



EasyFix

Design solutions worth your while

Case study

User Manual

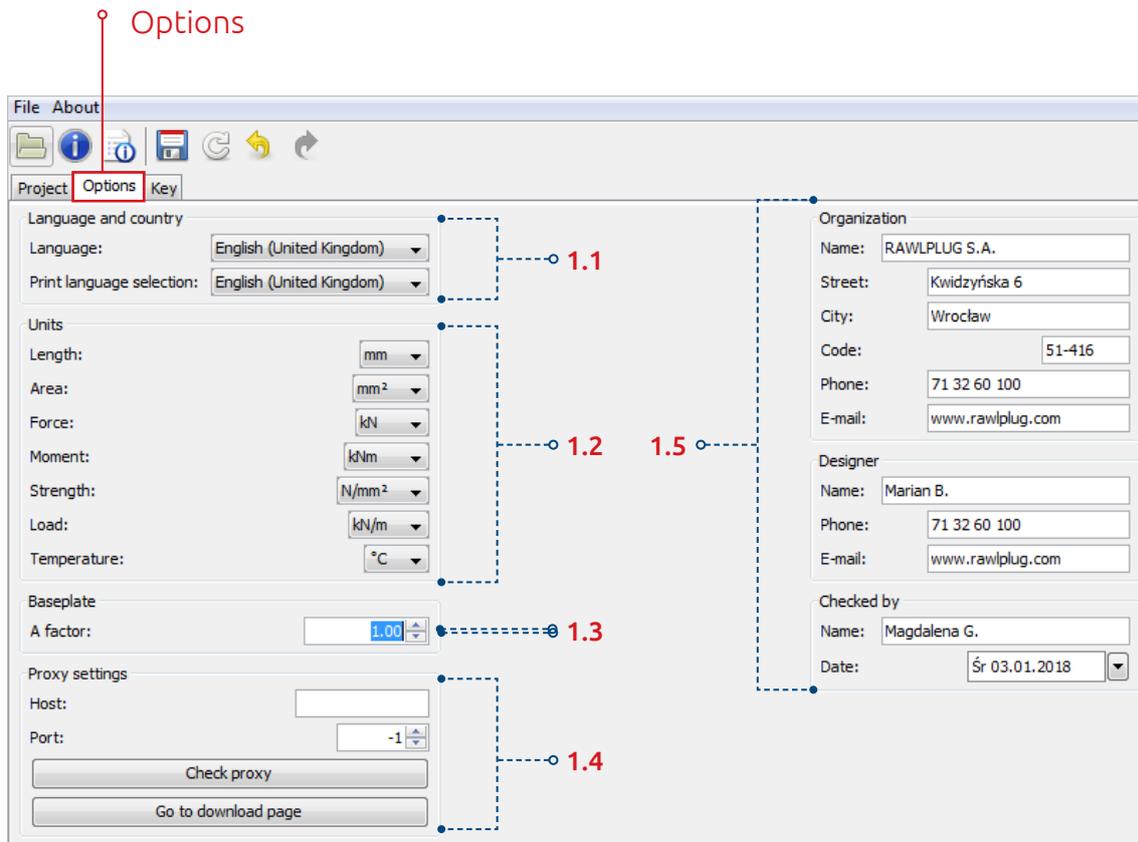
Case STUDY

EasyFix

CASE STUDY. Calculations for application of chemical anchors in a model multi-bay shopfloor using the EasyFix PRO application from Rawlplug.

This case study provides a detailed description of individual actions as well as capabilities of the EasyFix PRO program from Rawlplug, and more specifically – the CONCRETE module used to calculate the type and the number of chemical anchors intended for a multi-bay shopfloor.

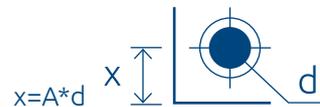
EASYFIX



Once you open the program, it displays the start window with 2 tabs available: PROJECT and OPTIONS. The Options tabs is where you can configure various settings affecting all the program's modules.

- 1.1** As you start the application for the first time, it will display its content in the pre-set language matching your computer's default language, but you can obviously change the language, and after saving this setting, the program will restart in the chosen language version. The same applies to the print-out language, but you should keep in mind that the main working language and the language used for printing may differ. For example, you can use English to handle the program, while at the same time results will be printed and sent out in a different language. The print-out language can also be changed directly before sending the given document to printing.
- 1.2** You can also define units to be used by the program in calculations. Both metric and imperial units are available for dimensions as well as load.

- 1.3** You can change the factor which determines the distance between the anchor and the fixture edge, while the default value is 1.5.

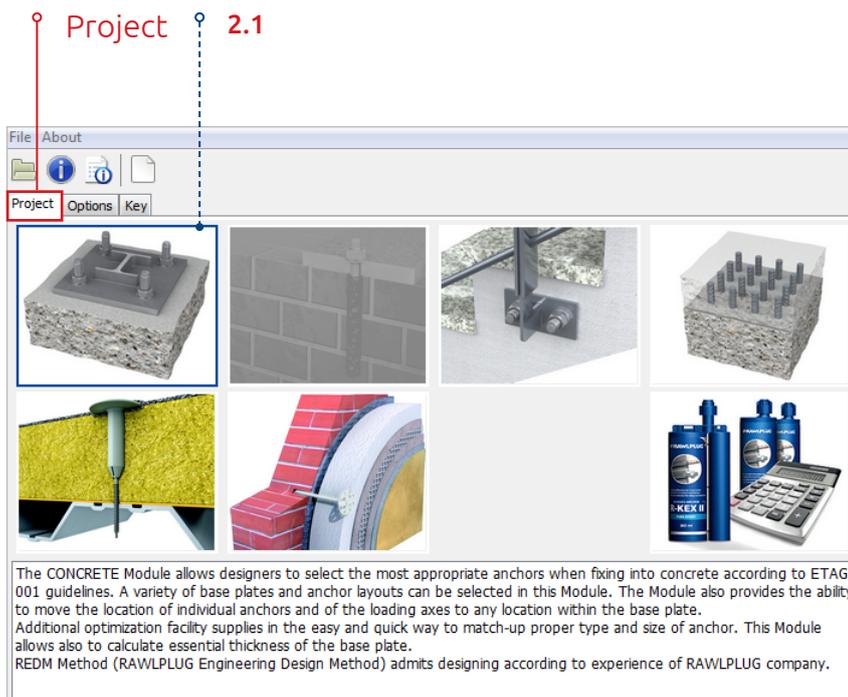
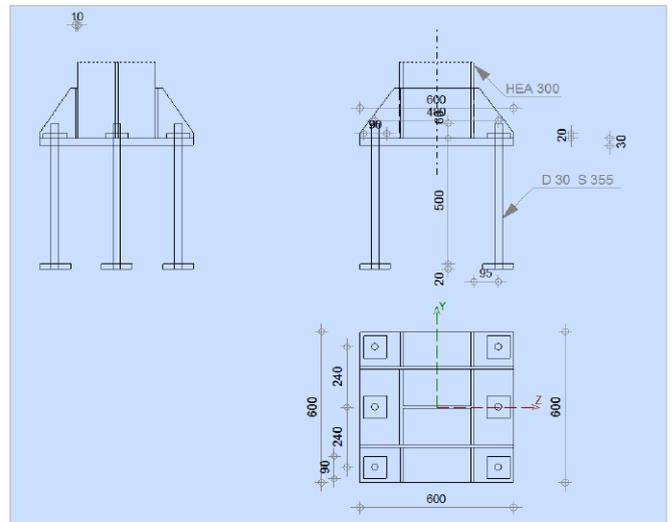


- 1.4** There is also a section containing Internet settings, including a function of automatic program updating to the latest version released by Rawlplug.
- 1.5** The right-hand side of the screen is where you can find text fields enabling entry of user-specific data, such as the name of the company for which the design is being created or your e-mail address. Please keep in mind that the data will not be saved unless you do it by clicking the Save icon.



The model design we are discussing includes both primary and secondary columns of the hall. It is also assumed that they are to be made of the HEA sections: the secondary columns of type HEA 220, and the primary ones of type HEA 300 sections. The fixture will be made of 20 mm thick steel, its dimensions being 600 x 600 mm. The chosen fixings are hammer-set anchors, 30 mm in diameter and 500 mm in length. They should be arranged in 2 rows of 3 pieces.

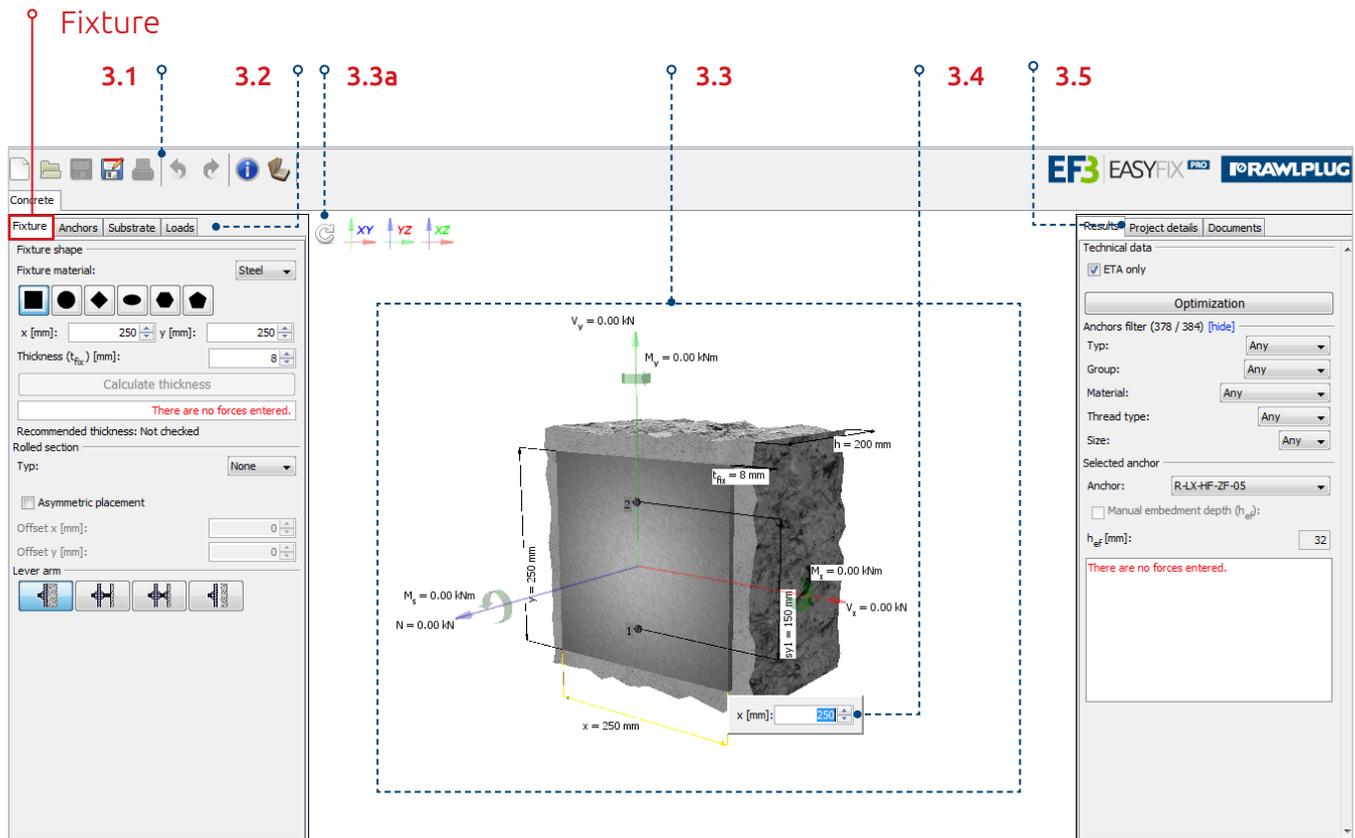
The designer's task is to conduct the calculations needed to replace mechanical anchors with bonded anchors. And the most convenient way to do it is to use the CONCRETE module of the EasyFix PRO calculation software from Rawlplug.



The PROJECT tab contains icons dedicated to individual calculation modules, while the OPTIONS tab enables you to enter data the program will save and apply repeatedly every time it is started, in every module that you decide to use.

2.1 In order to start the calculations, enter the PROJECT tab and double-click the base plate icon to open the CONCRETE module enabling you to calculate anchor parameters according to ETAG 001.





- 3.1** The top section of the window contains system icons, and starting from the left, they are used to:
- create a new project,
 - open an existing project previously saved,
 - save the outcomes of your work,
 - save the document to a separate file,
 - print results of your calculations,
 - undo the last action or redo it,
 - restore changes,
 - retrieve information about the current program version, including the program authors,
 - display the help window.

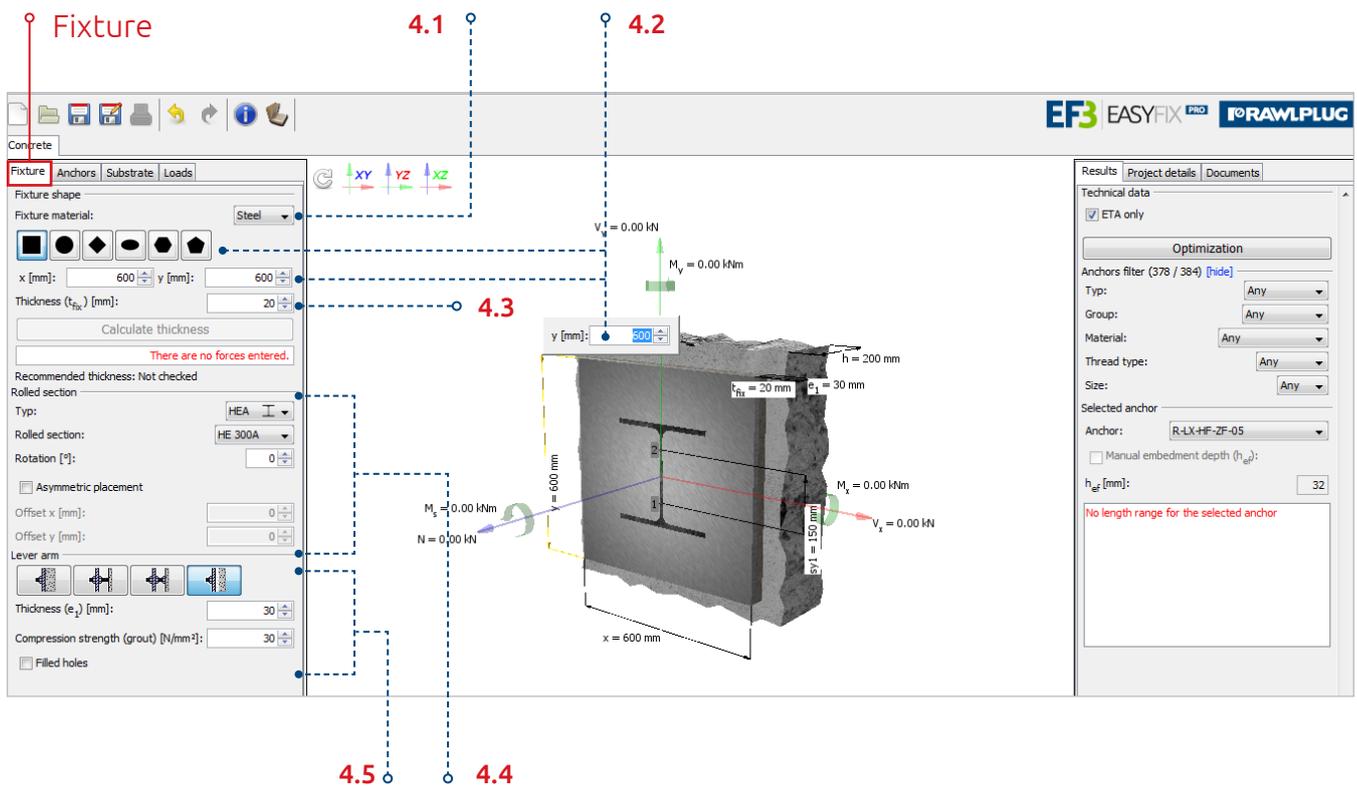
The program window consists of 3 sections. The data input section is on the left, the 3D model is displayed in the middle, while the right-hand section shows output date (results).

- 3.2** Input data have been grouped under four tabs: Fixture, Anchors, Substrate and Loads.

- 3.3** The middle section of the screen shows a 3D model for the object subject to calculations. You can rotate it to any chosen angle, as needed. You can also display it in planes corresponding to selected axes. Clicking the *Refresh drawing* icon (3.3a) allows you to return to the drawing's original view.

- 3.4** The model also enables you to enter all geometric dimensions and loads. Simply click the dimensional line corresponding to the given quantity to do it.

- 3.5** The right-hand section of the screen contains further 3 tabs: Results, Project Details (containing some of the data already entered in the OPTIONS tab) and Technical Library. The latter enables you to download approvals, technical datasheets or drawings of selected anchors in .dwg files.

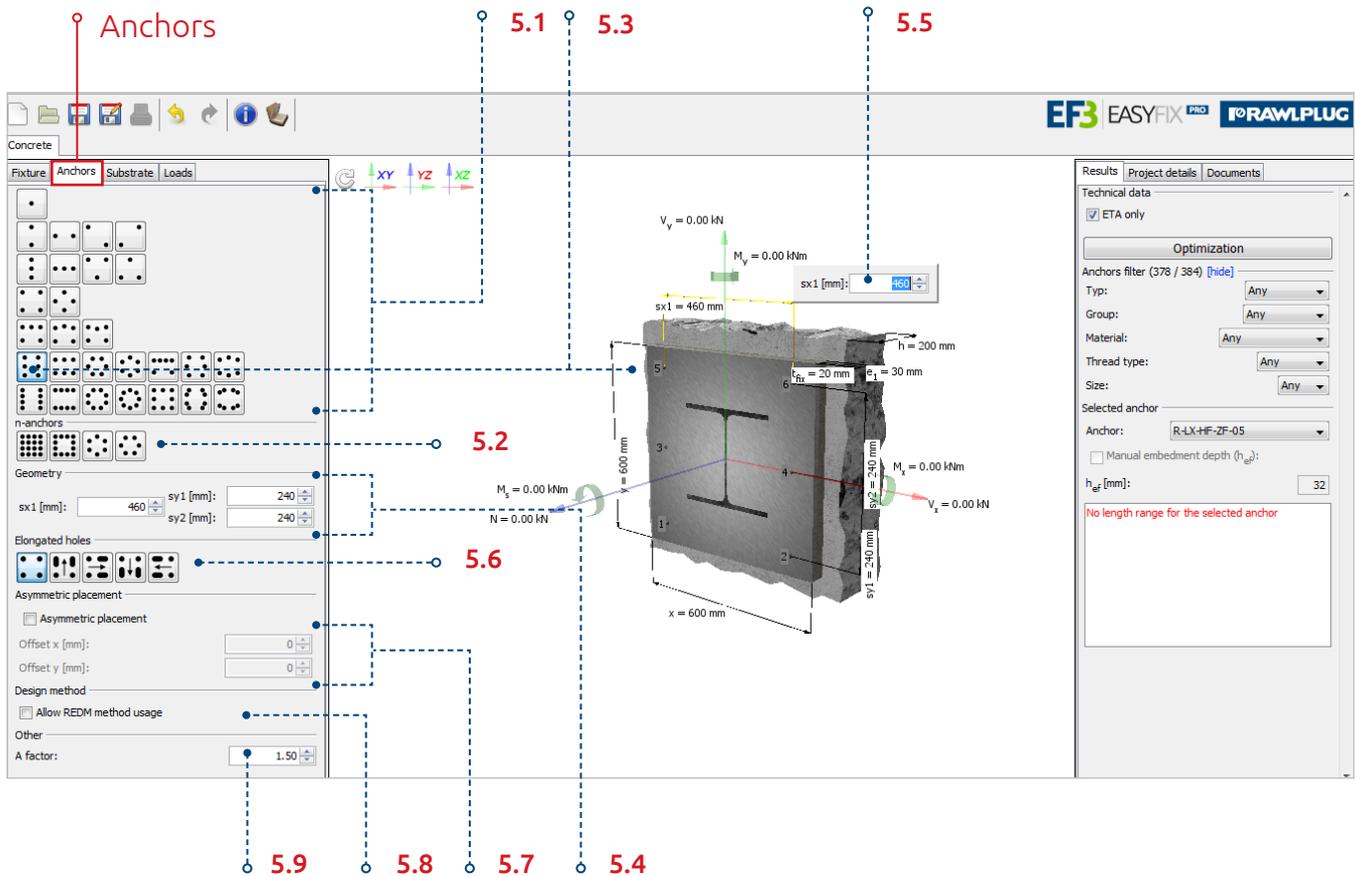


You begin proper calculations by entering the fixture data.

- 4.1 You can choose between steel or wood for the fixture material. Steel has been selected in this case.
- 4.2 You select the fixture shape then. This feature also enables you to choose from several options of the most popular shapes, and the square shape has been selected for the case studied. Another step is to enter the fixture dimensions – 600 mm in this example – and confirm them by pressing the *Enter* button. They will be automatically transferred to the computational model. However, you can also enter these data items directly in the model. Just click the right dimension line, enter the value of 600 and press *Enter* to confirm it. A drawing thus configured may extend beyond the display window, so you need to scale it down by clicking the *Refresh drawing* icon.
- 4.3 Lastly, you must define the fixture thickness – let it be 20 mm in this case. It is also possible to optimise the fixture thickness, but this feature is only available after a complete set of data has been entered, including data of rolled sections, loads and anchors.

- 4.4 To define the rolled section parameters, select its type (HEA section in this case) and size (300 mm). You can also freely rotate the chosen section against the fixture by entering the angle value. It will be rotated automatically. In this case, the section is positioned perpendicularly to the fixture edge, hence the value of 0. Moreover, you can also place the section asymmetrically.
- 4.5 Another step is to define the optional offset for fixing. The program's default setting is no offset, but you can define it in diverse optional configurations: without clamping and with or without piece rotation, with clamping and with or without piece rotation, and with grouting. Clicking the latter icon will display an additional section where you can set the grout's compression strength and decide whether to fill the holes between the fixture and the anchors, which exerts direct impact on the anchor stress intensity on shearing force in the setup with grouting. In the case studied, neither grouting nor stand-off has been defined.





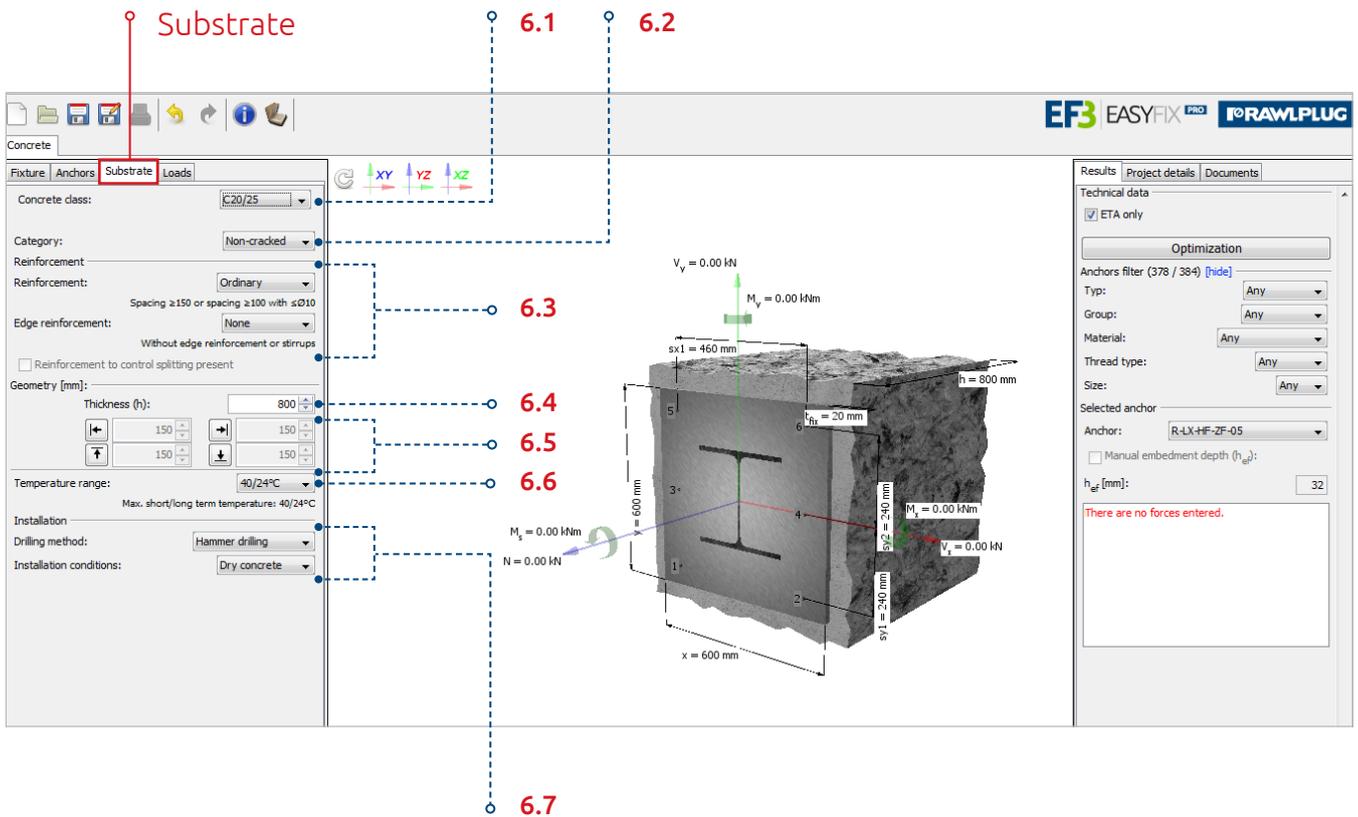
Go to the ANCHORS tab.

- 5.1** This section enables you to decide about the anchoring layout.
- 5.2** What is particularly important, the application allows you to declare any chosen number of anchors, arranged in any number of rows, in either rectangular or circular layout, in which case you should enter all distances between adjacent anchors.
- 5.3** In this example, there are two rows of 3 anchors, which is one of default layouts. Once you confirm it, the computational model is updated accordingly.

What other actions can you perform at this stage of design work?

- 5.4** Firstly, you can move anchors against one another and against the fixture. The spacing between anchors in our case is 240 mm.
- 5.5** Secondly, you can enter the relevant data directly on the drawing after first marking appropriate dimension lines. The spacing between rows of anchors will be 460 mm.

- 5.6** Thirdly, there is an option to introduce elongated or bean-shaped (oval) holes along the chosen fixture edges. This will prevent the given row of anchors from transferring shearing forces towards the edge. There are no edges in the case studied, and so this option remains disabled.
- 5.7** Fourthly, the application allows you to distribute anchors asymmetrically against the fixture.
- 5.8** Fifthly, even though ETAG 001 has set a limitation on the number of standard anchor models that can be directly calculated, EasyFix allows you to apply our proprietary engineering method known as REDM (Rawlplug Engineering Design Method) making it possible to perform direct calculations in virtually any chosen layout of anchors. Checking the corresponding box will allow you to calculate non-standard layouts that you find necessary in your design project.
- 5.9** Sixthly, you can change the A factor value pre-set in the Options tab.



6.1 Another tab is SUBSTRATE, where you can select the concrete class as per the relevant European standards. The concrete class chosen for this example is C25/30. It is also possible to define a custom concrete class by entering a specific compression strength value corresponding to non-standard concretes.

6.2 You may choose between two concrete categories: either cracked or non-cracked, the latter being the choice made in the case studied.

What other features are available in the SUBSTRATE tab?

6.3 You can choose the reinforcement type between the ordinary and the concentrated option. There is no reinforcement in this example. You can also select edge reinforcement options: either straight or with stirrups, but in this case, no such reinforcement has been assumed.

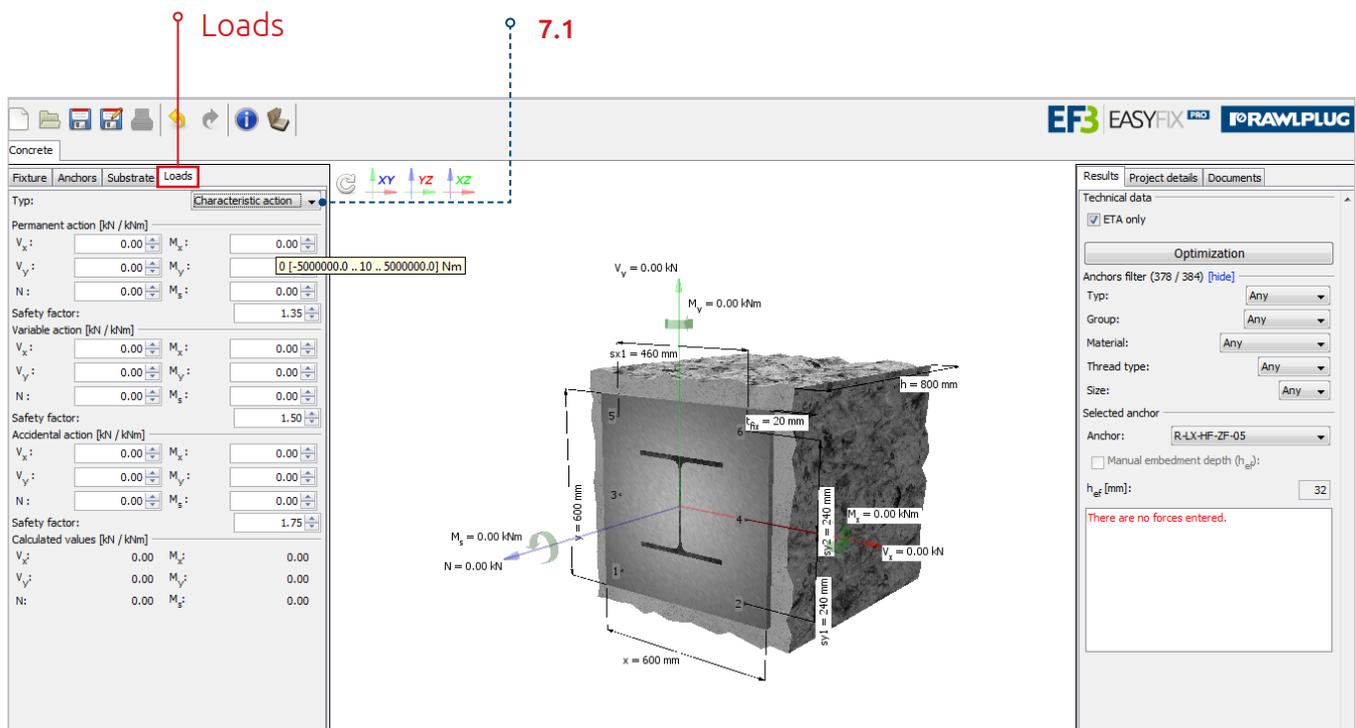
6.4 The application allows you to define the substrate thickness, which is 200 mm by default, but you may well enter any value that you find suitable, e.g. 800 mm.

6.5 In order to define edges, just click the corresponding icon, and the structure will automatically change into spot footing. This is also a stage at which you can enter values of distance between the edge of concrete and the nearest anchor rows, e.g. 300 mm. What you are dealing with in this project is a foundation slab, and so there are no edges and they have no effect on the load capacity of anchors.

6.6 You can also specify the range of operating temperatures for both short- and long-term variant; let it be 40/24°C in this case.

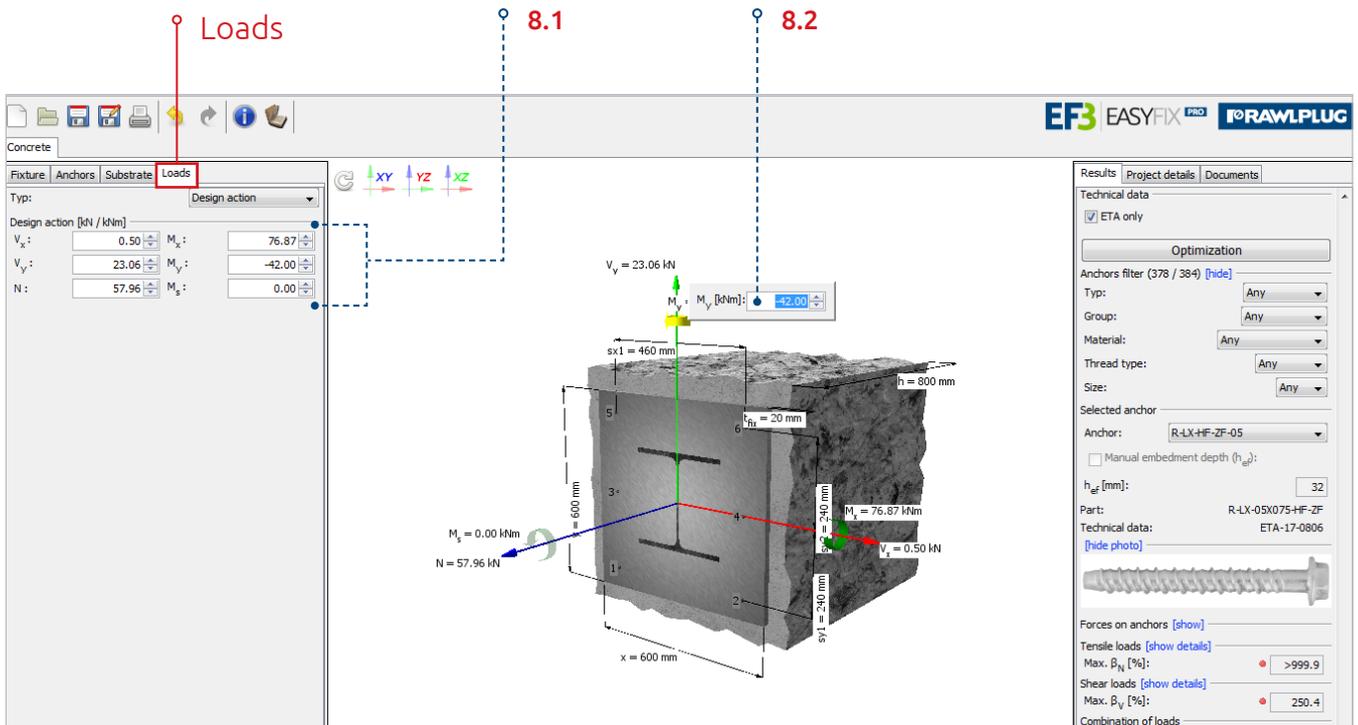
6.7 Another possible operation is making a choice of the installation method, where you may define both the drilling method and the installation conditions. The available drilling method options are: hammer drilling, diamond drilling and drilling with automatic suction cleaning, while the installation conditions to choose from are: dry or wet concrete, flooded holes or contact with sea water. The configuration chosen for this case is hammer drilling in dry concrete.





7.1 Another tab, i.e. LOADS, allows you to choose between design or characteristic loads. Having selected the characteristic loads, you can enter custom safety factors for each load type: either permanent, variable or accidental, making the program convert them into calculated values and apply them all at once in the computational model in further steps of the procedure.

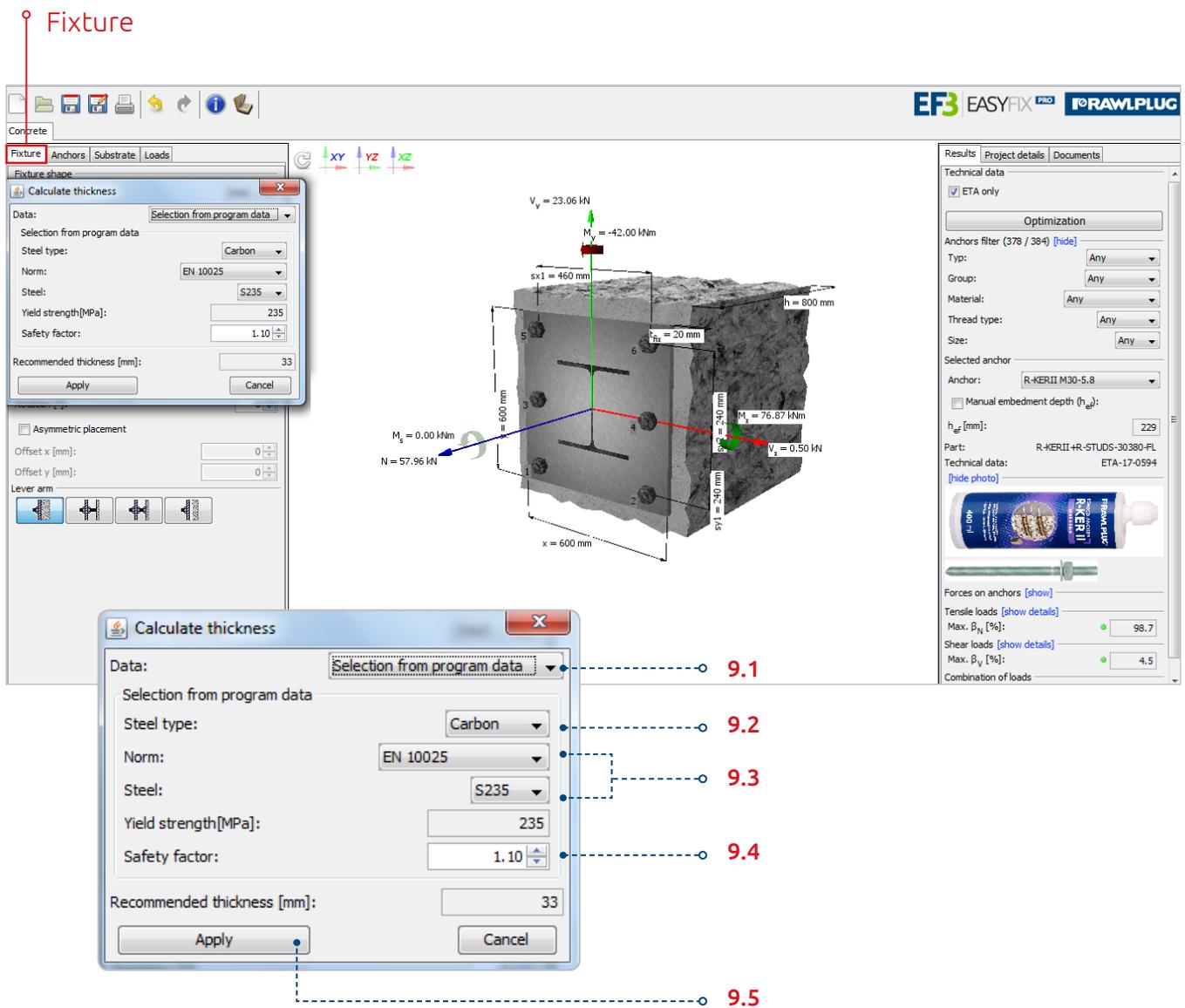




In the case studied, the design loads have already been calculated using a separate program for static calculations, so you only need to enter design load values in the tab.

- 8.1** You can also enter the load values directly on the drawing by clicking the relevant force or moment vectors, e.g. the pulling force of 57.96 kN. This can also be done in the Loads tab. Let's enter shearing forces: V_x of 0.5 kN and V_y of 23.06 kN.
- 8.2** The same applies to moments, which you can enter either on the model, e.g. M_x of 76.87 kNm, or in the Loads tab. $M_y = -42$ kNm. There is no torsional moment in this example, so the respective value remains zero.

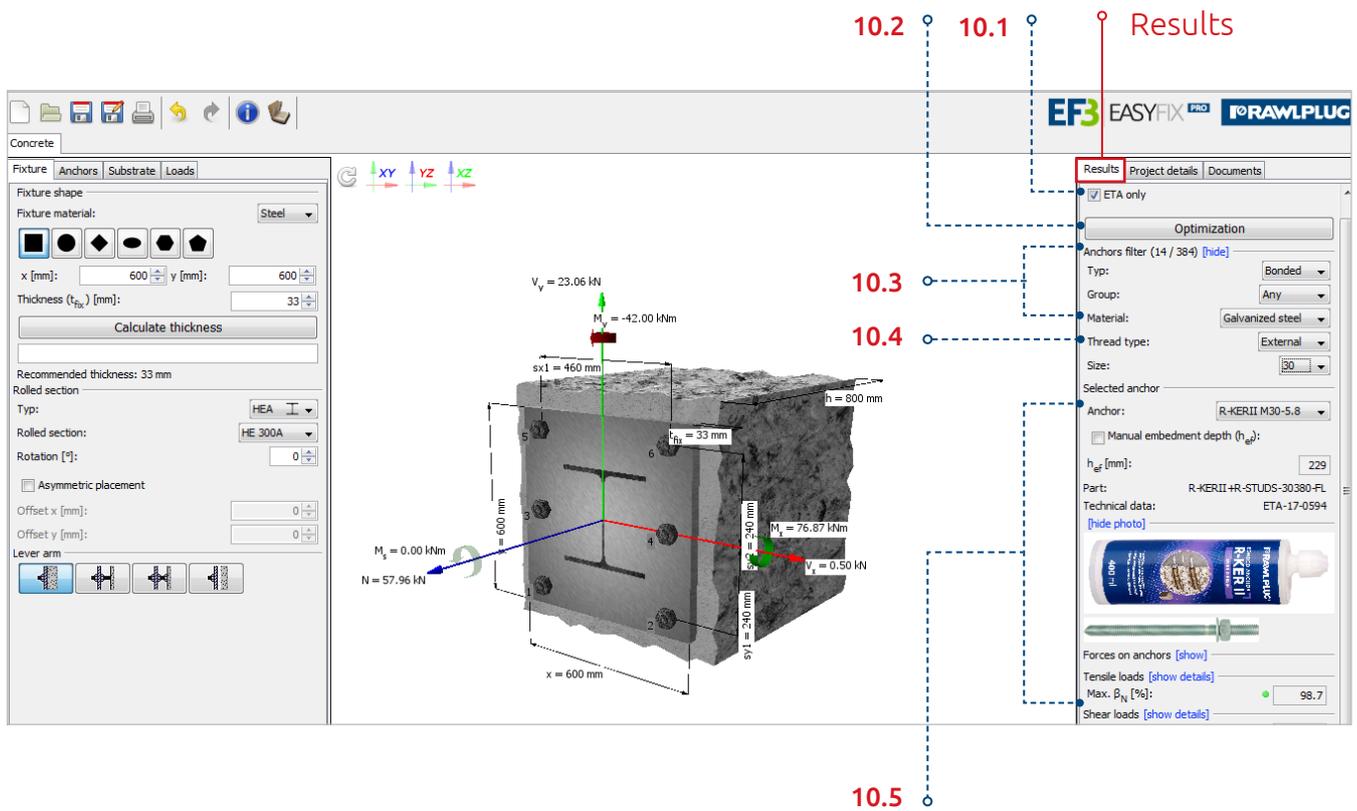




The program has already performed automatic calculations at this point, but before proceeding to the RESULTS tab, you had better return to the FIXTURE tab in order to make use of an option mentioned at the beginning. The application enables you to calculate the fixture slab thickness. And since you have entered all the required data, you can use this option.

- 9.1 Having clicked the *Calculate thickness* button, you can either choose to use the program data, or the user-defined data. The program data have been chosen this time.
- 9.2 There is more, since you can also choose steel type: either carbon or stainless steel, the former being the option set for this case study.

- 9.3 The program also enables you to choose the relevant standard, and what applies to this model project is a European Standard and steel grade S235.
- 9.4 Also safety factor can be altered, and the value of 1.15 has been set for this project. Clicking *Calculate* initiates calculation of the recommended thickness – 35 mm.
- 9.5 And since the thickness assumed in the project was 20 mm, you can change this parameter and confirm it by clicking the *Apply* button, whereupon the altered value will be automatically entered into the computational model.



It is time to enter the RESULTS tab.

10.1 The option enabled by default is *ETA only*, which means that the application only uses data provided in European Technical Approvals. If you uncheck the corresponding box, the program can also use Rawlplug Advanced Design (RAD) data which go beyond those contained in ETAs. The sources of these data are the approval tests (value rounding excluded) arising from ETAG or Rawlplug's in-house tests.

You can apply different filters to the results.

10.2 However, you can also make the right choice in another way, and this is where the *Optimisation* option comes in handy.

10.3 Basic filters enable you to choose the anchor type, and bonded anchors have been selected for this case study. In the next step, you can make a selection from among the available resins, as you find appropriate, and the anchor rod material, e.g. galvanized steel.

10.5 You can also define the thread type: either external or internal, and its size. And since the original project assumption was to apply anchors of 30 mm in diameter, the option to be chosen from the list of available sizes is M30.

10.5 Consequently, the application recommends you use the R-KER resin with an M30 rod made of the 5.8 steel, with a positive result and the total stress intensity ratio of 85.9%.



The screenshot shows the EASYFIX PRO software interface. On the left, there are configuration panels for 'Fixture shape', 'Thickness', and 'Lever arm'. The main area contains a table of anchor data. On the right, there is a 'Results' panel with various filters and technical data.

Table Data:

Anchor	OK	Utilisation	h_{ef} [mm]	Warnings	Typ
R-KERII M30-5.8	●	86.0	229	●	Bonded
R-KERII M30-5.8	●	87.1	226	●	Bonded
R-KERII M30-8.8	●	86.0	229	●	Bonded
R-CAS M30-5.8	●	86.4	270	●	Bonded
R-HAC M30-5.8	●	116.4	270	●	Bonded
R-CAS M30-8.8	●	86.4	270	●	Bonded
R-KEXII M30-8.8	●	87.1	226	●	Bonded
R-KEMII M30-5.8	●	86.3	308	●	Bonded
R-KEMII M30-8.8	●	86.3	308	●	Bonded
R-HAC M30-8.8	●	116.4	270	●	Bonded
R-KER M30-5.8	●	86.2	311	●	Bonded
R-KER M30-8.8	●	86.1	311	●	Bonded
R-KF2 M30-5.8	●	-	-	●	Bonded
R-KF2 M30-8.8	●	-	-	●	Bonded

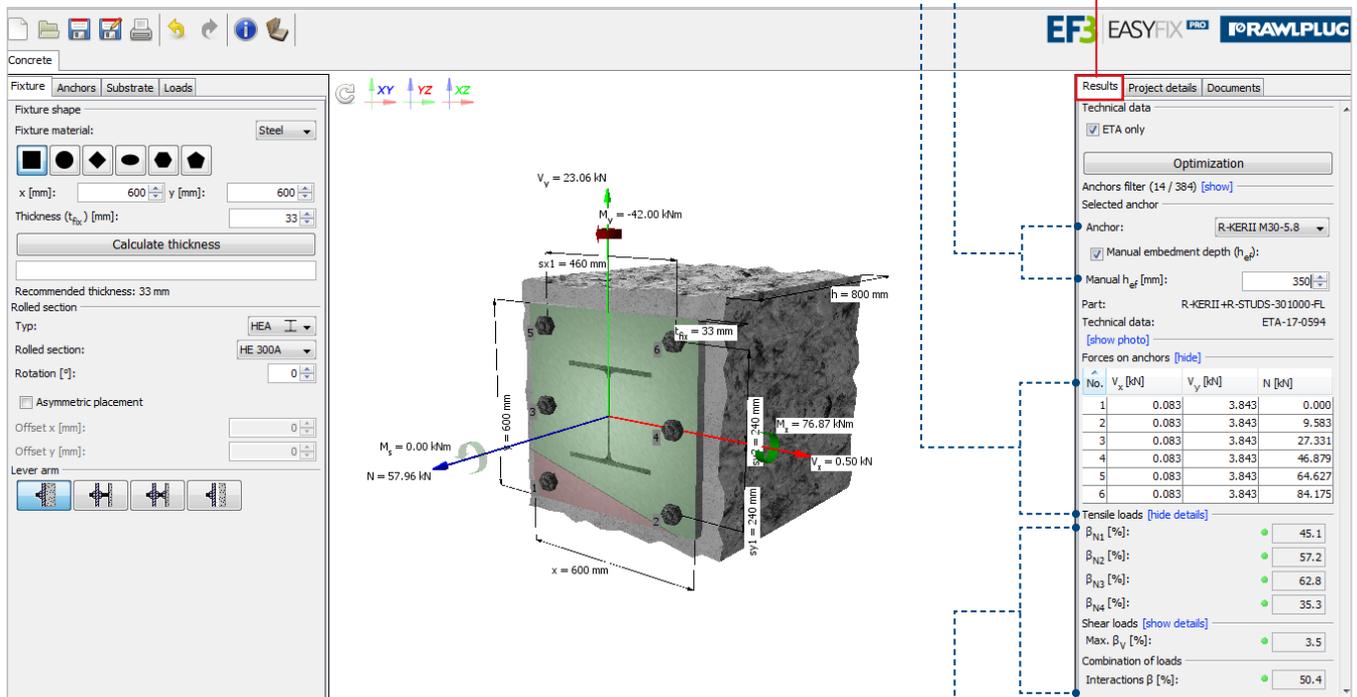
Results Panel Data:

- Technical data: ETA only
- Material: Galvanized steel
- Size: 30
- Selected anchor: R-CAS M30-5.8
- Part: R-CAS+R-STUDS-30380
- Technical data: ETA-10-0108
- Forces on anchors:
 - Tensile loads: Max. β_v [%]: 99.8
 - Shear loads: Max. β_v [%]: 3.9
 - Combination of loads: Interactions β [%]: 86.4

At this point, the program provides you with access to a table containing data of all anchors meeting the conditions that match the filters applied.

11.1 Moreover, the list may be limited to anchors offering stress intensity ratio of less than 100%.

11.2 Should you choose a different anchor than the recommended one, the data displayed in the RESULTS tab, and so the anchor itself, will change automatically.

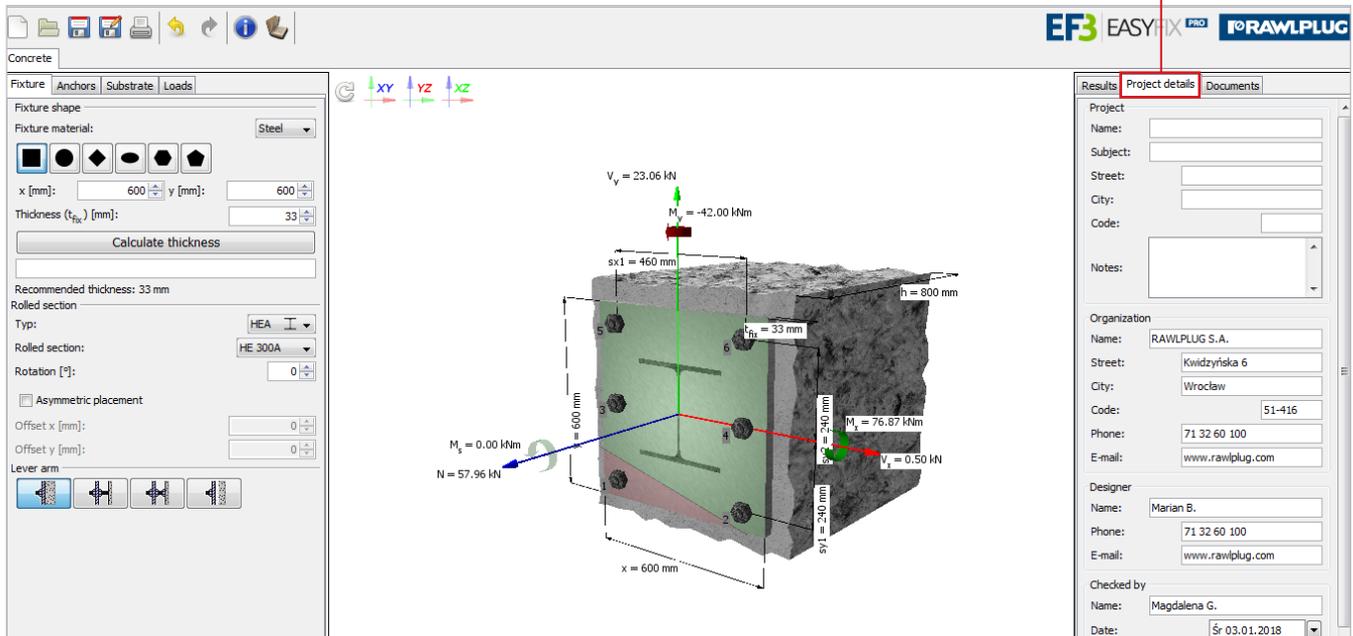


What other features are available in the RESULTS tab?

- 12.1 With bonded anchors, you can manually impose the embedment depth. Just check the box and enter the user-defined value, e.g. 350 mm. In this case, the combined stress intensity ratio has dropped to 73.5%.
- 12.2 By refreshing the model, you can see how loads affect individual anchors and how the neutral axis has been routed.
- 12.3 You may also display details of loads.



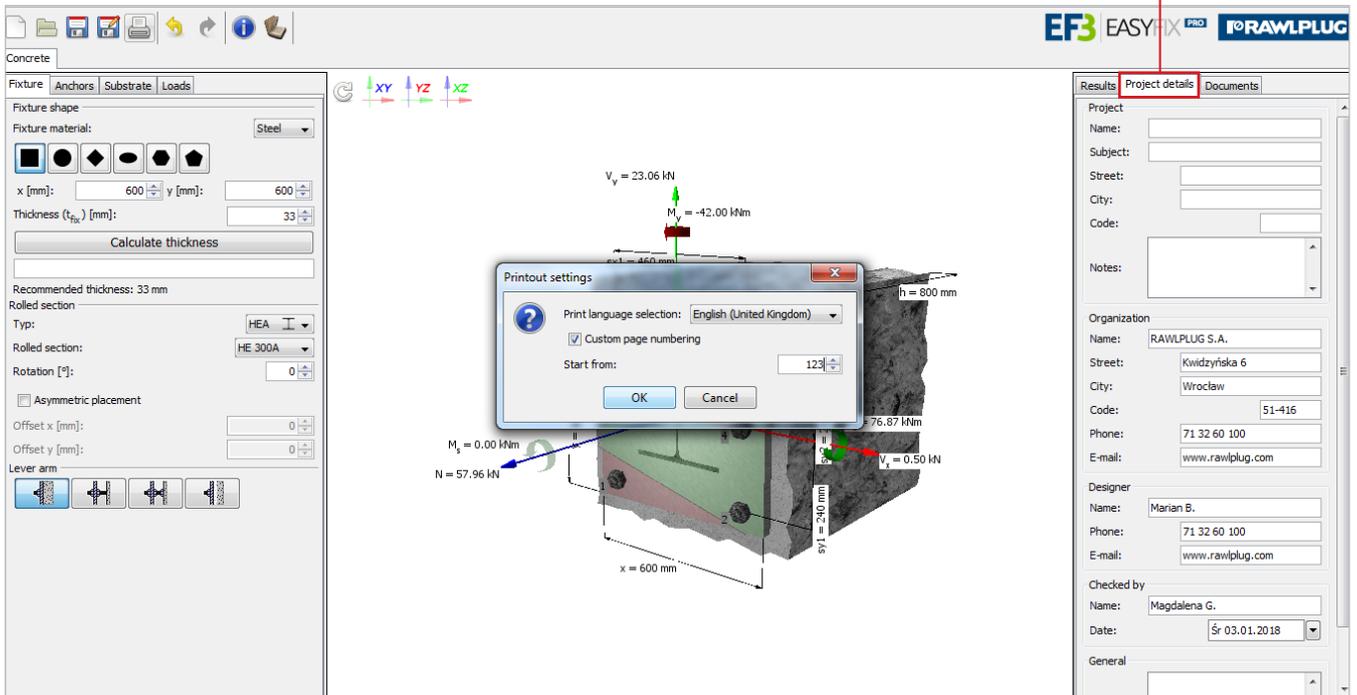
Project details



- The program allows you to print out a sample calculation report. However, at this point, you should navigate to the PROJECT DETAILS tab and enter project description data to be included in the print-out, for instance the project name and subject.



Project details



14. If you don't, the application will remind about once you have clicked the print icon, however, it is not mandatory. Just as a reminder – you can change the print-out language in options, and it does not have to be identical to the project language.



RAWLPLUG EasyFix PRO ver. 3.3.6

Project: 20/01/2018 Page: 1/4
 Subject: RAWLPLUG S.p.A.
 Address: Kavolizade 6, 51416 Wrocław
 Designer: phone: 71 32 60 100 e-mail: www.rawlplug.com

Input data

Anchor type and size: R-KERIT-R-STUDS-301000-FL
 High performance resin for use with metric threaded rods - 1000 (class 8.8)

Nominal depth b_n : 350 mm ($b_n = 350$ mm)

Base material: Non-cracked concrete (C20/25) temp. short/long 40/24°C

Reinforcement: Spacing 2100 or spacing 2100 with SB10

Longitudinal edge reinf.: Without edge reinforcement or stirrups

Installation: Hammer drilling, installation conditions: Dry concrete

Lever arm: None

Baseplate: Baseplate (L = 400, W = 400 mm)
 Declared thickness $t_b = 33$ mm
 Recommended thickness 33 mm
 Material: S235 (Ac. to EN 10025) f_y = 235 (MPa) vcl. 1.0

Roller section: RE 3008 (D=200, L=200 mm)

Proof: According to ETAG BOND, Technical Report EOTA TR029 and ETA-17-0594

Design action	
V [kN]	61.01 M [kNm]
V [kN]	23.06 M [kNm]
N [kN]	57.96 M [kNm]

National regulations, environmental and application conditions must be considered when designing the anchorage.

RAWLPLUG EasyFix PRO ver. 3.3.6

Project: 20/01/2018 Page: 2/4
 Subject: RAWLPLUG S.p.A.
 Address: Kavolizade 6, 51416 Wrocław
 Designer: phone: 71 32 60 100 e-mail: www.rawlplug.com

Resulting anchor forces

Anchor	Tension force [kN]	Shear force [kN]	Shear force x [kN]	Shear force y [kN]
1	0.000	3.844	0.083	3.843
2	2.583	3.844	0.083	3.843
3	27.331	3.844	0.083	3.843
4	46.879	3.844	0.083	3.843
5	64.027	3.844	0.083	3.843
6	84.175	3.844	0.083	3.843

Max. concrete compressive stress: 6.36 (N/mm²)

Tensile load (according to ETAG BOND and Technical Report EOTA TR029)

Steel failure	Combined pullout-concrete cone failure	Concrete cone failure	Splitting failure
$N_{t,Rk}$ [kN]	243.89	$N_{t,Rk}$ [kN]	330.67
$N_{t,Rk}$ [kN]	4.00	$N_{t,Rk}$ [kN]	10.10
$A_{s,Rk}$ [mm ²]	1,076,892.10	$A_{s,Rk}$ [mm ²]	1,195,900.00
$A_{s,Rk}$ [mm ²]	384,000.00	$A_{s,Rk}$ [mm ²]	384,000.00
$f_{t,Rk}$ [N/mm ²]	369.68	$f_{t,Rk}$ [N/mm ²]	42.00
$f_{t,Rk}$ [N/mm ²]	419.68	$f_{t,Rk}$ [N/mm ²]	419.68
$w_{t,Rk}$	1.00	$w_{t,Rk}$	1.00
$w_{t,Rk}$	1.00	$w_{t,Rk}$	1.00
$\alpha_{s,Rk}$ [mm]	0.10	$\alpha_{s,Rk}$ [mm]	0.10
$\alpha_{s,Rk}$ [mm]	2.14	$\alpha_{s,Rk}$ [mm]	2.14
$\alpha_{s,Rk}$ [mm]	95.65	$\alpha_{s,Rk}$ [mm]	95.65
$\alpha_{s,Rk}$ [mm]	1.41	$\alpha_{s,Rk}$ [mm]	1.41
$\beta_{s,Rk}$	1.00	$\beta_{s,Rk}$	1.00
$N_{t,Rd}$ [kN]	280.07	$N_{t,Rd}$ [kN]	355.68
$N_{t,Rd}$ [kN]	1.50	$N_{t,Rd}$ [kN]	1.50
$N_{t,Rd}$ [kN]	184.07	$N_{t,Rd}$ [kN]	170.20
$N_{t,Rd}$ [kN]	84.14	$N_{t,Rd}$ [kN]	232.60

National regulations, environmental and application conditions must be considered when designing the anchorage.

RAWLPLUG EasyFix PRO ver. 3.3.6

Project: 20/01/2018 Page: 3/4
 Subject: RAWLPLUG S.p.A.
 Address: Kavolizade 6, 51416 Wrocław
 Designer: phone: 71 32 60 100 e-mail: www.rawlplug.com

Shear load (according to ETAG BOND and Technical Report EOTA TR029)

Steel failure (without lever arm)	Steel failure (with lever arm)	Concrete pry-out failure	Concrete edge failure
$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]
$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]	$V_{s,Rk}$ [kN]
$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]
$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]	$A_{s,Rk}$ [mm ²]
$f_{t,Rk}$ [N/mm ²]	$f_{t,Rk}$ [N/mm ²]	$f_{t,Rk}$ [N/mm ²]	$f_{t,Rk}$ [N/mm ²]
$w_{t,Rk}$	$w_{t,Rk}$	$w_{t,Rk}$	$w_{t,Rk}$
$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]
$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]
$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]
$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]	$\alpha_{s,Rk}$ [mm]
$\beta_{s,Rk}$	$\beta_{s,Rk}$	$\beta_{s,Rk}$	$\beta_{s,Rk}$
$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]
$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]
$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]
$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]	$V_{s,Rd}$ [kN]

Combined tension and shear loads

$P_{t,Rk}$ [kN]	$P_{s,Rk}$ [kN]	α	Utilisation [%] = $P_{t,Rk} + P_{s,Rk}$
62.8	3.5	1.5	58.4

Utilisation 50.4% - correct connection

Warning

Responsibility for compliance with current standards lies with the user.

National regulations, environmental and application conditions must be considered when designing the anchorage.

15. Once you have confirmed the relevant prompt, the program starts generating a PDF file. The print-out sheet contains the following information:
- all the data previously entered, including the anchor type, anchoring depth, substrate type as well as fixture slab and rolled section parameters,
 - picture of the model with the neutral axis marked and a table of loads affecting individual anchors
 - table collating calculations results, including total load ratio, where in the case studied the latter value is 73.5%,
 - installation data, including an installation diagram.

RAWLPLUG EasyFix PRO ver. 3.3.6

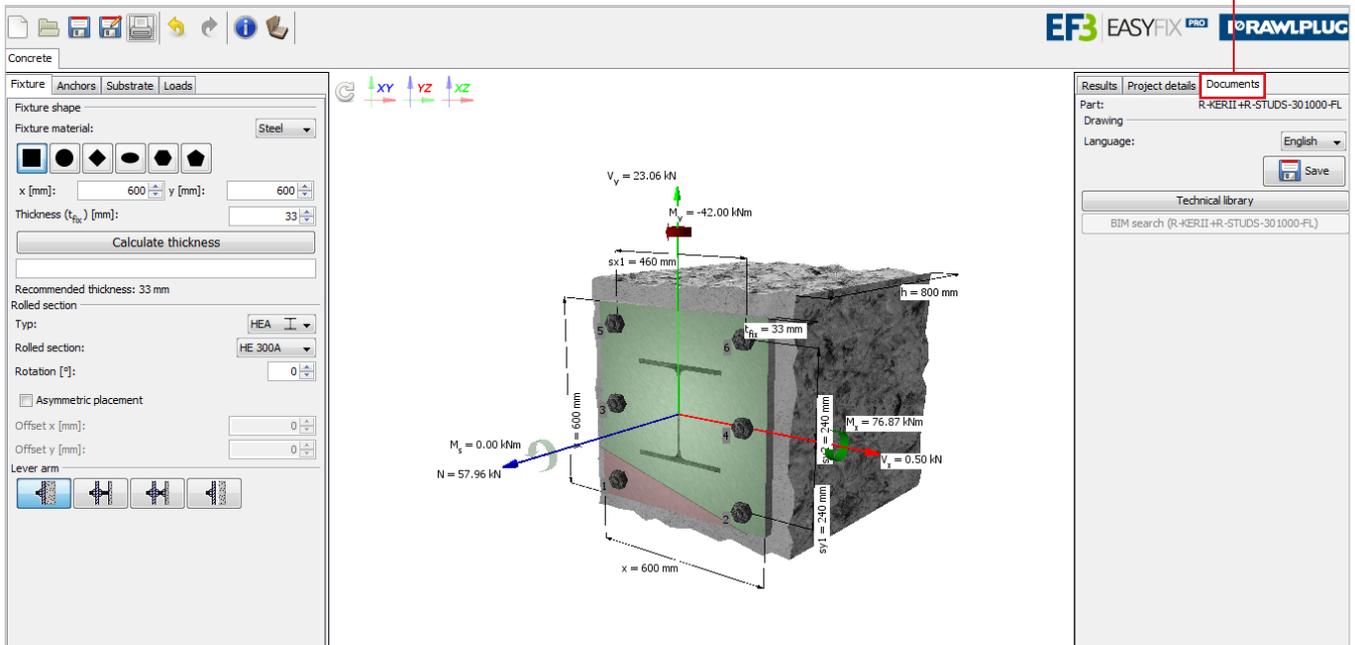
Project: 20/01/2018 Page: 4/4
 Subject: RAWLPLUG S.p.A.
 Address: Kavolizade 6, 51416 Wrocław
 Designer: phone: 71 32 60 100 e-mail: www.rawlplug.com

Installation data for R-KERIT-R-STUDS-301000-FL

Thread diameter	d [mm]	30.0
Hole diameter in substrate	d ₁ [mm]	35
Min. hole depth in substrate	h ₁ [mm]	350
Nominal depth	b _n [mm]	350
Min. substrate thickness	b _{min} [mm]	420
Installation torque	T _{inst} [N/m]	9.20
Anchor length	L [mm]	1,000
Fixture thickness	t _b [mm]	33
Hole diameter in fixture	d ₂ [mm]	32
Amount of resin per one mount	[ml]	163

National regulations, environmental and application conditions must be considered when designing the anchorage.





- The DOCUMENTS tab allows you to download technical data from the library, including technical approvals or drawings in the .dwg format. It can be done at any time.

And this is it. We hope that both the user manual and the case study instructing you on the use of the EasyFix program from Rawlplug have encouraged you to make the best of this application as well as clearly explained its scope and operating principles. If you have any doubts or questions, you are welcome to contact Rawlplug's Technical Department via rawlplug.com.



EasyFix