

Designing for fire safety: Case study Dhaka III

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One key component of fire design is to plan in advance to restrict the spread of fire within fire-tight compartments, so that the threat develops slowly, enabling the people to escape. Buildings have to be separated into fire compartments by Vertical Fire Separators (wall, partition) and Horizontal Fire Separators (floor/assembly) offering resistance.

It is necessary to create compartments within a building if its size so demands. In large buildings there may be several compartments on a floor. In multi-storied buildings, each floor can be a compartment. A compartment should survive a complete burnout of its combustible materials without the collapse of the fire-resisting separators.

After a fire breaks out it is of paramount importance for the safety of the inhabitants for them to find the quickest and safest route away from the fire and on to a safe area. The size of a compartment is usually given in volume with maximum

Fire Compartmentation (for example) An apartment, a suite of offices a retail outlet, or a vertical shaft, etc.

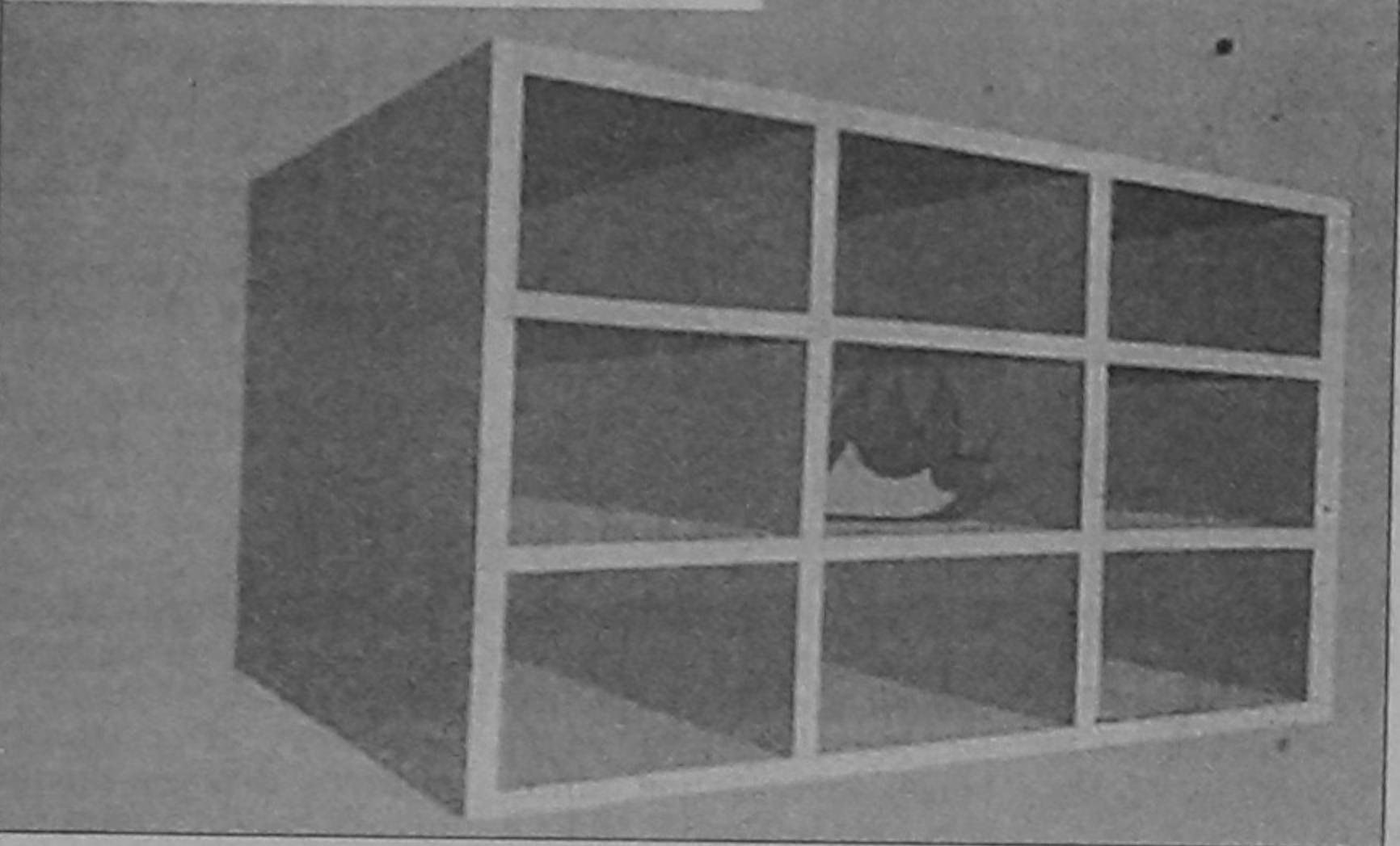


Figure 1: Fire is contained in the central compartment that is protected by heat resistant building elements, as are all the other eight compartments in a building.

allowable height, as well as the fire resistance required for the building elements (column, beam, walls, floor, and ceiling) for different floors.

Architects may consider an apartment, a suite of offices, a retail outlet, or a vertical shaft as a compartment, depending on their size and the safe travel distance.

Compartmentation shall fail if a path for fire spread is allowed, e.g. through an air-conditioning duct or above the drop (popular as false) ceiling. The vertical fire separator must extend from the fire separating floor to the fire separating floor above. To prevent fire/smoke spread via ducts fusible link operated dampers should be used. If a conveyor belt penetrates a fire separating wall, a fusible link operated shutter should be released when temperature rises above a set limit to stop fire spread. Escalators too can have covering hoods to contain fire/smoke within a compartment.

Steelworks are non fire resisting and require to be protected by fire resisting material, such as concrete or insulating board. In this regard there are lessons to be learnt from the collapse of the World Trade Centre on 9/11, 2001 particularly because Dhaka is bracing to have multi-storied steel structures.

The following is a chronology of events

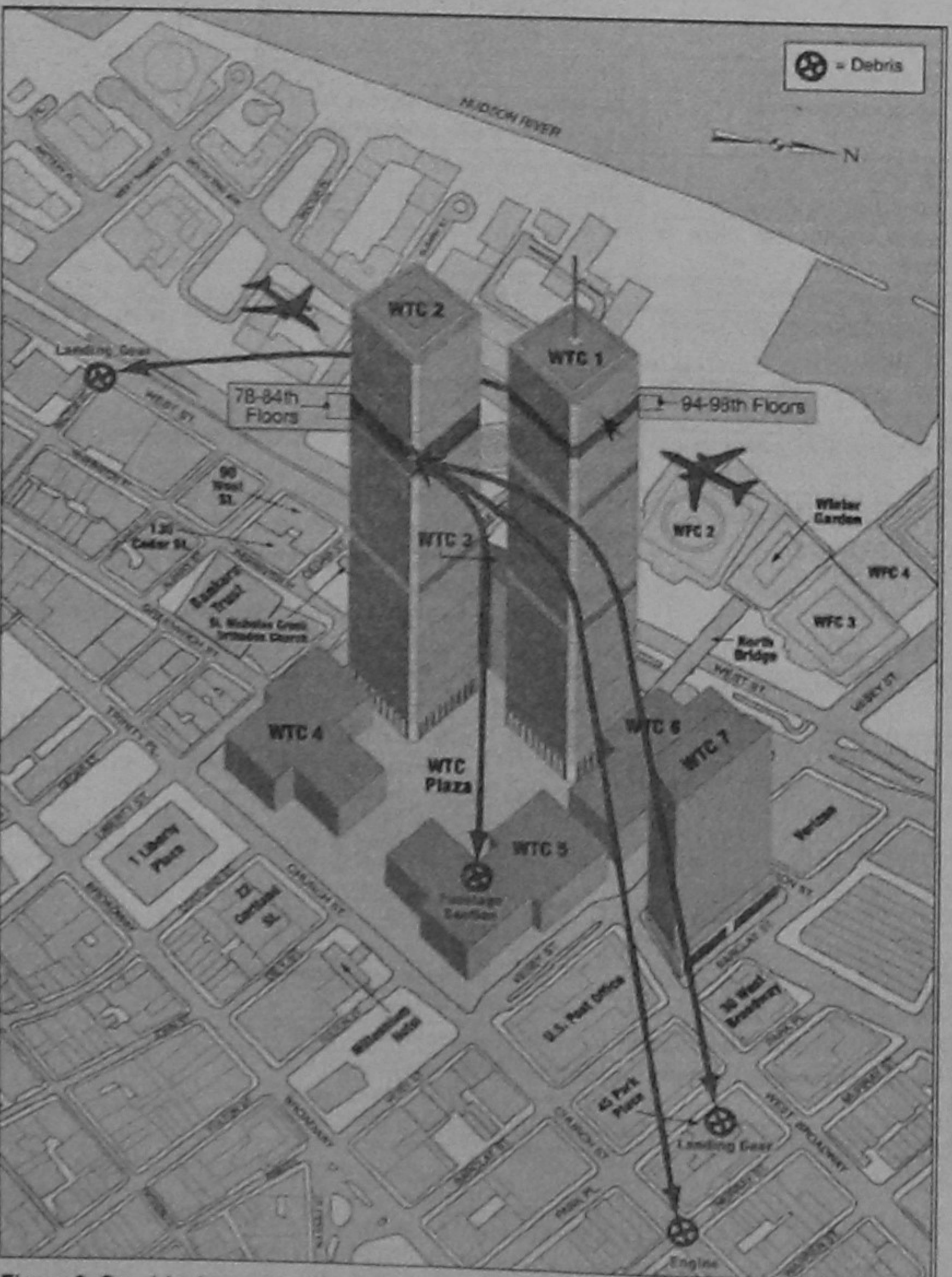


Figure 2: Graphical presentation of the events of 9/11

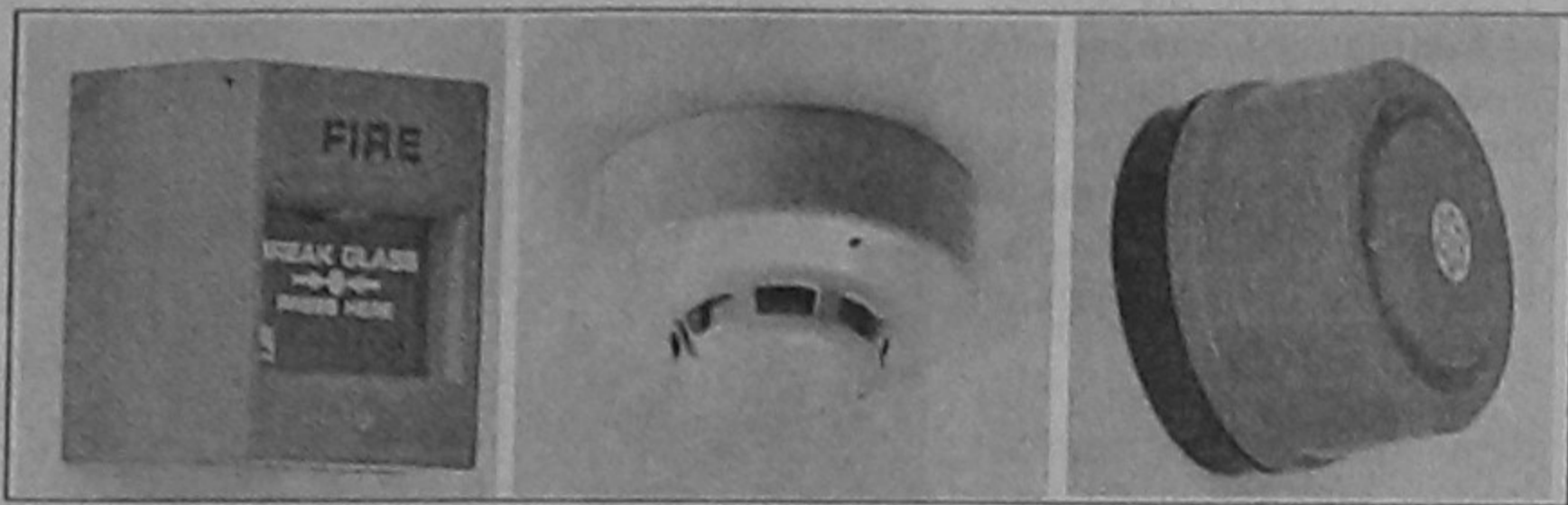


Figure 4: Break glass to set off alarm, smoke detector and fire alarm (from left)

of the twin towers in New York:

1960s, the architects provided fire resistance for floors to last for two hours and columns to hold for three. Three hours for floors and four hours for columns not chosen because there was "no economic advantage in using Class 1A construction" stated a 1987 memorandum by a chief structural engineer for the World Trade Department.

1969 Port Authority of New York and New Jersey directed contractors to coat the steel floor supports with a 1/2-inch-thick lightweight spray-on layer of fire-proofing (asbestos or mineral fibre),

beams should be encased in masonry or other more effective fire retarding material. Spray-on fire retarding is ineffective.

- Lightweight bar joists should not be used to support floors in high-rise buildings, unprotected steel bar joist fail after five or ten minutes of fire exposure
- For life safety in high-rise buildings smoke-proof stairways allows people to escape fire.
- Stairs and elevator shaft ways should be enclosed in masonry to prevent smoke spread.
- HVAC (heating, ventilation, and air-conditioning) should be provided by unit system serving only one or two floors. Central air system serving 10 or 20 floors creates shaft ways and duct systems that penetrate fire-rated floors, walls, partitions, and ceilings. Smoke spreads through ducts of central HVAC systems.
- Automatic sprinklers should protect all high-rise buildings.
- Fire-fighters can extinguish approximately 2500 square foot of fire with one hose line. The World Trade Centre floor areas were 40000 square feet in area.
- Remember: Building codes are only minimum standards.

In designing for fire, occupant load (capacity) of a building is vital, as number of people determine number of doors, and size of entry/exits. That is what makes a garment factory of, say 500 workers,

tors can be of various types: detectors for hazardous situation, ionization smoke detectors, visible smoke detectors, radiation, or flame detectors, ultrasonic and infrared ray detectors, combustion gas detectors, and heat detectors. In places where smoke detectors can become unreliable because of temperature and dust concentration, heat detectors are used. Heat detectors are unsuitable for protecting persons from fire in the same room. Automatic fire/smoke detectors eliminate the human element. Alarm should be synchronized with the fire services, if not automatically, at least by immediate telephone contact as soon as fire/smoke is discovered. In the United Kingdom there are about 400,000 false fire alarms annually. Fire is not a matter with which one can take a chance.

The smaller a fire the easier and effectively it is tackled. Do not wait for it to grow by thinking that perhaps, just perhaps, you may be able to tackle this one. In the BSEC Bhaban incident 26 February 2007, in which four persons died, fire was allowed to develop long after it was discovered. A survey of the building long before the February fire had dubbed the situation 'not safe in case of fire'.

When fire is discovered you have three possible things to do, (1) attack the fire with extinguishers/hose reel if you have the training to do, (2) escape from the fire by a pre-drilled route, (3) raise alarm by available means. Do not return to save someone you think/know is inside.

Every building should be well equipped with Fire Points, as required, depending on the area and volume of the building, which shall have fire alarm set-off system (by 'break-glass' units or by automatic detectors), telephone to contact fire control command station on ground floor/plaza level (especially in a large, high-rise building), fire smothering blanket, fire extinguishers of different types, hose reel that is primed to a hydrant, pick axe to break into locked space, if any, such as to be able to tackle

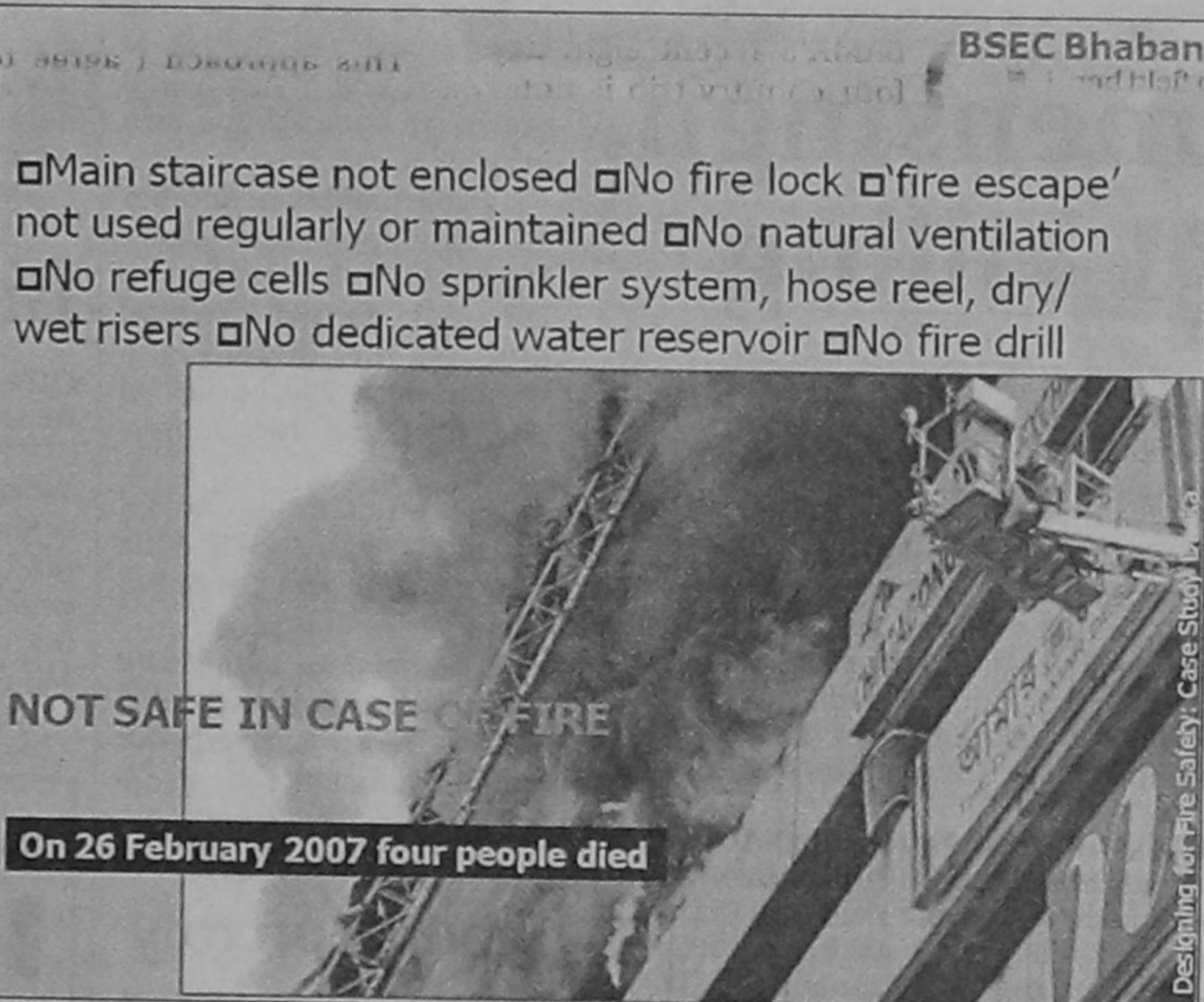


Figure 5: BSEC Bhaban declared unsafe long before the fire. The building has not learnt its lesson.

dangerous in a building that was designed as an office or apartment building housing 50 persons.

Bangladesh National Building Code 1993 (BNBC) has specific recommendations for area per person, e.g. 10m² per person in offices and factories, 0.3m² in halls for seated audience.

Early detection of fire and warning by fire alarms as soon as it is discovered is crucial for safety and effective fire fighting. Fire and smoke detectors are a prerequisite for maximum safety. Fire detec-

tor when it is small. The Fire Point should also have instructions, but it is advisable to read them before a fire attack, and definitely not after; you could be losing valuable time for your own safety. Run!

For a fire to start, you need heat, fuel (combustible material) and oxygen. In controlling fire, it is attempted to separate the fire from any one or all of the three elements.

For instance, every kitchen should have fire blankets (any blanket would do) that one would use to cover a pan on fire



Figure 3: The dying moments of the Twin Towers before its 9/11 collapse

Classification of fire extinguishers				
Classification	Class A	Class B	Class C	Class D
Old system of labelling, valid in Bangladesh	A	B	C	D
New system of labelling (USA)				No picture label
Use on	Ordinary combustibles	Flammable liquids	Electrical equipment	Combustible metals
Example of material	Wood, textile, paper, curtains, furniture	Grass, gasoline, oil	'C' means it is non-conductive	Open metal specific
Numerical rating means	The amount of water the extinguisher holds	The area (sq ft) that a person can extinguish	No numerical rating	No numerical rating

Figure 6: Properties of fire extinguishers

FIRE EXTINGUISHING AGENTS:

- Inhibit flaming
- Number and location based on size and organisation of space

For Electrical Equipments

Wet Chemical: Potassium Carbonate/Acetate solution

Dry Powder/ Chemical

Foam

Water

Carbon Dioxide

Halon

Figure 7: Fire extinguishers come as different types

with and thereby control perhaps the major cause of domestic fires.

Fire extinguishers are used to inhibit flaming. The number and location of extinguishers is based on size and organisation of space. There are different sources of fire and therefore basically four different types of fire extinguishers, or classes, labelled by coloured geometrical shapes with letter designations, as seen in Bangladesh. In the USA nowadays the extinguishers are labelled with pictures. In operating an extinguisher, the PASS acronym is useful to remember Pull (the pin), Aim (at the base of the fire), Squeeze (the handle to start the extinguisher eight feet away from the fire), and Sweep (the nozzle left and right of the area being attacked).

Multi-Class Rated Extinguishers: Can be used on different types of fires and will be labelled with more than one designa-

Carbon dioxide is used for extinguishing flammable liquid fires, gas fires, and electrical fires. It leaves no residue and requires no cleanup after application. However, it is toxic (can produce unconsciousness and death above certain concentrations) and therefore requires evacuation of occupied places before discharge.

Halogenated extinguishing systems contain halogenated hydrocarbon or Halon that hinders the chemical reaction of fuel and oxygen, thereby stopping the combustion. The system engages pipes, nozzles, an actuating device, and a container containing a halogenated agent under pressure.

Toxicity of Halon 1301 (identifying number) is very low. Halon is not considered carcinogenic. Being heavier than air, it could cause suffocation by reducing the availability of oxygen. Inhalation in mild

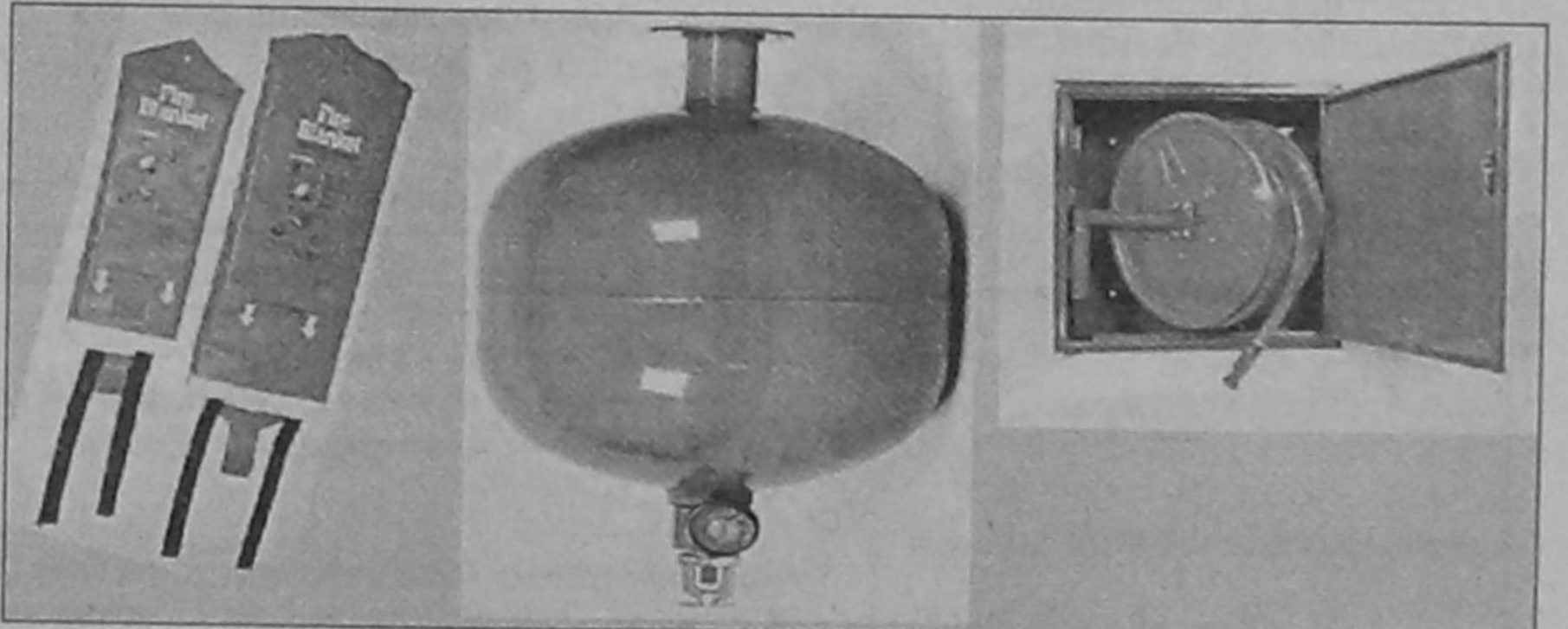


Figure 8: Fire blankets, ceiling-mounted dry powder extinguisher, and fire hose reel (from left)

tor, e.g. A-B, B-C, or A-B-C.

Fire hose reels provide a controlled supply of water to attack a fire. The hose can be extended up to 36 meters and can deliver at least 0.33 litres of water per second. The cooling effect of the water from the fire hose reel reduces the heat of the fire to below its ignition temperature. The hose comes in two operable types: (a) Auto Reel water is automatically turned when the reel has been pulled out 2-3 metres, and (b) Manual Reel to get water a valve has to be turned on. The attacker should be located between the fire and the escape route. The hose reel should not be continued to be used if the fire increases.

Fire-fighting foams (inert gas or air-filled bubbles made from specially formulated aqueous solutions), being lighter, floats on flammable liquids, producing an air-excluding, cooling, continuous layer of vapour-sealing, water-bearing blanket that halts combustion. They are defined by their expansion ratio final foam volume to the original foam solution volume before adding air. Foams are generally used against combustible liquids, oil spillage fires, flammable vapours, basement fires and liquefied natural gas fires. Foam layers, several inches thick, are unstable and broken by physical force (such as water spray). They are not recommended for electrical fires.

quantities (4-10%) can affect the central nervous system causing dizziness, impaired coordination, and ringing in the ears, but such ailments are completely reversible upon removal from exposure.

Dry powder Fire Extinguishers (filled with powder and pressurised with nitrogen) are the most versatile fire extinguishers available because of simple structure, flexible operation and convenient application with the advantages of fast extinguishing speed, high efficiency, continuous or intermittent spraying. It is used against fire caused by oil, fat, paint, solvents, flammable liquid, burning solids, grease, solid organics, natural gas, and electric equipment (being electrically non-conductive). Effective on Class A, Class B, and Class C fires, it is ideal for areas with multiple fire hazards (factory, office, school, hotel, oil pump house, filling station). It is not dangerous to humans or animals. The range of the jet is 4-7 metres.

Awareness building is a major prerequisite in making our premises safe from fire incidents. That is the purpose of this series.

TO BE CONTINUED IN THE FINAL INSTALLMENT NEXT WEEK

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