

Design of a Five-story Brick-concrete Structure Building Demolition Scheme by Folding Blasting

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Abstract: There are several schemes for controlled blasting demolition of buildings, including in-situ collapse, inward collapse, directional collapse, unidirectional collapse, and bidirectional collapse. The choice of blasting plan is mainly influenced by the structure and geometric size of the explosive, the surrounding environment, and the initiating equipment. This article designs a folding blasting demolition plan for a 5-story brick concrete structure building. Based on the structural dimensions of the building to be demolished and the surrounding environmental map. Only the south side of the building is relatively open and can provide a site for the collapse of the building, so the directional dumping blasting plan towards the south is chosen. Adopting a comprehensive protective system to eliminate or minimize blasting hazards as much as possible. This blasting adopts a hybrid blasting network with electric detonators detonating non electric detonators. Each blasting hole has one detonator, which is connected with one segment of detonator inside the hole and one segment of detonator outside the hole. After every 20 detonators are clustered together, they are connected to a double detonator to form a connection point, and then the connection points are double connected to form a blasting network.

Keywords: 5-story brick concrete structure building, Folding blasting, Demolition plan.

1. Introduction

Controlled blasting demolition technology has been widely used in the demolition of urban buildings and industrial and mining factories, but the demolition blasting is mostly carried out under the conditions of dense buildings, dense population, close to water-electricity-pipe network, and even in the factories where production is carried out. Therefore, the safety issue is very important, and the blasting hazards such as blasting flying stones, explosion seismic waves, air shock waves and blasting gas are directly related to the lives, property and daily life of the country and people [1]. Demolition blasting refers to controlled blasting, which strictly controls the release process of explosive energy and the crushing process of medium through technical measures such as careful design, construction and protection according to engineering requirements and specific conditions such as blasting environment, scale and object, so as to achieve the expected blasting effect and strictly control the influence range and harmful effect of blasting within the allowable limits [2]. The controlled blasting demolition of buildings has the following schemes: in-situ collapse, inward folding collapse, directional dumping collapse, unidirectional folding collapse and bidirectional folding collapse. The selection of blasting scheme is mainly influenced by the structure and geometric size of the blasted object, the surrounding environment and the blasting equipment. When some high-rise buildings reach the service life, the traditional demolition methods encounter great difficulties in demolishing high-rise buildings [3-4]. If the demolished building is tall and the surrounding environment is complex, the stacking scheme is adopted. If the plane size of the building is relatively large, when conditions permit, it is usually dumped along the short axis direction of the structure plane. From the analysis of the actual process of building collapse by blasting, it is found that

for brick-concrete buildings with good integrity, all the gravity of the building acts on the bearing wall and column on the side that has not been blasted immediately after blasting. The bottom of the load-bearing wall and the load-bearing column are used as the fulcrum of dumping, and under the action of the moment generated by gravity, they rotate towards the side of the exploding wall and collapse. A large number of practices show that as long as the demolition blasting technology is used reasonably, the blasting demolition method is safe and feasible. Compared with manual demolition and mechanical demolition, it has the advantages of short construction period and labor saving, especially in the demolition of some heavy, solid, tall and huge buildings, which is more superior than the traditional demolition method [5]. In this paper, a folding blasting demolition scheme for a five-story brick-concrete structure building is designed. According to the structural size of the building to be demolished and the surrounding environment map, only the south side of the building is relatively empty, which can provide a site for the collapse of the building. Therefore, the blasting scheme of directional dumping to the south is selected, and an all-round protection system is adopted to eliminate or minimize the blasting hazard [6].

2. Project Overview

After the roof of one building in a certain community was sealed, it was found that there was a problem with the construction quality, and it needs to be demolished. A 10 story building is located 6.0 meters east of the building, and a cable trench runs underground at 13 meters south. 12.4 meters away from overhead power lines and poles, and 15.2 meters away from the carriageway of Tianyuan Avenue. On the west side, 5m is the school wall, and on the north side, 5.20m is the school sports stadium stand. The specific environment of the explosion zone is shown in Figure 1.

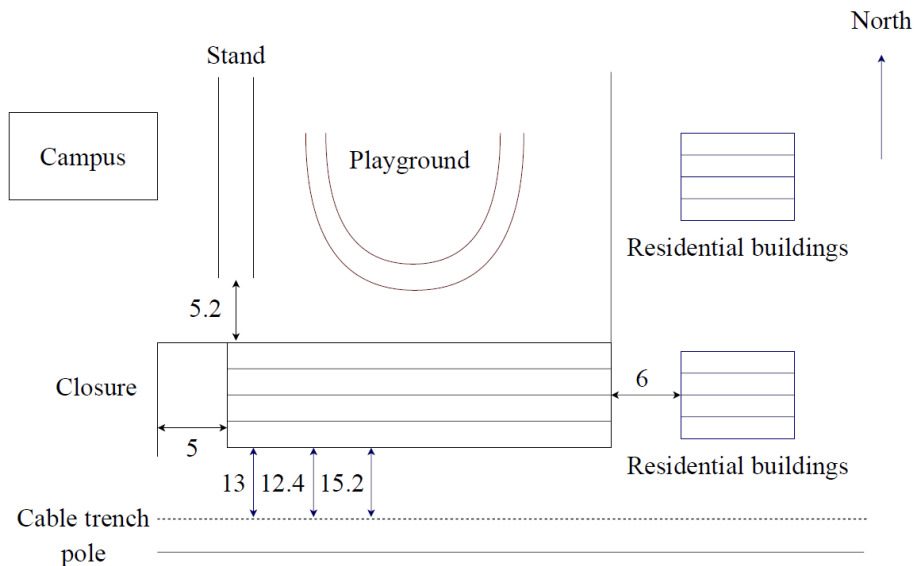


Figure 1. Schematic Diagram of Breaking the Environment

The building is a brick concrete structure with a total of 5 floors. The bottom layer has a thickness of 500 mm × There are 90 500 mm concrete columns, with brick concrete structures above 2 floors. There are structural columns at the corners of the wall, and the wall is a 26 cm thick hollow brick load-bearing wall. The second floor is made of 12 cm cast-in-place slabs, while the rest are prefabricated slabs. There are settlement joints in the middle of the building; The building is 78.6 meters long, 16.4 meters wide, 25.7 meters high, and has a total construction area of 7486 square meters.

3. Blasting Scheme

3.1. Master design

According to the environmental conditions, structural characteristics and construction period requirements of the building to be exploded, only the south side has limited space for the building to collapse. After full demonstration, it was decided to adopt the blasting scheme of "southward directional folding and collapse". That is, the incision is distributed on the first and fourth floors of the building. Weakening the walls of floors 2, 3 and 5. Once the blasting scheme is determined, it is necessary to determine the blasting notch width, because the blasting network is complicated in building demolition blasting, and the number of detonators detonated at one time often reaches thousands [7]. By using controlled blasting method, the concrete in a certain height range of the column foundation is fully broken and separated from the steel skeleton, so that the isolated steel skeleton will not have an overall bending section. When the static pressure load on the top of the steel skeleton exceeds its compressive strength limit or reaches the critical load of the compression bar instability, the steel bar will be plastically deformed and the column will collapse, and the minimum column failure height meeting the above conditions can be called the minimum blasting height. Reducing the blasting range can reduce the number of detonators and the amount of explosives, and reduce the harm of vibration and impact caused by blasting. Therefore, the determination of the size of notch width involves the specific blasting design, and the blasting workload will increase due to the excessive gap, and the phenomenon that the gap is too small or improperly selected will not fall down [8]. In this blasting, electric detonator is

used to detonate the series blasting network of non-conductive detonator. One nonel detonator is used in each blast hole, which is connected by a millisecond delay in the hole and a section of nonel detonator outside the hole. Every 20 detonators are clustered and connected with double nonel detonators to form a connection point, and then the connection points are connected in multiple ways to form a blasting network. The east and north and south side walls of the load-bearing wall are treated before the main explosion to form arch holes. There are two rows of holes in the back wall, one of which is a charging hole and the other is an empty hole, to ensure the smooth dumping. At the same time, the loud sound and seismic waves generated by external charging blasting will cause psychological panic to the people who have just suffered from the earthquake [9]. Scheme 2 has the disadvantages of long operation time and aftershocks, but the harm caused by controlled blasting is small, and the danger of aftershocks can be controlled by mastering the time law of aftershocks.

3.2. Treatment of hollow brick

Because the building is a high-risk building, it may collapse in the aftershock. If people work in the building for a long time, the risk is high. Using external group charge can carry out blasting operation in a short time, reducing the risk of casualties. Moreover, after the early earthquake relief, more buildings were demolished by using external group charge, and the troops accumulated a lot of practical experience, which can ensure the smooth collapse of teaching buildings after blasting [10]. Because the wall is built with hollow clay brick, there is no reference to the related materials before blasting. Before blasting, six concentrated blast holes were laid on a wall with the designed hole network parameters, and each hole was filled with 32 g explosive. The blasting effect was very ideal, and the blasting part of the wall was completely thrown out. It shows that the blasting parameters of hollow clay brick medium are close to those of ordinary clay brick. Blasting parameters should be used for reference.

4. Blasting Safety and Check

4.1. Collapse and dynamic effect

In the process of building collapse, it impacts the ground and produces vibration, and its intensity is higher than that of blasting vibration, and its frequency is lower, which is more harmful to the surrounding buildings and structures, so we must pay enough attention to it. In order to reduce the harm of collapse vibration effect, we should try our best to prevent the components from touching the ground at the same time, and adopt subsection and partition to make the components touch the ground in turn to control the collapse vibration, and at the same time adopt various effective measures to control the collapse vibration [11]. Collapse vibration is checked by the following formula:

$$v = k_t(mgH / \sigma) / R \quad (1)$$

In the formula, v represents the surface vibration velocity caused by collapse, cm/s; m is the mass of the falling component, t; g is the gravitational acceleration, cm/s; H is the height of the component center, m; σ is the failure strength of the ground medium, generally taken as 10MPa; R is the distance from the observation point to the center of the impact ground, m; k_t is the attenuation parameter.

4.2. Blasting vibration effect

To control the vibration effect of blasting, the maximum single detonation charge should be strictly controlled:

$$Q_{\max} = R^3 \cdot (v / kk) \quad (2)$$

In the formula: Q_{\max} represents the amount of explosive in one shot, kg; R is the distance from the protection target to the explosion point, m; v is the allowable vibration velocity, cm/s; k is a coefficient related to the medium properties and distance of the seismic wave propagation section.

The maximum explosive charge for this blasting is 60kg, so the blasting vibration will not have an impact on surrounding buildings. The vibration hazard generated by blasting itself is much smaller in controlled blasting demolition of buildings with a larger height to width ratio than the hazard of building collapse impact vibration. Therefore, sufficient attention should be paid in specific design and construction.

4.3. Protective measures for municipal pipeline network

For the cable trench on the south side, a steel plate with a thickness of 3cm shall be laid above, and sand with a thickness of not less than 50cm shall be laid below the steel plate. The sandbag wall of not less than 1.4m shall be arranged on one side of the pole near the building for retaining. One sandbag wall with a height of 1.7m shall be installed on one side of the residential building on the east side to prevent the lateral movement of the building from affecting the residential building. The vibration speed of this blasting

fully meets the safety requirements of the blasting safety regulations, but the calculation of the impact vibration of the building on the ground shows that the vibration speed caused by it is much faster than that of the blasting itself, so it must be protected.

5. Analysis and Conclusion of Blasting Effect

In this blasting, 678 holes were drilled, with a total length of 7340.2 m and a charge of 12742kg. 1370 millisecond delay nonel detonators, 3026m detonating cord and 23742m blasting stones were used. , one-time blasting forming 107m m. After the ballast cleaning, a double-wall cutting with a bottom width of 15m, an upper mouth width of 31m, a length of 107m and a slope length of about 22m is formed, and the slope is smooth, the slope is stable, the ballast is loose, the blasting pile is well distributed and evenly broken, and no obvious flying stones are found. In this controlled blasting construction, protection is carried out from two aspects: controlling the maximum explosive charge, explosive unit consumption and hole depth. Because the amount of primary explosive directly affects the blasting vibration and air shock wave, and the unit consumption of explosive is too large, the residual energy will produce flying stones and strengthen the direction of air shock wave, thus reducing the harm to the outside world. At the same time, the blasting site is covered with protective materials to control flying stones and shock waves. After the blasting, through the on-site investigation of the surrounding buildings, the left and right teachers' office buildings are intact, the collapsed objects have not been scattered to the two bungalows, the wall behind the buildings has not collapsed, and the collapsed ruins are about 7 meters away. The tent in front of the building is intact, and only a few stones fly to the vicinity of the tent, which has no damage to the surrounding houses and has a good blasting effect. The monitoring results of blasting vibration show that the vibration effect is completely controlled within the safe allowable range, which is very close to the designed safety check value. According to the principle of hole arrangement with wide spacing and small row spacing, the design method of adjusting the charge spacing according to topography and geology and explosive variety after the row spacing is fixed, and finally controlling the charge with the filling length is scientific and reasonable, which can achieve the purposes of reducing vibration, stabilizing slope, controlling block size, improving slope quality, reducing the difficulty of hole arrangement and simplifying network connection. The vibration hazard caused by blasting itself is far less than that caused by the toppling shock in controlled blasting demolition of buildings with large height and width, so it should be paid enough attention to in concrete design and construction.

6. Conclusions

After the explosion, the building collapsed in the predetermined direction and rushed forward 8.4 meters towards the south. The main body behind it did not recoil, with only a small amount of debris scattered around the playground. The debris near the sandbag wall on the east side was nearly 82 cm thick, and due to the buffering protection of the sandbag wall, it did not affect the residential building. In this controlled explosion construction, protection work is carried out from two aspects: active protection and passive protection. For buildings with simple structures, ring beams,

crossbeams, and other structures can be carried out together with the overall blasting. This is not only convenient, but more importantly, the structure is in a stable state before the blasting. To ensure that the building collapses completely in the designed direction during blasting, some load-bearing walls, floors, and ring beams are pre treated without affecting the safety and stability of the building. The width of the support points of the internal load-bearing wall is too small and the charge is too large. During blasting, these support points are not loosened but damaged, and cannot play a supporting and delaying role at all. By controlling the depth of the hole, the direction of flying rocks and air shock waves can also be controlled, so that this disaster is consumed inside the building during the blasting process, reducing the harm to the outside world. For buildings with simple structures, ring beams, crossbeams, and other structures can be carried out together with the overall blasting. This is not only convenient, but more importantly, the structure is in a stable state before blasting.

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