CORE DRILLING MACHINE FOR PERFECTLY VERTICAL DRILLS

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Abstract
The article is focused on the design of new drilling machine for building perfectly vertical drills. The need of the vertically accurate drills is given by the necessity of inverted pendulum installation into the water dams. The machine is designed with emphasis on mobility and installation dimensions in the dam corridors.

Key words: *drilling machine; core drilling; water dam; inverse pendulum; monitoring.*

INTRODUCTION

The security of water dams is very actual topic. The pendulums are used for monitoring of water dam tilt. These tilts can reach quite high values due to the temperature difference or amount of retained water. The fixed point of the pendulum is usually placed nearby the top of the dam and the weight is nearby the foundation joint of the dam. For more precise measurement the inverse pendulums are used in combination with classic pendulums. The inverse pendulums are installed through the foundation joint of the dam. This allows to separate the movements of the dam due to the temperature, water etc. and the movements caused by the changes in the subsoil. For this purpose, it is necessary to build very accurate vertical drill through the dam concrete, foundation joint and the subsoil rock (Webster, 1998). The verticality of the drill is required 0.1%, i.e. 1 mm deviation for 1 m of the drill. The designed drilling machine was further used in cooperation with company CHEMCOMEX Praha, a.s. for the new technology development within the project TA04020433.

MATERIALS AND METHODS

The drilling machine is designed as a two-column with a drill head on the lifting portal. The CAD model can be seen in Fig. 1.

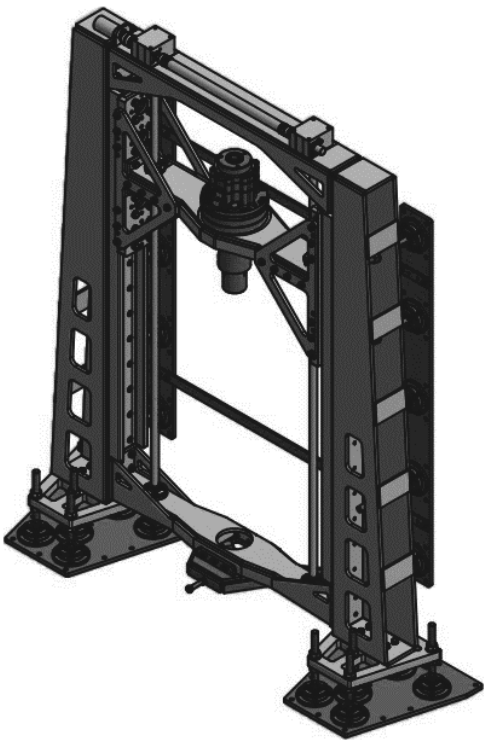

Fig. 1 The CAD model of the designed drilling machine

The drilling machine is designed for the bore diameter 137 mm and the tight drilling column is used. The necessary torque for the drilling is approx. 2000 Nm and revolutions 190 rev/min. These parameters are satisfied by the hydraulic drill head JANO RH 250. The stroke of the drill head is realized by means of the motion screws and lifting gearboxes. The input power is realized by the hydraulics again. The linear movement is secured by the rails and track runner bearings.

It has to be supposed that the connecting surfaces in the dam corridor are not ideally flat, see in Fig. 2. The correct setting up of the drilling machine is essential for the verticality of the built drill. For this purpose, the special adjustable struts with spherical joint were designed, see Fig. 2. These struts can compensate the imperfections both on the floor and on wall of the corridor. This system allows the correct setting up of the drilling machine into the vertical position. Whole adjustable system is in Fig. 3.

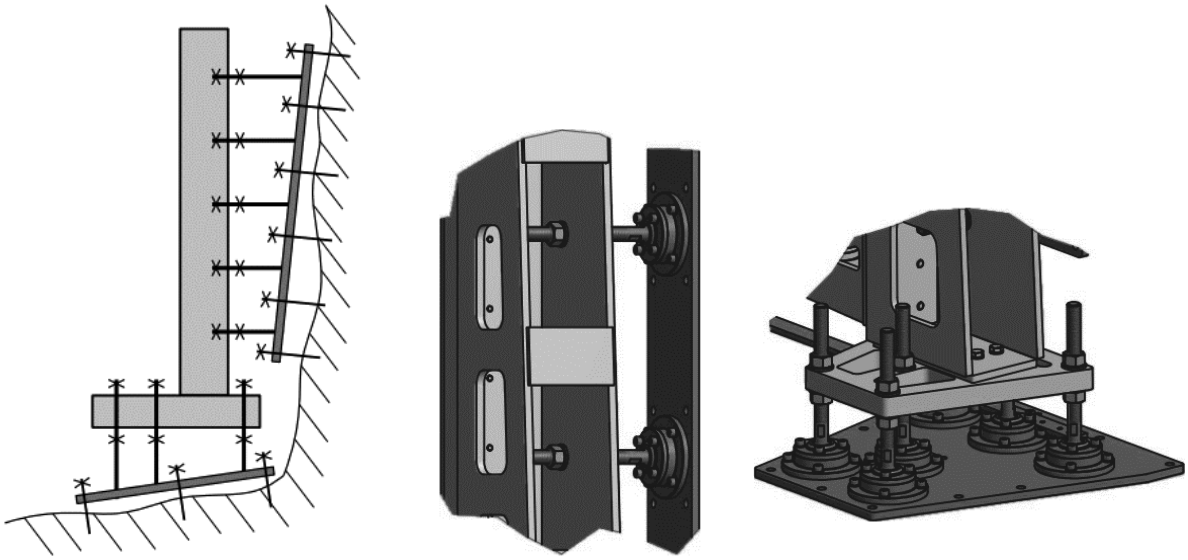

Fig. 2 Scheme of the non-ideal surface for the drilling machine connection and designed solution by means of the struts with spherical joints (Kavka, 2015)

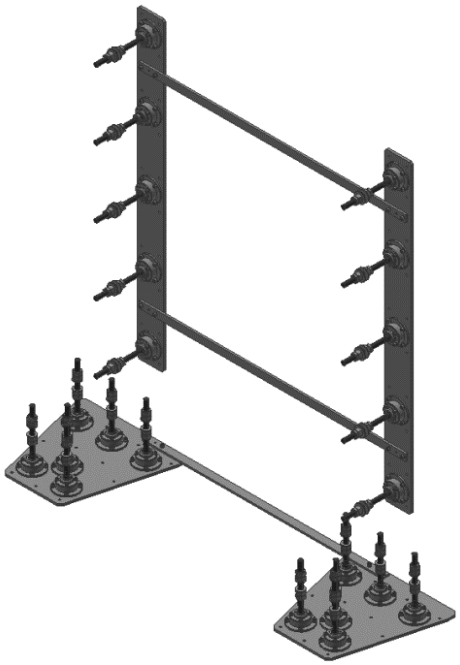

Fig. 3 Adjustable system for compensation of imperfections of the floor and wall (Kavka, 2015)

RESULTS AND DISCUSSION

The drilling machine was manufactured according the introduced design. The first testing took place on the testing polygon on the premises of the company CHEMCOMEX Praha, a.s. Complex drilling tests were carried out. Furthermore, the verticality of the test drill was measured by the special measuring pendulum. Measured data were evaluated with very good result of verticality.

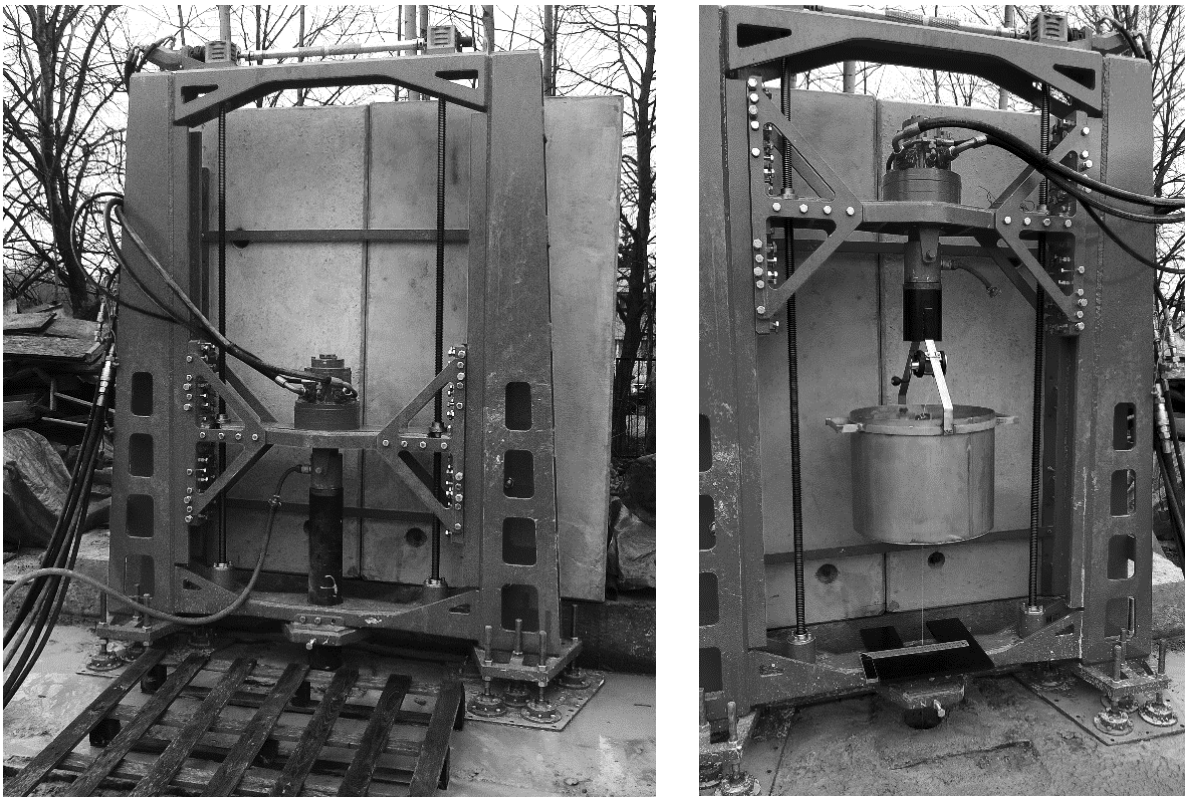

Fig. 4 Drilling machine on the testing polygon and special measuring pendulum mounted on the drill head

After necessary test of the drilling machine, it was moved to the Orlík dam, see Fig 5. The main goal was to build the 10.5 m deep drill of diameter 137 mm through the foundation joint of the water dam and keep up the given verticality 0.1%. At first, the drilling machine had to be mounted to the floor and wall using above mentioned adjustable system. The axis of the drill head was established into the coincidence with vertical. The problem with the rinse water had to be also solved due to the environmental and technical reasons.

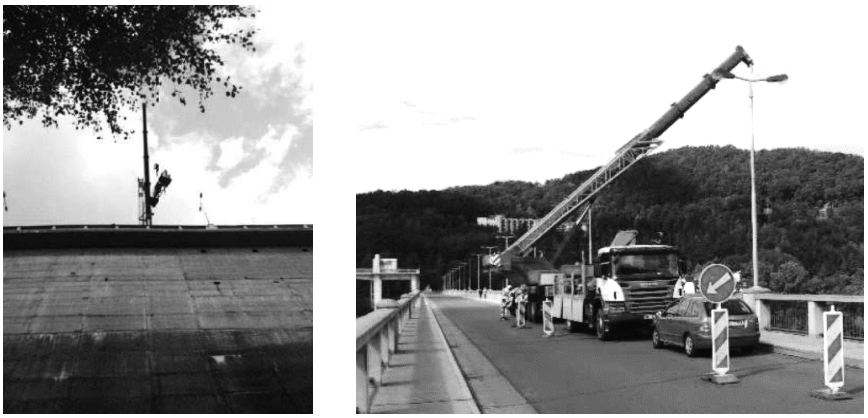

Fig. 5 Transport of the drilling machine into the Orlík water dam

The drill in the Orlík dam was built into the deep of 10.5 m. The first 2.8 m of the drill was built in the concrete structure of the dam and the rest of the drill is located in the rock base. The drill was continuously monitored by means of the special measuring pendulum to keep up the given verticality with very good results. Drilling machine in the corridor of the Orlík water dam can be seen in Fig. 6.

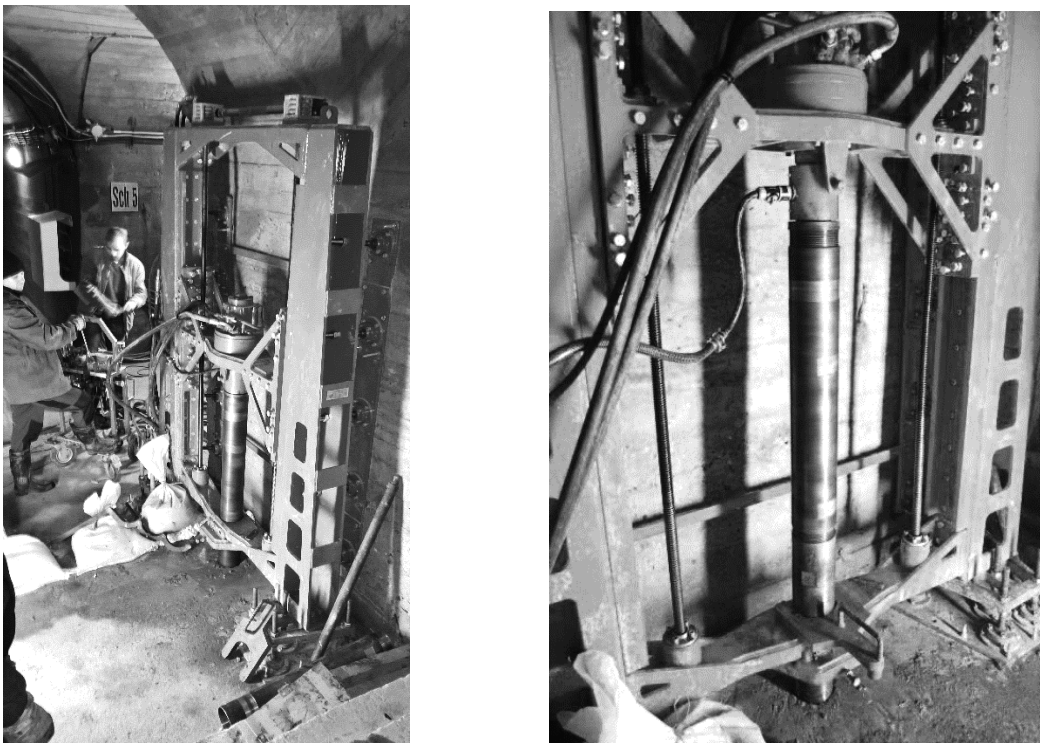

Fig. 6 Drilling machine during the drilling in the corridor of Orlík water dam

CONCLUSION

This contribution describes the design the new design of the special drilling machine. This machine is capable to build accurately vertical drill by means of core drilling technology. These vertical drills are requested nowadays due to the installations of inverted pendulums for the water dams. Further, the testing of the drilling machine, its transport to the Orlík water dam and own drilling in the dam is described.

REFERENCES

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