Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

Research on Underground Space Design and Construction Technology Combined with Civil Air Defense Engineering in the Context of Old City Reconstruction

Yunyang Zheng, Jiaxiang Ning, Ting Qu
School of Civil Engineering and Architecture, Nanchang Hangkong University, China

Abstract:

With the acceleration of urbanization in China, urban land and space resources have been compressed. The old city transformation has become a major concern in urban construction. The development and utilization of underground space provides a new development idea. The utilization of underground space in China is evolved from civil air defense engineering. Now the global situation has been relatively stable, and the utilization of civil air defense space is gradually decreasing. A major trend in the development of underground space is to transform and utilize it to meet the needs of "peacetime life and wartime air defense". Based on the combination of underground space and civil air defense engineering, this paper deals with the Xiangnan neighborhood center project in the old city block of Nanchang, Jiangxi Province, interpreting its underground space design and space construction technology, and discussing its uniqueness, so as to provide some reference for related projects.

Keywords: Combination of peacetime and wartime, Civil air defense engineering, Underground space, Design and construction, One scene, two walls in one.

I. OVERVIEW OF THE TRANSFORMATION OF THE OLD CITY

Throughout the world, redevelopment of stock land or urban public land is inevitable in urban development, with the extension of new land to a certain stage. In Table 1, we can see three phases in urban development since the founding of the People's Republic of China. The first phase is expansion (1949-1978). The second phase is expansion and regional transformation of old city (1979-2000). The third phase is large-scale transformation (2000 till now). Since 2000, the old city transformation has become the mainstream.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

Table 1. Urban construction mode

TIME	MODE	APPLICABLE SCOPE	Influence
1949-1978	Epitaxial expansion	New urban area	A large number of infrastructure and housing are built due to rapid urbanization. Urban construction land is constantly expanding, with lengthening commuting time, and unbalanced supply in employment and housing.
1979-2000	Incremental construction is the priority, and old city transformation takes place in some areas.	Cities with old urban area and to-be-developed areas.	With the focus on the development of new areas, little has been achieved in the transformation of the old cities.
2000 till now	The transformation of the old city has gradually become the mainstream.	Cities with saturated development and insufficient land for construction.	Rational distribution of land resources to avoid limitless expansion, with both incremental construction for the new urban areas of the city to increase the available construction area of the city, and stock construction (transformation of the old city) for the old and old urban areas

The transformation of the old city is to update and transform the whole or local areas in an orderly manner so as to restore or regain new functions and meet a series of requirements such as people's production, life and work. It can be seen from Table 1 that long-term incremental construction and expansion have exposed the related problems of urban land in China. In the case of serious shortage of ground resources and compression of urban space to the extreme, the old city transformation mode based on the development and utilization of underground space arises at the historic moment. As a necessary infrastructure in the city, civil air defense engineering can not only guarantee the safety of people's lives, but also provide the necessary activity space for people's daily life. But due to the changes of the background of the times, the utilization rate is gradually decreasing. If it is used, skillfully combined with the development and construction of underground space, it can solve the problems such as the shortage of urban land and space resources[1]. The Xiangnan neighborhood center project is a good case in point.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

Therefore, the underground space design and construction combined with civil air defense projects under the background of old city transformation are analyzed in detail, in order to serve as a reference for similar cases.

II. UNDERGORUND SPACE DESIGN COMBINED WITH CIVIL AIR DEFENSE ENGINEERING

2.1 Overview of the Xiangnan Neighbourhood Center Project

The Xiangnan neighborhood Center is located at the intersection of Xiangnan Road and Sanyanjing Street in Xihu District, Nanchang City, Jiangxi Province, to the east, adjacent to Metro Line 3, and primary and secondary schools to the south and west respectively. The location is shown in Figure 1(a & b). The surrounding residential buildings and underground pipelines are dense, and the surrounding areas are all old residential areas, and their geographical location and spatial composition show advantage in collecting and distributing the flow of people. Therefore, its construction should have a certain function of civil air defense. For example, the birth of the Xiangnan neighborhood Center can redevelop and utilize the public land resources with dense population and large population flow in the old urban areas, which can not only solve the problem of difficult urban construction land, but also produce huge economic benefits.

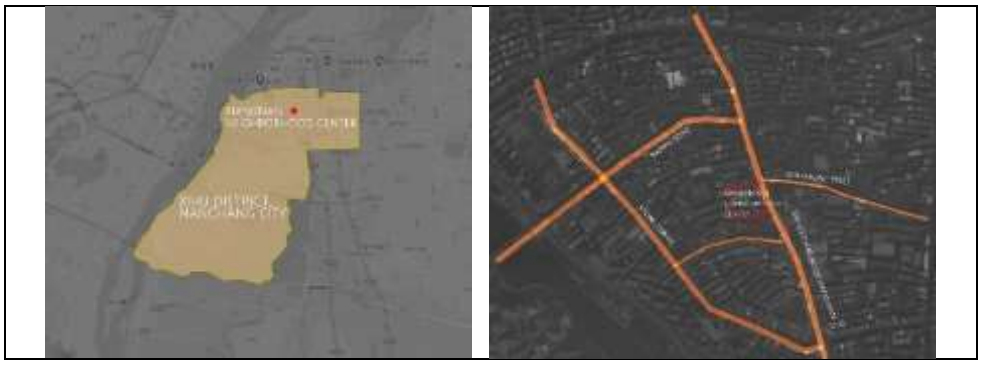

Fig 1: the geographical location of the center of the Xiangnan neighborhood

2.2 The relationship between Underground Civil Air Defense Engineering and the Development and Utilization of Underground Space in Xiangnan neighborhood Center

Underground civil air defense engineering and the development and utilization of underground space are mainly divided into resource relationship, functional relationship and spatial layout relationship[2-3]. Take Xiangnan neighborhood center as an example.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

2.2.1 Resource relationship

For example, the center of the Xiangnan neighborhood is located in the old block in the West Lake District. Its own development has reached a critical value, and the ground space resources are gradually shrinking, so the project focuses on underground space. At the same time of secondary classification of land resources within the site, it not only solves the problem of shortage of land resources, but also increases the interaction between surrounding residents and space, which meets the needs of civil air defense, and realizes the intercommunication of social resources and economic resources in underground space as well.

2.2.2 Functional relationship

For the old urban area, the emergence of the neighborhood center in the south of the city provides the possibility for the diversification of functions. The service function of the old urban area can no longer meet the needs of residents with the passage of time, so the primary function of the neighborhood center should be to meet the needs of people's daily life, promote contact between people, and provide a certain place for people to communicate. If we make a slight change on this basis and take the standards of civil air defense projects as the bottom line in construction, we can also turn the places we usually play into solid umbrellas, so there is a conversion relationship between the two when necessary. it is also in line with the "combination of peacetime and wartime" advocated by the government.

2.2.3 Spatial relationship

Whether it is the spatial layout of the neighborhood center or the spatial layout of underground civil air defense, it can be combined with some important nodes of the city, such as transportation hubs, such as high-speed railway stations, subway stations, commercial centers, such as commercial complexes, and so on. For example, the southern neighborhood center is located in the center of the old city, with the New fourth Army headquarter, a popular tourist spot, and the Jingxiang district, a hot spot with a steady stream of local residents. At the same time, there are also newly opened subway stations in the north of the city. Therefore, as an important node of the city and the gathering point of the flow of people, its safety performance is a major concern, and the underground space combined with civil air defense is a good choice.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

2.3 Design key

2.3.1 Peacetime and wartime conversion design

The conversion in peacetime and wartime can be divided into three situations. First, no conversion. One-time construction meets the protection standards, and there is no need for protection conversion in wartime. Second, Full conversion. Construction and protection are completely two levels of protection, which are converted at one time in wartime. Third, partial conversion. One-time meets the protection level of the space of the main facilities, converting the remaining space such as entrances and vents in wartime. Now the partial transformation pattern has been widely used in the design. The function conversion is shown in Figure 2.

The conversion in wartime is a great test of the conversion time. The requirements of the combination of peacetime and wartime in our country are varied, with 6-3 months for pre-conversion, 4-2 weeks for the temporary war conversion, and 72-43 hours in case of emergency. Therefore, it is necessary to identify the nature, scale, location, structure and other aspects of the project in planning and design and choose a good conversion mode. Here, special emphasis is placed on the conversion principles of entrances and exits: (1) the blocking design of entrances and exits should be simply-operated to facilitate rapid conversion in wartime; (2) some entrances and exits are converted to wartime design. Therefore, given its low operating frequency and short service life, it should be inspected and maintained regularly, and its location needs to be carefully considered to ensure secrecy and security.

In the project of the Xiangnan Neighbourhood Center, the first floor is shops and farmers' markets, and the second floor is an automated and manual garage, which not only increases the mobility of the area in daily life, but also provides sufficient parking space for the convenience of customers, as is shown in the figure 3. In case of civil air defense, an efficient model is formed with sufficient materials and crowd protection, with shops and farmers' markets quickly turning into material storage centers through peacetime accumulation, and underground garages turning into crowd concentration spots by emptying vehicles.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

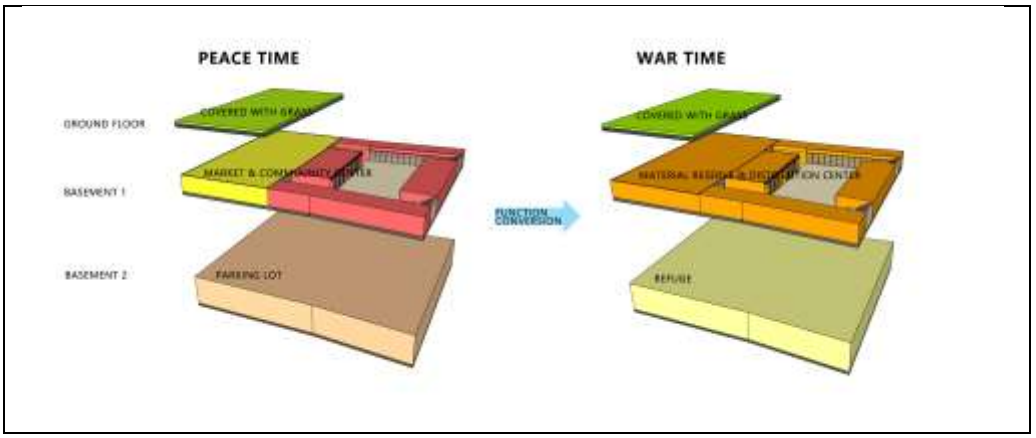

Fig 2: a schematic diagram of the underground function transformation of the Xiangnan Culture Plaza

Fig 3: underground garage of Xiangnan Culture Plaza (photo source: author's selfie)

2.3.2 Ventilation design

Natural ventilation is the focus of our research because the air quality inside plays a key role in refugees' survival. Though the interior of the space is usually equipped with a corresponding internal circulation system, it starts only in emergency. Natural ventilation is the usual practice to promote air circulation. It has three forms: combination with entrances and exits, combination with urban sketches, and combination with urban architectural landscape[4].

These three forms bring about different results:

1) The combination with entrances and exits helps to reduce the unnecessary entrances and exits in the underground space, enriching the external space in peacetime, and achieving a certain cover effect in wartime.

2) Combined with the urban sketches, the ventilation of the entrance and exit is the main

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

ventilation place. The combination with the sketches meets the need of ventilation of the underground middle space, and optimize the urban sketch design at the same time.

3) Combination with urban architectural landscape, through the design of urban architecture and landscape landmarks, not only enriches urban space, but also meets the needs of ventilation.

In the underground space of Xiangnan neighborhood center, ventilation combined with entrances and exits is adopted. The details are shown in figure 4. Because there are only two entrances and exits, many shops are added to the sunken square, and the doors of shops and emergency passageways are opened all the year round to solve the ventilation problems inside the site. As is shown in figure 5, the air drops into the sunken square and exchanges with the interior of the space through entrances, doors and windows to form air flow and circulation to improve air quality.

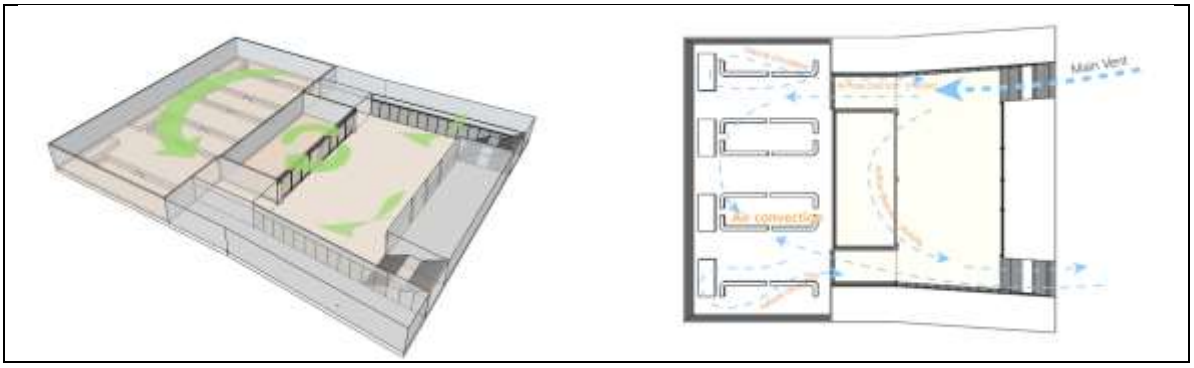

Fig 4: a schematic diagram of ventilation in the Xiangnan neighborhood center

Fig 5: the ventilation port of the Xiangnan neighborhood center (the first on the left is the entrance, the second on the right is the emergency passage)

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

2.3.3 Daylighting design

Lighting of underground space, besides artificial lighting, can be divided into three forms: sunken square, patio, sidewall lighting.

As is shown in Figure 6, sunken squares, such as some urban complex doors, urban central squares, activity courtyards, etc. are local or overall sinking, together with large areas of glass doors and windows, to achieve ventilation and natural lighting at the entrances and exits, so that the whole sinking space is integrated. For example, Guangzhou Victoria Square, Jiangxi Greenland Square are typical. The sunken square not only offers a broader vision, but also meets the underground lighting and functional needs. However, in terms of efficiency in conversion of the design in the combination of peacetime and wartime, it is not advisable.

Windows at the top of the building and transparent materials contribute to the indoor lighting of the building, which is very common in commercial complexes. This method is often used in underground squares or underground commercial streets with shallow burial depth. It improves lighting efficiency, save energy and materials, and enriches the underground space. But on the other hand, it is greatly affected by the weather, making it difficult to control the temperature and light indoors. For example, both the underground commerce of Zhongguancun Square in Beijing and MIG Tiandi in Shanghai adopt skylight at the top.

Side wall lighting is mostly used in the basement, and it is also the purpose of lighting by opening windows at the outer wall of the underground garage when it is high above the ground. When the floor of the basement is lower than or equal to ground outdoors, it is necessary to leave a gap between the exterior wall and the retaining wall to use natural light to achieve light transmission.

Fig 6: underground space lighting (photo source: author's selfie)

Due to the restriction of the leisure square on the ground, the lighting mode of the shops on Basement 1 of the Xiangnan neighborhood center and the vegetable market is the combination

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

of sunken square and internal lights. As is shown in Figure 7, natural light and internal lights are combined to meet the needs. Because the underground garage is located on Basement 2, there is only a small amount of natural light at the entrance of the garage, so it can only be illuminated by internal lights. (See Figure 8)

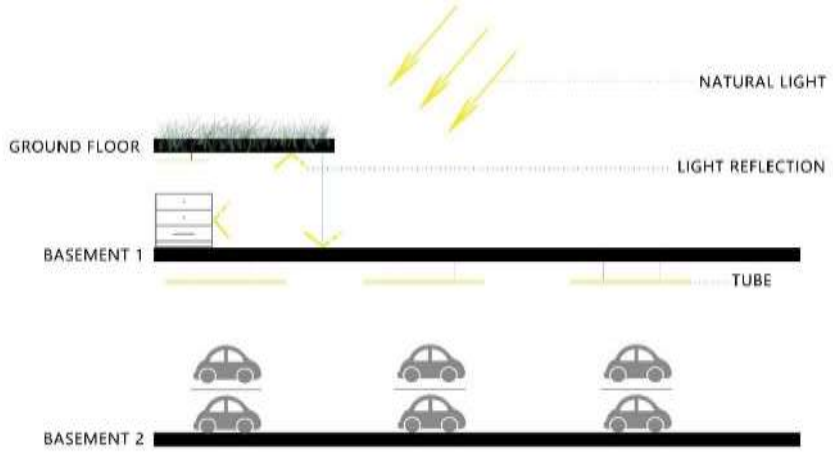

Fig 7: a schematic diagram of daylighting in the Xiangnan neighborhood center

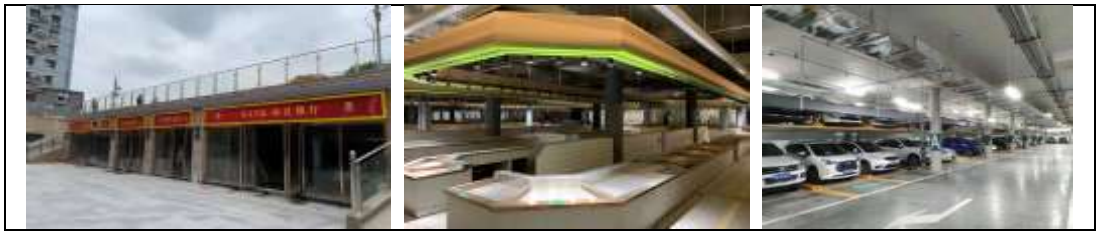

Fig 8: the sunken square and interior lighting in the center of the Xiangnan neighborhood

III. UNDERGORUND SPACE CONSTRUCTION TECHNOLOGY OF XIANGNAN NEIGHBORHOOD CENTER COMBINED WITH CIVIL AIR DEFENSE PROJECT IN NANCHANG, JIANGXI PROVINCE

In the design and construction of underground space, planning is only the beginning of the whole process, providing feasible advice for space construction, while the technology is the core. Next, we will take Xiangnan neighborhood Center in Nanchang City, Jiangxi Province as an example. Based on the combination of the background of old city transformation and civil air defense function, the introduction of its construction process and core construction technology is made in order to provide some reference for similar projects.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

3.1 Current situation analysis and construction requirements

The central area of Xiangnan neighborhood is about 8800 square meters. In Figure 9, Fig 9(a) shows the ground before construction completion; Fig 9(b) shows the ground after construction; Fig 9(c) shows sinking square after construction. In order to design it as a regional market and commercial center and take into account the underground civil air defense function, the corresponding requirements are as follows:

Site requirements. It is located in the center of the busy city and the soil site in the old city is narrow, so it is necessary to maximize the use of land resources. The surrounding buildings are dense, and it is necessary to do a good job in the protection of buildings such as old and dilapidated houses, so as not to occupy land resources and destroy cultural relics and historical memory. At the same time, the design of the column network of underground space should not be too dense. While meeting the load-bearing capacity, it is necessary to provide a certain space for crowd gathering in preparation for wartime needs.

Environmental requirements. In the process of construction, it is necessary to protect the above-ground and underground environment, especially the pollution of municipal pipe network caused by construction sewage during construction, which will cause blockage when it is serious. At the same time, it is necessary to ensure that people will not be disturbed by construction noise, environment, civilized behavior, etc. Strict control of dust, night lighting, will minimize the impact. Take the advantage of the surrounding ecological environment to meet the needs of ventilation and lighting in wartime .

Safety requirements. In the construction process, due to the dense construction surrounding environment, large population, and mostly old buildings, in order to minimize the damage to the surrounding buildings, mature support, water stop, soil retaining and other technologies need to be adopted, making sure that other underground projects nearby do not interfere with each other [5]. In terms of construction results, it is necessary to ensure the stability and firmness of the underground space and meet the protection function.

Efficiency requirements. Speed up the construction by completing the ground function, restoring the original function, and adopting new equipment and new technology on schedule to reduce the impact on the life, commercial activities and traffic of the surrounding residents during the construction process.

Functional requirements. Restore the original ground function, and at the same time achieve livelihood requirements, civil air defense requirements, economic requirements and other multiple functions, not only construction projects, but also livelihood projects, civil air defense

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

projects.

(a) (b) (c)

Fig 9: the ground construction of the Xiangnan neighborhood center before and after

3.2 Construction method-- three-in-one reverse method of one scene and two walls

3.2.1 A brief introduction of the method

The diaphragm wall is a kind of enclosure structure with large stiffness, small deformation and good water sealing effect, which can effectively reduce the deformation of the enclosure system[6]. "One scene and two walls in one" refers to the combination of the triple functions of waterproof curtain, supporting retaining wall and permanent structural external wall into the underground diaphragm wall, which can not only protect civil air defense engineering, but also reduce the amount of concrete and shorten the construction period.

This project adopts the three-in-one technology of one scene and two walls, and the construction method that matches this technology is the full reverse method. By making use of the horizontal supporting effect of the rib floor of each underground layer on the surrounding enclosure structure, the floor is poured as a whole and holes are reserved to ensure the transportation of soil and the entry of materials. The model is shown in Figure 10.

The "full reverse method" has obvious advantages compared with the traditional support form in terms of economy, stability and safety. With rapid development of foundation pit engineering, it will become an orientation in deep foundation pit research.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

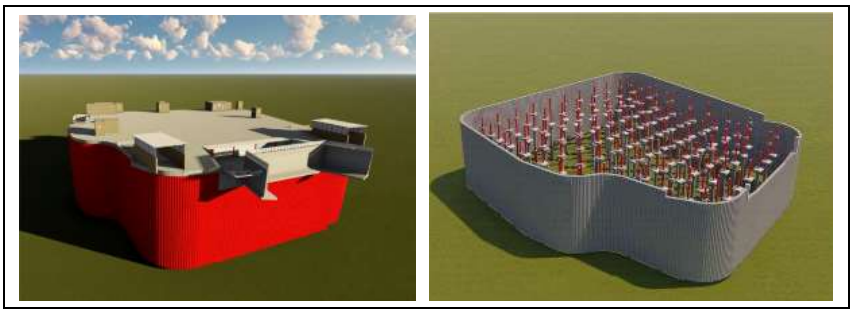

Fig 10: design model of diaphragm wall

3.2.2 Construction key

In civil air defense engineering, the quality of protection is particularly important. In this project, it is mainly reflected in the quality of underground diaphragm wall in the process of construction, while underground diaphragm wall belongs to the form of deep foundation pit support. The stability, strength and stiffness of the wall are easily affected by embedded depth and construction factors[7-8]. Therefore, based on the above requirements, the following five points are put forward for special attention:

1) To ensure the quality of grooves when making continuous walls

The main results are as follows: (1) In order to ensure the quality of the groove in production, a special personnel should be assigned to observe and measure the verticality of the groove in real time to eliminate the error; If there is a deviation, the construction should be stopped immediately and corrected.(2) The quality of wall protection slurry is also a very important factor in construction, whether its index meets the requirements or not directly affects the stability and bearing capacity of hole wall, as well as the protection effect of civil air defense space in the later stage.

2) Manufacture and hoisting quality of steel bar cage

The steel cage itself has a certain restraint effect on the concrete, at the same time, it increases the tensile effect of the column, and its production quality has a direct impact on the stability of the civil air defense space.

The main results are as follows: (1) In order to ensure the completeness of the tensile effect of the steel cage, it is necessary to ensure that the quality of the solder joint meets the relevant requirements.(2) When the steel cage is hoisted, it is necessary to pay attention to the selection

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

of lifting points to ensure the overall structure of the steel cage, to avoid unnecessary deformation and the increase of the subsequent work load.(3) During the installation process, the installation of the steel cage should be carried out step by step to avoid colliding with the hole wall, resulting in hole wall collapse or reinforcement cage deformation and other problems.

3) Accurate control of embedded parts

The main results are as follows: (1) The accuracy of the size of the groove in the embedded parts will directly affect the accuracy of the construction of the embedded parts, so it is necessary to accurately measure and locate the removal position and groove direction in the manufacture and post-examination of the embedded parts. (2) In the process of construction, it is difficult to locate and fix the embedded parts, for example, there may be some malposition problems when inserting steel bars with the ring beam of the floor. Or the fixing can not be completed when there is no intersection of the main reinforcement of the column, so it is necessary to pay attention to the position of the steel bar, making sure it doesn't shift.

4) Continuous wall connector processing:

Because of the uniqueness of the "one scene, two walls and three in one" structure, it is required to pre-bury the connector and related materials in the continuous wall construction stage, and then reuse it during the floor construction[9]. Because the construction is carried out underground, there are many hidden factors, so there is a certain probability that there will be some problems such as connector omission, position offset, inability to use and so on, which brings a lot of supplementary work, such as filling gaps, correcting proofreading, eliminating errors and so on.

5) The problem of anti-seepage after the completion of the wall:

Preparing for civil air defense in wartime, it is very important to ensure the tightness of the space, and the underground diaphragm wall is composed of multiple deep grooves, and how to deal with the joint between the deep grooves is the key to the anti-seepage problem. There are many methods of joints, which can be divided into two categories: rigid street joints and flexible joints. If the settlement of the building is uneven, it will be a huge hidden danger to the rigid structure; on the contrary, the flexible joint is beneficial to the force at the same time, it can also avoid the adverse consequences of uneven settlement, but we still need to pay attention to the quality of one-time survival of seams.

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

3.2.3 Construction route and technology

1) Full reverse construction route is as follows[10]. The process is shown in Figure 11.

(1) While completing the construction of the occlusal pile continuous wall, carry out the construction of the middle column; (2) Dig the soil on the surface of the construction site and go deep into the underground construction; (3) After the excavation is finished, carry out the construction of the connection between the roof and the crown beam: (4) Restore the surface of the square after the construction to facilitate the construction of the ground and underground at the same time; (5) Excavate the ground floor; (6) Connect the steel structure beam of Basement 1 with the embedded parts, and carry out the construction of the beamless slab on Basement 2; (7) Dig the earth on Basement 2, and begin the construction of the bottom plate and the foundation cap after completing the connection between the steel structure of Basement 2 and the embedded parts.

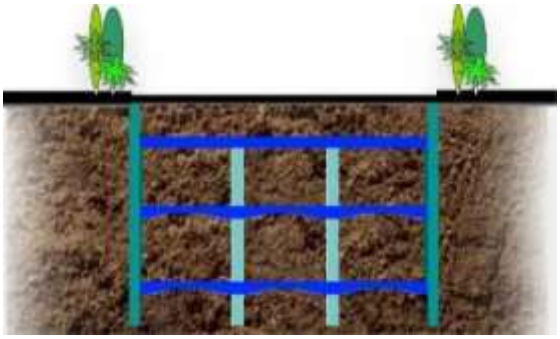

Fig 11: profile of construction route

In the above construction route, the core construction technology is the construction method of occlusal pile continuous wall. The details of construction process and results are in Figure 12 and Figure 13. In Figure 13, Fig 13(a) shows the current use of the underground garage, and Fig 13 (b) shows the continuous wall vaguely visible in the underground garage. The process is as follows:

(1) Testing and releasing the pile position, and the adjacent pile body is occlusal and lapped. (2) The long spiral pile machine is used to complete the construction of water stop pile; (3) The rotary drilling rig is in place, and the multi-function drill pipe is used to cut the two adjacent water-stop piles within the final setting time of the water-stop pile, and after drilling to the predetermined depth of the pile hole, the hollow self-retractable drill pipe and the multi-function drill pipe of the rotary excavator are used to pour concrete into the bottom of the pile hole, and at the same time slowly lift the hollow self-telescopic drill pipe of the long rotary excavator until it is pressed to the top of the designed pile, and then insert the steel bar cage with a noiseless steel bar vibrator. Complete the construction of supporting pile. (4) Repeat the

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

construction steps (2) and (3), and complete the construction of all water stop piles and supporting piles, and form an occlusal pile continuous wall after the concrete is finally solidified.

Fig 12: construction drawings

(a) (b)

Fig 13: underground construction completion map

3.2.4 Uniqueness analysis

In the project of Xiangnan Neighbourhood Center, the construction technology has the following characteristics:

Ecology: In the process of construction, it will have a certain negative impact on the environment of the surrounding buildings and related areas. The use of two-wall construction can effectively avoid producing too much noise and dust. It weakens the inconvenience caused by the construction to the nearby residents.

Practicability: There is generally no working face during the support period, which ensures the saving of underground space to a certain extent, and this technology can be used no matter

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

whether the soil is soft alluvium or dense rock foundation.

Stability: As the foundation of the building, the quality of the diaphragm wall is related to the quality of the whole project. Weak foundation will increase the chances of accidents. Two walls in one continuous wall are used, because the basement roof plays the role of internal support, which makes the foundation pit good. And the lateral displacement of the foundation pit retaining joint is relatively small, which can effectively avoid foundation subsidence and other problems.

Economy: This project belongs to the deep foundation pit project with an excavation depth of about 11 meters, adopting two-wall diaphragm wall, which has the advantages of fast speed, good overall benefit and high quality assurance rate. It not only has the supporting effect of ground wall in structure, but also reduces the investment in construction equipment, such as grooving machine, crane and so on.

Innovation: In the basement a one-time construction of concrete-filled steel tubular connected pile is adopted, which has the dual functions of supporting temporary column inside and vertical stress planting in permanent basement, saving materials and increasing overall stability. Compared with most of the conjoined piles used at present, it is an innovation.

Efficiency: High-rise or super high-rise building projects generally require a great load, and generally the geology with bedrock as the bearing layer. In order to ensure that the upper part of the construction does not exceed the bearing capacity of the foundation, it is generally adopted to increase the diameter and length of the pile to improve the bearing capacity of a single pile. But at present, the construction process of the traditional long spiral bottom-enlarged cast-in-place pile is complicated and inefficient, requiring the cooperation of several sets of tools. The operation is complex, and the above technology well solves the time-consuming and laborious problem in the traditional construction, and provides a relatively rapid and novel construction method that can guarantee the quality.

IV. CONCLUSION

Since the beginning of this century, the construction of the combination of underground space and civil air defense projects in the context of old city transformation has been gradually incorporated into the planning and design. The transformation of the old city is a major concern in urban construction. Under the premise of ensuring the development of the old city and steady renewal, the transformation of the underground space of the old city has also become an important part. Combined with the characteristics of the above-mentioned projects, a brief summary is made below:

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

The technology of "one scene, two walls and three in one" plays a very important role in this project. In the process of construction, there are requirements for "two highs and one depth" for the project, that is, high quality, high precision and deep foundation pit, so there are some difficulties in the follow-up construction. According to the characteristics of the project and relevant experience, we should deal with different types of problems carefully and calmly during construction, which ensures the overall quality and successful construction of underground diaphragm wall. The "full reverse method" is also a good match with the technology of the integration of the two walls, which can not only ensure the quality of the project, but also make the project time-efficient by starting on the ground and underground at the same time.

Due to the extremely poor construction environment of the underground diaphragm wall, involving underground and underwater operations, there are many unfavorable factors. It is common that connectors can not be widely used, so anti-seepage is a very key link in this project. In the process of construction and technical understanding, the anti-leakage technology of the project is well demonstrated. Therefore, in the follow-up construction, the application research of the technology should be strengthened, such as the treatment of concrete interface, the rational use of waterproof materials, the strengthening treatment of the structure between underground diaphragm walls and so on.

The transformation of the old city under the premise of "combination of peacetime and wartime" as a new topic requires constant exploration, whether in the planning and layout of space, or in the technical techniques of architectural design. Only by renewing and innovating can we keep up with the times.

REFERENCES

[1] Yanjun Shen, Huan Zhang, Shengxiang Lei, et al. (2019) The characteristics and development concept of underground civil air defense engineering in China under the new situation. Chinese Journal of Underground Space and Engineering 15:1599-1608

[2] Qiaoyi He, Song Chen, Yan Wu (2018) Practical research on underground space planning conditions. Planners 34:41-45

[3] Lihua Wei, Jun Tang (2016) Exploration on the integrated development and utilization of urban underground space and civil air defense engineering. Planners 32:54-58

[4] Hanbin Wan. Study on the Development Strategy of Underground Space in Urban High-density areas. p. 170. Dissertation. Graduate degree in architecture. Tianjin University, 2013.

[5] Yonghu Wan (2019) Application analysis of deep foundation pit supporting construction technology in construction engineering. Urbanism and Architecture 16:164-165

Forest Chemicals Revew
www.forestchemicalsreview.com
ISSN: 1520-0191
July-August 2021 Page No. 1858-1875
Article History: Received: 12 May 2021 Revised: 25 June 2021 Accepted: 22 July 2021 Publication: 31 August 2021

[6] Songyan Li, Sen Liang, Wen Zhang, et al. (2019) Construction technology of rock socketed diaphragm wall for ultra-deep foundation pit adjacent to Metro. Construction Technology 48:90-93
[7] Libao Sun (2010) Discussion on some problems in the construction of ultra-deep diaphragm wall. Exploration Engineering (Rock & Soil Drilling and Tunneling) 37:51-55
[8] Hu Feng, Guobin Liu, Weili Zhang (2010) Deformation characteristics of diaphragm wall of ultra-deep foundation pit in Shanghai area. Chinese Journal of Underground Space and Engineering 6:151-156
[9] Mengjun Lu (2012) Application of two walls in one diaphragm wall supporting structure in engineering Zhejiang Construction 29:41-45
[10] Qiping Weng, Weidong Wang, Jianlong Zhou (2010) Design of "two walls in one" diaphragm wall for super deep circular foundation pit by top-down method. Journal of Building Structures 31:188-194