Finite element analysis of crack causes in the exterior wall of ANSYS basement

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Abstract. Underground engineering is the product of the development of construction economy and construction technology, but it also faces serious problems such as underground structure cracking and water leakage, which affect the quality and service life of the project. For effective treatment of settlement cracks caused by leakage problem, in Henan a project, for example, with the help of concrete fracture mechanics theory and ANSYS finite element numerical simulation, the maximum crack width, compare the theoretical value and numerical results, reveal the causes of crack formation and law, by selecting the appropriate sealing material, leakage problem solved. It provides some reference for the analysis and plugging of crack leakage in the future.

Keywords: ANSYS; leakage treatment; finite element analysis; maximum crack;

1 Introduction

With the progress of social productivity, human demand for building space is growing, and high-rise and super high-rise buildings are rising around the world. The basement not only expands the use area, but also improves the efficiency of the building land, and makes full use of the space resources. As a garage, equipment room, commercial space, entertainment space and other functions of the place. To meet the requirements of civil air defense engineering, to provide wartime air defense shelter and medical aid functions. Enhance the structural stability of high-rise buildings, improve the seismic capacity. Reduce construction costs, save on backfill and waterproof material [1].

Of course, building a basement also has some disadvantages, such as the need to consider the groundwater level, soil conditions, drainage system and other factors to increase the difficulty of design. Take moisture-proof, waterproof, ventilation and lighting measures to ensure the safety and comfort of the basement. This paper takes the crack seepage of the rear pouring belt of the basement wall as the analysis object, and uses the combination of scientific theory formula and practical engineering to make an effective analysis and treatment method.

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Water leakage often occurs in underground engineering, so it is necessary to develop technical solutions that can be both waterproof and save cost.[2] The main problems of basement waterproof in China are unreasonable design, poor material quality, non-standard construction operation, leading to leakage, cracks, damp and other phenomena in the basement, which affect the use function and safety of the building. This paper discusses the water seepage of the basement wall of the first phase of a project.

In the settlement of a project in Henan province as an example, this paper uses the design principle of concrete structure and the maximum allowable width and stress strength factor of cracks, analyzes the stress strain factor and model plane displacement stress and fracture, and obtains the root cause of cracks and leakage, and analyzes the scope of application of different materials and construction methods.

2 Project overview

The project is located in Zhoukou Plain area, and the groundwater table is very shallow. The project is connected by 15 buildings with 17 floors above ground and the first floor garage. The total construction area is 220625.87m^2, the top elevation of the basement garage is-5.3m, the underground garage has only one floor, the height is 3.9m, and the groundwater elevation is-4.4m. At that time, light well point precipitation was used. The external wall thickness is 300mm, C35P6, the vertical and transverse reinforcement are 12@200, [3]and the basement waterproof grade is level 2 (partly level 1). SBS waterproof material for the basement exterior wall: clean the base level to measure the base moisture content, brush the base treatment agent paving coil additional layer (detail treatment) hot melt pavement coil hot melt sealing edge and finally make the protective layer.

In order to meet the construction period, the pouring time of the post-pouring belt concrete is the 43rd d after the completion of the concrete pouring on both sides, which meets the requirements of the relevant specifications. At that time, the aboveground garage structure had been built, and the house had also been built to three floors above the ground. Waterproof effect: In order to protect the outer wall waterproof layer from the external construction environment, the construction of the outer wall waterproof and backfill is completed about two months after the pouring of the outer wall is completed. Can understand the waterproof situation in advance, as soon as possible to find the leakage site as soon as possible treatment. The original soil is used for backfill, and the moisture content is consistent with the original soil. After the backfill ends, the light well point precipitation is closed.

About 45d after the backfilling, the basement. No water seepage was found at this time, and after about 21 days later, a few wet stains were found around the post-pouring zone. Professionals have set up settlement observation points in the post-pouring belt to collect data regularly. The seepage around the post-pouring zone was larger than before the 35th day, and the seepage was also found in other places on the wall. According to the instrument, the large crack length is 118mm, the width is 0.33mm, and the depth is about 230mm, located at 350mm on the ground.

By the 50th day, the waterproof layer of the outer wall at the post-pouring belt had failed, resulting in serious water seepage in the middle of the post-pouring belt and the wall. Usually, the leakage problems of underground buildings mostly occur in the fine nodes, which only account for about 1% of the wall surface area. The leakage is rarely caused by material factors, generally caused by the defects in design and construction.

For the cracks that have been generated, the maximum crack width can be calculated through theoretical analysis, and then combined with ANSYS and other finite element software to model and solve the problem site, so as to obtain the stress factor and displacement of the cracks, and use targeted treatment measures.[4] For example, the specific reasons through data analysis, is because the stiffness design is insufficient, or the local construction is not standard cracks. Help to develop a reasonable determination of the position of the grouting mouth, can save the amount of grouting, in combination with the specific situation of waterproof materials can choose different stiffness and ductility.

3 Theoretical analysis and calculation of open-type cracks

This paper mainly studies the open cracks in the mass concrete of the basement exterior wall. This concrete structure mainly involves temperature theory in theoretical calculation, and there are many literature to obtain the evolution of temperature-caused crack formula. These experiences and formulas are generally responsible for preventing and controlling the occurrence of cracks during the structural design. However, the paper focuses on the fact that the cracks have been formed at the post-cast zone, when the temperature theory can no longer adapt to the stress and strain conditions at the ends of these cracks. Therefore, this paper uses the theory of open crack in the branch of concrete fracture mechanics to analyze and calculate the cracks in the post-pouring belt, so as to obtain the stress strength factor that affects the degree of crack expansion, and evaluate the cracks accordingly. Concrete fracture mechanics is a discipline that studies the relationship between microscopic defects and macroscopic properties in the structure. It only targets the macroscopic crack problems existing in the stressed structure. There are mainly three types: open type, sliding type and tear type. The crack at the post-pouring belt of the basement involved in this paper belongs to the open type, that is, the positive stress σ acts perpendicular to the crack surface. Under the action of positive stress, the tip of the crack gradually opens with time, and the opening direction is perpendicular to the σ direction. When using the fracture mechanics theory, the stress strength factor, the displacement amount and the stress in the nearby area are obtained. ANSYS finite element software is used to simulate and analyze the stress factor cloud map and displacement cloud map and other data.

3.1 load calculation

In view of the constraints of concrete inner wall and concrete roof in the basement exterior wall, the load of backfill to the external wall belongs to the elastic range of line elasticity. In the calculation, the pressure of the soil to the wall is compared to the pressure of the static soil, and then the mechanical related theory is used to calculate. Project data: basement concrete exterior wall grade C35P6,300mm thick, high=3.9m, h_0=1.4m, h_1=3m, h_2=0.9 m. Raw soil heavy. y=19 kN/m3, saturated heavy.y=20 kN/m3, weighted heavy. y'=9.2kN/m3, stable soil pressure coefficient. k_0=0.6, [5] the groundwater level is-4.4m, when the bottom plate thickness is more than 200mm, the bottom plate and external wall can be regarded as completely consolidated, and the top is hairpin. See Figure 1 for the calculation diagram.

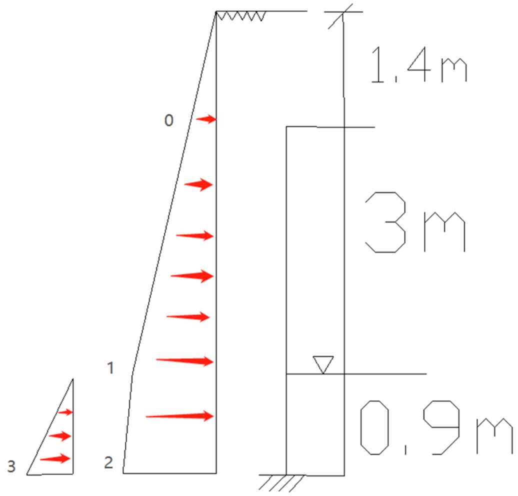

Fig. 1. Calculates the schematic diagram

The pressure values of the 4 points in the soil are:

$$\sigma_0 = Y h_0 k_0 = 19 \times 1.4 \times 0.6 = 15.96\text{kpa} \quad (1)$$

$$\sigma_1 = Y (h_0 + h_1) K_0 = 19 \times (1.4 + 3) \times 0.61 = 49.02\text{kpa} \quad (2)$$

$$\sigma_2 = \sigma_1 + y' h_2 K_0 = 49.02 + 9.2 \times 0.9 \times 0.6 = 53.03\text{kpa} \quad (3)$$

The resultant force of the static soil pressure is:E_0

$$E_0 = \frac{1}{2} (\sigma_0 + \sigma_1) h_1 \frac{1}{2} (\sigma_1 + \sigma_2) h_2 = 143.39\text{kn/m} \quad (4)$$

Steady-state water pressure:

$$\sigma_3 = y_w h_2 = 9.8 \times 0.9 = 5.88\text{kpa} \quad (5)$$

Steady-state water pressure in the wall combined force:E_w

$E_w = \frac{1}{2} y_w h_2^2 \frac{1}{2} 0.9^2 = \times 9.8 \times = 3.97 kn/m$ (6)

$\sigma_{bottom} = \sigma_{2+}\sigma_3 = 53.03 + 5.88 = 58.91 kpa$(7)

$$E_{overall=}E_0 + E_w = 143.39 + 3.97 = 147.36 kn/m \quad (8)$$

The distance between the resultant point of static soil pressure Eo and water pressure Ew to the bottom of the wall is:y_0

$y_0 \frac{1}{E_{overall}} \left[\sigma_1 h_1 \left(\frac{h_1}{2} + h_2 \right) + \frac{1}{2} (\sigma_1 - \sigma_0) h_1 \left(\frac{h_1}{3} + h_2 \right) + \frac{\sigma_1 h_2^2}{2} + \frac{1}{2} \times \frac{h_2^2}{3} (\sigma_b - \sigma_1) \right] = 2.13$ Meters (9)

The stationary soil pressure value varies linearly according to the depth,$E_{overall}$The pressure value of stationary soil varies linearly according to the depth, which is the joint number of stable soil pressure and water pressure in the height direction. At this time, the force of the wall is 2.13m away from the bottom, [6]and the sexual load of the horizontal line is 147.36kN/m. The theoretical analysis of the cracks caused by these loads is more complex. Whether the safety of the wall can be analyzed through the calculation of the concrete crack width.

3.2 Crack width calculation

The basement exterior wall of this project is a continuous beam mode. In order to simplify the calculation model, 1m wall is taken as the calculation unit.

The parameters are as follows: per meter width φ 12 reinforcement area As is 565 square mm; length b=1 m, thickness h=0.3 m, protective layer is 0.05 m, effective height h0=300-5=250mm; because the tensile strength of concrete has little effect on the wall crack width, using the reinforcement elastic modulus Es = 2 xN /$10^5 mm^2$

Calculcalculating the reinforcement rate is:0.005 <0.01

The bending moment is calculated as the maximum value. According to the relevant specifications:

Formula of maximum bending moment:

$$M = \frac{ql^2}{8} + \frac{ql^2}{15} = \frac{147.36 \times 1^2}{8} + \frac{147.36 \times 1^2}{15} = 28.24 kn.m \quad (10)$$

reinforcement stresses:

$$\sigma_{sk} = \frac{M}{0.87 h_0 A_S} - \frac{28.24}{0.87 * 250 * 565} - \frac{28.24}{1228875} = 229.8 N/mm^2 \quad (11)$$

Coefficient of reinforcement stress: take Ψ =0.2

Concrete structure design specification crack width calculation formula:

$$w_{max} = a_{cr} \frac{\sigma_{sk}}{E_S} \Psi (1.9 c_s + 0.08 \frac{d_{eq}}{P_{te}}) \quad (12)$$

a_{cr}: Is the force characteristic coefficient of the component

Ψ: It is the strain uneven coefficient of longitudinal tensile reinforcement between cracks:
when Ψ <0.2, take=0.2; when Ψ> 1.0, takeΨ = 1.0

σ_{sk}: According to the load quasi permanent combination of reinforced concrete members calculated by the longitudinal tensile ordinary reinforcement stress or the longitudinal tensile reinforcement of prestressed concrete members calculated by the standard combination [7];

E_S: The elastic modulus of the reinforcement bar is adopted according to Table 1 of this specification

Table 1. Elastic modulus of steel bar (10^5 N/mm²)

Card number or type	modulus of elasticity Es
HPB300concrete iron	2.10
HRB335、HRB400、HRB500concrete iron HRBF335、HRBF400、HRBF500concrete iron RRB400concrete iron Prestressed thread steel bars	2.00
Eliminate stress wire, medium strength prestressed wire	2.05
steel strand	1.95

c_s: Distance between the outer edge of the outermost longitudinal tensile reinforcement to the bottom edge of the tensile area (mm): whenc_s <20, takec_s=20; whenc_s> 65, takec_s=65;[8]

P_{te}: The reinforcement rate of the longitudinal tensile reinforcement calculated according to the effective tensile coagulation section area is [9];

d_{eq}: Equivalent diameter (mm) of the longitudinal reinforcement in the tensile area;

Maximum crack calculation:

$$w_{max} = 2.0\Psi \frac{\sigma_{sk}}{E_S}(1.9c_s + 0.08\frac{d_{eq}}{P_{te}}) = 2.0*0.2*\frac{229.8}{200000}*(1.9*30+0.08\frac{12}{0.01}) = 0.06 \quad (13)$$

0.06mm＜0.33mm

By calculating the load, the maximum crack is 0.06mm, and the crack width measured by the instrument is 0.33mm. This deviation should have several points: the backfill is not the original soil, the density deviation is too large; the possible underground water level data is inaccurate. The theoretical calculation results show that the crack width meets the design requirements, but the actual crack width is larger than the design specification. According to this guess, this may also be a problem of material or construction, in order to find a deeper reason, but also need to use the finite element software to establish a three-dimensional model for analysis.

4 Build a 3 D model

4.1 Workbench Modeling

ANSYS Workbench provides two modeling tools, Design Modeler (hereinafter referred to as DM) and Space Claim (hereinafter referred to as SC), DM is more suitable for parametric design, you can associate multiple feature parameters in the model through the formula, to facilitate the modification of parameters in design point;

SC is more suitable for model editing, can quickly remove chamfer, fill holes, process small edge small surface, shell extraction surface, cutting, body operation, Boolean operation and other operations;

DM can realize bidirectional association with most CAD software on the market, that is, the model modification in CAD software can be transmitted to DM, and the modification of model parameters in DM can also be transmitted back to CAD software;

SC supports keyshot rendering and algoryx rigid body dynamics simulation module, which can be more function expanded;

DM has no assembly modeling tool, all the geometry of contact is combined into one part, requiring freezing function to create multiple parts; SC has From New Part assembly function, which can combine multiple parts into a multi-body part to form a compatible grid when dividing the grid.

However, our general modeling is in CAD software, such as SolidWorks, Catia, UG, etc., so only the model modification function of DM or SC is generally used, such as establishing the imprint surface imposing boundary conditions, removing unnecessary holes, deleting or increasing round corners, drawing the middle, drawing the edges, etc. Because this model is relatively simple, DM is used to model this time.

In DM modeling, in DM, there is no assembly modeling tool, and the geometry of the thawing (also called activation) state that makes all contacts together is merged into one part. To create multiple parts, the freezing function is required.

Most now use separate modeling, which models reinforcement and concrete separately and gives different cell types, such as concrete units and structural steel units, and the current version of the material properties can be easily changed. Then the contact-binding method is used to realize the conode of reinforcement and concrete or consider the bonding slip effect.

This model is based on the actual fracture with a length of 0.12m. In order to simplify the calculation, the stress and strain around the three-dimensional cracks are analyzed. If the three-dimensional model is drawn according to the size of 1:1 in the actual project, the cracks of the model are small, and the stress and strain of the crack tip are difficult to distinguish. Through multiple comparison tests, it is found that there is only a small difference between the equivalent effect force cloud map and the equivalent displacement cloud between the 1:1 model and the equivalent model. The crack was created by using a separated geometry 12mm wide and 0.1mm thick based on the model as shown in Figure 2-3, which is easy to approach the actual situation. The depth is 23mm see Figure 4, which is lower in the middle of the model. Although the actual crack is closer to the bottom, but in order to simulate the development of the crack under worse conditions, the crack and the force are moved upward, biased to the middle of the lower point. The stress cloud map obtained from ANSYS calculation shows that, in accordance with the calculation data results and the actual engineering model, the calculation time is increased due to the same length due to the increase of area.

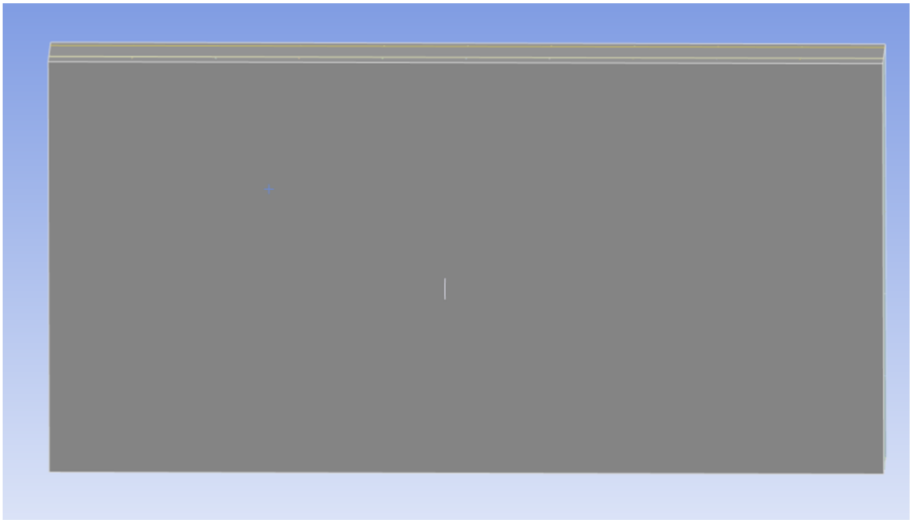

Fig. 2. The 3 D model plane

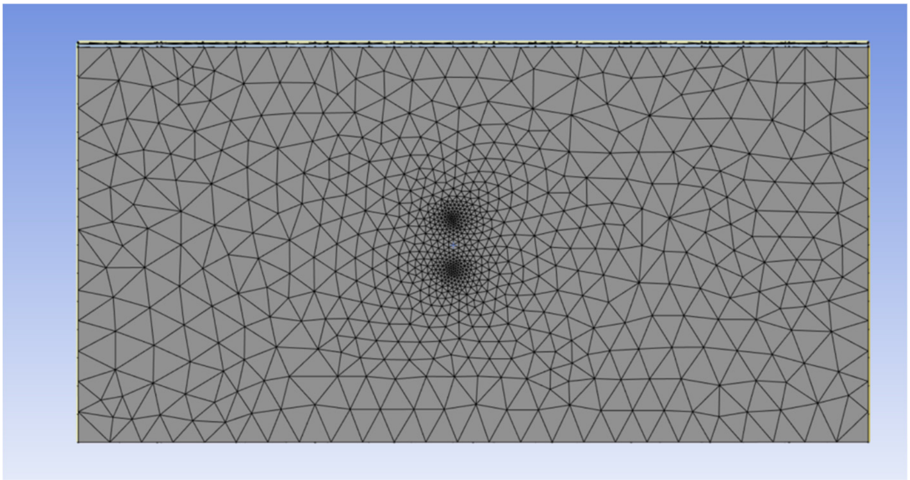

Fig. 3. Mesh division

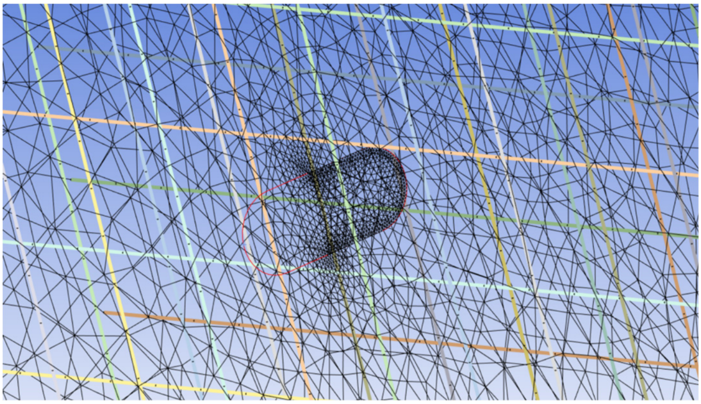

Fig. 4. Crack sample and grid division

4.2 Constraint and load imposed

Combined with the actual situation, according to the theoretical data, the left and right sides are due to the force frame column, and the following is connected with the basement floor, so the model adopts fixed constraints, the model is connected with the roof, using one-way hinged. The outer wall is subjected to uniform load 147.36kN/m along the direction of unit height, so the line load per unit height of the back of the wall is 147.36N/mm. Figure 5

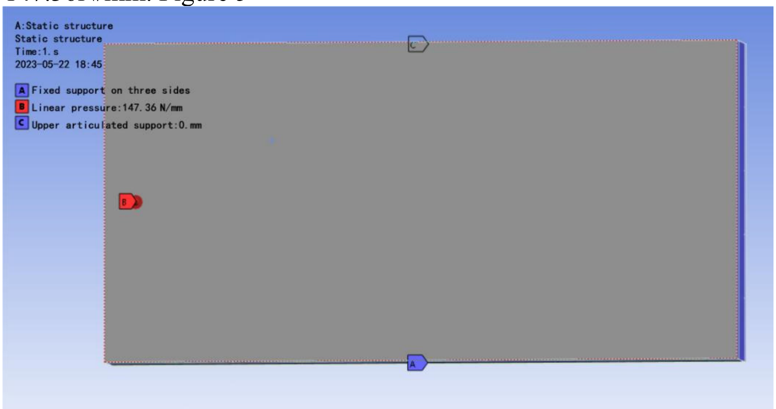

Fig. 5. for constraint and load application

4.3 Solve and analyze

The model solution, ANSYS takes about 40 minutes, and the output data is shown in Figure 6-Figure 11. These results show the development of stress and strain in the presence of cracks in the structure, which can analyze the state of the structure, and then analyze the evolution of the crack surface, and help to develop the sealing scheme for designing cracks.

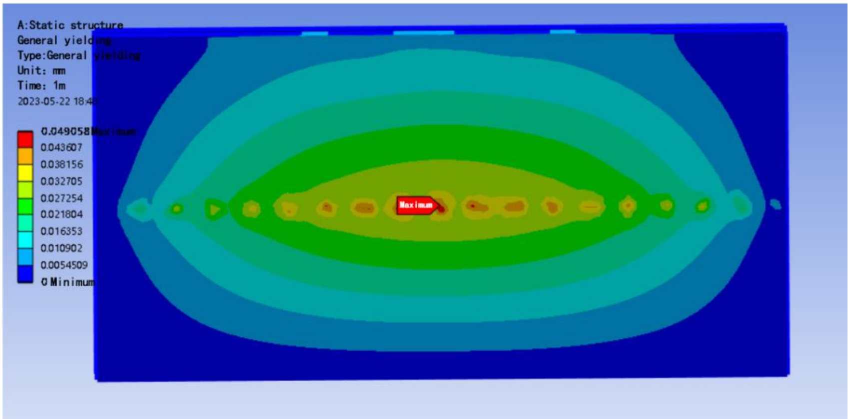

Fig. 6. Equivalent displacement cloud map outside the wall

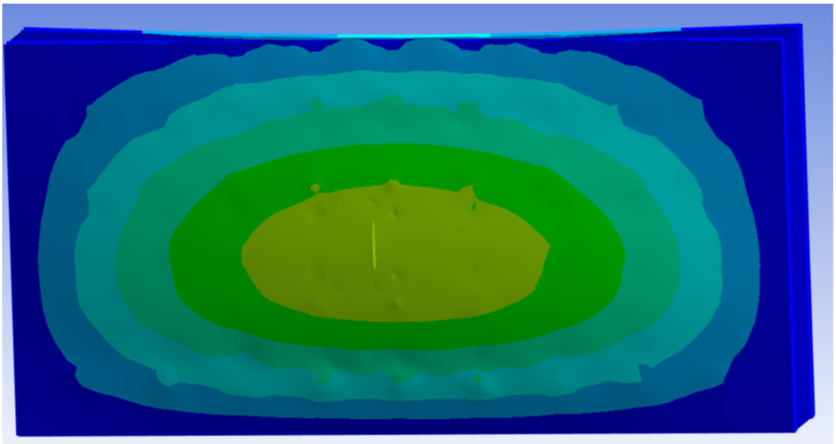

Fig. 7. Equivalent displacement cloud map at the crack inside the wall surface

As can be seen from the equivalent displacement cloud map outside the wall, the maximum displacement in the middle of the wall is 0.049mm, which is basically similar to the theoretical data of 0.06mm. The wall is protruding inward, and when the structural strength does not meet the design requirements, the middle will be the first to crack. Figure 7 The equivalent displacement at the crack in the wall surface shows that even if the three-dimensional model puts the crack in the middle, the maximum displacement in this area is only 0.0322mm, and the open displacement at both ends of the crack is about 0.059mm, which is far lower than the actual engineering measurement data of 0.33mm.

There is no crack in the middle of the wall around the post-pouring belt of this project, which proves that the external wall meets the design requirements. According to the concentration stress distribution height calculated by the previous theory, the maximum stress should be at the level-height of 2.13 meters. The general distribution of stress can be seen in the cloud diagram of the inner effect force of Figure 8.

According to the model output, the maximum stress is 63 kpa, which is the longitudinal reinforcement of the wall, and the maximum stress of the crack tip is 15.27kap. However, in the actual engineering, the cracks appeared below the maximum displacement of the model (350mm above the ground), where cracks appeared here, the reinforcement spacing exceeds the design requirements, workers in this area is not standard, three is due to the impurities in the wall. The results show that the wall in this area cannot meet the design requirements, and the cracks appear through. Therefore, the crack size of the above data combined with the three-dimensional crack cloud map, the reason for the crack is not insufficient design, it is likely to be the improper operation in the process of construction, or concrete reinforcement materials with impurities.

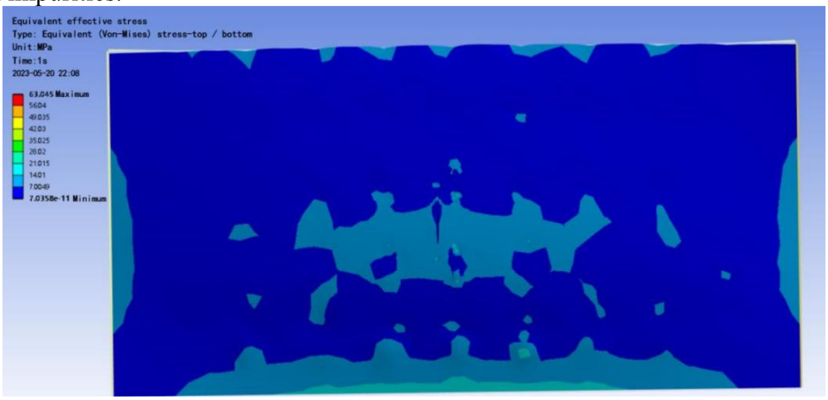

Fig. 8. Internal and equal effect force cloud

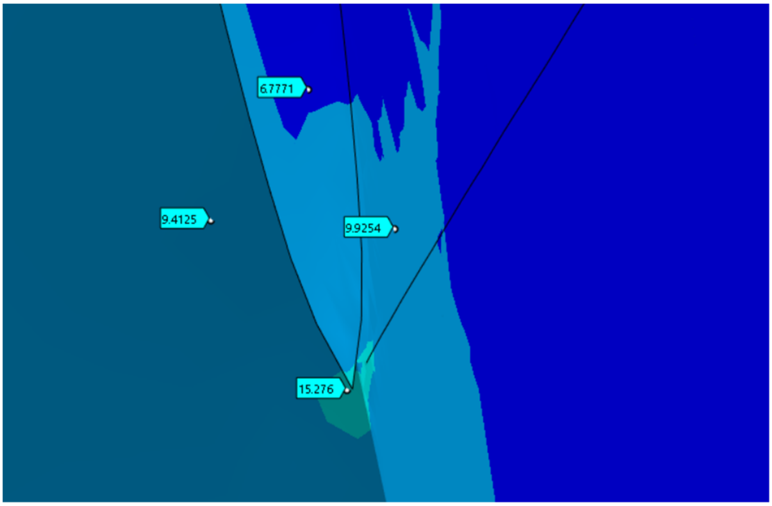

Fig. 9. Cloud diagram of equal effect force at crack

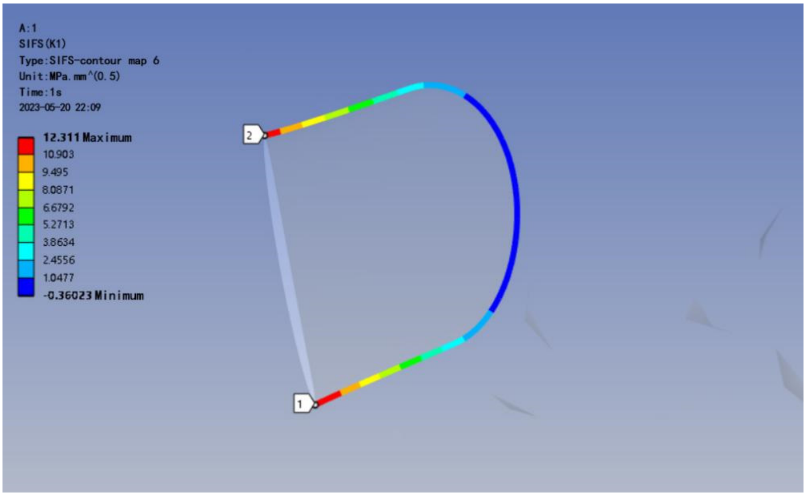

Fig. 10. Cloud diagram of equal effect force at crack

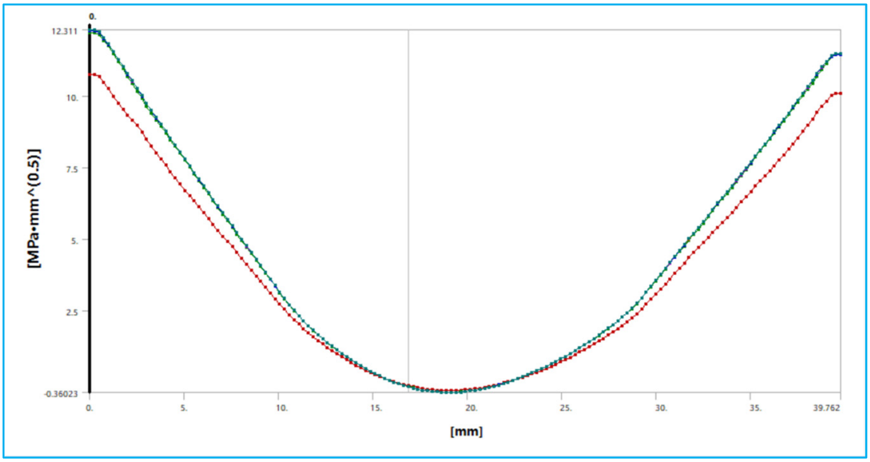

Fig. 11. Numerical chart of crack factor

5 Analysis of cause of leakage

According to the analysis of the output results of ANSYS equivalent model (Figure 9-Figure 11), [10] the maximum value of crack SIFS is 12.31pa, indicating that the force of the crack tip is not much, far lower than the tensile stress of reinforced concrete. With the extension of time, the probability of crack development is very small and a large crack will not appear. In the late plugging, the width of the crack was 0.34mm, which also verified the guiding role of theoretical 3 D analysis. If there are water seepage cracks in the protrusion and vicinity of the wall, the wall is caused by the lack of sufficient stiffness of the wall. Through the above analysis data, it can be proved that the cause of crack should be the cause of workers' irregular construction. Such as concrete filling is not uniform, the old wall connection is not cleaned up. Under the combined pressure of soil pressure and groundwater, cracks appear through the wall. Due to the wall load species change fast, there is no way to accurately determine the present situation of the wall middle of micro cracks and development trend, in addition, due to the wall waterproof doesn't work, now with the help of ANSYS processing data, this also consider waterproof plugging plan area, avoid due to time long external load change water seepage crack. At present, there are many ways and materials, [11] the cost is not high construction period is simple. Therefore, according to these goals to make the plugging plan to make the engineering waterproof become more practical value.

6 Crack sealing construction

6.1 Stock option

Basement grouting plugging material refers to the material that can inject waterproof material into the cracks, holes or cracks of the basement through grouting method, and block the leakage water leakage channel after reaction with water and consolidation, so as to achieve the purpose of waterproof and reinforcement.

Cement based waterproof material is a kind of waterproof technology that uses grouting method to inject cement base waterproof material into the formation or concrete structure to form water diversion or block leakage channel. Several types of grouting cement-based waterproof materials are the following:

Cement base permeable crystalline waterproof material: is a kind of through chemical reaction into concrete internal crystals block concrete capillary porous waterproof material, with inorganic material, never fail, self-healing, back water construction, non-toxic environmental protection characteristics, suitable for tunnel, underground continuous wall, cable tunnel and other new engineering waterproof construction, can also be used for structure cracking, seepage point, hole plugging construction, the disadvantages of concrete facilities maintenance.

Polymer cement based waterproof material: it is a kind of double polymer waterproof material composed of synthetic polymer emulsion and special cement, graded sand, has the characteristics of good flexibility, strong adhesion, aging resistance, good weather resistance, suitable for roof, basement, kitchen and bathroom and other parts of the waterproof construction.

Polymer modified cement based waterproof material: is a kind of waterproof material with a small amount of polymer emulsion or powder modifying agent in ordinary cement based waterproof material, has improved the bonding force, reduce shrinkage rate, increase flexibility and other functions, suitable for roof, basement and other parts of the waterproof construction.

Elastic cement based waterproof material: is a kind of waterproof material in ordinary cement based waterproof material with polymer elasticity or rubber emulsion waterproof material, has good expansion and crack resistance, suitable for roof, balcony and other parts of the waterproof construction.

Combined with the actual situation of the basement, the final selection of grouting plugging king material.

6.2 Arrangement and method for construction

Parouting and plugging material parameters. Rapid plugging materials, the main components are cement, bentonite, calcium silicate and so on. It has the following characteristics: can be constructed in water or underwater, not affected by temperature and humidity. Can be firmly bonded with concrete, masonry, metal and other materials, will not fall off or shrink. Can quickly solidify, the plugging effect is long-lasting, not aging or corrosion. To be used for various leakage occasions, such as pool, water tower, basement, tunnel, pipeline, etc.

Construction method. Drilling: according to the design requirements, drilling in the specified position and direction, drilling should pay attention to remove the dust and debris in the hole, keep the hole clean.

Installation pipe: insert the grouting pipe into the borehole, and fix it with mortar or cement, to ensure that there is no gap between the pipe and the hole wall.

Mixed slurry: according to the design requirements and material instructions, mix the grouting material and the clean tap water in proportion to adjust the fluidity and gel time of the slurry.

Grouting: the mixed slurry is pressed into the drilling hole through the grouting machine, and the grouting pressure and speed are well controlled, so that the slurry can fully penetrate into the formation or structure. When grouting, attention should be paid to the flow and color change of the outlet. When the outlet flows out of the primary color or close to the primary color, the grouting is completed.

Extubing: remove the pipe from the drilling hole and seal the drilling hole with mortar or cement.

Maintenance: according to the design requirements and material instructions, maintain the formation or structure after grouting, maintain the appropriate humidity and temperature, and make the slurry fully solidified.

Matters needing attention for grouting construction include. Before grouting, the leakage site should be accurately detected and positioned, the base surface should be cleaned, and the grouting holes and pipes should be set up to ensure their smooth and firm. The water injection test should be conducted to check the connectivity and sealing effect between the grouting holes and determine the grouting order and pressure. To prepare the appropriate slurry material, according to the different leakage conditions, adjust the curing time and expansion rate, to avoid premature or too late curing slurry.

When grouting, it should be conducted continuously to control the grouting speed and quantity, observe the changes of pressure and flow, and avoid running slurry, grouting or blockage. To use the jump hole interval grouting, subsection construction, the first periphery after the middle, the first low after the high, the first no water after the order of water.

After grouting, the equipment should be removed and cleaned in time to prevent the slurry from condensing in the pipeline. Then, check the grouting effect, and finally wipe the mortar flat on the surface.

In the process of grouting, the necessary labor protection articles should be worn to prevent dust, cement or chemical substances from causing harm to the human body.

7 Conclusion

In the face of the problem of crack water leakage in the basement rear pouring belt, this paper first analyzes the field situation and lists the effective data as far as possible, and then uses relevant theories to calculate certain results, uses the visualization tools of finite element software to verify and optimize, and obtain a series of data support. On this basis, according to the site situation to select the appropriate plugging material, plugging scheme, can not only achieve the ideal effect, but also save time and material resources.

The author summarizes the research conclusion of the paper as follows: the data in the construction process plays a great role in the maintenance of the later structure, and the detailed information of the key parts should be preserved as much as possible. With traditional theoretical knowledge, combined with field data, can calculate a lot of theoretical things, combine these into the actual situation, will have a good guiding role.

In recent years, with the development of computer chips, computer software technology cloud computing has gradually become powerful, and ordinary computers can gradually run finite element software and solve computing. Although large models need enough detailed nodes and solution time, they have made qualitative progress compared with traditional formulations. It is believed that with the development of science and technology, cloud computing should make finite element software more widely applied in the future.

In the original data, the field data enough preparation, can be obtained relatively accurate theory calculation data, reuse a finite element simulation characteristics, this is equivalent to the "sick" (wall) parts made a CT scan, in this way the problems in governance engineering, almost can do "suit the remedy to the case, medicine to the disease". Compared with the traditional way of governance, it not only saves time and money, but also avoids a lot of "sequelae" problems.

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