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Thoughts on the Design of Water Supply and Drainage of Infection Building——Taking the Infection Building of Xishan District People's Hospital as an Example

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Abstract. The outbreak of COVID-19 in 2020 has swept the world, bringing a huge impact on society and the economy, and at the same time exposing some inadequacies of public health facilities. Combining some key points and solutions of the water supply and drainage design of the new infection building of the People's Hospital of Xishan District, Wuxi City, this paper provides some references and ideas for the water supply and drainage design of similar buildings in the future.

Keywords: Coal based modified asphalt; Asphalt pavement; High temperature stability; Ruts; Rolling depth.

1. Introduction

The sudden outbreak of the epidemic has caught people all over the country by surprise. The normalized epidemic prevention and control of medical institutions has become one of the priorities of medical work in the future. Under this circumstance, only by deeply understanding the medical process of the infected building, the treatment needs of infectious patients and the work needs of medical staff can we make a safe and efficient building to meet the actual work needs of the infected building[1,2,4]. Taking the newly built infection building of Xishan District People's Hospital as an example, this paper discusses the points of attention for the water supply and drainage design of the infection building.

2. Specification Requirements and Design Points

The relevant specifications for the design of water supply and drainage in the infection building include the "Technical Guidelines for the Construction of Convertible Wards of General Hospitals "Combined with Epidemic Prevention" (Trial)" National Health Office Planning Letter [2020] No. 663, " The Design Standard of Infectious DiseaseEmergency Medical Facilities for Novel Coronavirus (2019-nCoV)Infected Pneumonia" T/CECS 661-2020, " Code for design of infectious diseases hospital" GB50849-2014, " Discharge standard of water pollutants for medical organization" (GB18466-2005) and " Code for design of general hospital" GB51039-2014, etc., It includes relevant specifications compiled before and after the outbreak of the epidemic. In the practice of water supply and drainage design, careful study and targeted design are required. The water supply and drainage design of infected buildings should pay attention to the following points:

1) Water supply system: According to the architectural design layout, the water supply system is divided into clean area and polluted area (some infected buildings have semi-polluted areas), The cleaning area can be directly supplied by the water supply pipe, The water supply in the polluted area (semi-polluted area) needs to be equipped with anti-backflow pollution measures. The national standard specification stipulates: The national standard specification stipulates: The domestic water supply system should be supplied by the water supply method of the cut-off water tank, and the water supply system should adopt the water supply system of the cut-off water tank and the water pump[9].

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2) Drinking water pipelines should avoid polluted areas, and protective measures should be taken when conditions cannot be avoided.
3) Drainage system: The sewage in infectious disease hospitals should be discharged separately from sewage in non-ward areas. When existing infectious disease hospitals are rebuilt or expanded, sewage should be collected separately from other sewage. For respiratory fever fever (emergency) clinics, separate toilets should be set up. Drain pipes and ventilation pipes should not be connected to pipes in other areas, and the drainage pipes should be discharged separately. Special washing facilities should be set up in the bacteria and virus inspection department, which should be discharged into the outdoor drainage pipe network after disinfection and sterilization, and enter the hospital sewage treatment station. The national standard specification stipulates: The emergency medical outdoor sewage drainage system should be connected with pipes without inspection wells, and the distance between the ventilation pipes should not be greater than 50m. The spacing of the cleaning openings should comply with the relevant provisions of the current national standard. The outlet of the ventilation pipe of the drainage system in the isolation area should be equipped with a high-efficiency filter for filtration or disinfection.[9,13]

3. Project Overview

The newly built infection building is located on the west side of the People's Hospital of Xishan District, Wuxi City, with a construction area of about 3,200 square meters (three floors), a building height of 14.5m, and a designed bed of 54 (which also treats patients with new coronary pneumonia). The hospital clearly proposes to meet the latest relevant specifications of the infectious building, and design it according to the requirements of the prevention and control of the new crown. At the same time, basic requirements such as combination of epidemic control, rational streamline, and humanization are also put forward[3].

The data of the existing water supply, drainage, fire hydrant water supply and sprinkler water supply system in the hospital provided by the hospital can meet the design requirements, and there is no need to add a living pump room and a fire pump room.

3.1 Overview of single water supply and drainage design

The design content of the single unit mainly includes: domestic water supply system, domestic sewage system, waste water system, roof rainwater (drainage) system, fire hydrant water supply system, automatic sprinkler system, building fire extinguisher configuration, gas fire extinguishing system, etc.

Calculation of water consumption for water supply shall take the value according to the water use standard in the relevant specifications [6], and the number of hospital beds, staff and outpatients shall be confirmed by the hospital. The domestic water consumption of this project is calculated in the following table, the maximum daily water consumption is 29.43m3/d, and the maximum hourly water consumption is 4.35m3/h.

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Table 1. Three Scheme comparing water consumption calculation

water parts	water standard	unit	quantity	water time	coefficient of variation	Water consumption (m3)	
						maximum day	maximum time
Inpatient beds	300	L/(bed*d)	54	24	2	16.2	1.35
medical staff	200	L/(CL*P)	40	8	2	8	2
Outpatient and emergency patients	25	L/(P*d)	30	12	2.5	0.75	0.156
logistics staff	100	L/(P*d)	20	8	2	2	0.5
greening	2	L/(m2*d)	250	4	1	0.5	0.125
road sprinkleroad sprinkle	2	L/(m2*d)	250	4	1	0.5	0.125
Unforeseen water use	10% of the above items in this table					2.8	0.43
total						30.75	4.68

Water supply system zoning: Clean area: the first and second floors are directly supplied by the municipal pipe network (pressure 0.20Mpa), and the third floor is supplied by the existing pipe network in the hospital with low pressure to supply water to the area. Contaminated area and semi-contaminated area: The first to third floors are all supplied by pressure from the roof cut-off water tank. The water supply area is divided into clean area, polluted area, semi-polluted area, and municipal direct supply and pressurized water supply[5]. Decompression, the set value of branch pipe water supply pressure is 0.18Mpa). The pressurized domestic water needs to be supplied after disinfection (in compliance with the requirements of the current national standard)[14], and the domestic water tank is equipped with a disinfection device. Contaminated areas and semi-contaminated areas use a water supply system with cut-off water tank and variable frequency pump set, which conforms to the relevant regulations[9]. Relevant regulations stipulate that the water points in the following places should adopt non-contact or non-manual switches to prevent sewage from splashing: a)wash basins, urinals and toilets in public toilets; b)wash basins in rooms such as nurse stations, treatment rooms, consultation rooms and laboratory departments; c)other sanitary utensils that have sterility requirements or need to prevent nosocomial infection[6].

The drainage system should pay attention that the pipeline should not cross the partition. In order to avoid cross-infection during outpatient visits for intestinal, hepatitis, respiratory tract, etc., the building is divided into different clinics, and waiting rooms and clinics are set up by departments. There is a respiratory fever clinic on the first floor of the unit, and a separate toilet should be set up in this area. Drain pipes and ventilation pipes should not be connected with pipes in other areas, and the drainage pipes should be discharged separately[6]. All extended roof ventilation pipes are 2.0m higher than the frequent access roof, and 0.6m higher than the non-recurrent access roof. Roof vent pipes and side wall vent pipes in polluted and semi-polluted areas, The outlet section should be equipped with high-efficiency filters, which should be cleaned and maintained regularly[9]. When the horizontal drainage pipes of public toilets exceed 10.0 meters or there are more than 3 toilets, annular ventilation pipes should be used, which is different from Article 4.7.3 of "Design Standards for Water Supply and Drainage of Buildings" GB50015-2019, and needs to be paid attention to..

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Wards, outpatient emergency hand washing areas, shower rooms, wash basins, etc. are hot water supply areas, which are supplied by a centralized hot water system. There is an existing centralized hot water system in the hospital area. Its heat source is solar energy + saturated steam provided by the municipal thermal power plant, and the backup heat source is a gas boiler. Therefore, the hot water in this project is no longer prepared by itself. Partitioning of the hot water system: The hot water in the clean area directly uses the hot water introduced by the first-stage hot water pipe network. Partitioning of the hot water system: The hot water in the clean area directly uses the hot water introduced by the first-stage hot water pipe network. The first-stage hot water is injected into an independent hot water tank as a hot water source for polluted and semi-polluted areas. Considering that this project has the needs of treating people infected with the new coronavirus, there are relatively higher requirements for hot water protection. In addition to using the first-phase hot water pipe network as the hot water source, the hot water tank is equipped with electric auxiliary heating as a backup. The hot water for surgical hand brushing is supplied by special equipment, and the power socket is reserved nearby, and the equipment must be equipped with devices to ensure safe use.

The quota of hot water consumption shall be valued in accordance with relevant specifications. The design hourly hot water volume is 1.80m^3/h; the design hourly heat consumption is 116.77kW/h.

The rainwater system of the infected building is internal drainage without special design requirements. Taking into account the minimum width of the patient aisle in the specification, and at the same time, there is no margin in the architectural design and the humanization consideration for the convenience of patients, the fire hydrants in the patient aisle in the fire hydrant system are concealed. There are no special design requirements for the configuration of building fire extinguishers. The monomer is considered according to the serious hazard level of Class A fire. The level of a single fire extinguisher is 3A, and the fire extinguishing agent ammonium phosphate is 5kg. The electrical room is considered for Class E fires. The level of the single fire extinguisher is the same as that of the unit where it is located, and the fire extinguishing agent is ammonium phosphate. Heptafluoropropane gas fire extinguishing system is installed in the room for valuable equipment (CT, etc.). Except for electrical rooms, operating rooms, blood wards, equipment rooms for invasive examinations, and other places that are not suitable for fire fighting with water, as well as areas where other forms of automatic fire extinguishing systems have been adopted, automatic sprinkler systems are installed and wet systems are used.

3.2 General floor plan design overview

The water supply and drainage design of the general plan mainly includes the outdoor water supply and drainage and fire-fighting water supply system of the infected building.

The water source makes full use of the original domestic water pipe network of the hospital. According to the information provided by the owner, the original domestic water pipe network meets the municipal two-way water supply, and the municipal water pressure is 0.20Mpa. It is planned to connect a DN65 water supply pipe from the municipal water supply pipe network in the hospital area and the domestic pressurized pipe network in the low area to supply domestic water. The domestic water supply introduction pipe is equipped with a water meter for measurement, and a backflow preventer (with an air partition) is installed behind the water meter.

Outdoor buried sewage and waste water pipes are made of PE pipes and connected by hot melt. Rainwater pipe adopts reinforced polypropylene (FRPP) double-wall reinforced corrugated pipe, ring stiffness $\geqslant$ 8kN/m^2, flared socket connection, "T" type rubber ring seal. The pipeline connection without inspection well specified in the specification shall be adopted, and the setting of the ventilation pipe and the cleaning port shall meet the requirements of the specification.Considering that the hospital requires that no pipes can be laid on the outer wall of the monomer, the ventilation pipe is moved to a suitable position in the monomer and connected to the roof for ventilation (with a high-efficiency filter). If the wastewater from the infected building is

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treated only by the existing sewage treatment station in the hospital, it does not meet the municipal sewage discharge standards. Therefore, the wastewater from the infected building should be pretreated (disinfection tank + septic tank) before being discharged to the sewage treatment station[7]. The wastewater treatment of the infected building shall comply with relevant regulations[6,7,8].

The infection building is within the protection scope of the first-phase outdoor fire hydrant, and there is no need to add an outdoor fire hydrant. Each single building shall share a set of indoor fire-fighting system, and a temporary high-pressure fire-fighting water supply system shall be adopted. Each single building shall share a set of indoor fire-fighting system, and a temporary high-pressure fire-fighting water supply system shall be adopted. The water pump adapter configured in the original phase 1 meets the needs of this project. The water for outdoor greening is supplied by the reclaimed water system, and the first phase has been considered uniformly.

4. Conclusion

During the fight against the epidemic, primary medical facilities have played an indispensable role. Humanized and standardized water supply and drainage design, and the implementation of the specification requirements into the actual construction drawing design is conducive to improving the hardware level of medical units. Considering the water supply and drainage design of the infected building, the following points should be paid attention to:

1) Timely update the relevant design specifications, the construction drawing design should meet the design requirements of the latest specifications, and the monomers with special requirements should also meet the corresponding specifications (the infected building has the needs to receive people infected with the new coronavirus. Therefore, it should meet The Design Standard of Infectious DiseaseEmergency Medical Facilities for Novel Coronavirus (2019-nCoV)Infected Pneumonia (T/CECS 661-2020);
2) Make full use of the existing water supply and drainage facilities to reduce engineering costs while meeting the design requirements;
3) Communicate with the owner in a timely manner, and fully consider the owner's demands on the premise of meeting the design specifications;
4) The design of construction drawings should also consider humanization while pursuing standardization. After all, the building needs to be used by people. It is hoped that in the future water supply and drainage design, we will continue to optimize and make more standardized and humanized building water supply and drainage construction drawings.

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