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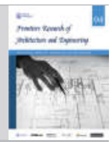

ARTICLE

Application of BIM Technology in Rapid Modeling of Residential Building Design

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ABSTRACT

Combining with engineering examples, this paper introduces BIM into architectural design model and adopts Revit rapid modeling. It focuses on realizing rapid combination modeling of similar components through secondary development, improving information conversion efficiency between engineering CAD and Revit building structure modeling, and quickly generating BIM structure construction drawings.

1. Introduction

IM (Building Information Modeling) has been widely promoted and applied in engineering construction. The main feature of the period is that it can focus on the process control of building design, construction, schedule, cost management, operation and maintenance on the same digital platform, greatly improving the convenience of design, speeding up the construction efficiency, and reducing costs. It has played a revolutionary role in reducing the waste of process resources and thus improving the level of project construction management.

The application of BIM technology involves a wide range of content, and there are still many problems in the process of landing the specific application. In the process of using BIM, there are still many places that can be more rapid, convenient and improved that need to be further developed to improve the convenience of use. For example, in the design of modern residential buildings, how to improve the modeling efficiency of many similar unit structural components needs to be improved in the existing BIM technology application method to improve the use efficiency. By promoting BIM technology, it is not only beneficial to the value of the project itself, but also has a good application prospect in the secondary development and research of the software.

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2. BIM Function

With the increasing popularity of application requirements, BIM function has not only initially combined structural design, collision detection and 3D design with the pre-design stage, but has continuously expanded its application scope and has gradually expanded to include construction stage, operation and Digital information carrier in the maintenance phase; And gradually formed to pursue the construction of the entire project life cycle within the general and management of the technical platform. The use of BIM combines a variety of engineering project software, visualization software and related secondary development software to provide refined model geometric data analysis, visual demonstration effects and dynamic information management functions for engineering projects. This reflects the coordination and unity between different units, to ensure that the whole project from design, construction to the maintenance of transport management can meet the expected requirements at all stages, while saving resources and costs and realizing the application of the project within the whole life.

3. BIM Technology Application Process

3.1 Establishment of Structural Model

The establishment of accurate BIM model based on CAD drawings provided is the basis of any project development and application. Therefore, it is important to build an accurate BIM model. There are many ways to model BIM, and most of the modeling methods for civil buildings are based on Revit. From an application perspective, the key to BIM modeling is the need for proper secondary development. Through secondary development, CAD can quickly and accurately establish a BIM model through Revit. For example, a social housing project is a frame structure project consisting of 32 buildings in residential, commercial and office areas. After familiarizing with the drawings, the pre-assignment settings of the common construction dimensions of the beam-slab column wall are first required, and then the bottom-up structure is modeled according to the content of the drawings and the relationship.

3.2 Secondary Development of Rapid Modeling Plug-ins

Generally, BIM software builds entity model, and usually USES the UI of Revit itself to arrange each structural component. However, how to achieve rapid modeling in dozens of buildings in a short period of time requires secondary development of the Revit engine part. How to make secondary development of the rapid modeling plug-in to make up for the inconvenience of Revit's large-scale modeling function, the solution is to increase the combination and connection application functions based on the original Revit UI, so that it can be quickly modeled according to CAD drawings. The specific processing method is as follows:

Revit uses C# voice as an interface. Using the original UI interface of Revit, compile the program according to the process of selecting CAD layer → screening information → confirming information → completing creation, so as to achieve fast modeling effect. Since architectural CAD drawings are simple two-dimensional wire-frame drawings, their specific meanings are distinguished by different definitions of layers. Therefore, the plug-in developed in the second development realizes batch modeling according to layer categories by extracting layers:

Take the construction of the structural wall as an example: After linking to the CAD basemap, select the UI interface of the transformation wall. Then select any wall from the base map (when making the CAD drawing, all the walls in the plane are made in the Wall layer by default), then the entire wall layer can be extracted. After determining the thickness of the Wall, the model construction is completed. The system will automatically perform the Create Wall operation (WA) according to the wall in the picked layer, and the height is based on the height of the elevation created by itself. At this point, the entire wall of the multi-layer 200 is established. Different categories of components can also be converted in the same way:

(1) Axis network conversion: respectively pick up the axis of the CAD and the label of the text symbol, quickly generate the grid;

(2) Pile conversion: pick up the layer and pile number information of the pile, select the pile material, and quickly generate the pile;

(3) Captain conversion: pick up the layer and cap size information of the cap, select the cap material, and quickly generate the cap;

(4) Column conversion: pick the column layer, select the material of the column, and quickly generate the column;

(5) Wall conversion: pick up the wall layer, determine the material and thickness of the wall, and generate the wall;

(6) Door and window conversion: pick up the door and window hole location layer, select the door and window type, generate windows and doors;

(7) Beam conversion: pick up the layer where the beam is located, and also pick up the reinforcement and size data in the beam to generate the beam.

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In this way, the speed of the large-scale model establishment is greatly improved, and many repeated command operations are cancelled, and only one command can be used to collectively create the same type of component implementation. As shown in Figure 1.

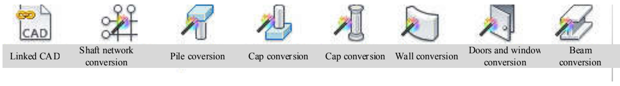

Figure 1. Conversion panel

4. Practical Application

4.1 Column Conversion

In the column conversion, first select the column in the CAD base picture, click the column conversion in the conversion panel, select all the columns, and then screen the column, including the material, section, etc. The most important is the information confirmation work, in this process is easy to pick up the special-shaped column. The special-shaped column created in this way (because the opposite-type column is imported directly by the built in model) will report an error because the corresponding column family cannot be found; So must carry on the careful confirmation, after the confirmation information is correct, automatically generates creates. The CAD base drawing of some engineering columns is shown in Figure 2, and the conversion is shown in Figure 3.

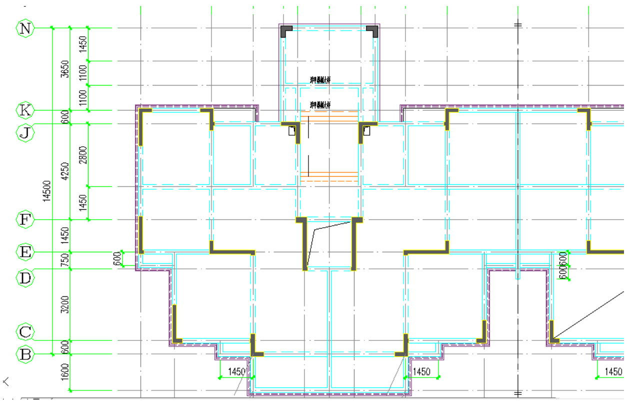

Figure 2. CAD drawing of the column

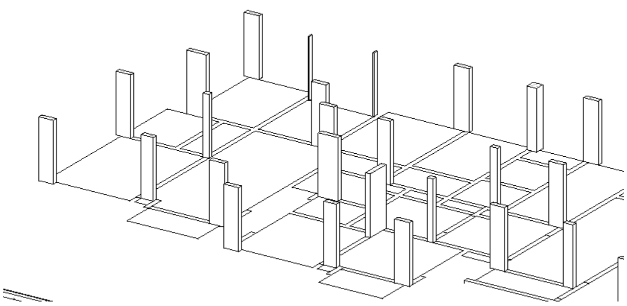

Figure 3. Column conversion

4.2 Beam Conversion

In the beam conversion, it is particularly important to pick up the parameters. Because there are many parameters definition marks of beam reinforcement and interface on the CAD base drawing, it is necessary to confirm that the corresponding parameters are obtained by the corresponding beam when picking up the parameters, otherwise, many wrong beam sizes similar to "200*200*1" will be generated in the confirmation information. After confirming the correct information of the beam, click the beam generated after transformation in the transformation panel for quick creation.

The CAD base diagram of the beam is shown in Figure 4, and the transformation is shown in Figure 5

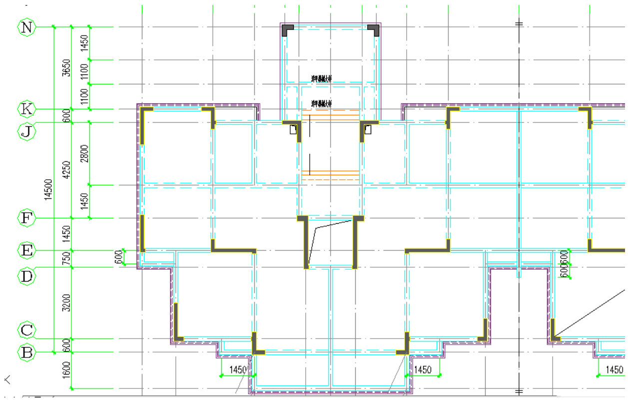

Figure 4. CAD drawing of the beam

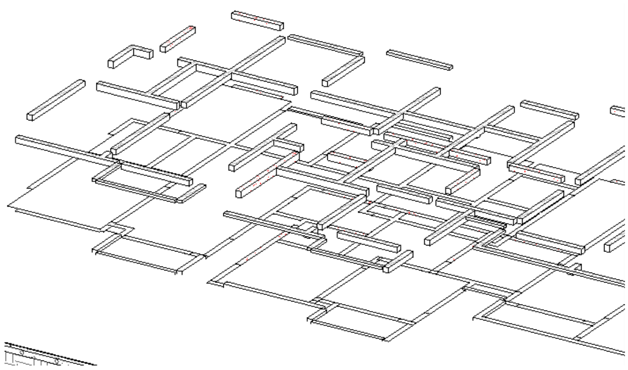

Figure 5. Beam conversion

4.3 Wall Conversion

In the conversion of the wall, the wall must be picked up first, then the door and window openings on the wall should be picked up, and the thickness of the wall should be determined. When "240" is entered, all generated walls are 240 walls, and those 300 walls are picked up, but will not be generated because they do not match the plane information. Repeat this operation to create separate walls

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of different thicknesses.

The CAD bottom view of the wall is shown in Figure 6, and the wall conversion is shown in Figure 7.

Through the combination of secondary development plug-ins, the collection and conversion of other components can be completed quickly, and finally the structural modeling of the standard layer can be created. Completing the standard layer model is the most complex and critical step in the whole modeling process. After that, models of other floors can be created by copying the standard layer and pasting it to align with other elevations, without having to create them one by one. Paste the elevation alignment as shown in Figure 8

During the paste alignment process, multiple elevations can be aligned at the same time, so that the basic framework of the entire model can be quickly established after the standard layer is completed. For each singular point of each layer, the local correction can be modified. The first layer model is shown in Figure 9, the standard layer model is shown in Figure 10, and the overall model is shown in Figure 11.

This example is a residential community project single building. Many buildings are similar in size or structure. When the entire building structure is modeled, the entire model can be copied directly, pasted and aligned to the base point of another building. In this way, the speed and efficiency in the modeling phase can be greatly improved.

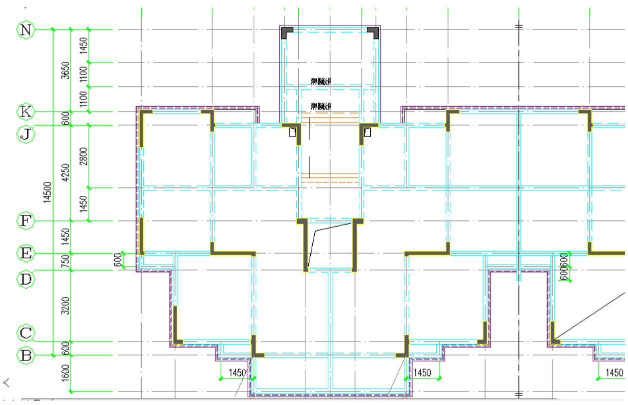

Figure 6. CAD drawing of the wall

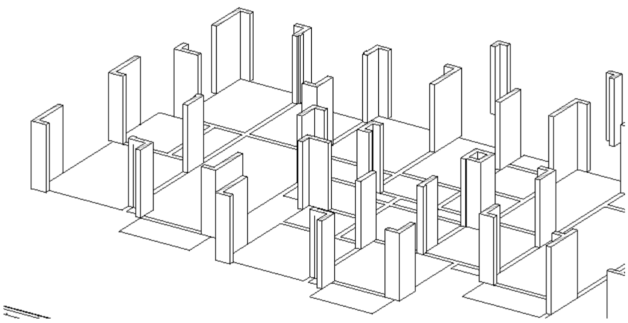

Figure 7. Wall conversion

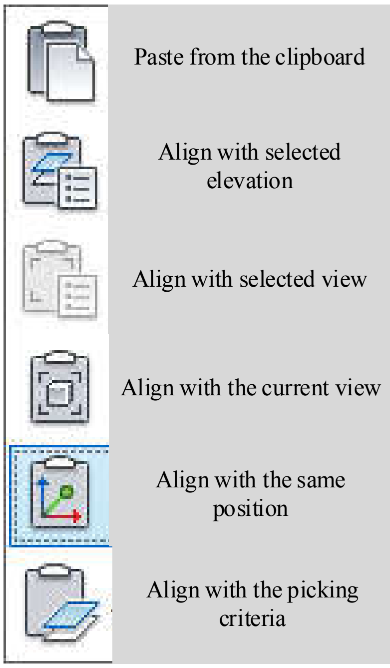

Figure 8. Paste elevation alignment

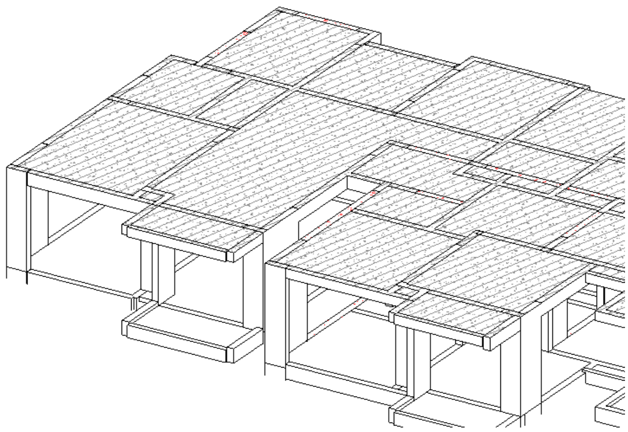

Figure 9. First layer model

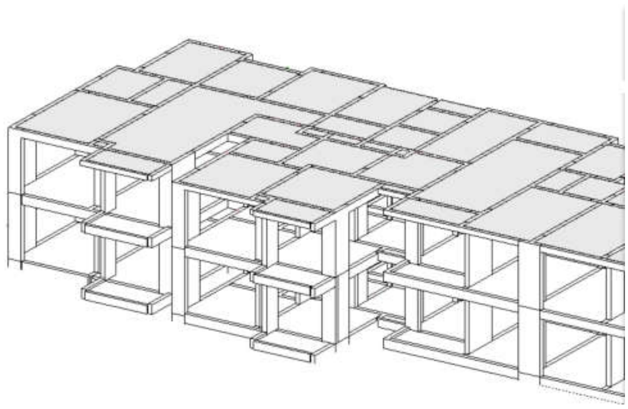

Figure 10. Standard layer model

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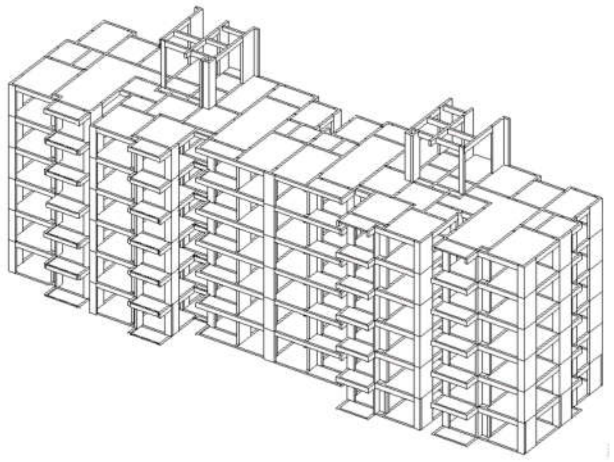

Figure 11. Overall model of a residential buildings

5. Conclusion

This paper introduces the ways and methods of BIM technology applied in general residential buildings, and solve the rapid establishment of large volume model based on CAD base drawing through secondary development. Through programming interface connection between component commands in Revit and layers in CAD, relevant information in CAD can be directly read, and 3d model establishment in Revit can be completed to avoid repeated operations in the design part, so as to greatly improve the design efficiency. The example of BIM modeling of a certain social housing project structure proves that the developed plug-in has wider applicability and significantly improves the efficiency of design work. The application of BIM technology in the whole life cycle of construction projects is worth promoting. In this process, how to deal with specific problems and carry out secondary development to make BIM technology become a widely accepted design technology means like CAD, which is worth the joint discussion and further development and improvement of relevant professionals.

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ARTICLE

Study on Correlation Characteristics of Static and Dynamic Explosion Temperature Fields

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ABSTRACT

The warheads such as missiles and artillery shells have a certain speed of motion during the explosion. Therefore, it is more practical to study the explosion damage of ammunition under motion. The different speeds of the projectiles have a certain influence on the temperature field generated by the explosion. In this paper, AUTODYN is used to simulate the process of projectile dynamic explosion. In the experiment, the TNT spherical bare charges with the TNT equivalent of 9.53kg and the projectile attack speed of 0, 421, 675, 1020m/s were simulated in the infinite air domain. The temperature field temperature peaks and temperature decay laws at different charge rates and the multi-function regression fitting method were used to quantitatively study the functional relationship between the temperature and peak temperature correlation calculations of static and dynamic explosion temperature fields. The results show that the temperature distribution of the dynamic explosion temperature field is affected by the velocity of the charge, and the temperature distribution of the temperature field is different with the change of the charge velocity. Through the analysis and fitting of the simulation data, the temperature calculation formula of the static and dynamic explosion temperature field is obtained, which can better establish the relationship between the temperature peak of the static and dynamic explosion temperature field and various influencing factors, and use this function. Relational calculations can yield better results and meet the accuracy requirements of actual tests.

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1. Introduction

In actual combat, the warhead's attack on the target is a dynamic process. The damage effect is affected by many factors. It is necessary to combine the warhead flight speed, attack attitude, landing point and other parameters, and fully consider the coupling of the damage element to the ground or target[1], find the damage element involved in the dynamic explosion damage process, and establish the corresponding damage power evaluation index to measure the distribution of the dynamic damage power field of the warhead. Designing and using more concerned issues is more practical.

In the process of evaluating the damage power of the explosion field, the temperature of the explosion fireball is an important indicator. At present, many universities and research institutes are conducting research on the temperature test of the explosion fireball. At present, there are two main methods for measuring the temperature of explosive fireballs: direct temperature measurement and indirect temperature measurement[2][3],but the two temperature measurement methods are affected by many factors in the actual test process and the acquired temperature data has A certain error, so for the temperature measurement of the warhead under the conditions of high temperature and high pressure and strong shock vibration, there is still no effective measurement method, and most of them are carried out by simulation[4], such as: Wu Meng based on AUTODYN value the simulation software performs one-dimensional and two-dimensional numerical simulations on the aerial explosions of traditional high-energy explosives and composite aluminum-containing explosives. The explosion temperature and the explosion fireball expansion process are obtained, and they are calculated with the calculation results of empirical formulas and the measured results of related experiments. By comparison, it is found that the two have a fairly good degree of agreement[5]; Zhang Rulin, Cheng Xudong, etc. established a numerical experimental method of explosion shock wave based on LS-DYNA software, ALE algorithm and fluid-solid coupling theory, and compared the numerical experimental results with the blasting field test. The comparison of data and empirical formula calculation results verified the effectiveness of the numerical simulation experimental technique[6]; Cheng Yuteng used numerical simulation The software AUTODYN expatiates and analyzes the action mechanism of warm-pressure explosives in limited space and the empirical calculation formula of quasi-static pressure. The results show that the numerical simulation of the shock wave curve shape, peak overpressure, impulse and quasi-static pressure is in good agreement with the test results good[7]; Jiang Haiyan, Li Zhizheng and others used the AUTODYN software to simulate the dynamic explosion shock wave field of the charge, analyzed the distribution law of the dynamic explosion shock wave field, and performed regression analysis on the data. Good engineering calculation model[8].

Under the conditions of the existing test and test technology capabilities, the static explosion fireball temperature test method is more mature than the dynamic explosion. The dynamic explosion fireball temperature test faces greater problems. To solve this problem, carry out simulation calculation of static explosion and dynamic explosion temperature field distribution, and based on this, take mature static explosion temperature field data as a reference, consider multiple factors affecting dynamic explosion temperature field, and establish static explosion temperature field Correlation model of dynamic explosion temperature field, and the distribution characteristics of dynamic explosion temperature field are studied through this correlation model.

In this paper, the effect of explosive charge on the temperature distribution of the explosion temperature field is studied by modeling and calculating the static and dynamic explosion by using the explosive mechanics simulation software AUTODYN. The temperature peak, high temperature duration and temperature decay of TNT at different speeds were analyzed. Then, the temperature peaks of the static and dynamic explosion temperature fields are analyzed and fitted to establish the correlation function between the two. The results calculated by the correlation function and the simulation results have a high degree of agreement.

2. Numerical Calculation Model

In order to accurately analyze the impact of the ammunition explosion on the temperature distribution of the temperature field, this article uses the TNT spherical naked charge in charge, and uses a two-dimensional axisymmetric design[9]. Domain environment, set the other three boundaries in the picture except the x-axis to pressure outflow. In this experiment, TNT spherical naked charge was used, so the radius of the model-filled TNT explosive can be obtained according to the calculation formula of the volume of the sphere, which is 111.8mm. Set the initiation method of TNT to be the initiation of the center point[10], so set the coordinates of the center point of the filling of TNT to (0,10000). Because the length of the model is 20m, in order to keep consistent with the layout of the measuring points in the actual test, the positions of the Gauges points are 1m, 2m, 3m, 4m, 5m, 6m, 7m, 8m, 9m, and 10m from the explosion center, Take the speed direction of the movement charge as the positive direction, arrange a row of measurement points every 30° counter clock wise, and the angle between the measurement point

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and the positive direction of the movement speed of the charge is expressed. The model is shown in Fig.1 below:

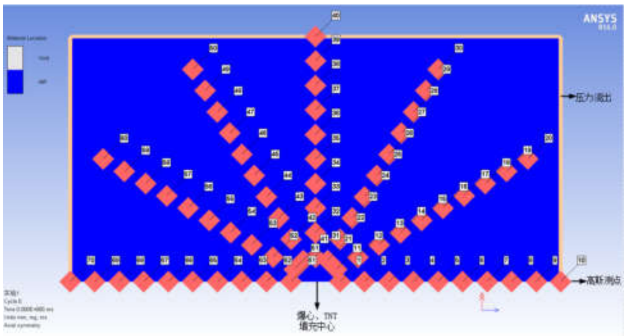
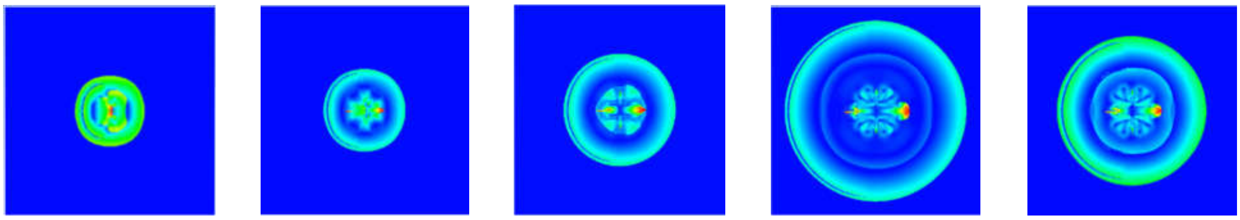


Figure 1. TNT explosion numerical simulation mode

The air in the model is an ideal gas state with a density of 0.001225g/cm; the charge is TNT, and the JWL equation of state is used. The equation is as follows[11]:

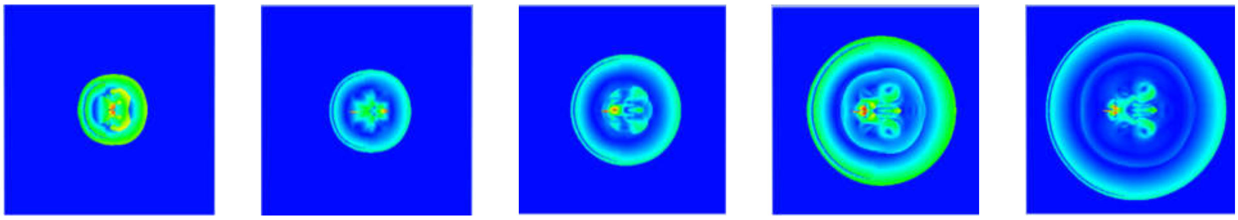
$$P = A\left(1-\frac{\omega}{R_1V}\right)e^{-R_1V} + B\left(1-\frac{\omega}{R_2V}\right)e^{-R_2V} + \frac{\omega}{V}E$$

In the above formula, P is pressure, V is volume, E is internal energy, A and B are material parameters, and are constants. $A = 3.712\times10^{11}$, $B = 3.23\times10^{9}\,Pa$, $R_1 = 4.15$, $R_2 = 0.95$, $\omega = 0.30$,Initial internal energy $E = 4.29\times10^{6}\,J/kg$ [12]. The square in the picture is the set Gaussian measurement point. The function of this measurement point is mainly to measure the decay curve of the



$t = 1.8ms$ $t = 3.35ms$ $t = 6.36ms$ $t = 10.85ms$ $t = 16.26ms$

(a) $v = 0m/s$



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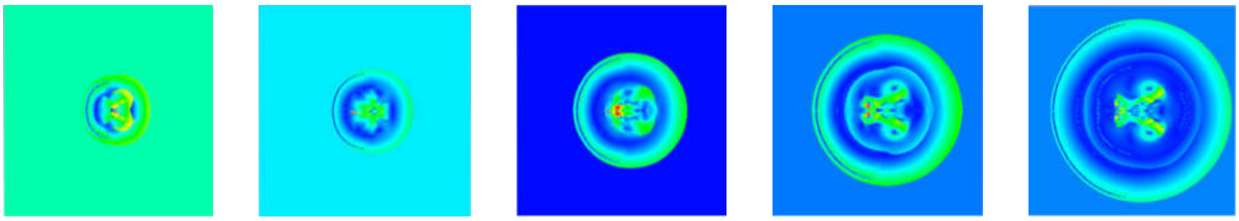
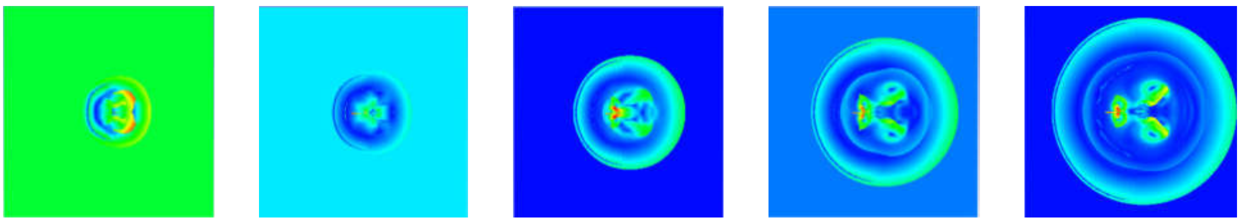
(b) $v = 421m/s$



$t = 1.8ms$ $t = 3.35ms$ $t = 6.36ms$ $t = 10.85ms$ $t = 16.26ms$

(c) $v = 675m/s$



$t = 1.8ms$ $t = 3.35ms$ $t = 6.36ms$ $t = 10.85ms$ $t = 16.26ms$

(d) $v = 1020m/s$

Figure 2. Temperature history of explosion temperature field at different times under 9. 53kg TNT

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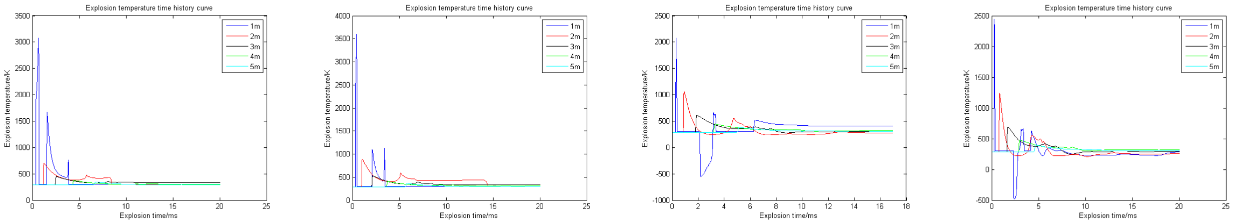
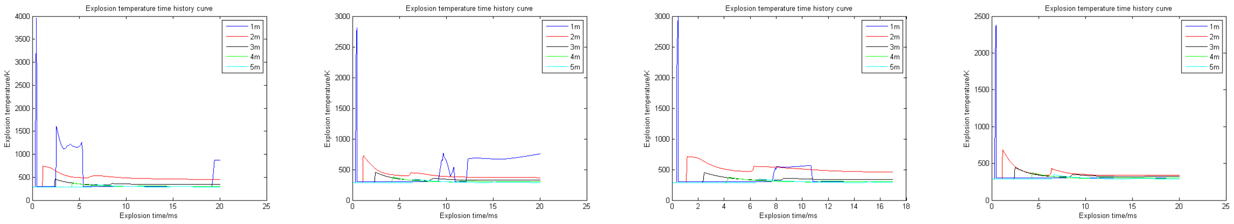


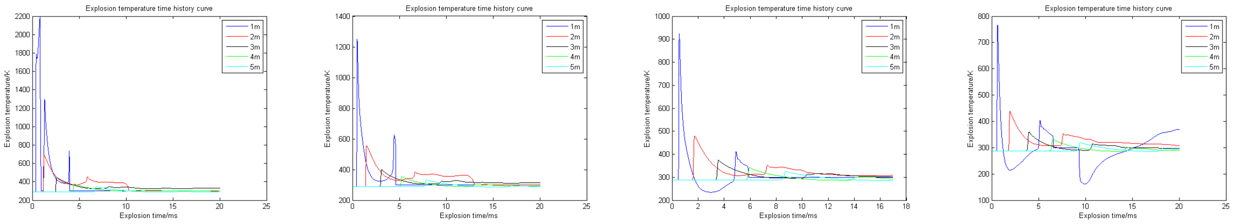
(a) $v = 0m/s$ (b) $v = 421m/s$ (c) $v = 675m/s$ (d) $v = 1020m/s$

Figure 3. 0° line explosion temperature time history curve



(a) $v = 0m/s$ (b) $v = 421m/s$ (c) $v = 675m/s$ (d) $v = 1020m/s$

Figure 4. 90° line explosion temperature time history curve



(a) $v = 0m/s$ (b) $v = 421m/s$ (c) $v = 675m/s$ (d) $v = 1020m/s$

Figure 5. 180° line explosion temperature time history curve

explosion field temperature with time during the explosion. Because the requirements for each part of the model are different, each part is also different when choosing a solver. Explosion temperature needs to be propagated in the air, so the Euler solver is used in the air. In order to ensure the accuracy of the simulation, the mesh size is divided and the material flows through the unit; TNT is a solid material, so the lagrange solver is often used for calculation[13].

3. Flow Field Evolution Analysis of Static and Dynamic Explosion Temperature Field

In this paper, the TNT equivalent is set to 9.53kg for the simulation of static and dynamic explosion. In order to study the effect of the charge motion speed on the temperature distribution of the dynamic explosion temperature field, the charge motion speeds were set to 0m/s, 421m/s,675m/s, and 1020m/s during the explosion simulation. In this case, Analyze the evolution characteristics of the explosion temperature field. The simulated temperature field evolution cloud map, temperature time history curve, and temperature field central velocity versus radius change surface are shown in Fig.2, Fig.3, Fig.4 and Fig.5:

Analysis of the evolution cloud diagrams of the explosion temperature field at different moments under the different charging motion speeds can be obtained: (1) The temperature distribution of the explosion temperature field is not an equal sphere, but there are temperature differences at each stage, and the explosion The diffusion of the temperature field is very similar to that of spherical waves. (2) In the case of the charge movement speed (static explosion), the temperature of the explosion temperature field is higher near the explosion center. As the explosion time passes, the temperature high-temperature region gradually expands outward, and the temperature around the explosion center starts slowly decline, and throughout the diffusion process, each temperature layer maintains a good sphere shape to diffuse outward and evolve, so the temperature diffusion of the static explosion temperature field is a structure with x-axis and y-axis symmetry. (3) As the charge motion speed increases, the temperature field evolution cloud diagram is no longer a standard sphere. The flow field distribution is closely related to the charge motion speed, which is mainly manifested by the dynamic explosion temperature field moving in the positive direction of the charge motion speed In the positive direction, a local high temperature area appears, and as the temperature increases, the temperature first increases and then decreases, and when it is greater than 90°, the temperature field temperature shows a uniform decay trend. Comparing the evolution of the temperature field of the charge motion speed $\boldsymbol{v}=421\text{m/s}$, $\boldsymbol{v}=675\text{m/s}$, $\boldsymbol{v}=1020\text{m/s}$, it can be found that as the charge motion speed gradually increases, the temperature gradient of the explosion temperature field at the same distance and in different directions also increases, and the entire explosion temperature the distribution of the field is also becoming more and more uneven, and its isotherms are increasingly deviating from the circular distribution.

Read the temperature data at different measuring points of the explosion temperature field under the moving charge and analyze it, and get the change of the center velocity of the temperature field with the explosion time at different charge movement speeds. The time change curve is shown in Fig.6 and Fig.7 below:

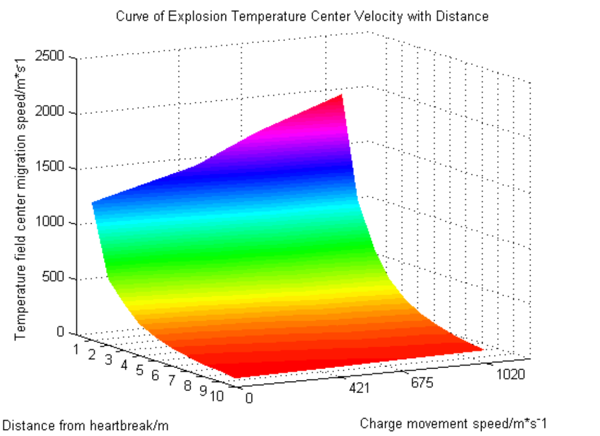


Figure 6. Surface of the change in the central velocity of the explosion temperature field with the explosion time

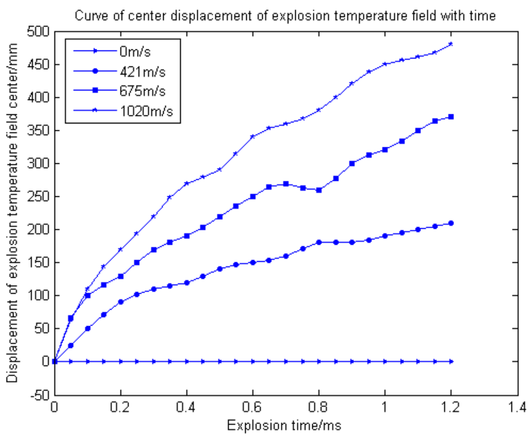
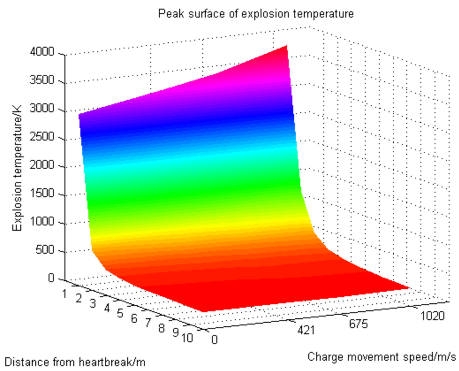


Figure 7. Curve of the center displacement of the explosion temperature field with time

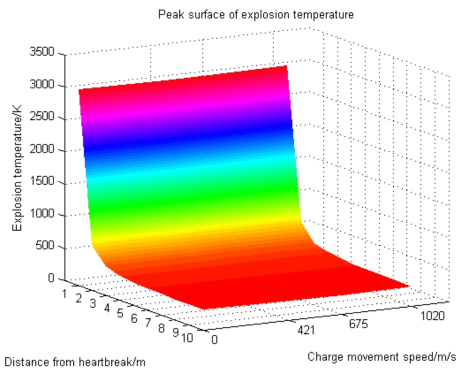
It can be seen from Fig.6 and 7 that the center moving speed and displacement of the dynamic explosion temperature field along the direction of the charging motion speed have a positive correlation with the charging motion speed, that is, the greater the charging motion speed, the greater the center moving speed of the explosive temperature field. The corresponding displacement is also greater. In the initial stage of the explosion of the sports charge, the yin deficiency of the speed of the charge, the temperature center of the explosion temperature field moves faster in the positive direction of the speed of the charge, and its displacement increases approximately linearly at this stage. As the explosion time progresses, the explosion temperature field gradually spreads outward, the center of the temperature field's moving speed gradually decreases, and the increase in its displacement also slows down. The impact gradually diminishes and eventually approaches zero.

3.1 Comparison of Temperature Peaks in Static and Dynamic Explosion Temperature Field

In order to study the impact of the charging speed on the explosion temperature field, the peak temperature of the explosion temperature field was quantitatively extracted based on the above simulation data. Curved surface to analyze the change rule of temperature with the speed of charge, as shown in Fig.8 below:



(a)0° line explosion temperature



(b)90° line explosion temperature

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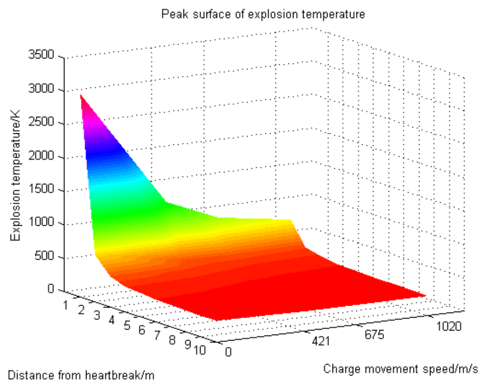


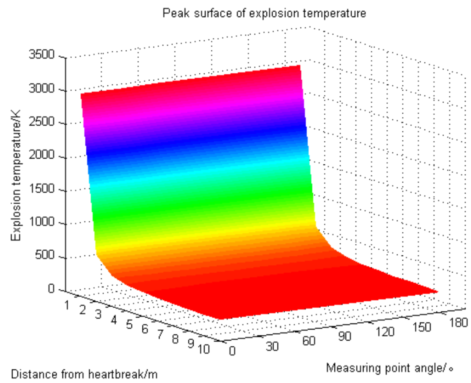
(c)180° line explosion temperature

Figure 8. Different azimuth temperature field temperature peak attenuation surface

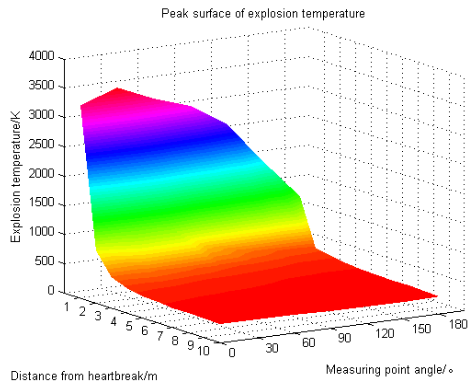
From (a) in Fig.8 above, it can be seen that as the speed of the charge increases, the explosion temperature on the 0° line increases, but the temperature change is not uniform. The main trend is that the temperature near the explosion center rises The amplitude is large, and the temperature rise in the area far from the explosion center is small. As shown in the spike rise area in the Fig.8, combined with specific data for analysis, when the speed of sports charging increases from to, the shock wave at the measurement point of 1m-5m The peak growth rates are 0.87, 0.61, 0.54, 0.27, 0.16, and the overall growth trend shows a decreasing law.

The impact of the speed of the charge on the explosion temperature field is very large, and according to the above analysis, the temperature generated by the explosion in the positive direction of the speed of the charge will increase. According to the law of conservation of energy, the explosion temperature in other directions it must also be affected by the speed of the movement of the charge. Analysis of the peak surface of the explosion temperature on the 90° survey line in (b) in Fig.4 above, it can be found that when the measurement point is 90° in the positive direction from the movement speed of the charge, the temperature peak has a smaller amplitude as the charge speed increases. In the range of 1m-5m, the maximum attenuation rate of the temperature peak at the same measuring point distance is 0.02, and the minimum attenuation rate is 0.0009. From the analysis of the peak surface of the explosion temperature on the 180° survey line in (c) in Fig.4 above, it can be seen that when the angle between the positive direction of the measurement point and the movement speed of the charge exceeds 90°, the explosion temperature no longer moves with the charge The increase in speed increases, but decreases with the increase of the charging movement speed, and the greater the charging movement speed, the faster the temperature peak attenuation rate, the maximum attenuation rate of the temperature peak at the same measuring point distance within the range of 1m-5m is 0.75, and the minimum decay rate is 0.08. And the maximum attenuation rate and the minimum attenuation rate both appear when the charge movement speed is v=1020m/s, which accords with the attenuation law of the explosion temperature field temperature.

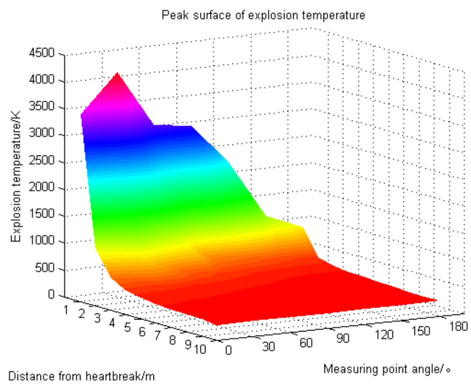
In order to analyze the peak temperature decay law of explosion temperature at different measuring points under different charging motion speeds $\boldsymbol{v} = 0\text{m/s}$, $\boldsymbol{v} = 421\text{m/s}$, $\boldsymbol{v} = 675\text{m/s}$, $\boldsymbol{v} = 1020\text{m/s}$ the temperature peaks at each measurement point are extracted and drawn into a three-dimensional surface,as shown in Fig.4 below:



(a)0m/s explosion temperature surface



(b)421m/s explosion temperature surface



(c)675m/s explosion temperature surface

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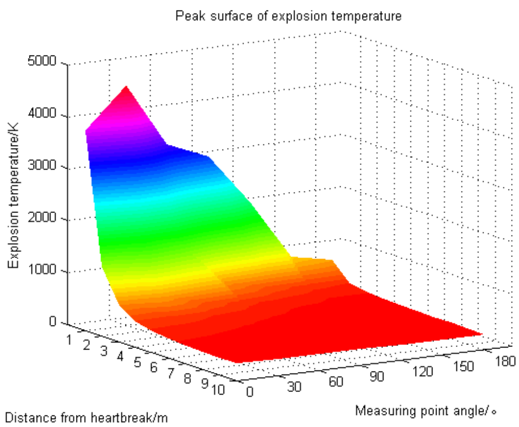

(d)1020m/s explosion temperature surface

Figure 9. Shock wave pressure peak surface at different measuring points under different loading speeds

Contrast analysis of (a) (b),(c),and (d) in Fig.9 above. Since the numerical simulation is performed in an ideal environment, the temperature evolution of the static explosion temperature field is in the form of a sphere. The outer diffusion propagates, so the peak temperature of the explosion temperature field at the same distance from the explosion center is equal, that is, the temperature of the explosion temperature field is uniformly distributed in space, as shown in (a) isotherm of Fig.4.However, with the increase of the charge movement speed, the peak temperature of the explosion temperature field at different azimuth measurement points gradually differentiates, which is mainly reflected in the temperature rise region. As the charge movement speed increases, the temperature rise also increases. In the same way, in the region where the temperature drops, the greater the speed of movement of the charge, the greater the magnitude of the temperature drop. For example, When charging speed increases from $v=0m/s$ to $v=1020m/s$, the maximum temperature increase peaks are 15.47%(421m/s),38.38%(675m/s),51.73%(1020m/s), and the maximum attenuation ranges are 58.85%(421m/s),69.61%(675m/s),74.80%(1020m/s), and the maximum increase ranges appear on the line 30° to the positive direction of the charging movement speed, and the maximum attenuation ranges all on a measuring line 180° to the positive direction of the charging movement speed. And according to the above analysis, the temperature of the explosion temperature field will be temperature pooled in the direction of 30° to form a local high temperature area, as shown in Fig.4(b),(c),and(d) at the azimuth of the measurement point at 30° the sharp corner area formed. Therefore, the temperature of the temperature field during the dynamic explosion process is not uniformly distributed in space, and there is a great difference in the temperature isobaric surface.

3.2 Establishing the Correlation Function of Temperature Peaks in Static and Dynamic Explosion Temperature Fields

In simple terms, the process of dynamic explosion is to add a movement speed to the charge on the basis of the static charge, so that the charge explodes during the movement, but because the speed of the charge will affect the temperature distribution of the explosion temperature field, When analyzing the temperature of the dynamic explosion temperature field, you can first use the temperature distribution of the static explosion temperature field as the basis, and then consider the impact of the charge motion speed on the temperature distribution of the dynamic explosion temperature field. The influence factor can be used to obtain the functional relationship between the temperature distribution of the static explosion temperature field and the temperature distribution of the dynamic explosion temperature field.

According to the conventional calculation method, usually the temperature peak at the dynamic explosion measurement point is subtracted from the temperature peak at the static explosion measurement point, and then the principle of controlling a single variable is used to apply a regression analysis method to each factor affecting the temperature peak of the dynamic explosion temperature field 0btain the functional relationship. The function relationship of the total static and dynamic explosion temperature field temperature peak correlation calculation is obtained by combining the functional relationships of multiple influencing factors. However, the above method considers one parameter and uses the static explosion each time. The difference between the data and dynamic explosion data, so the absolute error will increase in the calculation process, so that the final result will have great uncertainty. In order to reduce the error caused by the above, this paper uses the calculation of relative error The method to replace the absolute error is as follows(1):

$$Y=\frac{T_{dong}-T_{jing}}{T_{jing}} \qquad (1)$$

In the above formula, Y is the relative error influencing factor;T_{dong} is the temperature peak of the dynamic explosion temperature field, T_{jing} is the temperature peak of the static explosion temperature field, and uses the difference between them to divide by the temperature peak of the dynamic explosion temperature field to convert the absolute error into relative error.

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After obtaining the relative error Y, the method of controlling a single variable is used to calculate the effect of the distance d at different measuring points on the relative error factor Y under the condition that the measuring point angle and the speed of the charging movement remain constant, and it is named Y_d. The temperature analysis of the explosion temperature field can be obtained. The temperature distribution of the temperature field in the dynamic explosion state needs to be divided into two parts. The forward direction area of the charging speed is part and the reverse direction area is part. According to the above calculation method, it is obtained as follows Functional relationship (2):

$$Y_d = \begin{cases} 0.0016d^3 - 0.0229d^2 + 0.0502d + 0.213 & 0^\circ \le \theta \le 90^\circ \\ 0.0007d^3 - 0.0219d^2 + 0.1973d - 0.5622 & 90^\circ \le \theta \le 180^\circ \end{cases} \quad (2)$$

Similarly,under the condition that the charging movement speed v is maintained and the measurement point distance d is maintained constant, the influence of different measurement point angles θ on the relative error factor Y is calculated, and it is named Y_θ, Get the following functional relationship (3):

$$Y_\theta = \begin{cases} -0.0005\theta^2 + 0.0169\theta + 0.2662 & 0^\circ \le \theta \le 90^\circ \\ -0.0023\theta^2 + 0.2992\theta - 12.3263 & 90^\circ \le \theta \le 180^\circ \end{cases} \quad (3)$$

Using the same method as above, with the measurement point distance d and the measurement point angle θ kept constant, calculate the effect of the charging movement speed v on the relative error influence factor Y, name it as Y_v, and get the following functional relationship (4):

$$Y_v = \begin{cases} 0.0019v - 0.0487 & 0^\circ \le \theta \le 90^\circ \\ -0.0007v - 0.0112 & 90^\circ \le \theta \le 180^\circ \end{cases} \quad (4)$$

Since the above calculations are independent calculations of the functional relationship of each influencing factor to the relative error factor Y, in order to reduce the error when integrating the three influencing factor functions, the three functions need to be added together , And then open the square root, the calculation is as shown in (5):

$$Y = \frac{T_{dong} - T_{jing}}{T_{jing}} = \frac{T_{dong}}{T_{jing}} - 1 = \sqrt{Y_d^2 + Y_\theta^2 + Y_v^2} \quad (5)$$

By converting the above functional relations, a static and dynamic explosion temperature field correlation function model can be obtained, as shown in (6) and (7):

$$T_{jing} = \frac{T_{dong}}{Y+1} \quad (6)$$

$$T_{dong} = T_{jing} \times (Y+1) \quad (7)$$

In order to verify the accuracy of the functional relationship to the static and dynamic explosion temperature field temperature peak fitting accuracy, the above 9. 53kg static explosion temperature field temperature peak temperature simulation data was substituted into the above formula to calculate the temperature peak 5m before the dynamic explosion temperature field temperature as follows As shown in Table 1:

Table 1. 9.53kgTNT, $v = 675\text{m/s}$ correlation function to calculate the dynamic explosion temperature peak table

Measuring point distance / Measuring point angle	1m	2m	3m	4m	5m
0°	2254.17	1134.35	679.41	456.33	378.93
30°	5420.43	1823.56	893.22	467.12	380.63
60°	4601.02	1701.21	580.32	435.19	347.01
90°	3122.00	745.45	471.32	386.13	352.99
120°	2401.88	640.01	434.12	371.61	352.04
150°	1316.09	513.28	395.35	381.42	336.52
180°	977.12	503.06	389.54	379.73	335.98

According to the calculation results in Table 1 above, the peak value of the dynamic explosion temperature field temperature calculated using this function relationship is very close to the actual simulation peak value, and the temperature distribution and attenuation trend of the temperature field are also very close. By analyzing the above data, the maximum percentage error between the function calculation result and the actual simulation data is less than 15%. Considering the errors in the model simulation process and the system errors in the function calculation process, the functional relationship can be better It can be used in the calculation of the static and dynamic explosion temperature field temperature, which can meet the error accuracy required by the actual test.

4. Conclusion

In this paper, by using AUTODYN software to simulate the temperature of the explosion temperature field at different charge movement speeds, to obtain temperature data at different distances from the center of the explosion, and to analyze the temperature field evolution cloud map, temperature time history curve and temperature peak surface get:

(1)There is a large difference in the temperature distribution of the static and dynamic explosion temperature field. An analysis of the evolutionary cloud map of the static and dynamic explosion temperature field shows that the static explosion temperature field presents a uniform sphere and its isotherm is distributed in a circle; while the dynamic explosion is affected by the speed of the charge, the temperature field shows an ellipsoidal distribution, so its the isotherms are distributed in an oval shape.

(2)The temperature of the explosion temperature field changes with the speed of the charge. In the dynamic explosion, with the increase of the charge movement speed, the explosion temperature migrates to the positive direction of the charge movement speed, so that the temperature in the positive direction continuously increases, while the temperature in the opposite direction continuously decreases. And the temperature peak relative decay rate is faster in the forward direction, while the temperature peak relative decay rate is slower in the reverse direction.

(3) There is a zoning phenomenon in the peak temperature change of the dynamic explosion temperature field, which is greatly affected by the angle of the measurement point. The specific performance is: in the range of 0° -90° with the positive direction of the charge motion speed, the charge speed has a positive correlation with the peak temperature increase of the explosive temperature; in the range of 90° -180° with the positive direction of the charge motion speed Within the range, the charge movement speed has a negative correlation with the peak temperature increase of the explosion temperature, and the direction that is 90° with the charge movement speed is an interface between the temperature field temperature rising region and the falling region.

(4) In the case of obtaining the temperature peak data of the static and dynamic explosion temperature field, by considering the influencing factors that affect the temperature of the dynamic explosion temperature field, a multivariate function regression analysis is used to obtain the functional relationship of the dynamic explosion temperature field temperature calculation. The relational expression can well realize the peak correlation calculation of static explosion and dynamic explosion temperature field temperature, which is of great significance in the actual explosion test.

The conclusions obtained from the above analysis of the static and dynamic explosion temperature field temperature data can provide a theoretical analysis basis for the actual shooting range test of the static and dynamic explosion temperature field distribution, and provide a test plan for the explosion temperature field test and the verification of the measured temperature field data. This new inspection method is of great significance in the actual explosion test.

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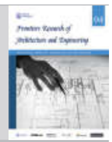

ARTICLE

Simulation of Temperature Effects on Concrete Residual Strength of the Slab-Column Connections

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ABSTRACT

Finite element simulations were conducted to explore the effects of high temperatures on the loading capacity of slab-column connection for the concrete flat-plate structures by the finite element analysis software ABAQUS. The structure used for the simulation is a slab which thickness is 150 mm with a 300 mm square column in the middle of slab, the column height is 450mm. The size of this slab is the same as experiments conducted by previous paper[1]. Based on the results of simulation, the punching capacity of this structure not experienced high temperature can be predicted with very good accuracy. But the result from simulations underestimated the loading capacity of the structure after it has been cooled by around 10%.　This phenomenon is a little bit conflicts with the known experimental results, however, it can be adjusted by modify the material parameters built-in the software. This article is focus on how to best simulate the concrete behavior for both linear and nonlinear part under the room temperature and cooling after experience a very high temperature.

1. Introduction

Reinforced concrete flat slab is a commonly used for both office buildings,　residential and parking garages, which consists a uniform thickness slab supported directly on the columns. By this way, the construction cost and architectural versatility will be very low. Unexpected fire will threaten the reliability of flat plate structure due to combined of bending and shear; it will increase the probability of failure of slab-column joint and may cause the progressive collapse of whole structure in the end.　One flat slab parking garage collapsed leads 7 people dead in this catastrophe in Switzerland. The reason of collapse is due to fire lasted for more than 90 minutes, this makes the punching capacity decrease at the slab-column joint[2,3]. If both the linear and nonlinear behavior of concrete before and after experienced high temperature can be simulated by the software accurately, it can prevent disaster like this and give suggestion about the probability of structural failure.

2. Heat Transfer Analysis

The author using ABAQUS to simulate the behavior of this structure during the heating and loading process because this software can simulate very well in many areas such as: dynamics, static loading, temperature and so on[4,5]. The square slab shown in Figure 1 is the structure simulated by ABAQUS, the model using element type

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C3D8T. Eight layers are divided along slab depth so the mesh size was approximately 18.75mm.

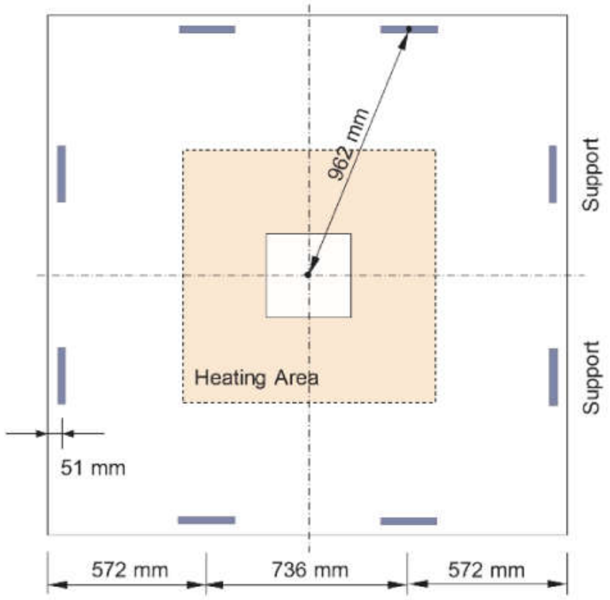

Figure 1. Plan view of experimental structure

On the other hand, in order to make the mesh size in all three directions are almost the same, use 25 mm size mesh in both two horizontal directions. There are two types of concrete slab will be simulated in this paper, Group A, concrete compressive strength is 39MPa, reinforcement distribution is NO.3 bars @ 152mm for the top mat and NO.4 bars @ 152mm for the bottom mat. Group B, concrete compression strength is 41.2MPa, with NO.3 bars @ 152mm for the top mat and NO.4 bars @ 89mm for the bottom mat, so the reinforcement ratio are 1% for Group A and 1.8% for Group B. Due to the presence of reinforcement has very few contribution to the heat transfer process of a reinforced concrete slab[6] and both the top and bottom reinforcement ratio of slab was not high, the reinforcement bars could be neglected from the heat transfer analyses. Neglecting free water evaporation in the heating process due to this effect to the result is small as well. Use 2400 kg/m^3 as the concrete. Both specific heat and thermal conductivity defined according to ASCE[7]. All the temperature data are acquired by the NI data acquisition system at the heated slab top face was applied as temperature boundary condition in the simulations. Introduce heat convection transfer coefficient in order to explain the heat transfer between the concrete surface and the air. All unheated specimen surfaces are assigned with a heat convection transfer coefficient of 20 J/(m˚C) and 15 J/(m˚C) to compare the simulation results to experimental results, because these two values are most commonly used in heat transfer analysis for concrete. From the Figure 2 (a) and Figure 2 (b), greater heat convection transfer coefficient means lower temperature in concrete and 20 J/(m˚C) is more suitable for concrete heat transfer. In general, the simulation results predict the temperature of concrete slab is a little higher than the experiment results. It is possible that the concrete thermal properties defined by ASCE does not consider the water evaporation effects. As it is shown in the figure, the simulation results have not a plateau when the temperature attains to 100˚C temperature in the middle of slab and this temperature is boiling temperature of water. This maybe the main reason that the simulation results overestimated the temperature by around 53˚C at 25 mm below slab heated face, 55˚C in the middle of slab and 30˚C at bottom face with heat convection transfer coefficient of 20 J/(m˚C).

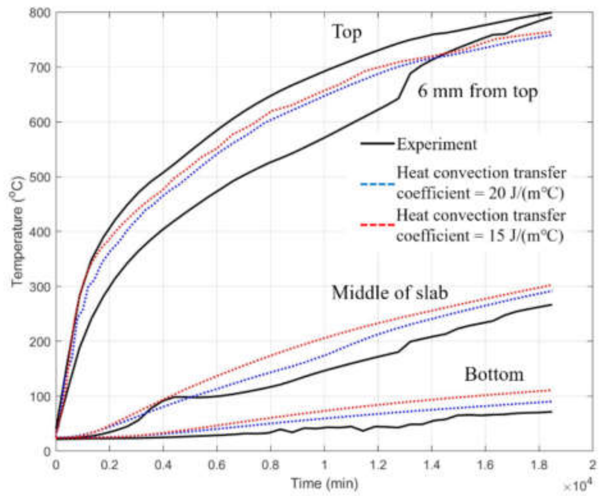

Figure 2(a). Comparison between simulated and measured temperature history of Group A

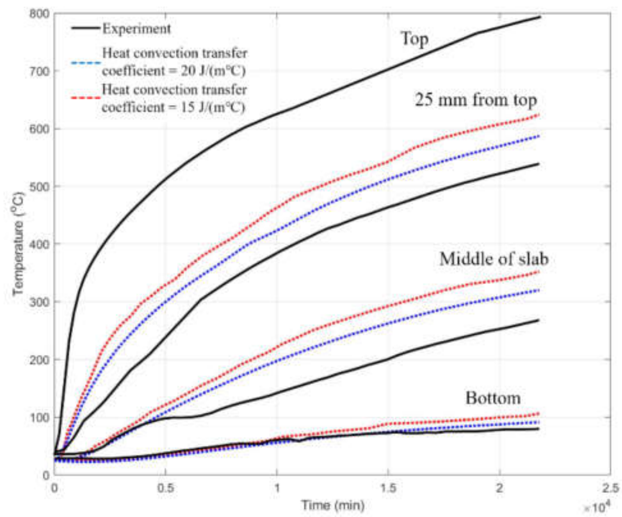

Figure 2(b). Comparison between simulated and measured temperature history of Group B

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Figure 3 shows the detail of temperature distribution for the whole model under Group A heating process. As it is shown in the figure, when the heated area of slab top face attains to hes 800℃, at the quarter height the simulation temperature exceeds 500 ℃, this will cause more than 50% reduction of concrete residual strength based on ACI 216[8]. Decrease of post-punching resistance should be expected according to result of heat transfer analysis, however, both the experimental and simulation results can't get this phenomenon very well.

3. Simulation of Loading Tests

Due to the symmetry, only one quarter of slab with the correct boundary restraints will be simulated in this part, using an equivalent displacement instead of load driven as analysis method. Dynamic explicit algorithm is used in the whole process. The mesh size is the same as heat transfer analysis. Reinforcement in the slab was modeled using embedded truss elements, the material property of steel is bilinear stress-strain relationship and 1% strain hardening ratio. Concrete was modeled using Concrete Damaged Plasticity[9,10]. Five important parameters used to define concrete material property are determined by suggestion of Polak[11].

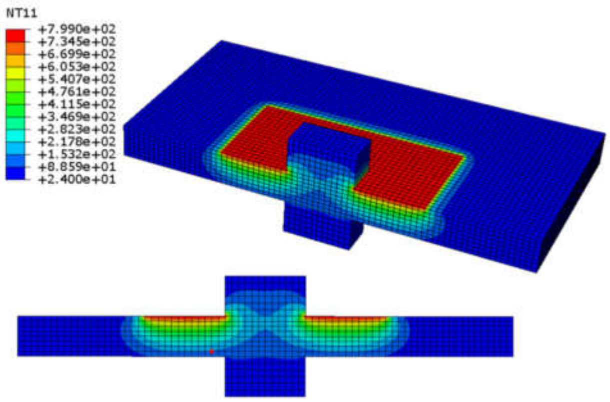


Figure 3. Predicted temperature distribution for group A specimen

(1). Dilation angle was defined as 40°, this parameter effects the result a lot; (2) Eccentricity e = 0.1. (3) fb0/fc0 = 1.16. (4) viscosity parameter was taken as zero. (5) K = 0.67. The stress-strain relationship of concrete in room temperature is determined according to ACI 318 code [12]. Stress-strain relationship of concrete after cooling from different temperatures is determined by the experimental data given by Lee et al[13]. The temperature of each layer is based on the average value of nodal temperature between the layers. Concrete compression property was defined by stress-strain relationship as shown in Figure 4, and the tension part was defined by tension fracture energy built-in ABAQUS. The material parameter of concrete tension part is shown in Table 1. As the temperature increase from room temperature to above 700 ℃, then cooling to the room temperature, the residual strength of concrete is shown through stress-strain relationship in Figure 4. Concrete material property of Group B is defined with the same method.

Temperature (℃)	Tension (MPa)	Tension Fracture Energy (**TFE**)
T = 24	0.83	0.55
T = 121	0.83	0.55
T = 165	0.83	0.55
T = 217	0.79	0.52
T = 280	0.70	0.49
T = 356	0.66	0.45
T = 451	0.54	0.31
T = 570	0.32	0.2
T = 716	0.22	0.2

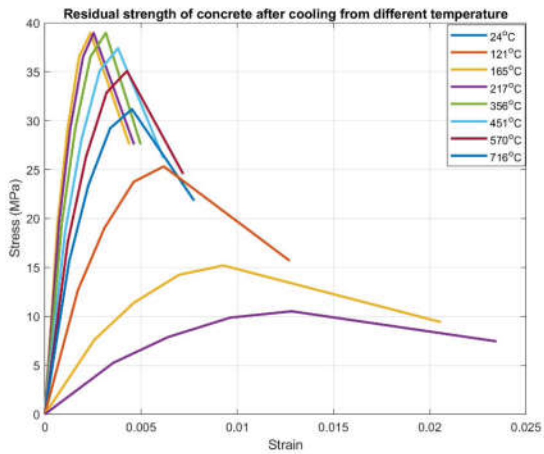
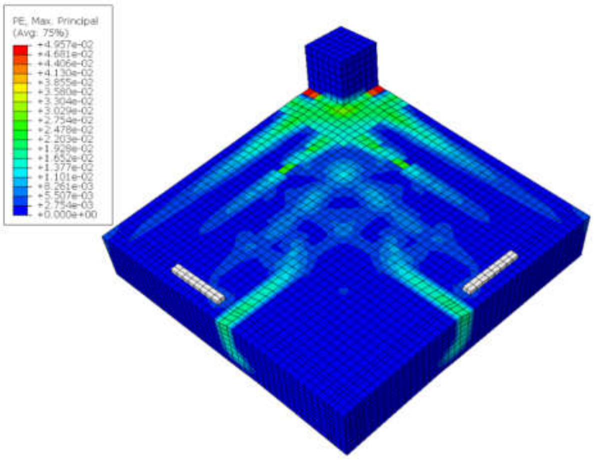
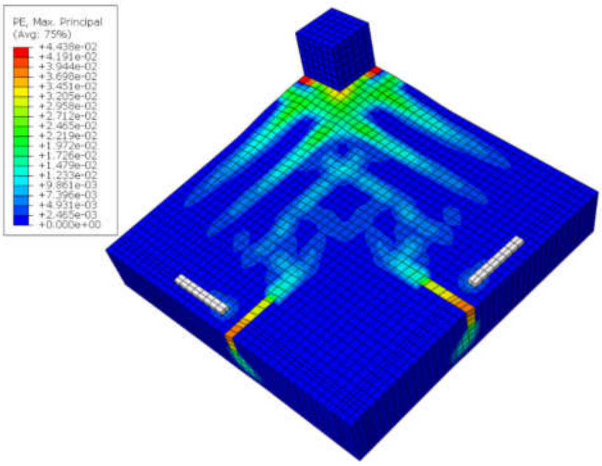


Figure 4. Stress-strain relationship for Specimen A concrete after cooling from different temperature

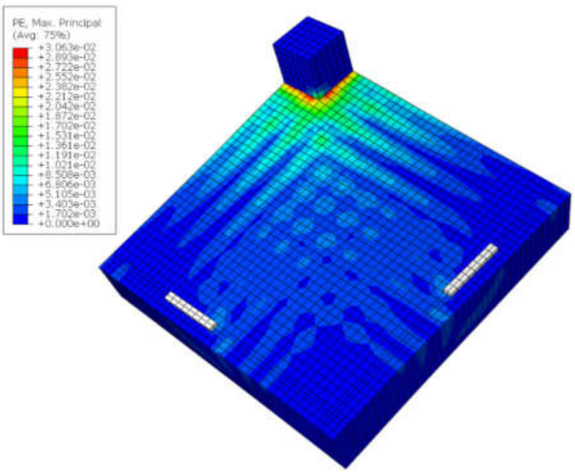
Loading simulation is performed after the all the material property have been determined, the slab is divided by 8 layers, each layers property is defined by the same as Figure 4 and Table 1, the results of both unheated and cooling after heated is shown in the Figure 5. When the maximum principle plastic strain becomes positive, concrete cracking occurs. Maximum principal plastic strain of both Group A and Group B specimen after cooling from high temperature is smaller than the unheated specimen, and loading capacity is in the same trend.



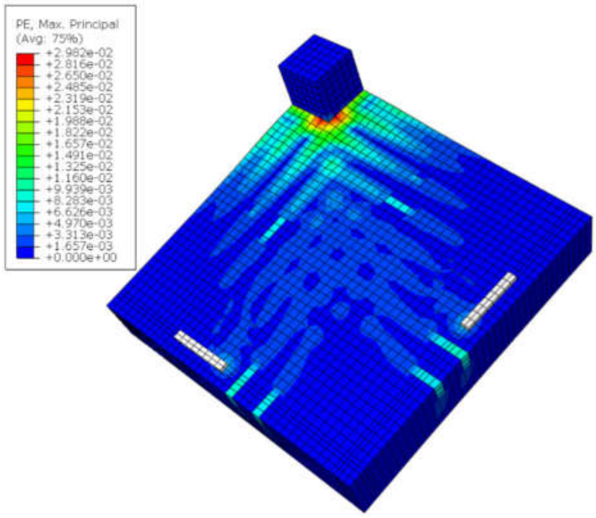
(a) Group A without experience Temperature



(b) Group A after cooling from high temperature



(c) Group B without experience Temperature



(d) Group B without experience Temperature

Figure 5. Cracking pattern in tension surface at the punching failure of Group A and B specimen

Due to the top layer of reinforcement distribution is the same in Group A and B, the stress in bottom layer of reinforcement is shown in Figure 6. The result is the same as the experiment result, in the real experiment, there are two reinforcements are broken in both Group A and B. From the simulation results, the there are two bars' stress greater than the yield strength 70ksi.

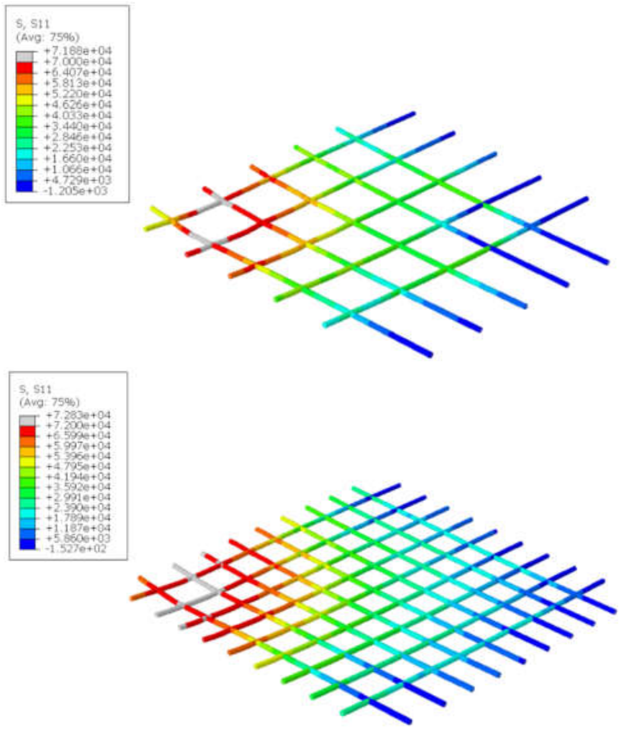


Figure 6. Stress distribution of reinforcement in the bottom layer after cooling from high temperature

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Concrete loading capacity doesn't change after cooling from temperature, this phenomenon can be achieved by changing the tension fracture energy in ABAQUS. This parameter effects both the linear and nonlinear part of Force displacement curve as shown in Figure 7 and Figure 8 as shown below.

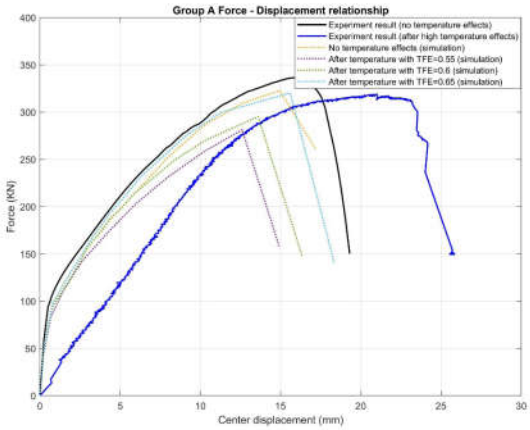

Figure 7. Comparison between experimental results and simulation results of Group A specimen

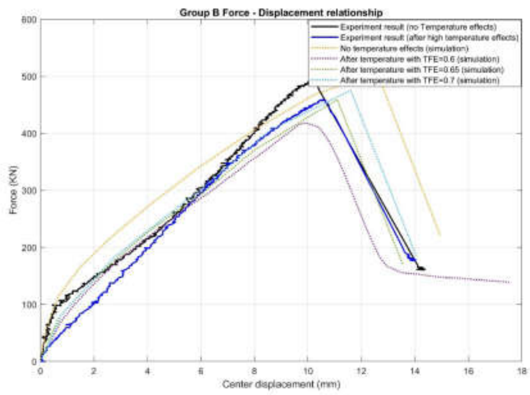

Figure 8. Comparison between experimental results and simulation results of Group B specimen

4. Conclusion

(1) Finite element simulation can predict the punching capacity of slab – column connections in room temperature well. However, the simulation underestimated the residual punching strength a little. This problem can be solved by modify the dilation angle and tension fracture energy (TFE) in the software

(2) Based on the simulation result, increase the dilation angle of concrete in the simulation process can improve the loading capacity of concrete and extend the non-linear behavior of concrete as well.

(3) Modify the tension fracture energy of concrete material can also improve the loading capacity and non-linear behavior of concrete. It makes the simulation result more like the experimental result. Find the optimized combination values of dilation angle and TFE is the best way to get the better simulation results.

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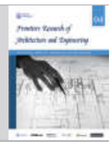

REVIEW

Exploration of Geotechnical Engineering Investigation under Complex Topographical and Geological Conditions

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ABSTRACT

This paper will explore the geotechnical engineering investigation technology under the complex topographical and geological conditions, and introduce how to construct the water supply tube wells faster and better under the complex topographical and geological conditions by taking Inner Mongolia as an example, so as to provide reference for the relevant professionals.

1.Introduction

From a map, we can see that the actual terrain of the Inner Mongolia Autonomous Region extends from east-west direction to south-west direction, showing long and narrow on the whole and most areas of the Inner Mongolia Autonomous Region are plateaus. As the Inner Mongolia Autonomous Region is dominated with the temperate continental climate and crosses the four major water systems i.e. the Yellow River, Ergun River, Nenjiang River and Xiliao River, the groundwater resources are rich there in general, but the surface water sources are low quality with small water yield, large change and more sediments and cannot satisfy the actual demand of residents of the Inner Mongolia for water completely. With the purpose to change the situation effectively, it is necessary to utilize groundwater resources fully. As water supply is the main way and means of extracting groundwater resources, how to conduct reasonable groundwater development under the complex topographic and geological conditions in Inner Mongolia will be a concern needing immediate solution by professionals.

2. Types and Distribution Features of Groundwater in Inner Mongolia

2.1 Daxinganling Region

The Daxinganling Region has the actual groundwater type of the bedrock fissure water mainly from volcanic rock, pyroclastic rock and metamorphic rock. The bedrock fissure water is dominated with phreatic water with the fissure weathering zone as the actual aquifer and the actual water content of groundwater directly depends on the development extent of fissures. However, in the Daxin-

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ganling Region, the whole bedrock fissure water presents the actual development direction from east to west and the closer to the west, the weaker the actual development of the fissure will be, thus resulting in the weakening of the actual aquifer thickness and water content of the fissure.

2.2 Xiliao River Plain Area

Xiliao River Plain Area of Inner Mongolia is a sedimentary basin formed since Mesozoic. The groundwater resources in this area can be classified into loose rock pore water and clastic rock pore water as the verticality. Thereof, the actual aquifer of loose rock pore water is widely distributed and its groundwater is thinner in basin edges and thicker in the center on the whole. The actual aquifer of clastic rock pore water is mainly distributed in the middle of Xiliao River Plain and the majority of the aquifer has such actual rock as glutenite, gritrock and middle- fine sandstone. Both types are high-quality and can act as the domestic water for residents.

2.3 Inner Mongolia Plateau Area

The Inner Mongolia Plateau Area is located in the north of Yinshan Mountain and the west of Daxinganling Mountain. It is mainly composed of mountain & hill area, basalt lava platform, Otindag desert area, high plain area and quaternary valley depression. As the actual geological environment of the whole area is relatively complex, the types and distribution of groundwater are also different. The groundwater in the mountain & hill area is mainly distributed around the northern national borderline and Suet-Xilinhot and mainly dominated with the fissure water from volcanic rock, metamorphic rock and granite, high quality on the whole; the groundwater in the basalt lava platform is mainly in the north of Xilingol and dominated with the fissure water from basalt, presenting gradually deeper groundwater level and larger water quantity from the third-level platform to the first-level platform on the whole; in the Otindag desert area[1], the groundwater changes little in depth and dominated with the water from sandstone and glutenite on the whole, with the likelihood of overflow due to pressure bearing; the quaternary valley depression is the main water source of the whole Inner Mongolia and its internal groundwater is mainly surrounded by alluvial sand, alluvial proluvial sand and gravel layer; as the majority of groundwater aquifer is distributed around Hulun Buir and the depth is smaller, the residents can extract and use the groundwater easily.

2.4 Yinshan Mountain Area

The groundwater in Yinshan Area is dominated with fissure water, mainly distributed around Jining-Fengzhen and mainly surrounded by ancient bedrock, high quality on the whole. But the groundwater resources in other places than Jining-Fengzhen belt are not very rich, so it is relatively more difficult for residents to extract water.

2.5 Hetao Plain Area

Generally speaking, the aquifer in Hetao area is mainly surrounded by middle-fine sand and middle-coarse sand. As Hetao area is closer to the Yellow River, the groundwater content in rock is relatively richer. In Hubao Plain area, the groundwater is mainly surrounded with alluvial rock and dominated with confined water, so it is likely for the water to flow over. In the Houtao Plain area, the aquifer is dominated with Pleistocene phreatic water in the upper part and Pleistocene confined water in the lower part [2].

2.6 Ordos Plateau Area

In Ordos area, the groundwater is dominated with loose rock pore water and clastic rock pore water. Thereof, the former is one of the main sources for the residents in Ordos Plateau and widely distributed and the latter, which is dominated with Cretaceous phreatic water and confined water with thicker aquifer, larger content and high quality, is also frequently used by the residents in Ordos Plateau.

3 Relevant Technologies of Geotechnical Investigation

With the purpose to get the actual data and parameters of the rock-soil layer, analyze the actual distribution of groundwater in the investigation area through the data of the rock-soil layer and discover the groundwater resources ASAP, it is necessary for relevant workers to conduct actual investigation and exploration according to relevant geotechnical engineering standards. Due to the complex topographical and geological conditions of Inner Mongolia, several geotechnical investigation methods will be used for practical exploration. The geotechnical investigation technologies which are frequently used today will be briefly described as follows.

3.1 Geological Surveying and Mapping

Geological surveying and mapping is a step which shall be firstly improved in all geotechnical engineering investigation processes. The main role of this step is to help relevant workers to analyze and learn the investigation area in a more scientific and clearer way. After completing the geological surveying and mapping, the relevant workers can have preliminary knowledge of the data in the topography and geological structure in the investigation area so that relevant workers can preliminarily analyze and authenticate the topographic and geological data and characteristics of the area according to these data and preliminarily assess that whether this investigation area is rich of groundwater resources and worth of groundwater resource exploitation[3].

3.2 Boring

Similar to geological surveying and mapping, the boring is also a very common technology in geotechnical investigation. In actual investigation, the boring technology is generally supported by certain bench drilling machines for actual boring and investigation on the rock-soil layer of the investigation area. With the purpose to improve the effect of boring, relevant workers usually conduct actual boring by convoluted drilling and mud-off [4]. During boring, if any clayed soil is discovered in the rock-soil layer in the investigation area, relevant workers shall keep the extraction rate of the geotechnical core over 90%. Therefore, with the purpose to discover the actual characteristics of the rock-soil layer, relevant workers shall have high expertise so as to guarantee the actual boring effect of the boring technology and provide important investigation indicators for future investigation assessment.

3.3 In-situ Test

In situ test is also a common testing technology during geotechnical engineering investigation. One of the important links of this technology is the static penetration experiment using penetration probe. With the purpose to guarantee the actual effect of static penetration in a better way, relevant workers shall use the original static penetration probe for static penetration experiment, and import the test data of the investigation areas fed back by the probe into a computer for analysis and processing[5]. The other important link of in-situ test is the standard penetration test where the tester needs to test using standard drop hammer, clean bores before test and conduct standard penetration test as 30min per time. This test link can not only effectively figure out the basic physical properties of the investigation area, but also, as the most fundamental and effective test method in the whole in-situ test technology, analyze the relevant data required for geotechnical engineering investigation so as to provide data support for subsequent data analysis.

3.4 Interior Test

We shall conduct targeted interior test according to the investigation issues that relevant workers encounter during geotechnical engineering investigation and the actual geological characteristics of the investigation area, find out the solutions according to the test results and obtain the scientific and accurate physical indicators and data. Generally speaking, during interior test, relevant workers need soil compressibility, soil layer properties determination and other soil information. Such information shall be figured out from field investigation by relevant workers in the investigation area. In combination with other aspects, the actual types of groundwater and concrete features of sandy oil can be finally determined for the subsequent groundwater exploitation[6].

4. Key Points for Design of Water Supply Tube Well

4.1 Well Depth

As the groundwater resources are richer with lower depth and thicker aquifer in Inner Mongolia, the range of 100m-150m is decided after all aspects are considered.

4.2 Well Structure

With the purpose to effectively prevent the infiltration of groundwater during the construction of water supply tube well, in combination with the actual situation of the aquifers of different areas, the thickness of the well filter material shall be controlled within 75-150mm in general.

4.3 Casing Tube

The frequently-used casing tubes for water supply tube wells are made of steel or cast iron, which shall be decided according to the actual regional characteristics from the geotechnical engineering investigation. The casing tubes can also be made of cement in certain areas. The diameter of casing tubes mainly depends on the actual demand of the residents for water and the design pumpage. When the quantity of water required is small, the design diameter of casing tubes can be decreased properly and when it is big, the design diameter can be increased properly.

4.4 Filter

A filter is usually composed of the filter tubes as well as screens of different forms and the filter materials of different specifications. Thereof, the filter tubes are usually selected from bridge tubes and spiral tubes as concrete requirements. When a filter tube is processed, it shall be perforated at the rate of not lower than 30% according to the actual water requirement. The filter tube is buried in the acquirer, so it is necessary to conduct test and processing according to the actuality of the area. The filter materials are usually the gravel with certain level and the thickness

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within 75-150mm. The concrete thickness shall be calculated according to the actual investigation data of the area[7]. In terms of filter screens, the filter screens are not recommended in the rock-soil geology dominated with middle-coarse sand and middle-fine sand represented by Hetao Area of Inner Mongolia, because they may reduce the actual pore size of the filters, increase the water intake resistance and decrease the actual water discharge yield from water supply tube wells. If the rock-soil layer contains more silty sands or silty fine sands, it is necessary to use screens in this area, because they can effectively prevent sands/stones from entering the water supply tube wells and improving the well completion rate and well supply effect.

4.5 Water Stop and Well Seal

The actual work of water stop and well seal usually depend on the actual demand of residents for water. For example, for the water supply tube well for agricultural water, we shall only consider the seal of the mouth rather than do more for water stop on the water supply tube well. But if there is a bad aquifer or polluted stratum around, we shall complete geotechnical engineering investigation, and shall not conduct water stop and well seal until relevant problems are discovered. For example, for the tube well of portable water for residents, during the well completion, we usually use pure clay or clay ball for actual water stop of the water supply well in the areas without bad aquifers or polluted stratums. The well mouth can be sealed by concrete and the length of the mouth water stop band after water stop and well seal shall not be smaller than 5m[8].

4.6 Well Flushing and Water Pumping Test

Both well flushing and water pumping test are important links during the actual construction of water supply tube well. In general, the well flushing will be conducted by the three methods i.e. piston, air compressor and immersible pump. If these methods don't generate good effect in flushing, relevant workers can use appropriate phosphate solution or CO_2 during flushing. The water pumping test is usually synchronous to the well flushing and is an important basis to determine whether the extraction equipment are suitable.

5. Conclusion

In light of the complex topographical and geological conditions in Inner Mongolia, with the purpose to construct the water supply tube well in a better way in this area, we shall conduct complete geotechnical engineering investigation before tube well construction, then relevant personnel shall figure out the groundwater types and distribution features based on the rock-soil data from the geotechnical engineering investigation, distinguish the points richest of groundwater, and then we shall conduct actual boring as well as subsequent test and determine the actuality of the groundwater in the investigation area so as to provide strong data support for the construction of the water supply tube well in future, increase the completion rate as well as the service life of the water supply tube well, guarantee the water safety and quality for residents.

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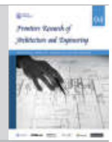

REVIEW

Aviation Fuel System Safety Management Analysis

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ABSTRACT

The development of China's aviation industry is accelerating, especially in terms of national political protection, military security and economic security. In the aviation industry's aviation fuel system management, safety management is an important content. This paper focuses on the safety management of aviation fuel systems.

1. Introduction

The military aviation industry can protect the country's territory from foreign forces. The role played by the civil aviation industry is to transport passengers and various goods. The aviation industry has adopted high-tech achievements, not only with high technical accuracy, but also with cutting-edge technology. Airport fuel is frequently used in the process of receiving and refueling aircraft. In order to ensure the safety of fuel use, it will inevitably place high demands on management. This requires the timely and effective adoption of scientific and effective safety management measures to improve the management level of the airport's fuel safety and maintain the airport's operational safety.

2. Contents Needing Attention in Aviation Fuel Safety Management

2.1 Aviation Fuel Transportation

During the normal supply of aviation fuel and the execution of aviation missions, attention needs to be paid to the issue of oil distribution and transportation. For a long time, aviation fuel used in China has been handmade. The source, amount, supply and total inventory of fuel will have a certain impact on the transportation and distribution of fuel, which not only affects work efficiency, but also leads to a large waste of time and a large consumption of human and material resources. When performing work tasks, pay attention to progress, time cannot be guaranteed, personnel cannot be flexibly scheduled, and various resource allocations are not reasonable, as a result, the economic benefits are poor. When an emergency occurs at the airport, the staff often cannot respond flexibly and cannot adjust their work in time. Fuel allocation and transportation still need to be adjusted and continuously improved, but some new problems will emerge. For example, increasing the quantity of imported oil, annual maintenance of refineries, and taking into account aviation petroleum engineering issues in daily work, which requires effective

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grasp of the transportation situation, rational distribution of oil, and actively seeking sources of oil supply, which will help improve the utilization of resources, and operating costs will also be greatly reduced, which will not only promote the better development of airlines, but also improve the competitiveness of the industry.

The management of aviation fuel projects needs to be carried out in accordance with prescribed principles, so that inventory becomes a new profit point. In the specific work, the fuel supply must be guaranteed, and the flight can run normally; ensuring that the fuel quality is qualified, which is the key to ensuring the safe operation of the aircraft, and also to maintain passenger traffic safety; from the perspective of oil supply and demand, since jet fuel is a very scarce resource, airlines need to develop transportation plans for the use of fuel. When transportation is inconvenient, it is a special period. At this time, inventory work must be done according to the plan. The maintenance time of the refinery should be considered, and the plan should be adjusted after clearing the space distance. Domestic and international oil prices are not fixed, but need to be constantly adjusted. After considering the relationship between supply and demand, it is necessary to do a good job of oil reserve, which will help improve economic benefits. Work started in accordance with the plan, transportation efficiency has improved, and fuel oil inventory turnover will also increase accordingly. At the same time, the improvement of transportation efficiency requires continuous innovation in management, which is the key to improving economic efficiency.

2.2 Aviation Control Equipment

Fuel is very important, so it is also very important to choose the right aviation fuel equipment. There are various types of aviation automatic control equipment on the market. Therefore, airlines should choose suitable equipment based on their own conditions and implement quality management work, which is essential to ensure the safe and reliable operation of the equipment. The performance of the equipment directly affects the transportation of aviation fuel, the storage and supply of fuel, and therefore requires great attention.

Nowadays, the level of science and technology continues to improve, technical results continue to emerge, and information technology is used in equipment management. When the equipment is running, information technology can be used for real-time monitoring, regular technical maintenance and maintenance, and it can effectively perform faults caused by the equipment and accidents and scraps during operation. In this series of work, the application of information technology can be dynamically tracked and monitored, and various kinds of information can be obtained in a short time to ensure the safe operation of the equipment. In the management of equipment, we must recognize that the effective management of equipment is closely related to the life cycle. Equipment management is related to production safety and oil quality. The flight safety of aircraft is directly related to the quality of equipment management and is closely related to the efficiency of airlines. Therefore, in the selection of equipment to ensure good performance and suitable equipment, can improve the management level of the enterprise, and the economic efficiency of the enterprise has also improved.

2.3 Aviation Fuel Safety Management

In the development of enterprises, safety production is an important driving force. Enterprises must continue to develop steadily. Safety is the first element. Aviation fuel is a chemical product, which is easy to burn and explosive. In the process of fuel production and operation, safety is an issue that needs to be considered. Therefore, the following issues need to be addressed in oil safety management:

First, workers must be regularly educated on safety in production, so that employees have a higher awareness of safety in production. The first consideration in work is safety, and “safe production” is the first priority, so that every Chinese person is serious. Perform security duties.

Second, in the daily management work, it is necessary to rationally plan the aviation fuel operation, and all the hidden dangers in the work must be eliminated in time to avoid risks in subsequent work.

Third, formulate and implement safety management principles into specific work, and work in accordance with relevant rules and regulations[1].

Fourth, preventive measures and resolution measures should be formulated for common dangers so that dangerous problems can be solved in time when dangers arise. Enterprises should organize employees to conduct safety drills to increase their awareness of potential safety hazards. Strictly control the quality of aviation fuel. If there is a problem with fuel, it will inevitably have different degrees of impact on air transportation, and it may even cause business problems. In serious cases, it will cause property damage and even pay the price of life.

2.4 Aviation Fuel Cost Management

Since the beginning of the 21st century, international oil prices have risen steadily, causing aviation fuel costs to increase by 20% to 30% per year. During the operation of domestic airlines, an important task is to control the cost of aviation fuel, and strict cost management is necessary. Of the total cost of Chinese airlines, the proportion of aviation fuel costs is very large. From the current situation of aviation fuel cost management, there are still some problems. Therefore, it is very difficult to fundamentally change the cost of air transportation. The cost of each part must be fully considered, and it must be combined with the daily management plan. Make adjustments to aviation fuel management measures and optimize management solutions in conjunction with changes in international oil prices, so that the cost of aviation fuel is effectively controlled[2].

3. Strengthen Aviation Fuel Safety Emergency Management System

3.1 Establish the Concept of Safety Development Management

Safety is related to the self-interest of the employees of the civil aviation fuel system, as well as aviation fuel supply. Aviation fuel companies need to implement safety management in place, in addition to the management and fulfillment of safety management responsibilities, also need technical personnel to take responsibility. To implement the safety responsibility system in place, all work must be carried out around safety, build a safety management system, and improve the safety awareness of employees. It is necessary to rationally plan security management work, optimize resource allocation, and make organization management more stringent.

At present, civil aviation companies are entering the stage of rapid development, which is also a stage where accidents are prone to occur. To ensure the safe development of the company, all employees need to establish a sense of safety. Recognize that safety is the primary condition. Without safety, the company cannot Sustainable development. In the operation and management of an enterprise, safety must be infiltrated into the production and operation process, and various management tasks should be combined with safety management. Establish a safety management system to ensure the realization of safe production. In the development of the aviation petroleum industry, attention to safety can ensure the stable and reliable development of the enterprise, and the production capacity can be enhanced, which plays a certain role in promoting the development of the aviation fuel industry[3].

3.2 Build a Security Emergency Management System

In work safety, safety emergency management plays a supportive role. The safety emergency management work is in place. It is necessary to establish an emergency management system in the management of aviation fuel. Implement systematic management so that emergency work is carried out in accordance with rules and a standard management model is implemented. The emergency planning system must be continuously improved, so that the emergency planning has strong operability in application. The emergency work support system will be established, the emergency management work will be continuously strengthened, and its basic role will be exerted, so that the emergency handling capacity of the staff will be improved and the quality of work will be improved. Strengthen emergency response capabilities and continuously improve emergency rescue plans from the perspective of work needs. It is also necessary to cooperate with the social emergency rescue forces and establish close communication channels to cope with emergencies, so as to improve the ability to handle accidents. Establish and continuously improve the emergency watch system, formulate accident information reports, improve emergency handling procedures, achieve comprehensive management of the watch system, do a good job of horizontal coordination, and also implement vertical implementation. Improve existing plans and run emergency response procedures. The exercise should be done well and carried out in practice, and the acceptance of emergency exercise standards should be done well[4].

3.3 Standardization of Aviation Fuel Safety Management

Aviation fuel safety management should change from a singular management model to compliance and adaptive management model to improve the effectiveness of management, at the same time, adjustments must be made to the security management model. Require safety management behavior to be in place, so that safety management work is standardized. In aviation fuel safety management, the main work direction is to fully cover the hazard sources, develop scientific management procedures and actively implement them, and also establish hazard source files. For the continuous improvement of the hidden danger analysis system, corresponding control measures need to be formulated. With the system evaluation team as the support, the construction of the safety management system is continuously improved[5]. The system files must be improved so that the grassroots managers have the ability to make overall plans. Establish the authority of the system manual, so that the adaptability of operating procedures is constantly strengthened. Real-time supervision of the operation status of the safety management system makes the

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system run effectively. Strict authenticity safety rules and regulations, process control of the implementation of the oil safety system, and ensure the effective implementation of the safety management system.

3.4 Implement the Investigation and Management of Hidden Safety Hazards

Safety precautions must be strengthened for all aspects of aviation fuel supply to ensure that there are no problems with aviation fuel supply. The specific supply work needs to combine the special climate and environmental characteristics and geographical environmental conditions, strengthen the inspection of facilities and equipment, focus on inspection and refueling, and also require regular maintenance to ensure the safe operation of pipelines and important facilities[6]. It is necessary to do a good job of monitoring the key parts, including valve wells, pipelines, oil tank farms and oil depots. The video surveillance equipment must be intact, and safety measures must be taken for the equipment to ensure its normal work. Inspections must be done for people entering and leaving, as well as vehicles, especially in important places. You must be strictly rigged, and personnel in key areas and vehicles entering and leaving must be strictly inspected.

The patrol system should be formulated for key posts, necessary control measures should be taken for oil depots, transformer distribution rooms, automatic control rooms and other places, and the work of patrolling key posts should be done. For important facilities and equipment, such as refueling vehicles, oil pipelines, etc. We must do a good job of security precautions and monitoring[7]. It is necessary to do a good job of coordinating the fuel transportation station's aviation fuel road transportation contractor, and communicate in all aspects. In the process of jet fuel distribution, we must attach importance to safety management, infiltrate safety management into specific work, and attach great importance to ground traffic safety management to avoid causing property damage and personnel safety accidents. We must like to identify the risk factors of the dangerous sources in the workplace. According to the identified risks, compare the control procedures, sort out the current operation records, and control the risk points. To do a good job of assessing the hidden risks, it is also necessary to implement hierarchical management, to carry out safety self-inspection work, to discover hidden dangers in a timely manner, and to take effective measures to eliminate them in a timely manner. If the hidden dangers found during the investigation are serious, leaders need to enter the site for supervision, and follow-up management should be done during the rectification to make the rectification effective. The operation and management of equipment must be gradually improved, the detection system must be continuously improved, regular inspections, and technical maintenance must be institutionalized. If abnormalities are found, they must be dealt with in a timely manner. For the implementation of dynamic management, the probability of failure can be effectively reduced[8].

3.5 Strengthen the Construction of Security Technology Teams

Strengthening the construction of safety technical teams has played an important role in improving the quality of safety management. The basic work of safety management is human management. It is necessary to attach great importance to the construction of the talent team and organize staff to receive training on a regular basis. The main training content is industry standards. All safety managers are required to actively learn business knowledge, and constantly update the knowledge structure to absorb new knowledge in a timely manner. My professional level has improved. In the field work, safety management personnel can make accurate judgments on issues, earnestly perform their responsibilities, and ensure the quality of safety management work. In safety performance management, performance should be used as an important measure of the remuneration of safety technicians, so as to mobilize the staff's positive awareness. By strengthening security management, the team's ability to perform its duties has been improved[9]. Enterprises can organize safety management lectures on a regular basis. The training method should not be based on preaching alone. Instead, it must be diverse in form and mobilize the positive awareness of professional learning of staff. Some safety managers also need to receive experiential training, and can also hold job skills competitions to improve the safety awareness of safety managers.

Enterprises can carry out activities such as "Safety Production Month". Each month has a fixed number of days to carry out safety production publicity and education, popularize safety knowledge to each employee, and help employees establish safety awareness. For the personnel of the supply station, emergency capacity training shall be conducted so that they can deal with emergencies during work and avoid serious consequences[10]. By strengthening safety management training, employees can correct their work attitude, fulfill their duties seriously, and establish the concept of safety development. In the work, we can unify our thinking and have a clear management goal, which is to promote the healthy and sustainable development of the aviation fuel industry.

4. Management Strategy for Airport Tanker Fueling Safety

In the airport tanker fueling safety management, it is necessary to avoid the top splash during the loading process, the grounding device must have high safety and reliability, the oil pressure and loading and unloading control, and the fuel loading speed after the filter element replacement is slower,

Establish safety standards and laws and regulations. Details are as follows.

4.1 Avoid Splashing from the Top during Filling

Because fuel is injected into the top of the airport tanker, it is easy to form a flammable mixture, and it is also easy to generate electricity. Therefore, the bottom refueling method should be the main choice for refueling. In the actual operation process, if the bottom of the tank cannot be refilled with oil, the nozzle of the crane should go to a position about 200 mm deep in the bottom of the tank, and use the underflow refueling method to refuel. If it is a large tank truck, if the electrical conductivity of the jet fuel is relatively low, the top injection method can be used. The fuel tank of the tank truck cannot be refueled with the pump's dual-pipe pump[11].

4.2 The Grounding Device Must Have High Safety and Reliability

Considering the disadvantages of static electricity, we must take targeted measures to solve them. Among them, there is a requirement for the grounding resistance value. At the same time, ensure that the crossover between the loading and unloading pipes and the tanker and the connection between the grounding are safe and reliable, and ensure the system. It is safe during operation. It should be noted that there is no fixation of the grounding device settings on the ground of cement roads, gas stations, etc. The grounding pin is thrown on the ground and cannot be effectively grounded. When metal fires on the ground, when the voltage reaches 300 to 500 volts, the gas mixture will be ignited. Therefore, great attention must be paid to the installation of grounding devices [12].

4.3 Oil Pressure & Loading and Unloading Control

When loading and unloading equipment maintains normal pressure and normal flow, accidents generally do not occur, however, due to the influence of various unexpected factors or the subjective operating measures of the staff, the pressure will increase, the flow will also increase, and the risk factor will increase. At the same time, try to avoid turning the pump on or off suddenly, as this will cause excessive instantaneous shock pressure and excessive flow, which will cause the static voltage to surge instantly and cause serious consequences.

4.4 The Oil Filling Speed Is Slower after the Filter Element Is Replaced

The oil filling speed of the filter element is relatively slow after replacement. This is because the new filter has high electrification characteristics. The use of the new filter is likely to cause electrostatic discharge problems and steam explosion problems. If the exhaust speed and refueling speed are relatively high, the problem of static electricity generation in the water tank filtration is likely to occur, and even the phenomenon of electrostatic explosion may occur[13].

At the airport, fuel storage and transportation equipment is inspected in consideration of natural factors such as special climate and geographical environment. Regular inspections of tanker trucks and other important equipment, as well as technical maintenance work in daily work, to ensure that the equipment has a high safety and stability[14]. It is necessary to strictly inspect the personnel of oil tank farms, oil depots, and vehicles, and conduct strict inspections, and do a good job of equipment management and control. Develop a safety patrol system, patrol the airport according to requirements, regularly patrol oil depots, oil garages and important places, take necessary safety precautions, and strengthen monitoring work. Real-time monitoring of tanker vehicles and other important equipment all risks and hidden dangers must be eliminated in time. The safety management of the fuel system must be in place. The airport should do a good job of inspecting the equipment and combine regular inspections with random inspections to detect abnormalities in equipment in a timely manner.

4.5 Establish Safety Standards & Laws and Regulations

In the safety management and monitoring of the pipelines used for transportation and storage of aviation fuel tanks in airports, developed countries have to monitor the whole process of pipeline design, equipment installation and use to achieve real-time management. For example, the United States has formulated standards for liquid management systems. In particular, in the design of pipelines, detailed technical requirements have been put forward for the design of pipelines, the use of materials, and the manufacture, installation, and maintenance of pipelines.

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The fuel pipeline will be damaged in use and the necessary protection measures need to be implemented. The technical requirements proposed here are very clear. In order to ensure the safety of pipelines, the United States has also issued industry standards for the safety management of hazardous liquid management systems. The issues involved include the improvement of pipeline safety, requiring precautionary measures in the process of pipeline design, and the use of risk assessments. The index enables the pipeline to be used safely and the accident rate during pipeline use is effectively controlled[15].

Technical standards will be formulated in the construction of oil pipelines, and relevant national safety supervision authorities will work on this basis. For example, the US government agency has issued a countermeasure to the safety of natural gas pipelines, which is used to ensure the safety of pipeline use and also plays a role in maintaining the safety of workers.

5. Conclusion

Through the research on the above content, it is clear that in view of the high danger of fuel oil, it is necessary to attach great importance to safety management. Any link must be strictly implemented in accordance with relevant safety standards and comply with relevant laws and regulations. The safety management of the aviation fuel system of the airport cannot be stagnant, but must be constantly improved to ensure that there will be no problems in fuel transportation and use, and to promote the healthy development of the civil aviation industry.

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