CHAPTER 3

FIRE SYSTEM

3.1 OVERVIEW:

The Friendship Tower is a new large-scale construction work, mainly used for office work, convention center, coffee shop with many live and work F & B. Especially, this is a multi-storey building, so the fight against fire has certain difficulties. Because of the importance of this, investment in fire protection equipment is a very important and practical objective.

Implementing ideas on us have chosen the design of fire protection system for the project. Based on the requirements of characteristics of works and Vietnamese standards on fire prevention and fighting, to design fire prevention and fighting systems for works, including the following items:

- Fire alarm system.
- Fire detection and alarm system.
- Sprinkler automatic fire fighting system.
- Automatic fire fighting system.
- Fire extinguisher and fire extinguisher system.
- Portable fire extinguishers.

3.1.1 APPLICABLE STANDARDS

QCVN 06-2010 / BXD - National Technical Regulation on Fire Safety for Houses and Buildings.

TCVN 2622-1995 - Fire protection for houses and structures - Design requirements.

TCVN 3890-2009 - Fire prevention and fighting equipment for houses and structures - Equipment, layout, inspection and maintenance.

TCVN 5738-2001 - Fire alarm system - Technical requirements.

TCVN 5760-1993 - Fire fighting system - General requirements for design, installation and use.
TCVN 6101-1996 - Fire fighting equipment - Carbon dioxide fire fighting system - Design and installation.
TCVN 6379-1998 - Fire fighting equipment - Fire hydrants - Technical requirements
TCVN 7161-1-2009 - Gas Fire Systems - Physical Properties and Design - Part 1: General Requirements
TCVN 7568-1 ~ 6: 2013 - Fire detection and alarm system - Equipment
TCVN 5738: 2001 - Fire alarm system - Technical requirements
TCVN 7336: 2003 - Automatic fire sprinkler system - Design and installation requirements.
TCVN 7435-1: 2004 - Fire prevention and fighting - Portable fire extinguishers and fire trucks

Refer to the NFPA (National Fire Protection Association) standards for the following:
NFPA 13: Standard design, installation sprinkler fire system.

**3.1.2 REQUIREMENTS FOR FIRE PROTECTION SYSTEMS FOR WORKS**

Based on the fire and explosion hazards of fire prevention system projects, the following requirements must be satisfied:

**a. Fire protection requirements**

Fire prevention measures must be applied to minimize the possibility of fire. In the event of a fire, the fire must be detected quickly and promptly to prevent the fire from spreading to other areas causing great fire and causing serious consequences.

Fire prevention measures must ensure that when people are in the fire, people and property in the building easily evacuated to the safety area as quickly as possible.

Under any conditions, when fire occurs in areas prone to fire such as technical areas, the hall in the school must be detected immediately in the place of fire to organize timely treatment.

**b. Fire fighting requirements**

Fire-fighting equipment of works must meet the following requirements:

- Fire-fighting equipment must be ready for use in the fire-fighting mode.
- Firefighting equipment must be suitable and effective fire fighting for fires occurring in the works.

- Fire-fighting equipment equipped for the project must be easy to use, suitable to the works and conditions in our country.

- Fire-fighting equipment must be fire fighting without damage to other tools and equipment in secondary fire-fighting areas.

- Equipped fire protection equipment must ensure minimum investment conditions but maximum efficiency.

3.2 DESIGNING THE AUTOMATIC FIRE ALARM SYSTEM

3.2.1 GENERAL DESCRIPTION

The design plan includes:
- Design and installation of fire alarm system for the entire project.
- Design and installation bell system, fire alarm button for the whole project.
- Design and install the emergency exit lamp (Exit) lamp incident when the incident occurred.

3.2.2 AUTOMATIC FIRE ALARM SYSTEM

The fire alarm system includes the following basic parts:
- The detector detects fire.
- Fire alarm button.
- Analysis modules, signal processing.
- The control center handles the information from the sensor and the hand-held press button.
- Fire alarm: horn, bell.
- Conduit system: including signal wiring and power supply wiring.
- Electricity supply.

Peripheral control devices such as fire alarm data recorders, control panel cabinets on computers, fire alarm control cabinets, elevator systems, as well as on-off devices. wind, escape door.
3.2.3 DESIGN OPTIONS

The design of the fire alarm system for the building was selected as intelligent fire alarm system.

The fire bell push button on the floor is arranged in the position of many people like the area near the elevator and stairs to facilitate the observation of troubleshooting in the event of a fire. The fire button on each floor is the fire alarm button usually associated with the address module and is mounted on a single address for each floor.

The alarm is selected as the fire alarm. Fire alarms are installed in the fire alarm knob. The bell is mounted on the same power line and sends the addressing module to the fire alarm to control the operation of all the bells on the same floor.

The signal conductor for the address fire detector is a dedicated anti-interference cable with a cross section of 1.2 mm2.

3.3. INFRARED FIRE PROTECTION & FIRE FIGHTING SYSTEMS

3.3 OVERVIEW

a. Design grounds

- Applicable Standards, Standards and References in Part II - Applicable Standards.
- Architectural drawings of the building.

b. General description of the system

After studying the architectural characteristics, scale, importance, nature and extent of danger of the project, the solutions for the design of the fire-fighting system for water shall include the following basic parts:

- Fire hydrant.
- Main fire pump system, spare pump, pressure compensation pump.
- Fire pump control cabinet.
- Pressure vessels, pressure gauges, pressure switches.
- Alarm valve system and flow switch.
- Stop valves, one-way valve, filter suction filter.
- Plumbing system.
- The sprinkler nozzle.

- Water vents fire walls.

- Fire extinguishers outside the house.

- The original fire extinguishers used ABC portable fire extinguishers, CO2 gas cylinders for power engineering rooms, control rooms, computer rooms.

### 3.3.1 FIRE FIGHTING SYSTEM WITH WATER

Fire extinguishers are supplied to sprinklers and sprinklers and fire hydrants, using a pipe network of diameters D25-D150. D150 main pipe runs from pump station to technical box. The main shaft goes in the technical box using D150 and D100 galvanized steel pipes running along the technical box and is connected to the roof water tank. There are two main shafts on each floor.

The water supply and pressure for fire mains are used between the sprinkler system and the wall fire hydrant by means of a horizontal fire pump.

At the design stage, the sprinklers are equipped with pressure gauges to check the pressure of the piping network.

Pump start-up and shutdown can be fully automatic or manual. The fire control cabinet receives the signal from the pressure switch, the flow switch to give the fire control signal to the pump fire pump cabinet. Depending on the state that the fire control cabinet decides to give the control signal to start the main fire pump, standby fire pump or pressure compensation pump. In addition, the fire alarm control panel also provides a fire alarm, a fire alarm as well as an automatic fire alarm.

When the pressure in the system drops to 90% of the preset pressure, the pressure switch will start the Jockey pump. A minimal run-time control Zole is attached to the control system to prevent the pump from being restarted continuously.

If the system pressure drops to 80% of the installed level, the pump will stop and the main pump will be started (one permanent pump is selected).

The power supply to the pump is taken from the priority source and is supplied by the building's generator power supply.

The whole fire-fighting system is used in conjunction with the living water tank located at the ground floor. The amount of water used for fire fighting is ensured by water level monitoring and pumping equipment.

### 3.3.2 SPRINKLER FIRE PROTECTION SYSTEM

Fire extinguishers that use upright sprinklers installed in the basement and floors without false ceiling, using a pendent sprinkler are arranged for floors with false
ceilings. The distance between the nozzles is 2.6m to 4m, the distance to the wall is 1.2m to 2.0m (see drawing design).

Basic specifications for calculation, system design "According to TCVN 7336: 2003" as follows:

- Maximum protection area for a nozzle: 9-12m².
- Danger Level: Normal.
- Pressure at nozzle: 1at (10m.c.n).
- Intensity: 14.4 liters / minute m².
- Spray time: 30 minutes.
- Calculated protected area: 200 m².

The water supply will be sufficient for both the Sprinkler system and the indoor fire hydrant to operate simultaneously.

Figure 3.1 3D simulation room fire pumps
### Table 3.1 Fire sprinkler head stats

<table>
<thead>
<tr>
<th>Floor</th>
<th>Area (m²)</th>
<th>Protection area for 1 nozzle (m²)</th>
<th>Number of Upright Sprinkler</th>
<th>Number of Pendant Sprinkler</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basement B4</td>
<td>1516</td>
<td>12</td>
<td>168</td>
<td>12</td>
</tr>
<tr>
<td>Basement B3</td>
<td>1095</td>
<td>12</td>
<td>149</td>
<td>12</td>
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<td>979</td>
<td>12</td>
<td>132</td>
<td>15</td>
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<td>12</td>
<td>120</td>
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<td>Level 1</td>
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<td>12</td>
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<tr>
<td>Level 2</td>
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<td>Level 21</td>
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<td>12</td>
<td>61</td>
<td>61</td>
</tr>
</tbody>
</table>

### 3.3.3.1. Our software components

**Spray nozzle**

- Our location see your photos
- Valve valve, software of Sprinkler
- In the meantime, you can do that. Our valve van collection is then:
  - Alamvan.
  - Main and Extra valves
  - Pressure relief.
  - Your collection
- Flow line formulation (flow switch):

Flow switches are installed for each floor as in the design drawings.

The switch and base are made of die-cast aluminum. Rubber padding between the base and the cover. Contact lenses can be calibrated to fit the size of the workpiece with a time delay adjustable from 0 to 60 seconds to prevent false alarms due to a sudden increase in pressure. The signal from the flow switch will be connected to the fire alarm system automatically.

- Pressure gauges.

3.3.3.2. Calculate parameters needed for Sprinkler system.

* Basis of calculation:
- The required flow from the basic water supply to the system
  \[ Q = I_b \times F \text{ (l/s)} \]

  Inside:
  \( I_b \): Standard spraying intensity of 14.4 liters/m2.min.
  \( F \): Protection area at the same time when the system works 200m2.
  \[ = 14.4 \times 2000 = 2880 \text{ l/min} = 48 \text{ (l/s)} \]

3.3.3 SELECTION OF FIRE PUMPS

a. Working pressure of the pump

\[ H_{ct} = H_{hh} + H_{fd} + \sum H \]

- \( H_{hh} \): the lowest water level in the tank reaches the high fire hose and the farthest is 80m.
- \( H_{fd} \): The required free pressure for the nozzle system is 10m.
- \( \sum H \): total pressure losses from the suction mouth of the pump to the highest and farthest fire hose (including longitudinal pressure loss and lag damage through valve, numb, spraying ...) 70m.

\[ H_{ct} = 80 + 10 + 70 = 160 \text{ m} \]

b. Flow of the pump

\[ Q_{ct} = 48 \text{ l/s} + 1 \text{ l/s} = 49 \text{ l/s} = 176.4 \text{ m}^3/\text{h} \]

c. Select pump:

From the above parameters, select the pump as follows:
\[ Q = 185 \text{ m}^3/\text{h}, H = 160 \text{ m} \] (including two main fire fighting pumps, one backup pump and one pressure pump)
Figure 3.2 The main fire pump

Figure 3.3 Pressure compensated pump
Hình 3.4 Basic configuration of water extinguishing system for high-rise buildings

3.4. REFRESHER

- It is a direct monitoring device, detecting smoke signals to transfer smoke signals to the treatment center. The time the smoke detectors receive and transmit information to the fire alarm no more than 30 seconds. Environmental density ranges from 15% to 20%. If the concentration of smoke in the environment exceeds the permitted level (10% -20%), the equipment will send an alarm signal to the center for processing.

Smoke detectors are usually located in the study rooms, halls, warehouses, areas with densely populated areas and pre-existing fumes.

- Smoke detector is divided into two main categories as follows:

3.4.1 SPECIFIC ROUND DETECTION

Installed in areas where the scope of supervision is small, low ceilings (offices, apartments ...).
a. Ion Smoke Detector: The device generates positive and negative ions that move in the presence of smoke and smoke, which interferes with the movement of positive and negative ions. mind processing.

b. Photo smoke detector (photovoltaic): The equipment consists of a pair of detectors (one transmitter, one receiver) arranged opposite, when there is smoke between the two alarm, smoke will obstruct the transmission. the signal between the two alarms, from which the alarm will send a fire signal to the central processing.

3.4.2 BEAM TYPE REQUIREMENTS

- Include a pair of equipment installed at both ends of the area to be monitored. The projection device emits an infrared beam through the area of the surveillance area and then to a receiving device containing a photosensitive cell that monitors the signal balance of the light beam. This detector operates on the principle of blurring the light as opposed to the principle of scattering light (smoke in the head).

- Beam smoke detectors have a very wide range (15m x 100m), suitable for use in areas where photoelectric smoke detectors are unsuitable, such as in places where smoke is present. Will there be black smoke?

In addition, the Beam head can withstand extreme temperatures, dust, excessive humidity, impurities, etc. Due to the Beam head can be placed behind the glass window. , it is easy to clean, preserve.

- Beam detectors are usually installed in areas with large monitoring range, too high ceiling can not install point detectors (factories ...)

3.5 HEATING INJECTION

- The heat detector is used to detect the temperature of the environment within the protection range, when the temperature of the environment does not meet the requirements of the manufacturer's prescribed heaters, it will signal The alarm sent to the processing center.

- Heat detectors are installed in places where smoke detectors can not be installed (where appliances, garages, kitchens, factories, kitchens, etc. are installed)
3.5.1 FIXED THERMOSTAT

This type of alarm is triggered and the alarm signal generated when the temperature in the air around the alarm head increases to the manufacturer's specified level (57°, 70°, 100° ...).

3.5.2 ADDITIONAL HEAT TUBE

This type of alarm is triggered and emits an alarm signal when the ambient air temperature sensor is suddenly increased by approximately 9°C/min.

3.6 Fire Alarms

It is a device that senses ultraviolet light emanating from the flame, receives a signal, and sends an alarm signal to the processing center when it detects fire.

Used mainly in places where there is a high risk of fire, where the light of the fire is a sign of fire (eg, flammable liquid storage).

- The fire detector is very sensitive to ultraviolet light and has been investigated to avoid false alarms. The probe only sends an alarm signal to the fire control center when there are two ultraviolet induction pulses after two intervals, each period of 5 seconds.

3.7 EMERGENCIES
Installed in the visible areas of the corridor for use when needed. This device allows the user to actively transmit fire alarms by pressing or pulling on emergency switches, emergency alarms for anyone present in the area known to have fire-fighting measures and Move out of danger area by emergency exit.

The following types of emergency switches are included:
- Urgent, round
- Urgent broken
- Urgent

3.8 ALARM BELL

Installed in a security room, rooms with concierge staff, corridors, stairs, or crowds of traffic are available to inform those around you who may be experiencing the problem. timely evacuation.

In the event of a fire incident, the alarm will sound an alarm that will allow the security guard to identify and by means of a fire alarm monitor (the secondary display panel), which area will be exposed to the fire. from time to timely notify the staff responsible for fire prevention and fighting to overcome the problem or take appropriate measures.
3.9 FIRE ALARM

It has the same features and installation location as the fire alarm, but the whistle is used when the distance between the place of notification and the place where the alarm message is received is too far away.

![Figure 3.8 Fire alarms](image)

3.10 LAMP

There is an alarm signal, each type of lamp has different functions and is installed in the appropriate position to maximize the features of this device. Composed of lamps:

3.11 LIGHT SWITCHES

Placed near the stairs of each floor, indicating the exit in the event of a fire. Automatic illumination in case of AC power loss.

3.12 FIRE FIRE ALARM

Placed above the emergency switch of each floor. The fire alarm will light up when the emergency works, and this is also an emergency light for those present in the building. This is important because, during the confusion caused by the fire, the user needs to clearly distinguish the emergency work that has triggered the fire pump.