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Experimental Verification of Prototype Rubber Suspension for Ball Bearing by QUALISYS System

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Abstract: This article deals about experimental verification of the prototype of rubber suspension to protect ball bearing using Qualisys system and stain gauges. Qualisys is a camera system designed for 3D record of body motion that is firmly marked with special points called markers. Qualisys was used for measuring relative position of frame and roller during testing rubber suspension on track with barrier. Strain gauges were measuring load impact on frame during testing on track.

Keywords: Rubber Suspension; QUALISYS; Testing; Measuring; Strain Gauges.

1 Introduction

Experimental verification of prototype rubber suspension was important to check acquired knowledge during design suspension and also to get new information about the rubber material and behavior of the prototype. This new information was used to modify prototype of suspension to final product. Important parameters were the decrease of loads impact on bearing and frame and the relative compression of suspension. The Measuring was realized on a testing track. Scheme of the testing track is in Fig. 1. There was a special equipment simulating an agricultural machine (Fig. 2 and 3) with the prototype of suspension driven by tractor. There were iron barriers on testing track representing nature barriers on field like stones.

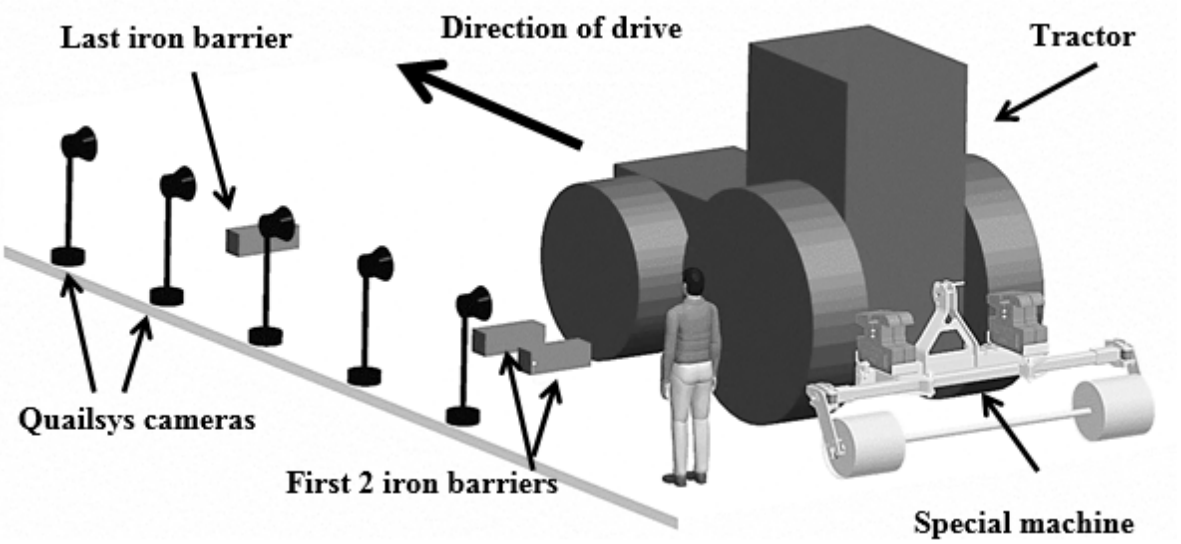

Fig. 1: Figure of testing track.

2 Methodic of the Measurement

Special markers used by Qualisys (Fig. 4) and strain gauges (Fig. 5) were installed on designated places on the machine with the prototype. Dewetron recording data from strain gauges was in tractor during testing. Qualisys cameras and PC for recording data was on the track. Cameras were oriented on the part of track with barriers.

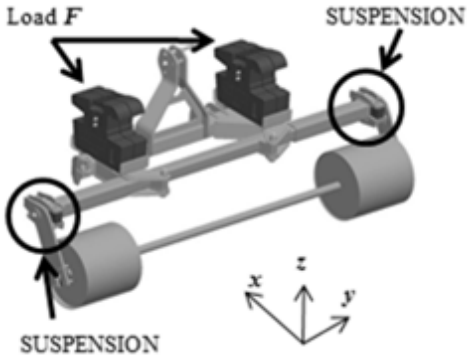

Fig. 2: Special machine for measuring rubber dynamic properties.

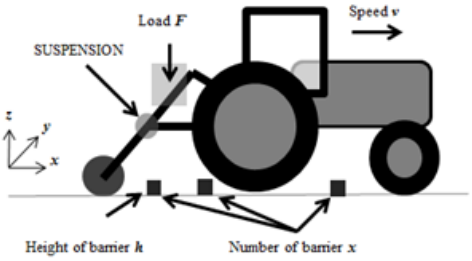

Fig. 3: Scheme of tractor and special machine.

Recording from gauges and Qualisys was synchronized by common electric signal at the beginning of every measuring. There were realized measuring for several speed of tractor, several dimensions of rubber suspension and several loads. Recorded motion of markers from Qualisys was post processed to the relative motion between the frame and roller respectively relative compression of the rubber suspension.

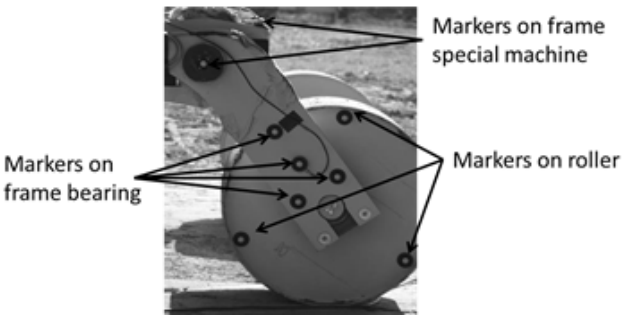

Fig. 4: Special machine with markers for Qualisys.

Fig. 5: Static compressed rubber suspension.

3 Analysis of Measured Data and Results

Measured data from the strain gauges were analyzed in Matlab. Data from Qualisys were analyzed in Qualisys postprocessor and in Matlab as well.

Print screen from Qualisys postprocessor is in the Fig. 6 where trajectory of frame special machine, trajectory of frame bearing and trajectory of roller are shown the difference coordinate between machine frame and bearings frame was important For us rubber suspension was installed Between these two frames. The difference coordinate was deformation of suspension.

All samples were made from 50 % Butadiene and 50 % natural rubber, but different cross section. Sample with mark * is made from 30 % Butadiene and 70 % natural rubber.

Higher relative deformations at sample from high natural rubber are shown in Fig. 7.

Negligible differences depending on the size of rubber suspension cross section are obvious in the Fig. 7 and 8. However, noticeable effect of rubber suspension occurrence is significant and obvious from the Fig. 8

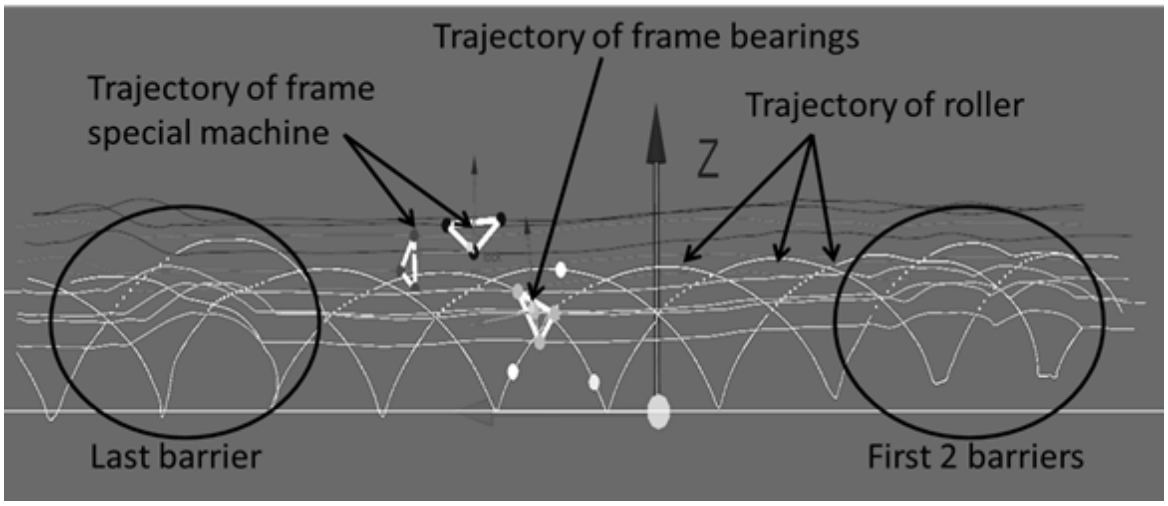

Fig. 6: Print screen from Qualisys postprocessor.

and 9 (WOS – without suspension). Results in the Fig. 7 and 8 are for speed 15 kmph. This speed is probably top speed in soil tillage currently.

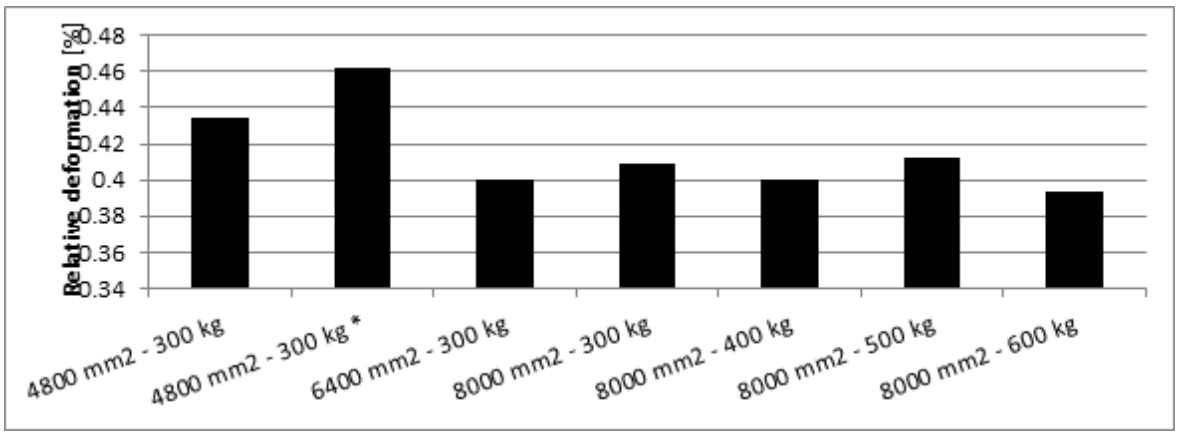

Fig. 7: Relative deformation of rubber suspension for load 300 – 600 kg.

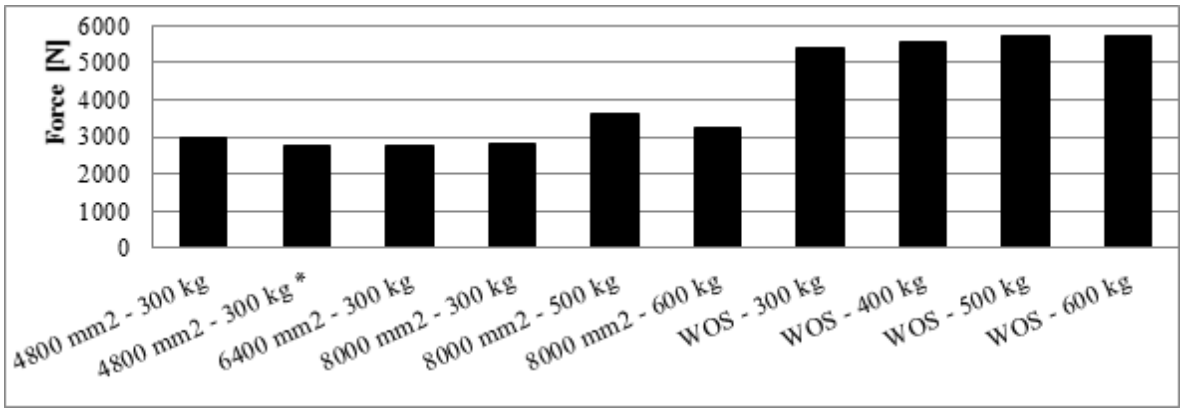

Fig. 8: Force on bearing for load 300 – 600 kg.

There is shown the positive effect on reduction impacts to bearing during conflict between iron roller and iron barrier in the Fig. 9 when rubber suspension was used.

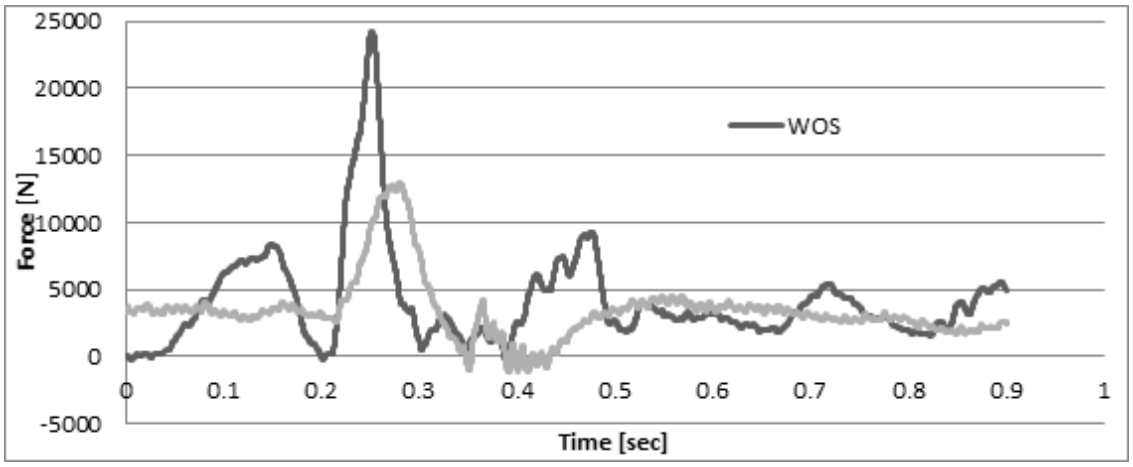

Fig. 9: Force on bearing with rubber suspension and without suspension (WOS).

4 Conclusion

The main result of measuring was that the rubber suspension positively decrease load impact on the bearing and frame. The other result of measuring specially the relative compression of rubber suspension and the value of loading will be used to modify the dimension and the shape of prototype for use on particular machine.

Acknowledgement

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References

[1] P. Syrovatka, F. Lopot, M. Janda, Experimental Analysis of Protorype Rubber Suspension for Agricultural Machine, In Book of Proceedings of the 55th International Conference of Machine Design Departments. Prague: CTU, Faculty of Mechanical Engineering, 2014, p. 439-442, ISBN 978-80-01-05542-7.

[2] M. Mrňák, Návrh odpružení ložiska pro zemědělské stroje Diplomová práce, ČVUT v Praze, 2013.

[3] P. Syrovátka, V. Dynybyl, Experimental Analysis of the Operational Loads on Agricultural Machine.

[4] Retrieved from: http://www.qualisys.com/