CHAPTER 4

CONTAINER STORAGE

4-1. General. Operations that need consideration when planning for a container storage area are: receiving and shipping administration, loading (stuffing) and unloading areas, storage area layout, surfacing requirements, and container handling equipment (CHE).

4-2. Types of containers.

a. Twenty-foot containers. The Army presently bases its fleet of containers on the standard 8- by 8- by 20-foot container. This container is similar to the commercial industry standard but has been given the name MILVAN. It functions as both a storage container and a shipping container. It fits on flat bed trucks for transportation purposes, and can be stacked and lifted by CHE as described later in this chapter. As a storage container, it has a 1,060-cubic foot storage capacity. It is made of steel with plywood interior sides and hardwood floor, so it will protect stored material in open storage situations. In its empty state, it weighs 4,770 pounds and is designed for a full capacity of 44,800 pounds.

b. Forty-foot containers. Available commercially but not yet part of the Army container fleet are 8- by 8- by 40-foot containers that are similar to the MILVAN but hold twice the volumetric capacity. These may show up in the storage inventory from time to time as a result of having goods shipped in commercial containers. The weight capacity of these containers is about 67,200 pounds.

c. Twenty-foot refrigerated container. For storage and transportation of perishable goods, the Army has in its inventory a 20-foot refrigerated container. This container measures 8 by 8 by 20 feet and weighs approximately 8,500 pounds empty. Due to the inclusion of its 10-kW engine generator, its storage capacity is less than the standard MILVAN. It is stackable with other refrigerated or standard MILVANs.

d. Transport. For over-the-road hauling of MILVANS, two containers can be secured to a special tractor trailer designed to carry these containers, and the result is similar to a standard 40-foot tractor trailer.

e. Forty-foot FLATRACK. For handling breakbulk cargo and items that are long or not adaptable to MILVANs, such as vehicles or tall items, the Army has developed the 40-foot platform container name FLATRACK. It can be used as a conventional 40-foot container or it can be equipped with trainer wheels and landing gear for use as an over-the-road trailer. As a storage container, the FLATRACK has adjustable corner posts which allow a variable height to the container.

This allows additional FLATRACK containers to be stacked on top of it without damage to the stored goods. Since it is built to industry dimensional standards, it is compatible with commercial 40-foot containers for stacking purposes and can be lifted by any commercial CHE. The container has an empty weight of 15,000 pounds and a gross capacity of 67,200 pounds. As an over-the-road trailer, it is compatible with tractors and can haul one 20-foot container or 67,200 pounds of cargo.

4-3. Storage requirements.

a. Shipping and receiving facilities. Material in containers received in the storage depot will fall into two categories. Either the container will contain one stock item and be destined to be used as a storage container, in which case it can be stored immediately, or it will contain multiple stock items, in which case it will be necessary to separate the items for distribution to their logical storage locations. In the latter case, a shipping and receiving section will be necessary. As containers loaded with multiple stock items will most likely arrive by truck, a truck dock should be provided. Should containers loaded with multiple stock items arrive by rail, the containers can be transferred to yard tractor trailers for transportation within the depot to the receiving area.

b. Container stuffing area for shipping. Quite often depots ship stock items for distribution to overseas bases via containerized freight. By present procedures, containers will be stuffed according to location of delivery overseas and then distributed to the various bases within one locale once they have arrived at the distribution depot. This will require an enclosed item assembly area in conjunction with the loading dock area.

c. Storage in containers. Since containers are, in themselves, shelter for the goods contained within them, they may be stored in open, outdoor storage areas.

d. Storage layouts. The density of the storage will depend upon the surfacing conditions and the CHE used. There are five basic types of CHE discussed below that can efficiently access containers from storage: side loaders, front loaders, straddle carriers, yard gantry cranes, and trailer chassis.

(1) Side loaders. Side loaders carry the container over the body of the loader and deposit it into its storage location from the loader's side. Since it loads from the side and can only load directly adjacent to itself, the most efficient layout for containers is as shown in figure 4-1. In this configuration, a density of 172 20-foot-long MILVANs per acre can be achieved when containers are stacked two high. Cross aisles should be spaced at approximately

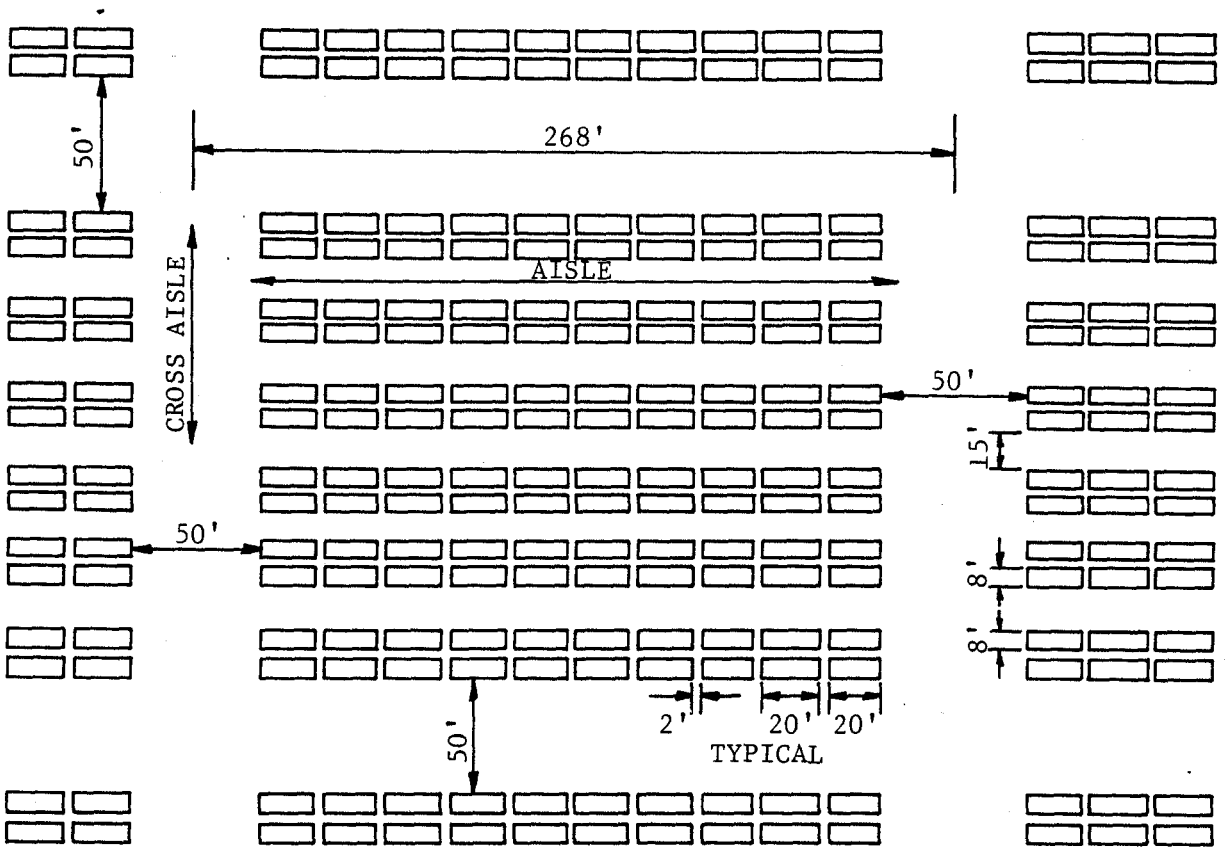

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FIGURE 4-1. BASIC CONTAINER CONFIGURATION FOR SIDE LOADER CHE

268-foot intervals or after a row of 10 MILVANs, as shown in figure 4-1.

(2) Front loaders. A front loader handles containers at its front and requires a larger access aisle to maneuver into position to pick up a container. However, containers can be stacked in groups where there is not direct access to every container, since the front-end loaders can move containers and easily maneuver into the center of the group. Also, there are several front loader-type vehicles that have been designed to reach over other containers to access top containers without moving ones that would otherwise be in the way. The layout shown in figure 4-2 provides for a density of 190 20-foot MILVANs per acre when stacked two high.

(3) Straddle carriers. Straddle carriers straddle the container and lift it from above. This type of carrier requires aisles between each row of containers, but the aisles are narrow, having only to accommodate the legs of the carrier. The layout shown in figure 4-3 will provide for 224 20-foot containers per acre when stacked two high. Rows of containers should not be longer than four 40-foot containers or eight 20-foot containers in order to minimize the difficulty of maneuvering the straddle carrier along the aisles. The configuration shown in figure 4-3 is for a straddle carrier that cannot operate outside the confines of its legs; therefore, there must be an aisle between each row of containers. If the straddle carrier can operate on either side of its body, then a configuration as shown in figure 4-4 may be used and a density of 250 20-foot containers per acre can be achieved.

(4) Yard gantry cranes. Yard gantries are like straddle carriers in that they straddle the containers, but they generally straddle from three to five rows of containers and are much more limited in their maneuverability. This lack of maneuverability is compensated by the compactness of container storage and flexibility of the gantry crane on its frame. For most layouts, the yard gantry will need only to move back and forth along one long row of containers, or it may need to get from one row to the next by an occasional cross aisle. The layout shown in figure 4-5 will provide for 260 20-foot containers per acre stacked two high in arrays 5 by 10. There is room for a truck lane beneath the gantry in this setup in order to remove the accessed container without using the gantry as a container transporter.

(5) Trailer chassis. The requirements of trailer chassis when equipped with containers are that they only be stacked one high and that there be access for a yard tractor to pick up any trailer without moving another trailer. The suggested layout for this type of container configuration is shown in figure 4-6. Using this layout, 74 20-foot MILVANs, two per 40-foot trailer chassis, can be stored per acre. One of the advantages of this type of container storage is

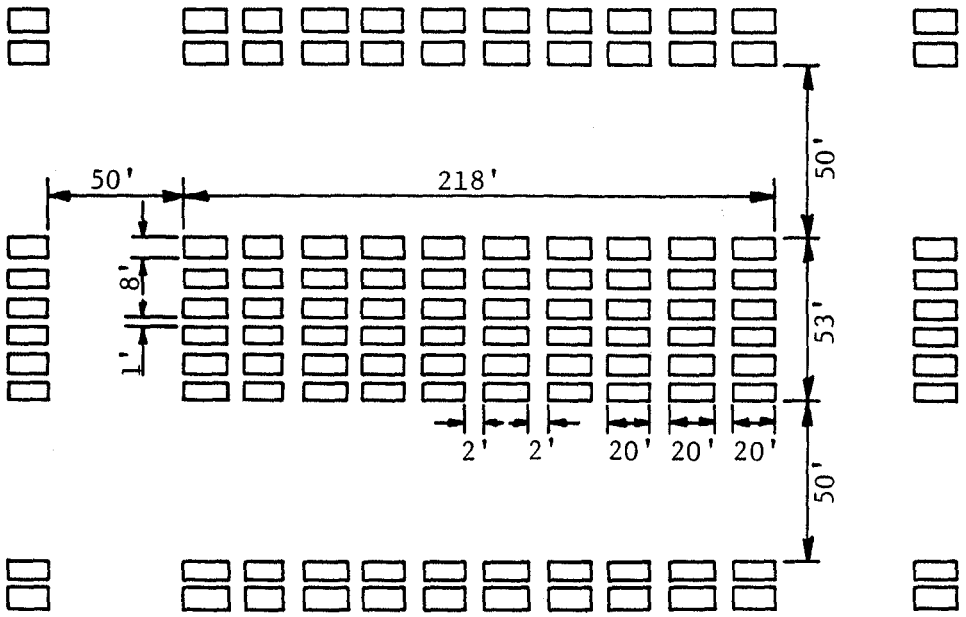

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FIGURE 4-2. BASIC CONTAINER CONFIGURATION FOR FRONT-LOADING CHE

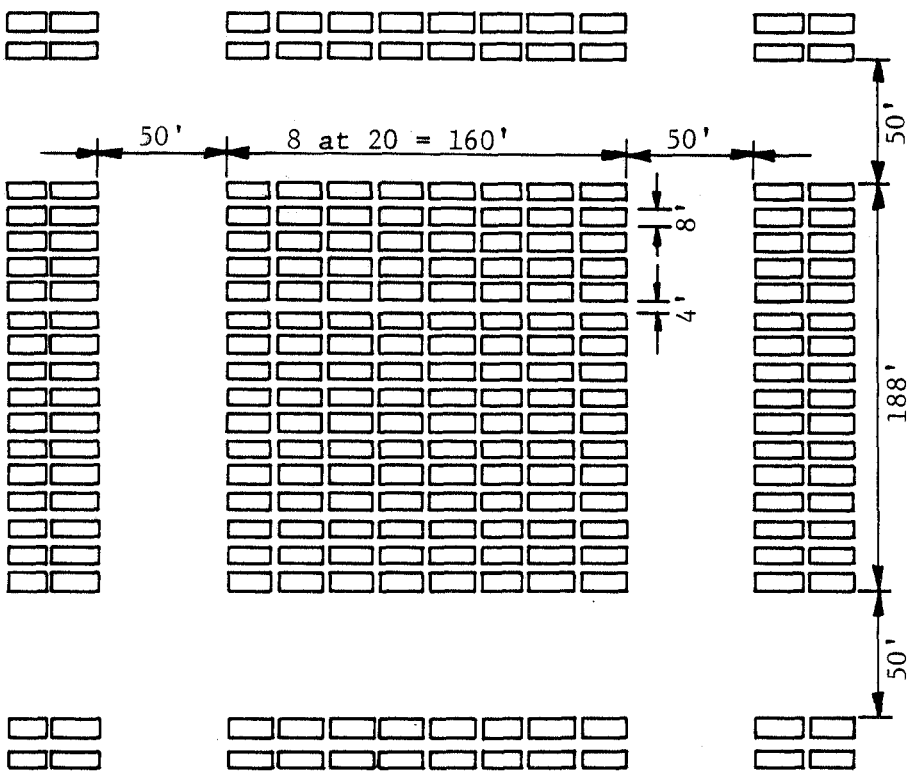

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FIGURE 4-3. BASIC CONTAINER CONFIGURATION FOR STRADDLE CARRIER THAT CAN ONLY OPERATE BETWEEN ITS LEGS

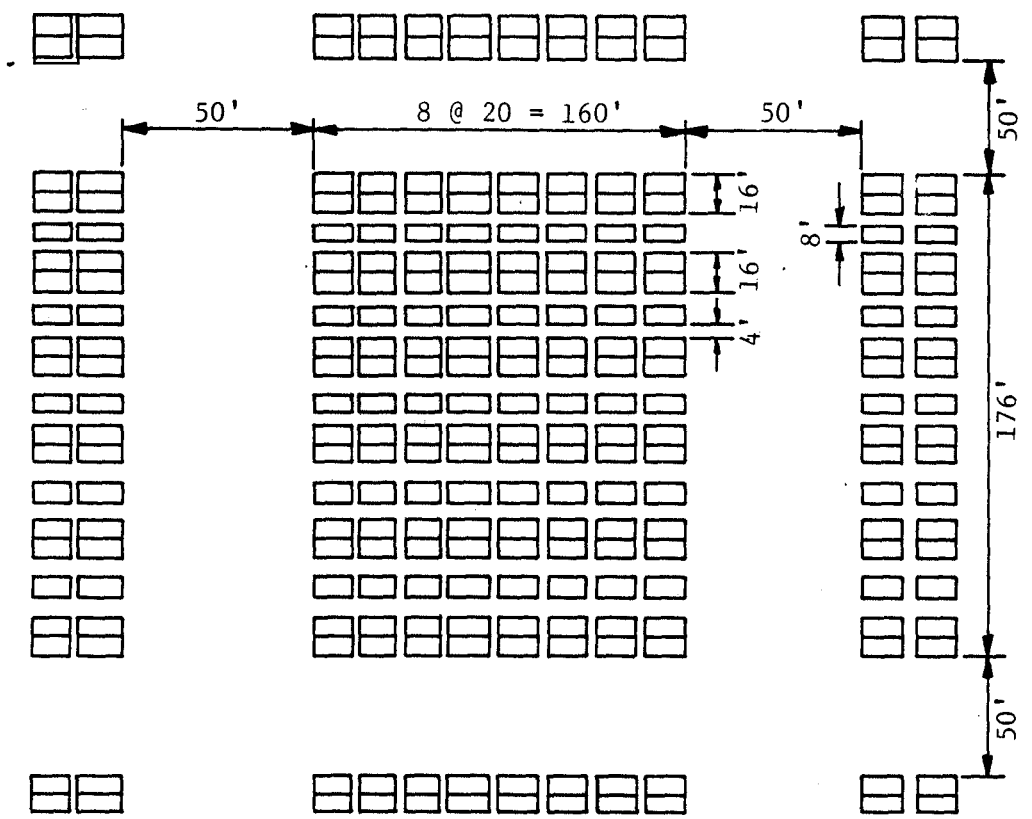

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FIGURE 4-4. BASIC CONTAINER CONFIGURATION FOR STRADDLE CARRIER THAT CAN OPERATE OUTSIDE THE CONFINES OF ITS LEGS

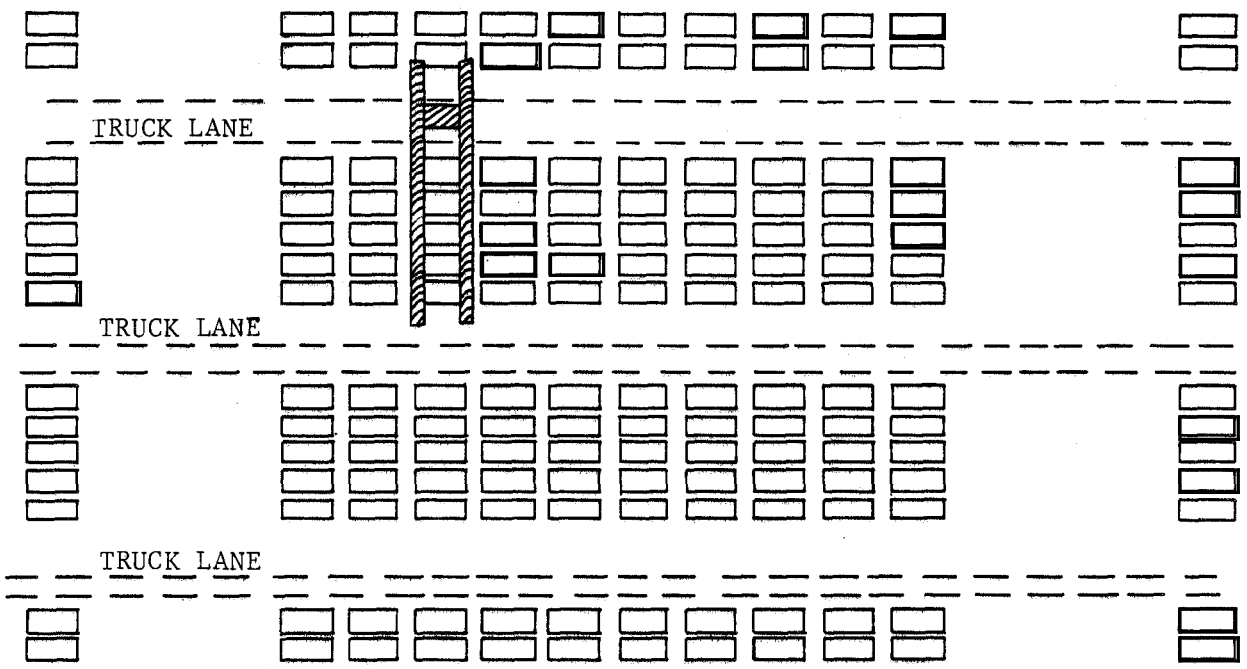

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FIGURE 4-5. LAYOUT OF YARD GANTRY CRANE SHOWING FIVE CONTAINER ROWS PLUS ONE TRUCK LANE BENEATH GANTRY

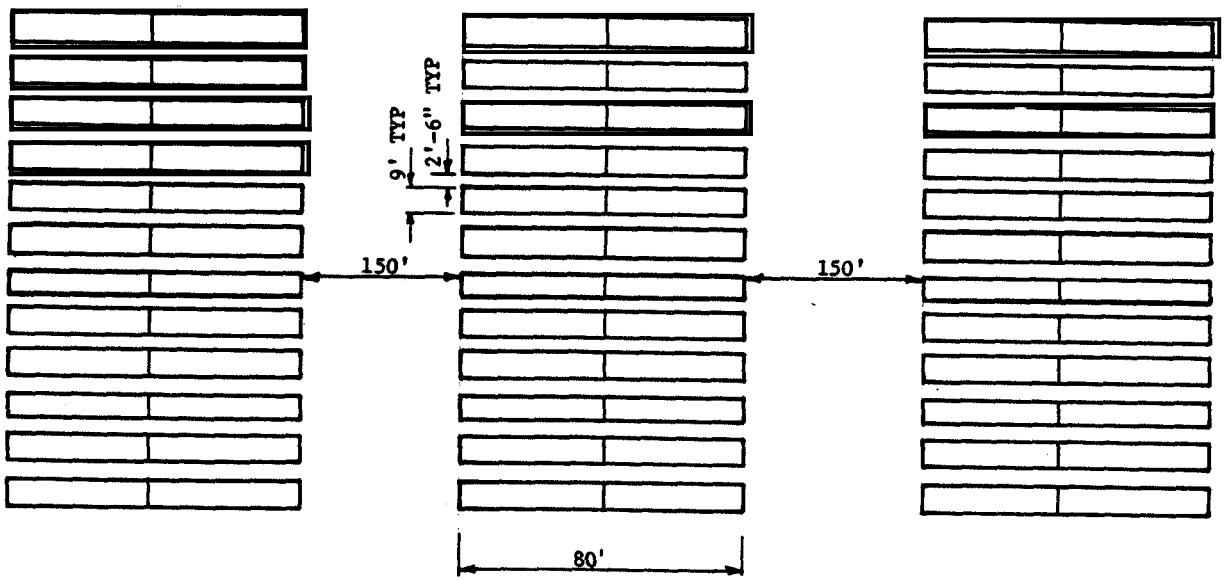

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FIGURE 4-6. CONTAINER LAYOUT FOR TRAILER CHASSIS

elimination of the need for sophisticated CHE. All that is necessary to move container and chassis is a yard tractor.

e. Empty containers. At each depot installation there will be a need to store empty containers. Area for empty containers should be set aside to store at least 10 percent of the inventory of containers. This area should be located near the container stuffing building such that containers will be easily available to personnel stuffing containers for shipment. The type of container layout will depend upon the type of container and the type of CHE expected to handle the containers from storage to stuffing point. Since access will most likely be to the first available container, the containers can be stored in a closer storage pattern than if they are stored full.

4-4. Proximity to truck and rail access. Containers will arrive and depart from the storage facility both by truck and by rail. Most of the containers will travel at least part of the time by some means of truck transportation. The container storage area should have direct access to portions of the rail track system, as well as a large open area where the containers can be transferred to or from the CHE for purposes of storage or shipment. The CHE can load the containers on or off trailers, or into or out of railway cars. In some instances, it may be necessary to utilize a mobile crane to load or unload containers from rail cars. The storage area should be served by double track sidings from a train makeup yard. These sidings should run the length of the container storage area with numerous crossovers so that empty or reloaded cars can be switched onto the outgoing track. A railway siding will also run down one of the aisles in the storage yard so that a yard gantry crane, straddle truck, or forklift truck can transfer containers to and from the flatbed railway cars.

4-5. Surface requirements.

a. General. The heavy loads imposed on the container storage surface due to container weight and CHE require special consideration in the design of the surface. Containers that are fully loaded may be stacked two and three high in the storage area exerting tremendous pressures on the pavement and subgrade, and CHE can have gross weights greater than 100,000 pounds producing large axle loads even in the unloaded condition.

b. Basic considerations. The basic considerations regarding the alternatives between flexible and rigid pavements have been outlined in paragraphs 3-1 and 3-2. In order to make the proper choice of pavement type, consideration must be given to the soil properties in the area, the expected life and degree of maintenance life of the pavement, the number of passes of CHE vehicles, and the type of CHE vehicle to be used at the storage site. Refer to the following manuals for design criteria of both rigid and flexible pavement: EM 1110-3-130, EM 1110-3-131, and EM 1110-3-132.

4-6. Container handling equipment.

a. Equipment scope. Efficient operation of container storage areas requires specialized handling equipment to move the containers from one location to another. This equipment falls into the category of MHE, but since it has such a specialized function of moving containers, it will be covered separately under CHE. This section will deal with CHE of the type used to load and unload truck and rail cars, and to store and move containers within the container storage area.

b. Considerations in choosing CHE. The choice of CHE depends upon the mission of the storage facility, the surface conditions of the storage area, the types of containers it is expected will be handled at the depot, and the volume of traffic anticipated within the lifetime of the depot. A short description of the available types of CHE and their technical capabilities will be presented here, such that the user can tailor his choice of CHE to the specific depot needs.

c. Types of CHE. It is anticipated that the majority of the containers that will be received at Conterminous United States depots will either be 8- by 8- by 20-foot MILVANs or the commercial 8- by 8- by 40-foot containers. These containers will arrive and depart the depot by either truck or rail. The types of CHE that best fill the needs of loading or unloading these containers are front loaders, straddle carriers, yard gantry cranes, and mobile cranes. The most efficient CHE for storing and transferring containers within the depot are the front loaders, side loaders, straddle carriers, and yard gantries. Equipment manufacturer's are noted with the various types of CHE. The manufacturers mentioned are not intended to be a complete list of those producing that type of CHE, nor is the list a recommendation by the Army. The manufacturers are mentioned only to give examples of the type of CHE described.

d. Front loaders. The front loading container handler is the larger capacity relative of the forklift truck. It handles the containers from the front of the vehicle. It is either a hydraulic or manual lift-type truck with lift capacity from 40,000 to 87,000 pounds. It is designed to lift containers by placing forks beneath the container, but it can be adapted to lift containers from above through the use of a special container adapter. Some manufacturers are Belotti, Caterpillar, Clark, Hyster, and Lancer Boss.

e. Side loaders. Side loaders access their containers from the side. One manufacturer is Lancer Boss.

f. Straddle carriers. Straddle carriers load and unload their cargo by straddling it. This means that there must be an access road on each side of a row of containers to accommodate the legs of the carrier; however, these rows are relatively narrow and the number of

containers per unit area is still high. Belotti and Clark/Ferranti are two manufacturers.

g. Yard gantry cranes. These handlers are gantry-type cranes that span several rows of containers and run on tracks or rubber tires. They are able to access containers in any particular row by means of a hoist that travels along the gantry to position itself over the proper container. They can access containers in stacks, from trucks/to trucks, or from rail cars/to rail cars. Some manufacturers are Drott, Marathon Le Tourneau, and Paceco.

h. Mobile cranes. The mobile crane, while basically thought of as a bulk cargo piece of handling equipment, can be used to good advantage as a container handler. It has the advantage of good mobility by being able to move exactly where needed, and once in place, it has a decided advantage of extended reach without moving. It is a piece of equipment that would be in the inventory of a storage depot whether or not the depot had a container storage mission. Also to its advantage is the fact that there are a number of mobile cranes already in the Army inventory. Listed here are some of those that are adaptable as container handlers.

(1) 40,000-pound truck-mounted crane. This crane is one of the smaller in the Army inventory that can handle less-than-full-loaded 20-foot containers. Its Federal stock number is 3810-554-4103. It can lift 40,000 pounds at a radius of 10 feet and has a 30-foot boom.

(2) 80,000-pound crawler-mounted crane. This crane, FSN 3810-230-2819, has principal characteristics which include 80,000-pound capacity at 12-foot radius and a 50-foot boom. It weighs 135,000 pounds without load.

(3) Other manufacturers. Some additional manufacturers are Marathon Le Tourneau, Harnischfeger Corporation, and FMC Corporation.

i. Tractors and trailers. For purposes of moving containers from depot to depot or for moving commercial trailers deposited on the depot property, linehaul tractors and yard tractors are needed in the depot inventory.

(1) M 52 linehaul tractor truck. This tractor is one of the smaller ones in the Army inventory. It is, however, capable of hauling container transporters on paved improved surfaces. It is a three-axle vehicle having a tractive capacity of approximately 30,000 pounds which would indicate that it cannot carry a fully loaded 20-foot container on a trailer; but it has carried such a load on improved surfaces. It is compatible with all the trailers mentioned in this subparagraph.

(2) M 818 linehaul tractor truck. This tractor is also a three-axle vehicle with a road tractive capacity in the vicinity of

30,000 pounds. Its capabilities are similar to the M 52, and it is compatible with the trailers mentioned here.

(3) M 915 linehaul tractor truck. The M 915 is an Army adaption of a commercial 6 by 4 tractor used for linehaul operations over primary roads. It is a three-axle vehicle with drive wheels on the rear two axles. It is capable of transporting fully loaded 40-foot containers on chassis or greater than 68,000 pounds of breakbulk cargo over primary roads. This tractor is intended to be the Army's primary container mover. It is primarily meant to haul the M 872-34 ton container/breakbulk transporter, but it is compatible with the majority of commercial trailers with which it may come in contact.

(4) M 878, yard type tractor truck. The yard tractor is primarily used to haul trailers around the depot. It is a highly maneuverable tractor which has a cab that is restricted to the operator only. It has an automatically locking, hydraulic-lift fifth wheel (trailer coupler). It is compatible with commercial trailers as well as the M 871 and M 872.

(5) Coupleable, MILVAN container transporter. This container chassis is the primary Army-owned container-mover for usage on primary, hard surface roads in the Conterminous United States. The chassis consists of a 20-foot frame, landing gear, and single-axle bogie. The bogie is movable along the length of the frame. The frame has provisions for coupling two 20-foot units to form a 40-foot chassis, with the bogies under the rear frame to form a tandem-axle configuration. Each frame has twist locks to accept International Standards Organization (ISO) containers. There is a provision for lowering the twist locks flush with the top of the frame so that 40-foot containers can be transported on a coupled chassis.

(6) M 871 22-1/2-ton dual purpose container/breakbulk transporter. It is designed as a tactical semitrailer to be hauled by the M 818, M 915, or M 52. It is primarily a mover of 20-foot, 44,600-pound containers, or breakbulk goods of this weight. It is meant to be used in the linehaul mission, but will serve in the capacity of a depot trailer. It has container locks on the chassis for 5-foot, 6-2/3-foot, 10-foot, and 20-foot containers. For breakbulk cargo it has 48-inch high side panels.

(7) M 872 34-ton container/breakbulk transporter. This semi-trailer is the heavy-duty chassis in the Army inventory. It is a tri-axle, commercial design semitrailer capable of hauling fully loaded 40-foot containers, or 67,200 pounds of breakbulk cargo. Its prime mover is the M 915 linehaul tractor or the M 878 yard tractor.

4-7. Loading/unloading facilities.

a. Roads. Rail cars and over-the-road trailers carrying containers will be loaded and unloaded from one central location within the container storage area. The facilities necessary include drive on/drive off flatcar ramps and the CHE described above. Loading and unloading should be accomplished in a large flat area adjacent to both the rail lines and the container storage area. CHE can load empty containers on trailers to ready them for stuffing or shipment; or CHE can unload full containers from rail cars or truck trailers in preparation for stripping or storage. Adequate road access to the loading/unloading area should be provided to allow fully loaded trailers pulled by yard tractors to pass one another without either having to yield way. As a safe minimum, such a two-way road should have at least 24 feet of pavement width. Sufficient turn-around area should be provided for trailer trucks that have been loaded or unloaded to easily maneuver out of the loading area. It would be preferable to have a loop type road where entering traffic exited by a different road. Requirements for roadway design at Army installations can be found in EM 1110-3-130.

b. Platforms. Flatcar platforms for drive on/drive off containers or vehicles transported by rail car should be built as near as possible to rail car height such that bridges from the car to the platform will be horizontal. Access ramp slopes should be less than 10 percent. Access from the ramp to where the CHE is operating should be provided to allow the CHE to on- or off-load the containers.

4-8. Lighting.

a. General considerations. In connection with container storage, all areas associated with the storage, handling, processing, and transportation of containers should be lighted to permit work during the hours of darkness, promote safety, and provide security to the stored goods.

b. Lighting intensity. Lighting intensity depends upon the task to be performed. Illumination intensities in the vicinity of 5 foot-candles are necessary for work around loading and unloading areas; illumination between 0.2 and 0.5 foot-candles is required for open storage areas. Roadway illumination levels fall in between these two extremes.

c. Lighting units. Most recent trends in lighting large open areas have been to use specialized lighting units called high mast overhead lighting. In this type of lighting, high-penetration luminaries are mounted on tapered poles or triangular steel towers that may range in height from 50 to 150 feet. The luminaries may be lowered to within 3 feet of the ground for inspection and servicing. Each mast contains from four to as many as 12 lamps aimed so as to spread the light over the desired area. Lamps may be 1,000-watt mercury vapor, metal halide, or high-pressure sodium vapor.