RISA TECHNOLOGIES, RISA-3D / RISA Floor
AUTODESK REVIT STRUCTURE
WHITE PAPER

Linking your Revit Structure model with RISA-3D / RISA Floor

Autodesk® Revit® Structure users can now leverage the full power of their analysis software by synchronizing their Revit Structure models with RISA-3D and RISA Floor. While RISA-3D provides a platform to analyze any three dimensional structure, RISA Floor provides a complete solution for building design. This white paper discusses the methodology for exporting a Revit Structure model to the two RISA programs and also for updating the Revit Structure model with structural changes. It also provides a guide on installing and troubleshooting the round-trip link between the two applications.

Why Revit Structure and RISA?

Imagine relocating a stairwell in an office building – reframing, redesigning, updating drawings. In the past, a task like this would have taken hours. Likely you would reframe plans and hand mark-ups to the draftsman. While new framing was making its way onto the plans, you'd manually update the analytical model, rerun the analysis/design, then pour over the results. With a new design in hand, you'd tag new sizes on the updated plans, spending more time than you'd like cutting sections.

With Revit Structure, you're already ahead of the curve. Every change – be it new framing, sizes, decks, notes – is automatically updated on all drawings in your set. Even sections! If only the same were true for your analysis software. With the latest versions of RISA programs and Revit Structure it is! Now you have the full power of RISA programs behind every step you make with Revit Structure. Export the entire Revit Structure model, or just a selected subset, to either of the RISA programs. Perform static or dynamic analyses, moving load analyses, vibration loading, live load reduction, automatically generate seismic and wind forces, design elements using provisions from various countries and tie the results back to your Revit Structure model. See the results...on the drawings and in your project budget.

Install the RISA-Revit Structure Link Component

You already have Revit Structure and atleast one RISA program in the office. In order to take full advantage of both programs you'll need to install the RISA-Revit Structure Link Component.

(1) Login to Windows – your account must allow registry access privileges

(2) Exit out of Revit Structure *and* all RISA programs

(3) Locate the Link Component installation file in one of three locations[1]

- Autodesk® Revit® Structure installation CD
- Autodesk® Buzzsaw® website
- RISA Technologies website
  www.risatech.com/partner/revit_structure.asp

(4) Run the self-executable installation file *RISARevitLink5.0.exe* [2]

The RISA-Revit Structure Link Component installation consists of eight files

RevitRISAComponent.dll	**RISA-Revit Structure Link Component** Controls communication between Revit Structure and RISA programs.
RISA_Revit_MapShapes.xml	**RISA Mapping File** Table listing RISA shape names and their Revit Structure equivalents Type names.
REVIT-RISA Round Trip Data.xls	**RISA Data Merge Table** Excel spreadsheet listing all data parameters that are managed by the link.
SharedParameterFile.txt	**Revit Shared Parameter File** Contains internal tracking data used by the link.
Revit_ini.txt	**Revit INI File Prototype** Sample modification to the *Revit.ini* file.
ReadMe.txt	**RISA-Revit Structure Link info text file**
RISA3D-Revit Component Link.doc	**RISA-3D Link Documentation**
RISAFloor-Revit Component Link.doc	**RISAFloor Link Documentation**

[1] For the most current version of the Link Component, visit the RISA Technologies website (www.risatech.com)
[2] The current Link Component installation file is *RISARevitLink4.0.exe*, (Version 4.0, Release 2).

Each of these files is installed to a new subfolder (*RISA Revit Link*) within the RISA installation directory.

In addition, the installation routine modifies the *Revit.ini* file to include the RISA-Revit Structure Link. This file is located in the Revit Structure program directory (default *C:\Program Files\Revit Structure 2008\Program*). Modifying the INI file helps in creating the Revit Structure menu commands for the link. An example of this modification is contained in the *Revit_ini.txt* file.

Shape Mapping File

Revit Structure and RISA use different data structures to reference the same element in a model. For example, in Revit Structure each particular member is an instance (column at grid A-2) of a type (W12x65) within a family (W-Wide Flange-Column). In RISA, however, a particular member is, well, a member (M37) with an associated shape type (W12x65). The RISA Mapping File is the master list that the Link Component uses when communicating between one program and the other.

The RISA Mapping File (*RISA_Revit_MapShapes.xml*) is an Excel based XML file listing RISA shape names and their corresponding Revit family names. The file is formatted with three columns separated by several spaces; the first column is the RISA shape name, the second column the Revit family type name and the third column is the shape type. Each column is tagged with a field prefix (e.g. **[RISA_NAME]**) and suffix (e.g. **[END_RISA_NAME]**). In certain cases, the engineer may want to edit the mapping file to add Revit family types and/or RISA shapes. As long as the shape (family type) and material are valid in both Revit Structure and RISA, shapes will map properly – even online and custom shapes. Any shape names that are not explicitly mapped by the files will be copied directly using the default name.[3,4]

Troubleshooting Installation

You must install both Revit Structure and RISA-3D v6.0.3 / RISA Floor v3.0 (or later) before attempting to install the Link Component. Version 6.0 users can upgrade to the v6.0.1 by downloading the update patch from the RISA website.[5] The Link Component will not work properly with the RISA demonstration software. Also, you cannot install the Link Component while Revit Structure is running, and you must be logged-in with registry access.

If for any reason the Link Component fails to install properly, you must perform a Windows uninstall.

Remove the Link Component

(1) Exit out of Revit Structure *and* all RISA programs

(2) Go to **Start > Control Panel > Add or Remove Programs**

(3) Select **RISARevitLink** and click **Remove**

[3] Currently, the mapping file lists only typical hot rolled steel shapes, but can be edited to include shapes from any material.

[4] When adding entries to the mapping file, pay close attention to material and structural usage.

[5] www.risatech.com/s_updates.asp

Export Your Revit Structure Model to RISA-3D / RISA Floor

In Revit Structure, to export your model to any RISA program, go to

Tools > External Tools > Send Model to RISA...

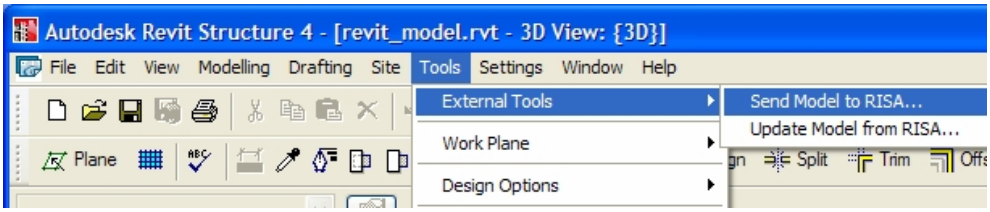

Figure 1:

External Tools Menu.

The Export Window will appear (below) with several options[6]

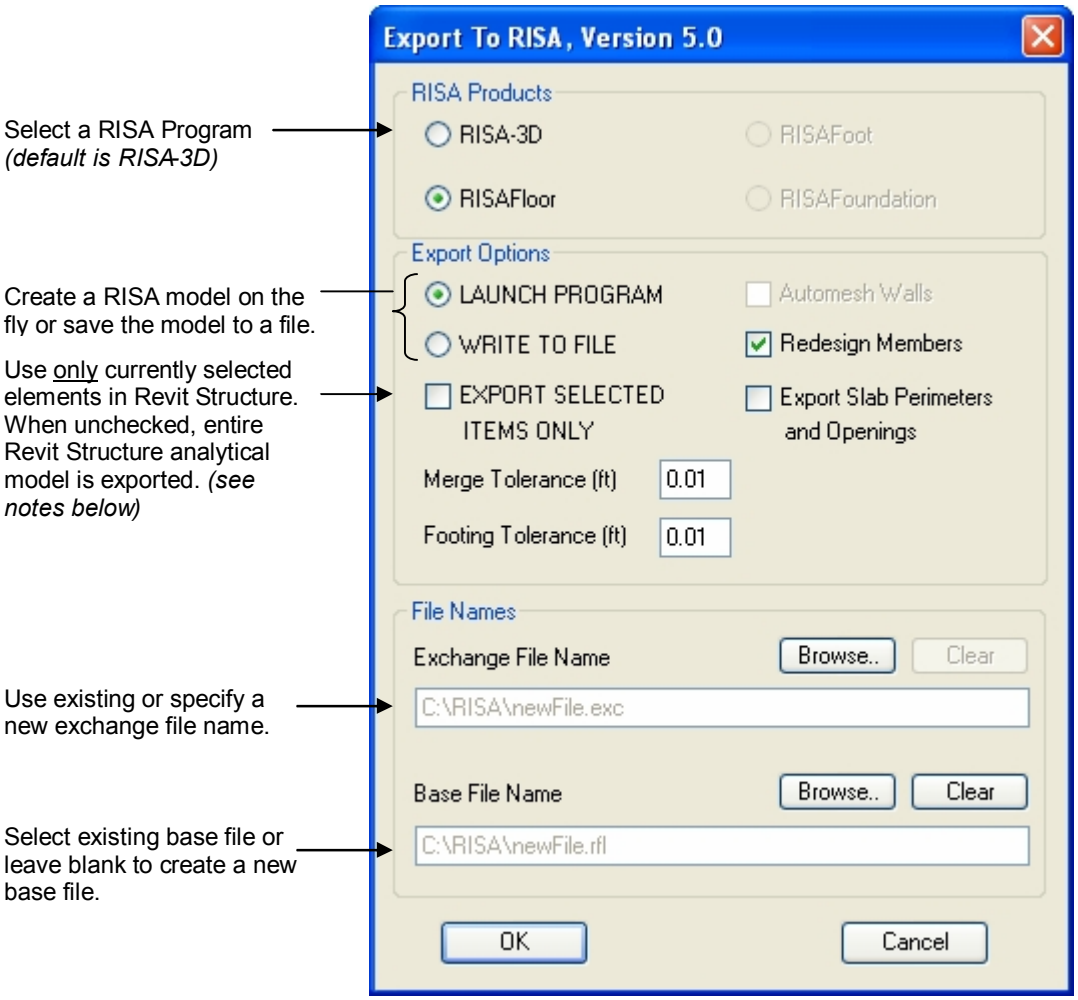

Figure 2:

RISA Link Component Export Window.

[6] Future supported programs and options not yet available are grayed out

Here, the engineer selects a RISA program to accept model data from Revit Structure, with the option of either exporting directly to RISA or writing to a file. By default, the Link Component will write an exchange and base files in the default RISA directory (typically C:\RISA) using the same Revit filename.

Revit Structural Walls are converted directly to individual plates unless the *AUTOMESH WALLS* option is checked. This option is currently only available for RISA-3D. When selected, walls are submeshed with the RISA-3D AutoMesh tool using beam, column, brace, and wall intersections as control points.[7]

The engineer also has the option of exporting only those elements currently selected in the Revit Structure model. This can be useful when analyzing a substructure such as a series of frames or a truss, for instance, without exporting the entire model.

IMPORTANT! When working with substructures (or the entire model, for that matter) be careful that the Revit Structure model geometry does not change before importing updated sizes from the RISA program. At this time the link component does not check for geometric inconsistencies between RISA and Revit Structure models. Methods such as worksets and watch monitors in Revit Structure can be helpful in managing these types of changes within the Revit Structure model.

The engineer can specify a Merge Tolerance and a Footing Tolerance value. Merge Tolerance value is provided to take into account the discrepancies while modeling in Revit Structure. Any points/ elements/ loads defined within this tolerance limit will be snapped to the same location. Footings located within this tolerance distance of a column will be snapped back to the column node in RISA. Footings outside of the tolerance distance will be ignored.

In RISA Floor, there is also an option to 'Redesign Members'. If this option is checked, the corresponding design list is automatically selected as the 'Shape Type' for each column and beam in the structure. This facilitates their design in RISA Floor. If this option is not checked, the shape names are explicitly exported to RISA Floor.

Finally, there is an option to export 'Slabs and Opening Perimeters'. If checked, it instructs the link to run around all defined decks and openings in Revit Structure and find a closed polygon of supporting framing around them. If closed framing polygon is found, it automatically creates slab perimeters and openings in RISA Floor.

Click "OK".

The Link Component then creates a RISA exchange file from the current Revit structure model. For larger models, this may take a few moments – you should see a progress bar similar to the one below.

[7] See *RISA3D-Revit Component Link.doc* for limitations.

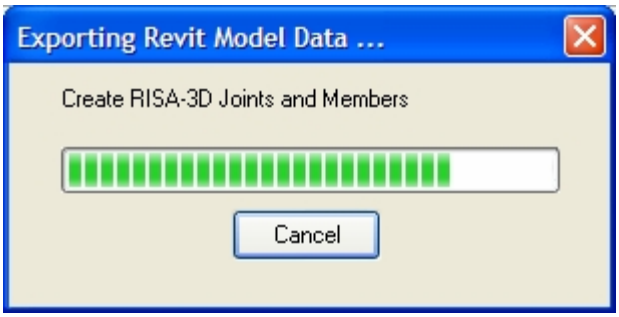

Figure 3:

Link Component Export Progress Window.

If the *WRITE TO FILE* option is selected, the engineer will need to manually import the exchange file into the RISA program. To do this in the RISA program, select

File > Import > BIM Exchange File.

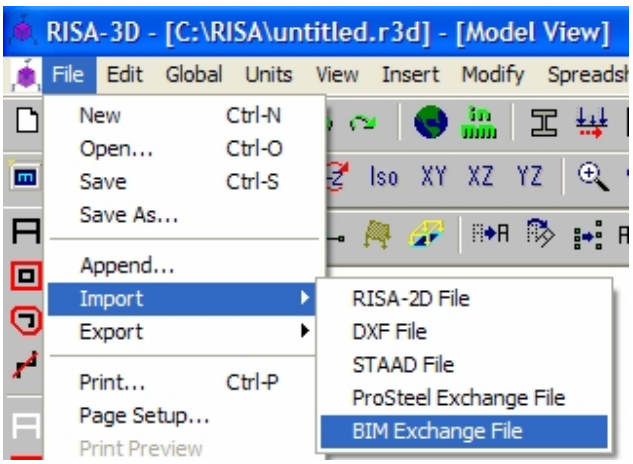

Figure 4:

File Import Menu.

After importing the BIM Exchange File, RISA automatically creates a corresponding .r3d / .rfl base file (depending on the RISA program) in the working directory. This base file can be saved to any directory location – it's path is correctly written to the exchange file during BIM Exchange File export (see next section).

Supported Elements

RISA 3D

Grid Lines

Both horizontal and vertical grid lines and labels are supported. While grid lines in Revit Structure have individual start/end locations, grid lines in RISA-3D span to the furthest intersecting grid line in each direction.

Columns, Beams, Braces

Family instances with column, beam, and brace structural usage parameters are supported. Other supported properties are: rotate angle, material type, family type name, start/end release codes, structural type, and element ID. RISA-3D Redesign Lists are set to "None" for Revit-native members. Rigid Links between columns and beams are supported. The Link Component has been updated to match material type to shape, and will now import physical material properties.

Structural Walls

All structural walls except "Non_Bearing" are supported and mapped to 4-node plates in RISA-3D. Structural wall thickness maps to plate thickness, and material type and properties are also supported. Doors and windows are not supported at this time.

Revit Structure structural walls map to one plate each in RISA-3D unless the *AUTOMESH WALLS* option is selected. When selected, RISA-3D automatically meshes each wall according to the control points of any intersecting geometry (beams, columns, braces, walls).

Footings

Family instances with the Footing-Rectangular structural usage parameter are supported, including length, width, and thickness. Only footings attached to the superstructure at a logical RISA-3D joint (base of column, beam, brace; wall corner) – or within the user-defined *Footing Tolerance* – will be recognized by the Link Component. Physical material properties, rebar data, and rotation angle are not supported at this time.[8]

Materials

Steel, Concrete, and Wood (Revit) materials are correctly mapped into RISA-3D. Any material associated with a Revit Wall is converted into an equivalent RISA-3D General Material.

Point Loads

Point Loads map to RISA-3D joint or member point loads based on location. Point Loads not located on a joint or member are ignored. The local coordinate system flag for point loads is ignored.

Line Loads

Line Loads map to RISA-3D member distributed loads. Any portion of a Line Load co-incident with a member will be translated. Line Loads may span multiple

[8] Only licensed RISA-3D users who have RISAFoot will be able to access this feature.

	members and start/end independently of individual members. The local coordinate system flag for line loads is ignored.
Area Loads	Only Revit Area Loads with 3 or 4 vertices are converted to corresponding RISA-3D member area loads – multi-sided Area Loads, Area Loads with Host having more than 4 sides are not translated. Area Loads flagged as projected will map to projected area loads in RISA-3D. The local coordinate system flag for area loads is ignored. Open Structure Area Loads are not yet supported by Revit Structure.
Load Cases	Load Cases map directly to RISA-3D Basic Load Cases. Load Case labels are used to filter Revit Structure loads into the proper RISA-3D basic load case. Load Case Natures are ignored.
Load Combinations	Load Combinations map directly to RISA-3D Load Combinations, including labels, references, and factors. Load Combination type maps to the RISA-3D solve or envelope flag. Load Combination state maps to the RISA-3D service flag. All materials are flagged for design in each Load Combination.
Boundary Conditions	Point Boundary Conditions are supported for Revit X/Y/Z translation and rotation. Point springs along with their modulus are also supported. Pinned Boundary Conditions are assigned to the bottom of all column stacks and walls where no beam, column, or brace falls below it.

RISA Floor

Floor/ Level Information	Levels are brought in as Floors in RISA Floor. Level name and elevation are the properties that are supported for various Levels.
Grid Lines	Both horizontal and vertical grid lines and labels are supported. While grid lines in Revit Structure have individual start/end locations, grid lines in RISA Floor span to the furthest intersecting grid line in each direction.
Beams, Columns, and Braces	Family instances with structural usages of column, beam, and braces are supported. While Columns and Beams are brought in as RISA Floor elements, Braces are brought in as supplemental RISA-3D elements. The following properties are supported; rotate angle, material type, family type name, start release code, end release code, structural type, and element ID. Material type and physical material properties are also supported. Uniform studs and camber information is also brought into RISA Floor for beam elements.

Cantilever Beams If either the “Moment Connection Start” or “Moment Connection End” fields of a beam are set to “Cantilever Moment”, then the beam would be brought in as a Cantilever in RISA Floor.

Physical/Multi-Level Columns If a column spans along multiple levels in Revit Structure, it will be exported as a physical column to RISA Floor. In RISA Floor, all floors/ levels through which this column passes will have a corresponding entry for this column, and a corresponding column stack will be added to the RISA Floor model.

Splices The offset associated with the actual top level of the column is read and converted appropriately as splice level elevation for relevant columns within the column stack. The splice type is also read in for Steel members.
Actual base level offsets are read for only the bottommost columns in each column stack. The base offset for the bottommost columns can be provided as a positive distance from any level. This provides flexibility to model structures on uneven terrains like in hilly areas.
The link will also automatically create splices if the following properties differ for columns in the same column stack: Shape Name, Material Type, Material Offset, Function and/or rotation angle.

Walls Wall Elements are supported for RISA Floor. Wall Thickness and function are the properties that are supported. Material Type and physical material properties are also supported.

Gravity / Lateral Elements If the ‘Analyze As’ field of a beam or column is set to “Lateral”, then it would be brought in as a Lateral Element. If set to “Gravity”, it would be brought in as a gravity member. Braces are always brought in as lateral elements. All columns sharing a node with a lateral beam or lateral wall are automatically converted to Lateral. Along with this, all column stacks that have bracings in the bay between them are also automatically converted to lateral. Any element having a lateral loading will also be converted to lateral.
If the ‘Structural Usage’ flag is set to 'Shear' or 'Combined' for Walls, then it is exported as a lateral element into RISA Floor. In all other cases, walls are exported as Gravity elements.

Area Load Definition All area loads along with their corresponding magnitudes have a corresponding entry under the ‘Area Load Definitions’ in RISA Floor,

Deck Definitions Slabs/Deck properties are brought in as ‘Deck Definitions’ in RISA Floor. The name of the deck, its thickness, deck direction, concrete strength, weight of concrete and Elastic modulus are brought into RISA Floor from Revit Structure**.**

Materials	Steel, Concrete, and Wood (Revit) materials are correctly mapped into RISA-3D. Any material associated with a Revit Wall is converted into an equivalent RISA-3D General Material.
Load Combinations	Load Combinations are directly translated into RISA Floor Load Combinations. Load Combination Labels, Load Case references and Load Case factors is being supported. The combination state is also brought over as the RISA Floor service flag. Load Cases are mapped in accordance with the corresponding category from REVIT to RISA Floor
Point Loads	REVIT point loads are translated into RISA Floor point loads. Point loads can be placed anywhere on the structure, and it is not necessary for these loads to lie on top of any element.
Line Loads	REVIT line loads are brought over as RISA Floor line loads. Line loads can be placed anywhere on the structure, and it is not necessary for these loads to coincide with any element.
Area Loads	REVIT area loads are brought into RISA Floor. Polygon area loads and multi-loop area loads are supported in RISA Floor. The user can define the area load edges anywhere on the structure and it are not mandatory for these loads to coincide with any elements on the structure.
Decks	REVIT Decks/slabs are brought in as RISA-Floor Decks. Polygon decks/slabs are supported in RISA-Floor. The user can define the decks/slabs anywhere on the structure and it is not mandatory for them to coincide with any element on the structure. At solution time, decks in RISA Floor will be automatically clipped to lie within the defined slab perimeters.
Slab Perimeters / Openings	Openings and slab perimeters are automatically created by the Component Link if a closed framing polygon is found around the defined edges in Revit Structure. Perpendicular distance from the mid point of each opening edge created by the link to the actual edge in Revit Structure gives the value of overhang for that particular opening edge.

Physical vs. Analytical Models

Remember, in Revit Structure there are two primary models: the physical model and its analytical counterpart. When you export your Revit Structure model to RISA, the Link Component reads the analytical model (including its connectivity) when creating the corresponding structure in RISA programs. For this reason it's important to maintain continuity in the Revit *analytical* model. If the analytical threads of physical elements are not connected, this can lead to discontinuities and instabilities in the RISA model. Part of this problem can be fixed by using a large value of 'Merge Tolerance'.

Exchange File vs. Base File

The RISA Revit Link Component v4.0 and later uses a split file system to manage the exchange of Revit and RISA native information. An exchange file (.exc) is used to pass information between Revit and RISA, and vice versa. The exchange file is simply a smaller RISA file containing only data being passed between the two programs. Since the RISA model contains certain parameters that are not part of a Revit model (e.g. Design Rules, braced lengths), RISA creates a base file – a full RISA (.r3d/.rfl) file – in which is stores this additional data.

As information is passed between the programs, both RISA and the Link Component compare information in the exchange file with the base file to correctly track changes and maintain data continuity. Initially, Revit creates an exchange file that is read into the RISA program. As new information is added to the RISA model, it is stored in the corresponding base file. A new exchange file is created and passed to Revit, thereby updating the Revit model. After changes are made in Revit, another exchange file is created. As this exchange file is imported into RISA, it is merged with the base file created earlier, retaining RISA-specific data created earlier. This process is illustrated in Figure 5, below.[9]

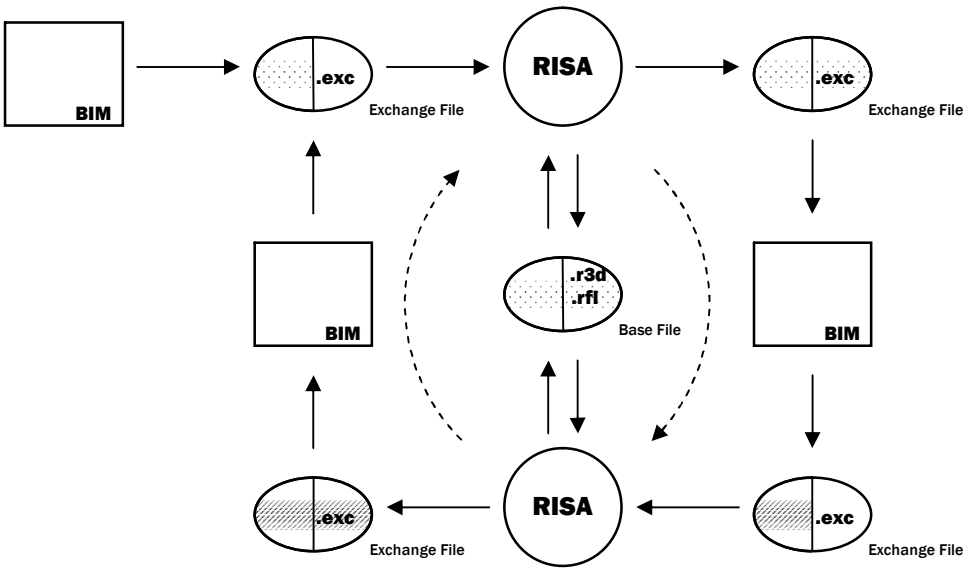

Figure 5:

Exchange File Process.

[9] Refer to the *REVIT-RISA Round Trip Data.xls* spreadsheet for specific details on which parameters are preserved, overwritten, and merged

Import Changes from RISA-3D / RISA Floor to Revit Structure

Be sure to save your work in the RISA program. Performing *Save* or *Save As…* will save your changes to the base file, but will not create an exchange file. To update the existing exchange file (or create a new one), you must export a BIM Exchange File.
To do this in the RISA program, select

File > Export > BIM Exchange File

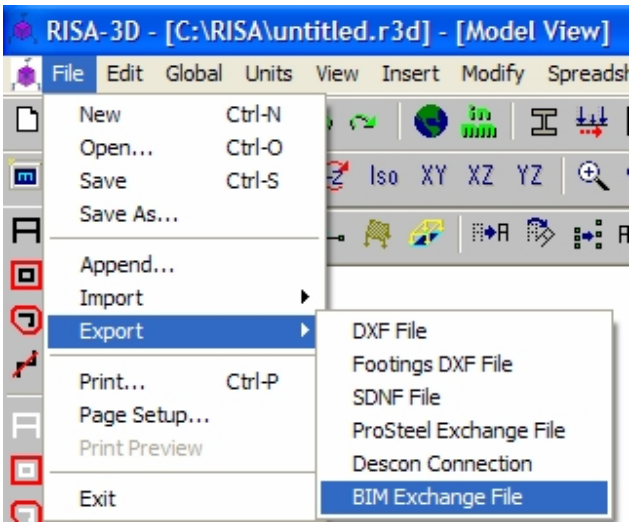

Figure 6:

File Export Menu.

If the exchange file was created successfully, an export confirmation dialog appears.

Figure 7:

Export Confirmation Dialog.

Note: The default BIM import/export directory can be set using the **Tools > Preferences** menu of the RISA program.

Go back to Revit Structure and import your changes from the RISA program.

Tools > External Tools > Update Model from RISA...

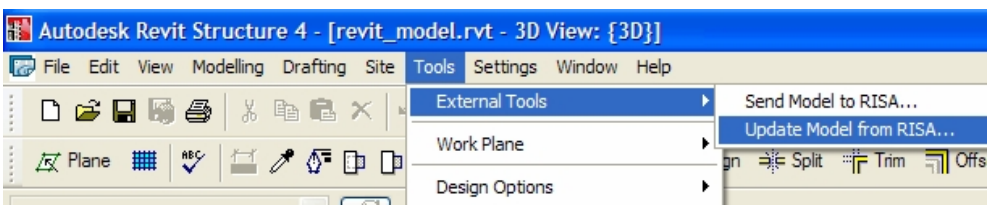

Figure 8:

External Tools Menu.

The Update From RISA Window will appear (below) with several options

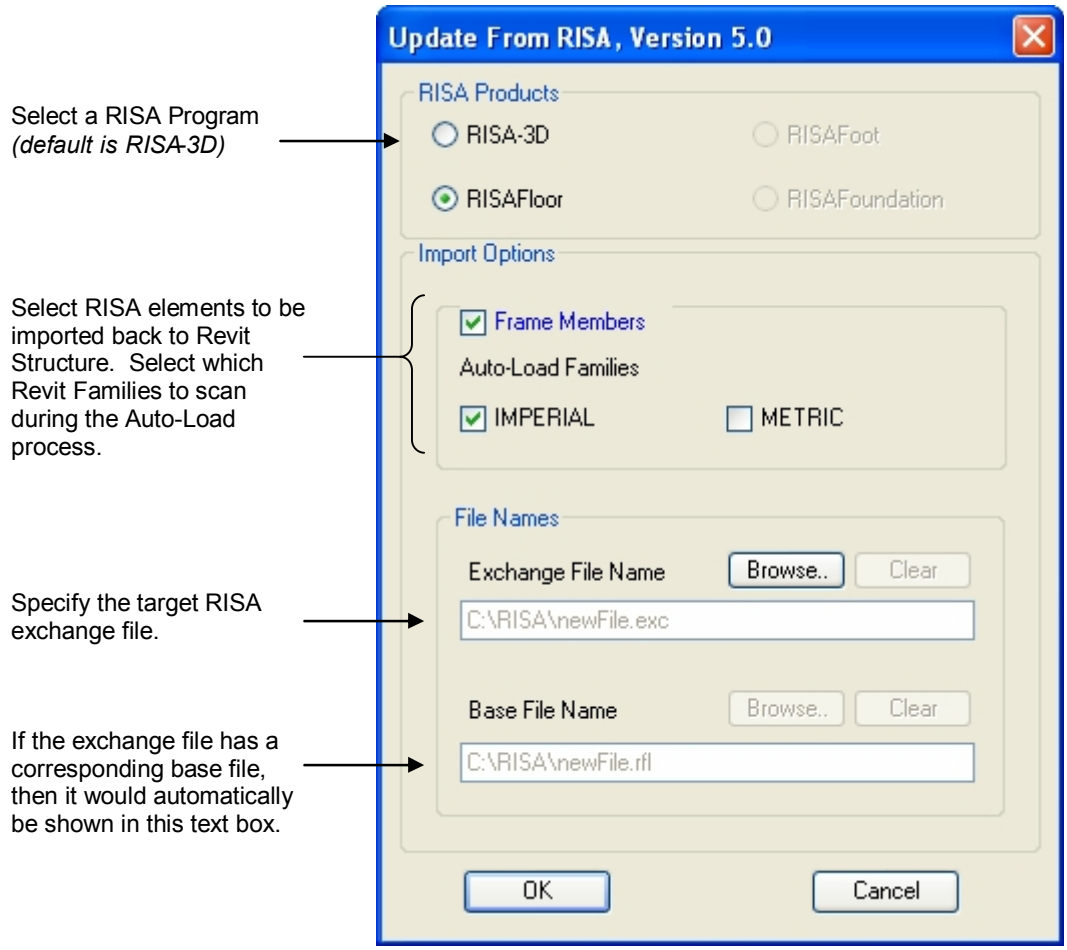

Figure 9:

RISA Link Component Import Window.

Click “OK”.

The Component Link scans the RISA file and updates Revit Structure family type names for supported elements. As before during Export, a progress bar will appear while importing larger models.

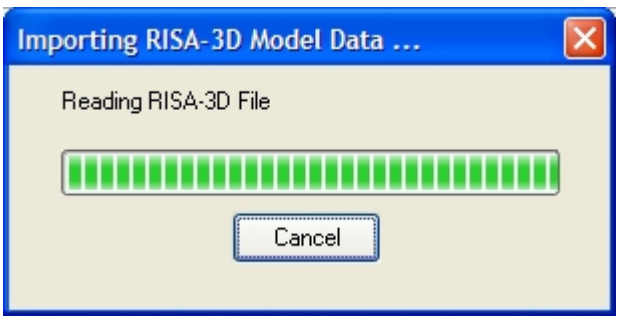

Figure 10:

Link Component Import Progress Window.

Once the Component Link finishes importing, the Revit Structure model will be updated.

Supported Elements

Columns, Beams, Braces Resized RISA members are mapped back to Revit Structure via the mapping file and family type names are updated. Shape names that appear in both the Structural Column and Structural Beam families are identified by the presence of "Column" in the Structural Column family name and "Framing" in the Structural Framing family name, respectively. The latest version of the Component Link supports AutoLoading of Revit families during import.

IMPORTANT! Revit Structure 4 users must use the v4.0 Component Link and are required to pre-load all structural family types (shapes) in the Revit Structure project before attempting to redesign in RISA.

What's New in the Component Link v5.5

- Ability to read curved beams.
- Ability to read in-place families.
- Multi-level Walls as supported in RISA Floor.
- Bug Fix for Metric Unit Shape Conversion.
- Log File added to Export / Import Operation.

What's New in the Component Link v5.0

- New Excel based XML Mapping File
- Ability to Export Negative Loads to RISA Floor.
- Ability to Export 'Analyze As' Flag to RISA 3D.

What's New in the Component Link v4.0

- New Exchange File Method
  - allows continuity of data throughout the exchange cycle (round trip)
  - only exchange file (.exc) is transferred between programs
  - base file (.r3d / .rfl) retains additional data not sent to Revit (i.e. K, Lb, Design Rules, etc.)
  - user can create new members in RISA that are stored in base file but are not read into Revit
- AutoLoad Families – automatically loads Revit families on import from RISA
- AutoMesh Walls – uses the RISA-3D AutoMesher to submesh Revit walls
- Vertical Axis –rotated automatically if user changes default orientation
- Physical Materials and properties – automatically created for all elements
- Physical Columns – supports RISAFloor physical columns and splices

Troubleshooting

Some common issues when using the RISA-Revit Structure Link Component.

How do I export a RISA (3D or Floor) model to Revit?

The current version of the link **does not** support creating a model in RISA and then exporting to Revit – the model must first be created in Revit. Revit Structure 4 Release 2 should support this workflow.

I go to TOOLS > EXTERNAL TOOLS in Revit Structure, and the option to "Send Model to RISA…" or "Update Model from RISA…" is not available.

You must install the Revit Structure Component Link. Be sure to exit both RISA and Revit before attempting to install the link.

The Tools > External Tools menu is grayed-out.

Be sure that the model view in Revit Structure is selected. Do this by clicking on the model view window. Go to the Tools menu and you should see that the External Tools submenu is available.

After importing my design changes from RISA-3D to Revit Structure, some member shapes are not updated.

Be sure to save the file in RISA-3D before importing back to Revit Structure. If you have saved the file under a different file name, be sure the SELECT FILE TO IMPORT box is checked in the import window and specify the file. If you are using the Component Link 3.0, pre-load necessary families and types before importing back to Revit Structure – it does not automatically load new shapes.

I notice that my walls are not connected or that beams do not connect with columns when exporting to RISA-3D.

RISA-3D scans the ***analytical*** portion of the Revit Structure model. Ensure proper connectivity of the analytical model in Revit Structure – vertical alignment of walls, column-to-beam connections (specifically, rigid links). When properly defined, Revit Structure automatically maintains this connectivity.[10]

When I export from Revit to RISA-3D my framing is OK but I lose my area loads!

RISA-3D only supports 3- and 4-sided area loads. Revit allows directly defined and hosted area loads that can have many sides. Redefine your Revit area loads with a maximum of 4 sides.

When I import from RISA (3D or Floor) my framing sizes aren't updated!

Be sure that you have first exported a BIM Exchange File from your redesigned RISA model. Save the RISA model, then go to ***File > Export > BIM Exchange File***. If you are using the Component Link 3.0, you must first load the corresponding family types (i.e. W14X22, W16X26, etc…) for your new designs.

[10] For more info on rigid links, see the Revit Structure User's Guide

I'm using the Component Link 3.0 and have pre-loaded all necessary family types into my Revit model, but sizes still aren't updating!

Revit supports both 'Architectural' and 'Structural' beams/columns/walls. If you received a model from the architect these members may not have their usage set to 'Structural' – only 'Structural' shapes are exchanged with RISA. You can see this by right-clicking on a member and selecting 'Properties…".

Also, the Component link does not support custom families. If you are trying to exchange custom families, they will not transfer. An exception is for built-up sections using the shape mapping file.

After installing the Component Link I get a warning message when opening Revit: ".NET 2.0 must be installed to take advantage of the associated external commands" or similar.

Our latest Component Link uses Microsoft .NET commands to interface with the Revit API. A simple Windows Update should offer to install .NET 2.0.

When I export my model from Revit to RISA, I have lots of instabilities.

Although you can assign end releases in Revit, Revit itself does not perform a stability check. You will need to assign the correct end releases on the Revit side to maintain a stable model for each roundtrip.

When I export my model from Revit to RISA, I get a version error.

The Component Link 2008 will only write a RISA-3D v6.0.1 / RISA Floor v3.0 file format (or later). Contact RISA Technologies to obtain a compatible version.

Recommended System Requirements

- 1 GB RAM or better
- Pentium 4, 1.5GHz or better

Resources

RISA Technologies	www.risatech.com/partner/revit_structure.asp support@risatech.com
Autodesk	www.autodesk.com/structure