

# Pocketed Steel Column Base ST6

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## Basic Documentation – Overview

In addition to the individual program manuals, you will find basic explanations on the operation of the programs on our homepage [www.friilo.com](http://www.friilo.com) in the Campus-download-section.

*Tip: Go back - e.g. after a link to another chapter / document - in the PDF with the key combination "ALT" + "left arrow key".*

## Application options

The ST6 application is suitable for base point verifications of steel columns clamped in pocketed foundations and exposed to biaxial loading according to EN 1993.

The permissible column cross sections are I-shaped steel profiles.

The column base is designed as a welded on base plate.

### Standards

- DIN EN 1993
- ÖNORM EN 1993
- BS EN 1993
- EN 1993
- DIN 18800

### Interfaces

The program can be called via interfaces from the STS+ Steel Column and S7+ Portal Frame programs.

The direct transfer of the geometry and internal forces from the decisive design load cases for further calculation with ST6.

## Basis of calculation

The vertical compressive force  $Nd$  is transferred via the base plate to the material underneath.

When entering the compressive force  $Nd$ , the user can specify a percentage to consider the bonding effect. The design of the base plate takes the compressive force reduced by this percentage into account.

The shear force and the moment will be transferred within the depth of restraint.

The depth of restraint is calculated on the basis of the permissible concrete compression and the maximum shear force borne by the column profile

Verifications are performed for the column profile over the depth of restraint, the base plate and the fillet welds between the base plate and the column profile.

## Verification as per EN 1993

The verification is based on:

[1] Beispiele zur Bemessung von Stahltragwerken nach DIN EN 1993 Eurocode 3, bauforumstahl e.V., Ernst & Sohn „bauforumstahl“

[2] Kindmann, R., Laumann, J.: Erforderliche Einspanntiefe von Stahlstützen in Betonfundamente; Stahlbau 74(2005),H.8,S.564-579

for I-profiles with biaxial bending.

According to this reference, the compressive force is transferred via a base plate, the moment  $M$  over the length of restraint via a pair of forces generated through the concrete compression against the bucket wall.

In addition, friction forces between the profile flange and the bucket wall are invoked in the transfer of the moment and included with a friction coefficient of  $C_{r,d} = 0.2$ .

The design value of the bond strength of  $0.3 \text{ N/mm}^2$  for fully cast-in I-profiles is also included.

The factors for friction and bond strength  $k_n$  and  $\Delta_r$  are calculated according to [2], Eq (16) and Eq. (17) or set by the user.

The user can exclude the influence of friction and bond strength ( $\Delta_r = 0$  and  $k_n = 1$ ).

The shear force is transferred via the upper compression area of the bucket wall.

The user can modify the maximum concrete compression with the help of a factor that allows including a larger design value for partial area loading as per EN 1992-1-1, eq. (6.63). This factor can be used for the flange compression as well as the base plate.

The heights of the compression areas and the magnitude of the supporting forces are calculated from the concrete compression and the effectively involved width of the flanges. The lower supporting force is included with 80 % of the plastic shear resistance.

The required length of restraint is calculated from the values specified above. The cross section verifications at the column profile are based on the behaviour of the internal forces over the length of restraint resulting of the previous calculations.

The base plate is designed for a central compression loading as per EN 1993-1-8. The load bearing capacity results from the sum of the load bearing capacities of the three T-stubs that do not overlap.

The fillet welds are verified with the help of the simplified method as per EN 1993-1-8, para. 4.5.3.3.

## Input

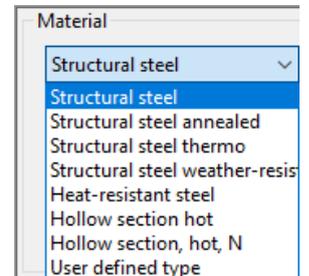
### Standard and material selection

Select first the desired standard. The available input options depend on the selected standard.

Select the material from the standard-specific list or enter the values manually (user-defined steel type).

#### Manual input:

Select the option "User-defined steel type" and click to the button  to the right of the steel selection box to display the input window.



Specifications for manual input:

- Material designation
- Yield strength  $f_{yk}$
- Tensile strength  $f_{uk}$
- Modulus of elasticity
- Shear modulus

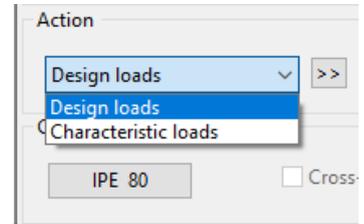
GammaMO            Indication of the partial safety factor (depending on the applicable National Application Document)

## Actions

Selection of Design- or Characteristic loads (only after creating a new item).

Design loads Input of several load combinations.

Characteristic loads Entry of characteristic actions.  
The program determines the decisive load combination for the design.



Activating the button  displays the load dialog.

Characteristic Loads									
		Combination acc. eq. 6.10				Consequence class CC 2			
	Designation	Nk[kN]	Myk[kNm]	Vzk[kN]	Mzk[kNm]	Vyk[kN]	Act	Sim	Alt
1	Load 1	10,00	1,00	1,00	0,00	0,00	99	0	0
2									

$N_k$  Axial force in [kN], compressive force must be entered with a positive sign

$M_{yk}/M_{zk}$  Moment around the y/z-axis in [kNm]

$V_{zk}/V_{yk}$  Shear force in [kN] in direction of the z/y-axis

Act Action group/category or kind of action of the load

Sim Simultaneous group assignment of the load to a group of loads acting jointly. The group is defined by a group number entered by the user. Loads that are assigned to the same concurrent group always apply simultaneously. Loads in a simultaneous group must also be member of an action group.

Alt Alternative group assignment of the load to a group of loads excluding each other. The group is defined by a group number entered by the user.

## Cross sections of the column and the base plate

Select the cross sections of the column and the base plate or define them by entering the individual dimensions - see the general description in the document [„Select - edit cross section“](#).

The thickness of the base plate should not exceed 60 mm, if possible. The software application checks compliance with the minimum values (min.  $B_f$  = profile width, min.  $L$  = profile height) and adjusts the values correspondingly.

Profile welded only active for user-defined dimensions (double-T).

## Base plate

$N_d$  with reduction of the axial force  $N_d$  due to the bond effect for the design of the base plate in %.

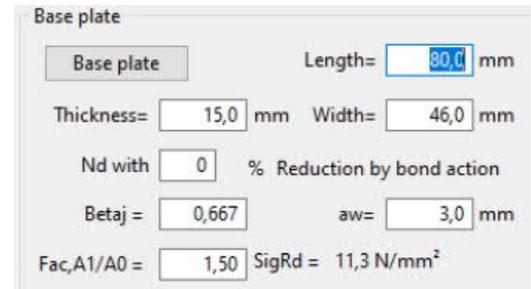
$a_w$  thickness of the weld between base plate and column.  
for I profiles:

outer flange side: Thickness  $a_w$ ; length  $\leq$  profile width  
or plate width

inner flange side: Thickness  $a_w$ ; length  $\leq$  profile  
or plate width minus profile rounding  
and web thickness

web per side: Thickness  $a_w$ ; length  $\leq$  weldable web length

Betaj coefficient of the connection according to EN 1993-1-8 section  
6.2.5



Fac,A1/A0 factor to increase the concrete strength at partial surface load by the base plate

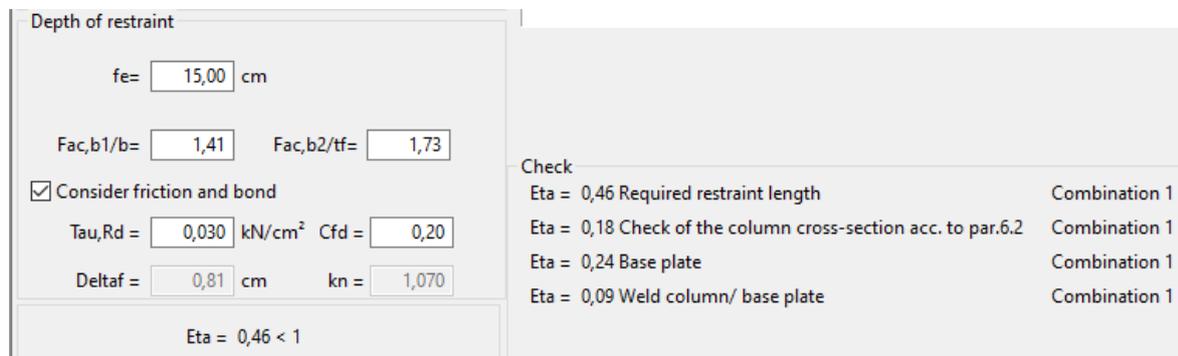
SigRd design value of the concrete compressive stress

## Depth of restraint

### Verifications

When editing the input values, the required depth of restraint and the maximum utilisation are displayed immediately.

→ see the chapter [Basis of calculation](#).



$f_e$  depth of restraint  $f_e$  in [cm] (> 10 cm)

Fac,b1/b, Fac,b2/tf factor to increase the concrete strength at partial area loading via the restraint ( $\sqrt{b_1/b}$  and  $\sqrt{b_2/tf}$ ).

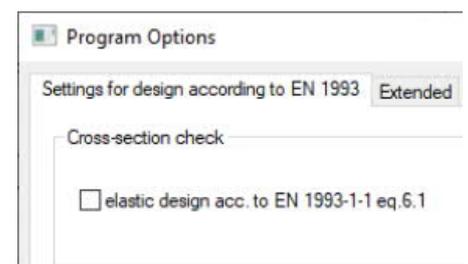
kn, Deltaf influence of friction and bond strength ( $\Delta_f = 0$  and  $k_n = 1$  means "no influence").  
Option calculate: the calculation of factors is based on [2], Eq. (16) and Eq. (17),  
otherwise user defined values.

## Options

Menu ▶ Options ▶ Settings ST6.

The following results are available for output for the verification of the profile as per EN 1993:

- Optional elastic verification using equation (6.1).
- Otherwise plastic verification using equation (6.2)



## Output

Output of the system data, results and graphical representations on the screen or the printer.

Screen	displays the values in a text window on the screen
Preview	Starts the print preview (PDF-format)
<a href="#">Printer</a>	starts the output on the printer
Word	If installed on your computer, the text editor MS Word is launched and the output data are transferred. You can edit the data to be put out in Word as required.

## Graphical representation



Display or hide the results in the graphic representation.



Launches the 3D graphical representation

### Toolbar of the 3D graphical screen



Zoom window. Allows you to zoom in (enlarge) the desired screen section with the help of the mouse.



Zoom using the mouse. The mouse cursor is transformed to a hand. Moving the mouse while keeping the mouse button pressed changes the size of the representation.



Zoom full screen. The entire graphical representation is shown on the screen.



Move. An enlarged section can be moved while keeping the mouse button pressed.



Rotate using the mouse. Keep the mouse button pressed to rotate the represented object.



Previous section. The previously displayed section is shown.



Saves the graphical representation in a BMP or WMF file.



Displays the view of the system as shown on the button.