RISK ASSESSMENT

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Risk is a potential that a chosen action or activity will lead to a loss of human or property. However, Hazard is a situation that poses a level of threat to life health or environment.

Risk assessment is a term used to describe the overall process or method where you:

Identify hazards and risk factors that have the potential to cause harm.

Analyse and evaluate the risk associated with that hazard.

Determine appropriate ways to eliminate the hazard, or control the risk when the hazard cannot be eliminated.

A risk assessment is a thorough look at your workplace to identify those things, situations, processes, etc. that may cause harm, particularly to people. After identification is made, you analyse and evaluate how likely and severe the risk is. When this determination is made, you can next, decide what measures should be in place to effectively eliminate or control the harm from happening.

Risk assessment involves the following:

- Hazard Identification
- Vulnerability Analysis
- Risk Analysis
- Emergency Preparedness Plan

Hazard Identification

The project is Commercial Complex, there may be following types of hazards:

1. Natural hazard:
   - Earthquake
   - Flooding
2. Man-made hazard:
   - Fire & explosion
   - Electrical
   - Mechanical
   - Radiation
   - Thermal
   - Chemical

Vulnerability analysis

This is a Commercial Complex hence, staff & visitors are vulnerable to risks.

The vulnerable analysis is done on all the hazards as below:

Table 1: Vulnerable Analysis

	During Construction	During Operation

HAZARD IDENTIFICATION		
Natural hazard		
Earthquake	For blocks which will be under construction	For all blocks
Flood	For immediate areas of construction	For the complete complex
Man-made hazard		
Fire & explosion	For all areas working area	For complete complex
Electrical	For all areas working area	For all areas working area
Mechanical	Cranes & Machineries	Elevator DG set room Services area
Radiation	Within the Complex	Within the Complex
Thermal	Within the Complex	Within the Complex
Chemical	Storage area	Storage area

Risk analysis

The risk is likelihood of harmful effect big or small due to hazard, together with severity of harm suffered. Risk also depends on number of people exposed to hazard.

Risk analysis provides severity of harm from particular type of hazard.

A safety plan mainly constituting the following shall be implemented during construction & Operation:

Table 2: Safety plan details

During construction Phase	**During Operation Phase**
• Safety mats would be provided at appropriate level and various shafts/ openings would be covered to prevent falls, slips, trips etc. • Necessary safety belts, helmets and eye-masks as required would be enforced at site • Adequate guardrails shall be provided to the staircases and common areas. • Adequate guardrails/ fences shall be provided around the water storage spaces to prevent drowning accidents.	• The project is located in Seismic Zone III; structural designing will be done as per best structural engineering practices complying with all the applicable codes / standards. • Proper designing of drainage system for domestic as well as storm water shall be provided. • Rain water harvesting pits will have provision of storage for 15 minutes peak rainfall.

• Adequate protection/ fence would be provided around the excavated areas • The machinery and the equipment would be regularly tested and maintained with the specific emphasis against accidents failures • The deployed Safety officers would ensure that the personnel/ labour are kept at a safe distance from working machinery to avoid accidents/ injuries due to toxic gases/ chemical/ noise. • Moving parts of various parts of machineries/ equipment shall be properly guarded • Required fire extinguishers would be maintained at the construction site. • Arrangements for clean drinking water would be made. • Rest rooms and first aid facilities would be made available for the workers • Fire Protection system has been designed as per requirements of NFPA & National Building Code – 2016	• Fire Protection system has been designed as per requirements of NFPA & National Building Code – 2016 • Proper Fire evacuation system shall be provided. • Safety parameters as indicated under Indian Electricity Rules 1956 and ECBC-2016 shall be complied. • Periodic replacement of critical components of elevator/ machines.

Earthquake:

The project is located at seismic zone IV where earthquake can occur from 4.0-7.0 Richter scale.

Flooding:

The project site is located at seismic zone IV where no chances of floods and landslides. However, flooding can occur due to excess rain.

Fire & Explosion:

Since it is a commercial complex, chances of fire are minimal. It can occur due to electrical spark or gas leakage from kitchen.

Fire caused in shopping mall complex is mainly due to carelessness, short circuits, and malfunctioning of gas regulator, tube, and such related products.

Electrical:

The electrical current can pass to the floor & metals due to inadequate insulation or accidently.

Mechanical:

The mechanical fault can cause the risk & hazard which include the elevators & DG Sets.

Radiation:

Due to use of wireless equipment's there may be electromagnetic radiation.

Thermal:

Thermal heat can be generated from the D.G sets and the vehicles in the Complex.

Chemical:

Chemicals used in complex are mainly cleaning agents & medicines.

Emergency preparedness plan

A hierarchy of controls has been developed and is described below to assist in selection of the most appropriate risk control measure/s which include the following.

Onsite emergency plan

An onsite emergency is caused by an accident or hazard that takes place within the complex and the effects are confined to the complex only.

The onsite emergency plan consists of following key elements:

- Health Hazards for construction activities
- Planning as per hazard analysis
- Preventive measures
- Emergency response procedure
- Recovery procedure

Health Hazards for construction activities

- Safety mats would be provided at appropriate level and various shafts/ openings would be covered to prevent falls, slips, trips etc.
- Necessary safety belts, helmets and eye-masks as required would be enforced at site
- Adequate guardrails shall be provided to the staircases and common areas.
- Adequate guardrails/ fences shall be provided around the water storage spaces to prevent drowning accidents.
- Adequate protection/ fence would be provided around the excavated areas
- The machinery and the equipments would be regularly tested and maintained with the specific emphasis against accidents failures
- The deployed Safety officers would ensure that the personnel/ labour are kept at a safe distance from working machinery to avoid accidents/ injuries due to toxic gases/ chemical/ noise.
- Moving parts of various parts of machineries/equipment shall be properly guarded
- Required fire extinguishers would be maintained at the construction site.
- Arrangements for clean drinking water would be made.

- Rest rooms and first aid facilities would be made available for the workers

Planning

1. Mapping of hazard vulnerable area shall be done in consultation with staff.
2. There shall be Disaster Management Cell in place
3. The disaster management cell has following members to share the responsibility
    I. Site Controller (Administrator)
    II. Incident Controller (Asstt. Administrator)
    III. Personal Manager
    IV. Communication Officer
    V. Fire Officer
    VI. Security Officer
    VII. Engineering In-charge
    VIII. Fire pump attendant
    IX. First Aid Team

Preventive Measures

A. Earthquake:
The project will be situated Seismic zone-III area. Special attention shall be given to the structural design of foundation, elements of masonry, timber, plain concrete, reinforced concrete, pre-stressed concrete, and structural steel.
All applicable guidelines will also be followed in this regard to ensure safety of the building and its staff. Structural designing shall be done as per National Building Code 2016.

B. Flooding:
- Proper designing of drainage system for domestic as well as storm water.
- Rain water harvesting pits will have provision of storage for 15 min rainfall.
- Excess water will be disposed off to sewer of the area as per discharge standards.

C. Fire:
Fire safety measures shall be taken as per NBC Code-2016 for proposed expansion.
In case of fire, fire extinguisher will be used. Fire extinguishers are put at the entrance of storage rooms. The Fire Extinguisher (FOG) System has been provided as per fire safety plan. The phone number of nearest fire service stations has been displayed at various points and also near the fire extinguishers. The fire-fighting system shall be designed as per NBC – 2016 for proposed expansion.

The complex is proposed to be provided with fire protection arrangements such as Manual call points, Underground water storage tank, Overhead storage tank, Portable appliances, Exit signs, D. G. Set, P. A. System, staircase etc. from fire safety point view.

(i) Proposed Fire Safety Measures
Fire Protection system shall be designed as per requirements of NFPA & National Building Code – 2016 for proposed expansion.

- Fire hydrant risers connected to the hydrant system with Hydrant landing valves with fire hose cabinet consisting of swinging hose reel, fire man's axe, 63mm dia canvas hose and nozzles.
- Externally fire hydrants will be located.
- Fire-fighting pumps of following capacity will be provided,
- Main Fire pumps for Hydrant System will be located.
- Main Fire pumps for sprinkler System will be located.
- Stand by pumps for Hydrant System will be located.
- Stand by pumps for Sprinkler System will be located.
- Jockey pumps will be provided.
- Booster pumps will be provided.
- Overhead & underground water tanks will be provided for firefighting system.
- Automatic Fire Hydrant system as per NFPA – 14 shall be provided.
- Automatic Sprinkler system as per NFPA – 13 shall be provided.
- Automatic Fire Detection and Alarm System with Voice Evacuation system & PA system as per NFPA – 72 shall be provided.
- Kitchen Hoods Fire Suppression system shall be provided.
- Portable Fire Extinguishers as per NFPA – 10 shall be provided.
- Gas Based Fire Protection System for Electrical Panels as per NFPA – 12 shall be provided.
- Gas Based Fire Protection System for IT Rooms as per NFPA – 2001shall be provided.
- Refuge areas shall be provided as per NBC 2005 norms

Note: The capacities of underground fire water storage tank calculated for 1-hour capacity of pumping sets. However, this needs to be confirmed as per the local chief fire officer's requirement.

Wet Riser & Hydrants System

It shall be consisting of: -

a) Static Underground storage fire tank of capacity- 650 m^3 for entire complex.
b) Terrace tanks of 10 m^3 at each tower of terrace level.
c) Fire main header of 150 mm dia. connected to external yard hydrants placed @ 45m c/c distance.
d) Wet - riser system with landing hydrant valves and fire hose cabinet @ 1000m^2 area minimum, and as per staircases/landing details of final architectural layouts. (As per recommendations of IS: 3844:1989, Code of practice for installation of Internal Hydrants)

Each Fire Hose Cabinet shall be consisting of:

- 2 nos., 63mm diameter and 15m long rubberized fabric lined hose pipe as per I.S:636 type-II.
- Gunmetal male and female instantaneous type coupling as per I.S:903 with I.S. specifications
- Gunmetal branch pipe with nozzle as per I.S:903
- First-aid fire hose reels with 20mm diameter, 36.5m long with 5mm bore gunmetal nozzle as per I.S:884 - 1969.
- Fireman's axe.
- All fire pumps (multi-outlet) shall be with positive suction arrangements.

- All the fire pumps shall cut-in automatically based on the pressure settings, so as to ensure that the entire fire main line, risers etc. are pressurized on a continuous basis.
- The jockey pump shall automatically cut-out based on the pressure settings. However, the remaining fire pumps shall off only in the manual mode.

Sprinkler System

- Sprinkler System shall be provided for all the basements. Sprinkler system shall also be provided in the Towers, greater than 45 meters height.
- Pendant sprinklers shall be provided @9m^2 in basement and @12 m^2 for upper floor. Sidewalls Sprinklers of normal/extended coverage shall be installed for the apartment units in the towers.
- Upright sprinklers shall be provided for any false ceiling areas in lobbies/common areas etc. and similar voids which are greater than 800 mm in height, if any.
- The sprinklers shall be automatically activated at 68^0 C and sprinkler line shall be always energized on a 24-hour basis by the main fire pumps.
- Necessary accessories such as Alarm Valves, Flow Switches, Inspection Test Assemblies and Annunciation Panel etc. shall be provided as per the detailed requirements.

Fire Extinguishers

The following type of portable fire extinguishers shall be provided at all levels of the towers, at strategic locations as per requirements, generally to follow IS – 2190: 1992)

a) 9 lit. water expelling type as per I.S:15683-2006
b) 4.5 kg, CO_2 type as per I.S: 15683-2006
c) 22.5 kg, CO_2 type as per I.S: 2878
d) ABC Powder Type as per I.S:15683-2006

Following Firefighting codes and standards shall be followed in the proposed group housing part of the project.

LIST OF APPLICABLE STANDARDS FOR FIRE ALARM SYSTEM

(1) IS: 2189 - 1962 Code of Practice for Automatic Fire Alarm System.

(2) IS: 2195 - 1962 Specifications for Heat sensitive Fire Detectors.

(3) IS: 732 - 1973 Code of practice for Electrical Wiring installation

(4) UL 168 Under writer's laboratory specifications for smoke detectors.

(5) SP: 35

D. Electrical:

(i) Planning Stage:

Safety parameters as indicated under Indian Electricity Rules 1956 and ECBC shall be complied. The following safety measurement are considered

- Earthing system

- The earthing system shall be based on the Indian TNS system. The earthing conductors proposed to be used are Copper plate for neutral and body earth.
- The design of the system shall follow the Indian Code of Practice IS 3043: 1987.
- ELCB in Distribution Board
- One Earth Leakage Breaker sensitivity 30 mA shall be used per phase in all Distribution Boards

In addition to that, following measures shall be adopted

- There will be colour coding and labelling of high voltage electrical wires
- Sand bags/ wire bucket shall be placed near the electrical control/panel
- Installation of electrical equipments shall be properly done like insulation, guarding and grounding.
- Work practices and handling of the electrical equipments shall be properly managed.
- Employees and workers shall be trained for awareness of safe work practices and systems.
- Properly maintained equipment and tools will be used.
- Service of electrical equipment shall be done under the supervision of trained personnel.
- Temporary connections made for experimental reasons shall be safe and properly insulated.
- Live electrical terminals shall be shielded.

(ii) Operation Stage:

- **Have only licensed electricians install, repair and dismantle jobsite wiring**.
- Check each extension cord before use.
- Do a thorough check for electrical wiring before cutting through any wall, floor or ceiling.
- **Inspect power equipment on a regular basis.**
- **Check insulated tools for damage before each use.**
- **Never modify electrical plugs.**
- **Keep extension cords in a safe place where they won't be stepped on or driven over.**
- **Ensure that all electrical components stay dry.**
- **Use the right extension cord for the job.**

1. Electric Hazards & Safety Measures

Safety parameters as indicated under Indian Electricity Rules 1956 and ECBC shall be complied.

The Contractors shall, at their own expense, arrange for safety provisions as per safety codes of Indian Standards Institution, Indian Electricity Act 1956 and such other Rules, Regulations and Laws as may be applicable and as indicated below, in respect of all labour, directly or indirectly employed in the work for performance of the Contractors' part of this agreement. The following safety measurements are considered:

- No inflammable materials shall be stored in places other than the rooms specially constructed for this purposes in accordance with the provisions of Indian Explosives Act.

- Protective and safety equipment such as rubber gauntlets or gloves, earthing rods, line men's belt, portable artificial respiration apparatus etc. will be provided in easily identifiable locations.
- Necessary number of caution board such as "Man on Line, Don't switch on" will be readily available in easily identifiable locations.
- Standard first aid boxes containing materials as prescribed by the Indian Red Cross will be be provided in easily identifiable locations and will be readily available. Periodical examination of the first aid facilities and protective and safety equipment provided shall be undertaken.
- Charts (one in English and one in regional language) displaying methods of living artificial respiration to a recipient of electrical shock shall be prominently displayed at appropriate places.
- A chart containing the names, addresses and telephone numbers of nearest authorized medical practitioners, hospitals, Fire Brigade and also of the officers in charge shall be displayed prominently along with the First Aid Box.
- Steps to train supervisory and authorized persons of the Engineering staff in the First Aid Practices, including various methods of artificial respiration with the help of local authorities such as Fire Brigade, St. John's Ambulance Brigade, Indian Red Cross or other recognized institutions equipped to impart such training shall be taken, as prompt rendering of artificial respiration can save life at time of electric shock.
- No work shall be undertaken on live installations, or on installations which could be energized unless one another person is present to immediately isolate the electric supply in case of any accident and to render first aid, if necessary.
- No work on live L.T. busbar or pedestal switchboards will be handled by a person below the rank of a Wireman and such a work should preferably be done in the presence of the Engineer-in -charge of the work. When working on or near live installations, suitably insulated tools should be used, and special care will be taken to see that those tools accidentally do not drop on live terminals causing shock or dead short.

2. ELCB in Distribution Board
    - One Earth Leakage Breaker sensitivity 30 mA shall be used per phase in all Distribution Boards
    - In addition to that, following measures shall be adopted
    - There will be colour coding and labelling of high voltage electrical wires
    - Sand bags/ wire bucket shall be placed near the electrical control/panel
    - Installation of electrical equipment shall be properly done like insulation, guarding and grounding.
    - Work practices and handling of the electrical equipment shall be properly managed.
    - Employees and workers shall be trained for awareness of safe work practices and systems.
    - Properly maintained equipment and tools will be used.
    - Service of electrical equipment shall be done under the supervision of trained personnel.
    - Temporary connections made for experimental reasons shall be safe and properly insulated.
    - Live electrical terminals shall be shielded.
3. Earthing system

The earthing system shall be based on the Indian TNS system. The earthing conductors proposed to be used are Copper plate for neutral and body earth.

The design of the system shall follow the Indian Code of Practice IS 3043: 1987.

E. Chemicals:

This is a commercial complex, No chemical container tanker shall be allowed inside the complex.

- The chemical hazard includes the following:
- Causing fire, explosion, Release of harmful /toxic gas or particles.
- Splashing of hot corrosive or toxic liquid.

To prevent chemical hazard following measures shall be taken:

- Use of safer chemicals as far as possible.
- Keep material safety Data Sheet (MSDS) of all chemical.
- Storage of chemical in appropriate container (which is safer for chemical)
- Storage of chemical at defined place will contribute to spillage control system.
- Proper environment like ventilation, temperature.
- Use of chemicals by qualified and trained personals.
- Use of personal protective equipment (PPE) during handing of chemicals.
- Use of emergency procedures in case of leakage like
    a) Fire-fighting – for fire
    b) Spillage treatment
    c) First aid
    d) Evacuation of area

For complex chemicals used are:

a) Cleaning agent (acid /caustic)
b) Insecticides
c) Medicines

- Cleaning agents can be treated by water.
- Insecticides shall be contained with specified space during sand & cotton and waste shall be sent to TSDF.
- The spray of insecticide shall be done by using gas mask.

F. Terrorism:

All the preventive measures shall be taken as given in security plan.

G. Mechanical:

Mechanical hazards are created by powered operation of equipment or tools.

Mechanical hazards can occur at three locations:

1) Elevators
2) DG set room, Pump & motors room.
3) Vehicular Movement

Following preventive measures shall be taken.

- Elevators shall be properly maintained with record book of maintenance.
- Periodic replacement of critical components of elevator/ machine.
- Proper training to operators of machines.
- The protective guard will be installed at fan & motors.
- There will be safe distance demarcation on heavy machines like cranes (during construction)
- Sign of danger at the hazard places.

H. Radiation:

The radiation hazard can be of two types:

- Ionizing Radiation (nuclear radiation)
- Nonionizing radiation (non-nuclear radiation)

In the commercial complex, radiation hazard is non-ionizing.
The radiation can be prevented in following manner:

- Shielding of radiation.
- Safe distance from radiation source.
- Sign of radiation hazard at vulnerable areas.

I. Thermal:

Thermal hazards are objects or substances that transfer energy as heat.

a) Typical building can have following points of thermal hazard.
   - Open flame
   - Boiling liquid
   - Hot machines/equipments

b) The thermal hazard can cause burn of skin; following preventive measures can be taken:
c) The open flame area like kitchen and mess shall be restricted.
d) D.G set room will have restricted entry.
   - Operators in the thermal hazard area shall be provided with protective gears like gloves, goggles etc.
   - For emergency first aid room will be maintained.

J. Emergency Response Procedure

Even after all the preventive measures for any emergency following infrastructure shall be provided.

- Administrative office shall also make an Emergency Control Room.
- Assembly area shall be demarked for each workplace.
- Communication system shall be installed in the complex which includes intercom and public addressing system.
- Fire alarm shall be installed at vulnerable place.
- The evacuation plan of each building shall be displayed at each floor of respective building.
- The safe zones (at the time of emergency) on map shall be displayed at different locations.
- First Aid facility shall be made available at Control room.
- In case of emergency following action shall be taken.
  - The emergency shall be declared in case of following:
  - Fire alarm buzzing (Fire hazard)
  - Any unusual smell of gas or suffocating feeling (Chemical leakage)

Security alarm from main gate. (Security risk/Terrorism)

1) On declaration of emergency communication shall be made to working staff for any type of emergency
2) All the working staff of the affected area shall be moved to safe zone
3) The control measures shall be done as per the emergency action plan for each type of hazard.
4) All the members of disaster management cell shall take charge of their respective duties.
5) Outside help like fire tender, police ambulance etc. shall be called by site controller or Incident controller.

K. Recovery Procedure

The recovery procedure will depend on the type of emergency. Recovery procedure shall be followed by engineering section to restore the essential services like electricity, water, telephone, food items.

Offsite emergency plan

If an accident take place in the complex and its effect are felt outside the complex, the situation thus created is called an offsite emergency.
In this case off site emergency is not applicable.

Security plan

An ISO 27001 and 27002, which are the international best practice information security management standards, defining and guiding Information Security Management System (ISMS) development shall be adopted. These will provide the necessary benchmarking for individual users to know the type of cover and the responsibilities that are defined and provided by that institution for its guests. Most importantly, training, to staff needs to be regularly imparted in dealing with such situations.

1. **Manual Checks**: At all gates the visitors and guest shall be manually checked and asked for ID's.
2. **CCTV:** At all important location with a remote viewing facility and record back up. With highest resolution and picture quality. DVR being the back bone, its recording and replaying capabilities must be considered.
3. **Checks at Entrances:** All car entering will be checked thoroughly inclusive of Bonnets, Luggage Hold with hand held, metal detectors, mirrors and other checking stuffs.
4. **Central Control Room**: This will control the security system from inside.
5. **Communication Systems:** Proper communication system to security staff shall help them to coordinate better during emergencies.

Training and Security Drills (including Surveillance System)

Disaster planning is the responsibility of all sections of the community. The police, fire brigade, civil defence, Home Guards, press, clergy, industrial groups, and community groups must participate in the pre-disaster planning. The community as a whole has the responsibility to teach first aid to groups in the community that could be utilized in disaster situations. The disaster may involve the normal communication network itself. Therefore, two-way radio systems and messenger systems must be included as backups in the event of a communication-system failure.

Proper training, security drill and evacuation drill shall be conducted in a defined time period, so as to train the management people, security personnel's, senior staff and all other working staff in the hotel to take control of all odds what so ever come in the way. These trainings shall be conducted for use of weapons and Arms by some trained agencies for the said trainings. The training shall be done periodically.

a) Making of Standard Operating Procedures
   A standard operating procedure manual shall be prepared, followed and maintained for all the eventualities due to attack by armed intruders.
b) Emergency Response Team
   The disaster management cell shall act as an emergency response team shall be formed in the complex which will comprise of persons from Internal Control room personnel, security staff, trainers, Police Control, Army official, Nearest Hospital Management, Fire officer to take control of any eventuality if comes in the complex.
   The nearest hospital in the area is Max Health Care Hospital.

Evacuation plan

Standard operating procedures will be formulated and maintained for all eventualities due to attack by armed intruders.

Evacuation plan includes the evacuation due to

- fire hazard
- Armed Intrusion
- Flood
- Earthquake

During any of the above-mentioned hazards, the evacuation will be as follows:

Communication

The communication system is useful for rapid notification to appropriate units and expeditious implementation of relief procedures. The fire brigade and metro police units are linked through a wireless communication network. Additional channels of communication are now available through personal cell phones. Use of personal cell phones will not be restricted during disasters.

On-site crowd control and information management

Disasters usually attract crowds consisting of curious bystanders, onlookers, overenthusiastic volunteers, and self-styled advisers. In general, this hampers rapid triage and transport. The primary responsibility for crowd management is with the police. When a call is received at any of the control rooms, the information is passed on to the local police. The police contingent which arrives on the scene has the primary responsibility for crowd control.

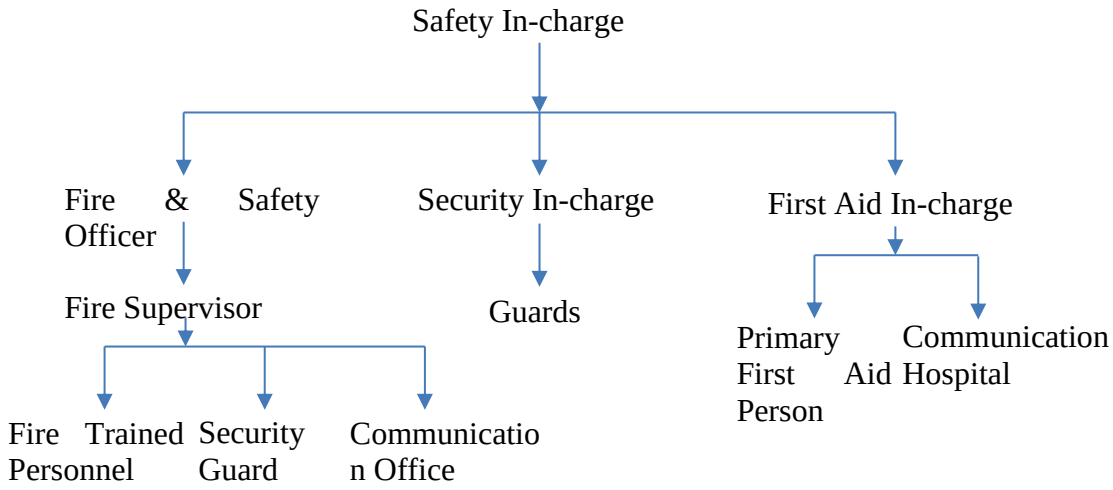

Figure 2: Disaster Management Cell