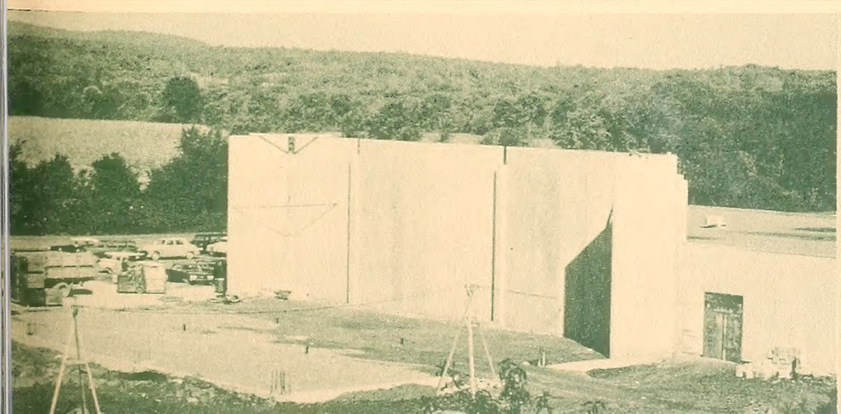
Marketing Research Report No. 610

APPLE STORAGE and PACKING FACILITIES

for SOUTHERN ILLINOIS



Transportation and Facilities
Research Division

Agricultural Marketing Service

U.S. DEPARTMENT OF AGRICULTURE

PREFACE

This study developed out of a request for assistance from the Illinois Department of Agriculture in early 1961. Primary objective was to plan centralized apple storage and packing facilities designed to meet the particular needs of the southern Illinois producing area on an economically sound basis.

Certain of the findings and determinations on which this report is predicated are adopted from surveys and analyses of producing trends and facility needs made by the Division of Markets, Illinois Department of Agriculture, by the Agricultural Industries Department of Southern Illinois University, and by the Federal-State Extension Service, University of Illinois. Most of the fiscal data were developed through field inquiries and research into the costs of construction and operation of similar facilities in Michigan, New York, and the Appalachian area. Two interim statements of summary financial aspects of this proposed plant were made to working committees in connection with preliminary consideration of the plant as an Area Redevelopment project.

This study is part of a broad program of continuing research by the Agricultural Marketing Service, designed to hold down the cost of marketing farm products.

ACKNOWLEDGMENTS

The cooperation of the following is gratefully acknowledged:

Robert B. Rogers, Superintendent, Division of Markets, Illinois Department of Agriculture, and Ruel Hindman, marketing specialist, of the Department; Herman Haag and Walter J. Wills, respectively acting dean and professor, College of Agriculture, Southern Illinois University; W. F. Lomasney, professor in extension, University of Illinois; Curt Eckert, Eckerts' Orchards, Belleville and Carbondale, Ill.; William H. Braman, Belding Fruit Sales, Belding, Mich.; Robert M. Smock, professor of pomology, Cornell University, New York; James Shockey, Howard Shockey & Sons, Winchester, Va.; and Henry W. Miller, Consolidated Orchards, Paw Paw, W. Va.

This study was conducted and the report was prepared under the general guidance and direction of William C. Crow, Director, Transportation and Facilities Research Division, Agricultural Marketing Service, U. S. Department of Agriculture.

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SUMMARY

The southern Illinois apple area is centered in Jackson and Union Counties, about 100 miles southeast of St. Louis. The area historically ranks second in apple production in the State, but current trends indicate it may become first. It has about 100 commercial growers, each with 10 to 1,000 acres, mainly Golden and Red Delicious, Jonathan, and Starkings. No existing storage is modern or has controlled-atmosphere (CA) space; all are inconvenient and costly to use. Together they have capacity for about 100,000 bushels. Two to five times that volume may be needed in a few years. Without adequate storage and packing facilities, the area faces serious problems in the successful marketing of substantially increased production.

Facilities recommended include one regular storage for 140,000 bushels, 8 CA rooms totaling 100,000 bushels, and a packinghouse large enough to handle this combined capacity plus some expansion of volume. This complex should be constructed as adjoining buildings laid out generally in accordance with plans suggested herein. All suggested operations are at grade level, from receiving to shipping, and are planned for handling apples in unit loads of pallet boxes or field crates with forklift transport and stacking. Carton makeup and supply, offices, and employee welfare rooms are planned for mezzanine space over the packing line.

It is recommended that the storages be of panel-wall construction with prestressed concrete framing and roof slabs. The suggested packinghouse should be a prefabricated steel building. Estimated total cost, if the facility is built at one time, is $631,000; this includes $37,000 in architect and engineer fees plus $57,000 (10 percent) for contingencies. For building in stages, estimated cost is about $27,000 more. Investment in packing and transport equipment would be $75,000, and in land and improvements $5,000, making the grand total project $711,000 to $738,000.

Estimated total annual operating cost, based upon complete construction at one time and full-capacity storage and packing, is about $101,000. This consists of: Management and general expense, $46,000; employment costs, $42,000; and equipment costs, $13,000. If built in stages, representing 40, 50, and 100 percent of completed-plant capacity, total annual operating costs would approximate $61,000, $69,000, and $102,000, respectively.

The financing plan is by means of loans and equity capital. A 10-year, first-mortgage, 4-percent loan of $142,000 to $147,000 would be needed from a local R. E. A. cooperative supplying power to the plant; a 25-year, second-mortgage, 4-percent loan of $462,000 to $480,000 would be requested from the Area Redevelopment Administration. Grower investment should be $140,000 to $146,000.

Storage income would increase from $37,000 to $124,000 in 4 years; packing and pre-grading income from about $25,000 to $75,000 in the same period. Net operating margins may range from minus $10,000 the first year to plus $50,000 by the fifth year. If the project can approach the volume of business for which it is designed, its financial future should be assured.

APPLE STORAGE AND PACKING FACILITIES FOR SOUTHERN ILLINOIS

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BACKGROUND

Illinois has two areas of commercial apple production. One is in and adjoining Calhoun County, north of St. Louis, Mo., in what is designated as the West Southwest Crop Reporting District. The other is in and around Jackson, Union, and Johnson Counties, about 100 miles southeast of St. Louis. The latter area is the locale of this study. It is composed mainly of the Southwest Crop Reporting District, but will be referred to throughout this report simply as the southern Illinois area.

Figure 1 shows the location of the seven counties which principally comprise this producing area, and indicates the distances from a central point to major markets. Apple growing in the area tends to be concentrated in a V-shaped region extending southward from around Murphysboro and Carbondale at the top and tapering in toward and around Anna at the bottom. Other important concentrations in the overall area are near Belleville in St. Clair County and Centralia in Marion County, northwest and north, respectively, of the counties shown on the map.

Production Trends and Prospects

Historically, the southern Illinois area has ranked behind the region north of St. Louis in commercial apple production. In the census year of 1954, for example, the volume harvested in the latter area was double that produced farther south. By 1959, however, production in southern Illinois had increased and in the West Southwest District had decreased to the point where the latter was only about one-fourth larger. Trends in the respective areas were even more pronounced in tree-count statistics. While both areas showed declines from 1954 in the number of bearing trees, the decline in the south was but 10 percent while that in the west was more than 45 percent. Conversely, the nonbearing tree counts showed a 100 percent increase in the south as compared to a gain of less than 40 percent in the west.

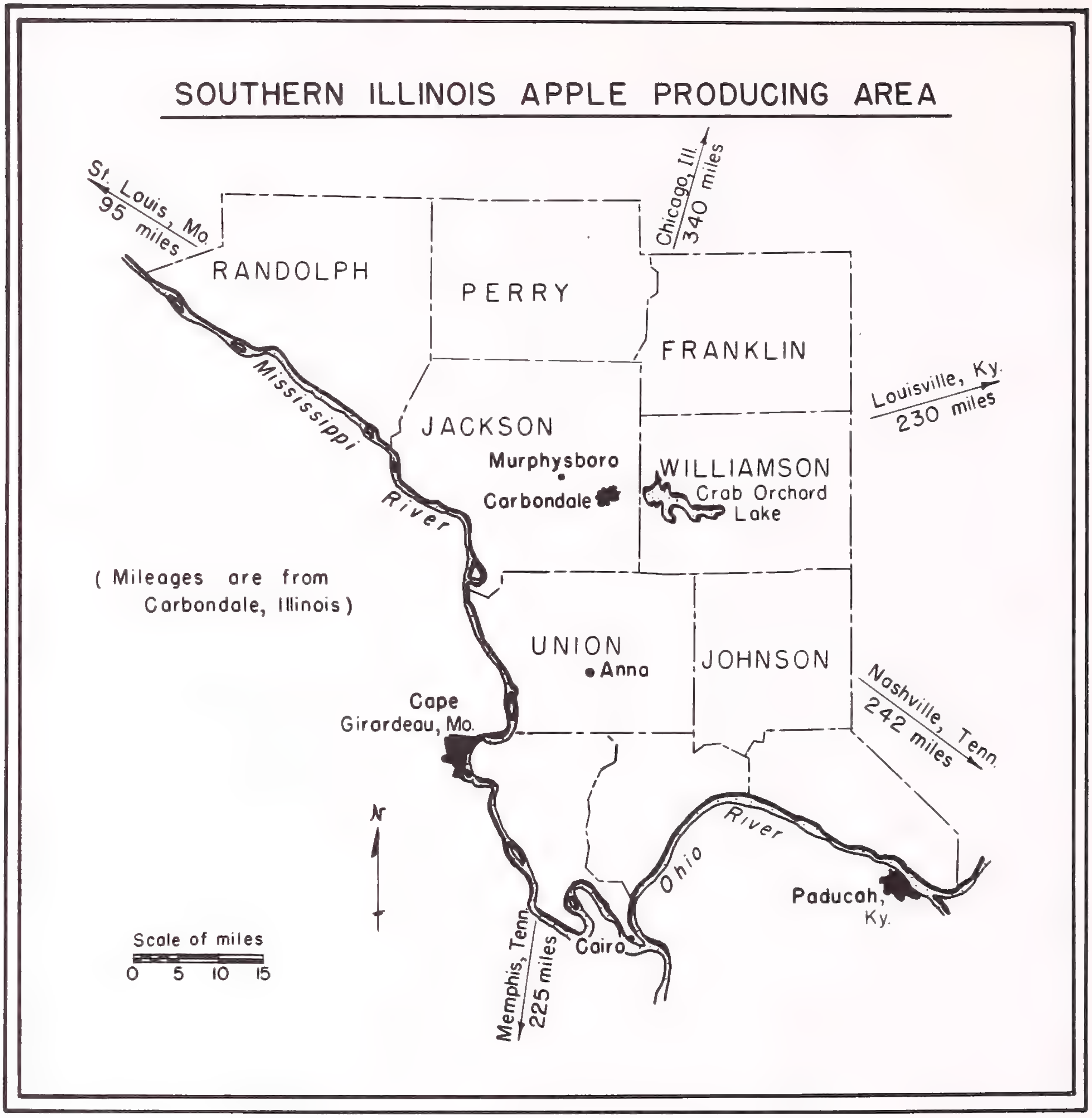

Figure 1.

Since 1959, new plantings in southern Illinois have continued to increase more rapidly than those in the other producing region. According to annual census data, as enumerated by township assessors and tabulated by the Illinois Crop Reporting Service for the past 3 years, apple trees of all ages in the two principal areas were:

Year	West Southwest Crop Reporting District	Southwest Crop Reporting District 1/
	1,000 trees	1,000 trees
1959	214	180
1960	211	191
1961	208	208

1/ Totals for the southern Illinois area, including Marion, Franklin, and Jefferson Counties: 206,000, 215,000, and 236,000 trees in these respective years.

It now appears probable that the southern area will become first in commercial importance within the next few seasons. Moreover, age distribution of the trees is such that, conceivably by 1964, production in that area could be double that of 1960. This would be approximately 1.2 million bushels. Prospects are for further production increases in succeeding years to a volume within the range of 1.5 to 2.0 million bushels.

Description of the Industry

There are approximately 100 apple growers in the southern Illinois area. Many of them also produce peaches, and a few grow pears. Scale of their apple operations ranges from 10 to 1,000 acres. Golden and Red Delicious, Jonathan, and Starking Delicious are the principal fall (storable) varieties. Most of them usually are harvested during the first 3 weeks of September, and harvest ends about the first week in October. Summer apples, mainly Transparent, Lodi, and Duchess, are harvested and sold from mid-June to late August, when the fall varieties come on.

The orchard land lies mainly on slopes and humps of the hills which make up most of the terrain in the area. Harvesting is done almost exclusively into field crates. Only one or two growers use pallet boxes. Marketing is conducted through four sales agencies, one a cooperative organization. All grading and packing is performed at individual producers' sheds. Some growers pack for others on a custom basis. Many of the smaller producers sell all of their apples ungraded.

Existing Storage and Packing Facilities

Present apple storage capacity of the area (exclusive of some individual holdings) totals about 105,000 bushels, divided among three places. Two are public cold-storage warehouses, holding 60,000 and 11,000 bushels. The third facility is owned by the cooperative and has capacity for 35,000 bushels.

None of these storages is modern; two are concededly obsolete (fig. 2). None can receive fruit in pallet boxes or in palletized field crates. The cooperative can transport and store such unit loads after they are palletized on its receiving platform. At the other storages, packages must be handled manually as well as individually, with consequent long delays in unloading. Since all of the storages are at some distance from the packing sheds, their employment involves considerable multiple handling. Partly to minimize this expense as well as to avoid reopening their sheds in winter, growers have been storing packed fruit despite the disadvantages of this practice. No controlled-atmosphere (CA) space has been constructed at any of the storages.

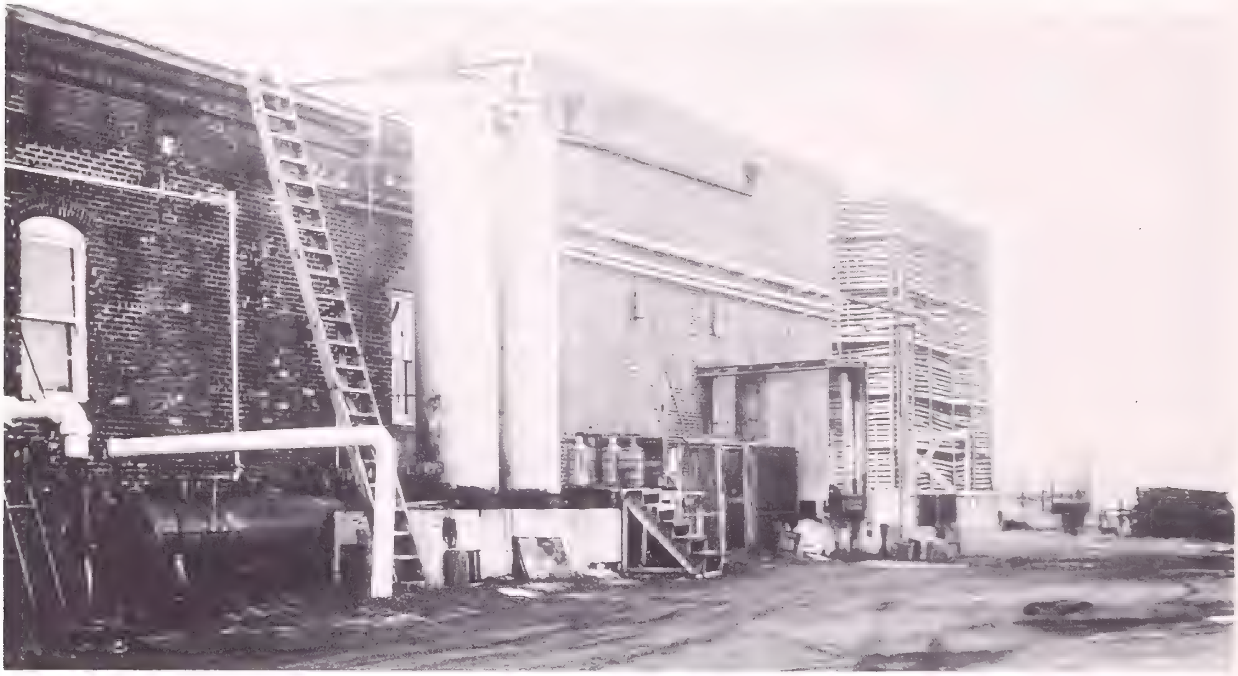

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Figure 2.--Receiving and shipping side of one existing cold-storage facility in southern Illinois.

All of the large apple producers have their own packing facilities. Several of these operations are quite modern and efficient. Some lack the kind of equipment needed today, however, to put up the types of pack that are in premium-price demand in the trade. Only one is equipped to handle fruit in pallet boxes. That producer also has an adequate storage facility. Most medium-size growers likewise have their own packing facilities. Many of these, however, are outmoded and inefficient. Some in this class have their fruit packed on a custom basis at the larger sheds. Few small growers do any grading or packing. They sell orchard-run fruit which the buyers usually bulk-load in trucks. Occasionally, these growers may hand-grade some fruit for sale in new or used baskets.

Need for New Facilities

The need for modern, centralized storage and packing facilities for apples in the southern Illinois area stems from several separate but complementary causes and considerations:

1. The imminent need for market price protection;
2. The inadequacy of existing storages, in capacity, efficiency, and quality control;
3. The need for more packing-facility capacity for those growers who now have sheds, as well as facilities for growers who do not;
4. The competitive urgency to operate in modern facilities which can accommodate pallet-box or unit-load handling and storing.

The first of these considerations is substantial and pressing. Given the production increase that is generally being predicted, the area will have a much larger supply of apples available for sale. It appears improbable, in a normal season, that this increased volume can be moved immediately into the market at satisfactory prices to growers. Without adequate storage capacity, excess supplies will be thrown into distributive channels as long as harvesting and marketing costs can be recovered. The resulting reduction in net returns to growers, or total elimination thereof, will affect the entire supply, not simply the surplus portion. It is apparent, therefore, that the industry must have the means to withhold increased production from the market for deferred, orderly distribution throughout the season if it is to secure a reasonable return for the product.

The inadequacy of present storage capacity to provide this necessary market price protection is evident in the prospective supply situation. It is further confirmed by the condition of present facilities. It appears that two to five times present storage capacity may be required, progressively, in as many years. Moreover, existing facilities are largely obsolete and expensive to use. Incidental handling costs involved in using them for unpacked fruit -- conceded to be the optimum practice from a quality-control standpoint -- would be prohibitive. With no CA storage space available, the industry now lacks the marketing advantages which this tool for retaining harvest quality and extending the selling season would provide. The storage period is now limited generally to a maximum of 3 to 4 months, with corresponding curtailment of marketing opportunity.

Some growers who have had adequate packing facilities for their production up to now will need additional capacity to handle increased volume, especially where two or more varieties may tend to ripen at the same time. They may find it more economical to supplement their own packing operations with the services of a centralized facility on a contract basis than to make substantial investment in additional equipment to handle this overload. They might also take advantage of the savings inherent in harvesting and transporting fruit in pallet boxes for storage and packing out at the centralized facility, while continuing to run only field crates at their own sheds. This would obviate the need to install pallet-box dumpers plus in-feed and take-away lines, which are not usable in any event unless the packing shed has heavy-duty forklift equipment. Growers with obsolete packing equipment, unable to put up a premium-price pack, might decide to utilize the modern facilities of the centralized operation rather than invest in expensive replacements. Also, growers who now have no packing shed -- mainly those operators with volume too small to amortize an installation -- could use the community packing plant on a custom basis to put up a pack as uniform and as well-graded as any turned out in the area.

With its decision to expand production, the southern Illinois apple industry is committed to greater competition with later producing areas during the storage season. It can no longer expect to market the bulk of its fall crop in the 2 to 3 weeks by which harvest here normally precedes that in later regions. It is imperative, therefore, that methods of handling, storing, and packing be competitive, and that modern plants, designed to house these more efficient operating methods, be planned and constructed. The handling of fruit in pallet boxes or in palletized unit loads of field crates, the high-stacking of such fruit in storages, the grading and packing out of storage to insure top quality and condition at shipping time, and the use of controlled atmosphere as an extended storage medium -- these are some of the methods that may enable the area to keep pace with its competition. Structures specially designed for application of these methods and the financial feasibility of building and operating them are accordingly the primary objects of this study.

FACILITIES RECOMMENDED

The apple-marketing facilities recommended for the southern Illinois area consist of conventional cold-storage, CA storage, and centralized packing--all integrated in one complex. These are planned in a manner that will permit progressive expansion of each phase of the project while maintaining an efficient functional layout of the whole. Initial construction should be restricted to a minimum practicable operating nucleus, consistent with the economies that can be effected through larger-scale building to anticipate space needs of the first few years.

Site Considerations

Some of the considerations which bear on the selection of a site for this storage and packing facility may be summarily listed (not necessarily in order of importance) as follows:

(1) Availability of power and other utilities;
(2) Centralized location;
(3) Accessibility to through highways;
(4) Adequate soil-bearing capacity;
(5) Relatively level terrain, entailing no major problems to place it in condition to build;
(6) Cost of the land, including site preparation;
(7) Availability and convenience of employees;
(8) Adequate size to accommodate expansion.

Availability of power (in three-phase service) is essential. While a primary distribution system can be extended some distance to provide service at new delivery points, this is subject to securing right-of-way and involves additional installation cost. For customers of a local R. E. A. cooperative, such cost must be amortized over 10 or fewer years and paid for by the subscriber along with current service charges.

A central location would have the most significant effect upon aggregate transportation costs of the users of the facility. To the extent that the weighted average hauling distance for producer patrons can be held to a minimum, substantial savings will be realized.

While location on a major highway is considered neither essential nor desirable (because of the traffic hazard created by trucks slowing down and making turns), the facilities should be conveniently accessible to through routes via State highways or paved county roads. In addition to facilitating trailer-truck shipments from the plant, this would save time and equipment for growers in hauling apples to the facilities, and benefit employees commuting to their work.

The advisability of a rail connection was considered in the planning, but was deemed of insufficient advantage to warrant its cost. Fruit shipments by rail from this area have been either negligible or nonexistent in recent years. Accordingly, no provision for siding or spur track is made in the plans. Piggyback service can be utilized, if the demand for it develops, by installing loading facilities at an existing spur off the main line of an important interstate carrier which crosses the area.

The site should be about 10 acres. To accommodate expansion in logical directions, it should have minimum dimensions of 550 by 750 feet. Highway frontage is not essential, if the management owns or controls necessary access to back acreage. Ideally, this access should be in separate drives, each 20 feet wide. If a single drive is used, the right-of-way should be 30 feet wide.

Overall Project

A plot plan of the recommended overall project is illustrated in figure 3. It indicates the manner and direction of successive expansions. The initial phase would occupy 48,800 square feet of enclosed space in a 200- by 240-foot area, plus a small adjunct. Expansion stages 1 and 2 would be in the form of wings to the conventional storage and the CA storage, respectively. The original packing area is designed to service these expanded storages without enlargement. As further additions were made to storage capacity (indicated in phases 3, 4, and 5), it would be necessary also to expand packing facilities into the adjoining location as provided for in the plan. The areas numbered for successive additions are not to be considered as minimum expansion units, but may themselves be built in stages. All facilities are planned at grade level, for reasons explained later. Maximum flexibility of operations was a primary objective in design.

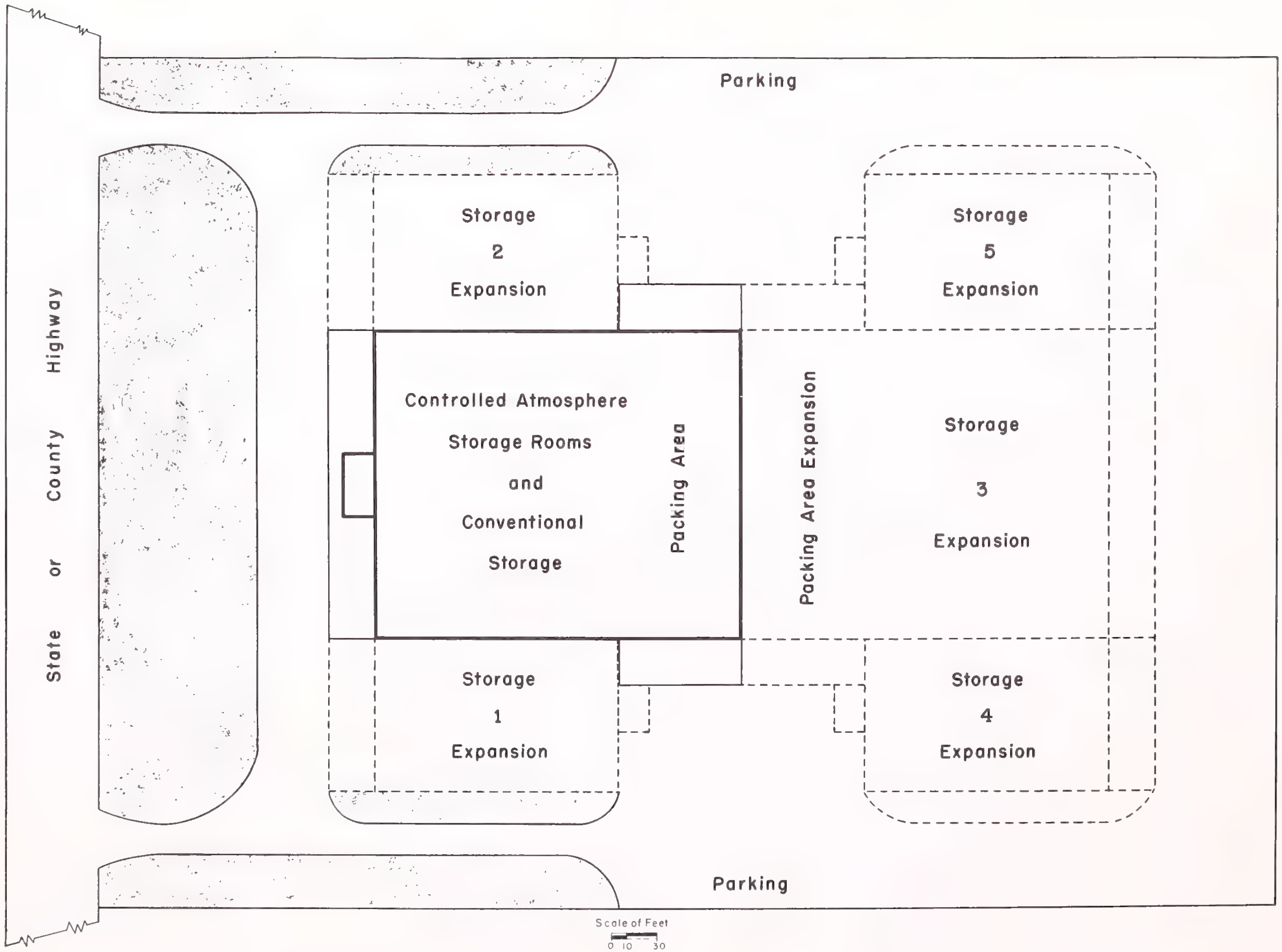

Figure 3.--Plot plan of proposed storage and packing facilities showing the orientation of initial construction to the areas reserved for successive expansions.

Conventional Storage Facilities

Conventional cold-storage capacity for 140,000 bushels of apples is recommended in the initial building program. This can be provided in a structure 100 feet wide and 160 feet long, with a clear stacking height of 22 to 23 feet under blower-type refrigeration units. As shown in figure 4, this facility would occupy half of the total storage building area, and would share the use of a compressor room with the CA space. A door at the front opens onto a covered unloading apron; one at the rear, directly into the packinghouse. To provide direct passage between them without obstruction from center-line columns, these doors can be placed off-center in the end walls. One or more lintels should be built into the outside wall where access to the first storage addition would be desirable.

Controlled-Atmosphere Storage

Controlled-atmosphere storage of apples is an operation in which the components of air are adjusted to retard the respiration of the fruit. The amount of oxygen in the storage medium is reduced to about 1/10 to 1/5 of its normal proportion in air and the level of carbon dioxide is allowed to increase to about 1 to 5 percent. Varieties differ in their carbon dioxide and oxygen requirements. A minimum relative humidity of 90 to 95 percent is maintained and temperatures are held at 29° to 38°, depending on variety. CA storage has been effective in controlling Jonathan spot in 32° storage. In addition to the special equipment needed to adjust and to maintain the storage environment, CA storage requires air-tight construction, effective vapor barriers, and provision for sealing, inspecting and venting the rooms. There are devices on the market for creating desired atmospheres within cold storage rooms by burning the oxygen in the air.

The plan calls for 16,000 square feet of building area to be constructed for CA storage. This facility would furnish eight rooms, nominally 40 by 40 feet, four on each side of a 20-foot center corridor. Fruit capacity would be approximately 12,500 bushels per room, for a total of 100,000 bushels. Refrigeration and electrical lines, valves, CO_2 scrubbers, control equipment, and other devices would be along the ceiling and walls of the center corridor, for each access and operation. The corridor would also serve for loading and unloading the rooms, and such clearances should be maintained as will permit the passage of field trucks to the door of each room when that would facilitate receiving operations. A 14-foot overhead door is designed for installation at the covered-apron end of the CA storage corridor. The other end would open into the packinghouse with no door required.

Refrigeration equipment, shown in the plan as typical for installation in the CA rooms, includes a cold diffuser and tapered duct. This kind of air distribution system is illustrated in figures 5 and 6. Blower-type units, such as those shown in figure 7, could be used instead to refrigerate these rooms. Alternate bids on both types might well be invited, with the contract award decided on the basis of relative efficiency as well as least cost.

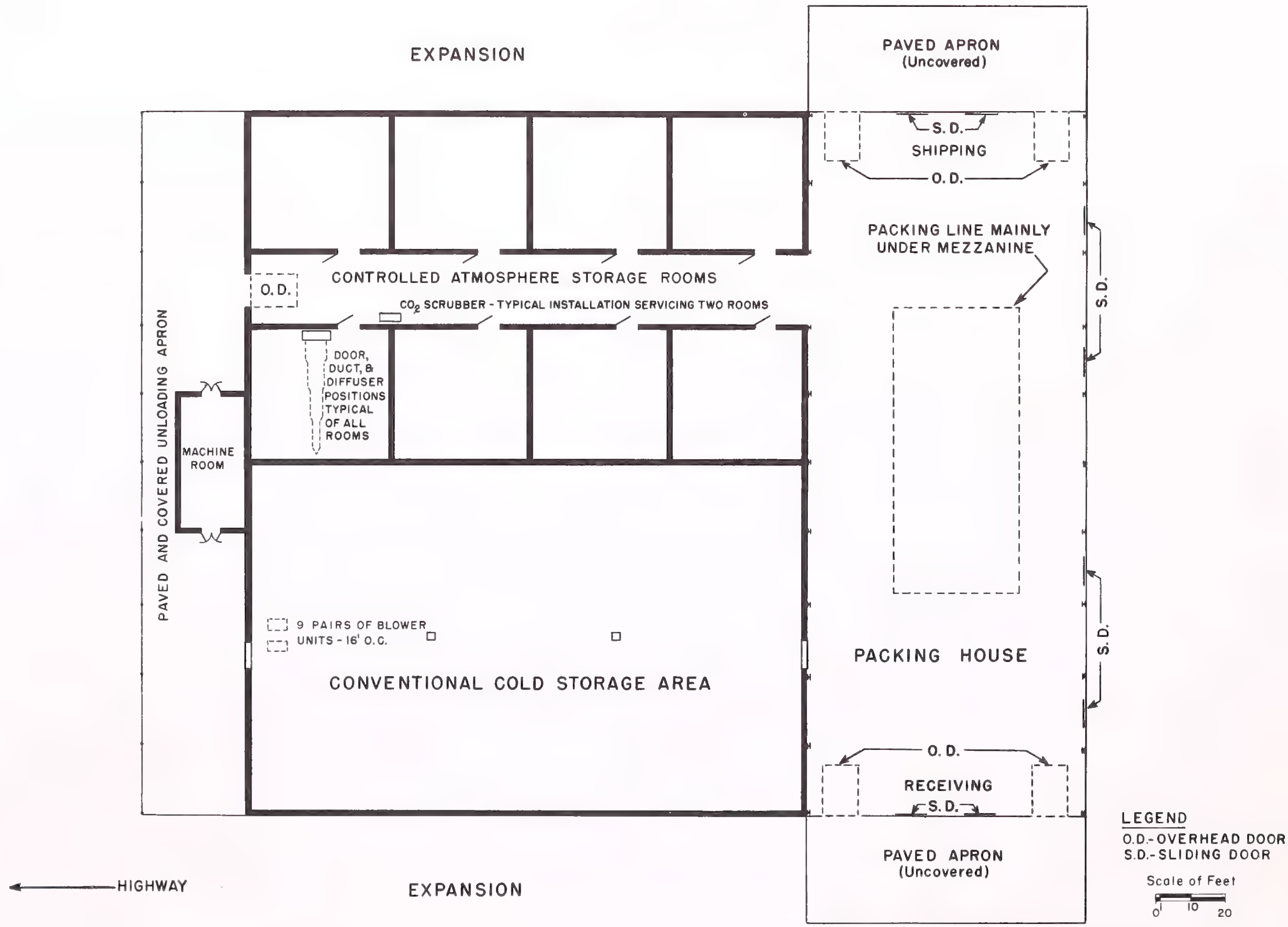

Figure 4.--Floor plan of the conventional and controlled-atmosphere storage areas and adjoining packinghouse.

In the center corridor, between the banks of CA rooms, the special equipment required to establish and maintain the storage environment should be positioned as close to the walls as is practicable for operation and servicing. This equipment will include CO_2 scrubbers, gas analyzers, thermometers, and electrical control panels. To the extent that these devices can be planned for installation within minimum distances of the side walls of the corridor, the working area available for loading-in and loading-out of the CA storages will be correspondingly enlarged. Some effective use of the ample head room in this corridor might be made in this connection by installing certain of this equipment at upper levels accessible by way of steps and catwalks. If run transversely of the corridor, the framework supporting the catwalks might also be used to carry the refrigeration lines suspended from the undersides.

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Figure 5.--Cold diffuser in a controlled-atmosphere room. (Note the sealing of the metal wall sheets).

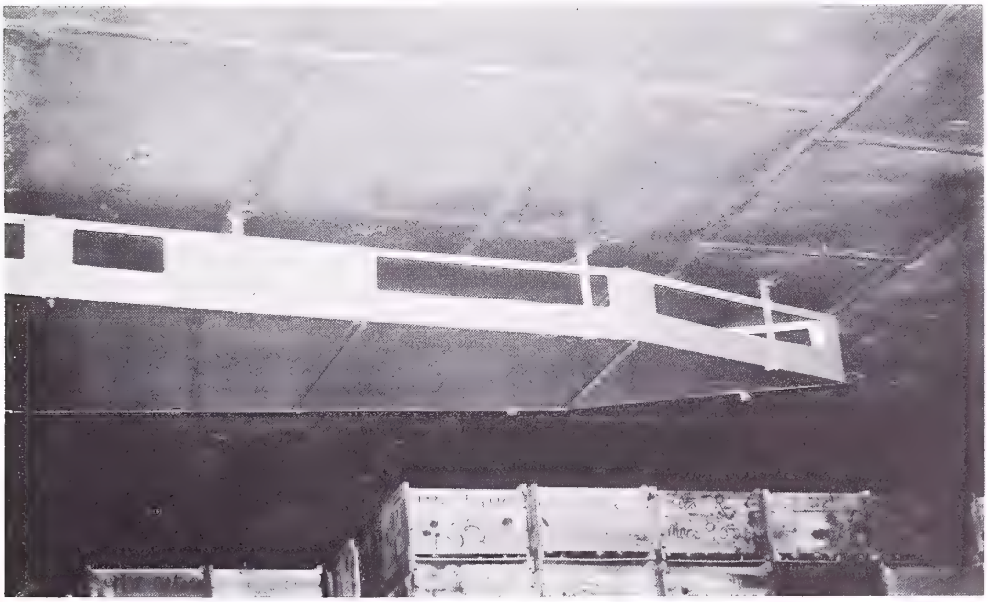

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Figure 6.--Tapered duct from cold diffuser in a controlled-atmosphere room.

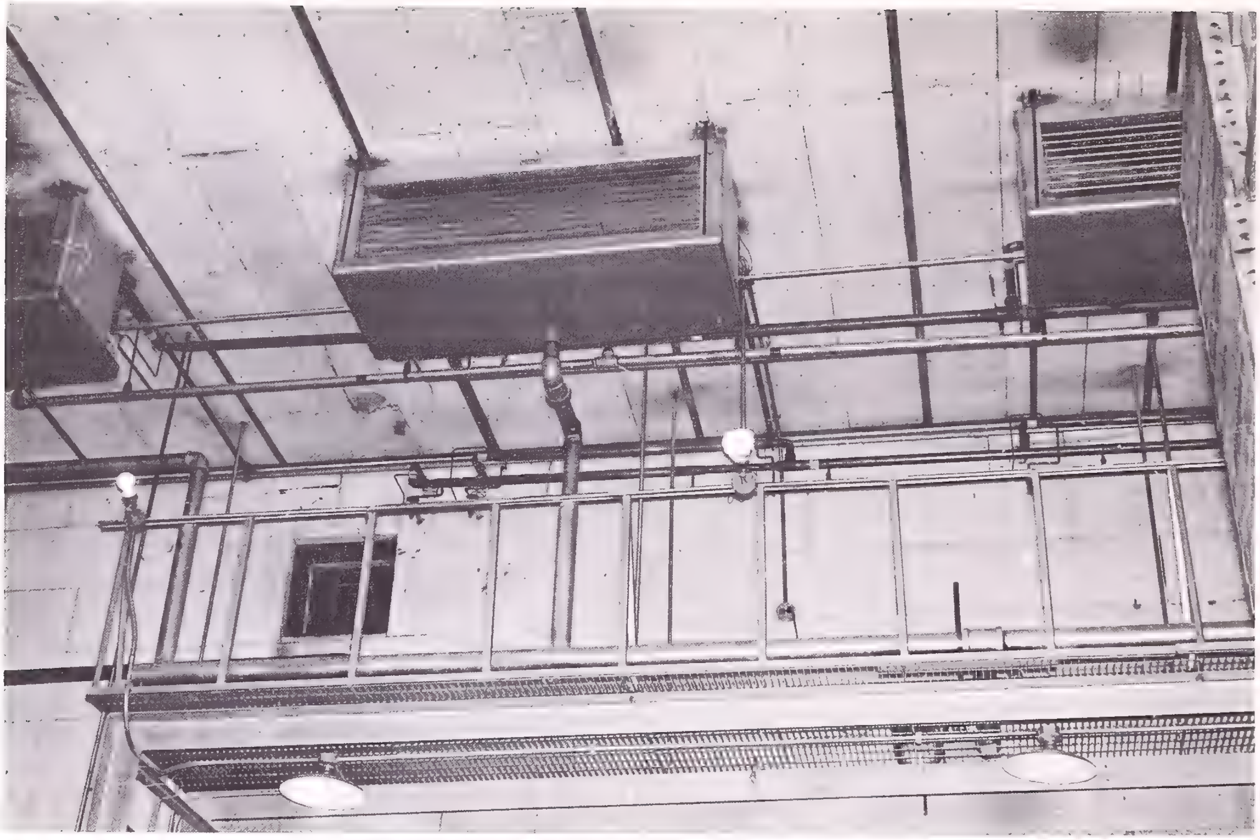

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Figure 7.--Blower units, catwalk, and inspection window in a controlled-atmosphere storage room.

Centralized Packing

The packing operation would be housed in an area 80 feet wide and 200 feet long which abuts the rear of both storage buildings. Grading and sizing equipment would be installed mainly within a space 40 by 100 feet, beginning about 65 feet from the receiving end of this area and running to about 35 feet from the shipping end. A mezzanine floor over the packing line would provide space for an office, employee welfare rooms, and carton makeup and supply areas. Uncovered paved aprons, the width of the packinghouse, would form 30-foot extensions of the floor slab. Two overhead doors, large enough to accommodate semitrailers, are planned at each end of the packinghouse, together with a pair of sliding doors (fig. 8-B). Four sliding doors in the rear wall should be spaced as indicated in figure 8-C.

Planning of the packing operation, in relation to receiving, storing, and shipping, was designed to eliminate cross-traffic and to utilize straight-line product flow as much as possible. Fruit not consigned to storage should be received at one end and shipped out from the other end of packinghouse to

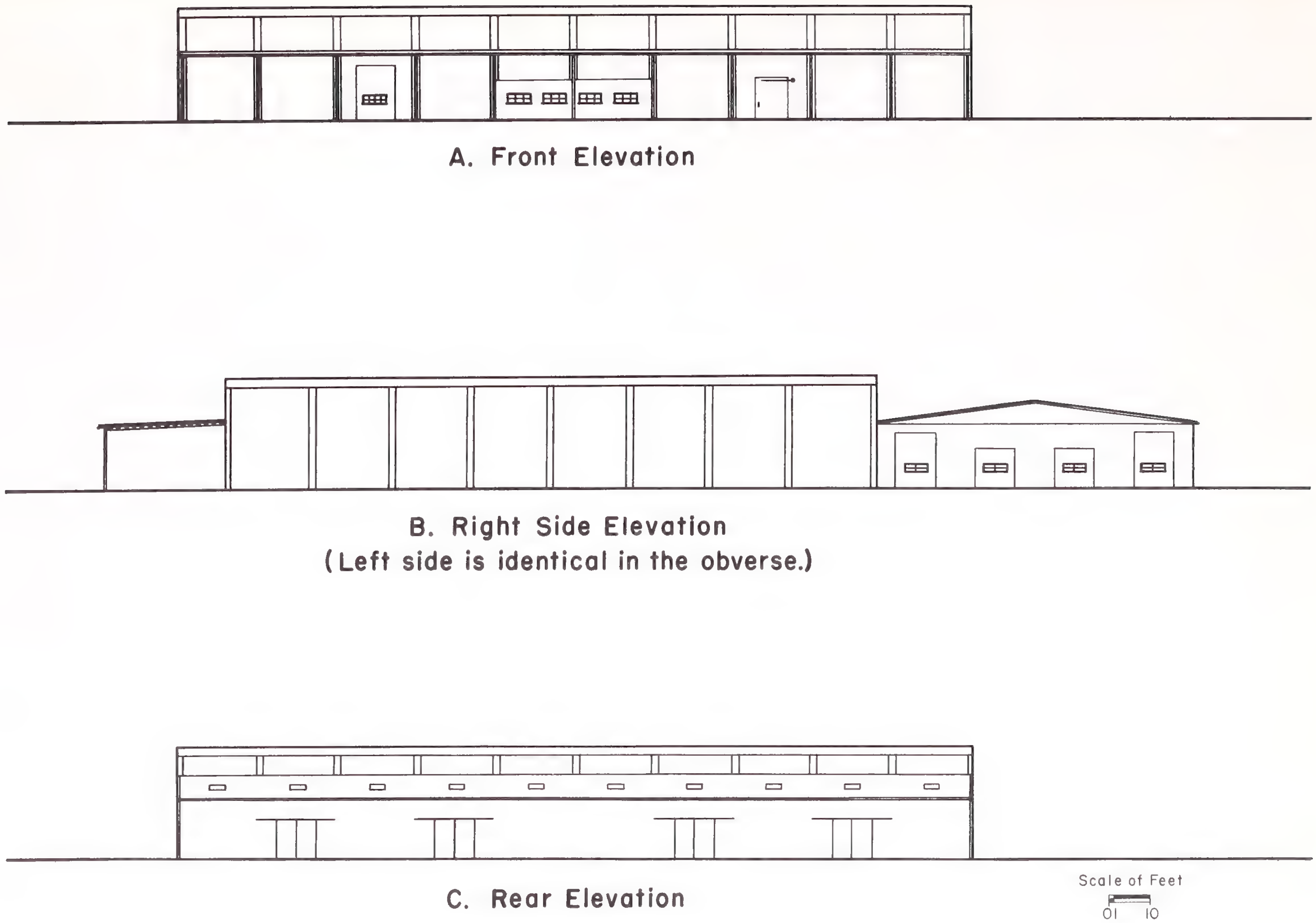

Figure 8.--Front, rear, and side elevations of proposed storage and packing structures.

accomplish this objective. Apples graded before being placed in storage would flow in an "L"-shaped course without line intersection. Those moving out of storage to packing and shipment would have longer transport distances but similar freedom from interference with other operations.

The more than 5,000 square feet of space in the receiving area is planned to provide: (1) A supply bank for feeding the line; (2) temporary holding of segregated lots of fruit from several sources; (3) inside unloading in inclement weather; and (4) circulation lanes for forklift truck traffic. For packing operations at harvest time, the supply bank would ordinarily be built up with fruit received directly from the orchards. Occasionally, the fruit would come out of storage where it had been placed for temporary holding.

All fruit transported within the plant would be handled in unit loads. In beginning years, most apples probably would be delivered in field crates already palletized. Only a minor part is expected to be in pallet boxes. Prospectively, however, use of these large boxes would increase each year until it becomes the dominant handling method of apples sent to this plant. Fruit received in field crates would be palletized in process of unloading.

Product Flow

A suggested packing-line layout for this facility is shown in figure 9. This drawing is presented primarily to illustrate the product flow and the operating relationships among the facilities comprising the project. A secondary object is to provide some basis for estimating aggregate equipment investment. It is not intended as a recommendation of the specific types of equipment shown (except where expressly so stated), nor of the size or number of individual pieces. Such determinations properly can be made only on the basis of detailed engineering analysis of the probable volumes to be pregraded, sized (by classes), bagged, tray-packed, bulk-packed, etc. The data upon which these packout estimates must be predicated also can be developed, in turn, only after determining who are the intended users of the facilities, their prospective patronage, and at least the general specifications of the custom packs they will want. In the outline of packing facility operations which follows, therefore, these qualifications must be borne in mind because of the many modifications which they may involve.

The sequence of operations in the packing process is described roughly in the order of the identifying legend at the bottom of figure 9. Beginning at the dump tank (1), pallet boxes are immersed (2), the apples float to the surface, and are moved forward by a pump-induced current. With capacity for four boxes on both in-feed and take-away sides of the tank, in addition to one box in position, the forklift supplying the line is released for other work for 10- to 12-minute intervals. Field crates are fed to the line out of the supply bank, in stacks of five or six. They are picked up with a clamp-type handtruck, placed on a chain conveyor moving along the floor to the destacker (3), and onto the drum dumper (4). After inversion over the tank, empty crates are conveyed (5) on out of the packinghouse at an elevated level above floor operations. This conveyor should have adequate clearance to allow for possible trailer truck passage. Following elevation from the dump tank (6),

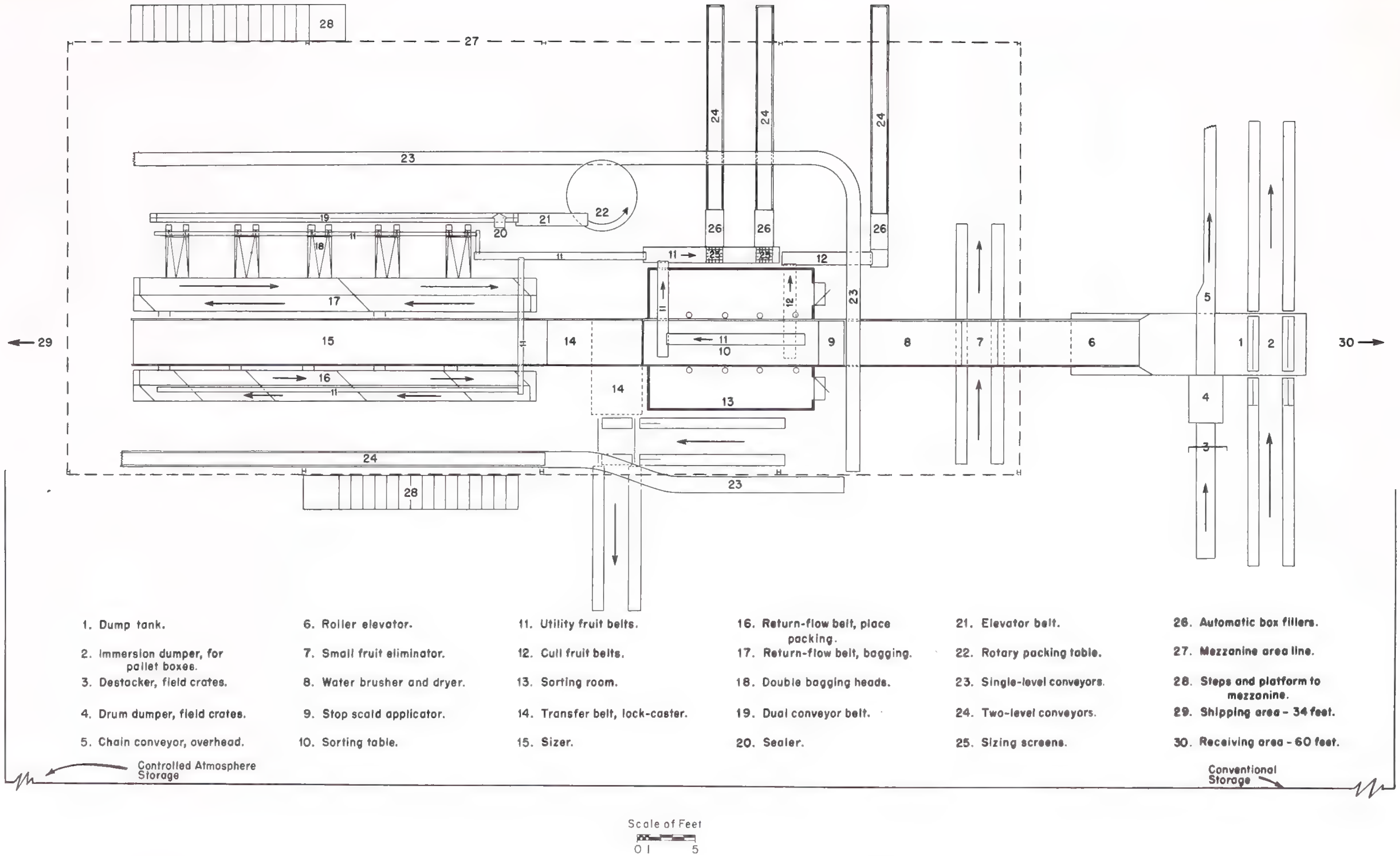

Figure 9.--Illustrative layout of a packing line set up largely under the mezzanine floor.

the apples traverse a screen which drops too-small fruit into pallet boxes (7), while merchantable sizes pass on through washing and drying brushes (8). At (9), fruit being pregraded for storage is chemically treated to inhibit scald; that for packing out and immediate sale is simply conveyed on to the sorting table (10).

The key to putting up high-quality packs lies in the sorting operation. For this reason, and to facilitate equipment installation and functioning, the area assigned to sorting is enclosed and elevated 14 to 16 inches above the packinghouse floor. These features contribute to the comfort and concentration of sorting-table employees and thus to the efficiency of the operation. The enclosure need be only plywood nailed to 2- by 4-inch studding, open at the top (fig. 10). Here, apples not meeting specifications of the grade being packed (or stored), but still salable, are picked out and placed on the "utility fruit" belt (11), which carries them over sizing screens (25) and into automatic box-fillers (26). Unsalable fruit is discarded into cull chutes (small circles along the sorting table in figure 9; rectangular attachment to the table in figure 10), which carry it to subfloor conveyor belts (12) and on into field crates or pallet boxes. It is suggested that the sorting table be of the float-roll type with divided lanes, for the reasons given in Marketing Research Report No. 230 (reference (10), bibliography; p. 30).

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Figure 10.--Enclosed sorting room, divided-lane table, elevated second-grade (or utility) fruit belt, and cull chute.

Acceptable fruit remains on the sorting table and is carried out of the enclosure onto a lock-caster transfer belt (14) which may be in one of two positions: In line with the table when the fruit is moving on for immediate packing, or at a right angle when fruit is being graded prior to storage. In the latter case, the apples are carried to a pallet box positioned off the end of the belt in this alternate position. Gravity tracks, holding three boxes on both the incoming and the outgoing sides, together with powered sections approaching and in the loading position of a seventh box, should provide sufficient capacity to permit forklift attention to be directed elsewhere for periods up to 15 minutes. Filling might best be done by employing an automatic pallet box filler such as that developed under contract with the U. S. Department of Agriculture.

Apples being packed move on into the sizing equipment (15), from which they are discharged either to (16), the return-flow belt for place-packing, or to (17), that for bagging. For the place-packing operation, rotary tables or tubs may be found equally or better suited to the needs of this facility. As illustrated in figure 9, only five size classes are provided for, but the line could be designed for more, if needed. The selection of fewer sizes can always be done by duplicating some sizer adjustments. Place-packers would obtain empty containers from the upper side of the two-level conveyor (24) behind them. These would be packed on adjustable-top stands equipped with casters from which the filled packages can be slid off onto the lower conveyor level.

A bank of five double-bagging heads (18) is shown. Operators would work over the dual conveyor belt (19) and simply lower the bags onto the belt when filled (fig. 11). Carried to the sealer (20), the fruit is then elevated (21) to the rotary packing table (22), where it is placed in master cartons, which could be successively positioned by a treadle just below the table level, on a continuous conveyor (23). A sorting-review operation is performed by both the baggers and the place-packers. Subgrade apples are picked out and placed on the utility fruit belts running across all stations (11); cull fruit, if any, is put into boxes at the feet of these workers.

It is suggested that fabricated steel staircases and platforms be secured as stairways to the mezzanine (28). These should be so designed as to be readily secured to the understructure at any of several places. While the locations shown in figure 9 are thought to be the most convenient

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Figure 11.--Bagging operation employing dual-belt conveyor, sealer, and rotary packing table.

for the facilities here planned, future modifications of the layout might make shifting of the steps advisable.

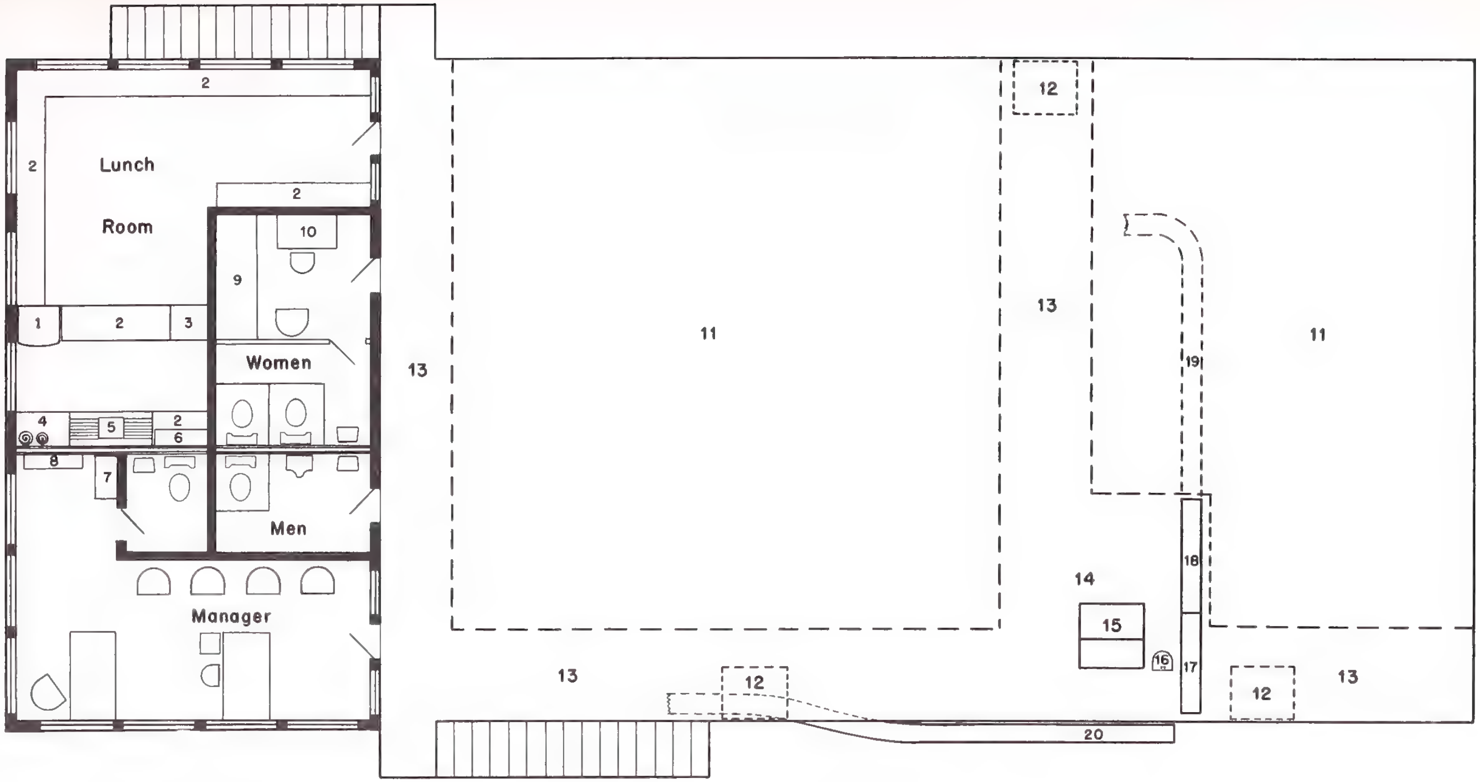
Carton supplies are maintained on the mezzanine floor of the packinghouse convenient to makeup and in-feed stations. The plan of this floor is shown in figure 12 with its own numerical legend. Cartons would be formed at (15) and stapled at (16). Those needed for the bagging operation would be loaded onto an inclined section of portable conveyor (17), pass through the floor at (18), and be carried on down to the rotary packing table through a conveyor (19) suspended from the joists supporting the mezzanine. The floor opening at (18) could be covered with hinged metal plate when not in use. Trays or boxes for place-packing would be fed into the conveyor at the side of the mezzanine (20), and thence down to the line. Packaging supplies would be palletized before storing on the mezzanine and could be received at any of several places when packing is not in progress. The places marked for this on the drawing (12) are those which a forklift could reach even during packing operations. The planning of this mezzanine area for package storage and carton-supply operations not only conserves prime first-floor space but also takes advantage of gravity conveyor possibilities.

A suggested layout of the plant office and employee welfare rooms also is shown in figure 12. Since no sales recording or related activity is involved, the space allotted for office purposes should be adequate. The stairways to the mezzanine are so placed as to minimize walking distances for employees. Average distance is no more than would be required if the rooms and office were located in any practicable place on the packing floor. Principal planned advantages of putting them on the mezzanine, however, are (1) that it either provides more prime operating space or obviates the need for a wider building, and (2) that it is not in the way of projected expansion of the packing area, nor will these facilities be as remote from such extended space as otherwise they would be.

All Facilities at Grade Level

As has been shown in the floor plan and elevations (figs. 4 and 8), all facilities are designed for construction at grade level rather than at platform or truckbed height. It is believed that the design considerations supporting this recommendation clearly outweigh those favoring the alternative arrangement.

A first consideration in this connection is the relative construction costs. Facilities designed with a floor level 3 to 4 feet or more above grade cost appreciably more. They would require not only a net addition to wall height, but also foundation walls and footings of heavier construction. Extensive fill also would be required, and platforms would have to be substituted for economical concrete aprons recommended in these plans. It is estimated that the total increase in basic building cost would amount to 6 to 8 percent. Some of this additional cost could be avoided, of course, by using a site grading plan which would provide either docking wells or fall-away slopes at doorways or platform areas. The plant could then be built on grade except at these approaches for receiving and shipping.



Office and Welfare Areas:

1. Refrigerator
2. Counter
3. Lift Gate
4. Stove
5. Sink
6. Cabinet
7. Filing Case
8. Coat Rack
9. Cot
10. Vanity

Packaging Supplies Area:

11. Storage areas - cartons, etc.
12. Receiving areas - pallet loads
13. Aisles
14. Make-up and infeed station
15. Forming table
16. Stapler
17. Conveyor
18. Conveyor opening, thru floor
19. Conveyor route to bagging line
20. Conveyor to place packing line

Scale of Feet
0 1 5

Figure 12.--Floor plan of the mezzanine level of the proposed packinghouse.

The principal reasons for recommending construction on grade, however, concern handling operations, mainly the efficiency of forklift truck transport. In receiving, particularly, the use of a paved apron, rather than a platform or elevated doorway, for unloading trucks coming from the orchard seems almost mandatory if pallet boxes or palletized field crates are to be employed. The bed levels of these trucks vary considerably in height, which makes it difficult to design a platform meeting the needs of more than half of them. Moreover, for all practical purposes, forklift handling of these loads must be carried on from the sides of farm trucks, the pickup being made on grade as illustrated in figure 13. Unless the storage or packinghouse floor is on the same level, therefore, receiving operations would necessarily involve multiple handling in the form of a transfer at a doorway or temporary placing on a platform at the higher floor level.

BN-19334

Figure 13.--Receiving palletized field crates of apples with a forklift truck on a paved unloading apron at grade level.

For apples received in field crates, those few at the back of the truck which may have to be unitized, before palletization can proceed on the truckbed, could probably be handled somewhat more easily on an adjacent platform than they could be on the ground. For all the rest of the load, however, the palletizing operation involves less work if done on the truck than if boxes are carried or conveyed to the platform. Once the boxes are palletized, the same handling situation described previously obtains.

There are other, incidental advantages to be realized from facilities constructed on grade. Both receiving and shipping operations are more flexible, since they can be carried on anywhere on the paved apron areas. This eliminates the need for maneuvering trucks into docking positions at doorways or platforms, with the accompanying space limitation. It also permits trucks to be driven into the plant, which is most useful at times, not only in inclement weather but whenever this facilitates operations. For example, palletizing of loads of field crates received for immediate grading at harvest time could be eliminated by driving the farm truck into the packinghouse and unloading directly into the supply bank for the destacker (fig. 9, at (3)).

If it be decided that a shipping door or platform at trailer truckbed height is desirable -- for utilizing continuous conveyors in loading or for other purposes -- it is suggested that such a facility, with its docking well, occupy approximately the first 20 feet from the left of the paved apron shown at the top of figure 4. This would provide two over-the-road truck positions, which should be adequate.

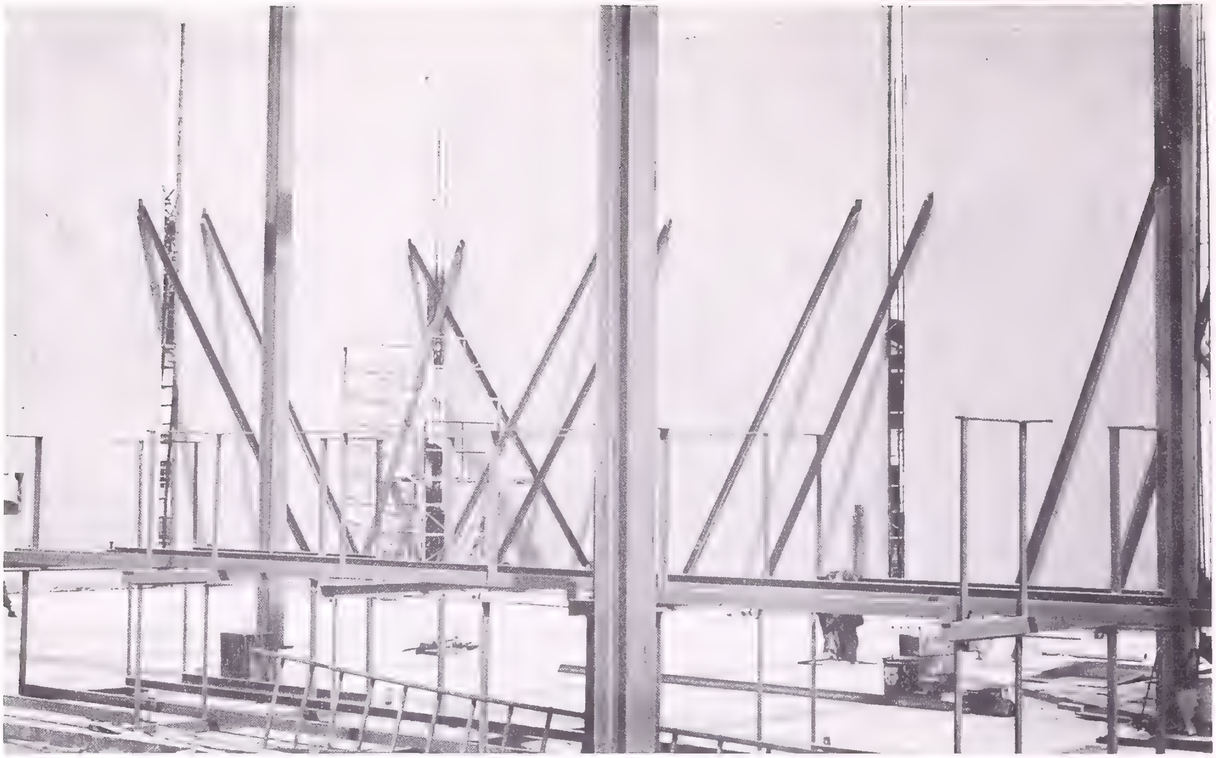
ESTIMATED INVESTMENT COSTS

The type of construction to be used for the facilities planned will have significant bearing upon the total investment cost of the project. A discussion of various possibilities in this connection follows.

Types of Construction

For the storage buildings, several kinds of construction are feasible, with various combinations of certain features in some of them. Perhaps the most common type of modern apple storage of small to medium size is constructed of concrete block, with a built-up roof on a metal or wooden deck, supported on steel columns or masonry pilasters. For storages of the capacity here being considered, however, there has been a pronounced trend toward the use of concrete panel walls, precast on the floor slab, and raised to position (cover photo). These may be either clear-span structures or buildings with interior columns to support the roof and the framework to which refrigeration equipment is attached (fig. 14). In clear-span design, large trusses are required for buildings of the width of the planned conventional storage, the trusses bearing on steel or masonry column supports in the sidewalls (fig. 15).

Another type of construction for storages of this scale involves the use of prestressed concrete framing and concrete block (fig. 16). Outstanding advantages of this kind of building are that (1) it permits the use of a concrete roof deck, which eliminates complications stemming from condensation in this area, and (2) it is economical construction even with long-span design. This latter consideration means that only two columns would be needed in the conventional storage area, as illustrated in figure 4, thereby minimizing interference with forklift truck operations and with the building of flexible pallet patterns.



BN-19339

Figure 14.--Wall panels braced in position ready for joining with poured pilasters; suspension frame for blower units and catwalk in foreground.

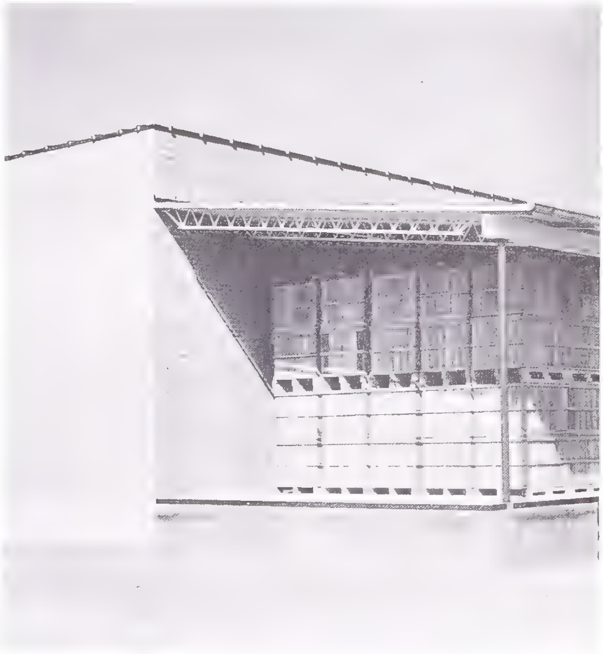
BN-19335

Figure 15.--Conventional storage built of tilt-up concrete wall panels, with clear-span truss-supported roof and covered apron.

A third kind of construction employs back-up block walls with brick facing. A storage of this type is pictured in figure 17. It may have fully independent steel framing with curtain walls, or steel framing only for the roof, which bears on the walls and interior columns.

BN-19338

Figure 16.--Storage structure of prestressed concrete framing, block walls, and precast roof slabs.



BN-19340

Figure 17.--Storage structure of concrete block and face brick, built at truckbed level.

A fourth type is the all-wood building (fig. 18), or the wood-framed, metal-clad storage. Like the popular concrete-block buildings first mentioned, however, this kind of construction is used mainly for smaller storages. It has been used principally in New England to house CA rooms. Some larger storages, both conventional and CA, have been built of wood in the Northwest, where long-span trusses of Douglas fir can be conveniently prefabricated.

BN-19343

Figure 18.--An all-frame controlled-atmosphere storage.

Relative costs of the types of construction just described vary to a significant extent in different areas, reflecting variations in availability of materials involved, wage rates of the trades employed, and the supply-demand situation in regard to contractors qualified to do the work. It is accordingly difficult to compare probable costs of the respective kinds of buildings without more definite information on factors affecting the relationships than could be determined in this study.

Subject to these qualifications, it appears that the most economical design combination would be panel-wall construction with prestressed concrete framing and roof slabs. It is strongly recommended, however, that bid plans be so drawn as to invite several alternates, such as substitution of steel for concrete framing and decking, concrete block for wall panels, and other variations. This should induce wide participation in the bidding and furnish a reliable index to the comparative costs of building with different types of construction. It is assumed, of course, that the specifications as to wall thicknesses, insulation, and similar details would be tailored to the alternative materials so as to provide substantially the same heat gain factor and other pertinent properties.

For the packinghouse, the most desirable type of construction is practically determined by these plans. To provide necessary ceiling height for installation of the mezzanine facilities and for related purposes, this should be a prefabricated metal building in which airspace under the ridge and roof center can be effectively utilized. While a masonry structure could no doubt be designed to serve these purposes, it would involve substantially greater investment. Even without the mezzanine plan, a steel structure should prove entirely adequate and more suitable, for other reasons as well as that of economy.

Facility Cost Estimates

Estimated total investment in the proposed project is $711,000. This figure covers all facilities. It is made up of $631,000 for structures and refrigeration and $80,000 for land and packing and handling equipment. Working capital is not included. The estimate of construction investment includes more than $37,000 in costs of architect and engineer fees and construction loan interest, as well as an overriding allowance of about $57,000 for contingencies. Cost of purchasing and preparing 10 acres of land for the site is put at $5,000.

Investment estimates for the individual facilities are shown in table 1. No benchmarks in the form of known unit costs of similar structures recently built in this area are available as a basis for making these dollar estimates; accordingly, the figures offered are simply informed estimates predicated on costs in other producing regions, adjusted to accord with known general differences in the cost of industrial construction. The 10-percent contingency allowance provides some cushion to absorb that much variance from the estimates on the upside, however, and whatever deviation may be realized on the downside makes the project all the more economically feasible.

Table 1.--Estimated costs of proposed apple storage and packing facilities in the southern Illinois producing area

Item	Facility	Cost
1.	Controlled-atmosphere storages: 8 rooms, 100,000 bushels of capacity @ $2.40/bu. 1/	$240,000
2.	Conventional cold storage: 1 room, 140,000 bushels of capacity @ $1.50/bu. 1/	210,000
3.	Packinghouse: Prefabricated steel structure, 18,880 sq. ft. @ $3.25/sq. ft.	61,360
4.	Covered unloading apron: Canopy and concrete slab	10,000
5.	Uncovered aprons (2), parking area, and driveways	15,000
6.	Estimated total construction cost	$536,360
7.	Architect and engineer fees at 6%	32,182
8.	Construction loan interest at 6% per annum 2/	5,117
9.	Contingency allowance at 10% 3/	57,366
10.	Estimated total construction and associated costs plus contingency	$631,025
11.	Packing equipment: Complete line installed, 400 bus./hr. capacity	50,000
12.	Transportation equipment: 2 forklift trucks, batteries, and charger	20,000
13.	Pallets, pallet boxes, and miscellaneous	5,000
14.	Land and site preparation: 10 acres @ $500 per acre	5,000
15.	Estimated grand total investment costs	$711,025

1/ Including allocable shares of refrigeration costs.
2/ On advances and progress-payment outlays against cost items 6 and 7, expected to average about 30 percent of their combined total over an estimated 6-month planning and construction period.
3/ Of total construction costs plus items 7 and 8.

Estimated Costs of Construction by Stages

As discussed later, it may be found advisable to limit initial construction of this project to capacities nearer the volumes for which commitments are obtained in the startup year. The remainder of the project here planned would then be built in stages over 3 or 4 years, or perhaps longer, depending upon development of the demand for space. While such a building program would obviously be more costly, this staggering of the investment may prove less burdensome to finance.

In any event, the planning problems are not preclusive of staged construction. Referring to figure 4, the conventional storage space can be halved with a wall on the center-line, making it 50 by 160 feet. Three lintels should be built into this wall on 40-foot centers for doors into the other half when it is built later. This wall would then become a partition that could contribute to more economical refrigeration of the storage. The doors would be moved from the locations shown, of course, toward the common wall with CA rooms. Single blower units could be installed in the same approximate positions in this half of the storage, later to be matched up in pairs by connections through the wall when the second half is constructed.

In the CA area, this construction might be done in four stages of two rooms each, or in three stages with successive doubling of capacity. In either case, it is suggested that expansion proceed from the front, progressively occupying the area between the covered unloading apron and the packinghouse. The slab should be poured the full length of the center corridor initially, to provide a traffic way for forklifts moving from the first pair of CA rooms to the packinghouse. Temporary walls and doors would be needed across the corridor enclosing the CA storage and along part of the packinghouse.

If the project were constructed in three stages, the estimated grand total investment cost would be $738,000. Estimates for individual facilities are detailed in table 2. The total is nearly $27,000, or almost 4 percent, more than the aggregate estimated cost if the facility were built at one time. Since costs of land and packing and transport equipment totaling $80,000 are not affected, the difference in building cost is slightly more. The projection made doubles CA capacity at both the second and the third stages; conventional storage space is doubled at the third. The estimates assume that invitations to bid on the initial construction would provide that the successful contractor should also build the subsequent stages, at the owner's option, within stated periods, subject to adjustment of agreed amounts for recognized changes in costs. Architect and engineer fees were slightly increased in these estimates, in consideration of the greater amount of work which such staging would involve.

Table 2.--Estimated costs of proposed apple storage and packing facilities in the southern Illinois producing area, if constructed in stages

Item 1/	Facility	Cost
	A. Initial stage	
1.	Controlled-atmosphere storages: 2 rooms, 25,000 bus. capacity @ $2.65/bu.	$ 66,250
2.	Conventional cold storage: 1 room, 70,000 bus. capacity @ $1.65/bu.	115,500
3.	Packinghouse, 18,880 sq. ft. @ $3.35/sq. ft.	63,248
4.	Covered unloading apron: Canopy and concrete slab	10,000
5.	Uncovered aprons (2), parking area, and driveways	15,000
6.	Estimated total construction cost	$269,998
7-9.	Percentage increments 2/	48,600
10.	Estimated total construction, etc., costs	$318,598
11-13.	Packing and handling equipment	75,000
14.	Land and site preparation: 10 acres @ $500/acre	5,000
	Estimated total initial investment costs	$398,598
	B. Second stage	
1.	2 CA rooms, 25,000 bus. capacity @ $2.50/bu.	62,500
7-9.	Percentage increments 2/	11,250
	C. Third stage	
1.	4 CA rooms, 50,000 bus. capacity @ $2.40	120,000
2.	1 conventional room, 70,000 bus. capacity @ $1.50	105,000
7-9.	Percentage increments 2/	40,500
15.	Estimated grand total investment costs	$737,848

1/ Numbered to correspond with the same facilities in table 1. Footnotes of that table also apply to this table.

2/ For architect and engineer fees, construction loan interest, and contingencies; percentages compounded and the consolidated amount rounded out at 18 percent for reason stated in text.

ESTIMATED OPERATING COSTS

Storage and packinghouse operating costs may be divided into management and general expense, employment costs, and equipment costs. Estimates are furnished under these headings in that order. Analysis is made on an annual basis for the full capacities of the planned facilities. Alternative costs under the volume assumptions associated with three-stage construction are summarily presented later in this section.

Management and General Operating Expense

Total management and general operating expenses are estimated at $46,300 per year. These include the costs of personal services, taxes, maintenance and repair, power and other utilities, insurance, supplies and miscellaneous, plus some contingency allowance. Table 3 lists the amounts assigned to each of these accounts, and notes the basis of the estimate in each instance.

The manager should organize and supervise all operations, with special attention to the scheduling of custom packing, which requires careful timing. He should not be called upon to develop policy affecting the relations of the project with its patrons and outsiders, or for decisions on similarly important matters. Properly, these should be formulated by the board of directors and simply given him to carry out. He must be experienced in CA storage operations or be capable of learning the necessary techniques in an intensive training period.

Office help can be retained on a part-time basis by reason of the relatively light and irregular work load anticipated. No sales accounting or sales billing is involved. Bookkeeping and other paper work would consist mainly of maintaining storage records, billing storage charges and packing or pregrading fees, keeping payroll accounts, handling paymaster work, and preparing all employment tax returns. The employment period would be September to May, with some inactive intervals during some of these months. A CA analyst also would be needed only part-time, to share with the manager the reading and recording of instruments twice daily and making of such control adjustments as the atmospheric analyses might dictate. If the plant be suitably located, this employee could be an advanced student in the Food Industries Department of Southern Illinois University at Carbondale.

The estimate for taxes is based upon the assumption that the project would be assessed at 50 percent of the costs set out in table 1. In view of the public-interest aspect in the construction and operation of these facilities, if it should be an Area Redevelopment project, however, local taxing authorities might grant it special concessions in the way of reduced assessments or possibly an outright moratorium on taxes in beginning years.

For new structures, the actual annual cost of maintenance and repair in beginning years should be less than 1 percent of plant and fixed equipment investment, the figure upon which the amount here used was predicated. A

Table 3.--Estimated annual management and general operating expenses of proposed apple storage and packinghouse in the southern Illinois producing area

Item	Expense	Amount
1.	Personal services and office	$16,000
2.	Taxes	13,300
3.	Maintenance and repair	6,300
4.	Power and other utilities	2,500
5.	Insurance	2,200
6.	Miscellaneous and contingency	6,000
	Total	$46,300

Item notes:

1. Manager, $10,000; part-time employees: clerk-bookkeeper, $2,000; CA analyst, $1,000; directors' fees, travel, telephone, legal, etc., $2,500.
2. Based on $42 per $1,000 at 50-percent assessed valuation of plant and fixed equipment; F.I.C.A. taxes under employment costs; taxes on packing and transport equipment under ownership costs of those facilities.
3. One percent of plant and fixed equipment investment; includes contract maintenance of refrigeration equipment.
4. Includes gas, water, and telephone, in addition to power service charges and amortization of substation installation.
5. Rounded total of:
   $1,200 for workmen's compensation @ $3.00 per $100; $630 for fire and extended coverage @ $1.25 per $1,000 (80% co-insurance basis); $367 for $100,000 - $200,000 and $10,000 of public liability and property damage @ $1.75 per $1,000.
6. 15% of the items estimated above; includes supplies.

sizable reserve should accumulate, therefore, in this account. During these first few years, however, it is suggested that some of this fund be expended on a service contract with the manufacturer or supplier of the refrigeration equipment. This should provide for continuing supervision of its operation, maintenance, and repair through training of and consultation with plant personnel responsible therefor. This might well be made a part of the installation contract, with bidders asked to quote an annual fee for such service over a specified period.

Employment Costs

Estimated total annual employment costs are somewhat more than $42,000, broken out (in rounded figures) into the respective operations as follows:

Packing	$34,800
Pregrading	3,600
Storing	3,800
Total	42,200

The bases for estimating packing and pregrading costs are spelled out in table 4. The same qualifications pointed out previously (page 17) apply with even greater force to these figures. To the extent that neither the size nor the number of individual pieces of equipment needed in the plant can be determined until volume by types of pack desired has been ascertained, crew requirements are necessarily speculative. These figures are largely assumptions, therefore, made for purposes of illustration and to provide some overall operating estimate.

Effort has been made, however, to cover maximum employee requirements. On the basis of certain assumptions, it is concluded that the work force would total 35 to 40 persons during capacity operations. The two types of pack for which crew dispositions are exemplified require more employees than do face-and-fill, jumble pack, and other methods not mentioned. Furthermore, while use of the average of these two more expensive packs may result in some overstatement of probable packing employment costs, this is roughly counterbalanced in the overall final analysis of fiscal feasibility by assuming that revenues from packing fees will also be confined to these two principal types of pack.

The wage rates listed are higher than those paid generally in the area for similar packinghouse work. These have been used in the study, however, because it is assumed that, unlike the operations of individual producers in the region, this project will be subject to the minimum wage provisions of the Fair Labor Standards Act. This is based upon the fact that more than 5 percent of the fruit stored and packed in the plant is expected to come from an area of greater radius than 15 miles and thus will not be eligible for the horticultural exemption provided in Sec. 13(a)(10) of the Act. Customary differentials above the minimum for the respective job operations likewise were maintained.

Table 4.--Estimated annual employment costs in packing and pregrading operations of the proposed southern Illinois apple facility

Job operation	Workers	Hourly rate	Cost per hour
Foreman	1 man	$2.00	$2.00
Forklift transport	2 men	1.50	3.00
Dumping or destacking	1 man	1.30	1.30
Sorting	8 women	1.15	9.20
Utility and cull handling	1 man	1.30	1.30
Bagging or place-packing	16 women	1.15	18.40
Sealing	1 woman	1.15	1.15
Master carton filling	1 woman	1.15	1.15
Closing and labeling	1 man	1.30	1.30
Segregating	1 man	1.30	1.30
Checking	1 woman	1.15	1.15
Carton makeup and supply	1 man	1.30	1.30
General warehousing	1 man	1.30	1.30
Maintenance	1 man	1.75	1.75
Total for bag packing 1/	9 m - 27 w	1.23 avg.	44.30
Total for place-packing 2/	10 m - 24 w	1.24 avg.	43.30
Total for pregrading 3/	7 m - 9 w	1.31 avg.	21.00

Assuming 240,000 bus. @ 360 bus./hr. 4/.	667 hours	
Plus 15% allowance 5/	100 hours	
Total	767 hours	
		Annual cost
767 hours @ $43.80 per hour		$33,595
Plus F.I.C.A. taxes 6/		1,175
Total		34,770
Pregrading:		
Assuming 54,000 bus. @ 360 bus./hr. 4/.	150 hours	
Plus 10% allowance 5/	15 hours	
Total	165 hours	
165 hours @ $21.00 per hour	=	$ 3,465
Plus F.I.C.A. taxes 6/		121
Total		$ 3,586
Grand total packing and pregrading employment costs		$38,356

1/ All listed operations except segregating.

2/ All listed operations except sealing and master carton packing.

3/ Operations required: Foreman, forklifts, dumping, sorting, utility handling, checking, general warehousing, and maintenance.

4/ Dumping rate. 5/ For downtime, startup time, etc.

6/ Computed at 3.5% to anticipate scheduled increases.

Estimated annual storage employment costs are itemized in table 5. Man-hour figures used here have been conservatively put at the maximum amount of time that should be required for the work involved. This is confirmed by time studies and work standards measuring the essential elements of forklift pickup, transport, high-stacking, and return, together with the complementary operations in removing from storage (see Marketing Research Report No. 476, bibliography reference 5). While the forklift equipment and operators employed in storing would be the same as those used in packing, required times, of course, are not concurrent. Man-hour and equipment-time requirements have been allocated on the basis of calculated total workloads. Frequent shifting from packing to storage activity and vice versa may make it impracticable to maintain detailed time charges to the respective operations.

The salary of the CA analyst is properly chargeable to storage employment costs. It was put under management costs, however, rather than in table 5, in order to emphasize the necessity for the manager to assume direct and personal responsibility for this most important control function. All readings taken and tests made by the analyst should be reviewed and checked by the manager within 24 hours.

Table 5.--Estimated annual employment costs in storage operations of proposed southern Illinois apple facility

Employees required	Man-hours employed	Rate per hour	Amount
2 forklift operators 1/	700	$1.50	$1,050
2 warehousemen 2/	400	1.30	520
1 maintenance man 3/	1,000	1.75	1,750
Total	2,100	1.58 avg.	3,320
	Plus 10% allowance 4/		332
			3,652
	Plus F.I.C.A. taxes at 3.5%		128
	Grand total		$3,780

1/ For receiving, loading in, loading out, and transporting to packing line supply banks.
2/ Pallet supply handling, palletizing, pallet load tying for high-stacking, and general warehousing assistance.
3/ Machine room supervision and operation; forklift servicing and repair.
4/ For contingencies.

Equipment Costs

Estimated nonfixed costs of equipment are expected to total almost $13,000 annually. Such equipment consists mainly of the packing machinery, the forklift trucks, and accessories. Costs covered are those chargeable to depreciation, taxes, interest, insurance, and maintenance, but not electric power, which was considered as a common operating cost. The amount and the basis of the estimate for each item are set out in table 6.

More than half of the total amount is for depreciation. All of the equipment is written down to 10 percent of initial cost within 10 years, amounting to $6,750 each year on a straight-line basis. Actually, the remaining service life, or alternative residual value, of several of the more expensive pieces of equipment, such as the forklift trucks, should be more than the percentage here assumed. Some additional equity should accrue, therefore, in the depreciation reserve. Interest on the undepreciated balance was charged to cost of ownership at 4 percent per annum because these assets will constitute a major part of the security pledged against a loan to be obtained on the electrically-powered equipment.

Summary of Operating Costs at Various Capacities

Annual cost estimates in the foregoing subsections are recapitulated in rounded figures as follows:

(a)	Management and general expense	$46,300
(b)	Employment costs	42,200
(c)	Equipment costs	12,800
	Total annual operating costs	$101,300

These figures are predicated on construction of the entire project at one time and operation at its full capacity of 240,000 bushels. There may be a lag of two or more seasons, however, between the realization of both assumptions. It is accordingly advisable to consider the likely costs if the facilities be built in stages and operated at respective completed capacities.

Table 7 itemizes the annual cost estimates under these alternative assumptions. Some reduction in the cost of personal services should be expected, through an escalator clause in the employment contract with the manager and the lesser volume of activity in the other categories. Taxes and maintenance would be affected pro rata, reflecting smaller dollar amounts of construction in place. Other items of general expense would be less, of course, but not in proportion to total investment up to that stage.

Employment costs also are estimated at levels higher than the amounts which would result from using the simple ratio of relative volumes. For the first stage, storage and packing and pregrading employment costs were put at

45 percent of the corresponding costs for operation of the completed plant, compared to a ratio of just under 40 percent between the 95,000- and 240,000-bushel capacities. At the second stage, these costs are estimated at 53 percent when volume is exactly half the planned final total.

The estimated annual cost of equipment is assumed to be constant throughout the three stages at the same dollar amount used in the cost analysis for completed-plant capacity. Construction by stages would probably be accomplished in a fairly compact period, possibly in successive seasons. It would not be practicable, therefore, to invest in packing and transport equipment not capable of handling the maximum capacity of the completed plant.

Table 6.--Estimated annual ownership and associated costs of packing and transport equipment for proposed apple facilities in the southern Illinois area

Item	Cost or value	Amount
1.	Initial cost of packing and transport equipment (items 11-13, table 1)	$75,000
2.	Less 10 percent resale, trade-in, or salvage value after 10 years	7,500
3.	Net total depreciation to be taken	67,500
4.	Annual straight-line depreciation, 10 yrs.	6,750
5.	Average annual interest on undepreciated balance of initial costs @ 4% per annum 1/	1,786
6.	Average annual taxes and insurance at 4% of two-thirds initial cost	2,000
7.	Average annual maintenance cost at 3% of initial investment 2/	2,250
8.	Total annual nonfixed equipment cost 3/	12,786

1/ R. E. A. loan rate (table 8).
2/ Largely parts, supplies, and outside servicing or repair, in addition to the maintenance-employee wages in tables 4 and 5.
3/ Not including electric power, which was charged to common operating expense (table 3).

Table 7.--Estimated annual operating costs of proposed apple storage and packinghouse in southern Illinois at three stages of construction

A. Management and general expense:

Item	Expense 1/	Stages of construction 2/ First	Second	Third
1.	Personal services	$13,000	$14,000	$16,000
2.	Taxes	6,720	8,274	13,818
3.	Maintenance	3,200	3,940	6,570
4.	Power and other utilities	1,500	1,700	2,500
5.	Insurance	1,200	1,300	2,240
6.	Miscellaneous and contingency	3,843	4,383	6,170
	Totals	29,463	33,597	47,298
B.	Employment costs:			
1.	Packing and pregrading 3/	17,260	20,330	38,356
2.	Storage 3/	1,700	2,005	3,780
	Total	18,960	22,335	42,136
C.	Equipment costs: 4/	12,786	12,786	12,786
	Grand totals	$61,209	$68,718	$102,220

1/ Item notes of table 3 also generally apply here.
2/ As outlined on page 30 and in table 2, providing overall capacities of 95,000, 120,000, and 240,000 bushels, respectively.
3/ Estimated on the basis of 45%, 53%, and 100% of corresponding costs under full-capacity (240,000 bus.) operation, respectively.
4/ Assumed constant for reason stated in text.

FINANCING THE PROJECT

Investment funds for the construction and operation of this project are expected to come from loans and from equity capital. Since the sponsors of this project have signified their desire to finance it with loan funds from the Rural Electrification Administration and the Area Redevelopment Administration, this section is based on the premise that this will be done. However, this is not intended to imply that a commitment has been made by these agencies nor to preclude other methods of financing. Application for first and second mortgage loans will be made respectively to the local cooperative borrower of the Rural Electrification Administration (R.E.A.), U. S. Department of Agriculture, serving the area decided upon for the site, and to the Area Redevelopment Administration, U. S. Department of Commerce. It is contemplated that a cooperative corporation will own and operate the plant. It would be organized among prospective producer patrons who would subscribe the necessary capital stock.

Basic Facilities Loan

Preliminary steps for eligibility for an Area Redevelopment Administration (A.R.A.) loan have been taken. The region has been officially designated by the U. S. Department of Labor as economically distressed. A local committee has formally recommended this project as part of its overall economic development plan.

An A.R.A. loan is limited to 65 percent of total project investment, exclusive of working capital. It may be subordinated to another obligation in the mortgage instrument. On industrial facilities such as this, it is repayable over a 25-year period, or earlier, and draws interest at 4 percent per annum. Uniform amortization is not required, and, upon a showing of need therefor, repayment may be arranged on the basis of making only interest payments in beginning years. The maximum amount obtainable from this source, based on the estimated investment required for construction of the entire project at one time, is approximately $462,000. For three-phase construction, it would be about $480,000.

Loan for Electrically Powered Equipment

A loan from an R.E.A. cooperative must be secured by a first mortgage on the equipment run by electric power in the plant. This includes the refrigeration, installation, practically all of the packing-line equipment, the forklifts, battery chargers, etc. Maximum maturity of this R.E.A. loan is 10 years. A flexible schedule of principal repayment may be agreed upon. Probable rate of interest is 4 percent per annum. A project such as this becomes eligible for a loan under the provisions of Section 5 of the Rural Electrification Act upon arrangement for service, subject to arrival at mutually agreeable terms with the local cooperative.

The A.R.A. can provide a maximum of only 65 percent of the project cost, exclusive of working capital. At least 5 percent must be provided in risk capital, and another 10 percent by a public body or development company. That leaves 20 percent, or about $142,000 in this case, which can come from any non-Federal source. It is this 20 percent that may be supplied by a local R.E.A. cooperative through a loan upon the electrically-powered equipment.

Equity Capital

It is planned that the balance of estimated total plant cost of $107,000 to $111,000, plus perhaps $33,000 in needed working capital, would be raised from the sale of stock. This could be both common and preferred, the common available only to producer patrons or prospective users of the facilities; the preferred for offering to other interested persons in the community or elsewhere. The working capital requirement is set at about half the estimated operating costs in the first year. While some part of the storage charges may be collected when the fruit is loaded in, or monthly thereafter, the major portion of this income, as well as that from packing fees, will not be received until after the apples are sold; hence the need for starting operations with a substantial cash position.

Debt Service Schedule

Assuming that agreed-upon terms of both loans provide for deferment of principal repayments for 3 years--the minimum time believed necessary to approach completed-plant capacity--a projected service schedule that would liquidate these obligations within their respective maturity periods is outlined below:

Periods	A. R. A. Loan ($462,000 @ 4%)	R. E. A. Loan ($142,200 @ 4%)
First 3 years 1/	18,480	5,688
Next 7 years	21,308 2/	23,692 3/
Next 15 years	39,543 4/	---

1/ Interest only, both loans.
2/ Residual amount available for application to the A.R.A. loan out of a total of $45,000 set up for debt service after making full amortization and interest payments on R.E.A. loan.
3/ $166.61 per $1,000, based upon single annual installment payments.
4/ $89.94 per $1,000 (annual payment) to amortize a balance of $439,664 remaining in this obligation after liquidation of the R.E.A. loan.

Annual charges for debt service, as tabulated, would be approximately $24,200 for the first 3 years, $45,000 during the following 7 years, and $39,500 in the last 15 years of the A. R. A. loan term. This program does not attempt to project the several additional obligations that prospectively would be incurred during these periods for equipment replacement and in the course of further expansion toward the much larger complex envisioned in figure 3.

No provision for establishment of a debt service reserve was included in this financing plan, on the theory that, by reason of the flexibility of R. E. A. loan terms in regard to deferral of principal repayments, it should not be needed. Purpose of the reserve is to help weather a season in which income may be seriously impaired by crop failure or other cause. Since it might be possible to negotiate the R. E. A. loan with provision for a drawback of principal (that is, almost on a revolving-fund basis), the debt reserve could be dispensed with. If it should be maintained, the suggested amount to be set aside is $10,000 annually, beginning with the fourth year and continuing until $50,000 is accumulated. To avoid the additional interest expense which an equivalent curtailment of principal would have saved, the reserve would have to be invested at a comparable rate of return.

The schedule presented was based on loan amounts calculated from the estimated costs of one-phase construction. If the plant be built in stages, loans could presumably be arranged for the estimated final costs with interest due at any given time only on amounts drawn to cover construction to the computation date. Assuming that the three stages of construction occur in successive years, the debt service schedule under this alternative program could be patterned after that suggested in table 8. Principal difference is that aggregate interest cost on the loan balances outstanding during the staggered construction period would be about $19,000 less than over a comparable period with one-phase construction.

Since it was estimated that operating costs would likewise be some $16,000 less under a three-phase project development program (table 7 as compared to table 3), mainly as a result of lower taxes and maintenance during the period, combined gross savings would apparently total approximately $35,000. This would overbalance the estimated increased construction cost of $27,000 by the net amount of $8,000. Should attainment of full capacity take longer than the assumed 3-year period, net savings from this programming would be considerably greater.

From the foregoing comparisons, it appears advisable to adopt a three-phase construction program. Implicit in such a decision, of course, is the assumption that demand for storage space and packing services would roughly parallel development of the project under this construction schedule. It is strongly recommended, however, that, to the extent possible, a careful determination of required capacity in these beginning years be made, based upon securing commitments from prospective patrons which are as firm as the nature of the projection will allow. Within workable limits, this can and should be done at the time when original bids on the alternative programming bases are being considered.

Table 8.--Possible debt service schedule of proposed apple storage and packing project for southern Illinois, with three-stage construction

Periods	Amount of construction in place 1/	A. R. A. loan 2/ Amount outstanding	A. R. A. loan 2/ Annual payment	R. E. A. loan 3/ Amount outstanding	R. E. A. loan 3/ Annual payment
	1	2	3	4	5
First stage	398,600	$259,090	$10,364	$79,720	$3,189
Second stage	472,350	307,028	12,281	94,470	3,778
Third stage	737,850	479,603	19,184	147,570	5,903
Next 7 years	4/ 737,850	5/	20,413	7/	8/ 24,587
Next 15 years	4/ 737,850	9/	10/ 42,263	---	---

1/ At beginning of the period; assumes that interest on necessary progress payments on construction completed during the period is paid out of the allowance for construction loan interest (item 8, tables 1 and 2) rather than as part of long-term financing.
2/ 65% of the respective amounts in column 1 at 4% interest.
3/ 20% of the respective amounts in column 1 at 4% interest.
4/ Amount financed by these obligations remains constant; additional construction contemplated through further loans.
5/ Maximum original loan balance of $479,603 reduced each year by the amount by which $20,413 exceeds the amount of interest due on the currently outstanding balance.
6/ Residual amount after deducting $24,587 from $45,000.
7/ Progressively reduced under 7-year amortization.
8/ $166.61 per $1,000 on $147,570; single-payment basis.
9/ Progressively reduced under 15-year amortization.
10/ $89.94 per $1,000 on $469,897; single-payment basis.

PROJECTIONS OF INCOME, NET OPERATING MARGINS, AND FINANCIAL CONDITION

All estimates of income must be predicated upon assumed volumes of business at assumed charges or fees. For purposes of these projections, the volume of fruit stored and packed out will be based upon a percentage of the capacity of the facilities at the stage then being considered. Attainment of full-capacity operation in each of these stages would be an unrealistic expectation, but there are no guidelines for estimating the probable shortfall. Accordingly, these calculations will be made on the uniform assumption of 85 percent of current capacities. It will also be assumed that 50 percent of the apples going into CA storage are pregraded. Storage rates and packing fees generally in line with those prevailing in competing producing areas will be applied to the assumed volumes.

Income from Storage

As previously indicated, storage fees should vary, depending upon how the fruit is received. Apples in pallet boxes should take the lowest rate for two reasons: (1) Such fruit is easier to handle; and (2) it requires less space to store. On average, from 10 to 15 percent more apples can be placed in storage in pallet boxes than in palletized field crates. A middle rate should apply to field crates already palletized. A slightly higher charge should be made where it is necessary to palletize the apples while they are being received at the plant.

In this analysis, the average basic storage rate for the conventional space is assumed at 35 cents per bushel. This should be a flat rate applicable from any time in the Fall to the end of January. An additional 5 to 10 cents per bushel could be charged for each further month, or fraction thereof, that the apples remain in storage. This should have some effect in moving regular storage apples out ahead of CA fruit so that the packing operation will not be overburdened.

For CA fruit, the suggested average rate is 75 cents per bushel through April 30, with added charges thereafter. This spread over the regular-storage rate appears to be fully justified, not only by the practice commonly prevailing in other areas, but principally because of the premium which CA apples command in the market. In recent years, that premium has been two to three times as much as the difference in storage costs (see bibliography reference 20).

At these rates, estimated storage income in beginning years, based on the volume of business previously assumed as a percentage of the capacities to be made available successively in three-stage construction, would be as follows (rounded to the nearest $1,000):

Income from:	First stage	Second stage	Third stage	Later years 1/
Regular storage	$21,000	$21,000	$42,000	$49,000
CA storage	16,000	32,000	64,000	75,000
Combined storage	$37,000	$53,000	$106,000	$124,000

1/ 100% of capacity; others at 85%.

Income from Packing and Pregrading

Packing fees also should be established in accordance with a schedule which reflects the variation in costs involved. Thus, the fee per bushel for place-packing should be higher than that for bagging, face-and-fill, jumble pack, or any of the other types which involve less labor and equipment time. All packing fees should be on a dumped-bushel basis in order to equalize the impact of substantial differences in the proportions of fruit being sorted out. A differential should prevail also between fruit dumped from pallet boxes and fruit fed into the line in field crates, to the extent that operating costs show a significant disparity.

For this analysis, it is assumed that the average packing fee will be approximately 30 cents per bushel of fruit dumped. It is further assumed that the quantity of apples packed will equal the volume stored. Actually, to the extent that fruit may be sent to the plant for packing out during harvest time in greater volume than the expected small quantity which may be stored there but packed elsewhere, the quantity put into the packing line may exceed that stored. On these assumptions, computed estimates of income from packing operations through the beginning stages would be:

Period	Amount
First stage	$24,225
Second stage	30,600
Third stage	61,200
Later years 1/	72,000

1/ 100% of capacity; others at 85%.

For projecting estimated income from pregrading, a fee of 12 cents per dumped bushel is assumed. As stated previously, the volume expected to be pregraded is estimated at 50 percent of the volume stored in CA space. While pregrading will not be limited to apples consigned for CA storage, there is an obvious economic interest in having this fruit put over the sorting table.

In this producing area, the percentage of apples which fail to grade up to the standards for the better packs ranges from 10 to as much as 50 percent. Since the apples which are being delivered for CA storage tend to be the better fruit with a lower percentage of grade-outs, an average of 20 percent is here assumed. If one-fifth of the fruit that is pregraded be eliminated before CA storage charges attach, then growers can afford to pay 12 cents per bushel for this service. The cost will be only 80 percent of the amount saved through not paying CA storage charges on the fruit sorted out. As a bonus benefit, the general keeping quality of the graded fruit will be better, not only because of the removal of the inferior apples, but especially by reason of the stop-scald treatment received in the process (see bibliography reference 17).

Pregrading income is estimated at $1,275, $2,550, $5,100, and $6,000 in the respective periods listed in the tables.

Net Operating Margins

Table 9 presents in rounded data a projection of net operating margins through development stages and into years of full-capacity operation. This

Table 9.--Projection of net operating margins through beginning stages, at assumed percentages of capacity 1/, for proposed southern Illinois apple storage and packing plant

Account	First stage	Second stage	Third stage	Later years
Income:	Dollars	Dollars	Dollars	Dollars
From storage	36,800	52,700	105,400	124,000
From packing	24,200	30,600	61,200	72,000
From pregrading	1,300	2,600	5,100	6,000
Total income 2/	62,300	85,900	171,700	202,000
Expense:				
Management and operating 3/	29,500	33,600	47,300	47,300
Equipment 3/	12,800	12,800	12,800	12,800
Employment 4/	16,100	19,000	35,800	42,100
Total expense	58,400	65,400	95,900	102,200
Balance before debt service	3,900	20,500	75,800	99,800
Debt service 5/	13,600	16,100	25,100	6/ 45,000
Net operating margin	7/ (9,700)	4,400	50,700	8/ 54,800

1/ 85% of then-current capacities through the beginning stages; 100% of capacities for later years.
2/ Not including some minor nonoperating income, such as interest on depreciation reserve, etc.
3/ Table 7 (figures rounded).
4/ Table 7 (data rounded and adjusted to 85% capacity assumption).
5/ Table 8 (payments rounded).
6/ Payment during liquidation of the R. E. A. loan; $42,300 thereafter (see table 8).
7/ Deficit.
8/ Operating margin until R. E. A. loan repaid; $57,500 thereafter.

analysis draws upon the estimates previously made on all income and expense accounts, under the stated assumptions, to show the probable net profit or loss that may be expected in the given periods. The results indicate that annual financial experience of the project would range from a loss of almost $10,000 in the first stage of development to a profit of about $55,000 when going at full capacity. The need for such apparently ample net operating margin under completed-plant capacity operations is fully evident in the fact that, in the event of a crop disaster resulting in total suspension of business in a given year, net loss for that period could be from $60,000 to $75,000.

Financial Condition

Table 10 projects the financial condition of the project from the beginning of business to the start of the fifth year of operation. This balance sheet shows the increase in net fixed assets during the development stages, with the corresponding rise in both short-term and long-term debt. Cash position of the proposed cooperative is perhaps too weak beginning the second and third years and may require some 6-month borrowing to provide adequate working capital. Members' equity, beginning above $90,000, declines to about $75,000 in the first year, then increases rapidly to almost double the original figure in the next 3 years.

Should actual operation of this project realize any substantial part of the success indicated in this study, it appears that the financing of any necessary expansion of these apple storage and packing facilities in southern Illinois could be assured.

Table 10.--Projection of pro forma balance sheet through the first four years for a proposed Southern Illinois apple storage and packing plant

Item no.	Account	As at beginning business	As at beginning of Second year	Third year	Fourth year	Fifth year
Current assets:						
1.	Cash	$30,000	$18,300	20,500	68,900	121,700
2.	Supplies inventory	2,000	2,000	2,000	2,000	2,000
Fixed assets:						
3.	Plant and fixed equipment	318,600	392,350	657,850	657,850	657,850
	Less depreciation 2/	---	10,620	23,665	45,560	67,455
			381,730	634,185	612,290	590,395
4.	Land and improvements	5,000	5,000	5,000	5,000	5,000
Other assets:						
5.	Packing and transport equipment	75,000	75,000	75,000	75,000	75,000
	Less depreciation 3/	---	6,750	13,500	20,250	27,000
			68,250	61,500	54,750	48,000
6.	Prepaid expenses	1,000	667	333	1,000	667
	Total assets	431,600	475,947	723,518	743,940	767,762
Short-term debt:						
7.	R. E. A. loan 4/	79,720	94,470	147,570	128,886	109,454
Long-term debt:						
8.	A. R. A. loan 5/	259,090	307,028	479,603	478,374	477,096
Capital stock:						
9.	Members' equity	92,790	74,449	96,345	136,380	181,212
	Total liabilities	431,600	475,947	723,518	743,940	767,762

1/ 85% capacity operation in first three years; 100% in fourth year.
2/ Straight line, 30 years. 3/ Straight line, 10 years (with 10% residual).
4/ No reduction in principal first three years; then fully amortized in next 7 years. 5/ No reduction in principal first three years; then reduced as stated in note 5/, table 8.

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