IMPROVED LAYOUT FOR A FOWL PROCESSING PLANT

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IMPROVED LAYOUT FOR A FOWL PROCESSING PLANT

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SUMMARY

A plant that processes fowl exclusively and that did not have Federal inspection was required to meet the standards of the Wholesome Poultry Products Act. The plant was studied to determine the changes needed to improve its layout and operating efficiency, as well as to meet the requirements of the Act. The cost of making these changes was also determined.

The plant, located in a rural area, has a production capacity of 700 birds per hour or from 1,200 to 5,000 per day. Labor requirements are relatively low, because several operations necessary under Federal inspection are omitted.

The study revealed several major problems. The cost of remodeling the plant to meet minimum sanitation standards was estimated at $125,000. This amount would be difficult to recover if the plant were closed later. The supply of labor was inadequate. The water supply, which was available only from the firm's own wells, was inadequate. Sewage disposal facilities were unacceptable. Because of these and many other problems, it was recommended that the business be relocated to another site and a layout for a new operation be developed.

The proposed plant has a maximum capacity of 2,100 birds per hour, with a normal operation of about 1,800 per hour. Initially most birds will be processed as ice-packed, whole eviscerated, with only a small percentage either cut up and tray packed or boned manually to produce raw chunk meat. The estimated cost of the proposed building is $250,000 excluding equipment.

INTRODUCTION

The total supply of fowl (mature female chickens) available for processing varies considerably because of seasonal and area distribution. The principal sources of fowl are (1) spent hens from commercial egg operations and (2) hens from breeding flocks maintained to produce hatching eggs. When commercial egg prices are relatively low, producers are encouraged to market egg-producing birds at an earlier age than they would if egg prices were higher. Likewise, relatively low prices for broilers cause breeders to sell breeder flocks at earlier ages than they would normally.

Although economies of scale exist in fowl processing, as in other poultry processing, the economies that can be obtained are modified by variable supplies. Average costs per pound generally decline with successively larger plants if the comparison is based on 100-percent capacity. However, economies are greater with broilers than with fowl, because large fowl processing plants have difficulty obtaining enough birds to maximize the use of the facilities. As volume increases, assembly costs rise and thus limit the scale of operation.

[1] The author expresses appreciation to John A. Hamann of this Laboratory for his assistance in developing the plant layout.

In 1970 about 65 percent of federally inspected fowl was processed in broiler plants, 1 percent in turkey plants, and the remaining 34 percent in fowl plants and multiple-purpose plants, which processed all three types of birds. Broiler plants are more adaptable to processing fowl than are turkey plants, because equipment designed for turkeys is inefficient for processing fowl.

Mature chickens are processed more slowly than younger chickens. The percentage of condemnations may be relatively high in some flocks.

To show how the layout and operating efficiency of a specialized fowl processing plant can be improved, a plant was studied that failed to meet requirements of the Wholesome Poultry Products Act.[2] Changes necessary to meet facility requirements under the Act and the cost of making the changes were determined. Consideration was also given to increasing the efficiency of the operation.

The existing layout and operating procedures are described in this report and the reasons given for concluding that the plant should be abandoned. A new plant is recommended as a replacement, along with a proposed layout and operating procedures. The principles of layout used in the study are also applicable to improving specialized broiler plants that process fowl as a secondary product.

EXISTING PLANT

The plant is located in the country about 4 miles from a village. Water is provided by the firm's own well. Effluent from the plant is discharged into a lagoon near a small river. Labor for operating the plant is drawn from the rural community.

The plant processes fowl exclusively. Most of it is sold as ice-packed, whole eviscerated birds to further processing firms.[3] Less than 5 percent of the output is wholesaled to grocery stores as individual bagged or tray-packed birds.

The maximum capacity of the plant is 700 birds per hour or from 1,200 to 5,000 daily. The output of the eviscerating operation averages 566 birds per hour allowing for 5-percent loss from condemnation. The plant operates on a variable schedule depending on the supply of birds. Some weeks it operates on every working day; other weeks there is no activity. The plant often stops operating when the price margin between live and eviscerated birds is narrow enough to make it more profitable to buy and sell live birds rather than to process them.

Building Design and Construction

The building (fig. 1) contains 4,786 square feet of floorspace and is constructed at ground level. Because the ground slopes, the floor at one side of the building is at truck-bed height where loading and unloading occur. The building is made of concrete blocks except the dry storage area, which is of wood with a 10-foot-high ceiling. Some room ceilings are 9 and others 13 feet high.

The original structure was enlarged to its present size by making additions on two sides of the building.

Layout and Operating Procedures

Unloading Area

Truckloads of live birds are driven into the unloading area next to the building. Since the wooden structure enclosing this area is without doors, the openings through which the vehicles pass are never closed. There is no platform from which to work; employees stand on a makeshift arrangement of ladders and a table-like structure to hang birds on the overhead conveyor. The shelter for the unloading operation is poorly constructed and temporary in appearance.

Processing Areas

Slaughtering and Picking.—The slaughtering and picking operations are performed in a 780-square-foot area separated only partially from the adjoining eviscerating area by a metal partition. The floor is not sloped sufficiently and the gutter drain is not long enough for adequate drainage. Feathers and dirt from the picking equipment collect on the low ceiling.

[2] Public Law 90–492, 90th Congress, Aug. 18, 1968.

[3] Refers to making products from eviscerated birds.

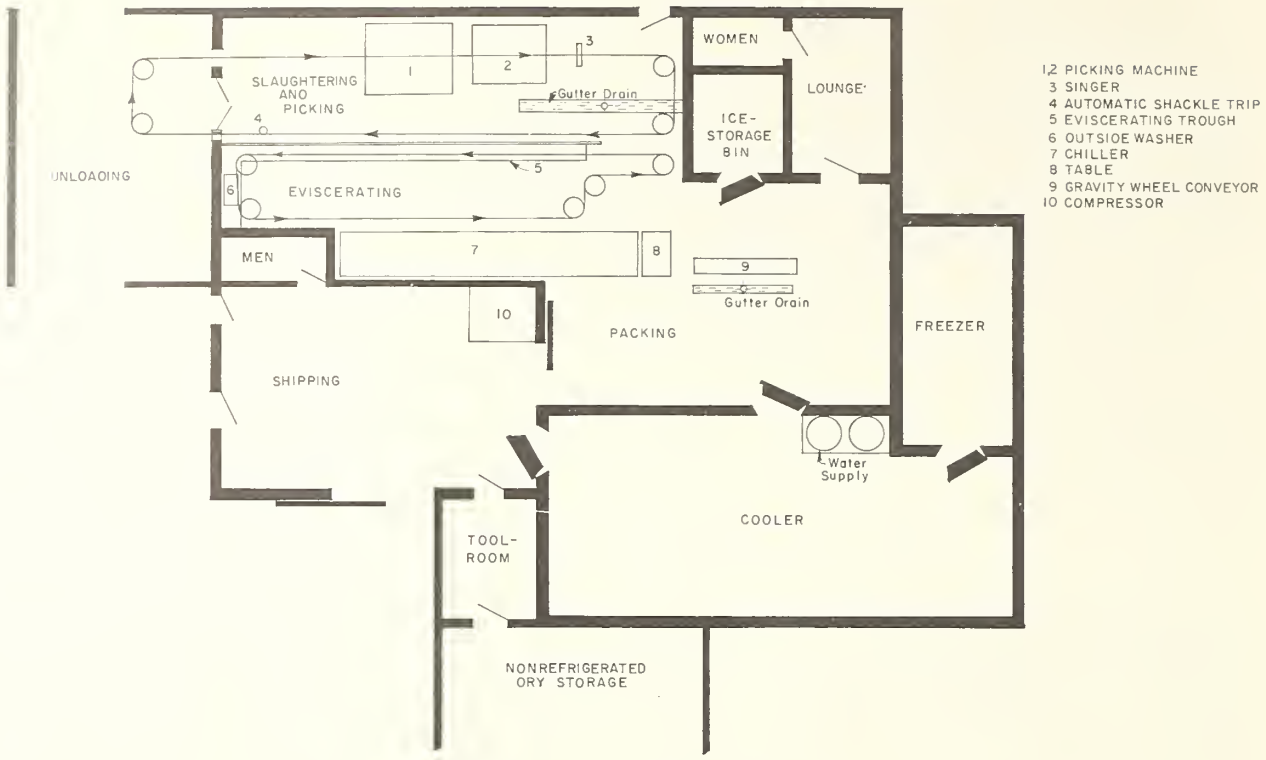

Figure 1.—**Layout of the existing plant.**

Since the slaughtering area is not separated from the picking area, blood can splatter on the walls and ceiling. Most of the blood accumulates on the floor near the front of the picking machine. As feathers accumulate under this machine, they are shoveled manually into a wheelbarrow and taken to barrels located in the aisle of the picking area.

Eviscerating.—The eviscerating area is congested (fig. 2). Water on the floor must pass beneath the metal partition between the slaughtering and picking area and the eviscerating area to reach the gutter drain at the end of the picking area. The ceiling is 13 feet high except for a small area that is only 9 feet high.

A narrow L-shaped eviscerating trough is located against the metal partition that separates the eviscerating area from the slaughtering and picking area and along the far wall of the eviscerating area (fig. 3). Offal flows from the forward end of the eviscerating trough into a perforated container, which allows the water to drain onto the floor. Periodically the offal is removed manually from the container and held temporarily in barrels located in the picking area near the picking machine (fig. 4).

Packing.—The packing area contains approximately 600 square feet of floorspace with a ceiling height of only 9 feet. When birds are packaged individually, a table on casters is moved out from the wall to the center of the room and the conveyor on which boxes are packed is moved out of the way. Because of the limited space the packing operation creates congestion.

Storage Areas

Refrigerated Storage.—The refrigerated storage consists of a cooler and a freezer. About two-thirds of the ceiling in the cooler is 9 feet high and the remaining one-third is 13 feet high. There are no floor drains. The freezer is very narrow and has a ceiling only 9 feet high.

Nonrefrigerated Dry Storage.—The dry storage area is constructed of wood and has a 10-foot-high ceiling. The only access to the area is through the adjoining toolroom.

PN–3171

Figure 2.—Worker at left removes birds from eviscerating shackles and drops them into the chiller. Note the congestion in the area.

Shipping Area

The floor of the shipping area is 12 inches below the level of the adjoining packing area and cooler. Products transported to and from the shipping area must negotiate an incline between it and the adjoining areas. There are no floor drains. The refrigeration compressors are placed on a 45-square-foot concrete slab in one corner of the area. Trucks are loaded at ground level through a 10-foot-wide sliding door at the side of the shipping area or else at truck-bed height through two 3-foot-wide doors at the end of this area.

Auxiliary Areas

The auxiliary areas include employee facilities, an ice-making and storage area, and a toolroom.

Employee facilities consist of a small lounge and two restrooms. The restrooms are small, poorly ventilated, and without locker space.

A flake ice machine is located on the roof above the packing area so the ice can drop into the storage bin, which is at floor level adjacent to the packing area. When the door to the ice-storage bin is opened, ice often spills out onto the floor of the packing area (fig. 5).

The toolroom adjoins the shipping area and provides the only access to the nonrefrigerated dry storage area, which is behind the toolroom.

Labor Requirements

The number of employees for the plant operations is as follows:

Operation	*Employees*
Unload and hang live birds	2
Slaughter	1
Cut hocks and transfer	1
Open birds, detach vents, and split necks	2
Pull viscera	1
Drop viscera	1
Pull crops	2
Remove lungs and ovaries	2
Remove oil glands	1
Inspect and drop birds into chiller	1
Box birds	2
Total	16

Shipments are made when processing is not occurring so that some employees can be used for both operations.

PN–3172

Figure 3.—One section of L-shaped eviscerating trough is next to metal partition.

PN–3173

Figure 4.—Offal is accumulated in barrels near the picking machine.

The labor requirements are relatively low, because several operations required of plants under Federal inspection are omitted.

Findings of Study

Many problems involving the location of the facilities, the layout, and the operating procedures were considered in analyzing the feasibility of remodeling the plant.

The cost of remodeling the existing plant to bring the structure up to minimum sanitation standards was estimated at $125,000. This expenditure, however, would have little effect on the efficiency of the plant—only on sanitation. Thus the investment in remodeling would be difficult to recover. The major problems can be categorized as follows:

Location:

- Labor supply is inadequate.
- Water supply is inadequate.
- Sewage disposal is unacceptable.
- Resale value of plant for other purposes is limited.

Layout:

- Access to plant is through a door opening into picking area where an overhead conveyor partially obstructs entrance.
- Live-bird unloading facilities are poor.
- Ventilation is inadequate.
- Floor drainage is inadequate.
- Floors and walls are rough and difficult to clean properly.
- Cracks in ceiling permit dirt to collect.
- Low ceilings in picking and eviscerating areas become dirty and are difficult to clean.
- Eviscerating trough is attached to rusty metal partition dividing eviscerating area from picking area.

PN–3174

Figure 5.—Ice is discharged onto floor of packing area when door of ice-storage bin is opened.

- Eviscerating trough provides insufficient space for work stations.
- Space is inadequate in eviscerating area.
- Ice spills out onto packing area floor when door to storage bin is opened.
- Packaging material is stored a long distance from packing operation.
- Because shipping area floor is 12 inches lower than the floor level of plant, products have to be moved down a ramp from cooler for loadout.
- Picking area employees have to pass through eviscerating and packing areas to reach employee facilities, which are too small.
- Business has to be conducted in a nearby residence because plant has no office.

Operating Procedures:

- No one checks birds for pinfeathers before they enter eviscerating area.
- Birds are not washed before they enter eviscerating area.
- No employee is assigned responsibility for trimming birds.
- Method of accumulating and decharacterizing condemned birds is unsatisfactory.
- Feathers and viscera are accumulated in barrels in picking area.
- Giblets are discarded.
- Inside of eviscerated birds is washed inadequately.
- Offal and feathers are not removed frequently enough, because worker assigned to remove them has other responsibilities that interfere.
- Worker has to drop each bird into chiller manually.
- House inspection of birds is superficial.

Recommendations

Because of the many problems, the business should be relocated to a new building on another site. The location selected should provide an adequate supply of water, should have acceptable sewage-disposal facilities, and should be near a reserve supply of labor.

PROPOSED PLANT

The proposed plant is designed to process 2,100 birds (fowl) per hour, with an actual output averaging 1,800 per hour. Initially most of the fowl will be marketed as ice-packed, eviscerated whole birds. A small percentage will be either cut up and tray packed or manually deboned and the meat boxed and frozen.

The processing capacity of the plant can be doubled to 3,600 birds per hour. Space also is provided for manually deboning a much greater percentage of the output as marketing outlets are developed. Then the wings, drumsticks, and backs would be put through a deboning machine to produce comminuted meat. The facility is designed so that it can be expanded to provide space for other processing operations in the future.

Design features of the plant conform to U.S. Department of Agriculture regulations governing the inspection of poultry and poultry products.

Building Design and Construction

The proposed plant consists of three functional areas—processing, storage, and auxiliary. The total usable floorspace of 18,491 square feet is utilized as follows:

First floor	*Square feet*
Live-bird receiving	1,834.0
Slaughtering	182.0
Picking	1,495.0
Feather and offal	962.5
Eviscerating, deboning, and tray packing	4,569.0
Cooler	1,357.0
Freezer	1,220.0
Blast freezer	527.0
Shipping	916.5
Auxiliary	4,071.0
Total	17,134.0

Second floor	
Dry storage	1,357.0
Total floorspace	18,491.0

The floor of the plant is 48 inches above ground level so that the receiving and shipping platforms are at truck-bed height. The floors of the refrigeration equipment, boiler, and shop areas are at ground level. Therefore the height of these areas, from floor to ceiling, is 48 inches greater than for the other areas. This additional cubic space helps to dissipate heat generated by the refrigeration and boiler equipment.

The overall height of the building from ground level to the roof is 19 feet for the processing areas, 26 feet for the storage areas, and 14 feet for the office and employee areas (fig. 6).

Layout and Operating Procedures

Receiving Area

The live-bird receiving area consists of a driveway for trucks and a platform for receiving and hanging live birds. Trucks enter and leave through doorways at each end of the 16-foot-wide driveway. The ceiling in the driveway is 19 feet high to provide adequate clearance for trucks hauling live birds. Two 6-inch floor drains with deep seal traps are located in the truck area for the removal of surface water brought in by trucks and water from cleanup operations in the receiving area. The driveway slopes one-fourth inch per foot toward the drains.

The receiving platform is 48 inches high and 14 feet wide at its broadest point. The remaining part is 6 feet wide. Steps at each end of the platform lead from the driveway to the platform. Two sets of hot and cold water outlets are provided on the platform to facilitate cleaning the receiving area.

Trucks with permanently attached cages are driven onto a hydraulic truck hoist (1) [4] (fig. 7) for unloading. Employees stand on a mobile work platform (2) on each side of the truck at a height convenient for unloading birds from the top level of cages on the truck. After the birds are removed from their cages, the truck is raised to bring each successive row of cages to a convenient height for the unloading crew. This makes it possible to unload and transfer the birds to the overhead live-bird conveyor, which circles the truck before entering the slaughtering area of the blood tunnel.

If the birds are received in coops, the employee platforms are pushed aside and the coops are removed from the truck and placed on the gravity wheel conveyor (3). This conveyor transports them to the hanging area, where workers remove the birds and hang them in shackles on

[4] Numbers in parentheses refer to equipment in figure 7.

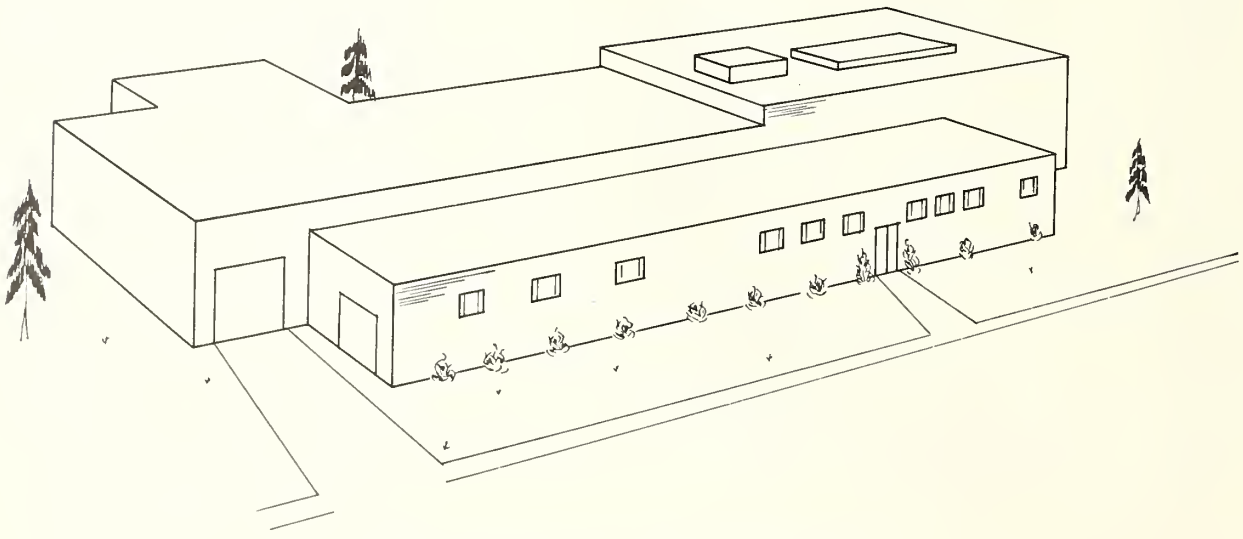

Figure 6.—Perspective of a fowl processing plant.

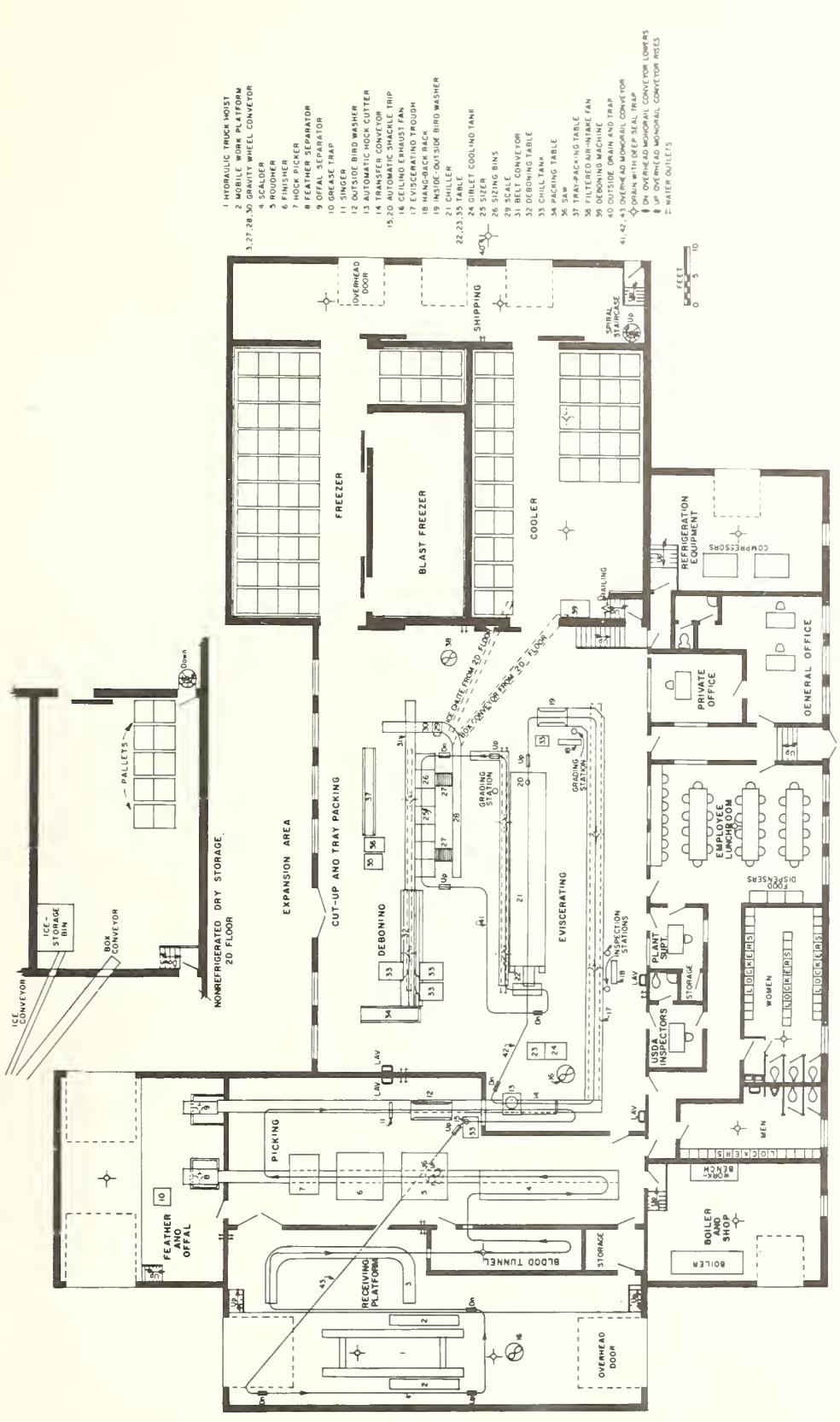

Figure 7.—Improved layout for proposed fowl processing plant.

the overhead bird conveyor. The empty coops remain on the conveyor (3) and are returned to the truck.

Processing Areas

Slaughtering.—Live birds are conveyed into the slaughtering area of the blood tunnel, where they are slaughtered by a worker who stands near the entrance. The congealed blood is scooped into a barrel and transported by a two-wheel handtruck to the offal disposal area.

The slaughtering area is 26 feet long and 7 feet wide with a 15-foot-high ceiling. The walls and ceiling of smooth water-impervious materials are easy to clean. The floor slopes one-fourth inch per foot to a 6-inch drain with a deep seal trap, which is closed during the slaughtering operation. A doorway provides access from the slaughtering work station to the adjoining picking area.

The overhead conveyor provides at least 90 seconds of bleeding time before the birds enter the scalder (4), which is in the picking area. By having the conveyor doubling back in the tunnel, less floorspace is required than in a "straight through" tunnel. This area can be lengthened if the processing rate increases by moving the wall back between the storage area and the end of the tunnel to a location near the doors. Bleeding times can be shortened simply by moving the slaughtering station farther down the blood tunnel.

Picking.—In the picking area the walls are impervious to moisture up to 6 feet above the floor, and the remaining wall and the ceiling are moisture resistant. Two parallel floor gutter drains, each 18 inches wide, extend the length of the room and terminate in the feather and offal area. The floor slopes approximately one-fourth inch per foot to provide for the complete runoff of water to the drains. A lavatory for employees is in the picking area. Two sets of hot and cold water outlets are provided for cleaning the area and equipment. The outlets are located so that hoses need not reach beyond a radius of 50 feet.

Doors are so located that employees in the receiving, slaughtering, and picking areas can go to the restrooms without having to enter the eviscerating area. An 8-foot-wide doorway between the picking area and the receiving platform facilitates the movement of equipment into or out of the picking area.

Birds are conveyed through the scalder (4), the rougher (5), the finisher (6), and the hock picker (7). This picking equipment is located over a gutter floor drain so that the feathers can be dropped into it and be flumed to the feather disposal area. Aisles around the scalder provide space for cleanup and passageways. A ceiling exhaust fan (16) above the picker removes heat and steam from the scalder.

After the birds are picked, pinfeathers are removed manually in the pinning area over the other floor drain, which carries offal from the eviscerating area to the offal disposal area. The birds then pass through the singer (11) and the outside bird washer (12) to complete the picking operations.

Feather and Offal.—The feather and offal disposal area is 35 feet long and 27.5 feet wide. A 14-foot-wide driveway allows a truck to enter for loading waste products. The floor of the driveway slopes one-fourth inch per foot toward a drain. Overhead doors are located at the ends of the driveway.

A platform, 14 feet wide and 35 feet long, slopes one-fourth inch per foot toward two pits where the feather separator (8) and the offal separator (9) are located.

Feathers from the picking area are brought into the disposal area by the gutter drain, which deposits them in the feather separator (8). Likewise, offal is deposited in the offal separator (9) by the gutter drain, which extends from the eviscerating area. Water from the two separators flows into floor drains located in the pits under each of the separators. A grease trap (10) strains grease from the water before it is discharged into the sewer.

Eviscerating.—The area for eviscerating, deboning, cut-up, tray-packing, and packaging operations is 86 feet long at the longest point and 56 feet wide. The walls are smooth and are finished with moisture-impervious materials up to 6 feet above the floor. All surfaces above this height are finished with moisture-impervious materials, including the 15-foot-high ceiling. The floor slopes approximately one-fourth inch per foot to provide complete runoff of water to three parallel floor gutter drains, which are each 18

inches wide. Each drain contains a 6-inch outlet with a deep seal trap. The drain serving the transfer belt conveyor area (14) in the eviscerating area extends through the picking area. An 8-foot-wide doorway permits equipment to be moved into the eviscerating area from outside the building and serves as an emergency exit for employees. All doors except those to the refrigerated areas have self-closing devices.

Three foot-controlled lavatories are provided for employees to wash their hands. Hot and cold water outlets supply water for cleaning the area and equipment.

A filtered air-intake fan (38) is located in the ceiling near the tray-packing operation (37). Air is removed by an exhaust fan (16) through a roof outlet in the area where birds enter to be eviscerated. This arrangement moves the air across the area from the finished product toward the incoming product where the air is exhausted. The processing areas are air-conditioned.

After the birds are picked and washed, they are moved by the picking-area conveyor to the automatic hock-cutting machine (13) in the eviscerating area. After the hock joints are cut, the birds fall onto a 6-foot-long conveyor (14) while the legs and feet remain in the shackle. The defeathering conveyor doubles back to reenter the picking area, where the severed legs are released by a shackle trip (15), after which they fall into a chill tank with casters (33) located beneath the conveyor. The conveyor then passes diagonally across the picking area to the unloading area.

Beginning at the hock-cutting machine (13), the overhead eviscerating conveyor parallels the overhead defeathering conveyor for a short distance. The two conveyors are 12 inches apart and extend above the transfer conveyor (14). Birds are transferred manually from the defeathering conveyor to shackles of the overhead eviscerating conveyor, which transports them above the eviscerating trough (17). The trough is 36 inches wide and 76 feet long. A hang-back rack (18) on which to hang birds removed from the line to be trimmed is behind the inspection stations. A 10-foot section of the trough located at a right angle provides space for the inside-outside bird washer (19). Workers stand 3 feet apart along one side of the trough to carry out their assigned tasks. Processing 1,800 birds per hour would require two inspectors. Since the eviscerating operation requires many more employees than other operations, it is located nearest the lunchroom, restrooms, and offices for the convenience of employees and supervisors.

Offal, carried by water, drops from the forward end of the eviscerating trough into the gutter drain, which carries it through the picking area to the feather and offal area.

After the birds are eviscerated, they are transported by the overhead conveyor through the inside-outside bird washer (19). The washed birds pass over the remaining section of the trough, where an employee detaches the necks and places them in a chill tank (33) filled with slush ice. Later the necks are deboned mechanically. The conveyor rises so that the automatic shackle trip (20) can drop the birds into the chiller (21), then the empty conveyor rises to pass over the remaining length of the chiller and returns to the hock-cutting area. After the viscera have been inspected, the livers are removed and placed in pans, which are taken to the table (23) to be prepared for cooling in the tank of slush ice (24) and later packaged. Gizzards and hearts are discarded with the viscera.

The chiller (21) is parallel to and near the gutter drain in the middle of the eviscerating area. Overflow water spills into this drain.

Birds are elevated from the end of the chiller and dropped onto a transfer table (22), where they are removed and hung by one leg on the carrier of the overhead sizing conveyor, which takes them to the sizer (25). The conveyor serves as a drip line while moving the birds to the sizing operation. Pans are suspended under the conveyor to catch and direct drip water away from work areas below. As birds pass over the in-line scales of the sizer (25), they are released and dropped into sizing bins (26) according to weight classes, in descending order, from the heaviest to the lightest birds. The conveyor then returns to the hanging area near the outlet of the chiller, where it passes over the transfer table again (22).

Tray Packing.—The packing area adjoins the eviscerating area. Sized birds are removed from bins and packed in boxes held on the gravity wheel conveyors (27). The filled boxes are capped

with ice from an overhead ice auger, closed, and pushed onto the lower level of the bilevel gravity wheel conveyor (28), which transports them to the scale (29) where they are weighed. After weighing, the boxes are pushed onto the holding conveyor (30), where they are palletized and transported to the cooler.

Empty boxes are held on the upper conveyor of the bilevel unit (28) convenient to the boxing employees. If the birds are to be cut up, deflectors at the back of the sizing bins (fig. 8) shunt the birds onto a belt conveyor (31), which transports them to the deboning table (32).

When birds are to be cut up and tray packed, the belt conveyor (31) can be moved aside and replaced with chill tanks positioned under the deflectors of the sizing bins.

Deboning.—The deboning table (32) is adjacent to the sizing and packing operations and over the floor gutter drain. The table is 20 feet long and 42 inches wide with a 30-inch-wide belt conveyor. Four channels are created by suspended stainless-steel dividers—a 4-inch channel for wings, a 6-inch channel for drumsticks, and two 10-inch channels—one for whole birds and chunk meat and the other for bony parts. Each side of the table has a ledge 6 inches wide and 12 feet long where work stations are located. Workers remove oncoming birds from the belt conveyor and place them in rigid shackles above the table. The shackles hold the birds in a fixed position while the meat is being removed and the remaining carcass dismembered. Parts are placed in the respective channels of the conveyor and carried forward to diverters that shunt the parts into chill tanks (33). Chunk meat is conveyed forward to the packing table (34), where it is placed in boxes, loaded on pallets, and transported by a forklift truck to the refrigerated storage area. Wings, drumsticks, and bony parts in chill tanks are taken to the cooler for mechanical deboning.

Cut-Up and Tray Packing.—A cut-up tray-packing operation is located parallel to the sizing operation. The equipment includes a table (35), a bandsaw (36), and a 15-foot-long tray-packing table (37).

Birds are transported in chill tanks from the sizing operation to the cut-up operation. They are removed from the tanks and placed on the table (35) adjoining the bandsaw (36). The operator of the saw takes the birds from the table, dismembers them, and places the parts on the 14-inch-wide conveyor belt of the packing table (37). Workers who stand along each side of the table remove the parts and place them in trays. Filled trays are returned to the conveyor, which transports them to the end of the table where they are wrapped, sealed, placed on freezing racks, and moved to the freezer. After the products are frozen, they are returned to the packing area, removed from the racks, packed in cartons, palletized, and transported to the holding freezer.

Storage Areas

The storage areas are either refrigerated (cooler and freezer) or nonrefrigerated (dry storage).

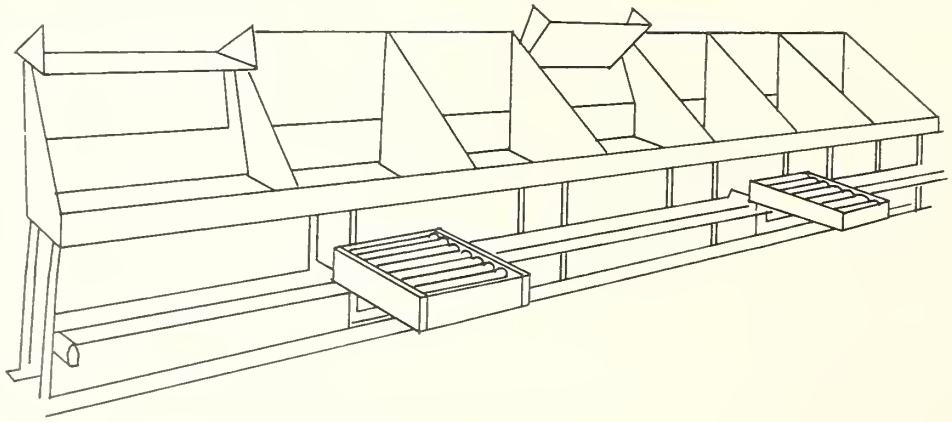

Figure 8.—Sizing bins with diverters.

Refrigerated Storage.—The cooler is 46 feet long and 29.5 feet wide with a ceiling height of 10 feet. The walls of the cooler and the ceiling are covered with insulating material equivalent to 3 and 4 inches of cork, respectively. The insulation is covered with a protective material approximately one-half inch thick. A floor curb, 4 inches thick and 8 inches high with a beveled top, protects the walls from damage by pallets and provides for better air circulation. Doors at each end of the area provide access to the eviscerating and packing area and to the shipping area.

The floor slopes toward two drains, each 6 inches in diameter with a deep seal trap. The floor may be insulated, depending on local conditions, so the cooler can be easily converted to a freezer as the demand for more freezer space increases.

Pallets of ice-packed fowl are stored four deep on one side of the area and two deep on the opposite side. An aisle, 8 feet wide, provides a passageway through the area to permit use of a forklift truck or a pallet transporter.

Approximately 300 square feet of the cooler floorspace is provided for a mechanical deboning operation. Sufficient space is available here for holding tanks of products to be deboned. Chill tanks of wings, drumsticks, and bony parts are held in the area. After the temperature of the product is reduced to 40° F. or less, the meat is removed from the bone by a mechanical deboning machine (39). The resulting comminuted meat is boxed and transported to the blast freezer.

The storage freezer has a 22-foot-high ceiling. A blast freezer located within the storage freezer space has a 10-foot-high ceiling. The holding freezer serves as a vestibule for the blast freezer.

All freezer walls have insulation equivalent to 8 inches of cork, except the two walls common to both the blast freezer and the holding freezer. These walls have insulation equivalent to 3 inches of cork. The ceiling of the holding freezer has insulation equivalent to 10 inches of cork. The walls in the freezer are protected with curbs in the same way as the cooler walls.

Insulating the floor of the freezer has to be decided locally. The same applies to determining the need for preventing floor heavage by using ventilating tiles or heating coils. These decisions should be based on the type, temperature, and moisture content of the ground beneath the floor as well as the height of the water table in the immediate area.

The loaded pallets are transported by forklift trucks to the storage freezer and placed on drive-in racks four pallets deep and three pallets high. Palletized boxed products are moved directly to the storage racks after blast freezing.

Nonrefrigerated Dry Storage.—The nonrefrigerated dry storage area is on the second floor above the cooler (fig. 9). It contains the same amount of floorspace as the cooler. The area is entirely enclosed except for a sliding door at the end above the shipping area.

Packaging material is received in the shipping area, palletized, and then lifted by a forklift truck through the doorway of the second floor storage area. Pallets are set on dollies and moved about the area. Made-up boxes and packaging materials are moved on gravity conveyors to the packing area below through small wall openings. The gravity conveyor is located at the opposite end of the room facing the eviscerating and packing areas. Access from the first floor to the storage area is by both a spiral stairway in the shipping area and a conventional stairway in the eviscerating area.

Ice Storage.—The ice-storage bin is in the corner of the dry storage area. The ice-making equipment is on the roof above the storage area. Ice is conveyed to the chiller and the bulk-packing work station by an auger conveyor. A flexible steel outlet tube beneath the storage area makes ice available in the cooler below for reicing fresh birds when necessary.

Shipping Area

The shipping area is 70.5 feet long and 13 feet wide. The floor, which is 48 inches above the ground, serves as a loading dock. It slopes one-fourth inch per foot to the drains. When pallets are not in use, they are stored at each end of the area. A doorway and steps provide access to the shipping area from outside the building. The apron in front of the shipping area is hard surfaced and slopes to the outside drain and trap (40), which collects the sand from the runoff water.

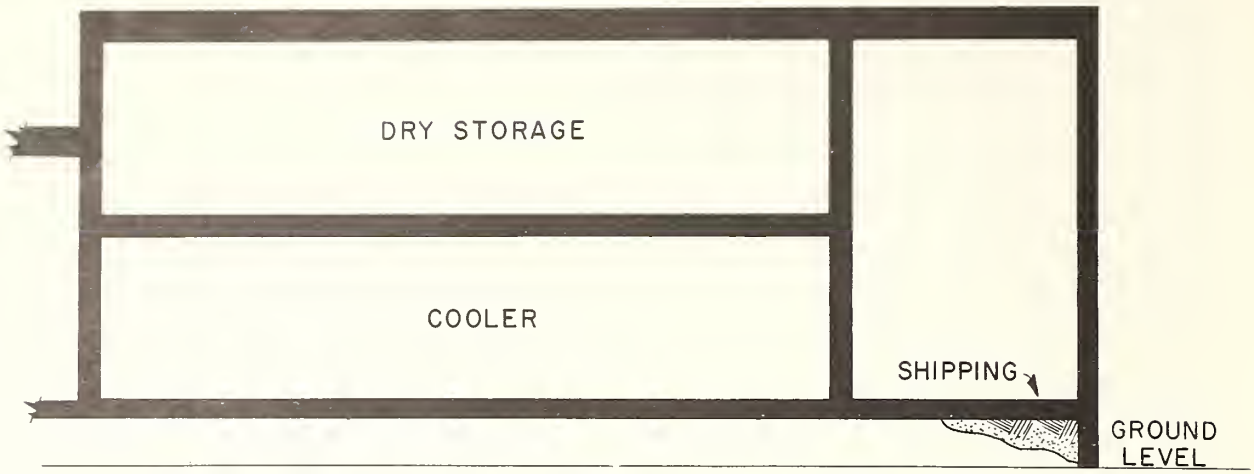

Figure 9.—**Sectional view of cooler and dry storage area.**

Auxiliary Areas

The auxiliary areas are in a section of the plant that is 138 feet long and 29.5 feet wide. Included are offices, employee facilities, boiler and shop area, and the refrigeration equipment area. The roof of the auxiliary areas is 14 feet above ground level.

The floors of the boiler and shop and the refrigeration equipment rooms are at ground level. The floors of the other areas are 48 inches above ground level, the same height as the floors of the processing areas.

Employee Lunchroom.—The employee lunchroom is 30 feet long and 23 feet wide with a 10-foot-high ceiling. Facilities include tables, chairs, and food and beverage dispensers.

Restrooms.—The women's restroom is 30 feet long and 13 feet wide and the men's restroom 24 feet long and 12 feet wide at the broadest point. The doors have self-closing devices. The number of lavatories, toilets, and other sanitary facilities provided is based on the guidelines prescribed by U.S. Department of Agriculture regulations governing the inspection of poultry and poultry products.

Offices.—The offices are air-conditioned. The general office is 21 feet wide and 21.5 feet long at the longest point. A private office adjoins the general office. A restroom for office employees is within this area.

A small office is provided for the USDA inspectors and an adjoining office of the same size for the plant superintendent. Both offices adjoin the eviscerating area. The inspectors' office has private toilet facilities.

Refrigeration Equipment and Boiler and Shop Areas.—Both the refrigeration equipment and the boiler and shop areas are at opposite ends of the plant section. Their 14-foot-high ceilings aid in dissipating heat generated by the equipment in them. Floors in both areas slope one-eighth inch per foot to 6-inch drains. An overhead door, 8 feet wide and 8 feet high, is located in the sidewall of each area so equipment can be moved in or out. The doors can also be opened to provide for additional ventilation when necessary. Walls are constructed of water-resistant material.

The boiler area includes space for a boiler, parts storage, tools, and shop for making repairs. The refrigerating equipment area provides space for two compressors and the electrical control panels of the refrigeration system. Two compressors and two roof-mounted air-cooled condensers supply the refrigeration and provide for continued refrigeration in the event one unit should fail to function. Air-handling units are suspended from the ceiling near the doorways to maximize cubic storage space. Low ambient controls are provided in addition to a hot gas defrost system.

Labor Requirements

Approximately 51 people are required to operate the proposed plant. Although more than 51 are listed in the following tabulations, some personnel will be shifted from one operation to another as needed.

Live-Bird Receiving, Slaughtering, and Picking.—The following personnel are used for unloading and hanging live birds, slaughtering, and picking:

Operation	*Employees*
Unload live birds and hang in shackles	4
Kill birds	1
Supervise receiving, killing, and defeathering operations	1
Pin birds	3
Total	9

When birds are not being slaughtered, the employees are used to move products from storage to the cutting-up and deboning operations, to move packaged products to the blast and holding freezers, to load trucks, or to perform other processing operations, such as deboning or packaging.

Evisceration.—The largest number of employees is needed in the eviscerating and packaging operations. The tray-packing line does not operate while the eviscerating line is operating. Evisceration personnel are used to perform the tray-packing and the deboning operations. Under this arrangement, eviscerated birds are held in the cooler until the eviscerating operation stops. Then the tray-packing and deboning lines are activated, utilizing the evisceration personnel. This procedure provides plant employees more hours of work and requires fewer part-time workers.

The number of employees for the eviscerating operation is as follows:

Operation	*Employees*
Rehang birds from picking line to eviscerating line	1
Remove oil glands	1
Open birds	1
Remove eggs	1
Draw vents	2
Draw viscera	3
Remove ovaries	1
USDA inspection	(2)
Trimmers	2
Remove livers	2
Drop viscera (including gizzards and hearts)	1
Remove heads	Automatic
Remove lungs	2
Split necks	2
Crop	3
House inspection	1 or 2
Inside wash	1
Outside wash	Automatic
Detach necks	1
Cool and package livers	1
Supervise	1
Total	28

Deboning and Cut-Up Operations.—The number of employees for deboning and related operations is as follows:

Operation	*Employees*
Debone manually	6
Box deboned meat	2
Move loaded pallets to freezer and supply boxing material	1
Operate manual deboning machine	1
Supervise [1]	1
Total	11

[1] The eviscerating operation supervisor would supervise both the deboning and cut-up operations since they would not occur simultaneously with the eviscerating operation.

The number of employees for the cut-up operation is as follows:

Operation	*Employees*
Supply saw operation with birds from chill tank	1
Operate saw	1
Tray-pack parts	4
Overwrap and seal trays	1
Place trays on freezing racks and move to blast freezer	1
Total	8

Packaging Whole Birds.—The number of employees for packaging is as follows:

Operation	*Employees*
Hang birds on drip line	1
Place birds in boxes	2
Ice birds, close boxes, and weigh	1
Move boxes to cooler—supply box material to operations	1
Make up boxes	1
Supervise	1
Total	7

Shipping.—One person is responsible for the loading and unloading of trucks and for forklift-truck operations. Additional labor can be recruited from other departments of the plant when trucks are being loaded. These operations are best scheduled when workers are available from other production operations.

Nonproduction Jobs.—Personnel would also be needed for such work as equipment maintenance and repair, engineering (boiler and refrigeration operation), and plant cleanup. Such jobs as making up boxes can be used for fill-in work.

Conclusions

The building excluding equipment is estimated to cost approximately $250,000. Since many kinds of equipment with varying capacity could be used, the cost of equipment was not estimated.

The benefits of the proposed layout are as follows:

- Sanitation requirements of Wholesome Poultry Products Act are met.
- Flexibility is provided in basic plan to double processing capacity.
- Firm will be able to incorporate new business activities, such as production of raw chunk meat for further processing.
- Palletized products are multiple-stacked in holding freezer because of higher ceiling and thereby cubic space is used.
- Cubic space above cooler, usually wasted because of restrictions on multiple-stacked ice-packed poultry, is used for dry storage.
- Packaging materials are moved to work stations by gravity, because dry storage space is on second floor.
- Eviscerating area is used for more than one operation.
- Construction costs are reduced because offices and employee facilities are not located in main plant.
- Adequate facilities are provided for employees.
- Supervision is improved because of plant and office area layouts.
- Backtracking is minimized by good product flow.
- Distances products move between operations are minimized.
- Overhead conveyors, belt conveyors, and forklift trucks are used to move products and materials.

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