STATIC FEA OF MECHANICAL COMPLEX STRUCTURES

***C. Iancu*, A. Nioata**

Department of Applied Mechanics, University "Constantin Brâncuşi" Târgu-Jiu, Romania

1. Introduction

In the large category of conventional machines for plastic deformation, the mechanical presses have the largest use. So, the mechanical presses, and especially the "C"-bed presses, represent one of major trend in designing, based on several advantages.

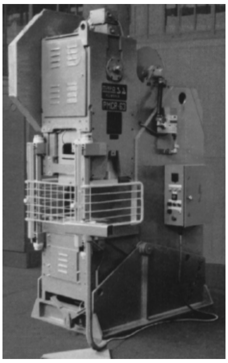

Fig.1 PMCR – 63 press

The bed is the base element of a mechanical press, having the role to sustain the cinematic assembly and to convey the pressing force from working parts to piece.

The classic calculus of the bed for crank mechanical press is based on determination of stress and deformation due to maximum load at the nominal force. So, this methodology has limitations, being impossible to estimate discrete values on different points or sections of structure. For the mentioned reasons have been developed modern analysis methods, FEA for structural calculus being hardly used lately. This method is presented on a numeric example, represented by the bed of a crank mechanical press type PMCR-63, mechanical press with open bed, with nominal force 630 kN, presented in fig.1.

2. STATIC ANALYSIS OF PMCR-63 MECHANICAL PRESS BED

The model of the analyzed structure, completed and prepared as shown in [1], is now ready for FEA. For either static or dynamic FEA, must be followed the phases: defining the mesh; defining the environment bonds; defining the loads; performing analysis and result interpretation.

2.1. Defining the mesh

The mode of obtaining the mesh was presented in [1]. The mesh have 10307 nodes, 25734 finite elements and 103590 degree of freedom (DOF), elements type SHELL 3 for discretization of all bed plates and type TETRA 4 for discretization of cantilevers and the bosses.

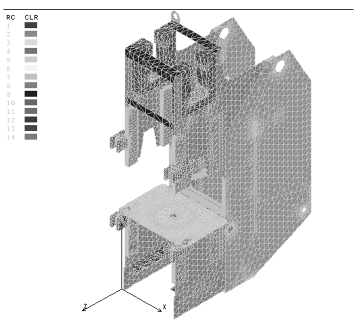

Fig.2 The discretized structure

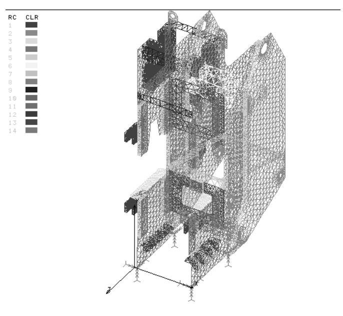

Fig.3 The environment bonds

2.2. Defining the environment bonds

The environment bonds are applied to nodes being in the zone of bed resting on foundation. In this zone are blocked all DOF (3 translations and 3 rotation). In fig.3 are presented the environment bonds.

2.3.Defining the loads

The forces developed on working are generated by rod-crank mechanism. Their effect is transmitted by superior bosses and by bed table in whole structure. So on the bed action forces on bed table, with maximum value of 63 tf and reaction forces on upper bosses, with same value, but contrasted direction. Since the action of these forces isn't concentrate, the forces on upper bosses were considered like a uniform distributed pressure on bosses width, having the value p_1= 63 N/mm^2 and the force on bed table like a distributed pressure on a surface of Φ300 mm, p_2= 9,17 N/mm^2

2.4.Performing analysis and result interpretation

The model completed and prepared for analysis as shown, was studied with COSMOS/M software, with solving option FFE (Fast Finite Element). The results show both displacement and stress analysis, concerning maximum values and distribution on structure.

In fig.4 is presented the *displacement distribution* for the structure, observing a continuous distribution that implies a correct model. The maximum displacement is: δ_{max}=0,94727 mm. Also for symmetric nodes the displacement value are very similar, that confirms the model is correct.

In fig.5 is presented the *stress distribution*, (Von Mises). The admissible strength considered are:

-bending strength: 200 MPa -traction-compression strength: 180 MPa

The maximum stress is 182 MPa, and because the structure is stressed on traction-compression compound with bending, the admissible strength considered is $\sigma_{Von\ max}$ = 200 MPa, so the stress is bellow the admissible strength.

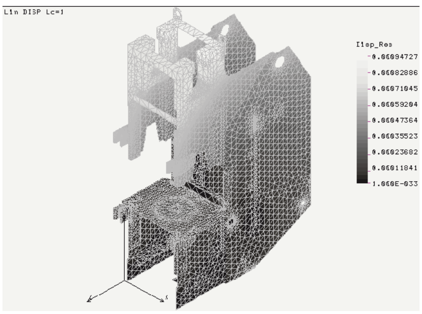

Fig.4 Displacement distribution

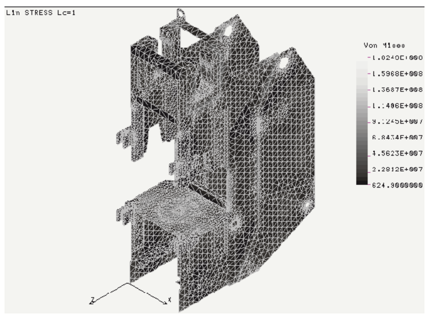

Fig.5 Stress distribution

3. Conclusions

In this paperwork are presented the steps needed in order to perform a static FEA analysis for complex structures, such as frames for mechanical presses. It was shown that the results show a continuous distribution of displacements and stresses that validate the model, proving it correct. Also, with this type of analysis it became possible knowing values in every point of the press bed that interest, and preparing the way for *the optimization of such a complex structure*.

References

[1] Iancu, C. (2002), *Contributions to dimensional optimization of mechanical press in dynamic regime*, Ph.D. Thesis, University of Pitesti, Romania.

[2]★★★★(2002), *Cosmos/M -Finite Element Analysis System, User Guide*, Structural Research & Analysis Corp., Los Angeles, CA, USA.