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# Springing Base Plate of Hydropulser

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**Abstract:** The hydropulser, when running is the source of broad-band vibrations. One possible way of removing these unfavorable influences on the environment, and especially on human beings, is an elastic support. Here, rubber or air springs are inserted between the frame of the hydropulser and the floor. Under these conditions, the transmission of vibration transferred to the floor declines according to values of natural frequencies. In the paper are discussed two possibilities of base plate supporting.

**Keywords:** Vibration; Vibration Minimization; Springing Base Plate; Air Spring.

## 1 Introduction

Hydropulser belongs to the basic equipment of dynamic testing laboratories nowadays, especially in automotive industry. Vehicle operating conditions are simulated with high fidelity by means of hydropulsers and control units, which are programmed according to the data obtained from the measurement on test ranges. In addition to achieving sufficient match of the vehicle dynamic conditions in measurement and in real life, hydropulsers also have to meet high demands in terms of the test duration. It is common that such vehicle test, representing a hundred thousand kilometers of journey, runs continuously for several days. Shortening the time leads necessarily to an increase in the frequency of emerging dynamic forces. This fact gives rise to vibrations of the hydropulser base plate that are transmitted into the ground. To prevent the vibration transmission, the base plates are supported on rubber springs or air springs. The intensity of vibration transmission into the ground is largely dependent on the size of the natural frequencies of base plate oscillation.

## 2 Support on Air Springs

The latest trend is to use elastic support for hydropulser base plates fastened to sufficiently heavy reinforced concrete block, which is placed on air springs. The requirement of effective vibration insulation depends on achieving low natural frequencies of such dynamic system. In principle we can say that the heavier is the block and the lower is the support stiffness, the greater chance for effective vibration insulation. However, the heavy block requires relatively large space, which is not available in testing rooms. Low support stiffness is limited by the structure of air springs and by compressed air flow resistance between the spring and its additional vessels, which are a necessary part of the support.

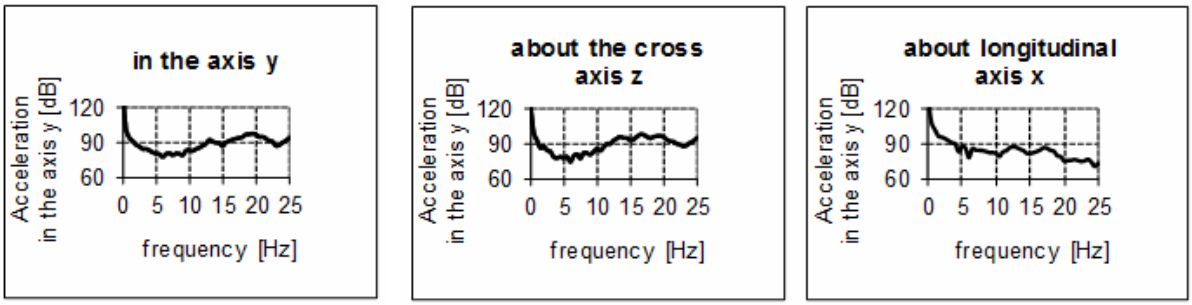


Fig. 1: Frequency as a function of acceleration in a base plate on rubber springs after shock excitation.

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To regulate the permanent static height, the air springs are divided into sections and connected to three permanent static height controllers. The system was complemented by hydraulic oscillation dampers in order to reduce resonance effects during the vehicle test. After completion of the support there were made measurements of the time progress of the natural oscillations. The results made it possible to ascertain the natural oscillation frequency of the base plate in the vertical y-axis, transverse z-axis and longitudinal x-axis of the plate symmetry (see Fig. 2).

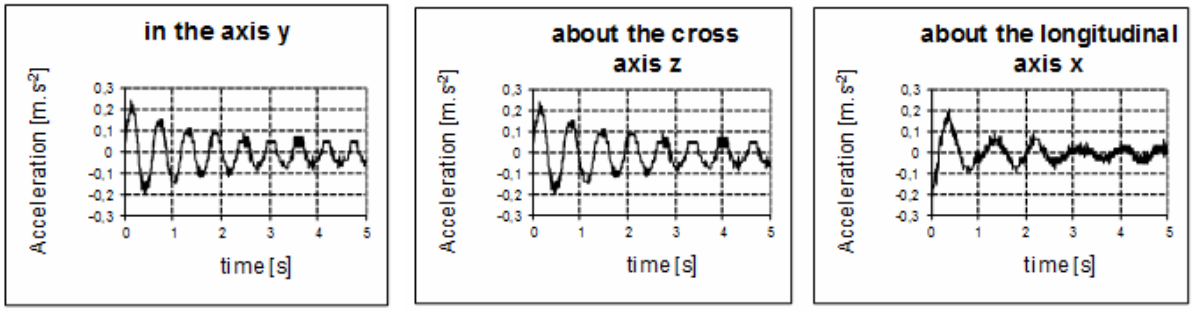


Fig. 2: Time as a function of acceleration in the base plate on air springs after shock excitation.

## 3 Conclusion

Vibration insulation abilities of both types of base plate support of hydropulsers vary considerably. Support on rubber springs is structurally simpler and requires only relatively low costs, but its vibration insulation efficiency is low due to higher natural oscillation values. Base plate support on air springs ensures low natural frequencies values and shows significant minimization of vibration transmission. Comparative measurements were performed during a vehicle driving simulation on the test polygon. The floor vibration frequency acceleration spectrum shows a significant difference between the efficiency of vibration insulation on rubber springs and air springs.

## References

[1] Pešík, L. - Němeček, P. Identification of the dynamic system of a machine with an elastic base. McNU 97, Chicago, USA, 1997.

[2] Pešík, L., Vančura, M.: Additional Air Volume Impact on Characteristics of Pneumatic Spring-Support of Driver's Seat. In. 49th International Conference of Machine Elements and Mechanisms Department, Západočeská univerzita v Plzni, Plzeň, Česká republika, 2008. ISBN 978-80-7043-718-6. S. 219-222.E.

[3] Harris, C. M.: Shock and vibration handbook. New York: McGraw-Hill, 2002.