3.6 Fire Protection – Thermal Insulation – Ventilation and Air conditioning

Fire safety and property protection systems for buildings requires knowledge and understanding of hazards to decrease the potential fire occurrence and its risk to life and property during fire.

Importance of Fire Safety and Property Protection Systems for Buildings

- When fire is occurred, injury and death might be due to suffocation from poisons fume and smoke, burns from direction exposure to the fire, heart attacks because of stress and exertion, impact resulted from structural collapse, explosions, and falls.
- Not only does the life safety and property protection influenced by the design of the structure and its fire protection measure but also, they affected by construction material quality, maintenance and building content. Balanced design depends on three complementary systems to decrease the danger of death and risk to property as a consequent of fire.
- The three systems are a detection system to warn occupants of fire, a contaminant system to limit or restrict the extent of fire, and an automatic suppression system to control the fire until it can be extinguished.
- These systems of balanced design complement each other by adding fire resistance feature which is not offered by other components. Moreover, some balanced design component features are redundant which mean if a certain part is failed the other part will offer fire safety.
- In addition to apply an excellent physical balanced design for fire safety, a perfect education and training program need to be integrated with fire safety plan.

Fire Safety and Property Protection Systems for Buildings

- Automatic detection
- Automatic suppression
- Compartmentation
- Property protection
- State of the art in designing for fire safety

Automatic Detection of Fire

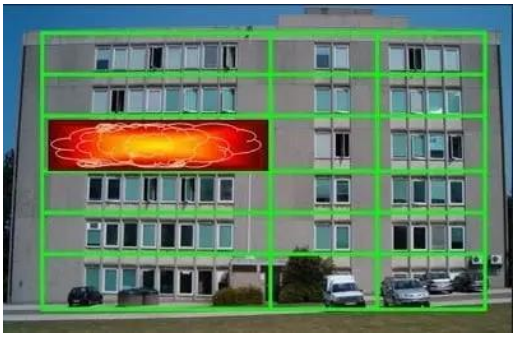
- The first and most important measure against fire, which is slow with smoke but without fire and low heat that does not activate sprinkler head, is an exact early warning.
- From life safety point of view, detectors are substantially significant because they warn occupants close to the source of the fire to run away.
- To alert fire department, alarm systems could be installed to decline reaction time of firefighters, increase the speed of rescue operation, and restricting the spread of fire and structural damages.
- If detectors are fixed at corridors and connected to central alarm, the evacuation of the whole occupant will be easy and potential injury and death will be reduced.
- Smoke sensing fire detector is the most usual detector that employed for early warning. Generally, detectors need to be connected to continuous power supply and should have a battery as a backup for the case where power is failed.

Automatic suppression of Fire in Buildings

- The purpose of automatic sprinkler system is to control fire at its origin. Despite that fact that residential sprinkler is not produced to extinguish fire, but it is dependable and influential in limiting the fire source in the room until it can be stopped completely.
- Automatic sprinkler can reduce the possibility of flashover that can be dangerous event. Not only does the fire suppression permits access to building to help occupants out of dangerous area but also allows the continuation of fire suppression.
- The **National Fire Protection Association (NFPA)** recommends minimum standard for sprinkler system design and installation
- The design, installation, testing, and maintenance of sprinkler systems are dealt with by NFPA standards. Clearly, effective and influential sprinkler head needs sufficient water supply and piping system to supply adequate water to the sprinkler head. The standard determines areas or rooms which are not needed to be sprinkled.
- After the completion of sprinkler installation, based on standards, inspection and acceptance of piping valves, pumps, and tanks of the system. Insufficient maintenance and improper water supply lead to poor performance of the sprinkler.

Compartmentation of Buildings

- Compartmentation restricts the spread of fire by dividing the building into compartment areas surrounded by fire walls and by fire rating floors and ceilings. Added to that, the spread of smokes and poisons fumes to adjacent areas of the building is limited by compartments.
- Large and destructive fire beyond compartments is avoided by restricting total fuel load increasing the fire. Not only do compartments provide a safe place for occupants for whom unable to escape such as elderly and handicapped but also safe refuge areas for long time when the fire are blocked or filled with smokes.
- Until the fire is controlled, compartments work to contain the fire. Each concrete or masonry walls that construct compartments walls need to have adequate fire resistant rating and need to have the capability of protecting structural integrity of the building during fire.
- In multifamily housing, it is recommended that each room constructed in such a way that works as a separate compartment. Added to that, storage rooms, electrical rooms, mechanical rooms, and interior exist ways must work as separate compartments



Property Protection Systems for Buildings

- The initial cost of installing fire safety can be quite large but it can be offset by advantage which obtained by applying balanced design. The possible loss thus fire can be decreased by providing high protection level for structures and its contents.
- Fire and smoke damages to the contents of the building is restricted by balanced design. The compartment boundary which is not combustible limit structural damages and substantially decrease the repair time after the fire.
- Generally, the repair is nonstructural and possibly it involves the replacement of doors, windows, switches, electrical outlet, wiring, heating ducts, and covers of floors, walls, and ceilings.

State of the Art in Designing for Fire Safety

- Fire protection is more like an art than a science, and number of unknowns and fire propagation possibilities are substantially large. So, fire protection mainly depends on risk assessment rather than exact computation.
- Designers use both Building Code criteria and understanding science of fire as guidance to deal with fire safety.
- There is a consensus among fire safety and regulatory communities that computer modeling contributes to improve fire safety in the built environment. Complex analytical models and computing equipment provide fire safety engineers contemporary and ever evolving tool to improve and enhance fire safety requirements in buildings.

Thermal Insulation

In general, people living in hot regions wants to make their inside atmosphere very cool similarly people living in cold regions, wants warmer atmosphere inside. But, we know that the heat transfer takes place from hotter to colder areas. As a result, heat loss happens. To overcome this loss in buildings thermal insulation is provided to maintain required temperature inside the building. The aim of thermal insulation is to minimize the heat transfer between outside and inside of building.

Purpose of Thermal Insulation of a Building:

- The main purpose of thermal insulation is to keep a house at the same temperature or heat.
- Insulation makes the inside a nice place to live and work. So, the room stays cool in the summer, and in the winter, it stays warm.
- To stop condensation from forming on walls, ceilings, windows, etc.
- the temperature up the heat loss in the winter and the air conditioner less in the summer.
- To make it less likely that water will freeze in the lines and the hot water system will lose heat.

Types of Thermal Insulation of Buildings:

1. Blanket Insulation:

Insulation blankets are available in sheets or rolls that resemble wallpaper and can be tacked to the ceiling or walls. They have a thickness of between 12 and 80mm and can be bent. We use animal hair, cotton, wood fibers, etc., to create these blankets.

2. Slab or Block Insulation:

Block or slab insulators are small, rigid units that measure 60 cm by 120 cm and have a thickness of 2.5 cm. Cement is used to bind materials like cork boards, cellular glass blocks, rubber blocks, mineral wood slabs, and wood fiberboards together. Small units like these can be used to line the walls and roofs.

3. Insulating Boards

Wood, cane, and paper are just a few materials that can be used to make insulation boards. At the right time and temperature, this pulp is pressed into solid boards. They come in many different shapes. These are often used in plasterboard and other partitions inside a building.

4. Loose-Fill Insulation

A stud hollow is cut into the wall to accommodate the positioning of windows and doors. The area between the wall studs is filled with loose-fill insulation. Materials like cellulose, wood fiber wool, rock wool, and other similar substances are employed.

5. Bat-insulating Materials:

These are also sold in blanket roll form, though the rolls used to insulate bats are much thicker. It works the same way as with the blanket. You may hang these anywhere, including the ceiling and walls.

6. Reflective Sheet Materials:

The outer shell of these materials is a big part of how long they last in high temperatures. Usually, they are used with air holes to ensure that the insulating, reflecting surface is always at the front. Reflective insulations include sheet or gypsum boards, steel sheet-reflecting materials, aluminum foils, etc.

Ventilation and Air conditioning

Ventilation and Air-Conditioning (HVAC) system are to help maintain good indoor air quality (IAQ) through adequate ventilation with filtration and provide thermal comfort

Ventilation simply means that the used and “dirty” indoor air is removed and replaced with new, fresh, and oxygen-rich air. Ventilation makes it easier for us residents to be and to breathe. Ventilation also keeps the structures of the apartment in good condition

There are three main types of ventilation:

- Natural ventilation
- Mechanised fans.
- Exhaust ventilation.
- Supply ventilation.
- Balanced ventilation.
- Smoke ventilation.

Natural Ventilation

- Natural Ventilation is pretty much as it sounds – natural ventilation that occurs in the work environment; openings in the ceiling, windows, doors and natural ventilation through the floor.
- This encompasses anything that allows the circulation of ambient air, getting rid of any harmful air coming from machinery and bringing in clean air to the space.
- While this is adequate and suitable for many working environments, it is unsuitable as the only means of ventilation in an industrial workplace.

Mechanised fans

When the air enters the impellers axially and is discharged radially from the impeller, it is called a centrifugal or radial flow fan. When the air flows parallel to the axis of impeller, it is called an axial flow fan.

Exhaust Ventilation

- The most efficient ventilation system to prevent a buildup of contaminants in the air, Exhaust Ventilation is a must in many work environments to prevent employees inhaling polluting substances.
- Local Exhaust Ventilation (LEV) captures fumes, dust, gases mists and vapours at their source, which means that they cannot escape into the air in the workplace.
- Your extraction system should enclose the process as much as possible and be easy for workers to use. This could be via the use of an adequately sized hood or booth.
- Adequate training should be given to all new and existing employees, and it is important to ensure that your system is maintained and tested (link) regularly to ensure compliance and effect ventilation.

Supply ventilation.

- Supply ventilation systems allow better control of the air that enters the house than exhaust ventilation systems do.
- By pressurizing the house, supply ventilation systems minimize outdoor pollutants in the living space and prevent back drafting of combustion gases from fireplaces and appliances

Balanced ventilation.

- Balanced ventilation systems, if properly designed and installed, neither pressurize nor depressurize your home. Rather, they introduce and exhaust approximately equal quantities of fresh outside air and polluted inside air.
- A balanced ventilation system usually has two fans and two duct systems.

Smoke ventilation.

In their most basic form, smoke vents are openings, such as windows or skylights, that offer an escape route for smoke and hot air. AOV's are smoke vents that work automatically when fire breaks out. When the sensors detect fire or smoke in the building, they open a roof vent or window to allow the smoke to escape.

Air conditioning

- Air-conditioning is that process used to create and maintain certain temperature, relative humidity and air purity conditions in indoor spaces. This process is typically applied to maintain a level of personal comfort.
- An air conditioning system, or a standalone air conditioner, provides cooling and/or humidity control for all or part of a building. Air conditioned buildings often have sealed windows, because open windows would work against the system intended to maintain constant indoor air conditions.

Types of Air Conditioners

- Central Air Conditioner.
- Window Air Conditioner.
- Smart Air Conditioner.
- Ductless Mini-Split Air Conditioner.
- Portable Air Conditioner.
- Through-The-Wall Air Conditioner.
- Geothermal Air Conditioner.
- Evaporative Air Conditioner.