Journal of Architecture and Urban Studies

Vol 1(2), 2024, 1-9
Accepted: June 17, 2024
Approved: June 24, 2024
Published: July 1, 2024

Sanitation, Drainage, and Plumbing System Utilities in Gedung Kuliah Bersama 2 (GKB 2) Universitas Muhammadiyah Semarang

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Abstract. In constructing high-rise buildings such as Gedung Kuliah Bersama 2 Universitas Muhammadiyah Semarang, the right planning and design stages are very important requirements in the process. The utility system of a building is a series of complementary things that must be planned from the beginning before the building operates. Utility systems are part of a building's success in meeting or accommodating the needs of its users. Utilities learn a lot about the effectiveness of space division in-room programming, access, property details, and other things that support the function of a building. This research is based on a field survey that focuses on the type of sanitation, drainage, and piping system (SDP) in building utilities. This study aims to analyze the performance of buildings in high-rise buildings in the education sector, namely the Gedung Kuliah Bersama 2. The utility system in the Gedung Kuliah Bersama 2 has met SNI (Indonesian National Standard) standards with a fully used connected system along with the distribution of power and capacity in the area within the building which is supported by modern and sophisticated equipment to be more effective and efficient in supporting building performance.

Keywords: sanitation; drainage; plumbing; utility

1. Introduction

Building utility systems are completeness in buildings that function as comfort, safety, and communication. Planning pipe joints and pipe components is a basic competency used as research material [1]. In addition, the architectural expression that is displayed in the functional process of a design processing process is carried out through structural elements and building utilities that show aesthetic value as a form of design that has opposite properties but still has an inevitable relationship [2]. As a means of supporting achieving the elements of comfort, health, safety, and mobility, the building utility system is also something that must be considered in the building design stage, especially in multi-story buildings [3].

The utility system consists of several such as plumbing (clean water, dirty water), lighting, ventilation, communication, transportation, fire prevention, and lightning rods. This time it will be discussed related to sanitation, drainage, and piping (SDP) in the building utility system. Sanitation, drainage, and piping systems (SDP) are always related to the installation of pipelines and the distribution of clean water, wastewater, or used water [4]. However, safety and comfort can be created according to the needs of its users through the installation of the right SDP system in a building that meets the criteria [5].

The distribution of clean water with the right pressure in the right place according to the standards will create a hygienic and healthy environment in a building [6]. Given the importance of the availability of clean water in a building, it is necessary to re-analyze the existing condition of the SDP system design installation in Gedung Kuliah Bersama 2 Universitas Muhammadiyah Semarang.

The standard SDP installation system for high-rise buildings or high-rise buildings is regulated through the Government Regulation of the Republic of Indonesia through Law of the Republic of Indonesia Number 28 of 2002 which contains standards for the availability and supply of clean water, aspects of treatment and management of used water as well as wastewater, rainwater and wastewater, in addition to the aspect of ease of operation and maintenance of the entire SDP system in the building [7].

Seeing the current condition of water treatment management is not running well, it is necessary to conduct an analysis and review of the SDP installation system to ensure whether the current system is in accordance with the Indonesian National Standard (SNI) which is used as the basis for data and guidelines for the design of the building utility system.

2. Methods

This research is carried out by the Qualitative Method, namely by making systematic and direct observations of the object and its supporting data sourced from technical and operational sources at the research site [8]. The data that has been obtained is then further processed through documentation and related literature studies (laws and regulations, scientific books, or academic sources) and the analysis process so that the desired results are obtained as shown in the following process chart:

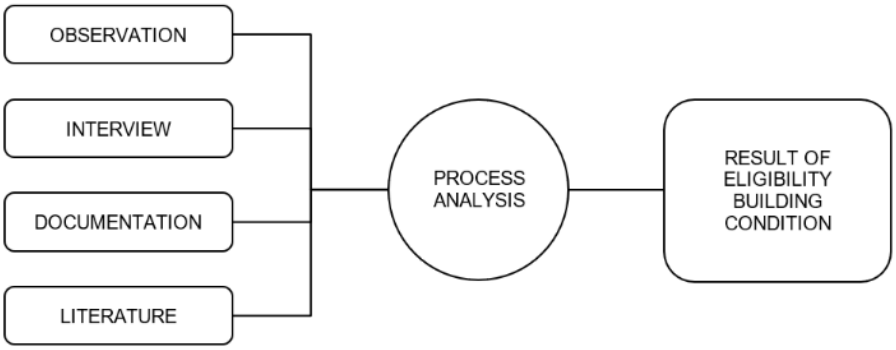

Figure 1. Research Method Process Diagram

3. Analysis and Results

3.1. Building Information

Gedung Kuliah Bersama 2 is in the Universitas Muhammadiyah Semarang on Jalan Kedungmundu Number 18, Kedungmundu Village, Tembalang District, Semarang City, Central Java which is strategically located in the eastern part of Semarang City. This building is a modern educational facility that is the center of academic activities for the Faculty of Engineering and Computer Science, the Faculty of Agricultural Science and Technology, and the Faculty of Education and Humanities.

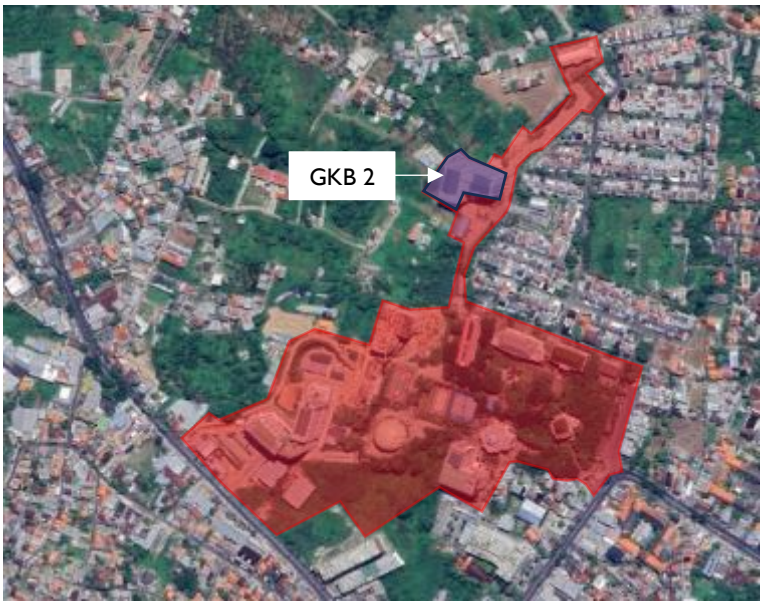

Figure 2. Location of GKB 2 in the Unimus Area

Figure 3. GKB 2 Building

This building consists of eight floors in the form of an "L" type basic corner plan which divides the plan into 2 parts, namely Zone A and Zone B. The picture below is a building plan consisting of lecture room areas and is equipped with 4 toilet rooms on each floor.

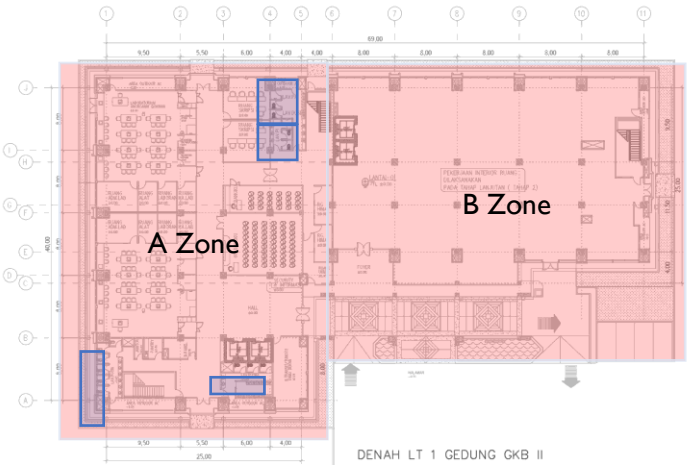

Figure 5. Existing Building Plan - First Floor

3.2. Water Distribution

3.2.1. Clean Water

Clean water is vital in life because of its very important function. Because of its vital role for humans, clean water must always be available to meet and sustain life [9]. The availability of clean water is a need that can be obtained from various sources according to the conditions of the place [10]. Raw water sources are water that comes from surface water, rainwater, and others that must meet the quality standards of drinking water [11]. To meet the need for clean water in a building, it is necessary to have a strong relationship between the water availability system and a good distribution system.

Planning a clean water distribution system in a building is useful to serve the water needs of all parts that need it with sufficient discharge and pressure [12]. Based on field surveys, the main source of clean water for this building only comes from PDAM which is owned by the government. No other sources were found such as deep groundwater installations. Thus, the water will go directly into the groundwater tank with a capacity of 183 m^3 as the main reservoir and then be pumped to the rooftop water tank with a capacity of 20 m^3 for daily use.

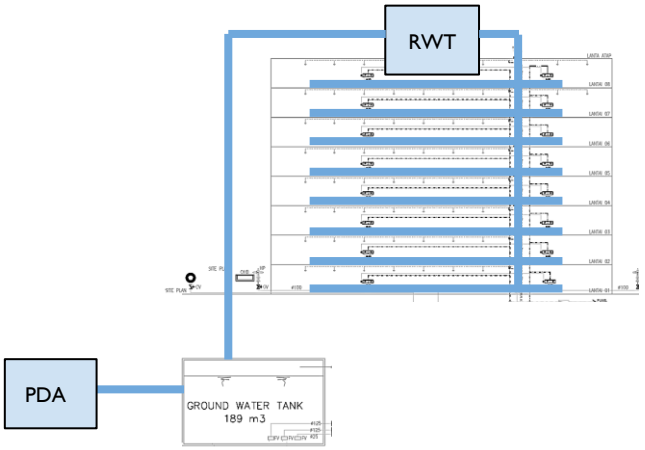

Figure 6. Building Clean Water Distribution Diagram

3.2.2. Grey Water and Wastewater

Domestic wastewater known as urban wastewater is wastewater discharged from residential, commercial, and institutional homes in a city or small urban area, which is collected through a sewer system. Often, liquid waste from small industries can also enter sanitary sewers along with domestic wastewater. The composition of this domestic wastewater varies depending on its origin and can contain different types of microorganisms, especially bacteria [13].

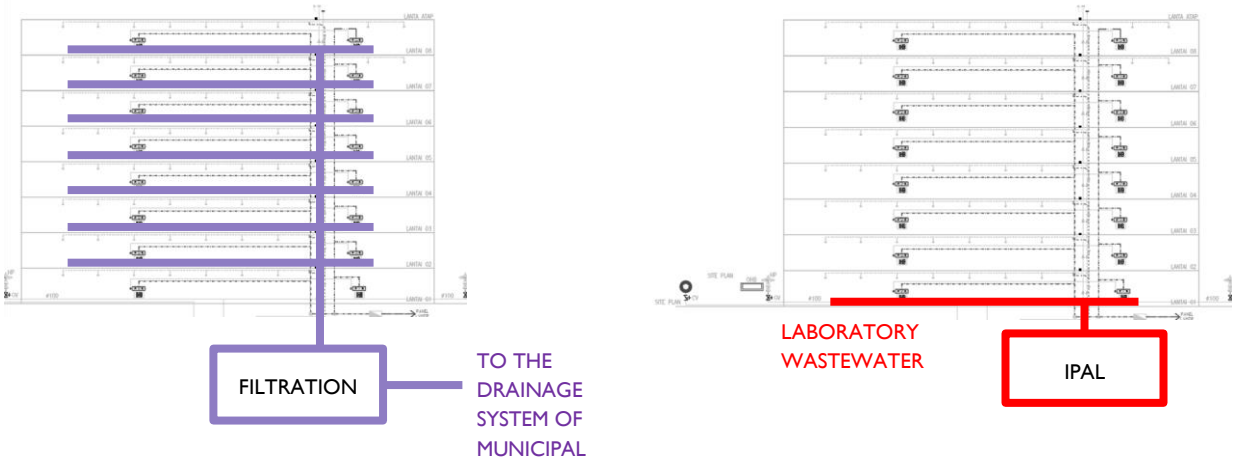

Figure 7. Distribution Diagram of Grey Water and Building Wastewater

This building has its own system for managing wastewater and wastewater. Daily wastewater is centralized, collected, and treated in an STP Tank (Sewage Treatment Plan) with a capacity of 20 m^3, while wastewater from the laboratory room is collected and treated in a 5 m^3 WWTP Tank (Wastewater Treatment Plant) and does not use a conventional system such as a septic tank. This management system is carried out so that wastewater and wastewater management can be more efficient and safer.

3.3. SDP System and Installation Management

3.3.1. Clean Water System and Management

The clean water system and management in this building comes from the Regional Water Company which is then stored in a storage tank with the help of a transfer pump. The tank is placed according to the existing height to create a water pressure that is sufficient to distribute water throughout the room. The water in the tank is distributed to every room in need through existing pipes. The clean water flows from high areas to low areas with the help of a gravity system.

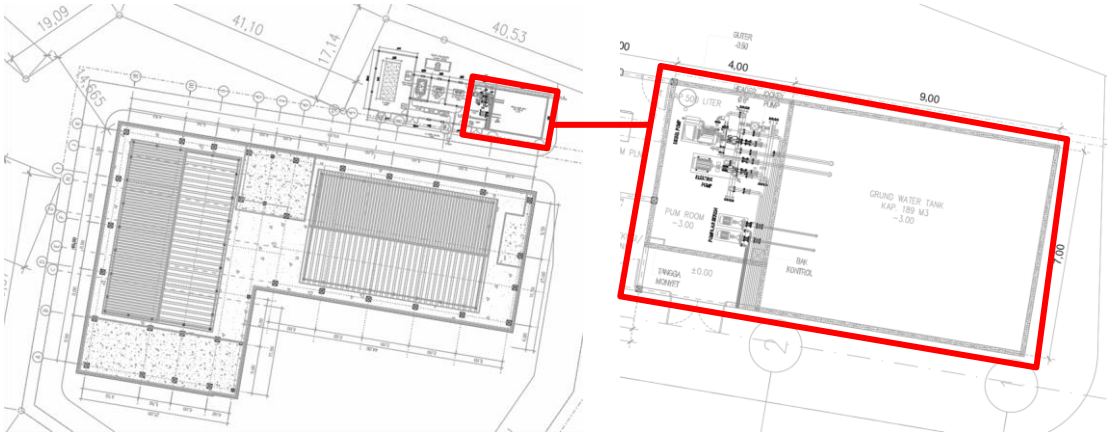

Figure 8. Central Water Management Development

After conducting a thorough investigation and observation on each floor of the building along with an inspection of the measurement of technical specifications, especially on the entire piping installation, the specifications in the installation were matched with the design of the building that used the Riser Pipe for clean water PPR PN 10 Ø2 to distribute clean water to all floors in the building.

Figure 9. Clean Water Installation System at GKB 2

Table 1. Observation Results of Clean Water Stations

Implementation	SNI Evaluation Results (SNI 8153-2015)
4	4

3.3.2. Wastewater and Grey Water Systems and Management

In the planning of the wastewater disposal system, wastewater distribution must be carried out with a good system and by standards so that it does not pose a danger to the health of building residents or the danger of environmental pollution [14]. Planning the correct pipe connection and pipe slope in the wastewater disposal system can facilitate the distribution of impurities, both liquid and solid.

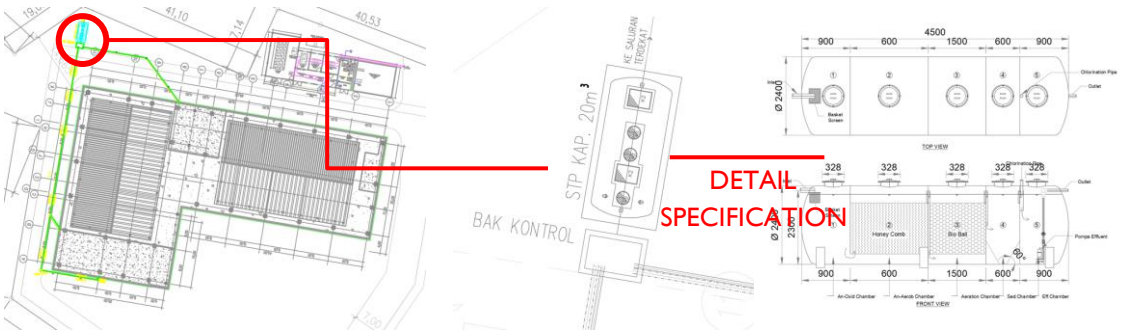

Figure 10. Wastewater and Dirty Water Installation Plan

Based on the results of measurement inspections in the field, the pipes used to accommodate wastewater and ash to the IPAL are in accordance with SNI standards.

Table 2. Observation of Wastewater Management System

Implementation	SNI Evaluation Results (SNI 8153-2015)
(dirty water) 10 & 4	4
(urinal) 8	4

The results are also similar to the specifications of pipes used to hold wastewater from laboratory rooms.

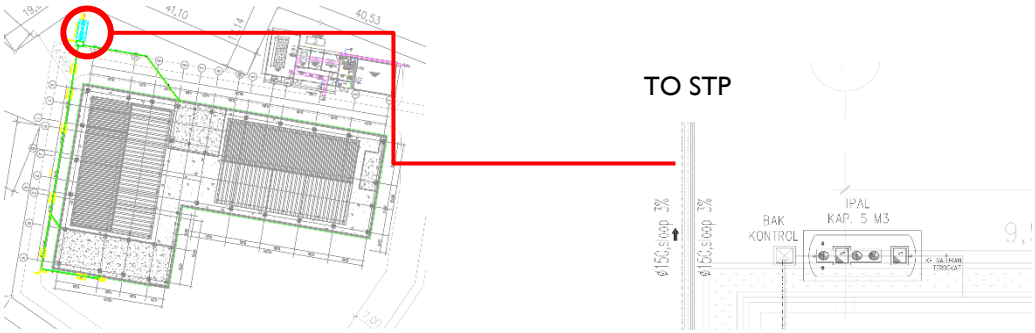

Figure 11. Existing Wastewater Installation Plan for Laboratory Use (on 1st Floor only)

3.3.3. Rainwater Management

Rainwater treatment is one of the efforts that can be made to reduce excessive rainfall runoff and can be a water reserve during the dry season. Efforts to manage rainwater that falls on buildings need to be carried out so that it can be used and accommodated as much as possible in infiltration [15]. The pipes to collect rainwater also use the same standard specifications, namely the type of pipe with a diameter of 4". The installation of pipes is carried out to collect rainwater from the upper floors and then flow to the bottom of the building.

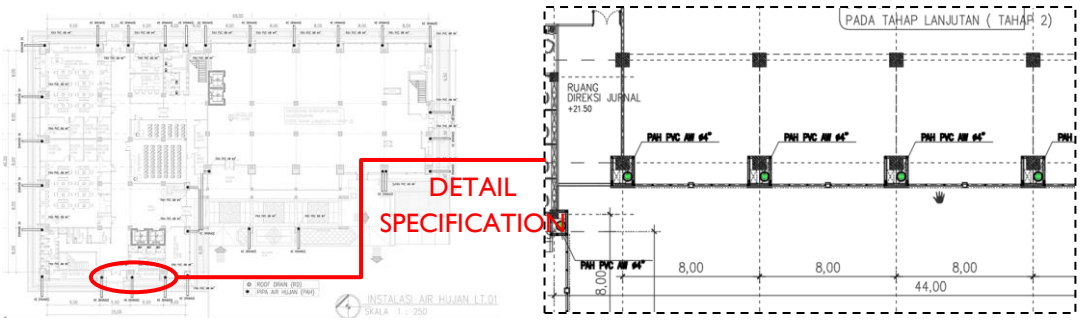

Figure 12. Rainwater Installation Plan on the 1st Floor

4. Conclusion

The overall SDP installation system in GKB 2 in the Universitas Muhammadiyah Semarang area has met the standard of technical specifications according to SNI 8153-2015 which is not only for the installation of clean water systems but also the installation of wastewater and wastewater systems. This is evidenced by the distribution and circulation in all piping installations running well without any problems found in the last 6 months, including circulation to collect rainwater and drain it to the university's drainage channel and then connect to the city's main drainage system.

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