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Tutorial Series

Shaft Calculation - Starter Basics
Simple Shaft

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1. Software Version

This tutorial was created with MESYS Shaft Calculation version 12-2024, dated 07/12/2024.

2. MESYS Shaft Calculation Package – Strengths & Capabilities

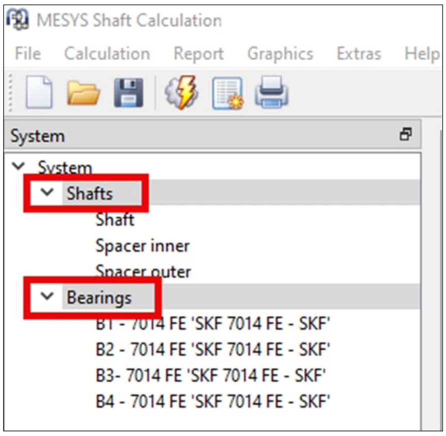

Figure 1

The basic version of this software essentially consists of the MESYS shaft calculation tool with the integration of MESYS Rolling Bearing Calculation, according to example figure 1.

To realize and consider the capabilities of MESYS Shaft Calculation, we strongly invite you to visit the MESYS website on the dedicated page for Shaft Calculation.

Please also take a look at the corresponding articles for shafts under Home/Downloads/Categories/Shafts according to figure 2:

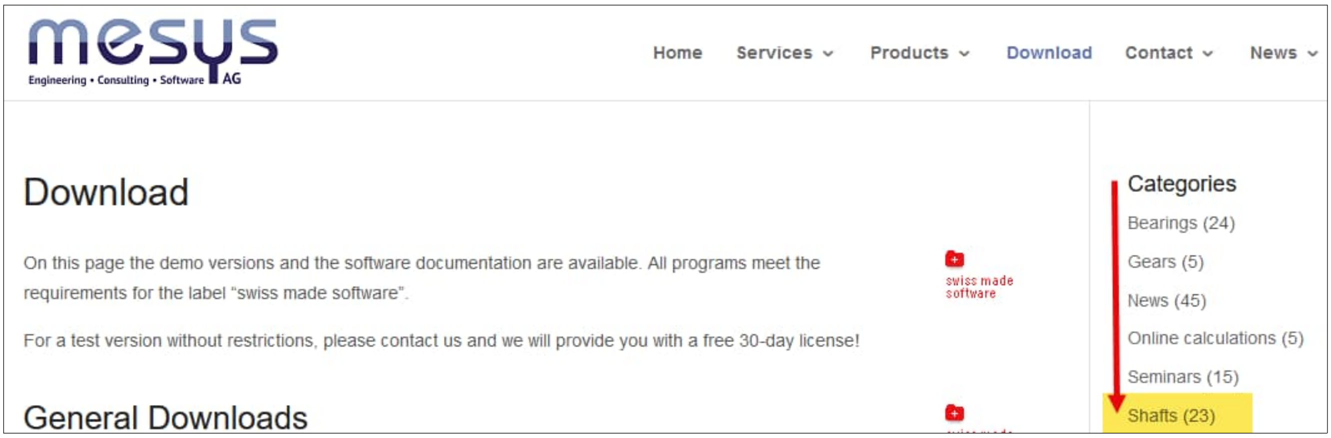

Figure 2

3. Software Manual

3.1 Manual online & under F1

In addition to the Online address via the MESYS download page, the software manual can also be accessed via the user interface by selecting the 'Help' menu under 'Manual F1':

At any point – you can open the Software Manual locally with specific content directly via your keyboard F1.

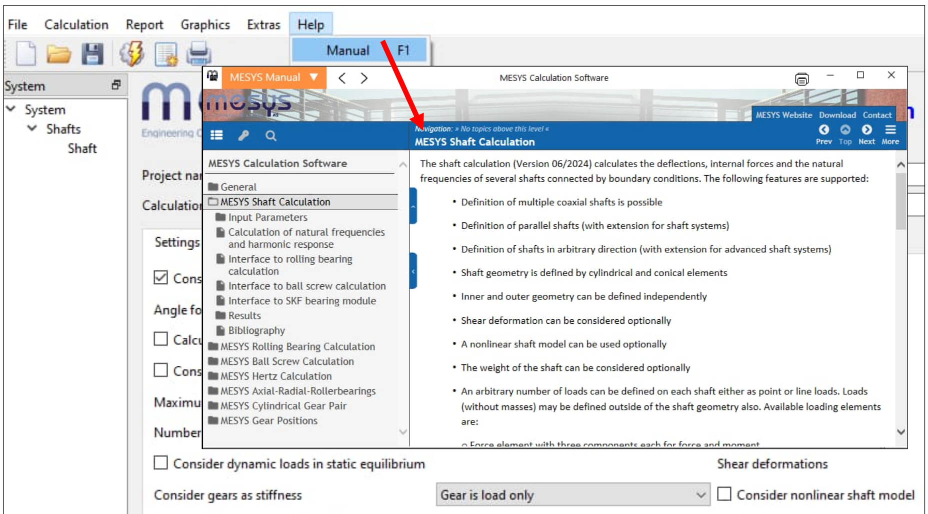

Figure 3

3.2 Manual as PDF

The Software Manual can also be found in all current languages as a pdf in the MESYS installation directory (fig. 4).

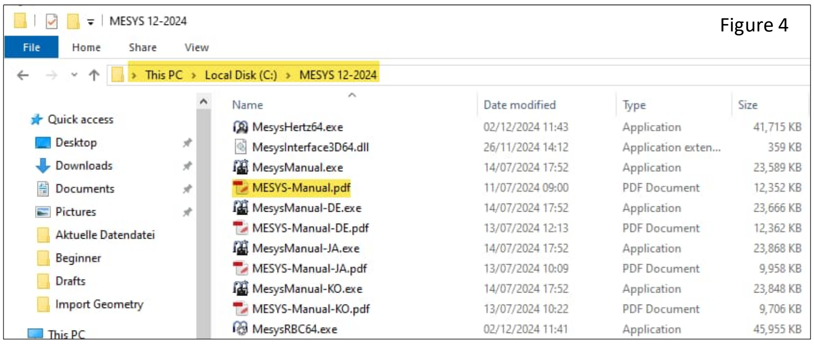

Figure 4

4. Shaft

4.1 Description of a shaft

4.1.1 Beam Model

The Shaft Calculation uses the Timoshenko beam model, which improves upon the classical Euler-Bernoulli theory by accounting for shear deformations and rotational inertia effects.

4.1.2 Limits and Assumptions

While the Timoshenko model is more realistic, it still simplifies the actual behaviour of a shaft. For instance, it does not consider 3D effects like local stress concentrations or nonlinear material properties, which would require more complex FEM analysis.

4.1.3 Options

A nonlinear shaft model can be taken into account. The nonlinear model calculates equilibrium of loads in the deformed state. Further information can be found in the Manual.

4.2 Shaft Project

4.2.1 Basic data of the shaft

A shaft in the MESYS Shaft Calculation requires a minimum description for corresponding running of the simulation. Let's go through this process sequentially.

➡ Start MESYS Shaft Calculation or open a new file using the 'New' icon or the File menu item and choose 'New':

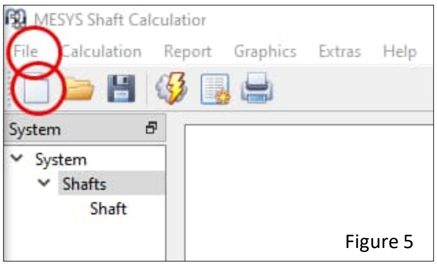

Figure 5

MESYS provides a placeholder for a Shaft in the 'System'-Tree. under 'Shafts' as standard. This Shaft can now be further defined in the main window.

The project for Shaft Calculation can be given a name and a description under 'System'.

➡ Assign an example name to the project.

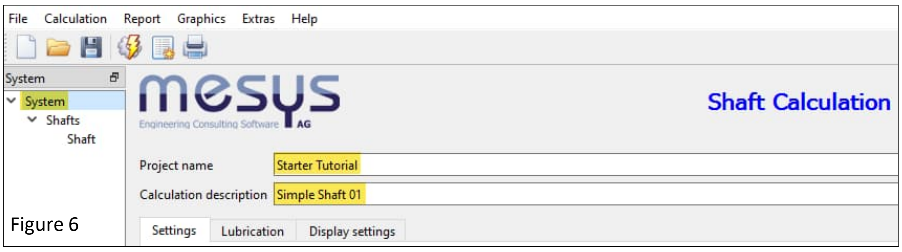

Figure 6

For the moment, we can leave the contents of 'System', chosen by 'System'-tree, i.e. the 'Settings', 'Lubrication' and 'Display settings' tabs untouched.

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4.2.2 Shaft input values

The following input data define a shaft:
- Length of the outer segment
- Length of the segment on the hollow shaft
- Diameter of the segment
- Diameter of the segment on the hollow shaft
- Material of the shaft

Optional:
- Temperature across the outer segments

For the purposes of this document, let us illustrate an example horizontal spindle shaft, as shown in figure 7:

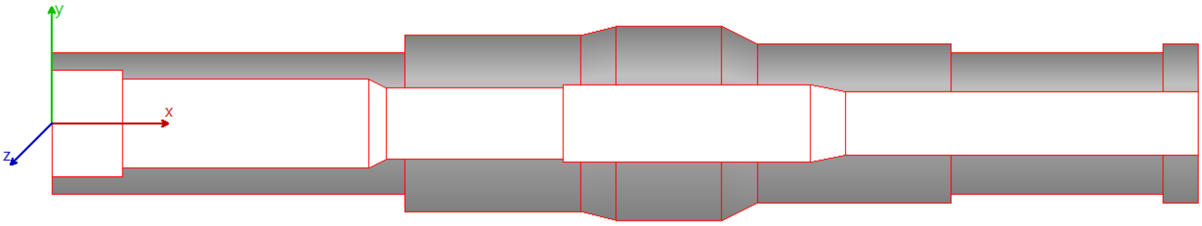


Figure 7

Please proceed as described below.

- Select 'Shaft' in the 'System'-Tree left-hand to display the input fields for the shaft in the main window. Start with the 'General'-tab.
- Choose a name for your shaft, e.g. “Simple Shaft 01”.
- Confirm that your shaft is to be exposed to a speed by ticking the 'rpm' box.
- Furthermore, please enter the intended speed, which shall be 1000 rpm here.

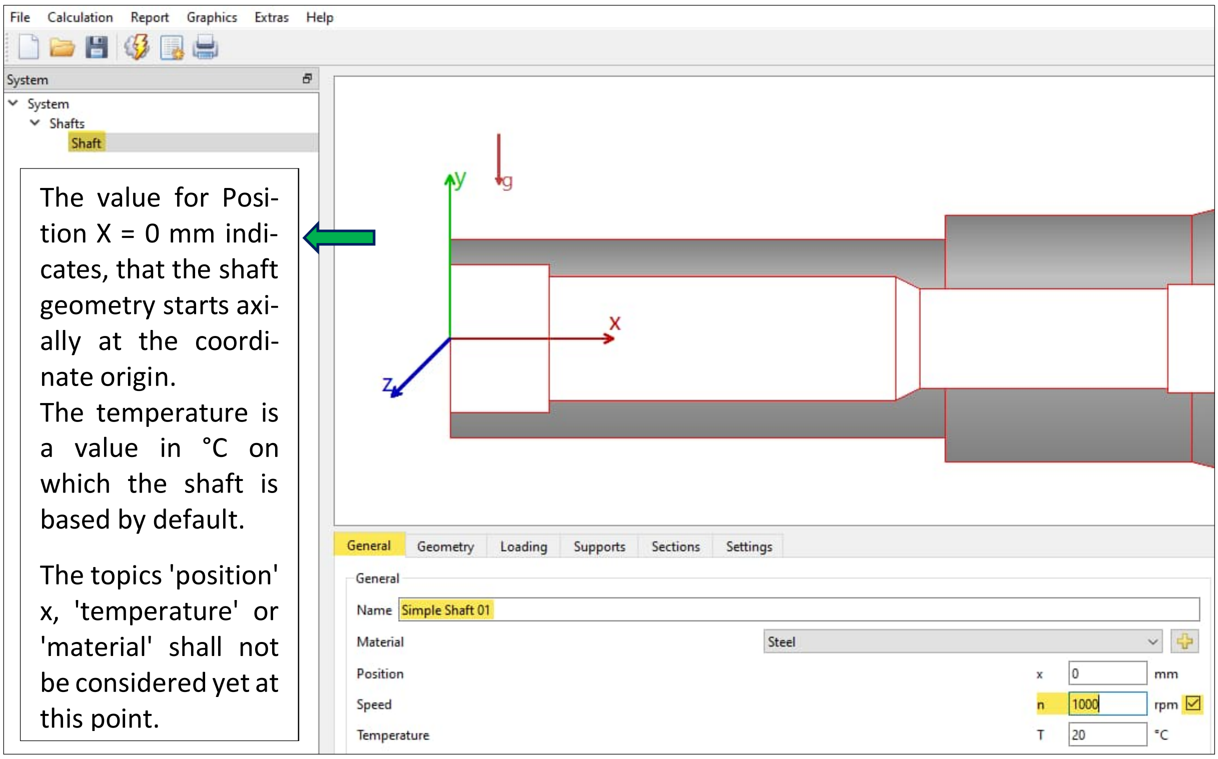


Figure 8

- Select 'Shaft' in the 'System'-tree to display the input fields for the shaft in the main window. Continue with the 'Geometry'-tab.

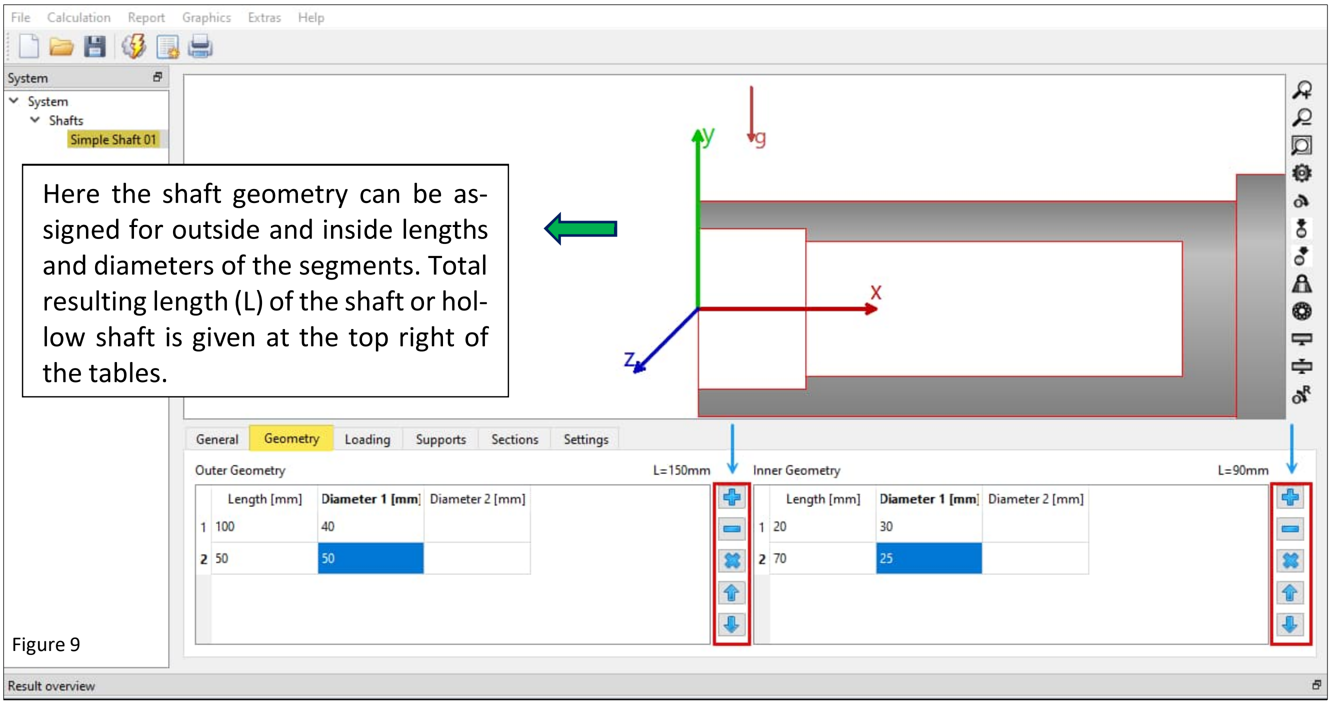


Figure 9

The blue control keys on the right side can be used to add, sort or delete rows, whereby ' ' deletes the entire table.

The example wave geometry should look as described in Figure 7 and as follows:

Outer Geometry

	Length [mm]	Diameter 1 [mm]	Diameter 2 [mm]
1	100	40	
2	50	50	
3	10	50	55
4	30	55	
5	10	55	45
6	55	45	
7	60	40	
8	10	45	

Inner Geometry

	Length [mm]	Diameter 1 [mm]	Diameter 2 [mm]
1	20	30	
2	70	25	
3	5	25	20
4	50	20	
5	70	22	
6	10	22	18
7	100	18	

Figure 10

These inputs should result in a shaft geometry as shown in Figure 7 and now shown correctly in Figure 11:

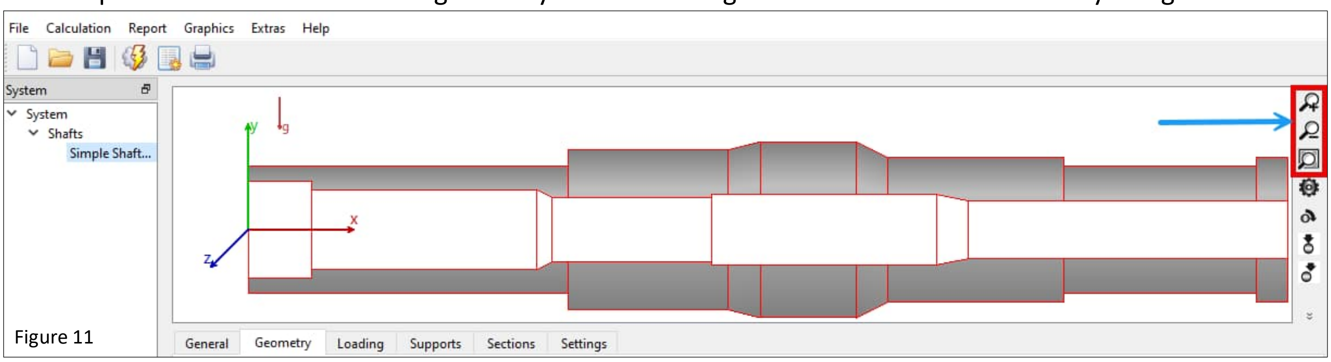


Figure 11

There are 'magnifying glasses' on the right-hand side of the graphical window that can be used to adjust the display of the shaft. Other buttons allow the user to add components such as couplings, gears, supports or rolling bearings to this graphical environment.

4.2.3 Position in space

Before continuing with the entries, the position in space must be defined. This exposes the configuration also to the corresponding weight forces.

➡ Select 'System' in the left-hand tree to display the input fields in the 'Settings'-tab. Assign the position in space to your shaft here, ticking the consideration of a weight force and define its direction (β_w).

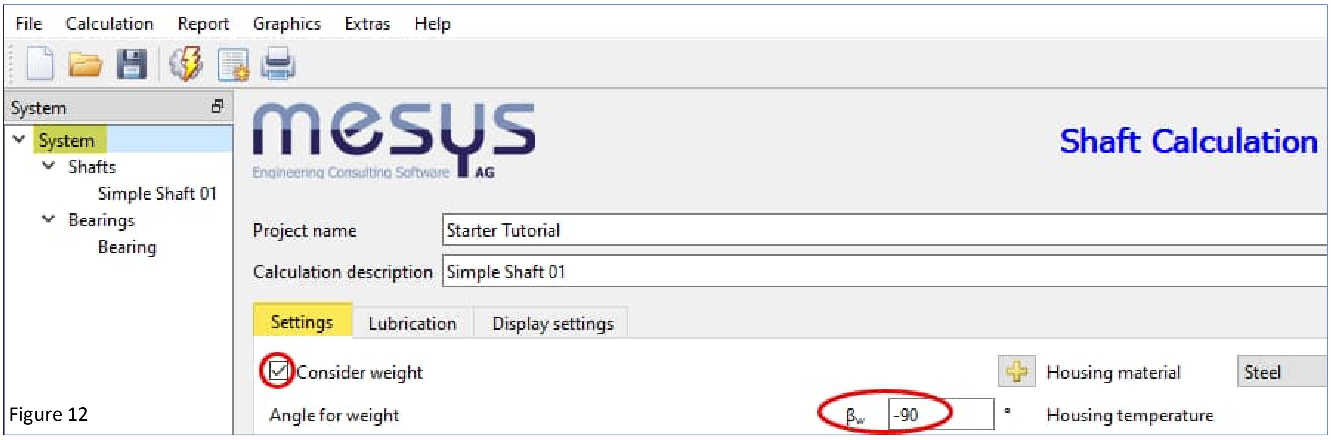
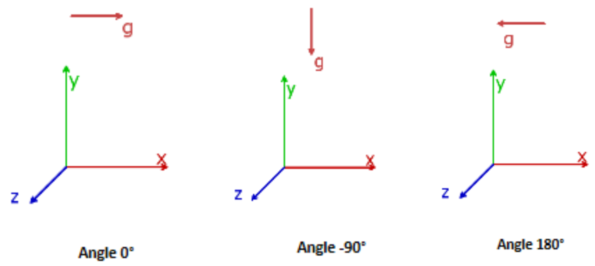


Figure 12



The angle is defined trough x-y-plane, a rotation around z-axis. A value of zero results in a weight in the direction of shaft axis. The weight direction is also shown as an arrow in the shaft graphics and it can be varied within the load spectrum.

Figure 13

After entering -90° for β_w, we should get the following arrow direction for weight force in the graphic window:

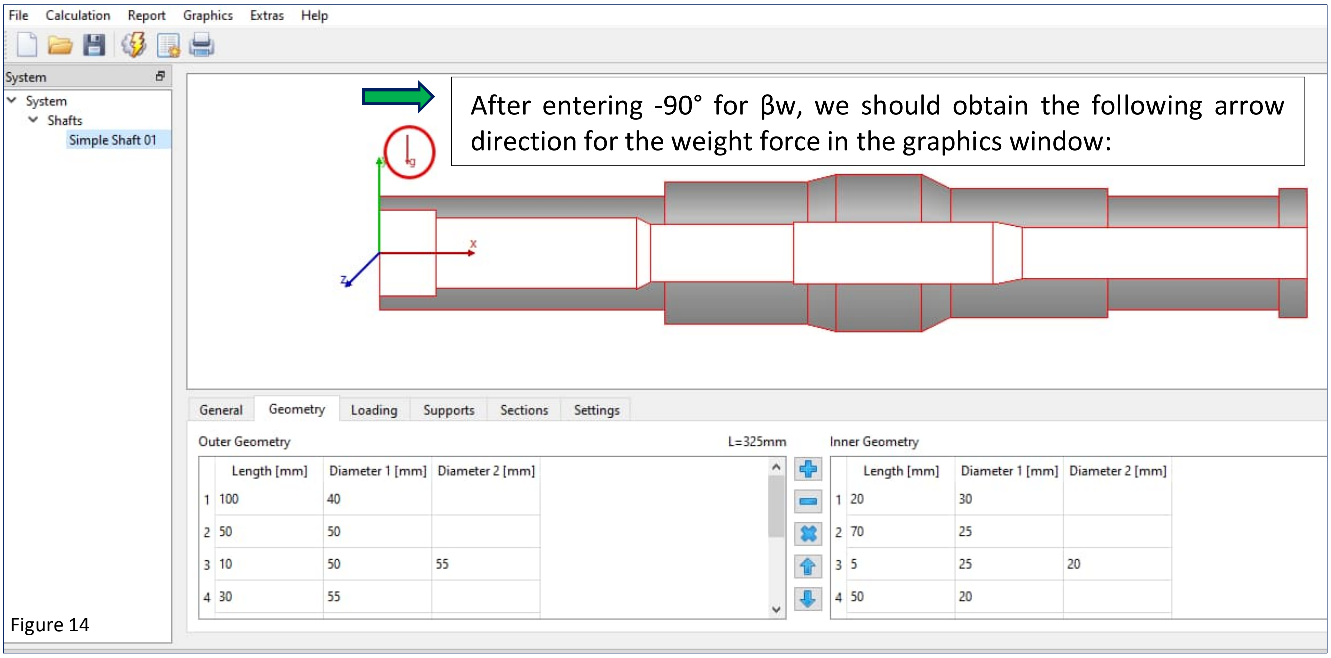


Figure 14

5. Loading

5.1 General

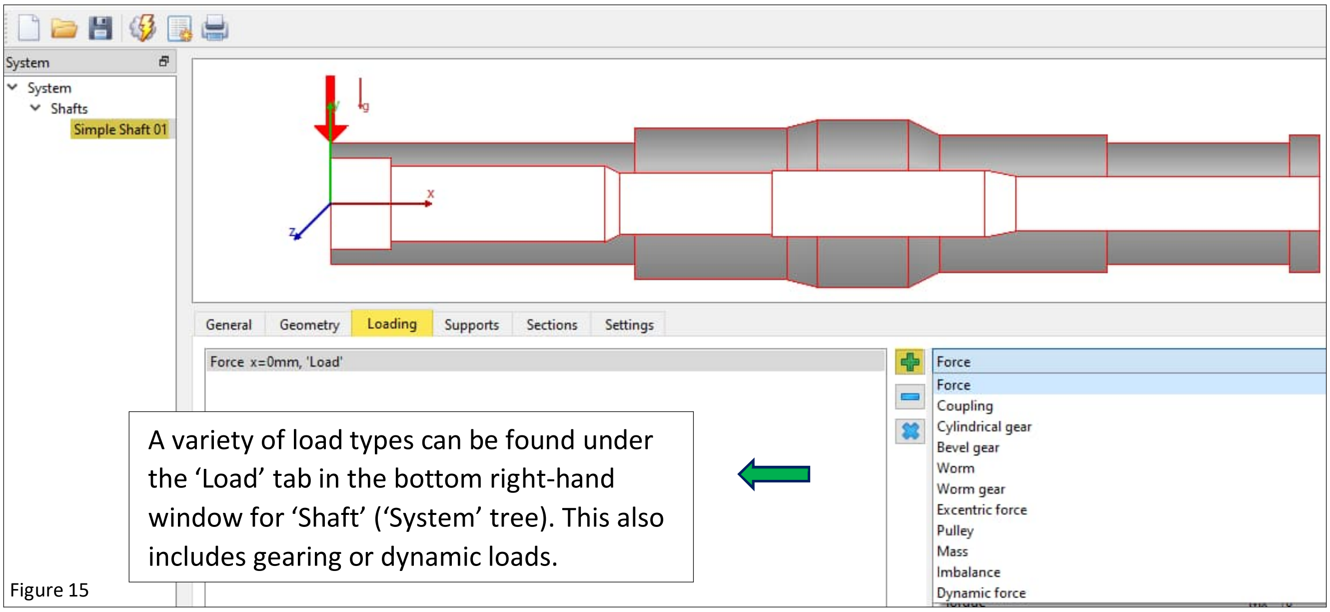


Figure 15

5.2 Force Vectors

To assign a common force, proceed as follows:

→ Assign a load with '+' and select the type in the drop-down on the right, which we define with 'Force'.

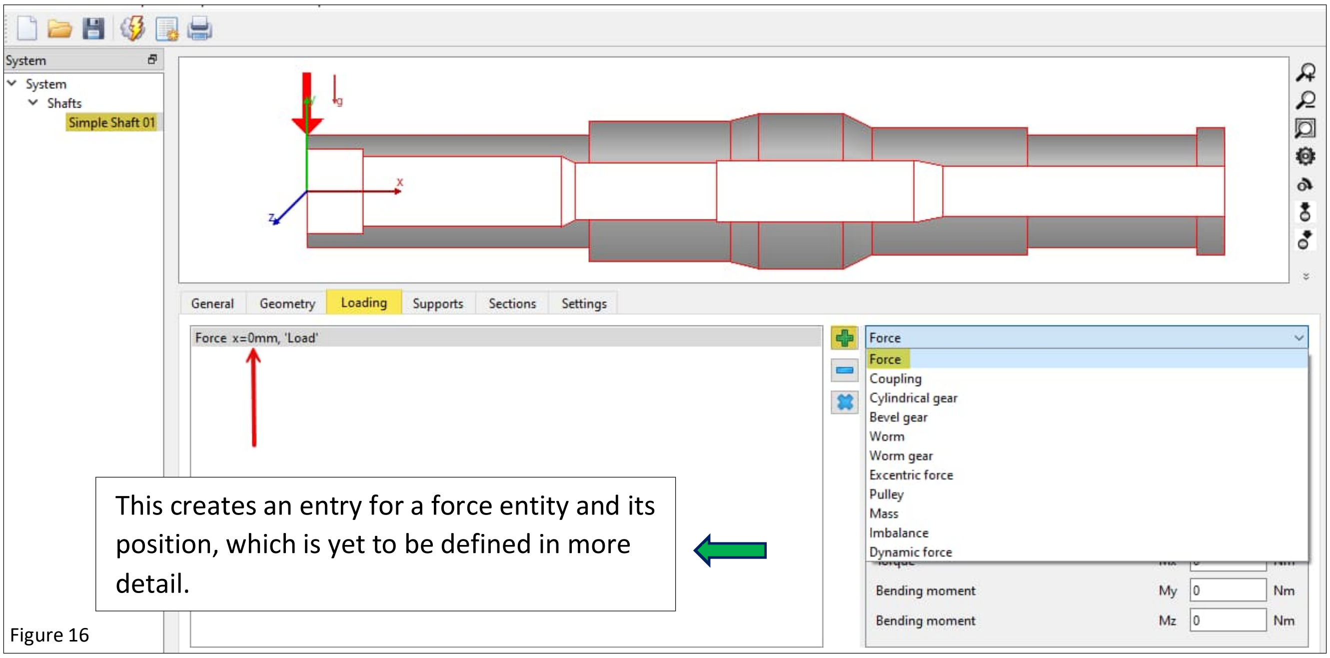


Figure 16

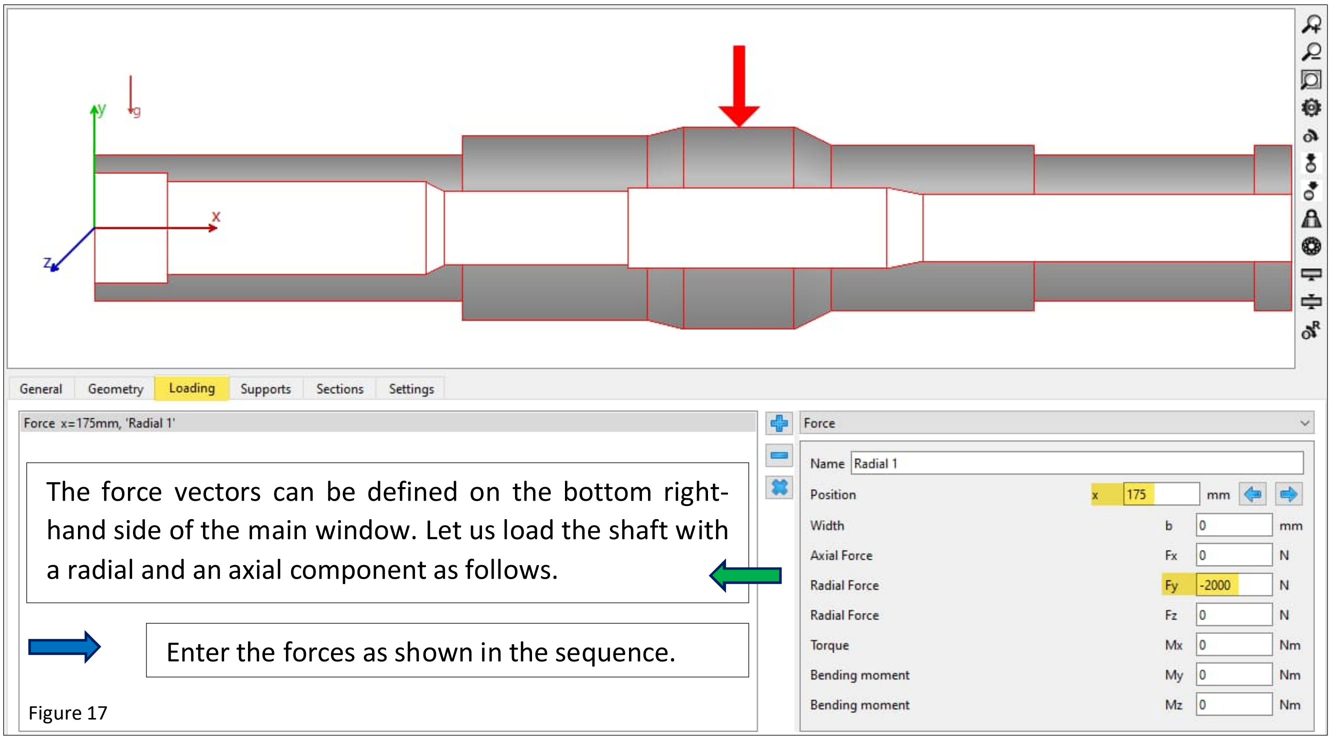


Figure 17

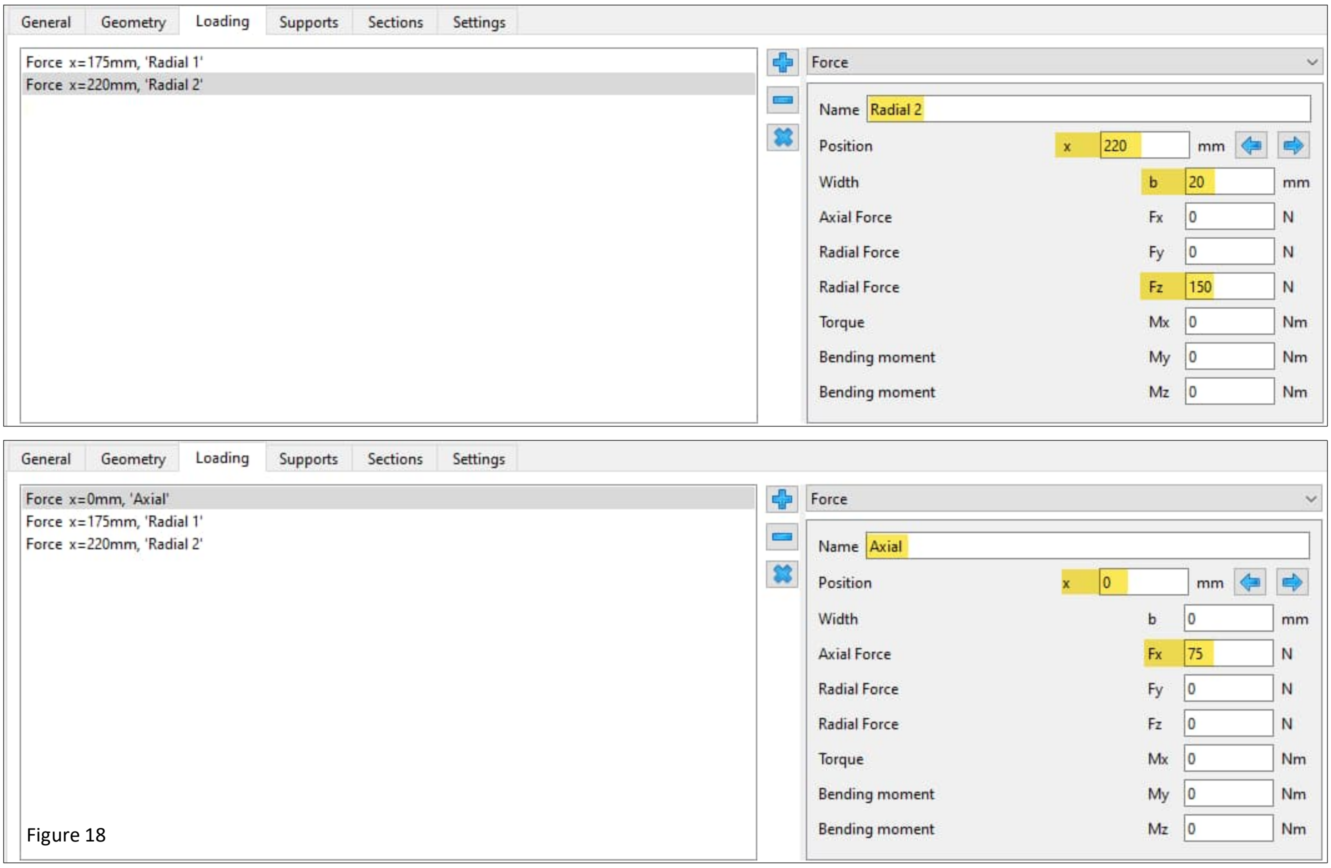


Figure 18

The shaft should now appear to us as shown in the following Figure 19:

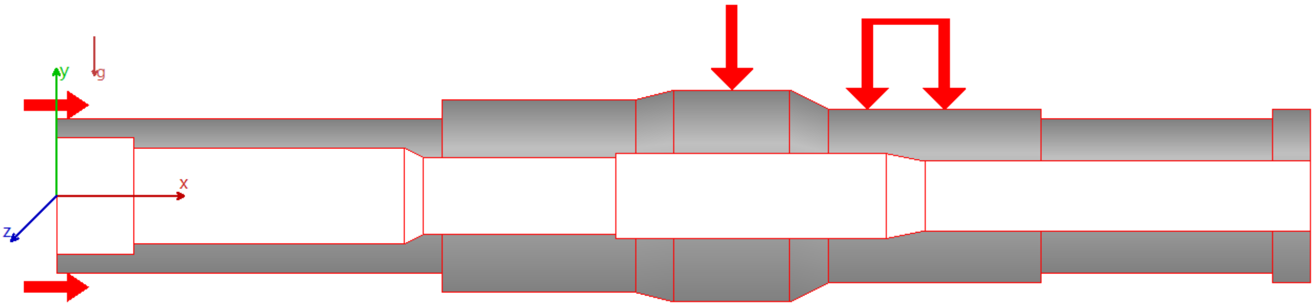


Figure 19

By selecting 'Shafts' in the system tree, the display of the force vectors can also be switched to 3D:

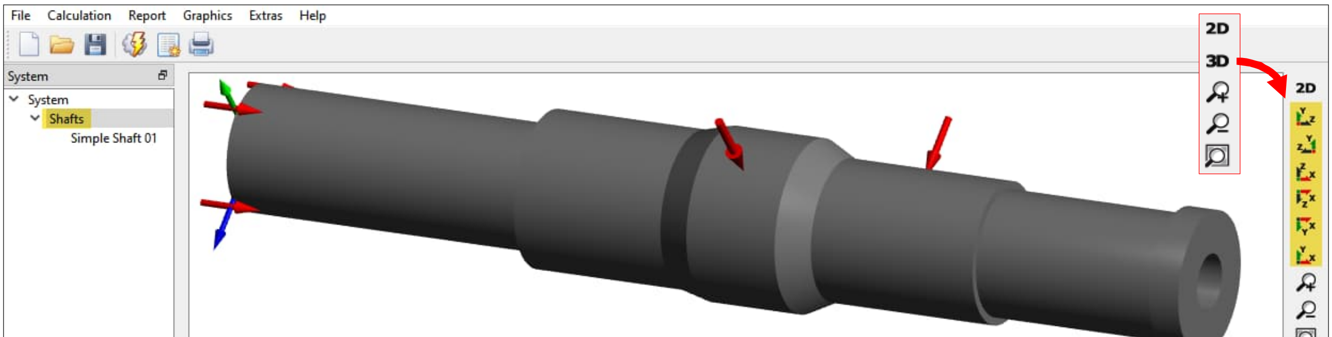


Figure 20

6. Supports

6.1 General

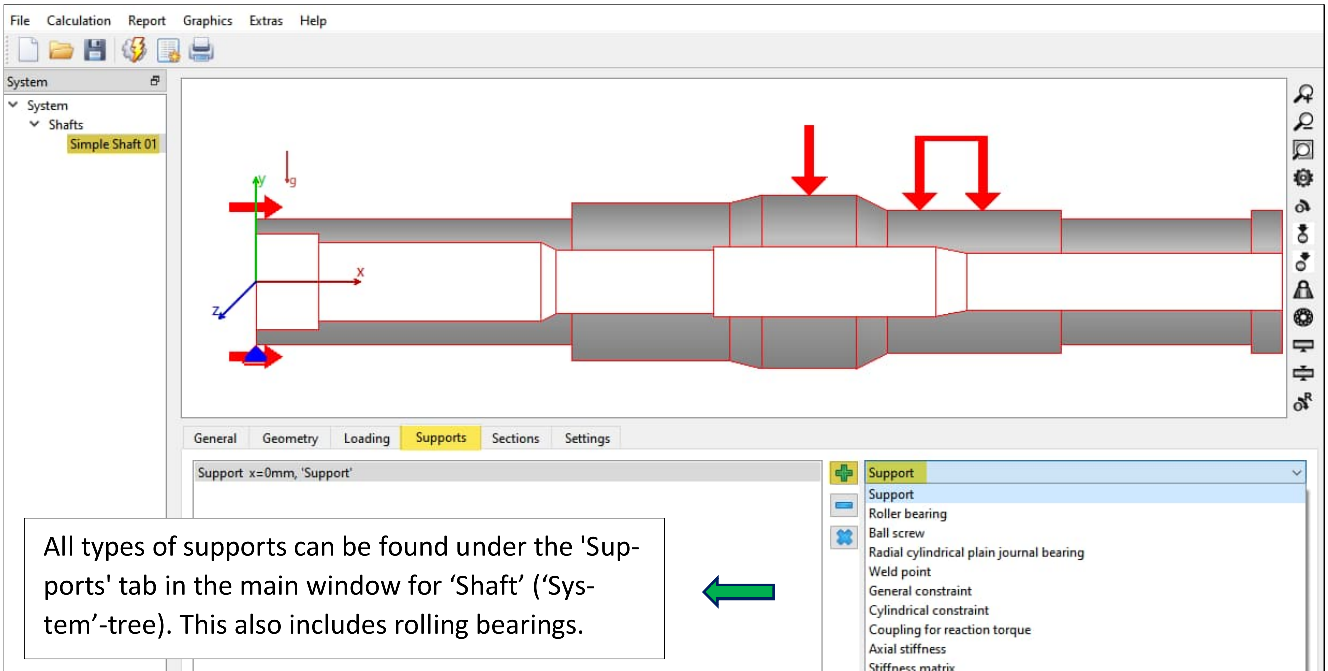


Figure 21

6.2 Rolling bearings

6.2.1 Mounting a Rolling Bearing

After assigning the support type, in this case rolling bearings, MESYS will place a deep groove ball bearing by default.

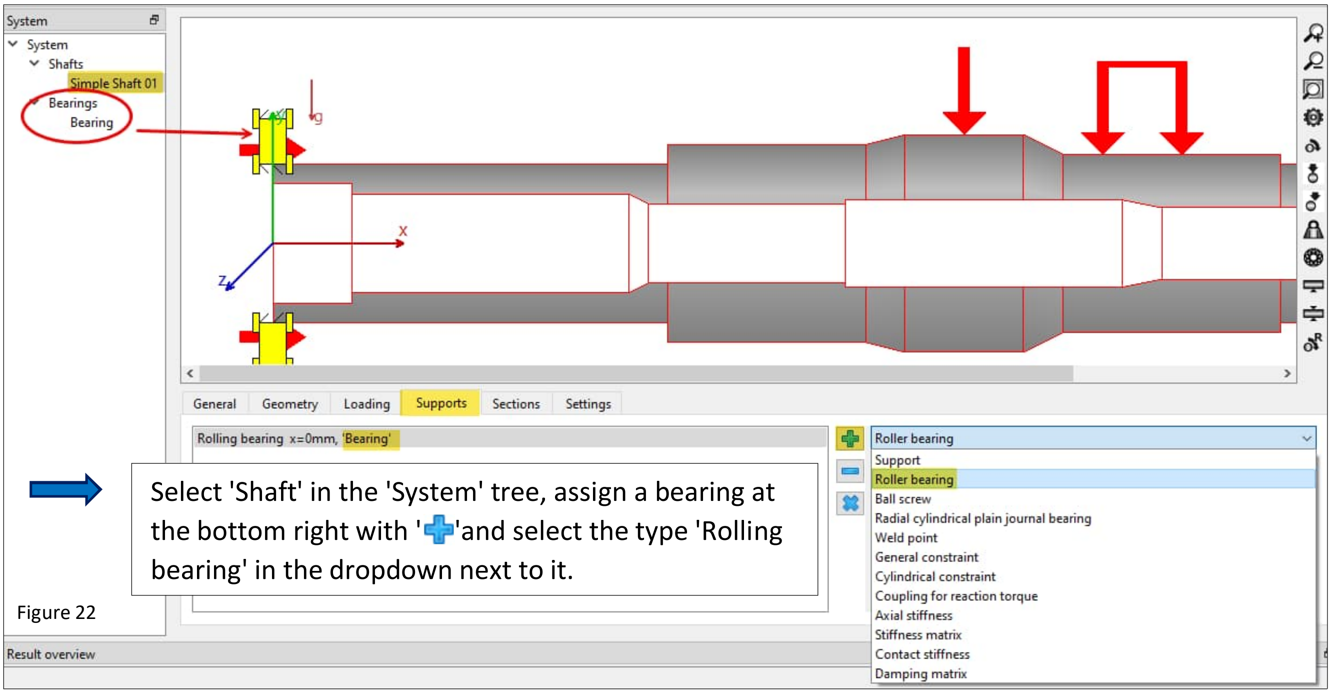


Figure 22

6.2.2 Bearing type and denomination

This insertion of a rolling bearing has following effects on the content of the simulation:
- Creation of a group 'Bearings' in the 'System'-tree
- Entry 'Bearings' under the 'Supports'-tab
- Placement of a rolling bearing at the axial position x = 0

The interface to MESYS Rolling Bearing Calculation is 'activated' when a rolling bearing is assigned. To select a rolling bearing or to define one in all its characteristics, please select 'Bearing' in the system tree.

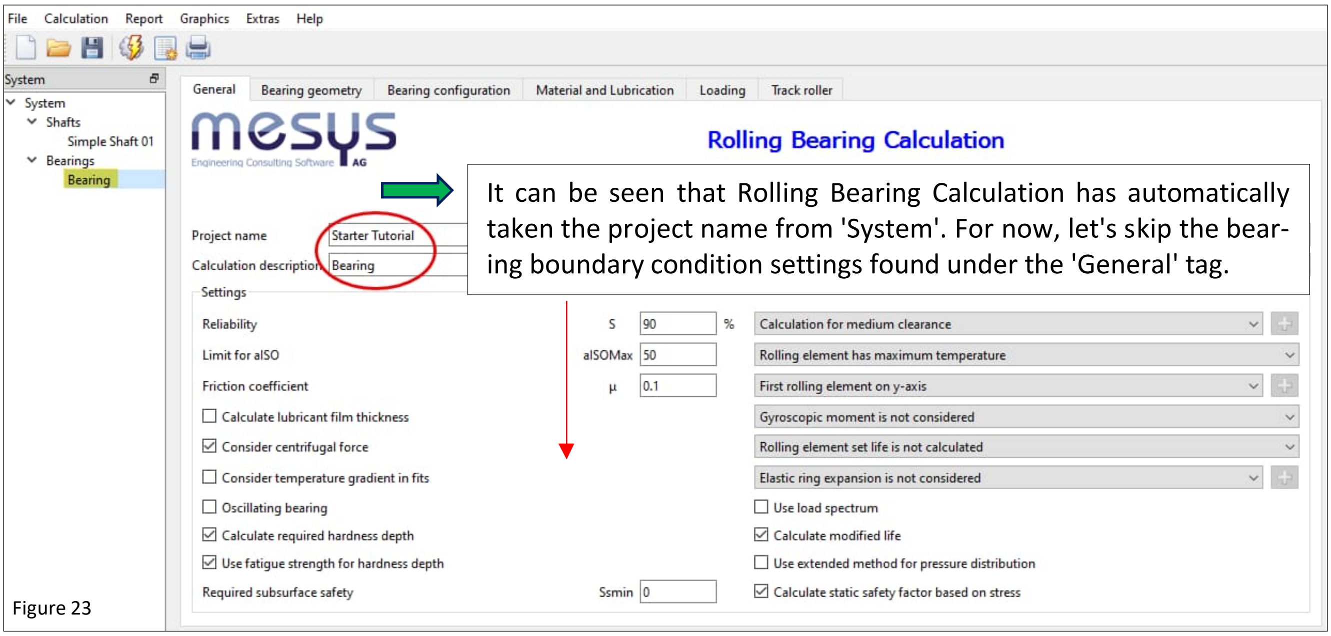


Figure 23

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Go to 'System'/'Bearing' and open tag 'Bearing geometry'. From the large selection of bearing types via the left dropdown, we select 'Deep groove ball bearing'.

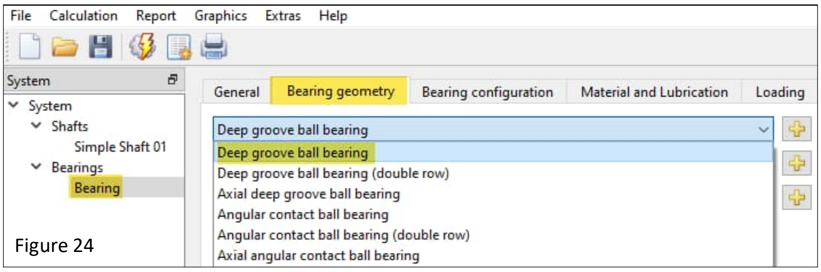

Figure 24

The design of the rolling bearing ('inner geometry') showed in figure 25 below the left bearing type selection dropdown, can be entered manually.

At this point however, we select an already defined rolling bearing from the database.

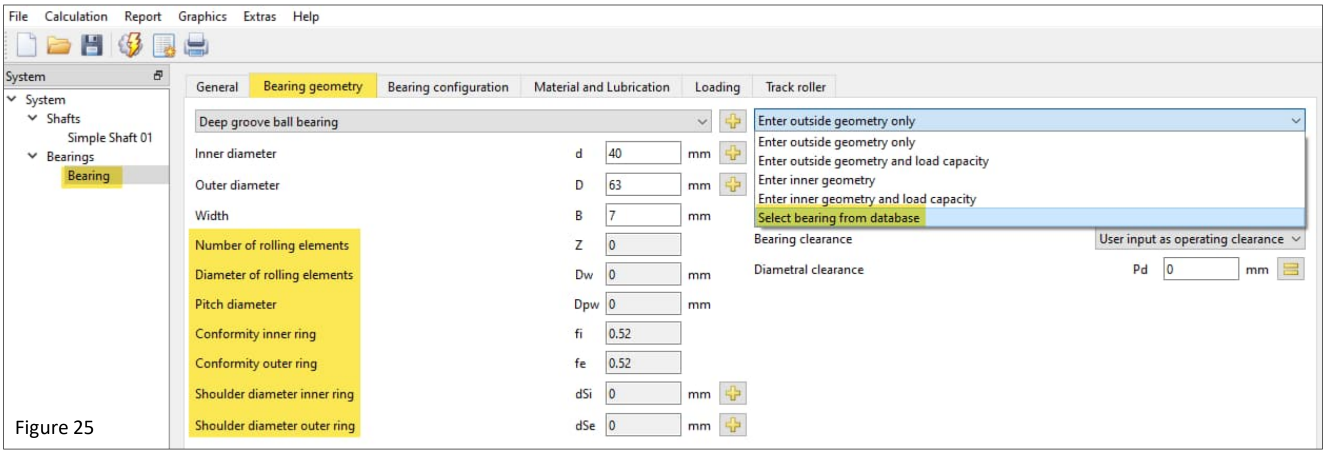

Figure 25

Choose 'Select bearing from database' on the right dropdown and filter inner & outer diameters d = 40 and D = 80 mm on the left side, to find the 'Generic' 6208 Deep groove ball bearing, as shown in figure 26.

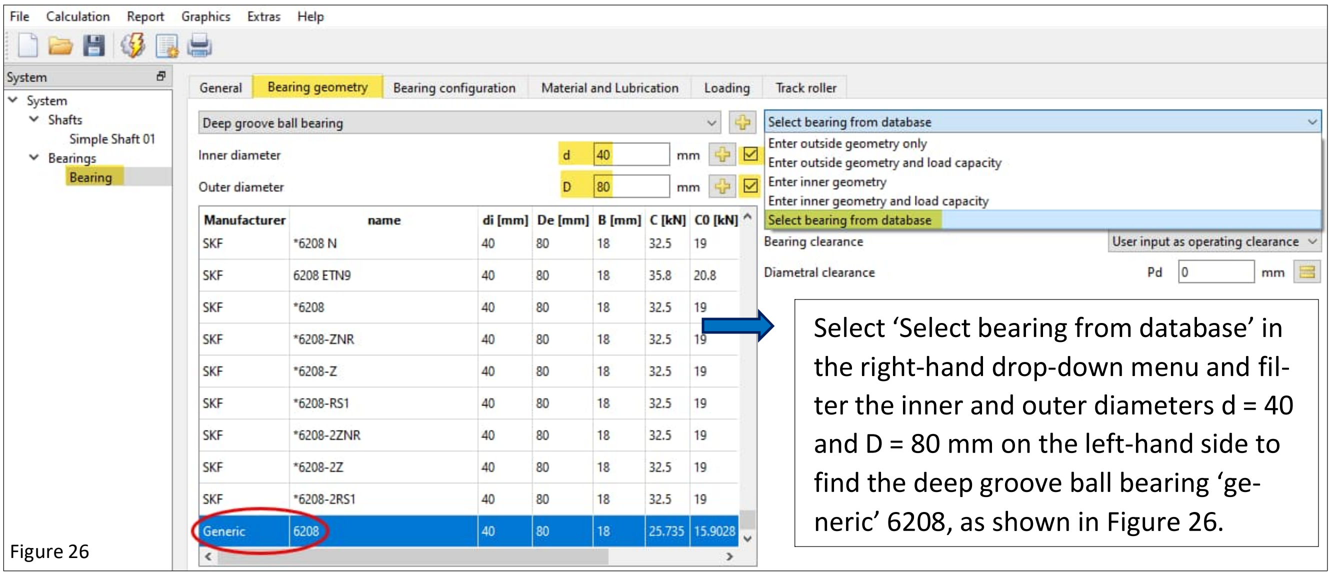

Figure 26

6.2.3 Positioning of Bearings

The positioning of the rolling bearing can be done by numerically entering the axial position on X. This can be done by turning back to 'System'/Simple Shaft 01/'Supports' in the lower right window or by combining Shift+left mouse button by sliding on the graphical representation of the bearing itself.

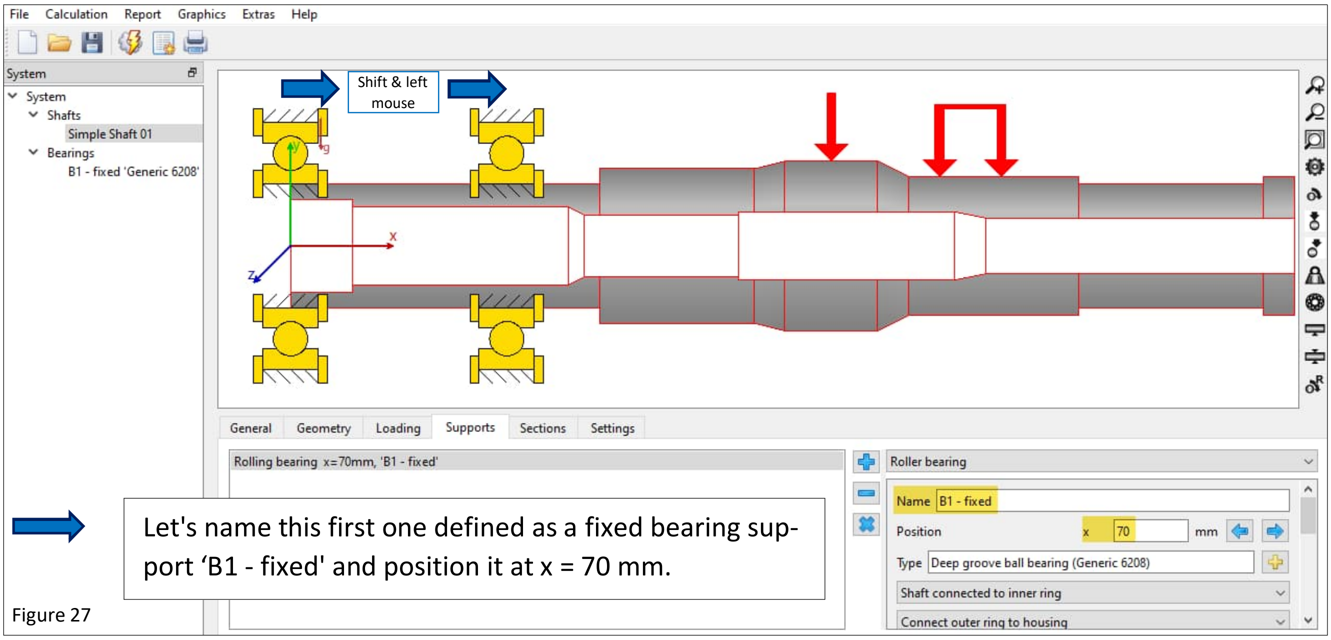

Figure 27

Add a second bearing by pressing the blue ' ✚ '-button shown in figure 26, which will cause a copy of the above bearing. We want to name the rolling bearing to be designed as a floating bearing 'B2 - floating'.

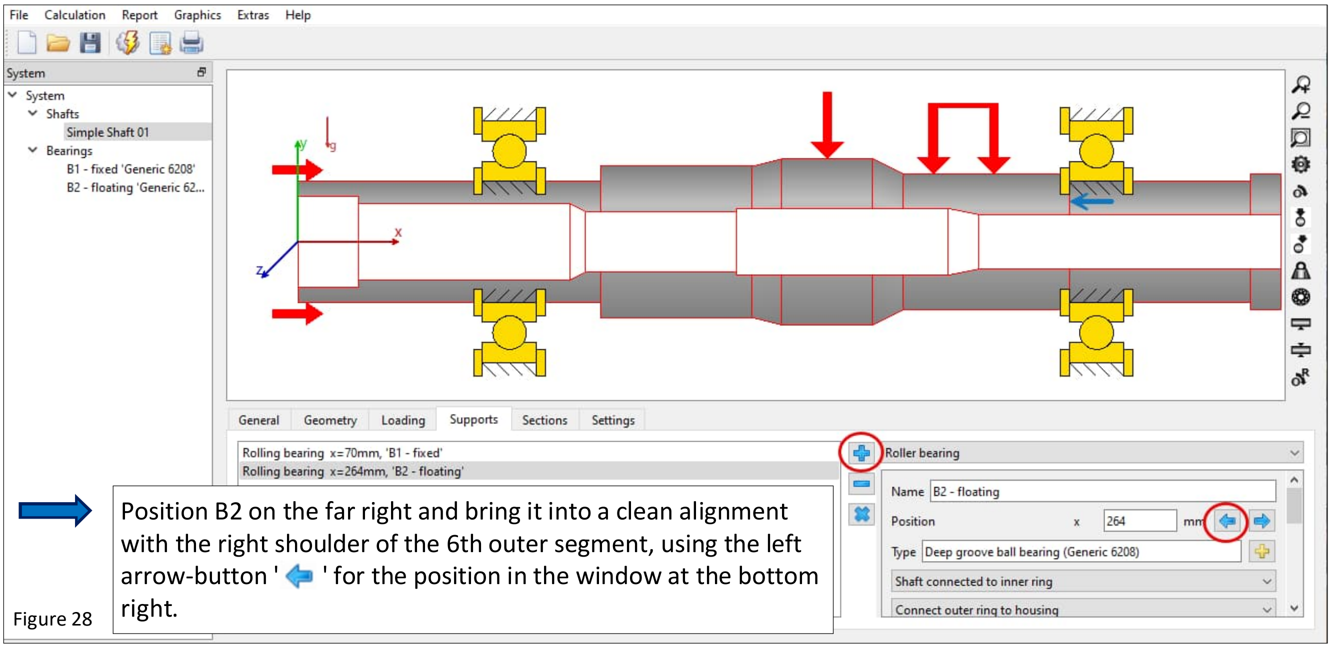

Figure 28

Figure 28

6.2.4 Conditions of Rolling Bearing

Let's now assign the operating conditions for the rolling bearing. Roughly assessed and within the scope of this tutorial, these could be the desired degrees of freedom, the fits, the properties of the bearing seats and, for example, the accuracy class.

So let's go back to 'System'/'Bearings', in the 'Bearing geometry' tab (fig. 29) and enter this basic information for the rolling bearings. For the time being, let's first deal with bearing clearance (CN) only conditionally.

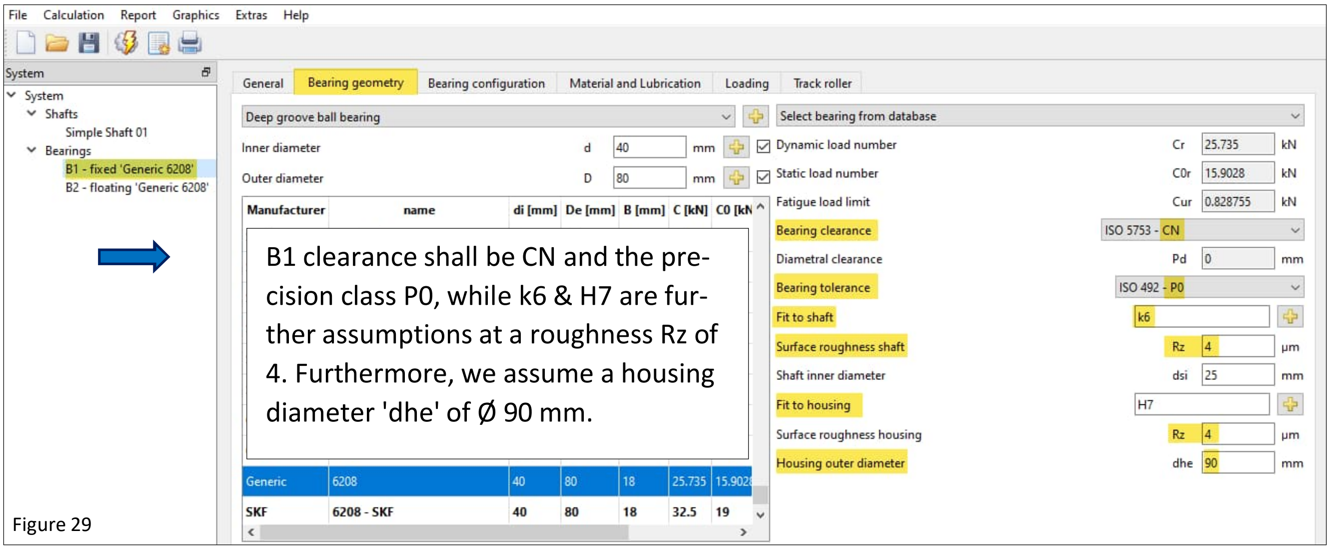

Figure 29

The rolling bearing editing window shown above (fig. 29) can alternatively be opened via the '✚' - button in 'System'/'Shafts'/Shaft' under the "Boundary conditions" tab (fig. 30), or via the context menu with the right mouse button directly on the graphical output (fig. 32).

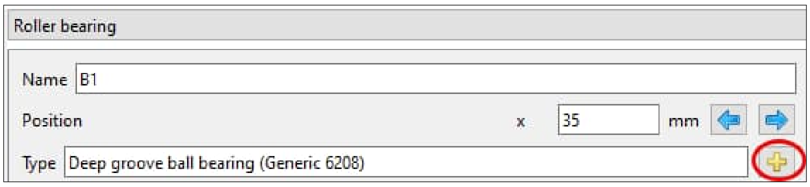

Figure 30

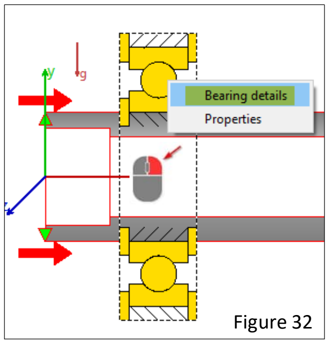

Figure 32

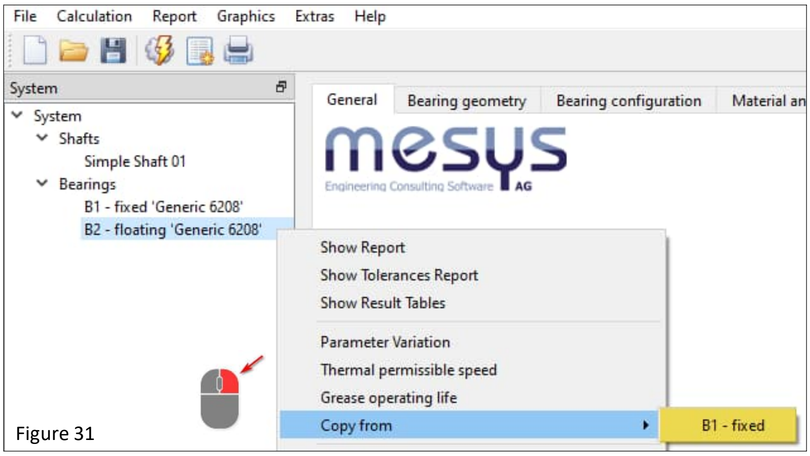

Figure 31

Enter the same settings for B2 as for B1 or alternatively chose to adopt settings from already configured B1, as shown in figure 32.

For B2, in the end a different setting is still required with regard to the support directions though. The non-locating bearing must not absorb axial forces and should be released axially. To do this, we go back to 'System/'Simple Shaft 01' in the 'Supports' tab for B2 – as shown in figure 28.

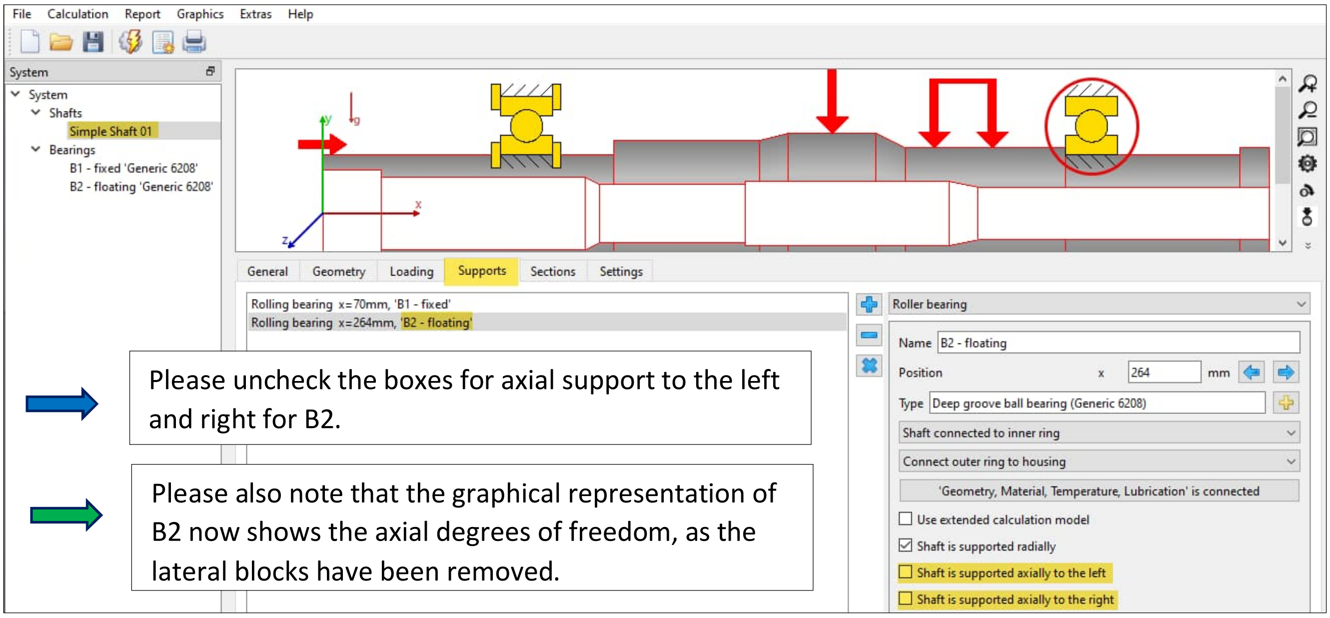

Figure 32

7. Shaft sections

7.1 General

For a proper calculation of shafts, stress concentrations, load types and sizes or necessary safety factors must be taken into account. For this purpose, the software offers the option of defining different notch cases for each shaft on the 'Sections' tab.

7.2 Shaft Strength

Note: This analysis needs the extension for DIN 743.

The method for shaft strength calculation can be selected under System, in 'Settings'-tab on right side. Currently, DIN 743 (2012) is available. It can be selected if the calculation should be done considering infinite or finite life. For finite life the number of cycles is calculated using the input for 'Required life' H.

For more information about sections please refer to Software Manual specific content.

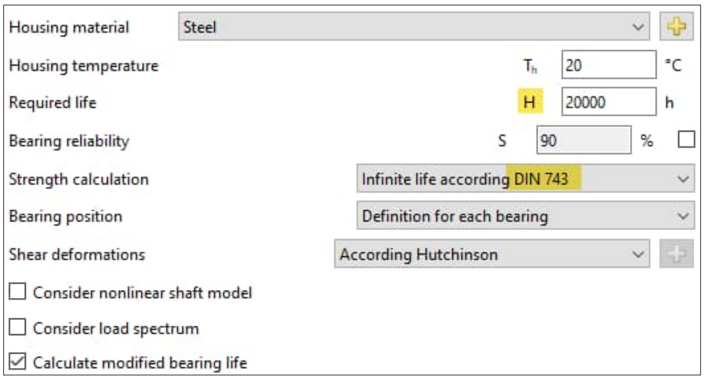

Figure 33

In our example, we focus the analysis on a point at which the diameter changes significantly. We therefore set a 'Section' at 'Simple Shaft 01' on a defined point, i.e. on the right shoulder of the 6th outer segment, as shown on the right.

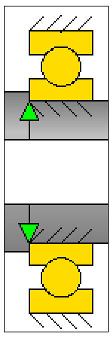

Figure 34

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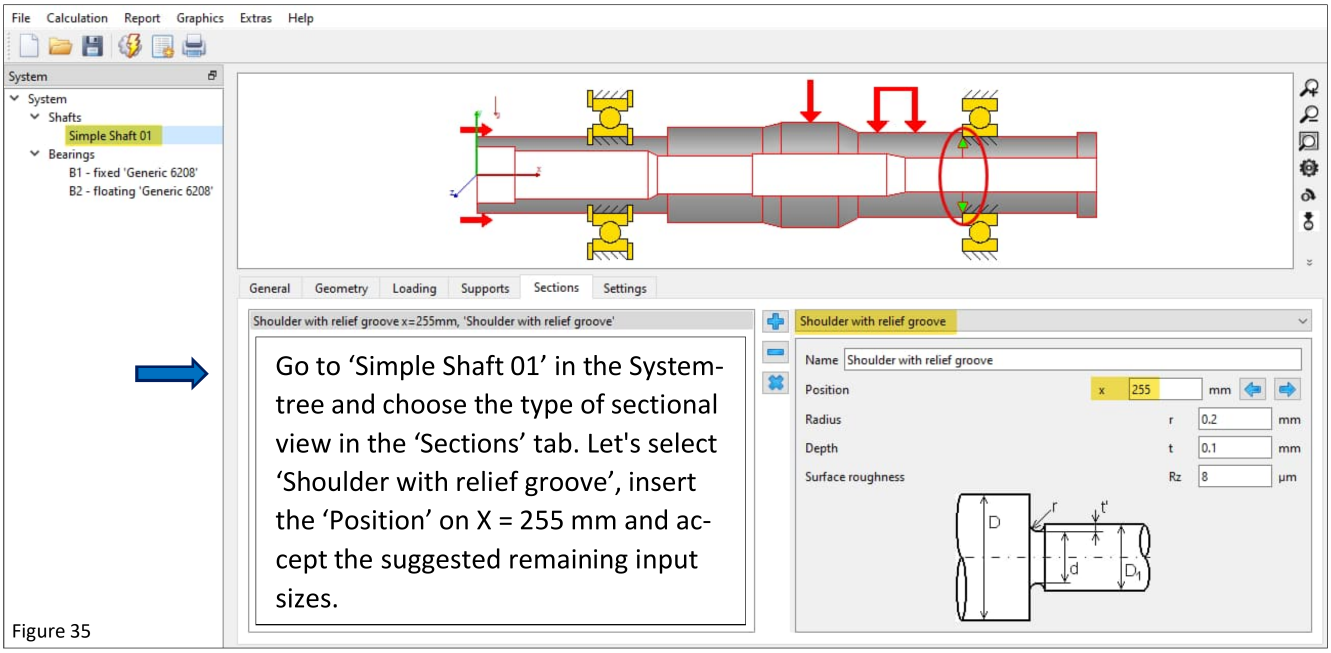

Figure 35

As the strength calculation requires a clear material definition, we will select one from the database (fig. 36).

Therefore, go to 'System/Shafts/Simple Shaft 01' and assign under the 'General' tab the material 42CrMo4 as an assumption to the shaft.

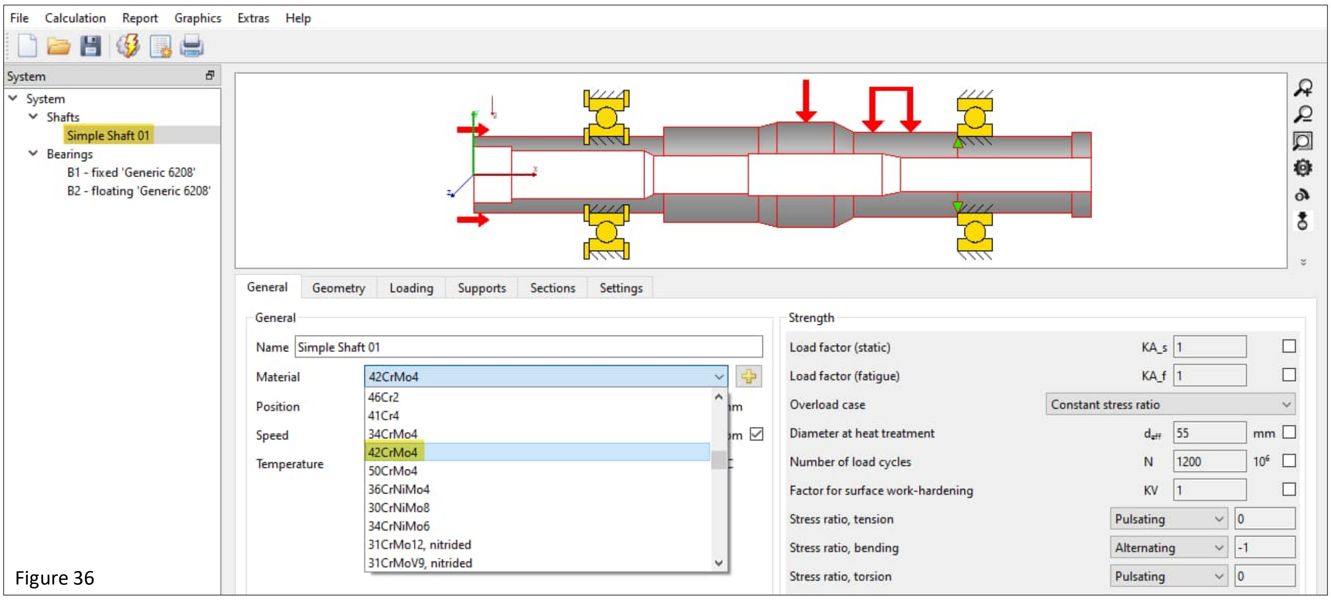

Figure 36

8. Lubrication

Let us assume that we are dealing with sealed DGBBs and that they are fitted with a standard lubricant of class ISO VG 46 mineral oil. Furthermore, the application should be carried out under normal contamination.

Select a lubricant class ISO VG 46 mineral oil as lubricating grease under normal cleanliness.

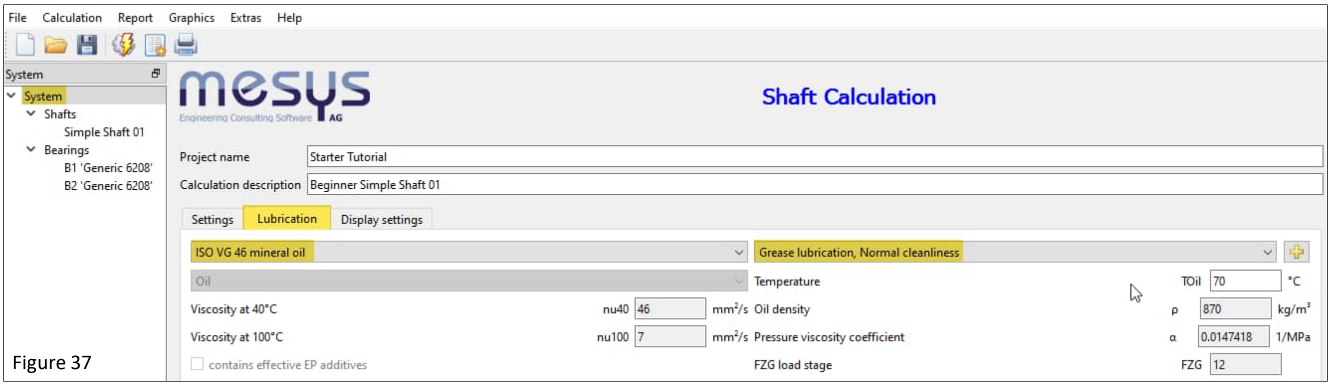

Figure 37

A lubricating grease selection that deviates from the series for mass-produced products such as deep groove ball bearings is usually not practicable in terms of cost. A comparison of reference viscosity and operating viscosity using the ISO VG value is recommended. However, in addition to the usual viscosity references, a lubricant used in mass production should also be evaluated with regard to its suitability in terms of lubricant quantity, lubricant displacement space, effective contact stresses or friction and thus potentially effective temperatures in contact.

9. Interfaces

9.1 Bearing to Shaft

If we consider the Rolling Bearing Calculation as a plug-in for Shaft Calculation, we can assume that the relative main interfaces are to be defined. We find the standard connection of the parameters under 'System'/'Shafts'/...B1 or B2, as displayed in following figure 38:

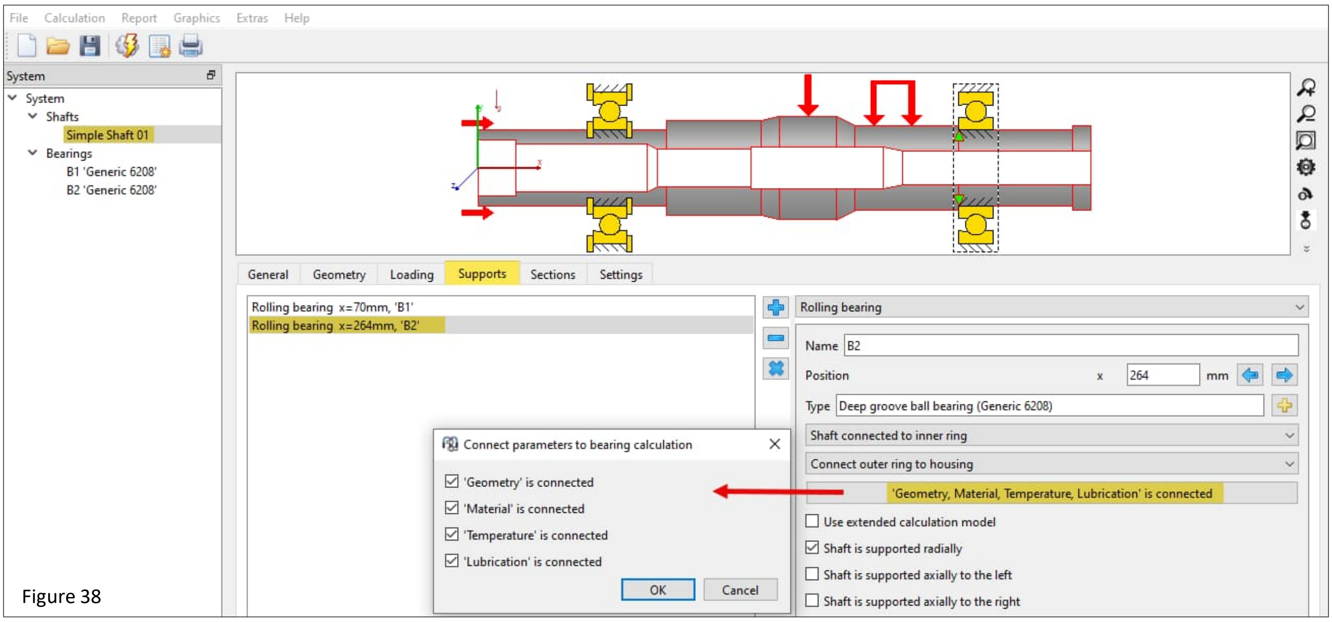

Figure 38

Let us then find and compare these interfaces on the programme interface. This step is not necessary if all 4 checkboxes in fig. 38 above are ticked (default)!

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9.2 Geometry

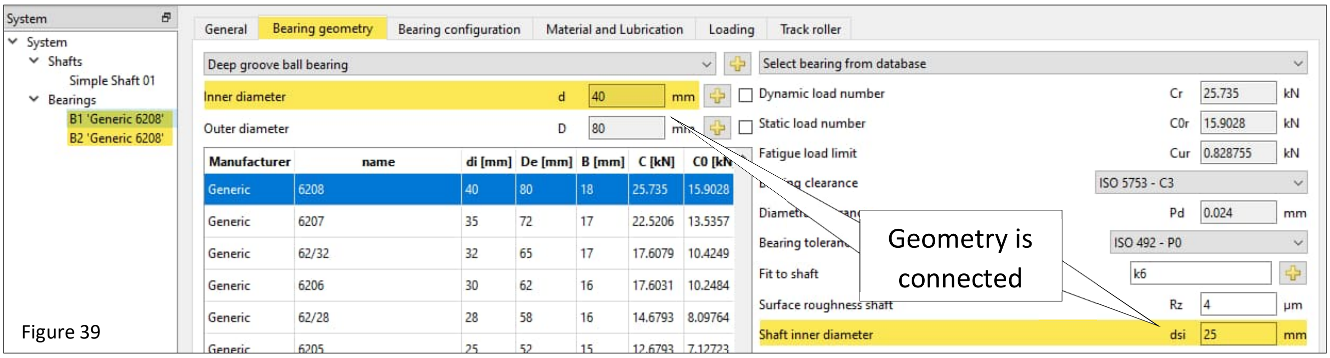


Figure 39

9.3 Material

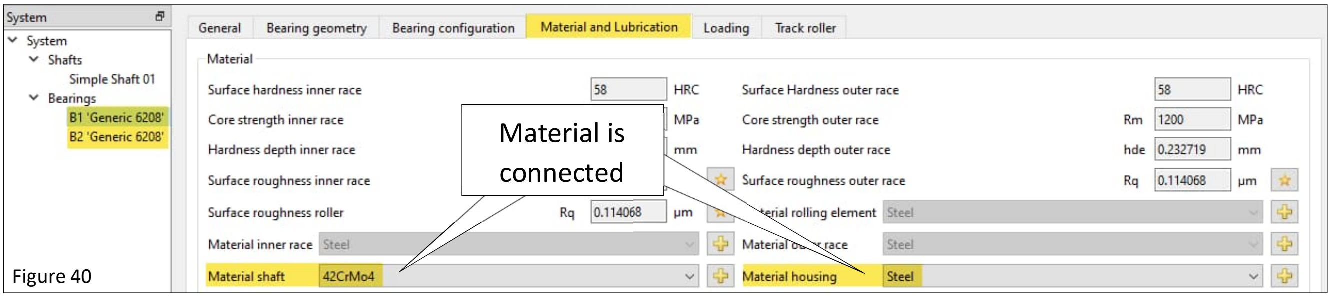


Figure 40

9.4 Temperature

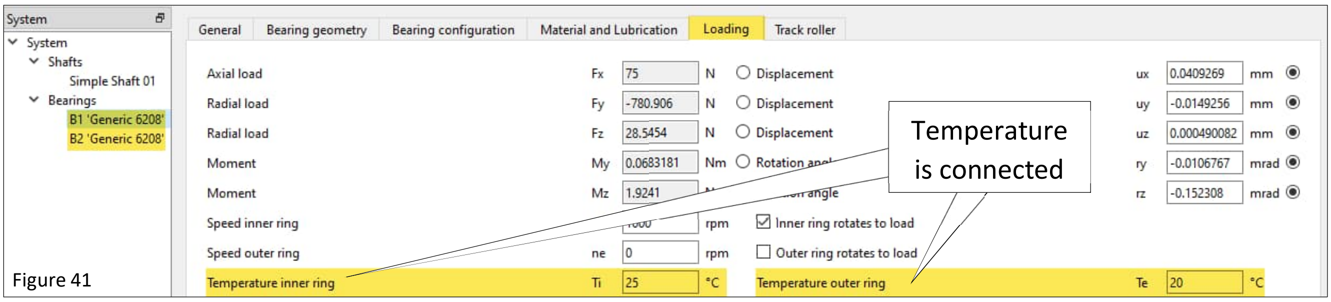


Figure 41

9.5 Lubrication

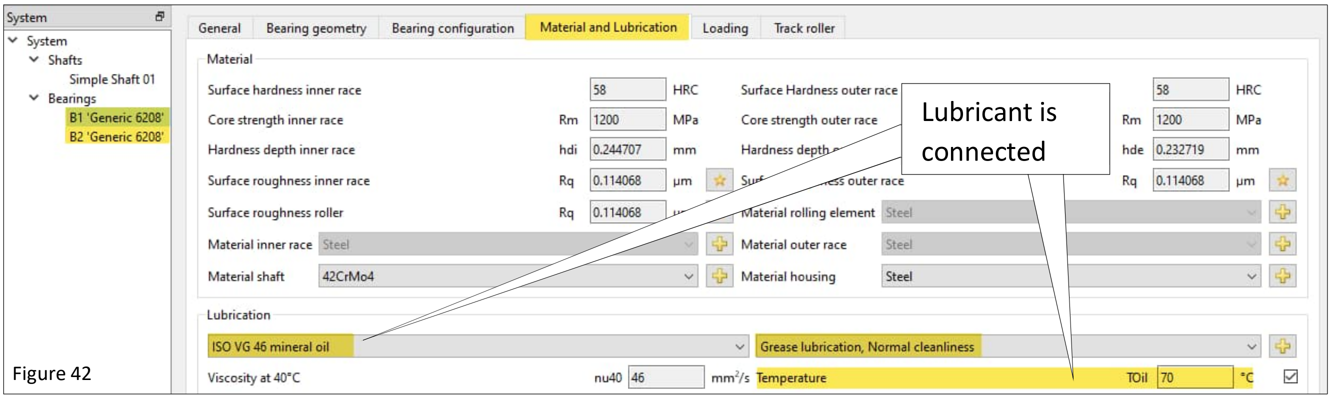


Figure 42

10. Calculation step

10.1 Activation

After entering and setting all the points and passages mentioned above, the resulting shaft model is ready to start the 1st calculation step.

By selecting System/Shafts, we find ourselves in the results overview, which can be viewed by topic using the vertical tabs at the lower right edge:

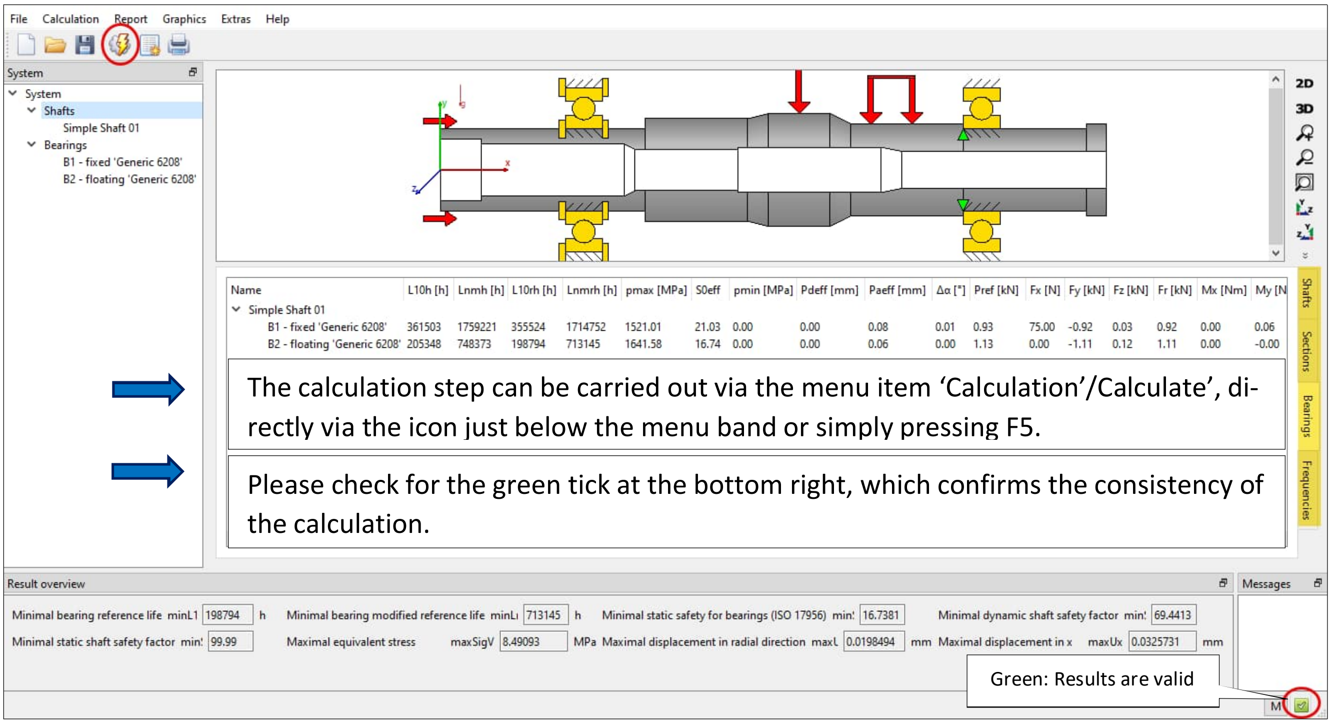


Figure 43

10.2 Results

Results are available in different outputs. There is the default result overview on the bottom of the user interface (figure 43), an overview of bearing forces and natural frequencies, several graphics and the editable report.

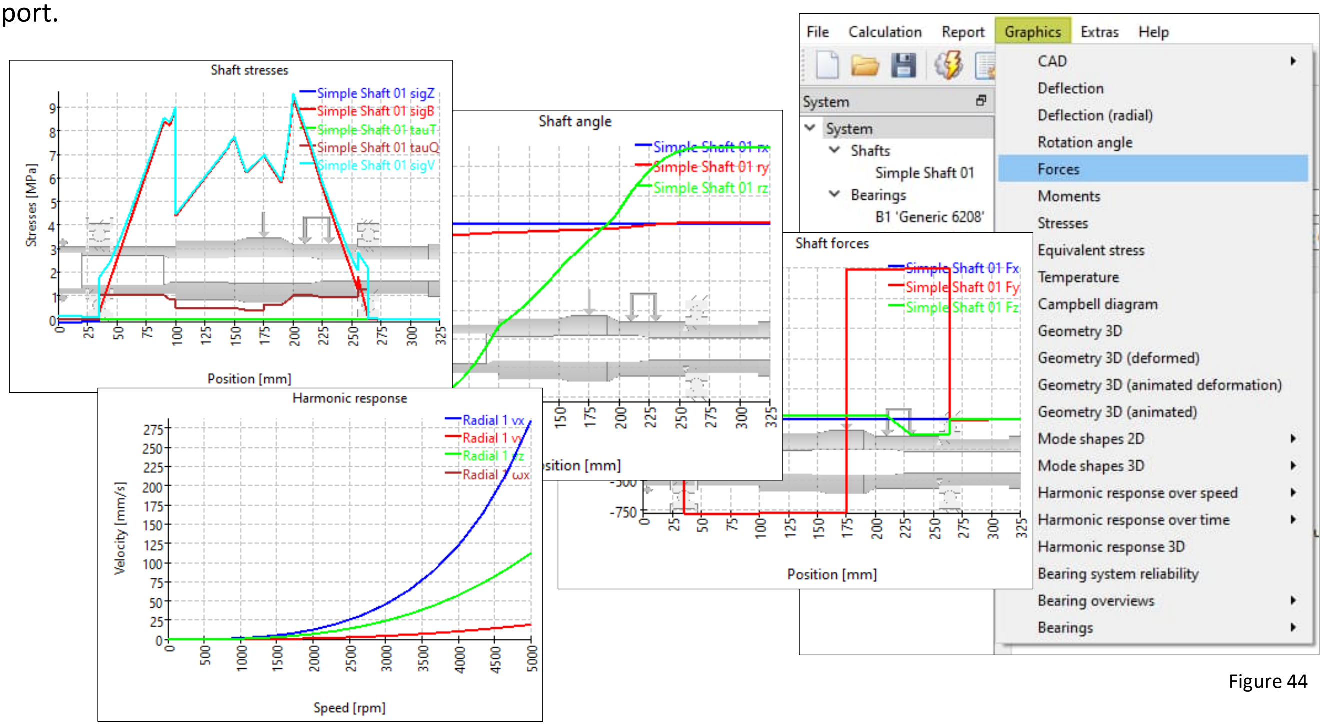


Figure 44

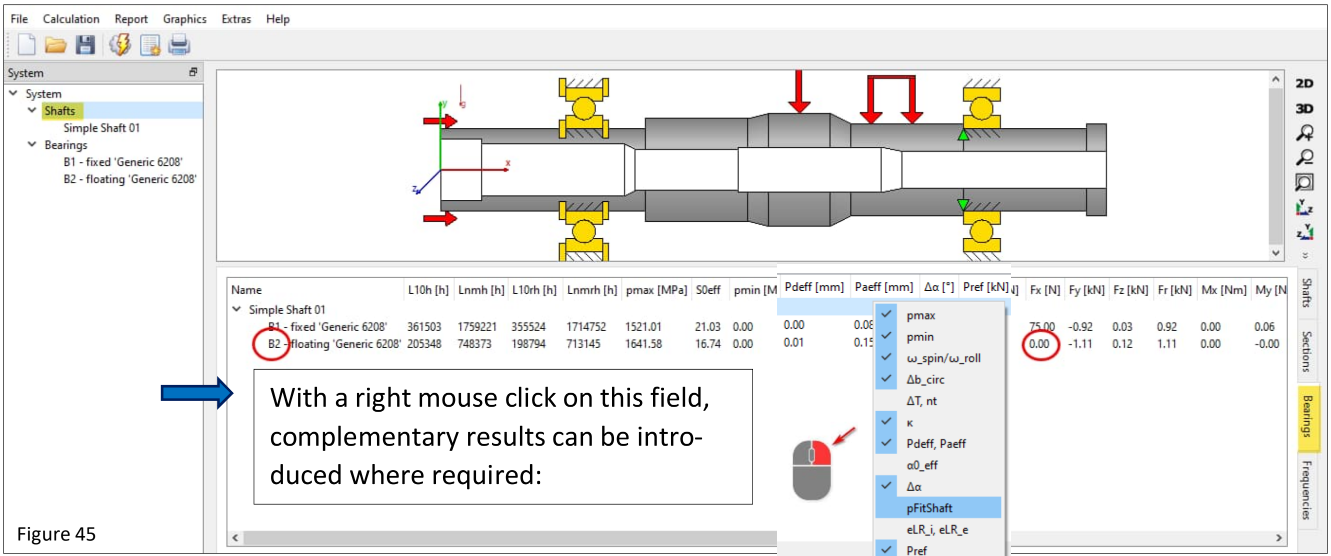


Figure 45

For example, it can be seen that the non-locating bearing function is working correctly, given the fact that bearing B2 with Fx = 0 is completely axially unloaded (fig. 45).

Have a look also at the other results and the additional tabs as shown in figure 46:

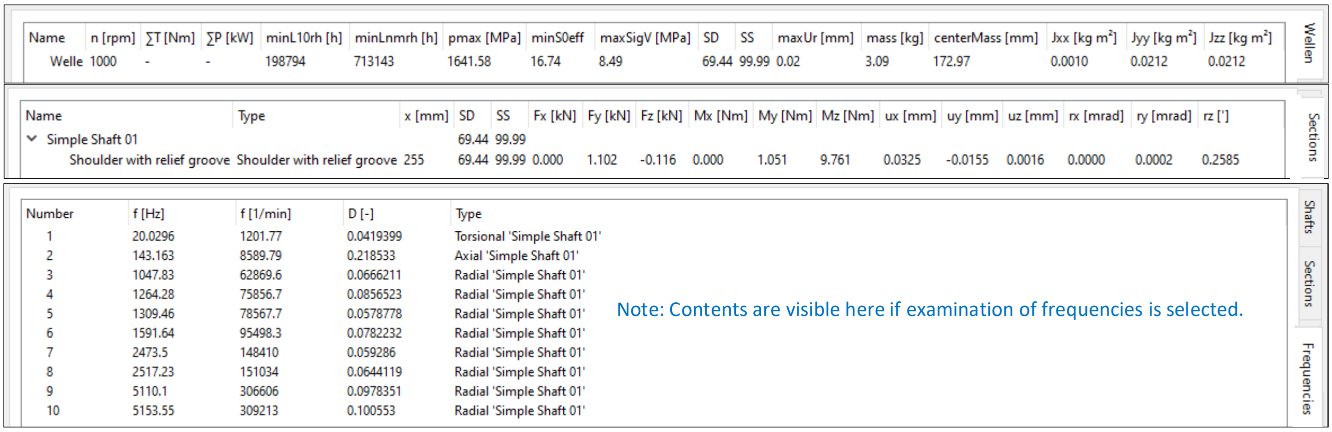


Figure 46

10.3 Report

10.3.1 Main Report

Using the toolbar button or menu 'Report'/'Show Report', a report for the shaft calculation is generated which only gives an overview for the bearing results. There is also 'Report'/'Full report' which is generating a full report with results of the shaft calculation and the full reports of the bearing calculations.

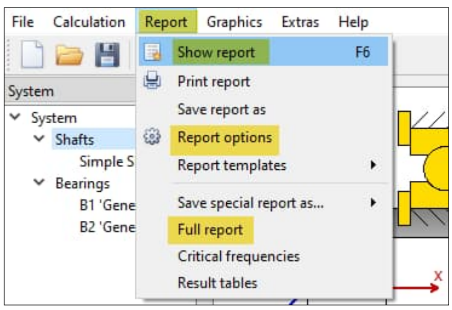


Figure 47

10.3.2 Report options

In the menu 'Report'/'Options' the contents of the report can be configured. The graphics to be included can be selected and some sections of the report could be discarded if not of interest. The legend for all the table parameters can be shown in the report.

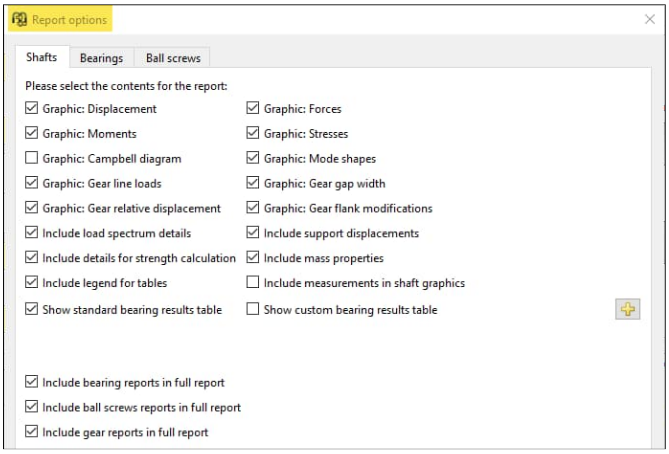


Figure 48

10.3.3 Report format

The report can be saved in .docx format, for instance, allowing further processing.

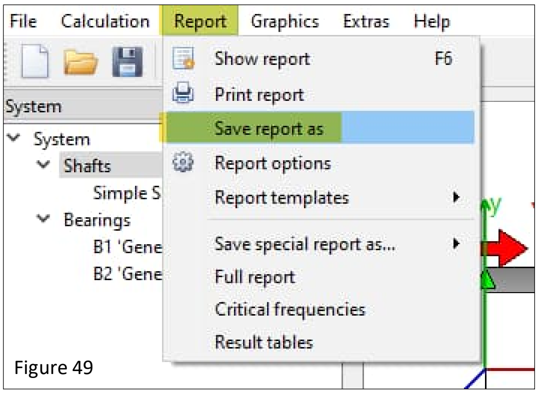


Figure 49

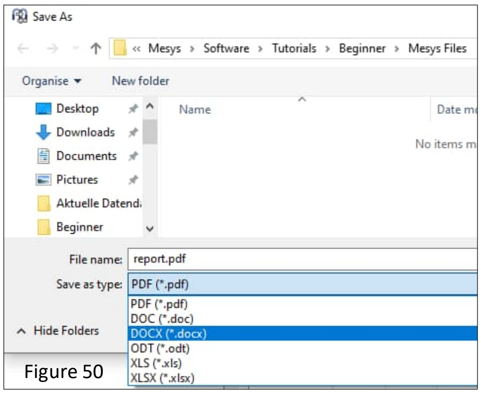


Figure 50

The logo in the report can be configured in 'mesys.ini'. See Configuration with INI-File. Further information on this can be found at appropriate page in the Manual.

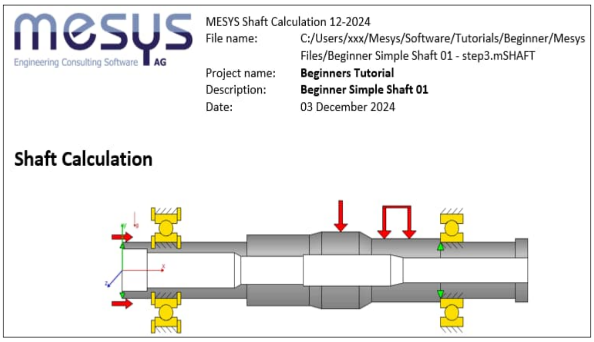
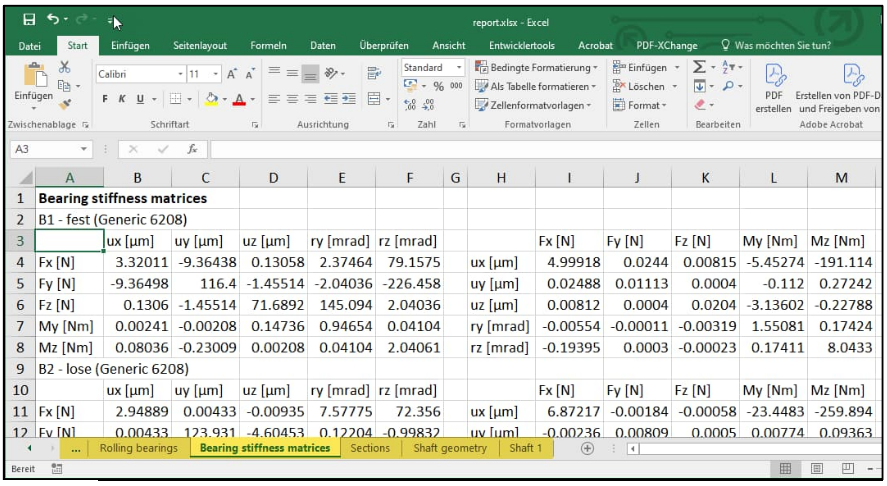


Figure 51

10.3.4 Report Tables



	A	B	C	D	E	F	G	H	I	J	K	L	M
1	Bearing stiffness matrices												
2	B1 - fest (Generic 6208)												
3		ux [µm]	uy [µm]	uz [µm]	ry [mrad]	rz [mrad]			Fx [N]	Fy [N]	Fz [N]	My [Nm]	Mz [Nm]
4	Fx [N]	3.32011	-9.36438	0.13058	2.37464	79.1575		ux [µm]	4.99918	0.0244	0.00815	-5.45274	-191.114
5	Fy [N]	-9.36498	116.4	-1.45514	-2.04036	-226.458		uy [µm]	0.02488	0.01113	0.0004	-0.112	0.27242
6	Fz [N]	0.1306	-1.45514	71.6892	145.094	2.04036		uz [µm]	0.00812	0.0004	0.0204	-3.13602	-0.22788
7	My [Nm]	0.00241	-0.00208	0.14736	0.94654	0.04104		ry [mrad]	-0.00554	-0.00011	-0.00319	1.55081	0.17424
8	Mz [Nm]	0.08036	-0.23009	0.00208	0.04104	2.04061		rz [mrad]	-0.19395	0.0003	-0.00023	0.17411	8.0433
9	B2 - lose (Generic 6208)												
10		ux [µm]	uy [µm]	uz [µm]	ry [mrad]	rz [mrad]			Fx [N]	Fy [N]	Fz [N]	My [Nm]	Mz [Nm]
11	Fx [N]	2.94889	0.00433	-0.00935	7.57775	72.356		ux [µm]	6.87217	-0.00184	-0.00058	-23.4483	-259.894
12	Fy [N]	0.00433	123.931	-4.60453	0.12204	-0.99832		uy [µm]	-0.00236	0.00809	0.0005	0.00774	0.09363

Figure 52

In the menu 'Report'/'Result tables', it is possible to output the result data by means of matrices (figure 52).

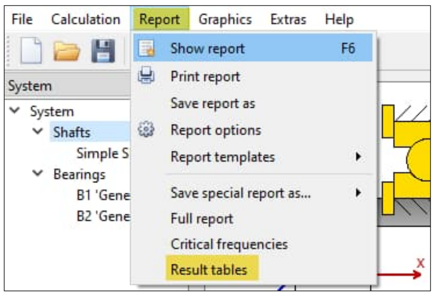
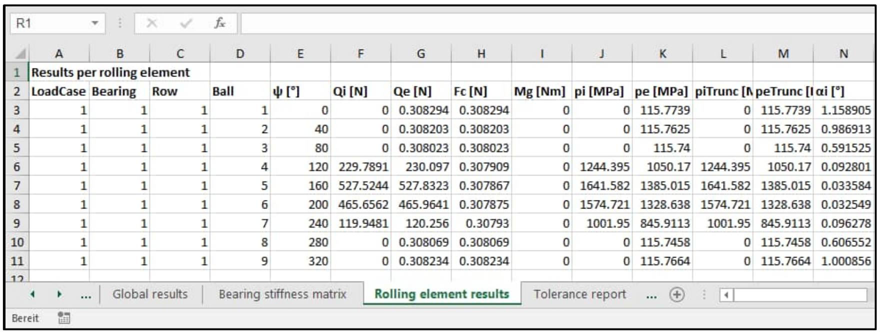


Figure 53

Result tables by means of matrices with detail results for bearings can also be opened (fig. 54) via context with a right click on the bearing in the system tree.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N
1	Results per rolling element													
2	LoadCase	Bearing	Row	Ball	ψ [°]	Qi [N]	Qe [N]	Fc [N]	Mg [Nm]	pi [MPa]	pe [MPa]	piTrunc [N	peTrunc [I	αi [°]
3	1	1	1	1	0	0	0.308294	0.308294	0	0	115.7739	0	115.7739	1.158905
4	1	1	1	2	40	0	0.308203	0.308203	0	0	115.7625	0	115.7625	0.986913
5	1	1	1	3	80	0	0.308023	0.308023	0	0	115.74	0	115.74	0.591525
6	1	1	1	4	120	229.7891	230.097	0.307909	0	1244.395	1050.17	1244.395	1050.17	0.092801
7	1	1	1	5	160	527.5244	527.8323	0.307867	0	1641.582	1385.015	1641.582	1385.015	0.033584
8	1	1	1	6	200	465.6562	465.9641	0.307875	0	1574.721	1328.638	1574.721	1328.638	0.032549
9	1	1	1	7	240	119.9481	120.256	0.30793	0	1001.95	845.9113	1001.95	845.9113	0.096278
10	1	1	1	8	280	0	0.308069	0.308069	0	0	115.7458	0	115.7458	0.606552
11	1	1	1	9	320	0	0.308234	0.308234	0	0	115.7664	0	115.7664	1.000856

Figure 54

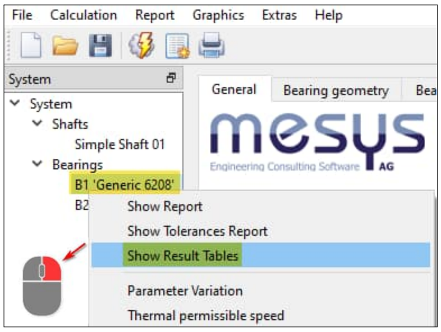


Figure 55

10.3.5 Tolerances Report

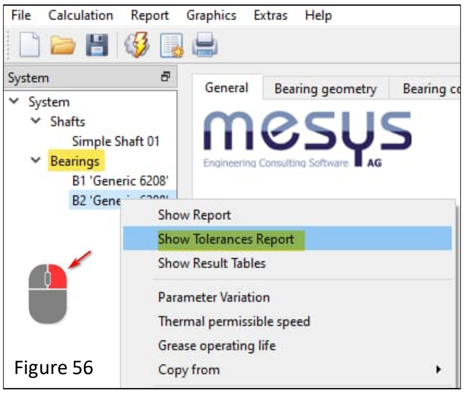


Figure 56

Let us now return to the practical content of this exercise. The question is now mature to understand if our chosen fits are the right ones for the intended speed and temperature.

A special report for tolerances can be created by right-clicking on 'B1' or 'B2' (Fig. 56). If a rolling bearing tolerance, radial or axial clearance is assigned under 'System'/'Shafts'/'Bearings'/B1 or B2 in the 'Bearing geometry' tab (refer to figure 29), pressure and interference of the bearing seats and resulting bearing clearances for Min, Mean, Max, and Probable can be output. If you want to print the 'Full report' (Figure 47), the information mentioned above is already included.

So let's see what the interference looks like at the bearing seats and what residual clearance is left on B1, taking into account the selected fits of ISO tolerance grades 6 / 7 (refer to figure 29), centrifugal force and temperature:

Print the tolerance report for B1.

Table 1

Properties for different clearance		Minimum	Minimum probable	Mean value	Maximum probable	Maximum	Unit
Nominal diametral clearance	Pd	6.00	7.99	13.00	18.01	20.00	µm
Tolerance shaft	Δds	18.00	15.71	10.00	4.29	2.00	µm
Tolerance bearing inner ring	Δd	-12.00	-10.29	-6.00	-1.71	0.00	µm
Interference inner ring	Iw_i	28.40	24.40	14.40	4.40	0.40	µm
Effective interference inner ring	Iw_iop	28.39	24.39	14.39	4.39	0.39	µm
Pressure inner ring	pFit_i	20.14	17.30	10.20	3.11	0.28	MPa
Tangential stress inner ring	sigt_i	101.64	87.33	51.55	15.77	1.46	MPa
Mounting force inner ring (µfit=0.1)	Ffit_i	4556.3	3913.7	2308.2	704.3	63.1	N
Tolerance bearing outer ring	ΔD	0.00	-1.56	-6.50	-11.44	-13.00	µm
Tolerance housing	ΔDh	0.00	3.59	15.00	26.41	30.00	µm
Interference outer ring	Iw_e	-1.60	-6.75	-23.10	-39.45	-44.60	µm
Effective interference outer ring	Iw_eop	-1.60	-6.75	-23.10	-39.45	-44.60	µm
Pressure outer ring	pFit_e	0.00	0.00	0.00	0.00	0.00	MPa
Tangential stress outer ring	sigt_e	0.00	0.00	0.00	0.00	0.00	MPa
Mounting force outer ring (µfit=0.1)	Ffit_e	0.0	0.0	0.0	0.0	0.0	N
Change of diametral clearance	ΔPd	-19.24	-13.66	-9.76	-5.86	-0.28	µm
Effective diametral clearance	Pdeff	-13.24	-5.67	3.24	12.15	19.72	µm
Effective axial clearance	Paeff	-	-	75.80	146.46	186.23	µm
Effective free contact angle	α0eff	0.00	0.00	4.89	9.48	12.09	°

It can be seen in Table 1, that the interference at the inner ring under 'Effective Interference inner ring' is still positive even in the worst case (Maximum). On the other hand, the residual radial clearance is no longer sufficient even at Minimum probable!
It should also be taken into account that the inner ring rotating under rotary load will probably experience a temperature higher than 20°C.

Change temperature of shaft to 25° C.

Change the radial clearance to class C3 for both bearings.

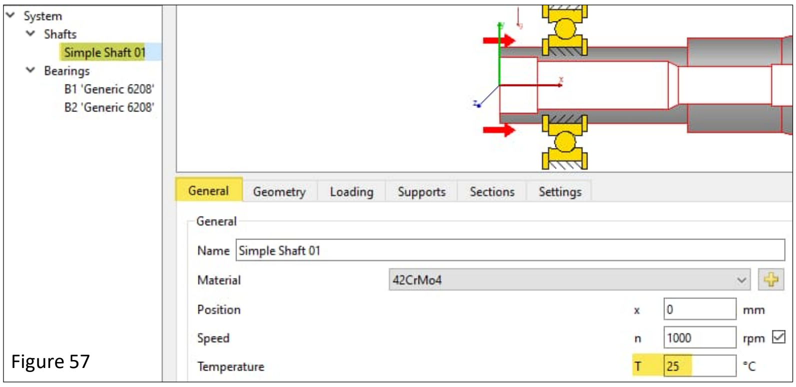


Figure 57

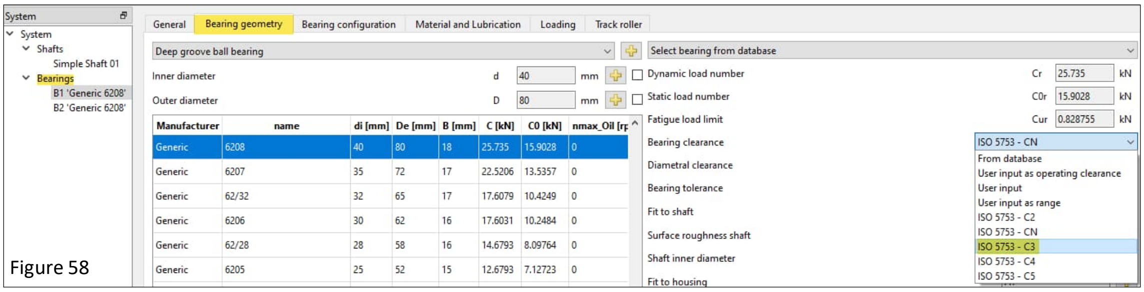


Figure 58

Run the Tolerance Report again.

Table 2

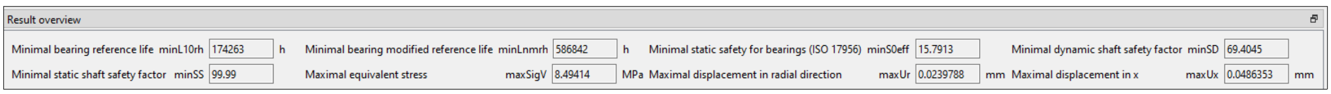
Properties for different clearance		Minimum	Minimum probable	Mean value	Maximum probable	Maximum	Unit
Effective diametral clearance	Pdeff	-8.33	0.34	10.15	19.96	28.64	µm
Effective axial clearance	Paeff	-	24.61	133.94	187.32	223.82	µm

It can be seen in Table 2, that an internal clearance C3 could prevent radial preload. However, it should be noted that the temperature gradient is usually not known exactly and that this clearance design should be checked again in practice!

11. Analysis

11.1 Bottom result window

Figure 59

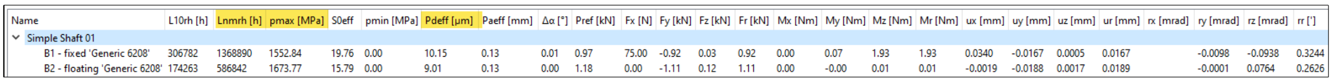


Result overview

Minimal bearing reference life	minL10rh	174263	h	
Minimal bearing modified reference life	minLnmrh	586842	h	
Minimal static safety for bearings (ISO 17956)	minS0eff	15.7913		
Minimal dynamic shaft safety factor	minSD	69.4045		
Minimal static shaft safety factor	minSS	99.99		
Maximal equivalent stress	maxSigV	8.49414	MPa	
Maximal displacement in radial direction	maxUr	0.0239788	mm	
Maximal displacement in x	maxUx	0.0486353	mm	

Above tooltip window shows significant results of the simulation such as minimum modified reference life, structural safety factors, equivalent stress and maximum axial and radial deviation from deformations of the shaft.

11.2 Lower results window



Name	L10rh [h]	Lnmrh [h]	pmax [MPa]	S0eff	pmin [MPa]	Pdeff [µm]	Paeff [mm]	Δα [°]	Pref [kN]	Fx [N]	Fy [kN]	Fz [kN]	Fr [kN]	Mx [Nm]	My [Nm]	Mz [Nm]	Mr [Nm]	ux [mm]	uy [mm]	uz [mm]	ur [mm]	rx [mrad]	ry [mrad]	rz [mrad]	rr [']
Simple Shaft 01																									
B1 - fixed 'Generic 6208'	306782	1368890	1552.84	19.76	0.00	10.15	0.13	0.01	0.97	75.00	-0.92	0.03	0.92	0.00	0.07	1.93	1.93	0.0340	-0.0167	0.0005	0.0167		-0.0098	-0.0938	0.3244
B2 - floating 'Generic 6208'	174263	586842	1673.77	15.79	0.00	9.01	0.13	0.00	1.18	0.00	-1.11	0.12	1.11	0.00	-0.00	0.01	0.01	-0.0019	-0.0188	0.0017	0.0189		-0.0001	0.0764	0.2626

Figure 60

-> The values for Hertzian pressure (pmax) are at a reasonable level
-> The effective mean radial clearance (Pdeff) has a positive value
-> The tilting (rr) is well within the permissible values specified by manufacturers

-> The modified reference service life (Lnmr) is at a particularly comfortable level

11.3 Graphics

It is possible to analyse the application in depth using graphical representations of numerous shaft and bearing parameters.

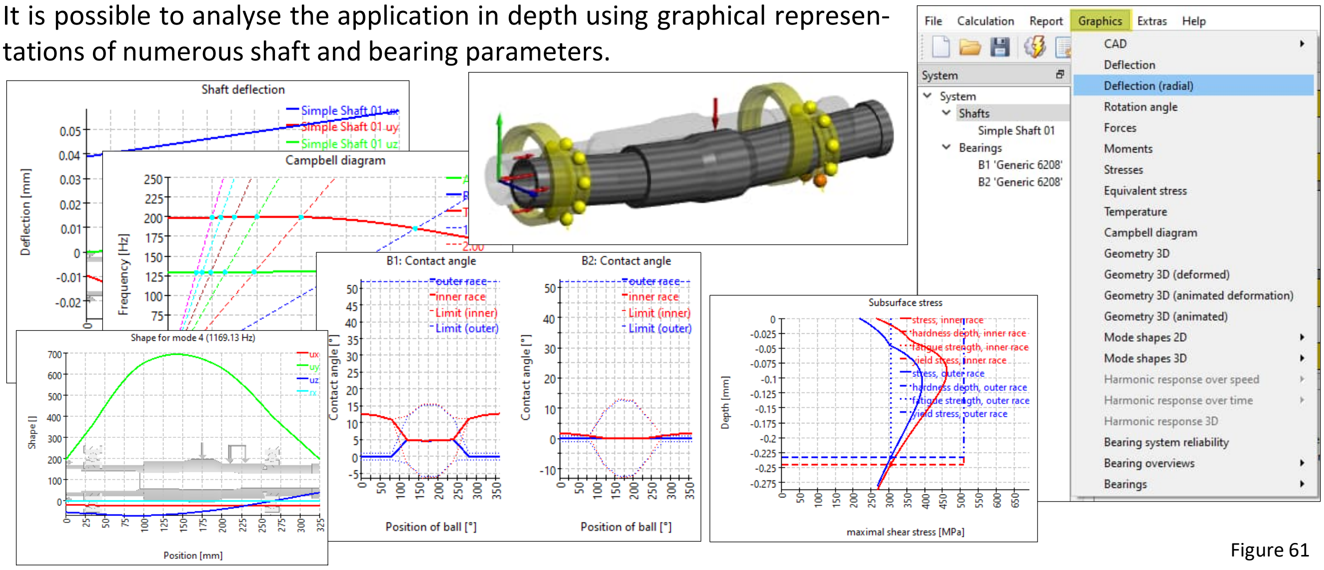


Figure 61

11.4 Load Spectrum

Another method of analysing application behaviour is to consider different conditions or load states. Work with load spectra under such conditions.
If the flag for the calculation with load spectrum is set on the 'System' page, an additional item titled load spectrum is shown in the system tree.

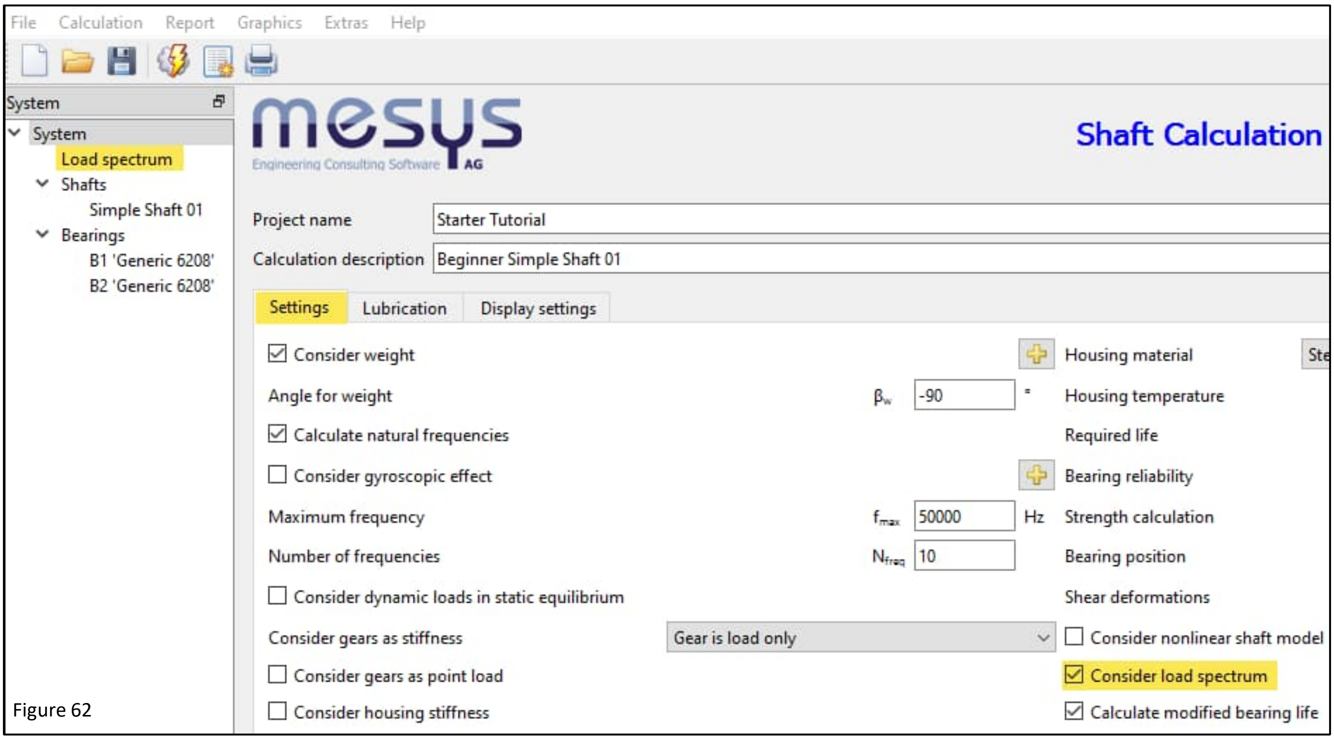


Figure 62

Activate the load spectrum mode via the corresponding field.

Under this setting, you have the option of loading the variable parameters into the table via the context menu and then assigning values to them, as demonstrated in following figure 63:

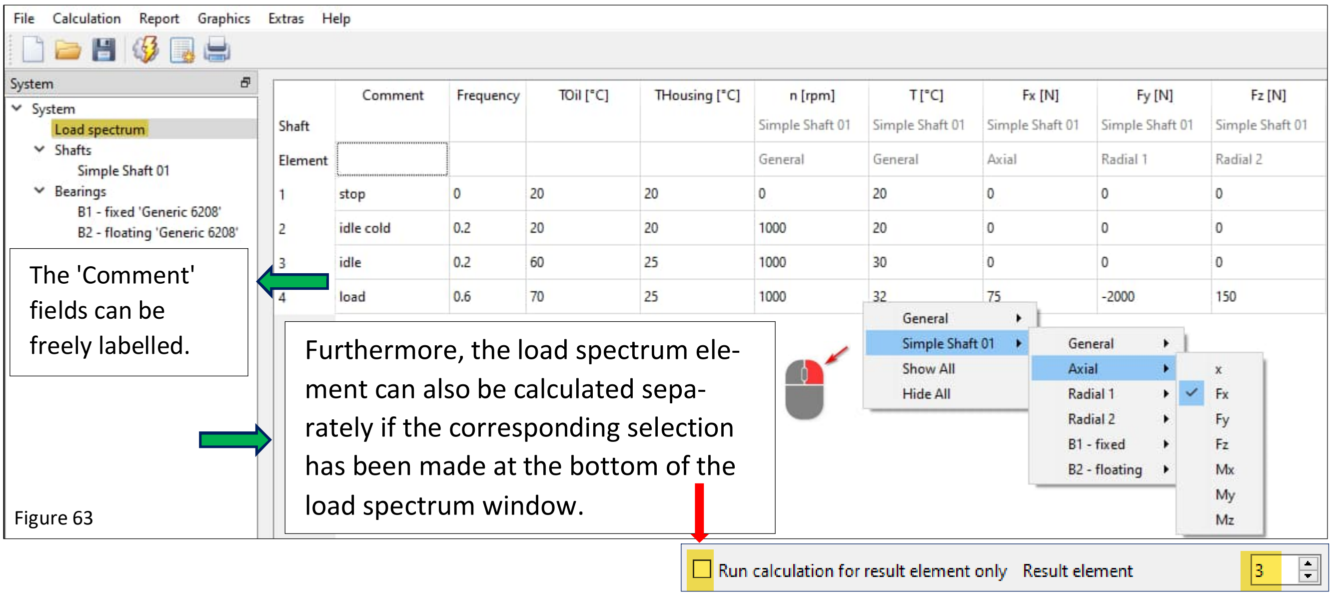
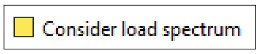
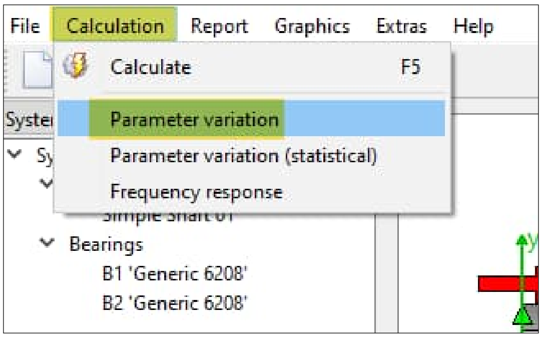


Figure 63

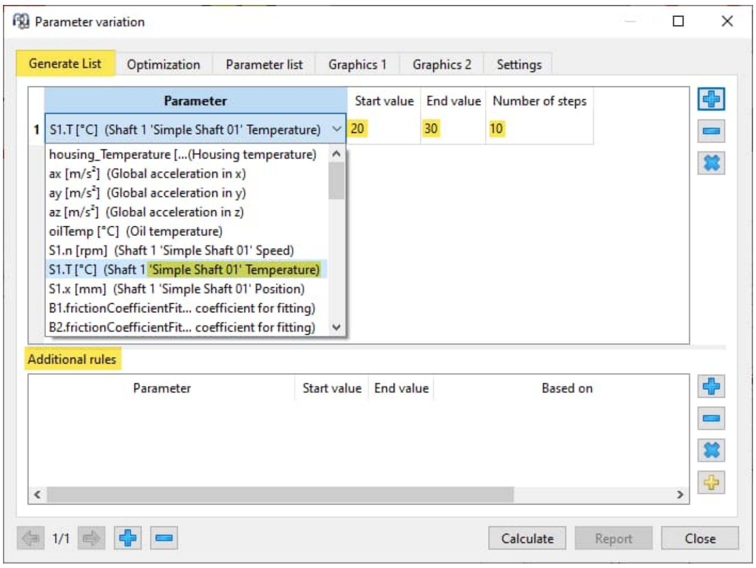
Enter the load spectrum according to the contents in Fig. 63.
Calculate the shaft using the corresponding button. 
Evaluate the results in the lower results window.
Deactivate the load spectrum mode. 

11.5 Parameter Variations

Figure 64

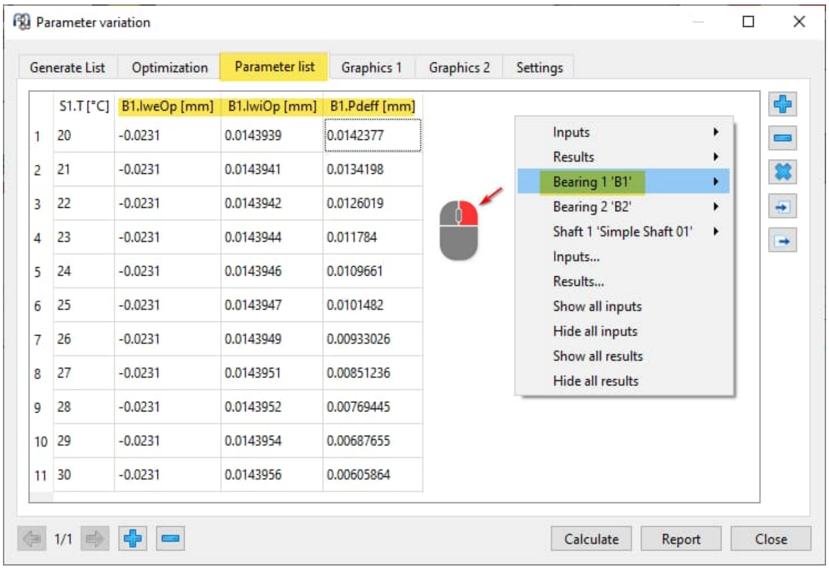


Using the menu point 'Calculation'/'Parameter variation' a dialog for parameter variations is shown. It allows the user to do parameter studies with results provided in tables and graphics. Typical applications are for example visualizing life over clearance, displacement over load or as shown here in the following, clearance over temperature. An optional optimization max., min. for parameter is available too. Further general information on parameter variation can be found in the Manual.



One or more parameters can be configured in 'Generate List'. These can be supplemented with 'Additional Rules'.

Figure 65



Under the 'Parameter list' tab, the required parameter results based on the given parametrization can now be chosen via the context menu.

Figure 66

Parameterisation of the shaft temperature (Fig. 67) to analyse the radial clearance and the effective mean interference Shaft / inner ring.

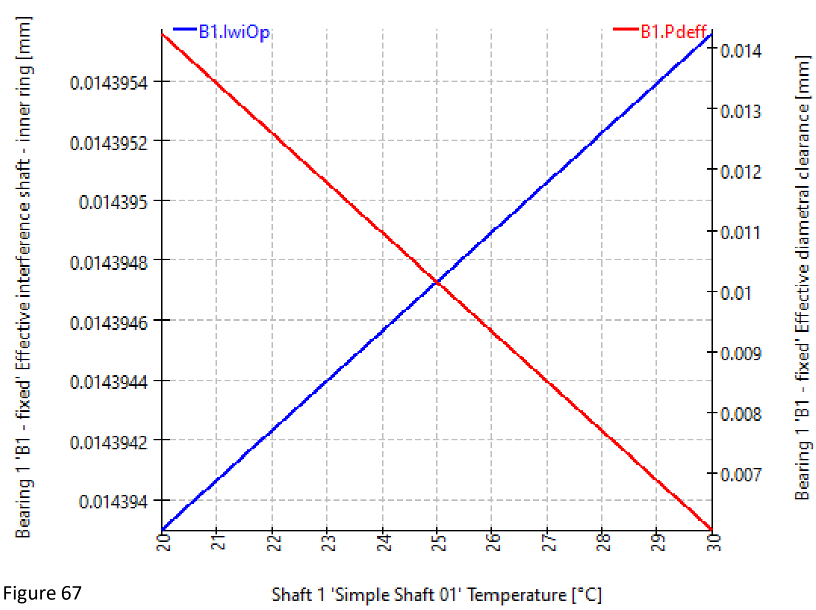


Figure 67

Perform the parameter study shown in figure 67.

MESYS wishes you an instructive and profitable experience with our tutorials. If you have any questions, suggestions or queries, please do not hesitate to contact info@mesys.ch .