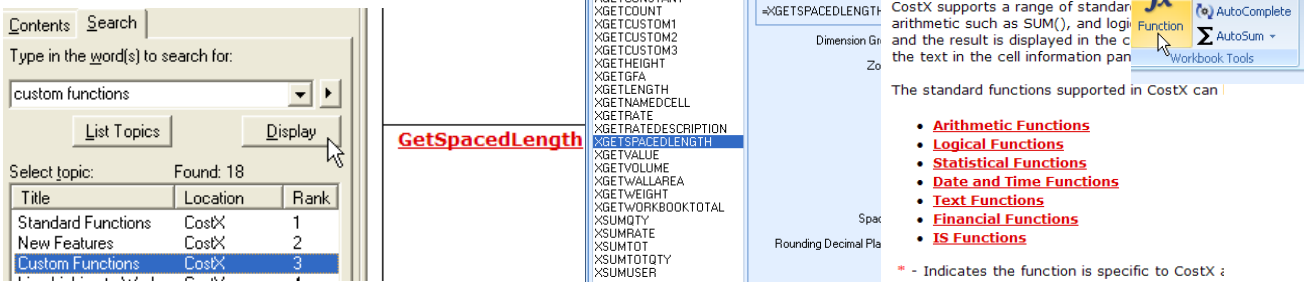
CostX® can be set to default round up or round down at instal in Server Administration (network version) or in CostX® Options (standalone).





12.7 Workbook Functions

Live links into a workbook cell can be created for a wide range of functions either by clicking the "Function" button on the Workbooks ribbon or right mouse click "Insert Function". Refer to the Help files for definitions of Standard and Custom Functions.



12.8 HLOOKUP and VLOOKUP functions in workbooks

These functions exist in Microsoft® Excel® and now work in CostX® in the same way, with the exception that CostX® does not support named ranges and so functionality in Excel® requiring named ranges is not supported. Their function is to search for specific information; HLOOKUP searches for data in rows and VLOOKUP searches for data in columns.

The **HLOOKUP** function searches for a value in the top row of a table or an array of values, and then returns a value in the same column from a row you specify in the table or array. The formula takes three arguments: the value to search for, the range or array of cells to search in, and the row in the array from which to return the result. It searches for the stipulated value in the first row of the array, and returns the corresponding value from the specified row on the same column of the array.

	A	B	C	D	E	F
1	1	2	3	4	5	
2	A	B	C	D	E	
3	First	Second	Third	Fourth	Fifth	
4	Alpha	Beta	Gamma	Delta	Epsilon	
5						
6	4.5					
7						

=HLOOKUP(3,A1:E4,3) returns "Third"

=HLOOKUP("B",A2:E4,3) returns "Beta"

=HLOOKUP(A6,A1:E4,4,FALSE) returns the #N/A! error as there is no exact match in row 1 for the search value in cell A6

=HLOOKUP(A6,A1:E4,4,TRUE) returns "Delta" as 4 in row 1 is the largest value less than the search value in cell A6

The **VLOOKUP** function can be used to search the first column of a range of cells, and then return a value from any cell on the same row of the range. The formula takes three arguments: the value to search for, the range or array of cells to search in, and the column in the array from which to return the result. It searches for the stipulated value in the first column of the array, and returns the corresponding value from the specified column on the same row of the array.

	A	B	C	D	E	F	G
1	1	A	First	Alpha		6	
2	2	B	Second	Beta			
3	3	C	Third	Gamma			
4	4	D	Fourth	Delta			
5	5	E	Fifth	Epsilon			
6							

=VLOOKUP(3,A1:D5,3) returns "Third"

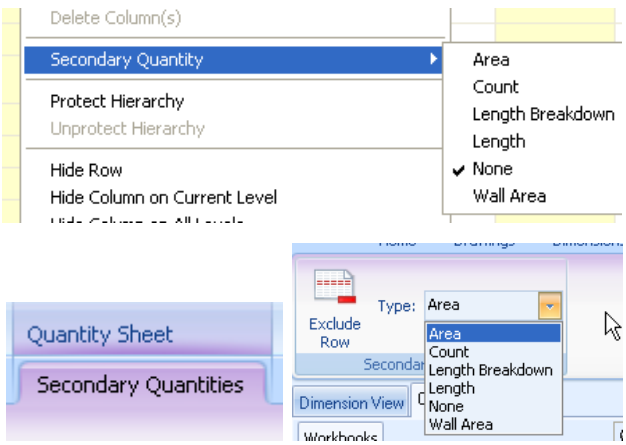
=VLOOKUP("B",B1:D5,3) returns "Beta"

=VLOOKUP(F1,A1:D5,4,FALSE) returns the #N/A! error as there is no exact match in column A for the search value in cell F1

=VLOOKUP(F1,A1:D5,4,TRUE) returns "Epsilon" as 5 in column A is the largest value less than the search value in cell F1

12.9 Secondary Quantities

CostX® workbooks can automatically display secondary quantities appended to workbook descriptions, such as the area of a slab measured by volume, or the lengths of steel members measured by tonnage. This feature is controlled by a simple right mouse click command in the cost sheet (thus allowing multiple cells to be selected), or the Secondary Quantities tab in the Qty sheet. The Exclude Row button allows rows to be selected for exclusion from the secondary calculation.



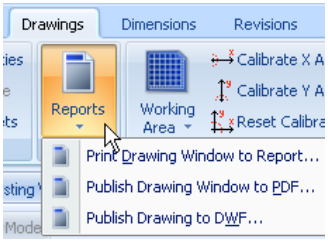
REINFORCED INSITU CONCRETE N32		
Pad footing placed between excavated faces :[5 no]	5	m3
Ground beam placed between excavated faces	3	m3
Pedestal :[22 No]	2	m3
Slab on ground 100-200 thick including thickenings :[5471 m2]	116	m3
Slab on ground 100-200 thick including thickenings laid to falls :[898 m2]	10	m3
COLUMNS		
75 x 4 SHS column :[5/3.2]	14.21	t
89 x 3.5 SHS column :[12/3.6 5/4.2 18/6.3]	198.92	t
100 x 4 SHS column :[4/6.0 5/6.3 3/6.5 2/6.8]	88.25	t
125 x 4 SHS column :[6/8.5 4/9.2]	87.80	t

13 Reports

(Not available in CostX® Takeoff 2D)

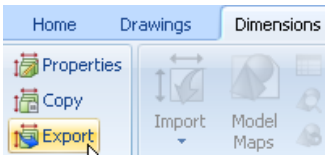
There are a number of options available to create report output from CostX®.

13.1 Drawing Reports



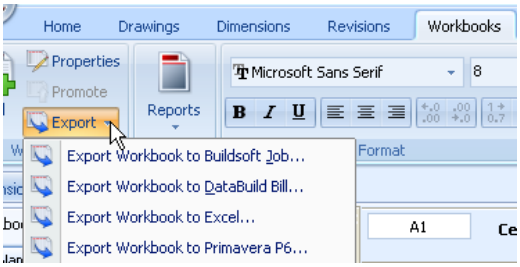
The Reports button on the Drawings ribbon provides a means to print the drawing window display to a report or publish a PDF or DWF. Reports can be printed to hard copy, PDF or to a selection of file types.

13.2 Export Dimensions to Excel®



The Export button on the Dimensions ribbon will export Dimension Groups and dimensions to an Excel® spreadsheet.

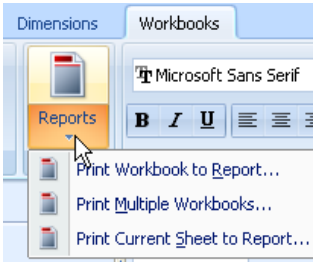
13.3 Export Workbook



The Export button on the Workbooks ribbon provides options to export workbooks to a variety of third party applications.

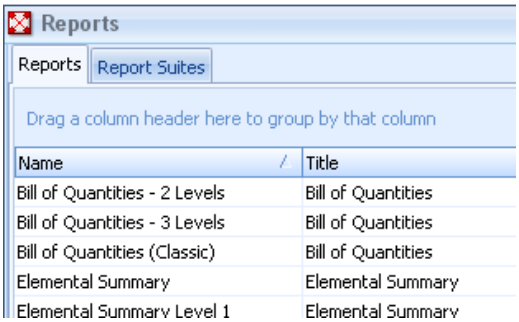
13.4 Workbook Reports

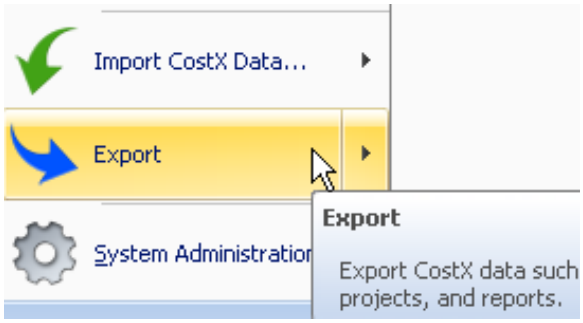
The Reports button on the Workbooks ribbon contains three options. The “Print Current Sheet to Report” will print the currently displayed Cost, Qty or Rate sheet.



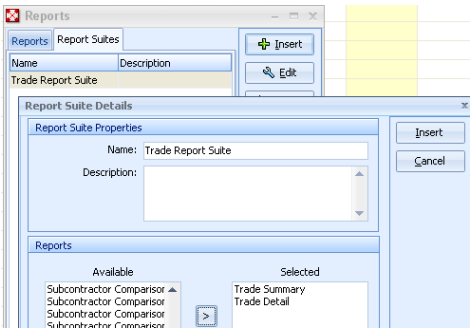
The “Print Multiple Workbooks” option allows any or all workbooks within the Building to be selected and the content at each workbook level either merged or itemised in a consolidated report. “Print Workbook to Report” applies only to the currently selected Workbook.

In both cases, the required report output is selected from the Reports window, which contains a listing of available Reports. These Reports are actually templates which contain formatting properties which determine report content and layout. By editing these templates, it is possible to manipulate the report output. CostX® ships with a selection of default Reports which users can copy and edit to suit their requirements. Report templates can also be exported and imported (main menu options “Import CostX Data” and “Export Report to EXF”) which is useful for sharing and also for archiving of job-specific reports rather than keeping them in the Reports list.





The Report Suites tab allows you to insert a Suite to enable reports selected from the Reports list to be grouped as a Suite and printed as a batch from single mouse click.



13.5 Standard, Custom and System Reports

CostX® has three types of report, namely “Standard”, “Custom” and “System”. The format and configuration of these reports is managed by two separate and discrete report writers.

The “Standard” Report Writer allows default Standard reports shipped with CostX® to be edited to suit user requirements. The editing tools allow a degree of customization but only within defined parameters.

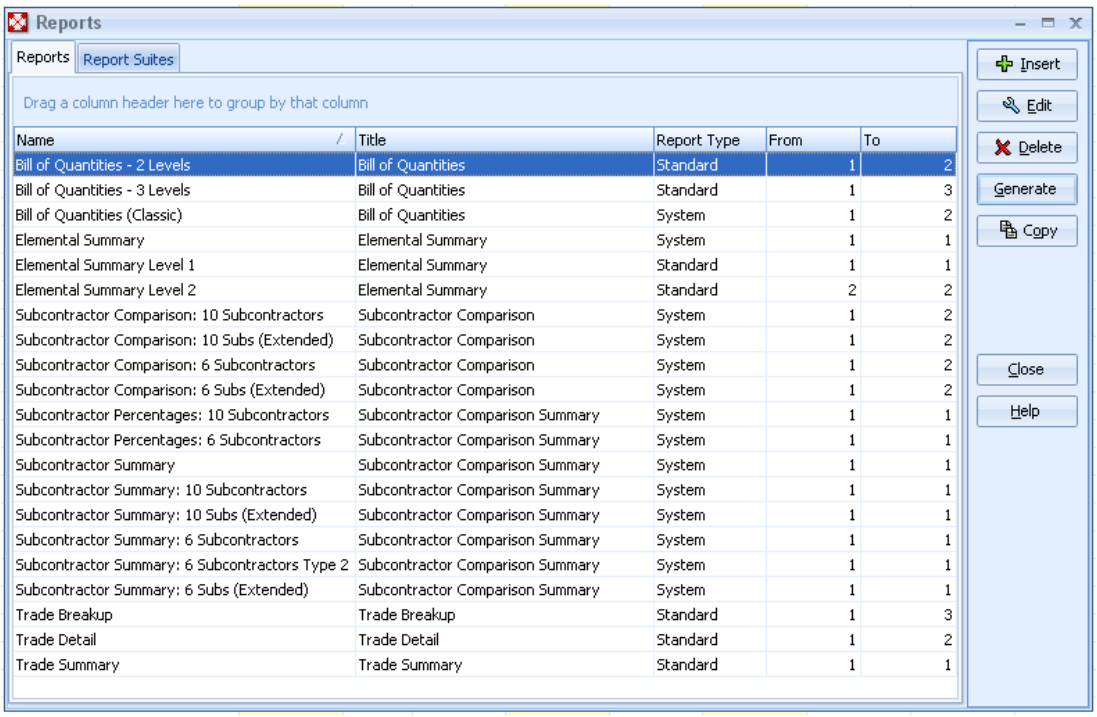
The “Custom” Report Builder allows fully customized reports to be designed from scratch and for existing Custom reports to be edited.

A “System” report is a default “Custom” report shipped with CostX®. “System” reports cannot be edited, but they can be copied as a Custom report which can then be edited.

Standard and Custom reports are not interchangeable and one cannot be converted to another.

The type of report is shown in the Reports list.

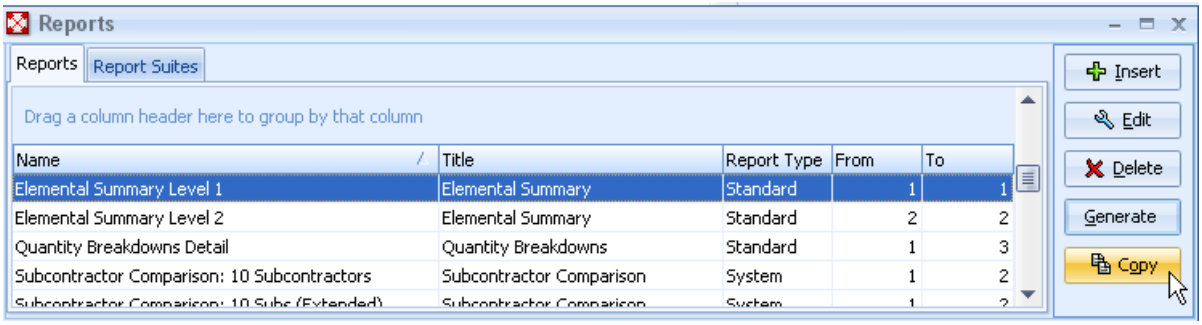
The following Reports list is the default set that ships with CostX®. In addition, two sample Standard report templates are included with the CostX® download package as EXF files that can be imported into CostX®. These are called Bill of Quantities Classic and Quantity Breakdowns Detail.



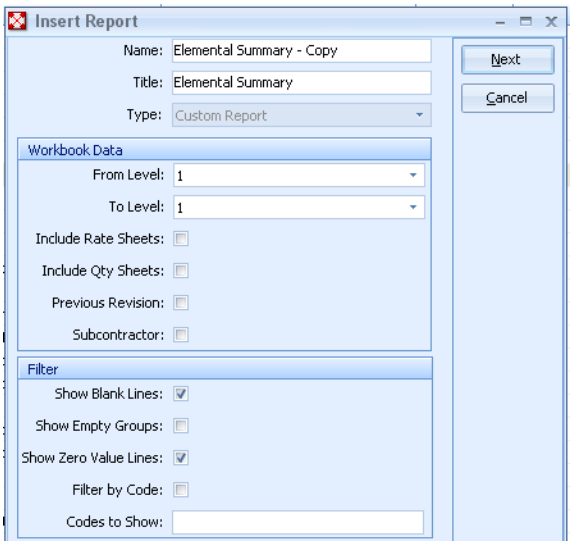
Name	Title	Report Type	From	To
Bill of Quantities - 2 Levels	Bill of Quantities	Standard	1	2
Bill of Quantities - 3 Levels	Bill of Quantities	Standard	1	3
Bill of Quantities (Classic)	Bill of Quantities	System	1	2
Elemental Summary	Elemental Summary	System	1	1
Elemental Summary Level 1	Elemental Summary	Standard	1	1
Elemental Summary Level 2	Elemental Summary	Standard	2	2
Subcontractor Comparison: 10 Subcontractors	Subcontractor Comparison	System	1	2
Subcontractor Comparison: 10 Subs (Extended)	Subcontractor Comparison	System	1	2
Subcontractor Comparison: 6 Subcontractors	Subcontractor Comparison	System	1	2
Subcontractor Comparison: 6 Subs (Extended)	Subcontractor Comparison	System	1	2
Subcontractor Percentages: 10 Subcontractors	Subcontractor Comparison Summary	System	1	1
Subcontractor Percentages: 6 Subcontractors	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary: 10 Subcontractors	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary: 10 Subs (Extended)	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary: 6 Subcontractors	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary: 6 Subcontractors Type 2	Subcontractor Comparison Summary	System	1	1
Subcontractor Summary: 6 Subs (Extended)	Subcontractor Comparison Summary	System	1	1
Trade Breakup	Trade Breakup	Standard	1	3
Trade Detail	Trade Detail	Standard	1	2
Trade Summary	Trade Summary	Standard	1	1

13.6 How to Copy a Report

In the reports list, click on a report title to select it, then use the “Copy” button.



This will bring up the “Insert Report” screen, which allows you to insert some high level properties for the new report. Then click “Next”.



Name: The name of the report that will be used in the report listing and in the EXF table of contents if the report is exported.

Title: The title of the report that will be available as the TITLE keyword. This value can be adjusted by end users on the generate screen.

Editing Access: Are other users able to modify the report?

Type: The type of the report – standard or custom. This cannot be changed when copying a report, but can be changed when inserting a new, blank report.

From Level: The workbook level from which data will be available in the report.

To Level: The workbook level to which data will be available in the report excluding any quantity or rate sheets.

Include Rate Sheets: Include the contents of the rate sheets in the report data.

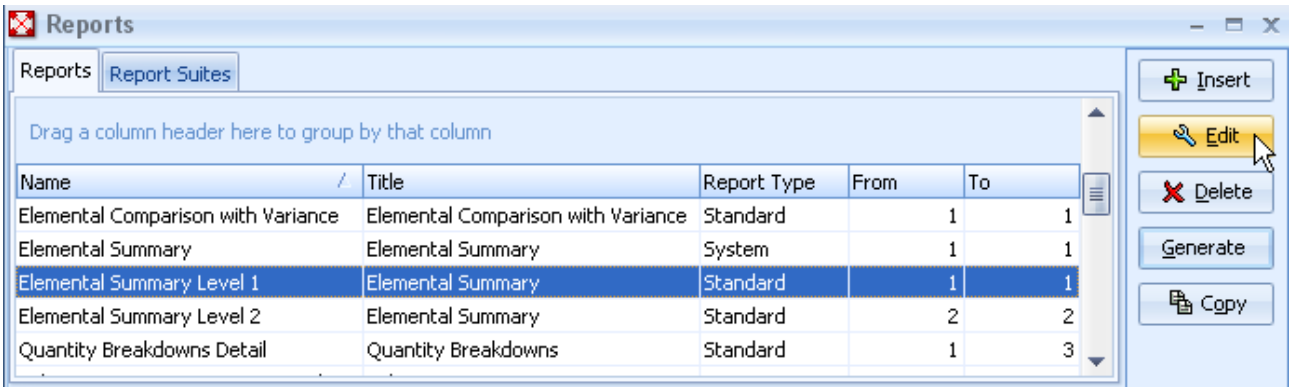
Include Qty Sheets: Include the contents of the quantity sheets in the report data.

Previous Revison: Include columns for the values of the fields at the previous revision, as well as the variance from the previous revision, in the report data.

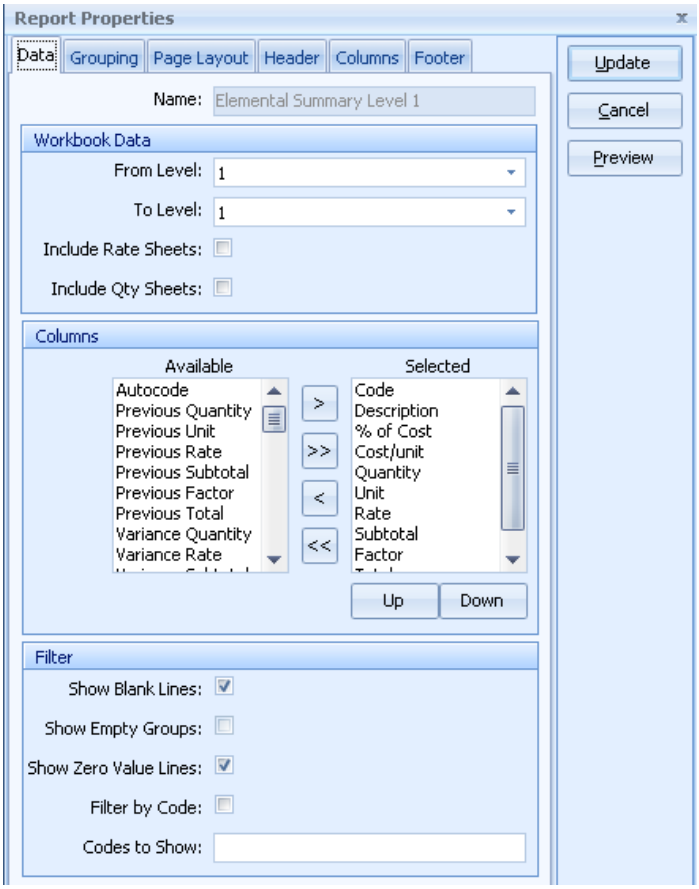
Subcontractor: Include columns for the subcontractor comparisons workbook reports.

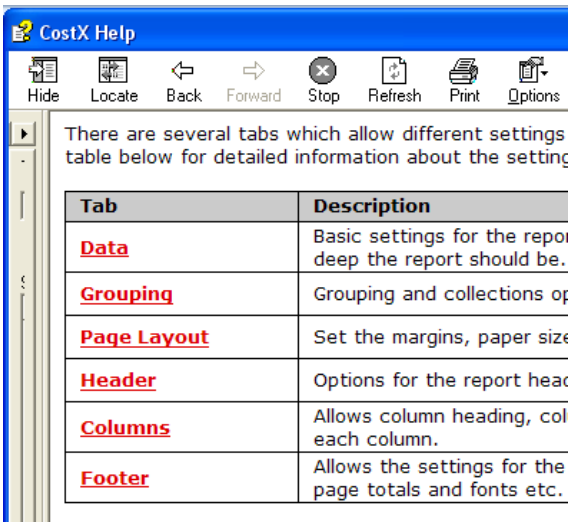
13.7 How to modify a Standard Report

Click on a Standard report title to select it, and then use the “Edit” button. It is not obligatory, but may be worthwhile to copy the report first, so that the default format is retained.



The Report Properties box will open. Each of the tabs contains various settings to configure a particular set of properties. Refer to CostX® Help for details of how to manipulate each of the Report Properties tabs. Note that whilst editing report properties, the report can be previewed at any time but this does not save the settings. The Update button must be used to save the edited report properties. Note also the ability to Filter reports by Code.

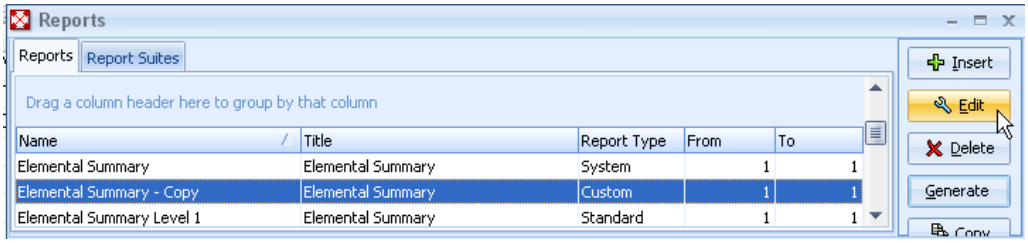


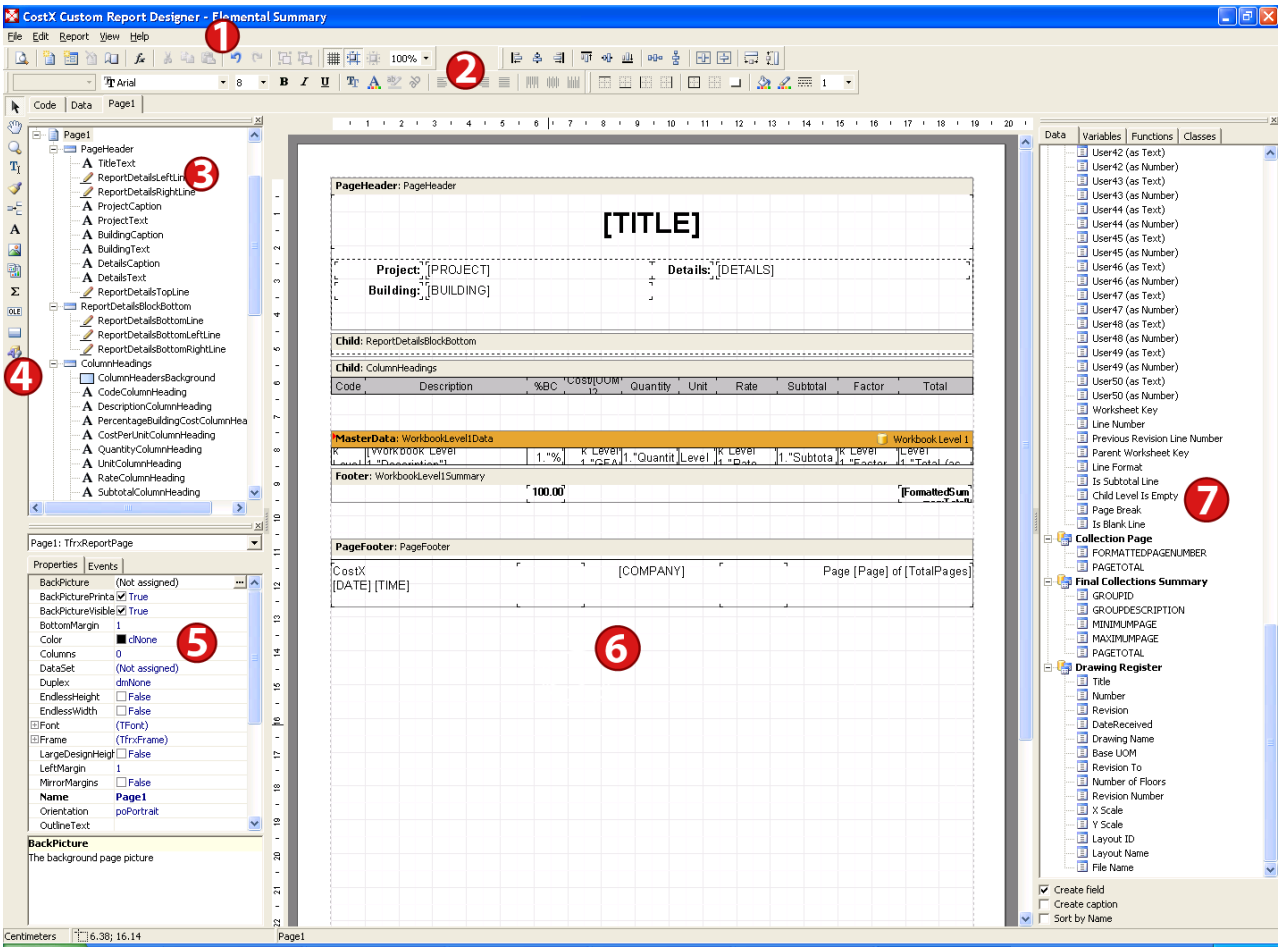


13.8 How to customise a System or Custom Report.

System reports are default templates which are fixed and cannot be edited. First copy and re-name the System report. The re-named report will be in Custom format.

Click on a Custom report title to select it, and then use the “Edit” button to open the Custom Report Designer screen. For more information, refer to the CostX® Custom Reports Guide.





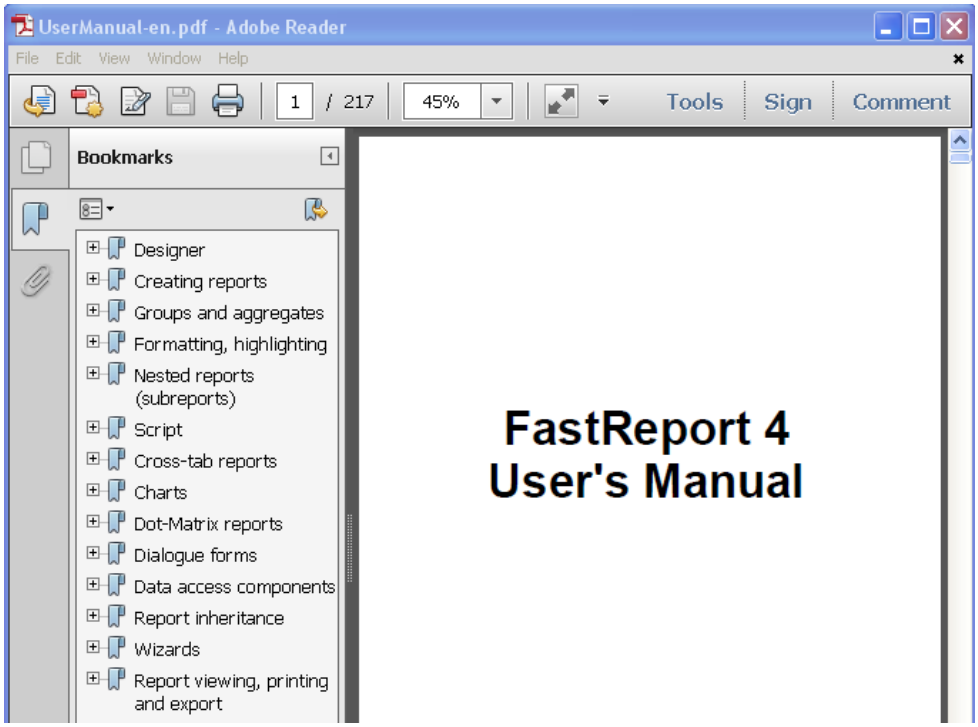
1. Menu bar: provides access to options, help, etc.
2. Toolbars: provides functions to allow you to modify existing report objects
3. Report Tree: shows the objects that exist in the current report
4. Object Toolbar: allows you to create new report objects
5. Object Inspector: allows you to see the properties of existing report objects
6. Design Workspace: shows the layout of the current report “page”. The tabs above the report tree allow you to switch between the pages of the report, the data area, and the code associated with the report.
7. Data Tree: shows available data that can be dragged and dropped to create new report objects. The tabs above the data tree allow you to view the various kinds of data you can use.

CostX® Custom Reports Guide

The CostX® Custom Report Builder allows fully customizable and programmable report templates to be created. The CostX® Custom Reports Guide provides guidance on the use of the Custom Report Builder and covers the most commonly required customisations. For more advanced functions including programming script, refer to the FastReport 4 User's Manual.

FastReport 4 User's Manual.

FastReport 4 is the underlying report builder engine to the CostX® Custom Report Builder. A comprehensive user's manual PDF document is included in the CostX® installation folder.



14 Rate Libraries

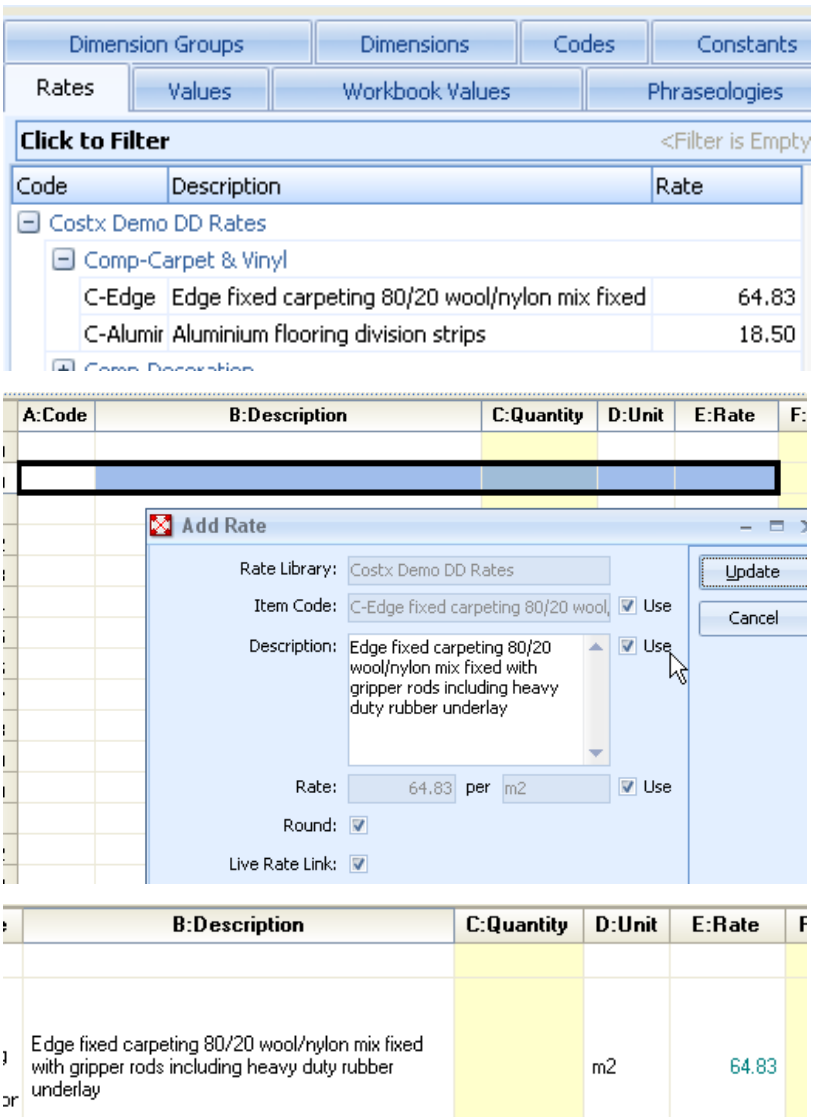
(Not available in CostX® Takeoff 2D)

14.1 Rate Libraries

Through the use of rate libraries it is possible to link items measured in an estimate to rates in a library. As a result, the rate cell in the workbook may be populated with an "XGetRate" formula and shown in green (live linked). When rate libraries get updated, all "XGetRate" cells will automatically update (unless locked). If rates are to be manually amended then simply overwrite the formula by entering the rate. Alternatively, rates can be simply manually input into the workbook without the use of libraries, or can be built up by drilling down to a Rate Sheet by double-clicking on the rate cell.

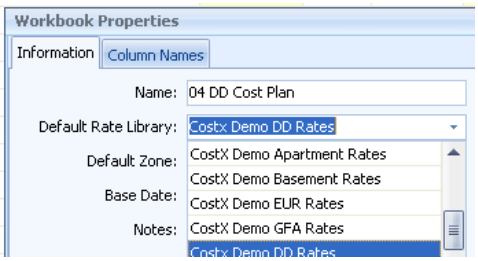
"XGetRate" links can be added into a workbook using the Edit function from the Function button or right mouse click, and may also be dragged and dropped from the Rates tab in the Dimension Group window. If the rate is dropped into the Description column B a line item will be created. However, if it is dropped into the rate column E only the rate will be entered into the destination cell.

A rate code can also be inserted into any cell which the rate column can reference with the formula "XGETRATE(cell ref)". This will return the relevant rate in the rate column.

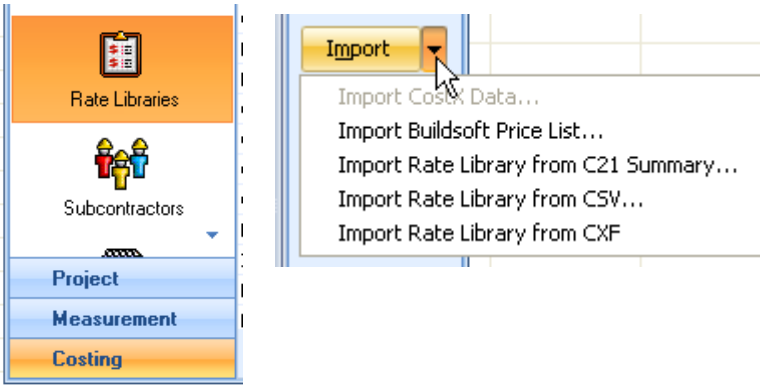


All rates are assigned to a Location and only rates with the same Location as the active Project, or rates in <Default Location>, can be accessed.

Different rate libraries can be selected in Workbook properties, eg. to enable pricing from alternate price lists.



Rate Libraries may be created from scratch by using the "Insert" button and manually creating the individual rate items, or can be imported in a variety of formats. Under System Administration, select "Costing", "Rate Libraries", "Import".



14.2 To Manually Create a Rate Library

To create a rate library enter System Administration. Click the Rate Libraries button under "Costing" and select "Insert". In the dialog enter a name for the rate library and select the upper Insert button to save the rate library to the system.

Reopen this new rate library by double clicking on it or by clicking Edit. When the rate library is open select the Insert button to create rate items.

Enter the code for the rate and set the location. Make sure the location is the same as the project location you wish to use it in. <Default Location> can be accessed by all projects, ie. all locations.

The description may be as brief or detailed as you wish. When the rate is added to the workbook, the description can be brought in at the same time so having comprehensive descriptions can be worthwhile. The rate group is optional but will allow multiple rates to be grouped together for organisation purposes, which can be very helpful with extensive rate libraries. The unit of measure can be typed in or selected from the pull down of the UOM. The rate can be directly entered as a numerical value, or the rate calculation icon clicked on to insert a rate build-up. (See 14.4 below).

To complete the rate calculation click Update, and to add the rate to the rate library select the Insert button.

14.3 Importing a Rate Library from Excel® (CSV)

Within Excel the rate list you wish to import must be in a specific format. Each rate must be on a separate line, and each line must include rate data in the following order:

Item Code, Description, Rate Group, UOM, Rate, Location

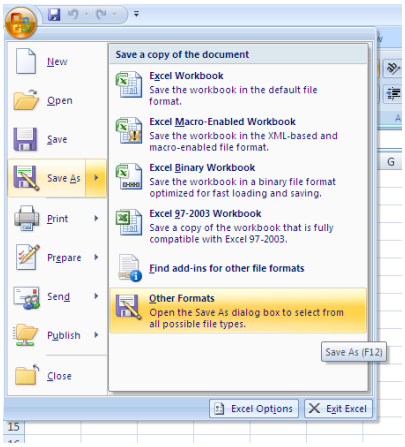
No headings defining the fields are required. Rates should be entered from the first line. The Item Code is the only mandatory field. Fields that are blank (except Location) cannot be omitted, ie. must be left blank.

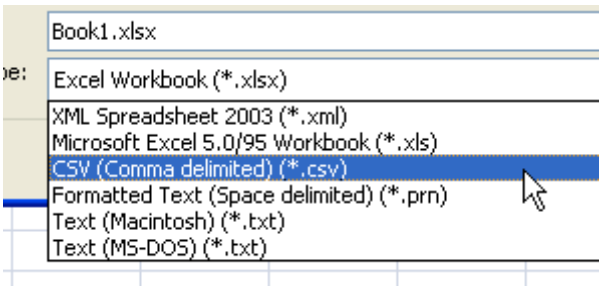
Additional fields after the Location field are ignored.

134770	METAL PELMET UP18	DOOR JAMBS	no	30.23
121200	19X12 FJ PINE	MOULDINGS	m	0.79
121250	31X12 FJ PINE	MOULDINGS	m	0.74
121290	42X12 FJ PINE	MOULDINGS	m	1.03
121330	68X12 FJ PINE	MOULDINGS	m	1.46
121380	93X12 FJ PINE	MOULDINGS	m	2.14
121420	116X12 FJ PINE	MOULDINGS	m	2.99

Rates that contain letters or other illegal characters are imported as zero (0).

Once the excel sheet is correctly formatted it should be “Saved As” “Other Formats” and saved as a .csv (Comma delimited) file, then you can import it into CostX®.





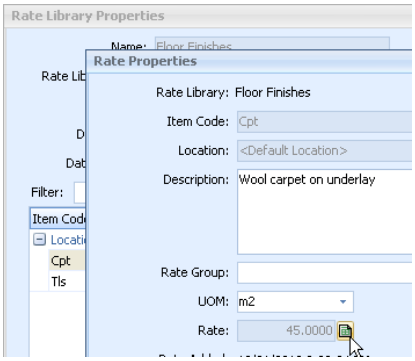
Rate libraries can also be exported to CSV. This can be used to export, copy and edit, (for example to a different Location) and then re-import rate libraries, The name of the re-import must be different to the existing library, or alternatively delete the existing rate library before re-importing the amended version if it is to be over-written.

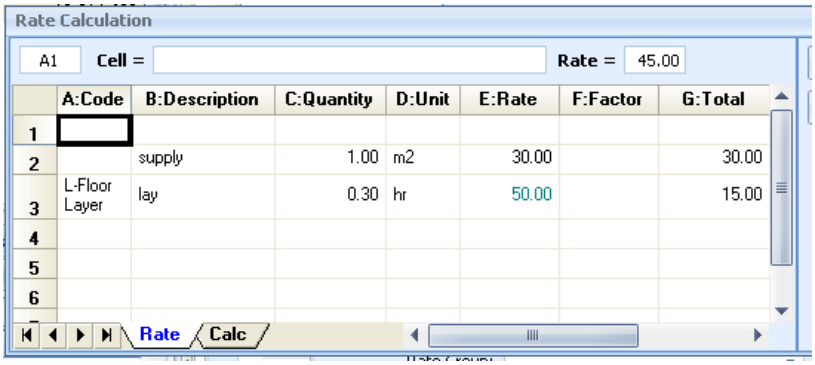
An Update button allows a selected Rate Library to be updated with additional or edited data from a CSV file without the need to delete and replace it. CostX® will compare the contents of the CSV Update to the existing Rate Library and all new data will be added and existing unchanged data will remain untouched.

Rate libraries can be exported as a CostX® EXF file for archival purposes or to share with other CostX® users.

14.4 Rate Build-Ups

Rate values may be built up or calculated in the Rate Calculation spreadsheet which is accessed by clicking the spreadsheet button in the Rate field of the Rate Properties box.





Note that when in the Rate Calculation sheet it is possible to insert a rate (right click "Insert Rate") from another library to create a hierarchy – for example, a rate calculation could include labour or material rates from other libraries. If the labour item is updated in the labour library, the rate calculation in this library is automatically updated when the rate library is recalculated.

Rate build-ups can be included in Excel® CSV imports/exports, in which case an additional column is inserted on the left with an item code I for the line item, immediately followed by B for the associated Build-Up items.

A	B	C	D	E	F	G	H
I	32mpa slab	32mpa slab	Concrete	m3	244.38	<Default Location>	
B		Supply	1.05	m3	154	1.03	
B		Pump	1	m3	22		

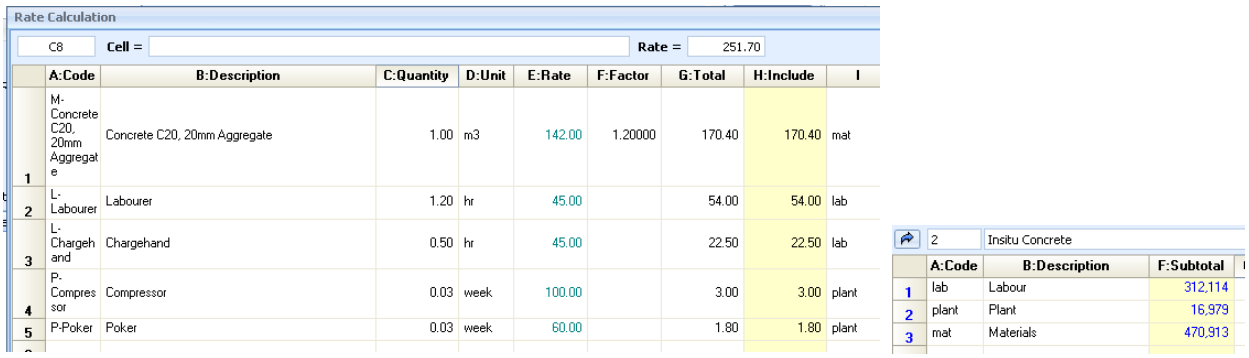
14.5 Rate Functions in Workbooks

Rate build-ups can be dragged and dropped into a Rate Sheet in a workbook. First open the Rate Sheet for the subject line item. Then drag and drop the library rate into column E in the Rate Sheet but before releasing the mouse click, hold the keyboard Alt key, then release. The rate calculation items will be inserted into the Rate Sheet.

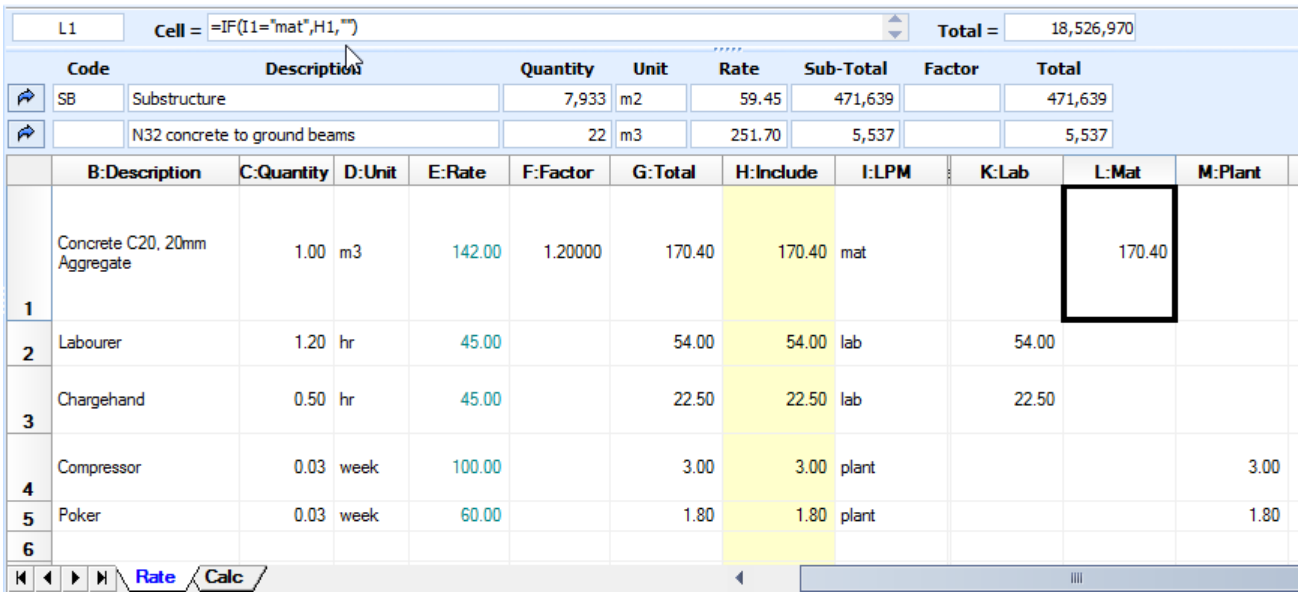
It is also possible to copy and paste Rate Calculation items into a workbook Rate Sheet. Select a live rate, open the Rate Properties (use the Show Source button or right click Edit Rate), and open the Rate Calculation.

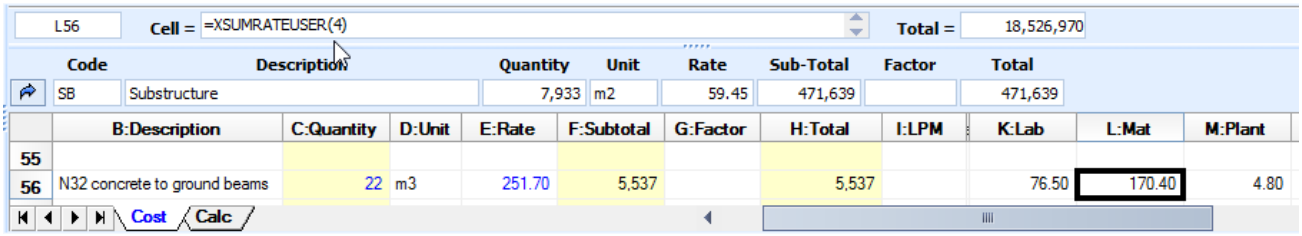
Hold left click and drag the mouse over the cells in the Rate Calculation that you wish to copy, then copy, close the Rate Calculation and Rate Properties boxes, then paste directly into the workbook Rate Sheet.

Rate build-ups can also be coded for sorting purposes (refer Section 11).



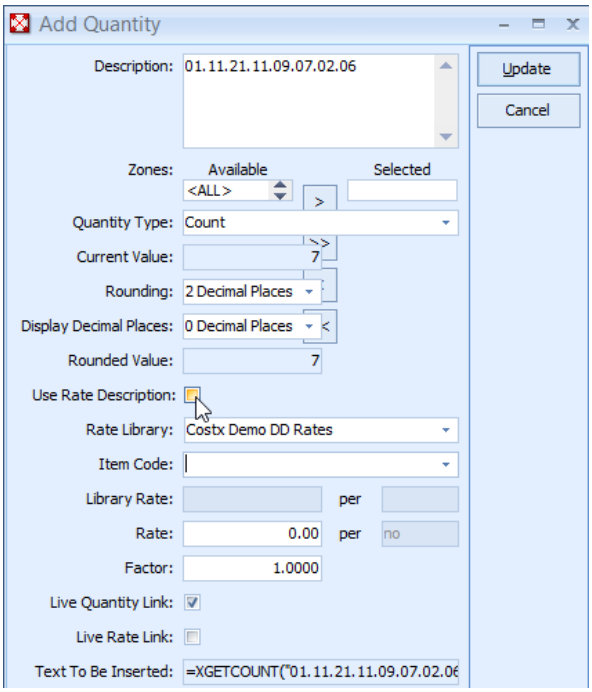
Rate calculations carried out in the user columns of a workbook Rate Sheet can be summarised on the parent Cost Sheet by using the "XSUMRATEUSER(Column)" function in a Cost Sheet cell, which will carry the total of the nominated user column up from the Rate Sheet onto the Cost Sheet. Note that in the formula the column numbering starts at column I which being the first user column is column 1; J is 2, K is 3 and so on. Also note the use of IF statements and the re-naming of workbook columns in the following example.



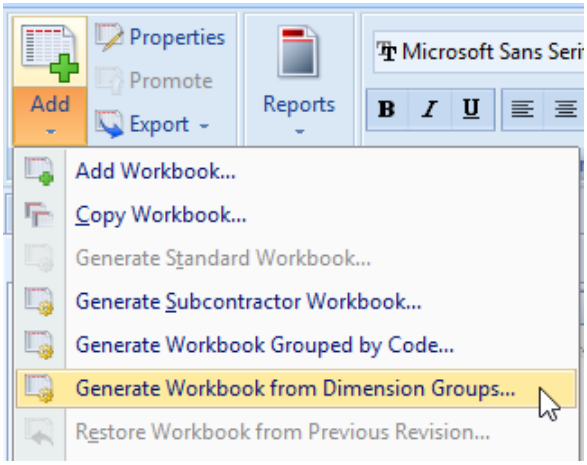


14.6 Rate Descriptions in workbooks

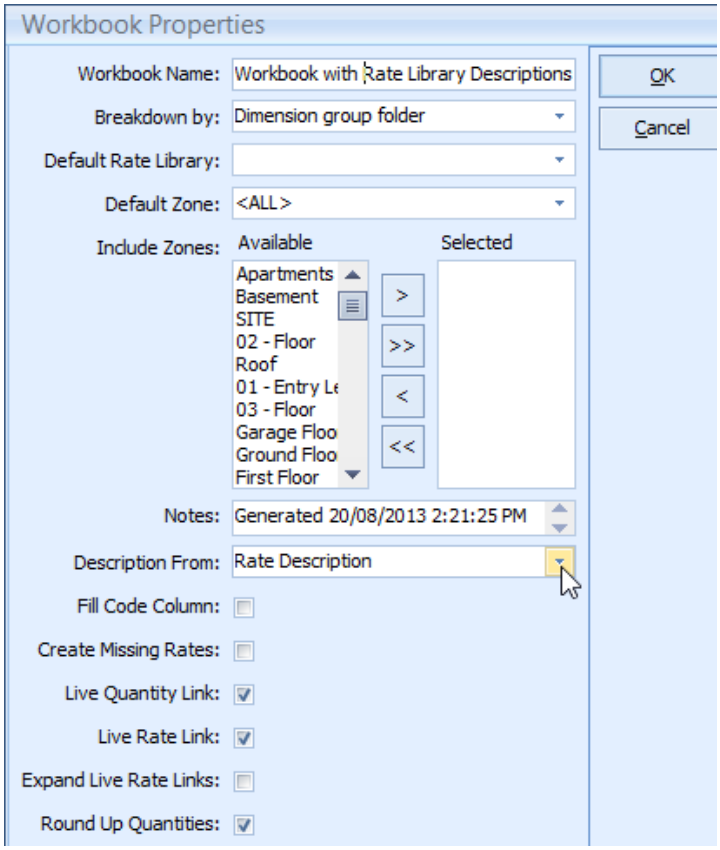
Rate descriptions can be auto-inserted into workbooks either via a Dimension Group drag-and-drop option, or when creating a workbook from Dimension Groups. To use this function, the rate codes should be used to name the Dimension Groups. Then, when dragging and dropping a Dimension Group, simply tick the "Use Rate Description:" box in the Add Quantity dialogue box. The Dimension group name (which will be the rate code) will be inserted into the A:Code workbook column, and a formula will be inserted into the C:Description column (XGETRATEDESCRIPTION(A1)) which will link to the relevant description for that code in the Rate Library, and into the E:Rate column (XGETRATE(A1)) which will link to the relevant rate for that code in the Rate Library. This allows a fully priced estimate item with full description to be automatically created when the Dimension Group is dragged and dropped.



When creating a workbook from the Dimension groups, use the Generate Workbook from Dimension Groups menu option.



Then select the Rate Description option from the drop-down menu in the "Description From:" box in the Workbook Properties dialogue box.



The Fill Code Column box will insert the rate code (Dimension Group name) into the A:Code workbook column.

The Create Missing Rates box will insert a rate item into the Rate Library for any code which does not currently exist in the Rate Library. The rate item can then be edited to include the missing data.

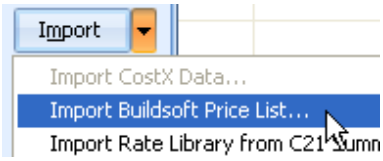
The Live Quantity Link and Live Rate Link boxes will maintain the workbook linkages to Dimension Groups and Rate Libraries.

The Expand Live Rate Links will insert any rate build-ups into the underlying rate sheet under the rate cell.

14.7 Project-Specific Rate Libraries

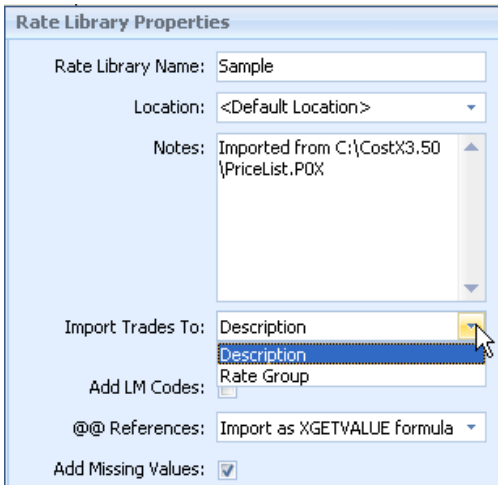
If it is required to edit particular rates in the library for a specific project, copy the library and re-name it with the name of the project, then edit the copy. To limit the number of libraries in the database, the project libraries can be exported and filed with the project files.

14.8 Import Buildsoft Price List



There are various options when importing a price list from Buildsoft.

The “Import Trades To” option allows the BS trades to be imported into either the description or rate group columns in the CostX® Rate Library.



If the BS rate build-up has separate labour and material columns, these will be aggregated into the CostX® rate column ass two separate line items. The Add LM Codes tick box will insert LAB and MAT codes into the CostX® rate calculation sheet and these can be used for coding purposes (Refer Section 11).

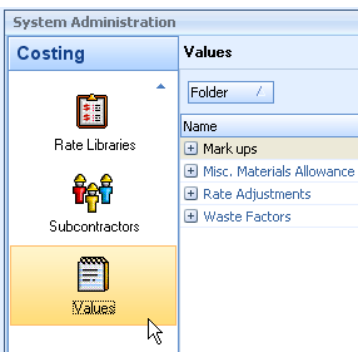
The @@ References option allows BS job references to Global Sheet items to be imported either as numbers or as an XGETVALUE formula which creates a link to a CostX® Value. By ticking the Add Missing Values box, a CostX® Value is automatically created for each @@ reference.

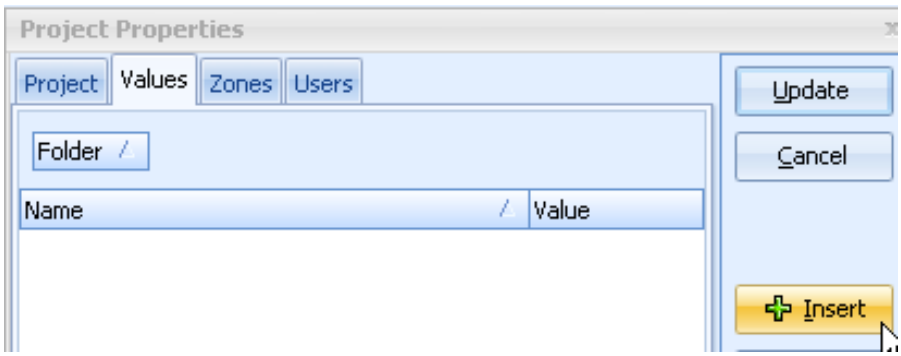
These are created as CostX® Global Values, which the user can then edit as Project Values by creating a Project Value using the same Value name.

14.9 CostX® Values

Values can represent any numeric amount that you wish to reference in workbooks. For example, Values may represent percentage factors, allowances, GFA values, and even boolean values that are used in conditional 'If' functions in workbooks (use 1 and 0 to represent true and false). Values are live linked so will update in workbooks when they are adjusted.

Values can be established on a Global or Project basis, or both. Global Values are created in System Administration. Project values can be assigned as a Project Property at any time. If given the same name, Project Values take precedence over Global Values. Hence, a Global Value can be established at a default amount with live-links pre-established in workbook templates, but can then be overwritten as a Project Value for specific projects.



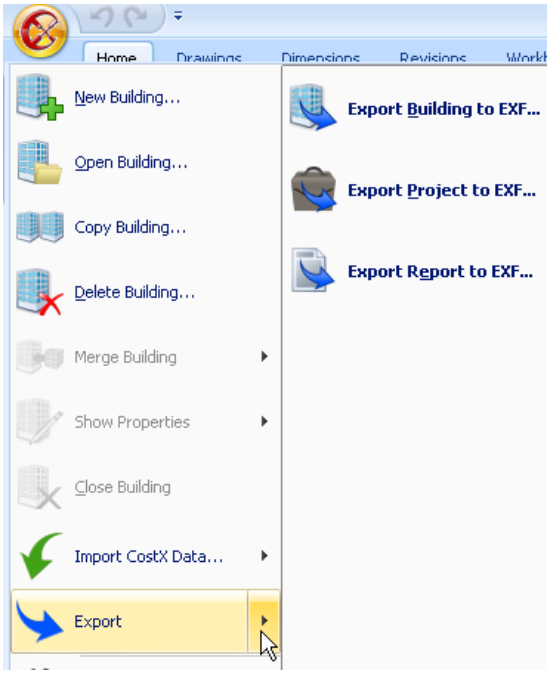


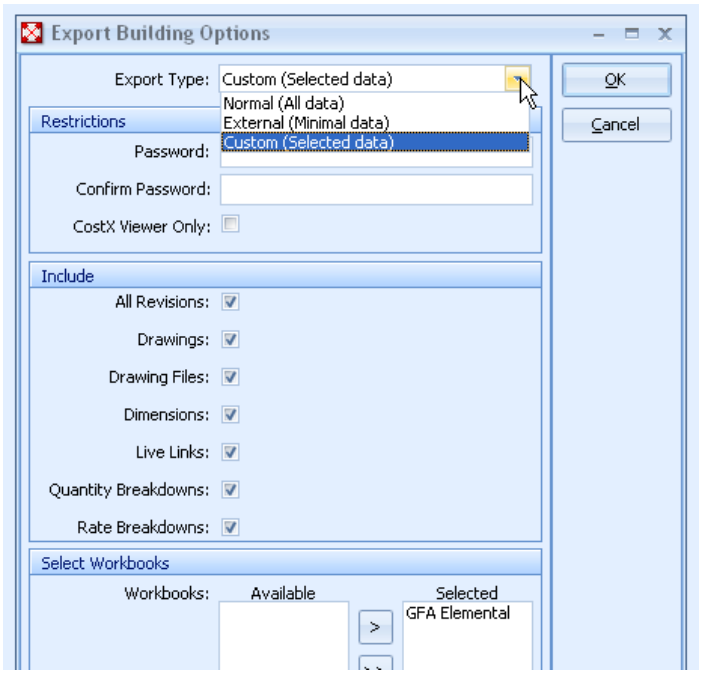
15 Exporting and Importing

15.1 Exporting Projects and Buildings

Exporting allows CostX® jobs to be shared with other users or for viewing with the free CostX® Viewer. It also means that finished projects may be exported to a separate archive server to reduce the size of the CostX® database. If desired, first lock the workbooks then under the Main Menu click the "Export" button. Export options are on the Main menu, alternatively Projects may be Exported or Imported using the relevant buttons in the Projects section of System Administration. Once exported to a secure server, the Project may be deleted from System Administration. A prompt will ask if it is to be exported first. It can always be imported back in the future.

The content of the exported file may be customised as shown below, and password protection is optional. The CostX® Viewer Only box may be ticked to restrict access to the file to the Viewer only.





15.2 Importing Building with Drawing Files

Imports a building and prompts for a Project to attach it to. Therefore you need to set up a recipient Project before the import. You will be prompted to nominate a separate folder to place the drawing files.

15.3 Exporting and Importing Reports

Reports may be exported (Export Report) and imported (Import CostX® Data). This is useful for circulating standard reports between standalone users. It also allows job specific reports to be exported to a separate job file so that the Reports window does not become too crowded.

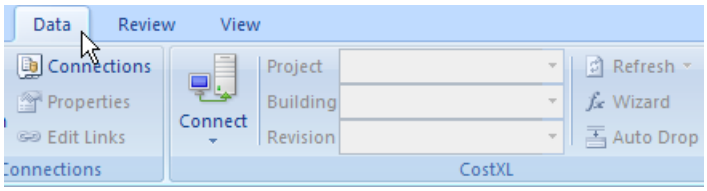
16 Integration into CostXL

(Only available with Network versions of CostX®)

CostXL is an Excel Add-In which allows data in CostX® to be accessed and live linked within an Excel® spreadsheet. CostXL supports Excel® 2007, 2010 and 2013 in 32 Bit and 2013 in 64 Bit.

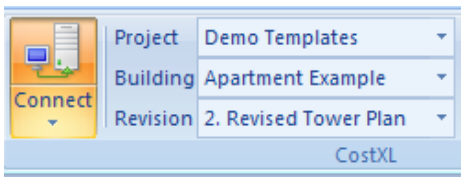
16.1 Opening CostXL

After installing CostXL a new ribbon toolbar section is placed on the Data ribbon in Excel®.

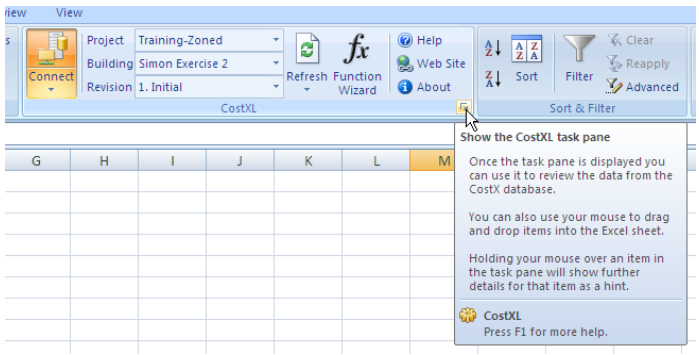


Clicking the Connect button automatically connects to the CostX® database using the last saved user login details. If you wish to login as a different user click on the drop down arrow of the Connect button and select Manual Connect, then enter a username and password, check the Save For Automatic Connection box if you wish these details to be used by default, then click OK.

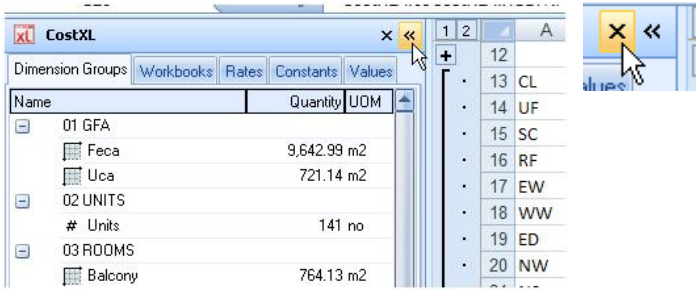
After connecting you are able to select the Project, Building and Revision that you wish to access.



To view the selected building data click on the 'Show the CostXL task pane' icon.



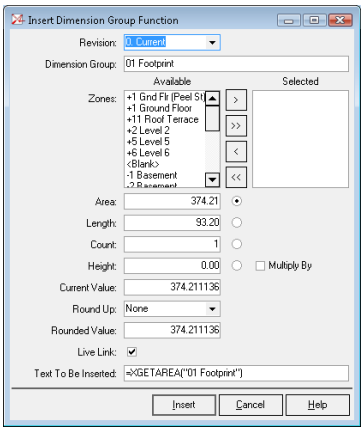
The CostXL task pane will be opened to the left of the sheet and displays the data from the selected Building. Use the buttons to minimize or close the pane.



16.2 Using CostXL Data

With the task pane now displayed it is possible to drag and drop data from the task pane into the Excel® spreadsheet.

- Dragging a Dimension Group from the Name column will place the Name, Quantity and UOM into three adjacent cells.
- Dragging from the UOM column will place the Quantity and UOM into two adjacent cells.
- Dragging from the Quantity column will place just the Quantity into the target cell.



When the Dimension Group is dropped a dialogue box opens. Depending on the measurement type, it is possible to select a revision, select one or more zones (default includes all zones) and choose either the Area, Length or Count value (depending on the measurement type). It is also possible to use the height as a multiplier to either an Area or Length value by checking the Multiply By box.

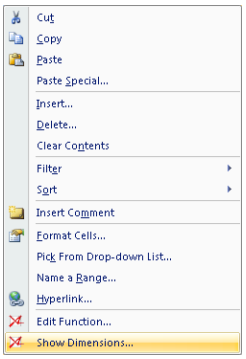
Once the desired selection is made click on the Insert button and the data is transferred to the sheet.

It is possible to select a single Dimension Group or multiple Dimension Groups by using Ctrl or Shift keys to multiple select. If dragging multiple Dimension Groups into a workbook be sure to select Dimension Groups of the same measurement type (eg all Area) as the dialogue box needs to display options for a measurement type common to all selected Dimension Groups eg. If an Area and Length were selected the measurement types available for selection would be Length and Count.

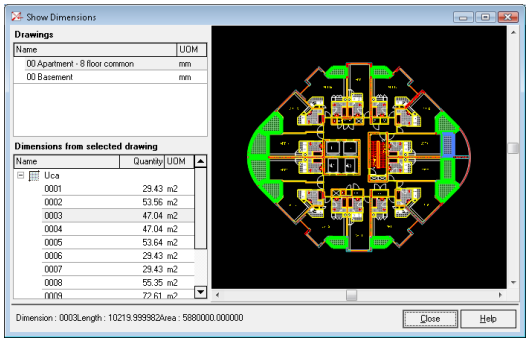
The Auto Drop feature is enabled from the Data ribbon. When enabled the dialogue box (shown above) is not displayed during the drag and drop process and all values are dropped based on the default for each dimension group selected.

16.3 Show Dimensions

Once a Dimension Group has been dropped into a sheet it is possible to see what has been measured. This is done by right clicking over the cell containing the measurement and selecting Show Dimensions.

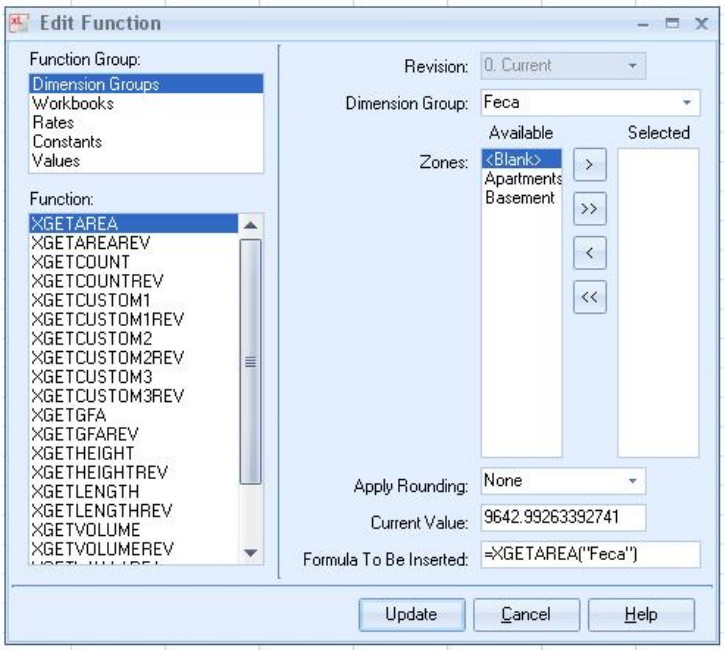


A window will appear displaying details of the drawings and dimensions to the left and displaying the drawing with the measurements overlaid to the right. The drawing window can be panned and zoomed as within CostX®. When the mouse cursor rolls over either a drawing or dimension in the list the drawing window contents display the selection.



16.4 Edit Function

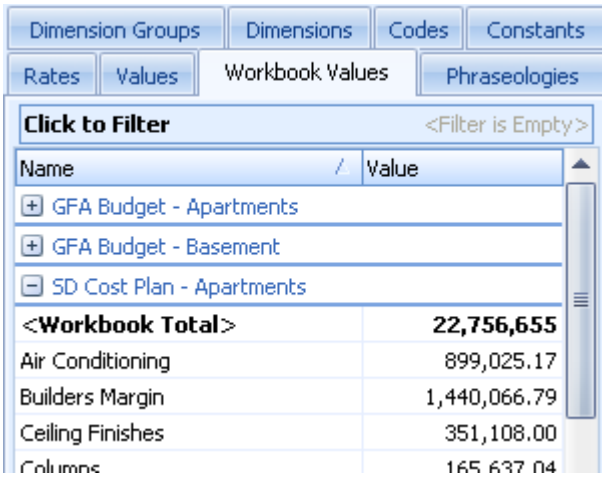
To review or change details of the dimension eg. zones included, rounding etc., select Edit Function from the right click menu.

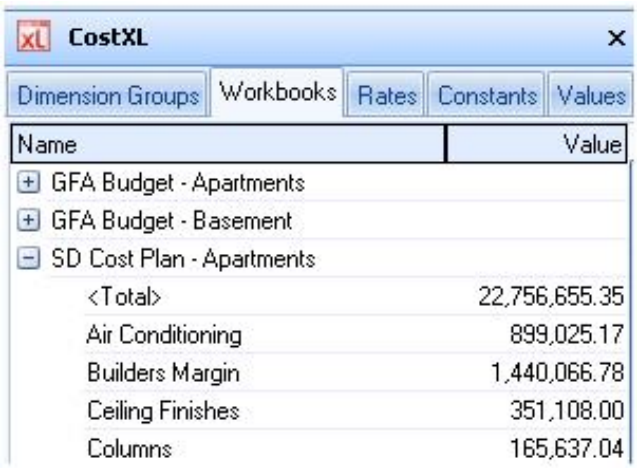


16.5 Other CostX® data

The CostXL Task Pane can also access Workbook values, Rate Libraries, Constants and Values under each of the respective tabs.

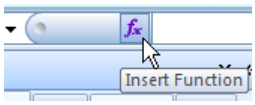
Note that CostXL cannot directly access CostX® workbooks. To access workbook values, use the Named Cell function (refer Section 12.4) in the CostX® workbook. Named Cell values are listed under the Workbook Values tab in CostX® and it is these values that are available in the CostXL Task Pane.

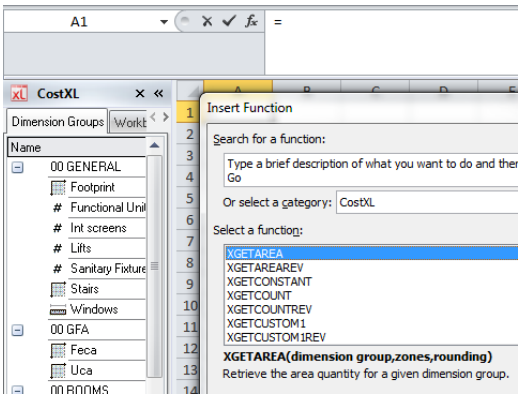




16.6 CostXL Functions

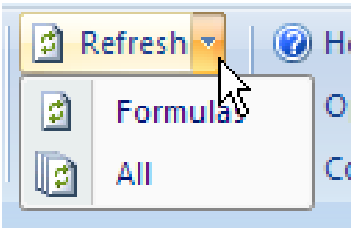
CostXL Functions are fully integrated into the Excel® Insert Function system so can be easily entered into a cell.





16.7 Refresh Data

The data in the Excel® spreadsheet is live-linked to the source CostX® database. Therefore, if the CostX® data is amended, the Excel® spreadsheet values can be refreshed accordingly.



To do this, click on the Refresh button on the Data ribbon. To refresh all data click on the drop down arrow and select All. This will also refresh the data in the Task Pane.

Cash Flow Forecast

Project Name	Sample Project	
Project Total	28,046,923	*Total cost to be distributed*
Start Date	Jul-12	*First month of projected costings*
Months	36	*Must be less than 120*
Factor	10	*Between -10 and 10 with 0 being normal*

costXL

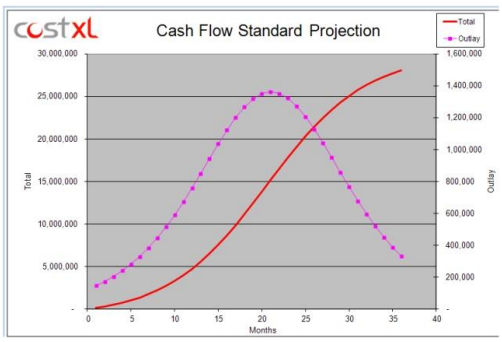
	Standard Projection			Adjusted Projection			Actual / Forecast Projection		
Month	Project %	Outlay	Total	Adj. +/-	Adj. Outlay	Adj. Total	Actual	Outlay	Total
1	0.5227%	146,595	146,595		146,595	146,595	150,000	150,000	150,000
2	1.1404%	173,243	319,838		173,243	319,838	100,000	100,000	250,000
3	1.8689%	204,322	524,159		204,322	524,159	150,000	150,000	400,000
4	2.7260%	240,404	764,563		240,404	764,563	400,000	400,000	800,000

Cash Flow Report

Project	Sample Project
Start	Jul-12
Months	36

costXL

	Per Month			Cumulative		
Month	Anticipated	Actual	Variance	Anticipated	Actual	Variance
Aug-12	146,595	150,000	3,405	146,595	150,000	3,405
Sep-12	173,243	100,000	-73,243	319,838	250,000	-69,838
Oct-12	204,322	150,000	-54,322	524,159	400,000	-124,159
Nov-12	240,404	400,000	159,596	764,563	800,000	35,437



17 CostX® Networking

17.1 Network Features

Improved productivity

- Ability for multiple users to be working on the same job at the same time on the same set of drawings;
- All users work to a common template;

Improved information management

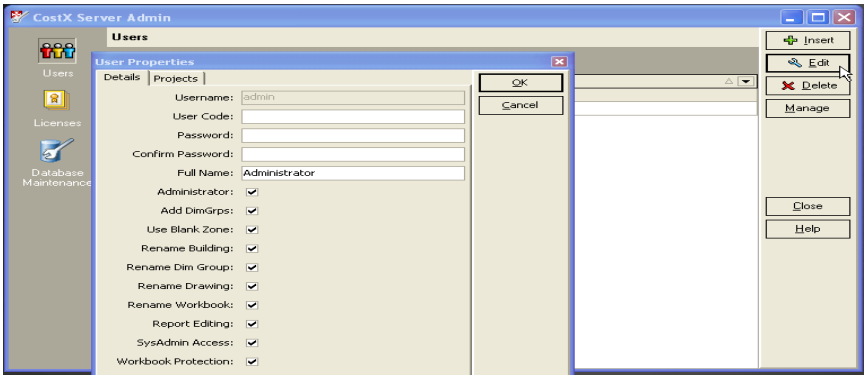
- Only one file exists which eliminates duplication;
- All users can access central Rate and other libraries;
- Single file ensures the server file is the latest version - eliminates version mismatch;
- No need to merge buildings.

Improved User flexibility

- Concurrent licence agreement provides flexibility for any users to login at any one time (up to the licence number limit), and no need to transfer licences when staff leave or join.

17.2 Network Administration

The Network software is held on a Server, and Client software is held on each user computer. Under Sever Admin user names are held and permissions may be set for each user which will determine which features they are able to access when logged onto their Client computer.

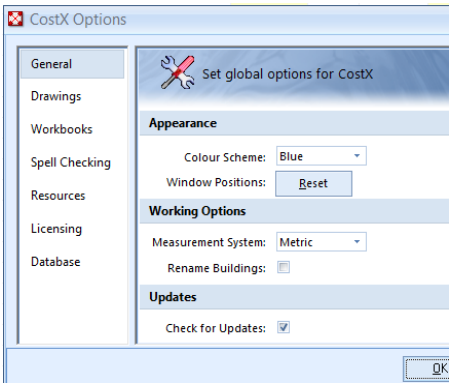


Most data processing takes place on the Client computer which reads and writes the data back to the Server. It is possible to specify that certain data intensive tasks such as copying or exporting a building, recalculating a workbook, and generating a report are run on the Server which can be much faster as it avoids the potential constriction of the network connection. Conversely, caching drawing files (excluding DGN™ files) on the Client instead of the Server can save time when opening the drawing and means the drawing is available even if the Client is offline.

18 CostX® Customisation

18.1 CostX® Options

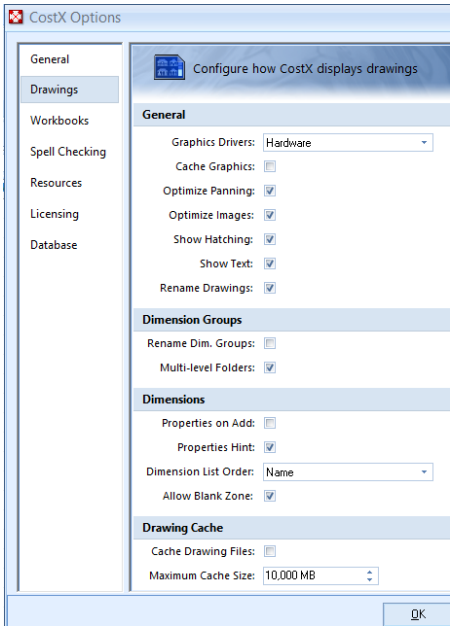
The "CostX® Options" button is accessed under the Main Menu.



General - Working options

The Measurement System may be set to Metric or Imperial. This will set the Units of Measure to metres and millimetres or feet and inches. Tick the Rename Buildings button to enable the user permission to rename existing buildings (Standalone only). In network Client, this permission is set on the User's account.

Drawings



Graphics Drivers refers to the level of acceleration and performance supplied by the computer's video card and drivers. This is also referred to as Hardware Acceleration. Normally hardware acceleration is useful in reducing CPU utilization which increases overall system performance especially for graphics intensive programs such as CostX®. In some circumstances however, the drivers may not be 100% compatible with the video card or other issues may occur, in which case the other drop-down menu options can be used.

It is recommended that the Hardware option to enable hardware acceleration is used unless it causes problems on your computer.

When drawings are loaded in CostX®, the graphics may be cached to the video card memory to speed up processing time. The preferred setting will be dependent upon the capacity of the video card, with higher performance cards likely to perform best with the Cache Graphics box ticked.

Optimise Panning can assist with speed when panning large drawings.

Optimize Images enables a video card setting to improve loading and viewing of image files, and is ticked by default. Older or lower quality video cards may not support this setting in which case the image may not display properly. In such cases, untick the box to disable the setting which will allow the image to display.

The Show Hatching and Show Text options are used to specify whether drawings are loaded with hatching and text turned on by default. This option is useful since disabling these is an effective way to speed up the loading of the drawing. This option applies as a global default for all newly added drawings.

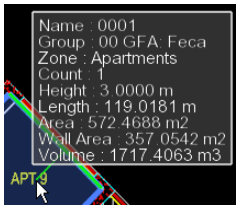
Generally leave these ticked especially if you have a dedicated graphics card, but if you have delays in loading drawings try un-ticking the boxes.

Tick the Rename Drawings button to enable the user permission to rename existing drawings (Standalone). In network Client, this permission is set on the User's account.

Ticking the Rename Dim. Groups will enable the user permission to rename existing Dimension Groups (Standalone only). In network Client, this permission is set on the User's account.

Ticking the Multi-level Folders buttons causes Dimension Groups with a \ in the name to be displayed as multi-level Dimension Group folders. If unticked, folders are one level only.

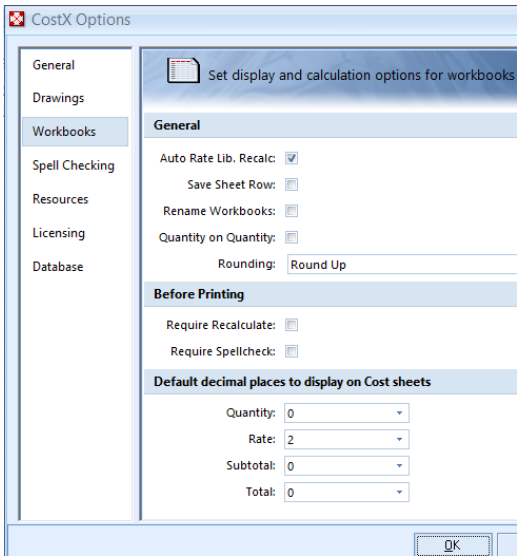
The Properties on Add option will open the Dimension Properties dialogue whenever a dimension is measured. This can be useful for inserting labels or default heights specific to individual dimensions.



The Properties Hint displays dimension data in a hint box when the cursor is moved over a measured dimension in the Dimension View. It also displays data about overlapping dimensions when in the Overlaps view.

Ticking the Cache Drawing Files button causes a copy of the drawing files being used in a Building to be cached locally in the Program Data of the C drive of the CostX® computer . The next time the drawing is opened in CostX®, it is loaded from the local disk drive which can improve performance, especially if the network connection to the original drawing file location is slow. It also enables drawings to be accessed when the computer is offline from the network.

Workbooks (not available in CostX® Takeoff 2D)

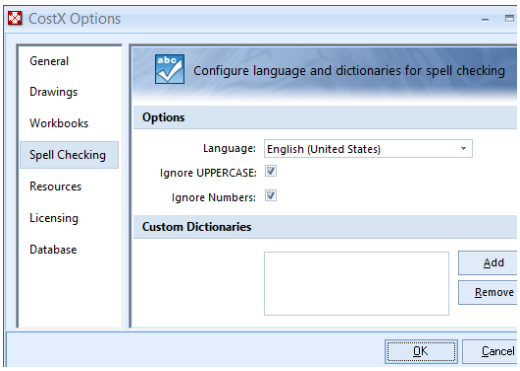


After a rate is edited and the value is updated from within a workbook, any other rates that reference it should be recalculated. If the “Auto Rate Lib Recalc” is ticked, the recalculation starts automatically and the rates in that rate library are updated.

Save Sheet Row returns to the last working location when a workbook is re-opened. Rename Workbooks enables the user permission to rename existing workbooks. Quantity on Quantity enables the function which allows a drill-down to a sub-quantity sheet under a quantity sheet by double-clicking on a cell in the C:Length column. Use the drop-down menu to select whether rounding should be up or to the nearest number (this is separate to “Display”, see below).

Automatic Workbook Recalculation and Spellchecking prior to printing can be selected.

Use the “Default decimal places to display on Cost sheets” section to set the default number of decimal places to display in the workbooks (this is display, not rounding).



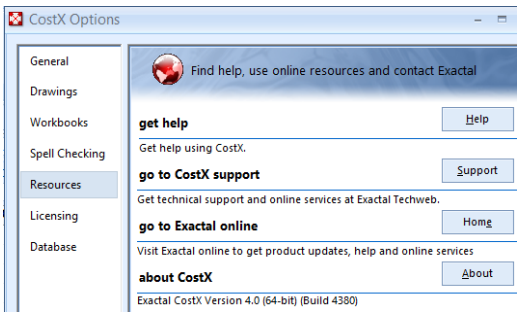
Spell Checking

Select the language that you wish to use for the spell checker.

If the “Ignore UPPERCASE” box is ticked, the spell checker will not check uppercase words (e.g. GFA).

If the “Ignore Numbers” checkbox is ticked, the spell checker will not check words containing numbers (e.g. m2).

It is also possible to add Custom Dictionaries to expand the list of words that are known to the spell checker.

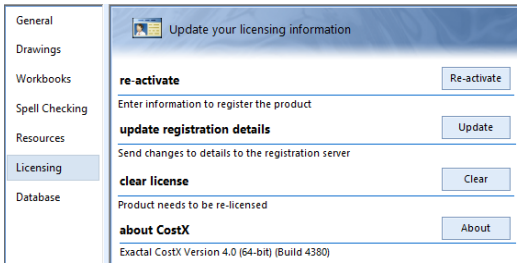


Resources.

Resources provides access to help and support resources. The version and revision number of CostX® can also be found here.

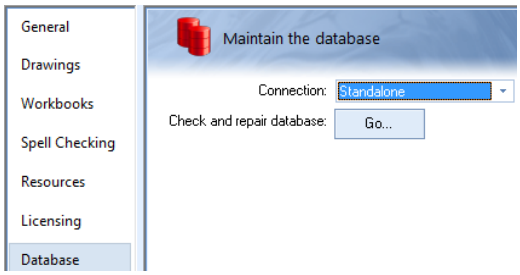
Licencing

This section enables licence management for Standalone licences. The version and revision number of CostX® can be found here. In a network configuration, licence management is undertaken by the Systems Administrator.



Database

Normally, CostX® is used in either a Standalone or Network Configuration. In some cases, both configurations can be installed on the same computer. This may happen for example when it is a laptop computer and the user has two licences, to work standalone at home and connected to the network in the office. To change which configuration CostX® operates in, select either *Standalone* or *Network* from the Connection drop down menu. The next time CostX® is opened it will use the specified connection type.



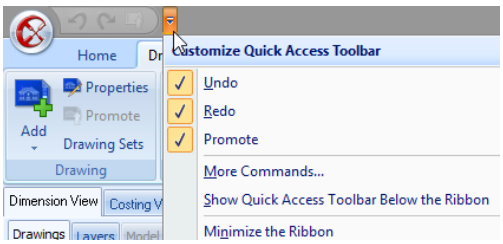
Within CostX® there is a facility to run a database consistency check and automatically repair problems where possible. This facility is known as Check and repair database**.**

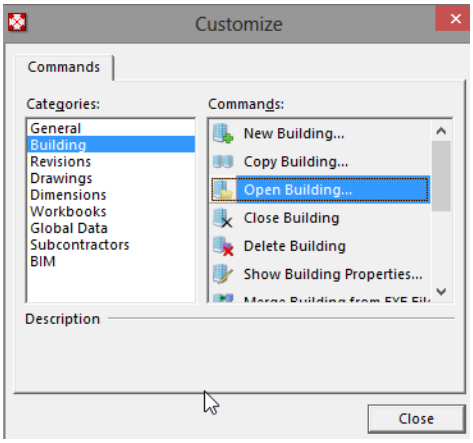
This can be run at any time, but is most useful if strange results occur after a computer crash, incorrect shutdown or other event that may cause database corruption.

For very large databases there is a significant amount of checking to be done, so a warning is displayed. Click Yes to proceed. While the database is being checked, the progress indicator shows the percentage complete.

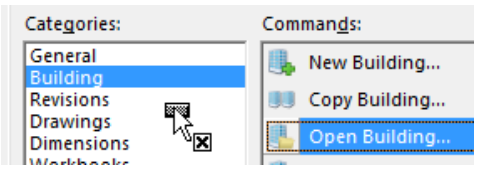
18.2 User defined Quick Access Toolbar

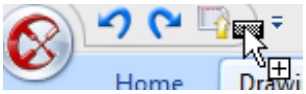
Users may create a customized toolbar using the More Commands option from the Customise Quick Access Toolbar switch.



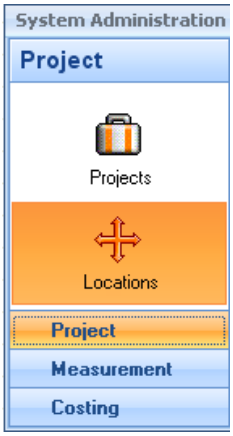


Drag and drop the command icons from the Customize window into the toolbar space by hovering over the switch until the cursor icon x changes to a +.



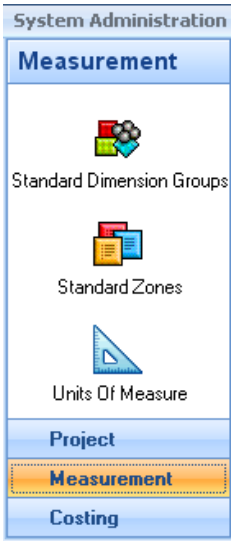


19 System Administration



Location is set for each project. Prices from the rates library are organised according to their location. Thus prices are being correctly sourced from the rate library according to the location of the project. In a network scenario, these locations are seen by all users.

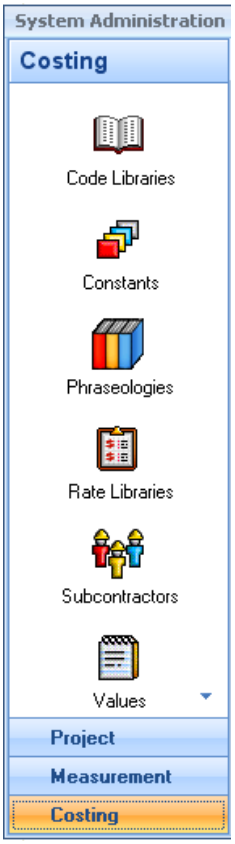
Dimension Groups are a grouping of dimensions of the same measurement type and generally the same object being measured. Dimension groups may be of type Area, Length, Count or Volume. **Standard Dimension Groups** are useful to establish measurement protocols for consistency and to avoid having to create groups from scratch. They can be imported and exported via Excel® CSV files (refer Section 7.8).



Zones are set up on projects to allow dimensions to be categorized and extracted on a per level/unit/story/functional area basis and could even be used to sort dimensions by time (the stage of construction). You can later filter by these zones. **Standard Zones** are global and can be added to all Projects and seen and used by all network users. (Refer Section 10).

Units of Measure holds typical abbreviations and properties for units of measure. Rounding and decimals to display can be assigned and edited here.

Code Libraries are used as a lookup or mapping file when a workbook is re-sorted according to codes. This is typically used when re-sorting from an elemental to a trade format or vice versa but of course it can be used to sort by any other coding categories such as functional area, building level, building block, options etc. (Refer Section 11).



Constants are fixed values or figures that can be referenced in workbooks. You can think of it as a rate library but for a unit of measure or tonnage. Constants do not change for each project (eg. steel weight in kg/m for typical members).

Phraseologies. Standard phraseologies or model description libraries may be imported into CostX® and accessed via a Phraseologies tab to drag and drop text into workbooks. Text strings may be selected individually or combined to create detailed descriptions. (Refer Section 8.7).

Rate Libraries are a collection of prices that can be referenced into a cost worksheet. They can be flat prices for items or built-up composite rates (assemblies) of items. Rates can be imported by CSV or entered manually. Rate libraries are location sensitive except Default Location which is global. (Refer Section 14).

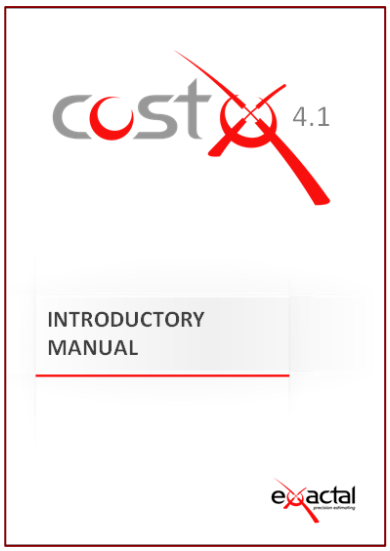
Subcontractors holds Subcontractor details for use in the Subcontractor Comparison feature. (Refer Introduction To CostX® Manual).

Values can represent any numeric amount that you wish to reference in workbooks. For example, Values may represent percentage factors, allowances, GFA values, and even boolean values that are used in conditional 'If' functions in workbooks (use 1 and 0 to represent true and false). Values are live linked so will update in workbooks when they are adjusted. Values may also be set up on a per project basis. Project values take precedence over global values with the same name.

20 Further Information

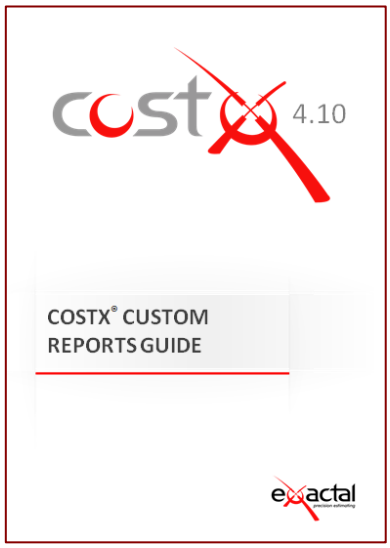
20.1 Additional Reading

Contact your local Exactal office or reseller to obtain a free copy of these documents



The CostX® Introductory Manual is essential reading for all CostX® users.

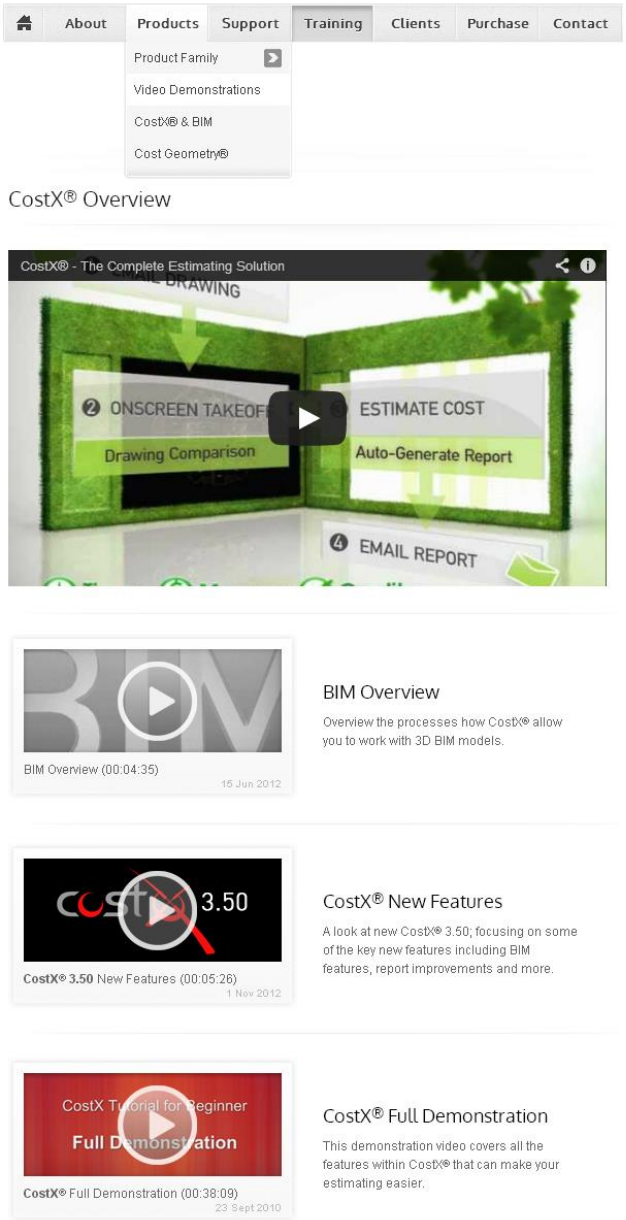
This document aims to provide general tips and guidance to Designers for the more common drawing file formats on how the files may be arranged and optimized to improve team communication, and specifically to assist in the quantities measurement and estimating activities. It is not intended to be a mandatory requirement for using each file format within CostX®, but rather to reflect some of the more common optimizations which are of benefit.



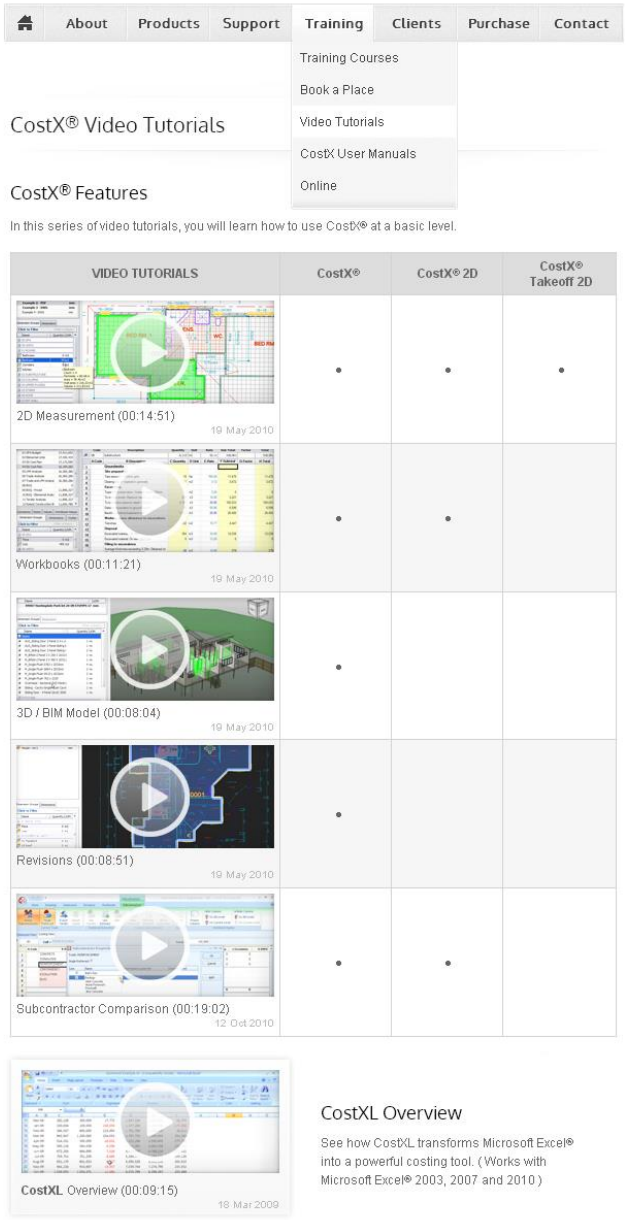
This document provides a guide for how to use the CostX® Custom Report Builder to create fully customized report output from CostX®.

20.2 Free Training Videos

The Exactal Website www.exactal.com contains a series of training and demonstration videos, as well as other useful resources.

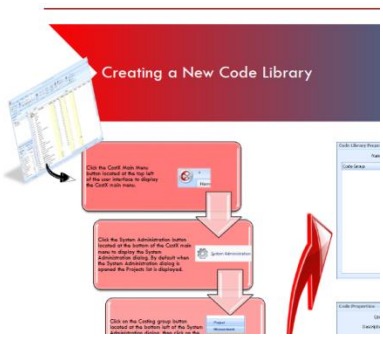


Demonstration videos



***T**raining videos*

20.3 Process Flow Charts



The Process Flow Charts provide a single page, at-a-glance diagram of the steps to follow to undertake the most common CostX® activities.

CostX® Process Flowcharts

1. Getting Started

1-1. Opening CostX® and Default View When CostX® is Opened

1-2. Overview of the User Interface

1-3. Creating a New Project

1-4. Creating a New Building

2. Drawings and Measurement

2-1. Adding, Calibrating and Manipulating Drawings

2-2. Adjusting Drawing Layers

2-3. Comparing Drawings

2-4. Creating a New Dimension Group

2-5. Taking Area Measurements (Standard and Polyline Methods)

2-6. Taking Area Measurements (Quickpoint Method)

2-7. Taking Length Measurements

2-8. Taking Count Measurements

3. Workbooks (not available in CostX® Takeoff 2D) and Template Files

3-1. Workbook Navigation

3-2. Dragging and Dropping Dimension Groups into a Workbook

3-3. Creating a Rate Library and Dragging and Dropping Rates into a Workbook

3-4. Recalculating a Workbook

3-5. Importing CostX® Template and Library Files

3-6. Creating a New Building Based On a Template File

4. Reports (not available in CostX® Takeoff 2D)

4-1. Exporting Dimensions to Excel

4-2. Printing Workbook Sheets to a Report

4-3. Generating CostX® Reports

5. Working with 3D Building Information Models (CostX® Only)

5-1. Adding a 3D Building Information Model

5-2. 3D Model Manipulation Tools and Adjusting Views of 3D Models

5-3. Creating a Dimension Group and Object Measurement from 3D Models

5-4. Importing Dimensions from 3D Building Information Model Properties

5-5. Importing Dimensions using a Model Map from 3D Building Information Model Properties

6. Revisioning with 2D Drawings (CostX® Only)

6-1. Revisioning Process Overview for 2D Drawings

6-2. Creating a new Building Revision and reviewing a previous Building Revision

6-3. Promoting a 2D Drawing & Offsetting Position and Rotation of Drawings

6-4. Comparing a 2D Drawing to another Revision

6-5. Revising 2D dimensions & other Revisioning Tools

6-6. Accepting 2D dimensions

6-7. Deleting & Restoring 2D Dimensions and Drawings

6-8. Promoting, Deleting and Restoring workbooks

6-9. Generating a Comparison Report

7. Subcontractor Comparison (not available in CostX® Takeoff 2D)

7-1. Generating a Subcontractor Workbook

7-2. Assign Subcontractors

7-3. Single Preferred

7-4. Fill Current Subcontractor From Estimate

7-5. Fill Current Subcontractor to Lump Sum

7-6. Use Current Subcontractor or Estimate as Preferred Subcontractor

7-7. Make Current Subcontractor Preferred Subcontractor

7-8. Clear Preferred Subcontractor

7-9. Freeze, Hide and Unhide Columns

7-10. Generating a Standard Workbook

8. Coding (not available in CostX® Takeoff 2D)

8-1. Creating a Code Library

8-2. Coding a Workbook

8-3. Generating a Workbook Grouped by Code

9. Workbooks (not available in CostX® Takeoff 2D)

9-1. Creating and Importing Dimension groups from a CSV File

9-2. Creating and Using Zones

9-3. Generating a Workbook from Dimension Groups

9-4. Creating and Importing a CSV Rate Library

9-5. Creating a Composite Rate Library Item

9-6. Phraseologies

Appendix

Information Requirements for Model-based Quantities

Definition of Base Quantities

buildingSMART
IAI - Industrieallianz für Interoperabilität e.V.

Information Requirements for Model-based Quantities

Definition of Base Quantities

Date: 2010-12-08

Publisher: buildingSMART German Speaking Chapter
Working Group: Model-based Quantity Take-off

Translation based on the German documentation
Editors: Martin Hubert, Thomas Liebich

English translation completed for NIBS QTie challenge project 2010

Table of contents

1 Overview ... 4
2 General ... 6
3 Space ... 6
3.1 Floor Areas ... 6
GrossFloorArea ... 6
NetFloorArea ... 6
3.2 Areas of vertical construction units ... 7
GrossWallArea ... 7
NetWallArea ... 8
3.3 Ceiling areas ... 8
GrossCeilingArea ... 8
NetCeilingArea ... 8
3.4 Perimeter ... 8
GrossPerimeter ... 8
NetPerimeter ... 9
3.5 Volume ... 9
GrossVolume ... 9
NetVolume ... 9
3.6 Heights ... 9
Height ... 9
4 Building element ... 10
4.1 Wall ... 10
4.1.1 Wall with constant thickness ... 10
Width ... 10
Length ... 10
Height ... 10
GrossSideArea ... 10
NetSideArea ... 10
GrossFootprintArea ... 10
GrossVolume ... 10
NetVolume ... 10
4.1.2 Any Wall ... 10
Length ... 10
Height ... 11
GrossSideArea ... 11
NetSideArea ... 11
GrossVolume ... 11
NetVolume ... 11
4.2 Opening ... 11
4.2.1 rectangular openings with constant depth ... 11
Depth ... 11
Height ... 11
Width ... 11
4.2.2 free-form openings with constant depth ... 11
Depth ... 11
Area ... 11
4.2.3 free-form openings with variable depth ... 12
Volume ... 12
4.3 Window ... 12
4.3.1 rectangular window ... 12
Height ... 12
Width ... 12
4.3.2 free form window ... 12
Area ... 12
4.4 Door ... 12
4.4.1 rectangular door ... 12
Height ... 12

Width 12
4.4.2 free form door 12
Area 12
4.5 Slab 12
4.5.1 Slab with constant thickness 12
Width 12
Perimeter 12
GrossArea 13
NetArea 13
GrossVolume 13
NetVolume 13
4.5.2 Any slab 13
GrossVolume 13
NetVolume 13
4.6 Beam 13
Length 13
CrossSectionArea 13
OuterSurfaceArea 13
GrossVolume 13
NetVolume 13
4.7 Column 13
Length 13
CrossSectionArea 14
OuterSurfaceArea 14
GrossVolume 14
NetVolume 14
4.8 Covering 14
4.8.1 Areas of floor covering 14
GrossArea 14
NetArea 14
4.8.2 Areas of ceiling covering 14
GrossArea 14
NetArea 14
4.8.3 Areas of wall covering 14
GrossArea 14
NetArea 14
4.9 Curtain wall 14
Width 14
GrossSideArea 15
NetSideArea 15
4.10 Ramp 15
4.10.1 Ramp with constant thickness 15
GrossFloorArea 15
NetFloorArea 15
Width 15
4.10.2 Ramp with variable thickness 15
GrossVolume 15
NetVolume 15
4.11 Railing 15
Length 15

1 Overview

The table shows all currently defined base quantities for building elements and spaces as result of the requirements defined at each space or building elements further below.

Element	Base quantity keyword	Further distinction
Space		
	Height	*Only, if height is constant*
	FinishCeilingHeight (new)	*Only, if height is constant*
	FinishFloorHeight (new)	*Only, if height is constant*
	GrossPerimeter	
	NetPerimeter	
	GrossFloorArea	
	NetFloorArea	
	GrossWallArea	
	NetWallArea	
	GrossCeilingArea	
	NetCeilingArea	
	GrossVolume	
	NetVolume	
Wall		
	Length	
	Height	*Only, if height is constant*
	Width	*Only, if thickness is constant*
	GrossFootprintArea	
	NetFootprintArea	
	GrossSideArea	
	NetSideArea	
	GrossVolume	
	NetVolume	
Opening		
	Depth	
	Height	*Only for rectangular openings*
	Width	*Only for rectangular openings*
	Area	
	Volume	
Window		
	Height	*Only for rectangular windows*
	Width	*Only for rectangular windows*
	Perimeter (new)	
	Area	
Doors		
	Height	*Only for rectangular doors*
	Width	*Only for rectangular doors*
	Perimeter (new)	
	Area	
Slab		
	Width	*Only, if thickness is constant*
	Perimeter (new)	
	GrossArea	
	NetArea	
	GrossVolume	
	NetVolume	

Element	Base quantity keyword	Further distinction
Beam		
	Length	
	Width (new)	Only for rectangular beams
	Depth (new)	Only for rectangular beams
	CrossSectionArea	
	OuterSurfaceArea	
	GrossVolume	
	NetVolume	
Column		
	Length	
	Width (new)	Only for rectangular columns
	Depth (new)	Only for rectangular columns
	CrossSectionArea	
	OuterSurfaceArea	
	GrossVolume	
	NetVolume	
Member		
	Length	
	CrossSectionArea	
	OuterSurfaceArea	
	GrossVolume	
	NetVolume	
Coverings		
	GrossArea	
	NetArea	
Curtain wall		
	Width	
	Length	Only for rectangular curtain walls
	Heigth	Only for rectangular curtain walls
	GrossSideArea	
	NetSideArea	
Ramp		
	Width	
	Length	
	GrossSideArea	
	NetSideArea	
	GrossVolume	
	NetVolume	
IfcRailing		
	Length	

2 General

The individual base quantities are described. In general, there is a distinction between gross and net values. A gross value determines the quantity of an element without taking into account any features (like openings, cut-outs, etc.), whereas a new value is the quantity after adding/subtracting all features of the element.

As a general note: the quantity take-off from a building information model can only be as precise, as the model. E.g. if no covering elements are created as elements in a building information model, then a net floor area of a space object cannot consider them for determining the net area. In this case the net area would be equal to the gross area.

The document only describes the instructions on how to measure a quantity, if does not determine, when a certain quantity shall be included in an exchange data set. The provision of such information at a given state in the design process might be determined by project handbooks, user guides, or exchange requirements. This document does not provide any of such requirements.

3 Space

3.1 Floor Areas

GrossFloorArea

The *GrossFloorArea* is the entire floor area of a space (room), independently of the space height. Openings at the floor are not subtracted. If only the row construction is drawn in the building information model, this area is equivalent to the “row area”. If the walls are drawn with covering, the floor area that is covered by the covering is not subtracted.

That means:

- Areas of openings in the floor are not subtracted.
- Foot print areas of construction elements, like columns, stanchions und pillars that are located inside the space are not subtracted.
- Areas, such as niches in walls, or thresholds of doors are not considered.
- Areas, which are covered by fixed installations, are not subtracted.
- Areas, which are covered by „not fixed installations“(furniture), are not subtracted.
- Different and varying ceiling heights do not have influence on the floor area.

NetFloorArea

The *NetFloorArea* is the entire floor area of a space (room), independently of the space height. All openings at the floor, independent of their size, are subtracted. If only the row construction is created in the building information model, this area is equivalent to the “row area”. If the walls are drawn with covering, the floor area that is covered by the covering is subtracted – the net floor area is then the area bounded by the vertical coverings.

That means:

- Areas of openings in the floor are subtracted.
- Foot print areas of construction units like columns, stanchions, and pillars that are located inside the space are subtracted.
- Areas, such as niches in walls, or thresholds of doors are not considered.
- Areas, which are covered by fixed installations, are subtracted.
- Areas, which are covered by „not fixed installations“(furniture), are not subtracted.
- Different and varying ceiling heights do not have influence on the floor area.

3.2 Areas of vertical construction units

These are areas, normally considered as wall areas, provided by vertical construction elements bounding a space. These areas are defined “as seen from within the space”.

Vertical construction elements are e.g.: Walls, columns, stanchions, pillars. Visibility relates to the space, as it is created in the building information model. That can be:

- with/without perpendicular covering
- with/without ceiling covering (suspended ceiling)
- with/without floor construction

The following rule applies: Only areas visible from the space are considered. It means that areas at the edges which are covered by other covering elements are not considered.

Example: The red part is not considered as *GrossWallArea*, or *NetWallArea*.

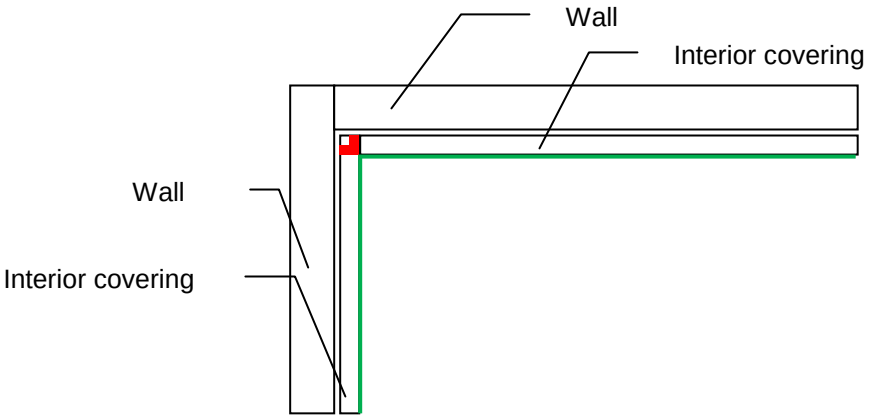


Figure 1: Walls with covering at plan view.

The same rule determines that areas at the edges of columns are considered twice (i.e. once from each side). The green is considered at both sides.

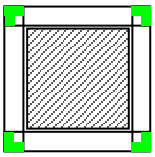


Figure 2: Columns with covering at plan view

Areas that are not vertical are not considered to be a wall area (i.e. a vertical area). Those areas are treated as ceiling area. An example is an area created by a sloped roof in an attic.

Areas from beams or girders are always assigned to the ceiling area, even if they are perpendicular.

GrossWallArea

Gross wall areas are all perpendicular covering areas in a space that are considered without subtraction of openings.

That means:

- Areas from all visible perpendicular areas at a space are considered. It includes the areas from walls, columns, stanchions, pillars, etc.
- Areas that limit a space only virtually and that are not caused by a construction element are considered.
- Areas from openings for windows, doors and other openings are not subtracted.
- Areas, which are covered by fixed installations, are not subtracted.
- Areas, which are covered by „not fixed installations“(Furniture), are not subtracted.

NetWallArea

Net wall areas are all perpendicular covering Areas in a space with subtraction of openings.

That means:

- Areas from all visible perpendicular areas at a space are considered. It includes the areas from walls, columns, stanchions, pillars, etc. belongs.
- Areas that limit a space only virtually and that are not caused by a construction element are not considered.
- Areas from openings for windows, doors and other openings are subtracted. Embrasures from windows and doors are not considered.
- Areas, which are covered by fixed installations, are subtracted.
- Areas, which are covered by „not fixed installations“(Furniture), are not subtracted.

3.3 Ceiling areas

Ceiling areas are the covering areas provided by the ceiling of a space. it includes horizontal ceiling area, and sloped ceilings that are provided by sloped roofs. Also visible (perpendicular and horizontal) area of beams and girders that are part of a ceiling are considered as part of the ceiling area.

GrossCeilingArea

Gross ceiling area is the entire ceiling area of a space (room), independently of the space height. Openings for example from roof windows or stairs are not subtracted.

That means:

- Areas from openings at the ceiling are not subtracted.
- Cross-sectional areas of construction elements in the space e.g. columns, stanchions, pillars that touches the ceiling are not subtracted.
- All areas from beams and girders which form part of the ceiling construction and are visible from the space are considered, even if they are perpendicularly.

NetCeilingArea

Net ceiling area is the entire ceiling area of a space (room), independently of the space height. Openings for example from roof windows or stairs are subtracted.

If only the row construction is drawn, this area is equivalent to the row construction area. If the vertical construction elements (mostly walls) are drawn with covering elements, then the area that is covered by the coverings is subtracted.

That means:

- Areas from openings at the ceiling are subtracted.
- Cross-sectional areas of construction elements in the space e.g. columns, stanchions, pillars that touches the ceiling are subtracted.
- All areas from beams and girders which form part of the ceiling construction and are visible from the space are considered, even if they are perpendicularly.

3.4 Perimeter

A line at the floor of a space is meant to limit the space.

GrossPerimeter

Gross perimeter is the entire perimeter as provided by the row construction elements bounding the space.

That means:

- Perimeter lines that limit a space only virtually and that are not provided by a construction element are considered.
- Openings of doors are not subtracted from the perimeter.
- Perimeters of stanchions and columns in the space are not considered.

- Perimeters of openings in the floor of the space are not considered.

NetPerimeter

Net perimeter is the perimeter that usually is used to determine the length of a skirting board. If no coverings are drawn in the BIM, the perimeter is determined by the row construction elements. If the coverings are drawn, the net perimeter is determined by the wall coverings.

That means:

- Perimeter lines that limit a space only virtually and that are not provided by a construction element are not considered.
- Openings of doors are subtracted from the perimeter.
- Perimeters of stanchions and columns in the space are considered.
- Perimeters of openings in the floor of the space are not considered.
- Edges between the door threshold area and the wall opening are not considered.

3.5 Volume

GrossVolume

Gross volume is the volume of a space without subtraction of construction elements or build-in parts located inside the space.

That means:

- The volume of columns, stanchions, pillars in the space is not subtracted.
- The volume of parts of beams and girders that extend into the space is not subtracted.
- The volume of openings, windows and doors is not a part of the GrossVolume of the space.
- The volume of fixed installations is not subtracted.
- The volume of drawn „not fixed installations“(furniture) is not subtracted.

NetVolume

Net volume is the volume of a space with subtraction of construction elements or build-in parts located inside the space. If no coverings are drawn in the BIM, the net volume is determined by the row construction elements. If the coverings are drawn, the net volume is determined by the coverings.

That means:

- The volume of columns, stanchions, pillars in the space is subtracted.
- The volume of parts of beams and girders that extend into the space is subtracted.
- The volume of openings, windows and doors is not a part of the NetVolume of the space.
- The volume of fixed installations is not subtracted.
- The volume of drawn „not fixed installations“(furniture) is not subtracted.

3.6 Heights

Height

The height should only be provided as a base quantity, if the space has an constant ceiling height. The height is the total height from the top of the slab (without covering) to the bottom of the ceiling (without coverings, such as suspended ceilings).

4 Building element

4.1 Wall

4.1.1 Wall with constant thickness

Such a wall is characterized by an constant thickness. The wall can consists of several material layers. Base quantities are defined for the total wall, and not separate for each material layer. Beyond that other quantities can be defined that refers to an individual layer.

Width

The sum of the thicknesses of the individual material layers.

Length

The length of the centre line of the wall. Centre line refers to the centre of the whole wall with all layers. For a straight wall whose end caps are cut perpendicular, the length of the center line is equal to the length of the individual material layers. For a straight wall with miter end caps the length of individual material layers may differ.

Height

Only provided if the wall has an constant height.

GrossSideArea

Side area measured at the centre line. No distinction between the left side and right side area. All openings in this area are not considered.

NetSideArea

Side area measured at the centre line. No distinction between the left side and right side area. All openings in this area are subtracted.

GrossFootprintArea

The area of a wall covered by the wall foot print. The GrossFootprintArea of the wall with perpendicular end caps can be computed by (Length * Width).

GrossVolume

The GrossVolume complies to GrossSideArea by Width. (GrossSideArea * Width)

NetVolume

The NetVolume complies to NetSideArea by Width. (NetSideArea * Width)

4.1.2 Any Wall

Such a wall is characterized by a non constant thickness. Only base values are defined that consider all layers of the wall as one unit. Base values that relates to individual layers are not defined.

Length

The length of the centre line of the wall. Centre line is at the middle of the whole wall independent of individual wall material layers.

Height

Only provided if the wall has an constant height.

GrossSideArea

Area of the wall as viewed by an elevation view of the middle plane of the wall. It does not take into account any wall modifications (such as openings).

NetSideArea

Area of the wall as viewed by an elevation view of the middle plane. It does take into account all wall modifications (such as openings).

GrossVolume

Volume of the wall, without taking into account the openings and the connection geometry.

NetVolume

Volume of the wall, after subtracting the openings and after considering the connection geometry.

4.2 Opening

4.2.1 rectangular openings with constant depth

If the opening is rectangular and is inside an element with constant thickness, the Depth, Width and the Height base quantities apply.

Depth

Depth (or thickness) of the opening, in case of openings it shall be identical to the width (or thickness) of the voided element. In case of recesses it shall be less.

Height

Height of the opening, in case of wall openings it is the vertical dimension in case of slab openings it is one horizontal dimension.

Width

Width of the opening, in case of wall openings it is the horizontal dimension in case of slab openings it is one horizontal dimension.

4.2.2 free-form openings with constant depth

If the opening is not rectangular and is inside an element with constant thickness, the Depth, and the Area base quantities apply.

Depth

Depth (or thickness) of the opening, in case of openings it shall be identical to the width (or thickness) of the voided element. In case of recesses it shall be less.

Area

Area of the opening as viewed by an elevation view (for wall openings) or as viewed by a ground floor view (for slab openings).

4.2.3 free-form openings with variable depth

Volume

Volume of the opening. It is the subtraction volume of the opening from the voided element (e.g. wall or slab). In case that the geometric volume of the opening is bigger then the subtraction volume, only the subtraction volume should be used.

4.3 Window

A window is considered as an unit with constant thickness and one area. The area of the windows is determined by the outer dimensions of the lining.

4.3.1 rectangular window

Height

Total outer height of the window lining.

Width

Total outer width of the window lining.

4.3.2 free form window

Area

Total area of the outer lining of the window.

4.4 Door

A door is considered as an unit with constant thickness and one area. The area of the door is determined by the outer dimensions of the lining.

4.4.1 rectangular door

Height

Total outer width of the door lining.

Width

Total outer height of the door lining.

4.4.2 free form door

Area

Total area of the outer lining of the door.

4.5 Slab

4.5.1 Slab with constant thickness

Width

Nominal width (or thickness) of the slab.

Perimeter

Perimeter measured along the outer boundaries of the slab.

GrossArea

Total area of the extruded area of the slab. Openings, recesses and projections are not taken into account.

NetArea

Total area of the extruded area of the slab. Openings and recesses are taken into account by subtraction, projections by addition.

GrossVolume

Total gross volume of the slab. Openings, recesses, and projections are not taken into account.

NetVolume

Total net volume of the slab. Openings and recesses are taken into account by subtraction, projections by addition.

4.5.2 Any slab

GrossVolume

Total gross volume of the slab. Openings, recesses, and projections are not taken into account.

NetVolume

Total net volume of the slab. Openings and recesses are taken into account by subtraction, projections by addition.

4.6 Beam

Length

Total length of the beam, not taking into account any cut-out's or other processing features.

CrossSectionArea

Total area of the cross section (or profile) of the beam.

OuterSurfaceArea

Total area of the extruded surfaces of the beam (not taking into account the end cap areas), normally generated as perimeter * length.

GrossVolume

Total gross volume of the beam, not taking into account possible processing features (cut-out's, etc.) or openings and recesses.

NetVolume

Total net volume of the beam, taking into account possible processing features (cut-out's, etc.) or openings and recesses.

4.7 Column

Length

Total length of the column not taking into account any cut-out's or other processing features.

CrossSectionArea

Total area of the cross section (or profile) of the column.

OuterSurfaceArea

Total area of the extruded surfaces of the column (not taking into account the end cap areas), normally generated as perimeter * length.

GrossVolume

Total gross volume of the column, not taking into account possible processing features (cut-out's, etc.) or openings and recesses.

NetVolume

Total net volume of the column, taking into account possible processing features (cut-out's, etc.) or openings and recesses.

4.8 Covering

4.8.1 Areas of floor covering

GrossArea

Entire area of floor covering (per material). All openings at the floor are not taken off.

NetArea

Entire area of floor covering (per material). All openings at the floor independent of their size are taken off.

4.8.2 Areas of ceiling covering

GrossArea

Entire area of ceiling covering (per material). Openings at the ceiling are not taken off.

NetArea

Entire area of ceiling covering (per material). All openings at the ceiling independent of their size are taken off.

4.8.3 Areas of wall covering

GrossArea

Entire area of wall covering (per material) from all walls at a space. Openings at the walls are not taken off.

NetArea

Entire area of wall covering (per material) from all walls at a space. All openings at the wall independent of their size are taken off.

4.9 Curtain wall

Width

Width of the curtain wall.

GrossSideArea
Area of the curtain wall. All openings are not considered.

NetSideArea
Area of the curtain wall. All openings are taken off.

4.10 Ramp

4.10.1 Ramp with constant thickness

GrossFloorArea
Area of the ramp. All openings are not considered.

NetFloorArea
Area of the ramp. All openings are taken off.

Width
Width of the ramp.

4.10.2 Ramp with variable thickness

GrossVolume
Volume of the ramp. All openings are not considered.

NetVolume
Volume of the ramp. All openings are taken off.

4.11 Railing

Length
The length of the railing.