ANNALS of the ORADEA UNIVERSITY.
Fascicle of Management and Technological Engineering, Volume VII (XVII), 2008

LOADING CONDITIONS MODELLING OF THE MACHINE TOOL SLIDES BY TELESCOPIC COVER

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Keywords : machine tools, telescopic cover, high speed telescopic cover, FEM analysis, margin of safety

Abstract : Solution and analysis of shear mechanisms of telescopic covers of machine tools for high speed motion up to 240 m/min and acceleration up to 50m/s^2 have been done for symmetric loading with respect of jamming effects with results of deflection and full destruction process.
Simple horizontal telescopic cover with differential supporting actuator by one pair of shear mechanism is analyzed. Modeling by FEM methods SHELL elements has been used in 3 and 4 nodes configuration. With respect of technological version – riveted parts of telescopic cover, two FEM models have been analyzed in two situations. One solution for slide in (pressure) and one for slide out process. Shear mechanism has been modeled by BEAM elements in case status of lose of stability and jamming. All parts of mechanism are small beams. Joints are simulated by coupling methods. Mechanism has been locked in fixed position and loaded by quasi static force. Inputs for simulations have been transferred from dynamic/kinematics simulations as an interface between telescopic cover and shear mechanism.

1. INTRODUCTION

Results from research describe, that failure of cover can be in a case of:

- strenght value of material of cover is higher than allowable value
- external or internal loading can cause loss of stability of parts of telescopic cover

Strenght computation of telescopic covers is described in [1,2]. In results is determination of maximal length and width of covers depends on thickness of metal plate, when loading of cover is constant e.g. 1000 N. Results of work describe, that to improve reliability of working operation is construct modification in :

- looking for nonconventional shapes of supporing elements of cover parts from point of increasing shape stiffness
- looking of suitable auxiliary machanism for simplyfing and secure control of simultaneous movement of cover parts
- looking for monitoring of movement of parts of cover with respect to feedback to driving parts of cover mechanism and actual kinematics and force status between elements of telescopic cover

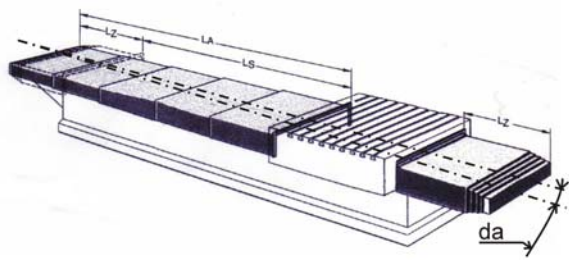


Fig. 1 Telescopic cover configuration

2. Modelling of parts of telescopic cover

Simple horizontal telescopic cover with differential supporing scissor mechanism has been analysed. FEM method implemented for modelling has been done with SHELL elemetnts. Elements has been 3 or 4 nodes. With respect to technological version – riveted front and back parts, two loading models have been realised.

Model A for pulling in and model B for pulling off cover. Both models are geometrically identical, but difference is in modeling of front part of cover. Front cover is mounting to telescopic scissor mechanism. Difference of force influence to cover depends on technological solution and realization of cover. Front cover is riveted to base cover part. In process of pulling off rivets are elements for force carrying, while in process of pulling on all forces are spreading to base part of cover via front cover part. In case of pulling off there is point stress while in case off pulling on there is area stress.

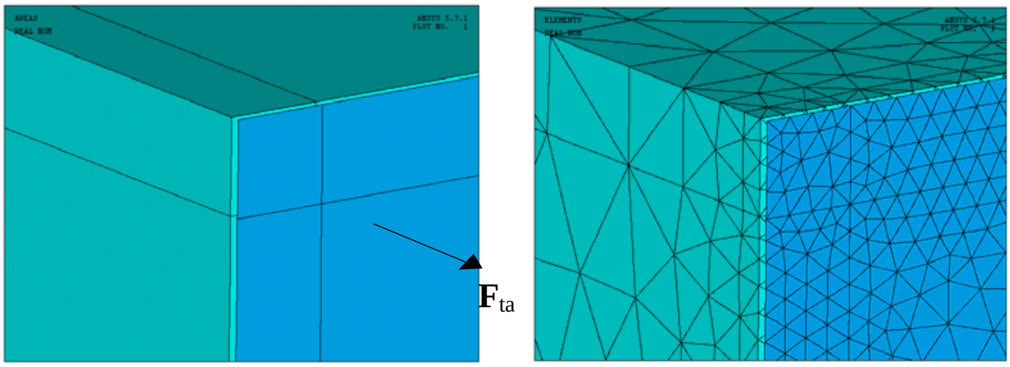


Fig.2 – Model A elements – pulling off process

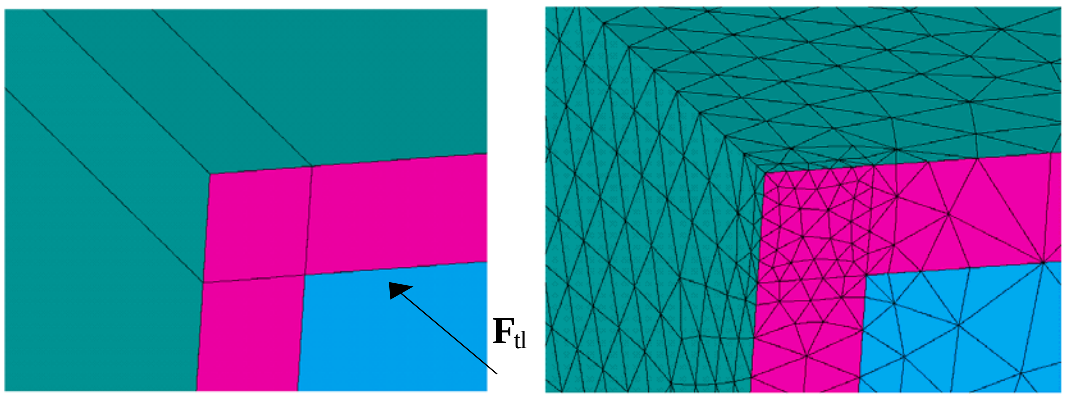


Fig. 3 Model Belements – pulling on process

It is necessary to note for correct results that for model according fig. 2 is applied only loading F_{ta}, while for model according fig. 3 is applied only loading F_{tl}.

Other figures are details on modeling of cover parts.

Fig.4 Model of cover – elements model

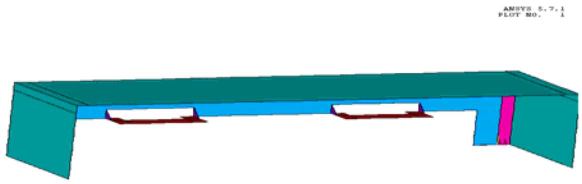


Fig.5 Model of cover – area view

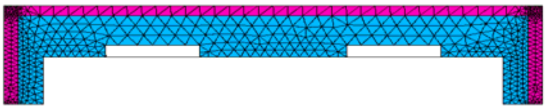
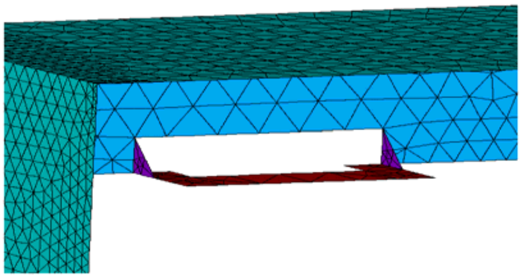


Fig. 6 Model of cover – elements after meshing process



Figr.7 Detail of modelling for location where telescopic mechanism is mounted

3. Modelling of loading process using telescopic scissor mechanism

Scissor mechanism has been modeled for numerical analyses in jamming status. BEAM FEM elemets have been used. Parts of mechanism are simly small beams. Model is fig. 8. Joints in model have been modeled using coupling methodology. Mechanism has been blocked in one position with applied quasy static loading force.

Applied forces have been computed separately using Adams software for multibody modeling of mechanisms.

Figr. 8 Model of telescopic scissor mechanism.

4. Numerical results of analysis

Numerical simulation is presented for loading of telescopic cover part (case A, see fig.2). Stress and strain results of simulation is in fig. 9 to 12. Solution is done for symetrical loading and jaming.

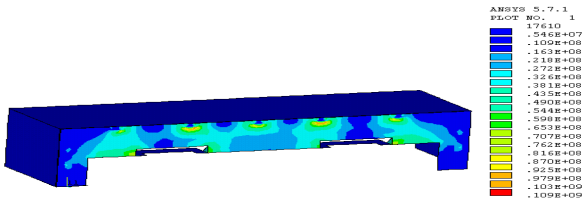


Fig.9 Max stress in a case of process pull off mechanism (case A, see fig. 2)

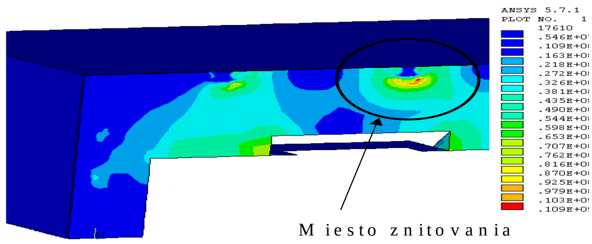
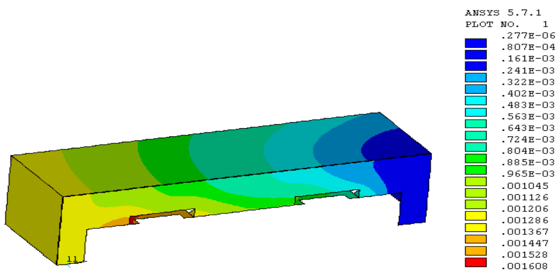


Fig.10 Max stress in a case of process pull off mechanism – detail, (case A, see fig.3)



Figr.11 Results of deformations (case A, see fig. 2) jamming process application

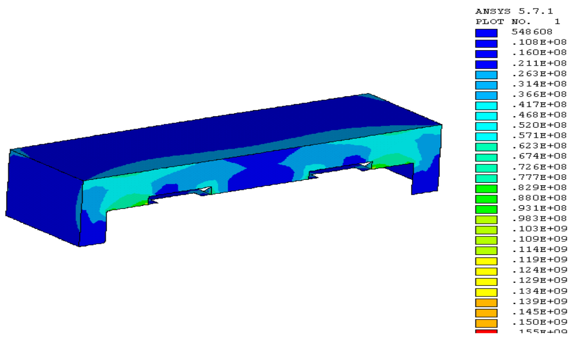


Fig.12 Results of max strain of cover (case B, see fig.3)

5. Results

It is visible, that in a case of pulling out movement without jaming there are maximally 109MPa strain. This value is significantly lower that level of maximal allowable strain in material of sheet metall. In fig. 12 can be seen that in a cas of jaming, maximal value of can be up to 390 MPa. It means, that material will be damaged. In real working operational process typically jamming is the most significal.

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