Pre-Tensioned Belts Overhanging Elastic Rollers

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Subject of this paper are deformation mechanisms in endless steel belts, which are used as high precision machine components for processing purposes or as conveyor belts. Among the many different mechanical problems associated with such endless belts, the case of a pre-tensioned belt, which is wrapped around an elastic roller that supports the belt over part of its width, was investigated.

By means of analytical models and the Finite Element method the corresponding deformation of the belt is predicted. Special emphasis was put on the effects of the nonlinear (contact) boundary conditions in the vicinity of the lateral edges of the roller. It proved to be possible to tackle this rather complicated contact problem in a semi-analytical way by application of Kirchhoff-Love shell theory in an axisymmetric setting. Due to the nonlinear nature of the contact problem the mathematical description of the problem had to be coupled to an iterative solution procedure for obtaining the correct deformed configuration.

The corresponding continuum Finite Element simulations provided reference solutions, and, furthermore, served as a means for predicting the contact stress distribution. The combination of numerical and analytical models offered deep insight into the deformation mechanisms at hand.