EAN 2019
57th conference on experimental stress analysis

Analysis of internal forces in chassis of bucket wheel excavator

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Keywords: Analysis, Chassis, Bucket Wheel Excavator

Abstract. Modern and high-power machines for surface mining of energy-producing raw materials require mechanisms of thoroughly perfect design and dimensioning. The theory of structure of mechanisms and methods of mechanics provide an indispensable theoretical foundation.

The presented research work deals with static analysis of bucket wheel excavator chassis. The knowledge of internal and external forces and their size is important for dimensioning of all parts of the chassis which have a direct impact on reliability and lifetime of the chassis.

Introduction

The crawler chassis are used in various types of machines, for example agricultural machinery, earth moving machines and machines for surface mining including large-sized excavators [1]. The chassis are manufactured in different variants of crawler design. Chassis serves several important functions:

- the transmission of weight and external forces to terrain,
- safeguarding the working stability while moving forward, backward and turning around,
- safeguarding that the allowed load of terrain in not exceeded,
- the transfer to a new locality of mining.

The connection of chassis to terrain is a complex issue. Thus, the research of chassis connection to its surroundings is planned for the next part of the project.

Headings. This type of chassis is of a new construction. According to the manner of excavator to its own chassis there are four-point supports. The movement of pair of crawlers is dependent by means of transverse beam. Each chain belt has its individual and reversible controled driving device which enables the machine to move in random bend or turn on the spot.

Fig. 1 shows very simplified 3D model of chassis we will analyse.

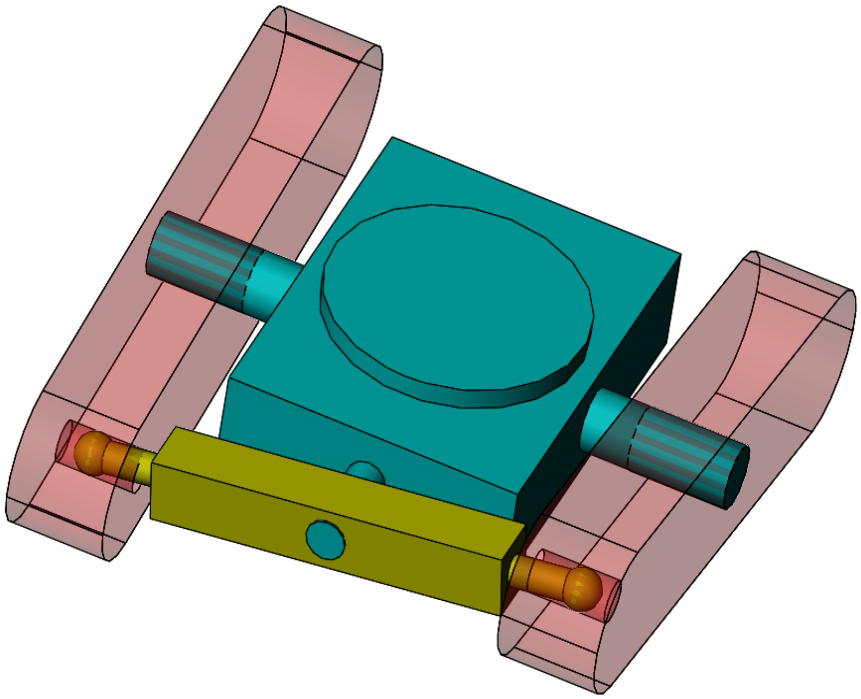

Fig. 1: Bucket wheel excavator chassis

Fig. 2 shows the kinematic diagram of simplified chassis and type of connections compiled in accordance with fig. 1. The illustrated spatial mechanism is assembled from five rigid bodies including frame. Each body has six degrees of freedom in space.

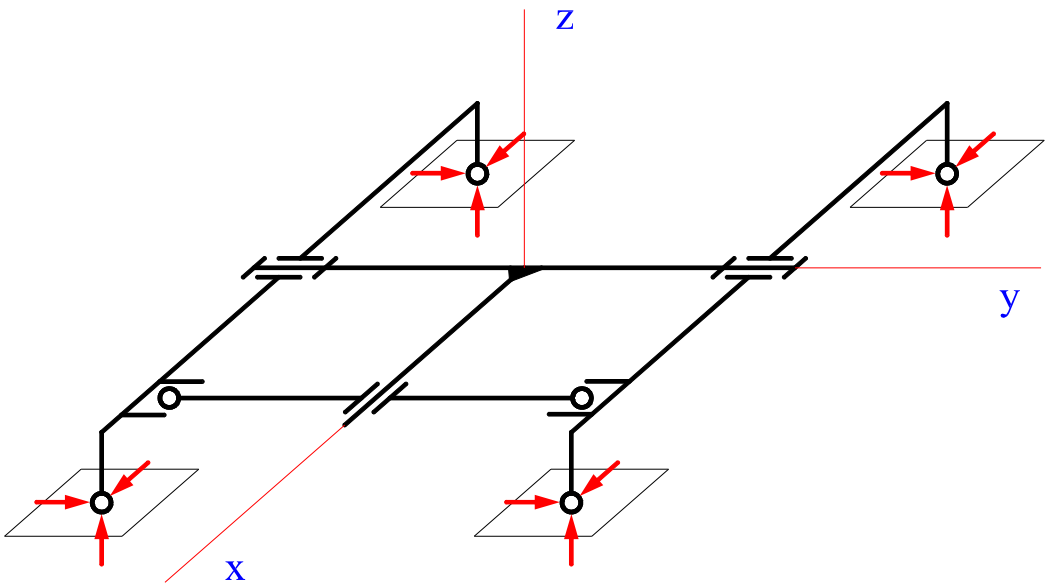

Fig. 2: Kinematic diagram of chassis

To find a solution it necessary to describe every body by the system of six linear algebraic equations [2]. The system of equations is driven by the extent of symplification of the real machine which might by performed on various levels [3].

The load of chassis is based on the assumption that the workload is situated in the level of ball trajectory by space system forces and moments, fig. 3.

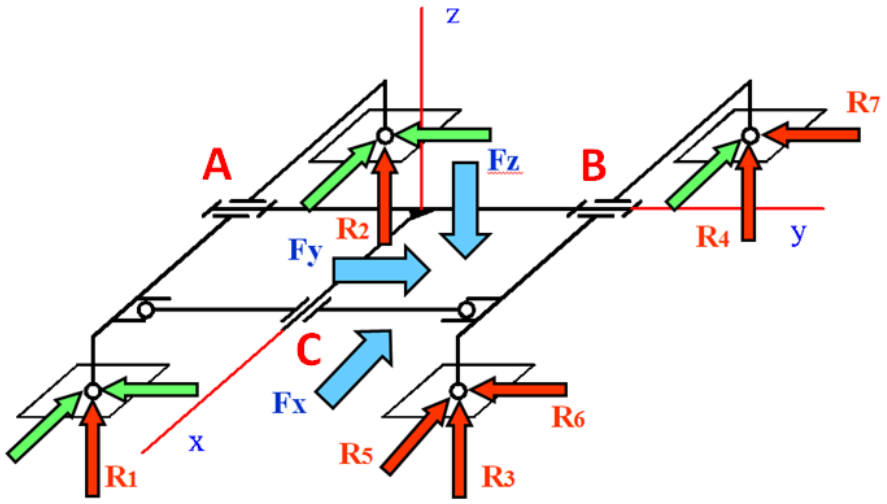

Fig. 3: Workload of chassis

The load of chassis is caused by its own weight, wind, breakout forces, forces of inertia and resistance to movement[1].

Numerical computation of unknown forces and moments has to executed for a great number of different operational situations. Acquired results will be used for designing and dimensioning of all chassis parts and for power determination of driving motors.

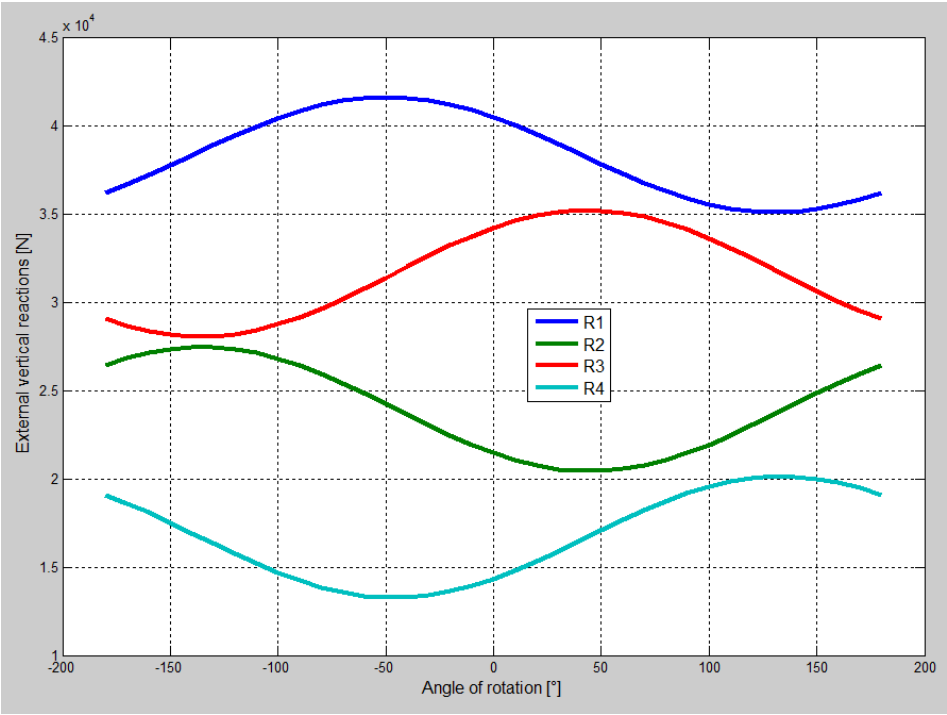

Fig. 4: Vertical forces in chassis contact points

Fig. 4 and fig. 5 show course of calculated force effects for one external load variation depending on bucket wheel position.

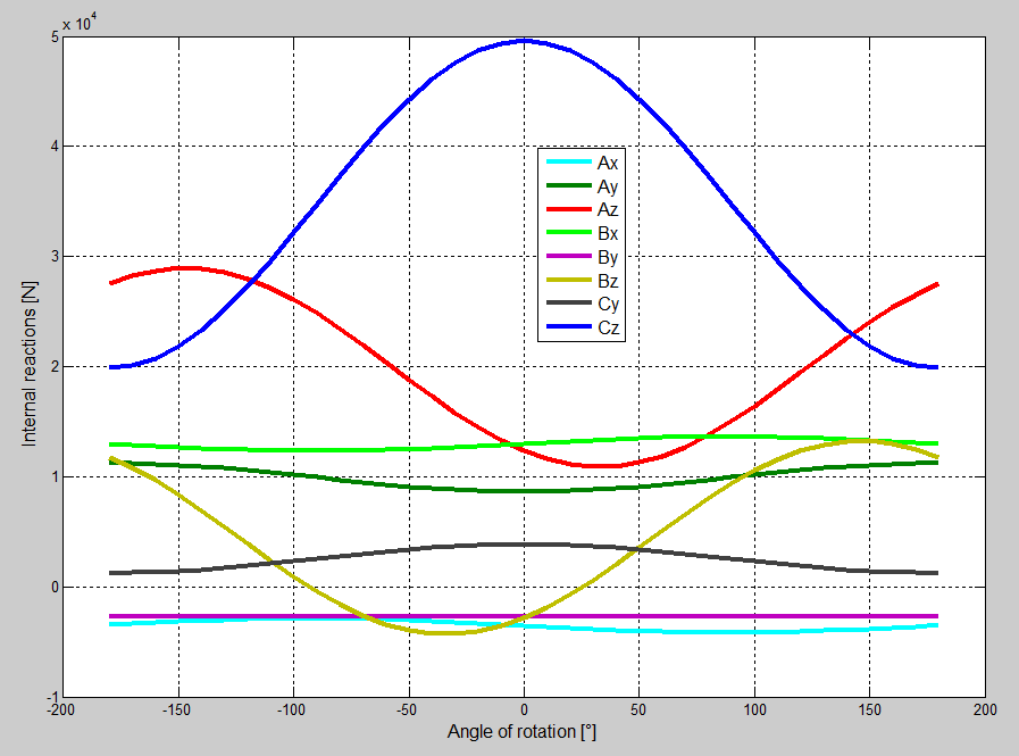

Fig. 5: Force effects in main journal of chassis

Conclusions

The contact of chassis with the surrounding muddy or rocky terrain presents an interesting issue. This will be the subject of further research.

References

[1] J. Hojdar, F. Helebrant, H. Gondek, Povrchové dobývací stroje, VŠB v Ostravě, 1991.

[2] V. Stejskal, J. Březina, J. Knězů, Mechanika I, ČVUT v Praze, 1998.

[3] V. Brát, Maticové metody v analýze a syntéze prostorových vázaných mechanických systémů, Academia Praha, 1981.