PLANNING A WHOLESALE FROZEN FOOD DISTRIBUTION PLANT

United States Department of Agriculture
Production and Marketing Administration

Washington, D.C.
June 1952

Marketing Research Report No. 18

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. Price 35 cents

PREFACE

This report is intended to aid wholesalers in planning improved distribution plant facilities.

In 1949 the Marketing and Facilities Research Branch of the Production and Marketing Administration, U. S. Department of Agriculture, completed a comprehensive study of frozen food marketing which revealed that one of the greatest needs of the frozen food industry is to improve wholesale distribution and warehousing facilities. After publication of the report entitled "Marketing Frozen Foods—Facilities and Methods" which was based on the 1949 study, the problems of adequate distribution facilities became magnified by the continued expansion of the frozen food industry. Recently, a number of wholesalers and a few public warehousemen have remodeled their facilities and others have built new distribution plants. Many distributors and warehousemen are planning improved facility changes within the next few years.

In building new wholesale plants or in remodeling old ones, wholesalers have had little information to guide them. When continuing research reveals further ways of improving distribution plant facilities, the results of findings will be published.

Acknowledgment is made to Harry K. Schauffler, Executive Director of the National Wholesale Frozen Food Distributors' Association, for his assistance in setting up the study on which this report is based and for reviewing the manuscript; also, to the following frozen-food wholesalers who made their plants available for detailed study and who assisted in gathering data: Carlton Eacho and David Odland, Washington, D. C.; Harold Leinbach, Reading, Pa.; William Walsh, Pittsburgh, Pa.; S. A. Kyte and Arthur B. Post, Detroit, Mich.; Joseph Gaudio, Camden, N. J.; Edward Hellman, Trenton, N. J.; and Sam Brown, St. Louis, Mo. About 20 other frozen food wholesalers were helpful in showing the authors through their plants.

Distribution problems were discussed with several officials of chain stores that deliver frozen foods to their individual stores from central warehouses. Warehousing and order-assembly problems were discussed with several grocery wholesalers and several drug wholesalers.

Special credit is due E. Clinton Stokes, agricultural economist, formerly with the Marketing and Facilities Research Branch, also Frederick C. Winter, assistant professor of industrial engineering, Columbia University and consulting industrial engineer to the Branch and Joseph F. Herrick, Jr., agricultural economist with the Branch for preparing the section of this report covering the "Selection and Use of Materials-Handling Equipment," and to A. B. Lowstuter, architectural engineer, and Charles D. Bolt, industrial engineer, all of the Marketing and Facilities Research Branch.

The study was part of a larger research project, covering the development of principles for improved layout, design, and location of farm and food product marketing facilities, under the general supervision of William H. Elliott, staff assistant for marketing facility and materials-handling research, Marketing and Facilities Research Branch.

CONTENTS

SUMMARY

Frozen-food wholesalers usually have three choices in obtaining facilities: (1) Lease space in a public refrigerated warehouse; (2) construct a plant designed to fit the wholesaler's individual requirements; or (3) get together with other frozen food wholesalers in a specially designed warehouse. Regardless of the choice made, the wholesale distribution plant should contain the following components: (1) Storage space; (2) order-assembly room, which may also provide some storage space; (3) order-holding space, which may be in the order-assembly or storage rooms; (4) covered platforms; (5) office space; and (6) toilet and washroom facilities. Other plant components may include: (1) Compressor room; (2) direct rail connections; (3) parking area and accommodations for refrigerating delivery trucks; (4) utility storage room; and (5) inspection and testing laboratory.

In planning for the storage of other than working stocks, frozen food wholesalers usually have a choice between storing principally in packers' and public refrigerated warehouses or providing adequate space in their own facilities. In choosing which should be used, individual wholesalers should consider: (1) Comparative storage and handling costs in each type of facility; (2) warehouse-to-plant cartage costs involved in public warehouse storage; (3) comparative ease of obtaining loans on stocks in each type of storage; (4) initial investment required in constructing facilities; and (5) control of inventories that may be had in each type of facility.

Where individual orders are assembled in the plant, an order-assembly room is needed because of the sale of a relatively large number of frozen food items in less-than-case quantities. With respect to temperatures, order-assembly rooms are either held at 0° (zero) or between 30° and 40° F. The latter are "warm" rooms. In zero rooms, space may be provided for storage and for holding assembled orders. Since frozen foods cannot be held for sustained periods in warm rooms, separate facilities must be provided for storage and for holding orders.

In zero room operations, dual assembly lines, each of which should be 60 feet long, are suggested for wholesalers who stock 100 frozen food items and whose peak daily sales approximate 1,000 cases. A single 88-foot line is suggested for the wholesaler who stocks 150 items but maintains the 1,000-case daily volume.

For warm-room order-assembly operations, either chute or pallet rack installations with single order-assembly lines are suggested. For the wholesaler stocking 150 items and with peak daily sales of 1,000 cases, 100 chutes and a 100-foot assembly line should be adequate. For the same scale of operation, 26 double-decked pallet racks and a 100-foot line might prove more desirable in plants handling products on pallets.

In several cities specially designed warehouses have been constructed to provide complete storage and distribution facilities for most of the wholesalers handling frozen foods in those localities. In addition to creating a frozen food "market," facilities of this type reduce the capital investment required for individual wholesaler plants, make possible a joint and more complete utilization of storage space, enable wholesalers to make common use of materials-handling equipment, and provide some of the advantages of operating in public warehouses.

Platforms, floors, doorways, column spacing, ceiling heights, and aisle widths should be properly designed for the types of materials-handling equipment to be used if maximum efficiency in handling operations is to be achieved. The types of materials-handling equipment which are adaptable to the frozen food industry fall into three broad groups: (1) Manual non-unit load equipment; (2) conveyors, and (3) unit-load equipment (pallets and skids). Scale of operation should be one of the major considerations in selecting equipment.

In developing the plant layout, proper integration of the various sections is important if maximum efficiency and managerial control are to be maintained. Provision should be made for definite lines for the flow of merchandise through the plant. Distances should be as short as possible consistent with the size of the plant, and the room should be arranged so that there will be a minimum amount of back haul.

In selecting the site for a wholesale frozen food distribution plant consideration should be given to: (1) The location of customers to be served; (2) convenience for motortruck and rail receipts; (3) the avoidance of traffic; (4) the cost of the land placed in condition to build; (5) the availability of space for expansion; (6) types of products other than frozen foods handled by the wholesaler; and (7) location of the public warehouse(s) used for long-term storage.

PLANNING A WHOLESALE FROZEN FOOD DISTRIBUTION PLANT

By James A. Mixon and J. Stanford Larson
agricultural economists
Marketing and Facilities Research Branch
Production and Marketing Administration

INTRODUCTION

The frozen food wholesaler is essentially a handler whose primary functions, other than those of obtaining and delivering orders, are receiving, storing, assembling orders, and loading out delivery trucks. This enterprise is usually conducted by independent wholesale firms or by chain store warehouses. All firms engaged in wholesaling frozen foods perform the normal operations of obtaining, handling, storing, rearranging, and transporting supplies. In addition, most independent wholesalers have responsibilities for the promotion, advertisement, and market development of the products they handle.

Some of the functions of frozen food wholesaling, particularly financing and storing stocks and promoting sales, are shared jointly with processors. However, most of the responsibilities in connection with the operation of a wholesale distribution business rest with the individual wholesaler: He has to bear some of the risk involved in price trends; he plans for and orders supplies; he obtains orders and maintains an organization to promote sales; he provides some storage facilities; he provides facilities, equipment, and manpower for assembling orders; and he delivers the merchandise. Since the wholesaler has the processor's assistance in seeing that stocks of frozen foods are available, most of the wholesaler's efforts are directed toward: (1) Sales promotion; (2) conducting the physical handling and storage operations in his wholesale plant with a view toward the distribution of supplies; and (3) delivering orders. It is the second of these efforts with which this report is concerned.

The suitability of the wholesale plant in many ways will determine the degree of success of the business. A well-designed and efficiently operated plant should result in low operating costs, and permit the wholesaler to deliver frozen food products in good condition.

In selecting facilities in which to operate, the wholesaler has at least three choices: (1) Obtain space and set up operations in a public refrigerated warehouse; (2) construct his own facilities; or (3) get together with other frozen food wholesalers in a specially designed warehouse that might be termed a "frozen food market." These possibilities are discussed in this report together with a comparison

of methods and facilities for assembling orders, suggestions for planning the plant layout, and considerations for selecting and using materials-handling equipment. Primary consideration is given to methods and facilities involved in wholesale plant operations.

The report does not attempt to answer the question as to whether a frozen food wholesaler who constructs his own facilities for distributing these products should depend primarily on public refrigerated warehouses for long-term storage space or whether he should provide for all, or the major part, of his long-term storage in his own facilities. To answer that question a study of the comparative costs of storing in different kinds of facilities as well as the availability of processors' stocks and the availability of in-transit storage space would be necessary.

THE COMPONENTS OF A WHOLESALE FROZEN FOOD DISTRIBUTION PLANT

Wholesale frozen food plants may be located either in public refrigerated warehouses or in privately constructed facilities. In either case, the wholesaler's frozen food distribution plant should comprise the components outlined herein.

Storage Space

Although a wholesaler may store part of his inventories in packers' warehouses or in in-transit or terminal public warehouses, he must also have storage space in his own plant to provide supplies from which merchandise can be drawn as needed for each day's operations.

Order-Assembly Room

Most wholesalers assemble each customer's order at the wholesale plant. This procedure requires a separate room or a special arrangement of facilities within the plant. These special facilities are required because a large number of frozen food items are ordered by customers in less-than-case lots which necessitates the opening of full cases and the handling of the loose packages.

Order-Holding Space

Order-holding space is needed for holding assembled orders before they are loaded onto delivery trucks. Space for this purpose may be provided in the storage room, in the order-assembly room if it is held at 0° (zero) F., or in a separate zero room used specifically for holding orders. Space in the plant for holding orders is unnecessary if orders are loaded from the order-assembly line directly onto a refrigerated delivery truck.

Receiving and Shipping Platforms

Covered platforms for receiving and shipping merchandise should be provided at wholesale frozen food plants. Platforms of either trailer-truck-bed height or refrigerator car-floor (including floor rack) height are necessary for receiving supplies if the greatest efficiency in handling operations is to be achieved. By the same token, platforms at delivery truck-bed height are necessary for efficient loading out operations. However, one platform for both receiving and shipping may be sufficient if receipts can be conveniently unloaded and stored when orders are not being loaded out. Where only one platform is provided, a compromise in its height is necessary.

Office Space

Office space should be provided as part of the plant layout, and the space allotted should be sufficiently large to allow for convenience and efficiency in performing the regular office work. Where the telephone sales system is used extensively for selling frozen foods, special arrangements should be made in the office to accommodate, at one point, telephones, inventory files, and price files.

Other Plant Components

Other components of a wholesale plant are: Accommodations for refrigerating and parking delivery trucks; compressor room; utility storage room; salesmen's conference room; inspection and testing laboratory; direct rail connections; and toilet and washroom facilities.

PLANNING FOR STORAGE

In planning their operations frozen food wholesalers can arrange for storage in one of several ways: (1) Store all except working stocks in public refrigerated warehouses or in packers' private warehouses; (2) provide long-term storage space in their own plants for a part of their inventories and store the remainder in public or packers' warehouses; or (3) provide adequate storage space for all stocks in their own facilities. Some of the factors that should be considered by wholesalers in deciding whether to use public or private storage facilities are discussed in this section. Data on the comparative costs of storing in the two types of facilities were not obtained in this study. Therefore, comparisons with respect to cost are not included herein. On the one hand, warehousemen contend that, in most instances, public warehouses can provide, through a more convenient location and the use of more efficient equipment, better service at a lower cost than could be provided by a wholesaler in his privately owned facility. On the other hand, a number of frozen food wholesalers contend that by operating his own warehouse, a wholesaler can integrate the functions of his warehouse and his wholesale plant, thus utilizing labor and equipment more efficiently, and that management, supervision, and clerical help can best be integrated in private facilities.

Storing in Public Warehouses

Public warehousemen who are specialists in the field of refrigeration and storage usually offer good storage conditions. Storage in public warehouses permits the wholesaler to operate with less capital investment in facilities; also, it affords him and his suppliers an opportunity to obtain loans on stocks in storage.

The extent to which a frozen food distributor who is constructing his own plant should plan to use public refrigerated warehouses for long-term storage is dependent on several factors: (1) Availability of economical public storage in the local distribution area; (2) location of the warehouse in relation to the wholesale plant; (3) arrangements made by packers for public warehouse storage space in the local distribution area; (4) availability of storage at packers' warehouses; (5) suitability of in-transit storage; and (6) business policies of the wholesaler and his ability to finance the construction of needed facilities.

In planning for storage in public warehouses, the frozen food wholesaler and his principal supplier should be careful to select warehouses that are strategically located with respect to both the areas of production and distribution. Public warehouses located at in-transit points can be used for assembling mixed carloads of frozen foods. Where foods are stored at in-transit points, advantage should always be taken of the "through" freight rate. A packer-distributor who packs vegetables in one section of the country, fruits in another location, and poultry in

209196 O—52——2

still another part of the country frequently finds it desirable to assemble stocks of these items in one place for distribution to wholesale outlets. The selection of a centralized storage point by a packer with several outlets eliminates the cross-hauling caused by local shortages and surpluses.

The principal concern of wholesalers using public warehouses for long-term storage are: The charges assessed by the warehouse for storing, handling, and performing other services; the relative ease of obtaining loans on stocks in public storage; and, if his plant is not located in the warehouse, the costs of warehouse-to-plant cartage.

Storage and Handling Charges

Charges for frozen food storage in public warehouses are assessed on the basis of types and quantities of products and types of containers. Additional charges are assessed for handling the products into and out of storage. Charges vary between public warehouses depending on the capital investment in facilities, wage rates, and other factors such as the supply of and demand for space.

Storage charges usually are assessed on a monthly basis, and, since public storage usually incurs a certain fixed cost, rates are much higher per hundredweight for receiving and storing small lots than those for large lots. The following example illustrates the storage charges (excluding handling charges) that a wholesaler might pay on specified lots of frozen vegetables:

Quantity received at warehouse	Monthly storage charges per hundredweight
Pounds	Dollars
Less than 300	0.40
300 to 999	.30
1,000 to 4,999	.23
5,000 to 14,999	.18
15,000 and more	.15

The charges for a storage month begin on the day the products are received at the warehouse. A fraction of a storage month counts as a whole month. It is important, therefore, that wholesalers who use public warehouses for long-term storage have adequate plant facilities so that merchandise may be withdrawn at or near the end of a storage month. Table 1 illustrates how a "loose" withdrawal schedule may result in the payment by wholesalers for considerably more storage time than is used.

Table 1.--Length of time 16 randomly selected lots of frozen foods remained in public refrigerated warehouses after being stored by wholesalers, in two cities, 1949 and 1950

Frozen food lots	Placed in storage	Taken out of storage	Days stored	Days of storage paid for	Days of storage paid for but not used
Number	Date	Date	Number	Number	Number
1. . . .	May 11	May 26	16	31	15
2. . . .	March 30	May 11	43	61	18
3. . . .	April 6	June 1	57	61	4
4. . . .	May 23	May 26	4	31	27
5. . . .	March 31	May 1	32	32	0
6. . . .	April 22	May 18	27	30	3
7. . . .	March 21	May 1	42	61	19
8. . . .	May 8	May 31	24	31	7
9. . . .	February 23	May 22	89	89	0
10. . . .	February 23	March 22	28	28	0
11. . . .	January 10	February 21	43	59	16
12. . . .	February 13	March 20	36	59	23
13. . . .	January 18	March 14	56	59	3
14. . . .	January 5	March 17	72	90	18
15. . . .	February 1	March 9	36	59	23
16. . . .	January 6	March 20	74	90	16
Total			679	871	192

The charges for handling products into and out of a public warehouse are in addition to the storage charges, although some warehouses bill the wholesaler for handling charges and the first month's storage charge as one item. Handling charges cover the unloading and loading of rail cars but usually do not include similar services for motortrucks. These charges are assessed on a hundredweight basis and usually are scaled in accordance with the storage rates shown in table 2. Breaking of lots for delivery purposes usually carries an extra delivery service charge. The handling of frozen foods across the warehouse platform from a common carrier to a private truck with warehouse labor and equipment is charged for at a rate which normally is about the same as that of the storage-handling fee.

Other Warehouse Services

Most public refrigerated warehouses are in position to perform from 25 to 30 services for the frozen food wholesaler. However, the services

Table 2.--Public refrigerated warehouse charges for handling and storing specified frozen foods in selected cities, 1947 1/ (Charges based on rates for carload lots)

Frozen food	Charges per cwt. for handling	Monthly charges per cwt. for storage	Cost per cwt. of storage for 1 year 2/
	Dollars	Dollars	Dollars
Fruits	0.17	0.18	2.33
Vegetables	.17	.18	2.33
Cream	.19	.22	2.83
Eggs	.12	.14	1.80
Poultry	.23	.25	3.23
Meat	.18	.20	2.58

1/ Handling and storage charges per cwt. based on unweighted average of charges made by warehouses in New York, Chicago, Denver and New Orleans.

2/ Computed on basis of only one handling charge and not considering other charges that would occur. The figures are derived by multiplying the monthly storage rate by 12 and adding the cost of handling.

of storage and handling previously discussed are the mainstay of the industry. Some of the most common of the miscellaneous services are: (1) Repacking; (2) reconditioning; (3) weighing; (4) sampling; (5) recoopering; (6) inspecting; (7) advancing cash for express; (8) furnishing dock space for loading and unloading vehicles; (9) special clerical services; (10) reporting inventory; (11) marking containers; and (12) providing delivery notices.

Ease of Obtaining Loans on Stocks

Under normal conditions, frozen food wholesalers or packers usually can obtain loans without difficulty on their products stored in public warehouses. Such loans are usually made by banks with the stipulation that the warehouse will permit the wholesaler or packer to withdraw from storage only that part of the merchandise on which the loan has been repaid. Insurance coverage usually is necessary before money can be borrowed on the merchandise. The insurance is issued at the wholesaler's or packer's expense, and the charges are in addition to other charges normally assessed.

Warehouse-to-Plant Cartage Costs

One of the principal items of cost that must be borne by the wholesaler who operates in his own facility but who depends on public refrigerated warehouses for a relatively large part of his long-term storage is the carting of products from the warehouse to his plant. The extent to which cartage affects the wholesaler's operating costs depends partly on the volume of business and partly on the distance from the wholesaler's plant to the warehouse. Moreover, a wholesaler with a relatively large volume of business who keeps his delivery trucks and drivers occupied throughout each working day on regular delivery assignments may find that carting frozen foods from warehouse to plant is a sizable expense. A wholesaler with a small operation might find that the normal deliveries to retail stores and restaurants will not keep the drivers fully busy during the week; consequently, only part of his cartage cost may be a direct additional expense, since he is able more fully to utilize motortrucks and workers.

The elements of cartage costs are: Travel cost to and from the wholesale plant; waiting at the warehouse for products to be delivered to the platform; loading at the warehouse; and unloading at the plant. Tables 3 and 4 show two examples of warehouse-to-plant cartage costs. Costs ranged from 1.4 cents per case for a wholesaler located only a few blocks from the warehouses to 4.7 cents per case for the wholesaler whose plant was 41 to 45 miles from the warehouses used.

Private Storage Facilities

The construction of a wholesale frozen food distribution plant with adequate storage facilities, of the type shown in figure 1, requires a relatively large capital investment, whereas the rental of space in a public warehouse does not require a large investment. Therefore, a number of wholesalers will continue to depend on public warehouses for long-term

Figure 1.--A private frozen food warehouse and plant. A common platform is used for in-and-out truck movements. This plant is of prefabricated construction. Rail connections, although not presently needed, are available for possible future use.

Table 3.--Labor and motortruck time and total warehouse-to-plant costs of a wholesaler having a private plant but keeping his reserve supplies at local public warehouses, in a large metropolitan area

Trip (No.)	Round-trip time and labor cost required to obtain merchandise from warehouse					
	Travel time, plant to warehouse and return 1/	Waiting time at warehouse	Loading time at warehouse	Cases loaded	Workers employed	Labor required	Labor costs 2/
	Hr.-Min.	Hr.-Min.	Hr.-Min.	Number	Number	Hr.-Min.	Dollars
1	0:06	1:25	2:08	800	1	3:39	3.29
2	:06	1:15	1:55	800	1	3:16	2.94
3	:06	1:55	1:45	1,065	1	3:46	3.39
4	1:10	:40	:25	85	1	2:15	2.03
5	:06	:12	:43	350	1	1:01	.92
6	:06	:05	:40	350	1	:51	.77
7	:06	1:35	1:56	965	1	3:39	3.29
8	:06	1:45	1:45	642	1	3:36	3.24
9	:06	1:18	1:56	895	1	3:00	2.70
10	:06	:47	1:17	660	1	1:30	1.35
Total	--	--	--	6,612	--	26:30	23.92
Average per trip	--	1:06	1:27	661	--	2:39	2.39

Trip (No.)	Unloading and moving supplies into storage at plant					Total labor cost	Total truck cost 3/	Total cartage cost
	Unloading time	Cases unloaded	Workers employed	Labor required	Labor cost			
	Hr.-Min.	Number	Number	Hr.-Min.	Dollars	Dollars	Dollars	Dollars
1	1:23	800	5	6:43	6.05	9.34	2.51	11.85
2	1:33	800	4	6:12	5.58	8.52	2.41	10.93
3	1:23	1,065	5	6:31	5.87	9.26	2.57	11.83
4	:15	85	4	1:00	0.90	2.93	1.25	4.18
5	:35	350	5	2:35	2.33	3:25	.80	4.05
6	:45	350	5	3:21	3.02	3.79	.80	4.59
7	1:16	965	6	7:50	7.05	10.34	2.43	12.77
8	:53	642	6	5:32	4.98	8.22	2.25	10.47
9	1:30	895	6	9:00	8.10	10.80	2.41	13.21
10	1:15	660	5	6:15	5.63	6.98	1.72	8.70
Total	--	6,612	--	54:59	50.51	73.43	21.20	92.58
Average per trip	1:05	661	--	6:30	5.05	7.34	2.12	9.26
Average cost per case								.014

1/ To nearest minute. Trip No. 4 was made to warehouse several miles from the wholesale plant. Other trips were to a warehouse only a few blocks away.

2/ Labor costs computed at an assumed rate of $0.90 per hour.

3/ Computed at 50 cents an hour. (Based on information supplied by wholesalers on depreciation, cost of operation, and maintenance of a $5,000 truck.)

Table 4.--Distance traveled, time and labor required, and total warehouse-to-plant cartage costs of a wholesaler having his plant in a medium-sized town but carting most of his supplies from public warehouses in a nearby city

Round trip	Distance traveled	Time required	Labor required 1/	Labor cost 2/	Truck cost 3/	Total cost
	Miles	Hr.-Min.	Hr.-Min.	Dollars	Dollars	Dollars
Travel:						
Wholesale plant to--						
First public warehouse	41	1:30	1:30	1.35	4.10	5.45
Second public warehouse	2	:15	:15	.22	.20	.42
Third public warehouse	7	:40	:40	.60	.70	1.30
Return to wholesale plant	45	1:35	1:35	1.42	4.50	5.92
Waiting for merchandise at:						
First public warehouse	--	:50	:50	.75	.36	1.11
Second public warehouse	--	--	--	--	--	--
Third public warehouse	--	:30	:30	.45	.20	.65
Loading merchandise at:						
First public warehouse (290 cases)	--	2:00	2:00	1.80	.80	2.60
Second public warehouse(100 cases)	--	:40	:40	.60	.27	.87
Third public warehouse (95 cases)	--	:40	:40	.60	.27	.87
Unloading merchandise at wholesale plant (485 cases) (four workers)	--	:55	3:40	3.30	.37	3.67
Total	95	9:35	12:20	11.09	11.77	22.86
Average cost per case						.047

1/ One man (truck driver) used for all operations except unloading truck at wholesale plant, an operation for which four men were used.

2/ Labor costs computed at an assumed rate of $0.90 per hour.

3/ Truck costs computed on $0.10 per mile and $0.40 per hour waiting time. Based on information supplied by wholesalers on truck depreciation and unpublished data obtained from Farm Credit Administration.

storage because they prefer not to invest capital for building their own facilities. A wholesaler attempting to build up his business in a new territory takes less risk by using public warehouse facilities than by constructing his own facilities. In some areas, however, adequate public warehouse space is not available and the wholesaler has no alternative except that of constructing his plant with adequate storage space.

The seasonality of storage receipts is an important factor in choosing between public and private storage facilities. If a wholesaler's receipts vary considerably from one season to another, the operation of storage rooms for all his receipts will result in considerable idle space during periods when stocks are low. However, with the advent of the frozen citrus concentrates, which are produced principally during the winter and spring months, the storage cycle for a general line of frozen foods is now fairly steady and results in a high percentage of year-round occupancy.

Because of the difficulties that might arise in obtaining loans on storage stocks in private warehouses, it is suggested that wholesalers who build warehouses for long-term storage include in their articles of incorporation authority to do business as public warehousemen. Such authority will permit a wholesaler serving as a public warehouseman to issue receipts which will usually constitute acceptable collateral to bankers who might be approached for loans on products stored by public depositors or suppliers. In such cases title to the products would remain with the supplier until he sells the product or any portion of it either to the wholesaler or any other customer. Generally speaking, warehouse receipts representing readily marketable staples which are in the custody of a warehouseman independent of the borrower constitute acceptable collateral. On such collateral bankers may loan as much as 25 percent of the capital and surplus of the bank to any one depositor. If the operator of the warehouse also stores his own commodities, ordinarily banking laws do not recognize receipts issued on such commodities as acceptable collateral to loans desired by the warehouseman.

Control of Supplies and Space

Of importance in planning private storage facilities is the fact that efficient warehousing requires special know-how concerning the control of supplies and space. Efficient storage operations require: (1) Adequate space for the volume of merchandise handled; (2) direct accessibility to supplies; (3) efficient utilization of space; manpower, and equipment; and (4) maintenance of an up-to-date inventory.

A wholesaler with a private plant should have, as a minimum, sufficient space to store one month's supply of merchandise. A number of wholesalers find it desirable to provide sufficient space to store at one time as much as one-third of their total annual volume. The wholesaler who has sufficient space for storing one-third of his estimated annual volume of frozen foods can usually receive most of his merchandise directly from packers' warehouses.

Space should be so arranged that ready access can be had to each item stocked. To obtain this accessibility it is often necessary to provide shelves, bins, or racks in the warehouse, as shown in figure 2, in which to store slow-moving items handled in small quantities. Such facilities also contribute to the efficient utilization of space.

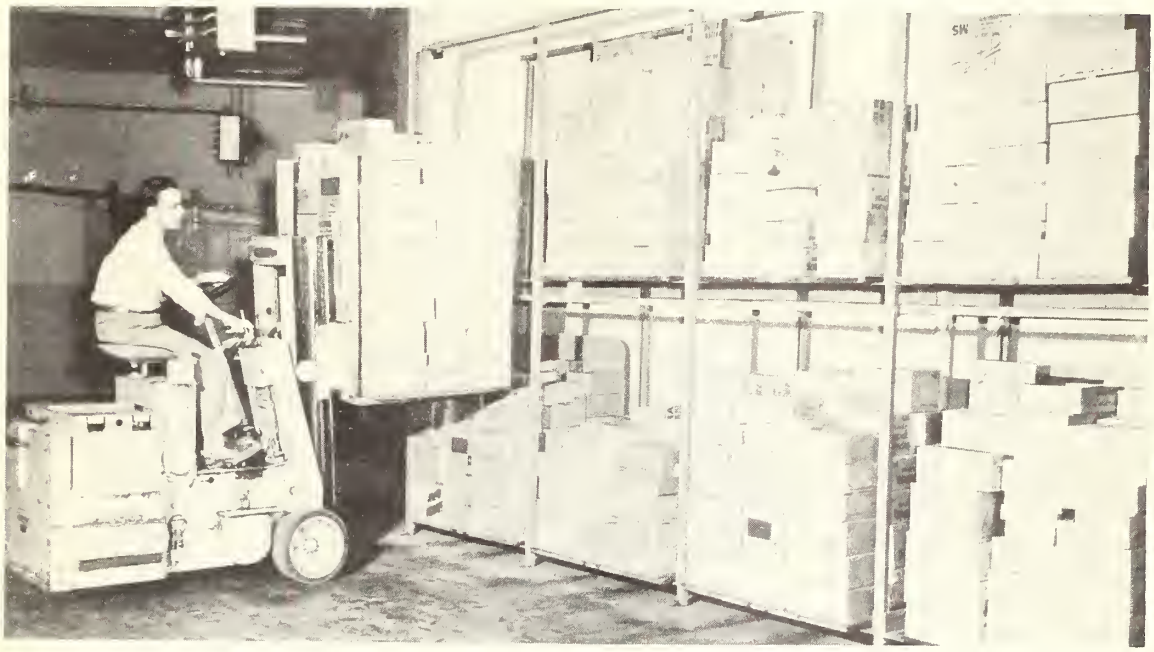


Figure 2.--Storage space in a warehouse might be better utilized if small lots of frozen foods and assembled orders awaiting delivery were stacked on racks or shelves. If operation is palletized, racks may be used as shown above. If commodities are hand stacked, several rows of shelves may be used.

The most efficient operations are those having the greatest utilization of space commensurate with efficient materials-handling operations. In planning a layout, efficiency in moving merchandise through all three cycles of materials-handling operations should receive primary consideration. These cycles of operations are: (1) Receiving; (2) order assembly; and (3) loading out. In warehouses where space is a limiting factor and ceilings are relatively low, the stacking of individual packages or cartons rather than palletizing, although increasing handling costs, may prove to be preferable from the viewpoint of space utilization. Hand stacking of packages usually permits greater utilization of space and allows about 75 to 80 percent of the gross piling space to be used for actual storage. However, if the warehouse is sufficiently large and the volume of the various items handled is sufficiently large, efficiency in handling can be gained in palletizing.

209196 O - 52 3

From the viewpoint of handling operations, 0° (zero) F., storage space should preferably be provided in one large room. Rooms having 5,000 to 10,000 square feet of floor space are common in recently constructed warehouses. In addition to being more adaptable to the use of mechanical equipment, large rooms usually have better air circulation and more even temperatures than do small rooms. Products should be stored to permit free air circulation. When stacks are built, several inches of air space should be left between the stacks and the insulated walls, and about 2 feet of space between the top of the stacks and the ceiling, refrigerant coils, or sprinkler pipes. Air circulation underneath the stacks can be provided by storing on 3- or 4-inch dunnage slats or pallets. Slats should run lengthwise in the direction of normal air circulation. Products that are solidly frozen at or below 0° (zero) F., can be piled in solid stacks. Products received not solidly frozen should be loosely stacked to allow air circulation, as shown in figure 3.

Care should be taken to see that posts in the zero room are spaced so as to allow the merchandise to be moved freely into and out of the stacks. Wide column spacing is preferable where mechanical equipment is to be used. In palletized operations the size of pallets should determine column spacing. Pallets should fit evenly between columns in order to prevent loss of space.

Figure 3.--When frozen foods are received at a warehouse or wholesale plant in a semi-thawed condition they should be stacked loosely until they are solidly frozen. A special low temperature room with air-blast might be used for this purpose.

In withdrawing merchandise from storage, honeycombing of the stacks should be avoided in order to conserve space. Where several rows of the same item are stacked together, withdrawals should be made from one of the stacks until the space it occupies has been completely vacated. Removal of cases from several rows at a time creates unusable vacant space, whereas when a whole row of a commodity is removed, as shown in figure 4, the space can be readily used for piling incoming merchandise.

The importance of a simple, efficient, and up-to-date inventory control system cannot be overemphasized. The systems most commonly used are: (1) The "bookkeeping" method; (2) the pegboard system; and (3) the

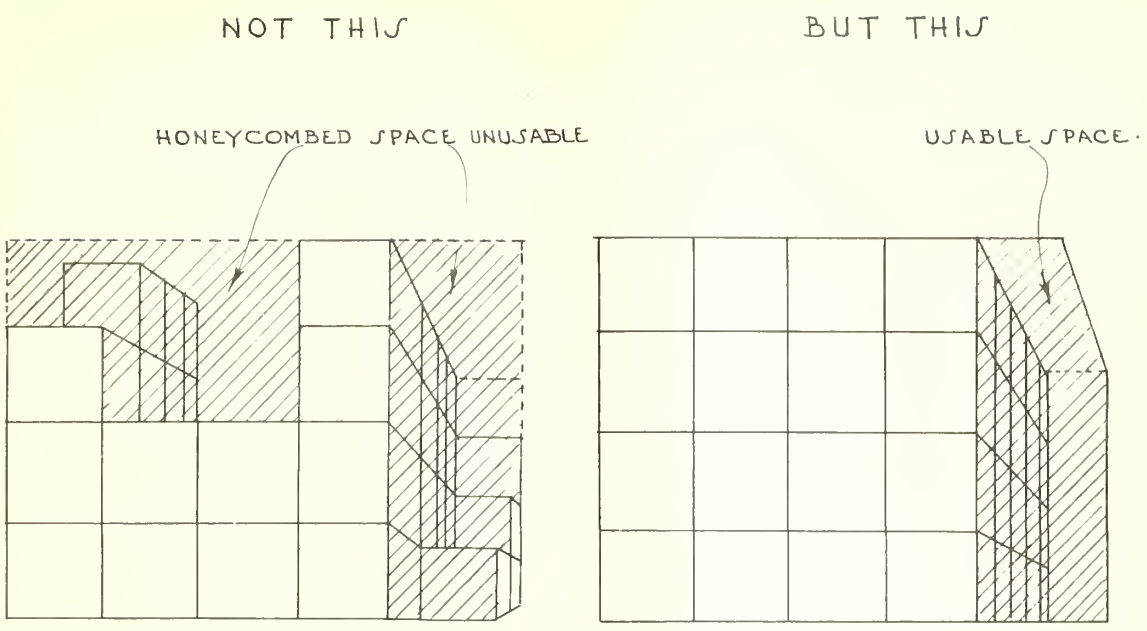


Figure 4.--Where several rows of a single item are stacked together, merchandise should be removed from only one stack at a time in order to maximize the amount of usable storage space.

punch-card system. For large-scale operations the punch-card system may be the most efficient. Medium- and small-size operators carrying a relatively small number of items, or wholesalers who sell exclusively by telephone, might find the pegboard system of control to be very satisfactory.

An inventory control should not be devised for the sole purpose of keeping current information on warehouse supplies. One of the principal aims of inventory control is to give management a daily picture of the entire operations—including sales. The mechanics of inventory control methods should tie in closely with the order-taking job of the salesmen and the order-filling job of the warehouse crew.

ORDER-ASSEMBLY METHODS AND FACILITIES

As previously pointed out, two of the more important functions of a frozen food wholesaler are: (1) Obtaining orders (sales promotion); and (2) delivering the merchandise ordered by retail stores, restaurants, institutions, and other buyers. Before individual orders can be delivered, the merchandise needed to fill the orders must be removed from storage and loaded onto delivery trucks either assembled into individual orders at the plant or for assembling of the orders at the point of delivery.

Three types of operations are in current use by wholesalers for obtaining, assembling, and delivering frozen food orders:

1. Obtain orders from customers in advance of delivery, and fully assemble each order at the wholesale plant. Load each order onto route delivery trucks in reverse order in which they are to be delivered. On arrival at each establishment remove the customer's order and leave it on his premises.

2. Obtain orders from customers in advance of delivery. Determine from the invoices the total number of cases of each item required for each truck route, assemble and load full cases of merchandise onto each delivery truck, and assemble the customer's order upon arrival at his store or restaurant.

3. Load an assortment of full cases of merchandise onto a truck, have the driver-salesman stop at the prospective customer's establishment, obtain his order, and assemble the items required to fill the order directly from the truck.

With the first type of operation, which is the type most widely used by wholesalers, special plant facilities are required for assembling and holding individual orders, and it is with this type of operation that the following discussion is concerned.

When individual orders are assembled in the plant for loading onto delivery trucks, "order assembly" covers the cycle of operations performed in: (1) Removing full cases or cartons of frozen foods from stacks in the storage area; (2) transporting the cases from the storage point to the order assembly room; (3) stocking chutes, bins, racks, or other facilities in the order-assembly room used for temporarily holding supplies; (4) assembling items for filling, marking, and checking individual orders; (5) transporting assembled orders from the order-assembly room to the order-holding room; and (6) stacking the assembled orders in

the holding room. Modifications may be made in this cycle of operations in individual plants depending on the plant layout and the types of equipment used. As an example, if assembled orders are stacked in the order-assembly room for holding prior to delivery, transportation may cover only the distance from the end of the order-assembly line to the stacking point rather than to an order-holding room. Moreover, stacking assembled orders may consist of positioning a loaded skid or pallet with the load remaining intact rather than removing the orders and manually stacking them.

When individual orders are assembled at the delivery point, no special order-assembly facilities are required in the wholesale plant except the platforms where full cases can be assembled for loading out. Each type of operation has some advantages, and the type used by an individual wholesaler should be largely determined by his business policy, the number of items handled, and the comparative costs. Fully assembling individual orders in the plant is the most widely used type of order-assembly operation because it gives a wholesaler good control over his operations and makes possible the stocking of a large variety of items. Also, since each customer's order is individually assembled at the plant and loaded onto the delivery trucks so that it can be readily identified and removed at the point of delivery, less time is required for making deliveries than with other types of operations. Since less truck time is required per delivery made, less delivery equipment will be needed to serve a given number of customers. However, when individual orders are fully assembled in the wholesale plants, more workers are required in the plant and special facilities are needed for handling orders. Assembling orders at the delivery point appears to be most efficient for the wholesaler who stocks only 30 to 40 items and sells mostly in case lots.

The total amount of frozen food delivered to one customer by a wholesaler in a single delivery is an "order," and a single product within an order is an "item." An order may consist of a single item or a large number of items. Moreover, an order may consist of only six consumer-size packages of one item or it may consist of full cases of each of a number of items and less-than-case lots of other items. Orders delivered to retail stores, restaurants, or institutions usually consist of packages of some items in less-than-case lots and some items in full-case lots. Less-than-case quantities of a single item are usually sold in minimum quantities of a dozen or a half dozen. The extent to which full cases are broken in assembling individual orders depends in part on the size of case in which an item is packed. Cases of frozen foods usually contain 24, 36, or 48 packages. However, some products are now packed 12 packages to the case. Frozen fruits and eggs for the institutional and industrial trades, for the most part, are packed in tin containers of 30- and 50-pound sizes. Although it has been assumed in some quarters that more extensive use of 12-package cases would reduce the number of cases to be split in assembling individual orders and thus

reduce the costs of frozen foods, this assumption has not been substantiated. The 12-package cartons are more costly in certain respects than are the larger sizes--principally in the cost of the cartons themselves for incasing equal amounts of products. Moreover, an increased amount of labor is required for stitching, stenciling, casing, sealing, loading on handling equipment, moving into and stacking in storage rooms, moving out of storage, and loading into carriers the 12-package case in comparison with that required for a given volume in larger-sized cases. Observations at several packing plants indicated that the additional cost to the packer for using 12-package cartons instead of the 36-package ones ranged from 2 to 4 cents per dozen consumer packages. In addition, increases in transportation and warehousing costs must be considered. However, wholesalers who sell large amounts of frozen foods in units of 12 may find that the use of the dozen-package carton will save enough in plant handling costs to more than offset the additional cost of packages packed in this size carton. Since a large percentage of frozen food items are still being sold in units of a half dozen, it is more efficient to split large cartons than to split the smaller ones.

Planning In-Plant Order-Assembly Operations

The methods and equipment to be used and the facilities that will be needed for performing the entire cycle of order-assembly operations in the plant should be determined by the individual wholesaler after consideration has been given to the following factors: (1) Total volume of business; (2) number of frozen food items stocked; (3) volume sold in less-than-case lots; (4) services offered to customers; (5) temperature of order-assembly room; (6) use of insulated containers; and (7) limitations imposed in remodeling an existing facility. An interrelationship exists between a number of these factors. As an example, if a daily delivery service is offered to customers, more equipment and facilities may be required to handle a given volume of business than would be required to make deliveries on alternating days.

Total Volume of Business

In determining the types and amounts of equipment and the size and layout of order-assembly facilities needed to perform most efficiently order-assembly operations, peak volume of business, if any, must be considered in addition to the total volume over an annual period. The volume or tonnage of frozen foods to be handled through the cycle of order-assembly operations is particularly important in selecting materials-handling and other kinds of equipment, since the monthly or annual hours of use of such equipment will determine its fixed or overhead cost per hour. If the monthly or annual hours of use of equipment requiring a substantial capital investment, such as

fork-lift trucks and pallets, are relatively low, the fixed costs per hour will be relatively high and these costs may offset possible efficiencies when compared with equipment requiring a smaller investment. All materials-handling operations in the plant should be considered in determining annual hours of use of applicable equipment.

Overhead costs should also be considered in determining the number and size of special rooms that should be provided for most efficiently performing order-assembly operations. Small volume wholesalers might assemble orders in the storage room. However, large volume wholesalers may find order-assembly operations can be performed more efficiently by providing special order-assembly and order-holding rooms. In either case, the amount of floor space, and the consequent investment, required for efficient operations will be influenced by the number of items stocked and the methods used for assembling orders in addition to the volume handled. Criteria with respect to floor space needed for handling specified daily volumes, when variable numbers of items are stocked, with different methods are described later in this section.

Total Number of Items Stocked

Although some wholesalers sell only 30 to 40 fast-moving frozen food items, a relatively large number of wholesalers sell over 100 items, and a few sell as many as 300 items. Working space along the assembly line, where cases are split as needed and items for individual orders are brought together, must be provided for all items stocked. Even though working space for the various items may be provided in roughly the proportion that each item has to the total volume sold, a considerably longer assembly line will be needed where a large number of items are stocked than that required for a relatively small number of items, to assemble the same volume of frozen foods. Although full cases of two or three slow-moving items may be stocked in the same bin, chute, or rack, depending on the method used, exact proportions between volumes of the slower moving items and space cannot be achieved.

Volume Sold in Less-Than-Case Lots

The splitting of full cases of a relatively large percentage of the total volume handled by frozen food wholesalers is, of course, the practice that makes necessary special facilities and equipment for order-assembly operations. The sale of full cartons only would eliminate the need for special order-assembly and order-holding rooms and permit orders tc be assembled directly from storage stacks.

However, data obtained from 10 wholesalers in 1950 show that, other than bulk quantities delivered to chain store warehouses, the size of their combined sales of frozen food items per order and the proportion to the total sales were: (1) Items sold in one-half dozen quantities, 35 percent; (2) items sold in one dozen quantities, 45 percent; and (3) items sold in full cases (2 dozen or larger), 20 percent.

Where packages are sold in less-than-case lots, cartons must be opened, the required number of packages removed, and these packages placed either in an empty carton or in a carton with other items. To simplify order-filling operations and minimize errors, full cases required in filling individual orders are usually moved over the order-assembly line with the less-than-case quantities.

Delivery Services Offered Customers

Wholesalers who require 24 hours between the time orders are received and deliveries are made can usually plan a more systematic and efficient order-assembly operation than can wholesalers who give quicker delivery service. Moreover, the costs of loading out delivery trucks and delivering the merchandise are likely to be much less where one delivery per day service is given. However, in a typical operation where two order fillers report for work at 7 a.m., and another crew of the same size reports at 4 p.m., in order to provide quick service, a smaller amount of space in special facilities may be required, particularly for holding orders, than would be required if the wholesaler operated on a one delivery per day basis and had a four-man crew report for work at 4 p.m.

When relatively quick delivery service is given, the methods and types of equipment used for performing order-assembly operations should take into account the smaller crew size usually employed at one time and the consequent less possibility for specialization of labor. If a two-man crew is used, each worker must, of course, perform a much larger range of duties than would be required with a four-man crew.

Temperature at Which Order-Assembly Facilities Are Held

Storage and order-holding rooms in wholesale frozen food distribution plants, in which part of the cycle of order-assembly operations is performed, are held at or near 0° F. Order-assembly rooms, in which the major portion of this cycle of operations is usually performed, may be held either at or near 0° F. (zero), or between 30° and 40° F. In the industry, the latter are usually referred to as warm rooms. In choosing between zero and warm rooms, the principal factors to be considered are: (1) Effect on product temperature; (2) productivity of labor; and (3) possible utilization of storage and working space.

Effect on product temperature.--The principal advantage of zero-room operations is that little if any risk in loss of quality is involved because of possible rises in product temperatures. Reports of laboratory research tests indicated that the effects of temperature rises on product quality vary by products, the amount of temperature rise, and the length of time the product remains at the higher temperature. Concerning the handling of frozen citrus concentrates, the director of research of one corporation, stated: "Loss of temperature and retention for very short periods (1 to 2 days) at, say, 10° to 15° F., does not appreciably injure

the product. However, recovery of the temperature is very slow." If the temperature of the product rises during the order-assembly process in a wholesaler's warm-room operation, and if the product is to be delivered to customers in unrefrigerated trucks and displayed in cabinets at temperatures above zero, deterioration is likely to occur. No attempt has been made in this report to appraise the effects of various temperature changes on product quality.

Figure 5 shows the average rises in product temperature when removed from a -5° F. storage room and held in unopened cases, opened cases, and loose packages for 6 hours in a room held at a constant temperature of 36° F. Temperature rises were rather rapid for products in individual consumer-size packages placed on work tables in small stacks. Merchandise left in opened cases and packages stacked several deep in bins also showed rapid rises in temperature, but not so rapid as the temperature rises shown in loosely stacked packages on work tables. Full unopened cases in stacks showed very slow rises in product temperature. Although this test was conducted over a 6-hour period, it would be unusual for loose packages of merchandise and opened cases to remain in warm order-assembly rooms for that length of time. Even in the least efficient operations care is usually exercised to see that turnover is rather rapid for loose packages and merchandise in opened cases. Wholesalers who operate their order-assembly rooms intermittently during most of the working day should use zero rooms to minimize handling and provide the merchandise with adequate protection.

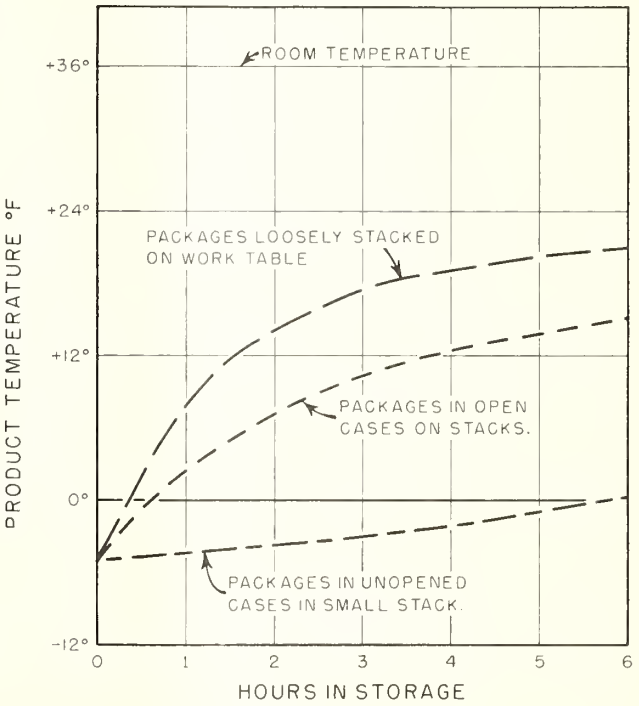


Figure 5.--Average temperature rises of frozen peaches, orange juice concentrate, cauliflower, and peas when removed from storage at -5° F. and placed in a room held constantly at 36° F. Four thermocouples were used in each of the three situations tested. These were located in packages, stacks, and cases so that the results would indicate a nearly average temperature.

Productivity of labor.--The chief disadvantage of zero-room operations is the loss of time taken by order fillers for "warm-up" periods. Wholesalers usually permit order fillers working in zero rooms to take

209196 O—52——4

about 10 minutes out of each working hour to warm up. During an 8-hour operation warm-up time amounts to about 60 minutes of unproductive time since warm-up time at lunch hour and at the end of the working day is usually taken on the employee's time. Moreover, since order fillers working in zero rooms have to wear heavy clothes which hamper their efforts, they are somewhat less productive than order fillers working in a warm room and wearing lighter clothing.

Unproductive time of order fillers working in warm rooms usually amounts to 10 to 15 minutes during an 8-hour period, which is allowable for personal needs. Personnel turn-over among order fillers is thought to be somewhat less in warm-room operations than in zero-room operations.

Since zero order-assembly rooms also can be used for storing reserve merchandise, a more flexible schedule which permits better utilization of labor can be used for stocking the order-assembly line than is possible with warm-room operations. However, since order fillers must remove individual cases from stacks in assembling items for individual orders, stacking more than one pallet load high is not desirable. Because cases of frozen foods can be stacked en masse along the order-assembly line in zero rooms, the line can be somewhat shorter than that in warm-room operations--a feature which is conducive to greater productivity on the part of order fillers.

Space utilization.--Since considerable quantities of frozen foods can be held in zero order-assembly rooms, less separate storage space will be needed than for warm-room operations. Where public refrigerated warehouses are used, items can be withdrawn from storage in relatively large quantities. Less aisle space is required in zero rooms than that for warm-room chute or warm-room palletized operations.

Use of Insulated Shipping Containers

Insulated shipping containers of the type shown in figure 6 are used by some wholesalers for making deliveries of frozen food orders, particularly when the motortrucks are unrefrigerated. Where such containers are used, the order-assembly line must be designed accordingly.

Limitations Imposed by Existing Facilities

A number of wholesalers will continue to operate in public refrigerated warehouses and other facilities not specifically designed for the wholesale distribution of frozen foods. In improving their order-assembly operations, these wholesalers may find that operations must be planned to fit the facility rather than having the facility designed to fit the operations. Although the suggested layouts for order-assembly rooms described in this report can be modified in numerous instances to meet limitations imposed by existing facilities without materially sacrificing efficiency, the ideal situation is one in which facilities are constructed "around" the operations.

Work Elements Involved in Filling Individual Orders and Moving Orders to Holding Room

The work elements involved in filling individual frozen food orders, by use of an assembly-line method, after the order-assembly room has been stocked are shown in figure 7. (Methods and equipment for performing intraplant handling operations required in stocking order-assembly rooms vary by types of operations in the room itself and are discussed later in this report.) Data from time studies of assembly-line order-filling operations of the type shown in figure 7 indicate that individual orders can be filled, moved to the order-holding room, and stacked at a rate of about 7 man-minutes per order. The number of workers required on the line and the labor requirements per order are dependent on the volume moved over the line during a given period and the number of items stocked. Other factors that affect the size of crew required are: (1) Volume sold in less-than-case lots; (2) temperature of order-assembly room; (3) skill and effort of workers; and (4) use of insulated shipping containers.

Figure 6.--Individual packages and/or full cases of frozen foods can be packed in insulated shipping containers for delivery to customers. Frozen foods in these containers can be delivered with products that do not normally require refrigeration. Dry ice is placed in the top of the container unless hauls are of very short duration. Wholesalers who make extensive use of these delivery containers should make special provisions for packing them during the order-assembly process.

Time study data also reveal that slightly more time is required for filling identical orders when one worker fills a complete order than when an order is filled on an assembly-line basis. More time is required than in the assembly-line system principally because a greater amount of walking is necessary and one worker has difficulty in becoming familiar with the location of all items handled. Figure 8 shows an example of the path followed by one worker in filling an order.

STATION NO. 1

1. Examines order sheet.
2. Takes empty case off of shelf and places it on conveyor.
3. Takes 6 packages of item from table and places them in case.
4. Places order sheet in case with 6 packages.
5. Pushes case down conveyor and walks along beside it.
6. Takes case from table already containing 12 packages (½ full) and places on conveyor.
7. Pushes both partly filled cases down conveyor and returns to pile of order invoices.

STATION NO. 2

8. Examines order sheet and pushes 2 cases further down line.
9. Takes full case from chute, carries it to conveyor, and sets it down behind other two cases.
10. Marks full cases with order and route number.
11. Takes 12 loose packages of item from table and puts them in case already containing 12 packages, closes flaps on case.
12. Marks full case with order and route numbers and pushes cases down conveyor.
13. Examines order sheet.
14. Takes full case from chute, carries it to conveyor.
15. Opens full case.
16. Empties packages onto table, and places empty case on shelf above.
17. Takes 6 packages of item from table and places them in case on conveyor already containing 6 packages.
18. Puts order sheet in front case containing 12 packages, pushes 3 cases down conveyor and returns to next order.

STATION NO. 3

19. Examines order sheet.
20. Takes 6 packages of item from table and places them in case on conveyor already containing 12 packages.
21. Takes full case from chute, carries it to conveyor.
22. Opens full case, takes out 12 packages, placing them on table (leaving 12 packages in case).
23. Examines order sheet.
24. Takes 6 packages of item from table and places them in case containing 18 packages.
25. Marks full case with order and route numbers and closes flaps.
26. Takes full case from chute and places it on conveyor.
27. Marks full case with order and route numbers.
28. Places order sheet in front case with 12 packages and pushes all cases in the order down the line.

STATION NO. 4

29. Examines order sheet.
30. Takes small empty case from shelf above table.
31. Takes 6 packages of item from table and places them in small empty case.
32. Marks small case with order and route numbers and closes flaps.
33. Takes 12 packages of item from table and places them in case already containing 12 packages.
34. Marks full case with order and route number and designation of pieces in order, puts order sheet under the flap, and pushes all cases to order checker.

ORDER-CHECKING STATION

35. Spot checks items in orders, loads cases on 4-wheel hand truck, pushes loaded hand truck into order-holding room, picks up empty truck, recaps driver route sheet, and exercises some supervision over operation.

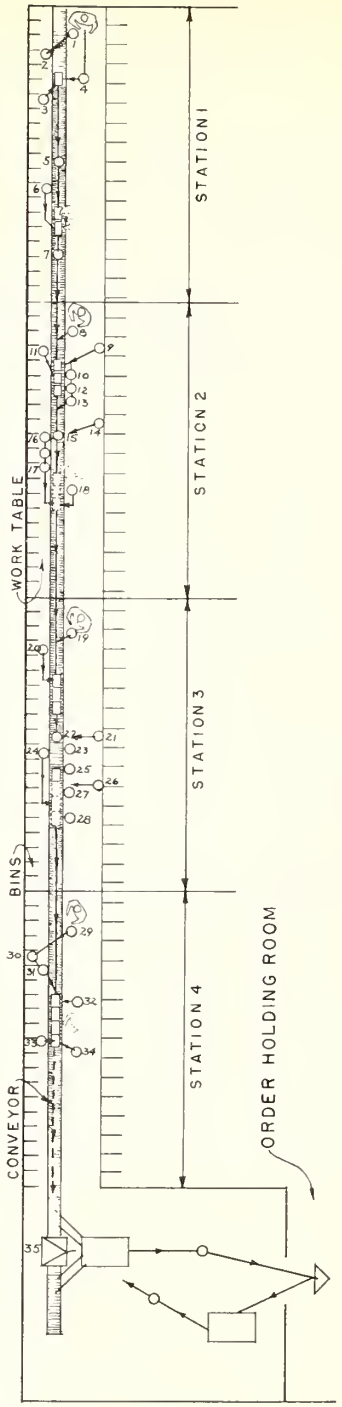


Figure 7.--Work elements and the sequence in which they are usually performed in filling an order consisting of 5 items of one-half dozen packages each, 4 items of 1 dozen packages each, and 2 items each for a full case. A warm-room chute operation is used for illustrative purposes but the elements of the operations performed would be basically the same for other types of operations.

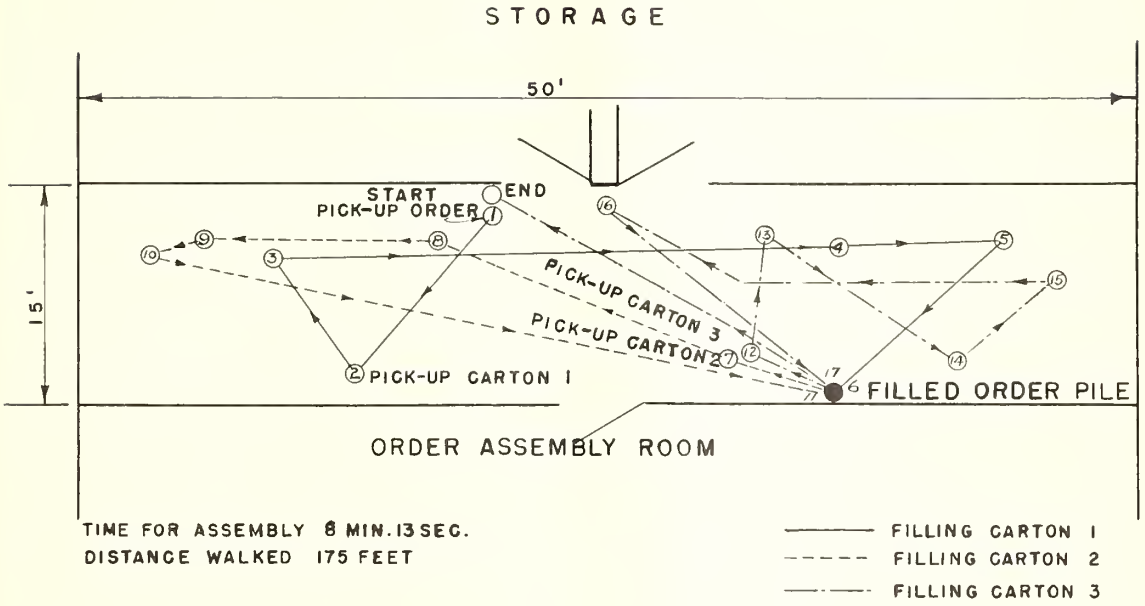


Figure 8.--A diagram showing the extent to which an order clerk walked in completely filling one order consisting of 5 items of one-half dozen packages each and 5 items of one dozen packages each. The lines represent the path followed by the worker. The time might be reduced by arranging the order-assembly set-up, allowing more space for the systematic arrangement of working stock.

In assembly-line methods only one worker is provided, as a rule, for checking and off-loading filled orders from the assembly line. This crew organization is predicated on the adoption of a thorough spot-checking system rather than a complete check of each order. One of the order fillers may be used part time if complete checking of the items is desired.

Orders off-loaded from conveyors and moved to and stored in the order-holding area by the checker are loaded onto delivery trucks the following morning by a day plant man and the truck drivers. In some plants using assembly lines no checkers are used while orders are being filled--the last order filler on the line off-loads the conveyor. Orders are checked the following morning as they are loaded onto trucks. If orders

are loaded directly onto refrigerated delivery trucks as the orders are assembled, an additional worker is required to stow the merchandise properly in each truck and replace filled trucks with empty ones.

Methods and Facilities for Assembling about 240 Frozen Food Orders, Totaling 1,000 Cases, Daily

Zero-Room Operations

In plants where orders are to be assembled in a room held at zero (0° F.) temperature, the order-assembly room should be planned to provide space for short-term storage and for temporarily holding assembled orders. The amount of short-term storage space provided in this room should not, of course, be so large that storage operations interfere with or lessen the efficiency of order-assembly operations. A separate order-holding room would be necessary only if facility limitations were such that adequate space of correct proportions could not be obtained in one room.

Dual order-assembly line.--In zero-room operations, dual assembly lines, each 60 feet long, are suggested for wholesalers who stock about 100 frozen food items and whose peak daily volumes of sales approximate 240 orders totaling roughly 1,000 cases of frozen foods.

The combined order-assembly and order-holding room shown in figure 9 is 40 by 90 feet. Where possible the room should be located adjacent to both the storage room, from which frozen food stocks will be received, and the loading platform, over which assembled orders will be moved for loading onto delivery trucks. Space for holding assembled orders should be at the end of the room nearest the loading platform, and the assembly lines should move the orders in that direction to minimize transportation distances and eliminate back hauls. Space for reserve stocks of the slower moving items should be provided at the opposite end of the room near the beginning of the assembly lines.

The "assembly lines" consist, in part, of two parallel 60-foot lines of 12-inch gravity roller conveyors which are connected at one end by use of curved sections to form a U. These lines are placed lengthwise of and in the approximate center of the room and are separated by a 52-inch double work table-bin installation, of the type shown in figure 10, which runs the entire length of the dual line. The top of a single work table is 26 inches deep, 14 inches of which is level and is left open for working space, and 12 inches of which is slanted toward the edge opposite the conveyors and is occupied by bins. Bins are 18 inches wide and are separated by removable partitions which fit in edgewise against a 3-foot high backboard. Thus, 40 12- by 18-inch bins are provided for each line. Since the 40 bins have to accommodate 60 items, some of the bins can be stocked with two or more items. The conveyor line is mounted 2 feet above the floor level. The top of the conveyor is roughly 6 inches below the top of the work table.

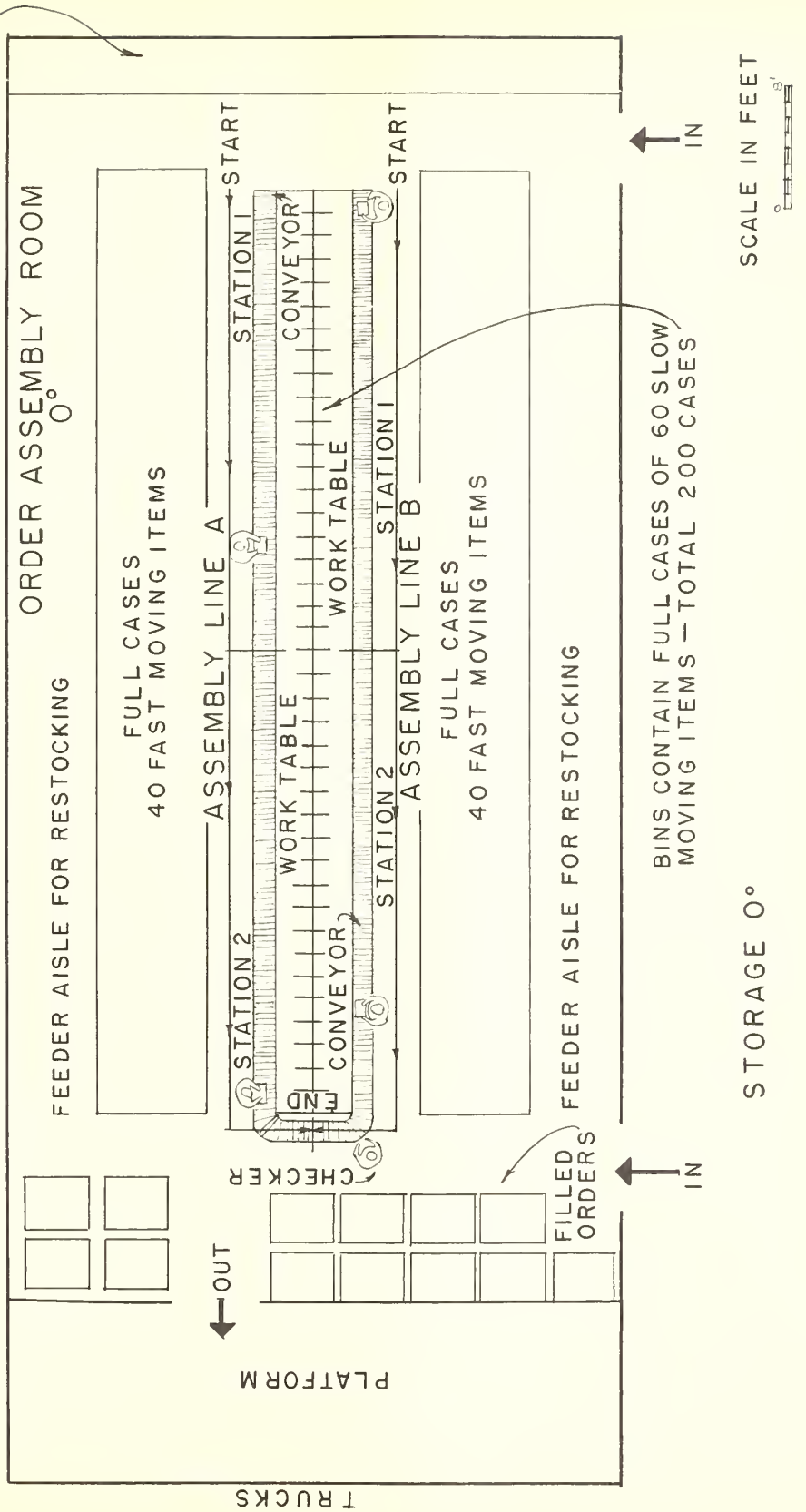
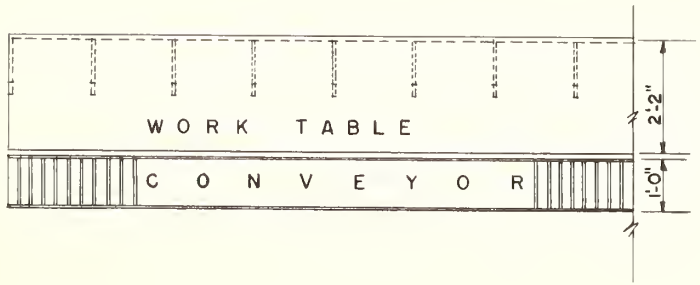
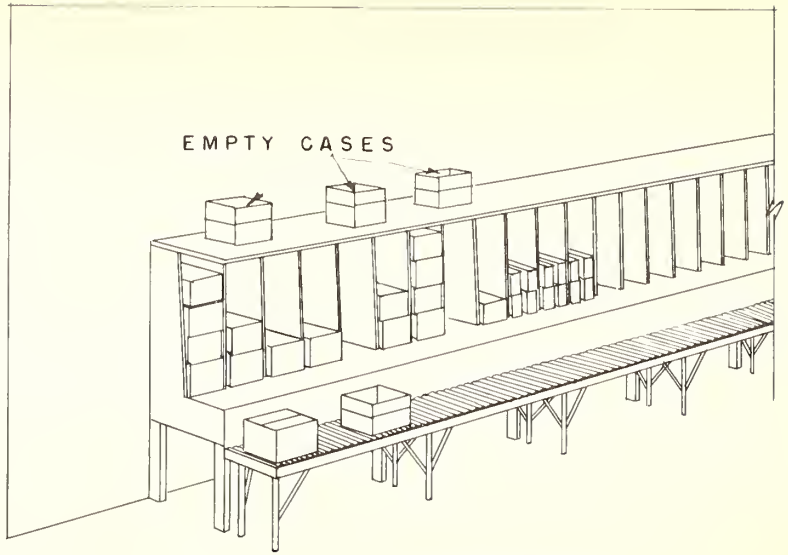


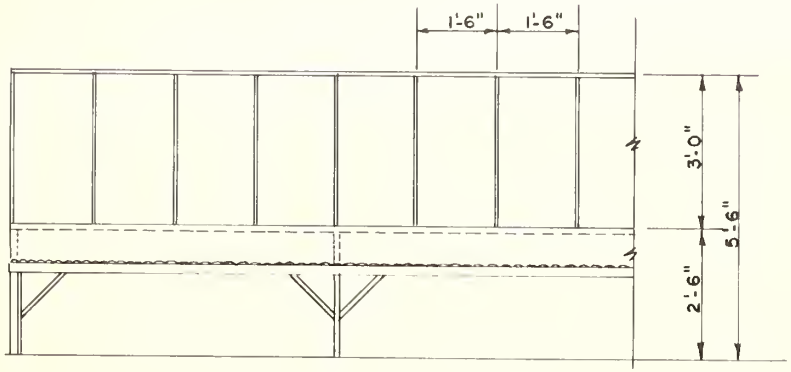
Figure 9.--Suggested layout for a dual order-assembly line in a zero room designed for a wholesaler stocking about 100 frozen food items and handling a peak daily volume of 1,000 cases or about 240 orders.



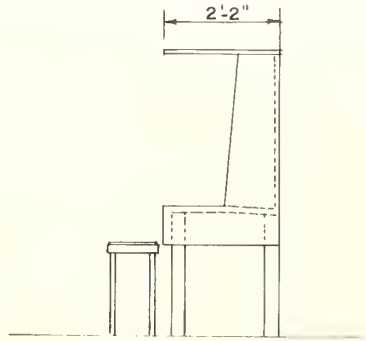
PLAN



PERSPECTIVE



SIDE VIEW



END VIEW

SCALE OF FEET

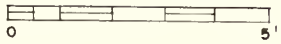


Figure 10.--Suggested design for work tables and bins for order-assembly rooms.

Separating each of the order-assembly lines from the storage areas used for stocking the faster moving items are 3-foot aisles. The aisles are the work areas for order fillers and are used for stocking bins. The storage areas, alongside each assembly line, used for stocking the faster moving items are roughly 10 by 60 feet and provide a total of 1,200 square feet of floor space for storage. Parallel to each storage area are 6-foot feeder aisles, which lead into the main aisles from the storage room, used for stocking these areas. Total storage capacity of the room, not including space for holding assembled orders, is roughly 6,000 cases.

The order-assembly room is stocked during the day by one or more workers depending on the stacking arrangements used in the storage room and the type, or the combination of types, of materials-handling equipment employed. The 40 bins along each assembly line are restocked with full cases of the 60 slower-moving frozen food items through the 3-foot order-assembly aisles. A reserve supply of these items is stacked in one end of the room for use in replenishing the bins during night operations. Full cartons of the 40 faster-moving items are stacked in the storage areas along each line on dunnage strips, pallets, or skids, through the 6-foot feed aisles at each side of the room. In stocking these areas full cases are moved toward the order-assembly aisles to replenish cases removed during the previous night. Although unit loads on pallets may be placed in the storage areas for the 40 faster moving items it is not suggested that the pallet loads be stacked more than one high.

Identical stocking arrangements are used for each assembly line, and each line operates independently of the other.

The night crew consists of 5 workers--4 order fillers, and 1 checker. Two order fillers are assigned to each line, and each order filler is usually assigned responsibility for the items along roughly 30 feet or one-half the line. The order checker is stationed at the end or the convergence of the two lines to spot check assembled orders, remove them from the line, and place them in the order-holding area.

Invoices are grouped by truck routes, and all invoices for the same route are assigned to one of the two lines. Order filling begins at the first station in each line. (See fig. 9.) The order filler in station 1 examines the invoice, determines the items and amounts of each required from his station, and starts removing these items from storage positions. Full cases are placed on the conveyor and marked with the order and route numbers. In assembling items in less-than-case quantities, a full carton is removed from its storage position, placed on the conveyor, opened, and the required number of packages are either removed and placed in an empty container or in a previously opened but partly filled case. Opened cases from which packages are only partly removed are placed on the work table for later use. Containers containing less-than-case quantities are also marked with the order and route numbers. This cycle is repeated until all items stocked in station 1 have been assembled. The invoice is then placed on the first or leading case, all cases are pushed into the second station,

209196 O—52——5

and the order filler in station 1 begins the assembly of another order. In station 2 the operation is continued as in station 1 until the order has been completely filled and all cases are pushed to the checker at the end of the line.

The checker spot checks the orders, removes them from the conveyor, and places them in the space reserved for holding orders. If skids or pallets are used, unit loads are built as the packages are removed from the conveyors and these loads are moved to and positioned in the storage area by use of skid jacks or other appropriate equipment. Four- or six-wheel hand platform trucks may also be used in holding orders in unit loads.

Data from time studies of actual operations performed by use of this method in facilities of the type described indicate that a 5-man crew can, after making allowances for preparation, clean-up, warm-up, and miscellaneous idle time, fill 240 orders totaling 1,000 cases during an 8-hour shift.

Single order-assembly line.--Wholesalers who stock about 150 frozen food items and whose peak daily volume of sales approximates 1,000 cases might give consideration to a single 88-foot order-assembly line for zero-room operations. The 88-foot line provides 28 feet of additional conveyor table, and bin space, above that provided in one of the 60-foot dual lines, for stocking the 50 additional items handled. For a wholesaler with a peak daily volume of 1,000 cases, dual 88-foot lines are not recommended. If used, each order filler's station would measure 44 linear feet which is considerably longer than desired. It is important to maintain the proper ratio between the average number of items per order and the length of each order filler's work station. However, space should be provided and the original line should be arranged so that an additional line may be installed when the volume of business increases to the point where additional order fillers are required.

A suggested layout for a 40- by 90-foot order-assembly and order-holding room with a single-line installation is shown in figure 11. As in the dual assembly line layout (fig. 9) reserve stocks of the slower moving items are held in the rear of the room with the flow toward the front or "platform" end in which space should be reserved for holding assembled orders. Space for storing reserve stocks of the slower moving items is also provided along the wall adjacent to the storage room.

The assembly line consists of a single line of 12-inch gravity roller conveyors and a single 26-inch work table-bin installation (fig. 10). The tables, on which bins are constructed, are placed along the wall of the assembly room opposite the storage room and along one-half of the wall at the end of the room opposite the loading platform. A total of about 60 18-inch bins are provided along the 88-foot line. A 3-foot aisle, paralleling the assembly line and separating the conveyor line from the area in which the faster moving items are stocked, provides working space for order fillers and space for stocking the bins. Two 12- by 60-foot storage areas are provided for stocking the 40 faster moving items. These areas

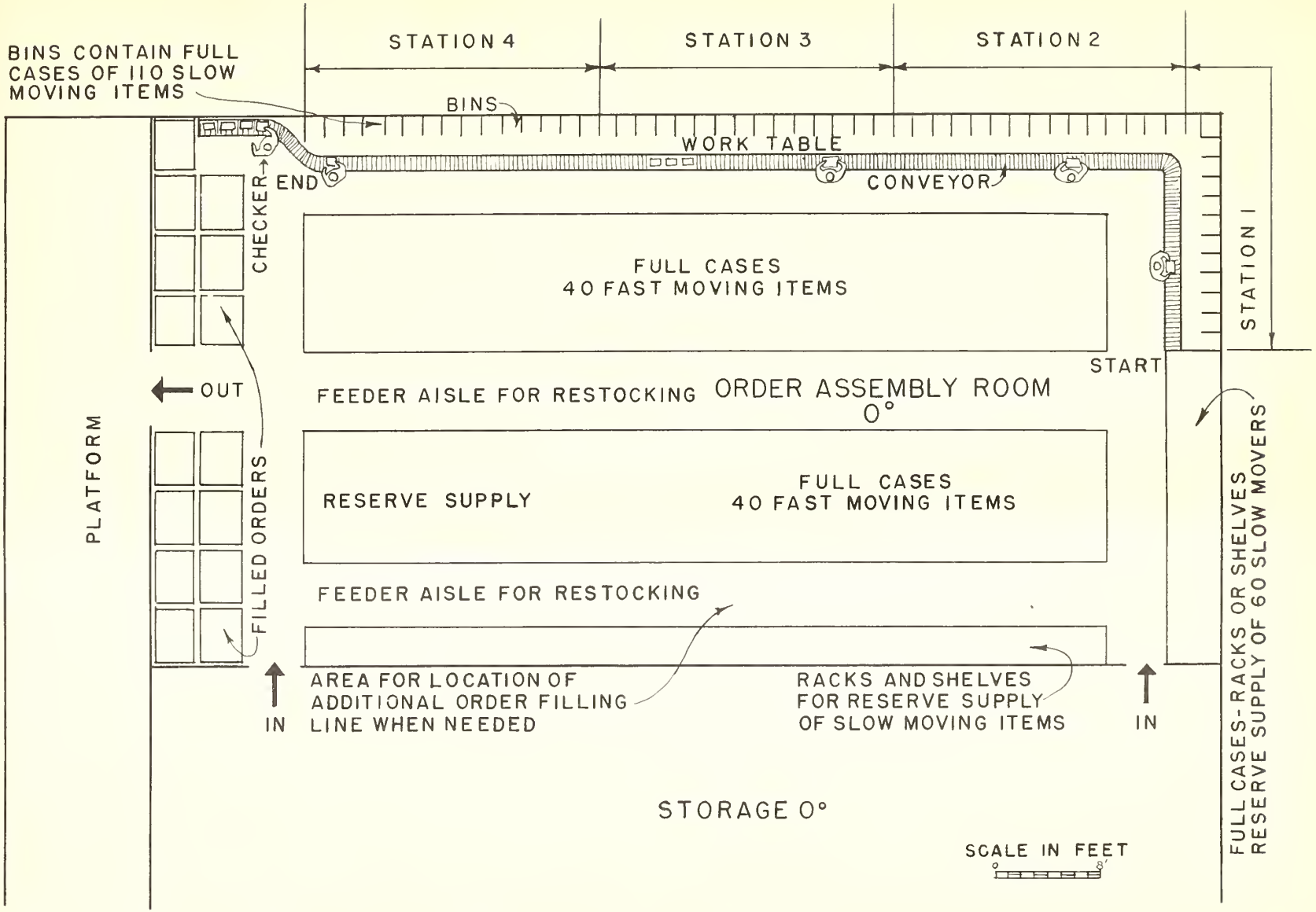


Figure 11.--Layout for a zero order-assembly room designed for a wholesaler stocking about 150 items and having a peak daily volume of 1,000 cases.

are separated by a 6-foot feeder aisle. The storage capacity of the room, not including space for holding assembled orders, is about 9,000 cases.

As in the dual assembly line layout, the order-assembly room is stocked during the day. Working stocks of the 110 slower moving items are placed in the bins along the assembly line. Reserve stocks are placed in the areas designated for these items. Working stocks of the 40 faster moving items are placed in the storage area adjacent to the assembly line with reserve stocks in the area designated.

The same size crew--4 order fillers and 1 checker--is used for the single 88-foot line as that used in the dual line operation. The line is divided into 4 stations of roughly 22 feet each. The method used in filling orders is also identical to the method described for the dual line.

Sales records of a representative sample of frozen food wholesalers show that orders contain an average of 8 different items when 100 items are stocked by wholesalers and an average of 11 different items when 150 items are stocked. On the 88 foot line one order filler would be responsible for handling roughly 3 items per order in a 22-foot station in comparison with roughly 3 items in a 30-foot station in the dual line installation.

Warm-Room Operations

Order-assembly rooms held at temperatures ranging between 30° and 40° F. are usually referred to as warm rooms. Because frozen foods are highly perishable they cannot be held for any sustained period at temperatures above zero (0° F.). For this reason, space cannot be provided in warm order-assembly rooms either for short-term storage or for holding assembled orders. For the same reason, it is necessary that frozen foods be moved through the line as rapidly as possible and into a separate order-holding room held at zero (0° F.).

Basically two types of installations (other than conveyors, work tables, and bins, which are used in all operations described) are used in warm order-assembly rooms: (1) Chutes; and (2) pallet racks or shelves.

Chute installation and single order-assembly line.--A suggested layout for a warm room, single assembly line, order-assembly operation in which refrigerated chutes connecting the storage and order-assembly rooms are used for holding working stocks of frozen foods is shown in figure 12. Although the layout and installation shown are designed for handling 150 different frozen food items, it may be adapted to 100 items by shortening the assembly line and reducing the number of chutes. In the layout for 150 items, a 100-foot assembly line and 100 chutes are provided. For a 100-item operation these might be reduced to an 80-foot line and 80 chutes.

Considering the space occupied by chutes as part of the storage room, the order-assembly room is 65 by 120 feet. Single work tables 26 inches

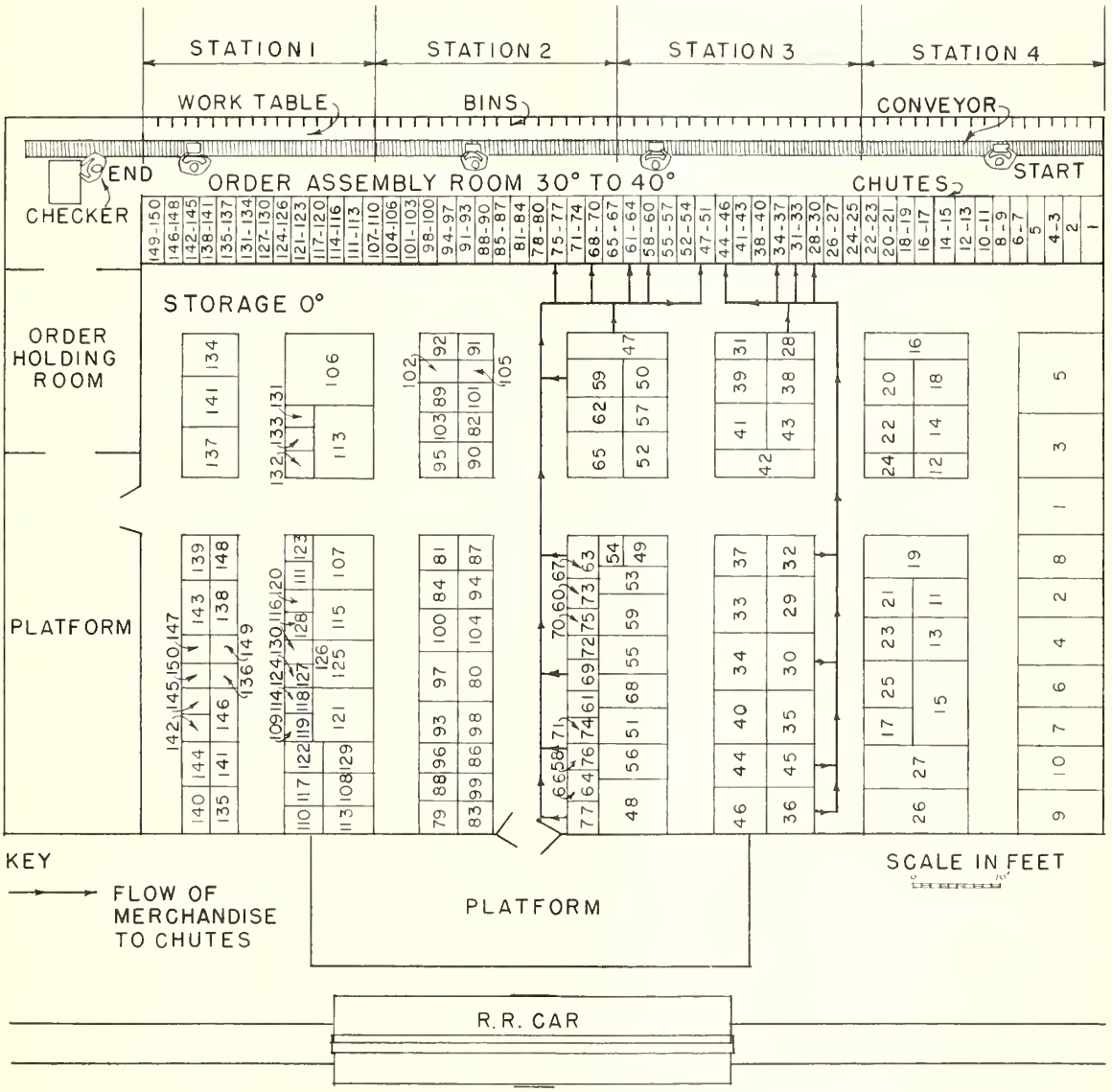


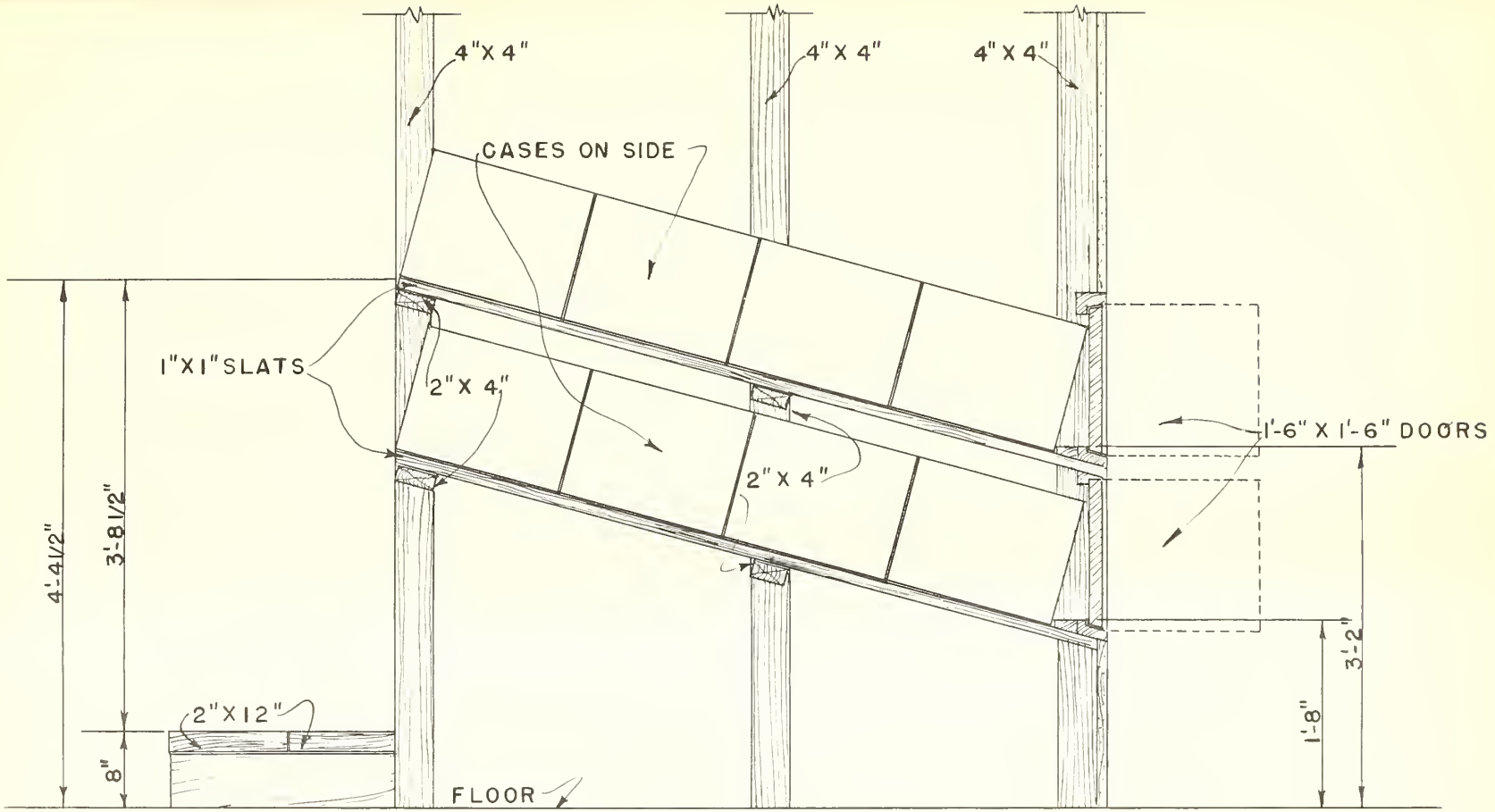
Figure 12.--Layout for a warm-room order-assembly operation, including storage, equipped with chutes, and designed for a wholesaler stocking 150 items and having a peak daily volume of 1,000 cases. Less linear space would be required for chutes and the order-assembly line if only 100 items were stocked.

deep and forming a total length of 100 feet are arranged along the wall opposite the chute doors. Single bins of the type shown in figure 10 occupy 12 inches of the depth of the work table surface, the remaining 14 inches being reserved for working space. A line of 12-inch gravity roller-type conveyors parallels the work tables for their entire length and have a 15-foot projection from the end of the order-assembly line on which orders are held for checking. The conveyor line is separated from chute doors by an aisle, roughly 3 feet in width, which provides the work area for order fillers. Chute doors and facings, and removable partitions, make up 100 feet of the side of the assembly room adjacent to the storage room.

Working stocks of frozen food items are moved from the storage room to the order-assembly room through refrigerated chutes of the type shown in figure 13. Chutes are 2 feet wide, $1\frac{1}{2}$ feet high, and, if constructed with floors of 1- by 2-inch maple wood slats, 6 feet deep. If gravity conveyor sections are used in lieu of wood slats, the chutes may be 8 feet deep. Chutes of 6-foot depth hold 8 to 10 cases, on side. Chutes are arranged one above the other with the lower edges of the doors 20 inches and 38 inches above the floor level. The chutes should slope toward the front with a pitch of 12° for those with wood floors and 5° for those with gravity conveyor floors. With a 12° pitch, the end of an upper 6-foot chute in the storage room would be 4 feet $4\frac{1}{2}$ inches above floor level and would necessitate the use of an 8-inch step in stocking operations.

Although a six-man night crew is used for performing order-assembly operations, it will be possible to keep the size of the crew down to this size only if a worker on the day crew completely stocks the chutes before the night crew reports for duty. An alternative might be for the chute stocker to report for duty sufficiently in advance of other crew members to perform this job. The night crew consists of one worker who restocks the chutes, four order fillers, and one checker who, in addition to spot checking, assembles orders, removes the orders from the end of the assembly line, and moves them to the order-holding room. Working stock is removed from chutes and placed on conveyor, working table, or bins as shown in figure 7.

In wholesale plants where chute installations are used in connection with order-assembly operations, there is some doubt as to whether the palletization of products more than one pallet high in storage is the most efficient method, since it is necessary to feed merchandise to chutes in small quantities. It might be desirable, however, to palletize in the course of unloading and transporting into storage. The breaking down of unit loads at this point means that units are maintained over a relatively short part of the handling job. Moreover, when one worker only must stock chutes with 100 different items, mixed loads must be handled. Where products are not stacked in unit loads in storage, 4-wheel hand platform trucks are generally used in performing the operations involved in chute stocking. From 20 to 30 cases of assorted items can be loaded on one truck. In moving 1,000 cases of frozen foods to the chutes with this



CROSS SECTION
SCALE IN FEET

Figure 13.--Layout showing arrangement and size of chutes in warm-room chute operation. The angle of incline of the chutes is 12°, and the depth 6 feet. If gravity conveyors were used in the floor of the chutes rather than wooden slats, angle of incline could be about 5°, and the depth about 8 feet.

type of equipment, about 50 round trips between the stacks and the bins will be necessary and will involve 2,000 separate handlings, or 2 for each case.

With the exception of the work elements, or basic motions, involved in removing full cases from the chutes, assembly-line operations are comparable with those previously described for zero-room operations. Where four order fillers operate along a 100-foot line, the line is divided into four 25-foot work stations.

With the warm-room chute installation a 15- by 20-foot order-holding room is provided between the end of the order-assembly room and the loading platform. This room, which is held at a temperature of 0° F., should provide adequate space for holding overnight about 240 average-sized orders stacked on 4-wheel hand trucks or skids.

Pallet rack installation and single order-assembly line.--The handling and storing of frozen foods on pallets, or in other types of unit loads, has brought about a need for order-assembly methods which will permit the unit loads to be kept intact until individual packages must be handled in filling orders on the assembly line. The pallet rack installation and single order-assembly line shown in figure 14 are designed to meet this need for a warm-room operation in which 150 frozen food items are stocked and in which a peak daily volume of 1,000 cases is handled. This layout could be adapted to an operation in which 100 items are stocked, but in which the daily volume is held to 1,000 cases, by shortening the assembly line and reducing the number of pallet racks.

The order-assembly room shown in figure 14 is 21 by 120 feet. The assembly line is identical in size, composition, and arrangement within the room to that described in the single line, warm-room, chute operation. In this room double-deck pallet racks are placed parallel to and separated from the assembly line by the usual 3-foot aisle which provides working space for order fillers. The double-deck pallet racks contain compartments, each of which is 46 inches wide, 48 inches deep, and 30 inches high, for handling 40- by 48-inch pallets. This width compartment provides a 2-inch clearance, plus space for rack posts, on each side of the 40-inch pallet width. Along the 100-foot assembly line space is provided for a total of 52 compartments, 26 uppers and 26 lowers. An aisle 10 feet wide, between the pallet racks and the wall of the room adjacent to the storage room and running the full length of the order-assembly room, is used for stocking the racks with an electric fork-lift truck.

In the storage room, frozen food products are stored on pallets which are either stacked one above the other on the floor or in pallet racks. Space is designated by number for each frozen food item. This number corresponds to the number assigned the same item in the pallet racks in the order-assembly room. Racks are also provided in the storage room for holding assembled orders.

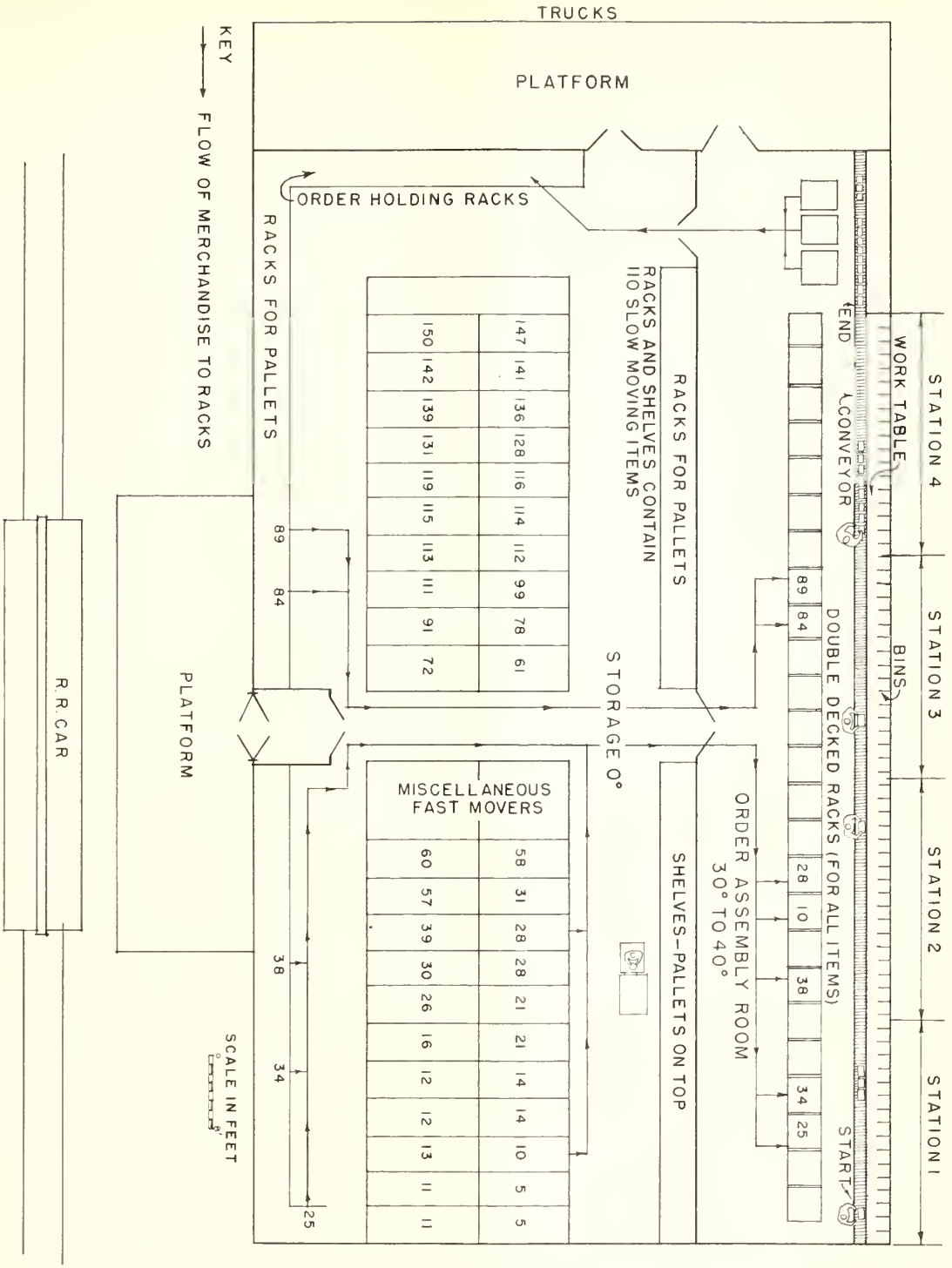


Figure 14.--Layout for a warm-room palletized, order-assembly operation (including storage), designed for a wholesaler stocking 150 items and having a peak daily volume of 1,000 cases. A shorter assembly line would be suitable if only 100 items were stocked.

A 6-man crew is used for performing order-assembly operations with this type of installation: 1 fork-lift truck operator; 4 order fillers; and 1 checker. The truck operator is responsible for stocking or restocking the pallet racks in the order-assembly room and for moving assembled orders from the order-assembly room back to the storage room. It is estimated that in stocking the order-assembly room about 500 cases of frozen foods must be handled manually, or a total of 1,000 handlings are necessary in rebuilding pallet loads since about 40 of the 52 pallet loads placed in the racks must contain stocks of two or more items and the quantity of products on each pallet cannot exceed about 24 inches in height (30-inch height of pallet rack minus 6-inch thickness of pallet). As assembled, orders are removed from the end of the assembly line by the checker and placed on pallets, which, when loaded, are picked up by the truck operator and returned to pallet racks in the storage room. Products remaining in the pallet racks after assembly-line operations have been completed must be returned to the storage room and the various items segregated, where necessary, which involves roughly 200 manual handlings of individual cases.

Operations on the assembly line in filling individual orders are comparable with the operations previously described and differ only in respect to the basic motions involved in removing full cases from pallet racks.

Methods and Facilities for Handling Daily Volume of 2,000 Cases

Zero-Room Operations

A zero-room order-assembly operation set up to handle a peak daily volume of 2,000 cases of frozen foods, in a plant which carries in stock 150 different items, should provide for the conversion of the single assembly line shown in figure 11 to a dual line. However, in the layout for handling the larger volume, the additional and independent line should be placed parallel to the wall of the order-assembly room adjacent to the storage room and against the wall of the rear of the room so that the two lines would form an inverted U.

Warm-Room Operations

The larger the volume above 1,000 cases per day the greater the incentive will be for increasing the productivity of labor through a warm-room palletized operation. However, an exception to this rule might be made with respect to wholesalers handling over 150 items. When the number of items handled is increased considerably above 150, the advisability of warm-room palletized operations, both from the standpoint of protecting the product against rises in temperature and productivity of labor, becomes questionable.

The key to maintaining a balanced order-assembly operation is to have the proper ratio between the average number of items per order and the length of each order filler's work station. In an operation with a peak daily volume of 2,000 cases, a 10-man crew comprising 7 order fillers, 2 checkers, and 1 worker to stock the pallet racks will be required. On a single assembly line each worker will average less than 2 items per order. Therefore, 2 order-assembly lines, as shown in figure 15, should prove more efficient than a single line. The lines are identical with respect to the stocking of items. Four order fillers should be stationed on one line and 3 on the other. The average number of items per order under this arrangement would be about 3 for the 4-man line and 4 for the 3-man line. The average working distance covered by each order filler is 20 feet.

Methods and Facilities for Handling Daily Volume of 300 Cases

A zero order-assembly room, which may be a part of the storage room, is suggested for an operation which involves handling 300 cases per day because of the relatively large number of cases that must be opened from a stock of from 100 to 150 items in filling orders totaling 300 cases.

An order-assembly room, of the type shown in figure 16, which is roughly 22 by 50 feet should be adequate for a 300-case daily volume. Full cases of the fast moving items are stacked near the 50-foot assembly line. Slower moving items are handled from bins on the work table.

This operation will require a 2-man crew, but it is contemplated that one order filler completely fills each order. The second worker keeps the room stocked, checks and removes assembled orders from the conveyor line, and moves them to the space reserved for holding assembled orders.

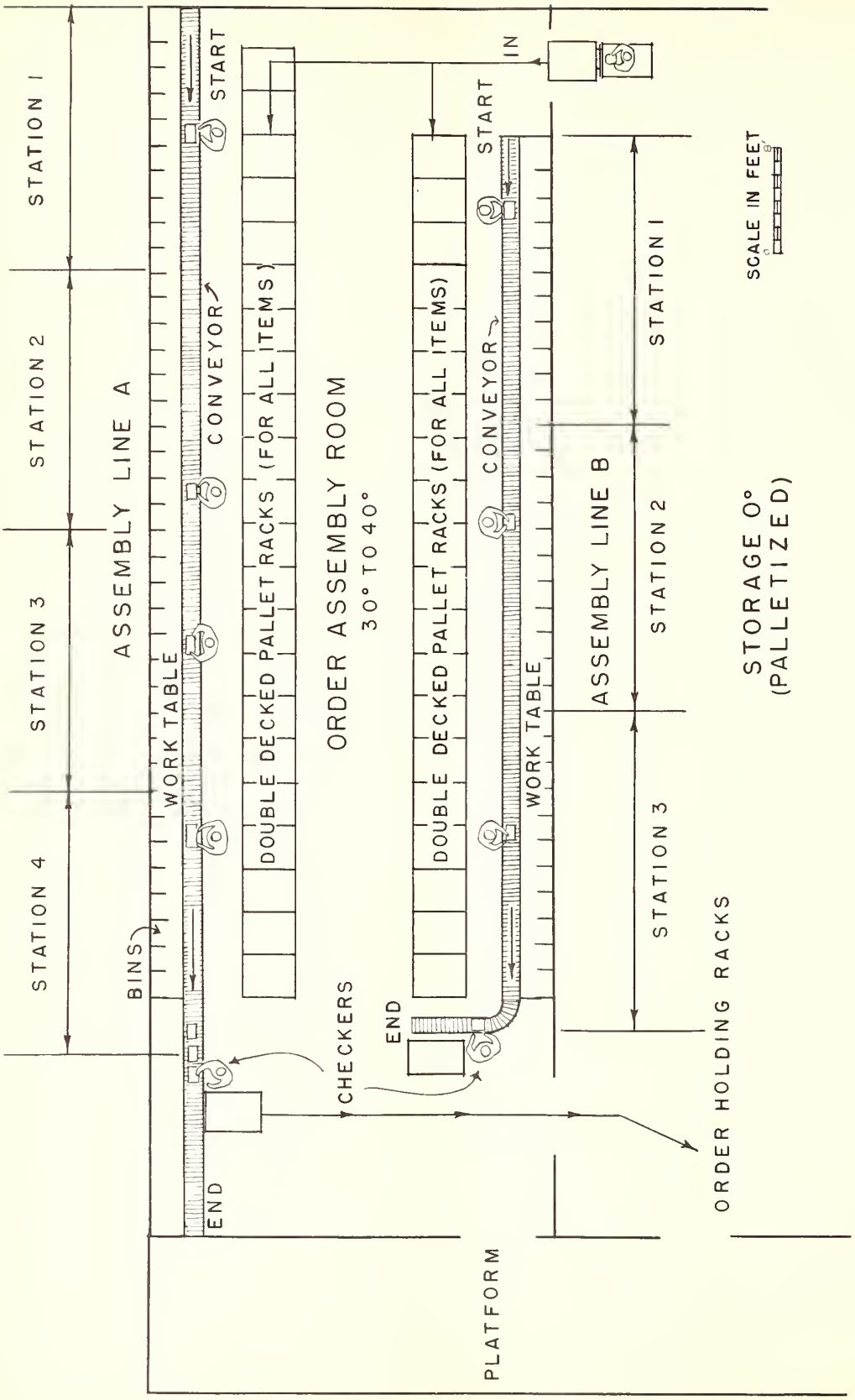


Figure 15.--Layout for an extra large wholesale operation, based on a peak daily volume of 2,000 cases. The arrangement is for a warm-room palletized operation.

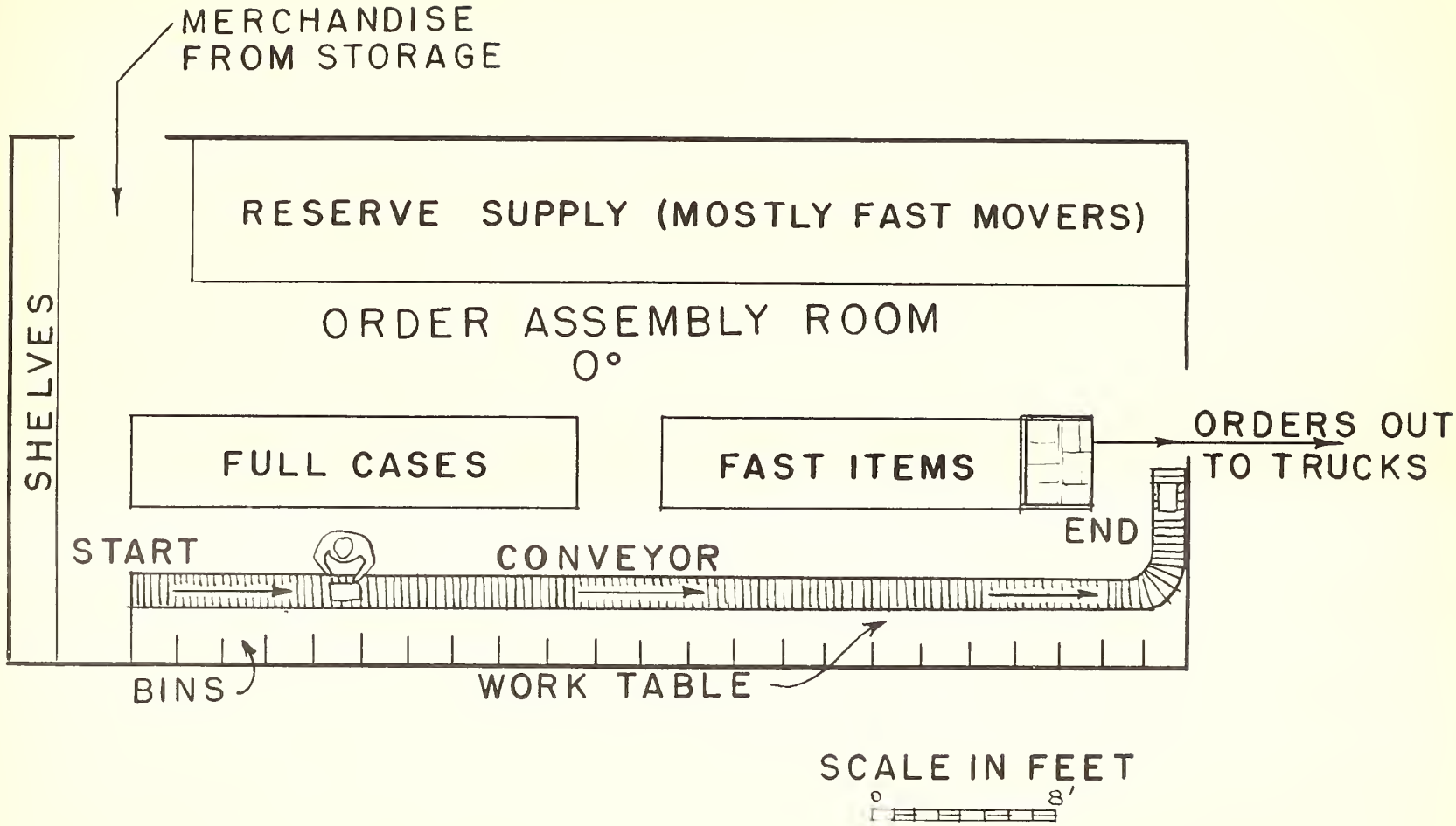


Figure 16.--Layout for a small wholesale operation, based on a peak daily volume of 300 cases. The arrangement is for a zero room.

THE WHOLESALE FROZEN FOOD "MARKET"

In several cities specially designed warehouses have been constructed to provide complete storage and distribution facilities for most of the frozen food wholesalers in those localities. The grouping of a majority of the dealers in one city in one facility creates a wholesale frozen food market comparable in some respects to a wholesale produce market. This arrangement permits the combined storage of the wholesalers' reserve stocks and provides special facilities for performing other wholesale operations.

The consolidation of frozen food wholesaling in one warehouse in a locality has considerable merit, particularly in that better use can be made of storage space and handling equipment than when facilities are individually owned by wholesalers. Small-volume wholesale distributors are likely to benefit more from a consolidated warehouse arrangement than are large-volume wholesale distributors.

A sketch showing the floor plan of a warehouse constructed primarily for the consolidation of small wholesale operations is shown in figure 17. The five wholesale store units shown are separated by movable steel mesh screens. The amount of space leased by each wholesaler varies with the individual wholesaler's requirements. The general storage room is operated on the same basis as that in other public warehouses. The ceiling of the warehouse is about 20 feet high, and merchandise in the general storage section is palletized. However, loaded pallets are not usually brought into the store units since a larger number of unpalletized frozen food items can be handled in a relatively small amount of operating space than can be handled on pallets. To facilitate filling orders, merchandise in the wholesalers' stalls is stacked no higher than a worker can reach and in the quantity needed for 1-day's operations. Extending across the top of the full width of the store units is a heavy, well-supported, steel screen that permits the space above to be used by the warehouse for the general storage of miscellaneous merchandise.

An improved layout for a public warehouse designed to accommodate relatively large wholesale operations is shown in figure 18. Although the layout shown provides space for four wholesalers, the facility is designed to provide operating space for one to about eight wholesalers, dependent on the sizes and types of operations of the organizations seeking accommodations.

Since the size and type of wholesale organizations that might rent space in such facilities could change considerably over a period of 1 or 2 years, the recommended layout has removable interior partition walls, "extra" doors are provided, and provisions are made for partitioning off parts of the general storage room. Because of the high degree of flexibility provided, the warehouseman could rent facilities to wholesalers who need or prefer zero (0° F.) space, or the same area might be rented to wholesalers who assemble orders in warm rooms. Distributors who assemble orders in rooms with temperatures of 30° to 40° F., or warmer,

would rent space for and put up partitions for a warm room to separate it from the zero-storage part of the warehouse used for holding working stocks and for holding orders after they are assembled.

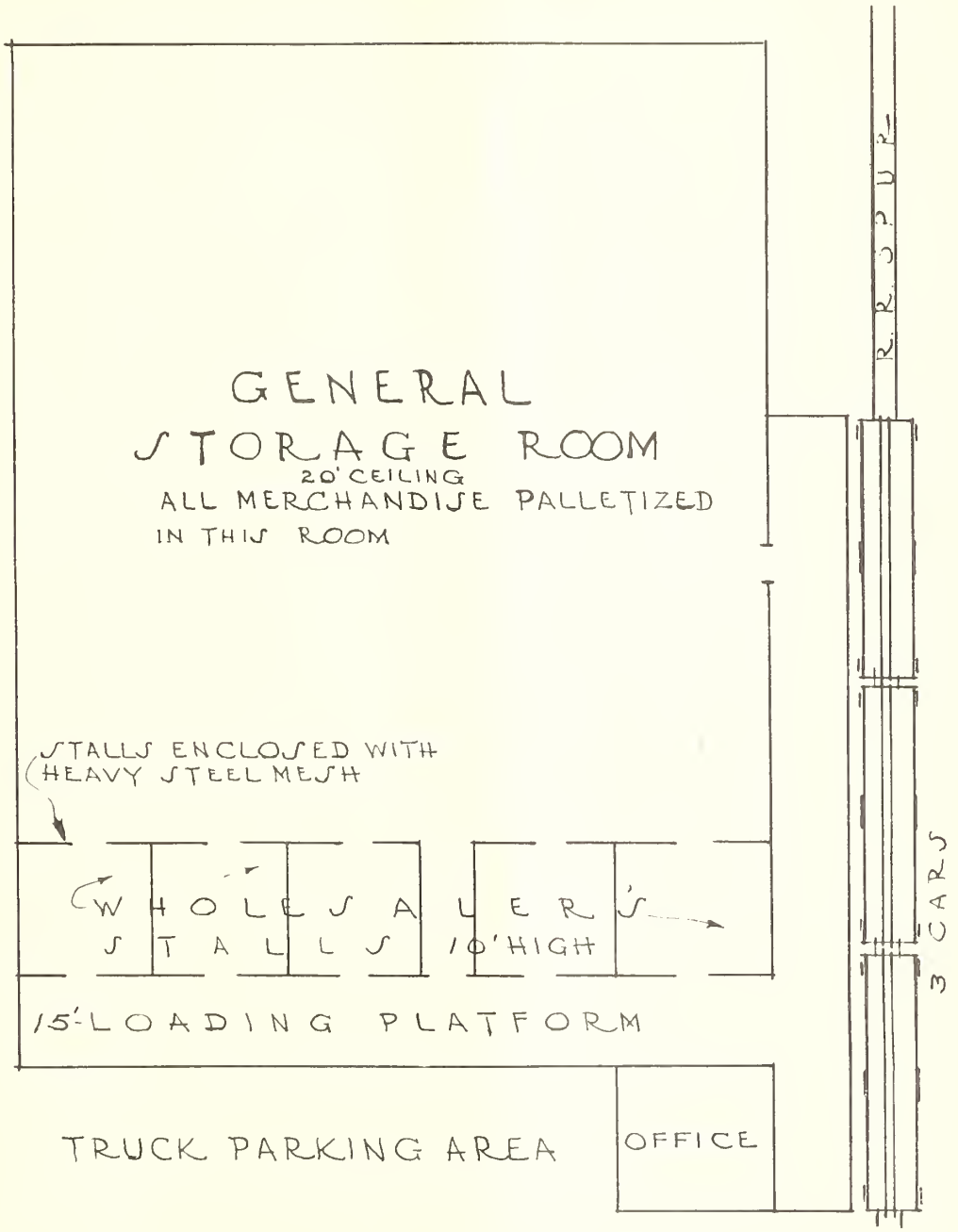


Figure 17.--Floor plan of a specially designed public warehouse that provides operating facilities for several small wholesale distributors and consolidates storage of reserve stocks. A warehouse with this general floor plan actually exists and is in operation.

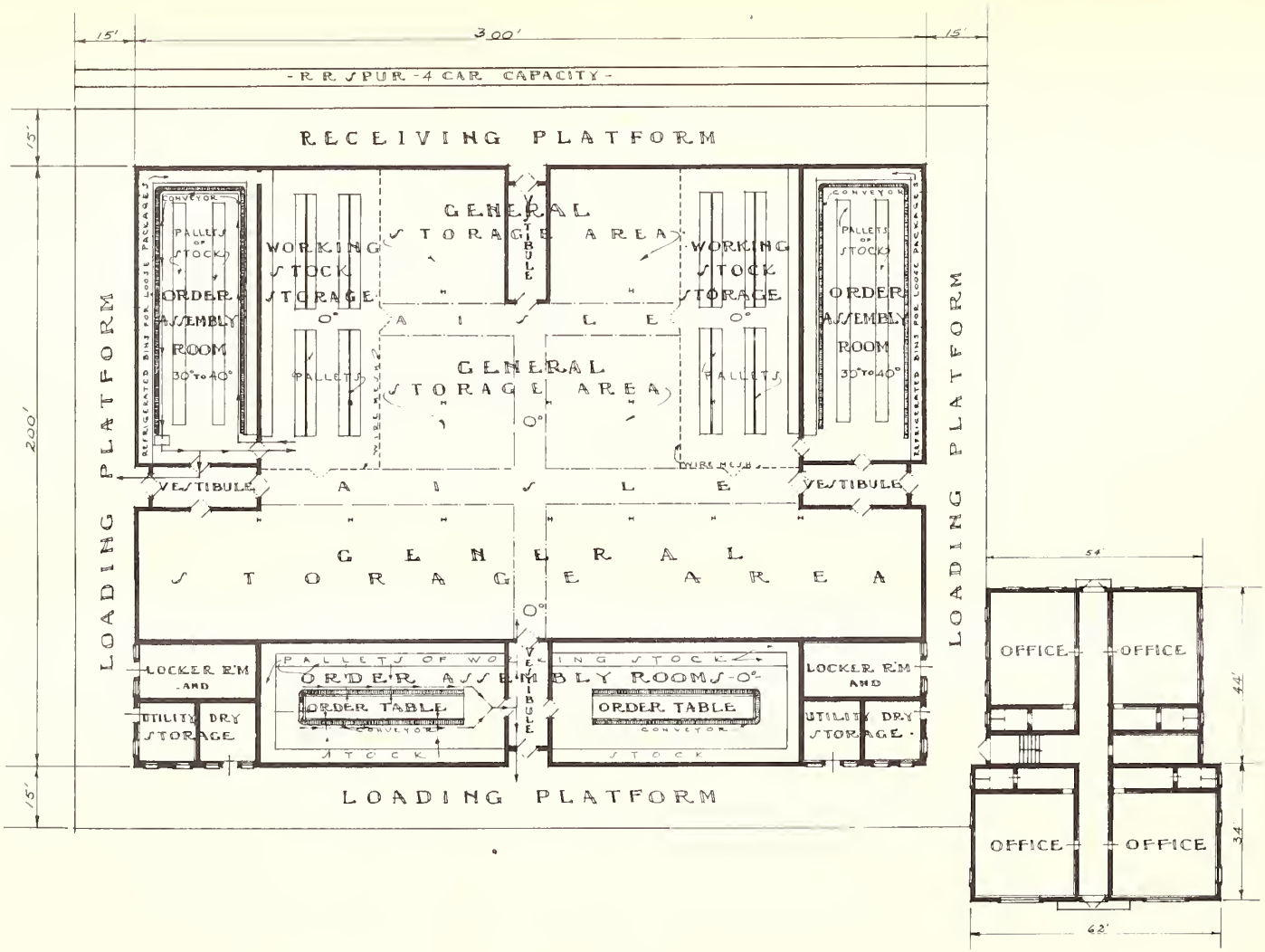


Figure 18.--An improved layout for a public refrigerated warehouse designed especially to accommodate relatively large wholesale frozen food operations and provide for consolidated storage of wholesalers' reserve stocks. Since the different methods of operations of wholesalers require different facility layouts, and since the methods of frozen food distribution are likely to change as volumes increase, warehouses of this type should be designed to provide considerable felxibility. Certain of the inner walls and the order-assembly room bins should be removable by sections. Provisions should be made to hold order-assembly rooms either at 30° to 40° F. or at zero (0° F.) temperature.

SELECTION AND USE OF MATERIALS-HANDLING EQUIPMENT

Frozen food wholesalers whose operations are efficient from the viewpoint of returns per dollar of capital invested, usually do an efficient job of handling the materials that move through their plants. Actually, frozen food wholesalers are materials handlers since they do not change the form of the product received or add anything to its intrinsic value. In other words, the items handled are not processed or repacked while in the wholesaler's possession. From the viewpoint of plant operations, the frozen food wholesaler receives, stores, assembles orders, loads out delivery trucks, and otherwise provides the protective services required in maintaining the quality of the product.

Efficient materials-handling operations cannot, as a rule, be performed in improperly designed facilities. In fact, facilities should be designed and constructed so as to permit the best use of equipment, depending on the wholesaler's scale of operation. Altogether too many facilities for the wholesale distribution of farm and food products have been constructed without taking into account the costs of performing necessary handling in them. In planning a wholesale distribution plant frozen food wholesalers should not overlook the specific facility requirements for the types of handling equipment they will use in the facility.

Facility Requirements for Most Efficient Use of Different Types of Materials-Handling Equipment

To achieve maximum efficiency in materials-handling operations, the equipment must be used in an environment which permits the best possible methods with the equipment selected to be employed, which means that platforms, floors, doorways, column spacing, ceiling heights, aisles, and other features must be properly designed for methods and equipment to be used. The facilities should be arranged to minimize the distances merchandise must be transported within the plant. The use of purely manual handling methods should be avoided where possible, and labor requirements in all methods should be kept to a minimum. The building should preferably be of single story design since with present-day equipment handling on a horizontal or plane surface is more economical than is the moving of products between floors.

Platforms should be specifically designed for the use to be made of them. Where frozen foods are to be received by rail the platform adjoining the house track should be about 55 inches above the top of the rails, and platforms should be of sufficient width, preferably 15 feet, for easy maneuvering of handling equipment into and out of the refrigerator cars. The center of the rail line should be 8 feet from the edge of the platform to provide sufficient clearance for refrigerator car doors to be opened without touching the platform. A bridgeplate can be used to bridge the gap between platform and the car. For motortruck receiving platforms a height of 50 inches is desirable when tractor semitrailer combinations are to be unloaded and 45 inches when straight trucks are used. Shipping platforms

should be of a height approximating that of the bed of delivery trucks. The normal height for the average-sized delivery truck is about 38 inches. Whether used for unloading refrigerator cars or motortrucks, platform widths should be adequate to allow free movement of materials-handling equipment. Wholesalers should check the heights of their motortruck beds and those of other motortrucks which will use the platforms and adjust these heights accordingly. Although small differences in platform and truck bed heights can be overcome by use of bridgeplates rather extreme differences may require a bridgeplate of a length that may partially block the platform. Ability to move materials-handling equipment into the car or motortruck appreciably reduces loading and unloading costs.

For ease and speed of travel, the floor of the warehouse including the platform should have a smooth surface--preferably of reinforced concrete. Slopes or grades which would interfere with the free movement of materials-handling equipment should be kept to a minimum and should be eliminated where the cost will not be prohibitive. If possible, warehouse floors should consist of a single flat surface, or with sufficient slope to provide adequate drainage, throughout those sections served by handling equipment. In remodeling old buildings the insulating of floors frequently raises the floor-level in freezer rooms 12 to 18 inches above the level of the uninsulated part of the building. In such cases it is sometimes necess sary to build up the floor level of shipping and receiving areas so that merchandise can be moved on a level plane. It is especially important to have the floors in the receiving area built up to the same level as the storage room floors. If not built up, additional manpower may be required to move products "up hill" by way of ramps. Out-bound merchandise moving down a ramp from the order-assembly room to the shipping area may not require additional manpower for handling but a safety hazard is usually involved in moving loaded equipment up and down sharp inclines.

Adequate load capacity should be built into all floors. This capacity will vary depending on the type of equipment used and the load it carries, and the weight of the merchandise and the stacking heights. Particular consideration should be given to floor-load capacity when floors are built above the ground level or above a filled surface. If heavy industrial-type trucks are to be used, the floor load capacity must be considerably greater than when four-wheel hand trucks are used. From the standpoint of materials-handling operations doorways should be located so as to provide as near as possible a straight-line movement between two rooms or areas which they link. The height and width should be sufficiently large to permit easy movement through them of materials-handling equipment loaded with the largest load to be handled. Narrow doorways and aisles can bottleneck operations in a plant that is otherwise efficiently laid out. In the sections of the plant where frozen food products will be manually handled, and where large industrial trucks will not be used, doors should be about 6 feet wide. Where mechanical equipment is to be used, doors should be 8 to 10 feet wide and sufficiently high to clear the masts or guard frameworks of industrial trucks. Labor saving devices can be installed which will open and close doors automatically.

In larger plants separate doors might be provided for receiving and shipping. To maintain consistent zero temperature in the storage room, it is desirable that a vestibule at the receiving entrance to the warehouse be provided. An arrangement of this kind is desirable because of the relatively long periods required for unloading railroad cars and trailer trucks into the storage area. The inner doors of the vestibule should be of the double-hinged type that swing both ways.

In plants where the order assembly room is located adjacent to the shipping platform, the outer door of the room is used principally for loading out. In most instances a vestibule at this point is unnecessary because of the small volume loaded out at any one time. However, double-hinged type doors, that swing both out and in, should be installed inside the heavy insulated door.

All doors should be constructed of durable material which will withstand continual bumping by hand trucks and other equipment. In recent years doors that swing both out and in have been constructed of rubber. Although the claim is made that rubber doors will last about 4 times as long as will wooden doors, their initial cost is somewhat more than that for wooden ones.

Consistent with construction costs, columns should be spaced to permit maximum efficiency in handling operations and the greatest utilization of space. Columns should not cause abnormal obstructions of the movement of products between two points or cause an excessive number of turns. Where pallets are to be used for storing products, column spacing should conform with the size of the pallet. In determining proper ceiling heights, consideration must be given to the type of materials-handling equipment to be used and the consequent height to which merchandise is to be stacked. In rooms where products are to be manually stacked a ceiling height of approximately 10 feet may be sufficient. However, if lift trucks are to be used, a ceiling height of 20 feet, which will permit the stacking of pallet loads three-high, is desirable.

Aisles should be sufficiently wide to accommodate loaded handling equipment, and the main aisles should accommodate two-way traffic. To accommodate hand trucks, a 5- or 6-foot aisle is of sufficient width. But for the average 2,000- to 4,000-pound capacity counterweight type industrial fork-lift truck, where right angle stacking is used, an aisle width of at least 10 feet is necessary. If angle stacking is used this aisle space can be reduced, but other losses of space may then result from this arrangement.

Some Applicable Types of Materials-Handling Equipment for Frozen Food Wholesalers

The types of materials-handling equipment adaptable for use by frozen food wholesalers might be grouped as follows: (1) Manual non-unit load; (2) conveyor; and (3) unit load (pallet loads and skid loads). Scale of operation should be one of the major considerations in selecting equipment.

As an example, it is doubtful whether wholesalers operating small-volume plants should acquire industrial type trucks (one type of equipment for handling unit loads) since overhead or fixed costs might more than offset savings in labor during the expected life of the equipment. Other factors, such as speed of operation and stacking height, might preclude the use of certain types of equipment by some wholesalers.

Manual Non-Unit Load

Four-and six wheel hand platform trucks, of the type shown in figure 19, are manual non-unit load types of equipment which are of considerable utility value in a frozen food distribution warehouse. The two-wheel hand truck is another type of equipment that has a place in small warehouses, but because of its limited load capacity (500 pounds) it should be used only for miscellaneous short-haul handling tasks.

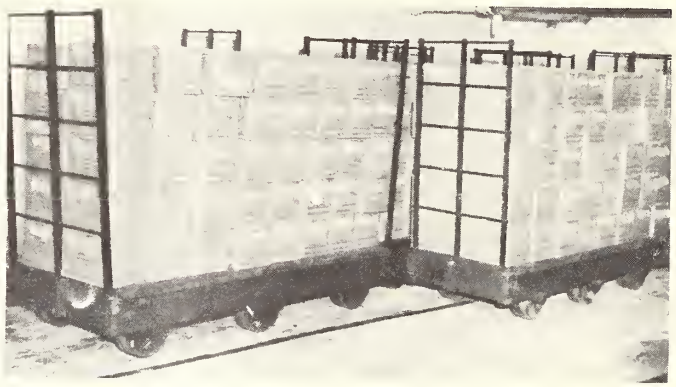


Figure 19.--Six-wheel hand trucks loaded with cartons of frozen food. Wholesalers with small-volume operations use smaller trucks than the ones illustrated.

Platform trucks can be used with a high degree of efficiency for many tasks: For unloading railroad cars and motortrucks; for moving merchandise from storage to the order assembly line; for making up or filling orders; and for loading delivery trucks. When not in use for performing other handling jobs, they may be used for temporary storage, such as holding assembled orders overnight.

Since equipment of this type requires a relatively small investment, ownership or overhead equipment costs are low. Moreover, maintenance is inexpensive, regular oiling being about the only cost involved. Rubber-tired wheels are not recommended for this type of equipment because of the danger of their freezing to the freezer room floors. Steel wheels, which should be used in such plants, are long-lived and rarely require replacement.

The disadvantages of manual non-unit load equipment are significant. When used for moving merchandise from one location to another, each package must be handled individually in loading onto the equipment and it must be handled individually in unloading. Such handling methods discourage workmen from the careful handling required to prevent breakage of original containers. Handling operations are slow, leading to a greater exposure of frozen foods to outside temperatures. Effective use of piling space in refrigerated storage rooms is not possible except by means of manual stacking and removal from stacks.

Conveyors

Conveyors are of two general types: Belt (powered) (fig. 20); and gravity (fig. 21). Each of these types may be either portable or fixed.

Conveyors are highly desirable for moving materials between fixed points, either on one floor or between floors. No substitute has been found for conveyors in the order-assembly line which remains more or less fixed in one position. Conveyors also have an important place in loading delivery trucks particularly when items must be checked as they are loaded. Characteristics which give them an advantage in moving materials between fixed points may, however, place conveyors at a disadvantage in performing some handling operations.

Figure 20.--Portable belt conveyors, such as the one shown, are useful for moving merchandise from a lower level to a higher one. They can be easily tied in with gravity conveyor operations.

By use of conveyors the transportation of materials can be accomplished with no labor except that for loading and unloading. Conveyors also provide a direct flow of materials between the points served. The cost of portable gravity conveyors is low in comparison with the cost of belt conveyors, and gravity conveyors should not be overlooked as a complement to other types of materials-handling equipment. As an example, they frequently can be used to move a loaded pallet from a point inaccessible to a fork-lift truck to a point where it can be picked up by the truck. Figure 22 shows the use of a conveyor system for removing loaded pallets from a refrigerator car. Figure 23 shows the use of pallet dollies, another type of conveyor, for performing this operation.

Figure 21.--Gravity conveyors can be used for performing a number of different operations at wholesale plants. However, conveyor operations are often unbalanced. The worker loading the conveyor above has to wait to send packages down the line until the worker stacking cases in the motortruck is ready to receive them.

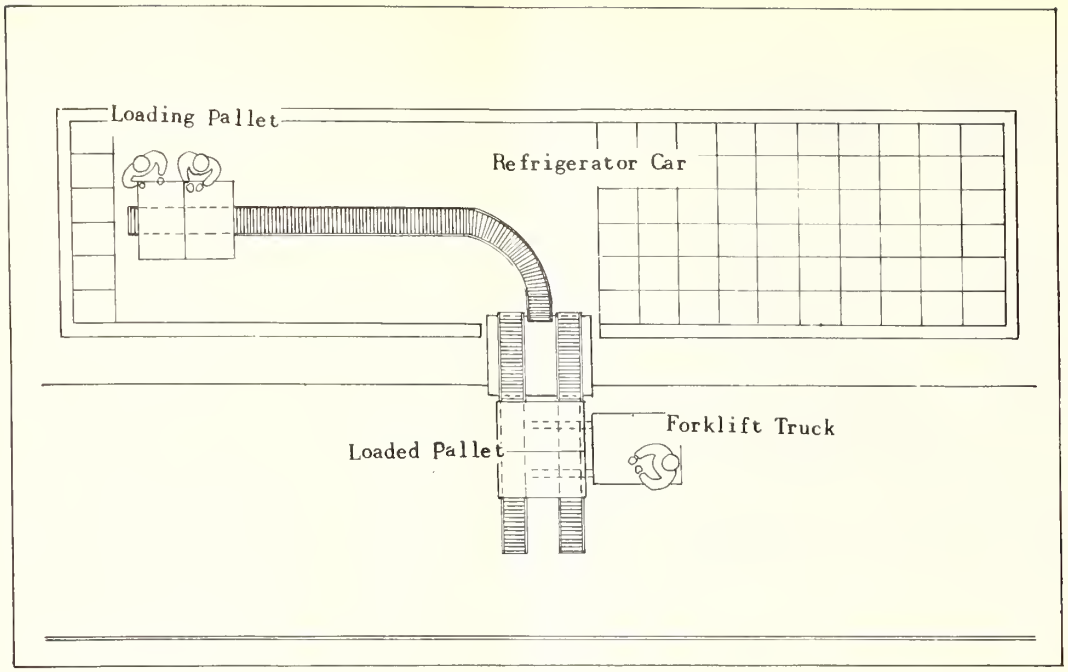


Figure 22.--Full conveyor system with curved section allowing pallet to be loaded next to stowed packages in car and moved to a position outside the car convenient for fork-lift truck handling.

Figure 23.--Pallet dolly in position for transfer of loaded pallet to conveyor for removal from railroad car doorway by fork-lift truck.

There are several objectionable features to the conveyor. Generally it is less flexible than other available types of handling equipment. Since it serves fixed points, set-up time is no small item where materials-handling operations of short duration are performed. When used for loading or unloading railroad cars and trucks, both ends of the conveyor line ordinarily must be manned at all times or the operation must stop. For short installations it is frequently necessary to hold packages until a worker on the other end is ready to receive the package. In some instances, setting up conveyor lines, as across a platform, may obstruct the simultaneous performance of another materials-handling operation which involves working in an opposite direction to the conveyor line. In other words, the conveyor line can cause an effective "road block" during the transportation cycle of other handling operations. Powered belt conveyors involve high materials-handling ownership costs if they are purchased and used only for a specialized purpose or operation which requires only a few hours of use per week.

Unit Load

Lift trucks (riding or powered walkie type) and pallets, semilive skids and jacks, and skids and pallets used with low-lift and high-lift pallet or platform hand-lift trucks are the principal types of materials-handling equipment which permit the utilization of the unit-load principle. 1/ Figure 24 shows three types of equipment used in handling unit loads. There are other types available for unit-load handling, but some of these are either variations of those named or are not adaptable to the facilities of frozen food distributors.

Handling of materials in unit loads has a number of advantages. Since packages are handled as a group after the unit load is made up, much labor is eliminated in rehandling and storing operations. Moreover, there is less damage to products handled in unit loads since each package is individually handled fewer times. Where products are stacked or stored in unit loads, inventory taking is simplified since it is necessary only to count the unit loads and multiply by the number of packages per load to determine the total package count. If there are partially empty skids or pallets, the packages remaining on them, of course, must be counted and added to the total. The tiering features of some types of equipment used for handling unit loads also permits better utilization of piling space without costly manual stacking costs. Finally, even with a small crew the handling of products can be performed in a shorter elapsed time and with fewer man-hours

---

1/ A unit load comprises several packages placed so that they can be handled as a unit through any handling operation or combination of handling operations, rather than as individual packages. As used in this report, a unit load is a loaded pallet or skid consisting of a number of packages which are so set together that they can be handled simultaneously as a unit.

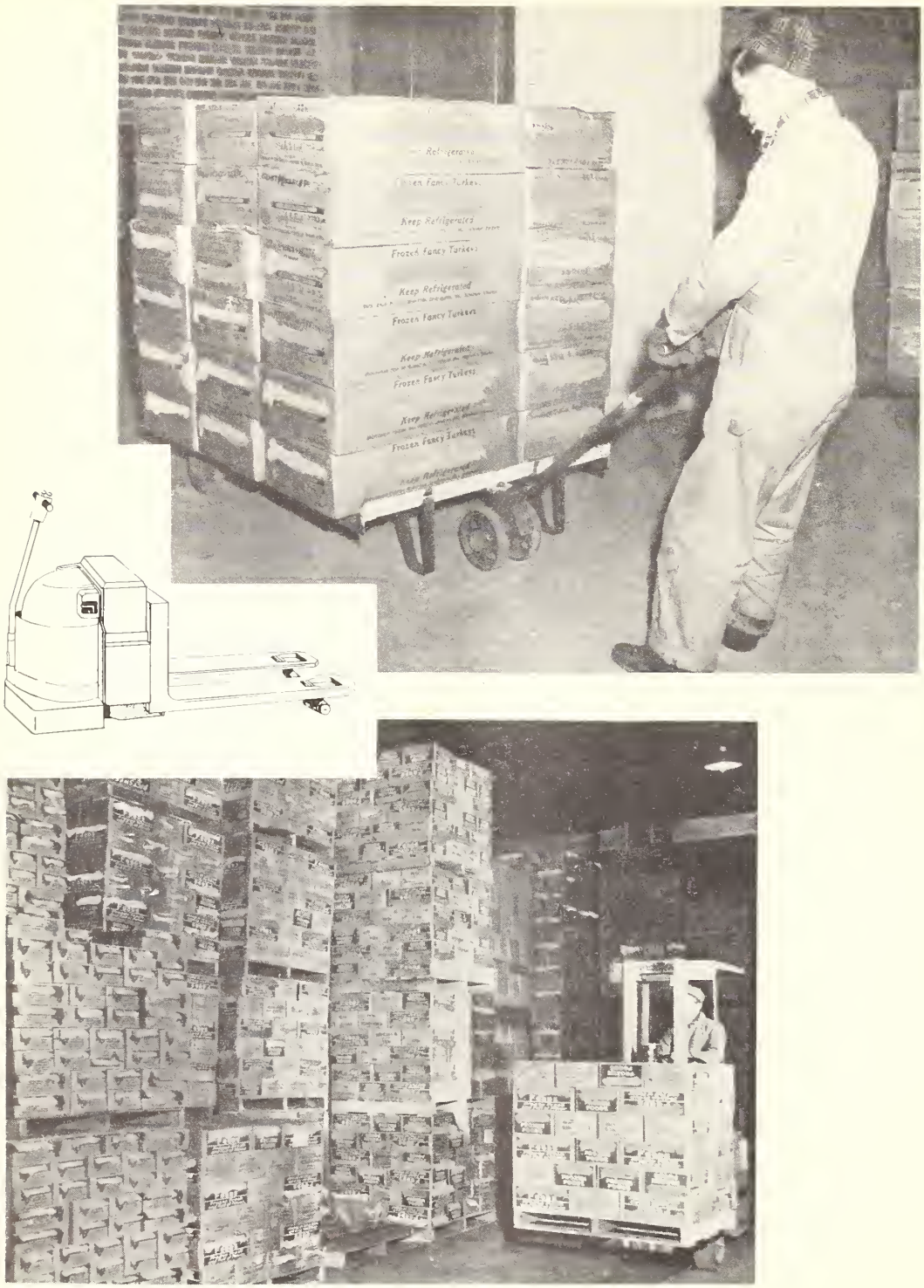


Figure 24.--Three examples of equipment used to handle unit loads. A.-Fork-lift truck transporting loaded pallet. B.-Powered walkie low-lift fork truck. C.-Semilive skid loaded with 36 boxes of frozen turkeys. Hand jack is used to lift "dead" end of skid and provide mobility.

of labor. Where ceilings are low and head room limited, semilive skids and jacks or dead skids and low-lift platform trucks might be used to advantage.

There are some significant disadvantages in unit-load handling. The standard type of fork-lift industrial truck requires a rather high initial investment by comparison with some other types of equipment, and as a result the volume handled must be sufficiently large to justify the expenditure. However, a high initial investment is not required for a semilive skid or dead skid system. Floor capacities must be adequate to support the weight of the loaded truck and tiered items. Some buildings lack this capacity and the fork-lift truck cannot be put into use without costly major alterations to the building. Powered walkie fork-lift trucks, being of lighter weight, do not require floors with as high a load capacity as heavy fork trucks require. When using fork-lift trucks wide aisles are necessary, as compared with the manual materials-handling equipment. Unit loads also require, except in special cases, a platform (pallet or skid) which uses piling space that might otherwise be used by the product to be stored. For example, an unloaded 40- by 48-inch pallet occupies over 6 cubic feet of space because of its 6 inches of thickness which may be an important consideration to a wholesaler who already has inadequate storage space.

Other Considerations in Selecting Materials-Handling Equipment

In selecting equipment, frozen food wholesalers should carefully consider the kinds of handling operations to be performed, the workload or volume to be handled, the layout and design of the facility in which it is to be used, the nature and path of the flow of work, and the rated capacities and capabilities of the various types of equipment. A profit that could be made by using space for refrigerated storage should be compared with savings that could be made by using such space for materials-handling equipment.

Other considerations are: (1) Possible savings in labor and supervisory costs; and (2) the possibilities of speeding up or otherwise facilitating warehousing and distributing operations. When a decision has been made to purchase new equipment, the simplest types of equipment which will do the job efficiently (that is with the lowest total cost) should be selected. An adequate supply of spare parts should be stocked so that repairs may be made on short notice and the machinery kept in operation with a minimum loss of time, in the event repairs are necessary. As a rule, special or custom-built equipment should be avoided since such equipment is usually more expensive than standard or stock models and parts may not be readily available. Decisions to purchase should not be based on first costs alone. A less expensive type of equipment, in the long run, may be more expensive than more costly equipment because it might be frequently out of operation and thus not available for work. Also, the costs of repairs and maintenance may add to the over-all cost. Unless equipment is properly operated, the maximum savings possible will not be obtained. Labor must be instructed in its proper use to preserve the equipment, to reduce accidents, and to reduce damage to merchandise.

Suggestions on Use of Materials-Handling Equipment

Before selecting and purchasing new equipment, frozen food distributors should be sure that their presently owned equipment is being used as effectively as is possible. Only after determining the handling costs with this equipment when the best methods are employed should a comparison be made with the costs to be obtained with the equipment to be purchased. Materials-handling methods should maintain proper balance between crew size and equipment. The proper ratio of workers to equipment minimizes delays and waiting time since in a properly balanced operation all workers can maintain a steady working pace. Unbalanced operations are evidenced by idle crew members waiting for handling equipment, and this is positive evidence that the work load and/or equipment is not properly distributed throughout the operation. Moreover, it is possible in any situation for the bottleneck to shift from one part of the operation to another as the work progresses. Unbalanced situations should be put into balance promptly.

Equipment should be kept in good repair at all times. One person should be made responsible for properly maintaining the equipment, including checking and lubricating at intervals as required. A good preventive maintenance program--lubrication, inspection (anticipation of repairs)--should be installed in all plants. Such a program reduces total maintenance costs and the time during which equipment is out of operation, and prolongs the useful life of equipment.

PRINCIPLES OF LAYOUT AND DESIGN FOR THE PLANT AS A WHOLE

In the preceding sections facilities and equipment for performing storage, order assembly, and other physical handling operations have been discussed independently of one another. This section covers the principles involved in properly grouping or arranging the components of a wholesale frozen food distribution plant to develop a layout conducive to efficient operations. Features of design that should be incorporated in plants of this type are also discussed. The arrangement of facilities for receiving, storing, assembling and holding orders, and loading delivery trucks should be made with the following objectives in mind: (1) To minimize the costs of performing order-assembly and materials-handling operations; (2) to minimize the capital outlay for facilities and equipment; and (3) to provide adequate protection in maintaining the quality of the product. Ideal circumstances for obtaining the most efficient layout usually prevail only when an entirely new plant is to be built. However, even when new plants are constructed, the layouts must frequently be fitted to or arranged to meet inherent limitations on the site. Where existing structures are remodeled, the problem is usually one that involves changing an existing layout to improve operating efficiency or to incorporate plant additions.

Unfortunately, plant layout is frequently not given the attention and study it rightfully deserves by wholesalers who plan the construction of new facilities or the remodeling of old ones. A number of plants have been constructed on the basis of some preconceived idea or on ideas obtained by visiting other distributors to determine how they have arranged their facilities. Although both approaches may have merit, final plans should not be based on these concepts alone. In most instances frozen food wholesalers would profit in the long run by calling in management engineers to make complete recommendations for the layout, or detailed plant plans might be appraised by a specialist in that field. Regardless of who may be employed to develop detailed plans and specifications, management should be in a position to make decisions on or to furnish the following types of information:

1. The types of materials-handling equipment to be used and the stacking arrangements to be adopted.

2. The amount of storage space that will be needed, based on annual volume and seasonality of receipts.

3. The type of refrigeration equipment to be installed.

4. The method to be used and the types of equipment that will be needed for assembling orders.

5. The amount of platform or dock space that will be required to accommodate properly motortrucks bringing in receipts and moving out supplies.

6. The amount, or number of cars, of railroad track space that will be needed.

7. A plot map of the site showing shape, topography, and directions of access of streets and railroads.

Most of the foregoing types of information are applicable to the remodeling of old plants as well as to the construction of new ones. However, since plans for remodeling an old plant are often restricted by certain inherent structural characteristics of the building, wholesalers should evaluate and compare the costs of operating in an entirely new building with those in a remodeled building before making a decision in this respect.

Interrelation of Sections

The various components of a wholesale frozen food distribution plant should be arranged so that operations to be performed in each of them will be properly coordinated and expedited and so that the merchandise can be moved through the plant with the greatest possible efficiency. Although a number of different layouts might be developed, they should all incorporate the following principles:

1. Definite lines of flow of merchandise through the plant should provide a direct flow of products through the cycle of receiving operations to the order-assembly room and on through the cycle of loading-out operations.

2. The flow or movement of products should be through the shortest possible distance consistent with the size of the plant, with a minimum amount of back haul.

3. Paper work required in obtaining, filling, and delivering orders should be properly coordinated with the flow or physical movement of products through the plant.

4. Rooms or components in which closely related functions are conducted should be grouped as closely as possible to minimize handling and supervision costs.

A plant layout which incorporates the proper relationship of essential components for receiving, storing, order assembling, shipping, office work, and auxiliary activities is shown in figure 25. This layout provides a compressor room in the basement underneath the storage room. Such an arrangement has at least three advantages: (1) The cost per square foot of floor space in a basement usually will be less than that on the main floor; (2) the cost of refrigeration lines should be lower with a basement installation directly underneath the storage room; and (3) vibration from the operation of the compressors in a basement is less likely to be transmitted to the offices and other units on the main floor.

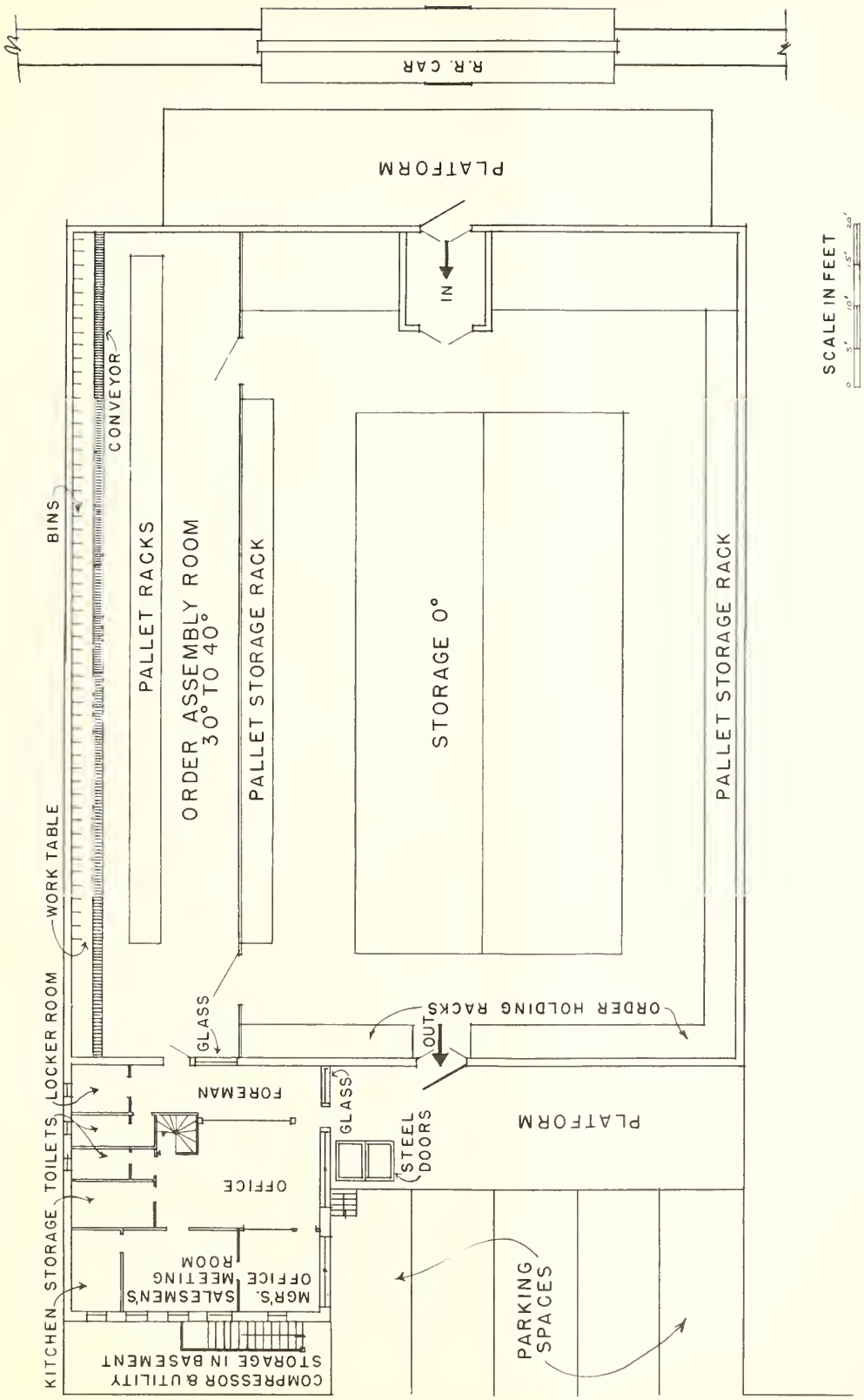


Figure 25.--A complete wholesale frozen food distribution plant showing proper relationship of facilities for receiving, storing, assembling orders, shipping, office work, and auxiliary activities.

Partitions dividing the order-assembly room from the storage room should be removable so that the size of the order-assembly room can be increased if necessary, or decreased if, in the future, most products are sold in case lots.

Office Space

The main office should be located near the main entrance to the plant for convenience to the public. It should also be near the order-assembly room so that close liaison can be maintained with the order-assembly and warehouse crews. The business office for a medium-sized or large distribution plant might be separated into several offices or sections including a reception hall or room located at the main entrance to the office area, private offices as required, and a salesmen's meeting and work room. In small plants all the features discussed above might be centralized in one room.

A small office for the foreman near both the order-assembly room and the business office is desirable in both large and medium-sized plants. Such an office might include a closet in which to keep heavy clothes for use in the zero room and other supplies for immediate use. The foreman's office might be separated by glass partitions from the business office and the order-assembly room or shipping area. For most plants the total area of the offices should not exceed 10 percent of the total plant floor area.

Auxiliary Facilities

Auxiliary facilities for most plants include refrigeration equipment room, utility storage room, heating equipment for offices, testing kitchen or laboratory, and toilet and washroom facilities. Some of these facilities may be provided at the basement level. However, the testing kitchen should be placed on the first floor, preferably adjoining the business office. Toilet facilities should also be on the main floor. In allocating space to auxiliary facilities the possibilities of future expansion should be kept in mind.

A parking area should be provided for motortrucks and automobiles. If delivery trucks are to be supplied with refrigerant from the plant's compressor units while they are parked overnight, parking space should be provided for them at the platforms where connections can be made with the refrigeration system (fig. 26). If delivery trucks are not supplied with refrigerant from the plant, they might be stored overnight at a nearby garage or in a fenced area on the plant site. The parking area for automobiles should be located near the offices.

Figure 26.--A delivery truck being refrigerated by plugging into a frozen food plant's brine-line system.

Communications

The transmittal of orders and other messages between departments is often a neglected feature of operational planning. Substantial savings can often be realized by an appraisal of various means of reporting orders by salesmen and the picking up of invoices in the office. Mechanical recording equipment connected to the telephone switchboard in the office has been found useful by several wholesalers in recording orders called in by salesmen. The use of a small recording device to be carried around by salesmen for making verbal recordings of orders might offer possibilities. Such a system would no doubt allow the salesmen more actual selling time, but would be practical only where the transmittal of orders to the office could be delayed until the salesmen completed the day's route.

A memo-belt or disc containing recordings of orders in some instances might also be used in the order-assembly operation in lieu of copies of invoices for filling orders. Invoices in the office may be prepared by a clerk writing them in longhand or by the use of mechanical equipment. If prepared by the use of mechanical equipment, inventory control records can usually be produced as a "byproduct."

SELECTING A DESIRABLE SITE FOR THE WHOLESALER'S PLANT

Established frozen food wholesalers who plan to construct new facilities or expand or rearrange existing facilities frequently overlook the desirability of appraising locations because of such factors as ownership of the existing site or the habit of doing business in a certain place. As a result a number of wholesalers have incurred heavy costs for only makeshift expansion. Some of the major factors that a wholesaler should consider when selecting a location for his frozen food operation are listed below.

Location of Customers to be Served

The wholesale frozen food distribution plant should be located at a point from which retail grocers, restaurants, hotels, or others to whom frozen foods are to be sold and delivered can readily be reached. From the viewpoint of a distributor who serves various types of trade, the ideal location would be at a point which is the shortest average distance from all retail and institutional outlets, assuming, of course, that from such a point satisfactory streets and highways radiate in each direction. A wholesaler who caters primarily to retail grocers might locate his plant in a suburban area of a town where land values are relatively low and serve his customers by skirting the business district when making deliveries. A wholesaler who has a large out-of-town business might advantageously place his plant on the side of town that would shorten his long-distance hauls.

A wholesaler should avoid locating in sections of a city where the movement of his trucks is made difficult because of congested traffic conditions. This situation can be costly from the standpoint of time wasted in making deliveries.

Convenience for Truck and Rail Receipts

The wholesale plant should be conveniently located to receive supplies by both rail and motortruck. For wholesalers who receive a large part of their merchandise by motortruck it is important that their plants be readily accessible to highways. The location selected should also be accessible to railroad lines. Although a wholesaler may be receiving supplies primarily by motortruck from a nearby producing area when his plant is constructed, consideration should be given to the possibility that in the future frozen food receipts might come mostly by rail from a distant section of the country. In that event, a lack of rail connections would result in cartage costs from the railroad tracks to the plant.

Cost of Land

The acquisition of land at a relatively low price reduces the capital investment that will be necessary in constructing a facility. For this reason a wholesaler might give preference to a site outside the downtown section. The costs of placing a site in condition to build and obtaining

utilities should be considered along with the cost of the land itself in determining the total cost of a site. Sufficient land should be acquired to meet present needs and provide for possible future expansion.

Room for Expansion

The frozen food industry is growing rapidly and it is difficult to predict the increased volume of business that may be handled in future years. Therefore, when a new plant is constructed consideration should be given to possible future expansion; otherwise, the wholesaler may find that he has made a large investment in a plant that cannot be expanded sufficiently to handle his volume of business.

Types of Products Handled in Addition to Frozen Foods

A fresh fruit and vegetable wholesaler who also handles frozen foods may find it more desirable, from the viewpoint of his fresh produce business, to locate his entire operation on a wholesale produce market. Such a location might also be desirable if he sells to buyers coming to such a market to obtain other products. In addition, a fresh meat wholesaler who operates in a public refrigerated warehouse may find advantages in locating his frozen food business in the same facilities.

Accessibility to Public Warehouses Used for Long-Term Storage

Accessibility to frozen food stocks in storage is important to the efficient operation of a frozen food wholesaling business. A wholesaler's plant should be convenient to the warehouse where his stocks are stored. If most of his products are stored in a local public warehouse at some distance from his plant, the cost of transferring these products will be a major expense item. When wholesalers store products for a long term in their private facilities and in packers' or in-transit warehouses only, the location of the frozen food plant in relation to the local warehouse is relatively unimportant.

PARTIAL LIST OF U. S. DEPARTMENT OF AGRICULTURE PUBLICATIONS RELATING TO FROZEN FOOD MARKETING

Marketing Frozen Foods – Facilities and Methods (PMA - 1949)

The Market Information Needed on Frozen Foods (PMA - 1950)

Transportation of Frozen Citrus Concentrate by Railroad and Motortruck from Florida to Northern Markets (PMA - 1951), Agri. Inf. Bul. No. 62, 40¢ ea. 1/

Merchandising Reconstituted Frozen Concentrated Orange Juice through the Use of Mechanical Dispensers (PMA - 1951)

Directory of Refrigerated Storage Warehouses (PMA - 1951)

Prepackaging Spinach and Kale (PMA - University of Maryland - 1951), Bulletin A-63

Frozen Food Research in the U. S. Department of Agriculture (PMA - 1952)

Planning a Wholesale Frozen Food Distribution Plant (PMA - 1952)

Use of Fruits by Chicago Bakers (BAE - 1951), Agri. Inf. Bul. No. 42, 50¢ ea. 1/

Price Relations between Methods of Sale of Florida Valencia Oranges (BAE - 1951)

New Concentrated Apple Juice – Its Appeal to Consumers (BAE - 1951)

The Marketing and Transportation Situation (BAE)

(A) *Marketing Cost and Margins for Frozen Foods,* August 1950 issue
(B) *Processing Cost and Margins,* May 1951 issue
(C) *Shifts in marketing Oranges from Fresh to Processed Form,* November 1951 issue

Home Freezers – Their Selection and Use (BHNE - 1949), Misc. Pub. No. 687, 10¢ ea. 1/

The Relation Between Locker Plants and Home Freezers in the Distribution of Frozen Foods in Arizona, Part I, 1950 (PMA); *Quantity Buying for Home Freezer Storage, Part II,* (PMA - University of Arizona), 1952

Frozen Food Locker Plants – Location, Capacity, Rates, and Use, (FCA - BAE - 1951)

Periodicals

(A) *Cold Storage Holdings* – Monthly and Annual Summaries (PMA)
(B) *Consumer Fruit and Juice Purchases* – Monthly and Quarterly Summaries (PMA - BAE)
(C) *Consumer Buying Practices for Selected Fresh Fruits, Canned and Frozen Juices, and Dried Fruits Related to Family Characteristics, Region, and City Size* (PMA - BAE)
(D) *Fruits and Juices Availability in Retail Food Stores* (PMA)
(E) *Marketing Margins for Florida Oranges in 10 Major Cities* – Monthly (PMA)

1/ May be obtained at indicated prices by sending check or money order to Superintendent of Documents, U. S. Government Printing Office, Washington 25, D. C. All other publications may be obtained free of charge from the U. S. Department of Agriculture while the supply lasts.

U. S. GOVERNMENT PRINTING OFFICE : O --1952