

## CHAPTER 3

### OPEN STORAGE

3-1. Description. Open storage areas are portions of the depot that are used for the storage of goods that do not require extensive protection from the elements. They are generally improved or semi-improved areas which do not provide any cover for the materials stored therein. These areas should be provided with the same access that is given to warehouse and sheds as well as shipping and receiving facilities that are necessary for open storage functioning.

3-2. Types of open storage areas.

a. Improved areas. These sites are cleared of vegetation, graded, and provided adequate drainage, and then given some sort of hard surface treatment. This allows the storage of many items that would not be suitable on unimproved areas due to the increased bearing capacity of the surface and the high level of control of runoff.

b. Semi-improved areas. These areas are similar to improved areas in that they are graded and drained, but they are not provided with a hard-top surface. The bearing capacity of semi-improved areas will change with the moisture content of the soil and in wet conditions will not bear as heavy loads as in dry.

c. Unimproved areas. Surfaces that have not been graded, drained, or hard-surfaced are classified as unimproved. Irregular surface contours do not allow uniform storage heights, and lack of grading and drainage tends to promote localized areas of water ponding and to reduce bearing capacity due to saturation of the soil. This is the least desirable form of open storage area since it does not promote dense storage practices nor does it provide for acceptable access to the storage area.

d. Control of vegetation. For semi-improved and unimproved areas, control of vegetation is an important consideration. Protection of the area by application of weed killers or the spreading of some cover material such as shells or salt that prohibits unwanted growth will improve the usefulness of the storage space and retard the deterioration of material stored there.

3-3. Locations and layouts. Each open storage area should be equipped to load and unload both truck and rail cars by either forklift or crane. Rail siding platforms will serve both rail cars and trucks by means of a forklift truck. Open rail cars or flat bed trucks can also be on- or off-loaded by means of mobile crane or rail crane. Receiving and shipping areas should be located such that MHE does not have to transport goods long distances to or from their storage location; access between rows of storage should be provided for wheeled vehicles,

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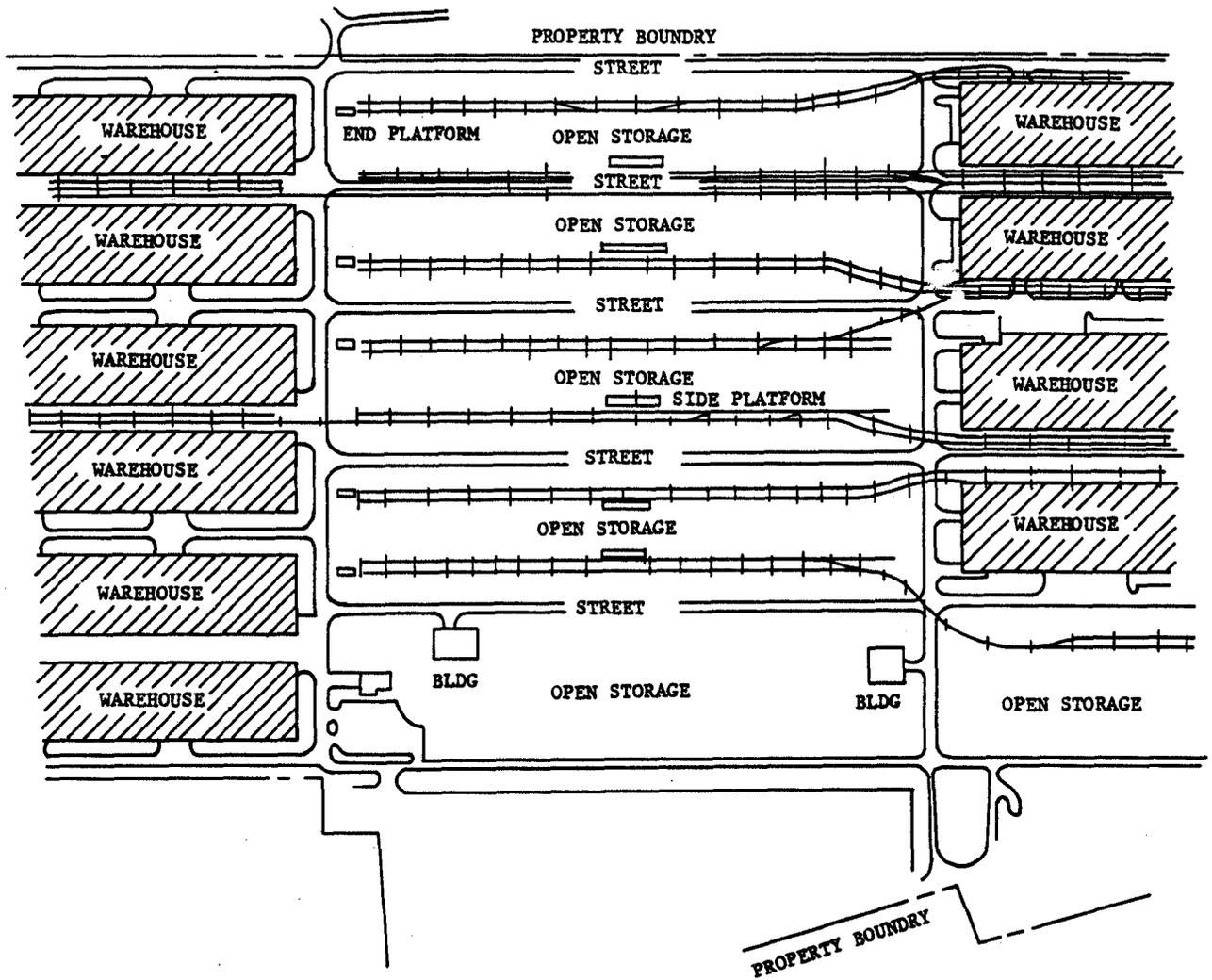
and rail platforms should be centrally located. Figure 3-1 gives a layout for open storage that provides for both rail and truck access to open storage areas.

#### 3-4. Loading and unloading platforms.

a. Size. Within each open storage area there should be at least one rail car loading and unloading platform. Ideally, there should be a platform located on each run of track within the storage area, but in order to adequately serve the storage area, platforms should be at least close enough that MHE carrying goods to and from the platform do not have to travel more than 700 feet from loading platform to storage. Side-loading platforms should be a minimum of 20 feet wide and one car length long. The length is preferably two car lengths. The platform should be located such that the side face is 6 feet 2 inches from the center line of track, and the elevation of the top of the platform should be 3 feet 9 inches above the top of the rail. Ramps up to the platform should have a slope no greater than 15 percent. If the platform is also to serve flat cars in which the cargo is to be unloaded from the end of the car, an end-loading platform should be constructed. The dimensions should be similar to the side-loading platform except that the width of the platform at the end-loading portion should be 32 feet wide (fig 3-2).

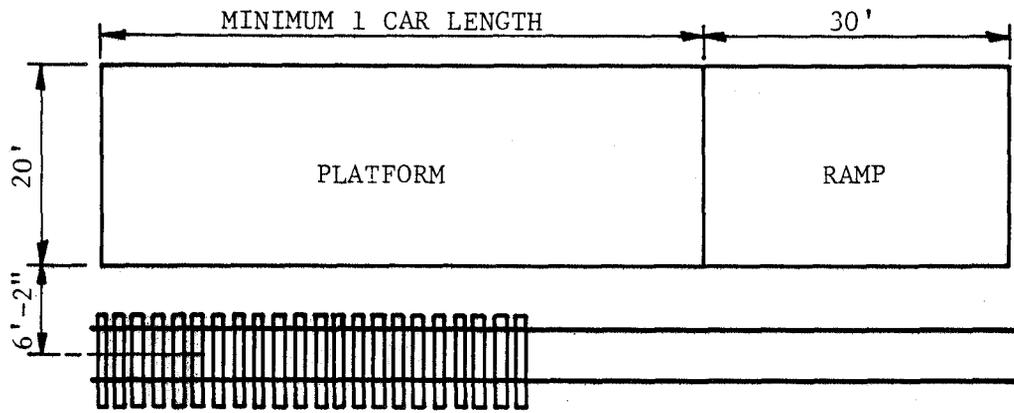
b. Materials. The platforms can be constructed of concrete, wood, or earth-filled timbers. The type of construction should be based on the expected service loads and environmental conditions that the ramp and platform will experience.

3-5. Aisle and track layout. The type of material will generally dictate the dimensions used and the proper MHE needed to accomplish transportation of the material. In general, though, efficient open storage layouts provide for straight-line flow of stock from loading and unloading areas to storage areas, ready access to each stock location, and both maximum and efficient utilization of road and track facilities. Aisles in open storage areas will be essentially roads since the dimensional requirements for MHE are large. Main aisles should be located in the longitudinal direction of the storage space, while cross aisles should be placed perpendicular to the main aisles. One efficient layout of main and cross aisles produces rectangular storage areas that are twice as long as they are wide. Double-track layouts should have crossovers at intervals of 1,000 to 5,000 feet. Single-track layouts of more than 1,000 feet should have rail connections at both ends. Figure 3-3 shows one example of open storage layout.

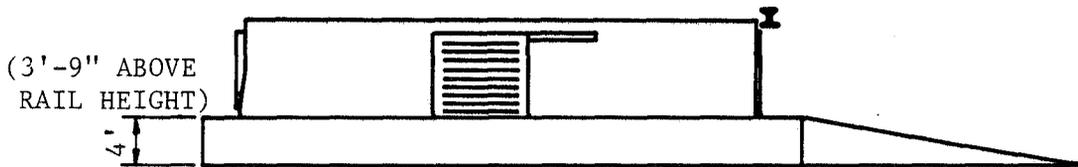


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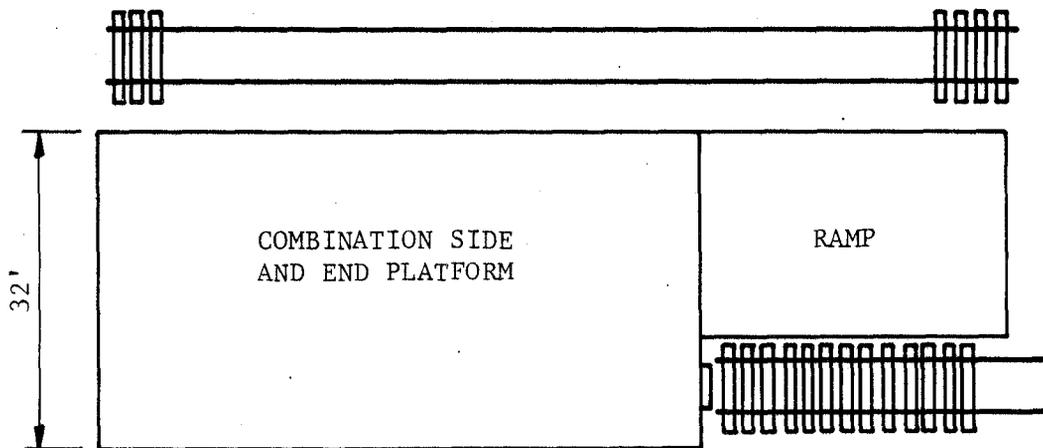
FIGURE 3-1. OPEN STORAGE AREA LAYOUT SHOWING STREET AND TRACK ACCESS



PLAN OF SIDE LOADING PLATFORM



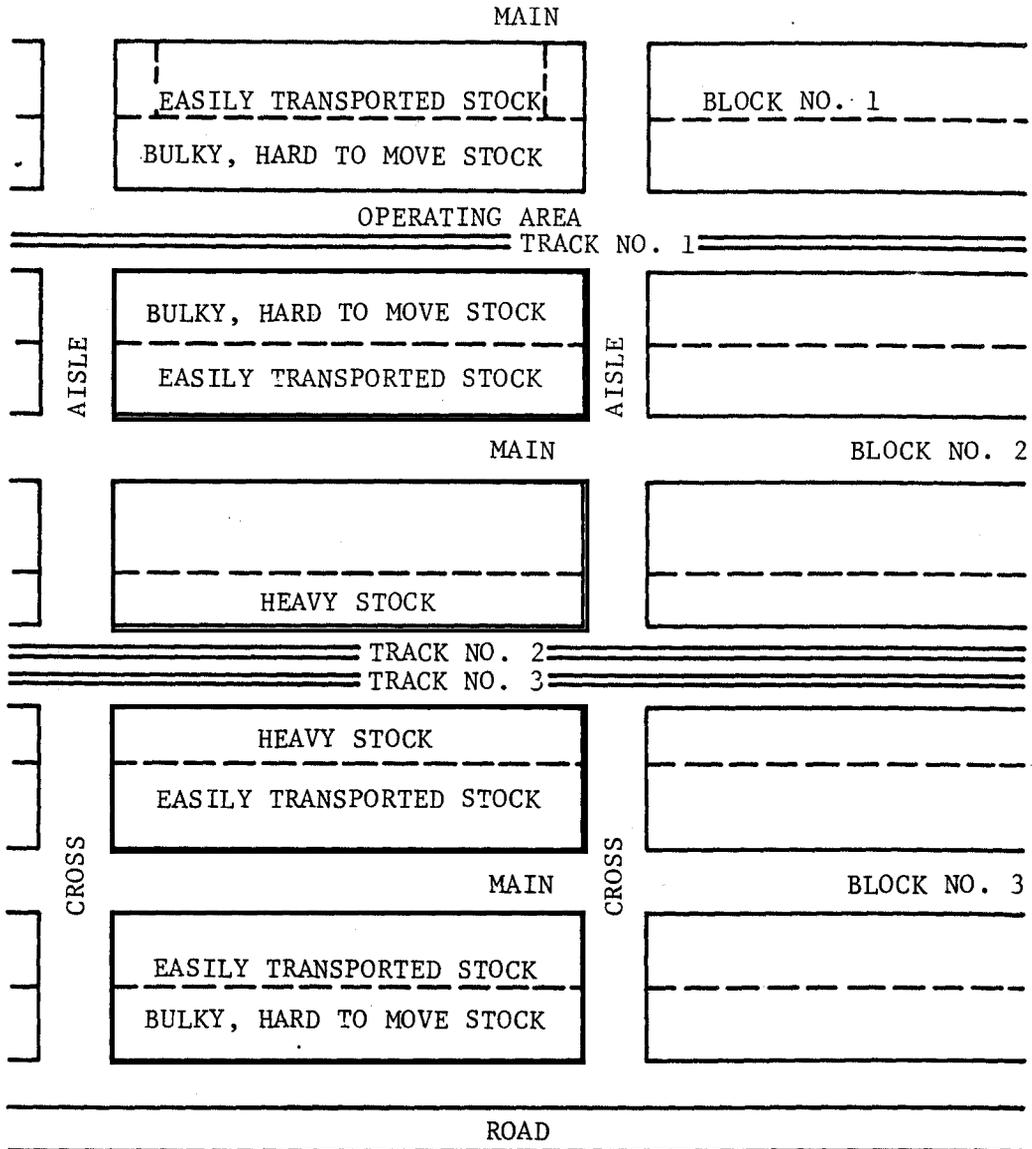
ELEVATION



PLAN OF SIDE AND END LOADING PLATFORM

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FIGURE 3-2. SKETCH OF END - AND SIDE-LOADING PLATFORM



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FIGURE 3-3. EXAMPLE LAYOUT FOR OPEN STORAGE AREA

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### 3-6. Material handling equipment.

a. Major types and uses. Forklift trucks are the chief means of transferring goods in open storage. Their load capacity ranges from 2,000 to 15,000 pounds, and they must have access to the entire open storage area. In addition, in order to be able to move in and out of rail cars, forklifts should have rail side ramps to allow forklift access to the interior of the car. Crawler or truck-mounted cranes are also typically used to handle material in open storage. Crawler and truck-mounted cranes usually operate from roadways alongside of the storage block but can be utilized in other areas.

b. Special purpose MHE. Special purpose MHE such as straddle carriers or side-loading forklift trucks may be economical for storage of long, bulky objects such as pipe, wood, or structural steel. The details of these and other MHE are covered later in this manual.

### 3-7. Surfacing requirements.

a. Choice of pavement type. The factors that affect the surfacing requirements of improved open storage areas include vehicle characteristics, traffic volume and flow patterns, material accessibility, and weight requirements of the stored material. There are two types of surfaces that are frequently used on improved storage areas: rigid pavements (EM 1110-3-132) and flexible pavements (EM 1110-3-131). Rigid pavement applications should only be used in areas where temperature fluctuations are extreme. They require considerable labor in fabrication and are generally the more expensive method of providing improved surfacing. Flexible pavements will normally be used. Steel mat may be selected for short term use as an expedient surfacing method.

b. Traffic volume and flow patterns. Traffic volume is a primary consideration in the design of the type of surfacing and its required thickness. The operation flow patterns and the number of passes of each vehicle under consideration will determine the design volume for a particular facility. For more information EM 1110-3-130 should be consulted.

c. Weight requirements. The type and thickness of pavement will depend on stack height and material weight storage requirements.

d. Area requirements. It is extremely important that the total surface area be limited in order to minimize construction and maintenance efforts. Area requirements vary with vehicle characteristics, operational patterns, container sizes and weights, driver skill, number of vehicles, and protective measures taken.

3-8. Personnel facilities. Shelter, restrooms, offices, and other personnel facilities necessary for the operating personnel of an open

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storage area should be located in the warehouse nearest to the open storage area. If the storage site is remote from all surrounding warehouses, then the personnel facilities must be constructed on site.

### 3-9. Lighting.

a. Type. Satisfactory illumination should be provided for night operations. Lighting units should consist of adjustable-type floodlights mounted on buildings, poles, or towers as required to provide a uniform distribution of light over the area to be lighted. Floodlight towers, where required, should be made of steel and should be grounded at the base. The number, size, location, mounting height, and beam characteristics of floodlights should be designed to provide a uniform distribution of light, avoiding objectionable glare, over the entire area with a minimum of waste light against buildings and in unused areas. Open storage areas subject to night operation should be provided with approximately 1/2 to 1 foot-candle at the working level. Loading platforms subject to night operations should be provided with approximately 5 foot-candles of light at the working level.

b. Wiring systems. Multiple systems should be utilized for floodlighting. Where the number and size of floodlights will permit, the wiring should be connected to the interior system of an adjacent building or to an exterior secondary distribution circuit. Where a substantial quantity of power is involved, a primary distribution system circuit may be extended to the area and transformers provided at suitable locations. Control should be by means of low-voltage switches or circuit breakers. Switches should be of the fused type unless the wiring is connected to a fused circuit. Primary wiring should be of the same type as the primary system to which it is connected, unless material handling, flying hazards, or other local conditions indicate that a change in the type of system is necessary or is desirable to affect economy. Aerial and underground circuits should comply with the requirements of EM 1110-3-190.

3-10. Fire protection requirements. While open storage areas are not as combustible as conventional warehouse buildings, the materials stored at the area may present a fire hazard. Requirements for outside storage should follow the NFPA Standards, with particular reference to NFPA 30, NFPA 46, and NFPA 231A. In general, there should be an adequate alarm system installed either on the open storage site or in an adjacent building within 200 feet of the storage site. The open storage area should also have adequate fire hydrants located around the area (guidance can be found in EM 1110-3-164), and goods and material should not be stored so close together that access to an area of the storage cannot be obtained in the event of a fire.