



Using Reactions

Rev 2, Updated 6 December 2021

Structural Toolkit V5.2 and later can apply reactions from previously designed steel and timber roof and floor members. As of Structural Toolkit V5.4.3 reactions can also be taken from and applied to Analysis models.

Member reactions are recalculated during the loading process. The reactions are tracked in the background during design. When a reaction changes due to a changed loading condition, the dependent documents are automatically updated, even if they are not open at the time.

If you have loaded an older version and want to start using reactions, use the [Project] > [Enable] (Reactions) button.

Applying a Reaction - Structural Toolkit Modules

To add a reaction in a compatible module, highlight the load cases you want to add from another member (i.e. DL/LL/WL in the point loads entry section), then right click and select [Add reaction].

Loadings

Roof area (A) =	32.0 m ²	Apply wind reduction =	Y (Y)
LL = 1.8/A+0.12 ≥ 0.25 =	0.25 kPa AS 1170.1 T3.2	Roof reduction (ka) =	0.89 A!
		Ratio Ws/Wu =	0.68 (R)

Uniform dead loads

Roof dead load (wdl) =	0.40 kPa *	8000 mm +	k↑
Other dead load (wdl) =	kPa *	8000 mm +	k↑
Down only load (wdl) =	kPa *	mm +	k↑
Include S.Wt =	Y (Y)es,(N)o		S.
		Σwdl.up =	3.52 kN/m

Uniform live loads

Roof live load (wll) =	0.25		k↑
Other live load (wll) =			k↑
Alternate point live load =	1.40		members

Uniform wind loads

Ult. wind load (Wu) =	0.75		
Cp,e =	0.7		

Point loads

Dead load (pdl) =			
Live load (pll) =			
Wind load (pwl*) =			
w* = 1.2*wdl + 1.5*wll =			
p* = 1.2*pdl + 1.5*pll =			
w.up* = 0.9*wdl.up + wwl* =			
p.up* = 0.9*pdl + pwl* =			
M*			
M.up*			

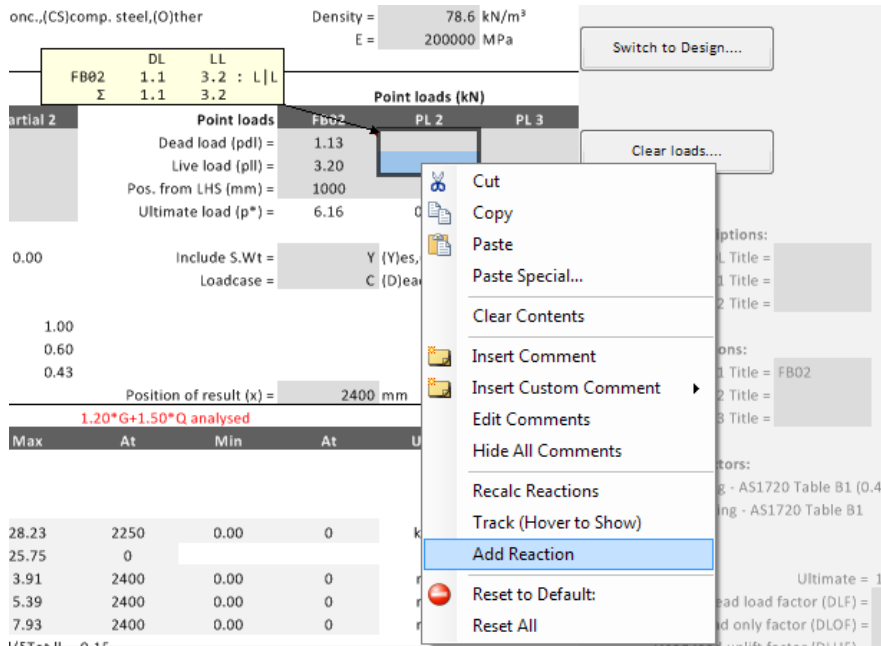
1000 m

Rdl =
Rll =
Rwl* =
R.dn* =
R.up* =

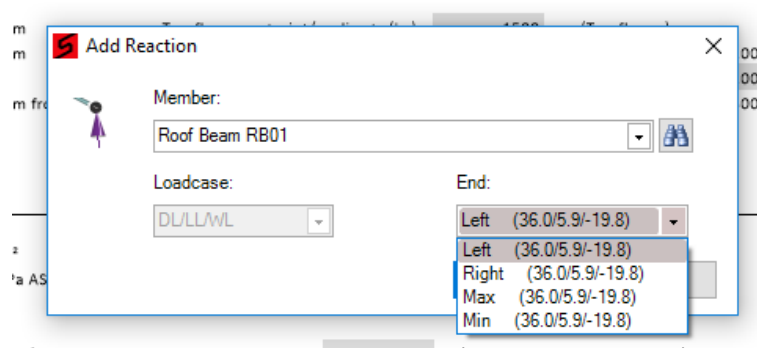
Info Design

- Cut
- Copy
- Paste
- Paste Special...
- Clear Contents
- Insert Comment
- Insert Custom Comment
- Edit Comments
- Recalc Reactions
- Track (Hover to Show)
- Add Reaction**
- Reset to Default:
- Reset All

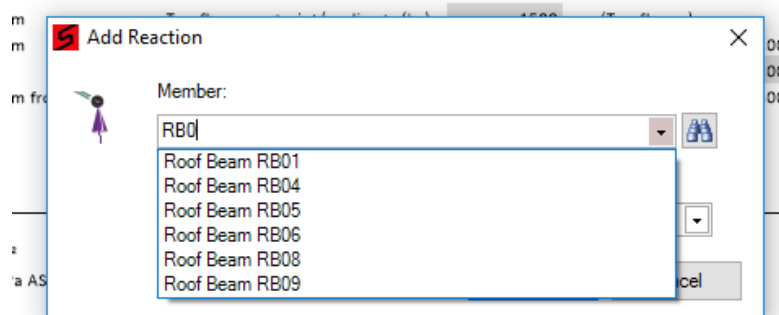
You can also add reactions to the Member Design Analysis.



After the right click, the Add Reaction dialog box will appear allowing you to select which member the reaction comes from, along with the member end (right, left or centre for double span timber beams, or the maximum or minimum reaction). As of Structural Toolkit V5.4.3 analysis module nodes will also appear within the drop down box providing Analysis reactions for the model are enabled. Refer to the Applying a Reaction – Analysis section for details on how this works.



You can search for a member by typing part or all of the member name in "Member" section and selecting the beam from the dropdown list.



Once you have selected the member and end to insert as a point load, press [OK] and the reaction will be inserted along with an automatically formatted comment showing the make-up of load with the end used.



Ult. wind load (Wu) = 0.75 kPa * 8000 mm
 Cp,e = 0.7 Cp,i = 0.5

Point loads

	DL	LL	WL	
Dead load (pdl) =	36.0	5.9	-19.8	: L L L
Live load (pll) =	5.9			
Wind load (pwl*) =	-19.8			
$w^* = 1.2*w_{dl} + 1.5*w_{ll}$	7.22			Rdl.max =
$p^* = 1.2*p_{dl} + 1.5*p_{ll}$	52.13			Rll.max =
$w_{up}^* = 0.9*w_{dl,up} + w_{wl}^*$	3.57			Rwl*.max =

(Point load position within span) 1000 mm

The above process can be repeated to add the reaction from as many members as required.

Additional point loads can be added by double clicking in the load cell and typing "+ <additional load>" after the formula within the cell. Do not alter this formula as this will cause an error within your reactions. You can also subtract, multiply or divide a load. These changes will automatically appear as an "Extra" in the comment.

Cp,e = 0.7 Cp,i = 0.5 w.wl* = -6.74 kN/m (up)

Point loads

	DL	LL	WL	
Dead load (pdl) =	48.1	23.7	-29.1	: L L L
Live load (pll) =	4.9	2.7	-9.3	: L L L
Wind load (pwl*) =	7.2	15.0		: L L L
$w^* = 1.2*w_{dl} + 1.5*w_{ll}$	93.18			Rdl.max = 43.11 kN
$p^* = 1.2*p_{dl} + 1.5*p_{ll}$	93.18			Rll.max = 21.74 kN
$w_{up}^* = 0.9*w_{dl,up} + w_{wl}^*$	3.57			Rwl*.max = -35.29 kN

Point load description: =Reaction("58-220317-083255","DL","Left")+Reaction("60-220317-083256","DL","Left")+Reaction("71-270317-163055","DL","Left")+5

Combinations: AS1170.0

A custom comment can be assigned to the Extra, which will remain if you alter the additional loads. Take care not to modify text elsewhere (extra comments are recorded after the colon to the end of the line).

Ult. wind load (Wu) = 0.75 kPa * 8000 mm
 Cp,e = 0.7 Cp,i = 0.5

Point loads

	DL	LL	WL	
Dead load (pdl) =	53.1	5.9	-19.8	: L L L
Live load (pll) =	23.7			
Wind load (pwl*) =	-29.1			
$w^* = 1.2*w_{dl} + 1.5*w_{ll}$	99.18			Rdl.max =
$p^* = 1.2*p_{dl} + 1.5*p_{ll}$	99.18			Rll.max =
$w_{up}^* = 0.9*w_{dl,up} + w_{wl}^*$	3.57			Rwl*.max =

Extra 5.0 0.0 0.0 : Girder



Deleting Reactions - Structural Toolkit Modules

Select the cell containing the reaction and right-click to show the context menu. Hover over the [Reactions:] item to show the order of the equation.

Uniform live loads

Floor live load (wll) = 1.50 kPa
 Partitions (wll) = kPa
 Alternate point live load = 1.80 kN

	DL	LL	
RB01	1.2	1.4	: L L
RB02	1.3	1.4	: R R
Σ	2.5	2.8	

Point loads

Dead load (pdl) = 2
 Live load (pll) = 2

Short term LL factor (Ψ_{su})
 Long term LL factor (Ψ_{lu})
 $w_d^* = 1.2 \cdot w_d + 1.5 \cdot \Psi_{lu} \cdot w$
 $w^* = 1.2 \cdot w_d + 1.5 \cdot w$
 $p_d^* = 1.35 \cdot (p_d + \Psi_{lp} \cdot p_l)$
 $p^* = 1.2 \cdot p_d + 1.5 \cdot p$

Bending and Shear Capacity - Cl 3.2.1 & Cl 3.2.2

Member = 240mm x 4
 Description = F17k season
 Design depth (dD) = 2
 Design width (dW) =

$S_1 = 1.25 \cdot dD$

Strength red

$\phi M(dI) = \phi \cdot (k_1 = 0.57) \cdot k_4 \cdot k_6$
 $\phi M = \phi \cdot k_1 \cdot k_4 \cdot k_6$

Context menu options:

- Cut
- Copy
- Paste
- Paste Special...
- Clear Contents
- Reinsert Reaction Comment
- Insert Custom Comment
- Edit Comments
- Hide All Comments
- Reactions: (Hover to Show)**
- Recalc Reactions
- Track (H) = (RB01:DL:Left)+ (RB02:DL:Right)
- Add Reaction
- Reset to Default:
- Reset All
- Equ: (Hover to Show)

Editing the cell, manually delete the "Reaction(...)" part of the equation associated with the reaction in each cell. The comment will automatically update.

Uniform live loads

Floor live load (wll) = 1.50 kPa
 Partitions (wll) = kPa
 Alternate point live load = 1.80 kN

	DL	LL	
RB01	1.2	1.4	: L L
RB02	1.3	1.4	: R R
Σ	2.5	2.8	

Point loads

Dead load (pdl) = 2
 Live load (pll) = 2

Point loads

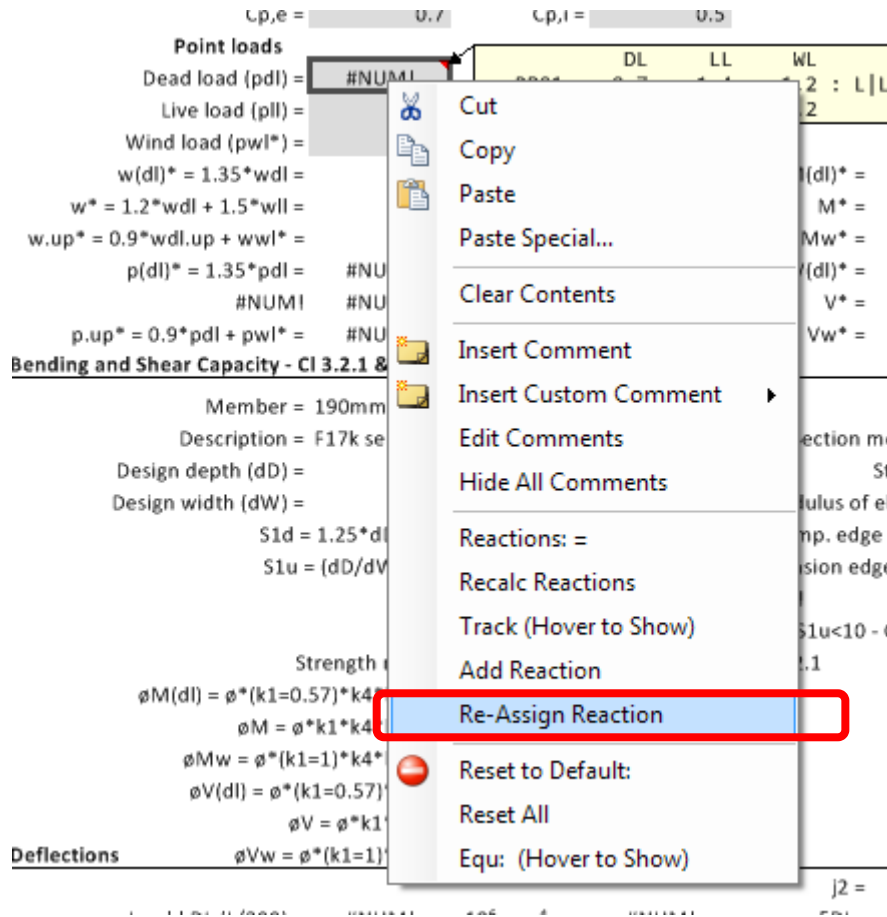
Dead load (pdl) = `=Reaction("519-150617-100742","DL","Left")+Reaction("26-150617-115822","DL","Right")`
 Live load (pll) = 2.80 kN

Shear using PL at support = N (Yes,(N)o



Re-assigning invalid Reactions - Structural Toolkit Modules

In the event that a dependent document cannot be found, you can use the [Re-Assign Reaction] to re-link the document.



Deleting a Reaction Comment - Standard Structural Toolkit Modules

Reaction comment can be deleted if you do not want to have it displayed. Select the comment frame, then select the [Delete Comment] from the context menu.

Reinserting a Reaction Comment - Standard Structural Toolkit Modules

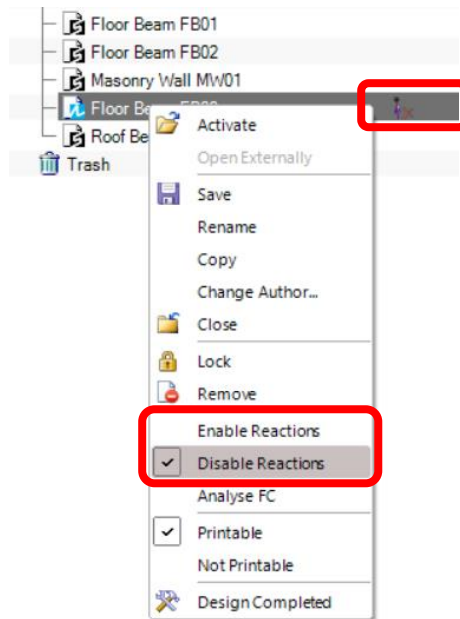
To re-insert the comment associated with a reaction, select the cells for commenting (i.e. the DL/LL/WL fields) and select [Reinsert Reaction Comment] from the context menu.



Reactions – Analysis Model

Reactions can be added to and from Analysis models as of Structural Toolkit V5.4.3. Reactions from Analysis models can be applied to Structural Toolkit modules in the same way as outlined in the previous section.

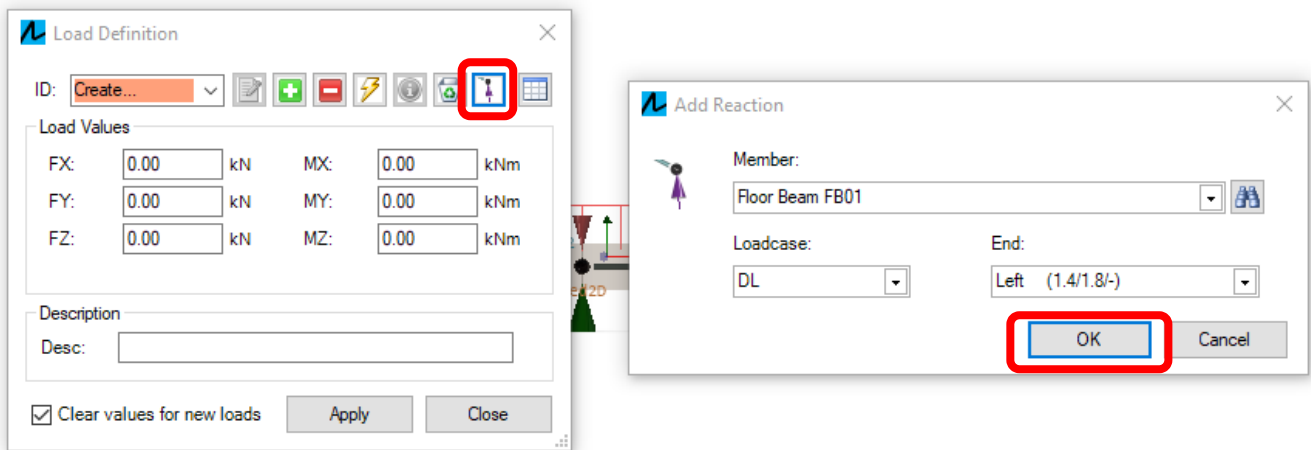
Depending on the user's hardware, having the reactions of all Analysis models within a project be calculated each time the project is opened can be a time-consuming process. To help with this, the reactions can be enabled or disabled for individual analysis models by right-clicking on the model in the "Project" pane and selecting [Enable Reactions] or [Disable Reactions]. This will then prompt the user to close all documents to allow for reaction recalculation. If disabled, the selected document will have an icon next to it to signify its reactions have been disabled, as shown below. Reactions can also be enabled by default. Refer the "Options" section at the end of this document.



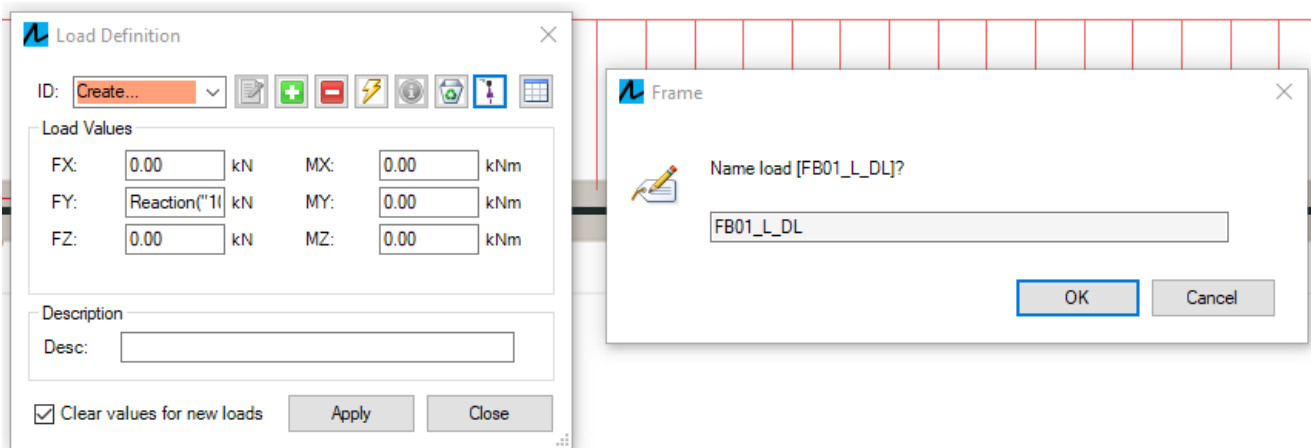


Applying a Reaction – Analysis Model

A reaction to Analysis can be done via the “Load Definition” interface (shown below). By clicking the [Reactions] button, an interface will appear that allows the user to insert a reaction from either a timber or steel beam module, or another analysis model within the same project. As Analysis applies dead, live and wind loads separately, a separate load needs to be created for each loadcase. Loadcases can be selected using the drop-down option in the “Add Reaction” interface. Press [OK] once the desired reaction has been selected. Note that reactions can only be applied in the Y-axis (up & down). In addition, when adding reactions from other Analysis models, ensure that the loadcases being used are the default DL, LL or WL (or WLu), otherwise these loads will not appear.



Once a reaction has been applied, it will appear in the “Load Definition” interface, and another dialogue box will appear for naming the load, as seen below. The default name will consist of the member name (e.g. “FB01”), reaction end (e.g. “L”) and loadcase (e.g. “DL”). Clicking [OK] will apply the name and respective load.



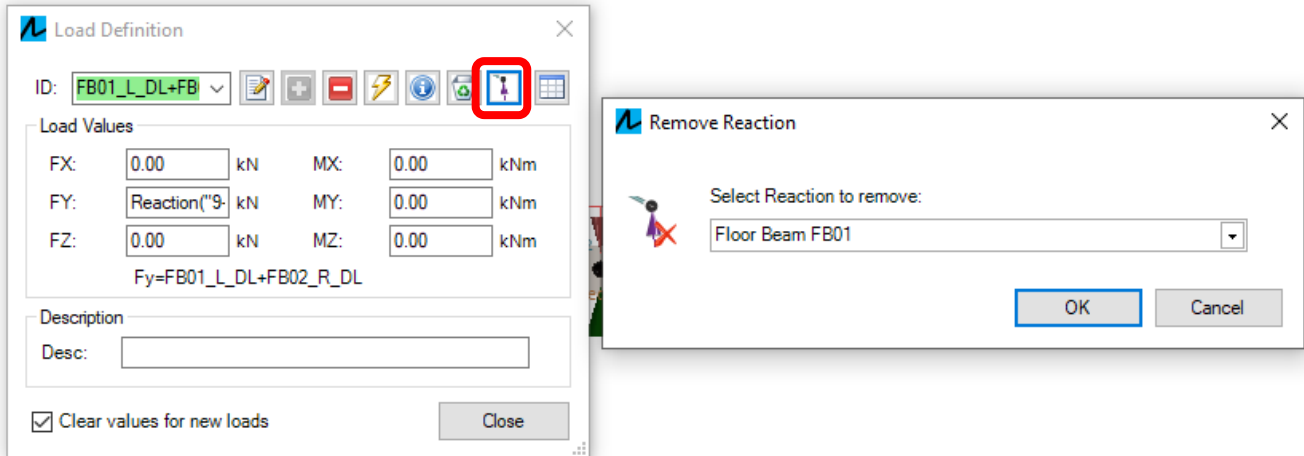
Further loads of the same loadcase can be added by repeating the above process. Each new load added will prompt a rename of the load definition.

Like with reactions for the Standard Structural Toolkit modules, reactions in Analysis will also automatically update. However to ensure that reactions coming from Analysis members are correctly found, analyse the member at least once during design. Otherwise, refer to the Refreshing the Reactions Database section.



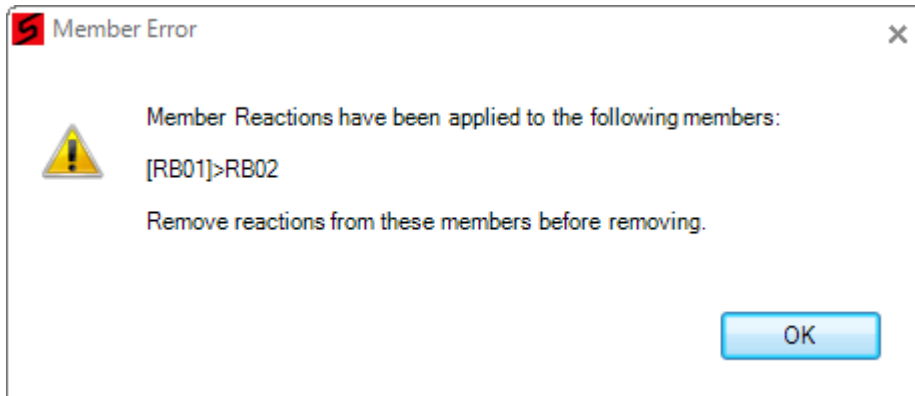
Deleting Reactions – Analysis Model

A reaction can be removed from load by [Shift] clicking the [Reactions] button in the “Load Definition” interface. This will bring up another interface that allows the user to select the reaction to be removed. This will also prompt the user to rename the load.



Removing Dependent Members

If you try and remove a member that is dependent on another member, you will get a dialog box advising that this cannot be done. To remove the member, the referenced reactions must be removed from the dependent member designs first. Refer to the “Deleting Reactions” section for the relevant member type (Standard or Analysis).

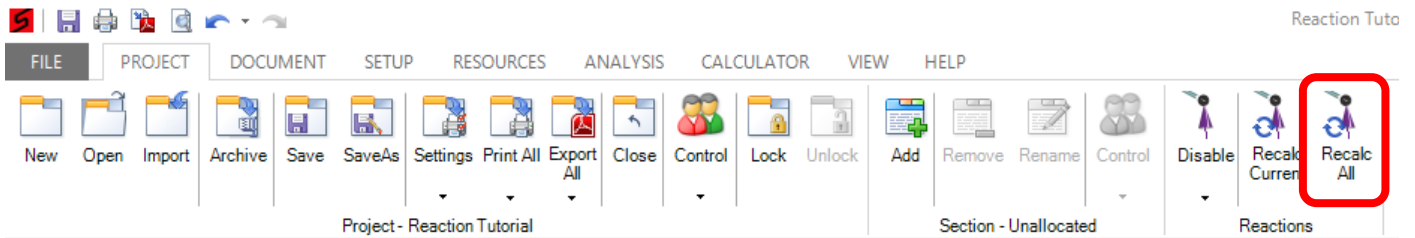




Refreshing the Reaction Database

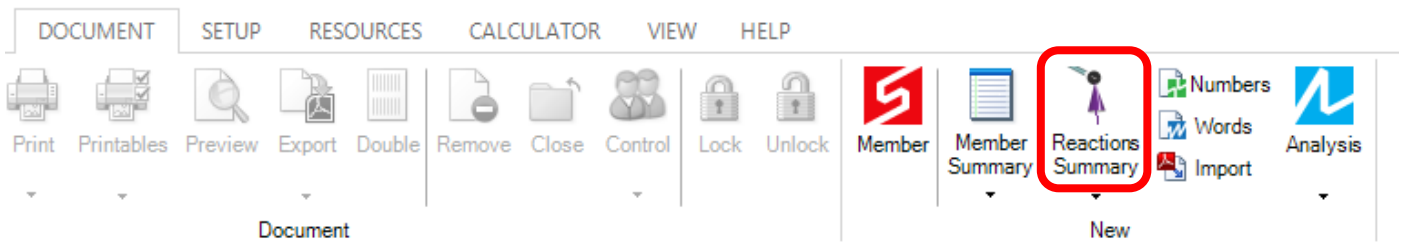
The management of reactions is quite complex, and on occasions it may be necessary to refresh all reactions. This may be necessary if you get a circular reference message, or the tracking on the reactions summary or context [Track] appears incorrect. It may also be required if loading an older version that did not support reactions.

To do this, select the [Project] > [Recalc All].



Reaction Summaries

Summaries of the reactions and tracking (i.e. which load goes to where) can be produced in landscape, portrait, or excel formats. This can be done from the [Document] tab.



The summary includes the reactions at each end (Dead, Live and Wind (ult.), if applicable. Combination reactions are not displayed.

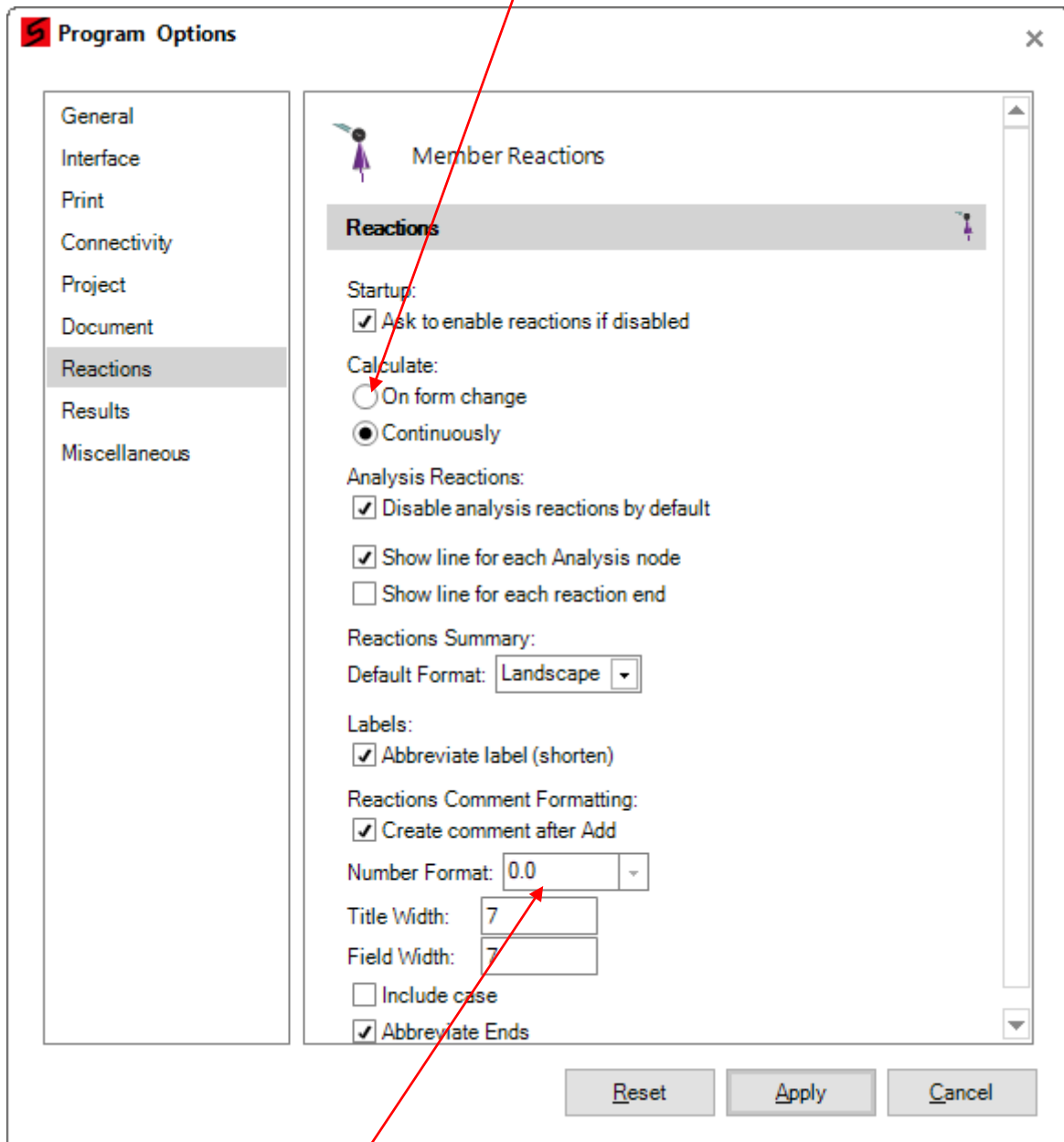
In the second section of the summary, reactions are tracked showing the path of reactions from other members and to other members.



Reaction Options

Options for the Reactions are found in [File] > [Options] > Reactions

Where beams are part of a long reaction chain (i.e. Beam to beam to beam...), the background calculations can cause the interface updating process to become slow. To resolve this you can change the calculation type to "On Form Change" which calculates the reactions when closing the active document, or switching to another document



To change the number of decimals for the reactions, change the number format.



Tips

Naming members

When naming members, avoid adding text after the member designation. Use a bracketed small entry if necessary, but preferably use the following:

Roof Beam RB01a > Shows as "RB01a"

Roof Beam RB01b > Shows as "RB01b"

Try to avoid text after the member as this will not format the reaction summary properly

Roof Beam RB01 Alt > Shows as "Alt"

Roof Beam RB01 Steel > Shows as "Steel"

Note that text within the brackets is abbreviated as:

Roof Beam RB01 (Alt) > Shows as "RB01*"

Roof Beam RB01 (Steel) > Shows as "RB01*" (also!)