Analysis of Spherical Coal Impacting Metal plates Based on Workbench

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Abstract

In order to study the response changes of coal impacting support and mining equipment, a simplified model of coal impacting support and mining equipment is established by using Workbench. The dynamic simulation of the same spherical coal impacting metal plates with different thickness is carried out. The mechanical response characteristics of the spherical coal impacting metal plates can be obtained by analyzing the results, which can provide a reference for the safe mining of coal.

Keywords

Impact; coal; Workbench.

1. Introduction

As an important energy source, coal has the advantages of good heat generation and high thermal efficiency[1,2]. It is often used as the main energy supply material for various large-scale industries[3]. In the actual mining process of underground mines, due to poor mining conditions, the situation of coal blocks impacting support and mining equipment often occurred[4,5]. In order to ensure the safe mining of coal underground, it is necessary to study the collision response between coal and underground equipment. The ANSYS Explicit Dynamic module of Workbench has the characteristics of high simulation precision and less calculating time. This paper uses this module to obtain the collisional mechanical response of spherical coal impacting metal plates with different thickness.

2. Establishment of simulation model

Due to the complexity of coal falling and the variety of underground equipments, a simplified model is established by using Workbench. The simplified model consists of two metal plates and a spherical coal. The underground equipment is simplified into metal plates with thickness of 10 mm and 15 mm, and the coal is simplified into spherical coal.The spherical coal impact the metal plates with different thickness vertically with the vertical speed of 10m/s, and exerts the gravitational acceleration during the whole collision process, and fixes the restraints on the four sides of the metal plates to simulate the field situation. The constraint mode and grid model are shown in Figure 1.

3. Simulation results and analysis

In order to study the mechanical response of metal plates with different thickness under coal impact, this paper uses Workbench simulate the display dynamics of steel plates with different thickness impacted by the same spherical coal, and obtains the different total deformation of the model during the collision. Meanwhile, the maximum equivalent elastic strain and maximum equivalent elastic strain of metal plates with different thickness are also obtained from simulation. As shown in Fig. 2 to Fig. 8.

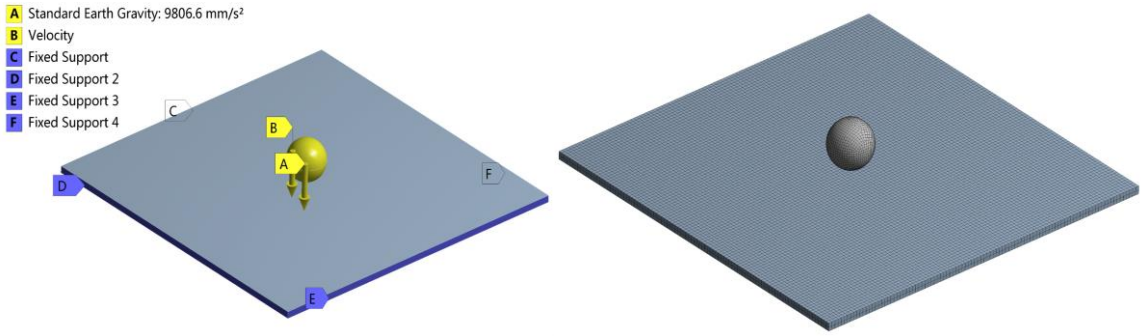

Fig. 1 Constraint mode and grid model

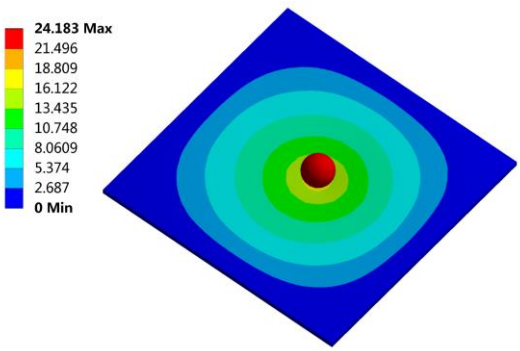

Fig. 2 The total deformation of 10mm steel plate and spherical coal

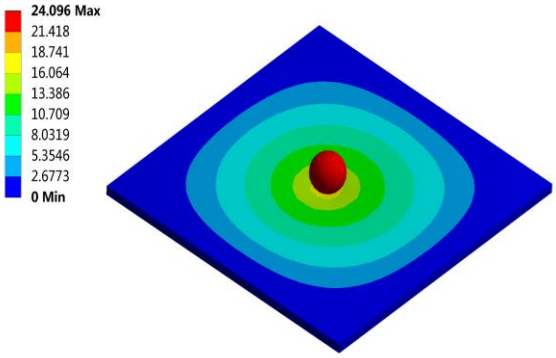

Fig. 3 The total deformation of 15mm steel plate and spherical coal

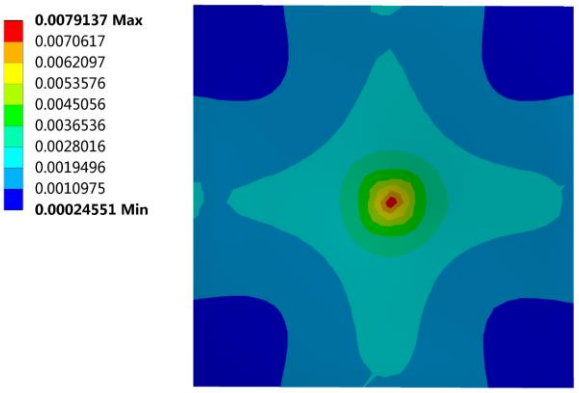

Fig. 4 Maximum equivalent elastic strain of 10mm metal plate

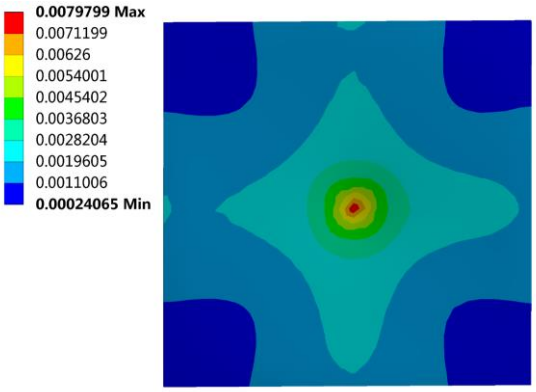

Fig. 5 Maximum equivalent elastic strain of 15mm metal plate

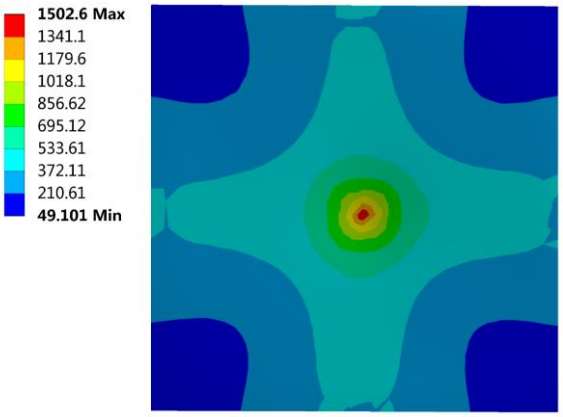

Fig.6 Maximum equivalent stress of 10mm steel plate

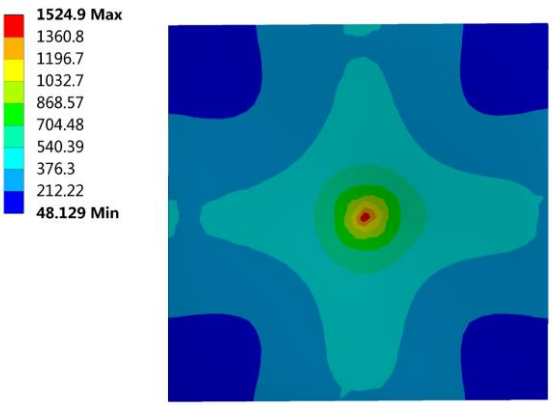

Fig.7 Maximum equivalent stress of 15mm steel plate

From Fig. 2 to Fig. 7, the maximum equivalent elastic strain and maximum equivalent stress of the steel plate occur at the impact point of spherical coal, and the stress and strain are distributed in cross shape. It can be seen that the total deformation of the whole model decreases effectively and the deformation range of the steel plate decreases remarkably with the increase of the thickness of the steel plate.The deformation parameters of metal plate and spherical coal are obtained simulation , as shown in Figures 8 to 11.

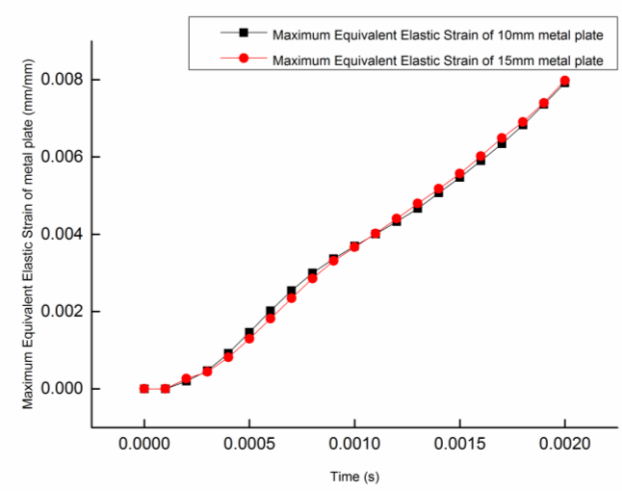

Fig.8 Maximum equivalent elastic strain Of metal plate

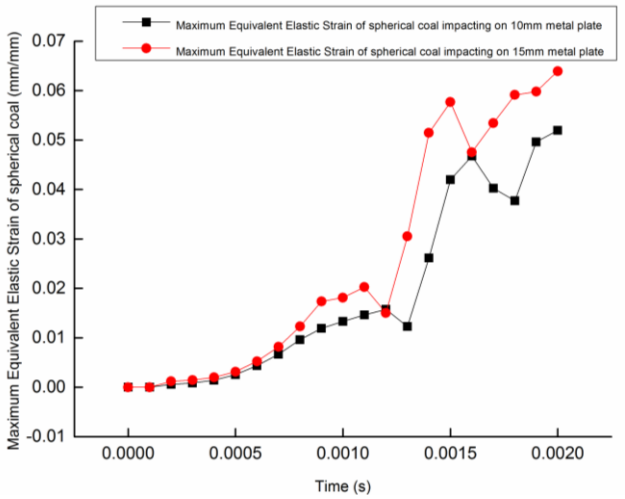

Fig.9 Maximum equivalent elastic strain of spherical coal

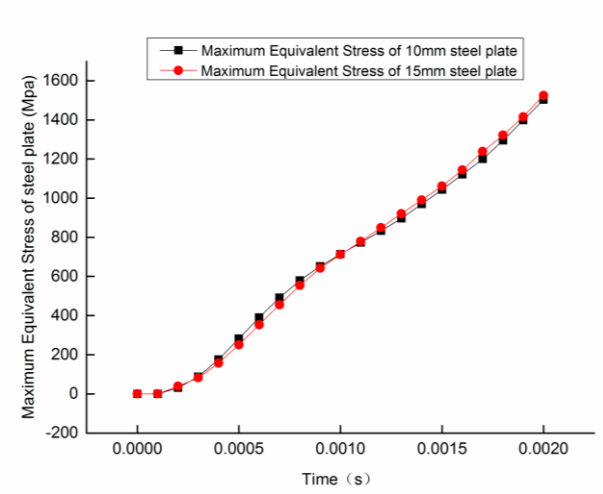

Fig.10 Maximum equivalent stress Of metal plate

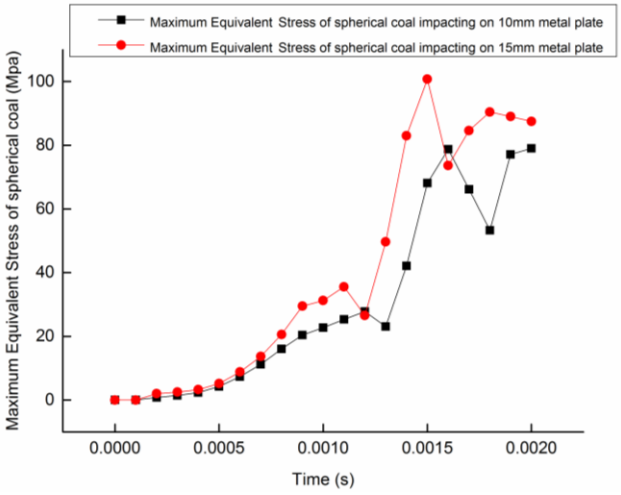

Fig.11 Maximum equivalent elastic stress of spherical coal

From Fig. 8 to Fig. 11, it is found that the maximum equivalent elastic strain and equivalent stress of the plates with different thickness are almost the same, but the equivalent elastic strain and maximum equivalent stress change of the spherical coal increase sharply with the increase of the thickness of the plates. Combining Fig. 2 to Fig. 7, it is found that the maximum equivalent elastic strain and maximum stress of the metal metal change slightly with the increase of the thickness of the metal plate. With the increase of the thickness of the metal plate, the maximum equivalent elastic strain and the maximum equivalent stress change of spherical coal increase greatly.

4. Conclusion

Through the simulation study of the impact of spherical coal on different thickness metal plates, the following conclusions can be drawn.

(1) With the increase of plate thickness, when spherical coal impacting the metal plates with different thickness, the total deformation of the metal plate decreases effectively, and the changes of maximum equivalent elastic strain and the maximum equivalent stress of the metal plate are not large .

(2) Both the maximum equivalent elastic strain and the maximum equivalent stress of the metal plate occur at the impact point, and the stress and strain are distributed in cross shape. The large strain range of the metal plate decreases effectively with the increase of the thickness of the metal plate.

(3) During the collision, the maximum equivalent elastic strain and maximum equivalent stress of spherical coal increase significantly with the increase of metal plate thickness.

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