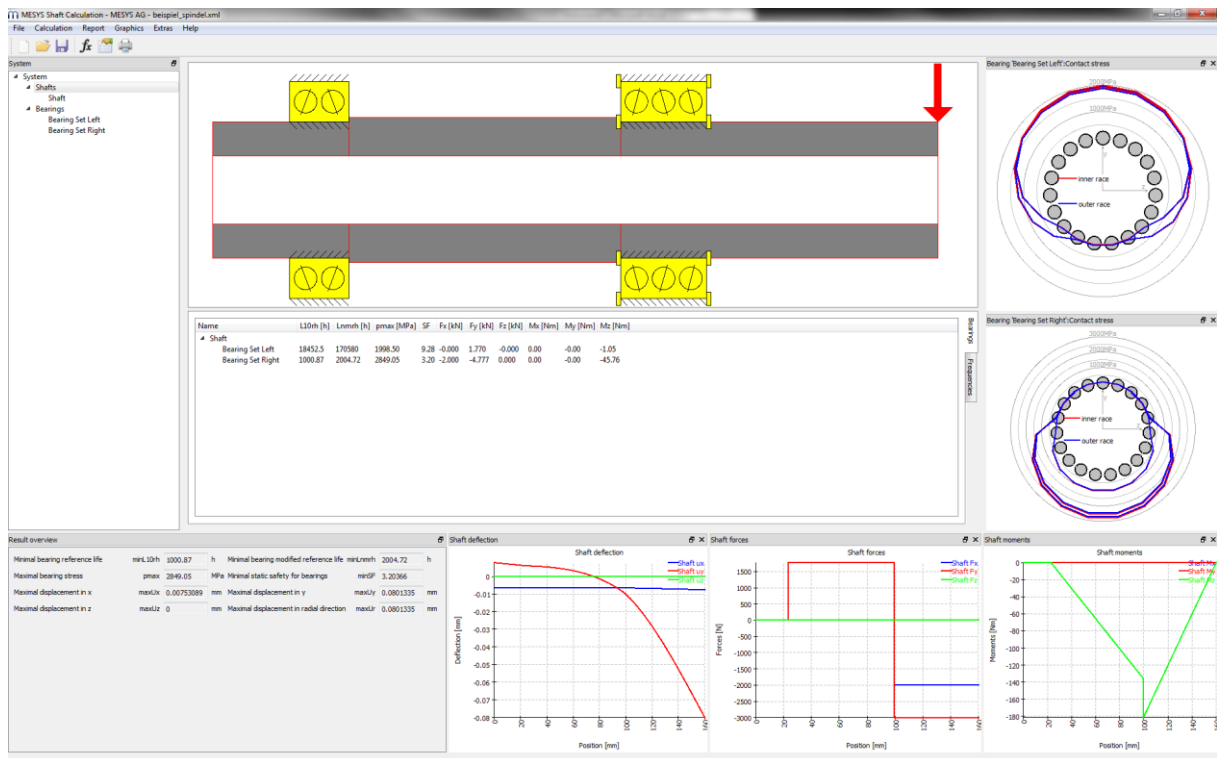# MESYS Shaft Calculation

The shaft calculation allows the calculation of displacement, forces, strength according DIN 743 and bearing life for several connected coaxial shafts. The MESYS Rolling Bearing Calculation according ISO/TS 16281 is included in the software and the nonlinear stiffness of rolling bearings in considered.
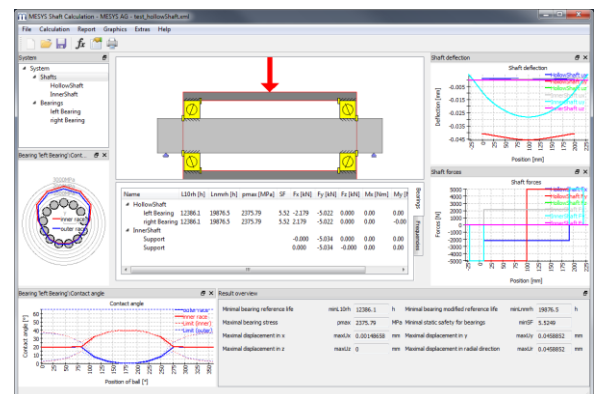
Because of the nonlinear bearing stiffness shafts with more than two bearings can be calculated with accurate bearing forces as result. Pretension of bearings can be considered. Combinations of angular contact bearings can be easily considered as bearing set:

Shaft geometry can be defined using an arbitrary number of cylindrical and conical elements for inner and outer geometry. The geometry input is done using tables.

Loads can be specified as centrical or excentrical forces or as complex load elements like a gear. Boundary conditions are some rigid constraints, springs, constraints with offsets, clearance and stiffness or a rolling bearing. There is no restriction in the number of loads or constraints.
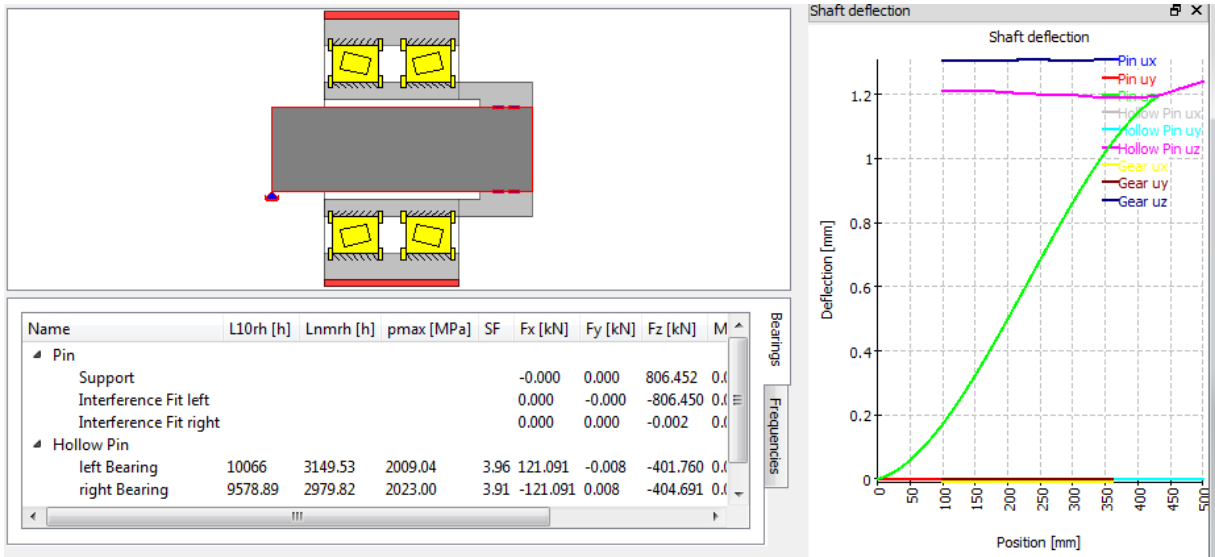

Several coaxial shafts can be defined and connected by rolling bearings or general supports. Shear and axial deformations are considered, a nonlinear shaft model can be used optionally.

Results are provided in a results overview, an additional table for bearing results, several graphics and a PDF report which also includes graphics.

Planetary gear on a flex pin

An example for the usage of several coaxial shafts is the support of a planetary gear using a flex pin. A pin is fixed in the planet carrier on the left side. On this pin there is a hollow shaft which is connected to the planetary gear with taper roller bearings in this example. A seen in the diagram for deflection, the gear stays horizontal and just moves horizontally because of the configuration. Because of the centrical loading both bearings carry the same load. The axial load is introduced by contact angles of the bearing.
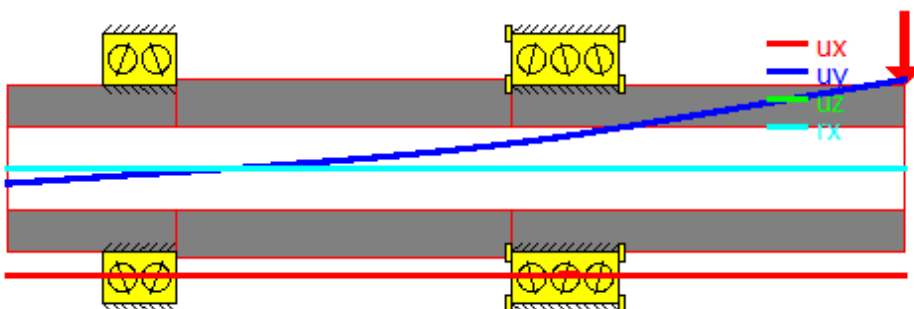

Load spectra

A calculation can be run using load spectra. The elements in the load spectrum can be chosen from load elements, speeds and temperatures. In addition to a run with the whole load spectrum also a single element can be selected.

Natural frequencies and mode shapes

Natural frequencies are calculated considering bending, axial, and torsional modes. These modes can be coupled, like seen here for an axial mode (red) with a bending mode (blue), because of the bearing stiffness.

Additional masses can be defined for each shaft. The gyroscopic effect can be considered and a Campbell diagram is also provided in the software.
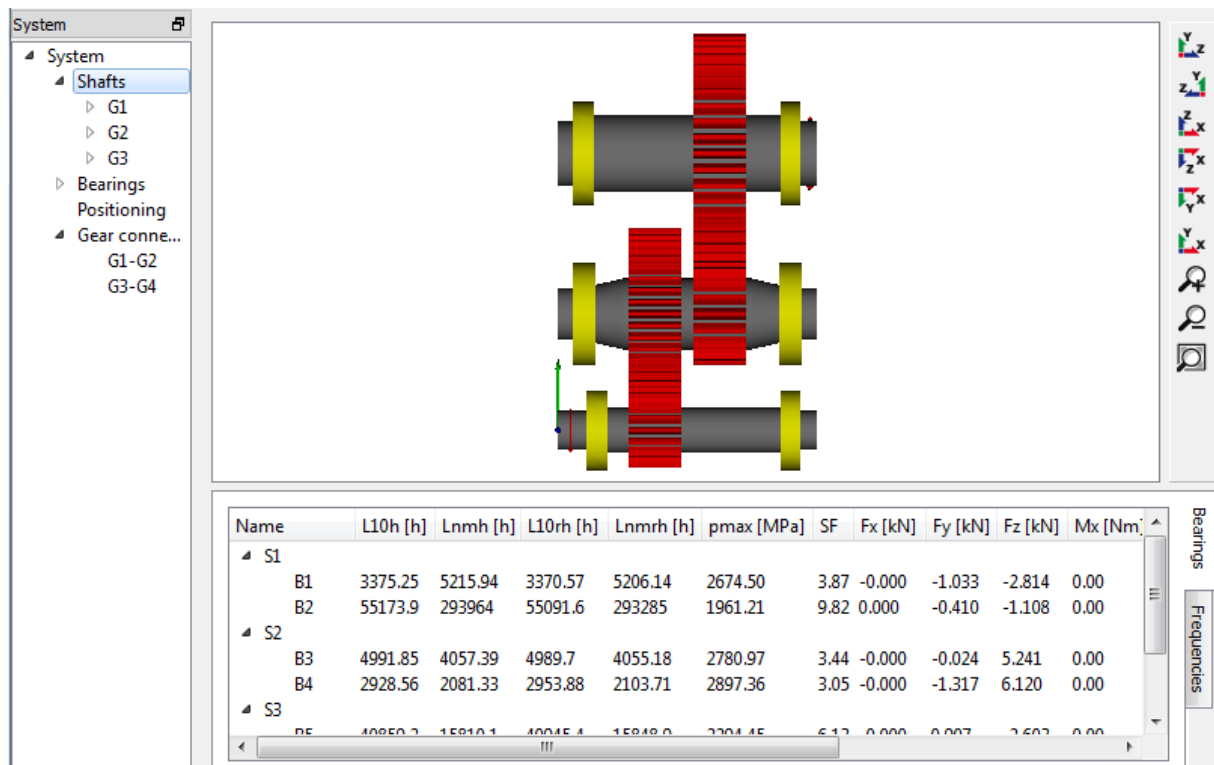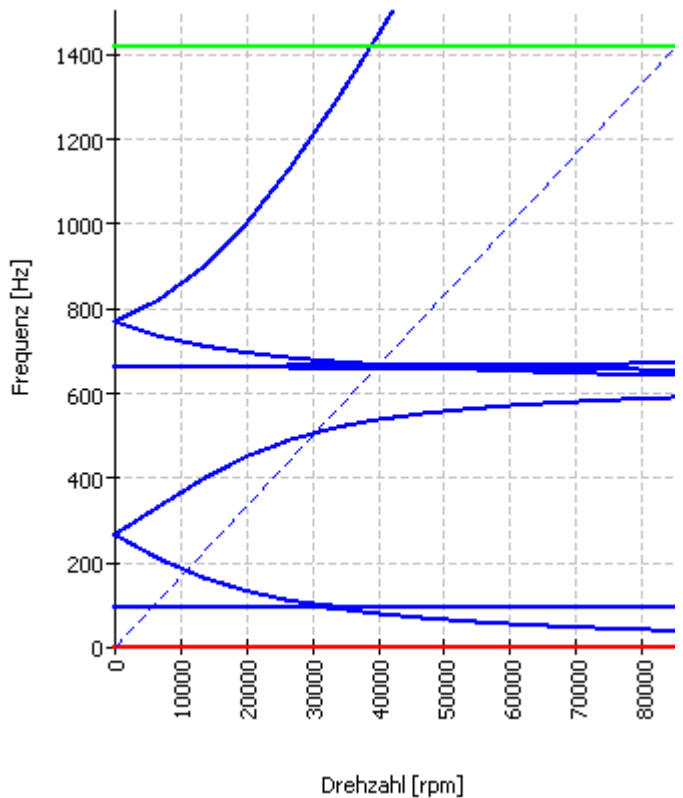
Campbell diagram

The speed dependency of frequencies can be shown in a Campbell diagram. Axial, torsional and bending modes are shown in different color.

The limits and number of calculation steps for generating the diagram can be configured. A separate report for critical frequencies is available.
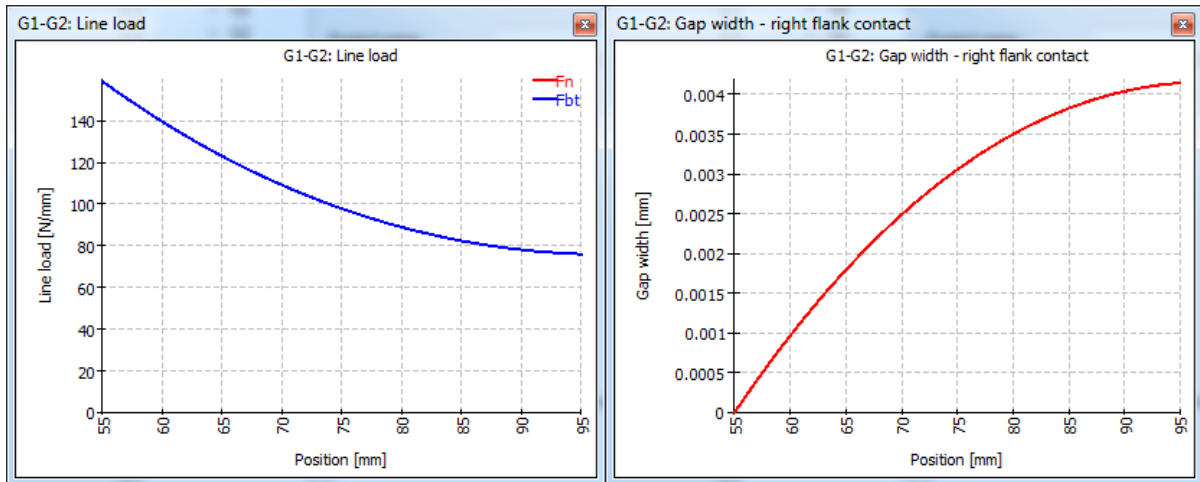
Systems of parallel shafts

Systems of parallel shafts can be modeled. They can be coupled by cylindrical gear pairs. Also general planetary gear stages can be defined.

The rotations speeds of the shafts are calculated using the constraints. Load spectra and different configurations for power flow can also be selected.

Name	L10h [h]	Lnmh [h]	L10rh [h]	Lnmrh [h]	pmax [MPa]	SF	Fx [kN]	Fy [kN]	Fz [kN]	Mx [Nm]
S1										
B1	3375.25	5215.94	3370.57	5206.14	2674.50	3.87	-0.000	-1.033	-2.814	0.00
B2	55173.9	293964	55091.6	293285	1961.21	9.82	0.000	-0.410	-1.108	0.00
S2										
B3	4991.85	4057.39	4989.7	4055.18	2780.97	3.44	-0.000	-0.024	5.241	0.00
B4	2928.56	2081.33	2953.88	2103.71	2897.36	3.05	-0.000	-1.317	6.120	0.00
S3										
B5	40850.2	15810.1	40045.4	15848.0	2204.45	6.12	0.000	0.007	2.602	0.00

Gear pairs are considered as line load considering a mesh stiffness. The load distribution over the width of the gears provides a hint for necessary flank line corrections.
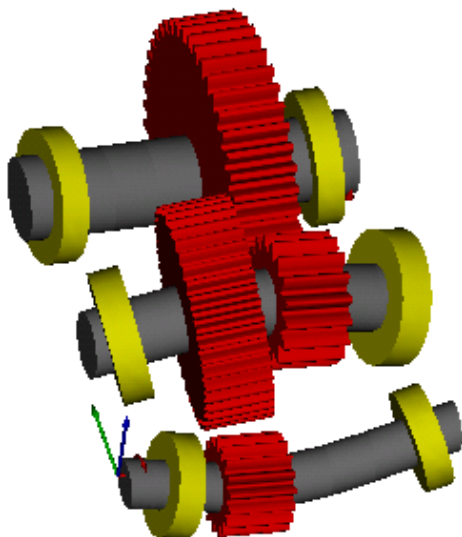
For the inputs of gear data in addition to the single force elements on the shaft an input of gear data is available for the connection.

Gear pairs can be coupled with several programs for gear calculations. The safety factors of gear sets are available in the results overview of the shaft calculation.

Natural frequencies on system level

Frequencies can be calculated on system level too. Gear pairs lead to a coupling of axial, torsional and bending modes. Mode shapes can be animated in the 3D view.

Shaft	S1	S2	
Gear	G1	G2	
Position	75	75	mm
Number of teeth	17	43	
Width	40	40	mm
Profile shift coefficient	0.3289	-0.3289	
Normal module	m_n	3	mm
Normal pressure angle	α_n	20	°
Helix angle	β	0	°
Helix direction	Spur gear	Spur gear	
Center distance	a	90	mm
Circumferential backlash	j_t	0.1	mm
Gear mesh stiffness	c_γ	20	N/mm/µm
Calculation	eAssistant		

Strength calculation

Shaft strength can be calculated according to DIN 743 (2012). All notch factors of the standard can be selected in the software.

In calculations with load spectrum either a calculation for infinite life for each load can be run or a calculation with an equivalent amplitude according to DIN 743 part 4.

Contact

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A demo version and the software documentation are available as download on the website. Please ask for a test version without restrictions.