Building Services
Lecture 9

Types of Fire System

What are the different types of fire safety systems? One is the fire reduction system or is also called the fire alarm panel system. Next is the fire hydrant system. This could be an external hydrant or an internal hydrant which comprises of a public hydrant. The next will be a 'sprinkler system' which are fixed installations in your building above the false ceiling or below the false ceiling, corridors, that supply water to the space where the fire has happened to put off the fire. Finally the 'gas suppression system', this is primarily used in industrial or hazardous areas where you can't use water or any other means to put out the fire. We will look into detail about every aspect of fire safety systems.

First is, Fire Detection. We can use fire alarm system. This is irrespective of whether you use other systems or not. This will act as a warning device and it will help people identify the exact location of where the fire has taken place. They can go and attend to it and put out the fire. Why have a fire alarm system? Its an automatic fire reduction, an alarm system that is generally provided. A network of manual cover points where you can inform people by pressing a button to let them know that a fire has happened. In fire senses, it could be smoke or heat senses and alarm warning device over the area cover which will rise or give a ring or a siren to inform other people. Basically, we have this to warn and inform people to evacuate in case of an emergency.

What are the various parts of a fire alarm system? The system is Analogue Addressable system. The control panel shall be placed in the ground floor of the building and be easily accessible. It has detectors which are of smoke and heat types. At least 2 detectors inside the building shall have a sounder base. The system shall be provided with a graphic software. This is our fire detection system or how the fire alarm panel system looks like. Here, you can see the rectangles that are called the detectors. This part called the isolator, there is also a manual call point and a sounder. These are various floors where all these components are present and all of them are looped to or connected to a control panel on the ground floor, this is how it looks. These are the pictures of the various components. One is the Ionisation Smoke Sensor, Heat Sensor, Optical Smoke Sensor, the Manual Call point, the Line Isolator and this is a sounder. What is the advantage of an analogue addressable fire alarm system? In this system, the information regarding the exact location of the incident is provided. It will help the people who are coming to put out the fire, mainly the firefighters to reach the place faster and put it off quickly. How do you place the detectors? You have to place the corridor ceilings and at a spacing of 7m to each other, the manual call points can be placed at exits. This entire fire alarm Matrix. As I told you, this is a control panel to which we connect all the smoke sensors which we

usually provide at lobbies, lift machine room, electrical room and offices. Heat sensors are present at the AHU, specifically for the AHU and the manual call point in all the staircase entries. The Sounder at stair entries and lift machine room. Once again, they connect a lot of trip modules or cut off modules connected to this fire alarm, this panel. There is an AHU trip module. What happens is, as soon as this fire breaks out, this control panel informs or cuts the supply from the main DB to the AHU. Then, it also cuts off the supply to the lift. Then it will trigger open all the fire escape doors. It will cut off all the toilet inlet fans, it will start the staircase pressurisation fans to be switched on and it will be sent to the building management system.

Fire Hydrant System

Moving on to the Fire Hydrant System. Basically, the water being the main extinguishing medium, major fires have to be controlled and extinguished by the use of water from fire fighting hoses operated by the regular fire services. This fire fighting water is usually obtained from hydrants installed on public mains or inside the premises. It is basically of two types; one is an external hydrant and the other is the internal hydrant. As the name says, external hydrant are installed in the open like the city or town water mains. Internal hydrants are installed within the buildings. Let us look at the scenario in India. Even though we say we can use external hydrants, in other developed countries there are other well maintained hydrants, water mains in the cities and towns. Fire service vehicles on a fire call, report to the scene, connect up to the hydrants, draw water from them, and carry out fire fighting operations sometimes even for several hours. When compared to India, we do not have such reliable hydrant water mains even in our metropolitan cities, not to speak of towns. Consequently most of our city fire brigades are forced to maintain a large fleet of heavy water tenders/ tankers for replenishment of their fire fighting vehicles. This arrangement is no substitute for having regular fire fighting water mains, which can only guarantee continuous supplies of water for firefighting purposes. Once you've run out of water, then you can't put out the fire. This is how an external fire hydrant looks. You might have seen them in movies. There are two types, one is the stand-post type. The hydrant you see sitting outside or a concealed underground type, you won't see the hydrant, its concealed below the ground which you can open and unleash the hydrant.

Coming to the Internal Hydrant system - these systems are generally installed for fire protection of buildings or special structures. An internal hydrant installation comprises of the following elements; Static or terrace tank for storing water for firefighting purposes. It has rising mains, downcomer mains or external mains to feed water from the source to the required point under pressure. Fire fighting pumps with all fittings and components and it also has acidic components like the landing valves, external hydrants, hose reels, hoses and branch pipes in cabinets. We will see pictures. This is nothing but the stand post, this is the cabinet where you

coil and put the hose inside and this is the branch pipe, so there will be a running valve here. These things will be present in your fire fighting lobby. The internal fire fighting system are of different types; one is the dry-riser system, the other is the wet-riser system, the wet-riser-cum-down-comer system and down-comer-system. What is a dry riser system? The dry riser system is not normally charged with water but could be charged either through the fire service inlet provided at the bottom or through an installed pump when required, or directly from a fire appliance. It is basically a system of pipes, metal pipes which are fixed without water inside. This is how it looks. The dry riser pipes run throughout the building, through all the floors in the protective lobby or fire fighting lobby. This is the breeching inlet through which the fire brigade can insert a hose or the water source. These are the landing valves, where people connect the fire hose and fire fight.

In wet riser system, the system remains charged throughout so that by connecting delivery hoses, fire fighting operations could be carried out immediately. Generally, hose reels are also connected to this system alongside landing valves. The landing valves provided in the system are required to be sited so as to ensure that no part of the building protected is more than 30m from the landing valve. This system is normally charged by the operation of the static fire fighting pump installed in the building. However, a fire service inlet is also provided for charging it from fire service appliances.

This is the wet riser arrangement, the same arrangement except that you will have water filled in the wet riser. Immediately you can plug in the hose and start fire fighting. This is the fire brigade inlet or in other words breeching inlet which is located by the base, by the ground floor of the building, where the fire brigade can come and immediately charge the system with water from their tanker. It has all these inlets, butterfly valves and the ring main.

The down comer system is connected to a terrace tank through a terrace pump. It's pretty much similar to a wet riser system. In a wet riser system, first aid hose reels are required to be installed on all floors of high rise buildings or special type of buildings. The hose reel has a specific requirement, how you should choose a particular hose reel. For a wet-riser system, you need have two automatic pumps, one is a standby pump and the other is a regular operating pump to pump water to the pipes. This is the whole setup of the pumping system where you can see the underground reservoir, where you can see the sprinkler pipes, the hydrants, the various standby pumps and the rest of them.

This is the System Architecture. This depicts how everything is interconnected by way of pipes and such. The requirement of water is very important because without water all these things have no meaning. The quantity of water required for fire extinguishing depends upon the

magnitude of fire and duration taken to extinguish it. It is advisable to use potable water. The use of non potable water should be avoided for the fear of cross contamination and subsequent health hazards. As far as storage of water is concerned, sufficient quantity of water for the purpose of fire fighting of the building must be made available in an underground tank within the premises. Tank capacity may be taken as 30 min water supply at 1000 litres per minute. This is how you calculate the capacity of the tank. If it is an underground tank, then the water tank and cover should be designed to take a load of 18 tonnes vehicular load and flush below ground level. It should basically accommodate or allow a fire engine truck to come and stand there on top of the tank. Hence, you must design a heavy tank.

Fire Sprinkler System

Next moving on to the Fire Sprinkler system. Automatic sprinklers are devices for automatically distributing water upon a fire in sufficient quantity to extinguish it completely or prevent its spread, by keeping the fire under control. The water for fire fighting is fed to the sprinklers through a system of piping, normally suspended from the ceiling with the sprinklers installed at intervals along the pipes. You might have seen these in shopping complexes or malls or theatres. The sprinkler pipes run in the ceiling. Sometimes in the exposed ceiling, you can see the pipes itself. If they have done a false ceiling, you can only see the sprinklers' heads. Now, in the subsequent slides you can see what are the different types of heads and the purposes for which they are used. The orifice of the sprinkler head incorporating the fusible link or fusible bulb of the automatic sprinkler is normally kept closed. It is thrown open on the actuation of the temperature-sensitive fusible ink or fusible bulb.

There are a few types of sprinkler systems; one is the wet sprinkler system, one is a dry system similar to a wet riser and a dry riser system. Then, one is an alternate system where it can be kept wet or dry and one is a pre-action system where the pipes are normally charged with air and it gets filled with water when the fire begins.

When coming to sprinkler heads, there are of two types, one is a fusible solder and the other is a glass bulb system. The fusible solder type as you can see in the picture here, there is a solder or a metal part here. The body of the sprinkler is held in place by two yolks or a flexible metal diaphragm into which a valve is fitted. In a fire condition the fusible solder or link melts and the component members are thrown clear of the head, allowing the water to flow out in the form of spray after hitting the deflector. This is the deflector, this fan portion.

The fusible bulb type system, it uses a frangible or a fragile bulb. The small bulb of a special glass contains a liquid leaving a small air bubble entrapped in it. This is the fusible, the glass bulb that contains the liquid and air bulb. When exposed ot heat from fire, the liquid expands

and the bubble disappears. Due to increase of pressure the bulb shatters, releasing the water in the form of spray. The operating temperature is regulated by adjusting the amount of liquid, the nature of the liquid itself as well as the size of the bubble.

These are the different types of sprinkler heads. One is the upright sprinkler head, the pendant type, the horizontal type, the concealed or royal flush type and the recessed pendant type. This pendant sprinkler is normally used in basements and ceilings without false ceilings and factory sheds. Here this upright sprinkler is usually used above false ceiling. Wherever, the real true ceiling and the false ceiling, if the depth is more than 800 mm, you have to provide two layers of sprinklers. One layer above the false ceiling and the other below the false ceiling. This is because there might be some fire happening inside the false ceiling also which we might not be able to see or might not know. That shouldn't damage the entire property. So, you should have heat detectors and fire sprinklers above the false ceiling if the depth is more than 800, that is where we use this upright type. When it comes to this pendant type, we use it as we saw earlier, in basements where ceilings don't have false ceilings. The sidewall sprinkler is used in cinema halls or in hotels where you can't use this pendant type. This pendant sprinkler with rosette plate or a recessed pendant is used in offices, malls and hotels where aesthetics is a concern and this is the top most aesthetic sprinkler where you can't see the aesthetic head at all, its a neat stainless steel plate covering the entire set up used in malls and hotels. So, this is how a sprinkler system looks like. This is the water main, the water coming from the hydrant, connected to a series of sprinkler pipes. This is a valve, the sprinkler valve at ground level or at various levels. Once again, the butterfly valve, the NRV, the flow switch and the Drain line. This is a more closer look of how the rising main and the branching, running valve looks like.

Here, you have this above ceiling detector and above ceiling sprinkler to take care of the fire above the ceiling and below you have another set of sprinklers. This is an above false ceiling sprinkler with an upright sprinkler head. This is a typical sprinkler with a pendant type or any other types of sprinkler heads. Based on the type of usage, the expected temperature, you can choose a specific sprinkler head and this is a sprinkler alarm valve. As soon as a sprinkler starts functioning, people will know that there is a fire. This is an alarm that informs people that the fire has happened.

Next, coming to fire extinguishers. In early days we used to have portable buckets with water and sand for trankling incipient fires. Now, we have gone to the stage of using portable fire extinguishers which people can carry and attend to it. These are the different types; water type, powder type, foam type and carbon dioxide type. Depending on the type of fire we can use different extinguishers. It's all mentioned here.

These are the good and bad practices of how one should use an extinguisher like how one should stand and use it. What they shouldn't do, all those things.

Moving on to the foam based or the gas based extinguishers. One is a CO2 based system, one is a halon based system. This CO2 based system is suitable for extinguishing the following types of fires; the fires that involve smouldering carbonaceous solid materials, where it involves flammable and combustible liquids, Class B fires or where it involves combustible gases, except where explosive atmospheres are likely to develop, Class C fires and Fires involving live electrical apparatus and installations, you should use CO2 extinguishing systems.

These are further classified into; High Pressure systems and Low Pressure systems. Based on the requirement you can choose a particular system. The High Pressure system consists of nothing but a battery of one or more cylinders of CO2 interconnected by a manifold and feeding into a high pressure distribution pipework. Special discharge nozzles are fitted in the pipework and on operation of the installation, the gas is discharged into the protected space with considerable noise. In terms of low pressure system, the gas is stored in a refrigerated tank at a temperature of 18 degree Celsius and at 20 bars pressure. The tank is connected by a pipework to protected spaces with discharge nozzles sited at strategic points on pipework.

This is a schematic diagram showing a High pressure system, where we have a battery of a CO2 tank connected to a manifold and linked to pipes and discharge nozzles through which fire is put off. Coming to Halon Based systems, halon is nothing but Halogenated Extinguishing Agents or hydrocarbons in which one more hydrogen atoms have been replaced by halogen atoms; Fluorine, bromine, chlorine or iodine. Where must halogens be used? where these agents are non-flammable, but impart flame extinguishment properties also. Halons are used both in portable fire extinguishers and in extinguishing systems. These are commonly used Halons- Halon 1301, 1211 and 2402. Halon 1301 is used in industrial, commercial and marine applications. This 1211 is used in portable fire extinguishers. This 2402, is used in defence and marine sectors. Having said, on account of it coming into force in the Montreal Protocol on substances having ODP (Ozone depletion properties), production of Halons ceased in the developing countries by 1994 and it has almost faded out in developing countries as well. Although there was a system, we don't continue to use it due to various obvious reasons.

Finally we are drawing closer to the end of this lecture where we see Configuring, sizing and space requirements for fire fighting equipment. These are the various aspects to be taken into consideration at site level. The fire apparatus should have unobstructed access to buildings. The fire apparatus meaning your fire engine. Then, bollards and fences used for traffic control must allow for sufficient open road width for fire truck to pass through. Prevent time consuming,

hazardous back-ups at dead ends by using T-turns and culde-sacs in your building premises. You should place fire hydrants maximum 3 meters from the curb. Then, the hydrant must be unobstructed. It should be visible to the people and fire hose connection should be least 0.3m above grade. Utility poles, kiosks, sculpture, fountains, plant boxes can impede fire rescue operations. So you should take care when locating and designing them.

With respect to fire trucks and the snorkel ladders depending on the height of the building. We can use a particular ladder of height and type, this diagram shows the position of the fire truck with respect to the height of the building and the angle at which the snorkel ladder can access the building and help in the evacuation of people.

Finally, when talking about the fire fighting lobby, as we are told that we should have fire fighting lobby where we put this wet and dry rises, valves, hose reels, then we have fire rated doors. This fire fighting shaft or fire fighting lobby provides access to buildings especially high rise buildings to fire brigades. It is fully equipped with firefighting equipment, service elevator, stair and lobby. Provides a sufficiently secure operating base and a rest area in between fire fighting operations.