STROBE

Stronger Steels in the Built Environment

Quick User Guide

SCI (the Steel Construction Institute) has been a trusted, independent source of information and engineering expertise globally for over 30 years, and is one of the leading, independent providers of technical expertise and disseminator of best practice to the steel construction sector.

We support everyone involved in steel construction; from manufacturers, consulting and design engineers, architects, product developers to industry groups.

Version	Issue	Date	Purpose	Author	Reviewer	Approved
1		19/03/2020	Software release	RJP		
2		17/06/2020	Software release	RJP		

Contents

1. Introduction

This software has been engineered and developed by SCI - The Steel Construction Institute and HOCHTIEF Engineering for Research Programme of the Research Fund for Coal and Steel STROBE. The software performs the design of bare steel beam-column elements and offers an optimization tool. The design tool covers standard hot-rolled profiles and fabricated steel sections with normal and high strength steels up to S690. For fabricated sections, different steel grades may be specified for flanges and web plates (hybrid profiles). The optimization can be carried out for hot rolled sections (UK and Euro-standard profiles) and welded sections based on user inputs. The tool covers the design of class 1, 2, 3 and 4 cross sections. Core Eurocode, UK, German and Portuguese national annexes to Eurocode 3 are available.

2. Disclaimer

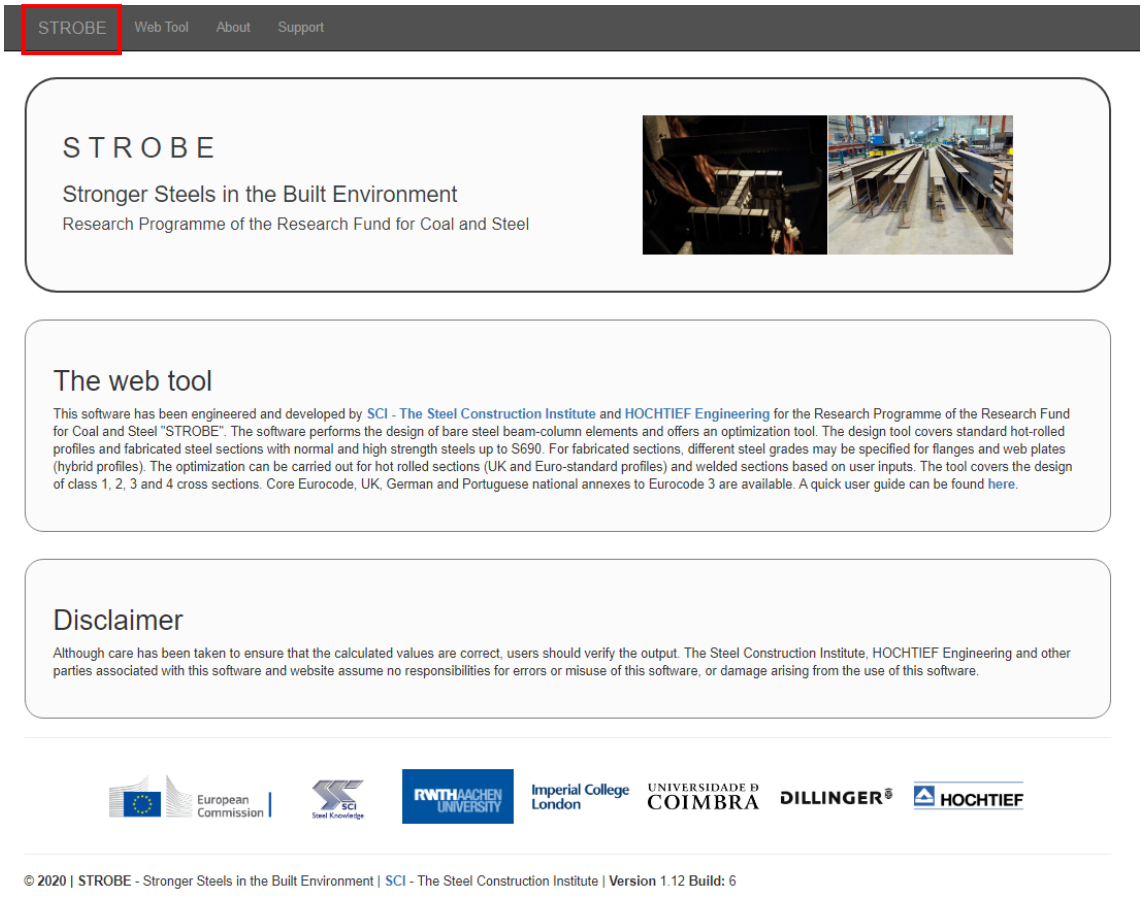
Although care has been taken to ensure that the calculated values are correct, users should verify the output. The Steel Construction Institute, HOCHTIEF Engineering and other parties associated with this software and website assume no responsibilities for errors or misuse of this software, or damage arising from the use of this software.

3. The User Interface

The functionalities of the software are grouped under separate tabs. Below is quick guide for each tab and the main buttons on each tab.

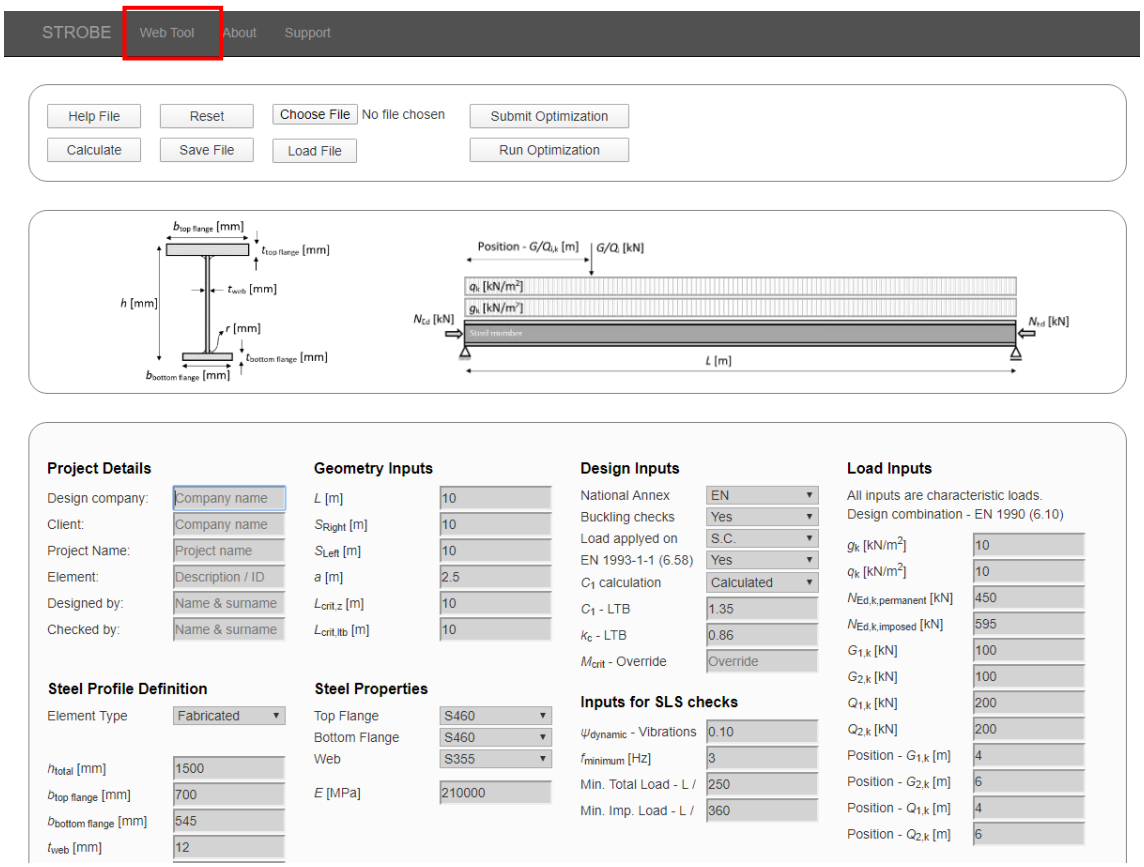
3.1 The “STROBE” tab

The “STROBE” tab gives a quick introduction about the project and explains the functionalities of the design tool.

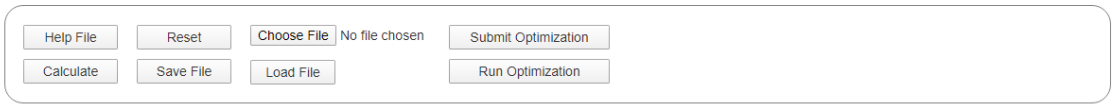


3.2 The “Web Tool” tab

The “Web Tool” tab shows the user interface for the design tool.

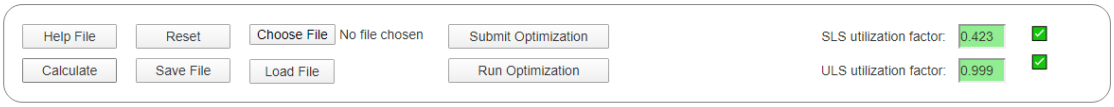


On top of the “Web Tool” tab, the user can find a group of buttons to run the web application:



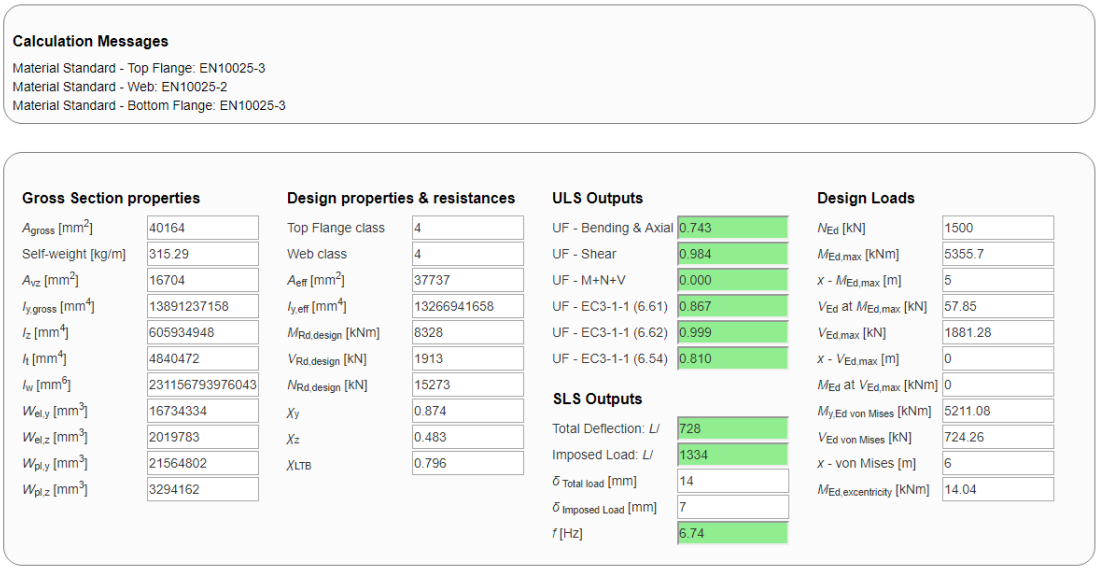
- The “User Guide” button: allows user to download the user guide for the web tool;
- The “Calculate” button: performs the calculations based on the user input variables. This button will make design outputs available;

After pressing the “Calculate” button, user will find a design output summary on the top right area of the web interface for ULS and SLS limit states:



There is a section called “Calculation Messages” that will be populated after completing the calculations.

Section properties, resistances, ULS outputs, SLS outputs and design loads will be also displayed.

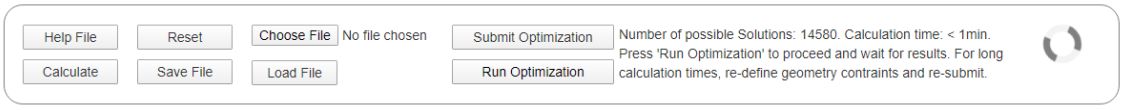


Calculation Messages

Material Standard - Top Flange: EN10025-3
Material Standard - Web: EN10025-2
Material Standard - Bottom Flange: EN10025-3

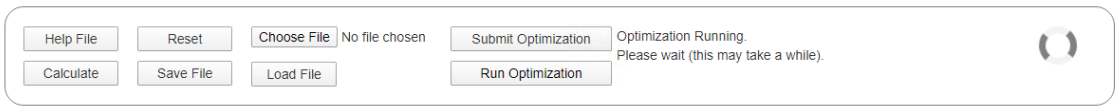
Gross Section properties		Design properties & resistances		ULS Outputs		Design Loads	
A_{gross} [mm^2]	40164	Top Flange class	4	UF - Bending & Axial	0.743	N_{Ed} [kN]	1500
Self-weight [kg/m]	315.29	Web class	4	UF - Shear	0.984	$M_{Ed,max}$ [kNm]	5355.7
A_{vz} [mm^2]	16704	A_{eff} [mm^2]	37737	UF - M+N+V	0.000	x - $M_{Ed,max}$ [m]	5
$I_{y,gross}$ [mm^4]	13891237158	$I_{y,eff}$ [mm^4]	13266941658	UF - EC3-1-1 (6.61)	0.867	V_{Ed} at $M_{Ed,max}$ [kN]	57.85
I_z [mm^4]	605934948	$M_{Rd,design}$ [kNm]	8328	UF - EC3-1-1 (6.62)	0.999	$V_{Ed,max}$ [kN]	1881.28
I_t [mm^4]	4840472	$V_{Rd,design}$ [kN]	1913	UF - EC3-1-1 (6.54)	0.810	x - $V_{Ed,max}$ [m]	0
I_w [mm^6]	231156793976043	$N_{Rd,design}$ [kN]	15273	**SLS Outputs**		M_{Ed} at $V_{Ed,max}$ [kNm]	0
$W_{el,y}$ [mm^3]	16734334	χ_y	0.874	Total Deflection: $L/$	728	$M_{y,Ed\ von\ Mises}$ [kNm]	5211.08
$W_{el,z}$ [mm^3]	2019783	χ_z	0.483	Imposed Load: $L/$	1334	$V_{Ed\ von\ Mises}$ [kN]	724.26
$W_{pl,y}$ [mm^3]	21564802	χ_{LTB}	0.796	$\delta_{Total\ load}$ [mm]	14	x - von Mises [m]	6
$W_{pl,z}$ [mm^3]	3294162			$\delta_{Imposed\ Load}$ [mm]	7	$M_{Ed,excentricity}$ [kNm]	14.04
				f [Hz]	6.74		

- The “Reset” button: reset default input for the web tool;
- The “Save File” button: allow users to download an input file that can be later uploaded to the web tool; the file has a clear XML structure that can be manually edited;
- The “Choose File” button: allows users to browse and select an input file previous downloaded from the web tool using the button “Save File”;
- The “Load File” button: allows users to load the selected file through the “Choose File” button to the web tool;
- The “Submit Optimization” button: submits the optimization options to the engine and reports an estimated calculation time. For an optimization using standard profiles (say HEB or UC profiles) this is not critical, but for “Fabricated”/welded/custom profiles, depending on the user defined optimization inputs, the calculation time may be unreasonable; the following message will be displayed:

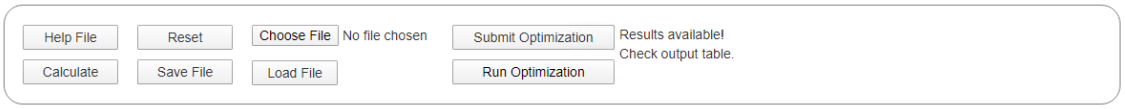


The user can judge if the calculation time is acceptable. If the calculation time is to high, user can red-define optimization inputs and re-submit the optimization.

- The “Run Optimization” button: triggers the optimization engine. After pressing the button, the following message will the displayed:



After completing the Optimization calculation, the following message will be displayed:



The user can the find the optimization outputs if the following table (scroll down in the web page to find it):

Optimization Outputs

ID	H [mm]	tw [mm]	b,top [mm]	tf,top [mm]	b,bottom [mm]	tf, bottom [mm]	SW [kg/m]	UF - M+N	UF - V	UF - M+N+V	UF - 6.54	UF - 6.61	UF - 6.62	Total - L/	Imposed - L/	f - [Hz]
12020	1500	12	600	25	500	15	314.16	0.72	0.97	0	0.79	0.84	0.98	770	1410	6.93
11667	1500	12	600	25	525	15	317.1	0.72	0.97	0	0.79	0.84	0.97	783	1434	6.98
11559	1500	12	600	25	500	16	317.99	0.71	0.97	0	0.78	0.83	0.97	786	1440	7

There is a section called “Optimization Messages” where the user can find output messages related with the optimization process. As an example, if user selects a certain profile type for which there are no solution available, a message will be displayed referring that “No solution for XX section type” exist.

Optimization Outputs

ID	Name	H [mm]	b [mm]	SW [kg/m]	UF - M+N	UF - V	UF - M+N+V	UF - 6.54	UF - 6.61	UF - 6.62	Total - L/	Imposed - L/	f - [Hz]
7	HL1100 R	1118	405	498.64	0.67	0.32	0	0.82	0.81	0.99	706	1301	6.61
1	UB 1100 x 400 x 499	1118	405	502.01	0.66	0.31	0	0.81	0.81	0.98	712	1312	6.64
2	UB 920 x 420 x 537	965	425	535.75	0.7	0.34	0	0.78	0.77	0.92	581	1071	5.99
3	UB 1000 x 400 x 539	1030	407	539.43	0.66	0.3	0	0.76	0.76	0.92	655	1209	6.37
8	HL1000 X 554	1032	408	554.06	0.64	0.29	0	0.74	0.74	0.89	671	1239	6.44
9	HL1000 X 642	1048	412	641.85	0.55	0.25	0	0.62	0.61	0.75	788	1458	6.97
10	HD400 X 990	550	448	990.99	0.8	0.3	0	0.76	0.74	0.82	278	522	4.12
4	UC 356 x 406 x 990	550	448	990.99	0.8	0.3	0	0.76	0.74	0.82	278	522	4.12
11	HD400 X 1086	569	454	1087.81	0.71	0.27	0	0.68	0.66	0.74	319	599	4.4
5	UC 356 x 406 x 1086	569	454	1087.81	0.71	0.27	0	0.68	0.66	0.74	319	599	4.4
6	UC 356 x 406 x 1202	580	471	1201.55	0.65	0.23	0	0.62	0.6	0.67	354	667	4.63

Optimization Messages

No solutons for 'HEA' section type.
No solutons for 'HEAA' section type.
No solutons for 'HEB' section type.
No solutons for 'HEM' section type.
No solutons for 'HP' section type.
No solutons for 'IPE' section type.
No solutons for 'IPEA' section type.
No solutons for 'IPEO' section type.
No solutons for 'IPEV' section type.

For “Fabricated” profiles, the optimization message “Geometry constraints changed to fulfil design requirements.” means that the minimum flange width was adapted so that existing rules for buckling curves according to Eurocode are applicable.

Optimization Outputs

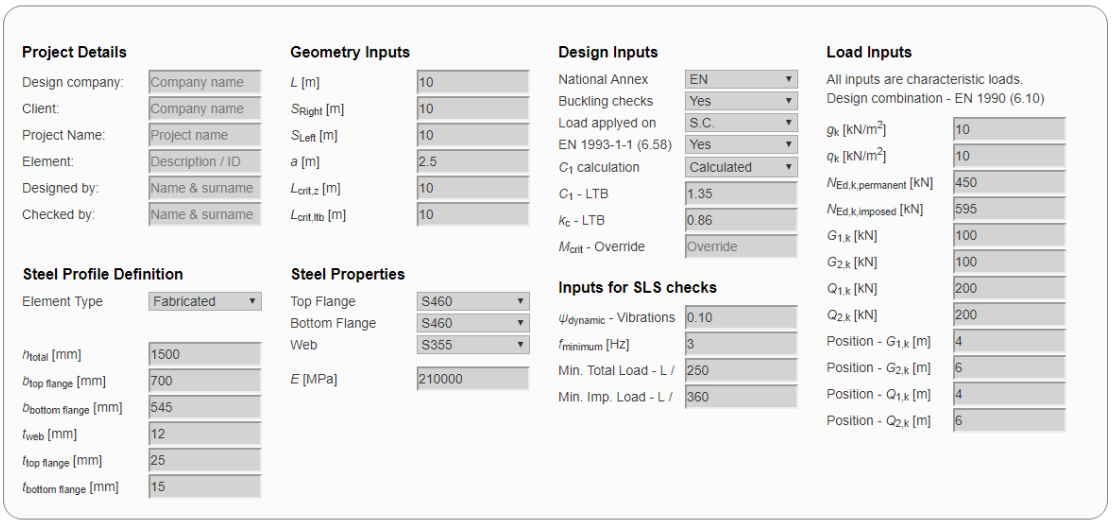
ID	H [mm]	tw [mm]	b,top [mm]	tf,top [mm]	b,bottom [mm]	tf, bottom [mm]	SW [kg/m]	UF - M+N	UF - V	UF - M+N+V	UF - 6.54	UF - 6.61	UF - 6.62	Total - L/	Imposed - L/	f - [Hz]
12020	1500	12	600	25	500	15	314.16	0.72	0.97	0	0.79	0.84	0.98	770	1410	6.93
11667	1500	12	600	25	525	15	317.1	0.72	0.97	0	0.79	0.84	0.97	783	1434	6.98
11559	1500	12	600	25	500	16	317.99	0.71	0.97	0	0.78	0.83	0.97	786	1440	7

Optimization Messages

Geometry constraints changed to fulfil design requirements.

User input cells are highlighted with a light grey background. There are two groups of inputs:

I. General inputs for the design tool containing the following sections:



Project Details

Design company:	Company name
Client:	Company name
Project Name:	Project name
Element:	Description / ID
Designed by:	Name & surname
Checked by:	Name & surname

Geometry Inputs

L [m]	10
S_{Right} [m]	10
S_{Left} [m]	10
a [m]	2.5
$L_{crit,z}$ [m]	10
$L_{crit,ltb}$ [m]	10

Design Inputs

National Annex	EN
Buckling checks	Yes
Load applyed on	S.C.
EN 1993-1-1 (6.58)	Yes
C_1 calculation	Calculated
C_1 - LTB	1.35
k_c - LTB	0.86
M_{crit} - Override	Override

Load Inputs

All inputs are characteristic loads.
Design combination - EN 1990 (6.10)

g_k [kN/m^2]	10
q_k [kN/m^2]	10
$N_{Ed,k,permanent}$ [kN]	450
$N_{Ed,k,imposed}$ [kN]	595
$G_{1,k}$ [kN]	100
$G_{2,k}$ [kN]	100
$Q_{1,k}$ [kN]	200
$Q_{2,k}$ [kN]	200
Position - $G_{1,k}$ [m]	4
Position - $G_{2,k}$ [m]	6
Position - $Q_{1,k}$ [m]	4
Position - $Q_{2,k}$ [m]	6

Steel Profile Definition

Element Type	Fabricated
h_{total} [mm]	1500
$b_{top\ flange}$ [mm]	700
$b_{bottom\ flange}$ [mm]	545
t_{web} [mm]	12
$t_{top\ flange}$ [mm]	25
$t_{bottom\ flange}$ [mm]	15

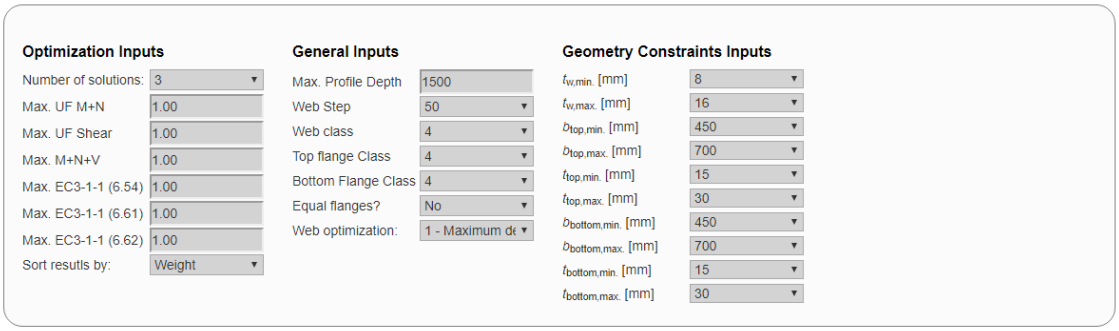
Steel Properties

Top Flange	S460
Bottom Flange	S460
Web	S355
E [MPa]	210000

Inputs for SLS checks

$\psi_{dynamic}$ - Vibrations	0.10
$f_{minimum}$ [Hz]	3
Min. Total Load - L /	250
Min. Imp. Load - L /	360

II. Inputs for the optimization tool:



Optimization Inputs

Number of solutions:	3
Max. UF M+N	1.00
Max. UF Shear	1.00
Max. M+N+V	1.00
Max. EC3-1-1 (6.54)	1.00
Max. EC3-1-1 (6.61)	1.00
Max. EC3-1-1 (6.62)	1.00
Sort resutls by:	Weight

General Inputs

Max. Profile Depth	1500
Web Step	50
Web class	4
Top flange Class	4
Bottom Flange Class	4
Equal flanges?	No
Web optimization:	1 - Maximum de

Geometry Constraints Inputs

$t_{w,min.}$ [mm]	8
$t_{w,max.}$ [mm]	16
$b_{top,min.}$ [mm]	450
$b_{top,max.}$ [mm]	700
$t_{top,min.}$ [mm]	15
$t_{top,max.}$ [mm]	30
$b_{bottom,min.}$ [mm]	450
$b_{bottom,max.}$ [mm]	700
$t_{bottom,min.}$ [mm]	15
$t_{bottom,max.}$ [mm]	30

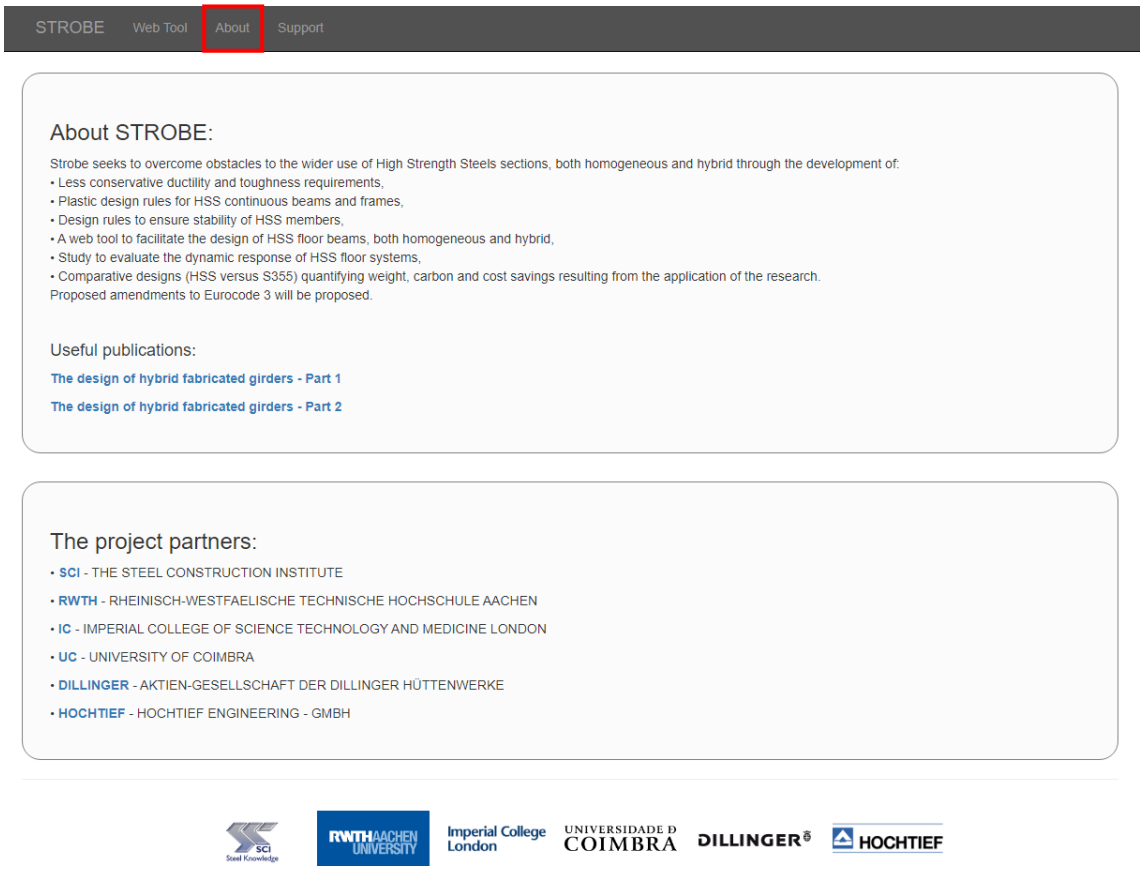
Most of the general inputs are also used for the optimization tool. The only inputs that are not used for the optimization tool are the ones that define the section geometry under the “Steel Profile Definition” group of inputs.

The “Element Type” input will change the options available in the interface.

Most of the input or output text boxes have a “ToolTip” option which provides useful information about the input/output. To trigger tis option please pass the cursor over the text box.

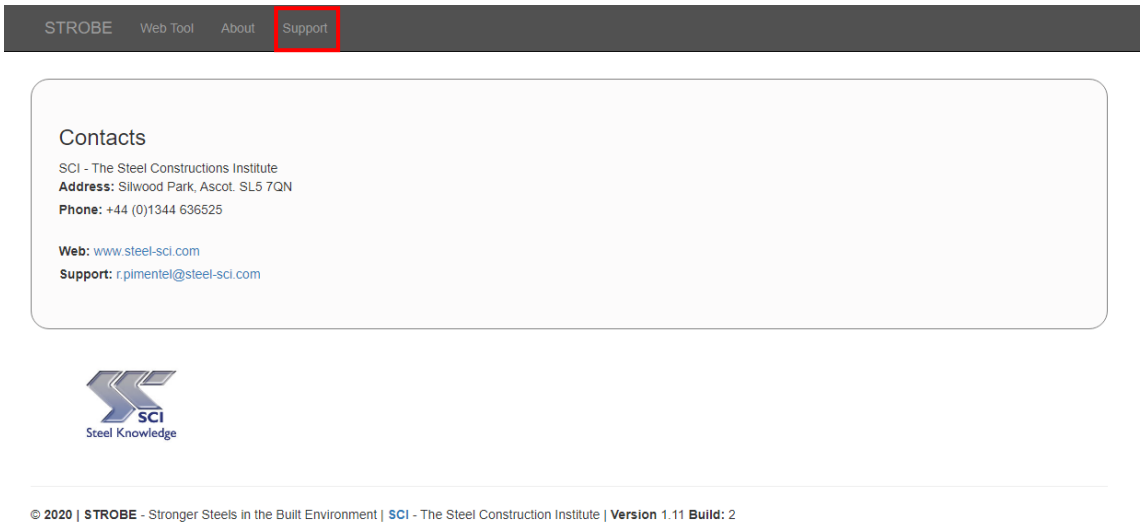
3.3 The “About” tab

The “About” tab gives more information about the project and the project and the project partners. Users can find two useful technical publications about the design of hybrid girders.



3.4 The “Support” tab

The “Support” tab gives the contacts that ca be used to report any issues found related to the web tool as well as to request any further clarification about the project or the web tool.



Contact SCI for more details:

https://steel-sci.com/contact/