

Tutorial Scia **External Application Checks using Excel** Engineer

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Version Information

Welcome to the External Application Checks Tutorial for Excel.

This document provides guided examples and information on the use of the External Application Checks based on Excel.

Version info

| Document Title | External Application Checks Tutorial - Excel |
|----------------|--|
| Release | 2008.1 |
| Revision | 06/2008 |

Introduction

In this tutorial, guided examples and information is given on the use of the External Application Checks using Excel.

In Scia Engineer, a large amount of advanced checks are available for a 1D member: Concrete Reinforcement Design, Steel Code Checks, Aluminium Design, and Connection Checks ...

It is off course possible that a user would like a special kind of check, something which is not currently implemented in Scia Engineer.

This is where the External Application Checks module for Excel comes up: using this module, the user can define his/her own type of check and link this to one or more existing Excel files. During the check, the input data from Scia Engineer (like internal forces, members data, dimensions ...) are sent to Excel and the results are read back. The Excel file itself can even be shown within the document preview of Scia Engineer!

The basic idea behind the external application checks is the following: the user can define his/her own additional data. This data contains the so called 'mapping' (which properties are send to and read from the external application) but can also contain user defined parameters, check boxes, combo-boxes and so on.

In general, the external check procedure involves the following steps:

| Step 1: | Activate the functionality External Application Checks |
|---------|--|
| Step 2: | Create User Defined Additional Data |
| Step 3: | Input the User Defined Additional Data on members/nodes |
| Step 4: | Execute the Custom Check |
| Step 5: | Save the User Defined Additional Data into a database for future use |

In this tutorial, the above procedure for the External Application Checks using Excel is illustrated using four guided examples.

| Example 1 | In the first example the general principles of the external application checks are explained. |
|-----------|---|
| | A typical bending check is used as a practical example to illustrate the workings of the module. |
| Example 2 | In the second example, the use of a combo-box is illustrated. In addition, the use of Named cells and output parameters with units are explained. |
| | As a practical case, Flange Induced Buckling as specified in article 8 of EN 1993-1-5 is used. |

Example 3In the third example, the mapping of arrays is explained. In addition, multiple
detailed outputs are used.As a practical case, concrete Corbel Design is used.

Example 4In the final example, the working of slave data is explained. In addition, the
use of point data and nodal data is illustratedAs a practical case a steel moment resisting connection is used.

Accompanying this document, the reader will find a set of files for each example.

| Excel_Example_X.xls | The Excel file which will be used for example X. |
|-----------------------------|---|
| Excel_Example_X_Picture.bmp | The picture which will be used for the additional data of example X. |
| Excel_Example_X_Icon.bmp | The icon which will be used for the custom check of example X. |
| Excel_Example_X_Initial.esa | The project file for example X without any External Application Check data. The user should use this file when going through this tutorial to follow all the steps described within the document. |
| Excel_Example_X.esa | The final project file for example X, after completing all the steps explained in this tutorial. |

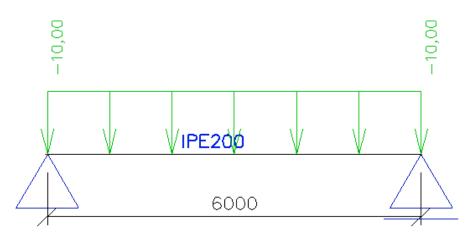
The External Application Checks using Excel supports Excel 97-2003 workbooks (.xls) which do not require any intermediate user interaction.

Example 1: Bending Check

In this first example the general principles of the external application checks are explained.

More specifically a bending check is used as a practical example to illustrate the workings of the module.

In this example, a beam on two supports is modelled. The beam has a cross-section type **IPE 200**, a length of **6m** and is manufactured in **S235** according to **EC-EN**.



One load case is defined, a uniform line load of 10 kN/m.

The check will be done according to the Excel file "Excel_Example_1.xls"

| | А | В | С |
|----|-------------------------|-----------|-------|
| 1 | Bending Check | | |
| 2 | | | |
| 3 | Data from SCIA Engineer | | |
| 4 | | | |
| 5 | Moment My | 100000 | Nm |
| 6 | | | |
| 7 | Section modulus Wel | 0,0015 | m^3 |
| 8 | | | |
| 9 | Section modulus Wpl | 0,002 | m^3 |
| 10 | | | |
| 11 | Yield Strength fy | 23500000 | N/m^2 |
| 12 | | | |
| 13 | Safety factor Gamma M | 1,1 | - |
| 14 | | | |
| 15 | Elastic Check ? | 0 | |
| 16 | | | |
| 17 | Bending Resistance | | |
| 18 | | | |
| 19 | MRd | 427272,73 | Nm |
| 20 | | | |
| 21 | Unity Check | | |
| 22 | | | |
| 23 | UC | 0,23 | - |

The bending resistance MRd of the member is calculated using the following formula:

$$MRd = \frac{W \cdot fy}{\gamma M}$$

| With: | W | Section modulus |
|-------|----|-----------------|
| | fy | Yield strength |
| | γM | Safety factor |

The choice of the section modulus as plastic or elastic will be determined from a check box labelled 'Elastic Check'.

As specified in the introduction, the following steps are required:

Step 1: Activate the functionality External Application Checks

Step 2: Create User Defined Additional Data

Step 3: Input the User Defined Additional Data on members/nodes

Step 4: Execute the Custom Check

Step 5: Save the User Defined Additional Data into a database for future use

Step 1: Activate the functionality External Application Checks

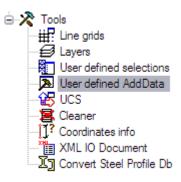
The first step is to activate the functionality **External application checks** on the **Functionality** tab in the **Project Data**.

| Project data | | | | | |
|---------------|---|--------------|-------------|--|--------|
| Basic data Fu | nctionality Loads Combinations Prot | ection Natio | nal Annexe: | s | |
| Basic data Fu | Inctionality Loads Combinations Prot Dynamics Initial stress Subsoil Nonlinearity Stability Climatic loads Prestressing Pipelines Structural model Parameters Mobile loads Overview drawings LTA - load cases External application checks | ection Natio | | s Steel Steel Fire resistance Connection modeller Frame rigid connections Frame pinned connections Bolted diagonal connections Expert system Connection monodrawings Scaffolding LTB 2nd Order ArcelorMittal | |
| 100 | | | | | |
| | | | | ОК | Cancel |

Step 2: Create User Defined Additional Data

In the second step, User Defined Additional Data will be defined.

Through Tools > User defined AddData the User Defined Additional Data Library can be opened.



| 🗖 My addData templates 🛛 🛛 🔀 | | | | |
|------------------------------|-------------------------|-------------------------------|--|--|
| 🔎 🤮 😼 🎒 🖉 🖬 🔺 🔹 🖓 | | | | |
| MYAT1 | Name | MYAT1 | | |
| | Slave add data | | | |
| | User string database | | | |
| | List of parameters | | | |
| | Picture | | | |
| | Remove picture | | | |
| | Service tree definition | | | |
| | Service name | MYAT1 Input of custom Add dat | | |
| | Icon | | | |
| | Remove icon | | | |
| | AddData definition | | | |
| | Type of data | Line on 1D member | | |
| | | | | |
| New Insert Edit | Delete | Close | | |

By default the Library contains a new item labelled 'MYAT1'. Since in this example a bending check will be defined, this **Name** is changed to 'Bending'.

The following steps will explain how to define User Additional Data.

Step 2.1 Slave data

The checkbox **Slave add data** can be used to specify that the current additional data is of the type 'slave'.

A distinction is made between 'master' data and 'slave' data.

Master data have all options available: they can be used to send data to Excel and read data back from Excel. The data for this example will be master data: member properties and loading are sent to Excel and a unity check value is read back.

Slave data do not have all options available: they can only be used to send data to Excel, not to read data from Excel. Slave data can then be linked to master data. The check and output options are thus defined in the master data while the input options are defined in both the master and slave data.

A typical example is a beam to column connection: the connection (master data) is inputted on the node between beam and column. In this connection data the check is defined as well as input properties like bolts, welds,...

On the beam and column, slave data will be defined which will send the beam and column properties to Excel.

The use of slave data will be illustrated in 'Example 4'.

For this example only one additional data will be defined and thus the checkbox is not activated.

| Name | Bending | |
|----------------|---------|--|
| Slave add data | | |

Step 2.2 Define text strings

In Scia Engineer, all text strings of the user interface are saved into a string database. This allows for easy translation of the interface to several languages.

The same logic is used in the User Defined Additional Data: all text strings are inputted in the **User string database** and can then be used when defining the additional data.

For example, when the user creates additional data in the English interface and also provides the German words in the string database, everything will automatically be shown in German in case the user switches to the German interface.

When opening the **User string database** the following contents are shown:

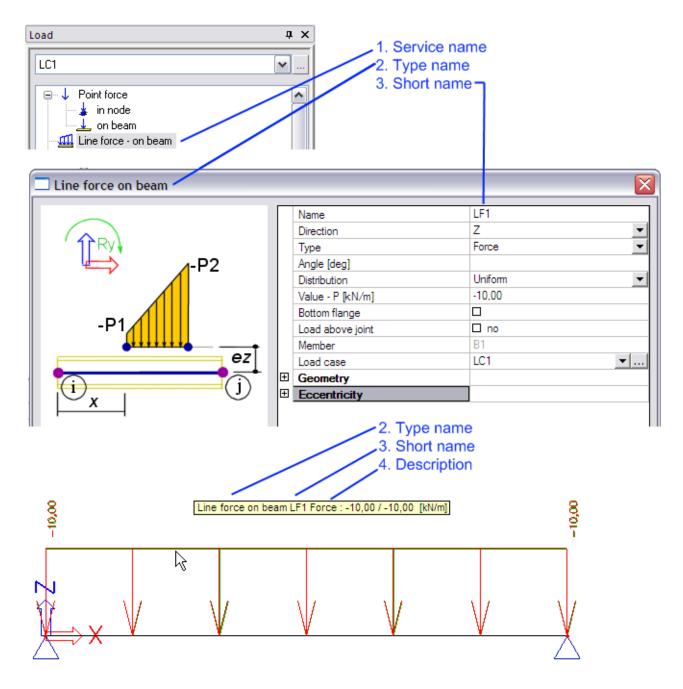
External Application Checks for Excel – Example 1: Bending Check

| s | tring | datab | oase 🛛 🔀 | |
|---|-------------------|-----------------------|---|--|
| | Langua | age | English (United States) | |
| | | ID | Text | |
| | 1 | 1 | MYAT1 Input of custom Add data | |
| | 2 | 2 | MYAT1 Custom defined data | |
| | 3 | 3 | MYAT1 MADI | |
| | 4 | 4 | MYAT1 Description | |
| | 5 | 5 | MYAT1 Custom check | |
| | • | 0 | | |
| | | F L. 441 | | |
| | Note: 1 defaul | The stri t set for | ng database which is used depends on the language r the workspace. | |
| | | | OK Cancel | |

Using the **Language** combo-box the user can switch between different languages. In the grid the different text strings can be inputted.

It is important to use the same ordering of strings when making the input for different languages i.e. the string in English with ID 4 should have its German translation also on ID 4 in the German string database.

By default, Scia Engineer provides 5 strings which will be used by default for the name of the Service, the Type, the Short name of the additional data, its Description and the name of the Custom check. The following picture illustrates how these strings are used for a line load:



In this example a Bending Check is being illustrated and therefore the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|-----------------------------------|-----------------------------|
| Service name | MYAT1 Input of custom add data | Input of Bending data |
| Type name | MYAT1 Custom defined add data | Bending data |
| Short name | MYAT1 MADI | Bend1 |
| Description | MYAT1 Description | Bending |
| Name of check | MYAT1 Custom check | Bending Check |

| S | String database | | | | | |
|---|----------------------------------|----|---|---|--|--|
| | Language English (United States) | | • | | | |
| | | ID | Text | | | |
| | 1 | 1 | Input of Bending data | | | |
| | 2 | 2 | Bending data | | | |
| | 3 | 3 | Bend1 | | | |
| | 4 | 4 | Bending | | | |
| | 5 | 5 | Bending Check | | | |
| | • | 0 | | _ | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | ng database which is used depends on the language r the workspace. | | | |
| | | | OK Cancel | | | |

By default the first five strings are used for the types specified above however the user can specify any other string to be used (for example the string with ID 6) as will be illustrated later.

Step 2.3 Define parameters

In Scia Engineer a large amount of parameters/properties is available for use with the Excel link (Cross-section properties, member data, internal forces, material properties ...). It is off course possible that more parameters are required.

Through List of parameters it is possible to create new parameters of the following types:

| Parameter type | Description | |
|---|---|--|
| Number | A numerical parameter | |
| | For example a length, safety factor, reduction factor | |
| Text | User defined text | |
| Check box | A checkbox which can either be activated or de-activated. | |
| | For example Advanced Calculation, Elastic check only, | |
| Combo box A list from which the user can choose the desired value | | |
| | For example a list of bolt diameters, a list of thicknesses, a list of weld methods | |

As will be illustrated later, for a check box the value 1 will be sent to Excel in case it is activated and 0 in case it is de-activated. For a combo-box the string of the selected line will be sent.

It is not required to define parameters. If the existing data of Scia Engineer is sufficient, no new parameters need to be defined.

| List of parameters | | | |
|--------------------|-------------|----|--------|
| | | | |
| Add item | Remove item | | |
| String database | | OK | Cancel |

For this example, two parameters will be defined:

| Parameter | Туре | Default value |
|-----------------------|-----------|---------------|
| Safety factor Gamma M | Number | 1,1 |
| Elastic Check | Check box | de-activated |

Through the button **String database** the text string database can be directly accessed. This allows a quick input of the strings required for the parameters.

For this example the following strings are added:

| Strings used in this example | |
|----------------------------------|--|
| Gamma M | |
| Safety Factor | |
| Elastic Check | |
| Perform elastic or plastic check | |

For each parameter a string is thus defined for the name and for the description.

External Application Checks for Excel – Example 1: Bending Check

| String database 🛛 🔀 | | | | |
|--|----|----------------------------------|--|--|
| Language | | English (United States) | | |
| | ID | Text | | |
| 1 | 1 | Input of Bending data | | |
| 2 | 2 | Bending data | | |
| 3 | 3 | Bend1 | | |
| 4 | 4 | Bending | | |
| 5 | 5 | Bending Check | | |
| 6 | 6 | Gamma M | | |
| 7 | 7 | Safety Factor | | |
| 8 | 8 | Elastic Check | | |
| 9 | 9 | Perform elastic or plastic check | | |
| • | 0 | | | |
| | | | | |
| Note: The string database which is used depends on the language default set for the workspace. | | | | |
| OK Cancel | | | | |

Through the button Add item the first parameter, the safety factor Gamma M, is added.

| List of parameters | | | | | | |
|----------------------|---|-------------|---|------------|--------|---|
| 1. Gamma M | Г | Туре | | Number | | - |
| | L | Name | | Gamma M | | • |
| | L | Description | | Safety Fac | tor | - |
| | L | Unit | | Not used | | - |
| | L | Value | | 1,1 | | |
| | | | | | | _ |
| | L | Use | | ⊠ | | _ |
| | L | Min | | 1 | | _ |
| | L | Max | | 10 | | _ |
| Add item Remove item | | | | | | |
| Add item Remove item | L | | | | | |
| String database | | | 0 | ĸ | Cancel | |

The Type field is set to 'Number'.

In the **Name** and **Description** fields the respective strings can be chosen from the string database, in this case 'Gamma M' and 'Safety Factor'.

The **Unit** field can be used to specify a unit for the defined parameter. In this case, for the safety factor, no unit is assigned since it concerns a dimensionless parameter.

The **Value** field allows setting the default value for the numerical parameter. In this example the default value for Gamma M is set to **1**,**1**.

Since it concerns a numerical parameter, the **Range** group allows specifying an input range. This is used to avoid incorrect input values. For this example, the input of the Gamma M value is limited between a minimum of **1** and a maximum of **10**. Only values between these limits are allowed.

In exactly the same way using the button **Add item** the second parameter, the elastic check checkbox, is added.

| List of parameters | | | | |
|--------------------------------|-------------|----------------------------|--|--|
| 1. Gamma M 2. Elastic Check | Туре | Check-box | | |
| | Name | Elastic Check 🗨 | | |
| | Description | Perform elastic or plast 💌 | | |
| | Check | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Add item Remove item | | | | |
| String database | 0 | K Cancel | | |

The Type field is set to 'Check-box'.

In the **Name** and **Description** fields the respective strings can be chosen from the string database, in this case 'Elastic Check' and 'Perform elastic or plastic check'.

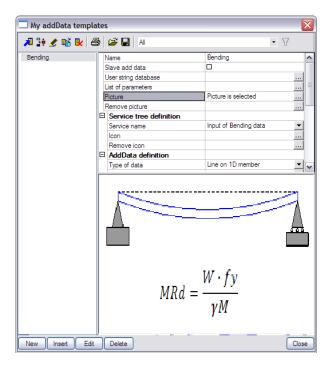
The **Check** field allows setting the default value for the check-box parameter. In this example the check-box will be de-activated by default which indicates a plastic check will be done.

Using the button **Remove item** a parameter can be removed again if required.

Step 2.4 Add a picture to the Additional Data

To clarify the use of the additional data and the defined parameters a picture can be added using the **Picture** button.

In this example the picture Excel_Example_1_Picture.bmp will be used.



Using the button **Remove picture** the picture can be removed again from the additional data if required.

It is not required to add a picture.

Step 2.5 Define Service Tree

In the next step the Service Tree is defined through the group Service tree definition.

| Ξ | Service tree definition | |
|---|-------------------------|-----------------------|
| | Service name | Input of Bending data |
| | Icon | |
| | Remove icon | |

As specified in *Step 2.2* the **Service name** is taken automatically from the text string database. If required a different string can be chosen from the database using the combo-box.

To clarify the Service name, an icon can be added using the **Icon** button. In this example the icon **Excel_Example_1_Icon.bmp** will be used.

An Icon has to have a bitmap format of 16 x 15 pixels

Using the button Remove icon the icon can be removed again from the additional data if required.

It is not required to add an icon.

Step 2.6 Define the Additional Data

Using the data from the previous steps, the additional data can now be defined in the group **AddData definition**.

| Ξ | AddData definition | |
|---|--------------------|-------------------|
| | Type of data | Line on 1D member |
| | Instance setup | |
| | Type name | Bending data 💌 |
| | Short name | Bend1 💌 |
| | Description | Bending 🔹 |

The **Type of data** field allows specifying the type of the additional data:

| Type of data | Description |
|--------------------|---|
| Line on 1D member | Line data is inputted along the length of the member like for example a line load. |
| | The check will be executed in each section of the member. |
| Point on 1D member | Point data is inputted on a specific position along the member like for example a point load. |
| | The check will be executed only in the specified section. |
| In node | Nodal data is inputted on a node like for example a connection. |
| | The check will be executed only in the node. |

In this example the bending check needs to be executed in each section of the member and thus 'Line on 1D member' is chosen.

The **Type name**, **Short name** and **Description** are taken automatically from the text string database as specified in *Step 2.2*. If required different strings can be chosen from the database using the comboboxes.

To get an overview of all the data entered in the previous steps the button Instance Setup is used.

| Bending data | | | |
|-------------------------------------|-------------------------------|-------------|-----------|
| | Name | | |
| | Parameters | | |
| | Gamma M | 1,1 | |
| | Elastic Check | | |
| | Drawings | | |
| 147 £ | Drawing style | Box on line | |
| $MRd = \frac{W \cdot fy}{\gamma M}$ | Property for drawing on begin | - | |
| $MRa = \frac{M}{M}$ | Property for drawing on end | - | |
| Y 14 | Colour | Others | |
| | Geometry | | |
| | Extent | full | |
| | Position x1 | 0,000 | |
| | Position x2 | 1,000 | |
| | Coord. definition | Rela | |
| | Origin | From start | - |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | OK Cancel |
| | | | OK . |

This dialog shows how the additional data will look like.

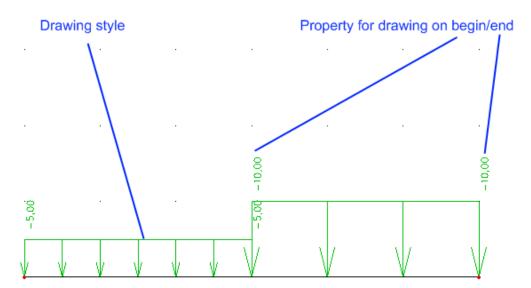
The **Parameters** group shows the parameters which have been defined in *Step 2.3*, in this case the safety factor 'Gamma M' and the check-box 'Elastic Check'.

The **Geometry** group is dependent on the selected Type of Data. For Line data the begin and end positions can be set as for a line load. For Point data a single position can be set as for a point load. For nodal data no position can be set since this data is not inputted on a member.

Since in this example the check needs to be executed in each section, no changes are made to the Geometry settings.

In addition to showing a preview of the eventual dialog, the **Instance Setup** also allows to define the Drawing style of the additional data. These options can be found in the **Drawings** group.

The options **Drawing style** and **Property for drawing on begin/end** are explained for a line load on the following picture:



For a line load the drawing style will be a set of arrows. The property for drawing on begin/end will be the value of the line load. As illustrated on the picture, this property serves as a scale for the drawing style: the line load with value -5 will be drawn smaller compared to the line load with value -10.

For this example the **Drawing style** is set to 'Box on Line'. The **Property for drawing on begin/end** is set to 'Gamma M'. The scale of the drawing style will thus be dependent on the value of the safety factor.

harrow Only numerical parameters can be used as property for drawing on begin/end.

It is not required to define a property for drawing on begin/end.

The **Colour** field allows choosing the colour of the additional data. The items in this list correspond to the dialog of **Setup > Colours/Lines**:

ь.

| creen Document Graphic output | | | | | | |
|--|----------------|-------|----------|----------------------------|---------|---|
| Current palette: White background | • | 🖻 日 | B | | | |
| Colours & lines Fonts Structural types | | s | | | | |
| Pen / brush type | Colour | Style | Width | Туре | Preview | [|
| Background | Š | | | | | |
| Member system line | 1 | | | - Pixels | | |
| Member surface | 💅 📃 | | | | | |
| Roof/facade panel with beams/Composite f | loor surface 🚿 | | | | | |
| Roof/facade panel | st 🕺 | | | | | |
| Member surface edges | / | | | - Pixels | | |
| Inactive member drawing | 1 | | | - Pixels | | |
| Cut-out regions drawing | 1 | | | - Pixels | | |
| Averaging strips | 1 | | | - Pixels | | |
| Nodes, rigid arms | / | | | Pixels | | |
| Supports, Hinges | 1 | | | - Pixels | | |
| Force load | 1 | | | - Pixels | | |
| Generated load | 1 | | | - Pixels | | |
| Displacement load | 1 | | | - Pixels | | |
| Wind load | / | | | - Pixels | | |
| Snow load | 1 | | | - Pixels | | |
| Thermal load | 1 | | | - Pixels | | |
| Predef. load | 1 | | | - Pixels | | |
| Self weight | 1 | | | - Pixels | | |
| Soil load | 1 | | | - Pixels | | |
| Water load | 1 | | | - Pixels | | ſ |

In this example, the colour is chosen as for a Predefined load

| Ξ | Drawings | |
|---|-------------------------------|---------------|
| | Drawing style | Box on line 💌 |
| | Property for drawing on begin | Gamma M 💌 |
| | Property for drawing on end | Gamma M 💌 |
| | Colour | Predef. load |

Step 2.7 Define the Check

In the group Check data the necessary data for the check itself are defined.

Check data

| 1 | Name of check | Bending Check 🔹 |
|---|------------------------|-----------------|
| | Setup for Brief output | |
| Ξ | Type of loads | |
| | Load cases | |
| | ULS combinations | |
| | SLS combinations | |
| | Result classes | |

As specified in *Step 2.2* the **Name of check** is taken automatically from the text string database. If required a different string can be chosen from the database using the combo-box.

The **Type of loads** group allows to specify which load types will be available for the check. Only the selected items will be available when executing the check.

Since in this example only one load case was defined, only the option 'Load cases' will be activated.

| Ξ | Type of loads | |
|---|------------------|-------------|
| | Load cases | \boxtimes |
| | ULS combinations | |
| | SLS combinations | |
| | Result classes | |

- At least one load type has to be activated.
- Important remark: In case more than one load type has been activated, the check will be executed SIMULTANEOUSLY for all load types together! This implies for example that the check is done for both a load case and a combination at the same time. This allows the use of special checks: in the Excel file it can be set that a certain check can be done for the load case while a different check is done for the combination. In general, it is recommended to use only one load type.

The final item for defining the check is the **Setup for Brief output**. In this dialog the output parameters have to be defined i.e. the unity check values which will be read from the external application. The dialog has the same layout as the dialog for the input parameters specified in *Step 2.3*

| List of parameters | |
|----------------------|-----------|
| | |
| Add item Remove item | |
| String database | OK Cancel |

For this example, one parameter will be defined:

| Parameter | Unit |
|----------------|------|
| Unity Check UC | - |

Through the button **String database** the text string database can be directly accessed. This allows a quick input of the strings required for the output parameters.

For this example the following string is added:

| UC String database | | | | |
|--------------------|-----|--|--|--|
| Langu | age | English (United States) | | |
| | ID | Text | | |
| 1 | 1 | Input of Bending data | | |
| 2 | 2 | Bending data | | |
| 3 | 3 | Bend1 | | |
| 4 | 4 | Bending | | |
| 5 | 5 | Bending Check | | |
| 6 | 6 | Gamma M | | |
| 7 | 7 | Safety Factor | | |
| 8 | 8 | Elastic Check | | |
| 9 | 9 | Perform elastic or plastic check | | |
| 10 | 11 | UC | | |
| * 0 | | | | |
| | | | | |
| | | ing database which is used depends on the language r the workspace. | | |
| | | OK Cancel | | |

Through the button Add item the unity check parameter is added.

| List of parameters | | $\overline{\mathbf{X}}$ |
|----------------------|---------------------------|-------------------------|
| 1. UC | Name | UC 🗨 |
| | Extreme for check Unit | max (Unity Check) |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Add item Remove item | | |
| String database | 0 | K Cancel |

In the Name field the respective string can be chosen from the string database, in this case 'UC'.

The **Extreme for check** is used to specify if the extreme is a minimum or a maximum. When it concerns a unity check, in most cases the extreme is a maximum.

In this example the extreme is set to 'max' since the maximal bending check will be limiting.

The **Unit** field can be used to specify a unit for the defined output parameter. In this case, since it concerns a unity check the default unit '- (Unity check)' is used.

Using the button Remove item a parameter can be removed again if required.

B At least one output parameter has to be defined, else it is not possible to execute a check.

Step 2.8 Specify the type of external link

In the **External link data** group the **Type of external link** allows to specify which external application will be used.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.9 Define the mapping with the external application

All preparation has now been done, what remains is the most important step of the process: defining the actual mapping between properties and parameters of Scia Engineer and the data fields (i.e. Excel cells) of the external application.

| Excel Link | | | | | × |
|--------------------------|---------------|------------------------|-----------|----------|--------|
| Data | File | \ | /orksheet | Cell | Array |
| | | | | | |
| | | | | | |
| | | | | | |
| Add Upd | late | | | | Remove |
| | | | | | |
| Source | | | | | |
| <u>O</u> bject | < | IS | | <u> </u> | |
| <u>P</u> roperty | Elastic Check | | | • | |
| Target | | | | | |
| <u>E</u> xcel file | | | | | Browse |
| <u>W</u> orksheet | | ▼ <u>C</u> ell address | | • | |
| Arrays <u>d</u> irection | Horizontal | Current value | | | Show |
| | | | | [| |
| | | | | OK | Cancel |

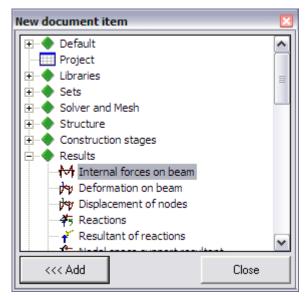
Through the button Edit external file mapping the mapping dialog is opened.

In the **Source** group, the **Object** field shows a list of all available objects in Scia Engineer as well as the parameters which have been defined in the previous steps. These objects can thus be classified into three different types:

| Object | Description |
|--------------------------|---|
| <<< My input parameters | This object contains the input parameters specified in step 2.3. |
| >>> My output parameters | This object contains the output parameters specified in step 2.7. |
| All others | These objects contain the existing Scia Engineer properties |

In the **Property** field the actual property can be selected. For ease of reference, this list of objects and properties is taken the same as the 'Available Items' found in the table composer when adding properties to a document table.

For example, in the document, the table for Internal forces on a member can be found under Results:



When viewing the contents of this table (otx file) in the table composer, the following screen is shown:

| Table Composer | | | | D > |
|--|---------------------------------------|---|--------|-------------------|
| C:\Documents and Settings\PeterVT\ESAD9 | \user\DocumentTemplates\EP_Results.EP | _ResMember [default].otx | | |
| Standard Advanced - Table Advanced Contents of table Items in Table Case dx N Vy Vz Mx My Mz | | Table Iemplate name Iable type Vertical table (co Eit Table to Page V Column(s) / Row(s) | | |
| <u>B</u> emove | My Mz | Caption Alignment No header Do not aggregate | Member | v ables |

The right side table, 'Available items', shows all Scia Engineer properties related to internal forces on a member. It is this same table which is shown in the **Property** field of the mapping dialog in case **Object** is set to 'Internal forces on member':

| Excel Link | | | | × |
|--------------------|---------------------------|-----------|------|--------|
| Data | File | Worksheet | Cell | Array |
| | | | | |
| | | | | |
| | | | | |
| Add Upda | ate | | | Remove |
| Source | | | | |
| <u>O</u> bject | Internal forces on member | | • | |
| <u>P</u> roperty | Case | | • | |
| - Target | Case css | 4 | | |
| <u>E</u> xcel file | dx Member Mu | | | Browse |
| | Mx My Mz | | | |
| | N | | | Show |
| | Type Name Vy Vz | | | |
| Ľ | ¥2 | | ОК | Cancel |
| | | | | Cancer |

The reference with the document properties is a very helpful tool: when looking for a specific Scia Engineer property, go through the document tables. These tables will indicate where the property can be found.

The **Target** group is used to specify to which Excel cell the property should be mapped. The group contains the following items:

| Item in Target group | Description | | |
|----------------------|---|--|--|
| Excel file | Using the Browse button an Excel file can be selected. This field will show the path and filename of the Excel file. | | |
| Worksheet | In this field a worksheet can be set. The list of worksheets is automatically read from the specified Excel file. | | |
| Cell address | In this field the cell address can be inputted in two ways: | | |
| | a) Manual input: the cell address can be typed i.e. A1 or B7 | | |
| | b) Named cells: In case Named cells have been used in the Excel file, these names are shown here automatically. | | |
| Current value | When a cell address has been inputted, this field shows the current content of that cell. | | |
| | Using the Show button the Excel file can be directly opened to show the location of this cell. | | |
| Arrays direction | The array direction is used to specify in which direction an arrayed property should be mapped. | | |
| | For example, when mapping the value of a point load on a member, this value is sent into one cell. In case there are more point loads on the member, this array of values can be mapped horizontally or vertically from the specified cell. | | |

In this example, the Excel file has the following layout:

| | А | В | С |
|----|-------------------------|-----------|-------|
| 1 | Bending Check | | |
| 2 | | | |
| 3 | Data from SCIA Engineer | | |
| 4 | | | |
| 5 | Moment My | 100000 | Nm |
| 6 | | | |
| 7 | Section modulus Wel | 0,0015 | m^3 |
| 8 | | | |
| 9 | Section modulus Wpl | 0,002 | m^3 |
| 10 | | | |
| 11 | Yield Strength fy | 23500000 | N/m^2 |
| 12 | | | |
| 13 | Safety factor Gamma M | 1,1 | - |
| 14 | | | |
| 15 | Elastic Check ? | 0 | |
| 16 | | | |
| 17 | Bending Resistance | | |
| 18 | | | |
| 19 | MRd | 427272,73 | Nm |
| 20 | | | |
| 21 | Unity Check | | |
| 22 | | | |
| 23 | UC | 0,23 | - |

The following table shows which properties should be mapped to which cells:

| Object | Property | Cell Address |
|---------------------------|-----------------------------------|--------------|
| Internal forces on member | My | B5 |
| Cross-Sections | Wely (Property) | B7 |
| Cross-Sections | Wply (Property) | B9 |
| Steel EC3 | Yield strength (code independent) | B11 |
| <<< My input parameters | Gamma M | B13 |
| <<< My input parameters | Elastic Check | B15 |
| >>> My output parameters | UC | B23 |

The mapping of the first property, the bending moment My is thus done as follows:

The **Object** field is set to 'Internal forces on member'. In the **Property** field 'My' can then be chosen.

Using the **Browse** button, the file **Excel_Example_1.xls** is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Sheet1'.

The **Arrays direction** is set to 'Horizontal'. In this example no array properties are mapped so choosing 'Horizontal' or 'Vertical' would make no difference.

| Excel Link | | | | × |
|--------------------------|-------------------------------|--------------|------|--------|
| Data | File | Worksheet | Cell | Array |
| | | | | |
| | | | | |
| Add Update | | | | Remove |
| Source | | | | |
| <u>O</u> bject Internal | forces on member | | • | |
| Property My | | | • | |
| Target | | | | |
| | Excel\Excel_Example_1\Excel_E | xample_1.xls | | Browse |
| Worksheet Sheet1 | ✓ <u>C</u> ell addre | ss B5 | • | |
| Arrays direction Horizon | al 💽 Current va | lue 100000 | | Show |
| L | | | ОК | Cancel |

Finally, in the field **Cell address** the cell 'B5' is typed. Automatically the **Current value** field will show the current content of the cell, in this case 100000. Using the **Show** button, the Excel file is opened and the specified cell is highlighted. This provides an easy way to check if the correct cell has been set.

| | А | В | С |
|---|-------------------------|--------|----|
| 1 | Bending Check | | |
| 2 | | | |
| 3 | Data from SCIA Engineer | | |
| 4 | | | |
| 5 | Moment My | 100000 | Nm |
| 6 | | | |

Important note: When clicking on the Show button a warning is displayed. The Excel window which is opened may NOT be closed. It should be hidden using the Hide button in the Excel link dialog.
In case the user by accident closes the Excel window instead of using the Hide button, the link with Excel will be lost! In this case, Scia Engineer has to be restarted in order to restore the link!

When all input has been done, this mapping is added to the table using the **Add** button.

| xcel Link | | | | | X |
|------------------------------|--------------------|------------------------|--------------|------|------------|
| Data | File | | Worksheet | Cell | Array |
| Internal forces on membe | r.My D:\ESA_ | Excel\Excel_Example_1 | \ Sheet1 | B5 | Horizontal |
| | | | | | |
| | | | | | |
| | | | | | |
| Add Upda | ate | | | | Remove |
| Source | | | | | |
| <u>O</u> bject | Internal forces on | member | | | • |
| Property | Му | | | | • |
| - . | | | | | |
| Target <u>E</u> xcel file | D:\ESA Excel\Ex | cel_Example_1\Excel_Ex | kample 1.xls | | Browse |
| | Sheet1 | | | | 7 |
| <u>W</u> orksheet | | <u>C</u> ell addre: | 100000 | | - |
| Arrays <u>d</u> irection | Horizontal | _ Current va | lue [100000 | | Show |
| | | | | | 1 |
| | | | | 0K | Cancel |

To remove a mapped parameter from the table, select the desired line in the table and press the button **Remove**.

When selecting a line in the table, the properties are shown at the lower part of the dialog. This way, the settings for the mapping can easily be modified. Using the **Update** button the selected line is updated with the modifications.

In the same way as described above, the other parameters can now be mapped to obtain the following mapping:

| Excel Link | | | | |
|----------------------------------|------------------------------------|--------------|-------|------------|
| | | | | |
| Data | File | Worksheet | Cell | Array |
| Internal forces on member.My | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B5 | Horizontal |
| Cross-Sections.Wely (Property) | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B7 | Horizontal |
| Cross-Sections.Wply (Property) | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B9 | Horizontal |
| Steel EC3.Yield strength (Code i | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B11 | Horizontal |
| <<< My input parameters.Gamm | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B13 | Horizontal |
| <<< My input parameters.Elastic | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B15 | Horizontal |
| >>> My output parameters.UC | D:\ESA_Excel\Excel_Example_1\ | Sheet1 | B23 | Horizontal |
| Add Update | | | | Remove |
| Source | | | | |
| <u>O</u> bject >>> My | output parameters | | • | |
| Property UC | | | • | |
| - Target | | | | |
| Excel file D:\ESA | _Excel\Excel_Example_1\Excel_Examp | ole_1.xls | | Browse |
| Worksheet Sheet1 | ✓ <u>C</u> ell address | B23 | • | |
| Arrays direction Horizont | al 💽 Current value | 0,2340425531 | 91489 | Show |
| | | | | |
| | | | ок | Cancel |
| | | | | Cancer |

During the check the Scia Engineer and input parameters are sent to Excel while the output parameters are read from Excel. Since in this example the additional data is of type 'Line on 1D member', this procedure will be repeated for each section along the member.

| The export of the Scia Engineer and input parameters follows the same logic as XML export. This implies that these properties are sent to Excel in basic SI-units! If required, a unit conversion should be accounted for in the Excel file. |
|--|
| unit conversion should be accounted for in the Excel file. |

At least one output parameter has to be mapped since else the check cannot be executed.

Step 2.10 Define the Detailed output

In *Step 2.7* the parameters for the Brief output have been defined. These parameters will be used for the check. In addition, a Detailed output can also be specified to show an in-depth overview of the check.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

By clicking on Setup for Detailed output, the Detailed output dialog is opened.

| E | xternal links for document | t | | | | |
|---|----------------------------|------------|-------------|----------|-----------------|------------|
| | Caption | Excel file | Worksh L | Jpper-l | Bottom | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | Add Update | | | | Ľ | Remove |
| | - Item | Caption: | | | | - |
| | | , | Source file | | | Range |
| | Excel file: | | | Top | ·left cell ▼ | |
| | Worksheet: | | | | | right cell |
| | | | | | | • |
| | String database | | | <u> </u> | ж | Cancel |

A Detailed output concerns an exact snapshot from the Excel file after the mapping has been sent. This way, the full details, check results, intermediate values... from Excel can be shown within Scia Engineer.

The unity checks shown on screen will always be the output parameters specified for the Brief output. The Detailed output concerns only a snapshot of the Excel file, not an actual unity check value.

In the same way as explained in Step 2.9 the Excel file and Worksheet can be specified.

In the **Range** group, the range can be defined which defines the area for the snapshot. An Excel range is defined by a **Top – left cell** and a **Bottom – right cell**. As specified in *Step 2.9* here also Named cells can be used in case they have been defined in the Excel file.

The **Caption** field allows specifying the header of the table. This field is directly linked to the text string database. Through the button **String database** the text string database can be directly accessed in case a new text string is needed for the caption.

In this example, the range will be defined from the cell A3 to the cell C23.

| | А | В | С |
|----|-------------------------|--------------|-------|
| 1 | Bending Check | | |
| 2 | | | |
| 3 | Data from SCIA Engineer | Top-left | |
| 4 | | | |
| 5 | Moment My | 100000 | Nm |
| 6 | | | |
| 7 | Section modulus Wel | 0,0015 | m^3 |
| 8 | | | |
| 9 | Section modulus Wpl | 0,002 | m^3 |
| 10 | | | |
| 11 | Yield Strength fy | 235000000 | N/m^2 |
| 12 | | \mathbf{i} | |
| 13 | Safety factor Gamma M | 1,1 | - |
| 14 | | \backslash | |
| 15 | Elastic Check ? | 0 | |
| 16 | | \backslash | |
| 17 | Bending Resistance | | |
| 18 | | | |
| 19 | MRd | 427272,73 | Nm |
| 20 | | | |
| 21 | Unity Check | Detterreit | |
| 22 | | Bottom-rig | |
| 23 | UC | 0,23 | - |

In the Caption field the string 'Bending Check' is chosen.

In the Excel file field the file Excel_Example_1.xls is searched using the browse button.

The Worksheet field is set to 'Sheet1'.

In the Range group the Top - left cell is set as 'A3' and the Bottom - right cell as 'C23'.

When all input has been done, the data is added to the table using the Add button.

| External links for | document | | | | X |
|-------------------------------|---------------------|------------------|-----------|-----------------|---------------------|
| Caption | Excel file | | Worksheet | Upper-left cell | Bottom-right cell |
| Bending Check | D:\ESA_Excel\Ex | el_Example_1 | Sheet1 | A3 | C23 |
| Add | Update | | | | Remove |
| | | Caption: Bendin | g Check | | • |
| Excel file: D:\ESA_Excel\E | xcel_Example_1\Exce | el_Example_1.xls | Source | Top - le | Range ft cell |
| Worksheet: Sheet1 | • | | | | Bottom - right cell |
| String database | | | | OK | Cancel |

To remove a Detailed output range from the table, select the desired line in the table and press the button **Remove**.

When selecting a line in the table, the properties are shown at the lower part of the dialog. This way, the settings for the Detailed output can easily be modified. Using the **Update** button the selected line is updated with the modifications.

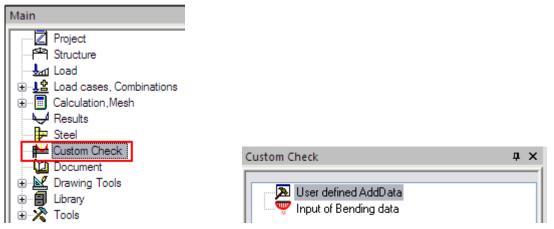
| Ð | More than one output range can be inputted with different captions, for example Bending |
|---|---|
| | Check, Shear Check, |

It is not required to define a Detailed output. When no range has been defined, the Detailed output will be empty.

With this final step, the User Defined Additional Data has been fully inputted and the **User Defined** Additional Data Library can be closed.

Step 3: Input the User Defined Additional Data on members/nodes

After closing the **User Defined Additional Data** Library a new service will be shown in the Scia Engineer tree: **Custom Check**.



Currently, this service holds two objects: **User defined AddData** provides a direct link to the **User Defined Additional Data** Library. This way, the library can be easily accessed in case modifications are needed.

Second, the additional data which was defined in *Step 2*, **Input of Bending data** is shown. As can be seen, the icon and Service name defined in *Step 2.5* are shown.

This user data can now be inputted on the member. When double clicking on **Input of Bending data** the dialog with the properties of the data is displayed:

| Bending data | | | | ٢. |
|-------------------------------------|---|--|-----------|----|
| | Name Parameters Gamma M Elastic Check Geometry | Bend1 | | |
| $MRd = \frac{W \cdot fy}{\gamma M}$ | Extent Position x1 Position x2 Coord. definition Origin | full 0,000 1,000 Rela From start | • | 4. |
| | | | | |
| | | [| OK Cancel | l |

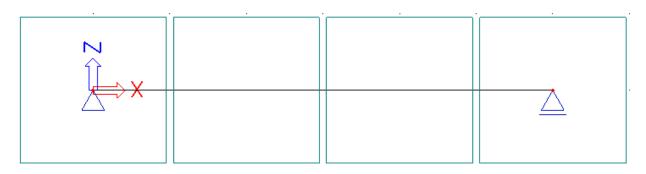
The title of the dialog shows the Type name specified in Step 2.6.

At the left side, the picture specified in *Step 2.4* is shown. The Name field shows the short name as defined in *Step 2.6*.

The **Parameters** group holds the user defined parameters of *Step 2.3* with their default values. In this case the factor 'Gamma M' and the check-box 'Elastic Check'.

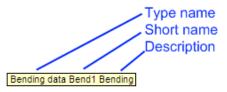
The **Geometry** group shows the default geometry options related to line additional data as specified in *Step 2.6*.

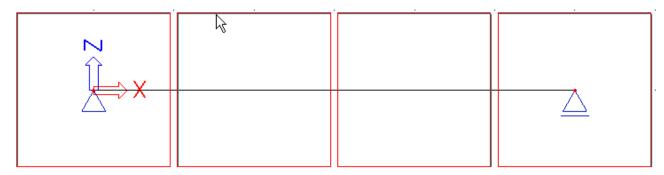
The default values are confirmed with [OK] and the data is inputted on member B1.



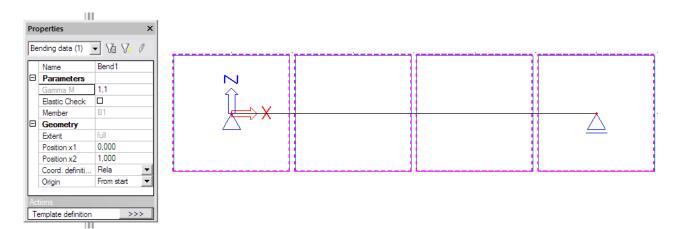
The colour of the additional data corresponds to the colour of a predefined load as specified in *Step 2.6*.

When moving the mouse pointer over the data, the tooltip shows the Type name, Short name and Description as specified in *Steps 2.2* and *2.6*.





When selecting the additional data, the properties are shown in the property window:

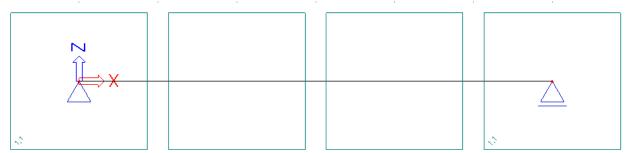


The action button 'Template definition' can be used to get a direct access to the definition of the additional data. This allows for quick modifications without the necessity to access the Library.

The Scia Engineer View parameter setting now holds an extra tab My Add Data.

| Vie | w parameters setting | |
|-------------------------|---|-------------------|
| | Check / Uncheck group | Lock position 🛛 🗌 |
| | 역 Structure 🖭 Labels 👗 M 2 Modelling/Drawing 🚺 MyAdd D | |
| $\overline{\mathbb{M}}$ | Check / Uncheck all | |
| | My Add Data | |
| | Display | |
| | My Add Data labels | |
| | Display | |
| | Name | |
| | Value | |
| | | |
| | | |
| | ОК | Cancel |

In the same way as for other additional data, the labels can be displayed to show the Name and the Value of the additional data. After activating these options the following is displayed:



Bend1

The label shows the short name of the additional data and at both ends the value of the safety factor Gamma M is displayed since this factor was set as 'Property for drawing on begin/end' as specified in *Step 2.6*.

The data has now been inputted and in the next step the check can be executed.

The user defined additional data has to be inputted on members/nodes to indicate on which members/nodes the custom check should be (or can be) executed.

Step 4: Execute the Custom Check

In *Step 2* the additional data has been defined including the definition of the check, the mapping to Excel... In *Step 3* the additional data has been inputted. What is left is the execution of the check.

| Since in this | example th | e bending m | noment will | be sent to | o Excel, it i | is required to | launch a | linear |
|---------------|------------|-------------|-------------|------------|---------------|----------------|----------|--------|
| analysis. | | | | | | | | |

| FE analysis | | |
|-------------|---|------------|
| | Single analysis Batch analysis | |
| | Linear calculation | V |
| | C Nonlinear calculation | Г |
| 100 | 🔿 Modal analysis | Г |
| | C Linear stability | |
| | C Concrete - Code Dependent Deflections | |
| | C Influence lines and surfaces | |
| | C Construction stage analysis | |
| | C Nonlinear stage analysis | |
| | C Nonlinear stability | |
| | Test of input data | |
| | Number of load cases: 1 | _ |
| | , | |
| | Solver setup | Mesh setup |
| al a | OK | Cancel |

When user defined additional data was inputted and the analysis has been executed, the **Custom Check** service will show a new item: **Custom Check**.

| Custom Check | д | × |
|---|---|---|
| User defined AddData Input of Bending data Custom Check | | |

The property window of this check has the same layout as the property window of other standard checks in Scia Engineer (Steel, Timber, Aluminium, Concrete ...)

External Application Checks for Excel – Example 1: Bending Check

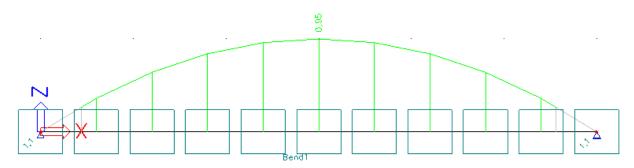
| Properties | × |
|------------------|-------------------|
| Custom check (1) | • Va V/ / |
| Name | Custom check |
| Selection | Al < |
| Load cases | LC1 - Loading 📃 💌 |
| Filter | No 💌 |
| Values | UC 🔹 |
| Extreme | Global 🔹 |
| Output | Brief 🔹 |
| Drawing setup | |
| Section | All 💌 |
| Actions | |
| Refresh | >>> |
| Single Check | |
| Preview | >>> |

Since many types of User Defined Additional Data can be defined, the **Selection** field is now depended on a selection of additional data (and not on a selection of members/nodes).

In this example the field **Load cases** is shown since, in *Step 2.7*, only the load type Load cases has been activated.

The **Values** field contains the output parameters specified for the Brief output in *Step 2.7*. In this example the parameter 'UC' was defined and thus this parameter is shown.

The **Refresh** action button is pressed to execute the check. The following check result is shown on screen:



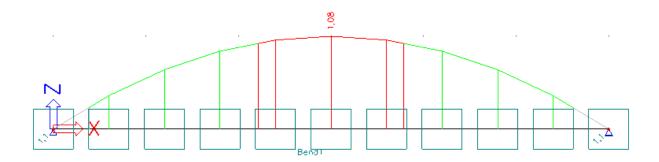
As can be seen, the shape of the unity is as expected, it follows the bending moment diagram My.

Note: The drawing style of the additional data can be scaled using the default scale settings of Scia Engineer.

Next the additional data is selected and the 'Elastic Check' option is activated.

| Pro | Properties X | | | | |
|-----|--------------------|--------------|--|--|--|
| Be | nding data (1) | - Vi V/ / | | | |
| | Name | Bend1 | | | |
| | Parameters | | | | |
| | Gamma M | 1,1 | | | |
| | Elastic Check | | | | |
| | Member | B1 | | | |
| | Geometry | | | | |
| | Extent | full | | | |
| | Position x1 | 0,000 | | | |
| | Position x2 | 1,000 | | | |
| | Coord. definition | Rela 💌 | | | |
| | Origin | From start 🔹 | | | |
| | | | | | |
| | | | | | |
| Act | tions | | | | |
| Te | emplate definition | | | | |

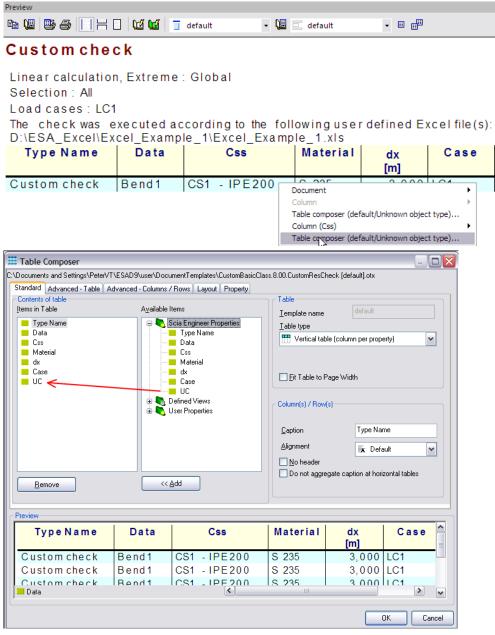
After pressing the **Refresh** action button again, the check results are updated:



The **Output** field is set to 'Brief'. Using the **Preview** action button the preview for the Brief output can be shown.

| Preview | | | | | |
|---|-------------|------------------|-------------|------------|--------------|
| ₽ 🛄 📑 🏉 🔲 H (| - M M - | default 👻 🕻 | 📱 📃 default | • II III | |
| Customchee | c k | | | | |
| Linear calculation Selection : All Load cases : LC1 The check was e D:\ESA_Excel\Ex | executed ac | cording to the f | <u> </u> | defined E: | xcel file(s) |
| Type Name | Data | Css | Material | dx [m] | Case |
| Custom check | Bend1 | CS1 - IPE200 | S 235 | 3,000 | LC1 |
| | | | | | |

As can be seen, the unity check value is not listed in the output table. This is because this new, user defined output parameter is not yet in the default otx for the Custom Check. Using default Table composer manipulation this value can be easily added to the output:



Now the UC value is correctly displayed:

| Preview | | | | | | |
|---------------|------------|--|-----------|------------|--------------|-----------|
| n 🖳 📑 🎒 🗌 H (| - M M = | default 👻 🚇 | 📃 default | • 🗉 📰 | | |
| Custom chee | ck | | | | | |
| | xecuted ac | :Global cording to the foll le_1\Excel_Examp | | defined Ex | cel file(s): | |
| Type Name | Data | Css | Material | dx [m] | Case | UC [-] |
| Custom check | Bend1 | CS1 - IPE200 | S 235 | 3,000 | LC1 | 1,08 |

Next the Detailed output is examined. The **Output** field is set to 'Detailed' and the **Refresh** action button is pressed.

Here also, the first time the Detailed output is shown, this new, user defined output is not yet added to the default otx for the custom check.



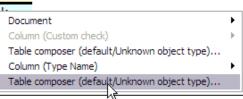
Again using default Table composer manipulation this value can be easily added to the output:

Customcheck

```
Linear calculation, Extreme : Global
Selection : All
Load cases : LC1
The check was executed according to the following user defined Excel file(s):
D:\ESA_Excel\Excel_Example_1\Excel_Example_1.xls
```

TypeName

Custom cher



| III Table Composer | | | |
|---|---|---|----|
| C:\Documents and Settings\PeterVT\ESADS | 3\user\DocumentTemplates\CustomBasicCl | ass.8.00.ResultPresentat [default].otx | |
| Standard Advanced - Table Advanced | J - Columns / Rows Layout Property | | |
| Contents of table | A⊻ailable Items | Table Template name default | ור |
| Type Name | 📮 🍋 Scia Engineer Properties | I able type | |
| Bending Check | Type Name Bending Check Defined Views Server Properties | Vertical table (column per property) | |
| | | Eit Table to Page Width | |
| | | Column(s) / Row(s) | |
| | | Caption Bending Check | |
| | | Alignment 🗟 Default | |
| | | No header | |
| <u>R</u> emove | << <u>A</u> dd | Do not aggregate caption at horizontal tables | |
| | | | |

As can be seen, the name of the item in the table composer corresponds to the Caption name specified in *Step 2.10*.

In the Table composer, the size of the Bending Check item is also set to 100mm by 100mm

| 🗱 Table Composer | | | | | | | _ 🗆 🗙 |
|---|--|----------------------|--------------|--------------------------|---------------------|---|-------|
| C:\Documents and Settings\PeterVT\ESAD9\user\Do | ocumentTe | mplates\(| CustomBasicC | lass.8.00.ResultPresen | tat [default].otx | | |
| Standard Advanced - Table Advanced - Column | ns / Rows | Layout | Property | | | | |
| Items in Table | – Column (| width (mn | J | ←Line(s)/Row(s) style | | | |
| Type Name Bending Check | | Default | 4 | Use <u>t</u> able styles | ~ | ✓ | |
| | <u>M</u> inimal | 15 | | <u>H</u> eader style | Table header | ~ | |
| | <u>D</u> elta | 5 | | <u>Content style</u> | Table line | ~ | |
| | ∼ <u>P</u> icture S <u>W</u> idth <u>H</u> eight | ize (mm) 10 10 | 0 | Other | not make ⊻alid line | | |
| | | | | | | | |

The Detailed output now shows the snapshot of the Excel file as defined in Step 2.10.

| Preview 🚇 🚇 🕌 📘 🕂 [| 🗌 🕼 🖬 🗍 default 💿 🖉 🔜 defau | uit 🗸 🖩 📳 |
|--|--|--------------------|
| Customcheo | : k | |
| Selection : All Load cases : LC1 The check was e: D:\ESA_Excel\Ex | , Extreme : Global xecuted according to the following cel_Example_1\Excel_Example_1. | xls |
| TypeName Customcheck | | g Check |
| oustom check | Data from SCIA Engineer | |
| | Moment My | 45000 Nm |
| | Section modulus Wel | 1,94E-04 m^3 |
| | Section modulus Wpl | 2,21E-04 m^3 |
| | Yield Strength fy | 235000000 2,35E+08 |
| | Safety factor Gamma M | 1,1 - |
| | Elastic Check ? | 1 |
| | Bending Resistance | |
| | MRd | 41509,55 Nm |
| | <u>Unity Check</u> | |
| | UC | 1,08 - |

As can be seen, layout and colours from Excel are shown also in the Scia Engineer output.

The action button **Single Check** can be used to directly open the Excel file after the mapping data has been sent. This provides an easy way to check if all data has been sent correctly to Excel.

When clicking the **Single Check** action button, the following message is given in the command line:

| Comma | and line |
|--------|---|
| ▶ . | <u> </u> |
| Select | : User defined Additional Data for Single Check > |

As specified previously, the Custom Check is executed on user defined additional data and therefore this data has to be selected instead of members or nodes.

After selecting the additional data, the following dialog is shown:

| Single check | |
|--|---|
| - Single check info | |
| The single check will be executed according to the following user defined Excel file(s): D:\ESA_Excel\Excel_Example_1\Excel_Example_1.xls | |
| | |
| | |
| | |
| Warning: Please do not close Excel window! For closing use button 'Close Excel' in the Single check dialog of Scia Engineer. | : |
| Close Excel | |

Important note: The Single Check dialog shows a clear warning. The Excel window which is opened may NOT be closed. It should be hidden using the Close Excel button in the Single Check dialog.

After confirming the dialog with [OK] Excel is opened and the Excel file is shown after all data have been sent to it:

| | А | В | С | D |
|----|-------------------------|----------|----------|---|
| 1 | Bending Check | | | |
| 2 | | | | |
| 3 | Data from SCIA Engineer | | | |
| 4 | | | | |
| 5 | Moment My | 45000 | Nm | |
| 6 | | | | |
| 7 | Section modulus Wel | 1,94E-04 | m^3 | |
| 8 | | | | |
| 9 | Section modulus Wpl | 2,21E-04 | m^3 | |
| 10 | | | | |
| 11 | Yield Strength fy | 23500000 | 2,35E+08 | |
| 12 | | | | |
| 13 | Safety factor Gamma M | 1,1 | - | |
| 14 | | | | |
| 15 | Elastic Check ? | 1 | | |
| 16 | | | | |
| 17 | Bending Resistance | | | |
| 18 | | | | |
| 19 | MRd | 41509,55 | Nm | |
| 20 | | | | |
| 21 | Unity Check | | | |
| 22 | | | | |
| 23 | UC | 1.08 | - | |

The check has now been executed and reviewed. To end this step, the document of Scia Engineer is examined.

In the document, the inputted User defined additional data can be inserted into the document in the same way as any other default additional data.

In the **New document item** dialog, the **Special** chapter holds the tables for all user defined additional data.

| New document item 🛛 🔯 | | | | | | | |
|---------------------------|-------|--|--|--|--|--|--|
| 🕀 🔶 Default | | | | | | | |
| Project | | | | | | | |
| 🗄 🔶 Libraries | | | | | | | |
| 🗄 🔶 Sets | | | | | | | |
| 🗄 🔶 Solver and Mesh | | | | | | | |
| 🗄 🔶 Structure | | | | | | | |
| 🗄 🔶 Load | | | | | | | |
| 🗄 🔶 Construction stages | | | | | | | |
| 🗄 🔶 Results | | | | | | | |
| 🗄 🔶 Steel | | | | | | | |
| 🗎 🗄 🔶 Aluminium | | | | | | | |
| 🗄 🔶 Pipeline | | | | | | | |
| 🛛 🗄 🗄 🔶 Timber | | | | | | | |
| 🗄 🔶 Concrete | | | | | | | |
| 🗄 🔶 Steel concrete bridge | | | | | | | |
| 🗄 🔶 Composite Beam | | | | | | | |
| 🗄 🔶 Mobile loads | | | | | | | |
| 🗄 🔶 Influence lines | | | | | | | |
| 🕂 🔶 Picture | | | | | | | |
| 🖻 🔶 Special | | | | | | | |
| Documents | | | | | | | |
| Bending data | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| <<< Add | Close | | | | | | |

In this example Bending data was defined and thus this data can be added into the document.

| | Project | Excel_Example_1 |
|------|-------------|-----------------------------------|
| | Part | - |
| Coio | Description | Example 1 for Tutorial Excel Link |
| | Author | PVT |
| | | |

1. Bending data

| Type Name | Name | Member | Extent | Pos x | Pos x | Coor | Orig | Gamma M | Elastic Check |
|-----------------|-------|--------|--------|-------|-------|------|---------------|---------|---------------|
| Bending data | Bend1 | B1 | full | 0,000 | 1,000 | Rela | From start | 1,1 | \checkmark |

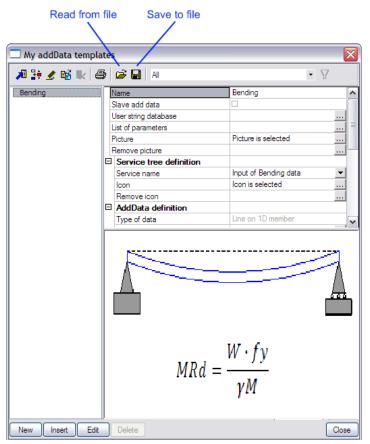
The table shows the different properties of the additional data, including the user defined parameters 'Gamma M' and 'Elastic Check'. In the same way as for any other default additional data of Scia Engineer this table can be edited and modified through the Table Composer.

Step 5: Save the User Defined Additional Data into a database for future use

In the previous steps it has been explained how to define additional data, how to perform the input and execute the check. In this final step it is specified how this definition of additional data can be saved for easy use in other projects.

The User defined additional data can be saved into a database using the standard Scia Engineer functionality of libraries.

Through Tools > User defined AddData the User Defined Additional Data Library can be opened.



Using the button Save to file the desired additional data's can be added into a database file (db4 file).

| Save As | | | | | | ? 🗙 |
|------------------------|---|--------------------------------|-----|-----|----------|--------|
| Save <u>i</u> n: | 🚱 Desktop | | ~ | 6 🕸 | P | |
| My Recent Documents | My Documents My Computer My Network Pla | | | | | |
| Desktop | | | | | | |
| My Documents | | | | | | |
| My Computer | | | | | | |
| | File <u>n</u> ame: | EP_MyAddDataDefi | | | ~ | Save |
| My Network | Save as type: | Application database file (*.d | b4) | | v | Cancel |

A new db4 filename can be inputted or an existing file can be specified.

| Write to database | × |
|-----------------------------------|---------------|
| Project database | User database |
| Bending | Bending |
| Write to database >> Write all >> | Delete |

Using **Write to database >>** the selected additional data is added into the database. In this example the 'Bending data' is added to the database file.

In any other project, after activating the **External Application Checks** functionality and opening the **User Defined Additional Data** Library the additional data can be read directly from the database using the button **Read from file**.

This functionality works in the same way as for Materials, Cross-sections, Load cases, ...

In this way, all data (definition of the additional data, definition of the check, icon, picture, mapping, ...) is already defined. Step 2 thus becomes very easy and one can continue directly with Step 3, the input of the additional data.

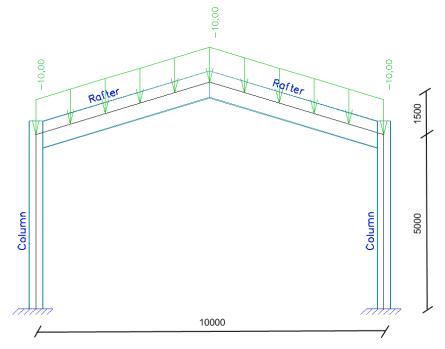
When using additional data from a database in another project, make sure that the paths to the Excel files are still valid! In case an Excel file cannot be found, the check will not be executed.

Example 2: Flange Induced Buckling

In this second example, the use of a combo-box is illustrated. In addition, the use of Named cells and output parameters with units are explained.

As a practical case, Flange Induced Buckling as specified in article 8 of EN 1993-1-5 is used.

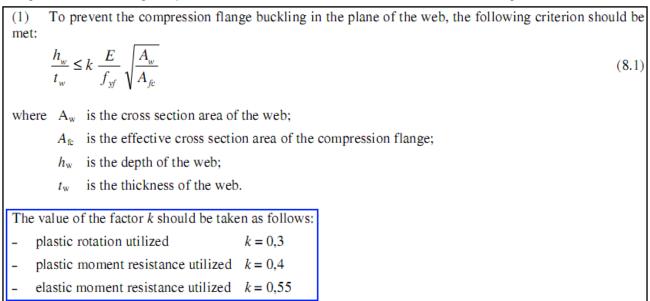
In this example, a frame with rigid supports is modelled. The frame has a column distance of **10m**, a column height of **5m** and a column top to ridge height of **1,5m**. All members are manufactured in **S355** according to **EC-EN**.



The columns have a sheet welded lwn cross section with parameters (400, 12, 300, 12, 200, 16). The rafters have a sheet welded lwn cross section with parameters (750, 12, 500, 12, 200, 16).

One load case is defined, a uniform line load of 10 kN/m on the rafters.

Flange Induced Buckling as specified in article 8 of EN 1993-1-5 concerns the following:



Cross-section and material properties will be sent to Excel. In addition, the factor k will be determined according to a combo-box setting. The combo-box contents are those shown in the blue rectangle of the previous picture.

The check is done using the corresponding Excel file "Excel_Example_2.xls"

| | А | В | С |
|----|---------------------------|---------------------------|-------|
| 1 | Top flange width | 0,3 | m |
| 2 | | | |
| 3 | Top flange thickness | 0,012 | m |
| 4 | | | |
| 5 | Bottom flange width | 0,2 | m |
| 6 | | | |
| 7 | Bottom flange thickness | 0,016 | m |
| 8 | | | |
| 9 | Cross-section height | 0,4 | m |
| 10 | | | |
| 11 | Web thickness | 0,012 | m |
| 12 | | | |
| 13 | | | |
| 14 | Yield Strength | 35500000 | N/m^2 |
| 15 | | | |
| 16 | E-modulus | 2,1E+11 | N/m^2 |
| 17 | | | |
| 18 | | | |
| 19 | Determination of factor k | Elastic moment resistance | |
| 20 | | | |
| 21 | Moment My | 50000 | Nm |

The Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:

The sheet 'Check' shows the intermediate results and the unity check:

| | А | В | С | D | E | F |
|----|-----------------------------|--------|--------|---|--------|-----|
| 1 | web height hw | 372 | mm | | | |
| 2 | | | | | | |
| 3 | web thickness tw | 12 | mm | | | |
| 4 | | | | | | |
| 5 | Web area Aw | 4464 | mm^2 | | | |
| 6 | | | | | | |
| 7 | Compression flange | Тор | | | | |
| 8 | | | | | | |
| 9 | Compression flange area Afc | 3600 | mm^2 | | 0,0036 | m^2 |
| 10 | | | | | | |
| 11 | Factor k | 0,55 | | | | |
| 12 | | | | | | |
| 13 | Yield Strength | 355 | N/mm^2 | | | |
| 14 | | | | | | |
| 15 | E-modulus | 210000 | N/mm^2 | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| | Web slenderness | 31 | | | | |
| 19 | | | | | | |
| 20 | Limit slenderness | 362,30 | | | | |
| 21 | | | | | | |
| 22 | Unity Check | 0,086 | | | | |

Since the check requires the area of the compression flange, the sign of the bending moment is used to determine which flange is in compression at each section along a member.

In the Excel file, all cells to which data has to be mapped and from which data is read have been given a name. This allows for a very easy definition of the mapping since these same names will be available in the mapping dialog of Scia Engineer. External Application Checks for Excel - Example 2: Flange Induced Buckling

Step 1: Activate the functionality External Application Checks

The first step is to activate the functionality **External application checks** on the **Functionality** tab in the **Project Data**.

Step 2: Create User Defined Additional Data

In the second step, User Defined Additional Data will be defined.

Through Tools > User defined AddData the User Defined Additional Data Library can be opened.

| 🗆 My addData templates 🛛 🛛 🔀 | | | | | |
|------------------------------|----------------|-------------------------|-------------------------------|---|--|
| 🔎 🦆 🗶 🛍 📐 🧉 | 3 | 🗃 🔜 Ali | • 7 | | |
| Buckling | | Name | Buckling | ^ | |
| | | Slave add data | | | |
| | | User string database | | | |
| | | List of parameters | | = | |
| | | Picture | | | |
| | Remove picture | | [_] | | |
| | | Service tree definition | | | |
| | | Service name | MYAT1 Input of custom Add dat | | |
| | | Icon | | | |
| | | Remove icon | | | |
| | | AddData definition | | | |
| | | Type of data | Line on 1D member | ~ | |
| | | | | - | |
| New Insert Edit | | Delete | Close | • | |

The Name of the additional data is changed to 'Buckling'.

Step 2.1 Slave data

Only one type of additional data will be defined here and as such the check-box **Slave add data** is left unchecked.

Step 2.2 Define text strings

In the **User string database** the required strings are defined for the definition of the additional data. Since in this example Flange Induced Buckling is being illustrated the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|--------------------------------|----------------------------------|
| Service name | MYAT1 Input of custom add data | Data for Flange Induced Buckling |
| Type name | MYAT1 Custom defined add data | Flange Induced Buckling |
| Short name | MYAT1 MADI | FIB1 |
| Description | MYAT1 Description | Buckling |
| Name of check | MYAT1 Custom check | Flange Induced Buckling Check |

| S | String database | | | | | | |
|---|-----------------|----------|---|--|--|--|--|
| | Language | | English (United States) | | | | |
| | ID Text | | | | | | |
| | 1 | 1 | Data for Flange Induced Buckling | | | | |
| | 2 | 2 | Flange Induced Buckling | | | | |
| | 3 | 3 | FIB1 | | | | |
| | 4 | 4 | Buckling | | | | |
| | 5 | 5 | Flange Induced Buckling Check | | | | |
| | • | 0 | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | | | | | | | |
| | Note: 1 | The stri | ng database which is used depends on the language | | | | |
| | | | r the workspace. | | | | |
| | | | | | | | |
| | | | OK Cancel | | | | |

The necessary strings for the definition of the data have been inputted and in the next step the parameters can be defined.

Step 2.3 Define parameters

In this example, the mapping will concern of default Scia Engineer data (Cross-section dimensions, material properties and internal forces) except for the determination of the factor k. In the code, this parameter was defined as follows:

| The value of the factor k should be taken as follows: | | | |
|---|------------------------------------|----------|--|
| - | plastic rotation utilized | k = 0,3 | |
| - | plastic moment resistance utilized | k = 0,4 | |
| - | elastic moment resistance utilized | k = 0,55 | |

To choose between these options, a combo-box parameter will be defined through List of parameters.

| List of parameters | |
|----------------------|-----------|
| | |
| Add item Remove item | |
| String database | OK Cancel |

For this example, one parameter will thus be defined:

| Parameter | Туре | Combo-box lines |
|---------------------------|-----------|---------------------------|
| Determination of factor k | Combo-box | Plastic rotation |
| | | Plastic moment resistance |
| | | Elastic moment resistance |

Through the button **String database** the text string database can be directly accessed. This allows a quick input of the strings required for the parameters.

For this example the following strings are added:

| Strings used in this example |
|------------------------------|
| Determination of factor k |
| Plastic rotation |
| Plastic moment resistance |
| Elastic moment resistance |
| |

| St | String database | | | | | |
|----------|--|-----|----------------------------------|--|--|--|
| Language | | age | English (United States) | | | |
| | | ID | Text | | | |
| | 1 | 1 | Data for Flange Induced Buckling | | | |
| | 2 | 2 | Flange Induced Buckling | | | |
| | 3 | 3 | FIB1 | | | |
| | 4 | 4 | Buckling | | | |
| | 5 | 5 | Flange Induced Buckling Check | | | |
| | 6 | 6 | Detemination of factor k | | | |
| | 7 | 7 | Plastic rotation | | | |
| | 8 | 8 | Plastic moment resistance | | | |
| | 9 | 9 | Elastic moment resistance | | | |
| | • | 0 | | | | |
| | | | | | | |
| | Note: The string database which is used depends on the language default set for the workspace. | | | | | |
| | OK Cancel | | | | | |

Next, through the button Add item the parameter is added.

| List of parameters | | \sim |
|------------------------------|--|-----------|
| 1. Determination of factor k | Type Name Description Combo Edit combo box lines | Combo-box |
| Add item Remove item | | |
| String database | 0 | K Cancel |

The **Type** field is set to 'Combo-box'.

For both the Name and Description fields the string 'Determination of factor k' is set.

Next, the lines in the combo-box are defined through the edit button **Edit combo box lines**.

External Application Checks for Excel – Example 2: Flange Induced Buckling

| E | Edit combo box lines 🛛 🛛 🔀 | | | | |
|-----------|----------------------------|----------------------------------|--|-------|--|
| 1 | | Row text | | Order | |
| | 1 | Data for Flange Induced Buckling | | 1 | |
| | 2 | Flange Induced Buckling | | 1 | |
| | 3 | FIB1 | | 1 | |
| | 4 | Buckling | | 1 | |
| | 5 | Flange Induced Buckling Check | | 1 | |
| | 6 | Determination of factor k | | 1 | |
| | 7 | Plastic rotation | | 1 | |
| | 8 | Plastic moment resistance | | 1 | |
| | 9 | Elastic moment resistance | | 1 | |
| | | | | | |
| OK Cancel | | | | | |

This dialog shows all strings defined in the user string database in the column **Row text**. The checkboxes can be used to specify which strings should be in the combo-box. For this example, the three final strings are thus activated.

| E | Edit combo box lines 🛛 🔀 | | | | | |
|---|--------------------------|----------------------------------|-------------|-------|--|--|
| | | Row text | | Order | | |
| | 1 | Data for Flange Induced Buckling | | 1 | | |
| | 2 | Flange Induced Buckling | | 1 | | |
| | 3 | FIB1 | | 1 | | |
| | 4 | Buckling | | 1 | | |
| | 5 | Flange Induced Buckling Check | | 1 | | |
| | 6 | Determination of factor k | | 1 | | |
| | 7 | Plastic rotation | | 1 | | |
| | 8 | Plastic moment resistance | \boxtimes | 1 | | |
| | 9 | Elastic moment resistance | \boxtimes | 1 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | OK Cancel | | | | | |

The lines for the combo-box have been defined so the next step is to set the order of the lines in the **Order** column.

The line with Order number 1 will be the first line in the combo-box. Each next line should have its Order incremented by 1.

For this example, the order in which the strings have been inputted in the string database is kept and thus in the Order column the numbers '1', '2' and '3' are inputted.

| 1 2 3 | Rov Data for Flange In Flange Induced B | v text iduced Buckling | | Order |
|-----------|---|---|--|---|
| 2 | Data for Flange In | | | Order |
| 2 | | iduced Buckling | | |
| - | Flance Induced B | - | | 1 |
| 3 | | uckling | | 1 |
| - | FIB1 | | | 1 |
| 4 | Buckling | | | 1 |
| 5 | Flange Induced B | uckling Check | | 1 |
| 6 | 6 Determination of factor k | | | 1 |
| 7 | 7 Plastic rotation | | \boxtimes | 1 |
| 8 | Plastic moment resistance | | \boxtimes | 2 |
| 9 | Elastic moment resistance | | \boxtimes | 3 |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| OK Cancel | | | | |
| | 4 5 6 7 8 | 4 Buckling 5 Flange Induced B 6 Determination of f 7 Plastic rotation 8 Plastic moment re | 4 Buckling 5 Flange Induced Buckling Check 6 Determination of factor k 7 Plastic rotation 8 Plastic moment resistance 9 Elastic moment resistance | 4 Buckling 5 Flange Induced Buckling Check 6 Determination of factor k 7 Plastic rotation 8 Plastic moment resistance 9 Elastic moment resistance |

When closing this dialog, the **Combo** item in the **List of Parameters** dialog shows how the combo-box will look like.

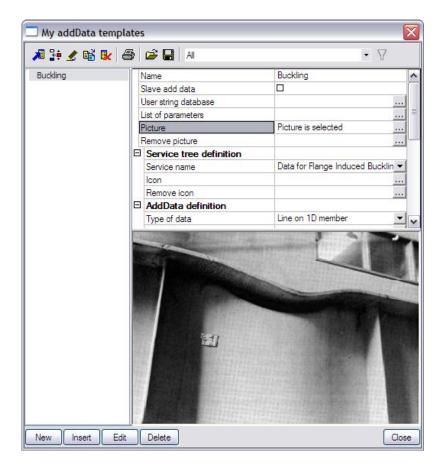
| List of parameters | | X |
|------------------------------|----------------------|--|
| 1. Determination of factor k | Туре | Combo-box 🔻 |
| | Name | Determination of facto 💌 |
| | Description | Determination of facto 💌 |
| | Combo | Plastic rotation |
| | Edit combo box lines | Plastic rotation Plastic moment resistance Elastic moment resistance |
| Add item Remove item | | |
| String database | (| DK Cancel |

The combo-box parameter has now been defined and the dialog can be closed.

Step 2.4 Add a picture to the Additional Data

To clarify the use of the additional data and the defined parameters a picture can be added using the **Picture** button.

In this example the picture Excel_Example_2_Picture.bmp will be used.



Step 2.5 Define Service Tree

In the next step the Service Tree is defined through the group Service tree definition.

The Service name is taken automatically from the text string database.

To clarify the Service name, an icon can be added using the **Icon** button. In this example the icon **Excel_Example_2_Icon.bmp** will be used.

| Ξ | Service tree definition | | |
|---|-------------------------|---------------------------------|--|
| | Service name | Data for Flange Induced Bucklin | |
| | Icon | Icon is selected | |
| | Remove icon | | |

Step 2.6 Define the Additional Data

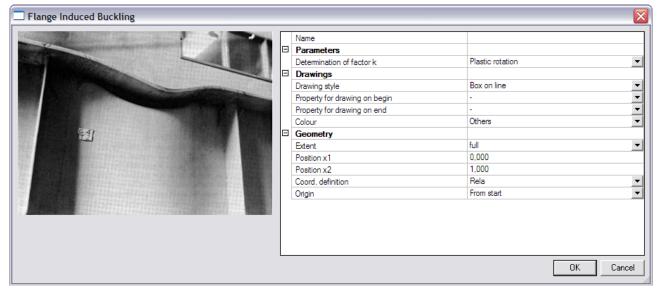
Using the data from the previous steps, the additional data can now be defined in the group **AddData** definition.

| Ξ | AddData definition | | |
|---|--------------------|-------------------------|---|
| | Type of data | Line on 1D member | - |
| | Instance setup | | |
| | Type name | Flange Induced Buckling | - |
| | Short name | FIB1 | - |
| | Description | Buckling | - |

Flange Induced Buckling has to be checked in each section of the member since the check contains the area of the compression flange which can change along the length of the member. Therefore the field **Type of data** is set to 'Line on 1D member'.

The Type name, Short name and Description are taken automatically from the text string database.

To get an overview of all the data entered in the previous steps the button **Instance Setup** is used.



The Parameters group shows the combo-box defined in Step 2.3.

In the **Drawings** group, the **Drawing style** is set to 'Simple'. For the **Colour field** 'Water load' is chosen.

| Drawings | | |
|-------------------------------|------------|---|
| Drawing style | Simple | • |
| Property for drawing on begin | - | • |
| Property for drawing on end | - | - |
| Colour | Water load | - |

Since in this example no numerical parameter was defined, no **Property for drawing on begin/end** is specified.

External Application Checks for Excel - Example 2: Flange Induced Buckling

Step 2.7 Define the Check

In the group Check data the necessary data for the check itself can now be defined.

| Ξ | Check data | |
|---|------------------------|---------------------------------|
| | Name of check | Flange Induced Buckling Check 📃 |
| | Setup for Brief output | |
| E | Type of loads | |
| | Load cases | |
| | ULS combinations | |
| | SLS combinations | |
| | Result classes | |

The Name of check is taken automatically from the text string database.

The **Type of loads** group allows to specify which load types will be available for the check. Only the selected items will be available when executing the check.

Since in this example only one load case was defined, only the option 'Load cases' will be activated.

| Type of loads |
|---------------|
| Load cases |

| | _ |
|------------------|---|
| ULS combinations | |
| SLS combinations | |
| Result classes | |

The final item for defining the check is the **Setup for Brief output** where the output parameters have to be defined.

| List of parameters | | | × |
|--------------------|-------------|----|--------|
| | | | |
| Add item | Remove item | | |
| String database | | OK | Cancel |

For this example, two parameters will be defined: the unity check value and the area of the compression flange.

| Parameter | Unit |
|--------------------------------|------|
| Unity Check UC | - |
| Area of compression flange Afc | mm² |

First of all, through the button **String database** the text string database is accessed to define the required strings. For this example the following strings are added:

| Strings used in this example | | | | |
|---|-------|----------------------------------|--|--|
| UC | | | | |
| Afc | | | | |
| String | datat | oase 🛛 🕅 | | |
| Langua | ige | English (United States) | | |
| | ID | Text | | |
| 1 | 1 | Data for Flange Induced Buckling | | |
| 2 | 2 | Flange Induced Buckling | | |
| 3 | 3 | FIB1 | | |
| 4 | 4 | Buckling | | |
| 5 | 5 | Flange Induced Buckling Check | | |
| 6 | 6 | Detemination of factor k | | |
| 7 | 7 | Plastic rotation | | |
| 8 | 8 | Plastic moment resistance | | |
| 9 | 9 | Elastic moment resistance | | |
| 10 | 10 | UC | | |
| 11 | 11 | Afc | | |
| • | 0 | | | |
| Note: The string database which is used depends on the language default set for the workspace. | | | | |
| | | OK Cancel | | |

When the strings are defined, the first parameter is added through the button Add item.

| List of parameters | | | | | |
|--------------------|-------------|-------------------|-----------------|---|--|
| 1. UC | | Name | UC | - | |
| | | Extreme for check | max | - | |
| | | Unit | - (Unity Check) | - | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| 1 | | | | I | |
| | Daman 1944 | | | | |
| Add item | Remove item | | | | |

In the **Name** field the 'UC' string is chosen from the string database.

The Extreme for check is left on 'max' since the maximal unity check value is extreme in this case.

Since it concerns a unity check, the Unit field is left on '- (Unity Check)'.

| List of parameters | | X |
|-------------------------------|-----------------------------------|--|
| 1. UC 2. Afc | Name Extreme for check Unit | Afc ▼ max ▼ mm^2 ([m^2]) ▼ |
| | | |
| | | |
| Add item R String database | emove item | OK Cancel |

Again using the button Add item the second parameter is added.

In the Name field the 'Afc' string is chosen from the string database.

The **Extreme for check** is left on 'max'. For this example it is of no importance if the extreme is minimum or maximum, the purpose of the parameter is to see which flange is in compression.

Since this parameter concerns an area, the Unit field is set to 'mm² ([m²])'.

During the mapping, parameters are always sent to Excel in basic SI units. Output parameters are also read from Excel in basic SI units. For this example this implies that the area in Excel has to be in m² as indicated in the Unit field. This unit will then be converted to mm² in Scia Engineer.

The check and output parameters have now been defined so in the next step the link can be set.

Step 2.8 Specify the type of external link

In the **External link data** group the **Type of external link** allows to specify which external application will be used.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.9 Define the mapping with the external application

All preparation has now been done, what remains is the most important step of the process: defining the actual mapping between properties and parameters of Scia Engineer and the data fields (i.e. Excel cells) of the external application.

Through the button **Edit external file mapping** the mapping dialog is opened.

The first time the mapping dialog is opened can take a few seconds. This is because, during the opening, all document tables are refreshed since these properties are available in the mapping dialog. This way, when new items are added to the document in future versions of Scia Engineer, they will automatically be available in the mapping dialog also.

| xcel Link | | | | | (|
|-------------------------|---------------------------|----------------|----------|------|--------|
| Data | File | Wo | orksheet | Cell | Array |
| | | | | | |
| Add | Ipdate | | | | Remove |
| Source | | | | | |
| <u>O</u> bject | <<< My input parameters | | | - | |
| Property | Determination of factor k | | | • | |
| Target | | | | | |
| <u>E</u> xcel file | | | | | Browse |
| <u>W</u> orksheet | | ✓ Cell address | | • | |
| Arrays <u>direction</u> | Horizontal | Current value | | | Show |
| | | | | ОК | Cancel |

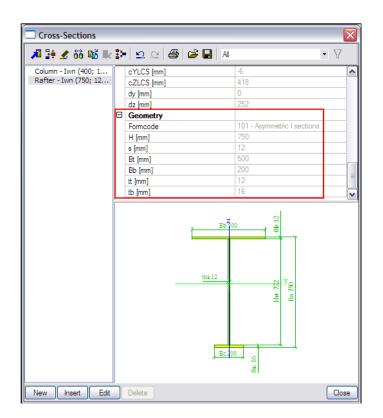
In this example, the Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:

| | А | В | С |
|----|---------------------------|---------------------------|-------|
| 1 | Top flange width | 0,3 | m |
| 2 | | | |
| 3 | Top flange thickness | 0,012 | m |
| 4 | | | |
| 5 | Bottom flange width | 0,2 | m |
| 6 | | | |
| 7 | Bottom flange thickness | 0,016 | m |
| 8 | | | |
| 9 | Cross-section height | 0,4 | m |
| 10 | | | |
| 11 | Web thickness | 0,012 | m |
| 12 | | | |
| 13 | | | |
| 14 | Yield Strength | 35500000 | N/m^2 |
| 15 | | | |
| 16 | E-modulus | 2,1E+11 | N/m^2 |
| 17 | | | |
| 18 | | | |
| 19 | Determination of factor k | Elastic moment resistance | |
| 20 | | | |
| 21 | Moment My | 50000 | Nm |

The sheet 'Check' shows the intermediate results and the unity check:

| | А | В | С | D | E | F |
|----|-----------------------------|--------|--------|---|--------|-----|
| 1 | web height hw | 372 | mm | | | |
| 2 | | | | | | |
| 3 | web thickness tw | 12 | mm | | | |
| 4 | | | | | | |
| 5 | Web area Aw | 4464 | mm^2 | | | |
| 6 | | | | | | |
| 7 | Compression flange | Тор | | | | |
| 8 | | | | | | |
| 9 | Compression flange area Afc | 3600 | mm^2 | | 0,0036 | m^2 |
| 10 | | | | | | |
| 11 | Factor k | 0,55 | | | | |
| 12 | | | | | | |
| 13 | Yield Strength | 355 | N/mm^2 | | | |
| 14 | | | | | | |
| 15 | E-modulus | 210000 | N/mm^2 | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | Web slenderness | 31 | | | | |
| 19 | | | | | | |
| 20 | Limit slenderness | 362,30 | | | | |
| 21 | | | | | | |
| 22 | Unity Check | 0,086 | | | | |

In this example, cross-section properties have to be sent to Excel. In the Cross-section manager, it can be seen how the dimensions of a sheet welded lwn section are defined:



More specifically the properties H, s, Bt, Bb, tt and tb will have to be mapped to Excel.

As specified in the introduction of this example, in the Excel file, all cells to which data has to be mapped and from which data is read have been given a name. These named cells can now be used in the **Cell address** field instead of manually typing the cell number.

| Object | Property | Worksheet | Named Cell (Address) |
|---------------------------|-----------------------------------|-----------|------------------------------|
| Cross-Sections | Bt (Geometry) | Input | Top_flange_width (B1) |
| Cross-Sections | tt (Geometry) | Input | Top_flange_thickness (B3) |
| Cross-Sections | Bb (Geometry) | Input | Bottom_flange_width (B5) |
| Cross-Sections | tb (Geometry) | Input | Bottom_flange_thickness (B7) |
| Cross-Sections | H (Geometry) | Input | Cross_section_height (B9) |
| Cross-Sections | s (Geometry) | Input | Web_thickness (B11) |
| Steel EC3 | Yield strength (code independent) | Input | Yield_Strength (B14) |
| Steel EC3 | E modulus (code independent) | Input | E_modulus (B16) |
| <<< My input parameters | Determination of factor k | Input | Determination_of_k (B19) |
| Internal forces on member | My | Input | Moment_My (B21) |
| >>> My output parameters | UC | Check | UC (B22) |
| >>> My output parameters | Afc | Check | Afc (E9) |

The following table shows which properties should be mapped to which cells:

As specified, during the mapping, parameters are always sent to Excel in basic SI units. Output parameters are also read from Excel in basic SI units. Therefore the cell E9 on the Check worksheet in Excel shows the area of the compression flange in SI units.

The mapping of the first property, the width of the top flange Bt is thus done as follows:

The **Object** field is set to 'Cross-sections'.

In the **Property** field 'Bt' can then be chosen.

Using the Browse button, the file Excel_Example_2.xls is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Input'.

The **Arrays direction** is set to 'Horizontal'. In this example no array properties are mapped so choosing 'Horizontal' or 'Vertical' would make no difference.

Finally, in the field **Cell address**, using the combo-box the named cell 'Top_flange_width' is chosen. Automatically the **Current value** field will show the current content of the cell, in this case 0,3. When all input has been done, this mapping is added to the table using the **Add** button.

| xcel Link | | | | | × |
|--------------------------|----------------------|---------------------|--------------|------------------|------------|
| Data | File | | Worksheet | Cell | Array |
| Cross-Sections.Bt (Geon | netry) D:\ESA_Exce | I\Excel_Example_2 | Input | Top_flange_width | Horizontal |
| | | | | | |
| | | | | | |
| < | | | | | > |
| Add Upd | ate | | | [| Remove |
| | | | | | |
| <u>O</u> bject | Cross-Sections | | | • | |
| Property | Bt (Geometry) | | | • | |
| | | | | | |
| - Target | D:\ESA_Excel\Excel_E | uample 2\Eucel Euar | nole 2 vls | | Browse |
| <u>E</u> xcel file | | | | | DIOMSE |
| <u>W</u> orksheet | Input | <u> </u> | Top_flange_u | width 🔽 | |
| Arrays <u>d</u> irection | Horizontal | Current value | , 0,3 | | Show |
| | | | | | |
| | | | | ОК | Cancel |

In the same way, all other parameters can be mapped using the above table. For all parameters the **Arrays direction** is set to 'Horizontal'.

| E | xcel Link | | | | | |
|---|--------------------------|--|--|--------|------------|---------------------------------------|
| | D-1- | | F 1- | [| | |
| | Data | | File | | sheet Cell | <u>^</u> |
| | Steel EC3.Yield strength | | D:\ESA_Excel\Excel_Examp | | | Strength |
| | Steel EC3.E modulus (Co | de independent) Determination of factor k | D:\ESA_Excel\Excel_Examp D:\ESA_Excel\Excel_Examp | | | duius mination of I |
| | Internal forces on membe | | D:\ESA_Excel\Excel Examp | | | nnnation_or_i ent My |
| | >>> My output parameter | | D:\ESA Excel\Excel Examp | | | and max |
| | >>> My output parameter | | D:\ESA Excel\Excel Examp | | | · · · · · · · · · · · · · · · · · · · |
| | < | | | | | > |
| | Add Upda | ate | | | | Remove |
| | Source | | | | | |
| | <u>O</u> bject | >>> My output paramete | ırs | | - | |
| | Property | Afc | | | • | |
| | - Target | | | | | |
| | <u>E</u> xcel file | D:\ESA_Excel\Excel_E: | kample_2\Excel_Example_2.xl | s | | Browse |
| | <u>W</u> orksheet | Check | <u>C</u> ell address | Afc | • | |
| | Arrays direction | Horizontal | Current value | 0,0036 | | Show |
| | | | | | ОК | Cancel |

All parameters are now mapped to Excel. The final step left for the definition of the additional data is specifying a Detailed output.

Step 2.10 Define the Detailed output

In *Step 2.7* the parameters for the Brief output have been defined. These parameters will be used for the check. In addition, a Detailed output can also be specified to show an in-depth overview of the check.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

By clicking on **Setup for Detailed output**, the Detailed output dialog is opened.

| External links for documen | t | | | | X |
|----------------------------|------------|--------|---------|-------------|--------------|
| Caption | Excel file | Worksh | Upper-I | Bottom | |
| | | | | | |
| Caption | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Add Update | | | | | Remove |
| _Item | Caption: | | | | - |
| Excel file: | , | Source | | - left cell | Range |
| | | | | - ieit cei | |
| Worksheet: | | | | Bottom | - right cell |
| | | | | | - |
| String database | | | (| ок | Cancel |
| String database | | | | OK | Cancel |

In this example, the range will be defined from the cell A1 to the cell C22 on the 'Check' worksheet.

External Application Checks for Excel - Example 2: Flange Induced Buckling

| | А | В | С | D | E | F |
|----|-----------------------------|--------|--------------|------------|--------|-----|
| 1 | web height hw | 372 | mm | | | |
| 2 | Top - left | | | | | |
| 3 | web thickness tw | 12 | mm | | | |
| 4 | | | | | | |
| 5 | Web area Aw | 4464 | mm^2 | | | |
| 6 | | | | | | |
| 7 | Compression flange | Тор | | | | |
| 8 | | | | | | |
| 9 | Compression flange area Afc | 3600 | mm^2 | | 0,0036 | m^2 |
| 10 | | | | | | |
| 11 | Factor k | 0,55 | | | | |
| 12 | | | | | | |
| 13 | Yield Strength | 355 | N/mm^2 | | | |
| 14 | | | | | | |
| 15 | E-modulus | 210000 | N/mm^2 | | | |
| 16 | | | | | | |
| 17 | | | | | | |
| 18 | Web slenderness | 31 | | | | |
| 19 | | | \mathbf{N} | | | |
| 20 | Limit slenderness | 362,30 | | | - | |
| 21 | | | <u> </u> | ottom - ri | gnt | |
| 22 | Unity Check | 0,086 | | | | |

For ease of reference, here also Named cells have been defined in the Excel file.

In the **Caption** field the string 'Flange Induced Buckling Check' is chosen. In the **Excel file** field the file **Excel_Example_2.xls** is searched using the browse button.

The Worksheet field is set to 'Check'.

In the **Range** group the **Top - left** cell is set to 'Top_Left_Cell' and the **Bottom - right** cell to 'Bottom_Right_Cell'.

When all input has been done, the data is added to the table using the **Add** button.

| E | xternal links for document | t | | | × |
|---|-------------------------------|---------------------------|----------|-----------------|--------------------|
| | | | | | |
| | Caption | Excel file | Worksh | Upper-left cell | Bottom-right cell |
| | Flange Induced Buckling Check | D:\ESA_Excel\Excel_Exam | Check | Top_Left_Cell | Bottom_Right_Cell |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | < | | | | > |
| ' | | | | | |
| | Add Update | | | | Remove |
| · | | | | | |
| | Item | | | Sh - J | |
| | | Caption: Flange Indu | - | | _ |
| | Excel file: | | Source f | file Top - left | Range |
| | D:\ESA_Excel\Excel_Exampl | a 2)Eural Euromala 2 yila | | Top_Left | |
| | | e_ziexcei_example_z.xis | | 1 ' | _ |
| | Worksheet: | | | В | ottom - right cell |
| | Check 💌 | | | | Bottom_F 💌 |
| | | | | | |
| | au 111 | | | | |
| | String database | | | OK | Cancel |

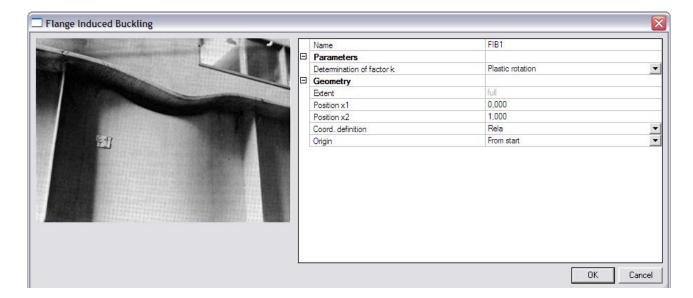
With this final step, the User Defined Additional Data has been fully inputted and the **User Defined** Additional Data Library can be closed.

Step 3: Input the User Defined Additional Data on members/nodes

After closing the **User Defined Additional Data** Library a new service will be shown in the Scia Engineer tree: **Custom Check**.

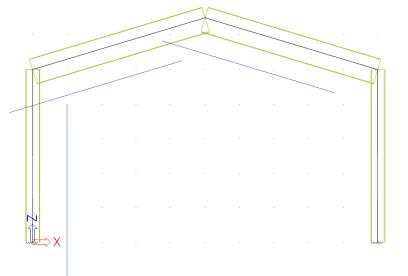
| Main | | | |
|---|--------------|----|---|
| Project Structure Load Calculation,Mesh Results | | | |
| Steel Custom Check Custom Chec | Custom Check | Ţ. | × |

The additional data which was defined in *Step 2*, can now be inputted on the member. When double clicking on **Data for Flange Induced Buckling** the dialog with the properties of the data is displayed:

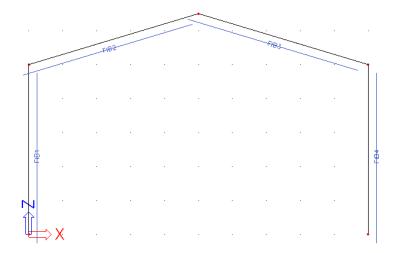


The **Parameters** group holds the user defined parameters of *Step 2.3* with their default values. In this case the combo-box 'Determination of factor k'.

The default values of the dialog are confirmed with **[OK]** and the data is inputted on all members.



Using the default Scia Engineer view parameters, the name of the additional data can be displayed.



The data has now been inputted and in the next step the check can be executed.

Step 4: Execute the Custom Check

In *Step 2* the additional data has been defined including the definition of the check, the mapping to Excel... In *Step 3* the additional data has been inputted. What is left is the execution of the check.

| First of all the linear analysis is I | aunched since internal forces | will have to be sent to Excel |
|---------------------------------------|-------------------------------|-------------------------------|
|---------------------------------------|-------------------------------|-------------------------------|

| FE analysis | | | × |
|-------------|---|------------|---|
| | Single analysis Batch analysis | | |
| 11 | Linear calculation | | |
| | C Nonlinear calculation | Г | |
| | C Modal analysis | Г | |
| 114 | C Linear stability | Г | |
| | C Concrete - Code Dependent Deflections | Г | |
| | C Influence lines and surfaces | Г | |
| | C Construction stage analysis | Г | |
| | C Nonlinear stage analysis | Г | |
| | C Nonlinear stability | | |
| | Test of input data | | |
| | Number of load cases: 1 | | |
| | , | | |
| | Solver setup | Mesh setup | |
| | ОК | Cancel | |

When user defined additional data was inputted and the analysis has been executed, the **Custom Check** service will show a new item: **Custom Check**.

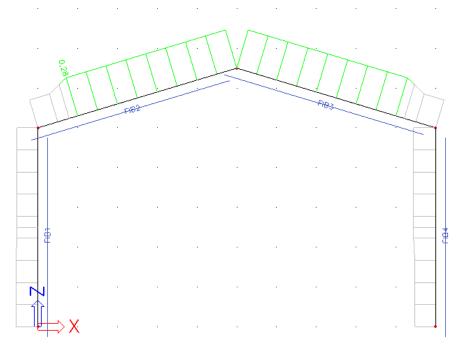
| Custom Check | ąΧ |
|----------------------------------|----|
| Data for Flange Induced Buckling | |

The default check service property window accompanies this check:

External Application Checks for Excel – Example 2: Flange Induced Buckling

| Properties | × |
|------------------|-------------------|
| Custom check (1) | • Va V/ / |
| Name | Custom check |
| Selection | All 💌 |
| Load cases | LC1 - Loading 📃 💌 |
| Filter | No 💌 |
| Values | UC 💌 |
| Extreme | Global 💌 |
| Output | Brief 💌 |
| Drawing setup | |
| Section | Al < |
| Actions | |
| Refresh | >>> |
| Single Check | |
| Preview | |

The **Refresh** action button is pressed to execute the check. The following check result is shown on screen:



The asymmetric result for the columns is correct since different flanges are in compression on both column sides.

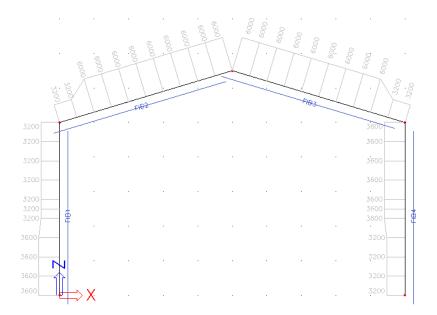
This can be checked by reviewing the compression flange area:

The Values field is changed to 'Afc'.

The Extreme field is changed to 'Section' to see the results in each section.

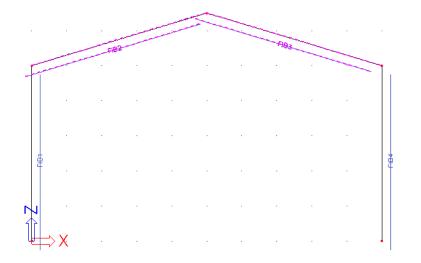
| Properties | μ× |
|------------------|--------------|
| Custom check (1) | • 14 17/ |
| Name | Custom check |
| Selection | Al 🗾 |
| Load cases | LC1 💌 |
| Filter | No |
| Values | Afc 🔹 |
| Extreme | Section 💌 |
| Output | Brief 🗨 |
| Drawing setup | |
| Section | Al |

After pressing the **Refresh** action button the following result is shown on screen:

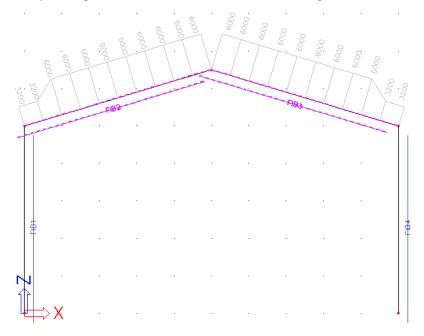


In order to see only the results for the rafters, the **Selection** field is set to 'Current'. This implies a selection has to be made which in this case implies the additional data of the rafters and not the members themselves!

The external application check is based on user defined additional data. The check is performed for the members/nodes on which this user defined additional data has been defined. Therefore this additional data has to be selected and not the member or node as in other checks.



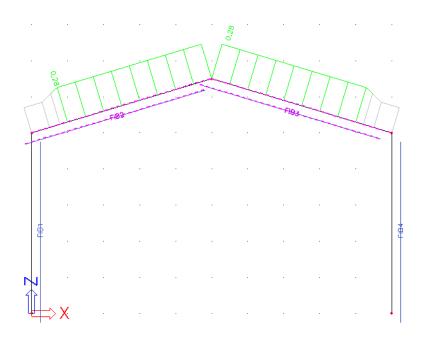
After pressing the **Refresh** action button the following result is shown on screen:



Next, the Values field is changed back to 'UC' and the Extreme field is set to 'Member'.

| Properties | ά X |
|------------------|--------------|
| Custom check (1) | • 🖬 🖓 🖉 |
| Name | Custom check |
| Selection | Current 💌 |
| Load cases | LC1 🗨 |
| Filter | No |
| Values | UC 🗨 |
| Extreme | Member 💌 |
| Output | Brief 🗾 |
| Drawing setup | |
| Section | All |

After pressing the **Refresh** action button the following result is shown on screen:



When pressing the **Preview** action button, the Brief preview shows the following:

| Preview | Preview | | | | | | | |
|---|-------------|--------------|-------------|-----------|------|--|--|--|
| n 🖳 📑 🏉 🔲 H 🛛 |) ka ka 💷 | default 🝷 | 📜 📃 default | - 🗉 | | | | |
| Customcheo | Customcheck | | | | | | | |
| Linearcalculation, Extreme: Member Selection: FIB2, FIB3 Load cases: LC1 The check was executed according to the following user defined Excel file(s): D:\ESA Excel\Excel Example 2\Excel Example 2.xls | | | | | | | | |
| TypeName | Data | Css | Material | dx [m] | Case | | | |
| Custom check | FIB2 | Rafter - Iwn | S 355 | 1,044 | LC1 | | | |
| Custom check | FIB3 | Rafter - Iwn | S 355 | 0,000 | LC1 | | | |
| | | | | | | | | |

Using the tablecomposer, both the UC and Afc parameters can be added to the output:

| Table Composer | | | | | | | - 🗆 🗙 |
|-----------------------------------|---|---------------------------------|----------|-------------------|----------------------|------------------------|----------|
| C:\Documents and Settings\PeterVT | \ESAD9\user\Docu | mentTemplates\CustomBa | sicClass | .8.00.Custor | nResCheck [default |].otx | |
| Standard Advanced - Table A | Standard Advanced - Table Advanced - Columns / Rows Layout Property | | | | | | |
| Contents of table | | | | Table | | | |
| Items in Table | A <u>v</u> ailable I | | _ | <u>T</u> emplate | name del | fault | |
| Type Name | | cia Engineer Properties | | <u>T</u> able typ | e | | |
| Css | | Type Name Data | | 💾 Vert | ical table (column p | er property) | ~ |
| Material | | Css | | | | | |
| dx 📃 | | Material | | | | | |
| Case | | dx Case | | 📃 <u>E</u> it Tal | ble to Page Width | | |
| Afc | | UC | | | | | |
| | | Afc | | Column(s) | / Row(s) | | |
| | | efined Views Jser Properties | | | | | |
| | | iser ropenes | | Caption | Af | c | |
| | | | | Alignmer | | | |
| | | | | | = | c Default | ~ |
| | | | | No he | | - the simulation to be | |
| Remove | | Add | | Done | t aggregate caption | at norizontal table | 25 |
| | | | | | | | |
| | | | | | | | |
| Preview | | | | | | | |
| Type Name | Data | Css | Ma | terial | dx | Case | <u>^</u> |
| | | | | | [m] | | Ξ |
| Custom check | FIB2 Rafter-lwn | | S 3 | | 1,044 | | |
| Custom check | FIB3 Rafter-lwn | | S 3 | | 0,000 | | |
| Custom check | | | | 55 | 0 000 | LIC1 | > |
| Ready [en] | | < | | | | | > ~ |
| | | | | | | | Court |
| | | | | | | ОК | Cancel |

When pressing the **Preview** action button, the Brief preview now shows the following:

| Preview | Preview | | | | | | |
|---|---------|------------|-------------|------------|------|-----------|---------------------------|
| n 🛄 🖪 🏉 🗌 H (| - M M = | default 🔹 | 📜 📃 default | - 🗉 | | | |
| Customcheo | : k | | | | | | |
| Linear calculation, Extreme : Member Selection : FIB2, FIB3 Load cases : LC1 The check was executed according to the following user defined Excel file(s): D:\ESA Excel\Excel Example 2\Excel Example 2.xls | | | | | | | |
| TypeName | Data | Css | Material | dx [m] | Case | UC [-] | Afc [mm ²] |
| Custom check | FIB2 | Rafter-lwn | S 355 | 1,044 | LC1 | 0,28 | 6000 |
| Custom check | FIB3 | Rafter-lwn | S 355 | 0,000 | LC1 | 0,28 | 6000 |

Note the Afc parameter which is shown with the unit defined in step 2.7.

The result was obtained by using the default setting for the factor k: 'Plastic rotation'.

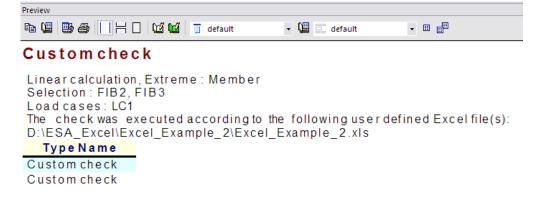
Since both additional data on the beams are selected, their properties can be modified in the Property window. In this example, the **Determination of factor k** is changed to 'Elastic moment resistance'.

| Pro | Properties 📮 🗙 | | | | | |
|-----|---------------------------|---------------------------|--|--|--|--|
| Fla | ange Induced Buckling (2) | • Va V/ / | | | | |
| Ξ | Parameters | | | | | |
| | Determination of factor k | Plastic rotation 🗸 🗸 | | | | |
| Ξ | Geometry | Plastic rotation | | | | |
| | Extent | Plastic moment resistance | | | | |
| | Position x1 | Elastic moment resistance | | | | |
| | Position x2 | 1,000 | | | | |
| | Coord. definition | Rela 💌 | | | | |
| | Origin | From start | | | | |

After pressing the **Refresh** action button, this less severe unity check is shown:

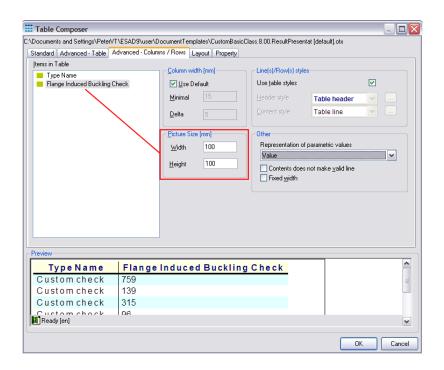
| Preview | | | | Preview | | | | | |
|---|---------|--------------|-------------|-----------|------|-----------|---------------------------|--|--|
| n 🖳 📑 🏉 🗌 H (| - 🖾 🖬 📑 | default 🝷 | 🚇 📃 default | - 🗉 | | | | | |
| Customcheo | ⊳k | | | | | | | | |
| Linear calculation, Extreme : Member Selection : FIB2, FIB3 Load cases : LC1 The check was executed according to the following user defined Excel file(s): D:\ESA_Excel\Excel Example_2\Excel Example_2.xls | | | | | | | | | |
| TypeName | Data | Css | Material | dx [m] | Case | UC [-] | Afc [mm ²] | | |
| Custom check | FIB2 | Rafter-lwn | S 355 | 1,044 | LC1 | 0,15 | 6000 | | |
| Custom check | FIB3 | Rafter - Iwn | S 355 | 0,000 | LC1 | 0,15 | 6000 | | |

Finally, the Detailed output is examined. The **Output** field is set to 'Detailed' and the **Refresh** action button is pressed.



Through the table composer the Flange Induced Buckling Check item can be added and its picture size set to 100mm by 100mm:

| III Table Composer | | | |
|---|--|---|----------|
| | \ESAD9\user\DocumentTemplates\CustomBasicClas | s.8.00.ResultPresentat [default].otx | |
| | dvanced - Columns / Rows Layout Property | | |
| Contents of table Items in Table Items in Table Flange Induced Buckling Ct Flange Induced Buckling Ct | Axailable Items Constraints C | Table Iemplate name Iable type Image: State of the sta | |
| Preview | , |) | |
| TypeName | Flange Induced Buckling (| Check_ | ^ |
| Custom check | 740 | | = |
| Custom check | 15 | | |
| Custom check | 912 | | |
| Custom chock | 585 | | |
| Flange Induced Buckling Che | CK | | • |
| | | OK Can | icel |



This gives the following output after refreshing:

| 9 4 5 5 1 H (| 🛛 🗹 🛍 🥛 default 💽 🖳 | • II [I |
|---|--|---------------|
| ustomcheo | : k | |
| Selection : FIB2, .oad cases : LC1 The check was e: | xecuted according to the following | |
| D:\ESA_Excel\Ex TypeName | cel_Example_2\Excel_Example_2. FlangeInduced Bu | |
| Custom check | web height hw | 722 mm |
| | web thickness tw | 12 mm |
| | Web area Aw | 8664 mm^2 |
| | Compression flange | Тор |
| | Compression flange area Afc | 6000 mm^2 |
| | Factor k | 0,55 |
| | Yield Strength | 355 N/mm^2 |
| | E-modulus | 210000 N/mm^2 |
| | Web slenderness | 60,16667 |
| | Limit slenderness | 390,96 |
| | Unity Check | 0,154 |
| Custom check | web height hw | 722 mm |
| | web thickness tw | 12 mm |
| | Web area Aw | 8664 mm^2 |
| | Compression flange | Тор |
| | Compression flange area Afc | 6000 mm^2 |
| | Factor k | 0,55 |
| | Yield Strength | 355 N/mm^2 |
| | E-modulus | 210000 N/mm^2 |
| | Web slenderness | 60,16667 |
| | Limit slenderness | 390,96 |
| | Unity Check | 0,154 |

Two outputs are given since the extreme per member was asked (with two entities selected). The Excel file could be modified to show also the name of the member and the section position on the output.

Cross-section X Name Rafter ^ Туре thb 12 750; 12; 500; 12; 200 Detailed Bb \$00 Parameters Material S 355 ×...
 S 235

 S 235

 S 275

 S 355

 S 355

 S 355

 S 420 N/NL

 S 420 N/NL

 S 420 N/NL

 S 420 N/NL

 S 420 M/ML

 S 455 W

 S 355 W

 S 355 H

 S 275 NH/NLH

 S 450 M/NLH

 S 420 M/MLH

 S 420 M/ML

 S 420 M/ML
 Ba [mm] tha [mm] Bb [mm] thb [mm] Bc [mm] thc [mm] <u>tha 12</u> Ba 750⁶ Hw [mm] Hw 722 Ξ General Draw color Colour Properties editable Buckling editable Buckling y-y I Buckling z-z Fabrication Curve dividing Use reduction factors Bc 200 9 Edit named items ~ Edit joints Ê, ıt. U Picture Fibres Warping lines Shear y Shear z Centre lines Stiffener

To finalize this example, the material for the rafter members is changed from **S355** to **S235**:

After recalculating, the Detailed output for the rafter members is refreshed:

| Preview | | |
|---|-------------------------|--|
| ₽ ₩ ₿ 6 | 🛛 🕼 🚺 🗍 default 🕞 🕮 | 📄 default 🔹 🗉 🗊 |
| Customcheo | : k | |
| Selection : FIB2, Load cases : LC1 The check was es | | owing user defined Excel file(s): ble 2.xls |
| TypeName | | ed Buckling Check |
| Custom check | web height hw | 722 mm |
| | web thickness tw | 12 mm |
| | Web area Aw | 8664 mm^2 |
| | Compression flange | Тор |
| | Compression flange area | Afc 6000 mm^2 |
| | Factor k | 0,55 |
| | Yield Strength | 235 N/mm^2 |
| | E-modulus | 210000 N/mm^2 |
| | Web slenderness | 60,16667 |
| | Limit slenderness | 590,61 |
| | Unity Check | 0,102 |

External Application Checks for Excel - Example 2: Flange Induced Buckling

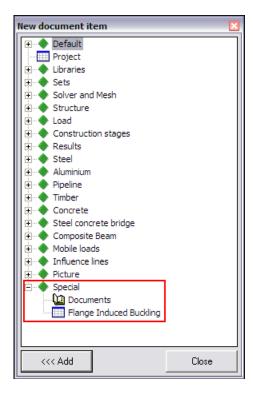
| Customcheck | web height hw | 722 mm | |
|-------------|-----------------------------|---------------|--|
| | web thickness tw | 12 mm | |
| | Web area Aw | 8664 mm^2 | |
| | Compression flange | Тор | |
| | Compression flange area Afc | 6000 mm^2 | |
| | Factor k | 0,55 | |
| | Yield Strength | 235 N/mm^2 | |
| | E-modulus | 210000 N/mm^2 | |
| | Web slenderness | 60,16667 | |
| | web sienderness | 60,16667 | |
| | Limit slenderness | 590,61 | |
| | Unity Check | 0,102 | |

The output clearly shows that the change of material is correctly taken into account.

The check has now been executed and reviewed. To end this step, the document of Scia Engineer is examined.

In the document, the inputted User defined additional data can be inserted into the document in the same way as any other default additional data.

In the **New document item** dialog, the **Special** chapter holds the tables for all user defined additional data.



In this example **Flange Induced Buckling** was defined and thus this data can be added into the document.

| NEMETSCHEK Scia | Project | Excel_Example_2 |
|--------------------|-------------|-----------------------------------|
| | Part | - |
| | Description | Example 2 for Tutorial Excel Link |
| | Author | PVT |

1. Flange Induced Buckling

| Type Name | Name | Member | Extent | Pos x, | Pos x | Coor | Orig | Determination of factor k |
|----------------------------|------|--------|--------|--------|-------|------|---------------|---------------------------|
| Flange Induced Buckling | FIB1 | B1 | full | 0,000 | 1,000 | Rela | From start | Plastic rotation |
| Flange Induced Buckling | FIB2 | B2 | full | 0,000 | 1,000 | Rela | From start | Elastic moment resistance |
| Flange Induced Buckling | FIB3 | B3 | full | 0,000 | 1,000 | Rela | From start | Elastic moment resistance |
| Flange Induced Buckling | FIB4 | B4 | full | 0,000 | 1,000 | Rela | From start | Plastic rotation |

The table shows the different properties of the additional data, including the user defined parameter 'Determination of factor k'. In the same way as for any other default additional data of Scia Engineer this table can be edited and modified through the Table Composer.

Through the Active Document feature of Scia Engineer, the user define properties can also be edited inside the document.

Step 5: Save the User Defined Additional Data into a database for future use

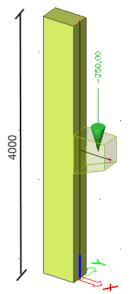
If required, this additional data can be saved into a database for future use as illustrated in Example 1.

Example 3: Corbel Design

In this third example, the mapping of arrays is explained. In addition, multiple detailed outputs are used.

As a practical case, concrete Corbel Design is used.

In this example, a column with corbel is modelled. The column has a height of **4m** and the corbel is attached in the middle. The column has a rectangular section of **500mm** by **300mm**. The corbel has a width of **300mm** and the height varies from **600mm** to **400mm**. The corbel has a length of **0,5m**. The column base is modelled as fully fixed. All members are manufactured in **C30/37** according to **EC-EN**.



One load case is defined, a point load of **250 kN** acting as design load on the corbel. This load is applied at the mid-length position of the corbel.

The check will be done according to the Excel file "Excel_Example_3.xls"

| | А | В | С | D | | E | E F | E F G | E F G H |
|----------|----------------------------|---------|-------|---|---|------|------------|-----------------|-----------------|
| 1 | Input Data from Scia Engin | ieer | | | | | | | |
| 2 | | | | | | | | | |
| 3 | Haunch height hc | 0,4 | m | | | / | /7 . | | |
| 4 | Haunch width bc | 0,25 | m | 1 | | 1 | / F | F _{vd} | F _{vd} |
| 5 | | | | f | | Í. | 1 | | T. L. |
| 6 | Load position ac | 0,2 | m | | | | a | la te | |
| 7 | | | | 1 | | * | 7 | the the | the the |
| 8 | Load Fvd | 150000 | N | | | | | | |
| 9 | | | | - | | 1 | | | 1 |
| 10 | Concrete strength fck | 3000000 | N/m^2 | - | | 1/2 | Hed | Hed | Hedge |
| 11 | | | | 1 | | | | | |
| 12 | - | 0,12 | m | | | , h | , he | , h. | , he |
| 13 | | | | h | | 2 | , <u>h</u> | 2 | 2 |
| 14 | Gamma M | 1,5 | - | | | | M | MANIE | MANIN |
| 15 | | | | | | 11 | 11/1/1 | MIIIINU | MININ |
| 16 | | 18 | mm | X | | Tall | Alling | annuquin | |
| 17 | | | | 1 | | | | | |
| 18 | | | | - | | | 1 | 1 | 1 |
| 19 | | | | | | 1 | 1 | 1 | |
| 20 21 | | 30000 | N | | T | | | | |
| T | Luau ncu (=0,20 * FVd) | 30000 | IN | | | | | | |

The Excel file contains two worksheets. On the sheet 'Input' the input data are set:

The sheet 'Check' shows the check and reinforcement design:

| | А | В | С | D |
|----|---------------------|-----------------|--------|----|
| 1 | Application of stru | t and tie model | | |
| 2 | 0,4 hc <= ac <= hc | ОК | | |
| 3 | | | | |
| 4 | | | | |
| 5 | Check of strut | | | |
| 6 | | | | |
| 7 | Ncd | 353,55 | kN | |
| 8 | | | | |
| 9 | A0 | 45000 | mm^2 | |
| 10 | | | | |
| 11 | Sigma cd | 11,11111111 | N/mm^2 | |
| 12 | | | | |
| 13 | Nu*fcd | 14 | N/mm^2 | |
| 14 | | | | |
| 15 | Check | 0,79 | | |
| 16 | | | | |
| 17 | | | | |
| 18 | Design of tension | reinforcement | | |
| 19 | | | | |
| 20 | Cover c | 25 | mm | |
| 21 | - | | | |
| 22 | d | 465 | mm | |
| 23 | | | | |
| 24 | As required | 578,71 | mm^2 | |
| 25 | | | | |
| 26 | As to provide | | diam. | 20 |
| 27 | | 628 | mm^2 | |

In addition to the default properties of Scia Engineer, the following user defined parameters will have to be defined: the bearing width b0, the safety factor Gamma M and the reinforcement diameter.

Using the input data, the Excel file generates two types of output.

First the compression strut is being checked and second the required tension reinforcement is determined.

In the Excel file, all cells to which data has to be mapped and from which data is read have been given a name. This allows for a very easy definition of the mapping since these same names will be available in the mapping dialog of Scia Engineer.

The calculation is a simplification based on the book "Reinforced Concrete, Design following NBN B15-002 (1999), Academia Press, 2001."

Step 1: Activate the functionality External Application Checks

The first step is to activate the functionality **External application checks** on the **Functionality** tab in the **Project Data**.

Step 2: Create User Defined Additional Data

In the second step, User Defined Additional Data will be defined.

Through Tools > User defined AddData the User Defined Additional Data Library can be opened.

| 🗖 My addData templ | ate | S | |
|--------------------|-----|-------------------------|-------------------------------|
| 🏓 🤮 🗶 é | 3 | 😂 🖬 Al | • 7 |
| Corbel | | Name | Corbel |
| | | Slave add data | |
| | | User string database | |
| | | List of parameters | = |
| | | Picture | |
| | | Remove picture | <u></u> |
| | | Service tree definition | |
| | | Service name | MYAT1 Input of custom Add dat |
| | | Icon | |
| | | Remove icon | |
| | | AddData definition | |
| | | Type of data | Line on 1D member |
| | | 1 | |
| New Insert Edit | | Delete | Close |

The Name of the additional data is changed to 'Corbel'.

Step 2.1 Slave data

Only one type of additional data will be defined here and as such the check-box **Slave add data** is left unchecked.

Step 2.2 Define text strings

In the **User string database** the required strings are defined for the definition of the additional data. Since in this example Corbel Design is being illustrated the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|--------------------------------|-----------------------------|
| Service name | MYAT1 Input of custom add data | Data for Corbel Design |
| Type name | MYAT1 Custom defined add data | Corbel Design |
| Short name | MYAT1 MADI | Corb1 |
| Description | MYAT1 Description | Corbel |
| Name of check | MYAT1 Custom check | Corbel Design Check |

| S | String database | | | | | | | | |
|---|----------------------------------|----|------------------------|--|--|--|--|--|--|
| | Language English (United States) | | | | | | | | |
| | | ID | Text | | | | | | |
| | 1 | 1 | Data for Corbel Design | | | | | | |
| | 2 | 2 | Corbel Design | | | | | | |
| | 3 | 3 | Corb 1 | | | | | | |
| | 4 | 4 | Corbel | | | | | | |
| | 5 | 5 | Corbel Design Check | | | | | | |
| | • | 0 | | | | | | | |
| | | | | | | | | | |

The necessary strings for the definition of the data are inputted and in the next step the parameters can be defined.

Step 2.3 Define parameters

In this example, the mapping will concern of default Scia Engineer data (Cross-section dimensions, material properties and loading properties) as well as user defined parameters.

The user defined parameters can be defined through List of parameters.

| List of parameters | | | |
|--------------------|-------------|----|--------|
| | | | |
| Add item | Remove item | | |
| String database | | OK | Cancel |

First, two numerical parameters will be defined, the bearing width and the safety factor:

| Parameter | Туре | Default value | |
|-----------------------|--------|---------------|--|
| Bearing width b0 | Number | 100 mm | |
| Safety factor Gamma M | Number | 1,5 | |

In addition, a combo-box will be defined from which the user can select the reinforcement diameter:

| Parameter | Туре | Combo-box lines |
|------------------------|-----------|-----------------|
| Reinforcement diameter | Combo-box | 16 |
| | | 18 |
| | | 20 |
| | | 28 |
| | | 32 |

Through the button **String database** the text string database can be directly accessed. This allows a quick input of the strings required for the parameters.

For this example the following strings are added:

| Strings used in this example |
|------------------------------|
| b0 |
| Bearing width |
| Gamma M |
| Safety factor |
| Reinforcement diameter |
| 16 |
| 18 |
| 20 |
| 28 |
| 32 |

| angu | lage | English (United States) |
|----------------|----------------------|---|
| | ID | Text |
| 1 | 1 | Data for Corbel Design |
| 2 | 2 | Corbel Design |
| 3 | 3 | Corb 1 |
| 4 | 4 | Corbel |
| 5 | 5 | Corbel Design Check |
| 6 | 6 | b0 |
| 7 | 7 | Bearing width |
| 8 | 8 | Gamma M |
| 9 | 9 | Safety factor |
| 10 | 10 | Reinforcement diameter |
| 11 | 11 | 16 |
| 12 | 12 | 18 |
| 13 | 13 | 20 |
| 14 | 14 | 28 |
| 15 | 15 | 32 |
| • | 0 | |
| | | |
| lote: efaul | The str It set fo | ing database which is used depends on the language or the workspace. |

Through the button **Add item** the first parameter, the safety factor Gamma M, is added.

| List of parameters | | | | | X |
|----------------------|-------------|---|------------|-----|-----|
| 1. Gamma M | Туре | | Number | | - |
| | Name | | Gamma M | 1 | • |
| | Description | | Safety fac | tor | - |
| | Unit | | Not used | | - |
| | Value | | 1,5 | | |
| | Range | | | | |
| | Use | | ⊠ | | |
| | Min | | 1 | | |
| | Max | | 10 | | |
| | | | | | |
| Add item Remove item | | | | | |
| String database | | O | ĸ | Can | cel |

The **Type** field is set to 'Number'.

In the **Name** and **Description** fields the respective strings can be chosen from the string database, in this case 'Gamma M' and 'Safety factor'.

For this parameter no Unit is used.

The default Value of the parameter is set to '1,5'.

In addition, a **Range** is set to make sure the input is only allowed between a minimum of '1' and a maximum of '10'.

In exactly the same way using the button **Add item** the second parameter, the Bearing width b0, is added.

| List of parameters | | | | | X |
|----------------------|---|---------------------|----|--------------------|---|
| 1. Gamma M 2. b0 | | Туре | | Number b0 | - |
| | | Name Description | | Bearing width | Ī |
| | | Unit Value [mm] | | mm (Length) 100 | - |
| | | Range Use | | 8 | |
| | | Min [mm] | | 10 500 | |
| | | Max [mm] | | 500 | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| | | | | | |
| Add item Remove item | L | | | | |
| String database | | | OK | Cancel | |

The Type field is set to 'Number'.

In the **Name** and **Description** fields the respective strings can be chosen from the string database, in this case 'b0' and 'Bearing width'.

For this parameter the Unit is set to 'mm (Length)'.

The default Value of the parameter is set to '100' mm.

In addition, a **Range** is set to make sure the input is only allowed between a minimum of '10' mm and a maximum of '500' mm.

Using the button Add item the final parameter, the Reinforcement diameter, is added.

| List of parameters | | |
|---------------------------|------------------------------|----------------------|
| 1. Gamma M 2. b0 | Туре | Combo-box |
| 3. Reinforcement diameter | Name Description Combo | Reinforcement diamet |
| | Edit combo box lines | |
| | | |
| | | |
| | | |
| | | |
| | | |
| | | |
| Add item Remove item | | |
| String database | C | K Cancel |

The Type field is set to 'Combo-box'.

For both the Name and Description fields the string 'Reinforcement diameter' is set.

Next, the lines in the combo-box are defined through the edit button Edit combo box lines.

| Edit combo box lines | | | | |
|----------------------|------------------------|---|-------|---|
| | Row text | | Orde | ~ |
| 1 | Data for Corbel Design | | 1 | |
| 2 | Corbel Design | | 1 | |
| 3 | Corb 1 | | 1 | |
| 4 | Corbel | | 1 | |
| 5 | Corbel Design Check | | 1 | _ |
| 6 | 60 | | 1 | |
| 7 | Bearing width | | 1 | |
| 8 | Gamma M | | 1 | |
| 9 | Safety factor | | 1 | |
| 10 | Reinforcement diameter | | 1 | |
| 11 | 16 | | 1 | |
| 12 | 18 | | 1 | |
| 13 | 20 | | 1 | ~ |
| | OK | 0 | ancel | |

The diameters inputted in the string database are selected and in the Order column the numbers '1', '2', '3', '4' and '5' are inputted.

| E | Edit combo box lines | | | | | | |
|---|----------------------|------------------------|-------------|--------|----------|--|--|
| [| | Row text | | Order | ^ | | |
| | 4 | Corbel | | 1 | | | |
| | 5 | Corbel Design Check | | 1 | | | |
| | 6 | 60 | | 1 | | | |
| | 7 | Bearing width | | 1 | | | |
| | 8 | Gamma M | | 1 | | | |
| | 9 | Safety factor | | 1 | | | |
| | 10 | Reinforcement diameter | | 1 | | | |
| | 11 | 16 | \boxtimes | 1 | | | |
| | 12 | 18 | \boxtimes | 2 | | | |
| | 13 | 20 | \boxtimes | 3 | | | |
| | 14 | 28 | \boxtimes | 4 | | | |
| | 15 | 32 | \boxtimes | 5 | | | |
| | | | | | ~ | | |
| | | ОК | | Cancel | | | |

When closing this dialog, the **Combo** item in the **List of Parameters** dialog shows how the combo-box will look like.

| List of parameters | | X |
|--|--|--|
| 1. Gamma M 2. b0 3. Reinforcement diameter | Type Name Description Combo Edit combo box lines | Combo-box Reinforcement diamet Reinforcement diamet 16 16 18 20 28 32 |

The required parameters are now defined and the dialog can be closed.

Step 2.4 Add a picture to the Additional Data

To clarify the use of the additional data and the defined parameters a picture can be added using the **Picture** button.

In this example the picture Excel_Example_3_Picture.bmp will be used.

| 🗖 My addData templa | ates | |
|---------------------|-------------------------|--|
| 🚚 🤮 🗶 🛍 🔛 é | 3 🚅 🖬 Al | • 7 |
| Corbel | Name | Corbel |
| | Slave add data | |
| | User string database | |
| | List of parameters | 🗏 |
| | Picture | Picture is selected |
| | Remove picture | |
| | Service tree definition | |
| | Service name | Data for Corbel Design |
| | Icon | |
| | Remove icon | |
| | AddData definition | |
| | Type of data | Line on 1D member |
| | h h. | Fa ea particular |
| New Insert Edit | Delete | Close |

Step 2.5 Define Service Tree

In the next step the Service Tree is defined through the group Service tree definition.

The **Service name** is taken automatically from the text string database.

To clarify the Service name, an icon can be added using the **Icon** button. In this example the icon **Excel_Example_3_Icon.bmp** will be used.

| Ξ | Service tree definition | | |
|------|-------------------------|------------------------|---|
| | Service name | Data for Corbel Design | - |
| lcon | | Icon is selected | |
| | Remove icon | | |

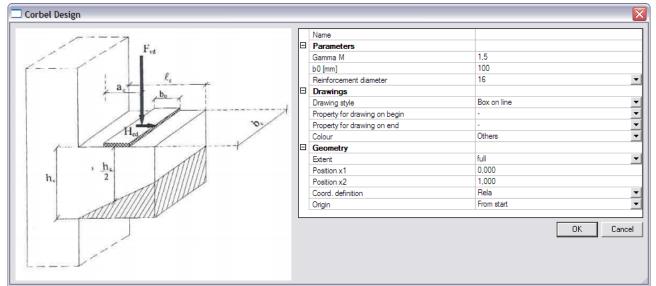
Step 2.6 Define the Additional Data

Using the data from the previous steps, the additional data can now be defined in the group **AddData** definition.

| Ξ | AddData definition | | |
|--------------|--------------------|-------------------|---|
| Type of data | | Line on 1D member | - |
| | Instance setup | | |
| Type name | | Corbel Design | - |
| | Short name | Corb 1 | - |
| | Description | Corbel | - |

Since the Corbel Design concerns the 'full' corbel, the check will be executed on the full length of the corbel. Therefore the field **Type of data** is set to 'Line on 1D member'.

The Type name, Short name and Description are taken automatically from the text string database.



To get an overview of all the data entered in the previous steps the button Instance Setup is used.

The Parameters group shows the user defined parameters specified in Step 2.3.

In the **Drawings** group, the **Drawing style** is set to 'Box on line'. For the **Colour field** 'Thermal load' is chosen.

| \square | Drawings | | |
|-----------|-------------------------------|--------------|---|
| | Drawing style | Box on line | • |
| | Property for drawing on begin | b0 | • |
| | Property for drawing on end | b0 | • |
| | Colour | Thermal load | • |

In addition, the Bearing width 'b0' is set as **Property for drawing on begin/end**. The Drawing style will thus change in function of the value of b0.

With this the additional data itself is defined and the dialog can be closed.

Step 2.7 Define the Check

In the group Check data the necessary data for the check itself can now be defined.

| Check data | | |
|------------------------|--|---|
| Name of check | Corbel Design Check 🗨 | |
| Setup for Brief output | | |
| Type of loads | | |
| Load cases | | |
| ULS combinations | | |
| SLS combinations | | |
| Result classes | | |
| Concrete combinations | | |
| | Name of check Setup for Brief output Type of loads Load cases ULS combinations SLS combinations Result classes | Name of check Corbel Design Check Setup for Brief output Type of loads Load cases ULS combinations SLS combinations Result classes |

The Name of check is taken automatically from the text string database.

The **Type of loads** group allows to specify which load types will be available for the check. Only the selected items will be available when executing the check.

Since in this example only one load case was defined, the design loading for the corbel, only the option 'Load cases' will be activated.

| Ξ | Type of loads | |
|---|-----------------------|-------------|
| | Load cases | \boxtimes |
| | ULS combinations | |
| | SLS combinations | |
| | Result classes | |
| | Concrete combinations | |

The final item for defining the check is the **Setup for Brief output** where the output parameters have to be defined.

| List of parameters | | | |
|--------------------|-------------|----|--------|
| | | | |
| Add item | Remove item | | |
| String database | | OK | Cancel |

For this example, two output parameters will be defined: the unity check value for the strut and the number of required reinforcement bars.

| Parameter | Unit |
|----------------|----------|
| Strut UC | - |
| Number of bars | Not used |

First of all, through the button **String database** the text string database is accessed to define the required strings. For this example the following strings are added:

| Strings used in this example |
|------------------------------|
| Strut UC |
| Number of bars |

| String database 🛛 🛛 🔀 | | | | | |
|----------------------------------|----------------------|--|----|--|--|
| Language English (United States) | | | • | | |
| | ID | Text | | | |
| 1 | 1 | Data for Corbel Design | | | |
| 2 | 2 | Corbel Design | | | |
| 3 | 3 | Corb 1 | | | |
| 4 | 4 | Corbel Design | | | |
| 5 | 5 | Corbel Design Check | | | |
| 6 | 6 | ь0 | | | |
| 7 | 7 | Bearing width | | | |
| 8 | 8 | Gamma M | | | |
| 9 | 9 | Safety factor | | | |
| 10 | 10 | Reinforcement diameter | | | |
| 11 | 11 | 16 | | | |
| 12 | 12 | 18 | | | |
| 13 | 13 | 20 | | | |
| 14 | 14 | 28 | 28 | | |
| 15 | 15 | 32 | | | |
| 16 | 16 | Strut UC | | | |
| 17 | 17 | Number of bars | ~ | | |
| Note: defaul | The stri t set fo | ing database which is used depends on the language r the workspace. | | | |
| | | OK Cancel | | | |

When the strings are defined, the first parameter is added through the button Add item.

| List of parameters 🛛 🔀 | | | | |
|------------------------|-------------------|-------------------|--|--|
| 1. Strut UC | Name | Strut UC 💌 | | |
| | Extreme for check | max 💌 | | |
| | Unit | - (Unity Check) 📃 | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| J | | | | |
| Add item Remove item | | | | |
| Add item Remove Item | | | | |
| String database | C | K Cancel | | |
| | | Curren | | |

In the Name field the 'Strut UC' string is chosen from the string database.

The Extreme for check is left on 'max' since the maximal unity check value is extreme in this case.

Since it concerns a unity check, the Unit field is left on '- (Unity Check)'.

Again using the button **Add item** the second parameter is added.

External Application Checks for Excel – Example 3: Corbel Design

| List of parameters | | |
|----------------------|-------------------|------------------|
| 1. Strut UC | Name | Number of bars 🔻 |
| 2. Number of bars | Extreme for check | max 💌 |
| | Unit | Not used 🔹 |
| | | |
| Add item Remove item | | |
| String database | C | K Cancel |

In the **Name** field the 'Number of bars' string is chosen from the string database. The **Extreme for check** is left on 'max'.

For this parameter no unit is required so the Unit field is set to 'Not used'.

The check and output parameters have now been defined so in the next step the link can be set.

Step 2.8 Specify the type of external link

In the **External link data** group the **Type of external link** allows to specify which external application will be used.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

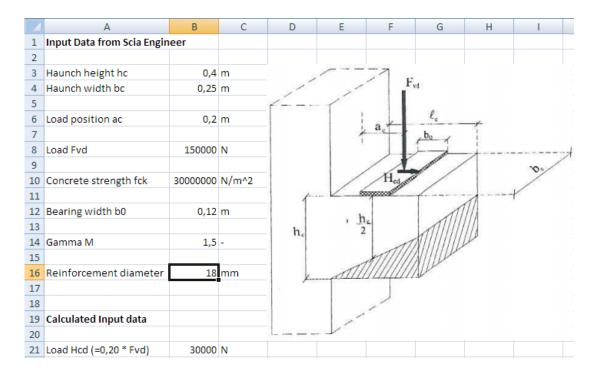
In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.9 Define the mapping with the external application

All preparation has now been done, what remains is the most important step of the process: defining the actual mapping between properties and parameters of Scia Engineer and the data fields (i.e. Excel cells) of the external application.

Through the button **Edit external file mapping** the mapping dialog is opened.

In this example, the Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:



The sheet 'Check' shows the check and reinforcement design:

| | А | В | С | D |
|----|---------------------|-----------------|--------|----|
| 1 | Application of stru | t and tie model | | |
| 2 | 0,4 hc <= ac <= hc | ОК | | |
| 3 | | | | |
| 4 | | | | |
| 5 | Check of strut | | | |
| 6 | | | | |
| 7 | Ncd | 353,55 | kN | |
| 8 | | | | |
| 9 | A0 | 45000 | mm^2 | |
| 10 | | | | |
| 11 | Sigma cd | 11,11111111 | N/mm^2 | |
| 12 | | | | |
| 13 | Nu*fcd | 14 | N/mm^2 | |
| 14 | | | | |
| 15 | Check | 0,79 | | |
| 16 | | | | |
| 17 | | | | |
| 18 | Design of tension i | reinforcement | | |
| 19 | | | | |
| | Cover c | 25 | mm | |
| 21 | | | | |
| | d | 465 | mm | |
| 23 | | | | |
| 24 | As required | 578,71 | mm^2 | |
| 25 | | | | |
| 26 | As to provide | | diam. | 20 |
| 27 | | 628 | mm^2 | |

In this example, cross-section properties have to be sent to Excel. In the document, it can be seen how the dimensions of a rectangular concrete section are defined:

| Param.length name | Н |
|------------------------|-----|
| | В |
| Param.length value[mm] | 600 |
| | 300 |

More specifically, the dimensions are located within the **Param. length value** array. This implies that, when this data is mapped to Excel, two cells will be filled since the array contains two items. Array mapping concern a very convenient way to map multiple values. Only the starting cell and the direction of the array (horizontal or vertical) need to be specified.

As specified in the introduction of this example, in the Excel file, all cells to which data has to be mapped and from which data is read have been given a name. These named cells can now be used in the **Cell address** field instead of manually typing the cell number.

| Object | Property | Worksheet | Named Cell (Address) |
|--------------------------|---|-----------|-------------------------------|
| Cross-Sections | Param. length value (Parameters) | Input | Cross-Section_Parameters (B3) |
| Point force on beam | Position x (Geometry) | Input | Load_position_ac (B6) |
| Point force on beam | Value - F | Input | Load_Fvd (B8) |
| Concrete EC2 | Characteristic compressive cylinder strength [28] (Fck) (EC2) | Input | Concrete_strength_fck (B10) |
| <<< My input parameters | b0 | Input | Bearing_width_b0 (B12) |
| <<< My input parameters | Gamma M | Input | Gamma_M (B14) |
| <<< My input parameters | Reinforcement diameter | Input | Reinforcement_diameter (B16) |
| >>> My output parameters | Strut UC | Check | Strut_UC (B15) |
| >>> My output parameters | Number of bars | Check | Number_of_bars (B26) |

The following table shows which properties should be mapped to which cells:

The Object 'Concrete EC2' exists twice, once for EC-ENV and once for EC-EN. The Property 'Characteristic compressive cylinder strength [28] (Fck) (EC2)' can be found in the EC-EN Object.

■ For the position of the loading, the property Position x is used. It is important to note that this position is dependent on the coordinate definition of the point load: this can either be absolute or relative. For this example, the Position x has been inputted as absolute. The Excel file could be modified with a test to see if the coordinate definition is absolute or relative and modify the Position x value accordingly.

The mapping of the first property, the cross-section dimensions, is thus done as follows:

The Object field is set to 'Cross-sections'.

In the **Property** field 'Param. length value (Parameters)' can then be chosen.

Using the Browse button, the file Excel_Example_3.xls is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Input'.

The **Arrays direction** is set to 'Vertical' since this array contains two values which need to be positioned in a vertical column.

Finally, in the field **Cell address** the named cell 'Cross-Section_Parameters' is chosen using the combo-box. Automatically the **Current value** field will show the current content of the cell, in this case 0,4. During the mapping, the first parameter of the array, in this case the value of the height, will be mapped to cell B3. The second parameter of the array, in this case the value of the width, will be mapped to cell B4.

When all input has been done, this mapping is added to the table using the Add button.

| Excel Link | | | | | × |
|-----------------------|-------------------|-----------------------|--------------|--------------------------|----------|
| Data | File | | Worksheet | Cell | Array |
| Cross-Sections.Param. | length val D:\ES | A_Excel\Excel_Exampl | . Input | Cross_Section_Parameters | Vertical |
| | | | | | |
| | | | | | |
| | | | | | |
| Add Ut | | | | | Remove |
| | odate | | | _ | nelliuve |
| Source | | | | | |
| <u>O</u> bject | Cross-Sections | | | • | |
| <u>P</u> roperty | Param. length val | ue (Parameters) | | • | |
| _ | | | | | |
| Target | | cel_Example_3\Excel_E | iuseste 2 de | | Browse |
| <u>E</u> xcel file | D. YESA_EXCEIVES | | | | Browse |
| <u>W</u> orksheet | Input | <u>C</u> ell addre | ess Cross | _Section_Parameters 💌 | |
| Arrays direction | Vertical | Current v | alue 0,4 | | Show |
| | | | | | |
| | | | | ОК | Cancel |
| | | | | | |

In the same way, all other parameters can be mapped using the above table. For the other parameters, the array direction is left on horizontal.

| Excel Link | | | | | X |
|---|--|--|--|--|---|
| Data | File | Worksheet | Cell | Array | ~ |
| Concrete EC2 Characteristic com <<< My input parameters.b0 <<< My input parameters.Gamma M <<< My input parameters.Reinforc >>> My output parameters.Strut UC >>> My output parameters.Numbe | D:\ESA_Excel\Excel_Exampl D:\ESA_Excel\Excel_Exampl | Input Input Input Input Check Check | Concrete_strength_fck Bearing_width_b0 Gamma_M Reinforcement_diameter Strut_UC Number_of_bars | Horizontal Horizontal Horizontal Horizontal Horizontal |] |
| Add Update | | | | Remov | 3 |
| Source | | | | | |
| Dbject >>> My o | Dbject >>> My output parameters | | | | |
| Property Number of | f bars | | • | | |
| - Target | | | | | |
| Excel file D:\ESA_E | Excel\Excel_Example_3\Excel_Exa | mple_3.xls | | Browse | |
| Worksheet Check | Cell address | . Nu | imber_of_bars | | |
| Arrays direction Horizonta | I 💽 Current valu | le 2 | | Show | |
| | | | | | |
| | | | OK | Cancel | |

All parameters are now mapped to Excel. The final step left for the definition of the additional data is specifying a Detailed output.

Step 2.10 Define the Detailed output

In *Step 2.7* the parameters for the Brief output have been defined. These parameters will be used for the check. In addition, a Detailed output can also be specified to show an in-depth overview of the check.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

By clicking on Setup for Detailed output, the Detailed output dialog is opened.

| E | xternal links for documen | t | | × |
|---|---------------------------|------------|------------------|---------------------|
| | Caption | Excel file | Worksh Upper-I B | ottom |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| | Add Update | | | Remove |
| | Item | Caption: | | _ |
| | | | Source file | Range |
| | Excel file: | | Top - le | ft cell |
| | Worksheet: | | | Bottom - right cell |
| | • | | | - |
| | | | | |
| | String database | | OK | Cancel |

In this example, two ranges will be defined. One which shows the input data and one which shows the results. For ease of reference, here also Named cells have been defined in the Excel file.

| Caption | Worksheet | Top – left cell | Bottom – right cell |
|---------------|-----------|-----------------|---------------------|
| Input Data | Input | Input_Top_Left | Input_Bottom_Right |
| Corbel Design | Check | Check_Top_Left | Check _Bottom_Right |

Through the button **String database** the text string database can be directly accessed. For this example the following string is added:

| Strings used in this example |
|------------------------------|
| Input Data |

| Langu | age | English (United States) | • | | | | |
|--|-------------------|-------------------------|---|--|--|--|--|
| | ID | Text | ^ | | | | |
| 2 | 2 | Corbel Design | | | | | |
| 3 3 Corb 1 | | | | | | | |
| 4 4 Corbel Design | | | | | | | |
| 5 | 5 | Corbel Design Check | | | | | |
| 6 | 6 | b0 | | | | | |
| 7 | 7 | Bearing width | | | | | |
| 8 8 Gamma M | | | | | | | |
| 9 | 9 9 Safety factor | | | | | | |
| 10 10 Reinforcement diameter | | | | | | | |
| 11 11 16 | | | | | | | |
| 12 | 12 | 18 | | | | | |
| 13 | 13 | 20 | | | | | |
| 14 | 14 | 28 | | | | | |
| 15 | 15 | 32 | | | | | |
| 16 | 16 | Strut UC | | | | | |
| 17 | 17 | Number of bars | | | | | |
| 18 | 18 | Input Data | | | | | |
| Note: The string database which is used depends on the language default set for the workspace. | | | | | | | |

All required strings are no available so the ranges can be defined.

In the Caption field the string 'Input Data' is chosen.

In the Excel file field the file Excel_Example_3.xls is searched using the browse button.

The Worksheet field is set to 'Input'.

In the **Range** group the **Top - left** cell is set as 'Input_Top_Left' and the **Bottom - right** cell as 'Input_Bottom_Right'.

When all input has been done, the data is added to the table using the Add button.

| kternal links | for document | | | | |
|--|-----------------------------|--------------------|--------|-----------------------------------|---|
| Caption Input Data | Excel file D:\ESA_Excel\ | Excel_Example_3\Ex | | Upper-left cell Input_Top_Left | Bottom-right cell Input_Bottom_Right |
| | | | | | |
| Add | Update | Caption: Input D | ata | | Remove |
| Excel file: D:\ESA_Exc Worksheet: Input | el\Excel_Example_3\ | | Source | | Range _To V Bottom - right cell Input_Bo V |
| String databa | ase | | | OK | Cancel |

In the same way, using the above table the second range is added.

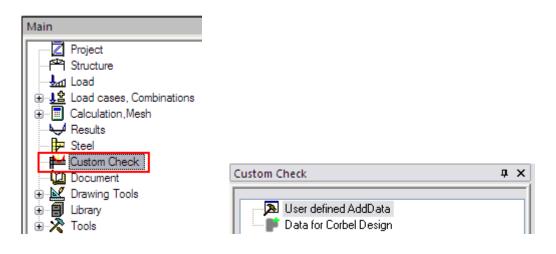
External Application Checks for Excel – Example 3: Corbel Design

| xternal links f | or document | | | | | | | 6 |
|-----------------|-----------------------|-----------|-----------|--------|--------------|--------|----------|--------------|
| kternat links i | or document | | | | | | | |
| Caption | Excel file | | | Works | Upper-lef | t cell | Bottom-r | ight cell |
| Input Data | D:\ESA_Excel\Excel | | | Input | Input_To | | | ottom_Right |
| Corbel Design | D:\ESA_Excel\Excel | _Example_ | _3\Ex | Check | Check_To | p_Left | Check_B | ottom_Right |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| | | | | | | | | |
| Add | Update | | | | | | | Remove |
| Item | | | | | | | | |
| | | Caption: | Corbel | Design | | | | • |
| | | | | Sc | ource file – | | | Range |
| Excel file: | | | | | | | eft cell | _ |
| D:\ESA_Exo | el\Excel_Example_3\Ex | cel_Examp | ole_3.xls | | | Check | <u>_</u> | |
| Worksheet: | | | | | | | Bottom | - right cell |
| Check | • | | | | | | Che | eck_Br 👻 |
| | | | | | | | | |
| | 1 | | | | | | | |
| String databa | se | | | | | OK | | Cancel |

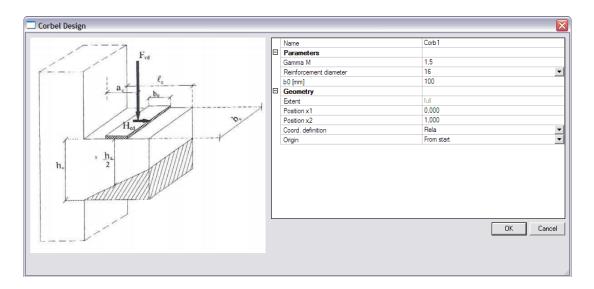
With this final step, the User Defined Additional Data has been fully inputted and the **User Defined Additional Data** Library can be closed.

Step 3: Input the User Defined Additional Data on members/nodes

After closing the **User Defined Additional Data** Library a new service will be shown in the Scia Engineer tree: **Custom Check**.

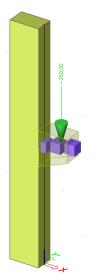


The additional data which was defined in *Step 2*, can now be inputted on the member. When double clicking on **Data for Corbel Design** the dialog with the properties of the data is displayed:



The **Parameters** group holds the user defined parameters of *Step 2.3* with their default values. In this case the safety factor 'Gamma M', the Bearing width 'b0' and the combo-box 'Reinforcement diameter'.

The default values of the dialog are confirmed with [OK] and the data is inputted on the corbel.



- Through the View Parameter settings, the Style / Rendering of the additional data can be specified on the Misc. tab. This works in the same way as for any other type of additional data (loads, supports ...).
- In case the additional data is too large or too small, the scale multiplier 'User defined AddData' in the default Scia Engineer Scales manager.

The data has now been inputted and in the next step the check can be executed.

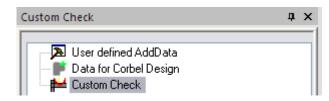
Step 4: Execute the Custom Check

In *Step 2* the additional data has been defined including the definition of the check, the mapping to Excel... In *Step 3* the additional data has been inputted. What is left is the execution of the check.

| First of all the linear analysis is launched | First of | all the | linear | analvsis | is | launched |
|--|----------|---------|--------|----------|----|----------|
|--|----------|---------|--------|----------|----|----------|

| FE analysis | | | X |
|-------------|---|------------|---|
| | Single analysis Batch analysis | |] |
| 18 | Linear calculation | V | |
| | C Nonlinear calculation | Г | |
| | 🔿 Modal analysis | Г | |
| | C Linear stability | Г | |
| | C Concrete - Code Dependent Deflections | Г | |
| | C Influence lines and surfaces | Г | |
| | C Construction stage analysis | Г | |
| | C Nonlinear stage analysis | Г | |
| | C Nonlinear stability | | |
| | Test of input data | | |
| | Number of load cases: 1 | | |
| | , | | |
| | Solver setup | Mesh setup | |
| 10 | ОК | Cancel | |

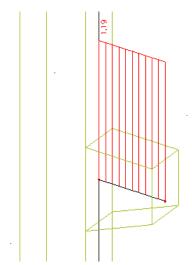
When user defined additional data was inputted and the analysis has been executed, the **Custom Check** service will show a new item: **Custom Check**.



In the property window of the check, the **Values** field is set to 'Strut UC' and the **Refresh** action button is pressed to execute the check.

| Properties | μ × |
|------------------|-----------------|
| Custom check (1) | - Vi V/ / |
| Name | Custom check |
| Selection | All |
| Load cases | LC1 - Loading 🔹 |
| Filter | No |
| Values | Strut UC |
| Extreme | Global 💌 |
| Output | Brief |
| Drawing setup | |
| Section | All |

The following check result is shown on screen:



When pressing the **Preview** action button, the Brief preview shows the following:

Customcheck

Linear calculation, Extreme : Global Selection : All Load cases : LC1 The check was executed according to the following user defined Excel file(s): D:\ESA_Excel\Excel_Example_3\Excel_Example_3.xls

| TypeName | Data | Css | Material | dx [m] | Case |
|--------------|-------|---------------|----------|-----------|------|
| Custom check | Corb1 | Corbel - RECT | C30/37 | 0,000 | LC1 |

Using the table composer, both the Strut UC and number of bars can be added to the output as specified in the previous examples. After refreshing the following preview is shown:

Customcheck

```
Linear calculation, Extreme : Global
Selection : All
Load cases : LC1
The check was executed according to the following user defined Excel file(s):
D:\ESA_Excel\Excel_Example_3\Excel_Example_3.xls
                                                                            Strut UC Number of bars
  Type Name
                   Data
                                  Css
                                             Material
                                                           dx
                                                                    Case
                                                          [m]
                                                                                [-1
Custom check
                           Corbel - RECT
                                            C30/37
                                                           0,000 LC1
                Corb1
                                                                                   19
                                                                                      3
                                                                                 1
```

Next, the Detailed output is examined. The **Output** field is set to 'Detailed' and the **Refresh** action button is pressed.

Customcheck

```
Linear calculation, Extreme : Global
Selection : All
Load cases : LC1
The check was executed according to the following user defined Excel file(s):
D:\ESA_Excel\Excel_Example_3\Excel_Example_3.xls
Type Name
Custom check
```

Here also, the newly created output table needs to be added to the output using the table composer. Both ranges defined in *step 2.10* can now be added to the output.

| Table Composer | | | | |
|---|-----------------|--|--|------|
| C:\Documents and Settings\PeterVT | | · · · · · · · · · · · · · · · · · · · | ss.8.00.ResultPresentat [default].otx | |
| Standard Advanced - Table A Contents of table Items in Table Type Name Input Data Corbel Design | Ayailable Items | ngineer Properties e Name ut Data bel Design I Views | Table Iemplate name Iable type Vertical table (column per property) Eit Table to Page Width Column(s) / Row(s) Caption Corbel Design Alignment Default No header Do not aggregate caption at horizontal tables | |
| <u>R</u> emove | << <u>A</u> dd | | | |
| Preview | | | | |
| TypeName | InputData | Corbel Desi | qn | |
| Custom check | 349 | 769 | | ≡ |
| Custom check | 907 | 706 | | |
| Custom check | 610 | 355 | | |
| Ready [en] | 660 | 63 | 1 | ~ |
| | | | ОК Са | ncel |

In addition, the size of these tables can be set to 100mm by 100mm.

| Table Composer | | | | | - 🗆 🛛 | | | | | |
|--|---------------------------|-----------------|------------------------------|-----------------------------|----------|--|--|--|--|--|
| C:\Documents and Settings\PeterVT\ESAD9\user\DocumentTemplates\CustomBasicClass.8.00.ResultPresentat [default].otx | | | | | | | | | | |
| Standard Advanced - Table | Advanced - Columns / Rows | Layout Property | | | | | | | | |
| Items in Table | <u> </u> | width [mm] | Line(s)/Row(s) styles | | | | | | | |
| 📒 Input Data | 🔽 <u>U</u> s | e Default | Use <u>t</u> able styles | | | | | | | |
| Corbel Design | <u>M</u> inima | i 15 | <u>H</u> eader style | Table header | ✓ … | | | | | |
| | <u>D</u> elta | 5 | Content style | Table line | | | | | | |
| | Picture Width | Size [mm] | Other Representation of p | parametric values | | | | | | |
| | Height | 100 | Contents does r | not make <u>v</u> alid line | | | | | | |
| | | | | | | | | | | |
| Preview | | | | | | | | | | |
| TypeName | Input Data | Corbel Desi | g n | | <u>^</u> | | | | | |
| Custom check | 490 | 280 | | | ≡ | | | | | |
| Custom check | 985 | 690 | | | | | | | | |
| Custom check | 427 | 239 | | | | | | | | |
| Ready [en] | 113 | Q/1 | | | ~ | | | | | |
| | | | | ОК | Cancel | | | | | |

After refreshing, the following output is shown:

Customcheck

| Selection:All Loadcases:LC1 The checkwas e | xecuted according to the follow | | (s): | |
|--|---------------------------------------|----------------|------------------------------------|------------------------|
| D:\ESA_Excel\Ex TypeName | cel_Example_3\Excel_Example Input[| - | | Corbel Design |
| Custom check | Input Data from Scia Engineer | | Application of strut and tie model | |
| | | | 0,4 hc <= ac <= hc | OK |
| | Haunch height hc | 0,6 m | | |
| | Haunch width bc | 0,3 m | Check of strut | |
| | Load position ac | 0,25 m | Ncd | 353,55 kN |
| | | | AO | 30000 mm^2 |
| | Load Fvd | -250000 N | Sigma cd | 16,666666667 N/mm^2 |
| | Concrete strength fck | 30000000 N/m^2 | Nu*fcd | 14 N/mm^2 |
| | Bearing width b0 | 0,1 m | Check | 1,19 |
| | Gamma M | 1,5 - | Design of tension r | einforcement |
| | Reinforcement diameter | 16 mm | Cover c | 21 mm |
| | | | d | 571 mm |
| | Calculated Input data | | As required | 417,10 mm^2 |
| | Load Hcd (=0,20 * Fvd) | -50000 N | As to provide | 3 diam. 16 603 mm^2 |

The output shows the array mapping of the haunch dimensions hc and bc. In addition the conditional formatting used in the Excel file is nicely shown in the Scia Engineer output.

In a next step, the additional data is selected and some changes are made to the input: the bearing width b0 is increased to **250 mm** and the reinforcement diameter is set to **20**.

| Co | orbel Design (1) | - Va V/ / |
|----|------------------------|--------------|
| | | |
| | Name | Corb 1 |
| E | Parameters | |
| | Gamma M | 1,5 |
| | b0 [mm] | 250 |
| | Reinforcement diameter | 20 💌 |
| | Member | B2 |
| E | Geometry | |
| | Extent | full |
| | Position x1 | 0,000 |
| | Position x2 | 1,000 |
| Ì | Coord. definition | Rela 🔻 |
| | Origin | From start 💌 |

After refreshing these changes are shown in the detailed output:

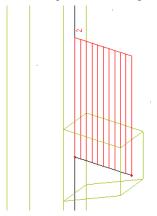
Customcheck

Linear calculation, Extreme : Global Selection : All Load cases : LC1 The check was executed according to the following user defined Excel file (s): D:\ESA_Excel\Excel_Example_3\Excel_Example_3.xls Type Name InputData CorbelDesign Custom check Application of strut and tie model Input Data from Scia Engineer 0,4 hc <= ac <= hc OK Haunch height hc 0,6 m Haunch width bc 0,3 m Check of strut 353,55 kN Ncd Load position ac 0,25 m **A**0 75000 mm^2 Load Fvd -250000 N 6.666666667 N/mm^2 Sigma cd Concrete strength fck 30000000 N/m^2 Nu*fcd 14 N/mm^2 0,48 Check Bearing width b0 0,25 m Gamma M 1,5 -Design of tension reinforcement 25 mm Cover c Reinforcement diameter 20 mm d 565 mm As required 496,64 mm^2 **Calculated Input data** As to provide 2 diam. Load Hcd (=0,20 * Fvd) -50000 N 628 mm^2

Previously the Strut unity check was displayed on screen. In the same way the number of bars can be shown by changing the **Values** field to 'Number of bars'.

| Properties | |
|------------------|----------------|
| Custom check (1) | 💽 Va V/ 🖉 |
| Name | Custom check |
| Selection | All |
| Load cases | LC1 - Loading |
| Filter | No |
| Values | Number of bars |
| Extreme | Global |
| Output | Detailed |
| Drawing setup | |
| Section | All |

After refreshing, the following result is shown on screen:



By default this graphical result is shown in red since the result is greater than 1,00. However, using the default Drawing Setup of Scia Engineer, this setting can be changed as in any other check service.

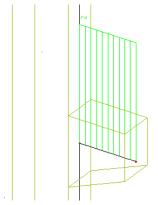
20

| Drawing setup | $\overline{\mathbf{X}}$ | |
|--|--|--|
| Representation : Limits : | Hatches 🗨 | |
| Number of bars Maximum [] 1 Minimum [] 0,25 | | |
| Description Image: Constraint of the section of the sectin of the section of the section of the section of the | | |
| Angle of text C 0 deg I 90 deg | C User defined 0,00 deg | |
| Setup for more components C Same scale C Same height | Space between diagrams 1 + Shift of the first diagram + 0 + | |
| | OK Cancel | |

The default minimum and maximum limits for check results are 0,25 and 1,00. For the Number of bars, the minimum can be set to 1 and the maximum to for example 10.

| Ξ | Number of bars | | |
|---|----------------|----|--|
| | Maximum [] | 10 | |
| | Minimum [] | 1 | |
| | | | |
| | | | |

After refreshing, the graphical result is now shown in green since the value is between the minimum and maximum limits.



Step 5: Save the User Defined Additional Data into a database for future use

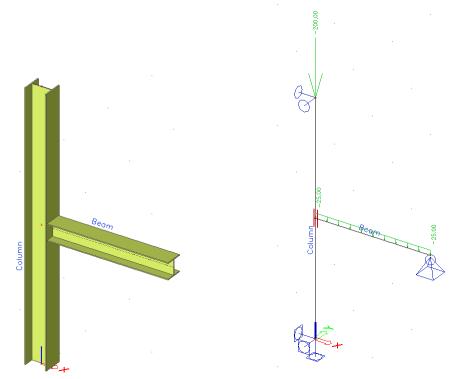
If required, this additional data can be saved into a database for future use as illustrated in Example 1.

Example 4: Moment Resisting Connection

In this fourth example, the working of slave data is explained. In addition, the use of point data and nodal data is illustrated

As a practical case a steel moment resisting connection is used.

In this example, a typical beam-column connection is modelled. The column has a height of **4m** and the beam is attached in the middle. The beam has a length of **2m**. Both members are manufactured in **S235** according to **EC-EN**.



For this example, the beam has a **HEA 260** cross-section. The column also has a cross-section of type **HEA** but can vary (i.e. any type of HEA can be applied).

Three load cases are defined:

- LC1: Self Weight of the members
- LC2: Dead Load: 50 kN/m on the beam
- LC3: Live Load: 25 kN/m on the beam, 200 kN on the column

The load cases are grouped into an ultimate limit state combination of type EN-ULS (STR).

The check will be done according to the Excel file "Excel_Example_4.xls"

The Excel file contains two worksheets. On the sheet 'Input' the input data are set:

| | А | В | С |
|----|----------------------------|--------|----|
| 1 | Input Data from Scia Engin | | |
| 2 | | | |
| 3 | Column Cross-section | HEA340 | |
| 4 | | | |
| 5 | MEd Beam at connection | 65000 | Nm |
| 6 | | | |
| 7 | Bolts | M16 | |
| 8 | | | |
| 9 | | | |
| 10 | Calculated Input Data | | |
| 11 | | | |
| 12 | Column Type HEA | 340 | |

| | А | В | С | D |
|----|----------------|-----------------|----------------|---------------------------|
| 1 | DSTV Table for | r IH3 connecti | on with HEA26 | 0 beam |
| 2 | | | | |
| 3 | Bolts | Column HEA | My,Rd [kNm] | Limiting part |
| 4 | M16 | 180 | 30,24 | Column Flange in bending |
| 5 | | 220 | 45,36 | Column Flange in bending |
| 6 | | 240 | 60,48 | Column Flange in bending |
| 7 | | 340 | 75,6 | Bolts in Tension |
| 8 | M20 | 200 | 47,96 | Column Flange in bending |
| 9 | | 280 | 71,94 | Column Web in Shear |
| 10 | | 340 | 95,92 | Column Web in Shear |
| 11 | | 450 | 119,9 | Bolts in Tension |
| 12 | M24 | 240 | 65,32 | Column Web in Compression |
| 13 | | 320 | 97,98 | Column Web in Compression |
| 14 | | 450 | 130,6 | Column Web in Compression |
| 15 | | 700 | 163,3 | Bolts in Tension |
| 16 | | | | |
| 17 | Check of Conn | ection | | |
| 18 | | | | |
| 19 | Connection ac | cording to DS | TV Anlage 1,43 | |
| 20 | | | | |
| 21 | Connection ty | pe: IH 3 with E | Beam HEA260 | |
| 22 | | | | |
| 23 | Bolts | M16 | | |
| 24 | | | | |
| 25 | Column | HEA340 | | |
| 26 | | | | |
| 27 | MEd | 65 | kNm | |
| 28 | | | | |
| 29 | MRd | 75,6 | kNm | |
| 30 | | | | |
| 31 | Limiting part | Bolts in Tensi | ion | |
| 32 | | | | |
| 33 | Unity Check | 0,86 | - | |

The sheet 'Check' shows the determination of the moment resistance and the unity check.

The determination of the moment resistance is based on tabulated values from "*DSTV*, *Anlage 1.43 zum Prüfbescheid II B 3-543-585 vom 14.07.2000*" which gives the MRd value of an extended end plate connection for different combinations of beam – column – bolts.

For this example, the beam has been given a fixed cross-section of HEA 260. The bolts can vary between M16, M20 and M24. The column can have any type of HEA cross-section.

As for a typical connection, data of different entities has to be sent to Excel. This can be done using slave additional data:

- From the column the cross-section has to be mapped. No check or output is required. On the column slave data will thus be defined.
- From the beam the end moment has to be mapped. No check or output is required. On the beam slave data will thus be defined.
- The actual Connection Data will include the bolt type and the connection check, combining the input of the previous two 'slaves'. The connection data will be inputted on the node between the beam and column.

External Application Checks for Excel - Example 4: Moment Resisting Connection

Step 1: Activate the functionality External Application Checks

The first step is to activate the functionality **External application checks** on the **Functionality** tab in the **Project Data**.

Step 2: Create User Defined Additional Data

In the second step, User Defined Additional Data will be defined.

Through Tools > User defined AddData the User Defined Additional Data Library can be opened.

As specified, three types of additional data will be defined:

- Column Data
- Beam Data
- Connection Data

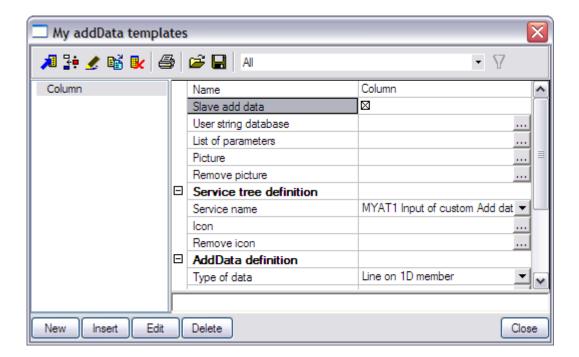
The different input steps are thus repeated for each data.

Step 2.1. (Column) Slave data

First of all the additional data for the column is inputted.

The Name of the additional data is therefore changed to 'Column'.

Since it concerns slave additional data the checkbox Slave add data is activated.



As explained during the first example, slave data can only be used to send data to Excel, not to read data from Excel. Therefore all output options are not available for this kind of data.

Step 2.2. (Column) Define text strings

In the **User string database** the required strings are defined for the definition of the additional data. For the column data the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|--------------------------------|-----------------------------|
| Service name | MYAT1 Input of custom add data | Input of Column Data |
| Type name | MYAT1 Custom defined add data | Column Data |
| Short name | MYAT1 MADI | Col1 |
| Description | MYAT1 Description | Column |
| Name of check | MYAT1 Custom check | Connection Check |

| s | String database | | |
|---|-----------------|----|--|
| | Language | | English (United States) |
| | | ID | Text |
| | 1 | 1 | Input of Column Data |
| | 2 | 2 | Column Data |
| | 3 | 3 | Col1 |
| | 4 | 4 | Column |
| | 5 | 5 | Connection Check |
| | • | 0 | |
| | | | ing database which is used depends on the language r the workspace. |
| | | | OK Cancel |

Since slave data have no output and thus no check, the text string for the check will not be used and therefore it is not required to modify it.

Step 2.3. (Column) Define parameters

In this example, the cross-section of the column has to be mapped to Excel. Therefore no additional parameters are required and thus no parameters are defined.

Step 2.4. (Column) Add a picture to the Additional Data

In this example, no picture is added to the column data since this data just represents slave data and does not require any clarifying picture.

External Application Checks for Excel – Example 4: Moment Resisting Connection

Step 2.5. (Column) Define Service Tree

In the next step the Service Tree is defined through the group Service tree definition.

The **Service name** is taken automatically from the text string database.

| Ξ | Service tree definition | |
|---|-------------------------|----------------------|
| | Service name | Input of Column Data |
| | lcon | |
| | Remove icon | |

In this example, no icon is added to the column data.

Step 2.6. (Column) Define the Additional Data

Using the data from the previous steps, the additional data can now be defined in the group **AddData definition**.

| Ξ | AddData definition | |
|---|--------------------|-------------------|
| | Type of data | Line on 1D member |
| | Instance setup | |
| | Type name | Column Data 💌 |
| | Short name | Col1 |
| | Description | Column |

The field Type of data is set to 'Line on 1D member'.

In this example, only the cross-section of the column will be sent to Excel so also 'Point on 1D member' could have been used.

The Type name, Short name and Description are taken automatically from the text string database.

To get an overview of all the data entered in the previous steps the button Instance Setup is used.

| Column Data | |
|-------------------------------|-------------|
| Name | |
| Parameters | |
| | |
| Drawing style | Box on line |
| Property for drawing on begin | · |
| Property for drawing on end | · |
| Colour | Others 💌 |
| Geometry | |
| Extent | full |
| Position x1 | 0,000 |
| Position x2 | 1,000 |
| Coord. definition | Rela |
| Origin | From start |
| | |
| | |
| | |
| | |
| | |
| | |
| | OK Cancel |

In the **Drawings** group, the **Drawing style** is set to 'Box on line'. For the **Colour field** 'Thermal load' is chosen.

| Drawings | | |
|-------------------------------|----------------|---|
| Drawing style | Box on line | l |
| Property for drawing on begin | · · | l |
| Property for drawing on end | · · | l |
| Colour | Thermal load 🔹 | l |

Since no user defined parameters have been inputted, no parameter can be set as **Property for drawing on begin/end**. These fields are thus left empty.

Step 2.7. (Column) Specify the type of external link

In the **External link data** group the **Type of external link** allows to specify which external application will be used.

| Ξ | External link data | |] |
|---|----------------------------|-------|---|
| | Type of external link | Excel | l |
| | Edit external file mapping | | |

In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.8. (Column) Define the mapping with the external application

The preparation of the slave column data has now been done, what remains is defining the mapping to Excel.

Through the button **Edit external file mapping** the mapping dialog is opened.

In this example, the Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:

| | А | В | С |
|----|----------------------------|--------|----|
| 1 | Input Data from Scia Engin | | |
| 2 | | | |
| 3 | Column Cross-section | HEA340 | |
| 4 | | | |
| 5 | MEd Beam at connection | 65000 | Nm |
| 6 | | | |
| 7 | Bolts | M16 | |
| 8 | | | |
| 9 | | | |
| 10 | Calculated Input Data | | |
| 11 | | | |
| 12 | Column Type HEA | 340 | |

This is the only sheet of importance for the column data since slave data concern only the mapping of input properties.

The following table shows which property should be mapped to which cell:

| Object | Property | Worksheet | Cell Address |
|----------------|----------|-----------|--------------|
| Cross-Sections | Туре | Input | B3 |

The mapping of this property is thus done as follows:

The **Object** field is set to 'Cross-sections'.

In the **Property** field 'Type' can then be chosen.

Using the Browse button, the file Excel_Example_4.xls is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Input'.

The Arrays direction is set to 'Horizontal'.

Finally, in the field **Cell address** the cell 'B3' is typed. Automatically the **Current value** field will show the current content of the cell, in this case HEA340.

When all input has been done, this mapping is added to the table using the Add button.

| Excel Link | | | | × |
|---------------------|--------------------------------------|--------------|------|------------|
| Data | File | Worksheet | Cell | Array |
| Cross-Sections.Type | D:\ESA_Excel\Excel_Example_4\ | Input | B3 | Horizontal |
| | | | | |
| | | | | |
| | | | | |
| Add Upo | late | | | Remove |
| Source | | | | |
| <u>O</u> bject | Cross-Sections | | • | |
| Property | Туре | | | |
| Tipperty | 1.164 | | | |
| Target | | | | |
| <u>E</u> xcel file | D:\ESA_Excel\Excel_Example_4\Excel_E | xample_4.xls | | Browse |
| <u>W</u> orksheet | Input Cell addre | ess B3 | • | |
| Arrays direction | Horizontal Current v. | alue HEA340 | | Show |
| | | | | |
| | | | ок | Cancel |
| | | | | |

With the input of the mapping, the definition of the column slave data has been completed. In the same way, slave data will now be defined for the beam.

Step 2.1. (Beam) Slave data

Second, the additional data for the beam is inputted using the button **New** in the **User Defined Additional Data** Library.

The **Name** of the new additional data is changed to 'Beam'.

Since it concerns slave additional data the checkbox Slave add data is activated.

| 🗆 My addData templates 🛛 🛛 🕅 | | | | | |
|------------------------------|-----------------------|-------------------------|--------------------------------|---|--|
| 🎜 🤮 🗶 🖬 🔣 🤅 | 🥕 💱 🖉 👪 🛃 🎯 🚅 🖬 🛛 🔹 🖓 | | | | |
| Column | | Name | Beam | ~ | |
| Beam | | Slave add data | | | |
| | | User string database | | | |
| | | List of parameters | | | |
| | | Picture | | Ξ | |
| | | Remove picture | | | |
| | | Service tree definition | | | |
| | | Service name | Column1 Input of custom Add da | | |
| | | Icon | | | |
| | | Remove icon | | | |
| | | AddData definition | | | |
| | | Type of data | Line on 1D member | ~ | |
| New Insert Edi | t(| Delete | Clos | e | |

Step 2.2. (Beam) Define text strings

In the **User string database** the required strings are defined for the definition of the additional data. For the beam data the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|----------------------------------|-----------------------------|
| Service name | Column1 Input of custom add data | Input of Beam Data |
| Type name | Column 1 Custom defined add data | Beam Data |
| Short name | Column 1 MADI | Beam1 |
| Description | Column 1 Description | Beam |
| Name of check | Column 1 Custom check | Connection Check |

| Strin | String database | | | | |
|-------|-----------------|-------------------------|--|--|--|
| Lang | guage | English (United States) | | | |
| | ID | Text | | | |
| 1 | 1 | Input of Beam Data | | | |
| 2 | 2 | Beam Data | | | |
| 3 | 3 | Beam1 | | | |
| 4 | 4 | Beam | | | |
| 5 | 5 | Connection Check | | | |
| • | 0 | | | | |

Step 2.3. (Beam) Define parameters

In this example, the bending moment of the beam has to be mapped to Excel. Therefore no additional parameters are required and thus no parameters are defined.

Step 2.4. (Beam) Add a picture to the Additional Data

In this example, no picture is added to the beam data since this data just represents slave data and does not require any clarifying picture.

Step 2.5. (Beam) Define Service Tree

In the next step the Service Tree is defined through the group Service tree definition.

The Service name is taken automatically from the text string database.

| Ξ | Service tree definition | |
|---|-------------------------|--------------------|
| | Service name | Input of Beam Data |
| | lcon | |
| | Remove icon | |

In this example, no icon is added to the beam data.

Step 2.6. (Beam) Define the Additional Data

Using the data from the previous steps, the additional data can now be defined in the group **AddData** definition.

| Ξ | AddData definition | |
|---|--------------------|--------------------|
| | Type of data | Point on 1D member |
| | Instance setup | |
| | Type name | Beam Data 💌 |
| | Short name | Beam1 💌 |
| | Description | Beam 💌 |

The field **Type of data** is set to 'Point on 1D member'. The purpose of this beam slave data is to send the bending moment at the location of the connection. Therefore only one position is required, the end of the beam at which the connection is located.

The Type name, Short name and Description are taken automatically from the text string database.

| | Beam Data | | X |
|---|----------------------|-------------------|---|
| Г | Name | | ٦ |
| | Parameters | | |
| E | Drawings | | |
| | Drawing style | Point box on line | • |
| | Property for drawing | | • |
| | Colour | Themal load | - |
| E | Geometry | | ٦ |
| | Extent | full | • |
| | Position x | 0,000 | ٦ |
| | Coord. definition | Rela | 1 |
| | Origin | From start | - |
| | Repeat (n) | 1 | 1 |
| | | | |
| | | OK Cancel | |

To get an overview of all the data entered in the previous steps the button **Instance Setup** is used.

In the **Drawings** group, the **Drawing style** is set to 'Point box on line'. For the **Colour field** 'Generated load' is chosen.

| Ξ | Drawings | | |
|---|----------------------|-------------------|----------|
| | Drawing style | Point box on line | - |
| | Property for drawing | - | - |
| | Colour | Generated load | - |

Since no user defined parameters have been inputted, no parameter can be set as **Property for drawing on begin/end**. These fields are thus left empty.

Step 2.7. (Beam) Specify the type of external link

In the External link data group the Type of external link allows to specify which external application will be used.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |

In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.8. (Beam) Define the mapping with the external application

The preparation of the slave beam data has now been done, what remains is defining the mapping to Excel.

Through the button **Edit external file mapping** the mapping dialog is opened.

In this example, the Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:

| | А | В | С |
|----|----------------------------|--------|----|
| 1 | Input Data from Scia Engin | eer | |
| 2 | | | |
| 3 | Column Cross-section | HEA340 | |
| 4 | | | |
| 5 | MEd Beam at connection | 65000 | Nm |
| 6 | | | |
| 7 | Bolts | M16 | |
| 8 | | | |
| 9 | | | |
| 10 | Calculated Input Data | | |
| 11 | | | |
| 12 | Column Type HEA | 340 | |

This is the only sheet of importance for the beam data since slave data concern only the mapping of input properties.

The following table shows which property should be mapped to which cell:

| Object | Property | Worksheet | Cell Address |
|---------------------------|----------|-----------|--------------|
| Internal forces on member | My | Input | B5 |

The mapping of this property is thus done as follows:

The **Object** field is set to 'Internal forces on member'.

In the **Property** field 'My' can then be chosen.

Using the Browse button, the file Excel_Example_4.xls is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Input'.

The Arrays direction is set to 'Horizontal'.

Finally, in the field **Cell address** the cell 'B5' is typed. Automatically the **Current value** field will show the current content of the cell, in this case 65000.

When all input has been done, this mapping is added to the table using the Add button.

| Excel Link | | | | | |
|------------------------|----------------------|--------------------------|-----------|------|------------|
| Data | File | | Worksheet | Cell | Array |
| Internal forces on mem | ber.My D:\ESA | Excel\Excel_Example_4 | Input | B5 | Horizontal |
| | | | | | |
| | | | | | |
| < | | | | | > |
| Add Up | odate | | | | Remove |
| Source | | | | | |
| <u>O</u> bject | Internal forces on m | ember | | • | |
| Property | Му | | | | |
| 2.44.0 | | | | | |
| Target | | | | | |
| <u>E</u> xcel file | D:\ESA_Excel\Exc | el_Example_4\Excel_Examp | ile_4.xls | | Browse |
| <u>W</u> orksheet | Input | <u> </u> | B5 | • | |
| Arrays direction | Horizontal | Current value | 65000 | | Show |
| | , | | | | |
| | | | | ОК | Cancel |
| | | | | | |

With the input of the mapping, the definition of the beam slave data has been completed. Both column and beam slave data are defined and now in the final step the master data, the connection data will be inputted.

The order of defining additional data is of no importance. In this example, first the slave data was inputted and then the master data. It makes no difference if first the master data would be inputted and then the slave data.

Step 2.1. (Connection) Slave data

Finally, the additional data for the connection itself is inputted using the button **New** in the **User Defined Additional Data** Library.

The Name of the new additional data is changed to 'Conn'.

Since it concerns master additional data the checkbox **Slave add data** is not activated.

| 🗆 My addData templates 🛛 🔀 | | | | | |
|------------------------------|---|-------------------------|--------------------------------|--|--|
| 🎜 🤮 🗶 🗟 🔛 | 3 | 😂 🔲 🛛 Ali | • 7 | | |
| Column | | Name | Conn 🔨 | | |
| Beam | | Slave add data | | | |
| Conn | | User string database | | | |
| | | List of parameters | = | | |
| | | Picture | | | |
| | | Remove picture | | | |
| | | Service tree definition | | | |
| | | Service name | Beam1 Input of custom Add data | | |
| | | lcon | | | |
| | | Remove icon | | | |
| | | AddData definition | | | |
| | | Type of data | Line on 1D member | | |
| | | | | | |
| New Insert Edit Delete Close | | | | | |

Step 2.2 (Connection) Define text strings

In the **User string database** the required strings are defined for the definition of the additional data. For the connection the strings are modified as follows:

| Type for which the string is used | Default string | String used in this example |
|-----------------------------------|--------------------------------|-----------------------------|
| Service name | MYAT1 Input of custom add data | Input of Connection Data |
| Type name | MYAT1 Custom defined add data | Connection Data |
| Short name | MYAT1 MADI | Conn1 |
| Description | MYAT1 Description | Connection |
| Name of check | MYAT1 Custom check | Connection Check |

| S | String database 🛛 🔀 | | | | | | | |
|---|---------------------|------------------|--------------------------|--|--|--|--|--|
| | Langua | age | English (United States) | | | | | |
| | | ID | Text | | | | | |
| | 1 | 1 | Input of Connection Data | | | | | |
| | 2 | 2 | Connection Data | | | | | |
| | 3 | Conn 1 | | | | | | |
| | 4 | Connection | | | | | | |
| | 5 | Connection Check | | | | | | |
| | • | 0 | | | | | | |

The necessary strings for the definition of the data are defined and in the next step the parameters can be defined.

Step 2.3 (Connection) Define parameters

In this example, the connection will have a combo-box parameter from which the user can select the bolt type.

| Parameter | Туре | Combo-box lines |
|-----------|-----------|-----------------|
| Bolts | Combo-box | M16 |
| | | M20 |
| | | M24 |

Through the button **String database** the text string database can be directly accessed. This allows a quick input of the strings required for the parameters.

For this example the following strings are added:

| Strings used in this example |
|------------------------------|
| Bolts |
| M16 |
| M20 |
| M24 |

| S | String database | | | | | | | |
|-----------|----------------------|----|--------------------------|--|--|--|--|--|
| | Language | | English (United States) | | | | | |
| 1 | | ID | Text | | | | | |
| | 1 | 1 | Input of Connection Data | | | | | |
| | 2 2 Connection Data | | | | | | | |
| 3 3 Conn1 | | | Conn1 | | | | | |
| | 4 4 | | Connection | | | | | |
| | 5 | 5 | Connection Check | | | | | |
| | 6 | 8 | Bolts | | | | | |
| | 7 | 9 | M16 | | | | | |
| | 8 10 M20 9 11 M24 | | | | | | | |
| | | | | | | | | |
| | • | 0 | | | | | | |

Through the button **Add item** the parameter is added.

| List of parameters | | | | | | |
|--------------------|-------------|----------------------|-----------|------------|--|--|
| 1. Bolts | | Туре | Combo-box | < - | | |
| | | Name | Bolts | - | | |
| | | Description | Bolts | - | | |
| | | Combo | | - | | |
| | | Edit combo box lines | | | | |
| | | | | | | |
| Add item | Remove item | | | | | |
| String database | | | ОК | Cancel | | |

The **Type** field is set to 'Combo-box'.

For both the Name and Description fields the string 'Bolts' is set.

Next, the lines in the combo-box are defined through the edit button Edit combo box lines.

| Edit combo box lines 🛛 🛛 🔀 | | | | | |
|----------------------------|--------------------------|--|-------|--|--|
| | Row text | | Order | | |
| 1 | Input of Connection Data | | 1 | | |
| 2 | Connection Data | | 1 | | |
| 3 | Conn1 | | 1 | | |
| 4 | Connection | | 1 | | |
| 5 | Connection Check | | 1 | | |
| 6 | Bolts | | 1 | | |
| 7 | M16 | | 1 | | |
| 8 | M20 | | 1 | | |
| 9 | M24 | | 1 | | |
| | | | | | |
| OK Cancel | | | | | |

The bolt types inputted in the string database are selected and in the Order column the numbers '1', '2'and '3' are inputted.

External Application Checks for Excel – Example 4: Moment Resisting Connection

| Edit combo box lines 🛛 🛛 🔀 | | | | | | |
|----------------------------|---------------------|---------|-------------|-------|--|--|
| | Row text | | | | | |
| | | | | Order | | |
| 1 | Input of Connection | on Data | | 1 | | |
| 2 | Connection Data | | | 1 | | |
| 3 | Conn 1 | | | 1 | | |
| 4 | Connection | | | 1 | | |
| 5 | Connection Chec | k | | 1 | | |
| 6 | Bolts | | | 1 | | |
| 7 | M16 | | \boxtimes | 1 | | |
| 8 | M20 | | \boxtimes | 2 | | |
| 9 | M24 | | \boxtimes | 3 | | |
| | | | | | | |
| | | | | | | |
| | | | | | | |
| | | ок | | ancel | | |

When closing this dialog, the **Combo** item in the **List of Parameters** dialog shows how the combo-box will look like.

| List of parameters | | | X |
|--------------------|----------------------|------------|---|
| 1. Bolts | Туре | Combo-box | - |
| | Name | Bolts | - |
| | Description | Bolts | - |
| | Combo | M16 | |
| | Edit combo box lines | M16 | |
| | | M20 M24 | |
| | | M24 | |

The combo-box has now been inputted and the dialog can be closed.

Step 2.4 (Connection) Add a picture to the Additional Data

To clarify the use of the additional data and the defined parameters a picture can be added using the **Picture** button.

In this example the picture Excel_Example_4_Picture.bmp will be used.

| 🗖 My addData templ | s | | | | | |
|--------------------|------------------------------------|----------|--|--|--|--|
| A 🕂 🖌 🚳 🔽 🖨 🖌 🗛 | | | | | | |
| Column | Name Conn | | | | | |
| Beam | Slave add data | | | | | |
| Conn | User string database | | | | | |
| | List of parameters | = | | | | |
| | Picture Picture is selected | | | | | |
| | Remove picture | | | | | |
| | Service tree definition | | | | | |
| | Service name Input of Connection I | Data 👻 | | | | |
| | Icon | | | | | |
| | Remove icon | | | | | |
| | AddData definition | | | | | |
| | Type of data Line on 1D member | T | | | | |
| | | | | | | |
| | | | | | | |
| New Insert Edit | Delete | Close | | | | |

Step 2.5 (Connection) Define Service Tree

In the next step the Service Tree is defined through the group **Service tree definition**. The **Service name** is taken automatically from the text string database.

To clarify the Service name, an icon can be added using the **Icon** button. In this example the icon **Excel_Example_4_Icon.bmp** will be used.

| Ξ | Service tree definition | | |
|---|-------------------------|--------------------------|---|
| | Service name | Input of Connection Data | - |
| | Icon | lcon is selected | |
| | Remove icon | | |

Step 2.6 (Connection) Define the Additional Data

Using the data from the previous steps, the additional data can now be defined in the group **AddData** definition.

| AddData definition | | |
|--------------------|-----------------|---|
| Type of data | In node | - |
| Instance setup | | |
| Type name | Connection Data | - |
| Short name | Conn 1 | - |
| Description | Connection | - |

The connection is defined in the node between the beam and column. Therefore the field **Type of data** is set to 'In node'.

The Type name, Short name and Description are taken automatically from the text string database.

To get an overview of all the data entered in the previous steps the button **Instance Setup** is used.

| Connection Data | | | | | |
|-----------------|--|--|--|----|--------|
| Connection Data | | Name Parameters Bolts Drawings Drawing style Propetty for drawing Colour Edit slave add data list | M16 Box on point - Generated load | | |
| | | | | OK | Cancel |

In the **Drawings** group, the **Drawing style** is set to 'Sphere on point. For the **Colour field** 'Nodes, rigid arms' is chosen.

| Ξ | Drawings | | |
|---|----------------------|-------------------|---|
| | Drawing style | Sphere on point | |
| | Property for drawing | · · | |
| | Colour | Nodes, rigid arms | ļ |

No numerical user defined parameter has been inputted and therefore the field **Property for drawing** is left empty.

Since the connection data concerns 'master' data and the User Defined Additional Data contains also 'slave' data (the beam data and column data) a new option is visible: **Edit slave add data list**. This option will be explained further in *Step 3*.

Step 2.7 (Connection) Define the Check

In the group Check data the necessary data for the check itself can now be defined.

Note that the defining of check data is only available for the connection data since it was not marked as slave data.

| Ξ | Check data | |
|---|------------------------|------------------|
| | Name of check | Connection Check |
| | Setup for Brief output | |
| E | Type of loads | |
| | Load cases | |
| | ULS combinations | |
| | SLS combinations | |
| | Result classes | |

The Name of check is taken automatically from the text string database.

The **Type of loads** group allows to specify which load types will be available for the check. Only the selected items will be available when executing the check.

In this example, both load cases and an ULS combination are available however the check is only required to be executed for the combination. Therefore only the check-box 'ULS combinations' is checked.

| Ξ | Type of loads | |
|---|------------------|-------------|
| | Load cases | |
| | ULS combinations | \boxtimes |
| | SLS combinations | |
| | Result classes | |

Important remark: In case more than one load type has been activated, the check will be executed SIMULTANEOUSLY for all load types together! This implies for example that the check is done for both a load case and a combination at the same time. This allows the use of special checks: in the Excel file it can be set that a certain check can be done for the load case while a different check is done for the combination. In general, it is recommended to use only one load type.

The final item for defining the check is the **Setup for Brief output** where the output parameters have to be defined.

| List of parameters | | | $\overline{\mathbf{X}}$ |
|--------------------|-------------|----|-------------------------|
| | | | |
| Add item | Remove item | | |
| String database | | OK | Cancel |

For this example, one output parameters will be defined: the unity check UC of the connection.

| Parameter | Туре | Unit |
|---------------|--------|------|
| Connection UC | Number | - |

First of all, through the button **String database** the text string database is accessed to define the required strings. For this example the following string is added:

| String used in this example | |
|-----------------------------|--|
| Connection UC | |

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| s | String database | | | | | |
|------------------------------|--|---------------|-------------------------|--|--|--|
| | Langui | age | English (United States) | | | |
| ID Text | | | Text | | | |
| 1 1 Input of Connection Data | | | | | | |
| | 2 | 2 | Connection Data | | | |
| | 3 | 3 | Conn 1 | | | |
| | 4 | 4 | Connection | | | |
| | 5 | 5 | Connection Check | | | |
| | 6 | 6 | Bolts | | | |
| | 7 | 7 | M16 | | | |
| | 8 | 8 | M20 | | | |
| | 9 | 9 | M24 | | | |
| 10 10 Connection UC | | Connection UC | | | | |
| | * 0 | | | | | |
| | | | | | | |
| | Note: The string database which is used depends on the language default set for the workspace. | | | | | |
| | OK Cancel | | | | | |

When the string is defined, the parameter is added through the button Add item.

| List of parameters | | | | |
|----------------------|-----------------------------------|----------------------------------|--|--|
| 1. Connection UC | Name Extreme for check Unit | Connection UC max (Unity Check) | | |
| | | | | |
| | | | | |
| | | | | |
| | | | | |
| Add item Remove item | | | | |
| String database | C | K Cancel | | |

In the **Name** field the 'Connection UC' string is chosen from the string database. The **Extreme for check** is left on 'max' since the maximal unity check value is extreme in this case.

Since it concerns a unity check, the Unit field is left on '- (Unity Check)'.

The check and output parameters have now been defined so in the next step the link can be set.

Step 2.8 (Connection) Specify the type of external link

In the **External link data** group the **Type of external link** allows to specify which external application will be used.

| Ξ | External link data | |
|---|----------------------------|-------|
| | Type of external link | Excel |
| | Edit external file mapping | |
| | Setup for Detailed output | |

In this example the link is made with Excel and thus 'Excel' is chosen.

Step 2.9 (Connection) Define the mapping with the external application

All preparation has now been done, what remains is the most important step of the process: defining the actual mapping between properties and parameters of Scia Engineer and the data fields (i.e. Excel cells) of the external application.

Through the button **Edit external file mapping** the mapping dialog is opened.

In this example, the Excel file contains two worksheets. On the sheet 'Input' the input data from Scia Engineer are set:

| | А | В | С |
|----|----------------------------|--------|----|
| 1 | Input Data from Scia Engin | | |
| 2 | | | |
| 3 | Column Cross-section | HEA340 | |
| 4 | | | |
| 5 | MEd Beam at connection | 65000 | Nm |
| 6 | | | |
| 7 | Bolts | M16 | |
| 8 | | | |
| 9 | | | |
| 10 | Calculated Input Data | | |
| 11 | | | |
| 12 | Column Type HEA | 340 | |

The sheet 'Check' shows the determination of the moment resistance and the unity check.

| | А | В | С | D |
|----|---|-----------------|----------------|---------------------------|
| 1 | DSTV Table for IH3 connection with HEA260 | | 0 beam | |
| 2 | | | | |
| 3 | Bolts | Column HEA | My,Rd [kNm] | Limiting part |
| 4 | M16 | 180 | 30,24 | Column Flange in bending |
| 5 | | 220 | 45,36 | Column Flange in bending |
| 6 | | 240 | 60,48 | Column Flange in bending |
| 7 | | 340 | 75,6 | Bolts in Tension |
| 8 | M20 | 200 | 47,96 | Column Flange in bending |
| 9 | | 280 | 71,94 | Column Web in Shear |
| 10 | | 340 | 95,92 | Column Web in Shear |
| 11 | | 450 | 119,9 | Bolts in Tension |
| 12 | M24 | 240 | 65,32 | Column Web in Compression |
| 13 | | 320 | 97,98 | Column Web in Compression |
| 14 | | 450 | 130,6 | Column Web in Compression |
| 15 | | 700 | 163,3 | Bolts in Tension |
| 16 | | | | |
| 17 | Check of Conn | ection | | |
| 18 | | | | |
| 19 | Connection ac | cording to DS | TV Anlage 1,43 | |
| 20 | | | | |
| 21 | Connection ty | pe: IH 3 with E | Beam HEA260 | |
| 22 | | | | |
| 23 | Bolts | M16 | | |
| 24 | | | | |
| 25 | Column | HEA340 | | |
| 26 | | | | |
| 27 | MEd | 65 | kNm | |
| 28 | | | | |
| 29 | MRd | 75,6 | kNm | |
| 30 | | | | |
| 31 | Limiting part | Bolts in Tensi | ion | |
| 32 | | | | |
| 33 | Unity Check | 0.86 | - | |

In the column and beam data, the column cross-section and the beam bending moment have already been mapped to Excel. What is left is the mapping of the bolts and the unity check value.

The following table shows which properties should be mapped to which cells:

| Object | Property | Worksheet | Cell Address |
|--------------------------|---------------|-----------|--------------|
| <<< My input parameters | Bolts | Input | B7 |
| >>> My output parameters | Connection UC | Check | B33 |

The mapping of the first property is thus done as follows:

The **Object** field is set to '<<< My input parameters'.

In the **Property** field 'Bolts' can then be chosen.

Using the **Browse** button, the file **Excel_Example_4.xls** is searched.

After the file has been specified, the **Worksheet** field contains a list of all sheets. This field is set to 'Input'.

The Arrays direction is set to 'Horizontal'.

Finally, in the field **Cell address** the cell 'B7' is typed. Automatically the Current value field will show the current content of the cell, in this case M16.

When all input has been done, this mapping is added to the table using the Add button.

| cel Link | | | | | | |
|--------------------------|------------|---------------------|----------------------|-----------|------|-----------|
| Data | | File | | Worksheet | Cell | Array |
| <<< My input parame | ters.Bolts | D:\ESA_Excel\Exce | el_Example | nput | B7 | Horizonta |
| | | | | | | |
| | | | | | | |
| Add | Jpdate | | | | | Remove |
| Source | | | | | | |
| <u>O</u> bject | <<< My inp | out parameters | | | | • |
| <u>P</u> roperty | Bolts | | | | | • |
| Target | | | | | | |
| <u>E</u> xcel file | D:\ESA_E | xcel\Excel_Example_ | _4\Excel_Example | e_4.xls | | Browse |
| <u>W</u> orksheet | Input | • | <u>C</u> ell address | B7 | • |] |
| Arrays <u>d</u> irection | Horizontal | • | Current value | M16 | | Show |
| | | | | | | |

In the same way, the second parameter can be mapped using the above table.

| Excel Link | | | | × |
|---|--|----------------|-----------|--------------------------|
| Data | File | Worksheet | Cell | Array |
| <<< My input parameters.Bolts >>> My output parameters.Conne | D:\ESA_Excel\Excel_Example D:\ESA_Excel\Excel_Example | Input Check | B7 B33 | Horizontal Horizontal |
| | | | | |
| | | | | |
| Add Update | | | | Remove |
| Copoate | | | _ | Helliove |
| Source | | | | |
| Dbject >>> My o | utput parameters | | • | |
| Property Connecti | on UC | | • | |
| - Target | | | | |
| | Excel\Excel_Example_4\Excel_Examp | ole_4.xls | | Browse |
| Worksheet Check | <u> </u> | B33 | • | |
| Arrays direction Horizonta | I Current value | 0,8597883597 | 8836 | Show |
| | | | | |
| | | | OK | Cancel |

All parameters are now mapped to Excel. The final step left for the definition of the additional data is specifying a Detailed output.

Step 2.10 (Connection) Define the Detailed output

By clicking on **Setup for Detailed output**, the Detailed output dialog is opened.

In this example, one range will be defined to show the output of the connection check.

| Caption | Worksheet | Top – left cell | Bottom – right cell |
|------------------|-----------|-----------------|---------------------|
| Connection Check | Check | A19 | C33 |

| | А | В | С | D |
|----|----------------|-----------------|----------------|---------------------------|
| 1 | DSTV Table for | r IH3 connecti | on with HEA26 | 0 beam |
| 2 | | | | |
| 3 | Bolts | Column HEA | My,Rd [kNm] | Limiting part |
| 4 | M16 | 180 | 30,24 | Column Flange in bending |
| 5 | | 220 | 45,36 | Column Flange in bending |
| 6 | | 240 | 60,48 | Column Flange in bending |
| 7 | | 340 | 75,6 | Bolts in Tension |
| 8 | M20 | 200 | 47,96 | Column Flange in bending |
| 9 | | 280 | 71,94 | Column Web in Shear |
| 10 | | 340 | 95,92 | Column Web in Shear |
| 11 | | 450 | 119,9 | Bolts in Tension |
| 12 | M24 | 240 | 65,32 | Column Web in Compression |
| 13 | | 320 | 97,98 | Column Web in Compression |
| 14 | | 450 | 130,6 | Column Web in Compression |
| 15 | | 700 | 163,3 | Bolts in Tension |
| 16 | | | | |
| 17 | Check of Conn | ection | | |
| 18 | | | | |
| 19 | Connection ac | cording to DST | TV Anlage 1,43 | |
| 20 | | Top - left | | |
| 21 | Connection ty | pe: IH 3 with E | Beam HEA260 | |
| 22 | \sim | | | |
| 23 | Bolts | M16 | | |
| 24 | | \backslash | | |
| 25 | Column | HEA340 | | |
| 26 | | | | |
| 27 | MEd | 65 | kNm | |
| 28 | | | | |
| 29 | MRd | 75,6 | kNm | |
| 30 | | | \mathbf{i} | |
| 31 | Limiting part | Bolts in Tensi | ion 🔪 Bott | om -right |
| 32 | | | | Ŭ |
| 33 | Unity Check | 0,86 | - | |

In the **Caption** field the string 'Connection Check' is chosen.

In the Excel file field the file Excel_Example_4.xls is searched using the browse button.

The Worksheet field is set to 'Check'.

In the Range group the Top - left cell is set as 'A19' and the Bottom - right cell as 'C33'.

When all input has been done, the data is added to the table using the Add button.

| External links for document | × |
|---|--|
| Caption Excel file Connection Check D:\ESA_Excel\Excel_Example_4\Excel_Example_4.xl | Worksh Upper-I Bottom s Check A19 C33 |
| | |
| | |
| | |
| | |
| | |
| AddUpdate | Remove |
| Caption: Connection Check | • |
| Excel file: | Top - left cell |
| D:\ESA_Excel\Excel_Example_4\Excel_Example_4.xls | Bottom - right cell |
| Check | C33 V |
| String database | OK Cancel |

With this final step, the User Defined Additional Data has been fully inputted and the **User Defined Additional Data** Library can be closed.

Step 3: Input the User Defined Additional Data on members/nodes

After closing the **User Defined Additional Data** Library a new service will be shown in the Scia Engineer tree: **Custom Check**.

| Main | | |
|------------------------------|--------------------------|-----|
| Project | | |
| Structure | | |
| Load | | |
| 🗄 📲 Load cases, Combinations | | |
| 🗄 📲 Calculation, Mesh | | |
| Results | Custom Check | ΦX |
| E Steel | Custom Check | ÷ ^ |
| Custom Check | | |
| Document | 🔁 User defined AddData | |
| 🖶 🔛 Drawing Tools | 🔁 Input of Column Data | |
| 🖶 🖷 🗐 Library | 🔁 Input of Beam Data | |
| 🗎 🗄 💦 Tools | Input of Connection Data | |

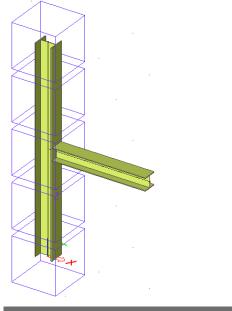
In a first step, the additional data which was defined in *Step 2*, can now be inputted on the members/nodes. Afterwards, the links will be made between the slave data and the master data.

Step 3.1 Input of additional data

First of all the column data will be inputted on the column. When double clicking on **Input of Column Data** the dialog with the properties of the data is displayed:

| Name | Col1 | |
|-------------------|------------|--|
| Parameters | | |
| Geometry | | |
| Extent | Full | |
| Position x1 | 0,000 | |
| Position x2 | 1,000 | |
| Coord. definition | Rela | |
| A | From start | |
| Origin | riun sau | |
| Ungn | riun sau | |

The default values of the dialog are confirmed with [OK] and the data is inputted on the column.



Using the default Scia Engineer scale buttons the drawing style of the additional data can be shown bigger or smaller.

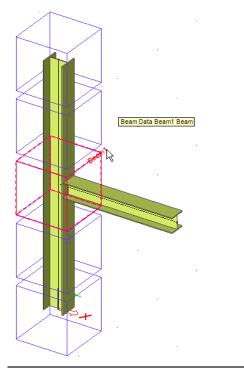
Next the beam data will be inputted on the beam. When double clicking on **Input of Beam Data** the dialog with the properties of the data is displayed:

| Beam Data | | × |
|-------------------|------------|-----------|
| Name | Beam1 | |
| Parameters | | |
| Geometry | | |
| Extent | full | |
| Position x | 0,000 | |
| Coord. definition | Rela | - |
| Origin | From start | - |
| Repeat (n) | 1 | |
| | | |
| | | OK Cancel |

Since the beam data have been defined as 'Point on 1D member' data, the position can be set in the **Position x** field.

For this example, the bending moment is needed at the position between the beam and column. This position is located at the beginning of the beam and thus the **Position x** field is left to 0.

The default values of the dialog are thus confirmed with [OK] and the data is inputted on the beam.

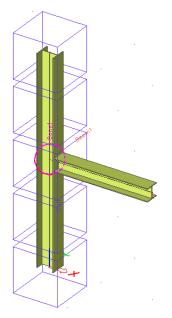


Using the default Scia Engineer view parameters the names of the additional data can be displayed.

Finally the connection data will be inputted in the node. When double clicking on **Input of Connection Data** the dialog with the properties of the data is displayed:

| Connection Data | | | \mathbf{X} |
|-----------------|----------------------|--------|--------------|
| | Name | Conn 1 | |
| | Parameters Bolts | M16 | - |
| | | | |
| M, | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | | |
| | | - | |
| | | | OK Cancel |

The default values of the dialog are confirmed with [**OK**] and the data is inputted on the node between the beam and column.



The different data has now been inputted and in the next step they can be linked together.

Step 3.2 Linking slave data to master data

In the User Defined Additional Data library, the column and beam data have been defined as 'slave data'.

In the previous step, 'instances' of this data have been inputted on different members. The final step is to link the correct instances together.

For example, if there would be two beams in this project with additional beam data on both, then it has to be specified which of the two beams should be taken into account for the connection i.e. is the connection between the column and beam 1 or between the column and beam 2.

To specify which slave data instance is linked to which master data instance, the master data has to be selected.

When selecting the Connection data inputted in the node between the beam and the column, the property window shows the following:

| Pro | perties | × |
|-----|--------------------------|-----------|
| Co | nnection Data (1) | 💌 Vi V/ / |
| | Name | Conn1 |
| | Parameters | |
| | Bolts | M16 💌 |
| | Edit slave add data list | |
| | Node | N3 |
| | | |
| Ac | tions | |
| Te | emplate definition | >>> |

The button **Edit slave add data list** can now be used to specify which slave data instances are linked to this connection data instance.

| Edit selection slave add data | | | |
|-------------------------------|---------|----------|--|
| Available | | Selected | |
| Col1 Beam1 | > | | |
| | ×> << < | | |
| | ОК | | |

When clicking the edit button, the following dialog is displayed:

The left column shows all **Available** slave data instances in the project. In this example the data inputted on the column 'Col1' and the data inputted on the beam 'Beam1'.

Using the arrow buttons, these instances can be added to the **Selected** column.

External Application Checks for Excel - Example 4: Moment Resisting Connection

| Edit selection slave ad | ld data | | | X |
|-----------------------------------|--------------------|---------------|----------|---|
| Edit selection slave ad Available | > >> << < | Col1 Beam1 | Gelected | |
| | 0 | ĸ | Cancel | |

The dialog can then be closed by pressing [OK].

Through these steps, the required slave data have been correctly linked to the master data. During the execution of the check, the mapping defined in the master data as well as in the linked slave data will be sent to Excel. In addition, the output mapping from the master data will be read back from Excel.

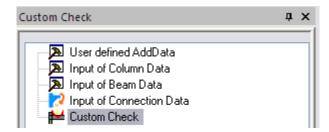
Step 4: Execute the Custom Check

In *Step 2* the additional data has been defined including the definition of the check, the mapping to Excel... In *Step 3* the additional data has been inputted and the slave data instances have been linked to the master data instance. What is left is the execution of the check.

| FE analysis | | | X |
|-------------|---|------------|---|
| | Single analysis Batch analysis | | |
| | • Linear calculation | V | |
| | C Nonlinear calculation | Г | |
| | 🔿 Modal analysis | Г | |
| 100 | C Linear stability | Г | |
| | C Concrete - Code Dependent Deflections | Г | |
| | C Influence lines and surfaces | Г | |
| | C Construction stage analysis | Г | |
| | C Nonlinear stage analysis | Г | |
| | C Nonlinear stability | | |
| | Test of input data | | |
| | Number of load cases: 1 | _ | |
| | , | | |
| | Solver setup | Mesh setup | |
| 1. 10 | ОК | Cancel | 1 |
| | | | - |

First of all the linear analysis is launched.

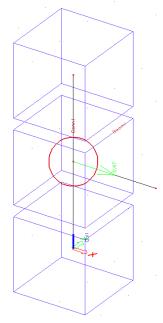
When user defined additional data was inputted and the analysis has been executed, the **Custom Check** service will show a new item: **Custom Check**.



In the property window of the check, the **Values** field contains only the output parameters of master data since the slave data do not have output parameters.

| Properties | × |
|------------------|-----------------|
| Custom check (1) | 🚽 Va V/ / |
| Name | Custom check |
| Selection | All 💌 |
| Combinations | CO1 💌 |
| Filter | No 💌 |
| Values | Connection UC 🗾 |
| Extreme | Global 💌 |
| Output | Brief 💌 |
| Drawing setup | |
| Section | All |
| Actions | |
| Refresh | _>>> |
| Single Check | >>> |
| Preview | >>> |

After pressing the **Refresh** action button the following check result is shown on screen:



As specified in the previous examples, the Brief preview can be shown and the check result can be added to it through the table composer. This results in the following output:

Customcheck

Linear calculation, Extreme : Global Selection : All Combinations: CO1 The check was executed according to the following user defined Excel file(s): D:\ESA_Excel\Excel_Example_4\Excel_Example_4.xls **Connection UC** dx Type Name Css Material Data Case [m] [-] **Connection Check** Conn1 not used not used 0,000 CO1/1 0.47

In the same way the Detailed output can be chosen which shows the following results:

Customcheck

| Linearcalculation, Extreme : Global Selection : All Combinations : CO1 The check was executed according to the following user defined Excel file (s): D:\ESA_Excel\Excel_Example_4\Excel_Example_4.xIs Type Name Connection Check | | | | | | | |
|--|----------------|----------------------------|--|--|--|--|--|
| Connection Check | Connection acc | ording to DSTV Anlage 1,43 | | | | | |
| | Connection typ | e: IH 3 with Beam HEA260 | | | | | |
| | Bolts | M16 | | | | | |
| | | | | | | | |
| | Column | HEA340 | | | | | |
| | MEd | 35,84 kNm | | | | | |
| | MRd | 75,60 kNm | | | | | |
| | Limiting part | Bolts in Tension | | | | | |
| | Unity Check | 0,47 - | | | | | |

The output shows that parameters from the three user defined additional data types are combined:

- From the Column slave data the cross-section has been sent to Excel.
- From the Beam slave data the bending moment has been sent to Excel.
- From the Connection master data the Bolts have been sent to Excel.

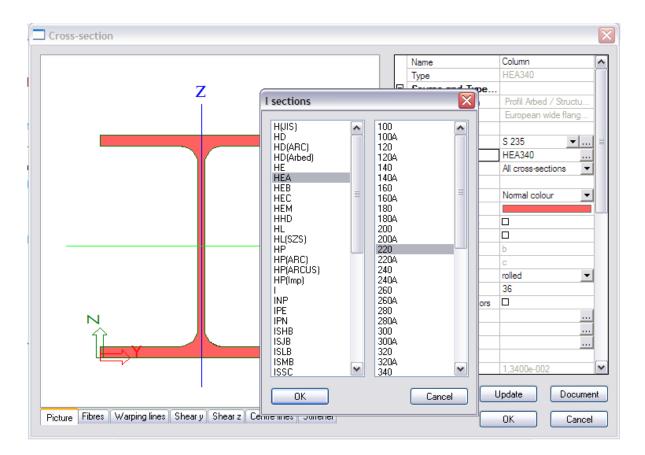
Eventually the resulting unity check defined in the Connection master data is read back from Excel.

In a next step, some changes are made to the input.

First of all the Connection data is selected and the Bolts are set to 'M20'

| Pro | perties | × |
|-----|--------------------------|-----------|
| Co | nnection Data (1) | 💽 Va V/ / |
| | Name | Conn1 |
| | Parameters | |
| | Bolts | M20 💌 |
| | Edit slave add data list | |
| | Node | N3 |
| | | |
| Ac | tions | |
| Te | emplate definition | >>> |

Next, the cross-section of the column is changed to HEA 220.



After recalculating the project, the Detailed output now shows the following results:

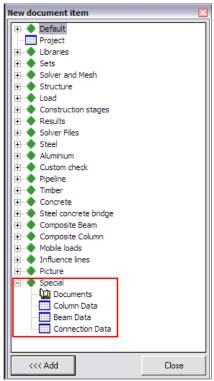
| Customcheck | | | | | | | |
|------------------|---------------|--|--|--|--|--|--|
| | | owing user defined Excel file (s): ole_4.xls | | | | | |
| Type Name | | Connection Check | | | | | |
| Connection Check | | ording to DSTV Anlage 1,43 e: IH 3 with Beam HEA260 | | | | | |
| | | | | | | | |
| | Bolts | Bolts M20 | | | | | |
| | Column | HEA220 | | | | | |
| | MEd | 20,49 kNm | | | | | |
| | MRd | 47,96 kNm | | | | | |
| | Limiting part | Column Flange in bending | | | | | |
| | Unity Check | 0,43 - | | | | | |

It can be seen that the changes are correctly taken into account.

The check has now been executed and reviewed. To end this step, the document of Scia Engineer is examined.

In the document, the inputted User defined additional data can be inserted into the document in the same way as any other default additional data.

In the **New document item** dialog, the **Special** chapter holds the tables for all user defined additional data.



In this example, three different types of additional data have been defined and can be added to the output.

| <mark>NEMETSCHEK</mark> Scia | Project | Excel_Example_4 |
|---------------------------------|-------------|-----------------------------------|
| | Part | - |
| | Description | Example 4 for Tutorial Excel Link |
| | Author | PVT |

1. Column Data

| Type Name | Name | Member | Extent | Pos x | Pos x | Coor | Orig |
|-------------|------|--------|--------|-------|-------|------|------------|
| Column Data | Col1 | B1 | full | 0,000 | 1,000 | Rela | From start |

2. Beam Data

| Type Name | Name | Member | Extent | Pos x | Coor | Orig | Rep (n) |
|-----------|-------|--------|--------|-------|------|------------|---------|
| Beam Data | Beam1 | B2 | full | 0,000 | Rela | From start | 1 |

3. Connection Data

| Type Name | Name | Node | Bolts | Slave data |
|-----------------|-------|------|-------|------------|
| Connection Data | Conn1 | N3 | M20 | Col1 |
| | | | | Beam1 |

As can be seen, for master data, also the linked slave data are shown. In this example, the slave data 'Col1' and 'Beam1' have been linked to master data 'Conn1'. This table provides a quick overview of linked master and slave data.

To finalize this example, one final remark is given concerning master and slave data:

| B | When removing a slave data instance which has been linked to a master data instance, |
|---|--|
| | the master data instance will ALSO be removed! The reasoning behind this is the |
| | following: in case slave data has been linked to master data, the slave data is required for |
| | a correct execution of the check. When the slave data instance is removed, the check for |
| | the master data instance becomes incomplete/invalid and thus the master data instance |
| | is automatically removed. This way, no accidental wrong check results will be obtained |
| | after removing slave data. |

Step 5: Save the User Defined Additional Data into a database for future use

If required, this additional data can be saved into a database for future use as illustrated in Example 1.