Design of Buried Drill Bit Salvage Device in Deep Hole Drilling

Xiangqiang Meng, Xirong Liu, Ruiguang Wu

Shandong University of Science and Technology, Shandong 266510, China.

1414520083@qq.com

Abstract

The directional long borehole in underground coal mine is the most direct and effective means for gas control, water damage control and hidden disaster detection. It is the main technical way for efficient gas extraction at home and abroad, and it is important to realize efficient extraction of coalbed methane in coal mines. means. A deep hole drilling and drilling tool was designed for the high-efficiency directional drilling rig in deep hole drilling. According to the designed parameter size, the three-dimensional model of the salvage equipment and related parts was constructed. The ANSYS software was used to analyze the salvage device including the salvage device, the coring tube and the female cone, and analyze the force of the salvage device, the coring tube and the female cone. situation. Ensure that the drilling tool can be salvaged without damaging the drill.

Keywords

Buried drill, gas extraction, salvage, deep hole.

1. Introduction

Buried drilling refers to the collapse of the coal wall during the drilling process, the cinder blocking the borehole, the flushing fluid cannot be drilled, and the drill bit cannot be rotated and raised in a hole. In deep hole drilling, the directional drilling machine has a faster drilling speed and the rock is soft. When the rock powder produced by the drilling is larger than the washed rock powder, the rock powder accumulates continuously, and finally the drill bit is blocked by the rock powder and cannot be measured. In addition, when the directional drilling machine encounters complicated geological conditions such as folds, faults or cracks during the drilling process, the rock powder particles generated by the drilling are large, and the original drilling flushing pressure is insufficient, resulting in a large amount of rock powder staying in the hole. Inside, it cannot be discharged, eventually leading to buried drilling. However, no matter which form of buried drill, there are generally obvious signs of accidents, such as larger particles of rock powder flushed out by the flushing liquid, less water returning from the flushing fluid, and a greater degree of wear in the drilling equipment. Slow entry speeds, etc., may cause a buried drill accident. Therefore, the construction personnel should pay close attention to the drilling process during the construction process. When the drilling process has the risk of drilling, timely adjustment will greatly reduce the risk of drilling and reduce the loss of the enterprise.Structure Characteristics of Main Drive Unit of High-voltage Breaker High-power Operating Mechanism.

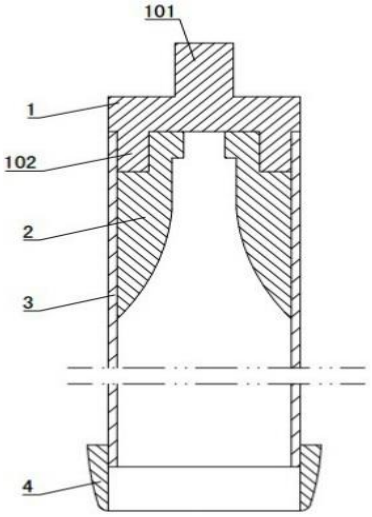
2. Design and Research of Drilling Device for Deep Hole Drilling

With the mature technology used in the underground coal mine to replace the high-level drainage roadway, the deep hole drilling directional drilling machine has broadened its use prospects. What followed was the failure in the hole, and the drilling became a major problem in the drilling industry. In the past few decades, for drilling tool failure processing technology, most drilling companies have

adopted the female cone and male cone with the rig manufacturer. Only international drilling companies use fishing rods. The use of the male cone and the female cone to salvage the drilling tool not only has a bad salvage effect, but also causes the drilling tool to be damaged. The use of fishing rods is better, but it is not usable for vertical holes, and parallel pressure relief holes are required for the use of buried holes. The troubleshooting procedure is complicated, transportation is difficult, and the price is expensive.Actuator cam design

2.1 Design of Drill Bit Fishing Device

Deep hole drilling high-efficiency directional drilling machine in the process of drilling, inevitably encountered in the hole in the hole or in the case of soft coal, so it is easy to appear buried. As the drilling tool itself is less able to withstand pressure, more and more deposits eventually cause the drill to crush the buried drill. Moreover, when the drilling signs are found and the drilling tools are lifted, the rock powder above the drilling tools is gradually increased. If the processing is not timely, the drilling tools are prone to breakage or buried drilling during the adjustment. Generally, the drill is difficult to handle, and it is easy to cause a chain accident in the hole. Therefore, according to these problems in actual production, a deep hole drilling and drilling tool is shown in Figure 1.



1—Coring tube seat； 101—Connecting part； 102—Installation section； 2—Female cones；
3—Coring tube； 4—Core drill bit

Fig.1 Deep hole drilling tool fishing device

2.1.1 Work Process

The core drill bit 4 is rotated by the drilling machine to sweep the hole wall on the basis of the original hole, and the original hole is reamed, and the hole is rinsed by the action of the mud pump high pressure water. The resistance of the borehole is reduced. Determine the length of the coring tube 3 to be used according to the length of the buried drill, and insert the core drill 4 and the coring tube 3 into the hole by using a sweeping hole, and then install the coring tube base at the upper end of the coring tube 3. 1. The female cone 2 is connected. Use the sweeping method to break into the fault location, slow down the drilling speed, let the buried drilling tool enter the coring tube 3, and at the same time ensure the water supply volume, observe the pulverized coal flushing in the hole until the buried drilling tool all enters Inside the core tube 3, and using the female cone 2 to cover the tail end of the buried drill, and then start repeatedly punching, until the coal powder in the hole is flushed, before the drill can be normally drilled and the drilling tool is salvaged.

The drill bit tool and the core drill bit are inserted into the hole through the hole sweeping manner, so that the buried drill tool all enters the core tube, and the mother cone covers the tail end of the drill tool, thereby achieving the salvage of the buried drill tool. The utility model has wide application range, small damage to the buried drilling tool, high success rate of the fishing drilling tool, simplified fault

handling procedure and convenient transportation. The coring tube holder is convenient for connecting the core tube to the drilling machine, the diameter of the connecting portion is smaller than the diameter of the middle portion, and the connecting portion is provided with a thread, so that the coring tube holder can be directly connected with the drilling machine. The mounting part facilitates the installation of the core tube and the female cone, thereby facilitating the connection between the core tube and the female cone and the drilling machine. The core tube and the female cone are connected to the mounting portion by threads, and the assembly and disassembly are convenient, and the connection is firm.Cam material,processing method and structural design[1].

2.1.2 Application Effect

(1) The footage is fast. In the lower part of the coring tube, the core bit is screwed, and since the hole is hollow, the hole wall is directly cut, so the footage is fast. The ordinary salvage device becomes a hole in 3 days, and the original hole bottom can be reached by using the salvage device for 5 hours.

(2) good core effect

① Due to the simple structure, only a small amount of cutting is performed on the original hole wall to ensure that the drilling integrity is intact and intact;

② The core tube is threaded to connect the core drill bit to ream the hole, and the fisherman takes the core tube hollow, and the rock powder and cinder appearing in the reaming are favorable for discharge;

③ When the salvage device is lifted, configure a matching flushing fluid pump to flush the rock powder floating above the salvage device out of the borehole.

(3) The wall of the hole is regular. The salvage device only needs to ream the hole on the basis of the original drill hole. The feed speed of the coring bit is fast, and the probe stone originally on the hole wall is cut and shredded. Therefore, the hole wall is relatively complete, which is beneficial for taking out the drill bit. condition.

(4) Wide application range

① can be used for both deep holes and shallow holes; it can be used for both large diameter and small and medium diameter.

② According to the geological conditions of the construction site, the drilling speed and the flushing pressure of the mud washing liquid can be adjusted. Therefore, the fishing device is adapted to different geological working environments and has a wide application range.

This innovative method carried out on-site construction experiments at the Tingnan Coal Mine in Shaanxi Province. It was proved by practice that the designed deep hole drilling directional drilling machine buried drilling and salvaging equipment can effectively complete the salvage task[2]. On the one hand, saving time and increasing efficiency, the effect of inquiring is obvious; on the other hand, the structure of the salvage device is simple, the production requirements are not high, and the material can be taken locally when used, without delaying the salvage progress, and completing the salvage operation as soon as possible.Output shaft structure design analysis and improvement process.

2.2 Buried Drill Bit Salvage Plan

After a drilling accident occurs, the wall must first be protected, that is, the wall of the hole is not allowed to collapse. Therefore, the viscosity of the mud should be increased to protect the wall of the hole. The buried drill is also divided into several states. When there is only a little collapse in the hole, and there are few residues such as rock powder, the tentative drilling can be carried out, and the drilling tool can be drilled; if the slight lifting effect is not obvious, then To remove the sludge, reduce the pressure on the upper part of the drill, and then carry out the drilling. The cleaning of the sludge can be achieved by using a sand pump or increasing the pressure of the cleaning fluid. If there is still a large piece of gravel after the discharge of the sludge, it is necessary to carry out the blasting and crushing. After the obstacles are all removed, the drilling can be continued.

1) Basic plan

(1) Careful analysis of the reasons for buried drilling and the degree of buried drilling

① Observe the state of the rock powder taken out by the rinsing liquid to judge the condition of the hole wall;

② determine the depth of the stuck portion;

③ Determine the cause of the drilling and the type of obstacle by trying to lift the drill.

(2) According to the principle of "easy first, then difficult, first regular and then special", find out the various reasons after drilling the cause of the drilling, first solve the easier problem, and then gradually solve the more difficult problem of buried drilling.

(3) Determine the optimal plan, save costs as much as possible to solve the problem of buried drilling, and optimize the solution to complete the final plan.

2) Technical measures

(1) closely monitor the signs of pressure drilling

Closely observe the return water condition of the borehole. If the amount of return water is small, you can tentatively retreat the drill, and then continue to drill and salvage[3]; if there is no return water, first increase the pump pressure, observe the drainage state, if it still does not return water, Stop the strong pressure to send water, change the intermittent water supply, and then tentatively drill. According to different situations, choose different programs, and you must not force them to be strong.

(2) Scientific analysis of drilling trajectories

Divide the situation of the hole, at different points, the drilling tool uses different ways. The air outlet at the branch point is small, and the drilling tool is used to repeatedly sweep the air to expand the drilling and continue to work. The speed of the drilling is slowed down, and the hydraulic pressure of the drilling tool is observed. If there is a sharp fluctuation, the drilling is abandoned and other routes are selected. Or give up the salvage; the environment of the puncture area is complicated, and it is easy to get stuck in the drilling and retreating[4]. Therefore, it is necessary to carry out repeated reaming and smooth out the drilling hole to continue working.

(3) using a washing solution

The use of the washing liquid is relatively extensive, especially in the drilling and salvaging operation, the washing liquid is like a lubricant in the machine, and plays three main functions in the drilling of the drilling tool: one is the lubricating effect. The viscosity of the washing liquid is high, and it is adsorbed on the wall of the hole. When the drilling tool collides with the wall of the hole, the washing liquid can effectively reduce the wear and ensure the smooth passage of the drilling tool. The second is the role of the wall of the protection hole. The drilling tool has destroyed the state of the rock formation during the drilling process. The rock wall powder and cinder are more, and the washing liquid forms a protective film when flowing through the borehole to prevent the fine particles of the hole wall from falling. The third is to enhance the slagging capacity. The rock powder that has been dropped and the coal slag are collected by the washing liquid to float together, which greatly improves the slagging efficiency of the drilling hole and is beneficial to the smooth operation of the drilling tool.

The drop of the drill bit into the bottom of the hole is generally caused by mechanical failure, miscalculation of complex geological conditions or improper human operation. From the experience of salvage in the past, it is very important to choose a suitable drilling tool. Under normal circumstances, the drill bit will not be easily stuck. Therefore, the buried drill bit is mostly complicated, and the drilling rig is in a stagnant state after the drilling, a large amount of toner and cinder. When the sediment falls and accumulates, it is very difficult to handle. The core drill bit of the salvage device is very demanding, and the core drill bit should be repeatedly moved up and down. It is necessary to ream the hole and drill the drill, and to remove the obstacles in the hole to ensure smooth salvage. The deep hole drilling tool for the design of this chapter can be adjusted according to the actual size of the drill bit to ensure that the core drill bit is used to cover the drill bit and reaming and drilling. In the actual

trial of the site, good results have been achieved, and an effective method for solving related problems in the future has been proposed.

3. Finite Element Analysis of Buried Drilling and Salvaging Device in Deep Hole Drilling

The designed deep hole drilling and salvaging device is suitable for salvage of vertical and directional wells and horizontal wells. According to the finite element mechanical model establishment method, the finite element numerical simulation analysis of the designed deep hole drilling and salvaging device is carried out, and the stress intensity and strain of the female cone are analyzed. The main purpose is to perform strength check and contact stress analysis of the joint threads. Based on the overall analysis of the salvage device, the stress and strain of each part under the pre-tightening condition and the added pressure of the pipe are analyzed. The three-dimensional analysis model established in this paper is close to the actual situation, and fully considers the real state of the job site. The results of the analysis have certain authenticity, and the result can show the mother cone in actual work. The distribution of force has a more accurate reference value in practical applications.

3.1 Establishment of Finite Element Mechanical Model of Buried Drilling and Salvaging Device

The object studied in this chapter is deep hole drilling and salvaging device. This device is mainly composed of coring tube base, connecting part, mounting part, female cone, coring tube and core bit. The inner wall and the outer wall of the mounting portion are provided with a thread, and the upper portion of the female cone and the inner wall of the upper end of the coring tube are provided with threads matching the mounting portion. According to the structural design of the salvage device, a Tweed connection is selected on the connection between the coring tube and the coring bit, and the taper of the special taper is 1:12.

The fishing device connection structure belongs to an axisymmetric rotator, and the force received by the female cone in the circumferential direction also has periodic symmetry. Considering the cyclic symmetry of the expected force of the connected structure, we only need to establish a periodic model (ie 1/20 of the overall structure) when constructing the analytical model. The analysis of a periodic model satisfies the purpose of the analysis. This not only satisfies the purpose of the research but also reduces the time taken for model building and model analysis. The final model includes the overall salvage device, a coring tube, and a female cone. According to the Saint-Venant principle, the length of the female cone analyzed is selected as Rt L 5.2 (R pipe average radius, t is pipe thickness). The three-dimensional model of the overall fishing device, the core tube and the female cone constructed by the data parameters consulted are shown in Fig. 2, Fig. 3 and Fig. 4.

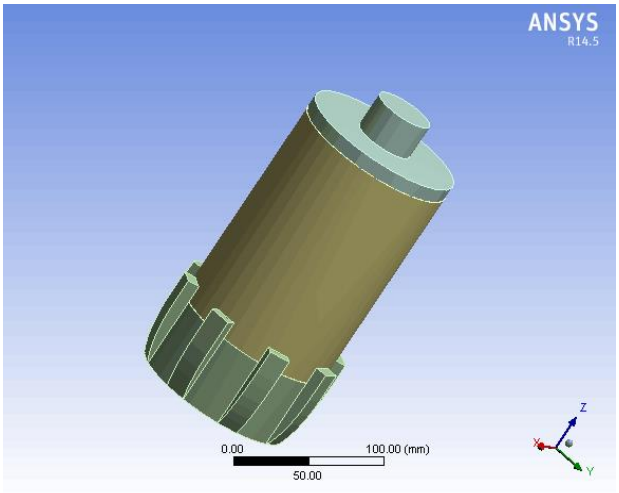


Fig. 2 Salvage model diagram

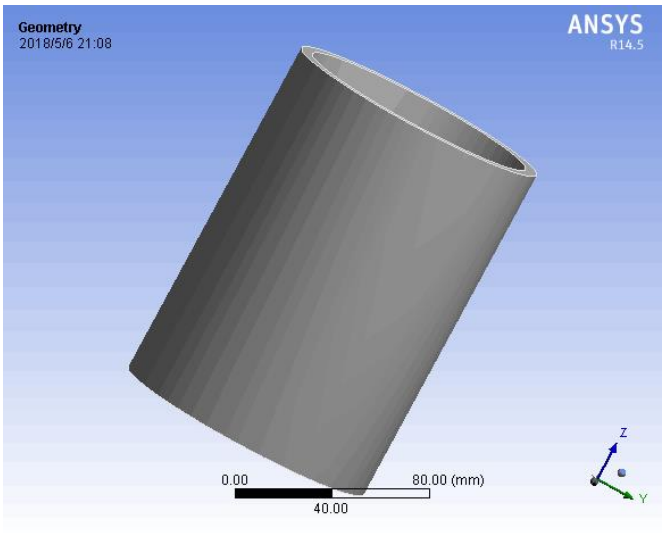


Fig. 3 Core tube model diagram

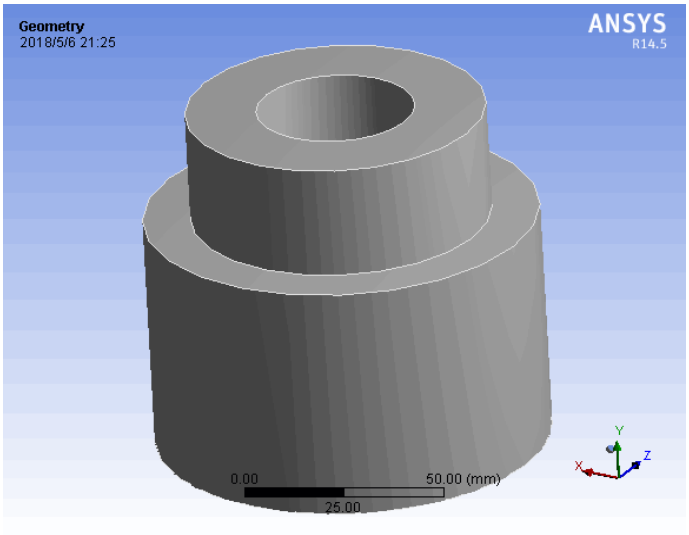


Fig. 4 Master cone diagram

3.2 Grid Division

When meshing with ANSYS, the mesh can be divided by the adjustment of the degree of association. According to these principles, the meshing of the fishing device model, the core tube and the female cone is shown in Figure. 5, Figure. 6, and Figure. 7[5].

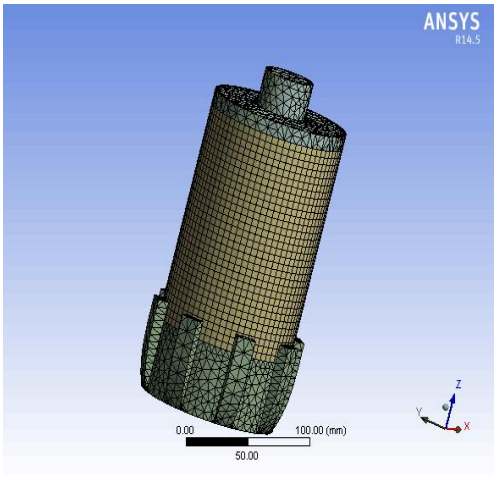


Fig. 5 Mesh division of fishing device

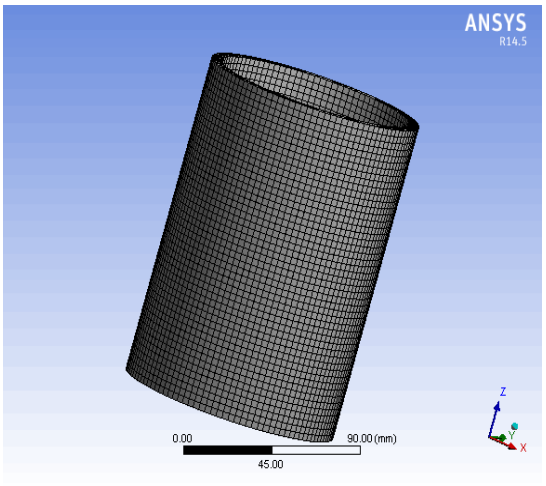


Fig.6 Meshing of core tube

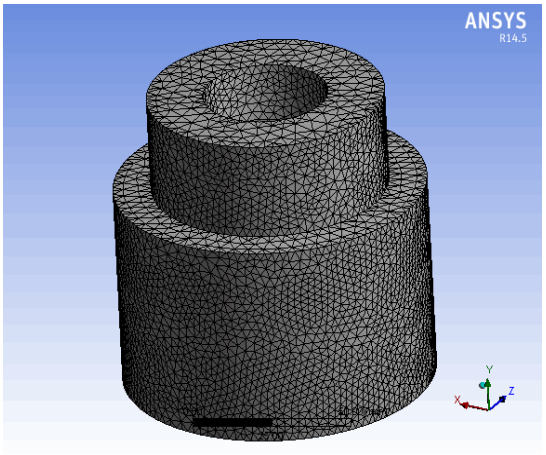


Fig. 7 Conical grid partition

3.3 Load and Boundary Conditions Settings

By adding loads and constraints to the finite element, the load and strain conditions of the deep hole drilling and salvaging device during the salvage operation can be analyzed. Therefore, the location, size and direction of the load will have a direct impact on the final analysis. Before the analysis, it is necessary to carefully understand the force of the salvage device, and then reduce the load for finite element analysis[6]. When adding boundary conditions, the axis and symmetry relationship between the load and the constraint on the structure of the salvage device should be considered as much as possible according to the force and constraints of the mechanism under the real situation. The boundary conditions added by the finite element model are as follows:

(1) Firstly, the assembly is analyzed, and the load is added to the core tube, the female cone and the core drill bit. The female cone and the core drill bit are added with a fixed constraint in the Y direction and the X direction, and a torsion force is added to the core tube. Limit axial and circumferential rotation, respectively.

(2) Add a symmetrical constraint on the female cone and the core drill.

(3) Since the entire device is in a rotating state, axial restraint is added to the female cone, the coring tube, and the coring bit.

3.4 Static Analysis of Buried Drilling and Salvaging Device

Through the established geometric model of the fishing device and the female cone, taking into account the force characteristics of the device, the ANSYS is used to simulate the salvage device and the female cone solid unit. Considering the force of the fishing device and the female cone, the total

salvage device is obtained. Deformation, stress and strain diagrams (Fig.8, Fig.9, Fig.10). Set the motor power of the rig to 7.5KW, and the output speed n=110r/min, then the maximum output torque $T = 650N \bullet m$. According to the calculation results, the overall deformation of the salvage device appears at the reaming of the coring bit, and the maximum strain occurs in the female cone, and the maximum stress that can be withstood is 247 MPa.

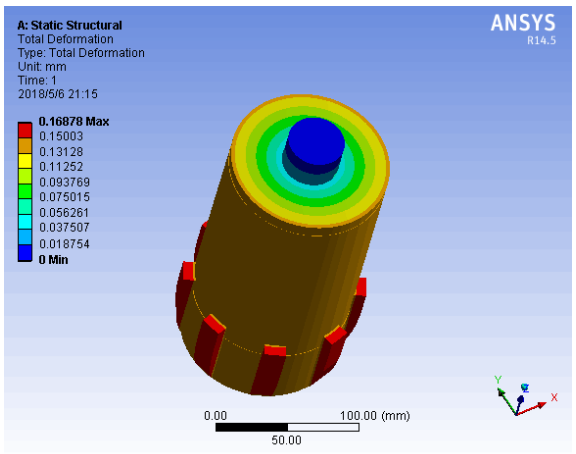


Fig. 8 Total deformation of the salvage device

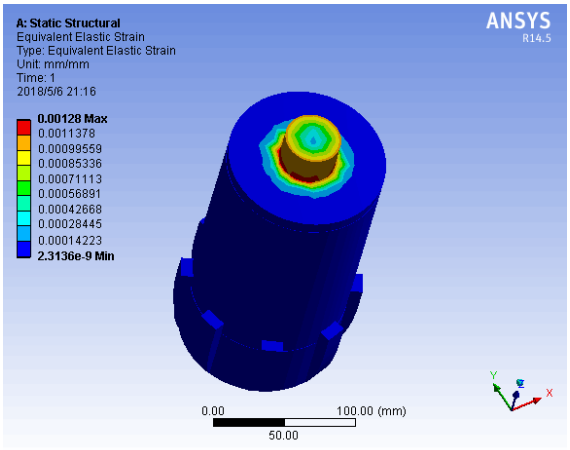


Fig. 9 Salvage strain cloud map

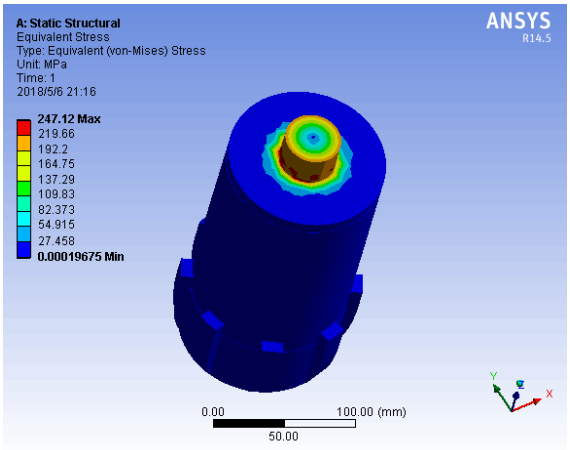


Fig. 10 Salvage stress cloud map

In the mechanical analysis of the salvage device, it can be seen that the maximum stress and strain of the device appear in the female cone. Therefore, further static analysis of the female cone is shown in Fig.11, Fig.12, and Fig.3, and the total deformation of the female cone is maximized in the fitting. The joint has a small strain and the maximum allowable stress is 153 MPa. The simplified model

calculation results are consistent with the calculation results of the salvage device model, which verifies the correctness of the simplified model.

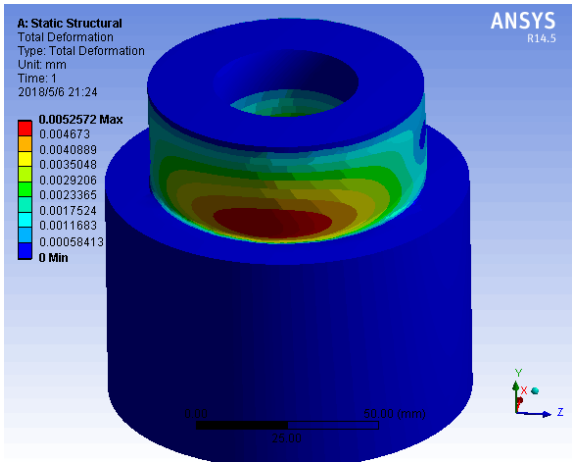


Fig. 11 Total deformation of the mother cone

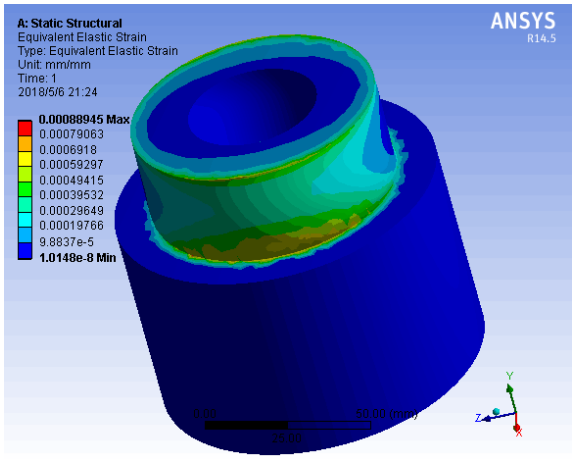


Fig. 12 Female cone strain cloud map

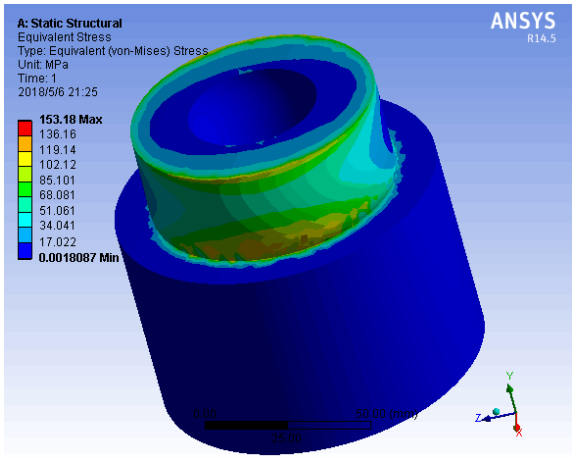


Fig. 13 Female cone stress cloud map

Through the finite element simulation, the newly designed deep hole drilling and salvaging device meets the actual work needs, the force is more balanced, and the joint surface stress distribution is more uniform, which has certain guiding significance for the design of the salvage equipment in the

future. Moreover, in the absence of relevant specifications for the selection, the analysis of the force of the salvage equipment through the finite element can effectively guide the construction.

4. Conclusion

This paper introduces the reasons for the deep hole drilling high-efficiency directional drilling machine to drill the drill in the drilling and analyzes the preventive measures. Therefore, a deep hole drilling and drilling tool salvage device is designed for the high-efficiency directional drilling machine. The core tube is used to take the drill bit, and the female cone, the coring tube and the coring bit are screwed. Secondly, the mechanical analysis of the fishing device, the core tube and the female cone was carried out, and the force of the fishing device and the female cone was introduced in detail. Finally, the analysis process of the finite element of the salvage device is introduced, and the corresponding parameters are selected according to the actual situation, and the three-dimensional model is established, meshing, loading and adding constraints. The stress, strain, and overall deformation of the salvage device are obtained.

References

[1] C.H.Lu Yubei, Liu Zhiguo, Cheng Cunping, Wu Qingsong.Causes and Treatment Techniques of Drilling Accidents in Drilling Process[J].Exploration Engineering(Rock & Soil Drilling and Tunneling),2004(12):33-35.

[2] C.H.Li Jian,Xia Yuanyuan,Liu Sicong.Summary of Drilling Accidents in Drilling Engineering[J]. Gansu Metallurgy,2014,36(01):83-85.

[3] C.H.Liu Wei,Wang Qiang,Li Li,Huang Min,Tan Wei.Application of conventional fishing tools in horizontal wells[J].Gas and Oil Well Testing,2008(02):54-55+77.

[4] C.H.Xu Chao,Shi Zhijun.Prevention and Treatment of Drilling Accidents in Directional Drilling in Coal Mines[J].Coal Geology & Exploration,2014,42(03):100-104.

[5] T.D.Chen Shichun,Lian Zhanghua,Wang Shuchao,Cong Changjiang,Qiao Yong.Finite element analysis of special taper joint of screw drilling tool[J].Petroleum Machinery, 2011, 39(09): 27-29+6.

[6] T.D.Chen Shichun,Lian Zhanghua,Wang Shuchao,Cong Changjiang,Qiao Yong.Finite element mechanical analysis of screw drilling tool joints[J].Oil Field Machinery,2011,40(06):4-7.