

Version June 2021

Add-on Module

RF-/STEEL HK

Design of Steel Members according to the Code of Practice for the Structural Use of Steel

Program Description

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Contents

Contents

Page

1.	Introduction	2
1.1	Add-on Module RF-/STEEL HK	
1.1	Using the Manual	
1.2	Opening RF-/STEEL HK Add-on Module	
2.	Input Data	
2.1	General Data	
2.1	Ultimate Limit State	
2.1.1	Serviceability Limit State	
2.1.2	Materials	
2.2	Cross-Sections	
2.5 2.4		
	Intermediate Lateral Restraints	
2.5	Effective Lengths - Members	
2.6	Effective Lengths - Sets of Members	
2.7	Nodal Supports - Sets of Members	
2.8	Member Hinges - Sets of Members	
2.9	Serviceability Parameters	
3.	Calculation	
3.1	Detailed Settings	
3.1.1	Ultimate Limit State	
3.1.2	Stability	
3.1.3	Serviceability	
3.1.4	General	
3.2	Starting the Calculation	. 32
	-	
4.	Results	
4.1	Results Design by Load Case	. 34
4.1 4.2	Results Design by Load Case Design by Cross-Section	. 34 . 35
4.1 4.2 4.3	Results Design by Load Case Design by Cross-Section Design by Set of Members	. 34 . 35 . 36
4.1 4.2 4.3 4.4	Results Design by Load Case Design by Cross-Section Design by Set of Members Design by Member	. 34 . 35 . 36 . 37
4.1 4.2 4.3 4.4 4.5	Results Design by Load Case Design by Cross-Section Design by Set of Members Design by Member Design by x-Location	. 34 . 35 . 36 . 37 . 37
4.1 4.2 4.3 4.4 4.5 4.6	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by Member	. 34 . 35 . 36 . 37 . 37 . 38
4.1 4.2 4.3 4.4 4.5 4.6 4.7	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of Members	. 34 . 35 . 36 . 37 . 37 . 38 . 39
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8	Results Design by Load Case Design by Cross-Section Design by Set of Members Design by Member Design by x-Location Governing Internal Forces by Member Governing Internal Forces by Set of Members Members Slendernesses	. 34 . 35 . 36 . 37 . 37 . 38 . 39 . 40
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by Member	. 34 . 35 . 36 . 37 . 37 . 38 . 39 . 40 . 41
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of Members	. 34 . 35 . 36 . 37 . 37 . 38 . 39 . 40 . 41 . 42
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5.	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults Evaluation	34 35 36 37 37 38 39 40 41 41 42 43
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResults on RFEM/RSTAB Model	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5.1 5.2	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResults on RFEM/RSTAB ModelResult Diagrams	. 34 . 35 . 36 . 37 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 44
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1 5.2 5.3	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResults on RFEM/RSTAB ModelResult DiagramsFilter for Results	. 34 . 35 . 36 . 37 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5.1 5.2	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResults on RFEM/RSTAB ModelResult DiagramsFilter for ResultsPrintout	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5.1 5.1 5.2 5.3 6. 6.1	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of Members.Results EvaluationResults on RFEM/RSTAB ModelResult DiagramsFilter for ResultsPrintoutPrintout Report	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 50
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1 5.2 5.3 6. 6.1 6.2	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResult DiagramsFilter for ResultsPrintoutPrintout ReportGraphic Printout	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 51
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5.1 5.1 5.2 5.3 6. 6.1	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResult DiagramsFilter for ResultsPrintoutPrintoutPrintout ReportGraphic PrintoutGeneral Functions	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 51 . 53
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1 5.2 5.3 6. 6.1 6.1 6.2 7. 7.1	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by X-LocationGoverning Internal Forces by Member.Governing Internal Forces by Set of MembersMembers Slendernesses.Parts List by MemberParts List by Set of Members.Results EvaluationResults on RFEM/RSTAB ModelResult DiagramsFilter for ResultsPrintoutPrintout Report.Graphic Printout.Design Cases	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 51 . 53
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1 5.2 5.3 6. 6.1 6.2 7. 7.1 7.2	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by x-LocationGoverning Internal Forces by MemberGoverning Internal Forces by Set of MembersMembers SlendernessesParts List by MemberParts List by Set of MembersResults EvaluationResult DiagramsFilter for ResultsPrintoutPrintout ReportGraphic PrintoutDesign CasesCross-Section Optimization	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 51 . 53 . 55
4.1 4.2 4.3 4.4 4.5 4.6 4.7 4.8 4.9 4.10 5. 5.1 5.2 5.3 6. 6.1 6.1 6.2 7. 7.1	ResultsDesign by Load CaseDesign by Cross-SectionDesign by Set of MembersDesign by MemberDesign by X-LocationGoverning Internal Forces by Member.Governing Internal Forces by Set of MembersMembers Slendernesses.Parts List by MemberParts List by Set of Members.Results EvaluationResults on RFEM/RSTAB ModelResult DiagramsFilter for ResultsPrintoutPrintout Report.Graphic Printout.Design Cases	. 34 . 35 . 36 . 37 . 38 . 39 . 40 . 41 . 42 . 43 . 44 . 47 . 48 . 50 . 51 . 53 . 55 . 57

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7.4.1	Exporting Materials to RFEM/RSTAB
7.4.2	Export of Results
Α.	Literature
В.	Index 61

1 Introduction

1.1 Add-on Module RF-/STEEL HK

The Code of Practice for the Structural Use of Steel [1] describes the design, analysis and construction of steel structures relevant to Hong Kong. With the add-on modules RF-STEEL HK (for RFEM) and STEEL HK (for RSTAB), DLUBAL provides a powerful tool for designing steel members according to the regulations published by the Building Department of Hong Kong.

In the following, the add-on modules of both main programs are described in one manual and are referred to as **RF-/STEEL HK**.

RF-/STEEL HK performs all typical ultimate limit state designs as well as stability and deflection analyses. In the ultimate limit state design, the add-on module considers the effect of various loadings. An essential part of the verification is the classification of the cross-sections to be designed into the classes 1 to 4. This way, the limitation of the capacity to withstand stresses as well as the rotational capacity due to local buckling of cross-section parts is checked. RF-/STEEL HK determines the c/t-ratios of the cross-section parts subjected to compression and carries out the classification automatically.

In the stability analyses, you can specify separately for each member or set of members whether flexural buckling in y- and/or z-direction is possible. You can also define additional lateral restraints in order to represent the model close to reality. Based on the boundary conditions, RF-/STEEL HK determines the slenderness ratios and elastic critical buckling loads. The elastic critical moment for flexural-torsional buckling required for the lateral-torsional buckling analysis is determined automatically. Optionally, the program takes into account the load application point of transverse loads, which has a decisive effect on the torsional resistance.

The serviceability limit state represents an important design for structures with slender cross-sections. Load cases, load combinations and result combinations can be assigned to different design situations. The limit deflections are preset by the Code, but can be adjusted, if necessary. In addition, it is possible to specify reference lengths and precambers that are considered accordingly in the deflection design.

The add-on module provides an automatic cross-section optimization with the possibility to export modified cross-sections to RFEM or RSTAB. Separate design cases allow for the flexibility to analyze individual structural components within complex structures.

Like other add-on modules, RF-/STEEL HK is completely integrated in RFEM and RSTAB. Thus, the design-relevant input data is preset when you start the add-on module. After the design, you can use the graphical user interface of the main program to evaluate the results. As they are also included in the global printout report, the entire verification can be presented in a consistent and appealing form.

We wish you ease and success with RF-/STEEL HK.

Your DLUBAL team

1.2 Using the Manual

Topics like installation, graphical user interface, results evaluation, and printout are described in detail in the manuals of the main programs RFEM and RSTAB. The present manual focuses on typical features of the RF-/STEEL HK add-on module.

The descriptions in this manual follow the sequence and structure of the module's input and result windows. In the text, the described **buttons** are given in square brackets, for example, [View Mode]. At the same time, they are pictured on the left. Expressions appearing in dialog boxes, windows, and menus are set in *italics* to clarify the explanation.

At the end of the manual, you find the index. However, if you don't find what you are looking for, you can go to the Knowledge Base to find related articles about the steel add-on modules or consult the FAQs.

1.3 Opening RF-/STEEL HK Add-on Module

RFEM and RSTAB provide the following options to open the RF-/STEEL HK add-on module.

Menu

۲

To start the program on the RFEM or RSTAB menu bar, select

 $\textbf{Add-on Modules} \rightarrow \textbf{Design-Steel} \rightarrow \textbf{RF-/STEEL HK}.$

Add-on Modules Window H	elp		
Current Module	> :	P 🕺 🙈 🐄 🐼	📾 🛤 🔚 🎬 🥵 🏟 🕸 🏦 🎾 🗞 🗘 🗡 🗿
Design - Steel	Ľ	STEEL	General stress analysis of steel members
Design - Concrete	1 EC	STEEL EC3	Design of steel members according to Eurocode 3
Design - Timber	Also	STEEL AISC	Design of steel members according to AISC (LRFD or ASD)
Design - Aluminum	Lis	STEEL IS	Design of steel members according to IS
Dynamic	SIA	STEEL SIA	Design of steel members according to SIA
Connections	J BS	STEEL BS	Design of steel members according to BS
Foundations	1G8	STEEL GB	Design of steel members according to GB
Stability	CSA	STEEL CSA	Design of steel members according to CSA
Towers	Ins	STEEL AS	Design of steel members according to AS
Others •	NIC	STEEL NTC-DF	Design of steel members according to NTC-DF
Stand-Alone Programs	Isp	STEEL SP	Design of steel members according to SP
	PIPM	STEEL Plastic	Design of steel members according to PIFM
	SANS	STEEL SANS	Design of steel members according to SANS
	NBR	STEEL NBR	Design of steel members according to NBR
	J FD	STEEL Fatigue Memb	ers Fatigue design of steel members
	Tik	STEEL HK	Design of steel members according to HK
	1	КАРРА	Flexural buckling analysis
	Ð	LTB	Lateral-torsional and torsional-flexural buckling analysis
	₽. Fe	FE-LTB Late	ral-torsional and torsional-flexural buckling analysis by FEM
	12	EL-PL	Elastic-plastic design
		C-TO-T	Analysis of limit slenderness ratios (c/t)
		PLATE-BUCKLING	Plate buckling analysis
	₽ ₿	VERBAND (not install	ed) Design of wind bracings for roofs

Figure 1.1: Menu Add-on Modules \rightarrow Design - Steel \rightarrow STEEL HK

Navigator

To start RF-/STEEL HK in the Data navigator, select

Add-on Modules \rightarrow RF-/STEEL HK.

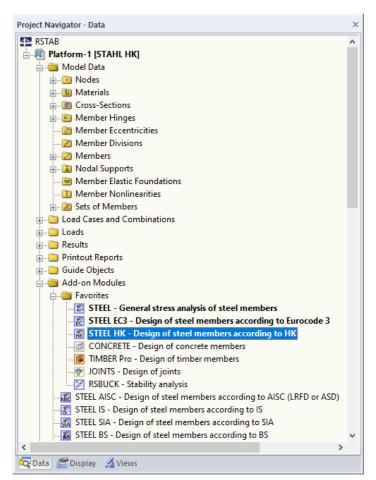


Figure 1.2: Data navigator: Add-on Modules \rightarrow RF-STEEL HK

Panel

STEEL HK CA1 - Beams	
LC1 - Self-weight LC2 - Live load	6
RC1 - 1.4*LC1/p + LC2 STEEL HK CA1 - Beams	
STEEL HK CA2 - Column	ns
	2
CTEEL UK	
STEEL HK	

If any results from RF-/STEEL HK are already available in the model, you can open the design module in the panel:

Set the relevant design case in the load case list of the menu bar. Click the [Show Results] button to display the design criterion graphically on the members.

When the results display is activated, the panel appears showing the [RF-/STEEL HK] button which you can use to open the add-on module.

Panel	×
Max Design Ratio [-]	
1.00 0.90 0.80 0.70 0.60 0.50 0.40 0.30 0.20 0.10 0.00	
Max : 0.61 Min : 0.00	
STEEL HK	
1 a 1	Q,

Figure 1.3: Panel with [STEEL HK] button

2 Input Data

When you start the add-on module, a new window appears. In this window, a navigator is displayed on the left, managing the available module windows. The drop-down list above the navigator contains the design cases (see Chapter 7.1, page 53).

The design-relevant data must be defined in several input windows. The following parameters are imported automatically when you open RF-/STEEL HK for the first time:

- Members and sets of members
- Load cases, load combinations, and result combinations
- Materials

P

Cancel

OK.

- Cross-sections
- Buckling lengths
- Internal forces (in background, if calculated)

To select a window, click the corresponding entry in the navigator. To go to the previous or subsequent module window, use the buttons shown on the left. You can also use the function keys to select the next [F2] or previous [F3] window.

To save the entered data, click [OK]. Thus, you exit RF-/STEEL HK and return to the main program. Click [Cancel] to exit the add-on module without saving the new data.

2.1 General Data

In Window 1.1 General Data, you select the members, sets of members, and actions that you want to design. The three tabs manage the load cases, load combinations, and result combinations for the ultimate limit state, the serviceability limit state, and the fire protection design.

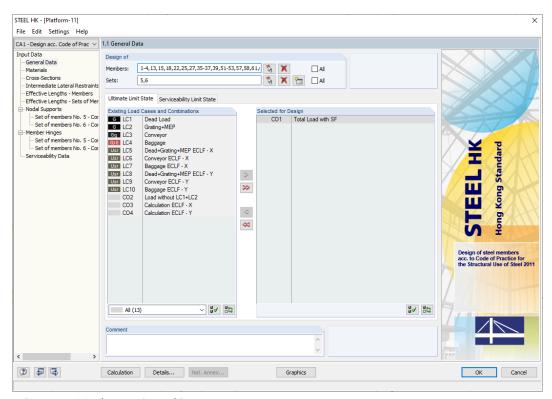


Figure 2.1: Window 1.1 General Data

Design of

Design of				
Members:	1,2,11,12,21,22,31,32,44,51,52,61-64,81-83,91-96,5	\$	×	All
Sets:	1-8	13	\times	✓ All

Figure 2.2: Design of members and sets of members



°

You can design *Members* as well as *Sets* of members. If you want to design only selected objects, clear the *All* check box: Then, you can access the text boxes to enter the numbers of the relevant members or sets of members. Use the [Delete] button to clear the list of preset numbers. Use the [Select] button to define objects graphically in the RFEM or RSTAB work window.

When you design a set of members, the program determines the extreme values of the designs of all members contained in this set of members and takes into account the boundary conditions due to connected members for stability analyses. The results are shown in the results windows 2.3 Design by Set of Members, 3.2 Governing Internal Forces by Set of Members, and 4.2 Parts List by Set of Members.

To define a new set of members, click the [New] button. The dialog box known from RFEM or RSTAB appears where you can enter the parameters for the set of members.

Comment



In this text box, you can enter user-defined notes describing, for example, the current design case.

2.1.1 Ultimate Limit State

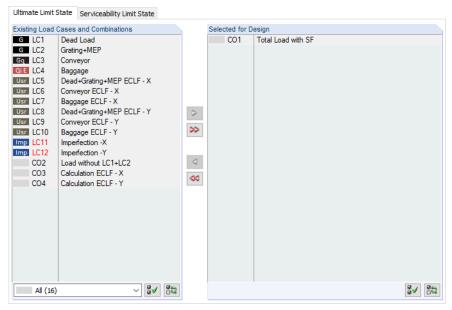


Figure 2.4: Window 1.1 General Data, tab Ultimate Limit State

Existing Load Cases and Combinations

This column lists all load cases, load combinations, and result combinations that have been created in RFEM or RSTAB.

To transfer selected entries to the *Selected for Design* list on the right, click the *>* button. Alternatively, you can double-click the entries. To transfer the entire list to the right, use the *>* button.

As common for Windows applications, selecting several load cases is possible by clicking them one by one while holding down the [Ctrl] key. Thus, you can transfer several load cases at the same time.

If a load case's number is marked in red such as LC11 or LK12 in Figure 2.4, you cannot design it: It indicates a load case without load data, or a load case that contains imperfections. A warning appears if you try to transfer it.

Below the list, several filter options are available. They help you assign the entries sorted by load case, load combination, or action category. The buttons have the following functions:

₫ √	Selects all load cases in the list
85	Inverts selection of load cases

Table 2.1: Buttons in Ultimate Limit State tab

Selected for Design

The column on the right lists the load cases as well as load and result combinations that have been selected for the design. To remove selected items from the list, click <</td>or double-click the entries. To empty the entire list, click <</td>



Designing an enveloping max/min result combination (RC) is faster than designing all contained load cases and load combinations, but the analysis of a result combination also has disadvantages:
 First, the influence of the contained actions is difficult to discern. Second, for the determination of the elastic critical moment M_{cr} for lateral-torsional buckling, the envelope of the moment distributions is analyzed, from which the most unfavorable distribution (max or min) is taken. This distribution, however, only rarely reflects the moment distribution that is available in the individual load combinations. Thus, for an RC design, more unfavorable values for M_{cr} are expected, leading to higher ratios.

Result combinations should be selected for design only in case of dynamic combinations. For "usual" combinations, it is recommended to use load combinations because here the actual moment distributions are applied for the determination of M_{cr} .

Details...

In the *General* tab of the *Details* dialog box, you can define how result combinations of the 'OR' type are handled in the design (see Chapter 3.1.4, page 30).



2.1.2 Serviceability Limit State Ultimate Limit State Serviceability Limit State Existing Load Cases and Combinations Selected for Design G LC1 Dead Load CO5 Deflection Analysis G LC2 Gq LC3 Grating+MEP Conveyor QiE LC4 Baggage Usr LC5 Dead+Grating+MEP ECLF - X Usr LC6 Usr LC7 Conveyor ECLF - X Baggage ECLF - X Usr LC8 Dead+Grating+MEP ECLF - Y >Usr LC9 Conveyor ECLF - Y ≫ Usr LC10 Imp LC11 Baggage ECLF - Y Imperfection -X Imp LC12 Imperfection -Y \triangleleft CO1 Total Load with SF CO2 Load without LC1+LC2 4 CO3 Calculation ECLF - X CO4 Calculation ECLF - Y

Figure 2.5: Window 1.1 General Data, tab Serviceability Limit State

Existing Load Cases and Combinations

~ 🖌 🖏

This column lists all load cases and combinations that have been created in RFEM or RSTAB.

Selected for Design

All (16)



You can add or remove load cases as well as load and result combinations as described in Chapter 2.1.1.

8**1**

The limit values of the deformations are defined in the Code of Practice [1] Table 5.1. They can be adjusted for the design situations in the *Serviceability* tab of the *Details* dialog box (see Figure 3.3, page 29) that you open with the [Details] button.

In Window 1.9 Serviceability Data, the reference lengths applying to the deformation analysis are managed (see Chapter 2.9, page 26).

2.2 Materials

This module window consists of two parts. The upper part lists all materials created in RFEM or RSTAB. The *Material Properties* section shows the properties of the current material, that is, the table row currently selected in the upper section.

Materials						
	A		E			
Material	Material					
No.	Description		Comr	nent		
1 Steel S	355 BS EN 1993-1-1:2005	User-defined material				
2 Concre	te C30/37					
					💐 🕸 🖏 👁	
laterial Properties						1
Main Properties					×	
 Modulus of Ela 	sticity	E	210000.0	MPa		
 Shear Modulus 	3	G	80769.2	MPa		
Poisson's Ratio	c	v	0.300			
 Specific Weight 	ıt	γ	78.50	kN/m ³		
Coefficient of T	Thermal Expansion	α	1.2000E-05	1/°C		
Partial Safety F	actor	7M	1.00			Material No. 1 used in
Additional Propert	ties					Material No. 1 used in
Thickness Rar	nge t ≤ 3.0 mm					Cross-sections No.:
Yield Streng	th	fy	355.00	MPa		1-4
Ultimate Stre	ength	fu	510.00	MPa		1-1
Thickness Rar	nge t > 3.0 mm and t ≤ 16.0 mm					
 Yield Streng 	th	fy	355.00	MPa		Members No.:
Ultimate Stre	angth	fu	470.00	MPa		1-4, 13-16, 18, 22-25, 27, 35-40, 51-53, 57
Thickness Rar	nge t > 16.0 mm and t ≤ 40.0 mm	I				
Yield Streng	th	fy	345.00	MPa		Sets of members No.:
Ultimate Stre	ength	Fu	470.00	MPa		
	nge t > 40.0 mm and t ≤ 63.0 mm	-				5,6
Yield Streng		fy	335.00	MPa		
Ultimate Stre		fu	470.00			Σ Lengths: Σ Masses:
	nge t > 63.0 mm and t ≤ 80.0 mm					157.78 [m] 4.046 [t]
Yield Streng		fy	325.00	MPa		
Ultimate Stre		fu	470.00			
	nge t > 80.0 mm and t ≤ 100.0 mm		470.00			
Yield Streng		fy	315.00	MPa	~	

Figure 2.6: Window 1.2 Materials

Materials that won't be used in the design are grayed out. Materials that are not allowed are highlighted in red. Modified materials are displayed in blue.

Chapter 4.3 of the RFEM manual, or Chapter 4.2 of the RSTAB manual, describes the material properties that are used for the determination of the internal forces (*Main Properties*). The properties of the materials that are required for the design are also stored in the global material library. These values are preset (*Additional Properties*).

To adjust the units and decimal places of the properties and stresses, select on the module menu **Settings** \rightarrow **Units and Decimal Places** (see Chapter 7.3, page 57).

Material Description

The materials defined in RFEM or RSTAB are preset but you can modify them anytime: Click the material in column A to activate the box. Then, click the substant button, or press the function key [F7] to open the material list.

Steel S 355 BS EN 1993-1-1:2005	5 💌	
Steel S 235	BS EN 1993-1-1:2005	^
Steel S 275	BS EN 1993-1-1:2005	
Steel S 355	BS EN 1993-1-1:2005	
Steel S 450	BS EN 1993-1-1:2005	
Steel S 275 N	BS EN 1993-1-1:2005	
Steel S 275 NL	BS EN 1993-1-1:2005	
Steel S 355 N	BS EN 1993-1-1:2005	
Steel S 355 NL	BS EN 1993-1-1:2005	
Steel S 420 N	BS EN 1993-1-1:2005	
Steel S 420 NL	BS EN 1993-1-1:2005	\checkmark

Figure 2.7: List of materials

According to the design concept of the Code [1], only materials of the *Steel* category can be selected.

After the material transfer, the design-relevant *Material Properties* are updated.

If you change the material description manually and the new entry is already listed in the material library, RF-/STEEL HK will import the material properties as well.

The material properties are generally not editable in the RF-/STEEL HK add-on module.

Material Library

or use the button shown on the left.

Many materials are stored in the database. To open the material library, click on the module menu **Edit** \rightarrow **Material Library**

Material Library					Х
Filter	Material to Select				
Material category group:	Material Description	Standard			
Metal ~	Steel Q235	🚟 GB 5001	7-2017		
	Steel Q345	GB 5001	7-2017		
Material category:	Steel Q355	🚟 GB 5001	7-2017		
Steel ~	Steel Q390	🚟 GB 5001	7-2017		
Standard group:	Steel Q420	💹 GB 5001	7-2017		
	Steel Q460	💹 GB 5001	7-2017		
GB/T ✓					
Standard:					
GB 50017-2017 ~					
Include invalid					
Favorites group:					
				_	
~	Search:			7	×
· · · · · · · · · · · · · · · · · · ·	Search:		Start 0245 1 0		
Material Properties	Search:		Steel Q345 G		
	Search:	E		B 50017-20	
Material Properties	Search:		Steel Q345 G 206000.0 79230.8	B 50017-20 MPa	
Material Properties	Search:	E	206000.0	B 50017-20 MPa	
Material Properties	Search:	E G	206000.0 79230.8 0.300	B 50017-20 MPa	
Material Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio		E G V	206000.0 79230.8 0.300	B 50017-20 MPa MPa kN/m ³	
Material Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Themal Expansio El Additional Properties		Ε G ν γ	206000.0 79230.8 0.300 78.50	B 50017-20 MPa MPa kN/m ³	
Material Properties Imain Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Thermal Expansio Additional Properties E Thickness Range t ≤ 16.0 mm		E G ν γ α	206000.0 79230.8 0.300 78.50 1.2000E-05	B 50017-20 MPa MPa kN/m ³ 1/°C	
Material Properties Imain Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Thermal Expansio Additional Properties □ Thickness Range t ≤ 16.0 mm Yield Strength		E G ν γ α	206000.0 79230.8 0.300 78.50 1.2000E-05 345.0	B 50017-20 MPa MPa kN/m ³ 1/°C	
Material Properties Imain Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Thermal Expansio Additional Properties E Thickness Range t ≤ 16.0 mm		E G ν γ α	206000.0 79230.8 0.300 78.50 1.2000E-05	B 50017-20 MPa MPa kN/m ³ 1/°C	
Material Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Thermal Expansio Additional Properties Thickness Range t ≤ 16.0 mm Yield Strength Utimate Strength Design Strength		E G V γ α f f f f	206000.0 79230.8 0.300 78.50 1.2000E-05 345.0 470.0 305.0	B 50017-20 MPa MPa kN/m ³ 1/°C MPa MPa MPa	
Material Properties Imain Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Themal Expansio Additional Properties Thickness Range t ≤ 16.0 mm Yield Strength Ultimate Strength Design Strength Design Strength	n	E G ν γ α fy fu	206000.0 79230.8 0.300 78.50 1.2000E-05 345.0 470.0	B 50017-20 MPa MPa kN/m ³ 1/°C MPa MPa MPa	
Material Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Themal Expansio Additional Properties Thickness Range t ≤ 16.0 mm Yield Strength Utimate Strength Design Strength	n	E G V γ α f f f f	206000.0 79230.8 0.300 78.50 1.2000E-05 345.0 470.0 305.0	B 50017-20 MPa MPa kN/m ³ 1/°C MPa MPa MPa	
Material Properties Imain Properties Main Properties Modulus of Elasticity Shear Modulus Poisson's Ratio Specific Weight Coefficient of Themal Expansio Additional Properties Thickness Range t ≤ 16.0 mm Yield Strength Utimate Strength Design Strength Design Strength	n	E G V γ α f f f f	206000.0 79230.8 0.300 78.50 1.2000E-05 345.0 470.0 305.0	B 50017-20 MPa MPa kN/m ³ 1/°C MPa MPa MPa	17

Figure 2.8: Dialog box *Material Library*

The *Steel* material category is preset in the *Filter* section. You can select the desired material grade from the *Material to Select* list; then you can check the properties in the dialog section below.

ОК

Click [OK] or use [←] to transfer the selected material to Window 1.2 of RF-/STEEL HK.

Chapter 4.3 of the RFEM manual, or Chapter 4.2 of the RSTAB manual, describes how to filter, add, or reorganize materials.

In the library, you can also select materials of the categories *Cast Iron* and *Stainless Steel*. However, please check whether these materials are allowed by the design concept of the Code [1].

2.3 Cross-Sections

This window lists the cross-sections used for the design. In addition, you can specify optimization parameters.

	A	В	С	D	E	F		4 - H HW 150x150 GB/T 11263-2010
	Material	Cross-Section	Cross-Section	Opti-				
No.	No.	Description	Туре	mize	Remark	Comment		
1	1	T H HW 125x125 GB/T 11263-2010	I-section rolled	No		Upright		+ 150.0
2	1	T H HW 125x125 GB/T 11263-2010	I-section rolled	No				
3	1	H HW 125x125 GB/T 11263-2010	I-section rolled	No				
4	1	H HW 150x150 GB/T 11263-2010	I-section rolled	No	•			0 0 <u>8.0</u>
				No				
				From current row				150.0
								-
								7.0
								1
								z
								[mi
		2 (1)			1		•	
					4	. 🔹 🖏 ·	۲	0 7 a
					×	B	•	
	ection Prop	Derties - H HW 150x150 GB/T 11263-2010)		M	. 🕸 🖏		Cross-section No. 4 used in
Cross	ection Prop Section Ty	Derties - H HW 150x150 GB/T 11263-2010		I-section rolled			•	
Cross Sectio	ection Prop Section Ty n Height	Derties - H HW 150x150 GB/T 11263-2010	h	150.0 mn				Cross-section No. 4 used in Members No.:
Cross Section Section	ection Prop Section Ty n Height n Width	Derties - H HW 150x150 GB/T 11263-2010	h b	150.0 mn 150.0 mn				Cross-section No. 4 used in Members No.:
Cross Section Section Web	ection Prop Section Ty n Height n Width Thickness	perties - H HW 150x150 GB/T 11263-2010	h b t _w	150.0 mn 150.0 mn 7.0 mn				Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6
Cross Section Section Web Flange	ection Prop Section Ty n Height n Width Thickness e Thickness	perties - H HW 150x150 GB/T 11263-2010	h b t _w tf	150.0 mn 150.0 mn 7.0 mn 10.0 mn				Cross-section No. 4 used in
Cross Section Section Web Flange Root	ection Prop Section Ty n Height n Width Thickness e Thickness Radius	erties - H HW 150x150 GB/T 11263-2010	h b tw tf	150.0 mn 150.0 mn 7.0 mn 10.0 mn 8.0 mn				Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6
Cross Section Section Web Flange Root Cross	ection Prop Section Ty n Height n Width Thickness e Thickness Radius Sectional /	erties - H HW 150x150 GB/T 11263-2010	h b t _w tf r A	150.0 mn 150.0 mn 7.0 mn 10.0 mn 8.0 mn 39.64 cm				Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.:
Cross Section Section Web Flange Root I Cross Shear	ection Prop Section Ty n Height n Width Thickness Thickness Thickness Radius Sectional / Area	erties - H HW 150x150 GB/T 11263-2010	h b tw tf r A Avy	150.0 mn 150.0 mn 7.0 mn 10.0 mn 8.0 mn 39.64 cm 30.00 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: -
Cross Section Section Web Flange Root Cross Shear Shear	ection Prop Section Ty n Height n Width Thickness Thickness Thickness Radius Sectional Area Area	perties - H HW 150x150 GB/T 11263-2010 pe	h b tw tf r A A vy Avz	150.0 mn 150.0 mn 7.0 mn 10.0 mn 39.64 cm 30.00 cm 10.50 cm				Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses:
Cross Section Web Flange Root Cross Shear Shear Mome	ection Prop Section Ty n Height n Width Thickness Thickn	perties - H HW 150x150 GB/T 11263-2010 rpe Is Area	h b tw tf r A Avy Avz ly	150.0 mn 150.0 mn 7.0 mn 8.0 mn 39.64 cm 30.00 cm 10.50 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses:
Cross Section Web Flange Root I Cross Shear Shear Mome Mome	ection Prop Section Ty n Height n Width Thickness Thickness Radius Sectional <i>J</i> Area Area nt of Inetia nt of Inetia	eventies - H HW 150x150 GB/T 11263-2010 grpe s Area	h b tw tf r A Avy Avz ly lz	150.0 mm 150.0 mm 7.0 mm 10.0 mm 39.64 cm 30.00 cm 10.50 cm 1620.0 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses:
Cross Section Web Flange Root I Cross Shear Shear Mome Mome Torsion	ection Prop Section Ty n Height n Width Thickness Phickness Radius Sectional / Area Area nt of Inertii nal Consta	berties - H HW 150x150 GB/T 11263-2010 ppe s Area a a nt	h b tw tf r A Avy Avz ly	150.0 mm 150.0 mm 10.0 mm 39.64 cm 30.00 cm 10.50 cm 563.00 cm 11.18 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses:
Cross Section Web Flange Root I Cross Shear Shear Mome Mome Torsion	ection Prop Section Ty n Height n Width Thickness Thickness Radius Sectional <i>J</i> Area Area nt of Inetia nt of Inetia	berties - H HW 150x150 GB/T 11263-2010 ppe s Area a a nt	h b tw tf r A Avy Avz ly lz	150.0 mm 150.0 mm 7.0 mm 10.0 mm 39.64 cm 30.00 cm 10.50 cm 1620.0 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses: 43,64 [m] 1.358 [t] Material:
Cross Section Section Flange Root Cross Shear Shear Shear Mome Torsion Radiu	ection Prop Section Ty n Height n Width Thickness Phickness Radius Sectional / Area Area nt of Inertii nal Consta	perties - H HW 150x150 GB/T 11263-2010 pe s Area a a nt n	h b tw tf r A vy Avz ly iz it	150.0 mm 150.0 mm 10.0 mm 39.64 cm 30.00 cm 10.50 cm 563.00 cm 11.18 cm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses: 43,64 [m] 1.358 [t]
Cross Section Section Web Flange Root I Cross Shear Shear Mome Torsion Radiu Radiu	ection Prop Section Ty n Height n Width Thickness a Thickness a Thickness Radius Sectional / Area Area Area ant of Inertii nal Consta s of Gyratic	eventies - H HW 150x150 GB/T 11263-2010 grpe s Area a a a nt nt on	h b tw tf r A Avy Avz iy iz iz it ry	150.0 mn 150.0 mn 7.0 mn 10.0 mn 39.64 cm 30.00 cm 10.50 cm 1620.00 cm 11.18 cm 63.9 mn		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses: 43,64 [m] 1.358 [t] Material:
Cross Section Section Web Flange Root Cross Shear Shear Shear Mome Torsion Radiu Radiu Elastion	ection Prop Section Ty n Height n Width Thickness a Thickness a Thickness a Thickness a Sectional / Area Area nt of Inertia nal Constat s of Gyratic s of Gyratic	perties - H HW 150x150 GB/T 11263-2010 ppe s Area a a nt n n n n n n on oldulus	h b tw tf r A A y A y ly lz lt t ry fz	150.0 mm 150.0 mm 7.0 mm 10.0 mm 8.0 mm 39.64 cm 30.00 cm 10.50 cm 1620.00 cm 563.00 cm 1.1.8 cm 6.3 mm 37.6 mm		8.2.1		Cross-section No. 4 used in Members No.: 1,4,13,15,22,25,27,35-37,39,61,65,6 Sets of members No.: - Σ Lengths: Σ Masses: 43,64 [m] 1.358 [t] Material:

Figure 2.9: Window 1.3 Cross-Sections

Cross-Section Description

The cross-sections defined in RFEM or RSTAB are preset together with the assigned material numbers.



To modify a cross-section, click the entry in column B. Thus, you set the cell active. Then, open the cross-section table of the current input field by clicking the [Cross-Section Library] button or the button at the end of the box. You can also use the function key [F7] (see Figure 2.10).



In this dialog box, you can choose a different cross-section or even a different cross-section table. If you want to select a completely different cross-section category, click the [Back to Cross-Section Library] button. Then, the general cross-section library opens.

Chapter 4.13 of the RFEM manual, or Chapter 4.3 of the RSTAB manual, describes how to select cross-sections from the library.

You can also enter a new cross-section description directly into the input field in column B. If the entry is already listed in the database, RF-/STEEL HK will import the cross-section properties. A modified cross-section is highlighted in blue.

4 - H HW 200x204 | GB/T 11263-2010

4 - H HW 150x150 | GB/T 11263-2010

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Details...

STEEL HK

RSTAB

A

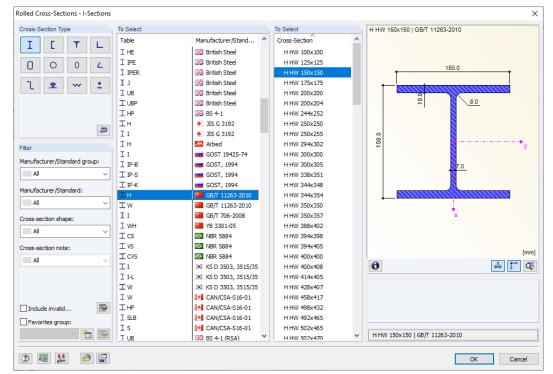


Figure 2.10: Rolled I-section types of cross-section library

If cross-sections set in RF-/STEEL HK are different from the ones used in RFEM or RSTAB, both cross-sections are displayed in the graphic to the right. The designs will be performed with the internal forces from RFEM or RSTAB for the cross-section selected in RF-/STEEL HK.

Cross-Section Type

This column shows the cross-section type that is used for the classification. The cross-sections referred to in [1], Section 7 must be designed plastically or elastically depending on their class. Non-typical cross-sections are classified as *General* and can only be designed elastically, which means Class 3 or 4.

Max. Design Ratio

This column is displayed only after the calculation. It is intended to be a decision support for the optimization: Looking at the design ratios and colored relation scales, you can clearly see which cross-sections are hardly utilized and thus oversized, or extremely stressed and thus undersized.

Optimize

Each cross-section of the library can pass through an optimization process: For the internal forces from RFEM or RSTAB, the program searches the cross-section that comes as close as possible to a user-defined maximum ratio that can be defined in the *General* tab of the *Details* dialog box (see Figure 3.4, page 30).

To optimize a cross section, open the drop-down list in column E or F, and select the relevant entry: *From current row* or, if available, *From favorites* 'Description'. Recommendations for optimizing cross-sections can be found in Chapter 7.2 on page 55.

Remark

This column shows remarks in the form of footnotes. They are explained below the cross-section list.

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If the warning *Incorrect type of cross-section!* appears before calculating, a cross-section is set which is not listed in the database. This may be a user-defined cross-section or a SHAPE-THIN cross-section that has not yet been calculated. To select an appropriate cross-section for the design, click the [Library] button (see description below Figure 2.9).

Member with tapered cross-section

For tapered members with different cross-sections at the member start and end, both cross-section numbers are shown in two rows, in accordance with the definition in RFEM or RSTAB.

RF-/STEEL HK also designs tapered members, provided that the cross-section at the member's start has the same number of stress points as the cross-section at the end. Normal stresses, for example, are determined from the moments of inertia and the centroidal distances of the stress points. If the cross-sections at the start and end of a tapered member have different numbers of stress points, the intermediate values cannot be interpolated. The calculation is neither possible in RFEM or RSTAB nor in RF-/STEEL HK.

The cross-section's stress points including numbering can be checked graphically: Select the cross-section in Window 1.3, and then click the 📦 button. The dialog box shown in Figure 2.11 appears.

Info About Cross-Section

Below the cross-section graphic, you find the [Info] button. Click it to open the *Info About Cross-Section* dialog box where you can see the cross-section properties, stress points and c/t-parts.

Cross-Section Property	Symbol	Value	Unit	^	H HW 150x150 GB/T 11263-2010
Depth	d	150.0	mm		
Vidth	Ь	150.0	mm		
Veb thickness	tw	7.0	mm		
lange thickness	tf	10.0	mm		150.0
Root fillet radius	r	8.0	mm		
Cross-sectional area	Α	39.64	cm ²		
Shear area	Ay	25.04	cm ²		8.0
Shear area	Az	8.89	cm ²		
hear area according to EC 3	A _{v,y}	31.05	cm ²		
hear area according to EC 3	A _{v,z}	11.94	cm ²		
Veb area	Aweb	9.10	cm ²		20.0
Plastic shear area	A pl,y	30.00	cm ²		
Plastic shear area	A pl,z	9.80	cm ²		7.0
Ioment of inertia	Iγ	1620.00	cm ⁴		
Ioment of inertia	Iz	563.00	cm ⁴		
Governing radius of gyration	ry	63.9	mm		
overning radius of gyration	٢z	37.6	mm		
Polar radius of gyration	ro	74.1	mm		▼ z
Radius of gyration of flange plus 1/5 of we	r zg	40.6	mm		
lolume	v	3964.00	cm ³ /m		
Veight	wt	31.1	kg/m		
Surface	Asurf	0.872	m²/m		
Section factor	Am/V	220.047	1/m		
orsional constant	J	11.18	cm ⁴		🛨 🔯 Stress points
Varping constant	Cw	27290.70	cm ⁶		C/t-Parts
1	c	210.00	7	~	

Figure 2.11: Dialog box Info About Cross-Section

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The buttons below the cross-section graphic have the following functions:

Button	Function
Ξ	Displays or hides stress points
IC.	Displays or hides c/t-parts
123	Displays or hides numbers of stress points or c/t-parts
	Shows details of stress points or c/t-parts (see Figure 2.12)
×	Displays or hides dimensions of cross-section
\uparrow	Displays or hides principal axes of cross-section
X	Resets full view of cross-section

Table 2.2: Buttons of cross-section graphic

Use the [Details] buttons to call up specific information about stress points (centroid distances, statical moments of area, warping ordinates, etc.) and c/t-parts.

	A	B	C	D	E	F	G	H HW 150x150
essP	Coordin	ates	Statical Mome	ents of Area	Thickness	Warp	ing	
lo.	y [mm]	z [mm]	Qy [cm ³]	Q _z [cm ³]	t [mm]	W _{no} [cm ²]	Qw [cm 4]	
1	-75.0	-75.0	0.00	0.00	10.0	52.50	0.00	
2	-11.5	-75.0	-44.42	-27.46	10.0	8.05	-192.25	
3	0.0	-75.0	-52.17	-28.14	10.0	0.00	-196.88	
4	11.5	-75.0	-44.42	27.46	10.0	-8.05	192.25	1 2 3 4 5
5	75.0	-75.0	0.00	0.00	10.0	-52.50	0.00	
6	-75.0	75.0	0.00	0.00	10.0	-52.50	0.00	
7	-11.5	75.0	-44.45	27.46	10.0	-8.05	-192.25	
8	0.0	75.0	-52.17	28.14	10.0	0.00	-196.88	
9	11.5	75.0	-44.45	-27.46	10.0	8.05	192.25	y 13
0	75.0	75.0	0.00	0.00	10.0	52.50	0.00	
1	0.0	-57.0	-110.14	0.00	7.0	0.00	0.00	8
2	0.0	57.0	-110.20	0.00	7.0	0.00	0.00	
3	0.0	0.0	-121.52	0.00	7.0	0.00	0.00	6 7 8 9 10
								z
								☆ 📬 (

Figure 2.12: Dialog box Stress Points of H HW 150x150

2.4 Intermediate Lateral Restraints

In Window 1.4, you can define lateral intermediate restraints for members. RF-/STEEL HK always assumes this kind of support to be perpendicular to the cross-section's minor axis z (see Figure 2.11). Thus, it is possible to influence the members' effective lengths (only for *Lateral and torsional* restraint type) which are important for the stability analyses concerning flexural buckling and lateral-torsional buckling.

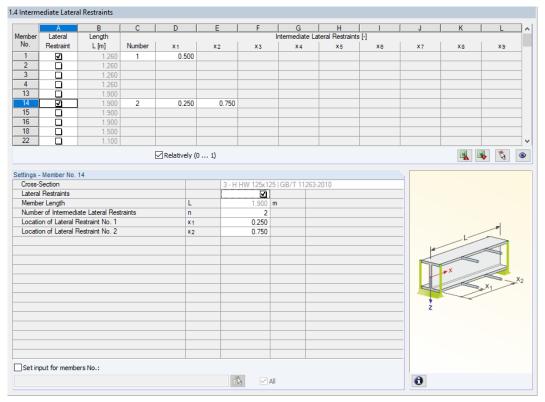


Figure 2.13: Window 1.4 Intermediate Lateral Restraints

In the upper part of the window, you can assign up to nine lateral supports to each member. The *Settings* section shows the entry displayed in a column view for the member selected above.

To define the intermediate restraints of a member, select the check box for *Lateral Restraints* in column A. With the solution you can select the member graphically to activate its row in the table. When the check box is selected, the other columns become available, and you can enter the parameters.

In column C, you can define the *Number* of intermediate restraints. Depending on the setting, you can access one or more of the following *Intermediate Lateral Restraints* columns for defining the x-locations.

✓ Relatively (0...1) When the check box for *Relatively (0...1)* is selected, you can define the support points by relative input: The locations of the intermediate supports result from the member length and the relative distances to the member start. It is also possible to define the distances manually in the table, if the *Relatively (0...1)* check box is cleared.

2.5 Effective Lengths - Members

This module window is subdivided into two parts. The table in the upper part shows summary information about buckling length factors and equivalent member lengths for buckling and lateral-torsional buckling of all members to be designed. The effective lengths defined in RFEM or RSTAB are preset. In the *Settings* section, you can see additional information about the member whose table row is selected in the upper part.

With the 🐧 button you can select a member graphically to activate its row in the table.

Changing entries is possible in the table as well as the Settings tree.

	A	B	С	D	E	F	G	H		J	K	L	
lember	Buckling		ig About Maj			g About Min			ateral-Torsic				
No.	Possible	Possible	Ky	KLy [m]	Possible	Kz	KL _z [m]	Possible	тLт [-]	KLT	KLLT [m]	Comment	
1	V	V	1.000	1.260	V	1.100	0.693		1.000	1.000	0.630		
2	V	☑	1.000	1.260	V	1.100	1.386		1.000	1.000	1.260		
3	✓		0.500	0.630	V	1.000	1.260		1.000	1.000	1.260		
4	2		0.500	0.630	V	1.000	1.260		1.000	1.000	1.260		
13	2	V	1.000	1.900	V	0.700	1.330		1.000	1.000	1.900		
15	2	V	1.000	1.900	V	0.700	1.330		1.000	1.000	1.900		
18	V		0.500	0.750	J	1.000	1.500		1.000	1.000	1.500		
22	V		0.500	0.550	V	1.000	1.100		1.000	1.000	1.100		
25	V	V	0.500	0.550	V	1.250	1.375		1.000	1.000	1.100		
27	✓	V	0.500	0.750	V	1.250	1.875		1.000	1.000	1.500		
	Member No.	2										H HW 125x125 GB/T 11263-20	10
	Section					2 - H H	W 125x125						
Length					L		1.260 m						
	ng Possible						2						
	ng About Axis					_	V					125.0	
	ctive Length	Factor			Ky		1.000					120.0	-
	ctive Length	D			KLy		1.260 m					+	
	ng About Axis ctive Length				Kz	_						8.0	
	ctive Length	Factor			KLz	_	1.100						
	-Torsional Bu	eldine Dees	ihla		NLZ	-	1.386 m					125.0	
	ivalent Unifor				MLT		1.000		_	_		12	+
	ctive Length				KLT		1.000					6.5	
	ctive Length			klina	KLI		1.260 m						
Comme		for caterary		nung	INCE!		1.200 11						
Comme	or n.				-								
												z	
Set in	put for memb	ers No.:				- 16						0	[m
						ER						∂	

1.5 Effective Lengths - Members

Figure 2.14: Window 1.5 Effective Lengths - Members

The effective lengths for buckling about the minor axis z are aligned automatically with Window *1.4 Intermediate Lateral Restraints*. If the intermediate supports divide the member into segments of different lengths, no values are displayed in columns G, K, and L of Window 1.5.

You can enter the effective lengths manually in the table and the *Settings* tree. You can also define them graphically in the work window by using the ... button that becomes active when the cursor is placed in the text box (see Figure 2.14).



The effective lengths of each member have to be defined manually on the basis of its boundary conditions.

The Settings tree includes the following parameters:

- Cross-Section
- Length of member
- Buckling Possible for member (corresponds to columns B, E, and H)
- Buckling About Axis y (corresponds to columns C and D)
- Buckling About Axis z z (corresponds to columns F and G)
- Lateral-Torsional Buckling (corresponds to columns I to K)

For the selected member, you can define whether a buckling or a lateral-torsional buckling analysis is generally to be carried out. In addition, you can adjust the *Effective Length Factor* for the respective directions. When changing a factor, the equivalent member length will be adjusted automatically, and vice versa.

~

It is also possible to define the effective length of a member in a dialog box that you open with the button [Select effective length factor]. You can find the button below the table.

Select Effective Length Factor	×
Buckling About Axis y	Buckling About Axis z
O Rigid - free $k_{G,Y} = 2.0$	O Rigid - free k _{cr,z} = 2.0 Z⊀+++↓
O Hinged - hinged $k_{\sigma,\gamma} = \underline{1}.0$	Hinged - hinged k _{cr,z} = 1.0
Image: Rigid - hinged Image: Rigid - hinged $\kappa_{\alpha,\gamma} = 0.7$ Image: Rigid - hinged	Rigid - hinged k _r ,z = 0.7
O Rigid - rigid $k_{\alpha,\gamma} = 0.5$	Rigid - rigid y k _{cr,z} = 0.5 y
$\bigcirc \underline{U}_{\text{ser-defined}}_{k_{C,Y}} = \dots$	O User-defined kar,z =
○ Import from add-on module RSBUCK (Eigenvalue Analysis) RSBUCK-Case:	O Import from add-on module RSBUCK (Eigenvalue Analysis) RSBUCK-Case:
Buckling mode No.:	Buckling mode No.:
Export effective length factor [-]	Export effective length factor k _{or,2} : 1.000 🗘 [-]
	OK Cancel

Figure 2.15: Dialog box Select Effective Length Factor

For each direction, you can select one of the four Euler buckling modes. You can also set a *User-de-fined* effective length factor. If an eigenvalue analysis has been carried out by the RF-STABILITY or RSBUCK add-on module, it is also possible to define a *Buckling mode* for the determination of the factor.

Buckling Possible

The stability analyses for flexural and lateral-torsional buckling require the ability to absorb compressive forces. Therefore, members for which such an absorption is not possible due to the member type (for example, tension members, elastic foundations, rigid connections) are excluded from the outset. The rows are grayed out in the table, and a corresponding note is shown in the *Comment* column.

The *Buckling Possible* check boxes in table row A and in the *Settings* tree offer a control option for the stability analyses: They determine if these analyses are performed or omitted for the member.

Buckling About Axis y or Axis z

With the check box in the *Possible* column, you decide if a member has the risk of buckling about the axis y and/or z. These axes represent the local member axes, with axis y being the "major" and axis z the "minor" member axis. The effective length factors K_y and K_z for buckling about the major or minor axis can be selected freely.



In Window 1.3 Cross-Sections, you can check the position of the member axes in the cross-section graphic (see Figure 2.9, page 13). With the [Jump to graphic] button you can also access the RFEM or RSTAB work window. There, you can display the local member axes by using the member's shortcut menu or the *Display* navigator.

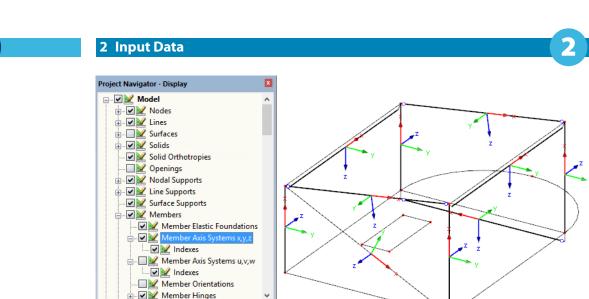


Figure 2.16: Activating the member axis systems in Display navigator of RFEM

If buckling is possible about one or both member axes, you can enter the effective length factors in columns C and F, and the effective lengths in columns D and G. The same is possible in the *Settings* tree.

To define the effective lengths graphically in the work window, use the button that becomes available when the cursor is placed in a KL text box (see Figure 2.14).

When you specify the effective length factor K, the program determines the effective length KL by multiplying the member length *L* by this factor. The K and KL text boxes are interactive.

Lateral-Torsional Buckling Possible

Column H shows which members are included in the analysis of lateral-torsional buckling.

Equivalent Uniform Moment Factor $m_{L_{\tau}}$

🔯 Data 🛛 🗃 Display 🕺 Views 🛛



The factor m_{LT} represents the equivalent uniform moment factor for lateral-torsional buckling. For cantilevers, m_{LT} is equal to 1. The equivalent uniform moment factors for typical moment distributions are specified in [1] Table 8.4a and Table 8.4b. The list of this column provides an option for the program to apply this factor automatically *according to Table 8.4b*. Alternatively, you can define this factor *manually*.

Effective Length Factor for LTB K_{LT}

The effective length factor K_{LT} controls the effective length for lateral-torsional buckling according to [1] 8.3.4. For a beam with its compression flange restrained against lateral movement at the end supports, but free to rotate on plan and with ends under nominal torsional restraint about the longitudinal axis of the beam at the end supports, this factor is 1.0. By increasing or reducing this factor, you can adjust the factor to the boundary conditions of each member.

If the effective length for lateral-torsional buckling KL_{LT} differs from the member length, you can also define it manually in column K or graphically with the ... button that appears when you select a cell. Columns J and K are interactive, i.e. the effective length factor is updated automatically.

Comment

In the final column, you can enter user-defined notes to describe, for example, the equivalent member lengths.

Set input for members No.

Below the *Settings* table, you find the check box *Set input for members No.* If you select it, the <u>subsequent</u> settings will apply to *All* members or to selected members (enter the member numbers manually or select them graphically with (). This option is useful if you want to assign the same boundary conditions to several members (see also DLUBAL article

https://www.dlubal.com/en/support-and-learning/support/knowledge-base/000726).



Settings which have already been defined cannot be changed subsequently with this function.

2.6 Effective Lengths - Sets of Members

Details...

This window appears when at least one set of members has been set for design in Window 1.1 General Data.

5 Effecti	ve Lengths ·	- Sets of M	embers									
	Α	В	C	D	E	F	G	H	1			J
Set	Buckling		ng About Maj									
No.	Possible	Possible	Ky	KLy [m]	Possible	Kz	KL _z [m]	Possible	mLT	ē 🗌		Comment
5	V	•	1.000	9.800	V	1.000		I	acc. to Ta	ble 8.4b		
6	2	 ✓ ✓ 	1.000	9.800		1.000		2	acc. to Ta			
												ی 🖏 🛃 🗟
ettings	- Set of Memi	bers No. 6									H HW 12	5x125 GB/T 11263-2010
	Members					Continuous bear	m					
Cro	ss-Section					3 - H HW 125x1						
Lengt	ı			L		9	.800 m					
Buckli	ng Possible						2					
	ng About Axis						J				+	125.0
	ctive Length			K	(y	1	.000					
	ctive Length			ĸ	(Ly	9.800 m						÷
	ng About Axis						V					∞ <u>8.0</u>
	ctive Length			ĸ	(z	1	.000					
	I-Torsional Bu						V				125.0	
	iivalent Unifo	rm Moment	Factor	n	ILT	acc.to Table	8.4b					y y
Comm	ent											6.5
											•_•	
												*
												z
Set in	put for sets I	No.:										[mm]
						a la companya de la compa					0	ă ₽ œ
							MI All					30 J

Figure 2.17: Window 1.6 Effective Lengths - Sets of Members

The concept of this window is similar to the previous Window 1.5 Effective Lengths - Members. Here, you can enter the effective lengths for buckling about both principal axes of the set of members as well for lateral-torsional buckling, as described in Chapter 2.5. They define the boundary conditions of the set of members that is handled in its entirety.





This window is displayed if at least one set of members has been selected for design in Window *1.1 General Data*.

Set of Members Continuous beam - Cross-Section 3 - H HW 125x125 I GB/T 11263-2010 Node with Support No. Support in Y [*] UY Q	
1 128 Q	
2 131 Q Q 0.00 0.0 0.0 3 129 Q 4105.0 642.9 0.00 0.0 58.0 4 132 Q 4105.0 642.9 0.00 0.0 58.0 5 642.9 0.00 0.0 58.0 6 7 8 9 10 9	nt
3 129 3 4105.0 642.9 0.00 0.0 58.0 4 132 3 4105.0 642.9 0.00 0.0 58.0 5 6 1 1 642.9 0.00 0.0 58.0 6 1	
4 132 2 4105.0 0 642.9 0.00 0.0 58.0 5 1 <td></td>	
5 6 1	
6 <	
7 <	
8 9 10 </td <td></td>	
9 10<	
10 Image: Continuous beam Im	
Settings - Nodal Support No. 129 Continuous beam Cross Section 3 - H HW 125k125 [GB/T 11263-2010 Node with Support No. Support In Y ury Pestrained about X' φx Pestrained about Z' φz Warping Restraint o Support Notation β Eccentricity ex Comment -	
Settings - Nodal Support No. 129 Continuous beam Cross-Section 3 - H HW 125x125 GB/T 11263-2010 Node with Support No. Support in Y' u' Pestrained about X' φx Pestrained about Z' gz Warping Restraint ω 642.9 Nm ³ Support Rotation β Eccentricity ex Comment	
Settings - Nodal Support No. 129 Continuous beam Cross-Section 3 - H HW 125x125 GB/T 11263-2010 Node with Support No. Support in Y' u Y' Pestrained about Z' ez Warping Restraint io 642.9 Nm ³ Support inclusion β Constrained about Z' ez Warping Restraint io Support inclusion β Comment - Comment - u - u - u - u - u - u - u - u - u - u - u - u - u - u - u - u - u - u - u	چ 😼
Set of Members Continuous beam Orss-Section 3 - H HW 125x125 [GB/T 11263-2010 Node with Support No. Support in Y uy Pestrained about X' ex Array Bestraint o Support Rotation β Eccentricity ez Support Rotation β Comment	•
Set of Members Continuous beam Orss-Section 3 - H HW 125x125 [GB/T 11263-2010 Node with Support No. Support in Y uy Pestrained about X' ex Array Bestraint o Support Rotation β Eccentricity ez Support Rotation β Comment	
Cross-Section 3 - H HW 125x125 GB/T 11263-2010 Node with Support No. 123 Support in Y' u Y' Q' Pestrained about X' ex 4105.0 Narde about Z' ez	
Support in Υ uγ Q Restrained about X' 9x 4105.0 Nm/rad Restrained about Z' 9z	
Restrained about X' φx 41050 Nm/rad Restrained about Z' φz	
Restrained about Z' φz mail Warping Restraint ω 642.9 Nm3 Support Rotation β 0.00 * Eccentricity e.x 0.0 mm Eccentricity e.z 58.0 mm Comment	~ ~
Warping Restraint o 642.9 Nm 3 Support Rotation β 0.00 * Eccentricity ex 0.0 mm Eccentricity ez 58.0 mm Comment	
Support Rotation β 0.00 * Eccentricity ex 0.0 mm Eccentricity ez 58.0 mm Eccentricity ez 58.0 mm Eccentricity ez 58.0 mm Eccentricity ez	
Eccentricity e.x 0.0 mm Eccentricity e.z 58.0 mm Comment	
Eccentricity e.z 58.0 mm Comment	
Comment Image: Comment	-
- -	
Image: Control of the second secon	X"
Image: marked bit is a state of the state of th	β
Image: marked bit is a state of the state of th	
Image: Constraint of the second sec	Z"
	Z'
Set input for supports No.:	

Figure 2.18: Window 1.7 Nodal Supports - Set of Members



The current table manages the boundary conditions of the set of members that is selected on the left in the navigator.

The supports defined in RFEM or RSTAB (for example, in Z for a continuous beam) are not relevant in this window: The distributions of moments and shear forces for the determination of the amplification factor are automatically imported from RFEM/RSTAB. Here, you define the support conditions affecting the stability failure (buckling, lateral-torsional buckling).

Supports on the start and end nodes of the set of members are preset. Any other supports, for example due to connected members, must be added manually. Use the substant to select nodes graphically in the RFEM/RSTAB work window.

To determine the elastic critcal moment M_{cr}, the program creates a planar framework with four degrees of freedom for each node.



The orientation of the axes in the set of members is important for the nodal support definition. The program checks the position of the nodes and internally defines the axes of the nodal supports for Window 1.7 according to Figure 2.19 to 2.22. The [Local Coordinate System] button below the model graphic can help you with the orientation: Use it to display the set of members in a partial view where the axes are clearly visible.



Figure 2.19: Auxiliary coordinate system for nodal supports - straight set of members

If all members of a set of members rest on a straight line, as shown in Figure 2.19, the local coordinate system of the first member in the set of members corresponds to the equivalent coordinate system of the entire set of members.

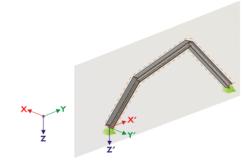


Figure 2.20: Auxiliary coordinate system for nodal supports - set of members in vertical plane

If the members of a set of members do not rest on a straight line, they still have to be located in the same plane. In Figure 2.20, the members rest in a vertical plane. In this case, the X'-axis is horizontal and oriented in the direction of the plane. The Y'-axis is horizontal as well and defined perpendicular to the X'-axis. The Z'-axis is oriented perpendicular downwards.

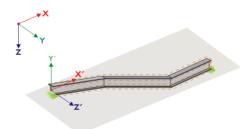


Figure 2.21: Auxiliary coordinate system for nodal supports - set of members in horizontal plane

If the members of a buckled set of members rest in a horizontal plane, the X'-axis is defined parallel to the X-axis of the global coordinate system. Thus, the Y'-axis is oriented in the opposite direction to the global Z-axis, and the Z'-axis is directed parallel to the global Y-axis.

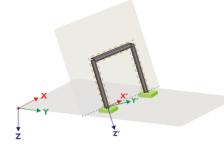


Figure 2.22: Auxiliary coordinate system for nodal supports - set of members in inclined plane

Figure 2.22 shows the general case of a buckled set of members: The members do not rest on a straight line, but in an inclined plane. The definition of the X'-axis results from the intersection line between the inclined and the horizontal plane. Thus, the Y'-axis is perpendicular to the X'-axis and in vertical position to the inclined plane. The Z'-axis is defined perpendicular to the X'-axis and Y'-axis.

The buttons below the graphic have the following functions:

Button	Function
	Shows model or system sketch
4	Shows members as 3D rendering or wire-frame model
Q,	Shows current set of members or entire model
	Displays irrelevant members of model as transparent or opaque
٧	Shows set of members with local coordinate system or entire model
∏ x	Shows view in direction of X-axis
₿ <mark>₽</mark>	Shows view in opposite direction of Y-axis
ŢŹ	Shows view in direction of Z-axis
	Sets isometric view

Table 2.3: Buttons for cross-section graphic

Q

With the [Edit warp stiffener] button it is possible to determine the constant of a warp spring by the program.

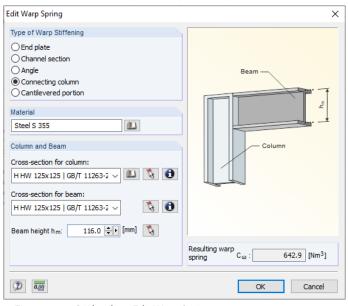


Figure 2.23: Dialog box Edit Warp Spring

The following warp stiffening types are available in the Edit Warp Spring dialog box:

- End plate
- Channel section
- Angle
- Connecting column
- Cantilevered portion

Materials and cross-sections can be selected by using the lists and [Library] buttons. With the solution you can select them also graphically in the RFEM/RSTAB model.

Based on the parameters, RF-/STEEL HK determines the *Resulting warp spring* C_{ω} which can then be imported with [OK] in Window 1.7.

2

2.8 Member Hinges - Sets of Members

This window is displayed if at least one set of members is selected for design in Window 1.1 General Data. Here, you can define hinges for members within the set of members that, for structural reasons, don't transfer the degrees of freedom locked in Window 1.7 as internal forces. Make sure that no double hinges are generated in coaction with Window 1.7.



The table manages the hinge parameters of the set of members selected in the navigator on the left.

	Set of Merric	ers No. 5 - Continu	ous beam			
A	В	C	D	E	F	G
Hinge Member	Member	Shear Release		Release	Warp Release	
No. No.	Side	Vy	Мт	Mz [kNm/rad]	M _w	Comment
1 24	End	Ó	V		Õ	
2 160	Start		Ö	15.00		
3						
4						
5						
6						
7						
8						
9						
10						v
		· · · · ·				× × ×
Settings - Member No Set of Members Cross-Section Member with Hingy Member Side Shear Release in y Torsional Release Moment Release Warping Release Comment	e at the End -Direction lobout z-Avis		No. Side Vy MT Mz Mω		beam 25x125 GB/T 11 160 3tart 5.00 kNm/rad 	

Figure 2.24: Window 1.8 Member Hinges - Set of Members



In column B, you specify the *Member Side* where the hinge is located, or if there are hinges on both member sides.

In columns C to F, you can define the releases or spring constants in order to adjust the set of members model to the support conditions of Window 1.7.





This window controls various settings for the serviceability limit state design. It is displayed if corresponding data has been set in the Serviceability Limit State tab of Window 1.1 (see Chapter 2.1.2, page 10).

	A	В	C	D	E	F	G	H
		Set of Members		nce Length	Direc-	Precamber		
) .	Reference to	No.	Manually	L [m]	tion	w _{c,z} [mm]	Beam Type	Comment
	Set of Members	_		9.800	z	0.0	Beam	
2	Set of Members	6		9.800	z	0.0	Beam	
}	Member	90		3.000	y, z	0.0	Cantilever End Free	
	Member	123		3.800	y, z	0.0	Beam	
j	Member	124		3.800	y, z	0.0	Beam	
	Member	161		3.800	y, z	0.0	Beam	
0								
1								
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3								
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2								

Figure 2.25: Window 1.9 Serviceability Data



In column A, you decide whether the deformation refers to single members or sets of members. For a set of members, it is necessary that a uniform member orientation and rotation of all included members is given. Only in this way can the deformation components be determined correctly.

In column B, you enter the numbers of the members or sets of members that you want to design. You can also use the button to select them graphically in the RFEM/RSTAB work window. Then, the Reference Length appears automatically in column D. The column presets the lengths of the members and sets of members. You can adjust the values Manually after ticking the check box in column C.





In column E, you define the governing Direction for the deformation analysis. You can select the directions of the local member axes y and z (or u and v for unsymmetrical cross-sections).

In column F, a Precamber can be taken into account. The precamber's general direction is defined in the Serviceability tab of the Details dialog box (see Figure 3.3, page 29). If the precamber is related to the "major" principal axis y or u, the column title $w_{c,z}$ changes to $w_{c,y}$ or $w_{c,u}$.

For a correct application of limit deformations, the Beam Type is of vital importance. In column G, you can specify whether a beam or a cantilever is to be designed and which end is free of support.

The setting in the Serviceability tab of the Details dialog box indicates whether the deformations are related to the undeformed system or to shifted members ends/set of members ends (see Figure 3.3, page 29).

3 Calculation

3.1 Detailed Settings

The designs are based on the internal forces determined in RFEM or RSTAB.

Details...

Before you start the calculation, it is recommended to check the design details. You can access the corresponding dialog box in all windows of the add-on module by using the [Details] button.

The Details dialog box has the following tabs:

- Ultimate limit state
- Stability
- Serviceability
- General

3.1.1 Ultimate Limit State

Details - HK	×
Ultimate Limit State Stability Serviceability General	
Options	
Elastic design (also for Class 1 and Class 2 cross-sections)	
[]	
	OK Cancel

Figure 3.1: Dialog box Details, tab Ultimate Limit State

Options

Cross-sections assigned to class 1 or 2 are designed plastically by RF-/STEEL HK. If this is not desired, you can activate the *Elastic design* also for those cross-section classes.

3.1.2 Stability

)etails - HK	×
Ultimate Limit State Stability Serviceability General	
Stability Analysis Perform stability analysis	Structure Type ☐ Sway y - y (m _V ≥ 0.85) ☐ Sway z - z (m _Z ≥ 0.85)
Determination of Elastic Critical Moment for LTB * Load application of positive transverse loads: (a) On cross-section edge directed to shear center (e.g. top flange, destabilizing effect) () In shear center (normal effect) () On cross-section edge directed from shear center (e.g. bottom flange, normal effect) * (set of members only)	$\begin{array}{l lllllllllllllllllllllllllllllllllll$
	OK Cancel

Figure 3.2: Dialog box Details, tab Stability

Stability Analysis

The *Perform stability analysis* check box controls whether to run a stability analysis in addition to the cross-section designs. If you clear the check box, Windows 1.4 through 1.8 are not displayed.

Determination of Elastic Critical Moment for LTB

For sets of members, RF-/STEEL HK determines the elastic critical moment by an eigenvalue analysis. For the calculation, the program uses a finite member model to determine M_{cr} taking into account the following items:

- Dimensions of gross cross-section
- Load type and position of load application point
- Effective distribution of moments
- Lateral restraints (by support conditions)
- Effective boundary conditions

If *transverse loads* are available, it is important to define the location where these forces are acting on the cross-section: Depending on the load application, transverse loads can be stabilizing or destabilizing, and thus have a major impact on the elastic critical moment.

The signs of the eccentricities are related to the cross-section's shear center M. The following DLUBAL article provides more information about the sign convention for transverse loads: https://www.dlubal.com/en-US/support-and-learning/support/knowledge-base/000880

Structure Type

If *sway* of structural components is relevant, the equivalent uniform moment factor for flexural buckling about x- and y-axis can be applied in a customary manner.

Limit Values for Special Cases

To design unsymmetrical cross-sections with the intended axial compression according to [1] 8.7, you can neglect *small moments* about the major and the minor axis by the settings defined in this dialog section.

Analogously, it is possible for the pure check of bending according to [1] 8.3 to neglect *small* compression forces by defining a limit ratio of F_c / P_c .

The intended *Torsion* is not clearly specified in [1]. If there is a torsional stress not exceeding the shear stress ratio of 5% preset by default, it is neglected for the stability design; only results for flexural and lateral-torsional buckling are displayed.



If one of the limits in this dialog section is exceeded, a note appears in the results window and the program won't perform any stability analysis. However, the cross-section designs are performed independently. These limit settings are <u>not</u> part of the Code [1]. Modifying the limits is the user's responsibility.

3.1.3 Serviceability

Details - HK	×
Ultimate Limit State Stability Serviceability General	
Serviceability (Deflections)	
Cantilevers Maximum deflection: L / 360 + L _o / 180 +	
Deformation relative to:	
$\textcircled{\sc op}$ Shifted members ends / set of members ends	
O Undeformed system	
	OK Cancel

Figure 3.3: Dialog box Details, tab Serviceability

Serviceability (Deflections)

You can check and adjust, if necessary, the *maximum deflection* relevant to beams and cantilevers. The deflection limits recommended by [1] Table 5.1 are preset.

The *Deformation relative to* options control whether the maximum deflections are related to the shifted ends of members or sets of members (connection line between start and end nodes of the deformed system) or to the undeformed initial system. Generally, the deflections are designed relative to the displacements in the entire structural system.

The following DLUBAL article presents an example describing the relation of deformations. https://www.dlubal.com/en/support-and-learning/support/knowledge-base/001081

3.1.4 General

Details - HK	×
Ultimate Limit State Stability Serviceability General	
Calculation of Result Combinations with OR Type	Display Result Windows
	Display Result Windows 2.1 Design by Load Case 2.2 Design by Cross-Section 2.3 Design by Set of Members 2.4 Design by Member 2.5 Design by X-Location 3.1 Governing Internal Forces by Member 3.2 Governing Internal Forces by Set of Members 3.3 Member Slendernesses 4.1 Parts List by Member 4.2 Parts List by Set of Members ④ Only for members / sets to be designed O f all members / sets of members
	OK Cancel

Figure 3.4: Dialog box Details, tab General

Calculation of Result Combinations with OR Type

If combinations are created automatically, usually many load combinations (CO) are produced. Generally, these combinations are summarized in a result combination (RC) as alternatively acting in an 'OR' connection which provides the envelope: CO1/p or CO2/p or CO3/p or CO4/p etc. For the design of these result combinations, you have two possibilities in RF-/STEEL HK.

The *load components* of the contained combinations can be analyzed *separately*. Thus, the elastic critical moments for lateral-torsional buckling are determined separately for each constellation, and the designs are performed accordingly. This approach provides exact results. However, it is very time-consuming and requires a high computational effort.

Alternatively, it is possible to *Analyze result combinations generally*. This calculation runs considerably faster because RF-/STEEL HK uses only the extreme values with the corresponding internal forces for the design. However, the result may be incorrect if the RC includes a combination where several internal forces (such as N and M_v) are together just below the extreme values.

Cross-Section Optimization

By default, the optimization is targeted on the maximum allowable design ratio of 100%. If necessary, you can set a different design ratio in this text box.

Check of Member Slendernesses

In the two text boxes, you can specify the limit values KL / r in order to define the member slendernesses. Separate specifications are possible for members with tension forces only and for members with compression and flexure. The slenderness ratios recommended by [1] 6.6.4 are preset.

In Window 3.3, the limit values are compared to the real member slendernesses. This window is available after the calculation (see Chapter 4.8, page 40) if the corresponding check box in the *Display Result Windows* section to the right is selected.

Display Result Windows

In this dialog section, you can select which result windows including parts list are displayed. The windows are described in Chapter 4.

Window 3.3 Member Slendernesses is deactivated by default.

3.2 Starting the Calculation

Calculation

In all input windows of the RF-/STEEL HK add-on module, you can start the calculation by clicking the [Calculation] button.

RF-/STEEL HK searches for the results of the load cases, load combinations and result combinations to be designed. If they cannot be found, the program starts the RFEM or RSTAB calculation to determine the design-relevant internal forces.

You can also start the calculation in the RFEM or RSTAB user interface: The *To Calculate* dialog box (menu **Calculate** \rightarrow **To Calculate**) lists the design cases of the add-on modules like load cases or load combinations.

ot Calculate	d		Selected for (Calculation	
lo.	Description		No.	Description	/
G LC1	Dead Load		CA1	STEEL HK - Design acc. Code of Practice HK	
G LC2	Grating+MEP				
q LC3	Conveyor				
iE LC4	Baggage				
Isr LC5	Dead+Grating+MEP ECLF - X				
Isr LC6	Conveyor ECLF - X				
Isr LC7	Baggage ECLF - X				
sr LC8	Dead+Grating+MEP ECLF - Y	>			
Isr LC9	Conveyor ECLF - Y	>>			
Isr LC10	Baggage ECLF - Y				
np LC11	Imperfection -X				
np LC12	Imperfection -Y	4			
CO1	Total Load with SF	~			
CO2	Load without LC1+LC2				
CO3	Calculation ECLF - X				
CO4	Calculation ECLF - Y				
CO5	Deflection Analysis				
CA2	STEEL HK - Design S355				
Al	~			1	

Figure 3.5: Dialog box To Calculate

	All	¥
	All	
LC	Load Cases	
CO	Load Combinations	
	Piping Combinations	
RC	Result Combinations	
	Add-on Modules	

٩

If the RF-/STEEL HK design cases are missing in the *Not Calculated* section, select *All* or *Add-on Modules* in the drop-down list below the list.

To transfer the selected RF-/STEEL HK cases to the list on the right, use the button. Then, click [OK] to start the calculation.

You can also calculate a design case directly by using the list in the toolbar: Set the RF-/STEEL HK case and click the [Show Results] button.

<u>O</u> ptions	<u>A</u> dd-on Modules	Window H	<u>H</u> elp
- I 🔍	STEEL HK CA1 - Des	sign acc 🝸 🖪	4 👂 🖉 🎬 🚇 📾 📾 📾 🔛 🖉 🏖 🤹 🖉
i 👷 🔍	! 🔍 🗊 🗗 I 🕅	YI IZ -XI	- M - O - Show Results N Vy Vz Mr My Mz Py Pz

Figure 3.6: Direct calculation of a STEEL HK design case in RSTAB

Subsequently, you can observe the calculation process in the solver dialog box.

4 Results

Window 2.1 Design by Load Case appears immediately after the calculation.

	2.1 Decim	n by Load Case										
-	2.1 Design	1 by Load Case										
Input Data General Data		A	В	C	DE			F				G
- General Data Materials	Load-		Member	Location	Design							
- Materials Cross-Sections	ing	Description	No.	x [m]	Ratio			Design According to	o Formula			DS
Cross-sections Intermediate Lateral Restraints		Ultimate Limit State Design										
Effective Lengths - Members	CO1	Total Load with SF	255	0.000	0.94 ≤ 1 3	172) Stability ar	nalysis - Bucklir	ng about y or z-axis an	d bending	, about y and	z-axis acc. to 8.9.	2 UL
- Effective Lengths - Members												
-Nodal Supports		Serviceability Limit State Des										
Set of members No. 5 - Cor	CO5	Deflection Analysis	161	1.900	0.96 ≤ 1 4	01) Serviceab	ility - Deflection	in z-direction for bear	n			
Set of members No. 6 - Cor												
- Member Hinges												
Set of members No. 5 - Cor												
Set of members No. 6 - Cor												
- Serviceability Data												
esults				Max:	0.96 ≤ 1 🤇		9	2,	5 > 1	1,0 🗸	7 🗳 强 1	1. 0
Design by Load Case						-		<u> </u>	<u>u</u> -		• •	- 10
- Design by Cross-Section	Details -	Member 255 - x: 0.000 m - CC	01						3	- H HW 125	x125 GB/T 11263	3-2010
Design by Set of Members		ial Properties - Steel Q345 GE	B 50017-20)17								
Design by Member	FI Cross-	Section Properties - H HW 1	25x125 G	B/T 11263-201	0							
- Design by x-Location	Design	n Internal Forces										
Governing Internal Forces by №	E Cross-	-Section Classification - Class	1									
- Governing Internal Forces by S	🖃 Design	n Ratio								+	125.0	+
- Parts List by Member	- Axia	al Compression			Fo	0.00	kN					
Parts List by Set of Members	Des	sign Strength			Py	305.00	MPa			0°	uullinnuun	
· · · · · · · · · · · · · · · · · · ·	Gro	iss Area			Ag	30.00	cm ²			6	8.0	
	Mod	dulus of Elasticity			E	206000.00	MPa					
	- Nor	minal Effective Length			KLz	3.000	m			25.0		.
		dius of Gyration			r _z	31.3						Y
		ndemess			λz	95.995		8.7.4			0.0	
		iting Slenderness			λ0	16.329		8.4				
		ckling curve			BCz	С		Table 8.7		+		
		bertson Constant			az	5.500		App 8.4			÷	
		ty Factor			ηz	0.438		App 8.4			z	
	Fac				Φz	311.15		App 8.4				
		er Buckling Stress			PEz	220.63		App 8.4				
		npressive Strength			Pcz	139.33		App 8.4				
					Poz	417.99	kN	8.7.5 and 8.7				ſmr
	Con	npression Resistance										
	Con	mpression Resistance mpressive Design Ratio ximum Moment			1) nz MLT.y.max	0.00		8.9.2		8	,× I	r là

Figure 4.1: Result window with designs and intermediate values

The designs are shown in the result windows 2.1 through 2.5, sorted by different criteria.

Windows 3.1 and 3.2 list the governing internal forces; Window 3.3 gives information on member slendernesses.

Windows 4.1 and 4.2 show the parts lists by members and sets of members.

Every window can be selected by clicking the corresponding entry in the navigator. To set the previous or next window, use the buttons shown on the left. You can also use the function keys [F2] and [F3] to go through the windows.

OK

Click [OK] to save the results. Then, you exit RF-/STEEL HK and return to the main program.

Chapter 4 describes the result windows one by one. Evaluating and checking results is described in Chapter 5, page 43.



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The upper part of the window shows a summary of the governing designs, sorted by load case, load combination, and result combination. In addition, the table is subdivided into ultimate and serviceability limit state design results.

The lower part includes detailed information on the cross-section properties, analyzed internal forces, and design parameters for the load case selected above.

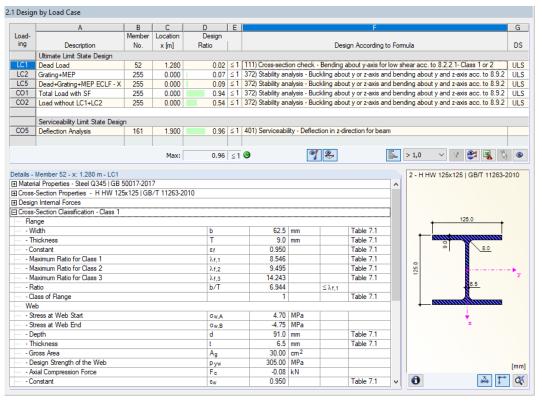


Figure 4.2: Window 2.1 Design by Load Case

Description

This column shows the descriptions of the load cases, load and result combinations for which the designs have been performed.

Member No.

This column shows the number of the member with the maximum design ratio for the designed action.

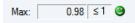
Location x

This column shows the respective x-location of the member where the maximum design ratio occurs. The following member locations x are used for the table output:

- Start and end node
- Division points according to possibly defined member division (see RFEM table 1.16 or RSTAB table 1.6)
- Member division according to specification for member results (*Calculation Parameters* dialog box of RFEM/RSTAB, *Global Calculation Parameters* tab)
- Extreme values of internal forces



Design Ratio



Columns D and E show the design conditions according to [1].

The length of the colored bar represents graphically the respective design ratio.

Design According to Formula

This column displays the Code's equations from which the designs have been performed.

DS

Column G provides information on the design relevant situations (DS): *ULS* for the ultimate limit state or *SLS* for the serviceability limit state design.

4.2 Design by Cross-Section

	A	B	С	D	E					F					
	Member	Location	Load-	Design											
No.	No.	x [m]	ing	Ratio				De	sign Acco	rding to Formula					
1	H HW 12	5x125 GB/1	Г 11263-20												
	313	0.000	CO1			102) Cross-section of		sion acc. t	o 8.7.5						
	312	0.000	CO1			110) Cross-section of									
	303	0.000	CO1			121) Cross-section of									
	307	0.000	CO1			123) Cross-section of					c. to 8.2	.1			
	303	0.000	CO1			126) Cross-section of									
	311	0.425	CO1			181) Cross-section of									
	314	0.425	CO1			201) Cross-section of									
	307	2.975	CO1			221) Cross-section of						e acc. t	o 8.8 or	8.9.1 - Cl	ass 1 or
	307	0.000	CO1	0.34	≤1	341) Stability analysi	s - Buckling and	l bending a	about y ar	nd z-axis acc. to 8.	9.2				
			Max:	0.96	≤ 1	۲		9	e.	3 🛓	> 1,0	~	7	2	Š
⊡ Cross- ⊡ Desigi	Section Pr n Internal F)17-2017 25 GB/T 11263-	-2010		.93 79	EN .				HW 12			
E Cross- ∃ Design Axia Des Des Tor	Section Pr	operties - H forces Force Force nent			-2010	F Vy Vz Mx		kN			t		125	.0	†
E Cross- ∃ Design Axia Des Des Tor Ber	Section Pr n Internal F al Force sign Shear sign Shear sional Morr	operties - H forces Force Force nent ent			-2010	F Vy Vz	-0.35 -0.72 0.00 0.00	kN kN kNm			ļ		125	huum	1
Cross Design Axia Des Des Tor Ber Ber	Section Pr n Internal F al Force sign Shear sign Shear sional Mom iding Mom	operties - H forces Force Force nent ent	HW 125x1		-2010	F Vy Vz Mx My	-0.35 -0.72 0.00 0.00	kN kN kNm kNm			25.0		125	huum	† 2
Cross- Desig Axia Des Des Des Tor Ber Ber	Section Pr n Internal F al Force sign Shear sign Shear sign Shear ding Mom dring Mom dring Mom Section Cla	operties - H forces Force Force nent ent ent	HW 125x1		-2010	F Vy Vz Mx My	-0.35 -0.72 0.00 0.00	kN kN kNm kNm			125.0		125	8.0	† ⊠
Cross- Desig Axia Des Des Des Tor Ber Ber Ber Ber Bersg	Section Pr n Internal F al Force sign Shear sign Shear sign Shear ding Mom dring Mom dring Mom Section Cla	operties - H forces Force Force ent ent ent assification - (HW 125x1		-2010	F Vy Vz Mx My	-0.35 -0.72 0.00 0.00 0.00 83.78	kN kN kNm kNm kNm			125.0		125	huum	•
Cross- Desig Axia Des Des Des Tor Ber Ber Bross- Desig Axia Gro	Section Prin Internal F al Force sign Shear sign Shear sional Mom ding Mom ding Mom Section Clion Ratio al Compres ss Area	operties - H Force Force Force ent ent assification - (sion	HW 125x1		-2010	F V _y V _z M _x M _y M _z	-0.35 -0.72 0.00 0.00 0.00 83.78 30.00	kN kNm kNm kNm kNm			125.0		125	8.0	
Cross Desig Axia Des Des Tor Ber E Cross Desig Axia Gro	Section Print Internal F al Force sign Shear sign Shear sional Momi ding Momi ding Momi ding Momi Section Cli n Ratio al Compres	operties - H Force Force Force ent ent assification - (sion	HW 125x1		-2010	F V _y V _z M _x M _y M _z	-0.35 -0.72 0.00 0.00 0.00 83.78	kN kNm kNm kNm kNm			125.0		125	8.0	
Cross Desig Axia Des Des Des Tor Ber Ber Ber Cross Cross Gro Gro Des Cor	Section Prin Internal F al Force ign Shear ign Shear sional Mon iding Momi Section Clin Ratio al Compres ss Area ign Streng npression F	operties - H Force Force Force ent ent assification - (sion	HW 125x1		-2010	F Vy Vz Mx My Mz Fo Ag	0.35 0.72 0.00 0.00 83.78 30.00 305.00 915.00	kN kNm kNm kNm kNm kN cm ² MPa		8.7.5	125.0		125	8.0	
Cross Desig Axia Des Des Des Tor Ber Ber Cross Cross Cross Gro Gro Des Cor	Section Pr Internal F al Force ign Shear ign Shear sional Morr ding Mome ding Mome Section Cla n Ratio al Compres ss Area ign Streng	operties - H Force Force Force ent ent assification - (sion th	HW 125x1		-2010	F Vy Vz Mx My Mz Fc Ag Py	-0.35 -0.72 0.00 0.00 0.00 83.78 30.00 305.00	kN kNm kNm kNm kNm kN cm ² MPa	≤1	8.7.5	125.0		125	8.0	
Cross Desig Axia Des Des Tor Ber Ber Cross Cross Cross Cross Cross Cross Cross	Section Prin Internal F al Force ign Shear ign Shear sional Mon iding Momi ding Momi Section Ci- n Ratio al Compres ss Area ign Streng npression F	operties - H Force Force Force ent ent assification - (sion th	HW 125x1		2010	F Vy Vz Mx My Mz Fo Ag Py Po	0.35 0.72 0.00 0.00 83.78 30.00 305.00 915.00	kN kNm kNm kNm kNm kN cm ² MPa	≤1		125.0		125	8.0	
Cross Desig Axia Des Des Des Tor Ber Ber Cross Cross Cross Gro Gro Des Cor	Section Prin Internal F al Force ign Shear ign Shear sional Mon iding Momi ding Momi Section Ci- n Ratio al Compres ss Area ign Streng npression F	operties - H Force Force Force ent ent assification - (sion th	HW 125x1		-2010	F Vy Vz Mx My Mz Fo Ag Py Po	0.35 0.72 0.00 0.00 83.78 30.00 305.00 915.00	kN kNm kNm kNm kNm kN cm ² MPa	≤1		125.0		125	8.0	

Figure 4.3: Window 2.2 Design by Cross-Section

In this results window, the maximum design ratios of all members and actions selected for design are listed by cross-section. The results are sorted by cross-section design and stability analysis as well as serviceability limit state design.

If there is a tapered member, the cross-sections of the member start and end are listed separately.

4.3 Design by Set of Members

	A	B	С	D	E					F							
Set	Member	Location	Load-	Design													
No.	No.	x [m]	ing	Ratio				Des	ign Acco	ding to Formula							
5	Continuou	us beam (Mer	mber No. 2	55,24,159,16,160	.40)												
	16	1.900	CO1	0.00	≤1	101) Cross-section	heck - Tension	acc. to 8.6									
	159	1.140	CO1			111) Cross-section							r 2				
	159	0.000	CO1	0.11	≤1	121) Cross-section	heck - Shear ca	apacity - Lo	ad paralle	to the web acc	. to 8.2.	1					
	255	0.190	CO1			123) Cross-section					cc. to 8.	2.1					
	255	0.000	CO1			126) Cross-section											
	24	1.100	CO1			161) Cross-section											
	16	1.900	CO1			221) Cross-section									.9.1 -	Class 1	l or
	255	0.000	CO1			372) Stability analys			is and be	nding about y ar	ıd z-axis	acc.t	o 8.9.2				
	255	0.000	CO5	0.00	≤1	400) Serviceability -	Negligible defle	ctions									•
			Max:	0.96	≤ 1	۲		9	2.	39 🛃	> 1,0		~ 7	, 🗧	1	1	٢
	an Internal F																
Desig	Section Cla n Ratio	assification - (Class 1				0.40				-	t		125.0	1		
Desig Be	-Section Cla on Ratio Inding Mome	assification - (ent	Class 1			My		kNm			-			125.0			
Desig Be Be	s-Section Cla gn Ratio nding Mome nding Mome	assification - (ent ent	Class 1			M _y Mz	3.15	kNm			- - - -		0.6	125.0			
Desig Be Be Pla	s-Section Cla gn Ratio nding Mome nding Mome astic Sectior	assification - (ent ent n Modulus	Class 1			My Mz Sy	3.15 151.95	kNm cm ³			- - - -		0.6	125.0	8.0		
Desig Be Be Pla Pla	-Section Cla gn Ratio nding Mome nding Mome astic Section astic Section	assification - (ent n Modulus n Modulus	Class 1			My Mz Sy Sz	3.15 151.95 71.72	kNm cm ³ cm ³			-		0.6	125.0		<u></u>	
Desig Be Be Pla Pla De	-Section Cla gn Ratio Inding Mome Inding Mome Inding Mome Inding Streng Isign Streng	assification - (ent ent n Modulus n Modulus th	Class 1			My Mz Sy Sz Py	3.15 151.95 71.72 305.00	kNm cm ³ cm ³ MPa			125.0		0 6	125.0		2	-•y
Desig Be Pla Pla De Sh	s-Section Cla gn Ratio Inding Mome Inding Mome astic Section astic Section astic Section astic Section astic Section astic Section	assification - (ent n Modulus n Modulus th Ratio	Class 1			My Mz Sy Sz Py ηvz	3.15 151.95 71.72 305.00 0.10	kNm cm ³ cm ³ MPa	≤ 0.6		125.0		0'6			<u></u>	-•y
Desig Be Pla Pla De Sh	-Section Cla gn Ratio nding Mome astic Sectior astic Sectior astic Sectior sign Streng ear Design ear Design	assification - (ent n Modulus n Modulus th Ratio Ratio	Class 1			My Mz Sy Sz Py ηvz ηvy	3.15 151.95 71.72 305.00 0.10 0.00	kNm cm ³ cm ³ MPa	≤ 0.6 ≤ 0.6	8221	125.0		0.6		8.0	2	-•y
Desig Be Pla Pla De Sh Sh	-Section Cla on Ratio Inding Mome astic Section astic Sect	assification - (ent ent n Modulus n Modulus th Ratio Ratio city	Class 1			My Mz Sy Sz Py ηvz ηvy	3.15 151.95 71.72 305.00 0.10 0.00 46.34	kNm cm ³ cm ³ MPa kNm		8.2.2.1	125.0		00		8.0	<u></u>	-•y
Desig Be Pla Pla De Sh Sh Mo	Section Cla n Ratio nding Mome astic Sectior astic Secti	assification - (ent ent n Modulus n Modulus th Ratio Ratio city city	Class 1			My Mz Sy Sz Py ηvz ηvy Moy Moy Moz	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87	kNm cm ³ cm ³ MPa kNm kNm		8.2.2.1 8.2.2.1	125.0		6		8.0	2	-*y
Desig Be Pla Pla De Sh Mo Mo Be	Section Cla n Ratio nding Mome astic Sectior astic Secti	ent ent n Modulus n Modulus th Ratio Ratio city city gn Ratio	Class 1			My Mz Sy Fy ηvz ηvy Moz ηmy	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87 0.18	kNm cm ³ cm ³ MPa kNm kNm			125.0		0.6		8.0	2	-• y
Desig Be Pla Pla De Sh Sh Mc Be Be	Section Cla gn Ratio nding Mome astic Section astic Sect	ent ent n Modulus n Modulus th Ratio Ratio city city gn Ratio	Class 1			My Mz Sy Sz Py ηvz ηvy Mcz ηmy ηmz	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87 0.18 0.14	kNm cm ³ MPa kNm kNm	≤ 0.6	8.2.2.1	125.0		0.6		8.0	2	- • y
Desig Be Pla Pla De Sh Sh Mo Be	Section Cla n Ratio nding Mome astic Sectior astic Secti	ent ent n Modulus n Modulus th Ratio Ratio city city gn Ratio	Class 1			My Mz Sy Fy ηvz ηvy Moz ηmy	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87 0.18	kNm cm ³ MPa kNm kNm			125.0		6		8.0	2	-•y
Desig Be Pla Pla De Sh Sh Mo Be	Section Cla gn Ratio nding Mome astic Section astic Sect	ent ent n Modulus n Modulus th Ratio Ratio city city gn Ratio	Class 1			My Mz Sy Sz Py ηvz ηvy Mcz ηmy ηmz	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87 0.18 0.14	kNm cm ³ MPa kNm kNm	≤ 0.6	8.2.2.1	125.0		0.6		8.0	2	y
Desig Be Pla Pla De Sh Sh Mo Be Be	Section Cla gn Ratio nding Mome astic Section astic Sect	ent ent n Modulus n Modulus th Ratio Ratio city city gn Ratio	Class 1			My Mz Sy Sz Py ηvz ηvy Mcz ηmy ηmz	3.15 151.95 71.72 305.00 0.10 0.00 46.34 21.87 0.18 0.14	kNm cm ³ MPa kNm kNm	≤ 0.6	8.2.2.1	125.0		06		8.0	2	[mr

Figure 4.4: Window 2.3 Design by Set of Members

This results window is displayed if at least one set of members has been selected for design. The window lists the maximum design ratios sorted by set of members.

The *Member No.* column shows the number of the member within the set of members that bears the maximum ratio for the individual design criteria.

The output by set of members allows you to clearly present the design of an entire structural group (a frame, for example).

4

2.4 Design by Member

	A	B	C	D					E						
	Location	Load-	Design					_							
No.	x [m]	ing	Ratio					Desi	gn Accord	ing to Formula					
3			HW 125x125 G												
	1.260	CO1				section check - T									
	0.000	CO1				section check - S									
	1.260	CO1				section check - E									
	0.000	CO1	0.39	≤1	351) Stabilit	y analysis - Buck	ling about z-ax	is and ber	nding abou	t y and z-axis wit	h late	ral torsio	nal buckling	acc. to 8.9.2	
4	0		HW 200x2041G	D CT	11000 0010										
4	Cross-section 0.000	CO1				section check - S	No	Landan			1				
	0.000					section check - 3 section check - 5					.1				
_	1.260	CO1 CO1				section check - 3 section check - E					. 1 .	- 2			
	1.260	COT	0.05	21	To I) Cross-	section check - E	laxial bending			CC. 10 0.5.1 - Cia	STO	٢Z			
		Max:	0.96	≤1	۲			۲	1 🎗	2	<u>5</u>	> 1,0	~ 7	😂 🖳 🐧	3 4
								_			_				
	Member 3 - x:	0.000 m -	CO1									2 - H H	IW 125x125	GB/T 11263-	2010
Fac						Φz	2706.70			App 8.4	^				
	er Buckling St					PEz	5003.02			App 8.4					
	npressive Stre					Poz	298.32			App 8.4					
	npression Res					Pcz	894.95	kN		8.7.5 and 8.7					
	npressive Des					ηnz	0.00			8.9.2			+ 1	25.0	
	kimum Momen	t				MLT.y.max	13.83					- L			
	ctive Length					LE	1.260	m		8.3.4			0.6	Winner	
Sler	ndemess					λ	40.318			8.3.5.3			6	8.0	
– Limi	ting Slendem	ess				λLO	32.658			App 8.1					
Equ	ivalent Slende	emess				λLT	30.938		$< \lambda_{LO}$			25.0			
- Max	imum Momen	t				My,max	13.83	kNm				-		8	3
Elas	stic Section M	odulus				Zy	134.00	cm ³						6.5	
Mor	ment Capacity					Mey	40.87	kNm		8.2.2.1				<u>k</u>	
Mor	ment Factor					MLT	0.999			Tab 8.4b		+		ivillilli.	
LTE	B Design Ratio)				ηm,LT	0.34			8.9.2				1	
Max	dimum Momen	t				M _{z,max}	1.02	kNm						z	
Elas	stic Section M	odulus				Zz	46.90	cm ³							
Mor	ment Capacity					Mcz	14.30	kNm		8.2.2.1					
Stru	icture Type					Туре	Non-sway			8.9.2					
	ivalent Unifor	m Moment	Factor			mz	0.714								le-
Equ						-			-						្រា
	iding Design F	Ratio				າງmz	0.05			8.9.2		0			•

Figure 4.5: Window 2.4 Design by Member

This results window shows the maximum design ratios for the individual designs sorted by member number. The columns are described in detail in Chapter 4.1 on page 34.

4.5 Design by x-Location

	A	В	С	D				E						/
Member	Location	Load-	Design	_										
No.	x [m]	ing	Ratio				Design /	According	to Formula					
2	Cross-section	n No. 2 - H	HW 125x125 G	B/T 1	1263-2010									
	0.000	CO1	0.00	≤1	126) Cross-section check	- Shear buckling acc	c. to 8.4.6	and App 8	.3					
	0.000	CO1	0.34	≤1	161) Cross-section check	- Biaxial bending abo	out y and z	-axis acc.	to 8.9.1 - Class 1	or 2				
	0.000	CO1	0.39	≤1	351) Stability analysis - Bu	ickling about z-axis a	nd bendin	g about y a	and z-axis with la	teral torsio	onal buck	ing acc.	to 8.9.2	
	0.252	CO1			110) Cross-section check									
	0.252	CO1			126) Cross-section check									
	0.252	CO1			161) Cross-section check									
	0.252	CO1			351) Stability analysis - Bu						onal buck	ing acc.	to 8.9.2	
	0.420	CO1			161) Cross-section check									_
	0.420	CO1	0.39	≤1	351) Stability analysis - Bu	ickling about z-axis a	nd bendin	g about y a	and z-axis with la	teral torsio	onal buck	ing acc.	to 8.9.2	
		Max:	0.96	≤ 1	9		9	.	3	> 1,0	\sim	7 🔮	3	۹
+ Cross	Section Prop	erties - H	5 GB 50017-201 HW 125x125 GB		263-2010						HW 125x	125 66		
	Section Prop n Internal For Section Class	erties - H ces	HW 125x125 GB		263-2010						HVV 120X	125 GB		
	Section Prop n Internal Ford Section Class n Ratio	erties - H I ces sification - C	HW 125x125 GB			13.70	kNm				+			†
	Section Prop n Internal For Section Class	erties - H I ces sification - C	HW 125x125 GB		263-2010		kNm kNm			+				†
	Section Prope n Internal Ford Section Class n Ratio nding Moment	erties - HI ces sification - C	HW 125x125 GB		My		kNm			+			8.0	1
	Section Prope n Internal Ford Section Class n Ratio nding Moment nding Moment	erties - H I ces sification - C t t Modulus	HW 125x125 GB		My Mz	1.02	kNm cm ³			+				ţ
Tross Desig Cross Cross Cross Desig Ber Ber Pla	Section Propo n Internal Ford Section Class n Ratio nding Moment nding Moment stic Section N	erties - H I ces sification - C t t Modulus	HW 125x125 GB		My Mz Sy	1.02	kNm cm ³ cm ³			+				1
Cross Desig Toss Cross Desig Desig Ber Ber Pla Pla	Section Prop n Internal Ford Section Class n Ratio nding Moment nding Moment stic Section N stic Section N	erties - H I ces sification - C t t Modulus Modulus	HW 125x125 GB		My Mz Sy Sz	1.02 151.95 71.72	kNm cm ³ cm ³	≤ 0.6		+				†
Cross Toss Cross Toss Cross Desig Desig Ber Ber Pla Pla Des She	Section Prop n Internal Forc Section Class n Ratio nding Moment stic Section N stic Section N sign Strength ear Design Ra ear Design Ra	erties - H ces sification - C t t Modulus Modulus atio	HW 125x125 GB		My Mz Sy Sz Py	1.02 151.95 71.72 305.00 0.00 0.00	kNm cm ³ cm ³ MPa	≤ 0.6 ≤ 0.6		+				† 9
Tross Desig Torss Desig Desig Desig Ber Pla Pla She She Mo	Section Prop n Internal Ford Section Class n Ratio ding Moment stic Section N stic Section N sign Strength aar Design Ra aar Design Ra ment Capacity	erties - H ces sification - C t t Modulus Modulus atio atio	HW 125x125 GB		My Mz Sy Sz py ηvz ηvy	1.02 151.95 71.72 305.00 0.00 0.00 46.34	kNm cm ³ cm ³ MPa kNm		8.2.2.1	+				†
Tross Cross Desig Cross Desig Desig Ber Pla Pla Des She Mo Mo	Section Propu- n Internal Ford Section Class n Ratio nding Moment stic Section N stic Section N sign Strength sar Design Ra ear Design Ra ment Capacity ment Capacity	erties - H ces sification - C t t Modulus Addulus stio stio y y	HW 125x125 GB		My Mz Sy Sz Py ηvz ηvy	1.02 151.95 71.72 305.00 0.00 0.00 46.34 21.87	kNm cm ³ cm ³ MPa kNm		8.2.2.1 8.2.2.1	+				† 9 9
Tross Toss Toss	Section Prop n Internal Ford Section Class n Ratio nding Moment stic Section N sign Strength sar Design Ra ment Capacity nding Design	erties - H ces sification - C t t Modulus Modulus stio y y y Ratio	HW 125x125 GB		My Mz Sy Sz py ηvz ηvy	1.02 151.95 71.72 305.00 0.00 0.00 46.34 21.87 0.30	kNm cm ³ cm ³ MPa kNm			+				† 9 9
Tross Toss To	Section Propu- n Internal Ford Section Class in Ratio ding Moment ding Moment stic Section N stic Section N stic Section N sign Strength aar Design Ra ment Capacity ment Capacity ding Design ding Design	erties - H ces sification - C t t Modulus Modulus stio y y y Ratio	HW 125x125 GB		My Mz Sy Py ηvz Nvy Mcy Mcy Mcy Name Name Name Name Name Name Name Name Name	1.02 151.95 71.72 305.00 0.00 46.34 21.87 0.30 0.30	kNm cm ³ cm ³ MPa kNm	≤ 0.6	8.2.2.1	+				† 9 9
Cross Desig Cross Cross Cross Desig Desig Desig Desig Pla Pla Pla Des She Mo Mo Ber Ber She	Section Prop n Internal Ford Section Class n Ratio nding Moment stic Section N sign Strength sar Design Ra ment Capacity nding Design	erties - H ces sification - C t t Modulus Modulus stio y y y Ratio	HW 125x125 GB		My M2 Sy Sz Py ηvz ηvy Mcy Mcz ηwz	1.02 151.95 71.72 305.00 0.00 0.00 46.34 21.87 0.30	kNm cm ³ cm ³ MPa kNm			+				† 9 9
Cross Desig Cross Desig Desig Ber Pla Pla Pla Des She She She Ber Ber	Section Propu- n Internal Ford Section Class in Ratio ding Moment ding Moment stic Section N stic Section N stic Section N sign Strength aar Design Ra ment Capacity ment Capacity ding Design ding Design	erties - H ces sification - C t t Modulus Modulus stio y y y Ratio	HW 125x125 GB		My Mz Sy Py ηvz Nvy Mcy Mcy Mcy Name Name Name Name Name Name Name Name Name	1.02 151.95 71.72 305.00 0.00 46.34 21.87 0.30 0.30	kNm cm ³ cm ³ MPa kNm	≤ 0.6	8.2.2.1	+				† 9 9
Cross Desig Cross Cross Cross Desig Desig Desig Desig Pla Pla Pla Des She Mo Mo Ber Ber She	Section Propu- n Internal Ford Section Class in Ratio ding Moment ding Moment stic Section N stic Section N stic Section N sign Strength aar Design Ra ment Capacity ment Capacity ding Design ding Design	erties - H ces sification - C t t Modulus Modulus stio y y y Ratio	HW 125x125 GB		My Mz Sy Py ηvz Nvy Mcy Mcy Mcy Name Name Name Name Name Name Name Name Name	1.02 151.95 71.72 305.00 0.00 46.34 21.87 0.30 0.30	kNm cm ³ cm ³ MPa kNm	≤ 0.6	8.2.2.1	+				y Imn (mn

Figure 4.6: Window 2.5 Design by x-Location

4

This results window lists the maxima for each member at all locations **x**, resulting from the division points defined in RFEM or RSTAB:

- Start and end node
- Division points according to possibly defined member division (see RFEM table 1.16 or RSTAB table 1.6)
- Member division according to specification for member results (*Calculation Parameters* dialog box of RFEM/RSTAB, *Global Calculation Parameters* tab)
- Extreme values of internal forces

4.6 Governing Internal Forces by Member

3.1 Governing Internal Forces by Member

	A	В	C	D	E	F	G	Н	
ember	Location	Load-		Forces [kN]			oments [kNm]		
Vo.	x [m]	ing	F	Fvy	Fvz	Mx	My	Mz	Design According to Formula
1	Cross-section	No. 4 - H H	HW 200x204	GB/T 11263-20	010				
	0.000	CO1	0.03	-0.65	0.90	0.00	4.39		121) Cross-section check - Shear capacity - Load parallel to the
	0.000	CO1	0.03	-0.65	0.90	0.00	4.39		126) Cross-section check - Shear buckling acc. to 8.4.6 and A
	0.000	CO1	0.03	-0.65	0.90	0.00	4.39		161) Cross-section check - Biaxial bending about y and z-axis a
	0.000	CO1	0.03	-0.65	0.90	0.00	4.39	-1.39	351) Stability analysis - Buckling about z-axis and bending about
2	Cross-section	No 2-HE	HW 125x1251	GB/T 11263-20	110				
-	1.260	CO1	-2.64	-0.58	-0.12	-0.01	13.82	-0.28	110) Cross-section check - Torsion
	0.000	C01	-2.64	-0.58	0.32	0.01	13.70		
	0.000	C01	-2.64	-0.58	0.32	0.01	13,70		161) Cross-section check - Biaxial bending about y and z-axis
	0.000	CO1	-2.64	-0.58	0.32	0.01	13.70		351) Stability analysis - Buckling about z-axis and bending about
3	C	N- 2 111	IM 105-105 I	GB/T 11263-20	10				
5	1.260	CO1	-1.00	0.58	-0.12	-0.01	13.81	1.02	110) Cross-section check - Torsion
	0.000	C01	-1.00	0.58	0.12	0.01	13.69		126) Cross-section check - Totsion 126) Cross-section check - Shear buckling acc. to 8.4.6 and A
	1.260	C01	-1.00	0.58	-0.12	-0.01	13.85		161) Cross-section check - Biaxial bending about y and z-axis a
	0.000	C01	-1.00	0.58	0.12	0.01	13.69		351) Stability analysis - Buckling about z-axis and bending about
	0.000	COT	-1.00	0.50	0.51	0.01	13.03	-0.23	
4	Cross-section	No. 4 - H H	HW 200x204	GB/T 11263-20	010				
	0.000	CO1	0.27	0.65	0.90	0.00	4.39	-0.58	121) Cross-section check - Shear capacity - Load parallel to the
	0.000	CO1	0.27	0.65	0.90	0.00	4.39	-0.58	126) Cross-section check - Shear buckling acc. to 8.4.6 and A
	1.260	CO1	0.26	0.65	0.35	0.00	5.18	-1.40	161) Cross-section check - Biaxial bending about y and z-axis a
	0.000	CO1	0.27	0.65	0.90	0.00	4.39	-0.58	351) Stability analysis - Buckling about z-axis and bending about
13	Cross-section	No. 4 - H H	HW 200x2041	GB/T 11263-20	010				
	0.760	CO1	2.02	-0.18	-6.18	0.00	0.03	1.14	116) Cross-section check - Bending about z-axis for low shear
	1.520	C01	2.24	0.03	-12.36	-0.01	-7.01	1.20	121) Cross-section check - Shear capacity - Load parallel to th
	0.380	C01	1.91	-0.29	-3.09	0.00	1.79	1.05	126) Cross-section check - Shear buckling acc. to 8.4.6 and A
	1.900	C01	2.33	0.14	-15.46	-0.02	-12.30		161) Cross-section check - Biaxial bending about y and z-axis a
	0.000	CO1	1.80	-0.40	0.01	0.00	2.38	0.92	351) Stability analysis - Buckling about z-axis and bending about
14	Cross-section	No 3-HE	HW 125x1251	GB/T 11263-20	110				
	0.760	CO1	-2.93	0.67	-5.90	0.00	3.54	0.03	111) Cross-section check - Bending about y-axis for low shear
	1.900	C01	-2.57	1.05	+15.73	0.00	-8.79		121) Cross-section check - Shear capacity - Load parallel to the

Figure 4.7: Window 3.1 Governing Internal Forces by Member

For each member, this window displays the governing internal forces, that is, the forces and moments that result in the maximum utilization in the individual designs.

Location **x**

This column shows the respective x-location of the member where the maximum design ratio occurs.

Loading

This column shows the numbers of the load case as well as the load or result combination whose internal forces result in the maximum design ratio.

Forces / Moments

For each member, this column displays the axial and shear forces as well as the torsional and bending moments producing the maximum ratios in the respective cross-section designs, stability analyses, and serviceability limit state designs.

Design According to Formula

The final column gives information on the design types and equations used for performing the designs according to the Code [1].

4.7 Governing Internal Forces by Set of Members

	A	B	C	D	E	F (G	Н	
et	Location	Load-		Forces [kN]		M	loments [kNm]		
0.	x [m]	ing	F	Fvy	Fvz	Mx	My	Mz	Design According to Formula
5	Continuous be	eam (Memb	er No. 255,24	159,16,160,40))				
	1.900	CO1	2.56	0.14	-15.73	-0.01	-8.78	0.67	101) Cross-section check - Tension acc. to 8.6
	1.140	CO1	1.73	-0.63	7.23	0.00	2.51	0.02	111) Cross-section check - Bending about y-axis for low shear ac
	0.000	CO1	1.35	-0.97	17.08	0.00	-11.34	-0.89	121) Cross-section check - Shear capacity - Load parallel to the
	0.190	CO1	0.69	-2.75	9.39	0.00	-0.43	-3.33	123) Cross-section check - Shear capacity - Load parallel to the
	0.000	CO1	0.63	-2.81	11.03	-0.01	-2.36	-3.86	126) Cross-section check - Shear buckling acc. to 8.4.6 and App
	1.100	CO1	1.56	-1.90	-14.87	0.00	-8.12	3.15	161) Cross-section check - Biaxial bending about y and z-axis ac
	1.900	CO1	2.56	0.14	-15.73	-0.01	-8.78	0.67	221) Cross-section check - Biaxial bending about y and z-axis, sh
	0.000	CO1	0.63	-2.81	11.03	-0.01	-2.36		372) Stability analysis - Buckling about y or z-axis and bending ab
	0.000	CO5	0.00	0.00	0.00	0.00	0.00	0.00	400) Serviceability - Negligible deflections
	1.900	CO5	0.00	0.00	0.00	0.00	0.00	0.00	401) Serviceability - Deflection in z-direction for beam
6	Continuous be	eam (Memb	er No. 254,23	,125,14,135,38))				
	0.760	CO1	-2.93	0.67	-5.90	0.00	3.54		111) Cross-section check - Bending about y-axis for low shear ac
	1.900	CO1	-2.57	1.05	-15.73	0.00	-8.79	-0.95	121) Cross-section check - Shear capacity - Load parallel to the
	0.660	CO1	-2.14	2.05	10.77	0.00	-1.81	1.83	123) Cross-section check - Shear capacity - Load parallel to the
	0.000	CO1	-2.97	-1.12	11.03	0.00	-2.37	-1.16	126) Cross-section check - Shear buckling acc. to 8.4.6 and App
	0.000	CO1	-2.38	1.81	16.46	0.00	-10.80	3.10	161) Cross-section check - Biaxial bending about y and z-axis ac
	0.000	CO1	-2.38	1.81	16.46	0.00	-10.80	3.10	372) Stability analysis - Buckling about y or z-axis and bending a
	0.000	CO5	0.00	0.00	0.00	0.00	0.00	0.00	400) Serviceability - Negligible deflections
	1.900	CO5	0.00	0.00	0.00	0.00	0.00	0.00	401) Serviceability - Deflection in z-direction for beam

Figure 4.8: Window 3.2 Governing Internal Forces by Set of Members

For each set of members, this window shows the internal forces that result in the maximum ratios for the individual designs.

	Α	B	C	D	E	F	G	H	
Member No.		Length		Major Axis y			Minor Axis z		
	Under Stress	L [m]	ky[-]	iy [mm]	λy[-]	k z [·]	iz [mm]	λz[-]	
52	Compression / Flexure	1.280	0.500	52.9	12.102	0.500	31.3	20.479	
53	Compression / Flexure	1.500	0.500	52.9	14.182	0.500	31.3	23.999	
57	Compression / Flexure	1.280	0.500	52.9	12.102	0.500	31.3	20.479	
58	Compression / Flexure	1.500	0.500	52.9	14.182	0.500	31.3	23.999	
61	Compression / Flexure	1.500	0.500	83.4	8.989	0.500	48.8	15.384	
65	Compression / Flexure	1.280	0.500	83.4	7.670	0.500	48.8	13.128	
69	Compression / Flexure	1.500	0.500	83.4	8.989	0.500	48.8	15.384	
72	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
76	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
84	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
90	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
122	Compression / Flexure	1.900	0.500	83.4	11.386	0.500	48.8	19.487	
123	Compression / Flexure	3.800	1.000	52.9	71.856	1.000	31.3	121.594	
124	Compression / Flexure	3.800	1.000	52.9	71.856	1.000	31.3	121.594	
126	Compression / Flexure	3.800	1.000	52.9	71.856	1.000	31.3	121.594	
128	Compression / Flexure	1.900	0.500	83.4	11.386	0.500	48.8	19.487	
132	Compression / Flexure	1.100	0.500	83.4	6.592	0.500	48.8	11.282	
133	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
134	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
136	Compression / Flexure	1.100	0.500	83.4	6.592	0.500	48.8	11.282	
140	Compression / Flexure	1.500	0.500	52.9	14.182	0.500	31.3	23.999	
141	Compression / Flexure	1.500	0.500	52.9	14.182	0.500	31.3	23.999	
142	Compression / Flexure	1.500	0.500	83.4	8.989	0.500	48.8	15.384	
151	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	
155	Compression / Flexure	1.280	0.500	83.4	7.670	0.500	48.8	13.128	
156	Compression / Flexure	1.280	0.500	52.9	12.102	0.500	31.3	20.479	
157	Compression / Flexure	1.280	0.500	52.9	12.102	0.500	31.3	20.479	
158	Compression / Flexure	1.280	0.500	83.4	7.670	0.500	48.8	13.128	
161	Compression / Flexure	3.800	1.000	52.9	71.856	1.000	31.3	121.594	
162	Compression / Flexure	3.000	1.000	52.9	56.728	1.000	31.3	95.995	

Figure 4.9: Window 3.3 Member Slendernesses

Details...

Details...

This result window is displayed if the corresponding check box is ticked in the *General* tab of the *Details* dialog box (see Figure 3.4, page 30).

The table lists the effective slendernesses of the designed members for both directions of the principal axes. They have been determined as a function of the load type. Below the list, you see a comparison with the limit values defined in the *General* tab of the *Details* dialog box (see Figure 3.4, page 30).

Members of the "Tension" or "Cable" type are not displayed in this window.

This window is only of an informative nature. It provides no stability analysis of slendernesses.

4.9 Parts List by Member

Finally, there is a summary of all cross-sections included in the design case.

	A	B	C (D (E	F	G	H (
Part	Cross-Section	Number of	Length	Total Length	Surface Area	Volume	Unit Weight	Weight	Total Weight
No.	Description	Members	[m]	[m]	[m ²]	[m ³]	[kg/m]	[kg]	[t]
1	4 - H HW 200x204 GB/T 11263-2010	2	1.26	2.52	2.95	0.02	56.15	70.75	0.142
2	2 - H HW 125x125 GB/T 11263-2010	2	1.26	2.52	1.82	0.01	23.55	29.67	0.059
3	4 - H HW 200x204 GB/T 11263-2010	8	1.90	15.20	17.78	0.11	56.15	106.69	0.853
4	2 - H HW 125x125 GB/T 11263-2010	8	1.50	12.00	8.68	0.04	23.55	35.33	0.28
5	4 - H HW 200x204 GB/T 11263-2010	8	1.10	8.80	10.29	0.06	56.15	61.77	0.494
6	4 - H HW 200x204 GB/T 11263-2010	8	1.50	12.00	14.04	0.09	56.15	84.23	0.674
7	4 - H HW 200x204 GB/T 11263-2010	4	1.28	5.12	5.99	0.04	56.15	71.87	0.28
8	2 - H HW 125x125 GB/T 11263-2010	4	1.28	5.12	3.70	0.02	23.55	30.14	0.12
9	2 - H HW 125x125 GB/T 11263-2010	8	3.00	24.00	17.36	0.07	23.55	70.65	0.56
10	2 - H HW 125x125 GB/T 11263-2010	4	3.80	15.20	10.99	0.05	23.55	89.49	0.35
11	1 - H HW 125x125 GB/T 11263-2010	12	2.97	35.70	25.82	0.11	23.55	70.06	0.84
Sum		68		138.18	119.42	0.60			4.67

Figure 4.10: Window 4.1 Parts List by Member

By default, this list contains only the designed members. If you need a parts list for all members of the model, you can set it in the *General* tab of the *Details* dialog box (see Figure 3.4, page 30).

Part No.

Details...

The program assigns part numbers to similar members.

Cross-Section Description

This column lists the cross-section numbers and descriptions.

Number of Members

This column shows how many similar members are used for each part.

Length

This column shows the respective length of an individual member.

Total Length

The values in this column are the product from the previous two columns.

Surface Area



For each part, the program displays the surface areas relative to the total length. The surface area is determined from the *Surface* of the cross-section that can be found in windows 1.3 and 2.1 through 2.5 in the info about cross-section (see Figure 2.11, page 15).



The volume of a part is determined from the cross-sectional area and the total length.

Unit Weight

The *Unit Weight* represents the cross-section weight relative to the length of one meter. For tapered cross-sections, the program averages both cross-section weights.

Weight

The values of this column are determined from the product of the entries in columns C and G.

Total Weight

The final column indicates the total weight of each part.

Sum

At the bottom of the list, you find a summary of the values shown in columns B, D, E, F, and I. The last row of the *Total Weight* column shows the required total amount of steel.

4.10 Parts List by Set of Members

	A	B	C	D	E	F (G	H	1
art	Set of Members	Number	Length	Total Length	Surface Area	Volume	Unit Weight	Weight	Total Weight
٥.	Description	of Sets	[m]	[m]	[m ²]	[m ³]	[kg/m]	[kg]	[t]
	Continuous beam	2	9.80	19.60	14.18	0.06	23.55	230.79	0.462
ım		2		19.60	14.18	0.06			0.46

Figure 4.11: Window 4.2 Parts List by Set of Members

The last result window is displayed if at least one set of members has been selected for design. It gives an overview of the steel parts of entire structural groups such as horizontal beams.

The columns are described in the previous chapter. If there are different cross-sections within a set of members, the program averages the surface area, the volume and the cross-section weight.

5 Results Evaluation

You can evaluate the design results in different ways. The buttons below the upper table may help you.

	A	B	С	D	1				E			
Nember	Location	Load-	Design									
No.	x [m]	ing	Ratio					Design	According	to Formula		
1	Cross-section	n No. 4 - H	HW 200x204 G	B/T	11263-2010							
	0.000	CO1	0.00	≤1	121) Cross-se	ection check - Sh	ear capacity - Lo	ad paralle	el to the we	eb acc. to 8.2.1		
	0.000	CO1	0.00	≤1	126) Cross-se	ection check - Sh	ear buckling ac	c. to 8.4.6	and App 8	3.3		
	0.000	CO1	0.04	≤1	161) Cross-se	ection check - Bia	xial bending abo	out y and :	z-axis acc.	to 8.9.1 - Class 1	1 or 2	
	0.000	CO1	0.06	≤1	351) Stability	analysis - Bucklin	g about z-axis a	nd bendin	ig about y	and z-axis with la	ateral torsional buckling acc. t	o 8.9.2
2		n No. 2 - H	HW 125x125 G									
	1.260	CO1				ection check - To						
	0.000	CO1				ection check - Sh						
	0.000	CO1	0.34	≤1	161) Cross-se	ection check - Bia	xial bending abo	out y and a	z-axis acc.	to 8.9.1 - Class 1	1 or 2	
		Max:	0.96	≤1	۲			9	۰	39 🖺	> 1,0 🗸 🏹 😂	ه وگ 🛃
								-			-	
	Member 2 - x			_							2 - H HW 125x125 GB/	T 11263-2010
			5 GB 50017-201		1000 0010						_	
			IW 125x125 GB		1263-2010						_	
	n Internal Ford Section Class										-	
-1 Desia		rication - U	ass I								125.0	
	nding Moment					Mv	13.70	le Neo			-	
	nding Moment					Mz		kNm				
	stic Section M					Sv	151.95				- 6	8.0
	stic Section M					Sz	71.72					
	sign Strength	oddido				PV	305.00				125.0	
	ar Design Ra	tio				1) yz	0.00		≤0.6		- 2	7
	ar Design Ra					η νγ	0.00		≤0.6		6.5	
 She 	ment Capacity					Mey	46.34	kNm		8221		
						Moz	21.87			8.2.2.1		///////
— Mor	ment Capacity					ηmy	0.30				-	
Mor Mor											-	
Mor Mor Ber	ment Capacity	Ratio					0.05				Z	
Mor Mor Ber Ber	ment Capacity nding Design F	Ratio				ຖາກy ຖາກz ຖ	0.05		≤1	8.9.1	-	
Mor Mor Ber Ber	ment Capacity nding Design F nding Design F	Ratio				ηmz			≤1	8.9.1	- -	
Mor Mor Ber Ber	ment Capacity nding Design F nding Design F	Ratio				ηmz			≤1	8.9.1	- Z	ſm

Figure 5.1: Buttons for results evaluation

The buttons have the following functions:

Button	Description	Function
%	Ultimate limit state	Displays or hides results of ultimate limit state design
۰	Serviceability	Displays or hides results of serviceability limit state design
9 9	Result combination	Creates a new result combination from governing load cases and load combinations
	Color bars	Displays or hides colored relation scales in result windows
> 1,0 ¥ > 1,0 Max Define	Filter parameters	Describes criterion by which results are filtered in tables: ratios greater than 1, maximum value, or user-defined limit
7	Apply filter	Shows only rows to which filter parameters apply (ratio > 1, maximum, defined value)
*	Result diagrams	Opens Result Diagram on Member window \rightarrow Chapter 5.2, page 47
X	Excel export	Exports table to MS Excel \rightarrow Chapter 7.4.2, page 58
₹ş	Select member	Selects a member graphically to display its results in the table
۲	View mode	Jumps to RFEM or RSTAB work window to change the view

Table 5.1: Buttons in the result windows 2.1 through 2.5



You can evaluate the design results also in the work window of RFEM or RSTAB.

Background graphic and view mode

The RFEM/RSTAB work window in the background is useful when you want to find the position of a particular member in the model: The member selected in the result window of RF-/STEEL HK is highlighted in color in the background graphic. Moreover, an arrow indicates the member's x-location selected in the active table row.

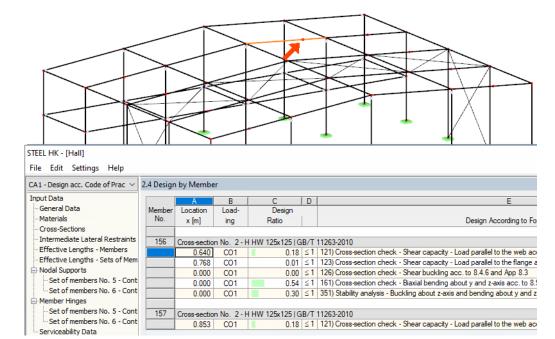


Figure 5.2: Indication of member and current *Location x* in RSTAB model



Graphics

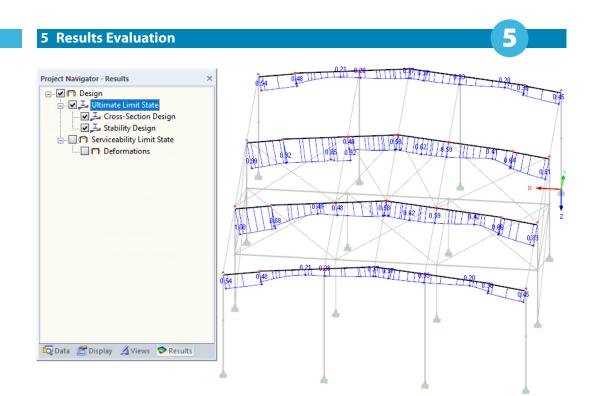
In case you cannot improve the model display by moving the RF-/STEEL HK module window, click the [Jump to graphic] button to activate the *view mode*: The program hides the module window so that you can adjust the view in the RFEM/RSTAB work window. The view mode provides the functions of the *View* menu, for example, zooming, moving, or rotating the model view. The indicating arrow remains visible.

Click [Back] to return to the RF-/STEEL HK add-on module.

RFEM/RSTAB work window

You can check the design ratios also graphically in the model: Click the [Graphics] button to exit the design module. In the work window of RFEM or RSTAB, the design ratios are now displayed like the internal forces of a load case.

In the *Results* navigator, you can select the design ratios separately for the ultimate and the serviceability limit state design as well as the fire protection design. It is also possible to check the classifications of cross-sections.





To turn on and off the display of design results, click the [Show Results] button that you know from the display of internal forces in RFEM/RSTAB. Click the [Show Result Values] button to the right to display the result values.

The RFEM/RSTAB tables are not relevant for the evaluation of the design results.

You can set the design cases in the drop-down list of the RFEM/RSTAB menu bar.

To adjust the graphical representation of results, you can use the **Results** \rightarrow **Members** entry in the *Display* navigator. The display of design ratios is *Two-Colored* by default.

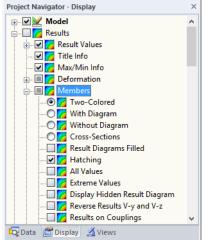


Figure 5.4: Display navigator options for Results \rightarrow Members



<u>×_xx</u>

STEEL HK CA1 - Beams

LC1 - Self-weight LC2 - Live load RC1 - 1.4*LC1/p + LC2

STEEL HK CA2 - Columns

If you select a multicolor representation (options *With/Without Diagram* or *Cross-Sections*), the color panel becomes available, providing common control functions. The functions are described in Chapter 3.4.6 of the RFEM or RSTAB manual.

5

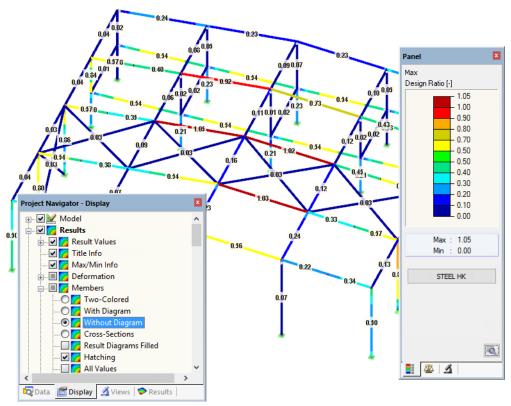


Figure 5.5: Design ratios with display option *Without Diagram*

It is possible to transfer the graphics of design results to the printout report (see Chapter 6.2, page 51).

STEEL HK

To return to the add-on module, click the [RF-/STEEL HK] button in the panel.

5.2 Result Diagrams

You can also evaluate the member results graphically in the form of result diagrams.

Select the member (or set of members) in the RF-/STEEL HK result window by clicking in the member's table row. Then, open the *Result Diagram on Member* dialog box by clicking the button shown on the left. You can find it below the upper result table (see Figure 5.1, page 43).

To access the result diagrams in the RFEM/RSTAB graphic, select on the menu

 $\textbf{Results} \rightarrow \textbf{Result Diagrams for Selected Members}$

Ł

2

or use the corresponding button in the toolbar of RFEM or RSTAB.

A window opens which shows graphically the distribution of the design values on the member or set of members.

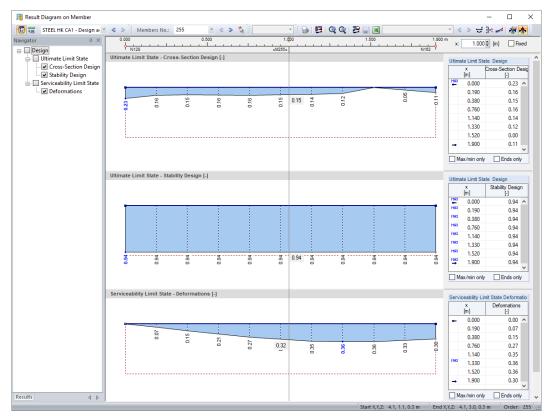
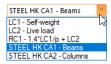


Figure 5.6: Dialog box Result Diagram on Member

Again, the *Results* navigator allows for a targeted selection among classifications and the designs of the ultimate and the serviceability limit state as well as of fire resistance.



Use the list in the toolbar to switch between the RF-/STEEL HK design cases.

The Result Diagram on Member dialog box is described in Chapter 9.5 of the RFEM or RSTAB manual.



> 1,0 V > 1,0 Max Define The arrangement of the RF-/STEEL HK result windows already provides a selection by various criteria. In addition, there are filter options for the tables (see Figure 5.1, page 43) to limit the numerical output by design ratios. This function is also described in a DLUBAL article: https://www.dlubal.com/en/support-and-learning/support/knowledge-base/000733

Furthermore, you can use the filter options described in Chapter 9.9 of the RFEM manual, or Chapter 9.7 of the RSTAB manual, to evaluate the results graphically.



Graphics

The possibilities offered by the *Visibility* function (see Chapter 9.9.1 in RFEM manual, or Chapter 9.7.1 in RSTAB manual) are also available for RF-/STEEL HK to filter the members for the evaluation.

Filtering designs

The design ratios can easily be used as filter criteria in the work window of RFEM or RSTAB that you can access with the [Graphics] button. To apply this function, the panel must be displayed. If it is not active, select on the RFEM/RSTAB menu

View ightarrow Control Panel (Color Scale ightarrow Factors ightarrow Filter)



or use the toolbar button shown on the left.

The panel is described in Chapter 3.4.6 of the RFEM or RSTAB manual. The filter settings for the results must be defined in the first panel tab (Color scale). As this tab is not available for the two-colored results display, you have to set the display options *With/Without Diagram* or *Cross-Sections* in the *Display* navigator.

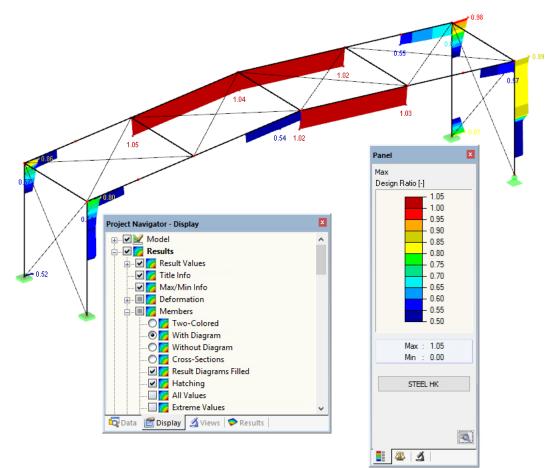


Figure 5.7: Filtering design ratios with adjusted color scale

As shown in Figure 5.7, the panel's scale of values can be set in such a way that only design ratios greater than 0.50 are displayed in a color range between blue and red.

The function *Display Hidden Result Diagram* in the *Display* navigator (**Results** \rightarrow **Members**) shows all design ratios which are beyond the value spectrum. Those diagrams are represented by dotted lines.

5

Filtering members

4

In the *Filter* tab of the control panel, you can specify the numbers of particular members to display their results filtered. The function is described in Chapter 9.9.3 of the RFEM manual or in Chapter 9.7.3 of the RSTAB manual.

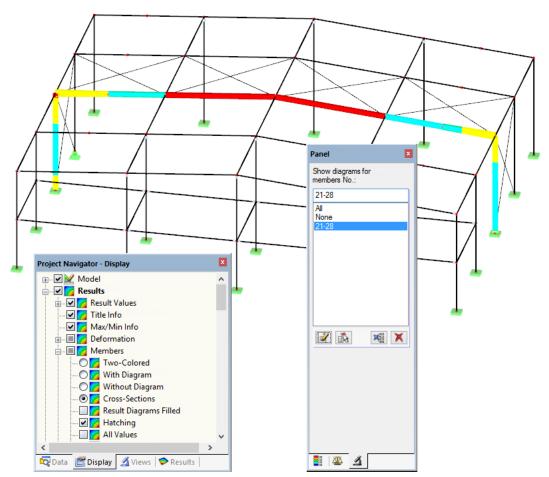


Figure 5.8: Member filter for design ratios of a hall frame

In contrast to the visibility function, the model will be displayed completely in the graphic. The figure above shows the design ratios of a hall frame. The remaining members are displayed in the model but are shown without design ratios.

6.1 Printout Report

A printout report is generated for the data of the RF-/STEEL HK add-on module, like in RFEM or RSTAB, to which you can add graphics and descriptions. The selection in the printout report determines which data from the design module will finally be included in the printout.

6



0

The printout report is described in the RFEM or RSTAB manual. Chapter 10.1.3.4 *Selecting Data of Add-on Modules* explains how to prepare input and output data of add-on modules for the printout.

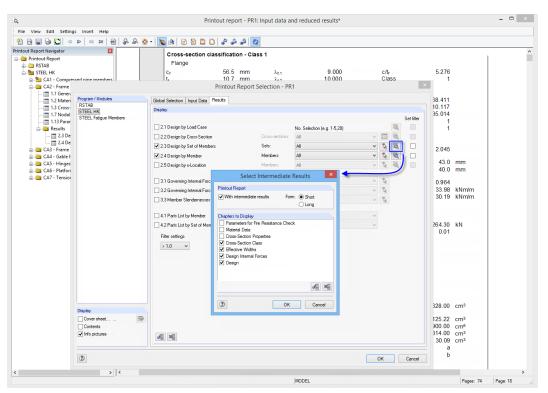


Figure 6.1: Selecting designs and intermediate results in the printout report

Click the [Details] button to specify if the printout also includes intermediate results. They can be defined in a list and documented in a *Short* (compact representation) or *Long* form (list representation).

For complex structural systems with many design cases, it is recommended to split data into several reports, thus allowing for a clearly-arranged printout.

6.2 Graphic Printout

In RFEM and RSTAB, you can transfer every image displayed in the work window to the printout report. It is also possible to send it directly to the printer. Thus, the design ratios displayed in the model can be prepared for the printout, too.



The printing of graphics is described in Chapter 10.2 of the RFEM or RSTAB manual.

Designs in RFEM/RSTAB model

To print the current graphic of design ratios, select on the menu

 $\textbf{File} \rightarrow \textbf{Print Graphic}$

or use the toolbar button shown on the left.

57							
4⊳	<u>F</u> ile	<u>E</u> dit	<u>V</u> iew	<u>I</u> nsert	<u>C</u> alculate	<u>R</u> esults	Tools
	2	33		ii 🖗	<u>n</u>		<u>°</u> 3
4	- 🤊	/ 🎢	- 7	• 🕸	rint Graphic	in - <u>2××</u>	

Figure 6.2: Print Graphic button in RFEM toolbar

Result diagrams



Also in the *Result Diagram on Member* dialog box, you can send the graphic with design values to the report by clicking the [Print] button. Alternatively, you can print it directly.

A			Result
Members No.: 64	~ 4 >	Ŕ	े 🙀 😕 🔍 🔍 🗃 🔜
STEEL HK CA	1 - Design ac 🍸 🔇	٢	Print

Figure 6.3: *Print* button in *Result Diagram on Member* dialog box

The following dialog box opens:

Graphic Printout						
General Options Color Scale Factors Bord	er and Stretch Factors					
Graphic Picture	Window To Print	Graphic Size				
 Directly to a printer 	 Current only 	As screen view				
To a printout report: PR1	O More	Window filling				
◯ To the Clipboard	🔿 Mass print	⊖ To scale 1: 20 ¥				
⊖ To 3D PDF						
Graphic Picture Size and Rotation	Options					
✓ Use whole page width	Show results for selected x-location in result diagram					
O Use whole page height	Lock graphic picture (without update)					
● Height: 53 [% of page]						
	Show printout report on [0	ĸj				
Rotation: 0 🗣 [°]						
Header of Graphic Picture						
Design Ratio						
D		OK Cancel				

Figure 6.4: Dialog box Graphic Printout, tab General

The *Graphic Printout* dialog box is described in Chapter 10.2 of the RFEM or RSTAB manual. There, you find also descriptions of the other dialog tabs.

6 Printout

Remove from Printout Report Start with New Page Selection... Properties... To move a graphic within the printout report to another position, use the drag-and-drop function.

6

To adjust a graphic subsequently in the printout report, right-click the relevant entry in the report navigator. The *Properties* option in the shortcut menu again opens the *Graphic Printout* dialog box, offering various options for adjustment.

	Graphic Printou	ut	×
General Options Color Scale Factors	Border and Stretch Factor	tors	
Proportional Constant	ymbols Proportional Constant actor:	Frame None Framed Title box	
Print Quality Standard (max 1000 x 1000 Pixels) Maximum (max 5000 x 5000 Pixels) User-defined Max number of pixels:	۲		
D		OK Can	cel

Figure 6.5: Dialog box Graphic Printout, tab Options

7 General Functions

This chapter describes useful menu functions as well as export options for the designs.

7.1 Design Cases

Design cases allow you to group members for the designs. This way, you can consider groups of structural components or analyze members with particular design specifications (for example, changed materials, partial safety factors, optimization).

It is no problem to analyze the same member or set of members in different design cases.



You can access the design cases of RF-/STEEL HK also in RFEM or RSTAB by using the load case list of the toolbar.

Create a new design case

To create a new design case, select on the RF-/STEEL HK menu

File ightarrow New Case.

The following dialog box appears.

New STEEL	HK Case	×
No.	Description	
2	Design of steel members according to HK	~
٢	ОК	Cancel

Figure 7.1: Dialog box New STEEL HK Case

In this dialog box, enter a *No*. (one that is not yet assigned) for the new design case. A *Description* will make the selection in the load case list easier.

After clicking [OK], the RF-/STEEL HK Window 1.1 General Data opens for you to enter the design data.

Rename a design case

To change the description of a design case, select on the RF-/STEEL HK menu

$\textbf{File} \rightarrow \textbf{Rename Case}.$

The following dialog box appears.

Rename S	TEEL HK Case		×
No. 2	Description New Description		~
D		ОК	Cancel

Figure 7.2: Dialog box Rename STEEL HK Case

In this dialog box, you can specify a different *Description* as well as a different *No*. for the design case.

Copy a design case

To copy the input data of the current design case, select on the RF-/STEEL HK menu

File ightarrow Copy Case.

The following dialog box appears.

Copy STEE	L HK Case X
Copy from	n Case
CA1 - De	sign acc. Code of Practice HK $$
New Case	3
No.:	Description:
3	Design S355 🗸
	OK Cancel

Figure 7.3: Dialog box Copy STEEL HK Case

Define the No. and, if necessary, a Description for the new case.

Delete a design case

To delete a design case, select on the RF-/STEEL HK menu

 $\mathbf{File} \rightarrow \mathbf{Delete} \ \mathbf{Case}.$

The following dialog box appears.

Delete Cases						
	le Cases					
No.	Description 🔺					
1	Design acc. Code of Practice HK					
2	New Description					
3	Design S355					
	•					
	OK Cancel					

Figure 7.4: Dialog box *Delete Cases*

You can select the design case in the list of Available Cases. To delete the selected case, click [OK].



The design module offers you the possibility to optimize overloaded or little utilized cross-sections: Define the relevant sections in Window *1.3 Cross-Sections* by opening the drop-down list in column E or F where you decide if the cross-sections are to be determined *From current row* or from user-defined *Favorites* (see Figure 2.9, page 13). You can also start the optimization in the result windows by using the shortcut menu.

	A	В	С	D	E		F
Section	Member	Location	Load-	Design			
No.	No.	x [m]	ing	Ratio			Design According to Formula
4 H HW 200x204 GB/T 11263-2010							
	297	1.100 CO1 0.00 ≤ 1 101) Cr				101) Cros	s-section check - Tension acc. to 8.6
	256	0.570	0.570 CO1 0.01 < 1.110\Cr				ခု-section check - Torsion
	122	<u>Go</u> to Cross-Section Doubleclick					-section check - Bending about y-axis for low shear acc. to 8.2.2.1- Class 1 or 2
	173	Info About Cross-Section					-section check - Bending about z-axis for low shear acc. to 8.2.2.1 - Class 1 or 2
	22						-section check - Shear capacity - Load parallel to the web acc. to 8.2.1
	165						-section check - Shear capacity - Load parallel to the flange acc. to 8.2.1
	1	Cross-Section Optimization Parameters			rame	ters	-section check - Shear buckling acc. to 8.4.6 and App 8.3
	298					101/005	s-section check - Biaxial bending about y and z-axis acc. to 8.9.1 - Class 1 or 2
	297					221) Cros	s-section check - Biaxial bending about y and z-axis, shear and axial force acc. to

Figure 7.5: Shortcut menu for cross-section optimization

7.2 Cross-Section Optimization

Details...

During the optimization process, RF-/STEEL HK determines the cross-section that fulfills the <u>ultimate limit state</u> design in the most "optimal" way, that is, it comes as close as possible to the maximum allowable design ratio specified in the *Details* dialog box (see Figure 3.4, page 30). The required cross-section properties are determined with the internal forces as available from RFEM or RSTAB. If another cross-section proves to be more favorable, it is used for the design. Then, the graphic in Window 1.3 shows two cross-sections – the original cross-section from RFEM or RSTAB and the optimized cross-section (see Figure 7.7).

If you select the Optimize option for a parametric cross-section, the following dialog box appears.

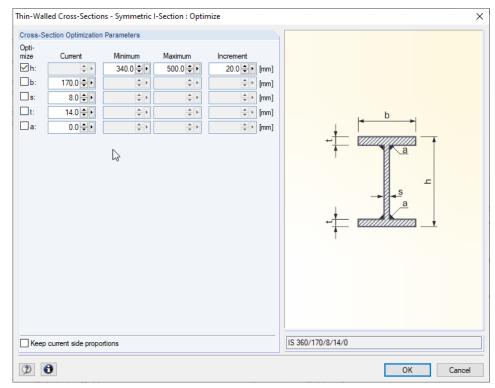


Figure 7.6: Dialog box Thin-Walled Cross-Sections - Symmetric I-Section : Optimize

You determine the parameter(s) that you want to modify by selecting the *Optimize* check box(es). This enables the *Minimum* and *Maximum* columns where you can define the upper and lower limits of the parameter. The *Increment* column controls the interval in which the size of the parameter varies during the optimization process.

If you want to *Keep current side proportions*, activate the corresponding check box. In addition, you have to select at least two parameters for optimization.

Cross-sections composed of rolled cross-sections cannot be optimized.

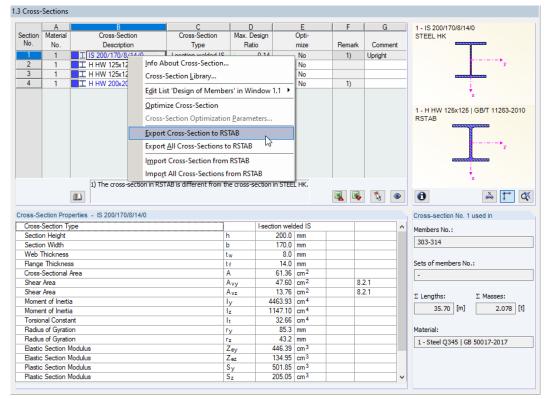


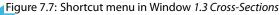
Please note that during the optimization the internal forces won't be automatically recalculated with the modified cross-sections: It is up to you to decide which cross-sections should be transferred to RFEM or RSTAB for recalculation. As a result of optimized cross-sections, the internal forces may differ significantly because of the modified stiffnesses in the structural system. Therefore, it is recommended to recalculate the internal forces with the modified cross-sections after the first optimization, and then to optimize the cross-sections once again.

You can export the modified cross-sections to RFEM or RSTAB: Go to Window 1.3 Cross-Sections and select on the menu

Edit \rightarrow Export All Cross-Sections to RFEM/RSTAB.

You can also use the shortcut menu in Window 1.3 to export optimized cross-sections to RFEM or RSTAB.





Before the modified cross-sections are transferred, a query appears asking if the results of RFEM or RSTAB should be deleted.

STEEL HK Information No. 71188
want to transfer the changed cross-sections to RSTAB? e results of RSTAB and STEEL HK will be deleted.
Yes No

Figure 7.8: Query before transfer of modified cross-sections to RSTAB

7 General Functions

Calculation

After starting the [Calculation] in RF-/STEEL HK, the internal forces and design ratios are determined in one calculation run.

If the modified cross-sections have not yet been exported to RFEM or RSTAB, you can reimport the original cross-sections to the design module by using the options shown in Figure 7.7. Please note that this possibility is only available in Window *1.3 Cross-sections*.



If you optimize a tapered member, the program modifies the member start and end and linearly interpolates the second moments of area for the intermediate locations. Since these moments are considered with the fourth power, the designs may be inaccurate if the depths of the start and end cross-section differ considerably. In such a case, it is recommended to divide the taper into several members, thus modeling the taper layout manually.

7.3 Units and Decimal Places

The units and decimal places are managed for RFEM/RSTAB and the add-on modules in one dialog box. In RF-/STEEL HK, you can access this dialog box for adjusting the units by selecting on the menu

Settings \rightarrow Units and Decimal Places

The dialog box known from RFEM or RSTAB appears. The RF-/STEEL HK add-on module is preset in the *Program / Module* list.

Units and Decimal Places							×
Program / Module RSTAB STEEL	^	STEEL HK Output Data			Parts List		
		Output Data Stresses: Design ratios: Dimensionless:	Unit MPa ~ - ~	Dec. places	Parts List Lengths: Total lengths: Surface areas: Volumes: Weight per length: Weight: Total weight:	Unit m ~ m^2 ~ m^2 ~ kg/m ~ kg ~ t ~	Dec. places 2 ÷ 2 ÷ 2 ÷ 2 ÷ 2 ÷ 3 ÷
FE-LTB EL-PL C-TO-T PLATE-BUCKLING CONCRETE 	~						
٦	œ					OK	Cancel

Figure 7.9: Dialog box Units and Decimal Places

ے (

The modified settings can be saved as user profile and reused in other models. The functions are described in Chapter 11.1.3 of the RFEM or RSTAB manual.

7.4 Data Transfer

7.4.1 Exporting Materials to RFEM/RSTAB

If the materials have been adjusted in RF-/STEEL HK for the design, you can export the modified materials to RFEM or RSTAB in a similar way as you export cross-sections: Open Window *1.2 Materials*, and then select on the menu

```
Edit \rightarrow Export All Materials to RFEM/RSTAB.
```

You can also use the shortcut menu in Window 1.2 to export materials to RFEM/RSTAB.



Figure 7.10: Shortcut menu of Window 1.2 Materials

Calculation

Before the modified cross-sections are transferred, a query appears asking if the results of RFEM or RSTAB should be deleted. After starting the [Calculation] in RF-/STEEL HK, the internal forces and design ratios are determined in one calculation run.

If the modified materials have not yet been exported to RFEM or RSTAB, you can reimport the original materials to the design module by using the options shown in Figure 7.10. Please note that this possibility is only available in Window *1.2 Materials*.

7.4.2 Export of Results

The RF-/STEEL HK results can also be used by other programs.

Clipboard

To copy cells selected in the results windows to the clipboard, use the keys [Ctrl]+[C]. To insert them, for example, in a word processing program, press [Ctrl]+[V]. The headers of the table columns won't be transferred.

Printout report

The data of RF-/STEEL HK can be printed into the printout report (see Chapter 6.1, page 50) where they can be exported. Then, in the printout report, select on the menu

File \rightarrow Export to RTF.

This function is described in Chapter 10.1.11 of the RFEM or RSTAB manual.

Excel/CSV export

RF-/STEEL HK provides a function for directly exporting data to MS Excel or to the CSV file format. To access this function, select on the menu

 $\textbf{File} \rightarrow \textbf{Export Tables}.$

The following export dialog box opens.

Export of Tables	×					
Table Parameters	Application					
With table header	Microsoft Excel CSV file format					
Transfer Parameters						
Export table to active workbook Export table to active worksheet Rewrite existing worksheet						
Selected Tables						
 Active table 	Export hidden columns					
○ All tables ✓ Input tables Result tables	Export tables with details					
Ø	OK Cancel					

Figure 7.11: Dialog box *Export of Tables*

When you have selected the relevant data, you can start the export with [OK]. Excel will be started automatically, that is, you do not need to open the programs first.

FIL		· ·	· ·				Sheet1 - Excel ? 📧 🗕 🗆	×
	LE	HOME	INSERT	PAGE	LAYOUT F	ORN	IULAS DATA REVIEW VIEW	
Past Clipt		B .	I <u>U</u> -	- 10 - ♪ ont √ .fx	· • • •		Image: System state st	~
	А	В	С	D	E	F	G	
1	Section	Member	Location	Load-	Design			
2	No.	No.	x [m]	ing	Ratio		Design According to Formula	
3	1	H HW 125	×125 GB/T 1	11263-2010	- Upright			
4		313	0,000	C01	0,09	≤1	102) Cross-section check - Compression acc. to 8.7.5	
5		312	0,000	CO1	0,00	≤1	110) Cross-section check - Torsion	
6		303	0,000	CO1	0,02	≤1	121) Cross-section check - Shear capacity - Load parallel to the web acc. to 8.2.1	
7		307	0,000	C01	0,00	≤1	123) Cross-section check - Shear capacity - Load parallel to the flange acc. to 8.2.1	
8		303	0,000	C01	0,00	≤1	126) Cross-section check - Shear buckling acc. to 8.4.6 and App 8.3	
9		311	0,425	CO1	0,04	≤1	181) Cross-section check - Bending about y axis, shear and axial force acc. to 8.8 or 8.9.1 - Class 1 or 2	
0		314	0,425	CO1	0,06	≤1	201) Cross-section check - Bending about z-axis, shear and axial force acc. to 4.8.2.2 or 4.8.3.2 - Class 1 or 2	
11		307	2,975	C01	0,31	≤1	221) Cross-section check - Biaxial bending about y and z-axis, shear and axial force acc. to 8.8 or 8.9.1 - Class 1 or 2	
2		307	0,000	C01	0,34	≤1	341) Stability analysis - Buckling and bending about y and z-axis acc. to 8.9.2	
3		307	0,000	CO1	0,39	≤1	351) Stability analysis - Buckling about z-axis and bending about y and z-axis with lateral torsional buckling acc. to 8.5	
4					000		354) Shehility analysis - Bending and compression acc. to 6.3.3, Method 2	-
-	() -)	2	.1 Design	by Load (Case 2.2 D	esig	n by Cross-Section + : •]
READ	DY							6

Figure 7.12: Results in Excel



[1] Code of Practice for the Structural Use of Steel. Building Department, Hong Kong, 2011.

Index

В	
Background graphic 4	4
Beam type 2	6
Buckling 1	9
Buttons	3

C

L
Calculation
Cantilever
Clipboard
Close RF-/STEEL HK
Color bars
Color scale
Comment
Control panel
Cross-section
Cross-section class
Cross-section design
Cross-section info
Cross-section library
Cross-section optimization
Cross-section type

D

Decimal places	
Deformation analysis	
Design	8, 33, 34, 35, 37
Design case	
Design colored	
Design ratio	
Design situation	
Detailed settings	
Display navigator	45, 48, 49

Е

-	
Effective length	21
Effective Length Factor	20
Elastic critical moment for LTB	28
Equivalent member length	18
Equivalent Uniform Moment Factor	20
Excel	58
Export	58
Export cross-section	56
Export material	58

F

Favorite	5
Filter	9
Filtering members 4	9
Flexural buckling	9

G

-
General data7
Go to module window7
Graphic printout
Graphics

Н

Hidden result diagram

I

Installation	
Intermediate lateral restraints	
Internal forces	

L

Lateral restraint	17
Lateral-torsional buckling	7,20
Length 1	8,41
Limit values	29
Load application	28
Load case	9, 10
Load combination	9
Loading	38
Location x	34

М

Material 11, 58
Material description
Material library 12
Material properties
Maximum deflection
Member hinge
Member slenderness
Members
Module windows

Ν

Navigator	7
Nodal support)

0

Open RF-/STEEL HK		ł
-------------------	--	---

Optimization 14, 31, 55, 56

Ρ

Panel	46, 48
Parametric cross-section	55
Part	41
Parts list	41, 42
Precamber	26
Print	51
Printout report	52, 58
Program start	4

R

Reference length 10
Relatively
Remark
Rendering
Result combination
Result diagrams
Result values
Result window
Results evaluation 43
Results representation 45
RF-STABILITY
RFEM/RSTAB graphic
RSBUCK

S

Serviceability	43
Serviceability limit state	26
Set of members 8, 21, 22, 25, 26, 36, 39,	42
Shifted member ends	30
Slenderness	40
Special cases	29

Stability analysis19, 28, 35Stability design29Stainless steel12Start calculation32Start program4Stress point16Structure type29Sum42Surface area41

B

т

Taper	7
Torsion	9
Transverse load	8

U

Ultimate limit state	. 8, 27, 43
Undeformed system	
Units	11, 57
User profile.	

V

View mode	44
Visibility	48
Volume	42

Х

x-Location			34, 38
------------	--	--	--------

W

Warp spring
Weight
Work window