



25th DAAAM International Symposium on Intelligent Manufacturing and Automation, DAAAM
2014

Monitoring Extremely Stressed Points on Stands of Forging Presses

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Abstract

Reliability of the press is a fundamental condition for the smooth operation of the forge. Therefore, it is necessary to conduct periodic checks on the condition of the machine. The paper presents points of stand for different types of presses that are experiencing the greatest stress concentrations, and where it is to be expected destruction. For one extremely stressed point presents a design solution for the removal dangerous stress.

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Peer-review under responsibility of DAAAM International Vienna

Keywords: forming machine; mechanical press; FEM analysis

1. Introduction

When evaluating the MPK analysis is very difficult to determine the values of allowable stress. There is not a rule that allowed stress must be same in all places at the machine. In some areas with high safety are frequent destruction and conversely in areas with low safety there is no destruction of the entire service life of the machine. For correct assessment of value of allowable stress, strain analysis of existing solution (longer time in smoothly operating) was conducted. Thus, it is possible to obtain a standard permissible stress corresponding to specific points on the machine. Monitoring was carried out on several local and foreign presses in the range of forces from 1600 to 3150 tons. To the set of presses we selected four presses in operation and four in the finished design proposals, both with preloaded, so nonpreloaded stands.

The paper is focused to the main structural node of the press, which is stand.

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In the paper are presented and compared stress analysis of stands. Places with higher stress are indicated by letters A-F. In case of increased stress on all monitored stands, the average value is given to the tables. It may be recommended value for allowable stress at specific point. [3, 7, 8, 10]

2. Diagnostics of stress in the stands of crank forging presses

All calculations were performed using the virtual modelling, using FEM analysis and software NX 9. The obtained results were virtual diagnosing stress distribution in the examined parts of the machine.

Calculations were made for eccentric loading presses, with an eccentricity of 300 mm (with the exception of the press with Table width 600 mm, which was burdened centric). [1, 2, 4, 9]

Anchoring stand was made on the bottom of the stand over a circular area defined by the axis of the stand. All inserted parts of the press (eccentric shafts, pin, connecting rods, and anchors) were inserted through contacts.

In anchored stands the anchor pretension was set as 1.4 times of the rated power.

The clearance in the guidance was set at 0.1 mm, 0.2 mm in the bearings. [5, 6]

Table 1. Technical parameters and display the stress in critical areas of the press 3 and 4 (see the table 3).


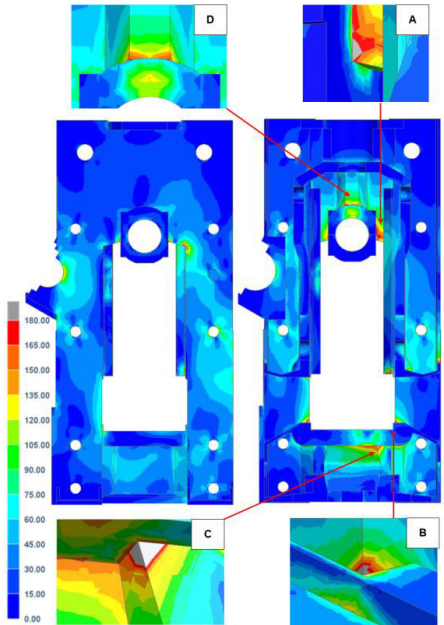
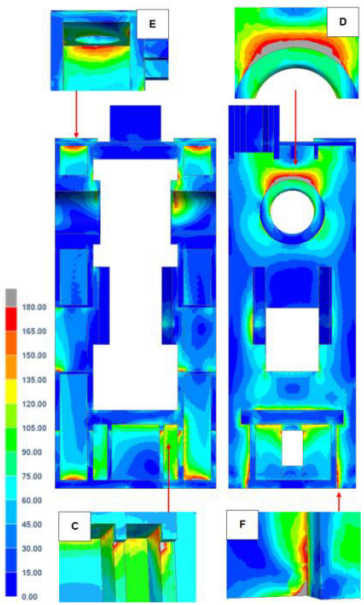
			
Nominal force of the press	31,5 MN	25 MN	
Width of workspace	1520 mm	1200 mm	
Placing the shaft	front to back	left to right	
Stand weight	97 t	52 t	
			

Table 2. Technical parameters and display the stress in critical areas of the press 6 and 8 (see the table 3).

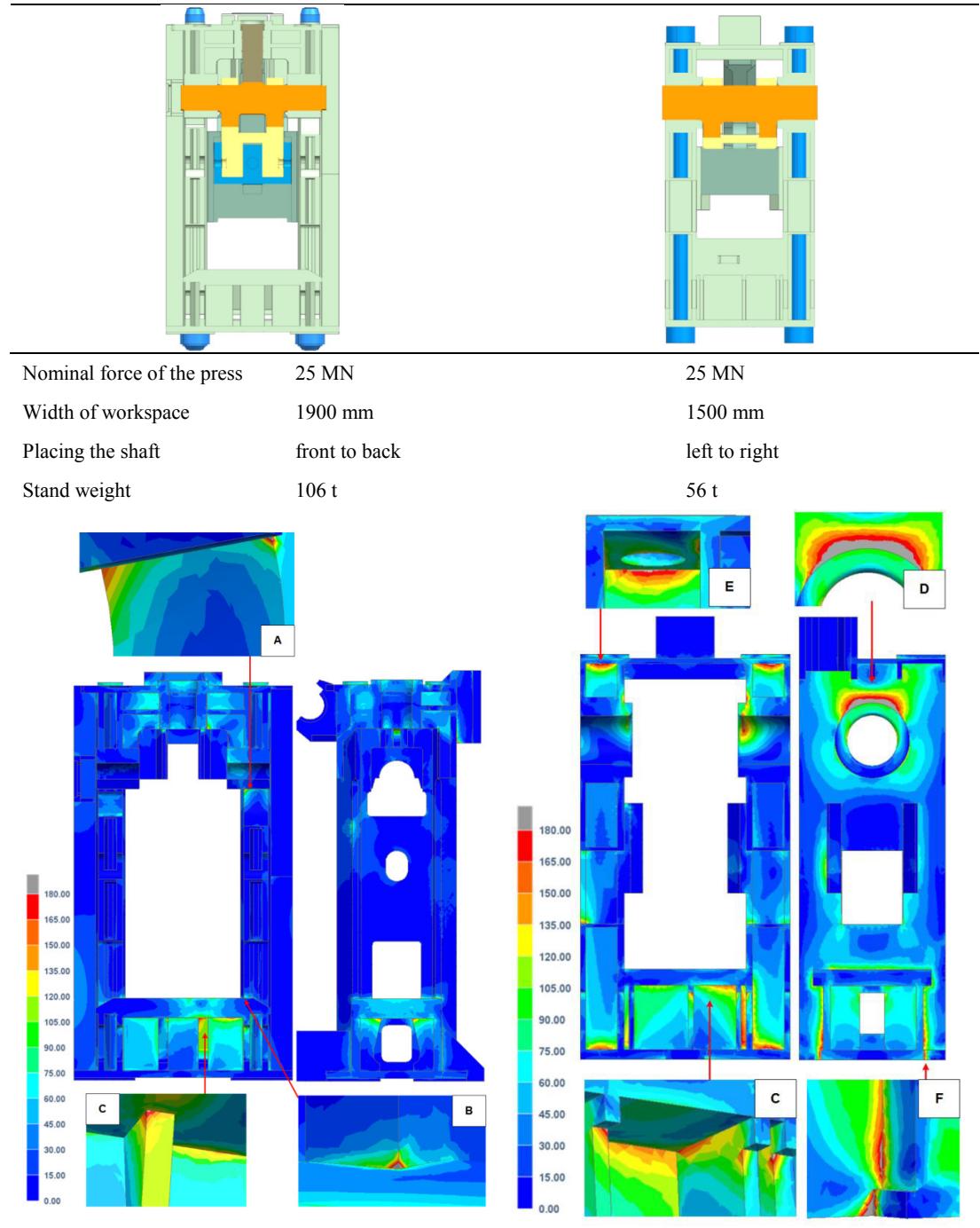
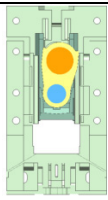
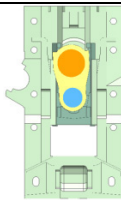
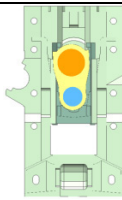

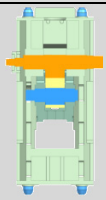
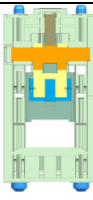
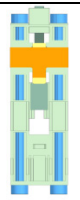



Table 3. The stress of monitored points (MPa).

	1	2	3	4	5*	6	7	8	Average
									
A	220	230	210		350	215			219
B	175	165	235			240			204
C	185	180	240	255	280	190	170	200	203
D			190	280	330		240	250	240
E				190			230	190	203
F				250			240	260	250

* Lis marked no. 5 with its high stresses in monitored points exceeds the value of other presses. There may be inappropriately chosen design solutions in problematic nodes structure. The press was not included in the average stress.

3. Evaluation of calculations

The analysis shows that all monitored machines have a critical place in the point C. The stress at this point is between 170 MPa to 255 MPa. The average value of the values of all monitored stands is 203 MPa. This place is located between the reinforcement (ribs) under the work table. This stress is mainly caused by compressive loads, thus rather leads to upsetting than to crack.

Another very stressed place is point A, where in five cases the higher stress concentrations ranging from 220 MPa to 230 MPa. The average value of the values of all monitored stands is 219 MPa. This place is located in the upper corner of the stand, the stress are mainly shear and tensile stresses, which are dangerous for that place. At this point there are frequent destruction.

The stress at the point D is in the range from 190 MPa to 280 MPa. The average value of the values of all monitored stands is 240 MPa.

Presses with a higher stress than the average, will have lower dynamic resistance and therefore a shorter lifetime.

4. Reinforcement of work table – point B

The stress at point B is in the range from 165 MPa to 240 MPa, at an average is 204 MPa. This place is located in the lower corner of the stand, in the corner of the table. These are the shear and tensile stresses. Although the average stress here is the lowest of all the foregoing, this place is the most common site of destruction. This is primarily due to more frequent eccentric loading table when stress at that site can be much higher than indicated.

To reduce unwanted stresses in the specified location was needed additional support of the table so as to achieve a smaller displacement and a small opening between the table and stand.

It would be appropriate if the support could be added to that position with preload (wedging, or undercooling). This would guarantee to calculated effect. The support should be welded only at the top and bottom. The support is mainly stressed by pressure, so that in places increased tension can be flexibly the plastic state (pressure) that the specified location is not dangerous.

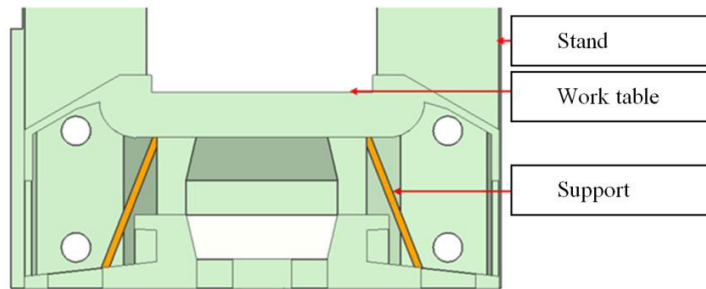


Fig. 1. Support of the work table.

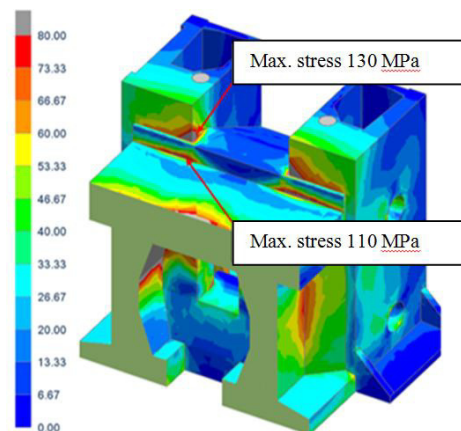


Fig. 2. Stand with support – stress (MPa).

Conclusion

The presented results should serve:

1. For technologists and maintenance to increased monitoring of indicated points, in order to early detect the formation of cracks and these could be removed in the beginning.
2. Those engineers already in the proposal prevent stress concentrations in these locations.
3. To determine the allowable stress in these areas for FEM calculations.

This method of solution (support insert) has been successfully applied to the damaged press frame. Size effect of the design is obviously influenced by the manner of its implementation. Selecting the size and thickness of the support depends on the size of the stand.

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