

**Version  
September 2013**

**Add-on Module**

# **RSIMP**

**Generation of Equivalent Geometrical  
Imperfections and Pre-Deformed  
Initial Models**

## **Program Description**

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# 1. Introduction

## 1.1 Add-on Module RSIMP

Many standards consider imperfections in the analysis of second order effects. For this purpose, you can select between two options: The first one is to define equivalent loads, as done for example in EN 1993-1-1, clause 5.3. Alternatively, you can perform the analysis on a pre-deformed initial model, where the system nodes are displaced according to the respective standard. Both options are provided in the RSTAB add-on module RSIMP.

The pre-deformations have to be applied in the most unfavorable directions of action. For small structural systems, this method may be still manageable so that imperfections can be defined manually. In complex systems, however, it might often be difficult to recognize the load-dependent direction of action. RSIMP is able to generate the governing imperfections for RSTAB, based on deformations, buckling shapes, or eigenvibrations.

With RSIMP, you can analyze different generated cases for imperfections quickly and efficiently. The application conforming to standards in the most unfavorable directions is guaranteed. Moreover, the implementation of the cross-sectional buckling curves according to Eurocode 3 and DIN 18800 proves to be a useful feature.

You need to specify only a few things in the two input windows of RSIMP. From the specifications, the module generates the imperfections in the governing direction. Members subjected to tensile forces are not taken into account. Before the generated imperfections are exported to RSTAB, you can graphically check them at the RSTAB model. Normally, the equivalent imperfections are defined in a separate imperfection load case, which you can then superimpose in the load combinations.

You can export the RSIMP tables directly to MS Excel or OpenOffice.org Calc for further use or storage.

Like other add-on modules, RSIMP is completely integrated in the main program RSTAB. It is also possible to generate all equivalent imperfections quickly and comfortably by accessing the results from RSTAB (deformations of load cases, load combinations, and result combinations), RSBUCK (buckling modes), and DYNAM (eigenmodes).

We hope you will enjoy working with RSIMP.

Your DLUBAL Team

## 1.2 RSIMP Team

The following people were involved in the development of RSIMP:

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## 1.3 Using the Manual

Topics like installation, graphical user interface, results evaluation, and printout are described in detail in the manual for the main program RSTAB. The present manual focuses on typical features of the RSIMP add-on module.



The manual follows the sequence and structure of the module's input and results windows. In the text, the described **buttons** are shown in square brackets, e.g. [Import All Members]. In addition, these buttons are pictured on the left. The **Expressions** appearing in dialog boxes, tables, and menus are set in *italics* to clarify the explanations.

At the end of the manual, you find the index. However, if you still cannot find what you are looking for, please check our website [www.dlupal.com](http://www.dlupal.com) where you can go through our comprehensive *FAQ* pages by selecting particular criteria.

## 1.4 Open the Add-on Module RSIMP

RSTAB provides the following options to start the add-on module RSIMP.

### Menu

You can start the add-on module by using the command from the RSTAB menu

**Add-on Modules → Others → RSIMP.**

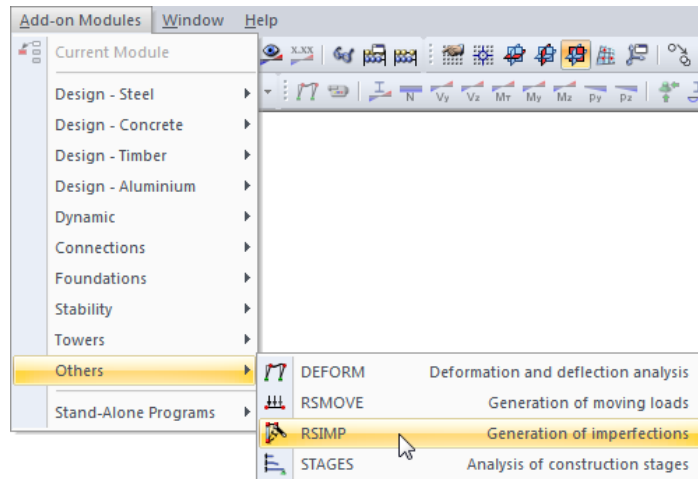


Figure 1.1: Menu: *Add-on Modules* → *Others* → *RSIMP*

### Navigator

You can also start RSIMP from the *Data* navigator by clicking the item

**Add-on Modules → RSIMP.**

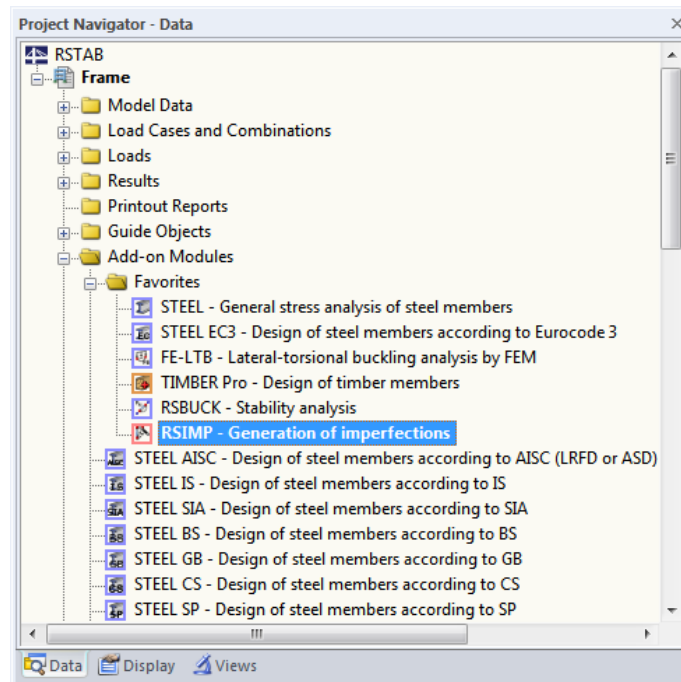


Figure 1.2: Data navigator: *Add-on Modules* → *RSIMP*

## 2. Input Data

When you open the add-on module, a new window appears. On the left of this window, you see a navigator containing all available module windows. Above the navigator, you find a drop-down list with the RSIMP cases (see chapter 4.1, page 19).

The data relevant for the imperfections is to be defined in two input windows. When you open RSIMP for the first time, the following parameters are automatically imported:

- Members and sets of members
- Load cases, load combinations, result combinations, and super combinations

To go to a module window, click the respective entry in the navigator. To select the previous or next window, use the buttons shown on the left. You can also use the function keys [F2] and [F3] to browse through the module windows.

To save the results, click [OK]. Thus, you exit RSIMP and return to the main program. To exit the module without saving the input data, click [Cancel].



## 2.1 General Data

In the 1.1 *General Data* window, you define the basic data for the generation of imperfections as well as the type of generation.

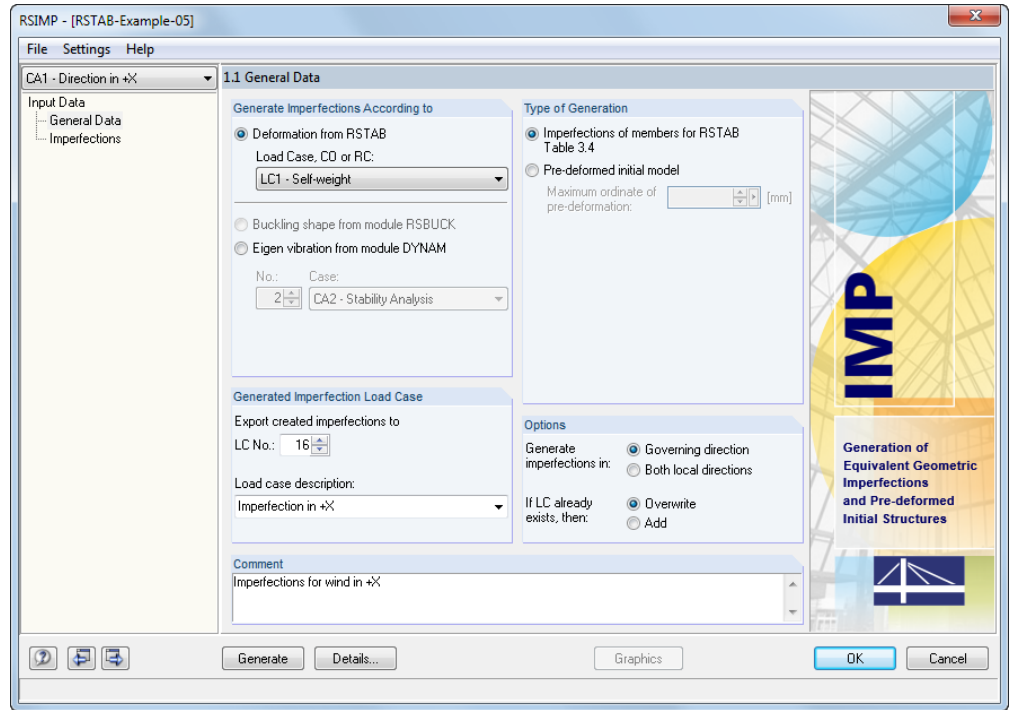


Figure 2.1: Window 1.1 *General Data*

### Generate Imperfections According to

First, you have to decide which results you want to use as a basis for generating imperfections or the pre-deformed initial model. There are three options in this dialog box section.

#### Deformation from RSTAB

You can select the governing load in the list *Load Case, CO or RC*.

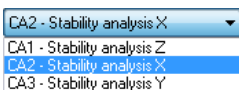
For result combinations, there are two result values at every x-location: the minimum and maximum of the superimposed values. For this reason, the list provides two entries for each result combination: *RC+* (maximum) and *RC-* (minimum), as shown in the picture.

According to EN 1993-1-1, clause 5.3.2 (1), it is required to set the equivalent geometric imperfections affine with the lowest buckling mode. Consequently, it would be necessary to create a separate imperfection load case for each loading in a distinct direction with a corresponding deformation. The RSIMP cases (see chapter 4.1, page 19) offer you the possibility to generate imperfections taking into account different directions of deformation.

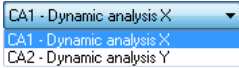
#### Buckling Shape from Module RSBUCK

Imperfections can be generated in such a way that they conform as much as possible to the deformation that belongs to the lowest buckling eigenvalue. To use the buckling mode, you must have a RSBUCK license.

In the *No.* list, you can select the number of the relevant buckling mode. In the list *Case*, you select the governing generation case from RSBUCK.







### Eigen vibration from DYNAM module

The imperfections or the pre-deformed initial model can also be based on an eigenmode that has been determined by the add-on module DYNAM. To use the eigenvibrations, you need a license for the module DYNAM Basis.

In the *Case* list, you define the governing DYNAM analysis case. The eigenvibration for generating the imperfections can be set in the *No* input field.

If no results from RSTAB, RSBUCK, or DYNAM are available, RSIMP automatically determines the relevant deformations, buckling modes, or eigenvibrations during the generation of the imperfections.

### Type of Generation

The imperfections can be generated in two completely different ways. Depending on the selection, the according parts are activated in the 1.1 *General Data* window.

#### Equivalent imperfections of members for RSTAB Table 3.4

The program creates a load case with equivalent imperfections in accordance with the Eurocode or DIN 18800, for members or sets of members. This load case can then be considered in a load combination.

If you select this type of generation, further specifications are required in the dialog sections *Generated Imperfection Load Case* and *Options* as well as in window 1.2 *Imperfections*.

#### Pre-deformed initial model

If you select this generation option, the program scales the normalized deformations from RSTAB, RSBUCK, or DYNAM to the *Maximum ordinate of pre-deformation* that you specify in the input field. No further specifications are required.



For the generated pre-deformed initial model, the nodal coordinates of the RSTAB table 1.1 are displaced according to the specified deformation. For this type of generation, you can take into account only one single imperfection mode for each model: The nodes can be displaced only once.

Pre-deformed initial models may be used, for example, for shell models for which the standards provide no application.

### Generated Imperfection Load Case

This dialog box section is available only for the *Imperfections of members* generation type.

The *LC No.* defines the load case to which you want to export the imperfections after the generation. The first free load case number is preset. You can enter the *Load case description* either directly or select it from the list.

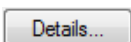
If you export the load case to RSTAB, an according query appears (see chapter 3.3, page 18).

### Options

This dialog box section is available only for the *Imperfections of members* generation type.

The imperfections can be generated in the *Governing direction* or in *Both local directions*. If you select the first option (default), RSIMP applies the imperfection only in one direction, that is, either in the direction of the local member axis y or z. The tolerance (see chapter 3.1, page 14) determines from which point on a deformation or deflection of an eigenmode is „governing“.

Click [Details] to check the defined tolerances that are also valid in the generation of both local directions.



If the number of an already existing load case is specified in the *Generated Imperfection Load Case* section, two additional options become available. Use them to decide if RSIMP is to *Over-write* the already existing load case or *Add* the generated equivalent imperfections to the existing loads.

### Comment

In this input field, you can enter a user-defined note describing in detail, for example, the parameters applied to the current RSIMP case.

## 2.2 Imperfections








The second window appears if you specify the *Imperfections of members for RSTAB Table 3.4* in the 1.1 *General Data* window.

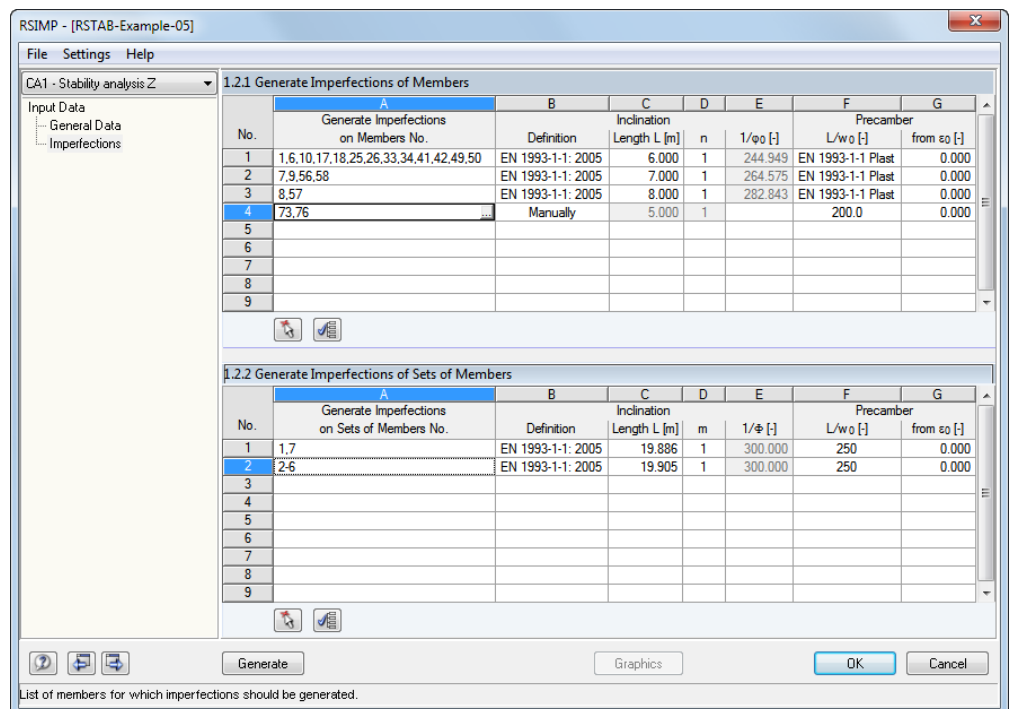
The window consists of two tables: The 1.2.1 *Generate Imperfections of Members* table manages the members relevant for generation; while the 1.2.2 *Generate Imperfections of Sets of Members* table lists the sets of members to be considered (groups of members cannot be used for imperfections).

Both tables offer you the same input options. The specifications in table 1.2.1 apply to individual members, in table 1.2.2 to sets of members. For this reason, they are described in this chapter together.

You can edit the specifications by using the common keyboard functions. For example, you can delete the active table row (where the cursor is placed) by pressing [Ctrl]+[Y] (see RSTAB manual, chapter 3.4.8). The context menu, which you open by right-clicking in a row, also provides important edit functions (see figure on the left).

To adjust the units and decimal places of lengths and loads, select **Units and Decimal Places** on the **Settings** menu (see chapter 4.2, page 21).

	Undo	Ctrl+Z
	Cut	Ctrl+X
	Copy	Ctrl+C
	Paste	Ctrl+V
	Copy Row	Ctrl+2
	Empty Row	Ctrl+Y
	Select...	F7



The screenshot shows the RSIMP software interface. The main window is titled 'RSIMP - [RSTAB-Example-05]'. It has a menu bar with 'File', 'Settings', and 'Help'. On the left, there is a tree view under 'Input Data' with 'General Data' and 'Imperfections' sub-items. The main area contains two tables:

**1.2.1 Generate Imperfections of Members**

No.	Generate Imperfections on Members No.	Definition	Inclination Length L [m]	n	1/φ [°]	Precamber L/w <sub>0</sub> [°]	from s <sub>0</sub> [°]
1	1.6,10,17,18,25,26,33,34,41,42,49,50	EN 1993-1-1: 2005	6.000	1	244.949	EN 1993-1-1 Plast	0.000
2	7,9,56,58	EN 1993-1-1: 2005	7.000	1	264.575	EN 1993-1-1 Plast	0.000
3	8,57	EN 1993-1-1: 2005	8.000	1	282.843	EN 1993-1-1 Plast	0.000
4	73,76	Manually	5.000	1		200.0	0.000
5							
6							
7							
8							
9							

**1.2.2 Generate Imperfections of Sets of Members**

No.	Generate Imperfections on Sets of Members No.	Definition	Inclination Length L [m]	m	1/φ [°]	Precamber L/w <sub>0</sub> [°]	from s <sub>0</sub> [°]
1	1,7	EN 1993-1-1: 2005	19.886	1	300.000	250	0.000
2	2,5	EN 1993-1-1: 2005	19.905	1	300.000	250	0.000
3							
4							
5							
6							
7							
8							
9							

At the bottom of the window, there are buttons for 'Generate', 'Graphics', 'OK', and 'Cancel'. A status bar at the very bottom reads 'List of members for which imperfections should be generated.'

Figure 2.2: Window 1.2 Imperfections

## Generate Imperfections on Members / Sets of Members

In column A, you specify the numbers of the relevant members or sets of members.



Please note that sets of members must already be defined in RSTAB in order to select them in the add-on module RSIMP. It is not possible to create new sets of members in RSIMP.



Clicking [ $\wedge$ ] allows you to select the members and sets of member graphically in the RSTAB work window. Alternatively, click in the input field to activate the [...] button (see Figure 2.2), to go to the RSTAB graphic window.

By clicking the members or sets of members in the RSTAB work window, you import their numbers in the *Multiple Selection* dialog box. If you have selected the wrong member, you can remove it from the list by clicking the selected member again. On [OK], you import the numbers of the select objects and return to RSIMP.



Clicking [Import All] selects all members or sets of members for the generation and imports their numbers and lengths in the tables.



For sets of members, numbering and directions of the contained members are of no importance. It is, however, important that all members in the set have the same member rotation.

### Inclination

In table columns B through E, you specify the parameters for the inclination. The following definition types are available (see also picture on the left):

- DIN 18800 E-E (elastic-elastic analysis method)
- DIN 18800 E-P (elastic-plastic analysis method)
- EN 1992-1-1: 2004-12 (Eurocode 2)
- EN 1993-1-1: 2005-07 (Eurocode 3)
- DIN 10445-1: 2001-07
- DIN 1052: 2004-08
- Manually

### Definition

In column B, you can select one of the standards mentioned above. Clicking in the input field activates the [ $\blacktriangledown$ ] button. Use this button to select the relevant setting from the list. You can also press [F7] to open the list.

In case of the Eurocode and DIN standards, the value of the inclination  $1/\varphi_0$  is entered automatically in column E.

### Length L

The length  $L$  represents the system length of the imperfect member. It is taken into account in Equation 2.2 (see below).

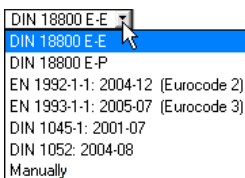
In column C, the member lengths are preset. You can modify them, if necessary. If you click in the input field, the [...] button becomes available, which allows you to determine the length graphically in the RSTAB work window.

### n or m

$n$  or  $m$  represent the number of causes (columns), which are independent from one another, and that must be taken into account for the inclinations of members and sets of members. This is illustrated in Figure 5.2 in EN 1993-1-1, clause 5.3.2. Generally, for  $n$  you may set the number of frame posts per floor in the corresponding frame plane.

### $1/\varphi_0$ or $\varphi$

If you choose to define the inclination *Manually* (column B), you can enter the value of the inclination directly. In this case, the columns for *Length L* and  $n$  are inactive.



If the inclination (sway) is determined automatically according to one of the two definition types for **DIN 18800**, it is normally determined for single members (non-built-up members) as follows:

$$\varphi_0 = \frac{1}{200} \cdot r_1 \cdot r_2$$

Equation 2.1: Inclination  $\varphi_0$  according to DIN 18800 part 2, Eq. (1)

This method is based on the analysis method *elastic-plastic*. The two reductions factors  $r_1$  and  $r_2$  are determined as follows.

$$r_1 = \sqrt{\frac{5}{L}}$$

where L: System length of the member or set of members

Equation 2.2: Reduction factor  $r_1$

Equation 2.2 applies only to lengths  $\geq 5.00$  m. For  $l < 5.00$  m,  $r_1$  is set to one.

$$r_2 = \frac{1}{2} \cdot \left( 1 + \sqrt{\frac{1}{n}} \right)$$

where n: Number of causes for inclinations independent from one another

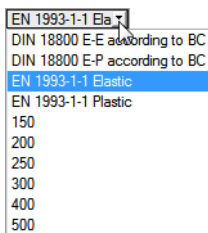
Equation 2.3: Reduction factor  $r_2$

If you select the *elastic-elastic* method, the inclinations will be determined according to the same principle. However, because the stress analysis is performed based on the *elastic-elastic* method, like for example in the module STEEL, the inclination may be reduced according to DIN 18800 part 2, El. (201) to  $2/3$  of the basic value (that is,  $\varphi_0 = 1/300$ ). In this way, the fact is taken into account that the plastic reserve of the cross-section is not used.

### Precamber $L/w_0$

In the table columns F and G, you define the parameters for the precamber. The following types of definition according to Eurocode and DIN 18800 are available: Click into the input field to activate the [▼] button. Use this button to select the relevant setting from the pull-down list. You can also press [F7] to open the list.

The list contains the precamber's values commonly used in accordance with the standards as well as two options for *EN 1993-1-1* and *DIN 18800 according to BC* (buckling curve) respectively. In EN 1993-1-1, the precamber is determined according to clause 5.3.2(3), Table 5.1, also depending on the buckling curve of the cross-section.



Buckling curve	Precamber $e_{0,d}/L$ elastic analysis	Precamber $e_{0,d}/L$ plastic analysis
a <sub>0</sub>	1/350	1/300
a	1/300	1/250
b	1/250	1/200
c	1/200	1/150
d	1/150	1/100

Table 2.1: Recommended values of precamber  $e_{0,d}/L$  according to EN 1993-1-1, Table 5.1

The buckling curves  $a_0$  through  $d$  are assigned to the types of sections in accordance with EN 1993-1-1, Table 6.2.

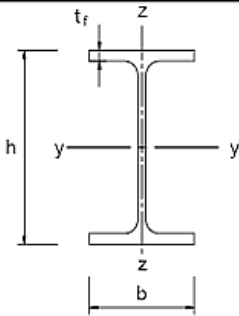
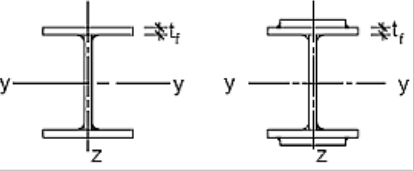
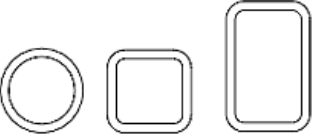
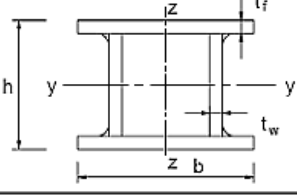
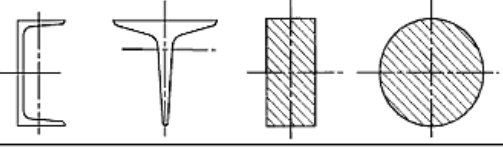
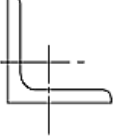
Cross section	Limits	Buckling about axis	Buckling curve		
			S 235 S 275 S 355 S 420	S 460	
Rolled sections 	$h/b > 1,2$	y - y z - z	$t_f \leq 40 \text{ mm}$	a b	$a_0$ $a_0$
			$40 \text{ mm} < t_f \leq 100$	b c	a a
	$h/b \leq 1,2$	y - y z - z	$t_f \leq 100 \text{ mm}$	b c	a a
			$t_f > 100 \text{ mm}$	d d	c c
Welded I-sections 	$t_f \leq 40 \text{ mm}$	y - y z - z	b c	b c	
	$t_f > 40 \text{ mm}$	y - y z - z	c d	c d	
Hollow sections 	hot finished	any	a	$a_0$	
	cold formed	any	c	c	
Welded box sections 	generally (except as below)	any	b	b	
	thick welds: $a > 0,5t_f$ $b/t_f < 30$ $h/t_w < 30$	any	c	c	
U-, T- and solid sections 		any	c	c	
L-sections 		any	b	b	

Figure 2.3: Assignment of cross-sections to buckling curves according to EN 1993-1-1, Table 6.2.

### from $\epsilon_0$

In the final table column, you specify the value of the member characteristic  $\epsilon$  from which the precamber should be taken into account in addition to the inclination. According to DIN 18800 part 2, El. (207), the precamber is relevant starting from a member characteristic of  $\epsilon_0 = 1.6$ . In EN 1993-1-1 clause 5.3.2(6), this is regulated in dependence of the slenderness ratio  $\lambda$ . User-defined specifications are also possible. Furthermore, you can click [▼] in the input field to select the appropriate value.

First, the member characteristics of the members and sets of members are determined in RSTAB by second-order analysis. If they are greater than the values  $\epsilon_0$  specified in column G, then the precambers are considered in the generation of the imperfections.

## 3. Generation

This chapter describes how imperfections are generated as equivalent lateral loads or pre-deformed initial models, and how the results are made available for RSTAB.

### 3.1 Starting the Generation

Details...

Before you start the generation of equivalent imperfections, it is recommended to check the tolerance specifications for RSIMP. Clicking [Details] button in the 1.1 *General Data* window opens the following dialog box:

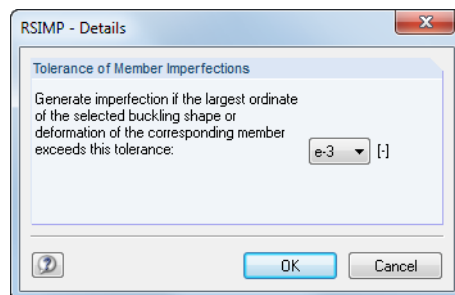
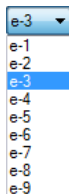


Figure 3.1: Dialog box *RSIMP - Details*



The dialog box does not affect the generation of pre-deformed initial models.

The *Tolerance* allows you to specify the ordinate of the selected deformation or buckling mode from which imperfections are to be generated: Very small amplitudes in the deformation or buckling shape are not taken into account if they are below the value given in the dialog box. Thus, RSIMP will not apply any imperfections to members or sets of members with ordinates below this tolerance.



To specify the value of the tolerance, click [▼] to select it from the drop-down list. You can choose from the values *e-1* through *e-9*. The value *e-1* represents the rounding to one decimal place. If you select *e-9*, the program considers nine decimal places.

RSIMP analyzes the scaled nodal values of a deformation or buckling shape. The maximum values are scaled to '1.' For example, if the maximum deformation of a model is 10 cm, thus corresponding to the scaled value 1, a deflection of 0.08 cm would result in a scaled value of 0.008. If the tolerance is *e-3* (that is, has a rounding limit of three decimal places: 0.005), RSIMP would apply an equivalent imperfection for this member because the scaled value is above the threshold. If the tolerance is *e-2*, the program would not take into account the imperfection for this member because its scaled deformation is smaller than the tolerance of 0.05 with two decimal places.

If RSIMP cannot generate any member imperfections due to the specified tolerance, the program shows the following message.

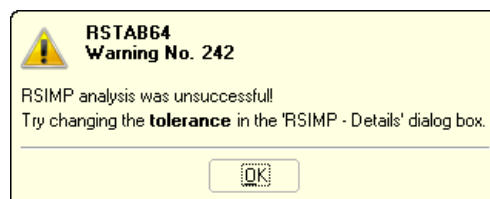


Figure 3.2: Warning if tolerance is too small

As described above, you can increase the *Tolerance* by defining several decimal places.

Generate

The [Generate] button is available in both RSIMP input windows. Clicking it starts the generation of the load case data or the pre-deformed initial model for RSTAB.

You can also start the generation in the RSTAB user interface. The *To Calculate* dialog box (menu *Calculate* → *To Calculate*) lists the RSIMP cases as well as load cases and load combinations.

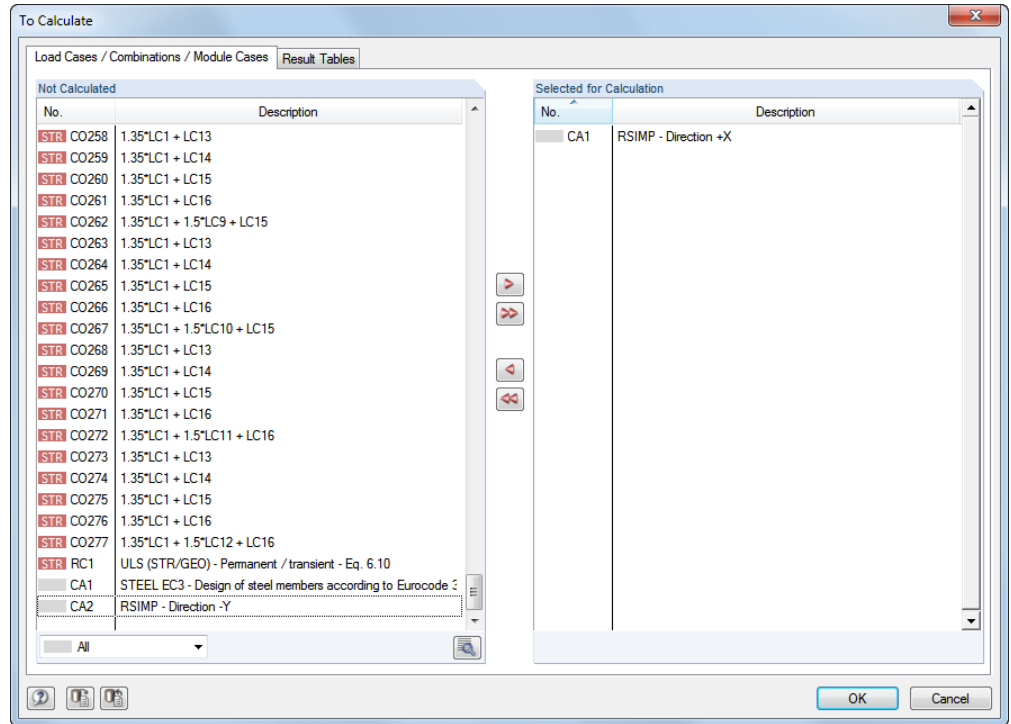
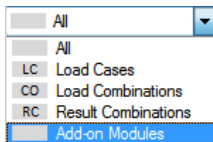


Figure 3.3: Dialog box *To Calculate*



If the RSIMP cases are missing in the *Not Calculated* list, select *All* or *Add-on Modules* in the drop-down list at the end of the section.

To transfer the selected RSIMP cases to the list on the right, click [▶]. Clicking [OK] starts the calculation.

To compute a design case directly, you can also use the list in the RSTAB toolbar. Select the relevant RSIMP case in the list, and then click [Show Results].

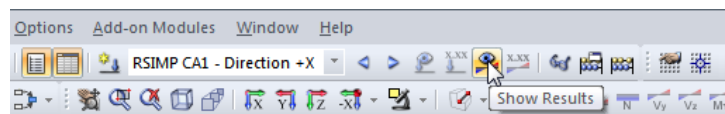


Figure 3.4: Direct calculation of an RSIMP case in RSTAB

After the successful generation, the 2.1 *Imperfections window* showing the imperfections of members and sets of members is shown (see Figure 3.6). In case of a pre-deformed initial structure, a message appears stating that the equivalent model has been generated.

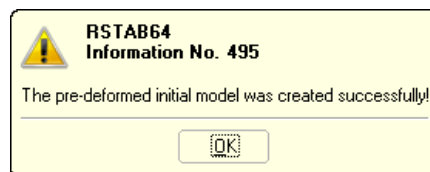


Figure 3.5: Message after generation of pre-deformed initial model

Now, the generation of the imperfections or of the pre-deformed initial model is complete. If you have defined several RSIMP cases, you have to perform the generation for each RSIMP case separately.

If you generate a pre-deformed initial model based on already calculated deformations, the results are deleted because the deformations are no longer valid for the pre-deformed initial model.



If you run the analysis from the RSTAB menu *Calculation* → *Calculate All*, all RSIMP cases are computed with the option *Imperfections of members for RSTAB Table 3.4*. The generated imperfections, however, are not automatically exported as load cases to RSTAB: You must make this step manually in the RSIMP module (see chapter 3.3). RSIMP cases generated with the *Pre-deformed initial model* option will be excluded from the complete analysis: It would be necessary to delete all results because RSIMP generates a modified initial model; the calculation would be trapped in a loop.

## 3.2 Generated Imperfections

The results for the generated *Imperfections* and the created *Pre-deformed initial model* are provided in different ways.

### 3.2.1 Imperfections

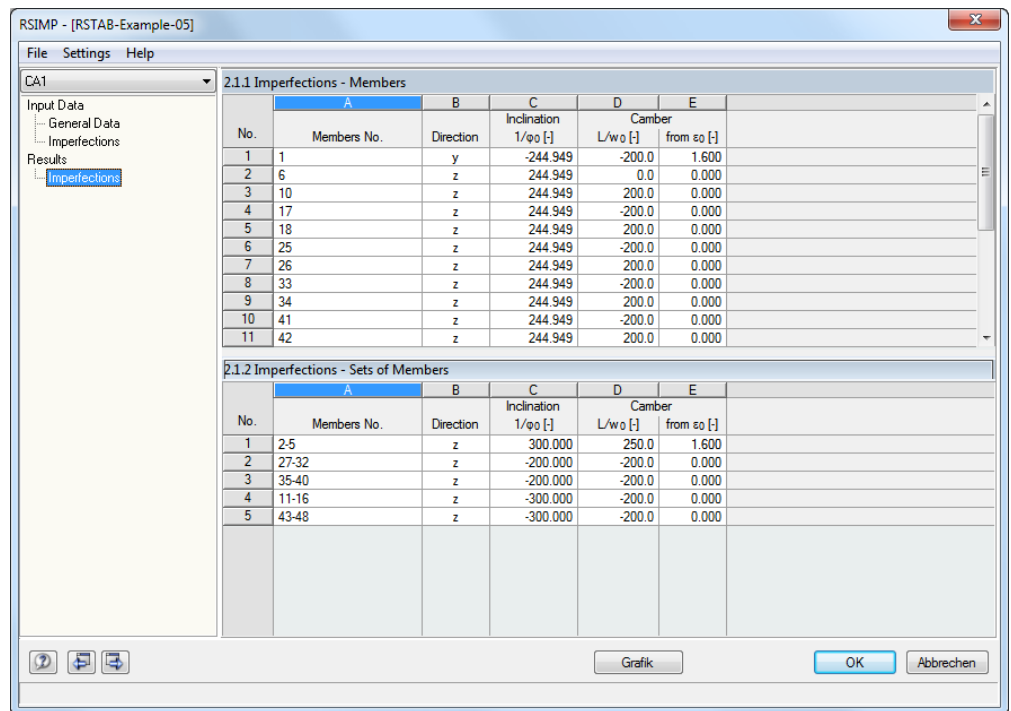


Figure 3.6: Window 2.1 Imperfections

Once the generation is complete, the 2.1 *Imperfections* window appears. It is divided into two parts. Both tables list the *Members* or *Sets of Members* with the generated imperfections. The indicated *Direction* refers to the local member axes y or z for which the inclinations and pre-cambers apply.

To graphically show the generated imperfections in the RSTAB work window, click [Graphics]. The graphic shows if imperfections have been created at all members and sets of members that are susceptible to buckling.

Graphics



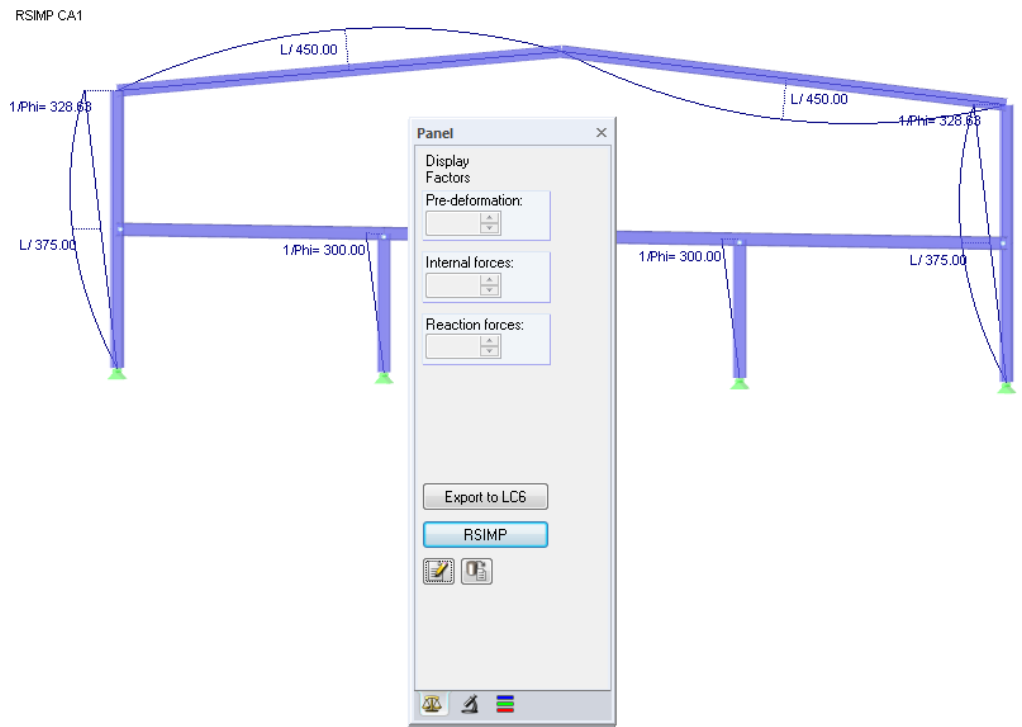


Figure 3.7: RSTAB graphic of generated equivalent imperfections

You can hide or unhide the local member axes by using the context menu of a member or specify this in the *Display navigator*.

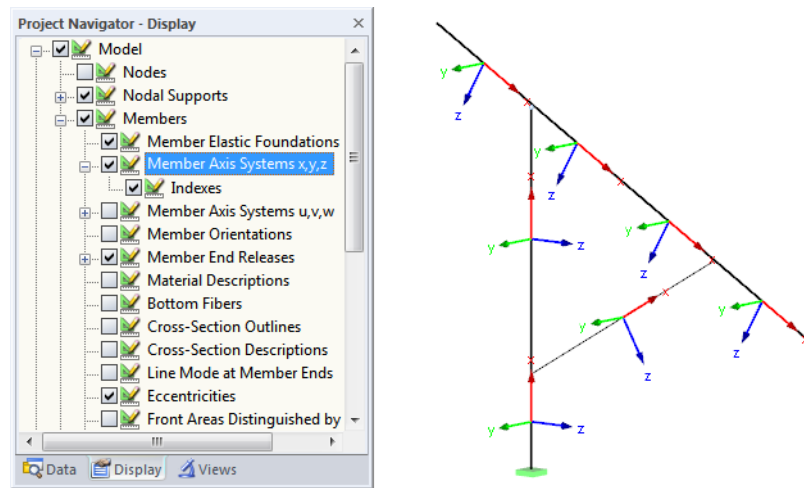
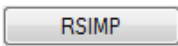


Figure 3.8: Selecting the member axis systems in the *Display navigator*



Click the [RSIMP] button in the panel to return to the add-on module RSIMP, where you can modify the input and start a new generation run, if necessary.

### 3.2.2 Pre-Deformed Initial Model

After you generate the pre-deformed initial model, the message shown in Figure 3.5 appears. Thus, RSIMP creates the modified initial structure immediately and the generation is complete.

In the pre-deformed initial model, the nodal coordinates are adjusted. To check this, for example, in the 1.1 *Nodes* table of RSTAB, close the module RSIMP by clicking [OK] or [Cancel].

In the centers of the members, no adjustments are made because only the coordinates of the nodes are changed.

Chapter 5, page 23 presents an example for the generation of a pre-deformed initial model.

### 3.3 Export of Imperfections

This chapter describes how the generated *Imperfections of members* can be exported as a load case to RSTAB. The *Pre-deformed initial model*, on the other hand, is created automatically in RSIMP.

To export the generated imperfections to RSTAB, click [OK]. The following message appears:

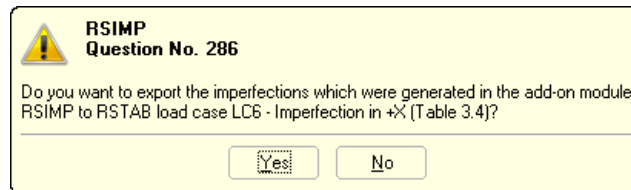


Figure 3.9: Message before exporting the load case data

As shown in Figure 3.7, the graphical user interface of RSTAB also provides an export option. The panel offers you the [Export to LC] button. Clicking also calls up the message shown above.

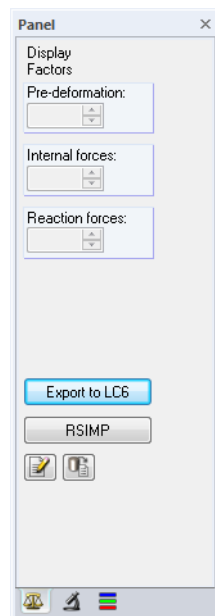
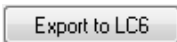
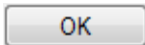


Figure 3.10: Panel with *Export* button

The imperfections are entered in the RSTAB table 3.4. If necessary, you can adjust them there or add specifications.



## 4. General Functions

This chapter describes useful menu commands and further export options for the RSIMP cases.

### 4.1 RSIMP Cases

RSIMP cases allow you to group the generation parameters of the members or sets of members according to particular specifications. In this way, you can generate the according load cases or buckling modes in different RSIMP cases in order to generate specific imperfections. For some members, imperfections can be governing that depend on certain loadings or buckling modes. According to the state of the art, they must consequently be taken into account in separate load cases.



Note: If there are several load cases, pay attention to the numbers of the target load cases to prevent mistaken overwriting.

#### Create a New RSIMP Case

To create a new RSIMP case, select the command on the RSIMP menu

**File** → **New Case**.

The following dialog box appears:

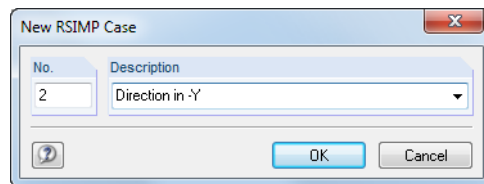


Figure 4.1: Dialog box *New RSIMP Case*

In this dialog box, enter a *number* (one that is still free) for the new RSIMP case. The *Description* will help you select the right case from the load case list.

By clicking [OK], you return to the 1.1 *General Data RSIMP* window for the input of parameters.

#### Rename RSIMP Case

To change the description of an existing RSIMP case, use the command on the RSIMP menu

**File** → **Rename Case**.

The following dialog box appears:

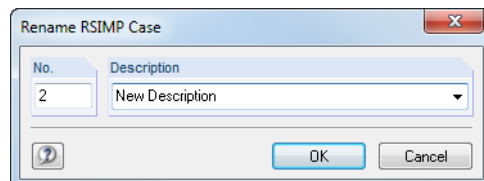


Figure 4.2: Dialog box *Rename RSIMP Case*

In this dialog box, you can specify a different *Description* as well as a different *No.* for the RSIMP case.

### Copy RSIMP Case

To copy the input data of the current case, use the command from the RSIMP menu

**File → Copy Case.**

The following dialog box appears:

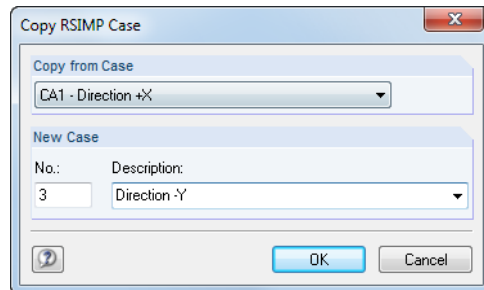


Figure 4.3: Dialog box *Copy RSIMP Case*

Specify the *Number* and, if necessary, a *Description* for the new RSIMP case.

### Delete RSIMP Case

To delete RSIMP cases, use the command on the RSIMP menu

**File → Delete Case.**

The following dialog box appears:

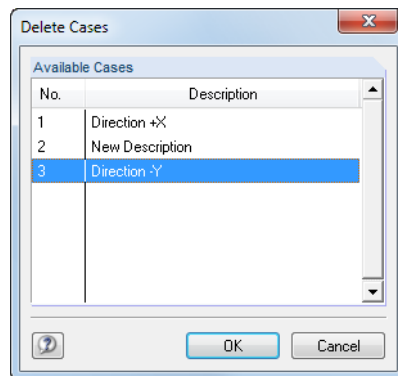


Figure 4.4: Dialog box *Delete Cases*

The case can be selected in the *Available Cases* list. To delete the selected case, click [OK].

## 4.2 Units and Decimal Places

The units and decimal places for RSTAB and the add-on modules are managed together in a common dialog box. In RSIMP, you can define the units by selecting the command from the RSIMP menu

**Settings → Units and Decimal Places.**

The dialog box known from RSTAB appears. RSIMP is preset in the *Program / Module* list.

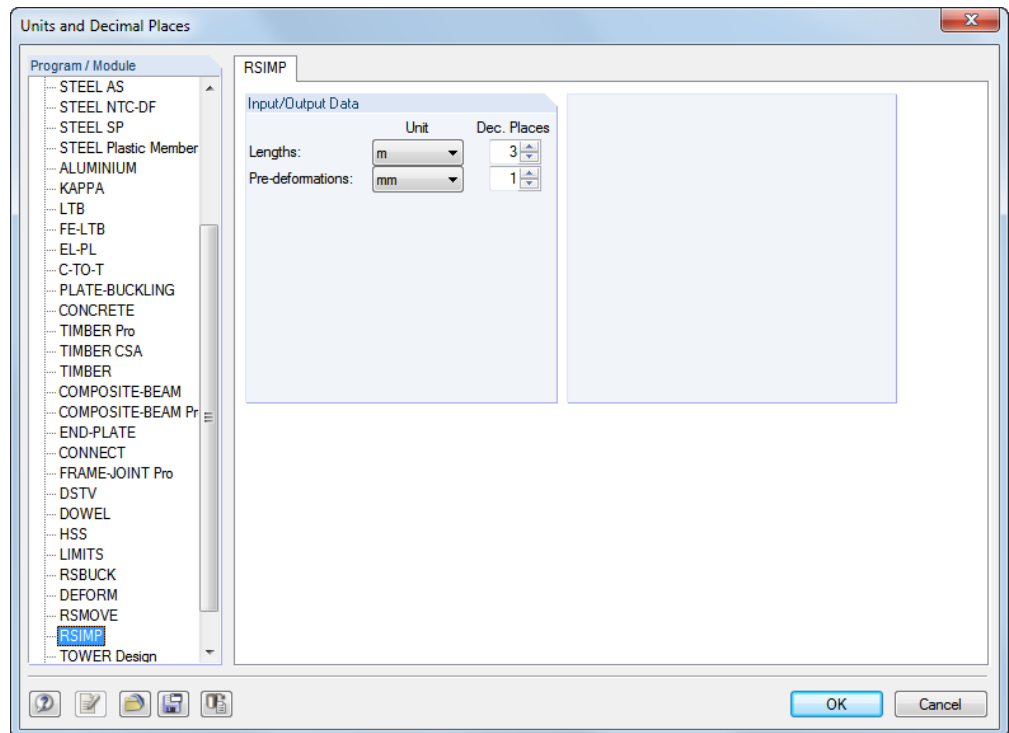


Figure 4.5: Dialog box *Units and Decimal Places*



You can save the settings as user profile to reuse them in other models. These functions are described in chapter 11.1.3 of the RSTAB manual.

## 4.3 Export of Data

The data export of the generated equivalent imperfections is primarily in the direction of the main program RSTAB: There, the program creates an imperfection load case that you can adjust or complete (see chapter 3.3, page 18). With some restrictions, it is also possible to prepare data from RSIMP directly for other programs.

### Clipboard

To copy cells selected in the 1.2 *Imperfections* and 2.1 *Imperfections* windows to the Clipboard, press [Ctrl]+[C]. To insert the cells, for example in a word processing program, press [Ctrl]+[V]. The headers of the table columns will not be transferred.

### Printout Report

Data from RSIMP cannot be integrated directly into the printout report. You can, however, export the imperfections created in the RSTAB load cases. To do this, select in the report menu

**File → Export to RTF.**

The function is described in detail in chapter 10.1.11 of the RSTAB manual.

### Excel / OpenOffice

RSIMP provides a function for the direct data export to MS Excel, OpenOffice.org Calc, or the file format CSV. To start this function, select the command from the menu

**File → Export Tables.**

The following export dialog box appears.

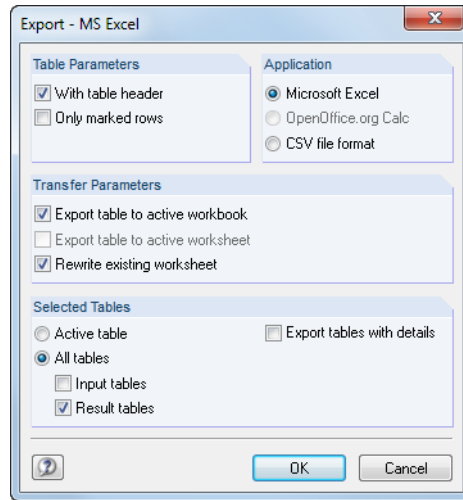


Figure 4.6: Dialog box *Export - MS Excel*

In accordance with the design concept of the add-on module, only the two windows 1.2 *Imperfections* and 2.1 *Imperfections* are considered for the data export.

By clicking [OK], you start the export. Excel or OpenOffice are called up automatically, that is, the programs do not have to be opened first.

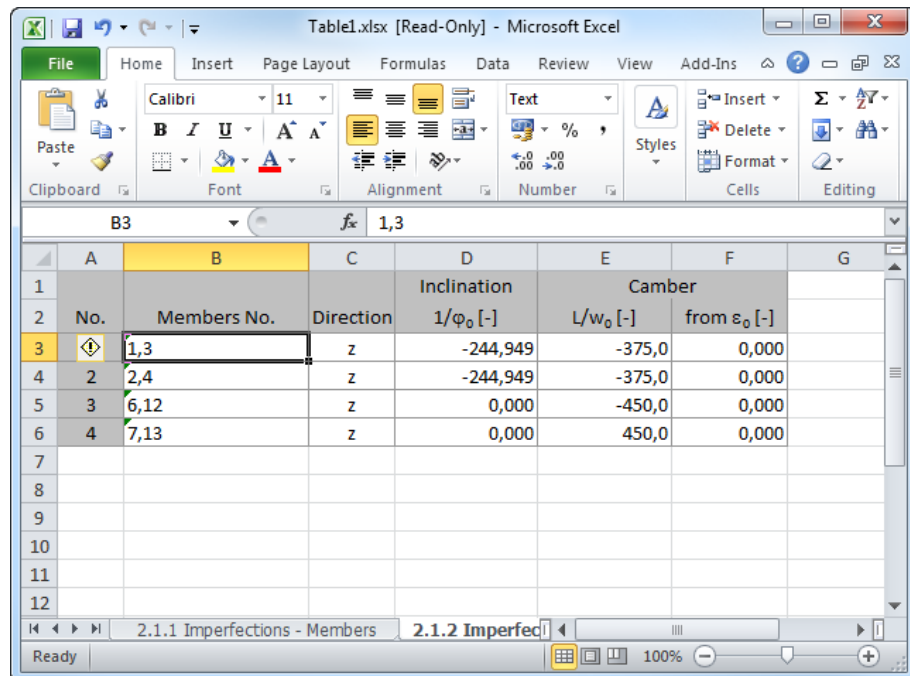


Figure 4.7: Result in MS Excel

## 5. Example: Pre-Deformed Model

The following dome was modeled in RSTAB. The imperfections for this system are to be generated as pre-deformed initial models.

First, the buckling modes for the load case self-weight are computed in the module RSBUCK.

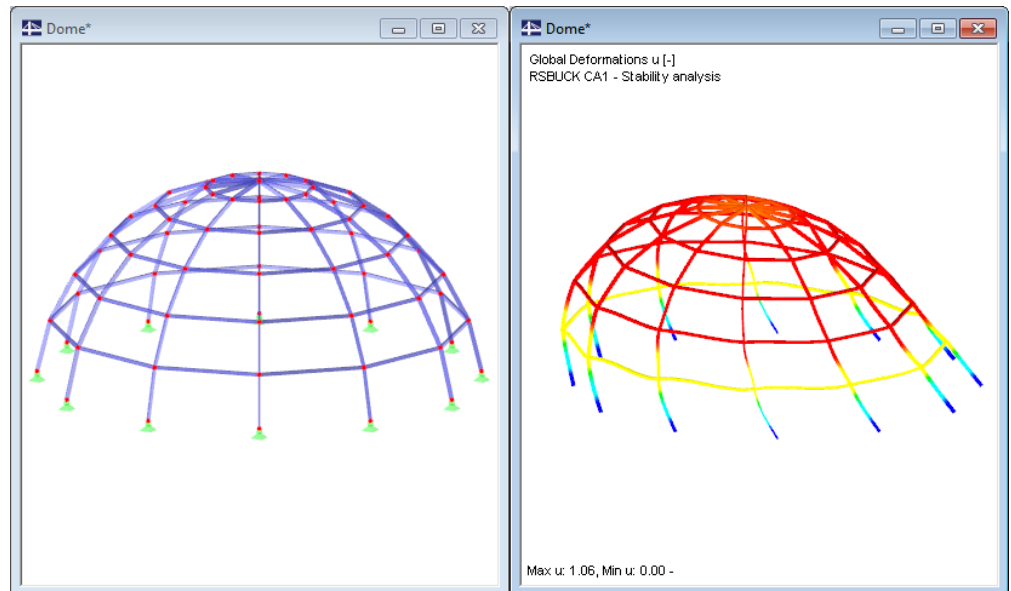


Figure 5.1: Dome model and buckling mode

After starting RSIMP, we make the following specifications in the 1.1 *General Data* window:

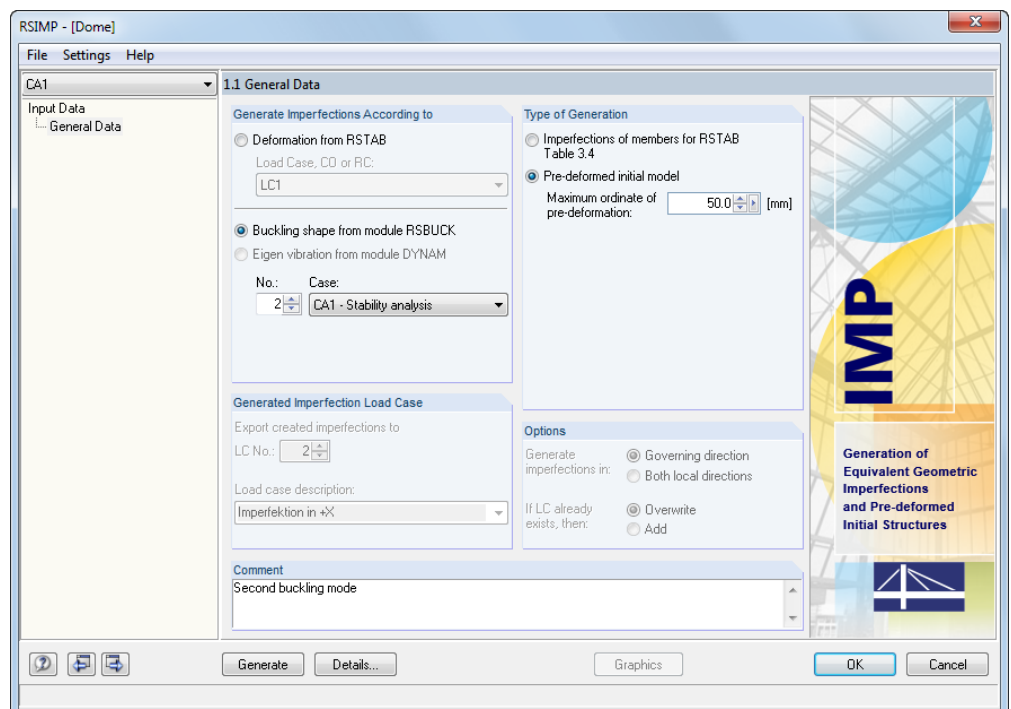


Figure 5.2: RSIMP window 1.1 *General Data*

We specify the buckling shape 2 in the input field **No.** The *maximum ordinate of the pre-deformation* is **50 mm**. The input is complete.

Generate

We [Generate] the pre-deformed initial model, and then confirm the message stating that the model was created successfully.

We close the dialog box by clicking [OK]. The RSTAB graphic shows the following figure:

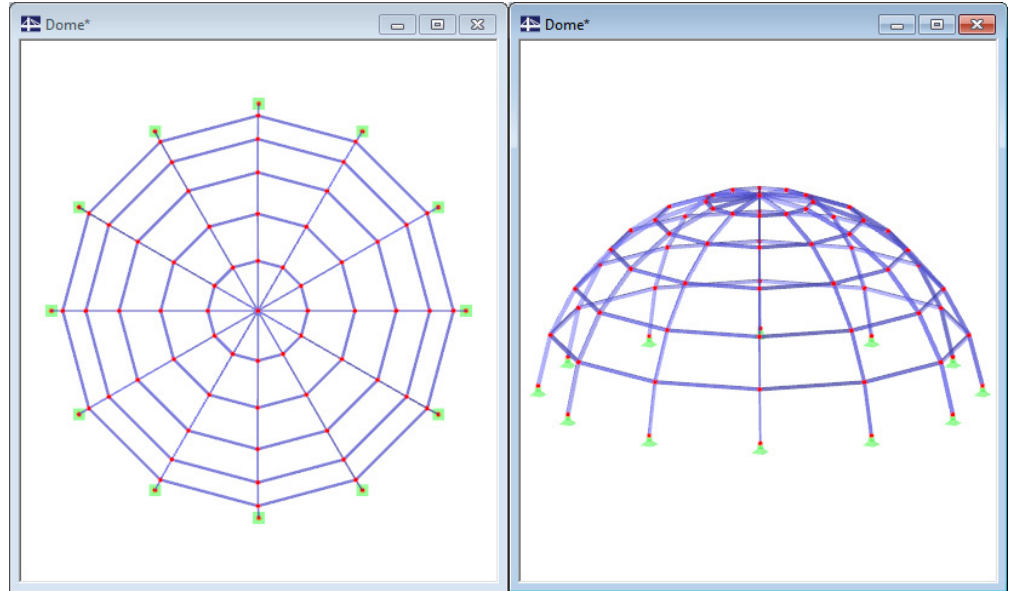


Figure 5.3: Generated pre-deformed initial model in Z-view and isometric view

Because the pre-deformation is relatively small for the dome radius of 10 m, the displaced nodal coordinates are hard to recognize in the graphic. You can check them in the 1.1 *Nodes* RSTAB table or in the editing dialog boxes of the nodes. There, you can see that the scaled deformations are added to the nodal coordinates.



# **A Literature**

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- [2] DIN 18800 (11.90) Teil 2: Stahlbauten - Stabilitätsfälle, Knicken von Stäben und Stabwerken, Beuth Verlag, Berlin/Wien/Zürich, 1992
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