

When openings require covers, the design should specify metal covers with hand rings folding flush with the top. Covers should fit snugly and be provided with lugs. Open pits may be safeguarded with fences or rails.

Stairs or fixed ladders provide safe access to pits. Drains reduce the hazard of falls on muddy, wet, or icy pit floors.

#### **Outside lighting**

Outside lighting must serve not only as a production tool and as a safety factor but should also function as part of the plant security system. Luminaires using many different types of light sources are available for all types of specialized applications. Considerations should be given to lamp life and ease of maintenance of luminaires selected. Lighting should be provided for

Wharves, docks, and loading platforms

Roadways, walkways, and railroad crossings

Entrances and exits

Production areas

Stairways and landings

Ramps

Active storage areas

Lighting equipment used in outdoor locations must withstand exposure to the elements without deterioration. American National Standard A11.1, *Practice for Industrial Lighting*, and a later section in this chapter, "Lighting."

#### **Docks and wharves**

The characteristic of the bottom of the sea, lake, or river is an important factor in design and construction of docks and wharves. A soft, deep bottom limits the use of concrete and of heavy fire-resistive materials. Wood piles must be protected if marine borers are present. Flexibility and elasticity are essential where waves force vessels against piers and in tidal waters.

Safety requirements include good illumination for night work, a floor that will withstand heavy trucking, and traffic control equipment. Fatigue and numerous injuries to stevedores can be greatly reduced by the use of mechanical handling equipment, such as forklift trucks.

Design of piers should take into account

the speed and size of vehicles to be operated on them. Provision for removing snow and heating icy surfaces should be provided.

### **Plant Layout**

Size, shape, location, construction, and layout of buildings and other facilities should permit the most efficient utilization of materials, processes, and methods.

Materials and processes may favor gravity flow and the construction of a multistory building, for example, in the case of mills for ore treatment.

Other uses, such as automobile assembly plants, may favor a one-story building because floor loads will be heavy and because excessive handling of materials by vertical and inclined conveyors would be required in a multistory building.

#### **Location of buildings and structures**

The segregation of raw materials storage, processing buildings, and storage for finished products warrants thorough study in laying out a plant to minimize fire and explosion hazards. Storage of volatile flammable liquids in an area apart from processing buildings reduces the fire hazard. In the event of fire, control is more easily achieved. Moreover, the cost of separate storage eventually may be less than the investment for storage in a processing building.

Ample space should be provided between segregated units, from such flame sources as boilers, and from shops, streets, and adjoining property. Fig 16-3 shows a well planned layout of the structures in a lacquer manufacturing plant.

The codes of local and state authorities and of the National Fire Protection Association should be followed in planning the location of the units of a plant.

Where no legal restrictions govern the storage of explosives, magazines should be located and constructed in accordance with the recommendations of the Institute of Makers of Explosives. Table 16-A specifies the quantities of explosives that may be stored safely at various distances from inhabited buildings, passenger railways, and public highways.

The type of retardant required in relation