

STX+ - Stability Analysis for Steel

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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 <u>www.frilo.com</u> 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 STX+ application allows you to verify the stability of single-piece members with fork supports in accordance with EN 1993 (equivalent member method).

Optionally, you can put out either the elastic cross-section verifications on the stress level or the analysis of the plastic internal limit forces.

Systematic central compression, uniaxial bending with or without axial force and biaxial bending are the definable actions.

The stability verifications are limited to double-symmetrical cross sections.

Available standards

- DIN EN 1993
- ÖNORM EN 1993
- BS EN 1993
- EN 1993
- Note: DIN EN 1993-1-1 does not specify any design rules for eccentrically loaded beams with U-channel section (i.e. not loaded in the centre of shear). These beams are not only under bending but also under systematic torsional loading.



Data entry

Help texts and information on each parameter to be defined are an integral part of the user interface. Clicking in an input field displays a description of the corresponding value in the information area.

A general description of the user interface is available in the document:

Basic operating instructions-PLUS

Basic parameters

Standard and safety concept

Definition of the design standard and its national annex

Ultimate limit state

Cross section design

plastic: verification of the cross section in accordance with the theory of elasticity (stress analysis).

Properties		4
Basic parameter	م	0
Output		
Design Standards and S	Safety Concept	0
Design Standard	DIN EN 1993:2015	-
Ultimate Limit State		0
Cross-section design	plastic	+

Equiv. beam detection acc.to 6.3.3 - annex B

elastic: verification of the cross section with utilisation of the plastic cross-sectional resistance (limit internal forces).

Equivalent member method acc. to

the calculation of the interaction factors for the component verification under compression and bending loads (eq. 6.61 and 6.62) is performed in accordance with Annex A or B of DIN EN 1993-1-1.



Structural system

In this section, you can define the material properties, the system dimensions and the support conditions.

Member properties

Length I specification of the length of the individual member

Cross-section you can select among all standards shapes of the FRILO profile selection file such as double-symmetrical I-profiles (double T), rectangular pipes and pipes. Just click on the *solution*.

You can find a description of the profile selection dialog in the document \rightarrow <u>Select - edit cross section</u>

Buckling length The buckling lengths can be specified optionally. In this case the buckling lengths determined from the boundary conditions will be ignored.

Supports

The specification of "0.0" defines a free support in the corresponding direction.

An elastic support is defined by specifying a spring stiffness in the corresponding direction.

The horizontal support at the front end of the member is always rigid.

Remarks

Entry of <u>remarks</u> on the system, which then also appear in the output.

Properties	4
Basic parameter <mark>- System</mark> Loading	٩0
Output	

Steel			0
Туре		Structural steel	-
Grade		S235	-
Characteristic values			
Member Properties			0
Length	1	[m]	5.00
Cross-section		HEA 340	
Default buckling length			
Support at Member Start			0
Displacement in y-direction	uy		rigid 🗹
Displacement in z-direction	uz		rigid 🗹
Rotation about z-axis p	hiy	[kNm/rad]	0.0
Rotation about z-axis p	hiz	[kNm/rad]	0.0
Support at Member End			0
Displacement in y-direction	uy		rigid 🔽
Displacement in z-direction	uz		rigid 🔽
Rotation about z-axis p	hiy	[kNm/rad]	0.0
Rotation about z-axis p	hiz	[kNm/rad]	0.0
Remarks			0
System remarks			



Loads

All actions are specified as internal design forces.

Nd	axial force N_{d} - compressive force shall be defined with a positive sign.	
Myd,1 Myd,2	design value of the internal moment about the y-axis at the <u>front end of the member</u> design value of the internal moment about the y-axis at the <u>rear end of the member</u>	S N N
Myd,F	design value of the internal moment about the y axis at point x0 in the span	N
in distance	Defines the distance x0 of the field moment from origin.	L
Linear curve	allows you to specify whether the moment behaviour is linear or parabola-shaped. If you do not define a span moment, the behaviour is always linear.	A
	HIN My	N R
	and the second sec	L

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Stresses in longitudina	al Directio	n	0
Pressure vertical force	Nd	[kN]	11.0
Stresses about y-axis			0
Moment at bar origin	Myd,1	[kNm]	112.50
Moment at bar end	Myd,2	[kNm]	195.00
Moment in field	Myd,F	[kNm]	250.00
in distance	×0	[m]	2.50
Linear curve			
Action impact		Shear Cer	nter 🔹
Stresses about z-axis		Shear Center	
Moment at bar origin	Mzd,1	Lower edg	je
Moment at bar end	Mzd,2	[kNm]	0.00
Moment in field	Mzd,F	[kNm]	0.00
in distance	x0	[m]	0.00
Remarks			0
Load remarks			1

Upper edge

Lower edge

- Action impact load application point of the transverse loading which is responsible for the span moment. The upper edge of the cross section always runs in the negative x-direction, the lower edge in the positive z-direction.
- Mz... Moment behaviour M_d about z (at the front/rear end of the member, in the span, in accordance with Myd)

Remarks

Entry of <u>remarks</u> on the loads, which then also appear in the output.



Comparative calculation of profile sections

Click on the "Compare shapes" button to perform a comparative calculation with the next smaller/large profile of the series.

Click on one of the listed profiles and apply it into the system.

	Cross-section		Stability	
HEA 260		1.17		1.3
HEA 280		0.97		1.12
HEA 300		0.78		0.8
HEA 320		0.66		0.7
HEA 340		0.58		0.6
HEA 360		0.52		0.5
HEA 400		0.42		0.4
HEA 450		0.34		0.3
HEA 500		0.27		0.3





Output

A general description of the output options is available in the document:

▶ Output and printing

View selection

The Graph/Document tabs of the view selection allow you to toggle between the graphical representation in the GUI and the preview of the output document.

Output options

The dialog offers comprehensive options for the control of the output scope.



Properties	4 ;
Basic parameter System Loading Output	۹ 🕲

Output Options	0
Brief output	\checkmark
Girder graphics	
Moment graphics	
Force the scale	
System Output	0
with cross section capacity	

Transfer of the system and the loading

If you have a valid licence for the <u>BTII+ application</u> (2nd Order Buckling Torsion Analyses) you can transfer the structural system to BTII+ for further calculations. BTII+ allows the calculation of more complex systems with consideration of e.g. lateral supports.



Reference literature

DIN EN 1993-1-1, Eurocode 3: Design of steel structures - Part 1 - 1: General rules and rules for buildings, December 2010