KISSsoft
Calculation programs for machine design

Optimizing a cylindrical bearing as used in a planetary gearbox

Bearing designer, KISSsoft release 03-2017

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SHARING KNOWLEDGE

1 Document information

1.1 Document change record

Revision	Date	Author	Comments
0	15.5.15	HD	Original document

1.2 Table of content

1.3 References

[1] KISSsoft 03-2017A

2 Example application

2.1 Gearbox model

A bevel helical planetary gearbox with input speed of 1700RpM, input torque of 3000Nm and 534kW power is analyzed. The first stage is a spiral bevel gear. The second stage is a spur gear (cylindrical) and the output stage is a planetary stage with four planets. Each planet has four planet bearings. The system is shown below.

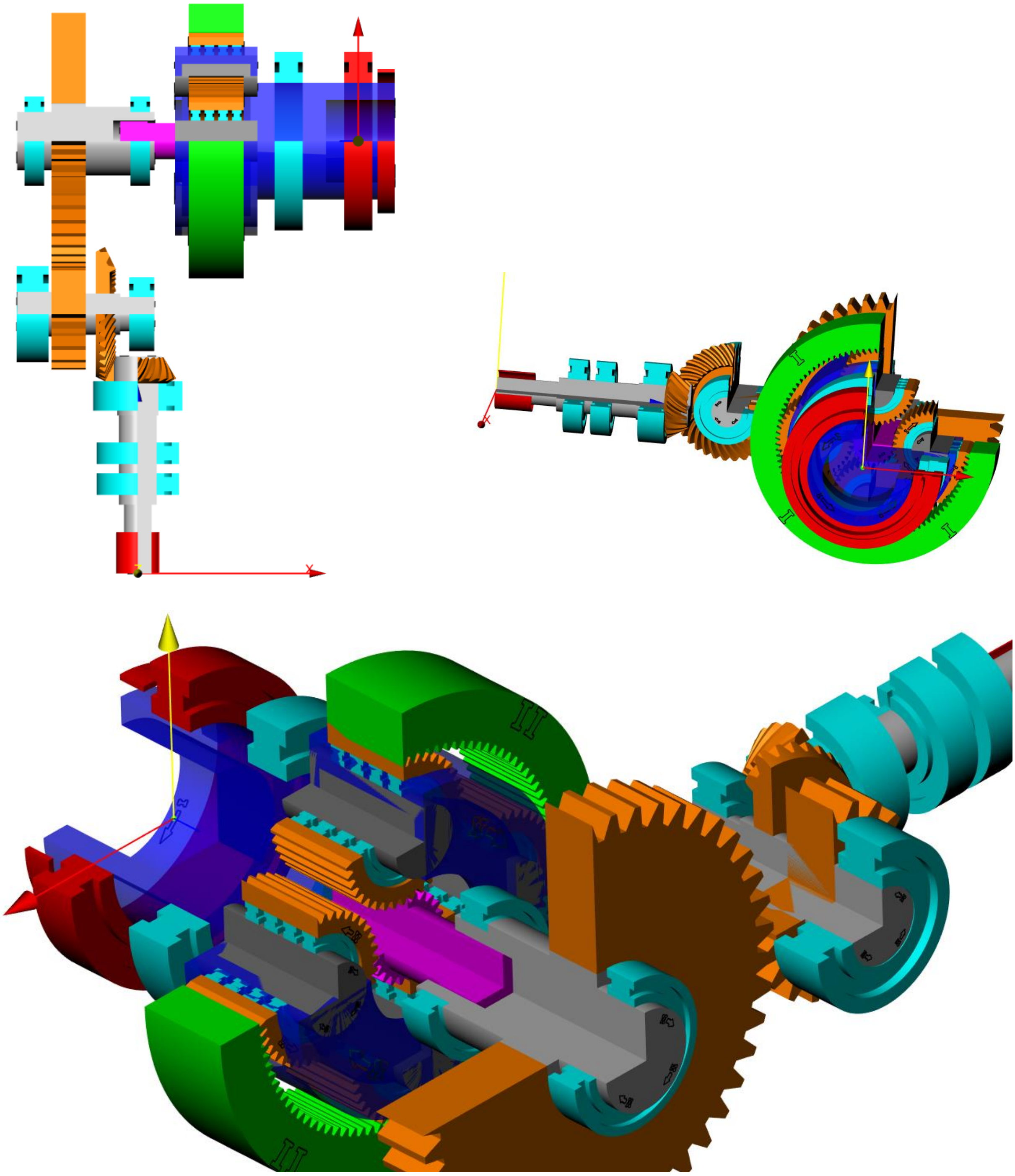


Figure 2.1-1 Gearbox model.

See file “THE-KSO-AS-1753-00-EES-Bearing-Designer.ks”.

In this example, we find that the two outermost bearings have a low lifetime at 3396 hours only:

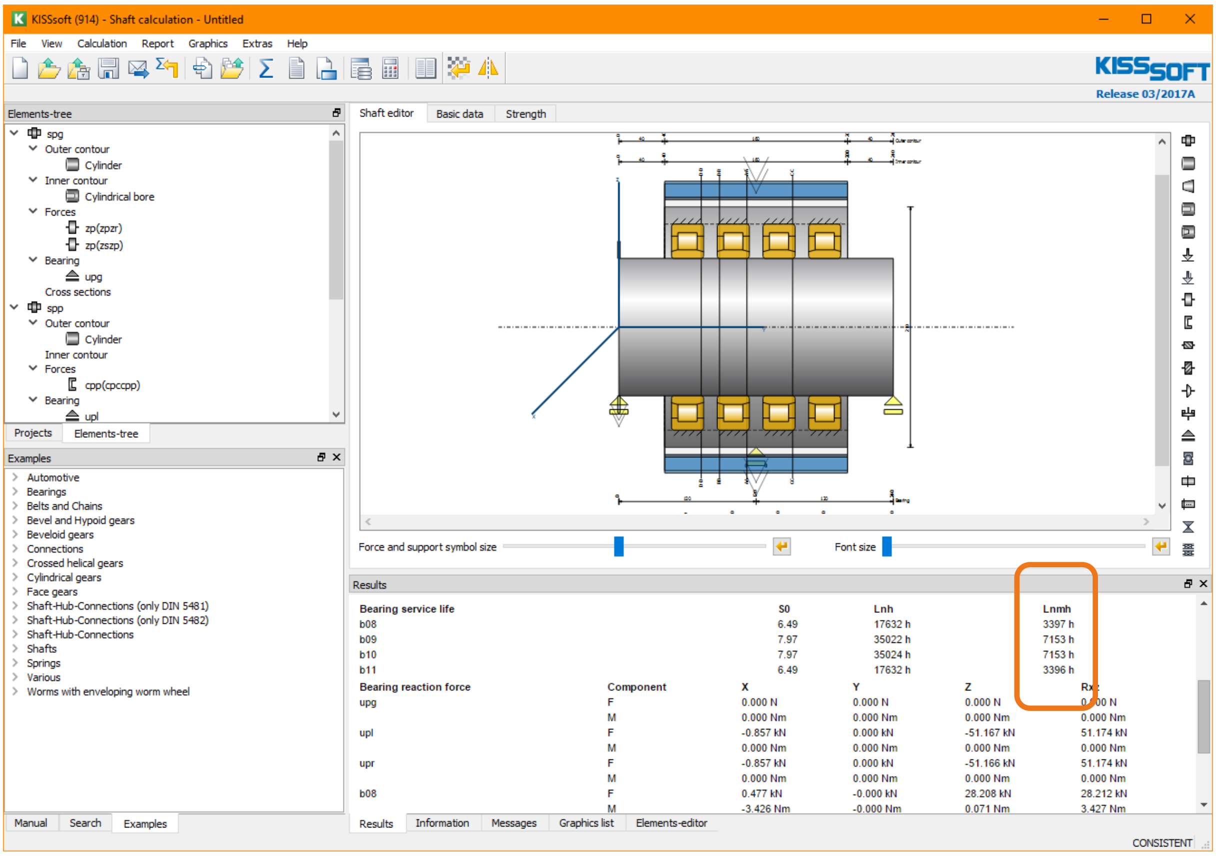


Figure 2.1-2 Resulting bearing life in the planet.

Using “File/Save as”, we can export the shaft model and save it:

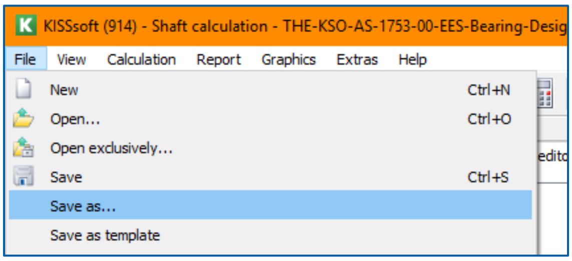


Figure 2.1-3 Export of the shaft model from KISSsys into a separate KISSsoft file.

2.2 Import of the bearing data

Start the bearing design tool by opening the module “Rolling bearing ISO/TS 16281”:

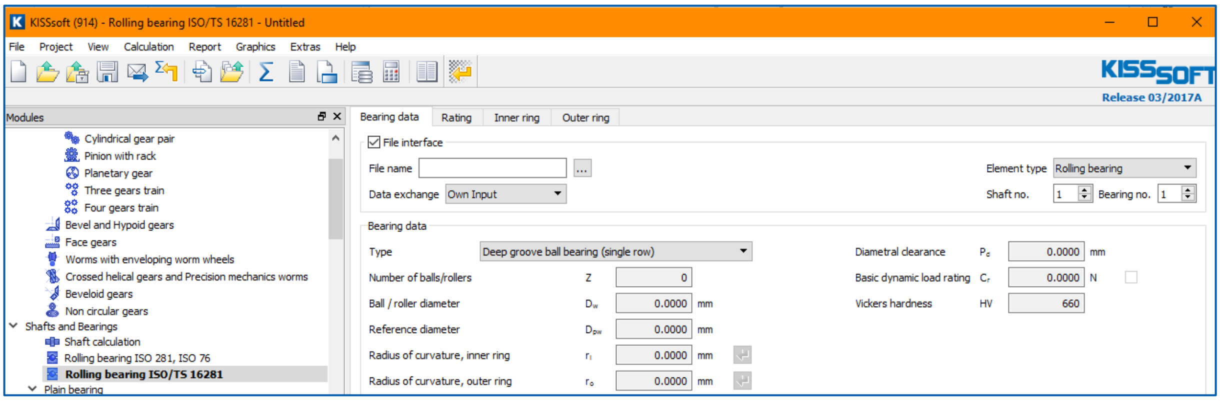


Figure 2.2-1 Module for single bearing calculation with inner geometry.

Now, import the previously save shaft file. Select that the bearing load is imported and select that the first connecting roller bearing is imported (the one on the left side, with the lowest life):

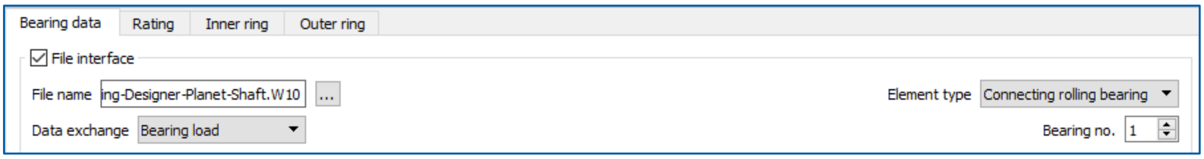


Figure 2.2-2 Import of the shaft file previously exported from KISSsys.

Run the calculation / import by pressing “F5”. The bearing inner geometry is then estimated as shown below:

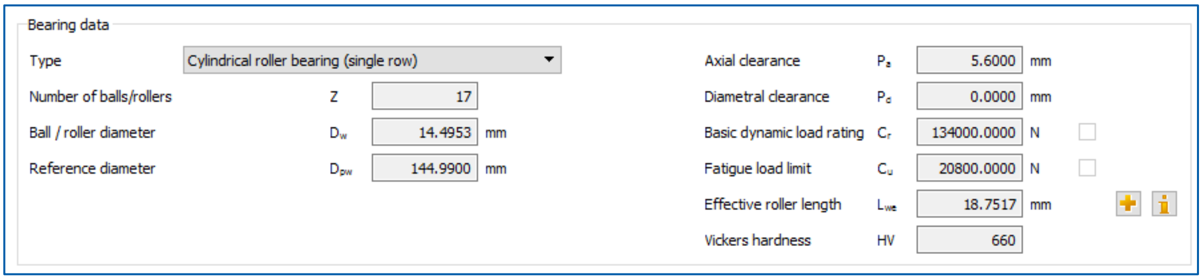


Figure 2.2-3 Bearing data, original design.

See file “THE-KSO-AS-1753-00-EES-Bearing-Designer-Left-Side-Bearing-Step-1.W51”

2.3 Calculation with given bearing data

We can now remove the link to the external shaft file:

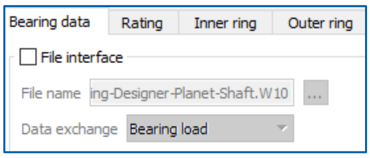


Figure 2.3-1 Remove the link to the external shaft file.

And we adjust the (estimated) bearing data to rounded values:

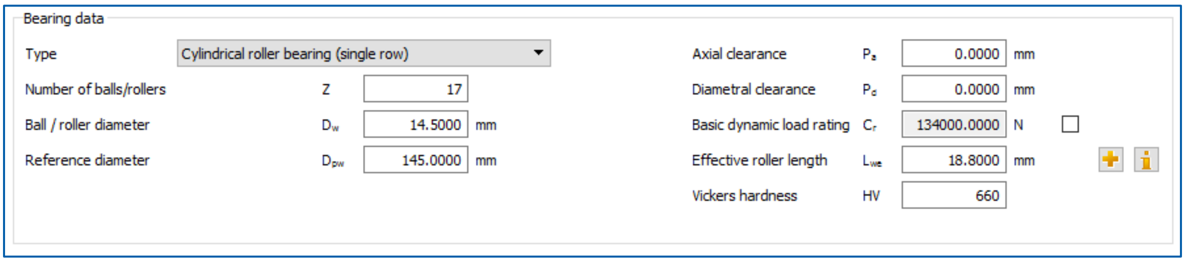


Figure 2.3-2 Rounded values for bearing data.

When running the calculation, we find the load capacity of Cr=134 kN.

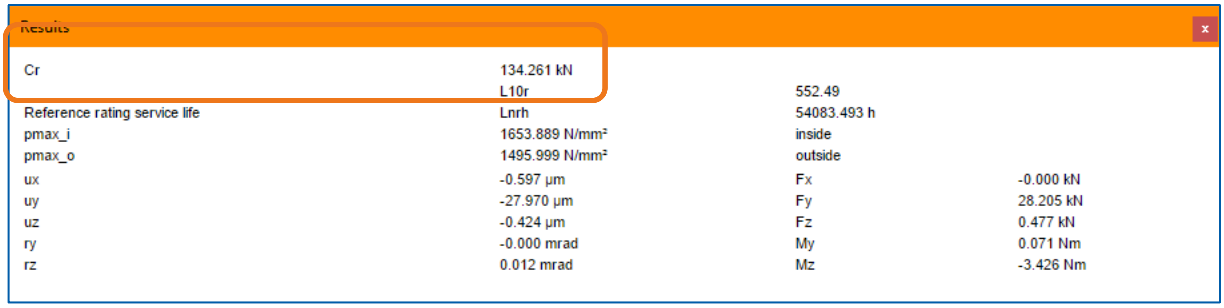


Figure 2.3-3 Resulting capacity for original bearing design.

The stress distribution in the bearing is as shown below:

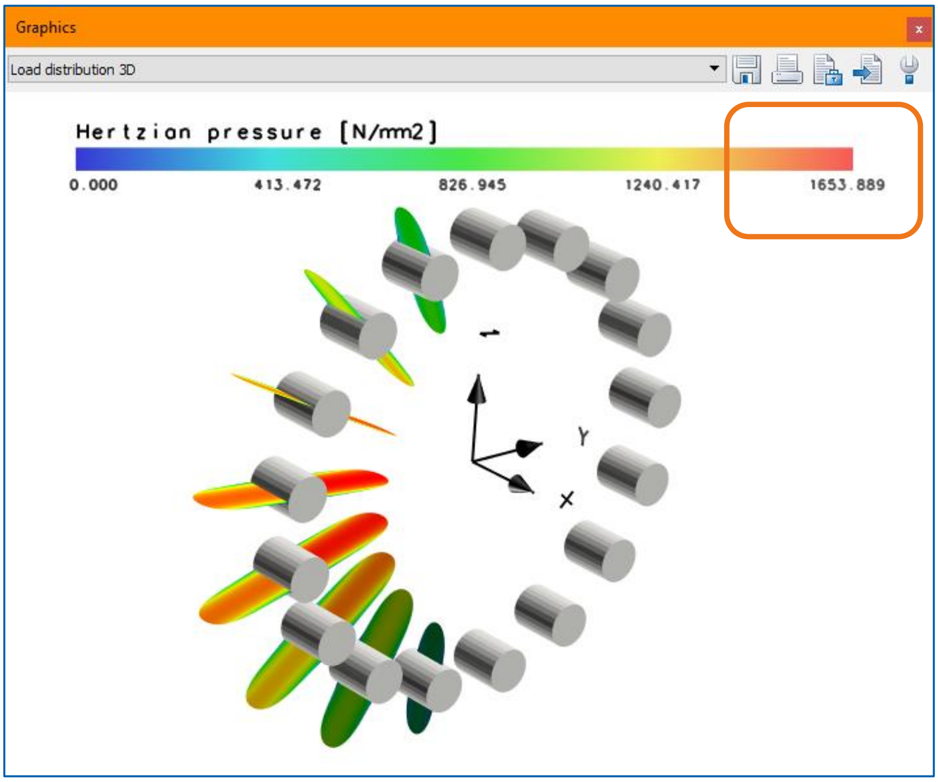


Figure 2.3-4 Stress level of about 1650MPa in the bearing.

See file “THE-KSO-AS-1753-00-EES-Bearing-Designer-Left-Side-Bearing-Step-2.W51”

2.4 Bearing fine sizing

Use the bearing fine sizing function and set it up as shown below:

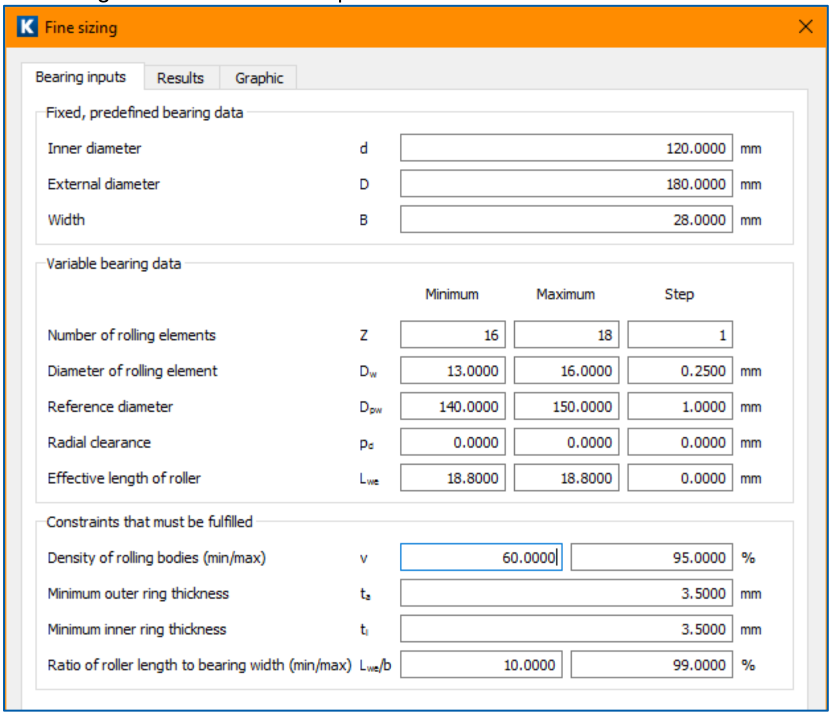
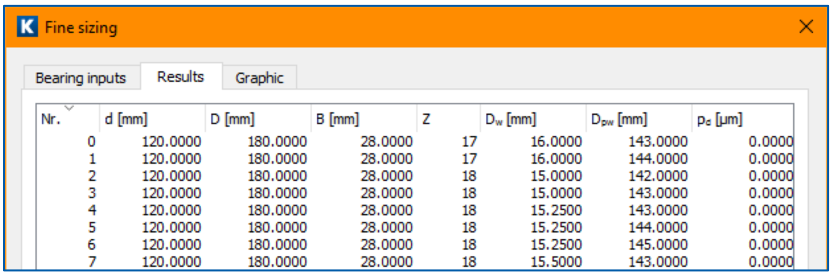


Figure 2.4-1 Bearing fine sizing, setup

Run the calculation and find several possible bearing designs with different roller diameter, pitch diameter and so on:



Nr.	d [mm]	D [mm]	B [mm]	Z	D_w [mm]	D_{pw} [mm]	p_d [µm]
0	120.0000	180.0000	28.0000	17	16.0000	143.0000	0.0000
1	120.0000	180.0000	28.0000	17	16.0000	144.0000	0.0000
2	120.0000	180.0000	28.0000	18	15.0000	142.0000	0.0000
3	120.0000	180.0000	28.0000	18	15.0000	143.0000	0.0000
4	120.0000	180.0000	28.0000	18	15.2500	143.0000	0.0000
5	120.0000	180.0000	28.0000	18	15.2500	144.0000	0.0000
6	120.0000	180.0000	28.0000	18	15.2500	145.0000	0.0000
7	120.0000	180.0000	28.0000	18	15.5000	143.0000	0.0000

Figure 2.4-2 Resulting bearing proposals.

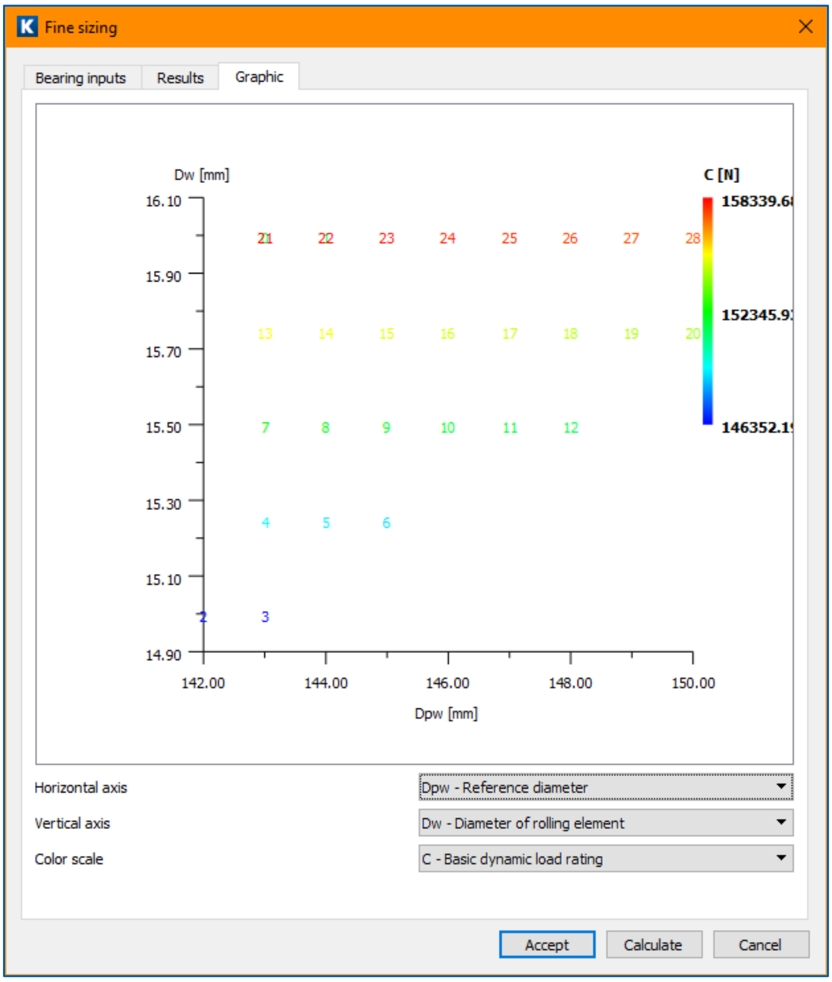


Figure 2.4-3 Graphical display of capacity vs. roller diameter and bearing pitch diameter.

Select the bearing design with the highest capacity as result and press “Accept”. The bearing data is transferred and the calculation is executed.

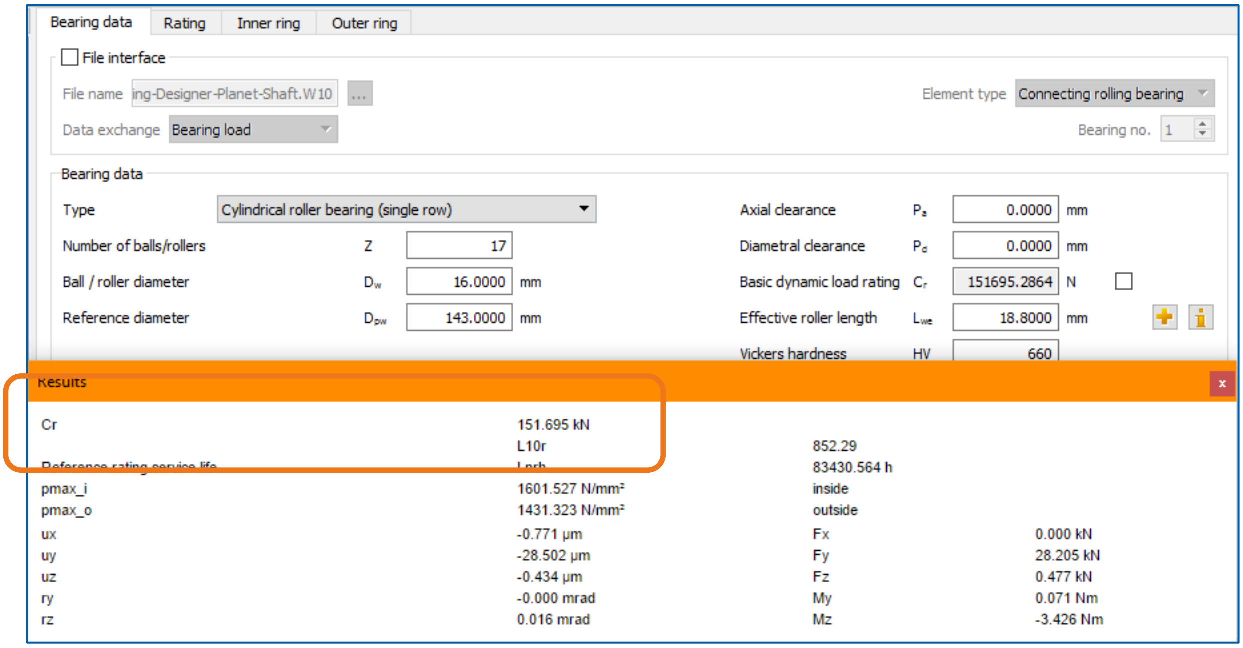


Figure 2.4-4 Resulting bearing design and resulting capacity.

With the modified bearing design, the contact pressure has now dropped to about 1600MPa. Accordingly, the capacity has increased from 134.0 kN to 151.7 kN.

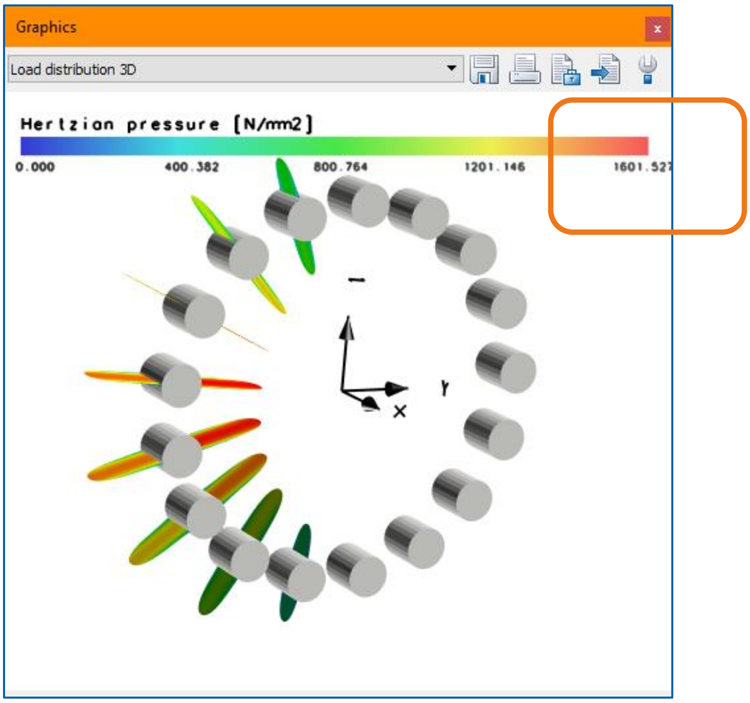


Figure 2.4-5 Improved bearing design with lower contact stress.

See file “THE-KSO-AS-1753-00-EES-Bearing-Designer-Left-Side-Bearing-Step-3.W51”