RFEM STRESS ANALYSIS

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1. FEM analysis – stress results on bellow weldment

The following analysis do serve as an additional information to the RFEM analysis. The main emphasis must be laid on the recommendations of the bellows producer, who guarantees its functionality and stress resistance.

The first picture of the stress results below depicts the reduced Mises stress in just the membranes. Taking into consideration the zero type of the boundary surfaces of the bodies, no stress occurs on the flanges and the middle tube. Evidently, on the bellow surfaces prevails the inner stress of the value about 300 MPa. The most compressed convolutions might be exposed to the stress of the peak value 620 MPa. Such a stress could appear mainly in the welded areas between the pressed rings and it seems that it exceeds the tensile strength 530 MPa. Nevertheless, the manufacturer of bellows guarantees the functionality as well as the durability set on 5000 cycles, so the following stress results should serve just as an additional information, but the attention should be payed rather for the shape behaviour.

The absolute stress peaks in the red numbers are probably caused by the inappropriate FEM analysis of the areas close to the geometry sketches and areas of the contact of the membrane with the bodies or more precisely with their zero-type surfaces, which is neglectable.

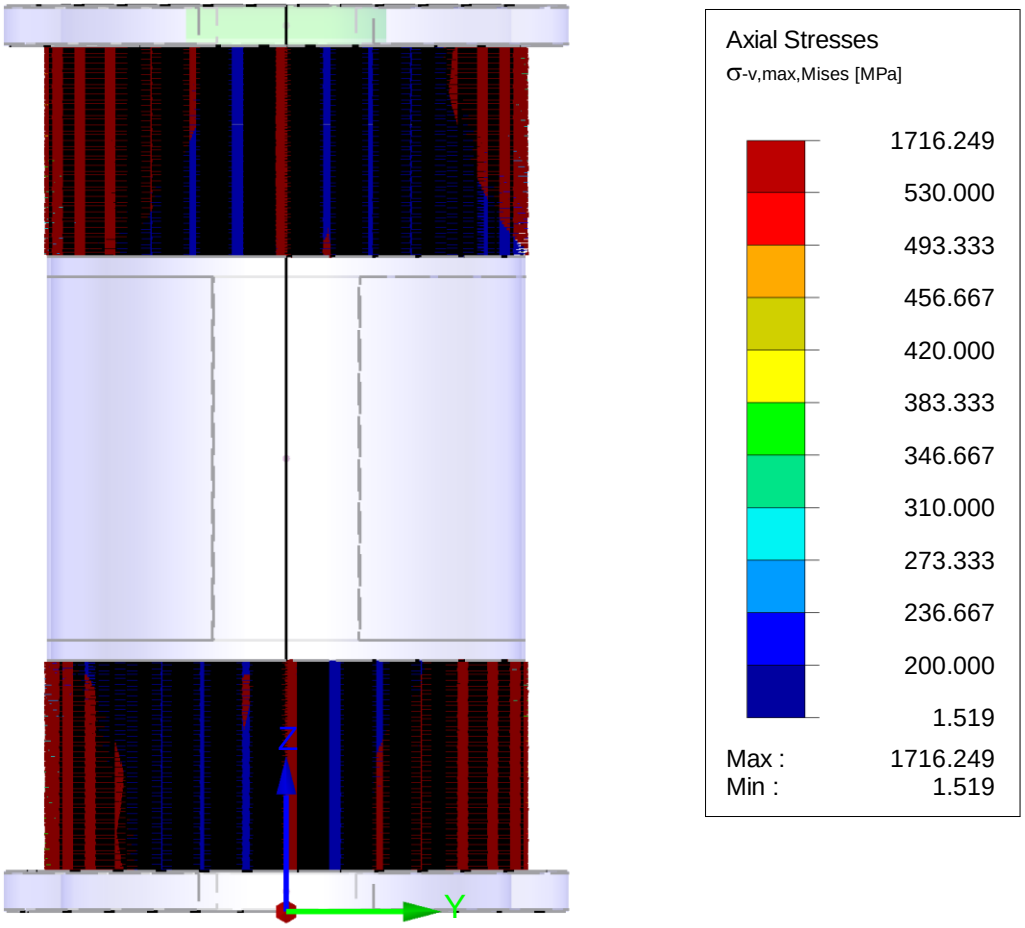

Fig. 1: Results of stress on surfaces

Below, the picture shows the stress distribution on the surfaces of the bellow in detail. The stress values are the same as in the chart in the figure 9 above. Apparently, the major part of the convolutions exposed to the milder stress, which might not exceed the value of the elastic limit, but there has been created a greater cumulation of inner stress at the edges of convolutions, where the pressed rings are welded together. According to the FEM analysis, these stress peaks could exceed the tensile strength of the material, because its values comes up to .600 MPa. Nevertheless, the stress analysis could be distorted due to simplified and estimated geometry of the convolutions. The welded joints have not been drawn at the edges of the joined rings thus it might be the reason, why the program evaluates the huge stress peaks in the welded areas.

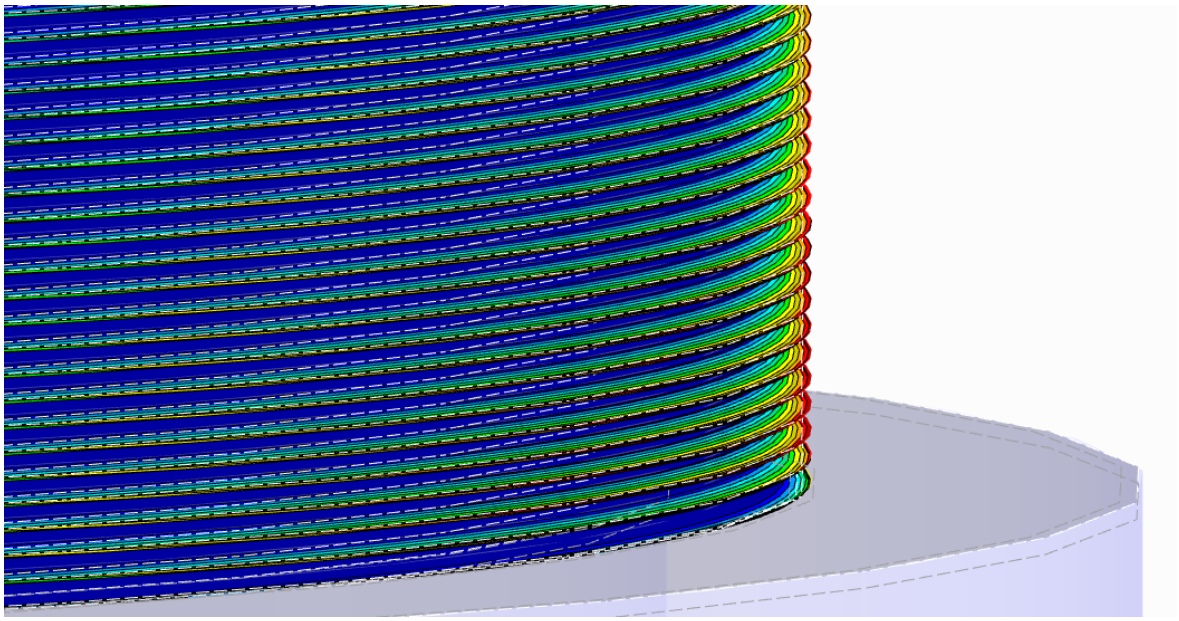

Fig. 2: Results of stress on surfaces in detail

The following diagram shows the stress development as well as the global deformation on the selected model edge line, which substitutes a weld seem.

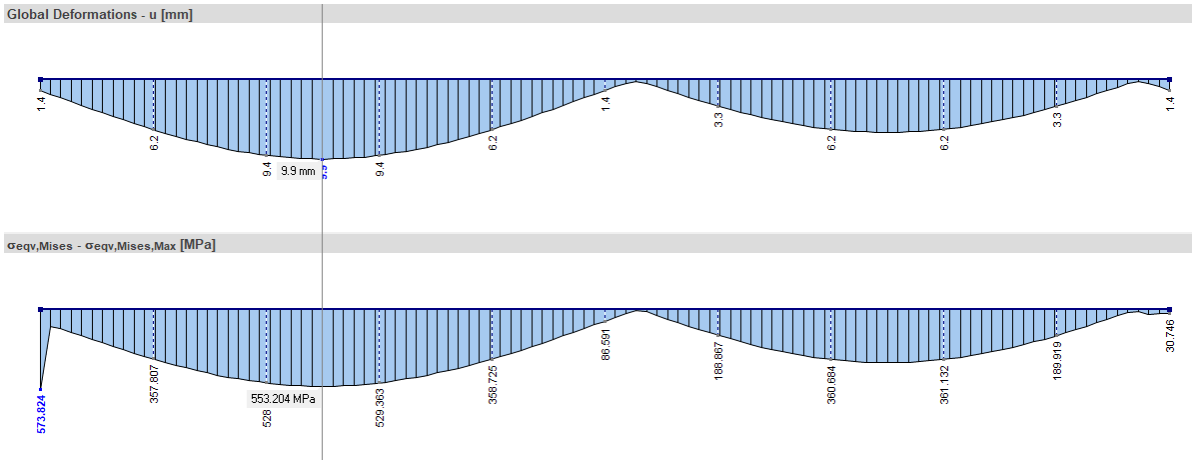

Fig. 3: Stress distribution and global deformation on an edge line

Furthermore, there are the results of the inner stress distribution on the bodies in the picture below. According to the attached table of its values, there occur very low stresses in comparison with the bellow surfaces. The middle tube absorbs the maximal stress of the value 1 MPa in the vertical area (light blue) of a bending load caused by the bellows deformation. The reason of the red numbers of the stress is the geometry of the sketches and moreover the contact of absolute rigid geometrical lines, which define the position of the reference point, with the inner edge of the upper flange. These areas might be possible to neglect again.

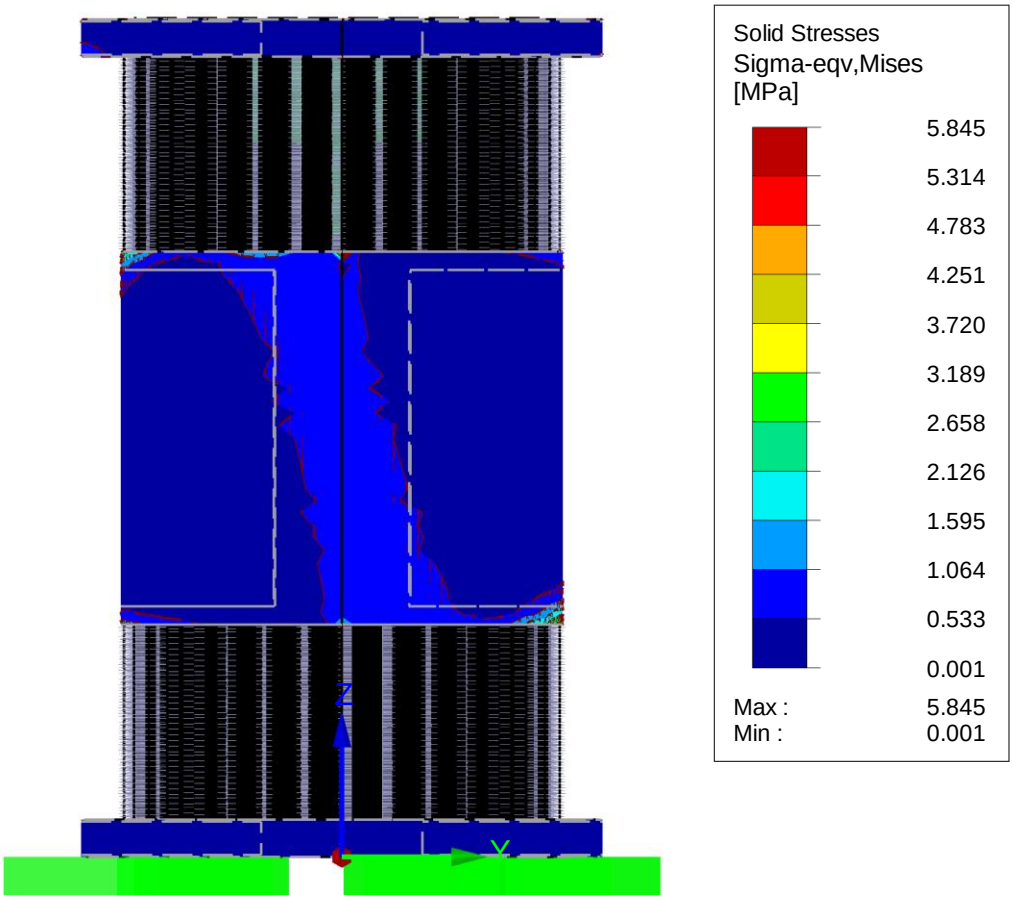

Fig. 4: Results of stress on bodies

2. FEM analysis – stress distribution on experimental bellow

The stress results of the experimental bellow serve just as an additional information about the RFEM analysis. The producer guarantees the bellows functionality and strength stability. So, the following results need not be taken into account.

The figure below captures the stress on surfaces of the edge-welded bellows, which are created as shells in the RFEM program. The high peeks are caused by the neglection of the weld seems shape.

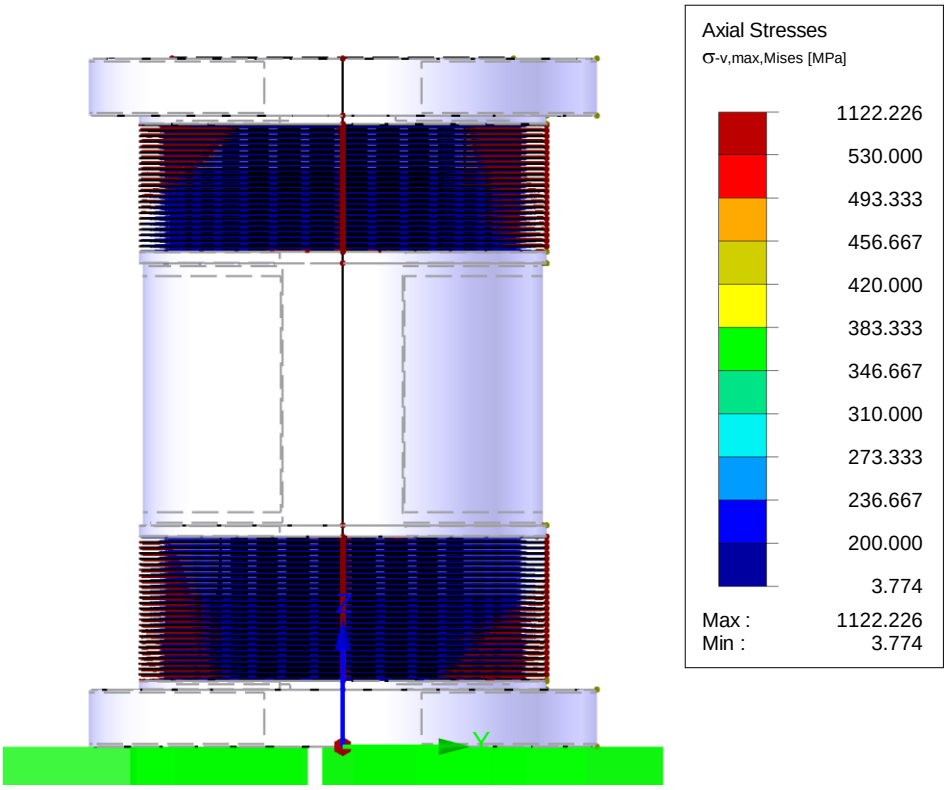

Fig. 5: Results of surface stress of experimental bellow

Furthermore, there is a detail view of the stress on bellows convolutions in the picture below.

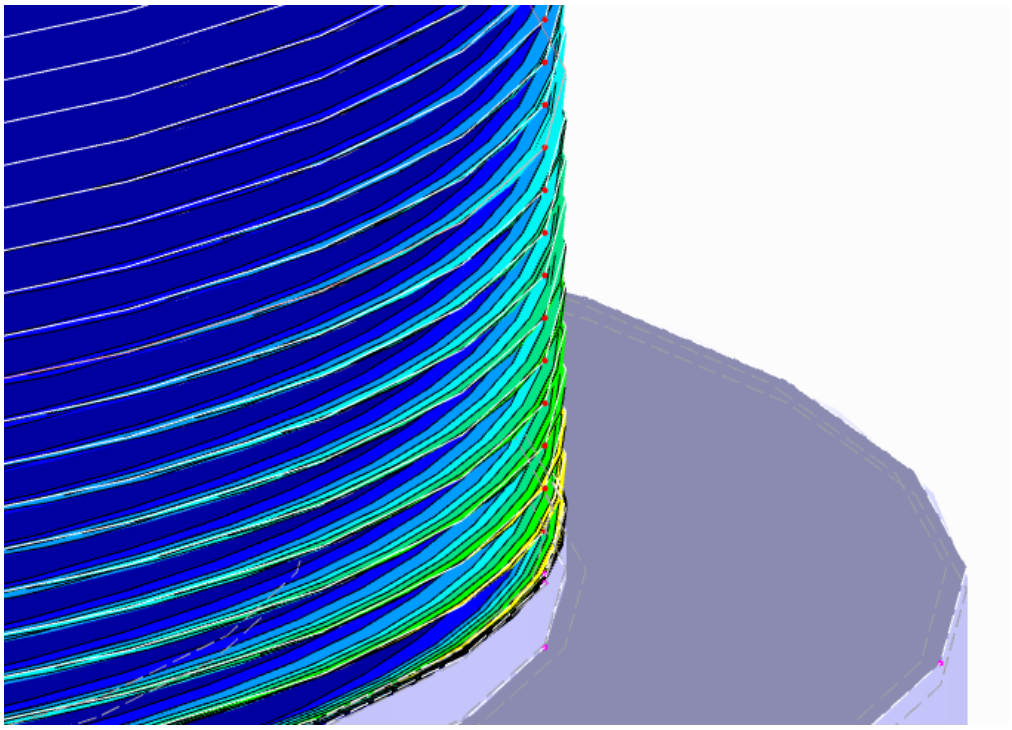

Fig. 6: Results of stress on surfaces of experimental bellow in detail

The last figure shows the stress distribution within the rigid bodies, which is the tube and both flanges.

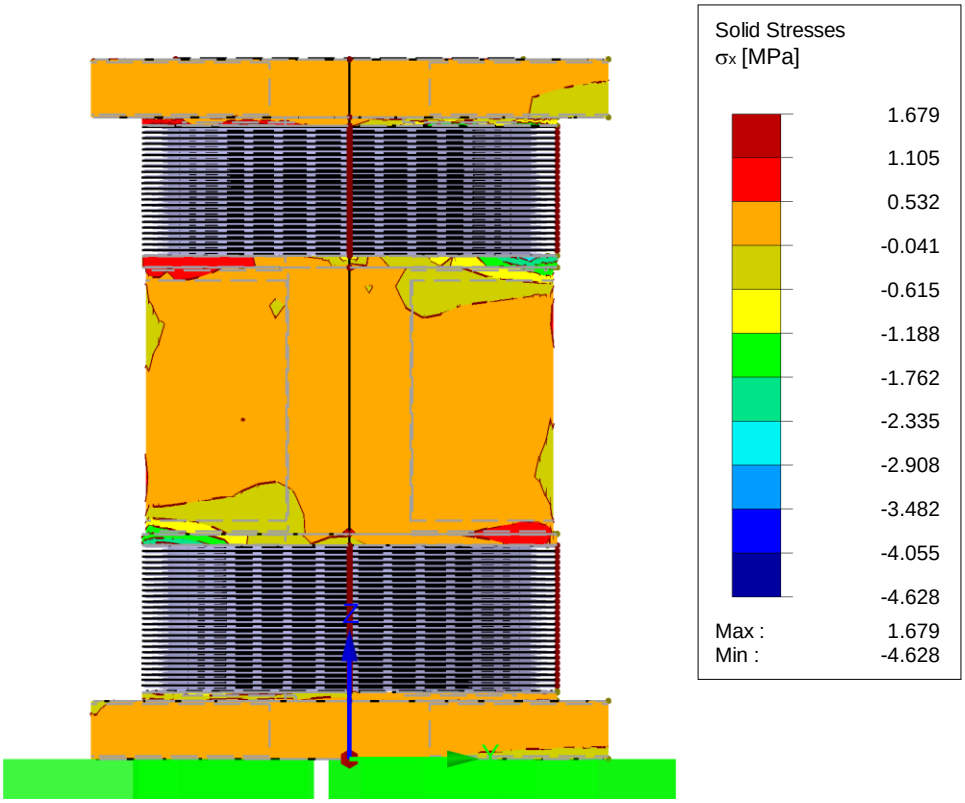

Fig. 7: Results of stress on bodies of experimental bellow

LIST OF FIGURES