Everything You Always Wanted to Know About Robot Structural Analysis, but Were Afraid to Ask

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About the speaker

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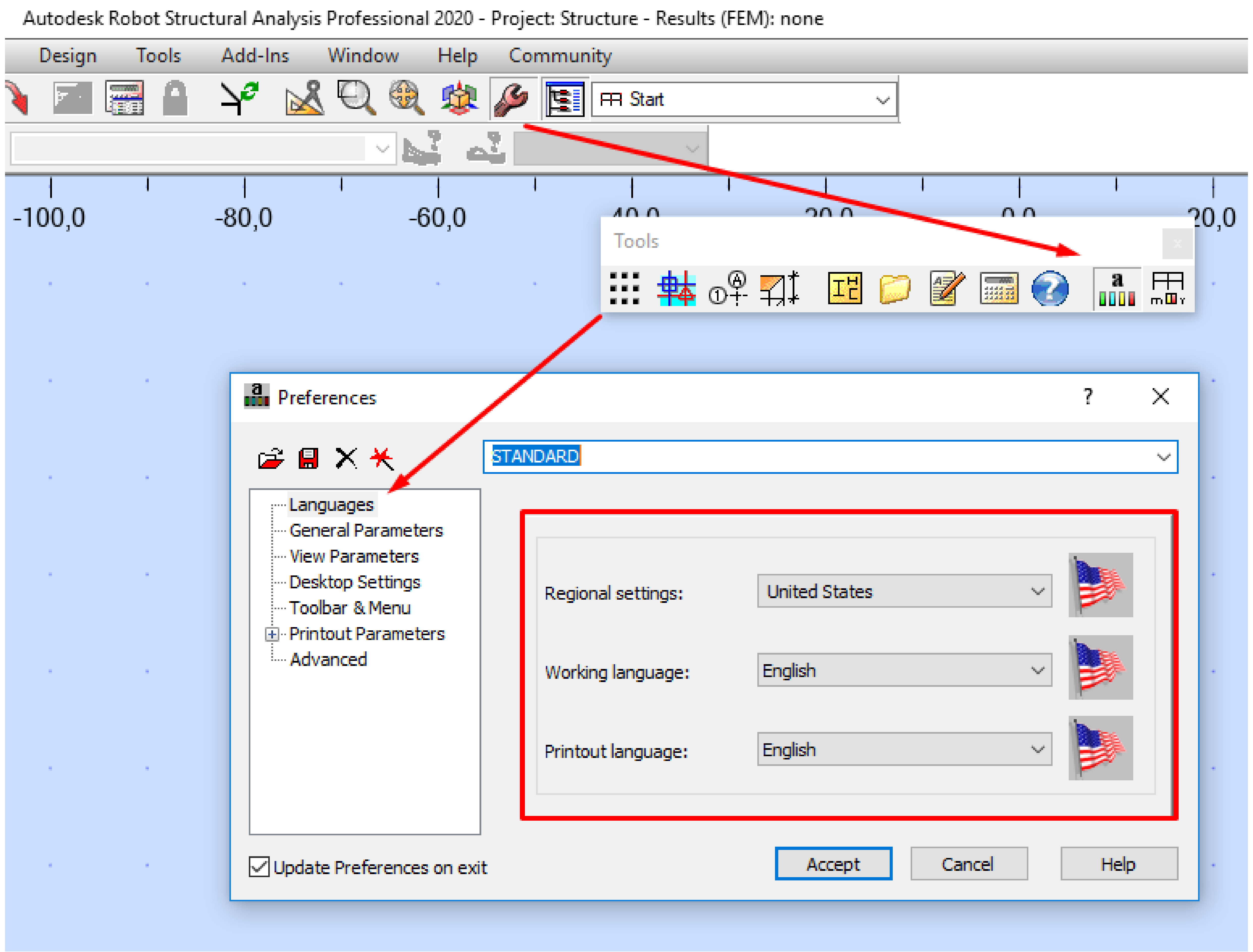
Structural Engineer with 4 years of experience as Structural Engineer Assistant – designing of steel structures, bridges, residential and office buildings, 3 years of experience as Civil Engineer Estimator– preparation of tenders and schedules for highway bridge and road contracts.
And over 15 years of experience as Technical Support Specialist and Trainer (Robobat, Graitec). - Robot Structural Analysis, Autodesk Advance Steel and other software.
Trainings and implementations for engineers in China, Denmark, Estonia, France, India, Indonesia, Ireland, Italy, Latvia, Lithuania, Norway, Romania, Russia, Spain, United Kingdom and Poland.
Currently working as Senior Technical Support Specialist in Autodesk.

Does Robot Work?

Robot is just a tool!

In order to use it effectively, remember to prepare it for work. It should be configured in such a way that both the regional settings, the interface language and the settings of the print-out language match our needs.

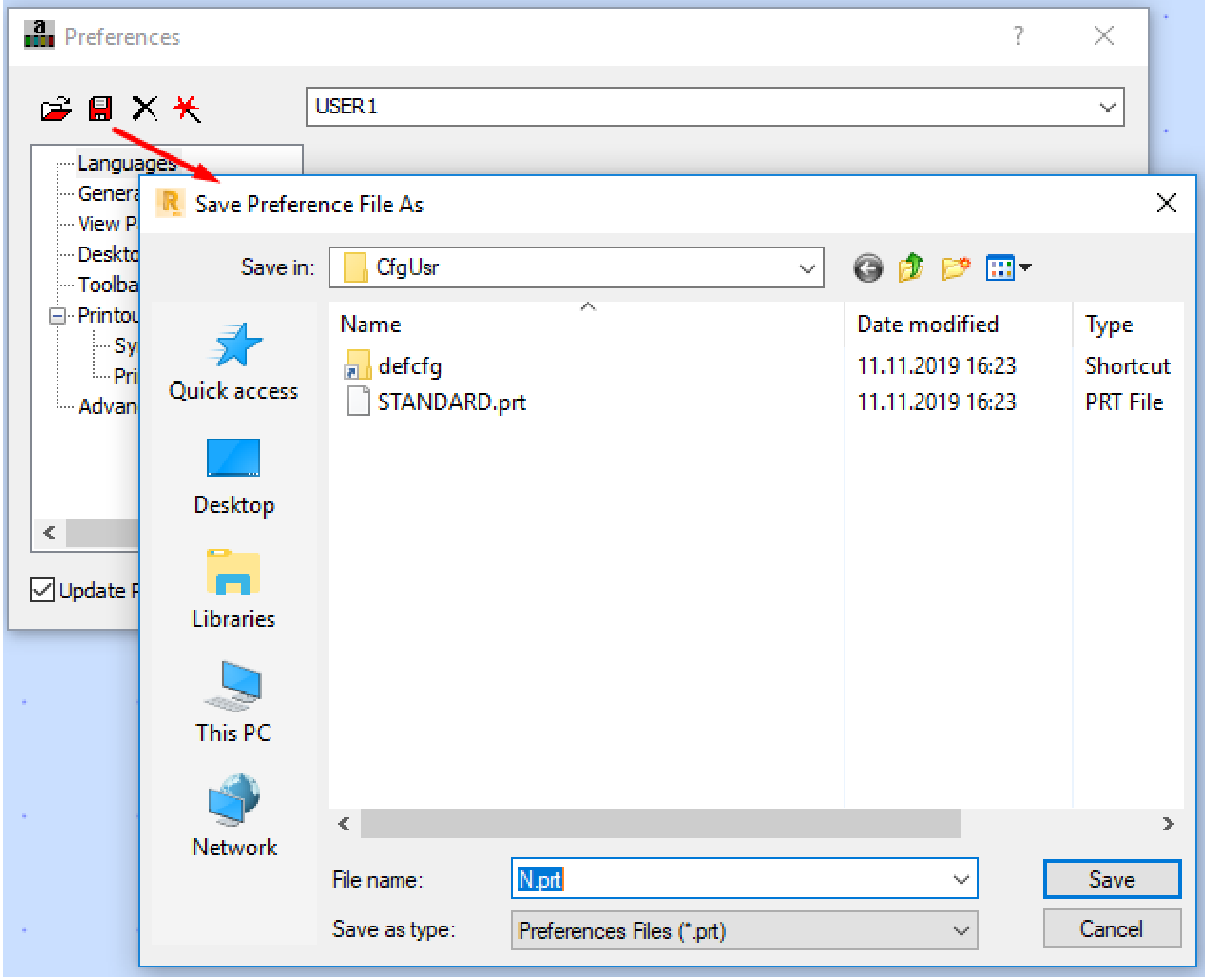
Please note that the regional settings are related to the operating system settings.



Save your configuration settings!

We don't have to do the same thing every time. Any Preferences settings can be saved in an external file and set as default. What matters is where we save these files!

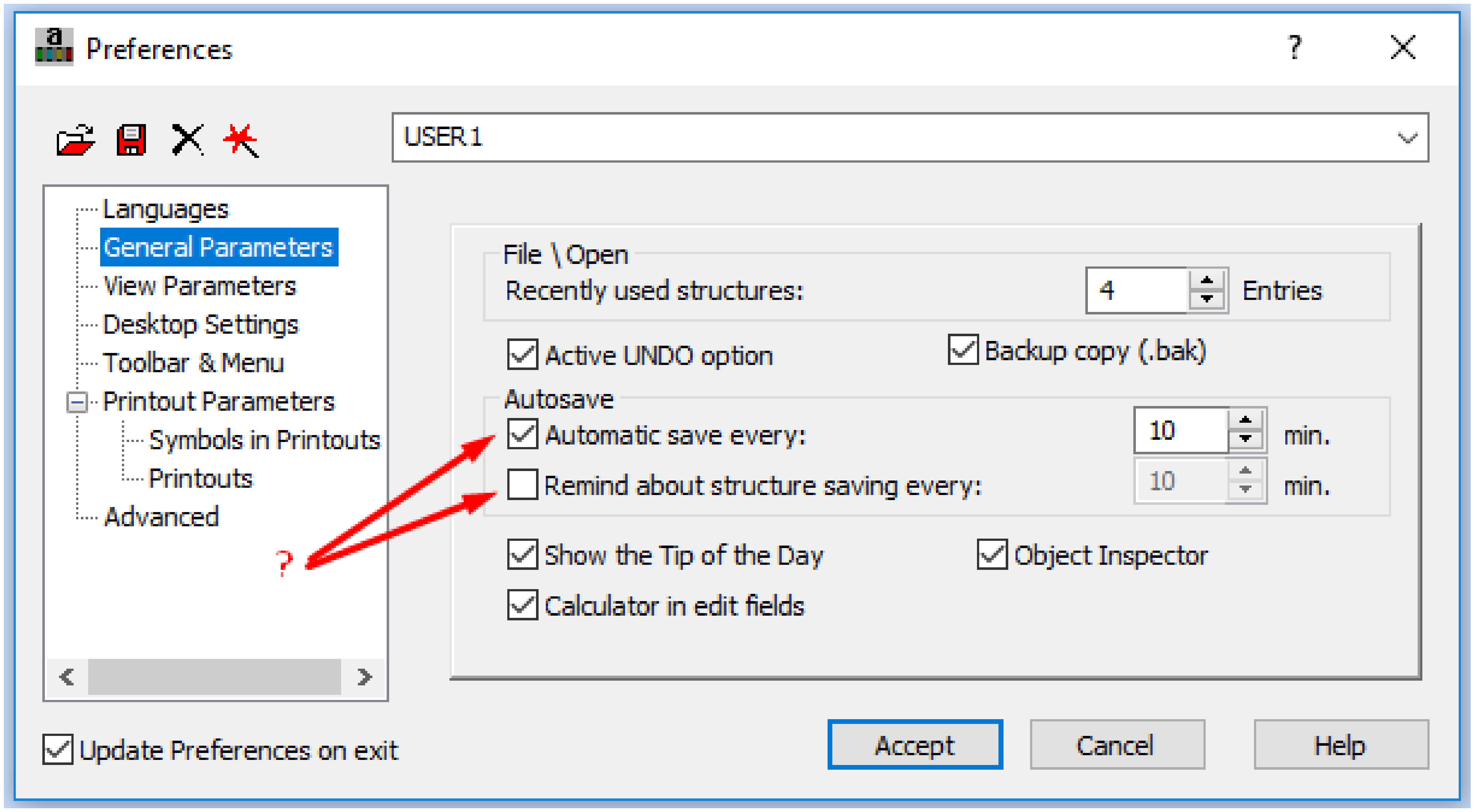
The same rule applies to Job Preferences!



Don't lose the results of your work!

We do not like to lose the effects of our work! It seems even more annoying when we set the "autosave" and it doesn't seem to work!

Let's use "reminder" and save separate files from each stage of the work.



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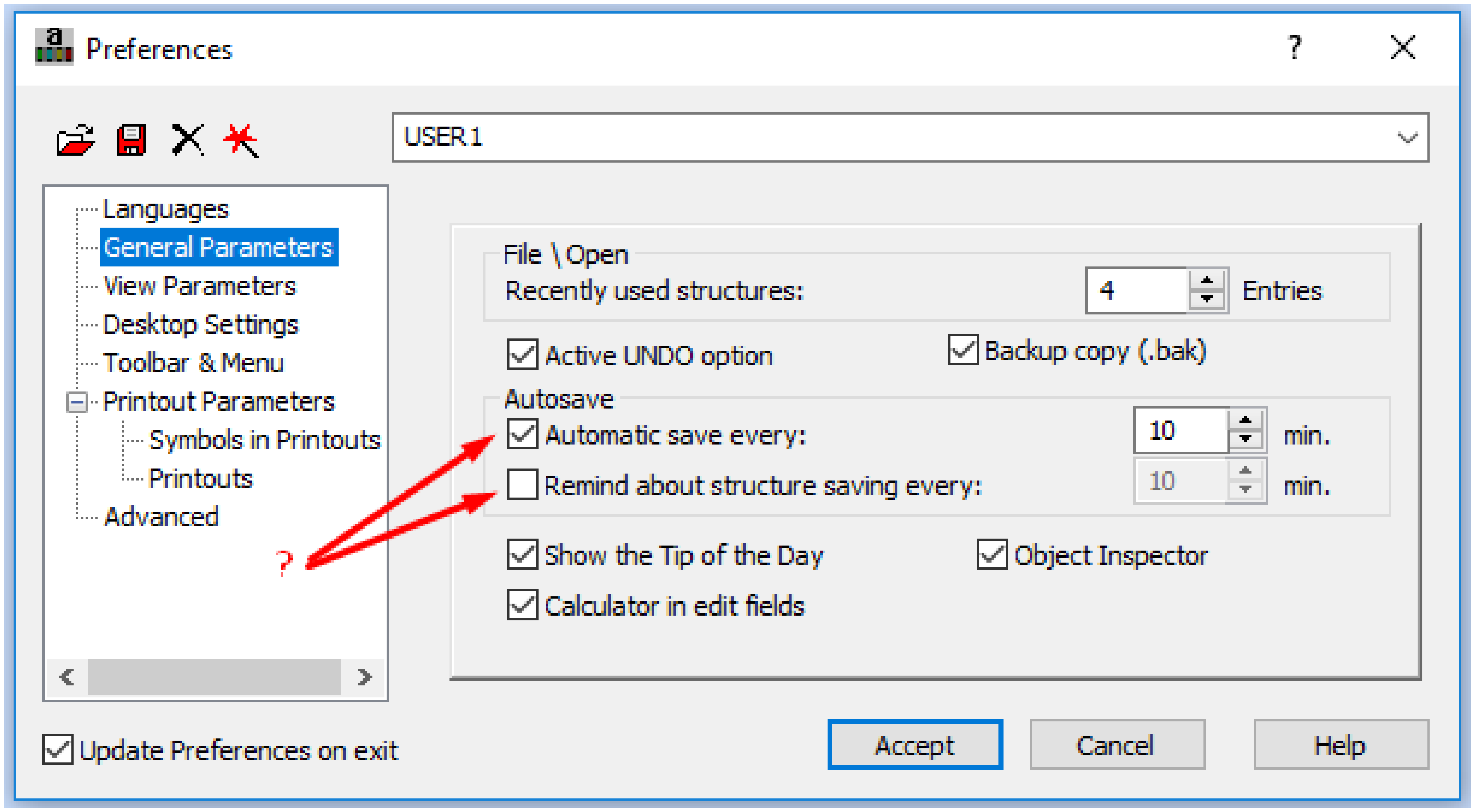
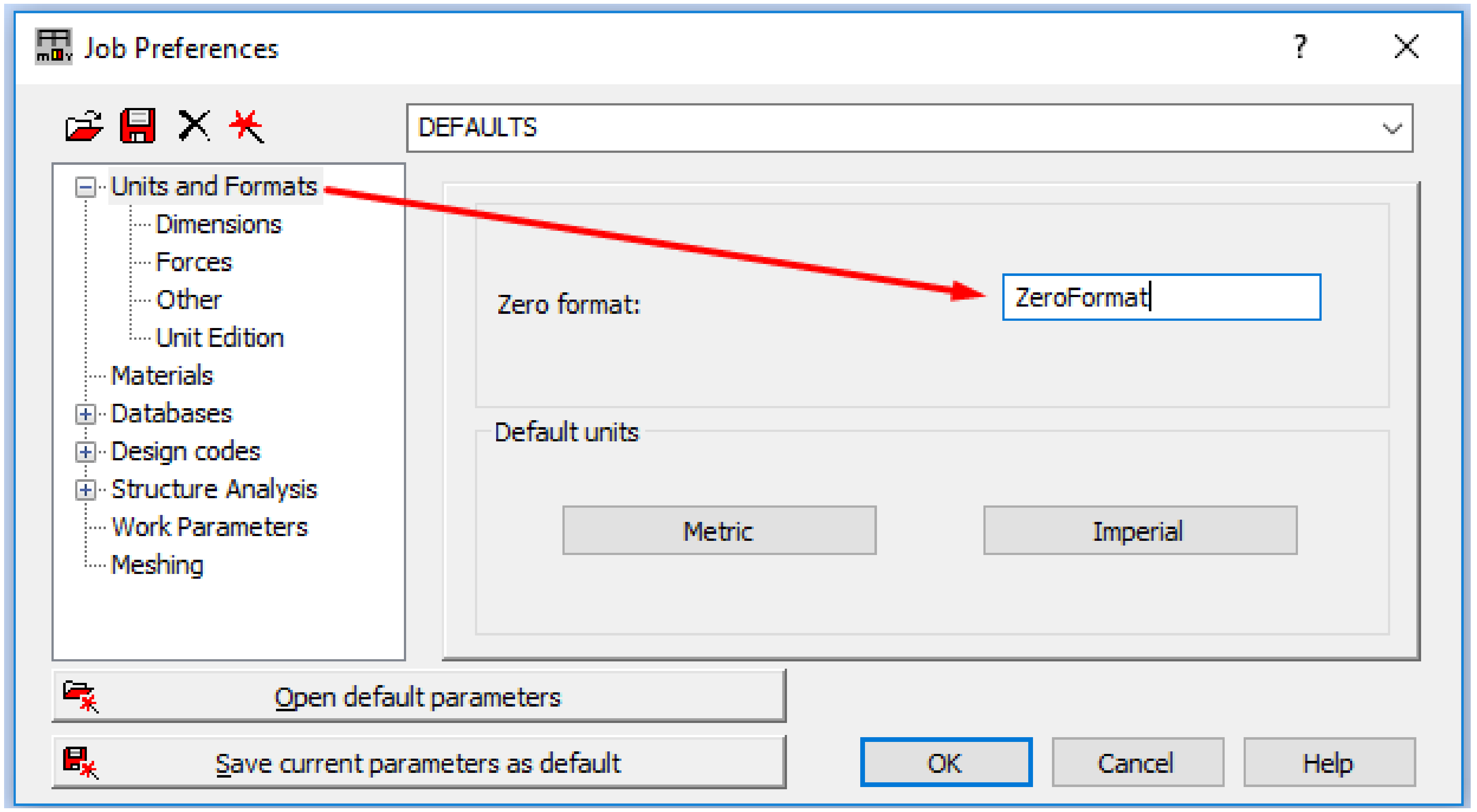


Zero isn't always zero!

Sometimes zero has a value. Especially numerically.

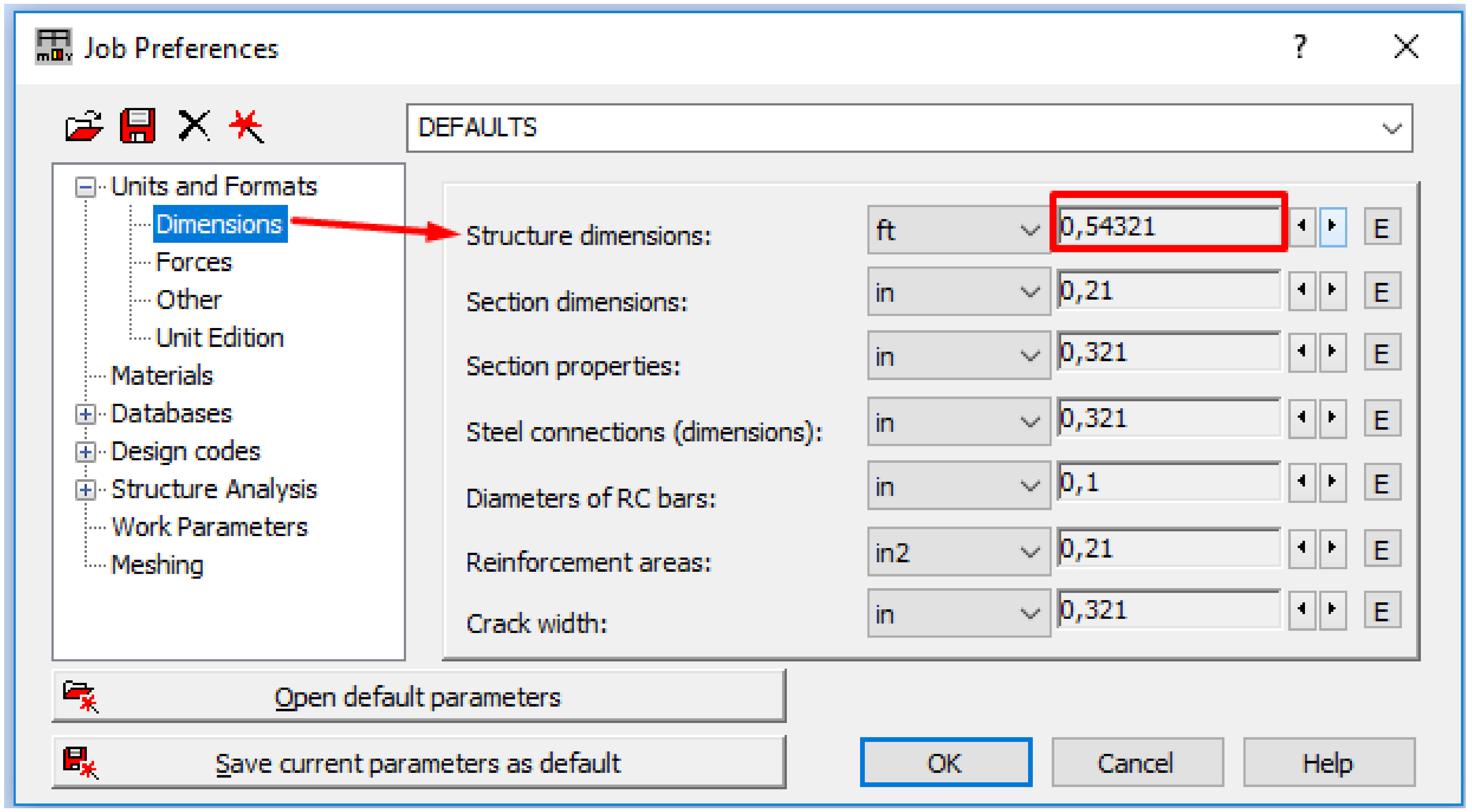
When we need to distinguish between "real zero" and "almost zero" it is worth to use the possibility of using your own zero format.



Dimensions are not equal to dimensions!

The position of nodes in the model is crucial for further calculations. Actual node positions are presented in numerical form, among others, in tables and properties.

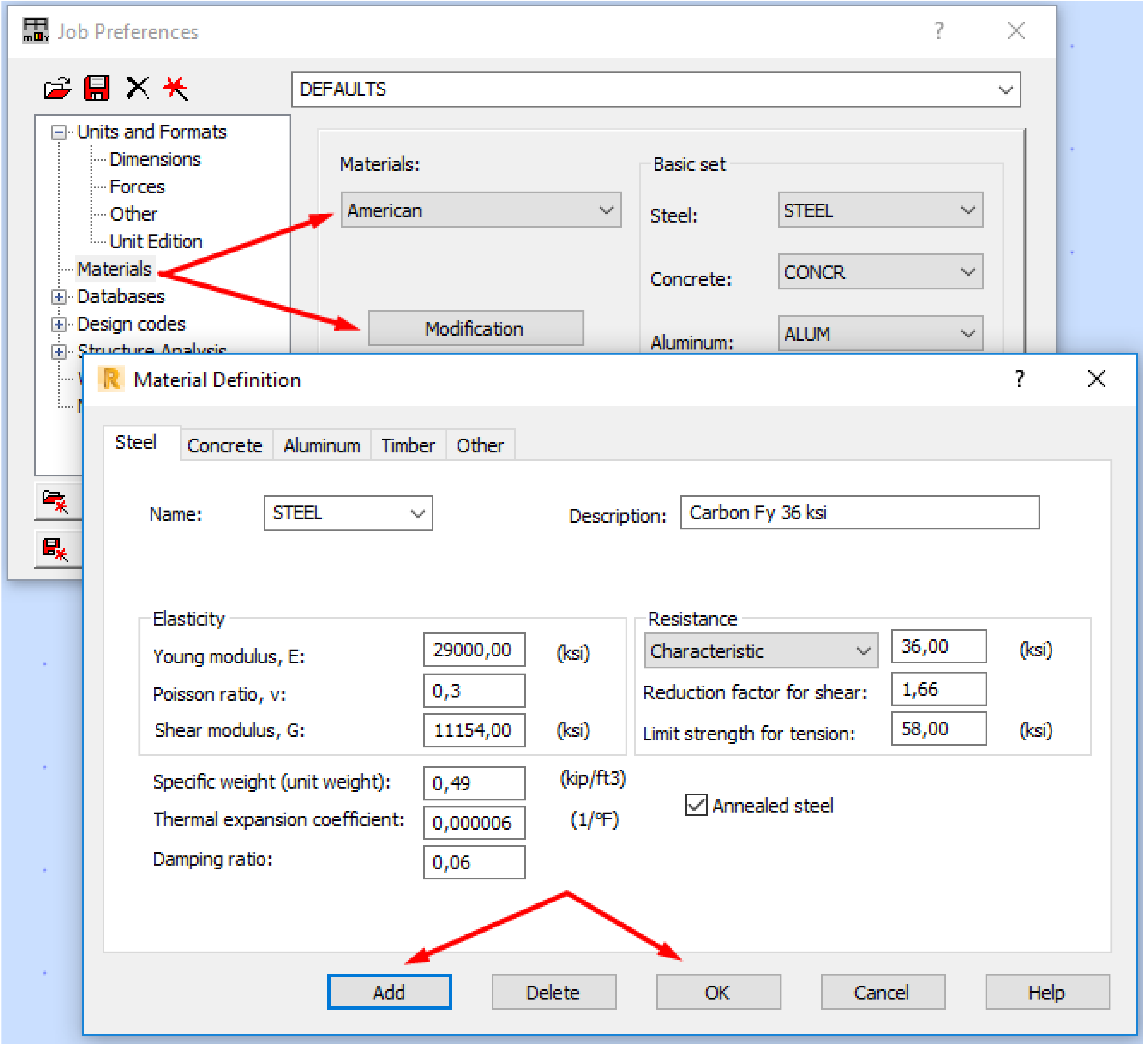
Not displaying them with the correct accuracy can lead to problems.



Choose the right material!

The choice of construction material has an influence on the load-bearing capacity of the structure. We use specific design standards to check the load capacity.

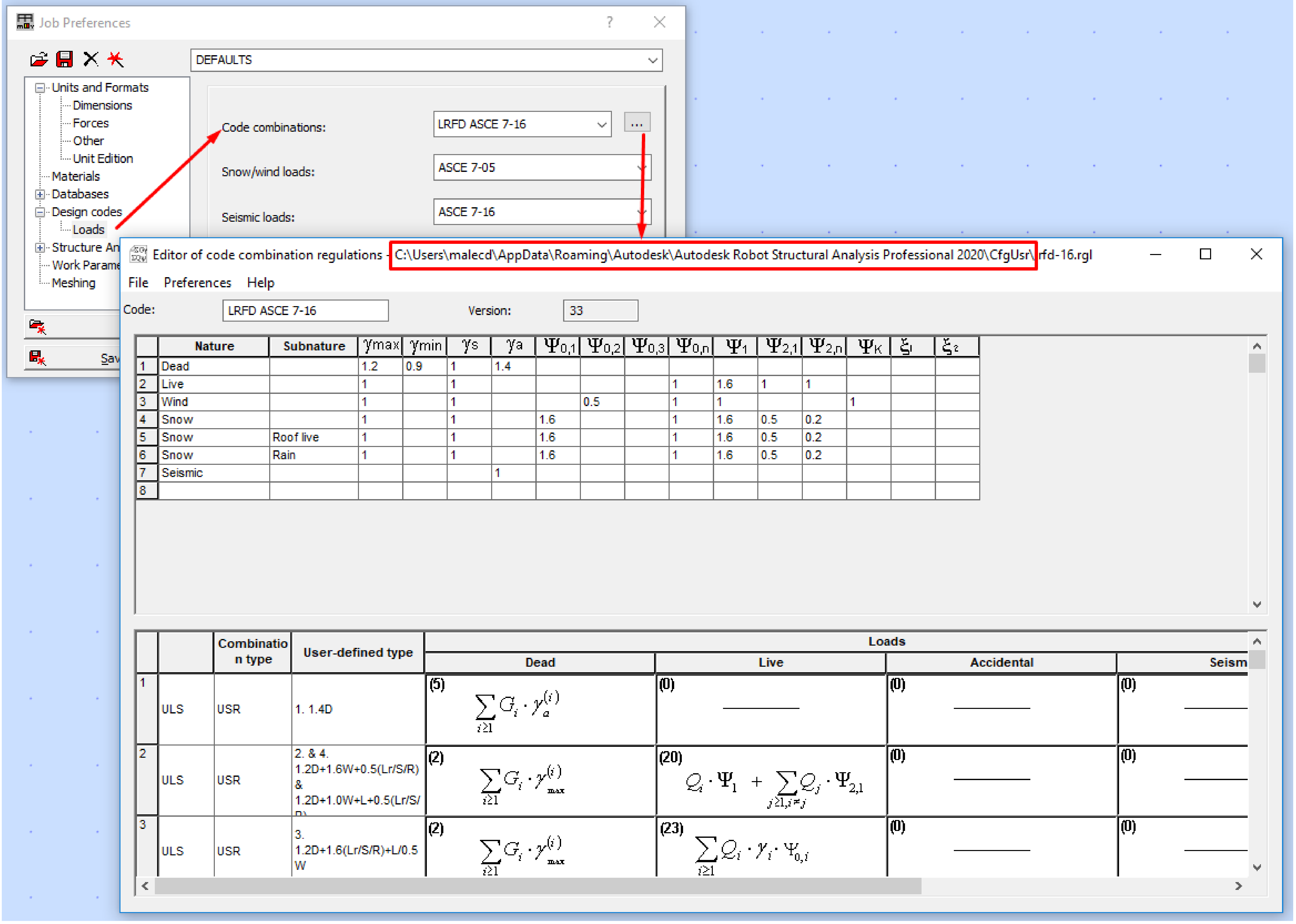
The selected or newly developed material must contain the complete information required by the selected standard.



Verify according to the standard!

The choice of the standard for the design of the structure requires the use of appropriate loads. At the same time, the individual loads do not work independently. Their interaction and coefficients are defined by the standard setter.

If the code regulations are modified, their copies should be used!

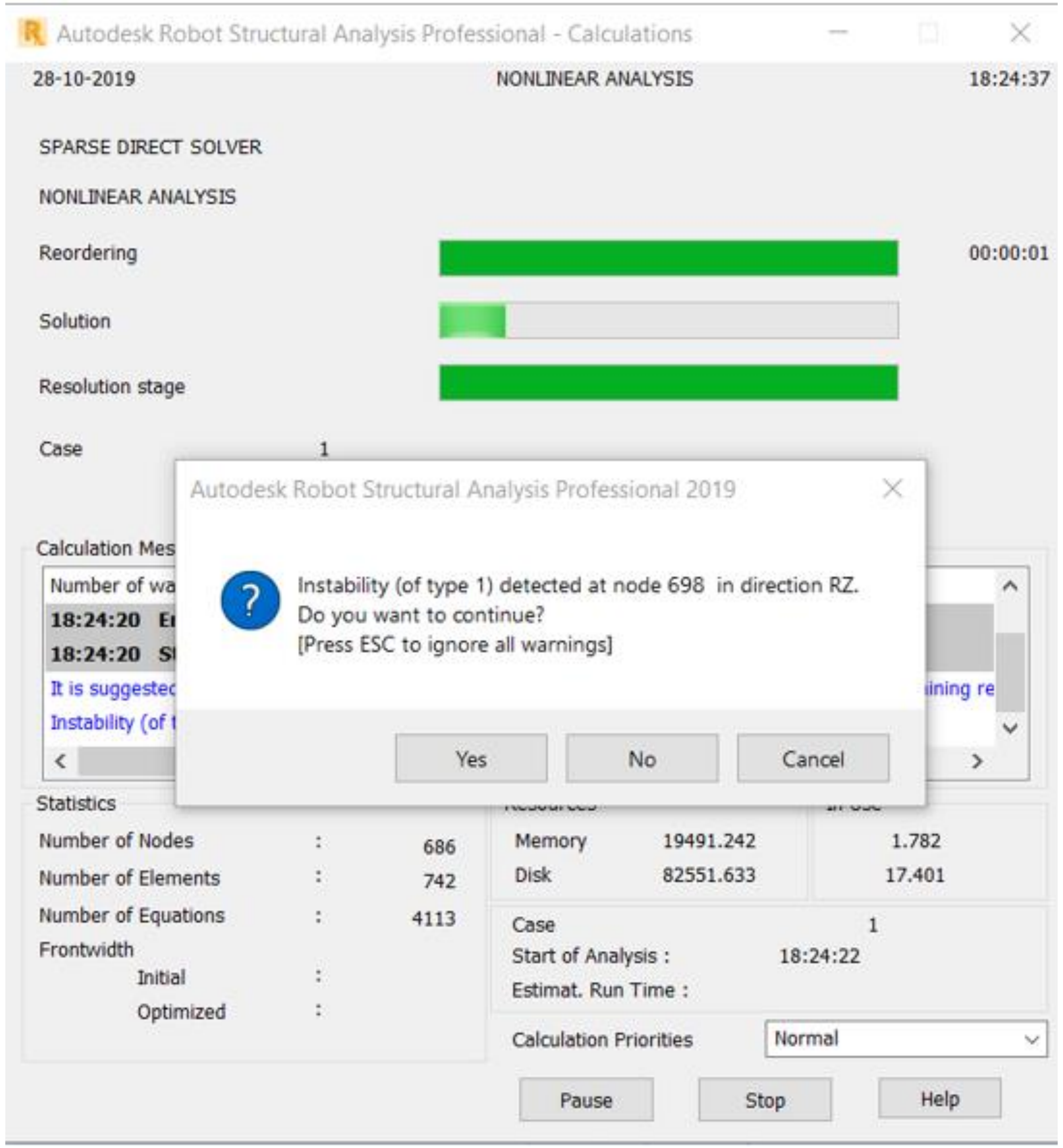


What Is Instability?

Stay calm and stable!

It is no coincidence that the standard Robot calculation type is static analysis. A structure cannot be a mechanism, it cannot "drive away" from the construction site.

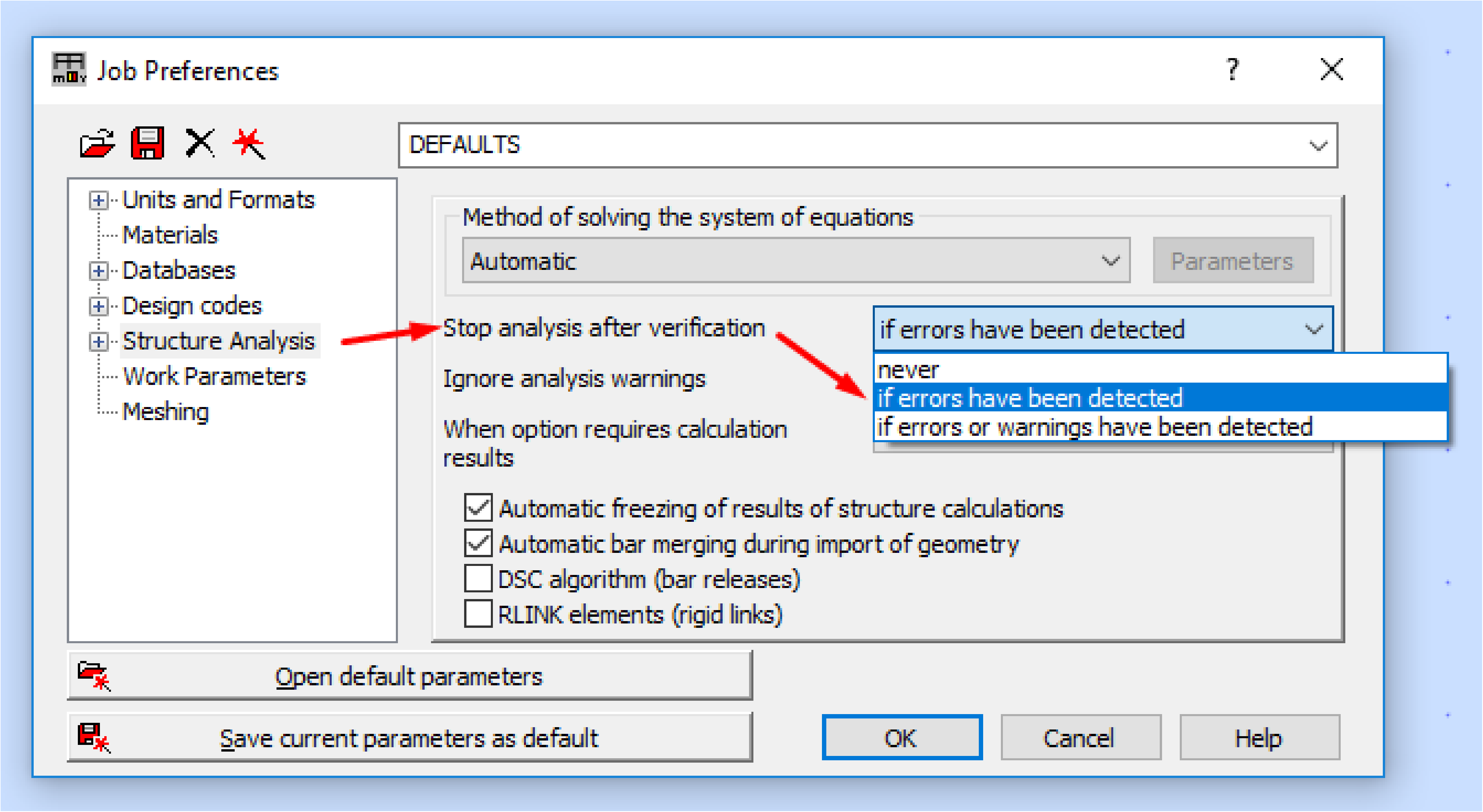
The instability message allows us to locate and prevent errors.



Never set "never"!

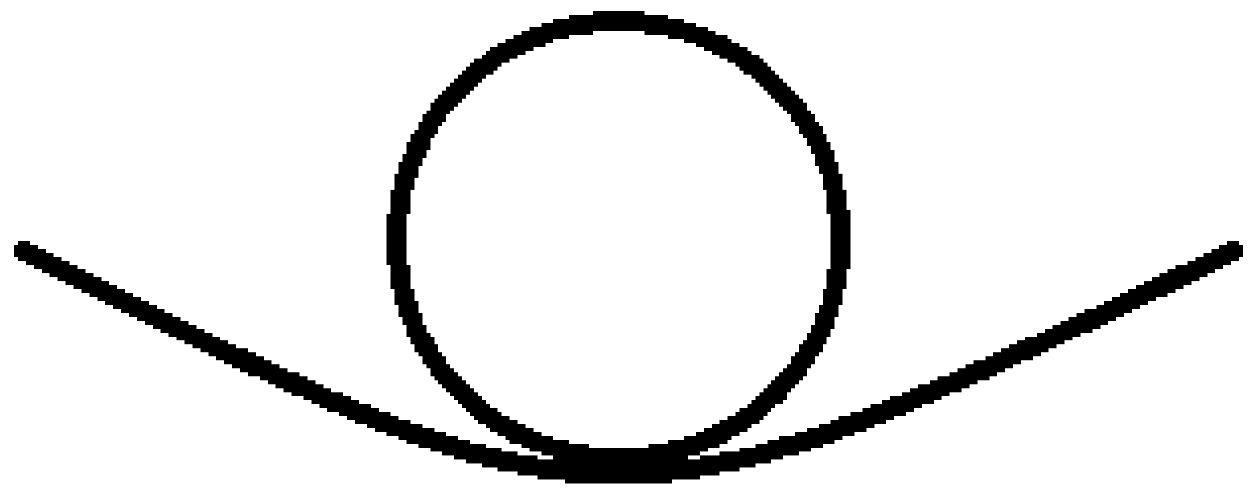
We can't ignore messages about model stability errors! It is even worse to turn them off.

Unless we know what's going on... Then let's check if we really know!



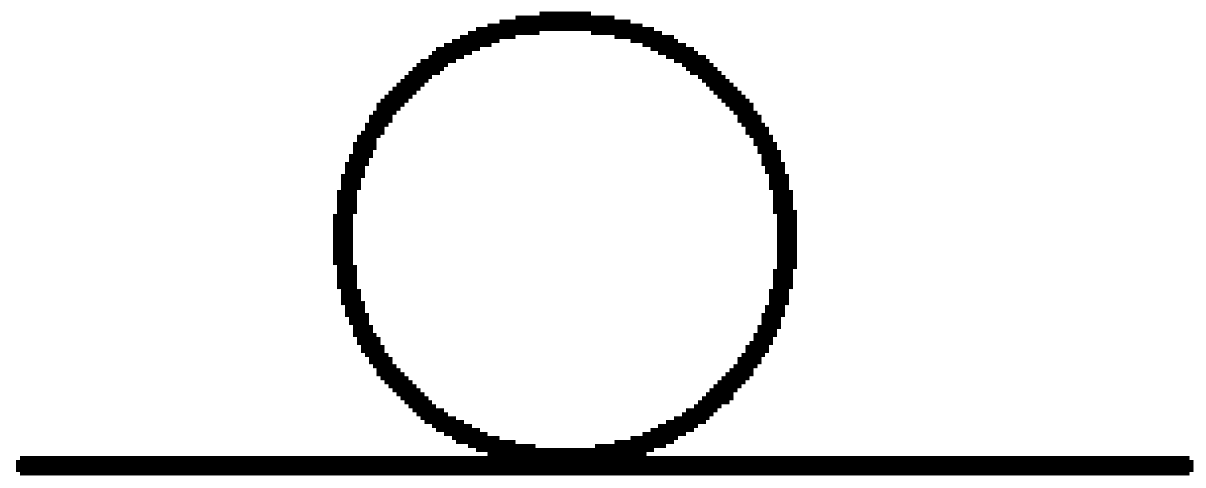
Type 3!

Type 3: 'mathematical' instability signalled when two elements of high size disproportion are detected in the matrix.



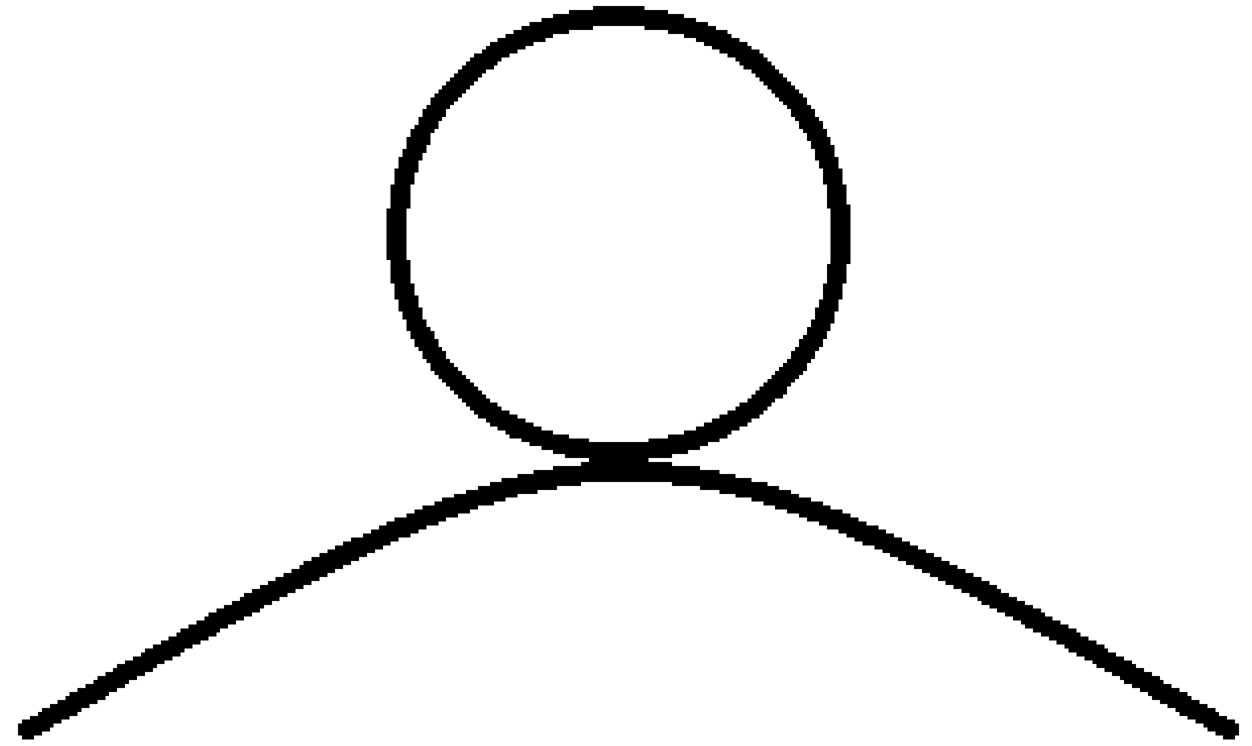
Type 2!

Type 2: ‚potential' instability indicated when a zero-value element is detected in an inverted matrix.



Type 1!

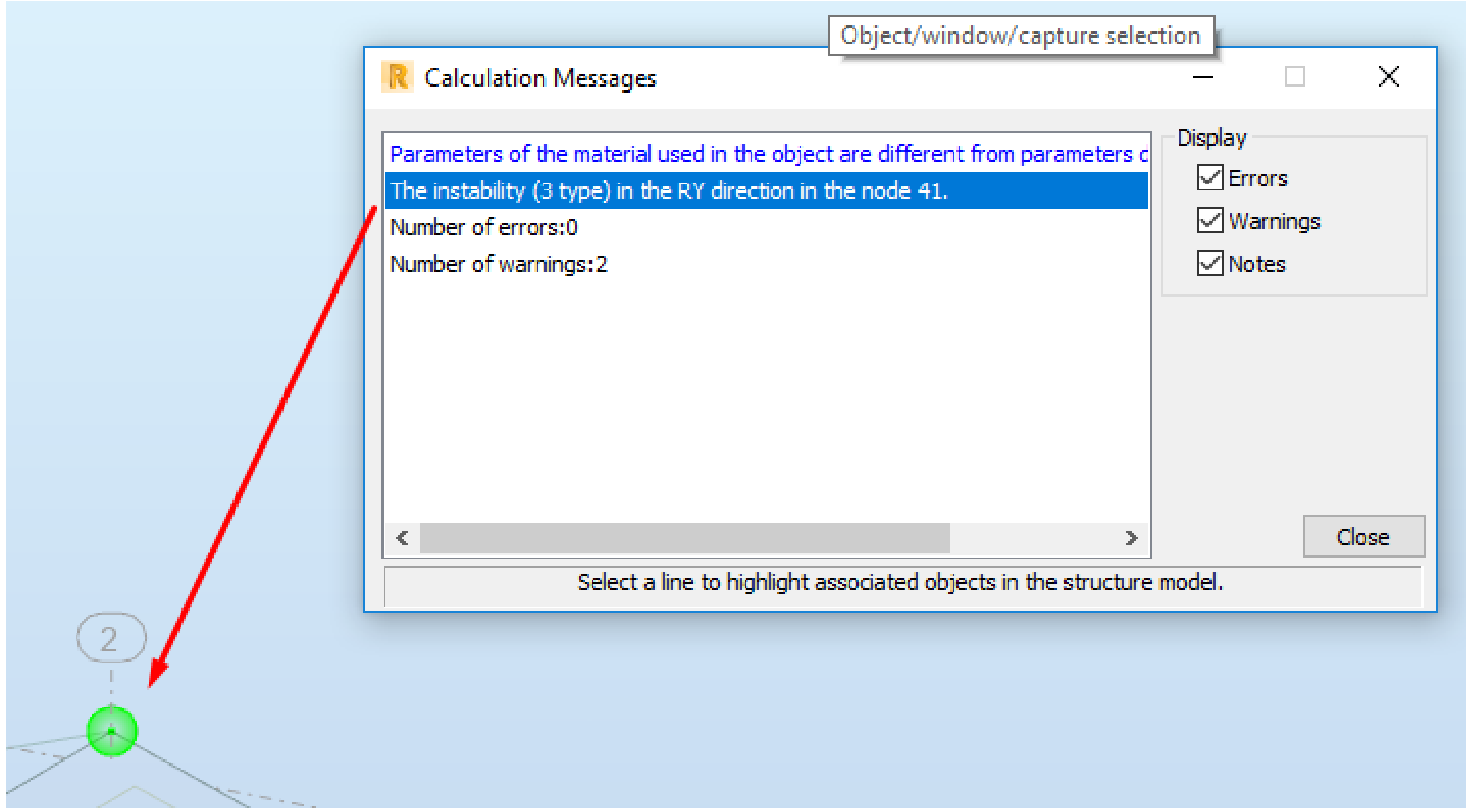
Type 1: 'real' instability indicated when a zero-value element is detected in the matrix.



Find this node (or these nodes)!

We need to find the node where the instability was detected! Simply click on the message and the node will light up green.

We can also display only selected nodes or finite elements connected to them.



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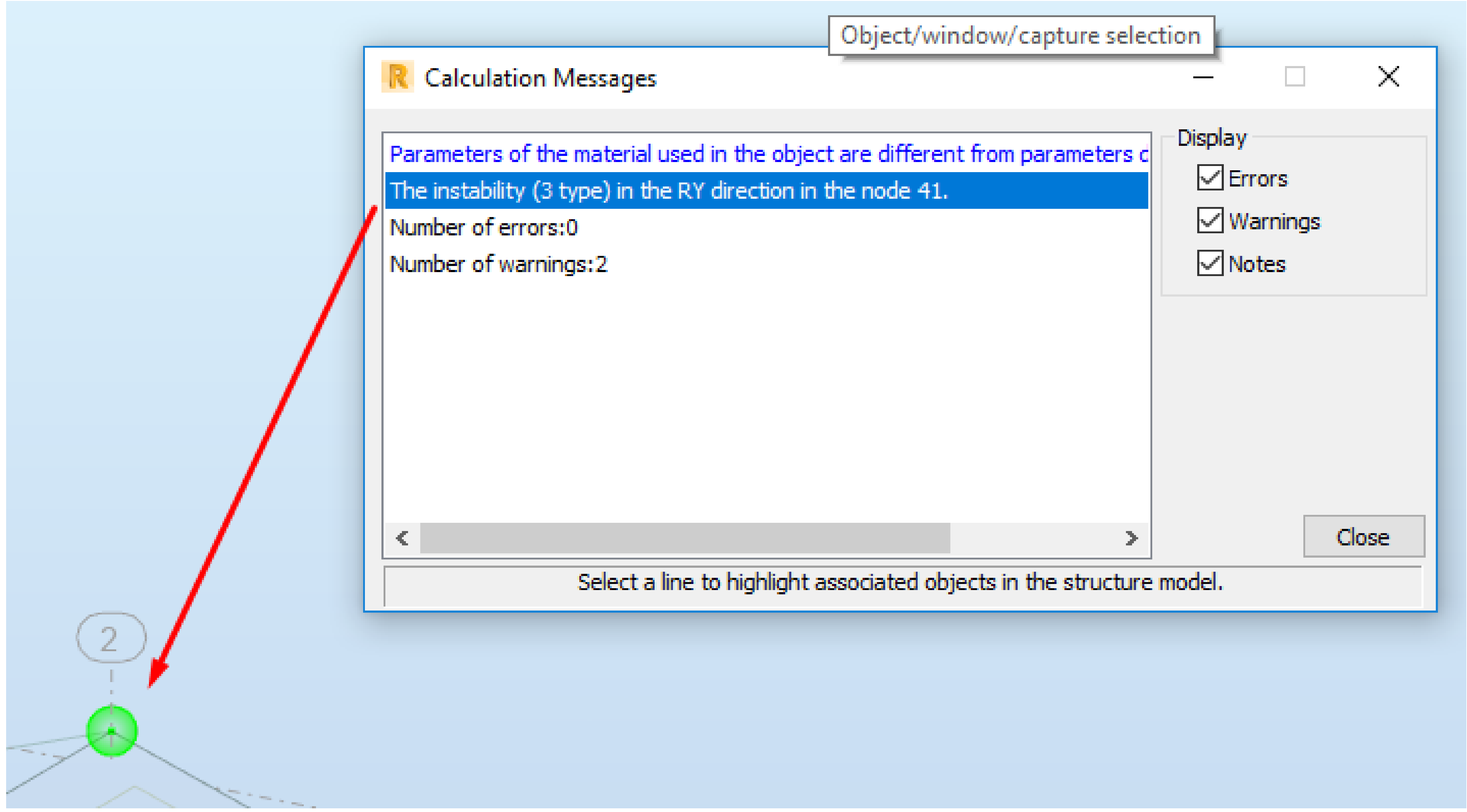
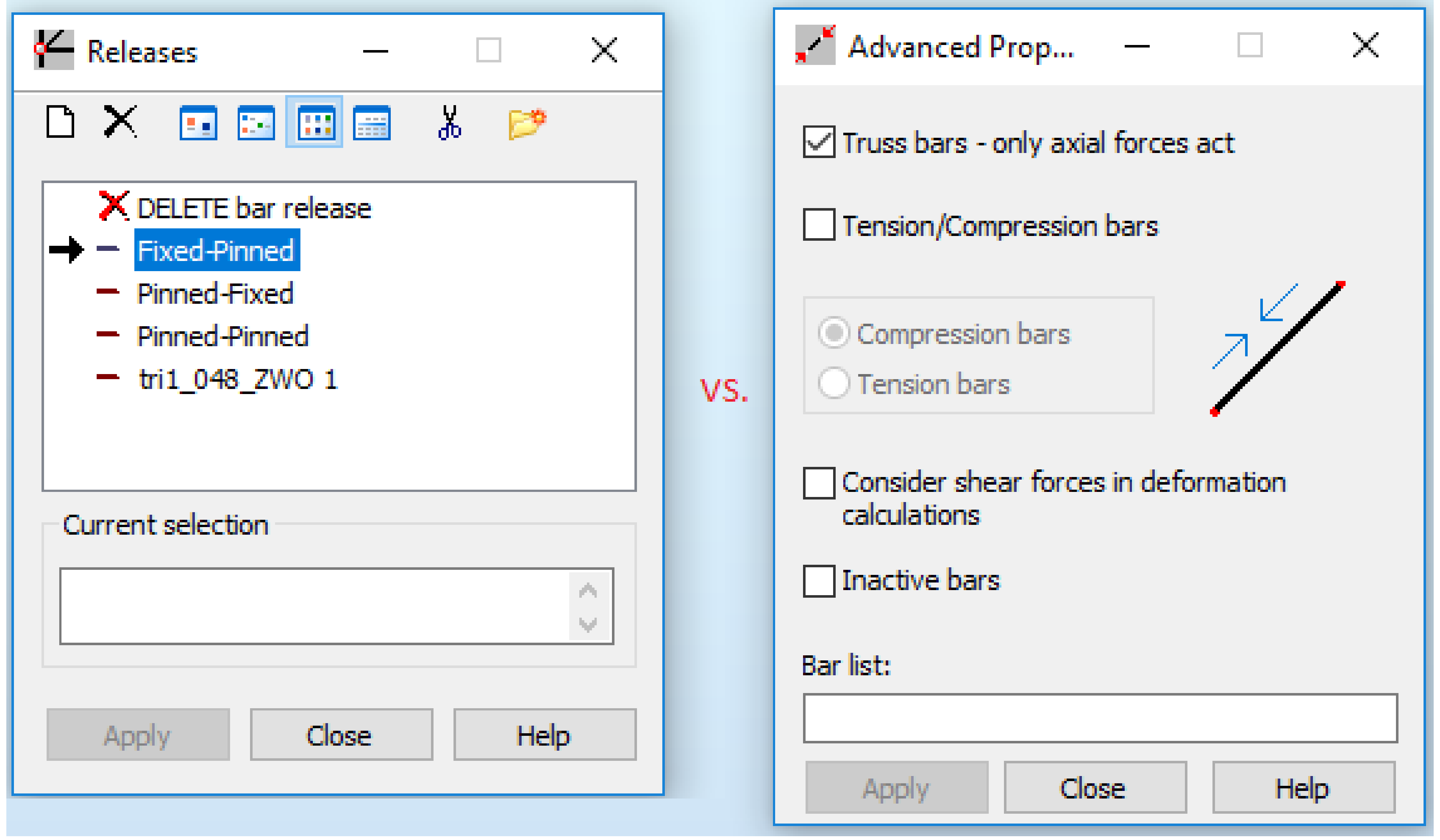


Releases vs. Truss bars!

We don't have to use too much bar releases. Especially in trusses.

In such situations, Truss bars are much better and more stable.



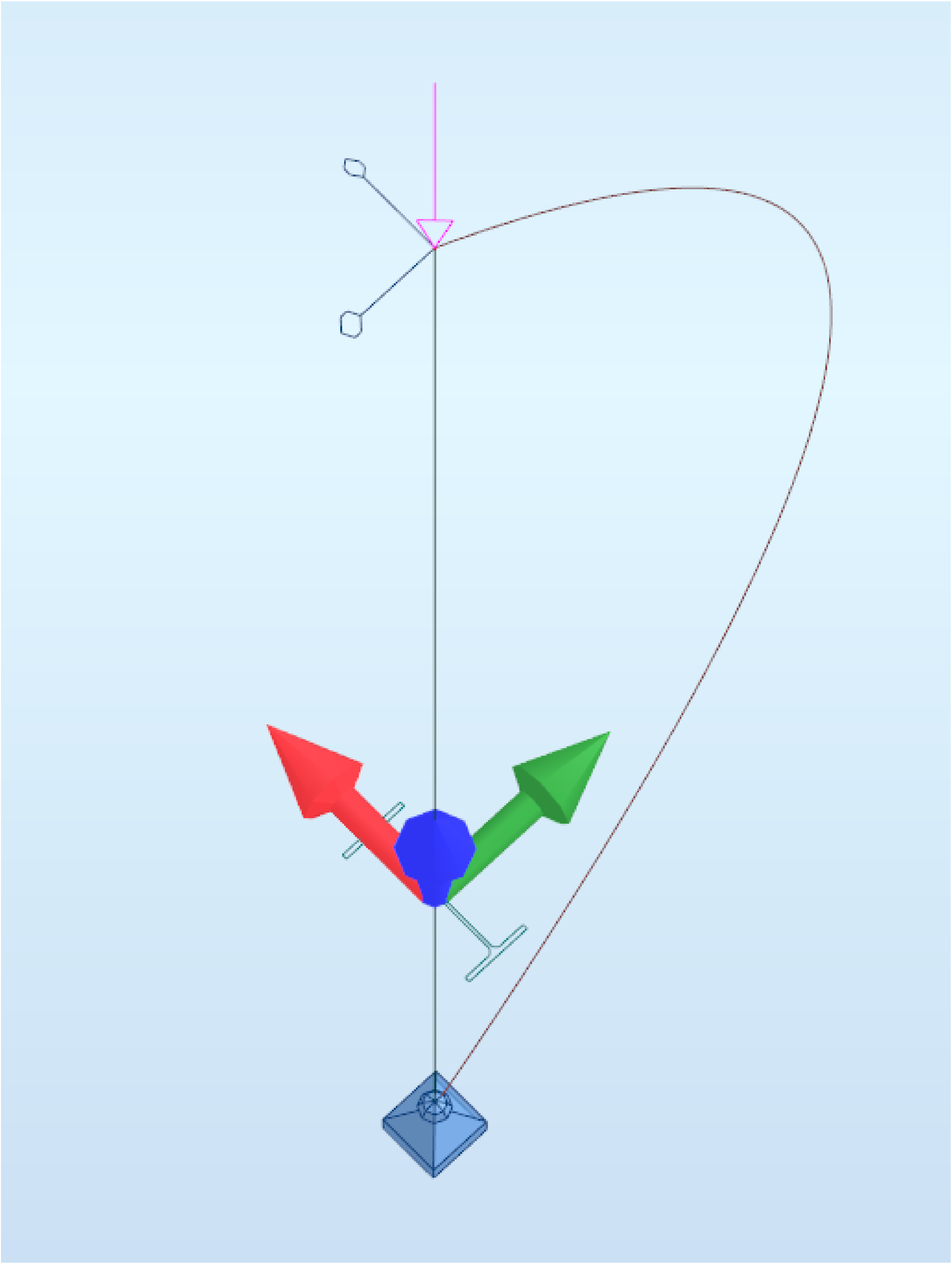
Buckling or Lateral-Buckling Choice Is Yours?

Buckling!

Buckling may occur in the elements subjected to compressive axial stress. The entire cross-section of the element must be compressed.

In such a situation, instability may occur where the element "bends" in the weaker direction.

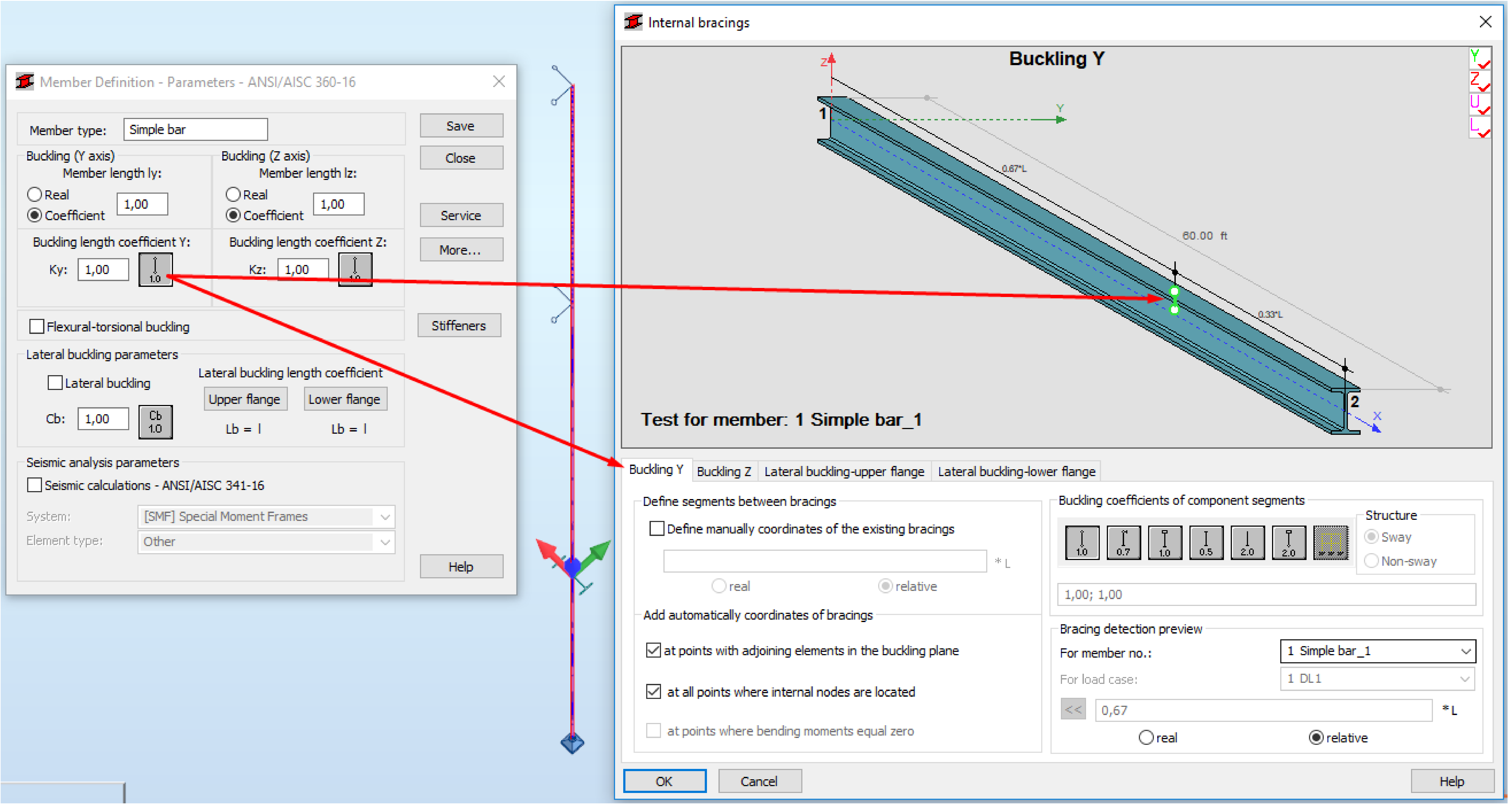
In engineering practice, we assume that stretched elements cannot buckle.



Buckling in steel member definition!

In the case of steel dimensioning, we determine whether the indicated element will be verified for buckling.

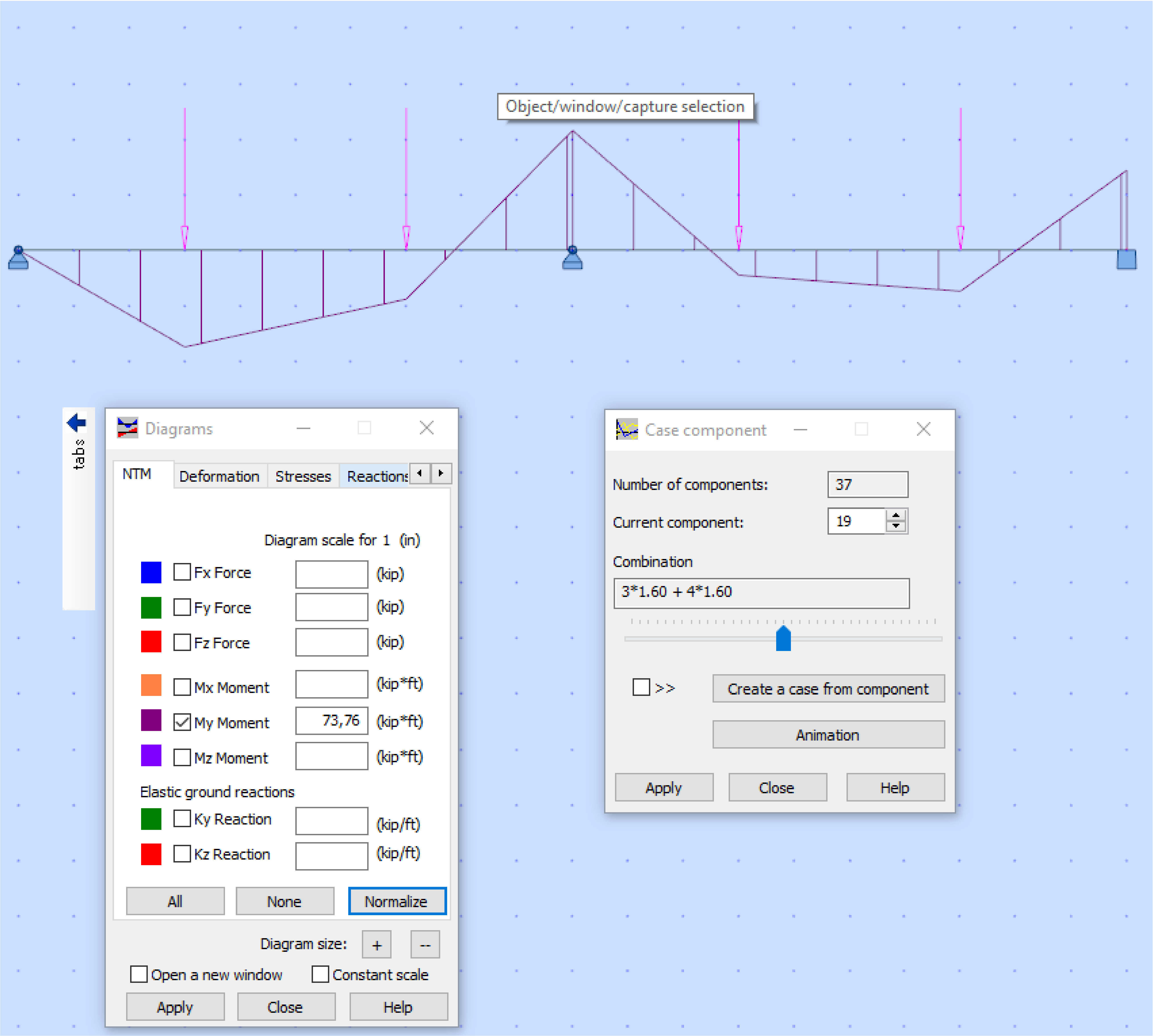
Remember, not only the columns are compressed!



Lateral Buckling!

Lateral buckling may occur in the elements subjected to bending. In such case part of the cross-section of the element is compressed while the rest of the cros-section is tensioned. In such a situation, instability may occur only in compressed part.

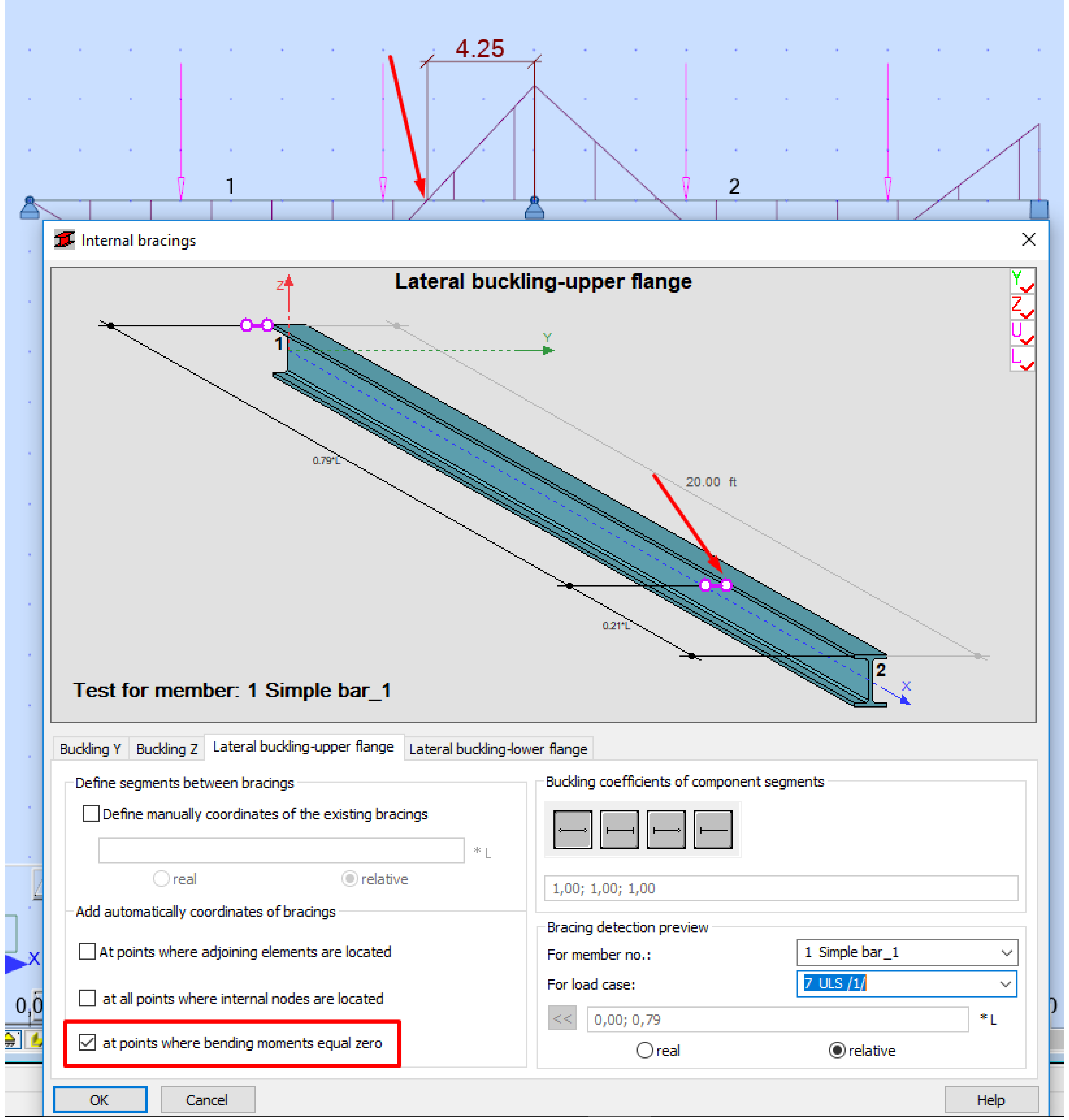
In practice, we must determine the length of the element at which the compression of the cross-section part occurs.



Lateral Buckling in steel member definition!

Indication of the length of the element where the compression of section parts occurs can be done by using the steel dimensioning module in the Robot. The basis for this analysis is a change in the bending moment sign.

It is important that the program updates the subject range itself after the load is changed.



Can you play guitar?

Sometimes it's worth reading the formula!

Thanks to this, we know what to include in the model in order to get results that correctly describe the behavior of the structure.

Focusing on the details of the structure will disturb the perception of the whole.

Eigenvalues and eigenmodes are obtained from the following formula.

$$(K - \omega_i^2 M)U_i = 0 \quad (1)$$

where:

K - stiffness matrix of the structure,

M - mass matrix of the structure,

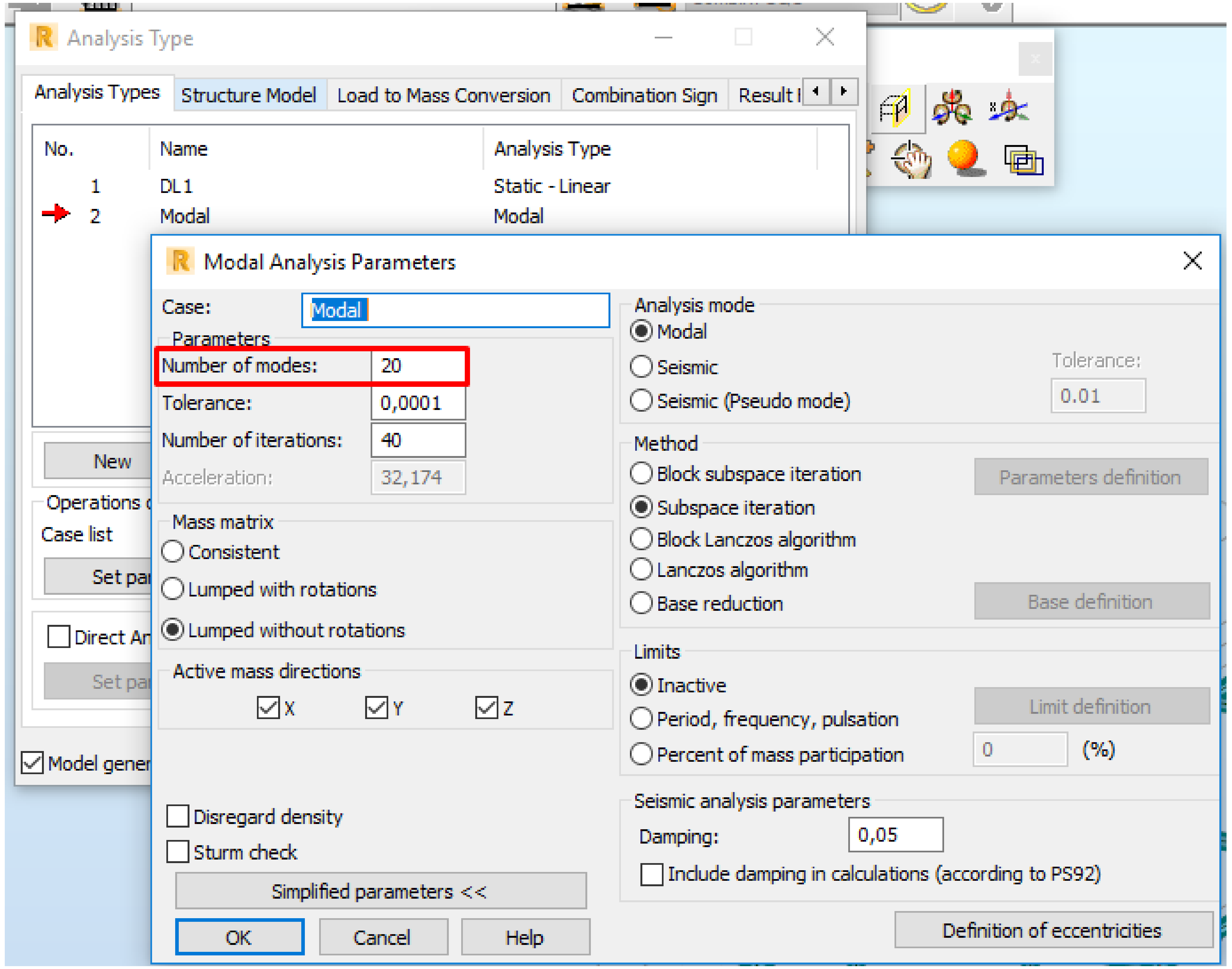
ω_i - natural pulsation (natural circular frequency) of mode "i",

U_i - eigenmode vector of mode "i".

Not too much, not too little!

Modal analysis provides information about frequencies and masses of participation for each mode. There shouldn't be too many of them, but when there are less of them, the program will reduce their number.

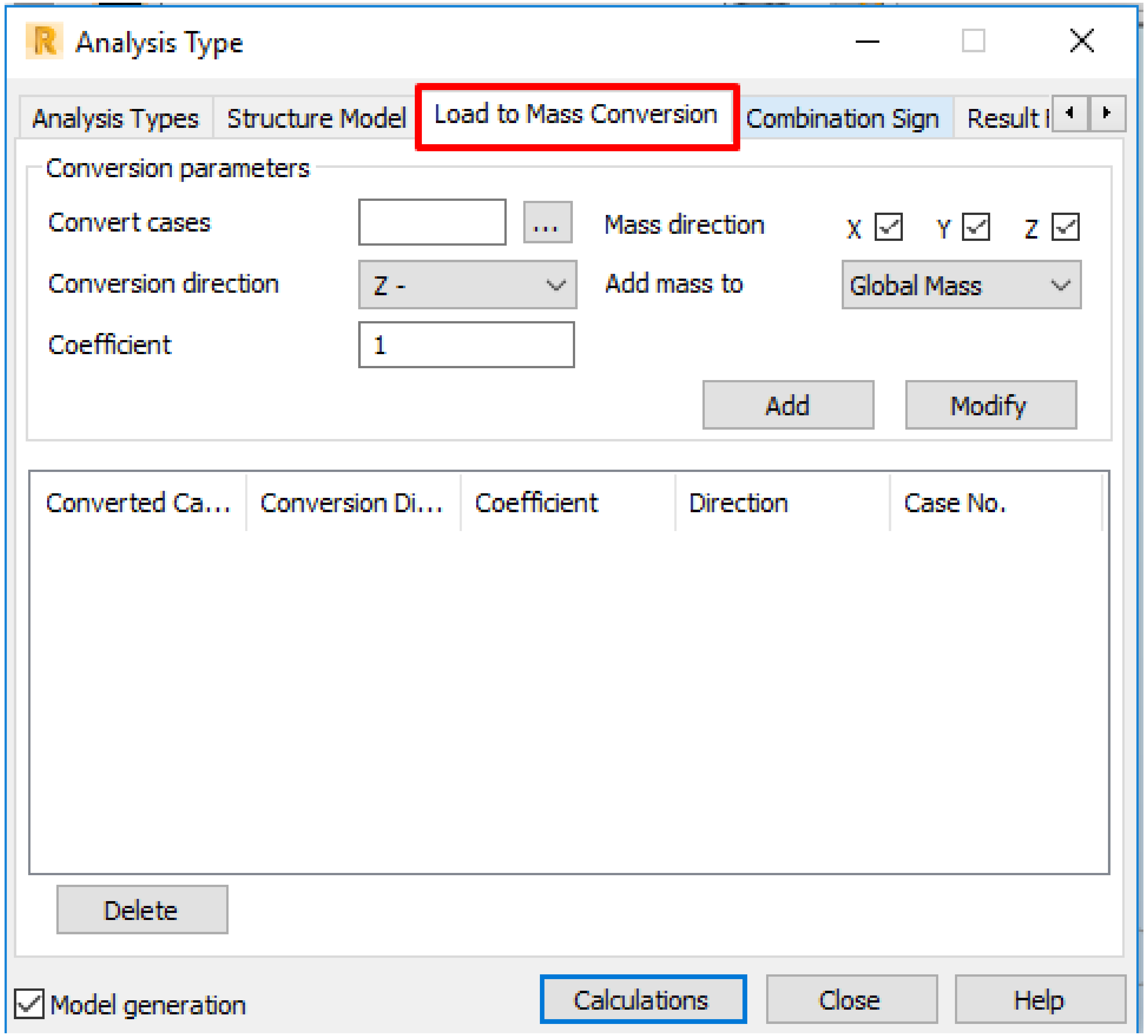
However, it will not increase the number, then we have to do it ourselves.



Massive vibrates differently!

The frequency of the pendulum's oscillations can be modified by changing its mass. The same applies to structural loads.

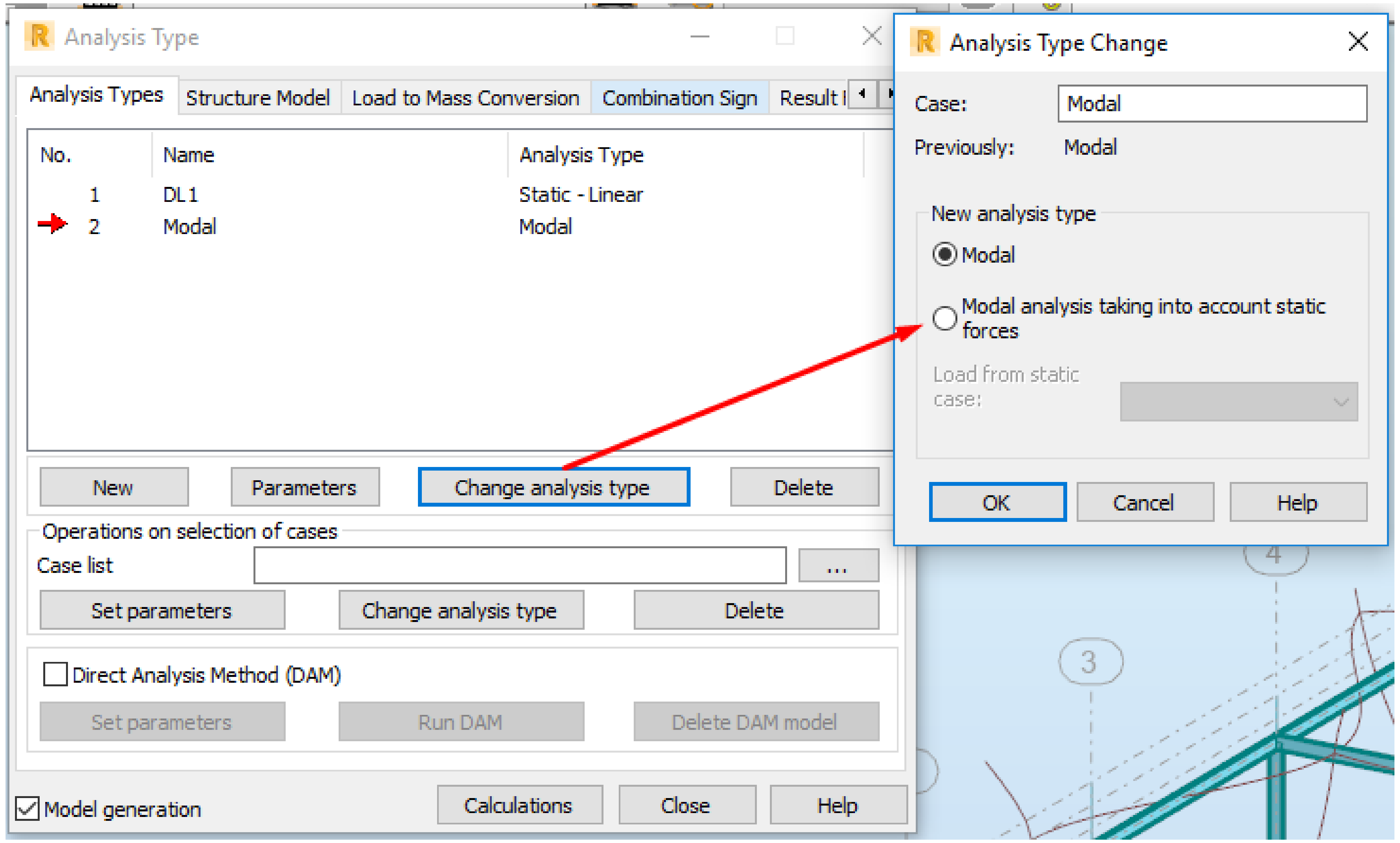
Converting loads intovibrating masses allows us to take this situation into account.



Force changes rigidity!

The more the string is tight, the higher the sound. The same applies to the construction.

Stressed components have a different frequency of vibrations.



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