

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.

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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.

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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.