



ACREHEALTH
2 0 2 2
Air With Care



FIRE & LIFE SAFETY MEASURES IN HEALTH CARE FACILITIES

BY

V.SRINIVAS

M.TECH,FIE, M.I.FIRE.E(UK), M.I.FIRE.E(INDIA)

MASTER TRAINER-ECBC

HFDP-ASHRAE



INTRODUCTION



- **HOSPITALS NEED IMPECCABLE FIRE SAFETY MEASURES DUE TO**
 - **PHYSICALLY IMPAIRED PATIENTS**
 - **SLEEPING RISK**
 - **OXYGEN RICH ENVIRONMENT**
 - **SEALED BUILDINGS TO MAINTAIN PRESSURE DIFFERENTIALS**



INTRODUCTION : AMRI FIRE – 9 DEC 2011



Fire at AMRI in Kolkata



INTRODUCTION

- **EQUIPMENT HAZARDS :**
 - HIGH POWERED EQUIPMENT LIKE MRI/ CT/ UPS SYSTEMS etc
- **CHEMICAL HAZARDS**
 - CHEMICALS AND FLAMMABLE ANESTHETIC, CLEANING OR DISINFECTION AGENTS, SOLVENTS, ACIDS, ETHERS AND ALCOHOL ETC
- **MEDICAL GASES**
 - **MEDICAL GASES:** Medical gases like OXYGEN AND NITROUS OXIDE AND ALSO LPG FOR KITCHEN
- **OTHER SOURCES OF HAZARDS:**
 - LAUNDRY AND STERILIZATION PLANTS
 - AIR CONDITIONING SYSTEMS, AHU AND AIR DUCTS : ROOM CIRCULATION TYPE AIR CONDITIONERS
 - KITCHEN AND CANTEEN
 - GENERAL STORE
 - CAR PARK AREA
 - MATTRESSES, BEDDING, FURNITURE
 - MEDICAL RECORDS STORES
 - ELECTRICAL DEVICES SUCH AS VENTILATORS
 - ADDITION OF MEDICAL EQUIPMENT OVER A PERIOD OF TIME
 - HARMONICS DUE TO LARGE UPS/ MEDICAL EQUIPMENT/ VFDs

AND



INTRODUCTION

- LACK OF AWARENESS







HOSPITAL FIRES – 2004-2010

Sl No	Year	Day	Time	Country	City	Location of fire	Casualties/injuries
1	2004	Aug 30	4:43 PM	USA	Chicago, IL	Cigarette	One death
2	2006	Jan 03	2:00 AM	India	Hyderabad	Incubator	One baby death
3	2006	July 06	Midnight	USA	Dayton, OH	Air conditioner	No injuries
4	2007	Mar 07	8:00 AM	USA	New York, NY	Space heater	No injuries
5	2008	Jan 02	1:30 PM	England	London	Air conditioner	No injuries
6	2008	Jan 23	Early Morning	USA	Minneapolis, MN	Incubator	One baby burned
7	2008	Mar 13	4:15 AM	India	Ahmedabad	Incubator	One baby death
8	2008	Mar 13	2.30 AM	India	New Delhi	Incubator	One baby death
9	2008	Nov 16	Night	India	Meerut, UP	Incubator	One baby burned
10	2009	Jan 10	7:00 AM	Philippines	Manila	Ventilator	No injuries
11	2009	Jan 31	3:00 AM	India	Patiala, Punjab	Incubator	5 babies burned
12	2009	Feb 11	2:00 AM	England	London	Electrical room basement	Hundreds Evacuated
13	2009	May 03	Afternoon	India	Allahabad	Incubator	One baby death
14	2010	Feb 02	9:30 AM	India	Hyderabad	Diesel generator/short circuit	One death, 38 injuries
15	2010	Feb 03	9:20 AM	India	Kolkata	Short circuit in meter box	No injuries
16	2010	April 15	1:30 AM	India	Mancherial, AP	Incubator	One baby death
17	2010	April 19	2:30 PM	India	Katni, MP	Air conditioner	8 babies evacuated
18	2010	May 14		India	Nashik, Maharashtra	Electrical short circuit in ICU	One death
19	2010	June 14	11:30 AM	India	Siliguri, WB	Air conditioner	No injuries
20	2010	Aug 17		Romania	Bucharest	Air conditioner	5 baby deaths
21	2010	Sep 13	Midnight	Pakistan	Lahore	Air conditioner	3 pt deaths
22	2010	Nov 20	5:20 PM	Pakistan	Lahore	Switchboard	No injuries



HOSPITAL FIRES – 2011-2012

Sl No	Year	Day	Time	Country	City	Location of fire	Casualties/injuries
1	2011	Mar 09	Early morning	India	Beed, Maharashtra	Incubator	Two baby deaths
2	2011	May 27	11:30 AM	Bangladesh	Chittagong	Electrical short circuit in store room	No injuries
3	2011	June 28	10.30 PM	India	Chandigarh	Ventilator	One person injured
4	2011	July 24	5:10 AM	India	Chennai	Air conditioner	Two pt deaths
5	2011	Nov 23	7:24 PM	England	Bristol	O ₂ cylinder	One pt injured
6	2011	Dec 09	2:30 AM	India	Kolkata	Air conditioner	93 deaths
7	2012	Jan 08	Not known	India	Hisar, Haryana	Electric stabilizer	No injuries
8	2012	Mar 20	3:00 AM	India	Jorhat, Assam	Radial warmer	26 babies rescued
9	2012	Mar 21	9:00 AM	India	Kolkata	Air conditioner	No injuries
10	2012	Mar 22	8:40 AM	India	Medinipur, WB	Air conditioner	No injuries
11	2012	April 06	Afternoon	India	Allahabad	Air conditioner	No injuries
12	2012	April 21	1:00 AM	India	Guwahati, Assam	Air conditioner	No injuries
13	2012	May 31	3:50 PM	India	Delhi	O ₂ line	40 pts saved
14	2012	June 08	3:15 PM	Pakistan	Lahore	Air conditioner	7 baby deaths
15	2012	June 14	5:00AM	Australia	Adelaide	Kitchen	No injuries
16	2012	July 01	Early morning	India	Moradabad, UP	Air conditioner	Two deaths
17	2012	July 02	5:00PM	India	Delhi	Air conditioner	No injuries
18	2012	Aug 17	11:30 AM	India	Cuttack, Orissa	Air conditioner	No injuries
19	2012	Aug 23	Evening	India	Mumbai	Air conditioner	No injuries
20	2012	Aug 29	7:50 PM	India	Delhi	Electrical box	No injuries
21	2012	Sep 05	5:00PM	India	Jaipur, Rajasthan	Air conditioner	No injuries
22	2012	Sep 06	11:15 PM	India	Madurai	Air conditioner	No injuries
23	2012	Sep 06	2:19 AM	USA	Durham, NC	Defibrillator	One death, three injuries
24	2012	Sep 08	8:15 PM	India	Bokaro, Jharkhand	Air conditioner	Three deaths
25	2012	Sep 25	3:30 PM	India	Ludhiana, Punjab	MCB box (NICU)	No injuries
26	2012	Sep 25	5:00 PM	USA	Linton, IN	Motor (air handling unit)	No injuries
27	2012	Oct 02	10:30 PM	India	Kolkata	Air conditioner	No injuries
28	2012	Oct 23	4:06 AM	Taiwan	Tainan	Storage room	13 deaths, 60 injuries
29	2012	Nov 24	10:00 PM	India	Kolkata	Air conditioner	No injuries



INTRODUCTION



INTRODUCTION

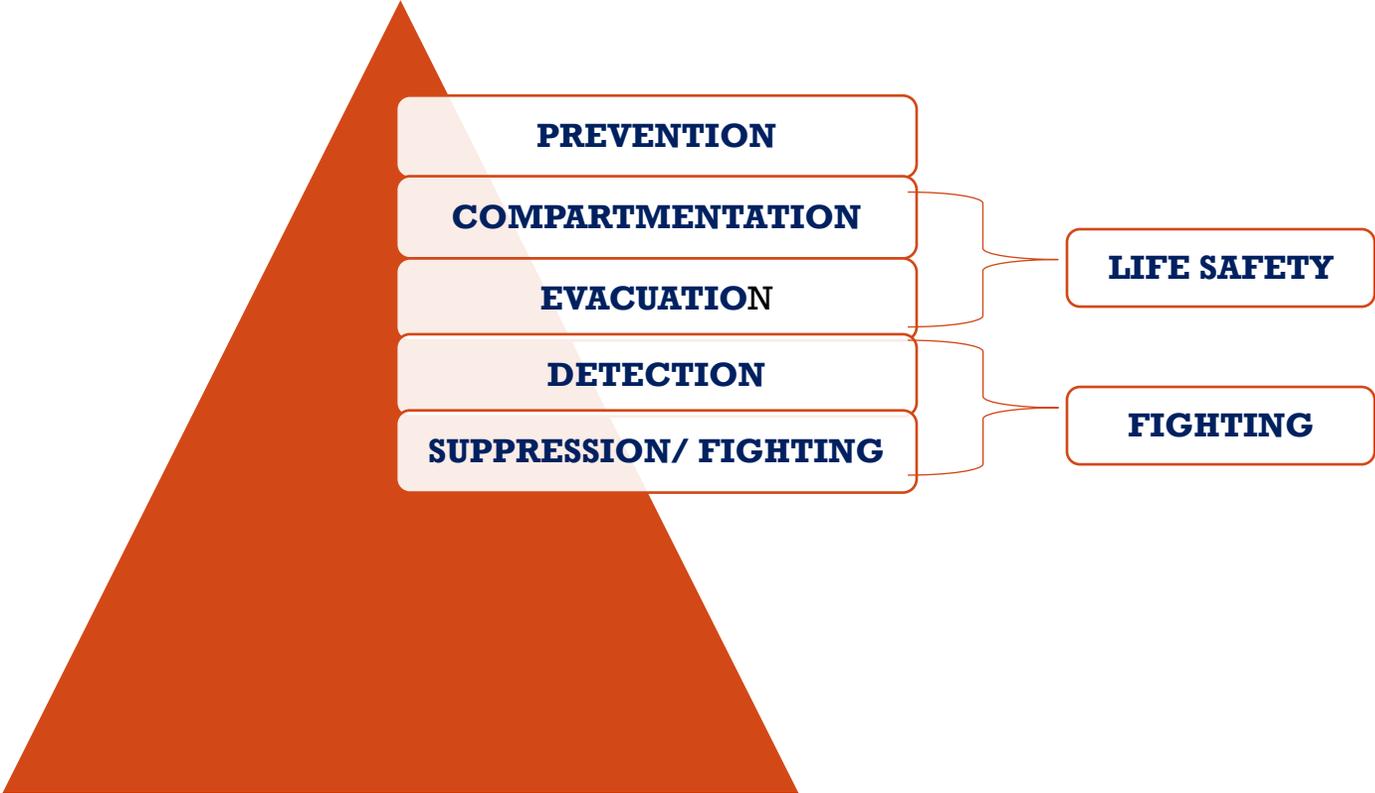


SMOKE

- **3/4 of all fire deaths are caused by smoke inhalation.
Source: Hall, Jr. John R. NFPA Fire Analysis & Research, Quincy, MA. “Burns, Toxic Gases, and other Hazards”.**
- **Approximately 57% of people killed in fires are not in the room of the fire’s origin.
Source: NFPA Fire Protection Handbook, 18th Ed. Table 1-1P. Pg. 1-15.**
- **Visibility - 47% of survivors caught in a fire could not see more than 12 feet.
Source: NFPA Fire Protection Handbook, 18th Ed. Table 8-1P. Pg. 8-17.**
- **Smoke travels 120-420 feet per minute under fire conditions
Source: Estimate based upon ceiling jet velocity calculations for typical ceiling heights and heat release rates.**



FIVE ELEMENTS OF FIRE SAFETY DESIGN



ELECTRICAL SAFETY:

IS 17512 SEGREGATES MEDICALLY USED ROOMS INTO THREE GROUPS BASED ON SAFETY CONSIDERATIONS.

- a) **GROUP 0** : WHERE **NO APPLIED PARTS** (PART OF MEDICAL ELECTRIC EQUIPMENT WHICH NEEDS TO BE TOUCHED BY PATIENT, OR BROUGHT INTO CONTACT WITH PATIENT TO PERFORM ITS FUNCTION), ARE INTENDED TO BE USED
- b) **GROUP 1** : WHERE **APPLIED PARTS** ARE USED EXTERNALLY OR INVASIVELY EXCEPT WHERE GROUP 2 APPLIES
- c) **GROUP 2** : WHERE **APPLIED PARTS** ARE INTENDED TO BE USED SUCH AS OPERATION THEATERS, INTERCARDIAC PROCEDURES, VITAL TREATMENT WHERE DISCONTINUITY OF POWER CAN CAUSE DANGER TO HUMAN LIFE



Medical location	Group			Class	
	0	1	2	≤ 0.5 s	> 0.5 s ≤ 15 s
1. Massage room	X	X			X
2. Bedrooms		X			
3. Delivery room		X		X ^a	X
4. ECG, EEG, EHG room		X			X
5. Endoscopic room		X ^b			X ^b
6. Examination or treatment room		X			X
7. Urology room		X ^b			X ^b
8. Radiological diagnostic and therapy room, other than mentioned under 21		X			X
9. Hydrotherapy room		X			X
10. Physiotherapy room		X			X
11. Anesthetic room			X	X ^a	X
12. Operating theatre			X	X ^a	X
13. Operating preparation room		X	X	X ^a	X
14. Operating plaster room		X	X	X ^a	X
15. Operating recovery room		X	X	X ^a	X
16. Heart catheterization room			X	X ^a	X
17. Intensive care room			X	X ^a	X

Medical location	Group			Class	
	0	1	2	≤ 0.5 s	> 0.5 s ≤ 15 s
18. Angiographic examination room			X	X ^a	X
19. Hemodialysis room		X			X
20. Magnetic resonance imaging (MRI) room		X			X
21. Nuclear medicine		X			X
22. Premature baby room			X	X ^a	X

^a Luminaries and life-support medical electrical equipment which needs power supply within 0.5 s or less.



ELECTRICAL SAFETY:

TO PREVENT ANY DIRECT SHOCK HAZARDS

- a. IN MEDICAL LOCATIONS OF GROUP 1 AND GROUP 2, THE NOMINAL VOLTAGE APPLIED TO CURRENT-USING EQUIPMENT **SHALL NOT EXCEED 25 V R.M.S.A.C. OR 60 V RIPPLE FREE D.C.** PROTECTION BY INSULATION OF LIVE PARTS OR BY BARRIERS OR ENCLOSURES IS ESSENTIAL
- b. IN MEDICAL LOCATIONS OF GROUP 2, EXPOSED-CONDUCTIVE- PARTS OF EQUIPMENT (FOR EXAMPLE, OPERATING THEATRE LUMINARIES), SHALL BE CONNECTED TO THE EQUIPOTENTIAL BONDING CONDUCTOR.

ALL MEDICAL EQUIPMENT OF 32 A AND ABOVE NEEDS TO BE CONNECTED WITH RESIDUAL CURRENT DEVICE (RCD) OF 30MA RATING



ELECTRICAL SAFETY:

- IN GROUP 2 MEDICAL LOCATIONS, AN ISOLATED POWER SUPPLY SYSTEM (USING ISOLATION TRANSFORMER) SHALL BE INSTALLED SEPARATELY EVERY ROOM, EXCLUDING THE FOLLOWING.
 - EQUIPMENT WITH A RATED POWER GREATER THAN 5KVA;
 - X-RAY EQUIPMENT;
 - THE SUPPLY OF MOVEMENTS OF FIXED OPERATING TABLES.
- ALL THE ELECTRICAL WIRING NEEDS TO BE SIZED PROPERLY, BE FIRE RETARDANT, BE OF LOW SMOKE TYPE AND RUN THROUGH STEEL CONDUITS.

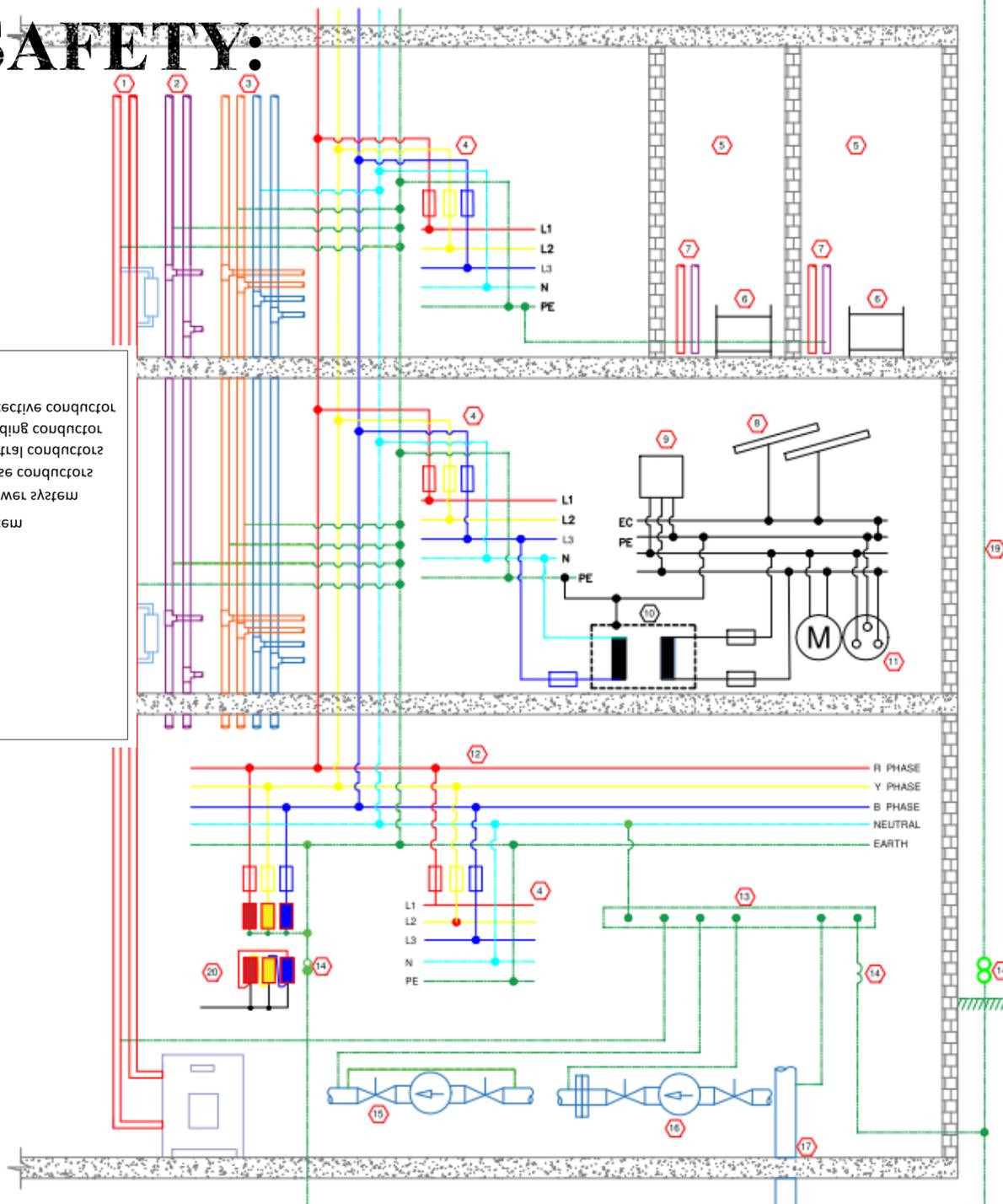


ELECTRICAL SAFETY:

- EQUI POTENTIAL BONDING
- All Transformer, DG sets, all medical electrical equipment and lightning protection system bonded together to form an equi-potential ring.
- The Cross sectional area of Protective (Earth) conductor needs to be equal in size to the phase conductor up to 16 sq.mm cross section and half of phase conductor for wires with cross section 16 sq.mm but up to 35sq.mm, and based on fault level, if more than 35sq.mm.
- All equi potential conductors between extraneous conductors (viz.water pipelines, fire fighting pipes and any other metal objects) and equi-potential bonding bar should not be less than 4sq.mm insulated copper conductor, and indicated in Green-yellow color. In treatment rooms , the size of same shall not be less than 16sq.mm copper



ELECTRICAL SAFETY:



- 15 Main distribution board
- 11 socket outlet
- 10 Medical isolation Transformer
- 9 Insulation Monitoring Device
- 8 Medical IT- system for operation theatre
- 7 Heating and water pipes
- 6 Hospital bed
- 5 General ward
- 4 Distribution board
- 3 Gas supply
- 2 Water supply
- 1 Heating pipes

- PE = Protective conductor
- EC = bonding conductor
- N = Neutral conductor
- L1, L2, L3 = Phase conductors
- S0 Flow public electric power system
- 18 Lightning protective system
- 18 Earth electrode
- 11 Waste water
- 10 Gas meter
- 12 Water meter
- 14 Joint
- 13 Main Earthing Bar

ГЕСЕИД



ELECTRICAL SAFETY:

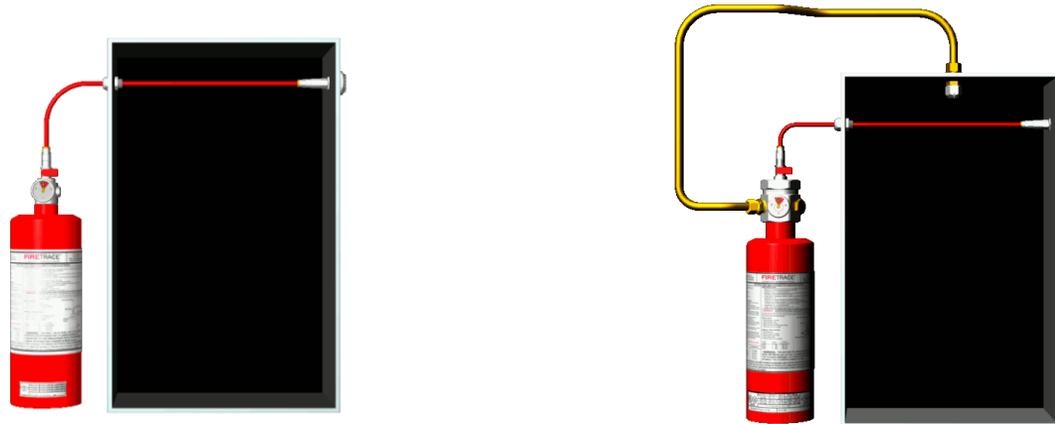
THE FOLLOWING EQUIPMENT RELATED TO FIRE AND LIFE SAFETY HAS TO BE SUPPORTED WITH EMERGENCY POWER

- a. FIRE PUMPS
- b. PRESSURIZATION/ VENTILATION FANS
- c. FIRE LIFTS
- d. EXIT SIGNAGE
- e. EMERGENCY LIGHTING
- f. FIRE ALARM SYSTEM
- g. PUBLIC ADDRESS SYSTEMS
- h. COMPARTMENT DOORHOLD OPEN DEVICES
- i. LIGHTING OF FIRE COMMAND CENTER



ELECTRICAL SAFETY:

- ELECTRICAL SUBSTATION WITH 2 HOUR FIRE COMPARTMENTATION
- AND WITH MECHANICAL VENTILATION OR AIR CONDITIONING
- ELECTRICAL MAIN DISTRIBUTION PANEL, EMERGENCY POWER SUPPLY PANELS, MEDICAL EQUIPMENT PANELS AND LIFT PANELS SHOULD BE PROVIDED WITH CO₂/ INERT GAS FLOODING SYSTEM



- OIL COOLED TYPE TRANSFORMERS ARE NOT PERMITTED TO BE INSTALLED INDOORS. FOR INDOOR INSTALLATIONS, ONLY DRY TYPE TRANSFORMERS SHALL BE USED
- OUTDOOR OIL COOLED TRANSFORMERS OF 10 MVA AND ABOVE (OR IN CASE OF AGGREGATE OIL QUANTITY MORE THAN 2000 LITERS) HAVE TO BE PROVIDED WITH FIRE PROTECTION SYSTEM USING HIGH VELOCITY WATER SPRAY (HVWS) SYSTEM OR WITH NITROGEN INJECTION PROTECTION SYSTEM



ELECTRICAL SAFETY:

- THE OIL COOLED TRANSFORMERS HAVE TO BE SEPARATED BY 4HR FIRE RATED BAFFLE WALLS UPTO A HEIGHT OF 600MM ABOVE THE TOPMOST POINT OF TRANSFORMER. OIL SOAK PIT IS TO BE PROVIDED TO DRAIN THE OIL.
- INDOOR DRY TYPE TRANSFORMERS HAVE TO BE LOCATED INSIDE A 2 HR FIRE RATED COMPARTMENT.
- DIESEL GENERATOR SETS NEEDS TO BE INSTALLED ONLY AT GROUND OR IN FIRST BASEMENT BUT NOT ON ANY OTHER FLOOR.
- THE DG SET-ROOM HAS TO BE COMPARTMENTED WITH 2HR FIRE RATED WALLS AND DOORS.
- THE DAY FUEL TANK OF THE DG SETS HAS TO BE PROVIDED WITH A DYKED ENCLOSURE, UPTO HEIGHT OF 300 MM AND FILLED WITH SAND HAVING A CAPACITY OF AT LEAST 10 PERCENT MORE THAN THE VOLUME OF FUEL TANK



ELECTRICAL SAFETY:

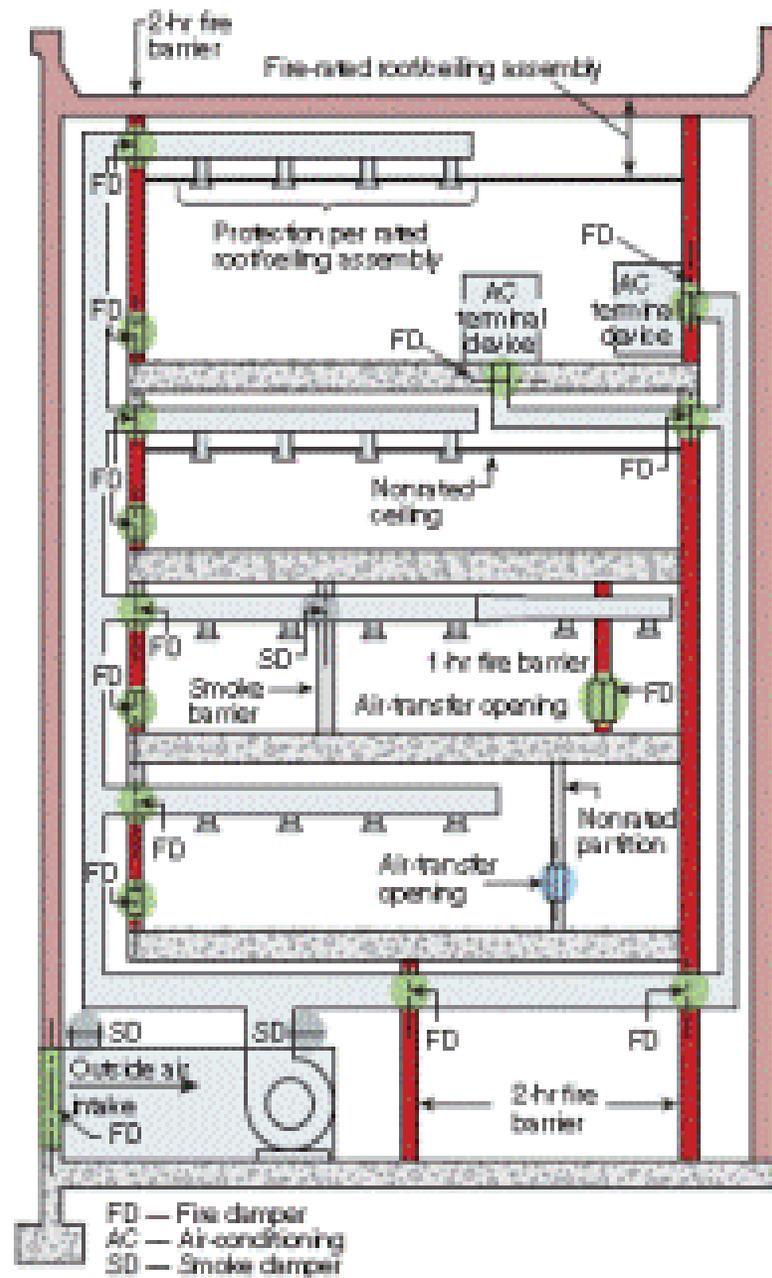
- BATTERY BANKS OF UPS SYSTEMS ARE TO BE ENCLOSED IN A 2HR FIRE RATED COMPARTMENT AND PROVIDED WITH MECHANICAL VENTILATION/AIR CONDITIONING.
- THE VENTILATION SYSEM SHALL ALSO BE PROVIDED WITH A FIRE DAMPER AT THE ENTRY TO ROOM. IT IS RECOMMENDED THAT A HYDROGEN GAS DETECTOR INTEGRATED WITH FIRE ALARM SYSTEM IS PROVIDED AS AN ADDITIONAL SAFETY MEASURE.
- LIGHTNING PROTECTION HAS TO BE PROVIDED AS PER IS/IEC 62305 WITH EARTH RESISTANCE VALUE NOT MORE THAN 10 OHMS. THE DOWN CONDUCTORS OF LIGHTNING PROTECTION SYSTEM SHOULD NOT BE ROUTED THROUGH ANY SHAFT



AIR HANDLING UNITS

- EACH FIRE COMPARTMENT NEEDS TO HAVE SEPARATE AIR HANDLING UNIT (AHU)
- DUCTS TO HAVE MINIMUM 30 MIN FIRE RATING,
- IF THERE IS A COMMON AHU FEEDING DIFFERENT FIRE COMPARTMENTS, FIRE/ SMOKE DAMPERS SHOULD BE PROVIDED AT
 - (A) FIRE SEPARATION WALL
 - (B) WHERE DUCTS/PASSAGES ENTER THE VERTICAL SHAFT
 - (C) WHERE THE DUCTS PASS THROUGH FLOORS (D) AT THE INLET OF SUPPLY AIR DUCT
 - (E) RETURN AIR DUCT OF EACH COMPARTMENT ON EVERY FLOOR. (NBC:VOL.1/PART 4, VOL2 /PART
- AIR CONDITIONING SUPPLY OR RETURN DUCTS SHALL NOT PASS THROUGH ANY EGRESS WAYS OR STAIRCASES.
- METAL DUCTS ARE PREFERABLE FOR RETURN AIR.





GLAZING:

- GLAZING IS NOT ALLOWED IN THE EGRESS ROUTES.
- FULLY SPRINKLED BUILDINGS HAVING FIRE SEPARATION OF 9 M OR MORE FROM THE ADJOINING BUILDING CAN HAVE GLAZING MADE OF TEMPERED GLASS IN A NON-COMBUSTIBLE ASSEMBLY AND WITH ABILITY TO HOLD THE GLASS IN PLACE.
- SPRINKLERS MUST BE LOCATED WITHIN 600 MM OF THE GLASS FACADE PROVIDING FULL COVERAGE TO THE GLASS.
- ALL GAPS BETWEEN FLOOR-SLABS AND FACADE ASSEMBLY HAVE TO BE SEALED BY FIRE RESISTANT SEALANT MATERIAL.



- OPENABLE PANELS HAVE TO BE PROVIDED,
 - SPACED NOT MORE THAN 10 M
 - AT A HEIGHT BETWEEN 1.2 M AND 1.5 M FROM THE FLOOR,
 - IN THE SIZE NOT LESS THAN 1000 MM × 1000 MM OPENING OUTWARDS.
 - THE WORDINGS “FIRE OPENABLE PANEL. OPEN IN CASE OF FIRE, DO NOT OBSTRUCT



KITCHENS:

- ALL KITCHEN HOODS HAVE TO BE FITTED WITH GREASE AND OIL TRAPS AND THERMAL DETECTORS.
- IN CASE OF FIRE, EXHAUST SYSTEM SHOULD BE AUTOMATICALLY SWITCHED OFF.
- FOOD SERVING AREAS HAVE TO BE SEPARATED FROM KITCHEN WITH ONE HOUR FIRE RATED CONSTRUCTION/ DOORS.
- AUTOMATIC WET CHEMICAL FIRE SUPPRESSION SYSTEM HAS TO BE PROVIDED ON ALL COOKING EQUIPMENT AND HOODS.
- LPG LEAK DETECTORS HAVE TO BE PROVIDED INSIDE THE KITCHENS.
- SPRINKLERS OF 141DEG.C, K80 RATING NEED TO BE



www.shutterstock.com · 1472076788



MEDICAL GASES:

- MEDICAL GAS OUTLETS LIKE OXYGEN AND NITROUS OXIDE SHOULD BE AT LEAST 20CM AWAY FROM POWER OUTLETS WHICH CAN GENERATE SPARKS IN NORMAL/ FAULT CASES.(NEC 2011, PART 3: SECTION 4: MEDICAL ESTABLISHMENTS) OR WITH GAS TIGHT COMPARTMENTS
- BOTH ELECTRICAL WIRING AND MEDICAL GASES ARE ALLOWED TO BE ROUTED THROUGH COMMON ENCLOSURE ONLY IF MULTIPLICATION VALUE OF NO LOAD VOLTAGE(V) AND SHORT CIRCUIT CURRENT (A) DOES NOT EXCEED 10VA.



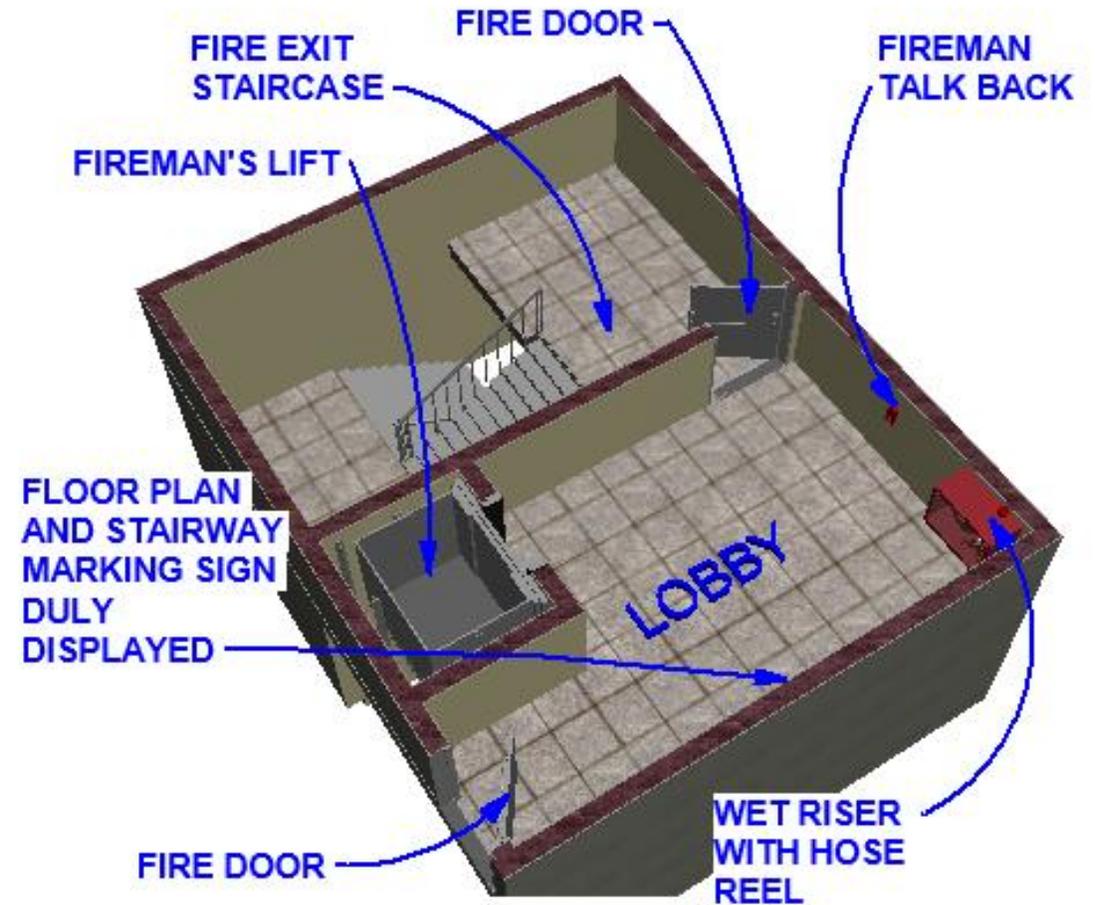
MEDICAL GAS ROOMS:

- ALL MEDICAL GAS STORAGE/ HANDLING ROOMS HAVE TO NECESSARILY BE PROVIDED WITH MECHANICAL VENTILATION SYSTEM
- WITH AT LEAST 12 AIR CHANGES PER HOUR.
- THE ROOMS NEED TO BE SEPARATED BY 2HR FIRE RATED WALLS/ DOORS.
- LPG CYLINDERS HAVE TO BE LOCATED WITHIN WELL VENTILATED SPACES WITH EACH BANK CAPACITY OF NOT MORE THAN 1000KGS.
- LPG LINES TO BE ROUTED THROUGH OUTSIDE VENTILATED WALLS BUT NOT THROUGH ENCLOSED SHAFTS, AND AWAY FROM STAIRCASES

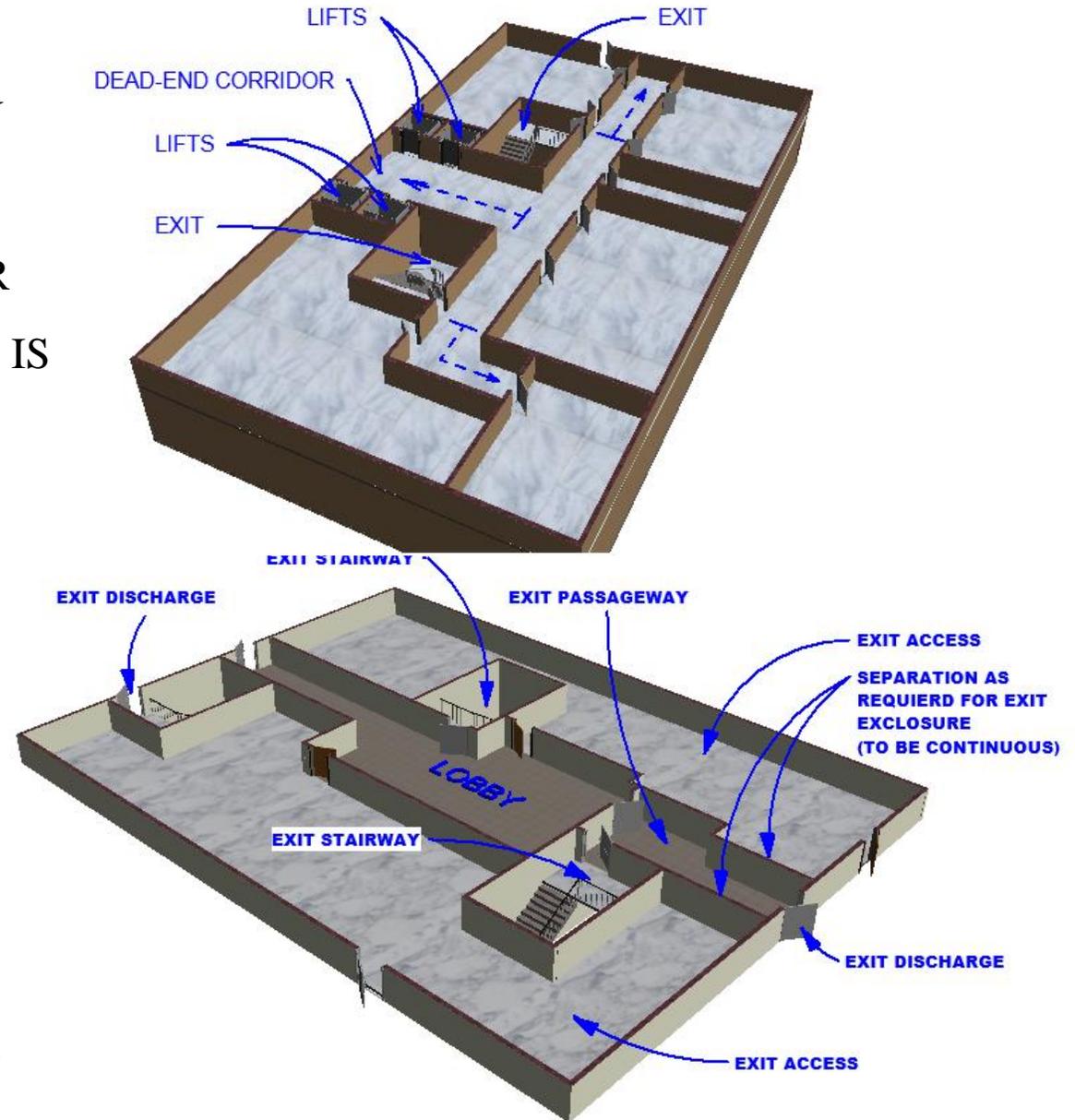


LIFE SAFETY AND MEANS OF EVACUATION

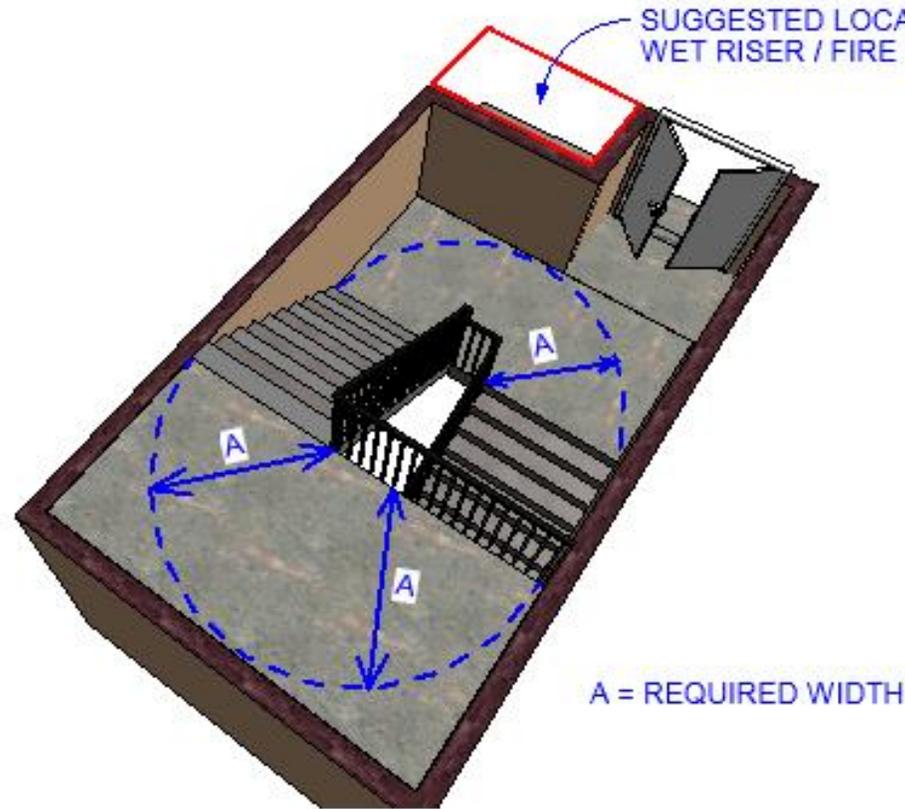
- MINIMUM ONE STAIR CASE AND ONE FIRE FIGHTING SHAFT (FIRE TOWER) IS MANDATORY FOR A HIGH RISE HEALTHCARE FACILITY.
- THE MINIMUM WIDTH OF STAIRCASE HAS TO BE 2.0M.
- TRAVEL DISTANCE TO A STAIRCASE SHOULD NOT BE MORE THAN 30M FROM FARTHEST POINT, IN CASE OF NON SPRINKLED BUILDING AND 45M IN CASE OF SPRINKLED BUILDING.
- HOWEVER THE TRAVEL DISTANCE FROM DEAD END CORRIDOR CANNOT BE MORE THAN 6M.



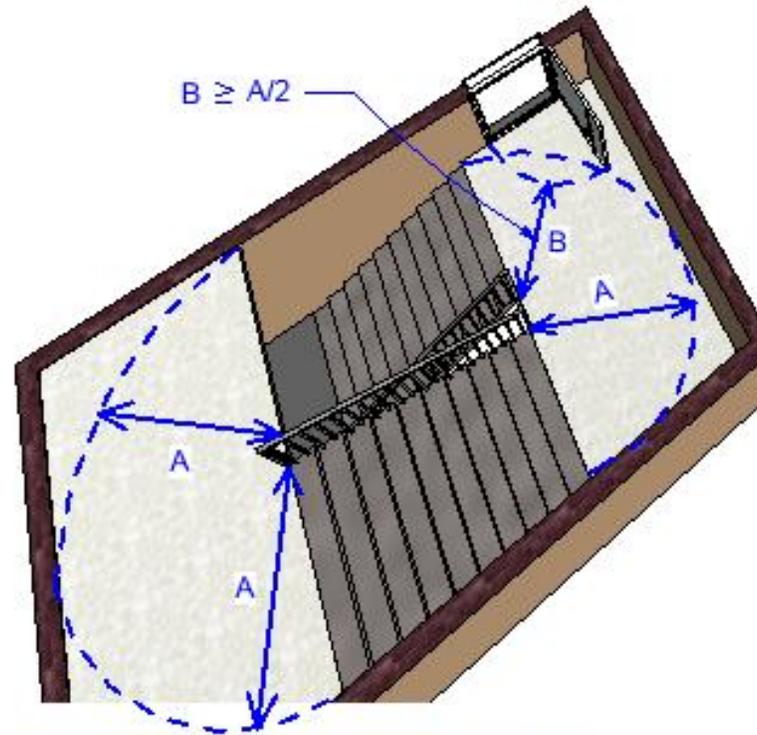
- THE TOTAL WIDTH OF STAIRCASES BASED ON OCCUPANT LOAD OF THE FACILITY WORKED OUT BASED ON 15MM PER PERSON. HOWEVER FOR LEVEL COMPONENTS/ RAMPS, THE SAME IS WORKED OUT BASED ON 13MM PER PERSON.
-
- THE OCCUPANT LOAD SHOULD BE 15SQ.M/ PERSON IN IN-PATIENT AREAS AND 10SQ.M/ PERSON IN OUTPATIENT AREAS.
- THE EXTERNAL STAIRCASES HAVE TO BE ON THE EXTERNAL WALL OF BUILDING WITH PROVISION TO DISCHARGE PEOPLE DIRECTLY OUTSIDE OR TO A SAFE EGRESS CORRIDOR.



DOOR LOCATION AT LANDING EXITS



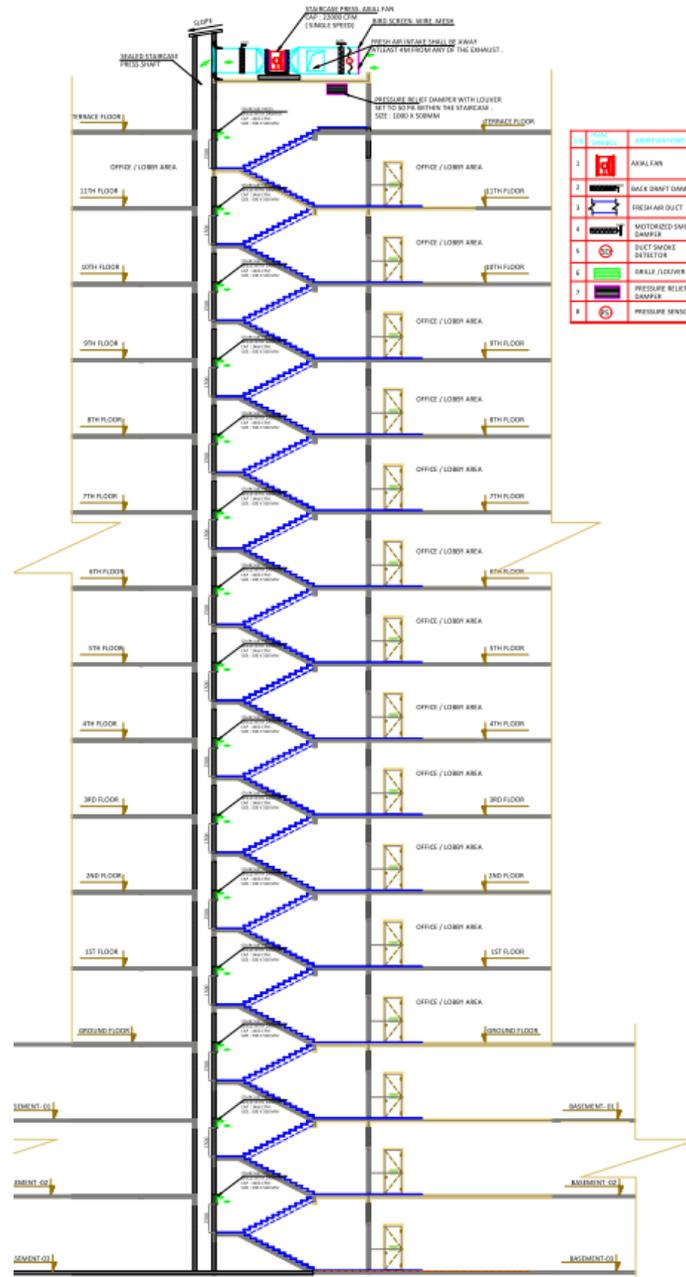
MINIMUM REQUIRED UNOBSTRUCTED CLEARANCE WITH DOOR LEAF ENCROACHING ON LANDING IN INSTITUTIONAL AND ASSEMBLY BUILDINGS



MINIMUM REQUIRED UNOBSTRUCTED CLEARANCE WITH DOOR LEAF ENCROACHING ON LANDING



SINGLE SPEED FAN WITH PRESSURE RELIEF DAMPER.



DISCHARGE (M³/S) = A (LEAKAGE AREA IN SQ.M.) * PRESSURE(PASCALS) ^1/N

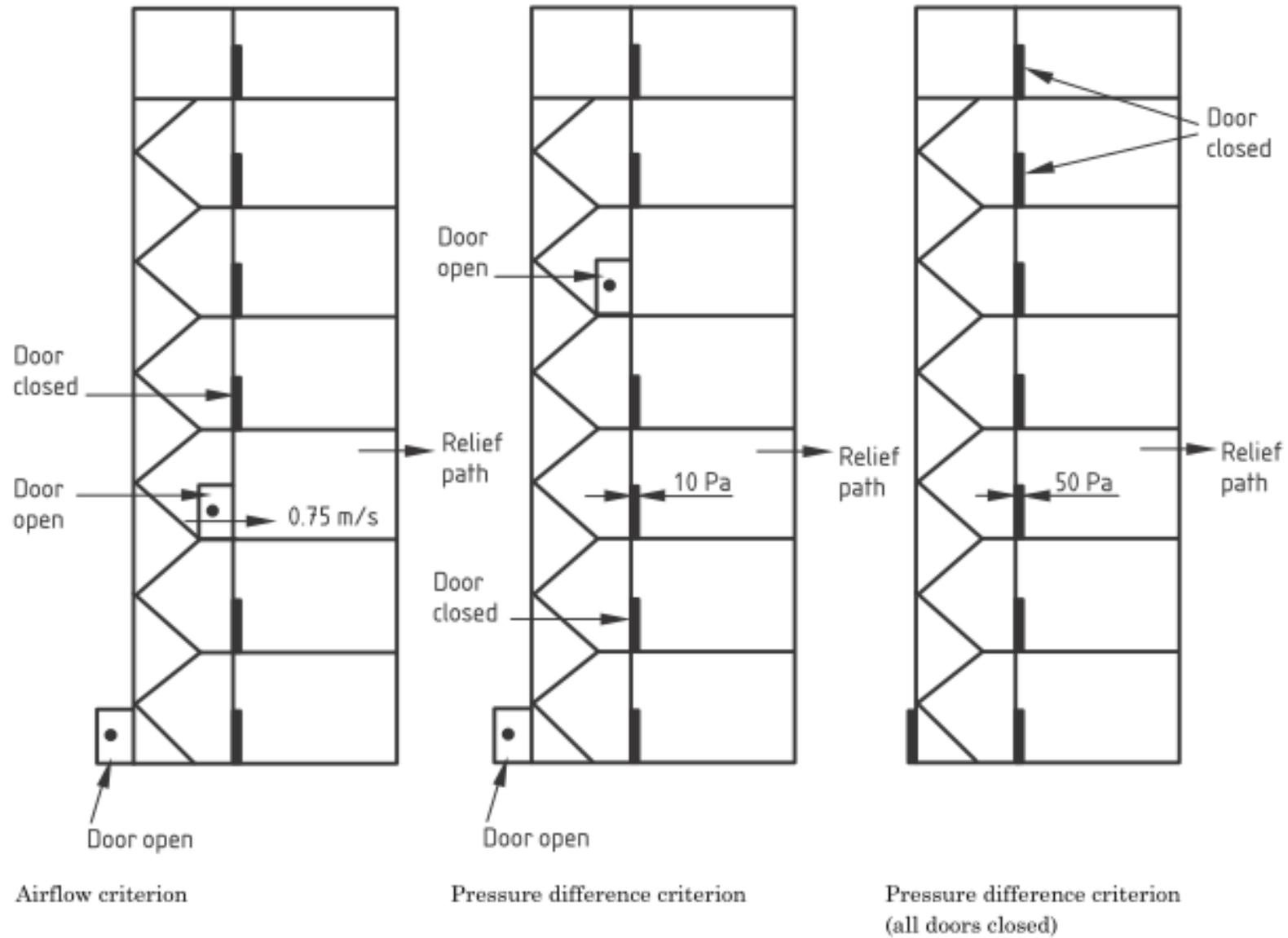
WHERE N = 1.6 FOR SMALL OPENINGS

AND 2 FOR LARGE OPENINGS LIKE DOORS/ WINDOWS

STAIRCASE SCHEMATIC



SUGGESTED DESIGN CONDITIONS FOR PRESSURIZATION



BASEMENT / CAR PARK VENTILATION SYSTEM:

- TO OPERATE AT 12 AIR CHANGES PER HOUR USING DUCTED OR DUCTLESS (JET FANS) SYSTEM, IF NOT PROVIDED WITH NATURAL VENTILATION CUTOUTS OF 2.5% OF FLOOR AREA.
- A SEPARATE SYSTEM HAS TO BE PLANNED FOR EACH COMPARTMENT AND EACH BASEMENT.
- MAXIMUM SIZE OF A COMPARTMENT SHOULD NOT BE MORE THAN 3000 SQ.M. HOWEVER REQUIREMENT OF MINIMUM TWO COMPARTMENTS IS NOT APPLICABLE IF THE AREA IS LESS THAN 750SQ.M



SMOKE MANAGEMENT SYSTEM:

- THE CORRIDORS WHICH ARE NOT NATURALLY VENTILATED AND ALSO CRITICAL CARE AREAS WHICH ARE NOT HAVING AN EXTERNAL WALL WITH BREAKABLE WINDOWS, THE SAME SHALL BE PROVIDED WITH SMOKE MANAGEMENT SYSTEM. ,
- BY A DEDICATED SYSTEM (WHICH IS WITH FANS AND DUCTS EXCLUSIVELY FOR SMOKE MANAGEMENT)
 - **OR**
- A NON DEDICATED SYSTEM (WHICH IS AN ADDITION TO REGULAR AIR CONDITIONING EQUIPMENT) IE BY PROVIDING AFIRE RATED (250°C FOR 2HRS) EXHAUST FAN IN AHU ROOM. THE SIZE OF FANS SHALL BE FOR 12 AIR CHANGES PER HOUR.



COMPARTMENTATION:

- WITH 2HOUR FIRE RATING IN SUCH A WAY THAT AREA OF EACH COMPARTMENT IS NOT MORE THAN 1800M² AND WITH MINIMUM TWO COMPARTMENTS, EVEN IF AREA IS LESS THAN 1800M².
- EACH COMPARTMENT HAS TO ACCOMMODATE, IN ADDITION TO ITS OWN, THE PATIENTS FROM ADJOINING COMPARTMENT BY CONSIDERING 3.5 M² PER PERSON. IF PATIENTS ARE NOT BED-RIDDEN, A FACTOR OF 0.6 M² PER PERSON IS ACCEPTABLE.
- CRITICAL CARE UNITS LIKE OPERATION THEATRES, DELIVERY ROOMS, INTENSIVE CARE UNITS, RECOVERY ROOMS, ETC, THAT ACCOMMODATE PATIENTS AND ALSO LABORATORIES OF MORE THAN 100SQ.M AREA NEED TO BE SEPARATED FROM ADJOINING AREAS BY 2HR FIRE RATED WALLS/ DOORS AS A SEPARATE COMPARTMENT





FIRE SEALANTS:

- ALL PIPING/ DUCTING/ CABLE PENETRATIONS THROUGH COMPARTMENTS SHALL BE SEALED OFF AS PER SMACNA “GUIDELINE ON THROUGH PENETRATION FIRE STOPPING”.
- HOWEVER AN ENGINEERING JUDGEMENT SHALL BE OBTAINED FROM MANUFACTURER FOR EACH AND EVERY SEALING.



PIPE & DUCT SEALING

System No. C-AJ-7003

October 05, 2006

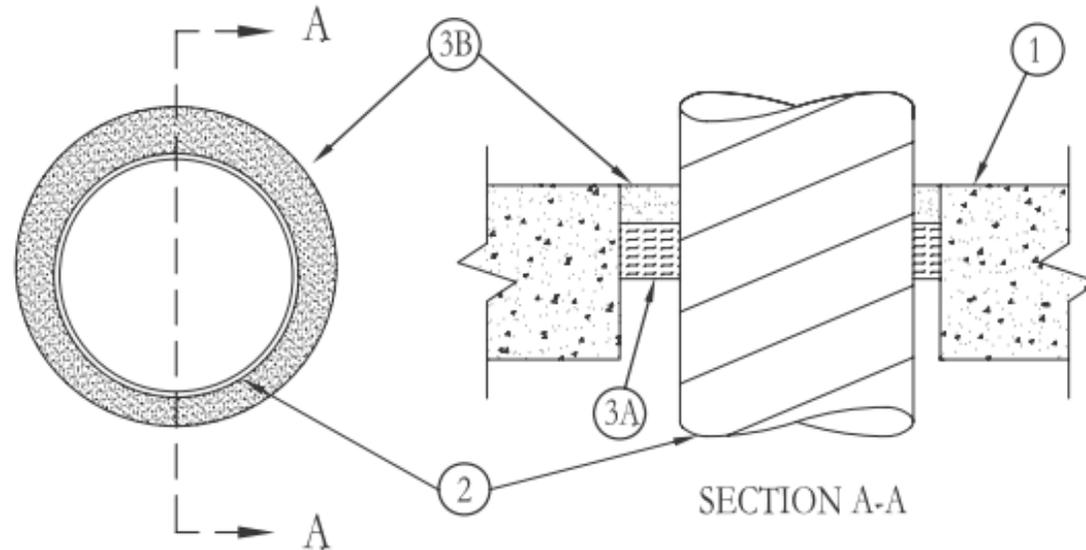
F Rating - 3 Hr

T Rating - 0 Hr

L Rating At Ambient - 1 CFM/sq ft (See Item 3)

L Rating At 400 F - less than 1 CFM/sq ft (See Item 3)

W Rating - Class I (See Item 3B)



1. **Floor or Wall Assembly** - Min 4-1/2 in. (114 mm) thick lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***. Max diam of opening is 18 in. (457 mm).
See **Concrete Blocks** (CAZT) category in the Fire Resistance Directory for names of manufacturers.
- 1A. **Steel Sleeve** - Nom 6 in. (152 mm) diam (or smaller) Schedule 40 (or heavier) steel pipe sleeve, cast into floor or wall flush with floor or wall surfaces.
2. **Through Penetrant** - One steel duct to be installed either concentrically or eccentrically within the firestop system. An annular space of min 1/2 in. (13 mm) to max 1-1/2 in. (38 mm) is required within the firestop system. Steel duct to be rigidly supported on both sides of floor or wall assembly. The following sizes of steel ducts may be used:
 - A. **Steel Duct** - Nom 16 in. (406 mm) diam (or smaller) No. 24 gauge (or heavier) spiral wound galv steel duct.
 - B. **Steel Vent Duct** - Nom 10 in. (254 mm) diam (or smaller) No. 28 gauge (or heavier) galv steel vent duct.
3. **Firestop System** - The firestop system shall consist of the following:
 - A. **Packing Material** - Nom 1 in. (25 mm) thickness of tightly-packed mineral wool batt insulation firmly packed into opening as a permanent form. Polyethylene backer rod or nom 1 in. (25 mm) thick glass fiber insulation may be used with steel vent ducts (Item 2B) in lieu of mineral batt insulation. Packing material to be recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of caulk fill material.
 - B. **Fill, Void or Cavity Materials*** - **Caulk or Sealant** - Min 1 in. (25 mm) thickness of fill material applied within the annulus, flush with top surface of floor or both surfaces of wall assembly. W Rating applies only when FB-3000 WT sealant is used. Water resistance



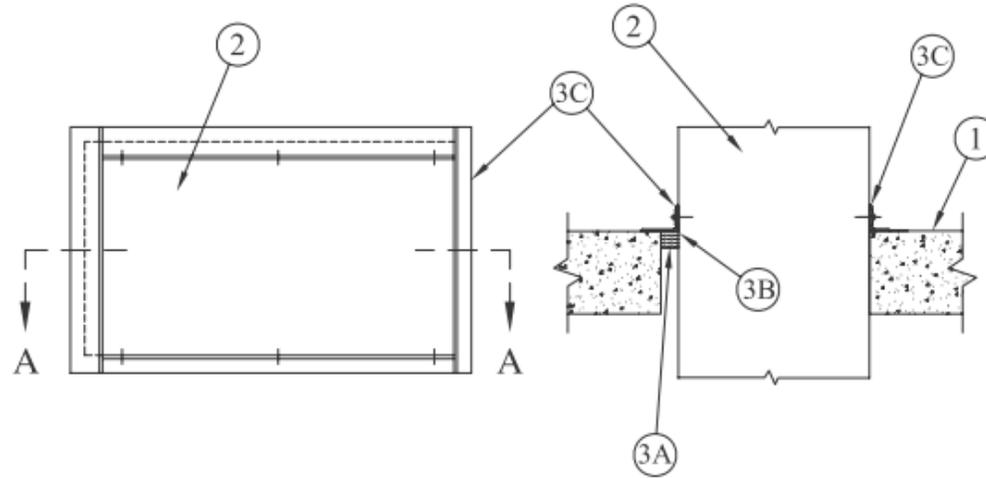
PIPE & DUCT SEALING

System No. C-AJ-7016

May 19, 2005

F Rating - 2 & 3 Hr (See Item 1)

T Rating - 0 Hr



1. **Floor or Wall Assembly** - Min 2-1/2 in. (64 mm) thick or min 4-1/2 in. (114 mm) thick lightweight or normal weight (100-150 pcf or 1600-2400 kg/m³) concrete. Wall may also be constructed of any UL Classified **Concrete Blocks***. **The F Rating is 2 hr and 3 hr for min 2-1/2 in. (64 mm) or min 4-1/2 in. (114 mm) thick assemblies.** Max area of opening is 576 sq in. (3716 c/m²) with max dimension of 36 in. (914 mm) for 2 hr assemblies and 544 sq in. (3510 c/m²) with max dimension of 34 in. (864 mm) for 3 hr assemblies.
See **Concrete Blocks (CAZT)** category in the Fire Resistance Directory for names of manufacturers.
2. **Through Penetrants** - One steel duct to be installed either concentrically or eccentrically within the firestop system. An annular space of min 0 in. (point contact) to max 4 in. (0 mm to max 102 mm) is required within the firestop system for 2 hr assemblies and min 0 in. (point contact) to max 2 in. is required within the firestop system for 3 hr assemblies. Steel duct to be rigidly supported on both sides of floor or wall assembly. The following sizes of steel ducts may be used:
 - A. **Steel Duct** - Nom 32 in. by 14 in. (813 mm by 356 mm) (or smaller) No. 22 gauge (or heavier) galv steel duct.
 - B. **Steel Duct** - Nom 30 in. by 12 in. (762 mm by 305 mm) (or smaller) No. 24 gauge (or heavier) galv steel duct.
3. **Firestop System** - The firestop system shall consist of the following:
 - A. **Packing Material** - Nom 1 in. (25 mm) thickness of tightly packed mineral wool batt insulation firmly packed into opening as a permanent form. Packing material to be recessed from top surface of floor or from both surfaces of wall as required to accommodate the required thickness of caulk fill material.
 - B. **Fill, Void or Cavity Material* - Caulk or Sealant** - Min 1 in. (25 mm) thickness of fill material applied within annulus, flush with top surface of floor or both surfaces of wall assembly. At the point contact location between duct and concrete, a min 1/4 in. (6 mm) diam bead of sealant shall be applied to the concrete/duct interface on the top surface of floor and on both surfaces of wall assembly.
3M COMPANY - CP 25WB+, IC 15WB+ caulk or FB-3000 WT sealant.
 - C. **Retaining Angles** - Min 16 gauge galv steel angles sized to lap duct a min of 2 in. (51 mm) in. and lap top surface of floor or both surfaces of wall a min of 1 in. (25 mm). Angles attached to duct with min 1/2 in. (13 mm) long, No. 10 (or larger) sheet metal screws spaced a max of 1 in. (25 mm) from each end of duct and spaced a max of 6 in. (152 mm) OC.

*Bearing the UL Classification Marking



Equipment/ Building category	G+1 floor with no beds	G+1 floor with beds	G+2 more floors with no beds	G+2 or more floors with beds	Less than 15m with plot<1000sq.m	>15m but <24m in Height	>24m i Height <45m*
Fire Extinguishers	Required	Required	Required	Required	Required	Required	Required
Hose reels		Required	Required	Required	Required	Required	Required
Wet Risers				Required	Required	Required	Required
Down comer			Required				
Yard Hydrants					Required	Required	Required
Sprinklers in basements > 200sq.m	Required	Required	Required	Required	Required	Required	Required
Sprinklers in all areas				Required	Required	Required	Required
UG Static tank, capacity in kilo- litre				75	100	150	200
Terrace tank, capacity in kilo- litre	(5)*	5(+5)*	10 (+5)*	10	10	20	20
Fire Pumps				1620 PM – One electric + One Diesel backup &180LPM -1no Jockey pump	1620 PM – One electric + One Diesel backup &180LPM-1no Jockey pump	2280 PM – One electric + One Diesel backup &180LP M-1no Jockey pump	2280 PM – Two electric + One Diesel backup &180LP M-2nos Jockey pumps
Terrace pumps	450 lpm (+450lpm) *	450lpm (+450lpm) *	900lpm (+450lpm) *				

Note :

1. ** indicates max height for Healthcare facility
2. * indicates additional capacity if basement > 200sq.m



SMOKE DETECTOR SPACING

Type of Detectors (1)		Spacing for Ceiling Heights								Remarks (10)
		Up to 3.5 (2)	4.0 (3)	5.0 (4)	6.0 (5)	7.0 (6)	8.0 (7)	9.0 (8)	10.0 (9)	
Smoke Detectors Conforming to IS 11360 both ionization and optical type		9	No Chance	No Chance	No Chance	7.5	6.5	6.0	5.0	The Spacing in corridors should not be greater than 3S/2;
Heat Detectors conforming to IS 2175	Grade 1 (Time instant 20s)	7	No Chance	6	5	5	4	3	Nil	Spacing from the boundary wall should be kept S/2
	Grade 2 (Time instant 40s)	6	5.5	5	4	3.5	3	Nil	Nil	
	Grade 3 (Time instant 60s)	5	4.5	4	3	3.5	Nil	Nil	Nil	

Air changes/Hour (1)	Multiplying Factor For Modified Spacing (Area For Coverage) (2)
7.5 or less	1(1)
8.6	0.95(0.91)
10	0.91(0.83)
12	0.83(0.70)
15	0.74(0.55)
20	0.64(0.40)
30	0.50(0.25)
60	0.38(0.15)



THE FIRE ALARM SYSTEM NEEDS TO INCLUDE MONITOR MODULES

- WATER LEVEL IN ALL TANKS
- HYDRANT AND SPRINKLER PRESSURES OF RESPECTIVE ZONES
- OPERATION OF FIRE PUMPS
- ISOLATING VALVES STATUS WHEREVER PROVIDED WITH SUPERVISORY SWITCH
- SPRINKLER FLOW SWITCHES

SYSTEM HAS TO INCLUDE CONTROL MODULES TO CONTROL

- AIR HANDLING UNITS TO STOP RECIRCULATION OF AIR TO SMOKE ZONES
- START PRESSURIZATION FANS IN EGRESS ROUTES
- INITIATE OPERATION OF EXHAUST FANS IN BASEMENTS/ OTHER AREAS
- RELEASE ALL ACCESS CONTROLLED DOORS/ COMPARTMENT DOORS
- INITIATE AUTOMATIC PUBLIC ADDRESS/ VOICE MESSAGE SYSTEMS
- INITIATE WATER CURTAINS/FIRE CURTAINS
- SWITCH OFF POWER EXCEPT FOR EMERGENCY EQUIPMENT LIKE FIRE PUMPS/ EXIT SIGNAGE/ FIRE



Spacings of Sprinklers as per IS 15105

Hazard	Coverage area (sq.m)		Spacing of sprinklers (m)	
	Side wall	Other types	Side wall	Other types
Light	17	21	4.5	4.5
Moderate/ Ordinary	9	12	3.4	4.0
High : In general		9		3.7



Fire Extinguisher Requirements as per IS 2190

Hazard	Class of Fire	Type of Extinguisher	Min No.'s per floor	Area of Coverage (sq.m)	Distance/ Radius (m)
Light	Class A	9 liter Water expelling or ABC 5/6Kg	2	200	15
	Class B	9 liter Foam or ABC 5/6Kg	2	200	15
	Class C	2/3 Kg Clean agent	1	20	15
Moderate/ Ordinary	Class A	9 liter Water expelling or ABC 5/6Kg	4	200	15
	Class B	9 liter Foam or ABC 5/6Kg	4	200	15
	Class C	10Kg DCP/ 6.5Kg CO2/ 5Kg Clean agent	1	100	15
High	Class A	Same as Moderate above + 50Kg Water/CO2 and 25kg ABC	1	100	15
	Class B	Same as Moderate above + 50 liter Mechanical foam or 25kg ABC and 135liter Foam mechanical	1	100 + 135 liter Mech foam for 300sq.m	15
	Class C	DCP 10Kg/ 6.5Kg CO2/ 5Kg clean agent	2	100	10
	Class D	10 Kg with special powder for metal fires	2	100	10
Special (For Computer installations)	Class A	4.5Kg CO2/ 2or 3Kg Clean agent	2	100	10



REFERENCES

1. National Building Code (NBC) of India 2016 : Volume 1, Part IV (Fire and Life Safety)
2. IS : 2189: Code of Practice for selection, installation and maintenance of Automatic Fire Detection and alarm system(2008)
3. IS : 2190: Code of Practice for selection, installation and maintenance of First Aid Fire Extinguishers (2010)
4. IS 15105 : Code of Practice for Design and installation of Fixed Automatic Sprinkler Fire Extinguishing system (2002)
5. National Electrical Code of India (2011)
6. National Disaster Management Guidelines- Hospital Safety, Government of India(2016)
7. HVAC design manual for hospitals and clinics(2nd edition)
8. National Fire Prevention Association NFPA 99, Health Care Facilities Code (2021)
9. NFPA-Emergency Evacuation planning guide for people with Disabilities (2016)
10. NFPA 101, Standard for Smoke Control Systems (2021)
11. NFPA 92,Standard for Smoke Control Systems (2018)
12. Healthcare Technical Manual, 05-02, Fire safety in the design of healthcare premises, Dept of Health, UK (2015)
13. International Fire Code, Published by INTERNATIONAL CODE COUNCIL, INC.USA (2018)
14. NFPA 110,Standard for Emergency and Standby Power Systems (2019)



THANK YOU

srinivas@synergyinfra.com

+919849008313

