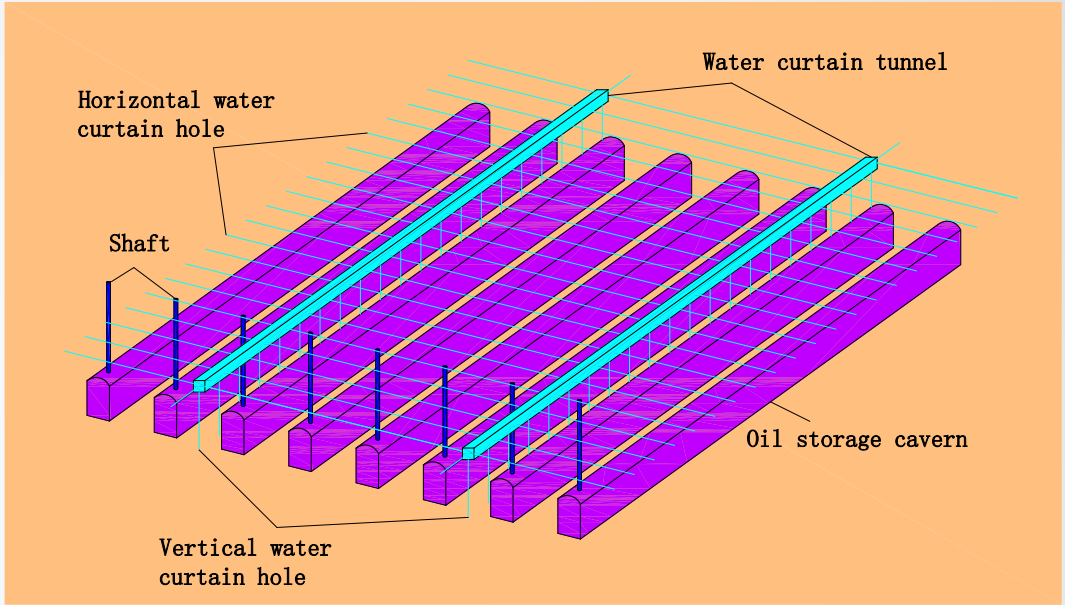
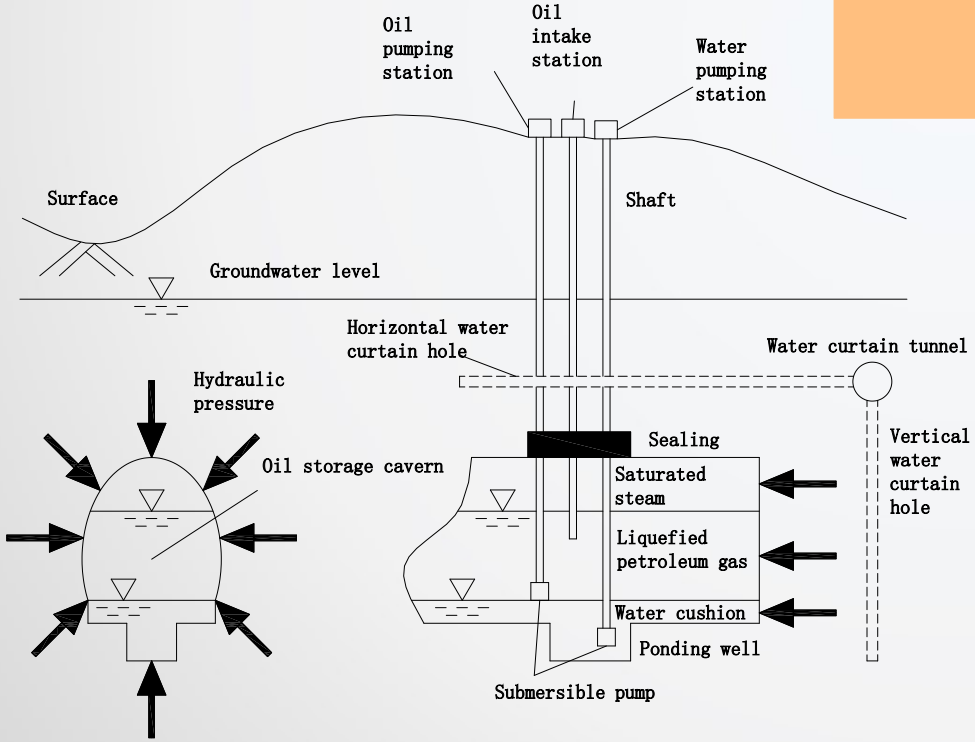
Stability analysis of the surrounding rock of cavern under extreme situation based on limited borehole data

Long Tan

Background

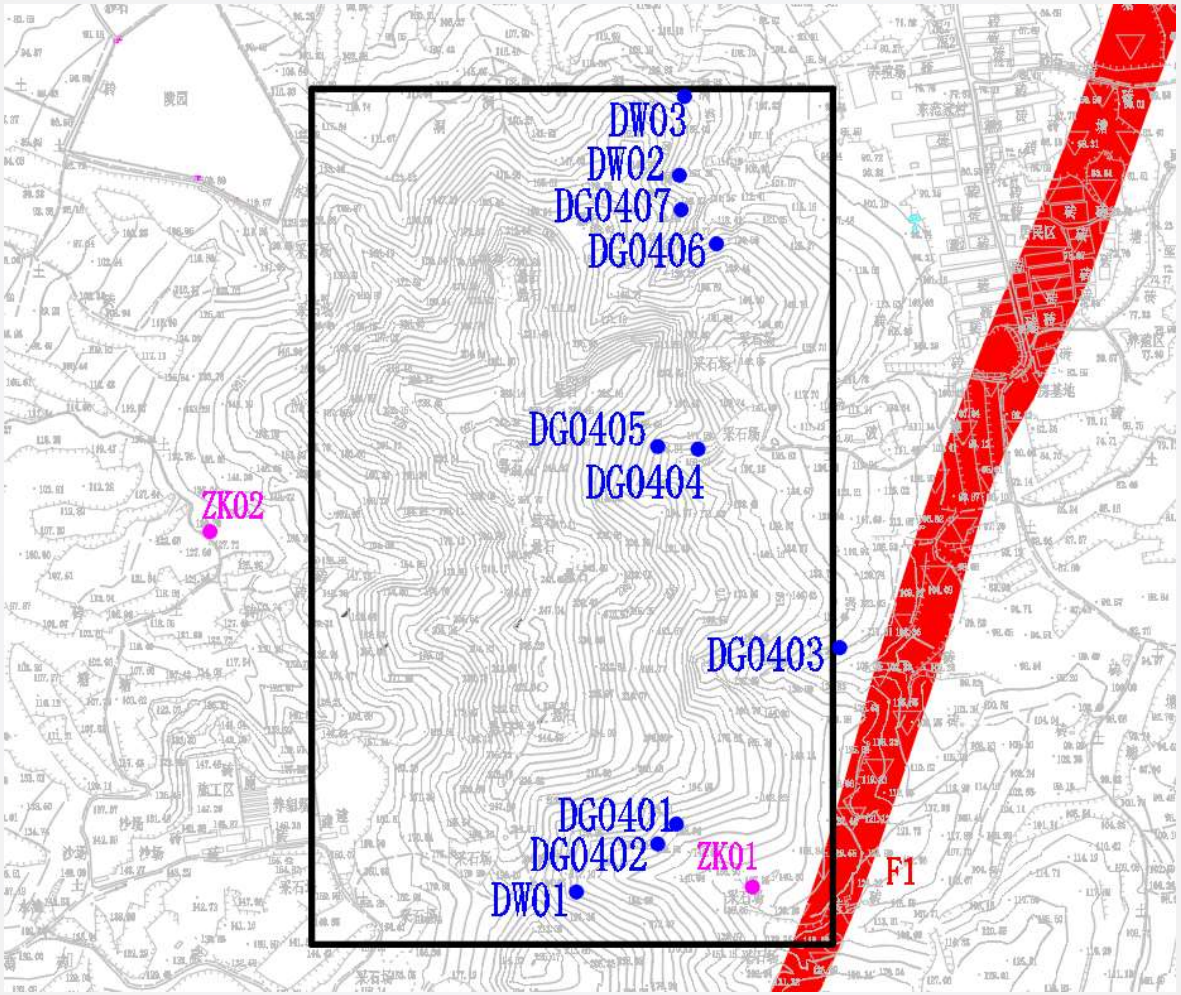


Schematic diagram of water seal principle of underground water sealed cavern



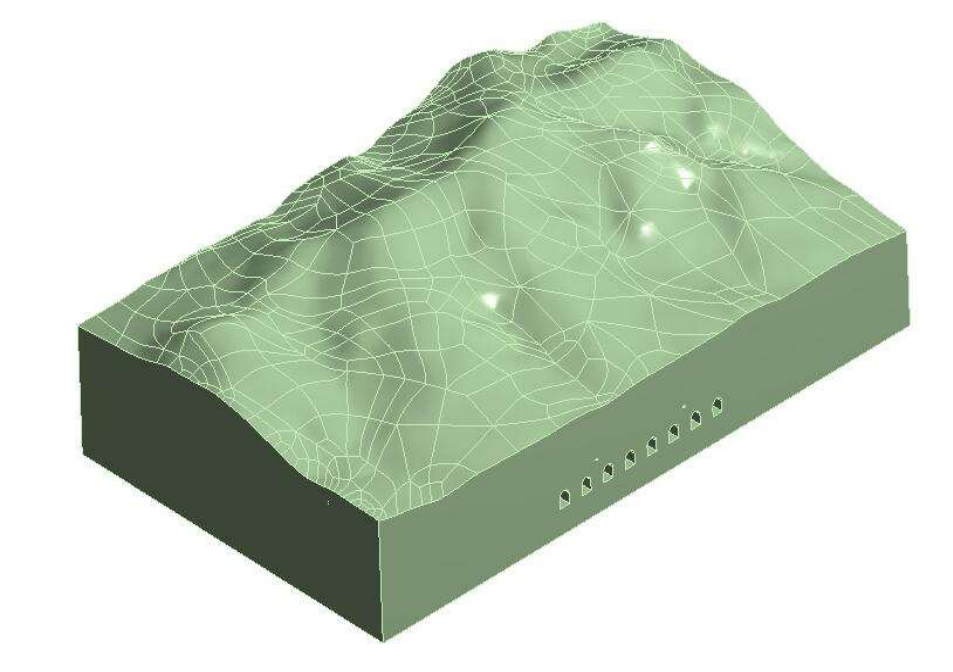
Layout of water sealed cavern and water curtain

Background



Sampling material drawing of structural plane of water sealed cavern

Modeling



Feature section diagram

Relevant parameters of cavern distribution

①Size: The shape of the cavern is straight wall arch with a side length of 20m at the bottom of the cavern;

②Space between caverns: 28m;

③Depth: The buried depth of the tunnel is distributed at an elevation of -30~0m 。

④Length: 718m。

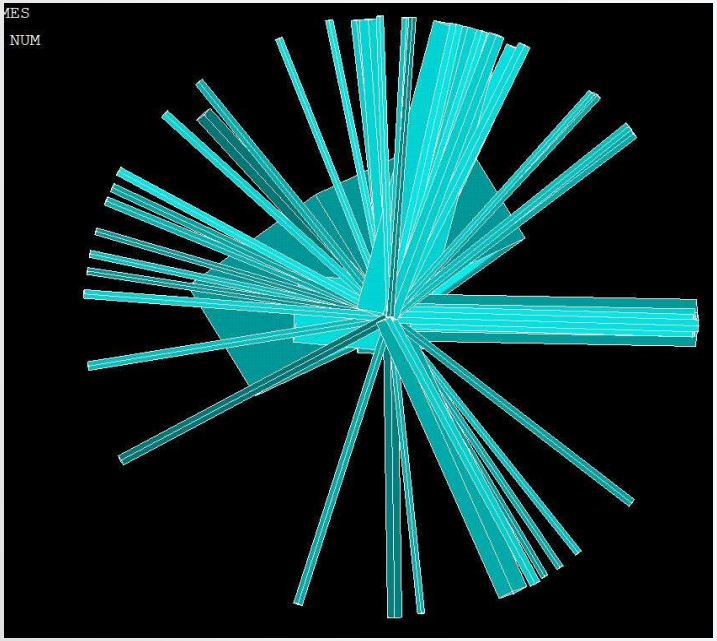
⑤Water curtain roadway elevation: +20m。

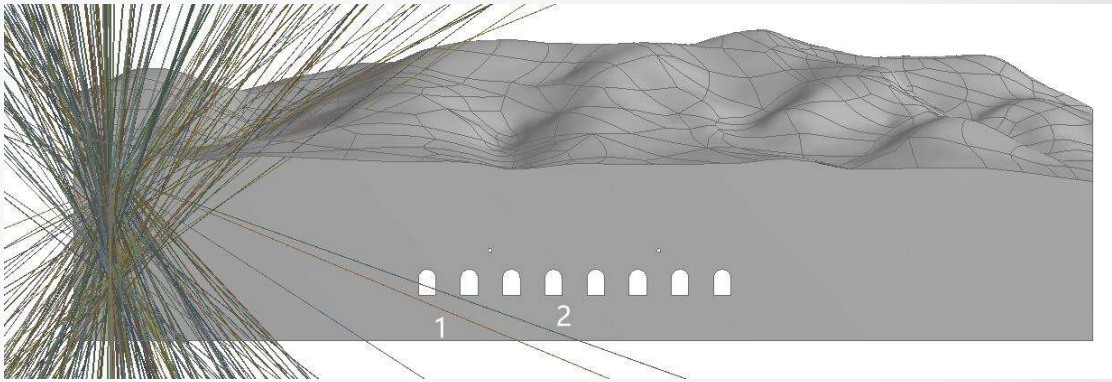
Because the water curtain hole is small, it has little influence on the stability of surrounding rock. In order to facilitate the calculation and modeling, its influence on the stability of surrounding rock is not considered in the stability calculation.

Modeling

Selection of potential dangerous fissures in underground water sealed cavern area

Top view of zk01 borehole crack

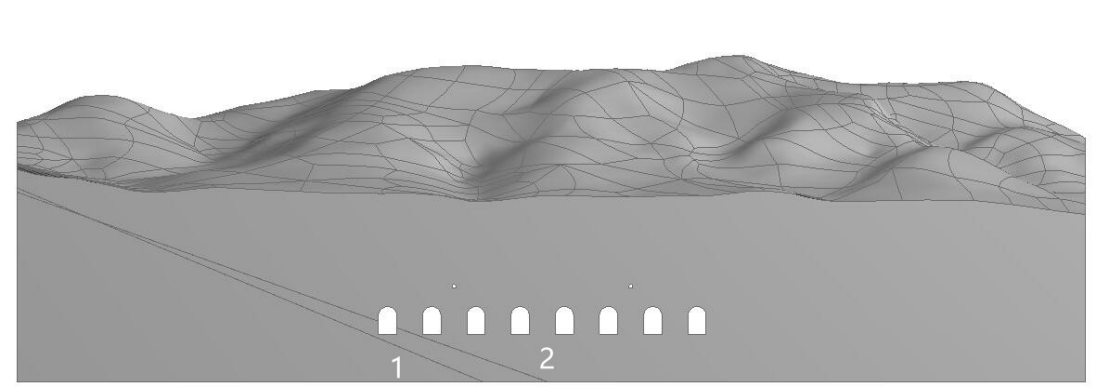




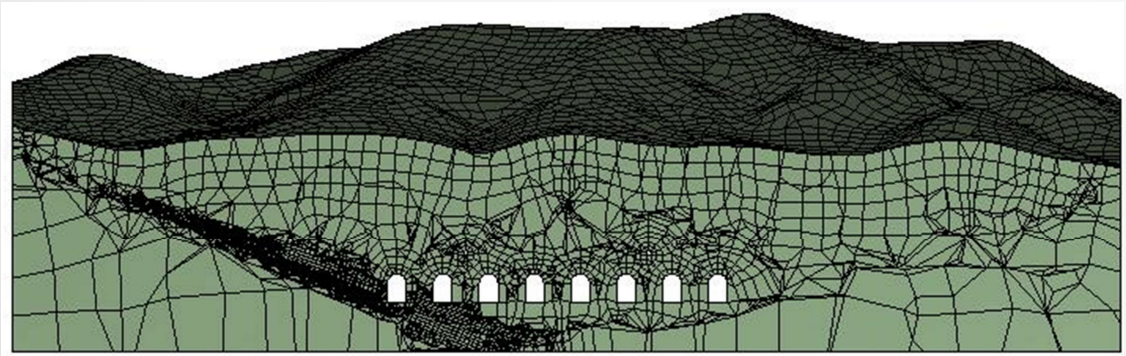
Schematic diagram of borehole fracture extension section

Modeling

Selection of potential dangerous fissures in underground water sealed cavern area

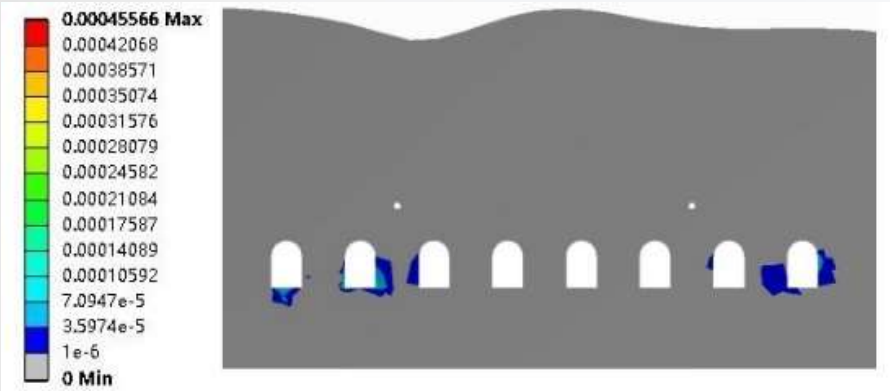


Profile of potential dangerous fracture extension

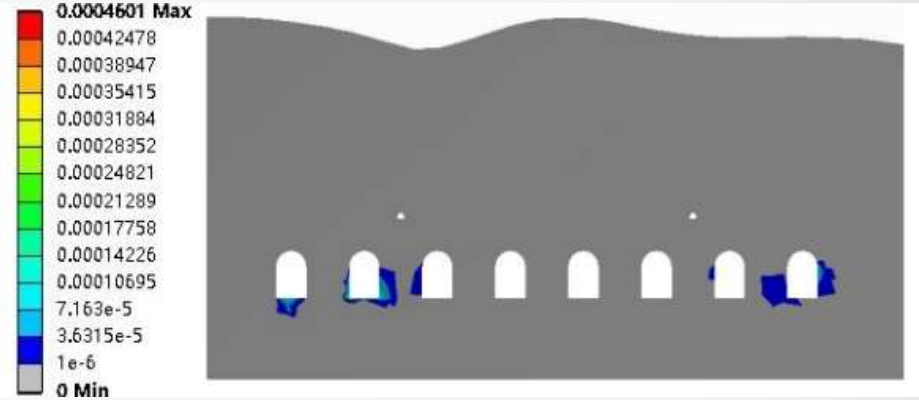


Fracture mesh generation

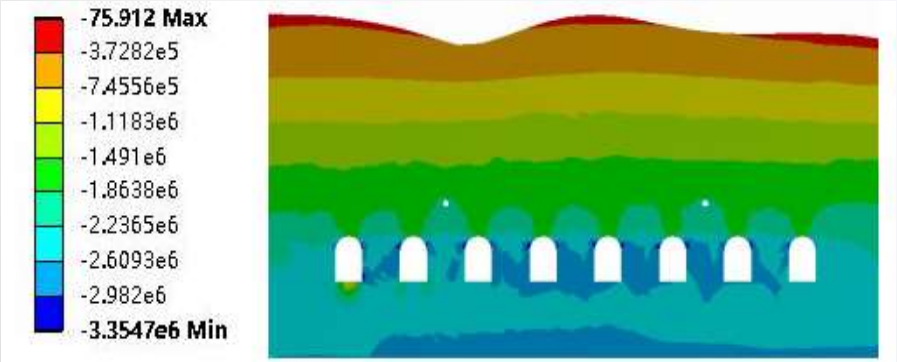
Modeling



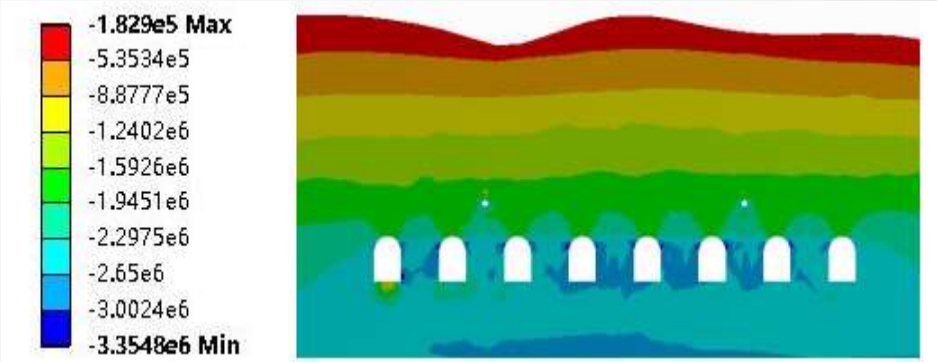
Distribution profile of plastic zone with cracks



Distribution profile of plastic zone without cracks

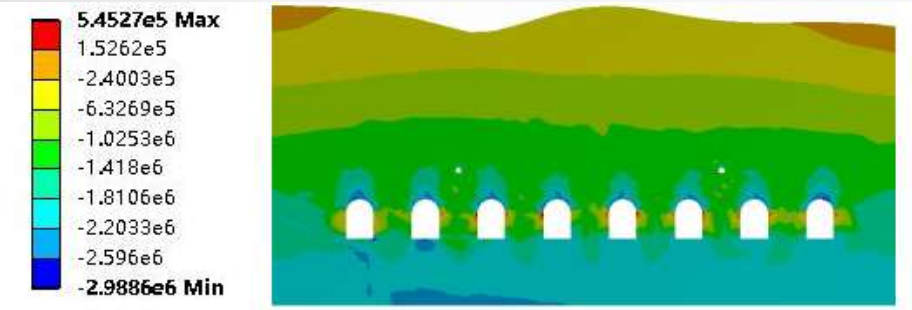


X-direction distribution profile of stress field with fracture

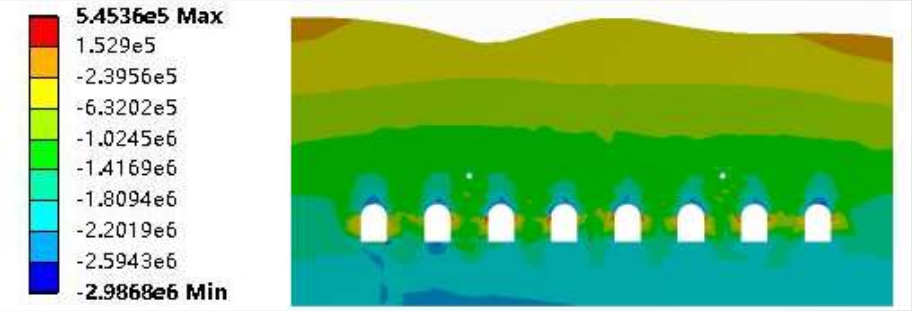


X-direction distribution profile of stress field without fracture

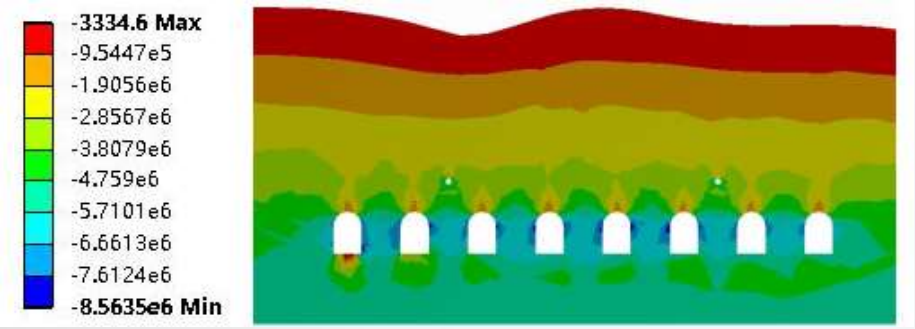
Modeling



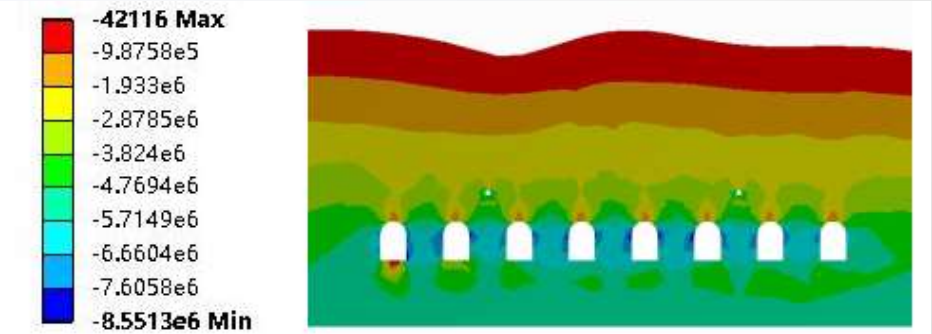
Y-direction distribution profile of stress field with fracture



Y-direction distribution profile of stress field without fracture

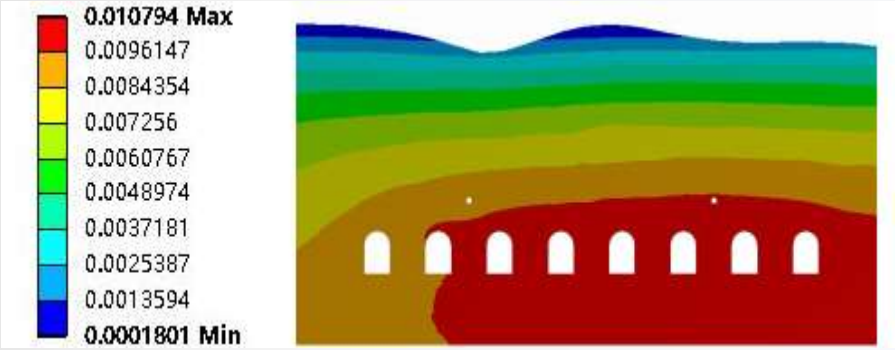


Z-direction distribution profile of stress field with fracture

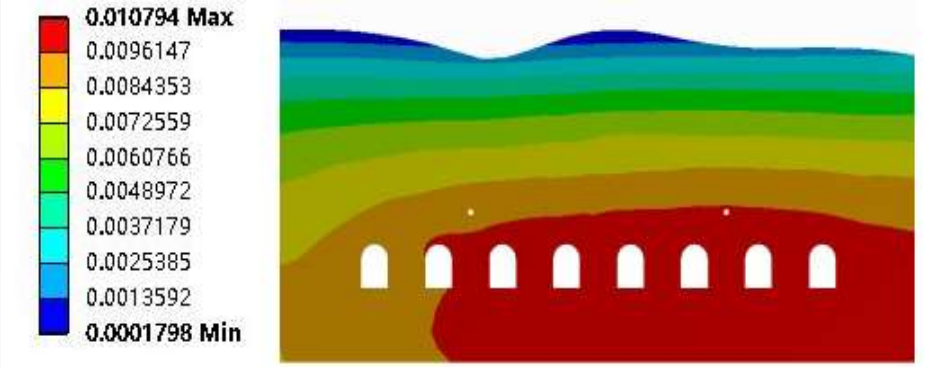


Z-direction distribution profile of stress field without fracture

Modeling



X-direction distribution profile of displacement field with cracks

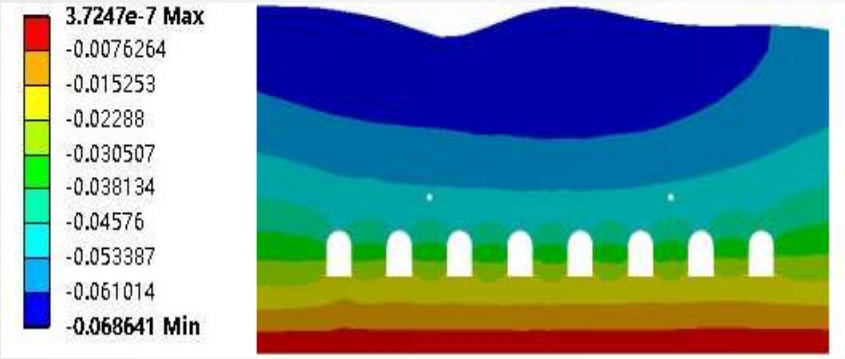


X-direction distribution profile of displacement field without cracks

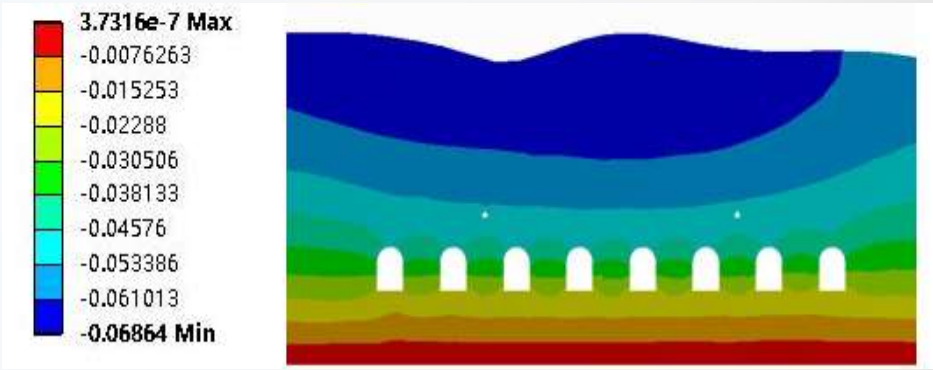
Y-direction distribution profile of displacement field with cracks

Y-direction distribution profile of displacement field without cracks

Modeling

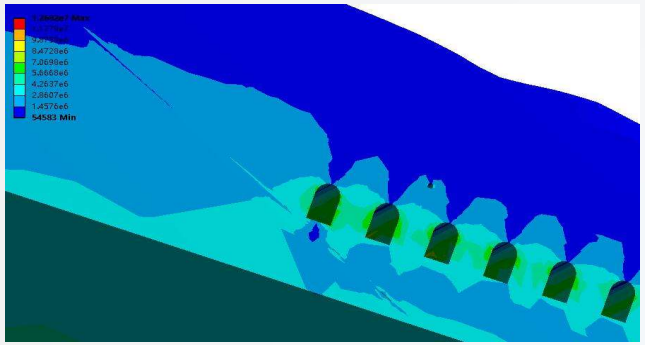


Z-direction distribution profile of displacement field with cracks

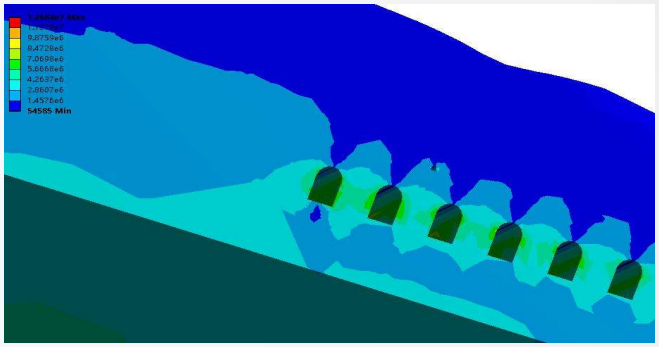


Z-direction distribution profile of displacement field without cracks

Modeling



Profile of total stress distribution with cracks



Profile of total stress distribution without cracks

When the fracture passes through the surrounding rock area, the stress field is disturbed to a certain extent. This point is clearer by observing the section cut along the fracture obliquely. However, except for the X direction of the stress field, the changes in other directions are not obvious. It should be because the tendency of the fracture is almost perpendicular to the direction of the cavern, and the influence on the cavern is mainly concentrated in the X direction.

Conclusion

In the case of a small number of boreholes, using the only geological information, combined with drilling data and survey results, a three-dimensional geological model of water sealed cavern is constructed, and the stability of surrounding rock in extreme cases is analyzed.

It is found that in extreme cases, the stability of surrounding rock of the cavern has been affected to a certain extent, and it is necessary to plug the potential dangerous cracks in time.

THANK YOU