Contents

FIN EC

Anchorage of column with end plate

Introduction

This guide shows how to calculate resistance of column connection to the concrete base using detail with end plate and haunches. The column is loaded by the axial force N_x= 500kN and bending moment M_y= 60kNm. The steel class *EN 10025:Fe360* and concrete class *C20/25* are used.

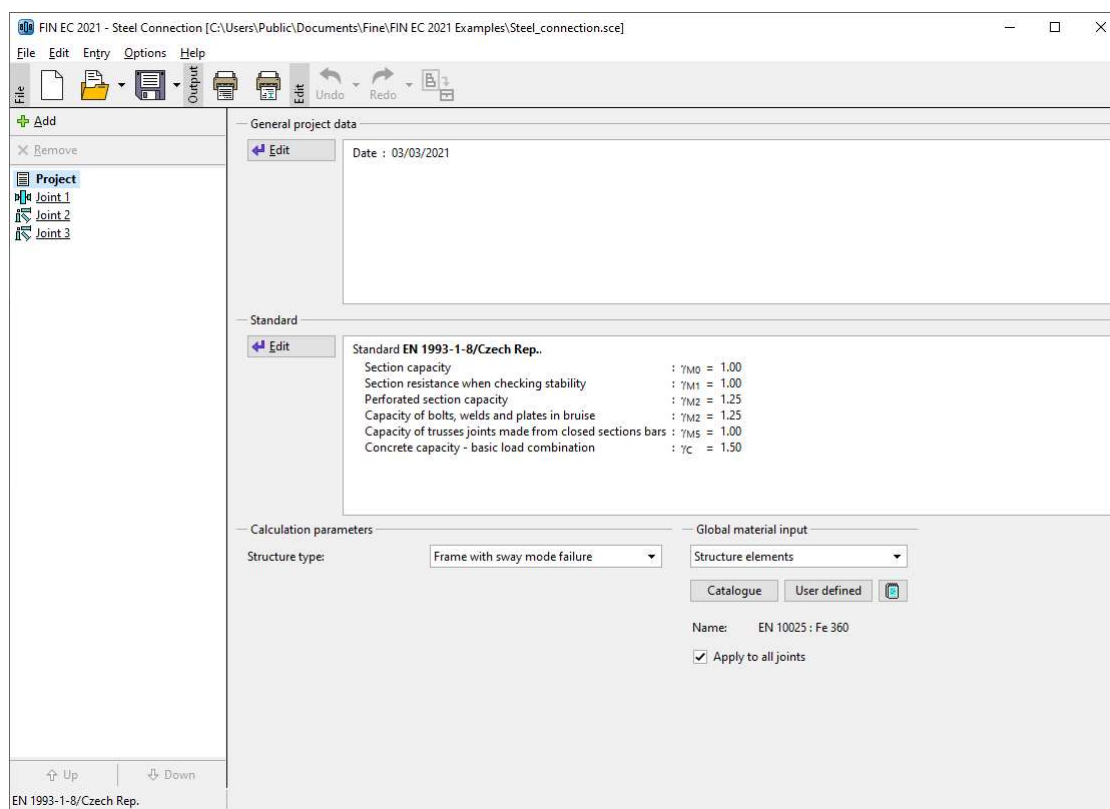|	
Column:	b= 150mm, h= 300mm, t_w= 12mm, t_f= 16mm
Haunches:	t_w= 16mm, h_w= 90mm, L_w= 300mm, L_f= 50mm, a_w= 6mm
Concrete base:	b_b= 1600mm, a_b= 1600mm, h_b= 1000mm, t_g= 30mm
Welds:	$a_{w,f}$= 8mm; $a_{w,w}$= 6mm
End plate:	b_p= 180mm, h_p= 510mm, t_p= 30mm, a_1= -105mm
Bolts:	M24 10.9, w_1= 45mm, e= [50,410]mm

Starting a new task

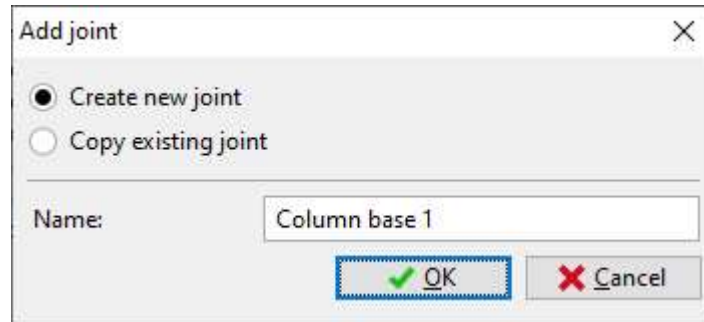We use a project created in previous tutorials.

Main screen

We add a new task with the help of the button "**Add**" at the top of the tree menu
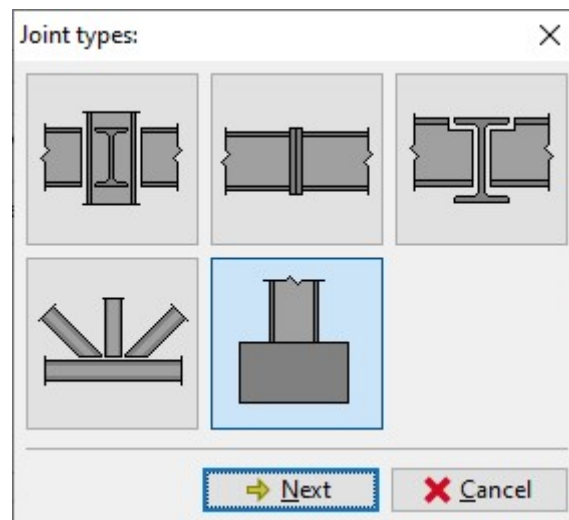

Insertion of a new task

We specify a name ("**Column base 1**") in the window "**Add joint**", that appears after the clicking on that button.
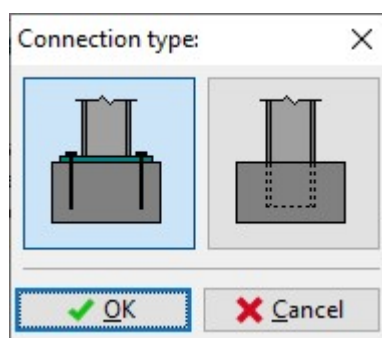

Input of task name

After the confirmation by the button "**OK**", the window with main joint types appears. We select column base (in the middle of the upper row).
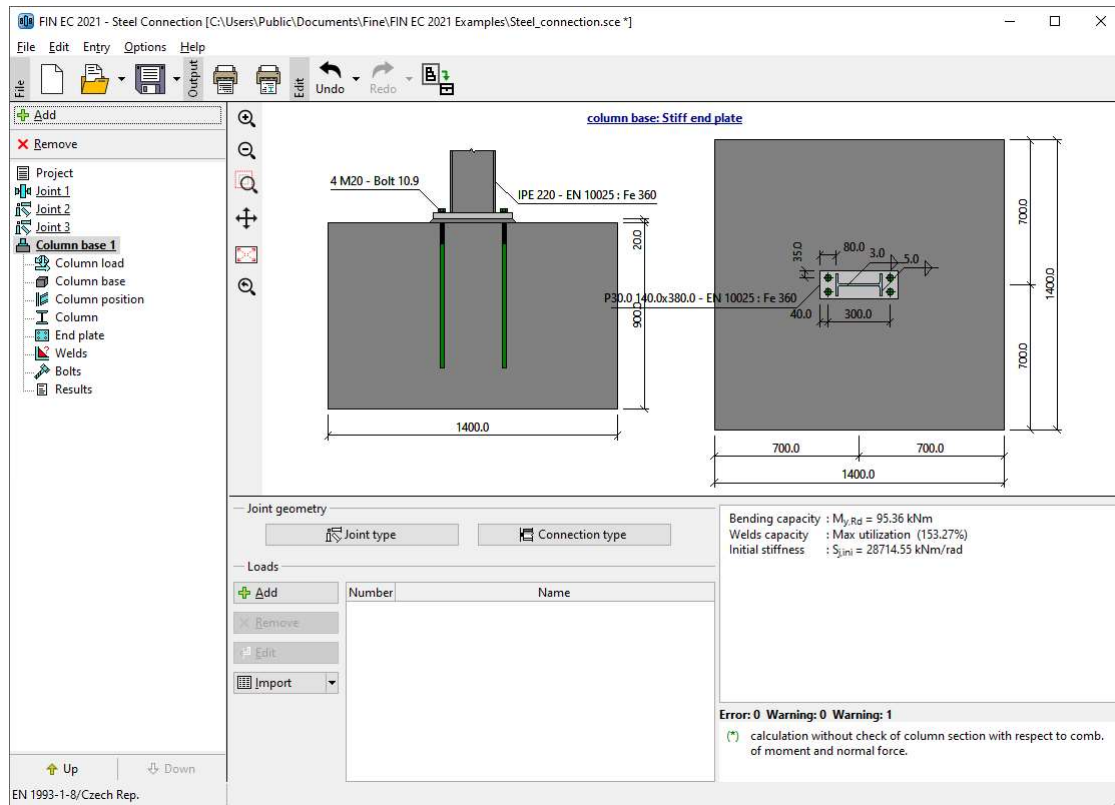

Choice of detail type

The choice of connection type follows. We select connection with end plate (left option) and confirm the choice by the button "**OK**".
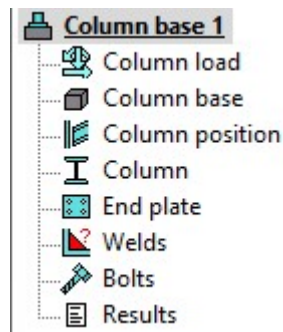

Selection of connection type

The initial geometry of the joint appears in the workspace.
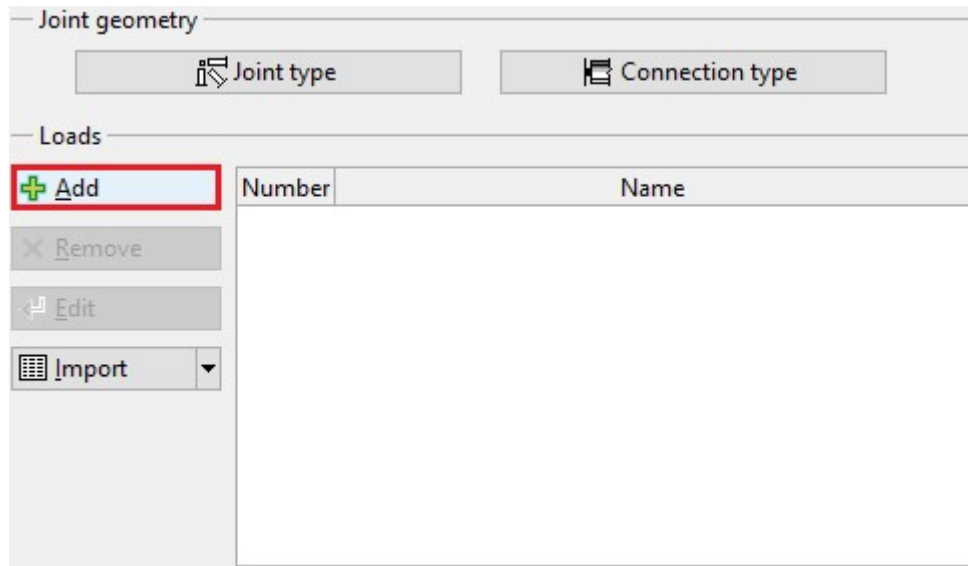
Fundamental geometry of column base

The following work is done with the help of the tree menu on the left side of the program. The structure of this menu is generated according to the specified joint geometry.

Inputs organized in the tree menu

We go through all parts from the top to the bottom and modify inputs. The connection to the left flange will be described in detail. The connection to the right flange would be solved in the same way.
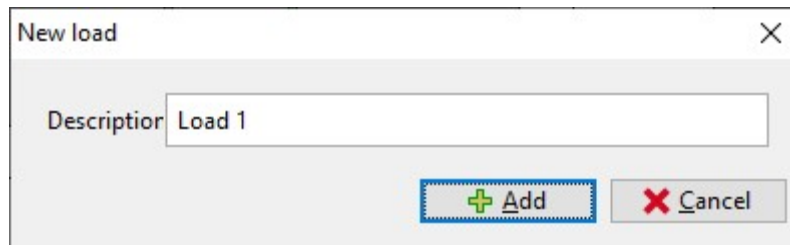
On the main screen of the joint, it is possible to change the specified geometry of the joint (buttons "**Joint type**" and "**Connection type**") and specify list of loads. The load represents a set of internal forces that have to be defined for all members in the joint (column, beams). These internal forces should be resulting values of certain load combination. Therefore, they are considered as design values. Number of loads for the joint is not limited. We insert a new load with the help of the button "**Add**" in the toolbar on the left side of the loads table. The toolbar also contains buttons for editing and deletion of loads and also a tool for import of loads including internal forces from *.txt* or *.csv* file.

![FINEC logo]

Button for input of new load

The new is specified by a name. The input has to be confirmed by the button "**Add**".
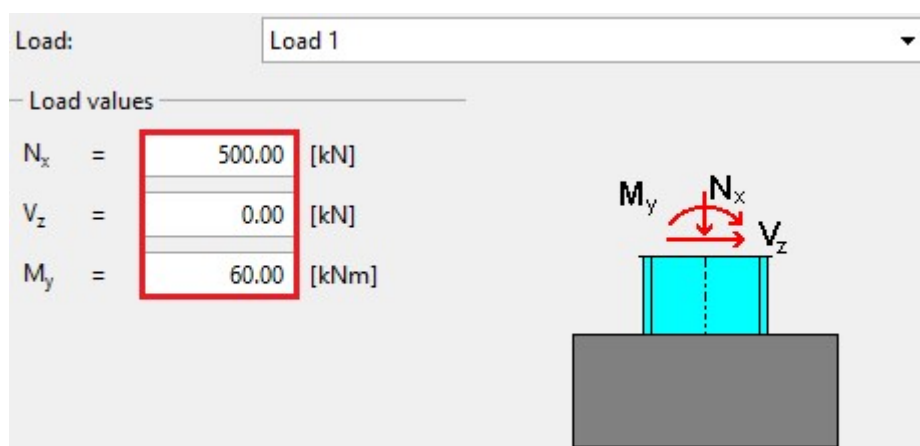
Window "New load"

As we want to add only one load, we close the window by the button "**Cancel**" after the input of first load.

Column load

If at least one load is entered, it is possible to switch to the part "**Column load**" in the tree menu and specify internal forces for the column. The axial force "N_x" should be *500kN* and the bending moment "M_y" is *60kNm*.

Input of forces

Column base

This mode contains dimensions of concrete base ("b_b" - width, "a_b" - length, "h_b" - height) and thickness of grouting "t_g". Choose the material of the column from the catalogue.
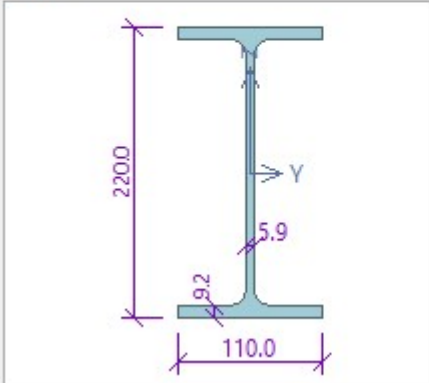
Dimensions

Column position

The position of the column relatively to the centre of concrete base and the column pitch can be specified here. We do not change default values and go to another part.

Column

We specify the column geometry (cross-section, haunches) with the help of the button "**Edit section**".

The button for edit of beam geometry

The window "**Column properties**" appears. Left part of the window contains input of cross-section, right part input of haunches. We change the cross-section with the help of the button "**New**".

Buttons for editing cross-section and haunches

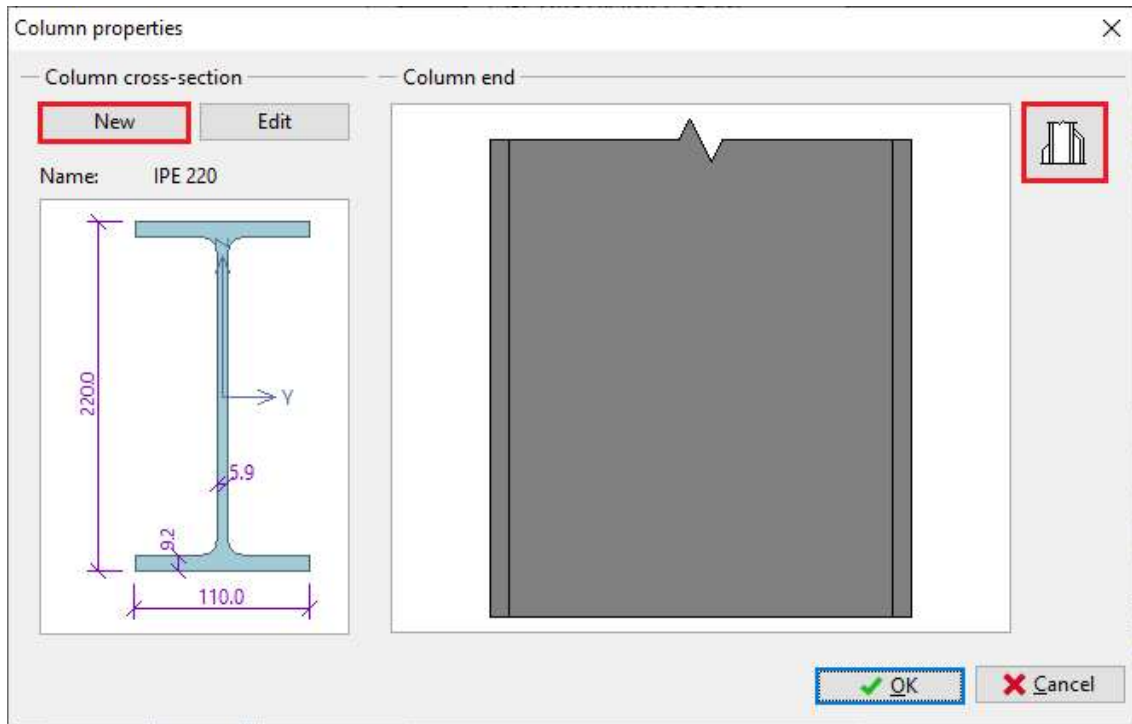The window "**Steel section**" that appears after the clicking on the button contains an option to select type of cross-section. We select an option to specify arbitrary dimensions of welded cross-section (the option "**Solid welded**") and open the window "**Cross-section editor**" by pressing the button "**OK**".
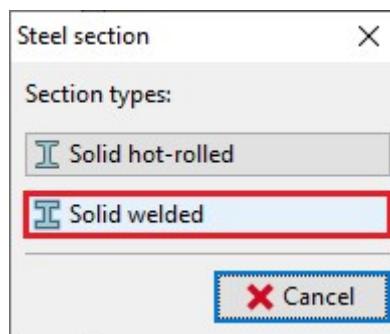
Selection of cross-section type

We enter the cross-sectional dimensions and confirm the input by the button "**OK**".

Dimensions of welded cross-section
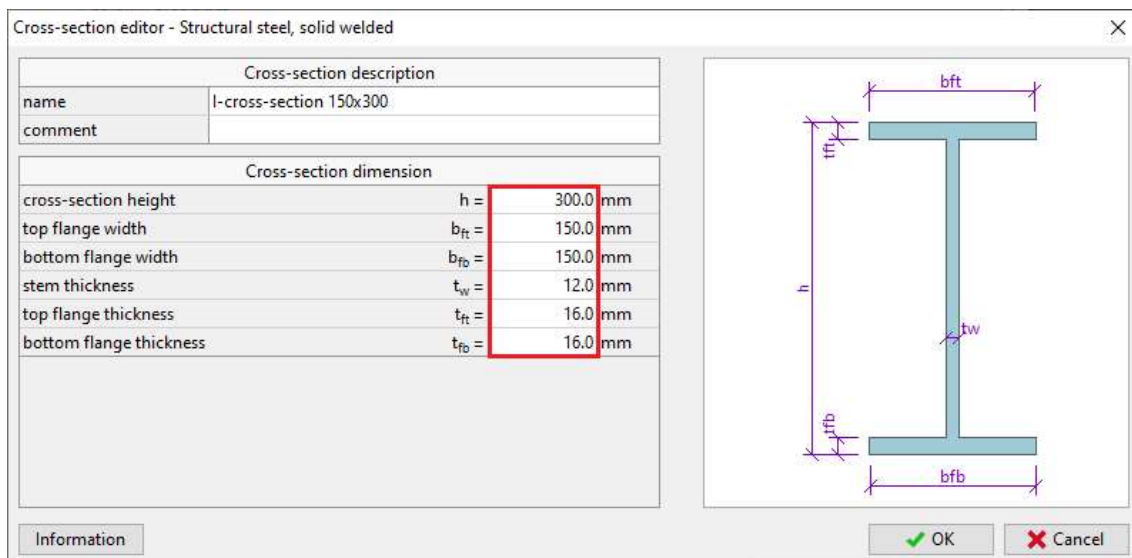
The button in the part "**Column end**" opens the window "**Column haunches**". We select an option "**Haunch without flange**" and specify dimensions according to the following figure in the tab "**Left haunch**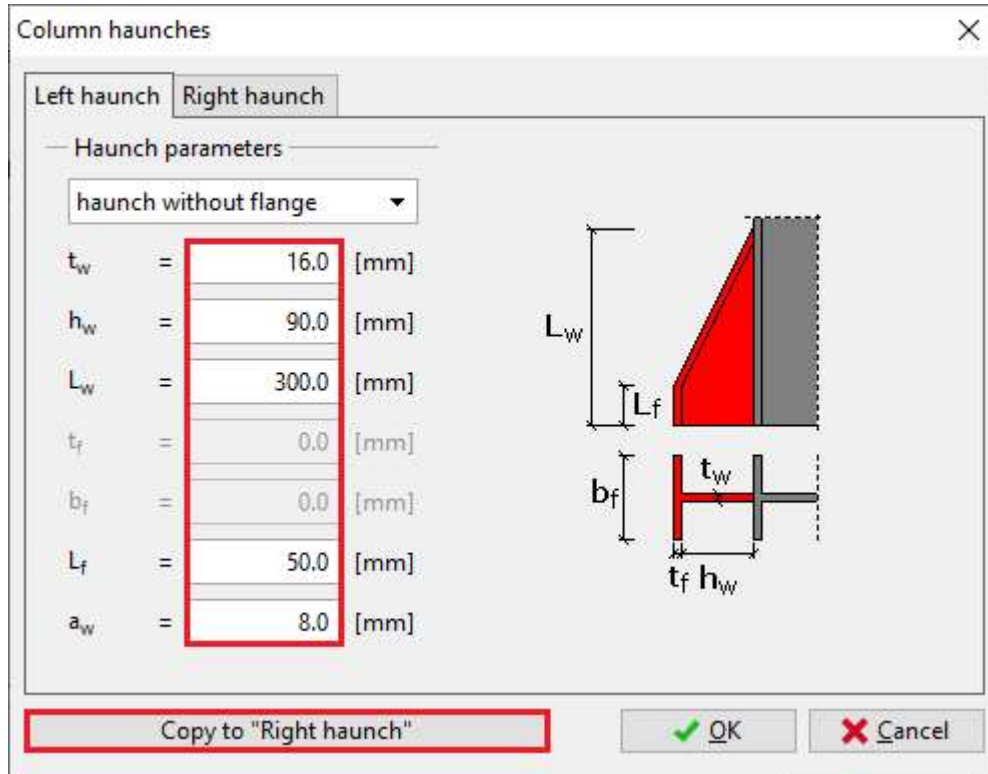". As the column cross-section is symmetrical, we copy the haunch also to the right flange. We use the dedicated button "**Copy to "Right flange""** in the left bottom corner for this operation.

The button for copying properties

The copy of haunch properties have to be confirmed in a new window.

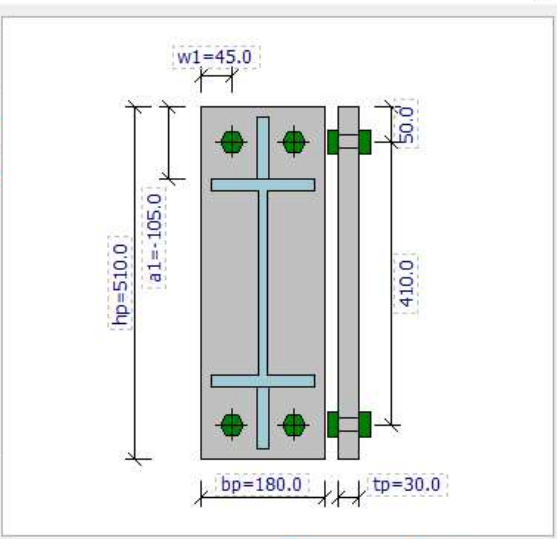*Confirmation window for copy of haunch properties*

End plate

The input of end plate geometry follows. We open an appropriate window using the button "**Geometry adjustment**" in the bottom frame.

The button for editing plate properties

We specify end plate dimensions "b_p", "h_p", "t_p", position of end plate relatively to the beam edge "a_1", horizontal position of bolts "w_1" and vertical positions of rows. Entered values are shown in the figure below. The input can be done with the help of input lines in the left part of the window or using active dimensions in the end plate figure in the right part of the window. The input has to be confirmed by the button "**OK**".

Properties of end plate

Welds

Fillet welds all round will be used for the connection of the end plate to the column. Therefore, we select weld type "**Weld all around**" and enter the throat thickness for flanges "$a_{w,f}$" and the throat thickness for the web "$a_{w,w}$". Lengths are calculated automatically according to the geometry of the cross-section. Arbitrary lengths can be defined using weld type "**User defined weld**".

Welds properties

Bolts
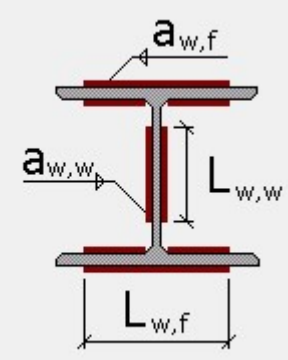
The part "**Bolts**" contains the input of bolt type, dimensions and material. The type and dimension can be specified with the help of the button "**Catalogue**" in the part "**Bolt type**" of the bottom frame. The material can be selected using the button "**Catalogue**" in the part "**Bolt material**".
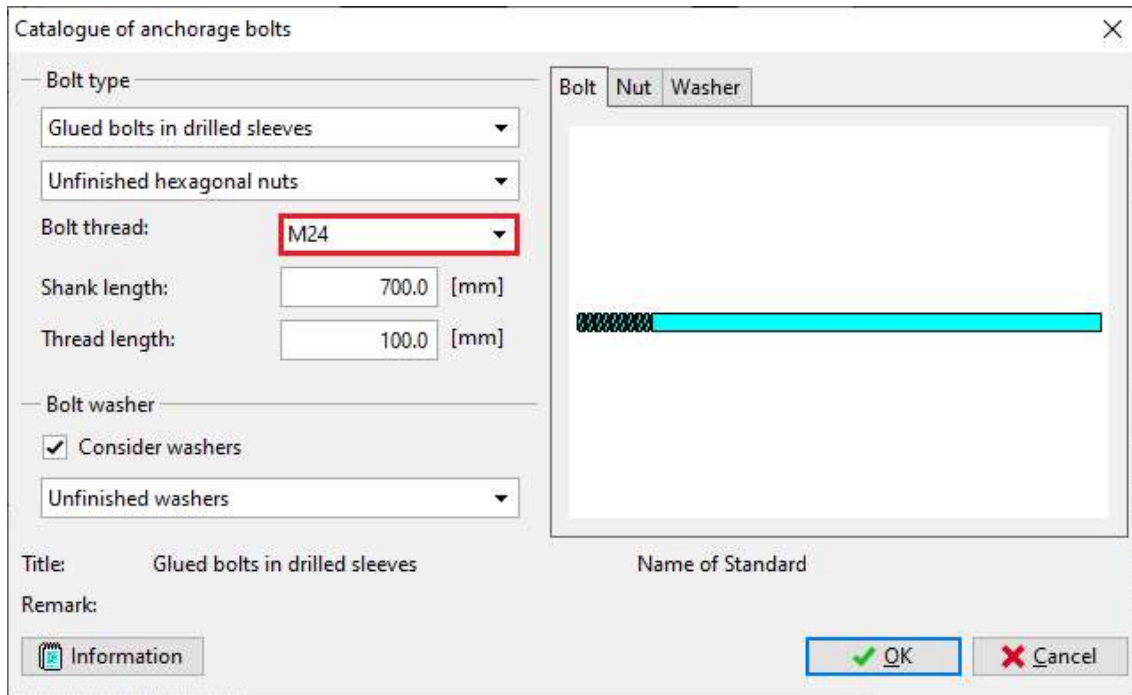
Buttons for input of bolt type and material

We select bolt type "**Glued bolts in drilled sleeves**" and the diameter "**M24**". The window has to be closed by the button "**OK**".
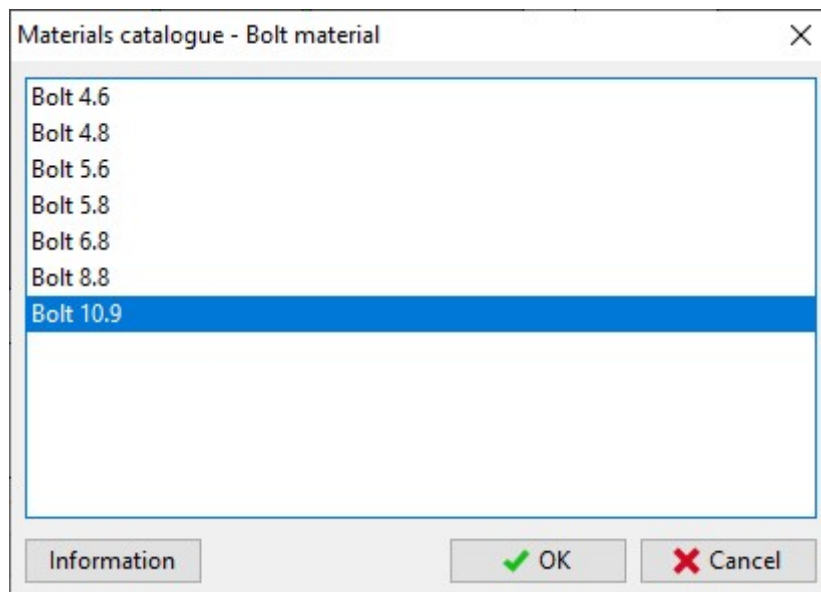
Properties of anchoring bolts

We choose the material "**Bolt 10.9**" in the window "**Materials catalogue**" and confirm the input by the button "**OK**".

Selection of material

Results

The total results are displayed in the right part of the bottom frame. They contain maximum utilization, the decisive load and connection and also brief results for decisive load.

Overall check : PASS (77.94%)
Decisive load : L 1 - Load 1
Bending capacity : $M_{y,Rd}$ = 230.40 kNm (26.04%)
Welds capacity : Max utilization (51.89%)
Haunches capacity : Max utilization (77.94%)
Initial stiffness : $S_{j,ini}$ = 51018.47 kNm/rad

Overall results

Th detailed results for particular components are displayed in the mode "**Results**". These results contain detailed bearing capacities and decisive c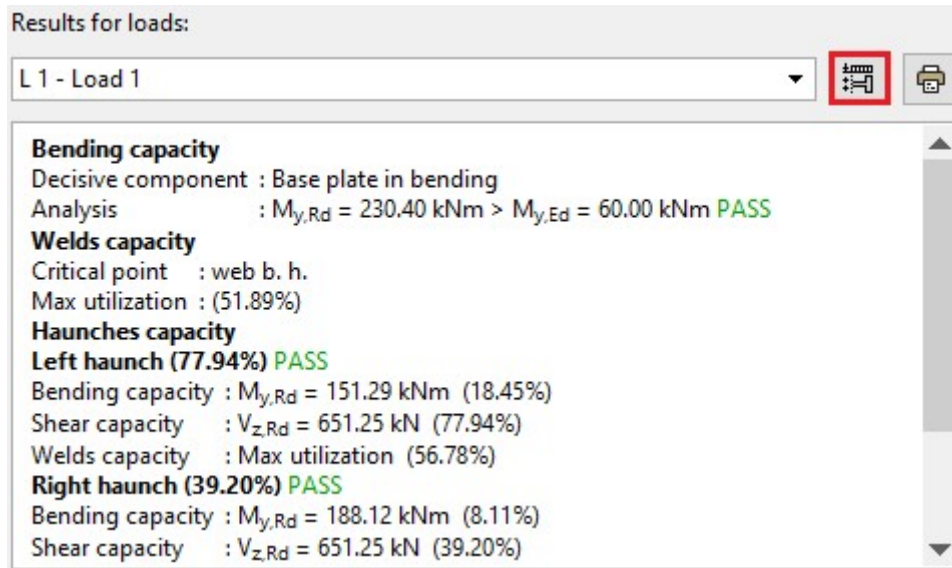omponents. The results can be displayed for all entered loads. Available is also an option "**Zero load**". In this case, maximum bearing capacities for all components are displayed.

Results for loads:

L 1 - Load 1

Bending capacity
Decisive component : Base plate in bending
Analysis : $M_{y,Rd}$ = 230.40 kNm > $M_{y,Ed}$ = 60.00 kNm PASS
Welds capacity
Critical point : web b. h.
Max utilization : (51.89%)
Haunches capacity
Left haunch (77.94%) PASS
Bending capacity : $M_{y,Rd}$ = 151.29 kNm (18.45%)
Shear capacity : $V_{z,Rd}$ = 651.25 kN (77.94%)
Welds capacity : Max utilization (56.78%)
Right haunch (39.20%) PASS
Bending capacity : $M_{y,Rd}$ = 188.12 kNm (8.11%)
Shear capacity : $V_{z,Rd}$ = 651.25 kN (39.20%)

The button for scheme of forces in contact joint

The button on the right side of the load list (can be seen in the figure above) is able to open a scheme of contact joint with distribution of forces.

Internal forces distribution in contact joint

Ft=507.61 kN

191.3

139.1

Fc=1007.61 kN

Cancel
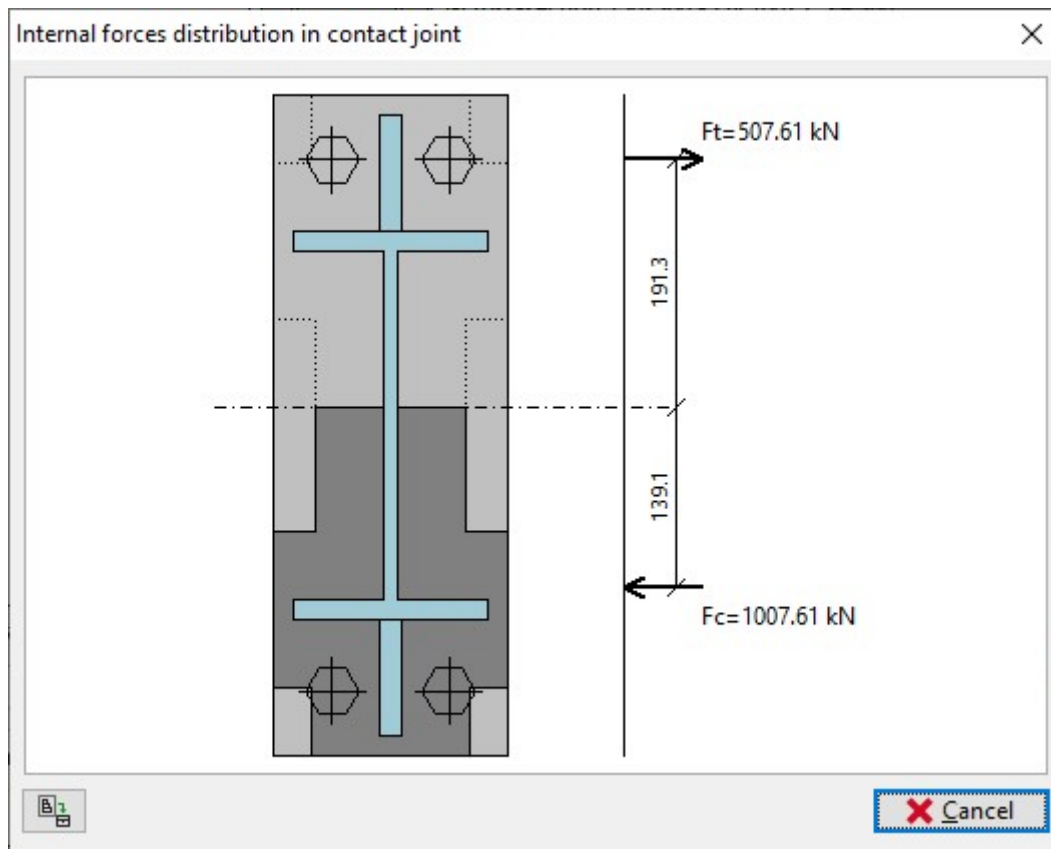
Distribution of forces in the contact joint

Steel column anchored in concrete footing

Introduction

Calculate the capacity of steel column - concrete footing connection. The steel column is anchored in the concrete footing. The depth of the anchorage is 600mm and the column is located in the centre of the footing. The values of internal forces acting in the connection are: $N_x = 694kN$, $M_y = 140kNm$ $V_z = 80kN$. The material of the column is steel EN 10025: Fe360 and the footing is made of concrete grade C20/25.
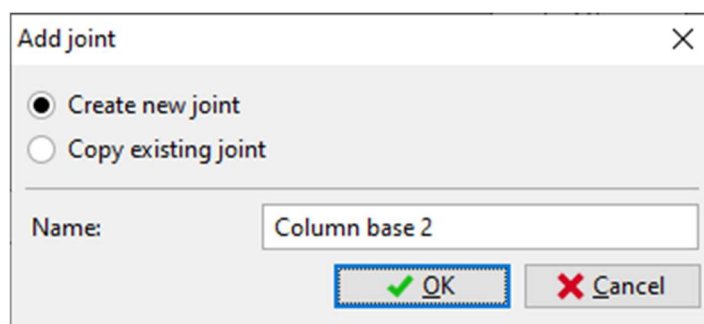
Column: HE 240B
Footing: b_b= 1600mm, a_b= 1600mm, h_b= 1000mm
End plate: b_p= 280mm, h_p= 280mm, t_p= 30mm

Creating new project

New connection to the project can be added by clicking the button "**Add**" in the main dialogue window. The "**Add joint**" dialogue window will appear, change the joint name to "**Concrete footing 2**" and confirm by clicking the button "**OK**".
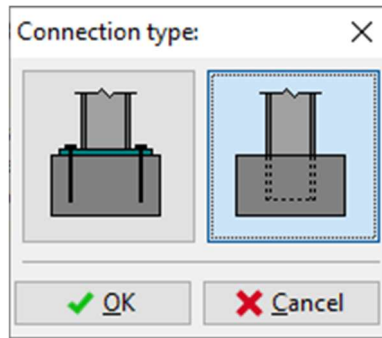

Creating new joint

Next, the "**Joint types**" dialogue window will open automatically, choose the preferred type of joint. In this example, it is the column - footing joint.
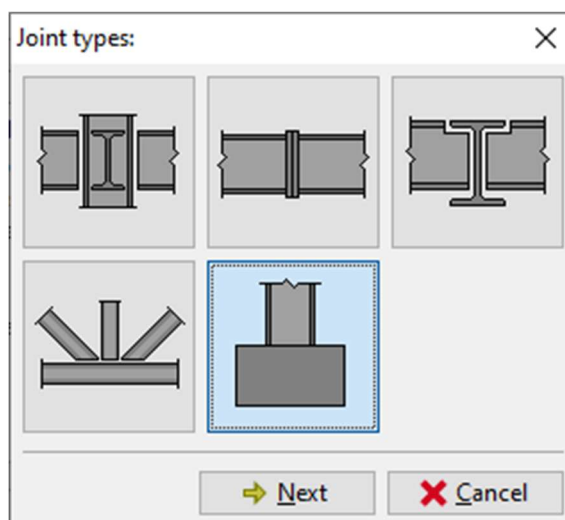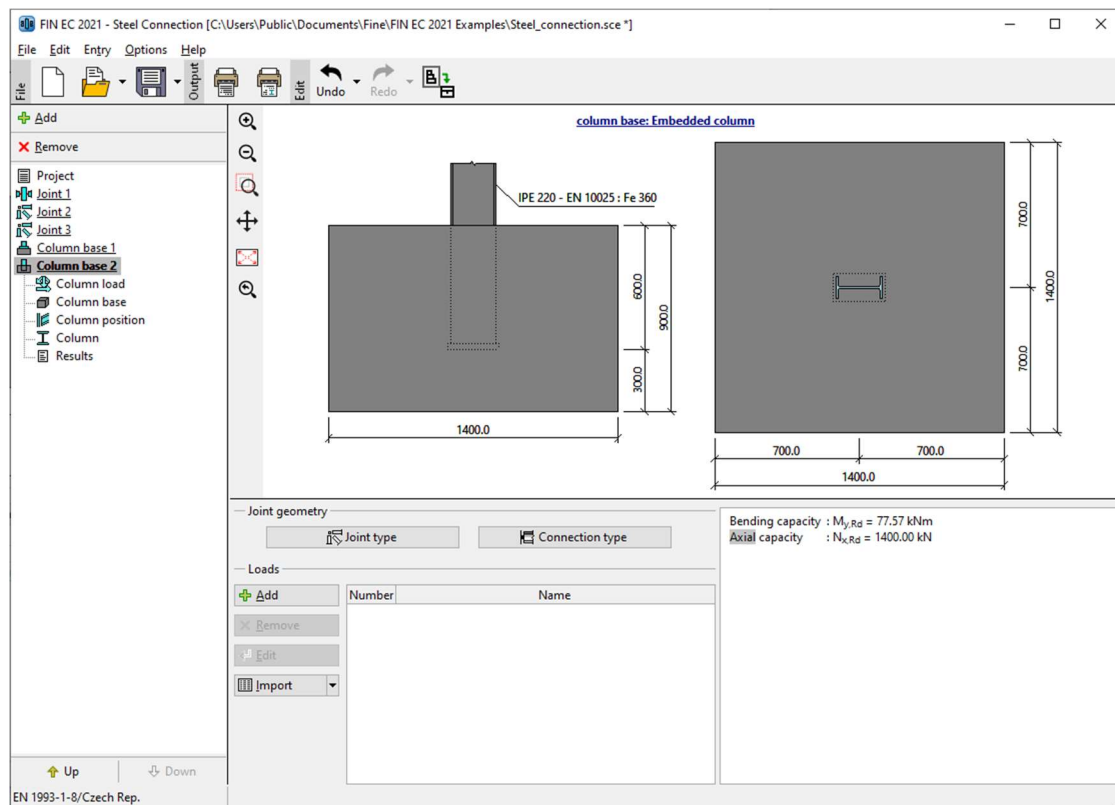

Joint types

Continue by clicking the button "**Next**", the dialogue window with the types of connection will appear. Pick the option, where the column is anchored in the concrete footing.

Column - footing connections

When this input is defined, the software will create new task named "**Concrete footing 2**" at the left side of the main dialogue window.

Main dialogue window for task "Concrete column 2"

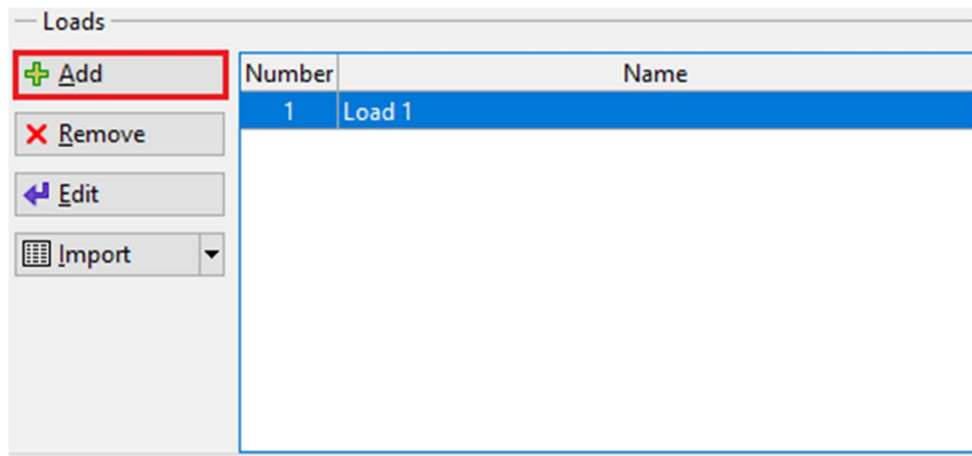## Defining properties of the connection

The connection properties are defined in the control tree under the task "**Concrete column 2**". Every connection has it's own control tree.
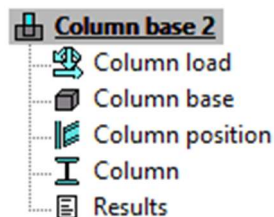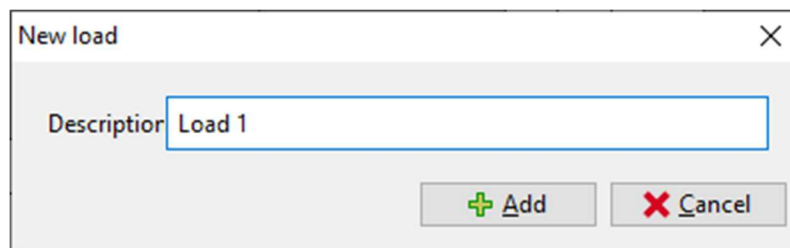

Control tree for the selected task

Load cases

First, create new load case by clicking the button "**Add**" in the "**Loads**" section.

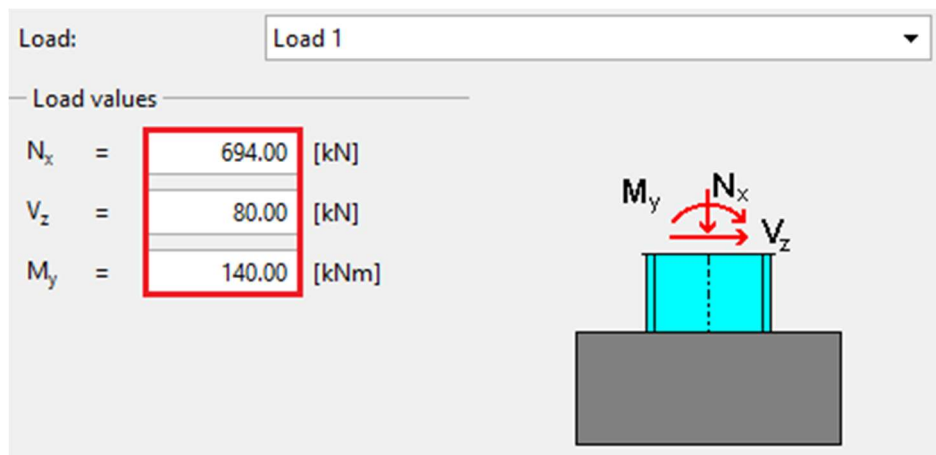*Adding new load case to the task*

The dialogue window, with name of the new load case will appear. Keep the name "**Load 1**" and continue.

Name of the new load case

Column load

The column load values are defined in the "**Column load**" section in the control tree. The "**Load values**" are N_x = 694kN, M_y = 140kNm V_z = 80kN.

Defining load values

Column base

In this section, define the values of the concrete footing geometry and material. When the geometry is changed, the graphical preview of the footing will automatically re-generate its dimensions.

Geometry and material of the footing

Column position

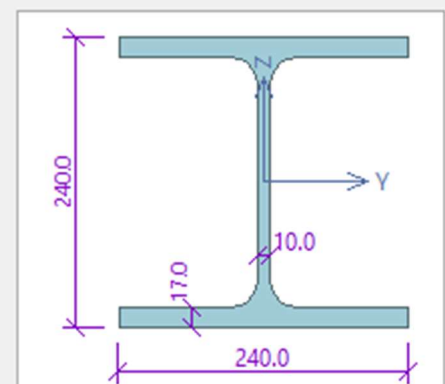Now, insert the anchorage depth of the steel column in the concrete footing, h_c = 600mm.


The joint position

Column

Define the cross-section of the column by clicking the button "**Edit section**" and the dialogue window "**Column properties**" will appear.


The column and the end plate dimensions

The dialogue window "**Column properties**" shows the preview of the cross-section. The supported types of steel columns are "**welded**" or "**hot-rolled**". The predefined type is "**hot-rolled**", therefore just click the "**Edit**" button and the catalogue with the cross-sections will appear.
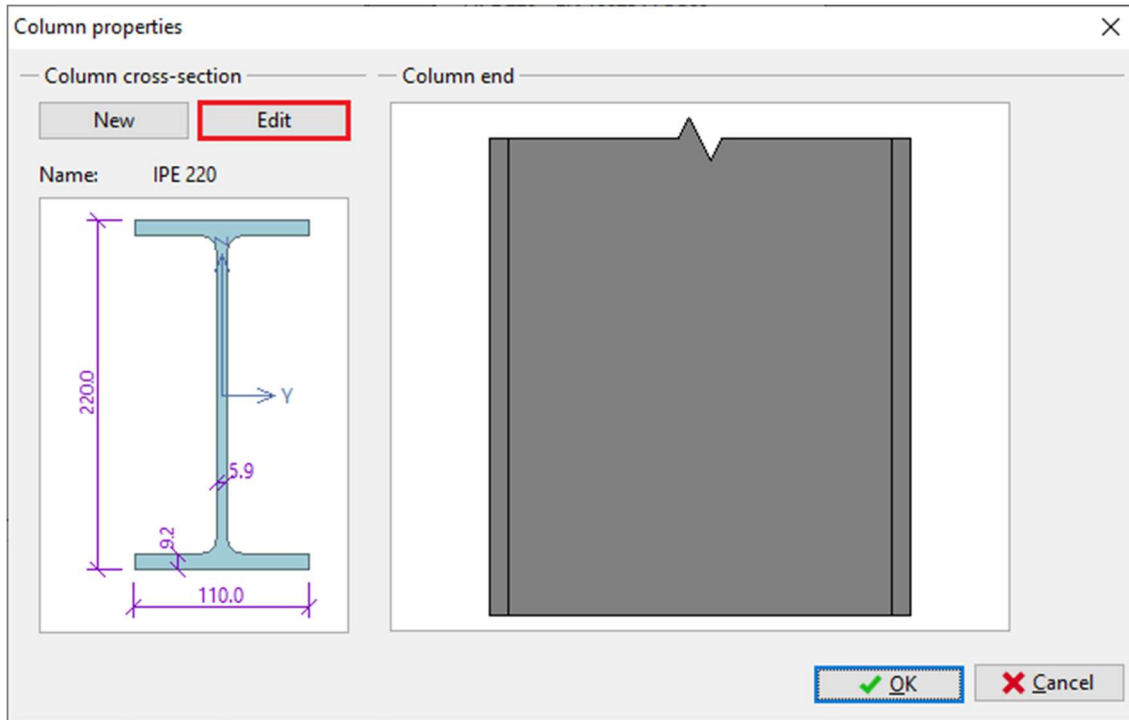

Cross-section of the column

In the dialogue window "**Profile catalogue**" pick the profile class "**Cross-section HE**" and choose the profile "**HE 240 B**". Continue by clicking the "**OK**" button.
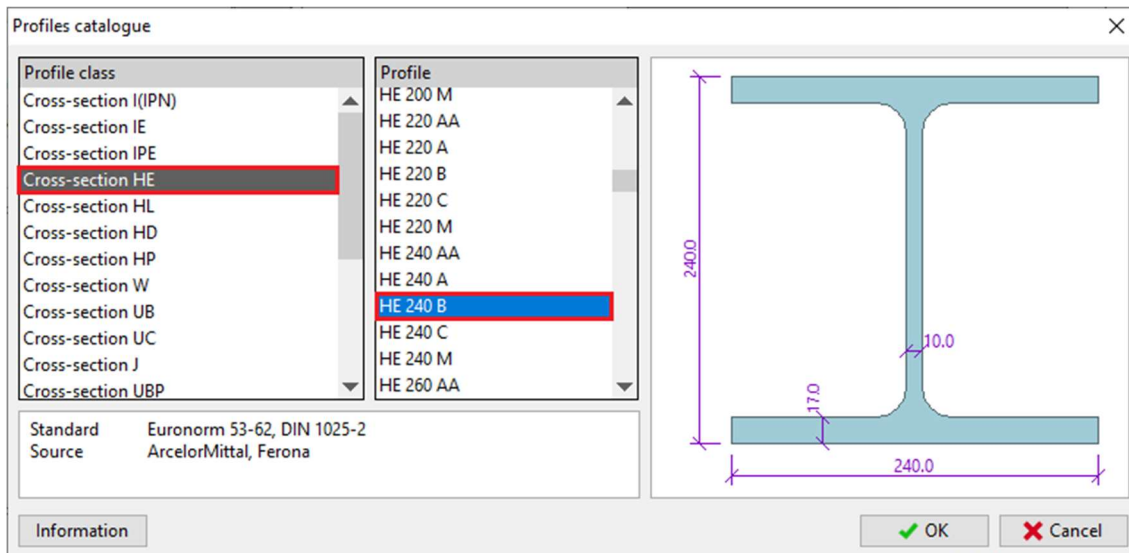
Column profile catalogue

Results

The overall results can be seen at the right-bottom section of the main dialogue window. It shows the capacity of the connection for the least favourable load case. The overall results show that the moment capacity of the connection is $M_{y,Rd}$= 152,14kNm (utilization 92.02%) and normal force capacity $N_{x,Rd}$= 2090,67kN (utilization 33.2%). The detailed results for every load case can be shown by selecting the section "**Results**" in the control tree.
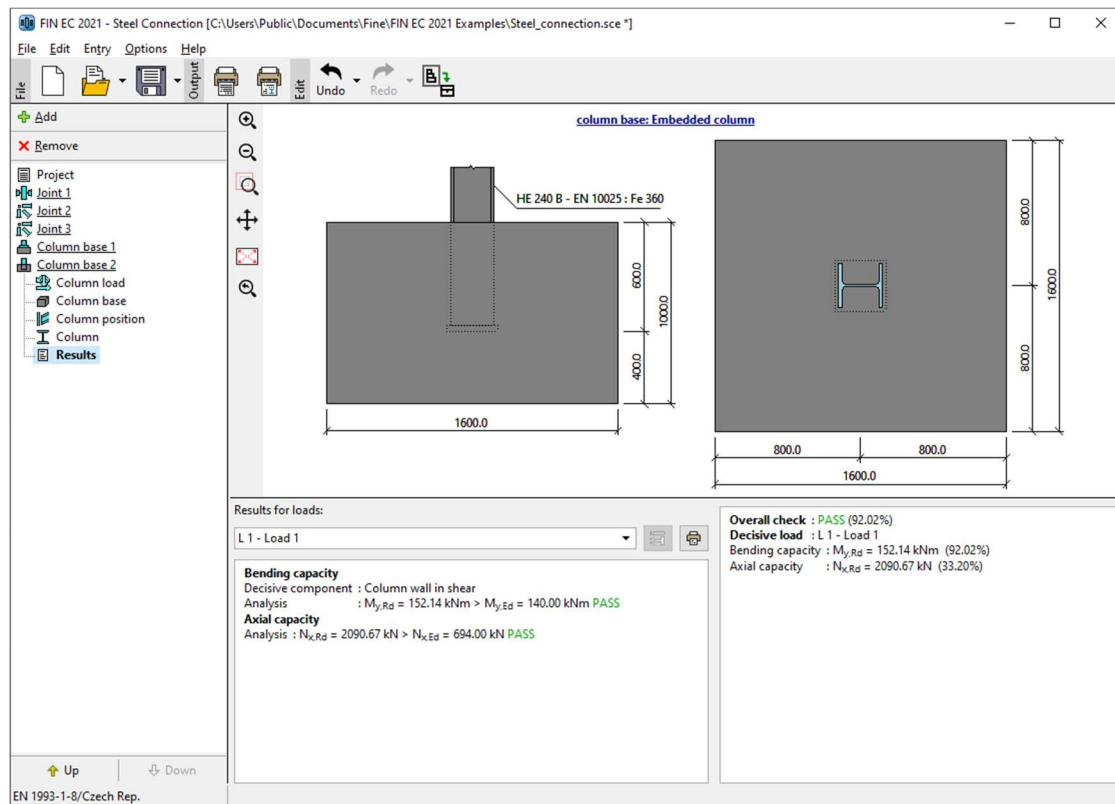
The main dialogue window with results