International Journal of Value Engineering (2024) Volume 1 Issue 1 ISSN: 0000-0000 (O)
doi: 0000-0000 (P)

RESEARCH ARTICLE

Study on construction management of large underground domestic waste transfer station

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ABSTRACT

In the current urban environmental operation system, domestic waste transfer stations, as indispensable transfer hubs in the collection, transportation and treatment of solid waste, are playing an increasingly important role. At the same time, with the gradual expansion of the scope of garbage collection and transportation, the increasing environmental requirements for sewage, odor, and noise, as well as the increasingly mature concept of building and environment coordination, and garden type base, large underground domestic garbage transfer stations are increasingly becoming the preferred optionfor engineering construction. Based on a project of an underground domestic waste transfer station in Hangzhou, this article analyzes the keypoints related to the construction and management of the transfer station in terms of its construction mode, process logistics, construction difficulties, operational efficiency, and stability maintenance work, with a view to providing reference and reference for the management and control of similar projects in the future.

Keywords: large; fully underground type; waste transfer station; engineering construction; engineering management

1. Introduction

With the continuous development of national economic income and the increasing living standards of residents, the corresponding amount of garbage generated in cities has also increased sharply. In order to alleviate the extreme phenomenon of "garbage surrounding the city", domestic garbage transfer stations have emerged, playing an indispensable role as transfer hubs in the solid waste collection, transportation and treatment process, and playing an increasingly important role in the current urban environmental operation system. At the same time, garbage transfer is often accompanied by serious phenomena such as sewage cross flow, odor diffusion, and noise disturbance, which have a certain degree of negative impact on the living environment of surrounding residents [1]. The resulting avoidance effect often leads to great obstacles and exceptional difficulties in the promotion and landing of garbage transfer station projects. Therefore, as the scope of garbage collection and transportation gradually increases, environmental requirements such as sewage, odor, and noise are increasing day by day, and the concept of building and environment complementing each other is becoming increasingly mature. Large all underground domestic waste transfer stations are becoming the preferred solution for engineering construction.

In engineering management, the early decision-making, process control, and quality management of construction projects play a crucial role in the smooth progress of the entire project. In the field of

ARTICLE INFO
Received: 20 January 2024 | Accepted: 9 March 2024 | Available online: 25 October 2024

CITATION
Yang HB. Study on construction management of large underground domestic waste transfer station. *International Journal of Value Engineering* 2024; 1(1): XXXX. doi: 10.59429/ear.v2i1.XXXX

environmental protection and solid waste municipal engineering, large-scale all underground transfer station projects have a series of problems such as high site selection requirements, large building volume, deeper foundation pit depth, higher construction difficulty, numerous process equipment, and complex coordination of construction and installation processes. The management of engineering construction is particularly important and is the leading force in determining the successful implementation and implementation of the project. This article is based on the construction mode, process logistics, construction difficulties, operational efficiency, and stability maintenance work of a fully underground domestic waste transfer station project in Hangzhou. It analyzes and elaborates on the relevant key points of its engineering construction management.

2. Project overview

A certain underground domestic waste transfer station project, as the first large-scale buried waste transfer station in China, has a domestic waste transfer scale of 600t/d. It adopts a vertical lifting (flat in and flat out) compression transfer process, and the construction content mainly includes an underground compression transfer workshop, an above ground supporting management room, a guard post, a ground scale, other supporting facilities, and green landscapes. The main functional layout of the compression transfer workshop includes unloading hall, compression packing area, transfer hall, ramp, central control room, deodorization equipment room, power distribution room, transfer vehicle parking area and container area, sewage collection pool, etc; The supporting management room is jointly built with the compression and transportation workshop, with the main functional layout including kitchen, restaurant, shower and changing room, environmental protection promotion exhibition hall, office, activity room, shift rest room, etc. The total land area of the project is 9431m^2, with a designed total construction area of 10602m^2, including an above ground construction area of 3500m^2 and an underground construction area of 7102m^2. The plot ratio of the project site is 0.37, the building density is 19.9%, the green space ratio is 20%, and the maximum building height is 13.5m. The excavation depth of the foundation pit is generally 11.850m, with a local depth of 19.05m. The total investment of the project is approximately 257 million, of which the engineering cost is 166 million. The actual scene of the completion of this project is shown in **Figure 1**.

Figure 1. Realistic view of project completion.

3. Engineering construction and design management

The engineering construction and design management of the transfer station project should be guided by the local environmental and health professional planning, adhere to the principle of sustainable development strategy, and based on research on domestic and foreign domestic waste transfer technologies, try to choose advanced and suitable treatment plans, achieve reasonable process, reliable operation, convenient management, environmental protection and energy conservation, and achieve the overall goal of reducing and resourceful domestic waste transfer. At the same time, taking into account the current situation of the project site selection and the surrounding area, following the relevant laws and regulations of the country on the transportation of household waste, ensuring that all indicators of the project comply with the relevant national standards and regulations. The following will discuss several key points of construction management in conjunction with this project.

3.1. Selection of construction mode

In today's engineering management, there are mainly two common construction modes, namely DBB mode (design bidding construction) and EPC mode (design procurement construction, also known as engineering general contracting). The DBB model is the most traditional engineering project management model. Its most prominent feature is to emphasize that the implementation of engineering projects must be carried out in the order of design, bidding, and construction. Only after one stage is completed can another stage begin. The advantage is strong universality, allowing for free selection of consulting, design, and supervision parties. All parties are familiar with the use of standard contract texts, which is conducive to contract management. The disadvantage is that engineering projects need to go through three stages of planning, design, and construction before being handed over to the owner, resulting in a long project cycle; The owner's management costs are relatively high, and the initial investment is large; Changes can easily lead to numerous claims. The EPC mode avoids the above shortcomings. The EPC contracting unit completes all work according to the owner's investment intentions and requirements, bears most of the risks such as design risks, natural force risks, and unforeseeable difficulties, while the owner can manage the project themselves or appoint the owner's representative, and participate in the project management work relatively less.

The construction of transfer stations belongs to large-scale municipal engineering projects, and civil construction and equipment installation (compression transfer, sewage, deodorization and other equipment) are the two core factors. They have the characteristics of strong professionalism, multiple process intersections, and large work coordination. Moreover, various equipment also vary significantly due to different manufacturers, reflected in the requirements for the size, force, and spatial position of civil structures[2]. There are many construction parties and equipment manufacturers, and without an effective leading party for overall planning, guidance and cooperation, it will inevitably bring certain difficulties to project management. Taking into account the above characteristics, this project has decided to adopt the EPC construction mode, with the design unit taking the lead and leveraging its leading advantages. The design, procurement, construction, and other work of the project will be entrusted to the general contractor, who will assume the role of the first responsible person on site and be responsible for the quality, safety, cost, and progress of the contracted project. This effectively avoids adverse phenomena such as multiple units shifting blame, arguing, and neglecting work.

3.2. Process plan design

In engineering construction, design work is the lifeline that runs through it. From the preliminary plan to feasibility study, preliminary design, construction drawing design, and finally to construction coordination and completion acceptance, the design stage is an important component of the entire engineering project, playing a decisive role in the quality of the project and directly related to the intrinsic value of the project and building quality[3]. Due to the fact that the domestic waste transfer station is essentially an environmentally sensitive building, the selection of its location plan needs to consider many comprehensive factors, including social environment, planning factors, logistics and transportation, and construction conditions. At the same time, as a municipal construction project dominated by the process profession, the process flow of compression transfer, sewage treatment, odor collection and treatment is closely related to subsequent production and operation. Therefore, the focus of its design management work is on the demonstration and selection of process plans, equipment parameter selection and control.

3.2.1. Site selection analysis

In the design phase of this project, starting from the perspective of technology, the architectural form and process characteristics are determined based on the external environmental conditions of the project. There are many sensitive environmental points around the site of this project, radiating from the center of the land red line to the surrounding areas. Within a 500m range, there are commercial centers, small and medium-sized enterprises, and factories, while within a 1000m range, there are many residential areas, residential areas, schools, etc. Therefore, in order to minimize the impact of noise, odors, and other issues on the surrounding environment and residents, it is considered to arrange the main workshop of the transfer station in an all underground building form to effectively control the escape and diffusion of odors in the workshop, and to minimize the noise impact generated during vehicle entry and compression processes. The location map of the proposed factory site and the range of sensitive environmental points in the surrounding area are shown in **Figures 2** and **3**.

Figure 2. Location map of the proposed factory site area.

Figure 3. Scope of environmental sensitive points around the proposed plant site.

3.2.2. Process demonstration

The land area of the project is only about 9434 square meters, and it is a relatively irregular triangular area, and the terrain fluctuates with elevation difference. Considering that the land area is limited and the shape is limited, and in combination with the existing mature compression transfer technology, it is proposed to adopt the vertical lifting (horizontal in and horizontal out) compression and rotation process, which is designed in the form of "overturning mechanism for lifting, pulling arm hook car for box pulling transfer", to ensure the progressiveness and feasibility of the process design to the greatest extent [4]: after the container is filled with garbage, the container is lifted from the vertical loading position to the horizontal state by the overturning lifting mechanism, and then the container is pulled to the vehicle chassis by the supporting arm hook on the transfer vehicle and placed horizontally. This process has the following major advantages: (1) The equipment occupies a small area, which can maximize the use of land area while ensuring compression efficiency; (2) Due to the direct discharge of garbage into containers, using containers as transfer units makes it easy to achieve the classification and transportation of various types of garbage; (3) Due to the concise process form, relatively simple equipment maintenance, and relatively low failure rate; (4) Due to the use of self gravity during the garbage unloading process, it can play a certain compression role and save the feeding process, resulting in relatively low energy consumption. The schematic diagram of the compression transfer process is shown in **Figure 4**.

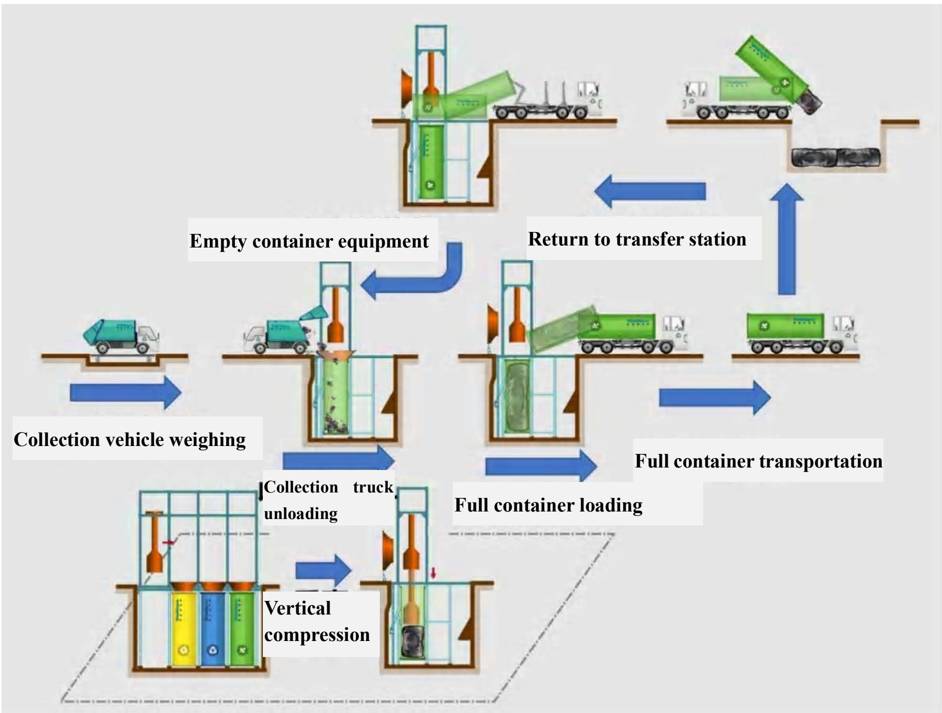

Figure 4. Compression transfer process flow chart.

In addition to the main compression transfer process, sewage treatment and ventilation deodorization are also auxiliary processes that need to be considered in this project. After scale and scheme demonstration, the sewage to be collected in this project includes: collection vehicle discharge water, workshop floor flushing water, vehicle flushing water, deodorization drainage, with a total water volume of about 105.05m^3/d. Taking into account the small amount of sewage generated by this project and the limited land area, the investment and operating costs of building small-scale sewage treatment facilities will be high. Therefore, the sewage generated by this project is stored in the sewage collection tank inside the plant and transported to the sewage treatment plant for treatment by a 30m^3 tank truck.

At the same time, according to the calculation of odor purification exhaust air volume, the processing air volume in the workshop of this project is relatively large, and the odor load in the odor removal area varies greatly. Therefore, taking into account the use of deodorization processes in similar projects and considering investment, cost, and effectiveness, the discharge hall and front end of the transfer hall in the compression transfer workshop of this project adopt an ion oxygen supply air+plant liquid atomization spray deodorization process. The discharge hall (including the discharge tank room), transfer hall, sewage collection tank, and the end of the underground transfer vehicle parking lot in the compression transfer workshop adopt a chemical washing+plant liquid washing+activated carbon adsorption deodorization process. To further improve the indoor space environment of the workshop, it is planned to install plant liquid atomization spray pre-treatment to assist in deodorization in the discharge chute, compression packing area, drainage area, and transfer vehicle parking area, further improving the air quality of the working environment in the workshop.

3.2.3. Logistics and transportation

Based on the current situation of the base, this project will arrange the supporting management room on the south side of the base, and open up the front land as much as possible to strive for the highest quality landscape. Set up entrances and exits for work vehicles and office personnel on the west side of the base. Near the entrance and exit for management personnel on the north side, ground level motor vehicle parking spaces are set up along the north side of the road, while logistics staff entrances and exits are set up on the south and west sides. Non motor vehicle parking spaces are also correspondingly set up on the south side of the building. This layout of the vehicle road area is the most economical and convenient for staff to use, while maximizing the guarantee of green space area. A spacious and simple green square is set up in front of the supporting management building, which effectively separates from the surrounding roads and fully displays the image of the park; On the southwest side of the plot, a backyard with a pedestrian walkway as the main feature is set up as a place for employees to relax and relax. The transportation and logistics organization diagram of this project is shown in **Figure 5**.

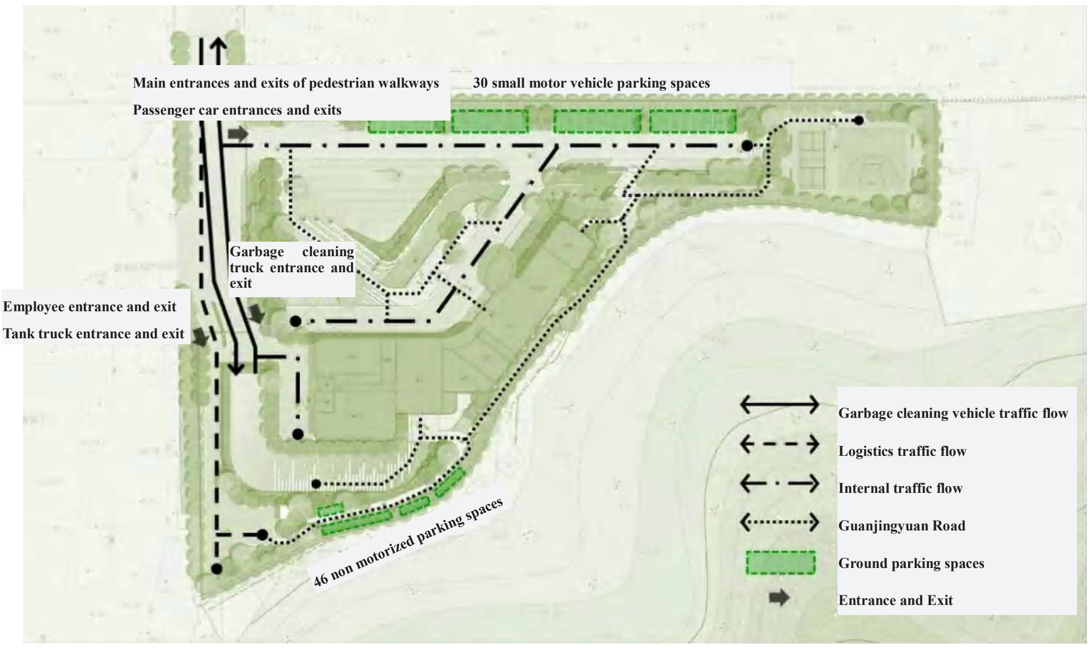

Figure 5. Schematic diagram of transportation and logistics organization at transfer stations.

Based on this design scheme, the transfer station not only serves as an environmental sanitation unit for garbage transfer, but also takes on the functions of ecological vegetation, landscape green space, and sightseeing and recreation. It cleverly integrates the building with the surrounding environment, creating a harmonious experience between the park, the city, and nature, meeting the principle of harmonious exterior construction, and thus creating a people-oriented green ecological and environmentally friendly factory[5].

4. Engineering construction and operation management

4.1. Promotion of stability maintenance work

As an environmentally sensitive project, the construction and landing process of domestic waste transfer stations often face significant obstacles. Although they can often bring general public benefits to the general public, they bring negative benefits and adverse effects to residents near the site. Therefore, they are often opposed and strongly resisted by surrounding residents, which in turn triggers consistent social conflicts[6]. This kind of neighbor avoidance effect often has strong mutual influence and rapid transmission, so timely arrangement and promotion of stability maintenance work are necessary and urgent.

In the early stages of this project, after the site selection is determined, the stability maintenance work will be quickly launched. A working group will be established in the local planning department, and online (online messages, telephone consultations, email contacts, etc.) and offline (on-site visits, paper messages, opinion inquiries, etc.) channels will provide platforms for residents to speak out. And please have engineering designers personally on-site to provide real-time science popularization and education to residents, making them aware that the construction of domestic waste transfer stations is actually a municipal engineering project that serves people's livelihood, and it is necessary to view the interaction effect between them and the living environment from a long-term development perspective. And a special emphasis is placed on the introduction of the all underground construction form, highlighting its significant advantages in odor and noise control, combined with the concept of a “garden style base” that showcases both functionality and landscape through renderings. At the same time, the operation monitoring data of other existing projects will be publicly disclosed, including the treatment and emission standards for sewage and odor indicators, the range of factory boundary noise fluctuations, the maintenance methods of facilities, relevant benefits and costs, etc., in order to dispel public concerns and truly reassure residents about the construction quality of the project through the use of data. Therefore, facing difficulties instead of avoiding them, being open and transparent instead of concealing the truth, guiding values instead of controlling public opinion are the core concepts for promoting stability maintenance work, in order to safeguard the completion of the project.

4.2. Construction difficulties

The main difficulty in the construction of this project lies in the foundation pit construction, with a general excavation depth of 11.850m and a local depth of 19.05m. The east and south sides of the foundation pit are adjacent to the mountain, and the north side is adjacent to the river. The excavation depth of the foundation pit is relatively deep, the surrounding environment is complex, and the safety level is level one. Therefore, high requirements are put forward for the construction of foundation pit enclosure. In accordance with the principles of safety, economy, rationality, and feasibility, the foundation pit support form of this project adopts Ø1000 rotary excavation cast-in-place pile+a reinforced concrete support. In areas with muddy soil layers, three-axis cement mixing piles are used as waterproof curtains. Based on the soil conditions, considering the construction period and economy, a combination of Ø800 rotary excavation pile cantilever support and soil nail support is adopted for local deep pits.

During the excavation process of the foundation pit, all parties involved in the construction closely cooperate to ensure the safety of the foundation pit. For example, at the end of December 2020, when the excavation of the large bottom plate was completed and the pit in the pit was ready for excavation, according to design analysis, this working condition was considered the most unfavorable in the foundation pit engineering of this project. In order to accelerate the construction progress and ensure project safety, close communication was held among all parties involved in the construction, and a special meeting was organized to analyze the monitoring data of the foundation pit. Different areas were divided based on the construction joints of the bottom plate, and pouring was carried out in different zones and times according to the different transmission characteristics. Temporary support was added in key areas, successfully forming a complete bottom plate transmission system before the Spring Festival, ensuring the safety of the foundation pit.

The entire process of foundation pit construction in this project is also synchronized with information technology construction, and dynamic management is implemented based on project schedule requirements, special geological conditions, and changes in foundation pit monitoring data. Based on information technology monitoring data, all parties should closely communicate, comprehensively analyze and judge, and take measures such as adjusting working conditions, zoning, local strengthening, and local optimization.

The final analysis of the monitoring data of the entire construction process of the foundation pit showed that there were no safety alarms for the foundation pit. The cumulative maximum soil displacement of 41.34mm in all monitoring points was far less than the design alarm value of 60mm. The safety of the foundation pit was effectively guaranteed, and the surrounding environment was also effectively protected.

4.3. Operational efficiency analysis

This project has entered the actual production and operation stage. According to on-site debugging feedback, the compressed transfer data shows that the single garbage loading capacity of the transfer vehicle is stable at 13.50-15.74t, which basically fluctuates normally within the rated loading range of the garbage box. Based on the effective volume of the garbage box of 24m^3, the compressed domestic garbage density value can be obtained to be 0.56-0.66t/m^3, which can basically meet the contract index of 0.57t/m^3. During this period, the average amount of garbage feed remained stable at 565.50t/d, meeting the contract index of 480t/d, and the average amount of garbage transfer remained stable at 562.53t/d. Based on the ratio of garbage transfer to garbage feed, it can be seen that the daily garbage in the station can basically achieve the goal of “daily feeding and daily cleaning”, and the operating efficiency can meet the design requirements.

At the same time, through third-party testing, the data of unorganized exhaust gas detection in various wind directions at different time periods within the factory boundary showed that the average concentration of ammonia was 0.04mg/m^3, the average concentration of hydrogen sulfide was 0.0126mg/m^3, and the average concentration of odor was 12.5. From this data, it can be seen that all odor pollutants can meet the requirements of the organized emission standard values (exhaust pipe height of 15m) in the “Emission Standards for Odor Pollutants (Draft for Comments)” (GB14554-201X, final version shall prevail). According to the noise detection data at the factory boundary, the average noise generated around the factory boundary during each time period is below the standard limit. Therefore, the operation quality of the equipment in this project is qualified, and the odor and noise pollution can be controlled within a reasonable range, meeting the regulatory limit requirements.

5. Conclusion

With the development of urban sanitation and the improvement of living quality, the domestic waste transfer station closely connects the entire process of urban solid waste operation, forming a transfer hub between the front-end collection system and the back-end disposal system. Through garbage compaction and vehicle replacement, it greatly saves transportation vehicles and costs [7-8]. At the same time, in line with the mainstream trend of integrating landscape and architecture engineering solutions, and synchronously responding to the requirements of efficient control of sewage, odor, noise and other factors, large-scale all underground domestic waste transfer station projects will increasingly stand out in the field of solid waste municipal engineering. Relevant operators should base themselves on the characteristics of local urban construction, starting from factors such as construction mode, process logistics, construction difficulties, operation efficiency, and stability maintenance, and reasonably control the details of engineering construction management from a technical and economic perspective, setting a model for “ecological” transfer station projects, and playing a leading and demonstrative role in the construction of all underground transfer stations in China.

References

1. Liu Yajiang, Hua Hongliang. Research on the Underground Design of Small and Medium sized Garbage Transfer Stations [C]//China Metallurgical Construction Research Institute Co., Ltd. Paper Collection of the 2020 Industrial Architecture Academic Exchange Conference (Volume 1) [Publisher unknown], 2020:18-22, 17
2. Han Feng. Whole process construction and process mode selection of urban waste transfer stations [J]. China Residential Facilities, 2021 (09): 130-131
3. Li Yi. Dimensions, Dimensions, and Matrices of Architectural Design Management [J]. China Survey and Design, 2022 (12): 39-41
4. Ding Changwei. Reflections on the Engineering Construction and Management of Urban Garbage Transfer Stations [J]. Doors and Windows, 2021 (13): 157-158
5. Zhu Songtao. Research on the Construction and Construction Management of Urban Garbage Transfer Stations [J]. Shandong Industrial Technology, 2018 (10): 142
6. Ye Yan. Research on Conflict Management in Urban Neighborhood Avoidance [D]. Southwest Jiaotong University, 2019
7. Xie Wei. Discussion on the Construction and Management of Small Domestic Waste Transfer Stations in Urban Areas [J]. Jiangxi Building Materials, 2020 (03): 133-134
8. Peng Jia. Construction and Process Model Selection of Large Garbage Transfer Stations in Typical Cities [J]. Environmental Sanitation Engineering, 2020, 28 (06): 22-27, 35