CHAPTER VIII

ON-THE-JOB TRAINING FOR STORAGE PERSONNEL

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Section 1. TRAINING PLAN

8–101. Introduction

In an ideal situation every person in any organization is thoroughly trained in his or her duties. In addition they have been made aware of the value of their individual job to the entire operation and just exactly how and where their position fits into the complete organization. Attainment of this goal in today's complicated and complex storage and materials handling operations is very difficult, yet it is one which must be constantly striven for if we are to have efficient, economical, and quickly expandable and flexible storage and materials handling. If left to one's own devices, each person learns something each day and develops a little more in the abilities required to do the job; however, this learning by "chance" or development by trial and error is costly both in time and mistakes made. Systematic training organizes the learning and developing processes and takes the mistakes out of them. It reduces learning time, accidents, and wasted material.

8–102. Purpose of Training

Training must have as its primary purpose and goal: trained and competent personnel, adequate and properly maintained equipment, intelligent job planning, alert supervision, and satisfactory organization morale.

8–103. Responsibility for Training

Every storage and materials handling activity must assume direct responsibility for initiating, directing, supervising, and conducting all training pertaining to its operation. Training is more effective when it is made a part of operations and is not considered as being disconnected from the job. Personnel responsible for operations must have a thorough knowledge of their work and have the confidence of their associates and subordinates. Training must be considered by operating supervisors as an integral part of the daily workload.

8-104. Support by Storage Managers

Since training is part of the daily workload, storage managers must strongly support and participate in the program. Such support and participation should ensure the necessary balance between operations and training, with the training program receiving proper emphasis. It is important that this training should be a continuous program and not an isolated, temporary interest.

8-105. Survey of Need for Training

The first step in installing a training program is instituting an overall survey to determine areas in which training is needed. In-service training cannot be justified unless definite need exists. Conversely, it is not justifiable to stop training until the need has been met. A typical preliminary "check sheet" developed as a means of determining possible areas in which training maybe needed and groups of personnel which might need the various types of training is shown in figure 8-1. Since it is possible that training may be needed in many or all of the indicated areas, priorities must be assigned so as to meet needs on the basis of urgency. An important point to remember is that too much training attempted at one time will interfere with operations and decrease training benefits. Thus, a well thought-out and balanced plan, increasing or decreasing in intensity and scope as the conditions require, is essential to the success of a training program.

8–106. The Three Phases of Instruction

a. Study of principles. The first phase of the program should center around the principles and fundamental facts basic to operations of which supervisors and key personnel should have an understanding.

(1) *Text.* The material in the Conference Leader's Guide, section 3, Storage and Materials Handling Training Program for Supervisors, will be used as the basic guide for the first phase of the program. The three parts, covering Detailed Training Out-

line, Storage of Materials, and Principles of Materials Handling can be adapted to the needs of the installation or activity.

(2) Classes. All key personnel, military and civilian, should be included in this phase. Experience has indicated that a minimum of 8 to 10 hours will be required to complete this portion of the training program. Ordinarily, classes should be arranged and scheduled so that no less than 10 or more than 14 persons will be in attendance.

(3) Leader. The leader of these sessions will be a qualified .re.preventative of top storage management who has authority to act upon or obtain action upon suggestions and problems which arise as a result of discussions held during the training period.

b. Study of organization and procedures. The second phase of the overall program" should concentrate on specific organization, operating procedures, and standard practices of which the supervisors and key personnel should have a complete working knowledge.

(1) Source *material.* The material to be used in this phase of the program must be adapted from the actual organization charts, duties and responsibilities sheets, written operating procedures, and standard storage and materials handling practices already developed.

(2) Coverage. In addition to organization and functions, general operational procedures and standard practices of prime importance to the activity will be covered. Examples of such procedures and standard practices are:

Receiving
Shipping
Inventory
Warehousing
Care of Supplies in Storage
Materials Handling Operations
Assembly/Disassembly Operations
Packing and Crating Operations

(3) *Kind of training.* All key personnel should receive general training in all procedures and standard practices, in addition, they must receive detailed instructions in those with which they are specifically concerned. The amount of time devoted to training in each functional item as well as op erational procedure should be determined according to the complexity of the job and the detail required for the training.

(4) *Method of training.* A modified conference method, in which group participation and discussion, within the bounds of the training objective and under the guidance and control of the session leader, should be used in presenting material in the first two phases. The leader of each session should be the top supervisor or manager of the operation concerned.

c. *Job instruction.* The third phase of the training program will concentrate on actual job instruction for nonsupervisors. Included in this phase (but not confined to) will be on-the-job instruction and step by step demonstrations through the use of working models, films, charts, diagrams, and by the training leader or an assistant actually performing the job. Jobs covered in this phase will consist of those involved in such activities as equipment operation, checking, packing, palletizing, recording stock locations, and other duties, as necessary. Training in safety practices should be an inherent factor in this type of training. Followup also must be an integral part of this program.

(1) *Responsibility of supervisors.* For purposes of expediency, an adequate number of supervisor-trainers will be delegated the responsibility of carrying on this training under the person responsible for directing and/or coordinating training activities. Ultimately, each supervisor should be prepared for and responsible for training workers in on-the-job instruction.

(2) *Benefit to new and old employees.* The training in this third phase is necessary if new employees are to be raised to the highest point of productivity in the shortest possible time. Old employees should be kept abreast of any and all changes in the job processes in which they are engaged through whatever medium of training is applicable; however, a survey, made to determine the amount of benefit old employees could obtain from the type of organized training defined in this third phase will be beneficial and should be made.

8-107. Understudies

In addition to the training given for the performance of their assigned jobs, selected personnel will be trained as understudies for all. employees in key positions.

8–108. Qualifications of Trainers

The following qualifications should be considered in selecting personnel to act as trainers:

a. Experience in storage and materials handling operations.

CHECK SHEET FOR STORAGE AND MATERIALS TRAINING PROGRAM

	Military Personnel	Storage Officer or Chief Assistant Chief	Staff	Unit Supervisors	Warehousemen	Labor Foremen	Laborers	Checkers	Forklift Operators	Packer Foreman	Packers	Clerks	Inspectors-Classifiers	Processors
LAYOUT OF STORAGE SPACE: Policies and Methods	(X)	(X)	(X)	(X)	(X)	X								
STORAGE OF MATERIALS: Policies and Methods	(X)	(X)	(X)	(X)	(X)	X			(X)				(X)	
ORGANIZATION: Duties and Responsibilities	(X)	(X)	(X)	(X)	X	(X)				(X)		X	(X)	
LABOR AND EQUIPMENT POOLS: Organization and Operation	(X)	(X)	X	(X)	X	(X)				X				
RECEIVING AND SHIPPING PROCEDARES	(X)	(X)	(X)	(X)	(X)	X		(X)	X			[X]	X	
SPACE AND OPERATING REPORTS: Compilation and Interpretation	(X)	(X)	(X)	X	X	X				X		(X)		
INVENTORY: Procedures and Methods	X	(X)	X	(X)	(X)			X				X	X	
CHECKING: Procedures and Methods	X	(X)	X	(X)	(X)			(X)	X			X	X	
CARE OF HAZARDOUS COMMODITIES	X	(X)	X	(X)	(X)	X								
BLOCKING, BRACING, DUNNAGING OF RAILROAD CARS	X	(X)	X	X	X	X	X							
PACKING AND CRATING: Methods and Specifications	X	(X)	X	(X)	(X)					(X)	(X)			(X)
FORK TRUCK OPERATIO	X	(X)	X	(X)	X	(X)			(X)					
TRACTOR OPERATION,	X	(X)	X	X	X	(X)			(X)					

X To be trained.
(X) Have been trained.

Figure 8.1

b. Aptitude for imparting instruction to others in an effective manner.

c. Probability of being able to remain on the trainer assignment until program is completed.

d. Interest in doing a training job.

e. Patience and consideration for the feelings of others.

8–109. Training Administrator (Specialist)

A specialist in training, responsible for planning and, initiating the training program, should be a member of the top storage managers staff or available from installation management as determined by the military service. Responsibilities of this position will relate primarily to:

a. Determining needs as well as points of weakness in operations and training.

b. Advising the staff as to whether training can assist in solving specific operating problems as they arise.

c. Obtaining information concerning current changes which might affect training already in progress.

8–110. Coordination With Other Installation Activities

Coordination should be maintained between the storage and materials handling training administrator and other affecting elements of the installation, for example: the installation personnel office and management offices. In this manner, the overall policies and objectives of the installation can be injected in the specific training programs of the separate activities or operations being trained. Where a training coordinator or staff is employed as a part of the overall civilian personnel placement and utilization program, the services and/or knowledge of this element should be utilized by 'the training administrator of the storage and materials handling activity to:

a. Instruct trainees in the techniques of presenting material to others.

b. Develop methods and devices for measuring and testing also instruct trainees in their usages.

c. Utilize existing training materials and adapt them to the needs of the storage and materials handling program.

d. Train supervisors in the techniques for analyzing their jobs and the jobs of their subordinate employees.

e. Assist in setting up necessary training records and schedules.

f. Assist in setting up and/or providing necessary physical facilities for training purposes.

Section 2. TRAINING PROGRAM

8-111. What Is Storage and Materials Handling Training?

a. The main reason for having the military storage installations is to receive, store, and move military supplies. The actual operations within the installation directly related to these activities may be called warehousing and materials handling. Training in this field must cover many specific jobs which require the use of a great deal of knowledge of warehousing principles, procedures, storage methods, and warehousing and materials handling management problems.

b. Training in warehousing and materials handling should be carried on by two methods:

(1) A series of planned conferences in which warehouse supervisors, military and civilian, have an opportunity to *think* through, step by step, and in a logical and organized way, the many points that go into making or breaking an efficient operation.

(2) On-the-job training in which specific operations are taught individually to men and women whose main duty is centered on one or two segments of the whole operation.

c. Too often training in warehousing and materials handling has been called "on-the-job training." This may mean anything from no training at all; training given by many different people who may or may not be in agreement on what they are teaching; or all the way to planned, organized, and practical on-the-job training. We need not choose between group or individual on-the-job training both are essential. The purpose of *this* training program is to give warehouse supervisors an understanding of the basic fundamentals and management policies of storage operations and materials handling.

8–112. What Is Included in Storage or Warehouse Operations and Materials Handling Training?

a. This regulation will be considered the textbook

for training in these fields. Instructors should ensure that all students have a working knowledge of the regulation and a detailed knowledge of the portion that affects their specific jobs.

b. The Conference Leader's Guide places emphasis on

(1) Proper methods of laying out and allocating space.

(2) Accepted ways of storing and stacking the many different items handled, so that space can be utilized to the best advantage.

(3) Efficient and speedy methods of handling materials in order to save manpower, equipment, and time; this is known as materials handling.

(4) Need for training the best qualified employees in the installation to carry on this program under the direction of the storage manager.

(5) Improvement of training already being done to make sure that each employee is receiving the fullest benefits from training being given and in turn to assure that training "pays its way" through increased employee productivity.

8–113. The Requirements for a Successful Storage and Materials Handling Training Program

Although the following points do not necessarily guarantee the success of this training program, they are fundamental and important:

a. *Management support.* The backing and interest of installation officials, the commander, staff, and all key personnel of the storage and materials handling function is essential.

b. Working relationships. Close working relationship between the storage operation and other affecting elements of the installations includes an appreciation of each other's responsibility and contribution and a willingness to pull together to put the job over.

c. *Competent leadership.* A prime requisite for competent leadership is the qualification of personnel to conduct training effectively and is the key to the success of the storage and materials handling program. Such leaders may be chosen from either of the following two sources:

(1) From any point within the installation-an individual with teaching background and experience who has or can prepare by: reading about the fundamental principles and practices of storage and materials handling, learning storage policies, observing operations and storage procedures, studying first hand and "living with" the actual work going on in the various storage operations, and knowing personally the supervisors of these operations.

(2) From the storage activity—an individual with warehousing background and experience should have the benefit of any supervisory courses given at the installation and should work closely with the person responsible for training to prepare himself in teaching and conference leadership techniques.

d. *Adequate conference rooms.* No compromise should be made in securing a comfortable, well-lighted and aired, quiet, and easily accessible space for conferences.

e. *Continuous training.* The turnover of warehouse personnel, changes in procedure, improvements in methods, and changes in commodities all point to the absolute necessity of a continuous training program.

8-114. How To Use the Conference Leader's Guide

a. To aid in the presentation of a training program in warehousing and materials handling, sectionalized guide material has been prepared. As many sections as logical, or as many as time permits may be covered in one session. There is no intent that this outline be followed word for word; however, its intent and scope should be followed very closely, particularly as to the order of presentation of topics and key points within the topics.

(1) This presentation has been built along organized lines, in logical sequence, that can be used effectively to give those concerned a thorough knowledge of the "ABCs" of warehousing and materials handling in the shortest possible time. The conference leader by prior knowledge of local problems and groups of trainees must fit this guide to installation requirements.

(2) The established outline should be followed—but not read. There is nothing more deadly to a group than continuous reading, The guide has been designed so that it can be followed with an occasional glance. The discussion should be kept running smoothly. In this outline are included: key ideas and questions, suggestions for group discussion, suggestions for illustration, and group answers to key questions.

b. Key points or questions are preceded by a hyphen and are included in quotation marks. Important words therein are capitalized. These key points

or questions are the basis for conference discussion-they need not be quoted as written, but should be expressed in a manner which puts the points across, For example:

—"keep your STOCK LOCATOR SYSTEM as SIMPLE as POSSIBLE."

—"what do we MEAN by ORDERLY STACKING?"

c. Suggestions for group discussion are indicated by instructions with such introductory words as: DISCUSS 'or ASK; these introductory words are in capital letters.

DISCUSS with the group BULK STORAGE as it occurs in their warehouses.

d. Suggestions for illustrations are always inclosed in parentheses. In cases where blackboard illustration is suggested, the material to be put on the board is inclosed in a rectangle.

(WRITE following points on blackboards, charts, or other visual aids)

CONSERVE SPACE
ASSURE SPEED OF MOVEMENT
ASSURE STABILITY
HAVE ORDER IN FORMING STACKS

e. Group answers to key questions are shown in the guide in capital letters and are inclosed in brackets and should be used as a check list. Answers should not be given by the leader unless they have been overlooked by the group. If the answers are given by the leader, they should be brought out in some indirect manner, such as: "Do you think — is important?" *The leader should never give the impression that he/she knows all the answers. Answers* should be drawn out from the group.

—"HOW can we ASSURE RAPID AVAILABILITY?"

AISLES WIDE ENOUGH
LOCATION OF FAST MOVING ITEMS
TYPE OF STACKING, AND MECHANICAL EQUIPMENT

f. The outline and discussion comments have been developed in a manner to give the attending groups the "ABCS" of storage and materials handling. Many questions and points of discussion will arise regarding methods and practices for handling specific problems and conditions peculiar to the installation or to a specific commodity. The conference leader therefore, should be thoroughly familiar with the contents of this regulation, as well as with the various storage and handling conditions within the installation in order that they may be measured against the criteria defined in the regulation. The regulation should be used both in and out of the classroom as a basic text and reference book by those attending as well as the instructor.

Section 3. CONFERENCE LEADER

Part I. INTRODUCTION

8–115. Foreword for the Conference Leader

a. *Things you should do BEFORE you meet the group:*

(1) Plan your work carefully.

(2) Have an enthusiastic beginning to the conference,

(3) Collect enough examples from your own depot experience.

(4) Plan to arrive at the conference room 15 minutes before the scheduled starting time.

(5) Check the conference room equipment: Is the room in order? Are there enough chairs, sufficient tables and writing space, chalk, eraser, notebooks for the group, pencils, ash trays (where smoking is permitted)?

(6) Arrange the room so that each person can see everyone in the group, the blackboard, charts, or other visual aids.

(7) Have sufficient copies of handouts (Figs. 8-3, 8-4 and 8-5 can be reproduced and usd as handouts.)

(8) Begin on time—end on time!

b. Purpose of session.	EXPLAIN PURPOSE AND PROCEDURE OF SESSIONS —"TO give the LESS EXPERIENCED people an OPPORTUNITY to THINK THROUGH the BASIC PROBLEMS of WAREHOUSING and MATERIALS HANDLING." —***"To give*** you MORE EXPERIENCED people an OPPORTUNITY to REFRESH YOUR KNOWLEDGE of the BASIC PROBLEMS and DISCUSS SPECIFIC PROBLEMS." —"To EXCHANGE IDEAS so that: we are AWARE of EACH OTHER'S PROBLEMS; we can AID in the SOLUTION of THESE PROBLEMS; we can INCREASE the EFFICIENCY and PRODUCTION. "
c." ***Why members of group*** were se***l e c t e d .***	—"YOU ARE RESPONSIBLE FOR ACTUAL OPERATIONS. " —"YOU KNOW the PROBLEMS." —"YOU CAN INCREASE the EFFICIENCY and REDUCE the COST of OPERATIONS. " —"YOU MUST TEACH OTHERS to DO THEIR JOBS—YOU MUST KNOW the WHOLE PICTURE."
d. Discussion procedure.	—"This is a special kind of school. " —"All of us should ENTER into the DISCUSSION—ONE AT A TIME." —"Address your ideas and questions to the GROUP—NOT TO ME." —"You will benefit by taking notes—they make things STICK." —"Keep your notes and the mimeographed material that will be given you—in this way you can compile a reference book which you can USE ON THE JOB."
e. Content of program.	(WRITE the TOPICS on the blackboard and GIVE a BRIEF DESCRIPTION of what each section of the program will consist of.) WAREHOUSE LAYOUT STORAGE OF MATERIALS Storage Principles Storage Standard Practices PRINCIPLES OF MATERIALS HANDLING

8-116. Key Ideas and Questions

a. Warehouse layout and allocation of space. This will include a discussion of the problems and knowledge needed in planning a storage area for the receipt, storage and shipment of materials; efficient methods of meeting these problems, as well as systems of space and location control. Planographs, or other visual aids should be utilized.

b. Storage principles. This will include a discussion on the basic principles of stacking and storing and the accepted practical methods for doing this job. The members of the group will be asked to present some of their specific problems.

c. *Storage standard practices.* This will include a discussion of standard practices of storing materials developed within the Department of Defense. The adaptation and application of these practices will be covered as well as the development of standard methods.

d. Principles of materials handling. This will include a discussion of the advantages to be gained by the proper use of materials handling equipment; existing physical conditions which determine and limit the type of operation; and basic principles of materials handling, stressing the importance of a *balanced operation.*

Part II. DETAILED TRAINING OUTLINE

8-117. Layout and Allocation of Space

a. Definition of warehousing.

DEFINE "WAREHOUSING

–"Before discussing the problems in warehousing we should all UNDERSTAND what we mean by 'warehousing' and just what we are trying to prove."

(WRITE the DEFINITION across the top of the blackboard.)

> Warehousing-the SCIENTIFIC and ECONOMICAL
> RECEIPT
> STORAGE
> ISSUE
> of materials for their BEST SAFEKEEPING and RAPID AVAILABILITY

— "UNLESS this job of warehousing is done in a SCIENTIFIC manner it is NOT ECONOMICAL."

—"To be ECONOMICAL-WHAT THINGS or in WHAT WAYS can we save in our warehouse operationa?

SPACE ---------- in terms of cubic feet
LABOR ---------- in terms of MAN-HOURS
EQUIPMENT --------- in terms of EQUIPMENT HOURS and EQUIPMENT TYPES
DAMAGES
ACCIDENTS
ELIMINATION OF WASTE ---------- in every form"

—"The definition mentions BEST SAFEKEEPING-by that is meant: we must PROTECT THE MATERIALS.

PROTECT AGAINST WHAT?"

> THEFT
> FIRE
> DETERIORATION-damage by:
> weather
> careless handling
> poor stacking conditions

—"The final statement in the definition of warehousing RAPID AVAILABILITY—is ALWAYS IMPORTANT."

—'To do an efficient job of warehousing we must lay out our warehouses so that the MATERIALS are EASILY ACCESSIBLE."

—"In these discussions-and more important, in doing your jobs in the warehouses—we must NEVER OVERLOOK or FORGET these POINTS.

—"We must constantly check to make sure that we are effecting SAVINGS in SPACE, LABOR, and EQUIPMENT, REDUCING DAMAGES and ACCIDENTS; PROTECTING the materials AGAINST THEFT, FIRE, and DETERIORATION; and storing our MATERIAL SO WE CAN GET TO IT IN A HURRY."

—"How we are going to do all this, and WHAT WE HAVE TO KNOW to accomplish it, are the things we want to discuss."

—"And we want to discuss them in a logical order—FIRST THINGS FIRST."

b. Discussion guide for definition of warehousing.

(1) *General.* The main purpose in developing the definition of warehousing is to start the group thinking about the objectives of their jobs, to make them critical of whether or not they are accomplishing their work along the lines set forth in the definition. Each of the main points in the definition should be carefully developed.

(2) *Ways in which we can save in a warehouse.*

(a) *Space.* Space is the basic resource in the warehousing operation. The entire storage operation hinges upon the efficient utilization of space. Space is emphasized in terms of CUBIC FEET. Too often operators think in terms of "square feet." Except where floor load capacities limit full use of cubage, material must be stacked as high as features of pack, facilities, and handling equipment permit in order to take full advantage of cubage and thereby save in square feet.

(b) *Labor.* Labor must "be conserved in every job. The amount and use of labor should be thought of in terms of MAN-HOURS rather than just in terms of number of men. We must get the most efficient use out of each hour paid to labor, in so doing, we can increase production and reduce cost.

(c) *Equipment.* The proper use of mechanical equipment helps to conserve labor., Every effort must be made to conserve the amount of equipment used and, as in the case of labor, its. efficient use should be considered in terms of equipment hours. Care must also be given to its mechanical maintenance.

(d) *Accidents and damages.* By reducing accidents and damages in the warehouses, it is evident that cost is reduced, materials saved, and man-hours reduced.

8-118. Facility Characteristics

a. Detailed planning.	STRESS NEED FOR PLANNING —"Before we can actually STORE materials we must PLAN." —"In order to PLAN there are certain FACTS we must know."
b. Facts about the warehouse.	DEVELOP FACTS ABOUT THE WAREHOUSE —'What must we know ABOUT the WAREHOUSES?" (Try to get the following points from the group and list them on the blackboard as they are given:) TYPE OF BUILDING SIZE. HOW MANY? SHIPPING AND RECEIVING PLATFORMS DOORWAYS AND ENTRANCES PILLARS, POSTS OR COLUMNS WINDOWS FLOOR LOADS ELEVATORS-ii multistory buildings

(1) Two prime factors influence the storage manager layout of available space; the characteristics of the storage area-THE CAPACITY FACTOR; and the characteristics of the supplies to be stored-THE COMMODITY FACTOR which will be discussed later.

(2) These factors cannot be separated; the one influences the other all through the storage operation. It must be realized that before we can actually store materials, there must be planning—WHERE and HOW we are going to store it. Unfortunately, many of our buildings were not designed primarily for the type of warehousing we must do. We must, therefore, in some cases, make the best of physical difficulties.

(3) In the planning of warehouse operations, we are mainly interested in the actual physical layout and size of the platforms, doors, columns, and windows. In multistory buildings particularly, we are concerned with floor load capacities and elevators. Without a thorough knowledge of all of these factors, we cannot efficiently start to do the job.

c. Type of building.	DISCUSS each in detail and in the order followed below —"There are two main types-SINGLE-STORY and MULTISTORY." —"The SINGLE-STORY BUILDING has MANY ADVANTAGES: NO ELEVATORS FEWER POSTS AND COLUMNS DIRECT CONTACT WITH SHIPPING AND RECEIVING DOCKS GREATER FLOOR LOAD LIMITS BETTER TRANSPORTATION FACILITIES' —"The MULTISTORY BUILDING has TWO ADVANTAGES: COVERS LESS GROUND AREA CAN BE LOCATED IN METROPOLITAN AREA."

(1) In a majority of our storage installations, particularly in the newer ones, we find single-story buildings constructed along similar lines.

(2) Storage installations vary in size from one or two to any number of these single-story buildings. Each building is usually divided into several sections. There is no typical multistory warehouse.

d. Size of building.	—"What primary facts must we know in order to determine our storage space in each warehouse?" LENGTH WIDTH HEIGHT —"Remember, in all buildings we must think in TERMS OF CUBAGE."

(1) To know how much storage space is available, we must know the size of our warehouse, the size of each section; and in the multistory buildings, the size of each floor.

(2) We must consider size in terms of length, width, and height—in other words-in terms of CUBIC FEET. We can use our square feet to fullest capacity and at the same time waste a great part of our full storage capacity by not stacking high enough. WE MUST CONSERVE OUR VALUABLE STORAGE SPACE.

e. Shipping and receiving ***platforms.***	—"There are THREE THINGS we must consider about our PLATFORMS or DOCKS: LOCATION SIZE HEIGHT (in relation to cars and trucks)." —"To intelligently plan location of materials we should also have some general appreciation of what percentage of our material is SHIPPED BY RAIL and what percentage BY MOTOR TRUCK." —"ASK the group if they know percentages as applied to their own warehouse or section. If they are guessing, ask them to check on the information.

(1) The normal, general-purpose, single-story warehouses have one long platform stretching the entire length of the warehouse, used for shipping and receiving by rail. On the opposite side, materials are received or shipped by motor truck on small docks at each section, or on one or more large docks spaced at intervals along the warehouse. The width of these platforms is a very important factor because it determines the type of materials handling operation that can be applied. For example: if the platform is too narrow, the use of the tractor-trailer train system is difficult or the platform may become dangerously congested during receiving and shipping operations in the same vicinity. The entire width of platforms should be covered to protect the material from the weather.

(2) In multistory buildings the platforms are located in as many different locations as there are

buildings. In some of the buildings, however, it is possible to use separate platforms for receiving and shipping in respect to both rail and truck facilities. Such a condition helps to ease the bottlenecks caused by elevators and permits a more continuous flow of material in the materials handling operation. Care should be taken to keep the platforms, which occupy a large portion of the ground floor, clear of stored material.

(3) The height of the platforms, whether in single or in multistory buildings, is an important factor. .. Platforms either. too high or too low will cause serious handicaps in our materials handling operations as well as create a serious accident hazard. A difference of 6 inches between the height of the platform and the floors of cars or trucks is maximum if an efficient operation is to be accomplished. Conditions where excessive difference in height exists should be corrected by either lowering or raising the track bed, the road surface, or through the use of a compensating bridge plate. The cost of such a change should pay for itself in speedier and more economical operations.

f. Doorways and entrances.	—"It is evident that we must know the LOCATION, NUMBER, and SIZE of our DOORWAYS or ENTRANCES. " —"Care must be taken that we make efficient use of these openings."

(1) There should be a sufficient number of doorways leading to platforms and between sections of a warehouse to handle the movement of materials. This is particularly true of single-story buildings.

(2) In most of our typical single-story warehouses, there are at least two, and sometimes more, doorways per section leading to the rail platforms; and two doors giving access to sections. THESE DOORS SHOULD BE OF SUFFICIENT SIZE TO ENABLE MECHANICAL EQUIPMENT TO PASS EACH OTHER. TOO MANY DOORWAYS CAN BE A HINDRANCE BECAUSE THEY REDUCE THE WALL SPACE WHICH IS SO VALUABLE FOR STORAGE AREAS.

g. Pillars, posts, and columns.	—"The location, number, and size of the pillara, posts, and columns in a warehouse are IMPORTANT FACTORS CONTROLLING OUR LAY-OUT." —"They consume valuable storage space. " —"They are usually more of a problem in multistory buildings. " ASK the group to figure approximate y how much square footage and cubage are taken up by the columns on their warehouse floors; also how much wasted storage space around the columns.

(1) The general plan of our floor layout is controlled, to a great extent, by pillars, posts, and columns which are necessary as floor and roof sup ports, and cannot be removed, yet which do reduce the amount of storage space and must be considered carefully in our planning.

(2) Pillars, posts, and columns, are a problem in our single-story buildings, but not so critical as in some multistory warehouses, where each column may use up as much as four square feet and many more cubic feet of storage space. In addition to this loss of space, we will lose even more in stacking pallets around columns, unless extreme care is given to the method of storing.

(3) where possible, columns or posts should be used as aisle guides and also to define the size and location of bays. Certain pieces of fire equipment can be placed on these columns, but care should be taken to place this equipment so that it uses the least amount of storage space. It should be hung on the post adjacent to an aisle, BUT NOT EXTENDING INTO THE AISLE BECAUSE IT CUTS DOWN THE AISLE WIDTH AND MAY BE DAMAGED BY PASSING MECHANICAL EQUIPMENT.

(4) Under no conditions should fire equipment be placed on the back of the post from the aisle line for, in so doing, storage space is greatly reduced and valuable seconds can be lost looking for equip ment in case of need.

h. Windows.	—***"Can*** you name any ADVANTAGES or DISADVANTAGES in having WINDOWS in a warehouse?"

Advantages	*Disadvantages*
LIGHT	LOSS OF WALL SPACE
AIR	DAMAGE TO MATERIALS (by elements)
ENTRANCE FOR FIREMAN	WASTE OF FLOOR SPACE

Windows are more numerous in multistory than in single-story buildings. Although. the light and air admitted by windows do improve working conditions, from a purely operations standpoint they are" a handicap.

i. Floor load limits.	—'We should all have the SAME IDEA of HOW to FIGURE the AMOUNT of MATERIALS we can STORE on" a FLOOR and STAY WITHIN FLOOR LOAD LIMITS. " ASK one of the group to explain how he determines this on his own floor. Continue to ask various members until an agreed method is reached. —'We should note the following CAUTIONS: WEIGHT should be FIGURED from EACH SQUARE FOOT COVERED. In the use of pallets, weight is determined by square feet covered by the pallet. Include the weight of the pallets. Do not depend too much on safety factor."

Note. Since floor load limits occur mainly in multistory buildings, the subject should be covered briefly when members of the group are concerned with only-single-story buildings. Point out some of the problems that are caused and some typical floor load limits. In discussion groups where multistory buildings are of concern the subject should be covered in detail.

(1) Floor load limits can cause a great waste in cubic feet of storage space; however, if these limits are not considered, a tremendous safety hazard is caused. Naturally, these floor load limits are more prevalent in the multistory buildings. Limits in this type of building usually range from 100 pounds per square foot to 350 pounds per square foot. The problem in single-story buildings is small because in the majority of them the limit is so high that it poses little restriction. In multistory buildings it is important that a standard method of determining permissible floor loads be decided upon in line with conditions existing in each building. Such a method should be clearly defined, agreed upon, and enforced by those responsible for storage operations.

(2) Normally, safe warehouse floor load limits are determined by reference to the building plans on which the floor capacities in pounds per square foot are customarily designated. Generally, plans for unconverted private buildings may be secured from the former owner or tenant. A competent engineer should be brought in to establish floor load capacity in all cases where building plans are not available, where the plans do not indicate safe floor loads, or where the accuracy of the stated floor load is doubtful.

j. Elevators.	(*Note.* As in the case of floor loads, the subject of elevatora should be touched only briefly in single-stow operations, but in detail in multistory buildings.) —"ELEVATORS in multistory buildings are often the cause of SERIOUS BOTTLENECKS. " —'What must we consider about elevatora?" LOCATION SIZE CAPACITY SPEED -"They are a SERIOUS SAFETY HAZARD."

(1) Freight elevators are the "arteries" of the multistory warehouse. The number and location of these elevators are important factors in determining the general plan of floor layout. Care must be taken to keep sufficient space clear in front of the elevators on each floor. The size and load capacity of these elevators determines the type of materials handling operation which can be performed. Care must be taken not to overload the elevator; THIS ISA SAFETY MUST. This means, of course, that we must figure not only the weight of the materials, but also the weight of the mechanical equipment, such as trailers or fork trucks, if such equipment is used. PROPER MAINTENANCE OF THE ELEVATORS AND TRAINING OF THE OPERATORS 1S ALSO A SAFETY "MUST."

(2) Because these elevators are often small in size and slow in movement, they create a bottleneck in the operation which is difficult to eliminate. In most cases we cannot enlarge or speed up the elevators; therefore, careful planning and thought can profitably be given to "timing" of the operation to the existing conditions.

8-119. Commodity Characteristics

a. Facts *about commodities.*	DEVELOP FACTS ABOUT COMMODITIES —"After we have viewed the warehouse from all physical angles, we must then consider the COMMODITIES WE WILL STORE ." —"We cannot separate these two factors in our planning and thinking-TOGETHER THEY INFLUENCE OUR METHOD OF LAYOUT AND ALLOCATION OF SPACE." —"In this portion we are interested in WHERE we will store the materials—NOT HOW. " —'WHAT DO WE HAVE TO KNOW ABOUT THE COMMODITIES?" (Try to get the following points from the group and list them on the blackboard as they are given.) NATURE (KIND OR TYPE) AMOUNT SIZE WEIGHT SHAPE TURNOVER (ACTIVITY) PERISHABILITY ODOR

b. Amounts of each commodity.	—"The AMOUNT of each commodity handled VARIES in EACH STORAGE INSTALLATION and from time to time WITHIN AN INSTALLATION." —"TO keep our planning up to date WE MUST KNOW CONTINUOUSLY what we will be expected to STORE." —"As STORAGE MANAGERS AND WAREHOUSE SUPERVISORS, What INFORMATION is AVAILABLE TO US? What information DO YOU GET? What information WOULD YOU LIKE TO HAVE to help you plan efficiently?" STOCK LEVELS DUES-IN NOTICES AVERAGE ACTIVITY OF MOVEMENT ADVANCE NOTICE OF SHIPMENT

(1) The supplies handled by the average military storage installation consist of thousands of items of different weight, size, shape, perishability, and crushability. These supplies are packaged various ways within different types of containers, such as: boxes, crates, cartons, bags, bales, or drums. The items vary from a small package of bearings to a complete field hospital and are shipped to the storage installation from thousands of manufacturers and producers.

(2) The fact that commodities or items vary to such a degree complicates the problem not only of handling in transportation, but also of storing in our warehouses or other storage areas. We must study our problem as it relates to the different commodities and do everything within our power to handle the materials efficiently.

(3) Before we can allocate space and layout warehouses or storage areas, we must know something about the type of material and how much will be stored. To aid in this, the controlling agency responsible for a particular storage installation furnishes such data as stock levels, tonnage, and item forecasts, information on manpower strength within a given area of distribution. All of these aids are a valuable asset in planning storage.

(4) By whatever means secured, a knowledge of the stock level or quantities to be stored will enable storage personnel to get an overall picture of supply and helps in laying out space in order to eliminate storage bottlenecks and unnecessary rewarehousing. On the other hand, experience gained through issue and receipt will be of invaluable help to storage personnel in determining the best layout for their commodities. Remember that a stock level is only a guide and should not be used as the absolute figure for determining space for an item. You must keep your storage layout simple and above all flexible.

(5) Usually, the first notification of incoming stock is a distribution directive, schedule of delivery, letter of award, or specific directive from the supply agency. From this information, the "dues in" can be compiled. Storage personnel should study these "dues in" and have their area planned for storage of material when supplies are received; this will help to eliminate unnecessary rewarehousing.

c. Popularity, size, weight, shape, perishability.	—"After we know HOW MUCH we have to STORE, and HAVE DECIDED in general WHERE it will be STORED, we must CONSIDER the ITEMS as to their POPULARITY, SIZE, WEIGHT, and SHAPE. —'WHERE do you STORE your LARGE, BULKY material?" —"Can you move your FAST MOVING goods EASILY and QUICKLY?" —"Are you having TROUBLE with DAMAGES to your PERISHABLE materials? If so, it is because of WHERE THEY ARE STORED?"

(1) After we have determined the amount of material we have to store, allocated the proper amount of space, and formulated a GENERAL PLAN; we THEN MUST determine the actual location of the material. Such location is controlled partly by certain characteristics of the items. Large

and bulky items should be placed as near the shipping and receiving points as possible to reduce the amount of handling.

(2) In locating materials that have a rapid turnover, every effort should be made to place the materials as near the shipping points as possible and, in multistory buildings as near the elevators as possible and on the floors near the shipping and receiving docks. Slow-moving commodities, of course, can be placed in less accessible locations.

(3) Perishable item: should not be stacked near windows or doors because of possible damage from sunlight, rain or snow. "Care should also be taken to store perishable items, bagged materials in particular, where they cannot be damaged by floor dampness caused by sweating. Generally, bagged items should be kept in storage areas having the least amount of temperature change. Commodities which need periodic turning, such as certain items of compounded or chemical nature or items such as kegs of vinegar or pickles, should be placed in an accessible location. Commodities which absorb odors should be kept away from odorous items.

8-120. Aisles

a. Layout.	EXPLAIN HOW TO PLAN LAYOUT -"Once we know ALL the facts ABOUT the BUILDINGS and the COMMODITIES, we can then LAY OUT the FLOOR PLAN." —"First, we must decide on AISLES regarding TYPE NUMBER SIZE (Length and width) LOCATION DIRECTION" —'We all realize that AISLES ARE NECESSARY TO: PROVIDE ACCESS to DOORS on LOADING PLATFORMS, PROVIDE ACCESS to ELEVATORS in multistory building, PROVIDE SUFFICIENT SPACE for operating EQUIPMENT, " PROVIDE ACCESS to different kinds of SUPPLIES PROVIDE SHORTER HAULING DISTANCE." —"AISLES should be kept to a minimum in number and size because they WASTE STORAGE SPACE." ***Note.*** Illustrate the above point by an example and then ask members of the group if they know exactly what percentage of their available storage space is used for aisles. If they do not know, work out one problem with the group.

(1) The number, type, size, and location of aisles are directly dependent upon the CAPACITY FACTOR and the COMMODITY FACTOR. A warehouseman should not be content to lay out aisles according to a pattern determined either by "someone else" or by precedent. He/she should know WHY the aisle plan is used and BE SURE THAT IT FITS INTO THE PARTICULAR OPERATION after study from all angles. He/She should constantly TRY TO REDUCE the amount of space used by aisles WITHOUT HAMPERING THE OPERATION.

(2) To illustrate the percentage of storage space that can be used by aisles, the following example can be used: Consider a warehouse section 120' x 180' or a total of 21,600 square feet. Two 10' main aisles, the length of section, equal 2,400 square feet which uses about 11 percent of gross storage space and leaves 89 percent for storage. This PLUS two 10' cross aisles running the width of section equals 3,600 square feet. TOTAL aisle space for the aisles equals 6,000 square feet which uses about 27 percent of gross storage space and leaves about 73 percent for storage (actually, 100 square feet should be subtracted for each point of crossing of aisles; however, for ease of illustration, this has not been considered). If we reduce the width of each of the four aisles ONE FOOT and make them 9 feet instead of 10 feet, we will have 600 square feet. This saving would make space for about 200 additional pallet loads where pallets are stacked three high. This reduction of ONE FOOT would raise the available storage space to 76 percent.

(3) How much area should be used for storage. Naturally the thought in relation to this question is "every available square foot. " That is certainly very true, but just how much should be the minimum available area for storage? This will certainly vary from installation to installation depending upon many factors such as building characteristics, and type of commodity to be stored or mission. As a good rule of thumb we may say that a minimum of 65 percent of the available gross space should be available for storage, of supplies. This leaves approximately 35 percent of the gross space (inside measurement) that can be used for offices, restrooms, posts, aisles, and other necessary space. To make the group think about the problem of aisle layout from a practical "know-the-reasons" viewpoint rather than from a "how-we-do-it-here" viewpoint, a chart or plan of a different type of building should be used in the discussion. For example: use a physical floor plan which is different from the one used at your installation. As each type of aisle is discussed, it should be on a chart as suggested by the group. A blackboard, about 3 feet by 4 feet, can be used with sample warehouse plans painted on the board. Aisles and commodity locations can then be chalked on it as suggested by the group.

(4) Before laying out aisles, the storage person must ask:

(a) Where and how far away are platforms and door openings?

(b) Approximately how much space will be needed for each item and the sizes of the lots the warehouse is at present expected to store?

(c) Is it likely that there will be changes in the quantities and types of material in the near future and can such changes be anticipated, so as to avoid extensive rearrangement of aisles?

(d) Where are fire walls and fire line valves?

(e) How many posts or columns support the roof and floors. Where are they, how big are they, and how far apart?

(f) Will materials be block-stocked or binned? Where binned, aisle space must be reserved in front of each bin.

(g) Which supplies will be stored mechanically and which by hand? Fork lift trucks cannot work in tight spots behind columns, nor pass packages around a corner.

(h) What is the size of the forklift trucks to be used? If 6,000 pounds, a larger aisle should be provided; if 2,000 pounds, smaller aisles naturally result.

b. Types of aisles.	—"There are three TYPES of AISLES COMMONLY used in our warehouses: MAIN AISLES, CROSS TRAFFIC AISLES AND FIRE AISLES." —DISCUSS in DETAIL each of these types, as to number, size, location and direction.
c. Main or transportation aisles.	—"MAIN AISLES are sometimes referred to as TRAFFIC or TRANSPORTATION AISLES." · "As in the case of elevatora in multistory buildings, MAIN AISLES are the LIFELINES or ARTERIES of a warehouse." —"The location, number, length, and width of these aisles depend upon certain conditions. " —'WHAT ARE THE DETERMINING FACTORS?" GET the following points from the group and then have them designate where they would place Main Aisles on the sample layout under varying conditions: TYPE OF STORAGE (Storage mechanically or by hand) SIZE OF EQUIPMENT LOCATION OF DOORS SIZE OF LOTS —Have the group explain WHERE and WHY Main Aisles are located in their own respective areas of operation.

(1) These serve as the lifeline or arteries of a warehouse. There should be no "breaks" or "bottlenecks" and they should be kept clear at all times. THEY SHOULD BE LOCATED so that they give direct access to shipping and receiving platforms, doorways between sections, and, in multistory buildings, give access to elevators and conveyors. Although 10 feet is the normally accepted width in warehouses utilizing 4,000-pound forklift trucks, the WIDTH may vary. Size is determined by the type of mechanical equipment used. Aisles should be wide enough to, permit equipment to pass and to permit easy working of the fork truck. Experience has taught us that a forklift truck of 2,000 pound capacity requires a 7-foot aisle, and a truck of 6,000 pounds requires a n-foot by 6-inch aisle in which to work efficiently.

(2) The NUMBER of transportation aisles in a section or on a floor of a multistory building depends on the number of communicating doors and elevators that must be used to move material in and out of the area. The number is also determined somewhat by the size of the lots and the number of different commodities. In a section where ONE ITEM will fill the entire area, the section could be stacked to its capacity. It would be necessary to leave only enough space to "get at" the items and to permit access for fire prevention or fire fighting purposes.

d. Fire aisles.	—"FIRE AISLES are NECESSARY IN SOME LOCATIONS under FIRE REGULATIONS." —"What are the REGULATIONS governing our own installation?" —DISCUSS the fire aisle regulations with the group and be sure each member has a clear understanding of them. CAUTION—BE SURE YOU, AS LEADER, UNDERSTAND THEM. —"what factors usually determine the location and number of fire aisles?" FIRE DOORS SUBSTANDARD WINDOWS LOCATION OF FIRE FIGHTING EQUIPMENT MATERIAL SUBJECT TO SPONTANEOUS COMBUSTION —"What is the MAXIMUM WIDTH of FIRE AISLES?" —Have the group designate where they would place fire aisles on a sample plan.

(1) Fire fighting aisles were once widely used in warehouses. Experience has proved that they are often of little help in controlling fire and may actually constitute a fire hazard. The present thinking is that fire aisles should be eliminated except along substandard interior walls and where they lead to tire fighting equipment. Ordinarily, fire is on the surface of the material; the greater the surface, the greater the fire hazard. The exception to this is material subject to spontaneous ignition; which must be watched constantly for overheating; however, fire aisles will not prevent ignition.

(2) In every depot or storage activity a certain number of fire aisles are necessary. The policy in each should be the guide in establishing these aisles. ALTHOUGH THEY ARE NECESSARY, THEY SHOULD BE REDUCED TO A MINIMUM IN NUMBER AND WIDTH. THEY WASTE VALUABLE STORAGE SPACE. It is seldom necessary to have fire aisles wider than 24". In many cases fire aisles can be eliminated by a simple change in the location of the fire fighting apparatus. Previously it has been mentioned that extinguishers and hose fixtures should never be hung BEHIND posts or columns opposite the aisle. Fire aisles must be used adjacent to windows THAT WILL BE USED AS ENTRANCES by firemen. Fire aisles are not necessary next to exterior walls or standard walls which serve as dividers of sections or units of a warehouse.

(3) Standard fire walls separating buildings or dividing warehouses and sheds into fire areas are those constructed in such a manner that the resulting wall will have a minimum tire resistance rating of 4 hours. The types of fire wall construction which will provide fire resistance for a period of four hours under revised ratings and are established as the minimum standard are:

Clay or Shale Brick, 8 Thick
Mass Concrete, 7%" Thick
Reinforced Concrete, 6½" Thick
Structural Tile, 12?42" Thick
Concrete Block, 10 Thick

A concrete block wall, 8 inches in thickness, compounded of expanded slag pumice in which 62 percent of the wall unit is solids will also meet the standard requirement.

(4) A 24" aisle is maintained along SUBSTANDARD fire walls. Commodities are stored up to a STANDARD fire wall (but not in such a manner as to use the wall to support the stack) EXCEPT that a 36 clearance must be maintained at the sides of the portals between the warehouse sections.

8–121. Stock Locator

a. ***Locators ystem.***	—"Keep your LOCATOR SYSTEM as SIMPLE as POSSIBLE." —"There are TWO THINGS we want to know: Where is it located? Which is the oldest? —"First, we must decide on a METHOD OF NUMBERING OR LETTERING the warehouses, sections, and bays." Explain the method employed at your depot. —"Then a method of RECORDING information is needed." Explain operation of vour locator system. —"Remember THREE THINGS about STOCK LOCATOR RECORDS: They should be as SIMPLE as POSSIBLE They are USEFUL ONLY IF they are FOLLOWED UP and KEPT UP TO DATE They should be USED FOR PROPER STOCK ROTATION."

(1) We must be able to locate any item upon call and we must not "take a chance" or carry this information around in our heads. We must devise a system for controlling the placement and locating of material. This system must be understandable not only to the storekeeper, but to ANYONE who may be called upon to find materials for ANY REASON.

(2) The locator system should contain the information necessary to identify and locate stored supplies. Complicating the system by including "extras" such as inventory figures, stock levels, and records of shipments and receipts breaks down its primary function; the quick and accurate locating of requested supplies.

(3) A good locator system must start with a plan of the storage areas. The system for numbering warehouses, sections, bays and rows must be devised and made as simple as possible. It must be readily understandable to ALL personnel working in the storage areas. This includes warehousemen, stockpickers, checkers, laborers, and other personnel. There also must be a file maintained, either mechanically, manually, or a combination of both, on which the data necessary to identify the item are maintained and which will reflect all established locations of the item.

(4) The importance of keeping such a locator system up-to-date cannot be stressed too strongly. Any system that is not accurate is of no value; therefore, it will be necessary that the system be audited periodically. Every location of every item in storage areas will be surveyed and the locations reflected by the locator, as presently established, will be reconciled with those locations surveyed.

8–122. Summary and Check List

Summary of session.	SUMMARIZE IMPORTANT POINTS OF SESSION —"The fact that it haa taken THIS LENGTH OF TIME to BREAK DOWN and DISCUSS some of the FACTORS in only a SMALL PART of our JOB as WAREHOUSEMEN SHOULD MAKE US REALIZE that we have a COMPLICATED and IMPORTANT job to do." —"As we warned you earlier, MANY OF THESE FACTORS SEEM **TRIVIAL—BUT THEY** ARE IMPORTANT. " —"FAILURE to CONSIDER ALL of THESE FACTORS can and has caused WASTE of SPACE, MANPOWER and VALUABLE TIME." —'"The following are a few things on which YOU can CHECK YOURSELVES. " (HAND. OUT check list fig. 8-2.) —"If YOU can sit back and answer these questions to your own satisfaction, you can consider yourself a SUPER WAREHOUSE MAN." —"If yOU CAN'T—LET'S DO SOMETHING ABOUT IT. " —"That's **all** for this session. We will meet again on ---------- ---------- ---------- (Day) (T i m e) (Place)

HANDOUT

CHECK YOURSELF CAREFULLY AND SERIOUSLY ON THE FOLLOWING QUESTIONS

	Yes-No		Yes-No
1. Is there enough light (daylight or electric) in aisles to permit safe and efficient operations?	_____	8. Are there unnecessary lateral or fire aisles?	_____
2. In multistory buildings are the floors overloaded?	_____	9. Can everyone find material?	_
3. Does layout permit efficient use of all available storage space?	_	10. Is excessive rewarehousing necessary?	_____
4. Are "rapid turnover" items easily accessible?	_____	11. Is the section or floor satisfactory?	_____
5. Does aisle layout permit speedy movement?	_____	12. Are plans being made to improve layout?	_____
6. Are aisles as narrow as practicable?	_____		
7. Are there any inventory aisles?	_		

Note. Unless you can answer "Yes" to Nos. 1,3,4,5,6, 9, 11, and 12, and "No" tutheothers, LET'S DO SOMETHING TO CORRECT THE FAULTS.

Figure 8-2.

Part III. STORAGE OF MATERIALS

8-123. Review

Review of previous session(s).	REVIEW PREVIOUS SESSION —"In our previous session(s) we discussed HOW we would LAY OUT our storage area and WHERE we would STORE MATERIALS under certain conditions." —"The SUCCESS of our PLANNING depends upon HOW WELL we are ACQUAINTED with the TOOLS with which we have to work." —"How much we KNOW about the WAREHOUSES as to: TYPE SIZE PLATFORMS DOORS COLUMNS WINDOWS FLOOR LOADS ELEVATORS." —"How much we KNOW about the MATERIALS as to: TYPE AMOUNT SIZE WEIGHT SHAPE TURNOVER PERISHABILITY CRUSHABILITY." —"From this information we determine the NUMBER, WIDTH and LOCATION of the TRANSPORTATION and FIRE AISLES." —"These AISLES DIVIDE our FLOORS into a number of AREAS where we STORE the MATERIAL."

8-124. Objectives

a. Objectives to be achieved.	STATE OBJECTIVES —'Today, we will discuss HOW we can STACK MATERIAL, the DIFFERENT METHODS used, and WHEN they are used." —"BEFORE we actually "put away" our supplies we must know the OBJECTIVES-WHAT we are trying to achieve." —"There are FOUR MAIN OBJECTIVES in storing" (WRITE following points on blackboard): CONSERVE SPACE ASSURE SPEED OF MOVEMENT ASSURE STABILITY ORDERLINESS

(1) There is more to "warehousing" and "storing" than handling materials. Certain objectives must be kept in mind at all times and constantly checked by those concerned. There are FOUR MAIN OBJECTIVES that must be accomplished if the job is to be done efficiently.

(2) Storage methods should be such that they CONSERVE SPACE, ASSURE SPEED OF MOVEMENT, ASSURE STABILITY OF THE STACKS, AND PERMIT THE EASY LOCATION AND INVENTORY OF MATERIAL BY HAVING GOOD ORDER IN FORMING STACKS.

b. Conservation of space.

—"We all agree and realize that we MUST CONSERVE SPACE."
—"To CONSERVE SPACE we must STACK as HIGH as practicable and as COMPACTLY as possible."
—"what are some of the FACTORS that LIMIT HEIGHT?"

TRUSSES
FIRE EXTINGUISHER LINES
HEATING EQUIPMENT
LIGHTS
FLOOR LOAD LIMIT
METHOD OF STACKING-
  BY HAND
  BY MECHANICAL EQUIPMENT
CRUSHABILITY OF MATERIALS

–'What are some of the FACTORS that make it DIFFICULT to STACK COMPACTLY?"
DISCUSS following points as to how they can CAUSE DIFFICULTY:

NUMEROUS POSTS AND COLUMNS
POORLY TRAINED LABOR AND EQUIPMENT OPERATORS
TYPE OF STACKING
ODD SIZE CONTAINERS OF THE SAME ITEM

(1) The necessity to CONSERVE STORAGE SPACE is generally accepted, particularly covered space-not only because of the possible shortage of such space, but also because of the cost. It would seem ridiculous if the Empire State Building engineers had planned to have office space on the first floor only, and left those millions of cubic feet overhead vacant. It is just as ridiculous to have ceilings twenty feet high in a warehouse and then stack material only five feet high. There are two things that SHOULD BE DONE if space is to be conserved. Material must be stacked as HIGH as practicable and as COMPACTLY as possible. Naturally, there are certain physical conditions that limit the height and compactness of stacking material in a warehouse.

(2) In many of our older buildings trusses handicap the height to which material can be stacked. In any case, the height of stacks BELOW the level of roof trusses or beams will provide that an 18" clearance will be maintained when stack heights do not exceed 15 feet or 36 clearance when stacks exceed 15 feet in height. In those instances where supplies are stored ABOVE the level of the lower truss members a HORIZONTAL clearance of 18" will be maintained.

(3) The height of the stack BELOW automatic sprinkler DEFLECTORS will allow for an 18" clearance when stack heights do not exceed 15 feet and a 36 clearance for stacks which exceed 15 feet. Stacks made up of hazardous commodities will maintain a 36 clearance regardless of height.

(4) Handicapping floor load limits occur most frequently in multistory buildings, however, may also be present in single-story structures. Because of the limitations on floor loads full advantage of height can be taken by locating heavier materials on floors or portions of floors having higher load limits.

(5) Whether we do stacking by hand or whether we use mechanical equipment, there are height limits in stacking.

(6) Ways must be devised to avoid damage to crushable materials. Use of racks, bins, or box pallets helps. Even with the use of such aids, it is sometimes difficult to stack to any great height and maintain stability.

(7) Compactness in stacks is just as important in storing as in packing a trunk. The more compactly we pack, the more we can get into a trunk. Likewise the more compactly we stack, the more we can get into warehouses or other storage areas.

(8) Much space is lost by failure to stack compactly around the posts and columns in buildings. In the planning of layout and stacking methods, we must consider how we can best eliminate waste

space around posts and columns. Although the space lost around EACH COLUMN may be a question of only a few feet, the total loss, when we consider ALL THE POSTS AND COLUMNS in a building, may amount to as much as several hundred square feet. In stacking PALLETS around COLUMNS, the pallets, in some instances, can be turned to make them fit closely. Care must be taken not to block the movement of other pallets.

(9) The method used to stack the material directly affects. the compactness of stacks. In block stacking by hand, there should be no wasted space. If block stacking by fork trucks with pallets or dunnage is not properly done, much space can be wasted. Operators should be well trained in the correct methods of stacking. These methods will be discussed in the portion devoted to materials handling.

(10) In stacking various size containers of the same item, much space can be wasted and compactness decreased UNLESS an effort is made to match and stack the containers by size. Although such care may take a little more time, it usually pays dividends in the conservation of space and convenience in inventory.

c. ***Assure speed of movement.***	"There are certain PRECAUTIONS we can take in our PLANNING and in our STACKING to ASSURE SPEED of MOVEMENT—to ASSURE RAPID AVAILABILITY as mentioned in our definition." —"HOW can we ASSURE RAPID AVAILABILITY?" GET following points from group: AISLES WIDE ENOUGH LOCATION OF FAST MOVING ITEMS TYPE OF STACKING, AND MECHANICAL EQUIPMENT —"Are we going to SACRIFICE STORAGE SPACE for SPEED?"

(1) In the objectives of storing, RAPID AVAILABILITY of the material is stressed. We must be "movement minded as well as storage minded." Movement of supplies is an all-important objective. Our present storage program must be built around the movement of material. Storage must be considered in terms of MORE material stored in the SAME amount of space-perhaps in less amount of space. The speed of the movement of material can be increased if certain precautions are taken in the warehouse to assure RAPID AVAILABILITY.

(2) Aisles must be wide enough to enable the mechanical equipment to operate easily and speedily. Material that is fast moving and has a high rate of turnover must be stored in locations where it can be quickly reached, thereby reducing the amount of handling. The type and. method of stacking used must be considered first and in the light of the turnover of the material.

d. Assure stability.	We must be sure that our STACKS ARE STABLE. —"This can be assured by CAREFUL PLANNING and by CAREFUL STORING OR STACKING." —"We must know HOW to STACK commodities packed loose, in cartons, drums, bags, glass, boxes, and crates." —"We must know HOW to USE the various STORAGE AIDS such as DUNNAGE, and PALLETS which we will discuss in detail later in this session." —"Once we PUT the STACKS UP, we want them to STAY PUT." —"Both LABOR and MATERIAL must be PROTECTED from ACCIDENTS, DAMAGE, and INJURY."

(1) Unfortunately, many items handled do not lend themselves easily to good stable stacking. Many items, subsistence for instance, because of their shape, size, and pack can be stacked uniform and stable without too much difficulty. Other items lend themselves to efficient stacking only by the use of proper storage aids.

(2) Every effort should be made to standardize

the methods of stacking these commodities; this can be done only by a constant study and search for improvement. These items must be stacked as high as possible with as little loss of space as possible. Constant check should be made of all stacks; those that are unstable, shifting, or leaning should be corrected and studied in the light of WHY they are not stable and what causes them to shift. By so doing, many accidents and much lost time rebuilding or repairing stacks can be prevented.

e. Orderliness.	—"Bring out through questions and comments from various class members their idea of ORDERLINESS in stacking." —"Means STRAIGHT, STABLE, EASILY ACCESSIBLE stacks-." —"Does NOT mean PRECISION warehousing which is NOT DESIRED." —"Means like items placed together so that CONTENTS of stack and containers may be QUICKLY and EASILY IDENTIFIED. " —"There is NO excuse for SLOPPY STACKING. " —"There are three self-evident reasons for ORDERLINESS in stacking: STOCK PICKING INVENTORY INHERENT NECESSITY IN STORAGE OPERATIONS TO MAINTAIN GOOD HOUSEKEEPING
. . ."	

(1) There is no more excuse for confusion and disorder in arranging stacks in a storage location than there is in placing the furniture in your home around the room in "helter skelter" fashion. We would not tolerate a dangerous unsightly three-legged chair in the room; we would not stack a table on top of the sofa; or we would not buy a beautiful picture and spend valuable time in the hanging procedure then turn the picture facing the wall.

(2) Examples which can be easily applied to warehousing military supplies in an orderly manner are:

(a) STABLE STACKS in reasonably regular and neat arrangement.

(*b*) QUANTITY in each row UNIFORM for ease in inventory.

(c) Boxes arranged so that CONTENTS are READILY DETERMINED.

(*d*) No "MIXED STACKS" to waste valuable time during inventory or "LOST MATERIAL that causes WAREHOUSE REFUSALS.

8–125. Types of Stacks and Their Use

a. Stacking.	—"Name and describe the storage circumstances wherein we build stacks for"— LARGE LOT BULK BAY STORAGE MEDIUM LOT STORAGE SMALL LOT STORAGE —"BULK BAY STORAGE consists of LARGE BLOCK STACKS for storing large quantities of the same item." —"MEDIUM LOT STORAGE is defined as a stack of material requiring one to three pallet stacks, stored to maximum storage height." —"SMALL LOT STORAGE is a stack consisting of a quantity of supplies ranging from one container to a lot consisting of two or more pallets but less than the quantity required to complete a full pallet stack. Stress following KEY THOUGHT. —"Where possible all stacks should START AT THE WALL and be WORKED FORWARD TO AN AISLE." —"Stacks built in the large center sections should be started at an imaginary back line and built forward to an aisle." Discuss with the group large bulk lot stacking as it is used in their warehouses. —"WHERE in your warehouse do you use this type of stacking?" —"WHAT items are usually stacked in large bulk lots?" Discuss the items and conditions of stacking supplies in medium lot storage. —"Explain 'side to back' stacking." —"Where is it used?" —"What commodities do we stack in this manner in our warehouses?" Discuss small lot storage. —'Why is it necessary to have small lot stacks?" —"What do you stack in small lot storage?"

b. Discussion guide for types of stacks.

(1) When discussing stacking we should take care to differentiate between type of stack and method of stacking. In this outline method refers to a WAY of building a stack such as by the use of forklift trucks and pallets or through the use of stacking equipment in outside storage. Excluding retail bin areas we might consider that our storage area is made up of two types of stacks-BLOCK STACKS and SHORT LOT STACKS.

(a) A BLOCK STACK may be defined as a "self-supporting regular stack two or more wide, two or more deep, and two or more high." From this we can see that the supplies we place in LARGE LOT BULK STORAGE as well as those we stack in MEDIUM LOT STORAGE are both block stacks. However, we have come to a general understanding that a BLOCK STACK consists of supplies stored in carload or truckload lots filling an area of perhaps 20 feet by 20 feet and stacked to a height of from 10 to 14 feet, or in other words LARGE lot storage. This type of stack is the most efficient method of conserving space, and we should try to follow this type of stacking as often as possible. It should be done with mechanical equipment.

(b) Block stacks are limited only by:

1. MHE.
2. Quantity of the item.
3. Size and height of the building.
4. Floor load limits.
5. Necessary aisle space.
6. Size, shape, and crushability of supplies.
7. Items subject to spontaneous combustion.

(c) Block stacks start back at the wall and end at an aisle, or in the case of large center sections of storage space, the block stack starts at an imaginary line drawn through the longitudinal axis of the space, and extends in either direction to the nearest aisle. Often two blocks of different kinds of supplies are stacked back to back in one of these large center spaces. In cases of extremely large quantities of one commodity, such as mattresses, it is possible to fill an entire floor area of a section and leave only the necessary aisles for fire protection and to get to and move the material. FOR SAFETY REASONS, CARE SHOULD BE TAKEN IN BUILDING BLOCK STACKS TO MAKE THEM STABLE AND SELF-SUPPORTING.

(2) *Stacking for medium lot storage.* One very efficient manner of stacking items in medium lots storage is "side to back" storage adjacent to aisles. By so doing we can eliminate in many instances, the need for additional aisles, or reduce the rewarehousing **nécessary** to recapture bulk storage space.

(3) *Small lots.* One of the greatest problems in stacking small lots is the necessity for obtaining accessibility without using bulk storage areas or increasing aisle requirements. To eliminate this, small lots should be stacked in shallow storage space adjacent to warehouse walls bordering transportation aisles or side to back with large storage blocks running parallel with aisles. Box pallets, pallet racks, or bin racks are the most convenient means of stacking this type of supplies in order to take full advantage of storage heights and to maintain quick accessibility to the various odd sizes, lots, or quantities of supplies stored in this manner.

8–126. Honeycombing

Cause and effect of honeycombing.	EXPLAIN CAUSE AND EFFECT OF "HONEYCOMBING" —"One of the BIGGEST SPACE WASTERS IS HONEYCOMBING." (EXPLAIN what is meant by HONEYCOMBING. ILLUSTRATE by picture or drawing on the blackboard.) —"By HONEYCOMBING we mean the LOSS of SPACE caused by storage or PARTIAL SHIPMENT of lots in a manner that leaves HOLES which CANNOT be FILLED except with an identical item until the BALANCE of that particular LOT is SHIPPED. " —"HONEYCOMBING can occur in ANY TYPE of STACKING. " —"Do you have difficulty with this problem?" —"What ITEMS or what CONDITIONS cause the biggest 'headache'?" LESS THAN CARLOAD LOTS MOTOR TRUCK SHIPMENTS ITEMS WHICH MUST BE SHIPPED IN ORDER OF AGE SIZE ITEMS SMALL LOTS —"What have YOU DONE or what CAN BE DONE to ELIMINATE or REDUCE HONEYCOMBING?" —"What CORRECTIVE MEASURES can we take to REDUCE HONEYCOMBING?" PROPER PLANNING USE OF SHORT ROWS IN BLOCK AND SIZE STACKING USE OF SHORT ROWS ALONG EDGES OF BLOCK STACKS USE OF RACKS, BINS, BOX PALLETS USE OF SHORT WALL SPACE MINOR REWAREHOUSING-"Floor CLEANUP"

a. To honeycomb is to store or remove supplies in such a way that unusable areas of storage space are created within the stack. Bad storage and delivery methods conceivably could leave a warehouse only limitedly occupied, yet with no space available for new storage. Preventing honeycombing is one of the most difficult problems faced by a warehouseman; it can occur, almost before he/she realizes it, in any commodity or in any method of stacking. Although honeycombing can occur even in large blocks of stacked commodities that are shipped in carload lots, its most usual occurrence is in the storing of "LESS THAN CARLOAD LOTS," MATERIAL RECEIVED BY MOTOR TRUCKS, ITEMS WHICH MUST BE SHIPPED IN ORDER OF AGE, SIZED ITEMS IN ROW STACKS, AND SMALL LOTS. There are certain things that can be done to REDUCE the amount of honeycombing in a warehouse.

b. The problem of honeycombing emphasizes the

necessity for CAREFUL PLANNING of operations and emphasizes the importance of knowing WHAT we are going to store, HOW MUCH and WHERE we will store, as well as HOW we are going to store. We must also know whether the material will be received or shipped in carload lots or whether they must be shipped in order of age. AFTER we know all of these facts, there are certain precautions to take in stacking and storing to reduce the amount of honeycombing in the warehouse. Minor. rewarehousing, or "floor cleanup" of short "~ lots, which have caused honeycombing due to shipping out of large blocks, should be considered. These items should be moved to short lot areas if receiving of similar items is not expected in the immediate future.

c. In the session on LAYOUT, we mentioned that by experience we determined that, as a general rule, we should limit the depth of our rows to between 25 and 40 feet. This means that under ordinary circumstances, a shipment will cause the removal of one, two or three rows, and leave space for a similar amount of new material to be stored in the same location. In cases where we know that exceptionally small shipments of a certain commodity are made, it is sometimes advantageous to shorten the rows further.

d. Another method that can be used in the case of short lots is to store such items along the edges of a large block stack, facing at right angles to the block stack, and also facing a transportation aisle. The depth of these rows depends, of course, upon the amount of the commodity and may vary from one to three containers or loads.

e. In stacking material along the edges of block stacks, the use of storage aids further reduces the chance for honeycombing and also conserves space, in that it is possible to stack higher and thereby reduce the square footage. In other words, it eliminates having to spread material all over the floor and takes advantage of cubage.

f. In many warehouses, there are numerous short wall spaces which can be used for the storing of odd lots. This, of course, prevents wasting valuable square footage and cubage in the large center bays.

8--127. Storage Aids

a. ***Types and uses of storage aids.***	DISCUSS TYPES AND USES OF STORAGE AIDS —"There are NUMEROUS WAYS of STABILIZING STACKS—they might be called 'tricks of the trade':" —"They are such things as: CROSS-STACKING DUNNAGE BINDERS PALLETS/PALLET SUPPORT SETS/BOX PALLETS." —"We should understand HOW, WHEN and WHERE to use them. " —DISCUSS each of these STORAGE AIDS in order and ILLUSTRATE —ASK the group to give EXAMPLES of where they are used in their own warehouse and get improvements, if possible.

(1) Regardless of the quantity of supplies to be stored, there are certain "tricks of the trade" which we must know and use if we are to stabilize our stacks properly and facilitate handling.

(2) Such things as "cross-stacking," dunnage, binders, bulkheads, and the most used. storage aid-pallet-must be understood from the standpoint of both meaning and purpose.

b. Cross-stacking.	—"What is meant by 'CROSS-STACKING'?" —"What ADVANTAGE is to be gained by CROSS-STACKING material on a pallet?" STABILITY —"What OTHER MEANS can be used to get STABILITY in addition to, or instead ***of,*** CROSS-STACKING?" DUNNAGE BINDERS

(1) By cross-stacking we mean alternating the direction of placing cartons or containers in a stack in order to "tie" them together. The method of cross-stacking varies with the size, shape, and crushability of the various items. Care must be taken to cross-stack in a uniform manner so that inventory can be easily taken. Also, care must be taken in cross-stacking to effect as little loss of space as possible; this calls once more for careful PLANNING-it must NOT be done haphazardly. Thousands of valuable cubic feet can be lost in a warehouse by poor cross-stacking; this is particularly true in cross-stacking loads on pallets.

(2) Although the primary purpose of cross-stacking is stability, poor cross-stacking can cause serious INSTABILITY. In stacking pallet loads, the effort to assure stability often causes excessive waste of space. Both factors must be carefully weighed before a standard practice is set up. Sometimes it pays to use other ways to get the desired stability.

c. ***Dunnage*** (general).	—"The term 'DUNNAGE' as applied to warehousing covers a NUMBER of TYPES-DIFFERENT as to MATERIAL and USE." —"Let's WRITE them on the blackboard and DISCUSS IT and WHERE YOU USE them in the warehouse." HORIZONTAL DUNNAGE FLOOR DUNNAGE LONG DUNNAGE SHORT DUNNAGE VERTICAL DUNNAGE

(1) Dunnage as applied to warehousing covers a number of different uses. Dunnage is used primarily for spacers and in some cases to protect the material from deterioration. Specifically, the types of dunnage used throughout our military warehouses may be identified as horizontal dunnage consisting of floor dunnage, long dunnage, short dunnage, and vertical dunnage. Each of these has a definite place in our stacking methods and should be used only for the purpose intended and when actually needed.

(2) We should not use dunnage "just for the sake of using dunnage." Many times careful PLANNING and a thorough study of the problem will effect with satisfactory results some way to stack WITHOUT the use of dunnage.

d. Floor dunnage.

—'What do we mean when we speak of 'FLOOR DUNNAGE'?"
—'WHERE do you USE FLOOR DUNNAGE?"
—"IS IT NECESSARY? REMEMBER—LUMBER IS EXPENSIVE."
—'What are the ADVANTAGES to be gained?"

SAFEGUARDS PERISHABLE ITEMS such as
BAGGED COMMODITIES
CLOTHING
From FLOOR SWEATING
RAIN LEAKS

—"Are there any DISADVANTAGES?"

USES MANY BOARD FEET OF LUMBER
HANDICAPS MATERIALS HANDLING
SAFETY HAZARD

(1) Floor dunnage consists of boards of various thicknesses and widths, laid in some systematic way on the floor to raise the material and protect it from moisture and dampness. This type of dunnage should be used only where materials are hand-stacked and is required only in a few instances and under certain unusual conditions. Perishable items, which can be damaged by moisture, should be either palletized or placed on floor dunnage.

(2) If the lengths of dunnage are ten feet or more, floor dunnage may be a hindrance to materials handling operation. Such misuse tends to slow up the movement of equipment and is also hazardous to people working in the area. A good rule to follow is: eliminate the use of floor dunnage as much as possible.

e. Long dunnage.

—"ALTHOUGH LONG DUNNAGE can be used as FLOOR DUNNAGE, we USUALLY THINK of LONG DUNNAGE as being used to STABILIZE STACKS of IRREGULARLY SHAPED and CRUSHABLE ITEMS."
—"Can you think of any DISADVANTAGES in the use of LONG DUNNAGE?"

DIFFICULT TO HANDLE
SAFETY HAZARD
WASTES LUMBER (usually must be cut)

—"BEFORE you use LONG DUNNAGE, BE SURE there is NO OTHER WAY. IF YOU MUST USE IT, KEEP the lengths within TEN FEET."
—"Is LONG DUNNAGE being used?"
(If "YES')
—'WHERE is it used? Can we use SHORT DUNNAGE instead?"

(1) The use of dunnage is being discontinued as much as possible; it has been found by experience that many of the items formerly thought to require long dunnage can be more effectively and economically stabilized by either cross-stacking *or* the use of short dunnage or pallets. As in the case of floor dunnage, long dunnage hampers the materials handling operation. In "tearing down" a stack, the long dunnage must be sawed off as the work progresses; this results in a waste of lumber as well as a cumbersome operation. If the lumber is not cut, then the stack must be broken down layer by layer rather than by column.

(2) In some instances in outside storage, long dunnage is used—merely because "that's the way we have always done it''—rather than as a result

of a careful study of the problem. For example, in stacking drums, the use of long dunnage on top of each layer is sometimes used to get a more stable and more even stack-and supposedly to facilitate handling. Actually, if the surface of the storage area is leveled off by use of long dunnage (floor dunnage) and the drums are pyramided, blocks placed under the front and rear of the stack, the job will be much easier, more compact, and much more stable. This method of forming block stacks is known as PYRAMIDAL stacking. Six inches of long dunnage should be placed on the ground, but no dunnage is needed between the tiers. Wedge-shaped blocks or butt boards can be used at the ends of tiers for stability.

f. Short dunnage.	—"We usually refer to SHORT DUNNAGE as meaning pieces of LUMBER 2" x 4" or 4 x 4, cut in lengths of from two to four feet." —"What is the MOST COMMON USE of SHORT DUNNAGE?" SPACERS BETWEEN BOXES PERMITTING USE OF FORKS FOR LIFTING —"WHERE are you using SHORT DUNNAGE, and in handling WHAT COMMODITIES?" —"How do you DETERMINE WHETHER to use PALLETS or SHORT DUNNAGE?"" —"When using SHORT DUNNAGE be sure that it is cut the CORRECT SIZE and RIGHT AMOUNT—READY BEFORE you START the job."

(1) Usually, this type of dunnage is cut from pieces of 2" x 4" lumber and is used primarily in handling heavy boxes that do not lend themselves to palletizing, such as refrigerators, machinery, and similar items. Short dunnage serves to separate the containers so that the forks of the truck can be inserted for transporting and stacking the commodity. Care should be taken in cutting this type of dunnage so that there is sufficient dunnage to do the job and that it is cut in correct lengths. Dunnage to be used in handling a container 30 deep should be cut between 28" and 30. UNDER NO CONDITIONS SHOULD IT BE CUT SO THAT IT EXTENDS BEYOND THE LIMITS OF THE CONTAINER.

(2) One problem that often confronts storage personnel is whether to use pallets or short dunnage. This should be easily solved by remembering one of the principal objectives in materials handling "to transport and stack as much as is humanly or mechanically possible in one load, under existing conditions, with an eye to cost, speed, and safety—in other words, to do the job efficiently. " Therefore, IF AN EQUAL AMOUNT OF MATERIAL CAN BE HANDLED EFFICIENTLY ON EITHER PALLET OR SHORT DUNNAGE, SHORT DUNNAGE IS MORE ECONOMICAL.

g. Vertical dunnage.	—"Pieces of DUNNAGE can ALSO be used in a VERTICAL position to STABILIZE CRUSHABLE ITEMS and to SPREAD WEIGHT OF PALLET LOADS." —"WHERE in your warehouses have you used VERTICAL DUNNAGE?"

Pieces of dunnage can be used in a vertical position to stabilize crushable items and to spread the weight of pallet loads.

h. Binders.

—"Strips of PAPER, OSNABURG or BURLAP, and sometimes thin strips of WOOD, can be used to 'TIE' columns of MATERIALS TOGETHER. "
—"In some depota they speak of these types of binders as DUNNAGE."
—'We should refer to them simply se BINDERS."
—'When and WHERE do you think that such a method can be used to advantage?"

BETWEEN LAYERS OF SLIPPERY CONTAINERS
BETWEEN THE TWO TOP LAYERS OF A PALLET WHICH NEEDS STABILITY BECAUSE IT HAS NOT BEEN CROSS-STACKED.

—'WHAT OTHER MEANS, besides CROSS-STACKING and BINDING, can we USE for STABILIZING and TYING TOGETHER ODD SHAPED and SLIPPERY ITEMS on PALLETS or in BLOCK STACKS?"

CORD or STRING
STEEL STRAPPING

(1) Strips of paper, osnaburg, or burlap, and sometimes thin strips of wood can be used to "tie" columns together. Although such storage aids are sometimes referred to as "dunnage," they are actually "binders" and should be referred to as such. The binder in this case should be inserted between the two top layers, depending upon the commodity. Such binders can be used also to "tie" cartons on a pallet if, due to their shape, they cannot be cross-tied, or if they have been stacked to conserve space on the pallet. In the latter case, the binder should be inserted between the two top layers of the pallet load.

(2) In addition to the use of the above-mentioned aids, pieces of cord, string, or steel strapping can be used to bind pallet loads together. These can be used to bind loads of paper rolls or cartons which have not been cross-tied. It is necessary to tie such loads around the top layer only or, in the case of paper rolls, around the tops of the rolls. The use of metal strapping is recommended only in exceptional cases.

i. Pallets (general).

—"PALLETS are really 'GLORIFIED DUNNAGE'. They are an IMPROVEMENT on the SKID."
—"There are THREE GENERAL TYPES of PALLETS used in our warehouses. Can you NAME them?"

SINGLE-FACED (SKID)
DOUBLE-FACED
BOX (Permanent and Collapsible)

—DESCRIBE AND DISCUSS TYPES in following order:

(1) A pallet is a small wooden platform upon which containers are loaded in unit blocks. There are three common types: SINGLE-FACED PALLET, DOUBLE-FACED PALLET, BOX PALLET.

(2) Actually, pallets might be called "glorified" dunnage and are an improvement in storage operations over the "skid" or "sling board" used in marine operations.

j. Single and double-faced pallets.

—'What do we mean by SINGLE-FACED PALLETS?"
—"Do you USE SINGLE-FACED PALLETS in your operation?" (If "YES'):
—"WHERE and HOW?" (If "NO"):
—"COULD we USE them to ADVANTAGE?""
—"The MOST COMMONLY USED PALLET in our warehouses is the DOUBLE-FACED PALLET."
—"FORK TRUCK and PALLETS have become as closely connected as 'HAM and EGGS'. "
--"They have become so CLOSELY related that quite often we forget that FORK TRUCKS can DO many EFFICIENT JOBS WITHOUT the AID of PALLETS. BUT PALLETS ARE USELESS WITHOUT FORK TRUCKS. "
—'Will someone explain the basic CONSTRUCTION of the DOUBLE-FACED PALLET and give the REASONS for ita CONSTRUCTION THIS WAY?"
Check to make sure that he explains the following pointa with the "whys."

TYPE OF WOOD (hard or soft)
SIZE OF BOARDS AND SPACINGTOP PLATFORM
SIZE OF BOARDS AND SPACING—BOTTOM PLATFORM
SIZE AND NUMBER OF STRINGERS
CHAMFER ON BOTTOM OF FRONT FACE
NAILS OR BOLTS FOR FASTENING (Drive screw nails)
PLATFORM OVERHANG STRINGERS
4-WAY OR 2-WAY ENTRY
WEIGHT

—'WHAT SIZE PALLETS are used here? WHAT DETERMINES the SIZE?"
—'WHAT are the DIFFERENT SIZES USED for?"
—"COULD THE NUMBER OF DIFFERENT SIZES BE REDUCED?"
—DISCUSS THE 4way 40 x 48 pallet

CONSTRUCTION
PURPOSE
FEATURES
ADAPTABILITY

(1) A single-faced pallet is a single platform with stringers underneath to provide clearance for the tines of a fork lift truck and may be set down upon such items as wooden boxes, barrels, and drums which will not be damaged by the concentrated pressure of the stringers. Single-faced pallets could be used to advantage in some multistory buildings on floors which have such a low floor load capacity that pallet loads cannot be topped and mechanical equipment cannot be used. Single-faced pallets are used quite often in conjunction with hydraulic hand lifts and straddle-type fork trucks.

(2) A double-faced pallet is the one most commonly used; hundreds of thousands of them are in use at this time. A double-faced pallet is constructed as a double platform separated by stringers. The tines of the fork truck enter between the two platforms. The boards of the lower platform are separated to make room for the drop wheels of hand fork trucks. The smooth bottom surface distributes pressure equally on the pallet load stored beneath. Fork trucks and pallets have become as closely connected as "ham and eggs," and we sometimes forget that fork trucks can do many efficient jobs without the aid of pallets. Pallets, however, are of little value without fork trucks.

(3) It would not be efficient to have as many different sized pallets as we have items. To make pallet loads fit perfectly would require hundreds of different sizes; although it might save space, it would cause confusion and waste of time in the operation. The basic factors which determine pallet

design and size are: size of package or pieces of material to be stored; distance between warehouse columns; distance between loading or unloading points and points of storage; width of aisles required for type of fork lift trucks to be used; layout of storage space, location of aisles; whether pallets are to be used in hoisting operations; whether pallets **are to** be used for shipping purposes; maximum weight to be stored on a pallet; floor load-weight limit; whether pallets are to be used for storage in the open; and whether pallets must pass through doors of railroad cars or trucks and loaded therein.

(4) Much experience and research has developed the 40" x 48" pallet as the size that will accommodate most packages and also store well in most military warehouses and commercial carriers, both car and truck; it has, therefore, been adopted as the standard size for use in the **military** supply system. **There** are other sizes which have **special** though somewhat limited application.

k. Box pallets/pallet support sets.	—"BOX **PALLETS/PALLET** SUPPORT SETS are being used MORE AND MORE in our storage operations." —"What is meant by BOX PALLET/PALLET SUPPORT SET?" —'WHEN and WHERE can we use BOX **PALLETS/PALLET** SUPPORT SETS EFFICIENTLY?" STACKING SMALL LOTS STACKING CRUSHABLE ITEMS STACKING SLIPPERY BAGGED ITEMS STACKING AGAINST SHORT WALL SPACE STACKING ALONG ENDS OF LARGE BLOCK STACKS

(1) Box **pallets/pallet** support sets are being used more and more in warehouses; as in the case of anything that solves problems for us, we tend to overuse it. These aids have a definite place in our operations and should be used only in their place. Pallet support sets adapt to pallets and forma metal super structure (box effect) for stacking pallets and material. Box pallets are merely an adaption of the standard double-faced pallet. A simple superstructure is built on the pallet to give the general **appearance** of a crate.

(2) CRUSHABLE ITEMS **which** will not hear up under the weight of stacked regular pallet loads can be stored in these aids; this method gains more height and assures stability. In handling such crushable items box **pallets/pallet** support sets are speedier than portable racks. SLIPPERY BAGGED ITEMS in many cases can be handled more efficiently on box **pallets/pallet** support sets than by hand stacking. SMALL AND ODD LOTS can be stacked to advantage in box pallets; this eliminates much honeycombing and permits higher stacking. Box **pallets/pallet** support **sets** instead **of** regular **pallets** or permanent racks, can be used to **advantage against** SHORT WALL SPACE and along the EDGES OF LARGE BLOCK STACKS.

L ***Stacking materials on pallets.***

—"What are the main PURPOSES and the ADVANTAGES of using PALLETS in warehousing?"

MOVE GREATER NUMBER OF PIECES AT ONE TIME
INCREASE SPEED OF HANDLING
PERMIT HIGH STACKING FASTER AND WITH LESS DANGER

—".Are there any DISADVANTAGES in the use of PALLETS?"

USE LARGE AMOUNT OF LUMBER
COSTLY
WASTE OF CUBAGE IN STORAGE SPACE

—"HOW can we determine WHAT ITEMS should be PALLETIZED?" CAUTION GROUP IN FOLLOWING KEY THOUGHT:

—"NO MATERIAL SHOULD BE PALLETIZED ON FLAT PALLETS UNLESS WE ARE SURE THE STACKS WILL BE STABLE."

—"What determines the NUMBER OF CONTAINERS that can be STACKED on a PALLET?"

SIZE OF PALLET
SIZE AND SHAPE OF ITEM
WEIGHT OF ITEM
FLOOR LOAD LIMIT (in multistory buildings)
LIFTING CAPACITY OF FORK TRUCK
LIFTING HEIGHT LIMIT OF FORK TRUCK
EFFICIENT STACKING HEIGHT OF MANPOWER

DISCUSS each of the above points with reference to how it affects the number of containers to be placed on a pallet. Give examples.

(1) The use of pallets helps in attaining this objective because it enables us to move a greater number of pieces at one time, increases speed of handling, reduces higher stacking with more speed and less danger. Care must be taken to make sure that pallets are used to advantage. We must remember that palletizing loads does consume more storage space then hand stacking. All of these points are mentioned to emphasize the need for PLANNING and knowing WHEN and WHERE t-o use pallets; they should not be used indiscriminately. We must weigh carefully the advantages with the disadvantages.

(2) The number of containers that can be placed on a pallet depends upon a number of factors:

(a) SIZE OF THE PALLET.

(*b*) SIZE AND SHAPE OF THE CONTAINER.

(c) WEIGHT OF THE COMMODITY.

(3) If we are using a truck with 108 inch lift and we want to stack three pallets high and maintain uniformity in the pallet loads, care must be taken to load the lower two pallet loads so that their combined overall height will not exceed 102" or an average of 51" overail for each pallet load; or in another vein the lifting capacity of the forklift truck AT SPECIFIED DISTANCES FROM THE HEEL OR FORK should not be exceeded informing pallet loads. Most 2,000 lb forklift trucks will lift 2,000 lbs IF THE LOAD DOES NOT EXTEND BEYOND 24" FROM HEEL OF FORK, however, for EVERY INCH the load protrudes beyond this point a sharp reduction in lifting capacity occurs.

(4) Careful PLANNING is again emphasized in order that the number of different sizes of pallets be reduced to a minimum, and that those sizes agreed upon fit the requirements of the operation. We must keep in mind also the overall picture of all installations and the trend to shipping and receiving unit pallet loads. Although such handling has not been completely perfected, it is an important. objective which must be kept in mind.

8–128. Summary for Storage Aids

Summary.

SUMMARIZE SESSION

—"As a review let's make a list on the blackboard of the various STORAGE TYPES, METHODS, and AIDS *or* DEVICES we have **discussed."**

L BINDING AIDS:
PAPER
OSNABURG
2. BINS AND RACKS
3. BLOCK STACK
4. BOX PALLET/PALLET SUPPORT SETS
5. CROSS-STACKING
6. DOUBLE-FACED PALLET
'?. 4-WAY PALLETS
8. FLOOR DUNNAGE
9. LONG DUNNAGE
10. PYRAMIDAL STACKING
11. SHORT DUNNAGE
12. SINGLE-FACED PALLETS
13. SIZE OR ROW STACK
14. VERTICAL DUNNAGE

—"Referring to this list, WHAT STORAGE METHOD OR STORAGE DEVICE or AID WOULD YOU USE in EACH **of** THESE WAREHOUSE SITUATIONS?"

PRESENT each of the following warehouse problems one at a time, with some such **introductory** remark **as:** "Suppose we had **to** _. What type of stack and storage aids would you use?"

1. Store ***small*** **amounts** of ten different items that are packed in corrugated cartons.
2. Give a single row of supplies support **to** avoid spilling into the aisle.
3. Warehouse a large shipment of 36" rolls of paper.
4. Warehouse two boxcars of one item.
5. Warehouse three bays of an item such as mattresses.
6. Store crafted refrigeratora.
7. Prevent damage **from** moisture to a block hand-stacked item.
8. Store ten **thousand** 55 ***gallon*** empty drums **in** outside storage.

—'That's **all** for this **session.** We will meet again on

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(Day) (Time) (Place)

a. The purpose of this portion of the course was **to** discuss the various methods and storage devices or aids commonly used in storing material in military supply warehouses. At close of a discussion, it is wise to try to pull together the general idea, conclusions, or points **discussed** in a conference. It is likely to make every member of the group more conscious of what he has learned. It is probable that additional discussion will result. Any doubts should be cleared up.

b. Some of the warehouse situations indicated may have been **discussed** in the session. The leader should be prepared to add or substitute others from observation or experience at the depot. If a member of the group answers in a very general way, such as: "it **depends on** the size," or "it depends on the commodity," **or "it** depends on the warehouse," he/she should be asked to pick a specific situation and present Ids/her method to the group. There maybe **different answers.** Each person should give reasons or enough details **to** make answer clear. **If** time does not permit the use of this summary, it maybe used at the beginning of the third session as a review.

8-129. Review

Review of previous session(s).	REVIEW PREVIOUS SESSION-STATE TODAY'S TOPIC "In our previous sessions we have discussed STORAGE OF MATERIALS, with regard to BASIC FACTS WE MUST KNOW, as well as the NECESSITY FOR DEVELOPING STANDARD PRACTICES." —'We determined that, in order to accomplish the FOUR OBJECTIVES OF STORAGE: CONSERVE SPACE ASSURE SPEED OF MOVEMENT ASSURE STABILITY ORDERLINESS We must determine the BEST METHOD and then ALWAYS USE IT." —'We emphasized the fact that once these methods are standardized, THEY SHOULD BE PUT DOWN IN WRITING."

a. To "warm up" the group mentally, a short time at the beginning of the class should be spent in reviewing some of the main points in the previous session(s). This helps, not only to impress these points upon their minds but also to continue the lines of thought into the following meetings.

b. Future *session(s) will* deal with the most expensive, most troublesome, and most important part of any storage operation the handling and movement of supplies. The purpose of the next series of conferences is to point out many of the problems involved in materials handling, to make the group THINK about them, and to emphasize the necessity for ANALYZING each operation from the bottom up. The success or failure of the entire program can depend upon how well YOU put over this session. Since certain material in this session is likely to be a "new approach"—in the eyes of the group-it requires skillful presentation and leadership. The group probably has never considered "Principles of Materials Handling" and, unless these principles are carefully related to their specific jobs, they may be considered as "theories" or "schoolish." In preparing for this session, the leader should have up-to-date information on many of the materials handling operations taking place in the depot. This information may be used to illustrate principles or methods of analyzing. At the conclusion of these sessions, the group must have a clear understanding of the five main principles of materials handling and their application to actual jobs. The group also must have a realization of the necessity for analyzing EACH JOB and their responsibility y for maintaining efficient operations.

8-130. Materials Handling Efficiency

a. Definition of materials handling.

—"To be sure that we all have the SAME UNDERSTANDING of what we mean by MATERIALS HANDLING in warehouses, let's put the DEFINITION on the blackboard." "MOVEMENT OF MATERIAL, other than by common carrier."

In further explanation of the definition of materials handling:

> MATERIALS HANDLING
> Is the LIFTING and SHIFTING of commodities UP, DOWN, or SIDEWAYS (that is, VERTICALLY or HORIZONTALLY). This can be done MANUALLY, MECHANICALLY, or by a COMBINATION of BOTH.

(REFER to definition on blackboard)

—"In EACH of these TYPES of MOVEMENT we are faced with PROBLEMS-WHETHER we do them by HAND, by MACHINE, OR by a COMBINATION of BOTH."

—"These points alone, without considering others, make us understand that MATERIALS HANDLING IS NOT A SIMPLE JOB."

—'There's more to it than 'picking-it-up and laying-it-down!"

—"There are TWO WAYS to 'pick-it-up and lay-it-down'-the WRONG or HARD way, and the RIGHT or EASY way."

—"At the conclusion of these meetings, we hope you will he able to DISTINGUISH more easily between the WRONG and the RIGHT way-and be sure of it."

(1) One of the purposes for defining materials handling is to give-the group an understanding of what is meant generally by the term. In many cases the interpretation of materials handling is LIMITED TO THE JOBS DONE BY FORK TRUCKS. Many times we hear the person in charge of the equipment pool or the shop referred to as the "materials handling chief." Materials handling, in the broader aspect, refers to ANY MOVEMENT of materials, whether by hand or by use of a locomotive crane. Materials handling is the physical handling of supplies into and out of storage; its most elementary method is a person carrying a package from a freight car to a storage pile. An advanced method is the operator of a fork lift truck driving the machine into a freight car, picking up supplies loaded on a pallet, carrying loaded pallet to its storage location and lifting it, still unaided, onto the top of a stack. Materials handling is the actual storage process in operation; the aims are conservation of labor, time, and space to the maximum degree consistent with safety of men and materials.

(2) A second purpose for developing the definition of materials handling is to establish a means through which the importance of analyzing and breaking down a materials handling operation can be emphasized. By breaking down this definition with the group, we can immediately make them aware of the fact that there are problems in the warehouses which can be broken down and analyzed. We can drive home the point that materials handling is not a simple job, that there is more to it than merely picking up and laying down materials, and that THERE IS A RIGHT WAY and A WRONG WAY TO DO IT. The leader must be careful not to read the definition—make it PROVE AND MEAN SOMETHING to the group.

b. Where ***materials handling occurs.***

WHERE MATERIALS HANDLING OCCURS

—"To start, let's LIST on the blackboard WHERE and WHAT MATERIALS HANDLING TAKES PLACE in our WAREHOUSES or STORAGE AREAS."

—"Will someone name the THREE MAIN OPERATIONS in a storage operation and point out the MATERIALS HANDLING INVOLVED?"
WRITE ON BLACKBOARD

Operation	*Materials Handling Involved*
RECEIVING—	Unloading cars and trucks, horizontal movement to storage, elevating to upper floors (multistory buildings).
STORING—	Stacking.
SHIPPING—	Removing stock from stacks; lowering from upper floors in multistory buildings; horizontal mmovement to processing, packing, and crating areas and to platforms; loading cars and trucks

—"Are there any ADDITIONAL OPERATIONS in which MATERIALS HANDLING is INVOLVED?"
(Add to list on blackboard.)

ADDITIONAL—Checking, assembly, inspecting, **rewarehousing,** selecting.

(1) Before we can break down the analysis of specific materials handling operations, it is necessary to know WHERE and WHAT materials handling takes place in our depots. This can be done by determiningg what handling takes place in each of the three main operations: RECEIVING, STORING, and SHIPPING.

(2) In the three basic operations, receiving, storing, and shipping, about 85 percent of all of the work in a warehouse is done. Unloading cars and trucks, moving from receiving platforms to storage points, stacking at the storage point, pulling down those stacks, moving back to the shipping point, and then loading the cars and trucks—these activities include most of the interior transportation mentioned previously. In addition, there is some materials handling that takes place in miscellaneous operations, such as assembly, inspection, packing, processing, and rewarehousing.

(3) After we have isolated the problems involved in each of these operations, we should then study them-one at a time. In this way we can reduce, slowly but surely, the cost of our materials handling operations, and thereby help to reduce the cost of the entire operation.

c. *General way to raise efficiency.*

DEVELOP WAYS OF RAISING EFFICIENCY (REFER to blackboard)
—"The TIME AND LABOR involved in these operations amount to about 85 percent of ALL WORK done in our storage and materials handling operation."
—"Therefore, if we can REDUCE the COST of HANDLING, we can greatly REDUCE the COST of the WHOLE OPERATION."
—"In what GENERAL WAYS can we REDUCE the COST and INCREASE the EFFICIENCY of operations?"
TRY TO GET the following points from the group, and discuss generally what each means and how it can be applied.

BETTER PLANNING
BETTER UTILIZATION OF MANPOWER AND EQUIPMENT
BETTER METHODS
BETTER SUPERVISION

—"To ANALYZE THOROUGHLY and THINK THROUGH our operations to ATTAIN our OBJECTIVE, we MUST HAVE a WORKING KNOWLEDGE of the following
(1) Types of equipment available and the advantages to be gained by their use.
(2) Existing physical conditions which determine and limit types of operation.
(3) BASIC PRINCIPLES OF MATERIALS HANDLING. "

(1) *There are* four things that can be done to raise the efficiency of any job: take time for better planning, use better methods, get better utilization of manpower and equipment, and provide better supervision. These four points are more easily said than done. They are essentially the basis for a good operation but each in its own right presents a problem to those responsible for the operation.

(2) The necessity for taking time to plan was mentioned previously but cannot be stressed too strongly. As a matter of fact, much of the "planning" should be "ADVANCE PLANNING." For example, to plan a receiving operation, we must know what commodities are coming in, how they will be received, by car or truck; how many are to be received; and where and how they will be stored. Such information should be available as far ahead of time as possible. Unfortunately, the supervisor concerned often does not have ALL OF THE INFORMATION to do a good PLANNING JOB.

(3) THE USE OF BETTER METHODS must always be uppermost in the minds of supervisors. They must not be content to do things because "they-have-always-been-done-that-way." There are very few jobs in which improvement cannot be made. The efficient improvement depends upon the supervisors ability to analyze jobs properly, step by Step.

(4) The assurance of better utilization of labor and equipment depends upon the results of a good analysis. The supervisor, in the role of the watchdog, must ever be on the lookout for waste.

(5) Better supervision is perhaps the hardest to get. There is an acute shortage of GOOD SUPERVISORS. We must develop our *supervisors. They* should know types of equipment available, physical limitations of equipment, and basic materials handling principles.

8-131. Various Types of and Advantages in Using Mechanical Equipment

a. ***Types of equipment.***

DISCUSS TYPES AND USES OF EQUIPMENT

—"Will someone name the various types of equipment that are being used in materials handling operations at our own installations?"

(LIST types on blackboard).

BLACKBOARD

TRACTORS
TRAILERS
FORK TRUCKS
CONVEYORS
TWO-WHEEL HAND TRUCKS
FOUR-WHEEL HAND TRUCKS
STOCK PICKING TRUCKS
HAND LIFT TRUCKS
CRANES
DOLLIES

DISCUSS in general terms how each type is being used.
Suggest additions to list if any have been omitted.

(1) ***General.*** To help speed the movement of supplies and to make the materials handling job easier for laborers, there are certain types of handling equipment that are used in military storage establishments. Any person in a supervisory job—whether the warehouse officer or a squad leader—should know what these types are, how they should be used, and in what operations they serve to the best advantage. Many man and equipment-hours can be wasted by failing to use proper equipment in an operation or by failing to know how to use it. For example, in stacking unit loads by fork truck, it is not necessary to have a helper for the fork truck operator if the operator has been properly trained. In most operations of this type, a helper represents manhours wasted. The most commonly used equipment AND their primary uses are listed and further identified in chapter IV, section 2, of this regulation.

(2) ***Forklift truck.*** These machines have become the most used mechanical aid of all. The primary use of forklift trucks is to transport and stack palletized loads or large boxes and crates with skids. They are most economically used when the distance of travel is limited to distances under 400 feet. Selection of the size of the forklift truck is determined by the weight of loads, size of pallets, width of aisles, width of doorways, and whether it must be used to enter freight cars. Generally, the 2,000 pound and 4,000 pound capacity trucks are the most popular for inside storage operations. Trucks having a greater lift capacity are used chiefly in outside storage areas.

(3) ***Tractors.*** Generally, there are two kinds of tractors used in storage operations: the three and the four-wheel tractor. The three-wheel tractor may have either a single or twin wheel as its front steer wheel; its short turning radius makes it well suited to cramped, congested areas. Usually, the four-wheel tractor is larger and lacks the short turning radius of the three-wheel type. Hence, it cannot be used in congested areas, but its four wheels and greater bulk give it great stability and increased drawbar-pull capacity. The three-wheel type comes equipped with either solid rubber or pneumatic tires. Usually those with the solid rubber tires are used within the warehouses. Usually, the four-wheel type is equipped with pneumatic tires and is most often used for outside hauls, in outside storage, or hauls between warehouses; its most common use is in connection with the tractor-trailer trains.

(4) ***Trailers.*** *The* trailers used in our storage operations are an adaptation of the four-wheel platform truck, with attachments for hooking them together so that two or more can forma "train." Light duty trailers have capacities up to 6,000 pounds; heavy duty up to 10,000 pounds. Platforms are usually 6 to 9 feet long and 3 to 4 feet wide. Platform height from the floor ranges from 14 to 18. The most commonly used trailer has a capacity of 4,000

pounds, platform 6' x 3' 14 from the floor. Automatic coupling devices have replaced the old hook and eye coupler; this has reduced injuries. The primary use of the tractor-trailer train is for hauling unit loads, palletized or not, for distances over 400 feet. Tractor-trailer trains also can be used to advantage in collecting and delivering LCL ship ments to the collecting point. Traina should never be "frozen" by storing on them materials that will not be moved for a long period of time.

(5) *Conveyors.*

""(a) 'I'here are many types of conveyors that can be used in our depots. The permanent belt conveyor, portable belt conveyor, gravity roller conveyor, and skate roller conveyor can be used to advantage, if they are used for the purpose for which they were designed. In many operations the conveyor can be used in conjunction with the fork truck. The conveyor *cannot* efficiently replace the fork truck in certain operations any more than the fork truck can replace the conveyor in other operations. The skate wheel conveyor which is light in weight, speedy, easily set up, and readily transported is the type most commonly used. This conveyor can be used efficiently for loading and unloading trucks or freight cars where no platform is available and where the surface does not permit the use of a fork truck.

(*b*) Conveyors can be used to advantage also in packing operations, serving both as a work table and a means of moving the material from one operation to the next without lifting. Care must be taken regarding the weight of the material handled by conveyors. Heavy roller gravity conveyors can be used in handling heavier material.

(c) Where permanent operations take place, roller gravity conveyors can be setup with a certain number of power-driven "live rollers." In such operations as assembly of various kits or set where the material is not too heavy and the operation is permanent, power belt conveyors can be installed and used efficiently. The big advantage of a conveyor, particularly the power-driven type, is that it ACTS AS A PACE SETTER FOR THE OPERATION. Insetting up any conveyor, care should also be taken that it be the correct and easiest working height from the floor or ground.

(6) *Handlift truck.* The handlift truck, some. times known as the hydraulic jack, can be used to move pallet loads short distances as on and off elevators or for moving material in packing or inspection rooms. In *no case* should it be used to replace the forklift truck, but merely to supplement it.

(7) *Two-wheel and four-wheel platform truck.* Although both of these types of hand trucks are used, they are fast becoming outmoded. Two-wheel hand trucks can be used in handling large cartons, cases, bags, or barrels for very short hauls. The four-wheel platform truck can be used in stock rooms and in packing rooms for miscellaneous movement of material where it would not be economical to use mechanical equipment.

b. Advantages in using mechanical equipment.

DISCUSS ADVANTAGES OF PROPER USE OF EQUIPMENT

—'What are some of the ADVANTAGES that YOU WANT to GAIN by the PROPER USE of this MECHANICAL EQUIPMENT?"

SAVE TIME (Man-Hours)
SAVE LABOR
SPEED MOVEMENT OF CARS AND TRUCKS
GET MAXIMUM USE OF OVERHEAD SPACE
REDUCE INJURIES
REDUCE DAMAGES

—"Will some of you give specific examples where any or all of these advantages have been gained in your own operations by the proper use of mechanical equipment?"

(1) To use mechanical equipment just for the sake of using it, is NOT REASON ENOUGH. There are certain advantages which are quite evident:

(a) Time. If time is not saved when we are using mechanical equipment, it is not properly used. Time SHOULD BE saved when equipment is added to an operation, if the equipment is in good condition and is properly used.

(b) Labor. Saving of labor can be accomplished if mechanical equipment is properly used; this saving can come in the better utilization of labor. For example, in an extreme situation, if eight laborers are used to unload a freight car, the addition of one or two fork trucks to the job permits the unloading of TWO CARS at the SAME TIME in LESS OVERALL TIME.

(2) We should be able to speed up the movement of cars and trucks if we use mechanical equipment properly. If, by the addition of mechanical equipment and the reduction of manual handling in a job, we reduce the amount of labor involved, we automatically REDUCE THE POSSIBILITY OF INJURY. Reduction in labor and consequent reduction in injury can be effected only if mechanical equipment is maintained and used properly.

8–132. Movement Factors

a. ***Factors to be considered*** in ***horizontal movement.***

POINT OUT OPERATING PROBLEMS IN HORIZONTAL MOVEMENT
—"Our definition of Materials Handling points out that there are TWO TYPES of MOVEMENT—HORIZONTAL and VERTICAL. "
—"In EACH TYPE of MOVEMENT there are CERTAIN FACTORS which AFFECT our MATERIALS HANDLING OPERATIONS. "
—'We must UNDERSTAND these CONDITIONS PECULIAR to OUR OWN OPERATIONS BEFORE we can PLAN an EFFICIENT OPERATION and DETERMINE the TYPE of EQUIPMENT to be used."
—"For example, we have to know whether the HAULING DISTANCE is LONG or SHORT."
'We have to consider the PLATFORM SPACE, the CONDITION of ROADWAYS and FLOORS, and the WIDTH of DOORS and AISLES."
(LIST FACTORS on blackboard)

BLACKBOARD

SHORT HAULS
LONG HAULS
PLATFORM SPACE
ROADWAYS AND FLOORS
DOORS AND AISLES

—'What do we mean by LONG and SHORT HAULS?"
LONG HAUL, OVER 400 FEET
SHORT HAUL, UNDER 400 FEET
—"How can the AMOUNT of PLATFORM SPACE affect your operation?"
—'What trouble can you run into, if your ROADWAYS and FLOORS are not smoothly surfaced?"
—"How does the WIDTH of the DOORS and AISLES affect the job?"

(1) Two *types of movement. Our* definition of materials handling states that there are two general types of movement: HORIZONTAL and VERTICAL. In both of these types there are certain existing conditions which affect our materials handling operations. We must understand them as they apply, not only generally, but to a particular job. Failure to understand will handicap the efficiency of the job and the type of equipment used.

(2) *Distance of haul.* In horizontal movement, THE DISTANCE OF THE HAUL will have a bearing on the type of equipment to be used. Is it a long or a short haul? What is meant by a short haul? From experience, we have come to apply the term "short haul" to any distance under 400 feet. Distances over 400 feet, hauling between warehouses or the length of one warehouse, have been accepted as "long hauls," usually, these distances are handled by tractor-trailers. There is a difference, in application of this rule, between long and

short hauls in single-story and in multistory buildings, where the elevator must be taken into consideration.

(3) *Platform* space. The amount of platform space available for loading and unloading cars and trucks is a determining factor in the method used. For example: Platforms may be too narrow for tractor-trailers or conveyors; or they maybe too narrow to permit the use of tractor-trailer trains in conjunction with a gravity conveyor for unloading, sorting, and checking sized items.,

(4) *Roadways* and *floors.* If we plan to carry commodities any distance by means of mechanical equipment, THE CONDITION OF THE ROADWAYS OR FLOORS will determine the method used. In cases where the roadways and floors are rough and uneven, it maybe necessary to stack the material differently. In some cases tying or strapping is necessary to keep the material from shifting.

(5) *Width of aisles.* Width of aisles, as mentioned in our study on LAYOUT, is important, since it influences the type of equipment that can be used in the handling of material. The aisles and doors must be wide enough to permit mechanical equip ment to be used; otherwise material will have to be handled by hand. For example: It would not be efficient to try to use a 6,000 pound fork truck in nine foot aisles. Trailers and tractors cannot be used in 30-inch or even 36-inch aisles, which are sometimes found in loose issue rooms.

b. Factors to be considered in vertical movement.

POINT OUT LIMITING FACTORS IN VERTICAL MOVEMENT
—*"There are* CERTAIN CONDITIONS which LIMIT or AFFECT the OPERATION in VERTICAL MOVEMENT."
(LIST CONDITIONS on blackboard)

CEILING HEIGHTS
OVERHEAD OBSTACLES
TYPE OF MATERIAL
SAFETY PRECAUTIONS

—"How do ceiling heighta limit the operation?"
—'What overhead obstacles are likely to be found? What regulations are related to them?"
—"How does the type of material affect the operation?"
—'What safety precautions must be observed?"

(1) Ceiling heights determine the height to which we can stack and also constitutes a factor in the size and type of equipment that can be used in an installation. In a building that has a 15 foot ceiling, it would certainly be **uneconomical to sacrifice** the advantage of "full air rights" by using only forklift trucks with 103" **materials lifting** height.

(2) Overhead obstacles, such as trusses, sprinklers, lighting fixtures, and skylights are all factors that **affect vertical** movement.

(3) Type of commodities (the shape, size, weight, and **crushability)** directly controls our method of handling, as well as the height **to** which we can stack.

(4) Size and capacity of elevators in multistory buildings are controlling factors in the equipment used, such as: trailers, pallets, handlift trucks, **or** fork trucks, as well as how and in what order such equipment can be used. Care must be taken to prevent damage and injury in handling materials in **vertical** movement. There are certain SAFETY PRECAUTIONS AND REGULATIONS as **to stability,** height, and weight of **a stack** that must be considered. Such elementary regulations as prohibiting men from riding **or** being elevated **on** the forks are primary. The use of **a** "back-rest" and an overhead guard on a fork truck **to** protect the operator **from being** injured by **a** falling load is important. Training laborers in the proper way of lifting **to** avoid strains is another safety need.

8–133. Principles of Materials Handling

a. Definition of principles of material handing.

DEFINE "PRINCIPLE." DEVELOP IN DETAIL MAIN PRINCIPLES OF MATERIALS HANDLING

—"The third-and perhaps the most important-KNOWLEDGE a good warehouseman or storekeeper must have, is knowledge of the PRINCIPLES OF MATERIALS HANDLING."

—"Before discussing these, let's determine first what is meant by 'PRINCIPLE'."

—"One definition which covers it pretty well is: a PRINCIPLE is the DEVELOPMENT of a THEORY which has been USED MANY TIMES SUCCESSFULLY and haa become accepted as a STANDARD RULE or PRACTICE."

"These PRINCIPLES are NOT **THEORIES—THEY WORK!"**

"The most significant PRINCIPLES which should be applied are as follows"

(LIST PRINCIPLES on blackboard)

STRAIGHT-LINE FLOW CONTINUOUS FLOW CONCENTRATION OF OPERATION EFFICIENT HANDLING PRINCIPLE OF WORK

DISCUSS in detail each of these principles and use them as a guide to analyze some operation which is being done in your organization.

(1) The third requisite of a good storage person is that he/she knows the basic principles of materials handling. He/she must not only know what they are, but also understand how to APPLY them in THE OPERATION. He/she should be able to ascertain quickly when principles do not apply and correct the condition immediately. Too often the word "principle" is used as a "blanket" term to cover up real understanding. Because of this, the word often has been associated-incorrectly-with things divorced from practical, down-to-earth facts that are so important to the average warehouseman. As pointed out in the definition of principle—"a principle is the DEVELOPMENT of a theory which has been used many times successfully, and has become accepted as a STANDARD RULE or PRACTICE."

(2) Principles are not theories. They are sound GROUND RULES which, if applied, will work. There are many principles applied to materials handling; however, there are FIVE SIGNIFICANT PRINCIPLES. Their meaning should be discussed at length and subsequently applied to the various operations with which the members are familiar. These principles are: principle of straight-line flow; principle of continuous flow; principle of concentration of operation; principle of efficient handling, applied to both manual and mechanical handling principle of work, which includes what may be considered by some as another principle—that of a balanced operation.

b. Principle of straight-line flow.

—"By PRINCIPLE of STRAIGHT-LINE FLOW we mean the MOVEMENT OF MATERIAL BETWEEN ANY TWO POINTS SHOULD TRAVEL BY WAY OF THE SHORTEST DISTANCE."
—"This is baaed on the old principle—'a straight line is the shortest distance between two pcints'."
—'We cannot always travel in a STRAIGHT LINE, but we should always travel the SHORTEST DISTANCE."
—"Inour SHIPPING AND RECEIVING OPERATIONS, what is the FIRST THING TO BE CONSIDERED if this principle is to be applied?"

CAR SPOTTING

—"In those cases where warehouses are constructed with multiple truck docks or with truck docks extending the length of the warehouse then TRUCK SPOTTING must be considered also. "
—'What is the METHOD we use here in SPOTTING CARS?"
DISCUSS the car spotting system and have the group evaluate its efficiency.

(1) THIS PRINCIPLE MEANS THAT THE MOVEMENT OF MATERIALS BETWEEN ANY TWO POINTS SHOULD TRAVEL BY WAY OF THE SHORTEST DISTANCE. In application to our problems, it cannot always be thought of as the shortest distance. How well we adhere to this principle determines, in some cases, the type of equip ment used in the operation. For example, in receiving and stacking commodities in a warehouse, the distance from the car to the stack determines whether we use a fork truck and pallet method alone, or with the addition of tractor and trailers. We have discussed previously that it is not economical, in an average operation, to have a fork truck travel farther than 400 feet in hauling and stacking. To save man-hours and equipment; therefore, we should make every effort to keep the distances from car to stack under 400 feet. We cannot move our warehouse, but we can move the car to a location nearer the stack. This, of course, calls for PLANNING and the correct SPOTTING OF CARS.

(2) Car spotting means placing the freight car at a SPECIFIC location or SPOT for loading or unloading. By spotting cars as near the storage points as possible, the hauling distance of supplies is reduced and man-hours and equipment are saved.

c. ***Principle of continuous flow.***

—"The second principle is the PRINCIPLE of CONTINUOUS FLOW."
—"By that is meant-MATERIALS SHOULD MOVE CONTINUOUSLY ALONG ANY PRODUCTION LINE. "
—'WHICH materials handling JOBS do you know about that lend themselves most naturally to the application of this PRINCIPLE?"

LOOSE ISSUE ROOM PACKING
KIT ASSEMBLY
UNLOADING CARS
SORTING SIZED ITEMS

—'What is one of the best ways to ASSURE CONTINUOUS FLOW?"

USE OF CONVEYORS

—"CONTINUOUS FLOW should be applied to ALL of our SHIPPING and RECEIVING operations."

Note. DISCUSS shipping and receiving operationa generally, to determine if the principle does apply. If it does not apply, discuss the reasons and get the group to think along the lines of eliminating these causes.

(1) This principle stresses the point that materials should move continuously along any production line. Material should always move as smoothly as possible; spasmodic or interrupted" flow causes confusion and delay. In shipping or receiving materials, every **effort** must be made to move the materials DIRECTLY **to** the car or **stack;** this, of course, requires PLANNING. There are certain operations that lend themselves more easily than others to the application of this principle. Loose **issue** room **packing,** kit or set assembly, and sorting **sized items on** a **conveyor** are **all operations** in which we **SEE** the continuous flow, or easily recognize the lack of it.

(2) Whenever it can be used, one of the best methods to assure continuous flow is the use of a conveyor system of some type. Such a conveyor **will** act as a PACE SETTER and interruptions are **easily** observed. We can, however, have continuous **flow,** even in the **following:** operations involving hand labor, use of platform trucks, tractor-trailer trains, forklift trucks, and pallets. We must take care in such operations, particularly in shipping and receiving, that the flow is not interrupted by inefficient **checking** or inspection methods, **unnecessary** marking, miscellaneous bottlenecks caused by poor planning, or lack of necessary labor and equip ment. A very simple ground rule to follow is: "Plan where you want the material to **go—and** then take them **there!"** Question very critically the necessity and reason for any **stops enroute.**

d. ***Principle of concentration of operation.***	—"The next principle listed is the PRINCIPLE of CONCENTRATION OF **OPERATION** which implies that-in the MOVEMENT and HANDLING of material, the OPERATION SHOULD BE LIMITED IN DISTANCE AND AREA COVERED." —'We **all** realize that an OPERATION SPREAD OVER TOO MUCH AREA causes PROBLEMS in HANDLING and SUPERVISION." —"Don't, however, limit the operation **to the point** of **CONGESTION."** —"In which **operations** could we most likely **make** improvements along the lines **implied** in this PRINCIPLE?" PACKING LOOSE ISSUE ROOMS INSPECTIONS ASSEMBLING SIZE CHECKING DISCUSS setup of these operations. Have group apply the principle **to** determine whether it is applied efficiently in the depot. ASK the following questiona **to** stress application of principle in terms of manpower. Have members give reasons for their answers. —"How many people can be used efficiently in strapping a carton?" —"How many people can be used efficiently in breaking a freight car door and getting working space inside the car?" —"How many people can be used efficiently to load or unload INSIDE the **freight** car?" —"How many people can be used efficiently in loading a pallet?"

(1) in movement and handling of materials, the operation should be limited in distance and area covered. This principle stresses the idea that operations spread over **too** much area **cause** problems in handling and **supervision** which do not occur in more compact operations. It is unwise, however, **to** limit a production line or area to a point of **congestion.** We can see clearly the importance of applying this principle in operations such as packing, **inspection,** assembly and certain checking operations.

In setting up such operations, it is necessary first to study just what and how much work must be done; then apply the first two principles, straight-line and continuous flow, which should eliminate much of the confusion that can occur; then limit the operation to an area in which people can work without interference, and without taking unnecessary steps, or making unnecessary motions in doing their part of the job.

(2) Often by combining different operations into one, we, can save. not only in working space required; but also in number of laborers required and amount of supervision needed. For example, in preparing shipments we are faced with many different operations: removing from the stack, strapping, "blocking out" old markings, stenciling new markings," weighing, checking, transportation to car, and loading car. Rather than move each container to five or six different locations in the warehouse to get the whole job done, it is certainly more economical to move the operations to one spot and, in the smallest workable area, perform the job with the least amount of handling of the containers.

(3) In connection with this principle, we must take care not to overman an operation to the extent that workers are getting in each other's way. Many times an operation is CONGESTED merely because there are too many people involved. We must determine by careful study how many people can efficiently perform a certain operation at one time in one location. For example, it would be very inefficient to permit three or four persons to strap an average-sized container; at most, two persons can do the job efficiently and then only if one doesn't have to wait on the other. Generally, it is inefficient for four or five persons to "break" a freight car. Usually, two persons can do the job faster and easier. Once inside the car, two persons can work more efficiently unloading one end of a car; three or four persons get in each other's way. When you see three "or four persons trying to load a standard sized pallet with average sized containers, it is probable that there is "congestion." The work area is too small for an efficient operation by more than two people, unless the operation is so planned and balanced that two "crews" can work in opposite ends of the car.

(4) Studying the various operations, considering the amount of space used, and the number of people working in the area will pay dividends. BE SURE THAT THERE IS CONCENTRATION OF OPERATION, BUT NOT CONGESTION.

e. Principle of efficient handling.	—***"The*** FOURTH PRINCIPLE—the PRINCIPLE of EFFICIENT HANDLING is one which too often is overlooked." —"It is perhaps the MOST IMPORTANT." —"It means simply that —In the MOVEMENT of MATERIALS, THERE SHOULD BE THE LEAST POSSIBLE HANDLING. " —"It should be applied to both MANUAL and MECHANICAL OPERATIONS." —"Despite the use of mechanical equipment, the MAJORITY of our MATERIALS HANDLING is still done by HAND."

This principle means that in the movement of materials, there should be as little handling as possible. Constant picking up and putting down is wasteful of time and energy, ties up the use of equipment, and causes damage. The principle of efficient handling should be applied to both manual and mechanical operations.

f. Applied to manual ***handling.***	(ILLUSTRATE this point on the blackboard. Example included with this outline can be used.) —"You will note that in this unloading operation 75 percent of the total WORK-HOURS consists of MANHANDLING. " —'[We can improve the efficiency of an operation immediately by REDUCING excessive MANHANDLING." —'What things in an operation cause a laborer to tire rapidly?" ITEMS TOO HEAVY EXTREME BENDING HIGH LIFTING LONG CARRYING —"Those are things that WE CAN CORRECT. " —"Can you think of any of your operations in which a laborer handles the same items two or three times?" ***Note.*** if not, point out an operation you have observed personally. Take care not to embarrass any member of the group.) —'We should constantly check our operations and reduce MANUAL RE-HANDLING to a minimum. " —"It is part of our jobs as supervisors to show our people the EASY WAY to do a job. " —"These few POINTERS on LIFTING maybe a guide in showing the workers the SAFE and EASY way. " (HAND OUT mimeographed material on "WHAT EVERYONE SHOULD KNOW ABOUT LIFTING. ") DISCUSS each point with the group or have one member demonstrate the correct procedure. DISCUSS carefully and in detail the following EASIER METHODS. Point out advantages and determine extent of use of each method. (1) SWING instead of STRAIGHT lift. (2) Unloading cars and trucks by TIERING method. (3) REPALLETIZING by use of "THREE PALLET" method.

(1) Regardless of the type of mechanical equipment we use, there will be SOME MANUAL HANDLING somewhere along the line. Manual handling should be reduced to a minimum and done properly.

(2) Manual handling of material can be illustrated if we break down the job of unloading a freight car in which we use two laborers and one fork truck and operator. For purposes of illustration, the job takes two hours to complete.

2 laborers x 2 hours = 4 man-hours
1 truck operator
x 2 hours = 2 man-hours
1 truck X 2 hours = 2 truck-hours

Total ---------- 8 work-hours

It can easily be seen that in the 8 WORK-HOURS consumed, only 2 hours were used by mechanical equipment and 6 hours consumed by man-hours. In other words, about 75 percent of the work in this job was done by MANUAL LABOR.

(3) The job might have taken many more hours to complete without the use of mechanical equipment, and may have involved many more laborers. Let's not get the misconception that mechanical equipment REPLACES manual handling it does not, it merely supplements it and makes it easier. By eliminating all excess manual handling, particularly that involving lifting, it is possible to increase immediately the efficiency not only of the laborer, but of the job itself. Whether picking up pieces from floor level or loading a truck from ground level, the element of fatigue rapidly cuts efficiency and production. The human body is a most flexible and adaptable machine, but this machine is also subject to two weaknesses: FATIGUE AND HABIT.

(4) A person can move a light object in the same plane from one position to another continuously for a long time and at a high production rate without excessive fatigue, if he/she does not have to take steps, bend extremely low, or reach extremely high. A good rule, which can be applied to the work done' by manpower alone, might be found in the

answers to these questions: Does the weight exceed 50 pounds? Does picking up require extreme handling? Does carrying require more than one step? Must lifting be higher than eye level? If the answer to any of these questions is "yes," then it is very doubtful whether manpower alone is the answer to that particular handling problem. Persons should be given the help of the proper type of mechanical equipment; this will help to reduce the element of fatigue. The elimination of rehandling will further reduce, the element of fatigue—LET'S PLACE THE MATERIAL IN ITS FINAL RESTING" PLACE AND LEAVE IT THERE.

(5) Part of a supervisor's job is to teach workers the EASY WAY to do a job. It was mentioned that the human body had two weaknesses: FATIGUE AND HABIT. It is important that we do everything possible to reduce the fatigue element and, even more important, that we guide our workers into correct habits of doing the job. Once formed, incorrect habits are difficult to break.

(6) The HANDOUT on "Lifting" should be mimeographed and distributed to the group for use in teaching workers. In addition to these correct methods for lifting, there are certain "knacks" or "tricks" that can be used to reduce the element of fatigue. For example, in handling containers of average size and weight, it is easier to move and lift them by using a certain "swing" motion than by a stiff or rigid lifting motion. In using this "swing" motion, the laborer can take advantage of pendulum motion, obtain a kind of rhythm, and reduce the physical effort required.

(7) In unloading average-sized containers from a freight car or truck onto trailers or pallets, a systematic method should be used to break down the load. The method might be called "UNLOADING BY THE TIERING METHOD." The load should be broken down in such away that the number of times it is necessary to lift the bottom cartons in the load to the top of the pallet is reduced to a minimum. Where repalletizing must be done, the "three pallet method" can be used as follows: Repalletize half of loaded pallet #l onto empty pallet #2; temporarily withdraw pallet #2 from the operation; place empty pallet #3 into position and repalletize the rest of pallet #1 onto empty pallet #3; half of loaded pallet #4 is repalletized on half-loaded pallet #3. Such a method reduces the amount of bending and lifting as a SHIFTING rather than a lifting process is employed.

g. Applied to mechanical handling.	—"To use our mechanical equipment to fullest advantage we must constantly try to: ELIMINATE EXCESSIVE HANDLING ELIMINATE REHANDLING AVOID INCORRECT HANDLING." —"There are certain PRECAUTIONS we must take to assure greater efficiency in use of equipment: PROPER TRAINING OF OPERATORS APPLICATION OF BOTH PRINCIPLES— STRAIGHT-LINE AND CONTINUOUS FLOW COMBINE CARRYING AND LIFTING OPERATIONS." —"In the majority of SHIPPING and RECEIVING OPERATIONS there should be NO STOPPING PLACE between the STORAGE POINT and the CARRIERS VEHICLE." DISCUSS with the group the shipping and receiving operation and have them determine whether there is rehandling—setting down and picking up-which could be eliminated.

(1) To use mechanical equipment to its fullest advantage, we must eliminate excessive handling, rehandling, and incorrect handling. Equipment improperly used can cause more waste and hamper operations to a greater extent than failure to use it at all. There are certain precautions that must be taken to assure efficiency in the use of equipment.

(2) Operators of mechanical equipment must be properly trained; this should include operators of equipment such as fork trucks, tractors, conveyors, and strapping machines. We should not take it for granted that because a person has been operating a machine over a period of time, he/she is operating it correctly or in the most efficient manner; we must be sure. We can be sure only by carefully spot

checking at frequent intervals and then providing time and means for improving his/her work by training.

(3) In addition, we must be sure that the application of the first two principles—STRAIGHT-LINE AND CONTINUOUS FLOW— be made in the use of equipment. We should determine the shortest possible moves and then take advantage of them. The "flow" of the equipment must be continuous, with no time wasted. Maximum loads . . . . . should be determined and carried to reduce the number of trips and pieces of equipment to a minimum. One large handling unit requires less total handling than many small units. Concentrating small packages into large units, as the palletized load plan, reduces handling time.

h. Principle of work.	"The PRINCIPLE OF WORK stresses the fact that the GREATEST AMOUNT of WORK MUST BE DONE in the LEAST AMOUNT OF TIME (MAN-HOURS)." —"The successful application of this principle is largely dependent upon the FIRST FOUR PRINCIPLES." —"To REDUCE COST and INCREASE SPEED we must constantly CHECK in TWO WAYS: TIME IT TAKES TO DO THE JOB MAN-HOURS USED IN DOING IT. "

(1) The fifth important materials handling principle may be referred to as the PRINCIPLE OF WORK. It cannot be supplied unless the other four principles have been adhered to and is actually the culmination of a BALANCED OPERATION through proper application of the other four principles. The principles of work means simply, doing the greatest amount of work in the least amount of time (man-hours). Speed of movement does not necessarily mean a good operation. A balanced operation, with each step performed in its proper sequence without lost motions, and at a speed consistent with the slowest step or capabilities of the personnel or mechanical equipment involved, is a good operation. The question, "How long does it take to do a job?" can be answered in two ways: Length of time it takes to accomplish the job, TOTAL MAN-HOURS it takes to accomplish the job; both are important in relation to results that are to be attained. The fact that a carload of materials has been unloaded in 1½ hours is a clue ONLY TO THE SPEED with which it was unloaded. The added fact that it took six persons 1 ½ hours to do the job is indicative of the MAN-HOURS required and also the efficiency of the job in relation to cost in manpower.

(2) We must remember that we want to accomplish TWO THINGS: REDUCE COST—directly in MANPOWER, in MONEY-and INCREASE THE EFFICIENCY with which the job is done. Figures indicating this decrease in manpower and increase in efficiency are difficult to compute, but it is most nearly accomplished by use of the TONS PER MAN-HOUR figure. How well this PRINCIPLE OF WORK is applied can also be measured by the TONS PER MAN-HOUR figure. Some examples of variations in operation and results in tons per man-hour follow:

i. Balance in an operation.	—"To do any MATERIALS HANDLING JOB EFFICIENTLY and apply the PRINCIPLE OF WORK, we must have BALANCE IN THE OPERATION. " —"By 'BALANCE' we mean-WORK has been PLANNED so that all MANPOWER and EQUIPMENT used on the job are WORKING CONTINUOUSLY WITHOUT LOST MOTION OR TIME." —"To get BALANCE in an operation: the TIME it take to perform EACH PART of the job must be determined and the DIFFERENCE EQUALIZED by the NUMBER of persons used and the PIECES of EQUIPMENT used." ILLUSTRATE what is meant by using example given or one which you have prepared from an actual operation which you observed and studied. —"After you have determined WHERE the operation is OUT of BALANCE, then CHECK EACH PART of the JOB to make sure it is being done PROPERLY. " ***Note.*** To illustrate how this can be done, use the suggested checklist if the tractor-trailer train example has been used. If you have used an example of your own, develop a similar check list by breaking down the job into all of its parts. (Have the group discuss each of the points and decide what is the "PROPER WAY.") —"If each part of this job cannot be improved-and we are convinced of that fact-THEN ADD or REDUCE MANPOWER or EQUIPMENT." —"We can also aid in the attaining of BALANCE if we take care to AVOID the following TIMEWASTERS: EQUIPMENT WAITING FOR LABORERS LABORERS WAITING FOR EQUIPMENT EQUIPMENT ARRIVING EMPTY WHEN PALLETS OR OTHER NECESSITIES SHOULD BE CARRIED WAITING FOR CHECKERS. "

(1) Even after the seemingly best method has been chosen, it will not produce the desired results unless there is balance in the operation. Need for synchronized and balanced operations is a most pressing problem in warehouses today. BY "BALANCE" IN AN OPERATION IS MEANT THAT THE WORK HAS BEEN PROPERLY PLANNED SO THAT ALL MANPOWER AND EQUIPMENT USED ON THE JOB ARE WORKING CONTINUOUSLY—WITHOUT LOSS OF MOTION OR LOSS OF TIME.

(2) In order to gain balance in any materials handling operation, the time it takes to perform each part of the job must be determined and the differences in production of the separate parts equalized by adding or reducing the number of persons and pieces of equipment used. For example, in unloading a boxcar, using a tractor-trailer train, we should determine: time it takes two persons to load pallet; time it takes tractor to travel to stack with loaded train, uncouple at stack, pickup empty train, and return to car; and time it takes fork truck to stack loaded pallets.

(3) In this operation, the tractor-trailer is the balance wheel and by increasing or reducing the number of trailers hauled, the entire operation should be kept continuous. After it has been determined where the operation is OUT OF BALANCE, we must then check each part of the job to make sure that it is being done properly—that the workers know how to do it. Applying this idea to the illustration, we would jot down the various parts of the job and then check them: Laborers handling material properly, the easy way; pallets properly placed on trailer; trailers placed in car correctly; trailers coupled and ready for the tractor; trailers in proper location at the stack; fork truck stacking properly, the easy and safe way; empty trailers in proper location near the car; and in multistory buildings check the elevator operation. If all of these operations are being done correctly-the easy and the safe way—then we should consider adding or reducing manpower and equipment.

(4) Quite often an operation gets out of BALANCE because of poor timing at the start. Part of the supervisor's job is to PLAN properly so that everybody and everything is READY and ON THE SCENE at the time the job is scheduled to start. Care should be taken to avoid such time wasters as: equipment on the job waiting for the laborers

to arrive; OR, laborers on the job waiting for the equipment; OR, both laborers and equipment on the job waiting for a checker; OR, equipment arriving "empty handed," when it should have brought pallets or other miscellaneous equipment needed.

DO NOT OVERLOOK THE LITTLE DETAILS THAT GO INTO MAKING AN OPERATION. LOOK FOR TIMEWASTERS IN ALL OPERATIONS!

8–134. Summary

Brief summary of main point%.	BRIEFLY SUMMARIZE MAIN POINTS —"To SUMMARIZE briefly, we can list THREE MAIN QUESTIONS which must be asked in analyzing a materials handling operation." (LIST points on blackboard.) BLACKBOARD ARE THE PRINCIPLES APPLICABLE? IS THE OPERATION BALANCED? IS EACH PART OF THE JOB DONE PROPERLY? —"There are NO SHORT CUTS-NO TRICKY OFFICE METHODS for analyzing a MATERIALS HANDLING operation." —"It requires CAREFUL STUDY ON THE JOB-some clearly ORGANIZED THINKING." —"After we arrive at what WE THINK is the BEST METHOD, we should PUT IT DOWN IN WRITING-not carry it around in our heads." —"Have the CORRECT METHOD AVAILABLE for YOUR FUTURE REFERENCE." —"Give the next fellow a break."

a. Throughout this session many points have been discussed concerning the THINKING ABOUT and DOING an efficient operation. The number of things to think about emphasizes that it is no simple job; that it has many complexities. The summary should stress the necessity for ANALYZING, in an organized way, EVERY JOB for which supervisors are responsible. The basis for such an analysis can be summed up in three questions:

Are the principles applicable?
Is the operation balanced?
Is each part of the job done properly?

b. After answering these questions we should be more able to spot the weak points, and take the necessary action to correct these weak points. REMEMBER, A SUPERVISOR CAN DO A BETTER JOB BY USING HIS/HER HEAD AND SAVING HIS/HER BACK.

HANDOUT

WHAT EVERYONE SHOULD KNOW ABOUT LIFTING*

1. Never try to lift beyond your own strength. Get help!
2. Always crouch down to what you are going to lift.
3. Get a good footing. Place feet eight to twelve inches apart.
4. Get a firm grip with fingers underneath the load whenever possible.
5. Keep your arms straight and keep your back in as near a straight up and-down position as possible.
6. Lift gradually. Avoid jerky motions!
7. Avoid twisting motions by shifting the position of your feet.
8. Lift by standing up or pushing up with the strong leg muscles. This takes the strain off the back muscles.
9. Put things down by generally reversing the lifting methods.
10. Your job may involve handling of cases, boxes, baskets, drums, or odd-shaped containers, under unusual conditions. Check your methods of lifting these with your foreman to make sure they are safe and proper.

*Published by National Safety Council.

Figure 8–3.

HANDOUT

MAIN PRINCIPLES. OF MATERIALS HANDLING

I

1. PRINCIPLE OF STRAIGHT-LINE FLOW. THE MOVEMENT OF MATERIAL BETWEEN ANY TWO POINTS SHOULD TRAVEL BY WAY OF THE SHORTEST DISTANCE. This is based on the old principle that "a straight line is the shortest distance between two points." In our consideration, it does not have to be a STRAIGHT line, but should always 'be the SHORTEST distance.

2. PRINCIPLE OF CONTINUOUS FLOW. MATERIAL SHOULD MOVE CONTINUOUSLY ALONG ANY PRODUCTION LINE. Material should always move as smoothly as possible. Spasmodic or interrupted flow causes confusion and delay.

3. PRINCIPLE OF CONCENTRATION OF OPERATION. IN MOVEMENT OF MATERIAL, THE OPERATION SHOULD BE LIMITED IN DISTANCE AND AREA COVERED. This principle stresses the idea that operations spread over too much area cause problems in handling and supervision which do not occur in more compact operations. However, it is unwise to limit a "production line" or area to the point of congestions.

4. PRINCIPLE OF EFFICIENT HANDLING. IN THE MOVEMENT OF MATERIAL THERE SHOULD BE THE LEAST POSSIBLE AMOUNT OF HANDLING. The constant picking up and setting down of material is wasteful of time and energy, ties up the use of equipment, and causes damage. The principle can be applied to both manual and mechanical operations as follows:

a. Principle of efficient handling as applied to manual movement: IN MOVING MATERIAL THERE SHOULD BE AS LITTLE MANUAL HANDLING AS POSSIBLE. Although it is the basis for all materials handling, manual handling should be reduced whenever possible.

b. Principle of efficient handling as applied to mechanical movement: To reduce handling, MATERIAL SHOULD BE MOVED WITH MECHANICAL EQUIPMENT WHENEVER POSSIBLE AND EFFICIENT. PROPER USE OF MECHANICAL EQUIPMENT IS ONE OF THE BEST WAYS FOR LOWERING COST AND INCREASING SPEED.

5. PRINCIPLE OF WORK. THE GREATEST AMOUNT OF WORK SHOULD BE DONE IN THE LEAST AMOUNT OF TIME (MAN-HOURS). Mere speed of movement does not necessarily mean a good operation. The PRINCIPLE OF WORK suggests the most efficient handling for the amount of time spent. Often apparently slow movements may be efficient if they are steady, continuous, direct, and synchronized-and balanced operation of work is the most pressing problem in our warehouse today.

HANDOUT

COMMON DEFICIENCIES, CAUSES, AND CONSEQUENCES

Common deficiencies	*Causes*	*Consequences*
Materiel release denials.	Incorrect inventory counts. Poor in float documentation control. Rewarehousing of stock in progress. Delay in placing materiel in location. Erroneous quantity, stock ***number,*** owner, or condition code recorded in receipt actions. Erroneous location recorded. Excess quantity selected in previous issue.	Special inventory required. ASDA/depot stock record imbalance. Delay or failure in supply fill. Additional manpower/paperwok requirements.
Failure to maintain relative humidity at 50% in controlled humidity (CH) facilities.	Warehouse doors left open when outside humidity conditions are unfavorable. Humidistats not properly calibrated. Faulty dehumidification equipment. Failure on the part of responsible personnel to periodically and properly inspect the CH facility and dehumidification equipment.	Improper humidity conditions maintained. Inefficient and/or unnecessarily costly operation of dehumidification equipment. Could adversely affect stored material condition.
Vertical stacking of material not being accomplished to full potential.	Storing material by hand rather than mechanically. Unevenly palletized material preventing effective stacking. Proper lift equipment not utilized (e.g., size, type, and capability not suited for job being performed). Proper storage aids (e.g., pallet support sets) are not utilized. Storage patterns no longer suitable fcr quantities normally stored.	Inefficient use of space. Additional locations required. Could cause other material requiring covered storage to be stored in open storage with accompanying increase in inspection, preservation, and packaging actions. Less covered, storage space available for new mission assignments. Square feet required per ton is high resulting in poor density factors.
Failure to perform quality control statistical sampling of locator file actions on a daily basis or failure to determine sources of errors uncovered during samplings.	Experiencing a satisfactory locator accuracy and discontinuing the quality control sampling on the assumption that such accuracy will continue indefinitely. Lack of management emphasis on both daily sampling and error source identification.	Undetected error introduction into the locator file. Possible increase in material release denials.

Figure **8-5.** ***Potential storage problems.***

COMMON DEFICIENCIES, CAUSES, AND CONSEQUENCES

Common deficiencies	*Causes*	*Consequences*
mproper utilization of bulk type torage space (honeycombing).	Inadequate planning and space planograph layouts such as storing short lot materiel in large storage blocks. Failure to accomplish timely rewarehousing actions. Improper stock selection resulting in vacant space in front of stacks.	Vaste of storage spaces. .0ss of control over space vailabilit y. tepeated unplanned rewarehousing ctions.
Aultiple "stock numbers 'in a bulk torage stack.	Desire to achieve higher stacking. Failure to use proper storage aids. Insufficient instruction to warehousing personnel.	Could increase material release lenials. additional handling actions to select r count stock. Possible materiel damage due to xtra handling actions or ncompatible weight conditions.
ncorrect item or quantity election.	Inadequate lighting. Duplicate MROS. Incorrect item or location identification. ncorrect data on forms, labels or lacards. Failure to consider unit of issue or mit of measure quantity. Mixed stock and failure to ecognize such. nadequate training of stock election personnel.	rebalance of stock records. ncreasse in inventory investigation. Possible increase in warehouse lenials. ncorrect item or quantity possibly hipped to the requisitioner. Possible delay in supply fill. Possible waste of assets and rocessing resources. Possible unnecessary transportation osts.
nadequate or improper packaging acking.	Use of substitute, inferior naterials. Packaging/packing instructions not vailable. Failure to recognize requisition priority, destination, and mode of shipment.	Underpackaged items are more usceptible to damage. Overpackaged items can result in excessive material and transportation costs as well as wasted manpower resources. Possible failure to meet due-out" date when overpackaging is involved.
Placing materiel received at the warehouse into holding areas or into aisles rather than directly into location.	Heavy workload surges. Improper scheduling of equipment and personnel. Lack of receiving personnel to properly palletize at time of receipt. Inadequate intra-depot transport capability.	Double handling actions required. Possible need to search hold areas or aisles for requisition fill. Obstruction of travel through aisles and possible delay in gaining access to other stock.

Figure 8-5. *Potent ial storage problems—Continued.*

COMMON DEFICIENCIES, CAUSES, AND CONSEQUENCES		
Common deficiencies	*Causes*	*Consequences*
/	Lack of understanding of double handling penalties. Inadequate visibility of workload conditions. Lack of training or lack of management emphasis on correct techniques.	
Placing different stock numbered items behind other stock numbered items in shelf and rack locations.	Lack of proper training of warehousing personnel. Inattention to warehousing tasks. Lack of sufficient storage space for additional items being received coupled with poor enforcement of proper warehousing procedures.	Possible lost assets. Delay in requisition fill. May result in erroneous inventory counts.
Not assuring containers are positioned on pallets and in the storage location so that identification markings are easily visible.	Lack of proper training of receiving and warehousing personnel. Lack of attention to good warehousing practices and their enforcement.	Can delay stock selections. Delays inventory counting and inspection actions. Can contribute to incorrect inventory count. Causes additional handling actions.
Excessive forklift truck travel distances (more than 400 feet one way).	Lack of planning in storage layouts and unloading or loading sites. Lack of proper long haul handling equipment (e.g., lack of warehouse tractor and trailer system or other vehicles to supplement the forklift fleet for intra-depot stock movement).	Inefficient use of forklift/intra-depot handling. Possible loading/unloading delays. Excessive equipment wear and manpower requirements.
Failure to develop and maintain storage space planographs.	Lack of management emphasis.	Timely storage space control and reporting affected. Improper storage layouts for type and quantity of stocks on hand.
Storing items in open storage when such items require covered storage.	Lack of sufficient covered storage space. Poor management of covered storage space.	Possible stock deterioration." More frequent inspections. More frequent preservation and packaging actions.
Storing items by commodity grouping rather than by physical handling requirements.	Earmarking storage space by commodity groups. Excessive emphasis on a particular commodity group for physical visibility.	Additional wide aisle requirements. Duplicate equipment requirements or excessive transfers of handling equipment among warehouses. Possible additional personnel requirements.

Figure 8-5. Potential storage problems-Continued.

COMMON DEFICIENCIES, CAUSES, AND CONSEQUENCES		
Common deficiencies	*Causes*	*Consequences*
Use of storage space for nonstorage purposes.	Establishment of excessive holding areas *or* processing areas in storage warehouses.	Reduction of net available space for storage. Poor vertical space utilization. Could cause material to be stored in open storage.
Failure to plan for large quantity receipts or receipts of large or heavy items.	Failure to use prepositioned receipt information as a planning consideration. Lack of management emphasis on preplanning for receipts.	Inefficient receiving actions. Can result in multiple locations for the same stock number. Possible delay in storing material. Possible inefficient use of storage space.
Failure to accomplish daily warehouse housekeeping actions (stock alignment, closing lids, etc.).	Lack of management emphasis. Lack of training. Heavy workloads. No routine schedule for examination or correction of such deficiencies.	Actions accumulate to major tasks. Can create safety hazards. General relaxation in discipline for accomplishing such actions. Unsightly appearance.
Failure to properly palletize applicable receipts to standard pallet patterns in the receiving area prior to movement to location.	Lack of management emphasis. Lack of standard pallet pattern guides in receiving area. Procedures not specific in this regard. Lack of training.	Workload placed on warehouse personnel. Delay in properly and promptly storing materiel.
Failure to apply identification placards/inventory aids to bulk storage locations.	Lack of management emphasis. Lack of training. Procedures are not sufficiently definitive. Placards and aids are not readily available.	Can cause delays in stock selection or selection of improper item. Places additional workload on inventory counters. Can introduce location survey errors.

Figure 8-5. *Potential storage problems-Contmwd.*