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PLANNING ANALYSIS OF THE HYDRANT SISTYEM AS A FIRE EMERGENCY RESPONE FACILITY AT STIKES BHAKTI HUSADA MULIA MADIUN

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ABSTRACT

Fires represent a significant disaster capable of causing material loss, loss of life, and operational disruptions in higher education institutions. STIKES Bhakti Husada Mulia Madiun encompasses various academic facilities, laboratories, and public areas with potential fire risk, yet lacks an integrated hydrant system plan. This study aims to analyze and plan a hydrant system as an optimal fire emergency response facility. The research method utilized is a descriptive qualitative approach based on field observation, expert judgment interviews, and literature review guided by SNI 03-1735-2000, SNI 03-1745-2000, Regulation of the Minister of Public Works No. 26/PRT/M/2008, and NFPA 14 standards. The planning results demonstrate that for a total campus area of 10,123 m², a total of 38 hydrant units are required, comprising 28 indoor hydrant box units (coverage area of 360–400 m² per unit) and 10 outdoor yard hydrant pillar units (45 m pillar spacing). The total water flow rate requirement for the hydrant system is 1,550 L/min (25.88 L/sec) with a minimum water supply duration of 30 minutes, necessitating a ground storage tank capacity of 46.5 m³ (46,500 liters). This planning is expected to serve as a technical reference for campus management in implementing active fire protection installations to guarantee the safety of the entire academic community.

Keywords: "Hydrant System, Fire Emergency Respone, Fire Risk Assesment, Campus Safety"

INTRODUCTION

Fires are one of the most frequent disasters occurring in various types of buildings, including higher education institutions. The impacts extend beyond material damage and destruction of academic facilities to threatening the safety of the academic community and disrupting the learning process. Preparedness in facing potential fire disasters requires the availability of reliable fire protection facilities, both passive and active systems. A major element in active fire protection systems is the hydrant system (Irvan and Kusmantoro 2020). STIKES Bhakti Husada Mulia Madiun, as a health sciences higher education institution, comprises a building complex that includes lecture halls, medical/pharmaceutical practice laboratories, a library, and administrative offices. The characteristics of academic activities, alongside the use of high-power electrical equipment and laboratory chemicals, increase the potential risk of fire originating from electrical installation failures or operational errors. Although basic safety facilities such as Portable Fire Extinguishers (APAR) and evacuation routes are available, the campus does not yet possess a comprehensively planned and integrated hydrant system (Ibrahim, Muhammad, and Widodo 2025).

Hydrant system planning must be grounded in hydraulic technical calculations and applicable regulatory standards, such as SNI 03-1735-2000, SNI 03-1745-2000, Minister of Public Works Regulation No. 26/PRT/M/2008, and National Fire Protection Association (NFPA) standards. Crucial parameters that must be evaluated include determining the number and distribution of hydrant points, estimating water flow rate and pressure requirements, calculating ground tank storage capacity, and specifying piping networks and pumps

(Meliala 2025). Therefore, this study aims to comprehensively plan and analyze a hydrant system as a fire emergency response facility at STIKES Bhakti Husada Mulia Madiun, particularly in ensuring an adequate water supply for extinguishing fires during the emergency response phase.

MATERIALS AND METHODS

This study employs a descriptive qualitative research design with a field observation and technical planning approach. This approach was selected to thoroughly examine existing conditions and fire protection requirements within STIKES Bhakti Husada Mulia Madiun from April to May 2026. Data collection involved both primary and secondary data. Primary data were obtained through direct observation of the spatial layout, building area, and fire truck access routes, as well as interviews with expert judgment personnel in occupational safety and health (OSH) and piping system technicians. Secondary data consisted of campus architectural floor plans, electrical power capacity data, and technical regulatory standards such as SNI 03-1735-2000, SNI 03-1745-2000, Permen PU No. 26/PRT/M/2008, Kepmenaker No. 186/MEN/1999, NFPA 14, and NFPA 551. The data analysis phase commenced with hazard identification and fire risk assessment using the Fire Risk Assessment (FRA) method based on a risk matrix. Subsequently, technical calculations were performed to determine the quantity and layout of indoor hydrant boxes and outdoor hydrant pillars based on coverage area and perimeter. Water flow rate (Q) and reservoir volume (V) calculations were performed using standard hydraulic equations ($V = Q \times t$), with the minimum fire suppression duration set at 30 minutes. The technical planning outcomes were translated into layout floor plans and 2D isometric piping network drawings.

RESULTS AND DISCUSSION

Based on architectural mapping and the guidelines of SNI 03-1735-2000, the total campus area of STIKES Bhakti Husada Mulia Madiun requiring protection is 10,123 m², with an outer building perimeter of 449.8 meters. The effective coverage area of a single indoor hydrant box ranges from 360 m² to 400 m².
The required number of hydrant boxes is calculated using the following equation:

Number of Hydrant Boxes = Campus Area / Coverage Area = 10,123 m² / 360 m² = 28.12 ≈ 28 units

Meanwhile, the placement of outdoor hydrant pillars in the yard maintains a safe inter-pillar spacing of 45 meters along the access route for fire engines, in compliance with the maximum limit specified in SNI 03-1735-2000 (maximum 50-meter obstacle-free radius). The number of hydrant pillar units is calculated as follows:

Number of Hydrant Pillars = Outer Perimeter / Pillar Spacing = 449.8 m / 45 m = 9.99 ≈ 10 units

Thus, the total number of planned hydrant protection points at STIKES Bhakti Husada Mulia Madiun is 38 units, consisting of 28 indoor hydrant boxes and 10 outdoor hydrant pillars. A summary of the required components is presented in Table 1.

Table 1 Fire Hydrant Schedule

No	Protection Component	Specification/Standard	Quantity	Placement Description
1	Indoor Hydrant Box	Class 2 (Hose 1½ inch spray/Jet Nozzle)	28 Unit	Building Corridors & Lab Area (Coverage 360-400m²)
2	Outdoor Hydrant Pilar	Class 1/3(Twin Outlet 2½ Inch)	10 Unit	Yard & Fire Truck Access (45m Spacing)
3	Ground Storange Tank	Minimum Capacity 46.5 m² (46.500)	1 Unit	Underground Area near Pump Houses
4	Main Pump (Eletric Pump)	Flow Capacity 1,550 L/min (25.88 L/s)	1 Unit	Main Pump Room (Backup Generaton/Genset)
5	Stand by Pump (Diesel Pump)	Flow Capacity 1.550 L/min (25.88L/s)	1 Unit	Main Pump Room (Backup Generator/Genset)

6	Jockey Pump	Automatic Pipe Pressure Maintainer	1 Unit	Main Pump Room

Table 1 Fire Hydrant Schedule

Water Flow Rate, Pressure, and Storage Capacity (Ground Tank) Requirements The reliability of an active fire protection system relies heavily on maintaining adequate water flow rates and pressure during emergency events. Based on combined hydraulic calculations for a moderate-hazard fire classification in educational buildings, in accordance with SNI 03-1745-2000, the total water flow rate (Q) required for the hydrant system is calculated as follows:

Q = (2 × 400 L/min) + (1 × 750 L/min) = 800 + 750 = 1,550 L/min

Expressed in seconds, the system must deliver a flow rate of:

Q = 1,550 L/min / 60 seconds = 25.88 L/sec Underground water storage tank volume (ground tank) is determined based on a minimum safe

suppression duration of 30 minutes (t = 30 minutes):

V = Q × t = 1,550 L/min × 30 minutes = 46,500 Liters = 46.5 m

This minimum reservoir capacity of 46.5 m³ is an absolute requirement to guarantee adequate

water supply prior to the arrival of Fire Department personne

CONCLUSION

Hydrant line layout planning for a total campus area of 10,123 m² results in a total requirement of 38 protection facility units, comprising 28 indoor hydrant box units with a coverage area of 360–400 m² per unit and 10 outdoor hydrant pillar units with a 45-meter inter-pillar spacing. Hydraulic calculations yield a total hydrant system water flow requirement of 1,550 L/min (25.88 L/s), with a minimum operational duration of 30 minutes, requiring an underground water storage tank (ground tank) with a minimum capacity of 46.5 m³ (46,500 liters). The findings of this study provide practical implications and technical recommendations for the management of STIKES Bhakti Husada Mulia Madiun to implement a standardized active fire protection system, thereby enhancing occupational safety and safeguarding the academic community against fire hazards.

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