

CHAPTER 2

STORAGE SPACE MANAGEMENT

Section 1. TYPES OF FACILITIES

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2-101. Introduction

The contents of this section show the general appearance and functions of the most common types of storage facilities used by DOD Components.

2-102. Covered Storage Space

Covered storage space is storage space within any roofed structure. Within this category are a variety of structure types. Those types in general use are as follows:

- General-Purpose Warehouse
- Controlled Humidity Warehouse
- Refrigerated Warehouse
- Flammable Storage Warehouse
- Dry Tank
- Shed
- Transitory Shelter
- Above Ground Magazine
- Earth Covered Magazine

a. General-purpose warehouse. A general-purpose warehouse has a roof, side walls and end walls, and may have ground level and/or truck or **railcar** bed-level loading docks. Cantilever support canopies over docks may also be provided. This type warehouse may be heated or unheated. It is used for various storage functions and for the storage of a wide variety of items. The greatest portion of covered storage space at DOD installations is normally in this type structure. General-purpose warehouses are primarily single-story buildings, though multistory buildings also qualify. Because of its predominance, the single-story structure is the only one shown in this section. The single-story structure with loading docks at truck and **railcar** bed

level has become the standard warehouse (fig. 2-1).

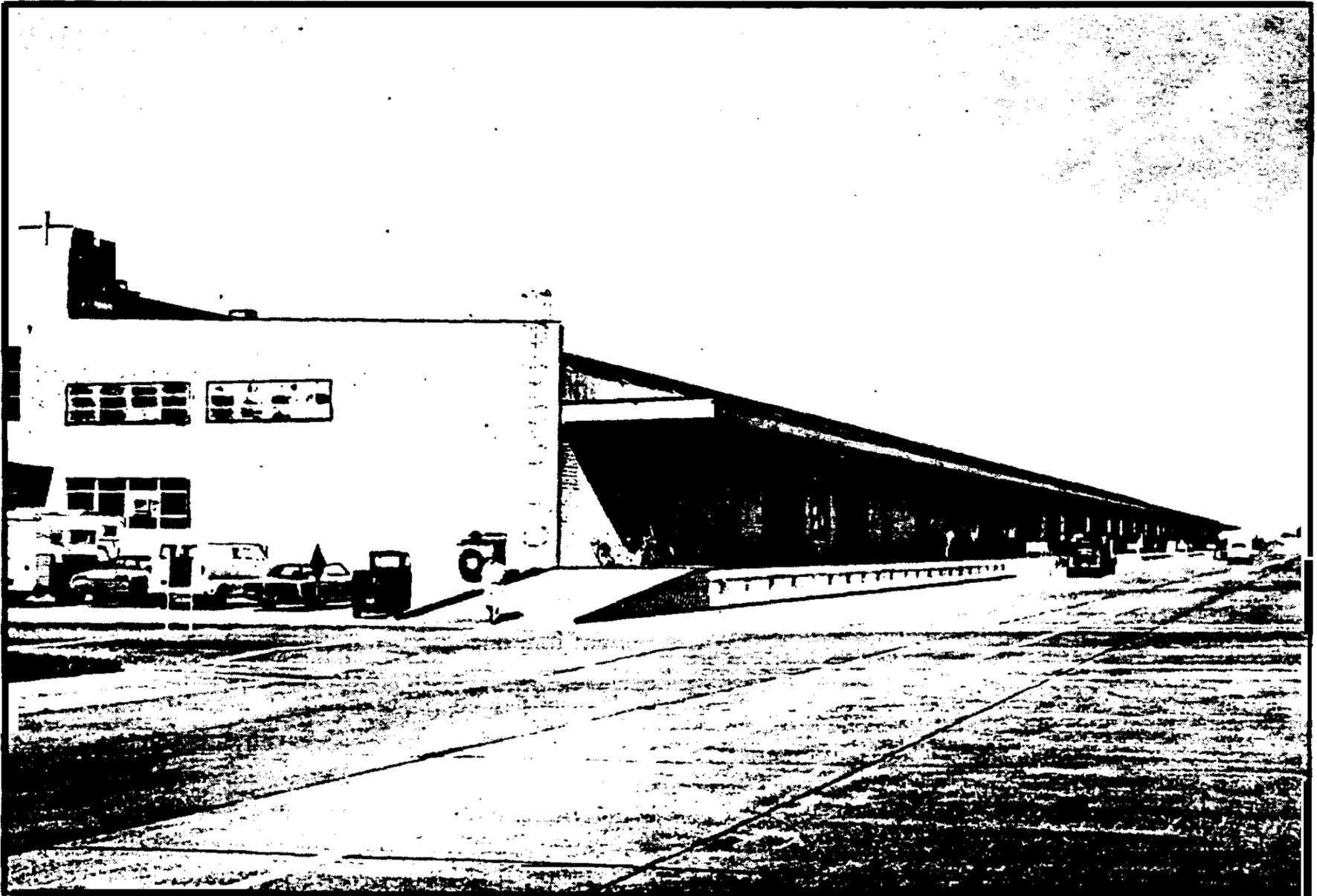
(1) A truck dock of sufficient width, on one side of the general-purpose warehouse, provides for loading/unloading of truck-hauled supplies. The matching dock and warehouse floor permit direct access of materials handling equipment to and from warehouse interior to and from interior of carrier conveyance.

(2) On the opposite side of the standard general-purpose warehouse, a **railcar** dock runs the full length of the structure. This permits easy access to **railcars** from any warehouse door. Rail docks should be located on either side of the two right angle sides of new warehouses to allow for future expansion of the buildings.

(3) Office space in general-purpose warehouses may vary in size and location. In most instances, such space is located within the warehouse. In others, the space is attached to the outside of the warehouse. In either case the office space is generally located on the same side of the warehouse as the truck docks.

(4) Normally, two main aisles run the length of the general-purpose warehouse. These aisles allow materials-handling equipment or supplies to move straight through the length of the building. Typically, these main aisles are connected by cross aisles.

(5) Functions found in a general-purpose warehouse may include loose issue and/or bulk storage, receiving, shipping, preservation, packing, carton fabrication, unit and set assembly, security areas, and administrative offices.



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Figure 2-1. An example general-purpose warehouse.

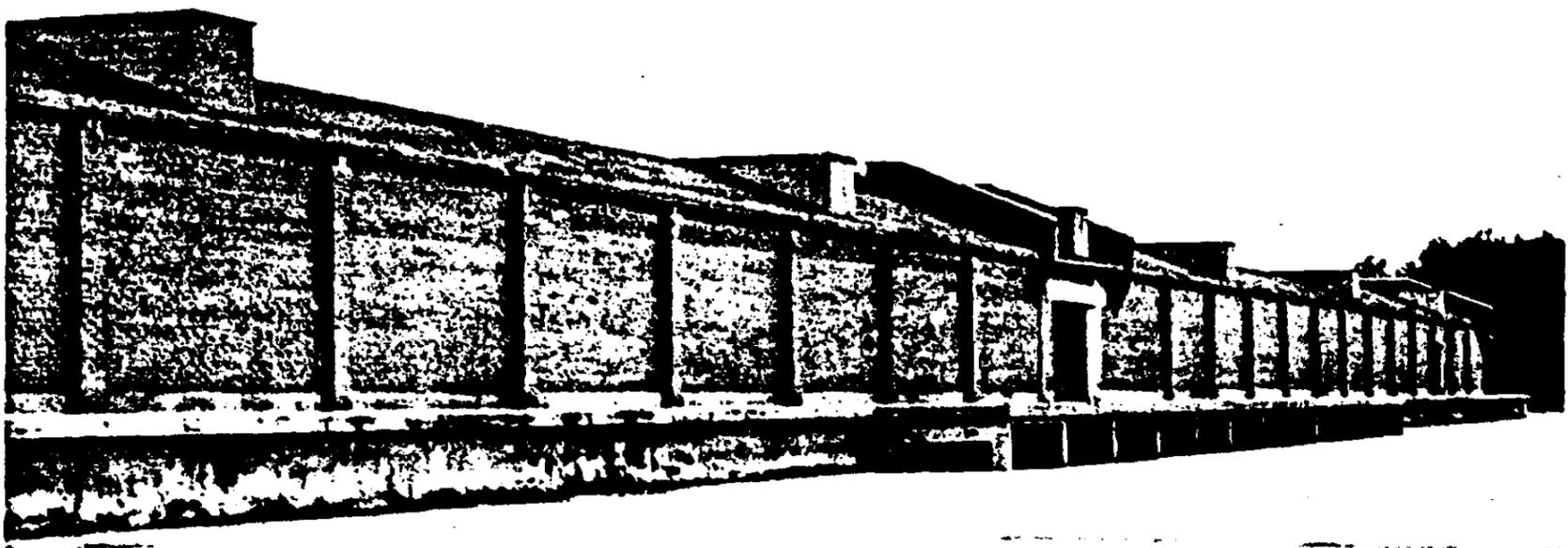


Figure 2-2. Controlled humidity warehouse.

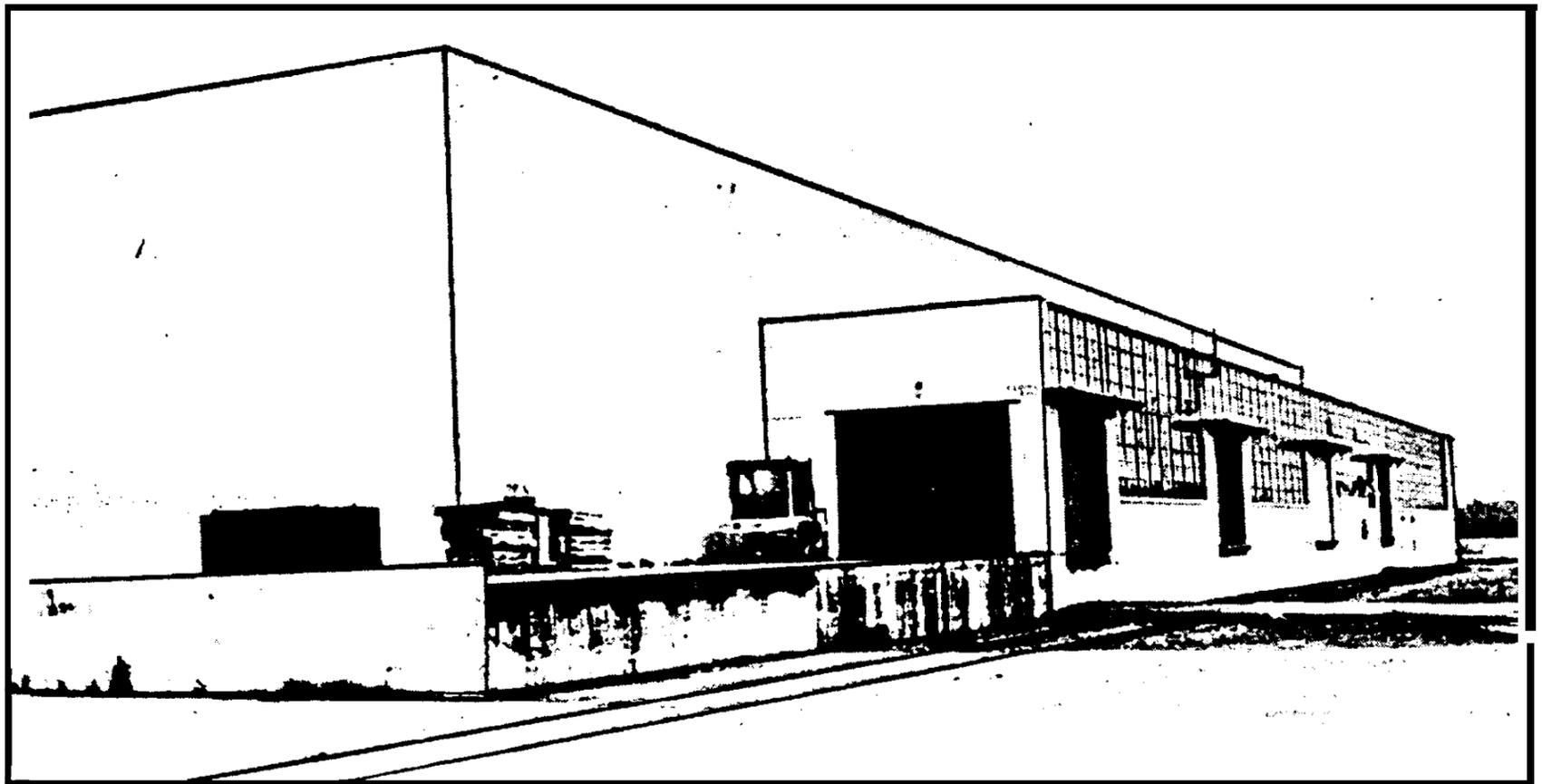


Figure 2-S. Refrigerated storage warehouse.

b. Controlled humidity warehouse (CH).

(1) Almost any type of warehouse may be operated under CH conditions if properly sealed and equipped. However, the general-purpose warehouse is the type most frequently built for or converted to a CH environment. Figure 2-2 is an example of a general-purpose warehouse converted to a CH type warehouse.

(2) Humidity control equipment and operations in CH warehouses are discussed in detail in section 7 of chapter III.

c. Refrigerated warehouse. Outwardly, such a warehouse resembles a general-purpose warehouse though usually smaller. It may have truck and rail-car docks on opposite sides of the warehouse or combination docks on one side (fig 2-3).

(1) The interior of refrigerated warehouses is usually divided into two parts. One part is designated as chill space in which the temperature can be controlled between 36° F. and 46° F. (2° C. and 8° C.). The other part is designated as freeze space. In this area, the temperature can be controlled below a level of 32° F. (0° C.).

(2) Because of the division of refrigerated warehouses into chill and freeze space, there are no main aisles that run the length of the warehouse. Cross aisles provide access to railcar and truck docks.

d. Flammable storage warehouse. The flammable storage warehouse is built of noncombustible materials and has fire walls with a 4-hour fire-resist-

ance rating. The main source of protection comes from an alarm reporting system and automatic deluge-type sprinklers connected to an adequate water supply.

(1) Inner fire walls with no doors are preferred in flammable storage warehouses because of the greater fire protection afforded. However, fire walls without doors necessitate greater care in stock location, since subsequent stock movements must be accomplished without benefit of free movement within the building.

(2) Because it is a special-purpose warehouse, varying sizes and construction features of flammable storage warehouses are found at different storage installations. The flammable storage warehouse shown in figure 2-4 is constructed at ground level.

(3) Some general-purpose warehouses or sections therein may be converted for storage of flammable material. However, alterations must be in strict accord with fire protection requirements.

(4) More specific details on flammable warehouse operations are contained in section 4, chapter V, of this regulation. Details on storage of compressed gases and storage of acids are also found in section 4, chapter V.

e. Dry tank.

(1) Dry tanks are constructed of metal (bolted) except for a concrete floor. These tanks may have controlled temperature and humidity. Tanks may

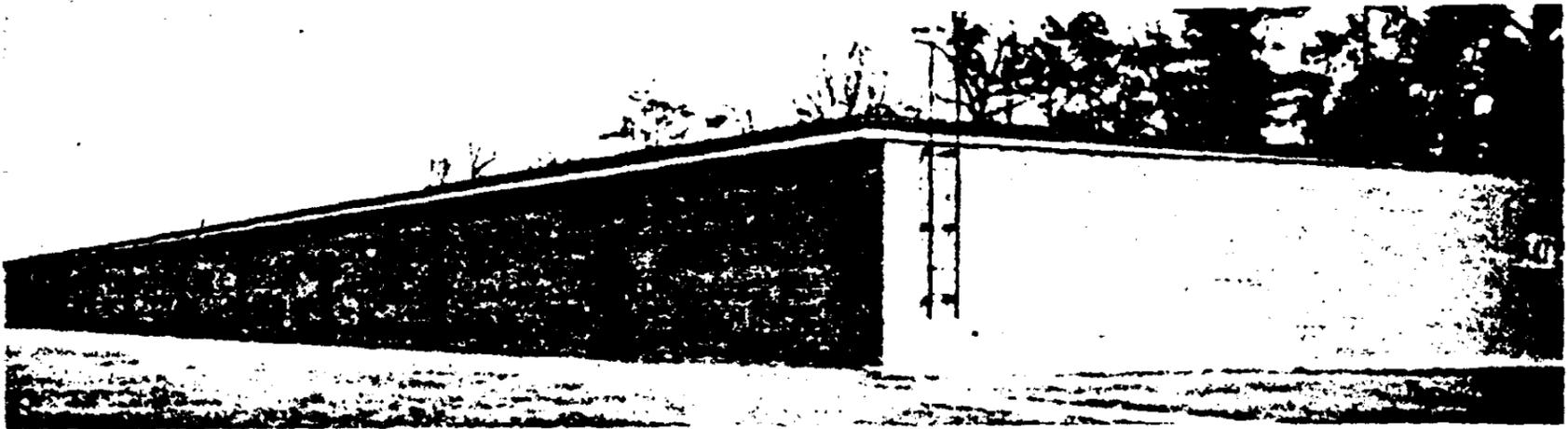


Figure 2-4. Flammable warehouse.

be sealed units (fig. 2-5) or fitted with doors (fig. 2-6).

(2) Dry tanks are used for long-term storage. Access roads parallel the rows of tanks. Because of the size and shape of dry tanks, there are no operating aisles for materials handling equipment although materials handling equipment is used in the storing process. Figure 2-7 shows a partially completed storage arrangement inside a dry tank.

f. Sheds.

(1) Sheds are buildings without complete sides and end walls. Some utilities may be provided. Figure 2-8 is an example of one type of shed. Since they are not readily dismantled for relocation, they are usually considered permanent structures. Sheds are used for the storage of material that requires maximum ventilation or material that does not require complete protection from the weather.

(2) There are various means by which shed-

stored supplies requiring added protection from the weather may be protected while other supplies requiring only minimum protection are left semiexposed. As illustrated in the left side of figure 2-9, tarpaulins may be used as side walls. Pallets may be positioned to form a protective wall (fig. 2-10). The use of pallets in this fashion, where feasible, serves a dual purpose since valuable storage space inside the shed will not be occupied by empty pallets.

(3) Figure 2-11 shows a transitory shed. This is a prefabricated structure which can be dismantled for movement and reassembly. These can also be positioned on concrete slabs.

g. Transitory shelters. These are prefabricated metal structures normally with complete sides and ends but no utilities therein. Such structures can be dismantled for movement and reassembly. Figure 2-12 is an example transitory shelter.

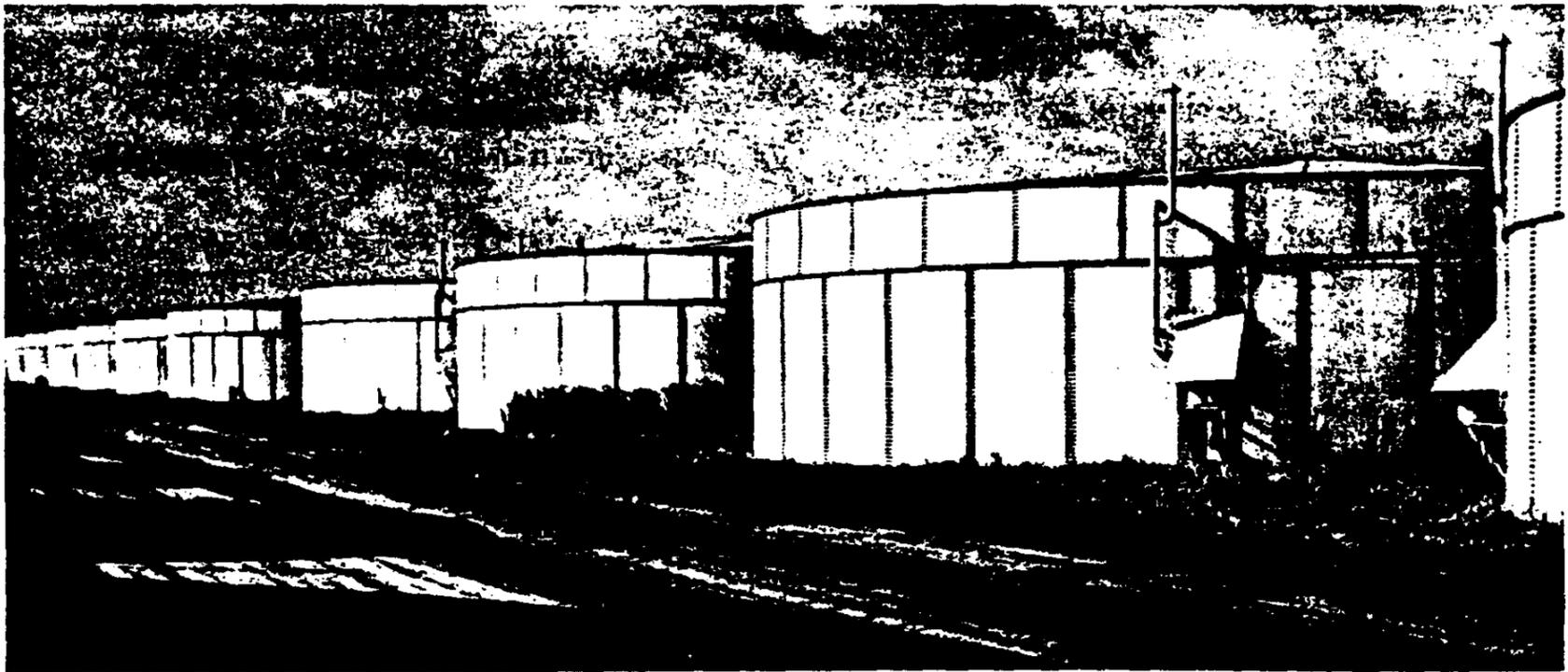


Figure 2-5. Sealed dry tanks (sections must be unbolted for access).

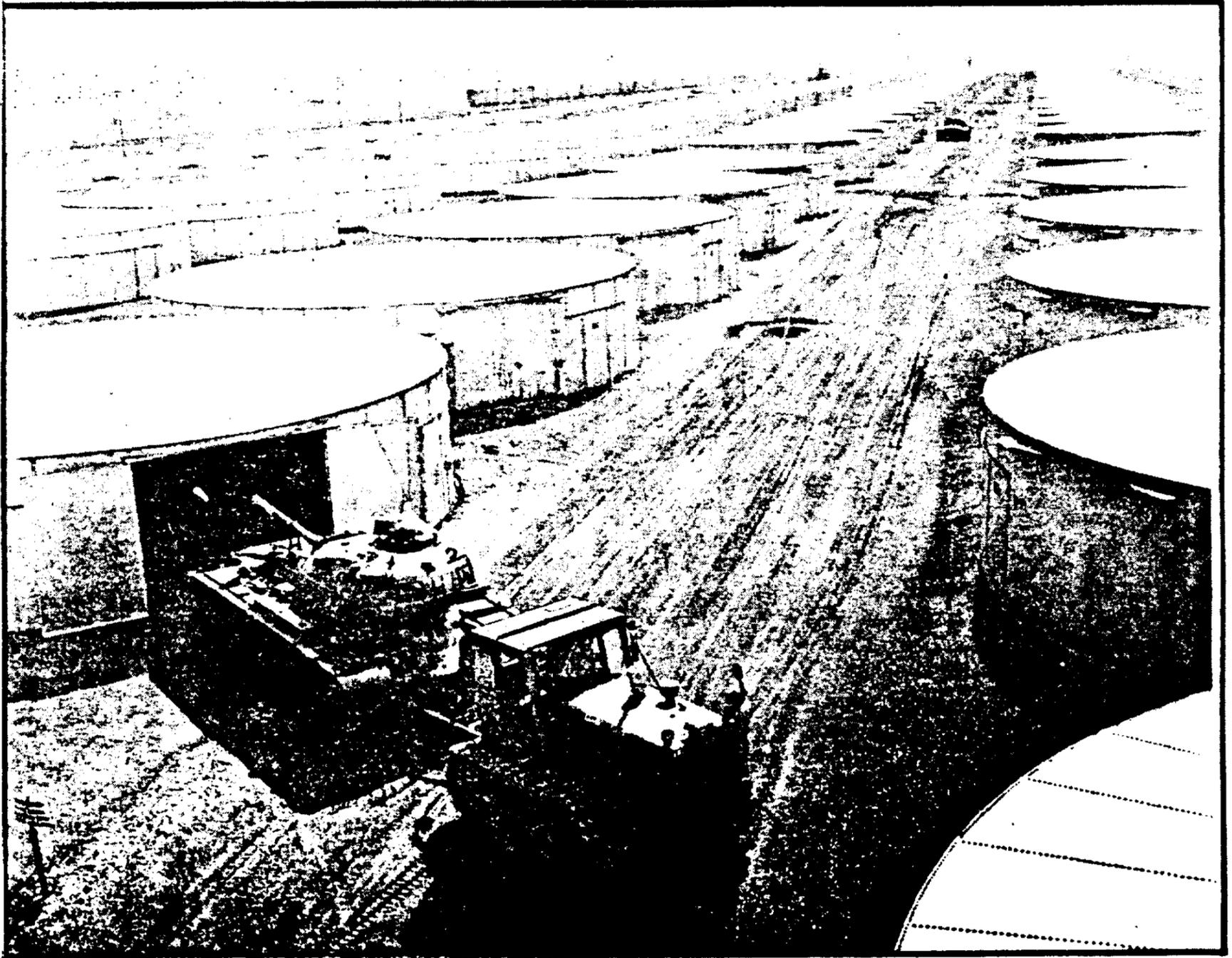


Figure 2-6. Dry tanks fitted with doors.



Figure 2-7. Partially filled dry tank.

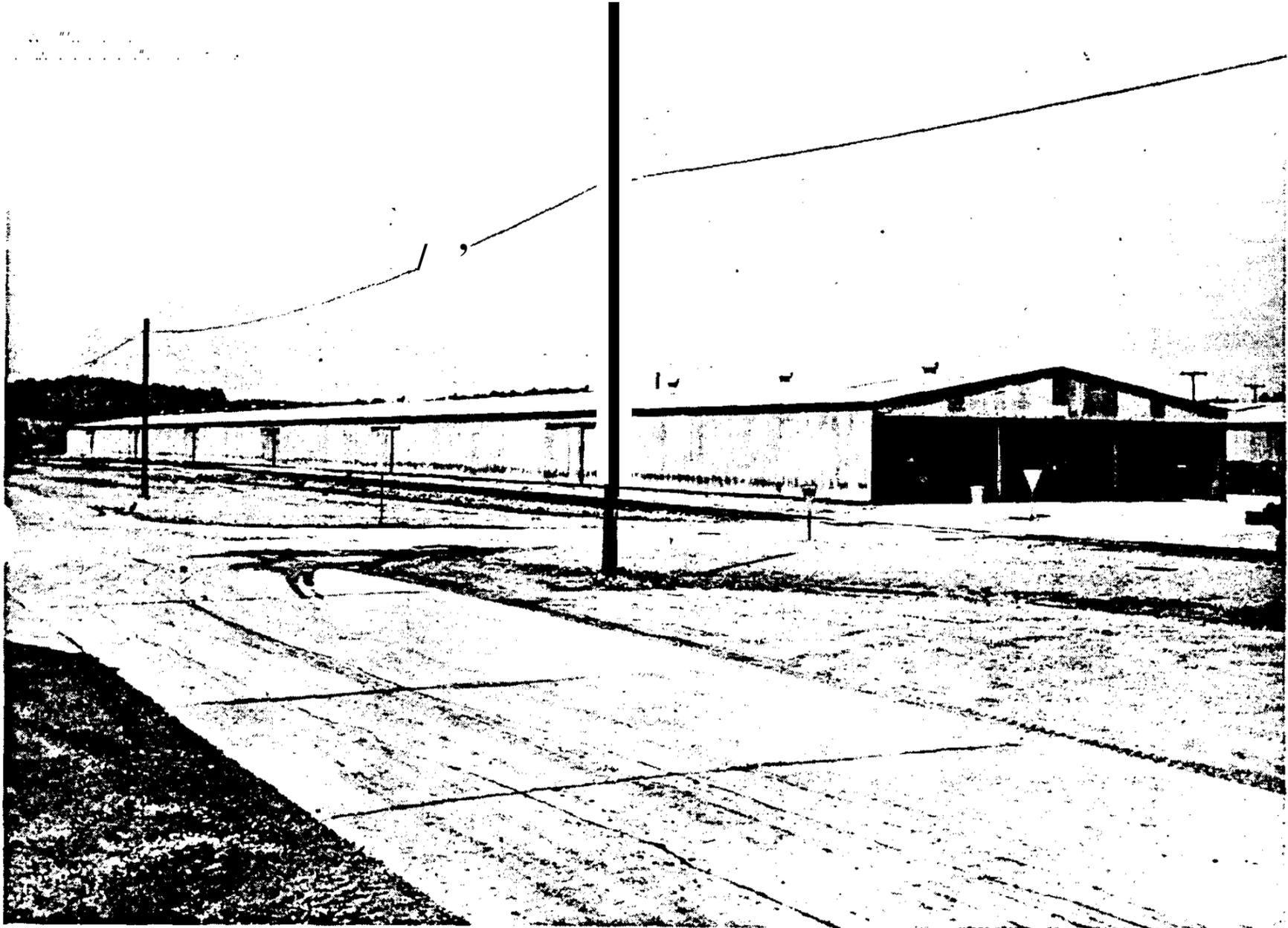


Figure 2-8. A type of shed.

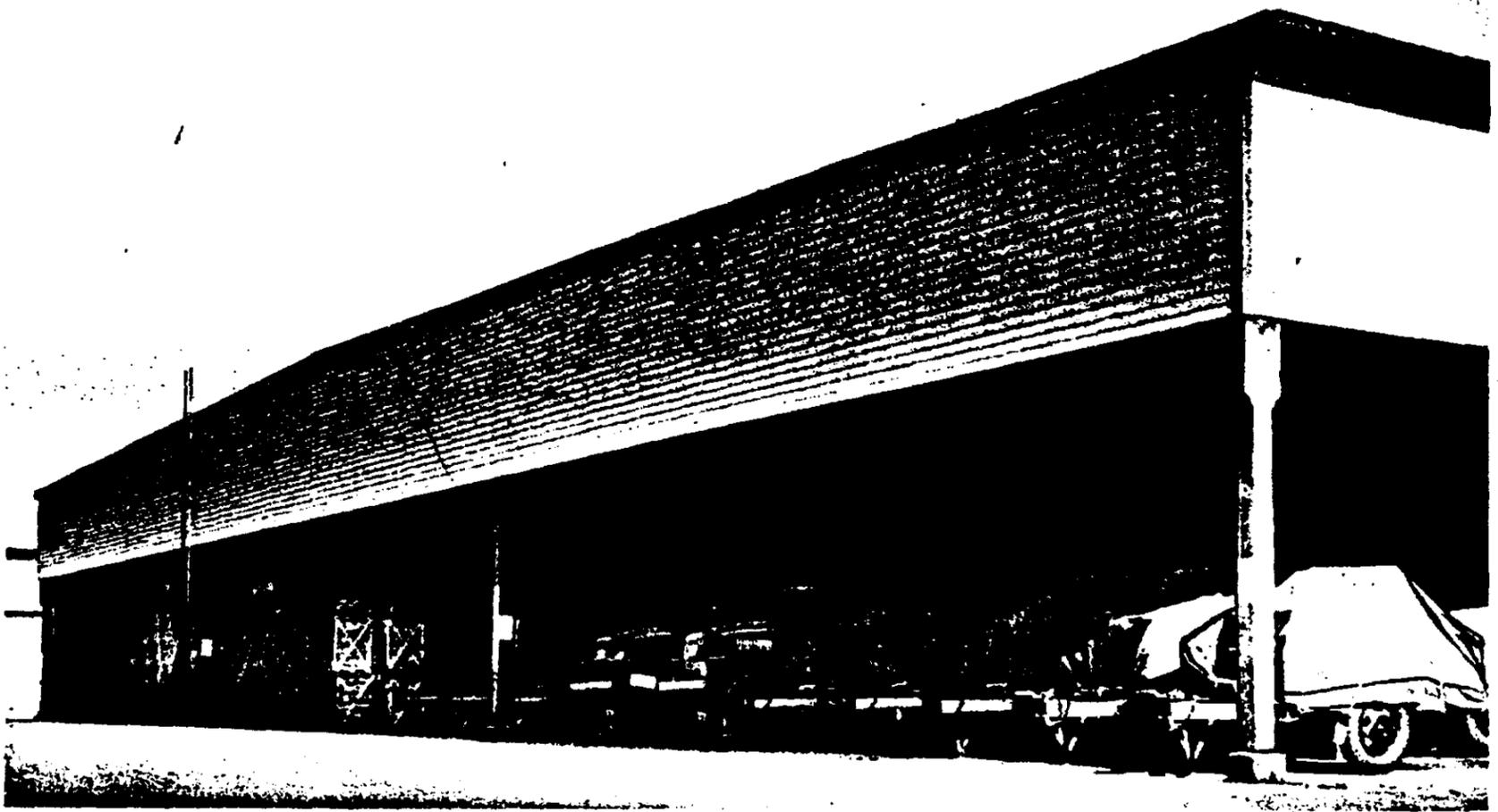


Figure 2-9. Shed storage showing the utilization of tarpaulins as end walls.



Figure 2-10. Shed storage showing the utilization of pallets as protective sidewalls.

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Figure 2-11. A type of transitory shed.

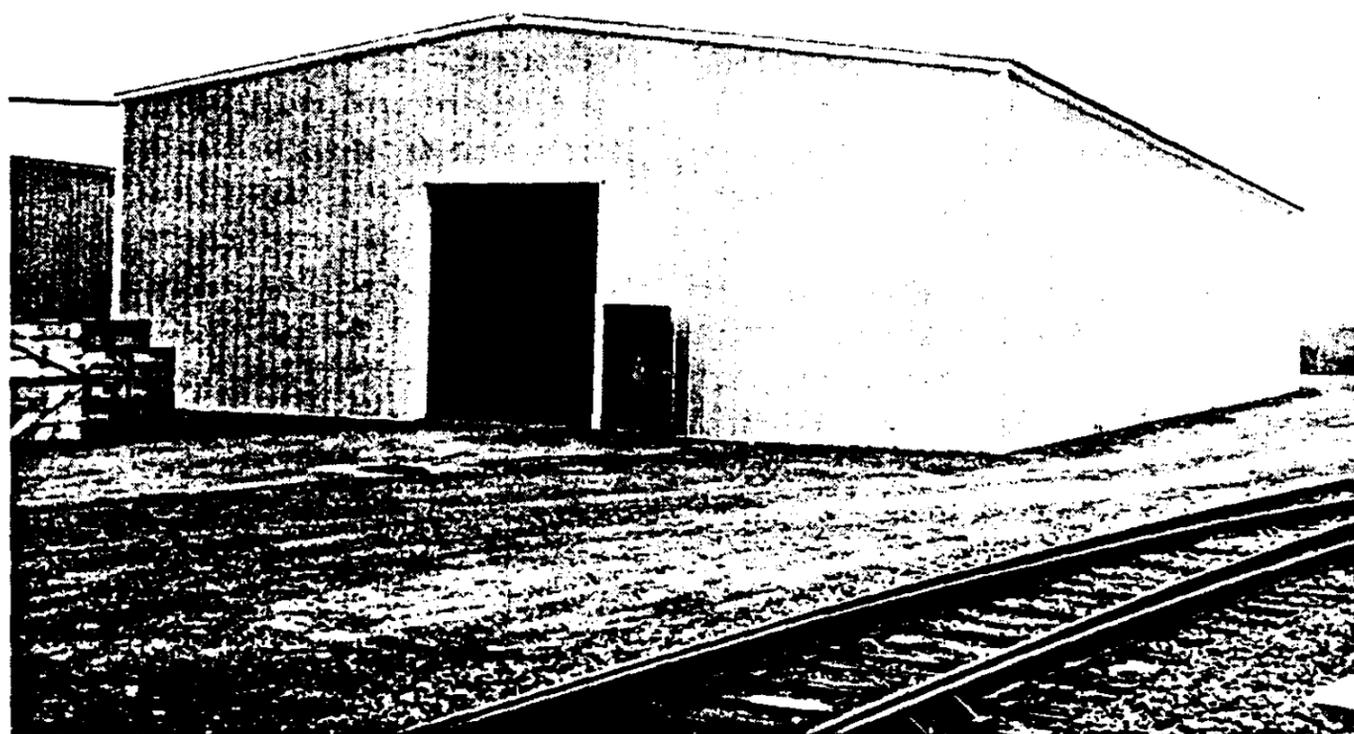


Figure 2-12. A type of transitory shelter.

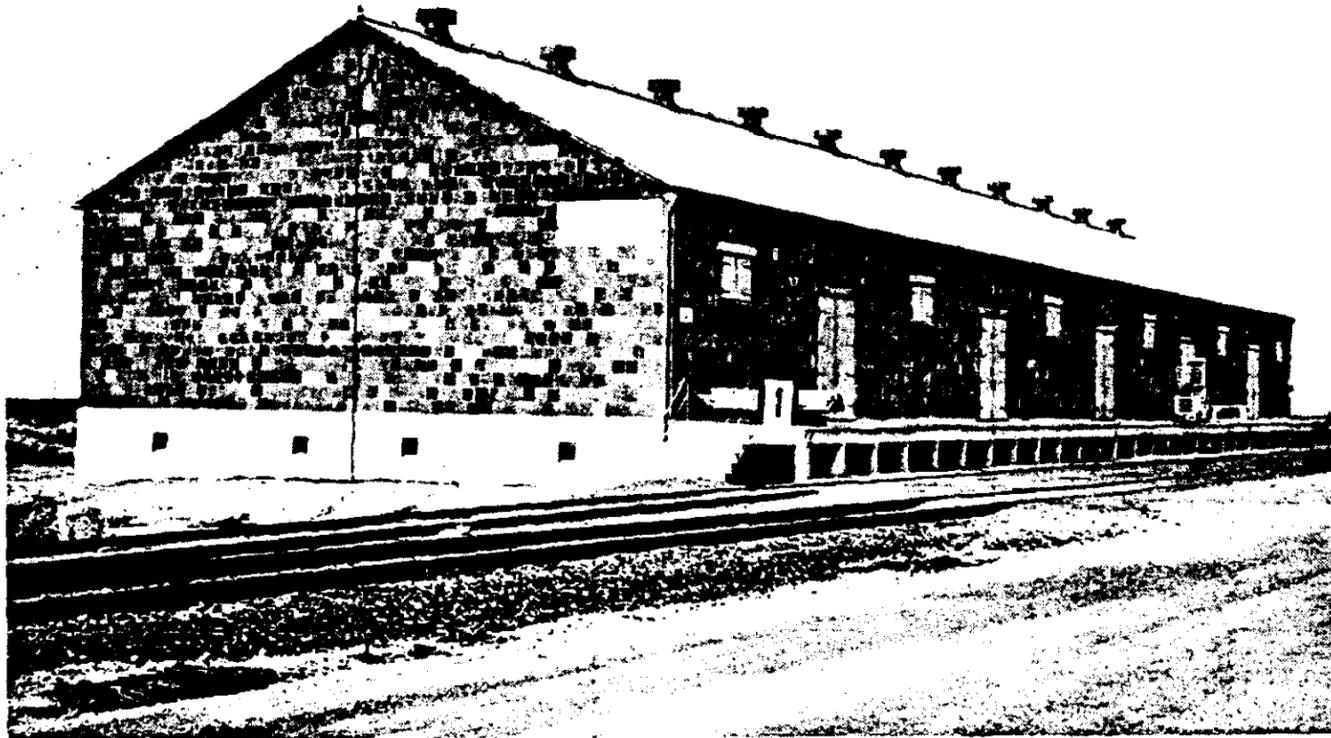


Figure 2-13. Typical above-ground magazine.

h. Above-ground magazine.

(1) An above-ground magazine is especially designed for the storage of ammunition and explosives. Because of the nature of the items stored, above-ground magazines are built of fireproof materials and well ventilated to lessen the danger of explosion. Note the ventilators on top of the building and the metal roof in figure 2-13. These buildings are widely separated to minimize the destructiveness of an explosion. Although it may be necessary at times to use a general-purpose warehouse to store small arms ammunition, the warehouse will not be classified as a magazine because it does not have the special design required for proper storage of *ammunition* and explosives.

(2) **One** type of above-ground magazine has a dock that runs the entire length of the building to service both trucks and **railcars**. Inside the typical magazine, there are no main aisles running the length of the building. Generally, cross aisles, corresponding to outside door location, run from the

front to rear of building. However, in the instance of large-lot storage as a single item of ammunition, **aisles** in certain sections of the magazine may be eliminated.

i. Earth-covered magazines. Earth-covered magazines such as igloos are also used for the storage of ammunition and explosives.

(1) The igloo is generally constructed of reinforced concrete with an arch-type roof covered with earth. The arch roof is an added safety feature. In the event of an explosion, the highest point of the arch, being the weakest point, would collapse first, thereby lessening the damage caused. Adequate ventilation is provided by earth-covered magazines. Although they are not heated, the inside temperature ordinarily ranges between 40° F. to 45° F. in winter to 60° F. and 70° F. in summer.

(2) Because of the isolated location and peculiar construction features of an earth-covered magazine, the type of materials-handling equipment used is often limited. A clearance must be provided be-

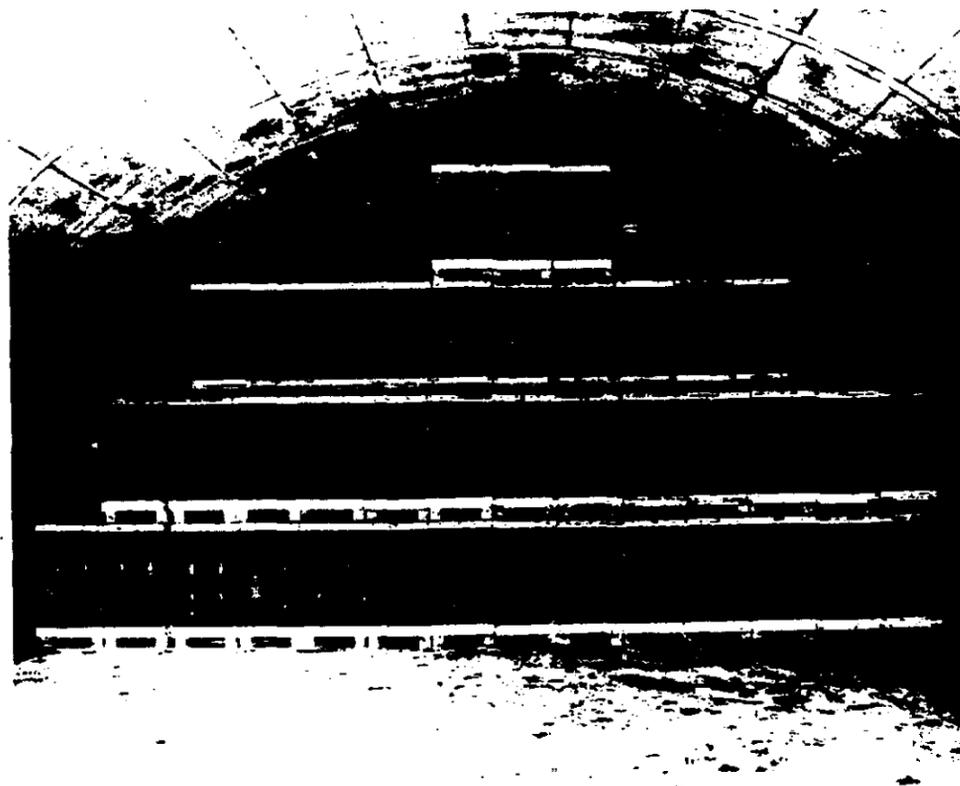


Figure 2-14. Explosives stored in a typical igloo.

tween stacks and walls. The amount of clearance will be in accordance with commodity characteristics and regulations of the appropriate military service. The typical earth-covered magazine has door(s) on only one end. Truck doors at earth-covered magazines are rare. Normally, a centrally located dock(s) is constructed in the ammunition area to service **railcars** and trucks.

(3) In addition to quantity-distance factors, storage heights in earth-covered magazines are limited by the arched roof (fig. 2-14).

(4) Figure 2-15 depicts some typical earth-covered magazines.

2-103. Open Storage Space

Open storage space is an improved or unimproved open area designated for storage purposes.

a. Open improved storage space. This includes space that has been graded and surfaced with concrete, tar, or asphalt, crushed stone or gravel, or other suitable topping. While covered space is preferred and even necessary for most supplies, certain material not readily susceptible to damage by adverse weather conditions can be stored in this type space.

(1) An open improved storage area usually has a hard surface of a more conventional surfacing material (fig. 2-16). The area shown provides adequate drainage, affords protection of supplies from wet ground conditions and provides adequate running surface for operation of materials handling equipment. A steel mat topping may be used but is a least desirable method but necessary in some instances due to immediate need *or* lack of other suitable topping material.

(2) Storage layouts for improved open areas vary because of terrain features and type of commodity stored. Aisles become in reality roadways due to the size of the materials-handling equipment required.

b. Open unimproved storage space. Open unimproved storage space is an unsurfaced open area designated for storage purposes.

(1) The limitation on the use of material-handling equipment is a significant disadvantage of this type storage. Storage managers must be very selective of the type stocks designated for this type storage and use such space **only** when a higher grade of open improved storage space is not available.

(2) A storage layout for an open unimproved

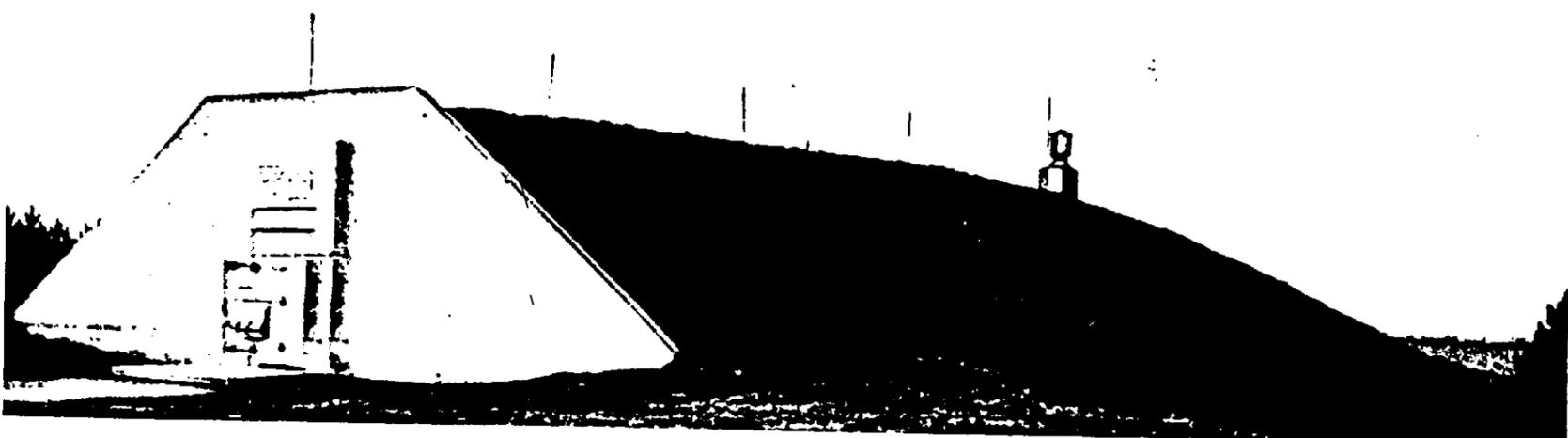
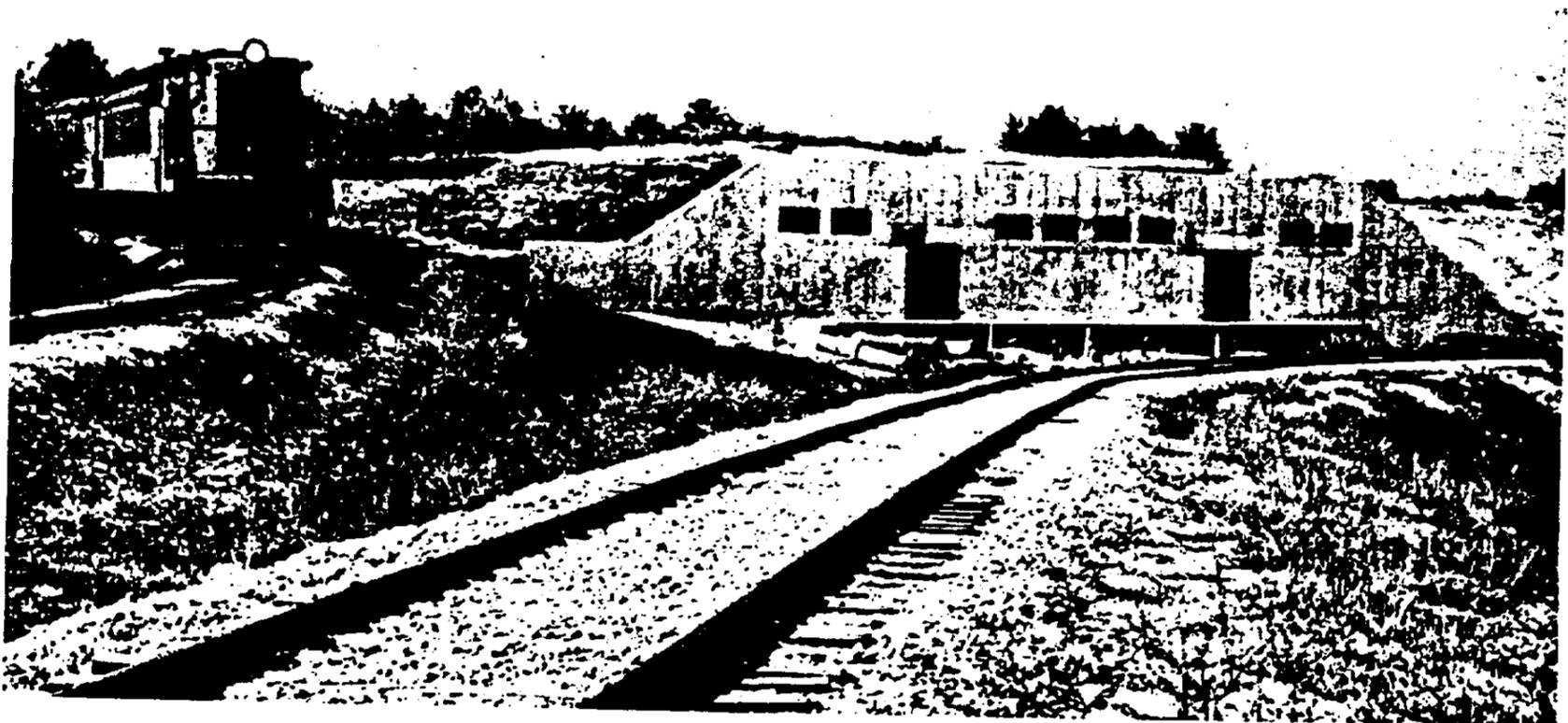
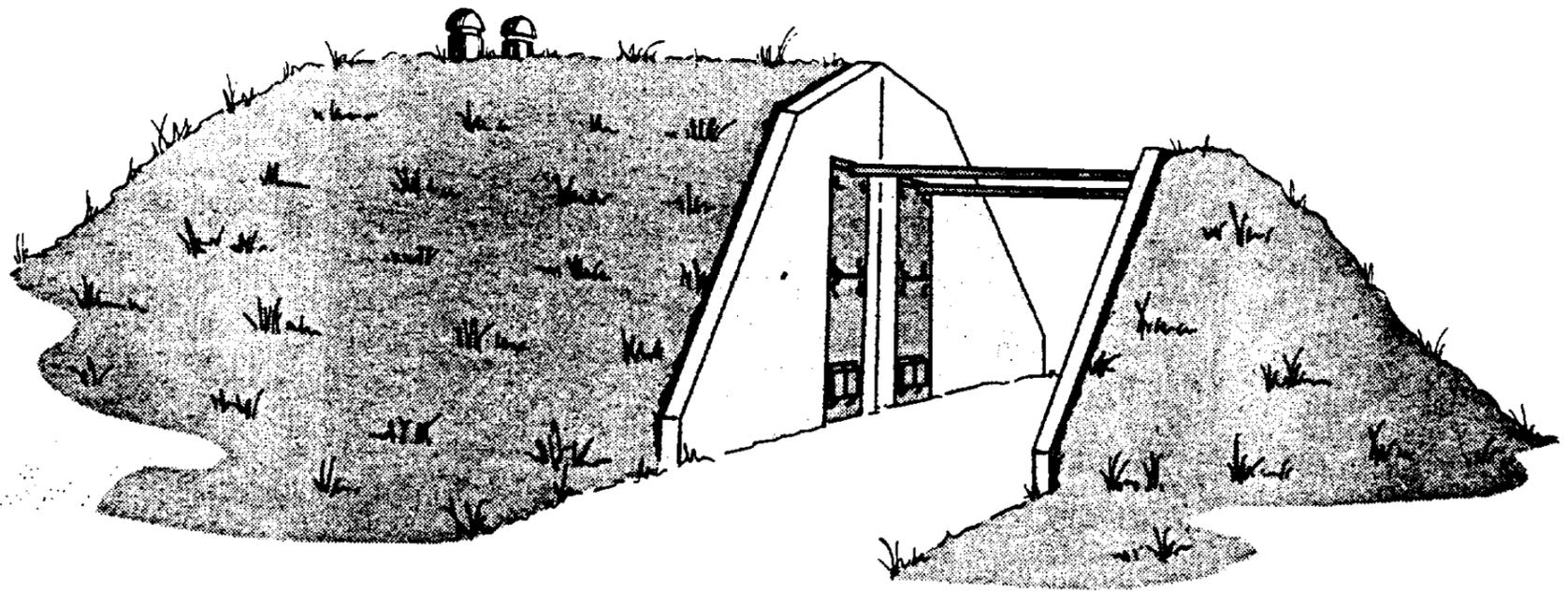


Figure 2-15. Typical earth-covered magazines.

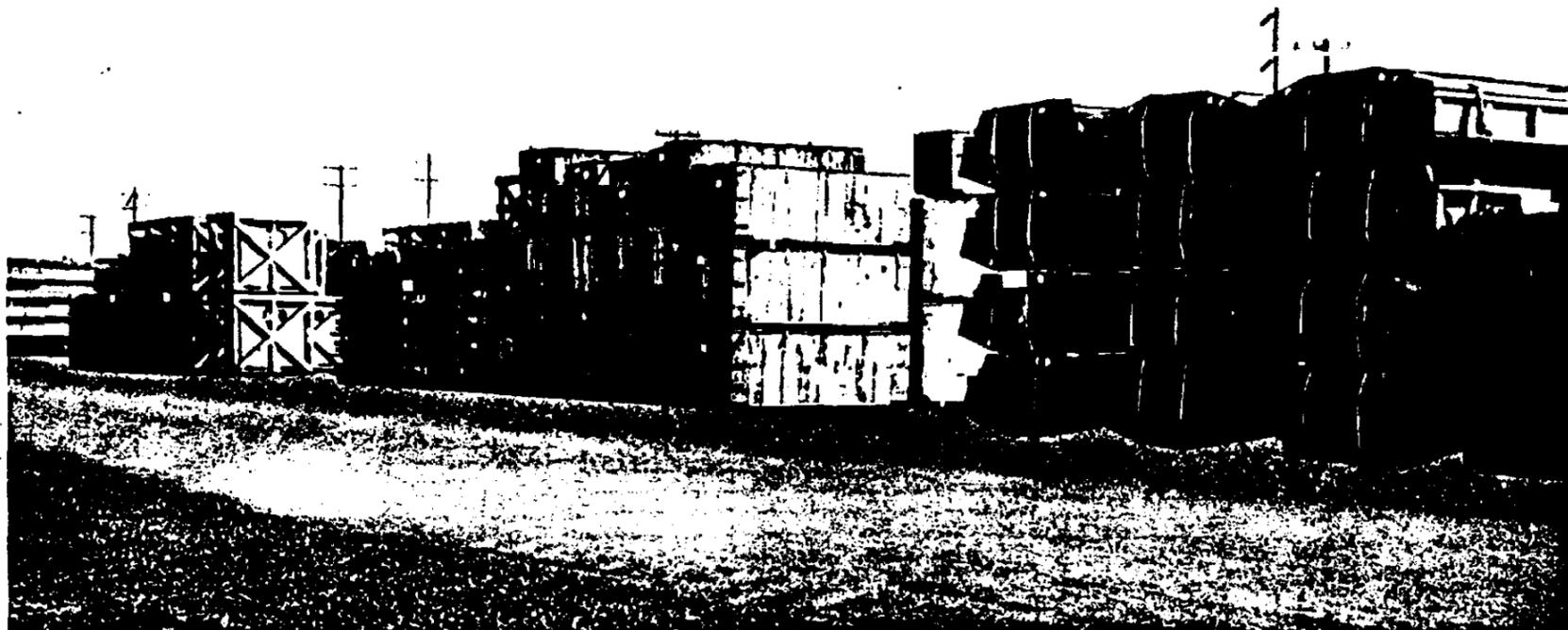


Figure 2-1 6. Hard surfaced open improved area.

storage area is affected by the same criteria as that for open improved storage areas. However, to take advantage of existing drainage, supplies may have to be positioned and aisles or roadways may have

to be located, without regard to conventional storage practices. More details on storage layouts for all types of storage are contained in section 3 of this chapter and section 3 of chapter III.

Section 2. SPACE REQUIREMENT FACTORS

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Development of data for use in space requirement computations	2-204
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2-201. General

Storage space is a basic resource of any storage operation. Economy depends upon the optimum utilization of this space, and the proper arrangement of operations incident to the receipt, storage, and issue of materials. Space economy can be obtained only by thorough planning for the use of space,

2-202. Scope

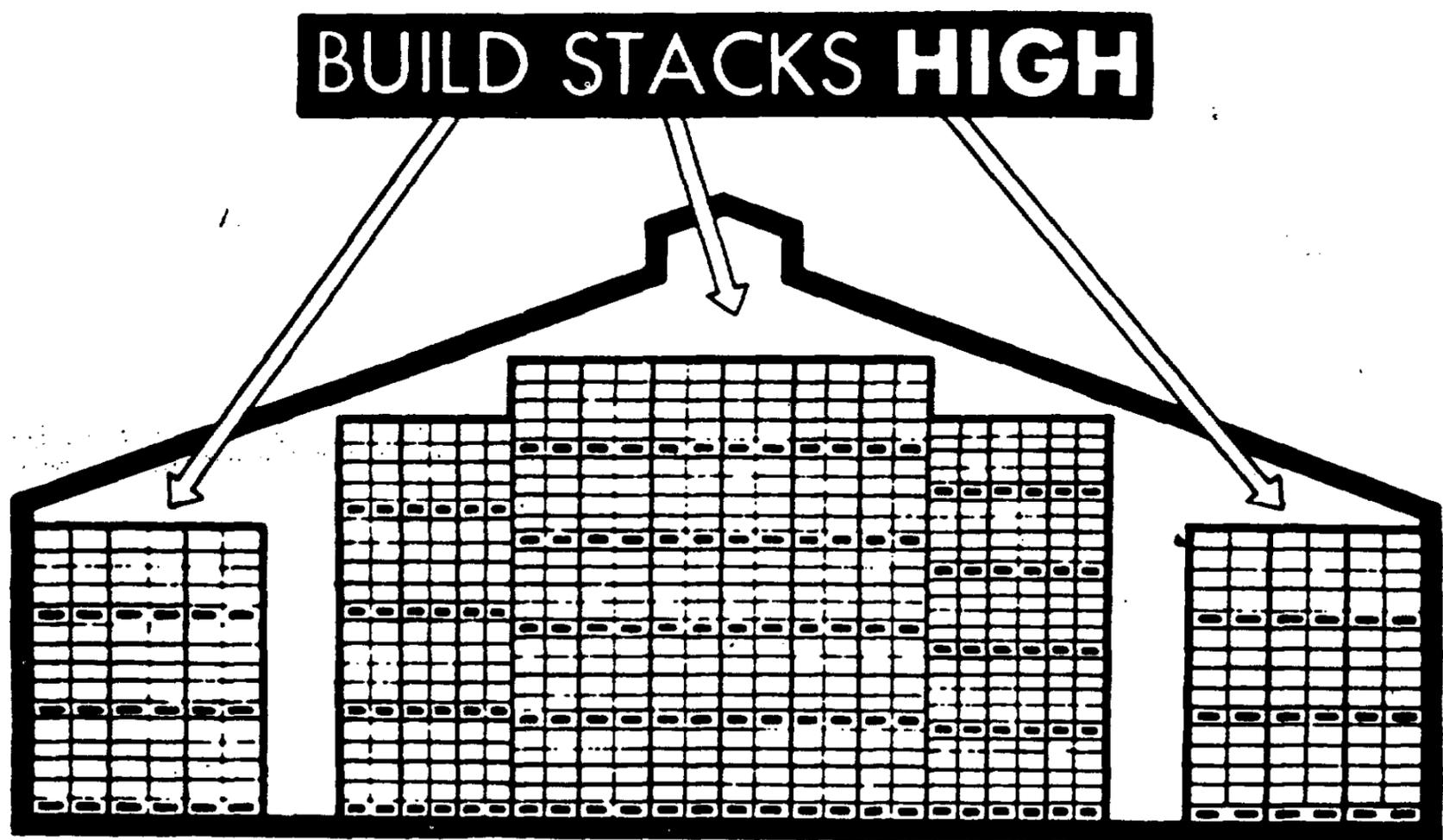
This procedure does not apply to wet storage areas, rolling stock yards, petroleum, oil, and lubricants (POL) tank farms, storage of complete aircraft, industrial tool storage in contractor plants, or to ammunition storage space computations which are developed under separate instructions of the military services.

2-203. Considerations in Space Requirement Computations .

There are many factors which must be considered in developing a procedure for computing storage space requirements. These factors must be recognized in a way that will enable ready adaptability by all echelons concerned with computing space requirements or occupancy factors. The following **identify** these key factors:

“a. *Quantity of inventory.* Although many elements contribute to the computation of storage space requirements, quantity is the basic element or conversion factor. From this, space requirements can be computed through application of dollar value **and/or** cubic footage of supplies.

b. *Characteristics of storage facility.* Since storage space is three dimensional, facility **character-**



... utilize vertical space to the fullest extent . . . save floor space for additional receipts.

Figure 2-1 7. Effective use of vertical space.

istics must be carefully analyzed. Limitations such as stacking height, floor capacity, structural clearances, and other obstacles must be recognized.

c. Equipment capabilities. Use of potential warehouse storage height may be restricted by equipment capabilities to achieve the vertical utilization.

d. Commodity characteristics. The maximum stacking height potential is also influenced by the characteristics of the material or its packaging. These may not permit stacking to the height available. The type of commodity being stored must therefore be considered in determining whether the gross cube available can be filled. This consideration supports the idea of categorizing supplies into groups to promote a constant storing height potential.

e. Total warehouse storage space. The gross storage space within a warehouse includes

(1) *Storage support space.* See section 2, chapter 1.

(2) *Aisles.* See section 2, chapter 1, and section 3 of this chapter.

(3) **Structural 10SS.** See section 2, chapter 1.

(4) *Net storage space.* See section 2, chapter 1.

f. Occupancy of net storage space. Considerations such as ceiling heights, commodity characteristics, and “elbow room” are factors which preclude the possibility of complete occupancy of net storage space. In any storage operation, it is desirable to have “elbow room” available for operational flexibility. This “elbow room” space must be limited to the absolute minimum required for effective storage. **Sufficient** “elbow room” should be available to minimize the continuous necessity for relocation of stocks to “fit” additional receipts into the storage

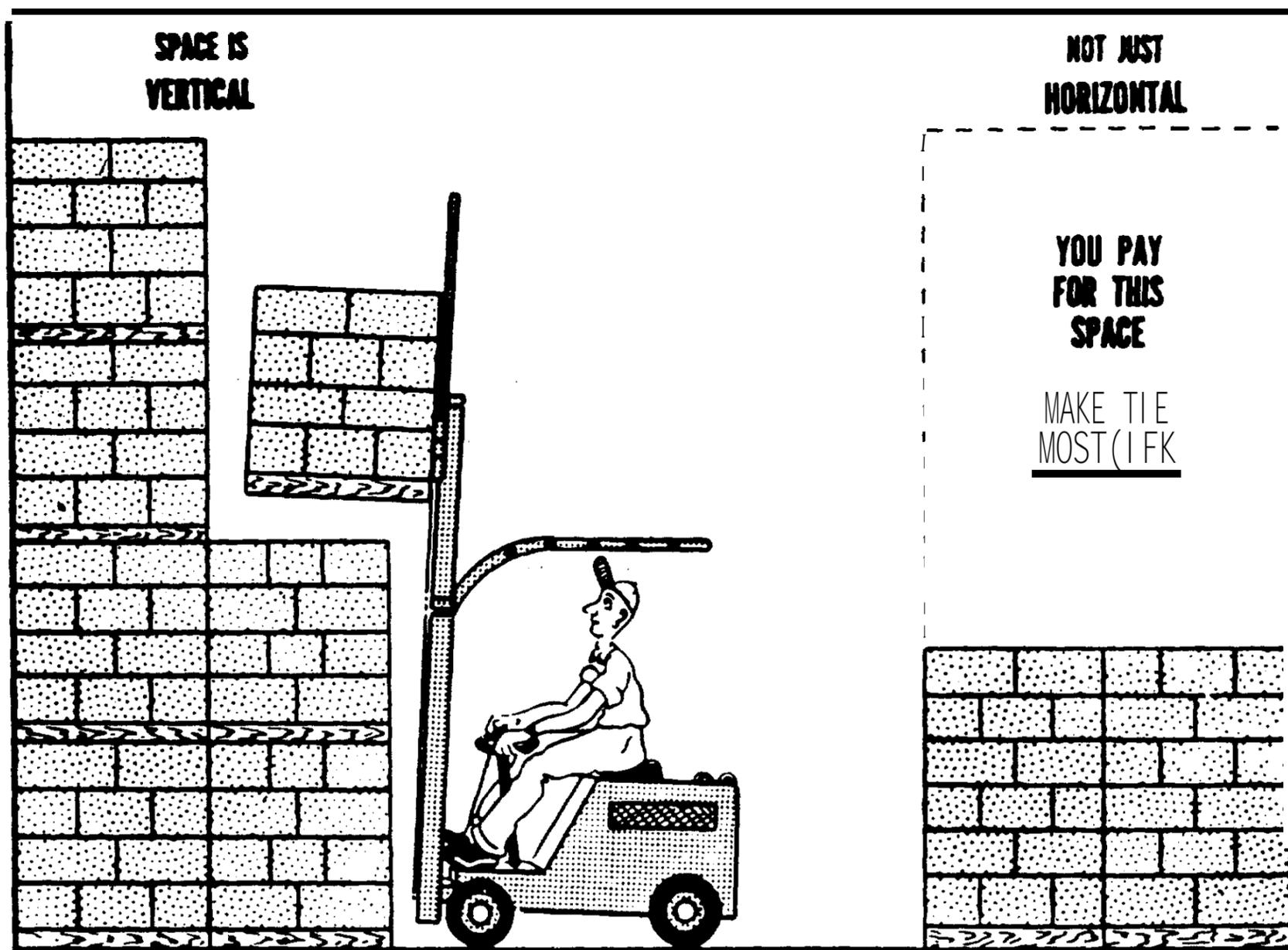


Figure 2-18. Space is three-dimensional.

pattern. Fifteen percent of the net available space is considered an adequate allowance for "elbow room" for general supplies. Ammunition is of course governed by quantity-distance factors found in appropriate publications.

g. *Examples of space considerations.* Figures 2-17 through 2-21 are illustrations of some of the considerations in properly computing storage space requirements.

2-204. Development of Data for Use in Space Requirement Computations

Computation of space requirements should use cubic feet and/or square feet as conversion factor(s) in relating material to space. In the planning for, and selection of material for storage in specific warehouses or warehouse sections, the selection should be based upon the volume of inventory, stackability, bin requirements, etc. In other words,

material with low stackability should not be located in high ceiling warehouses when lower ceiling or low floor level capacity warehouses are available. This also applies to bin areas, storage support areas, relatively small inventories of the same item, etc. The following will apply in developing data to support space computations:

a. *Average stacking heights.* The characteristics of storage warehouses influence the heights to which material may be stacked. The composition of the inventory will normally vary from installation to installation with resultant effects on average stacking heights. For example, a substantial inventory of an item that possesses very limited high storage potential, as opposed to a very limited inventory of the same item, would have a marked bearing on storage height average for that item. For this reason, each storage activity must compute independent data which will reflect average potential storage height of inventory.

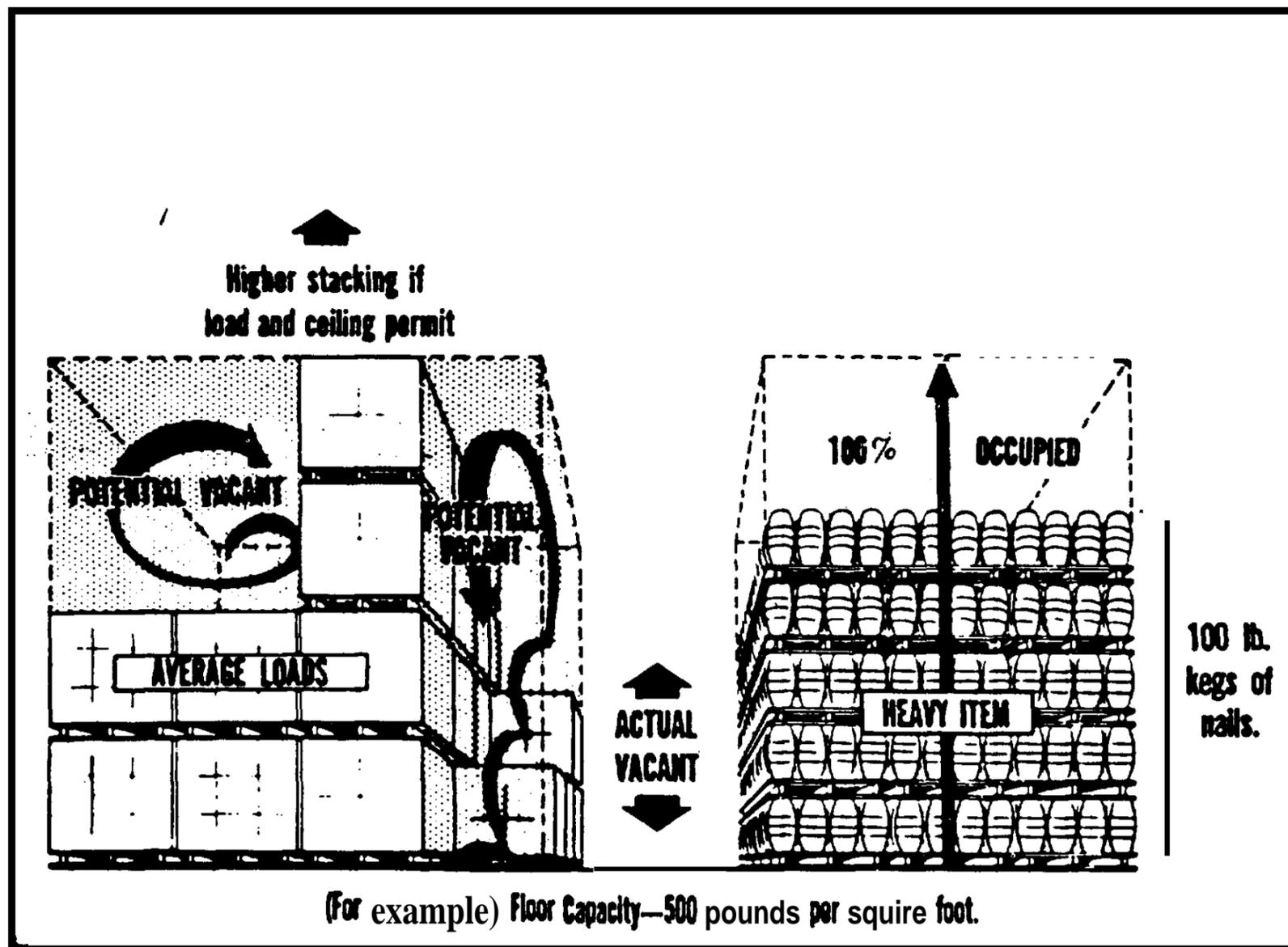


Figure 2-19. Floor load limitation.

(1) In order to relate to space, the stacking height must be established. Establishing stacking heights should not be predicated on the basis of the height to which supplies are currently stored, but rather to the height that supplies are capable of being stored in accordance with proper warehousing practices. This height to which supplies are capable of being stored is known as the potential storage height. Another influence which must be recognized is the inventory. For example, the quantity on hand could result in some supplies being stacked to less than the potential height. This practice reduces the average potential storage height. The term "adjusted potential storage height" applies to this recomputation.

(2) It will be necessary to survey inventories in order to determine acceptable and attainable storage heights. Computer facilities, where available, should be utilized to provide greater accuracy and lessen expenditure of manpower. To attain satisfactory benefits from such a survey, and to avoid establishing stacking heights for each item, supply

inventory should be grouped into selected categories and the average-heights determined for each category. As examples, separate categories may possibly be established for type 1, easy load, type 2, average load, and type 3, difficult load, as defined in glossary of terms, and for unpacked items such as vehicles.

(a) Supply groupings should be sufficiently categorized to reflect relatively constant and accurate average potential stacking heights as well as adjusted potential stacking heights which take into account the variables of supply inventory.

(b) Results of the survey will indicate an overall potential height and adjusted potential height for each category grouping. This should be frequently assessed to assure data correctly reflect the current storage situation.

b. Square foot computations. Stacking height data will be reconciled to the amount of floor area (square footage) that is currently utilized in storing inventory. In the event that potential or adjusted potential storage height is not fully occupied, pro-

vision must be made to identify the current excessive occupancy of square feet of floor area in order to reflect the actual net square feet of storage space required to store inventory. The height of stacking should be extended by attrition to bring the actual storage in 'balance with the adjusted potential, thereby equalizing the amount of net square feet actually occupied. An example problem is worked out as follows:

A survey has indicated that supply category X is capable of being stacked to an average potential height of 14 feet and an average adjusted potential height of 13 feet. The survey also disclosed that material **currently** occupies 218,000 square feet of floor space. The average stacking height to which materials are actually stored averages only 12 feet. How many square feet are required to store inventory? See figures 2-22 and 2-23.

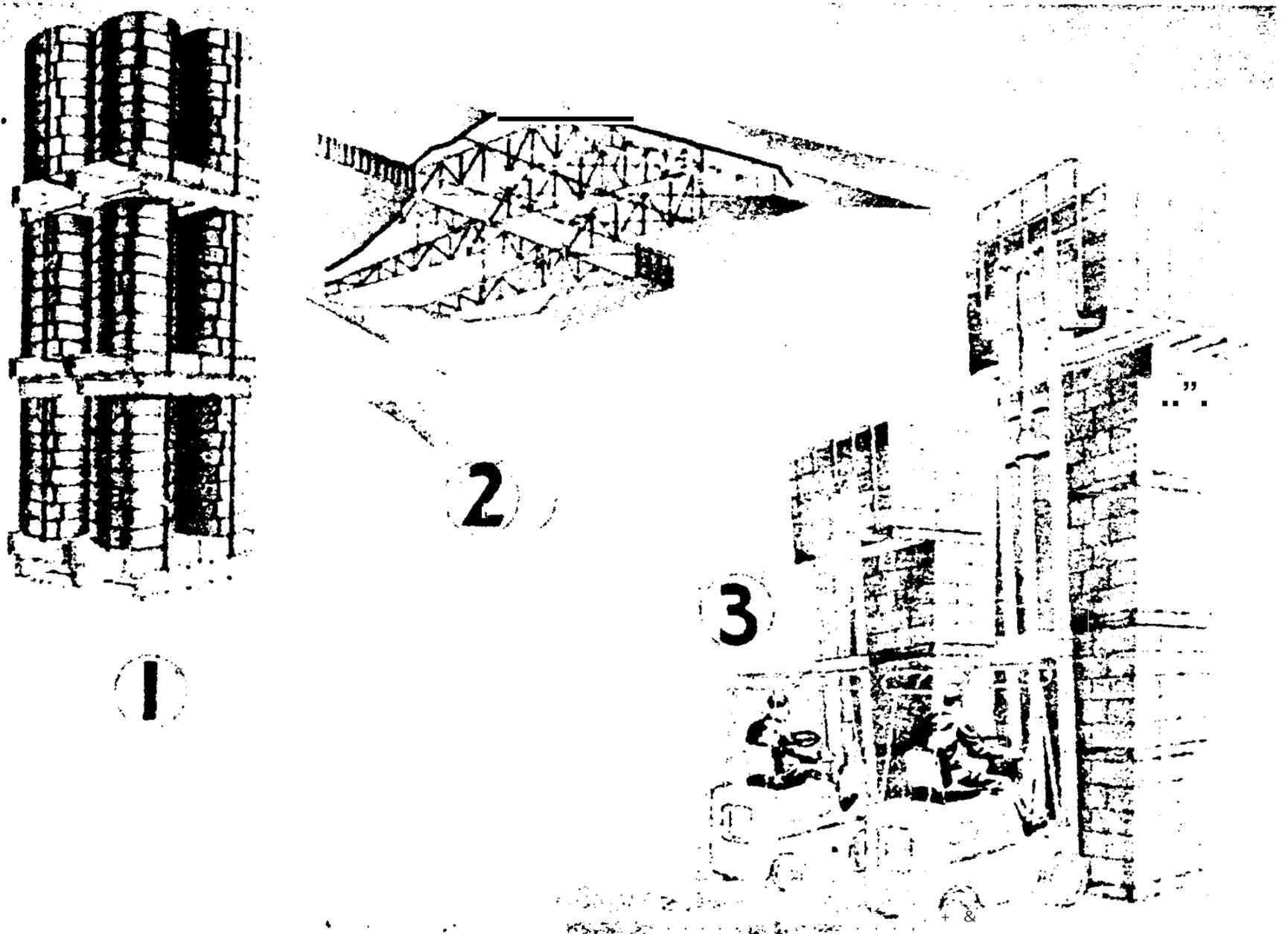


Figure 2-20. Facilities and equipment are limiting factors in attaining storage heights;

① Coils of steel banding are shown in a stack *column* that is erected to only moderate storage height. Although the characteristics of this item with regard to stability would allow a substantially higher stacking level, the weight, considering floor load capacity, has reached the maximum. Floor load capacity may, therefore, influence stacking heights.

② Structural supports of a warehouse are a major limiting factor in attainable stacking heights. Above illustration depicts a shed-and-monitor-type warehouse. Note that shed area has substantially less stacking height potential than does the middle area, or monitor section.

③ Even though a warehouse possessed highly preferable features as relates to floor load capacity and clear vertical space, these would be to little avail unless characteristics of stacking equipment were capable of taking full advantage of the potential. Illustration depicts the lost space consequences of a lift truck with limited stacking reach.

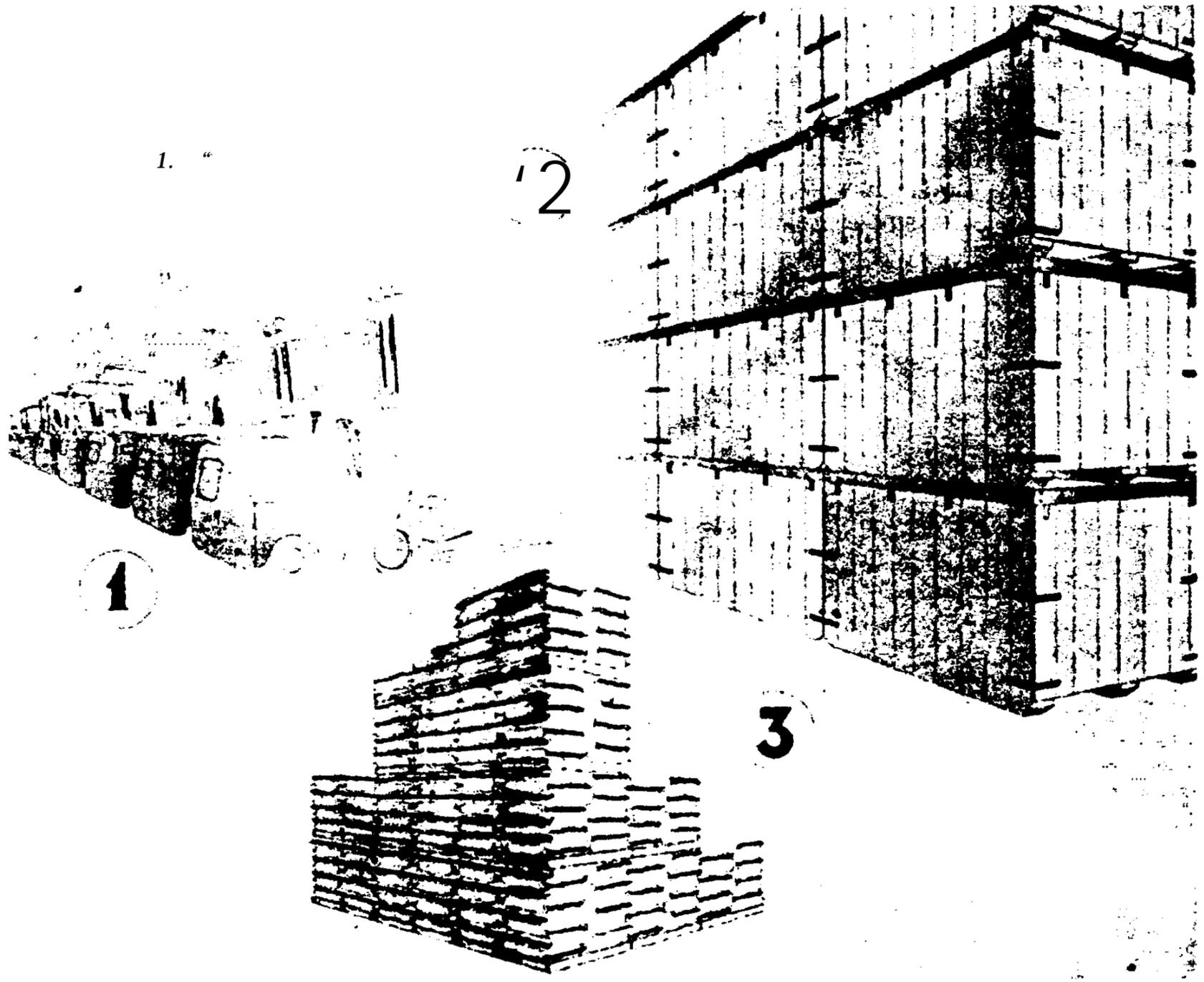


Figure 2-21. Commodity characteristics also influence storage heights.

① Forklift trucks represent those items that are stored unpacked and are of such contour to preclude stacking. Within the limits of appropriate facility assignment, items of this type, in the interests of space utilization effectiveness, are normally located in storage areas where the least storage height potential exists. Inventory such as this is categorized as being of limited stacking height potential.

② Items which are packed in containers of substantial strength or items which support the surface of the containers will ordinarily lend to high stacking. Therefore, selection of storage location should provide for maximum stacking height potential.

③ There are many items which lend only to moderate stacking heights for several reasons. As an example, the packs may be too weak to withstand the extreme stack weights imposed as a result of relatively high storage or else the packs are somewhat unstable. The bagged items shown in this illustration are representative of the above reasons which limit stacking heights.

PART A

P = POTENTIAL storage height
 A = ACTUAL storage height
 AP = ADJUSTED POTENTIAL storage height

$\frac{A}{P}$ = Potential vertical space utilization effectiveness (fig. 22).

$\frac{A}{AP}$ = Adjusted vertical space utilization effectiveness.

$\frac{12}{14}$ = 86% Potential vertical space utilization effectiveness.

$\frac{12}{13}$ = 92% Adjusted potential vertical space utilization effectiveness.

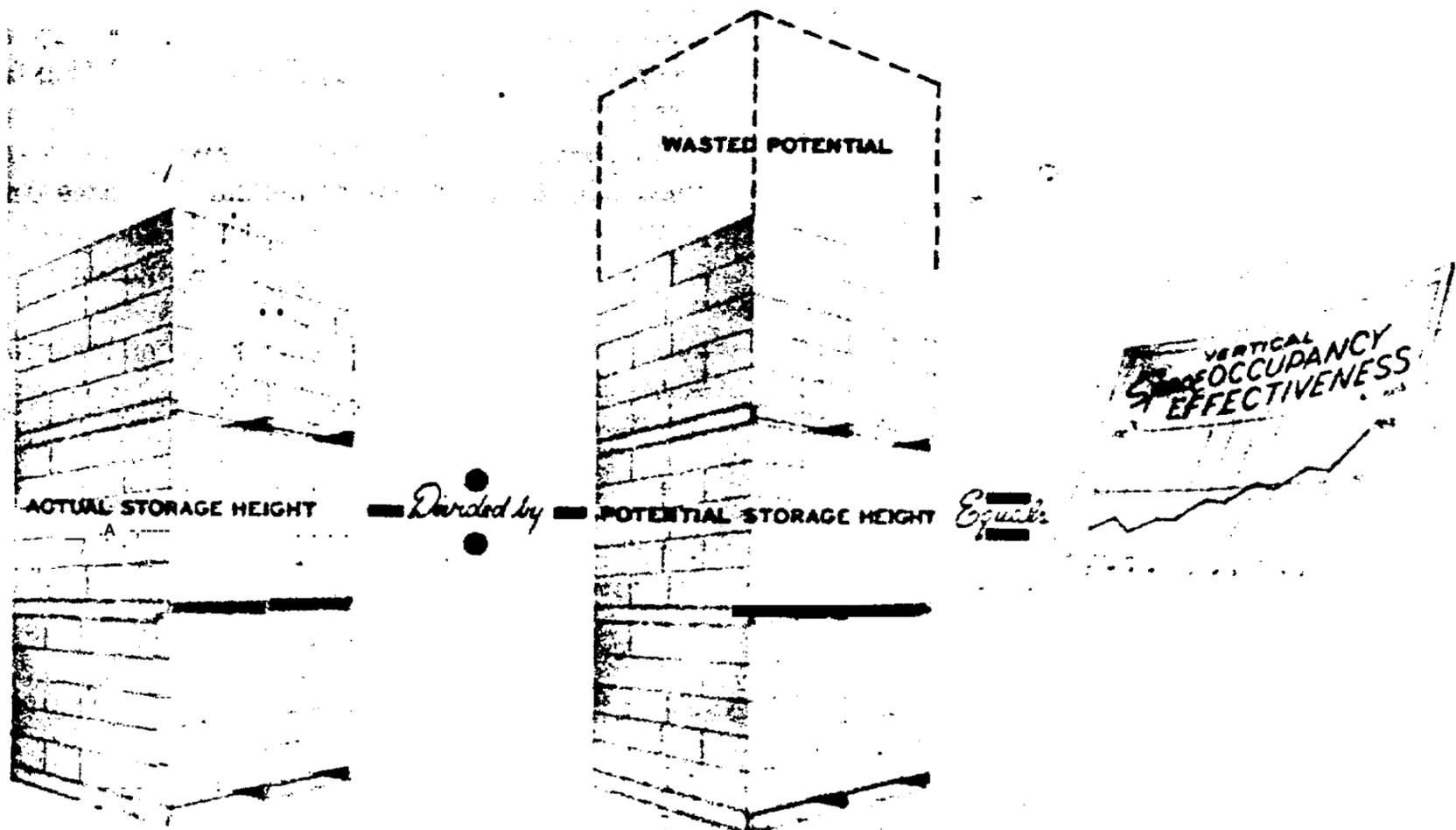


Figure 2-22. Space occupancy effectiveness ($\frac{A}{P}$ = effectiveness).

PART B
 S = SQUARE FEET occupied by inventory
 E = Space occupancy EFFECTIVENESS
 R = Square feet REQUIRED to store inventory
 (fig. 23)
 $S \times E = R$

218,000 x .86 = 187,480 Square feet required for optimum effectiveness
 or
 218,000 x .92 = 200,560 Square feet required to store present inventory.



Figure 2-23. Actual square feet required to store inventory ($S \times E = R$).

c. *Cubic foot computation.* Since both horizontal and vertical dimensions have been provided in *a* and *b*, above, the multiplication of the total square

foot area of storage by the stacking height (feet) will equal the total cubic feet of storage space available. Formula will read:

H = Vertical storage HEIGHT
 S = SQUARE FOOT area
 TCF = TOTAL CUBIC FEET
 H x S = TCF

AH = Attainable stacking HEIGHT
 S = SQUARE FOOT area
 ACF = ATTAINABLE CUBIC FEET
 AH x S = ACF

d. Dollar value of inventory (except ammunition). In, any space computation formula, quantity of inventory is the primary "element. Knowledge of the total dollar value of the supply inventory is also a valuable asset for use in conversion of receipts and issues to space occupied or vacated. For example, computation of this data can be used in formula development to indicate that \$5,000 worth of

supply receipts will require X amount of storage space or \$10,000,000 worth of supply inventory will occupy Y amount of space. (Inflation/deflation factors must be considered when determining space requirements by this method.) The value of this approach, as a convenient medium. of space computation, should be apparent. These data may be applied as indicated in succeeding formulas:

PART A—Determining dollar value of inventory per cubic foot

DV = DOLLAR VALUE of supply inventory on hand
 CF = CUBIC FEET required to store inventory (c above)
 VC = Dollar VALUE of inventory per CUBIC foot (fig. 24)

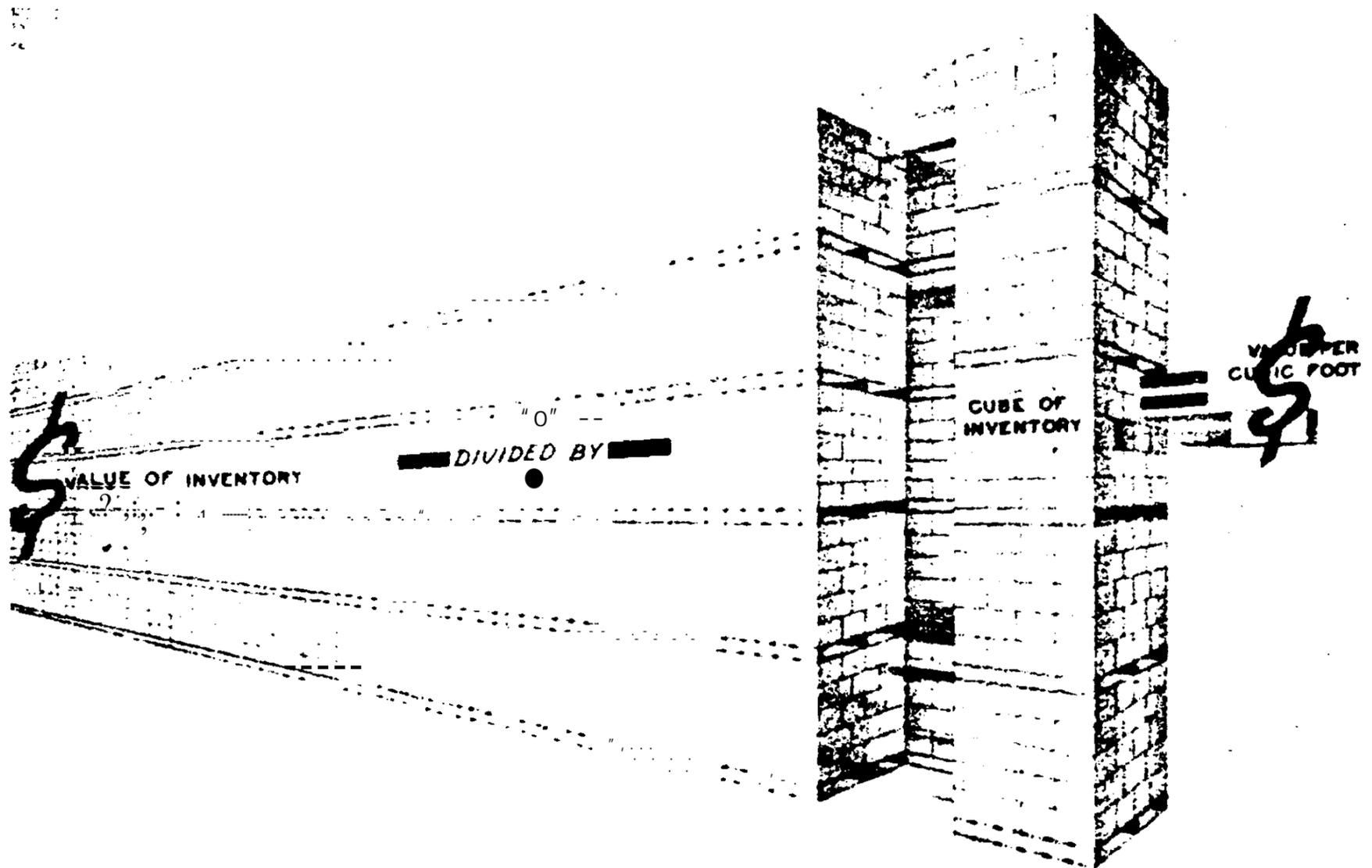


Figure 2-24. Dollar value per cubic foot ($\frac{DV}{CF} = VC$).

Part B-Allowance for incoming receipts (estimated):

Element I:

I = INBOUND receipts cost value

VC = DOLLAR VALUE of "on hand" inventory per CUBIC FOOT

CF = CUBIC FEET required to store additional inventory (fig. 25)

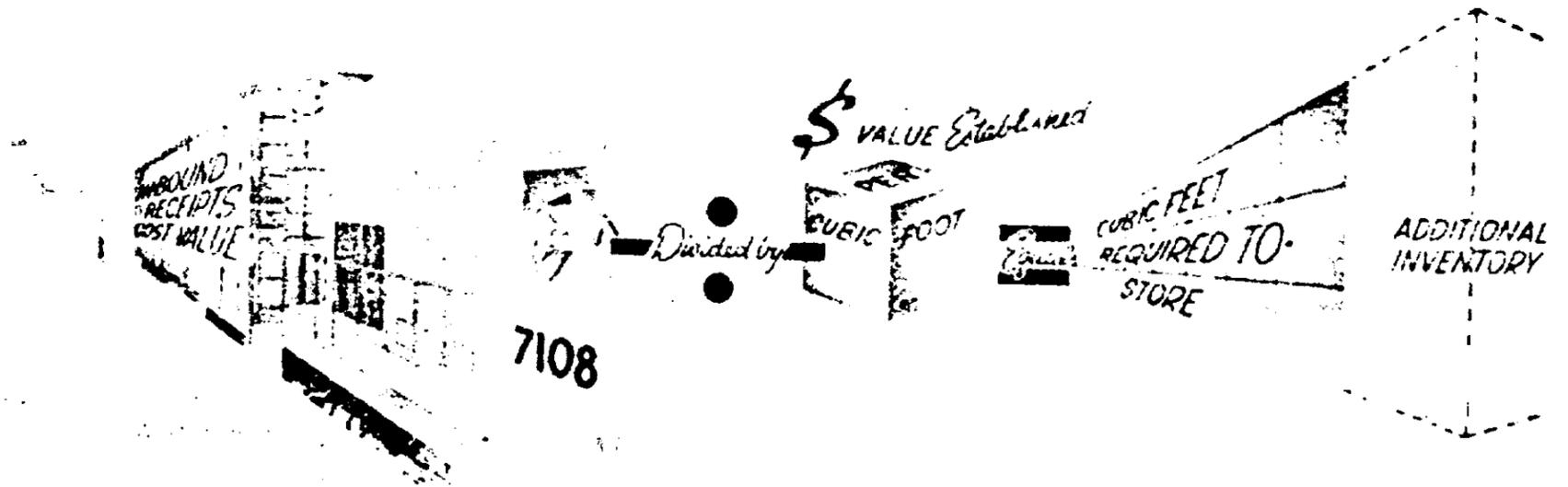


Figure 2-25. Cubic feet required to store additional inventory ($\frac{I}{VC} = CF$).

Element 2:

H = Vertical storage HEIGHT to which additional inventory may be stacked.

CF = CUBIC FEET required to store additional inventory.

S = SQUARE FEET required to store additional inventory (fig. 2-26).

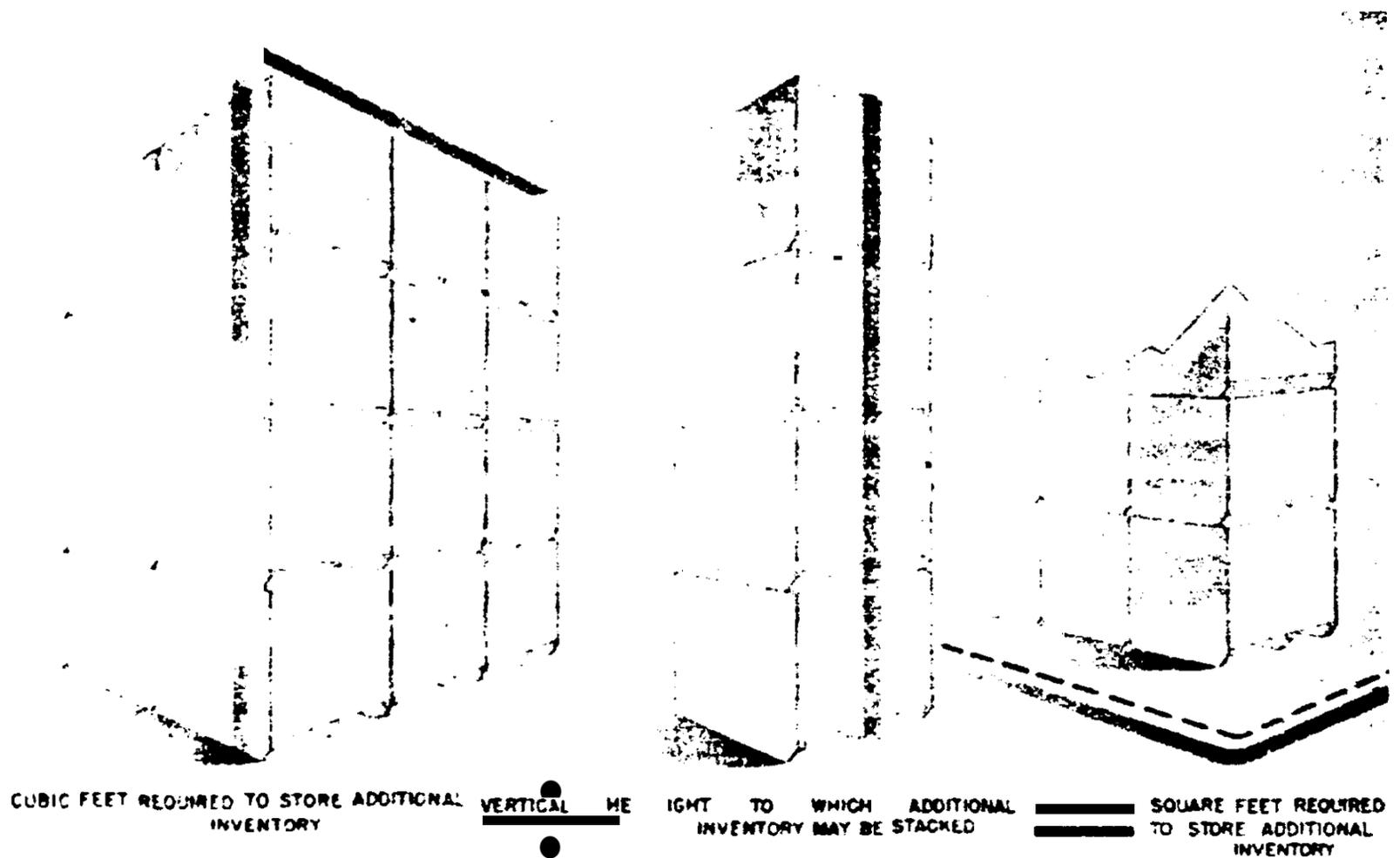


Figure 2-26. Square feet required to store additional inventory ($\frac{CF}{H} = S$).

Part C-Allowance for outgoing shipments (estimated) is a reversal of the procedure enumerated for incoming receipts and is computed as follows:

Element 1:

O = OUTBOUND shipment cost value.
 VC = DOLLAR VALUE of "on hand" inventory per cubic foot.

CR = CUBIC FEET of space RELEASED
through shipment of inventory.

$$\frac{O}{VC} = CR$$

Element z:

H = Vertical storage HEIGHT to which
inventory was stacked.

CR = CUBIC FEET of space RELEASED
through shipment of inventory.

SR = SQUARE FEET of space RELEASED
through shipment of inventory.

$$\frac{CR}{H} = SR$$

e. Bin areas. The computation of space requirements for establishment of bin areas will be predicated on the following

(1) The number of line items to be stored which will reflect the number of bin openings required.

(2) The size of bin openings (outside dimensions).

(3) The height to which bin columns will be erected.

f. Space utilization in storage support. Not all space in a storage area can be allocated to material storage. However, the diversion of space from actual storage to storage support functions should be held to the minimum consistent with good operating practices. Considerations in computation of space requirements for storage support activities are as follows:

(1) The requirements for space for storage support functions are greatly influenced by the mission responsibilities of the particular activity. As an example, tonnage handled or net storage space operated need not necessarily have an absolute bearing on the amount of space allocated to preservation, and packing. Detailed evaluation of the particular operating circumstances would, therefore, be necessary before accurate computation could be accomplished.

(2) It would be impractical to establish firm

ratios of space allotted for storage support purposes on the basis of personnel employed or gross area operated. However, storage management personnel should frequently appraise actual support requirements to assure that valuable space is not allocated to these functions in excess of minimum requirements.

(3) Computation of space requirements for support functions should be developed, in great part, through review of both past and current requirement experience. When projecting future needs, consideration should be given to possible mission changes which would alter requirements. Such acknowledgment will enhance the accuracy of projected allocations as compared to actual proved need (fig. 2-27).

g. Gross space requirements. Formula for computing gross space requirements for storage is as follows:

N = NET SQUARE FEET of space allocated to storage.

A = Space allocated to AISLES.

Ss = Space consigned to STORAGE SUPPORT functions.

s = STRUCTURAL loss space.

G = GROSS storage area $N + A + SS + S = G.$.=-

2-205. Open Storage Areas

The formula described in g above will also apply in determining open storage space requirements, except that consideration need not be given facility restrictions as may affect stacking heights.

2-206. Summary

Space requirements are not computed on an "after the fact" basis. To put it another way, inventories are not stored and then computations developed to indicate that X amount of storage space is required. To the contrary, space requirements are projected ahead of actual physical occupancy with a degree of accuracy to assure avoiding overallocation.

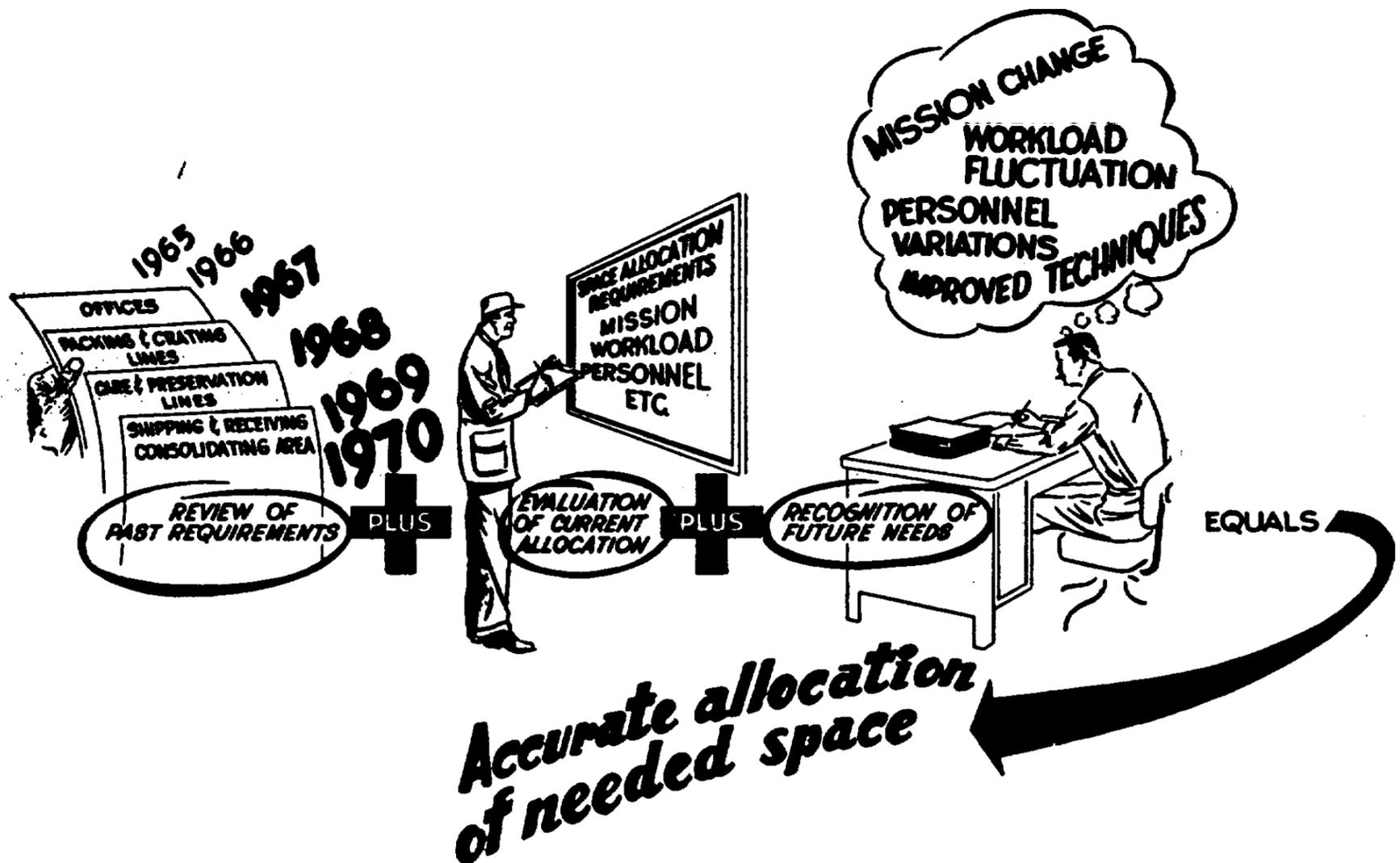


Figure 2-27. Factors of consideration in computing storage support space requirements.

Section 3. PLANNING THE STORAGE LAYOUT

	Paragraph
Introduction	2-301
Factors influencing layout plan	2-302
Preparation of layout plan	2-303
Utilization of floor plan in stock layout	2-304

2-301. Introduction

a. A storage area floor plan layout is an excellent management tool for space control. It enables planning for the effective use of space. The layout is the framework in which the overall depot storage space layout is developed. It serves as the basis for developing the storage area **planographs**. (See sec. 3, chap. III, for instructions on **planographs**.) The layout also is the basis for preparation of the storage space status report. (See sec. 4, this chap.) Storage plans for installations and activities storing ammunition will be developed as prescribed by the responsible military service.

b. Using the principles of space requirements determinations outlined in section 2 of this chapter, effective storage area layouts can be developed.

c. A complete and current floor plan shows the actual manner in which the gross space within a storage area is used. The plan shows the division of space into storage, receiving, shipping areas, main aisles, cross aisles, **fire** aisles and offices. Each section or other subdivision of the floor plan will show the square footage of gross space, nonstorage space, and the net space available for storage.

2-302. Factors Influencing Layout Plan

a. **Item similarity.** Items with similar handling requirements should be stored together when practicable. This facilitates storage and issue and contributes to effective care of supplies. There is normally no requirement that material will be segregated and stored by an inventory manager.

b. Item popularity. Activity or popularity is an important factor in planning the storage layout for material. The fastest moving bulk stocks should be planned for storage in areas that are quickly and easily accessible to reduce travel of materials handling equipment and stock selection personnel. Loose issue areas should be located adjacent to packing and processing areas. Fast moving bin stocks should be easily accessible to expedite stock selection and replenishment actions. To the extent feasible, items with the slowest turnover rate, should be planned for placement in areas progressively farther from active stock or processing areas. The principle of location by popularity is shown in figure 2-28.

c. Item size and weight. The dimensions and weight of individual items affect not only the amount of storage space allotted, but also the location in which items are to be stored. For example, a 5-ton dynamo would be stored in a location that would provide a balance between accessibility to required handling equipment and the least amount of intradepot transport. Normally, except for those items requiring overhead cranes for handling, the greater the item density the less overhead clearance or ceiling height required.

d. Item quantity. Quantity of material on hand affects the amount of space required on the layout. It will frequently be desirable to increase the

amount of space assigned to an item in a single location in order to eliminate the need for two locations. This may reduce effort and travel in replenishment actions for binnable items and reduce administrative effort required for maintenance of the location record system.

e. Item characteristics. Most items of supply are of such nature that special storage areas are not required. However, there are some items which do require special considerations.

(1) *Hazardous.* Some materials have characteristics which require the materials to be specially stored or handled to prevent a hazard to personnel and facilities. Appropriate recognition of this factor must be taken when planning storage layouts. (See sec. 4, chap. V.)

(2) *Sensitive.* Material which requires a high degree of protection and control due to statutory requirements or regulations, such as narcotics and drug abuse items; precious metals; items which are of high value; highly technical or of a hazardous nature; and small arms, ammunition, explosives and demolition material. (See sec. 8, chap. III.)

(3) *Perishable and deteriorative.* Some materials have a limited storage life and care must be taken to assure that the oldest stock or that which may have an earlier expiration date is issued first. Many foods, drugs, etc., must be kept in refrigerated areas or in temperature controlled areas. For

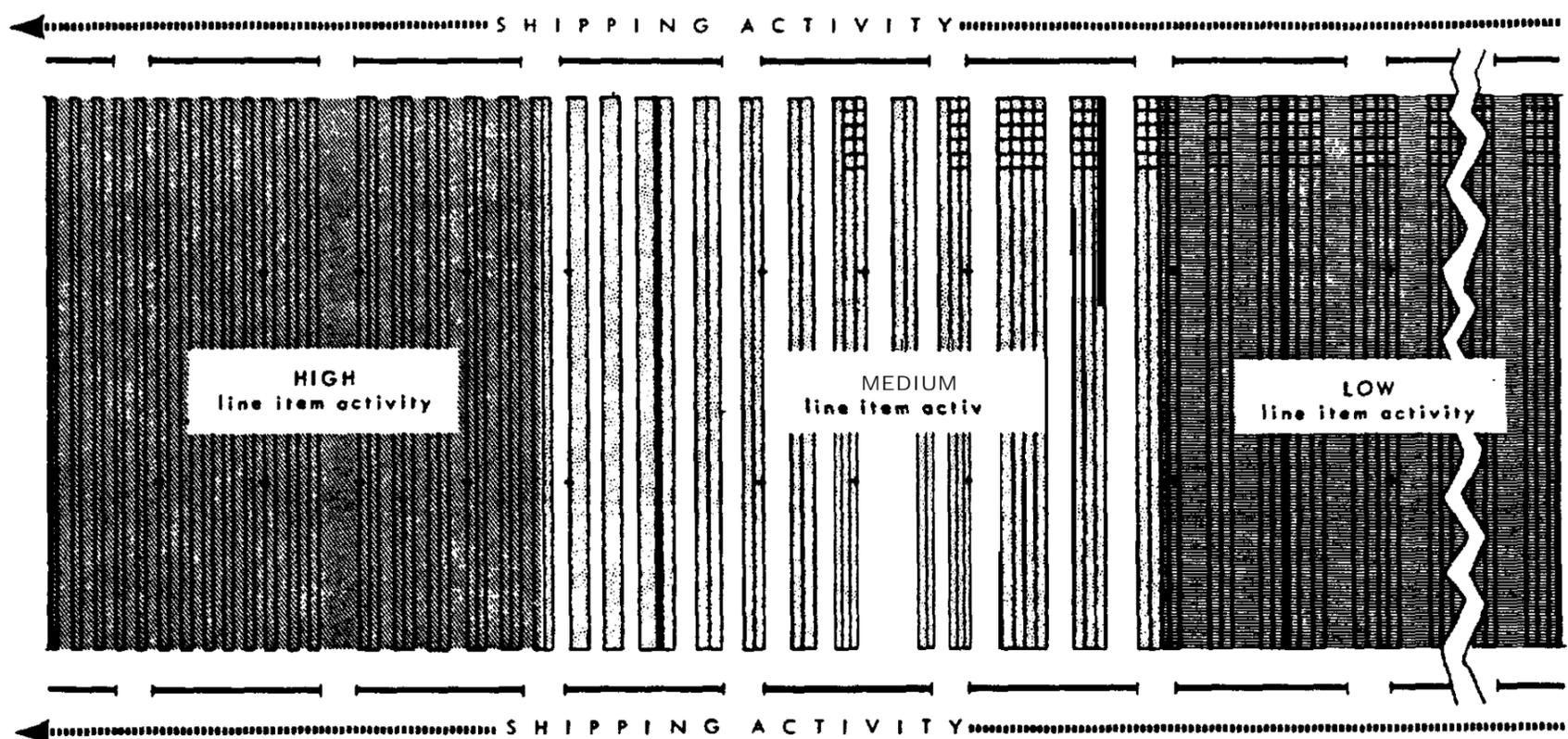


Figure 2-28. Storage of stocks by popularity.

all items of a perishable or deteriorative nature, the most suitable storage environment must be made available. (See sec. 5, chap. V.)

f. Aisles. Preplanning of aisle positioning on layouts must be done prior to placement of materials. Allowing the aisle layout to take shape as materials are placed in stock may result in placing materials in inaccessible locations and loss of space.

(1) Aisle layout is determined by the structure of the warehouse; quantity, nature, and activity of materials to be stored; and by the types and capacity of materials handling equipment available.

(2) "Aisles should only be wide enough to provide maneuvering room for the materials handling equipment available for the stock storage and selection actions. For aisle widths required for forklift truck operation, see (7) (a) below.

(3) Width of aisles in bin and shelving areas should permit easy movement of stock selector trucks through the storage area. Generally, this requires an aisle of 30 to 36 inches in width.

(4) Aisles should be planned to provide straight and clear passageways unobstructed by support columns, elevators, heaters, or other such construction features. A particularly important factor is the location of columns. Space loss due to columns will be reduced if columns are used as aisle and bay boundaries.

(5) Every block of material should be adjacent to a working aisle and stored so that stock can be removed without the necessity of moving another item. The simplest means of providing accessibility is to create a large number of aisles and short rows, but this practice is inconsistent with the principle of minimizing the number of aisles. The best rule to follow is to be certain that materials are stored on both sides of and facing the working aisles. Pallet racks, placed parallel to the long dimension of the building, in side-to-back storage with a bulk stock, permit the use of transportation aisles to provide accessibility to small lot material (fig 2-29).

(6) Since a mix of material may contain a wide variety of lot sizes, various bay depths must be provided. For example, if a single column of pallet loads is placed in a bay which has a capacity of five such columns, space for four columns is lost (fig 2-30). The availability of a variety of bay sizes is affected by aisle layout and the direction of storage. When the best conceived plan for direction of storage fails to produce a sufficient number of small

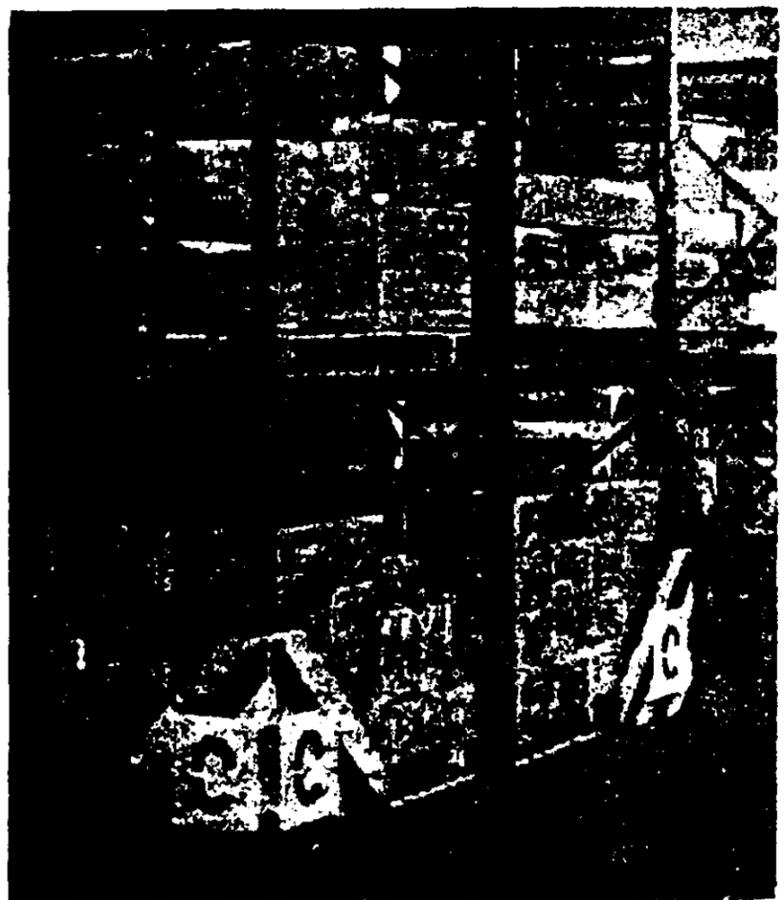


Figure 2-29. Storage of small lot items in racks in bulk storage areas.

bays for the class of material handled, the number of working aisles must be increased.

(7) Working aisles are those from which material is placed into and removed from storage. Working aisles are of two types, transportation aisles, running the length of the building, and cross aisles, running across the building.

(a) The working aisle widths specified herein are not to be construed as the absolute limitation for all operations. They represent the dimensions under which most operations may be conducted. Aisle widths must be established to assure complete consonance between operational efficiency and space economy. The aisle widths specified below are based upon a load of 40 inches.

2,000-pound trucks	-----	9'6"
3,000-pound trucks (narrow aisle)	-----	6'0"
3,000-pound trucks (extensive reach)	-----	7'0"
4,000-pound trucks	-----	10'0"
6,000-pound trucks	-----	11'6"

Aisle widths for different load lengths will be determined on the basis that a variation of 8 inches in the load length will have a corresponding variation of 6 inches in the aisle width. For example, a 48-inch load length will increase the aisle widths indicated above by 6 inches. Determination of aisle

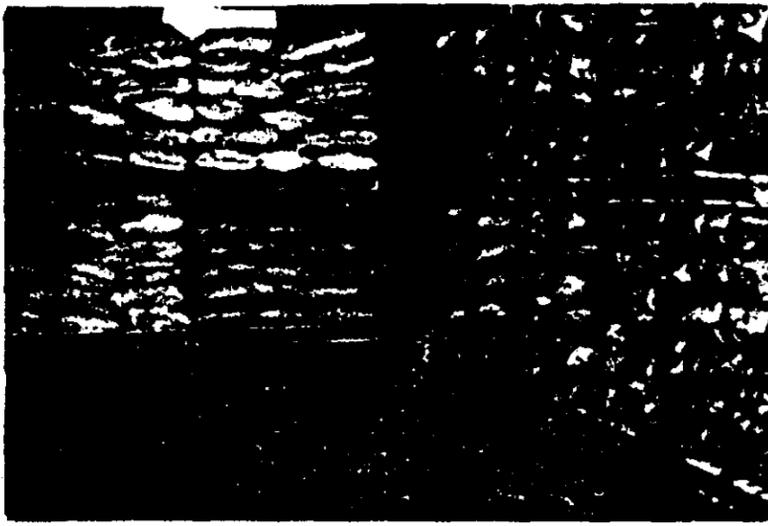


Figure 2-30. Space loss resulting from storage of medium lots in bulk large lot storage location.

width is affected by turning radius of equipment (MHE) to be used.

(b) In most storage layouts, the volume of activity requires two transportation aisles for efficient layout. Such aisles run the length of the building and should be wide enough to permit two-way traffic for the materials handling equipment being utilized in that particular area.

(c) At least two cross aisles are needed in the standard warehouse section. Such cross aisles should be in accordance with the aisle requirements outlined in (7) (a) above as the bulk of storage operations will be carried on in cross aisles.

(8) Personnel aisles are those used as pedestrian routes only and may be required for access to doors or to special interior areas; such aisles should be held to a minimum. Where there is not enough traffic on working aisles to prohibit use as personnel aisles, working aisles should double as such.

(9) Service aisles are those which provide access to stacks for inventory, inspection, or for protective processing. These type aisle requirements are normally very limited. Efficient warehousing operations require that each storage row contain only one item with the same number of containers per pallet. This facilitates inventory as well as issue and normally makes special service aisles unnecessary. Such aisles may be necessary, however, for special commodities (e.g., subsistence) which require frequent inspections.

g. Working areas. Working areas are nonstorage space (other than aisles) in which operations incident to storage or materials handling are performed. Working areas include receiving and shipping bays, packing floor space, strapping lines, battery charging stations, offices, and locker rooms. Such

spaces reduce storage area and, therefore, should be held to the minimum compatible with efficient operation.

(1) Working areas are normally located in those portions of a warehouse which have the lowest ceilings. Usually points which serve all personnel in a building, such as offices and locker rooms, are located in the center section of the building against a side wall so as not to interrupt work in large storage bays, and so that personnel entering from outside will not walk through the storage areas. Working areas are located so as to minimize the total time required for travel of personnel and equipment between storage locations and working areas.

(2) Although set rules cannot be established for allocation of space to working areas, it is essential to keep such space to a minimum. Working areas must be controlled to ensure that such areas do not expand beyond the defined boundaries.

(a) Temporary storage of materials within a working area, particularly in receiving and shipping bays, should be held to a minimum. Clerical procedures and checking operations should be so organized that materials can be processed immediately upon arrival in the working area and quickly removed to storage.

(b) utilization of cube in working areas is just as important as in storage space. The use of pallet racks and shelving frequently will save space in working areas.

(c) When practicable, working areas which serve several buildings should be consolidated. For example, the establishment of a central packing floor space for several buildings will result in less space consumption than the total required by packing floor space in each building. Also, this facilitates the centralized use of special equipment and concentrates the supervision of specialized jobs.

2-303. Preparation of Layout Plan

When making storage layouts whether for covered or open storage, a floor plan of each storage area should be prepared. The plan must indicate all obstacles such as support columns, stairwells, elevator shafts, office locker rooms, and washrooms (fig. 2-31).

a. Basic bulk storage layout criteria. Most of the principles involved in bulk storage are exemplified in the layout for a complete building as illustrated by figures 2-32 and 2-33. Various layouts for bulk

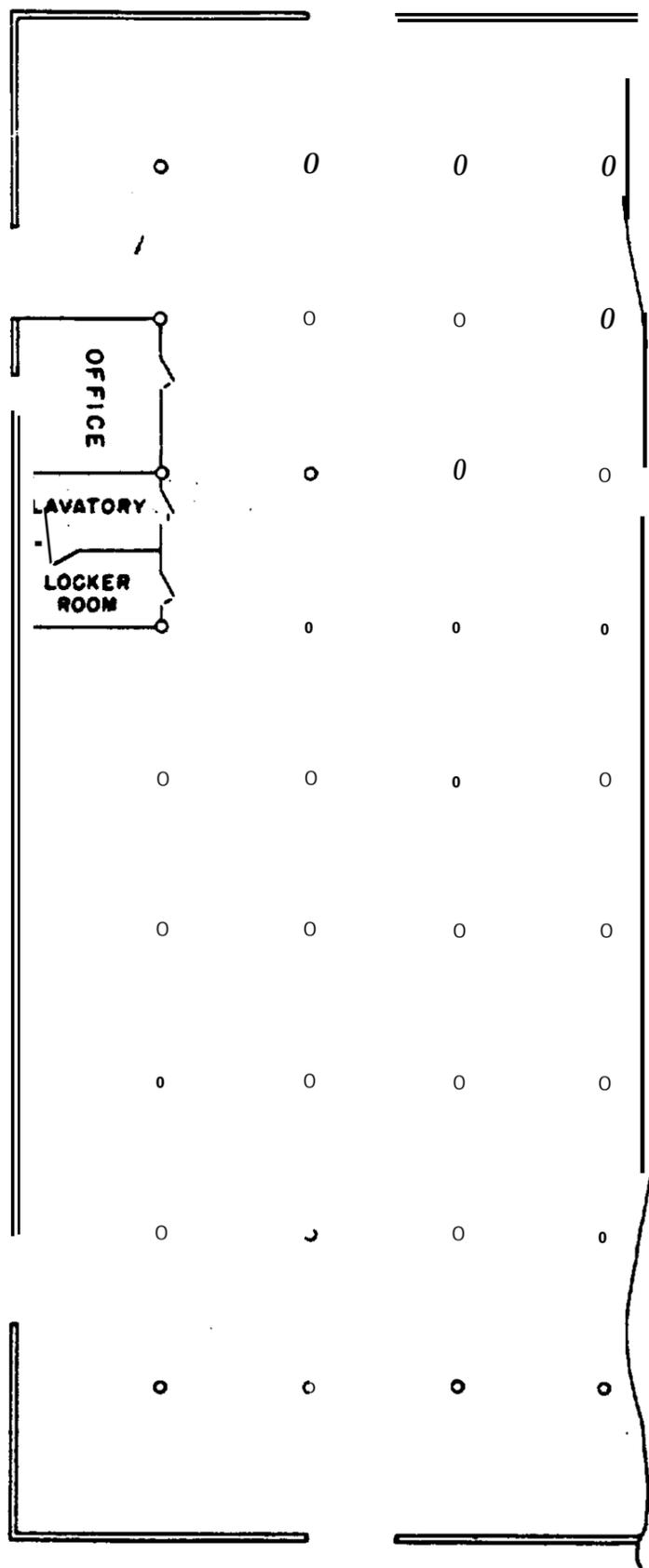


Figure 241. Storage floor prior to stock layout.

storage are shown. There is practically no variation in bay depth as shown in figure 2-32; each bay is about 40 feet in depth so that any lot of **less-than**-carload quantity will have to be placed in a bay which it will not completely fill, resulting in loss of space. The main aisle runs lengthwise through the building. When comparing figure 2-32 with figure 2-33, note that the aisle layout is unchanged, but that in figure 2-33 all aisles are used as storage spaces and a variety of bay sizes are provided. Also, in figure 2-33, side-to-back bays of various sizes are

located adjacent to each intersection, so that the distance required for movement of a small lot from the door or from another bay is at a minimum.

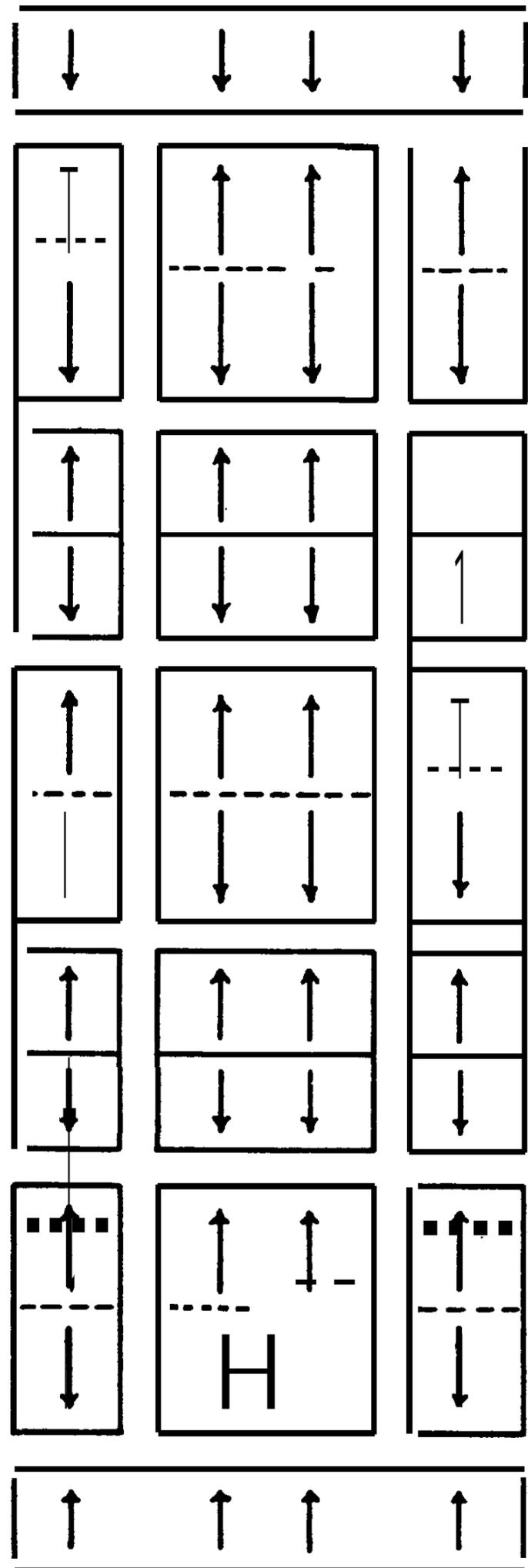


Figure 2-32. Space layout for large lot.

(1) Easy access to material makes direction of storage a significant factor in space utilization. Selection of the proper direction of storage can be

invaluable in providing a variety of bay sizes without increasing the number of working aisles. At the same time, such planning tends to spread the volume of traffic equally over all working aisles, relieving congestion.

(2) Figure 2-34 shows a layout for large lot storage developed in respect to direction of storage in a bay 80 feet square. Columns and other obstructions are not shown in this arrangement.

(3) The simplest but most inflexible disposition of storage space is storage of a single item aisle to aisle shown by figure 2-34, part A. With four pallet loads stacked in each space, there are faces for 17 different items, with each row containing 68 pallets, which is the equivalent of about two carloads of materials. This layout does not provide for storage of small lot items.

(4) One method of increasing the number of rows and of reducing the depth of each row is shown by figure 2-34, part B. The area has been bisected by an imaginary line perpendicular to the direction of storage, and in each row different items are placed in opposite directions from this line. This practice is known as "back-to-back" storage and is standard for all storage using the forklift truck and pallet system. This method allows faces for 34 items instead of 17 and each row is only 40 feet deep, the

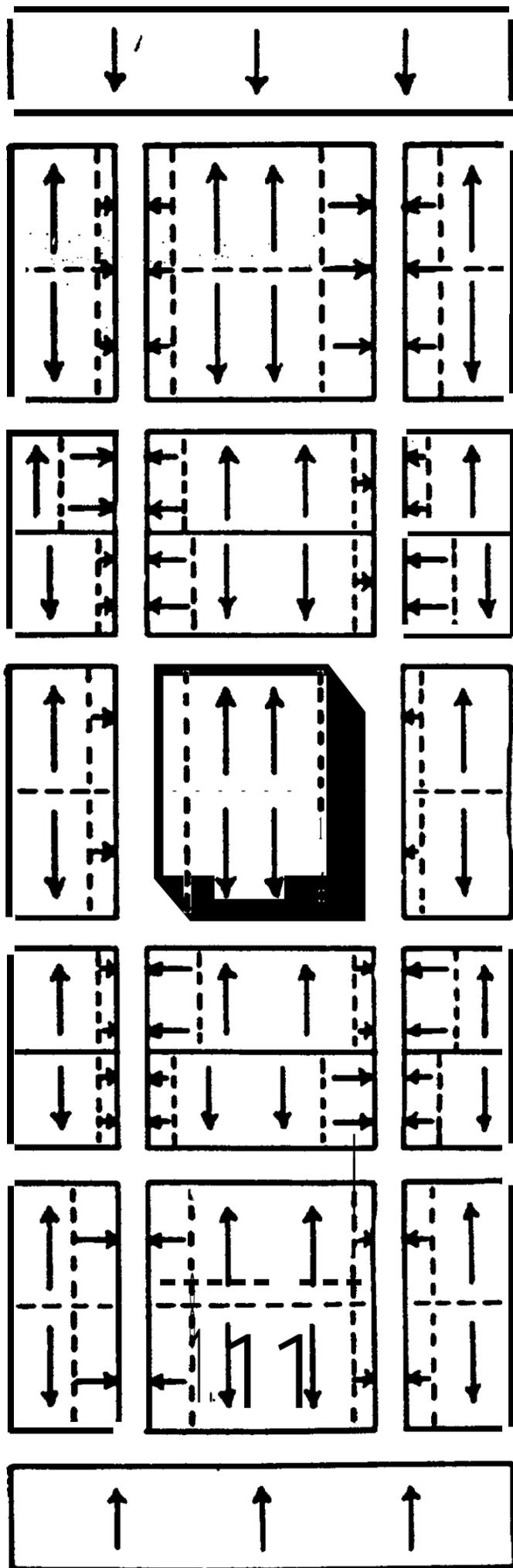


Figure 2-33. Space layout for large lot and small lot.

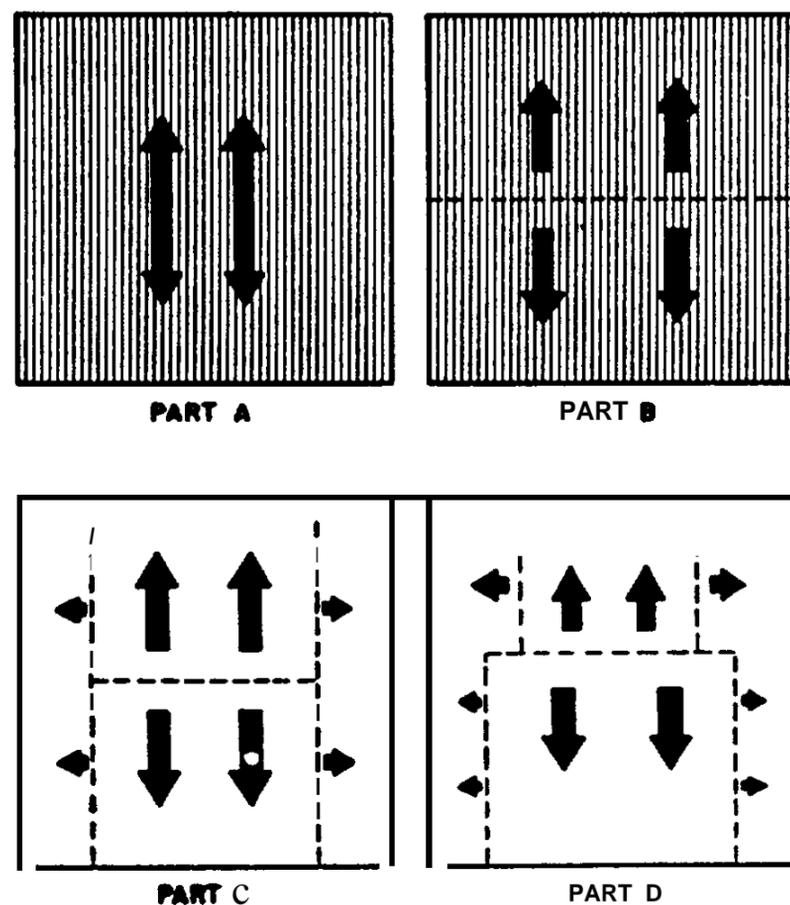


Figure 2-34. Example direction of storage arrangements.

equivalent of one carload. This layout is an improvement over that shown in figure 2-34, part A, but still makes no provision for less-than-carload quantities.

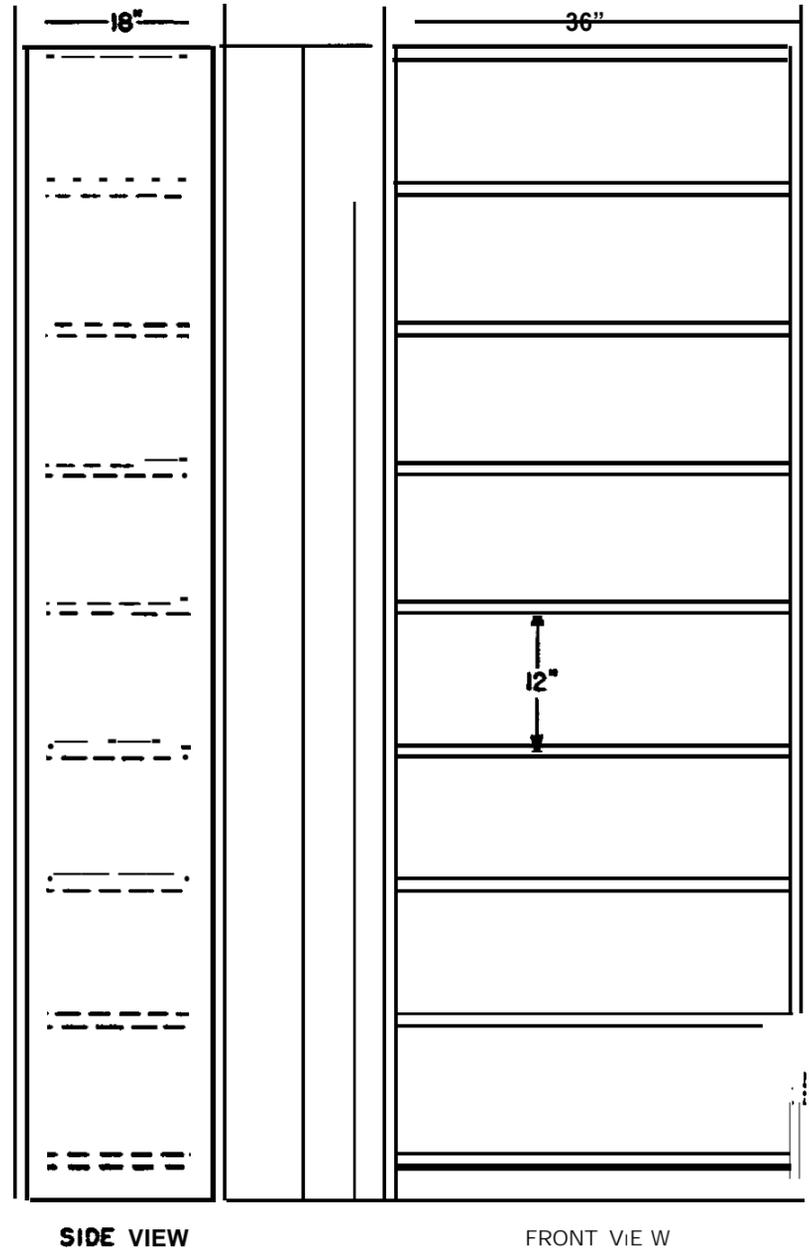
(5) Another method of storage which provides further flexibility is obtained by placing short rows of pallets along the sides of a large bay as shown by figure 2-34, part C. Stringers for these pallets are perpendicular to the predominant direction of storage; this is known as "side-to-back" storage. An imaginary line is drawn, and small lots are placed from this line out to the aisles. By using all aisles as faces of stacks, space has been provided for small lots without increasing the number of aisles and without sacrificing accessibility.

(6) The off-center division shows how further variety in row sizes can be provided (fig. 2-34, part D). The back-to-back line is set off-center, providing one very large bay and one of intermediate depth. Such a layout is desirable only when there is assurance that a substantial number of items will be held in quantities of two carloads or more. The depth of side-to-back bays varies from one to four pallets to provide a variety of short rows. Pallet racks placed side-to-back in bays permit fuller space utilization. Figure 2-34, parts A, B, C, and D, are not intended to present a standard layout for any class of materials, but only to point out what can be done with a fixed space and various aisle arrangements to provide maximum flexibility for storage operations.

b. Basic bin, shelf, and rack layout criteria. The amount of space assigned to a specific item within a bin section is governed by the factors shown in paragraph 2-302. However, the size or weight of an item is not necessarily related to its popularity. Fast moving **binnable** items, whether large or small, must be assigned space adequate to minimize replenishment frequency, time, and effort. There are many factors favoring issues from bin locations and the repetitive issue of small quantities of **binnable-type** items from bulk storage can rarely be **justified**. Proper use of bins will minimize the inventory and security problems found where there are broken cases of **binnable-t** type items in bulk storage locations. Fast moving items should be kept in the center levels to facilitate issue and the heavy items should be placed in the lower levels. Light-weight items should be placed on the upper levels. Bin shelving arrangements are developed on the plan sheet (fig. 2-35).

(1) The utilization of 75 percent of space within bin and shelf openings, determined on the stock level to be **carried**, will be considered adequate. Losses in cube beyond this figure indicate the need for readjusting size of bin or shelf opening.

(2) Double decking of bins and shelving, if practicable, **will** result in better utilization of storage space. However, other factors involving economy of operation should be considered and when increased operating costs offset the savings, bins and shelving should not be double decked. When mezzanine platforms are used, they should have open



BILL OF MATERIAL			
ITEM	SIZE	QUANTITY CUE UNIT	QUANTITY UNITS
UPRIGHTS			
BACKS			
SIDES			
SHELVES			
LABEL HOLDERS			
BASE STRIPS			

Figure 2-35. Bin shelving plan sheet.

type metal floors which will not obstruct the effective use of sprinkler systems.

(3) A determination of storage aid requirements **should** be made prior to **actual** development of stock layout **planographs**. Appropriate adjustment of these requirements should be accomplished at any time it is **found** that increased space utilization can be achieved. Typical storage aids are bins, shelving, shelf boxes, and various types of racks. For illustrations of standard bin sizes and proper bin alignment see figures 2-36, 2-47, 2-38, and 2-39. Typical rack designs are illustrated in figures 2-40 and 2-41.

(a) Shelf boxes can provide a flexible arrangement for efficient use of shelf space. The shelf boxes provide retainer walls on four sides of the material being stored thereby eliminating stock sloping which wastes usable cube space. Shelf boxes can also be "double stacked" on a bin shelf to facilitate use of cubic space. When relocation of the item is required, it can be accomplished by moving the shelf box with contents. The result is reduced **handling** of loose stock. Basic types of shelf boxes are:

1. Small, one compartment.
2. Small, two compartments.
3. Large, metal, one compartment.
4. **Large**, corrugated.

A complete study of shelf boxes has been made to determine the sizes which provide the greatest flexibility. The standard small one and two compartment shelf boxes are 4 1/2 inches high, 5 1/2 inches wide and 1 foot 5 inches deep as shown by figure 2-36; the standard large one compartment steel shelf box is 10 3/8 inches high, 11 1/4 inches wide and 17 1/2 inches deep as shown by figure 2-37; the standard large corrugated shelf box is 8 inches high, 10 inches wide, and 16 inches deep and shown by figure 2-38. The shelf space sizes 1 through 6 indicate the number of standard boxes required to house the items; size 3X indicates 1 complete shelf without boxes; size 6X indicates 2 complete shelves without boxes (fig. 2-39). Smaller items are stored in **small** one or two compartment shelf boxes which fit 12 to the shelf.

(b) All single pallet lots should be stored in metal pallet racks whenever practicable. In build-

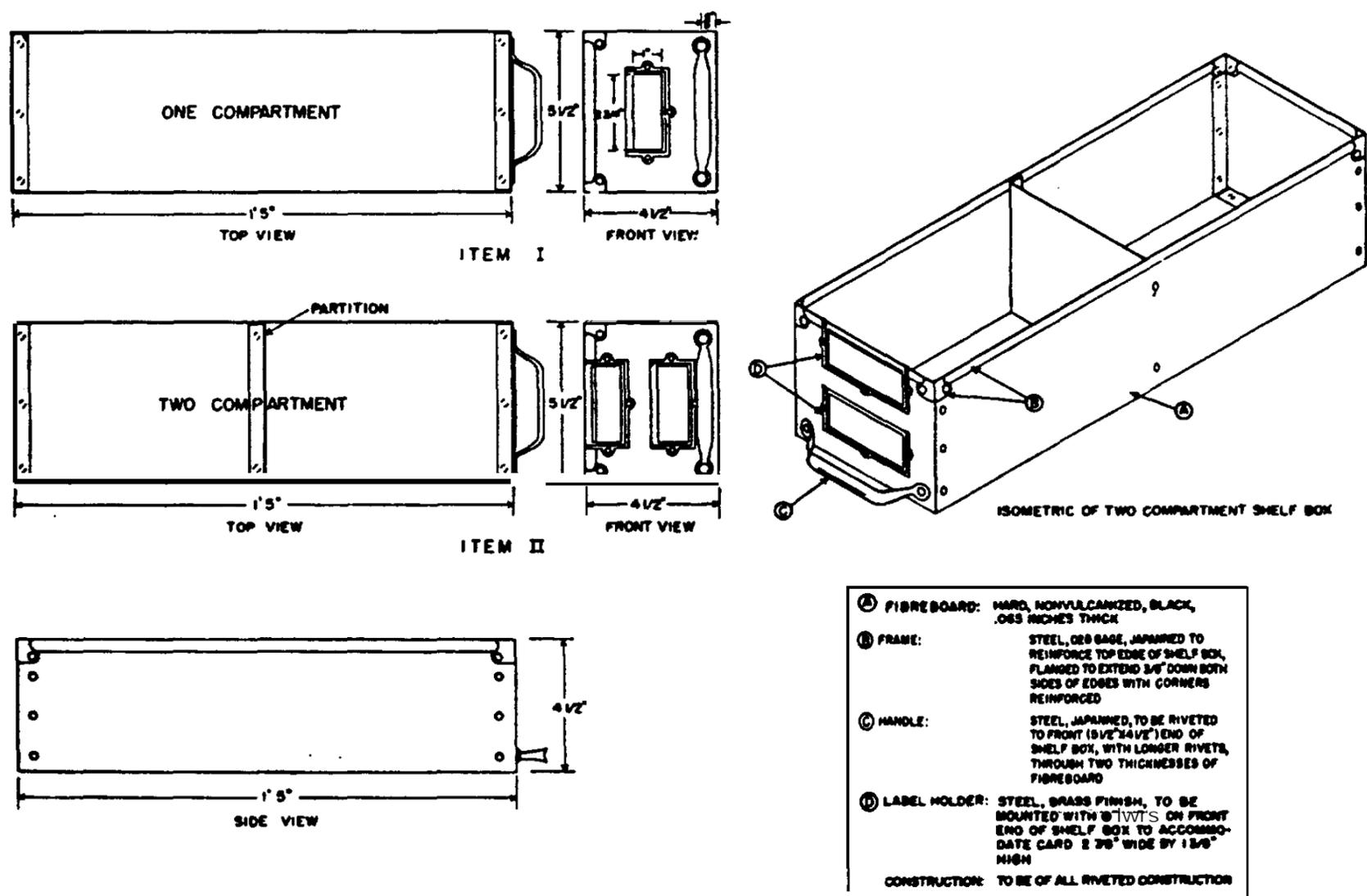
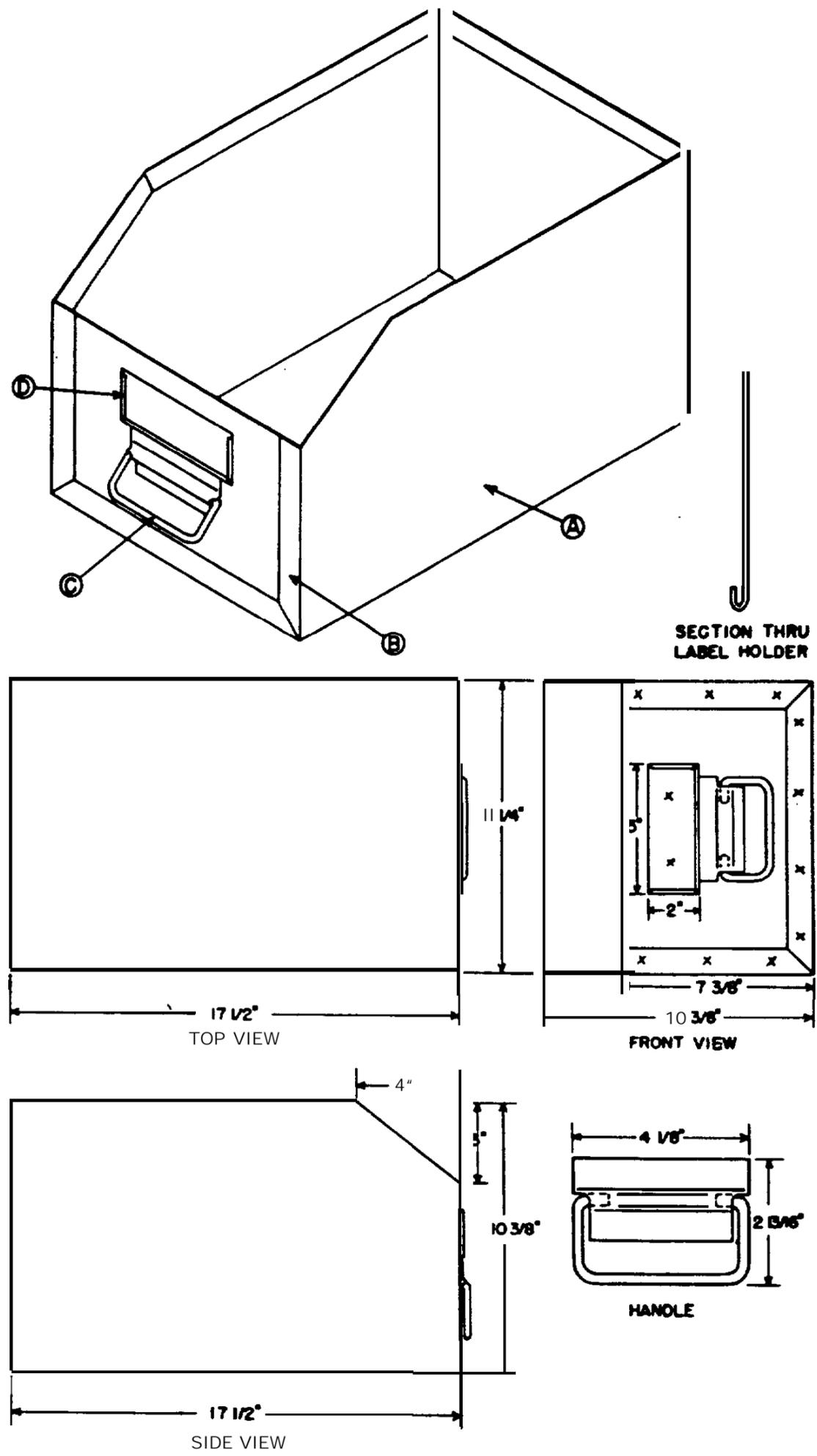
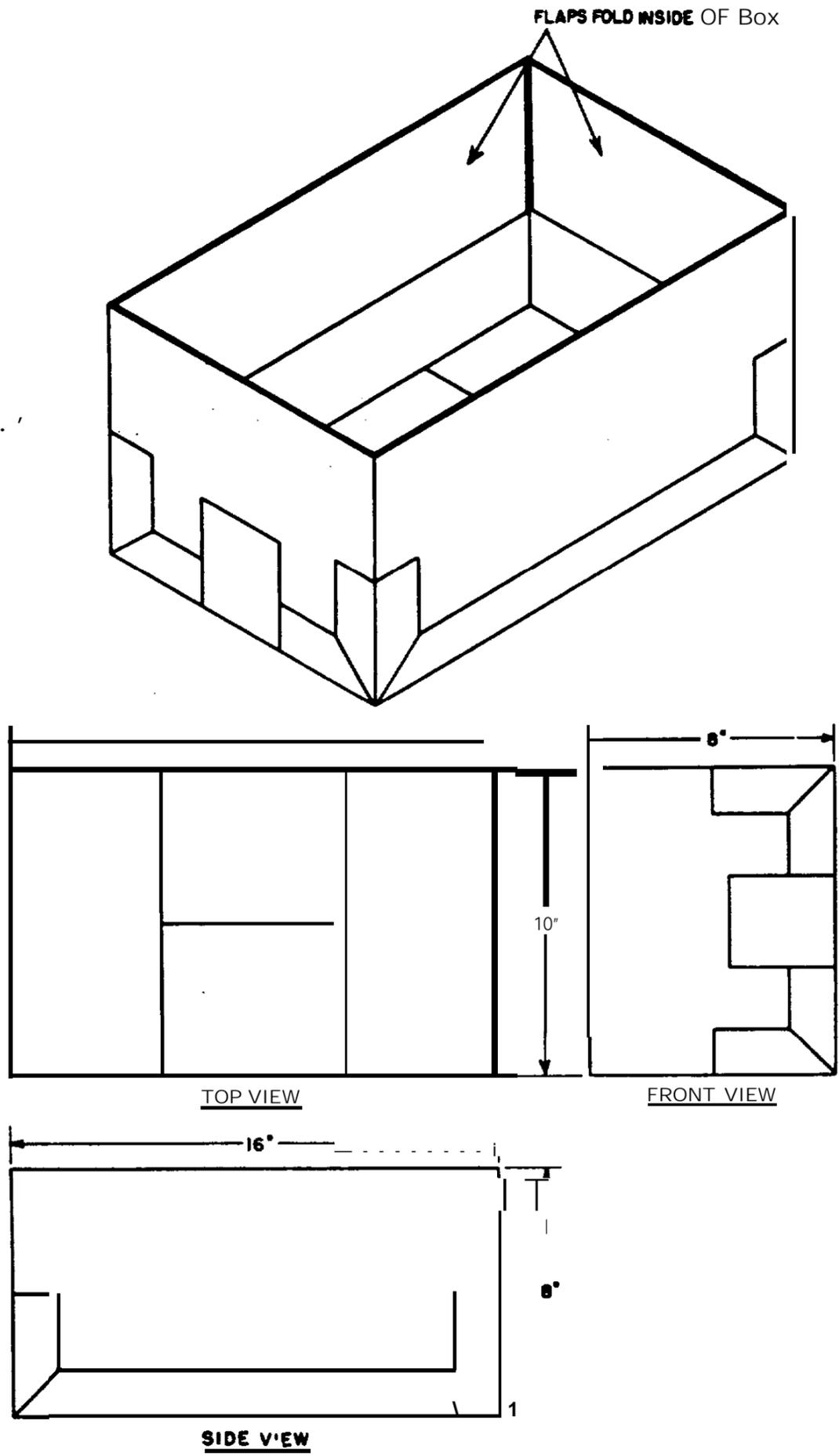


Figure 2-36. Shelf box, small, one and two compartments.



- Ⓐ Steel ----- # 18 ga.
- Ⓑ Construction---- Steel # 18 ga. spot welded, all laps forming box shall be 1".
- Ⓒ Handle _____ Steel No. 20 to be spot welded to front (11 1/4" x 7 9/8") end of shelf box.
- Ⓓ Label Holder---- Steel No. 20 to be spot welded on front end of box to accommodate card 4 1/2" wide by 1 3/4" high.

Figure 2-37. Large metal shelf box.

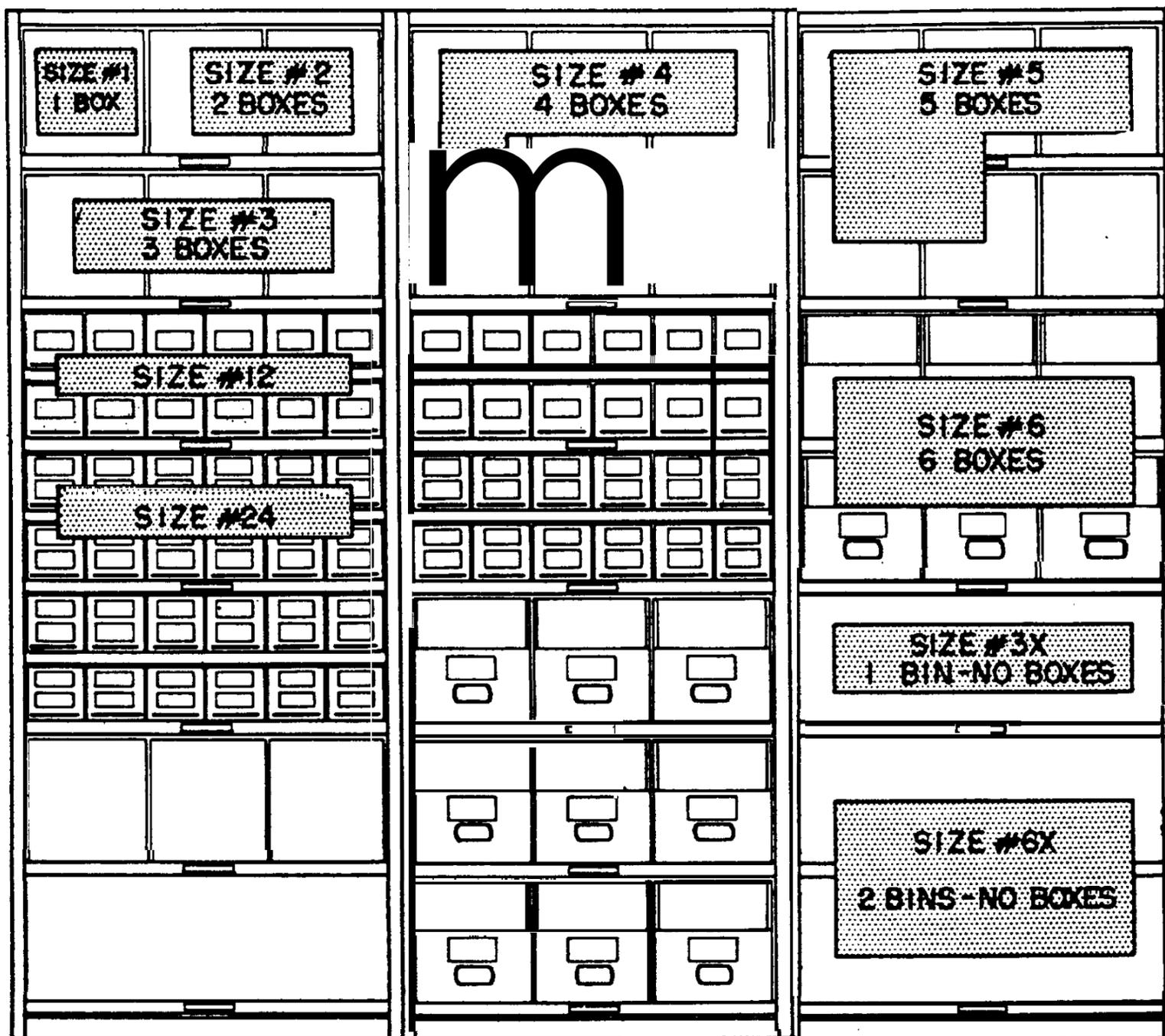


NOTES

SPECIFICATIONS: **SHELF BOX**, LARGE **CORRUGATED** IS MADE UP FROM A REGULAR **SLOTTED FIBREBOARD** SOX

APPLICATION: THIS TYPE **SHELF** Box IS USEO FOR **LIGHT WEIGHT** MATERIALS. **WHERE POSSIBLE, BULK STOCKS SHOULD BE PACKED IN THIS BOX TO FACILITATE BULK TO BIN TRANSFERS. THE FLAPS SHOULD BE TURNED IN WHEN USED AS A SHELF BOX TO MAINTAIN SALVAGE VALUE.**

Figure %?8. Large corrugated fiberboard box.



NOTE

THE SHELF BOX **ARRANGEMENTS** SHOWN ABOVE ARE EXAMPLES OF ONLY **SOME OF** THE LAYOUTS THAT CAN BE USED. THE NUMBER OF SMALL OR LARGE BOXES OR WHOLE SHELVES TO **BE** USED DEPENDS UPON THE **PHYSICAL** CHARACTERISTICS AND VOLUME OF BIN STOCKS TO BE STORED.

THE MAIN PRINCIPLES TO **BE** FOLLOWED ARE:

1. USE SHELF BOXES EXTENSIVELY FOR EASE OF **IN-VENTORY** AND STOCK **RELOCATI** ON.
2. SMALL LOTS IN THE CENTER SO THAT THE MAJORITY OF ITEMS ARE IN CHEST HIGH POSITION FOR EASY PICKING.
3. HEAVY, LARGE ITEMS TOWARD THE BOTTOM WITH MOST INACTIVE ON LOWEST SHELVES.
4. LIGHT, LARGE ITEMS **TOWARD** THE TOP WITH MOST INACTIVE ON HIGHEST **SHELVES**.

Figure 2-.?9. Typical bin shelf box arrangement.

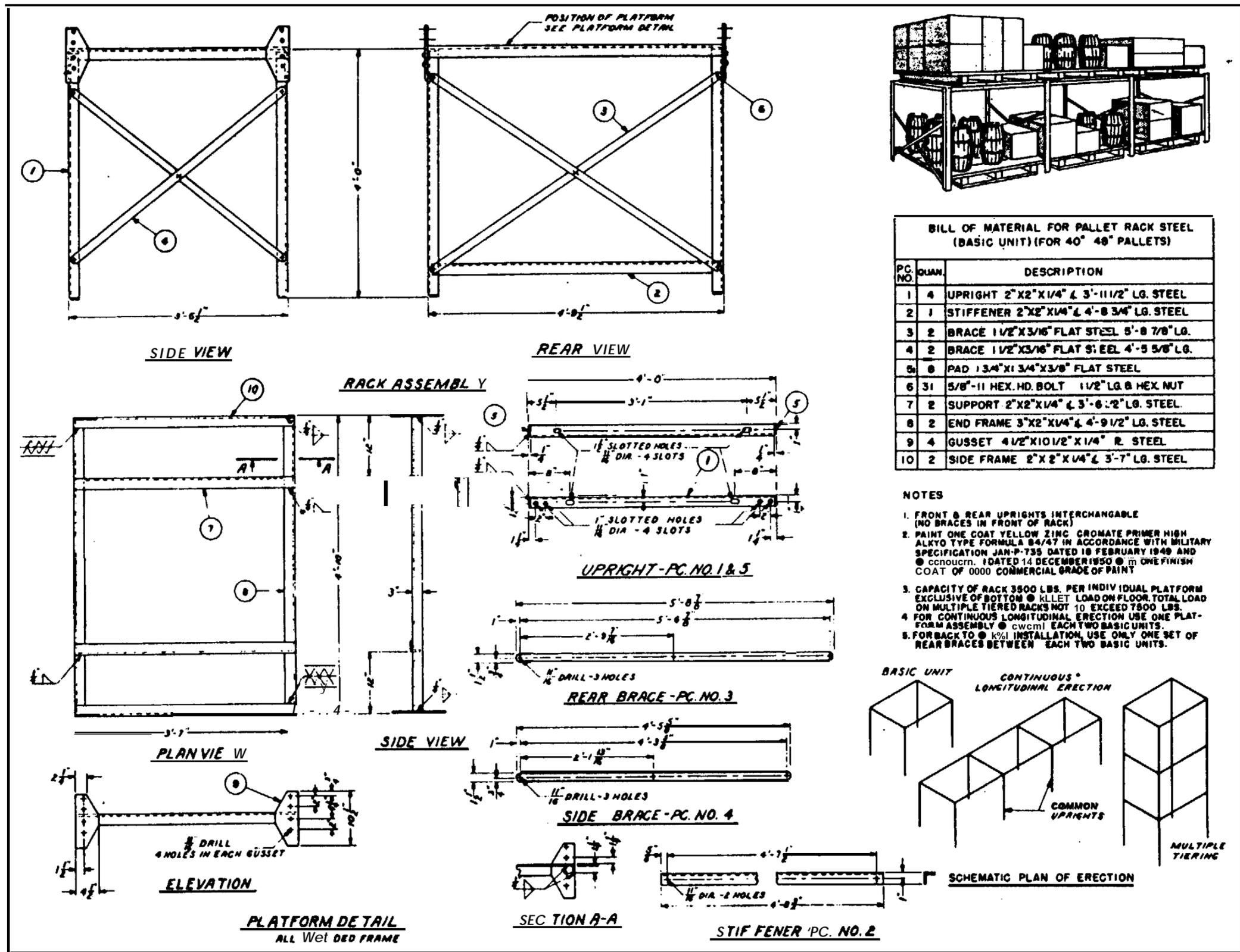
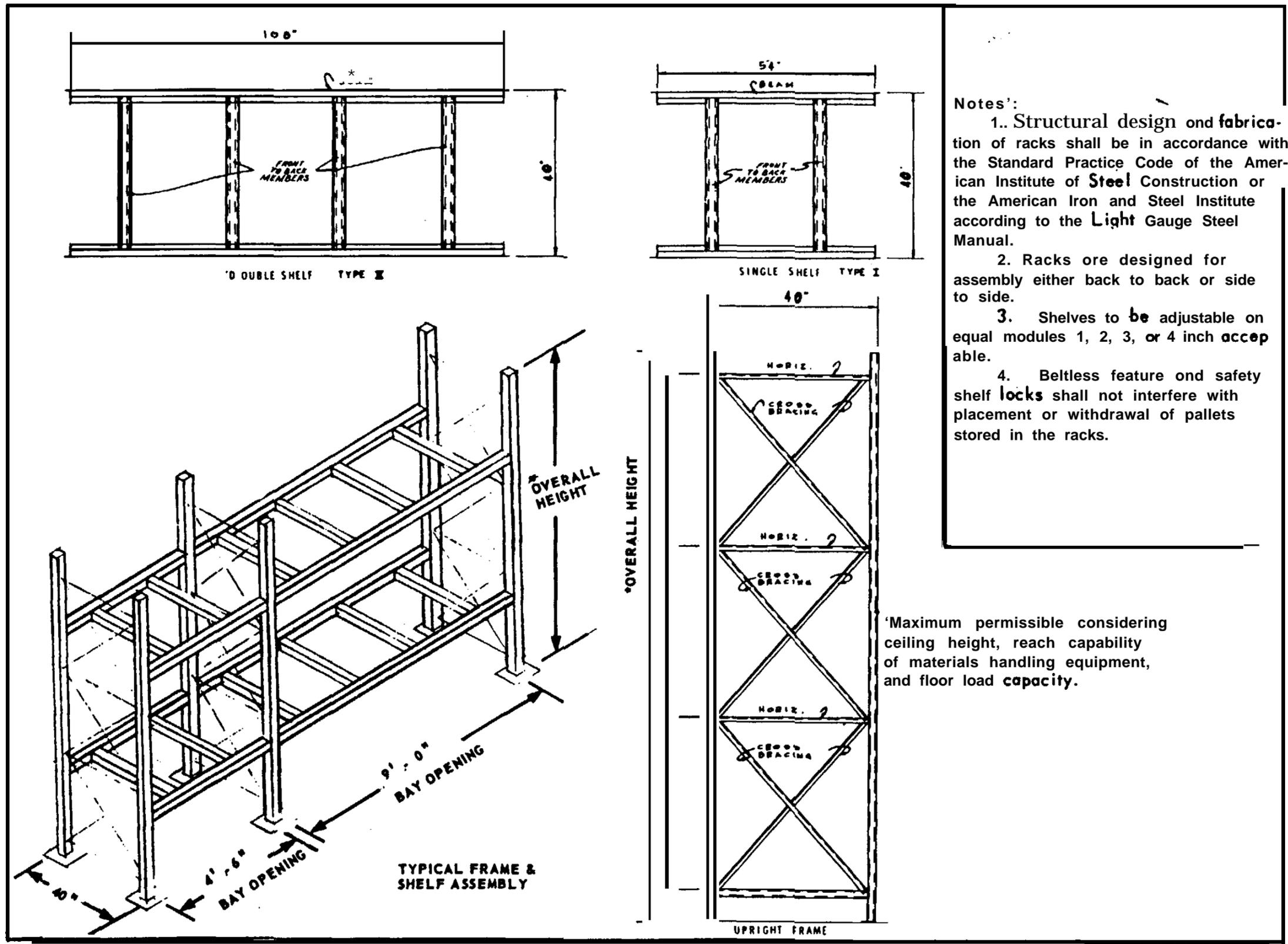


Figure 2-40. Metal pallet rack for storage of small-lot items.



- Notes:
1. Structural design and fabrication of racks shall be in accordance with the Standard Practice Code of the American Institute of Steel Construction or the American Iron and Steel Institute according to the Light Gauge Steel Manual.
 2. Racks are designed for assembly either back to back or side to side.
 3. Shelves to be adjustable on equal modules 1, 2, 3, or 4 inch acceptable.
 4. Beltless feature and safety shelf locks shall not interfere with placement or withdrawal of pallets stored in the racks.

Maximum permissible considering ceiling height, reach capability of materials handling equipment, and floor load capacity.

Figure 2-41. Metal pallet rack for storage of small lot items (boltless adjustable type).

ings with stacking overhead of 10 feet or less, a one-platform, two-level rack similar to the illustration in figure 2-40 should be used. In buildings with stacking overhead in excess of 10 feet, the number of levels will be determined by the available stacking height, the reach capability of materials handling equipment and floor load capacity. Normally, 4 feet should be allowed for each level opening. A building with a 20-foot maximum stacking height, could therefore accommodate five stacking levels or a four-platform pallet rack.

1. **Multiplatform** pallet racks are illustrated in figure 2-41. "The conversion to metal pallet racks at installations" not so equipped is a highly desirable goal if maximum space utilization and most effective use of resources are to be achieved.

2. Racks for military use have been standardized for use with either one (single opening) or two (double opening) 40 by 48-inch pallet loads of material per level. Single opening racks have platforms approximately 54-inches wide and hold one 40 by 48-inch pallet per level. Cost per pallet opening is higher in a single opening rack and this type should only be used when space limitations preclude use of the double opening size. Double opening racks have platforms approximately 108 inches wide and hold two 40 by 48-inch pallets per level. Since the difference in cost between a 54 and a 108-inch platform is relatively small, and an upright column has been eliminated, the cost per pallet stored is smaller in a double opening rack than in a single opening rack.

3. Cantilever racks provide excellent storage aids for long narrow items (see chap. IV, sec 2).

4. Use of racks for storage of tires is explained in chapter V, section 6 of this regulation.

c. Open storage layout criteria. The efficient utilization of open storage space can be accomplished by proper planning and space layout. There are many types of open storage space and to utilize each in the most effective manner requires judicious planning and a thorough knowledge of materials handling by storage personnel. Considerable thought must be given to the types of equipment to be used in each storage area to assure that adequate operational or working areas are provided in the layout of various types of space.

(1) *Determinant of open storage layout.* The layout of open storage areas is determined, to a

great extent, by the location and layout of the existing track and road facilities that serve the area.

(2) Objectives of open storage layout. The objectives of open storage layouts are—

(a) Efficient utilization of each type of storage space.

(b) Straight line flow of stock from unloading point to storage.

(c) Maximum utilization of existing track and road facilities.

(d) Ready access to each storage area or stock item.

(3) Cube utilization in open storage maybe increased materially by the utilization of storage aids. It is impossible to designate a maximum or minimum acceptable storage height for all open stored materials; however, cubic space should be utilized as efficiently in open storage areas as is practicable commensurate with good storage practices. The same general principles used in stacking supplies under cover apply to most items that can be stored in the open. The efficient utilization of open storage cubic space is just as important as the utilization of covered storage space.

(4) Storage adjacent to double tracks should be reserved for storage of extremely heavy stock. This is the ideal layout for heavy lifts as it permits the car to be spotted on the more distant track and the crane to operate between the car and the storage point. In this arrangement, the distance from the crane to the material in the car or its intended storage point is at a minimum. This permits maximum utilization of crane lift capacity. Usually, double-track storage areas are at a premium, therefore, where possible the area on both sides of a double-track should be used for storage of heavy materials. However, to facilitate the use of the storage area behind this heavy material it is necessary to provide 20-foot aisles at 100-foot intervals leading from the track to the inner storage areas.

(5) With a locomotive crane, stores can be stacked on a line 8 feet from the nearest rail of the track. This will permit the crane to make the swing required to move material from the car to the stack without danger of the counterbalance or cab of the crane colliding with the materials stored on either side of the tracks.

(6) Where crawler, truck mounted, or warehouse type cranes are used, it is necessary to maintain along one side of the track an operational aisle 25 feet in width, measured from the rail nearest to

the storage area. This aisle provides the necessary clearance between the car and stock for efficient crane operations. Also, this aisle is necessary to permit the loading or unloading of cars by fork truck and the transportation of stock by crane, fork truck, or tractor-trailer train from car side to the storage areas not immediately adjacent to the track.

(7) Because of track and road layout or terrain, each hard-surfaced open storage area presents varied problems in space layout. For this reason, layout plans must be flexible in order to utilize a higher

percentage of the net 'usable storage space in each area. Some example open storage layouts are shown in figures 2-42 and 2-43.

2-304. Utilization of Floor Plan in Stock Layout

a. *Basic* use. Using the floor plans, enter the location of aisles, shipping, receiving, bin, bulk, medium lot, pallet rack, and storage operational areas. After the location of the basic storage and operational areas are determined, the direction of flow and storage must be established and entered

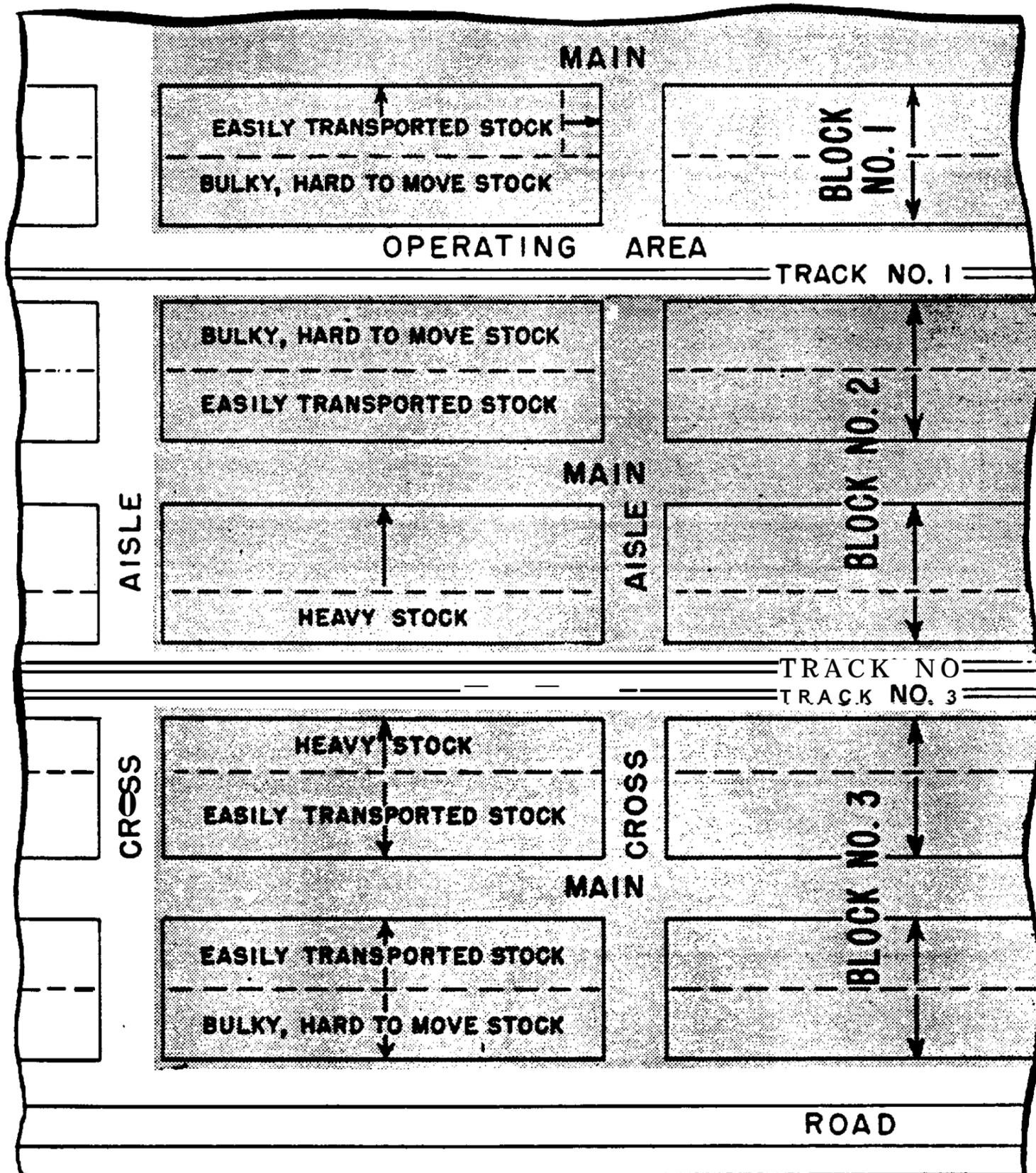


Figure 2-42. Example layout for open storage area.

on the floor plan. Figures 2-44, 2-45, and 2-47 (located in back of manual) are examples of layouts after preparation of initial floor plans.

b. *Planning uses.* The requirement for storage space, by type, amount, and position must be calculated utilizing estimated or known quantities,

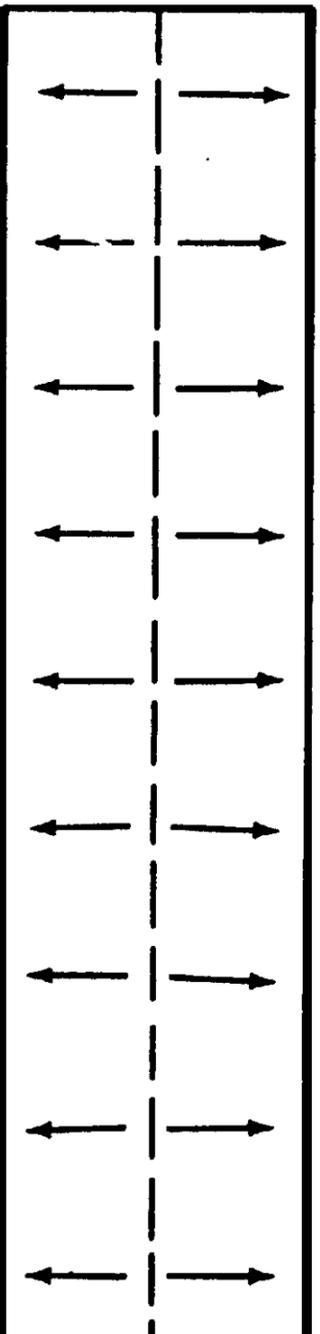
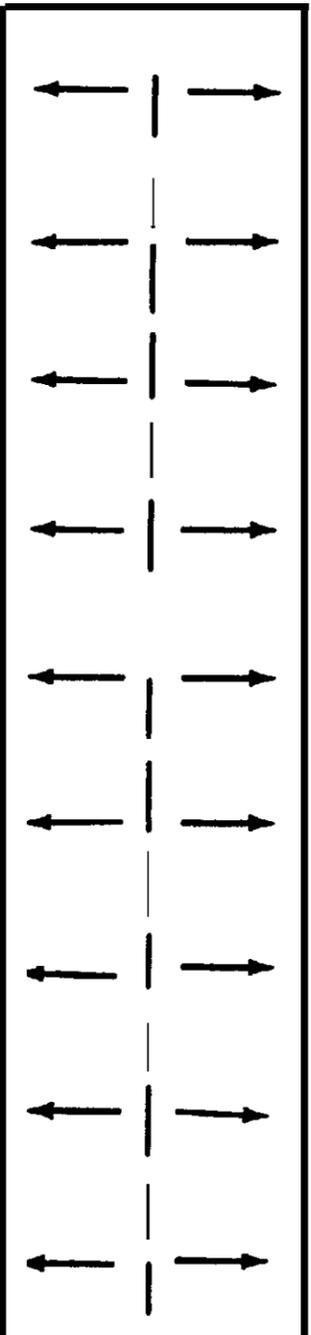
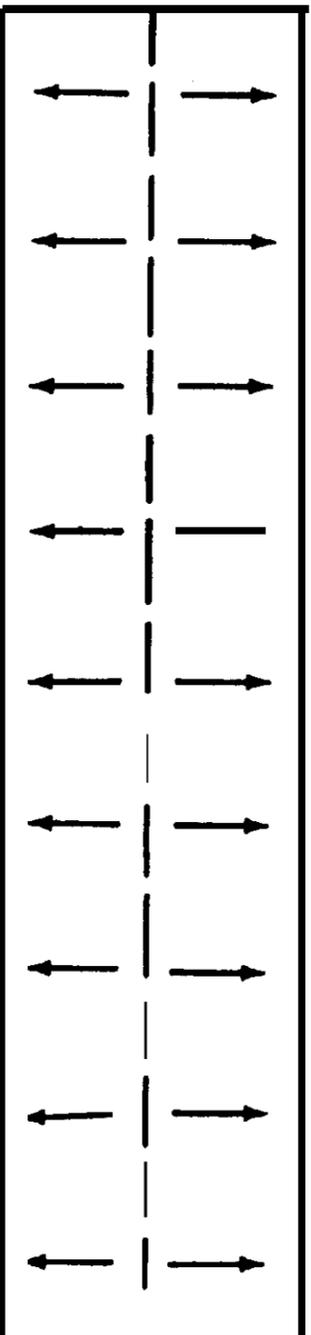
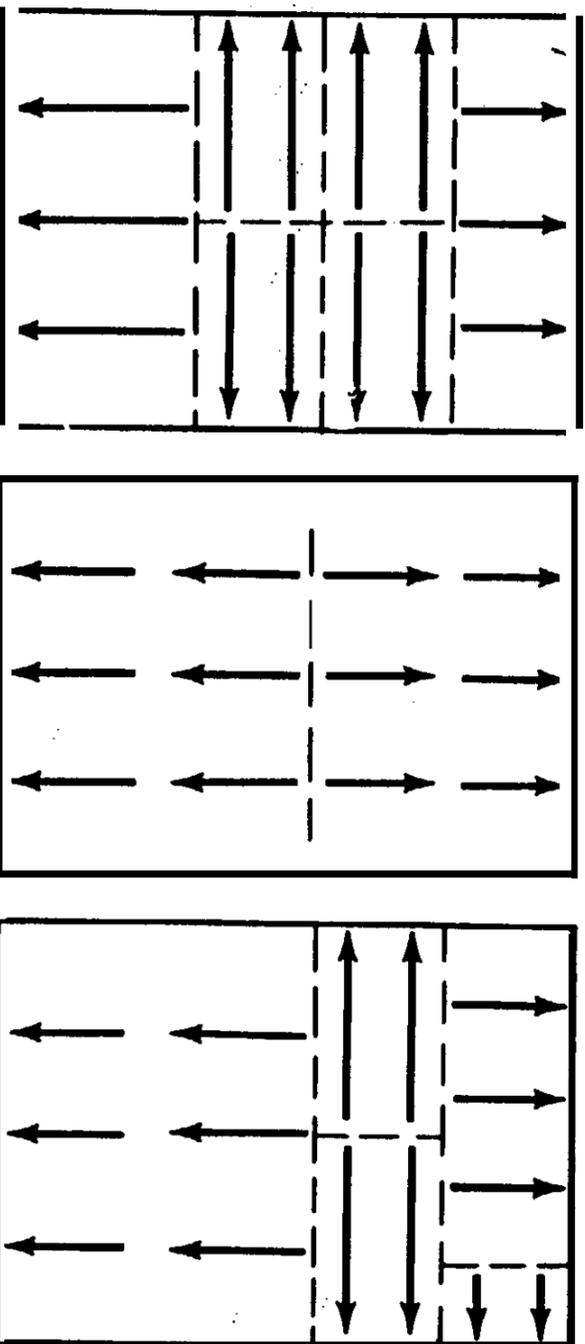


Figure 2-43. Example layout for open storage area.

sizes, characteristics, and the demand frequency shown in current reports, historical data, and forecasts (sec. 2). Quantities of bin sections and the various types of racks required **will** then be determined. The amount and location of the space assigned for **these** storage aids will be in consonance with the principles discussed in preceding portions of this section. A preliminary layout will be drawn on the floor plan and submitted to a comprehensive check as to the probable validity of the data used and to review the calculations which were made **from the data**. It is essential that any revision of a layout **be** accomplished in the "planning stage rather than after storage aids have been erected and material stored. The principles of efficient storage layout, as illustrated by figure 2-44, require the minimum number and width of aisles, the maximum degree of straight flow movement patterns, the approximate positioning of bin and rack storage areas, storage support **function** areas, and the **maintenance** of flexibility in storage depth. The storage operation illustrated by figure 2-44 is small in size, but the principles shown apply to any storage operation regardless of square feet occupied, the range and depth of items stored, or the simplicity or sophistication of the materials handling equipment used. Figure 2-45 illustrates placement of bins for a warehouse automated materials handling system. In such a system, popular items are placed in bins nearest the material flow lines (conveyors,

etc.). Storage layouts must be planned to consolidate productive **functions** into a centralized location to the greatest feasible extent. Such planning will result in a layout which reduces travel time and distances. This, in turn, decreases the requirements for materials handling equipment, increases work unit production per manhour, lessens personnel fatigue and error rate, provides for closer supervision and greater security, and permits flexibility in use of the work force.

c. *Flexibility.* Changes in the types of the materials handled or the average quantities in stock will require periodic changes of layout. The storage officer must be aware of the need for changes and when such changes occur, alter a layout if a change will increase operational efficiency. Also, consolidation of the material in **several** partially depleted rows into one location, or removal of residual **quantities** to small lot or loose issue areas can convert unusable space into usable space and honeycombing is reduced.

d. *Effect of stock selection on layouts.* Stock selection from **bulk storage areas can influence** the effectiveness of layouts. Material must be withdrawn row by row starting from the aisle and working back **to** the wall or imaginary line, and never across the whole front of the stacks. Withdrawals across the front of the stacks merely widen the aisle and do not create additional space for the storage of new commodities. This incorrect method of stock

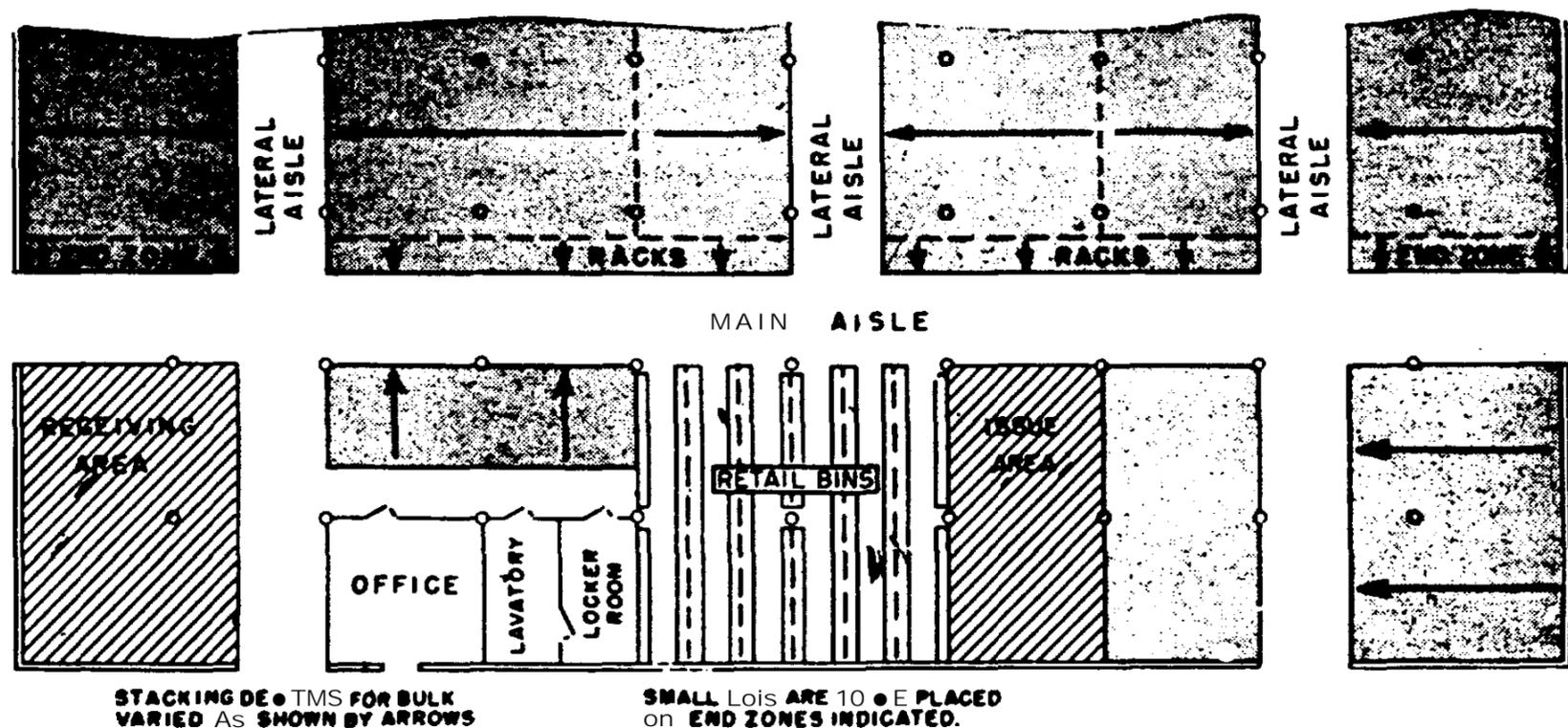


Figure 2-44. Example stock layout.

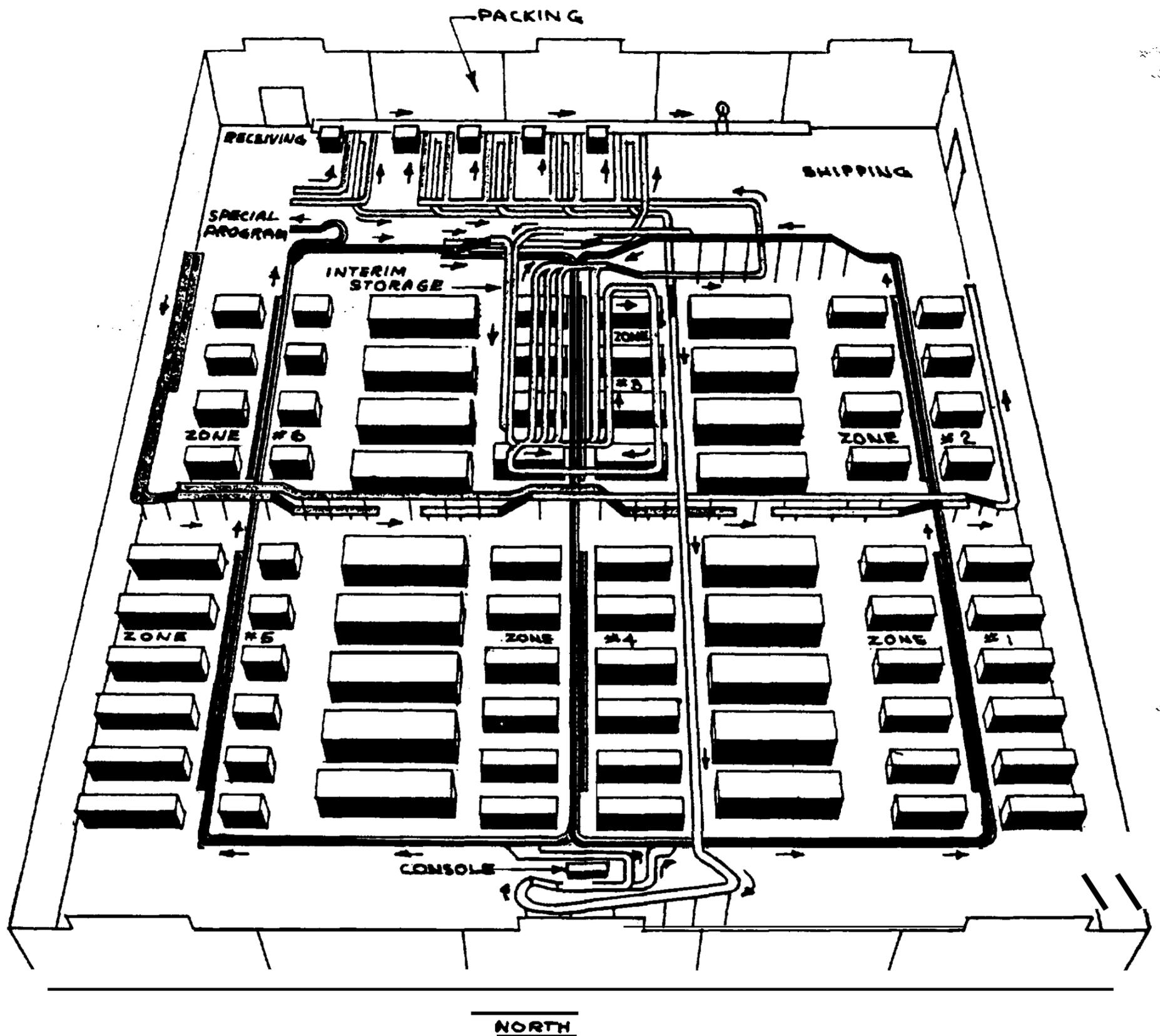


Figure 2-45. Layout containing an automated materials handling system.

withdrawal is a common cause of "honeycombing" in storage areas (fig. 2-46). Honeycombing also includes void spaces within the arrangement of materials on pallets, which results in space loss. Space

loss between stacks may be due to excessive overhang, resulting from poor palletization of the stock item.

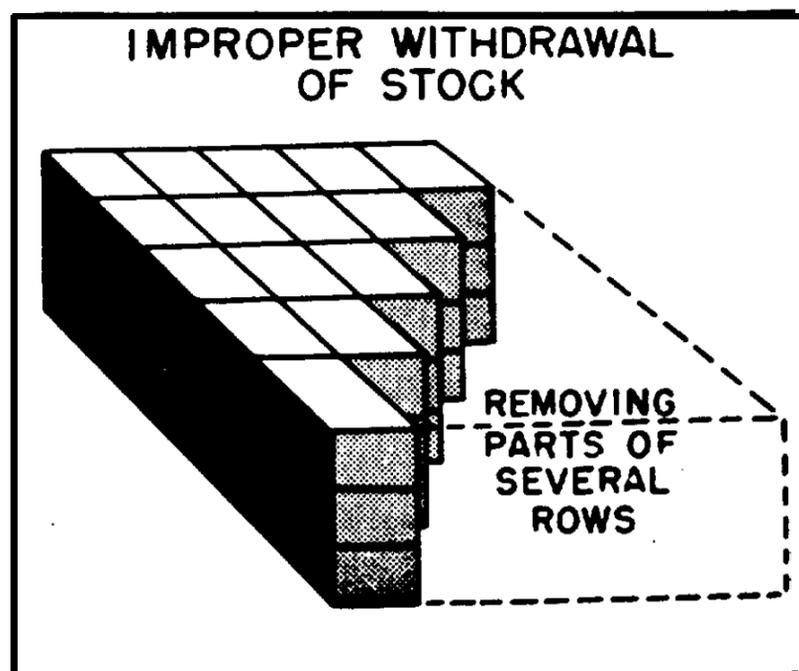


Figure 2-46. Honeycombing due to improper withdrawal of stock.

Section 4. SPACE CONTROL AND REPORTING

Space control techniques	Paragraph 2-401
Space reporting illustrated	2-402
DOD storage space reporting requirement	%403

2-401. Space Control Techniques

a. Scope and purpose. Effective control of space begins with the operating supervisor and extends through the storage manager, the activity or installation commander, the major command headquarters, and to higher department or agency levels of command. This section provides certain uniform techniques to be used for proper space control. Storage plans for installations and activities storing ammunition will be developed as prescribed by the responsible military service.

b. Space allocation map. A map of the installation reflecting the current status of the total area allocated for storage operations and the location or other related activities will be maintained by the storage manager. This map will show the type of space, **specific** functional use, e.g. receiving, shipping, bulk storage, loose issue storage, office space, etc. When applicable, broad material groupings may be added to identify storage of repair parts, end items, ammunition, etc. Identification of these areas may be accomplished by the use of color coding. An overlay may be used to facilitate updating the map.

c. Floor plan or planograph. The base for designing local space control techniques for storage

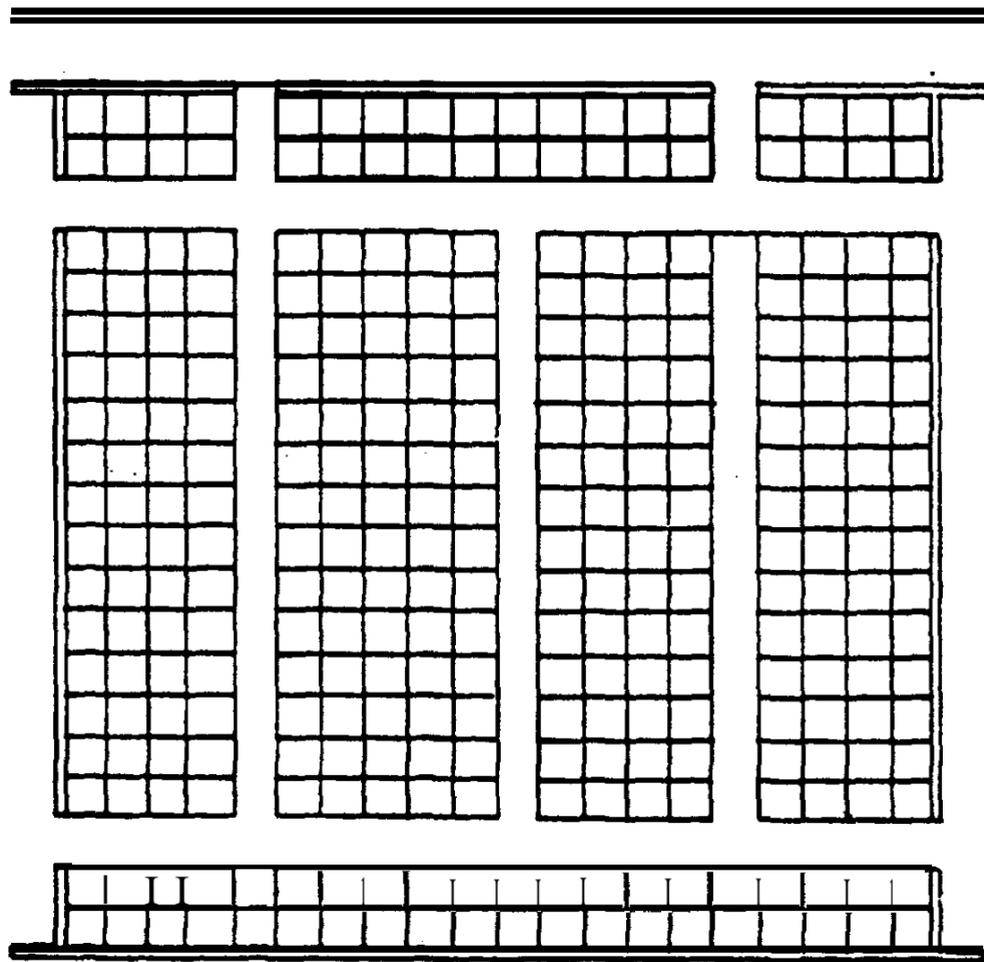
areas is the floor plan or **planograph**. Floor plans for general supply storage areas are discussed and illustrated in section 3 of this chapter. Detailed **planographs** depicting specific storage layouts are generally developed from these floor plans. Detailed **planographs** for general supply storage areas are discussed and illustrated in chapter I H, section 3, of this regulation.

d. Storage space survey worksheet. Utilizing information obtained **from planographs**, storage space survey worksheets should be developed for each general supply warehouse section, shed, open storage area, etc. Figure 2-48 is an example survey worksheet which can be used. These worksheets are scaled drawings of storage areas and provide feeder data input for storage space status **reports**. Ammunition storage space data will be maintained on **planographs** in the manner prescribed by the responsible service. The example survey worksheet shown is not applicable to ammunition.

e. Storage space status report.

(1) A storage space status report will be prepared periodically. For control purposes, storage space status reports may be required monthly, or quarterly or as often as deemed necessary by the individual DOD Component. For reporting pur-

Sample



Building or room _____ **Section** _____ **Date** _____
Gross square feet _____
Aisles _____
Structural loss _____
support space _____
Net square feet _____

• Occupied square feet _____
 • Vacant square feet _____
 • Unobstructed stack height (s) _____
 • Attainable stack height (s) _____
 * Average stack height _____

Total Cubic Feet _____ **Attainable cubic feet** _____
 (Unobstructed stack height (s) x net sq. ft.) (Attainable stack height (s) x net sq. ft.)

NOTES

Occupied cubic feet
 Common/cross-serviced _____
 DOD material _____
 Non-DOD material _____
 Reporting Component material _____

1. Information identified with ● dorisk Will normally be constant.
2. Information shown on this illustration should be modified to meet requirements.

Potential vacant space
 TYPE "A" ----- (Total "A") _____
 TYPE "B" _____

 _____ (Total "B") _____

Recoupable through rewarehousing _____ **cubic feet**
 (Potential vacant type "A" x average stack height + potential vacant type "B")

Figure 2-48. Storage space survey worksheet.

111

poses, DOD Components must comply with the **frequency** requirements of the Storage Space Management Report (DD Form 805).

(2) Storage space status reports are basically current records of space utilization and occupancy. These reports are to be assembled by the storage administrative activity responsible for space control and reporting. The information contained therein will be recapitulated for space reporting to higher levels.

(3) Internal reports **will** also include **specific data pertaining** to-potential **space** improvements. For general supplies, potential space improvement data are **identified** during storage space surveys as potential vacant type "A" (sq. ft.) and type "B" (cu. ft.). This potential vacant "B" space information is reported informal space reports as recoupable cubic

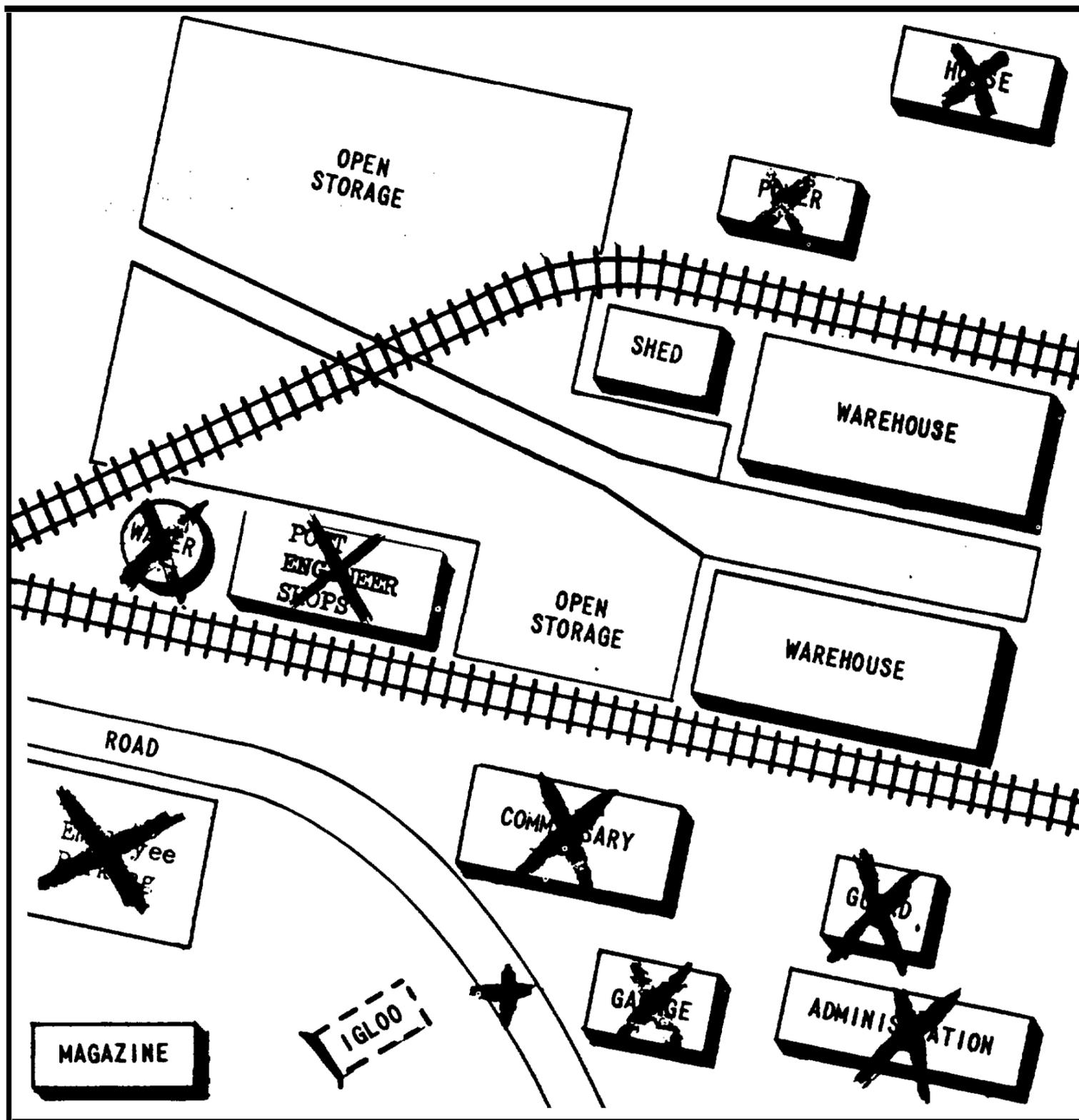
space through **rewarehousing**. For local management purposes, potential vacant space, type "A" (sq. ft.) warrants **consideration when it reaches 5** percent of net square feet occupied in a specific storage area. These affected areas will be reviewed by storage managers to direct efforts to reclaim such space by rewarehousing. Potential vacant space is discussed and illustrated in more detail in this section under "Space Reporting Illustrated."

f. Space recapitulation record. Figure 2-49 represents a sample space recapitulation record which may be used to recap storage space data. Such a record provides an effective means of consolidating storage space data by building, area, type of space, etc., and can be used in conjunction with storage space status reports.

2-402. Space Reporting Illustrated

The following illustrations provide pictorial guidance in understandable terms for use by personnel involved in space reporting.

STORAGE AND NON-STORAGE

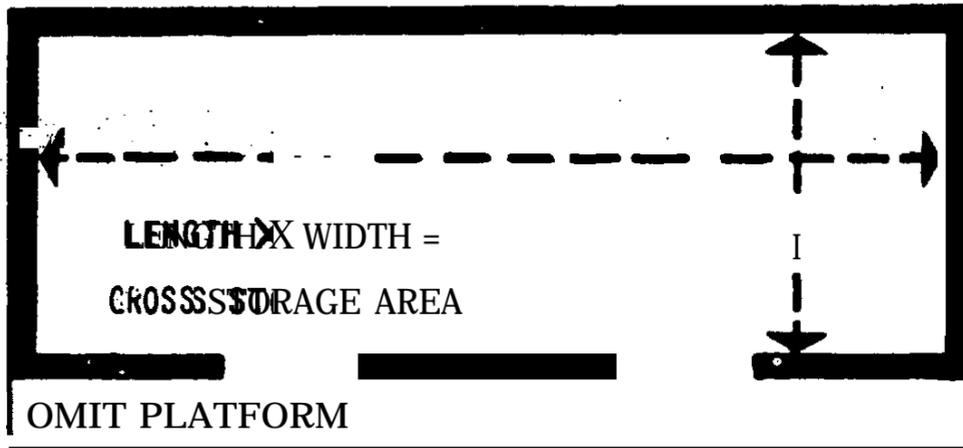


THIS IS A
 MAJOR SUPPLY
 INSTALLATION.

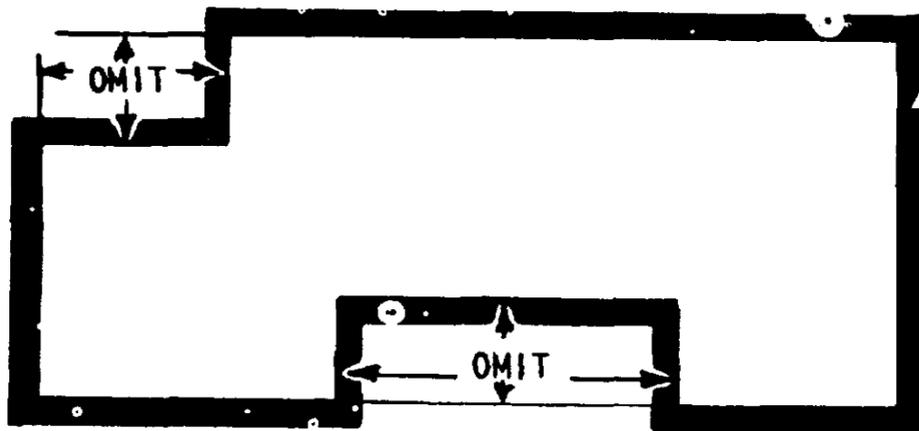
Not all of the area in a supply installation is storage area. Not all of its buildings are storage buildings. Some of its open area is not storage area. But certain parts of the installation, either by nature or by use, constitute storage area. Their dimensions—side by side and end to end—make up GROSS STORAGE AREA, expressed in square feet. Added all together, this footage is GROSS SPACE FOR STORAGE OPERATIONS. This is the only area of the installation you report as STORAGE SPACE.

MEASURING WAREHOUSE SPACE

, USE INSIDE DIMENSIONS

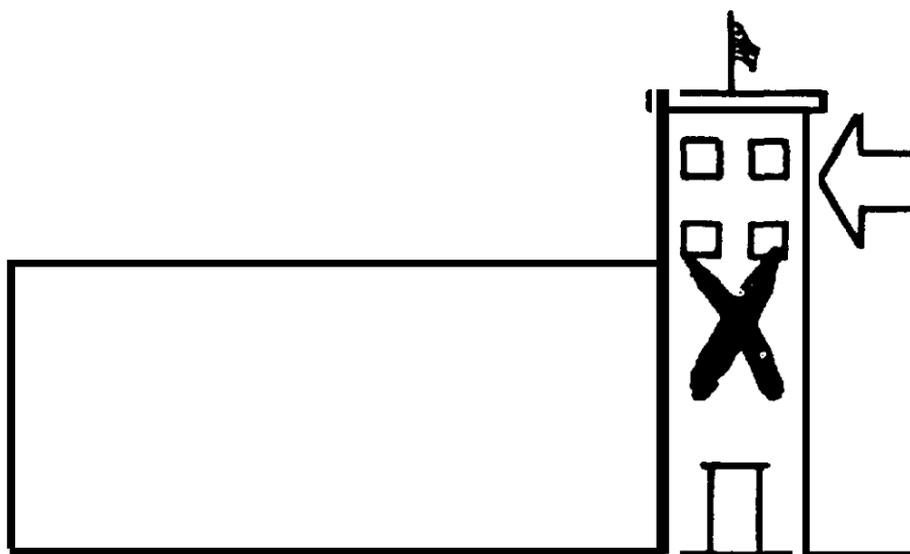


You measure all these structures by taking inside dimensions. The width in feet is multiplied by the length in feet and the result is the square-foot area, or TOTAL GROSS STORAGE AREA. This is less than the outside dimensions by the thickness of the walls. You don't pay any attention to inside fire walls, passageways, ramps, stair wells, or such matters. However—



IF YOU HAVE A BUILDING LIKE THIS

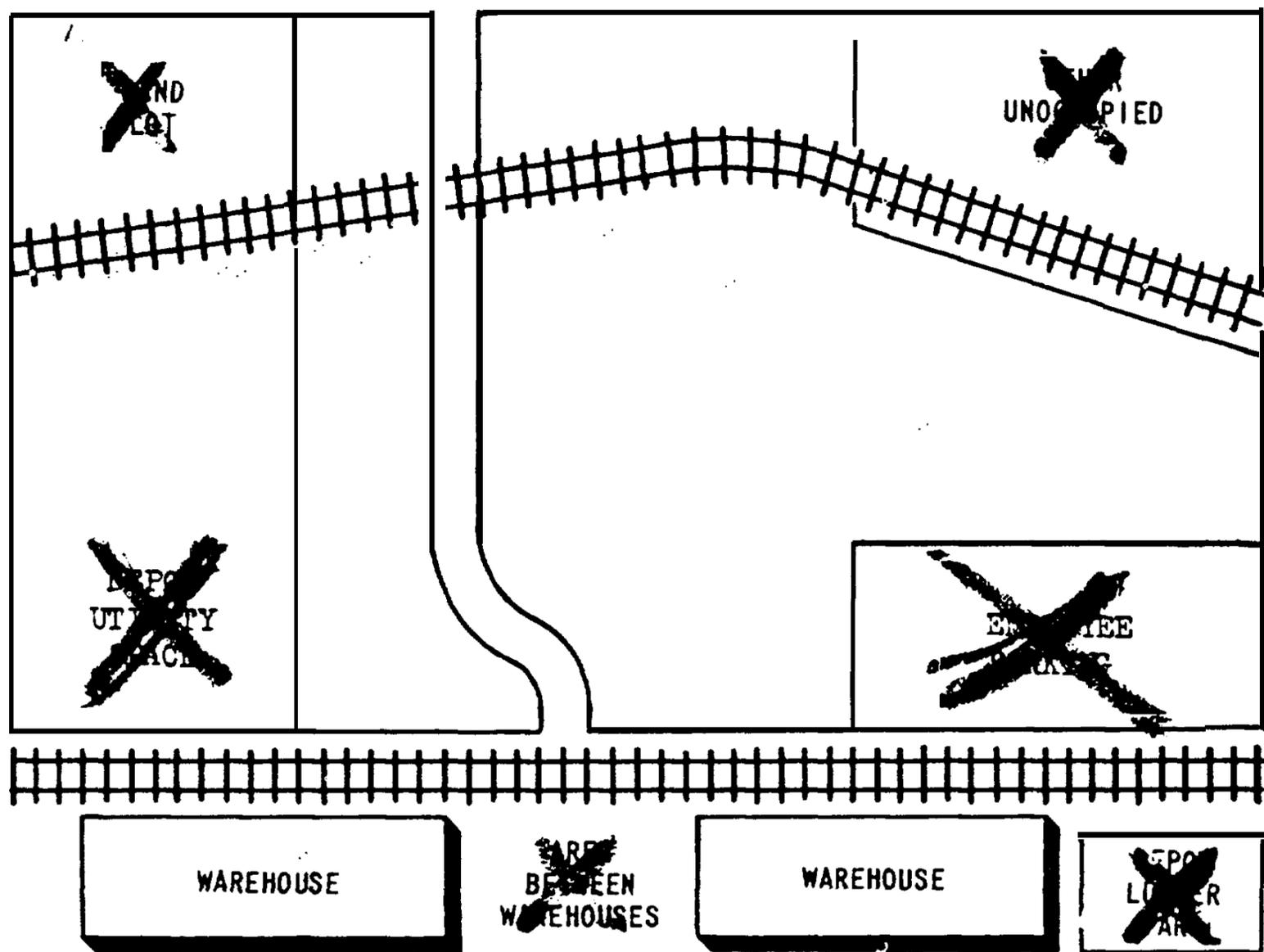
in which there is a cutback in the walls you measure the cutback and exclude it from TOTAL GROSS STORAGE AREA.



OR LIKE THIS

in which there is a tower for offices, or any portion not designed for storage (though in a storage building) you exclude it from TOTAL GROSS STORAGE AREA. However, if this tower had been designed for storage and later converted to storage offices, you would include it in TOTAL GROSS STORAGE AREA. Even if it was not designed for storage but is used for that purpose you report it during the period of use.

MEASURING "OPEN" AREAS



THIS IS OPEN STORAGE

Open storage may be either improved or unimproved (occupied or unoccupied), or OTHER (occupied only). Improved is included in making up your figure for TOTAL GROSS STORAGE AREA. However, in the case of unimproved open areas, only that space actually occupied by stored material or used in support of storage operations will be reported.

Measure open area in much the same way as you measure covered area. But take **outside** dimensions. Take the length in feet **and** the width in feet, and multiply the two **together**.

This will give you gross area expressed in square feet. If, however, the area is irregular in shape, you may have to make additions or deductions to arrive at a correct figure. But make no deductions for tracks or roadways running through the area.

Bear in mind that open storage does NOT include sand lots, depot parking space, maneuvering space between warehouse, etc.-even **though** some have prepared surfaces. However, if such space is actually occupied by material it will be **reported** as storage space for the period actually occupied.

THIS IS HOW YOU FIGURE SPACE

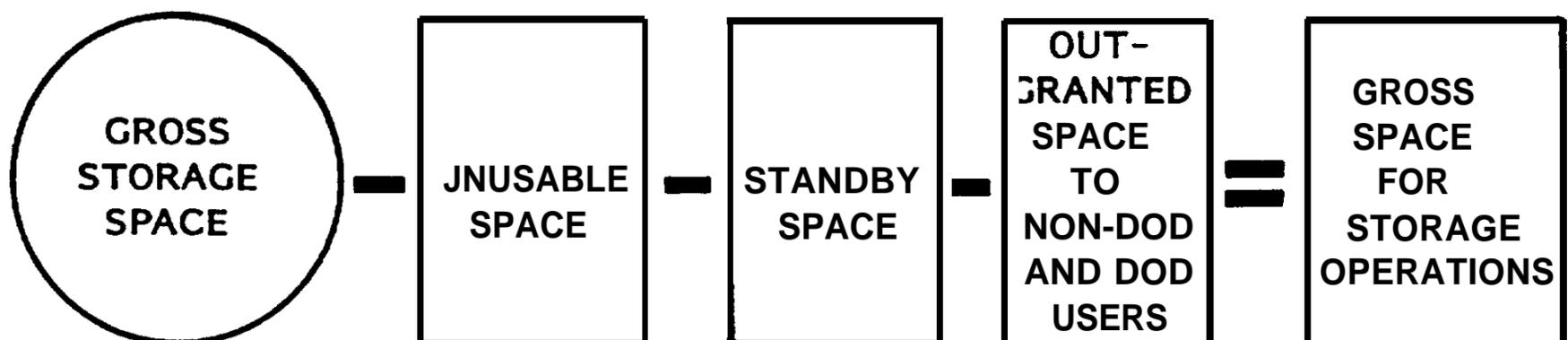
WHAT IS GROSS SPACE FOR STORAGE OPERATIONS?

STEP 1

GROSS STORAGE SPACE IS CALCULATED BY MEASURING LENGTH X WIDTH (SQ FT) OF BUILDINGS , OR AREAS DESIGNATED AS STORAGE AREAS (AS SHOWN IN PREVIOUS ILLUSTRATIONS).

STEP 2

UTILIZING DATA (SQ FT) CALCULATED, YOU MUST THEN SUBTRACT GROSS STORAGE SPACE NOT USED FOR STORAGE OPERATIONS, SUCH AS:



EXPLANATION OF TERMS:

UNUSABLE SPACE-- IS SPACE SO DETERIORATED THAT IT FAILS TO PROVIDE A SUFFICIENTLY PROTECTIVE ENVIRONMENT FOR STORAGE, OR SPACE THAT IS UNSAFE FOR ANY STORAGE PURPOSE, UNDERGOING REPAIR, OR SPACE UNWARRANTED FOR STORAGE BECAUSE OF ITS LOCATION, SECURITY RISK, OR ITS OCCUPANCY WOULD BE IN VIOLATION OF LOCAL SAFETY ORDINANCES.

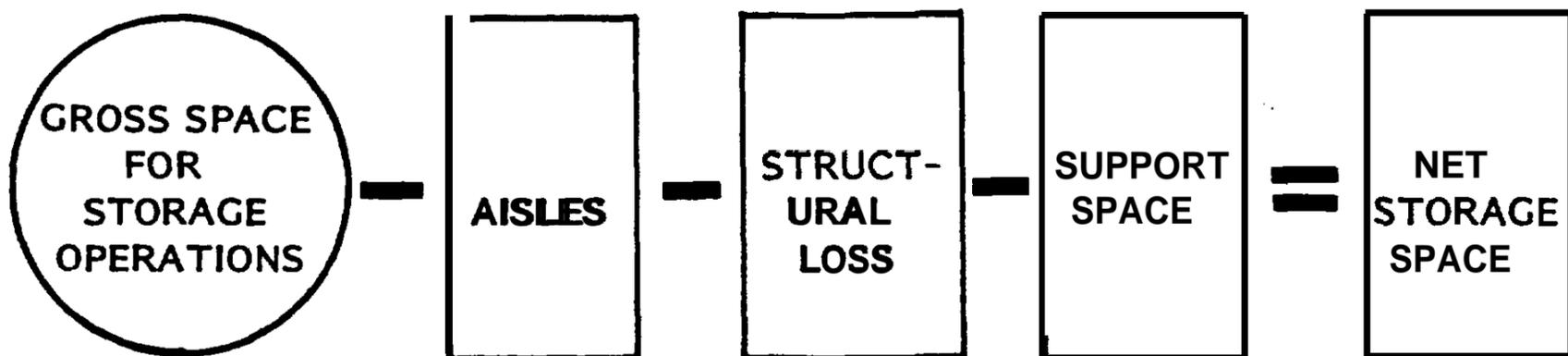
GROSS SPACE FOR STORAGE OPERATIONS-CONTINUED

STANDBY SPACE ----- GROSS SPACE PLACED IN STANDBY
STATUS.

OUTGRANTED SPACE ----- IS GROSS SPACE LEASED, LICENSED
OR PERMITTED TO PRIVATE OR NON-
DOD GOVERNMENT AGENCIES FOR
THEIR OPERATION AND/OR GROSS
SPACE LICENSED OR PERMITTED TO
OTHER DOD COMPONENTS FOR THEIR
OPERATION.

WHAT IS NET STORAGE SPACE?

ANSWER: NET STORAGE SPACE IS GROSS SPACE FOR STORAGE OPERATIONS MINUS GROSS SPACE USED FOR AISLES, STRUCTURAL LOSS AND SUPPORT SPACE . (REMEMBER--WE ARE STILL USING SQUARE FEET CALCULATIONS .)



EXPLANATION OF TERMS:

AISLES-- GROSS SPACE USED IN STORAGE TO PROVIDE FIRE AISLES; PERSONNEL ACCESS AISLES; MAIN AISLES; AND CROSS AISLES .

STRUCTURAL LOSS-- IN COVERED STORAGE STRUCTURAL LOSS IS GROSS SPACE THAT IS NOT USABLE FOR STORAGE BECAUSE OF OBSTRUCTIONS CAUSED BY PHYSICAL CHARACTERISTICS SUCH AS POSTS, PILLARS, RAMPS, DOOR CLEARANCES, FIRE WALLS AND SPACE LOST BY INSTALLED EQUIPMENT SUCH AS SWITCH PANELS, DEHUMIDIFICATION EQUIPMENT, ETC. IN OPEN

NET STORAGE SPACE-CONTINUED

STRUCTURAL LOSS

(CONT'D).....

OR OUTSIDE STORAGE STRUCTURAL LOSS INCLUDES SPACE TAKEN UP BY RAILROAD TRACKS, FIRE BREAKS, AND CLEARANCES FOR UTILITY LINES, ETC. **AISLES ARE NOT INCLUDED.**

SUPPORT SPACE -----

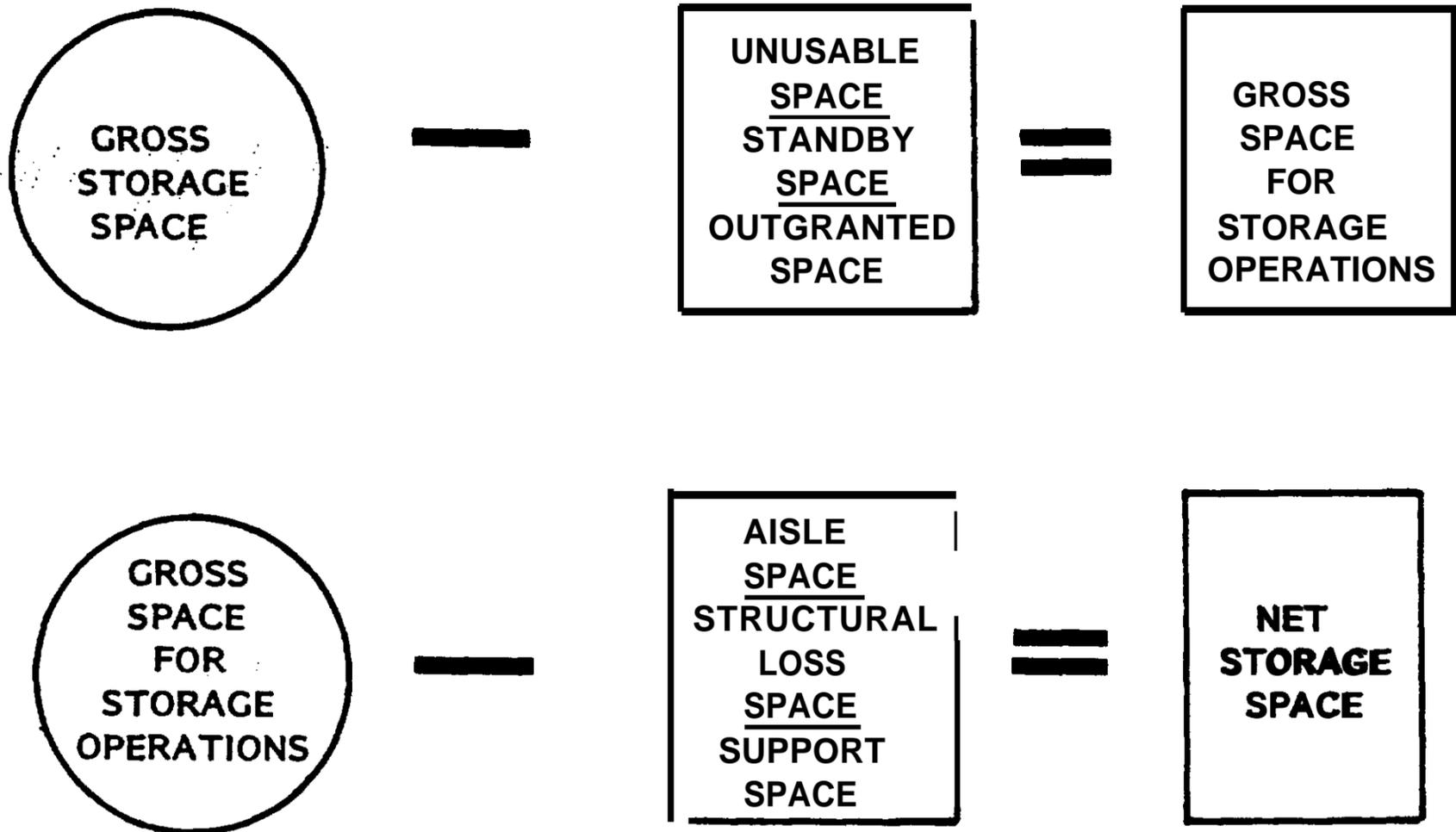
GROSS SPACE USED IN SUPPORT OF STORAGE OPERATIONS INCLUDES STORAGE SPACE USED FOR:

- RECEIVING
- SHIPPING
- PRESERVATION AND PACKAGING
- INSPECTION AND IDENTIFICATION
- PACKING
- BOX SHOP
- ASSEMBLY
- OFFICES

- OTHER**SUCH AS PARKING OR STORAGE AREAS FOR MHE (AISLES NOT INCLUDED) BATTERY CHARGING STATIONS EMPLOYEE REST ROOMS TOOL ROOMS LOCKER ROOMS TIME CLOCK AREAS SMOKING AREAS**

But remember *IT MUST BE STORAGE SPACE THAT IS BEING USED FOR ANY OF THE ABOVE.*

NOW! LET'S SUMMARIZE WHAT WE HAVE COVERED SO FAR



NOTE

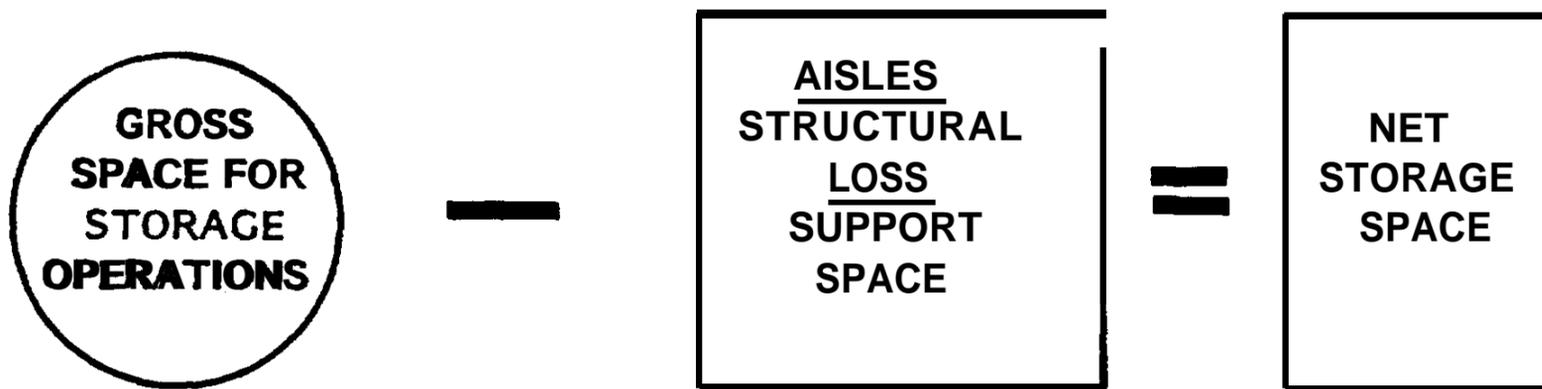
UP TO THIS POINT WE ARE STILL DISCUSSING SPACE BY SQUARE FEET MEASUREMENTS . NOW WE ARE READY TO EXPLAIN HOW NET STORAGE SPACE IS REPORTED IN TERMS OF SQUARE FEET AND CUBIC FEET.

HOW DO WE REPORT NET STORAGE SPACE?

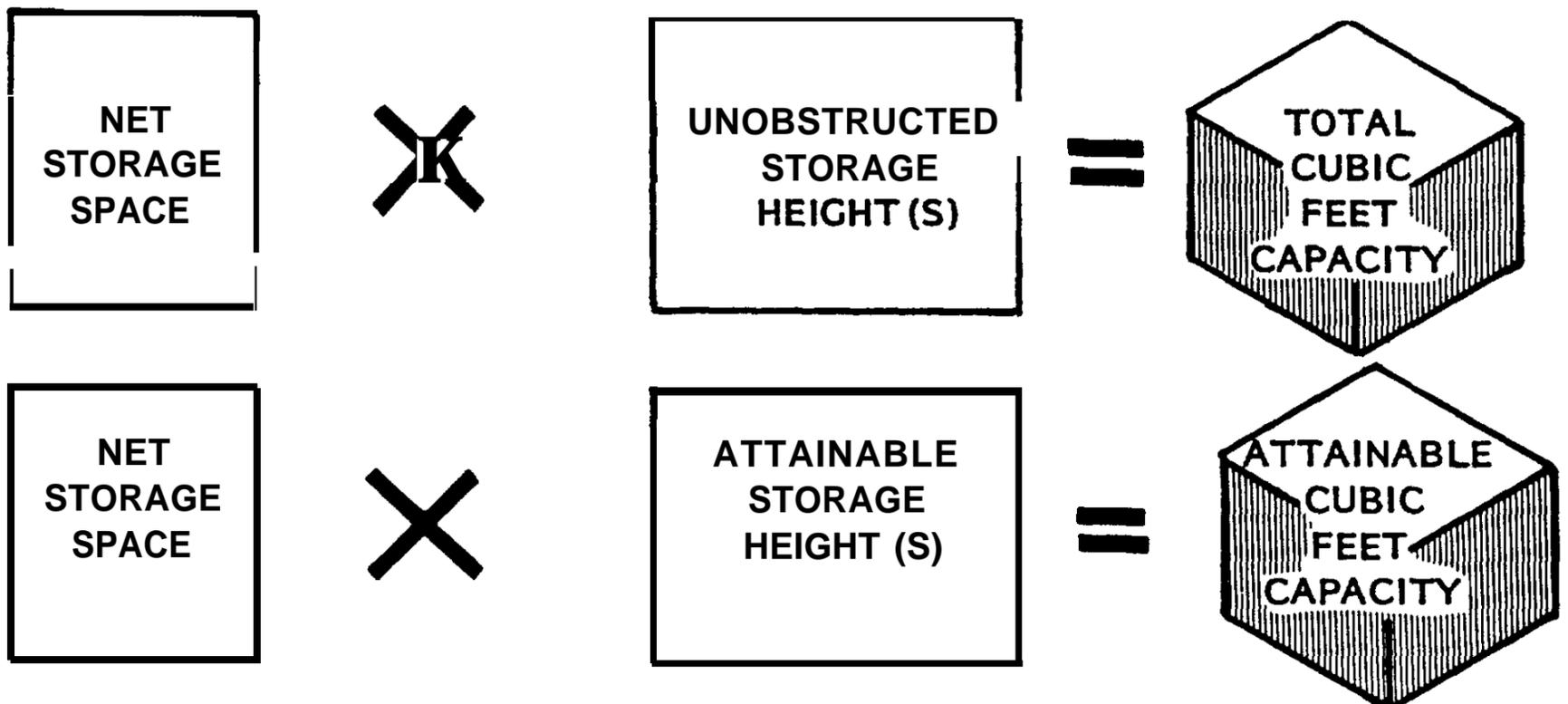
NET STORAGE SPACE IS REPORTED TO HIGHER HEADQUARTERS BY BOTH SQUARE FEET AND CUBIC FEET MEASUREMENTS . FIRST WE MUST DETERMINE OUR CAPACITY OF NET STORAGE SPACE, THEN WE CALCULATE OCCUPANCY AND VACANT SPACE . LET'S LOOK AT CAPACITY FIRST:

CAPACITY OF NET STORAGE SPACE IS DETERMINED BY:

1. DETERMINING NET STORAGE SPACE (SQ FT)
(WHICH HAS ALREADY BEEN ACHIEVED IN PREVIOUS ILLUSTRATIONS)



2. DETERMINING TOTAL NET CUBIC FEET AND ATTAINABLE CUBIC FEET:



LET'S CLARIFY TOTAL CUBIC FEET AND ATTAINABLE CUBIC FEET CAPACITIES:

IN COVERED STORAGE . . .

TOTAL CUBIC FEET—IS THE PRODUCT OF NET STORAGE SPACE (SQ FT) MULTIPLIED BY THE UNOBSTRUCTED STACKING HEIGHT(S) PERMITTED BY SAFETY REGULATIONS/RESTRICTIONS IN A PARTICULAR STORAGE AREA, BAY OR SECTION OF A COVERED FACILITY

ATTAINABLE CUBIC FEET—IS THE PRODUCT OF NET STORAGE SPACE (SQ FT) MULTIPLIED BY THE STACKING HEIGHT(S) PER-

MITTED BY SAFETY REGULATIONS/RESTRICTIONS AND FLOOR LOAD LIMITATIONS WITH AVAZLABLE MHE STORAGE AIDS. THEREFORE, ATTAINABLE CUBIC FEET REPRESENTS THE CUBIC SPACE USABLE OR AVAILABLE FOR STORAGE WITH EXISTING RESOURCES.

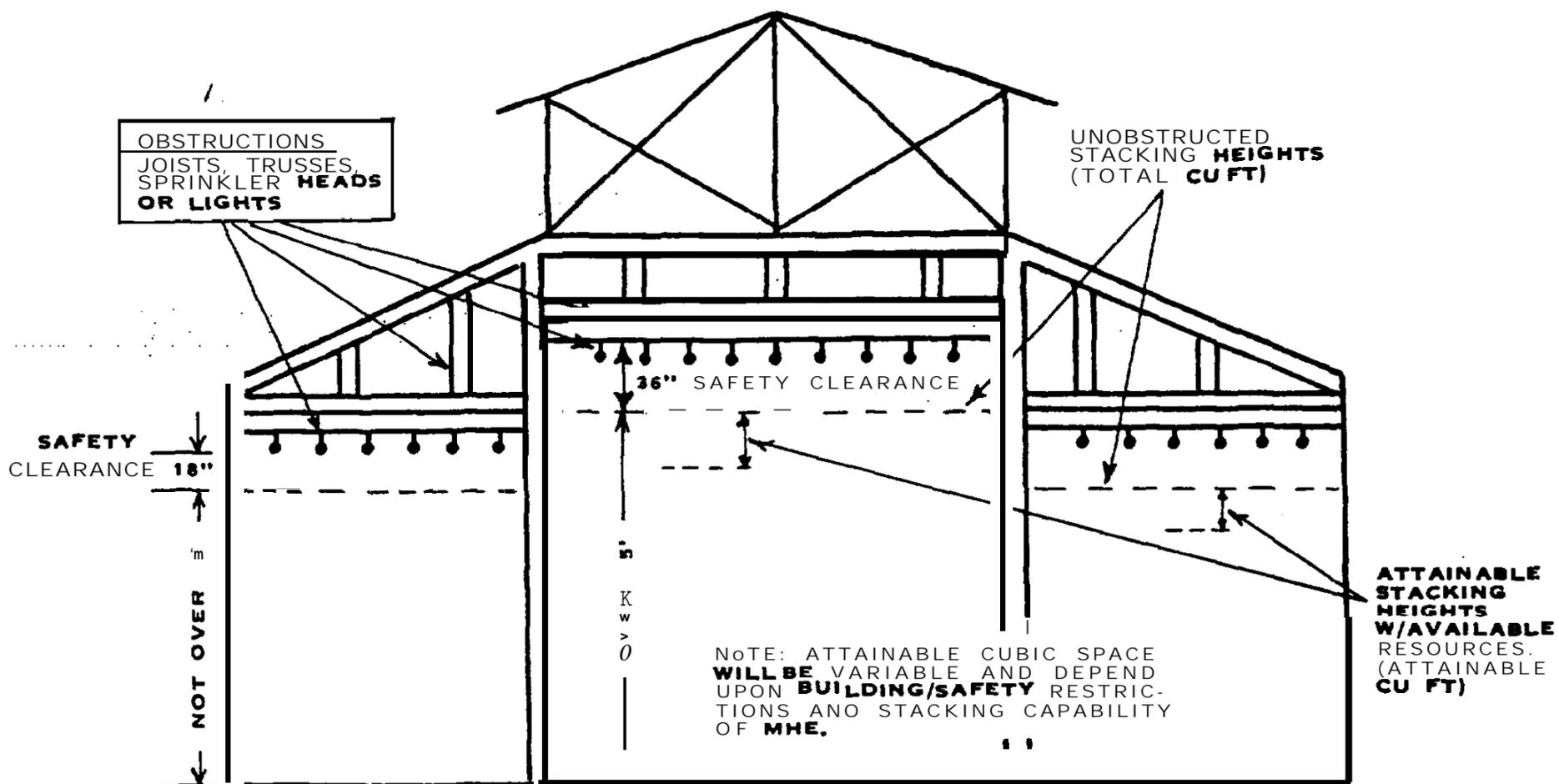
BIN CUBIC

CAPACITY .-.----- IS THE PRODUCT OF OUTSIDE DIMENSIONS—LENGTH, WIDTH, AND HEIGHT (L x W x H), UNUSED CUBIC SPACE ABOVE THE BINS WILL NOT BE INCLUDED AS ATTAINABLE SPACE.

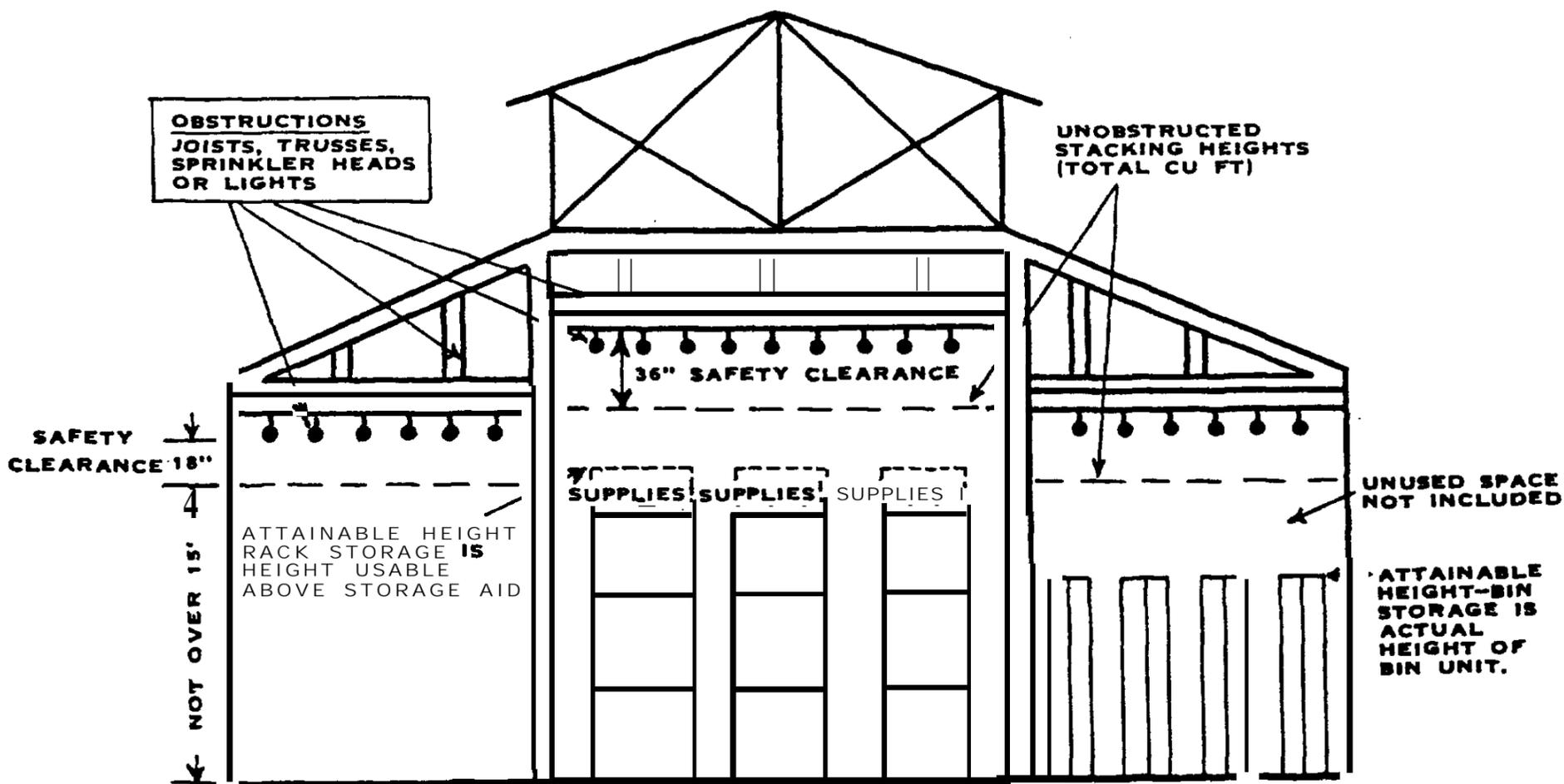
RACK CUBIC

CAPACITY -----_---_-- IS THE PRODUCT OF THE RACKS' OUTSIDE DIMENSIONS (L x W x H). CUBIC SPACE ABOVE THE RACKS WILL BE INCLUDED TO THE EXTENT THAT USE OF SUCH SPACE IS PERMITTED BY SAFETY LIMITATIONS

EXAMPLES OF DETERMINING CUBIC SPACE CAPACITY IN COVERED STORAGE:



BULK STORAGE



RACK

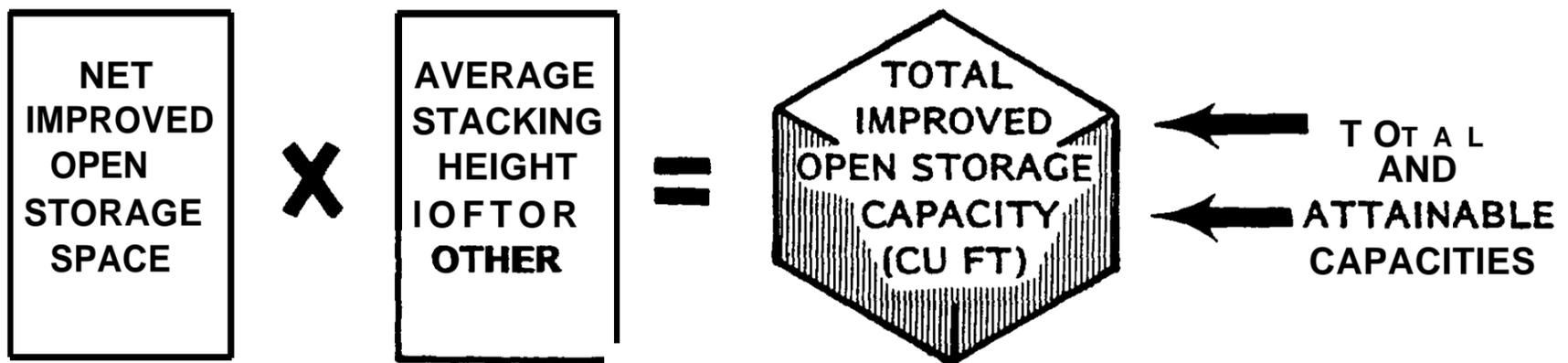
BIN

HERE'S HOW TO COMPUTE CUBIC SPACE CAPACITIES IN OPEN STORAGE--

IMPROVED OPEN STORAGE . . .

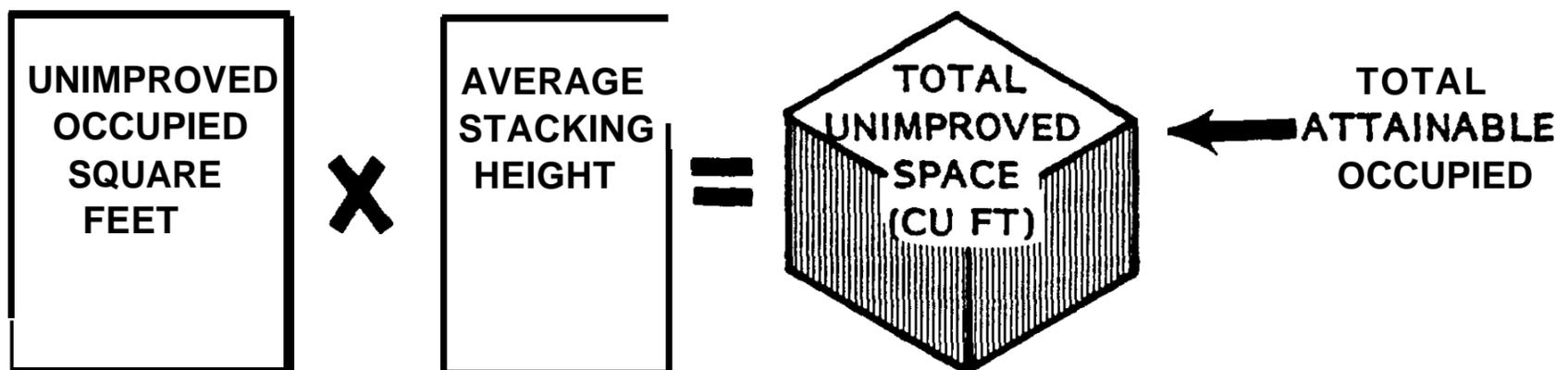
TOTAL CUBIC CAPACITY-- WILL GENERALLY BE COMPUTED BY USING AN AVERAGE STACKING HEIGHT OF 10 FEET MULTIPLIED BY NET STORAGE SPACE (SQ FT) . WHERE LOCAL CONDITIONS AND ACTUAL COMMODITY CHARACTERISTICS DICTATE A SPECIFIC STACKING HEIGHT, THE LATTER WILL APPLY.

ATTAINABLE CUBIC CAPACITY-- WILL BE COMPUTED BY USING THE SAME CRITERIA EXPLAINED ABOVE.



UNIMPROVED OPEN STORAGE . . .

IN UNIMPROVED OPEN STORAGE ONLY REPORT CUBIC SPACE ACTUALLY OCCUPIED BY MULTIPLYING SQUARE FEET OCCUPIED BY A REPRESENTATIVE (SAMPLE) STACKING HEIGHT .



IGLOO AND MAGAZINE SPACE

THE BASIC INSTRUCTIONS CONTAINED HEREIN FOR COVERED STORAGE APPLY ALSO FOR REPORTING AMMUNITION CUBIC STORAGE SPACE CAPACITIES WITH REGARD TO:

/. *TOTAL CUBIC FEET ... NET STORAGE x UNOBSTRUCTED STACKING HEIGHT(S).*

AND

ATTAINABLE CUBIC

FEET NET STORAGE x ATTAINABLE STACKING HEIGHT(S).

THESE GUIDELINES MAYBE AUGMENTED BY SPECIAL DOD COMPONENT INSTRUCTIONS ESTABLISHING UNIFORM *UNOBSTRUCTED* OR *ATTAINABLE HEIGHTS* IN SPECIFIC FACILITIES (IGLOOS AND MAGAZINES). WHEN SUCH SPECIFIC HEIGHTS ARE ESTABLISHED AND FURNISHED, REPORTING ACTIVITIES WILL COMPUTE CUBIC SPACE CAPACITIES ACCORDINGLY.

DETERMINING OCCUPIED AND VACANT NET STORAGE SPACE--

SPACE IS, EITHER OCCUPIED OR VACANT. ALSO, OCCUPIED SPACE CAN BE UTILIZED IMPROPERLY AND BE CLASSIFIED AS POTENTIAL VACANT SPACE. FOR REPORTING PURPOSES, LET'S FIRST DISCUSS THE METHODS

OF REPORTING OCCUPIED SPACE; THEN WE WILL ILLUSTRATE EXAMPLES

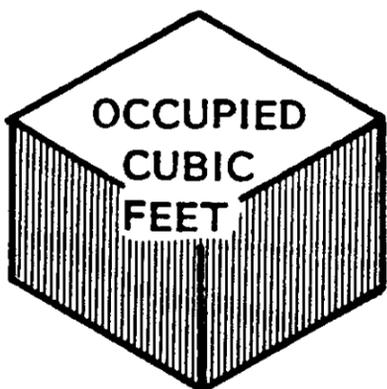
OF OCCUPIED, VACANT AND POTENTIALLY VACANT SPACE:



(L x W)

=

THE AMOUNT OF SQUARE FEET OCCUPIED BY BINS, RACKS, AND MATERIAL IN COVERED AND OPEN BULK STORAGE AREAS. BIN AND RACK SPACE IS CONSIDERED OCCUPIED WHETHER OR NOT MATERIAL IS STORED THEREIN (L x W).



(L x W x H)

=

THE PRODUCT OF NET SQUARE FEET BY ACTUAL STORAGE HEIGHTS OR HEIGHTS DETERMINED BY STATISTICAL SAMPLING, WHEN APPLICABLE:

BIN AND RACK OCCUPANCY WILL BE COMPUTED BY DETERMINING WHAT PORTION OF TOTAL ATTAINABLE SPACE IS VACANT THROUGH STATISTICAL SAMPLING OR RECORDS OF AVAILABLE AND OCCUPIED OPENINGS. THEN: TOTAL ATTAINABLE CUBIC FEET MINUS VACANT CUBIC FEET EQUALS OCCUPIED BIN AND RACK SPACE.

*DETERMINING OCCUPIED AND VACANT NET STORAGE SPACE—
CONTINUED*

BULK OCCUPANCY IN COVERED STORAGE WILL BE BASED UPON PERIODIC SURVEYS OF BULK LOCATIONS TO DETERMINE REPRESENTATIVE BULK STACKING HEIGHTS FOR EACH STORAGE FACILITY.

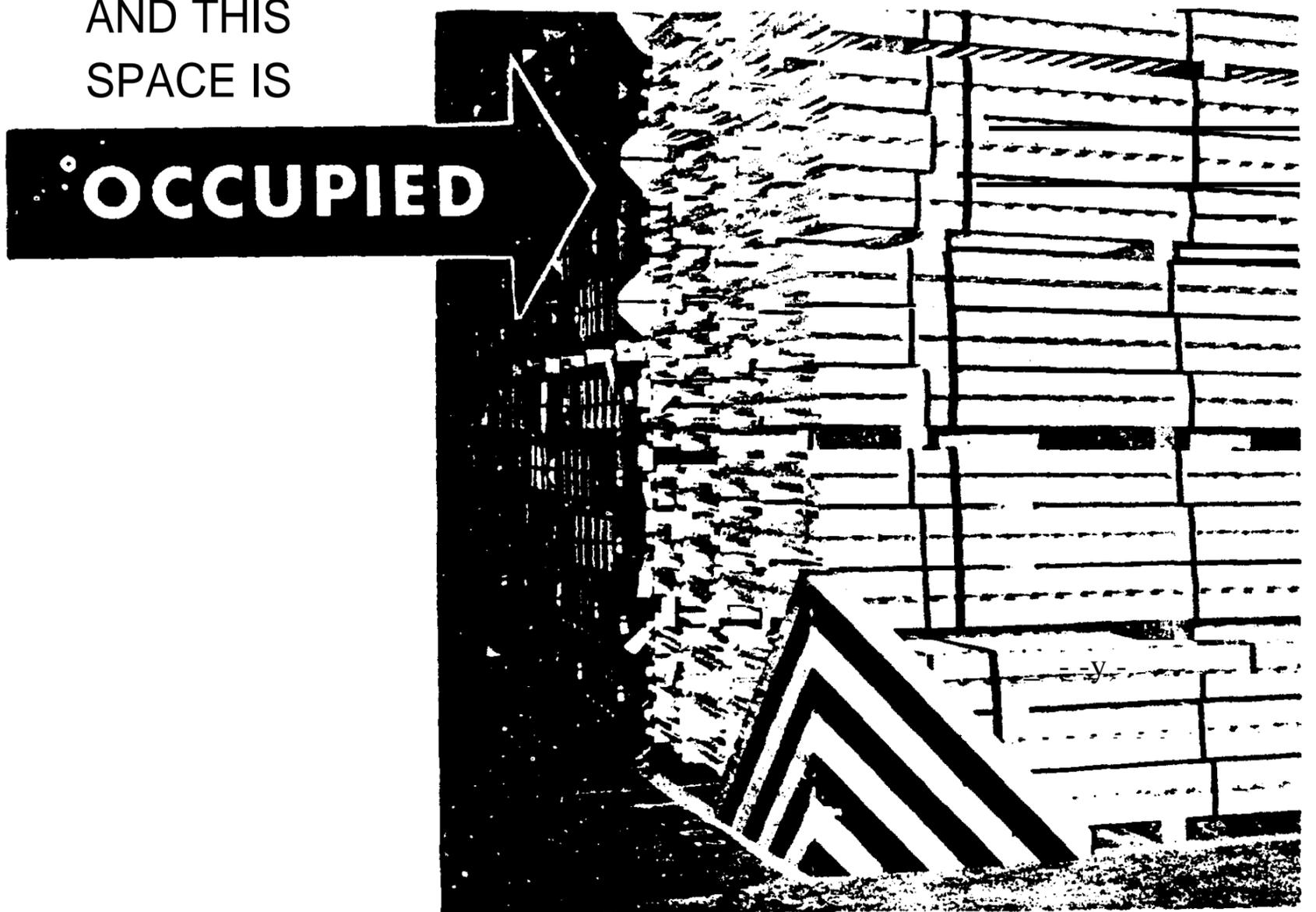
IMPROVED OPEN OCCUPANCY IS BASED UPON NET SQUARE FEET OCCUPIED MULTIPLIED BY AN AVERAGE STACKING HEIGHT OF 10 FEET (OR OTHER SPECIFIC HEIGHT IF DETERMINED).

UNIMPROVED OPEN OCCUPANCY WILL BE BASED ONLY UPON OCCUPIED SQUARE FEET TIMES AN AVERAGE STACKING HEIGHT.

● **OCCUPIED VS VACANT**

Space **is** Three-Dimensional

AND THIS
SPACE IS



Our next item is OCCUPIED NET STORAGE SPACE. To get this figure you could of course measure the space actually occupied. That's doing it the hard way because *in* most cases your occupied space is greater than your vacant space. It's simpler and more accurate to compute the total vacant space

and subtract that figure from NET STORAGE SPACE. ACTUAL VACANT is not much of a problem. You just measure the floor space that is not occupied by supplies. You include space occupied by empty pallets and dunnage, you do not include short spaces in front of stacks or broken spaces.

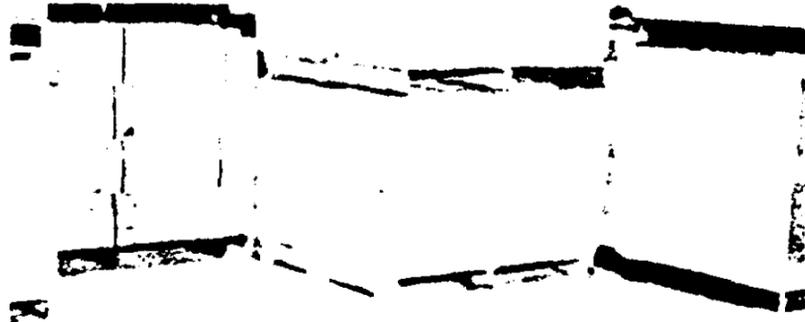
USABLE BUT NOT USED

THESE ARE THE PRINCIPAL TYPES OF OCCUPIED SPACE THAT ARE REVIEWED AND REPORTED AS:

POTENTIAL VACANT SPACE

TYPE **A**

SHORT SPACES AND BROKEN SPACES ("HONEYCOMBING")

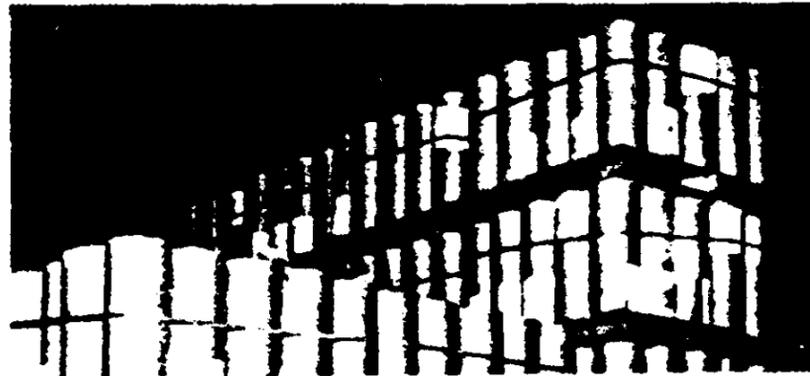


TYPE A POTENTIAL VACANT includes ALL spaces in front of stacks which cannot be used for the storage of supplies other than identical sizes, lots, etc. It is a type of space loss which can frequently be overcome by setting aside shallow spaces along aisles for small lots.

This space is captured during the space surveys and reported as space recoupable through rewarehousing.

TYPE **B**

LOW STACKING (failure to stock to full **permissible** height)



The test for TYPE B is simple. Just ask yourself, Has stock been stacked to maximum permissible height, considering the floor load, height of roof rafters and ceiling joists, commodity characteristics, and strength of package? If not, correct the condition mentally—in other words, do a job of mental rewarehousing—and enter the space thus uncovered (mentally reclaimed) as potential vacant.

AVOID CONFUSION

These are not POTENTIAL VACANT:

- **Space occupied** by empty pallets or racks (=ACTUAL VACANT).
- **Low stacking** caused by limitations of floor load, height of roof rafter and ceiling joists, commodity characteristics, and strength of package (=100% OCCUPIED).

These are cases of *Potential Vacant, Type A*

We begin with short spaces or broken spaces caused by poor warehousing. In the two examples on this page supplies have been stacked in such a way as to create unusable areas-unusable, that is, except for the identical item or lot number. Such space is POTENTIAL VACANT (TYPE A).



By stacking forward from wall to aisle three cases deep (instead of across the space); 30 percent of this space could be reclaimed. Such reclaimable area is to be reported as POTENTIAL VACANT,

**30%
POTENTIAL
VACANT**



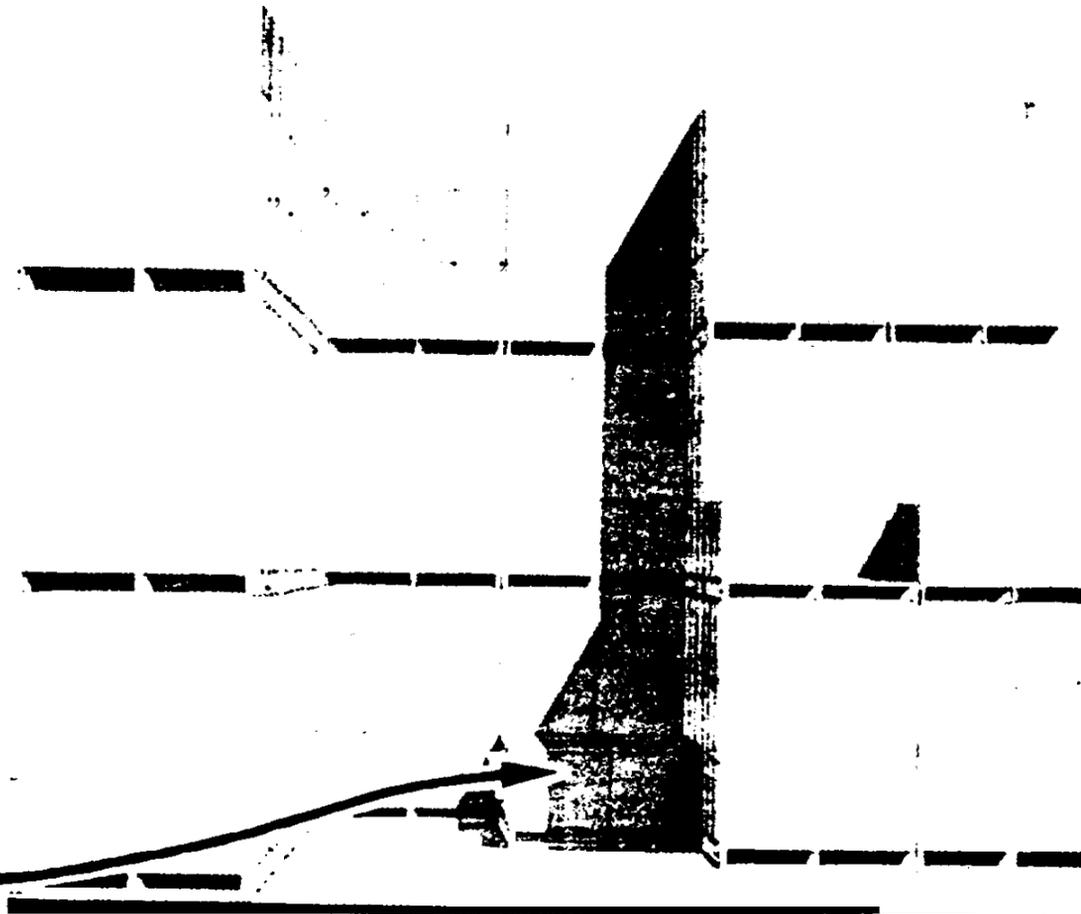
In this case supplies have been removed across the front instead of in rows from aisle to wall. As a result these supplies occupy parts of three rows instead of filling one. Report 66⅔ percent of central area as POTENTIAL VACANT.

**66⅔%
POTENTIAL
VACANT**

● POTENTIAL VACANT

Also Type A - Short Spaces *in* Front of *Stacks*

In some instances this type of space loss-short spaces in front of stacks-can be avoided. In some instances the condition may be more or less unavoidable. In either case the space that might be reclaimed is reported "as POTENTIAL VACANT-no matter what the cause or application.



**50%
POTENTIAL
VACANT**

Here are items (small-arms ammunition) which must be stored by lot number, thus causing short spaces in front of stacks. POTENTIAL VACANT results.



Generally speaking, warehousing practice that leaves short spaces in the midst of a stack is not good warehousing. But good or bad, avoidable or unavoidable, such spaces are reported as POTENTIAL VACANT. Fifty percent of the center row in the photograph is occupied; accordingly the rest is POTENTIAL VACANT (TYPE A).

**50%
POTENTIAL
VACANT**

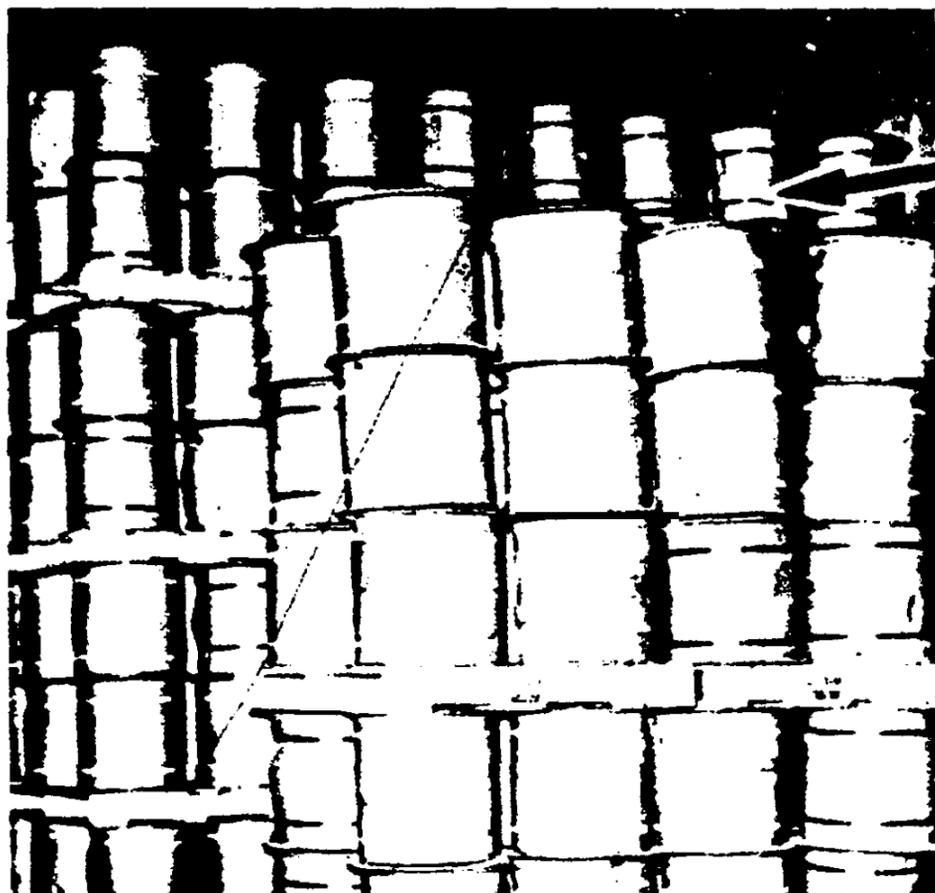
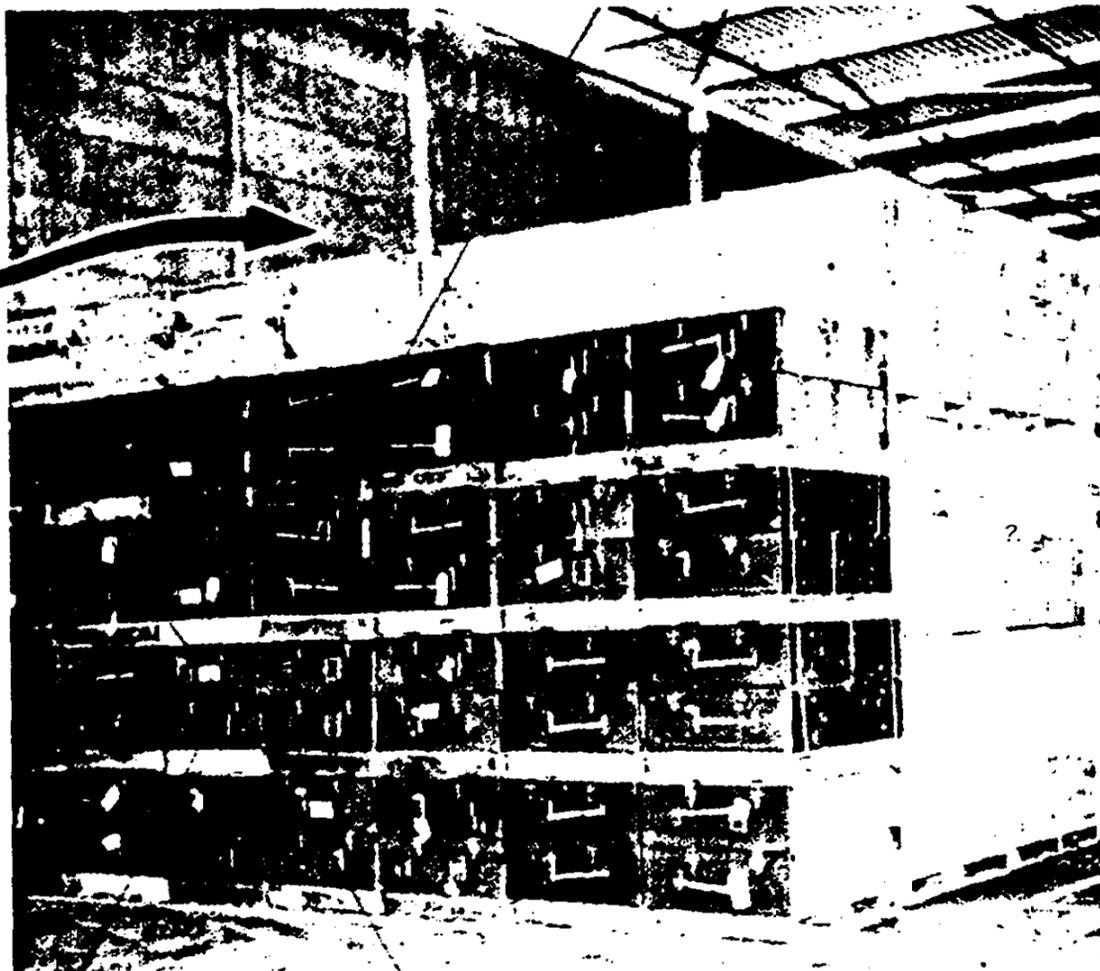
F 7

● POTENTIAL VACANT

Next we have Type B-LOW Stacking

**20%
POTENTIAL
VACANT**

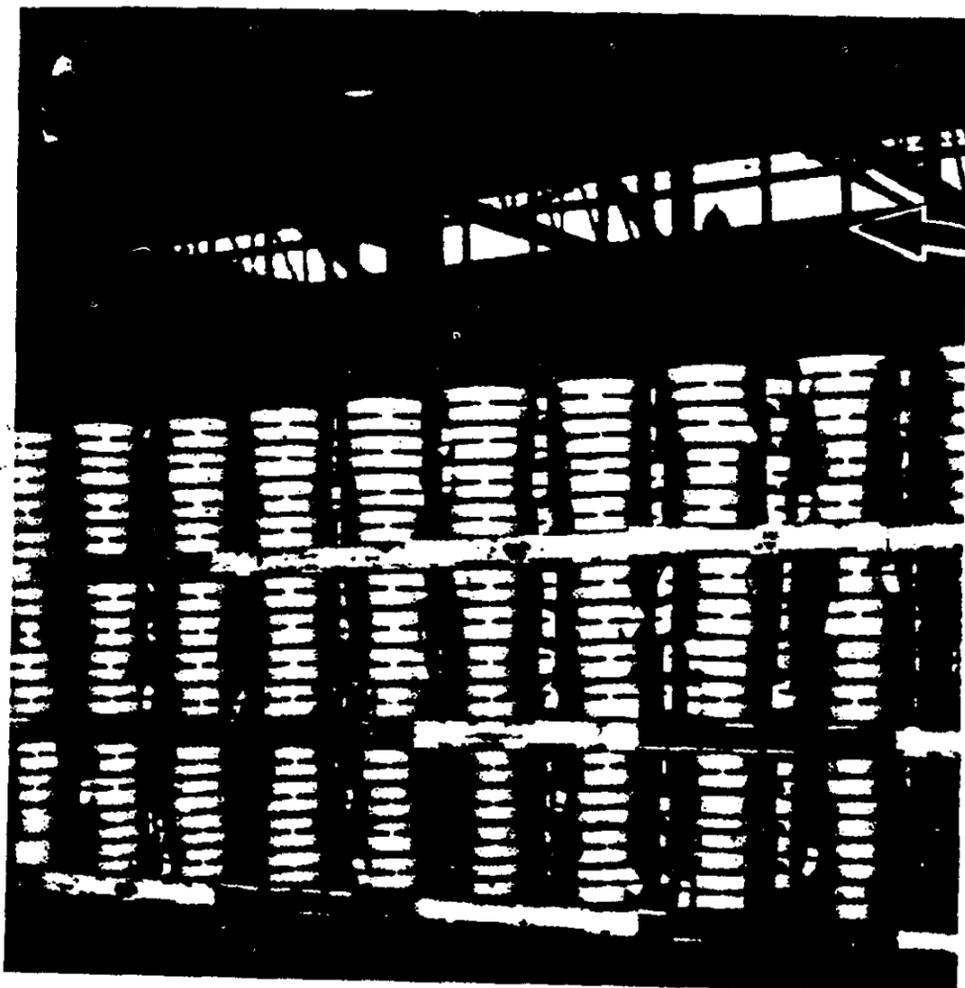
Simple inspection shows that the lot in the foreground could be stacked one pallet higher or, preferably, **three** eases high (instead of two) on each pallet. This means that 20 to 33 percent of the space occupied by this lot should be reported as **POTENTIAL VACANT**.



**25%
POTENTIAL
VACANT**

By loading the pallets in the foreground in the same way as the pallets in the rear, these reels could be stacked eight high instead of six; therefore 25 percent of the near row is **POTENTIAL VACANT (TYPE B)**. **TYPE A POTENTIAL VACANT** is present in the two unfilled rows.

● **POTENTIAL VACANT**



**25%
POTENTIAL
VACANT**

These reels could have been stacked one pallet higher with a resultant saving of space amounting to 25 percent (TYPE B).

Another subject for "Mental Rewarehousing"

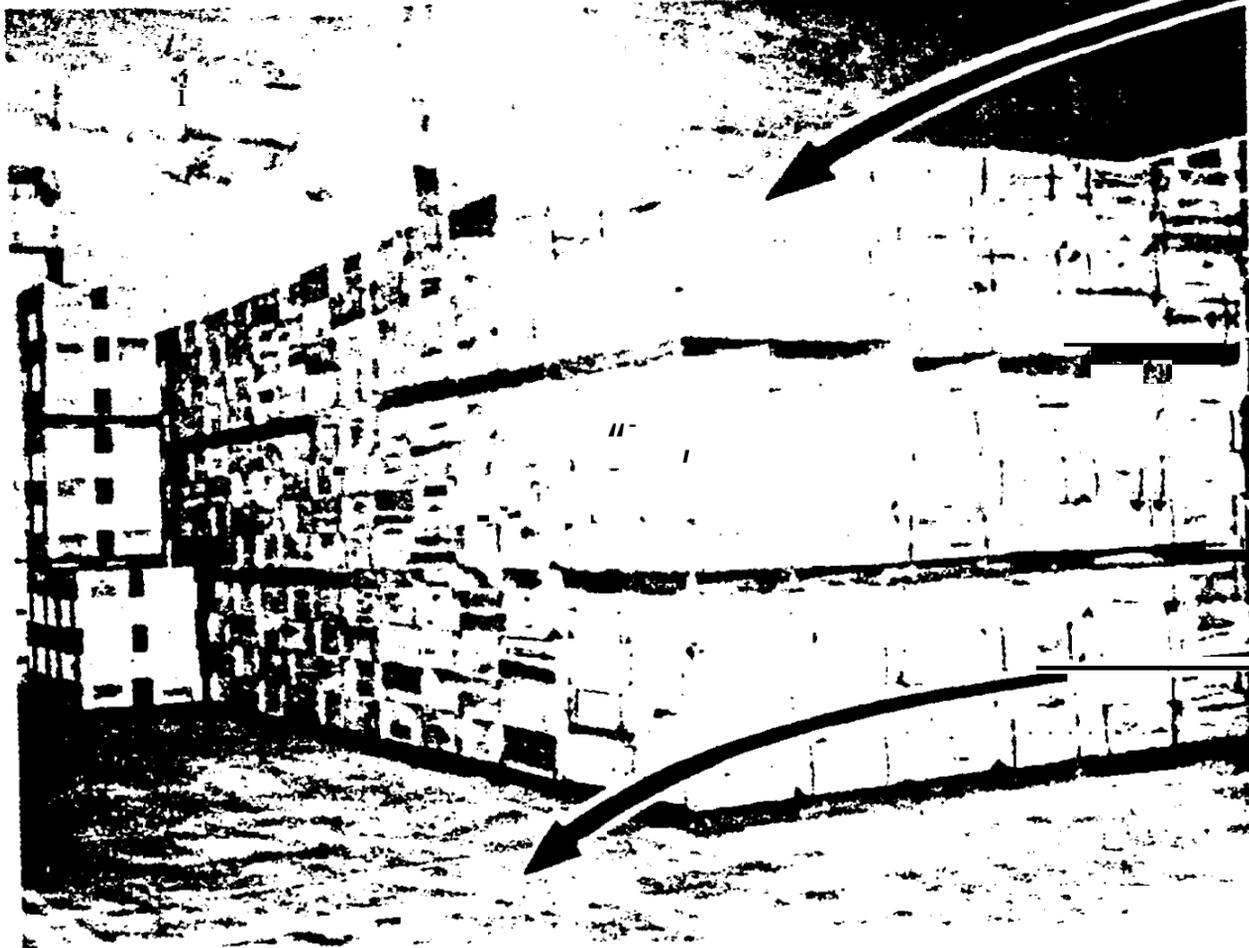
As a practical matter it is desirable to supplement 'mental rewarehousing' with paper computations. Suppose you have a situation like that shown above. As noted in the caption, another tier could be stacked above the three already in place.

By simple inspection we can see that one-

fourth, or 25 percent, of the available height is not utilized. This means that 25 percent of the floor space occupied by this stack could be saved by rewarehousing; hence if the stack occupies 1,200 square feet of floor space, then 25 percent or 300 square feet would be reported as POTENTIAL VACANT.

STORAGE SPACE IS CRITICAL
Use it wisely. Report it accurately,
especially take action to recover
POTENTIAL VACANT. This is
"found" space. Don't overlook it.

POTENTIAL AND ACTUAL Mixed and Miscellaneous (CONTINUED)

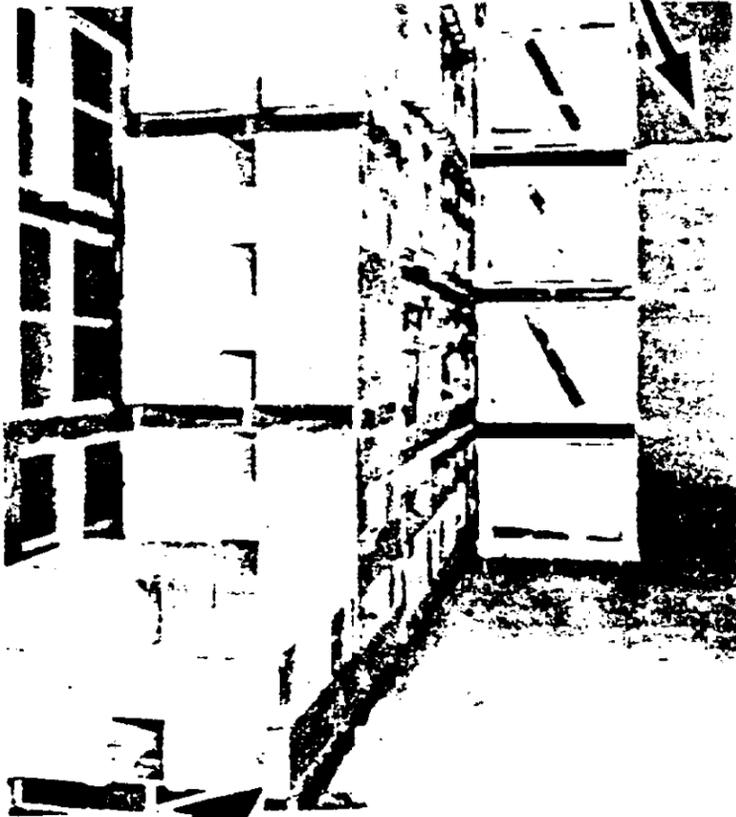


**25%
POTENTIAL
TYPE B**

**POTENTIAL
VACANT
TYPE A**

**ACTUAL
VACANT**

Here are two types of POTENTIAL VACANT. They're easy to diagnose. Central block exhibits TYPE B, because full height is not utilized. The same is true of reels in background. Foreground obviously is TYPE A POTENTIAL VACANT, though actual percentage cannot be determined from the photograph. As in the photo reproduced at the bottom of the preceding page, if back-to-back stacking were employed here, a half row of ACTUAL VACANT space would be gained.



POTENTIAL VACANT TYPE A

● SPECIAL CASES

Stacking *Height* Limited

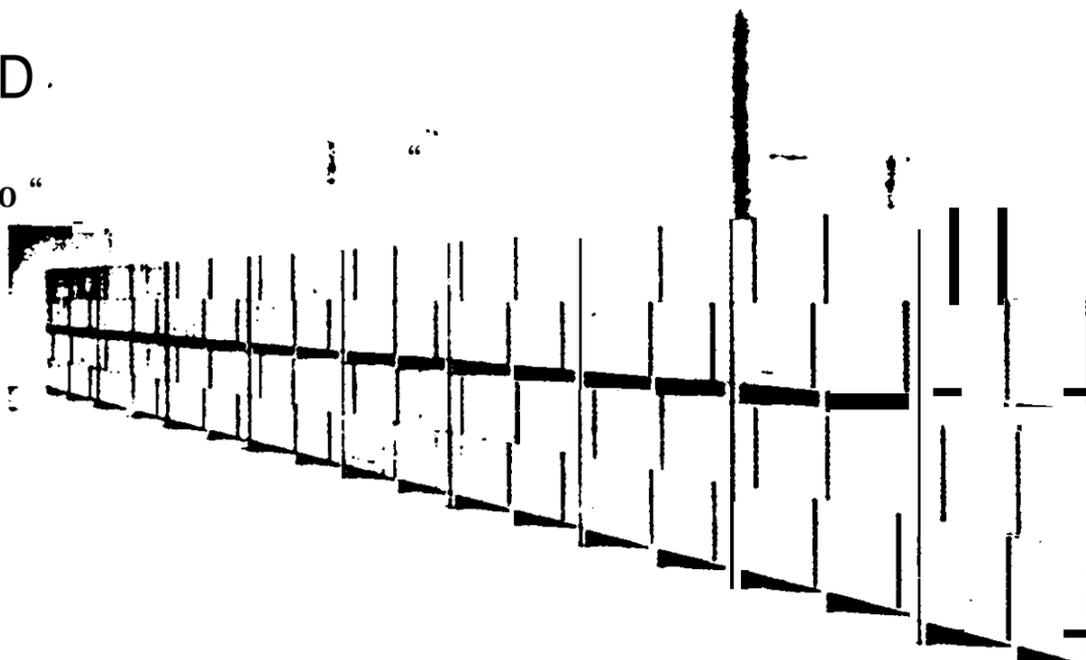


**100%
OCCUPIED**

At first glance this might appear to exhibit TYPE B POTENTIAL VACANT, but these are coils of rubber-insulated wire which could not be stacked higher without damage to the commodity; hence by definition this space is 100 percent OCCUPIED.

**100%
OCCUPIED**

These are batteries stacked to "the limit of permissible floor load (second floor, multistory warehouse); hence the space occupied is 100 percent OCCUPIED. Frequently, more economical stacking of such items can be attained by placing them on the ground floor where the permissible floor load is greater. But this fact does not change the status, for reporting purposes, of a stack already in existence.



GUIDE FOR COMPUTING OCCUPIED AND VACANT SPACE

1. During storage space surveys, estimates and computations will be based upon pallet sizes and square feet grids occupied by each, including overhang and space between pallet tiers. The factors to use for various pallet sizes are as follows:
 - a. 32 x 40 = 12 sq ft.
 - b. 40 x 48" = 16 sq ft.
 - c. 48 x 60 = 26 sq ft.
 - d. 48 x 72" = 31 sq ft.
 - e. Other size pallets will be computed by multiplying the length plus 6 inches (2 inches on each side for overhang plus 1 inch on each side for space between tiers) times the width plus 6 inches.

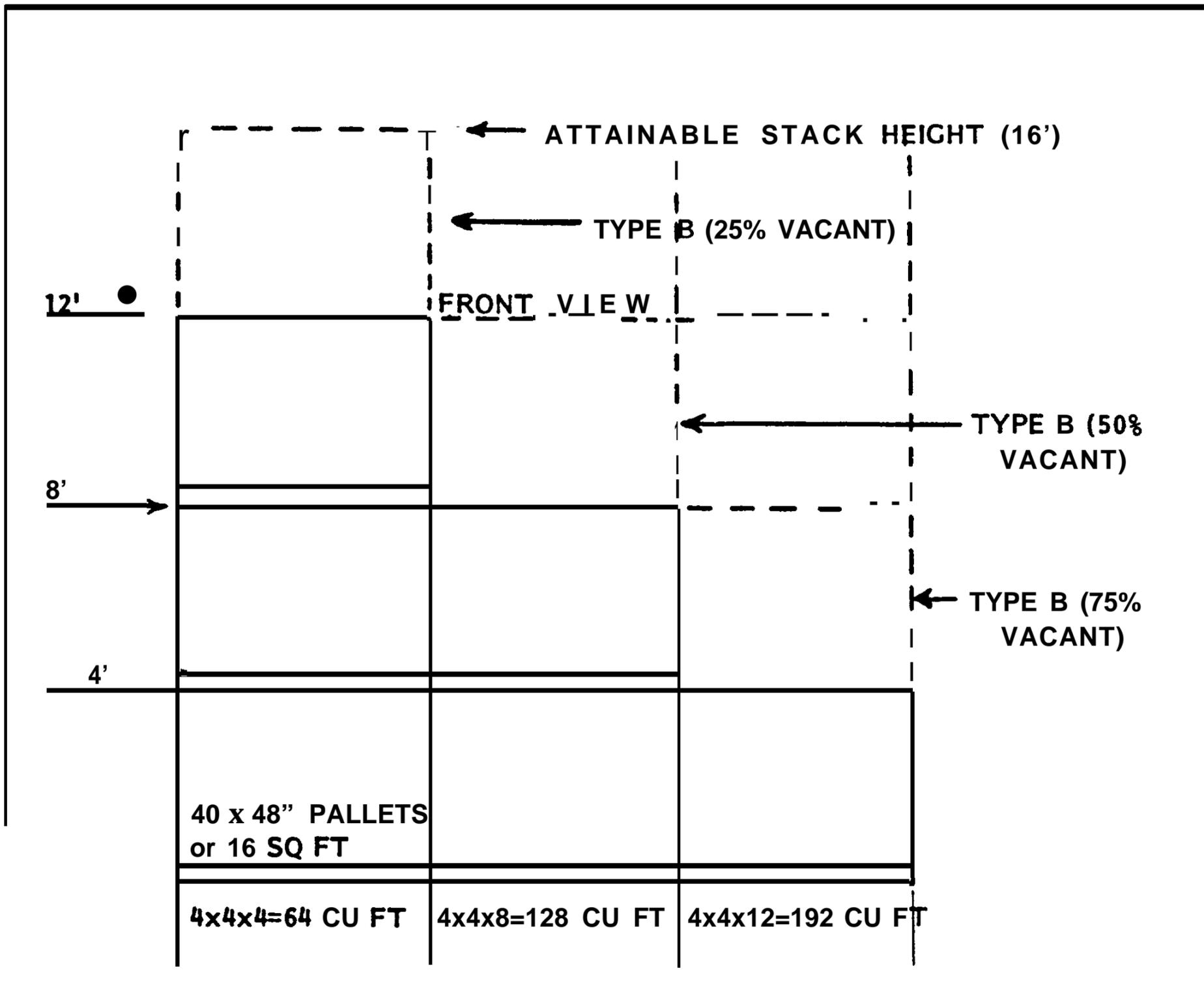
2. To determine whether a partially loaded pallet is to be counted as full or empty, the standard will be a loaded pallet of a particular item and the following computation will be made:
 - a. Pallet containing less than 50 percent of an item will be considered as empty.
 - b. Pallet having more than 50 percent of an item will be counted as full.

3. Difference between "Actual Vacant Space" and "Potential Vacant Space":
 - a. *Actual vacant space*—Floor area of net storage space which is not occupied by materials or storage bins. (Do not include potential vacant space as vacant space.)
 - b. *Potential vacant "A" space*—That portion of occupied net usable space which is temporarily not used for storage because of space voids in front of stacks of material (honeycombing) or space voids at the height of stacks which can be made available by rewarehousing or utilization of maximum heights in stacking.

4. In computing potential vacant space on the floor, the following figures will be used:
 - a. Distance less than 6 inches will be disregarded. For example: 5" = 0'; 1'4" = 1'.
 - b. Distances in excess of 6 inches will be figured as 12 or 1', i.e., 9" = 1'; 1'7" = 2'.

GUIDE FOR COMPUTING POTENTIAL "B" STORAGE SPACE

During storage space surveys, personnel performing this function must compute potential type "B" (cubic space) voids when maximum stacking heights are not achieved, and in those instances where such space can be recouped by rewarehousing. This information is annotated on survey worksheets and totaled. Later it will be added to the total cube determined for type "A" space to achieve recoupable cubic feet through rewarehousing. Here is a simple way to figure type "B" cubic space:



5/5

*GUIDE FOR COMPUTING POTENTIAL "B" STORAGE SPACE--(CON-
TINUED)*

NOTE

Each stack of vacant type "B" space in this example is equal to 64 cubic feet. By figuring the capacity of one void space (or pallet load), you can arrive at a total figure by counting vacant spaces then multiplying vacant pallet loads by 64 cubic feet. *This method should also be used for depth of stacks.*

Example:

64 cubic feet = 1 stack

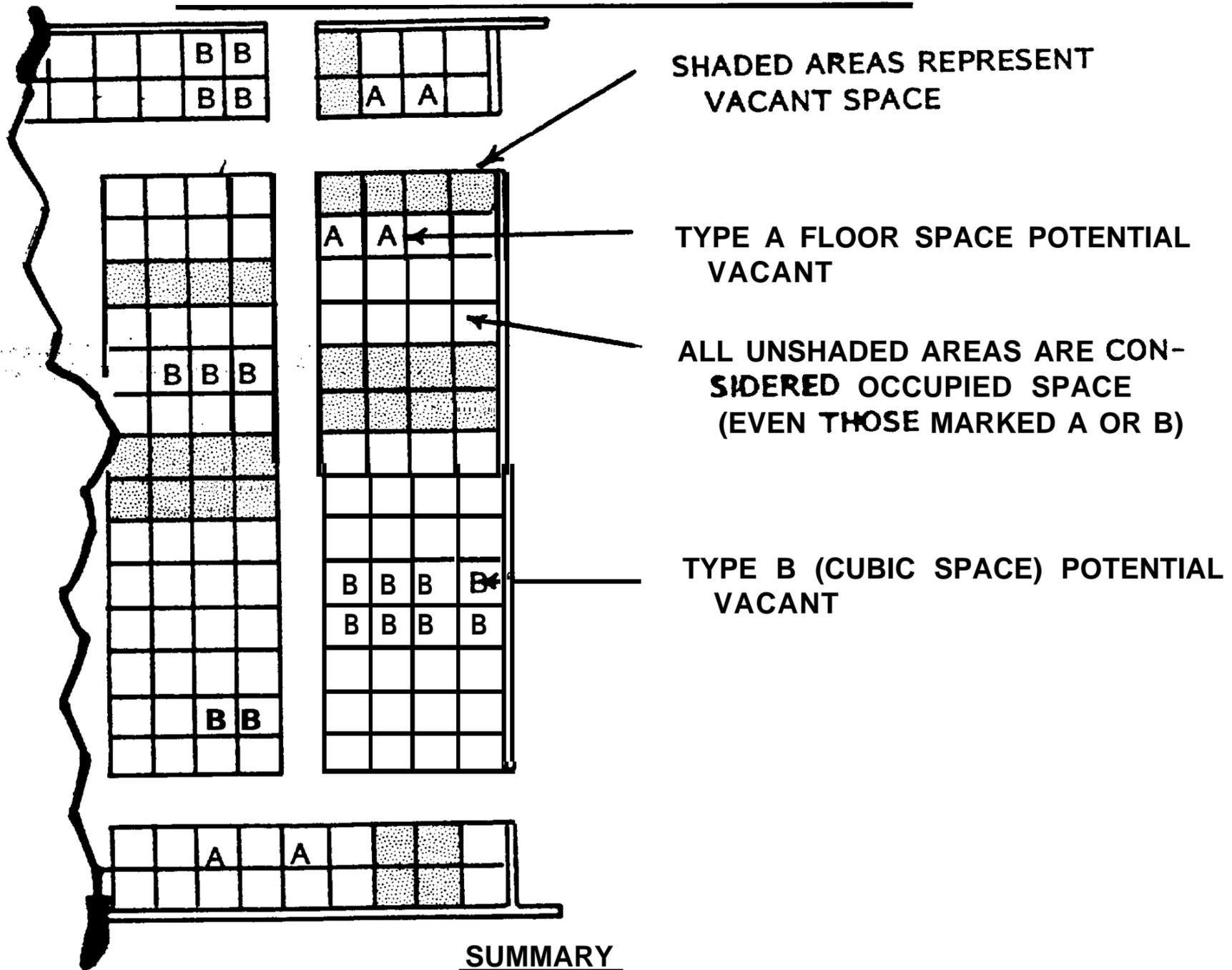
No. of void spaces

(pallet loads) = 10

10X64 = 640 cubic feet (type B)

You simply annotate 640 cubic feet on worksheet for above item.

SAMPLE STORAGE SPACE SURVEY WORKSHEET



VACANT SQUARE FEET = THE SUM OF ALL SHADED GRIDS
 OCCUPIED SQUARE FEET = NET SQUARE FEET—VACANT SQUARE FEET

POTENTIAL VACANT SPACE

TYPE A: THE SUM OF ALL GRIDS ANNOTATED "A"

NPE B: THE TOTAL CUBIC FEET, APPLIED TO WORKSHEET BY SURVEY PERSONNEL

CONVERT POTENTIAL VACANT SPACE TO CUBIC FEET (OFFICE PERSONNEL)

NPE A: MULTIPLY ALL GRIDS "A" x AVERAGE STACK HEIGHT TO CONVERT TO CUBIC FEET

TYPE B: TOTAL CUBIC SPACE DATA FROM WORKSHEET

	TYPE A (CU FT)	
+	TYPE B (CU FT)	
=	TOTAL	CUBIC FEET RECOUPABLE THROUGH REWAREHOUSING

Space is reported as:

VACANT -----	Only if actually vacant. (Do <i>not</i> include potential vacant space as vacant.)
OCCUPIED -----	Only if occupied by material. (This includes floor space (type A) caused by short or broken spaces in front of stacks.)
POTENTIAL -----	Only if occupied and recoupable by rewarehousing with existing resources (storage aids and MHE). This applies to Type A and B potential space.
NOW -----	Let's see how the above information is actually recorded, then computed on survey worksheets for reporting purposes.

*How To Record, Then Compute Vacant, Occupied and Potential Vacant Space
During Storage Space Surveys*

How is it done?

1. Have necessary **worksheets ready for survey personnel.**
2. **instruct survey personnel to record appropriate data.**

NOTE

Computations (except for potential space type "B") should be accomplished later by office personnel.

3. Information to be recorded will be applied to worksheets as follows:
 - a. Record actual vacant space by shading in those areas of the storage layout that are vacant. You do *not* include short spaces in front of stacks or honeycombing as vacant space.
 - b. Record type "A" vacant space by annotating the letter "A" in those grids where short spaces exist in front of stacks or where honeycombing is evident.
 - c. Record type "B" vacant space by annotating the letter "B" in those grids where stacking heights could be improved by **rewarehousing**. (When "B" is recorded during a survey, **cubic** feet to be gained must also be recorded somewhere on the worksheet.)

2403. DOD Storage Space Reporting Requirement

DODI 4145.5 requires DOD Components to submit a DD Form 805, Storage Space Management Report. The guidance and illustrated methods shown in this section **should** provide operating personnel

with an understanding of how storage space is measured and computed. Application of this information will aid in overall storage space management and control and also will assist in preparation of feeder data for separate reports required by the DOD Components and for the DD Form 805 report.