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Cold Water System Design In Low-Rise Office Building Using Revit

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Abstract: A study about a software development for cold-water system specially for low rise building has been aim for this research work. Most of cold-water system provide water throughout the building, the purpose of which is to provide enough water for the living inside especially during the peak hour. There are two basic systems of cold-water system used in domestic dwelling which are direct cold-water system and indirect water system. Referring to Uniform Building by Laws (UBBL) and Commission of Malaysian Water Services (SPAN) as standard requirement for Malaysia is one of the references to explain and predict new building model. Building Information Modelling (BIM) Autodesk Revit created this software. This software is a database type that is used in the simulation of a new building. As a result, the creation of new buildings equipped with cold water systems that meet authorities' standards has been explored.

Keywords: Cold-Water System, BIM Autodesk Revit, Low Rise Office Building

1. Introduction

This chapter deals with the simple and general analysis of the cold-water system. This case study that will conducted is a low-rise office building. The knowledge alluded to is related to a case study of how the cold-water system is accessible and delivered across the whole building.

In Malaysia, Jabatan Bekalan Air (JBA) distributes water throughout the country and receives water to private companies in each province. For Johor, the private company that obtained water supplies from JBA is Syarikat Air Johor Sdn. Bhd. (SAJ). SAJ then distributes the water to the entire of Johor, which has been collected and handled prior to delivery. Aeration, coagulation, flocculation, sedimentation, filtration, disinfection and conditioning process is used to manage runoff and river flow to the water treatment facility. Then from the utility tanks, the water supply to the office building.

1.1 Objective

The objectives of this study are:

1. To design of cold-water system in an office type building.

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2. To make sure that the design of the cold-water system is in accordance to the standard by authority

1.2 1.4 Scope of Study

The scope of work for this study are:

1. The mechanical to be studied is cold-water system (CWS).
2. The cold-water system to be studied is the low-rise office type building.
3. The guidelines and requirements for this project are outlined by the Uniform Building by Law (UBBL) and Malaysian Water Association (MWA).
4. The programming language used in the study is Building Information Modelling (BIM) Software Autodesk Revit.

2. Materials and Methods

The key aim of his case study is to construct a cold-water system, or known as a water supply system, for the 3D modeling of a building. This project will be carried out using Building Information Modeling (BIM) software, Autodesk Revit. This case study focuses on the specifications of the water distribution system for low-rise office-type buildings. This analysis is in compliance with the Uniform Building By-laws (UBBL) and the Malaysian Water Association (MWA).

2.1 Modelling architectural design

Building Information Modeling (BIM) is a system that starts with the development of an intelligent 3D model which facilitates document management, coordination and simulation over the entire life cycle of a project (plan, design, build, operation and maintenance). BIM is used to plan and chart the development and design of facilities. Each detail of the building is modeled in the BIM. The model will be used for research to explore design alternatives and to generate visualizations that help stakeholders visualize what the building would look like when it is completed. The model is then used to produce the building design documents.

2.2 Modelling the cold – water system

The direct water supply system used in most of the buildings relies on the continuous supply from the main to all the installations in the house. The continuous water supply method includes the installation of an indirect water supply system in the building where water is treated from the main storage tank to all fixtures in the building. Water from the main or external pumps can be used to fill the holding tank.

3. Results and Discussion

This chapter discusses the outcomes of created software for designing the building of specific field applications for cold water systems in commercial and residential buildings, hospitals, and shopping malls. The water system design software was created in-house using the programming language Building Information Modelling Autodesk Revit. When compared to AutoCAD Autodesk, this is one of the more user-friendly languages.

3.1 Water storage design calculation

This office building has an estimated occupancy of 1 person per 10sqm net floor space and measures 321.14sqm (14.84m x 21.64m) as an office. Because this office is typically open for 10 hours, the estimated water storage need for this office is provided by the expression:

$$water\ storage = (area\ of\ office)/10 \ \times 45\ litres$$

$$= 321.14/10 \times 45 = 1445.12\ litres/24hrs$$

$$= 602.13\ litres/10hrs$$

3.2 Design on peak hours

The anticipated yearly water consumption for each settlement in each sector was computed to establish the peak hourly flows. This value is compounded by the peak daily demand coefficient and the peak hour demand coefficient. This leads in the system having to deal with the most water hourly use that it has ever had to deal with. The hourly design flow for office usage was calculated using the following equation:

$$Q\_max = 1.48 \times 0.1 \times 0.0027 \times 60.21 = 0.024 m\^{}3\ \ per\ hour$$

Where 1.48 is coefficient for peak daily consumption

1/10 = 0.1 which divides the consumption over the constant use during work hours

1/365 = 0.0027 which divides the total annual consumption over the days of the year giving the average daily consumption

3.3 Gravity Feed System (Elevated Water Tank System)

Water is pumped from the water main to an elevated water storage tank placed above the highest and most hydraulically distant point in the building's water supply system in an elevated water tank system, such as the simplified arrangement depicted as shown in Figure 4.1. The increased static head provided by the height of the water tank results in higher pressure in the water distribution system. The pressure increases by 1 psi for every 2.31 ft. (0.7m) elevation of the tank (6.9 kpa).

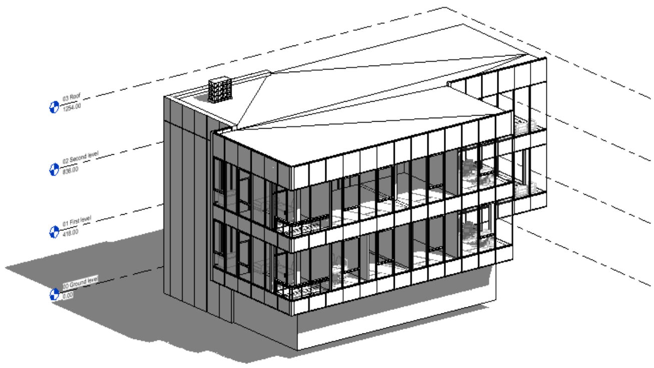

Figure 4.1: Location water storage tank

3.4 Design of building

From the Figure 4.2, consider the existing water storage tank having total floor area is 100.82 sqm (14.2m x 7.10m) and floor height of 11.8m. Indirect water system is chosen because the cold-water storage tank provides even water pressure, resulting in quieter plumbing and less wear and tear on fittings.

For the Figure 4.3, Figure 4.4 and Figure 4.5, there are three restrooms stated in the floor. If we compare among the floors, there are basic differences which is there is a store and cafe in ground floor while two rooms Musollah in the Level 1. Considering the office building of 3 floors having 12.54m of floor height, it is assumed that indirect system which is elevated water tank system is needed in order to relieve instantaneous demand from the main at peak hours.

Water is delivered to the water storage tank through the supply pipe. The main water line from the tank flows out to the distribution pipe through the main pipe. The yellow line in the figure below indicates the water flow direct from the water storage tank and the black line indicates waste water.

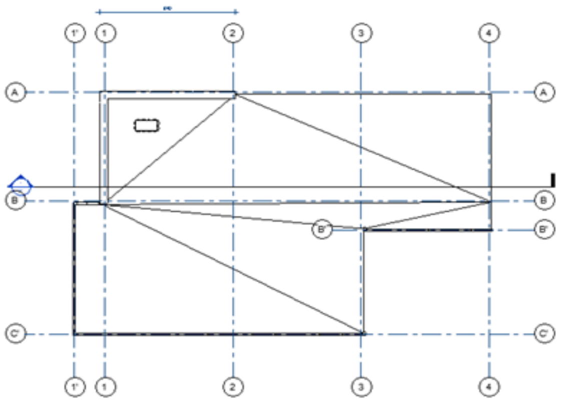

Figure 4.2: Roof Floor Plan (the location of water storage tank)

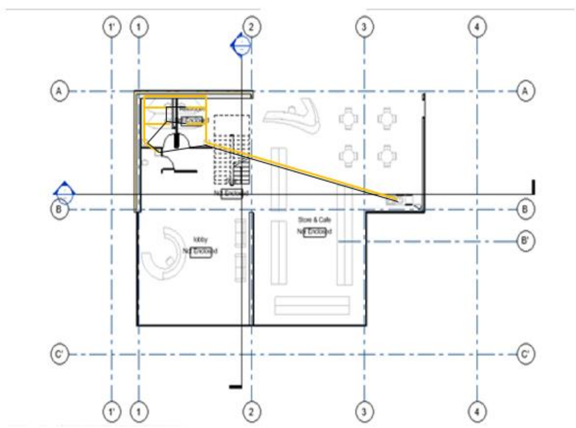

Figure 4.3: Ground Floor

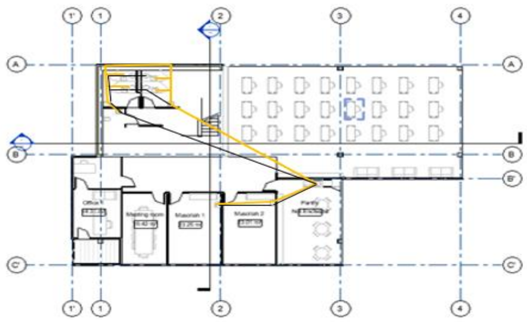

Figure 4.4: Level 1

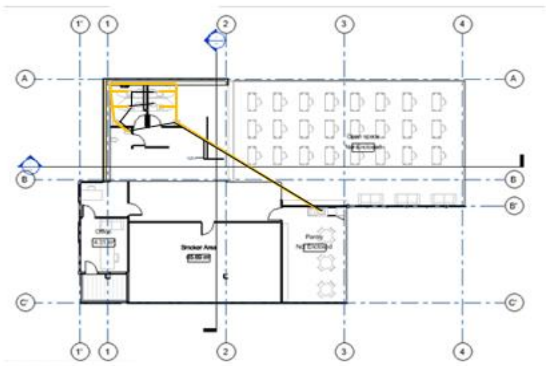

Figure 4.5: Level 2

4. Conclusion

The following conclusions may be drawn from the investigation, analysis, and outcomes of this research work:

1. According to the findings of this study, an indirect cold-water system or gravity feed system is more appropriate and environmentally friendly than a direct cold-water system.
2. In the current study, it was discovered that the cold-water system is dependent on the design during peak hours. If the design during peak hours is poor, the success of the cold-water system will be poor.

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