



SteFi User Guide

This document contains the user guide for the 1.0.2 beta version of SteFi and provides an overview of the different windows and settings in the program. This software (code and documentation) is released under the CC-BY-NC-SA license. (<https://creativecommons.org/licenses/by-nc-sa/4.0/legalcode>)

Content

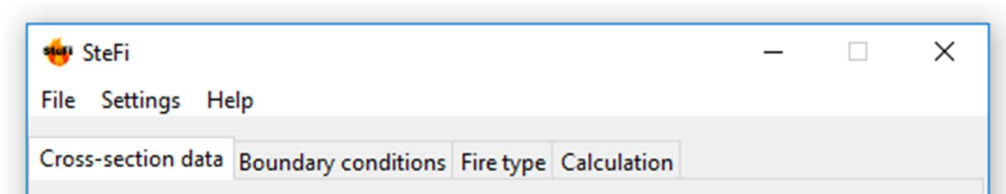
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General notes

For the program to work correctly the following must be respected:

- Decimal numbers must be separated with a dot and not a comma
- Any number must be entered in the specified unit

The program is designed with four pages which contains different information required for the calculation to run, and three menus in the upper left corner which contains general functions not required for the calculation to run.



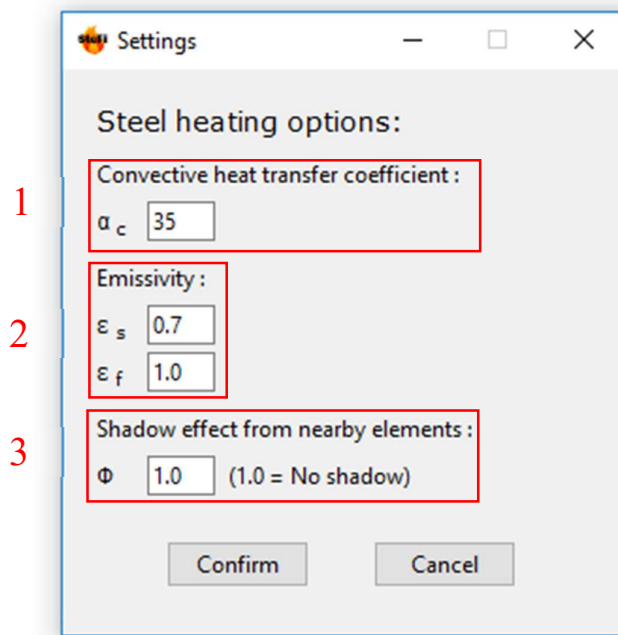
File-menu:

- New Project: This clears all data and resets options to default
- Import Data: Here, data can be imported by selecting the file containing data exported from a BIM model.

- Export Data: When the calculation is completed, the results can be exported from SteFi to an already existing .xlsx or .csv file by selecting this option.
- Exit: This function terminates the program, which also can be done by pressing the cross in the upper right corner.

Settings-menu

The Settings-menu contains only one option, which opens a pop-up window containing advanced settings with predefined values, which can be changed if wanted.



1. The convective heat transfer is per default set to 35.
2. The emissivity is divided into two parameters:
 - ϵ_s is the surface emissivity set to 0.7 as default.
 - ϵ_f is the emissivity of the flame set to 1.0 as default.
3. The shadow effect from nearby elements is set to 1.0 as default and can be reduced to accommodate the shadowing from other elements.

Help-menu:

- About: This option opens the “About” file which contains information about the program.
- User Guide: Selecting this option opens this exact user guide.
- License agreement: Opens the “License agreement”.

Cross-section data page

SteFi

File Settings Help

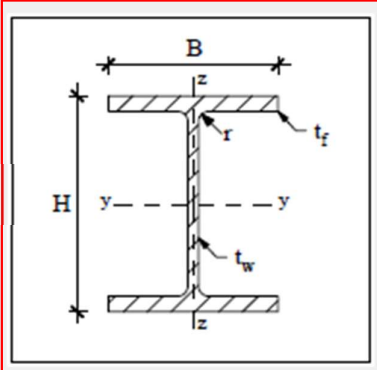
Cross-section data Boundary conditions Fire type Calculation

4 Section Type : I-Profile

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Height (H)	<input type="text"/>	mm
Width (B)	<input type="text"/>	mm
Web thickness (tw)	<input type="text"/>	mm
Flange thickness (tf)	<input type="text"/>	mm
Rounding (r)	<input type="text"/>	mm

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Yield strength at 20°C (fyk)	<input type="text"/>	MPa
Stiffness at 20°C (Es)	<input type="text" value="210"/>	GPa
Steel density (ps)	<input type="text" value="7850"/>	kg/m³
Partial factor $\gamma_{M,fi}$	<input type="text" value="1.0"/>	

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4. The different available cross-section types in the program can be selected from a predefined list in this drop-down menu which contains:
 - I-Profile
 - RHS
 - CHS
5. Depending on the selected cross-section type, this field changes as the different cross-section types are described by different parameters.
6. This image changes with the selected profile to illustrate the parameters for the selected profile type.

7. These input fields describe the material properties for the element, with predefined values for:
 - Stiffness with a default value of 210 GPa.
 - Steel density is set to 7850 kg/m³ as default.

Boundary conditions page

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

8 Element Type: ☐ Beam ☒ Column

9 Boundary Conditions: Simple/Simple

10 Length (L) m

11 Load (N,fi) kN

12 ☒ Temperature dependant imperfection (EN1993-1-2)
☐ Fixed imperfection ($\lambda^2 \cdot 4.8 \cdot 10^{-5}$)

13

14

Fire exposure:

Diagram showing a vertical column of length L, fixed at the bottom and free at the top, with a load N applied at the top.

8. This is where the element type is selected and if “Beam” is selected, 12 is not displayed and 14 is reduced to the first two options.
9. Dependent on the choice of element type, this drop-down either shows eight pre-set boundary conditions for a beam, or three for a column.
10. The length of the element should be inserted here.

11. The load acting on the element is either inserted as a point load or as a uniformly distributed load, depending on the boundary conditions, with the appropriate unit always displayed.
12. The choice here dictates the type of imperfection to use for the calculation.
13. This image changes depending on what is selected in 9 to visualise the boundary conditions.
14. The possible options for exposure type changes depending on the choice made in 8, and displays three different exposure types for a column and two for a beam.

Fire type page

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type Calculation

Please select a fire type:

☐ No fire (20°C)

☐ ISO834 Standard fire curve

☒ DS Parametric fire curve

Resistance time min

Opening factor (O) m^{1/2}

Thermal inertia (b) J/m²s^{1/2}K

Fuel load (q) MJ/m²

Plot fire curve

15. Here three different fire types can be selected which affects whether the entries in 16 are enabled or disabled.
16. If the option for “No fire” is selected in 15, all entries are disabled. If “ISO834 Standard fire” is selected in 15, the resistance time is enabled. If “DS Parametric fire” is selected in 15, the three other entries are enabled and the resistance time disabled.
17. Here the selected fire type in 15 with the inputs from 16 can be plotted and saved.

Calculations page

SteFi

File Settings Help

Cross-section data Boundary conditions Fire type **Calculation**

Please select a calculation criteria:

18 ☒ VERIFICATION - for the given resistance time
(Returns the load-bearing capacity)

☐ DESIGN - for the given load
(Returns the needed insulation thickness)

19 Calculate
Plot steel heating
Print Report

Insulation material:

20 ☐ None ☒ Hollow encasement ☐ Contour encasement

Gypsum board Thickness (di) mm

21 Material data

Section data:

22

Cross section class :				W _{el,y}	0.0	· 10 ³ mm ³
As	0.0	· 10 ³ mm ²		W _{el,z}	0.0	· 10 ³ mm ³
I _y	0.0	· 10 ⁶ mm ⁴		W _{pl,y}	0.0	· 10 ³ mm ³
I _z	0.0	· 10 ⁶ mm ⁴		W _{pl,z}	0.0	· 10 ³ mm ³

Calculation results:

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18. The program can either verify an element or design the insulation for an element, dependant on the choice here. If “VERIFICATION” is selected, all options in 20 is enabled whilst the option for no insulation and the “Thickness” are disabled if “DESIGN” is selected.

19. Here the calculation is initiated by clicking on the “Calculate” button. A pop-up window with calculation options will occur if all required inputs are inserted, and an error message will occur if some data is missing. The pop-up calculation window can be seen in detail in the chapter “Calculation options menu”. Once the calculation is complete, the two other buttons are enabled and gives the possibility to plot the steel heating curve and print a report with the results for the calculation.
20. Depending on the choice in 18, either all options are enabled if “VERIFICATION” is selected or the option for no insulation and the “Thickness” is disabled. The drop-down menu contains some pre-defined insulation materials which changes depending on the selection for either “Box encasement” or “Contour encasement”. It is possible to see the thermal conductivity and define a custom insulation material in 21.
21. This button opens the pop-up window “Insulation data” where the thermal conductivity of the insulation materials can be inspected and a custom material can be defined. The pop-up window “Insulation data” can be seen in detail in the chapter “Insulation data menu”.
22. When the calculation is completed, the calculated values for the cross-section is displayed here.
23. The results from the calculation, apart from the cross-section data, are displayed here. The data varies depending on the selected options for the calculation. If “VERIFICATION” is selected in 18, the load bearing capacity is displayed, whilst the required insulation thickness is displayed if “DESIGN” is selected in 18.
If any of the other pages are selected or any setting are changed, the results are erased as they may no longer be valid, but can be generated again by clicking the button “Calculate” in 19.

Calculation options menu

This menu appears as a pop-up window whenever the calculate button in 19 is pressed, and data is inserted in all entries required for the calculation.

24. The factor used for the deterioration of the steel is selected here, and if the “Analytical” is selected, both options will be enabled for 25. Otherwise only the 2.0% option is enabled.
25. Depending on the selection in 24, either both or only the 2.0% stress option is enabled.
26. If the selected element is a beam, this is where either a sectional or an element analysis is selected for the calculation. If a column is selected as the element type, 26 is not displayed.

24

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26

Calculation options

Select calculation options:

Deterioration factor :

☒ Tabulated (EN1993-1-2)

☐ Analytical (Hertz, 2007)

Stress type :

☒ 2.0% ☐ 0.2%

Calculation method :

☒ Section analysis ☐ Element analysis

Confirm Cancel

Insulation data menu

This pop-up window opens whenever the “Material data” button, 21, is clicked.

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28

29

Insulation data

Insulation material :

Custom

Custom material name :

Heat capacity ratio :

$\phi =$ 0.0

Confirm

λ [W/m°C]	
0°C	0.21
100°C	0.21
200°C	0.14
300°C	0.157
400°C	0.181
500°C	0.198
600°C	0.22
700°C	0.24
800°C	0.26
900°C	0.29
1000°C	0.32

27. Depending on the selected insulation type in 20, the drop-down list provides the same options as the drop-down list in 20. Whenever “Custom” is selected, the entry for the “Custom material name” is enabled. The custom material name will not appear anywhere in the program, but will be printed in the report and included in the data export.

28. The heat capacity ratio between the insulation material and steel can be inserted here, and is set to 0.0 as a default.
29. The thermal conductivity properties for the material can be inserted for different temperatures if the “Custom” insulation material is selected. If any of the pre-defined materials are selected, the entries are disabled.