CHAPTER 6
SPECIAL STORAGE AREAS

6-1. Flammable and combustible storage areas.

a. Size and location requirements. The size of flammable and combustible storage warehouses will be dependent upon the volume of stored material. Certain specifications will be followed in determining the shape. The warehouse will be single-story construction, built along a longitudinal axis (fig 6-1). It should not be longer than 300 m (1,000 ft) and it should have transverse fire walls constructed such that no interior space between fire walls is greater than 1850 m^2 (20,000 sf). The building will be detached from any other building and located away from any other building by at least 15 m (50 ft). When design considerations allow, the building should be located as far away from occupied buildings as possible and situated with respect to the prevailing wind direction such that toxic fumes or smoke do not drift over occupied areas.

b. Construction requirements. Buildings housing flammable or combustible material should be constructed from fire-resistive materials or non-combustible materials. Floors should be slab-on-grade-type construction made of structural concrete. Walls should be constructed of fire resistant materials of sufficient thickness, and designed to develop a 4-hour fire resistance rating. Fire walls should be constructed to limit internal areas to 1850 m^2 (20,000 sf) of clear storage space. Doors should be of the rolling steel type and where practicable should be eliminated in fire walls. All construction and control joints in the floor must be sealed to prevent spills from contaminating the subsurface soil or permeating to adjacent modules. A 100 mm (4 in) tall concrete curb will be required around the base of each storage area's wall containment. Each personnel door within a storage module will have a 100 mm (4 in) set up. The elevation of storage area's floors will be approximately 100 mm (4 in) below adjacent areas (hallways and shipping/receiving). Hallways and shipping/receiving areas will be the same elevation, but will be recessed approximately 50 mm (2 in) below the exterior grade. The discharge of fire water within a storage area will be contained to a certain extent by the internal spill containment curbs. Once the liquid level within the room reaches the top of the curbs, it should immediately be discharged to the exterior of the facility by means of overflow devices or scuppers. The elevation, size and number of scuppers within a storage module will be such to prevent the migration of fire water into adjoining building areas. Scuppers will be provided on exterior walls only, be as small as possible, provide automatic drainage, and prevent rain, snow, insects, or rodents from entering a facility. An emergency drainage system will be provided around the exterior of a HAZMAT facility in order to prevent contaminating nearby bodies of water (i.e. lakes, ponds, rivers streams, groundwater, etc.). The drainage system, if connected to public sewers or storm drains, will be equipped with traps or separators as applicable. The drainage system will be in accordance with all applicable Federal, State, and local regulations. If the capture and containment of discharged fire water is required, the preferred containment system would be via a remote imponding or ponding area. Imponding dike or berms surrounding a facility will be considered only as a secondary alternative. Below ground storage tanks will not be used in an emergency drainage system. Ramps within the warehouse will have a maximum grade of 10 percent. Electrical installations will be in accordance with Class I, Division 2, as defined in NFPA 70. When exterior wall panels are employed in areas where potential for explosion exists, the use of explosion fasteners should be considered. Should an explosion occur, these fasteners would allow the panels to "break away" upon absorbing the explosive impact, thereby, minimizing the damage to the structural members.

c. General considerations.

(1) Drum storage of combustible materials in open areas should be in an area with a concrete surface and a 150 mm (6 in) berm running entirely around the storage area.

(2) It is preferable that gas cylinders be stored in open-sided, concrete slab-type shells in order to minimize the possibility of harm due to build-up of a combustible, flammable, or toxic gas if the cylinder should leak.

(3) Construction of gas cylinder storage should conform to the requirements set forth in DOD 4145.19-R1 paragraph 5-405(d).

(4) Positive ventilation systems should be planned into the design of enclosed flammable and combustible storage areas to prevent the possibility of explosive vapor build-up.

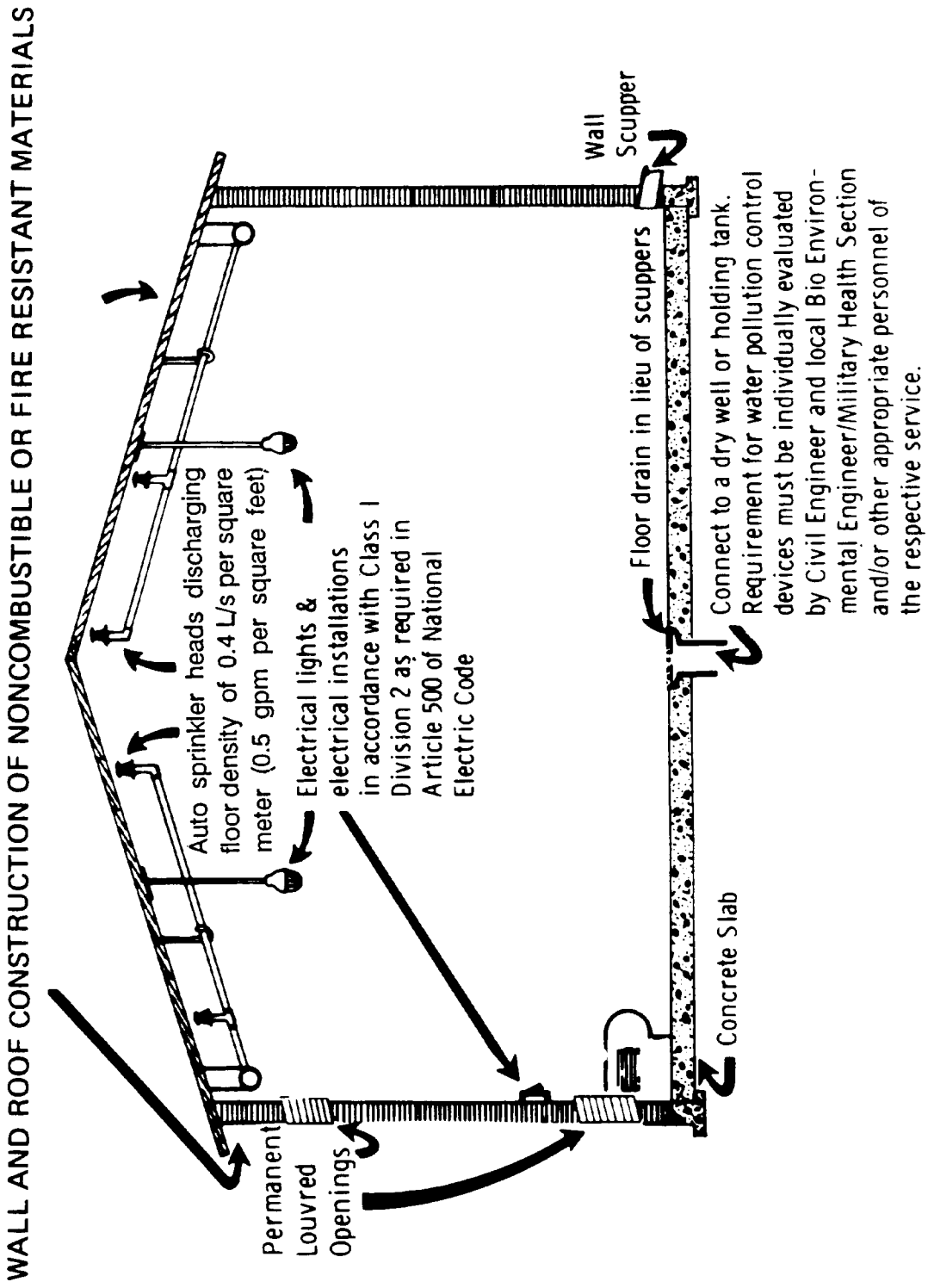


Figure 6–1. Cross section of a flammable storage warehouse.

(5) Flammable and combustible materials must be kept segregated from other storage items to prevent large-scale damage.

(6) AH hazardous materials storage areas should be identified as dangerous areas and warnings about smoking and other flammable items should be posted.

6-2. Radioactive storage areas.

a. General. The storage of radioactive material involves serious health-related hazards that are not readily apparent. Radioactive material gives off radioisotopes which emit several types of radiation that are damaging to human tissue. The hazard is complicated by the fact that the radiation is not detectable by any of the human senses.

b. Location and containment requirements. Buildings that are used to store radioactive material do not have to be separate facilities, although for purposes of safety in case of a fire, it is recommended that a separate building be constructed for the housing of all stored radioactive material. If the depot's radioactive storage mission is small and construction of an entire building is not justified, a portion of an existing building can be modified to provide the containment requirements necessary for safe storage.

c. Construction requirements. Buildings in which radioactive materials are to be stored should preferably be single story without basements or other below-grade spaces. Construction should be fire resistive or noncombustible, including interior finish, acoustical or insulating treatments, and partitions.

(1) *Floors.* Care should be taken to determine the load to be carried by the floor since the shielding material used to contain the radioactive materials can often be quite heavy. If the stored material is flammable in addition to being radioactive, the floor should be electrically conductive or nonsparking and should have a continuous surface to facilitate ease of cleaning and decontamination in case of spills of radioactive liquids and powdered solids. A concrete base covered with waterproof paper or metal foil and a top surface of impervious flooring materials in sheet or tile form is adequate. The floor should be waxed to fill the cracks in divisions and to provide the required surface continuity.

(2) *Walls and partitions.* Exterior walls of the building should be of a nonporous material and partitions within the building which separate high radiation areas from low radiation areas or secure areas should also be nonporous. These surfaces should also be smooth for ease of cleaning in case of a spill. Unprotected porous surfaces such as plaster walls are susceptible to contamination and in the removal of such a wall, plaster dust may spread contaminants throughout the building. Metal partitions, preferably with vitreous enamel surfaces, are probably the most easy to handle of the materials. A concrete block wall with a special smooth hard surface coating will generally reduce porosity to a satisfactory degree. Partition walls should be constructed so as to shield the stored radioactive material from personnel who must enter the building, and there should be baffle wall construction or positive interlocks at these entrances to prevent escape of radiation.

(3) *Ceilings.* Ceilings serve as the support for service pipes, heating and ventilating ducts, and light fixtures in addition to their normal functions. Structural framing, duct work, and piping runs should be planned to obviate the need for suspended ceilings. Where suspended ceilings are justifiable for providing certain conditions of cleanliness, lighting, and ventilation, gypsum board with taped joints or removable metal panels may be used. If the ceiling is merely the exposed lower side of the floor above, it should be given a smooth, nonporous finish. Pipes, ducts, and conduits leading out of the containment area should be baffled to prevent the escape of radiation.

(4) *Protective coatings.*

(a) Through the proper selection of materials the designer can economically facilitate decontamination efforts. Materials which are expensive but easily cleaned, or materials which are inexpensive and easily replaced may be used. Metal with a vitreous enamel coating is a good example of the first group; strippable paint is typical of the second. Ordinary paint is usually too porous to prevent contamination of the base material and it has been found that most of the organic paints tested under intense radiation tend to blister and check.

(b) Low-porosity surface coatings for application to various wall constructions can be obtained through the use of certain commercially prepared coatings including high gloss enamel and plastic paints. These materials have been found to provide satisfactory surfaces where spills are unlikely.

(c) Removable sheeting or strippable coatings can be used to cover surfaces directly exposed to contamination. These coatings are plastic solutions usually containing flammable solvents which can be applied with spray guns to specially prepared bases and removed without great difficulty. The use of spray guns for applying such materials may be hazardous, especially in small areas or rooms. Care should be taken to provide plenty of forced

ventilation in the area and to remove all sources of ignition to avoid a possible fire or explosion. Certain plastic adhesive tapes are also being used for this purpose.

(d) Care should also be used in removing and disposing of these coatings. Not only should their contaminated nature be considered, but some, when burned, liberate corrosive vapors which can cause extensive damage to sensitive equipment.

6-3. Hazardous chemicals.

a. There are two areas of safety consideration associated with hazardous chemical storage, chemical leakage and fire or combustion. Facilities to house these chemicals should be designed with both these considerations in mind. Among these chemicals are explosive chemicals, flammable chemicals, oxidizing chemicals, toxic and corrosive chemicals, and water-sensitive chemicals.

b. Construction requirements. Since most of the hazards associated with chemical storage involve combustion, fire, or explosion, the general requirements for construction should be similar to those outlined in paragraph 6-1. However, the nature of the type of chemical stored should dictate that special construction requirements be considered.

(1) *Special construction considerations.* Maintenance of cool surroundings is a condition suited to all chemical storage. Consequently, ventilation and exclusion of excess heat are important construction features. Natural ventilation can be utilized by designing louvers into the walls of the storage building. Openings placed under the eaves and just above the floor level will provide good movement of air in and around containers. Where a particularly hazardous situation may occur requiring a specific number of air changes per hour, forced ventilation can be achieved by mechanical means. Cool temperatures can be maintained by selecting materials that reflect the heat of the sun, and by limiting the number of windows allowed within the building.

(2) *Acid storage areas.* Figure 6-2 shows a cross section of an acid storage warehouse. Building construction should be single story without attic or basement and made of noncombustible or fire-resistant materials. Sprinkler systems are recommended as the method of automatic fire protection. Spill containment for these areas will be as defined in the construction requirements in paragraph 6-1. General purpose electrical installations are adequate. Noncombustible and corrosion-resistant partitions sealed to the floor to prevent spread of leaking acid are recommended. The building should have safety equipment such as eye wash fountains and deluge showers installed at easily accessible locations. Acid storage warehouses will contain enough heating equipment to prevent freezing of the acid during cold portions of the year.

(3) *Toxic chemical areas.* Floors and walls of areas used to store toxic chemicals will be made of smooth, nonporous materials that will not absorb the chemicals in case of a spill. Porous floors would make decontamination of a chemical spill difficult. Due to the nature of stored material, change areas and shower facilities should be installed for personnel required to work in these areas.

(4) *Oxidizing chemicals.* The NFPA categorizes liquid and solid oxidizing materials into four classes based on the burning property of the oxidize material when contacting a combustible material:

Class 1. An oxidizing material whose primary hazard is that it may increase the burning rate of combustible material with which it comes in contact.

Class 2. An oxidizing material that will moderately increase the burning rate or which may cause spontaneous ignition of combustible material with which it comes in contact.

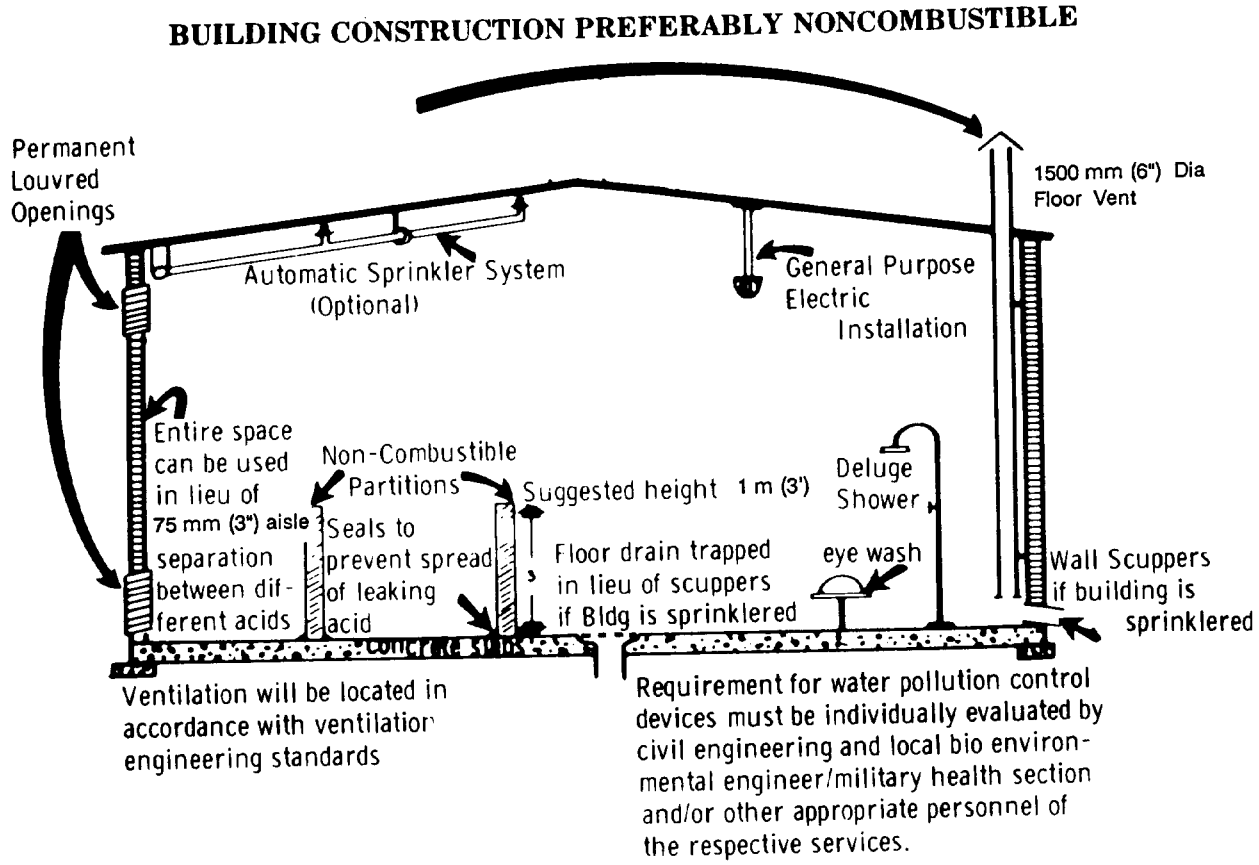
Class 3. An oxidizing material that will cause a severe increase in the burning rate of combustible material with which it comes in contact or which will undergo vigorous self-sustained decomposition when catalyzed or exposed to heat.

Class 4. An oxidizing material that can undergo an explosive reaction when catalyzed or exposed to heat, shock, or friction.

Oxidizing chemicals should be kept separated from flammable materials since the chemicals provide their own oxygen and contribute to the combustion process. Fire protection systems in these areas should provide a specified water density according to classification in compliance with the provisions of NFPA Standard 43A and 43C.

6-4. Open chemical storage.

Certain chemicals are such that they can be stored in open storage areas. Chemicals stored in drums should be given layouts such that all drums are easily inspected for leakage and that ready access to these drums can be made. Storage of sealed drums lying on their sides is preferable to stacking drums on end. When drums are laid on their sides, they will shed water rapidly due to the geometry of the drums, and there will be no areas for water to collect and cause corrosion. Inspection of drums is made easier when they are laid on their sides since the tops are always visible.



Note: Strong oxiziding acids such as perchloric and nitric acids should be seperated from organic acids such as acetic acid.

Figure 6–2. Cross section of typical acid storage building.