Bevel and hypoid gears

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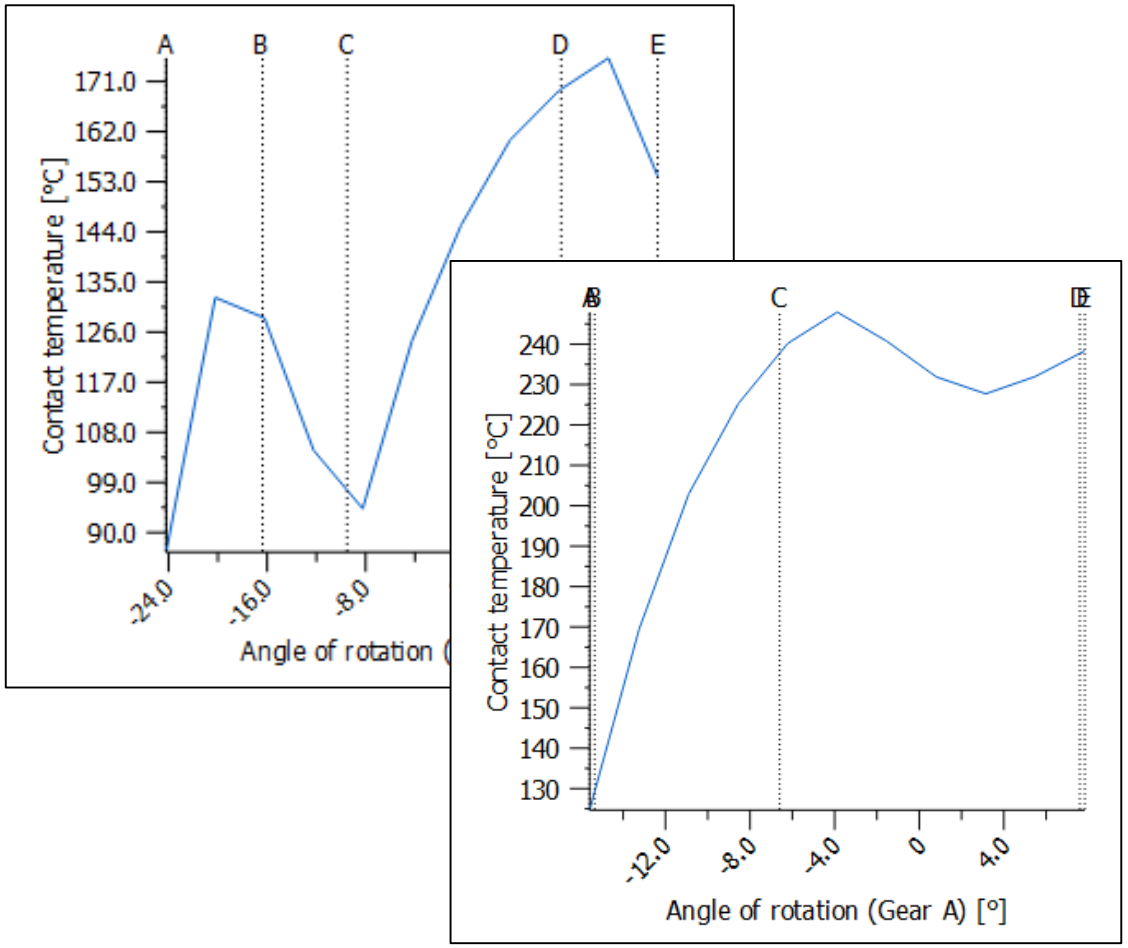
Scuffing (ISO / DTS 10300-20)

- based on flash temperature method
- considers hypoid gears much more precise
- local calculation at 10 points over the path of contact

Major effects are:

- oil has a big influence (e.g. GL5)
- profile crowning leads to decreased load
- running in is very benefitial



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Flank fracture (ISO 10300-4)

- based on theory from Dr. Witzig
- comparison of shear stresses

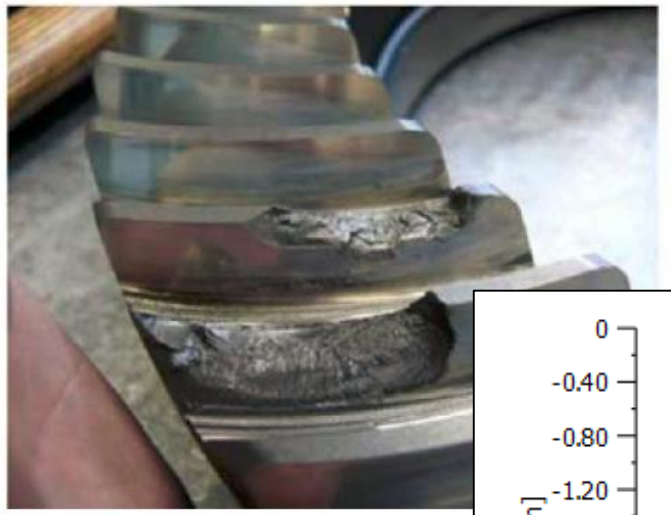
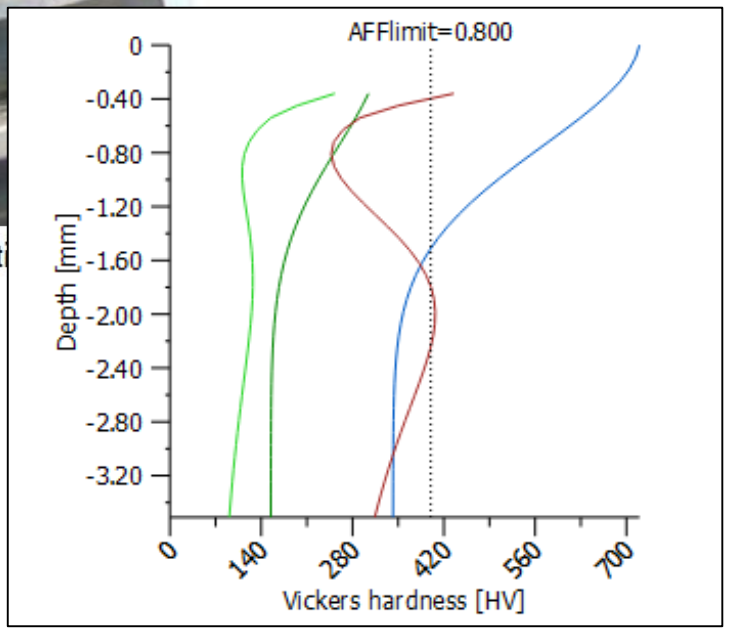


Figure 1 Flank breakage and pitti



Major effects are:

- residual stresses
- hardness course
- Material cleaniness

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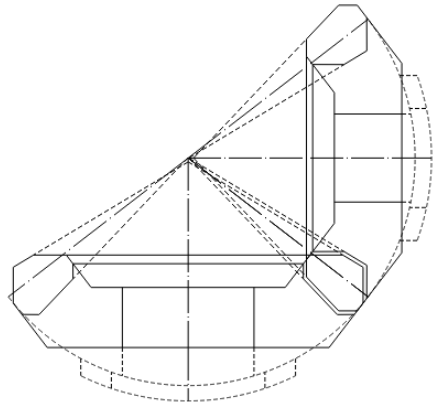
Differential bevel gears (forged bevel gears)

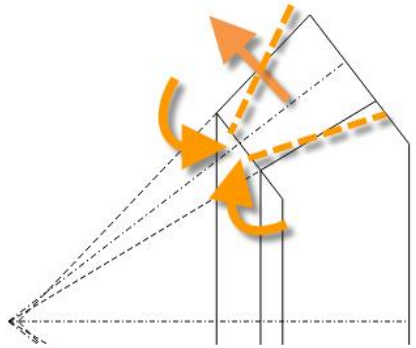
Webbing dimensions are determined
- based on webbing thickness
- max. pressure at trust washer

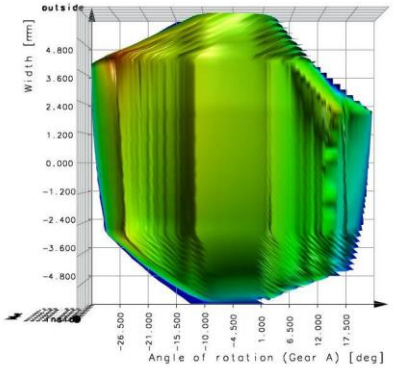
Sizing of differential bevel gears
- variation of tooth proportions and cone angles
- evaluation of contact ratio etc., at inner, mean and outer side

Contact analysis
- considers the reduced contact area due to webbings



Source: GKN





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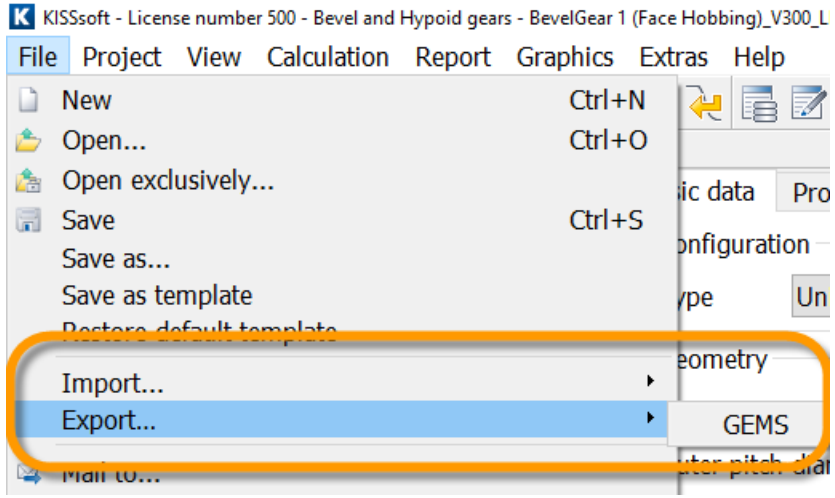
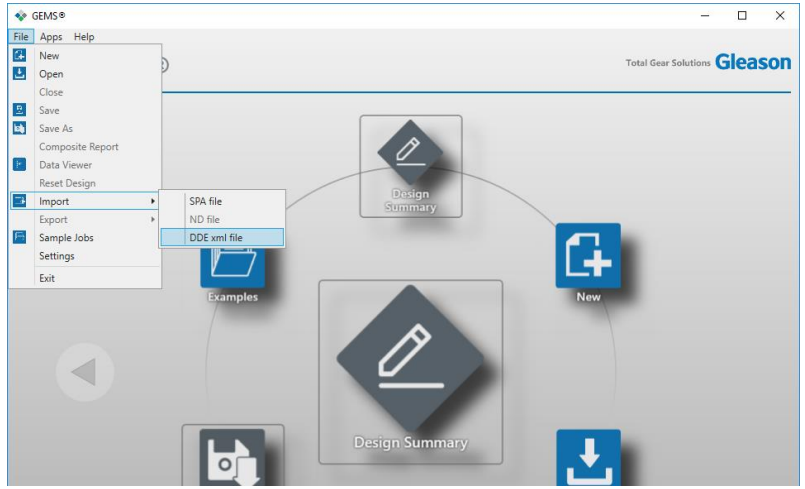
Interface between KISSsoft and GEMS

Workflow on component level

- for bevel and hypoid gears
- macro geometry of gears
- tool data

- check for cutter head size
- check for final blank geometry
- check for blade design (radius, ..)





Bevel gears in transmissions – EPG misalignemnt

Under load, the shafts are misaligned due to

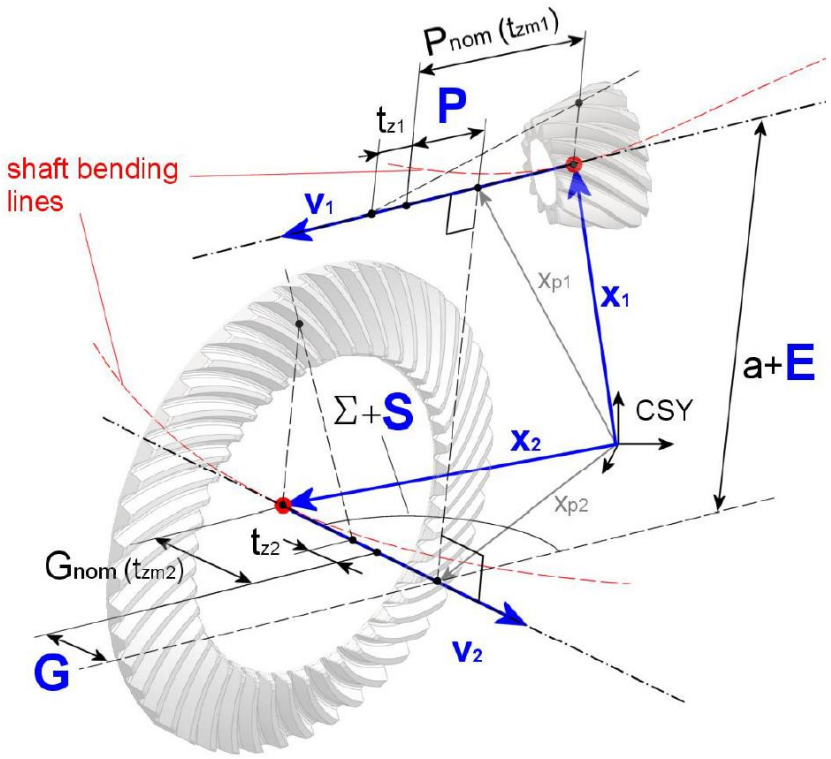
- bearing inner geometry
- housing deformation
- temperatures and bearing seats
- ...

Calculation of EPG by approach of vectors:

$$\mathbf{S} = a\cos\left(\frac{\bar{v}_1 \bullet \bar{v}_2}{\|\bar{v}_1\| \cdot \|\bar{v}_2\|}\right) \cdot \frac{180}{\pi} - \Sigma \qquad \mathbf{E} = \frac{\left|(\bar{x}_1 - \bar{x}_2) \bullet (\bar{v}_1 \times \bar{v}_2)\right|}{\|\bar{v}_1 \times \bar{v}_2\|} - a$$

$$\frac{\left\|(\bar{x}_{p1} - \bar{x}_2) \times \bar{v}_2\right\|}{\|\bar{v}_2\|} = E+a \quad \text{,where } \bar{x}_{p1} = \bar{x}_1 + (P_{nom} + \mathbf{P}) \cdot \bar{v}_1$$

$$\frac{\left\|(\bar{x}_{p2} - \bar{x}_1) \times \bar{v}_1\right\|}{\|\bar{v}_1\|} = E+a \quad \text{,where } \bar{x}_{p2} = \bar{x}_2 + (G_{nom} + \mathbf{G}) \cdot \bar{v}_2$$



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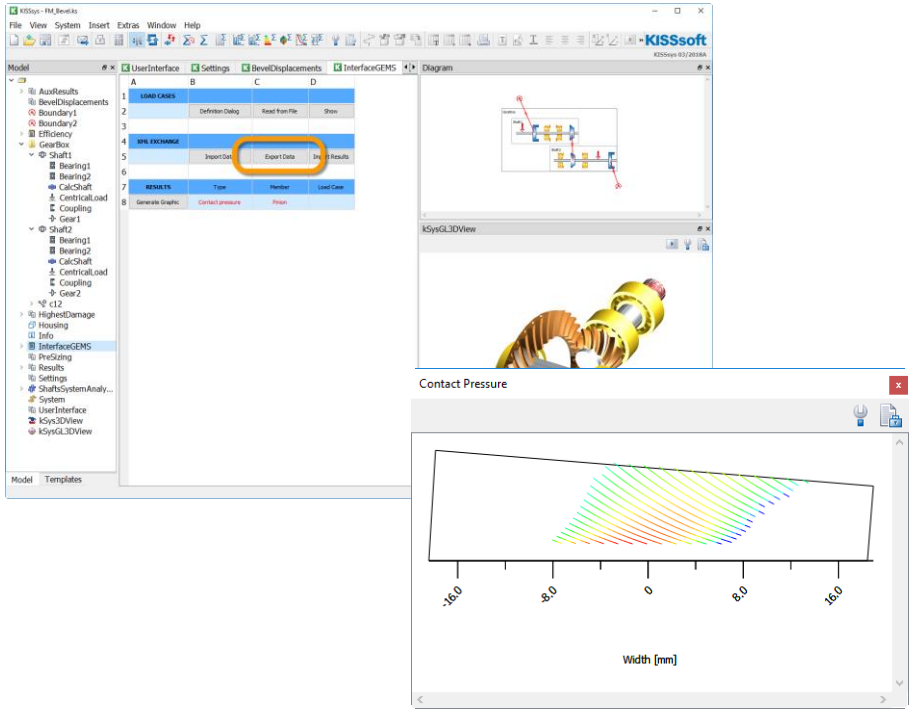
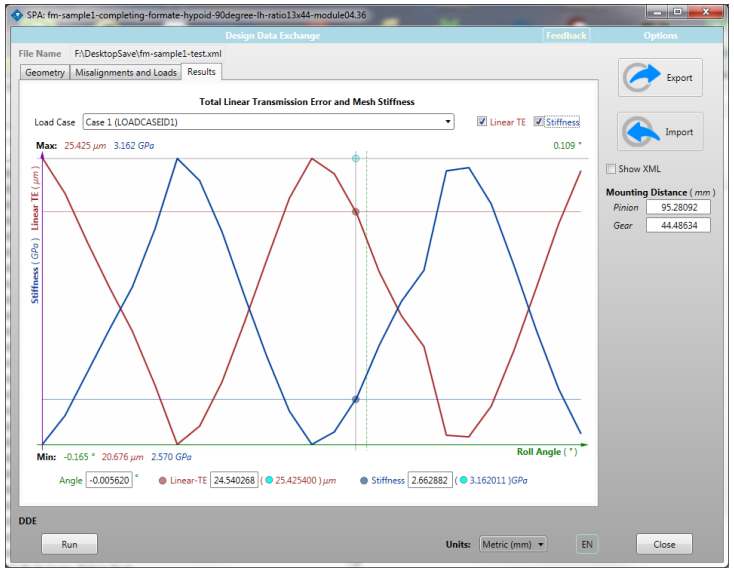
Interface between KISSsys and GEMS

Workflow on transmission level





Thank you for your attention!

Sharing Knowledge

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