Design of Test Bed for Identifying Coal and Gangue

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Abstract

In this paper, a test bed for identifying coal and gangue designed to simulate the real process of coal and gangue falling and its vibration response, so as to better study the situation of the fall of coal and gangue in coal mining site. The test-bed mainly includes Gear-rack lifting mechanism, punching mechanism, and vibration mechanism. The transmission part of the lifting mechanism is analyzed and checked by finite element analysis software to verify the reliability of the design. Best results.

Keywords

Test bench ; modeling; simulation.

1. Introduction

Coal, as an important energy source, is an indispensable material foundation for social development. In order to effectively exploit and utilize coal, fully mechanized top coal caving are used[1]. However, in the process of fully mechanized mining, due to the harsh mining environment, the phenomenon of over-caving and under-caving often occur in the process of mining[2], over-caving will lead to a large number of gangue mixed into coal, resulting in a serious decline in coal quality, under-caving will lead to a large number of coal cannot be released in the underground, resulting in waste of resources[3, 4].In view of the above situation, this paper designs a test bed for identifying coal and gangue, which is mainly composed of lifting mechanism, punching mechanism, and vibration mechanism . It can be used to simulate the actual situation of coal caving. At the same time, coal and gangue can be identified by vibration signal analysis.

2. Design of test bed for identifying coal and gangue

2.1 Design of punching mechanism

The punching mechanism mainly consists of punching block, screw and other devices. The schematic diagram of the mechanism is shown in Fig. 1.

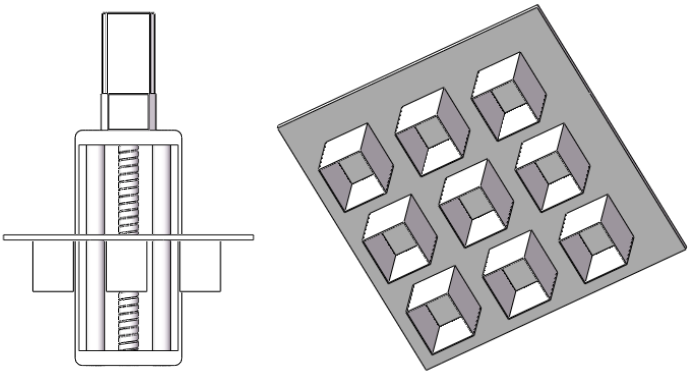

Fig. 1 Punching mechanism and punching block

Ball screw is the most commonly used transmission element in tool machinery and precision machinery. Its main function is to convert rotary motion into linear motion or torque into axial repetitive force. It also has the characteristics of high precision, reversibility and high efficiency. Because of the small friction resistance and the above advantages, 40Cr ball screw is selected as the driving device of the punching. The innovative point of punching mechanism is the design of punching plate. The punching plate is the combination of punching block and plate. The plate is connected with the lead screw. The lead screw is driven by the motor and then the lead screw drives the plate. Finally, the plate drives the punching block to punch down and the movement after the punching finished. And the punching process is shown in Fig. 2.

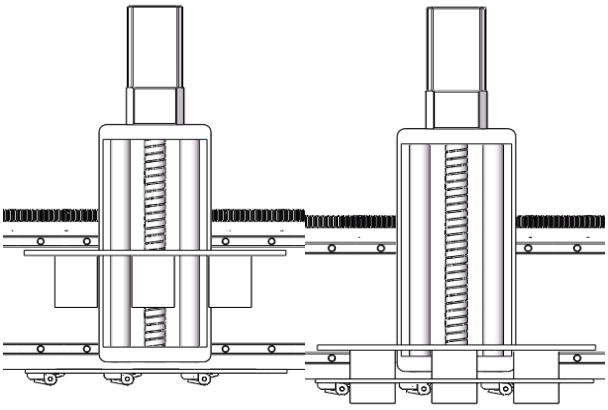

Fig. 2 Process of punching

2.2 Design of Gear-rack lifting mechanism

In the process of coal and gangue identification, the distance between coal and gangue is a very important parameter, but due to the heavy weight of the whole device, it should be considered to drive the workbench up and down on the one hand, on the other hand, to achieve accurate positioning of lifting, so the lifting mechanism is finally considered to be used. Rack and pinion lifting mechanism. In this paper, the lifting mechanism is mainly composed of rack and pinion drive. TheGear-rack drive has the characteristics of high precision and high accuracy. It can achieve precise positioning in lifting. The rack clamping mechanism is used to fix the position by self-locking. The lifting mechanism is shown in Fig. 3.

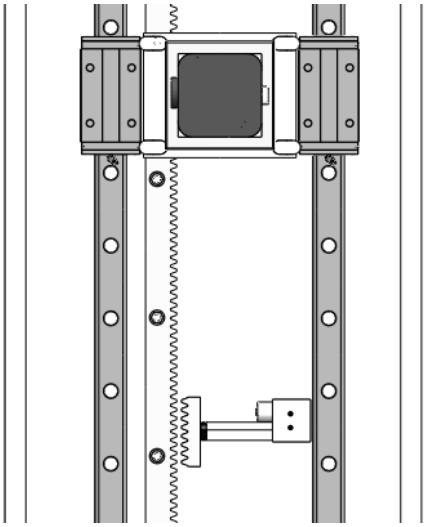

Fig. 3 Lifting mechanism

2.3 Design of vibration mechanism

In the process of coal gangue identification, vibration signal is an important parameter to distinguish coal and gangue. This paper designs a new vibration plate to simulate the real vibration of caving coal by adjusting the angle of vibration plate, so as to realize the simulation of coal and gangue falling

impact. The vibration mechanism is composed of vibrating plate, electric hydraulic push rod and movable hinge. The electric hydraulic push rod has the advantages of small size, high precision, complete synchronization and good self-locking performance. The advantages of small size of the electric hydraulic push rod are fully considered in the design and selection. It saves space, has good stability and friendly operation. The electric hydraulic push rod can be extended when the power supply is connected with the negative electrode and the electricity is used. The push rod can be retracted by moving it, but the angle deviation of the vibrating plate can not be realized by only relying on the electric hydraulic push rod, so the connection between the vibrating plates is realized by the movable hinge. The structural design of the vibration mechanism is shown in Fig. 4.

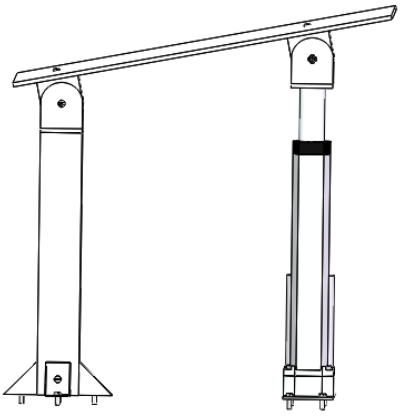

Fig. 4 vibration mechanism

3. Simulation analysis of test bed

When the lifting mechanism running, the lifting connection has the greatest force. Therefore, the simulation analysis of the connection of the lifting mechanism is carried out to realize the reliability of the simulation, the lifting mechanism is simplified. The connection mode of the mass block geometry model and the equivalent geometry model of the connecting plate of the mobile assembly body is defined as bonded, and the meshing of the two models is carried out. As shown in Fig. 5.

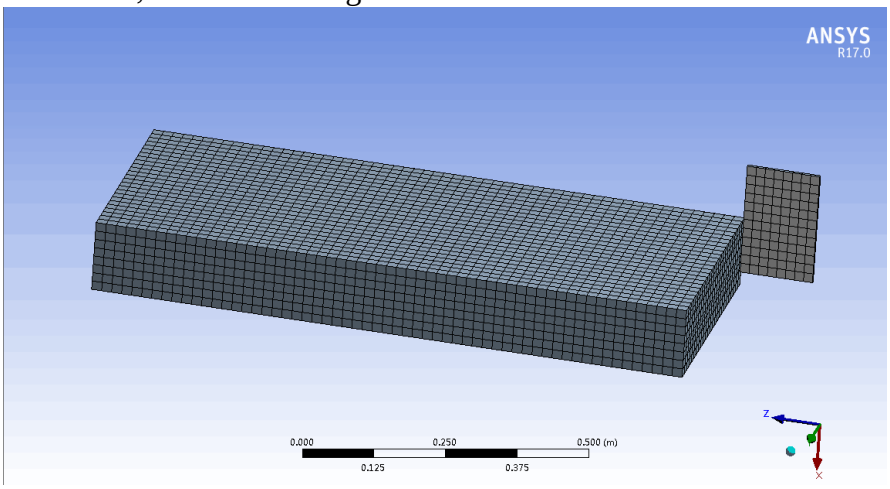

Fig. 5 Connection mode and grid

Define the boundary condition, and the negative Y of the connecting plate is constrained to the surface, and the plate is fixed. As shown in Fig. 6.

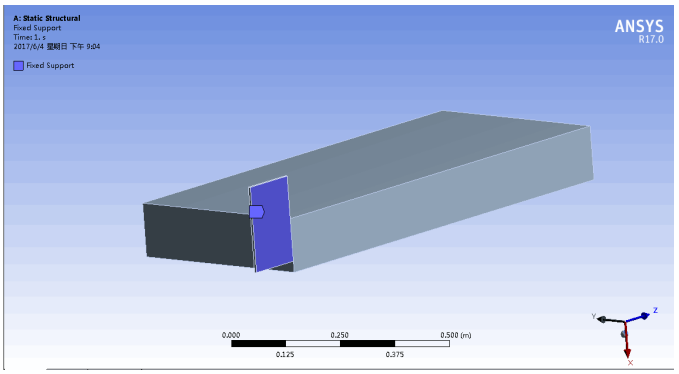

Fig. 6 Definition of boundary conditions

The equivalent stress, equivalent elastic strain and the maximum stress point can be obtained by can be obtained from the simulation analysis which are shown in Fig. 7 and Fig. 8.

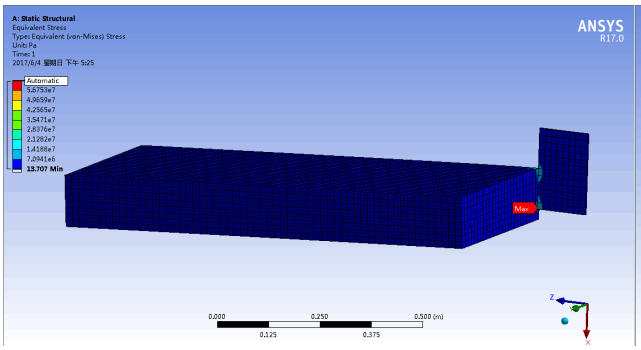

Fig. 7 Equivalent stress

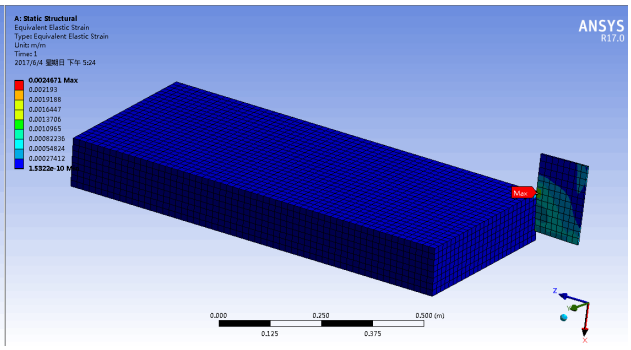

Fig. 8 Equivalent elastic strain

From the diagram, the maximum stress point is at the bottom of X direction, at which the stress is about 57 Mpa, and the material of the connecting plate is Q235. The yield limit is greater than that of the point, so the design is reliable.

4. Conclusion

(1) The punching mechanism adopts mode of screw drive, gear drive and linear slider drive to ensure the movement is accurate and effective.

(2) The lifting mechanism is composed of rack-and-gear transmission, which can realize precise positioning in lifting. The rack clamping system is adopted to fix the position by self-locking.

(3) The vibration mechanism can change the angle of the vibration plate by lifting the electric hydraulic push rod, and the angle can be controlled accurately by fastening the movable hinge.

References

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